KONGSBERG

Kongsberg EM 304
Multibeam echo sounder
Installation manual

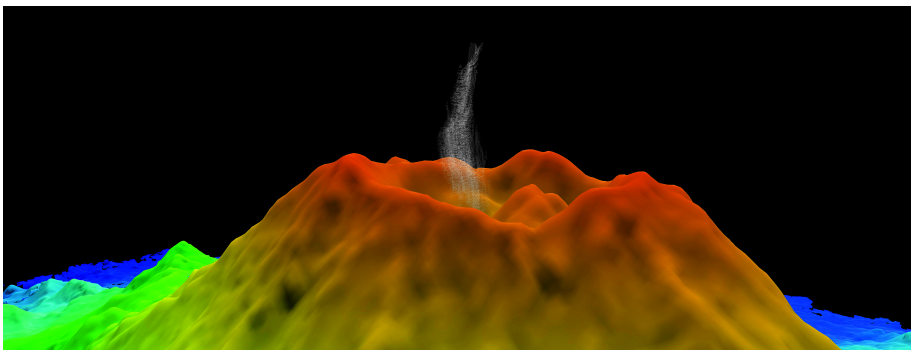

Image: Vailulu'u Plume. Courtesy of Amanda Bittinger, Sunset Hydrographic, LLC.

Kongsberg product: EM 302 bathymetry and water column data.

Location: American Samoa.

Depth: (Plume) 100.2 - 800.7 m (Bathymetry) > 547.1 m

427620/A

Document information

- **Product**: Kongsberg EM 304
- **Document**: Installation manual
- **Document part number**: 427620
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Warning

The equipment to which this manual applies must only be used for the purpose for which it was designed. Improper use or maintenance may cause damage to the equipment and/or injury to personnel. You must be familiar with the contents of the appropriate manuals before attempting to operate or work on the equipment.

Kongsberg Maritime disclaims any responsibility for damage or injury caused by improper installation, use or maintenance of the equipment.

Disclaimer

Kongsberg Maritime AS endeavours to ensure that all information in this document is correct and fairly stated, but does not accept liability for any errors or omissions.

Support information

If you require maintenance or repair, contact Kongsberg Maritime's support organisation. You can also contact us using the following address: km.hydrographic.support@kongsberg.com. If you need information about our other products, visit https://www.km.kongsberg.com.

Table of contents

About this manual

Purpose of manual

The purpose of this manual is to provide the information, procedures and basic drawings required for the physical installation of the EM 304.

Target audience

The manual is intended for technical personnel; such as skilled shipyard workers, electricians, qualified engineers and naval architects. It is assumed that you understand the general principles of maritime electronic equipment. You must also be familiar with computer hardware, interface technology and installation of electronic and mechanical products.

We assume that you are familiar with the basic acoustic principles of sound in water. We also expect that you have some experience with multibeam and/or single beam echo sounders in hydrographic applications..

Installation instructions

You must follow the instructions in this manual to ensure optimal performance. As a guide, installation procedures are presented in the order they must be done.

The equipment described in this manual includes the complete system with relevant cabinets. Units provided locally by the customer, installation shipyard or local representative are not described.

The manual also defines the equipment responsibility, and provides applicable instructions for unpacking and storage of units.

Note

You must follow the instructions given in this manual. If not it may affect the warranty.

Kongsberg Maritime AS will accept no responsibility for any damage or injury to the system, vessel or personnel caused by equipment that has been incorrectly installed or maintained, or by drawings, instructions or procedures that have not been prepared by us.

Installation drawings

The installation shipyard must provide all necessary installation drawings unless otherwise specified in the delivery contract.

Kongsberg Maritime AS may, on special order, provide assistance to these drawings.

Note

If required, all documents provided by the shipyard for the physical installation of the EM 304 must be approved by the vessel's national registry and corresponding maritime authority and/or classification society. Such approval must be obtained before the installation can begin. The shipowner and shipyard doing the installation are responsible for obtaining and paying for such approval.

The outline dimensions of the EM 304 units are found in the *Drawing file* chapter in this manual.

Online information

For information about the EM 304 and other products from Kongsberg Maritime, visit our website.

- https://www.km.kongsberg.com

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Kongsberg EM 304

Topics

System description

The modular, state-of-the-art EM 304 performs accurate, high resolution seabed mapping in shallow to deep waters at depths of more than 8000 metres.

The EM 304 is designed to perform seabed mapping to 8000 metres with an unsurpassed resolution, coverage and accuracy. The system is cost effective, reliable, and easily operated. The design of the EM 304 is based on more than 50 years of hydrographic experience with echo sounders, sonars and underwater positioning for civilian and military use. It is the latest model in a series of deep sea multibeam echo sounders that started with the EM 300 in 1997.

The EM 304 consist of new state-of-the-art electronics and separate transmit and receive transducers in a Mills Cross configuration. It uses the same field-proven transducers as the EM 302, making it easy to upgrade. Care has been taken to design a highly, modular and flexible solution with compact electronics for easier and faster installation. Due to a flexible transducer design, the system can be tailored to almost any required size. The largest standard size, 0.5 x 0.5 degrees, gives the ultimate system performance in terms of resolution and range, while a smaller 4 x 4 degrees solution can be installed on any vessel of opportunity.

The EM 304 multibeam echo sounder consists of the following main units.

- Transducer arrays
- Transmitter Unit(s)
- Receiver Unit(s)
- Processing Unit
- Hydrographic Work Station

To form a complete system it is also required to have sensors providing vessel attitude, velocity, position, sound speed profile of the water column and speed of sound at the transducer depth.

Technical details

The EM 304 operates at sonar frequencies in the 26-34 kHz range.

The transmit fan is divided into 4 sectors in shallow modes (8 sectors in deep modes) to maximize range capability but also to suppress interference from multiples of strong bottom echoes. The sectors are transmitted sequentially within each ping, and uses distinct frequencies or waveforms.

The nominal sonar frequency is 30 kHz with an angular coverage sector of up to 150 degrees and 1600 beams per ping. Achievable swath width on a flat bottom will normally be up to 5.5 times (140 degrees) the water depth. The angular coverage sector is operator controllable or may be set to a fixed range. It may also be set to vary automatically with depth according to achievable coverage. This maximizes the number of usable beams. The beam spacing is normally high density equidistant with equiangle available.

The transmit fan is split in several individual sectors with independent active steering according to vessel roll, pitch and yaw. This place all beams on a “best fit” to a line perpendicular to the survey line, thus ensuring a uniform sampling of the bottom and 100% coverage.

In dual swath mode the transmit fan is duplicated and transmitted with a small difference in alongtrack tilt. The applied tilt takes into account depth, coverage and vessel speed to give a constant beam separation alongtrack.

The sectors are frequency coded or have FM chirps, and they are transmitted sequentially at each ping. The sector steering is fully taken into account when the position and depth of each beam is calculated, as is the refraction due to the sound speed profile, vessel attitude and installation angles. The pulse length and range sampling rate are variable with depth (auto or manual) for best resolution.

In shallow waters due care is taken to the near field effects through nearfield focusing individually applied in the different sectors.

EM 304 applies one focus range for each of the transmit sectors which are used for shallow water environment. Dynamic beam focusing is used for the reception beams.

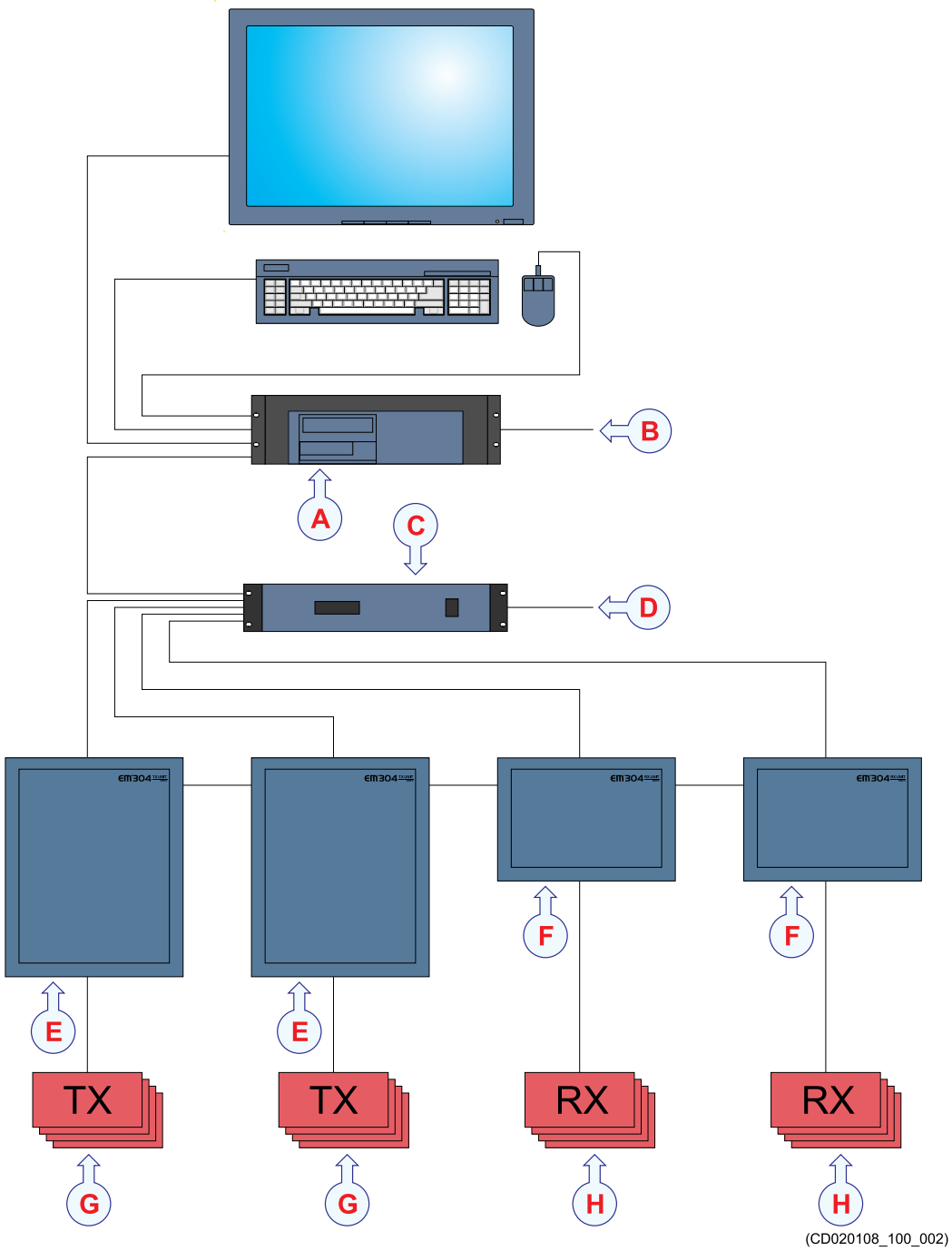
The ping rate is mainly limited by the round trip travel time in the water up to a ping rate of more than 5 Hz.

The system may be delivered in several different versions identified by the "Transmission x Reception" beamwidth.

- 0.5 x 0.5 degrees system: 16 TX modules and 16 RX modules
- 0.5 x 1 degrees system: 16 TX modules and 8 RX modules
- 1 x 1 degrees system: 8 TX modules and 8 RX modules
- 1 x 2 degrees system: 8 TX modules and 4 RX modules
- 2 x 2 degrees system: 4 TX modules and 4 RX modules
- 2 x 4 degrees system: 4 TX modules and 2 RX modules
- 4 x 4 degrees system: 2 TX modules and 2 RX modules

System diagram 0.5 x 0.5 degrees system

The system diagram identifies the main components of a basic EM 304 system. Only the main connections between the units are shown. Detailed interface capabilities and power cables are not shown.



A *Hydrographic Work Station*

B *Interfaces:*

- *Sound speed sensors*
- *Tide*
- *Centre depth output*

C *Processing Unit*

D *Interfaces:*

- *Positioning systems*
- *Attitude (roll, pitch and heave)*
- *Sound speed sensor*
- *Velocity*
- *Clock*
- *Trigger input/output*
- *Clock synchronisation (1PPS)*

E *Transmitter Unit (TXU)*

F *Receiver Unit (RXU)*

G *Transmit transducers*

H *Receive transducers*

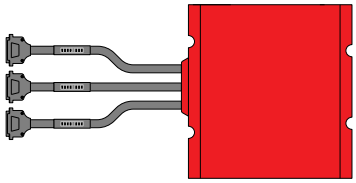
System units

Topics

Transducer description

A transducer is a device that converts one form of energy to another. In an echo sounder system the transducer converts between electric energy and sound.

The EM 304 uses separate transducer arrays for transmitting and receiving sound pulses. Both transducer arrays can have one or more modules which are assembled in mounting frames.



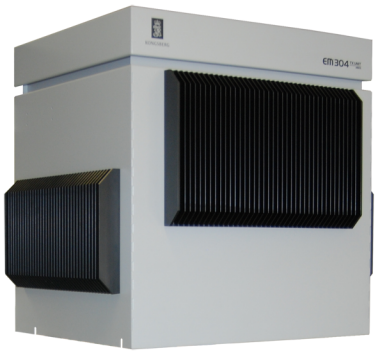
(CD020108_400_001)

The EM 304 transducer modules are available in an ice reinforced version. For more information, contact Kongsberg Maritime.

The two transducer arrays are normally mounted as “T” or “L” configurations under the vessel’s hull (Mills Cross configuration). The transmit transducer array should be aligned parallel to the vessel’s keel. The receiver transducer array should be aligned 90 degrees on the keel. Both transducer arrays should be horizontal on a plane on the keel.

Transmitter Unit description

The EM 304 Transmitter Unit has all transmit electronics, like control processors, power amplifiers, power supply, capacitor battery and Ethernet interface.



The Transmitter Unit is a wall-mounted steel cabinet with integrated shock and vibration absorbers, designed for bulkhead mounting. One 19 inch sub-rack is contained in the cabinet. The number of circuit boards in the sub-rack will depend upon the chosen transducer configuration.

Twisted pair Ethernet is used for data communication with the Processing Unit.

The Transmitter Units are normally located in a "sonar room" close to the transducer arrays.

For a 0.5 degree transducer array, two Transmitter Units are used.

Receiver Unit description

The EM 304 Receiver Unit has all receive electronics, like control processor, amplifiers, Analog-to-Digital Converters, power supply and Ethernet interface.

The Receiver Unit is a small wall-mounted steel cabinet with integrated shock and vibration absorbers, designed for bulkhead mounting. The number of circuit boards will depend upon the chosen transducer configuration. Twisted pair Ethernet is used for data communication with the Processing Unit.

The Receiver Unit is normally located in a "sonar room" close to the transducer arrays.

For a 0.5 degrees transducer array, two Receiver Units are used.

Processing Unit description

The EM 304 Processing Unit is provided to process the signals to and from the Transmitter and Receiver Units.

The EM 304 Processing Unit is an industrial computer using both COTS (commercial off-the-shelf) components and custom made components. The unit is designed and tested for rugged use.

The Processing Unit performs the receiver beamforming, bottom detection, and motion and sound speed corrections. It contains all interfaces for time-critical external sensors such as vessel attitude (roll, pitch, heading and heave), vessel position and external

clock. More than one sensor of each type may be connected simultaneously, with one in use and all of them logged.

The Processing Unit controls the Transmitter and Receiver units via Ethernet communication, and is also interfaced to the Operator station via Ethernet.

The 48 V output from the Processing Unit can be used for remote on/off control of the Transmitter and Receiver Units.

The Processing Unit is normally located in a "sonar room" close to the transducer arrays. The unit can also be placed in the "survey room" or on the bridge.

Hydrographic Work Station description

The Hydrographic Work Station is the operator station for the EM 304.

A dedicated maritime computer is provided with the EM 304 Multibeam echo sounder . It is set up with all necessary software.

The Hydrographic Work Station is based on the Microsoft® OperatingSystem operating system.

The Hydrographic Work Station is normally mounted near the operator work space.

Support information

Should you need technical support for your EM 304 you must contact a Kongsberg Maritime office. A list of all our offices is provided on our website. You can also contact our main support office in Norway.

A 24 hour telephone support service may also be available depending of the level of SLA (Service Level Agreement).

- **Company name**: Kongsberg Maritime AS
- **Address**: Strandpromenaden 50, 3190 Horten, Norway
- **Website**: https://www.km.kongsberg.com
- **E-mail address**: km.hydrographic.support@kongsberg.com

Preparations

Topics

Tools, equipment and consumables required for EM 304 installation

In order to do the EM 304 installation, all necessary tools and equipment for mechanical work, cabinet installation and electrical wiring must be available.

It is not practical to provide a detailed list of all necessary tools and equipment. You must be equipped with a standard set of tools. This tool set must comprise the normal tools for electronic and electromechanical tasks. This includes different screwdriver types, pliers, spanners, a cable stripper, a soldering iron, etc. Each tool must be provided in various sizes. We recommend that all tools are demagnetized to protect your equipment.

However, you must make sure that the following specialized tools are available.

- All necessary tools and consumables required for welding
- All necessary tools and consumables required for physical installation of transducer frames and transducer modules
- All necessary tools and consumables required for electrical installations
- An articulated jack or similar arrangement capable of lifting the individual EM 304 units
- Torque wrench

Note

If you need specific consumables, or if special tools and/or test instruments are required, these are identified in the relevant procedure(s).

Personnel qualifications

The installation of the EM 304 is a demanding task. It is very important that the personnel involved in the installation tasks are competent and experienced craftsmen.

As a minimum, the following certified craftsmen must be available.

- Service engineer from Kongsberg Maritime
- Welders
- Electricians

Note

The quality of the welding is critical to the safety of the vessel. Welding must only be done by a certified welder.

If applicable, the final installation welds must be approved by the vessel's national registry, the corresponding maritime authority and/or classification society. Observe the relevant rules and regulations related to welding.

Sonar room requirements

Topics

Environmental requirements

The EM 304 units must be installed in a dry and dust-free environment. The units are not fully protected against humidity, dust or water.

It is important that the sonar room is kept dry. The EM 304 units must not be exposed to excessive temperatures, dust, moisture or humidity. Such conditions can cause corrosive attacks and subsequent failures to the electronic circuitry. Visit the sonar room at regular intervals to check temperature and humidity, and take the necessary actions if the environmental conditions are poor.

Avoid running large power cables trough the sonar room.

Observe the environmental specifications related to the EM 304 units.

Size and access requirements

A well designed sonar room with a well fitted size and easy access reduces the risk of corrosion, and simplifies maintenance. This increases system reliability.

The sonar room must be large enough to house all the system units. The room must provide enough space to allow efficient maintenance. You must be able to keep all the cabinet doors fully open without undue restriction to your movements.

1 The room must not be used for any other heavy machinery.

2 The room must not be unnecessarily obstructed by girders, pipes etc, which may cause installation problems or impede maintenance.

3 The sonar room must be accessible under all conditions at sea or at a berth.

4 All doors or hatches must be designed so that the tools and equipment can be removed without being disassembled.

Requirements for insulation, heating and ventilation

The bulkheads in the sonar room should be insulated and provided with an interior wall to the deck. The room should be equipped with heater and connected to the vessel's ventilation system.

Heating requirements

Heating is an effective method for reducing humidity. The heater in the sonar room must dimensioned to maintain the equipment within its environmental tolerances.

Observe the environmental specifications related to the EM 304 units.

Ventilation requirements

The sonar room should be connected to the vessel's ventilation system to ensure a supply of cooling air. If a ventilation system is not available, install two 3” pipes from the sonar room to a suitable fresh air location on deck.

The fresh air should enter the room as close to the floor as possible, and should be extracted from as high as possible. A funnel shaped drip-collector must be mounted below the vent pipes to divert moisture to the bilge. On the main deck, the best ventilation is provided when the outlet pipe is at least four meters higher than the inlet pipe. To keep out sea water, rain and spray, the ventilation pipes must be fitted with goosenecks or an equivalent design.

Note

If the vessel is likely to operate in tropical conditions, a suitable air conditioning system must be installed. The air conditioning system must be able to provide an ambient temperature that does not exceed the maximum operating temperatures of the EM 304 units that are installed in the room.

Requirements for electrical installations, cables and communication

The electrical installations in the sonar room must meet minimum requirements to provide suitable lights and supply power.

Light requirements

The sonar room must be equipped with suitable lighting to simplify the installation and to aid future maintenance.

Communication requirements

The sonar room should be equipped with a telephone, an intercom system, or any other means of oral communication between the sonar room and the bridge and/or control room(s).

Power requirements

Each unit in the sonar room should be provided with a separate circuit breaker on the mains supply.

Proper vessel ground must be provided.

A minimum number of additional electrical outlets must be provided for other equipment.

Cabling requirements

The sonar room units are connected to other EM 304 units located in different compartments on the vessel. The units may also be connected to peripheral devices. If these cables pass through hatches or areas where they may be damaged, they must be run in conduits. Minimum 2” conduit is recommended.

Make sure that all system cables are properly connected and secured, and installed with some slack. The slack is essential to withstand vibrations, and to facilitate future maintenance and replacements.

Where to install the transducer

Topics

Introduction to transducer location

A single answer to the question "where to install the transducer" cannot be given.

The physical location of the transducer depends on the vessel's design and construction, how the hull is shaped, and how the water runs along the hull. There are however a number of important guidelines, and some of these are even conflicting.

Note

The information here must be considered as general advice. Each EM 304 installation must be handled separately depending on the hull design and the other electrical and mechanical systems installed on the vessel.

Mount the transducer deep

In order to achieve the best possible EM 304 performance, mount the transducer as deep as possible under the vessel’s hull.

There are several reasons for this recommendation.

Flow noise

Consider the situations when the vessel is unloaded, and pitching in heavy seas. The vessel is riding high, and the bow may even be lifted out of the water. This will cause a lot of air to follow the shape of the hull.

The upper water layers of the sea contain a myriad of small air bubbles created by the breaking waves. In heavy seas the upper 5 to 10 metres may be filled with air, and the highest concentrations will be near the surface. Air bubbles absorb and reflect the sound energy, and they may in worst cases block the sound transmission altogether.

Cavitation

Cavitation is the formation of small air bubbles close to the transducer face. The bubbles appear because the local pressure becomes negative during parts of the acoustic pressure cycles. The cavitation threshold increases with the hydrostatic pressure. The noise is made when the bubbles implode.

Transmitting in air

The transducer must never be lifted free of the water surface. If the transducer is activated when out of the water it may be damaged beyond repair. Mounting the transducer at a deep position on the hull will in normally prevent this.

Slamming

Slamming happens if the vessel hull climbs out of the water in heavy seas. The force of the water when the hull falls down may push the transducer up, and may cause damage both to the transducer and to its mounting. This is especially important for low frequency transducers with large faces. The effect of slamming can be reduced by mounting the transducer as deep as possible on the hull.

Note

Kongsberg Maritime AS takes no responsibility for any damages to the transducer, the cable or the mounting arrangement, caused by slamming.

Avoid protruding objects near the transducer

Objects protruding from the hull will generate turbulence and flow noise. This will reduce the EM 304 performance.

Protruding objects may be zinc anodes, transducers or even the vessel's keel. Holes and pipe outlets are also important noise sources, as well as rough surfaces caused by bad welding. Even traces of sealing compound, sharp edges, bolts or empty bolt holes will create noise. All these protruding objects may act as resonant cavities amplifying the flow noise at certain frequencies.

Do not place a transducer in the vicinity of protruding objects, and especially not close behind them. Make sure that the surface of the transducer face, the hull plating and putty around the transducer is as even and smooth as possible. Mounting screws or bolts must not be extruding from the transducer, the installation hardware or the hull plating. If necessary, grind and polish all surfaces.

Keep the transducer far away from the propellers

The propulsion propellers is the dominant noise source on most vessels. The noise is easily transmitted through the water. This noise may often reduce the overall performance of your EM 304.

The transducer must be installed as far away from the propellers as possible. The best positions are therefore on the fore part of the hull. Positions outside the direct line of sight from the propellers are best.

On small vessels we recommend mounting the transducer on that side of the keel where the propeller blades move *upwards*. This is because the propeller cavitation is weakest on that side. The cavitation starts when the water flows in the same direction as the propeller blades. This is where the propeller blades move downwards.

Mount the transducer at a safe distance from bow thruster(s)

Bow thruster propellers are extremely noisy. When you decide where to place the transducer, you must consider the noise created by most bow thrusters.

When in operation, the noise and cavitation bubbles created by the thruster may make your EM 304 Multibeam echo sounder useless, almost no matter where the transducer is installed. When the bow thrusters are *not* in operation, the tunnel creates turbulence. If your vessel is pitching, the tunnel may be filled with air or aerated water in the upper position and release this in the lower position.

In general, the transducer should therefore be placed well away from the bow thruster(s).

However, this is not an invariable rule. Certain thruster designs - combined with their physical locations on the hull - may still offer a suitable location for the transducer, even close to the thruster. If you are in doubt, consult a naval architect.

Summary and general recommendations

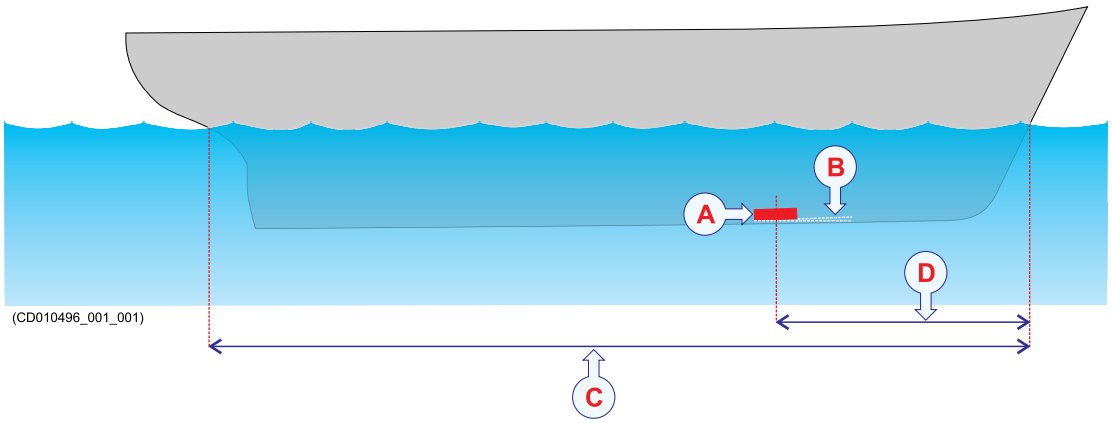
Some of the installation guidelines provided for transducer location may be conflicting. For this reason, each vessel must be treated individually in order to find the best compromise.

In general, the most important factor is to avoid air bubbles in front of the transducer face. For this reason, the recommended transducer location is normally in the fore part of the hull, well ahead of the noise created by the bow wave.

The maximum distance from the bow is normally equal to one third of the total water line length of the hull.

Note

Mounting the transducer more than 10–15 meters from the bow may cause problems with the turbulent flow.



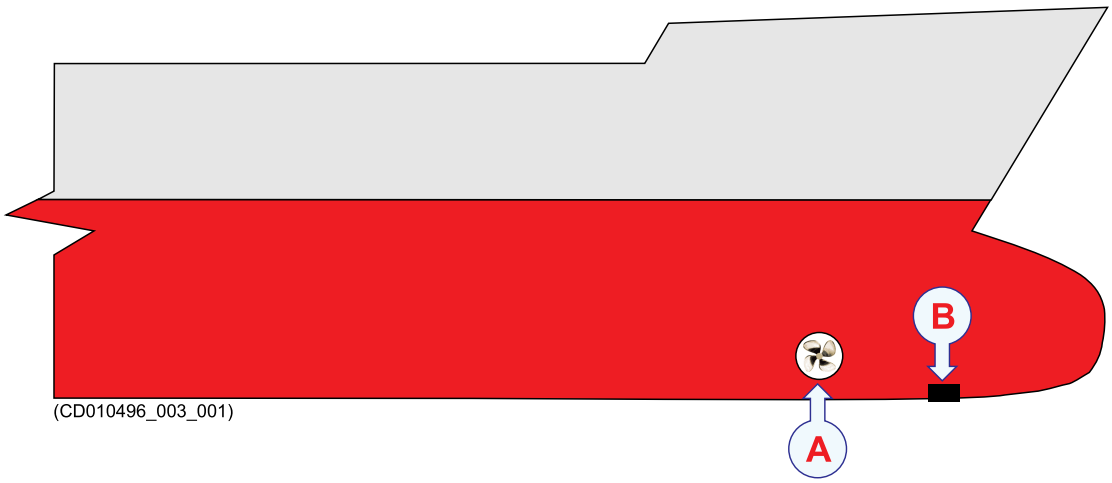
A *Transducer*

B *Inclination angle*

C *Hull length at water line*

D *Maximum 1/3 of the hull length at water line (C)*

If the vessel hull has a bulbous bow, this may well be a good transducer location, but also in this case the flow pattern of the aerated water must be taken into consideration. The foremost part of the bulb is often a good location.



A *Thruster*

B *Transducer location*

This applies to the vessel in normal trim and speed.

Important

The transducer must not have a negative inclination angle compared to water flow.

Do not place a transducer in the vicinity of protruding objects, and especially not close behind them.

Make sure that the surface of the resulting installation is as smooth and streamlined as possible.

Acoustic noise

As with any other hydroacoustic systems, the quality of the EM 304 echo data and presentations are subject to unwanted acoustic noise. The echoes from any large and small target must be detected inside the noise.

It is important that we keep the noise level as low as possible. The is necessary to obtain long range and dependable interpretations of the echoes. Even with the advanced noise filtering offered by the EM 304, we must address the noise challenge. This is important during the planning and preparations for the EM 304 installation.

Topics

Contributing factors

Several factors are contributing to the performance of the hydroacoustic equipment used on board a vessel.

Factors contributing to the performance of the hydroacoustic equipment used on board a vessel are:

- The quality and properties of the transmitted signal
- The quality of the receiving system
- The operational settings made during operation
- The properties of the target(s)
- The signal-to-noise ratio

The majority of these factors can neither be controlled nor improved by means of installation methods or transducer locations. The quality and properties of the transmitting and receiving systems are key factors during our product development, while our end user documentation aims to help the user to make the right filter settings during operation. As for the target properties, there is nothing any of us can do with those.

The *signal-to-noise ratio*, however, can be improved by making the correct choices during installation.

> Signal-to-noise ratio (often abbreviated SNR or S/N) is a measure used in science and engineering that compares the level of a desired signal to the level of background noise. It is defined as the ratio of signal power to the noise power, often expressed in decibels. A ratio higher than 1:1 (greater than 0 dB) indicates more

> signal than noise. While SNR is commonly quoted for electrical signals, it can be applied to any form of signal [...].
>
> *http://en.wikipedia.org/wiki/Signal_to_noise_ratio (September 2013)*

The *signal* is the echo that we want to know something about, while the *noise* is any unwanted signals or disturbances. The echo must be detected in the noise and therefore it is necessary to keep the noise level is as low as possible in order to obtain long range and dependable interpretation.

The noise that contributes to the signal to noise ratio may be divided into the following types of noise:

- Self noise
- Ambient noise
- Electrical noise
- Reverberation

A The transducer can pick up noise from

- Biological disturbances
- Interference
- Cavitation
- Propeller noise
- Flow noise
- Acoustic noise from other hydroacoustic systems

B The transducer cable is long, and may pick up electric noise from generators, pumps, cooling systems and other electric or electromechanical devices.

C The preamplifiers are very sensitive, and they can easily pick up electrical noise from internal and external power supplies. The preamplifiers are also vulnerable for analogue noise created by their own electronic circuitry. Digital noise created by the converter and processing circuitry can also create problems.

D Converters transform the analogue echoes to digital format.

E Signal processing circuitry can create digital noise.

Self noise

Any vessel equipped with a hydroacoustic system (for example echo sounder or sonar) will produce more or less self noise.

There are many sources of such self noise. We will here go into some details in order to analyse the different sources of self noise on a vessel and how they may influence upon the noise level of the hydroacoustic instruments.

Machinery noise

The main contributor to machinery noise is usually the main engine on board the vessel. The contribution from auxiliary machinery may, however, be considerable, especially if it is in poor shape. The machinery noise can be transmitted to the transducer as:

- Structure-borne noise through the ship structure and the transducer mountings
- Water-borne noise through the hull into the water to the transducer

Electrical noise

Modern vessels are normally equipped with a lot of electric instruments such as hydroacoustic systems, radars, navigation systems, and communication equipment. Any electric instruments may in some cases cause electrical interference and noise. International regulations and certifications are used to control and reduce this, but even these are limited if the electrical systems are poorly installed and/or maintained.

Propeller noise

Propeller noise is often the main source of noise at higher vessel speeds. Variable pitch propellers or fast moving propellers usually make more noise than fixed propellers or slow moving propellers.

Propeller noise is usually water-borne. In some cases, however, shaft vibrations or vibrations in the hull near the propeller may be structure-borne to the transducer. If a propeller blade is damaged, this may increase the noise considerably.

Propeller cavitation is a severe source of noise. "Singing" propellers might be a source of noise, which interferes at discrete frequencies. In some cases static discharge from the rotating propeller shaft may be quite disturbing.

Cavitation

Cavitation is the formation of small air bubbles close to the transducer face. The bubbles appear because the local pressure becomes negative during parts of the acoustic pressure cycles. The cavitation threshold increases with the hydrostatic pressure. The noise is made when the bubbles implode.

Cavitation noise may appear near extruding objects at higher speeds, but more often it is caused by the propellers. Propeller cavitation is a severe source of noise. The cavitation starts when the water flows in the same direction as the propeller blades. This is where the propeller blades move downwards.

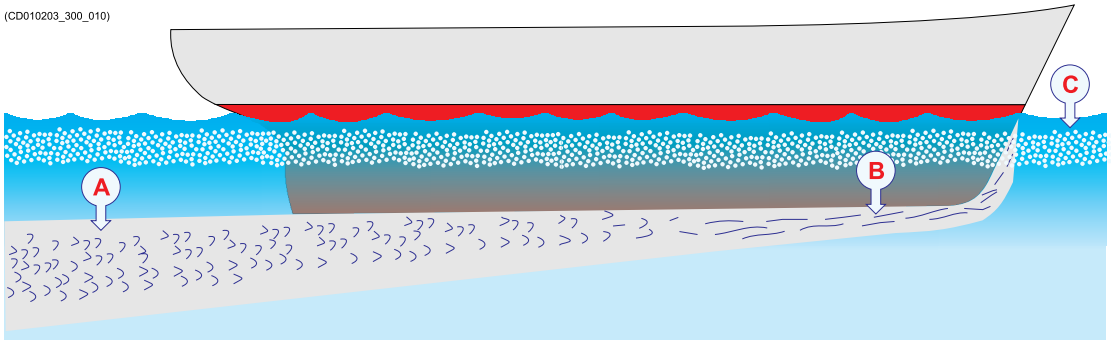
In some cases a resonant phenomenon is set up in a hole near the hull. This sound will have a discrete frequency, while all other flow noise will have a wide frequency spectrum.

(Image from U. S. Navy in the public domain.)

Flow noise

The upper water layers of the sea contain a myriad of small air bubbles created by the breaking waves. When the hull moves through water it will cause a disturbance, and this will generate friction. The friction zone is called the *flow boundary layer*. The flow in this boundary layer may be *laminar* or *turbulent*.

- The *laminar* flow is a nicely ordered, parallel movement of the water.
- The *turbulent* flow is a disorderly flow pattern, full of eddies.



A *Turbulent flow*

B *Laminar flow*

C *Air bubbles*

Air bubbles absorb and reflect the sound energy, and they may in worst cases block the sound transmission altogether.

The boundary layer increases in thickness when it becomes turbulent. The boundary layer is thin in the forward part of the vessel hull, and increases as it moves aft. The thickness depends on ships speed and on the roughness of the hull. All objects sticking out from the hull, or dents in the hull, will disturb the flow and will increase the thickness of the boundary layer. When the flow speed is high, the turbulence can be violent enough to destroy the integrity of the water. Small voids or cavities in the water will occur and this is called cavitation.

Rattle noise

Rattle noise may be caused by loose objects in the vicinity of the transducer, like fixing bolts. The rattle may also come from loose objects inside the hull.

Interference

Interference from other hydroacoustic equipment on board the same vessel may be an annoying source of disturbance. Unless the same frequency is used for more than one piece of equipment only the transmitted pulse will contribute to the interference.

> In physics, interference is the phenomenon in which two waves superpose each other to form a resultant wave of greater or lower amplitude. Interference usually refers to the interaction of waves that are correlated or coherent with each other, either because they come from the same source or because they have the same or

> nearly the same frequency. Interference effects can be observed with all types of waves, for example, light, radio, acoustic, surface water waves or matter waves.
>
> *https://en.wikipedia.org/wiki/Interference_(wave_propagation), April 2016*

Ambient noise

Ambient noise is usually not a limiting factor to the performance of sonars and echo sounders.

The ambient noise may be split up as follows:

- **Sea noise**: Air bubbles, seismic disturbances, waves, boundary turbulence, etc.
- **Biological noise**: Fish, mammals
- **Man made noise**: Other vessels, interference
- **Precipitation noise**: Heavy rain or hail

In some areas, where many vessels operate together, the engine and propeller noise from other vessels may be disturbing. Interference from hydroacoustic instruments located in other vessels may also be a limiting factor. The sea noise depends on the weather conditions. In bad weather the sea noise can be quite high due to the waves.

Electrical self noise

Electrical or electronic self noise is picked up or generated in any other part of the equipment than the transducer.

Hum picked up by the transducer cables or picked up from the power supply is usually the most common source of electrical self noise. At higher frequencies – where rather wide bandwidths are necessary – the noise from components, transistors or other analogue electronic may be a limiting factor.

Some means to reduce acoustic noise

Several factors are contributing to the performance of the hydroacoustic equipment used on board a vessel. Careful planning of the EM 304 installation may reduce the acoustic noise.

Unfortunately, it is impossible to simply provide a number of specific procedures to reduce the noise.

An important factor is the physical location of the transducers. This depends on the vessel's design and construction, how the hull is shaped, and how the water runs along the hull. Other factors deal with other equipment mounted on board, and this will also be vessel dependant. At moderate ship speeds the machinery noise is usually dominant. At medium speeds the flow noise increases more rapidly and takes over, while at higher speed the propeller noise will be the main contributor.

Note

The information here must be considered as general advice. Each EM 304 installation must be handled separately depending on the hull design and the other electrical and mechanical systems installed on the vessel.

Reducing flow noise

- The shape of the transducer (or dome around it) must be as streamlined as possible.
- The hull plating in front of the transducer must be as smooth as possible.

  Important

  Be especially aware of bilge keels and zinc alloy anodes. The keel must be rounded off without sharp edges. Neither extruding objects nor abrupt transitions must be present.

Reducing machinery noise

- The main engine and relevant auxiliary engines and equipment must be fixed to rigid foundations to avoid vibrations.
- Any hull structure that may vibrate should be damped or coated to reduce the vibrations.

The use of shock absorbers or floating rafts may sometimes reduce this noise. The structure-borne noise may be reduced by isolation, for example by providing vibration clamping between the transducer and the hull structure.

Reducing propeller noise

- Sufficient clearance between the propellers and the hull, the rudder and the keel must be provided.
- Place the zinc alloy anodes in places where the water flow is the least disturbed.
- Ensure that the propellers blades are correctly designed and without damages.
- The use of a baffle between the propellers and the transducer may reduce noise appreciably.
- Static discharges caused by the rotating propeller shaft may be removed by proper grounding or by mounting a coal brush from the shaft to vessel ground.

Reducing rattle noise

Ensure that no parts near the transducers can rattle as a result of water flow or vibrations.

Reducing interference

Interference from the transmission pulses from other hydroacoustic instruments on board the vessel is difficult to avoid. The problem may be reduced by choosing the working frequencies carefully and to some extent by separating the different transducers. On vessels with a large number of separate hydroacoustic systems installed and in

simultaneous use, a separate synchronizing system (for example the K-Sync) should be considered.

Reducing electrical noise

- Make sure that all units are properly grounded, as this is important to avoid electrical noise.
- Use shielded cables with correct grounding.
- Separate EM 304 cables from other cables with high voltages, large currents or transients.
- Place all high voltage power cables in metal conduits.

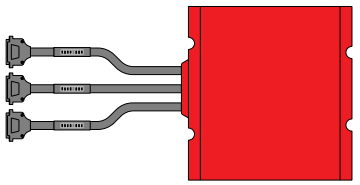
Installing the transducer

Topics

Transducer description

The EM 304 uses separate transducer arrays for transmitting and receiving sound pulses. Both transducer arrays have several modules which are assembled in mounting frames.

Two different TX modules are used, TX1 and TX2. Each TX module has three cables.



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TX transducer module number 1 is always the most forward module. TX module number one is always a type TX2.

All RX modules are identical. Each RX module has one cable.

RX transducer module number 1 is always the first on the port side.

The cables are moulded to the transducers. They connect to the Transmitter Unit and Receiver Unit with connectors.

The standard length of the transducer cables is 15 or 25 metres.

The number of individual TX and RX modules in the two arrays depends on the chosen configuration. The standard types identified by "transmission x reception" beamwidth are:

- **0.5 x 0.5 degrees system**: 16 transmit transducer modules and 16 receive transducer modules
- **0.5 x 1 degree system**: 16 transmit transducer modules and 8 receive transducer modules
- **1 x 1 degree system**: 8 transmit transducer modules and 8 receive transducer modules
- **1 x 2 degrees system**: 8 transmit transducer modules and 4 receive transducer modules
- **2 x 2 degrees system**: 4 transmit transducer modules and 4 receive transducer modules
- **2 x 4 degrees system**: 4 transmit transducer modules and 2 receive transducer modules
- **4 x 4 degrees system**: 2 transmit transducer modules and 2 receive transducer modules

Note

The red protective coating is an vital part of the transducer. It is very important that neither this coating nor the internal parts of the transducer are damaged during the handling, installation or cleaning. Any holes and/or scratches in the transducer surface will allow water to penetrate the transducer. If a leak occurs, the transducer must be replaced.

Transducer orientation

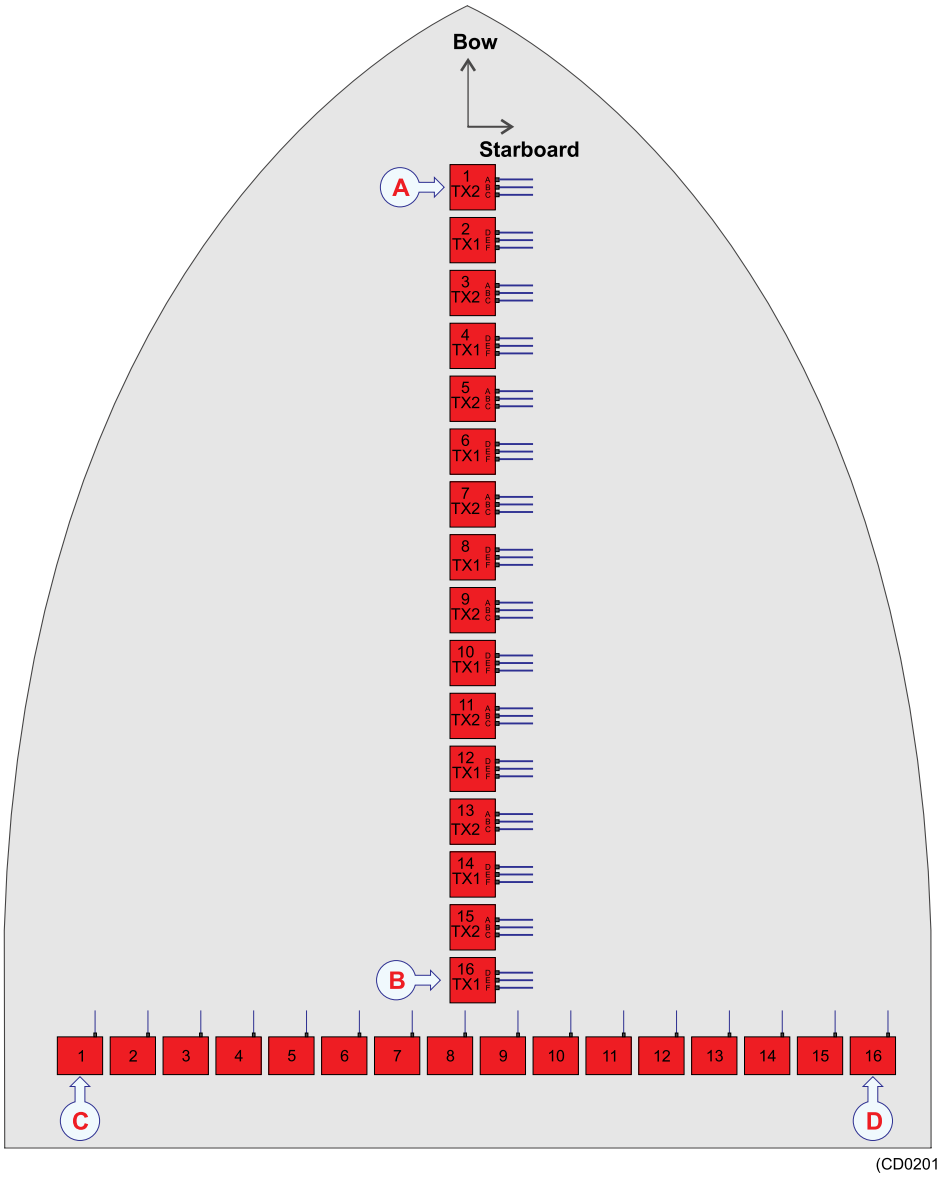
The two transducer arrays are normally mounted as “T” or “L” configurations under the vessel’s hull (Mills Cross configuration). The transmit transducer array should be aligned parallel to the vessel’s keel. The receiver transducer array should be aligned 90 degrees on the keel. Both transducer arrays should be horizontal on a plane on the keel.

The transducer modules are assembled in the mounting frames especially designed for this purpose. The modules are secured with steel brackets, while the cables are pulled out trough the side of the frame.

The transducer modules must be installed with the correct orientation.

The RX cables must point towards the vessel's bow. The TX cables must point towards the starboard side.

Orientation of transducer modules, top view, 0.5 x 0.5 degrees system.



(CD020108_150_001)

A Transmit transducer module number 1

B Transmit transducer module number 16

C Receive transducer module number 1

D Receive transducer module number 16

Transducer installation principles

Topics

Introduction

The transducer can be installed using different installation principles.

The EM multibeam system is supplied with transducers and electronic units. While the electronic units are installed using normal tools, the transducers must be located and installed depending on the vessel's design. A number of different factors related to the vessel's design must be taken into consideration during the installation planning.

The EM multibeam transducer arrays can be installed using one of the following principles.

- Gondola
- Blister
- Flush mounted
- Externally mounted with fairings
- Box keel
- Portable mounting
- Hull unit
- Drop keel

Not all installation principles are possible for all EM models.

	EM 124	EM 304	EM 712	EM 2040 series
Gondola	X	X	X	X
Blister	X	X	X	X
Flush mounted	X	X	X	X
Externally mounted with fairings	X	X	X	X
In a box keel	X	X	X	X
Portable mounting			X	X
Hull Unit			X	X
Drop keel	X	X	X	X

Normally, in a permanent installation, the cables enter the hull through tubes which are fitted with standard ship type cable glands (Brattberg, Roxtec or equivalent) to provide water tightness. The cable glands should be of the type having a pressure rating of 4 bars or more. If the tubes end below the vessel's water-line, classification requirements may require a double set of approved glands. They should be filled with water up to the waterline.

The installation of the transducer arrays must thus be planned together with the installation shipyard and/or the client.

Once the installation method is defined, the installation shipyard must provide the necessary drawings. These drawings must be approved by the vessel's classification authority.

If required, Kongsberg Maritime AS can assist with the required engineering.

Gondola

A gondola is a streamlined pod mounted under the hull of the ship. It can either be welded or bolted under the hull plates. It is well suited for refitting a vessel with an EM 304 system.

There is a gap between the gondola and the hull. Aerated water will pass through this gap, and thus not be pushed under the transducer.

This is often the preferred installation approach for Kongsberg Maritime and the method that gives the optimum weather window and system performance.

The gondola can be tailored to fit the ship and also the scope of supply.

Kongsberg Maritime recommends to place a "debris knife" in the forward end of the gondola.

The gondola will be water filled. To let the air escape, make suitable holes in the rear end close to the vessel's hull.

A gondola installation may help in avoiding air bubble blockage of the sound path under the transducers by aerated water. Gondolas may also contain additional transducers for other systems.

The transducers must be installed flush with the surrounding surface area to ensure best possible performance of the system.

Note

The inside surface of the gondola must be protected with appropriate protective paint and an adequate amount of sacrificial anodes.

The installation shipyard must provide all necessary installation drawings.

If required, all drawings and documents must be approved by the vessel's national registry and corresponding maritime authority and/or classification society.

Such approval must be obtained before the installation can begin. The shipowner and shipyard doing the installation are responsible for obtaining and paying for such approval.

Blister

A recommended method for transducer installation is by using a blister.

A blister is a mounting construction fully welded to the hull of the ship. The blister contains casings, which form the main part of the unit, housing the transducer frames and modules. The design of the blister is aimed at guiding the aerated water and air bubbles around both sides of the installation and create an environment around the transducer free of air bubbles.

Blisters of different sizes and shapes have been used from the early days of echo sounder installation, and this method of installation is a well known principle. A blister is well suited for refitting a vessel with an EM 304 system.

The blister can also be used for other sonar and echo sounder transducers.

The interior of the blister must be filled with water. Use drainage holes in the bottom and an air outlet on the top.

The transducers must be installed flush with the surrounding surface area to ensure best possible performance of the system.

Note

The inside surface of the blister must be protected with appropriate protective paint and an adequate amount of sacrificial anodes.

The installation shipyard must provide all necessary installation drawings.

If required, all drawings and documents must be approved by the vessel's national registry and corresponding maritime authority and/or classification society.

Such approval must be obtained before the installation can begin. The shipowner and shipyard doing the installation are responsible for obtaining and paying for such approval.

Flush mounted

With the flush mount method the transducers are installed inside the ship's hull.

This method exposes the transducers to passing air bubbles which might affect the system performance. The benefit of a flush mounted installation is that nothing protrudes from the keel. This solution is mainly used on ice classed vessels with additional Ice protection.

The transducer arrays may be mounted flush with the vessel's hull. In order to do this, the shipyard must design a framework inside the hull to support the casings. The arrays must then be mounted so that their faces are flush with the outer hull.

Vents with sufficient capacity must be installed in the casings to prevent any air to be trapped and to avoid back pressure behind the transducers.

Note

This installation method may prove unsuccessful due to aerated water blocking the signal path to and from the transducers. Thorough research on the vessel's hull design and the acoustic conditions must be made before attempting this installation method.

The transducers must be installed flush with the surrounding surface area to ensure best possible performance of the system.

Note

The installation shipyard must provide all necessary installation drawings.

If required, all drawings and documents must be approved by the vessel's national registry and corresponding maritime authority and/or classification society.

Such approval must be obtained before the installation can begin. The shipowner and shipyard doing the installation are responsible for obtaining and paying for such approval.

External mounted with fairings

The transducer arrays can be mounted directly under the vessel's hull.

A fairing will usually be added around the transducers to ensure laminar water flow without any aeration problems.

Installation with fairings has proven successful in former multibeam echo sounder installations.

Note

The installation shipyard must provide all necessary installation drawings.

If required, all drawings and documents must be approved by the vessel's national registry and corresponding maritime authority and/or classification society.

Such approval must be obtained before the installation can begin. The shipowner and shipyard doing the installation are responsible for obtaining and paying for such approval.

Transducer installation summary

The installation of the EM 304 transducer requires careful planning and preparations. It is a key task for successful use of the EM 304 Multibeam echo sounder . An overall installation procedure is provided.This procedure does not describe any detailed tasks. Refer to the relevant tasks in this chapter.

Prerequisites

In order to prepare the installation of the EM 304 transducer, the following prerequisites must be met:

- All relevant literature is available.
- All relevant vessel drawings are available.
- Detailed information is available about other systems on the vessel that may cause noise or interference.
- You have good knowledge about hydroacoustic systems and the challenges related to physical installation of these.

Context

The installation shipyard must provide all necessary design and installation drawings, as well as the relevant work standards and mounting procedures.

Note

In order to obtain maximum safety and EM 304 performance, it is very important that the installation procedures in this manual are complied to. You must do the tasks in the order they are described.

The vessel owner must make sure that the installation shipyard holds the applicable competence to perform the installation, and that the applicable maritime authorities are available to verify and certify the installation.

If required, all documents provided by the shipyard for the physical installation of the EM 304 must be approved by the vessel's national registry and corresponding maritime authority and/or classification society. Such approval must be obtained before the installation can begin. The shipowner and shipyard doing the installation are responsible for obtaining and paying for such approval.

The outline dimensions of the EM 304 transducer and the relevant installation items can be found in the *Drawing file* chapter in this manual.

Procedure

1 Determine the physical location of the transducer.

Note

It is important to minimize the alongship gap between the receiver and tranceiver arrays to improve the performance at very shallow water (to get overlap between RX and TX footprints).

Make sure that all possible considerations are made to reduce noise.

For more information, see:
Where to install the transducer, page 23

2 Determine the installation principle.

Several installation principles may be used. The principle must be chosen according to the vessel's hull design.

For more information, see:
Transducer installation principles, page 38

3 Prepare the transducer installation arrangement.

The installation arrangement must be capable of accepting the transducer frames. We recommend that the frames are mounted into steel casings.

For more information, see:
Manufacturing and installing the casings, page 47

4 Prepare and install the necessary cable conduit from the top of the casing to the sonar room.

For more information, see:
Designing, manufacturing and mounting the steel conduits, page 49

5 Install the mounting frames.

For more information, see:
Installing the RX mounting frame, page 53
Installing the TX mounting frames, page 55

6 Install the transducer modules.

For more information, see:
Installing the RX transducers into the mounting frames, page 58
Installing the TX transducers into the mounting frames, page 61

7 Lay the transducer cables from the transducer modules to the steel conduits.

Each cable is marked in both ends with the module's serial number and cable number.

8 Pull the transducer cables up through the steel conduit and strap them to protect against damage.

9 Seal the steel conduits.

10 Consider applying a thin layer of anti-fouling paint to the transducer face.

Marine growth (biological fouling) on the transducer face reduces the EM 304 performance. We recommend that you paint the transducer face immediately after installation, and then again as often as required to maintain the protection.

For more information, see:
Painting the transducer face, page 66
Approved anti-fouling paints, page 68

Further requirements

Connect the transducer cables to the Transmitter and Receiver Units.

Related topics

Transducer array flatness, page 137
Checking the transducer array flatness and correcting deviations, page 138
Dimensional survey accuracy requirements, page 159
Alignment specifications, page 161
Drawing file, page 162

Manufacturing and installing the casings

The transducer mounting frames needs to be mounted into a solid base construction also called casing. The casings can be integrated in different kind of installation types like a gondola, blister or flush in the hull.

Prerequisites

You must be equipped with a standard set of tools. This tool set must comprise the normal tools for mechanical tasks. This includes different screwdriver types, pliers, adjustable spanners, etc. Each tool must be provided in various sizes. We recommend that all tools are demagnetized to protect your equipment. Depending on the tasks at hand, additional tools may be required.

Observe the relevant rules and regulations related to welding. The quality of the welding is critical to the safety of the vessel. Welding must only be done by a certified welder. The final installation welds must be approved by the vessel's national registry, the corresponding maritime authority and/or classification society.

Before you can do this task, the following prerequisites must be met:

- All relevant vessel and transducer drawings must be available.
- All relevant drawings have been approved by the classification society.
- All relevant work instructions, procedures and standards must be available.
- The installation principle has been determined.
- The physical location of the transducer has been determined.
- The installation angles of the transducer have been defined.
- All relevant personnel (naval architects, designers) and tools must be available.

Context

The casings must be individually designed for each vessel, and it is not a part of the system delivery.

The casings must be provided (or manufactured) and installed by the installation shipyard. It is the shipyard's responsibility to get the installation approved by the classification society.

The installation must be carried out according to arrangement drawings designed for the specific vessel. Refer to the drawings included in the *Drawing File*, and the applicable drawings prepared by the installation shipyard.

Note

Follow the general safety procedures. This units are heavy.

Procedure

1 Manufacture the casings according the production drawings.

Alter the drawings and the design as required to fit the vessel and the chosen installation principle.

2 Install the casings under the hull in either the blister, the gondola or into the hull.

Designing, manufacturing and mounting the steel conduits

Steel conduits are used to protect the transducer cables. They should be filled with water up to the waterline.

Prerequisites

You must be equipped with a standard set of tools. This tool set must comprise the normal tools for mechanical tasks. This includes different screwdriver types, pliers, adjustable spanners, etc. Each tool must be provided in various sizes. We recommend that all tools are demagnetized to protect your equipment. The following specific tools and items are required for this task:

- All relevant vessel and transducer drawings must be available.
- All relevant work instructions, procedures and standards must be available.
- All relevant drawings have been approved by the classification society.
- The physical location of the transducer has been determined.
- The installation method has been determined.
- The installation angles of the transducer have been defined.
- All relevant personnel (naval architects, designers, skilled shipyard workers) and tools must be available.

Observe the relevant rules and regulations related to welding. The quality of the welding is critical to the safety of the vessel. Welding must only be done by a certified welder. The final installation welds must be approved by the vessel's national registry, the corresponding maritime authority and/or classification society.

Context

The transducer cables connect through the vessel's hull using steel conduits. The conduits are welded to the hull. The top of each conduit must be closed and sealed to preserve the watertightness. This can be done with a "Bratberger", "Roxtec" or a similar sort of sealing device.

The installation of the conduits must be properly planned. All plans and drawings must be approved by the classification authority. This is always the yard's responsibility.

The steel conduit must be designed to fit each individual ship. The quality of the materials used to manufacture the conduit, as well as the quality of the workmanship must be defined by the vessel owner and the installation shipyard.

The conduits are not included with the system delivery. They must therefore be both provided (or manufactured) and installed by the installation shipyard.

Note

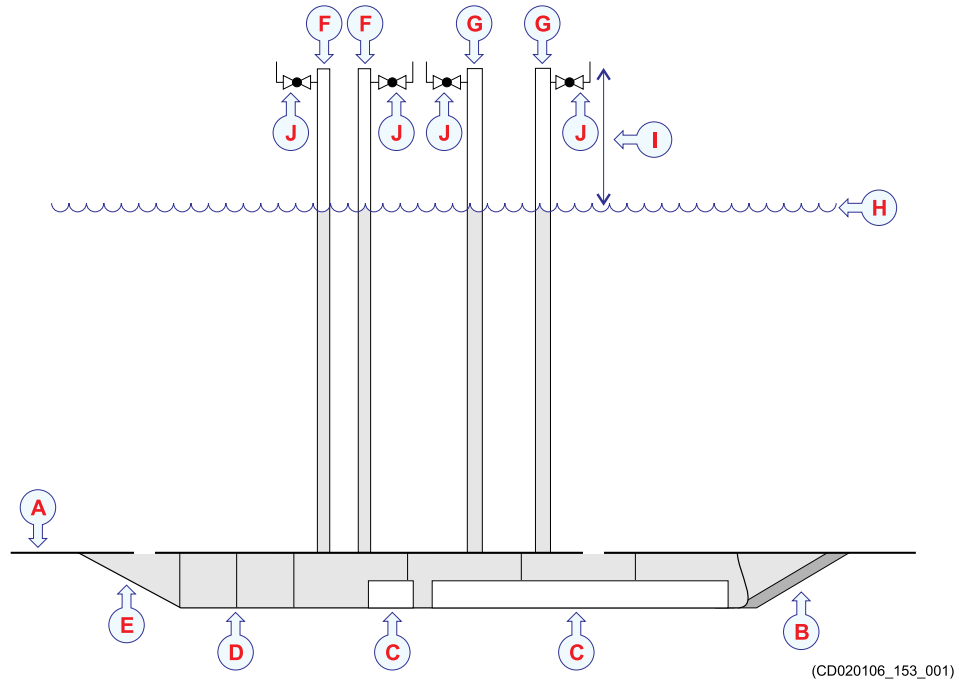
Make sure that there are no spatter, sharp edges or protruding objects that can damage the transducer cables.

All necessary precautions must be made to avoid damage to the cables while pulling them through the steel conduit. If water leaks into the cable, the transducer module has to be replaced.

The conduits should have a diameter of 6 inches (168 mm) or 8 inches (219 mm).

The number of conduits depends on the chosen system configuration and the internal diameter of the conduits.

- **0.5 x 0.5 degrees system**
  - 3 TX conduits, 8 inches
  - 1 RX conduit, 8 inches
- **0.5 x 1 degree system**:
  - 3 TX conduits, 8 inches
  - 1 RX conduit, 6 inches
- **1 x 1 degree system**:
  - 2 TX conduits, 8 inches
  - 1 RX conduit, 6 inches
- **1 x 2 degrees system**:
  - 2 TX conduits, 8 inches
  - 1 RX conduit, 6 inches
- **2 x 2 degrees system**:
  - 1 TX conduit, 8 inches
  - 1 RX conduit, 6 inches
- **2 x 4 degrees system**:
  - 1 TX conduit, 8 inches
  - 1 RX conduit, 6 inches
- **4 x 4 degrees system**:
  - 1 TX conduit, 6 inches
  - 1 RX conduit, 6 inches



A *Vessel's hull*

B *Ice and debris knife*

C *Casings for the transducer arrays frames and modules*

D *Support brackets inside the casing must not block for the transducer cables*

E *Water filled blister. With air outlet towards the hull*

F *One or more water filled steel conduit for the RX Transducer array*

G *One or more water filled steel conduit for the TX Transducer array*

H *Waterline*

I *Minimum 2 m above waterline. This must be verified by the classification society*

J *Separate air outlet pipes with ball valve, to above deck*

Procedure

1 Design the steel conduits with appropriate length and diameter to fit the transducer cables.

2 Manufacture the steel conduit according to the relevant production standards.

3 Mount the steel conduits from the casings and up towards the sonar room where the transmitter and receiver units are located.

The steel conduits are laid as required by the vessel structure and the location of the blister and sonar room. The conduits may be bent if required, but not more than 30 degrees. If a bend beyond 30 degrees is required a higher conduit diameter may be required. Please consult Kongsberg Maritime if this is the case.

The upper opening of the steel conduits should be minimum 2 metres above the vessel's waterline as specified by the classification society. If the openings of these conduits are under the water level, then special acceptances are needed from the classification society.

4 Mount an air outlet on top of each conduit

Each conduit should have an air outlet on top. This can be performed by a small ball valve and a 1 " pipe routed above the deck.

5 Close the top of the steel conduits with a cable sealing system.

Kongsberg Maritime recommends the use of sealing from Roxtec, Brattberg or similar.

6 If relevant, allow the maritime authority and/or classification society to inspect and approve the design and the installation of the steel conduit.

Installing the RX mounting frame

The mounting frames have been designed to offer a reliable and maintenance friendly installation method for the EM 304 transducers.

Prerequisites

Note

Engineers from Kongsberg Maritime must be present to install the transducer mounting frames.

- The casings have been installed and machined according to the requirements.
- All relevant vessel and transducer drawings must be available.
- All relevant work instructions, procedures and standards must be available.
- All relevant personnel (skilled shipyard workers) and their tools must be available.

The following specific tools and items are required for this task:

- Torque wrench
- Loctite 242 (removable medium strength threadlocker)
- Lifting device
- Rope
- Tackles

Context

Mounting frames are designed to house the individual transducer modules. While the transducer modules are mounted into the frames, the frames require casings.

The installation must be carried out according to arrangement drawings designed for the specific vessel. Refer to the drawings included in the Drawing File, and the applicable drawings prepared by the installation shipyard.

The mounting frame should be aligned 90 degrees on the keel. There is no difference between starboard and port side of the frame.

Note

The mounting frames must be handled with care. Please observe normal safety precautions for dockyard work and welding.

Drawings for EM 304 mounting frames

- RX mounting frame assy. 1 deg. drawing 499-133996
- RX mounting frame assy. 2 deg. drawing 860-210592
- RX mounting frame assy. 4 deg. drawing 860-210446

Procedure

1 Mount the frame in the casings.

The mounting frame must be bolted onto the flat bars inside the casing. The number of flat bars depends on the length of the transducer array. There are three (3) holes in each flat bar. Use a torque of 187 Nm.

Bolts of grade A4-80 should be used.

Note

The safest way to prevent cross-threading is to screw the bolt most of the way by hand. Tighten the first 80% of the bolt length by hand and then with a torque wrench to the appropriate torque.

Do not use an air wrench!

2 Check that the each frame is mounted completely flat.

Important

No point on the frame may deviate from the ideal plane with more than 0.6 mm.

The maximum allowed gradient between two adjacent mounting points on the frame is 0.1 % (1 mm/m).

This can be checked by measuring the relative vertical positions of the module mounting bars on the frames. If the deviations are too large, this has to be corrected by applying shims.

When the frame is installed completely flat:

3 Remove one bolt.

4 Apply Loctite 242 to the bolt.

5 Install the bolt using a torque of 187 Nm.

6 Repeat steps 3 - 5 for all the bolts.

Related topics

Transducer array flatness, page 137
Checking the transducer array flatness and correcting deviations, page 138
Dimensional survey accuracy requirements, page 159
Alignment specifications, page 161
Drawing file, page 162

Installing the TX mounting frames

The mounting frames have been designed to offer a reliable and maintenance friendly installation method for the EM 304 transducers.

Prerequisites

Note

Engineers from Kongsberg Maritime must be present to install the transducer mounting frames.

- The casings have been installed and machined according to the requirements.
- All relevant vessel and transducer drawings must be available.
- All relevant work instructions, procedures and standards must be available.
- All relevant personnel (skilled shipyard workers) and their tools must be available.

The following specific tools and items are required for this task:

- Torque wrench
- Loctite 242 (removable medium strength threadlocker)
- Lifting device
- Rope
- Tackles

Context

Mounting frames are designed to house the individual transducer modules. While the transducer modules are mounted into the frames, the frames require casings.

The installation must be carried out according to arrangement drawings designed for the specific vessel. Refer to the drawings included in the Drawing File, and the applicable drawings prepared by the installation shipyard.

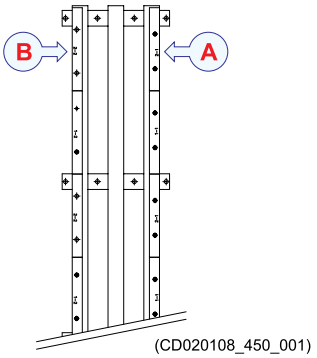
Note

The mounting frames must be handled with care. Please observe normal safety precautions for dockyard work and welding.

Observe the orientation of the mounting frame.

The mounting frame should be aligned parallel to the vessel's keel. Mount the frame so that the most forward transducer module is a TX2.

The brackets are marked with 2–1 and 2–2. This indicates a TX2 transducer module fits in this position, and this is the forward end of the mounting frame.



A 2–1

B 2–2

Drawings for EM 304 mounting frames

- 424606 - TX mounting frame assy. 0.5 deg. drawing
- 499-134005 - TX mounting frame assy. 1 deg. drawing
- 860-210440 - TX mounting frame assy. 2 deg. drawing

Procedure

1 Mount the frame in the casings.

The mounting frames must be bolted onto the flat bars inside the casing. The number of flat bars depends on the length of the transducer array. There are three (3) holes in each flat bar.

The frames are fastened by M16 bolts. Bolts of grade A4-80 should be used.

Use a torque of 187 Nm.

2 Check that the each frame is mounted completely flat.

Important

No point on the frame may deviate from the ideal plane with more than 0.6 mm.

The maximum allowed gradient between two adjacent mounting points on the frame is 0.1 % (1 mm/m).

This can be checked by measuring the relative vertical positions of the module mounting bars on the frames. If the deviations are too large, this has to be corrected by applying shims.

When the frame is installed completely flat:

3 Remove one bolt.

4 Apply Loctite 242 to the bolt.

5 Install the bolt using a torque of 187 Nm.

6 Repeat steps 3- 5 for all the bolts.

Related topics

Transducer array flatness, page 137
Checking the transducer array flatness and correcting deviations, page 138
Dimensional survey accuracy requirements, page 159
Alignment specifications, page 161
Drawing file, page 162

Installing the RX transducers into the mounting frames

When all the preparations have been made, the transducers must be installed into the mounting frames.

Prerequisites

Note

Engineers from Kongsberg Maritime must be present to supervise installation of the transducer modules.

- The mounting frames has been installed.
- The steel conduit is mounted with all installation work finalized.
- All relevant drawings have been approved by the classification society.
- All relevant personnel (skilled shipyard workers) and their tools must be available.

You must be equipped with a standard set of tools.This tool set must comprise the normal tools for mechanical tasks. This includes different screwdriver types, pliers, adjustable spanners, etc. Each tool must be provided in various sizes. We recommend that all tools are demagnetized to protect your equipment.

The following specific tools and items are required for this task:

- Torque wrench
- Loctite 242 (removable medium strength threadlocker)
- Lifting device
- Ropes and tackles

Context

Caution

Observe the physical size and weight of the transducer. Unless a suitable lifting device is available, make sure that enough manpower is available to lift, hold and fasten the transducer.

A transducer must always be handled as a delicate instrument. Incorrect actions may damage the transducer beyond repair.

***Do not** lift the transducer by the cable.*

The number of individual TX and RX modules in the two arrays depends on the chosen configuration. The standard types identified by "transmission x reception" beamwidth are:

- **0.5 x 0.5 degrees system**: 16 transmit transducer modules and 16 receive transducer modules
- **0.5 x 1 degree system**: 16 transmit transducer modules and 8 receive transducer modules
- **1 x 1 degree system**: 8 transmit transducer modules and 8 receive transducer modules
- **1 x 2 degrees system**: 8 transmit transducer modules and 4 receive transducer modules
- **2 x 2 degrees system**: 4 transmit transducer modules and 4 receive transducer modules
- **2 x 4 degrees system**: 4 transmit transducer modules and 2 receive transducer modules
- **4 x 4 degrees system**: 2 transmit transducer modules and 2 receive transducer modules

Note

During the installation of the transducer array, you must fill in the serial number in the cable identification table.

Procedure

1 Put the first transducer module into the frame.

You can start at either end of the array.

Note

Observe the direction of the transducer.

The cables shall point towards the vessel's bow.

2 Pull out the transducer cable, and guide it out through the side of the mounting frame.

EM 304 transducer cables have a minimum bending radius of 105 mm.

Note

Ensure that minimum bending radius is not exceeded and that no damage is inflicted to the cables during the pull.

Damaged cables can only be replaced by replacing the entire transducer module and would require the vessel to be in dock.

3 Secure the transducer module in place with the brackets, one on each side.

Secure each bolt with Loctite 242, use torque 64 Nm.

4 Fill in the serial number in the cable identification table.

RX transducer module number 1 is always the first on the port side.

5 Mount the next transducer module next to the previous.

6 Repeat until all modules have been installed.

7 Check that the transducer cables pass through the casing in such a way that they are not exposed to wear and tear. Secure as required.

Related topics

Cable plan, Receiver Unit, page 98
Weight and outline dimensions, page 150
Drawing file, page 162

Installing the TX transducers into the mounting frames

When all the preparations have been made, the transducers must be installed into the mounting frames.

Prerequisites

Note

Engineers from Kongsberg Maritime must be present to install the transducer modules.

Before you can do this task, the following prerequisites must be met:

- The mounting frames has been installed.
- The steel conduit is mounted with all installation work finalized.
- All relevant drawings have been approved by the classification society.
- All relevant personnel (skilled shipyard workers) and their tools must be available.

You must be equipped with a standard set of tools.This tool set must comprise the normal tools for mechanical tasks. This includes different screwdriver types, pliers, adjustable spanners, etc. Each tool must be provided in various sizes. We recommend that all tools are demagnetized to protect your equipment.

The following specific tools and items are required for this task:

- Torque wrench
- Loctite 242 (removable medium strength threadlocker)
- Lifting device
- Ropes and tackles

Context

Caution

Observe the physical size and weight of the transducer. Unless a suitable lifting device is available, make sure that enough manpower is available to lift, hold and fasten the transducer.

A transducer must always be handled as a delicate instrument. Incorrect actions may damage the transducer beyond repair.

***Do not** lift the transducer by the cable.*

The number of individual TX and RX modules in the two arrays depends on the chosen configuration. The standard types identified by "transmission x reception" beamwidth are:

- **0.5 x 0.5 degrees system**: 16 transmit transducer modules and 16 receive transducer modules
- **0.5 x 1 degree system**: 16 transmit transducer modules and 8 receive transducer modules
- **1 x 1 degree system**: 8 transmit transducer modules and 8 receive transducer modules
- **1 x 2 degrees system**: 8 transmit transducer modules and 4 receive transducer modules
- **2 x 2 degrees system**: 4 transmit transducer modules and 4 receive transducer modules
- **2 x 4 degrees system**: 4 transmit transducer modules and 2 receive transducer modules
- **4 x 4 degrees system**: 2 transmit transducer modules and 2 receive transducer modules

Note

During the installation of the transducer array, you must fill in the serial number of each module in the cable identification table.

Procedure

1 Put the first transducer module into the frame.

Two different TX modules are used, TX1 and TX2. Each TX module has three cables.

TX transducer module number 1 is always the most forward module. TX module number one is always a type TX2.

Note

Observe the direction of the transducer.

The TX cables must point towards the starboard side.

2 Pull out the transducer cables, and guide them out through the side of the mounting frame.

EM 304 transducer cables have a minimum bending radius of 105 mm.

Note

Ensure that minimum bending radius is not exceeded and that no damage is inflicted to the cables during the pull.

Damaged cables can only be replaced by replacing the entire transducer module and would require the vessel to be in dock.

3 Secure the transducer module in place with the brackets, one on each side.

Secure each bolt with Loctite 242, use torque 64 Nm.

4 Fill in the serial number in the cable identification table.

   TX transducer module number 1 is always the most forward module.

5 Mount the next transducer module next to the previous.

6 Repeat until all modules have been installed.

7 Check that the transducer cables pass through the casing in such a way that they are not exposed to wear and tear. Secure as required.

Related topics

Cable plan, Transmitter Unit, page 92
Weight and outline dimensions, page 150
Drawing file, page 162

Rules for transducer handling

To secure long life and accurate results, the transducer must be handled correctly.

A transducer must always be handled as a delicate instrument. Incorrect actions may damage the transducer beyond repair. Observe these transducer handling rules:

1 **Do not** activate the transducer when it is out of the water.

2 **Do not** handle the transducer roughly and avoid impacts.

3 **Do not** expose the transducer to direct sunlight or excessive heat.

4 **Do not** use high-pressure water, sandblasting, metal tools or strong solvents to clean the transducer face.

5 **Do not** damage the outer protective skin of the transducer face.

6 **Do not** lift the transducer by the cable.

7 **Do not** step on the transducer cable.

8 **Do not** damage the transducer cable, and avoid exposure to sharp objects.

Cleaning and painting the transducer face

During normal use, the transducer is subjected to biological fouling. If this marine growth is excessive, it will reduce the performance of the EM 304.

The transducer has not been designed with any protection against biological fouling.

Whenever opportunity arise, typically when the vessel is dry-docked, the transducer face must be cleaned for shells and other marine growth.

- Be careful so that you do not accidentally make cuts or inflict other physical damage to the transducer face.
- Remove biological fouling carefully using a plastic brush, a suitable synthetic detergent and fresh water.

  Biological material which is strongly rooted in the substrate can be removed carefully with a piece of wood or plastic.
- **Do not** use high-pressure water, sandblasting, metal tools or strong solvents to clean the transducer.

Anti-fouling paint may be applied to the transducer face. To minimize the negative acoustical effects the layer of anti-fouling paint must be as thin as possible.

Note

The anti-fouling paint will reduce the acoustical performance of the transducer.

The surface roughness of the transducer substrate and the thickness of the paint may also influence the performance.

Because some paint types may be aggressive to the polyurethane in the transducer, consult our list of approved paints.

Observe the relevant instructions and safety information provided by the paint manufacturer.

Rinse with fresh water

For non permanent installations, the transducer should be rinsed with fresh water every time it is taken out of the water.

Painting the transducer face

Marine growth (biological fouling) on the transducer face reduces the EM 304 performance. We recommend that you paint the transducer face immediately after installation, and then again as often as required to maintain the protection.

Prerequisites

The following tools and consumables are required.

- Personal protection
- Fresh water
- A mild synthetic detergent and a plastic brush
- Fine-grade sandpaper (240 inch grit size)
- Primer
- Anti-fouling paint
- Wet film gauge
- Airless spray

Because some paint types may be aggressive to the polyurethane in the transducer, consult our list of approved paints.

Context

The transducer has not been designed with any protection against biological fouling. Anti-fouling paint may therefore be applied to the transducer face. To minimize the negative acoustical effects the layer of anti-fouling paint must be as thin as possible.

Note

The anti-fouling paint will reduce the acoustical performance of the transducer. The surface roughness of the transducer substrate and the thickness of the paint may also influence the performance. Kongsberg Maritime cannot be held responsible for any negative consequences of the anti-fouling paint.

Observe the relevant instructions and safety information provided by the paint manufacturer.

Procedure

1 Clean the transducer thoroughly.

  Make sure that you remove all oil grease residues, as well as salt and other contamination.

2 Allow the transducer surface to dry.

3 Abrade the transducer surface using a sanding paper with 240 inch grit size.

Do not exceed a surface roughness (R_{max}) of 35 microns as this can influence the EM 304 performance.

4 Remove all dust.

5 Apply the primer, and let it dry.

6 Apply the paint.

Observe the instructions provided by the paint manufacturer. Use airless spray. Apply the minimum specified film thickness per coat and for the complete layer. It is not possible to measure dry film thickness on transducer surface. You must therefore use a wet film gauge to frequently measure the paint thickness.

Note

We strongly recommend that you do not use a paintbrush and/or a roller.

7 Allow the paint to dry.

Further requirements

The contractor or shipyard must keep a daily paint log recording all relevant information from the surface treatment.

Approved anti-fouling paints

This is our list of approved antifouling paints for all transducer types. Always refer to the manufacturer's documentation and data sheets for a complete procedure and for relevant safety information.

Important

Do not paint the transducer with traditional hull plating paint. Use only the correct type of approved paint specified.

Do not use high-pressure water, sandblasting, metal tools or strong solvents to clean the transducer face.

Jotun

- **Manufacturer**: Jotun
- **Address:** P.O.Box 2021, N-3248 Sandefjord, Norway
- **Manufacturer's website**: http://www.jotun.com

Products:

- SeaQuantum Ultra S
  - **Primer**: Safeguard Universal ES

    Apply 80 µm wet film thickness (50 µm dry film thickness).
  - **Paint**: SeaQuantum Ultra S

    Apply 250 µm wet film thickness (125 µm dry film thickness).
- Seaforce 200 AV
  - **Primer**: Safeguard Universal ES AV

    Apply 70 µm wet film thickness (50 µm dry film thickness).
  - **Paint**: Seaforce 200 AV

    Apply 140 µm wet film thickness (90 µm dry film thickness).

Data sheets and application guides can be downloaded from:

http://www.jotun.com/ww/en/b2b/technical-info/tds/index.aspx

International Marine Coatings

- **Manufacturer**: International Marine Coatings
- **Address:** Stoneygate Lane, Felling, Gateshead, Tyne & Wear, NE10 0JY United Kingdom
- **Manufacturer's website**: www.international-marine.com

Products:

- Intersleek 1100SR
  - **Primer**: Intersleek 737

    Apply 50 µm dry film thickness.
  - **Paint**: Intersleek 1100SR

    Apply 150 µm dry film thickness.
- Intersmooth 7465Si SPC
  - **Primer**: Intergard 269

    Apply 40 µm dry film thickness.
  - **Paint**: Intersmooth 7465Si SPC

    Apply 100 µm dry film thickness.

The list can also be found on http://www.km.kongsberg.com.

Installing the EM 304 hardware units

Topics

Transmitter Unit

Topics

Installing the Transmitter Unit

The Transmitter Unit is normally located in a "sonar room" close to the transducer arrays. The physical length of the cables limit the distance between the transducers and the Transmitter Unit.

Prerequisites

The standard length of the transducer cables is 25 metres.

The length of the cables are fixed. The cables can not be extended or shortened during installation.

The Transmitter Unit is heavy. Make sure that the necessary manpower and lifting equipment are available before you start the installation work.

Free bulkhead space is required to mount the Transmitter Unit.

Note

The installation shipyard must provide all necessary installation drawings.

If required, all drawings and documents must be approved by the vessel's national registry and corresponding maritime authority and/or classification society.

Such approval must be obtained before the installation can begin. The shipowner and shipyard doing the installation are responsible for obtaining and paying for such approval.

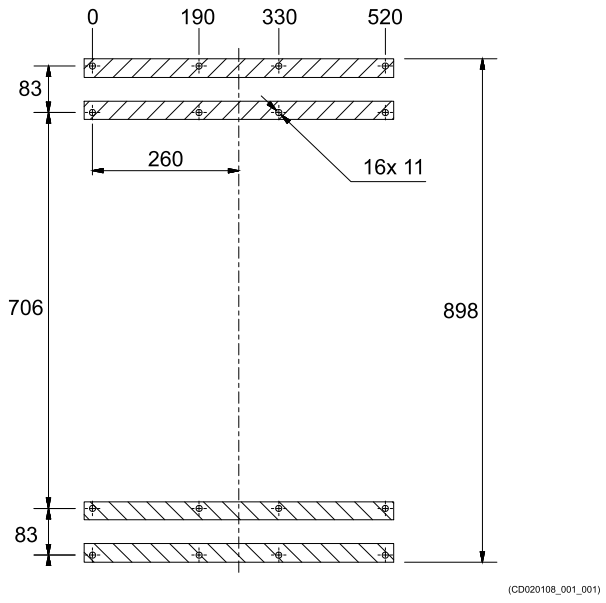
The Transmitter Unit is delivered as a complete cabinet with shock absorbers.

Procedure

1 Prepare the installation site.

a Observe the general sonar room requirements.

b Provide ample space around the cabinet to allow for inspection, maintenance and parts replacement. Make sure that the space allows the cabinet door to be fully dismounted for unobstructed access to its internal parts. General space requirement between units is minimum 200 mm, unless otherwise stated.



Mounting hole pattern for the Transmitter Unit.

c Verify that the installation does not cause problems with existing cabling, ventilation ducts, piping etc. Check both sides of the bulkhead.

2 Mark the location of the holes for the upper and lower shock absorber on the bulkhead.

3 Drill eight (8) 11-mm holes for each shock absorber.

Note

Always check on the other side of the bulkhead before drilling holes.

4 Mount the cabinet to the bulkhead with sixteen (16) M10 bolts.

The bolts must be supplied by the shipyard. Bolts of grade A4-80 should be used.

As the cabinet is heavy, a lifting arrangement (articulated jack or similar) must be used.

The foundation onto which the cabinet is mounted will determine the correct torque to be applied to the bolts.

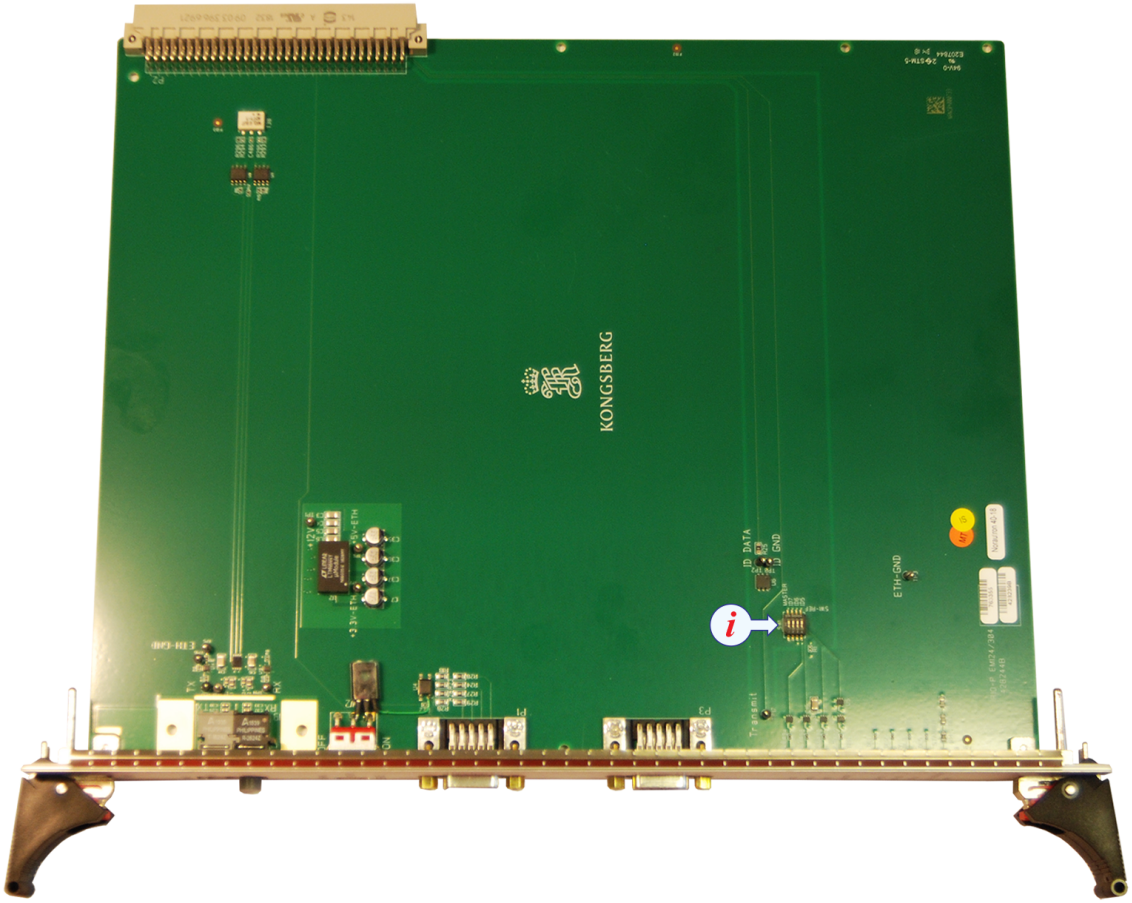
Alternatively, the shock absorbers can be mounted to a pair of specially designed support brackets.

Related topics

Weight and outline dimensions, page 150
Drawing file, page 162

RIO-P board - dip switch setting

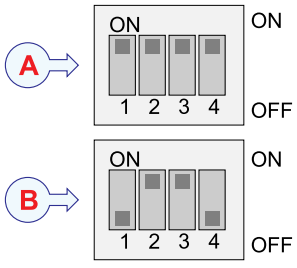
The dip switch setting on the RIO–P board has to be correct.



A Transmitter Unit 1 (MASTER): All switches must be set to ON.

The position of the dip switches are shown with the LED lights on the front of the RIO-P board when the board is installed and the Transmitter Unit is powered up.

- MASTER should be lit.
- ID5, ID6 and ID7 should not be lit.



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B Transmitter Unit 2 (SLAVE): Switch 1 and 4 must be set to OFF, switch 2 and 3 must be set to ON.

Note

If there is only one Transmitter Unit in the system, it has to be set to Transmitter Unit 1 (MASTER).

Receiver Unit

Topics

Installing the Receiver Unit

The EM 304 Receiver Unit is normally located in a "sonar room" close to the transducer arrays. The physical length of the cables limit the distance between the transducers and the Receiver Unit.

Prerequisites

The standard length of the transducer cables is 25 metres.

The length of the cables are fixed. The cables can not be extended or shortened during installation.

Free bulkhead space is required to mount the Receiver Unit.

Note

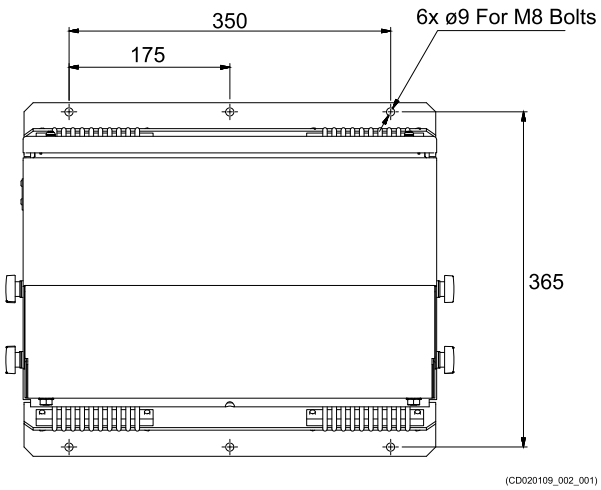
The installation shipyard must provide all necessary installation drawings.

If required, all drawings and documents must be approved by the vessel's national registry and corresponding maritime authority and/or classification society.

Such approval must be obtained before the installation can begin. The shipowner and shipyard doing the installation are responsible for obtaining and paying for such approval.

Context

The Receiver Unit is delivered as a complete cabinet with shock absorbers.



Mounting hole pattern for the Receiver Unit.

Procedure

1 Prepare the installation site.

   a Observe the general sonar room requirements.

   b Provide ample space around the cabinet to allow for inspection, maintenance and parts replacement. Make sure that the space allows the cabinet door to be fully dismounted for unobstructed access to its internal parts. General space requirement between units is minimum 200 mm, unless otherwise stated.

   c Verify that the installation does not cause problems with existing cabling, ventilation ducts, piping etc. Check both sides of the bulkhead.

2 Mark the location of the holes for the upper and lower shock absorber on the bulkhead.

3 Drill three (3) 9-mm holes for each shock absorber.

Note

Always check on the other side of the bulkhead before drilling holes.

4 Mount the cabinet to the bulkhead with six (6) M8 bolts.

The bolts must be supplied by the shipyard. Bolts of grade A4-80 should be used.

The foundation onto which the cabinet is mounted will determine the correct torque to be applied to the bolts.

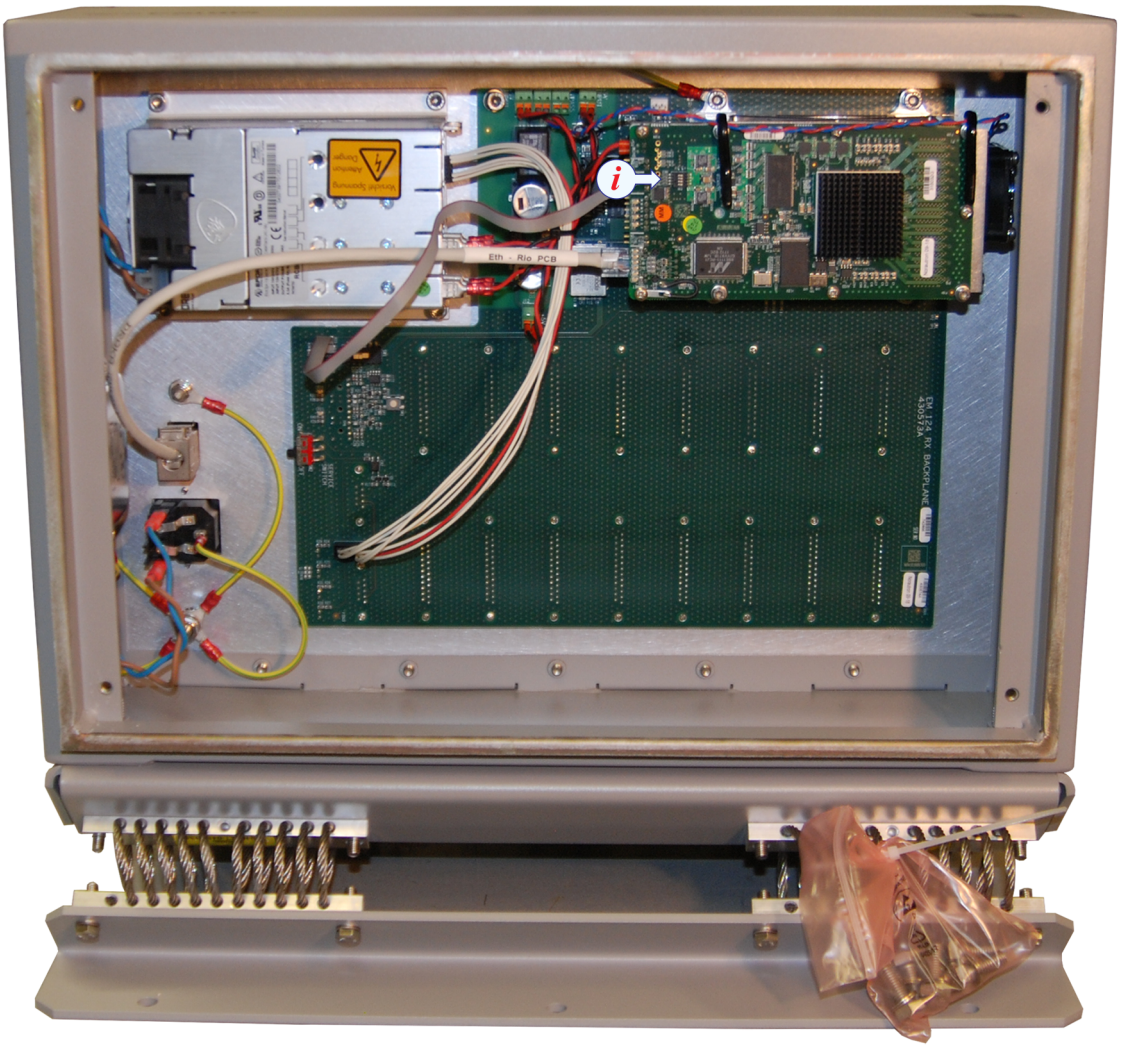
Related topics

Weight and outline dimensions, page 150
Drawing file, page 162

Receiver Unit - dip switch setting

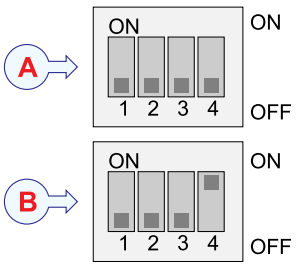
The dip switch setting in the Receiver Unit has to be correct.

The software in the Processing Unit must know the identification of the Receiver Units. A switch on the processing board inside the Receiver Unit is used for this.



A Receiver Unit 1 (MASTER): all switches must be set to OFF.

B Receiver Unit 2 (SLAVE): switch 1, 2 and 3 must be set to OFF, switch 4 must be set to ON.



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Note

If there is only one Receiver Unit in the system, it has to be set to Receiver Unit 1 (MASTER).

Processing Unit

Topics

Installing the Processing Unit

The Processing Unit is designed to be installed in a 19" rack. A suitable location for the Processing Unit must be defined prior to installation.

Prerequisites

You must be equipped with a standard set of tools. This tool set must comprise the normal tools for electronic and electromechanical tasks. This includes different screwdriver types, pliers, spanners, a cable stripper, a soldering iron, etc. Each tool must be provided in various sizes. We recommend that all tools are demagnetized to protect your equipment.

Context

A suitable location for the Processing Unit must be defined prior to installation. The unit can in principle be mounted anywhere on board the ship, provided that the location is dry and ventilated.

Make sure that adequate ventilation is available to avoid overheating.

Procedure

1 Prepare the location and the necessary tools.

2 Observe the installation requirements.

   a The Processing Unit is designed to be installed in a 19" rack.

   b The position must be chosen to fit the available cable lengths between the Processing Unit and the other units it connects to.

   c Make sure that enough space is made available for maintenance purposes.

   d Make sure that adequate ventilation is available to avoid overheating.

   e Make sure that the installation method allows for the physical vibration, movements and forces normally experienced on a vessel.

Note

In order to allow for future maintenance, we recommend to mount the unit with its cables and connectors available for easy access.

3 Make sure that the chosen location meets the installation requirements.

4 Mount the Processing Unit using four bolts through the front panel. The mounting bolts and nuts are supplied with the unit.

Note

We strongly advise that you provide additional support for the Processing Unit, for example by using a standard component shelf suitable for the 19 " rack you are using.

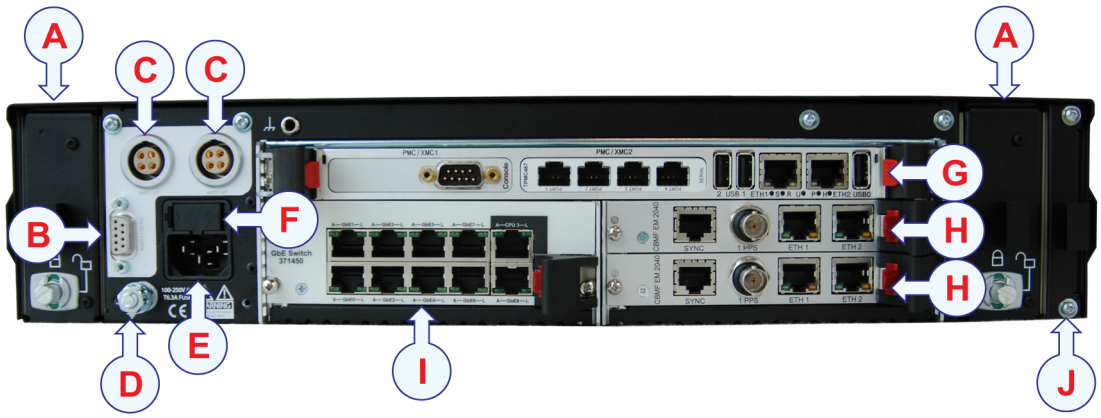
5 Connect the cables.

Note

When you connect the cables, make sure that they are all properly secured, and able to withstand the vibration and movements of the vessel.

Processing Unit rear panel description

The rear panel of the Processing Unit holds all the connectors used to communicate with external devices and the power input socket. It also holds a fuse for the power input.



A ***Fan unit***

The Processing Unit has two fan units for cooling purposes.

B ***Remote Control*** *connector*

C ***48 Vdc*** *output connector*

D *Ground connector*

E *AC mains power socket*

F *Fuse for the AC mains supply*

G ***Concurrent PP833 CPU board***

H ***CBMF board***

There are one or two Compact Beamformer (CBMF) boards in the Processing Unit. The number of CBMF boards depend upon the configuration of the EM 304 system.

I ***CP219 Ethernet switch***

J *Air filter unit*

Processing Unit circuit boards and modules

In order to do the necessary tasks and meet the operational requirements, the Processing Unit is equipped with several circuit boards and modules. All the circuit boards and modules are line replaceable units (LRU).

The following circuit boards and modules are used in the EM 304 Processing Unit.

A ***Concurrent PP833 CPU board***

The Concurrent PP833 is the Central Processing Unit (CPU) of the EM 304 Processing Unit.

B ***CBMF board***

The Compact Beamformer (CBMF) board is used by the Processing Unit for beamforming and signal processing purposes.

There are one or two Compact Beamformer (CBMF) boards in the Processing Unit. The number of CBMF boards depend upon the configuration of the EM 304 system.

C ***VadaTech CP219 board***

The VadaTech CP219 board is used as an Ethernet switch in the EM 304 Processing Unit.

D ***Fan unit***

The Processing Unit has two fan units for cooling purposes.

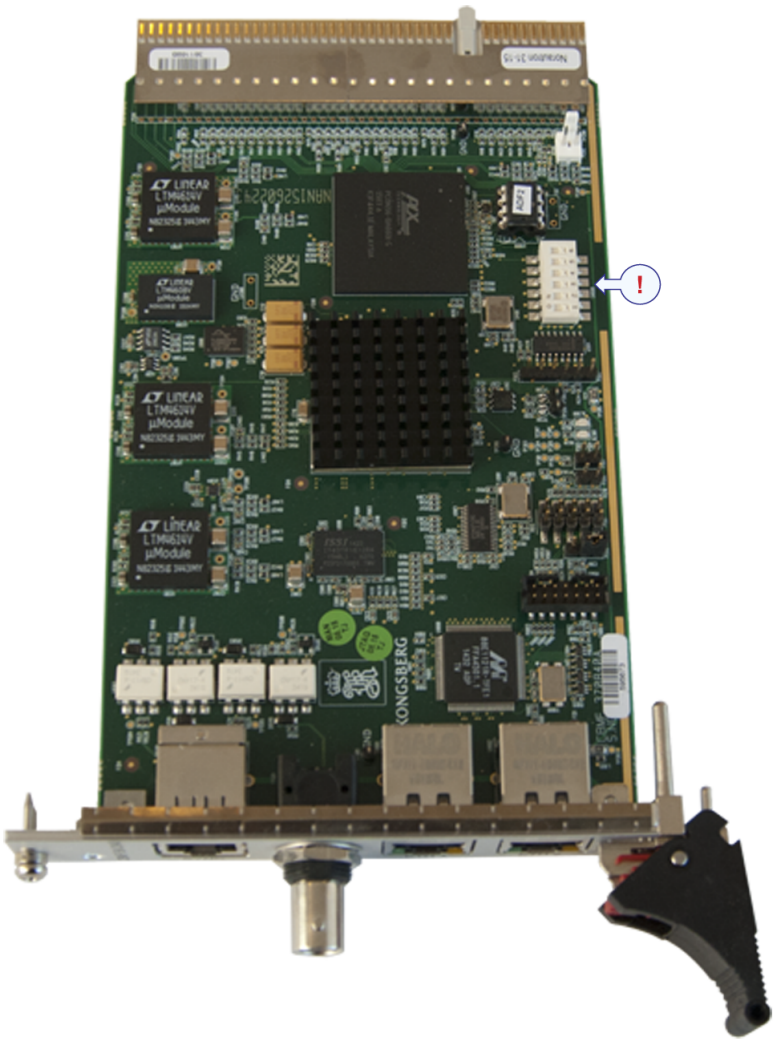
- ***Power supply***

  One power supply unit is used in the EM 304 Processing Unit for supply of 5, 24 and 48 VDC.

  The Excelsys XLB power supply is located inside the Processing Unit, and is not visible from the outside.

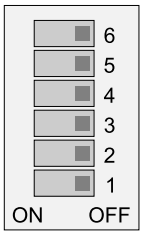
CBMF board - dip switch setting

The dip switch setting on the CBMF board has to be correct.



All the dip switches on all the CBMF boards in the Processing Unit should be set to OFF.

OFF is when they are pushed towards the edge of the circuit board.



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Installing the Hydrographic Work Station

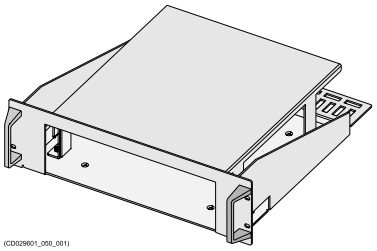
Topics

Installing the Hydrographic Work Station

The Hydrographic Work Station can be installed inside a console, inside a suitable cabinet, in a 19" rack or on a desk. Make sure that adequate ventilation is available to avoid overheating.

Prerequisites

You must be equipped with a standard set of tools. This tool set must comprise the normal tools for electronic and electromechanical tasks. This includes different screwdriver types, pliers, spanners, a cable stripper, a soldering iron, etc. Each tool must be provided in various sizes. We recommend that all tools are demagnetized to protect your equipment.



A suitable location for the Hydrographic Work Station must be defined prior to installation.

Note

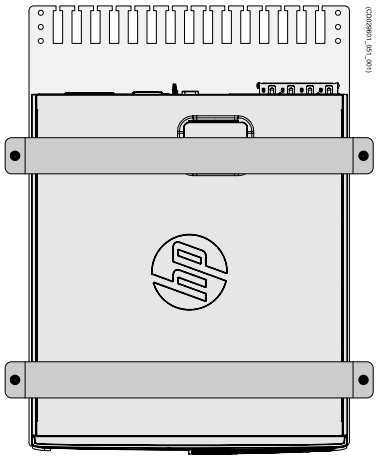
Observe the compass safe distance.

Context

The Hydrographic Work Station can be installed in several different ways using various installation kits.

- 19” rack mounting using kit (371931)
- Horizontal or vertical mounting kit (331385)
- Stand-alone desktop mounting (No installation kit)

Procedure



1 Prepare the location and the necessary tools.

2 Observe the installation requirements.

   a Depending on its physical properties, install the computer inside a console, in a cabinet or 19” rack, or on a desk.

   b Choose a position to fit the available cable lengths between the computer and the other units it connects to.

   c Observe the compass safe distance.

   d Make sure that enough space is made available for maintenance purposes.

   e Make sure that adequate ventilation is available to avoid overheating.

   f Make sure that the installation method allows for the physical vibration, movements and forces normally experienced on a vessel.

   Note

   In order to allow for future maintenance, we recommend to mount the unit with its cables and connectors available for easy access.

3 Make sure that the chosen location meets the installation requirements.

4 Provide ample space around the computer.

   You must be able to reach and use the front and rear mounted connectors and on/off switches. It is also important that you allow for easy access to all the cables, and enough space for inspection, maintenance and parts replacement. If relevant, make sure that the space allows you to open the computer for unobstructed access to its internal parts.

   Note

   Make sure that you can access both the rear and front side of the computer after it has been installed.

5 If you are mounting the computer using the 19” rack kit:

   a Remove the lid on the rack shelf.

   b Place the computer on the shelf.

   c Mount the lid, and secure it properly.

   d Place the shelf into the 19" rack.

   All necessary nuts and bolts are provided with the mounting kit.

6 If you are mounting the computer using the horizontal/vertical kit:

   a Prepare four holes – each M6 – for the bottom plate.

b Mount the bottom plate using M6x20 bolts, washers and nuts.

c Place the computer on the bottom plate.

d Mount the two brackets to the bottom plate using M5 locking nuts and washers.

7 If you are mounting the computer as a stand-alone desktop unit:

a Place the computer on the surface.

b Secure the computer using any means available.

8 Connect the cables.

Note

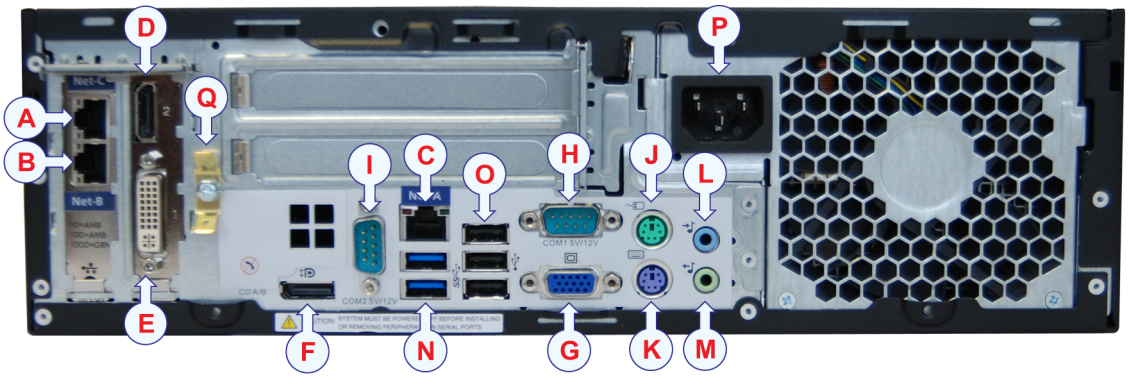
When you connect the cables, make sure that they are all properly secured, and able to withstand the vibration and movements of the vessel.

Related topics

Weight and outline dimensions, page 150
Drawing file, page 162

Hydrographic Work Station rear connectors

The rear panel on the Hydrographic Work Station holds connectors for the various EM 304 cables.



The image shows the MP5810 Fishery SIS5 model. Part number: 438803

If another model is used, the connections can be different.

A *Ethernet cable: From Hydrographic Work Station to local area network (LAN) (C18)*

B *Ethernet cable: From Hydrographic Work Station to local area network (LAN) (C19)*

C *Ethernet cable: From Hydrographic Work Station to Processing Unit (C10)*

It is very important that high-quality Ethernet cables are used. You must use CAT-5E STP (Shielded Twisted Pair) quality or better. If you use cables with lower bandwidth capacity you will reduce the EM 304 performance.

D *Display Port*

Display cable: From Hydrographic Work Station to display (C1)

This is a commercial cable. The display cable is often physically attached to the display, and terminated in the "computer end" with a male connector. If the cable is not attached, it is normally provided with the display.

E *Video Port: DVI*

F *Display Port*

G *Video Port: VGA*

H *Serial cables: From Hydrographic Work Station to external device(s) (C14)*

I *Serial cables: From Hydrographic Work Station to external device(s) (C15)*

J *Computer cable: From Hydrographic Work Station to mouse (or another similar device) (C4)*

The cable is often physically attached to the mouse, and terminated in the "computer end" with a male PS/2 or USB connector. Depending on the type of connector you must connect the mouse to the PS/2 connector or an USB connector on the computer.

K *Computer cable: From Hydrographic Work Station to keyboard (C3)*

The cable is often physically attached to the keyboard, and terminated in the "computer end" with a male PS/2 or USB connector. Depending on the type of connector you must connect the keyboard to the PS/2 connector or an USB connector on the computer.

L *Audio cable: Not used*

M *Audio cable: Not used*

N *USB interface connectors: USB 3.0 From Hydrographic Work Station to external device(s)*

O *USB interface connectors: USB 2.0 From Hydrographic Work Station to external device(s)*

P *AC power cable: From Hydrographic Work Station to uninterruptible power supply (UPS) (C7)*

Q *Ground cable: From Hydrographic Work Station to vessel ground (C8)*

Cable layout and interconnections

Correct cabling is essential for EM 304 operation. Cabling principles, cable plans and drawings, as well as relevant procedures, are provided.

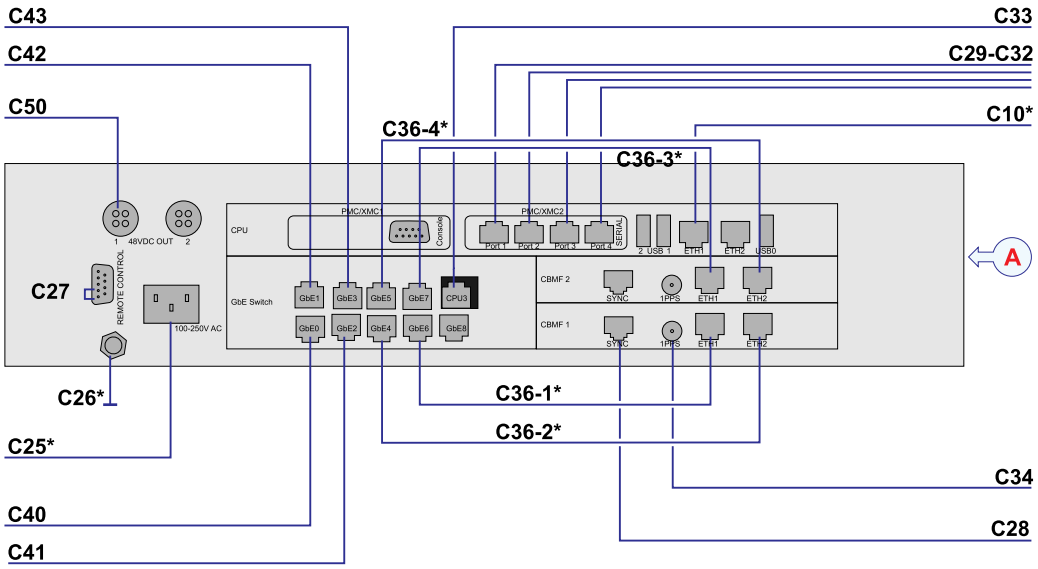
Topics

Cable plans

Topics

Cable plan, Processing Unit

The Processing Unit cables include those used to connect the EM 304 Processing Unit to AC mains power, and to the transmitter and receiver units. One Ethernet cable is used to connect the Processing Unit to the Hydrographic Work Station.



(CD020108_200_002)

Cables identified with an asterisk (*) are system cables. These cables are supplied with the EM 304 delivery.

A Processing Unit

Related topics

List of EM 304 cables, page 107

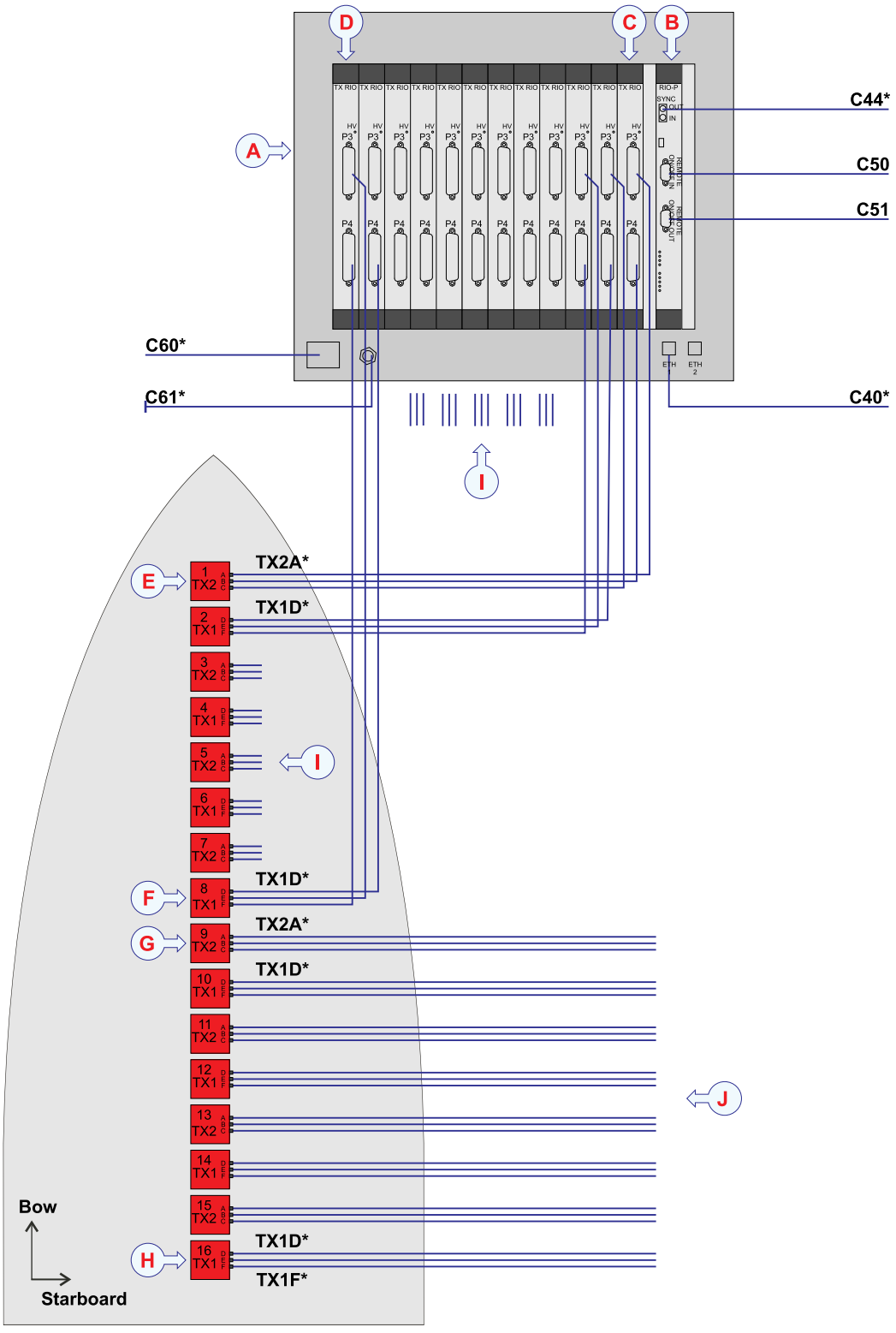
Cable plan, Transmitter Unit

The transmitter (TX) Unit cables include those used to connect the EM 304 TX Unit(s) to AC mains power, to the receiver (RX) Unit, to the Processing Unit and to the transducers. If there are more than one TX Unit they have to be connected to each other with a fibre optic cable.

The EM 304 system can have one or two Transmitter Units (TXUs), depending on the system configuration.

A system with 0.5 degrees transmitter array will need 16 Transmit Transducer modules and two Transmitter Units.

Transmitter Unit 1



(CD020108_201_001)

Cables identified with an asterisk (*) are system cables. These cables are supplied with the EM 304 delivery.

A *Transmitter Unit (TXU) 1*

B *RIO-P board*

C *TX RIO board 1*

D *TX RIO board 12*

E *Transmit transducer (TX) number 1*

F *Transmit Transducer (TX) number 8*

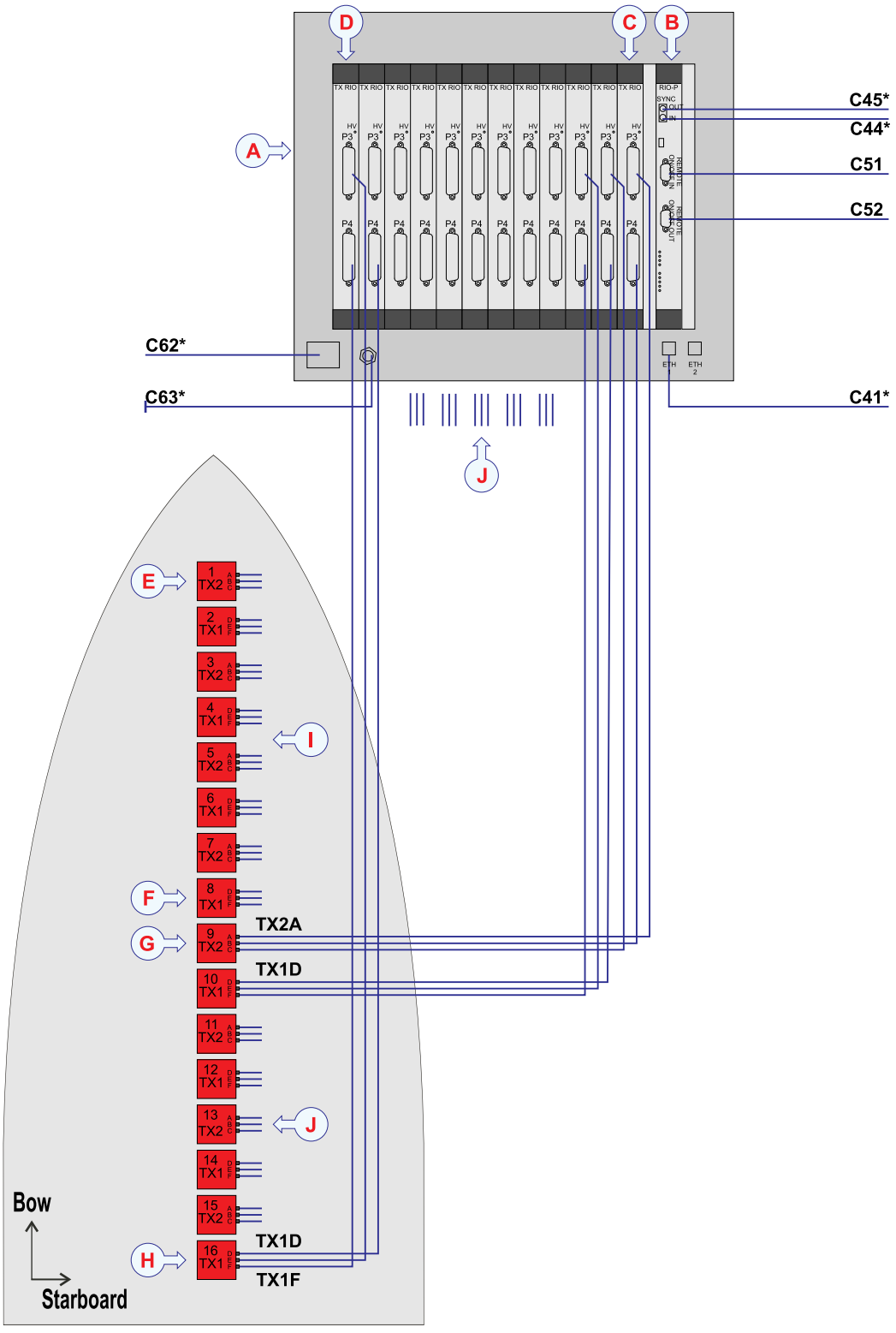
G *Transmit Transducer (TX) number 9*

H *Transmit Transducer (TX) number 16*

I *Cables from Transmit Transducer (TX) 1 to 8 are connected to Transmitter Unit (TXU) 1 according to table*

J *Cables from Transmit Transducer (TX) 9 to 16 are connected to Transmitter Unit (TXU) 2 according to table*

Transmitter Unit 2



(CD020108_201_002)

Cables identified with an asterisk (*) are system cables. These cables are supplied with the EM 304 delivery.

A *Transmitter Unit (TXU) 2*

B *RIO-P board*

C *TX RIO board 1*

D *TX RIO board 12*

E *Transmit transducer (TX) number 1*

F *Transmit Transducer (TX) number 8*

G *Transmit Transducer (TX) number 9*

H *Transmit Transducer (TX) number 16*

I *Cables from Transmit Transducer (TX) 1 to 8 are connected to Transmitter Unit (TXU) 1 according to table*

J *Cables from Transmit Transducer (TX) 9 to 16 are connected to Transmitter Unit (TXU) 2 according to table*

Marking of TX transducer cables

Each transducer module and its cable is identified with a serial number as follows:

TX 1 modules: TX1D<nnn>, TX1E<nnn>, TX1F<nnn>,

TX 2 modules: TX2A<nnn>, TX2B<nnn>, TX2C<nnn>

Each transducer module is also identified by its physical location in the array (frame). This location number must be recorded during the installation of the transducer modules, and written down in the table provided in this chapter.

The TX transducer array is physically positioned in the fore-and-aft direction under the hull.

Transducer module number 1 is always the most forward module. The most forward one is always a type TX 2.

Connection of TX transducer cables

The 0.5 degree system consists of 16 TX modules with 48 TX cables.

The 1 degree system consists of 8 TX modules with 24 TX cables.

The 2 degree system consists of 4 TX modules with 12 TX cables.

The 4 degree system consists of 2 TX modules with 6 TX cables.

Note

It is essential to connect all TX cables successively to the TX RIO boards in the Transmitter Unit(s).

During the installation of the TX array, you must fill in the serial number in the cable identification table.

Table 1 Cable identification TX

Position	Transducer serial number (fill in)	Cable	Socket	TX RIO board	TX Unit	Size of system			
1	TX2-	A	P3	1	1	4 deg	2 deg	1 deg	0.5 deg
		B	P4	1	1				
		C	P3	2	1				
2	TX1-	D	P4	2	1				
		E	P3	3	1				
		F	P4	3	1				
3	TX2-	A	P3	4	1				
		B	P4	4	1				
		C	P3	5	1				
4	TX1-	D	P4	5	1				
		E	P3	6	1				
		F	P4	6	1				
5	TX2-	A	P3	7	1				
		B	P4	7	1				
		C	P3	8	1				
6	TX1-	D	P4	8	1				
		E	P3	9	1				
		F	P4	9	1				
7	TX2-	A	P3	10	1				
		B	P4	10	1				
		C	P3	11	1				
8	TX1-	D	P4	11	1				
		E	P3	12	1				
		F	P4	12	1				
9	TX2-	A	P3	1	2				
		B	P4	1	2				
		C	P3	2	2				
10	TX1-	D	P4	2	2				
		E	P3	3	2				
		F	P4	3	2				
11	TX2-	A	P3	4	2				
		B	P4	4	2				
		C	P3	5	2				
12	TX1-	D	P4	5	2				

Position	Transducer serial number (fill in)	Cable	Socket	TX RIO board	TX Unit	Size of system			
		E	P3	6	2				
		F	P4	6	2				
13	TX2-	A	P3	7	2				
		B	P4	7	2				
		C	P3	8	2				
14	TX1-	D	P4	8	2				
		E	P3	9	2				
		F	P4	9	2				
15	TX2-	A	P3	10	2				
		B	P4	10	2				
		C	P3	11	2				
16	TX1-	D	P4	11	2				
		E	P3	12	2				
		F	P4	12	2				

Related topics
List of EM 304 cables, page 107

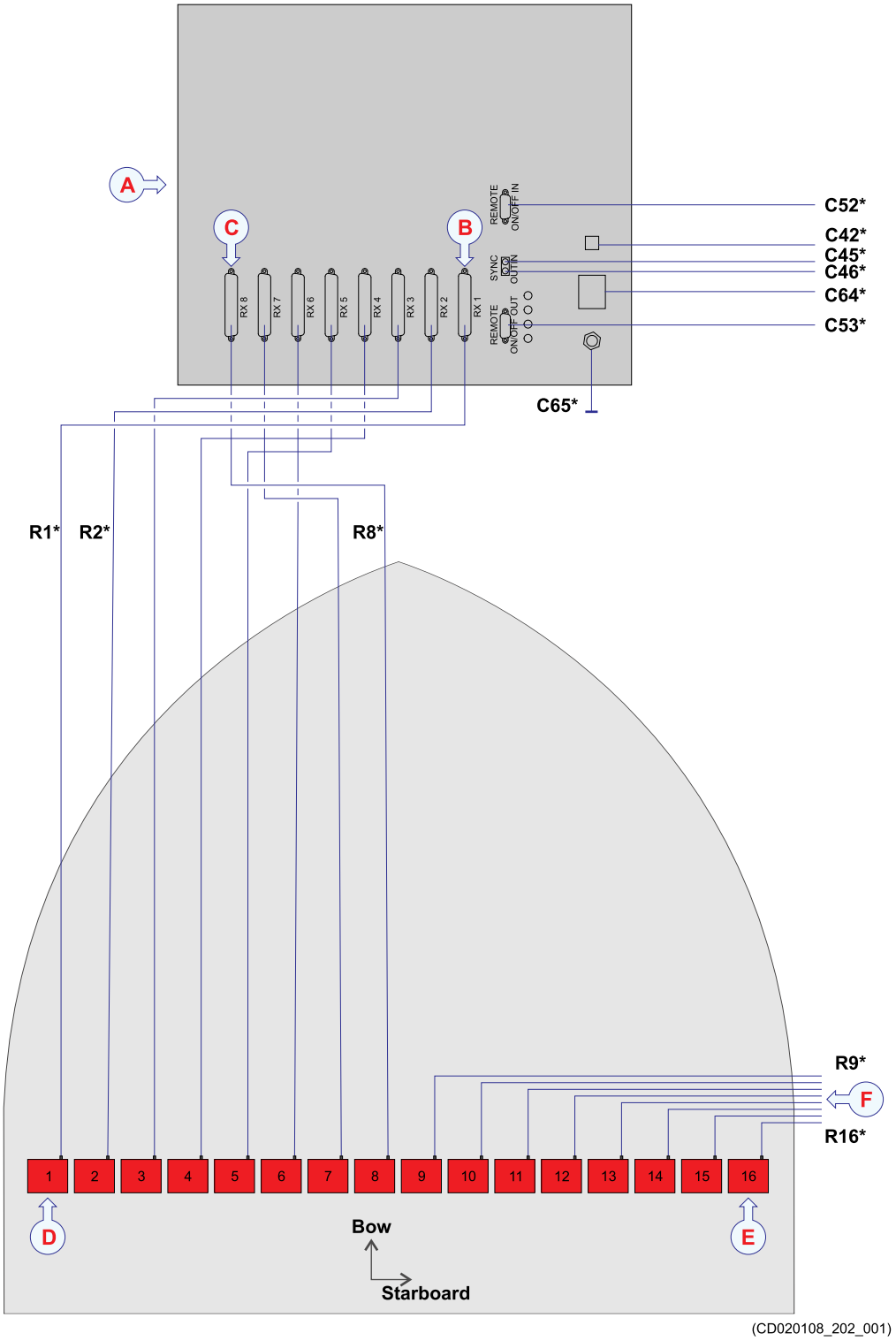
Cable plan, Receiver Unit

The receiver (RX) Unit cables include those used to connect the EM 304 RX Unit(s) to AC mains power, to the transmitter (TX) Unit, to the Processing Unit and to the transducers.

The EM 304 system can have one or two Receiver Units (RXUs), depending on the system configuration.

A system with 0.5 degrees receiver array will need 16 Receive Transducer modules and two Receiver Units.

Receiver Unit 1



Cables identified with an asterisk (*) are system cables. These cables are supplied with the EM 304 delivery.

A *Receiver Unit (RXU)* 1

B *Socket RX 1*

C *Socket RX 8*

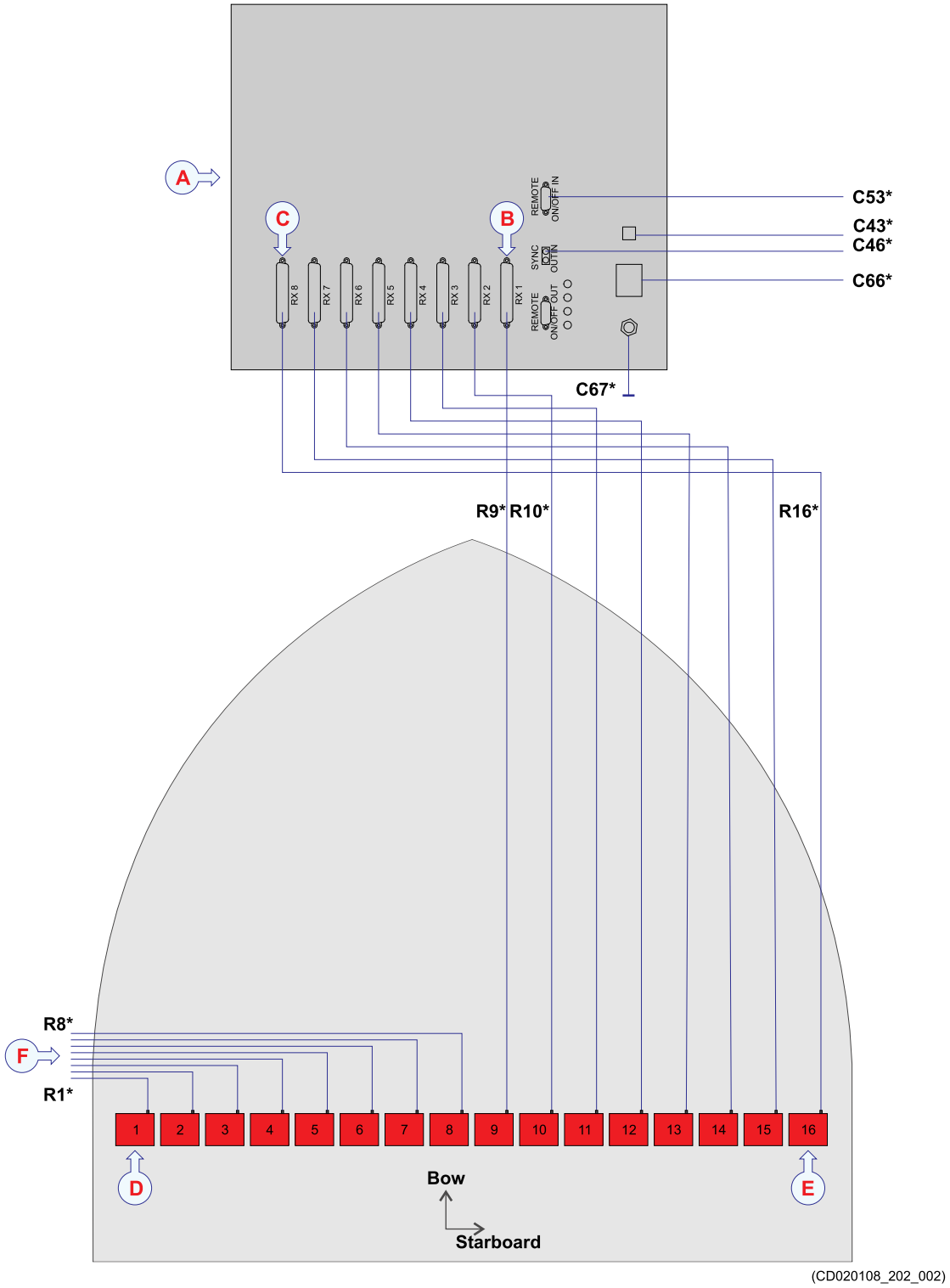
D *Receive Transducer module number 1*

E *Receive Transducer module number 16*

Cables from Receive Transducer modules 1 to 8 are connected to Receiver Unit (RXU) 1 according to table

F *Cables from Receive Transducer modules 9 to 16 are connected to Receiver Unit (RXU) 2 according to table*

Receiver Unit 2



Cables identified with an asterisk (*) are system cables. These cables are supplied with the EM 304 delivery.

A *Receiver Unit (RXU)* 2

B *Socket RX 1*

C *Socket RX 8*

D *Receive Transducer module number 1*

E *Receive Transducer module number 16*

Cables from Receive Transducer modules 9 to 16 are connected to Receiver Unit (RXU) 2 according to table

F *Cables from Receive Transducer modules 1 to 8 are connected to Receiver Unit (RXU) 1 according to table*

Marking of RX transducer cables

Each Receive Transducer module and its cable is identified with a number as follows:

Transducer: RX<nnn>

Where **<nnn>** is a numerical value.

RX cable: R<n>

Where **<n>** is a number between 1 and 16.

Transducer module number 1 is always the first on the port side.

Connection of RX transducer cables

The 0.5 degree system consists of 16 RX modules/cables.

The 1 degree system consists of 8 RX modules/cables.

The 2 degree system consists of 4 RX modules/cables.

The 4 degree system consists of 2 RX modules/cables.

Note

It is essential to connect all RX cables successively to the sockets in the Receiver Unit(s).

During the installation of the RX array, you must fill in the serial number in the cable identification table .

Table 2 Cable identification RX

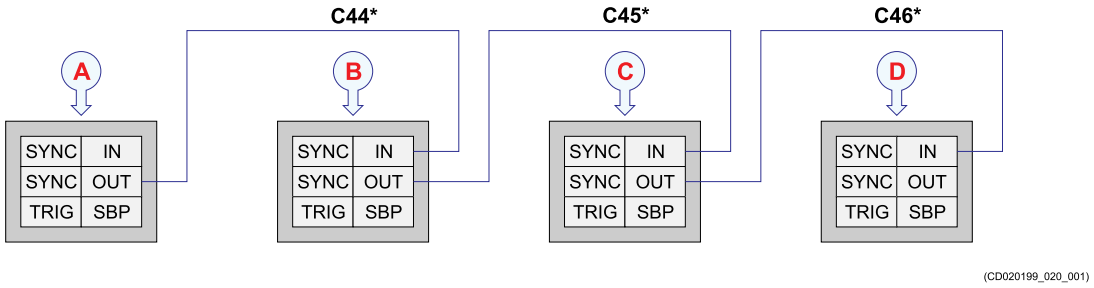
Position	Transducer serial number (fill in)	Cable	Socket	RX Unit	Size of system			
1	RX	R1	RX 1	1	4 deg	2 deg	1 deg	0.5 deg
2	RX	R2	RX 2	1				
3	RX	R3	RX 3	1				
4	RX	R4	RX 4	1				
5	RX	R5	RX 5	1				
6	RX	R6	RX 6	1				
7	RX	R7	RX 7	1				
8	RX	R8	RX 8	1				
9	RX	R9	RX 1	2				
10	RX	R10	RX 2	2				
11	RX	R11	RX 3	2				
12	RX	R12	RX 4	2				
13	RX	R13	RX 5	2				
14	RX	R14	RX 6	2				
15	RX	R15	RX 7	2				
16	RX	R16	RX 8	2				

Related topics

List of EM 304 cables, page 107

Synchronization overview, 2 Transmitter Units 2 Receiver Units

The transmitter and receiver unit(s) must be connected with a fibre optic synchronization signal.



A *Transmitter Unit (TXU) 1*

B *Transmitter Unit (TXU) 2*

C *Receiver Unit (RXU) 1*

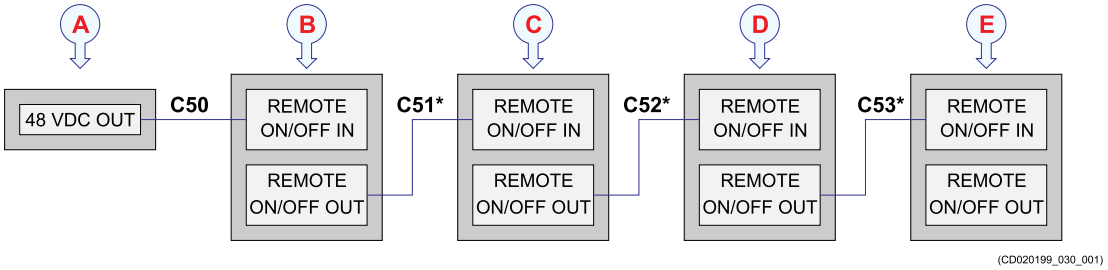
D *Receiver Unit (RXU) 2*

Cables identified with an asterisk (*) are system cables. These cables are supplied with the EM 304 delivery.

The fibre optic cable and the cable for remote control between the Transmitter Units and Receiver Units are delivered as a kit. The standard cable length is 10 metres.

Remote on/off overview, 2 Transmitter Units 2 Receiver Units

The EM 304 system can be switched on/off via the Processing Unit.



A *Processing Unit*

B *Transmitter Unit (TXU) 1*

C *Transmitter Unit (TXU) 2*

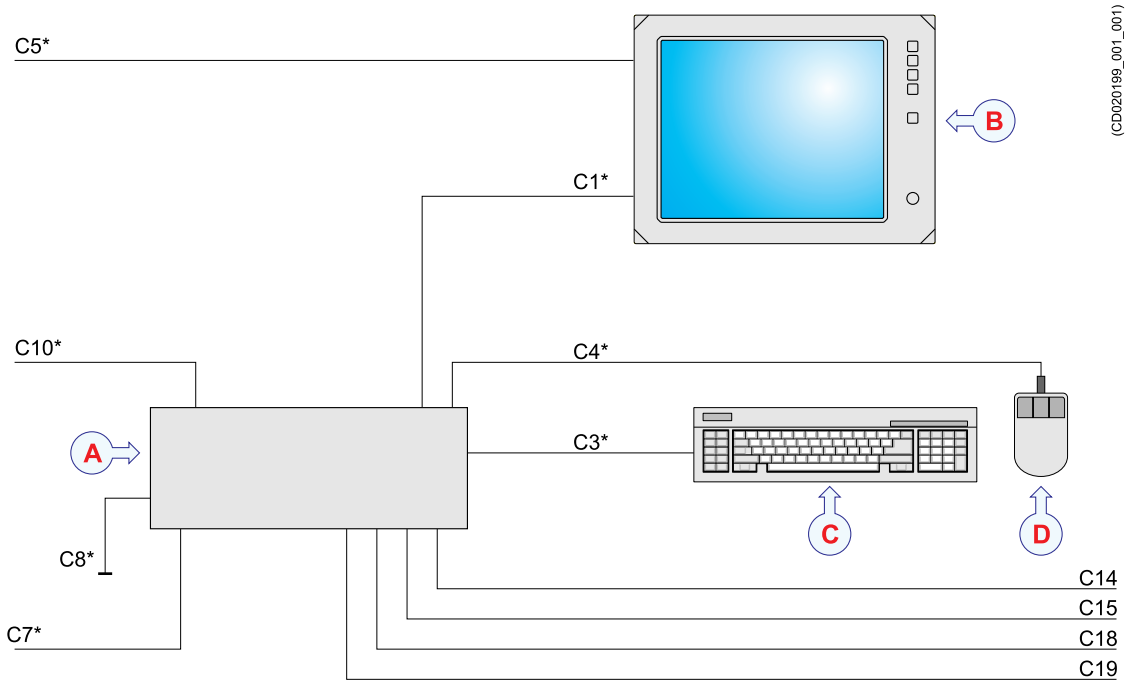
D *Receiver Unit (RXU) 1*

E *Receiver Unit (RXU) 2*

Cables identified with an asterisk (*) are system cables. These cables are supplied with the EM 304 delivery.

Cable plan, Hydrographic Work Station

The topside/bridge cables include those used to connect the EM 304 Hydrographic Work Station and the display to each other, to AC mains power, and to external devices.



A *Hydrographic Work Station*

B *Display*

The Hydrographic Work Station supports up to three displays.

C *Computer keyboard*

D *Computer mouse or trackball*

Cables identified with an asterisk (*) are system cables. These cables are supplied with the EM 304 delivery.

Related topics

List of EM 304 cables, page 107

List of EM 304 cables

A set of cables is required to connect the EM 304 units to each other, and to the relevant power source(s).

Cable	Type	From/To	Minimum requirements
C1	Video cable	From Hydrographic Work Station to display	
	This is a commercial cable. It is normally provided with the display.		
C3	Computer cable	From Hydrographic Work Station to keyboard	
	This is a commercial cable. It is normally provided with the keyboard.		
C4	Computer cable	From Hydrographic Work Station to mouse (or another similar device)	
	This is a commercial cable. It is normally provided with the mouse.		
C5	AC power cable	From display to AC power outlet	
C7	AC power cable	From Hydrographic Work Station to AC power outlet	
C8	Ground cable	From Hydrographic Work Station to vessel ground	
C10	Ethernet cable	From Hydrographic Work Station to Processing Unit	CAT5-E STP (Shielded Twisted Pair)
	A 4.5 meter long Ethernet cable is provided with the Processing Unit. If a longer cable is required, this must be provided by the installation shipyard.		
C14	Serial cable	From Hydrographic Work Station to external device(s)	
C15	Serial cable	From Hydrographic Work Station to external device(s)	
C18	Ethernet cable	From Hydrographic Work Station to local area network (LAN)	
C19	Ethernet cable	From Hydrographic Work Station to external device(s)	
C25	AC power cable	From Processing Unit to AC power outlet	
C26	Ground cable	From Processing Unit to vessel ground	
C27	Control cable	From Processing Unit to remote control device	
	Remote on/off switch If remote control is not used, a termination plug has to be inserted in the Remote control plug on the Processing Unit. This plug is a 9 pin D-SUB supplied with the Processing Unit.		
C28	Control cable	From Processing Unit to synchronization device	
	External synchronization		

Cable	Type	From/To	Minimum requirements
C29–C32	Serial cable	From Processing Unit to external device(s)	
C33	Ethernet cable	From Processing Unit to external device(s)	CAT5-E STP (Shielded Twisted Pair)
	Attitude Velocity sensor		
C34	Coax cable	From Processing Unit to the global positioning system (GPS)	
	The software clock can be synchronized to an external 1PPS (Pulse per second) signal.		
C36	Ethernet cable	Processing Unit internal connection	CAT5-E STP (Shielded Twisted Pair)
C40	Ethernet cable	From Processing Unit to Transmitter Unit 1	CAT5-E STP (Shielded Twisted Pair)
C41	Ethernet cable	From Processing Unit to Transmitter Unit 2	CAT5-E STP (Shielded Twisted Pair)
C42	Ethernet cable	From Processing Unit to Receiver Unit 1	CAT5-E STP (Shielded Twisted Pair)
C43	Ethernet cable	From Processing Unit to Receiver Unit 2	CAT5-E STP (Shielded Twisted Pair)
C44	Fibre optic cable	From Transmitter Unit 1 to Transmitter Unit 2	
	The fibre optic cable and the cable for remote control between the Transmitter Units and Receiver Units are delivered as a kit.The standard cable length is 10 metres.		
C45	Fibre optic cable	From Transmitter Unit 2 to Receiver Unit 1	
	The fibre optic cable and the cable for remote control between the Transmitter Units and Receiver Units are delivered as a kit.The standard cable length is 10 metres.		
C46	Fibre optic cable	From Receiver Unit 1 to Receiver Unit 2	
	The fibre optic cable and the cable for remote control between the Transmitter Units and Receiver Units are delivered as a kit.The standard cable length is 10 metres.		
C50	Control cable	From Processing Unit to Transmitter Unit 1	
	Remote control of Transmitter Unit		
C51	Control cable	From Transmitter Unit 1 to Transmitter Unit 2	
	The fibre optic cable and the cable for remote control between the Transmitter Units and Receiver Units are delivered as a kit.The standard cable length is 10 metres.		
C52	Control cable	From Transmitter Unit 2 to Receiver Unit 1	
	The fibre optic cable and the cable for remote control between the Transmitter Units and Receiver Units are delivered as a kit.The standard cable length is 10 metres.		

Cable	Type	From/To	Minimum requirements
C53	Control cable	From Receiver Unit 1 to Receiver Unit 2	
	The fibre optic cable and the cable for remote control between the Transmitter Units and Receiver Units are delivered as a kit.The standard cable length is 10 metres.		
C60	AC power cable	From Transmitter Unit to AC power outlet	
C61	Ground cable	From Transmitter Unit to vessel ground	
C62	AC power cable	From Transmitter Unit to AC power outlet	
C63	Ground cable	From Transmitter Unit to vessel ground	
C64	AC power cable	From Receiver Unit to AC power outlet	
C65	Ground cable	From Receiver Unit to vessel ground	
C66	AC power cable	From Receiver Unit to AC power outlet	
C67	Ground cable	From Receiver Unit to vessel ground	
TX2A TX2B TX2C	Transducer cable	From Transmitter Unit to transducer	
	The transducer cables are moulded to the transducer modules and connect in the other end to the Transmitter Unit (TXU) or Receiver Unit (RXU) with connectors.		
TX1D TX1E TX1F	Transducer cable	From Transmitter Unit to transducer	
	The transducer cables are moulded to the transducer modules and connect in the other end to the Transmitter Unit (TXU) or Receiver Unit (RXU) with connectors.		
TX2A TX2B TX2C	Transducer cable	From Transmitter Unit to transducer	
	The transducer cables are moulded to the transducer modules and connect in the other end to the Transmitter Unit (TXU) or Receiver Unit (RXU) with connectors.		
TX1D TX1E TX1F	Transducer cable	From Transmitter Unit to transducer	
	The transducer cables are moulded to the transducer modules and connect in the other end to the Transmitter Unit (TXU) or Receiver Unit (RXU) with connectors.		
TX2A TX2B TX2C	Transducer cable	From Transmitter Unit to transducer	
	The transducer cables are moulded to the transducer modules and connect in the other end to the Transmitter Unit (TXU) or Receiver Unit (RXU) with connectors.		
TX1D TX1E TX1F	Transducer cable	From Transmitter Unit to transducer	
	The transducer cables are moulded to the transducer modules and connect in the other end to the Transmitter Unit (TXU) or Receiver Unit (RXU) with connectors.		

Cable	Type	From/To	Minimum requirements
TX2A TX2B TX2C	Transducer cable	From Transmitter Unit to transducer	
	The transducer cables are moulded to the transducer modules and connect in the other end to the Transmitter Unit (TXU) or Receiver Unit (RXU) with connectors.		
TX1D TX1E TX1F	Transducer cable	From Transmitter Unit to transducer	
	The transducer cables are moulded to the transducer modules and connect in the other end to the Transmitter Unit (TXU) or Receiver Unit (RXU) with connectors.		
TX2A TX2B TX2C	Transducer cable	From Transmitter Unit to transducer	
	The transducer cables are moulded to the transducer modules and connect in the other end to the Transmitter Unit (TXU) or Receiver Unit (RXU) with connectors.		
TX1D TX1E TX1F	Transducer cable	From Transmitter Unit to transducer	
	The transducer cables are moulded to the transducer modules and connect in the other end to the Transmitter Unit (TXU) or Receiver Unit (RXU) with connectors.		
TX2A TX2B TX2C	Transducer cable	From Transmitter Unit to transducer	
	The transducer cables are moulded to the transducer modules and connect in the other end to the Transmitter Unit (TXU) or Receiver Unit (RXU) with connectors.		
TX1D TX1E TX1F	Transducer cable	From Transmitter Unit to transducer	
	The transducer cables are moulded to the transducer modules and connect in the other end to the Transmitter Unit (TXU) or Receiver Unit (RXU) with connectors.		
TX2A TX2B TX2C	Transducer cable	From Transmitter Unit to transducer	
	The transducer cables are moulded to the transducer modules and connect in the other end to the Transmitter Unit (TXU) or Receiver Unit (RXU) with connectors.		
TX1D TX1E TX1F	Transducer cable	From Transmitter Unit to transducer	
	The transducer cables are moulded to the transducer modules and connect in the other end to the Transmitter Unit (TXU) or Receiver Unit (RXU) with connectors.		
TX2A TX2B TX2C	Transducer cable	From Transmitter Unit to transducer	
	The transducer cables are moulded to the transducer modules and connect in the other end to the Transmitter Unit (TXU) or Receiver Unit (RXU) with connectors.		
TX1D TX1E TX1F	Transducer cable	From Transmitter Unit to transducer	
	The transducer cables are moulded to the transducer modules and connect in the other end to the Transmitter Unit (TXU) or Receiver Unit (RXU) with connectors.		
R1	Transducer cable	From Receiver Unit to transducer	
	The transducer cables are moulded to the transducer modules and connect in the other end to the Transmitter Unit (TXU) or Receiver Unit (RXU) with connectors.		

Cable	Type	From/To	Minimum requirements
R2	Transducer cable	From Receiver Unit to transducer	
	The transducer cables are moulded to the transducer modules and connect in the other end to the Transmitter Unit (TXU) or Receiver Unit (RXU) with connectors.		
R3	Transducer cable	From Receiver Unit to transducer	
	The transducer cables are moulded to the transducer modules and connect in the other end to the Transmitter Unit (TXU) or Receiver Unit (RXU) with connectors.		
R4	Transducer cable	From Receiver Unit to transducer	
	The transducer cables are moulded to the transducer modules and connect in the other end to the Transmitter Unit (TXU) or Receiver Unit (RXU) with connectors.		
R5	Transducer cable	From Receiver Unit to transducer	
	The transducer cables are moulded to the transducer modules and connect in the other end to the Transmitter Unit (TXU) or Receiver Unit (RXU) with connectors.		
R6	Transducer cable	From Receiver Unit to transducer	
	The transducer cables are moulded to the transducer modules and connect in the other end to the Transmitter Unit (TXU) or Receiver Unit (RXU) with connectors.		
R7	Transducer cable	From Receiver Unit to transducer	
	The transducer cables are moulded to the transducer modules and connect in the other end to the Transmitter Unit (TXU) or Receiver Unit (RXU) with connectors.		
R8	Transducer cable	From Receiver Unit to transducer	
	The transducer cables are moulded to the transducer modules and connect in the other end to the Transmitter Unit (TXU) or Receiver Unit (RXU) with connectors.		
R9	Transducer cable	From Receiver Unit to transducer	
	The transducer cables are moulded to the transducer modules and connect in the other end to the Transmitter Unit (TXU) or Receiver Unit (RXU) with connectors.		
R10	Transducer cable	From Receiver Unit to transducer	
	The transducer cables are moulded to the transducer modules and connect in the other end to the Transmitter Unit (TXU) or Receiver Unit (RXU) with connectors.		
R11	Transducer cable	From Receiver Unit to transducer	
	The transducer cables are moulded to the transducer modules and connect in the other end to the Transmitter Unit (TXU) or Receiver Unit (RXU) with connectors.		
R12	Transducer cable	From Receiver Unit to transducer	
	The transducer cables are moulded to the transducer modules and connect in the other end to the Transmitter Unit (TXU) or Receiver Unit (RXU) with connectors.		
R13	Transducer cable	From Receiver Unit to transducer	
	The transducer cables are moulded to the transducer modules and connect in the other end to the Transmitter Unit (TXU) or Receiver Unit (RXU) with connectors.		
R14	Transducer cable	From Receiver Unit to transducer	
	The transducer cables are moulded to the transducer modules and connect in the other end to the Transmitter Unit (TXU) or Receiver Unit (RXU) with connectors.		
R15	Transducer cable	From Receiver Unit to transducer	
	The transducer cables are moulded to the transducer modules and connect in the other end to the Transmitter Unit (TXU) or Receiver Unit (RXU) with connectors.		

Cable	Type	From/To	Minimum requirements
R16	Transducer cable	From Receiver Unit to transducer	
	The transducer cables are moulded to the transducer modules and connect in the other end to the Transmitter Unit (TXU) or Receiver Unit (RXU) with connectors.		

Comments

Note

It is very important that high-quality Ethernet cables are used. You must use CAT-5E STP (Shielded Twisted Pair) quality or better. If you use cables with lower bandwidth capacity you will reduce the EM 304 performance.

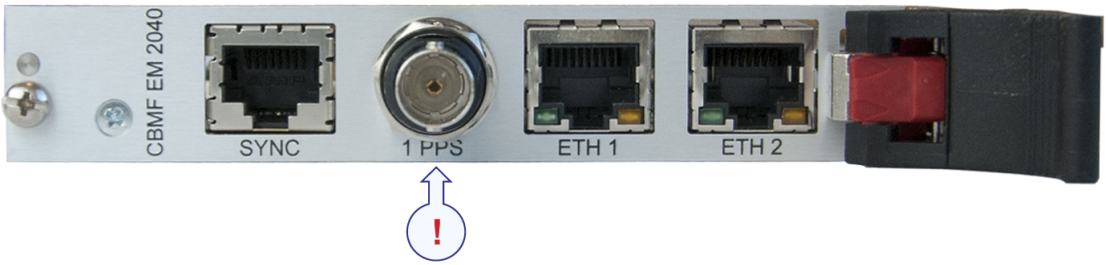
The EM 304 is often a part of a project delivery. For such deliveries, specific project cable drawings are established to show all the main cables, and how the various products are connected. In such project cable drawings, the EM 304 cables may be identified as **EM 304/Cx**.

Related topics

Cable plan, Processing Unit, page 91
Cable plan, Transmitter Unit, page 92
Cable plan, Receiver Unit, page 98
Cable plan, Hydrographic Work Station, page 106

Clock synchronization (1PPS)

The Processing Unit has a 1PPS (one pulse per second) input for clock synchronization.



It can be selected in the operator software SIS wether the falling edge or the rising edge of the 1PPS signal is used by the Processing Unit to synchronize the internal clock. The 1PPS signal must be minimum 1 microsecond long.

The 1PPS signal is connected to the coax connector on the CBMF board. This connection is marked **1PPS**. If the Processing Unit has two CBMF boards the lower one must be used for **1PPS**.

The CBMF board is equipped with an optocoupler at this input. The input series resistor is tuned for a TTL signal (Low level<0.6 V, High level>3.2 V).

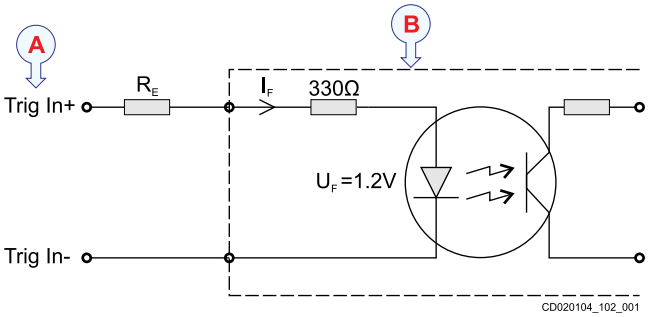
Optically isolated input signals

Note

The input signals must not be negative, that is no RS-232 signals can be used for these inputs.

A *Input from external system*

B *Processing Unit input circuitry*



The input current must be approximately 10 mA. Depending on your input signal additional resistance must be applied to achieve the required input current.

Two examples are shown to clarify.

- $$I_F = \frac{4.5V - 1.2V(U_F)}{330\Omega} \approx 10mA$$

  Using +4.5 V input signal the input current will be as required (~10 mA). No additional resistance required.

- $$R_{TOT} = \frac{12V - 1.2V(U_F)}{10mA} = \frac{10.8}{0.010} = 1080\Omega$$

  $$R_E = 1080 - 330 = 750\Omega$$

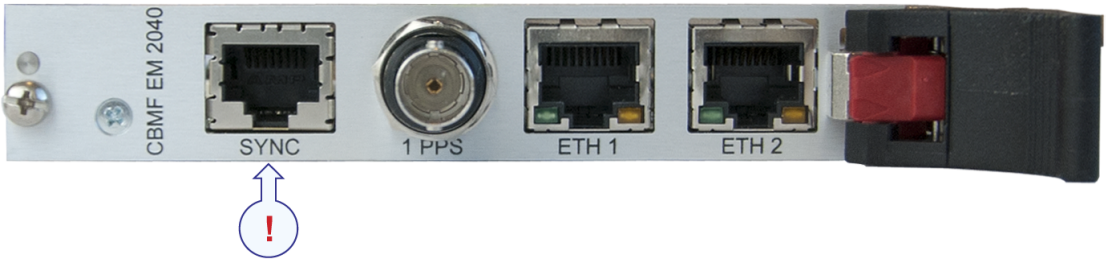
  An added resistor of 750 Ω and minimum 0.1 W must be used.

Related topics

Clock synchronisation (1PPS) using a coax cable, page 121

External synchronization

The Processing Unit is has a connection for interface to an external synchronization system.



This connection is used for interface to an external synchronization system (for example K-Sync) used when multiple echo sounders are employed on the same vessel. The external synchronization connector is located on the CBMF board in the processing unit. If the Processing Unit has two CBMF boards the lower one must be used for synchronization.

This is an optically isolated connection that requires ~10mA current. Input power and resistor value must be adjusted accordingly. The connector is RJ45 type.

RJ45 connector pin layout

1	TRIG OUT +
2	TRIG OUT -
3	+ 5 VDC
4	TRIG IN +
5	TRIG IN -
6	+ 5 VDC
7	RTS OUT +
8	RTS OUT -

(CD0806_701_001)

Pin 3 and 6 is used by Kongsberg Maritime only.

External synchronization signal characteristics

Signal	Description	Type	Active
RTS	Ready To Send - Output from EM 304 when it is ready for the next trigger pulse	Open collector output from isolation unit	High
TRIG OUT	Trigger out - Output to external synchronization system, active while the EM 304 is transmitting	Open collector output from isolation unit	Low
TRIG IN	Trigger in - Input to EM 304 enabling it to transmit	Optical isolated input	High

Note

To avoid ground loops and damage of the electronics caused by external connections, all connections are optically isolated.

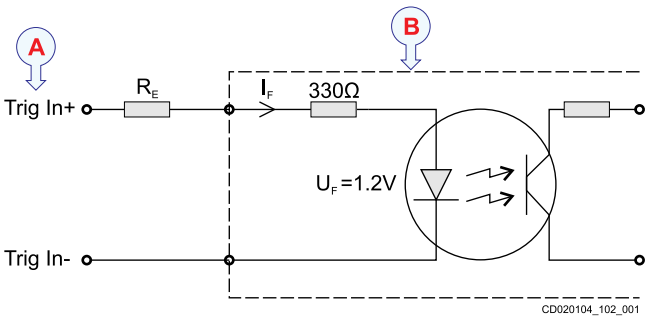
Optically isolated input signals

Note

The input signals must not be negative, that is no RS-232 signals can be used for these inputs.

A *Input from external system*

B *Processing Unit input circuitry*



The input current must be approximately 10 mA. Depending on your input signal additional resistance must be applied to achieve the required input current.

Two examples are shown to clarify.

- $$I_F = \frac{4.5V - 1.2V(U_F)}{330\Omega} \approx 10mA$$

  Using +4.5 V input signal the input current will be as required (~10 mA). No additional resistance required.

- $$R_{TOT} = \frac{12V - 1.2V(U_F)}{10mA} = \frac{10.8}{0.010} = 1080\Omega$$

  $$R_E = 1080 - 330 = 750\Omega$$

  An added resistor of 750 Ω and minimum 0.1 W must be used.

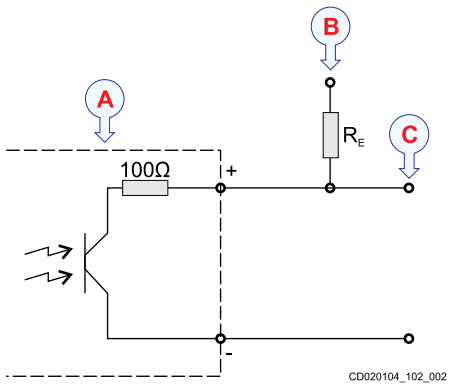
Optically isolated output signals

A *Processing Unit output circuitry*

B *External power*

C *Input to external system*

The collector current must be approximately 10 mA. A resistor must be used to tune the collector current depending on your voltage.



Power	Resistor value	Minimum effect
5 V	0.38 kΩ	0.1 W
12 V	1.08 kΩ	0.15 W
24 V	2.28 kΩ	0.25 W

Related topics

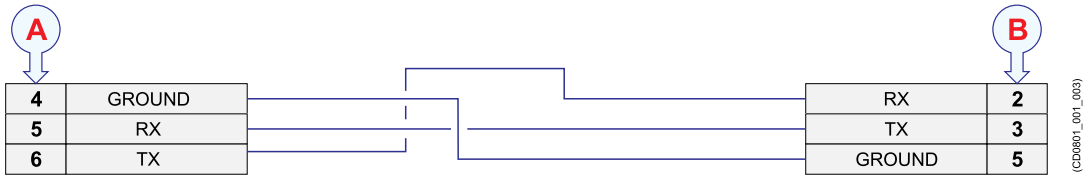
External synchronisation, page 122

Cable drawings and specifications

Topics

RS-232 serial line using three wires and RJ45 connector

An RS-232 serial line connection using three (3) wires is a common way to connect the EM 304 to external devices.



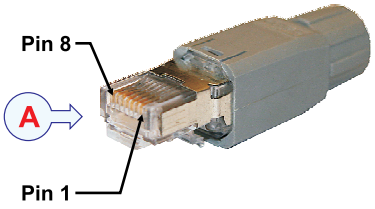
A *Local connection*

RJ45 connector

B *Connection on remote device*

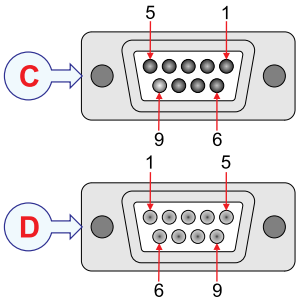
C *Female 9-pin D-Subminiature connector*

D *Male 9-pin D-Subminiature connector*



(CD0804_001_004)

Unless otherwise specified, this cable must be provided by the installation shipyard. Note that this cable does not support all the signals in the standard RS-232 specification.



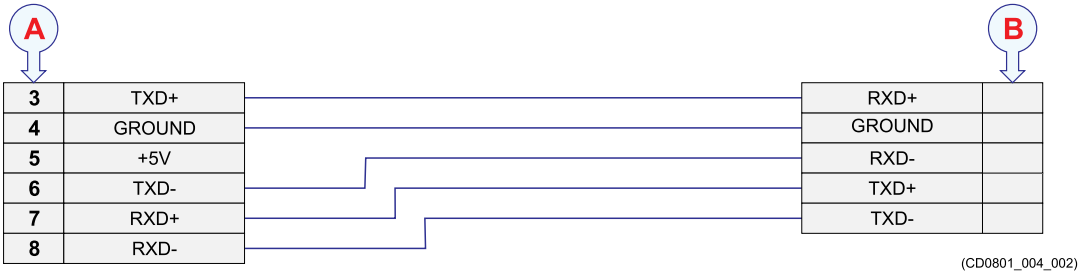
Minimum cable requirements

- **Conductors**: 2 x 2 x 0.2 mm²
- **Screen**: Overall braided
- **Voltage**: 30 V
- **Maximum outer diameter**: Defined by the plugs and/or the cable gland

We recommend using a shielded CAT-6A quality or better cable.

RS-422 serial line using five wires and RJ45 connector

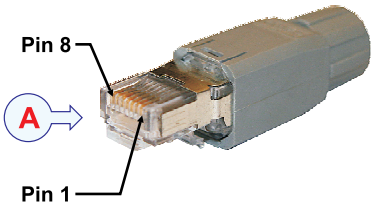
An RS-422 serial line connection is a common way to connect the EM 304 to external devices. An RS-422 serial line connection can transmit data at rates as high as 10 million bits per second, and may be sent on cables as long as 1500 meters.



A *Local connection*

RJ45 connector

B *Connection on remote device*



Unless otherwise specified, this cable must be provided by the installation shipyard.

Minimum cable requirements

- **Conductors**: 2 x 3 x 0.2 mm²
- **Screen**: Overall braided
- **Voltage**: 30 V
- **Maximum outer diameter**: Defined by the plugs and/or the cable gland

We recommend using a shielded CAT-6A quality or better cable.

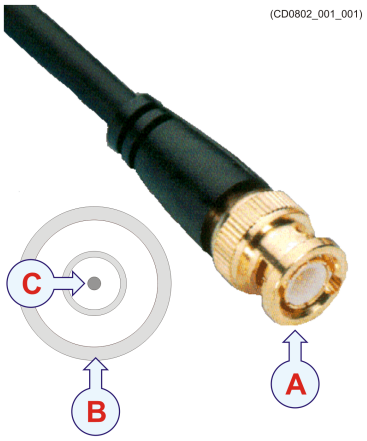
Clock synchronisation (1PPS) using a coax cable

The Processing Unit is equipped with a 1PPS signal input for clock synchronisation.

A *Male BNC connector*

B *Ground*

C *1PPS signal*



This cable must be provided by the installation shipyard.

The 1PPS (one pulse per second) signal is normally provided by a positioning system.

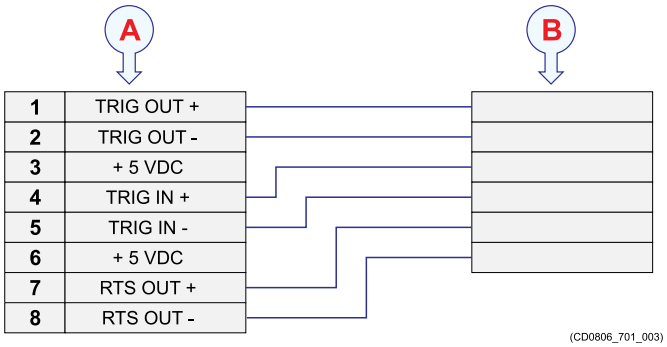
Related topics

Clock synchronization (1PPS), page 113

External synchronisation

The Processing Unit (PU) is equipped with a connection for interface to an external synchronisation system.

This connection is used for interface to an external synchronisation system (for example K-Sync) used when multiple echo sounders are employed on the same vessel. The external synchronisation connector is located on the CBMF board of the processing unit. The connector is RJ45 type.



A *Local connection The connector is RJ45 type.*

Note

Pin 3 and 6 is used by Kongsberg Maritime only.

B *Connection on remote device*

Unless otherwise specified, this cable must be provided by the installation shipyard.

Minimum cable requirements

- **Conductors**: 2 x 3 x 0.2 mm²
- **Screen**: Overall braided
- **Voltage**: 30 V
- **Maximum outer diameter**: Defined by the plugs and/or the cable gland

We recommend using a shielded CAT-6A quality or better cable.

Related topics

External synchronization, page 115

Remote control

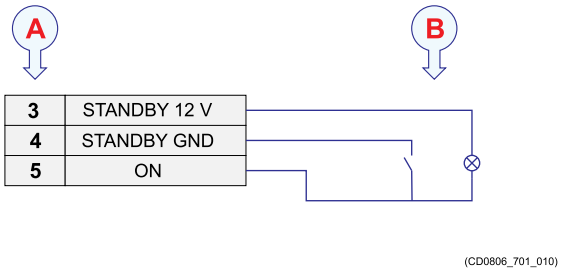
The Processing Unit can be switched on/off with a remote switch. This switch is connected to a 9–pin D-connector on the Processing Unit.

A *Local connection, male 9–pin D-connector*

B *Connection to remote lamp and on/off switch*

C *Female 9–pin D-connector*

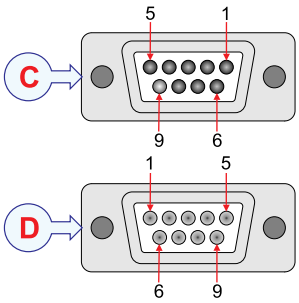
D *Male 9–pin D-connector*



Minimum cable requirements

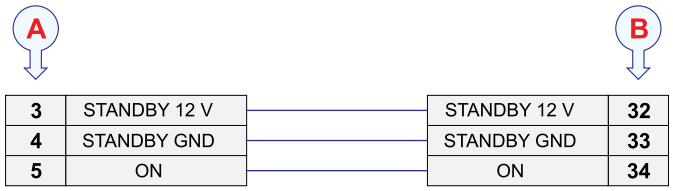
- **Conductors**: 3 x 0.5 mm²
- **Screen**: Overall braided
- **Voltage**: 60 V
- **Maximum outer diameter**: Defined by the plugs and/or the cable gland

This cable must be provided by the installation shipyard.



Remote Control using K-Rem

The Processing Unit can be switched on/off with a remote switch. This switch is connected to a 9–pin D-connector on the Processing Unit. A dedicated junction box with on/off switches and light indication has been designed for this purpose (K-Rem).

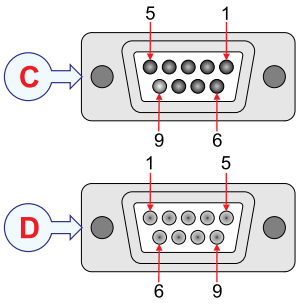


A *Local connection, male 9–pin D-connector*

B *Connection at the terminal strip in Remote Control Unit (K-Rem)*

C *Female 9–pin D-connector*

D *Male 9–pin D-connector*



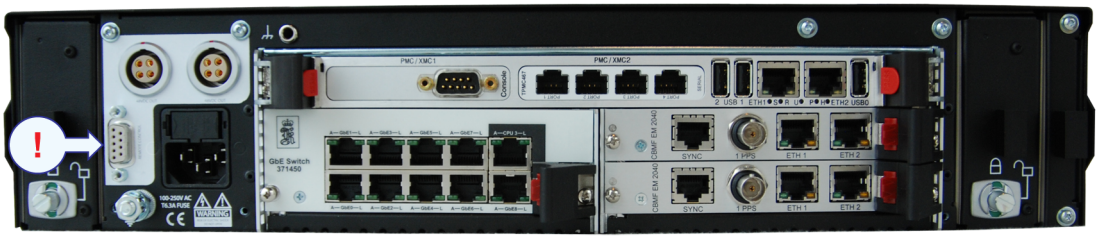
Minimum cable requirements

- **Conductors**: 3 x 0.5 mm²
- **Screen**: Overall braided
- **Voltage**: 60 V
- **Maximum outer diameter**: Defined by the plugs and/or the cable gland

This cable must be provided by the installation shipyard.

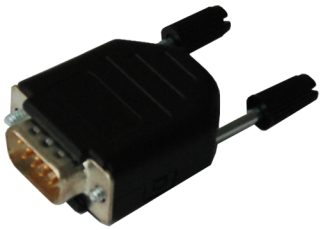
Dummy plug for not using remote control

The Processing Unit can be switched on/off with a remote switch. If remote control is not used, the enclosed remote control dummy plug has to be inserted in the **Remote Control** connector in the Processing Unit.



Note

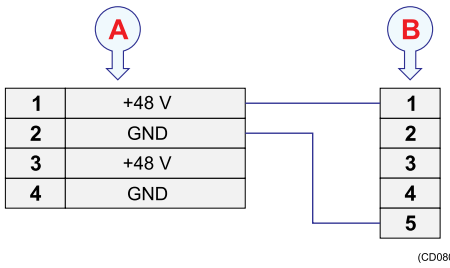
*If remote control is not used, the enclosed remote control dummy plug has to be inserted in the **Remote Control** connector in the Processing Unit. The Processing Unit will not work without this dummy plug.*



Remote control of Transmitter Unit

Cable for switching on/off the Transmitter Unit from the Processing Unit.

This cable between the Transmitter Unit and the Processing Unit is required if you want to switch on and off the Transmitter Unit from the Processing Unit.



A *Processing Unit end, male 4–pin Lemo connector.*

Lemo part number: FGG.3B.304.CLAD62Z .

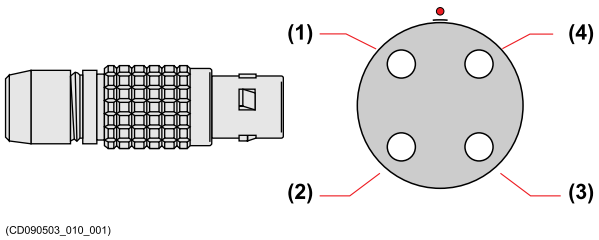
Kongsberg Maritime part number: 348015

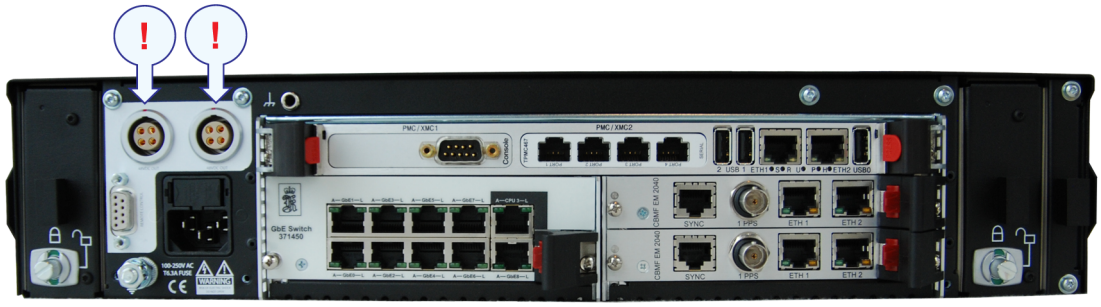
B *Transmitter Unit end, male 9–pin D-connector*

Processing Unit end

Pin layout male 4–pin Lemo connector. Solder side view.

Connects to **48 VDC OUT** on the rear of the Processing Unit.

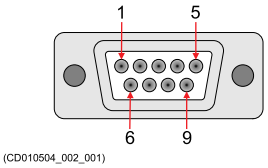




Transmitter Unit end

Pin layout male 9–pin D-connector.

Connects to **REMOTE ON/OFF IN** on the RIO-P board at the bottom of the Transmitter Unit.



Minimum cable requirements

- **Conductors**: 2 x 0.5 mm²
- **Screen**: Overall braided
- **Voltage**: 60 V
- **Maximum outer diameter**: Defined by the plugs

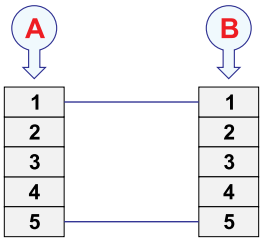
This cable must be provided by the installation shipyard.

Remote control of Receiver Unit

Cable for switching on/off the Receiver Unit from the Processing Unit.

This cable between the Transmitter Unit and the Receiver Unit is required if you want to switch on and off the Receiver Unit from the Processing Unit.

The fibre optic cable and the cable for remote control between the Transmitter Units and Receiver Units are delivered as a kit.The standard cable length is 10 metres.



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A *Transmitter Unit end, male 9–pin D-connector*

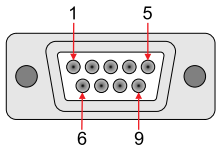
Connects to **REMOTE ON/OFF OUT** at the bottom of the Transmitter Unit.

B *Receiver Unit end, male 9–pin D-connector*

Connects to **REMOTE ON/OFF IN** at the Receiver Unit.

Pin layout male 9–pin D-connector.

Connects to **REMOTE ON/OFF OUT** on the RIO-P board at the bottom of the Transmitter Unit.



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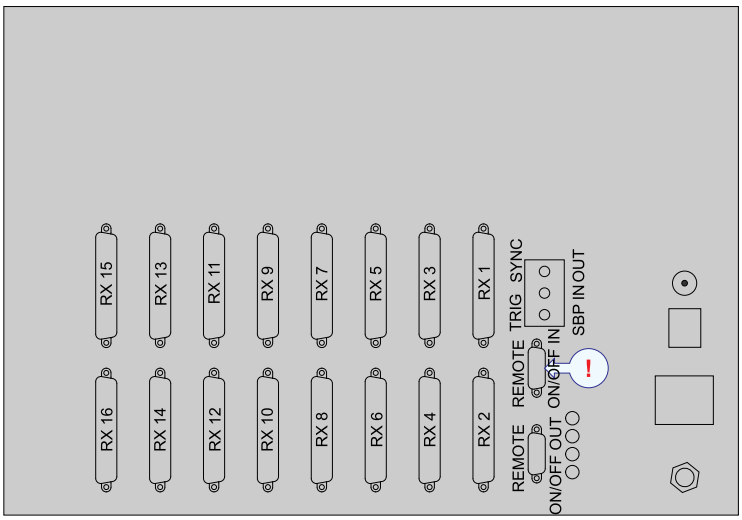
Connects to **REMOTE ON/OFF IN** at the bottom of the Receiver Unit.



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Minimum cable requirements

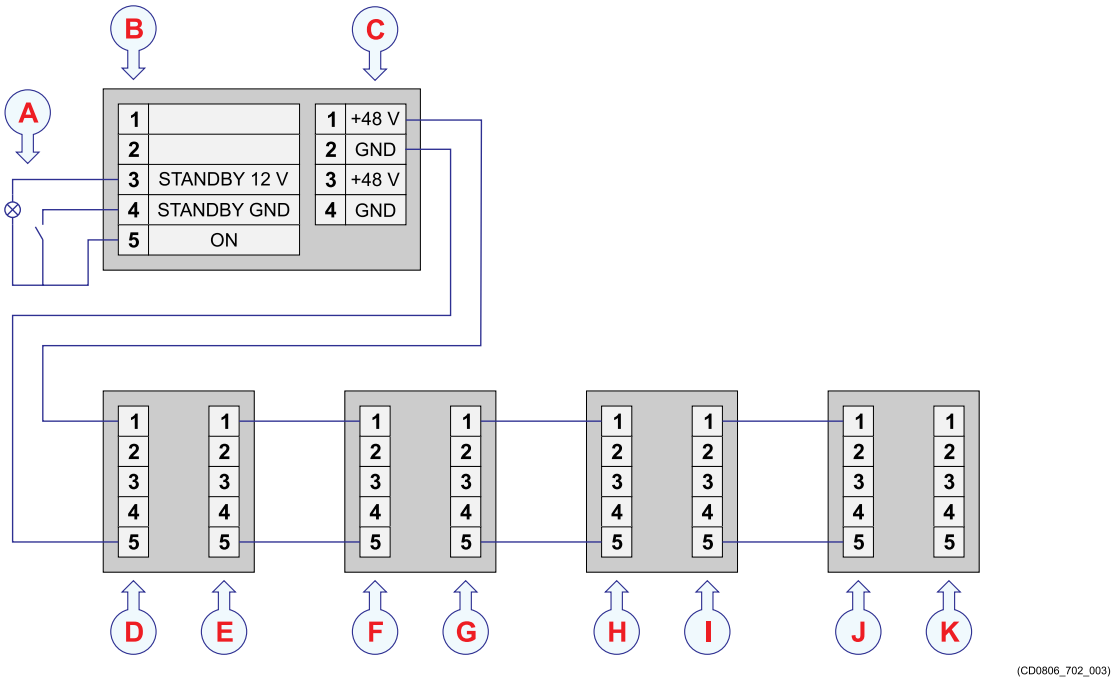
- **Conductors**: 2 x 0.5 mm²
- **Screen**: Overall braided
- **Voltage**: 60 V
- **Maximum outer diameter**: Defined by the plugs

Remote control overview

The EM 304 system can be switched on/off with a central control switch.

An EM 304 system has several hardware units, and to make it easier to switch on/off the system it is prepared for remote control. There are several methods to do this:

- Using a remote switch to turn on/off the entire system. The remote switch can either be the K-Rem Remote Control Unit ordered from Kongsberg Maritime or a switch and lamp provided by the installation shipyard.
- Using the Processing Unit to switch on/off the entire system. The on/off switch on the Processing Unit can be used to switch on/off the Transmitter and Receiver Units in addition to the Processing Unit itself. In this case the enclosed remote control dummy plug has to be inserted in the Remote Control connector in the Processing Unit.



A Remote switch and lamp (optional)

B Processing Unit, connector marked **REMOTE CONTROL**

C Processing Unit, connector marked **48VDC OUT**

D Transmitter Unit 1, connector marked **REMOTE ON/OFF IN**

E Transmitter Unit 1, connector marked **REMOTE ON/OFF OUT**

F Transmitter Unit 2, connector marked **REMOTE ON/OFF IN**

G Transmitter Unit 2, connector marked **REMOTE ON/OFF OUT**

H Receiver Unit 1, connector marked **REMOTE ON/OFF IN**

I Receiver Unit 1, connector marked **REMOTE ON/OFF OUT**

J Receiver Unit 2, connector marked **REMOTE ON/OFF IN**

K Receiver Unit 2, connector marked **REMOTE ON/OFF OUT**

Note

The number of Transmitter Units and Receiver Units depends upon the chosen system configuration.

The diagram shows the principle for a maximum possible solution, with two Transmitter Units and two Receiver Units.

Transmit Transducer cable

The transducer cables are moulded to the transducer modules and connect in the other end to the Transmitter Unit (TXU) with connectors.

The standard length of the transducer cables is 15 or 25 metres. Each TX module has three cables.

The length of the cables are fixed. The cables can not be extended or shortened during installation.

Extended cables can be delivered upon request. Cables are extended by splicing onto existing standard 25m length cables.

Cable specifications

- Cable length: 15 or 25 m
- Maximum outer diameter: 17 mm
- Minimum bending radius: 105 mm
- Connector: 50-pin D-Sub connector

Receive Transducer cable

The transducer cables are moulded to the transducer modules and connect in the other end to the Receiver Unit (RXU) with connectors.

The standard length of the transducer cables is 15 or 25 metres. Each RX module has one cable.

The length of the cables are fixed. The cables can not be extended or shortened during installation.

Extended cables can be delivered upon request. Cables are extended by splicing onto existing standard 25m length cables.

Cable specifications

- Cable length: 15 or 25 m
- Maximum outer diameter: 17 mm
- Minimum bending radius: 105 mm
- Connector: 50-pin D-Sub connector

Dimensional surveying and alignment

Topics

About dimensional surveying and alignment

The EM 304 Multibeam echo sounder is a precision instrument for scientific measurements.

In order to obtain precision data that are both detailed and correct, it is necessary to align the transducer, measure the location and offset of each sensor in relation to the vessel's coordinate system, and calibrate the complete EM 304 prior to use. Modest accuracy requirements apply when your EM 304 system is only used to investigate objects in the water column.

The quality assurance tasks required for EM 304 include:

- Aligning the transducer during installation
- Dimensional surveying
- Calibration

The alignment and dimensional surveying must be done during the EM 304 installation with the vessel in dry dock. The first calibration is normally done at sea during the Sea Acceptance Test. This calibration may not be complete, and must then be repeated later. The calibration is then repeated at regular interfaces, and prior to each survey.

Dimensional surveying

Determining the relative positions and orientations of the sensors and the transducer with high accuracy is important. This can only be met using a survey company/personnel with good experience in maritime dimensional surveying.

The dimensional surveying tasks required for EM 304 include:

1 Establishing the vessel coordinate system

2 Defining the location of the origin in the coordinate system

3 Establishing waterline with reference to the origin of the coordinate system

4 Setting out the required coordinate reference points throughout the vessel.

5 Defining the vessel's centre line, and if required — identify this line with physical markings

6 Measuring the necessary position and angles for all relevant sensors in the coordinate system.

7 Measuring the location and orientation of the EM 304 transducer in the coordinate system.

All results from the dimensional survey measurements must be summarized in a report by the consultants doing the work.

The information provided by the dimensional survey is entered into the EM 304 software as installation parameters.

More detailed information of Kongsberg Maritime's requirements are found in the chapter *Technical specifications.*

Note

Determining the relative positions and orientations of the sensors and the transducer with high accuracy is important. This requires professional surveying done by qualified and trained personnel using proven equipment and methods for maritime dimensional surveying. We recommend that you use third-party consultants with well proven experience with vessel dimensional control. Sufficient time and satisfactory work conditions must be given to the survey work. The installation engineers from Kongsberg Maritime are neither equipped nor trained to do dimensional surveying.

If the accuracy requirements are not met, and this is found to be the reason for a malfunctioning system, the vessel will most likely need to be dry docked in order to repeat the dimensional survey.

Related topics

Dimensional survey accuracy requirements, page 159

Alignment

To ensure a successful installation of the EM 304, all alignment and measurements must be done to the highest possible accuracy.

The alignment tasks required for EM 304 include:

- Measure and adjust the transducer frames to ensure that they have been mounted within the given tolerances.

Note

Aligning the transducer for correct installation within the given tolerances requires professional skills. The installation engineers from Kongsberg Maritime are neither equipped nor trained to perform the dimensional surveying, and they have no means of verifying the results until calibration at sea has been done.

Related topics

Alignment specifications, page 161

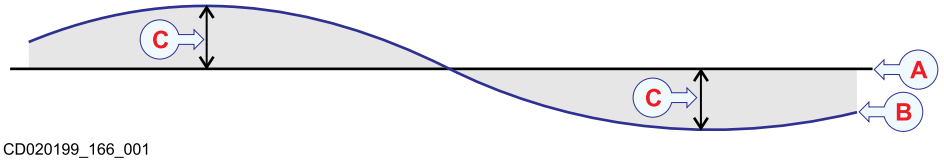
Transducer array flatness

To avoid unwanted acoustic effects caused by misalignment of the transducer elements the transducer array must be installed with a flat surface.

It may be most practical to perform these measurements on the transducer mounting frames before installation of the transducer modules. A final verification after module installation is then required.

The installed transducer array shall form a plane, the following requirements apply:

- No point on the frame may deviate from the ideal plane with more than the tolerance limit shown in *Technical specifications*. The limit will vary between the different multibeam echo sounders.



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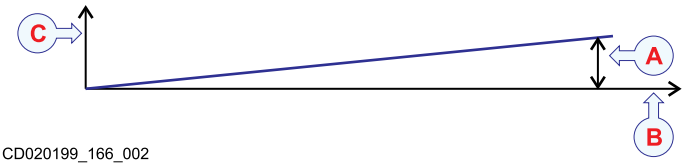
A *Ideal plane*

B *Installed plane*

C *Deviation*

- The maximum allowed gradient between two adjacent mounting points is 0.1 %.



CD020199_166_002

A *Maximum gradient 0.1 % = 1 mm/m*

B *Distance between mounting points*

C *Difference in relative height between mounting points*

The flatness must be controlled by land survey methods, to the highest possible accuracy. The survey of the flatness can be carried out independently from the survey of the vessel coordinate system and alignment of the sensors.

Related topics

Dimensional survey accuracy requirements, page 159
Alignment specifications, page 161

Checking the transducer array flatness and correcting deviations

An overall procedure specifying the main tasks is provided. The detailed knowledge about how to do the measurements is offered by the consultants doing the work.

Prerequisites

In some occasions a flatness survey of the frame mounting foundations can be recommended. This will give an indication of how much time and shims will be required.

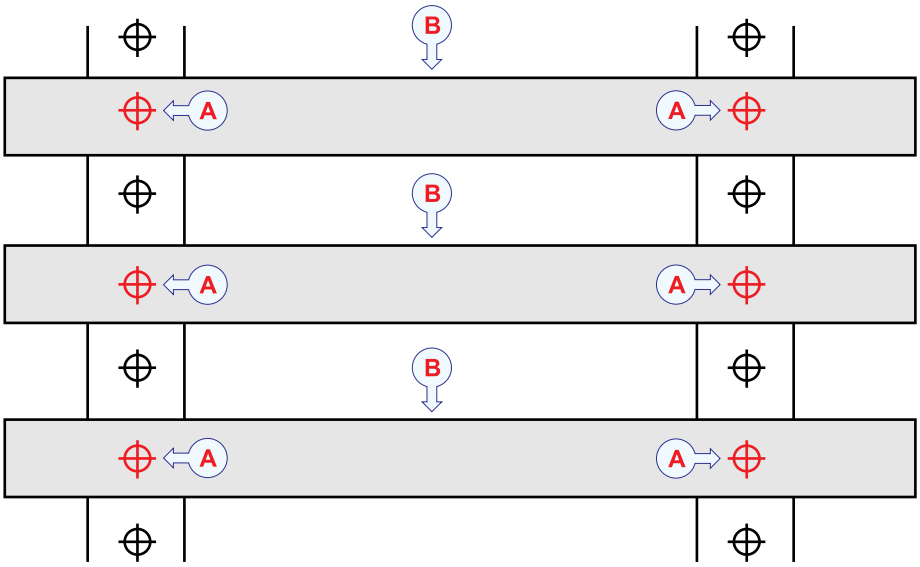
Context

The maximum allowed gradient between two adjacent mounting points is 0.1 %.

Procedure

1 Mount the mounting frame.

2 Measure the relative height of all mounting points on the closest available module foundation inside the frame.



CD020199_166_003

A *Measure points*

3 Determine the necessary adjustments to obey the given tolerances.

Note

There is one requirement applicable to the gradient between two adjacent mounting points and one that applies to the whole array.

4 Apply shims to level out the height differences.

5 Verify that the mounting frame is in plane within the given tolerances.

6 Repeat the procedure until the tolerances are met

Related topics

Dimensional survey accuracy requirements, page 159
Alignment specifications, page 161

Calibration

During the sea trials, calibration surveys are required as described in the EM 304 end user documentation.

In order to check and verify the performance of the EM 304 system, we strongly recommend that calibration surveys are done at regular intervals, or prior to any large survey.

The calibration process is described in detail in the *Seafloor Information System (SIS) Operator Manual.*

Note

Calibration must be taken seriously. The final verification of correct installation can only be done during calibration at sea. Installation and operational parameters that do not meet the accuracy requirements may lead to incorrect data. To achieve the best results, the calibration must be planned and done carefully.

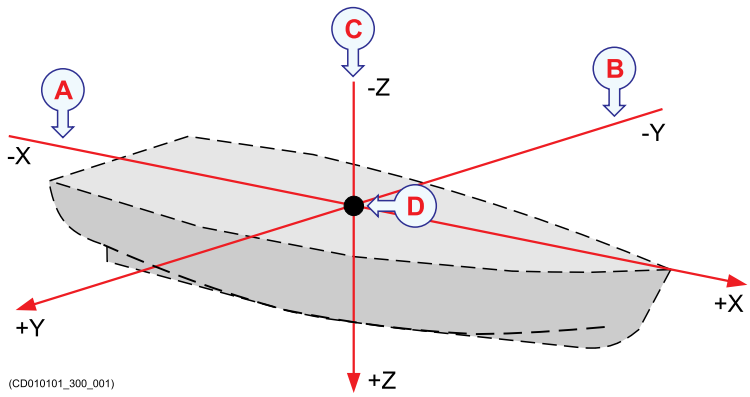
Vessel coordinate system

The vessel coordinate system is established to define the relative physical locations of systems and sensors.

When you have several different sensors and transducers on your vessel, and you wish each of them to provide accurate data, you need to know their relative physical positions. The antenna of a position sensor is typically mounted high above the superstructure, while a motion sensor is often located close to the vessel's centre of gravity. Both of these are physically positioned far away from the transducer on a depth sensor, which may be located closer to the bow. Very often, the information from one sensor depends on data from an other. It is then important that the relevant measurements are compensated for these relative distances.

Reference points must be established on the vessel at selected positions. These are needed during measurements of the sensor positions. Visual markings at these positions should be prepared and noted on the vessel drawings with **X**, **Y** and **Z** coordinates in the vessel coordinate system.

In order to establish a system to measure the relative distance between sensors, a virtual coordinate system is established. This coordinate system uses three vectors; X, Y and Z.



1 *The X-axis is the longitudinal direction of the vessel, and in parallel with the deck. A positive value for X means that a sensor or a reference point is located ahead of the reference point (origin).*

2 *The Y-axis is the transverse direction of the vessel, and in parallel with the deck. A positive value for Y means that a sensor or a reference point is located on the starboard side of the reference point (origin).*

3 *The Z-axis is vertical, and in parallel with the mast. A positive value for Z means that a sensor or a new reference point is located under the reference point (origin).*

4 *Reference point (Ship Origin)*

Coordinate system origin

The *origin* is the common reference point where all three axis in the vessel coordinate system meet. All physical locations of the vessel's sensors (radar and positioning system antennas, echo sounder and sonar transducers, motion reference units, etc.) are referenced to the origin. In most cases, the location of the vessel's "official" origin has been defined by the designer or shipyard. This origin is normally identified with a physical marking, and also shown on the vessel drawings.

Frequently used locations are:

- Aft immediately over the rudder (frame 0)
- Vessel's centre of gravity
- The physical location of the motion reference unit (MRU)

Technical specifications

Topics

Performance specifications

These performance specifications summarize the main functional and operational characteristics of the EM 304 system.

- Maximum ping rate: More than 5 Hz
- Number of swaths per ping: 2
-

Model	Transmit beamwidth	Receive beamwidth	Transmit waveforms	Number of beams per ping
0.5 x 0.5 degrees	0.5 degrees	0.5 degrees	CW + FM	1024 *
0.5 x 1 degree	0.5 degrees	1 degree	CW + FM	
1 x 1 degree	1 degree	1 degree	CW + FM	
1 x 2 degrees	1 degrees	2 degrees	CW + FM	1024
2 x 2 degrees	2 degrees	2 degrees	CW + FM	
2 x 4 degrees	2 degrees	4 degrees	CW + FM	512
4 x 4 degrees	4 degrees	4 degrees	CW + FM	

* 1024 beams, 1600 soundings in high density mode

- Standard beamwidths: 0.5 x 0.5, 0.5 x 1, 1 x 1, 1 x 2, 2 x 2, 2 x 4 or 4 x 4 degrees
- Beam spacing: Equidistant, Equiangle, High density (only with 1 degrees RX array)
- Coverage sector: Up to 150 degrees
- Transmit beam steering: Stabilized for roll, pitch and yaw
- Receive beam steering: Stabilized for roll
- Depth range from transducers: 10 to more than 8000 metres
- Nominal pulse length: 0.7 ms CW to 200 ms FM
- Maximum range sampling rate: 3.9 kHz (19cm) at data output
- Source level:
  - 1 degree TX: Up to 237 dB re 1 µPa ref 1 m
  - 0.5 degrees TX: Up to 243 dB re 1 µPa ref 1 m

Dual swath restrictions

FM mode is used to extend the maximum range capability.

In the deepest modes (from Very Deep mode) long FM pulses are prioritized. Dual swath is not available in these modes.

Reduced power output (Mammal protection)

Maximum intensity is encountered in a thin wedge extending below the ship with an angular coverage of about 140°. The intensity level may be lowered by 10 or 20 dB by the operator. The EM 304 may be set in a mode to begin pinging with a flexible soft-start as a possible means of inducing marine mammals to leave the area of high intensity sound.

Interface specifications

Topics

Datagram formats

Different EM multibeams will use and log data on different formats.

The KMall format is the successor of the all format, and uses the file extension kmall. Water column data can be logged in a separate file with extension kmwcd. The format is a generic format with high resolution data and the structure of the datagram is designed to make updates easier.

EM multibeams using KMall will be controlled and configured using the K-Controller and can acquire and log data using SIS 5 or other third party acquisition software.

Older generation EM multibeams will not have support for the new datagram format or use the K-Controller and SIS 5. This includes:

- EM 120/122
- EM 300/302
- EM 3000/3002
- EM 710

Newer generation multibeams will get support for both all and KMall format and will have full compatibility with SIS 4, K-Controller and SIS5. This includes:

- EM 2040 Series multibeams
- EM 712

Next generation multibeams will only have support for KMall format, and as such will require K-Controller and SIS5. This includes:

- EM 124
- EM 304
- Any future EM multibeams

The KM multibeam output datagram format is described in a Doxygen document, a documentation generator writing software reference documentation, and can be downloaded from the Kongsberg websites.

See the Support EM 304 page.

Processing Unit

The EM 304 system will interface with peripheral systems and sensors using standard and/or proprietary datagram formats. This is a description of available datagram formats for EM multibeams using KMall format.

Supported datagram formats for position information

The EM 304 supports the following datagram format for position information.

- **NMEA GGA**

  The NMEA GGA datagram transfers the time, position and fix related data from a global positioning system (GPS).

- **PTNL GGK**

  This third party datagram format is used to transfer latitude and longitude of vessel position, time of position fix and status from a global positioning system (GPS).

Supported datagram formats for external clock

The EM 304 supports the following datagram format from an external clock.

- **NMEA ZDA**

  The NMEA ZDA datagram contains the universal time code (UTC), day, month, year and local time zone.

Supported datagram formats for motion information

The EM 304 supports the following datagram format from a motion sensor.

- **Kongsberg EM Attitude 3000**

  The EM Attitude 3000 is a proprietary datagram format created by Kongsberg Maritime for use with digital motion sensors. It holds roll, pitch, heave and heading information. The datagram contains a 10-byte message.

Supported datagram formats for motion information including velocity

The EM 304 supports the following datagram formats from a motion sensor.

- **KM Binary**

  KM Binary is a general datagram format defined by Kongsberg Maritime. This format has very high resolution on timing and sensor parameters.

- **Seapath Binary 11**

  This is a proprietary format created by Kongsberg Seatex (http://www.km.kongsberg.com/seatex) for position, attitude and velocity data from the Seapath sensor.

  Seapath Binary 11 is an old format with low resolution that Kongsberg does not recommend.

- **Seapath Binary 23**

  This is a proprietary format created by Kongsberg Seatex (http://www.km.kongsberg.com/seatex) for position, attitude and velocity data from the Seapath sensor.

- **Seapath Binary 26**

  This is a proprietary format created by Kongsberg Seatex (http://www.km.kongsberg.com/seatex) for position, attitude and velocity data from the Seapath sensor.

- **POS-MV GRP 102/103**

  This is a third party proprietary datagram format created by Applanix (http://www.applanix.com) for position, attitude and sound speed data.

Supported datagram formats for sound speed probe

Sound speed probe can be interfaced directly to the Processing Unit and configured in K-Controller or interfaced to the Hydrograpic Work Station and configured in SIS 5.

The EM 304 supports the following datagram format from a sound speed probe.

- **AML**

  This is a third-party proprietary datagram format created by AML Oceanographic for use with their sound speed sensors. The file format is ASCII with a five-line header plus a variable number of data lines. For more information, see http://www.amloceanographic.com.

  The supported AML Smart Sensor message formats are

  – **AML NMEA**: NMEA like format
  – **AML SV**: Sound Velocity
  – **AML SVT**: Sound Velocity and Temperature
  – **AML SVP**: Sound Velocity and Pressure
  – **Micro SV**: Sound Velocity
  – **Micro SVT**: Sound Velocity and Temperature
  – **Micro SVP**: Sound Velocity and Pressure

- **Valeport**

  This is a third-party proprietary datagram format created by Valeport Ltd. for use with their sound velocity sensors.

  The supported Valeport message formats are

  – **MiniSVS SV**: Sound velocity

No longer supported

Some external sensors are no longer supported.

- Position sensor format Simrad 90
- Attitude sensor format Sperry MK-39
- Heading sensor format NMEA HDT, SKR 82

Special interfaces

- Trigger input/output for synchronisation
- 1 pulse per second (1PPS) clock synchronisation signal

Output datagram formats

The KMall format is described in it's own document.

See the Product support A to Z page.

External sensors requirements

The external sensors must fulfil these requirements to achieve the specified performance for the EM 304 system.

Sensor accuracy

The accuracy of the sensor data, as specified by the sensor manufacturer, must fulfill (preferably surpass) the following requirements

- **Roll, pitch and yaw rate**: 0.03 deg/s RMS
- **Velocity**: 0.03 m/s RMS
- **Latency**: Maximum 5 ms
- **Update rate**: 100 Hz
- **Roll**: 0.02 degrees RMS
- **Pitch**: 0.05 degrees RMS
- **Heading**:
  - 0.5 degrees TX array: 0.1 degrees RMS
  - 1 degree TX array: 0.2 degrees RMS
  - 2 degrees TX array: 0.4 degrees RMS
- **Heave (real-time output)**: 5 cm or 5 % whichever is highest

Doppler shifts

All new generation of multibeam echo sounders from Kongsberg Maritime have an extended range performance by use of a frequency modulated transmitter pulse (FM), also called chirp pulse. In the FM mode, the Doppler shift made by the movements of the survey vessel relative to the bottom, causes a range error. This error must be corrected.

The following motion sensors have specifications that fulfils Kongsberg Maritime requirements for Doppler shift corrections.

- Kongsberg Maritime – Seapath series
- Applanix – Pos MV
- IXSEA – Phins

Hydrographic Work Station

The EM 304 system will interface with peripheral systems and sensors using standard and/or proprietary datagram formats. This is a description of available datagram formats for EM multibeams using KMall format.

Hydrographic Work Station

- Sound speed at transducer
- Printer/plotter
- Interface for input of sound speed profile (Ethernet or serial line)
- Tide input (Ethernet or serial line)
- Single beam echo sounder depths (Ethernet)
- Output of all data normally logged to disk (to Ethernet)
- Output of depth below keel in NMEA DPT format (serial line)
- Output to autopilot in NMEA APB format (serial line)

Weight and outline dimensions

These weights and outline dimension characteristics summarize the physical properties of the EM 304 system.

Transmit transducer module

- **Outline dimensions**:
  - **Length**: 371.5 mm
  - **Width**: 350 mm (480 mm with frame)
  - **Height**: 160 mm (197 mm with frame)
- **Weight**:
  - **Weight (in air)**: 37 kg
  - **Weight (in water)**: 17 kg

Transmit transducer array

- **Weight**:
  - **0.5 degree**: 592 kg (16 TX modules)
  - **1 degree**: 296 kg (8 TX modules)
  - **2 degrees**: 148 kg (4 TX modules)
  - **4 degrees**: 74 kg (2 TX modules)

Transmit transducer frame

- **Outline dimensions**:
  - **Length**:
    - **0.5 degree**: 5960 mm
    - **1 degree**: 2992 mm
    - **2 degrees**: 1505 mm
    - **4 degrees**: 800 mm(Approximately)
  - **Weight**:
    - **0.5 degree**: 600 kg
    - **1 degree**: 185 kg
    - **2 degrees**: 95 kg
    - **4 degrees**: 60 kg (Approximately)

Receive transducer module

- **Outline dimensions**:
  - **Length**: 406 mm
  - **Width**: 300 mm (330 mm with frame)
  - **Height**: 160 mm (197 mm with frame)
- **Weight**:
  - **Weight (in air)**: 19 kg
  - **Weight (in water)**: 6.5 kg

Receive transducer array

- **Weight**:
  - **0.5 degrees**: 304 kg (16 RX modules)
  - **1 degree**: 152 kg (8 RX modules)
  - **2 degrees**: 76 kg (4 RX modules)
  - **4 degrees**: 38 kg (2 RX modules)

Receive transducer frame

- **Outline dimensions**:
  - **Length**:
    - **0.5 degrees**: 6542 mm
    - **1 degree**: 3271 mm
    - **2 degrees**: 1643 mm
    - **4 degrees:** 829 mm
- **Weight**:
  - **0.5 degrees**: 304 kg
  - **1 degree**: 152 kg
  - **2 degrees**: 75 kg
  - **4 degrees**: 38 kg

Transmit transducer ice protection window (ice breaker version)

- **Weight**: 52 kg per module
  - **0.5 degree**: 10 modules required
  - **1 degree**: 5 modules required
  - **2 degrees**: 3 modules required
  - **4 degrees**: 2 modules required

Receive transducer ice protection window (ice breaker version)

- **Weight**: 32 kg per module
  - **0.5 degrees**: 10
  - **1 degree**: 5 modules required
  - **2 degrees**: 3 modules required
  - **4 degrees**: 2 modules required

Processing Unit

- **Outline dimensions**:
  - **Length**: 424 mm
  - **Width**: 482.5 mm
  - **Height**: 88.6 mm
- **Weight**: 10.5 kg

Transmitter Unit

- **Outline dimensions**:
  - **Height**: 898 mm
  - **Width**: 606 mm
  - **Depth**: 612 mm
- **Weight**:
  - 1 degree:96 kg
  - 2 degrees: 80 kg
  - 4 degrees: 72 kg

Receiver Unit

- **Outline dimensions**:
  - **Height**: 285 mm
  - **Width**: 488 mm
  - **Depth**: 420 mm
- **Weight**: 21 kg

Hydrographic Work Station

Make and model: Hewlett Packard MP5810

The standard commercial computer has been configured to fit the operational requirements of the EM 304.

- **Outline dimensions**:
  - **Depth**: 379 mm
  - **Width**: 338 mm
  - **Height**: 100 mm
- **Weight**: 7 kg (Approximately)

Display

- **Manufacturer**: Isic
- **Manufacturer's website**: http://www.isic-systems.com
- **Model**: MD24 (DuraMON WS 24)
- **Outline dimensions**:
  - **Depth**: 68 mm
  - **Width**: 601 mm
  - **Height**: 408 mm
- **Weight**: 10 kg (Approximately)

Related topics

Drawing file, page 162

Power requirements

These power characteristics summarize the supply power requirements for the EM 304 system.

TX Unit

- **Voltage requirement**: 230 VAC, 47 to 63 Hz
- **Maximum voltage deviation**: 15 %
- **Maximum power consumption**:
  - **1 deg**: 1000 W
  - **2 deg.**: 550 W
  - **4 deg.**: 350 W

RX Unit

- **Voltage requirement**: 230 VAC, 47 to 63 Hz
- **Maximum voltage deviation**: 15 %
- **Maximum power consumption**: 50 W

Processing Unit

- **Make and model**: Kongsberg Maritime, EM PU
- **Voltage requirement**: 100 to 250 VAC, 47 to 63 Hz
- **Maximum power consumption**:
  - **With two CBMF boards** : 125 W

Hydrographic Work Station

- **Make and model**: Hewlett Packard MP5810

  The standard commercial computer has been configured to fit the operational requirements of the EM 304.
- **Voltage requirement**: 100/240 VAC, 50 to 60 Hz, autosensing
- **Maximum power consumption**: 240 W (Approximately)

Note

The use of an Uninterruptible Power Supply (UPS) is highly recommended for the Hydrographic Work Station.

Display

- **Manufacturer**: Isic
- **Manufacturer's website**: http://www.isic-systems.com
- **Model**: MD22/24/27 (DuraMON WS 22/24/27)
- **Input voltage**: Standard: 90–264 VAC, Optional: 18–36 VDC, 50–60 Hz
- **Power consumption**: Max. 40 W

Environmental requirements

These specifications summarize the temperature requirements and other environmental standards for the EM 304 system.

Transducers

- **Operational temperature**: -5 to 50 °C
- **Storage temperature**: -30 to 70 °C
- **Depth rating**: 60 m

Processing Unit

- **Operational temperature**: 0 to 50 °C
- **Storage temperature**: -30 to 70 °C
- **Relative humidity**: 5 to 95% relative non-condensing
- **Ingress protection (IP) rating**: IP22
- **Certificates**:
  - IEC 60945:2002 and CORRIGENDUM 1:2008
  - IACS E10:2006

TX Unit

- **Operational temperature**: 0 to 40 °C
- **Storage temperature**: –30 to 70 °C
- **Relative humidity**: 5 to 93% relative non-condensing
- **Ingress protection**: IP23
- **Vibration**:
  - **Frequency range**: 5 to 100 Hz
  - **Excitation level**: 0.7 g
- **Shock**:
  - **Peak acceleration**: 15 g
  - **Duration**: 11 ms
  - Half sine pulse
- **Reference standards**:
  - IEC 60945:2002 and CORRIGENDUM 1:2008
  - IACS E10:2006

RX Unit

- **Operational temperature**: 0 to 50 °C

- **Storage temperature**: –30 to 70 °C
- **Relative humidity**: 5 to 93% relative non-condensing
- **Ingress protection**: IP23
- **Vibration**:
  - **Frequency range**: 5 to 100 Hz
  - **Excitation level**: 0.7 g
- **Shock**:
  - **Peak acceleration**: 15 g
  - **Duration**: 11 ms
  - Half sine pulse
- **Reference standards**:
  - IEC 60945:2002 and CORRIGENDUM 1:2008
  - IACS E10:2006

Hydrographic Work Station

- **Make and model**: Hewlett Packard MP5810
- **Operational temperature**: 0 to +50 °C
- **Storage temperature**: -20 to 70 °C
- **Relative humidity**: 5 to 95% relative, non-condensing
- **Certificates**:
  - IEC 60945
  - IACS E10
- **Ingress protection (IP) rating: IP22**

  This IP rating is only applicable when the unit is mounted using the optional kit for 19-inch rack.

Display

- **Manufacturer**: Isic
- **Manufacturer's website**: http://www.isic-systems.com
- **Model**: MD22/24/27 (DuraMON WS 22/24/27)
- **Operational temperature**: -15 to 55 °C
- **Storage temperature**: -25 to 70 °C
- **Relative humidity**: 8 to 95% relative non-condensing

- **Ingress protection (IP) rating**
  - Front: IP65
  - Rear: IP20
- **Certificates**
  - IEC 60945
  - IACS E10

Dimensional survey accuracy requirements

Minimum accuracy requirements are defined for the dimensional survey. Higher accuracy will provide better survey results.

Note

The following accuracy requirements are minimum requirements. Higher accuracy will provide better results and should therefore always be aimed at.

Transducer

- **Position (x)**: ± 0.05 m
- **Position (y)**: ± 0.05 m
- **Position (z)**: ± 0.05 m
- **Pitch**:
  - TX transducer: ± 0.05 degrees
  - RX transducer: ± 0.20 degrees
- **Roll**:
  - TX transducer: ± 0.20 degrees
  - RX transducer: ± 0.02 degrees
- **Heading**: ± 0.1 degrees
- **Relative heading between RX and TX transducer (**: ± 0.1 degrees

Motion Reference Unit (MRU)

Note

These spesifications are minimum requirements. Consult the installation manual for each sensor for how it is to be aligned and how accurately the location needs to be measured.

- **Position (x)**: ± 0.05 m
- **Position (y)**: ± 0.05 m
- **Position (z)**: ± 0.05 m
- **Pitch**: ± 0.05 degrees
- **Roll**: ± 0.02 degrees
- **Heading**: ± 0.10 degrees

Heading sensor

Note

These spesifications are minimum requirements. Consult the installation manual for each sensor for how it is to be aligned and how accurately the location needs to be measured.

- **Heading**: ± 0.10 degrees

Global positioning system (GPS) (Antenna)

Note

These spesifications are minimum requirements. Consult the installation manual for each sensor for how it is to be aligned and how accurately the location needs to be measured.

- **Position (x)**: ± 0.05 m
- **Position (y)**: ± 0.05 m
- **Position (z)**: ± 0.02 m

Waterline reference mark

- **Position (z)**: ± 0.02 m

Related topics

Dimensional surveying, page 135

Alignment specifications

These alignment specifications summarize the alignment accuracy requirements of the EM 304 system.

Note

The following accuracy requirements are minimum requirements. Higher accuracy will provide better results and should therefore always be aimed at.

Transducer

- **Flatness**: 0.6 mm
  - **Maximum deviation from ideal plane**: 0.6 mm
  - **Maximum gradient**: 0.1 %

    The maximum allowed gradient between two adjacent mounting points on the frame is 0.1 % (1 mm/m).
  - **Mounting angle between TX and RX transducer**: 90 degrees ± 2 degrees

Related topics

Alignment, page 136
Transducer array flatness, page 137
Checking the transducer array flatness and correcting deviations, page 138

Drawing file

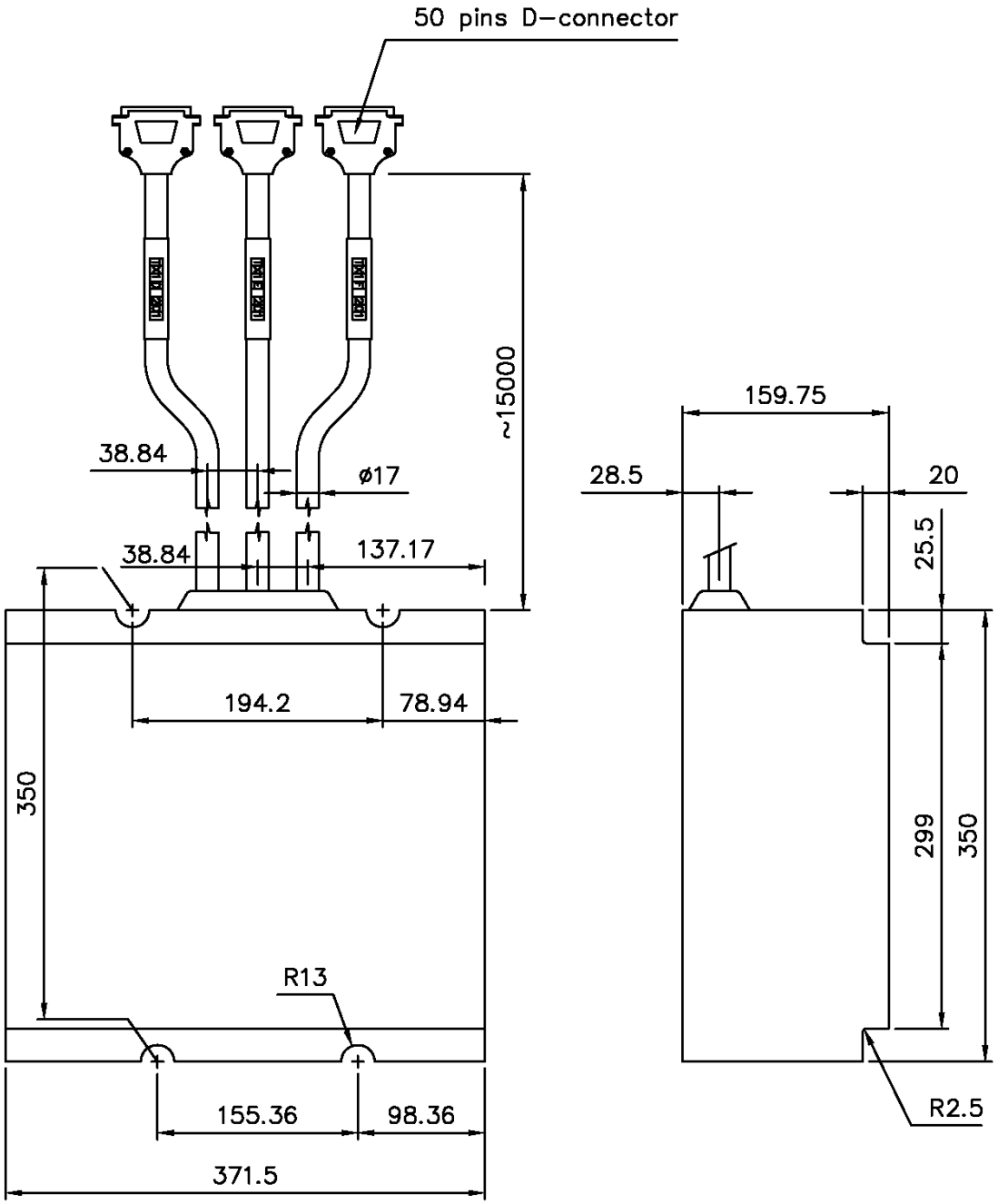
Topics

Drawing numbers referred in this document, page 162

Drawing numbers referred in this document

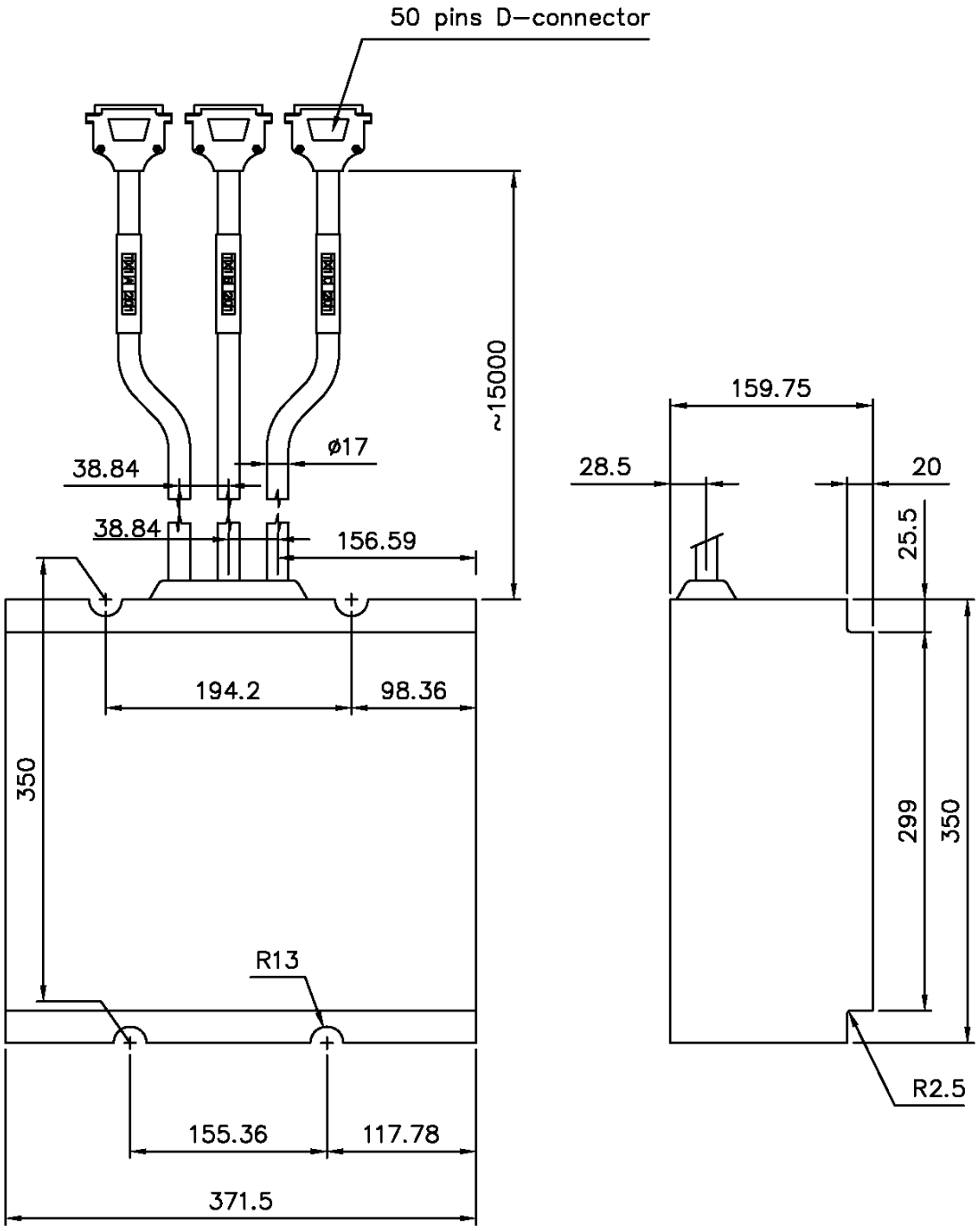
This chapter contains documentation referenced in this manual.

Drawing Number	Title
834-211473	TX1 module, outline dimensions
834-211474	TX2 module, outline dimensions
834-211475	RX module, outline dimensions
424606	TX Transducer frame, 0.5 deg.
499-134005	TX Transducer frame, 1 deg.
860-210440	TX Transducer frame, 2 deg.
499-133996	RX Transducer frame, 1 deg.
860-210592	RX Transducer frame, 2 deg.
860-210446	RX Transducer frame, 4 deg.
437505	Ice window TX transducer, outline dimensions
353047	Ice window RX transducer, outline dimensions
426226	TX Unit, Outline dimension
426264	RX Unit, Outline dimension
385422	Processing Unit, outline dimensions
378828	Hydrographic Work Station, outline dimensions
445723	HWS MPxxxx Rack mount kit
365290	MPxxxx with KM 1000 mounting kit
409067	Signal/Fiber Cable Kit
370275	Remote Control Unit (K-REM), outline dimensions



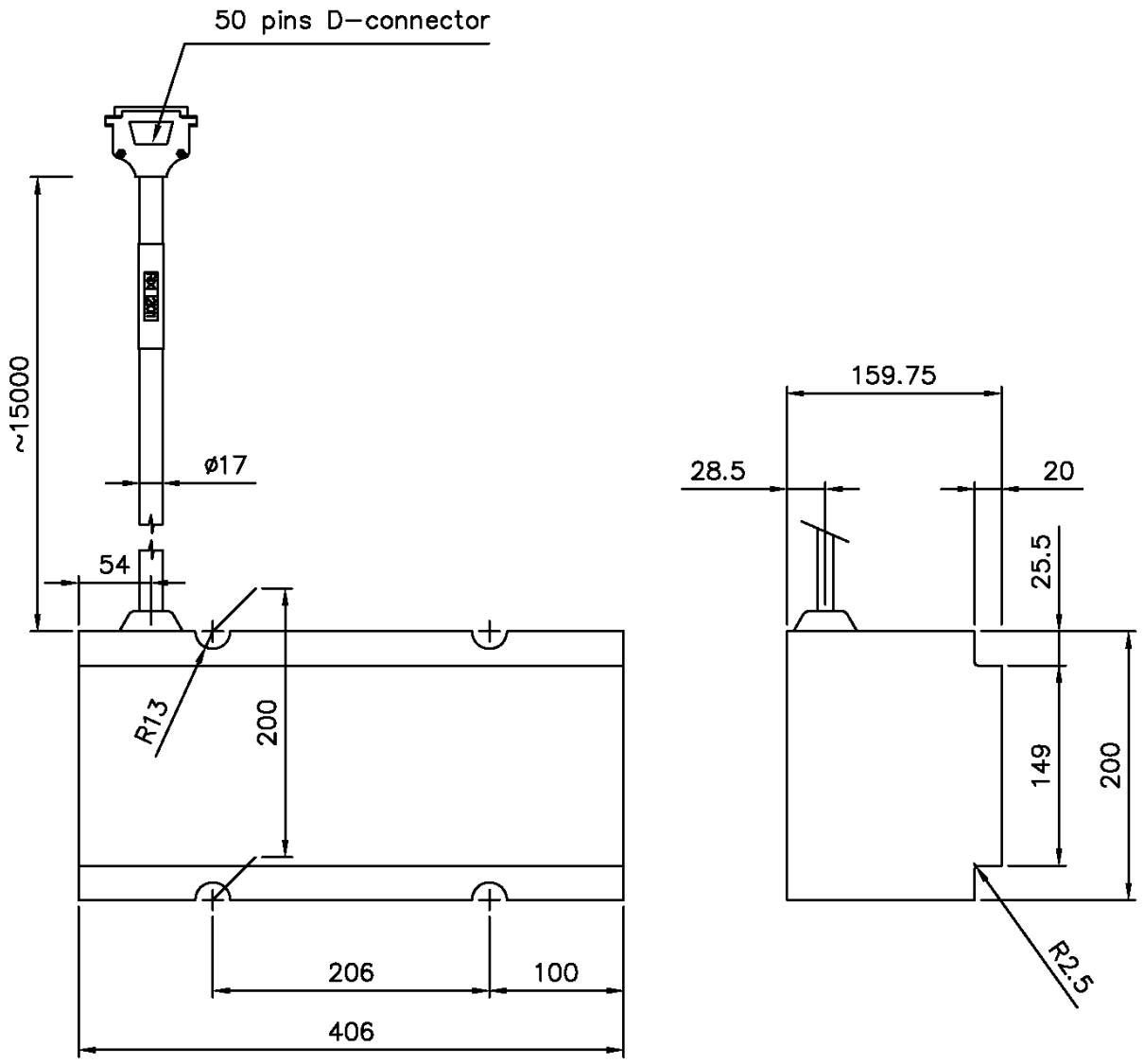
Weight incl. cables: ~37Kg

REV./SIGN.										
DATE										
PROJ. METHOD			UNLESS OTHERWISE STATED, TOLERANCE: DIM.: THREAD:				PARTS LIST: N.A.	KONGSBERG SIMRAD		
SCALE	1:5		OUTLINE DIMENSIONS				SHEET 1 OF 1	SH.SIZE: A4	REV.:	
DRAWN	98.04.28	EEn	TX MODULE 1				834-211473		A	
CHECKED	98.06.17	K.H.								
APPROVED	98.06.20	EEn	EM 300A				FILE NO.: CAD04			



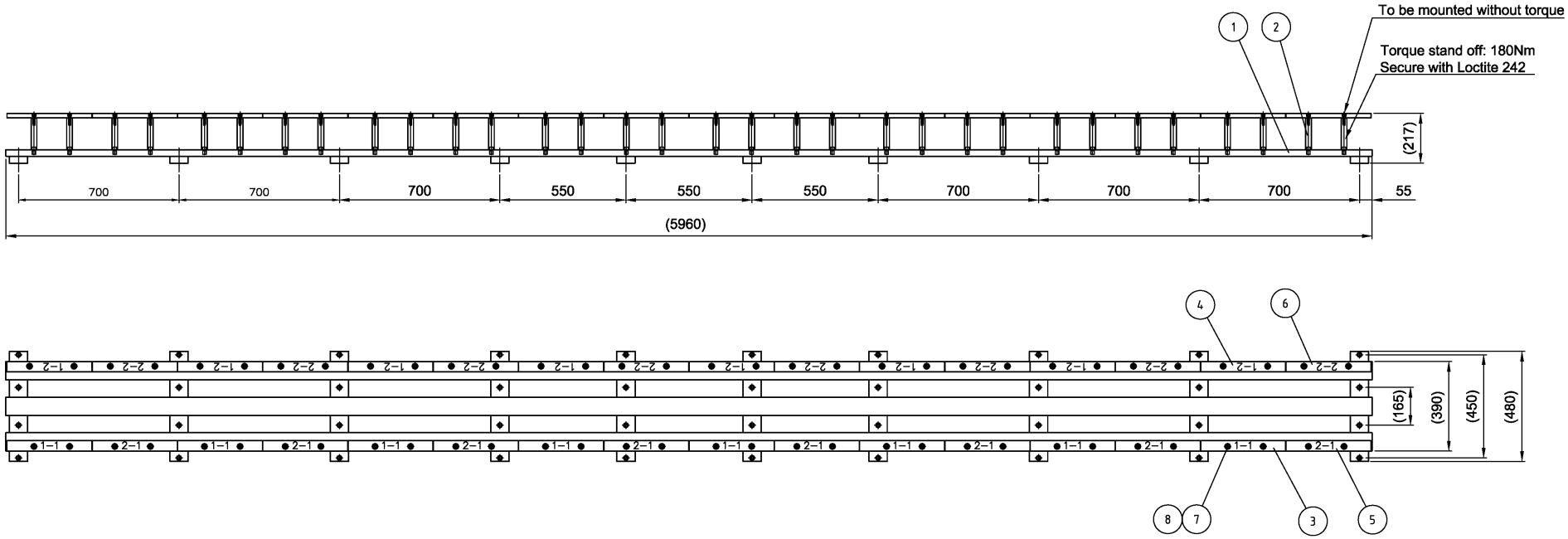
Weight incl. cables: ~37Kg

REV./SIGN.										
DATE										
PROJ. METHOD			UNLESS OTHERWISE STATED, TOLERANCE: DIM.: THREAD:				PARTS LIST: N.A.	KONGSBERG SIMRAD		
SCALE	1:5		OUTLINE DIMENSIONS				SHEET 1 OF 1	SH.SIZE: A4	REV.:	
DRAWN	98.04.28	EEn	TX MODULE 2				834-211474		A	
CHECKED	98.06.17	K.H.								
APPROVED	98.06.20	EEn	EM 300A				FILE NO.: CAD04			



Weight incl. cables: ~19Kg

REV./SIGN.										
DATE										
PROJ. METHOD			UNLESS OTHERWISE STATED, TOLERANCE: DIM.: THREAD:				PARTS LIST: N.A.	KONGSBERG SIMRAD		
SCALE	1:5		OUTLINE DIMENSIONS				SHEET 1 OF 1	SH.SIZE: A4	REV.:	
DRAWN	98.04.28	EEn	RX MODULE				834-211475		A	
CHECKED	98.06.17	K.H.								
APPROVED	98.06.20	EEn	EM 300A				FILE NO.: CAD04			



Note: Before permanent mounting the stand offs, pos. 2, verfy that all positions are correct by using dummy modules,
TX1 599–134019.
TX2 599–134020.

Note: Før distanseboltene, pos 2 monteres permanent, kontrolleres korrekte posisjoner ved hjelp av dummy modules,
TX1 599–134019.
TX2 599–134020.

Weight: ~600Kg
Classification code: 595

Rev.	Date	Description	Designed by	Checked by	Approved by
A					
A	2017.03.14	First issue	HF	LK	BH

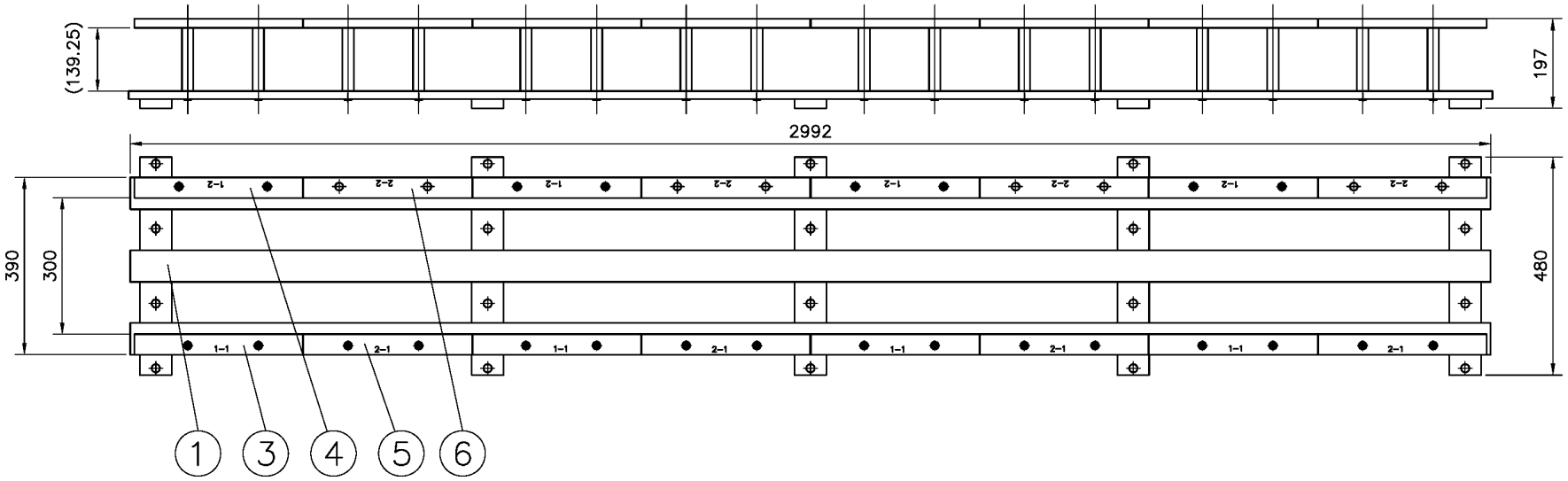
Material: -
Surface treatment: -
Tolerances unless otherwise stated: ISO2768-mK
Surface: Ra 6.3
Threads: 6g/6H
Broken edges: 0,1-0,5 x 45°

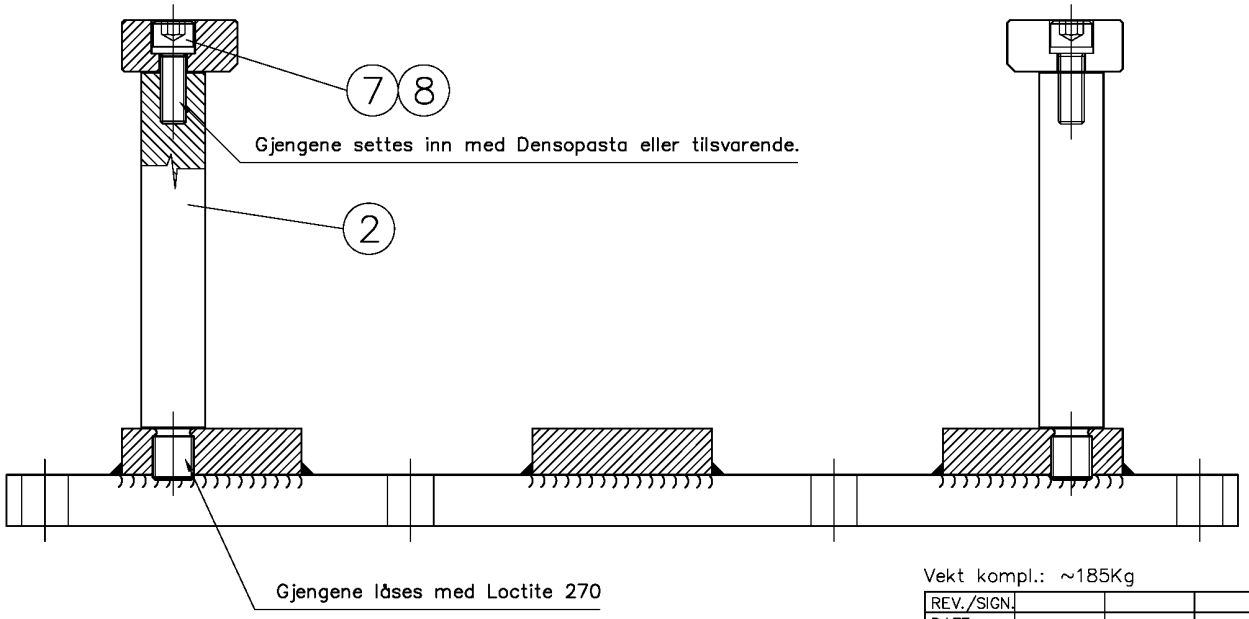
KONGSBERG
Kongsberg Maritime AS
Subsea Division
Horten

Title: Mounting Frame Assembly
TX1/TX2
0,5 Deg. TX Array

Sheet: 1/1
Size: A2
Scale: 1:12.5

Project / Product name: EM 304
Project number / Item ID:
Drawing type: 595
Document ID: 424606
Revision: A

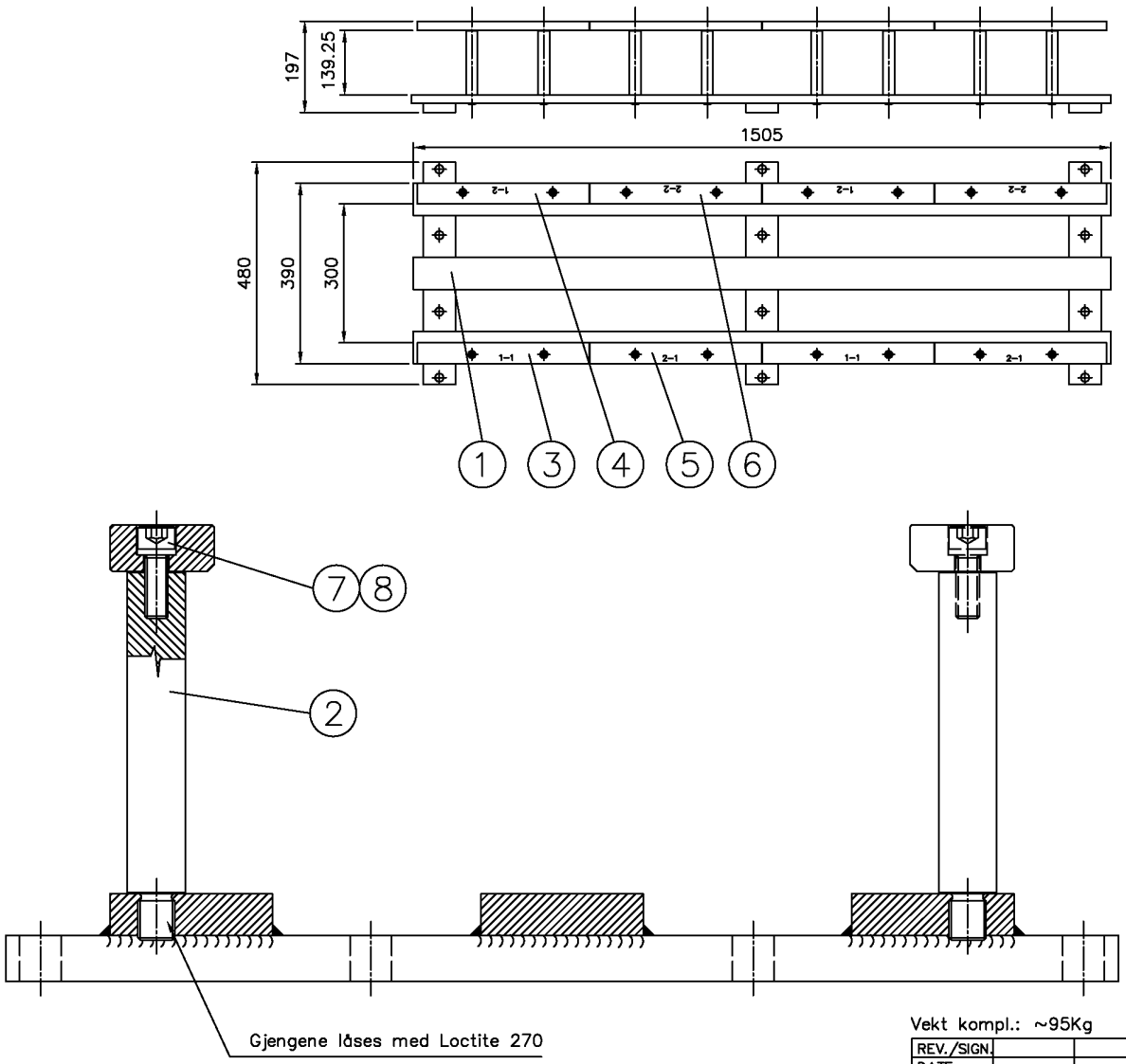




Vekt kompl.: ~185Kg

Note: Mounting Frame monteres slik tegning viser.
Kontrolleres med å prøvemontere TX moduler.
Klemkraft skal tilsvare 0.5–0.8mm differanse mellom stagbolter og moduler.

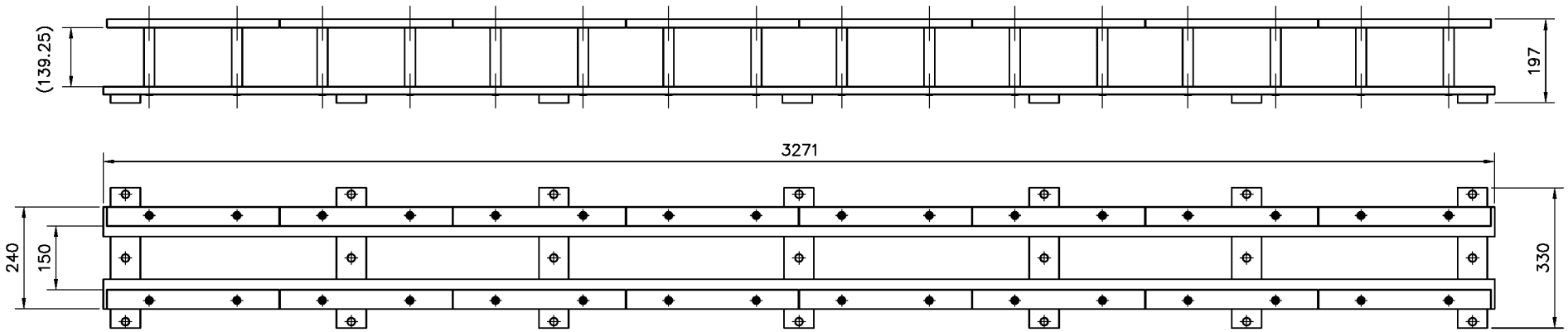
REV./SIGN.				
DATE				
PROJ. METHOD			UNLESS OTHERWISE STATED, TOLERANCE: DIM.: ISO 2768–mK THREAD: 6g/6H	SIMRAD
SCALE	1:10	1:2	MOUNTING FRAME ASSY	SHEET 1 OF 1 / SH.SIZE: A3 / REV.:
DRAWN	96.03.01	E.En.	TX MODULER	499–134005 / A
CHECKED	97.0411	A.Aa.		
APPROVED	97.04.14	E.Ha.	EM 300	FILE NO.: CAD03

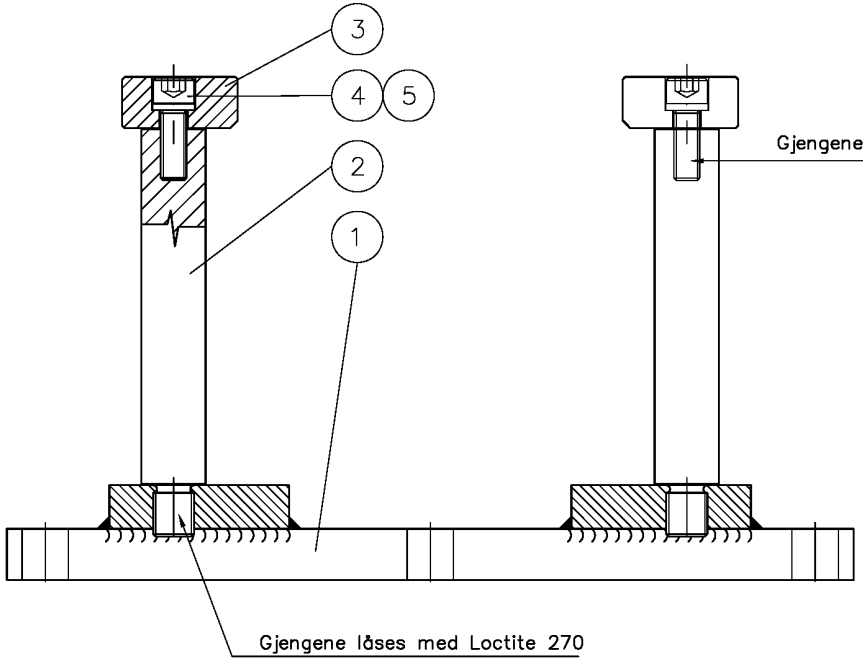


Vekt kompl.: ~95Kg

REV./SIGN.										
DATE										
PROJ. METHOD			UNLESS OTHERWISE STATED, TOLERANCE: DIM.: ISO 2768-mK THREAD: 6g/6H				SIMRAD			
SCALE	1:10	1:2	MOUNTING FRAME ASSY				SHEET 1 OF 1	SH.SIZE: A3	REV.:	
DRAWN	97.08.14	EEn	TX MODULES				210440		A	
CHECKED	97.09.18	K.H.	2 DEGREES SYSTEM							
APPROVED	97.09.23	E.Ha.	EM 300				FILE NO.: 669-59			

Note: Mounting Frame monteres slik tegning viser.
Kontrolleres med å prøvemontere TX moduler.
Klemkraft skal tilsvare 0.5–0.8mm differanse mellom stagbolter og moduler.

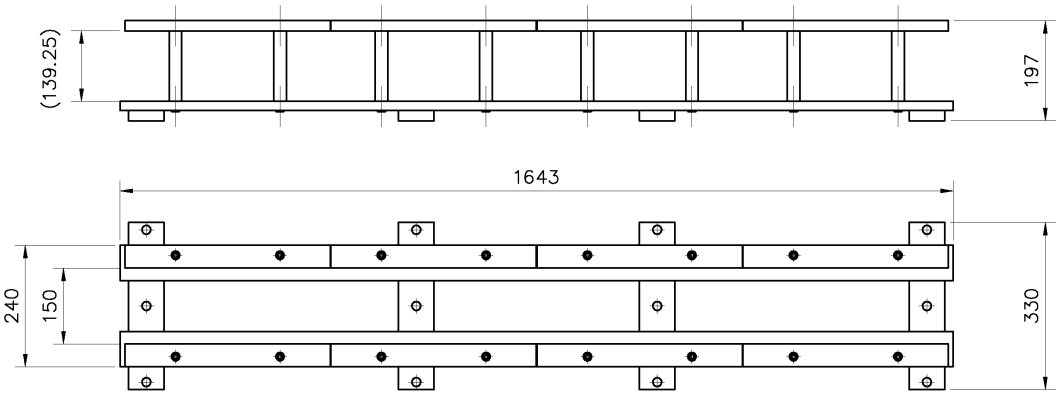


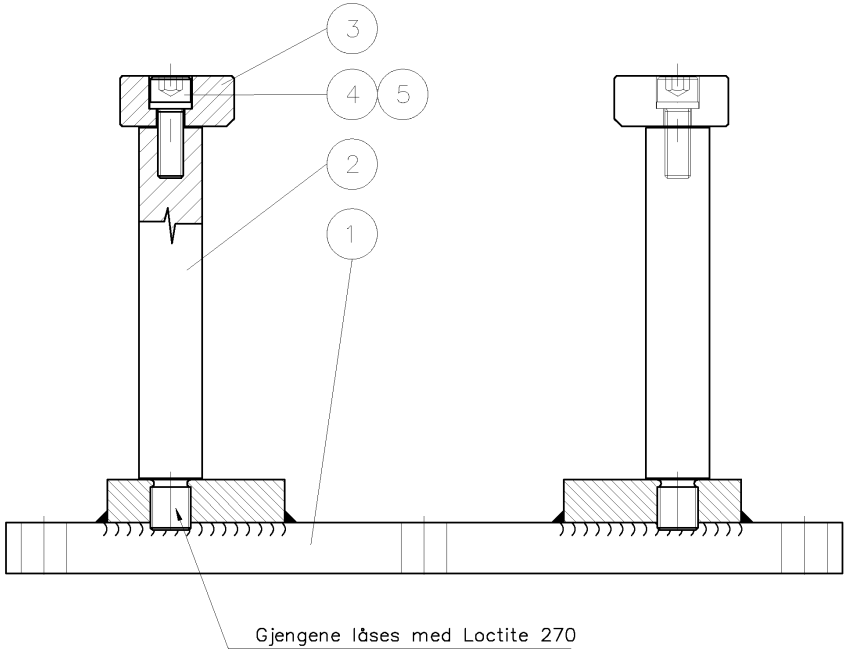


Note: Mounting Frame monteres slik tegning viser
Kontrolleres med å prøvemontere RX modul.
Klemkraft skal tilsvare differanse på 0.5–0.8mm mellom stagbolt og modul.

Vekt kompl.: ~152kG

REV./SIGN.	B EEn				
DATE	97.04.18				
PROJ. METHOD			UNLESS OTHERWISE STATED, TOLERANCE: DIM.: ISO 2768–mK THREAD: 6g/6H	SIMRAD	
SCALE	1:10	1:2	MOUNTING FRAME ASSY	SHEET 1 OF 1	SH.SIZE: A3 REV.:
DRAWN	96.02.27	E.En.	RX MODULER	499–133996	B
CHECKED	97.04.10	A.Aa.			
APPROVED	97.04.14	E.Ha.	EM 300	FILE NO.: CAD03	

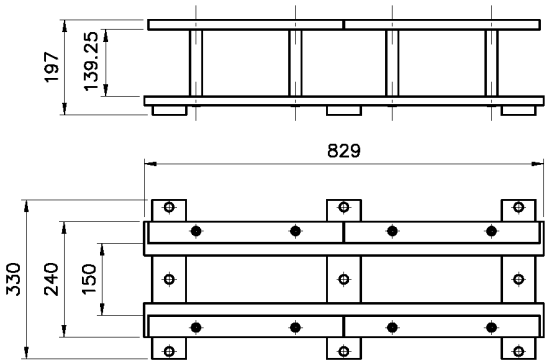


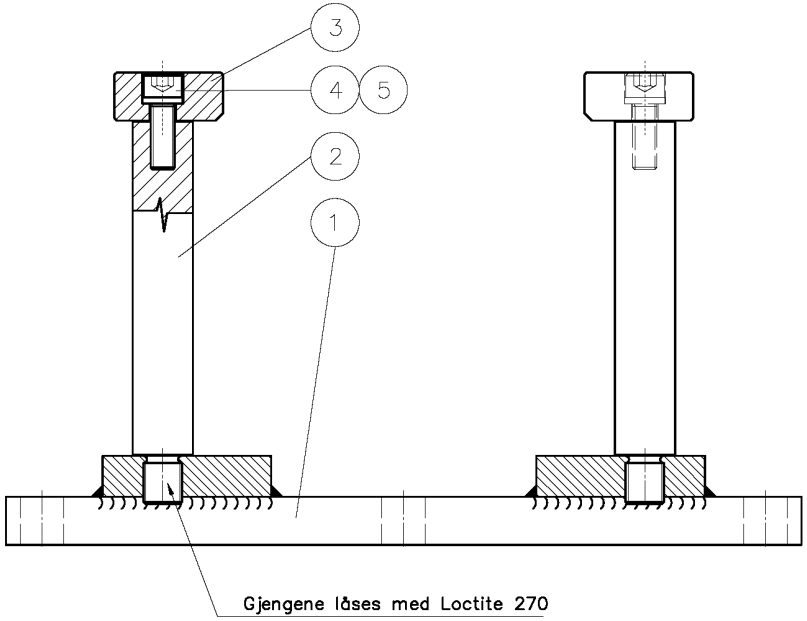


Note: Mounting Frame monteres slik tegning viser
Kontrolleres med å prøvemontere RX modul.
Klemkraft skal tilsvare differanse på 0.5–0.8mm mellom stagbolt og modul.

Vekt kompl.: ~75kG

REV./SIGN.				
DATE				
PROJ. METHOD			UNLESS OTHERWISE STATED, TOLERANCE: DIM.: ISO 2768–mK THREAD: 6g/6H	SIMRAD
SCALE	1:10	1:2	MOUNTING FRAME ASSY	SHEET 1 OF 1 / SH.SIZE: A3 / REV.:
DRAWN	96.02.27	E.En.	RX MODULES	210592 B
CHECKED	97.09.22	K.H.	2 DEGREES SYSTEM	
APPROVED	97.09.23	E.Ha.	EM 300	FILE NO.: 669–92

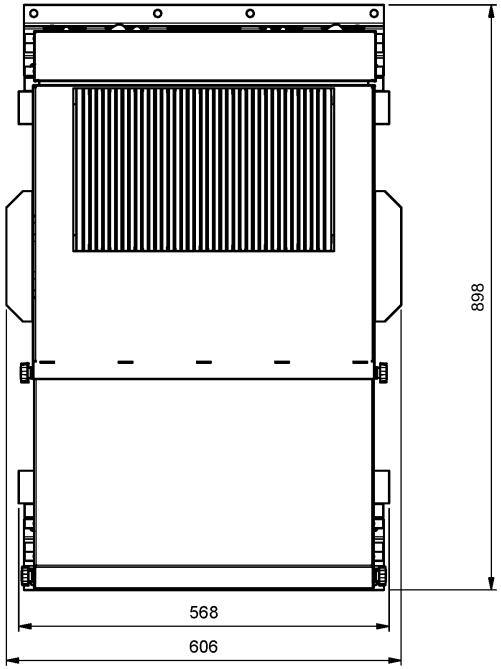


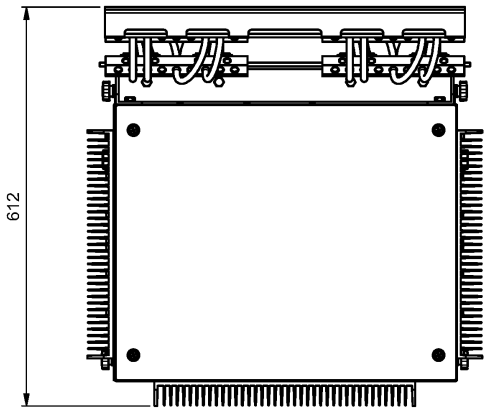


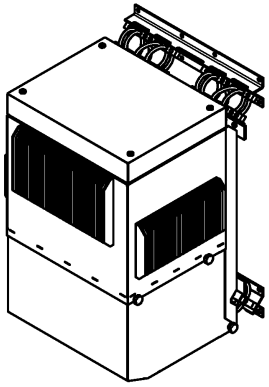
Note: Mounting Frame monteres slik tegning viser
Kontrolleres med å prøvemontere RX modul.
Klemkraft skal tilsvare differanse på 0.5–0.8mm mellom stagbolt og modul.

Vekt kompl.: ~38kG

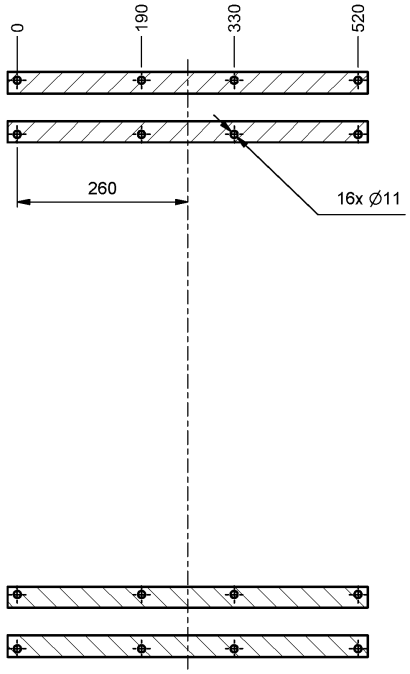
REV./SIGN.					
DATE					
PROJ. METHOD			UNLESS OTHERWISE STATED, TOLERANCE: DIM.: ISO 2768–mK THREAD: 6g/6H	SIMRAD	
SCALE	1:10	1:2	MOUNTING FRAME ASSY	SHEET 1 OF 1	SH.SIZE: A3 REV.:
DRAWN	97.08.14	EEn	RX MODULES	210446	A
CHECKED	97.09.22	K.H.	4 DEGREES SYSTEM		
APPROVED	97.09.23	E.Ha.	EM 300	FILE NO.: 669–61	

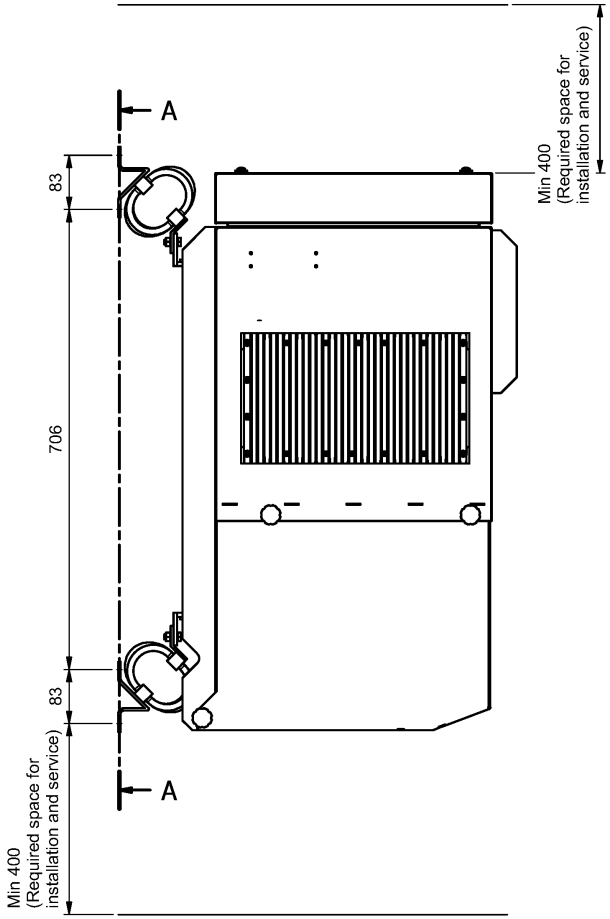






A-A (1:7.5)





Weight:
1 Degree version ~96kg
2 Degree version ~80kg
4 Degree version ~72kg

Rev.	Date	Description	Designed by	Checked by	Approved by
A	2018-06-29	First Issue	HF	eriksi	kn

Material: -
Surface treatment: -
Tolerances unless otherwise stated:ISO 2768-mK
Surface: Ra 3,2 µm
Threads: 6g/6H
Broken edges: 0,1 - 0,5 x 45°

KONGSBERG

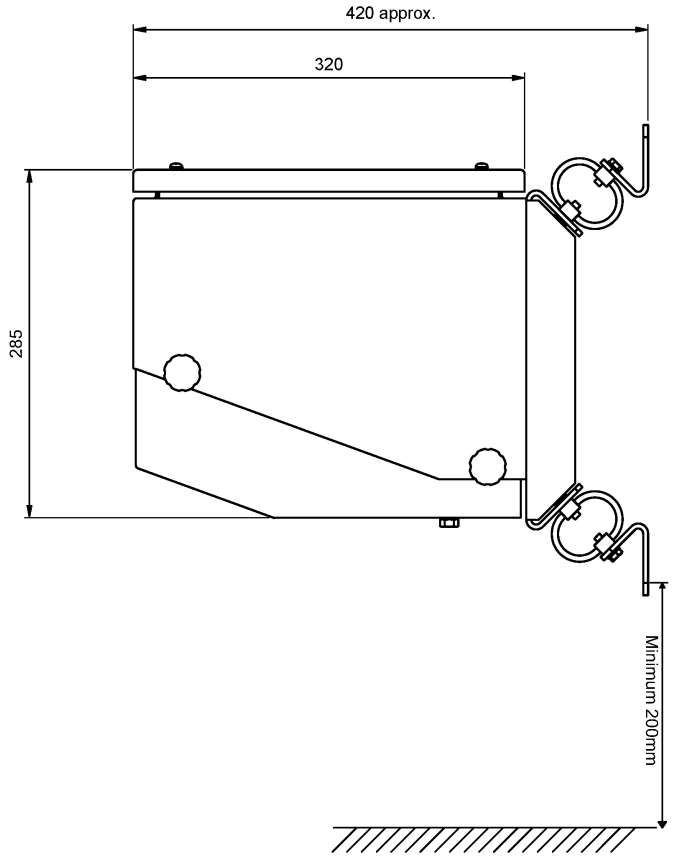
Kongsberg Maritime AS
Subsea Division
Horten

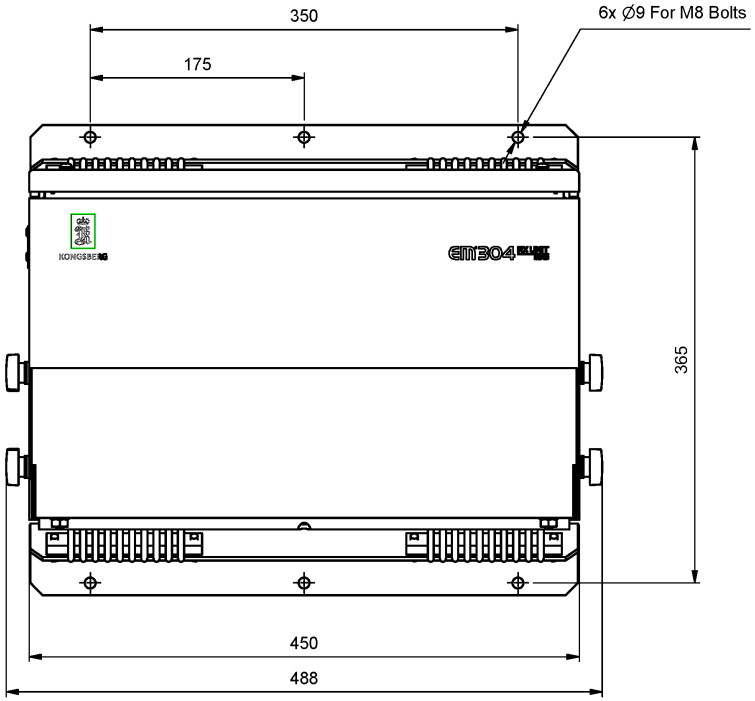
Title: OUTLINE DIMENSIONS
TX UNIT
EM304/124

Sheet: 1 of 1
Size: A3
Scale: 1:7.5

Project / Product name: Underwater Mapping
Project number / Item ID: 436581
Drawing type: Outline Drawing (100416)

Document ID: 426226
Revision: A





Weight complete unit approx.: 21 kg.

Rev.	Date	Description	Designed by	Checked by	Approved by
A	2018-01-15	First Issue	eriksi	hf	kn

Material:
Surface treatment:
Tolerances unless otherwise stated: ISO 2768-mK
Surface: Ra 3,2 µm
Threads: 6g/6H
Broken edges: 0,1 - 0,5 x 45°

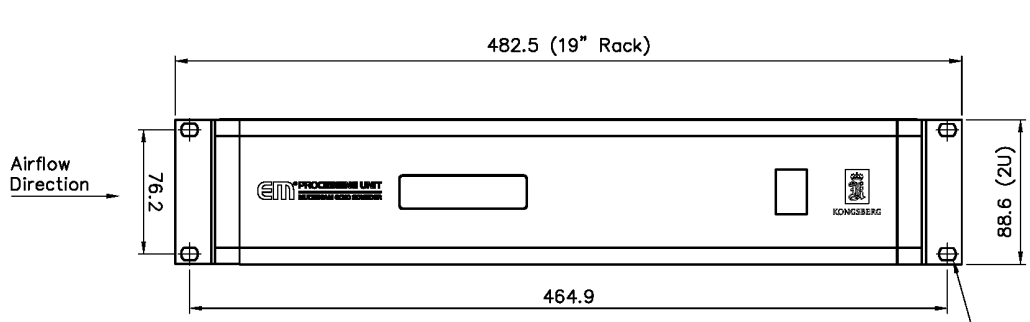
Kongsberg Maritime AS
Subsea Division
Horten

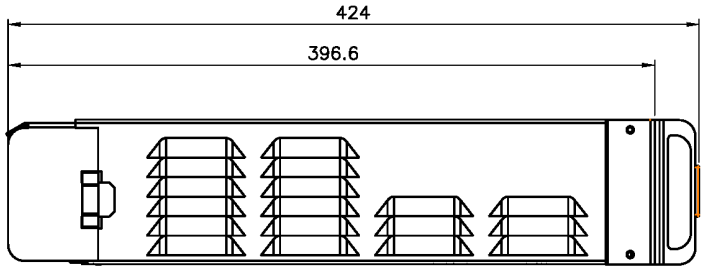
Title: Outline Drawing
RX Unit
EM 304

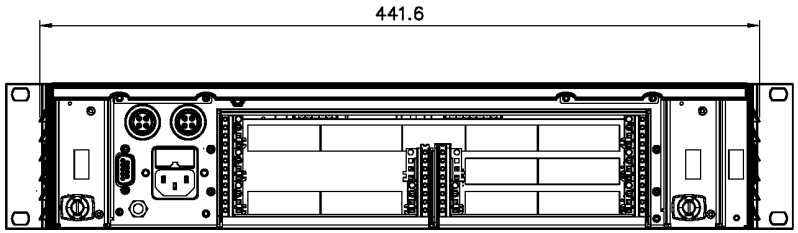
Sheet: 1 of 1
Size: A3
Scale: 1 : 4

Project / Product name: MPC
Project number / Item ID:
Drawing type: Outline Drawing (100416)

Document ID: 426264
Revision: A







Weight: 10,5kg

REV.	DATE	DESCRIPTION	Designed by	Checked by	Approved by
B	2017.06.09	Upd. holepattern acc. to 2U unit spec. Effective from Q3 2017	HF	BH	KJ
Pro01	2013.08.05	First Prototype Release	HF	–	–

Material: –
Surface Treatment: –

Unless Otherwise Stated, Tolerances:
DIM.: ISO 2768–mK Threads: 6g/6H Surface: Ra6.3

Class. Code: –

KONGSBERG

Kongsberg Maritime AS
Subsea Division
Horten - Norway

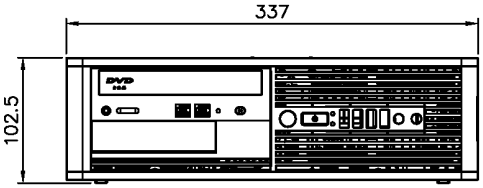
Title: Outline Dimensions Processing Unit –

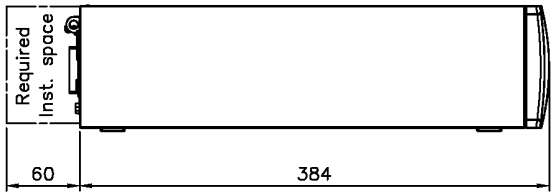
Sheet: 1/1
Size: A3
Scale: 1:3

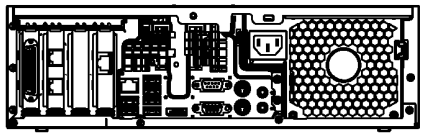
Project / Product name: EMx
Project number: –
Drawing type: –

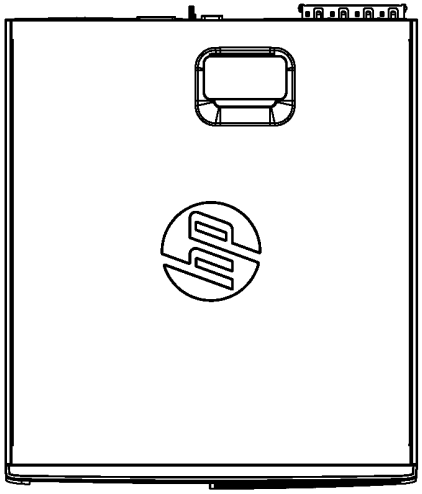
Document ID: 385422

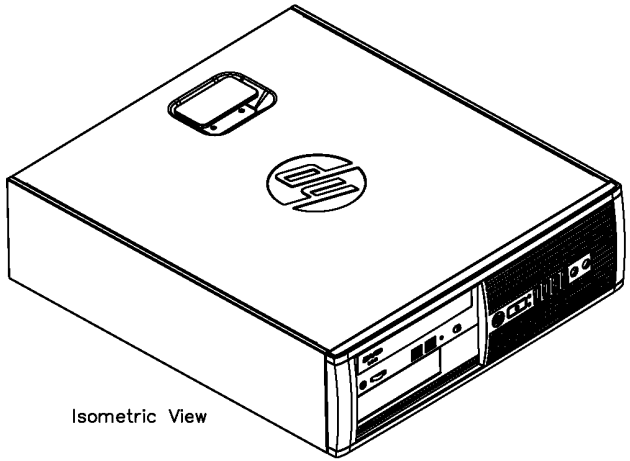
Revision/Version: B











Weight approx. 8Kg

Reference documentation:

Outline Desk Mounting:	366001
Outline Rack Unit:	371591
Rail Kit Rack Unit:	375288
Instruction Manual Rack Unit:	372140
Outline KM1000 Mounting Kit:	365290
Outline Mariner Mounting Kit:	327993

REV.	DATE	DESCRIPTION	Designed by	Checked by	Approved by
A	2012.12.19	First Issue	HF	LK	TP

Material: –
Surface Treatment: –

Unless Otherwise Stated, Tolerances:
DIM.: ISO 2768–mK Threads: 6g/6H Surface: Ra6.3

Class. Code: 100416

KONGSBERG

Kongsberg Maritime AS
Subsea Division
Horten - Norway

Title: Outline Dimensions
MP8200H
HWS

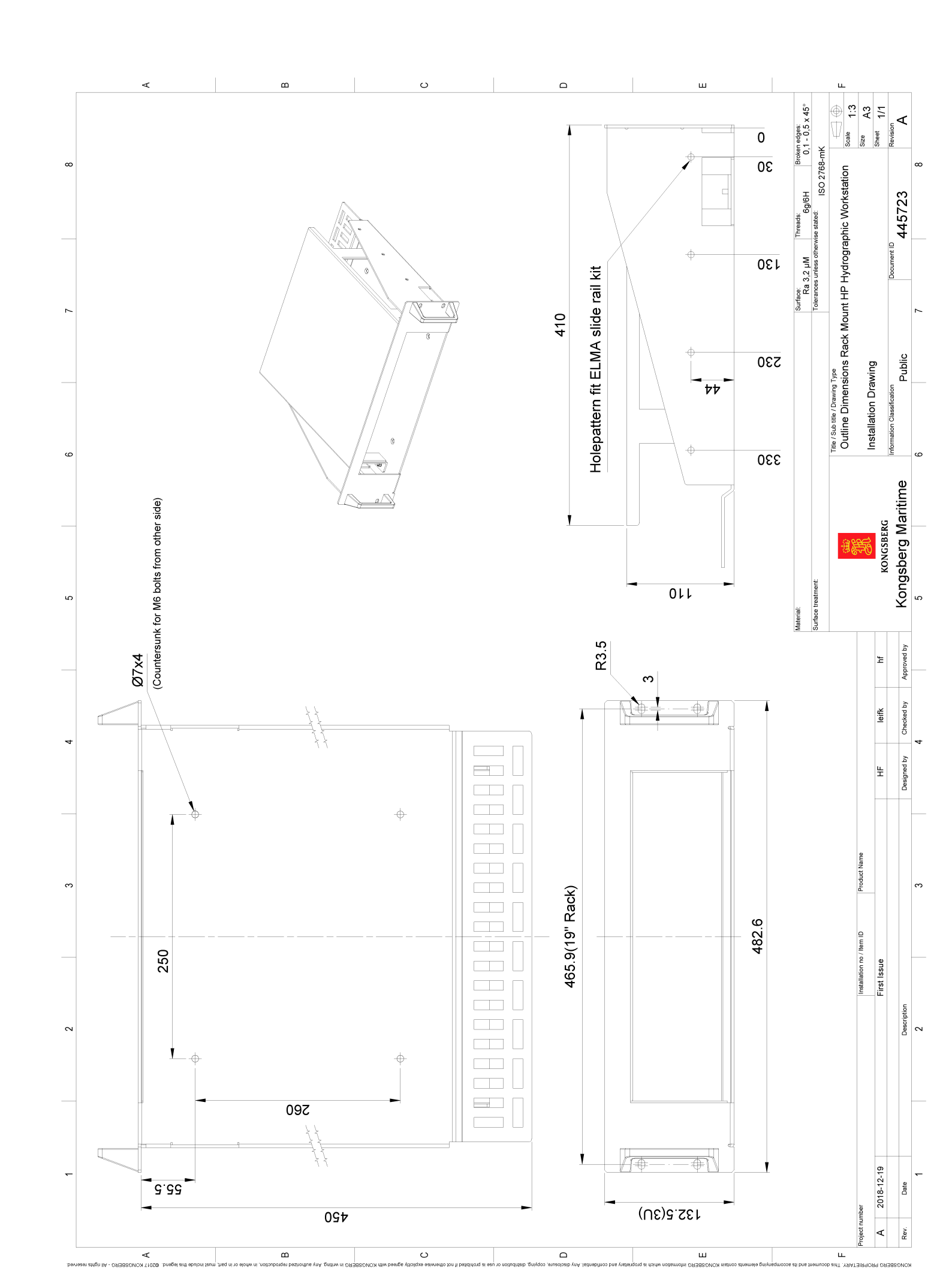
Sheet: 1/1
Size: A3
Scale: 1:4

Project / Product name: EMx
Project number: –

Drawing type: Outline

Document ID: 378828

Revision/Version: A


Ø7x4
(Countersunk for M6 bolts from other side)
250
260
55.5
450
R3.5
3
465.9(19" Rack)
482.6
132.5(3U)
Holepattern fit ELMA slide rail kit
410
0
30
130
230
330
44
110
Material:
Surface treatment:
Surface: Ra 3.2 µM
Tolerances unless otherwise stated: ISO 2768-mK
Threads: 6g/6H
Broken edges: 0,1 - 0,5 x 45°
KONGSBERG
Kongsberg Maritime
Title / Sub title / Drawing Type
Outline Dimensions Rack Mount HP Hydrographic Workstation
Installation Drawing
Information Classification
Public
Document ID
445723
Scale 1:3
Size A3
Sheet 1/1
Revision A
Project number
Installation no / Item ID
Product Name
Rev. Date Description Designed by Checked by Approved by
A 2018-12-19 First Issue HF Ieifk hf
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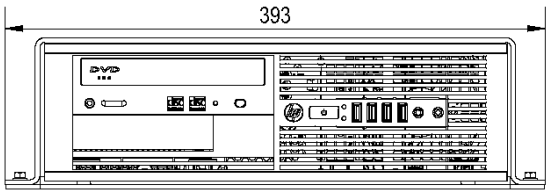
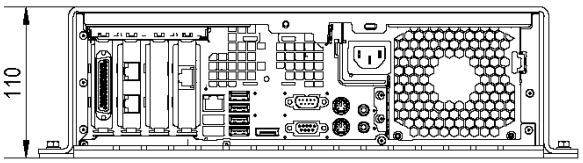
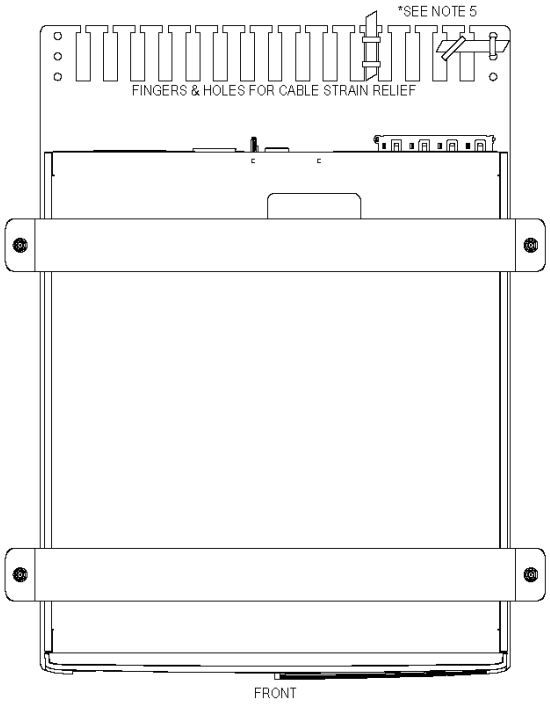
FRONT VIEW



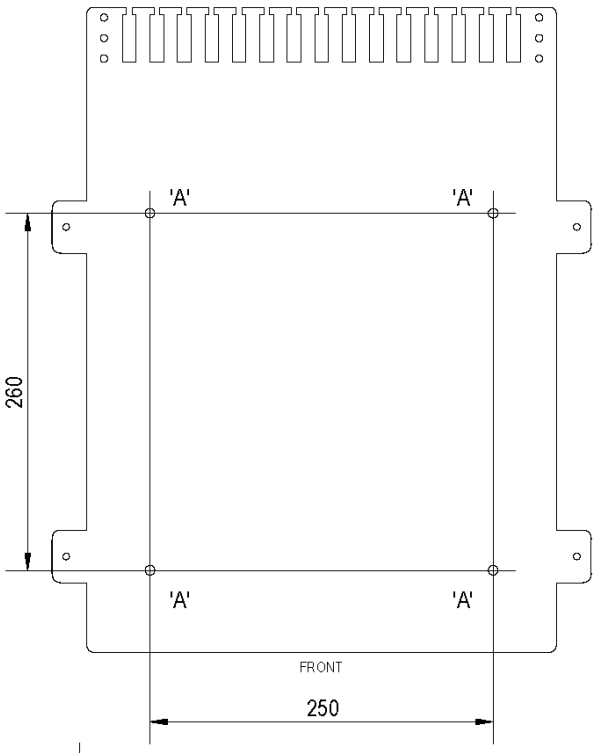
REAR VIEW



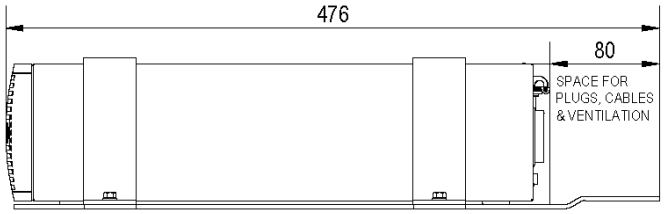
TOP VIEW



DRILLING DETAILS FOR BOTTOM PLATE



RIGHT SIDE VIEW



DIM. (WxHxD): 393x110x476 mm
POWER SUPPLY: 100-240 VAC 50-60 Hz
POWER CONSUMPTION, MAX: 120 Watt
WEIGHT WITHOUT MOUNTING KIT: 7,6 kg
WEIGHT WITH MOUNTING KIT: 8,6 kg

ASSEMBLY NOTES:
1) DRILL M6 HOLES IN MOUNTING SURFACE (4 OFF)
2) HOLE DETAILS: 'A': M6 CLEARANCE
3) SECURE BOTTOM PLATE TO SURFACE USING M6 x 20 mm CSK SLT SCREW, WASHER & NUT (4 OFF)
4) SECURE THE CLAMPS (2 OFF) TO BOTTOM PLATE USING M5 LOCKING NUT AND WASHER (4 OFF)
5) SECURE ALL CABLES TO THE CABLE MANAGEMENT FINGERS AND HOLES USING TWO CABLE TIES PER CABLE
6 THE MOUNTING KIT CAN BE USED BOTH FOR HORIZONTAL AND VERTICAL MOUNTING

C	22.05.14	CO20712	FT	EB	ES

KONGSBERG

Kongsberg Maritime AS
Offshore
Kongsberg

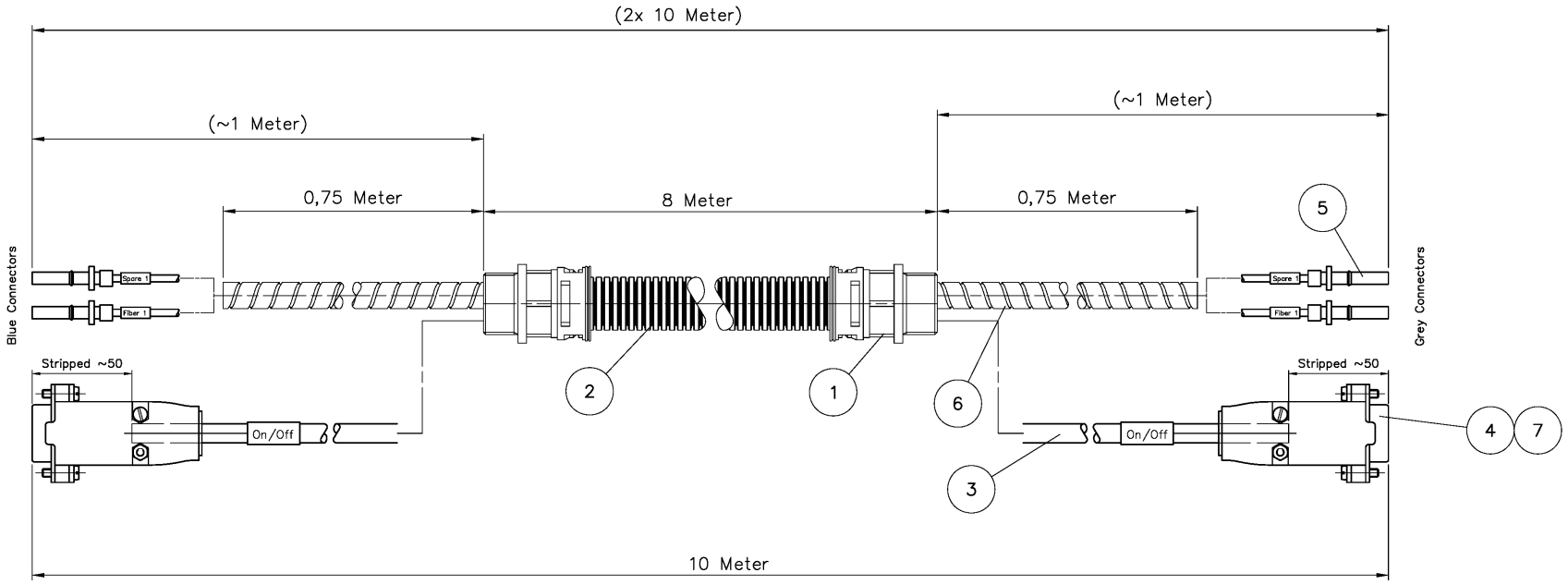
Title: MPxxxx with KM1000 Mounting kit

Sheet: 1/1
Size: A4
Scale: 1:5

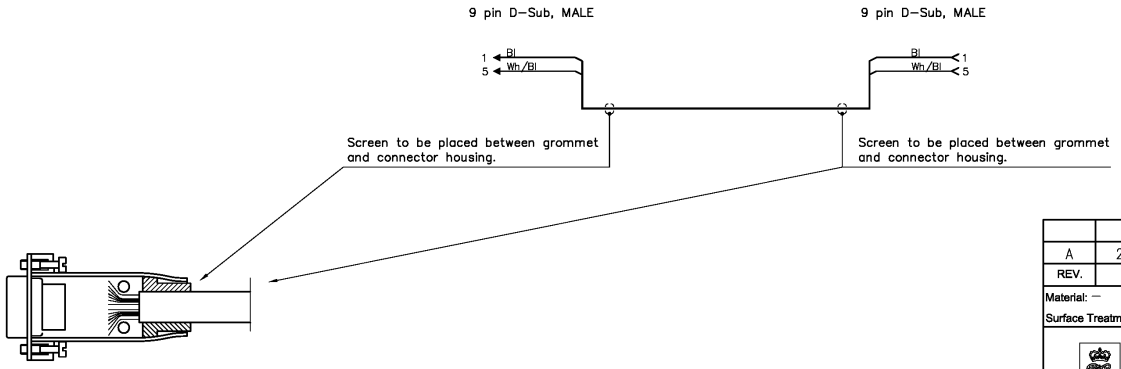
Project / Product name	Project number	Drawing type
Basis	-	General Arrangement

Document ID: 365290

Revision: C



NOTE: TERMINATIONS AND SCREENS ARE INSULATED WITH HEAT–SHRINKABLE TUBES.



All cables to be labeled as shown with printable heatshrink–tubing.

All fiber connectors ends to be protected with suitable heatshrink–tubing. This is for extra protection, just a precaution while installing on sight, and must be easy to remove when needed.

Check:
Wire identification, check pin no. vs pin no.

REV.	DATE	DESCRIPTION	Designed by	Checked by	Approved by
A	2016.01.27	First Issue	HF	ES	KEN

Material: –
Surface Treatment: –

Unless Otherwise Stated, Tolerances:
DIM.: ISO 2768–mK Threads: 6g/6H Surface: Ra6.3

Class. Code: 378

KONGSBERG

Kongsberg Maritime AS
Subsea Division
Horten - Norway

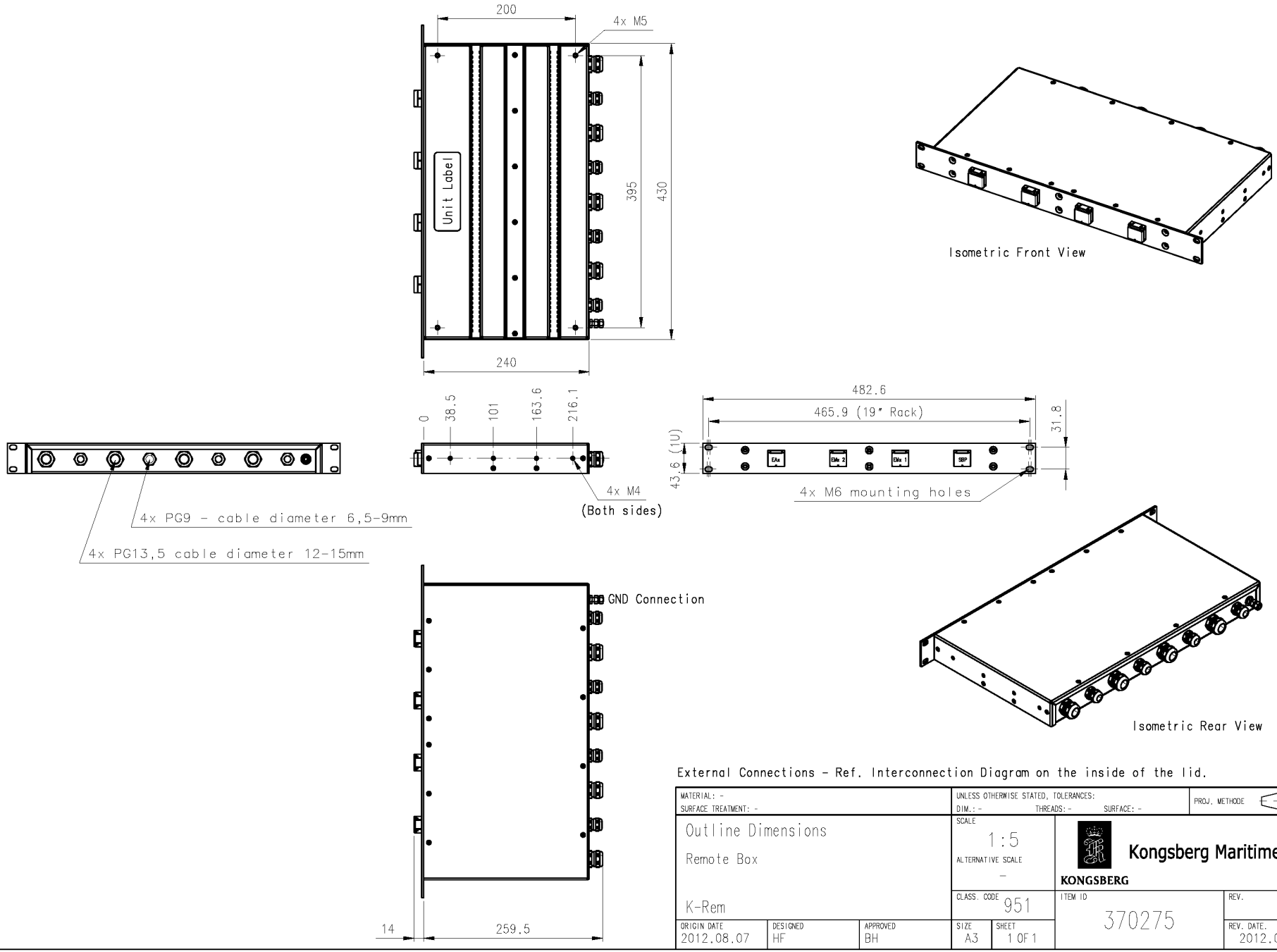
Title: On/Off and Fiber Cable Kit TX–RX / RX–RX

Sheet: 1/1
Size: A2
Scale: –

Project / Product name: EM712
Project number: –
Drawing type: –

Document ID: 409067

Revision/Version: A



External Connections - Ref. Interconnection Diagram on the inside of the lid.

MATERIAL: - SURFACE TREATMENT: -			UNLESS OTHERWISE STATED, TOLERANCES: DIM.: - THREADS: - SURFACE: -		PROJ. METHODE	
Outline Dimensions Remote Box K-Rem			SCALE 1:5 ALTERNATIVE SCALE - CLASS. CODE 951	Kongsberg Maritime AS KONGSBERG ITEM ID 370275		REV. A
ORIGIN DATE 2012.08.07	DESIGNED HF	APPROVED BH	SIZE A3	SHEET 1 OF 1		REV. DATE. 2012.08.07

Index

D

E

F

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