XDi

4189350049

Flexible display indicator

XDi designer's handbook

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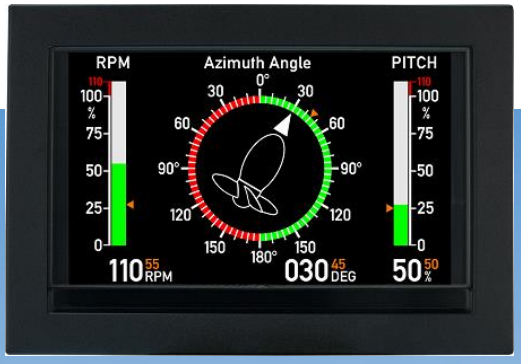


1 Useful reference documents

Document name	Document no.	Link to web page
XDi data sheet	4921250067	Link to XDi
XDi-net/CANopen reference manua1	4189350066	
XDi standard libraries	4189350067	
XDi quick start guide	4189350046	
Rudder systems Application notes	4189350085	
XDi supported NMEA sentences	4189350086	Link to XDi-N (wind)
Wind system application note with XDi-N	4189350080	
Application notes, Heading indicator system using XDi-N indicators	4189350085	Link to XDi-N (navigation)

NOTE: Some of the documents are found in more than one of the links above.

2 General information

2.1 Warnings, legal information, and safety

2.1.1 Warnings and notes

Throughout this document, several warnings and notes with helpful user information will be presented. To ensure that these are noticed, they will be highlighted as follows to separate them from the general text.

Warnings

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

Notes

Notes provide general information, which will be helpful for the reader to bear in mind.

2.1.2 Legal information and disclaimer

DEIF takes no responsibility for installation or operation of the product. If there is any doubt about how to install or operate the XDi unit, the company responsible for the installation or the operation of the set must be contacted.

The XDi unit is not to be opened by unauthorised personnel. If opened anyway, the warranty will be lost.

Disclaimer

The contents of this document are subject to revision without notice. DEIF A/S shall have no liability for any error or damages of any kind resulting from the use of this document.

DEIF A/S customers using the XDi, may copy and use the information from this manual in own manuals without additional permission from DEIF A/S.

2.1.3 Safety issues

Installing and operating the XDi unit may imply work with dangerous currents and voltages. The installation should only be carried out by authorised personnel who is fully capable of recognizing, understanding and judging the dangers of the task at hand.

Be aware of the hazardous live currents and voltages.

2.1.4 Electrostatic discharge awareness

The XDi is protected against static electric discharges, but it is recommended to protect the unit against static electric discharges during the installation and when connected to a PC or laptop for library upgrade.

Once the unit is installed and connected, these precautions are no longer necessary.

2.1.5 Factory settings

The XDi unit is delivered from factory with a preinstalled indicator library with certain default parameter settings. These are not necessarily the correct settings for matching the ship system in

question. Precautions must be taken to check the settings before running the ship.

2.2 About the Designer's Handbook

2.2.1 General purpose

This Designer's Handbook mainly includes functional descriptions, presentation of the virtual indicator library, description of the installation wizard, and the user and installation menus. The menu functions are supplemented by a number of examples of how to set up and change parameters.

The general purpose of this document is to provide useful overall information about the functionality of the XDi and some application examples. It should also help you get a good understanding of the XDi product series and how you can best utilize it in your own system solutions. Either using a DEIF standard indicator library or have a custom library made to exactly match your needs for indicators and input profiles.

Please make sure to read this document before starting to work with the XDi unit and making system integration. Failure to do this could result in damage to the equipment.

2.2.2 Intended users

This Designer's Handbook is mainly intended for technical users like developers and system integrators. On the basis of this document, you should be able to copy and paste the relevant part into your own product documentation.

2.2.3 Contents and overall structure

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

3 Product Introduction

XDi is an illuminated bridge indicator where a high quality display replaces the mechanical scale and pointer combination. A high number of predefined virtual indicators (VIs) can be stored in the built-in memory. VIs are organised in a library structure.

This high flexibility is implemented much in line with the way that we handle our traditional XL family of indicators and in a controlled manor not compromising the ability to make customised indicator libraries and most important, still securing the needed approvals for relevant indicator applications on the ship's bridge.

DEIF offers a series of standard libraries with a selection of often-used indicator types and in addition, the opportunity to have customised libraries designed.

Four push-buttons hidden behind the front frame combined with the installation wizard makes it easy to select the right indicator during first time installation and to make necessary parameter adjustment via the user or installation menu.

XDi normally replaces two or more traditional, class-approved, illuminated indicators that are very often part of the safety system on-board the ship. In an emergency, it is very important that such indicators present exactly the expected data type, and it is therefore not allowed to change between presentations of different data types on such indicators during normal operation.

After installation, the front frame is mounted, hiding the four buttons, and the selected virtual indicator will be fixed, most likely for the rest of its life.

The graphical display allows a high flexibility in both design and configuration. The XDi concept is made with easy customisation in mind, making it possible to make highly customised indicators, still based on the type-approved standard XDi platform.

XDi is available in three different physical sizes: XDi 96, XDi 144 and XDi 192, each with performance class:

- Dual, where indicators may present data from a single or two input sources
- Multi, where indicators may present data from multiple data source, typically between 1 and 8
- Nav, optimized for presentation of navigation related data, but not limited to that

The basic XDi unit is equipped with two galvanic separated CAN ports as standard data interface.

Adding an AX1 extension module, analogue inputs are available, and by adding a DX1 digital I/O extension module, digital inputs and relay outputs are available.

When other systems like a VDR or integrated navigation system needs data input from an XDi based indicator system, it is possible to add the NX1 NMEA output extension module to output relevant NMEA data sentences.

With the NX2 NMEA input/output extension module several serial input and/or output ports are available for reception or transmission of NMEA data. This module is mainly intended for the XDi-N version.

For technical details about the different extension modules, please see the XDi data sheet.

3.1 Virtual indicator library

All available virtual indicators in an XDi are located in the preinstalled XDi library. For each virtual indicator, there is also at least one VI-setup profile and one or more product profiles.

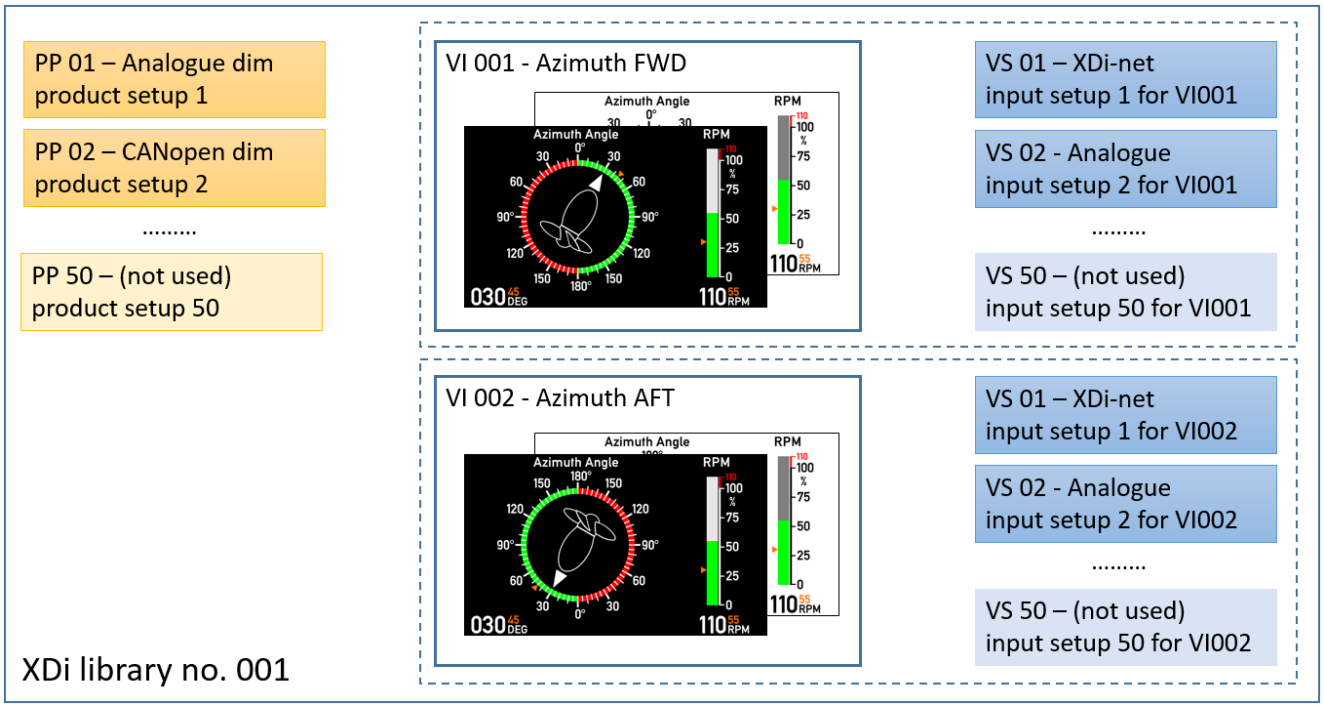


Fig.1A Virtual indicator library structure for XDi- Dual or Multi

It is important to be aware that all virtual indicators in an XDi library are predefined and version controlled to make sure that the requirements for relevant marine approvals are fulfilled. Therefore, indicators cannot be changed, rescaled or redesigned via the XDi menu. However, it is possible to make some adjustments during installation, such as adjusting input parameter values or change headlines and/or labels, but no change that conflicts with the marine approvals.

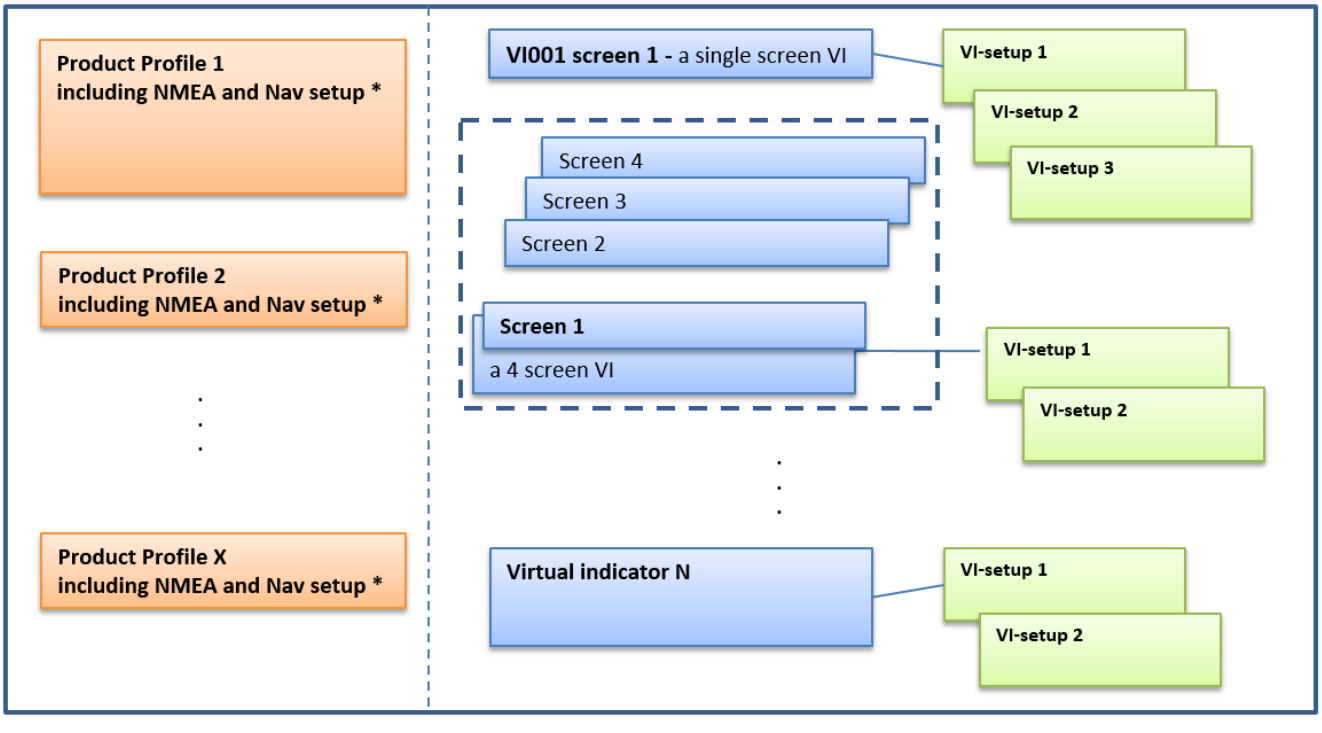


Fig.1B Virtual indicator library structure for XDi- Nav

The library structure for XDi-Nav is basically the same as for Dual and Multi , but the product profiles (PP) contain the supported NMEA sentence setup and the default NMEA configuration. The virtual indicators (VI) can contain up to 4 predefined screens.

3.1.1 Product profile (PP)

A product profile contains products- and system-related parameters with their default settings.

Parameters like: CAN bus settings, dimmer settings, dimmer group, CAN bus settings, sound, and warning settings.

If NMEA serial data interface is supported by the indicator library, the supported NMEA data types and relevant setup parameters are also included in the PP.

The PP may also contain a default list of NMEA sentences to be routed from one or more inputs to one of the NMEA output, but normally this is setup during installation instead.

Up to 50 different product profiles can be predefined in a library. The predefined product parameters can be changed or adjusted via the XDi menu.

NOTE: The Product Profile selection is independent of the selection of virtual indicator and VI-setup.

3.1.2 Virtual indicator (VI)

The virtual indicator VI contains drawings of scales and other indicator elements and defines the graphical layout of the VI, like the example below.

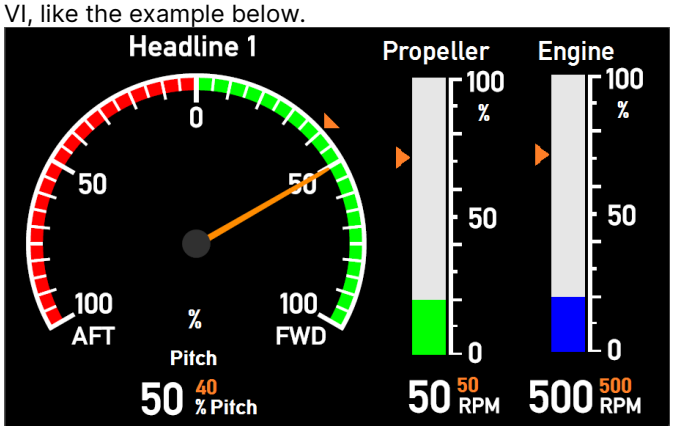


Fig. 2 virtual azimuth indicator

Virtual indicators in an XDi-D or M library presents one fixed indicator layout called a screen.

Where virtual indicator in an XDi-N can have up to 4 screens that can be toggled from one of the front buttons or via external control.

Special indicator functions in XDi-N

- Virtual indicators with up to 4 independent screens assigned to a VI mode group.
    - Edit the VI screens assigned to the 4 modes in a given VI mode group.
    - Toggle between modes either locally in one XDi unit or for a whole group of indicators within a CAN system.
- Change presentation unit, for example change the wind speed unit between knots, m/s and Beaufort.
- Toggle between 3 unit profiles either locally or globally for a complete CAN system.
- Multi data sources for a presented data type, with automatic prioritised fall-back in case a source is lost.
    - Edit the priority order or lock presentation to a given source.
    - Present the name of the active data source on the screen.
- Present special data types like LAT/LONG, Date, Time on the virtual indicator screen

3.1.3 VI-setup profile (VS)

For each VI, at least one VI-setup profile (VS) will be predefined.

The “Virtual Indicator setup” profile is a predefined list of parameters such as: input settings, data scaling, selectable headlines, labels, units and more.

Collecting all the vital indicator parameters in a VS profile makes it simple, secure and easy for the installer to make a complex setup, simply by selecting the right VS.

In the selection menu, each VS has a unique number, name and a detailed help text description that makes the selection easy.

All input parameters and indicator related output parameters (relay output or NMEA output) are gathered in the VS profile. The VS profile for the special multi-screen indicator available in the XDi-N version contains input setup parameters for all screens (up to 4).

Defining several VI-setup profiles is very handy if a virtual indicator is used in different applications, with different interface requirements, for example presenting data from different propulsion systems with different combination of CAN and analogue data inputs to the same type of indicator.

It is possible to change or adjust most VS parameters from the XDi installation menu.

It is possible to have up to 50 predefined VS profiles for each virtual indicator.

NOTE: Only one VI-setup profile can be active at any given time.

3.1.4 Library types

XDi libraries may either be a DEIF standard library, containing a selection of commonly used virtual indicator types. DEIF standard indicators always include a day- and a night-design optimised for presentation on the XDi display under all light conditions.

If the DEIF standard design does not fulfil your needs or wants, the XDi concept opens for a flexible pallet of customisation opportunities from small changes like adding a logo on a standard design, making a customised interface profile and all the way to a full-customised design fitting perfectly into your company's overall product design line.

DEIF stores all libraries in a secure master database, providing the needed version control and design verification to secure that indicator designs follow the appropriate regulations. Once an indicator is finally approved as part of a library, it will be available precisely as approved even years from now when a spare part is needed.

The XDi library may contain up to at least 100 virtual indicators depending on the complexity and number of day/night colour schemes (or even day/dusk/night schemes).

All XDi libraries are defined by a unique owner identification number (Owner ID). DEIF owner ID for standard libraries are in the range 000001 to 009999.

The owner ID for a customised library is normally the same as the customer's account number at DEIF.

Each library owner may have up to 999 libraries, each identified by a unique number starting from 1.

A customised library is by default only available for use in XDi units purchased by the library owner, and on request, DEIF can open for sister companies or sub-suppliers to also be able to purchase XDi units with a customised library.

3.1.5 XDi type and related library classes

There is a library type for product size XDi 96 and XDi 144/192 and for each performance class.

XDi 144 and 192 both have the same display resolution (WVGA) and can therefore use the same library.

XDi 96 has a QVGA display resolution and thus needs its own library.

In addition to product size, the libraries are also classified as: Single*, Dual and Multi.

The library needs to be compliant with the size and performance class of the XDi indicator:

		Library class		
		Dual	Multi	Nav
XDi type	Dual	•		
	Multi	•	•	
	Nav	•	•	•

This means that an XDi Nav will accept all library classes, where a XDi Multi will only accept Multi or Dual libraries and a XDi Dual will only accept a Dual library.

Since all library classes can be installed on an XDi Nav, it can be used as a universal service unit, where the needed library can be uploaded from a laptop or PC whenever needed.

3.1.6 Upload a new library

It is possible to upload a new library via the USB service port on the XDi unit. The library is encrypted and requires a special “XDi update tool” to be installed on your PC or laptop. The tool is available for download at www.deif.com. The zip-package includes a detailed installation and user instruction. If you need further help, please contact DEIF support.

Be aware that the library package selected for an update must match the XDi size and performance class as explained in the previous chapter.

3.2 Input data for XDi

Virtual indicators in the XDi library may present data from one or more data sources depending on the XDi performance class (Dual or Multi). The standard XDi unit is designed to receive data via the two CAN bus ports. When an extension module is mounted on the XDi, data can also be received from an analogue, digital or NMEA input. Input data from an extension module may even be shared on the CAN bus, making the XDi act as a data source for other XDi indicators on the bus.

Utilising this function limits the number of extension modules needed and only one adjustment or calibration of an analogue, digital or NMEA input is needed in such a CAN base system.

Other devices on the CAN bus may also use CAN data provided by the XDi.

The DEIF XL, BW and BRW-2 indicators with CAN interface and TRI-2 CAN panorama indicator can be integrated in a system where XDi is providing calibrated CAN data.

3.2.1 Object dictionary – Object index table

All variable input data types are firmly defined and stored in the manufacture specific part of the CANopen object dictionary. Object index 0x3000 to 0x3FFF.

In the XDi-net specification, all variable data used for indication is structured in a fixed format making it possible to broadcast data without complicated setup.

Each data type has a name (source name) and data is stored as a value with a defined resolution and with a standard data unit. When data is shared on XDi-net or CANopen it is the standard data value that is sent.

The detailed description of how XDi utilises CANopen can be found in the “XDi-net/CANopen reference manual”.

3.2.2 Data type instance

To be able to handle several instances of the same data type in a CAN bus system, each defined data type can support up to either 7 or 15 instances dependent of the data type.

An example: in a large system with 4 azimuth thrusters on the same CAN bus, each thruster is using a different instance of the data type “azimuth angle”.

3.3 Sourcing data to the XDi

There are six different ways of sourcing measured data into an XDi for presentation on a virtual indicator, see the illustration below.

In the VI-setup profile (VS), each virtual indicator input will be predefined to use a defined data type/instance in the Object index table, and this data type/instance will be pre-set to receive its input data using one of the input methods described below.

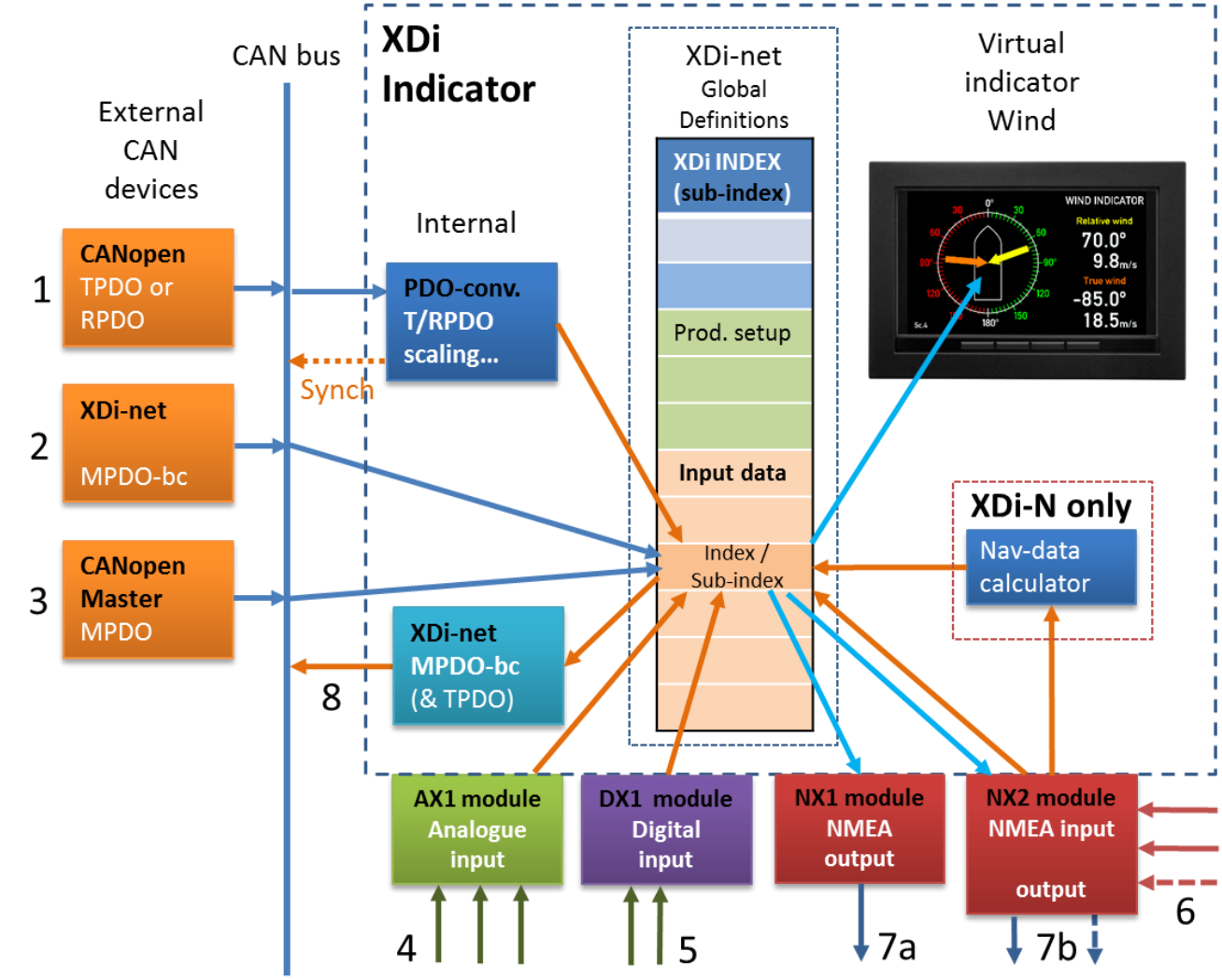


Fig. 3 XDi input output structure

The figure above shows all the different ways input data can be received by an XDi.

The same method applies for dimmer level input data and control for indicator day/(dusk) /night shift.

3.3.1 CANopen TPDO or RPDO (1)

A TPDO (Transmit Process Data Object) contains up to 8 data bytes. A data type is often located in byte 0 and 1 and the rest is not used, but it is possible to have different data types mapped into one TPDO. TPDOs are often used by sensors to transmit data. RPDOs (Receive Process Data Objects) are often used by a CAN controller or master device to send data to a receiving device.

XDi can be set up to use any of the TPDOs or RPDOs as CAN input, but please note that if the XDi-net is active, there are some restrictions on the use of RPDO1. Please see the XDi-net/CANopen reference manual for details.

Example:

The DEIF RTC 600 CAN angle transmitter with the default NodeID=1 is used as angle transmitter for an XDi azimuth indicator.

The azimuth angle between +/-180deg. is transmitted as a signed 16 bit value located in TPDO 1, byte 0 and 1 (TPDO1 for NodeID=1 has COB-ID: 0x180+"RTC600 NodeID").

The selected VI-setup profile VS 01, for this azimuth indicator, is pre-set to read TPDO1 from node 1.

The relative angle value received as a figure in the range +/-32767 is predefined to be scaled to an absolute value between +/-1800, equal to 180.0 deg. This value is stored in the Object index table where the VI reads the value for presentation on both the round azimuth indicator and in the digital readout.

Data received in a TPDO/RPDO can be either absolute data with a predefined resolution (for example 1800 @ resolution 0.1, equal to 180.0deg.) or data can be relative like in the example above.

It is possible from the installation menu to adjust the TPDO/RPDO settings, for example adjust the zero point, change max/min values, or change direction (CW/CCW) of the data received from a rudder angle transmitter. It is also possible to select another TPDO or RPDO as input.

Synchronisation of adjustments

All XDi units on the same CAN bus have access to read a given TPDO or RPDO.

In case data received in a TPDO needs a correction, for example a zero alignment, this is performed via the installation menu in one XDi on the bus. If this adjustment must apply to all XDi units on the bus using exactly this TPDO, simply press "Yes" to accept synchronisation in the pop-up menu, presented when you leave the installation menu. This will activate a broadcast of changes to relevant XDi units on the CAN bus.

NOTE: Synchronisation via XDi-net must be set ON in the PP (or via menu) for this to work.

Self-starting devices

If there is no CAN master in the system to start a transmitting device, then the device should be set up as a self-starting device. Alternatively, the XDi can be set up to act as a master, in this case by sending a CAN start command to force passive sensors to start transmitting. Normally, this function is not activated in the product profile, but it can always be activated via the installation menu.

3.3.2 XDi-net as data input (2)

XDi-net is a predefined way of broadcasting data via CANopen, and it requires no complicated setup or specific allocation of NodeIDs. Data is broadcasted using RPDO1 in SAM-MPOD mode (Source Address Mode – Multiplexed PDO). This means that data is sent directly as a defined data type into the Object index table for the indicator to use for its presentation.

For XDi-net to work, "XDi-net variable data ON" must be activated in the PP or manually via the installation menu.

The XDi-net broadcast format is often used to share data between XDi units, for example analogue input data from an AX1 analogue extension module.

Independent of the default data source for a given virtual indicator, it is always possible to shift the data source to XDi-net via the installation menu – "Data adjust".

The XDi-net broadcast format can also be used to distribute data from a customer CAN controller to all XDi units on the CAN bus, without any complicated NodeID setup.

More information of the XDi-net broadcast format is found in the "XDi-net/CANopen reference manual", where you will also find examples of transmission formats.

XDi-net restrictions

When "XDi-net variable data" is activated, all RPDO1s (COB-ID 0x200 to 0x27F) are allocated for XDi-net use and must not be used by other applications on the CAN bus.

IF "Send XDi-net setup synch data" is active NodeID 127 is reserved and used as parking place for an XDi service unit and then COB-ID: 0x27F, 0x37F, 0x47F and 0x57F (=RPDO1-4) and 0x1FF, 0x2FF, 0x3FF and 0x4FF (TPDO1-4) are all reserved for this function.

XDi-net can be disabled in the product profile or manually via the installation menu to release all RPDO1s and NodeID 127 to be used by other applications.

3.3.3 DAM-MPDO as data input (3)

Destination Address Mode – Multiplexed Process Data Object (DAM-MPDO) is another way of using an RPDO for transmitting multiplexed data. The format is similar to the SAM-MPDO described above. Only a single bit in front of the NodeID in byte 0 is shifted to make it a DAM-MPDO.

Data sent in a DAM-MPDO must be in the format given by the Object index location it is sent to, exactly like data sent using the XDi-net format (SAM-MPDO). Data will be stored directly in the destination Object index/Sub-index defined in the message.

Since the XDi-net format and the DAM-MPDO format are so similar, they are considered as one data source type, defined as source “XDi-net”. This means that when the XDi-net is selected as source for a data type presented on an indicator, then a DAM-MPDO may also be used to input data to this indicator.

To activated DAM-MPDO mode, an RPDO must be assigned for DAM-MPDO communication. This can be pre-set in the product profile or manually activated via the installation menu.

Select either: RPDO 2, RPDO 3 or RPDO 4 for this. RPDO 1 may only be selected if XDi-net is deactivated.

Please note that “XDi-net” must be selected as source when DAM-MPDO is used, even if XDi-net is deactivated!

The DAM-MPDO format is used by a controller or master to send data to each receiver (CAN node) - one at a time. Only the XDi unit with the specified destination address (NodeID) will accept and use the data.

This type of communication requires that the master knows each NodeID on the bus, its type and exact need for data. Obviously, this requires very precise setup of all NodeIDs in a system. Another thing is that the same data type will often be sent to several indicators one by one. This will load the CAN bus much harder than if data was broadcasted using either XDi-net or predefined TPDOs (or RPDOs).

3.3.4 SDO data transfer (3a)

Service Data Object (SDO) is a way to open a “service channel” with handshake, between one CAN device and another. The data format is also a multiplexed format like MPDOs and is normally used to read and write parameters to and from the XDi Object index table. This format can also be used to transfer variable data, but it is not meant for this purpose and should only be used for parameter transfer, for example for automated setup.

3.3.5 Analogue data input (4)

When the AX 1 analogue extension module is snapped on the XDi rear plate, analogue inputs are available.

For an AX1 module to work, the analogue input must have been predefined in the selected VI-setup profile (VS).

The VS specifies the data type represented by this analogue input, analogue input type and the scaling of the input value.

Example:

In the VI setup VS01, the data type RPM instance 1 is defined as input for an analogue pointer, and the source for this data type is set up to be: AX1 on slot 1, analogue input 1, set up to: 4-20 mA input and scaled to: +/- 200.0 RPM (4 mA = -200.0 RPM, 12 mA = 0.0 RPM and 20 mA=200 RPM).

Propeller RPM instance 1 is located in Object index/sub-index: 0x3081-0x02 and always defined as absolute value with a resolution of 0.1 RPM, giving a max. of +/- 3276.5 RPM

AX1 has two analogue input ports that can be configured for either current in the range +/-20 mA or voltage in the range +/-30 V. In addition, a third analogue voltage input is available.

Input 1 and 2 are always used as instrument inputs, where input 3 is earmarked for analogue dimmer input, if analogue dimmer is preconfigured in the selected product profile (PP).

All inputs are fully calibrated, so if input 3 is not used for analogue dimmer in the actual XDi product configuration, this input may be configured as a normal voltage input for a virtual indicator, in the VI-setup (VS) profile.

The AX1 module also includes a voltage reference output that may be used as voltage supply for either a dimmer potentiometer or a potentiometer providing input for an indicator, for example a rudder indicator.

The pre-configuration of an AX1 module must be available in the selected VS or PP profile for the module to work, but it is also possible to change some selections and adjust parameters from the XDi menu.

The AX1 electrical details can be found in the XDi data sheet and connection and setup menus are found later in this document.

3.3.6 Digital data input (5)

The DX1 Digital I/O module has two isolated inputs that can be preconfigured as data inputs. It is also possible to preconfigure them as control data inputs.

The digital input can be preconfigured in the VS profile as an RPM pickup input, for example for direct connection to an inductive pickup.

It is either as a single RPM input (one direction) or as a double input (forward/reverse direction). In the VS profile, the input mode and pre-set parameters for converting the input pulses to an RPM value are predefined.

The scaling parameters can be adjusted via the XDi installation menu.

Alternatively, the two digital inputs can also be used for control of special indicator functions, for example control input to hide a data readout or activate a predefined label.

It is also possible to configure the two inputs as a dimmer contact pair, making it possible to step dimmer level up and down and change colour pallet; this must be defined in the PP.

The digital inputs can either be defined as data/control inputs for a virtual indicator in a VS profile or as dimmer contact inputs for the XDi product as defined in the PP. They can of course only have one function at a time.

The DX1 electrical details can be found in the XDi data sheet, and connection and setup menus are found later in this document.

3.3.7 NMEA serial data input (6)

When the NX2 NMEA input/output extension module is snapped on the XDi rear plate, NMEA serial input data is made available. The NMEA interface can be setup to comply with either IEC61162-1 (Normal) or IEC61162-2

(High speed), the data protocol for the 2 standards are the same .

The XDi-N version has support for all NMEA functions described in this document, where XDi-D and XDi-M have only support for a few data types via NMEA input.

For XDi-D only 2 data types are supported. In addition, the dimmer can also be controlled via NMEA input is a product profile supporting this is selected.

In general, the XDi-library installed in the XDi must have product profiles that supports the NMEA data types and sentences for NX2 NMEA input to work.

3.3.8 NMEA serial data output (7a and 7b)

XDi with an NX1 or NX2 interface attached has the ability to transmit some predefined NMEA serial data sentences. For example, rudder angle to a VDR (voyage data recorder). The XDi-N version can route NMEA sentences from one of the NMEA inputs to one of the outputs.

Share NMEA input data on CAN

All data types receiving data from an NMEA input can also be setup to share those data on XDi-net.

The XDi-net setup can be changed from the NMEA setup menu in the installation menu system. Use the manual NMEA setup sub-menu.

NMEA data will be shared at the same update rate as they are received. If NEMA input data is received every 100 millisecond, then XDi-net data will also be sent every 100 millisecond.

NMEA data can also be shared in a standard CANopen TPDO, but in that case the VS profile used for the selected virtual indicator must have a predefined TPDO output function included.

If TPDO output support is not mentioned in the description of the VS profile for a given virtual indicator, this function will not be available. It is however always possible to include this in a customised library.

3.4 Change selected input via menu

Inputs for indicators and dimmer input are always predefined as one of the 6 input types described and with parameter pre-sets stored in the respective VI-setup profile (VS) or Product Profile (PP).

In general, a new profile should be defined for every new combination of inputs.

Well-designed setup profiles make it very easy afterwards to set up the XDi during installation, simply because all setup parameters are loaded when the basic installation wizard is completed and only some small fine adjustments may be needed via the installation menu.

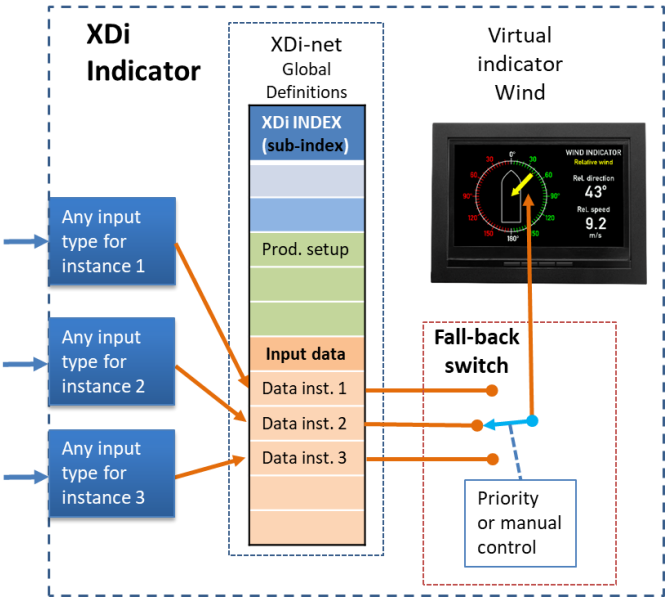
3.5 Multi sources and automatic fall-back

In most cases each indicator element in a virtual indicator has a single data source, but in XDi software platform 2 it is made possible to use the fall-back function to make up to 3 input sources available for a given indicator element.

This function can handle all normal 16bit data types and is not restricted to XDi-N but can also be used in XDi-M and with some limitations in XDi-D that can only handle 2 inputs. The function was originally made for handling some types of navigation data where a fall-back from a main source to a backup source can be relevant.

It is also in DEIF standard navigation libraries that this function at present is used, but it can also be useful in different types of customized solution where a need for selectable data sources or a fall-back to a backup source is needed.

The functionality is illustrated in the sketch below, where 3 instances of wind direction data is coming from 3 wind sensors are routed via the Fall-back switch to the indicators wind direction pointer.



Note: In fact, the fall-back switch delivers the wind angle to a “Data switch index” where the direction pointer is getting its angle value, but it clutters the drawing unnecessarily .

In the above example the wind speed data will also be routed via a similar fall-back switch. The wind indicator can also be designed so that the active wind sensor (source name) is shown on the screen. If data is received from the wind sensor via NMEA the sensor data shown on the screen can be controlled by simply powering the wind sensor that you want to see data from. Alternatively, a switch on NMEA input data lines can be used to switch between the 3 wind sensors.

Source shift via CANopen. In manual mode it is also possible to control the active source by a CANopen parameter. Contact DEIF to get the details if you have a need for that. The parameter to used depends on the selected VI and VS profile in a given library.

To illustrate how the fall-back functions works in more detail, we will look at an example from our standard navigation library.

3.5.1 Example – Fall-back function used in the standard heading indicator library.

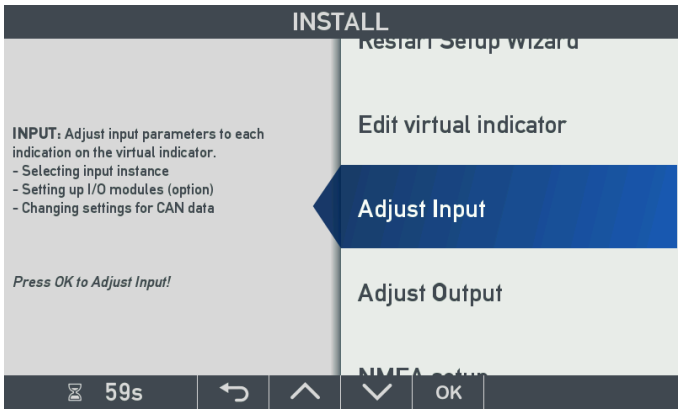
In the XDi 144/192 N Standard heading library it is possible to connect up to 3 heading sources (Gyro1, Gyro2 and Mag. compass) to the traditional heading repeaters.

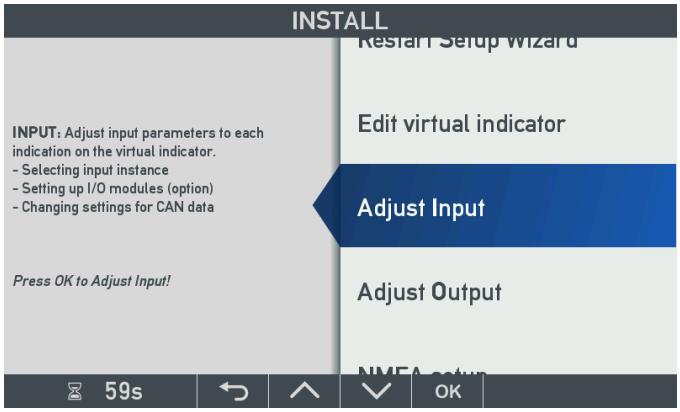
The source selection is default setup to be automatic, in this case the 1st priority source is selected if it is available and if it is unavailable 2nd priority is used and if that one also drops out the 3rd priority is used.

From the XDi menu, it is possible to make a manual fixed selection of a source or change the priority order.

The following example shows the input adjust for VI002 in the standard heading library.

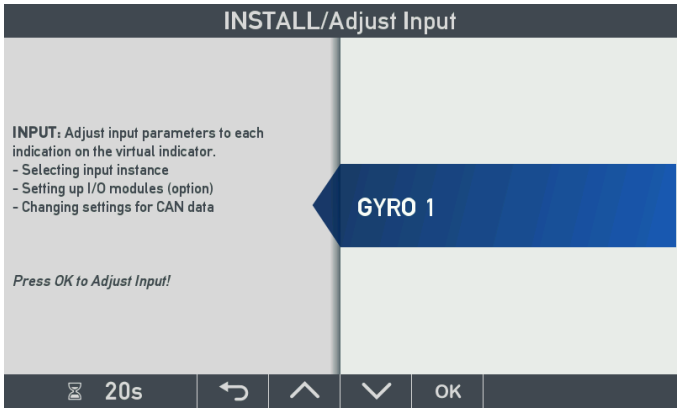
To view or change the multi-source and fall-back function, enter “Adjust input” in the installation menu:



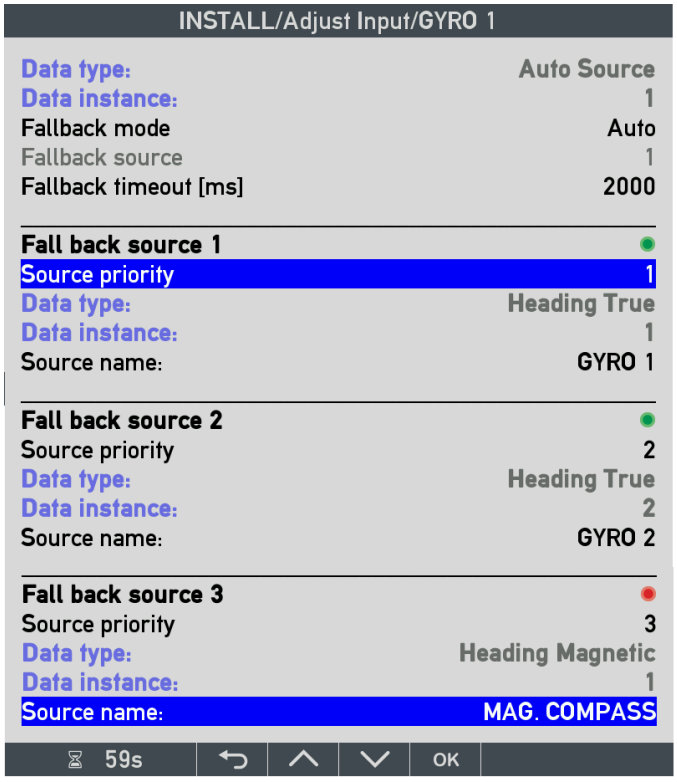


VI002 is only presenting heading.

In the input adjust menu the name of the active data type is presented (GYRO 1).



Press OK to open the multi-source menu:



The fall-back mode can be “Auto” or “Manual”.

In manual mode the fall-back source number (shown in the next line) will be locked as the input source.

Fall-back timeout: This parameter defines the time to go before the active source is replaced by the next priority source, after the active source has lost its data.

When a higher priority source reappears, it will automatically take over as source.

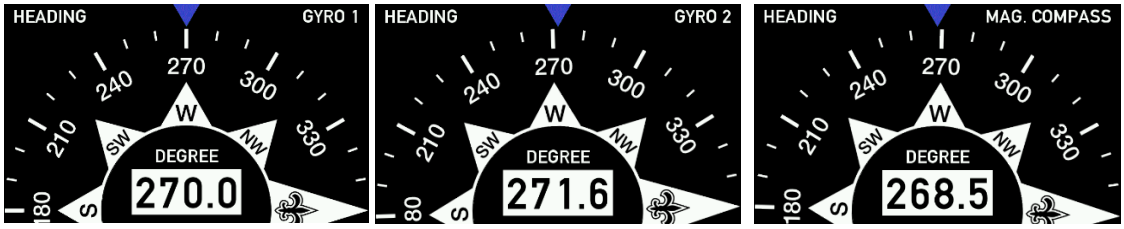
 or  indicates if the source at present is providing input data or not.

Source priority: It is possible to change the priority order from this menu. It is possible to give 2 fall-back sources the same priority. In this case, reappearance of the other source with the same priority will not result in a source shift.

Source name: It is also possible to change the source name.

Be aware that the source name is often presented at the indicator to show which source is active and providing data.

In the standard heading indicator, the names: GYRO 1, GYRO 2 and MAG. COMPASS is shown on the scale as illustrated below.



Heading indicator VI003 with rate of turn

In the standard heading indicator VI003 the ROT has 2 fall-back sources, the input selected should be consistent with the selected gyro.

It can also be set to fixed source or the same NMEA source can be selected for both ROT 1 and ROT 2.

(The auto NMEA setup will normally select same source for both).

3.6 Menu structure

The XDi wizard and menu system are operated by 4 pushbuttons placed beneath the display. The buttons are used to set up the product during installation. After the XDi-D or -M is set up, the buttons are normally hidden away behind the front frame, and they are not used during daily operation. (See also front button option/accessory below).

Fig. 4.1 XDi 144 D or M when the front frame is removed – the 4 pushbuttons are available

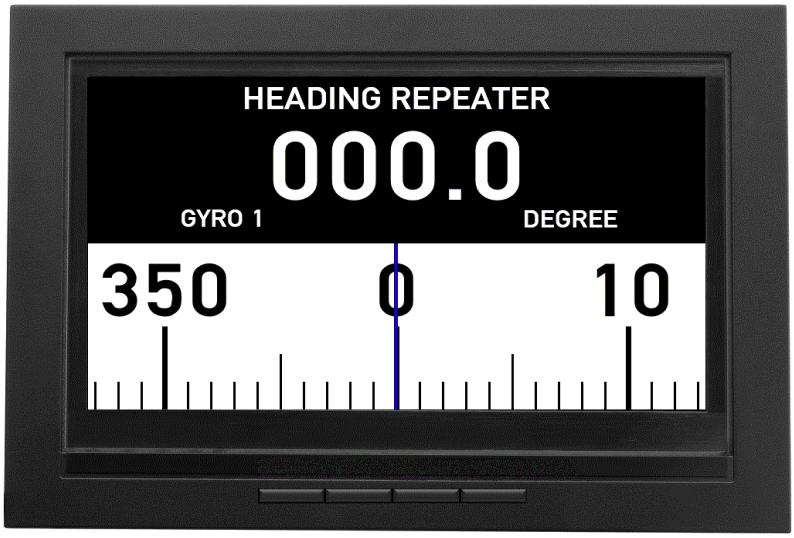


Fig. 4.2 XDi 192 N with the 4 push-buttons available on front

The 4 pushbuttons on XDi-N are available on the front frame and are also used for daily operation such as: toggling between screens, dimming up/down and quick access to user menu.

A front frame with 4 pushbuttons is also available for XDi-D and XDi-M. It can be ordered preinstalled as an option or ordered as an accessory kit to replace the standard front frame on XDi-D or XDi-M. This option will make dimming up/down available from the front buttons.

NOTE: This function is only available on XDi with platform 2 software and in some cases, it may require a new or modified product profile in your custom library, to get support for dimming from front buttons.

3.6.1 Installation Wizard

XDi has an installation wizard which starts automatically start at power up until the XDi unit has been set up.

After first time setup, the normal menu structure is available offering “Surveyor info display”, “Master reset” and access to the user and installation menus. Access to these functions requires a simultaneous long push on a combination of two buttons.

The installation menu system is protected by double access sequence. First a long push on a combination of two pushbuttons to access the user menu and from there a hidden long double push to access the installation menu. This is part of the required protection against unauthorised changing of vital setup parameters.

The menu structure has therefore 2 levels:

User menu level, where information and basic setup parameters, like dimmer setup, are located. (User accessible)

Installation menu where all vital setup parameters are located. (Limited access)

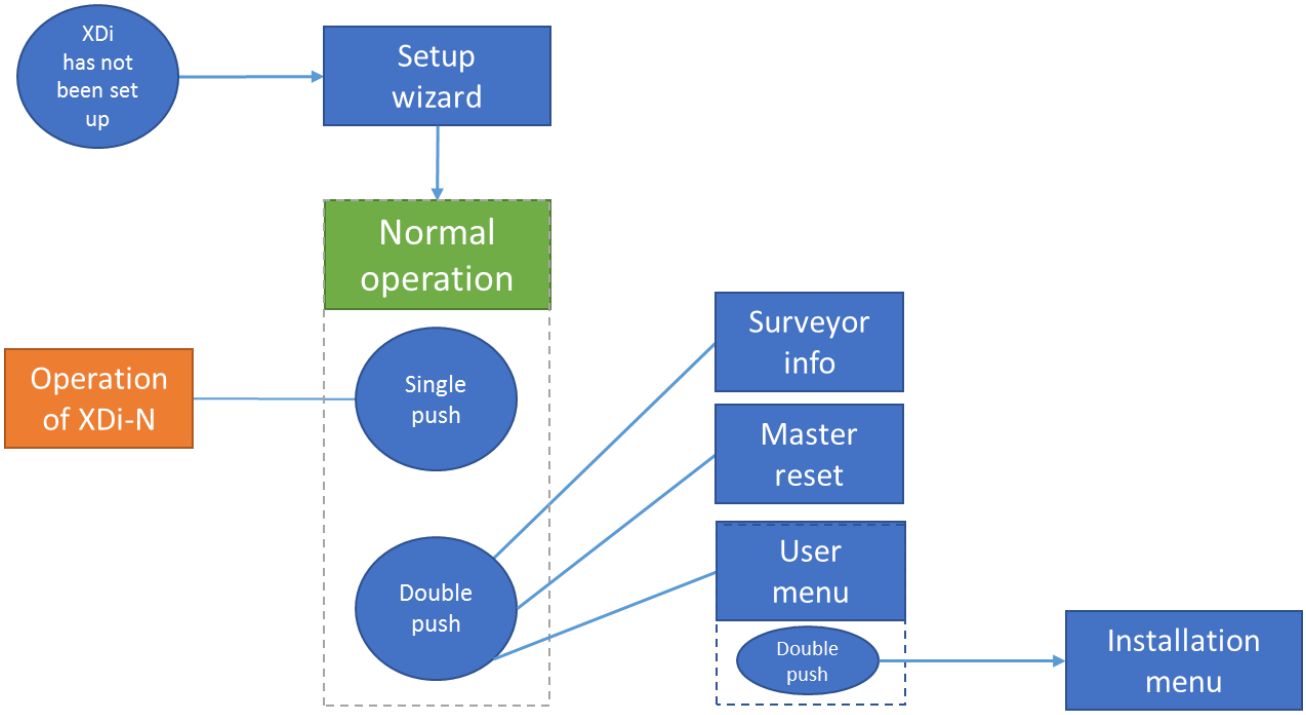


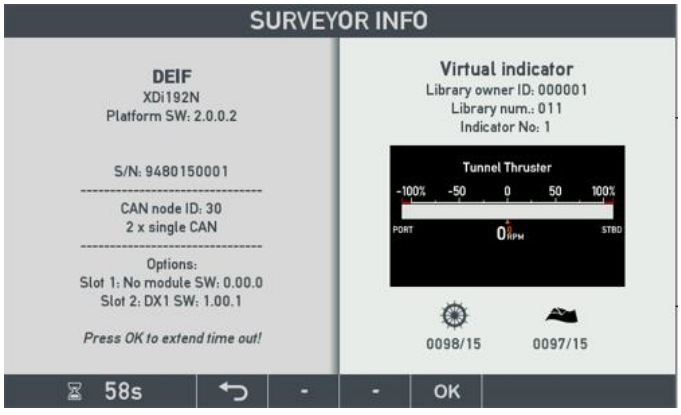
Fig. 5. Diagram illustrating the overall XDi menu structure.

NOTE: Single push on front button 2 and 3 can be used for front button dimming on all XDi versions.

3.7 Surveyor info

It should be highlighted that a simultaneous push on button 1 and 2 (from the left) will reveal the “Surveyor info” page where serial number, approval marking, software version and other relevant data are presented.

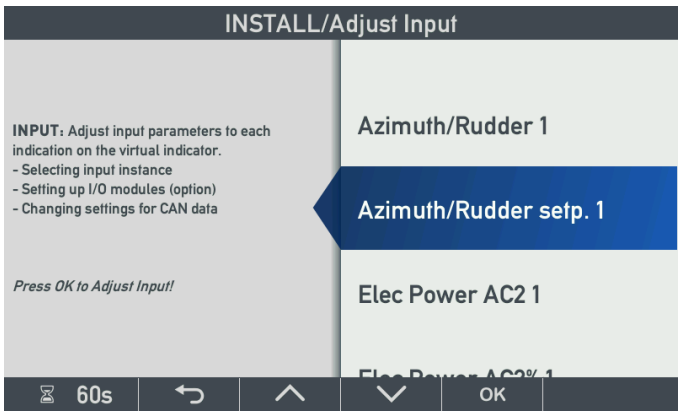
NOTE: UK MER approval mark is only shown in libraries released later than 2023-1-1.



3.8 General menu structure

The wizard and main menu pages are divided into 2 sections:
the right side where you will find the menu with one menu line highlighted in the blue arrow

the left side pane shows detailed information about the highlighted menu



Timeout: All menus except the start-up wizard have a timeout function. When the timer reaches 0 sec, the system will jump one step back in the menu structure and restart the timer, and in the end the XDi will resume normal operation. Timeout acts like the “return arrow” soft key.

3.8.1 Soft keys description (left to right):

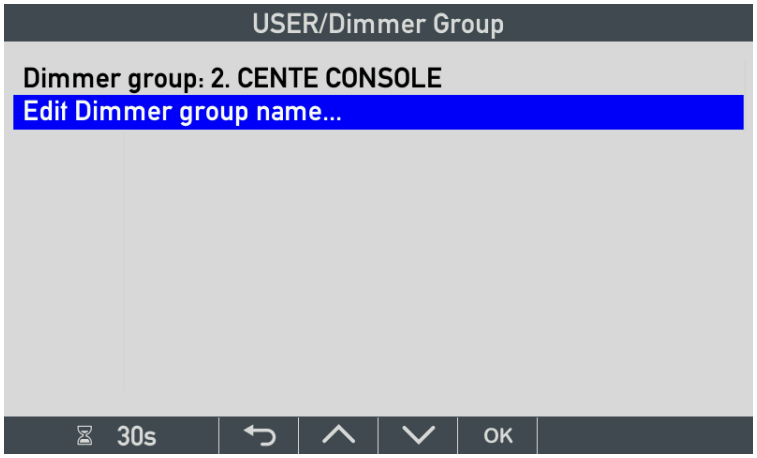
Return arrow: will step back to the present menu or from the top level menu return to normal operation.

Up and down arrows: used to navigate between menu lines

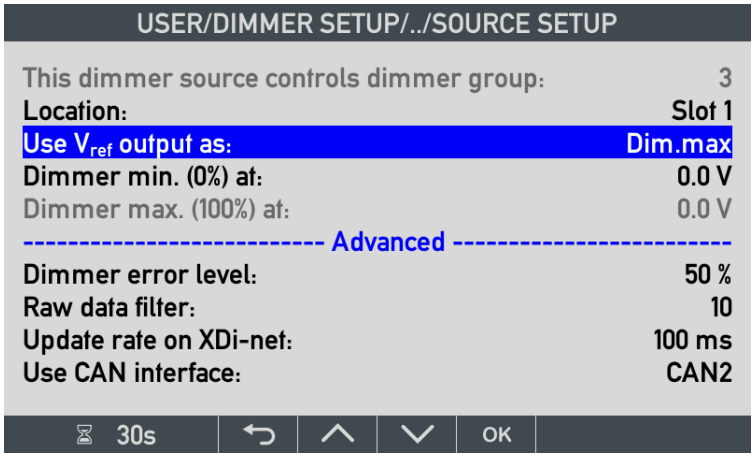
OK: open or accept the highlighted menu or parameter.

3.8.2 Submenus

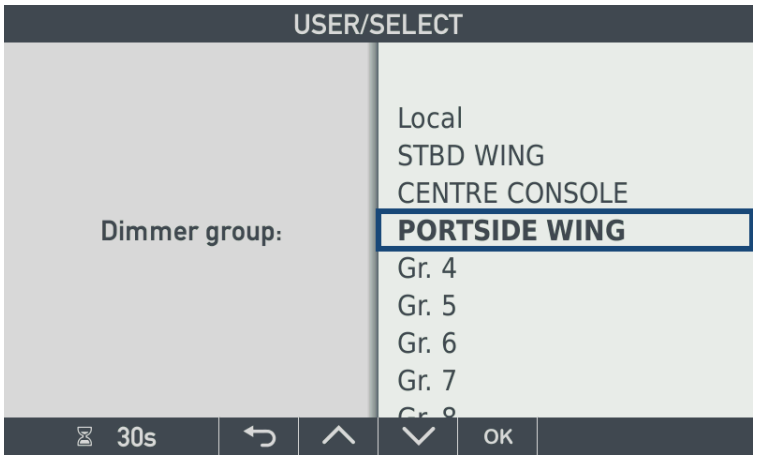
Several submenus are used in the different menu levels and for different functions. The following pages contain examples of typical submenus and their function.



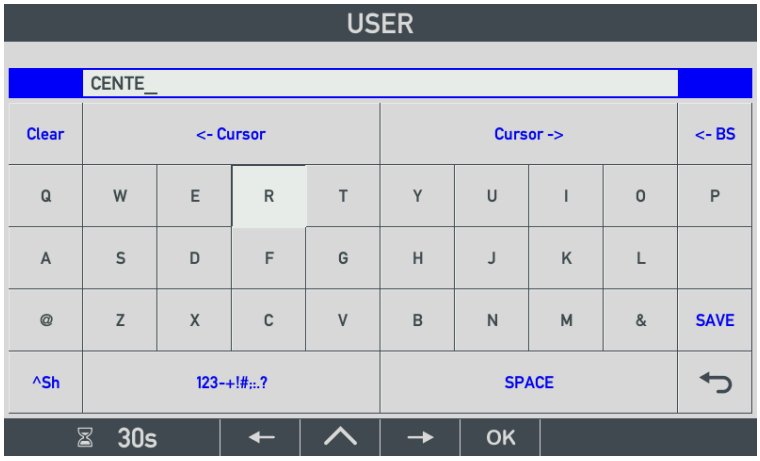
Select and press OK to open the line for editing.



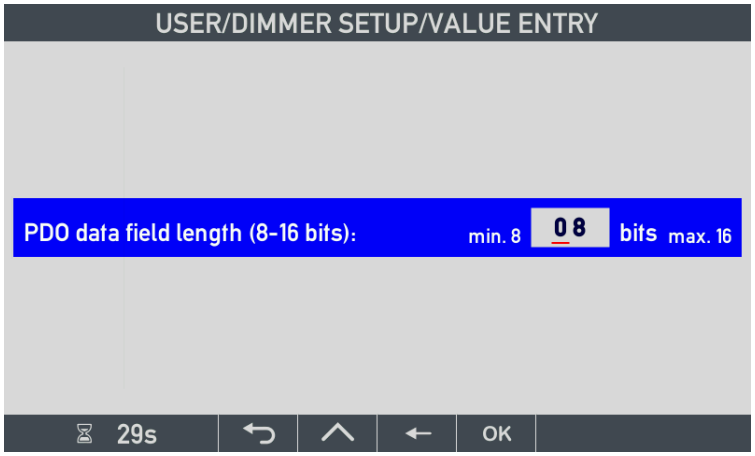
View and change setup parameters.



Select from a list.



Virtual keyboard for entering a new text line



Change a data value

The detailed menu functions are in the relevant chapters. To learn more about XDi functions and menu system please see the chapter 6 XDi menu system and functions**.**

4 Installation

4.1 Unpacking

The XDi indicator is delivered in a cardboard box. To protect the indicator, it is important to store it in the box until it is being mounted in the panel.

This will also eliminate the risk of dust, or even worse, metal parts, to enter the cabinet through the airgaps in the rear part of the XDi that may sooner or later damage the unit.

4.1.1 ESD

The indicator is protected against ESD (static electricity). Therefore, no special attention to ESD is needed during the mounting and wiring of the indicator.

4.1.2 Box content

The cardboard box contains	Number of items
Quick start guide	1
XDi indicator	1
Terminal block	2
Cable tie	1

Some XDi variant includes an extension module as standard and XDi can also be ordered with one or two extension modules as option. Each extension module is in a small white cardboard box and packed in the larger cardboard box containing the XDi unit.

Please note that the module must be mounted in the right extension slot on the XDi after unpacking.

4.2 Panel mounting of XDi

XDi is mounted from the front where the mounting screws are located beneath the front frame. The special mounting clamps make installation easy.

XDi can be mounted in any angle from horizontal to vertical. It is important that there is space in the cabinet for sufficient airflow around the XDi and that the operating temperature of the unit is not exceeded. Especially when mounted in top of a horizontal panel, the temperature inside the console may be higher than expected, in which case forced air circulation inside the console is recommended.

Overheating will reduce the expected lifetime of the unit.

4.2.1 Cut-out and mounting depth behind panel

XDi type	Panel cut-out	Front size	Free depth below panel surface, XDi without extension module	Free depth below panel surface, XDi with extension module
XDi 96	92 mm (-0.0/+0.8 mm) x 92 mm (-0.0/+0.8 mm)	102 x 102 mm (equal to XL96)	Min. 55 mm Rec. >70 mm	Min. 90 mm Rec. >100 mm
XDi 144	138 mm (-0.0/+1.0 mm) x 92 mm (-0.0/+0.8 mm)	148 x 102 mm (wide as XL144)	Min. 55 mm Rec. >70 mm	Min. 90 mm Rec. >100 mm
XDi 192	186 mm (-0.0/+1.1 mm) x 138 mm (-0.0/+1.0 mm)	196 x 148 mm (wide as XL192)	Min. 60 mm Rec. >75 mm	Min. 95 mm Rec. >105 mm

See the data sheet for detailed 2D drawings.

3D drawings (step files) for use in CAD systems are available on request, please contact DEIF support.

4.2.2 Waterproof mounting

The XDi front, front glass and buttons are waterproof. Therefore, the protection around mounting screws and between the XDi front flange and the surface of the panel where the XDi is mounted are the critical areas to obtain the required IP protection.

The XDi is available with a factory-installed IP66 option for use in wet rooms, like a thruster room.

To obtain IP protection in general, the panel must be flat and smooth (not curved) where the XDi is mounted, and please pay special attention to the accuracy of the cut-out and the tightening of the screws (do not overtighten).

In installations where IP protection is important, the IP66 option is required. If the requirement is IP52 or lower, the standard XDi can be used.

For IP52, the panel surface where XDi is mounted must be completely flat and smooth. In practice, this is often not the case and therefore a water resistant sealant should be used between the XDi front flange and the panel surface to obtain the required protection. Alternatively, use the XDi with the IP66 option.

4.3 Mounting instructions

To mount the XDi follow these steps:

1. Remove the front frame by gently pulling one corner (the frame is snapped on the front when you receive the XDi unit)
2. Make the cut-out in your panel (see previous section).
3. Connect wires in connectors according to installation instructions.
4. Mount the connectors in the unit.
5. Use the cable tie to fixate the cables to the XDi unit (use cable support and cable relief on long cables inside the panel)
6. Insert the unit from the front of the panel
7. Fixate it firmly by tightening the screws on the XDi front (see the smart-grip function on fig. 6 below).

The recommended screwdriver torque is: 0.5 Nm +/- 0.1 Nm

8. Connect power to the unit
9. Follow the setup wizard instructions
10. Write the assigned CAN Node ID number on the white label on the XDi front.
11. If needed, make setup adjustments
12. Mount the front frame again
13. Installation is completed

The detailed information about connections, wiring and setup can be found in the next chapters of this manual.

Smart grip:

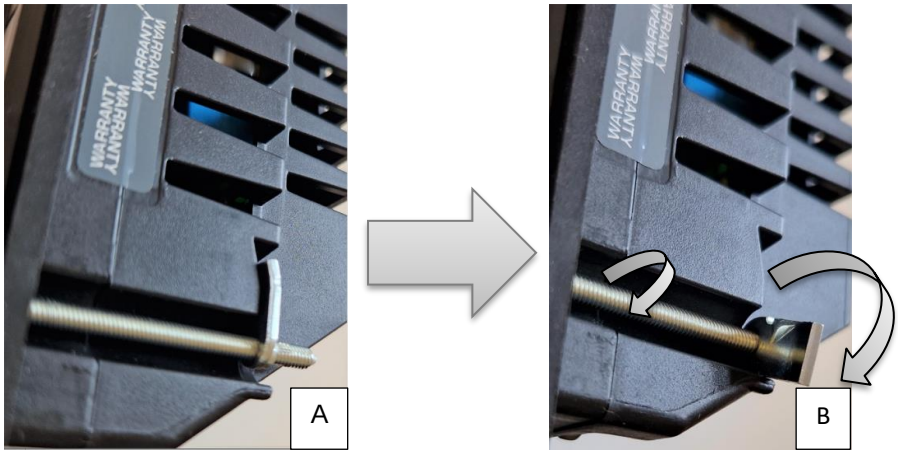


Fig. 6. Mounting screws and smart-grip clamps are pre-mounted on the XDi unit

The smart grip is tightened when received from the factory (A). It enables mounting the XDi from the front without the need to hold the grip.

To tighten the XDi:

1. Push the XDi through the cut-off all the way
2. Use a screwdriver to turn the screw half a turn Counterclockwise ((B) the smart grip is released)
3. Tighten the screw clockwise until the screw is tightened (0.5 Nm +/- 0.1 Nm)
4. Repeat steps 2 and 3 for all screws

To dismount the XDi:

1. Remove the front frame
2. Use a screwdriver to open the screw (Counterclockwise) until you can feel that the grip is tightened again
3. Repeat step 2 for all screws
4. Pull the XDi out.

4.4 Installing a CAN bus system

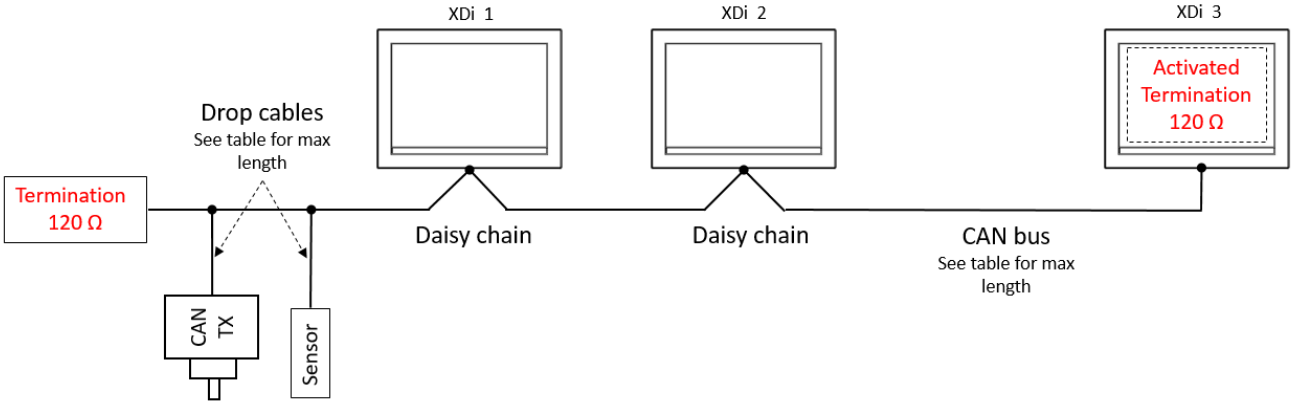
4.4.1 XDi CAN bus ports

The XDi base unit is equipped with two CAN bus ports, and CANopen is the standard interface protocol. The unique DEIF XDi-net Plug & Play extension to the CANopen protocol is used in all DEIF standard libraries for easy data sharing and is also used in many custom specific libraries, to make system setup and integration easy.

The following sections describe the basic CAN installation information. For more detailed information, please consult the “XDi-net/CANopen reference manual.

4.4.2 CAN bus system wiring

The XDi unit can be connected to the CAN bus either by a short drop cable to the backbone or by daisy-chaining the backbone from unit to unit (see following drawing).



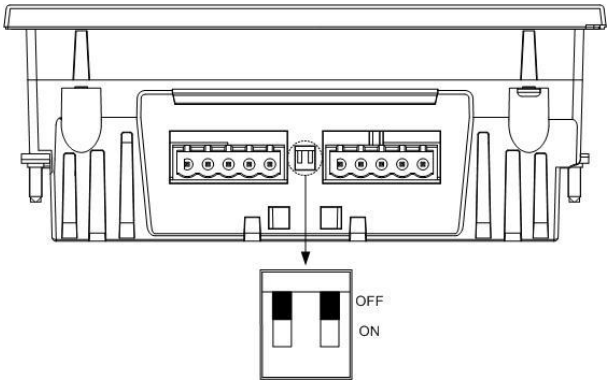
The standard terminal block, with a single row of 5 screw terminals, supplied as standard for the XDi, is most appropriate for drop cable connection. Daisy chaining will require two wires to be mounted in each terminal location.

Recommendation: if daisy chain is the preferred installation form, we recommend that you order the XDi unit with either the double screw terminal option or the double spring terminal option. (See the XDi data sheet for ordering information)

4.4.3 CAN backbone and Termination

Termination

The CAN bus must be terminated in each end of the CAN bus cable line by a 120 Ω resistor. To make termination easy, the XDi has a built-in 120 Ω termination resistor. Set the switch to ON (see drawing) to activate the termination. Each of the two CAN ports has a separate built-in termination resistor and ON/OFF switch.

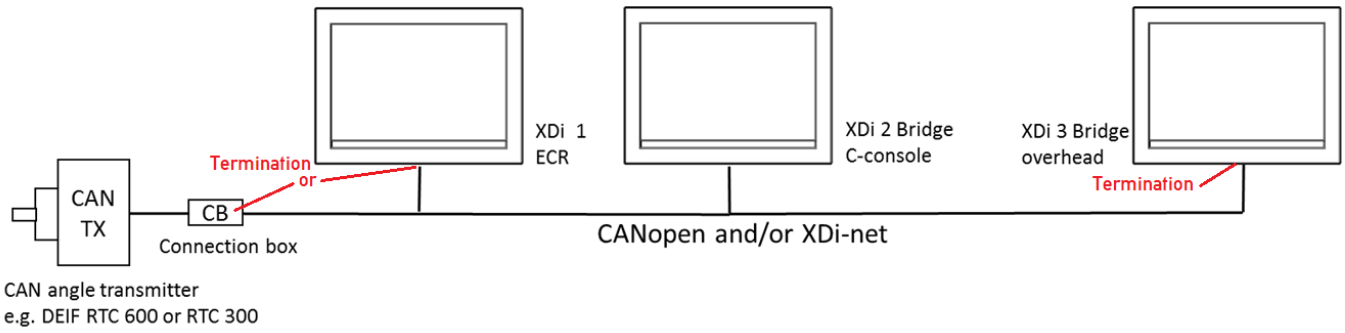


Only two termination resistors can be connected in a CAN bus network. Adding more terminations will overload the CAN drivers, disturb communication and in the long run maybe damage the CAN driver circuit.

Termination example

This example shows a system where it can be considered where to insert the termination.

If the total cable from the CAN angle transmitter to XDi 1 exceeds the max allowed drop cable length (10 m @ 125 kbps), then a 120 Ω termination resistor should be installed in the connection box.



If the cable from the CAN TX (angle transmitter) to XDi 1 is less than the max allowed drop cable length (10 m @ 125 kbps), then the CAN bus can be terminated by switching ON the internal termination resistor in XDi 1 (left side), and the other termination can be made switching ON the internal termination in XDi 3 (right side).

Backbone and drop cable

The CAN bus backbone is the CAN bus cable between the two end-point terminations. In a practical installation, terminations should be inserted in a way so that the most cable length will be serial connected between the two terminations. This cable will then be defined as the backbone. A cable section connected to the backbone in one end and to a product in the other end, (without termination), is called a drop-cable. Drop-cables are not part of the backbone, but the length of all drop-cables must be included in the total allowed CAN bus cable length.

4.4.4 CAN bus cable recommendation

Obtaining the optimal performance and cable length of the CAN bus requires the use of a good shielded CAN bus cable. It may be a shielded single twisted pair, or it may be a single shielded cable containing 2 twisted pairs for respectively data and power supply.

CAN bus bit rate	Theoretical max CAN cable length (optimal installation)	Recommended max CAN cable length (practical installation)	Max. drop cable length	Max. accumulated drop cable length
250 kbps	250 m	150 m	6 m	30 m
125 kbps	500 m	300 m	10 m	60 m
50 kbps	1000 m	500 m	15 m	100 m
20 kbps	2500 m	1000 m *)	20 m	250 m

*) For cable length >1000 m, a CAN buffer or repeaters should be used.

Specifications of the data wire pair (twisted pair):

Gage: Not less than AWG24/0.205 mm^2 (approx. 90 mΩ/m), thicker cable is recommended as long as the entity parameters are considered.

Characteristic impedance: 120 Ω +/-10 % up to at least 500 kHz

Cable loss: The AC signal attenuation must be less than 24 dB/100 m up to 16 MHz

Propagation delay: Maximum 5 ns/m

Recommendation for the power wire pair:

Gage: Not less than AWG20/0.5 mm^2 (approx. 33 mΩ/m). Where long supply cables are used, thicker wire is recommended, and worst case calculations of supply voltage drop in the cable should be made.

Guidelines for selecting CAN bus cable can also be found in ISO11898-2.

If redundant CAN bus is used, the two CAN bus cables should be routed separately and in a safe distance from each other to reduce the risk of a single event damaging both CAN bus cables.

4.4.5 Shielding and grounding of the CAN bus cables

Cable shield

Where CAN cables are connected, the cable shielded must be interconnected. The cable shield must not be connected to the CAN GND terminal on the XDi. CAN GND is a “common” terminal that must only be used if there is an extra “common mode wire” included in the CAN cable (that is the twisted pair for data + one common wire). This extra wire reduces common mode voltage between CAN devices on the bus, but it is only rarely used in marine applications.

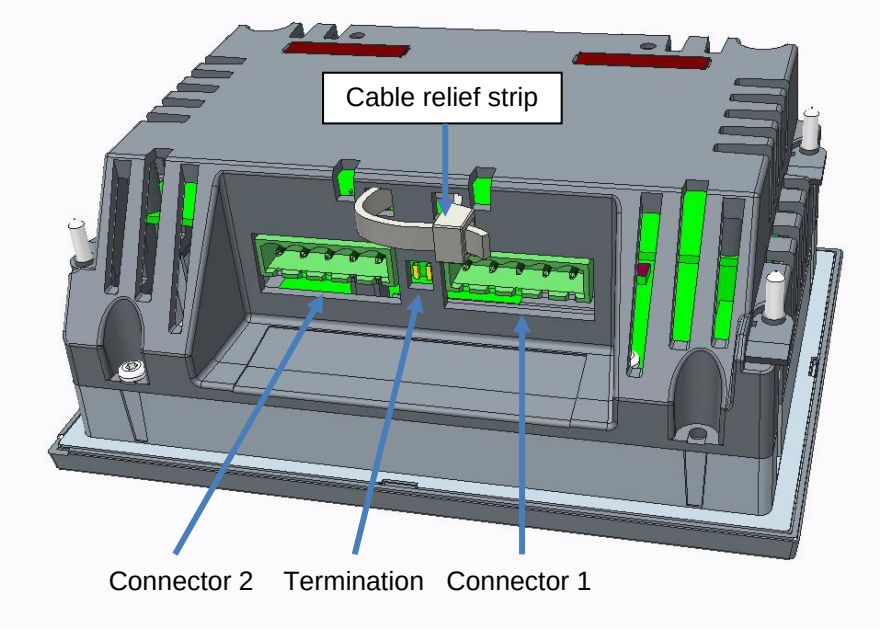
Grounding of the CAN bus cable

It is recommended only to connect the shield, of the total CAN bus network, to the ship’s ground in one single location.

It is important that the ground connection used is free from noise and transients from other devises using the same ground connection. If a good and noise-free ground connection is not available, it is normally better not to connect the CAN bus cable shield to ground at all.

Using multiple ground connections on the CAN bus cable may create electrical noise loops disturbing the CAN bus communication.

4.5 XDi power supply and CAN connections

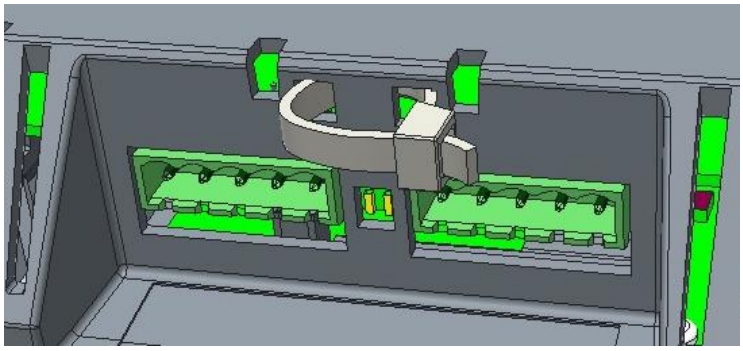


XDi base unit connectors				
Type	Terminal no.	Signal	Marking	Remark
Connector 1	1	CAN 1 connection	CAN 1 GND	Common, should not be connected *)
	2		CAN 1 LOW	
	3		CAN 1 HIGH	
	4	Supply Voltage	+24 V DC	Standard power input
	5		0V	
DIP switch 1	-	ON/OFF	CAN 1 Term	120 Ω termination
DIP switch 2	-	ON/OFF	CAN 2 Term	120 Ω termination
Connector 2	6	CAN 2 connection	CAN 2 GND	Common, should not be connected *)
	7		CAN 2 LOW	
	8		CAN 2 HIGH	
	9	Supply Voltage	+24 V DC	Redundant power input
	10		0 V	

*) The common wire should only be used if an extra dedicated “common” wire is available in the CAN bus cable. This terminal should not be connected to cable shield or ground!

4.5.1 Strain relief of cable and termination of cable shield

When the cable and connectors are mounted on the XDi, the cable should be relieved using a cable strip that can easily be inserted in the small slots (see drawing).



If the CAN bus cable is daisy-chained, the shield of the cable must be electrically connected beneath the strain relief strip and must not be connected to CAN common!

Be aware, that the shield must not touch any other electrical parts or any metal parts around it. It is therefore recommended to connect the two cable shields up against each other and cover the shield joint with a heat shrink hose, before it is fixated below the cable strip. The two shields may be soldered together (with great care), but in protected indoor panels, it should not be necessary.

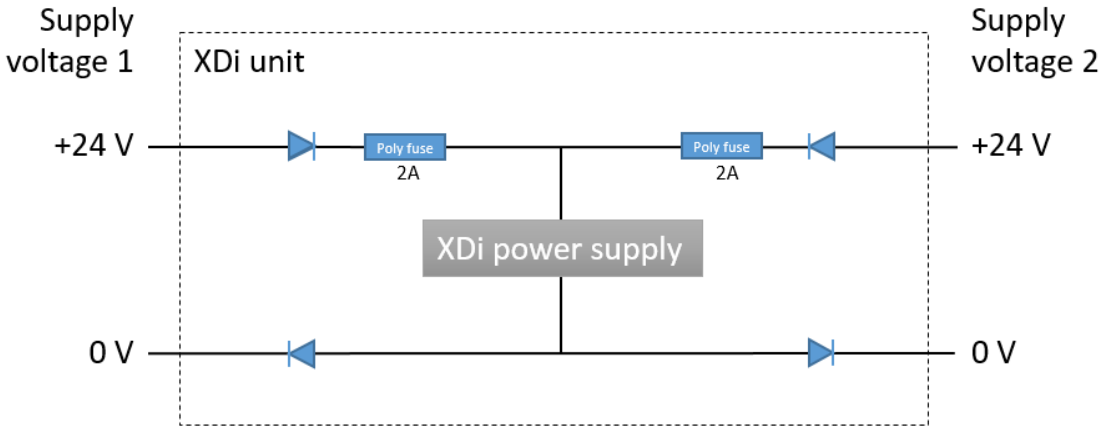
4.5.2 Supply voltage monitoring:

The XDi has two supply voltage inputs, separated by diodes as shown below.

This allows the XDi to be supplied from two independent power sources. Each input is also protected by a polyfuse that will disconnect the XDi unit in case of a short circuit in the internal power supply unit.

A single failure in one of the power source lines will not affect the XDi or the source located on the other side of the separation diodes.

An internal single failure in one of the built-in separation diodes will not affect either the function of the XDi or the rest of the system.



Each supply voltage input is equipped with an isolated voltage monitor circuit. This circuit will detect if the input voltage drops below the minimum recommended supply voltage level.

This level is approximately 18 V DC.

In the product profile or via the menu, it is possible to activate supply voltage monitoring of one or both supply voltage inputs.

If monitoring is active, a warning or alert pop-up will be presented on the display if the input voltage is too low (or missing).

A warning is issued if the only available supply is below the limit and the alert is issued if only one of the two supply inputs is below the limit (or lost). This is of course in a system with redundant power supplies.

A warning or alert beep audio signal can also be activated. (Only issued once when the warning or alert first occurs).

It is recommended always to have at least one power line monitored.

4.5.3 Warning/alert output

Not only warnings for power supply faults, but also all other active warnings and alerts will be sent in an emergency message on CANopen.

In the product profile stored in a customised library, it is also possible to pre-configure one or both relays in the DX1 module to be activated when the XDi detects a warning and/or alert.

4.6 First time setup using the wizard

When the XDi unit is received from factory and has not previously been set up, it will automatically start the setup wizard when powered up the first time:

Please note that the library owner, performance class, library number and version of this library are indicated below the headline.

Important: check that the library identification and version are correct before you start to set up the XDi.

4.6.1 Rotate the display180º.

The XDi display has a wide viewing angle. However, depending on the colour pallet used on the virtual indicator, a change of colour may be observed when the display is viewed from below. To compensate for this in installations where the indicator is normally looked at from an angle below the centre line, it is possible to rotate the presentation 180º and install the XDi indicator upside down.

When the recommended DEIF colours are used in the virtual indicator design, the colours are very slightly affected by the change in viewing angle.

For convenience, it is even possible to have this 180º rotation predefined in a customised XDi library, in which case the XDi will start up being rotated 180º.

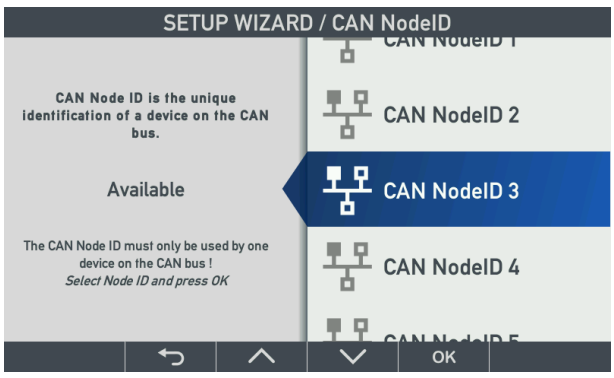
4.7 Manual setup procedure

When you press the “OK” soft key, the wizard will guide you through the 5 main setup steps.

4.7.1 Step 1 - Select CAN Node ID

First step is to assign a CAN Node ID as soon as it is selected XDi is accessible on the CAN bus.

If you don’t use CAN bus in your system, just select the default CAN NodeID by pressing OK.

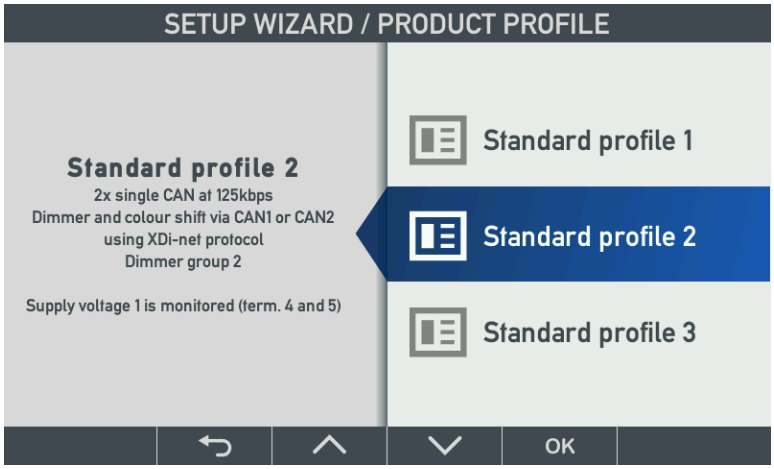


XDi has two CAN ports as standard, and they will always be assigned a common node ID between 1 and 126. (127 is reserved).

The XDi library contains a default NodeID number, which will be the one suggested at start-up. If this NodeID is already in use, it will be greyed out, and the next available NodeID will be suggested instead.

After selecting the CAN NodeID, write the number on the white label on the XDi front, behind the front frame. This will help you identify the unit in the physical CAN network and be beneficial if an XDi needs to be replaced in a service situation.

4.7.2 Step 2 - Select product profile



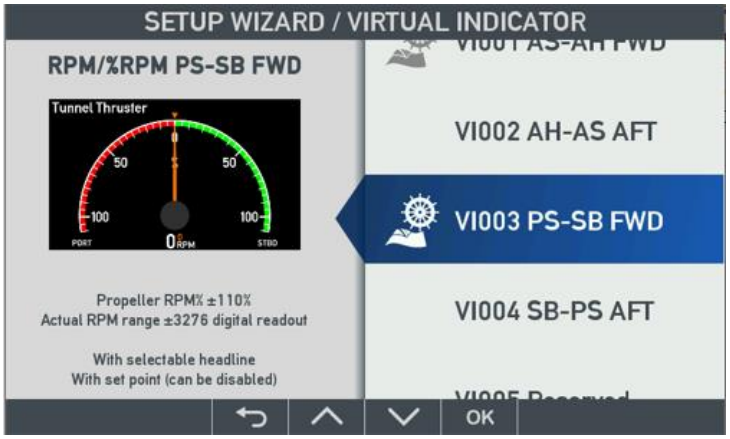
The list of predefined Product Profiles (PP) will be shown. (In this example, there is only one PP).

The PP contains the product-related settings for: dimmer/colour shift, CAN bus, warnings, and sound.

The parameters in the selected PP may later be changed via the user or installation menus.

(In this example, there is only one PP).

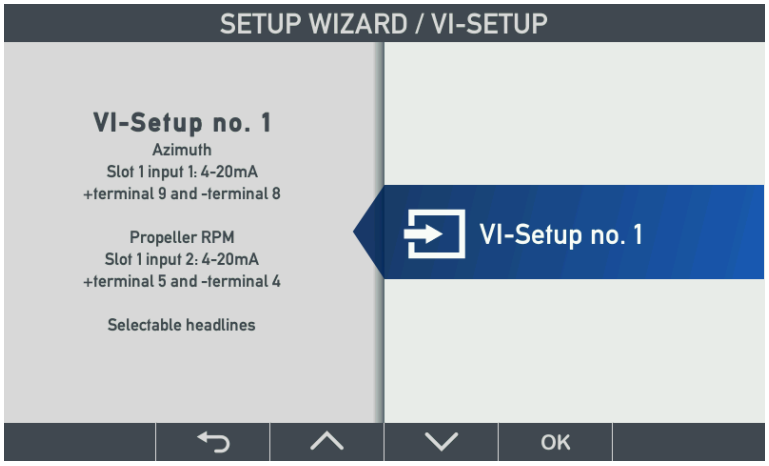
4.7.3 Step 3 - Select virtual indicator



The XDi is delivered with either a standard DEIF library or a customer library installed.

The XDi library can contain several predefined virtual indicators which can be selected from this menu. Each virtual indicator is identified by a unique VI-number, and if the indicator is wheel-marked, it will be shown in front of the VI-number.

4.7.4 Step 4 - Select VI setup profile



The Virtual Indicator (VI) setup profile contains pre-set parameters for: input sources, scaling, headlines, labels, units, indicator behaviour and much more.

Selecting a predefined profile makes complex setup simple, secure, and easy.

The VI setup is related to the VI selected in the previous step, and there may be up to 50 VI setup profiles for each Virtual Indicator to select from.

(In this example, there is only one VI setup).

4.7.5 Step 5 – Finish – XDi without NX2 module

When the first 4 selections are made, you can either press OK to finish the wizard and go to normal operation or select one of the detailed setup menus.

Installation menu: change or fine-tune the predefined setup parameters.

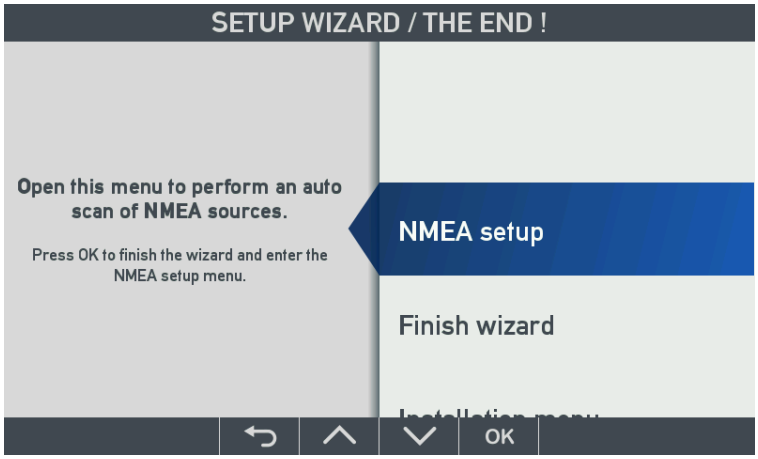
User menu: change dimmer, audio, and visual settings.

Restart wizard: go back to start and make or change the PP or VI.

In the installation and user menu, it is possible to adjust the pre-set parameters; detailed description of those menus will follow.

4.7.6 Step 5 – NMEA setup – XDi with NX2 module

In case an NX2 NMEA module is mounted on one of the XDi extension slots, the NMEA setup menu will be presented as the default selection.



The preinstalled virtual indicator library must support NMEA input.

Only XDi-N libraries will have full NMEA functionality and support NMEA input, output and routing.

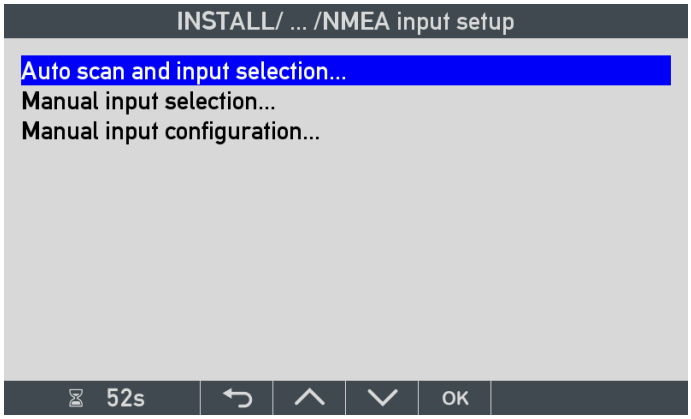
Dual and multi libraries may have support for NMEA output and very limited NMEA input function. If there is NMEA support, it will be clearly stated in the library description.

Before you push “OK”, it is a good idea to make sure that all relevant NMEA sensors and system devices are connected to the relevant NMEA inputs on NX2 and that they are powered up and transmitting data.

Then press OK to select the NMEA setup menu.

4.7.7 NMEA auto scan and input selection

The next step is to select the highlighted “Auto scan and input selection...” by pressing OK. This function will now scan all input channels and look for all relevant NMEA sentences.



The “Manual input selection...” should first be used after the auto scan routine is performed.

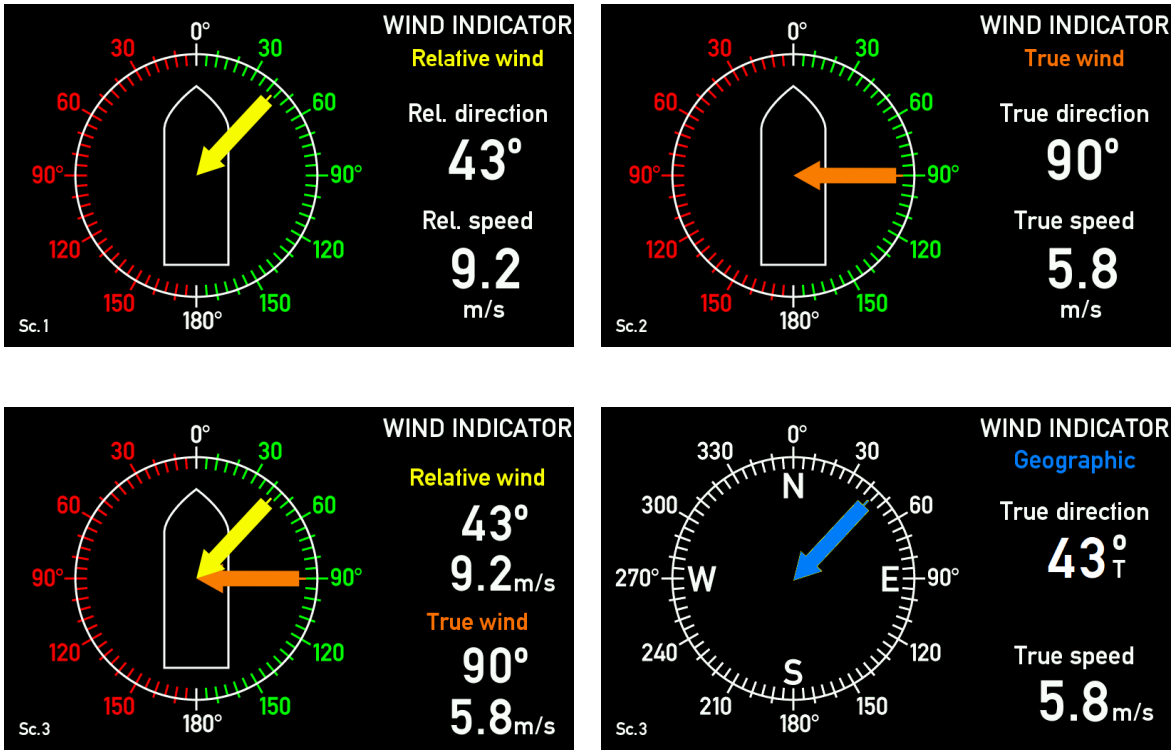
“Manual input configuration...” can be used to configure an NMEA input where no sentence is available when the input scanning is performed.

If the sensor and other data sources are connected to the correct inputs on the NX2 module, and if there is only one data source for every relevant data type, then the auto scan function will automatically detect and select them as source.

4.7.8 NMEA auto setup example

This example is for a main XDi-N wind indicator used in an application where relative wind data is received from the wind sensor, and the true and geographic true wind data is calculated by the XDi-N.

The XDi-N setup is: NodeID=40, PP01, VI007 (with 4 screens), VS03.



The wind data is coming from a DEIF WSS 550 wind sensor connected to RX/RTX 2 (RS-485) on the NX2 mounted in slot 2 (in XDi, this input is presented as 2.2).

To calculate the true wind data, speed and heading information is required. In this example speed and heading data is available on one NMEA output from the ship’s integrated navigation system. This output is connected to the RX1 input on the NX2 module in slot 2 (in XDi presented as 2.1).

XDi/NX2: NMEA input S2.2 (sensor data):

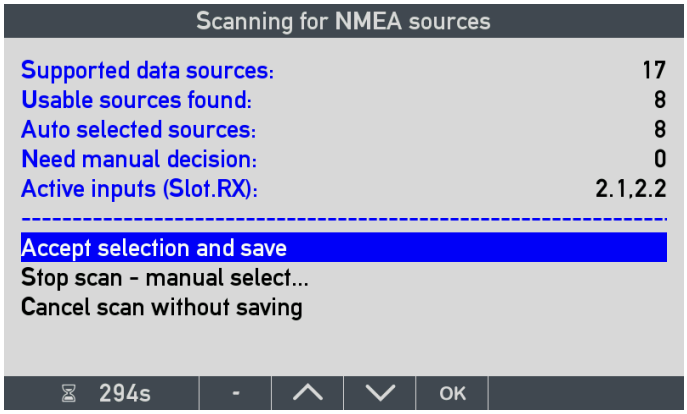
Wind speed: $WIMWV,220.0,R,028.0,N,A*29

XDi/NX2: NMEA input S2.1 (Nav. data):

Speed data: $VDVBW,06.0,00.0,A,05.0,00.0,A,00.0,V,00.0,A*45

Heading: $HEHDT,194.2,T*21

We select auto scan by pushing the OK button, and the automatic NMEA input scanning is performed.



After a short period of time, the numbers in the right side will be stable. This means that no new data sources are detected.

“Supported data sources” are all the sources that can be set up for NMEA in the selected product profile. Normally it covers all data types that the different indicators in the library will use. It also includes the dimmer groups that can be controlled by NMEA. Normally, this figure is more than what is needed for the selected indicator.

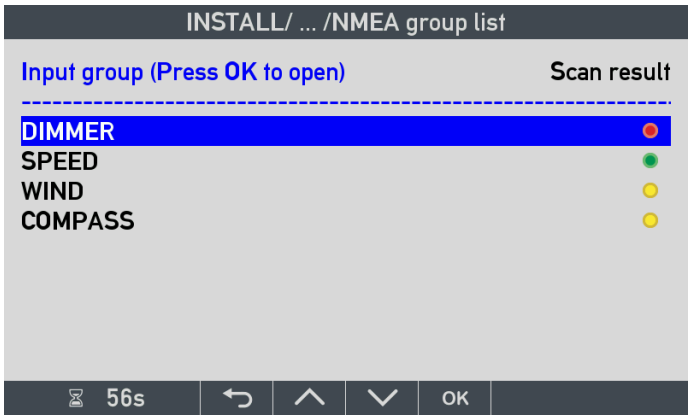
In this case, we have selected one of the most complex wind indicators that is able to present relative wind and calculated true wind data, and it has found 8 usable data sources and auto-selected all 8.

“Active inputs (Slot.RX)” show the ports that NMEA data is currently receiving from.

Stop scan - manual select

To see what is actually selected, highlight “Stop scan – manual select...” and press OK.

You will then get this picture:



RED dot means that no external sources are available, in this case for the dimmer data group.

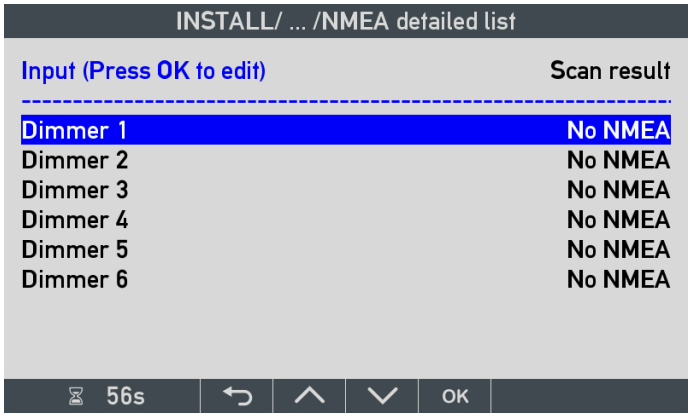
YELLOW dot means that sources are available for some data in the group, but it should be checked. Some data types may need manual selection, or some may be missing.

GREEN dot means that all data types in this group have been assigned a source.

We can now look through the automatic selection and check that needed data has a source assigned:

DIMMER

The dimmer group is red on the above display. That is because the XDi-N does not receive any NMEA DDC sentences to control the dimmer. If we press OK on the dimmer group, it will open and we can see that no NMEA sources are available.

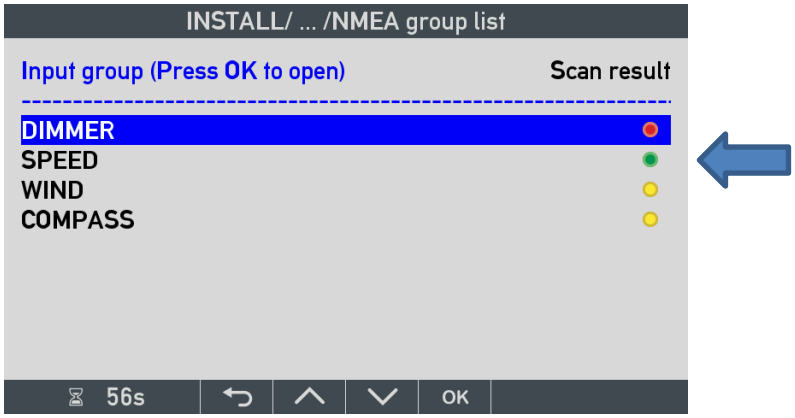


In this case, it doesn't matter since we have chosen a product profile (PP) where dimming is controlled by the front buttons.

If you want to use NMEA to control the dimmer level you must select a PP that supports NMEA dimming.

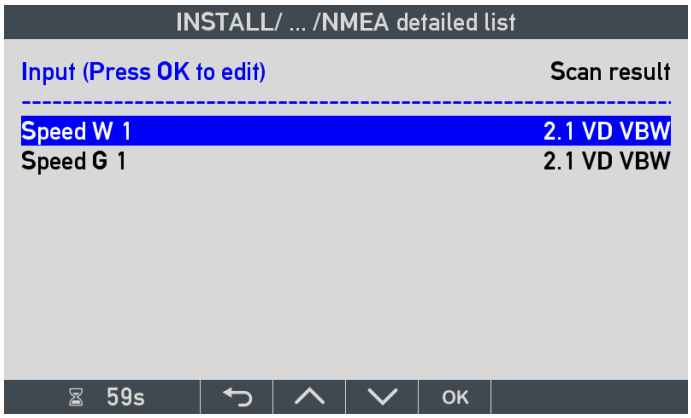
SPEED

In this example speed data is needed to be able to calculate the true wind data.



The speed group is green, so everything is good.

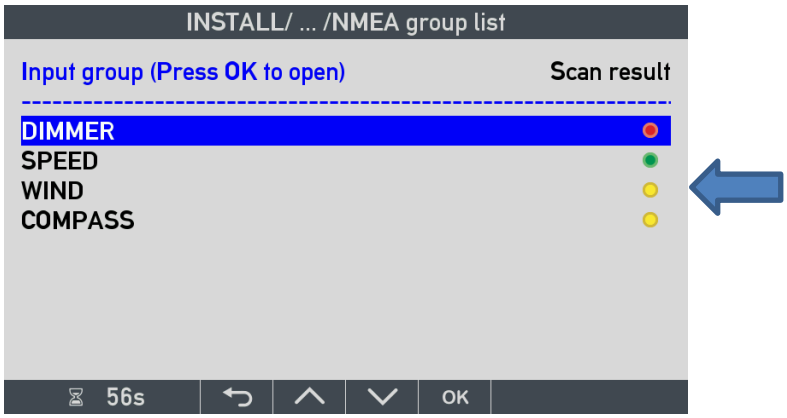
If we open this group, we can see which port and sentence is used to provide data.



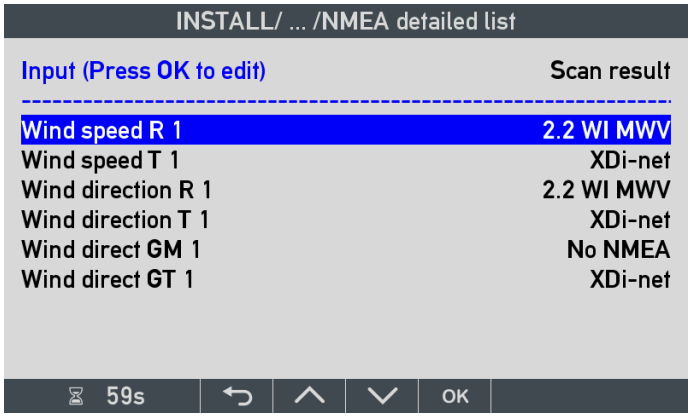
In this case, "Speed through water (STW)" instance 1 and "Speed over ground (SOG)" instance 1, are received from input port 2.1, provided by talker VD, and sent in sentence VBW.

The XDi only needs one of the speed data to be able to calculate true wind. If STW is available, it will by default be used. If not, SOG is used. Please note that the default selection can be changed via the installation menu.

WIND



This data group is yellow, so not all data is selected, or maybe manual setup is needed:



Relative wind speed and direction are received from the wind sensor connected to input port S2.2 and contained in the MWV sentence with talker WI. The selection is made automatically and needs no further attention.

The “Wind speed T 1” and “Wind direction T1” (T= true) are marked in the menu as XDi-net.

The reason for this marking is that the internal wind calculator is active and delivers calculated data as XDi-net data, for presentation on the indicator as well as transmitted on CAN bus using the XDi-net protocol.

In this way, other XDi-N indicators on the CAN bus that are set up to receive XDi-net data will present the same calculated wind data.

The geographic wind direction can be calculated both relative to the magnetic north pole and/or to the geographic true north pole.

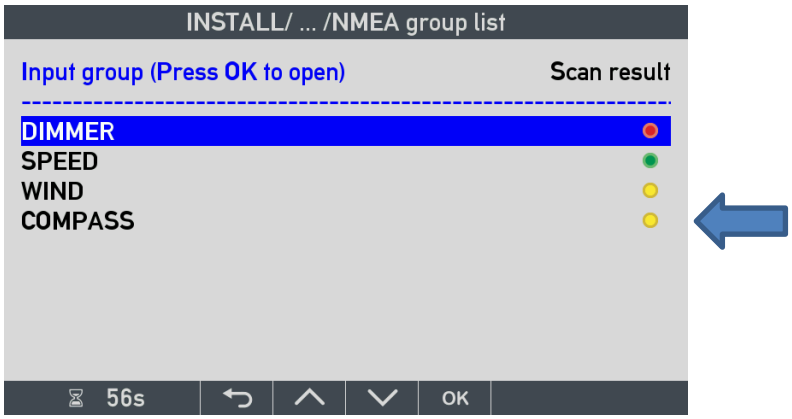
In this example, VI007 is selected, and this indicator only presents the geographic true wind direction relative to true north, therefore only “Wind direction GT 1” is calculated by the XDi-N.

The “Wind direction GM 1” which references to magnetic north is not used and therefore “No NMEA” is indicated.

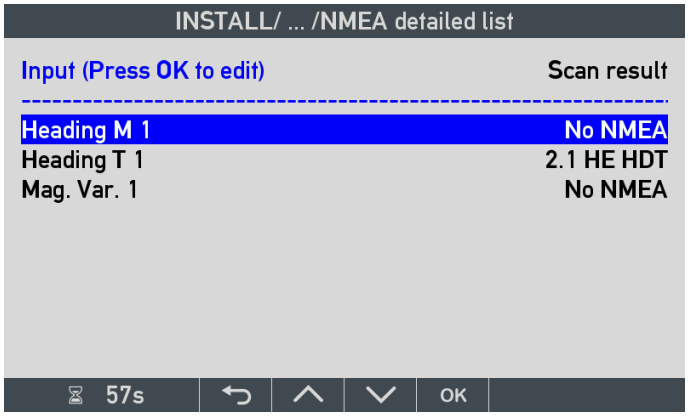
Please note that there is only one true wind speed parameter. It is the same independently of the reference point used for the wind direction (ship’s heading or the north poles.

COMPASS

In this example compass data is used to calculate geographic true wind inside the XDi.



The compass group is also yellow and should therefore be checked:



The magnetic heading of the ship, “Heading M1”, is not available on NMEA, but it is not needed in the actual configuration, since the selected virtual indicator does not calculate and present geographic wind direction relative to magnetic north.

The true heading, “Heading T1” is received from the navigation system connected to input port S2.1, provided by talker HE and contained in sentence HDT.

When the magnetic variation, “Mag. Var. 1” parameter is available on NMEA, the XDi can calculate the magnetic compass heading based on the true heading (Heading T1) or the other way around. If for example magnetic heading was calculated based on the HDT data available, it will be shown as HE HDTcc (cc for calculated).

Finish the installation

The NMEA setup has now been verified and all data needed to show relative wind data and to calculate true wind data is available, and all left to do is to press the return arrow until the wind indicator is shown on the display and presents wind data.

When you leave the menu, the NMEA settings will be stored and locked. This means that only the selected sources will be used by the XDi.

4.7.9 Change NMEA setup

If you make changes in your installation or want to change to another data source, you can always access the installation menu and make changes.

See the section “NMEA input” for details.

4.7.10 Skipping the wizard

If you have entered the setup wizard by accident and want to leave it again, please push OK on each step to jump to the next stage without making any changes and end with accepting “Finish Wizard”.

When you make a new selection in the wizard, all previous parameter adjustments made via menu (or via CAN) will be reset to default settings. For example, if you select a new VI setup profile for a virtual indicator, then manually entered zero adjustments of input data and selection of a headline will be reset to the default value!

If you are not completely sure what you are doing, do not make changes using the wizard or installation menu!

4.8 Automated XDi setup via CAN

Instead of making a full manual first time setup, it is possible to use an automated setup via the CAN bus.

To make an automated setup, the XDi must have a unique NodeID assigned, two devices on a CAN bus must never have the same NodeID. As previously described, it is a good idea to make a “NodeID system” to identify each physical XDi location in an installation with a unique NodeID.

The “CAN setup controller” must use a list of all NodeIDs in the installation and the combination of virtual indicator (VI), VI setup (VS) and Product Profile (PP) to auto-setup. If needed, adjustments of default parameters like selecting another headline from the default headline list can be made. It is even possible to write a new headline text and activate that.

When the NodeID is selected by pressing OK, the XDi will send a message on the CAN bus that tells the controller that a new XDi needs setup, and the controller can take over and complete the setup immediately.

The installer will just see the XDi start-up with the selected indicator.

See the “XDi-net/CANopen reference manual” for a detailed description of how to integrate automated setup in your CAN bus system.

5 Detailed product description

5.1 XDi CAN bus

All XDi units are equipped with two galvanic separated CAN ports as standard.

5.1.1 Detailed XDi-net/CANopen description

A detailed description of the CANopen and XDi-net implementation is available in: **XDi-net/CANopen reference manual.**

It is recommended to consult this document if you intend to fully utilise the CAN bus.

The following is a short introduction to get started using CAN.

5.1.2 XDi-net for easy integration

If CANopen is new to you, using XDi-net for easy plug and play data sharing via CANopen will be the obvious choice. The only thing you need to do, is to connect the CAN bus according to the guidelines for installation, remember the termination, assign a unique node ID for each XDi on the bus, and select appropriate setup profiles that supports the XDi-net. The XDi will take care of the rest.

5.1.3 CAN NodeID

All transmitting devices on a CAN bus must have a unique NodeID assigned to them. Two devices on the same bus must never have the same NodeID.

The two CAN ports on the XDi will always be assigned the same NodeID, in other words the NodeID is the unique "name" of the XDi.

In the XDi Library, a default NodeID is stored. This is simply to guide the installer to the desired section of NodeIDs for indicators.

Which NodeID should you select?

The importance of selecting a particular NodeID depends very much on the type of CAN communication used by the virtual indicator and the dimmer system.

If automated installation setup is used, the NodeID is the unique identification of each physical device and should be connected to a physical location of the actual device, this will be explained later.

XDi function	Particular NodeID is required for the XDi	NodeID/COBID of the data source must be correctly set up in the XDi	Notes
Use only analogue or digital data inputs.	No Use default	No Use default	No CAN bus connection. However, XDi must be assigned a NodeID.
Receive and/or transmit data in XDi-net format.	No (Any will do*)	No (Not used)	XDi-net is independent of NodeID setup.
Receive data in a TPDO or RPDO	No	Yes	XDi must know the COBID of the TPDO or RPDO containing source data. COBID is based on source NodeID.
Receive data in a DAM-MPDO	Yes	No	Data is addressed directly from a CAN controller (source) to each XDi identified by their NodeID.
Automatic setup	Yes	-	A service data channel (SDO) is established between "Master" and one XDi identified by its NodeID, and setup parameters are transferred.

*) Any will do, but two units on the CAN bus must not have the same NodeID.

CANopen uses an arbitration process on the 32 bit header of a CAN frame. The smart thing is, that in case of a data collision, the CAN frame with the lowest header value will continue transmitting, while the one with the highest header value will redraw and try again later. The NodeID is indirectly part of the CAN frame header, and it is possible to give a CAN unit higher priority by selecting a lower NodeID. In most indication systems, using CAN bus, the busload is so low that collisions and thereby priority is not an issue. Anyhow, we recommend that the low NodeIDs are used for controllers and sensors and higher NodeIDs are used for the indicators themselves.

NodeID for automated setup

If you now or later want to include an automated installation-setup function in your CAN-based indicator system, it is a very good idea to make a standardised structure for the use of NodeIDs in your systems.

There are 127 available NodeIDs, which is NodeID = 1 to 126, and 127 is in most cases reserved by XDi-net.

The NodeID structure or list should reflect the selection of virtual indicator, VI-setup and PP for each XDi node.

Example of a custom NodeID list:

In this example, all indicators are running on the same redundant CAN bus with up to two propulsion systems on the same bus. Data of the same type (for example azimuth angle 1 and 2) are determined by the data type instance, which is then pre-configured in the two VI-setup profiles. The dimmer function is also distributed via CAN bus and is divided into 5 dimmer groups, each pre-configured in a PP, one PP for each dimmer group.

Location	Product profile	Virtual indicator	VI-setup	Indication	NodeID
System controller	-	-	-	No indication – transmits data and setup parameters.	01
Azimuth angle transmitter 1	-	-	-	for example, RTC 300 or RTC 600	02
Azimuth angle transmitter 2	-	-	-		03
Reserved....					...
Pitch angle transmitter 1	-	-	-	for example, DEIF RTC 300	06
Pitch angle transmitter 2	-	-	-		07
Reserved....					...
Centre console FWD	PP1	VI1	VS1	FWD azimuth, RPM, Pitch 1	20
" " "	PP1	VI1	VS2	" " " " 2	21
Reserved....					...
Centre console AFT	PP2	VI2	VS1	AFT azimuth, RPM, Pitch 1	24
" " "	PP2	VI2	VS2	" " " " 2	25
Reserved....					...
Portside bridge wing	PP3	VI1	VS1	FWD azimuth, RPM, Pitch 1	28
" " "	PP3	VI1	VS2	" " " " 2	29
Reserved....					...
Starboard bridge wing	PP4	VI1	VS1	FWD azimuth, RPM, Pitch 1	32
" " "	PP4	VI1	VS2	" " " " 2	33
Reserved....					...
Engine control room	PP5	VI1	VS1	FWD azimuth, RPM, Pitch 1	36
" " "	PP5	VI1	VS2	" " " " 2	37
Reserved....					...
Centre console FWD	PP1	VI3	VS1	FWD stern thruster % 1	40
" " "	PP1	VI3	VS2	FWD stern thruster % 2	41
Reserved....					...
Centre console AFT	PP1	VI4	VS1	FWD stern thruster % 1	44
" " "	PP1	VI4	VS2	FWD stern thruster % 2	45
Reserved....					...
Engine control room	PP5	VI3	VS1	FWD stern thruster % 1	48
" " "	PP5	VI3	VS2	FWD stern thruster % 2	49
Reserved....					...

Some NodeIDs are reserved in between for future system expansion.

5.2 Overall CAN bus parameter settings

Editing the CAN bus parameters list below requires a very good knowledge of CANopen and the special manufacture specific CANopen functions built on top to obtain the XDi-net functions. It is therefore highly recommended to consult the "XDi-net/CANopen reference manual" before making any changes in the CAN setup parameters.

The parameters in the table below are the overall CAN controls, and they will in some cases overrule or limit local CAN setting predefined in a product profile (PP) or a VI-setup profile (VS).

Example: an analogue input is set up to share data on CAN1 and CAN2, and the overall CAN bus mode in the table below is set up to be "Single CAN" (CAN1). Then data is only shared on CAN1.

The default CAN bus parameters are defined in the selected product profile.

CAN function	Available selection	XDi-net ON	XDi-Net OFF	Note
CAN bus mode:	Single CAN, 2 x single CAN, Redundant CAN	2 x single CAN	2 x single CAN	Selecting Single CAN will keep CAN 1 active and close all activities on CAN2.
Bit rate CAN1 (kbps):	20, 50, **125,** 250 (500, 800, 1000)	125	**125**	500, 800, 1000 kbps is only for short distances.
Bit rate CAN2 (kbps):	20, 50, **125,** 250 (500, 800, 1000)	125	**125**	125 kbps is normally used for marine CANopen application.
XDi-net functions:	ON/OFF	ON	OFF	All XDi-net functions are disabled.
XDi-net variable data on: (See "Important XDi-net restrictions")	NO, CAN1, CAN2, CAN1&2	CAN1&2 (not OFF)	NO	Allows for transmission and reception of XDi variable data between XDi units on the CAN bus.
Send XDi-net setup synch data on: (See "Important XDi-net restrictions")	NO, CAN1, CAN2, CAN1&2	CAN1&2 (not OFF)	NO	XDi will be able to synchronise parameter changes if this function is ON.
Send CAN Heartbeat on:	NO, CAN1, CAN2, CAN1&2	CAN1&2 (not OFF)	NO (All is OK)	Must be ON when XDi-net and/or redundant CAN is used.
Auto start XDi on the CAN bus:	YES/NO	YES	**NO** (or YES)	Must be ON when XDi-net is active.
Send CAN start command on CAN bus:	NO, CAN1, CAN2, CAN1&2	NO (All is OK)	NO (All is OK)	Used to activate a CAN sensor without built-in auto-start.
DAM-MPDO to be used: (See "Important XDi-net restrictions")	**NON** or RPDO2-4	**NONE** or RPDO2-4	**NON** or RPDO1- 4	Only used if DAM-MPDO data transfer is used.

Bold is the preferred selection.

5.2.1 Important XDi-net restrictions:

When "XDi-net variable data on" is set to one or both CAN ports, then ALL RPDO1s for all CAN NodeIDs on that CAN bus are reserved for XDi-net functions, and RPDO1 must not be used for other purposes!

When function "Send XDi-net setup synch data on" is set to a CAN port, then TPDO1-4 and RPDO1-4 with COB ID for node 127 are reserved. Node 127 is also used as a "parking" node for the XDi's service units.

Standard XDi-net is using RPDO1 as mentioned above, but in a custom library, it is possible to move the XDi-net to one of the other RPDOs: RPDO2, RPDO3 or RPDO4. This should only be considered if there is an unsolvable conflict in the user system due to the restrictions on RPDO1.

5.2.2 The CAN bus mode

1. Single CAN mode where only CAN1 is activated.
2. 2 x Single CAN mode, used when data is available on separate CAN bus systems.
3. Redundant CAN mode, primary/secondary CAN bus line.

Two independent CAN lines

This is a very useful feature in applications where two separated CAN busses are used for respectively indication and control, for example where the actual azimuth angle is available on the “indicator bus” and the commanded azimuth angle is available on the “control bus”.

It has also proven to be useful in some applications to separate indicator data and dimmer on separate buses. An example could be a supply vessel with four azimuth thrusters, each with a separate data bus, and with XDi indicators located in respectively centre bridge, port and starboard bridge wing and aft bridge. In this application, dimming must be performed centrally via CAN for all the indicators in the same panel (for example starboard bridge wind).

To achieve this, both CAN ports are used:

CAN1: Handles variable data that is routed individually on separate CAN bus lines to each of the four indicators (one for each thruster).

CAN 2: Handles dimmer data to control all four indicators in the same location. Data is routed on a separate CAN bus line between the four indicators.

In this way, the four CAN data lines are independent and isolated from each other and the CAN dimmer line.

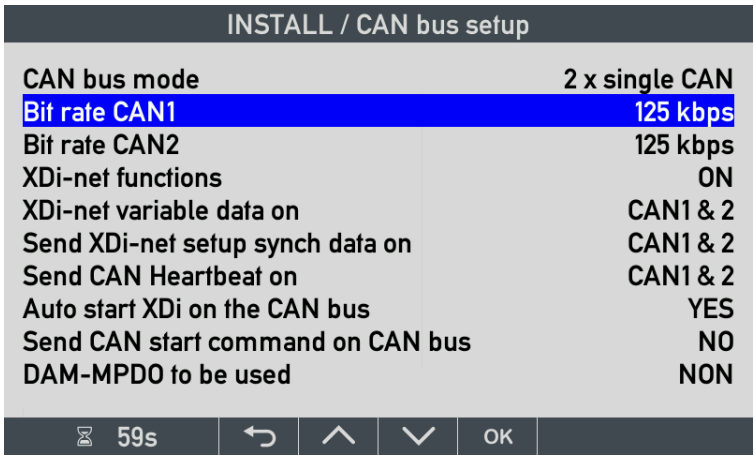
See the example in appendix 8.

Redundant CAN

Redundant CAN requires a CANopen master to control the two CAN bus networks and decide which bus should be used. By default, CAN1 is the primary line and CAN2 is the secondary (backup) line.

5.2.3 CAN bus changes via menu

The default CAN bus parameters can be changed manually via the XDi installation menu.



NOTE: RPDO1 is used for XDi-net using SAM-MPDO.
If XDi-net to is ON then menu point “DAM-PDO to used” must be either: None, RPDO2, RPDO3 or RPDO4.

5.3 Error indication

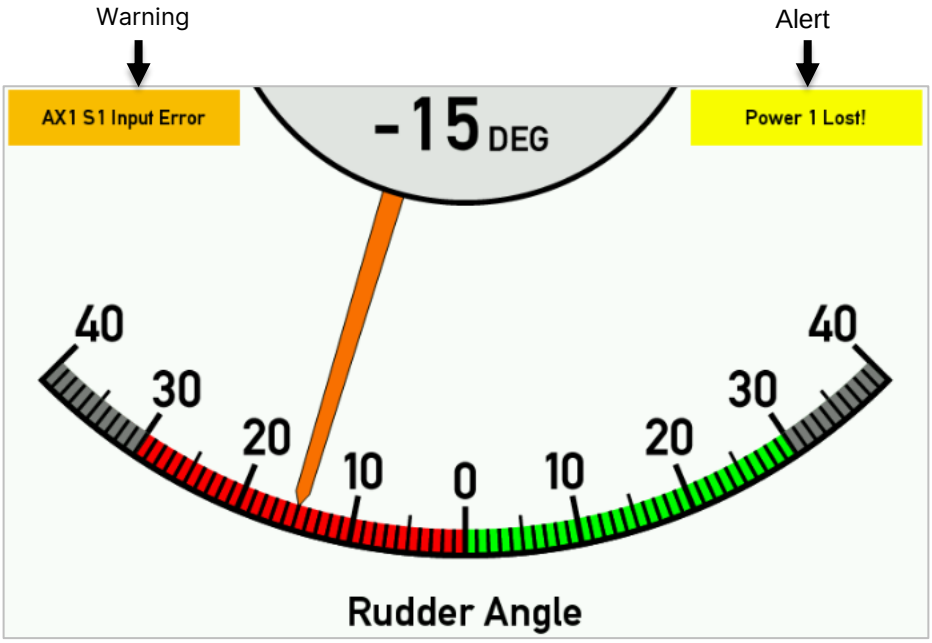
When the XDi detects errors, it alerts attention by the built-in buzzer (can be disabled from the user menu or by default in custom libraries) and a pop-up message as well as a CANopen message (see XDi-net/CANopen reference manual for details). If the error is missing data for an indication, the pointer of that indication starts blinking. It is possible to disable warnings and sounds separately, from the user menu (default is configured in the product profile), however, even if the warning pop-up is disabled, the pointer will still blink if data is missing.

If an indication is disabled, no error indication is shown when data is missing for that indication. For example, if a set-point for rudder is disabled (by default or from the install menu) in a virtual indicator, the XDi will not show warning, when the data for the set-point is missing.
The same applies for CAN bus errors, from CAN bus monitoring that will not be shown if the specific port is not configured as used.

See chapters 10.3.2 Warning setup, and 10.3.4 Sound setup for information on how to enable and disable the warnings and sound. Note that the “Alert” type is designated as “Caution” in the menu.

In the XDi there are two types of error messages:

1. Warning which is the more severe type – always shown in orange on the top left of the display. Due to the severity, the warning is constantly shown until the reason for the warning is no longar active.
2. Alert which is less serious type – always shown in yellow on the top right of the display. The alert is shown every approximately 10 seconds for approximately 1.5 – 2 seconds. It is blinking (2s on;10s off) to enable the user to see what is behind it.



If there are more than one message of the same kind, the XDi switches between the active messages. The message is shown after a 3s time out for the input where the error persisted.

The following table lists the errors and how they are displayed (can also be used for troubleshooting):

Display pop-up text	Warning type	Duration	Error causes
Data lost!	Warning	On while error persists	• Used CAN data is not received before timeout • Data from XDi-net or an internal input converter is not received (for example data for a digital readout of analogue % indication)
AX1 S1 Input Error	Warning	On while error persists	• Data from analogue module in slot 1 input is not received • Data value is outside error/range limits • AX1 module not mounted in Slot 1
AX1 S2 Input Error	Warning	On while error persists	• Data from analogue module in slot 2 input is not received • Data value is outside error/range limits • AX1 module not mounted in Slot 2
DX1 S1 Input Error	Warning	On while error persists	DX1 module not mounted in Slot 1
DX1 S2 Input Error	Warning	On while error persists	DX1 module not mounted in Slot 2
NMEA S1 Input Error	Warning	On while error persists	NMEA data on a configured NX2 module mounted in Slot 1 is not received (can also alternate with Data lost!)
NMEA S2 Input Error	Warning	On while error persists	NMEA data on a configured NX2 module mounted in Slot 2 is not received (can also alternate with Data lost!)
Power Low!	Warning	On while error persists	Single power supply monitoring only. The monitored power supply (1 or 2) voltage is under 18.5 VDC (±1 V) *
Power 1&2 Low!	Warning	On while error persists	Monitoring both supply inputs. Both power supplies voltage is under 18.5 VDC (±1 V)*
Power 1 Lost!	Alert	Blinking while error persists	Power supply 2 voltage is under 18.5 VDC (±1 V)*
Power 2 Lost!	Alert	Blinking while error persists	Power supply 2 voltage is under 18.5 VDC(±1 V)*

* Provided the XDi is still on

5.4 XL, BW, BRW-2 and TRI-2 with sCAN

The traditional DEIF XL indicator with single CAN input (sCAN) is a “listen only” device on the CAN bus, and it is therefore not necessary to assign a unique NodeID for an XL on the bus. Instead, the XL indicator needs to know the CAN data source that will provide the CAN data to be presented. XL with sCAN protocol requires variable data to be transmitted in byte 0 and 1 of TPDO1 for the CAN source identified by its NodeID (source ID). The COBID of the used TPDO1 is: 0x180 + ”Source NodeID number”.

The XDi can be configured to use the same sCAN format as the XL family is using.

It is also possible to configure the XDi to act as a sCAN data source, for example transmitting its analogue or digital input data in a TPDO1 recognised by the XL family as source data.

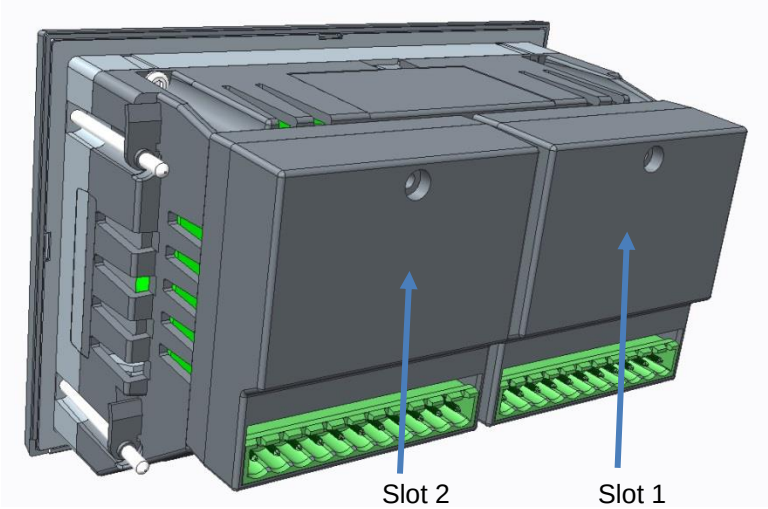
It is therefore possible to make a combined system where the XL family of indicators and XDi are using the same CAN data, and the XDi may share additional analogue or digital input data with other XL or XDi units on the bus.

To define such combined system configurations in a combined system requires a good understanding of XL sCAN and XDi, so it is recommended to require some assistance from DEIF when such systems are designed.

Application notes may be available from DEIF to help you specify indicators for your combined system.

5.5 Extension modules

The input/output capability of an XDi can be extended by adding one or two extension modules on the rear of the XDi unit. XDi 96 has one extension slot, and XDi 144 and XDi 192 have two slots. This is a very flexible way of extending the XDi CAN bus interface with additional analogue or digital inputs.



(Drawing – XDi unit - exploded view main unit with options)

The XDi 96 has one slot for an extension module, where XDi 144 and XDi 192 have two extension slots and can therefore be equipped with two extension modules.

Input can be extended with analogue or digital inputs, and it is possible to have the XDi configured with relay or NMEA0183 (IEC61162-1) output.

Extension modules are in addition to the two CAN bus ports, and input data from the extension module will be shared on the CAN bus as defined in the product or VI-setup profile.

The data sharing on CANopen can either use XDi-Net format and/or CANopen TPDO or RPDO.

The selected virtual indicator using the data from the extension module will scale input data and share them on CAN if it is set up in the VI-setup profile (VS).

This means, that in a system with multiple indicators presenting the same data, only one XDi needs to be equipped with extension module(s) and sharing data on CAN. The rest of the XDi units can receive those shared data via CAN.

If there are more analogue or digital inputs in a system than one XDi can handle, it is possible to make several XDi units with extension modules work together providing all data on CAN for the rest of the indicators to use. This is made very easily when the XDi-net protocol is used, but can also be achieved using TPDO/RPDO data sharing.

Please note, that normally only input data used by the selected virtual indicator is shared on the CAN bus. In customised libraries, it is possible to make an extra invisible input to share a data type that is not used by the virtual indicator itself, but only shared on CAN.

5.6 AX1 analogue extension module

The AX1 analogue extension module contains two analogue standard inputs (1 and 2). Each can be configured as voltage (high or low voltage), current (high or low current) or potentiometer input.

In addition, a 3rd voltage input is intended as input for an analogue dimming voltage (range +/-30 V). This input is fully calibrated and may also be used as an extra indicator input (voltage or potentiometer).

The XDi supports up to 7-point calibration of an un-linear analogue input, normally 2-point is used of 0...X type data and 3-point for –X...0...X data types.

The number of calibration points is predefined in the selected VS profile and cannot be changed via the input adjust menu.

It is possible to adjust key parameters for the analogue input via the XDi menu. This can be used to align the input and scale max/min input correct.

5.6.1 Reference voltage for potentiometer applications

The AX1 module has a very stable reference voltage output +7.3 V DC (7-7.5 V) with a built-in voltage monitor function. This is intended for potentiometer applications, since the variations in the reference voltage will be measured and automatically compensated to obtain a very high accuracy. It is even possible to overwrite the reference voltage output by an external voltage between 7.5 V to 30 V DC still monitored and variations are compensated.

Advanced potentiometer load correction

When a potentiometer is used as voltage source, the internal resistance of the analogue input circuit will load the potentiometer output resulting in a measuring error. The load impact depends of the resistance value of the potentiometer that is used. If the potentiometer has a low resistance the impact is low, but the higher the potentiometer resistance is, the more impact the load will have on the measurement.

When the high voltage input type is used it possible to enable a potentiometer compensation function in XDi. It can be activated and setup in the VS profile, but it can also be activated and setup in the input adjust menu. When this function is activated with the correct potentiometer resistance value inserted in Ω, then XDi will compensate for the error caused by the load of its own analogue input resistance (112 kΩ).

The benefit of using this function is most significant for linear potentiometers with high resistance.

Please NOTE: This function is only available on single high voltage inputs (HV1, HV2 or HV3), not for double input configuration like SIN/COS or Double triangle potentiometers for example used for 360° angle measurements.

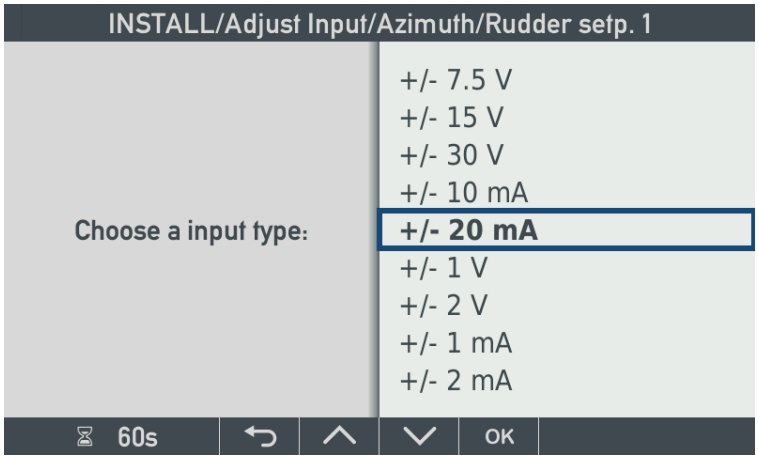
Due to the nature of those dual input types, the load impact is much lower and insignificant for potentiometer values up to at least 5 kΩ.

5.6.2 Analogue input types

The setup and scaling of the analogue indicator inputs are predefined in the selected VI-setup profile (VS).

If input 3 is used as dimmer input, the default setup parameters are defined in the selected product profile (PP).

The analogue input types are shown below. Select the input type and value that best fits your application.



Input type can be changed from the XDi menu, the highlighted input type, in the example above, is used for a

4-20mA input, one of the most used analogue interface types for indicators.

Input type	Input parameter range	AX1 Input to be used	Marking	Input resistance	Note
+/- 7.5 V	+/- 7 500 mV	High voltage input	HVI (1,2 or3)	112 kΩ	Select the range that best matches your input voltage
+/- 15 V	+/- 15 000 mV				
+/- 30 V	+/- 30 000 mV				
+/- 10 mA	+/- 10 000 µA	High current input	HI (1 or 2)	< 65 Ω (50 Ω*)	Select the range that best matches your input voltage
+/- 20 mA	+/- 20 000 µA				
+/- 1 V	+/- 1 000 mV	Low voltage input	LIV (1 or 2)	1 kΩ	The low input is used for both low current and low voltage.
+/- 2 V	+/- 2 000 mV				
+/- 1 mA	+/- 1 000 µA	Low current input			
+/- 2 mA	+/- 2 000 µA				

*) The resistance used to measure the current excl. the resistance in the poly-fuse.

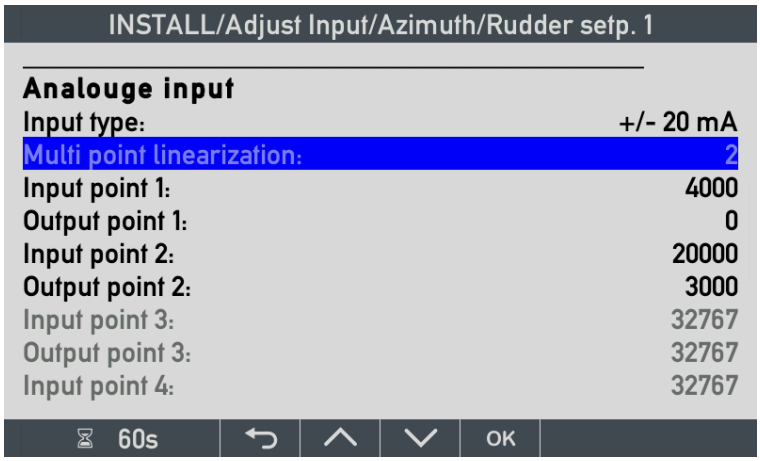
5.6.3 Analogue scaling

In the VS profile, each analogue input used is pre-configured to scale the incoming analogue signal to the correct output values that fit the data type it sources data to.

The example below shows the setup menu for a typical scaling of an analogue RPM 0 to 200.0 RPM input represented by a 4-20 mA input signal. The analogue input is configured in the VS to use 2 point calibration (or scaling); this requires 2 sets of scaling points:

Input	Value	Note
Input point 1	4 000	in µA equal to 4.000 mA
Output point 1	0	0.0 RPM @ x0.1 res.
Input point 2	20 000	in µA equal to 20.000 mA
Output point 2	3000	300.0 RPM @ x0.1 res.

Input point 1/output point 1 defines that 4000 µA (4 mA) is representing 0.0 RPM, and 20 000 µA (20 mA) is representing 300.0 RPM. Please note that the standard RPM resolution of x0.1.



The highlighted “Multi point linearization“ above is grey and cannot be changed from the menu. This is intentionally blocked to avoid unintentional changes that may result in a critical setup error.

5.6.4 Analogue multi-point linearisation

When the analogue input is used for a data type where the output value is type “+/-X“, for example rudder angle, then at least 3-point calibration is normally used. This means that 3 scaling pairs are active, for example rudder angle: -45° to 0° to +45° to match 4 to 12 to 20 mA.

Input	Value	Note
Input point 1	4 000	in µA equal to 4.000 mA
Output point 1	-450	- 45.0° Rudder angle @ x 0.1 res.
Input point 2	12 000	in µA equal to 12.000 mA
Output point 2	0	0° Rudder angle
Input point 2	20 000	in µA equal to 20.000 mA
Output point 2	450	+ 45.0° Rudder angle @ 0.1 res.

The scaling of input value for respectively 100 % portside (-) rudder angle and 100 % starboard (+) rudder angle can now be adjusted individually during installation.

The XDi has a very strong multi-point linearisation function that allows for up to 7 calibration points.

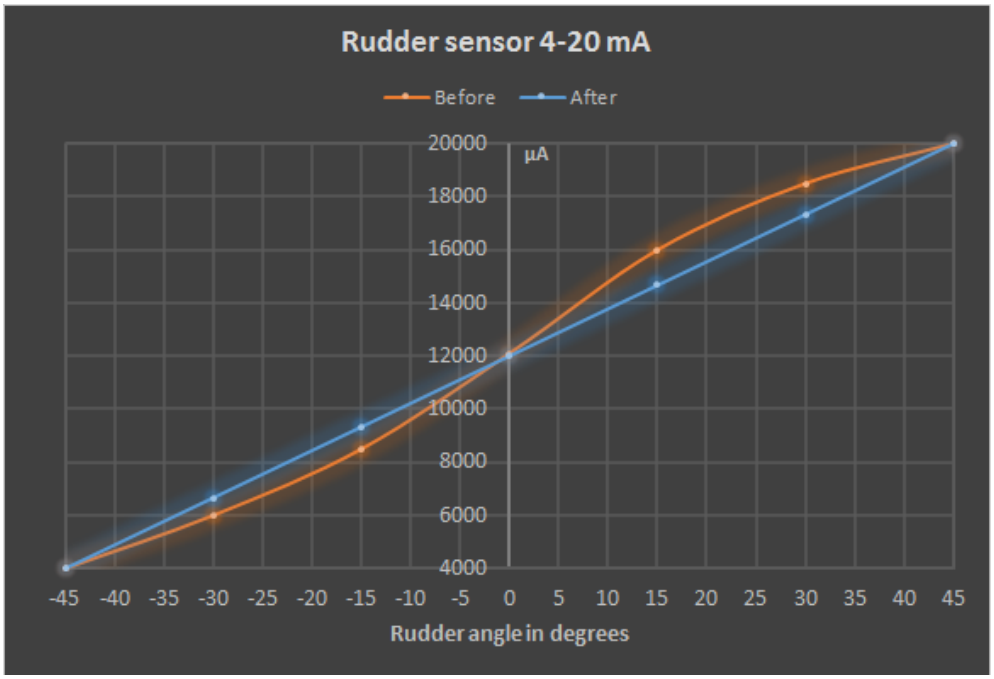
This strong feature makes it possible to calibrate a non-linear input signal to best match a linear output.

Via the installation menu, it is possible to make a very precise calibration and linearisation of such analogue inputs to obtain very accurate data for the indicator.

By sharing such data via CAN, all other XDi units using the same data will have direct access to those precisely calibrated data. In this way, it is only necessary to make calibration once in the complete system.

Example:

Using a +/-45 degree rudder angle indicator system as example, it is possible to calibrate a nonlinear rudder angle sensor to comply with the calibration accuracy requirements in the international standard: ISO 20673 Ships and marine technology — electric rudder angle indicator systems.



Example of result of 7-point calibration, the rudder is positioned at every 15 degrees, and the actual current is entered as the input point value for each.

The function is the same as explained for 3 point calibration above.

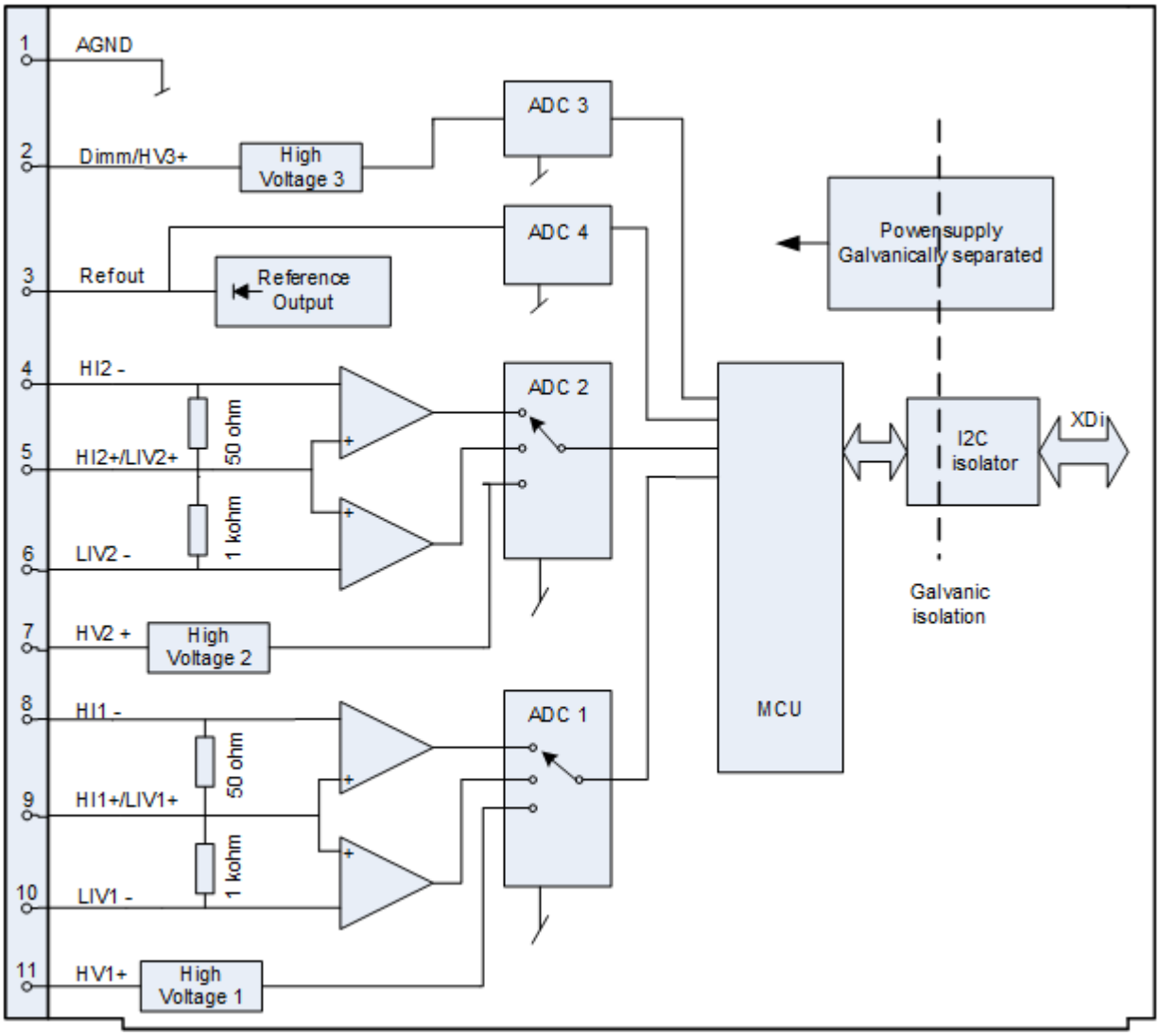
The DEIF RTA 602 analogue rudder sensors (4-20 mA) do not need more than 3 linearisation points to fulfil the accuracy requirements in the ISO standard. That is why DEIF standard libraries do not support more than 3 linearisation points; this also makes installation easier.

In most installations, it is not necessary to make any adjustments in the XDi menu when the RTA 602 is installed and set up.

Pitch application and other

The multi-point linearisation can of course be used for several applications; at present it has been used in a customised library for a pitch angle indicator where the pitch input was quite un-linear.

5.6.5 AX1 input circuit - principle diagram



All inputs/outputs on the same AX 1 module are galvanic separated from the XDi's supply voltage inputs, from both CAN ports and from input/outputs on other extension modules (XDi 144 and XDi 192 only).

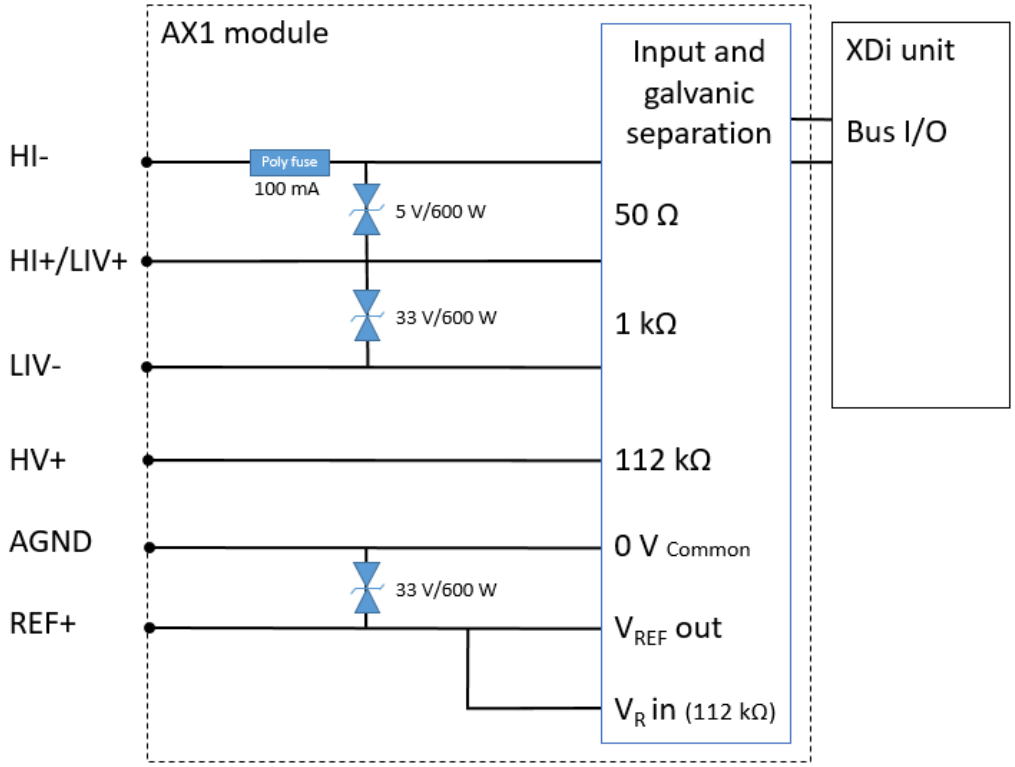
The 2 current inputs (including the low voltage inputs) are differential inputs, but not galvanic separated, so common mode rejection must be taken into consideration.

The 3 high voltage inputs refer to the same common terminal (AGND).

5.6.6 Input protection

AX1 inputs are protected for over-voltage, and the HI (+/- 20 mA) inputs are over-current protected.

The AX 1 module is protected against accidental connection of 24 V supply voltage between any combinations of terminals.



I/Os on the same AX1 module are not galvanic separated, and therefore common mode must be carefully considered when more than one input is used.

5.6.7 Common mode rejection

The common mode potential between inputs and from one input to the analogue common/ground terminal (AGND) must not exceed:

AX1 Inputs:	High current input 1	Low current input 1	Low voltage Input 1	Analogue GND
High current input 2	+/-30 V	+/-30 V	+/-30 V	+/-15 V
Low current input 2	+/-30 V	+/-30 V	+/-30 V	+/-15 V
Low voltage input 2	+/-30 V	+/-30 V	+/-30 V	+/-15 V
Analogue GND	+/-15 V	+/-15 V	+/-15 V	

Common mode voltage will slightly affect the measurements, but within the limits above, the impact will be less than 0.3 % and the overall accuracy will be within class 0.5.

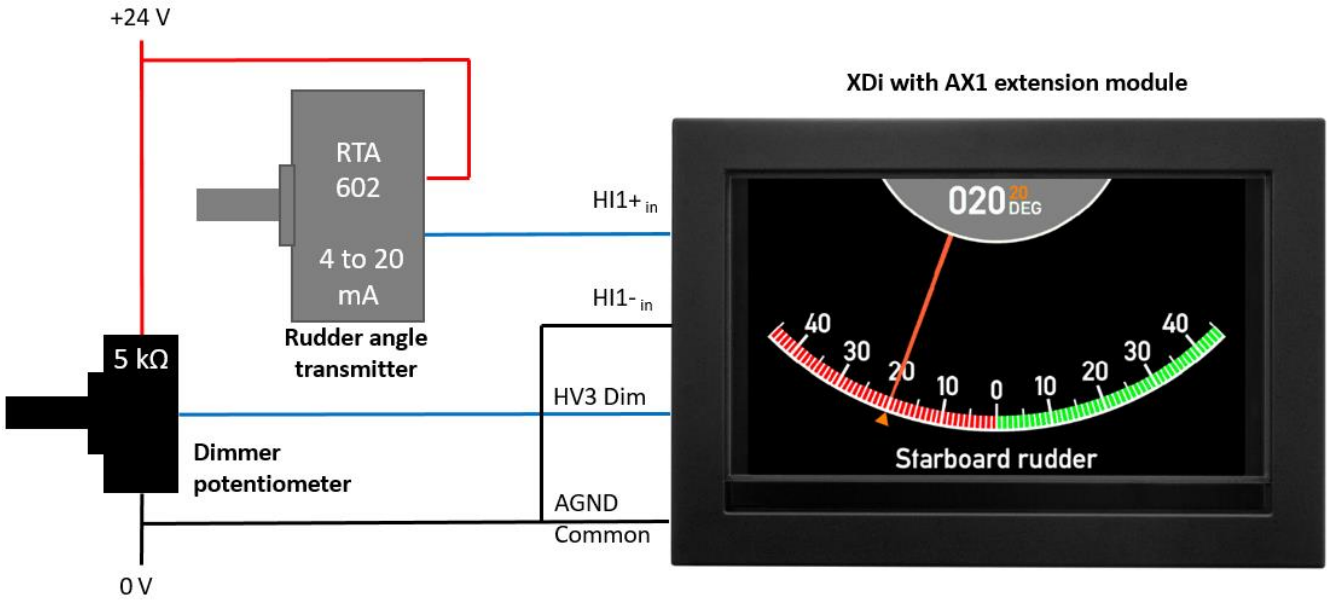
If a common mode voltage between a differential input and AGND exceeds 20 V, the input circuit will be forced out of range, and the measurement will no longer be valid.

Therefore, when more than one type of input is used, it is important to carefully consider the common mode situation.

Analogue current inputs to the AX1 module sometimes come from different devices that are more or less galvanic separated and maybe sourced from different power supplies. This may introduce a DC offset, hum and/or electrical noise between the individual input terminals, and also from the inputs to the common analogue ground terminal. This type of common mode interference may disturb the measurements made by the AX1 module.

Connecting the AGND (common) to the common terminals on the analogue sources is a way of eliminating such common mode disturbances.

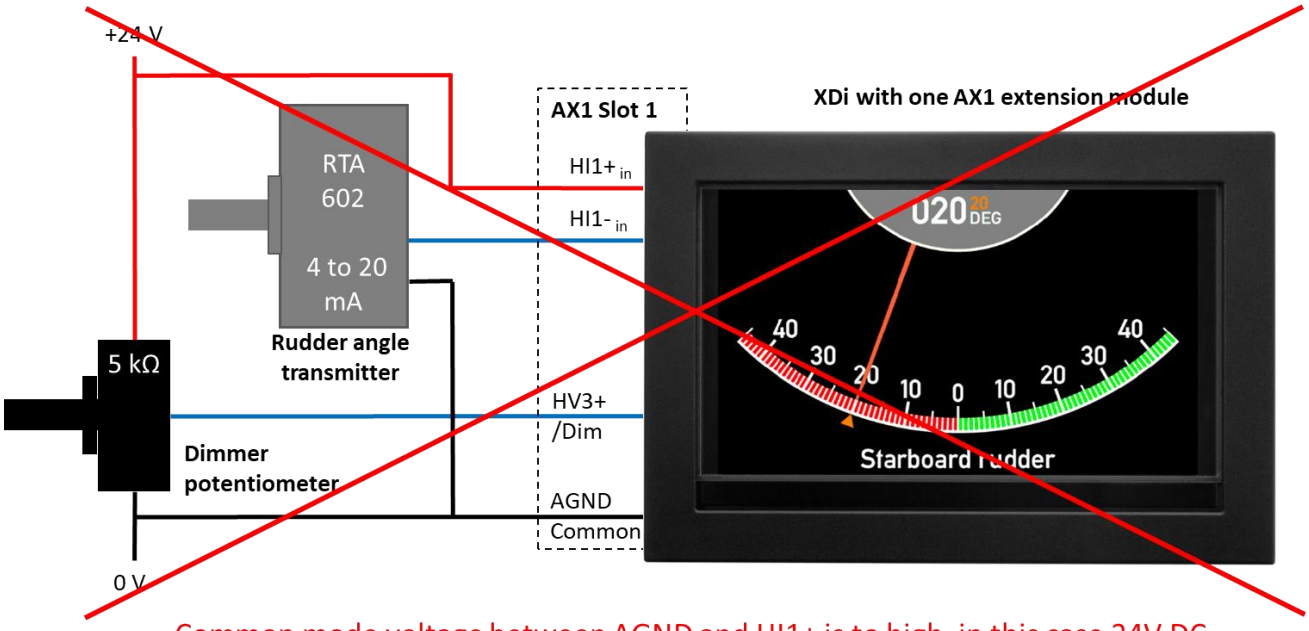
Example: rudder angle indicator system correctly configured (current source)



The RAI system is with a DEIF RTA 602 rudder angle transmitter 4 to 20 mA, and with an external dimmer, all is supplied from the same 24 V DC source. When connecting the RTA to +24 V DC and the XDi 4 to 20 mA current input HI1- to AGND (common), the common mode voltage from HI1+ to AGND will in the worst case be approximately 1.2 V and is well within the +/-15 V common mode limit.

Example of an incorrect RAI system configured (current sink) and some solutions

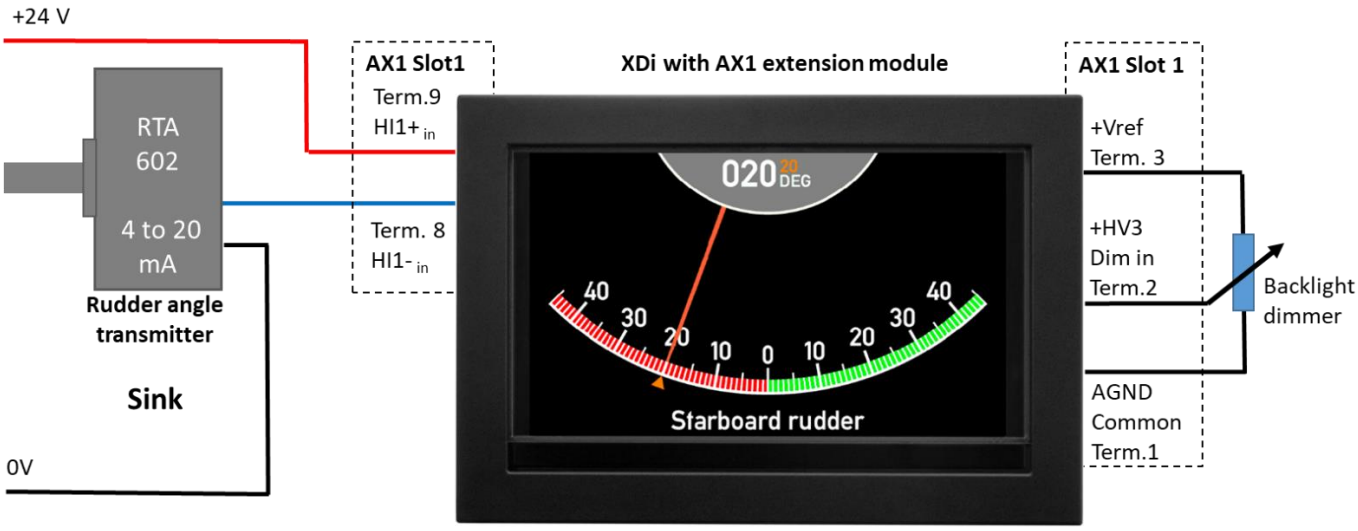
In this example the RTA angle transmitter is in a current sink configuration, where the RTA is connected to 0 V (AGND), and the XDi 4 to 20 mA current input HI1+ is connected to +24 V. The common mode voltage from HI1+ to AGND (common) will be 24 V, and this exceeds the +/-15 V common mode limit, and the system will not work, and the indicator will constantly be out of range!



Common mode voltage between AGND and HI1+ is to high, in this case 24V DC

Alternative 1 – How to solve the common mode problem above

If the dimmer configuration is slightly changed, as shown in the following figure, where the dimmer potentiometer uses Vref instead, and it is separated from the current loop, then the system will work fine.



Do not connect 0V to AGND common terminal 1 on AX1 !

This solution will be possible using the DEIF standard rudder library where dimmer and measuring circuit is configured to be connected to the same AX1 module and it will work for all XDi sizes (96, 144 and 192).

Alternative 2 - how to solve the common mode problem

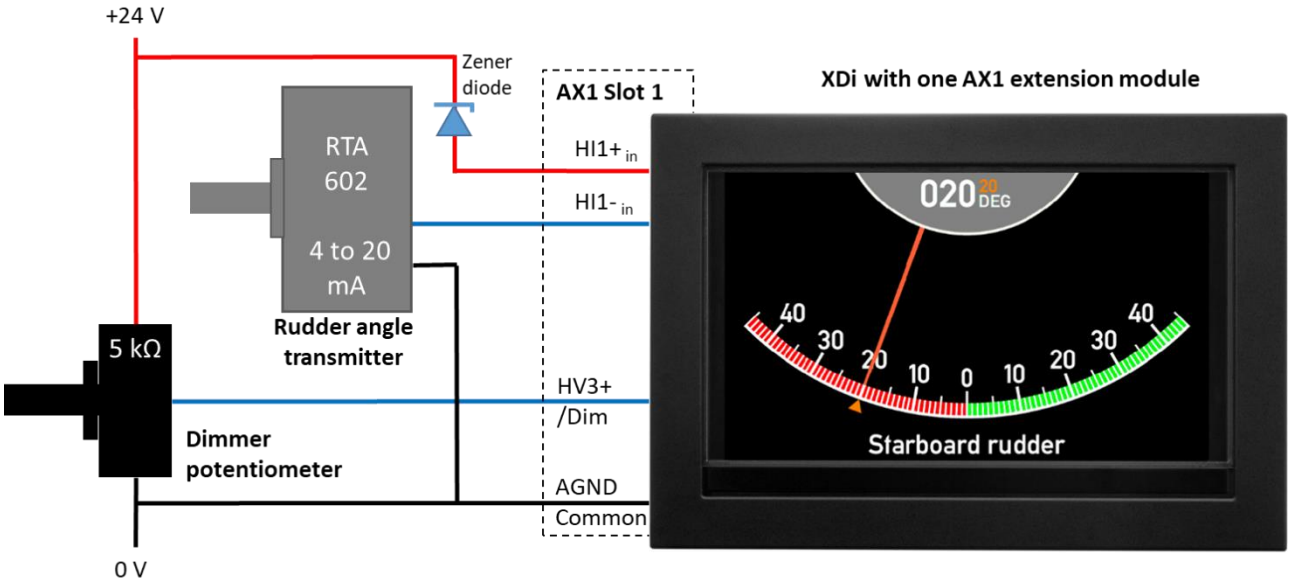
To fix the problem in the above example it is important rot educe the common mode voltage to below 15V, so you can either reduce the supply voltage for the current loop to below 15V (instead of 24V).

With the RTA 602 sensor the minimum voltage across the sensor at 20mA must be at least 7V and across a single AX1 current input the drop will be max. 1.3V (20mA x 65Ω) so the supply must never be below 8.3V at 20mA.

If a 10V to 15V power supply is available for the current loop it will work fine.

It would also be possible to insert a Zener diode in series with the wire going from +24V to HI1+, as shown below,

If the power supply is a stable 24V (not a battery) this will work fine with a 10 to 15 volt Zener diode. The power rating for the Zener diode should not be below 0.5W (15V and 20mA is 0.3W).



Common mode voltage between AGND and HI1+ is reduced to 14V DC with the 10V Zener diode in series with the current signal.

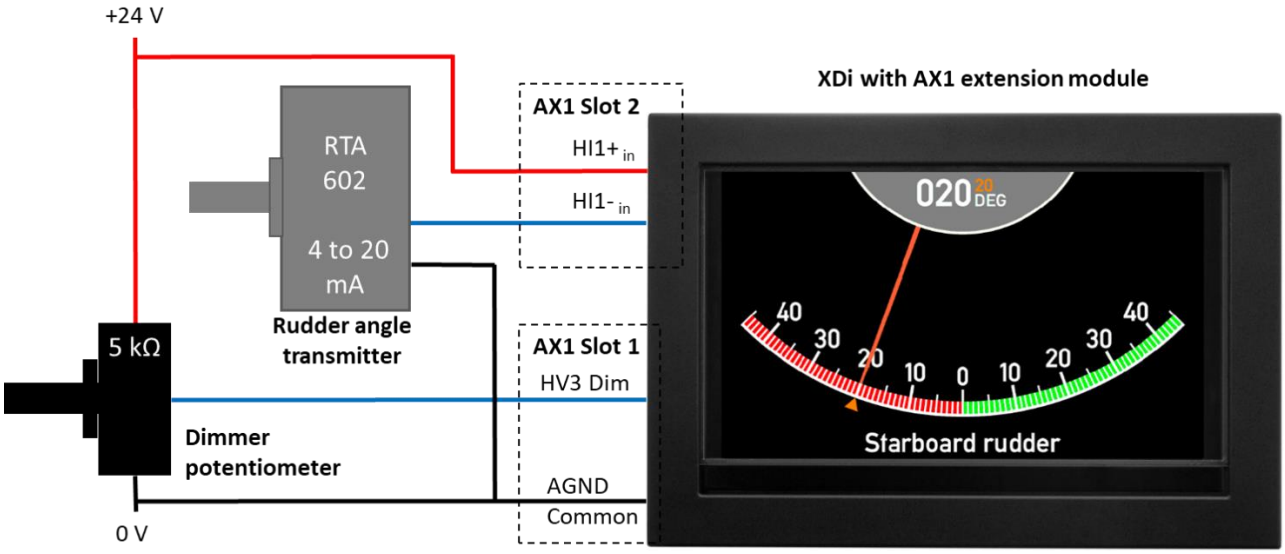
If a 10V Zener diode is used resulting in a 14V supply to the current loop. It will be possible to connect 5 XDi units (7V + 5 x 1.3V = 13,5V) in series and they can all have the dimmer voltage connection as shown above.

NOTE: If the power source is including a 24V emergency battery with a charger, which means that the voltage range can be between 18V and 29V this solution cannot be used.

Alternative 3 - how to solve the common mode problem

The above system will work if the current loop and dimmer circuit is connected to 2 separate AX1 modules, since the two modules are galvanic separated the problem with common mode voltage is solved.

But please note that this solution will not be possible for XDi 96 (only one extension slot) and that the DEIF standard rudder library for XDi 144 and XDi 192 does not support this configuration either, so a customized library will be needed.



Common mode issue in the previous example can be solved by using 2 AX1 modules

5.6.8 Connecting to the AX1 module

Analogue Extension Module AX1		
Terminal no.	Marking	Remark
1	AGND	Analogue common connection (or ground)
2	DIM/HV3+	Dimmer input configurable in the range, max. 30 V DC, port 3 It can be configured as an extra high voltage indicator input (max. +/-30 V DC), if it is not used for dimmer.
3	REF	REF out typ. 7.3 V DC (min. 7 V...max 7.5 V) and max. 10 mA. This port can also be used as reference potentiometer input, if the external voltage applied is between 7.5 V and 30 V DC.
4	HI2-	Negative input for: High current input (max. +/- 20 mA DC), port 2
5	HI2+/LIV2+	Positive input for: Low voltage, low current or high current, port 2
6	LIV2-/HV2-	Negative input for: Low voltage (max. +/-2 V DC) or Low current (+/- 2 mA DC), port 2
7	HV2+	Positive input for: High voltage (+/-30 V DC), port 1
8	HI1-	Negative input for: High current input (max. +/- 20 mA DC), port 1
9	HI1+/LIV1+	Positive input for: Low voltage, low current or high current, port 1
10	LIV1-/HV1-	Negative input for: Low voltage (max. +/-2 V DC) or Low current (+/- 2 mA DC), port 1
11	HV1+	Positive input for: High voltage (+/-30 V DC), port 1

The input wiring to the AX1 module must be in accordance with this table:

Voltage and current connection			
Terminal no		Signal	Input
+	-		
11	1	High voltage (HV1) input range, max. +/-30 V	Analogue port 1
9	10	Low voltage (LIV1) input range, max. +/- 2 V	
		Low current (LIV1) input range, max. +/- 2 mA	
9	8	High current (HI1) input range, max. +/- 20 mA	
7	1	Hi voltage (HV2) input range, max. +/-30 V	Analogue port 2
5	6	Low voltage (LIV2) input range, max. +/- 2 V	
		Low current (LIV2) input range, max. +/- 2 mA	
5	4	High current (HI2) input range, max. +/- 20 mA	
2	1	Dimmer input/high voltage 3 (DIM/HV3), max. +/-30 V	Analogue port 3
3	1	REF out voltage	

Terminal 1, analogue common (AGND), is used as the common connection for input REF, HV1+, HV2+ and DIM/HV3+ .

IMPORTANT: Only one input signal (voltage or current) must be connected to an input port, so be careful not to connect 2 different sets of input wires to the same input port!

5.6.9 Configuration of the AX1 module

Analogue input ports used as indicator input are pre-configured in the “VI-setup” profile (VS) defined for a virtual indicator (VI); this is also the case if DIM/HV3 is used as indicator input.

The configuration of the analogue dimmer input is pre-configured in the selected Product Profile (PP).

If you by accident select a PP and a VS profile that are both set up to configure the DIM/HV3 input port, then the XDi will assign port 3 as dimmer input as defined by the product profile (PP) and the virtual indicator (VI) will miss the input configuration and indicate that analogue input data is lost!

Menu access: The default settings of the extension module may be changed/adjusted via the XDi menu system.

Adjustment of dimmer settings is in the “User menu”, and indicator input settings are located in the more protected “Installation menu”.

Via the installation menu, it is possible to adjust the analogue setup parameters, for example calibrate the zero point, adjust max/min scaling values, or change direction of the scaling (CW/CCW) and much more.

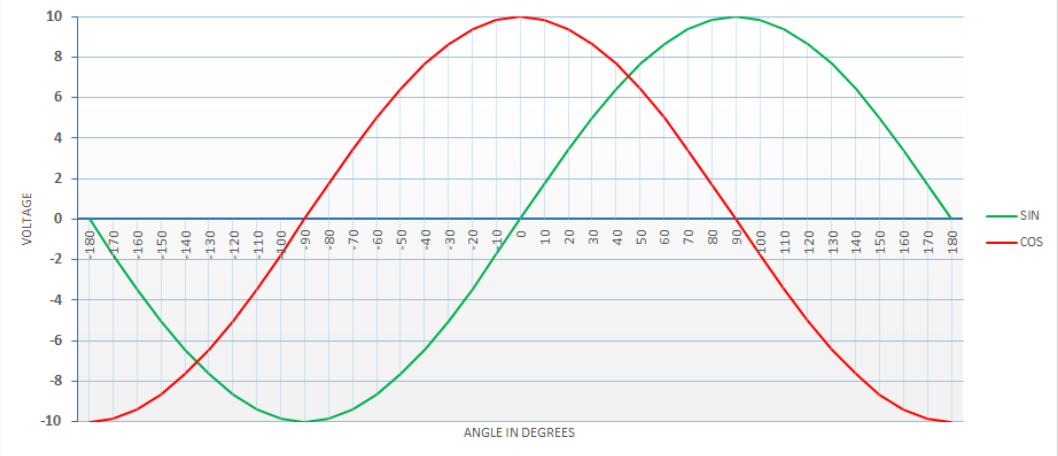
Please see the “Installation menu” section for detailed information.

The available analogue inputs on the AX1 can be configured as follows:

Type	Input	Type	Note
Sin cos input	Port 1 = SIN and Port 2 = COS	High voltage, max. +/-30 V or High current, max. +/-20 mA	Input pair
Double triangle input	Port 1 = input 1 Port 2 = input 2	High voltage, max. +/-30 V or High current, max. +/-20 mA	Input pair
Single input	Port 1 or Port 2	High voltage, max. +/-30 V or High current, max. +/-20 mA or Low current, max. +/- 2 mA or Low voltage, max. +/- 2 V DC	Low current and Low voltage use the same input connectors.
Single input	Port 3 (Dim)	High voltage, max. +/-30 V DC	Dimmer input. Is fully calibrated and can also be configured as an indicator high voltage input (3).
High accuracy potentiometer input	Port 1, Port 2 or Port 3 (Dim)	High voltage, default 0 to 7.3 V (= Vref) Vref is continuously measured and may be overwritten by an external voltage between +7.5 and +30 V DC	The input to output scaling is made relative to Vref and thereby corrected for drift or fluctuations in the reference voltage also if it is overwritten.

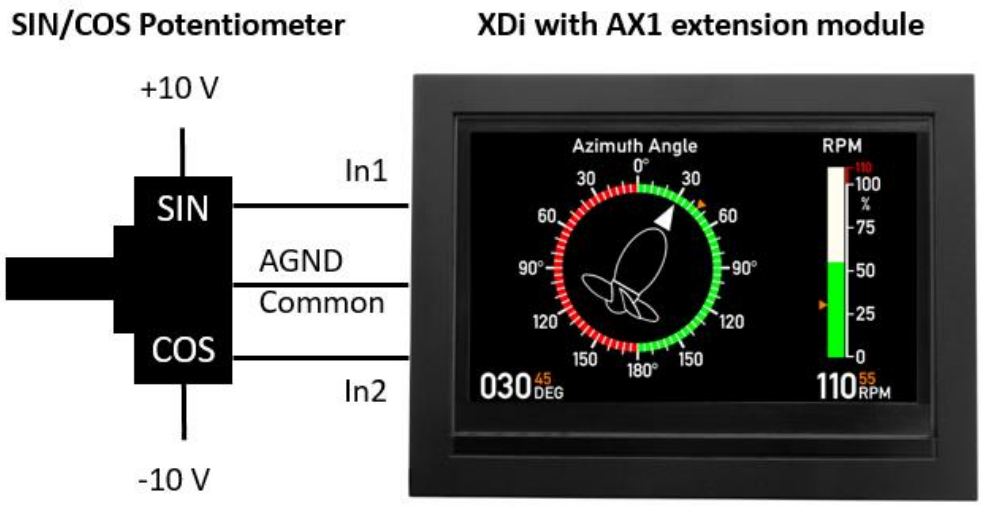
Sin/cos dual input with +/- 10V supply to the potentiometer

Input 1 and 2 can be predefined in the VS as a SIN/COS input pair. This type of input is often used for 360° angle measurements, and the input signals are provided by a special double potentiometer, supplied by the same voltage source.



In the VS profile, the sin/cos max input voltage must not exceed the selected measuring range. If for example the voltage max. swing is +/-10V (as in above figure) then the selected voltage range for the dual inputs are set to +/-15V to make sure that the voltage always is within then range. Selecting +/-30V will also work fine but may reduce the accuracy slightly (but in most cases not noticeable).

Due to the nature of the sin/cos signals, the XDi can compensate for variations in the supply voltage to the potentiometer at least up to the max input voltage limit and down to a few volt. To obtain a good resolution and not risking running the input circuit into saturation, the selected input range should be the nearest higher range.



Example: In the DEIF standard library for azimuth thruster indication, it is possible to select a VS for sin/cos potentiometer input. This input pair has a predefined potentiometer supply voltage of +/-10 V, but this indicator will also work fine with any potentiometer supply between +/- 6 V and +/-15 V.

The high voltage input resistance of the AX1 module is 112 kΩ, and it is therefore possible to connect the sin and cos potentiometer wiper directly to the input, without any pre-amplifier.

The sin/cos potentiometer resistance should be as low as possible; this will minimise the influence of the internal resistance in the AX1 module.

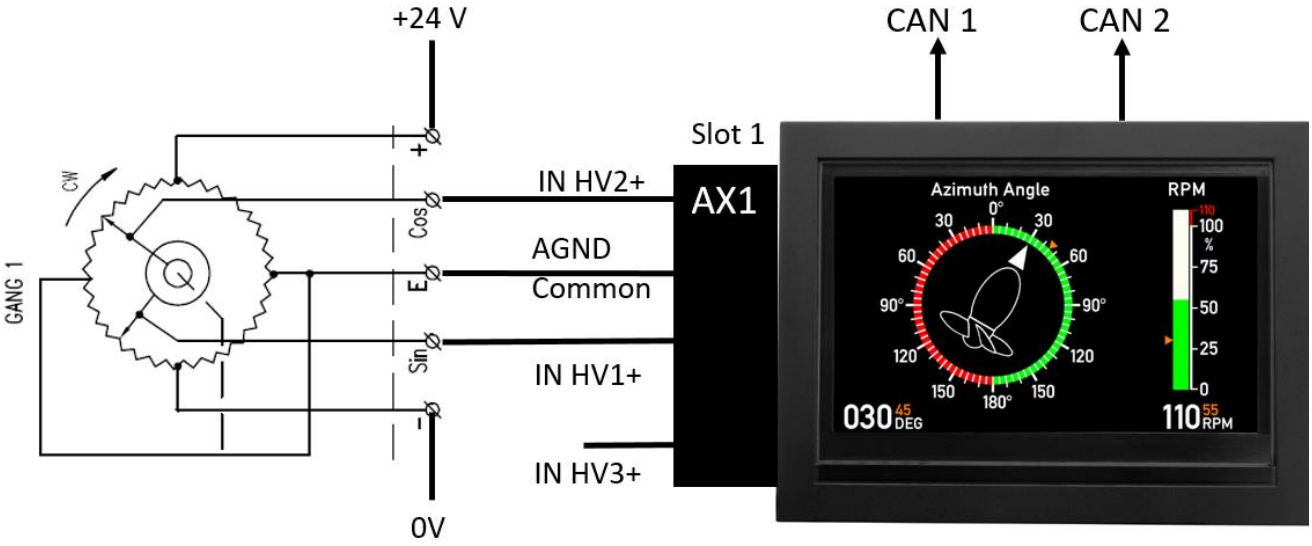
It is recommended to use a SIN/COS potentiometer in the range of 500 Ω to 5 kΩ.

A sin/cos input pair cannot be changed to single input via the XDi menu or vice versa.

Sin/cos dual input with +24V as potentiometer supply

The SIN/COS potentiometer is supplied form 0 to +24V and the used type of potentiometer will create an artificial 0V point on AGND. From the AX1 input it looks like the potentiometer is supplied by a +/-12V source.

This setup will work fine even if the 24V supply is also used as voltage supply for XDi, simply because the AX1 input circuit is galvanic separated from XDi voltage supply.



In this example XDi is setup to share the azimuth angle measurement with other XDi indicators on the CAN bus.

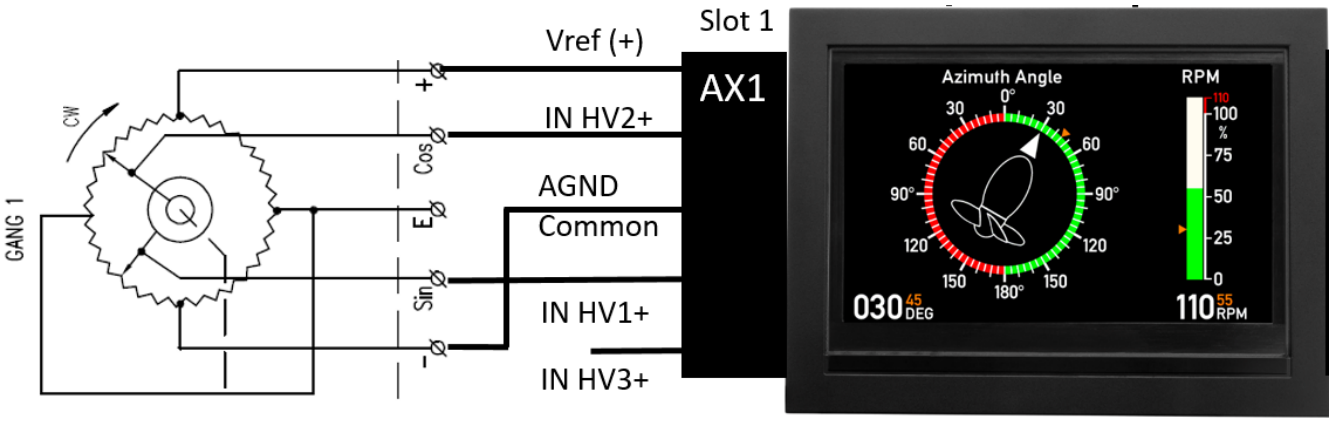
NOTE: AX1 in Slot1, DIM/HV3+ can be used for connection of a dimmer potentiometer between AGND and Vref. However, the potentiometer should be isolated from 0V and also ships ground.

Use of an analogue dimmer voltage from another system is not recommended in this application example, unless you use a 2nd AX1 module on Slot 2 and connect the dimmer voltage to DIM/HV3+ on this module instead (it may require a new product profile with analogue dimmer setup from AX1 on slot 2.

Sin/cos dual input with Vref as potentiometer supply

In the following example the double potentiometer is connected to Vref on the AX1 module.

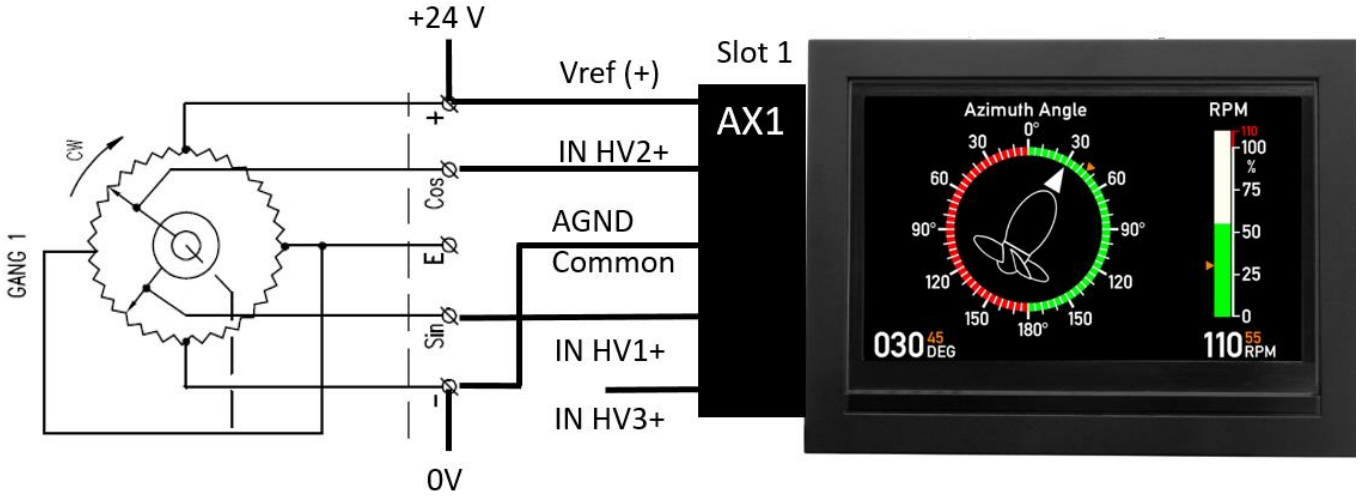
In this case XDi is setup to use Vref as supply for the potentiometer and it will measure Vref and automatically set the analogue centre value to ½ Vref. The voltage input range can be setup to +/-7.5V in this case.



Note 1: Input DIM/HV3+ can be used for a dimmer potentiometer between AGND and Vref. Do not to overload the Vref output, max. current is 10mA.

To use analogue dimmer voltage from another system connected to DIM/HV3+ is possible. Note that the 0V reference from the external system will be connected to AGND. If the SIN/COS potentiometer is isolated from all other systems, the AGND is the only connection to another system and therefore it should work fine.

It is even possible to overwrite the internal Vref by and external supply, for example 24V, connected to AGND and Vref like this:



In this case XDi will continuously measure the voltage on the Vref terminal and calibrate the measurements accordingly. It will even be able to eliminate slow fluctuations in the 24 V supply voltage, for example if the system in an emergency is powered by a 24 V battery that is slowly dropping its voltage over time.

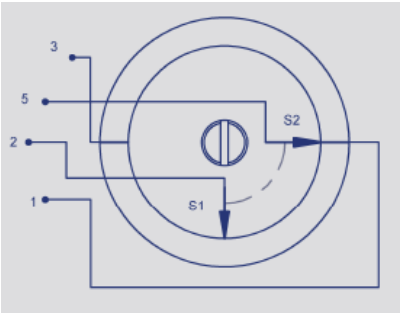
Double triangle input, external +10V supply for potentiometer

Instead of using a sin/cos potentiometer it is also possible to use a double potentiometer with two tringle shaped outputs with an angle offset of 90° between the two.

For this angle sensor type, the analogue input 1 and 2 must be setup in the VS profile as a “Triangle input” pair.

NOTE you cannot change from sin/cos to double triangle input type via the Adjust input menu found in the XDi installation menu. Instead, you must select a VS profile where double triangle input is supported for the azimuth angle. (If there is no such VS profile for the virtual indicator you are using, please contact DEIF support or sales, they can help you find the best solution)

In the following example the double potentiometer is connected to a stable external 0-10V power supply:



Connection of the potentiometer

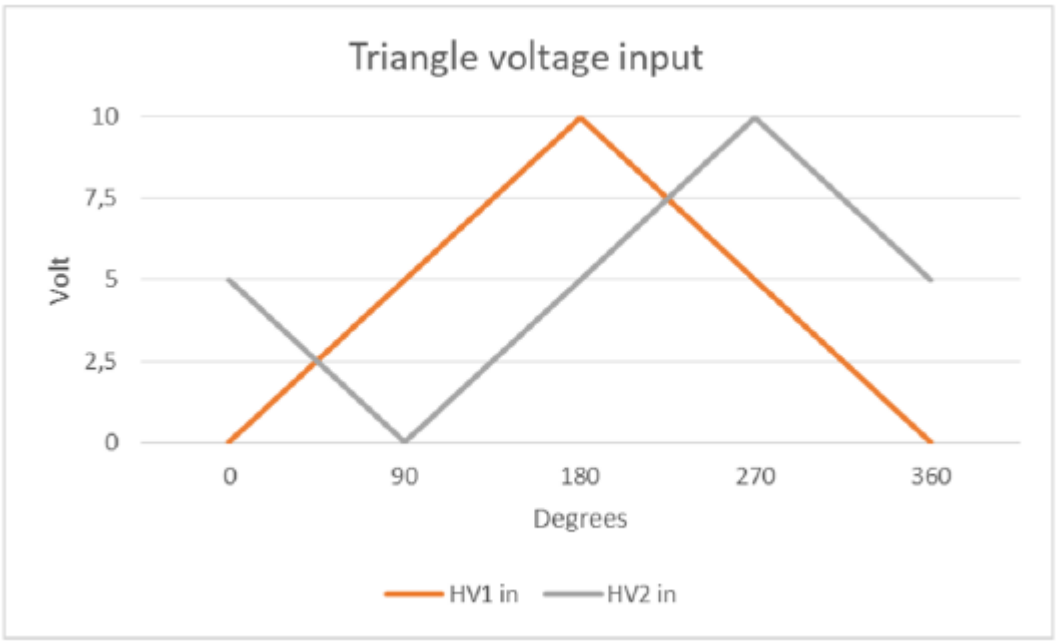
Terminal 1: 0V supply and AX1 AGND

Terminal 2: To AX1 +HV2 input

Terminal 3: +10V supply

Terminal 5: To AX1 +HV1 input

Potentiometer is shown at 0°



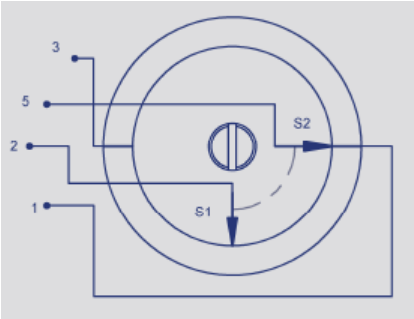
In this example the potentiometer is supplied by a single +10V DC voltage and the output swing is therefore 0 to 10V. This means that an artificial zero must be inserted as an analogue input centre value. This is to make the input swing symmetric around this centre point. In this case the analogue centre point is 5.000V =5000 mV.

To make room for the input voltage swing up to 10V the +/-15V input voltage range is selected.

This configuration will automatically adjust to the max voltage range, as long as it is inside the max. input range, but please note that the measurements will be performed with the input centred at 5.000 V and in this application the supply voltage must be relatively stable to give an accurate performance.

Double triangle input, Vref as supply for potentiometer

In the following example the double potentiometer is connected to Vref on the AX1 module:



Connection of the potentiometer

Terminal 1: AX1 AGND

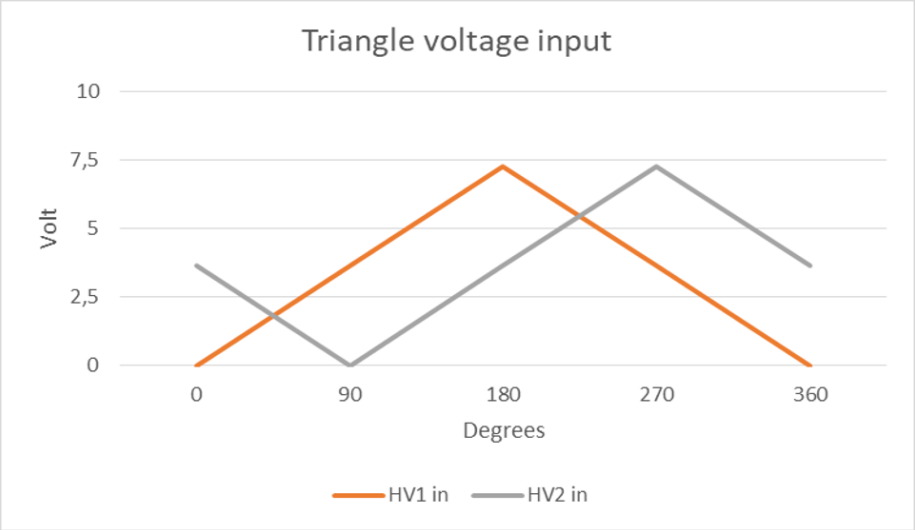
Terminal 2: To AX1 +HV2 input

Terminal 3: AX1 Vref output (app. +7.4V)

Terminal 5: To AX1 +HV1 input

Potentiometer is shown at 0°

In this case XDi will measure Vref and automatically set the analogue centre value to ½ Vref. The voltage input range could be selected as +/-7.5V in this case.



Like in the example with the sin/cos potentiometer it is possible to overwrite the internal Vref by and external supply, for example 24V, connect 0 V to terminal 1 AGND and +24V to terminal 3 (Vref).

XDi will continuously measure the voltage on the Vref terminal and calibrate the measurements accordingly. It will even be able to eliminate slow fluctuations in the 24 V supply voltage, for example during an emergency situation where the indicator system is powered by a 24 V battery source with a slowly dropping voltage.

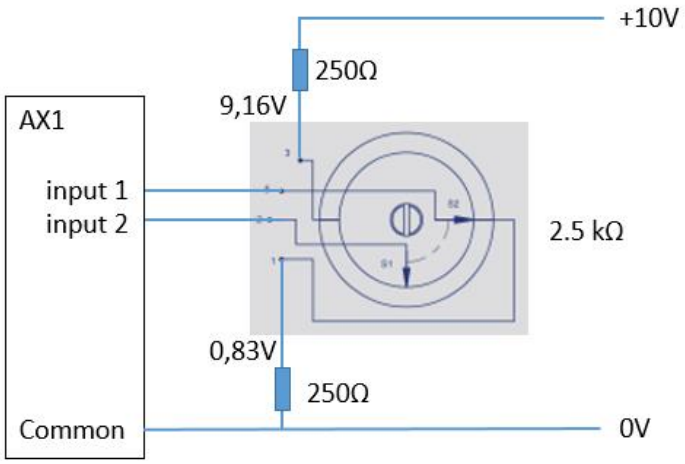
Input lost detection on dual potentiometer input

On a voltage or potentiometer input 0 is often a valid value and it is therefore not directly possible to detect if the input connection is lost since it will just create a 0 input signal. To make it possible to detect a lost connection in such a system it can be necessary to move the active input range so that it is possible to detect when the input is lost.

Double potentiometers

In the example below the double potentiometer configuration 2 additional resistors are used to create a minimum and maximum voltage that is used to detect if one of the connections to the potentiometer is lost.

When you use 2 resistors as shown it is possible to detect not only if one of the inputs (or both) is lost, but also if the connection potentiometer to 0V or +10V is lost.



This can be either a sin/cos or triangle (double linear) potentiometer.

In the example the low error voltage can be inserted as 400mV (0.4V) and the high error voltage to 9250mV (9.25V).

In case of a double potentiometer the use of 2 resistors will balance the 0 point to ½ x 10V and that may make calibration easier, but both for sin/cos and double triangle inputs XDi is able to detect if the difference voltage between inputs is to low which will happen if potentiometer connection to 0V or +10V is lost. In this case the 250Ω resistor to 0V will be sufficient to detect if connection to one or both inputs are lost.

Single high voltage input

AX1: +HV1 (High voltage 1) on terminal 11, +HV2 on terminal 7 or +HV3/Dim on terminal 2. All 3 with 0V reference at AGND, terminal 1.

The high voltage input can be configured to use full data resolution within the ranges:

+/-7.5 V, +/-15 V or +/-30 V, this secures a very high accuracy in the analogue measurements.

The input is pre-configured to an input range that is scaled to an absolute data range for the selected data type.

All voltage inputs are measured with a resolution in mV (1V = 1000mV)

Example: A rudder indicator with voltage input, +/- 10 V input is scaled to +/-45.0° rudder angel.

In this case 3-point input calibration is typically used and this means that:

- i/o-pair 1: -10 000mV = -450 (=-45.0° (PS)),
- i/o-pair 2: 0mV = 0° and
- i/o-pair 3: 10 000mV = 450 (+45.0° (SB))

Input load:

The high input resistance (112kΩ) of this input results in an insignificant load of the voltage source. The internal resistance of the power source and resistance in the signal wires should be as low as possible. If the total source resistance exceeds 100 Ω, adjustment of the input voltage pre-set may be necessary.

Potentiometer used as input source is covered in a separate section.

Single high current input

AX1 current loop inputs:

- +HI1 (High current 1) on terminal 9, -HI1 on terminal 8

  or

- +HI2 on terminal 5, -HI2 on terminal 4.

The high current input can be configured to use an input range between either +/-10 mA or +/-20 mA.

The internal current resolution is in µA (1mA = 1000µA)

Very often this input type will be pre-configured to 4 to 20 mA. (4000 to 20000 µA)

The high current input is overcurrent-protected by an auto recovery fuse (polyfuse). This adds slightly to the input resistance, but has no impact on the measuring accuracy.

The internal resistance is between 55 and 65 Ω, resulting in a max. voltage drop of +/-1.3 V at +/-20 mA. The total voltage drop must be considered when several current inputs are serial-connected. In the application note for 4 to 20 mA rudder indicator systems, you will find a detailed description of how to design a current loop system.

Single low current and low voltage input

AX1 current loop inputs:

- +LIV1 (Low Current/Voltage 1) on terminal 9, -LI1 on terminal 10

  or

- +LIV2 on terminal 5, -LI2 on terminal 6.

The low current input can be configured in the range: +/-2 mA (+/-2000 µA).

The same input is also used as a low voltage input and can be configured in the range +/-2 V (+/-2000mV).

Please note that the input resistance is only 1 kΩ. This input is designed to withstand accidental connection to the 24 V supply voltage, at least for a short period of time.

Input lost detection on a current input

The 4 to 20 mA is still one of the most popular input types for indicators and in XDi it is possible to insert an input current lost and an over current limit that will flag a AX1 input lost message in case of a wire break or if the supply voltage for the sensor is lost.

In our standard indicators with 4-20mA input we normally set the low current level to 3500µA (3.5mA) and the over current level to 21000 µA (21 mA).

This can always be adjusted if needed in the installation menu / input adjust.

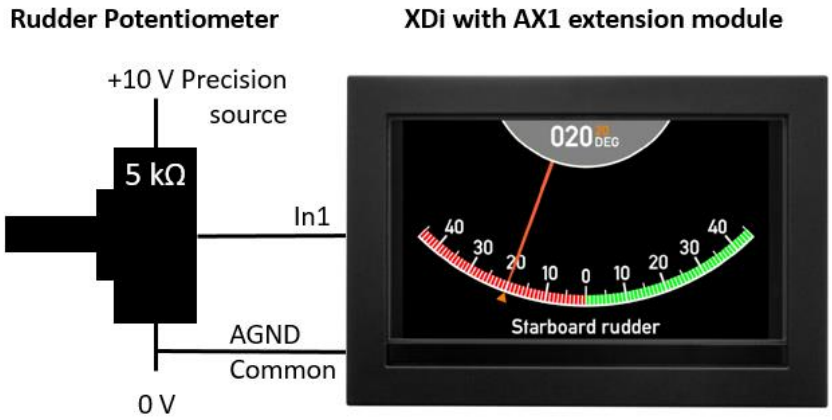
NOTE: If you change a 4 – 20 mA input to a voltage input you will of cause need to change the input scaling but also remember to change or deactivate the input error limits. If you change minimum level to -32000 and maximum level to 32000 the input error detection is disabled.

High accuracy potentiometer input

On AX 1 any of the High Voltage inputs can be configured to give optimal performance when it is sourced form a potentiometer.

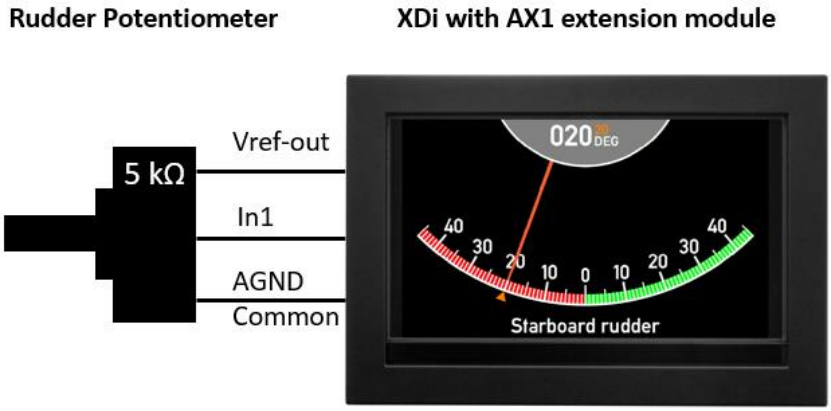
When a potentiometer is used as input voltage source for an indicator, there are two important things to be aware of:

1. The measuring error caused by the input resistance loading the potentiometer output. In the system below, the max measuring error of 1.1 % due to input load, is reached when the wiper is located in the centre position (½ rotation angle). If the potentiometer resistance value is doubled to 10kΩ, the max. error is also nearly doubled.
2. The precision and stability of the voltage source that supplies the potentiometer is important. If this voltage source is fluctuating, the indication will fluctuate.



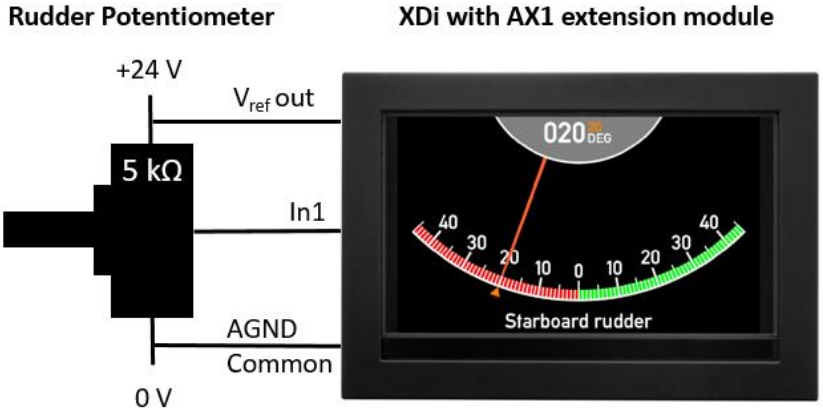
Ad.1. The XDi has a special function to eliminate the error caused by the input load. From the adjust input menu in the installation menu, simply enter the potentiometer resistance value and activate the “Potentiometer correction” function. XDi will now automatically compensate for this error.

Ad.2. AX1 has a built-in 7.3 V reference voltage that is very stable and is intended to be used as supply for potentiometer applications:



The high-voltage input can be pre-configured as a “V_{ref} potentiometer input” type; this means that the input data is measured relative to the actual measured reference voltage. This means that any drift or fluctuations in the reference voltage will be corrected.

If there is a need for using another reference voltage than the one provided by the AX1 module, it is still possible to use the correction function simply by overwriting the reference voltage by an external reference voltage. In the example below, the 24 V supply is used as external reference voltage. Since the high-voltage input is pre-configured as a “Vref potentiometer input”, the input voltage will be measured relative to the external reference voltage and scaled to a value between 0 (input = 0V) and 10000 (input = Vref):



Again, drift and fluctuations in the external voltage supply will automatically be corrected. This makes it even possible to use a 24 V battery with a charger as the voltage source for the complete system.

In such a system XDi will compensate even when the voltage has dropped down to 18V, when the battery is nearly discharged, and up to 28-29V when the battery is fully charged again.

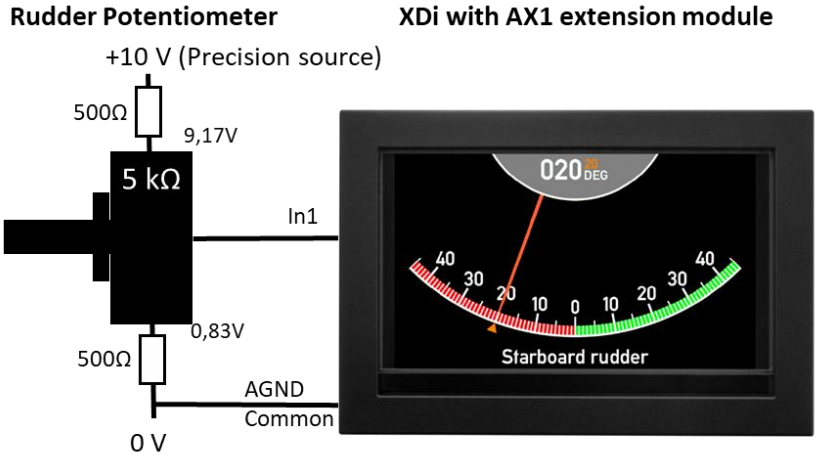
Input lost detection on a single potentiometer input

Single potentiometer with external voltage:

In a single potentiometer application, for example when a potentiometer is used for rudder angle measurement.

It is possible to detect if a connection to the potentiometer is lost, it just requires that 0V is not part of the valid measuring range.

If the complete rotation angle of the potentiometer is needed in the system, it is possible to obtain the above by adding 2 extra resistors as shown below:



The input voltage from 0.83V to 9.17V shall be scaled to -45 to +45 degrees and the input error detection low level can for example be setup to 0.5V (500mV) and the high error levels can be 9.3V. If any single connection is now lost the input voltage will either be 0V or somewhere between 9.5 and 9.9V.

This is due to the 112kΩ input resistance, in worst case when the 0V connection to the potentiometer is lost the input voltage will raise to 9.53V and activate the input max error detection above 9.3V.

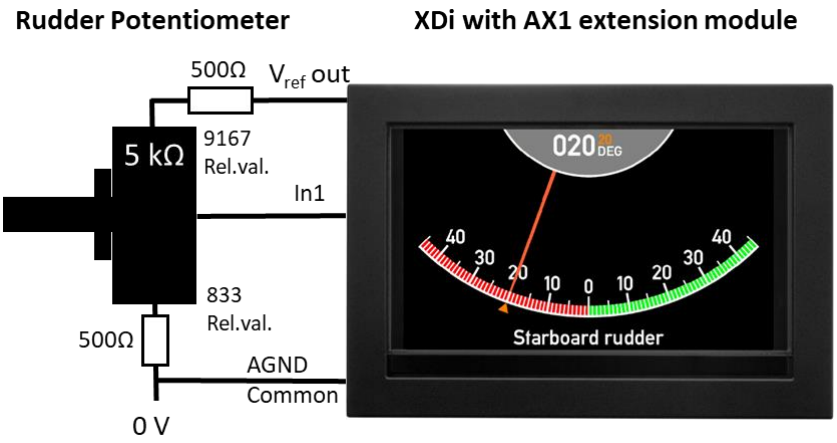
Worst case calculation if 0V connection is lost:
V error max, o =10V(source)*112kΩ/(112kΩ+5kΩ+500Ω)= 9.53V so, the max. error value shall be between this value and 9.17 that is the max. valid value, therefore 9.3V seems to be a good choice.

If it is a rudder application where the full potentiometer rotation angle is not used it may not be necessary to add extra resistors to be able to make the detection of lost connection as long as the used voltage level leaves enough extra voltage range to be able to detect that an input is lost, exactly the same way as in the above example.

The shown external resistors will in that case just be part of the internal potentiometer resistance.

Single potentiometer connected to Vref:

When you use the build in Vref output to stabilize the measurement from a potentiometer, you must be aware that the input voltage is measured as a relative value to Vref. 0V=0 and Vref=10 000.



This means that if you insert high and low input error values in this case has to be calculated as the relative value and inserted as such. The values you insert shall have a small margin to the min and max values, so in this example you can use 400 for the low error value and use 9300 for the high. Be sure that if you lose 0V connection to the potentiometer then the input voltage will raise to above max error value.

Worst case calculation if 0V connection is lost:
Rel. error max, o =10000(Vref. relative value)*112kΩ/(112kΩ+5kΩ+500Ω)= 9532 so the max. error value shall be between this value and 9167 that is the max. valid value. Therefore 9300 seems to be a good choice.

It will be the same also if you connect an external voltage source to the Vref terminal to use a higher supply voltage for the potentiometer.

Dimmer input

AX1: +HV3/DIM on terminal 2 with 0V reference at AGND at terminal 1.

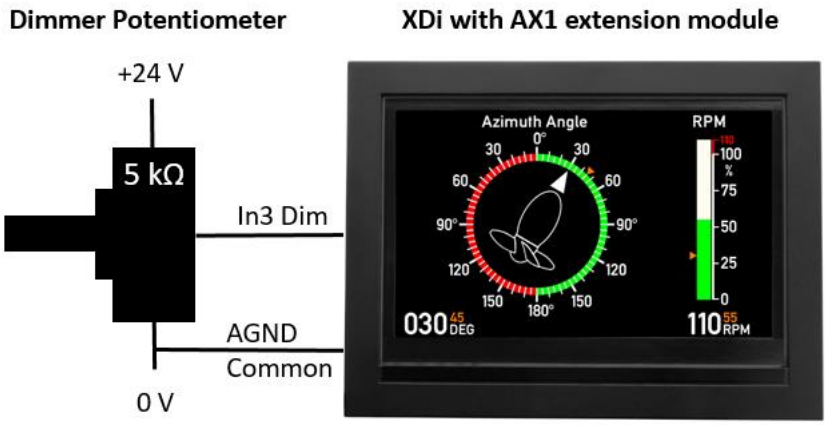
The dimmer input is a standard high-voltage input and can be configured as previously described. When used as dimmer input, the pre-configuration is located in the Product Profile (PP), and changes can be made via the XDi user menu.

In all DEIF standard libraries you will find product profiles for analogue dimmer connection to the dimmer input on AX1 located in slot 1. It is important that the AX1 module is located in the correct slot specified in the PP documentation / help-text. By default, this input is configured for potentiometer operation using Vref to supply the potentiometer, but the analogue dimmer input can alternatively be re-configured as a voltage input via the user menu.

This means that the dimmer level will be controlled by the voltage at terminal 2 (+HV3/DIM).

The voltage can be generated by a central dimmer controller or by a potentiometer used as variable voltage source, as in the example below.

Independently of the analogue dimmer input configuration, the actual dimmer level can be shared via CAN, to control other XDi units forming part of the same dimmer group as the XDi unit with the analogue dimmer input.

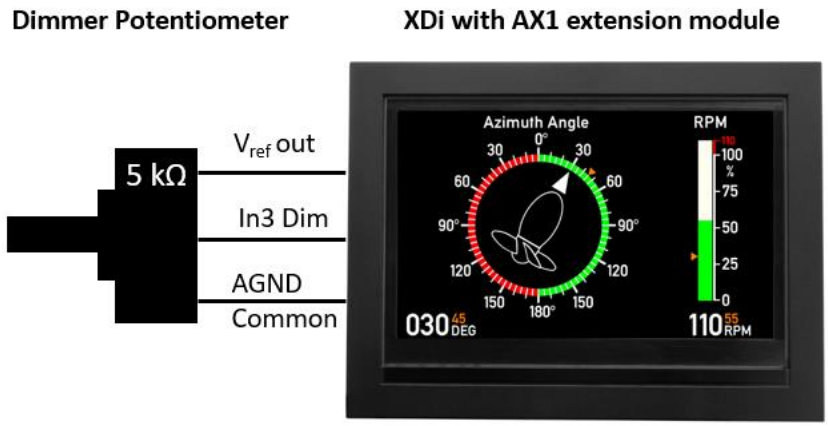


The supply voltage for the potentiometer in this configuration should be relatively stable since changes in this voltage will directly affect the dimmer level. The potentiometer value is not critical in a dimmer application.

It is recommended to use a potentiometer in the range 1 to 20 kΩ.

Dimmer input using Vref

To avoid voltage fluctuation affecting the dimmer input, it is possible to use the AX1 V_{ref} output as supply for the dimmer potentiometer. Configured like that the dimmer level will be stable and independent of the supply voltage, and like previously described for the HV input, it is possible to overwrite the reference voltage by an external voltage (7.5-30 V) and still get fluctuations corrected.

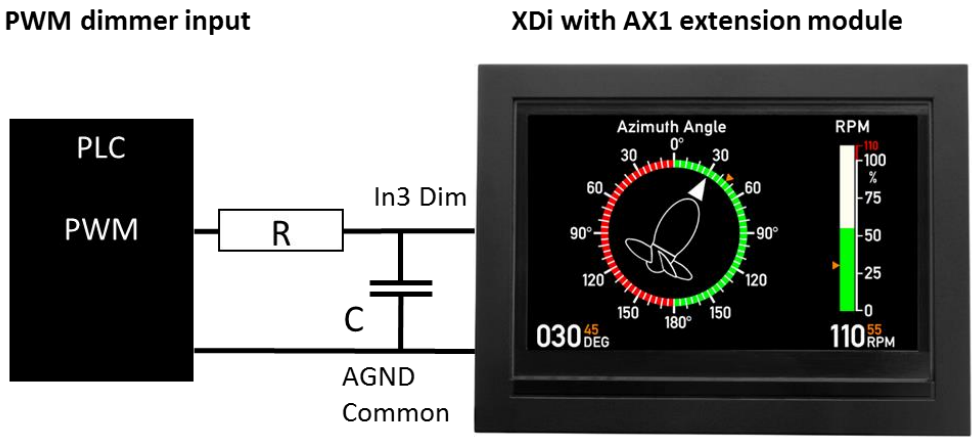


It is recommended to use a potentiometer in the range from 1 to 20 kΩ.

Dimmer input using PWM

The XDi does not directly support PWM (Pulse Width Modulation) input for dimmer control, but it is possible to route the PWM signal through a low pass filter to obtain a DC voltage at the analogue input. The high input impedance (112 kΩ) of the analogue dimmer input limits the load of the RC filter.

The PWM frequency should be as high as possible to be able to filter hard to avoid backlight flicker and keep a fast response.

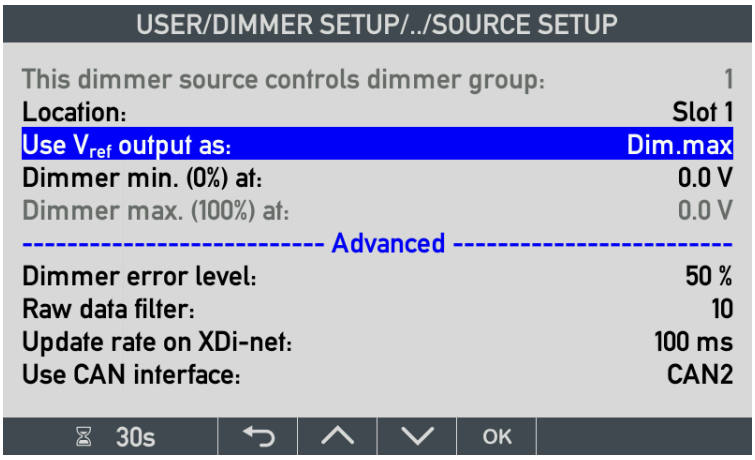


The resistor R should not exceed 5 kΩ, and the capacitor C can be calculated as:

$C = \frac{10}{2\pi F R}$ [µF]

Where F is the PMW frequency in kHz, resistor in kΩ and the capacitor C in µF, the max/min dimmer input voltage span should be adjusted via the menu to best match the usable voltage range from the PWM signal.

To eliminate flicker, it may be necessary to increase the raw data filter value via the XDi user menu by entering the dimmer source setup menu. Alternatively, the capacity C can be increased.



The raw data filter can be set between 0 and 100 (0 is OFF). The filter value indicates the number of samples used for averaging.

In the example above, a change of Raw data filter value from 10 to 100 will increase the averaging time from 1 to 10 seconds (100 samples of 100 ms).

Dimmer error handling

In DEIF standard libraries, the default dimmer settings and behaviour are predefined in the available selection of Product Profiles (PPs). Select a PP that best match the dimmer needs and make necessary parameter adjustments to match the installation using the XDi user menu.

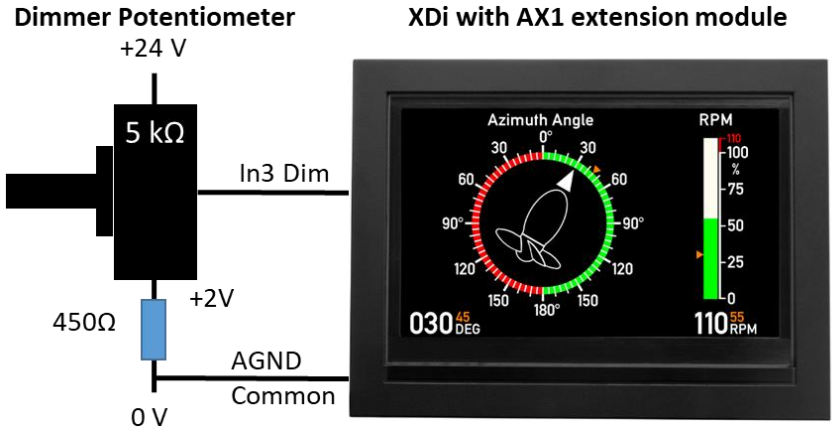
When a customised library is made, it should be considered how the dimmer must behave when for example the potentiometer wiper loses its connection, or the dimmer supply fails. If the dimmer input is a traditional input where 0 V equals minimum backlight (0 %) and 24 V is maximum backlight (100 %), then a lost dimmer input will result in a nearly black display.

It is possible to reverse the XDi dimmer input signal, so that 0 V equals max backlight (100%) and 24 V is minimum backlight (0%). This secures that the XDi indicator is visible if input is lost.

Alternatively, the dimmer input can be configured with an offset, so that for example 2 V equals minimum backlight (0%), and if the voltage drops below 2 V, then the backlight will shift to a predefined error stage. This could be pre-set at for example 50 % backlight.

The default dimmer settings are all predefined in the product profile (PP).

One way of doing this is by connecting a resistor from the potentiometer to 0V as shown below:



In the user menu the standard dimmer configuration can be changed so that 0% = 2000mV and 100% = 24000mV.

This solution will bring the dimmer level in error stage if the connection to the wiper or the supply voltage is lost, and it will go to max backlight if the 0V connection is lost (or the resistor is broken). This will be a good solution in most cases. It can be improved slightly by adding a resistor to +24V as well so that a lost 0V connection also will bring the dimmer in error stage. For example, 500Ω in top and bottom will decrease the dimmer voltage span to 20V from 2V to 22 V and you will have to adjust the dimmer levels in the user menu accordingly.

5.6.10 Share analogue data via CAN

XDi-net

All analogue input data for an indicator can be shared on CAN. Data sharing state is predefined in the VI-setup profile. If sharing is turned off, you may activate it from the installation menu (adjust input).

It is possible to share XDi analogue or digital input data either on: CAN1, CAN2 or CAN1&2 or turn XDi-net sharing OFF.

Data that is shared is the variable XDi-net data defined in the XDi specific object index table, and is in most cases

2 byte data, a 16 bit signed value. Data is always scaled to an absolute value with a defined unit or a relative % value in both cases it with be with a predefined data resolution. (Very often the internal data resolution is 0.1, this means that the data value you will find in the menu is x10 the value presented in the display, for example rudder angle value 450 is in fact 45.0°.)

The data resolution for different variable data can be found in the XDi-net/CANopen reference manual.

Special data formats

In the XDi-N version there are some special navigation data formats, for example Latitude/ Longitude (position) and time and data that has special 32 bit data formats and will be transferred via XDi-net it those formats.

Share data in a TPDO

It is also possible to configure XDi to send variable data from the object index table using a TPDO or RPDO format. Due to the complexity this feature is something that is added to the indicators VS profile for the data types it is relevant to send in a TPDO or RPDO. When this is implemented, it is possible to adjust the settings like the COBID used, transmission rate, CAN bus to use and other relevant parameters via the installation menu / output setup.

Some standard libraries contain virtual indicators with analogue VS profiles where TPDO output is made available. This is for example the case with the XDi standard rudder libraries.

In most libraries you must activate the TPDO function via the XDi menu, this is simply to avoid that more than one XDi is transmitting data using the same TPDO, this will violate the CAN protocol and most likely cause serious data collisions. **So only one XDi must transmit a given TPDO on the selected CAN bus !**

This TPDO output function is intended for system integration with XL indicators using sCAN format, but may also be used for other types of system integration.

Standard TPDOs intended for XL integration will have COBID in the range 0x180 to 0x1FF and will have their variable data located in byte 0 and 1 (I16).

NOTE: The sCAN integration is available for DEIF XL, BW, BRW-2 and TRI-2 CAN indicators.

In the XDi data structure most data is of type I16, but there are a few XDi-N data types as mentioned that contains more than 16 bits of data (for example Position and UTC time and date).

Mapping several data types in one TPDO

In customised libraries, up to 4 data types (I16 or U16) may be mapped into the 8 byte data field of any of the TPDO's or RPDO's defined in CANopen.

Please consult the dedicated document: 4189350066A "XDi-net CANopen reference manual" for details.

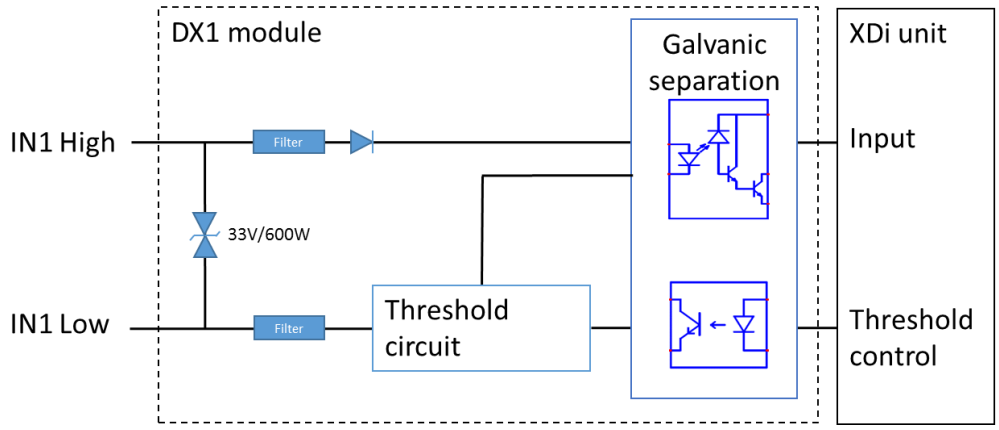
5.7 DX1 digital extension module

The digital extension module has two galvanic separated digital inputs and two general-purpose relay outputs.

The digital inputs are primarily intended for use as direct RPM pickup input(s), but may be configured differently.

5.7.1 DX1 input circuit - principle diagram

The two digital inputs are identical, and the principle diagram below illustrates the main function.



The input circuit is protected for over- and reverse-voltage.

The threshold (or trigger) level is set up in the relevant setup profile (it cannot be changed from menu).

The setup will be one of 4 fixed levels, intended for input signals of respectively 5 V, 12 V, 24 V or 30 V.

The input voltage level must not exceed +/-32 V DC.

Please see the XDi data sheet for specific technical data.

5.7.2 Connecting to the DX1 module

DX1 Digital extension module connector		
Pin no.	Marking	Function
1	OUT2 COM	Relay 2 contact, common
2	OUT2 N.C.	Relay 2 contact, normally closed
3	OUT2 N.O.	Relay 2 contact, normally open
4	OUT1 COM	Relay 1 contact, common
5	OUT1 N.C.	Relay 1 contact, normally closed
6	OUT1 N.O.	Relay 1 contact, normally open
7	IN2 LOW	Digital input 2, negative (-)
8	IN2 HIGH	Digital input 2, positive (+)
9	NOT CONN.	The terminal is not connected internally.
10	IN1 LOW	Digital input 1, negative (-)
11	IN1 HIGH	Digital input 2, positive (+)

5.7.3 Digital inputs configuration

The inputs can be configured as:

- Two independent inputs for single direction RPM measurements with or without Revolution counter function .
- Input pair for bidirectional RPM measurement. With or without Revolution counter function.
- Input pair for dimmer control (up/down and colour shift on simultaneous activation)
- Input pair for control purposes* (modes: 4 stage input or set/reset)
- Two independent control inputs* (modes: H/L control, toggle on flank, 4 stage time-based input)

* The digital input can be configured as a control input. This type of function is only used in special custom libraries, and the function is not described further in this manual.

The DX1 input mode is defined in one of the selected setup profiles.

When the DX module is used as data input for an indicator or mode control of an indicator, the input definition and its pre-set parameters are defined in the VI-setup profile (VS).

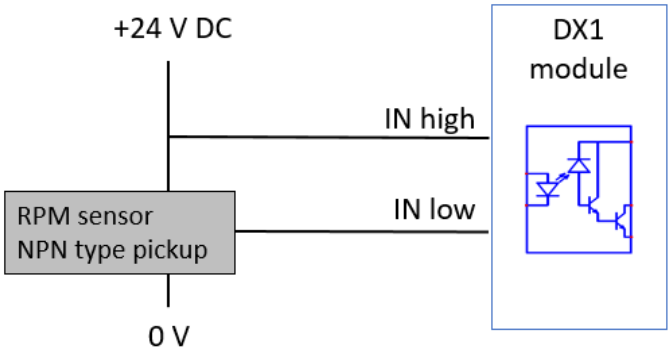
When DX1 is used as interface for external dimmer pushbuttons, the definition and pre-sets are located in the Product Profile (PP).

Important: Be careful not to select a VS (indicator input) and a PP (dimmer) both using the same DX1 input(s), if you make such a selection by accident, the PP will have priority and get access to use the DX1 input for dimming, and the indicator input defined in the VS will be disabled, and the indicator will show “Data lost”.

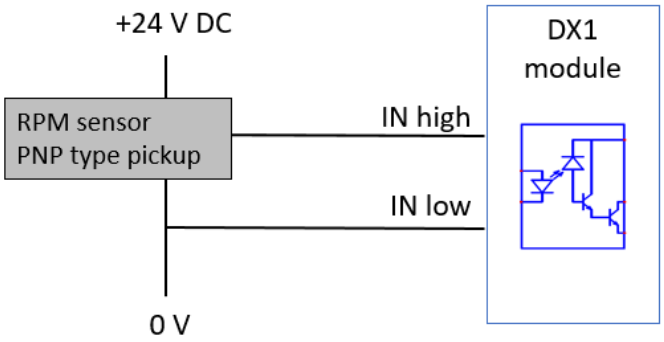
Connecting an RPM pickup

The galvanic separation of the digital inputs makes it easy to connect either an NPN or PNP type inductive pickup sensor. In fact, any type of sensor able to provide digital pulses can be used as RPM input device.

Connecting an NPN type sensor:



Connecting a PNP type sensor:

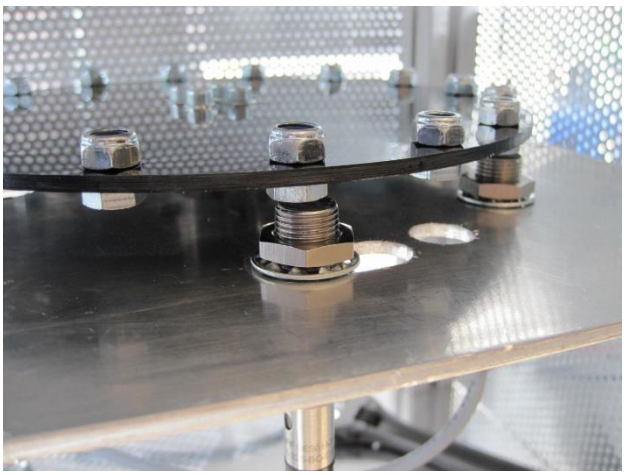


Recommended sensor types

For the practical test of the DX1 RPM function, we have used two different inductive sensors from BALLUFF sensor.

- NPN type: BES M12MI-NSC40B-BV02 / BES00FM, normally open, 4 mm rated sensing distance
- PNP type: BES M12MI-PSC40B-BV02 / BES0064, normally open, 4 mm rated sensing distance

The full specification of the tested sensors can be found on www.balluff.com and can be a useful reference for selecting a suitable RPM pickup sensor to use with DX1.



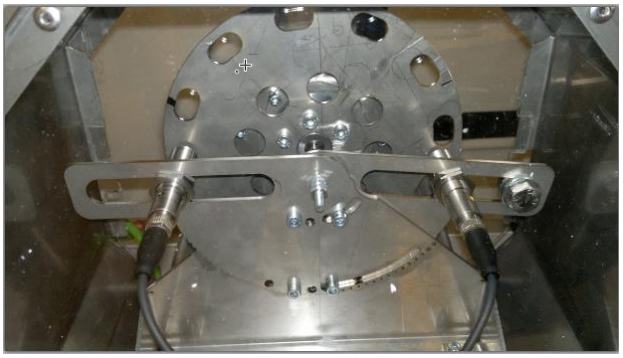
The sensor tests were performed using a specially constructed RPM test machine with a rotary disc where 16 bolts were equally distributed around the edge. One or two pickups can be mounted depending on the actual test, see picture. The test machine is able to rotate the disc at a maximum speed of 5250 RPM, and with 16 bolts this equals a max frequency of 1400 Hz.

For unidirectional RPM measurements (direction independent) only one sensor is used.

For bidirectional RPM measurements both sensors are used. In this case, the sensors are mounted with a mechanical offset, meaning that the pulses from the sensors are also offset in time, making it possible to determine the direction of the movement.

Mechanical RPM system recommendations

The mechanical RPM pickup system can be made in several different ways, either with bolts passing the inductive sensor or using a disc with a number of cut-outs along the edge to activate the inductive sensor (see picture).



It is recommended to use a high number of bolts (or cut-outs) in the disc as possible to obtain the highest possible RPM resolution, but keep in mind that the frequency at max RPM does not exceed the max rating on the pickup sensor or the DX1 input.

The following table contains a guideline for number of bolts or cut-outs dependent on the max. rotation speed.

Max RPM range	Number of bolts (or cut-outs)	RPM resolution	Max frequency
<100	20	0.05	33 Hz
100 to 500	10 to 20	0.05 to 0.10	16.7 to 167 Hz
500 to 5000	6 to 10	0.10 to 0.167	50 to 833 Hz

To get the best possible performance it is important to position the bolts (or cut-outs) with high accuracy on the disc and mount the disc on the shaft using a stable construction to reduce jitter on the measurements.

Less than 3 bolts or cut-outs on the disc are not recommended.

RPM pickup cable recommendation

The galvanic separated inputs are well protected and not very sensitive to electrical noise. It is, however, recommended to use a shielded twisted pair cable in installations where long cables are used or where strong electromagnetic disturbance may occur. The shield must only be terminated in one end to a good ground connection and must not be connected to any of the terminals on the XDi.

Tested cable type and length:

The DX1 system test includes a test of both Balluff sensor types connected to the DX1 input using 110 meter shielded twisted pair cable type Belden 9841NH. This test was performed using a rotating disc with an input frequency up to 1400 Hz. (The max available frequency from test machine).

The measurements on input signals and the data presentation on the XDi indicated no problem with this cable length.

The maximum cable length depends on the cable type and the maximum operating frequency, but the conclusion of the test was that 110 meter @ 1400 Hz was not even close to the maximum cable length.

Sharing RPM data from DX1 via CAN

The RPM data calculated based on the pickup signal(s) can be shared on CANopen/XDi-net.

Therefore, it is only necessary to connect the RPM pickup to the first XDi in the indicator system. The rest of the XDi units will receive their RPM data via CAN; the easiest way is just to use the XDi-net format, but as for analogue data, the XDi can be configured to send TPDO or RPDO instead or in addition to XDi-net format.

Even XL CAN indicators may be integrated in such a system. It only requires that the XDi unit that is sharing data is configured to support the XL sCAN data format (TPDO type data).

Bidirectional RPM pickup system

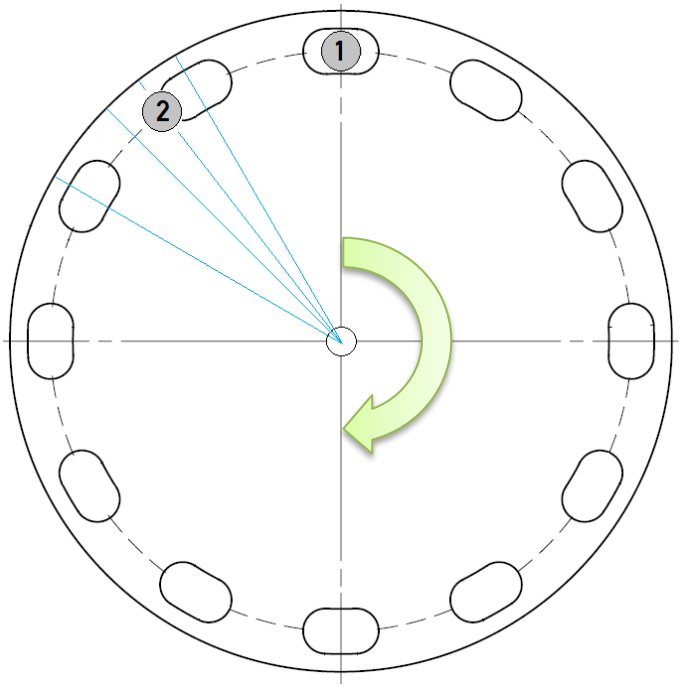
To measure bidirectional RPM rotation, it is necessary to configure the virtual indicator to use an RPM input pair. This is defined in the VS profile.

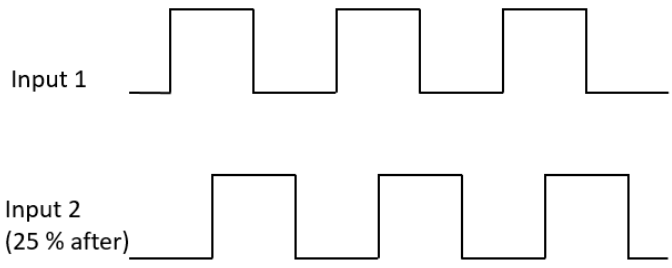
To be able to determine the direction of the rotation, the two pickup sensors must be mounted with a mechanical offset.

The optimal position of the pickup sensors is as illustrated in the drawing.

Sensor no.1 is right at the centre of a cut-out. Sensor no. 2 is located with a 25 % offset.

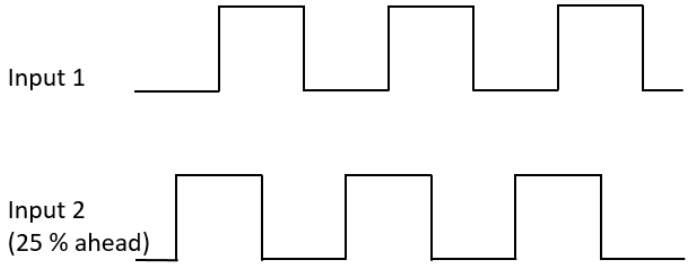
For practical reasons, the two sensors are not located around the same cut-out; this has no influence on the function as long as the offset is correct.





When the disc is rotating clockwise, the 25 % mechanical offset between the sensors will delay the signal from sensor no. 2 with 25 % of the period time (90 degree phase shift) as illustrated below.

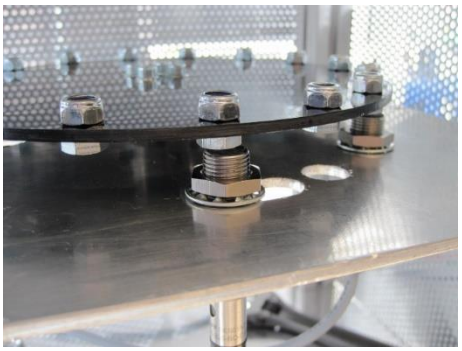
When the disc rotates Counterclockwise, the 25 % mechanical offset between the sensors will make the signal from sensor no. 2 arrive 25 % of the period time ahead of the signal from sensor no.1, as illustrated below.

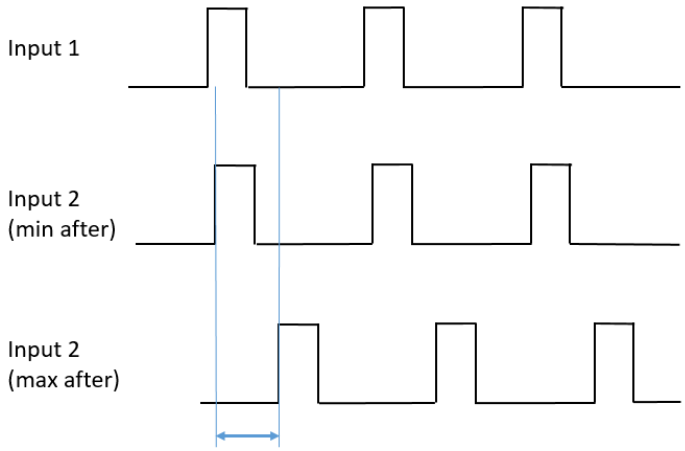


Positioning of the sensors

The signal below is from the test system mentioned before where the disc has 16 bolts and where the size of the bolt head is only ¼ of the distance between bolts. This results in a pulse shape with 25 % duty cycle.

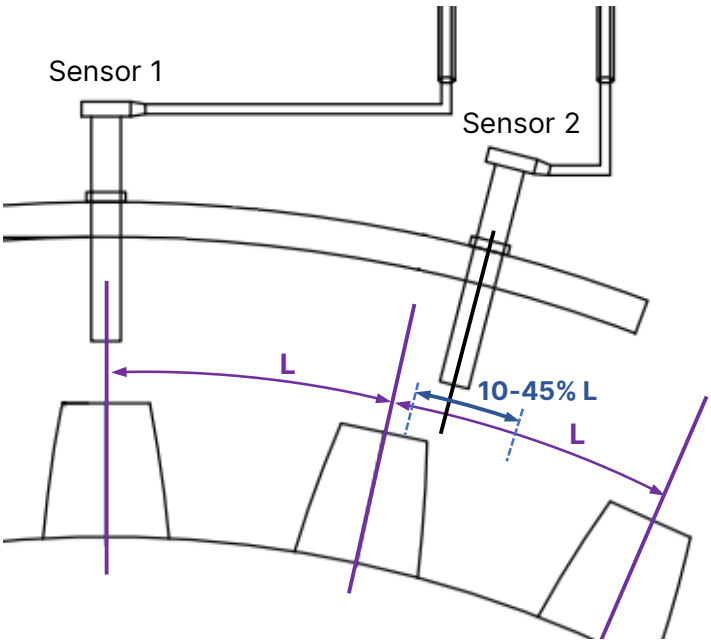
Depending on the location of sensor no. 2, the signal will be more or less delayed.





The input offset between sensor 1 (input 1) and sensor 2 (input 2) must be between 10 % (min) and 45 % (max) of the period time, for the XDi to be able to determine the rotation direction. In the example above, input 1 is ahead of input 2 and therefore the RPM direction is positive. To shift the measured direction, simply connect sensor 1 to input 2 and vice versa.

Example:



The optimal positioning of the 2nd sensor is with an offset of approximately 25% of the distance L.

Revolution counter

DX1 extension module produced later than 2022 (SW 1.01.x or later) has a special revolution counter function. This counter counts the number of revolutions registered by the DX1 module and stores them in the non-volatile memory every 2 minutes. This function can be used for example to estimate when it is time for scheduled maintenance on motor or shaft. The counter counts absolute revolutions (it doesn't matter which direction the XD1 RPM counts). The revolution counter has the following functions:

- The counter uses the configured RPM scale value (number of pulses per 100 revolutions). Maximum number of revolutions for the revolution counter parameter is 2,147,483,647 revolutions (it is a signed 32 bit parameter)
- It is possible to set the maximum counter value after which the counter roles over and starts from zero again. The max number of digits that can be presented in the digital readout of the virtual indicator will define the role over value (part of the design). Maximum value is 2,147,483,647 revolutions
- It is possible to set the start value from the install menu (for example if the XDi is replaced, it is possible to program the old value in the new XDi). The start value is visible in the instal menu.

The new start value must be activated to take effect. In the installation menu select: Reset counter to start value in the "Reset counter" dropdown menu.

- It is possible to reset the counter value to zero (for example if a motor or shaft are replaced) from the install menu in the "Reset counter" dropdown menu.
- It is possible to set the XDi to send the counter value as TPDO (TPDO output must be designed into the used VS profile) or share it with other XDis through XDi-net (This function can always be activated or deactivated from the installation menu).
- The counter value is not erased in a master/factory reset. Only Master Reset / Reset as service unit erases the counter value.
- There are up to 6 memory locations for revolution counter data in the non-volatile memory, for respectively:
    - Slot 1: RPM input 1, RPM input 2 and RPM input pair (+/-RPM)
    - And in XDi 144/192 also Slot 2: RPM input 1, RPM input 2 and RPM input pair (+/-RPM)

  The memory location used depends on the RPM input type defined in the VS profile.
- It is possible to have up to 4 independent revolution counters designed into one virtual indicator.

5.7.4 Digital dimmer input

The DX1 inputs can also be configured to act as push-button dimmer inputs. The input is only shared on CAN when it is activated (that is at a change), and therefore it is possible to have more than one push-button dimmer device controlling the dimmer level in the same dimmer group.

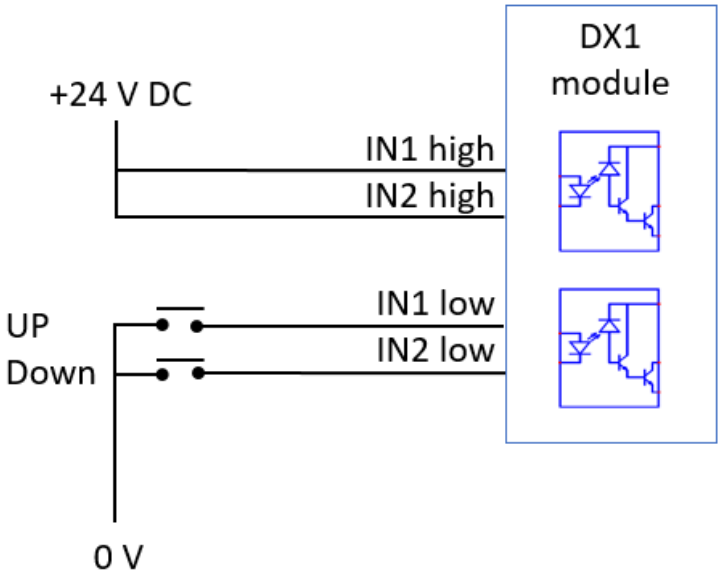
The digital dimmer input must be preconfigured in the selected product profile to be active.

The digital dimmer uses both inputs as an input pair, making it possible to change the dimmer level up or down by activating the input by a connected push-button contact.

The function has 2 modes:

A. Dimmer up/down, input 1 up and input 2 down.
B. Dimmer up/down, but with colour shift when input 1 and 2 are activated simultaneously.

Connection of 2 push-button dimmer controls (Mode A or B):

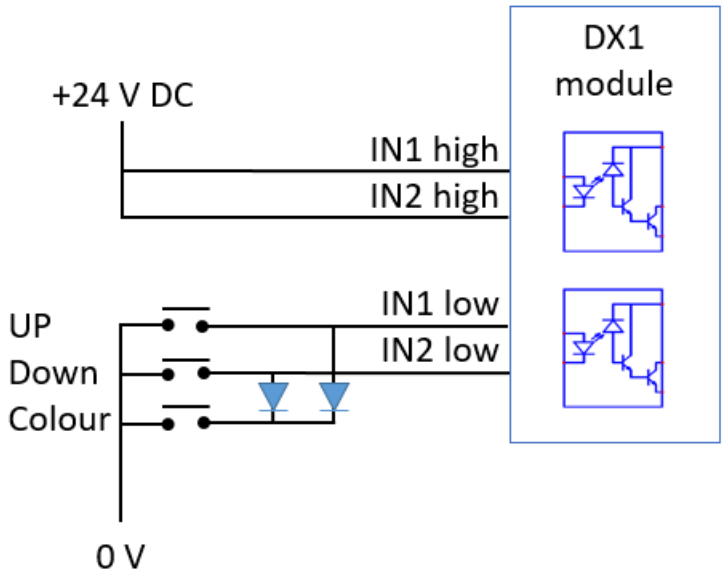


This connection can be used in both dimmer modes.

Mode A: Dim up/down. Day/night colour shift can be automatic at a defined dimmer level.

Mode B: Dim up/down and make a colour shift by a simultaneous push on both push-buttons.

Connection of 3 push-button dimmer/colour controls (Mode B):



This configuration is used for digital dimmer mode B, where there are 3 push-buttons for: Up, Down and Colour shift.

5.7.5 Relay outputs

The relay function makes it possible to design customised virtual indicators with a warning or control function.

The two relay outputs can be individually configured to serve the functions described in this chapter.

A relay output can be:

a) Predefined in the product profile (PP) as product warning or alert outputs.

b) Predefined in the VI-setup (VS) as an output from a virtual indicator for example set up to be triggered when the pointer enters a restricted section of the scale.

c) Predefined in the VS to be activated by a control flag.

Please note, that it is possible to activate a relay output function from both PP and VS at the same time. The relay will when activate if either of the selected criteria are true.

Relay mode

Each relay can be predefined to one of the activation modes:

0x00= Normal De-energised (ND) = OFF

0x01 = Normal Energised (NE) = ON

Normal energised mode can be used if the relay output must activate a function either when the XDi supply power is totally lost or when the relay function is true. This function is recommended when the relay functions for warnings and alerts are used.

Timer function

It is possible to define a timer function to control the length of the relay activation or periodically repeat the relay activation if the event is still true. This can be useful if the relay is activating a sound or light signal.

The timing of this function is selectable in steps of 500 msec.

This function can also be disabled.

Functions activated from product profile (PP)

0x00 = Disabled (PP function disabled)

0x01 = Activate on XDi Warning

0x02 = Activate on XDi Alert

0x03 = Activate on XDi Warning & Alert

These functions are self-explanatory.

Functions activated from the VI-setup (VS)

0x00 = Disabled (VS function disabled)

0x01 = Activated inside critical band

0x02 = Activate outside critical band

0x03 = Activate below user def. low value

0x04 = Activate above user def. high value

0x05 = Activate on flag-H (Flag AND mask >=1)

0x06 = Activate on flag-L (Flag AND mask =0)

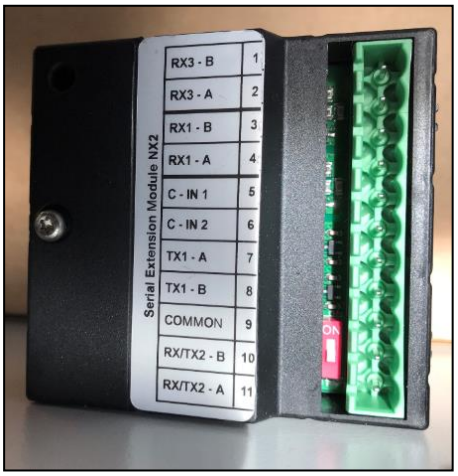
The relay activation related to critical band can be controlled by one, two, three or all four critical bands for a data type used by the selected virtual indicator.

The alternative to using critical band is to use a single low or high parameter to activate the relay.

Activation using a data flag includes a data-mask where desired flag bit (or bits) is masked “in” using value “1”. The relay can be set to either activate when one in-masked flag bit is going 1 or by all in-masked flag bits being 0.

See the XDi data sheet for technical specifications of the relays.

5.8 NX1 and NX2 NMEA interface module



Serial NMEA data is often the primary data source for XDi-N. To receive and transmit NMEA data the NX2 module must be mounted on the rear plate of the XDi-N main unit.

To reduce the number of extension modules needed, NMEA data can be shared with other XDi-N units via the CAN bus using the XDi-net protocol. Basic numeric data can also be shared with XDi-D/M, but not the special data formats like for example time/date and position). Other devices on the CAN bus may also use NMEA data provided by the XDi-N.

If only NMEA output data is required, the NX1 module can be used.

The NX1 NMEA output module contains one serial output following IEC61162-1 (NMEA0183) and may be used to supply output data like rudder angle and RPM to external devises like integrated navigation system or a VDR.

5.8.1 Connection of the NX modules

Term. no.	Signal	NX2 Label	NX1 Label	Remark
1	COM 3 input NMEA 0183	RX3 – B	Do not connect	Opto-insulated serial input RS-422 (IEC 61162-1 and -2)
2		RX3 – A	Do not connect	
3	COM 1 input NMEA 0183	RX1 – B	Do not connect	Opto-insulated serial input RS-422 (IEC 61162-1 and -2)
4		RX1 – A	Do not connect	
5	Contact input 1	C-IN 1	C-IN 1	Push-button input 1 with internal pull-up to +5 V
6	Contact input 2	C-IN 2	C-IN 2	Push-button input 2 with internal pull-up to +5 V
7	COM 1 output NMEA 0183	TX1 – A	TX1 – A	RS-422 Differential output (IEC 61162-1)
8		TX1 – B	TX1 – B	
9	Common GND	COMMON	COMMON	Note1
10	COM 2 in/out NMEA 0183	RX/TX2 – B	Do not connect	RS-485 configured as input or output.
11		RX/TX2 – A	Do not connect	
DIP switch (red)	RS-485 termination	See picture above	No function	120 Ω termination resistor, default OFF. The red DIP switch is located above term. 10.

Note1: Common (Reference GND) for the RS-485 COM port, COM 1 output and the two contact inputs.

Important: The common GND terminal should NOT be connected to the NMEA cable shield, the cable shield should be connected to a good ground connection in only one point !

NX2 is the extension module enabling the XDi-N to receive and transmit NMEA 0183 serial data (in accordance with IEC61162-1 and -2).

When the NX2 module is mounted in the extension slot, several input/output ports are available for the serial NMEA 0183 data.

All serial inputs are setup to use the NMEA protocol and default port parameter setup in accordance with IEC 61162-1.

By changing the bit rate from 4.8 to 38.4 kbps it complies instead with the NMEA high speed standard IEC 61162-2.

XDi 96 N can have one NX2 module mounted on the rear side.

XDi 144/192 N can have one or two NX2 NMEA modules mounted on the rear side at the same time.

5.8.2 Connection and cable for NMEA

The RS-422 output may be connected to up to 10 standard NMEA inputs complying with IEC 61162-1

(load >1 kΩ). It is recommended to use a shielded twisted pair cable.

5.8.3 NMEA inputs

The NMEA inputs RX1 and RX3 is galvanic separated and fully complies with the two IEC 61162 standards.

The RX/TX2 (RS-485 port) is used to connect a DEIF wind sensor to an XDi-N wind indicator. This port can also be configured as either an input or an output, in both cases it will use the NMEA data protocol.

Please note that the RX/TX2 connections are marked according to the RS485 standard and therefor A and B is swapped around compared to the NMEA RS422 terminal markings.

For information of supported NMEA sentences please see “XDi supported NMEA sentences” (separate doc).

5.8.4 NMEA outputs

Only data types used by the selected virtual indicator can transmitted in an NMEA sentence. It requires that the selected VS profile contains an NMEA output definition for data to be packed in to one or more NMEA sentences and transmitted via the NMEA output.

Data types may be generated from an AX1 or DX1 module or be received via CAN either using XDi-net data format or received in a TPDO.

It can also be data received via NMEA that is retransmitted, but in that case, it is often better to use the NMEA routing function available in XDi-N.

For information of supported NMEA sentences please see “XDi supported NMEA sentences” (separate document).

Example NMEA from a rudder systems:

All DEIF standard rudder indicators contains VS profiles that will support NMEA output.

The RSA sentence that contains actual rudder angle may be used in a CAN-based rudder system to output the rudder angle to the VDR.

NMEA for dimming:

When a XDi library contains a product profile where the DDC dimmer sentence is supported, it can control the dimmer level of the backlight and the day/(dusk)/night colour shift can either be automatic based on dimmer level (for example shift from night to day at 70%) or separately controlled dimmer level and colour pallet.

When a NX1 or NX2 module is mounted on XDi it is possible to activate the dimmer NMEA output using the DDC sentence. Depending on the Product profile the DDC can contain the dimmer value and the selected colour pallet. This will be for the dimmer group that this XDi is a part of.

Example: $IIDDC,,49,D,C*hh this DDC sentence contains: level 49%, D= day colour, C = configuration message (hh is checksum).

5.8.5 Contact inputs

The two contact inputs on both NX1 and NX2 module is used for connection of two external pushbuttons.

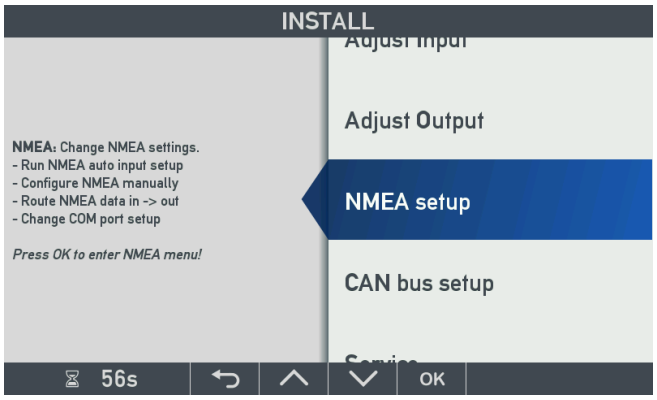
Via the NMEA setup menu/NX Button setup..., the contact inputs can be configured to control either the two centre buttons (button 2 and 3) or the left and right button (button 1 and 4).

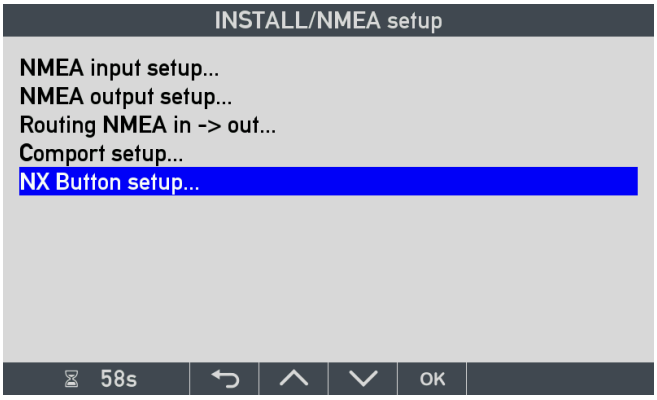
The external buttons will work in parallel with the buttons on the front. If 4 external buttons are connected to two NX modules on an XDi 144 N or XDi 192 N then full button operation can be achieved from 4 external pushbuttons.

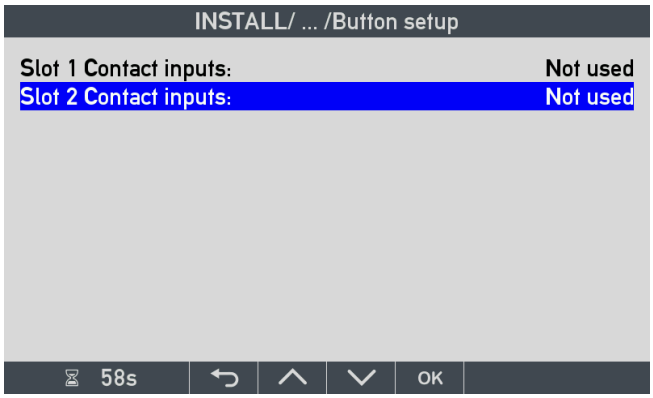
On XDi dual or multi it is only the two dimmer buttons (button 2 and 3) that can be controlled from the contact inputs.

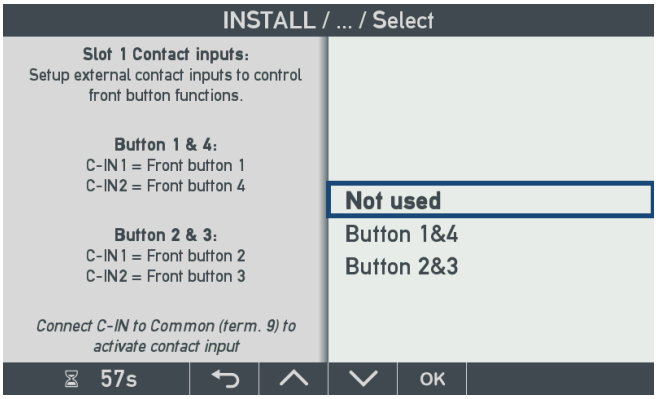
The external pushbuttons work in parallel with the front buttons on XDi, so you can just shift between operating the XDi from the front buttons or via the external buttons.

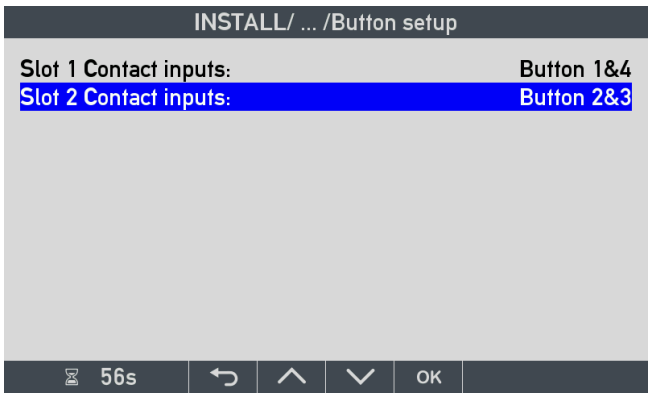
The contact input setup is found in the installation menu:











A potential free pushbutton connected between contact input C-IN1 (term. 5) and Common (term. 9), on the NX module in Slot 1, will now work in parallel with button 1 on the front frame and toggle between the screen modes.

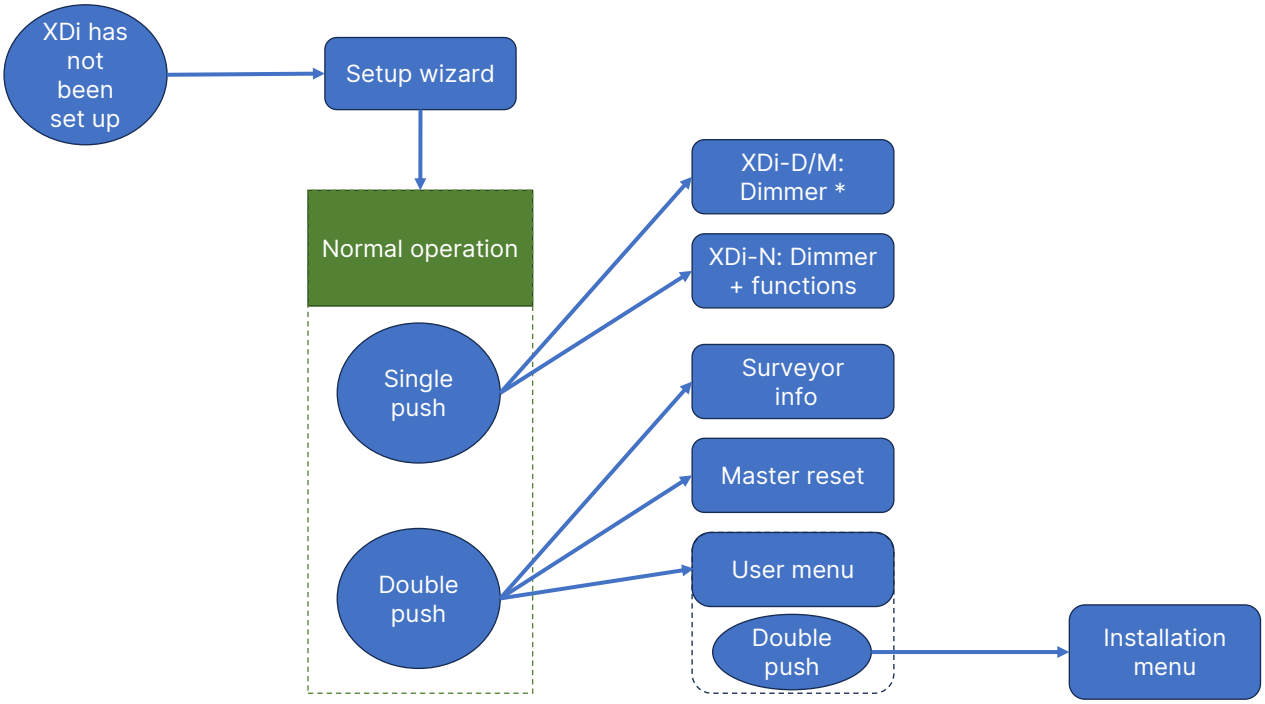
If a pushbutton is connected between C-IN2 (term. 6) and common (term. 9) it will work in parallel with front button 4 (right side) and make it possible to remotely change presentation unit (e.g. Wind speed: Knot, m/s...)

if this function is activated in the selected VI.

For remote dimmer use the selection: Button 2&3 setting.

6 XDi menu system and functions overview

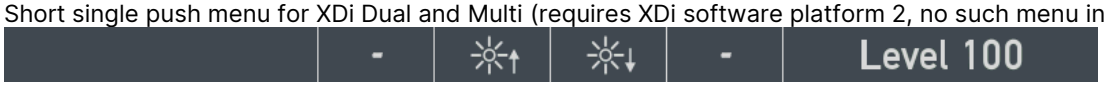
Overview of the overall menu structure in XDi



* Platform 2 only

7 XDi menu level 1 – short push

A short push on one of the 4 pushbuttons on the front will first role up a soft key menu line and it will not make any changes to the settings only show the help text line.
Short single push menu for XDi Dual and Multi (requires XDi software platform 2, no such menu in platform 1)



Short single push menu for XDi Nav (N version is always on software platform 2)

The second short push on a button will perform the function stated in the soft key menu line.

7.1 Dimmer level up/down (button 2 and 3)

Use the push-buttons below the symbols (2 and 3) to dimmer backlight up or down:

Press shortly to adjust the dimmer level one step at a time or keep pushing the button to make larger adjustmets.

The actual dimmer level is shown in the right side of the menu bar: 

Level 100 is equal to maximum backlight and 0 is the minimum level.

NOTE: According to IEC 62288 a display based product should not be able to dim the backlight to totally OFF, it shall be readable in dark night conditions on the ships bridge, without jeopardizing the crew's night vision.

Backlight level 0 is therefore not 0% backlight but will be slightly illuminated.

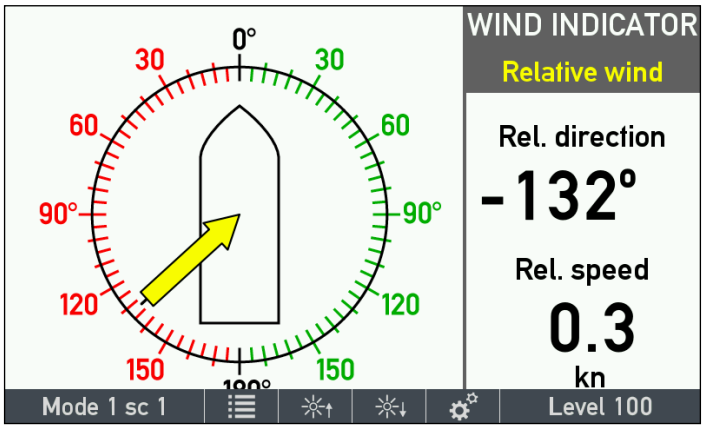
8 Menu level 1 functions only in XDi-N

DEIF standard wind indicator VI007 is used as example in this description.

8.1 Toggle between screens (button 1)

The XDi-N can have up to 4 screen in a virtual indicator and some of the standard wind indicators have 2, 3 or 4 screens presenting different wind data types or combinations.

By default, each “Screen mode” has one screen assigned. This means that when you toggle between the modes, the screen will shift.



The screen mode and the screen assigned to this mode is presented in the left side of the pop-up menu:

Mode 1 sc 1 this indicates that the present screen mode is 1 and the assigned screen is sc. 1 (screen 1).

Press the left button (1) shortly to highlight the pop-up menu bar and then press again to toggle to the next screen mode.

Pushing several times when the help menu is visible will toggle you through all the available screens.

8.1.1 Using Screen mode grouping in system integration

Normally the mode function is set up as local, which means that only the XDi where you have pushed the button will shift screen.

In a CAN bus system, the “screen mode” function can be grouped much like the dimmer function, and this means that all indictors in a mode group will shift screen simultaneously.

In a wind system, this function can be used to shift all indicators to show the preferred wind indicator screen in a given work situation.

In each XDi within a mode group, the 4 screen modes will have a screen assigned and the assigned screen can be changed via the quick menu. The same screen can even be assigned to be used in more than one “screen mode” if needed.

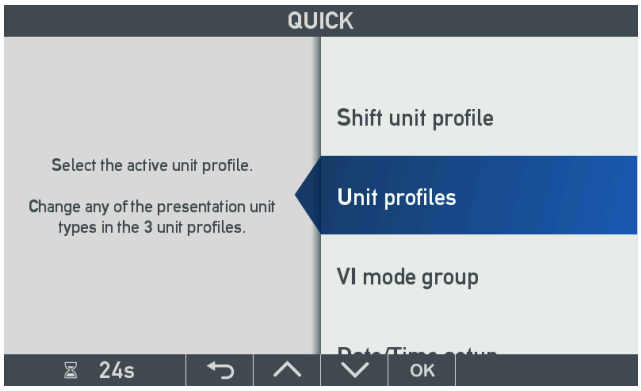
This mode grouping function can be used to make quite advanced systems where a combination of different XDi-N indicators forms an information system where relevant data for a given work situation is presented on all indicators with a single push on a button or even controlled from an integrated control system.

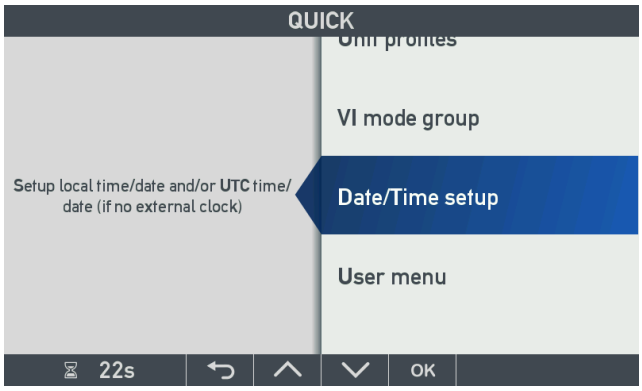
In the chapter “VI mode group setup” you can find much more information about how this mode group function works and see some examples.

8.3 Quick menu (only XDi-N)

The quick menu opens for the basic user setup functions:

- Unit profile toggle,
- Unit profile setup
- VI mode group setup
- Data and time setup
- User menu (gives access to dimmer, warning and sound setup)





8.3.1 Change unit profile

The XDi-N supports different selectable data units. The default presentation units are predefined in the three unit profiles. In the standard wind indicators, it is the wind speed unit that is selectable via the unit profiles. Each unit profile contains default setup for all selectable data units that the XDi-N supports.

Be aware that the unit shift function will only work if the selected virtual indicator is designed to support this function for the given data type.

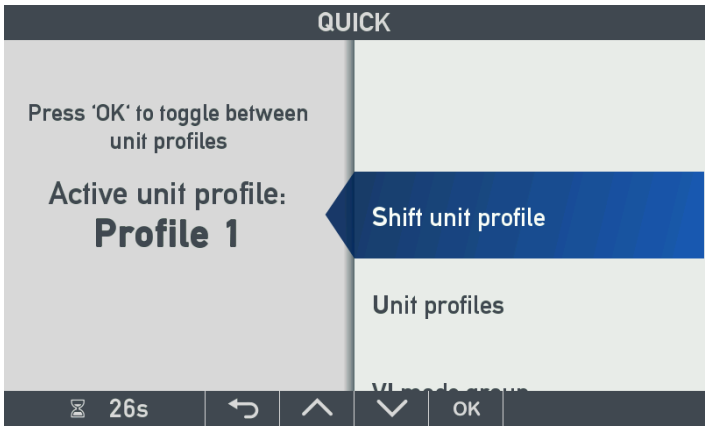
The default setup for the wind indicator is:

Profile 1: Wind speed in m/s
Profile 2: Wind speed in knots

Profile 3: Wind speed in Beaufort

The default profile when the XDi-N wind indicator is installed is unit profile 1. This means that wind speed is presented in m/s.

To shift to knots, you must select unit profile 2. To do that press the right button shortly once to have the soft key menu presented, and push the right button  again to open the quick menu.

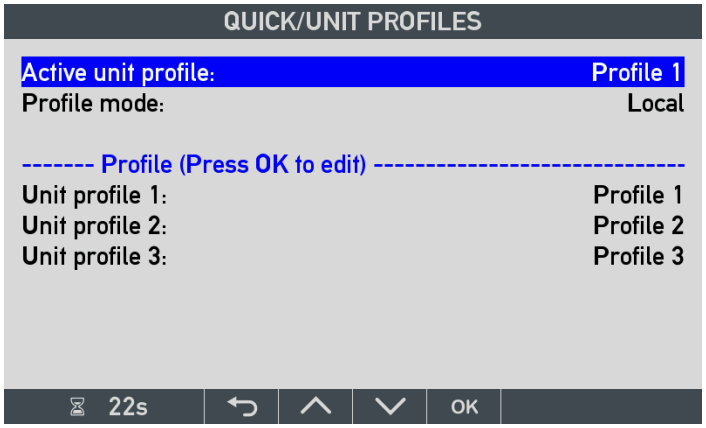


To toggle to Profile 2, push the “OK” button shortly and push the left button  to go back to normal operation.

The toggle function on the “OK” front button (button 4) makes it possibel to to change unit using only two buttons - button 4 and button 1. This means that unit shift can also be performed via two external pusbuttons connected to the two contact input on the NX module (input: C-IN1 and C-IN2). See also: “How to activate NX external pushbutton inputs” in connection with chapter “VI mode group setup” in this document.

8.3.2 Change unit profile setup

Wind speed can be presented in the following units: m/s, knot, Beaufort, km/h, MPH. To change the wind speed unit in one of the unit profiles, select “Unit profile” in the quick menu, and highlight the profile that you want to edit. Press OK to open the profile for editing.



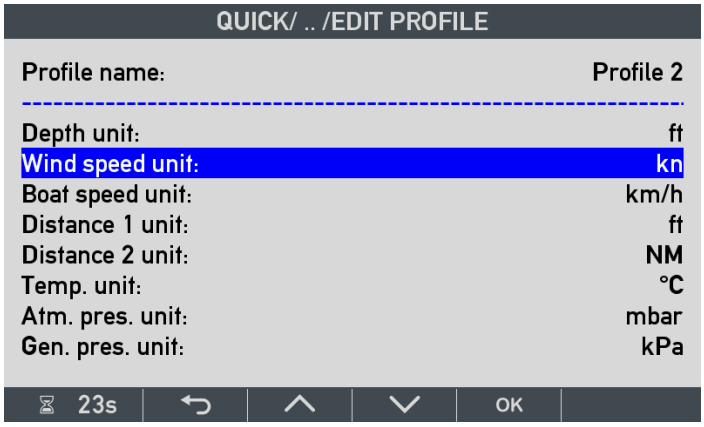
The active profile can also be changed from this menu.

Profile mode can be “Local” or “Global”.

In local mode, only this indicator is affected by a profile shift.

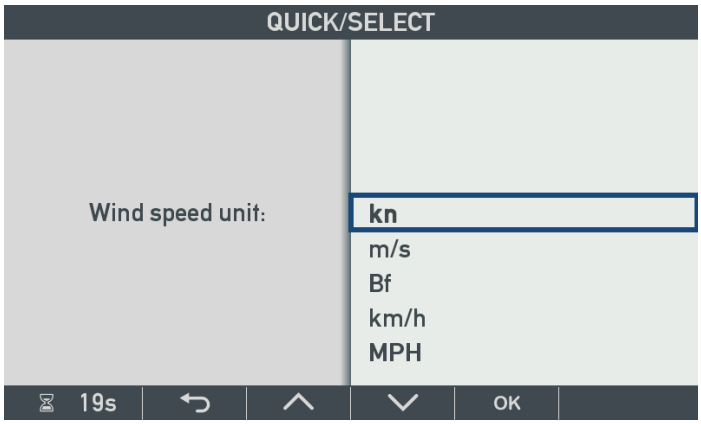
In global mode, this indicator is synchronised with other indicators on the CAN bus (see description in the next chapter).

Highlight and press OK on Profile 2 to open it for editing:



The profile name can be edited by highlighting and pressing OK. The virtual keyboard will appear, and a more informative name for the unit profile can be typed in.

Highlight “Wind speed unit” and press OK:



It is now possible to select another unit from the list.

8.3.3 Change unit profile in a CAN bus system

The advanced XDi-net functions allow all indicators connected via CAN to make a simultaneous shift of unit profile.

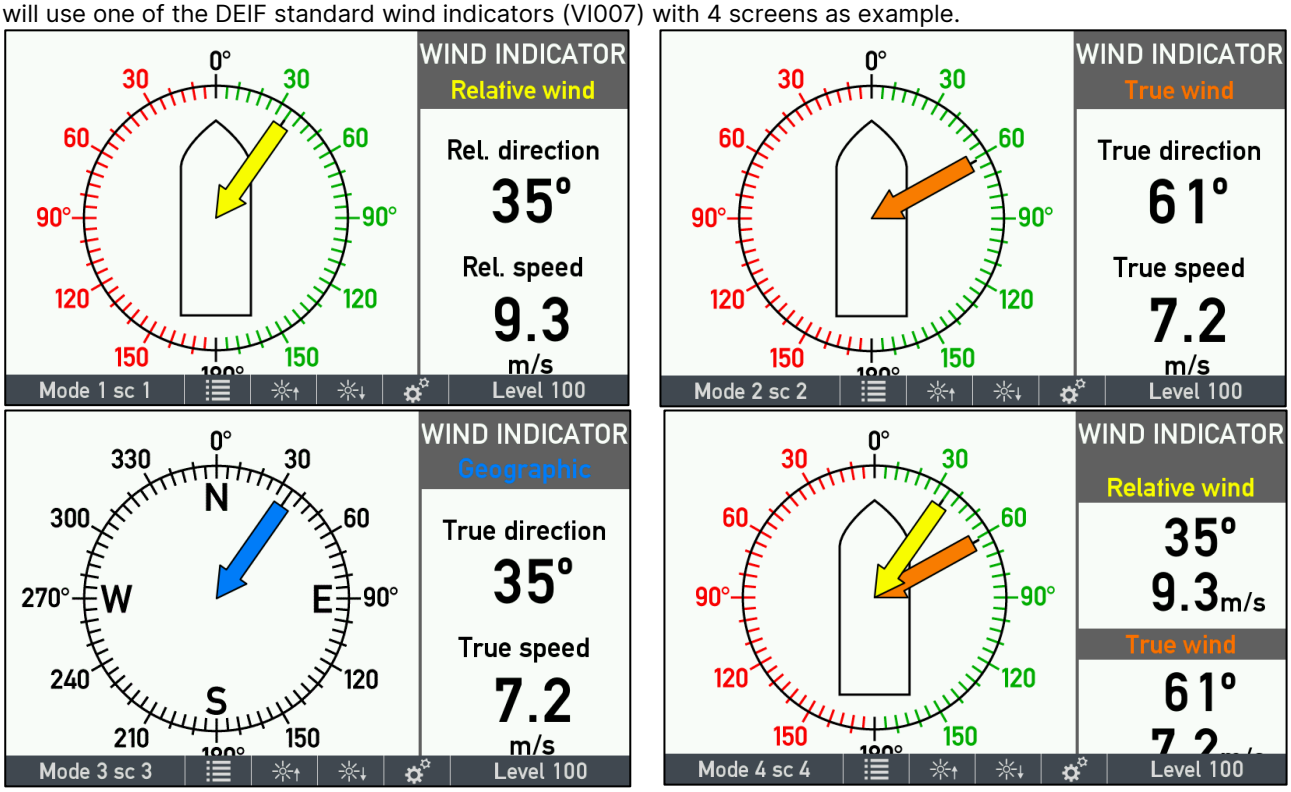
All XDi-N indicators where you want the unit profile selection to be synchronised must have their “Profile mode” changed from “Local” to “Global” in the quick menu “UNIT PROFILES” shown in the first menu picture above.

If the unit profile is changed on one XDi, then all other XDi-N units in Global mode and connected to the same CAN bus, will follow.

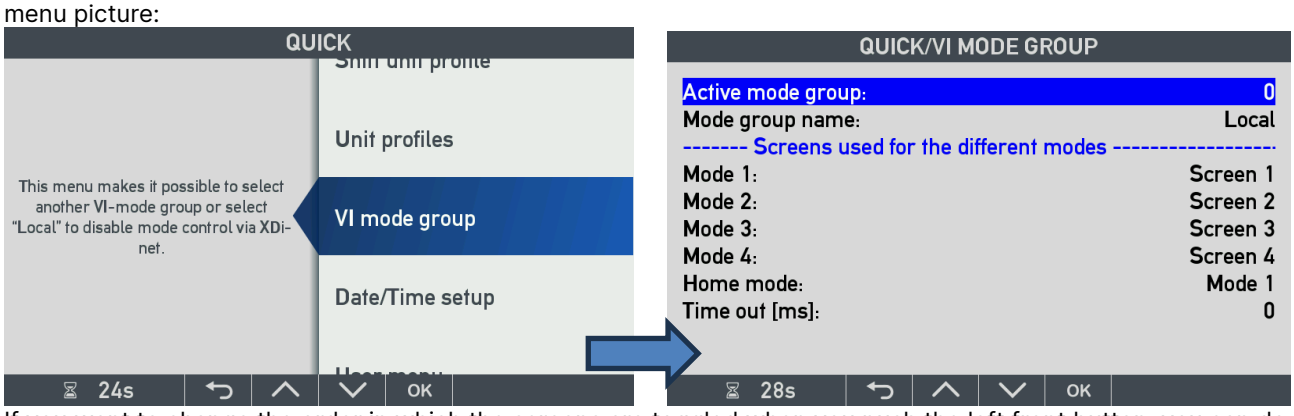
If you edit the selection of presentation units in one of the 3 Unit profiles, the change will also be synchronised, via the CAN bus, with all the other XDi-N indicators that is in “Global mode”.

8.3.4 VI mode group setup

In this quick menu it is possible to reorganize the different screens in a virtual indicator (VI) with multiple screens. We will use one of the DEIF standard wind indicators (VI007) with 4 screens as example.

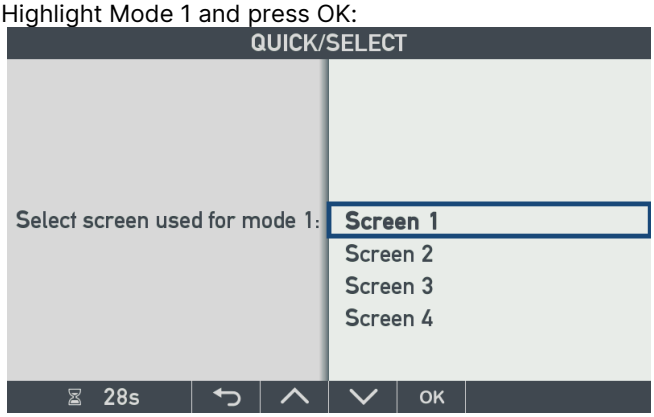


By default, Screen 1 is assigned to Mode 1, Screen 2 to Mode 2 and so on as it can also be seen below in the quick menu picture:



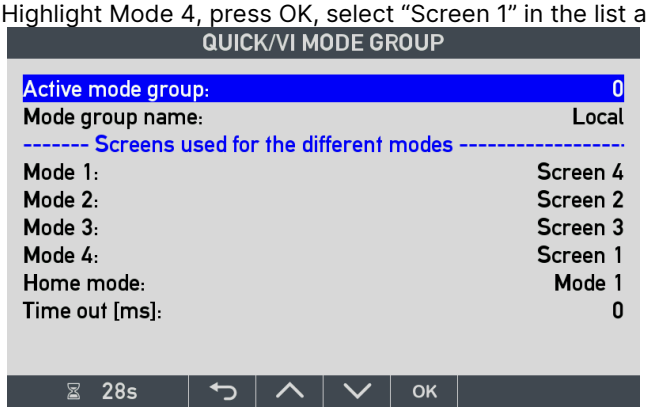
If you want to change the order in which the screens are toggled when you push the left front button, you can do it in the Mode Group setup menu:
If you want this XDi to toggle between screen 4, 2, 3 and 1 then you can change the assigned screens for each mode.

Highlight Mode 1 and press OK:

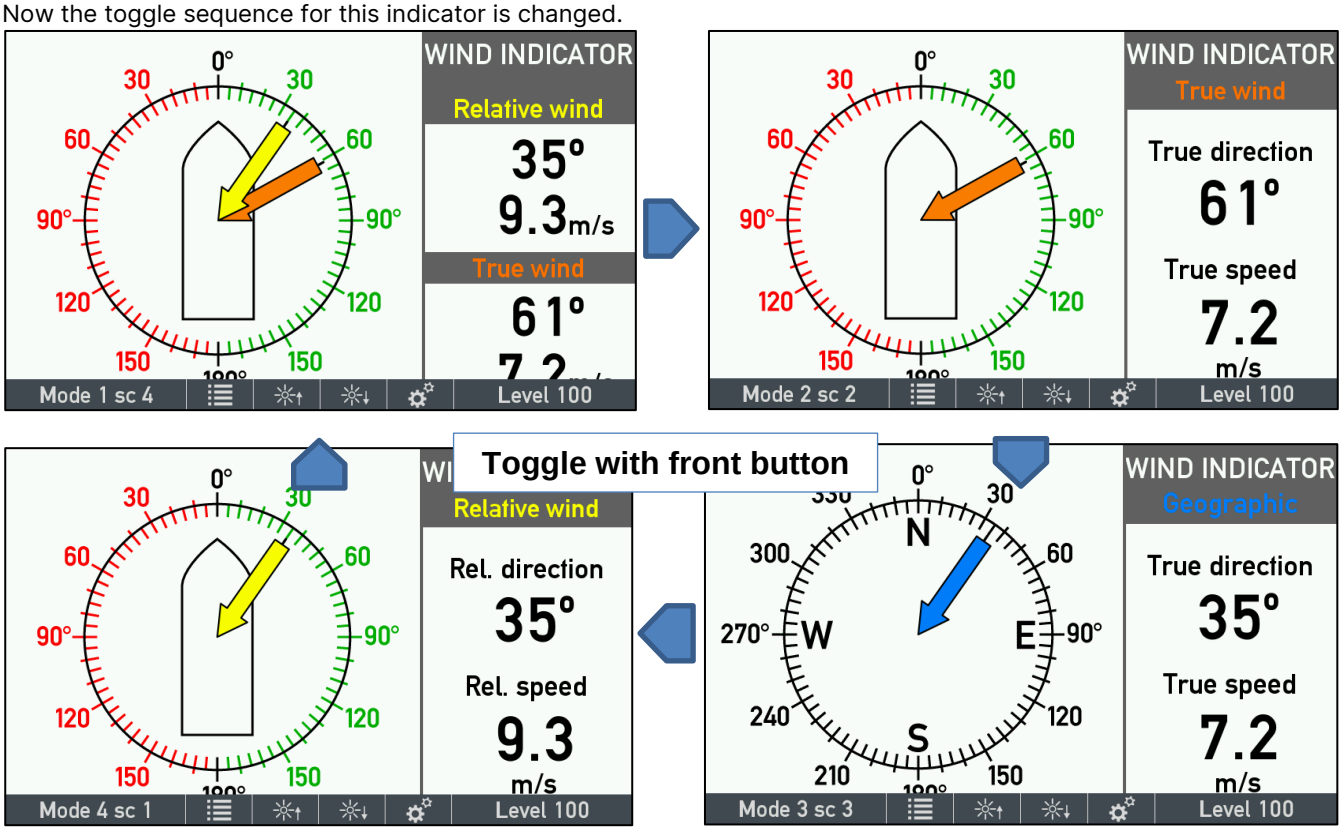


now highlight Screen 4 and press OK

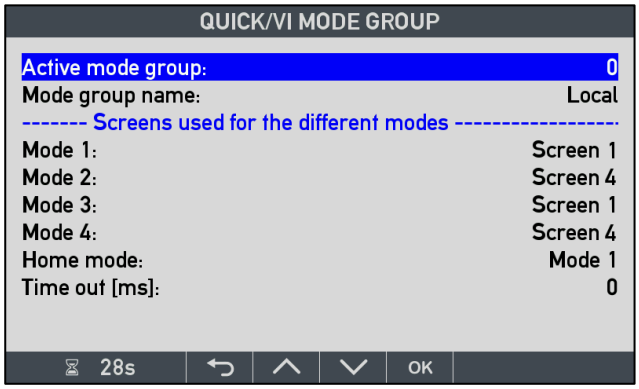
Highlight Mode 4, press OK, select “Screen 1” in the list above and press OK:



Now the toggle sequence for this indicator is changed.



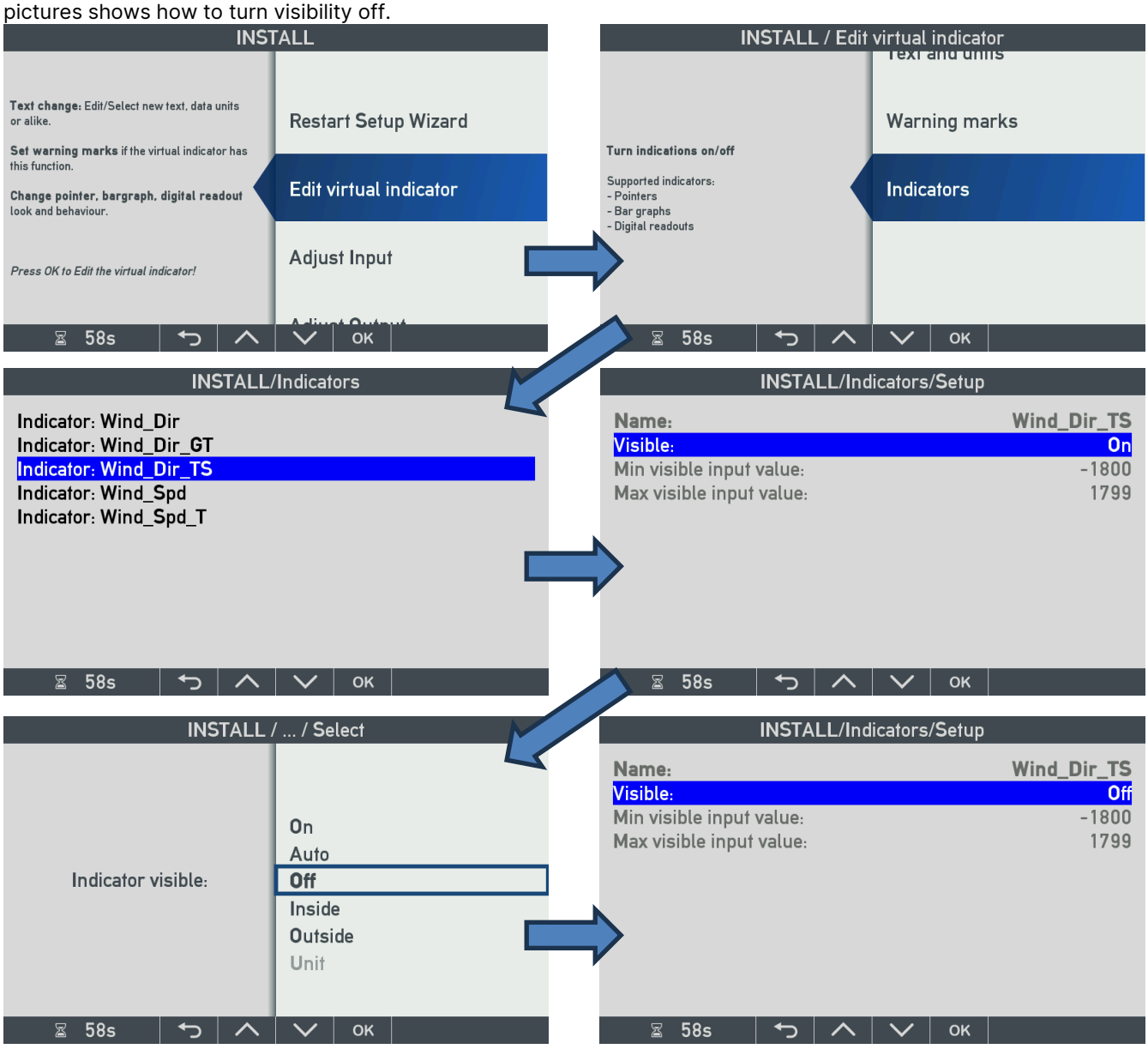
If you for example in the virtual wind indicator above only want to use Screen 1 and 4, then just set the mode 1 to 4 like this:



Now XDi-N will toggle Sc.1, Sc.4, Sc.1, Sc.4 and so on.

How to fix data lost warning when not all screens are used

If you select not to use a screen in the mode toggle sequence, you may still get a data lost warning from the screen that is never presented. It can easily be fixed by entering the XDi installation menu and select: Edit virtual indicator \ Indicators where you select the data type (or types) that is not presented/available and press OK to access the setup menu where you must set Visible to OFF.
In the following example we don't have data for the true wind relative to ship (orange arrow pointer), we only have relative and geographic true wind data. Therefore, we only toggle between screen 1 and 3, screen 2 and 4 is never used. To avoid a data lost warning for True wind direction relative to ship (Wind Dir TS) we enter the installation menu and turn the visibility for this parameter OFF. When a parameter is not visible it will not create a data lost. The following pictures shows how to turn visibility off.

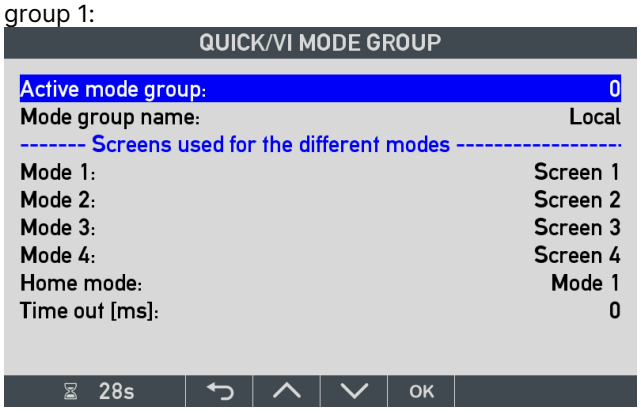


Now press the ↩ several times to return to normal operation where you now can toggle between screen 1 and 3 without getting a data lost warning.

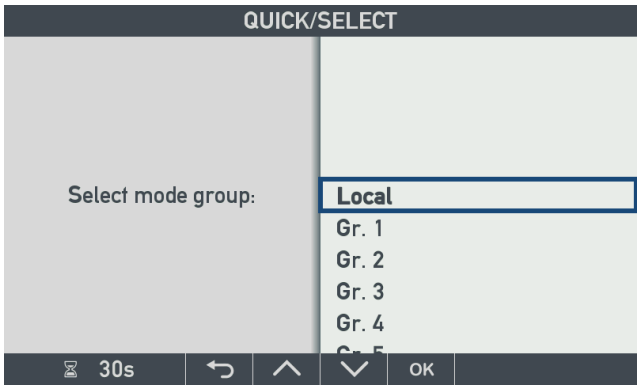
NOTE: In this case it is only the true wind direction relative to ship that needs to be disabled. The True wind speed is always the same and independent of which reference is used for the true wind direction (the ships bow or the north pole).

Use of screen mode grouping in a CAN based system

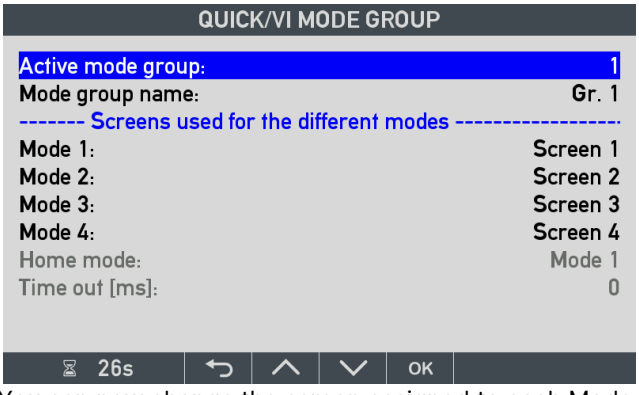
Like dimmer grouping it is also possible to group several XDi-N indicators with multiple screens in a screen mode group. All indicators in the same group will show the screen that is assigned to the active mode for the group. If the screen mode on one of the indicator in the group is toggled to a new active mode, then all the other XDi-N indicators in this group will receive a CAN command to follow.
By default, XDi-N is in "Local mode" (0) so to make a group you must change the active mode group, for example to group 1:



Press OK to select another group:



highlight Gr.1 and press OK



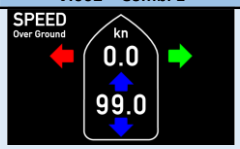
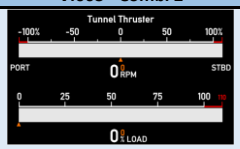
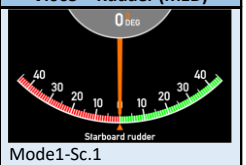
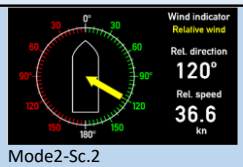
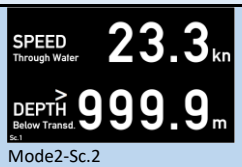
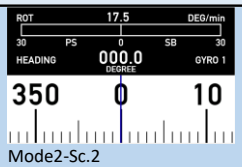
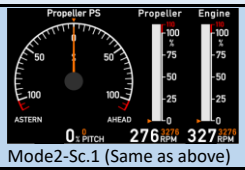
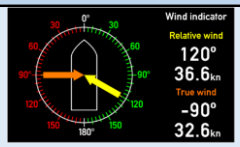
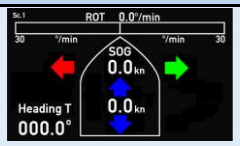
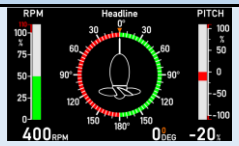
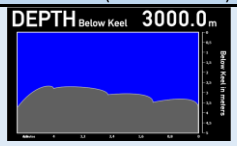
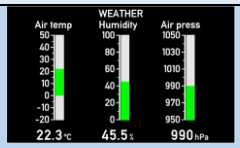
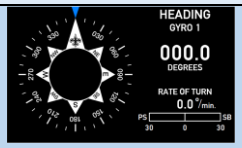
You can now change the screen assigned to each Mode in Gr. 1 for this XDi indicator or keep them as they are.

You must make this setup in all indicators you want to be in the same mode group.

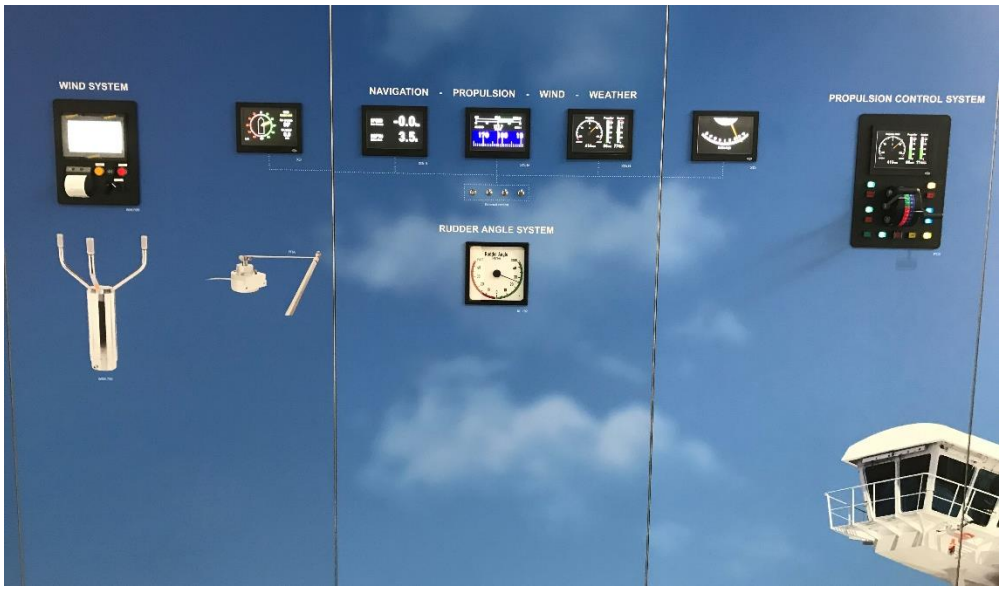
NOTE: In a customized library it is possible to make a default mode group setting (e.g. Gr.1) and also make a different default screen assignment to the group. The default screen mode setup is located in the selected Product Profile.

How can you use the screen mode function

Using this Mode group function, it is possible to make an integrated system with 4 working modes, where all the XDi-N indicators in the same group shifts to the screen that is preselected for this working mode.
The following picture illustrates this function in an actual system where the mode function is used in the 4 XDi-N indicators out of the 5 indicators in an overhead panel:

	XDi1 (Navigation)	XDi 2 (Navigation)	XDi 3 (Navigation)	XDi 4 (Navigation)	XDi 5 (Dual)
VI number	**VI001 - Weather**	**VI002 – Combi 1**	**VI003 - Combi 2**	**VI004 - Combi 3**	**VI005 – Rudder (MED)**
Mode 1 Harbour	 Mode1-Sc.4	 Mode1-Sc.1	 Mode1-Sc.1	 Mode1-Sc.1	 Mode1-Sc.1
Mode 2 Steaming	 Mode2-Sc.2	 Mode2-Sc.2	 Mode2-Sc.2	 Mode2-Sc.1 (Same as above)	Fixed in all modes
Mode 3 Work	 Mode3-Sc.3	 Mode3-Sc.3	 Mode3-Sc.3	 Mode3-Sc.2	Fixed in all modes
Mode 4 Info	 Mode4-Sc.1	 Mode4-Sc.4	 Mode4-Sc.4	 Mode4-Sc.3	Fixed in all modes

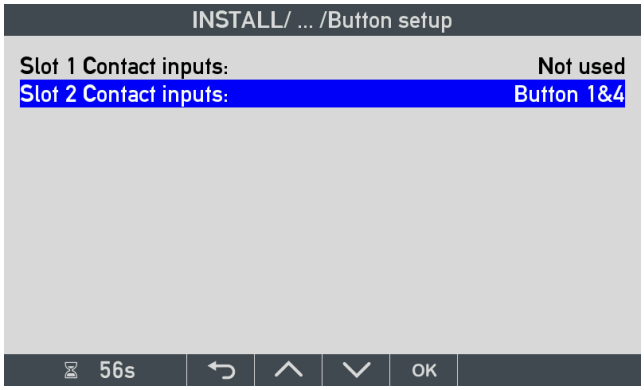
In XDi 1 (Weather) the toggle order of the screen is changed to: Sc. 4, Sc. 2, Sc. 3 and Sc. 1
In XDi 2 and 3 (Combi 1 and 2) the screen order is the default 1, 2, 3, 4
XDi 4 (Combi 3) use VI004 that has only 3 screens and the first screen (Sc. 1) is used in both Mode 1 and 2
XDi 5 (Rudder) is a XDi Dual version with a fixed MED approved rudder indicator, that is independent of mode.
The above example is not from a real ships application, but the XDi demo system used on several exhibitions.



Screen mode input / control options

There are several ways to control the screen mode function, Locale on one XDi-N or for a group of XDi-N indicators on a CAN bus.

1. The basic way to make a screen toggle is via push button 1 (left) on the front panel.
2. It is also possible to control the active screen mode using a CANopen command from an external device.
3. It is possible to use the external contact input C-IN 1 on a NX2 (or NX1) NMEA extension module to toggle the mode. You must in that case make sure that contact input 1 and 2 (C-IN1 and C-IN2) is setup to control button 1 and 4. (see how in the example below)



NOTE: The contact inputs are normally off. In a custom library they can be activated in one or more PP's.

4. In a customized library it is also possible to make a setup for a VI so that the two digital inputs on the DX1 extension module can control each of the 4 screen modes by a 2 bit BCD code.
For example:

DX1 in 2	DX1 in 1	BCD Value	Screen mode
0	0	0b00	Mode 1
0	1	0b01	Mode 2
1	0	0b10	Mode 3
1	1	0b11	Mode 4

The DX1 setup is made in the VS profile for the virtual indicator where this function is relevant.

Also, in this case it is only necessary to have one XDi with DX1 extension module to control a defined group of XDi indicators. The XDi with DX1 can share its active mode via XDi-net with all other indicators in that mode group via the CAN bus connecting the XDi units.

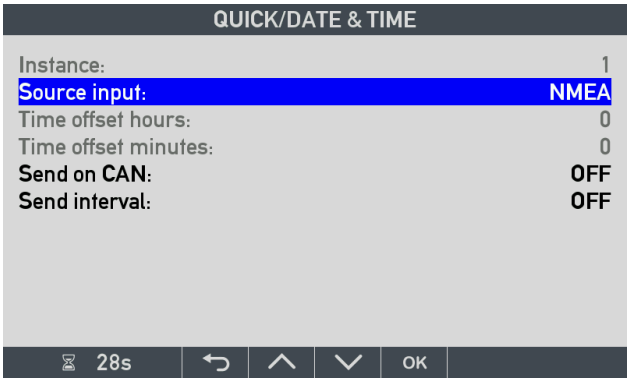
8.3.5 Date/time setup

XDi does not have an internal real time clock, so to be able to show time and date it is depending on external UTC time and date received via either NMEA or via XDi-net (CAN bus).

Local time offset via NMEA

To be able to show local time the local time offset is required.

In many cases the local time offset will be included in the NMEA ZDA sentence that is also providing time and date. In that case all time/date data can also be shared via XDi-net (CAN) with other XDi units without the NMEA access, but connected to the same CAN bus.



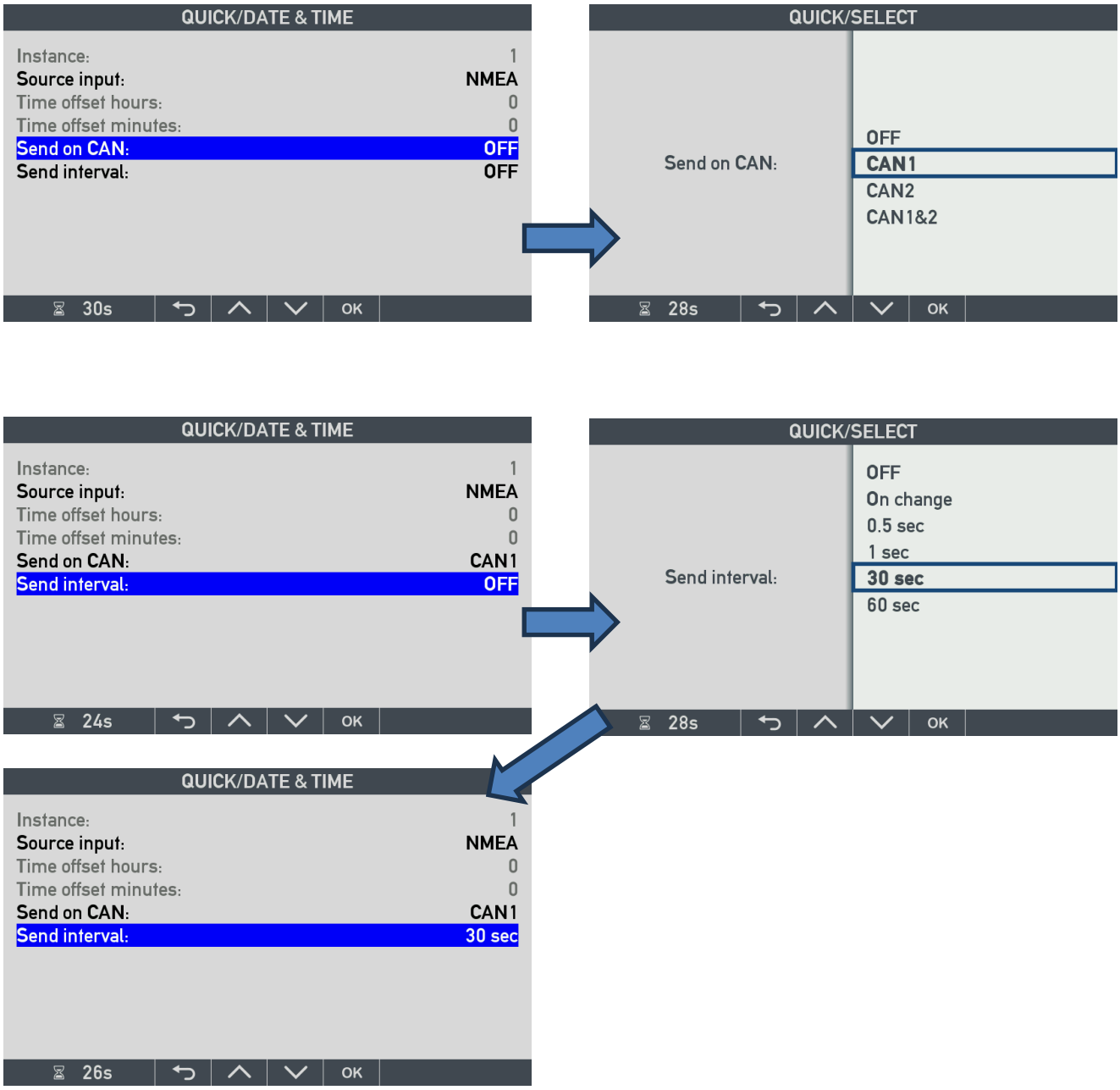
NMEA is normally the default source setup for date and time:

This source setting is correct for the XDi-N where the NMEA time data is connected and selected in the initial NMEA setup procedure.

NOTE: You can always go into NMEA input setup and see the actual NMEA data and time setup.

NMEA Local time offset shared via CAN

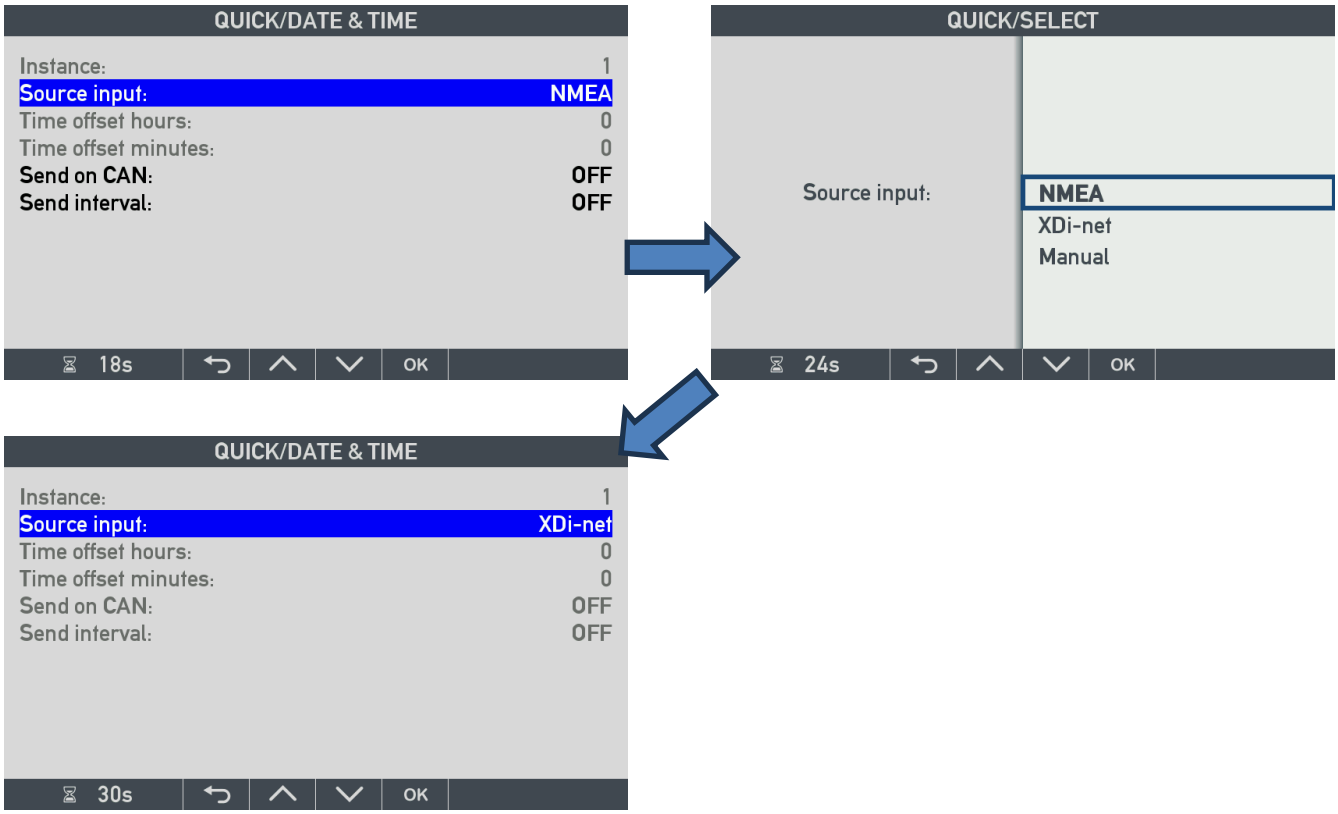
If other XDi-N units needs the local offset via CAN bus, then “Send on CAN” and “Send interval” must be setup.



Now local time offset is shared via CAN 1 every 30 sec. It is also possible only to send data it on a change instead. However, making transmissions periodical secures that all XDi units are synchronized regularly, even when they were powered down at the latest change of the local offset.

Local time offset received via XDi-net

XDi indicators that needs local time offset via XDi-net (CAN) must be setup so that “Source input” is changed to XDi-net:



Change the source input to XDi-net:

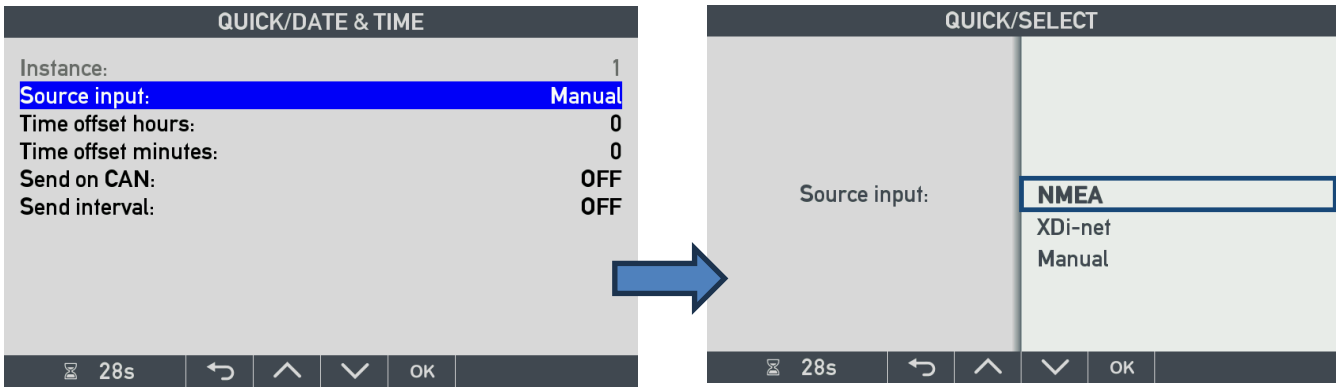
The local time offset parameters that XDi-needs, is now received via XDi-net and it is not possible to change any of the other parameters since it is not relevant (they are greyed out in the menu).

Local time offset – manual setup

If the local time offset is not available via NMEA or via XDi-net, it is possible to manually insert a local time offset.

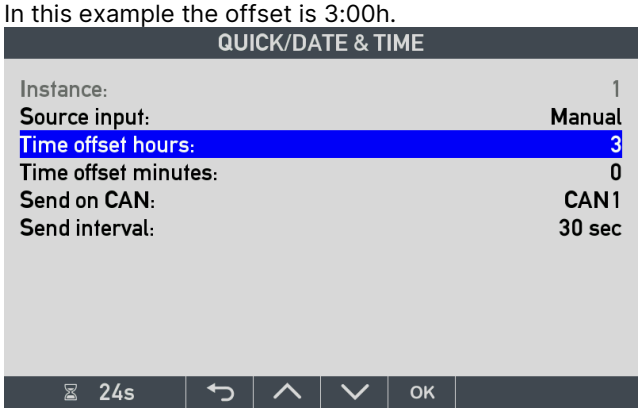
The time offset that can be inserted is relative to UTC time.

The source input for local time offset shall then be changed to Manual:



In manual mode the local “Time offset” parameters: hours and minutes can be setup and are then used to calculate the local time that may be presented on another XDi-N virtual indicator on the CAN bus.

In this example the offset is 3:00h.



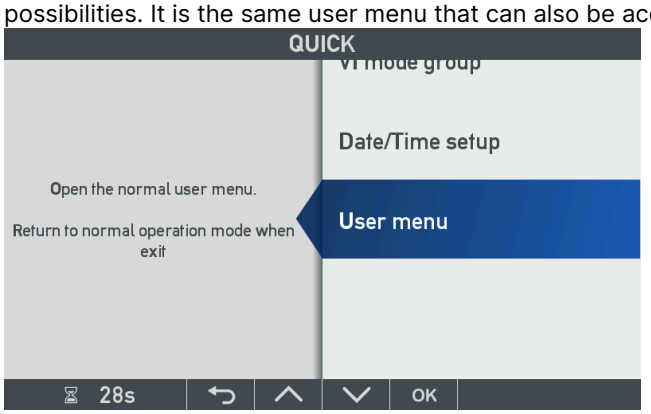
The manually inserted local time offset can also be shared via CAN with other XDi unit's setup to manual time offset and one of the indicators (kind of master) is setup to share on CAN like above, manual data is sent in sub index 0x07). So manual local offset is different from NMEA generated offset (or offset from normal XDi-net data) both sent in sub-index 0x02.

To share data in CAN the "Send on CAN" and "Send interval" must be setup, for example like in the picture above where offset value is shared on CAN1 every 30 sec. The receiving XDi must in this case also be setup with source: Manual.

NOTE: If you select to use "On change" data will only be transmitted on CAN and thereby the system is synchronized only when the offset value is changed. It may be a good idea to use a fixed time interval instead. However, if you want to be able to change a manual offset from different XDis on the bus, then activate CAN on all and set data to be sent on a change, then the system will automatically be synchronized when you make a change. If you use CAN sharing with periotic manual local offset data only one unit should be transmitting periodically (master) where other units can send new offset on a change, if you only let the "master XDi" synchronize manual offset data every 30 sec. you should be fine.

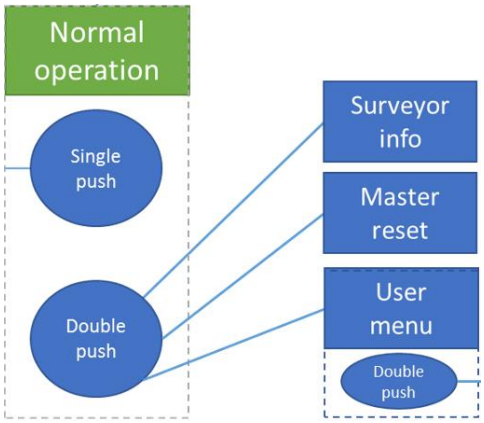
8.3.6 Quick access to the user menu

In XDi-N the quick menu gives you also easy access to the "User menu" where you can find all the user related setup possibilities. It is the same user menu that can also be accessed by a long double push on button 1 and 4.



Press OK to enter the User menu and get access to user setups like dimmer, warnings, sounds.

9 Menu level 2 – Long double push (easy access)



The three main menus are accessed by pressing a combination of two push-buttons simultaneously for approximately 5 seconds. When the display writes “Loading”, your selection has been accepted.
The table below shows the valid push-button combination to use to access a menu from normal operation mode.

Menu/Function	Button 1	Button 2	Button3	Button 4
Surveyor Info	■	■	-	-
Master reset	■	-	■	-
User Menu	■	-	-	■
Pop-up menu *)				

*) The pop-up menu shows which push-buttons to press simultaneously to access the related menu.

Access to the installation menu requires a “secret” double push-button combination from user menu, see the Installation menu chapter.

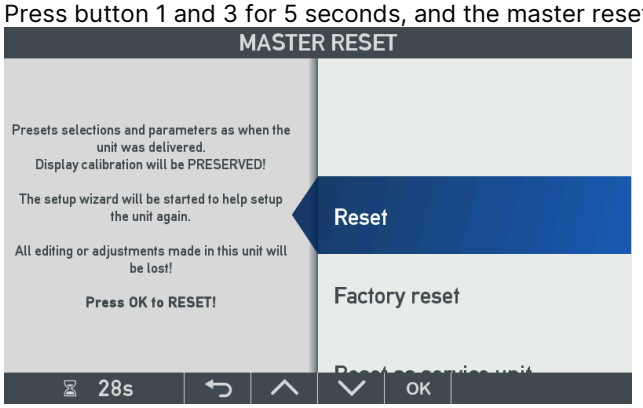
9.1 Surveyor information (INFO)

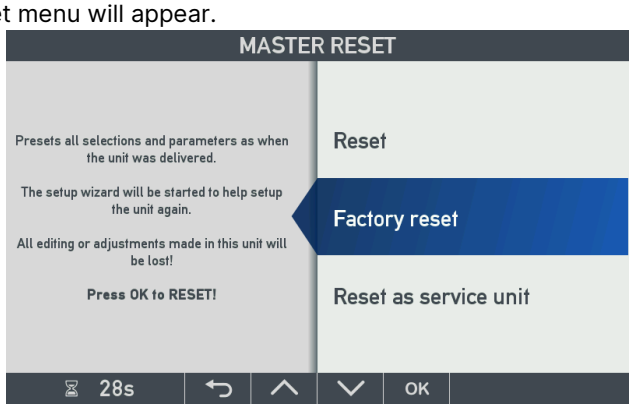
Press button 1 and 2 for more than 5 seconds, and the surveyor page will provide information about the XDi and its configuration.

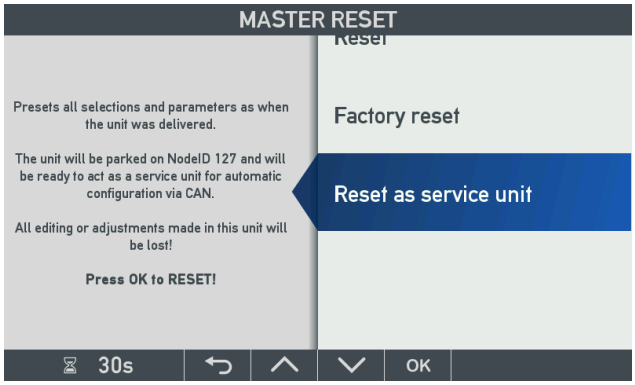
1	Serial number and software information
2	CAN bus settings
3	Information about extension modules (if mounted)
4	Library owner and library number
5	Active virtual indicator number
6	Thumbnail picture of the active virtual indicator
7	Approvals: Wheel-mark/UK MER if the active virtual indicator is compliant. The figures to the right of the symbols indicates the notified approval body no. (0098 – DNV GL for MED, 0097 – DNV GL for UK MER) and the production year of the actual XDi unit (in the screen above it is 14, corresponding to 2014).

9.2 Master reset

Press button 1 and 3 for 5 seconds, and the master reset menu will appear.







There are 3 levels of master reset:

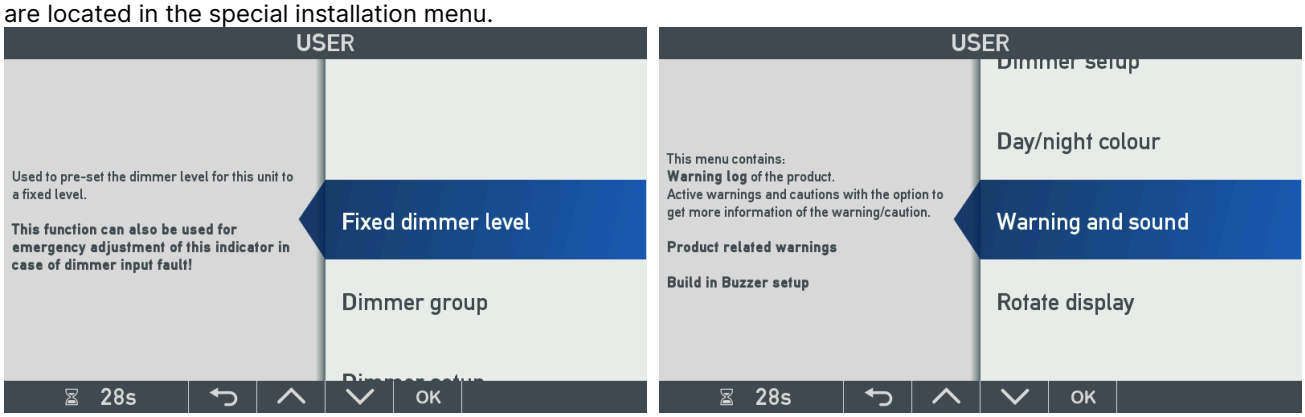
1. Reset: will bring all system and indicator related parameters back to factory settings, but it will not change display colour calibration made in connection with a previous setup. The setup wizard will be started after a reboot sequence.
2. Factory reset: resets all XDi selections and parameters back to the predefined settings it had when it left the factory. The setup wizard will be started after a reboot sequence.
3. Reset as a service unit: in this mode, the unit will be reset to factory settings and parked on the service NodeID 127, ready for fully automated configuration via CAN.

Master reset requires an extra user confirmation (YES) before reset is performed. It is possible to skip without making the master reset, simply push the return soft-key.

Activating the master reset will erase all selections and input adjustments made during installation, and all such settings will be lost!

10 User menu

The user menu gives access to change the predefined basic setup parameters, where advanced installation settings are located in the special installation menu.



The user menu is used for adjusting:

- Dimmer (Fixed dimmer level, Dimmer group, Dimmer setup, Day/Night colour)
- Warnings and sound
- Rotate display (Rotate the display screen 180°)

10.1 Dimmer

The XDi provides different ways of controlling the dimming of the backlight:

- Dimer level can be set at a fixed level (see note below).
- Dimmer control value between 0 % and 100 % backlight level sent via the CAN bus.
- Dimmer voltage input via the analogue dimmer input on the AX1 extension module .
- Dimmer step up/down via the digital inputs on the DX1 extension module.
- Dimmer control via NMEA input on NX2 extension module (sentence DDC).

NOTE: Fixed dimmer was often used when a XDi unit (platform 1) was located in the engine control room, to set a reduced backlight level and thereby increase the lifetime of the display. With the new direct dimmer function on front button 2 and 3, only available in XDi platform 2, this function is no longer used in practise. But it is still important to reduce the backlight level when XDi is used in a location where the backlight is permanently turned on. Reduction from 100 to 85-90 will more than double the expected lifetime.

There are also different ways of controlling the Day/(Dusk*)/Night colour:

- Fixed colour
- Automatic colour shift determined by the dimmer level
- Colour shift controlled by an input (normally via CAN)
- Colour shift controlled by DX1 digital inputs
- Colour shift control via NMEA input on NX2 extension module (sentence DDC)

*) In most cases, the XDi only uses day/night colour designs, but in customised libraries “Dusk” may be used.

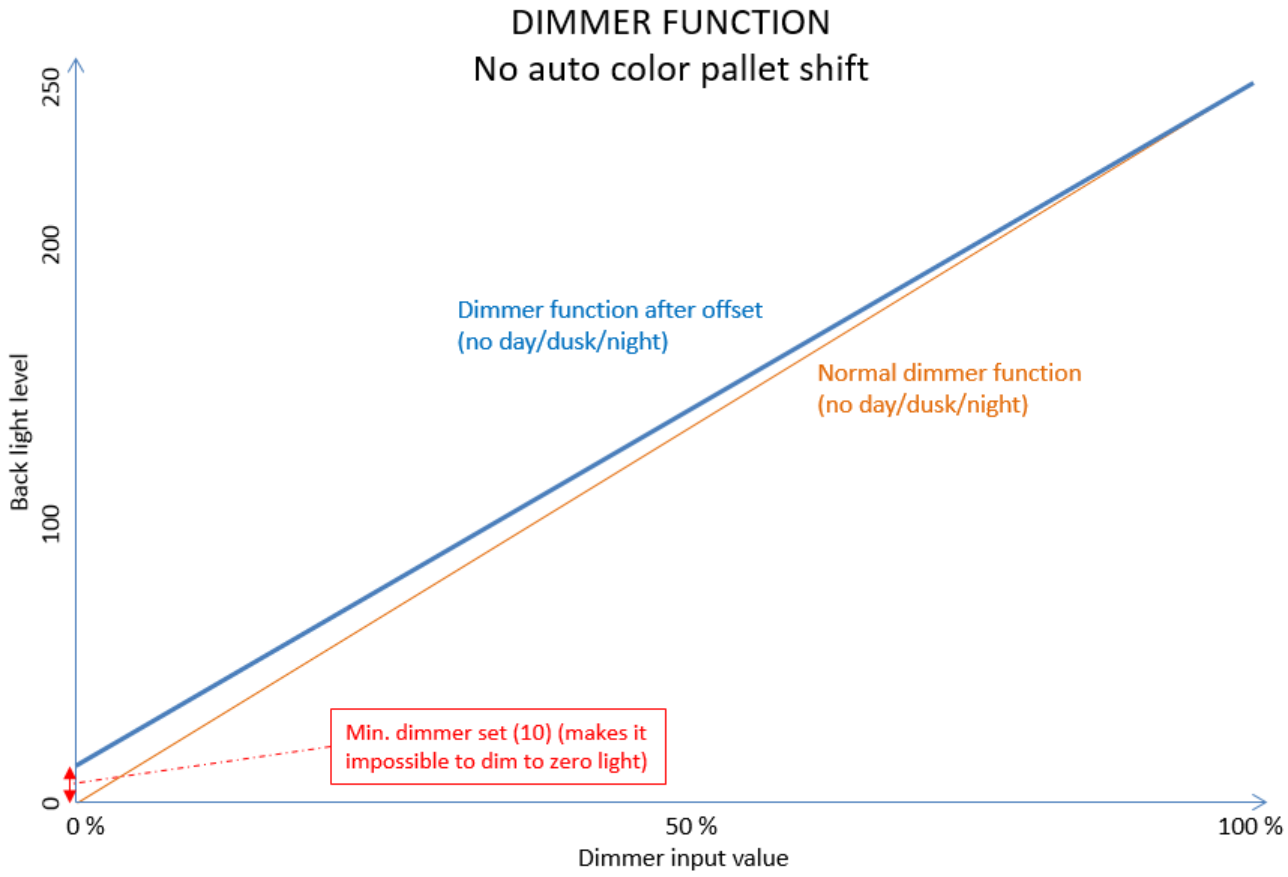
The dimmer and colour settings are predefined in the selected product profile and may be adjusted from the user menu.

10.1.1 Normal dimmer function

The maximum XDi backlight level range is from 0 to 250.

In normal dimmer mode (without auto colour shift), the dimmer level from 0 to 100 % controls the backlight level range from “Min backlight level”. This must be set at the lowest backlight level where the display is still readable in dark night conditions (typically level 10) to “Max backlight level”, which is the level used in full daylight. Typically for XDi 96 and 144 this parameter is set to the max. level 250.

In XDi 192 the max. level is automatically reduced to 225 when the library for this version is generated, this is to extend the backlight life expectation.



Min and max. backlight level can be used to align backlight on several XDi indicators controlled by the same dimmer source, for example adjust a new XDi to match another XDi with a slightly aged display.

(see dimmer setup description below).

In case of very aged displays, it may also be necessary to adjust/calibrate the display colours of a new XDi, please see the chapter on Display colour adjust.

10.1.2 Fixed dimmer level

When the XDi is installed in a location where dimmer adjustment is not needed, for example Engine Control Room (ECR), the fixed dimmer function should be used to set the backlight level to a fixed level.

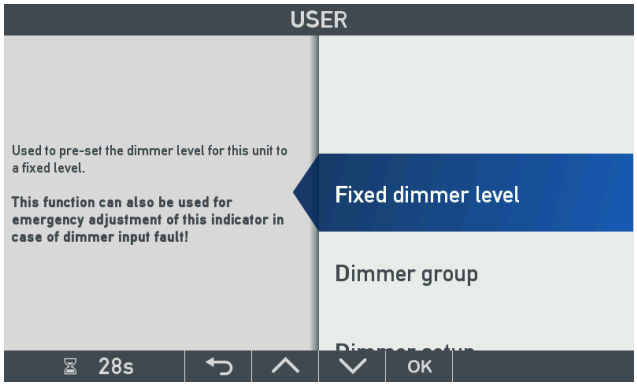
It is often a good idea to use the local group setting for indicators using fixed dimmer level, but if a number of XDi units in the ECR are connected via the same CAN bus, it makes sense to place them in a dimmer group and then you only need to adjust the level on one unit to get all of them synchronised.

Reducing the backlight level will increase the lifetime of the backlight LEDs. When the XDi is used in the engine control room or other locations where a fixed dimmer level is used, it is recommended to reduce the dimmer setting to 75-85 %. This will more than double the expected lifetime of the backlight.

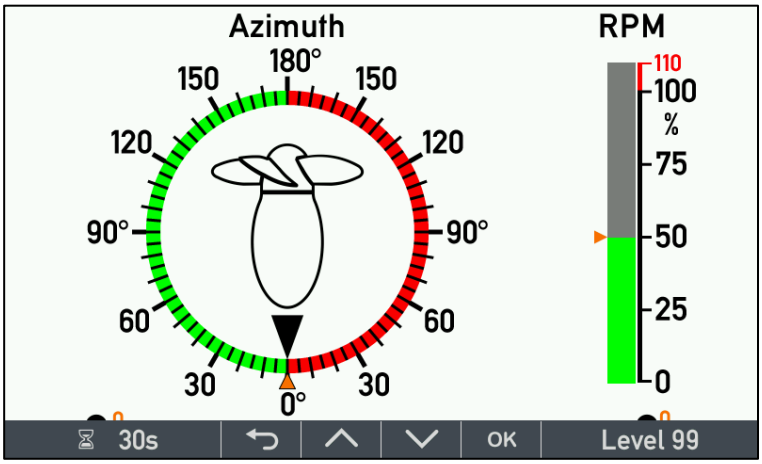
In XDi with library with version 2000 or higher, meaning that it is running on XDi software platform 2, the fixed dimmer function is not that important since the dimmer level can easily be adjusted directly from the front using pushbutton 2 and 3.

In all DEIF standard libraries and many customized libraries you will find a special ECR product profile.

It is highly recommended to use that profile in applications where the backlight always is turned ON, you can easily adjust the level using the pushbuttons or in platform 1 libraries (version 0001 or higher) use this fixed dimmer menu to fine tune the level.



Press OK to enter “Fixed dimmer level”, and a new menu will appear showing the actual virtual indicator together with a new soft-key menu for adjusting the fixed dimmer level:



Using the actual indicator design when adjusting the backlight level makes it easier to find the desired level.

10.1.3 Dimmer groups

9 dimmer groups (Gr. 1 to 9) can be controlled via CAN and in addition a “Local” mode, which will not be controlled via CAN.

Parameters for all dimmer groups including the default selected dimmer group are predefined in the Product Profile (PP). Parameters may however be changed and adjusted via the user menu.

The dimmer level will be set to the same for all units in the group. The control method is defined in the PP.

A dimmer group can be preconfigured to be controlled by:

1. An XDi-net command
2. A CANopen TPDO or RPDO
3. An analogue dimmer input on one XDi shared using XDi-net protocol (requires AX1 module)
4. A digital input dimming on one (or more) XDi units shared using XDi-net protocol (requires DX1)

A popular system dimmer method is to connect an analogue dimmer control output (for example a potentiometer) to one XDi in the group (3) and then set up the rest in the group to use dimming via XDi-net (1). This is a simple plug and play method.

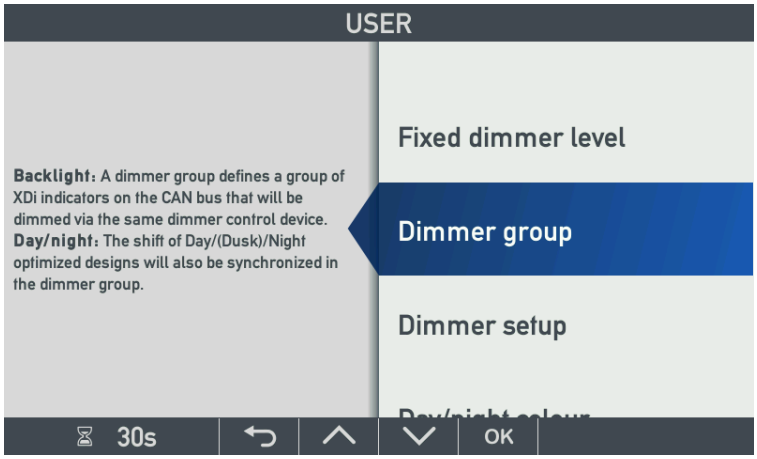
It is important that only one XDi with analogue dimmer control is used in a dimmer group. The analogue dimmer level is shared using periodic transmissions, and if 2 units are controlling the same group, the dimmer level will jump up and down between the 2 incoming levels.

If more than one unit must be able to control a dimmer group, then the digital input (DX1) can be used. This up/down dimmer system will only send a new level on a change (when the input is activated), and it is therefore possible to have two or more XDi units controlling the dimmer level in the group.

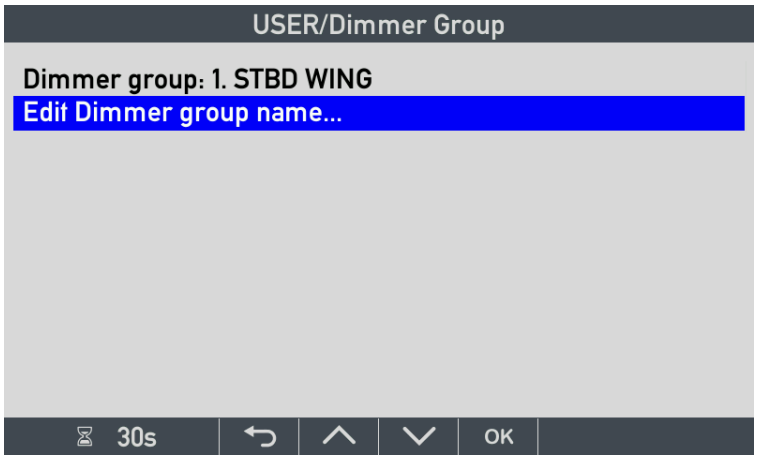
The shift between Day/(Dusk)/Night colour scheme is also part of the dimmer group function.

Changing dimmer group

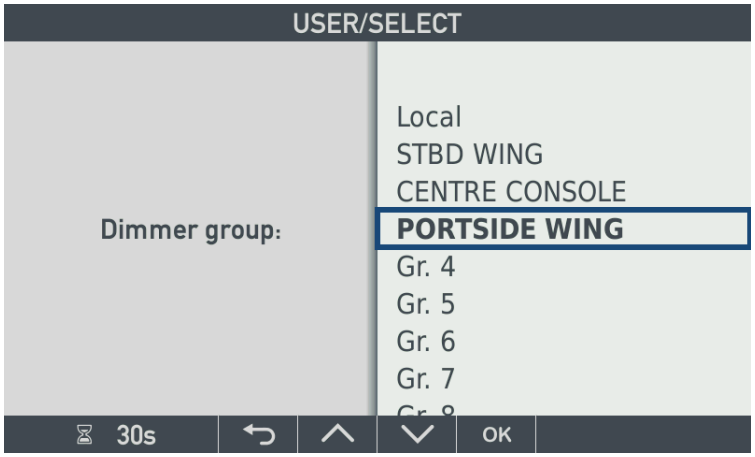
Highlight the “Dimmer group” menu and press OK:



Highlight the “Dimmer group: 1. STBD WING” and press OK.



Select another dimmer group, for example “PORTSIDE WING” by pressing OK.



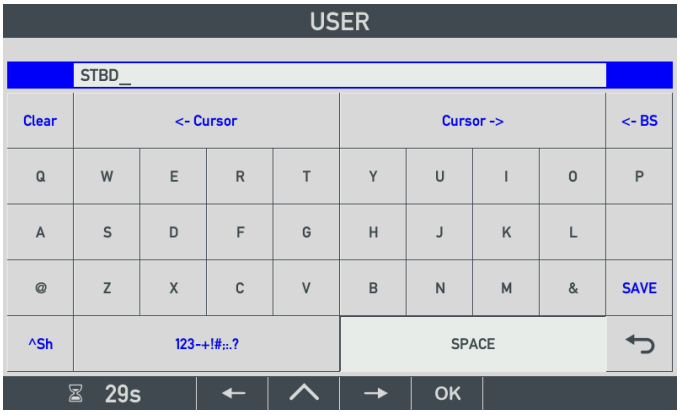
Local mode

In “Local” mode, the XDi will respond to a dimmer command sent to the local dimmer group index or get the analogue or digital dimmer input from an extension module mounted on this XDi unit. In local mode, the XDi will not share analogue or digital dimmer data via XDi-net.

Edit the dimmer group name

In addition to the dimmer group number, each dimmer group may have a describing name.

The name will normally be predefined in the PP, but it can also be added or changed via the “Edit dimmer group name...” menu, using the onscreen virtual keyboard.



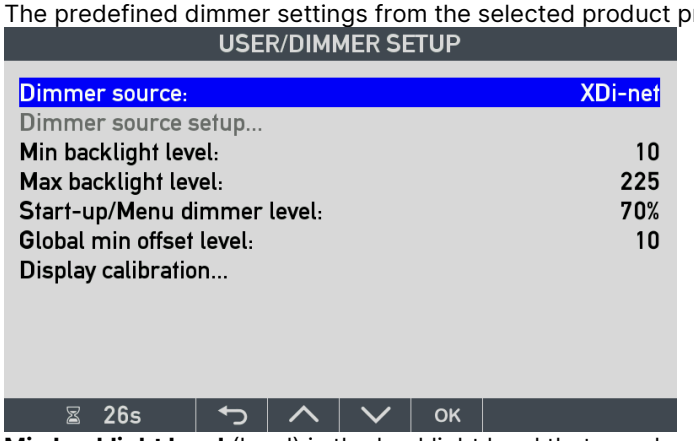
Highlight a key using the arrows and press OK to select.

SAVE: remember to finalise the editing process by selecting the SAVE button, or your changes will be lost.

If this display reaches time-out, it will step one level back and changes will be lost.

10.1.4 Dimmer setup

The predefined dimmer settings from the selected product profile (PP) may be changed via the user menu.



Min backlight level (local) is the backlight level that equals a dimmer value of 0 %. This setting should never be set to 0 since it turns the backlight totally off, and it will no longer be in accordance with regulations for a display-based bridge product. The valid value range is 0-100 out of the total of 250 backlight steps.

This is a local setting for the XDi itself and can be used to level minimum backlight level between several XDi units placed next to each other.

Max backlight level (local) is a function that makes it possible to fine-tune the max backlight level equal to 100 %. This is useful to equalise the light level on different XDi units sitting next to each other or to match other screen-based equipment using the same dimmer control input. Default is 250, and valid value range is 50-250 again out of the total of 250 backlight steps.

NOTE: To extend backlight life on the XDi 192 display this value is automatically reduced to 225 in all XDi 192 libraries, when the library package is generated / released.

Start-up/Menu dimmer level is the default dimmer level % if no dimmer input is available and also the minimum level when the menu structure is entered. This should not be set to a value below 20 %.

Global min offset level: this function offers the possibility to adjust the minimum backlight level for all XDi units in a dimmer group on the CAN bus. This global minimum level is added to the local minimum dimmer level.

Display calibration: This function makes it possible to adjust the display colours, so that it is possible to adjust a brand new service unit to an aged XDi where the display colours has changed.

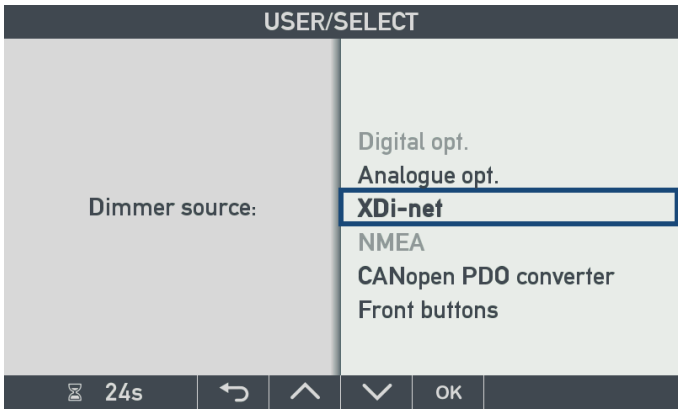
Please see “Appendix 1: Colour calibration - service instruction” for a detailed explanation and service instruction. This function is only available in XDi libraries with version number 2000 or higher with a release date after 25.03.2020.

Dimmer source

The dimmer input source is preconfigured in the selected product profile (PP), but it may be manually adjusted during installation.

The dimmer source can be preconfigured in PP to be:

- **Digital option** (DX1) push-buttons connected to the digital inputs.
- **Analogue input** (AX1) voltage source is connected to the Dim/HV3+ input.
- **XDi-net** dimmer signal is received in XDi-net data format via CAN
- **NMEA (**NX2) a NMEA DDC sentence is received on one of the NMEA inputs.
- **CANopen PDO converter** is used to convert and un-map TPDO or RPDO dimmer data
- **Front buttons** up/down adjustment on front.



It is always possible to shift from a preconfigured dimmer source to XDi-net as dimmer source (and back to the default source). Shifting to another source type than XDi-net requires selection of a PP supporting this type of source.

Analogue or digital dimmer input

When the XDi-net function is enabled the analogue or digital dimmer level used by an XDi unit will normally also be shared via XDi-net with all XDi units being part of the same dimmer group and of course connected to the same CAN bus.
An XDi unit with analogue or digital dimmer input can only control the dimmer group that it is part of via XDi-net. (Dimmer sharing can be on CAN1, CAN2 or CAN1&2)

Source	Receive from XDi-net	Transmit on XDi-net	Note
Analogue	[Yes[3]*]	Yes	Only one XDi with analogue dimmer and sharing data on XDi-net must be part of a dimmer group*)
Digital	Yes	Yes	Data is only sent on a change, and several dimmer controllers can be in the same dimmer group. **)
XDi-net	Yes	No	If “XDi-net variable data on” is active, then an XDi unit can receive dimmer data in the normal XDi-net data format using COBID 0x201 to 0x27F. If only “XDi-net function” is enabled, dimmer data can only be received using XDi-net format using COBID 0x27F (node 127).
PDO converter	[Yes[3]*] (Synch)	No (Synch)	All devices on CAN have access to the dimmer data, and they are not retransmitted in XD-net format. All devices in the group must therefore use PDO converter instead of XDi-net. Setup changes in the PDO converter may be synchronised via CAN.
Front buttons	Yes	Yes	XDi can share the front button dimmer adjustment with other XDi units in the same dimmer group and on the same CAN bus.
NMEA	[Yes[3]*]	Yes	One XDi can share dimmer data for received via the NMEA DDC dimmer data sentence. One XDi can in fact control a group it is not part of and it is even able to control more than one dimmer group if the selected product profile (PP) supports it and several DDC sentences is available on different inputs or with different talker ID.

*) Please note that if more than one XDi in a dimmer group shares its analogue dimmer data via CANopen or

XDi-net, then all XDi units in that group will receive different dimmer levels from 2 sources, resulting in a flickering backlight.

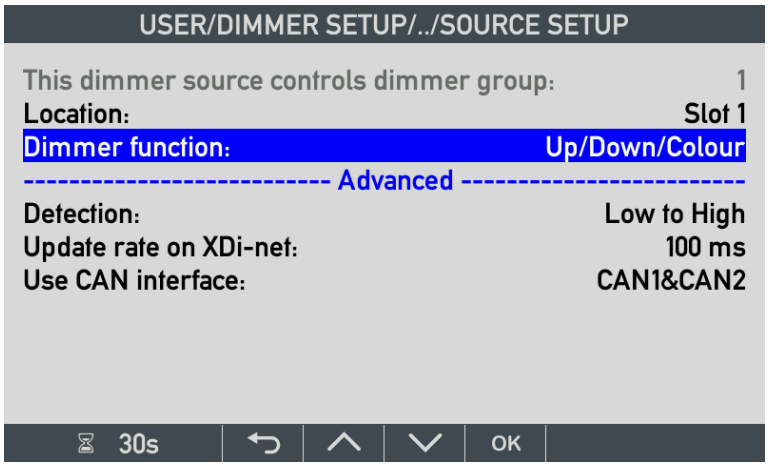
**) The above (*) is not the case with XDi units using the digital dimmer input option, since the dimmer command can be configured so that it is only sent when there is a change, that happens when the digital input for example connected to a push-button, is activated.

[3]*) The XDi is always able to receive XDi-net data when the XDi-net is active, but data will be overwritten immediately by the analogue dimmer input value.

The dimmer source setup menu is only available if the selected source has parameters that may be changed via menu.

Digital dimmer source setup

Requires a DX1 module to be mounted on the XDi at the specified slot.

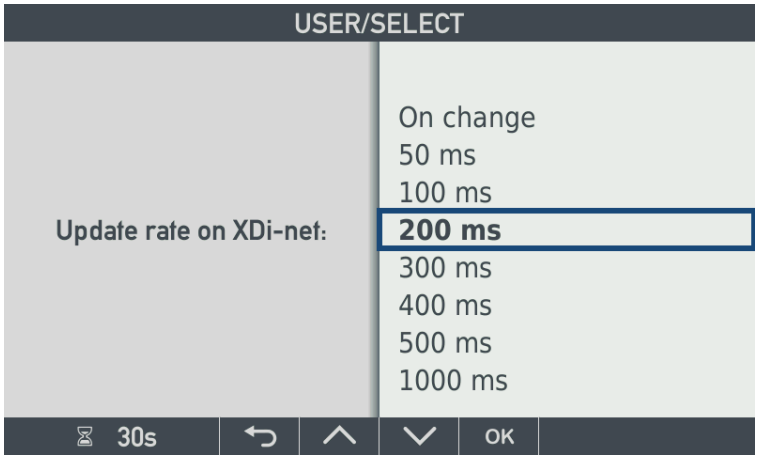


Dimmer function: defines the function of the two digital inputs used for dimmer. Selections are UP/Down or UP/Down/Colour. The functions are described in the DX1 section.

Detection: defines how the signal on the digital input must be detected, either trigger the function on a “Low to High” transition or on a “High to Low” transition. Default is low to high equal to detection when a serial connected contact is pushed to close the circuit.

Update rate on XDi-net: is the repetition rate of dimmer messages being sent on XDi-net (CAN).

The DX1 has a setting called “On change”. This setting should be selected if more than one XDi controls the dimmer group in parallel.



The analogue module does not have the setting “On change,” and therefore only one XDi with analogue input can control a dimmer group.

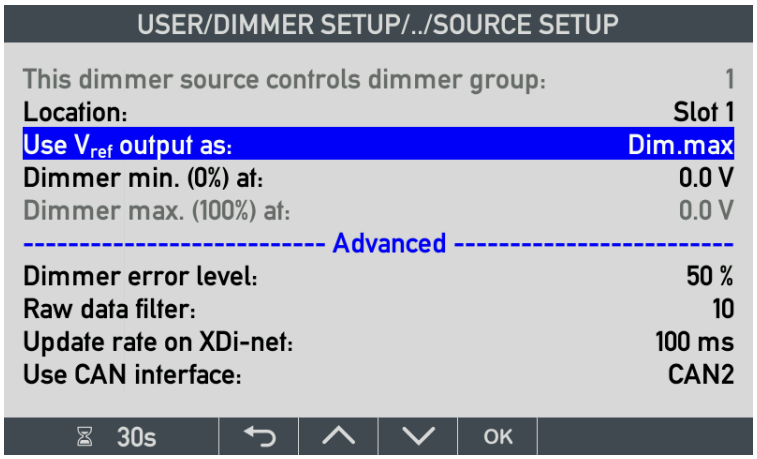
Use CAN interface: if a CAN port is selected, dimmer data is shared on the selected port(s) using XDi-net protocol and at the repetition rated above.

The settings are: NO, CAN1, CAN2 or CAN1&2

Analogue dimmer source setup

For analogue dimmer input, an AX 1 extension module must be mounted in the extension slot specified in the product profile, for example Slot1.

In the example below, the XDi is set up to be part of dimmer group 1 and therefore all the dimmer settings, including the dimmer source setup, relates to this dimmer group.



Use V_{ref} output as:

This setting can be used when a dimmer potentiometer is connected using the V_{ref} output as supply

(typically 7.3 V). The reference voltage V_{ref} is internally monitored.

When “**Dim.max**” is selected, the measured reference voltage will automatically be used as the maximal dimmer voltage, and the dimmer input voltage will be measured relative to this reference. This means that fluctuations in V_{ref} will be corrected.

It is even possible to connect an external voltage source V_{ext} (V_{ref} <V_{ext}<30 V) from V_{ref} to AGND (in parallel) overwriting the internal ref. voltage. V_{ref} is still monitored, and measurements are corrected accordingly.

If the dimmer potentiometer is supplied from a battery source, where the voltage is varying over time, it is recommended to use the “V_{ref} mode” to eliminate fluctuations in dimmer level caused by this.

The setting can also be: **“Dim.min”.** In this case, the reference voltage is equal to 0 % dimmer and 100 % can be set to 0 V in which case the dimming will be reversed. The backlight will be a max when the dimmer voltage is 0 V.

This setting is useful to avoid the XDi to go black when dimmer input is disconnected.

Setting **“Not used”** indicates that the automatic scaling to reference voltage is not in use, and the dimmer input is a normal input.

Dimmer min/max settings:

The min and max dimmer input voltages may be set between 0 and 30 V DC.

Dimmer min. (0 %) voltage and dimmer max. (100 %) voltage can be set up individually, so that the dimmer input can be defined within a range of for example 7 V to 24 V DC.

If V(Dimmer min) > V(Dimmer max), then the dimmer input function is reversed (the higher the dimmer voltage - the lower is the backlight level).

Dimmer error handling:

There are 2 ways that the XDi can be set up to handle a disconnection of the analogue dimmer input (for example the wiper inside the potentiometer losing its connection to the resistive layer).

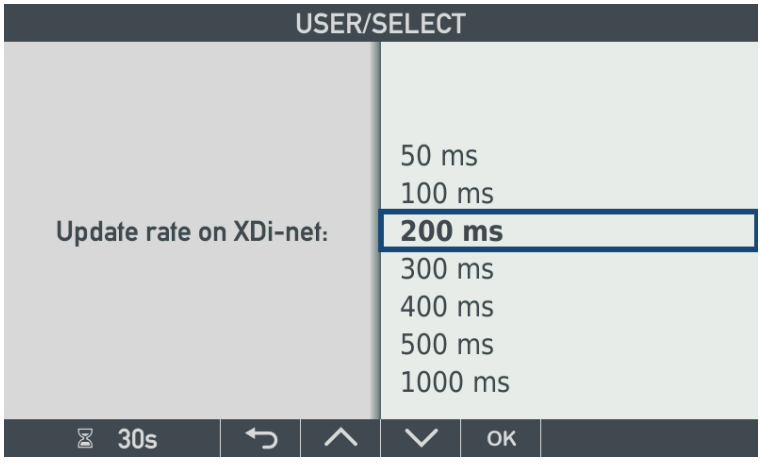
1. Set up analogue dimmer in reverse mode as described above, and the dimmer level will go to 100 % when the input voltage drops to 0 V.
2. Define the input as a voltage range for example from 1 V to 10 V and add a fixed resistor (1.2 kΩ) from the potentiometer (10 kΩ) to analogue ground (terminal 1) to raise the minimum voltage to 1 V. If the dimmer input loses connection, the voltage will drop to 0 V, and the XDi will activate the dimmer error backlight level at for example 50 % (see below).

The dimmer error level: this is the dimmer level used if the dimmer voltage drops more than 2% outside the defined dimmer low level. When this level is set to 50 %, the backlight will shift to 50 % in a fault situation,

Raw data filter: is an averaging filter that can be adjusted to reduce noise and fast fluctuations on the input voltage. This filter is useful to reduce flicker when a PWM signal with external LP filter is used as analogue dimmer input. The filter range is 0 to 100, and the normal default is 10. Increase this value to reduce flickering.

Update rate on XDi-net: is the repetition rate of dimmer messages being sent on XDi-net (CAN).

The AX1 analogue module does not have the setting “On change”, and therefore only one XDi with analogue input can control a dimmer group.



Use CAN interface: See digital dimmer setup above

XDi-net dimming (or DAM-MPDO)

This source type does not need a setup menu.

Dimmer values are received and routed directly into the object index table as defined in the table below, where the actual dimmer value is located in sub-index 0x02 as an unsigned 8 bit parameter (U8).

The data range is 0 to 100 representing the dimmer level of 0-100 % (100 % being max. backlight).

Dimer Group no.	Object index	Sub-index
1	0x3501	0x02
2	0x3502	0x02
3	0x3503	0x02
4	0x3504	0x02
5	0x3505	0x02
6	0x3506	0x02
7	0x3507	0x02
8	0x3508	0x02
9	0x3509	0x02
Local (0xA) *	0x350A	0x02

*) When XDi is in Local group the dimmer data is not sent on XDi-net, but XDi will be able to receive data via CAN from an external CAN source.

How to send XDi-net data (or DAM-MPDO data) is described in detail in the “XDi-net/CANopen reference manual”.

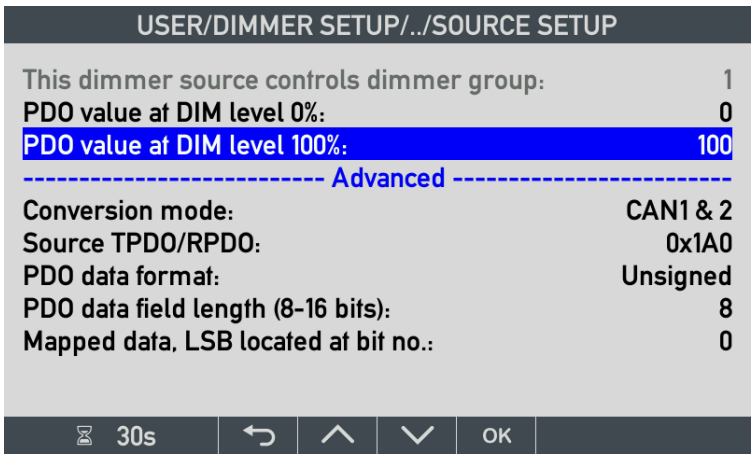
Dimmer PDO converter setup

This requires that a PDO converter is defined in the Product Profile (PP) as input source for each dimmer group that must be supported by the selected PP. In most cases, a TPDO data value is defined for each of the 9 dimmer groups.

Data can either be sent in a separate TPDO for each dimmer group or they can be mapped into one or two TPDOs.

The Dimmer TPDO converter can handle input values from 8 to 16 bytes mapped into a TPDO or RPDO.

One TPDO can max handle 8 dimmer groups each using 1 data byte. To support all 9 groups, at least two TPDOs must be used.



PDO value at DIM level 0 % defines the input value that must be converted to 0 %.

PDO value at DIM level 100 % defines the input value that must be scaled to 100 %.

The PDO converter makes a linear scaling of the input value range received to the XDi dimmer range from 0 to 100 %.

Do not change any of the following advanced settings if you are not familiar with CANopen.

Conversion mode: the defined PDO can be received from CAN1, CAN2 or CAN1&2. If the conversion mode is turned off, then the TPDO converter is disabled.

Be aware that the XDi can receive dimmer data sent in XDi-net format even when it is set up to receive dimmer data in a TPDO or RPDO, but since dimmer data from a PDO is not retransmitted on the XDi-net, problems will not occur.

Source TPDO/RPDO: the default COBID of the TPDO or RPDO (0x1A0 in the example above), can be changed.

PDO data format: unsigned/signed, in this case it should not be changed.

PDO data field length (8-16 bit): the PDO converter can receive and convert any Unsigned or signed data package between 8 and 16 bit and convert the content to a dimmer value between 0 to 100 %.

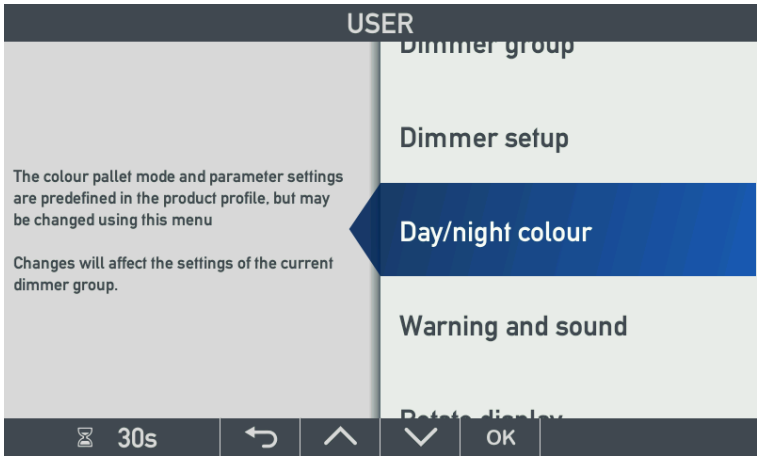
Mapped data, LSB located at bit no.: this value indicates the location of the least significant bit in the data package defined above and mapped into either a TPDO or RPDO. This makes the PDO converter able to identify the mapped data package to use.

Synchronise dimmer group

Changes of dimmer parameters in the PDO converter may be shared with all other XDi indicators in the same dimmer group. Accept synchronisation in the pop-up menu when leaving the setup menu.

10.2 Day/Night Colour shift

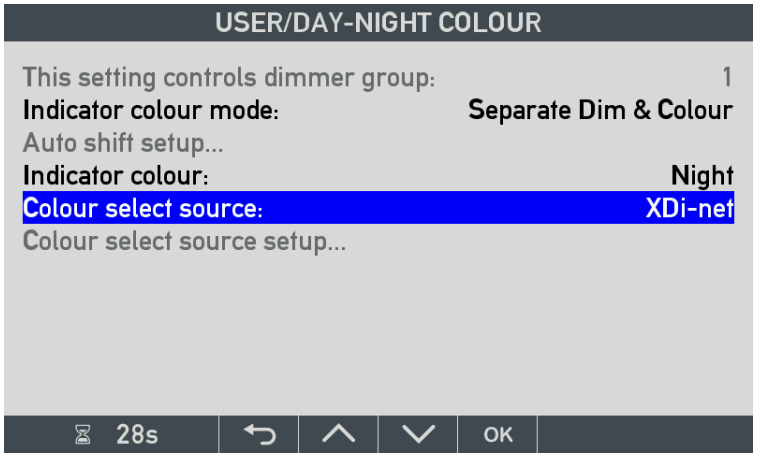
In the XDi library, each indicator will normally be defined with at least day and night colour designs, but it is even possible to add a design for dusk conditions if needed.



The intension of the colour shift in combination with the backlight dimming is to optimise visibility and contrast in any ambient light condition on a ship's bridge.

For example, in daytime: black text, scale and pointer boundary on a white background and full backlight will provide a very clear readability. Where during nighttime, white text and scale, orange pointer on a black background combined with the right dimmer level, provides a clear view even in the darkest night conditions and without jeopardising the night vision of the officers on the bridge.

Dusk may be used to optimise the readability in the grey twilight, but if the virtual indicator is well designed, it is really not necessary.



10.2.1 Virtual indicator colour modes

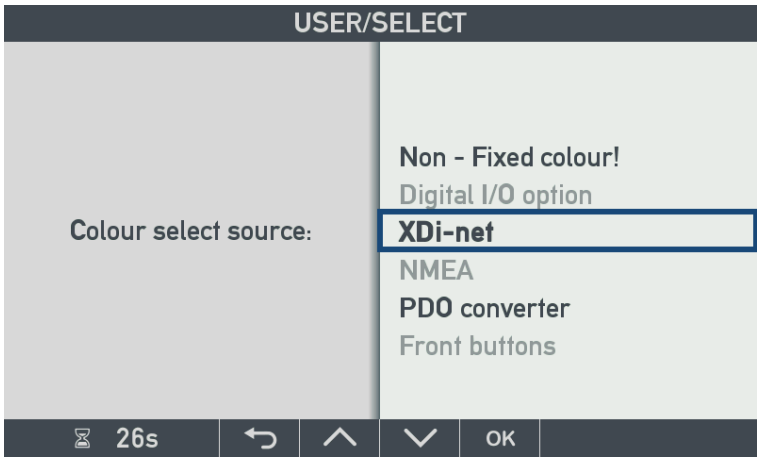
The indicator colour mode can be set to:

1. Separate Dimmer & Colour
2. Auto Day/Dusk/Night
3. Auto Day/Night

Colour shift source in mode 1

In mode 1, the source used to make the colour selection can be:

NONE-fixed colour	Select this setting if a fixed design is needed (Day, Dusk or Night).
Digital I/O option	Parameter is received from digital input, when the digital input dimmer mode supporting colour shift is selected.
XDi-net (DAM-MPDO)	Parameter is received via CAN using XDi-net format or received in a DAM-MPDO.
PDO converter	Parameter is received via CAN in a TPDO or RPDO, and has to be predefined in the selected PP.
Front buttons Front b.& Digital opt.	Reserved for future XDi-N version (Not available in this version)



10.2.1..1 Colour shift using XDi-net or DAM-MPDO

This selection has no setup menu. The colour pallet selection is received in sub-index 0x03 of the dimmer group object index range in the table above. The selection is located in an unsigned 8 bit field using only 2 bits (LSBs). The 2 bit selection values are:

00 = Day

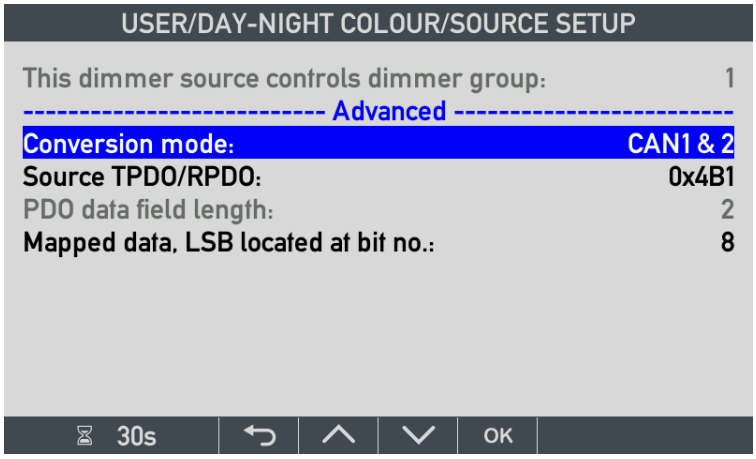
01 = Night

10 = Dusk

11 = Reserved

See the “XDi-net/CANopen reference manual” for details.

10.2.1..2 Colour shift using PDO converter



If the colour shift is defined in the Product Profile (PP) to be received using a TPDO or RPDO, then a PDO converter is used as the input source for colour shift. The PDO converter can select any 2 bits in the 8 byte data package and use them as colour shift input. This means that it is possible to map colour shift parameters for all 9 dimmer groups in one TPDO using only 3 data bytes with data for up to 4 groups in each byte.

The following menu is available:

The PDO may be received via CAN1, CAN2 or both

The COB-ID of the PDO used for data transfer may be changed.

Also, the mapping of the 2 input bits in the 64 bit data frame of the TPDO may be changed via menu.

Example 1:
TPDO containing all 9 colour shift parameter set in the 3 first bytes

Byte 0				Byte 1				Byte 3				Byte4	Byte5	Byte6	Byte7
Gr1	Gr2	Gr3	Gr4	Gr5	Gr6	Gr7	Gr8	Gr9	-	-	-	-	-	-	-
00	00	00	00	00	00	00	00	00	-	-	-	-	-	-	-

Byte 0	Gr. 1 with LSB located at bit 0, Data in bit 0 & 1 Gr. 2 with LSB located at bit 2, Data in bit 2 & 3 Gr. 3 with LSB located at bit 4, Data in bit 4 & 5 Gr. 4 with LSB located at bit 6, Data in bit 6 & 7
Byte 1	Gr. 5 with LSB located at bit 8, Data in bit 8 & 9 Gr. 6 with LSB located at bit 10, Data in bit 10 & 11 Gr. 7 with LSB located at bit 12, Data in bit 12 & 13 Gr. 8 with LSB located at bit 14, Data in bit 14 & 15
Byte 2	Gr. 9 with LSB located at bit 16, Data in bit 16 & 17

Example 2:
It is also possible to combine dimmer level and colour shift data in the same TPDO. In this example, data for dimmer group 1 to 4 is located in byte 0 to 4:

Byte 0	Byte 1	Byte 2	Byte 3	Byte4				Byte5	Byte6	Byte7
Dimmer Gr.1	Dimmer Gr.2	Dimmer Gr.2	Dimmer Gr.2	Gr1	Gr2	Gr3	Gr4	-	-	-
0000 0000	0000 0000	0000 0000	0000 0000	00	00	00	00	-	-	-

Byte 0	Dimmer Gr. 1 with LSB located at bit 0,	Data in bit 0 to 7
Byte 1	Dimmer Gr. 2 with LSB located at bit 8,	Data in bit 8 to 15
Byte 2	Dimmer Gr. 3 with LSB located at bit 16,	Data in bit 16 to 23
Byte 3	Dimmer Gr. 4 with LSB located at bit 24,	Data in bit 24 to 31
Byte 4	Colour sh. Gr. 1 with LSB located at bit 32, Data at bit 32 & 33 Colour sh. Gr. 2 with LSB located at bit 34, Data at bit 34 & 35 Colour sh. Gr. 3 with LSB located at bit 36, Data at bit 36 & 37 Colour sh. Gr. 4 with LSB located at bit 38, Data at bit 38 & 39	

10.2.2 Auto Day/Night shift mode

“Auto Day/Night shift” and “Auto Day/Dusk/Night shift” modes are basically the same mode. The only difference is that Day/Night mode does not have a dusk indicator design implemented in the library.

If Day/Dusk/Night is selected in a library without dusk design, the night design will be used instead of the dusk design.

In normal dimmer mode without auto shift, the dimmer level from 0 to 100 % controls the backlight level from min. (typically 10) to max. (typically 250). Where the backlight level range is 0-250.

The Auto Day/Night colour shift function makes the dimmer work slightly different, by using the dimmer value from 0 to 100 % to control not only dimmer level but also the display colour.

For each display colour (Day/(Dusk)/Night), the XDi is programmed to generate the optimal backlight range.

Auto Day/Night Colour shift

The feature is illustrated by an example in the following figure:

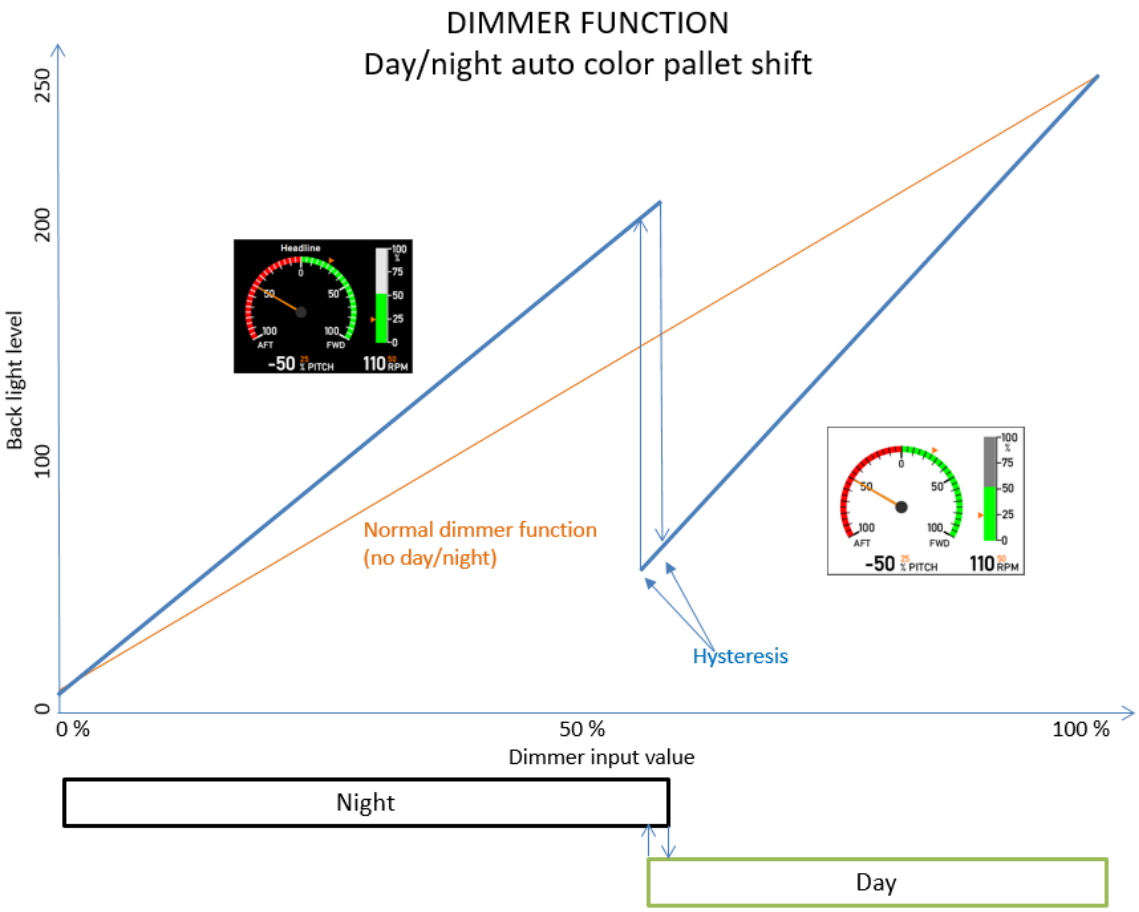


Figure description:

The Day/Night shift point is in this example located at 60 % with a hysteresis of 2 %.

The hysteresis secures that the display will never be flickering between day and night presentations.

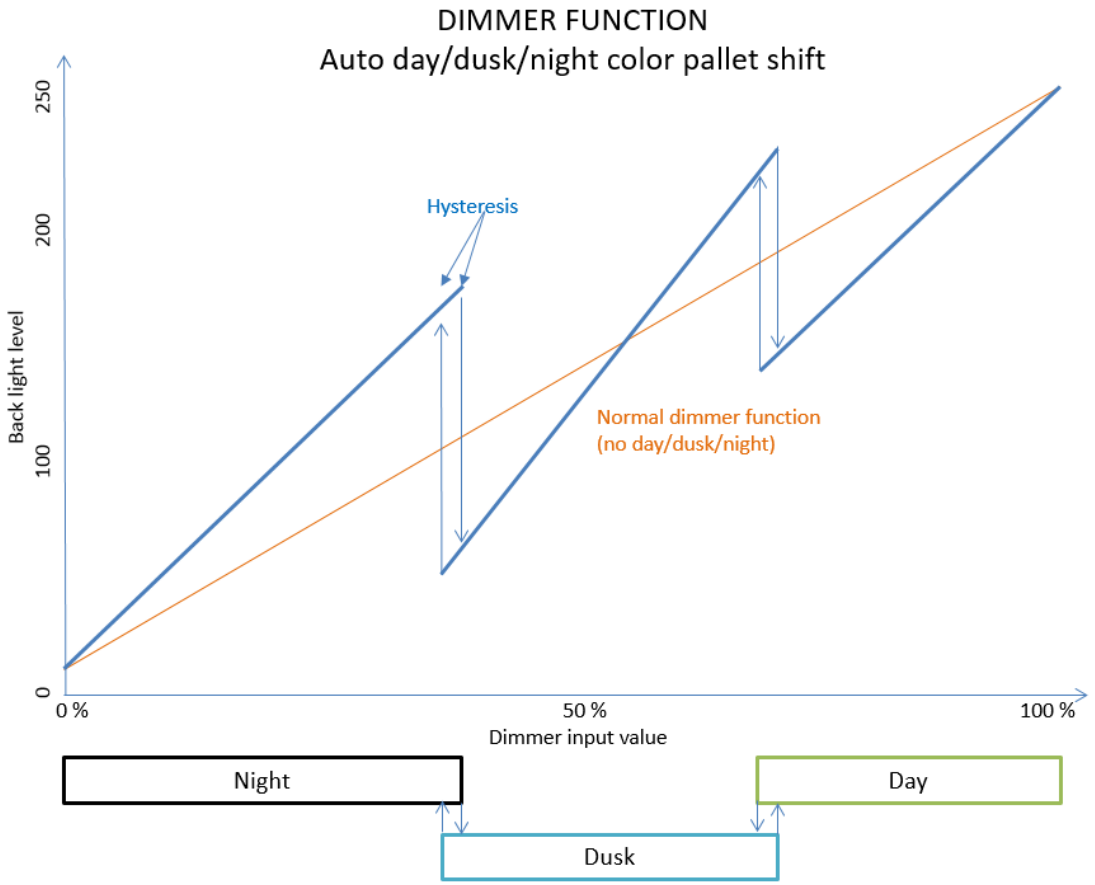
When the dimmer level is increased gradually from dimmer level 0 % to 61 %, the indicator will use the black night design, and the backlight will be increased from 10 to the “Night max” level of setup to 200.

When the dimmer level reaches 62 %, the indicator will shift to the white day design and reduce the backlight level to 50.

Continuing the dimmer level from 62 % to 100 % will increase the backlight level again from 50 to the maximum level setup to be 250.

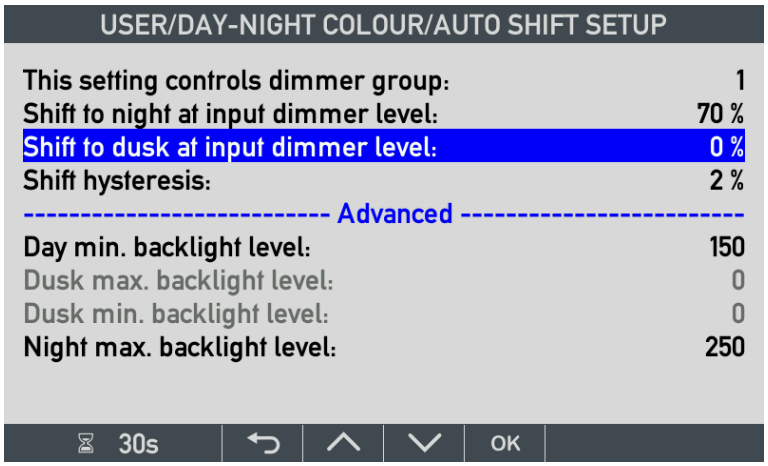
Auto Day/Dusk/Night Colour shift

This function works similar to auto Day/night shift, but has an extra step for dusk.



Auto shift setup menu

If auto colour shift is activated, the menu below will be available for fine-tuning the parameters. For example, adjust the backlight levels to best match the actual location of the indicator.



In the example above, the indicator is in Auto Day/Night mode, and the shift is at 70 % with a hysteresis at 2 %. This means that the shift will happen at 70 % +/- 2 % depending on the direction of the dimmer adjustment.

(The dusk setting is 0 % because it is not used in this mode.)

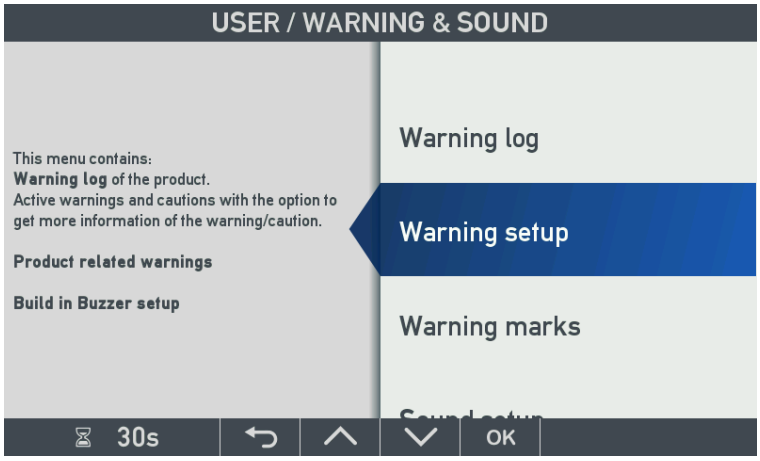
Day min. backlight level at 150 means that the backlight level at dimmer level 70 % will be 150, that is just before the shift to night colour.

When shifted to night colour, the backlight level will automatically be increased to 250 and dimmed down to min. when dimmer level reaches 0 %.

Only the day min. backlight level and the night max. backlight level is used in this example, but if a dusk design is available in the installed XDi library, then the dusk min. and max. levels will also be pre-set and available for editing.

10.3Warning and sound

In addition to the safety functions in the XDi, as data lost indicated by a flashing pointer, bar graph or digital readout or the display watchdog that blanks the display if the micro process freezes, the XDi has some supplementary warning functions that can be activated. This is either as a pop-up or a beep sound when a warning is issued. The default setting of warnings and sound is located in the selected product profile (PP) and may be reconfigured via the user menu.



The XDi is a basic indicator without push-buttons being available in normal operation mode (front frame is in place), and it has no alarms as such. It has 2 levels of warnings, respectively called a warning or a caution.

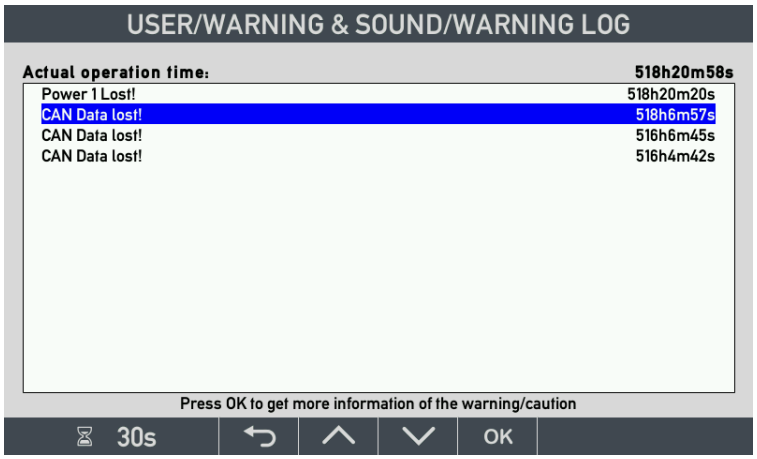
Warnings (most important) are indicated by a small amber-coloured pop-up box in one of the display corners and/or a long beep sound when the error occurs. The pop-up box will stay on the display as long as the error condition exists.

Cautions (least important) are indicated by a small yellow pop-up box in a display corner (not used by warning type pop-up). It will only be visible for a few seconds every 10 seconds and/or sound 3 short beeps the first time it is shown.

There are 4 submenus in the alarm and sound: warning log page, warning setup, warning marks and sound setup.

10.3.1Warning log

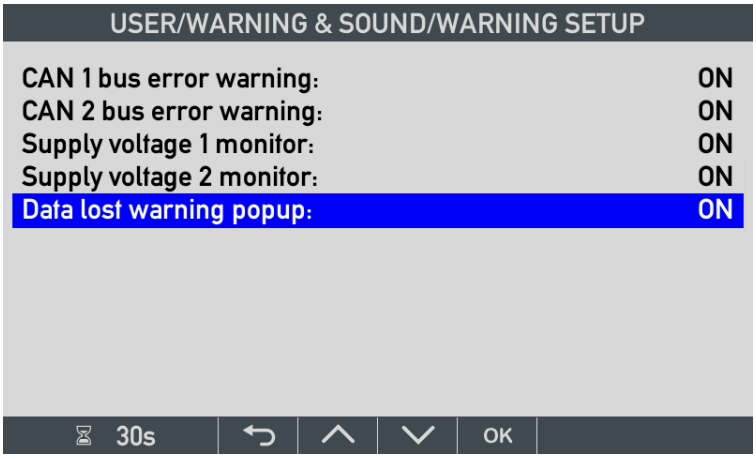
This page contains a list of all registered warning and cautions with a time stamp. Since the XDi does not have a built-in real time clock, the running hour timer is used as time stamp. The actual running time is indicated in the right side above the log list, so it is relatively simple to calculate how long time ago the fault occurred.



In the present XDi version, there is no additional fault information when OK is pressed.

10.3.2 Warning setup

The menu below makes it possible to adapt the need of warnings to the actual application. Se also 5.3 Error indication.



CAN bus error warning indicates a problem on the CAN bus and should be set OFF if CAN bus communication is not used.

Supply voltage monitor is mostly used in systems where redundant power supply is used. In systems with only one power supply, monitoring of the used input should be ON.

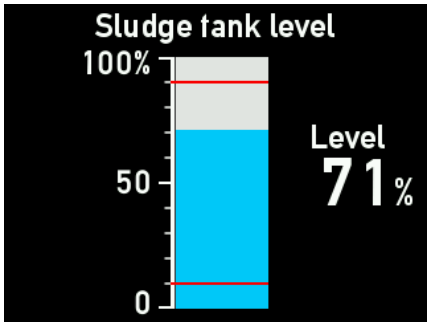
Data lost pop-up is a supplement to the flashing pointer, bar graph and/or digital readout. It provides information of the type of problem and should always be ON.

10.3.3 Warning marks

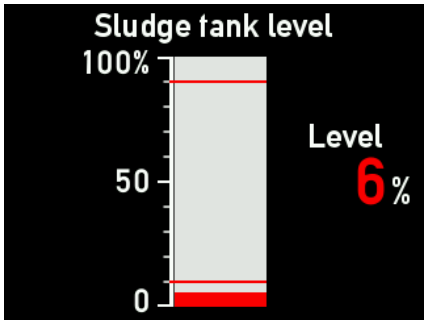
In indicators where warning marks are implemented in the virtual indicator for example warning marks on a tank level indicator.

The following example is from DEIF standard library for XDi 96 D that is containing tank level indicators.

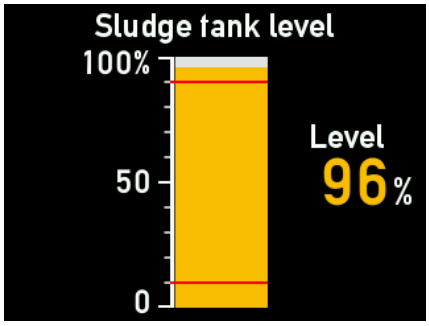
Normal level



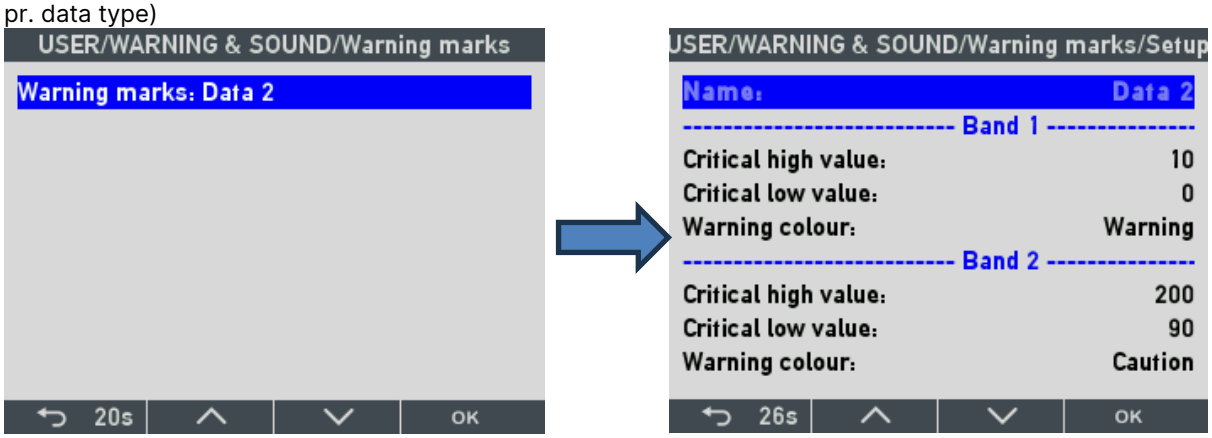
Low level



High level



This function is using critical bands to control the limit lines and the colour shift. (XDi can handle up to 4 critical bands pr. data type)



In the menu it is possible to change the low level limit and the high level limit value, defining where the lines are located, and it is also possible to change the Warning colours. In this indicator:

- Normal colour: Bar graph is blue and digital readout is white (black in day mode).
- Caution colour: Yellow for both bar graph and digital readout.
- Warning colour: Red for both bar graph and digital readout.

If you don't want bar graph and text colour to shift just select Normal colour instead of Caution or Warning colour.

To disable the critical band function and remove one or both warning lines, simply set the high and low value to the same figure, that will disable the function.

Note1: Band 2 critical high value is set to 200 because the digital readout on this indicator can show a value up to 200%.

Note 2: The user menu point “Warning marks” may be empty if the warning mark function is disabled.

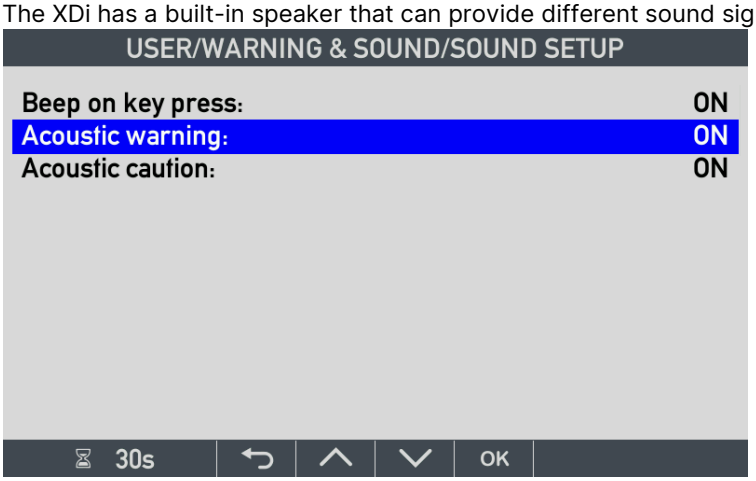
Release **NOTE:**

It is only possible to see this menu in libraries released after October 2021 and with a library version 2000 or higher.

Access to this menu was originally in the installation menu where access is also still available.

10.3.4 Sound setup

The XDi has a built-in speaker that can provide different sound signals.



In this menu, it is possible to activate or deactivate beep on key-press. The beep response makes it much easier to operate the menu system during installation and setup.

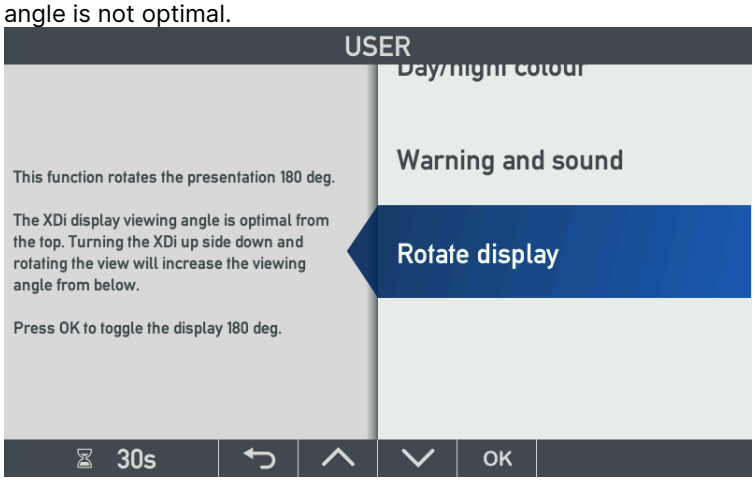
You should keep this function ON.

Warning sound indicates an important fault situation and should be ON if no other systems are monitoring such faults.

Acoustic caution indicates a less important incident, and it may be turned OFF.

10.4 Rotate display

Rotating the display 180° is used to optimise the viewing angle when the XDi is mounted in a location where the viewing angle is not optimal.



This function is the same that is available on the start page of the setup wizard where you will also find more information about this function and where to use it.

11 Installation menu

The Installation menu is dynamic and contains vital setup parameters for the product, system and selected virtual indicator. The dynamic behaviour means that the menu structure will adapt to the actual selection of virtual indicator and product profile made using the “Setup Wizard”, and it will change if a new product profile or virtual indicator is selected. If a menu selection is not active or selectable, it will be greyed out. Some of the grey menu lines present fixed information and are never active. Occasionally, a parameter may only have one valid parameter value and cannot be changed, even if it is not greyed out.

In general, it is only the functions that is actively selected or used in each product profile or virtual indicator (including VS profile) that you can setup via the installation menu. It is therefore always a good idea to look into the library description PDF to see if a given function is used.

Due to this dynamic behaviour of the menu structure, not all menu combinations can be covered in this document.

This chapter contains a number of menu examples representing some of the most used menu types.

Based on this, it should be relatively simple to use other similar menu types that may be used in your customised library.

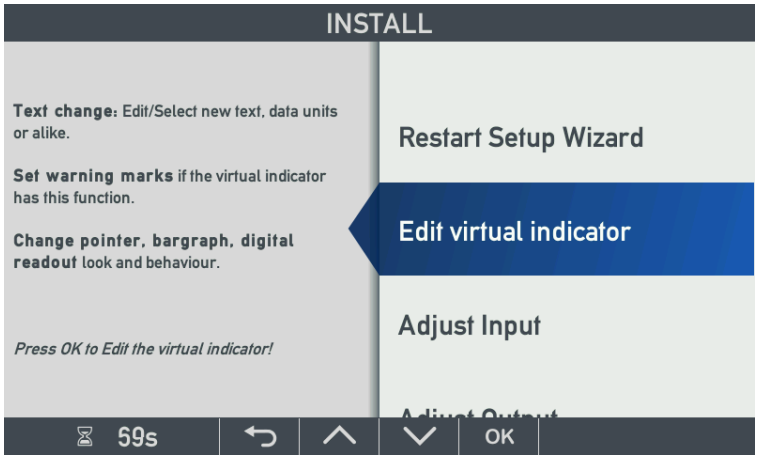
IMPORTANT: The installation menu must only be accessed by trained or skilled personnel who know the XDi system and the detailed operation of the XDi device. If CAN bus is used, it is also recommended to consult the “XDi-net/CANopen reference manual”.

Warning: Changing mode or parameters may jeopardise the operation of the XDi.

11.1 Accessing the installation menu

The installation menu is protected by a “secret” button combination that is only active from the user menu; secret in the way that there is no pop-up help menu to guide you. This is simply to protect the installation menu form unauthorised access. In other words, the installation menu is a submenu to the “USER MENU” and can only be accessed by the secret double-press from a user menu page.

Double press for more than 5 sec.:			
Button 1	**Button 2**	**Button 3**	**Button 4**
-	■	■	-



11.2 Restart Setup Wizard

This menu point will restart the setup wizard and make it possible to change CAN NodeID, select a new Product Profile (PP) and/or Virtual Indicator (VI), or maybe change the default input setup by selecting another VS for the selected VI.

IMPORTANT: Restarting the "Setup Wizard" from the installation menu, the previous selections will be the new default and the wizard will not change any selection or parameter setup, but if a new change/selection is made manually in the wizard, all changes made previously via user or Installation menu will be erased!

Please note, that it is not possible to skip the wizard directly using a soft-key (push-button) if it is started by accident.

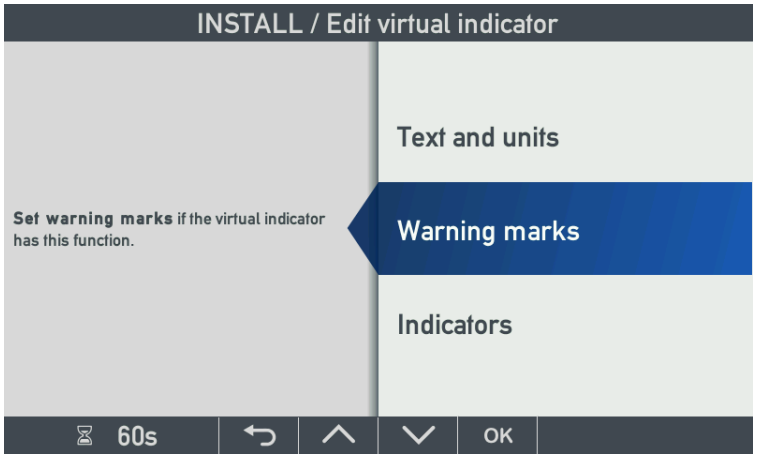
You can remove the power when the wizard is in start screen, and the XDi will start up in normal operation mode again when repowered.

Alternatively, you can just step through all steps pushing "OK", then no changes will be made.

See the chapter describing the setup wizard functions for more details.

11.3 Edit virtual indicator

This menu opens for editing elements in the virtual indicator.



The following elements must be implemented in the selected virtual indicator for the editing function to work.

11.3.1 Text and units

This menu opens for changing or adding headlines, labels or units (text only) on the selected virtual indicator.

Only selectable text lines (text boxes) embedded in the virtual indicator and predefined in the VI-setup profile (VS) can be changed or new text added.

It is possible to implement a text box for units in the virtual indicator, but it should be noted that only different representations of the presented unit can be selected; for example, RPM, rpm, min^{-1} or 1/min.

Example: Change of temperature unit from °C to F is not possible using the "Change unit" feature.

In XDi-D and XDi-M different data units can only be made available by implementing 2 different virtual indicators, one indicator using °C and another using F, you will then have to decide which one you prefer during installation.

In XDi-N it is possible to make virtual indicators with support for shift of active data units. If the unit shift function is activated in the VI, there is fast access to shift a set of units defined in one of the 3 unit profiles. Please see the separate chapter on unit profiles.

Headlines labels and units

A headline, label or unit is a text element that is predefined in the graphical design of the virtual indicator (VI).

Each VI in a library can have several headlines, labels, or units.

The first headline is Headline 0, Next Headline 1 and so on.

In the following we will use headline as an example.

In each VS profile for a VS the will be a list of up to 32 predefined headline texts to easily select from during installation setup. There is always one text in the headline list that is defined as the default selection. The default text will automatically be selected when the VS profile is chosen via the setup wizard. After the wizard is completed, you can change the default selection as described below.

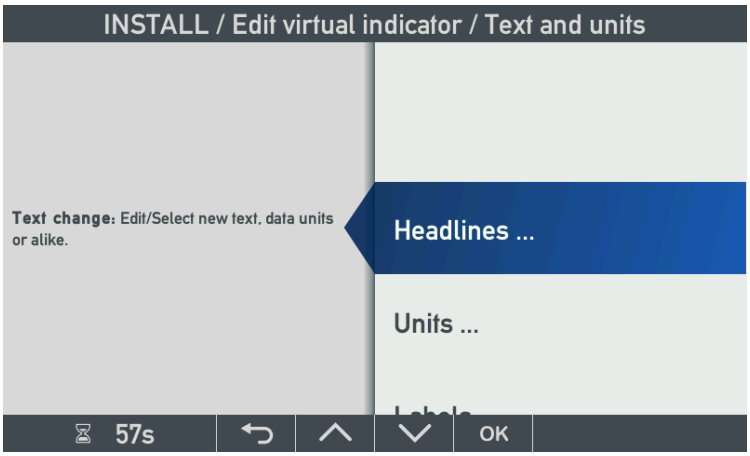
Quit often it is the same headline list that is copied to all VS profiles for a given VI, but depending on the nature of the indicator it is different text lines that is selected as default headline for a given VS.
For example, in a customer library using CAN data input for up to 4 tunnel thrusters on the same CAN bus, we have most likely defined four VS profiles for respectively TT 1, TT 2, TT 3, TT 4 with their respective instance of CAN input data. If we use a standard headline list like this:

Headline #	Text	Default selected in:	XDi-net index
Headline 0	Bow Thruster 1	VS01	0x4101:11
Headline 1	Bow Thruster 2	VS02	0x4101:12
Headline 2	Stern Thruster 1	VS03	0x4101:13
Headline 3	Stern Thruster 2	VS04	0x4101:14
Headline 4	Tunnel Thr. 1		0x4101:15
Headline 5	Tunnel Thr. 2		0x4101:16
Headline 6	Tunnel Thr. 3		0x4101:17
Headline 7	Tunnel Thr. 4		0x4101:18
Headline 8	Tunnel Thr. 5		0x4101:19
Headline 9	Tunnel Thr. 6		0x4101:1A
.....			

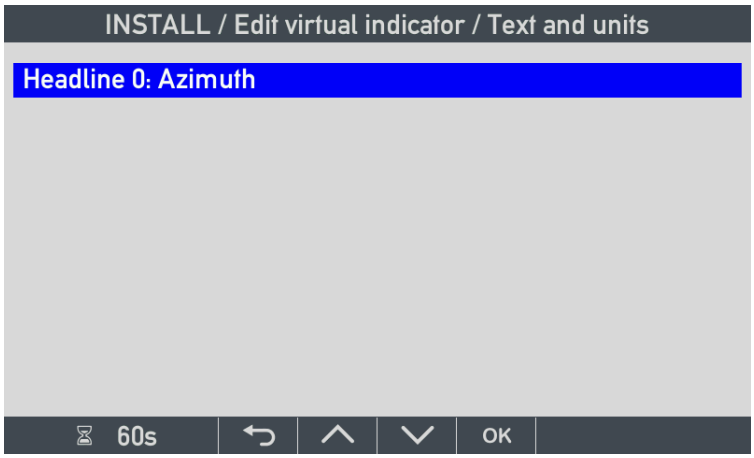
We have used the same headline list in all four VS profiles (VS01 to 04), but the default selection is set differently in each VS profile so that it is the match the normal system setting, used in most installations. But it is always possible to make a change from the installation menu as we will see in the next chapter.

Select a new headline

The following example is an azimuth indicator where we will see how to select or add a new headline text.

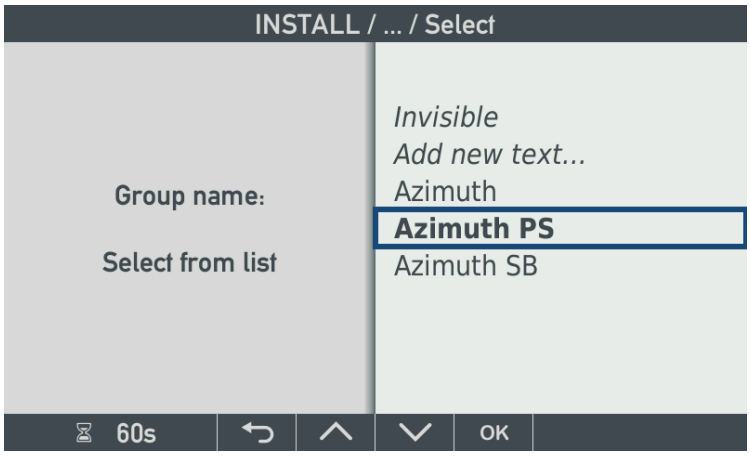


To see or select a new headline, press OK.



To select or add a new headline, press OK.

A headline is predefined in the virtual indicator design and each VI in a library can have several headlines, the first is Headline 0, Next Headline 1 and so on.

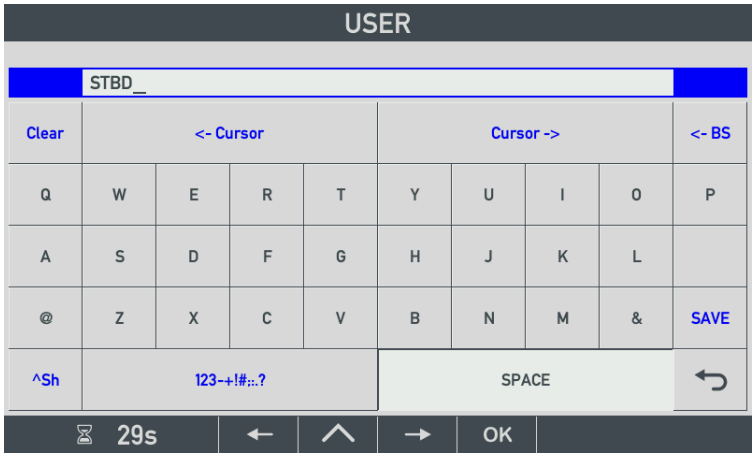


Select a new headline from the list and press OK.

Each headline in a VI has a list of up to 32 predefined headline texts to choose from.

It is always possible to hide the headline by selecting “Invisible”.

To add a new headline, press OK on “Add new text”, and the virtual keyboard will appear.



You may add up to 32 new headlines before the “user headline list” is full.

Select new label or unit

If one or more text boxes with labels or units are embedded in the selected virtual indicator, it is also possible to select a new label or unit from a list or to add a new text from the virtual keyboard. The procedure is exactly the same as explained for headlines.

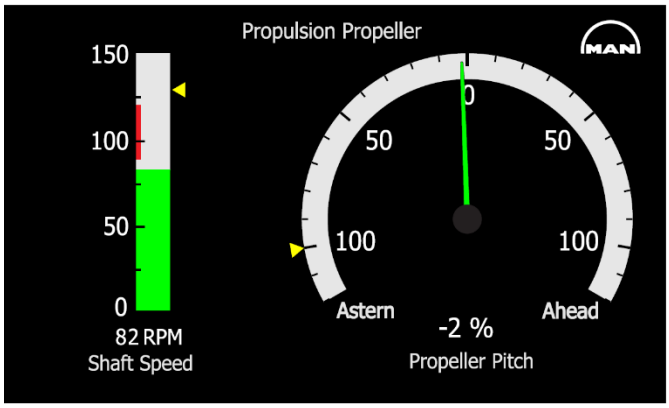
Please note, that the added “user headlines” are stored in the permanent memory of the XDi, but if you restart the setup wizard and select a new VS, the added headlines will be erased.

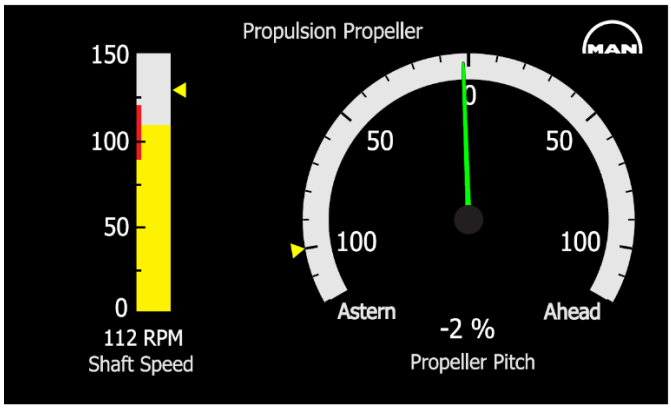
11.3.2 Warning marks/restricted band

XDi supports up to 4 restricted bands for each data type presented on an indicator. The restricted bands can be used to indicate warning sectors on the scale of an analogue indicator.

Application example: on the RPM indicator for a two-stroke MAN engine, the “Red sector” indication is implemented in the RPM bar graph. The red sector is configured during installation and sea trails, indicating the RPM range where the engine should not normally operate (these restrictions could be due to resonances causing heavy vibrations).

One red sector is activated and shown on the RPM scale.

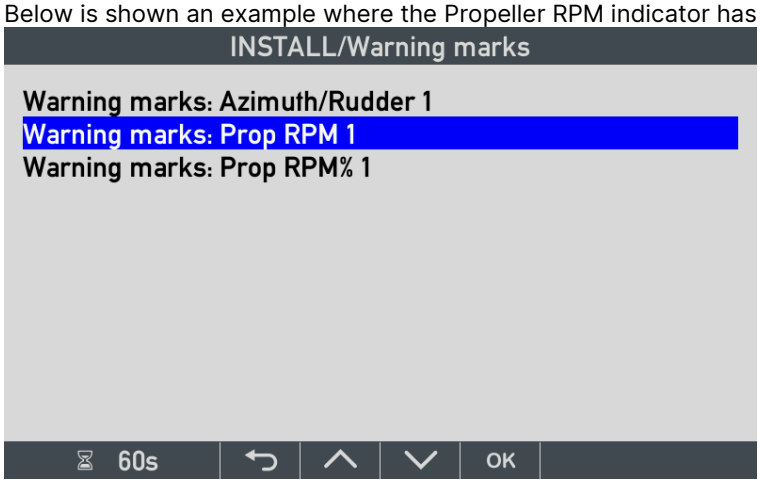




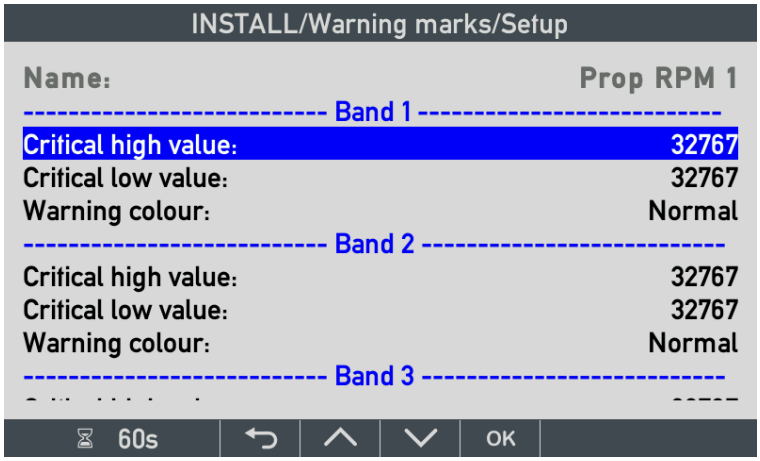
In the virtual indicator, it is also possible to define that the bar graph will shift colour when the input value enters a restricted band, as in this example where the bar graph shifts from green to yellow when RPM is within the restricted band. This can help make it very visible that you are now operating your engine in a restricted RPM range and should only be in this range for a short time. In the above picture the small yellow pointer is showing that you are actually commanding the engine to go to 128 RPM.
The warning marks must be designed into the virtual indicator to be operational.

Edit warning marks and related critical bands

Below is shown an example where the Propeller RPM indicator has up to 4 critical bands defined.



Select warning marks for Prop RPM 1, press OK.



The critical band is inactive since the high and low value is both 32767 (largest positive value = not available).

A critical band is disabled when high and low is the same value.

To activate the band, you must insert the critical band boundary values. If the critical band is from 238 to 276 RPM, and keeping in mind that standard RPM values internally in XDi is defined with a resolution of 0.1, the value you have to enter is:

Critical high value: 2760 (=276.0 RPM)

Critical low value: 2380 (=238.0 RPM)

Warning colour:

The warning colours are defined when the virtual indicator is designed. There are 3 warning levels, each with a predefined colour. The colours may be different in Day, Dusk and Night mode.

The colours for the 3 warning levels are defined for the Bar-graph as:

Normal (Green)

Caution (Yellow)

Warning (Red)

The colours in ( ) are only examples of colours and is in this case the same in both day and night mode.

The warning marks open for configuration of quite flexible scale markings during installation.

NOTE: This warning mark menu is also accessible from the user menu, please see the relevant chapter under “Warning and sound”.

Different applications for the critical band function

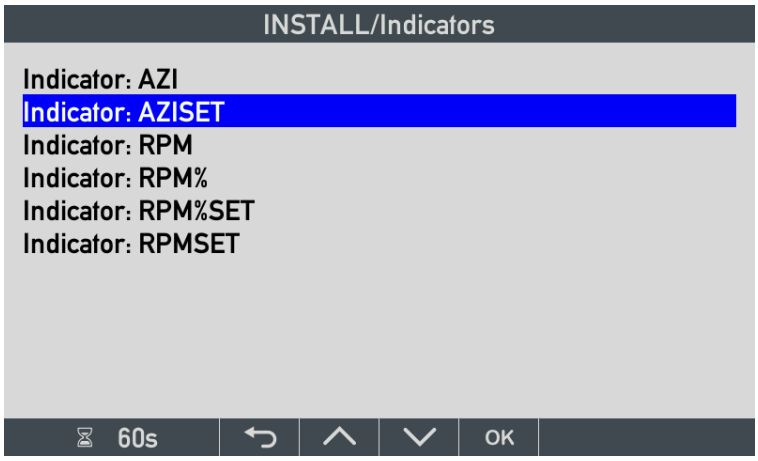
Critical bands may also be assigned to control the colour of the pointer of an analogue indicator type, the colour of a bar graph or the colour of a digital readout, but this type of functionality has to be included in the virtual indicator design that is stored in the XDi library and you are not able to change the predefined colours from for the different element from the installation menu.
When a DX1 digital i/o module is mounted on the XDi, the critical bands can also be used to control one or both relay outputs on that module, but only if support for DX1 relay output is included in the selected VS profile.

This is for example used to activate the wind speed alarms in some of the wind indicators available in the DEIF standard wind indicator library.

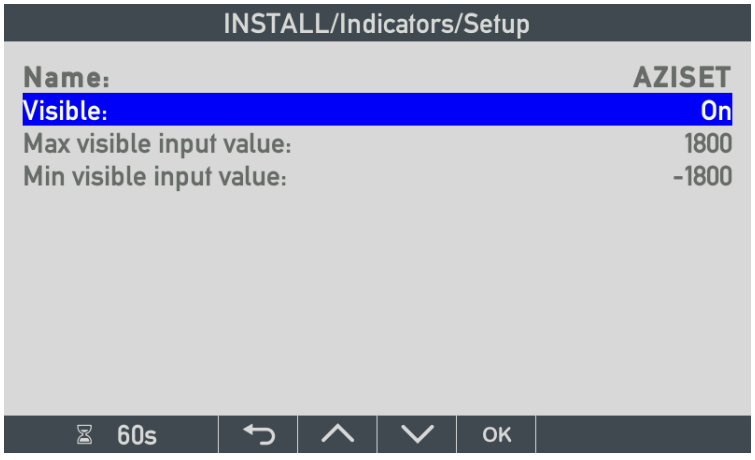
11.3.3 Indicators

The indicator menu makes it possible to change the visibility of each indicator element included in the virtual indicator.

The example VI has 6 indicator elements as shown on the menu. To make a change to the azimuth set point pointer (AZISET), highlight it and press OK.

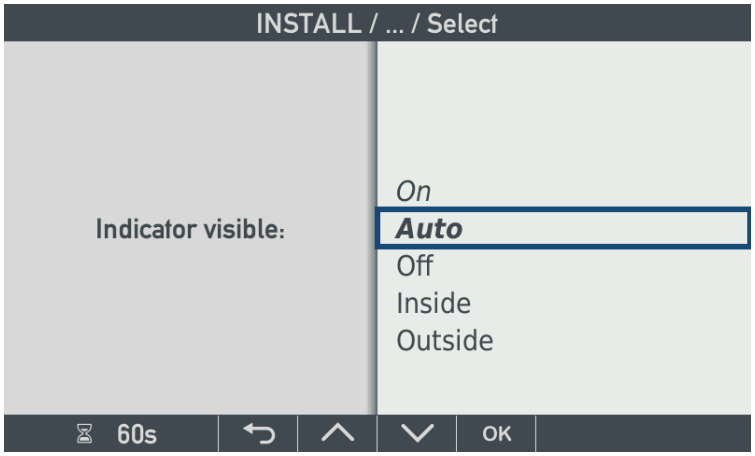


Press OK to open AZISET for editing.



The indicator is set up to be visible (ON).

Press the OK button to open the visibility settings.



The visibility function has 5 modes:

On: The pointer and/or digital readout is always visible.

Auto: The pointer/readout is controlled by a flag defined in the VS.

Off: The pointer/readout is always invisible and inactive (OFF).

Inside: The pointer/readout is only visible when data is inside the set visibility band.

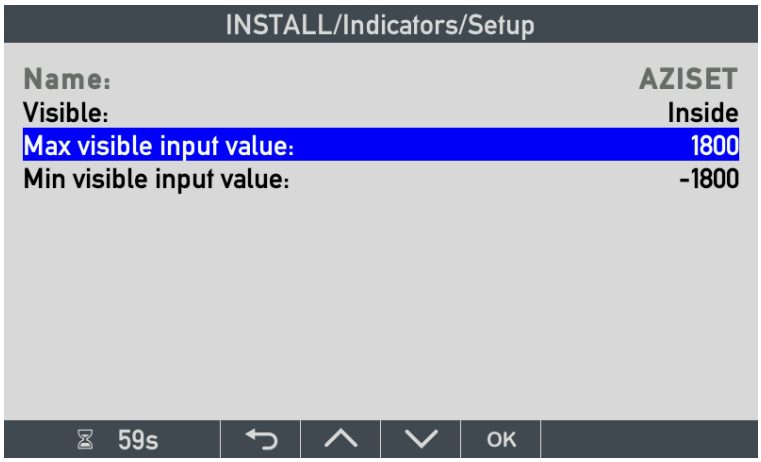
Outside: The pointer/readout is only visible when data is outside the set visibility band.

IMPORTANT: When a pointer and/or digital readout is invisible, it is also disabled. This means that data lost will not be detected. When the indicator is visible again, all functions are reactivated, and data lost will be detected.

Visibility band:

The boundaries of the visibility band used in the last two modes (inside/outside) are defined by the parameters: Max visible input value and Min visible input value.

To make the azimuth set point pointer and readout only visible when the commanded angle is between +/- 45°, the mode inside must be selected, and the Max visible input value set to +450 (+45.0 °), and the Min visible input value set to -450 (-45.0°).



IMPORTANT: Pointers, bar graphs and digital readout are an integrated part of the virtual indicator design, and editing might therefore be more or less disabled. This may also be due to MED or other regulations and approvals.

11.4 Adjust input settings

The XDi 192 Multi-indicator with DEIF standard azimuth library shown below is used as an example. The virtual indicator below is a multi-type with 6 data inputs: azimuth angle, pitch % and RPM / %RPM. The set point (commanded) values are also presented by orange triangle pointers and orange digital readouts.

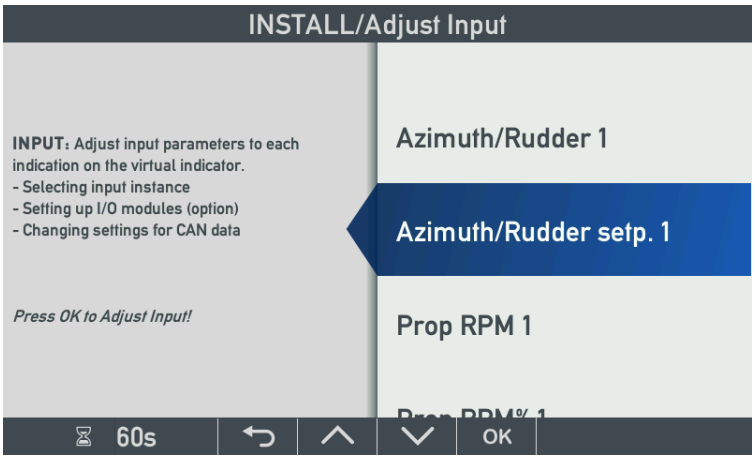
Please note, that set points can be disabled from the installation menu.

The data inputs for the standard indicator used in this example depend on which VI-setup profile (VS) is selected.

In this chapter the input setup menu examples are based on the above azimuth indicator. The intention is to cover the input adjust menus for the most important types of analogue, digital and CAN indicator inputs.

The menu principles can be used in general, also for other data types than the ones in the examples.

Each input source for the selected virtual indicator will be available in the “Adjust input” menu and submenus will be active if setup parameters can be adjusted via menu.



In this example, the virtual indicator has 6 inputs, one for each data type indicated on the virtual indicator (XDi type Multi).

The predefined setup parameters for all 6 inputs are defined in the selected VS profile.

In this example the inputs are defined with different types of input sources to illustrate the different type of adjust menus.

Input data sources can be: XDi-net (CAN), DAM-MPDO, PDO converter (CANopen TPDO or RPDO), Analogue input (AX1 is required), Digital input (DX1 i/o module is required).

In some cases, NMEA0183 input is available as input source (requires NX2 NMEA i/o module). NMEA is however a little special and requires its own dedicated setup menu. In the adjust input menu, that we are looking at now, data sourced from an NMEA input will be presented in the same way as XDi-net data.

11.5 XDi-net – input adjust and special use

11.5.1 XDi-net adjust menu – Prop RPM% set point 1

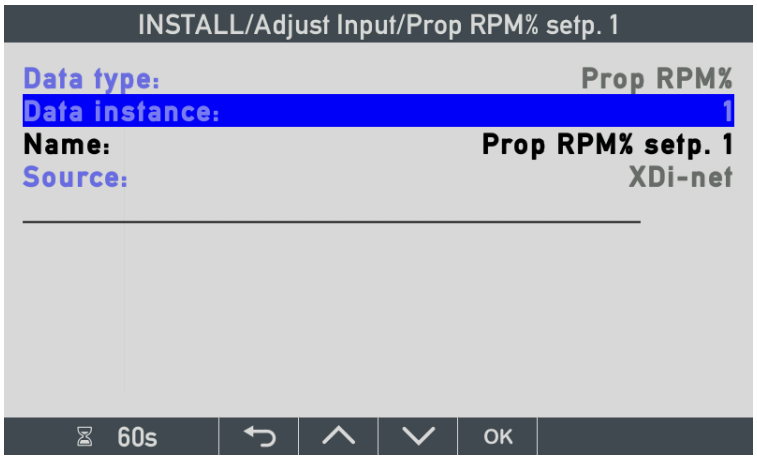
Variable data is stored in the XDi unit as absolute values in a predefined location in the CAM object index table. Details can be found in the XDi-net/CANopen reference manual.

Data in XDi-net format is transmitted in a Multiplexed PDO (SAM-MPDO), automatically addressed to the right predefined object index location, and received by the XDi as a data broadcast.

Using XDi-net format, data is shared on a CANopen network without the need for a CANopen master or any complicated NodeID setup.

The device acting as a data source is just broadcasting XDi-net data, and any XDi indicator (receiver) is simply listening for the broadcasted data they need.

This means, that there are no parameters to set up via menu when XDi-net is used as input.



In this menu the only thing you can change is the name of the input source, in this case Prop RPM% setp. 1.

NOTE: In some virtual indicators (especially in XDi-N) we use the special input fall-back function, the name of the active source is often presented on the indicator screen and in that case, it can be useful to be able to change the source name to match a given installation.

Data from more than one data instance on the same CAN bus

When for example several azimuth thrusters are on the same CAN bus, each with one or more XDi indicators connected, it requires a separate VS profile for each data instance that the indicator must support.

For example, if there are two azimuth thrusters on the same CAN bus, each with one or more XDi units for indication, then the selected VI must have a separate VS profile for data instance 1 and another for data

instance 2. But often the CAN busser are physically separated, one CAN bus line for each thruster.

Special use of XDi-net as source

XDi-net is also used as input type if two different data types are generated based on the same input value.

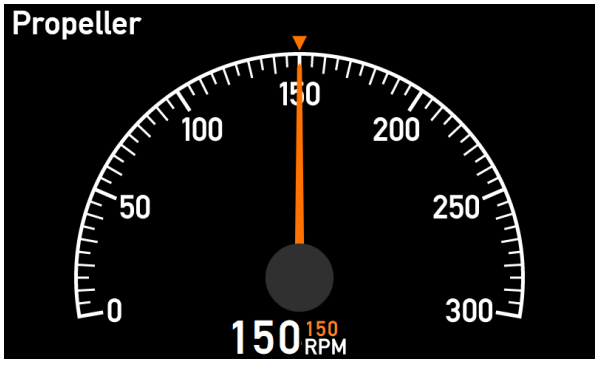
This is for example the case when the following data inputs are used to generate 2 or more data types:

Input type	Data type 1	Data type 2	Data type 3	Data type 4
AX1 analogue input	RPM	% RPM	% Trust	% Power
	Rudder angle	% Rudder		
	Pitch angle	% Pitch		
TPDO converter	RPM	% RPM	% Trust	% Power
	Rudder angle	% Rudder		
	Pitch angle	% Pitch		
DX1 digital input	RPM	% RPM	% Trust	% Power

There can be other data types where the input device is set up to generate both an actual value and scale this value to a % value in addition.

Data is routed internally in the XDi as if it was XDi-net data. To adjust such inputs, it is necessary to enter the adjust menu where the data is generated.

A similar situation can be seen where a data type is presented both on an analogue indicators and also presented in a digital readout, where the digital readout is able to show values exceeding the max value on the analogue screen.



Standard RPM indicator with set point.

In this RPM indicator example, the max value on the analogue scale is 300, but the digital readout can present values up to 999 RPM. So, in this indicator there will be defined 2 RPM sources with different max value, at least one of those sources will be defined as a XDi-net source and may be visible as such in the input adjust menu.

NOTE: In a resent main software release it is made possible to create VS profiles where the input adjust menu is disabled, in cases where it is not needed, but in many of the existing libraries the source line will still be visible in the adjust input menu.

11.6 CANopen MPDO as data source

When XDi-net is selected as source, it is also possible to send variable data to an object index/sub-index by use of a Destination Addressed Mode Multiplexed PDOs (DAM-MPDO) instead of the XDi-net broadcast format.

This requires that an RPDO is selected for MPDO communication in the CAN setup parameters list (in PP or via CAN setup menu).

DAM-MPDO means that data is separately sent directly addressed to each XDi identified by its NodeID (address) and then stored in the object index/sub-index defined in the MPDO.

This option is sometimes preferred in networks with a CAN Master controlling all data distribution on the CAN bus network. This method is a point to point communication and requires much more of the available bus bandwidth.

The data content of the DAM-MPDO is the same as the XDi-net format. The only difference is bit 7 in byte 0 defining the type of MPDO (1=DAM or 0=SAM), see the XDi-net/CANopen reference manual for more details.

IMPORTANT: If RPDO1 is used for DAM-MPDO communication, XDi-net must be disabled (in PP or via CAN setup menu). If instead RPDO2, 3 or 4 is selected for DAM-MPDO transmission, then XDI-net can be active and run in parallel.

11.7 CANopen TPDO/RPDO input adjust

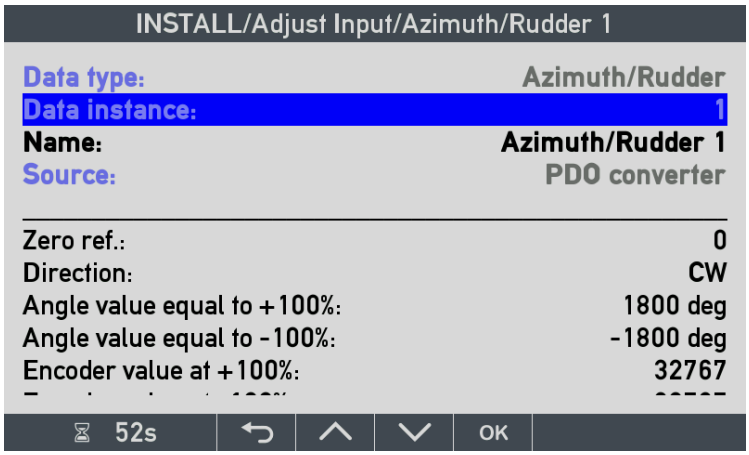
11.7.1 PDO converter for azimuth/rudder

The azimuth angle in the virtual indicator used in this example is predefined in the VS profile to come from an angle transmitter (encoders) with CANopen interface (for example DEIF RTC 300 or RTC 600). The transmitter sends the measured angle between +/-180° represented by a signed 16 bit relative data value packed into a TPDO in byte 0 and 1. This means that the input data value range is: -32768 to 32767.

To receive a TPDO or RPDO, the built-in tool called a “PDO converter” is used to convert the incoming relative angle value to an absolute angle value between +/-180.0°. That will then be presented on the XDi azimuth indicator. A PDO converter input is only available if it is defined as the data source in the selected VS profile.

This type of input can be used for any standard angle transmitter (encoder) with CANopen interface according to “CiA 406 Device profile for encoders”. It will be possible to adapt to most of those CAN transmitters by adjusting the standard parameters in the TPDO converter as explained below, but if this is not possible due to a special configuration of the CANopen angle transmitter, it may be necessary to make a customised VS profile.

Most transmitters on CAN are delivered with auto-start. If the sensor does not use auto-start on CANopen, then XDi can be set up to send out the CANopen start command after boot up. This function is located in the CAN setup menu.



Data type: defines the data type that is used for this indicator and is fixed (cannot be changed via menu).

Data instance: is used to separate multiple azimuth transmitters on the same CAN bus. It is a fixed defined number typically between 1 and 15.

The “Data type” and “Instance” defines the Obj.index where data is stored.

(See the XDi-net/CANopen reference manual for details)

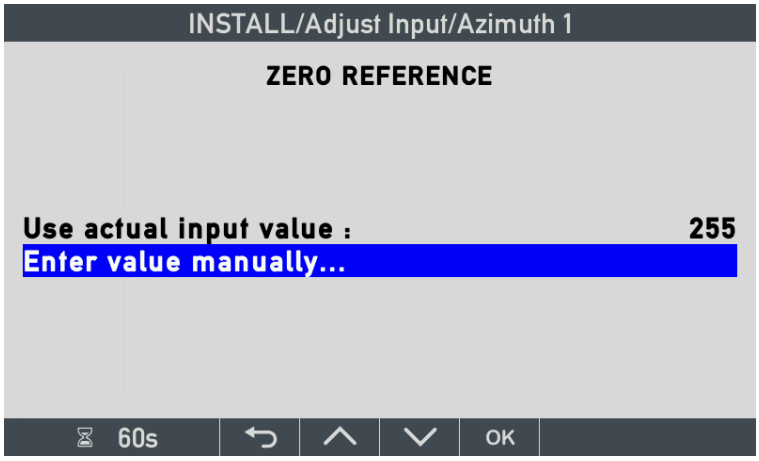
Name: is a unique name for this data type and instance. It makes it easier to identify the data source. The name may be edited from the menu, using the virtual keyboard and can be synchronised via XDi-net.

Source: is the input source type that is defined in the selected VS. It is fixed for PDO converters, and if XDi-net and XDi-net variable data are active, it will also be possible to send data using the XDi-net data protocol. This makes it possible to use either PDO or XDi-net format even if the source is a PDO converter. Do not send XDi-net data to this data type/instance in parallel with the TPDO specified in the converter. This will make the azimuth indicator jump between the received values. This function can be useful to establish a backup function in a system, for example if the PDO transmitter fails, a CAN master/controller can send backup data in XDi-net format.

Zero ref.: makes it possible to insert a zero reference (or offset) to the received angle value.

Often you will however make the zero angle calibration of the CAN azimuth or rudder transmitter (encoder) instead; it is always good praxis to adjust or calibrate the data source if possible.

To zero-adjust DEIF RTC 300 or RTC 600 angle transmitters, please see the quick start guide or the detailed installation instructions.



Either set the azimuth physically to 0 degree and press OK to accept the actual value as the new zero reference input value, for example 255 as shown in this case, press OK when “Use actual input value:” is highlighted to accept that actual value 255 is set up as the new zero reference.

Please note that it may take a few seconds before the actual value is updated.

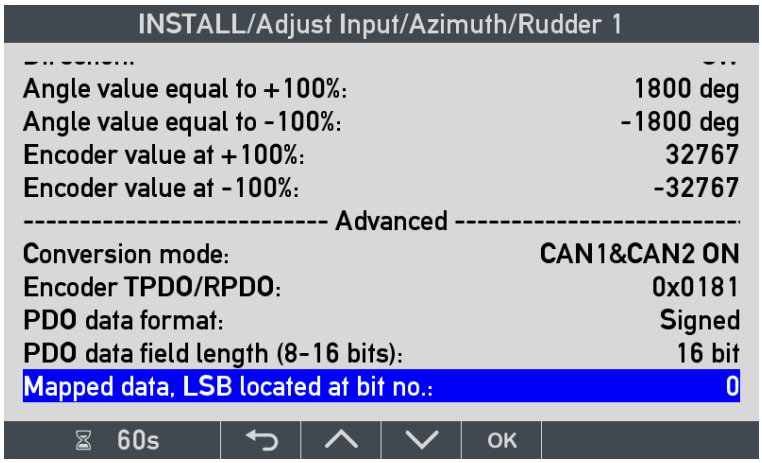
Alternatively, select “Enter value manually...” by highlighting and pressing OK.

This function can be used if it is not possible to physically set the azimuth at 0 degree, but the offset between physical and transmitter zero is known.

Use the softkeys to enter a new zero reference value. The actual parameter value is also presented in this case for information. This is sometimes very useful when a new value must be entered.

Please be aware, that the min/max values that the “value input tool” handles exceed the relevant input values for this data type. In this example, using a signed 16 bit, all values above +32767 are not relevant.

Direction: makes it possible to change the measuring direction of the angle transmitter (encoder) between clockwise (CW) and counter clockwise (CCW). In praxis, the sign of the absolute angle will be shifted. This is very useful if the angle transmitter is mounted upside-down.



Angle value equal to + or – 100 % and related encoder values for + or – 100 % are predefined as +/-1800 (+/-180° with 0.1° resolution). In azimuth mode, this should not be changed.
If this was a rudder angle input, these menu entries are used to scale the angle transmitter input to an actual rudder angle, and if needed also a %Rudder value.

If there are more than one CAN based angle encoder on the same CAN bus, the TPDO COB-ID can easily be changed via the menu above. If for example a DEIF RTC 600 CAN angle transmitter is programmed by wire to use NodeID 2 instead of the default NodeID 1, you must change the Encoder TPDO/RPDO hex value to 0x0182 and XDi will now receive angle data from the 2nd angle encoder (transmitter) instead.

11.7.2 CANopen Rudder transmitter (for example DEIF RTC 600)

If the rudder transmitter was providing input for a +/-45.0 degree rudder angle indicator, the default settings would be:

Zero ref.:	0
Direction:	CW
Angle value equal to +100%:	450 deg
Angle value equal to -100%:	-450 deg
Encoder value at +100%:	8191
Encoder value at -100%:	-8191

Angle values equal to +100 %: 450 (that is 45.0° with the standard resolution for a rudder that is x0.1°).

Angle values equal to -100 %: - 450 (again x0.1° resolution).

The encoder (or CAN rudder transmitter) values must be scaled accordingly, in this case:

Encoder value at +100 %: 8191 (This equals 45.0° shaft angle on a 16 bit encoder – for example RTC 600)

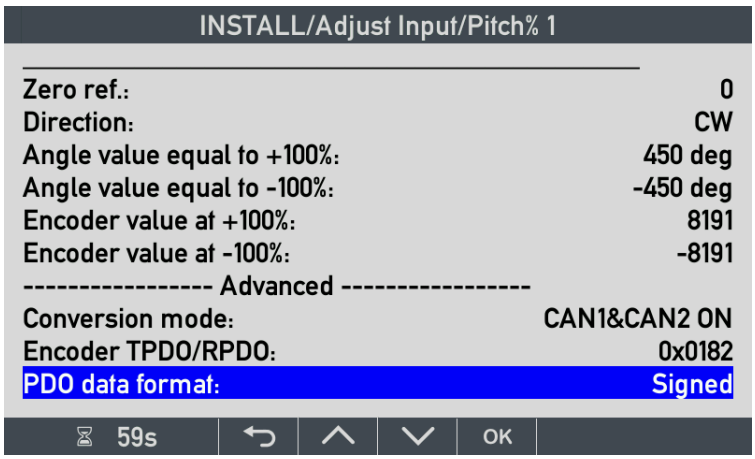
Encoder value at -100 %: -8191 (equals – 45.0°).

If the mechanical rudder system needs calibration, this can be performed using the following procedure:

1. Set Zero: position rudder at 0° and either zero set the encoder acting as source or make zero set via the menu (see Zero reference above).
2. Set rudder to 45° starboard and set the new encoder value (if you are not able to move rudder to 45 deg, just adjust the figures manually. You may also adjust the “Angle value equal to +/-100 %” to for example +/- 40° if the rudder can be physically positioned at this angle, and adjust the encoder values by selecting actual value.
3. Set rudder to 45° portside, and adjust the encoder value at -100 % accordingly.

11.7.3 PDO converter for pitch %

The pitch sensor is also in this example a 16 bit encoder with a CANopen interface. As for the azimuth and rudder described before, this data source is also a PDO converter. The function is similar to the PDO converter described for the rudder above:



Zero ref.: it is recommended to calibrate the pitch angle transmitter (encoder) if possible. Alternatively, the zero reference can be used to offset the angle transmitter input.

Direction: Works as previously described, it shifts the direction (sign) of the pitch values.

The scaling is set up so that the angle transmitter (encoder) input +/-8191 (equal to +/- 45° rotation angle for a 16 bit transmitter) is scaled to +/-45.0°. Please note, that the data resolution for pitch angle is x0.1, and that it is unfortunately not presented like that in the menu; 450 means 450x0.1=45.0 degrees.

The PDO converter will also output +/- 100.0 % pitch-scaled based on the same inputs.

Very often, only % pitch is presented in the virtual indicator, and the absolute pitch angle in degree is not used. It is however still the pitch type PDO converter that is used, and therefore the "Angle value equal to +100 %" (or … -100 %) is the same as the % values. In such cases, they are often set up to +/- 1000 equal to +/- 100.0.

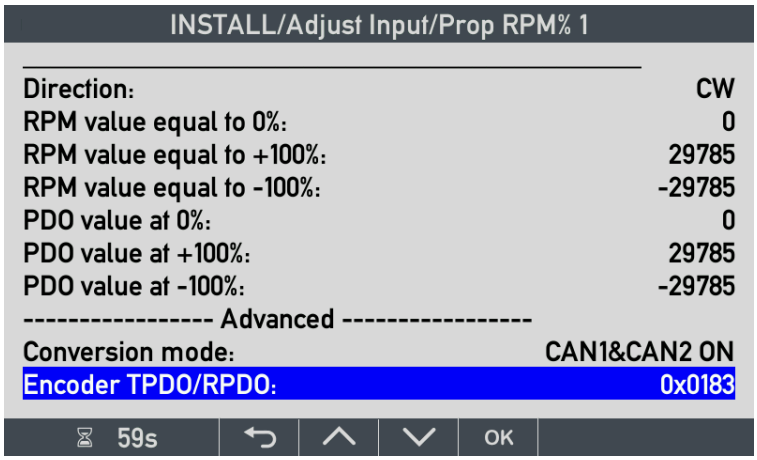
11.7.4 PDO converter for RPM

The RPM PDO converter follows the same principles as already described. This converter type is also able to calculate actual RPM and %RPM, but in addition it can also calculate: %Thrust = (%RPM)^2 and %Power = (%RPM)^3 if the virtual indicator needs to be able to present those data types. The selected VS profile will then contain parameters to configure the PDO converter to make this calculation. (This is similar to what is described for the AX1 RPM input adjust a little later in this document)

RPM as well as most data types in the internal object index table are defined with 0.1 resolution (see the XDi-net/CANopen reference manual for details).

The following example is taken from "DEIF standard azimuth library" where the virtual indicator VI003 is selected, and the setup profile VS02 for CANopen TPDO is selected.

In this example, the default scaling setting in the VS02 profile is changed, so that +/-200 RPM is equal to 100 % (110 % is 220 RPM).



Default setup.

Default VS02 settings:

In the VS02 profile, the actual RPM values are set up to be scaled 1:1 (still with resolution 0.1, meaning that the RPM value in the menu is presented as RPMx10).

With the 100 % at 29785, the %PRM bar graph indicator will be at 110 % when the input value is +32765 (the largest valid value – equal to 3275.5 RPM).

Change RPM settings:

To obtain the desired RPM settings of +/-200RPM equal to 100 % and still use the 0.1 RPM resolution of the input value (PDO value), the RPM settings must be changed like this:

RPM value equal to +100 %: 2000

RPM value equal to -100 %: -2000

PDO value equal to +100 %: 2000

PDO value equal to -100 %: -2000

If the RPM value is sent in the TPDO with 1RPM resolution instead, the PDO value setting must be changed to:

PDO value equal to +100 %: 200

PDO value equal to -100 %: -200

In this case, the XDi will scale the input values still using 0.1RPM data resolution internally for the RPM data type. You cannot change the internal resolution.

The PDO converter will not stop the scaling at 100 %. It will make a linear scaling as long as the result is within the valid limit for actual the data type, in this case RPM.

The presentation can however be limited. In the DEIF standard indicator used as example, the bar graph is limited to 110 % and the digital readout will stop at 200 %. But in a customised indicator, this can be made differently, but the setup procedure and scaling principle is the same.

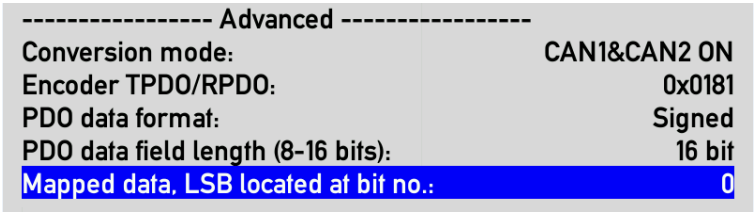
11.7.5 Universal PDO converters

A number of universal PDO converters are available in the XDi, which can be used to generate any other data type from a TPDO or RPDO. Electrical power could be an example.

The universal converters use the same principles as already described and are also able to calculate both actual and a relative (%) data value.

11.7.6 Advanced CAN functions

The advanced settings should only be changed by system experts who have detailed knowledge of the CAN bus system, protocol and the XDi-net specification. Via this menu, it is possible to adapt the PDO converter settings to other CAN sensors, for example angle transmitters with slightly different CAN settings.



Conversion mode: defines which CAN bus contains the azimuth angle TPDO. It may be set to CAN1&CAN2 ON, CAN1 ON, CAN2 ON or OFF. If the converter is set up to OFF then the XDi-net function previously described can be used as input instead. Without interference from the defined TPDO, that maybe is used for something else in this CAN system.

Encoder TPDO/RPDO: defines the COBID of the TPDO or RPDO that the PDO converter is receiving data from, all valid COBIDs for TPDOs and RPDOs is basically supported. But please note the restrictions on all RPDO1s (COBID 0x200 to 0x27F) when XDi-net is active. Please see the XDi-net/CANopen reference manual for details.

PDO data format: can be either type “Signed” or “Unsigned”. For CAN angle transmitters (encoders), this defines where the zero point reference point is located after a “zero set” is performed. Transmitters using signed will have zero reference in 0, and unsigned will have zero reference in ½ data range. For example, an encoder transmitting a unsigned 12 bit value will have zero at 2047, and the full data range is 0 to 4095.

In some cases, the control system will transmit the angle data as an absolute angle e.g. +/-1800 in a in a TPDO, in that case you must adjust the PDO converter settings accordingly.

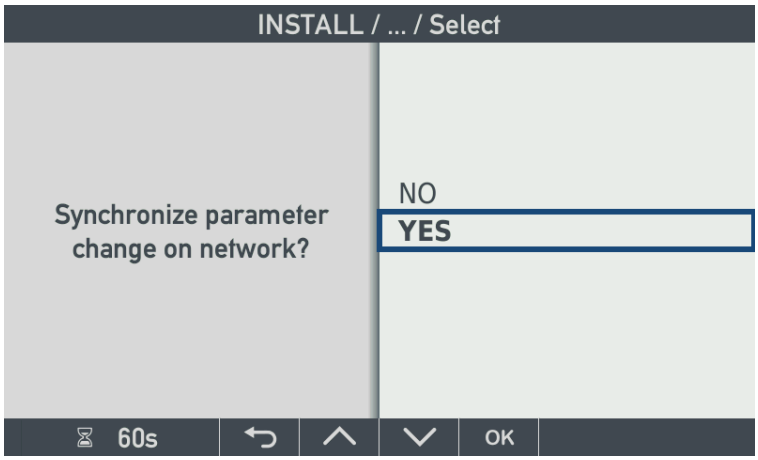
CAN data field length: this must match the CAN data resolution of the used angle transmitter. The XDi supports any resolution from 10 to 16 bits. (DEIF RTC type angle transmitters use full 16 bit resolution for optimal accuracy)

Mapped data. LSB located at bit no.: defines where the 10 to 16 bits of data are located in the 8 byte data frame of a TPDO or RPDO. If data is located in byte 0 and 1, then data is not mapped, and this value is 0. If data however is located in byte 2 and 3, then this parameter must be set up as 16. This makes the converter read data of the specified length starting at bit 16 (LSB location of the 2 byte data).

11.7.7 CANopen PDO converter synchronisation via XDi-net

Data sent in a PDO is already available for all XDi units on the CAN bus and can be received by all XDi units each using a PDO converter. However, if the received data need to be corrected via menu, for example the zero set of the incoming azimuth angle, the change made will in the first place only affect the XDi where the adjustment is made, even though several XDi units on the network need the same adjustment.

To avoid the need of making the same adjustment individually on all the XDi units in a system using the same encoder, XDi has a built-in synchronisation function. When leaving the adjust menu, you will be asked via a “Synch select menu”, where you want the XDi to send a synchronisation message to all other XDi units on the CAN bus to make exactly the same adjustments on all.



Highlight YES and press OK to synchronise.

This function will only work when XDi-net and “Send XDi-net setup synch data” are both active on the CAN bus. This is activated in the Product Profile or may be set up via the CAN setup menu.

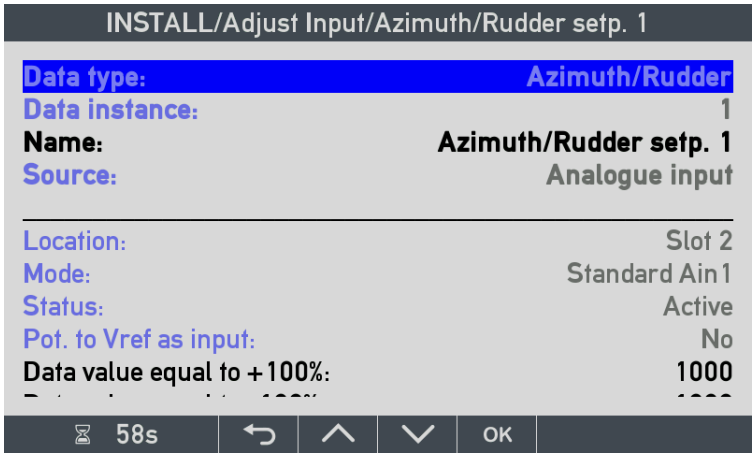
This is a very useful function which reduces the time it takes to adjust a full system containing several XDi indicators.

IMPORTANT: If you do not know how the CAN system is set up and configured, you should select NO to only make the setup locally. That is also why the default selection is NO.

11.8 AX1 analogue input adjust

11.8.1 AX1 analogue input – azimuth/rudder set point 1

In this example, the selected VS profile defines the input for azimuth set point to be an analogue 4-20 mA input, but this can be changed via the installation menu below. The detailed description of the inputs and functions are found in the AX1 Chapter.



Data type and instance is always fixed defined in the VS profile.

Name of the data type (source) may be changed using the text virtual keyboard (highlight and press OK).

The following is fixed defined in the VS:

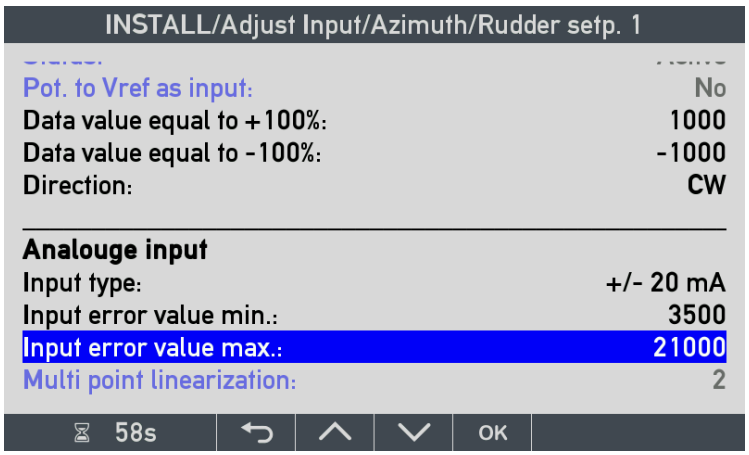
Source: type of data source

Location: the slot where AX1 extension module is installed (or must be installed).

Mode: input mode is in this case Analogue input 2.

Status: active (must be active or else the interface is not working)

Data value equal to + or – 100 % defines the angle value equal to + or - 100 % rudder angle. %Rudder is not used in this azimuth indicator. In some cases, when the % data is not used, the value 0 or 1000 is pre-set for both.

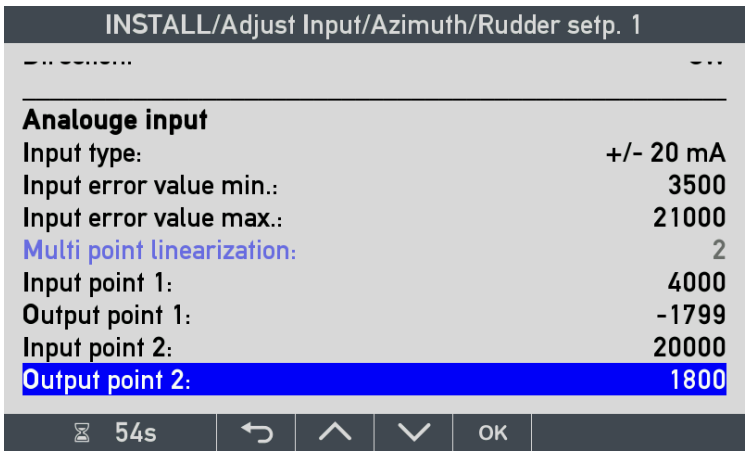


Direction is quite useful if the analogue input is reversed in the actual installation.

But be careful using it on 4-20mA input since it is the +/- sign on the input that is changed when direction is changed !

Input type: can be changed (see below).

Input error value min and max: by setting a valid input range between min and max, it is possible to get an AX1 input error message and data lost indication when input value is outside the range.

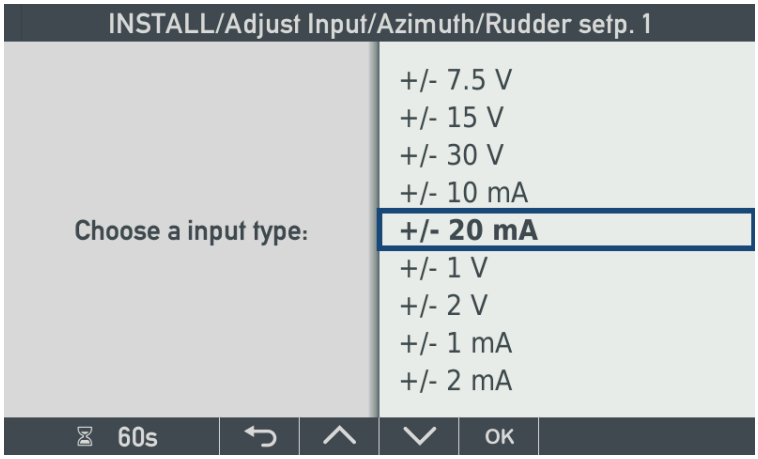


Multi-point linearisation: indicates the number of calibration points that are activated for the input in this VS profile (fixed). In this case, it is 2 point calibration that makes 2 sets of in/out calibration parameters active.

Note: For an azimuth 180° = -180° you should only scale to -179.9° as shown in this example.

Analogue single input types

The analogue input types are shown below. Select the input type and value that best fit your application.



Detailed description is found in the chapter describing the AX1 module.

If the input type is changed, then all used input points must be re-entered, and make sure also to edit the input error min/max values.

The input types are described in more details below and in the chapter regarding AX1 module.

Analogue input with multi-point linearisation
The azimuth angle input is only using 2 point linearisation (scaling) as shown below.

Multi point linearization:	2
Input point 1:	4000
Output point 1:	-1799
Input point 2:	20000
Output point 2:	1800

Input point 1: when input type is +/-20 mA, this parameter is the input current in µA that must be equal to the

Output point 1: in this case, the angle -1799 at the standard resolution of x0.1°.

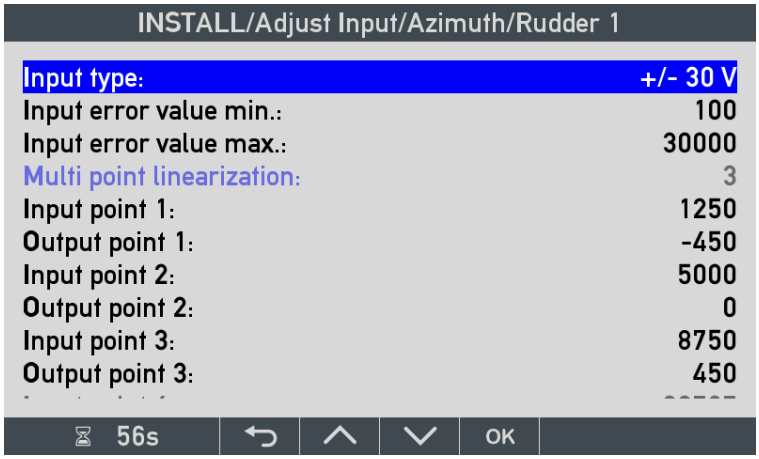
Input point 2: is the input current in µA equal to the

Output point 2: in this case, the angle 1800 at the standard resolution of x0.1°.

(See also AX1 chapter)

Analogue rudder input voltage

When the analogue input is used for rudder applications, 3-point linearisation of the analogue input is normally used. Below is a 0-10V input signal from the rudder sensor calibrated in the actual system.



As it can be seen in the screen picture:

This VS profile use 3 point calibration.

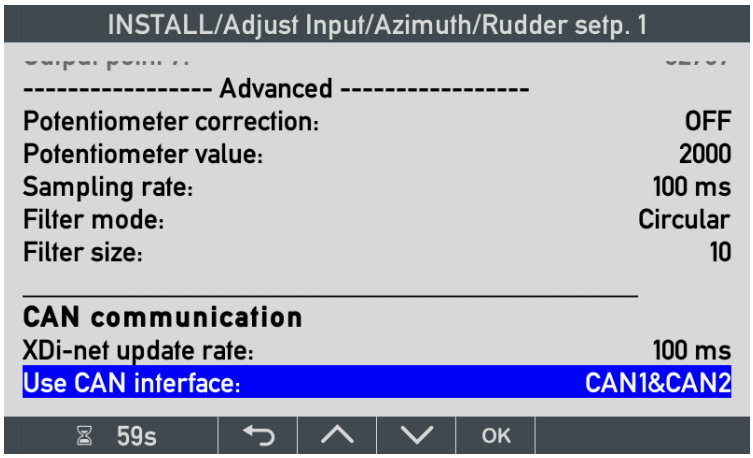
Input point 1 is 1250mV (1.25V), that is equal to

Output point 1: max PS rudder -450 (-45.0°)

In/out 2: 5000mV (5.0V) is the centre 0° and

In/out 3: 8750mV (8.75V) is the max SB rudder 450 (+45.0°).

In XDi it is possible to make customised VS profiles with analogue input that has up to 7-point linearisation (see description in the AX1 chapter).



Potentiometer correction: this function is only active if the input is a single high voltage input (HV). When active, the XDi will compensate the measurements for the impact of the AX1 input resistance on the potentiometer output voltage.

The potentiometer value is ohm.

Sampling rate is default 100 ms. It may be changed in fixed steps (50, **100**, 200, 300, 400, 500, 1000 msec.).

The analogue input data is filtered to avoid fluctuations due to signal noise.

Analogue data filter

Filter mode: is the type of filter algorithm used: off, linear or circular.

Linear: is used for normal linear data type where the value is 0 to X or +/-X.

Circular: is used for angular data types where the data range is circular, meaning that there is a “wraparound” between +X and –X, for example the azimuth type indicator input where the +180 and -180 degree is the same value.

In this example, the input current will change abruptly from 20 mA to 4 mA in a split second when the angle is moved from 180° to -179.9°. To handle this, the special circular filtering algorithm is used to have a smooth transition with normal filter function, also when this point is passed.

Filter size: this parameter defines the number of samples used to calculate the average data value.

Filter size can be set between 0 and 100, where 0 means no filtering and 100 means that the data value is calculated based on an average of the last 100 samples. If data presentation is fluctuating, the filter value should be increased, but be aware that the higher the filter value, the slower the indicator will react on a change.

Data sharing on XDi-net

CAN communication

The scaled data provided by the analogue interface we have looked at may be shared on CANopen using the XDi-net protocol. In all DEIF standard libraries this function is by default set to CAN1 & CAN2, so data is automatically shared with another XDi “repeater” on the same CAN bust that is setup with a XDi-net input profile (usually VS01).

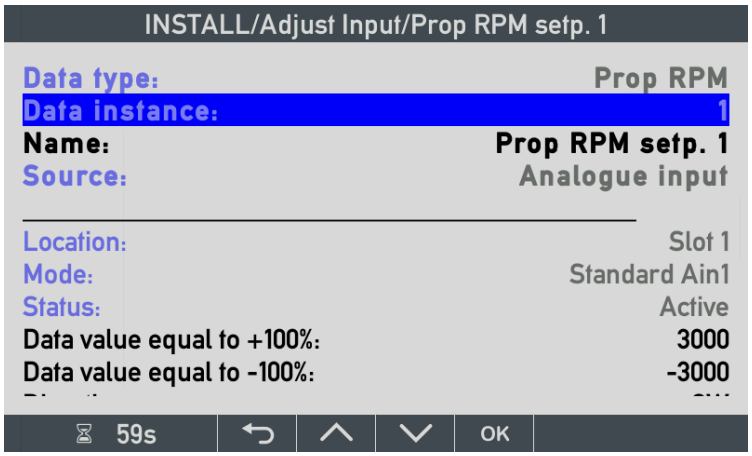
XDi-net update rate: can be used to change the repetition rate on data sent on the CAN bus. Available settings are: 50 ms, **100 ms** (default), 200 ms, 300 ms, 400 ms, 500 ms or 1000 ms. Where 100ms is the default selection.

Use CAN interface: defines if and where XDi-net data is transmitted, settings are: OFF, CAN1, CAN2 or CAN1&CAN2. XDi will share the data that the analogue module is calculation also if it is more than one value.

For example if the AX1 interface in a given indicator is setup to calculate all the four RPM-based data types: RPM, %RPM, %Thrust and %Power, then all 4 types will be shared on CAN using XDi-net protocol if the CAN interface is set active, for example to CAN1.

11.8.2 AX 1 Analogue input for RPM set point

The AX 1 module has 2 input channels that can be set up in the VS profile to represent any type of data available as an analogue voltage, current or potentiometer input signal type. In this example, input 1 on slot 1 is set up as a 4-20 mA input for propeller RPM set point (commanded RPM). The RPM set point is +/-300 RPM equal to +/-100 % RPM, both represented by the 4-20 mA input signal.

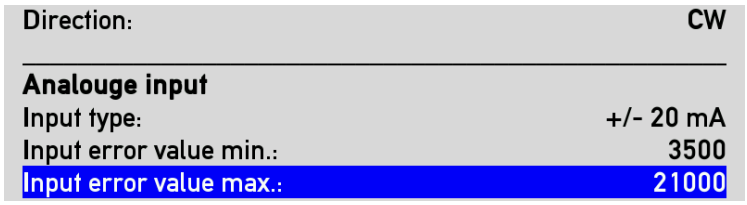


Name: identifies the input parameter, and it may be changed.

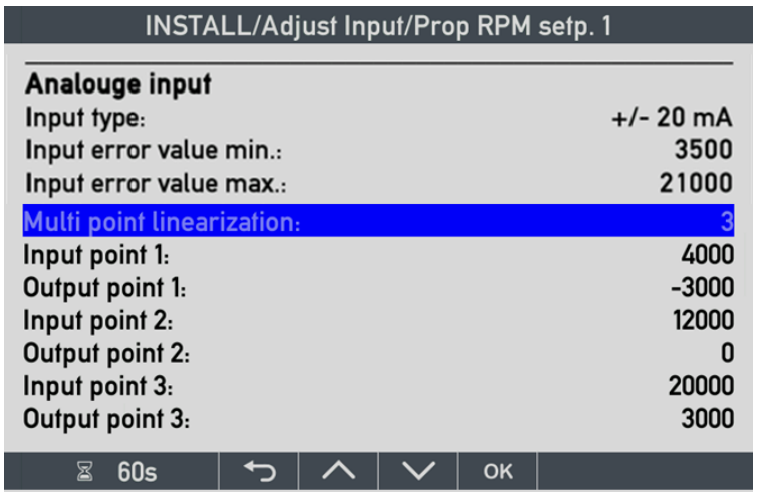
Source: analogue input (single). This is fixed defined in the selected VS.

Data value equal to +100 %: is used to calculate the %RPM set point value (and also %Thrust (%RPM) [2] and %Power (%RPM) [3]. If those data are used by the indicator and set up in the VS).

Direction: CW/CCW can also be set up to change the conversion direction of the analogue input, but please note that it is the sign of the input signal the CW/CCW function is changing, so it is not of any use in a 4-20mA system.



Input error value min/max: See the description for azimuth / rudder



Input type: can be changed. See previous description of AX1 for azimuth.

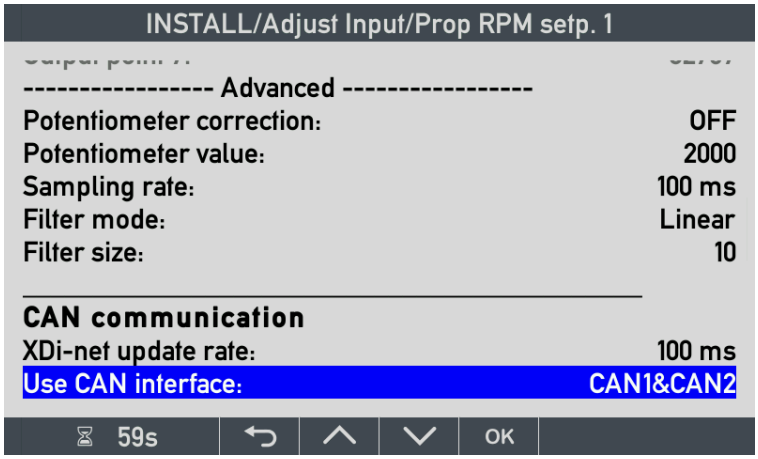
Multi-point linearisation:

RPM is +/- type; therefore 3-point linearisation is used.

Input point 1: 4000 µA (4 mA) equals the output point 2: -3000 res. x0.1 that is equal to -300.0 RPM.

Input point 2: 12000 µA is 0 RPM

Input point 3: 20000 µA is set to output 300.0 RPM.



Potentiometer correction: if a potentiometer is used for the analogue set point, this feature may be useful (see previous chapter for details).

Filter mode: in this case, the normal linear filter type is used.

Filter size: can be set between 0 and 100. Increase the filter value to reduce noise and fluctuations in the presentation.

See previous chapter (AX1 used for azimuth set point) for more details.

11.9 DX1 Digital input adjust

11.9.1 DX1 digital RPM from pickup

A virtual indicator can be configured to receive digital signals directly from one or two RPM pickups as previously described in the DX1 chapter of this document.

The DX1 extension module can be preconfigured in the VS to support either a digital input pair (bidirectional RPM) or as one or two single direction RPM inputs.

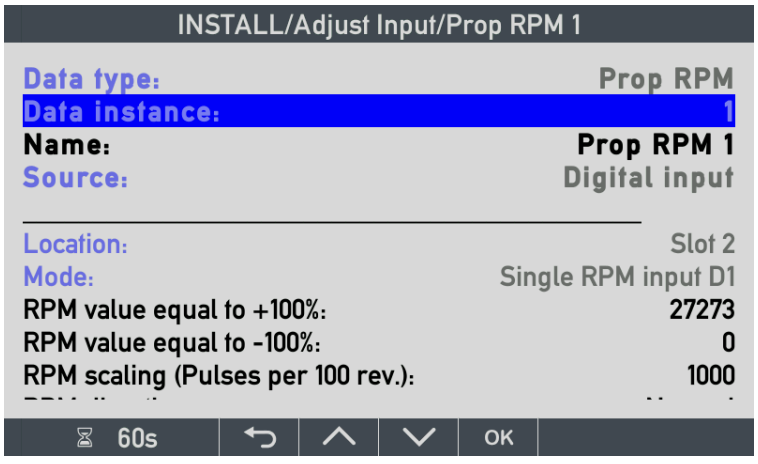
In this example, the RPM is a single direction.

The digital RPM function calculates both the actual RPM value based on pulses per 100 revolutions, and it is also able to calculate %RPM value based on a positive or negative RPM scaling value.

The digital RPM function can also calculate %Thrust as $(\%RPM)^2$ and %Power as $(\%RPM)^3$; this is a predefined setting in the VS, only relevant if one of those parameters are used in the virtual indicator.

(No special setup is needed for %Thrust and %Power).

The above RPM-based calculations are handled by one calculator function in the XDi, and therefore adjustments are handled by one setup menu, described below.

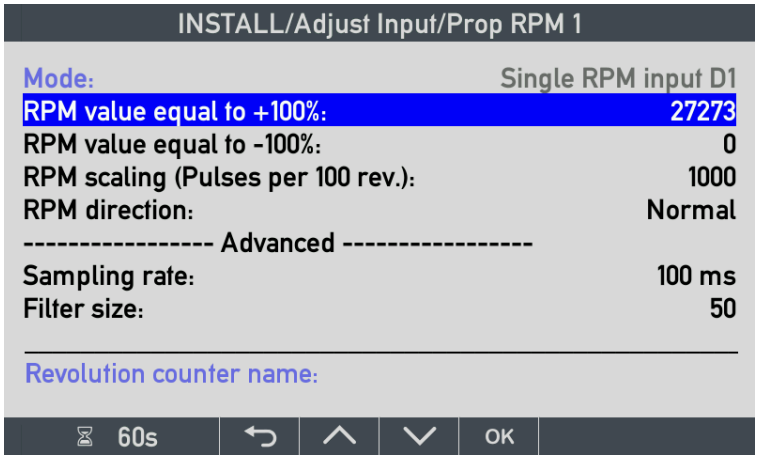


Data type and **Data instance** have the same function as described for the azimuth; they define the data type and instance to use.

Name of the data type may be changed via virtual keyboard.

Source is in this case the digital input from the DX1 module located in slot 2 on the XDi.

Mode: is in this case single RPM input D1, where D1 is short for digital input 1 on the DX1 module.



NOTE: "Revolution counter name" will not be visible in library versions released before January 1st 2023.

RPM value equal to +100 %

This input is also controlling the %RPM bar graph, where the default scaling is set up to 3000 RPM with a 0.1 RPM resolution. In the DEIF standard library, the default 3000.0 RPM is equal to a 110 % RPM scale value. This means that 100 % must be set up to 27273 (x 0.1 RPM = 2727.3 RPM).

If the normal max. RPM in this actual installation is 400 RPM equal to 100 %, then the "RPM value equal to +100 %" must be changed to 4000 (x0.1) RPM. The %RPM bar graph will then be able to show RPM overrun up to 440 RPM.

RPM value equal to -100 %

In this case, it is a single direction input, so this parameter is not used. In case of an RPM bidirectional pair, this value scales the negative %PRM values.

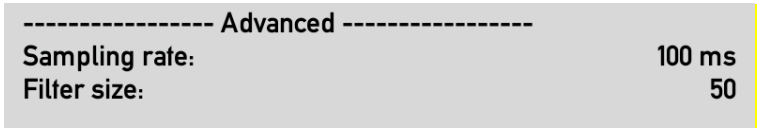
RPM scaling (Pulses per 100 rev.): defines the number of pulses from the pickup that equals 100 revolutions. In this case, there are 10 bolts in the disk on the shaft, so for each revolution of the propeller shaft, 10 pulses will be generated, which equals 1000 pulses per 100 revolutions.

RPM scaling can be set between 60 and 65535.

RPM direction: defines the direction of the rpm. In practise, this function shifts the sign of the RPM value.

The settings are Normal or Reversed.

Advanced functions:



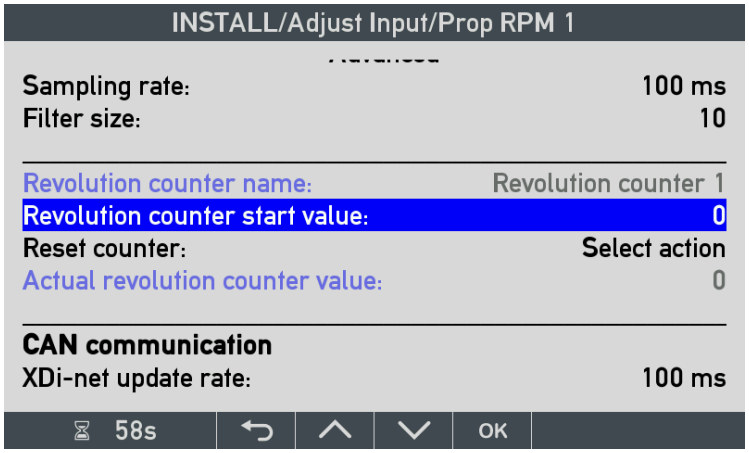
Sampling rate: function should be self-explanatory. It can be set in predefined steps from 50 ms to 1 sec.

Filter size: this parameter defines the number of samples used to calculate the average data value.

Filter size can be set between 0 and 100, where 0 means no filtering and 100 means that the data value is calculated based on an average of the last 100 samples. If data presentation is fluctuating, the filter value should be increased, but be aware that the higher the filter value, the slower the indicator will react on a change.

Revolution counter:

If the revolution counter is not used in the VI, the counter name and value are empty. The start value and Reset counter can be changed but have no effect whatsoever.



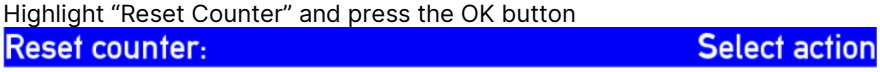
NOTE: In libraries released before January 1st 2023 the Revolution counter menu lines will not be shown.

The **Revolution counter start value** and **Reset counter** can be used to change the actual counter value. This can be used in a service situation, where one XDi with revolution counter function, is replaced with another XDi and you want the new XDi to start with the revolution value that the old XDi was showing.

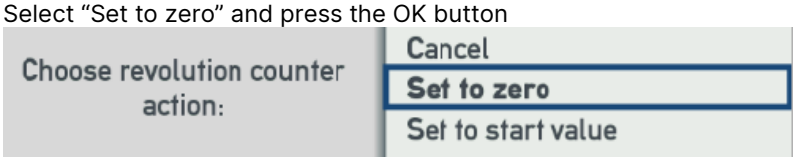
You might also want to reset the counter, if the motor or shaft have been replaced.

- Reset to zero:

1. Highlight “Reset Counter” and press the OK button

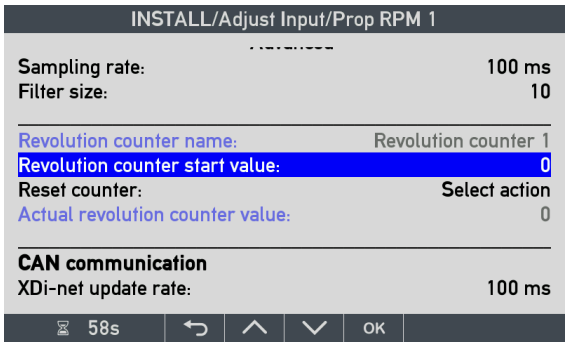


2. Select “Set to zero” and press the OK button

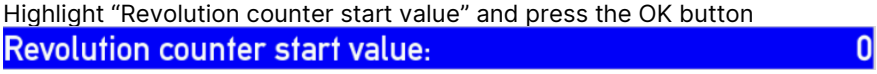


3. The “Actual revolution counter value” will be changed to zero

- Change to start value:



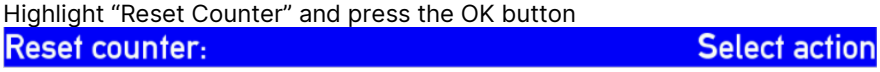
1. Highlight “Revolution counter start value” and press the OK button



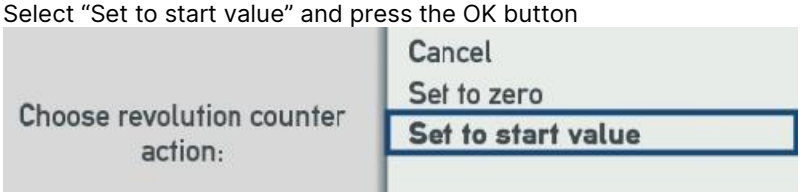
2. Use the buttons to enter the desired start value and press OK

The value must not exceed the maximum number of digits that the virtual indicator can show.

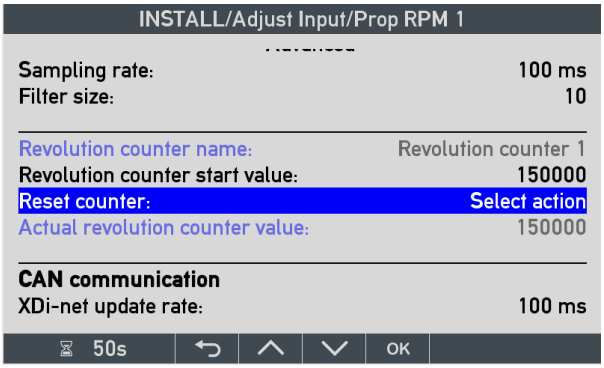
3. Highlight “Reset Counter” and press the OK button



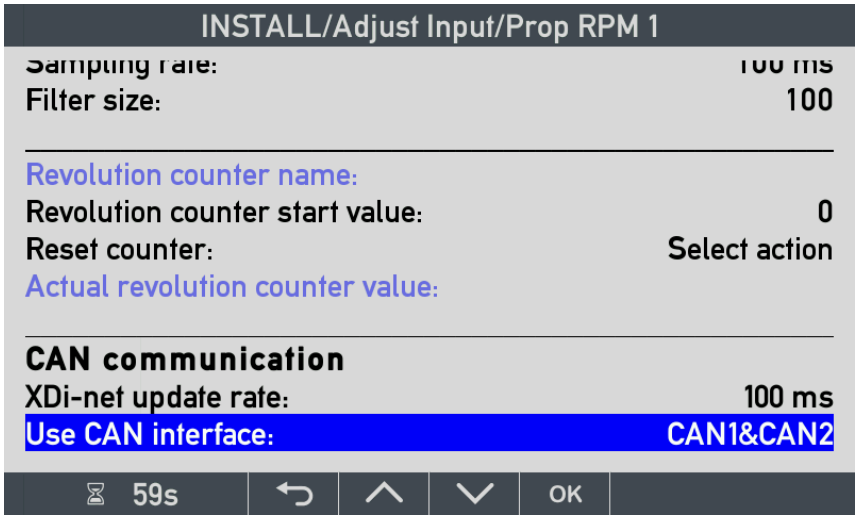
4. Select “Set to start value” and press the OK button



5. The “Actual revolution counter value” will be changed to the start value



CAN communication (XDi-net)



The RPM counter data provided by the digital RPM calculator may be shared on CANopen using the XDi-net protocol. If the VS profile is configured to calculate both RPM and Revolution count both data types will be shared on XDi-net, in the above example both at CAN1 and CAN2.

XDi-net update rate: can be used to change the repetition rate on data sent on the CAN bus. Standard settings are: 50 ms, **100 ms** (default), 200 ms, 300 ms, 400 ms, 500 ms or 1000 ms.

Use CAN interface: defines if and where XDi-net data is transmitted, settings are: OFF, CAN1, CAN2 or CAN1&CAN2. (It is controlling all RPM-based data types setup to be calculated: RPM, %RPM, %Thrust and/or %Power).

Digital RPM data shared in a TPDO

It is also possible to preconfigure the XDi to share digital RPM data using a CANopen TPDO or RPDO, but it must be defined in the VS as a special PDO output. In a customized library it is even possible to get different data types mapped into the same TPDO or RPDO to reduce the data communication load on the bus.

11.10 External input for control flags

The XDi is able to make some changes of indication based on the status of a control flag. Functions like control of the presentation of a data type, for example shift between presenting set point data (visibility flag ON) and turning set point data presentation OFF (visibility flag OFF = invisible). This has also been used to control a text label or shift text label. The flag can be directly controlled using the XDi-net on CAN, but can also be controlled using other input devices such as: analogue input, digital input or CANopen TPDO or RPDO as input.

11.10.1 AX1 – Analogue input as “digital” control input

It is possible to configure an analogue input to act as input for a control flag, for example set up AX1 input1 to be scaled so that for example 0 V is equal to flag value 0, and input voltage ≥5 is scaled to a flag value 1 (for example input voltage 0 to 4.99 V will give flag value 0, and input 5 to 10 V will give flag value 1).

Using this method, even control flag with several control levels can be controlled by one input where the voltage has several steps.

If needed, it can be combined with the multi-point linearisation function to scale the analogue input in up to 7 steps.

This can for example be to externally control the visibility of set point data presented on the virtual indicator, so that set point data is externally controlled to only be shown when there is a change, and then turned off again after a short while or when actual data has reached the set point. This has to be controlled via the analogue input by the external control system; it is not performed by the XDi.

In some cases, it can be useful to be able to use a spare analogue input as a digital control input, but it will normally be in connection with a customized library solution. If you have special wishes, please contact the experts at DEIF to get help to find the best solution for your application.

The control flag function setup and default settings must be predefined in the VS for the actual virtual indicator.

The setup menu is the standard analogue input adjust menu, presented in another section of this document.

More complex control of a flag may require digital input(s) on the DX1 module instead.

11.10.2 DX1 - Universal digital input of a control flag

Control flags may also be externally controlled using a digital input (DX1). The input can be defined to control a flag in the object index table.

This can be used to control visibility of a data type as described for the AX1 module or other similar control functions. Two digital inputs can also be set up as a pair to control 4 flag levels.

In XDi-N this function can for example be used to externally control the shift between several screens on the XDi or even screen shift on a complete group of XDi-N indicators connected via CAN and using the screen mode group function (see separate description).

The digital flag setup can set a defined object index to a predefined internal control flag value.

This function may be used in customised libraries, and the function depends on the actual indicator application. Therefore, it is not described in more details in this manual.

11.11 DX1 Relay output adjust

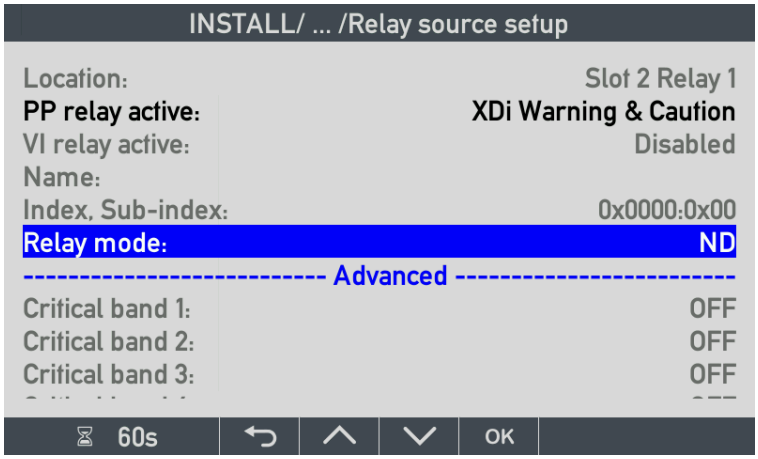
The two relay outputs on the DX1 module can be configured to be controlled either by product-related event, pre-set in the selected PP and/or by an indicator-specific event predefined in the VS profile for the selected virtual indicator.

The product related relay functions are available when a DX1 module is mounted. If the function is disabled in the PP, it can be activated from the installation menu.

The virtual indicator (VI)-related relay functions must be preconfigured in the VS profile for the relay function to be available in the menu. If menu lines are greyed, out it is because they cannot be selected or edited.

It is possible to activate both PP and VI relay control at the same time. If both are active, the XDi performs an “or” function, and if one of the events is true, the relay will be activated. This means that the relay can be activated both if the indicator pointer is within a critical band and if data is lost (warning).

To enter the Relay setup go to Install menu-> Adjust output-> Relay setup, and select the relay:



In this example, relay 1 is set up to be activated when a warning or caution event is present in the XDi. The actual warning or caution that will activate the relay depends on which warnings or cautions are activated in the selected PP or set up via the XDi user menu.

The grey functions in the menu will first be active if the “VI relay active” is activated. In this example, the VI-related functions are not predefined in the VS, and the “VI relay active” is therefore greyed out too.

11.11.1 Product-related events

The “PP Relay active” function defines which product-related events the relay must be controlled by (control event).

The following event selections are available: disabled, XDi warning, XDi caution or XDi warning & caution.

It is the same warnings that the XDi presents in an amber (orange) pop-up on the display, and cautions are the ones presented periodically in a yellow pop-up.

Warnings are the reporting of more important issues like CAN bus errors and data lost, but it can also be if the power supply is low in a system with single power supply.

Where cautions are minor issues that may become important if not acted on, for example if one of the power supply lines in a redundant powered system is low or missing. This is not an important problem as long as the second power supply is OK.

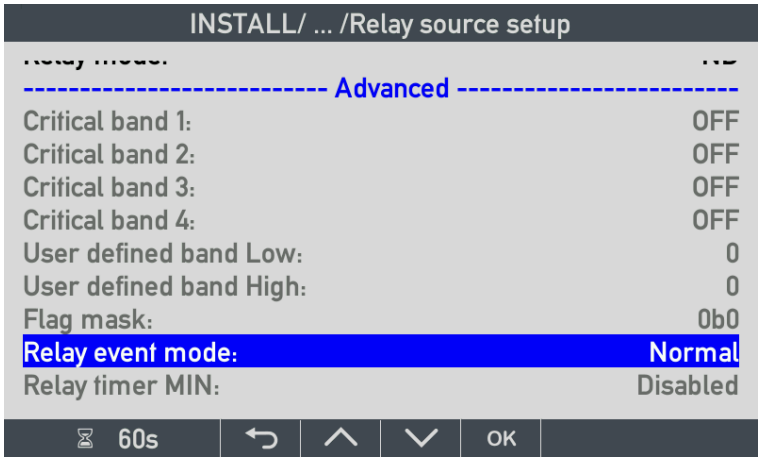
Some of the warning/caution functions can be set ON/OFF in the user menu, and this will affect the relay function accordingly. (Turning off sound on warnings and cautions does not affect the relay function).

11.11.2 Relay mode

The relay mode defines the relay idle state. There are two modes:

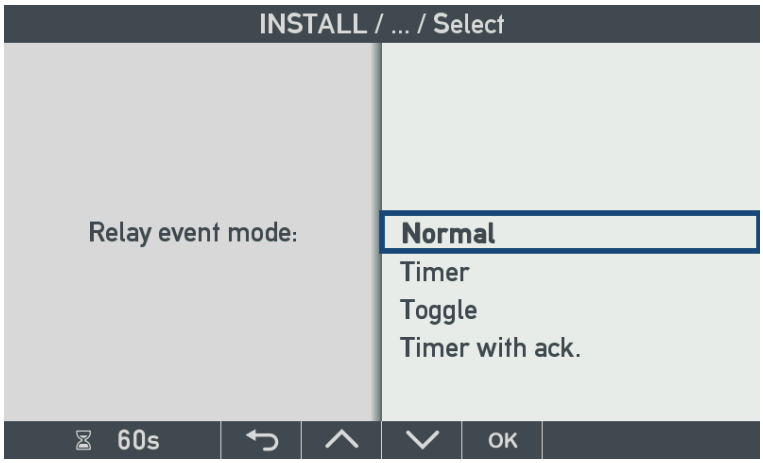
- Normal de-energised (ND); the relay is not activated as long as the control event is “False”.
- Normal energised (NE), the relay is activated as long as the control event is “False”.

When NE is used, the relay contact will be activated when the XDi is powered up and for as long as the relay control event is “False”. This means that both supply power dropout and control event “True” will change the relay state. This is often used where the relay is used for important warnings or even in some cases alarms, I a customized XDi is designed into a system using this functionality.



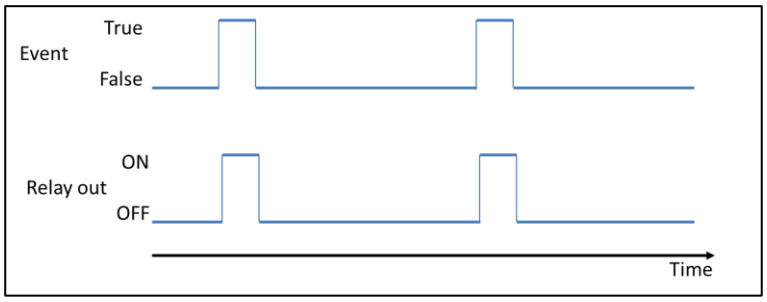
11.11.3 Relay event mode

The relay mode defines how the relay acts on the event that is set up to activate the relay function. Selecting the right mode and timing parameters can adapt the function to different applications.



Normal mode

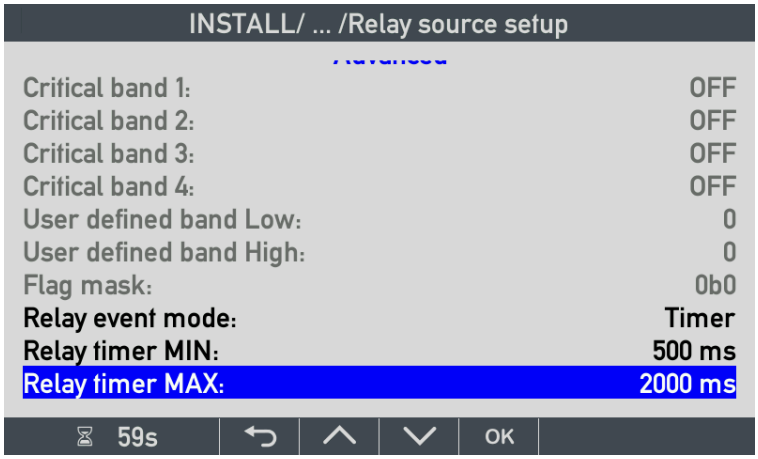
The relay will act directly on the event. When the event occurs (true), the relay will be activated and stay activated as long as the event is true and first deactivate when the event disappears (false).



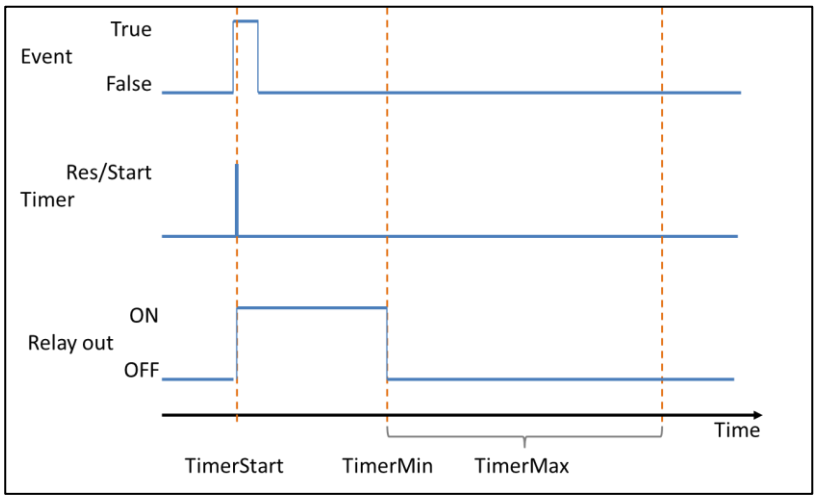
Relay in ND mode

Timer mode

This is a function that runs every time the event occurs, but only once, so the event has to disappear, before the timer function will be able to run again.

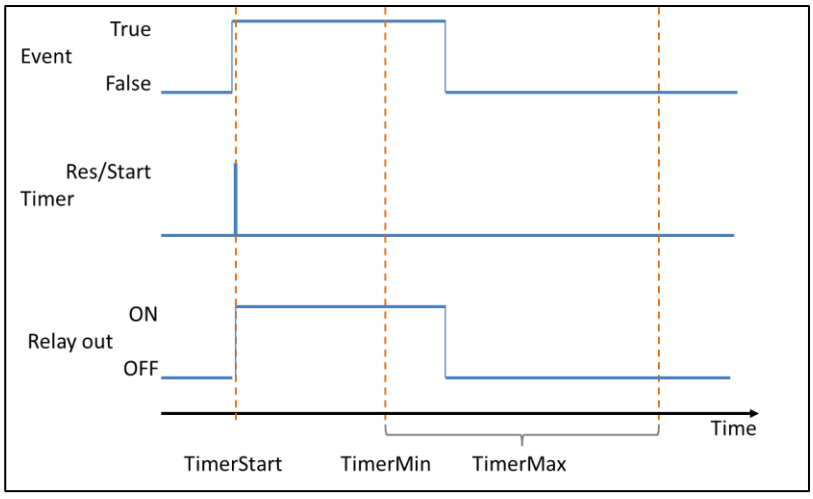


The two timing parameters “Relay timer MIN” and “Relay timer MAX” can be predefined or changed via menu to one of the following selections: disabled, 500, 1000, 1500,... 30000 ms (steps of 500 ms until 10000, 1000 ms from 10000 to 30000).



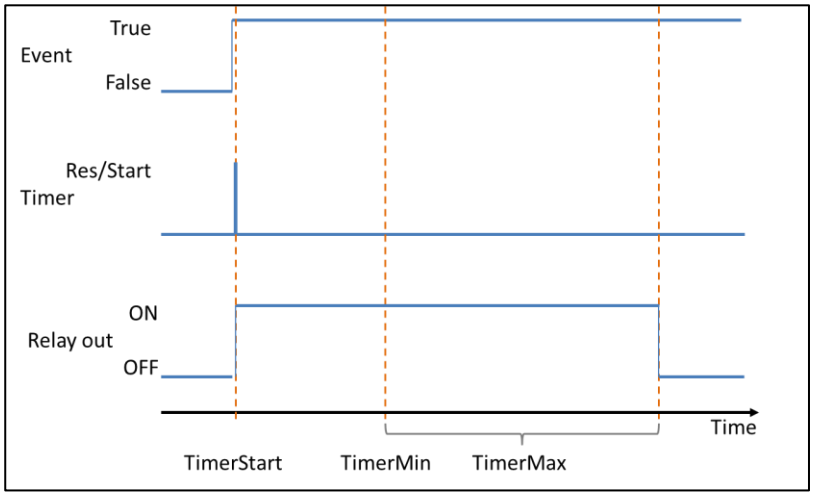
Relay in ND mode.

The timer mode can be used to make a short event activate a longer relay output. This can be useful in several situations where the relay is driving a warning lamp or an acoustic alarm. If the short event happens again after “Timer min.”, then the sequence will reappear.



Relay in ND mode.

In this example, the event lasts longer than “Timer Min.”, but it is not longer than the (Timer Min + Timer Max) limit, so the relay output will be equal to the length of the event.



Relay in ND mode.

In this example, the event lasts longer than “Timer Min.+Timer Max” time limit, and the relay output will switch OFF when the time limit is reached.

In general, the timer function can be used to secure a minimum length of the relay output, but also to shorten a very long event.

If “Timer MAX” is disabled (it is the same as 0 msec.), then the relay output will always have the same ON time whenever triggered.

Example: the XDi is set up to monitor power supply 1 and 2 and provide a caution if power is not OK. The DX1 Relay 1 is set up to act on the event “XDi caution” and timer mode is used with setting: Timer Min.: 3000 msec. and Timer Max.: 10,000 msec.

The XDi power supply 1 is shortly interrupted for approx. 1 sec, the XDi issues a caution on the display, and at the same time relay 1 is activated and is ON for 3 sec. before it goes OFF again.

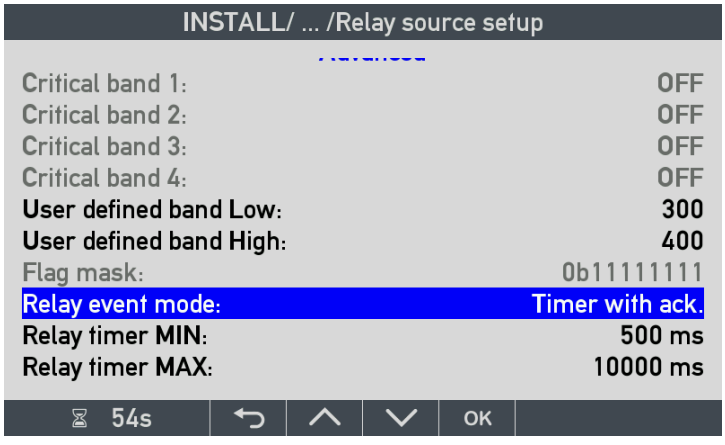
Later that day power supply drops totally out and again the caution is issued, but this time the relay 1 will stay on for 3+10 seconds before it goes OFF again. If the power supply 1 lost event is still there, the caution will be indicated periodically on the XDi display, but the relay output will not go on again before the event has disappeared for a short while and then re-appear.

The timer function will only react once on a given event.

In the above example, if you desire the relay output to periodically repeat the activation for as long as the event lasts, then the “Toggle mode” is the right choice, and it will be described in the following.

Timer mode with acknowledge

This timer mode works like the normal timer mode. When the Relay time min and max is setup, and the relay is activated by an event. When the relay is activated, it is possible for a person to deactivate it again, by simply pushing any of the front buttons shortly.
This function was implemented in connection with the XDi upgrade to platform 2 (including XDi-N). In that connection front frame with pushbuttons was made available for all XDi models and with front pushbuttons a manual acknowledge function can sometimes be useful.



In the above example a rudder angle indicator is activating the timer function when the value is inside 300 to 400 (equal to outside SB 30.0° on this 40 degree indicator). The relay activates when the event happens, and it stays on for minimum 0.5 seconds even if the rudder again moves below 30°. If the rudder continues to be >30° then the relay is disabled after 10 seconds.

If you don't need a minimum time, you can disable "Relay timer MIN".

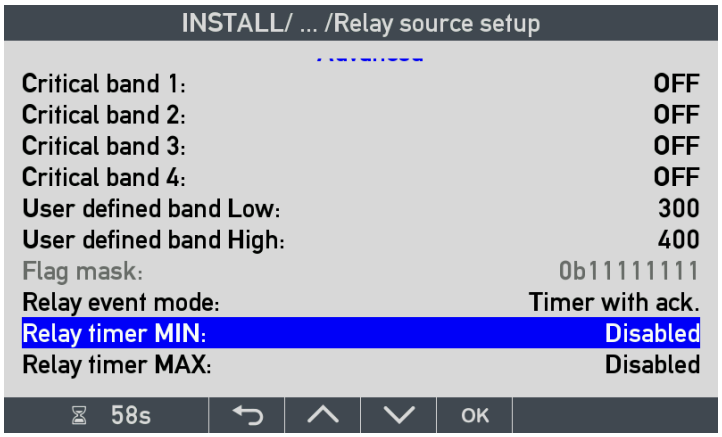
Acknowledge (Normal): The operator can disable the relay within the activation timer frame above, by shortly pushing any of the buttons on the XDi front frame.

NOTE: If external pushbuttons are connected via an NX1 or 2 module then acknowledge can also be performed from an external pushbutton.

Special acknowledge setup 1

In this mode you can set the Relay timers to "Disabled",

If you disable both "Relay timer MAX" and "Relay timer MIN"

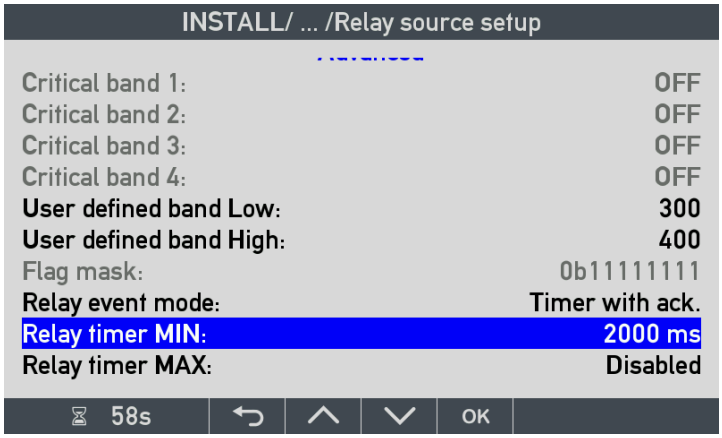


The relay will activate immediately when the rudder angle exceeds 30° and it will stay active until you make an acknowledge by pushing any of the front buttons.

Even if the rudder again moves into the normal sector below 30° the relay will stay activated.

Special acknowledge setup 2

The "Relay timer MIN" has a slightly different function when "Relay timer MAX" is disabled, the minimum timer will act as a delay.



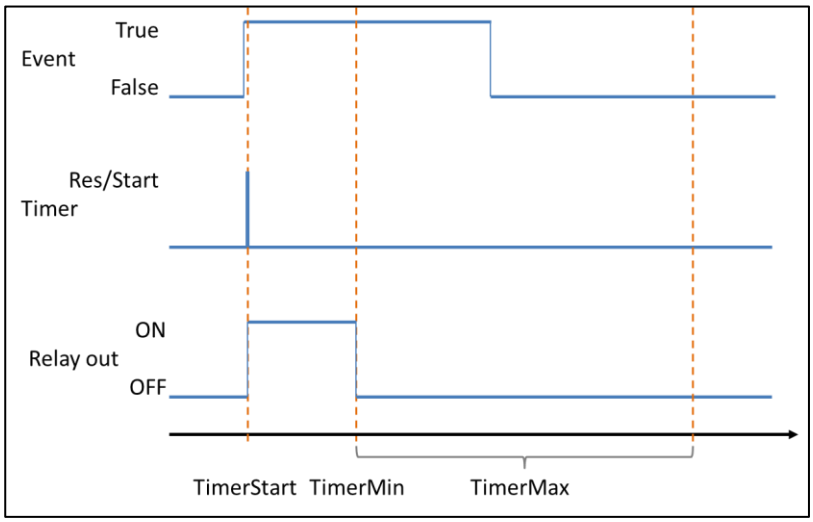
In this example with Relay timer MIN at 2000ms the relay will first activate when the rudder has stayed at, or above, 30° for the 2 second period and it will then stay active until you acknowledge by pushing any of the front buttons.

NOTE: Even if the rudder again moves into the normal sector below 30° the relay will stay activated until it is acknowledged.

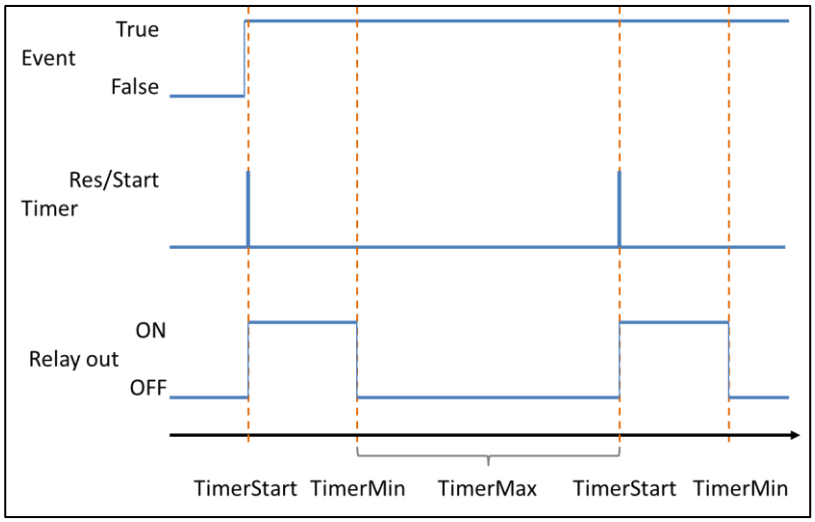
Toggle mode

The toggle mode is another way of controlling the relay output timing when it is triggered by a given event.

For events shorter than “Timer Min.”, the relay output acts like in normal mode event and relay output have the same length. But if the event is longer than “Timer Min.”, then the relay output will be forced OFF when the “Timer Min.” limit is reached.



If the event continues after “Timer Min.” +” Timer Max.” time limit, then the timer will be reset and restarted when this time limit is reached. This activates a new output pulse of a length defined by “Timer Min.”.



This function will periodically activate the relay output as long at the same event still exists.

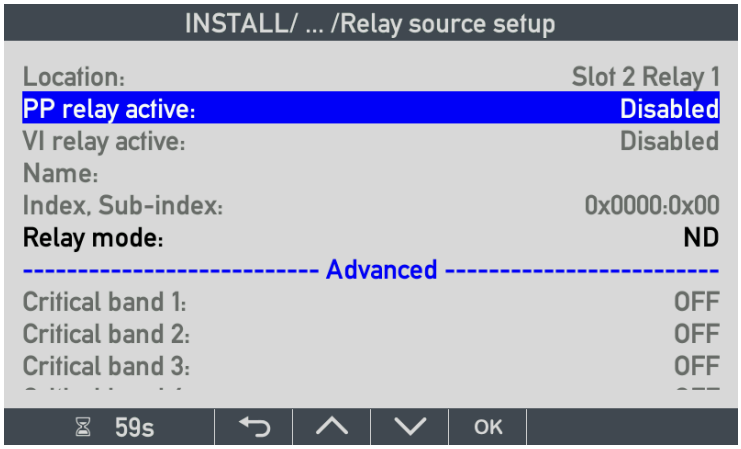
If the event is shortly interrupted, the toggle function will restart and act as if it was a new event.

11.11.4 Indicator-related relay setup

The relay can also be configured to react on event(s) predefined in the virtual indicator setup profile (VS). The “VI relay function” is only accessible for adjustments in the “Relay source” menu when it is predefined in the selected VS.

The VI relay functions that can be selected in the “VI relay active” menu line are:

- Disabled (the function is inactive)
- Activate inside Critical band
- Activate outside Critical band
- Activate below user def. low value
- Activate above user def. high value
- Activate on flag-H (Flag & mask >=1)
- Activate on flag-L (Flag & mask =0)



When the “VI relay active” is set up, the “Name” and the “Index, Sub-index” defines which data type or flag is controlling the relay output. Example: we want the relay 1 to be controlled by Propeller RPM instance 1, then the object index will be 0x3081 (Prop. RPM instance 1), and the sub-index 0x02 (actual data) or in the notation used in the menu: 0x3081:0x02. If the relay should instead react on set point data for propeller RPM 1, then the sub-index must be 0x07.

Activate inside critical band

All normal variable data (like RPM) has up to 4 critical bands where Max and Min. can define warning marks on the indicator scale as previously described. But the same critical bands can also be used to define boundaries for relay functions.

If for example “VI relay active” is set up to “Activate inside critical band” and critical band 1 is set to “ON”, then the relay will activate when the data value is within the boundaries (max/min) of critical band 1. The relay event mode (ND/NE) will define how the output will act as previously described.

More than one critical band may be activated at a time.

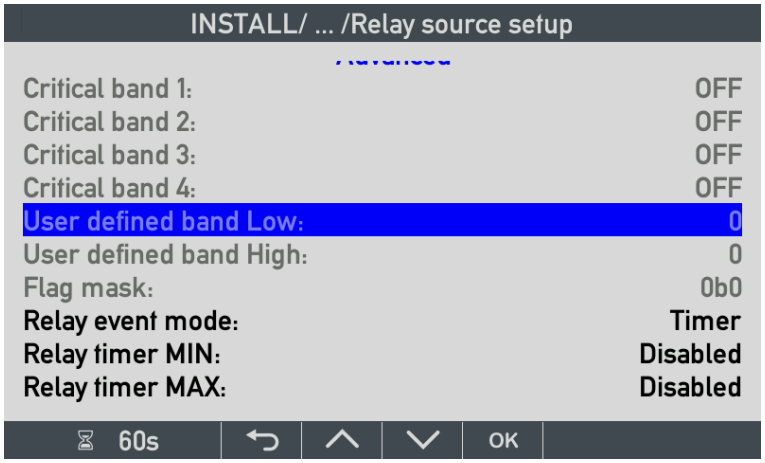
Activate outside critical band

This function works similar to the function “Activate inside critical band”. In this case, the relay is activated when the data value is outside the active critical band(s).

More than one critical band may be activated at a time.

User-defined relay activation band

It is also possible to insert one additional custom relay activation band. The user defined band is activated by inserting the required low and high value defining the band boundaries.



If the low and high values are the same (for example 0), the user-defined band is disabled.

The user-defined band may be used separately or in addition to the 4 critical bands.

Relay controlled by internal flag:

If the predefined index/sub-index is an internal flag, the flag mask is used to determine which bits in the flag the relay must react on. The flag mask value is multiplied with the flag value (using logic “AND” function), and the result controls

the relay. This is also a function that must be preconfigured into the VS for a given virtual indicator, and the detailed description will be in the library specification document.

11.11.5 Relay activation indication on a VI

The extended relay function in software platform 2 open also for indication of the relay status on the indicator screen. It can for example be a text label that is presented when the relay is activated and another when it is deactivated. For example, the text: Normal and Overload.

It can of cause also be a text that is only shown in case the relay is activated for ex. WIND WARNING !

The text line can for example be made as a text label that is controlled by the relay status flag function.

It can also be a graphical symbol that is shown in the VI indicator screen when the relay is activated,

for example, like this: 

If you need a special warning or alarm function in your customized library, please take contact with the experts at DEIF.

11.12 NMEA output using NX1 (or NX2)

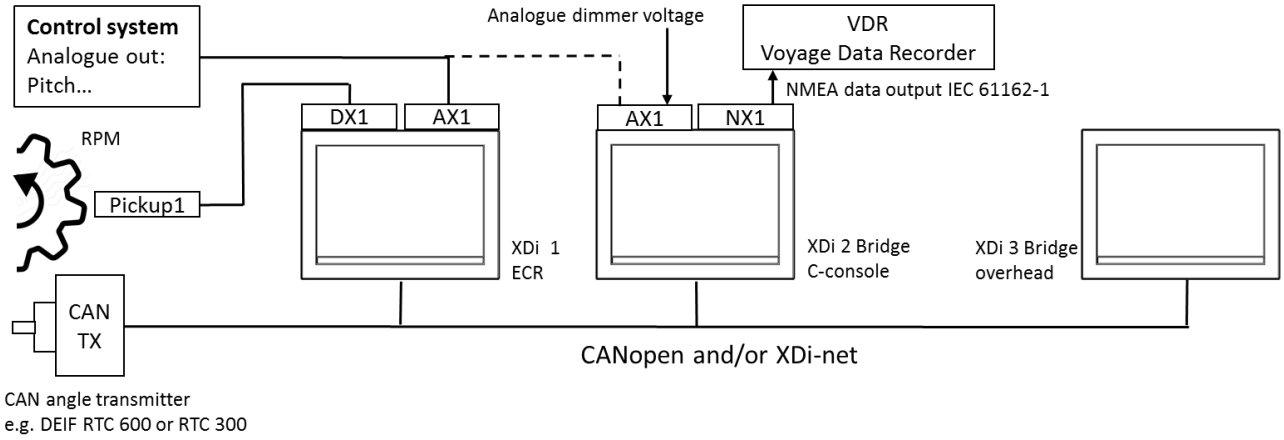
Some data types, generated by the XDi via analogue or digital input, may be necessary for external systems, such as Voyage Data Recorder (VDR) or the integrated navigation system. XDi is able to share such data on NMEA0183 with the same high digital data accuracy used in the XDi system. The XDi must have the NX1 NMEA output or NX2 NMEA in/out module installed, and the set up profile (VS) for the selected virtual indicator must be preconfigured to support the NMEA output for the actual data type.

This function obviously requires a free slot for the NX module, but if data is shared to other XDi units using CAN (for example XDi-net), then one of these other XDi units can be set up as an NMEA output source.

The NX1 module has one NMEA output port and the NX2 module has one standard NMEA output but the RS485 type output can also be configured as an output if it is not used as a NMEA input.

The NX module can be mounted in one of the two slots available on XDi 144/192 (only one slot on XDi 96). It is possible to mount two NX modules on XDi144/192 at the same time and route data to each output individually. The same data type can even be shared on both. This can be beneficial if the two systems need galvanic separation of the outputs. (Note that normally, galvanic separation is obtained on the input side).

Example: in an RPM indicator system, the XDi with DX1 extension module is located in the engine control room (ECR) and calculates the RPM value, based on the inductive pickup input signal. RPM data is shared on XDi-net (CAN) with 2 XDi indicators on the bridge.



One of these indicators is located in the centre console close to the VDR, which requires the RPM data from the indicator system. This XDi unit in the centre console is therefore equipped with a NX1 module connected to the VDR and is set up to output RPM data on the NMEA serial data output (RS422 according to IEC61162-1).

The combination of input modules, data sharing on CAN and outputting NEMA data close to where they are needed, makes this a very flexible system solution.

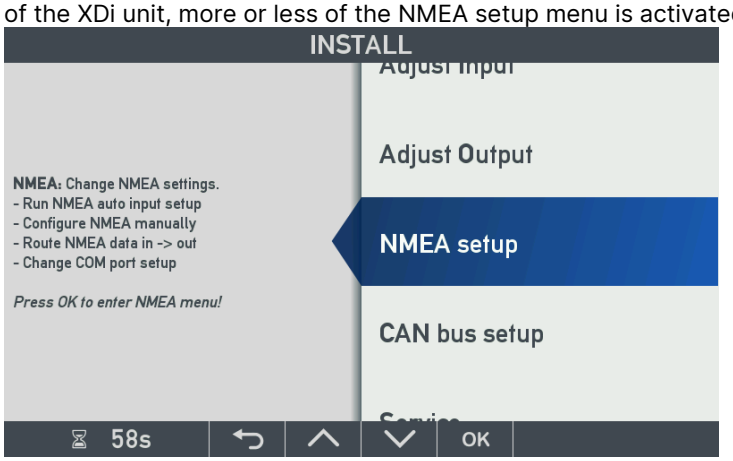
11.12.1 NMEA output in standard virtual indicators

In most cases DEIF standard indicators are prepared for NMEA output support it there are a spare slot for a NX extension module. If it is standard propulsion indicators showing RPM, like the type we looked at in the previous example, then the NX module with NMEA are supported and preconfigured in the relevant VS profiles. Please note that the NMEA output by default is set to OFF.

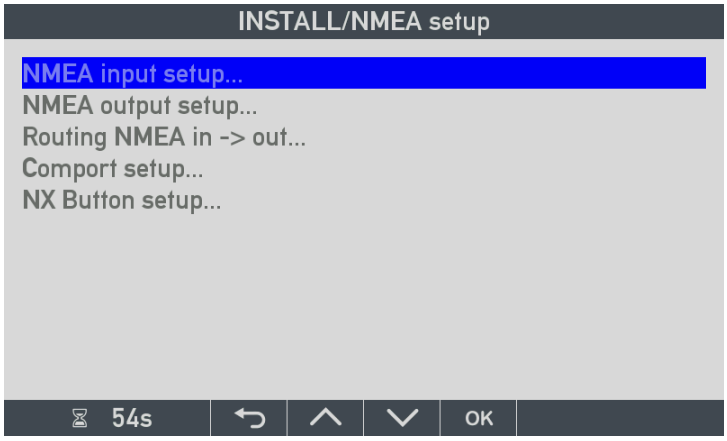
To activate the output after you have installed the NX1 extension module on the recommended slot (often slot 2) you must go into the installation menu and select “NMEA setup”.

11.13 NX1/NX2 NMEA0183 setup menu

XDi can be extended with two different types of NMEA interfaces. NX1 contains a single NMEA0183 (RS422) type output and the more advanced NX2 module has also one standard NMEA output, but in addition two standard NMEA inputs (RS422) with galvanic separation (opto-insulation) and one RS485 serial data channel that can be configured either as an input or as an output using NMEA0183 protocol, (but not both input and output at the same time). Depending on the type of NX extension module and/or the combination of NX modules installed on the extension slots of the XDi unit, more or less of the NMEA setup menu is activated.



If no NX module is mounted on the XDi, the NMEA setup menu line can be selected by pushing OK, but all the content in the opened menu is greyed out.



NMEA input setup is available for XDi (D, M or N) that has a NX2 module and where NMEA input is enabled in the library.

XDi output setup is available for XDi (D, M or N) with a NX1 or NX2 module and where the selected VI/VS profile contains a NMEA output setup.

Routing NMEA in -> out is only available in XDi-N with at least one NX2 module connected.

NX Button setup is available on XDi (D, M, N) with at least one NX1 or NX2 mounted.

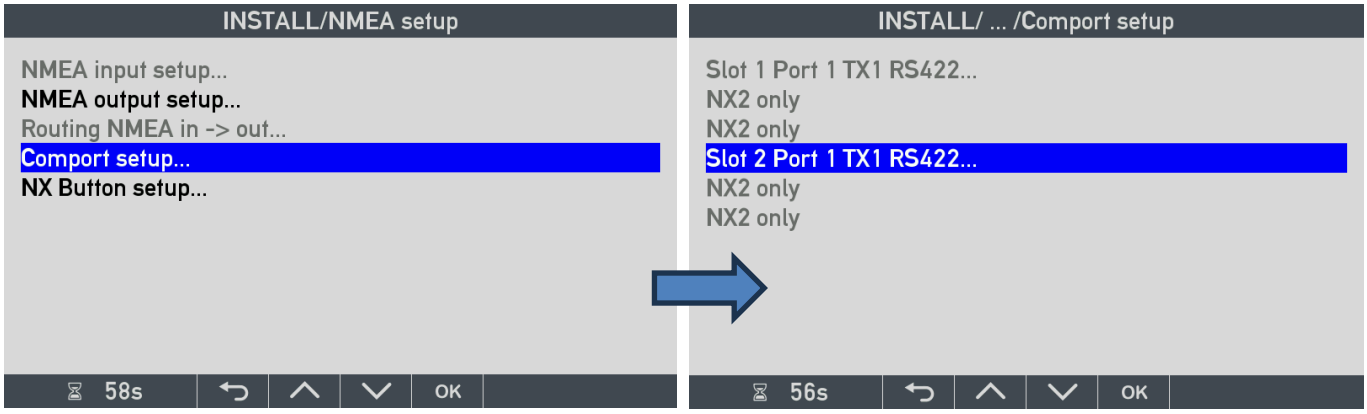
No NX module is mounted on the XDi above all menu lines are grey.

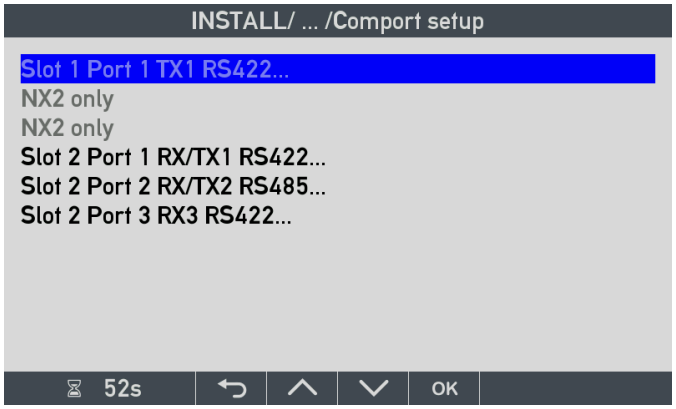
NOTE: Remember to disconnect the power supply before you install a NX module on you XDi unit.

When a NX module is mounted on the XDi, in the following it is a NX1 module mounted on a XDi 192D on Slot 2.

11.13.1 COM port setup

With the NX1 module mounted on the XDi you can enter the menu lines that is relevant for this XDi configuration:





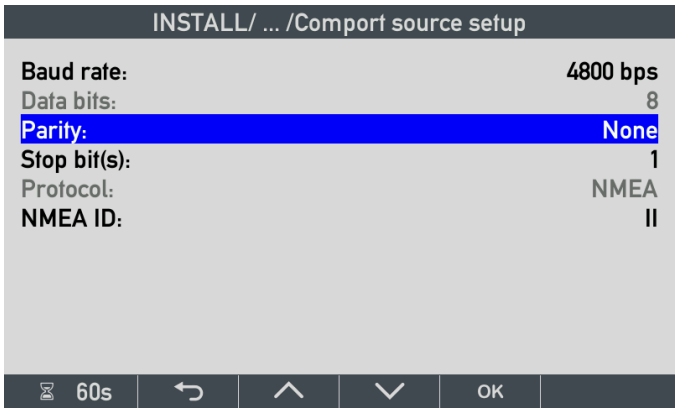
Please note that NMEA input 1 (RX1) and output 1 (TX1) is using the same UART and is therefore setup as one port, that is COM1.

RX2 and TX 2 is a RS485 port that can be configured as either a NMEA input or NMEA output, there is therefore also in this case one setup for the COM2 port.

RX3 use a separate UART and can be setup independent of the other 2 ports, this is COM 3.

Standard NMEA input/ output

In DEIF standard libraries all the RS422 (and RS485) NMEA COM ports are by default set up according to IEC 61162-1/NMEA0183 standard:



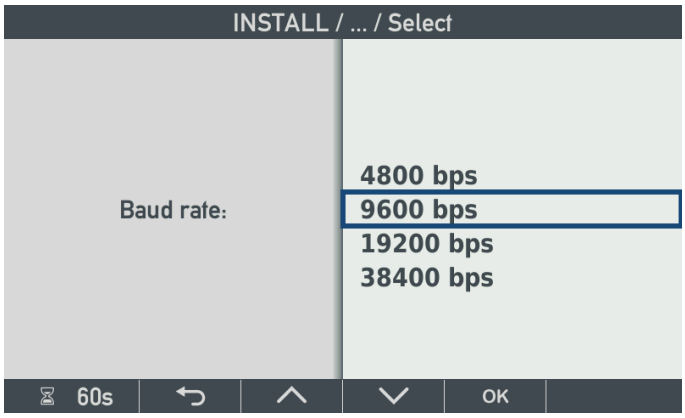
It is possible to change the settings for each COM port independently. A XDi-N with two NX2 modules mounted will have 6 COM ports that can be configured independently.

Changing bitrate can be used to increase the data bandwidth, default NMEA0183 is 4800 bps.

High speed NMEA input / output

To comply with IEC 61162-2 you must change the Baud rate to 38.400 bps.

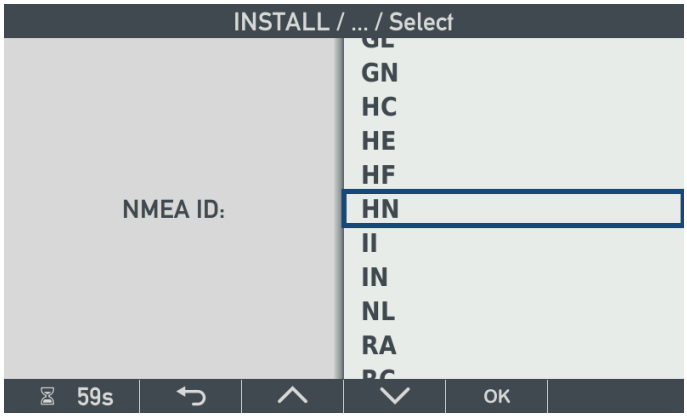
In a customized library the default NMEA bitrate can be setup differently for one or more input ports, this can sometimes be useful to connect a Gyro-compass that often have a high speed NMEA output port.



NMEA talker ID

NMEA ID is the NMEA0183 talker ID. This can be changed to one of the other valid NMEA talker IDs.

In some cases, the connected system requires a specific talker ID to accept the NMEA data sentence.



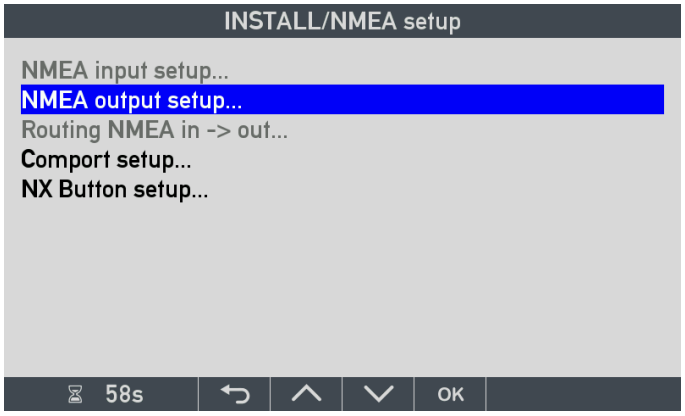
XDi supports all the relevant talker IDs defined in the IEC 61162-1 standard.

Please note that XDi can send NMEA data with different talker IDs depending on which COM port is used. This can be useful in cases where different data of the same type (same sentence name) is transmitted on the same NMEA communication line and where the receiver must be able to distinguish between different data of the same type.

11.13.2 NMEA output setup

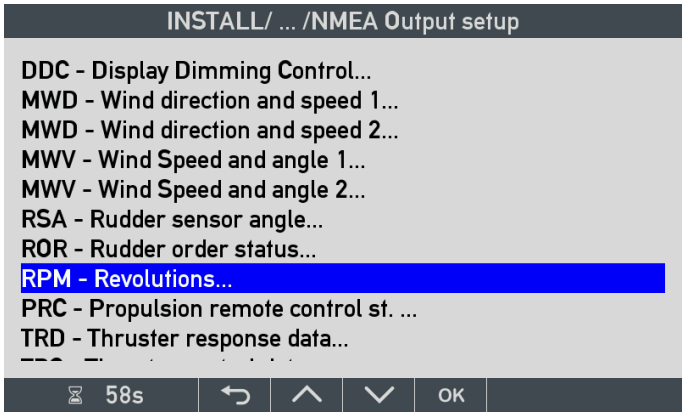
XDi can be setup to transmit some of its internal data in a NMEA0183 sentence format on a serial output on the NX1 or NX2 extension module. You can find a list of data types that can be supported if setup in the VS profile for the selected virtual indicator. It can for example be an XDi 144D with standard RPM library and analogue 4-20mA input that is setup to be able to share the NMEA $xxRPM sentence if a NX module is attached. Where xx is the NMEA talker ID for the COM port that is used to transmit the sentence.

To change the default settings of the supported NMEA sentences shown in the menu below, simply highlight the sentence line and press OK to open the setup menu.



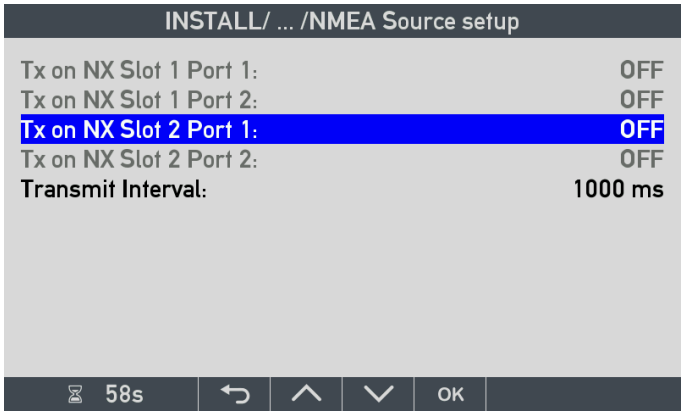
If no NX1 module is mounted on the XDi, the NMEA output setup menu line cannot be selected (greyed out).

If you press OK on the highlighted menu above:



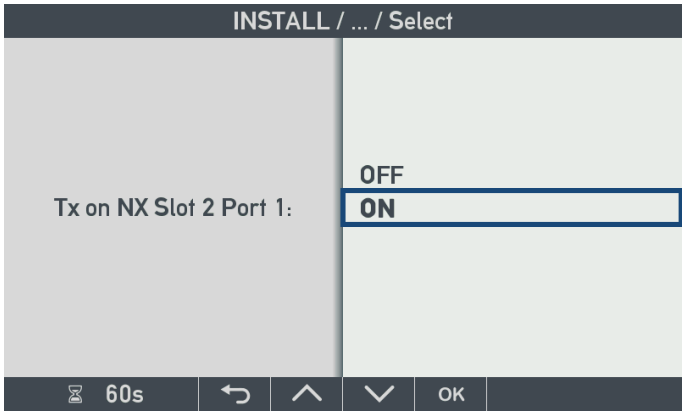
It is only the data types that is relevant for the selected indicators that you can enter and activate.

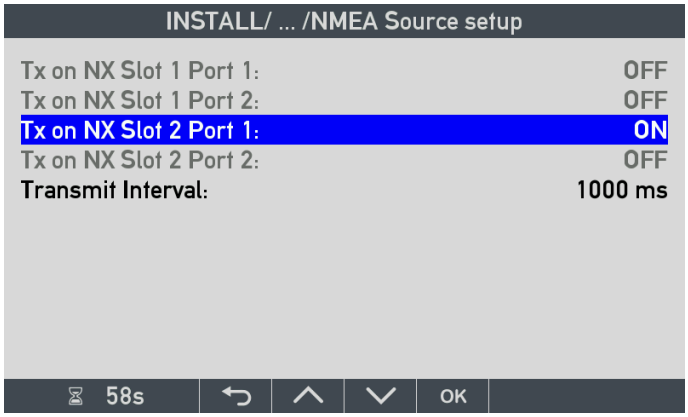
The NMEA sentence RPM is opened for editing by highlighting “RPM – Revolutions...” and press OK.



NX1 has only one NMEA output port, Port 1. The greyed out Port 2 is only available if NX2 module is used.

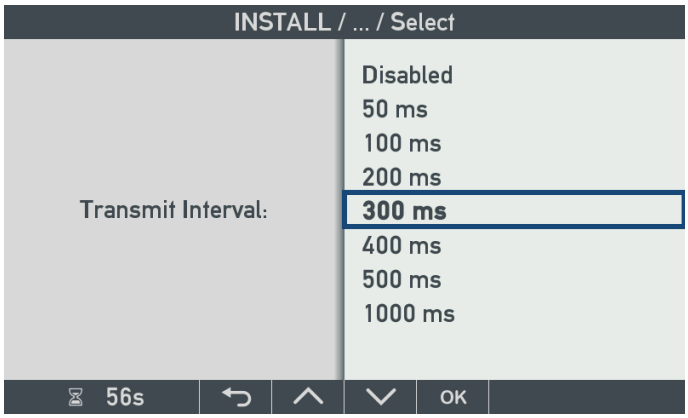
In this example, you can only select to send RPM data on “Slot2 Port1”.





If the NX1 module was mounted in Slot 1, then “Slot1 Port1” can be selected.

The transmit interval can be changed in fixed steps from 50 ms to 1 s (or output can be Disabled).



You must consider the very limited bandwidth of the NMEA0183 port running at 4800 bps. Update every 1 sec. is often used for data not changing that fast. Where compass data in some cases is transmitted every 50msec (20 times per second), in such cases the high speed NMEA standard IEC 61162-2 with 38400 bps is often used.

11.13.3 NMEA input setup (NX2 only)

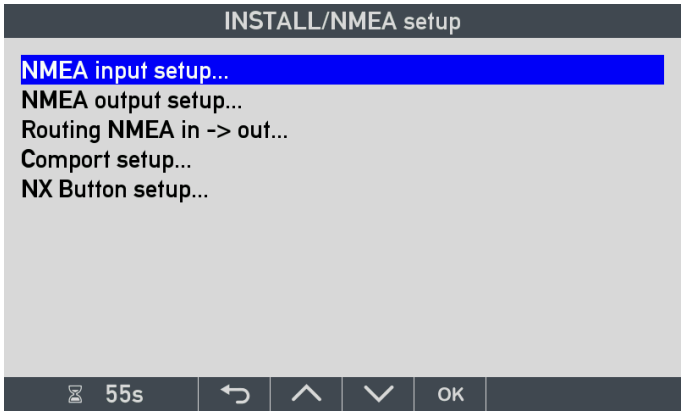
If you make changes in your installation or want to change to use another NMEA input source or adjust the setup parameters, you must access the installation menu and make the changes.

Change NMEA input source using the NMEA installation menu

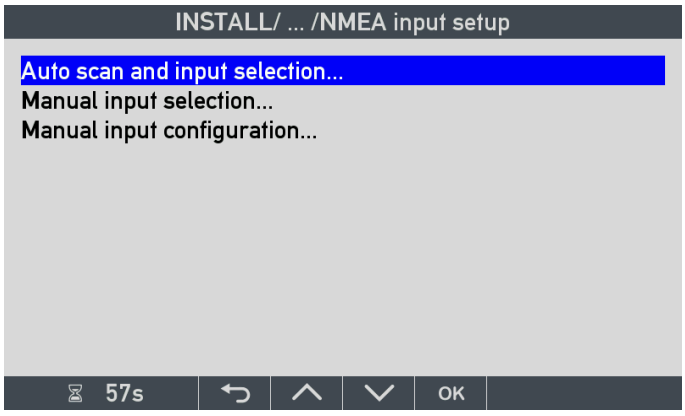
Press button 1 and 4 simultaneously for approximately 5 seconds to open the user menu.

When the user menu is open, press the “secret button combination” 2 and 3 for more than 5 seconds to open the installation menu.

In the installation menu highlight “NMEA setup” and press OK



Select NMEA input setup....



If a new NMEA source is added or a source is moved to another input port, you must run the auto scan again to update the list of available data sources.

Please note that XDi is not allowed to make source changes automatically, even if a source is no longer available.

So XDi will keep the locked source selection until you change it manually.

To change a source, you must enter the manual input selection menu, open the data group where you want to make a change and then open the actual data type to select another source.

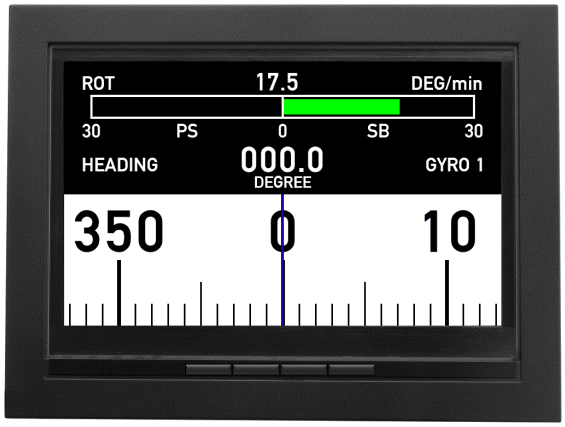
Example: the standard heading repeater
This standard heading repeater (compass indicator) is able to use 3 instances of heading data:

Primary: Heading True 1 (with the default source name: GYRO 1)

Secondary: Heading True 2 (with the default source name: GYRO 2)

Backup: Heading Magnetic 1 (with default name MAG. COMPASS)

To select the data type it is using the special fall-back function (described later on in this chapter).



DEIF standard heading repeater, using the rotating “endless tape” indicator for excellent readability even on a long distance. This indicator also has a rate of turn indicator (ROT) in the top part.

11.13.3..1 The NMEA COMPASS data

The NMEA compass angle data is in this example received in the following NMEA sentences:

GYRO 1: $HEHTD,A,0.0,L,M,T,45.0,25.0,0.5,3275.0,200.0,1.0,250.0,T,A,A,A,270.0*67

Mag.Com 1: $HEHDG,265.5,03.0,E,25.0,E*44

GYRO 1: $HEHDT,293.5,T*22

ROT 1: $HEROT,14.0,A*1E (ROT is only sent once and the controller decides the source)

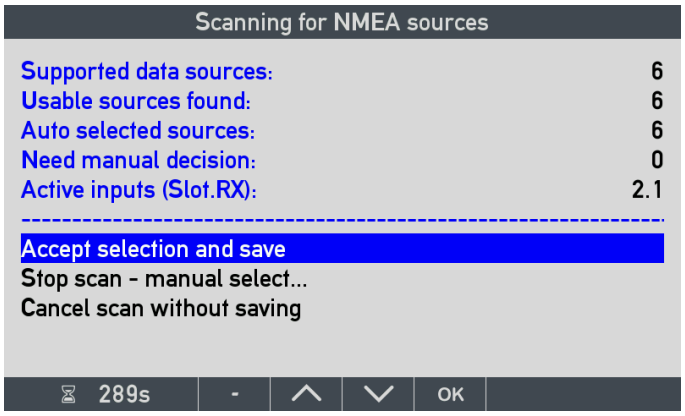
GURO 2: $IIHDT,271.6,T*20

All are transmitted on the same NMEA input coming from a central heading control unit.

to be able to distinguish between Gyro 1 and Gyro 2 that is both using HDT, the control unit change the NMEA talker ID for Gyro 2 to II (integrated instrumentation). **NOTE:** A north seeking gyro normally use HE.

In this system the operator can change source on the indicator simply by selecting source on the control system that is only transmitting the NMEA sentence for the heading source that the indicator is supposed to show.

We have stepped through the installation wizard and in the end made an automatic NMEA scan for available sources and were making sure that all the above NMEA data sentences were transmitted at some time from the heading control unit when this search for sources was running. (For example, by shifting between the 3 headings on the controller.)



In this case XDi has found sources for all 6 NMEA data types that is supported by the selected product profile and used by the heading indicator we have selected from the standard heading indicator library.

As we will see later the number of usable sources does not necessarily need to be 6 it depends on the indicator we have selected, and the data needed for that indicator.

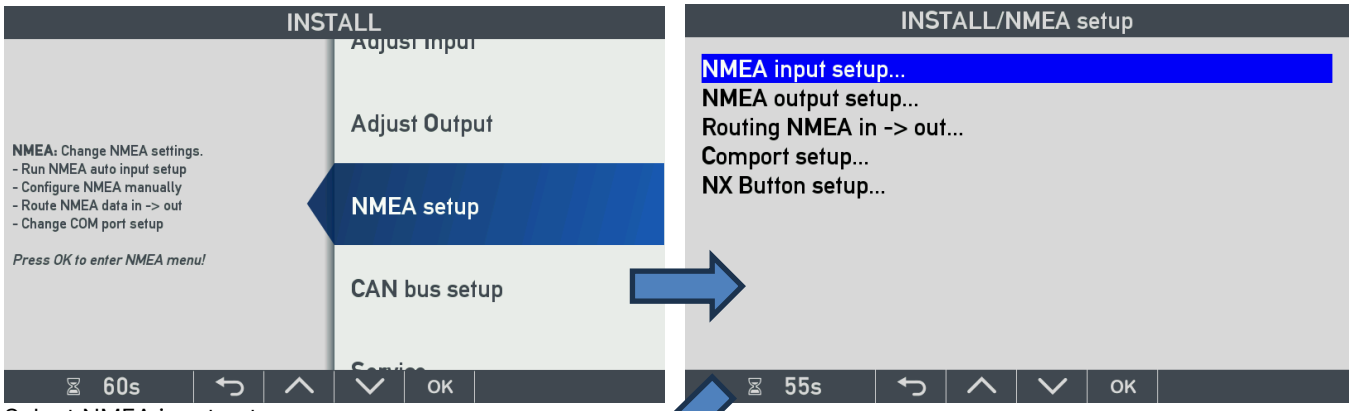
Test of the heading system

On the surface everything looks OK after we have made the auto setup and XDi has returned to normal operation, but when we now test the system by shifting between the 3 heading sources on the controller between Gyro1, Gyro2 and Mag. Compass and the controller is only transmitting the relevant NMEA sentences from respectively Gyro 1 $HEHTD (and $HEHDT), Gyro 2 $IIHDT and Mag. Compass $HEHDG.

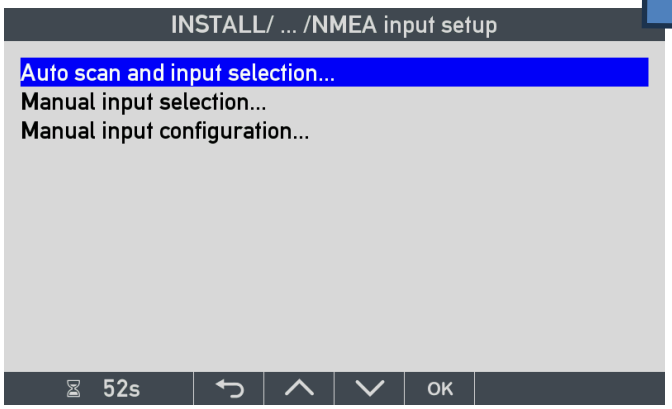
We would expect XDi to use the fall-back function to automatically shift source depending on the received heading data. But it turns out that only Gyro 1 and Mag. Compass are working when we select Gyro 2 we get a NMEA data lost message.

Something in the Gyro 2 setup is not correct.

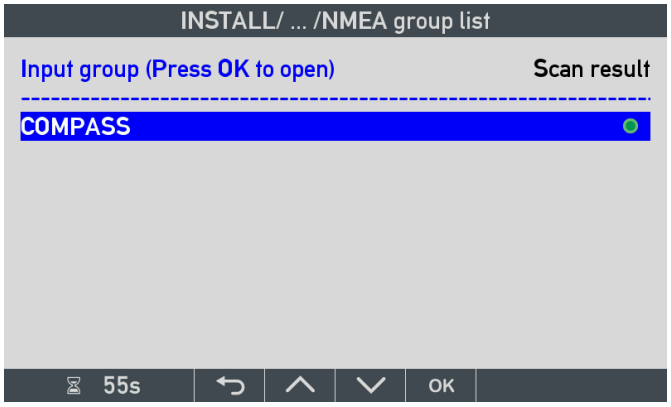
A look in the NMEA input setup menu may help us:



Select NMEA input setup....



In this case we have not made any changes of the NMEA data so a new Auto scan is not needed, so we will go directly to “Manual input selection...” menu:



RED dot means that no external sources are available.

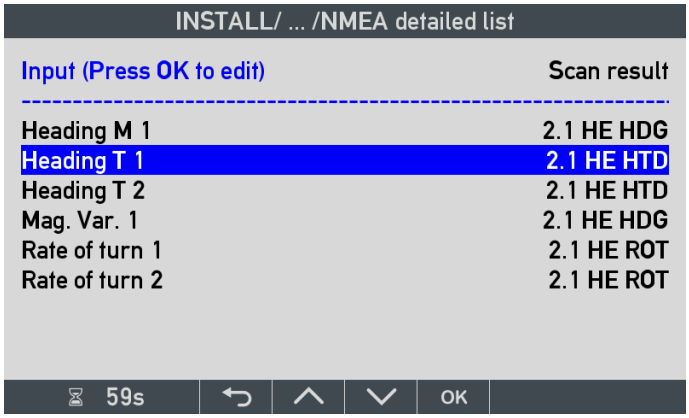
YELLOW dot means that sources are available for some data in the group, but it should be checked. Some data types may need manual selection or some may be missing.

GREEN dot means that all data types in this group have been assigned a source.

Even if the dot is green, it is a good idea to look through the automatic selection and check that needed data has the right source assigned.

In this case the compass group is green, so everything looks to be good. All data types in the group have a source assigned, but in some cases where there are multiple instances of the same data type, it may be necessary to change some of the automatic selections made.

If we press OK on the highlighted compass group to open it, we can see which NMEA port and sentence is used to provide data.



In this case, GYRO 1 using “Heading T1” (True heading instance 1) and GYRO 2 using “Heading T2” (True heading instance 2), are both automatically selected to use the same input source.

The HTD sentence received from input port 2.1, provided by talker with ID: HE.

Mag.Com. 1: $HEHDG,265.5,03.0,E,25.0,E*44

GYRO 1: $HEHTD,A,0.0,L,M,T,45.0,25.0,0.5,3275.0,200.0,1.0,250.0,T,A,A,A,270.0*67

GYRO 1: $HEHDT,293.5,T*22

GYRO 2: $IIHDT,271.6,T*20

Why has XDi made this selection of HTD for both?

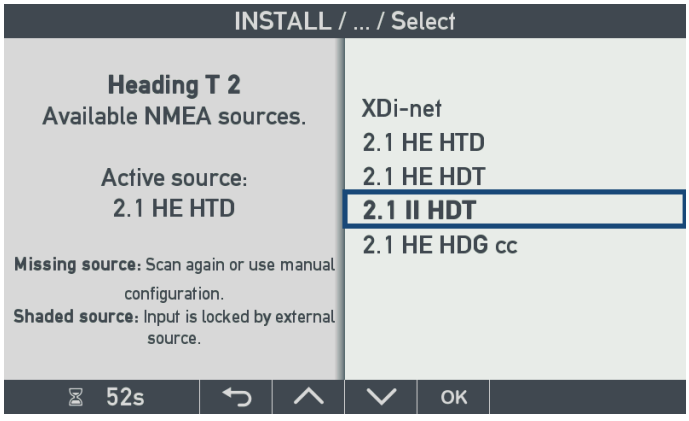
When XDi makes an automatic selection, it has a priority list of sentences to choose from.

For True heading the sentence priority list is: HMR, THS, HTD, VHW, HDT.

Because the HTD sentence has a higher priority than HDT it is automatically selected even though there is other heading sentences of type HTD.

If only HDT was sent, one sentence from each of the two gyro compasses, then XDi would detect 2 usable sources for both Heading T1 and Heading T2 and ask you to make a manual selection.

In this case we can see that Heading T2 is also using HE HTD, so what you need to do is highlight Heading T2 and press OK to open it for editing:



In the list you can see all the sources that XDi has detected as potential sources for “True heading”.

NOTE: XDi-net is always a possible selection, and it can also be used if you want to disable a NMEA input.

In the actual case “Heading T2” shall be setup to use II HDT, so just highlight this source and press OK to change the selection.

Calculated data - HDG cc:

When the magnetic variation, “Mag. Var. 1” parameter is available on NMEA, then XDi is able to calculate the true heading based on the magnetic heading (from true to magnetic if that is relevant).

In this example true heading can be calculated based on the magnetic heading and the magnetic variation both available in the HE HDG sentence and it is shown in the selection list as HE HDGcc (cc for calculated).

In the standard library the following is the priority list for the True heading sentence:

HMR, THS, HTD, VHW, HDT, HMRcc, HDGcc, HTDcc, VHWcc

The calculated sentences have the lowest priority, so if the real data is available XDi will prefer to use that, but you can always change the automatic selection for a given parameter if an alternative is available.

Finish the installation

The NMEA setup has now been verified and all data needed is available, and all left to do is to press the return arrow until the heading indicator is shown on the display and starts to present data.

When you leave the menu, the NMEA settings will be stored and locked. This means that only the selected sources will be used by the XDi.

Alternative NMEA input configurations for the heading example

Instead of using data from a central control unit the, NMEA data could also be connected directly to 2 NMEA input ports on the NX2 module and in that case both Gyro 1 and Gyro 2 can use $HEHDT since XDi will differentiate between the physical input ports as well as the talker ID.

In the example the magnetic heading data is also coming from the heading controller unit with talker ID: HE, but the magnetic compass could also be connected directly to a NMEA input port on a NX2 module and in that case the talker ID would most likely be HC ($HCHDG,265.5,...), this will also work find and XDi will automatically detect this source on a separate input, even if it still was using talker ID HE it will work fine.

Possibilities in a customized library

The DEIF standard heading library we have used as example is made for general purpose use and the room for auto-selection of NMEA sources are therefore relative wide. In customized libraries it is possible to limit the auto selection to specific hardware ports and sentences, but also change sentence priority so that it fits directly into the customers system and so that auto source scanning will automatically find the correct NMEA sources without need for manual setup via the NMEA menu.

Troubleshooting the NMEA auto scanning and selection

If you cannot find a given NMEA sentence in the list and you know it is active on one of the input ports, you can try to run the auto scan function again. If it is still not showing up there can be different reasons why it is not detected as source, some typical situations are:

- The RX A and B wire is swopped around, especially if RX2 (RS485) is used since the A/B convention for marking is opposite the RS422/NMEA way of marking inputs. So just swop the wires and run the scanning again, it this wiring is correct the sentence will be detected.
- Not so common problem is that the sentence format used by the transmitter device is not quite correct, if the format is not according to the IEC standard or from a very old NMEA0183 standard, XDi will not accept the sentence as valid.
- In some cases a problem can also be that a given sentence does not contain the actual type of data, the data field may be empty (,,) or data may be marked as invalid (typically status V = invalid and A = valid)

XDi has a strong service tool for NMEA, where you can check if a NMEA sentence is actually received on one of the inputs or not. The NMEA monitor tool is available in the Service menu (see the separate chapter).

11.13.4 When is manual NMEA input selection necessary ?

It is necessary to scan the NMEA inputs again and make a manual setup:

- if you move the data source to another input port.
- if you change the transmitting unit (data source) to a new type with another talker ID.
- If you change the transmitting unit to a unit with same talker but use another NMEA sentence to transmit the data. For a given data type, XDi normally supports all relevant sentences from the IEC standard and automatically selects the sentence that has the highest priority (see document: XDi supported NMEA sentences).
- or if you make several of the above changes at the same time.

Master reset to clear it all

If you lose the overview and you can't find sources or make the correct setup manually, it may be a good idea to start from scratch. To do that you must make a "Master reset" (button 1 and 3 at the same time in 5 sec.) to clear all NMEA source lists and input selections and make a completely new setup.

It may be a good idea to make a master reset and start from the beginning:

- I If you have made big changes in the NMEA installation
- Has moved the XDi from one system to another

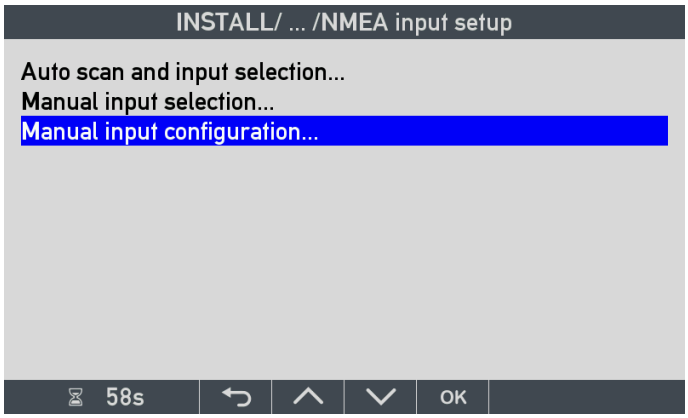
Master reset is the only way to completely clear the source selections and start over from scratch.

11.14 Manual input configuration

11.14.1 Adjust a wind sensor misalignment from a menu

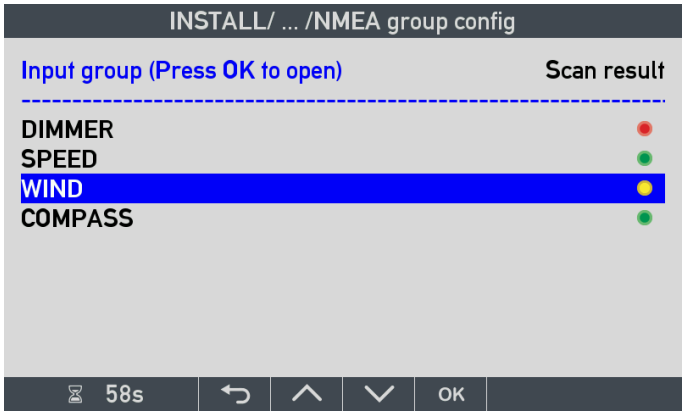
If the wind sensor was incorrectly aligned when it was mounted in the mast top, it is easier to make an angle correction in the XDi instead of climbing the mast again.

Enter the installation menu and select "NMEA input setup" menu where you find this:



Select "Manual input configuration..."

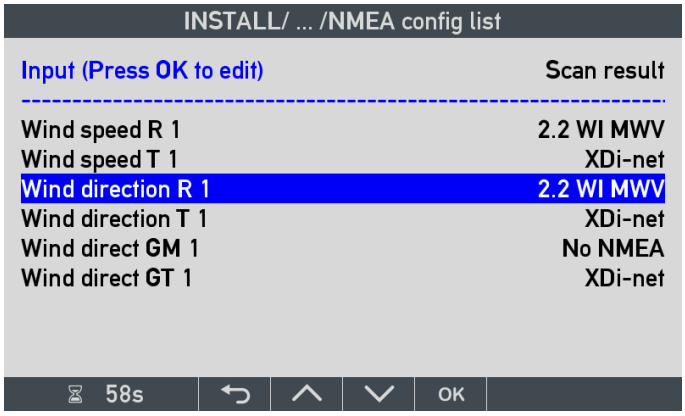
You will see a list of the NMEA data groups that this XDi is able to support.



NOTE: The dimmer is red because there is no NMEA data available for dimming in this system.

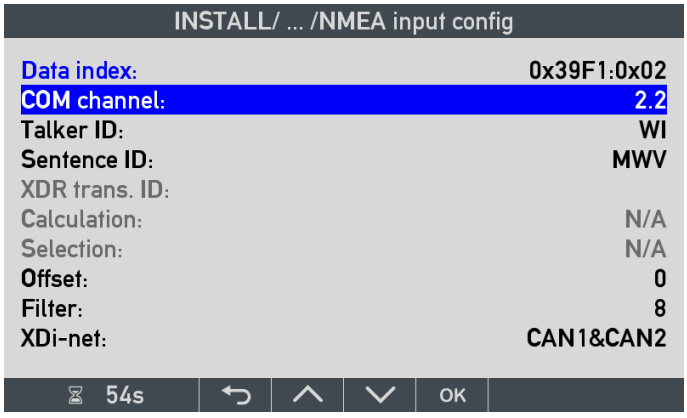
The Wind group is yellow because not all data in the group has a source assigned, in the below picture we can see that it is the Geographic wind direction relative to the magnetic north pole that is not available. It is not a problem since the VI we have selected does not show this type of wind direction.

Select the “WIND” data group



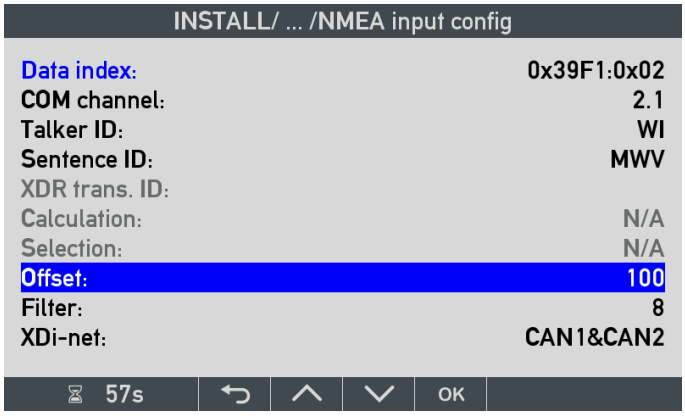
To correct the relative wind angle for the sensor’s misalignment, select the “Wind direction R 1”

(the relative wind direction instance 1).



Select the “Offset:” line and insert the angle correction. Be aware that XDi is using 0.1 resolution of the angle values, so a positive angle correction of +10.0 degrees must be entered as 100.

The offset is added to the received wind angle.



If the received wind angle is +70 degrees (700), then the correction of 100 (=10.0 degree) is added and the wind indicator will show a relative wind direction of +80.0 degrees.

The corrected wind angle is distributed on CAN using the XDi-net protocol, and all XDi wind indicators on the CAN bus will automatically present the correct wind angle.

The corrected wind angle will also be used if the XDi is set up to output relative wind on one of the NMEA outputs.

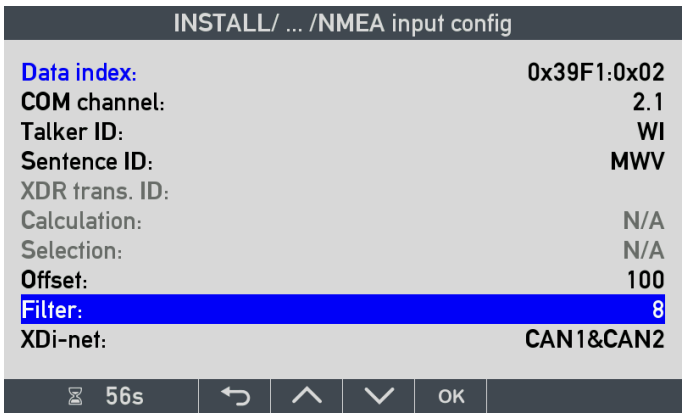
However, if the NMEA routing function is used to distribute the relative wind data, this angle correction will not be included. The received wind sentence will just be routed directly to the output without any change.

It is possible to make an offset on all normal data types, but be aware of the resolution. It can be different from data type to data type. You can find the resolution in the “XDi-net CANopen reference manual 4189350066 UK.pdf”.

11.14.2 Changing filter settings

All standard parameters can be filtered to reduce fluctuations.

The filter function is calculating the average of the latest received input values, and the filter value indicates the number of values used to calculate the average value.



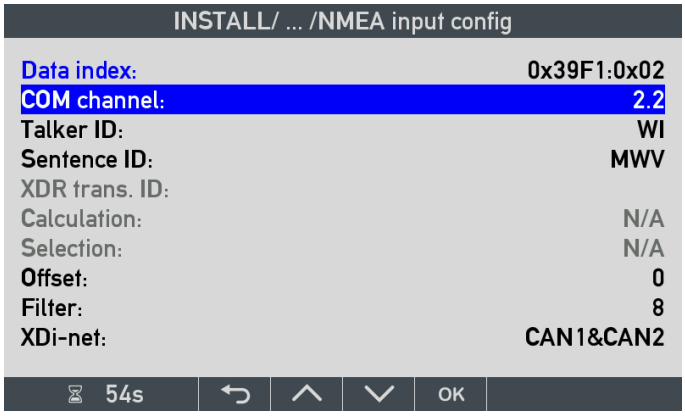
When the wind direction is received every second from the wind sensor, the filter value 8 means that data is averaged over the last 8 measurements or over 8 seconds.

Please note that relative wind speed and wind direction both by default have a filter value.
It often makes sense to filter harder on the wind direction than on wind speed.

11.14.3 The other input configuration parameters

The hex value 0x39F1:0x02 in the top line is the data index and sub-index used to distribute data on XDi-net, it is only for information and cannot be changed from the menu.

In the last menu line, you can change or stop the distribution of this data type on XDi-net (CAN).

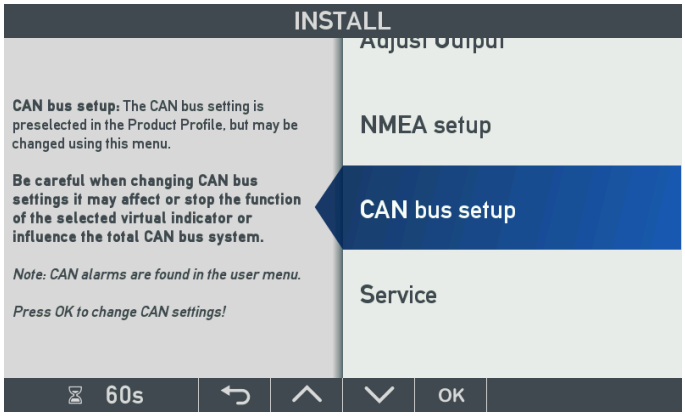


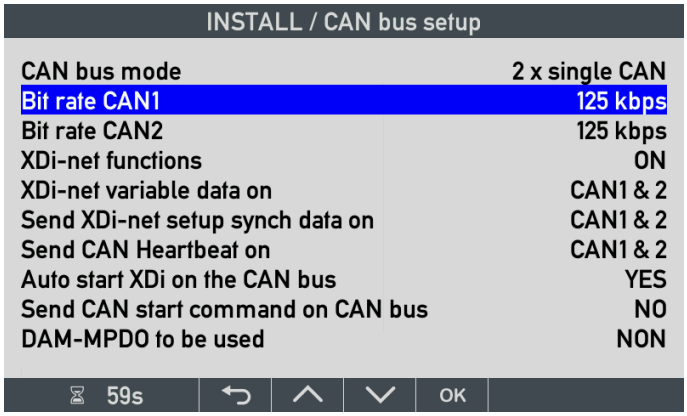
In this input configuration menu, it is also possible to manually set up the input channel, the talker ID and the sentence. You should only set up or change those parameters if you know what you are doing.

It can however be useful in the situation where an NMEA sentence is not available when the auto scan and setup process is performed during installation. Maybe the sensor is not added until later, but the sentence and input port are known.

11.15 CAN bus changes via menu

The default CAN bus parameters is defined in the product profile you have selected during setup, and they can be changed manually via the XDi installation menu.



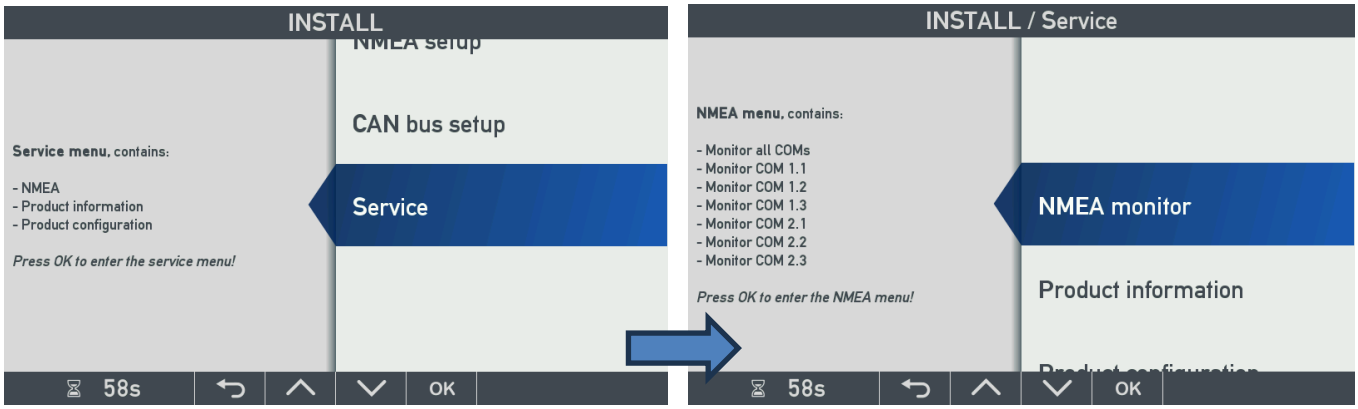


Before you make changes in the CAN bus setup, it is recommended to read relevant parts of the

XDi-net/CANopen reference manual.

11.16 Service menu

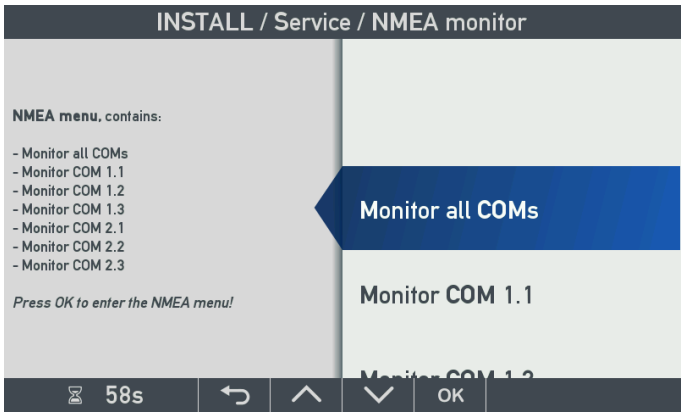
The service menu consists of two pages, containing product information and setup status that may be quite important to have on hand in case DEIF is contacted in relation with service or support.



11.16.1 NMEA monitor

XDi has a built-in monitor function that can present all NMEA sentences received (RX) from devices connected to one of the NMEA inputs on an NX2 module.

The monitor will also present NMEA sentences sent out (TX) on one or more of the NMEA outputs.

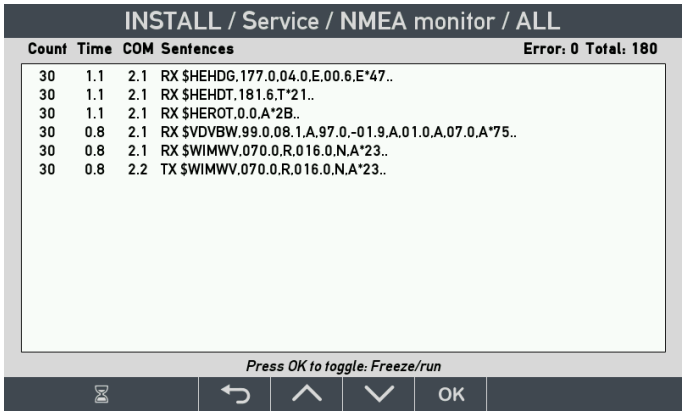


The first monitor is monitoring the NMEA sentences sent on all COM ports both inputs and outputs.

When two NX2 extension modules are mounted on the XDi, there can be up to 6 active ports, that can result in a lot of NMEA sentences to look at in the monitor.

If you are only interested in what is send or received from one of the COM ports, you can select the monitor only for that port. Monitor COM 1.1 will only show communication on NX2, Slot1.COM1 (RX1 input and TX1 output).

In the following it is NMEA data from a wind indicator system that is used to illustrate the function of this monitor tool, it is the Monitor all COMs that is opened.



In this case Heading , speed and wind data are received correct (RX) and the wind data sentence MWV is also retransmitted (TX) to the NMEA output Slot 2.COM2 (TX2 output).

In a fault situation, the NMEA monitor can be a great help determining whether a given NMEA sentence is available or not.

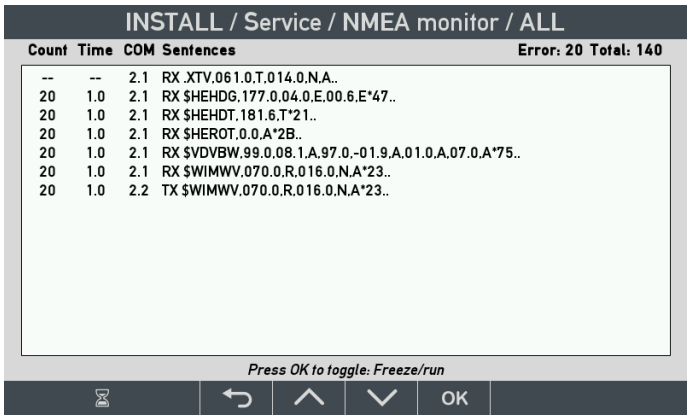
If you know the structure of an NMEA sentence, you can also see if data is valid or invalid.

The NMEA monitor presentation is explained in the table below.

Count	Time	COM	Sentence	
Number of received/transmitted sentences since the logging started	Interval between last 2 sentences (in seconds)	Slot number and COM port on NX2 module receiving or transmitting data	RX: received TX: transmitted	NMEA sentence content

For easy analyse of the NMEA sentence content, it is possible to freeze the screen on the NMEA monitor. Press the OK button once to freeze and once more to return to normal mode showing every received sentence.

In some case the same NMEA sentence can contain different data types, it can for example be MWV that is sent one time with relative wind data and shortly after again but now with true wind data. To see one or the other it can be useful to be able to freeze the screen. XDR is another example where this function can be quite useful.



In the upper right corner of the screen, you find the total number of received sentences and the error counter that shows the number of faulty sentences that have been received since the monitor was started. Errors can occur if the NMEA line is connected and disconnected in a running system, bad connections or it can be caused by a faulty NMEA transmitter.

If the received data in the first line for a given input port looks strange and has no Count and Time registered, it is because the sentence format is not in accordance with NMEA standard format. Every faulty string will be registered as an error. It can be caused by the same bad conditions as mentioned above, but it can also be due to wrong polarisation of the A and B input terminals. Try to swap the A and B wires around.

Strange looking sentences can also be caused by input data with an incorrect bit rate. The default bit rate on all NMEA inputs is 4800 bps, but it can be changed via the comport setup located in the INSTALL/NMEA setup menu.

NMEA sentence example

The wind sensor is connected to the XDi, but relative wind speed and direction is flashing, and the data lost pop-up is shown on the indicator.

Enter the service menu and select the NMEA monitor to see the received NMEA sentences.

The NMEA monitor shows:

25	1.0	2.2	RX $WIMWV,70,R,14.6,N,V*2E

This means that 25 sentences are received since you started the monitor, and the MWV wind data sentence is received (RX) every 1.0 second from COM port 2.2 (Slot 2, NMEA input RX2).

$	is the start sign of the NMEA sentence
WI	is the talker ID for a weather system.
MWV	is the weather sentence
70	is the wind angle (wind angle can be from 0 to 359 degrees)
R	means that it is relative wind, it can also be T=true wind
14.6	is the wind speed
N	means that wind speed is in knots (other valid units: K=km/h and M=m/s)
V	is the data status flag, V = data is invalid and A = data is valid.
*2E	is the termination and checksum

NOTE: You can find the standardised NMEA sentences with explanation of the actual sentence content in the IEC 61162-1 standard or in the NMEA0183 standard.

In this example, the missing wind data is caused by the status flag V indicating that the wind sensor is not able to calculate the wind data. The data sent from the sensor is invalid.

If there are no communication errors registered and no strange looking sentences without count and time, then it looks like the communication with the senor is fine, so the fault must be found in the sensor and not in the installation / wiring.

Trouble shooting NMEA input faults:

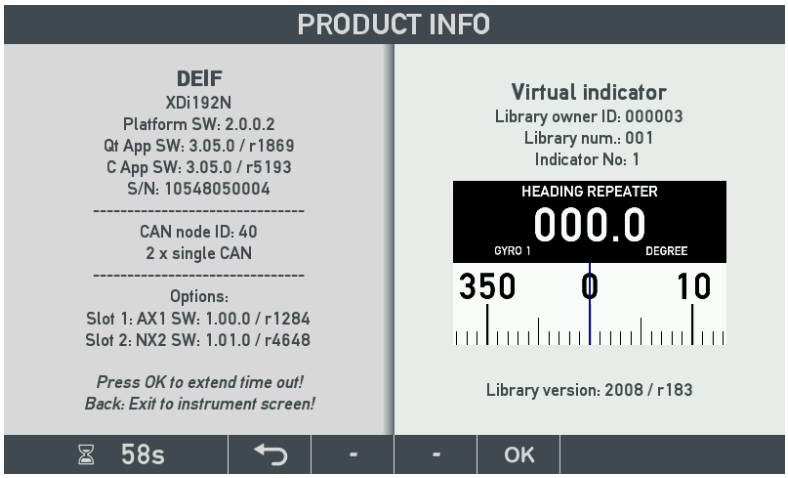
No.	Situation	Result on the XDi indicator	Cause of problem
1	The NMEA sentence looks fine and is coming from port 2.2	The NMEA data from the sensor is not auto selected, so the indicator shows data lost.	The standard library expects the heading sensor data to be connected to RS-422 port 2.1 or 2.3. In this case, it is port 2.2 RS-485 so you must manually select this input port.
2	The status flag in the sentence is V (not A = valid)	The NMEA sentence is selected as source, but the indicator shows data lost.	The heading sensor is not able to measure heading data and is sending data marked invalid.
3	Data on port 2.1 is shown as a string of random letters, and the error counter is increasing	No NMEA heading source is detected, and the indicator shows data lost.	The A and B wire is most likely incorrectly connected. Check that it is the NMEA wires and try to swap them around.
4	Data sentence is OK, but sometimes the indicated time jumps from 1 to 5 seconds.	Periodic data lost pop-up	Bad connection, in which case errors and an incorrect sentence from this slot/port will also often be registered.
5	The time jumps from 1.0 to 2.0 seconds and the error counter increases.	The heading indicator seems to work OK	The time jump indicates that data are lost. It may be due to a bad connection or electrical interference.

No.	Situation	Result on the XDi indicator	Cause of problem
6	The heading sentence looks OK, but the talker ID is WA (not HE)	No data source is indicated, and data is missing.	WA is not a valid talker ID and the sentence is therefore rejected. If you know the sentence is OK, you can manually set the talker ID to “don’t care” and the sentence will be accepted.
8	The heading sentence is dropping out periodically	Data lost is indicated. The pointer and digital readout is flashing.	Bad interface cable connection. Bad cable shield connection or grounding of the sensor.

11.16.2 Product information page

The product information page contains information of the product software and installed library:

MED / UK MER approved indicator



Not MED/UK MER approved indicator

Please note, that the library version uniquely identifies the full software (Platform, Qt App. and C-App) and library installed in an XDi unit.

The software version of the installed extension module is also listed.

The library **revision** number is only of interest as long the library is under development and where several draft versions may have been generated, before the final version is approved.

When an XDi library is released, the revision number is locked, and when the library is then opened for new additions, the library version will be increased by one, and the revision number is reset to 0000.

If the selected indicator is MED approved, a Wheel-mark approval symbol is shown. The figures to the right of the symbol indicate the notified approval body no. (0098: DNV GL), and the production year of the actual XDi unit (in the screen above it is 18, corresponding to 2018).

11.16.3 Product configuration page

This page contains the main XDi setup:

- CAN Node ID
- Product Profile (PP) number
- Virtual indicator (VI) number
- Input setup profile (VS) number

11.17 Trouble shooting help

If you contact DEIF to get help with solving some installation and configuration problems, then it is always a great help if you take a picture of the **Product information** and the **Product configuration** page and attach that to your request for support. This gives our supporters very much information and makes it much easier to give you good support and help you to solve the problem fast.

12 Appendix 1: Colour calibration - service instruction

The menu function in this document is available in all XDi library packages released

after the date 25.03.2020 - but only if the version number is v2000 or higher.

NOTE: Library ver.2xxx means that the library package includes the needed XDi platform 2 software.

Libraries with version v0xxx or v1xxx must first be moved to software platform 2 and released as a platform 2 library to get the new functions.

12.1 Display colour calibration

12.1.1 Introduction

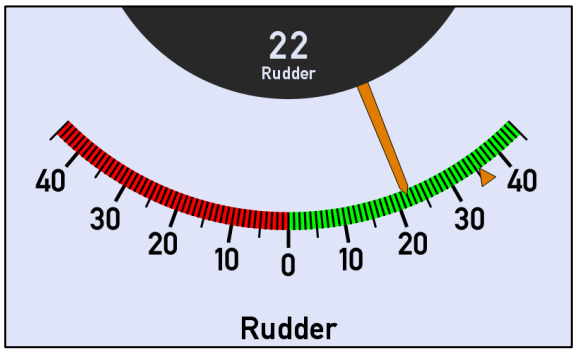
When an LCD colour display with LED backlight ages it is not only the backlight level that is reduced, but also the colour temperature of the backlight LEDs that may change. The actual aging seems to be different from type to type, and also under which conditions the aging takes place.

The worst case scenario is installations where the display is running with a constant full backlight level and at high ambient temperatures. In such installations the aging process is accelerated, and the colour change seems to be more visible, and the illumination level is also decreasing faster.

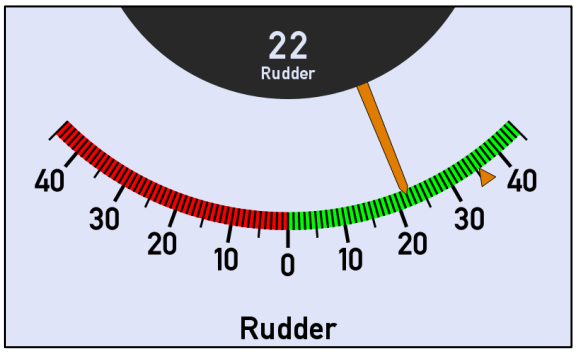
We have experienced some XDi 192 displays where the backlight colour over time goes from warm white to a more bluish white.

In the following example two XDi 192 rudder indicators has been running for a long time at a very high temperature and with full backlight all the time. This has resulted in a degradation of the backlight and the white colours are now turned blueish as illustrated on the pictures below.

PORT RUDDER

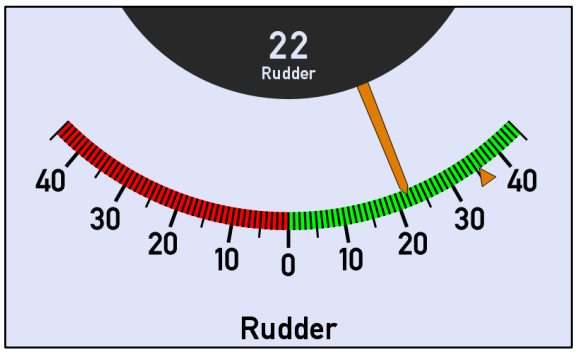


STBD RUDDER

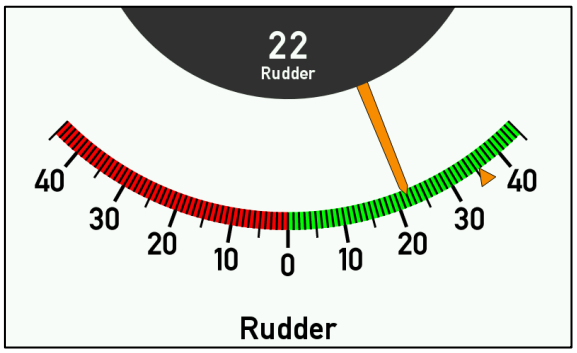


If the starboard indicator now fails and is replaced by a new XDi 192 directly from production, it may look like this:

PORT RUDDER



STBD RUDDER



The nature of the backlight degradation makes it impossible to adjust an old unit to match the warm white screen colour on the new unit. Instead, the new unit must be adjusted to match the background colour of the old indicator, and maybe also reduce the backlight slightly to make a good match.

12.2 Colour and Backlight adjustment

It is now possible to adjust a new service unit to appear as the rest of the indicators in the existing indicator system. A new menu function that makes colour adjustment of the screen picture possible, and also adjust the max available backlight level at dimmer level 100%.

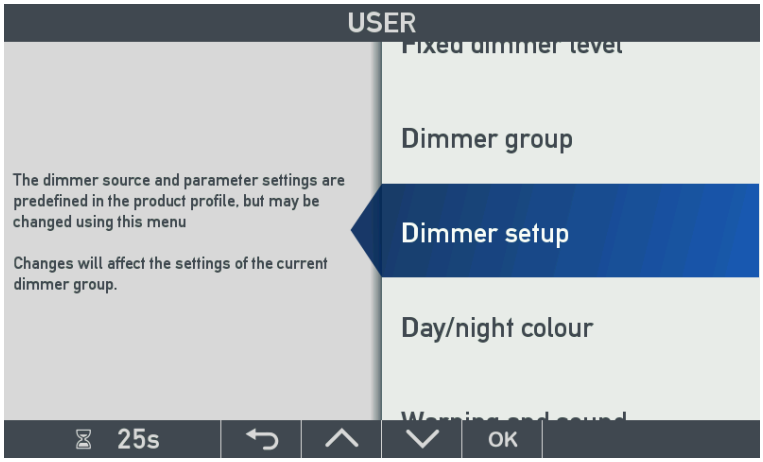
Any library built with QTapp v. 3.03.0 and CApp v.3.03.0 or higher will have this function(typically all libraries made after 2020/03/25 with library version no. 2000 or higher). See chapter 11.16.2 Product information page how to check the QT and Capp versions (will have this function.)

In the following the new colour/backlight calibration menu will be explained and how to use this new tool in praxis, to obtain the right appearance.

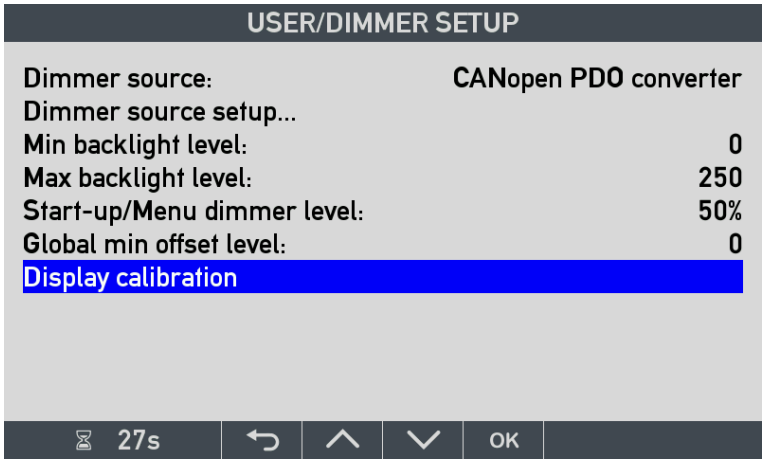
12.2.1 Access the new display calibration function

The new colour calibration function is located in the User menu / Dimmer setup.

To access the new colour /backlight adjustment tool in XDi, first open the user menu by pushing button 1 & 4 (left and right button) at the same time for more than 5 sec. to enter the user menu.



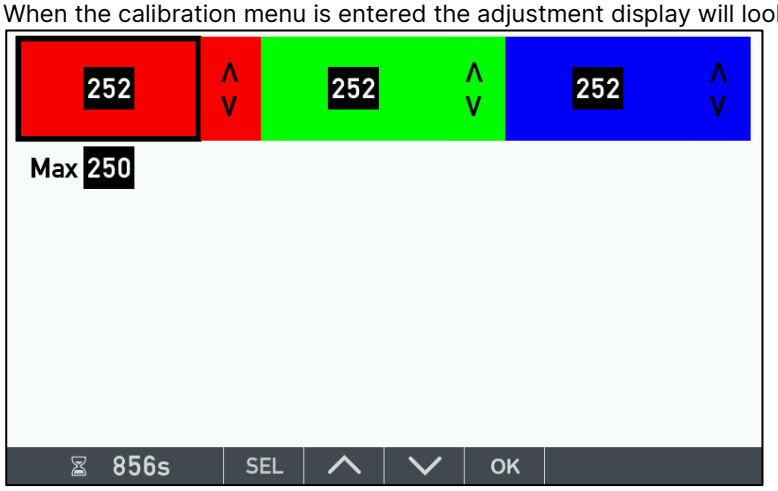
Select the “Dimmer setup” menu and press the OK button:



Highlight “Display calibration” and press OK to open the new menu page.

12.3 Display calibration

When the calibration menu is entered the adjustment display will look like below.



Display calibration screen

The selected parameter to be adjusted is marked with the black cursor frame.

12.3.1 Menu functions

The calibration menu has 2 main functions:

1) Adjust the red, green and blue colours

2) Adjust the max backlight level at 100% Dimmer setting (max level is 250)

12.3.2 Colour adjustment

You can adjust red, green and blue colour individually by highlighting the field:

Using the front button ^ or ˅ you can adjust the red colour from 0 to 252. (Steps size is 4)

You will immediately see the change on the white background colour on the calibration screen.

When you have a new unit all colours are at level 252.

If you want to match an old display where the white background is bluish then you must reduce the red and green colour to get the same blue colour appearance on the new service unit.

This can be quite time consuming to adjust the 2 colours independently.

Based on our experiments with manual colour adjustment, we have made a “smart function” on each colour 

When you for example has a bluish display, you can select the blue “smart function” by pushing the “SEL” button several times until you have this field highlighted by the black frame cursor, as shown:

You will now be able to adjust the blue appearance of the display and not necessarily the blue colour itself.

When you have a new XDi service unit, all colours are at 252.

When you now want the white screen to be more bluish, you push the ^ front button to increase the blue colour.

Since blue colour is already at max 252 the red and green colours are both reduced one step for each push on the ˅ button, this will make the white screen turn bluer for each push.

Use the ^ or ˅ button to find the best possible colour match between old and new screen.

If the blue colour has already been adjusted down to a value below 252, the “smart function” will first increase blue to max level before it will start to reduce red and green level.

Max backlight adjustment

In some cases, it will also be necessary to reduce the max backlight level to make the new service unit match the overall backlight level of the existing indicators.

To do this highlight this field:

Using front button ^ or ˅ you can adjust the max backlight level and see the result immediately on the calibration screen.

IMPORTANT: By default, the max backlight of XDi 192 is set to 225 to reduce the aging that a high backlight level tends to accelerate.

This small 10% reduction will reduce heat dissipation in the backlight LED’s with more than 50% !

This reduction is especially important if backlight is always at 100%, for example in an engine control room, where we recommend to adjust the fixed dimmer level or max backlight to the minimum acceptable level.

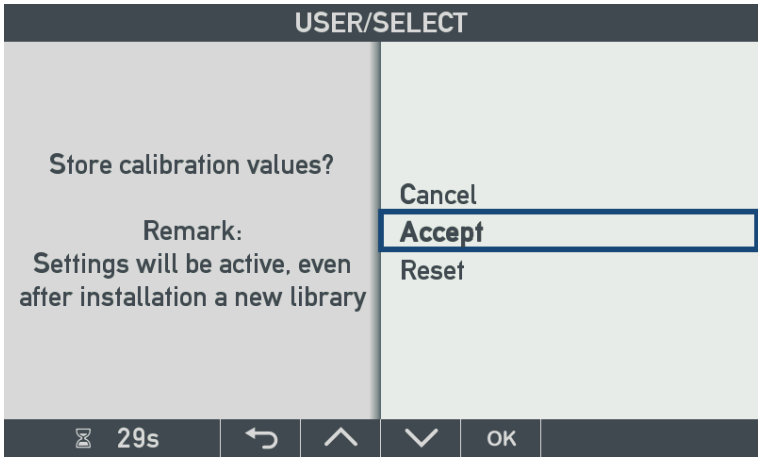
12.4 Some experience

The few examples we have seen where the aging has changed display colour, it seems that the XDi 192 display backlight LED’s ages toward blue colour and the XDi 96 backlight ages more towards red.

But with the “smart function” it is relatively easy to match either of the two situations following the procedure described in the next chapter.

12.4.1 Save or undo your display calibration

When you have made the best possible match between the old and the new indicator displays, press the OK button to move to the following menu screen:



Highlight and press OK on:

Cancel (default): Then all changes you have made will be deleted and previous calibration values will be used.

Accept: to save your new adjustment

Reset: to go back to original factory settings, this can be very useful if you have lost the overview of your changes. After resetting you can go back and make a new attempt to match the colours and backlight level.

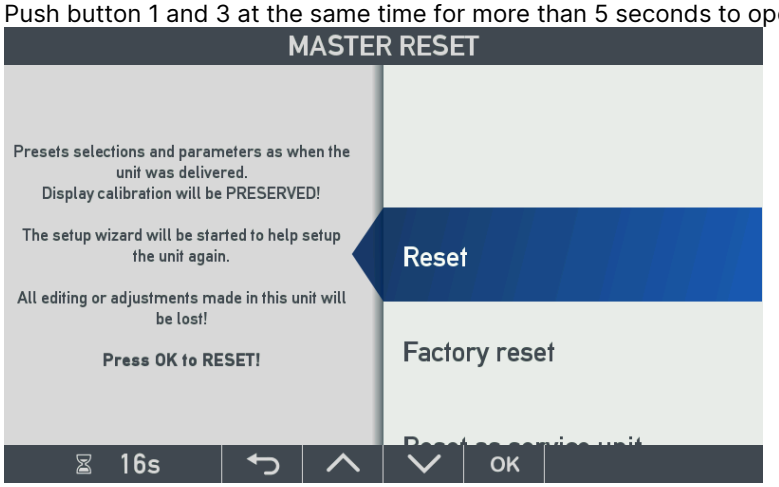
12.4.2 What happens if you install a new library package

If you have calibrated the display and accepted to saved calibration values, they will be present even after installation of a new library package.

You can however bring back the original display settings (Factory settings) by performing a master reset, see next chapter.

12.5 Master reset

When you want to reset an XDi unit or bring it totally back to factory settings, you must use the “Master reset” function.
Push button 1 and 3 at the same time for more than 5 seconds to open this menu:

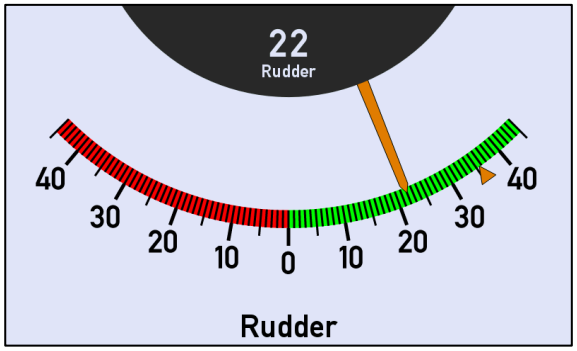


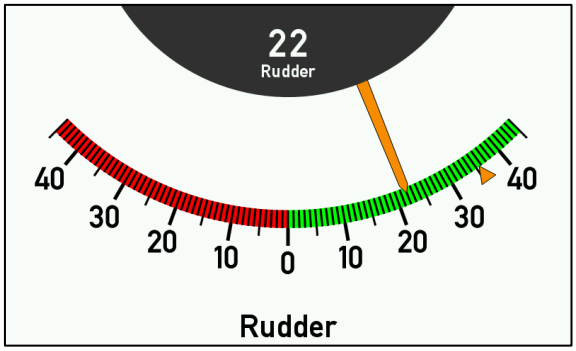
In this menu we have added a new **“Reset”** function that is bringing all back to factory settings except the colour calibration made via the “Display calibration” menu.
To restore all parameters to factory settings including colour and backlight level adjustments, you must select **“Factory reset”** instead.

12.6 Display calibration step by step (Example)

On a vessel equipped with double rudder, we have replaced a faulty XDi192D in their engine control room with a brand new service unit. After normal setup both indicators are again running as they should, but the high temperature in the ECR panel and the fact that the old indicators has been operating constantly at max backlight for years, has aged the backlight LED's so that the white background on the old display appears to be more blue than the new unit with a warm white backlight, as you can see in the pictures below:

PORT RUDDER STBD RUDDER





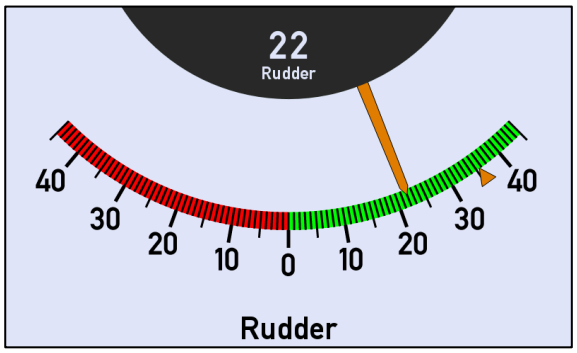
You shall select 100% backlight and the day design (white background) on both XDi indicators.

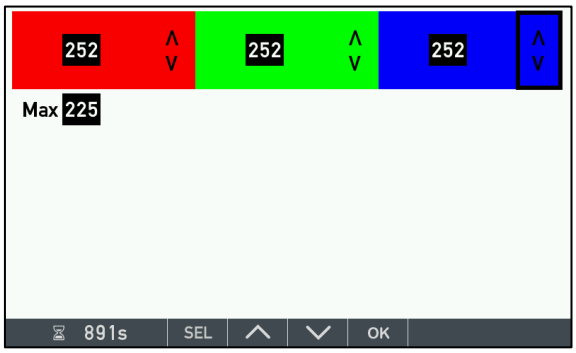
The next task is now to calibrate the colour and intensity of the display on the new STBD indicator.

IMPORTANT: When you make the calibration you must look at the indicators from the position where the system is normally operated, this is because the viewing angle has an impact on the display colours.

1) On the XDi showing STBD RUDDER, enter the "USER" menu and open "DIMMER SETUP" and then "Display calibration" (as described in the previous section):

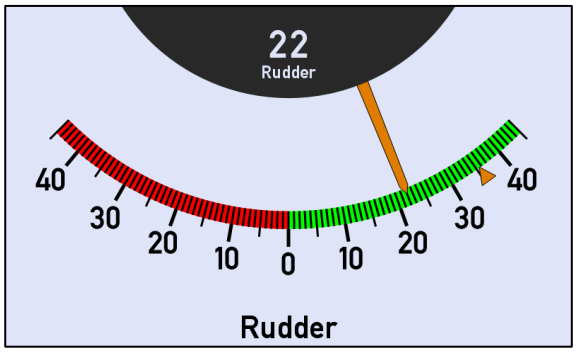
PORT RUDDER STBD RUDDER

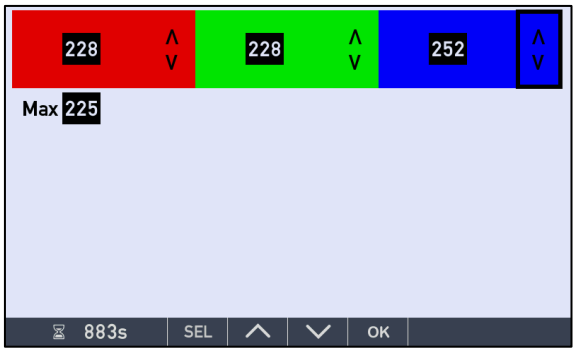




2) Now highlight the blue arrows with the frame using "SEL" (select) button:

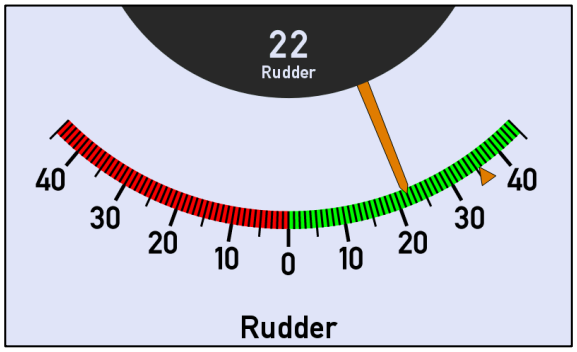
3) Push the ^ button to increase the blue colour (by reducing the red and green)

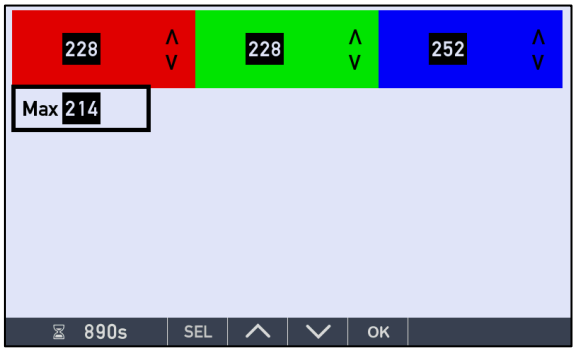




if the white background gets too blue, just push the ˅ button to reduce it again.

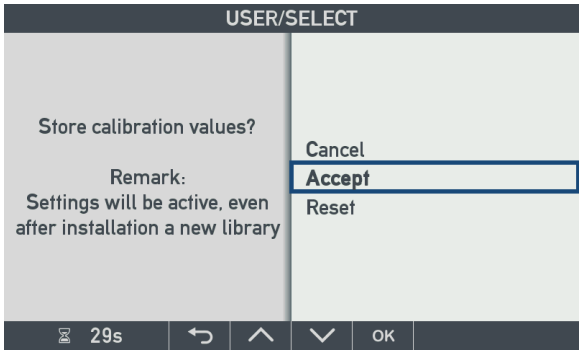
4) Since the backlight is too bright on the new unit compared to the old indicator, we reduce the max backlight level to get a better match. (You can't see this on the pictures above only on the real displays)





Now the scale background colour is calibrated to match the old unit.

5) Press OK to leave the calibration menu and save your new settings:



Highlight "Accept" and press OK.

XDi will now calibrate the graphics it normally takes a few seconds before it returns to normal operation with the new colours.

6) In this installation in the ECR where backlight is set on a fixed level, we will recommend that you adjust both indicators to as low a level that you find acceptable, preferable below 80% dimmer level.

This will extend the backlight life on both the old and the new unit.

12.7 Reservation

The display aging is related to the white backlight LED's. Over time the backlight level decreases and will also sometimes change colour temperature.

The colour adjust tool in the XDi software, is not able to adjust the colour of the backlight LED's in a new service unit, but it is adjusting the colours of the indicator graphics instead, to best possible match the colours of the old and aged indicator display. The most important is the batch of the white background colour typically used in the day designs of most virtual indicators.

In many situation this is a good way to make a replaced indicator fit into an existing indicator system, with many years of continuous operation behind.

The colours of a new XDi unit with a display that has been colour calibrated to match an old display, will be more sensitive to different viewing angles then the old, aged display. Unfortunately, that is the nature of this phenomena.

If the colour calibration is not sufficient in a given installation, it can be necessary to upgrade the other old indicators with a new display to get a unified look.

13 Appendix 2: Application examples

In the following is a collection of typical XDi application examples based on XDi indicators using DEIF standard libraries for propulsion indication. Due to the high configuration flexibility of the XDi; this will only be an appetiser.

At deif.com you can also find some dedicated application notes for:

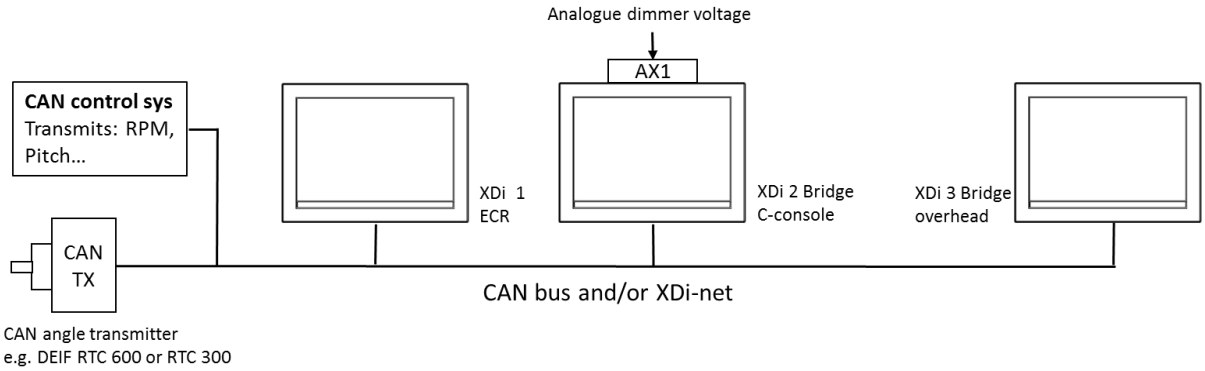
- Rudder systems
- Wind indicator systems
- Heading repeater system
- and more will come over time.

The application notes refers to the use of DEIF standard libraries, but can also give you some inspiration to possible custom designed library solution. XDi is very flexible and often it is your imagination and the class rules that limits the possible solutions.

13.1 Application 1 - XDi azimuth system, CANopen and XDi-Net

The azimuth indicator system below is fully CAN-based. When a CAN angle transmitter (encoder) is used as azimuth angle source, data is transmitted in a TPDO.

Data sent from the CAN control system can either be sent in a TPDO, RPDO or as an XDi-net broadcast (plug and play solution). All XDi indicators in this example are using the XDi144/192 Dual or Multi DEIF XDi Standard azimuth library no. 001.



Default setup for the DEIF XDi standard library is to use both CAN 1 and CAN 2, which means that you can select on which bus you want to transmit CAN data. CAN settings can be changed via the XDi installation menu, and each data type can be limited to only one bus, also from the menu.

Select a different NodeID for each of the 3 XDi indicators, and be sure that it is not already used by another CAN device on the bus.

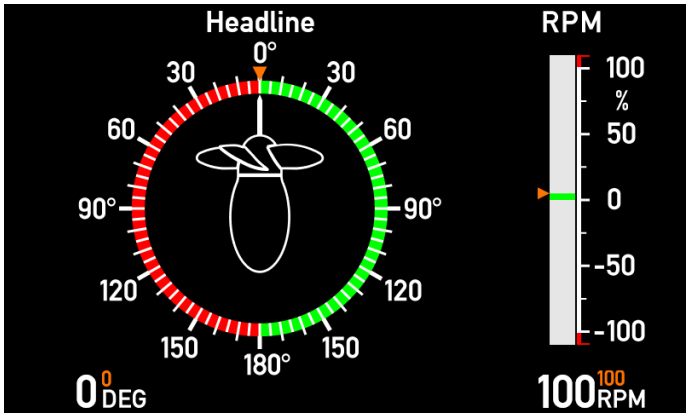
If presentation of set point (commanded value) data is activated in the virtual indicator, data is sent by using either a TPDO or the XDi-net broadcast protocol.

If you do not want set point (commanded value) data to be presented on the selected virtual indicator, you must select "Visible: OFF" in the installation menu "Edit virtual indicator/indicators".

Consult the XDi-net/CANopen reference manual for more information about the use of CANopen and XDi-net.

13.1.1 Azimuth and RPM indicator system with set point

The above system is configured for azimuth angle and RPM/RPM%, with set point (commanded value) for azimuth angle and RPM presented. In this case, it is VI007 Pulling azimuth type with dynamic azimuth pointer and indicating +/- RPM/RPM%.

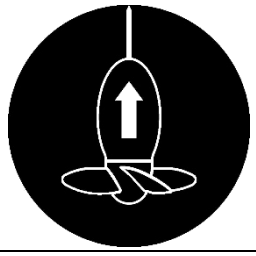
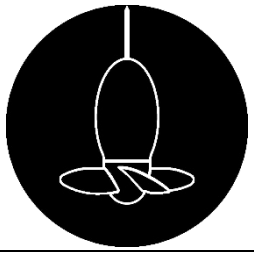
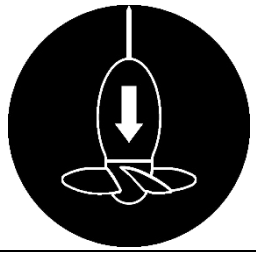
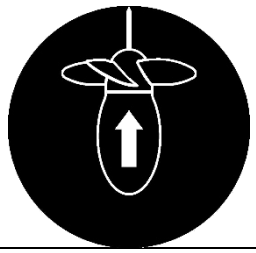
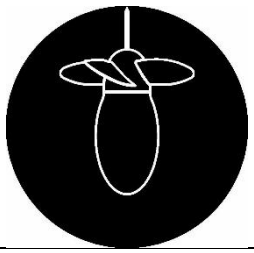
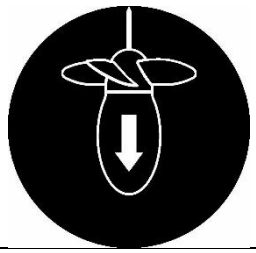


(Orange set points can be disabled from menu).

XDi units in this system are all multi-versions, but if there is no need for set point (orange) the Dual version can be used instead.

Dynamic azimuth pointer

The dynamic azimuth pointer is used when the direction of the thrust shifts depending on either RPM or %Pitch. The symbol is only used on indicators, on which the thrust direction can be reversed.

Thruster type	Forward RPM or %Pitch	No RPM or %Pitch (<2 %)	Reverse RPM or %Pitch
Pushing azimuth thruster			
Pulling azimuth thruster			

The dynamic azimuth pointer may also be used in azimuth indicators where +/- %thrust, +/-power or +/-%power controls the arrow in the pointer symbol.

CAN angle transmitter (TPDO) and RPM via XDi-net

XDi device	Selected azimuth indicator	CAN TX azimuth angle		Control sys. RPM/%RPM *		Select VS profile
		Actual	Set point	Actual	Set point	
XDi 1	VI007	XDi-net	XDi-net	XDi-net	XDi-net	VS01
XDi 2	VI007	XDi-net	XDi-net	XDi-net	XDi-net	VS01
XDi 3	VI007	XDi-net	XDi-net	XDi-net	XDi-net	VS01

In the XDi-net broadcast protocol, all data is sent separately using the XDi-net SAM-MPDO format.

If all data comes from the CAN control system, it may just use the XDi-net format instead of a TPDO.

From the installation menu, it is also possible to set up the XDi to use an RPDO instead of the default TPDO.

Then CAN angle transmitter must use XDi-net protocol (data format +/-1800). Alternatively, the azimuth input should be adjusted to match the selected angle transmitter (encoder). This can be performed via the installation menu.

CAN angle transmitter (TPDO) and RPM via TPDO

XDi device	Selected azimuth indicator	CAN TX azimuth angle		Control sys. RPM/%RPM *		Select VS profile
		Actual	Set point	Actual	Set point	
XDi 1	VI007	TPDO	TPDO	TPDO	TPDO	VS02
XDi 2	VI007	TPDO	TPDO	TPDO	TPDO	VS02
XDi 3	VI007	TPDO	TPDO	TPDO	TPDO	VS02

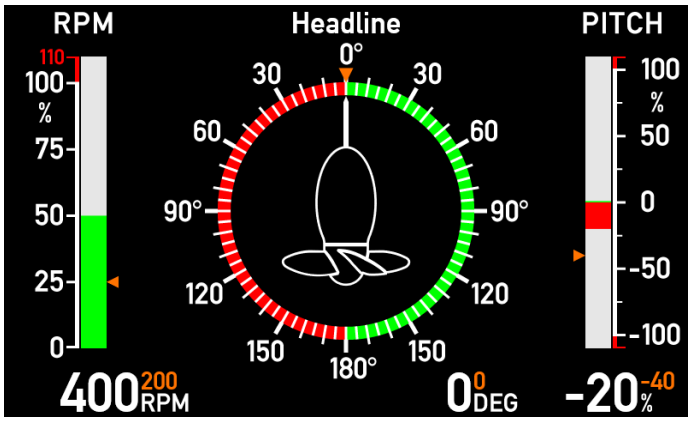
When RPM data is sent in a TPDO, then %RPM is calculated based on actual RPM.

From the installation menu, it is also possible to set up the XDi to receive data in an RPDO instead of the default TPDO.

13.1.2 Azimuth, Pitch and RPM system with set point

The same system is now set up to support azimuth angle, pitch% and RPM/RPM%, all with set point if required.

In this example, it is VI015 Pushing azimuth type with dynamic azimuth pointer, indicating RPM/RPM% and +/- %Pitch.



All XDi units in this system must be the Multi-version.

CAN angle transmitter (TPDO), RPM and Pitch via XDi-net

XDi device	Selected azimuth indicator	CAN TX azimuth angle		Control sys. RPM/%RPM *		Control sys. Pitch/%Pitch *		Select VS profile
		Actual	Set point	Actual	Set point	Actual	Set point	
XDi 1	VI015	XDi-net	XDi-net	XDi-net	XDi-net	XDi-net	XDi-net	VS01
XDi 2	VI015	XDi-net	XDi-net	XDi-net	XDi-net	XDi-net	XDi-net	VS01
XDi 3	VI015	XDi-net	XDi-net	XDi-net	XDi-net	XDi-net	XDi-net	VS01

In the XDi-net broadcast protocol, all data is sent separately using the XDi-net SAM-MPDO format. If all data including azimuth comes from the CAN protocol system, it makes sense to send all data using the XDi-net format instead of TPDO for azimuth. When the XDi is pre-configured to TPDO, it will also be able to receive data in XDi-net format, because the XDi-net is default active in all DEIF standard libraries. The CAN angle transmitter must use XDi-net protocol (data format +/-1800).

From the installation menu, it is also possible to set up the XDi to use an RPDO instead of the default TPDO.

CAN angle transmitter (TPDO), RPM and Pitch using TPDO

XDi device	Selected azimuth indicator	CAN TX azimuth angle		Control sys. RPM/%RPM *		Control sys. Pitch/%Pitch *		Select VS profile
		Actual	Set point	Actual	Set point	Actual	Set point	
XDi 1	VI015	TPDO	TPDO	TPDO	TPDO	TPDO	TPDO	VS02
XDi 2	VI015	TPDO	TPDO	TPDO	TPDO	TPDO	TPDO	VS02
XDi 3	VI015	TPDO	TPDO	TPDO	TPDO	TPDO	TPDO	VS02

When data is sent in a TPDO, then %RPM is calculated based on actual RPM, and pitch is either sent as a %Pitch value or the %Pitch value can be calculated based on a pitch angle.

From the installation menu, it is also possible to set up the XDi to receive data in an RPDO instead of the default TPDO.

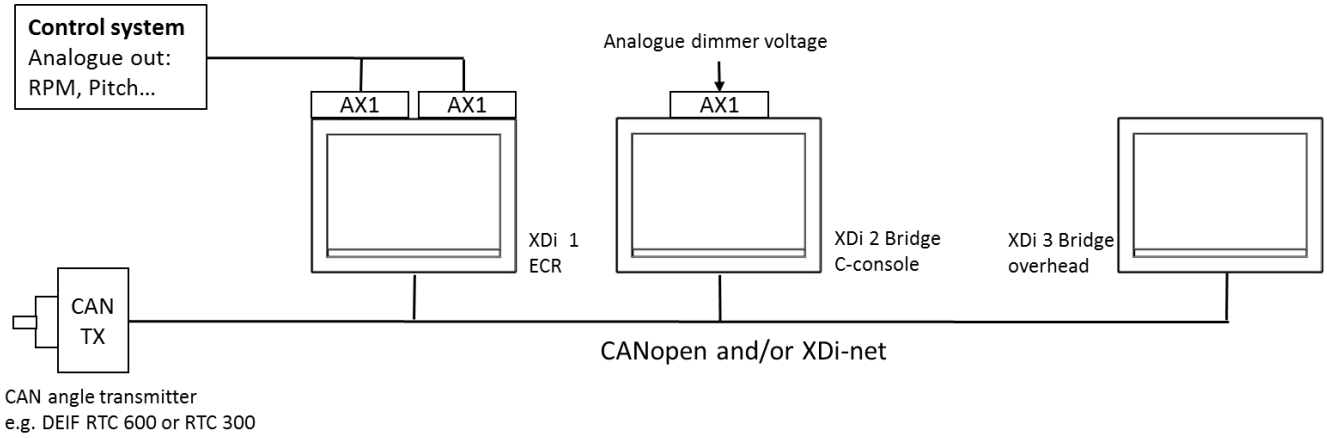
In all DEIF standard libraries, XDi-net is default on. This means that as long as the CAN function “XDi-net variable data on CAN1 & 2” is not deactivated, the XDi unit will also be able to receive data in XDi-net format, in addition to the defined TPDO.

In a fully TPDO- (or RPDO-) based CANopen system where XDi-net functions are not used, it is recommended to disable XDi-net or just the functions not used.

(Normally, XDi-net will just coexist and not affect the CAN system).

Recommendation: it is recommended to read the relevant sections in the XDi-net/CAN open reference manual if you use other CAN devices or controllers on a network, on which the XDi-net is active.

13.2 Application 2 – azimuth CANopen and analogue system



The azimuth angle is received from a CAN angle transmitter. All other data types are analogue and are supplied from the control system to the AX1 extension module(s) mounted on the XDi 1.

Analogue inputs are default 4 to 20 mA, but this can be changed from the XDi installation menu.

The standard library is set up to share the analogue data via the XDi-net; this means that if analogue signals are connected to one XDi, it will transmit the data on CAN, using the plug and play XDi-net protocol. This makes system integration quite easy: select the right input setup profiles according to the table below and fine-adjust the analogue input on the XDi, to which the analogue signals are connected; then the complete system is set up and ready.

Default setup for the XDi standard library is to use both CAN 1 and CAN 2, which means that you can select on which bus you want to transmit CAN data. CAN settings can be changed via the XDi installation menu, and each data type can be limited to one bus, also from the menu.

If presentation of set point (commanded value) data is activated in the virtual indicator, the additional analogue inputs must be connected.

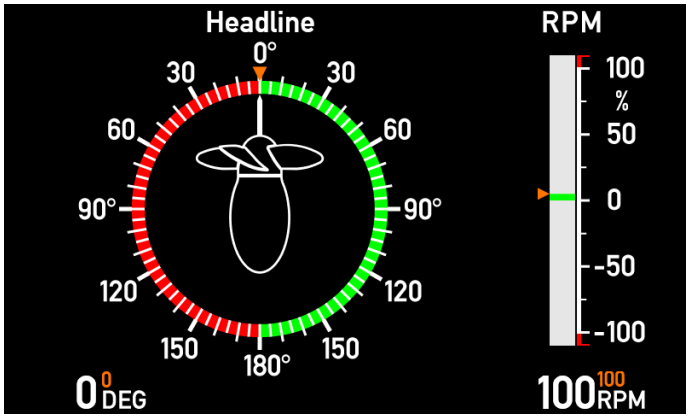
Select a different NodeID for each of the 3 XDi indicators, and make sure that it is not already used by another CAN device on the bus.

If you do not want set point (commanded value) data to be presented on the selected virtual indicator, you must select "Visible: OFF" in the installation menu "Edit virtual indicator/indicators".

13.2.1 Azimuth and RPM indicator system with set point

This is the system above configured for azimuth angle and RPM/RPN% and with all set point data presented.

In this example, it is VI007 Pushing azimuth type with dynamic azimuth pointer and indicating +/- RPM/RPM%.



(Orange set points can be disabled from menu).

XDi units in this system are all multi-versions, but if there is no need for set point (orange), the Dual version can be used instead.

CAN azimuth encoder, analogue RPM and set points

XDi device	Selected azimuth indicator	CAN TX azimuth angle		Control sys. RPM/%RPM *		Select VS profile
		Actual	Set point	Actual	Set point	
XDi 1	VI007	TPDO	4-20 mA	4-20 mA	4-20 mA	VS03
XDi 2	VI007	TPDO	XDi-net**	XDi-net**	XDi-net**	VS02
XDi 3	VI007	TPDO	XDi-net**	XDi-net**	XDi-net**	VS02

*) The analogue RPM input can calculate %RPM based on actual RPM.

**) You can disable the TPDO input in VS02 to make it only listen on XDi-net (it will function with TPDO active).

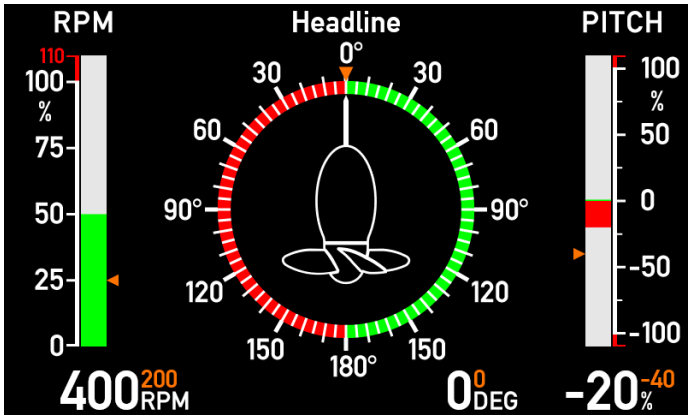
All analogue data is default shared via the XDi-net.

13.2.2 Azimuth, Pitch and RPM system with set point

The same CAN/analogue system is now set up to support azimuth angle, pitch% and RPM/RPM%, all with set point if required.

In this example, it is VI015 Pushing azimuth type with dynamic azimuth pointer, indicating RPM/RPM% and

+/- %Pitch.



(Orange set points can be disabled from menu)

All XDi units in this system must be the multi-version.

CAN azimuth, analogue RPM and Pitch

XDi device	Selected azimuth indicator	CAN TX azimuth angle		Control sys. RPM/%RPM *		Control sys. Pitch/%Pitch *		Select VS profile
		Actual	Set point	Actual	Set point	Actual	Set point	
XDi 1	VI015	TPDO	4-20 mA	4-20 mA	XDi-net	4-20 mA	4-20 mA	VS03
XDi 2	VI015	TPDO	XDi-net**	XDi-net**	4-20 mA ***	XDi-net**	XDi-net**	VS04 (VS02 ***)
XDi 3	VI015	TPDO	XDi-net**	XDi-net**	XDi-net**	XDi-net**	XDi-net**	VS02

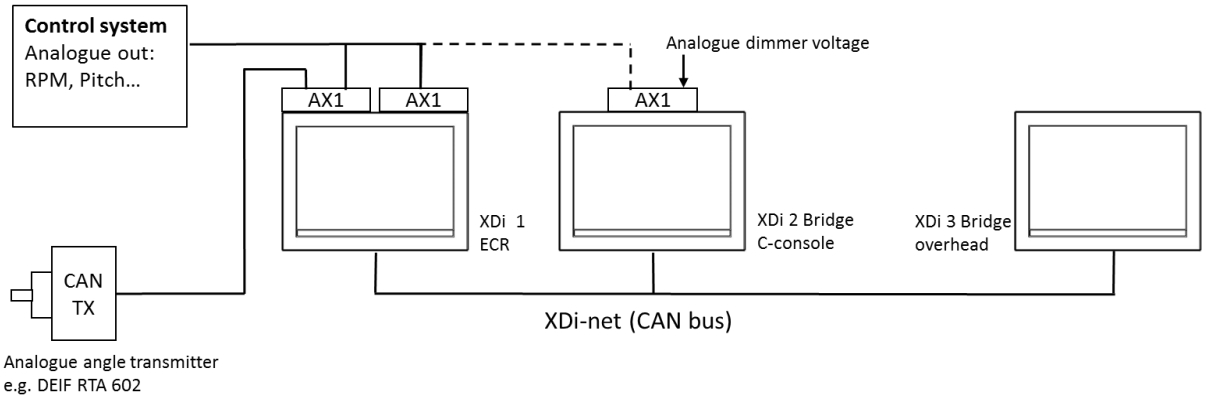
*) The analogue RPM input can calculate %RPM based on actual RPM, and analogue pitch input is scaled to a %Pitch value. (From the installation menu, an analogue pitch angle input can be scaled to %Pitch for indication). All analogue data is default shared via the XDi-net.

**) You can disable the TPDO input in VS02 to make it only listen on XDi-net (it will function with TPDO active).

***) An AX1 module is needed on the XDi 2 to get the RPM set point. If the RPM set point is not used, then VS02 must be used for the XDi 2.

Presentation of set point (commanded value) for each data type must be activated via the menu; it is by default OFF.

13.3 Application 3 – azimuth analogue system using XDi-net



All inputs for this system are analogue, default they are 4 to 20 mA. All data is shared using the XDi-net protocol for easy plug and play system integration.

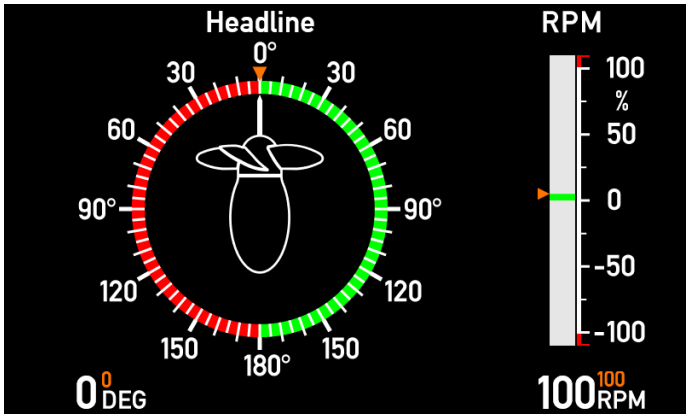
Select a different NodeID for each of the 3 XDi indicators. Make sure that it is not already used by another CAN device on the bus.

If you do not want set point (commanded value) data to be presented on the selected virtual indicator, you must select “Visible: OFF” in the installation menu “Edit virtual indicator/indicators”.

13.3.1 Azimuth and RPM indicator system with set point

This is the system above configured for azimuth angle and RPM/RPN% and with all set point data presented.

In this example, it is VI007 Pushing azimuth type with dynamic azimuth pointer and indicating +/- RPM/RPM%.



(Orange set points can be disabled from menu).

XDi units in this system are all multi-versions, but if there is no need for set point (orange), the Dual version can be used instead.

Normal analogue azimuth and RPM

XDi device	Selected azimuth indicator	CAN TX azimuth angle		Control sys. RPM/%RPM *		Select VS profile
		Actual	Set point	Actual	Set point	
XDi 1	VI007	4-20 mA	4-20 mA	4-20 mA	4-20 mA	VS04

XDi 2	VI007	XDi-net	XDi-net	XDi-net	XDi-net	VS01
XDi 3	VI007	XDi-net	XDi-net	XDi-net	XDi-net	VS01

SIN/COS azimuth angle and normal analogue RPM

XDi device	Selected azimuth indicator	CAN TX azimuth angle		Control sys. RPM/%RPM *		Select VS profile
		Actual	Set point	Actual	Set point	
XDi 1	VI007	sin cos	4-20 mA	4-20 mA	0 to 10 V*	VS05
XDi 2	VI007	XDi-net	XDi-net	XDi-net	XDi-net	VS01
XDi 3	VI007	XDi-net	XDi-net	XDi-net	XDi-net	VS01

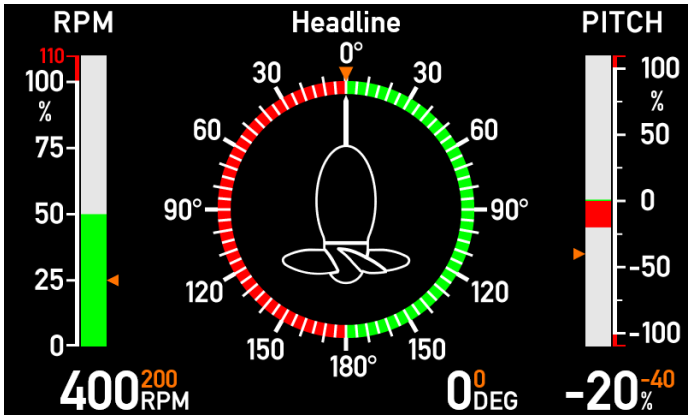
*) sin cos requires two analogue inputs, and therefore voltage input 3 (dimmer) on the second AX1 module (slot 2) is used as RPM set point input. (Voltage input 3 (dimmer) on AX1 in slot 1 is always reserved for dimmer in the DEIF standard libraries).

13.3.2 Azimuth, Pitch and RPM system with set point

The same CAN/analogue system is now set up to support azimuth angle, pitch% and RPM/RPM%, all with set point if required.

In this example, it is VI015 Pushing azimuth type with dynamic azimuth pointer, indicating RPM/RPM% and

+/- %Pitch.



(Orange set points can be disabled from menu).

All XDi units in this system must be the multi-version.

Normal analogue azimuth, RPM and Pitch

XDi device	Selected azimuth indicator	CAN TX azimuth angle		Control sys. RPM/%RPM *		Control sys. Pitch/%Pitch *		Select VS profile
		Actual	Set point	Actual	Set point	Actual	Set point	
XDi 1	VI013 to 020	4-20 mA	4-20 mA	4-20 mA	XDi-net	4-20 mA	XDi-net	VS05
XDi 2	VI013 to 020	XDi-net **	XDi-net **	XDi-net **	4-20 mA ***	XDi-net **	4-20 mA ***	VS08 (VS01***)
XDi 3	VI013 to 020	XDi-net	XDi-net	XDi-net	XDi-net	XDi-net	XDi-net	VS01

*) The analogue RPM input can calculate %RPM based on actual RPM, and analogue pitch input is scaled to a %Pitch value. (From the installation menu, an analogue pitch angle input can be scaled to %Pitch for indication). All analogue data is default shared via the XDi-net.

**) You can disable the TPDO input in VS02 to make it only listen on XDi-net (it will function with TPDO active).

***) An AX1 module is needed on the XDi 2 to get the RPM and pitch set point. If the RPM and pitch set point presentation is not used, then VS02 must be used for the XDi 2.

SIN/COS azimuth and normal analogue RPM and Pitch

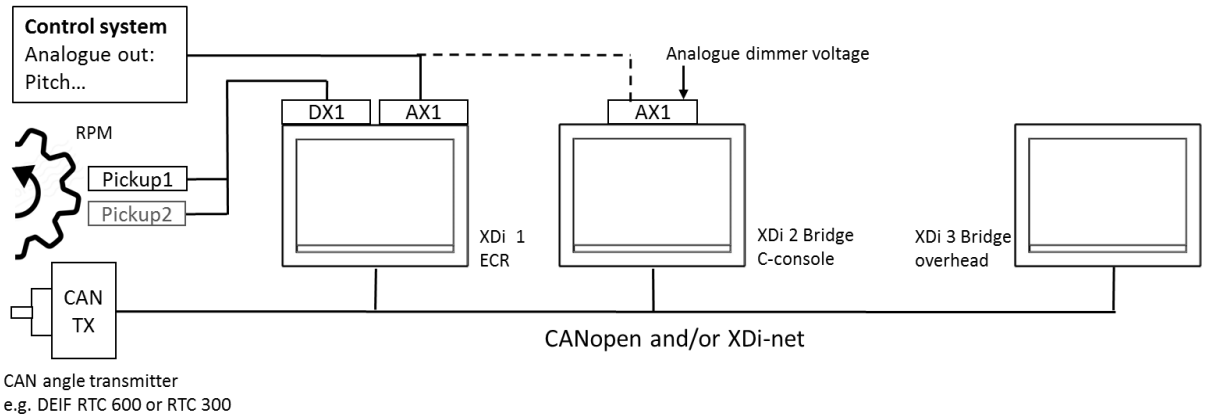
XDi device	Selected azimuth indicator	CAN TX azimuth angle *		Control sys. RPM/%RPM *		Control sys. Pitch/%Pitch		Select VS profile
		Actual	Set point*	Actual	Set point	Actual	Set point	
XDi 1	VI013 to 020	sin cos	0 to 10 V *	4-20 mA	XDi-net	4-20 mA	XDi-net	VS06
XDi 2	VI013 to 020	XDi-net **	XDi-net **	XDi-net **	4-20 mA ***	XDi-net**	4-20 mA ***	VS08 (VS01***)
XDi 3	VI013 to 020	XDi-net	XDi-net	XDi-net	XDi-net	XDi-net	XDi-net	VS01

*) sin cos requires two analogue inputs, and therefore voltage input 3 (dimmer) on the second AX1 module (slot 2) is used as azimuth set point input. (Voltage input 3 (dimmer) on AX1 in slot 1 is always reserved for dimmer in the DEIF standard libraries).

**) You can disable the TPDO input in VS02 to make it only listen on XDi-net (it will function with TPDO active).

***) An AX1 module is needed on the XDi 2 to get the RPM and pitch set point. If the RPM and pitch set point presentation is not used, then VS01 must be used for the XDi 2.

13.4 Application 4 – azimuth, RPM pickup analogue system using XDi-net



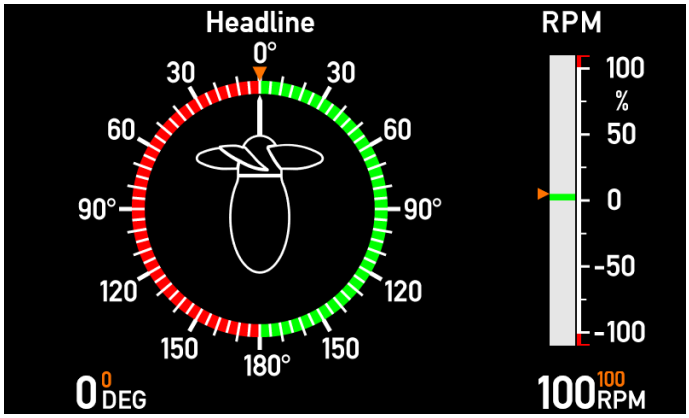
Select a different NodeID for each of the 3 XDi indicators, and make sure that it is not already used by another CAN device on the bus.

If you do not want set point (commanded value) data to be presented on the selected virtual indicator, you must select "Visible: OFF" in the installation menu "Edit virtual indicator/indicators".

13.4.1 Azimuth and RPM indicator system with set point

This is the system above configured for azimuth angle and RPM/RPN% and with all set point data presented.

In this example, it is VI007 Pushing azimuth type with dynamic azimuth pointer and indicating +/- RPM/RPM%.



(Orange set points can be disabled from menu). XDi units in this system are all multi-versions, but if there is no need for set point (orange), the Dual version can be used instead.

Normal analogue azimuth and RPM:

XDi device	Selected azimuth indicator	CAN TX azimuth angle		Control sys. RPM/%RPM *		Select VS profile
		Actual	Set point	Actual	Set point	
XDi 1	VI007	TPDO	4-20 mA	Digital in	4-20 mA	VS06
XDi 2	VI007	TPDO	XDi-net**	XDi-net**	XDi-net**	VS02
XDi 3	VI007	TPDO	XDi-net**	XDi-net**	XDi-net**	VS02

*) The analogue RPM input can calculate %RPM based on actual RPM. All analogue data is default shared via the XDi-net.

**) You can disable the TPDO input in VS02 to make it only listen on XDi-net (it will function with TPDO active).

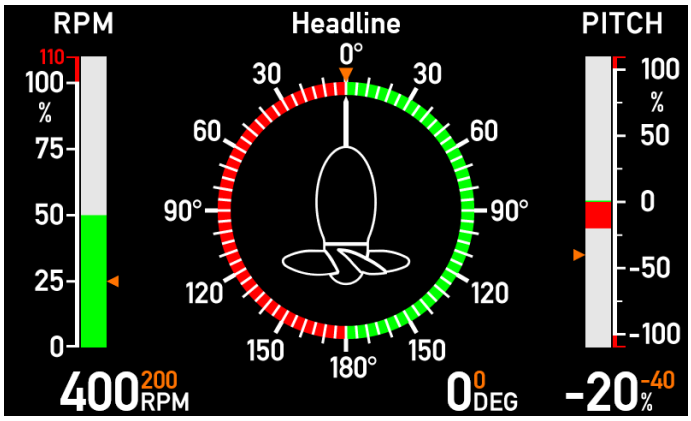
The DX1 module has two inputs. Only one RPM pickup is needed to detect RPM without direction. When the RPM is bidirectional, two RPM pickups are needed, and both digital inputs are required on the DX1 module.

13.4.2 Azimuth, Pitch and RPM system with set point

The same CAN/analogue system is now set up to support azimuth angle, pitch% and RPM/RPM%, all with set point if required.

In this example, it is VI015 Pushing azimuth type with dynamic azimuth pointer, indicating RPM/RPM% and

+/- %Pitch.



(Orange set points can be disabled from menu).

All XDi units in this system must be the multi-version.

Normal analogue azimuth, RPM and Pitch:

XDi device	Selected azimuth indicator	CAN TX azimuth angle		Control sys. RPM/%RPM *		Control sys. Pitch/%Pitch *		Select VS profile
		Actual	Set point	Actual	Set point	Actual	Set point	
XDi 1	VI015	TPDO	4-20 mA	Digital in	XDi-net	4-20 mA	XDi-net	VS07
XDi 2	VI015	TPDO	XDi-net**	XDi-net**	4-20 mA ***	XDi-net**	4-20 mA ***	VS08 (VS02***)
XDi 3	VI015	TPDO	XDi-net**	XDi-net**	XDi-net**	XDi-net**	XDi-net**	VS02

*) The analogue RPM input also calculates %RPM based on actual RPM, and the same for analogue pitch where %Pitch is calculated. (From the installation menu, an analogue pitch angle input can be scaled to %Pitch for indication).

**) You can disable the TPDO input in VS02 to make it only listen on XDi-net (it will function with TPDO active).

***) An AX1 module is needed on the XDi 2 to get the RPM and pitch set point. If the RPM and pitch set point presentation is not used, then VS02 must be used for the XDi 2.

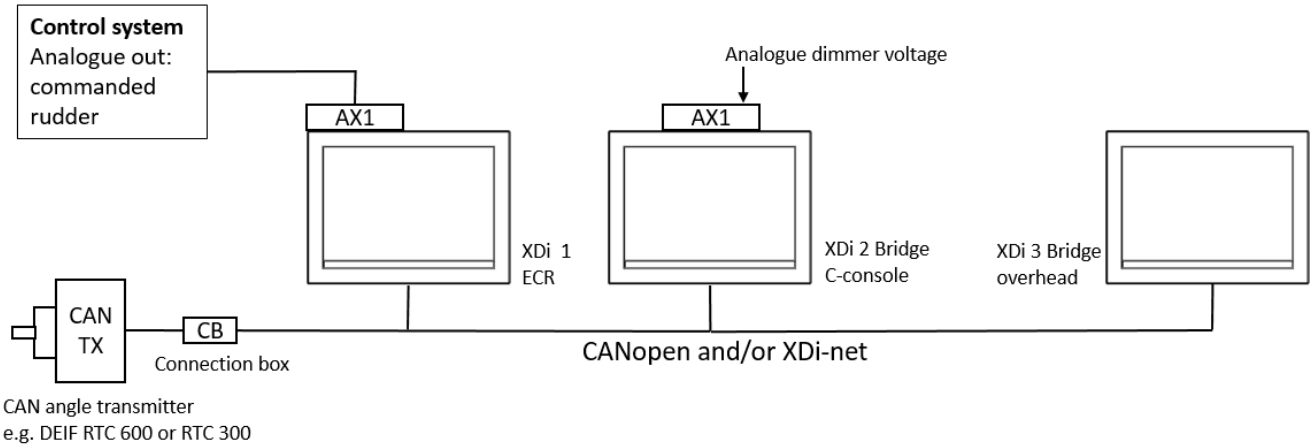
The DX1 module has two inputs. Only one RPM pickup is needed to detect RPM without direction.

13.5 Application 5 - XDi rudder system using CANopen and XDi-net

The system below is a CAN-based rudder indicator system using the DEIF Standard XDi Dual rudder library.

The indicators are presenting actual rudder angle and the commanded rudder angle.

(See DEIF standard XDi rudder libraries for indicator details).



Select a different NodeID for each of the 3 XDi indicators, and make sure that it is not already used by another CAN device on the bus.

System setup overview

Unit	Description	Node ID	VI no.	VI type	VS no	VS input description	PP	PP description
RTC 600	CAN angle TX using COBID 0x181	1						
XDi 144 D	XDi 1 located in ECR	e.g. 30	003	+/-45° FWD	03	Angle: TPDO1 Comm.: 4-20 mA	06	ECR fixed dimmer. XDi-net active
XDi 144 D	XDi 2	e.g. 31	003	+/-45° FWD	02	Angle: TPDO1 Comm.: XDi-net	02	Analogue dim. gr.1 XDi-net active
XDi 192 D	XDi 3 in overhead panel	e.g. 32	003	+/-45° FWD	02	Angle: TPDO1 Comm.: XDi-net	01	XDi-net dim. gr.1 XDi-net active

By selecting from the standard virtual indicators and standard setup profiles, the system can be configured.

The CAN angle transmitter is preconfigured to NodeID 1 and use TPDO1 for periodic data transmissions (COBID 0x181). All XDi units are using angle data directly from the CAN transmitter by listening for this TPDO1.

The commanded angle value from the steering control is analogue and is connected to AX1 on the XDi in the engine control room (ECR). This XDi is set up to share commanded rudder via XDi-net.

The XDi in the ECR is using a fixed dimmer profile since it is mounted below deck where dimming is not needed (artificial light).

The bridge indicators are dimmed from the analogue input on XDi 2 and shared with XDi 3 via CAN, using dimmer group 1.

A combined power and CAN cable (four wires) can be used to make installation easier.

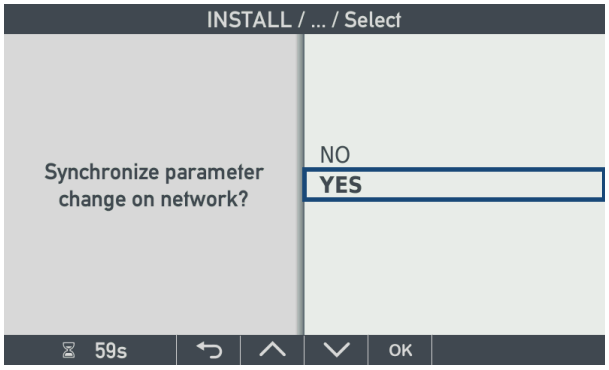
Please follow the guidelines for correct CAN bus installation in this manual.

Especially remember to make correct bus termination in each end of the CAN bus.

13.5.1 Setup procedure

When powered up the first time:

1. Follow the installation wizard to select can Node ID, Product profile (PP), Virtual indicator (VI) and setup profile (VS), and finish the wizard on XDi 1, XDi 2 and XDi 3 (see selection in table).
2. Follow the instructions for electric zero set of the rudder angle transmitter.*)
3. If the min/max rudder angle is inaccurate, it may be due to mechanical inaccuracy or gearing between rudder and transmitter. Choose one of the XDi units and enter the installation menu and select the “Adjust input” menu, and then the rudder angle input (PDO converter adjust). Use the setup menu to calibrate the endpoints one by one (zero should be adjusted first if point 2 was not successful). To share this new calibration with all other XDi units on the CAN bus, you must remember to synchronise parameters when you leave the adjust menu:



Please see chapter “PDO converter for azimuth/rudder” for detailed information on how to make this calibration from menu.

4. If the commanded rudder (set point) needs adjustment, select the rudder set point from the “Adjust input” menu. The calibrated data is shared on XDi-net.
5. Setup is completed.

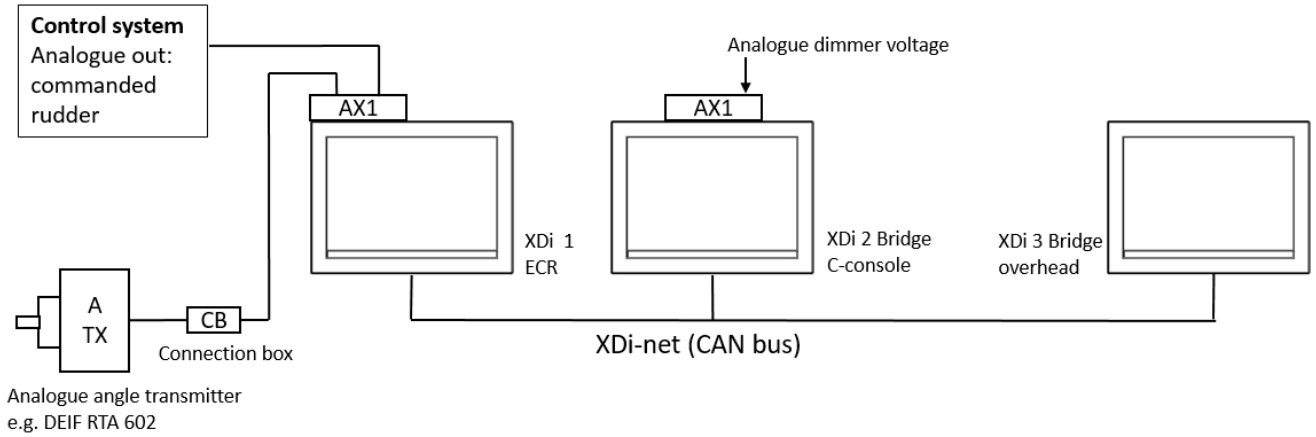
*) If it is difficult to physically reach the rudder transmitter, the alignment can be made in the indicator itself via the setup menu. The alignment will automatically be shared with all other XDi rudder indicators.

13.6 Application 6: XDi rudder system, analogue angle transmitter and XDi-net

The system below is using an analogue 4-20 mA rudder transmitter (for example RTA 602) and three XDi units using the DEIF Standard XDi Dual rudder library.

The indicators are presenting actual rudder angle and the commanded rudder angle.

(See DEIF standard XDi rudder libraries for indicator details).



Select a different NodeID for each of the 3 XDi indicators, and make sure that it is not already used by another CAN device on the bus.

System setup overview

Unit	Description	VI no.	VI type	VS no	VS input description	PP	PP description
RTA 600	Analogue angle TX with 4-20mA output						
XDi 144 D	XDi 1 located in ECR	003	+/-45° FWD	04	Angle: 4-20 mA Comm.: 4-20 mA	06	ECR fixed dimmer. XDi-net active
XDi 144 D	XDi 2	003	+/-45° FWD	01	Both XDi-net	02	Analogue dim. gr.1 XDi-net active
XDi 192 D	XDi 3 in overhead panel	003	+/-45° FWD	01	Both XDi-net	01	XDi-net dim. gr.1 XDi-net active

By selecting from the standard virtual indicators and standard setup profiles, the system can be configured.

The system is similar to the system in APP.1, but the angle transmitter has analogue output.

13.6.1 Setup procedure:

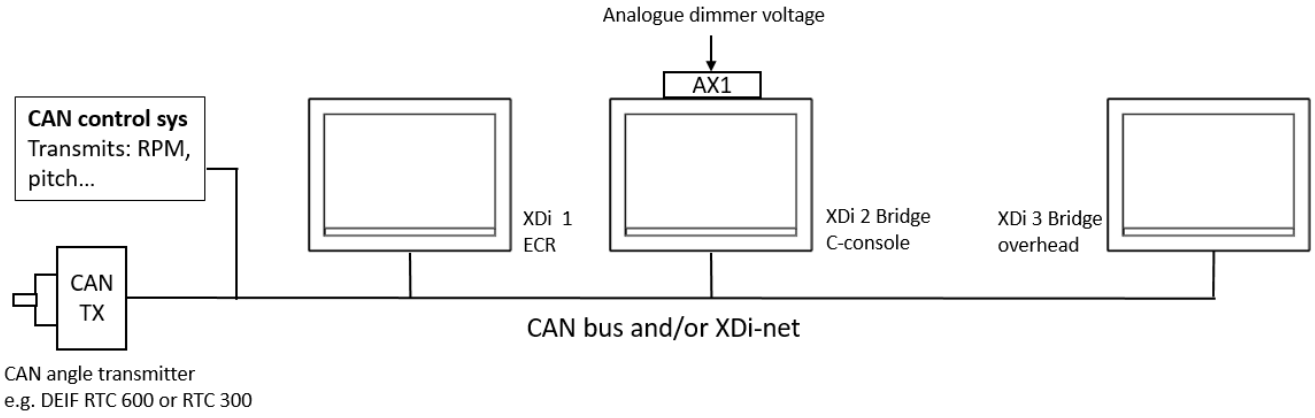
When powered up the first time:

1. Follow the installation wizard to select can Node ID, Product profile (PP), Virtual indicator (VI) and setup profile (VS) and finish the wizard on XDi 1, XDi 2 and XDi 3. (See selection in table.)
2. Follow the instructions for electric zero set and min/max adjust of the rudder angle transmitter.*)
3. If the min/max rudder angle is inaccurate, it may be due to mechanical inaccuracy or gearing between rudder and transmitter. Open the installation menu on the XDi where the analogue input is connected, select the “Adjust input” menu, and then the rudder angle input (analogue input adjust). Use the setup menu to calibrate the zero point and endpoints one by one. This XDi shares angle data on XDi-net, so you should select NO to synchronise parameters; it has no effect in this case.

   See chapter “AX1 analogue input – azimuth/rudder set point” for a detailed description on how to make this calibration from menu.
4. If the commanded rudder (set point) needs adjustment, select the rudder set point from the “Adjust input” menu and make the adjustments; again, the calibrated data is shared on XDi-net.
5. Setup is completed.

13.7 Application 7 – dimmer control

The dimmer control is independent of the selected virtual indicator, and the dimmer input options are controlled by the selected product profile. The XDi handles nine dimmer groups via CAN, and the local group that is not controlled via CAN.



In DEIF standard libraries, voltage input 3 on the AX1 module in slot 1 is always reserved for analogue dimmer and is not used as input for any of the virtual indicators.

13.7.1 XDi-net, CAN TPDO or analogue dimmer using AX1

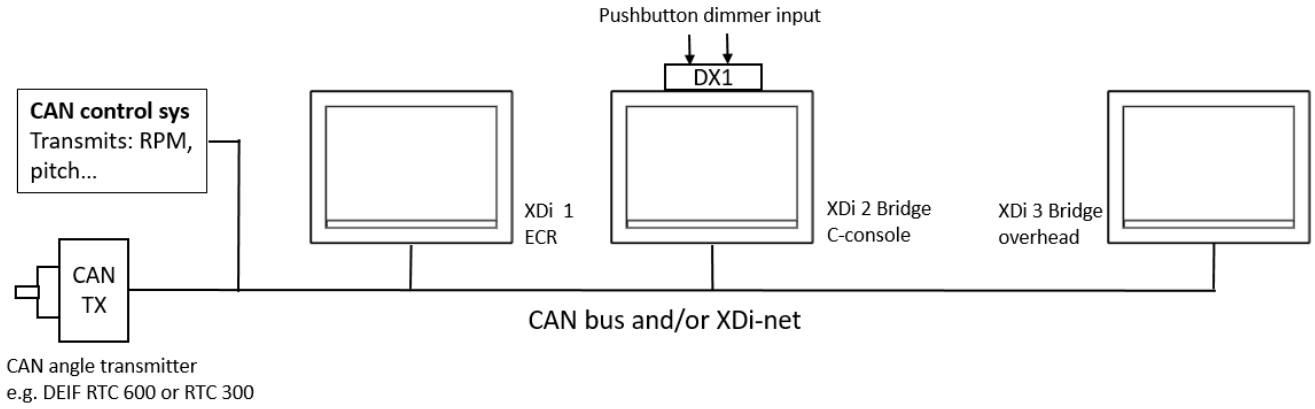
Dimmer control type	XDi-net All controlled from central dimmer (AX1 not needed)		Analogue control of XDi units on bridge, fixed dimmer level in ECR		TPDO Bridge controlled from central dimmer ECR is local analogue	
XDi device	Dimmer input	Select PP	Dimmer input	Select PP	Dimmer input	Select PP
XDi 1	XDi-net	PP01	Fixed	PP06	Voltage **	PP05
XDi 2	XDi-net	PP01	Voltage *	PP02	TPDO	PP03
XDi 3	XDi-net	PP01	XDi-net	PP01	TPDO	PP03

*) The input is default set up to use a potentiometer connected to the Vref output on AX1 module terminal 3, but it can easily be reconfigured to a dimmer voltage input instead.

The analogue dimmer value is shared on CAN for the actual dimmer group, and since the XDi 3 is part of group 1 (default), its dimmer level will be controlled from the XDi 2 via the XDi-net.

**) This will require an AX1 module mounted on the XDi 1 located in the ECR.

13.7.2Push-button dimmer using DX1

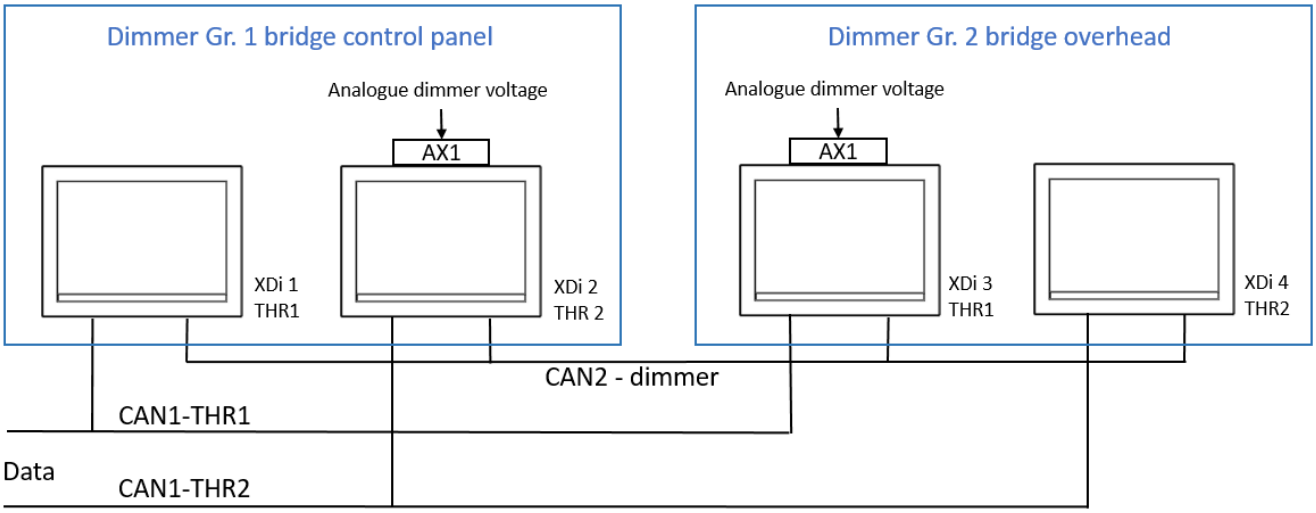


Dimmer control type	Push-button control of XDi units on bridge Fixed dimmer level in ECR	
XDi device	Dimmer input	Select PP
XDi 1	Fixed	PP06
XDi 2	Digital input 1&2	PP04
XDi 3	XDi-net	PP01

13.8 Application 8 – group dimmer control

The system in this application note consists of two azimuth thrusters, each with an XDi indicator located in the control panel and one in the overhead console. CAN data is distributed on two separate CAN lines, both use CAN input 1 on the XDi.

One XDi in the console and one in the overhead panel are equipped with an AX1 module for dimmer input. Dimmer level data is shared on CAN 2.



By using the dimmer grouping function, it is possible to individually control the dimmer level of XDi units in the bridge control panel (gr.1) and XDi units in the bridge overhead panel (gr. 2) on the same CAN bus.

Dimmer control type	Analogue control of XDi groups on the bridge		XDi dimmer group selection via user menu	Dimmer source setup
XDi device	Dimmer input	Select PP	Dimmer group	Send analogue dimmer value on
XDi 1 THR 1	XDi-net	PP01	(Default Gr. 1)	-
XDi 2 THR 2	AX1 voltage	PP02	(Default Gr. 1)	CAN 2 *
XDi 3 THR 1	AX1 voltage	PP02	Gr. 2	CAN 2 *
XDi 4 THR 2	XDi-net	PP01	Gr. 2	-

*) The DEIF standard libraries are by default set up to share analogue dimmer data on CAN 1 and CAN 2. As long as dimmer groups are used, it is not necessary to change to CAN 2.

In this example, however, it may be more practical only to connect CAN 2 on the two XDi units in the bridge console and similarly only CAN 2 on the two XDi units in the overhead bridge console. If the default dimmer group 1 is used in both locations, it is important to change the default setting of data sharing on the XDi-net, so that analogue dimmer data is only shared on CAN 2, since the indicators are also interconnected on CAN 1.

Fault symptom: If dimmer data is shared on both CAN 1 and CAN 2, and all XDi units are in group 1, then the backlight level will jump between the two dimmer levels and make the backlight flicker.

14 Terminology, Terms, and abbreviations

Abbreviation (short text)	Full text	Explanation
XDi	Flexible Display indicator	Illuminated indicator based on display technology and with a library architecture offering very flexible indicator design, interfaces and CANopen network handling.
CANopen	CANopen	Standard but relative open protocol for communicating via the CAN bus network layer. Contact CiA (CAN in Automation) for more detailed information.
XDi-net	XDi-net	DEIF-specific way to use CANopen and the manufacture-specific section of the object index.
PP	Product profile	Collection of default product specific parameter values like dimmer, CAN-bus settings, sound and visual warnings and alike.
VI	Virtual indicator	Predefined indicator stored in the XDi library.
VS	VI-setup	Collection of default indicator parameter values like input setup parameters for the selected virtual indicator.
Extension Module	Extension module	Physical module to be mounted in one of the extension slots on the rear side of the XDi unit. The XDi 96 only has one extension slot, where XDi 144 and XDi 192 both have 2 extension slots.
AX 1	Analogue input extension module	Analogue interface module that can be snapped on the back of the XDi indicator to add: 2 analogue inputs, 1 dimmer/universal voltage input and a reference voltage output.
DX 1	Digital I/O extension module	Digital interface module that can be snapped on the back of the XDi indicator to add: 2 digital input (often used for RPM pickups) and 2 relay outputs.
NX 1	NMEA output extension module	NMEA interface module that can be snapped on the back of the XDi indicator to add: 1 RS422 NMEA output IEC 61162-1.
L-pan	Left menu pane	The left part of the standard XDi menu screen, often containing added information to the highlighted menu.
R-pan	Right menu pane	Right part of the standard XDi menu screen, often containing the actual menu structure.
Slot	Extension slot	The extension slot is used when mounting an extension module on the XDi, see Extension module.
NMEA	NMEA	NMEA is a serial communication standard using RS422 and in this product compliant with IEC 61162-1.
MED	Marine Equipment Directive	MED-approved products are compliant with relevant standards in the Marine Equipment Directive.

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