



Danfoss IXA - Installation Guide

MES 1001 Installation Guide In Situ Marine Emission Sensor





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1. Safety

1.1. Safety Message Types

The following symbols are used in this manual.

Definitions



Indicates a potentially hazardous situation, which, if not avoided, could result in death or serious injury.



Indicates a potentially hazardous situation, which, if not avoided, could result in minor or moderate injury. It may also be used to alert against unsafe practices.

NOTICE

Indicates important information, including situations which may result in damage to equipment or property.

1.2. General Safety



This manual contains important instructions that must be followed during installation and maintenance of the marine emission sensor.

NOTICE

BEFORE INSTALLATION

Check for damage to equipment and packaging. If in doubt, contact the supplier before commencing installation.



External personnel conducting maintenance must be:

- Trained and authorized in general safety rules for work on electrical equipment.
- Familiar with local requirements, rules, and regulations for the installation.



HOT SURFACES

The surrounding environment may become very hot and surfaces should not be touched.

NOTICE

When planning the installation site, ensure that the product label and warning labels remain visible.

NOTICE

Handle the marine emission sensor with care. Ensure safe mounting by lifting and moving the marine emission sensor carefully. Two people may be necessary to carry the unit.

The weight of the marine emission sensor is considerable and may cause injury if dropped. Wear safety boots.

2. Introduction

2.1. Purpose of the Manual

The *Installation Guide* provides information required to install the marine emission sensor.

Other available resources:

- *Marine Emission Sensor Data Sheet* (100300-DSH)
- *Marine Emission Sensor User Guide* (100320-MAN)

These documents are available for download at the Danfoss IXA web site, or from the supplier of the marine emission sensor.

2.2. Abbreviations and Definitions

Abbreviation	Description
CCD	Charged Coupled Device
DIN	Deutsche Industrie Norm
LAN	Local Area Network
NH ₃	Ammonia
NO	Nitric oxide
NO ₂	Nitrogen dioxide
NO _x	A generic term for NO and NO ₂ (nitric oxide and nitrogen dioxide)
ppm	Parts Per Million
RoHS	Restriction of Hazardous Substances
SCR	Selective Catalytic Reduction
SO ₂	Sulfur dioxide
UV	Ultraviolet
WEEE	Waste Electrical and Electronic Equipment Directive

Table 1: Abbreviations

Term	Description
Purge Air	Clean air (free of particles, water, oil, NO _x , SO ₂ , and NH ₃). An air purge system is used to flush optical parts and electrical control equipment with clean air before it is turned on. This ensures that the functionality of the equipment is not affected or damaged by the contaminants from the surrounding environment or exhaust gas.
Probe	The part of the gas sensor product where the gas measurement takes place. This part consists of the measurement chamber, source, optical system, and supporting sensors (pressure, temperature).

Table 2: Definitions

2.3. Considerations

Consider the following when mounting and installing the marine emission sensor:

- Exhaust gas pipe orientation, vertical or horizontal
- Dimensions, clearances – see 3.2 Dimensions.
- Flange – see 4.2.2 Preparing the Flange and 4.2.3 Mounting the Flange.
- Compressed air – see 4.3 Pneumatic connections
- Connections, cabling – see 5.1 Overview of Connection Area and 5.2 Cables.
- Interfaces – see 5.5 Interfaces.
- Connector types – see 5.5 Interfaces.

2.4. Items Supplied

The product is delivered with:

- Installation Guide, supplied on USB
- User Guide, supplied on USB

2.5. Identification



Illustration 1: Example of Product Label

Part no.	100100-003
Rev.	D
Ser. no.	1745-0007 or 1745-0007-0001

Table 3: Example of Emission Sensor ID Information

3. Product Description

The In Situ Emission Sensor is a marine emission sensor intended for measuring gases in various maritime applications. It is designed to withstand harsh environments. The ability of the marine emission sensor to operate in harsh environments with a low maintenance rate makes the marine emission sensor suitable for demanding applications. The marine emission sensor measures the content of these gases: NO_x, SO₂ and NH₃ in the engine exhaust gas. The marine emission sensor is an in situ sensor, i.e. it performs the measurement directly in the exhaust gas. The sensor unit is mounted on the wall of the exhaust pipe and measures the exhaust gas passing the sensor probe.

The probe is the part of the gas sensor product where the gas measurement takes place. This part consists of the measurement chamber, source, optical system, and supporting sensors (pressure, temperature).



Illustration 2: Marine Emission Sensor

Features of the marine emission sensor

- Measures NO_x, SO₂, and NH₃
- Designed as a standalone unit
- Designed for easy installation on site: 2 persons are able to mount the marine emission sensor using standard tools and installation instructions
- Installation and setup/configuration do not take longer than 1 hour (as a prerequisite, the required infrastructure must be available and appropriately prepared (cable, flange etc.))
- Is able to measure in an exhaust stack, which is either horizontal or vertical

3.1. System Overview

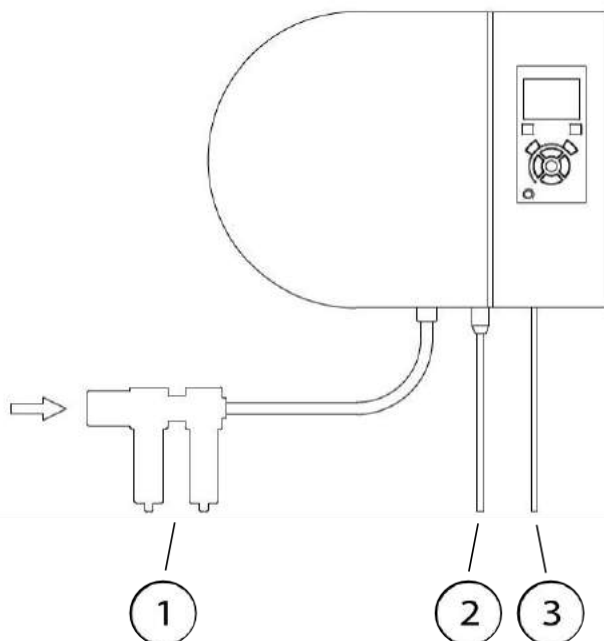


Illustration 3: System Overview

Item	Description
1	Filter for compressed air
2	24 V DC
3	Interfaces

Table 4: Legend to Illustration 3

3.2. Dimensions

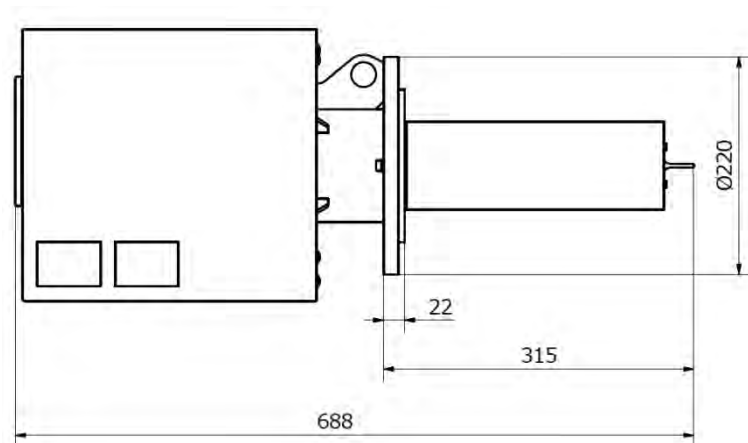


Illustration 4: Dimensions

All dimensions are in mm.

3.3. Sensor Overview

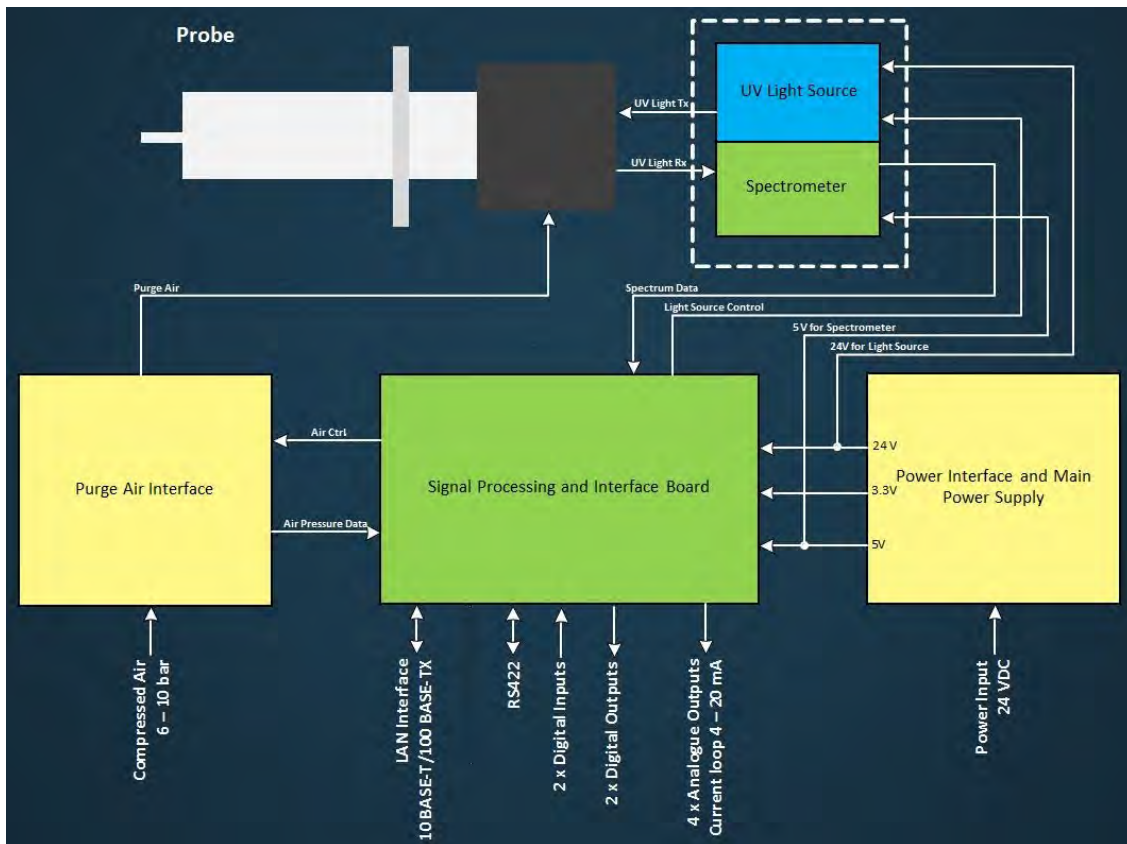


Illustration 5: Marine Emission Sensor Block Diagram

The probe is mounted in the exhaust gas system so that the exhaust can flow through the opening. A UV (ultraviolet) light source emits light through an optical fiber into the probe where it is reflected and then collected by another fiber, which is connected to the spectrometer. A CCD (charged coupled device) in the spectrometer collects the incoming light and the spectrum is then sampled and delivered to the output.

The Signal Processing Board acquires the data from the spectrometer, and through an advanced algorithm, the gaseous concentrations are calculated. The signal processing compensates for the exhaust gas pressure and the exhaust gas temperature gives a more accurate measurement.

The marine emission sensor is automatically calibrated at specific intervals to compensate for various potential sources of error. This is achieved by applying compressed air into the probe opening. This way the exhaust gas in the measurement path is evacuated and only clean compressed air will be present. The Signal Processing Board calculates a new reference and compressed air is removed bringing the marine emission sensor back to normal operation.

The Signal Processing Board also controls the interfaces for external communication with the marine emission sensor. Interfaces like Ethernet, Analog Out, RS-422, and discrete inputs/outputs are available and can be set up individually. The marine emission sensor can be operated locally through a display but the user may also use a software-based service interface for remote access.

A Purge Air System ensures that the optics are not contaminated with soot and other particles during operation. The same system also provides compressed air for the zero-point calibration process.

4. Mechanical Installation

This chapter covers the following subjects:

- General installation requirements
- Preparation
 - Planning the installation site and planning phase
 - Preparing the flange
 - Re-establishment of the heat insulation
- Pneumatic connections
- Lifting and Mounting

4.1. General Installation Requirements

CAUTION

Read the safety instructions before installing the unit. Failure to follow the recommendations could result in personal injury.

CAUTION

It is important to plan the installation of the unit. Neglecting to plan may result in extra work during and after installation.

NOTICE

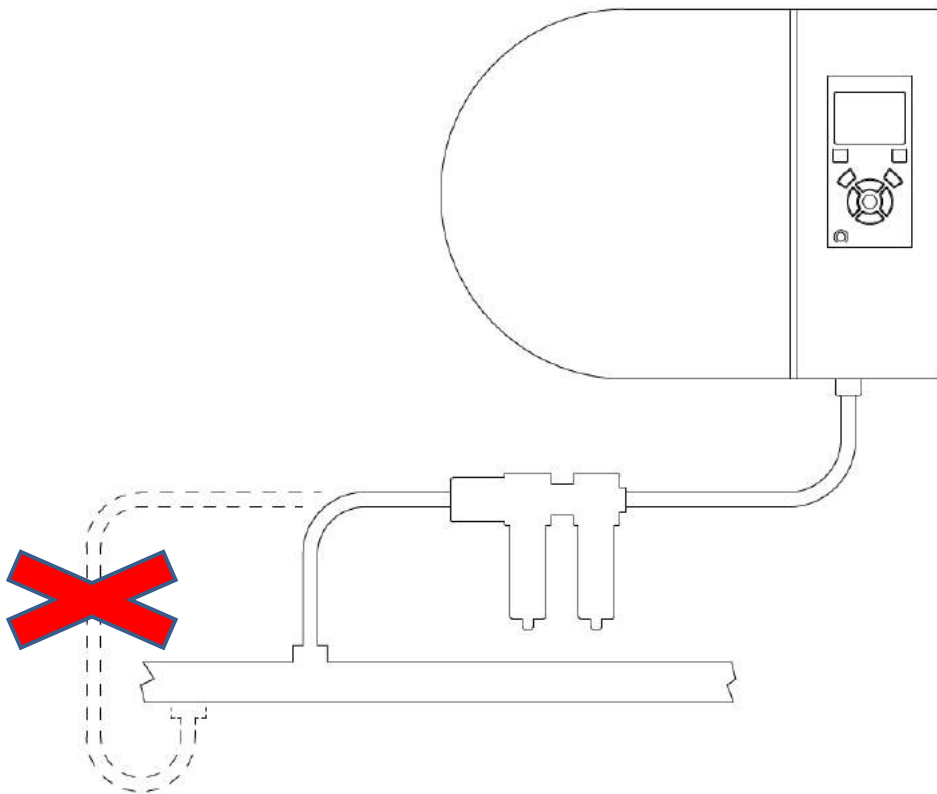
When receiving the unit, make sure that the packaging is intact. Also be aware of any damage that might have occurred to the unit during transport. In case damage has occurred, immediately contact the shipping company to claim the damage.

4.2. Preparation

4.2.1. Planning the Installation Site

NOTICE

- Determine the installation location. Observe the ambient conditions.
- Always pay attention to the flow direction and consider this when mounting the unit.
- Observe the space requirements and clearances. Provide for additional space for maintenance work.
- Provide the appropriate power supply. Observe the power requirements stated in the Data Sheet.
- The flange must be prepared appropriately, e.g. load-carrying capacity of the welded flange. The material must be compatible with the surrounding environment,
- Provide compressed air according to description in this guide.

**Illustration 6: Correct Positioning of the Marine Emission Sensor**

The air outlet to the sensor must be placed on top of the ship's pneumatic supply tube (the thick tube at the bottom) to avoid intake of condensate in the sensor. The sensor must be mounted above the supply tube.

The marine emission sensor is a flexible product, which can be installed in several suitable positions in the exhaust line, e.g. after the turbocharger or after the SCR.

4.2.2. Preparing the Flange

This section describes how to prepare and mount the flange for the marine emission sensor on the exhaust system. The flange is customer-built according to Danfoss IXA specifications.

The flange must be of the following type:

- For installation on exhaust pipes with a heat insulation thickness up to 70 mm ($0 \text{ mm} \leq \text{insulation thickness} \leq 70 \text{ mm}$).

NOTICE

The circular welding neck flange is based on NT 16, DN100, DIN2633, PN16, ISO standard.

Note that positioning of the flange immediately before or after bends is not recommended as it may lead to incorrect measurements, see Illustration 7.

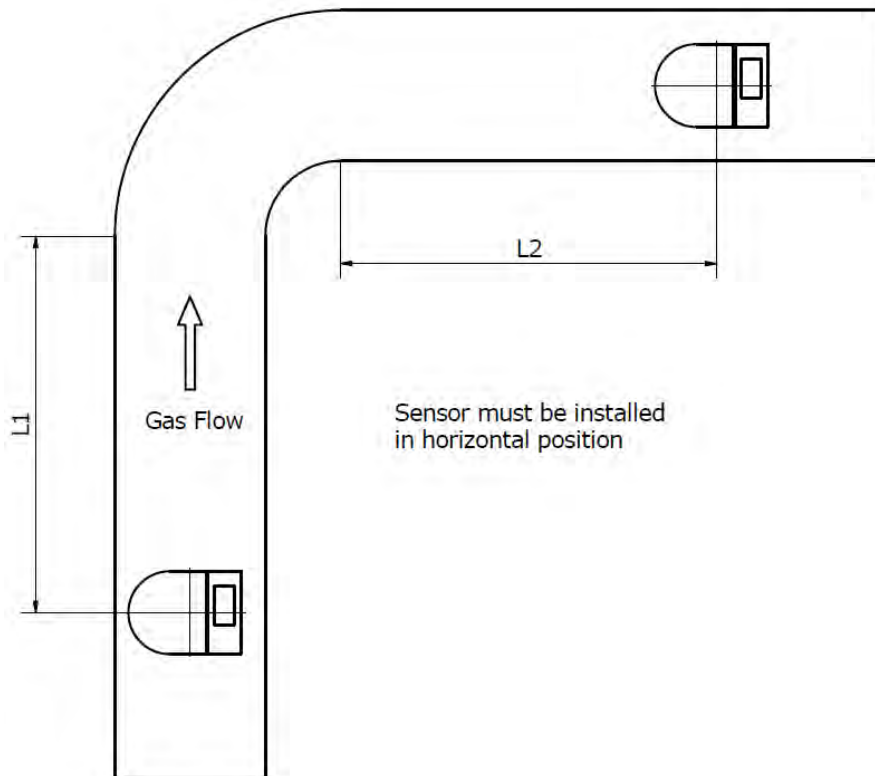


Illustration 7: Installation Recommendations for the Exhaust Pipe

No.	Description
L1	= At least 1.5 m
L2	= At least 1.5 m

Table 5: Legend to Illustration 7

Cut a hole, $\varnothing 115$ mm, in the exhaust pipe, which is aligned to the center of the exhaust pipe according to Illustration 8.

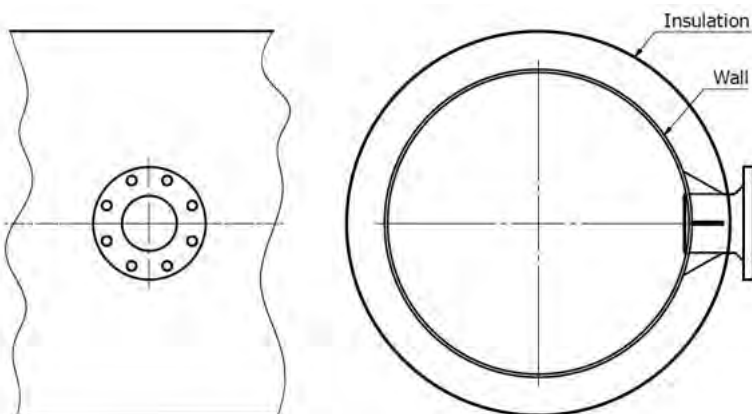


Illustration 8: Alignment of the Flange

Flange is aligned to center of exhaust pipe

4.2.3. Mounting the Flange

The flange is positioned in the hole ($\varnothing 115$) and the flange and the bolt holes must be orientated according to Illustration 9, depending on the exhaust pipe installation.

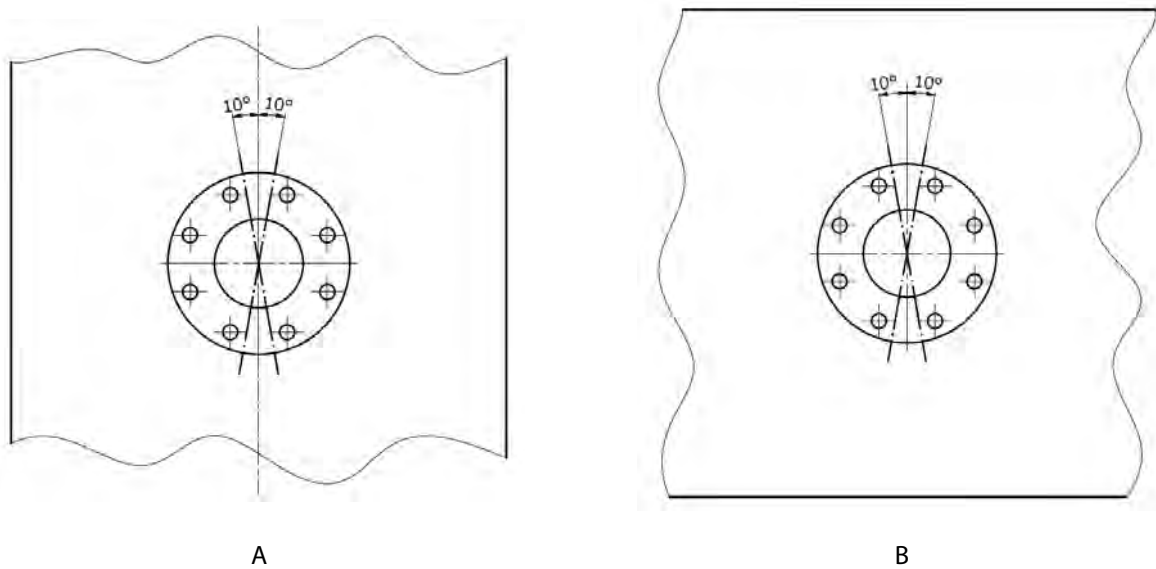


Illustration 9: Positioning Tolerance of the Flange in Different Exhaust Pipe Installations
Vertical (a) and Horizontal (b)

Tolerances	Specification
Vertical (a)	10° / 10°
Horizontal (b)	

Table 6: Legend to Illustration 9

The flange is fully welded to the exhaust pipe from the outside. The thickness of the welding must be appropriate for the installation. The Center of Gravity (COG) B for the marine emission sensor is 100 mm from the flange, see Illustration 10. Mass of sensor is 350 N.

NOTICE

The fixation of the flange shall be designed in accordance with the environmental and mechanical specifications of the actual location. Additional support of the flange may be required.

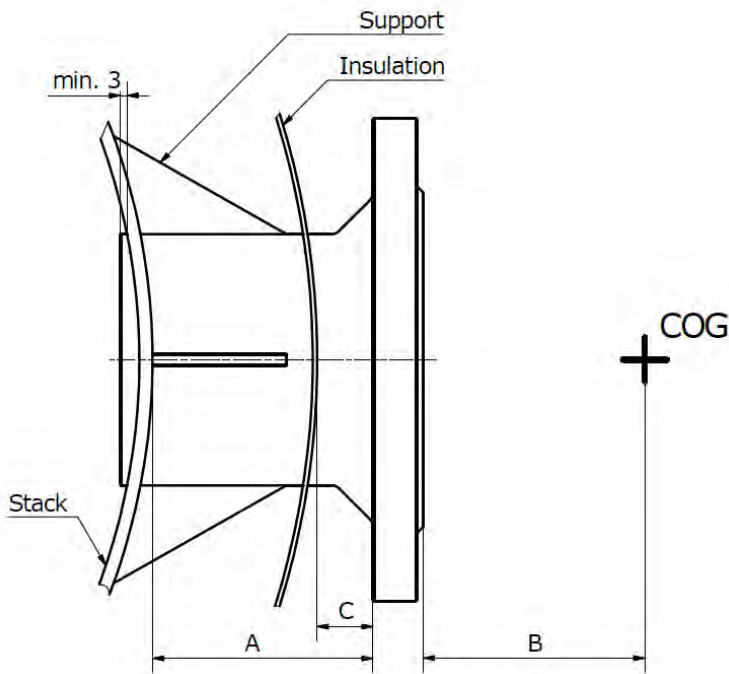


Illustration 10: Welding of the Flange

Item	Description
A	Distance from exhaust pipe to flange. Max. 100 mm depending on stack insulation thickness.
B	Distance from flange to COG = 100 mm
C	Distance from stack insulation to circular flange. Min. 30 mm clearance to ensure room for bolts and nuts.
COG	Center of gravity

Table 7: Legend to Illustration 10

NOTICE

The length A can be adjusted depending on the heat insulation thickness. See 4.2.2 Preparing the Flange.

Check that full access is available through the inner diameter of the flange, and that the inside appears free from burrs and welding spatter.

4.2.4. Horizontal/Vertical Configuration

The sensor MUST be installed on the exhaust pipe in correct vertical or horizontal configuration.

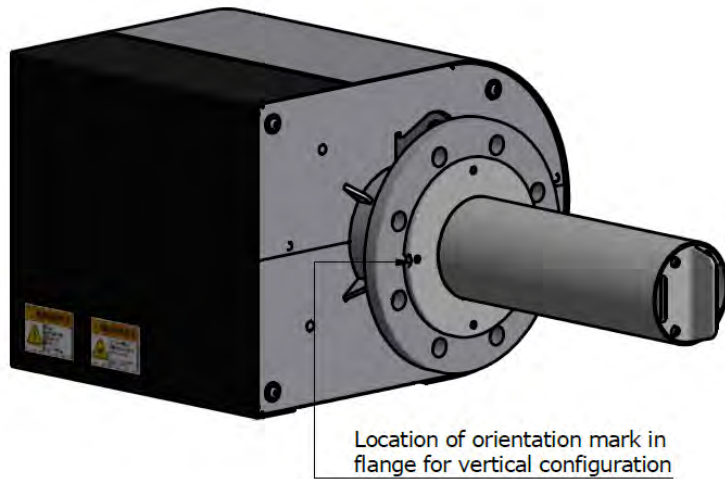


Illustration 11: Vertical Configuration

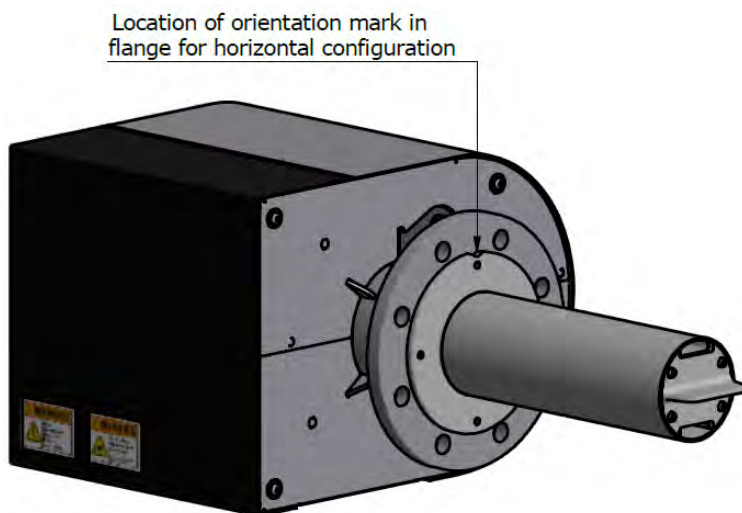


Illustration 12: Horizontal Configuration

The sensor must not be reconstructed for alternative configurations. However, in case another configuration is required, it is essential to consult Danfoss IXA for specific guidance.

4.2.5. Thermal Insulation

Heat insulation and cover plates must be re-established properly after mounting the flange. Refer to the example shown in Illustration 13. Note that the cover plates must be mounted close to the flange.



Illustration 13: Re-establishment of the Heat Insulation

4.3. Pneumatic connections

The compressed air supplied to the sensor through an appropriate filter must be supplied from the instrument air supply.

4.3.1. Filter

Ensure installation of a separate filter, complying with ISO 8573-1:2010 [1:3:1]. Filter must be ordered separately.

Mount the filter unit at a maximum distance of 3 m from the marine emission sensor, positioned before the marine emission sensor in the flow direction. The filter unit must be mounted in such a way that the metal bowls are pointing down to ensure that condensate will be (automatically) drained out. Ensure that the drain outlets are open and not blocked.

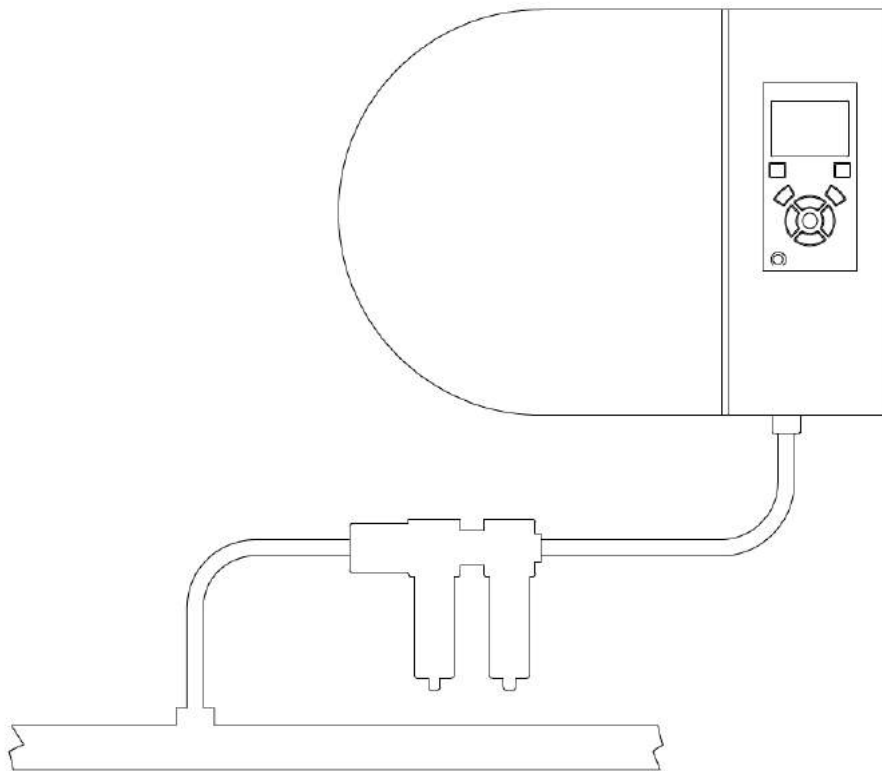


Illustration 14: Position of Filter

CAUTION

Shutting off is only permitted when no exhaust gas is present in the system.

The flexible tube, which is reinforced with double stainless steel wire braid between the filter and the marine emission sensor, must be tightened with a recommended torque of 13 Nm.

NOTICE

Check the purge air supply. The condensate level, which is visible in the 2 metal bowl liquid level indicator lenses, must not be too high.

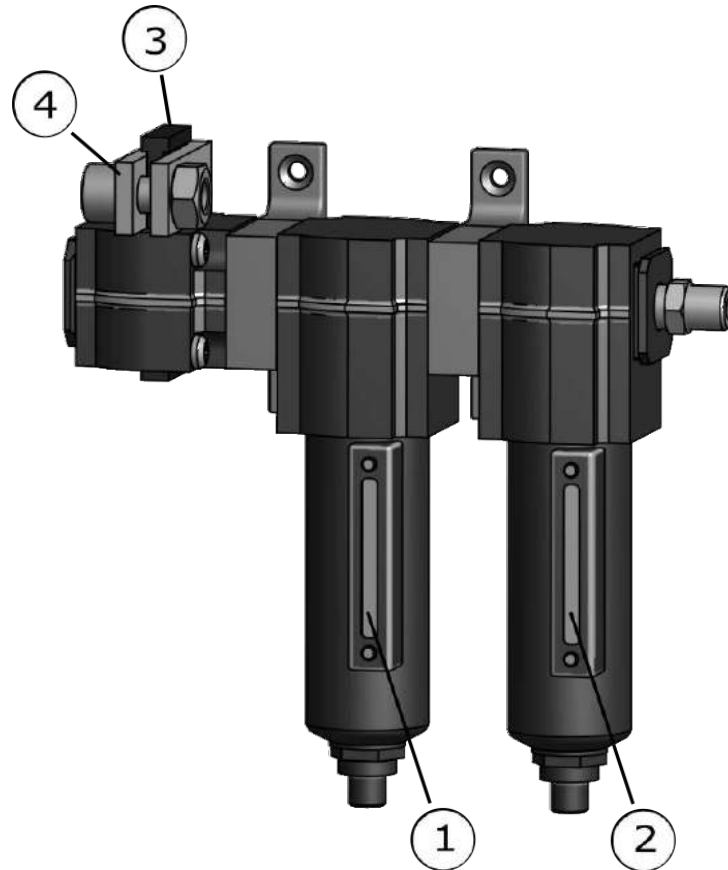
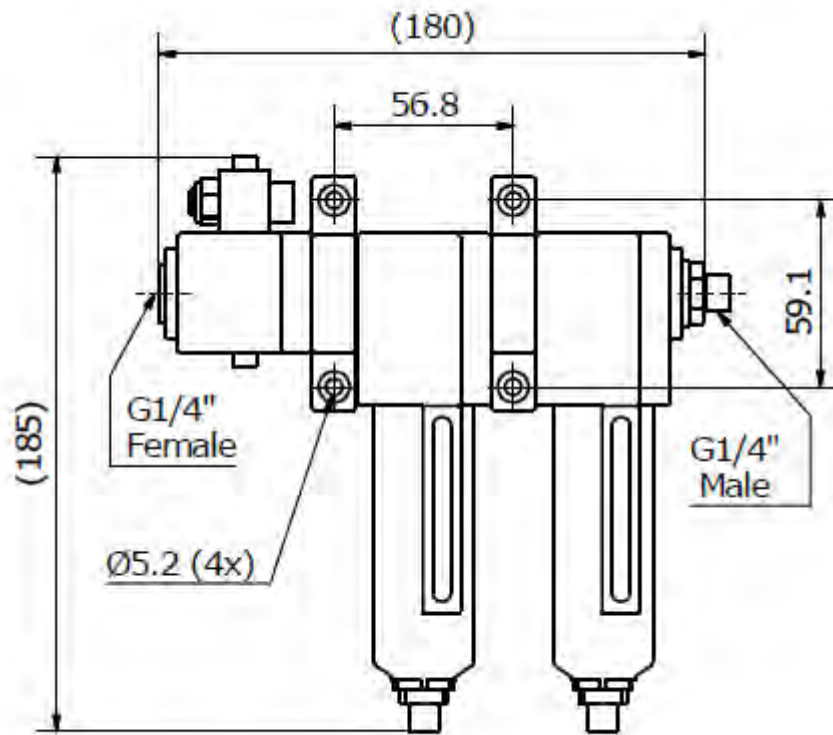


Illustration 15: Filter Unit

No.	Description
1 and 2	Liquid level indicator lens
3	Shut-off valve
4	Locking bracket, to secure filter with screw, padlock, or similar

Table 8: Legend to Illustration 15

**Illustration 16: Filter Dimensions****⚠ CAUTION**

During operation, the shut-off valve before the filter is 'normally open' (NO). Wear safety glasses for eye protection when the system is under pressure. For safety reasons, the locking mechanism must be closed when performing service or maintenance. Shutting off is only permitted when no exhaust gas is present in the system.

4.4. Lifting

NOTICE

- Do not place the sensor directly on floor.

When lifting the unit, use the dedicated lifting eye (1). The diameter of the hole is $\varnothing 25$ mm. Ensure the lifting equipment can accommodate the weight of the unit (35 kg).

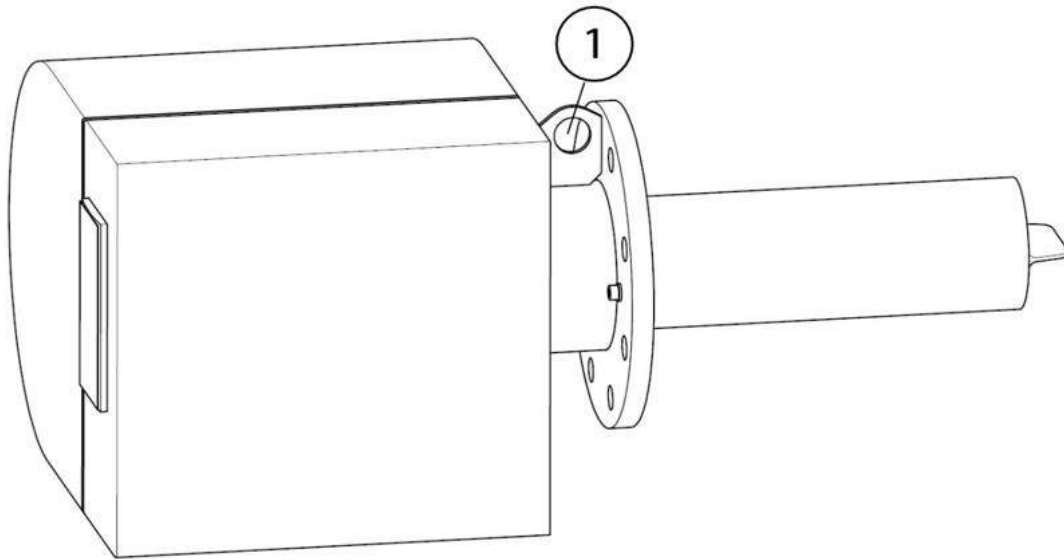


Illustration 17: Marine Emission Sensor with Lifting Eye

No.	Description
1	Lifting eye, inner diameter $\varnothing 25$ mm

Table 9: Legend to Illustration 17

4.5. Mounting

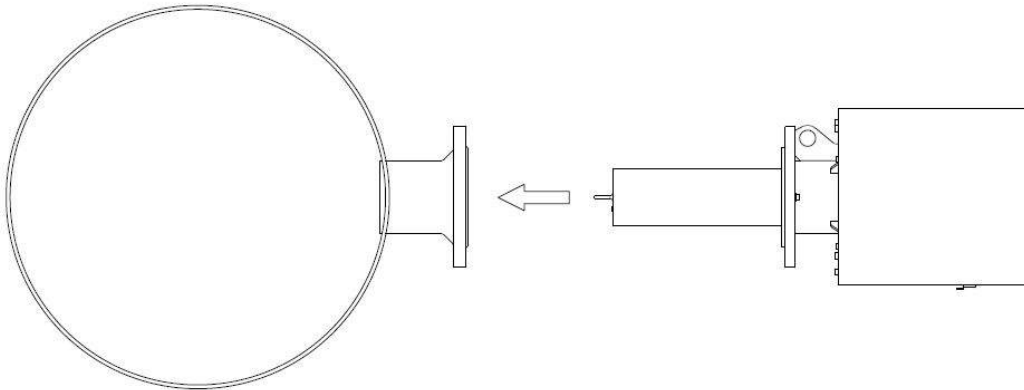


Illustration 18: Mounting of Sensor on Flange

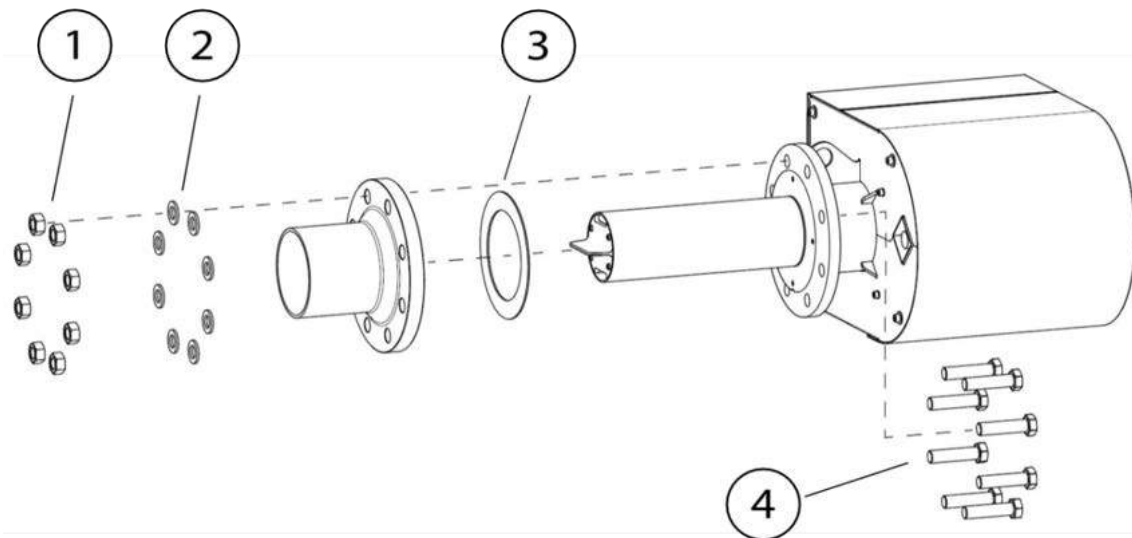


Illustration 19: Exploded View

No.	Description	Specification
1	Nuts (8)	Hex nut, M16, DIN 934, Steel Class 8, zinc finish or similar
2	Steel washers (8)	M16, DIN 125.A, Steel, zinc finish or similar
3	Gasket (1)	For flange, Steffca, FSS-DN100 - 000691-108. PN10 or similar
4	Bolts (8)	Bolts M16 x 65, DIN 931, Steel 8.8, zinc finish or similar

Table 10: Legend to Illustration 19

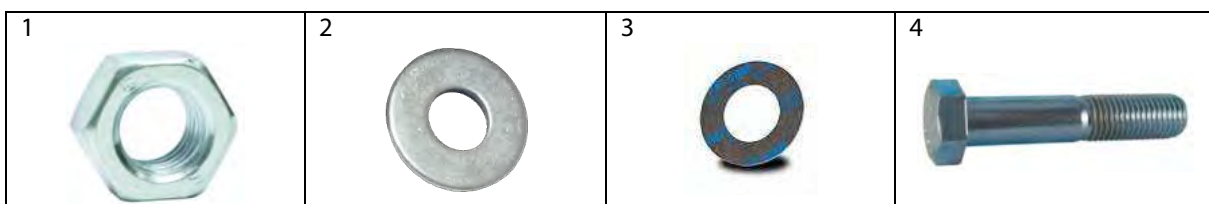


Illustration 20: Illustrated Examples

CAUTION**HOT SURFACE**

Be aware that the marine emission sensor flange and the surrounding environment may become hot during engine operation.

Tighten bolts with the appropriate tightening torque:

Item	Tool	Tightening torque
Bolts M16 x 65	Wrench 24 mm	200 Nm

Table 11: Torque Specification

NOTICE

Make sure to tighten the bolts using a crosswise tightening sequence 3 times all the way around.

5. Electrical Installation

5.1. Overview of Connection Area

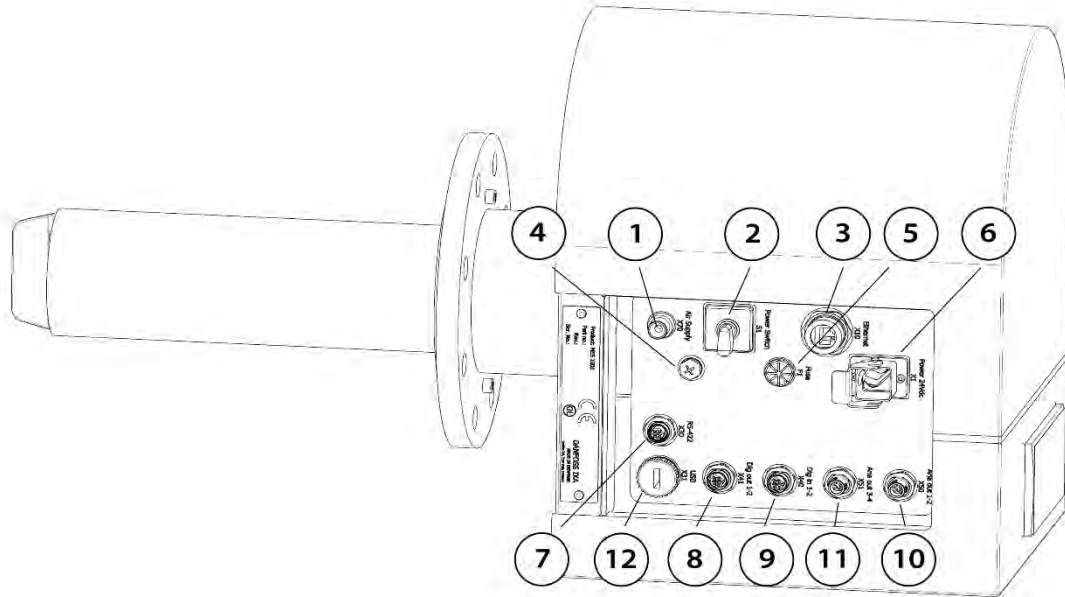


Illustration 21: Overview of Connection Area

No.	Description	Interface specification
1	Air supply	
2	ON/OFF switch	
3	Ethernet	5.5.5 - Table 23
4	(Reserved)	
5	Fuse	
6	Power input 24 VDC	5.5.4 - Table 20, Table 21 and Table 22
7	RS-422	5.5.6 - Table 24 and Table 25
8	Digital output 1 and 2	5.5.3 - Table 18 and Table 19
9	Digital input 1 and 2	5.5.2 - Table 16 and Table 17
10	Analog out 1 Analog out 2	5.5.1 - Table 14 and Table 15
11	Analog out 3 Analog out 4	5.5.1 - Table 14 and Table 15
12	USB	

Table 12: Legend to Illustration 21

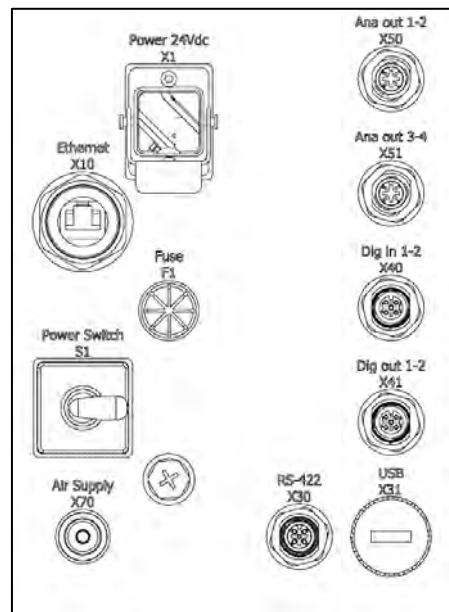


Illustration 22: Interfaces

5.2. Cables

Connect all required cables. Ensure correct cable connections.

CAUTION

DO NOT apply power before cables are properly connected. Hold cables in place with cable ties.

NOTICE

Allow enough excess cable length between the sensor and the first fixation point in order for the sensor to move freely in vibrating environments.

NOTICE

It is important that each connector is mounted on the cable according to the manufacturer's specification.

NOTICE

Incorrect mounting of the cable shielding in the connector may cause the sensor to malfunction.

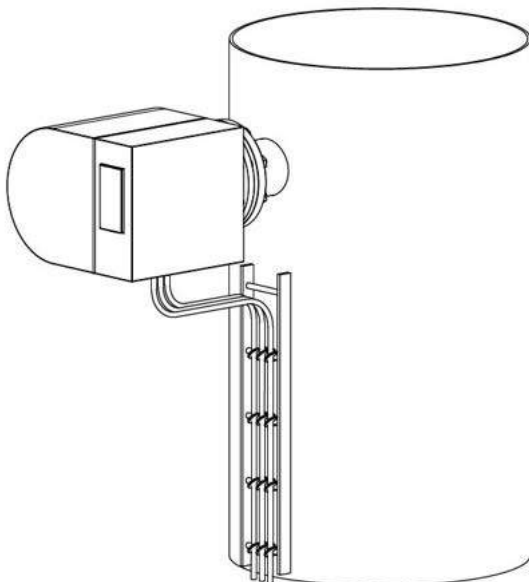


Illustration 23: Cabling Example



Illustration 24: Example of Cable Ties

5.3. Analog Data

NOTICE

In order to reduce random noise in the Analog Out data signal, it is recommended to apply a sample rate of at least 20 Hz together with a running-average of at least 20 samples at the receiving end.

5.4. Fuse Specifications

Parameter	Specification
Rated current	6.3 A
Class	T (time-lag)
Size	6.3 x 32 mm
Insulating tube	Ceramic, non-transparent with extinguishing filler

Table 13: Fuse Specification



Illustration 25: A Standard 6.3 x 32 mm Fuse with Extinguishing Filler

5.5. Interfaces

5.5.1. Analog Outputs

Two connectors are required.



Illustration 26: Analog Output Connector

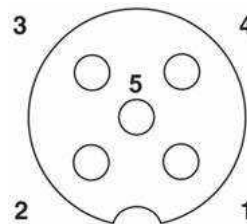


Illustration 27: Connection Diagram, Analog Output

Connection	Range of cable diameter	Recommended connector type	Manufacturer
Analog output	4-8 mm	SACC-FS-5SC SH DN SCO	Phoenix Contact

Table 14: Analog Output Specification

NOTICE

Remember to connect cable shield to connector housing in one end of the cable ONLY!

Pins	Description
Analog outputs 1 and 2	
Pin 1	+24 VDC loop power (analog output 1)
Pin 2	+24 VDC loop power (analog output 2)
Pin 3	4-20 mA output (analog output 2)
Pin 4	4-20 mA output (analog output 1)
Pin 5	Not used

Analog outputs 3 and 4	
Pin 1	+24 VDC loop power (analog output 3)
Pin 2	+24 VDC loop power (analog output 4)
Pin 3	4-20 mA output (analog output 4)
Pin 4	4-20 mA output (analog output 3)
Pin 5	Not used

Table 15: Connection Details, Analog Output

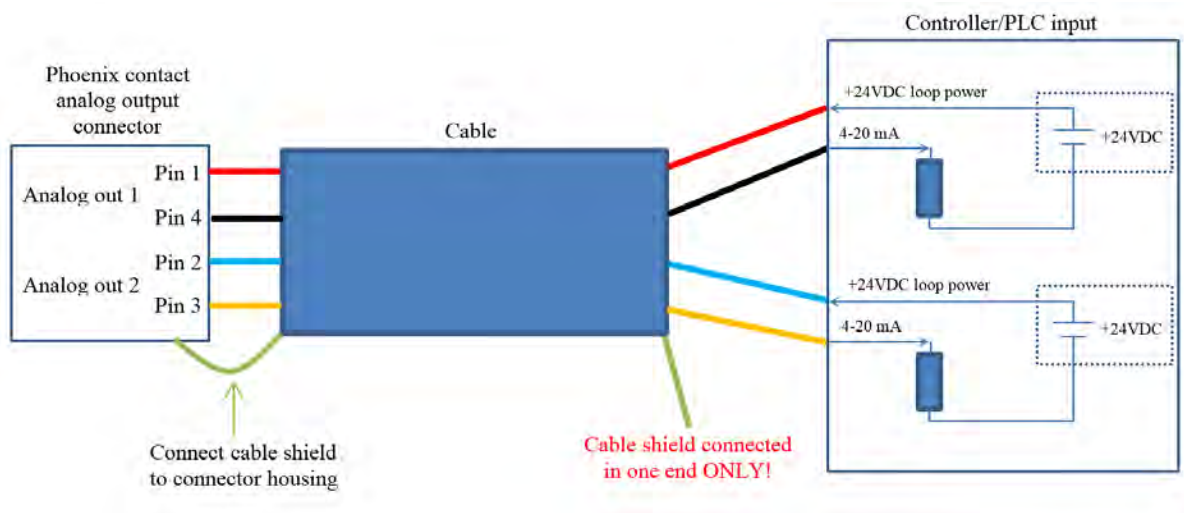


Illustration 28: Electrical Diagram, 24 V DC Loop Power to Analog Output Interface 1 and 2

5.5.2. Digital Inputs

One connector is required.



Illustration 29: Digital Input Connector

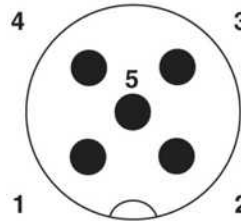


Illustration 30: Connection Diagram, Digital Input

Connection	Range of cable diameter	Recommended connector type	Manufacturer
Digital input	4-8 mm	SACC-MS-5SC SH DN SCO	Phoenix Contact

Table 16: Digital Input Connector Specification

Pins	Description
Digital inputs 1 and 2	
Pin 1	0 VDC (digital input 1)
Pin 2	0 VDC (digital input 2)
Pin 3	+24 VDC (digital input 2)
Pin 4	+24 VDC (digital input 1)
Pin 5	Not used

Table 17: Connection Details, Digital Input

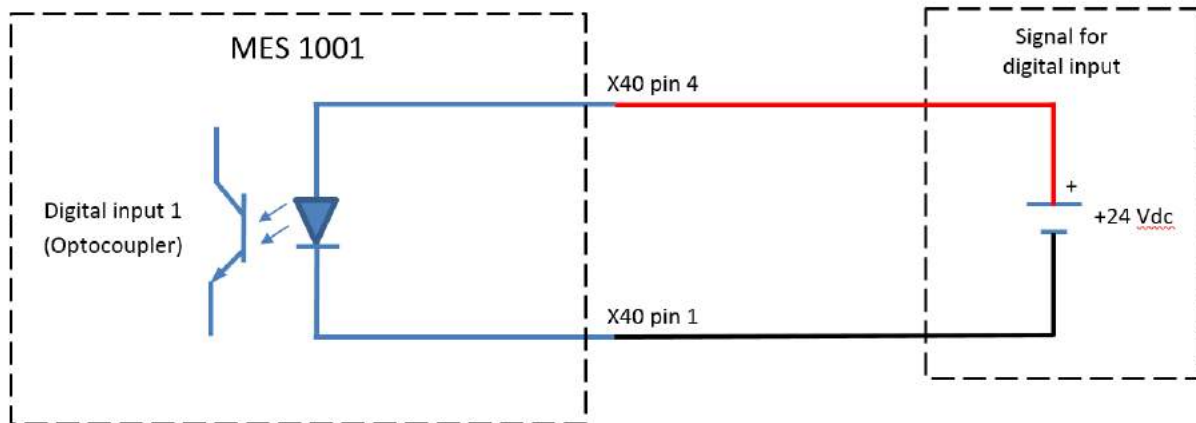


Illustration 31: Digital Input 1 Connections

5.5.3. Digital Outputs

One connector is required.



Illustration 32: Digital Output Connector

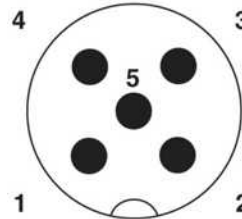


Illustration 33: Connection Diagram, Digital Output

Connection	Range of cable diameter	Recommended connector type	Manufacturer
Digital input	4-8 mm	SACC-MS-5SC SH DN SCO	Phoenix Contact

Table 18: Digital Output Connector Specification

Pins	Description
Digital outputs 1 and 2	
Pin 1	Solid state output pin A (digital output 1)
Pin 2	Solid state output pin A (digital output 2)
Pin 3	Solid state output pin B (digital output 2)
Pin 4	Solid state output pin B (digital output 1)
Pin 5	Not used

Table 19: Connection Details, Digital Outputs

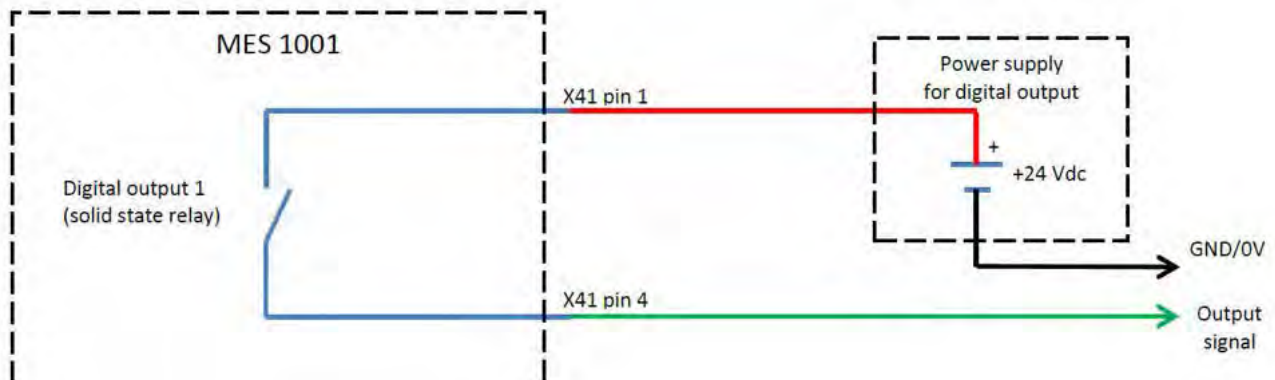


Illustration 34: Digital Output Channel 1 Connections

5.5.4. Power Supply

The following housing and contact insert are recommended.



Illustration 35: Housing



Illustration 36: Contact Insert

Connection	Range of cable diameter	Recommended connector type	Manufacturer
Housing	7.5-12.5 mm	HC-D 7-TFL-57/M1PG11G	Phoenix Contact

Table 20: Housing Specification

Connection	Connection cross-section	Recommended connector type	Manufacturer
Contact insert	0.5 mm ² -1.5 mm ²	HC-A 3-EBUS	Phoenix Contact

Table 21: Contact Insert Specification

Pins	Description
Power supply	
Pin 1	+24 VDC
Pin 2	0 DC
Pin 3	Not used
Pin 	Cable shield

Table 22: Connection Details, Power Supply

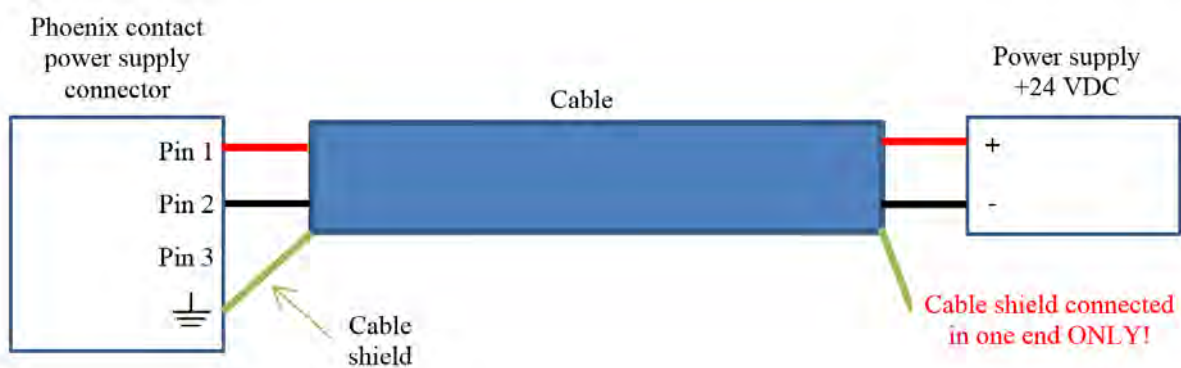


Illustration 37: Electrical Diagram, Power Supply Interface

5.5.5. LAN/Ethernet



Illustration 38: RJ-45 Connector

Connection	Range of cable diameter	Recommended connector type	Manufacturer
LAN/Ethernet RJ-45 connector	5-10 mm	VS-V1-C-RJ45-MNNA-PG9-8-I-5-S	Phoenix Contact

Table 23: LAN/Ethernet Specification

5.5.6. RS-422 Interface

One connector is required.



Illustration 39: RS-422 Connector

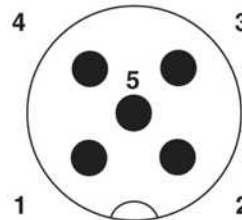


Illustration 40: Connection Diagram, RS-422

Connection	Range of cable diameter	Recommended connector type	Manufacturer
Digital input	4-8 mm	SACC-MS-5SC SH DN SCO	Phoenix Contact

Table 24: RS-422 Connector Specification

Pins	Description
RS-422 interface	
Pin 1	TxB (-)
Pin 2	RxB (-)
Pin 3	RxA (+)
Pin 4	TxA (+)
Pin 5	Shield/GND

Table 25: RS-422 Interface Specification

 IXA Danfoss

One solution provider of emission monitoring **in the maritime industry**

Danfoss IXA A/S, part of the Danfoss Group, is a leading player in certified marine emission monitoring solutions. We develop sensors and systems, and our innovative sensors precisely and continuously measure climate parameters and environmentally harmful gases, providing documentation of regulatory compliance and essential input for energy optimization.

We are engineering a more sustainable shipping industry.

Maritime expertise across divisions

To serve the marine industry in the best possible way, several Danfoss divisions bring a particular range of technical know-how and benefits on board. On their own, each division is at the forefront of its field with industry-leading insight and innovation. Working together, the Danfoss **divisions** form a comprehensive array of components that help major ships around the world ashore safely and on-time.

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