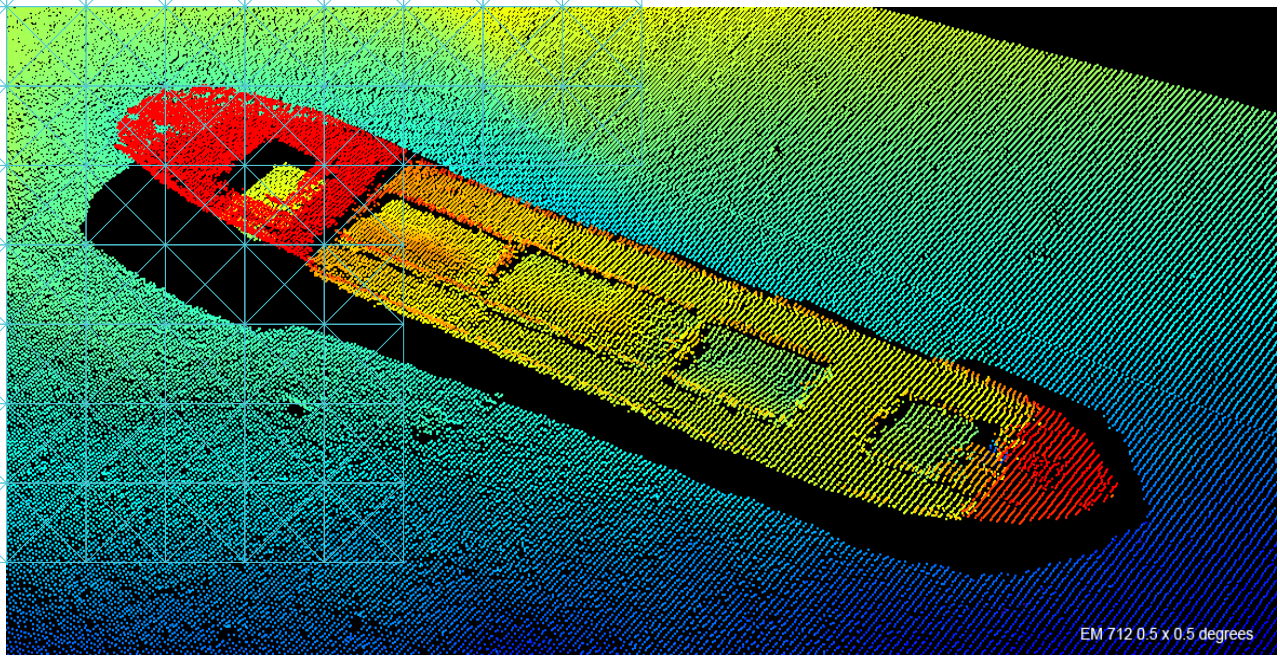
KONGSBERG

INSTALLATION MANUAL

EM 712



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EM 712

Multibeam echo sounder

Installation manual

401027/C

Document information

- **Product**: Kongsberg EM 712
- **Document**: Installation manual
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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.

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About this manual

The purpose of this manual is to present the descriptions and drawings required to install the EM 712 Multibeam echo sounder .

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..

Online information

For information about the EM 712 and other products from Kongsberg Maritime, visit our website.

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

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EM 712

Study this chapter to familiarize yourself with the EM 712.

Topics

System description

The EM 712 multibeam echo sounder is a high to very high resolution seabed mapping system.

The EM 712 multibeam echo sounder is capable of meeting all relevant survey standards. The system configuration can be tailored to the user requirements, allowing for choice of beamwidths as well as transmission modes. The minimum acquisition depth is from less than 3 m below its transducers, and the maximum acquisition depth is up to 3600 m.

The EM 712 replaces the EM 710. EM 712 is built with new, state of the art technology.

By increasing the frequency range from 70-100 kHz to 40-100 kHz, the range performance is greatly improved. The transmit transducer arrays are the same, while the receive arrays has got a built in preamplifier. The preamplifier reduces the electronic self noise and this gives extended range capability as long as the external noise (ships noise, flow noise , sea-state) is low. The EM 712 receiver can be configured for 0.5°, using two receiver modules. For upgrade from EM 710 to EM 712, the TX and RX frames plus the transmit array(s) can be reused.

Acrosstrack coverage (swath width) is up to 5.5 times water depth and the maximum achievable depth is 3600 m. The sounding density is very high, allowing even the very demanding LINZ special order survey specification for object detection to be met in full.

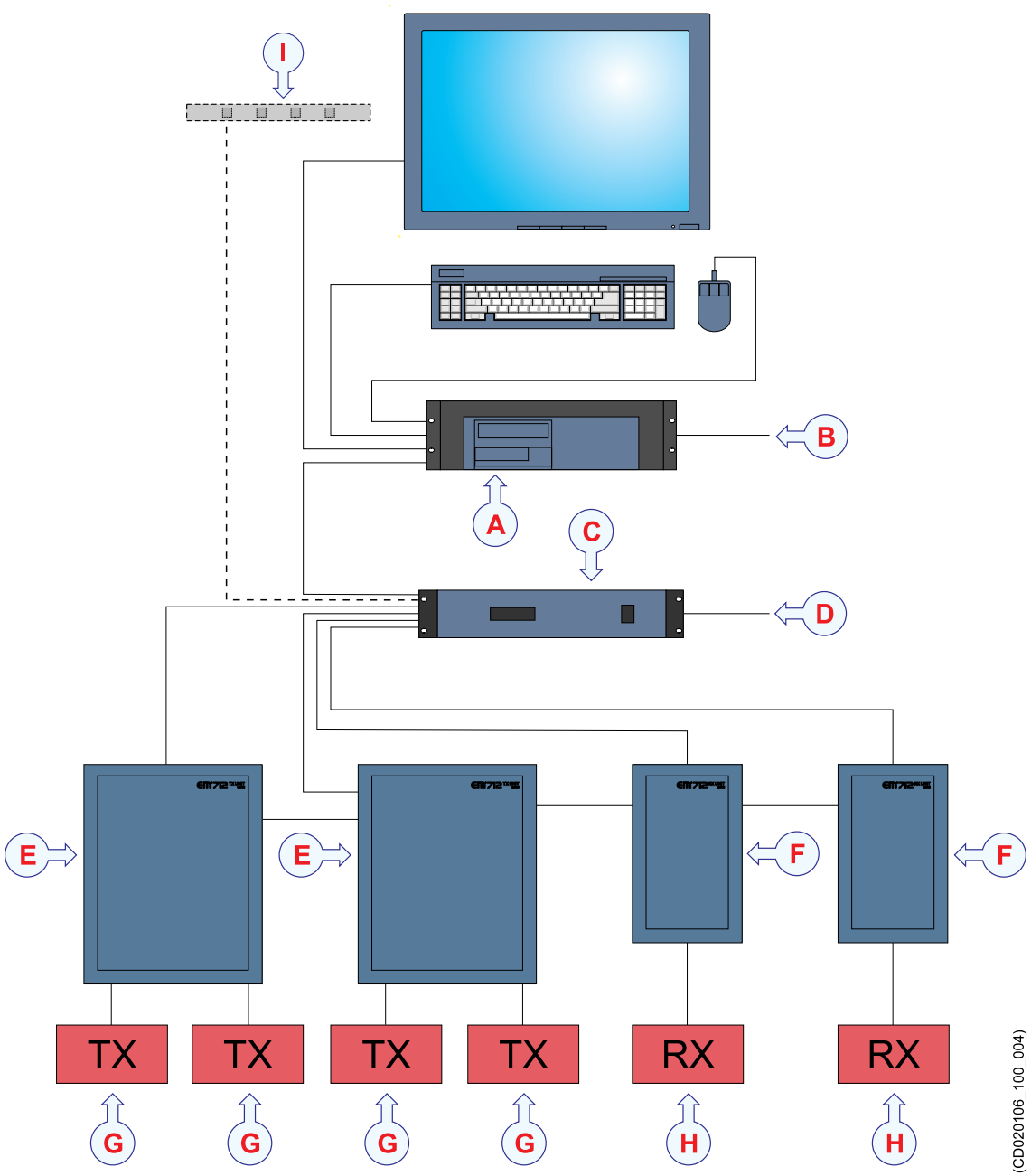
- EM 712 - Full performance version
- EM 712S (shallow) - Continuous wave (CW) pulse forms only
- EM 712RD (reduced depth) - Short CW pulse only, restricted to 600 m water depth.
- EM 712 USV - Full performance for Unmanned Surface Vehicles (USV)

The reduced performance versions EM 712S and EM 712RD can be upgraded to full performance.

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.

System diagram - 0.25° x 0.5° system

The system diagram identifies the main components of a basic EM 712 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 sensor*
- *Tide*
- *Centre depth output*

C *Processing Unit*

D *Interfaces:*
- *Positioning systems*
- *Attitude (roll, pitch and heave)*
- *Sound speed sensor*
- *Velocity*
- *Heading*
- *Clock*
- *Trigger input/output*
- *Clock synchronization (1PPS)*

E *Transmitter Unit*

F *Receiver Unit*

G *Transmit transducer module*

H *Receive transducer module*

I *Remote Control Unit (K-Rem) (This item is optional.)*

System diagram - USV Subsea Transducer/Transceiver Unit System

The system diagram identifies the components of EM 712 system and connections between the units. Detailed interface capabilities and power cables are not shown.

A *Hydrographic Work Station*

B *Interfaces:*

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

C *Processing Unit*

D *Interfaces:*

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

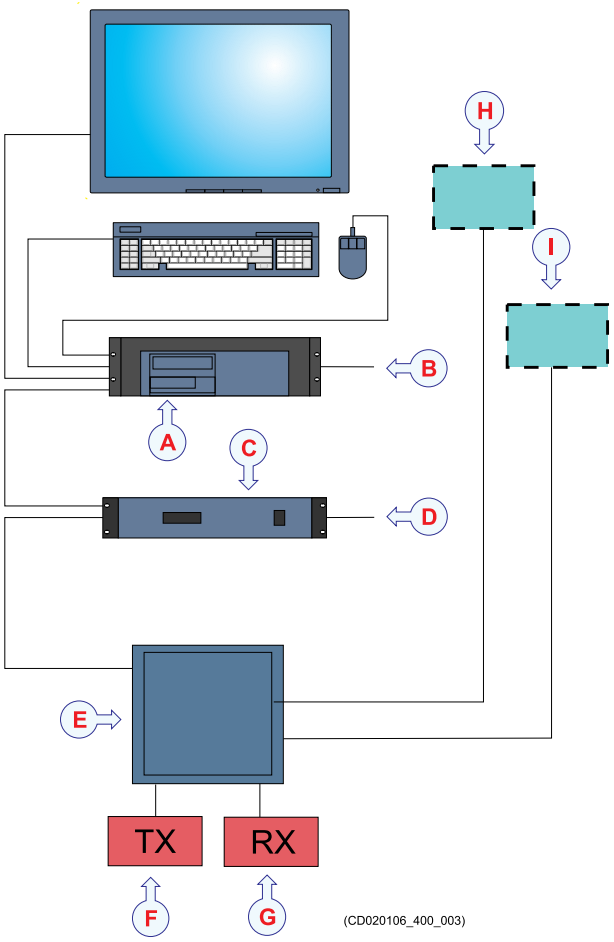
E *USV Subsea Transducer/Transceiver Unit*

F *Transmit transducer module*

G *Receive transducer module*

H *Temp/Leak, Supplied by customer*

I *Power, Supplied by customer*



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 712 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.

The EM 712 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 receive 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 712 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 on the chosen transducer configuration.

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

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

For a 0.25 degrees transducer array, two Transmitter Units are used.

Receiver Unit description

The EM 712 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 in the Receiver Unit will depend on 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° transducer array, two Receiver Units are used.

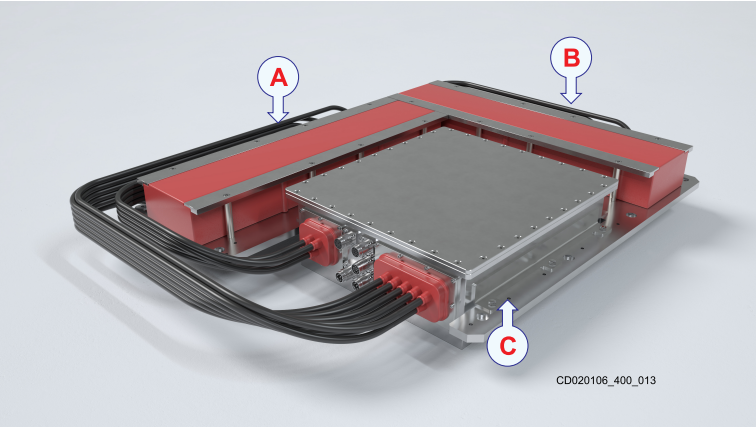
EM 712 USV Subsea Unit

The USV Subsea Transducer/Transceiver Unit is compact unit with both TX and RX transducers and a waterproof titanium container for the transceiver mounted on a common plate. The waterproof titanium container contains a 1.0 deg TX Unit and 1.0 deg RX Unit. The 1.0 deg TX and 1.0 deg RX transducer has special adapted transducer cables to the titanium container.

A Transmit transducer module

B Receive transducer module

C USV Subsea Transceiver Container



The USV Subsea Transducer/Transceiver Unit is designed for mounting on an Unmanned Surface Vehicle (USV).

The USV Container has all transmit and receiver electronics, like control processors, Analog-to-Digital Converters, power amplifiers, power supply, capacitor battery and Ethernet interface.

Processing Unit description

The EM 712 Processing Unit is provided to process the signals to and from the Transmitter and Receiver Units.

The EM 712 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 of the EM multibeam system.

A dedicated maritime computer is provided. It is set up with all necessary software.

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

The Hydrographic Work Station is based on a commercial design. Due to the constant development of new computer parts, older parts are no longer manufactured. This means that the computer type used with the EM 712 system changes from time to time.

For more detailed information about the different models of Hydrographic Work Station see the separate manual:

- *495770 - Hydrographic Work Station Instruction Manual*

Remote Control Unit (K-Rem) description

A dedicated junction box has been designed to provide remote on/off switches with light indication and interface to a remote synchronizing system. The junction box contains a terminal block and four switches with lamps mounted in the front.

Note

The Remote Control Unit is not a standard part of the EM 712 delivery.

The Remote Control Unit is called K-Rem. It is prepared for remote control and interface to an external synchronization system up to four Kongsberg echo sounders.

- One Sub-bottom profiler (SBP 27 or SBP 29)
- Two EM multibeam echo sounders
- One EA single beam echo sounder

The Remote Control Unit is designed to be mounted in a 19 inch rack, but it is also possible to mount it on a flat surface or in a bulkhead. It is also prepared for mounting on telescopic rails.

Preparations

Topics

Tools, equipment and consumables required for installation

To install the EM 712 system, 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 712 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).

Related topics

Weights and outline dimensions, page 194

Personnel qualifications

The installation of the EM 712 system is a demanding task. Installation tasks must only be done by fully trained personnel.

As a minimum, the following certified personnel 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 712 topside units must be installed in a dry and dust-free environment. The units are not fully protected against humidity, dust or moisture.

It is important that the sonar room is kept clean and dry. The system 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 for dust, high temperature and humidity. 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 each unit.

Related topics

Environmental requirements, page 199

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.

Related topics
Weights and outline dimensions, page 194

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 be dimensioned to maintain the equipment within its environmental tolerances.

Observe the environmental specifications related to each unit.

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 712 units that are installed in the room.

Related topics
Environmental requirements, page 199

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 712 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.

Related topics

Power requirements, page 197

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 system 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 performance, mount the transducer as deep as possible under the vessel’s hull.

There are several reasons for mounting the transducer as deep as possible.

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 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 can push the transducer up, and this 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 overall performance of your system.

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 near 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 712 system.

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 712 transducer useless, almost no matter where it 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

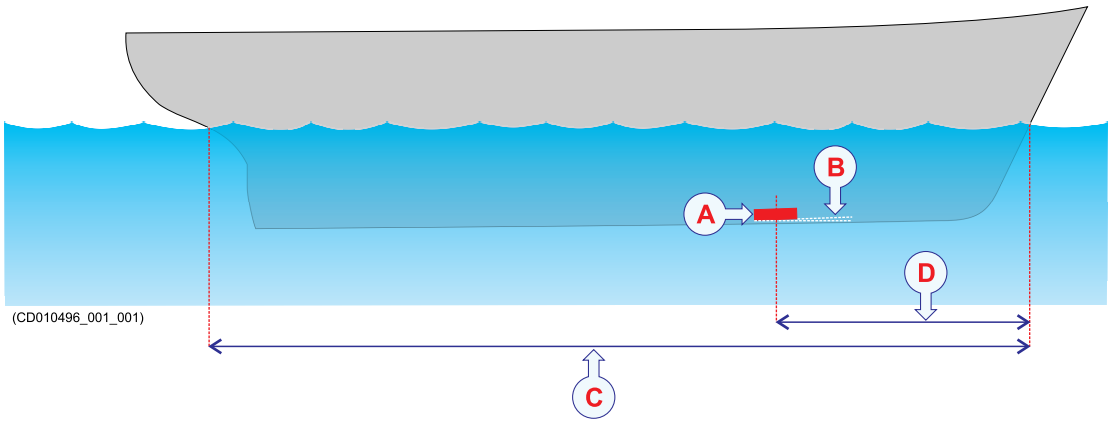
Some of the installation guidelines provided for transducer location may be conflicting. For this reason, each vessel must be treated individually in order to find the best compromise.

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.



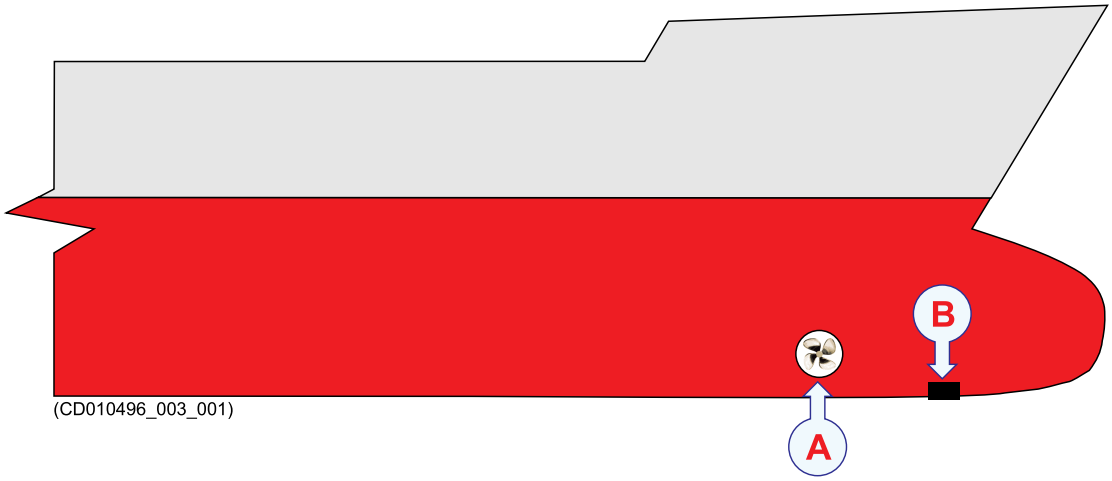
A *Transducer*

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 near 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 712 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. This is necessary to obtain long range and dependable interpretations of the echoes. Even with the advanced noise filtering offered by the EM 712 system, we must address the noise challenge. This is important during the planning and preparations for the installation of the EM 712 system.

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 you 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 [...].

Wikipedia, Copied 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 as low as possible in order to obtain high echo 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
- Underwater noise

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 cables are long. Electric noise from generators, pumps, cooling systems and other electric or electromechanical devices is easily picked up.

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

D The 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. It is necessary to analyse the different sources of self-noise on a vessel, and find out how each source can affect 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.

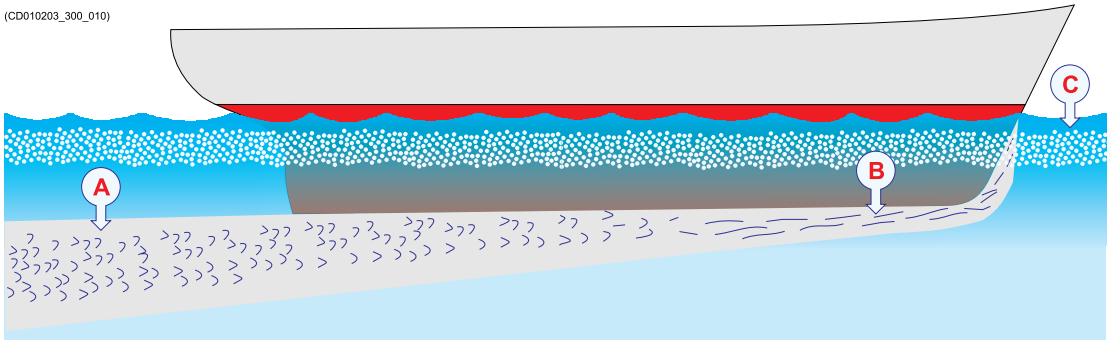
In some cases a resonant phenomenon is set up in a hole near the hull. This sound will have a discrete frequency, while all other flow noise will have a wide frequency spectrum.

(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 water 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/Wave_interference — 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.

The most common source of electrical self noise is hum. The hum is normally generated by a low quality power supply. It is then picked up by the transducer cables and/or sensitive electronic circuitry. 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 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 system 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 sacrificial 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 must 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 sacrificial 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. This is important to avoid electrical noise.
- Use shielded cables with correct grounding.
- Separate the cables used by the EM 712 system 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 712 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.

The EM 712 can use two sizes of transmit (TX) and receive (RX) modules.

The number of cables for each transducer module varies.

- **1 degree transmit transducer**: TX1, 10 cables
- **2 degrees transmit transducer**: TX2, 5 cables
- **1 degree receive transducer**: RX1, 4 cables
- **2 degrees receive transducer**: RX2, 2 cables

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 metres. There is an option for cable length of 25 metres.

The EM 712 is designed for cable length up to 45 meters. The delivered cables can be extended with lengths of 5, 10 or 15 meters. Kongsberg Maritime ideally advices on using the shortest possible cables, and routing the cables away from electromagnetic sources.

The EM 712 transducer modules are available in an ice reinforced version. For more information, contact Kongsberg Maritime.

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**: 2 TX1 modules and 2 RX1 modules
- **0.5 x 1 degree system**: 2 TX1 modules and 1 RX1 module
- **1 x 1 degree system**: 1 TX1 module and 1 RX1 module
- **1 x 2 degrees system**: 1 TX1 module and 1 RX2 module
- **2 x 2 degrees system**: 1 TX2 module and 1 RX2 module

Note

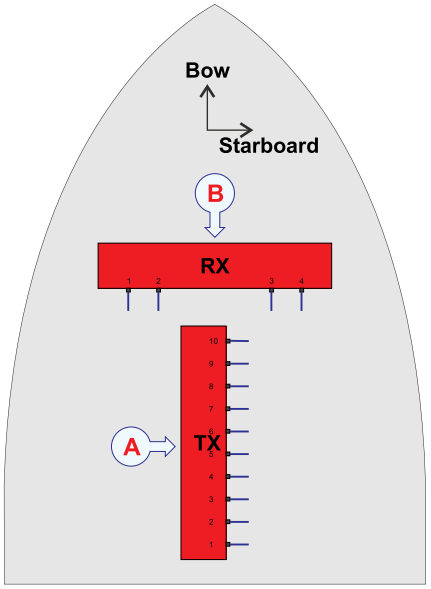
The protective coating is a vital part of the transducer. It is very important that neither this coating nor the internal parts of the transducer are damaged during the handling, installation or cleaning. Any holes and/or scratches in the transducer surface will allow water to penetrate the transducer.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

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 receive transducer array should be aligned 90 degrees on the keel. Both transducer arrays should be horizontal on a plane on the keel.

It is possible to mount the transmit transducers with the cables pointing to the port or to the starboard side. The default orientation is to the starboard side, this should be used if possible.

It is possible to mount the receive transducers with the cables pointing to the stern or to the bow. The default orientation is astern, this should be used if possible.



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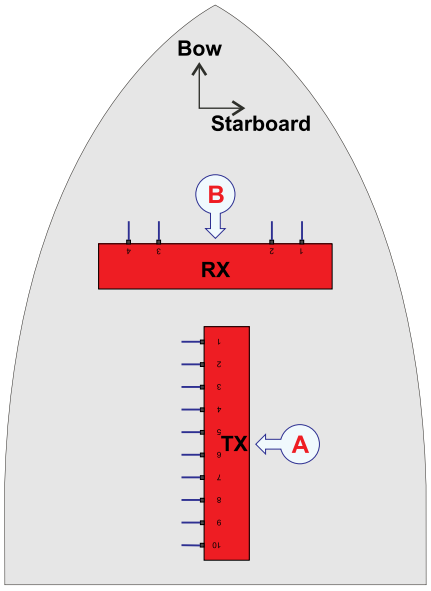
Default orientation of transducer modules, top view, 1 x 1 degrees system.

A Transmit transducer (TX)

B Receive transducer (RX)



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Optional orientation of transducer modules, top view, 1 x 1 degrees system.

A Transmit transducer (TX)

B Receive transducer (RX)

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.

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

- Gondola
- Blister
- Flush mounted
- Externally mounted with fairings
- Keel box
- Portable
- 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
Exter-nally moun-ted with fair-ings	X	X	X	X
In a box keel	X	X	X	X
Portable mounting			X	X
Hull unit			X	X
Drop keel			X	X

Normally, in a permanent installation, the cables enter the hull through steel conduits 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 conduits end below the vessel's water-line, classification requirements may require a double set of approved glands. The conduits 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.

Unmanned Surface Vehicle

Unmanned Surface Vehicle (USV) is a boat or ship that operate on the surface of the water without a crew.

EM 712 USV Multibeam Echosounder is designed to be mounted on an Unmanned Surface Vehicle. The installation is in a gondola, as shown in the figure. Similar installation for Gondola, page 39

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The USV Subsea Transducer/Transceiver Unit fits inside the same footprint as the transducers and can therefore be easily installed, thereby reducing the number of cables protruding through the USV's hull to a bare minimum.

Note

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

The installation shipyard must provide all necessary installation drawings.

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 712 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 712 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 for deep water multibeams 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.

Externally 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 712 transducer requires careful planning and preparations. It is a key task for successful use of the EM 712 system. An overall installation procedure is provided. This procedure does not describe any detailed tasks. Refer to the relevant tasks in this manual.

Prerequisites

In order to prepare the installation of the EM 712 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 optimal 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 712 system 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 712 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 transceiver 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 22

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 36

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 46

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

For more information, see: Designing, manufacturing and mounting the steel conduits, page 48

5 Install the mounting frames.

For more information, see: Installing the mounting frames, page 51

6 Install the transducer modules.

For more information, see: Installing the transducers into the mounting frames, page 53

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 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 61
Approved anti-fouling paints, page 63

Further requirements

Connect the transducer cables to the Transmitter and Receiver Units.

For more information, see:
Transmit transducer cables, page 146
Receive transducer cables, page 151

Related topics

Cable layout and interconnections, page 120
Drawing file, page 76

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.

Drawings for EM 712 casings

- 0.25 degrees, TX/RX drawing 483945
- 0.5 degrees, TX/RX drawing 317812
- 0.5 degrees, TX/RX drawing ice protected 366689
- 1 degree, TX/RX, drawing 320320

- 1 degree, TX/RX, drawing ice protected 366678
- 2 degrees, TX/RX, drawing 331369
- 2 degrees, TX/RX, drawing ice protected 366903
- 1x1 degree, comb.casing, drawing 481309

Note

Follow the general safety procedures. These 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.

Related topics

Designing, manufacturing and mounting the steel conduits, page 48
Drawing file, page 76

Designing, manufacturing and mounting the steel conduits

Steel conduits are used to protect the transducer cables.

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. 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.

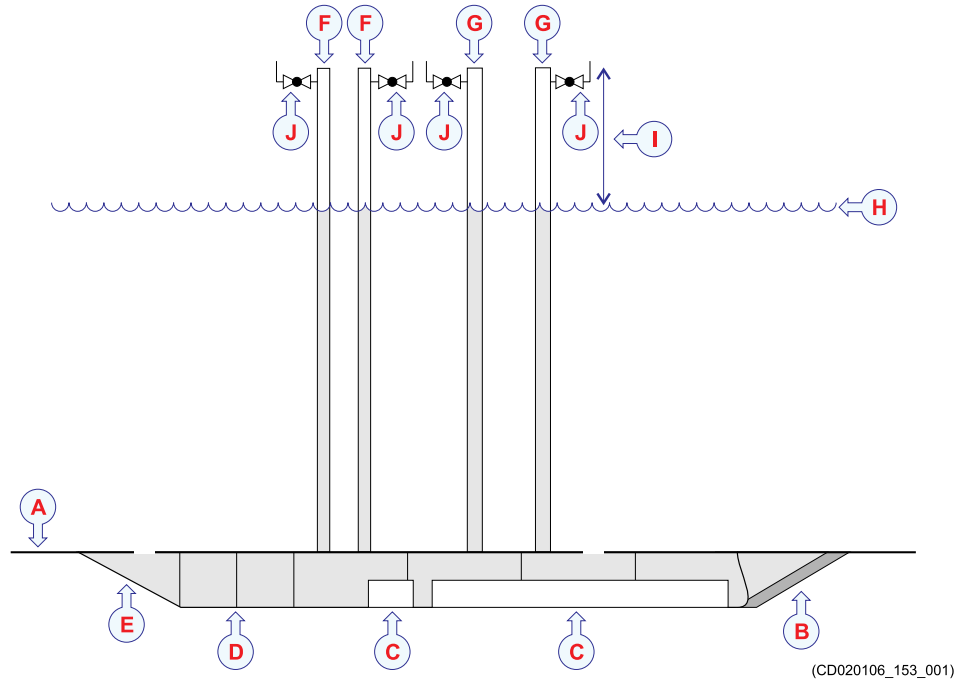
The steel conduit must be designed to fit each individual ship. The quality of the materials used to manufacture the conduit, as well as the quality of the workmanship must be defined by the vessel owner and the installation shipyard.

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

The conduits should have an outer diameter of approximately 219 mm and an inner diameter of approximately 197 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**: 2 TX conduits, 2 RX conduits
- **0.5 x 1 degrees system**: 2 TX conduits, 1 RX conduit
- **1 x 1 degrees system**: 1 TX conduit, 1 RX conduit.
- **1 x 2 degrees system**: 1 TX conduit, 1 RX conduit
- **2 x 2 degrees system**: 1 common TX and RX conduit



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, air outlet towards the hull*

F *One or more steel conduits for the RX Transducer array*

G *One or more steel conduits for the TX Transducer array*

H *Waterline*

I *Minimum 1.5 m above waterline. This must be verified by the classification society.*

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.

- Mount the steel conduits from the vessel hull and up towards the sonar room and the transmitter and receiver units.

  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. Note however that one or two sharp bends on the conduits may require a larger diameter.

  The upper opening of the steel conduits should be minimum 1.5 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.
- Close the top of the steel conduits with a cable sealing system.

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

Related topics

Manufacturing and installing the casings, page 46
Installing the mounting frames, page 51

Installing the mounting frames

The mounting frames have been designed to offer a reliable and maintenance friendly installation method for the EM 712 transducers.

Prerequisites

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

- 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
- 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.

Drawings for EM 712 mounting frames

- 0.25 degrees, TX/RX, drawing 479254
- 0.5 degrees, TX/RX,drawing 499-223137

  0.5 degrees, TX/RX ice protected, drawing 366686
- 1 degree, TX/RX, drawing 499-223139

  1 degrees, TX/RX ice protected, drawing 366661
- 2 degrees, TX/RX, drawing 499-223273

  2 degrees, TX/RX ice protected, drawing 366903

Procedure

1 Mount the frames 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.

The frames are fastened by M12 hex cap screws. Use a torque of approximately 74 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 ±0.2 mm.

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 before the modules are put in place.

3 Loosen each M12 screw.

4 Apply Loctite 242 to secure, and firm mount. Use a torque of approximately 74 Nm.

Related topics

Designing, manufacturing and mounting the steel conduits, page 48
Installing the transducers into the mounting frames, page 53
483772 Transducer mounting frame - 0.25°, page 86
477671 Transducer mounting frame - 0.5°, page 87
331493 Casing Arrangement - 2°, page 93

Installing the 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.

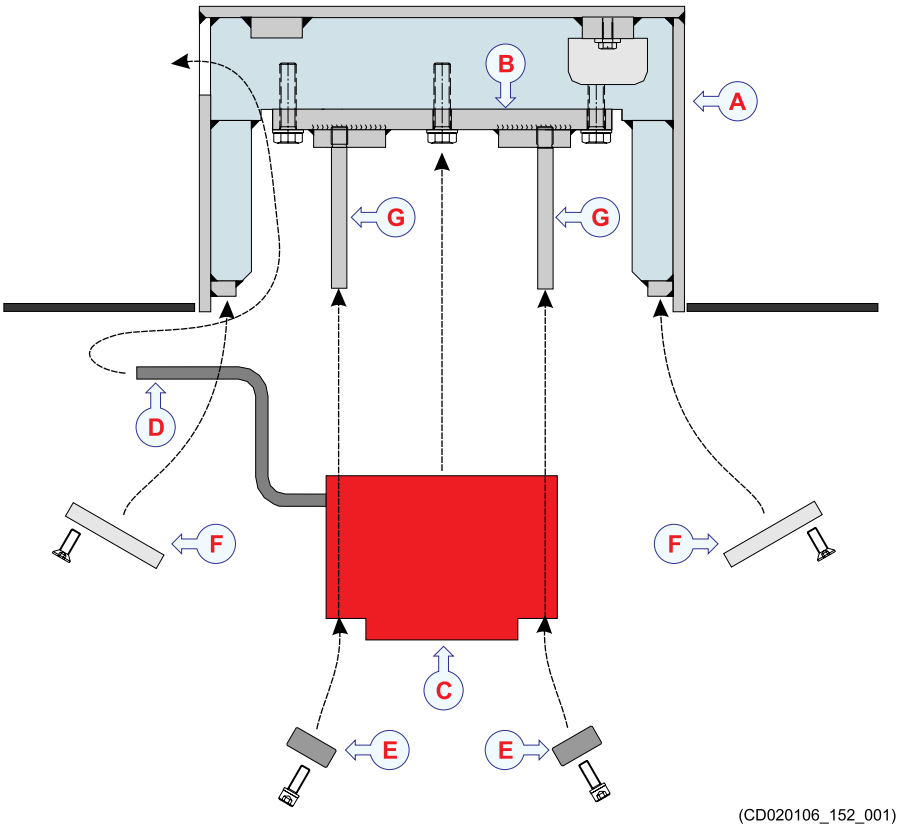
The following specific tool is required for this task:

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

Context

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**: 2 TX1 modules and 2 RX1 modules
- **0.5 x 1 degree system**: 2 TX1 modules and 1 RX1 module
- **1 x 1 degree system**: 1 TX1 module and 1 RX1 module
- **1 x 2 degrees system**: 1 TX1 module and 1 RX2 module
- **2 x 2 degrees system**: 1 TX2 module and 1 RX2 module



A *Casing*

B *Mounting frame*

C *Transducer face*

D *Transducer cable*

E *Clamping bars*

F *Cover plates*

G *Stay rods*

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.*

Procedure

1 Dismount as illustrated, the cover plates and clamping bars.

2 Lift the transducer up into its location.
Check the orientation according to the individual requirement.

3 Pull out the transducer cable, and guide them out through the side of the mounting frame

4 Place the transducer modules into the frames and fasten them the clamping bars to the stay rods.

The clamping bars are fastened to the stay rods on the mounting frames by M10 bolts with self lock treads. Bolts, clamping bars and stay rods are included with the mounting frames.

Apply Loctite 242 to secure the bolts.Use torque approximately: 42 Nm.

5 Mount the next transducer module next to the previous. (applicable for 0.5 degree transducer array).

The gap between the individual modules is determined by the mounting frame.

6 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.
The minimum bending radius for the transducer cables is 95mm.

7 Note the orientation of the cable outlet from the transducer modules. Fill in the tables below.

	Serial number	**Module type (TX1/TX2)**	**Cable orientation (port/starboard)**
Transmit transducer (TX) number 1			
Transmit transducer (TX) number 2			

	Serial number	**Module type (RX1/RX2)**	**Cable orientation (bow/astern)**
Receive transducer (RX) number 1			
Receive transducer (RX) number 2			

The number of individual TX and RX modules in the two arrays depends on the chosen configuration.

8 Check that all bolts are properly fastened.

9 Measure the location of the transducer modules and their angular orientation in the vessel coordinate system accurately.

10 If required, allow the relevant maritime authority and/or classification society to inspect and approve the transducer installation.

Related topics

Installing the mounting frames, page 51
Transmit transducer cables, page 146
Receive transducer cables, page 151
216148 Transducer TX1 dimensions, page 78
221048 Transducer TX2 dimensions, page 80
219621 Transducer RX1 dimensions, page 82
216146 Transducer RX2 dimensions, page 84

Installing USV Subsea Transducer/Transceiver Unit System

The mounting frame for the USV Subsea Transducer/Transceiver Unit must be designed to offer a reliable and maintenance friendly installation.

Prerequisites

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

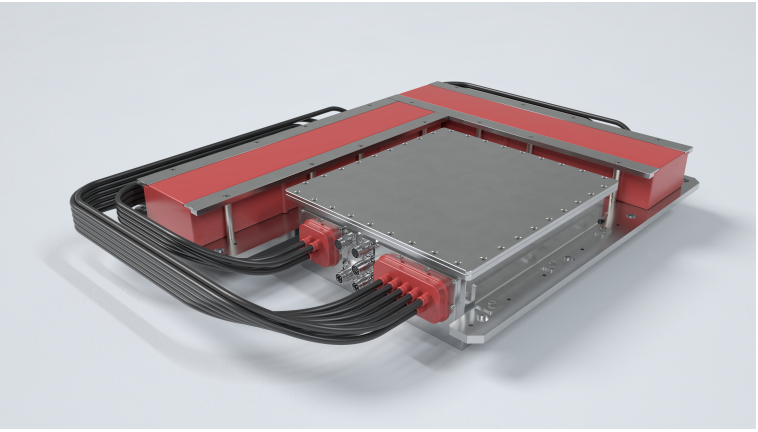
- All relevant vessel and transducer drawings must be available.
- All relevant work instructions, procedures and standards must be available.
- All relevant personnel (skilled shipyard workers) and their tools must be available.

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

- Torque wrench
- Loctite
- Lifting device
- Rope
- Tackles

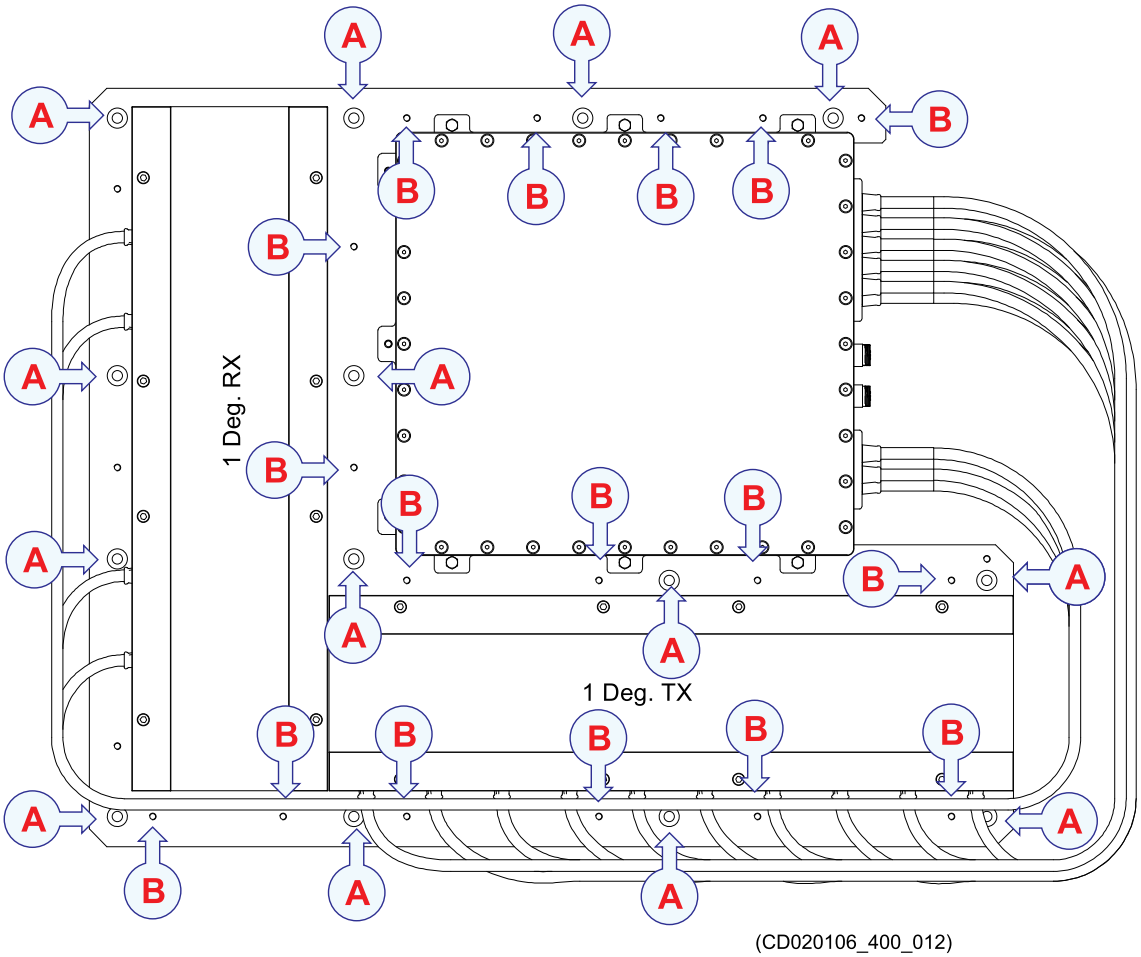
Context

The installation shipyard must provide all necessary design and installation drawings, as well as the relevant work standards and mounting procedures. The installation must be carried out according to arrangement drawings designed for the specific USV.



Note

The USV Subsea Transducer/Transceiver Unit must be handled with care. Please observe normal safety precautions.



A Mounting holes for securing the unit to the vessel assembly.

B Mounting holes for cover plates.

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.*

Procedure

1 Lift the transducer up into its location.

2 Check that all bolts are properly fastened. (**A**)

3 Mount the cable connectors from the topside.

4 Mount the cover plates.

5 Check that all bolts are properly fastened. (**B**)

6 Measure the location of the transducer modules and their angular orientation in the vessel coordinate system accurately.

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. 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.

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

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

8 **Do not** damage the transducer cable. 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 overall performance of your system.

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.

Recommended procedure for painting is found here: Painting the transducer face, page 61

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.

Approved anti-fouling paints

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.

The list of approved anti-fouling paints can be found on our website.

- https://www.kongsberg.com/anti-fouling-paints

Non-permanent transducer installations

For non-permanent installations, rinse the transducer with fresh water every time you take it out of the water.

Painting the transducer face

Marine growth (biological fouling) on the transducer face reduces the 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
- Plastic brush
- Mild synthetic detergent
- Piece of wood or plastic without sharp corners
- 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. Approved anti-fouling paints for transducers are found on our website.

- https://www.kongsberg.com/anti-fouling-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 transducer 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

The list of approved anti-fouling paints can be found on our website. Always refer to the manufacturer's documentation and data sheets for a complete procedure and for relevant safety information.

Online information

- https://www.kongsberg.com/anti-fouling-paints

Installing the EM 712 system 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 15 metres. There is an option for cable length of 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.

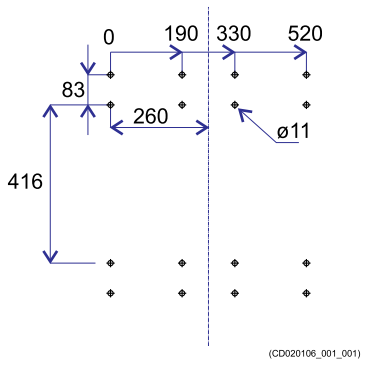
If required, all drawings and documents must be approved by the vessel's national registry and corresponding maritime authority and/or classification society.

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.

Context

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

Mounting hole pattern for the Transmitter 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.

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.

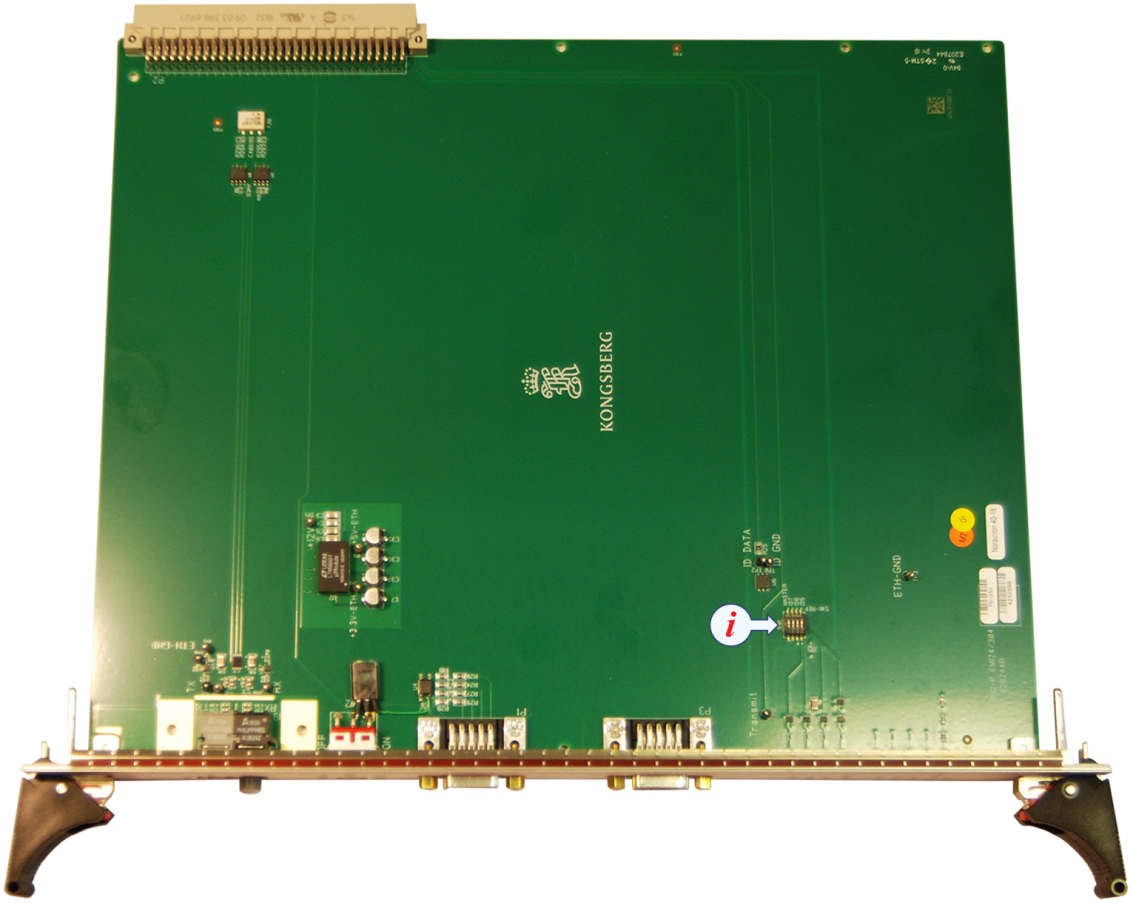
- Alternatively, the shock absorbers can be mounted to a pair of specially designed support brackets.

Related topics

396402 EM 712 Transmitter Unit dimensions, page 104
212984 EM 712 Optional Mounting bracket, page 105
Weights and outline dimensions, page 194

RIO-P board - dip switch setting

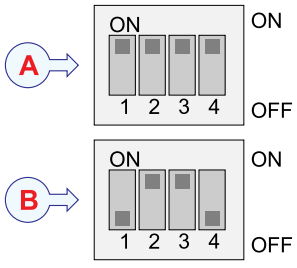
The dip switch setting on the RIO–P board has to be correct.



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 712 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 15 metres. There is an option for cable length of 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.

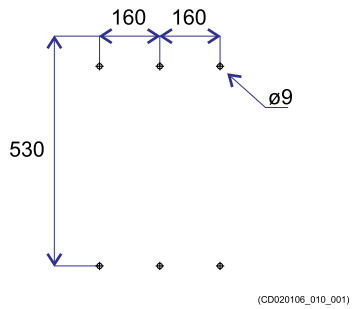
If required, all drawings and documents must be approved by the vessel's national registry and corresponding maritime authority and/or classification society.

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.

   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

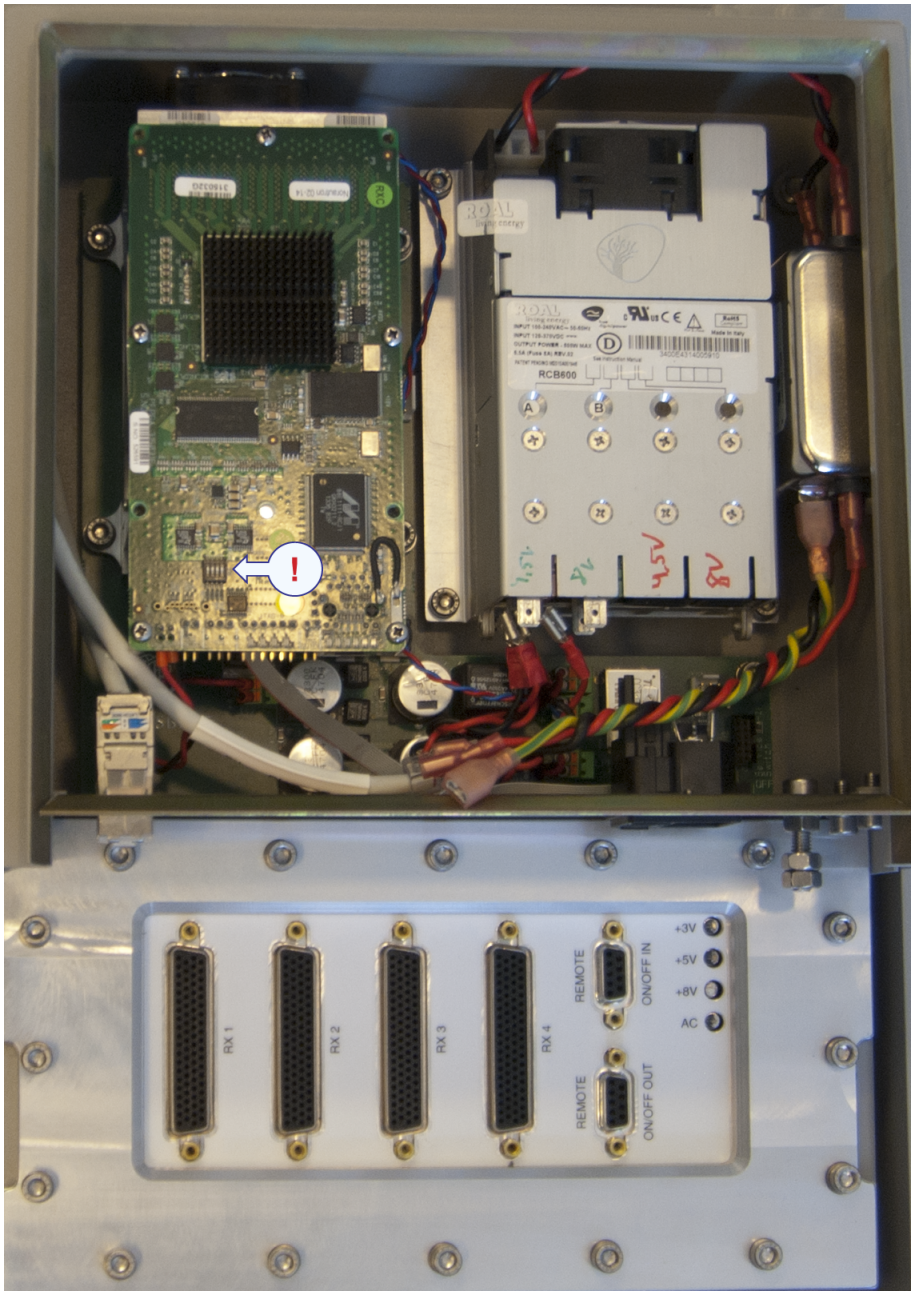
396428 EM 712 Receiver Unit dimensions, page 106
Weights and outline dimensions, page 194

Receiver Unit - dip switch setting

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

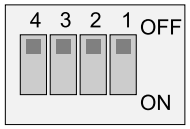
For a 0.5° transducer array, two Receiver Units are used.

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.



One Receiver Unit

All switches must be set to OFF. OFF is when they are pushed up.



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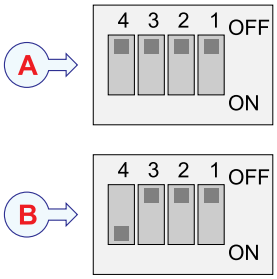
Two Receiver Units

A Receiver Unit 1: all switches must be set to OFF. OFF is when they are pushed up.

Receiver Unit 1 is connected to RX transducer 1.

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

Receiver Unit 2 is connected to RX transducer 2.



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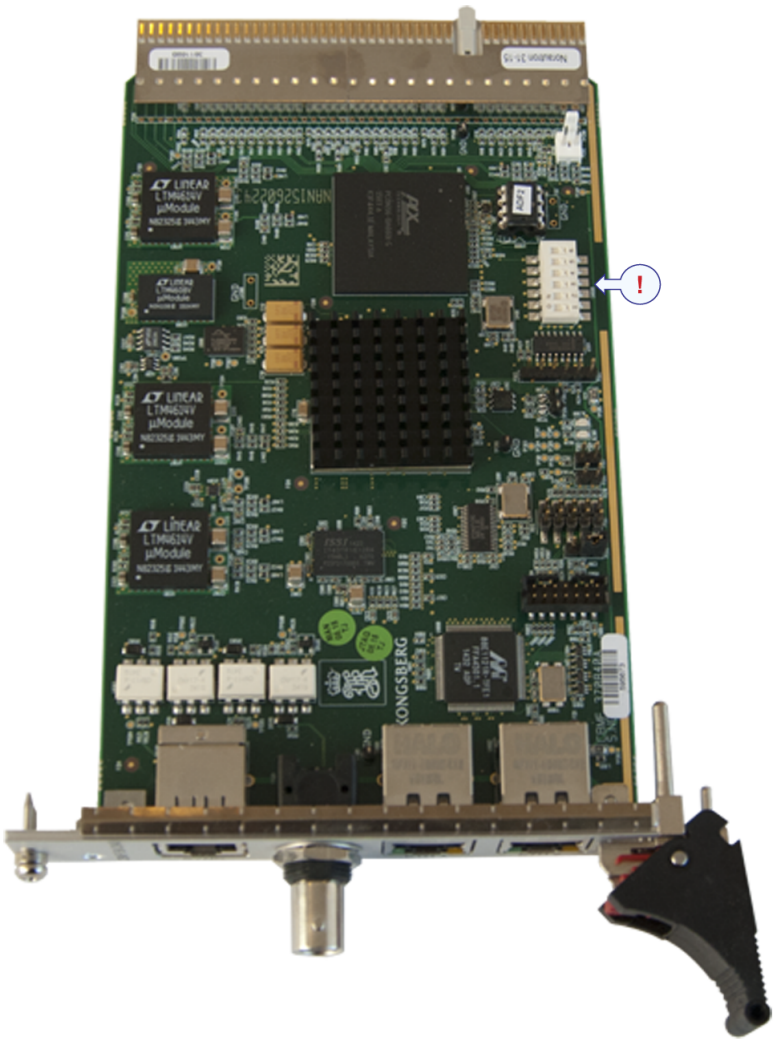
Processing Unit

Topics

CBMF board - dip switch setting, page 75

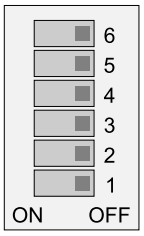
CBMF board - dip switch setting

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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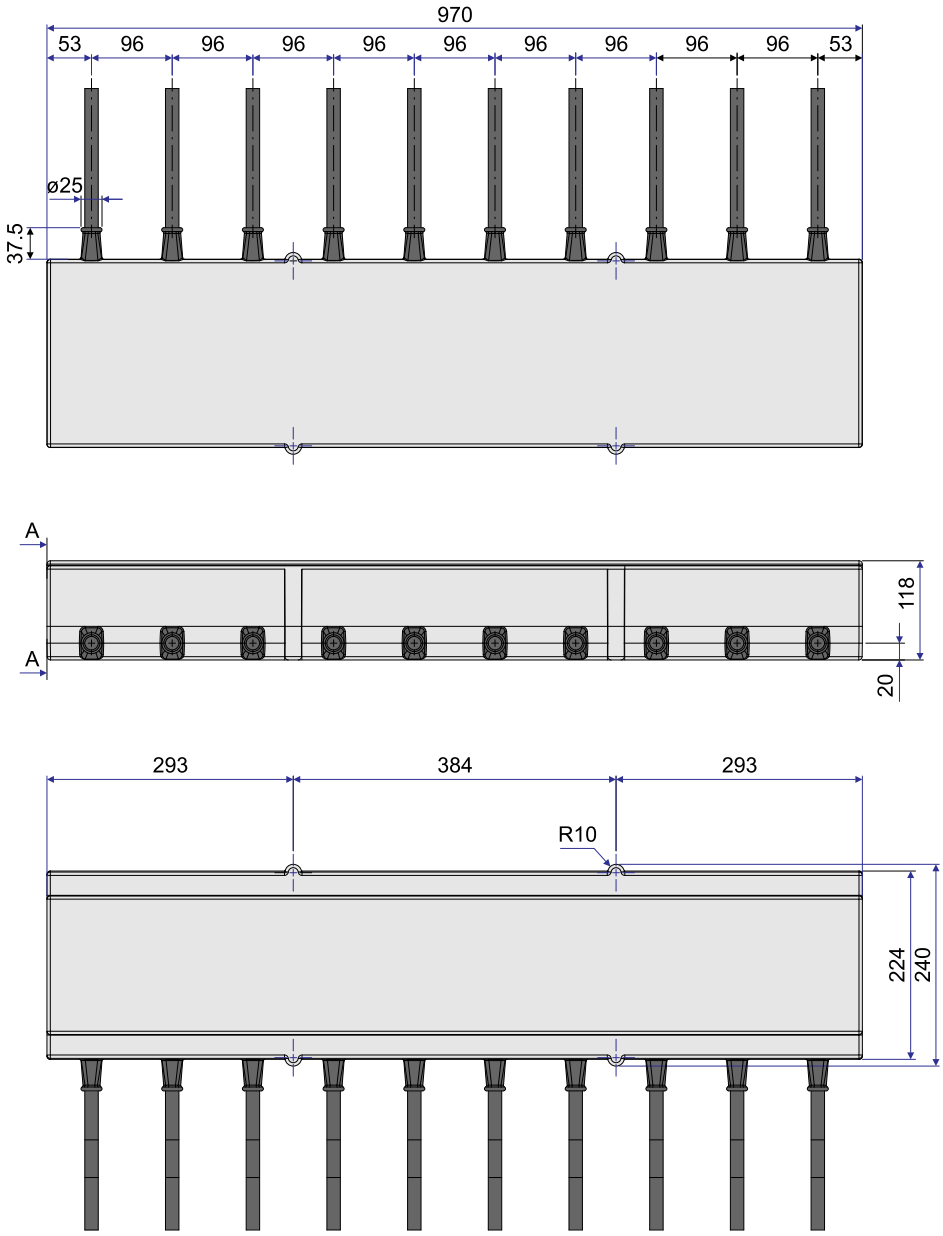
Drawing file

Topics

216148 Transducer TX1 dimensions



All measurements in mm.
The drawing is not in scale.
Information may be omitted. Observe the source drawing for additional details.

[216148] Rev.A
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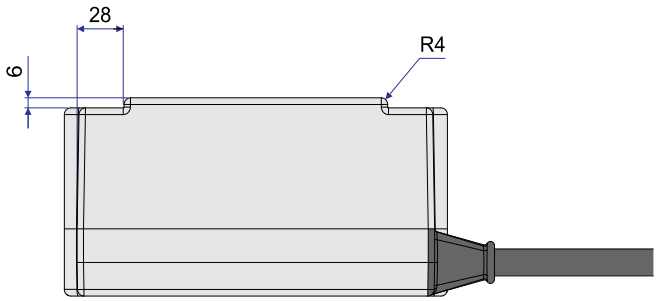
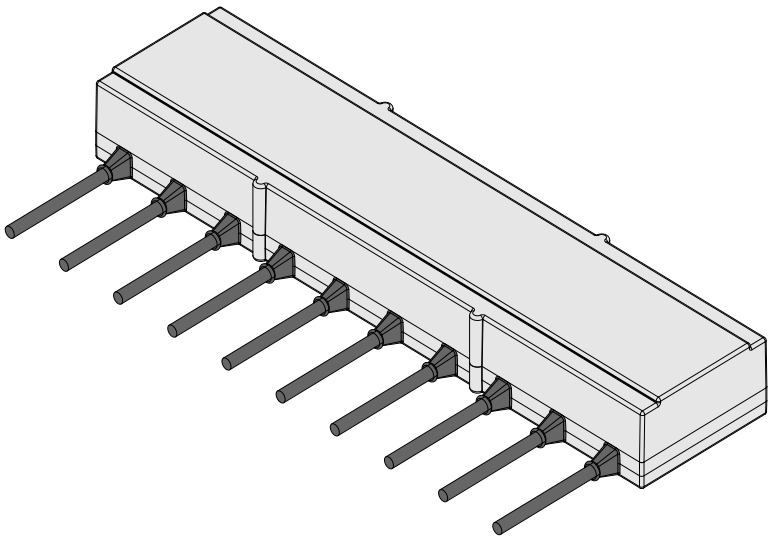


Section A-A



All measurements in mm.
The drawing is not in scale.
Information may be omitted. Observe the source drawing for additional details.

[216148] Rev.A
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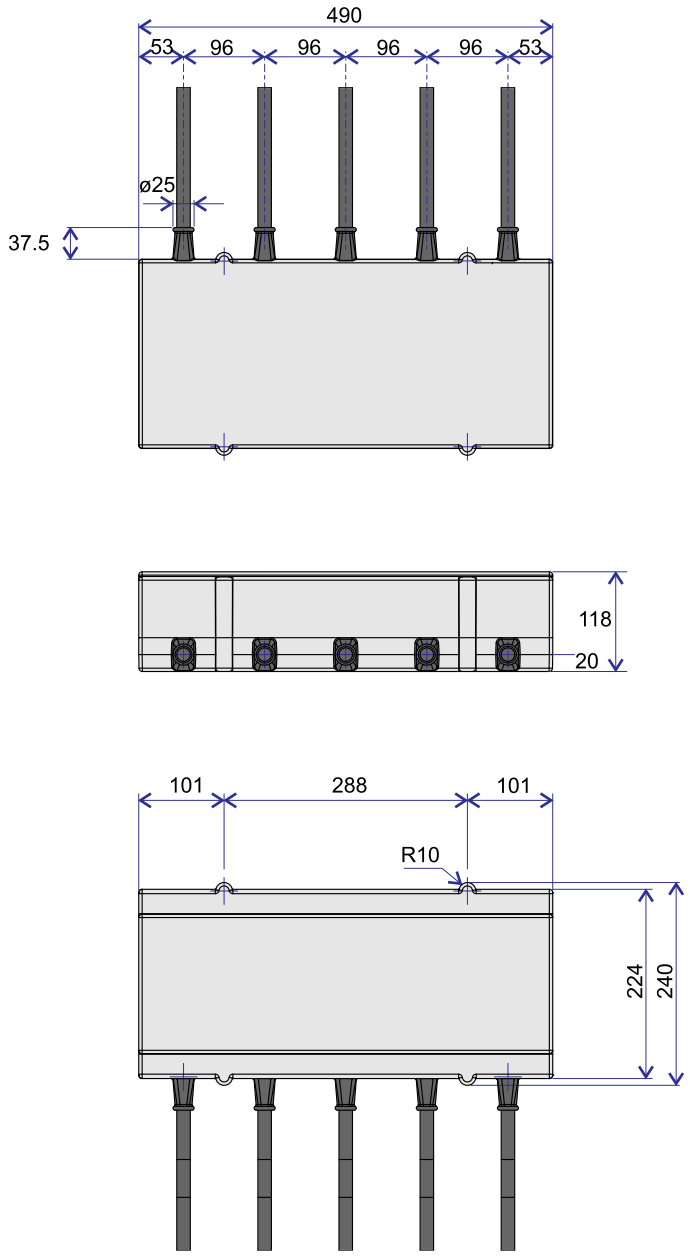
221048 Transducer TX2 dimensions



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Information may be omitted. Observe the source drawing for additional details.

[221048] Rev.B
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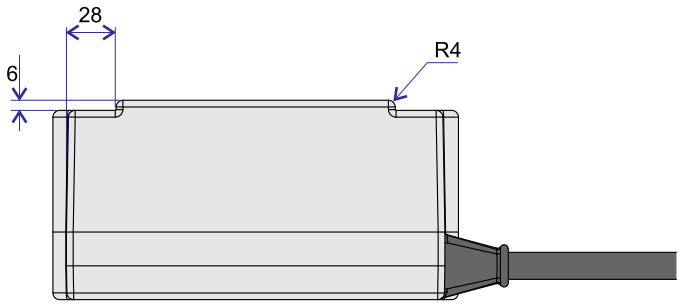

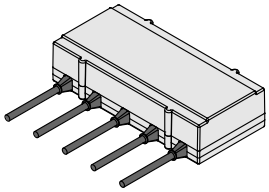

All measurements in mm.
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Information may be omitted. Observe the source drawing for additional details.

[221048] Rev.B
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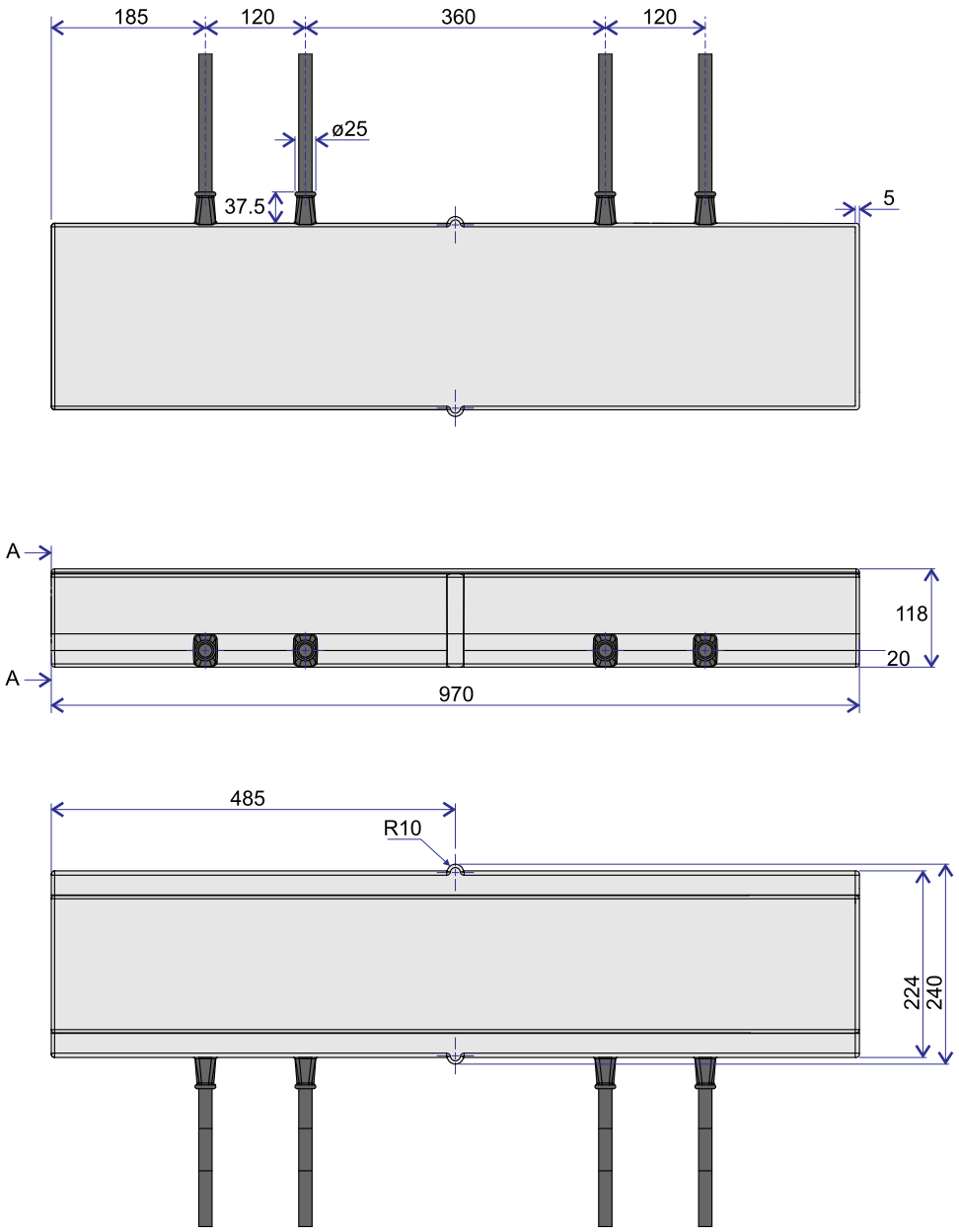
219621 Transducer RX1 dimensions



All measurements in mm.
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Information may be omitted. Observe the source drawing for additional details.

[219621] Rev.A
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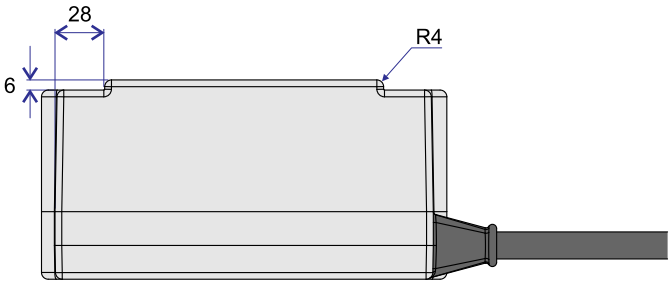
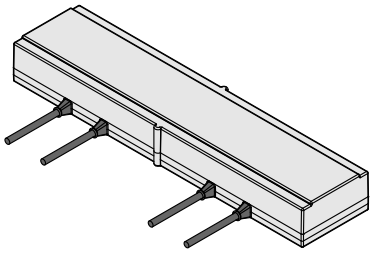


Section A-A



All measurements in mm.
The drawing is not in scale.
Information may be omitted. Observe the source drawing for additional details.

[219621] Rev.A
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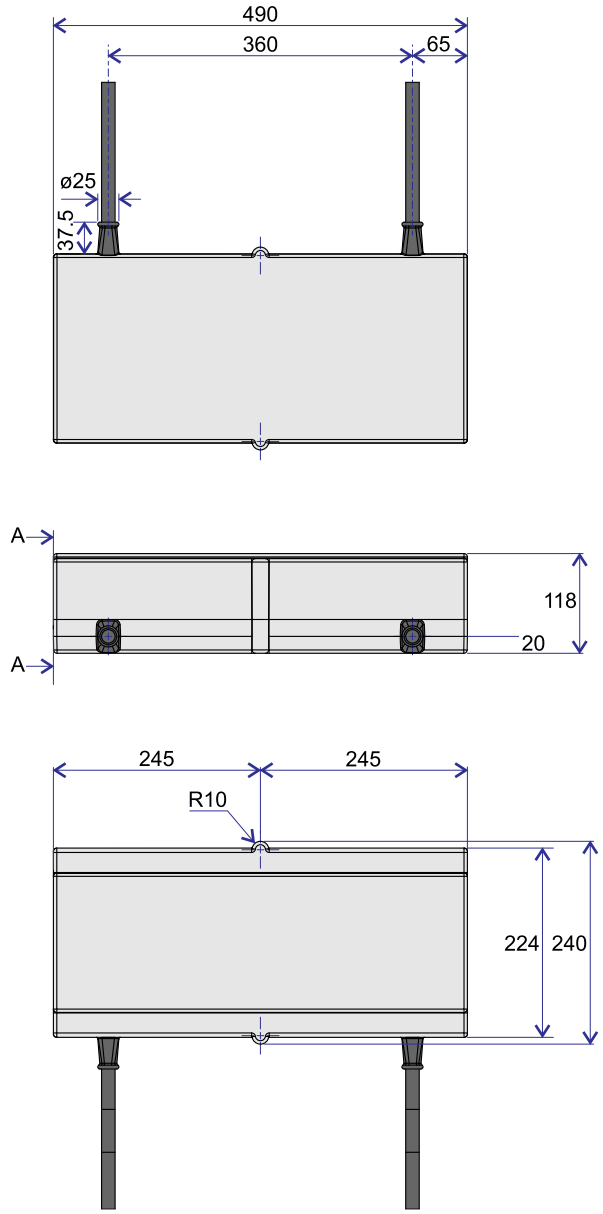
216146 Transducer RX2 dimensions



All measurements in mm.
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Information may be omitted. Observe the source drawing for additional details.

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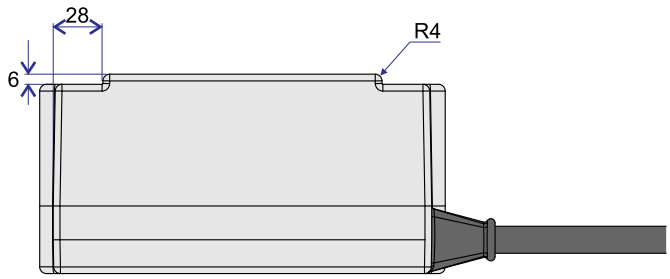
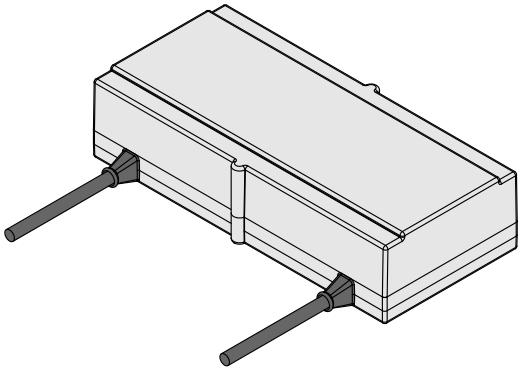


Section A-A



All measurements in mm.
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Information may be omitted. Observe the source drawing for additional details.

[216146] Rev.A
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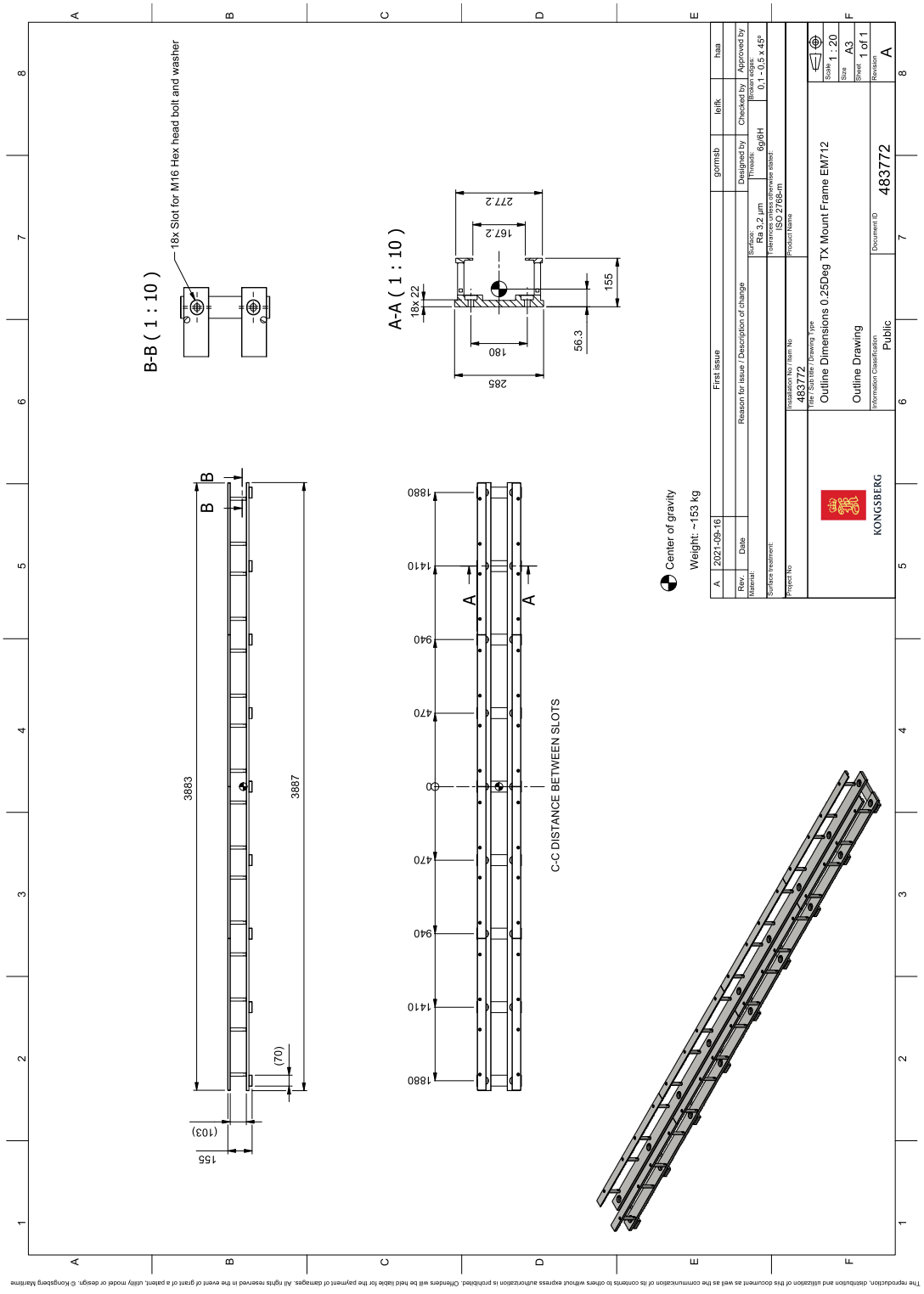
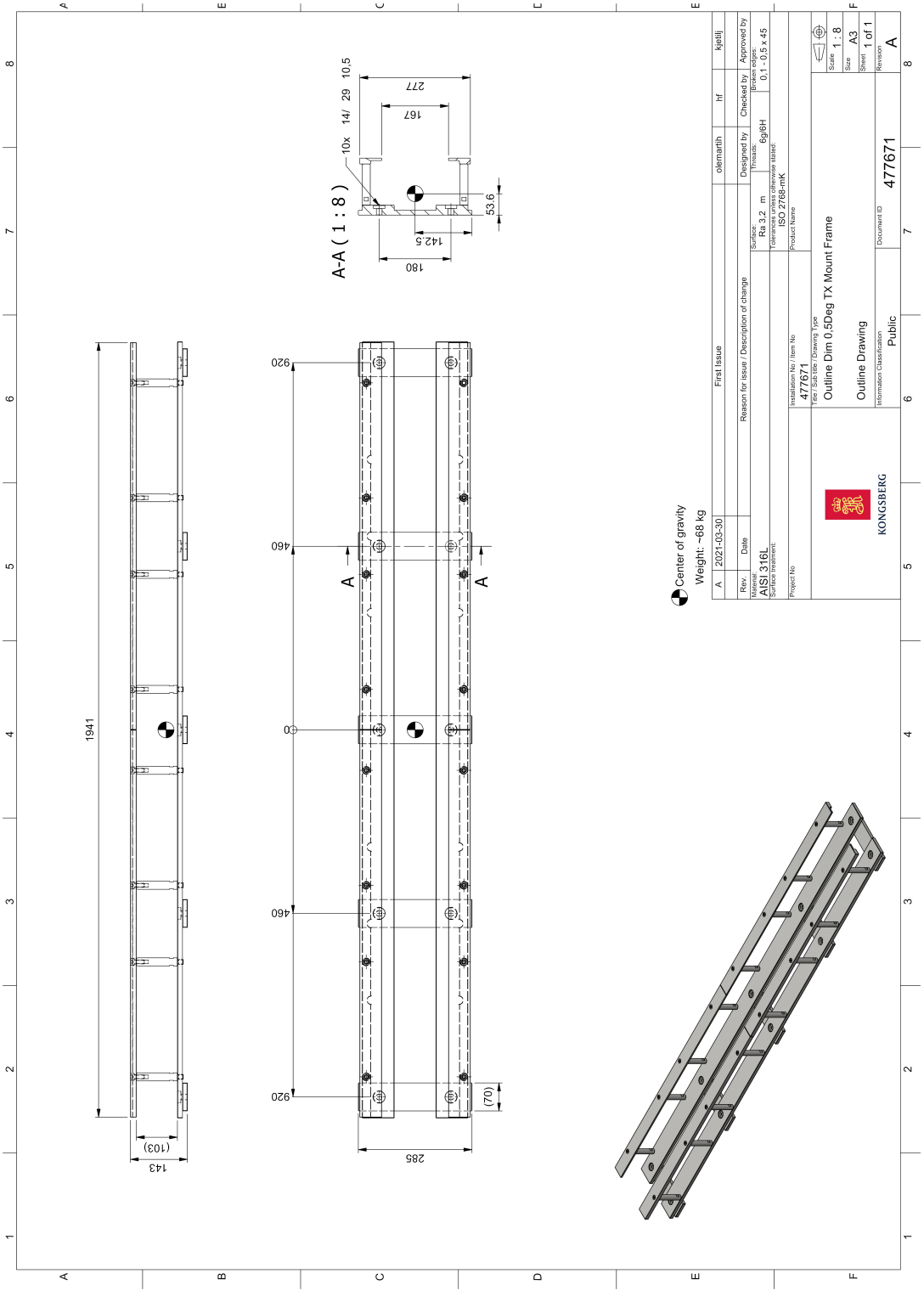
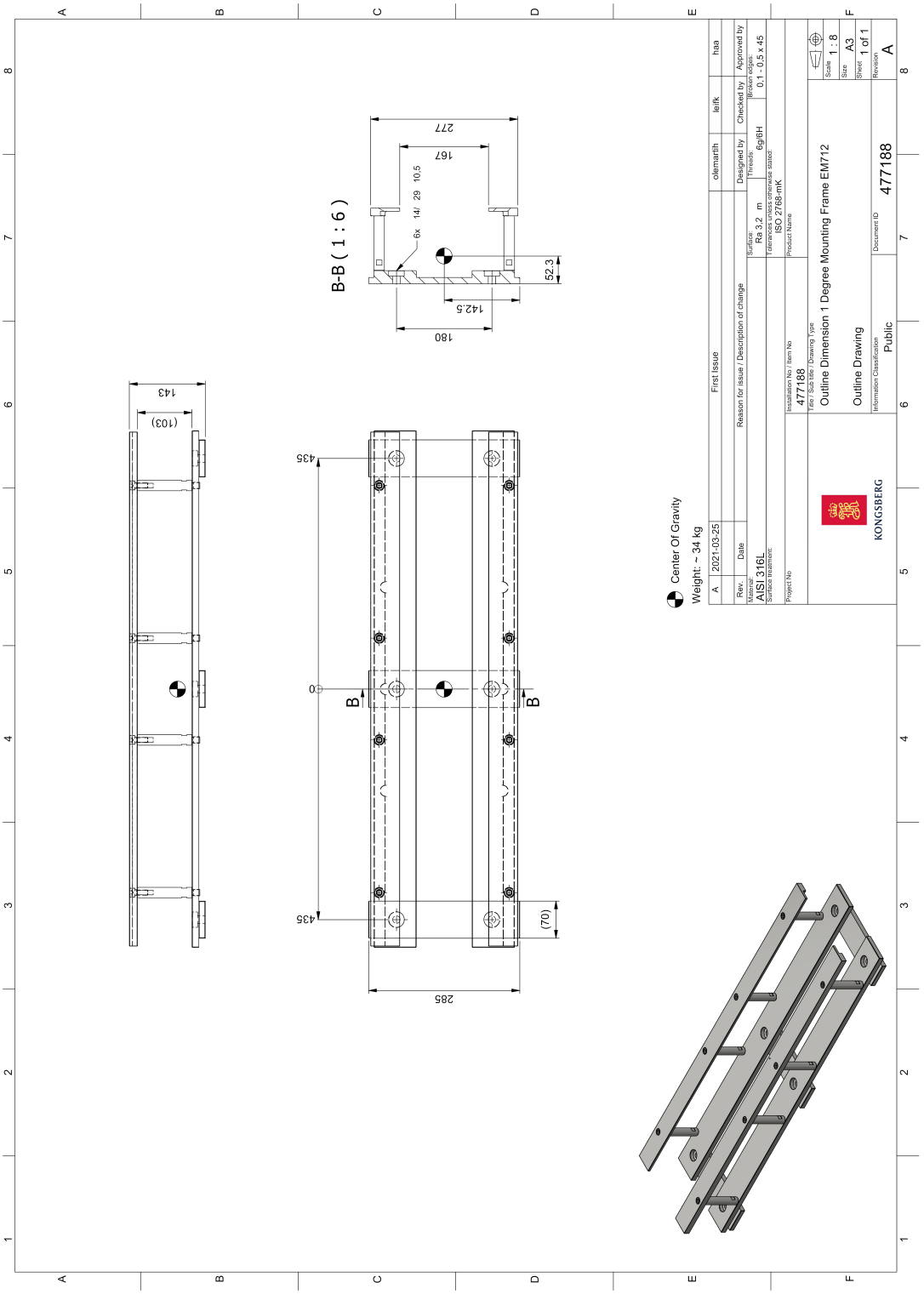
483772 Transducer mounting frame - 0.25°



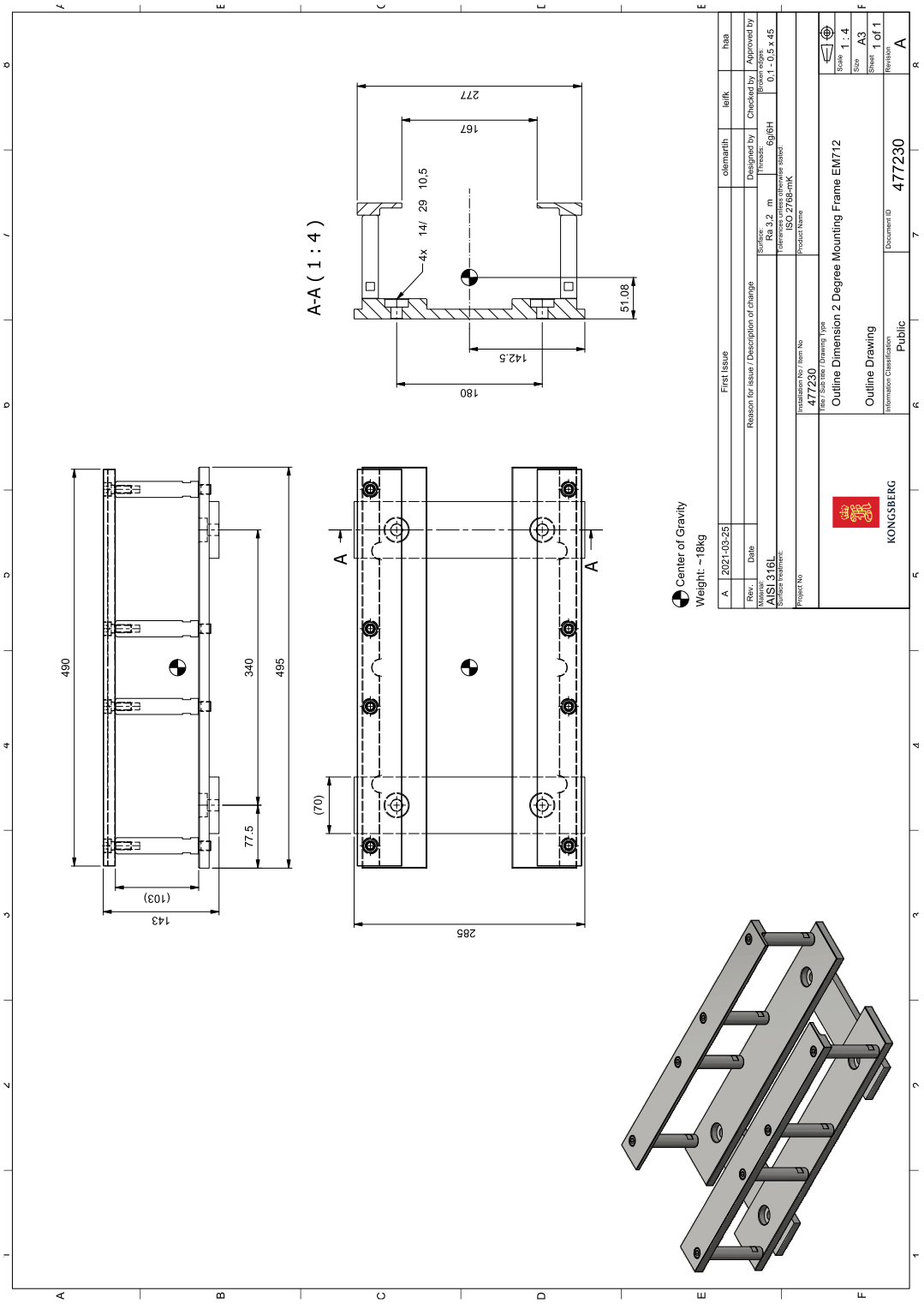
477671 Transducer mounting frame - 0.5°



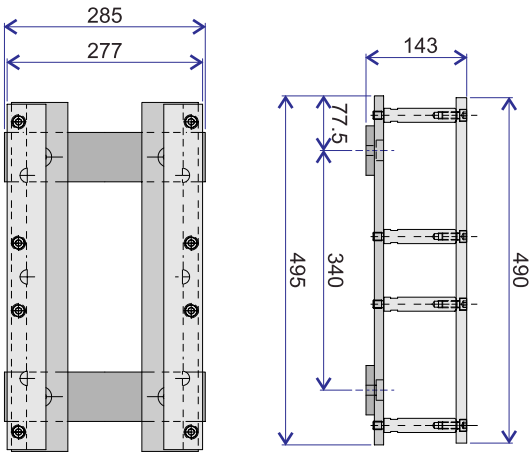
477188 Casing - 1°



477230 Casing w/mounting frame - 2°

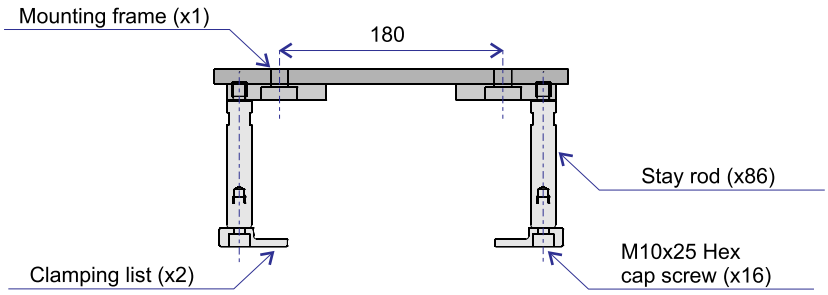


223273 Transducer mounting frame - 2°



All measurements in mm.
The drawing is not in scale.
Information may be omitted. Observe the source drawing for additional details.

[223273] Rev.B
CD12_223273_001_001



All measurements in mm.
The drawing is not in scale.
Information may be omitted. Observe the source drawing for additional details.

[223273] Rev.A
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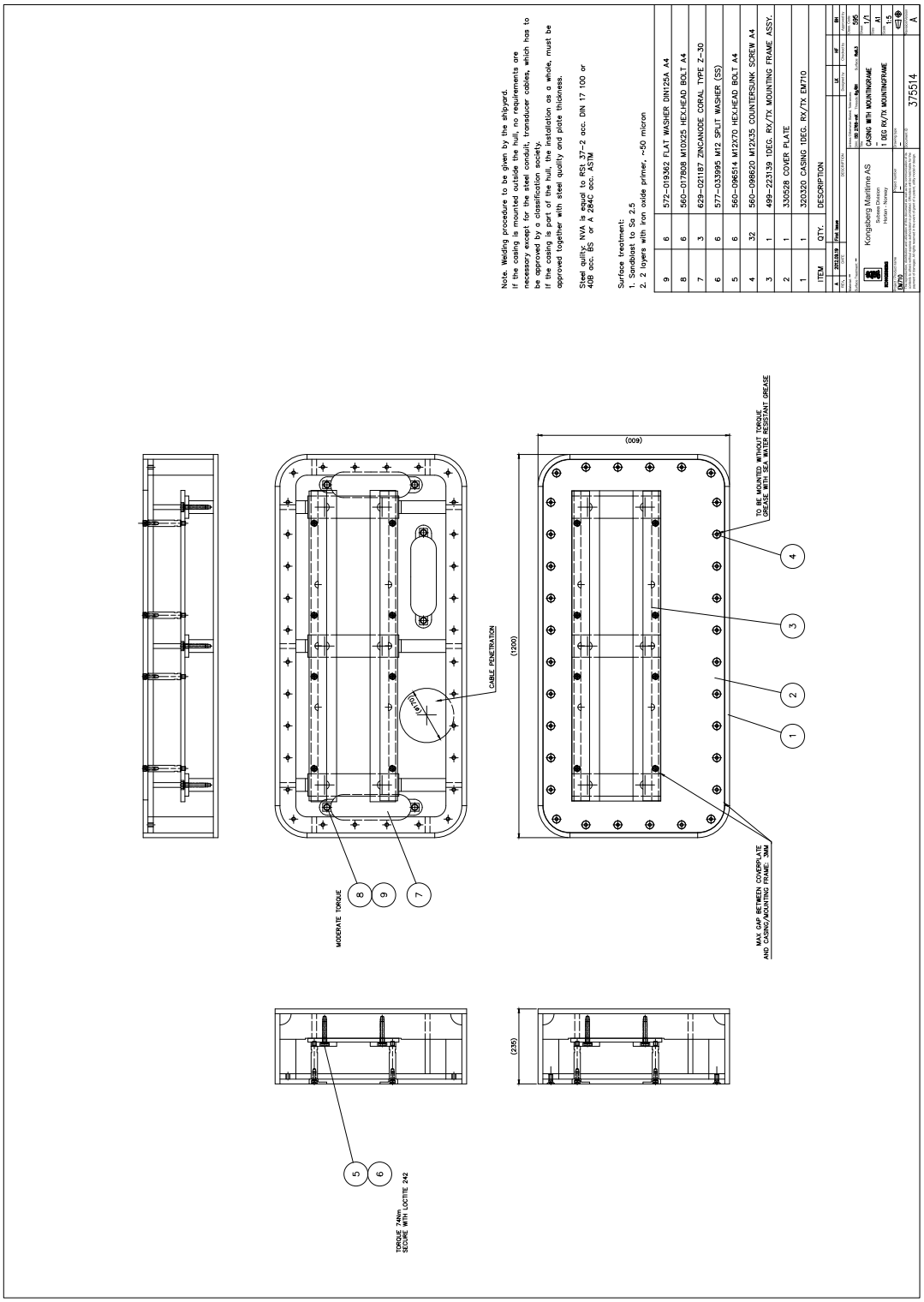
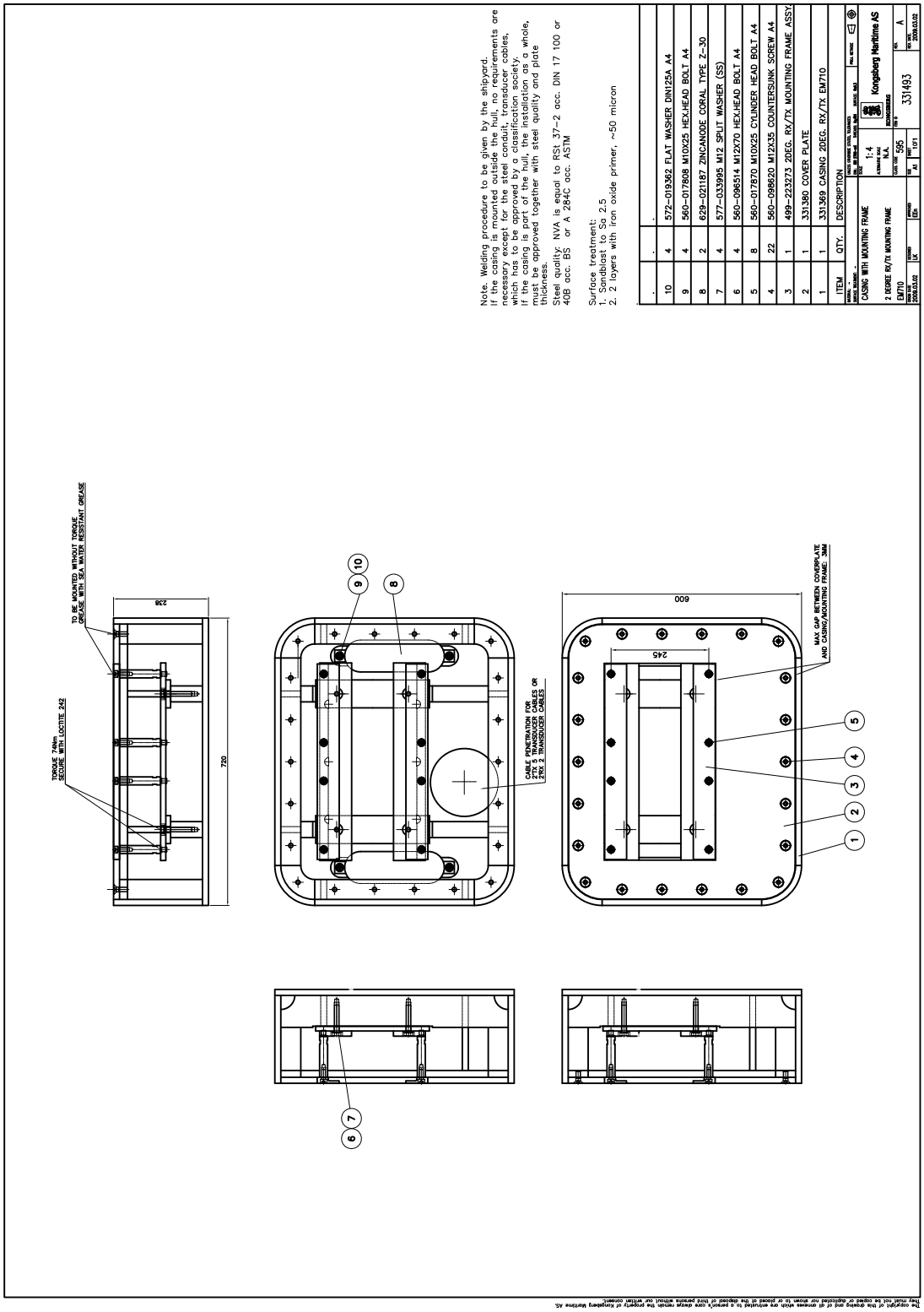
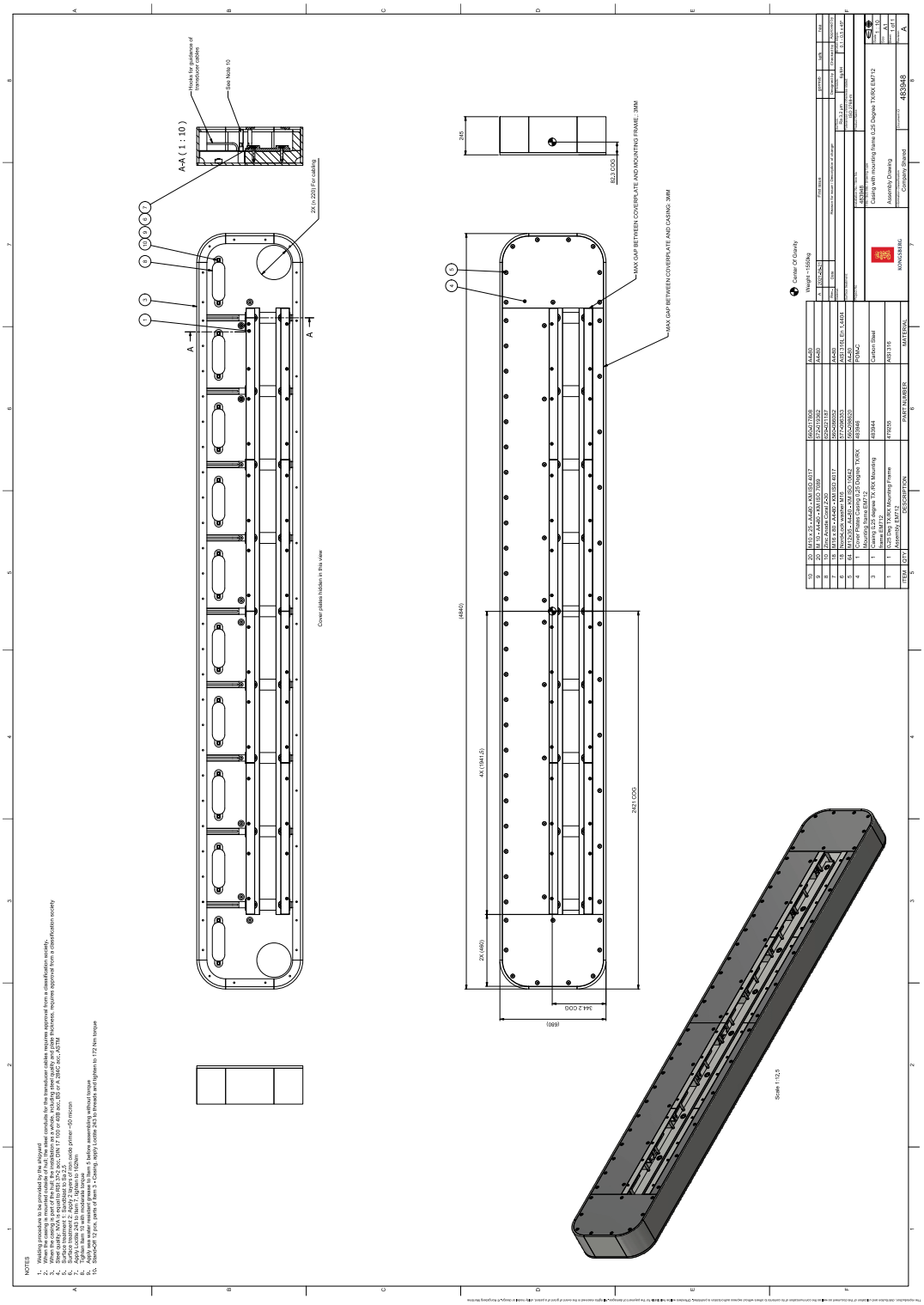
375514 Casing Arrangement - 1°



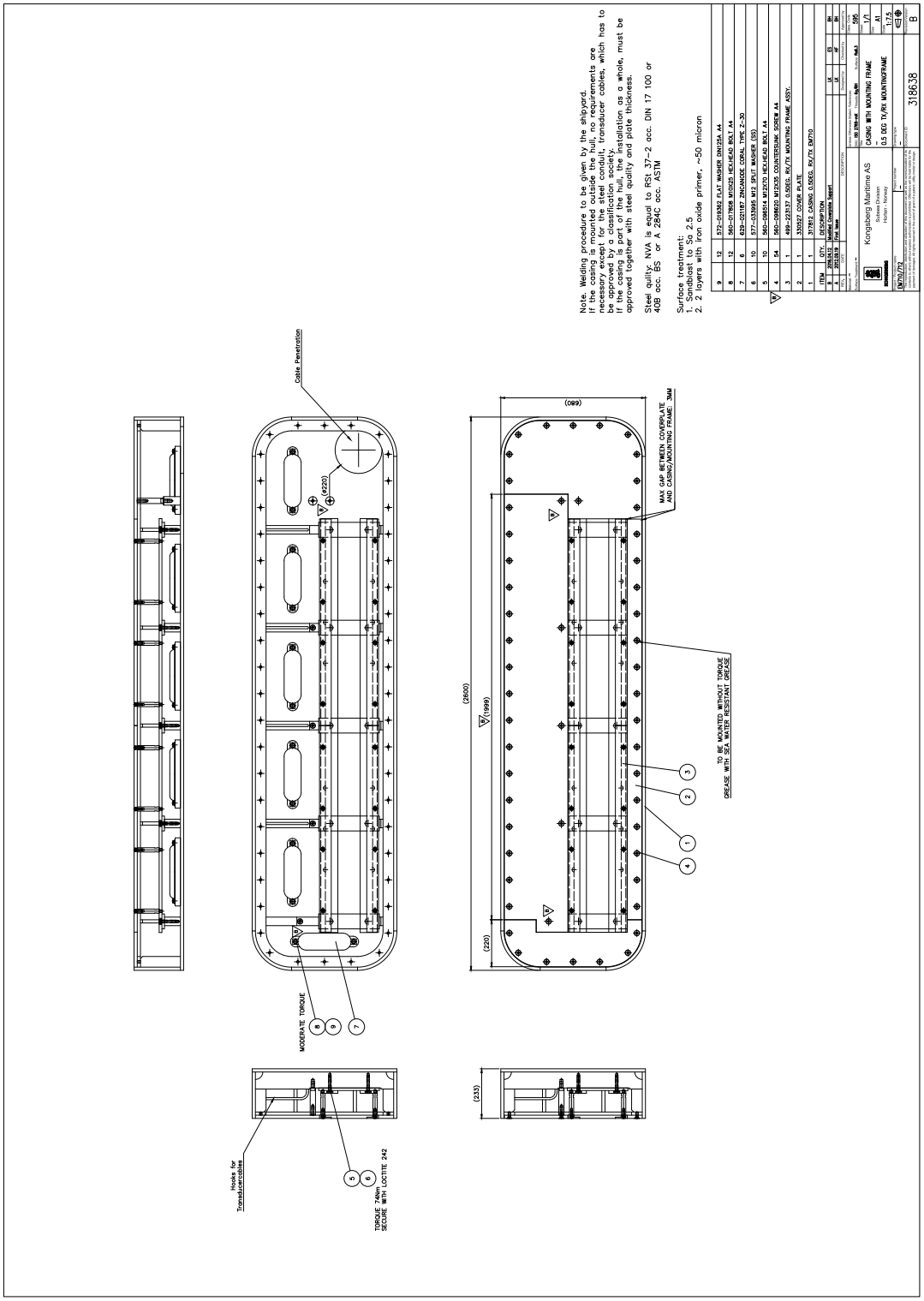
331493 Casing Arrangement - 2°



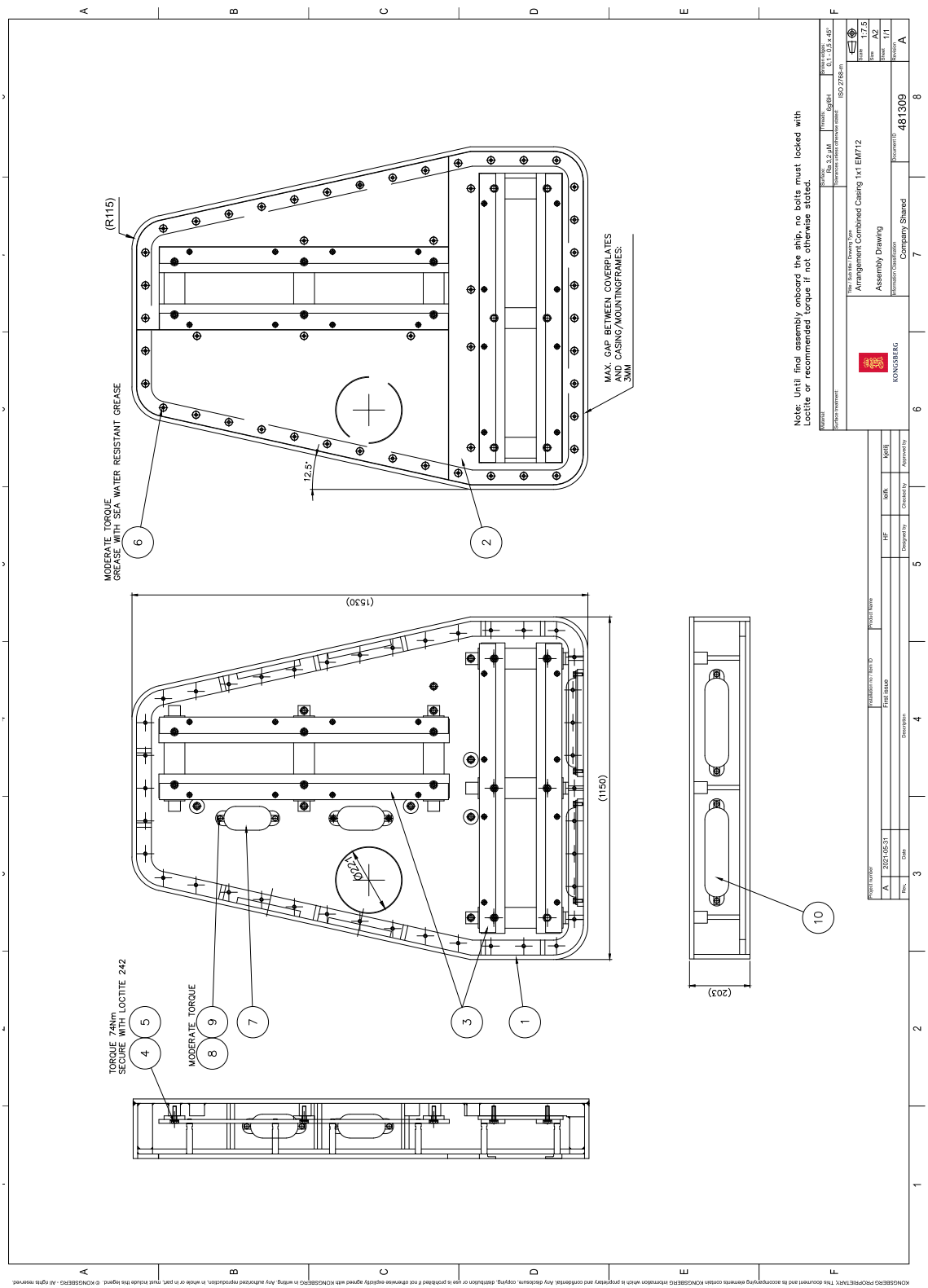
483948 Casing Arrangement - 0.25°



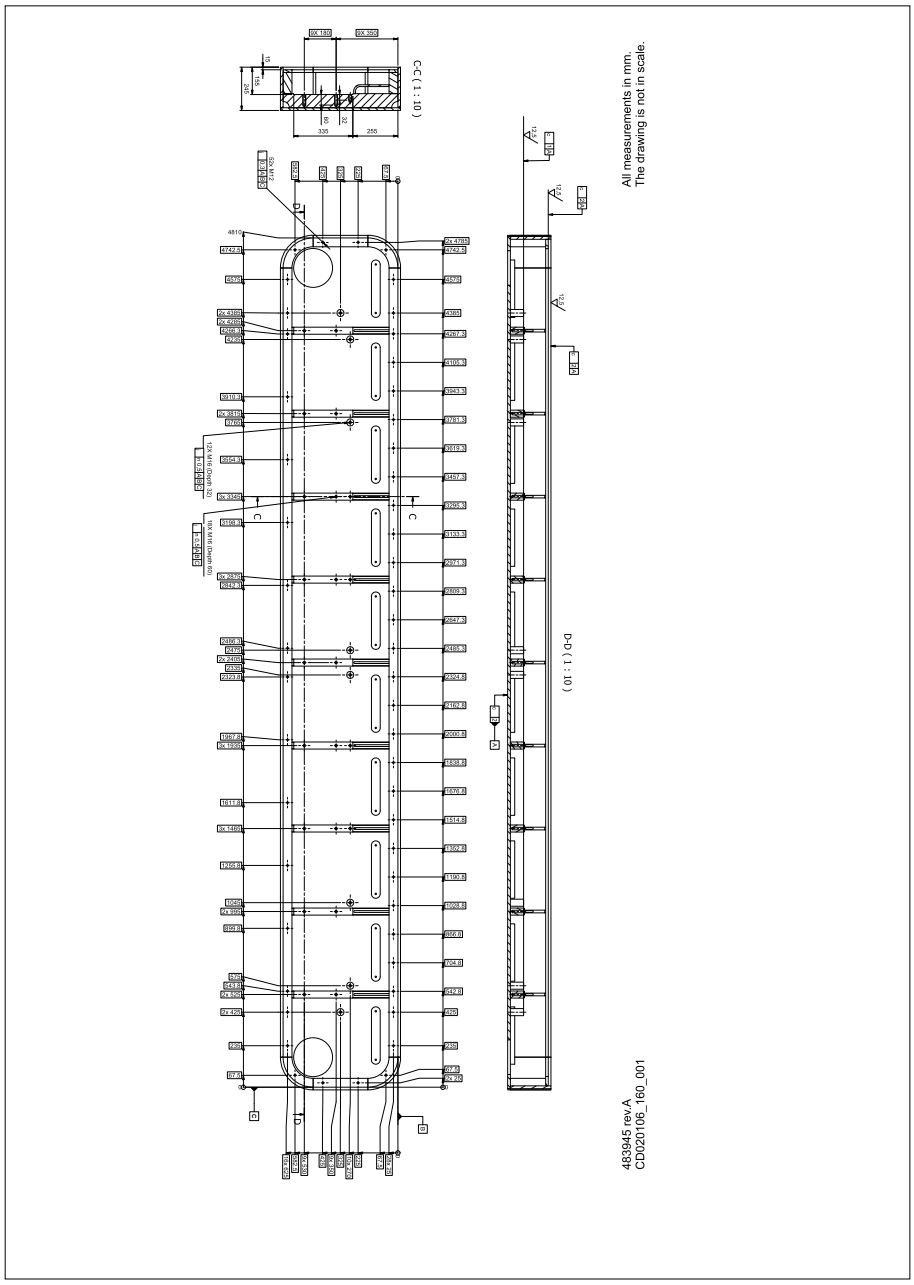
318638 Casing Arrangement - 0.5°



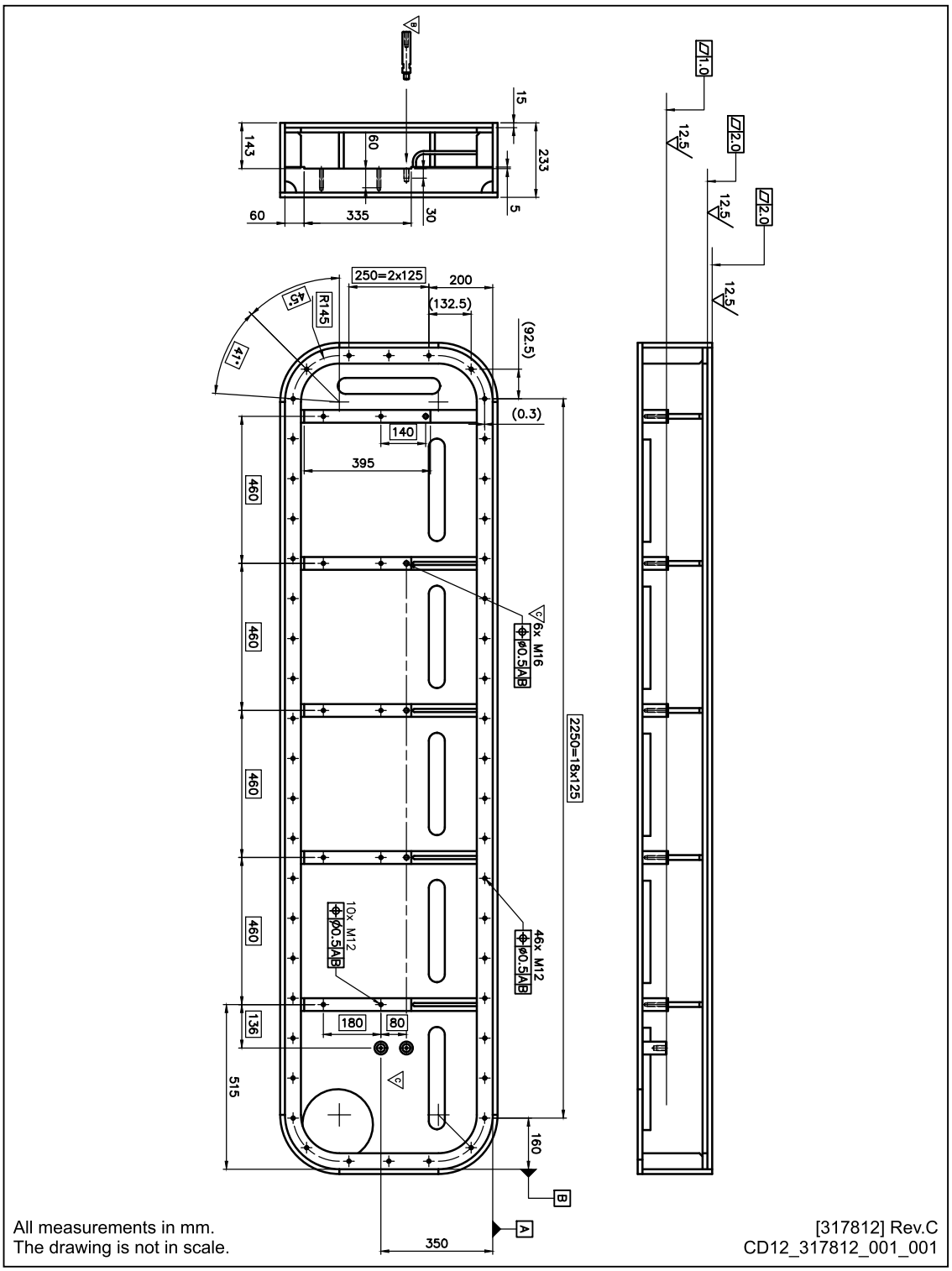
481309 Casing Arrangement Combined - 1°



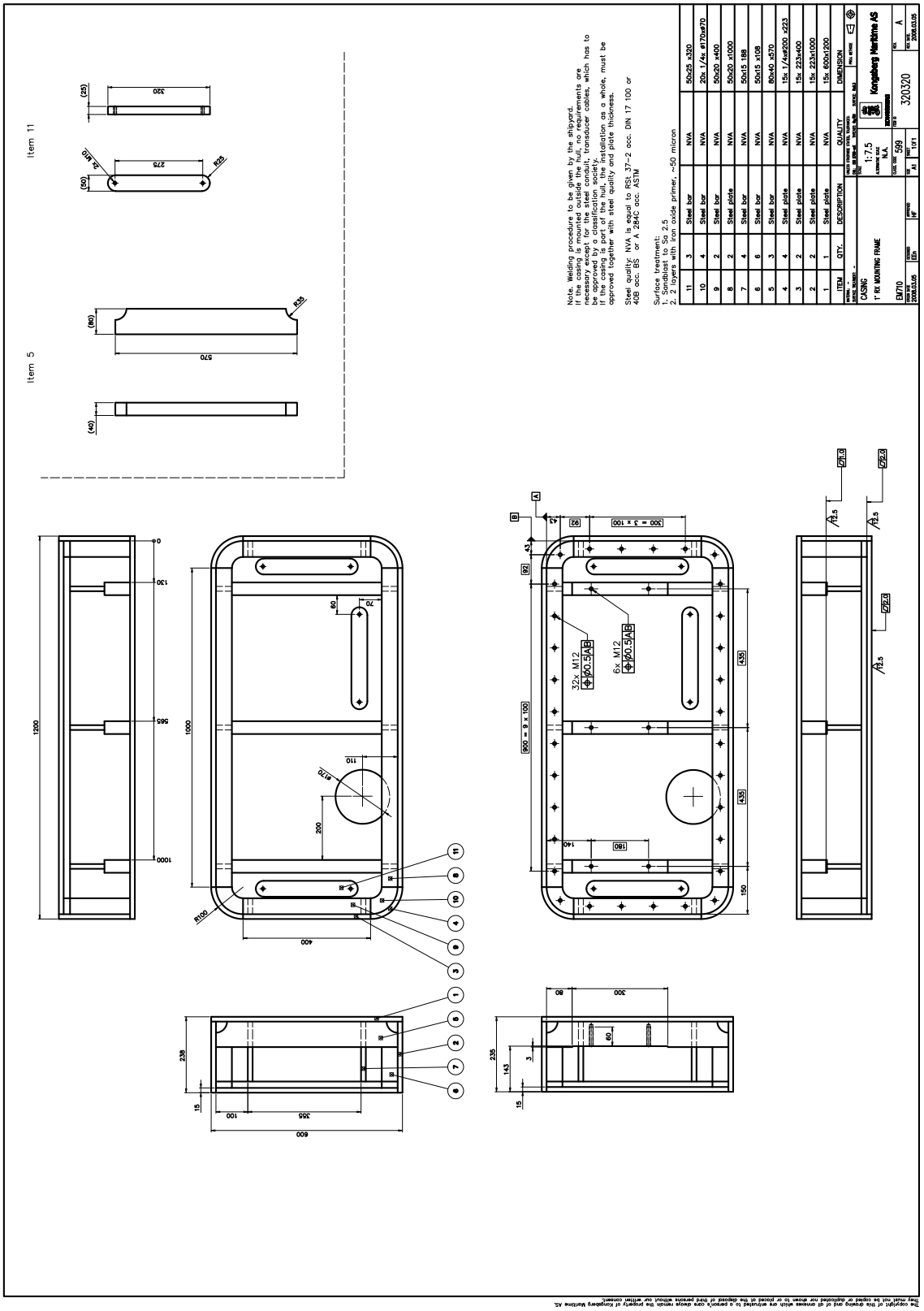
483945 Casing - 0.25°



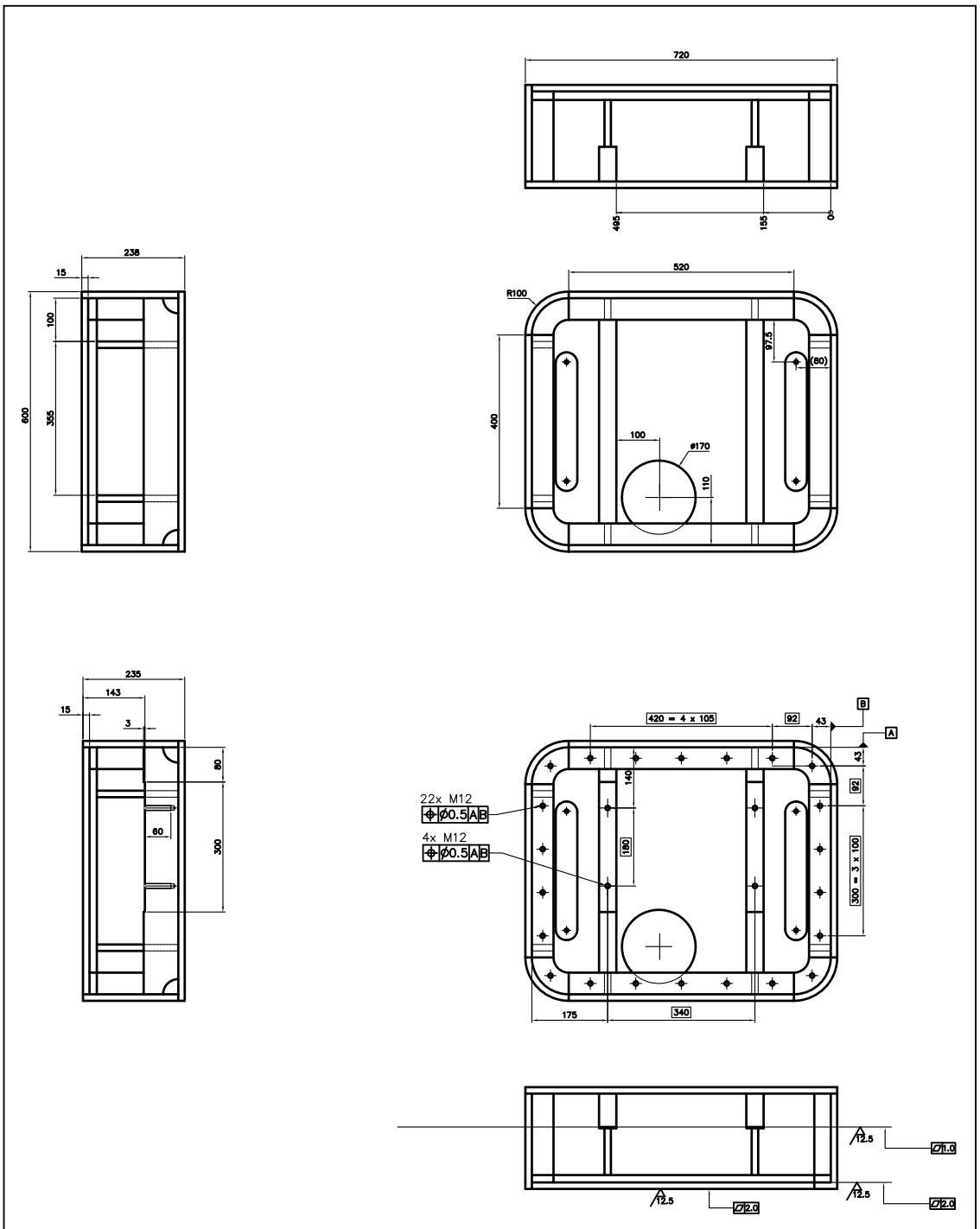
317812 Casing - 0.5°



320320 Casing - 1°



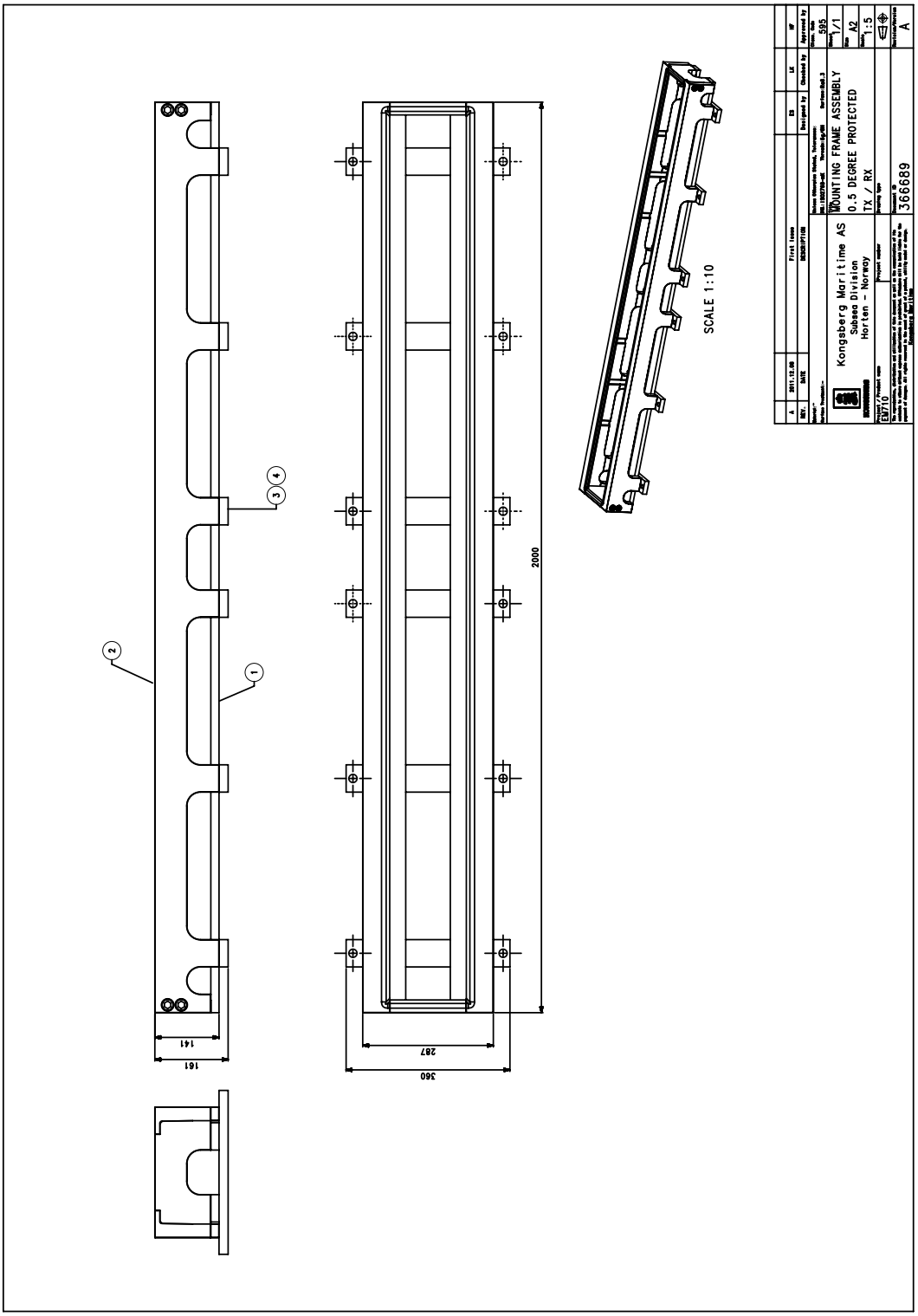
331369 Casing - 2°



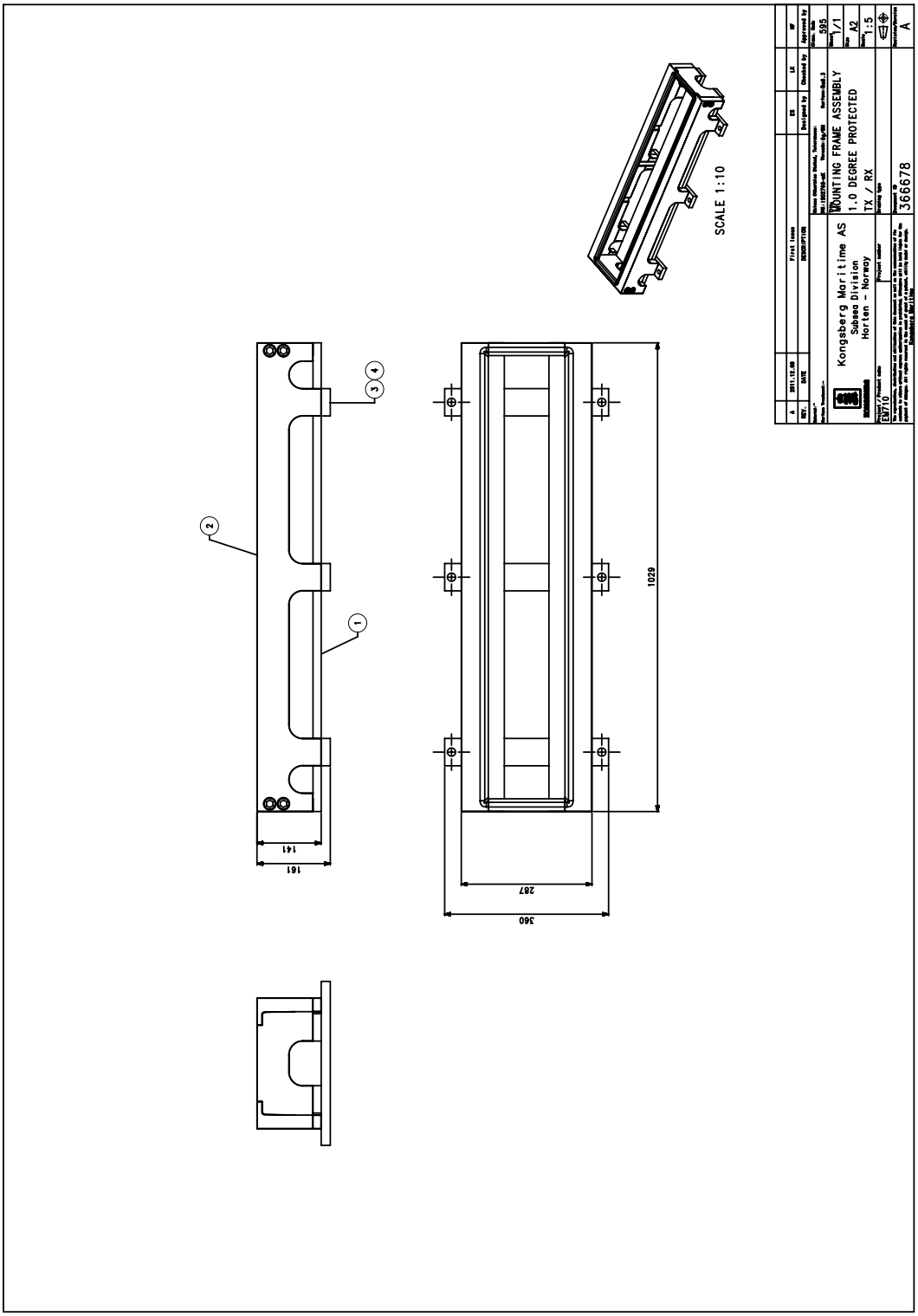
All measurements in mm.
The drawing is not in scale.

[331369] Rev.A
CD12_331369_001_001

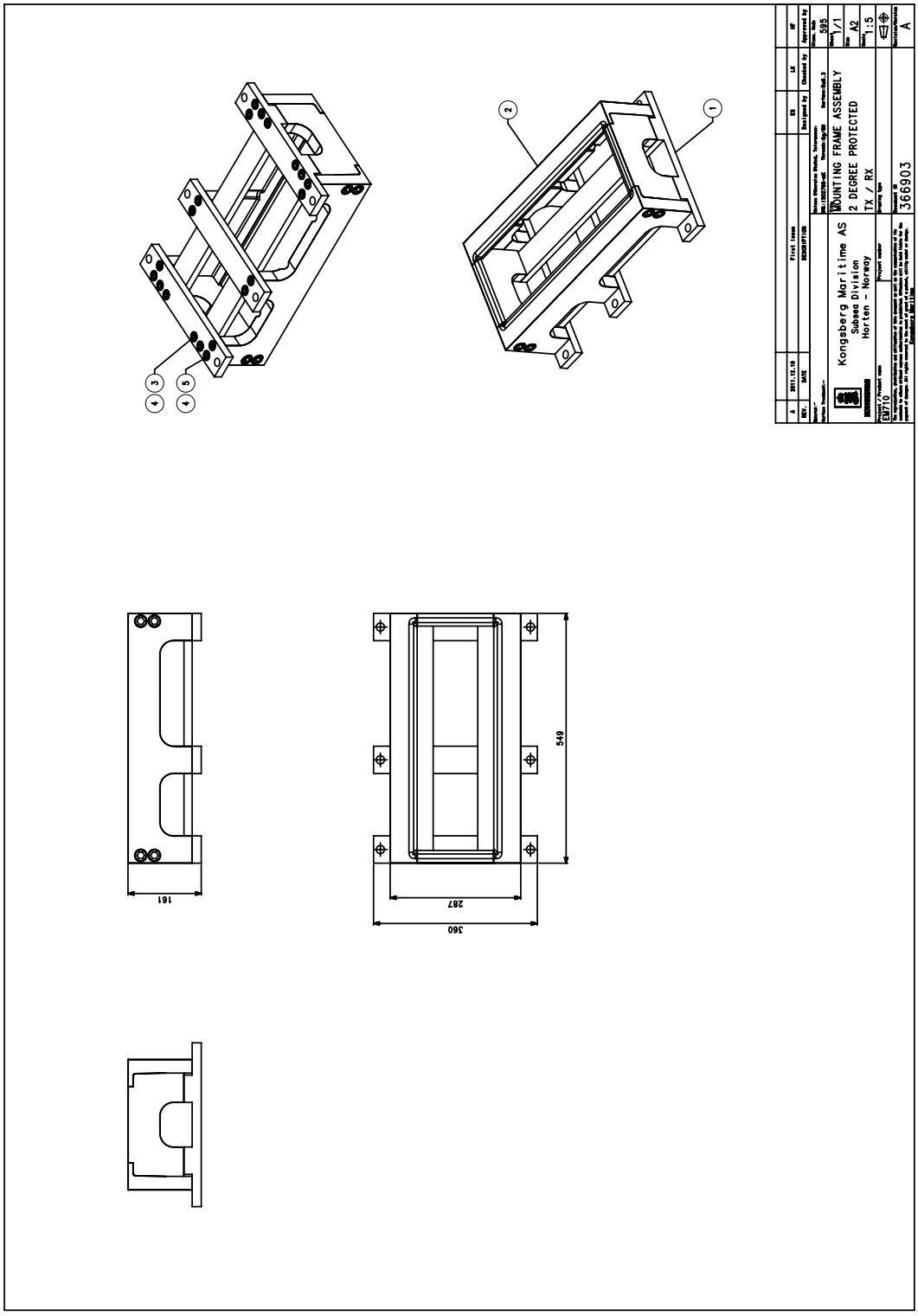
366689 Mounting frame, ice protected - 0.5°



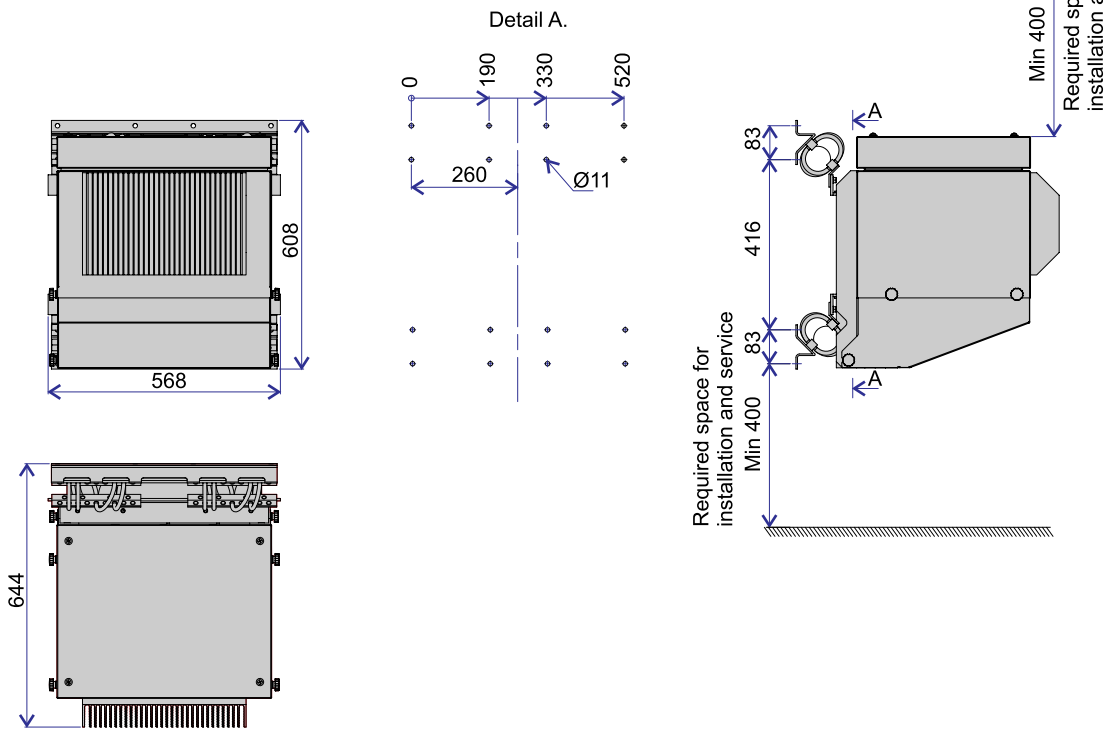
366678 Mounting frame, ice protected - 1°



366903 Mounting frame, ice protected - 2°



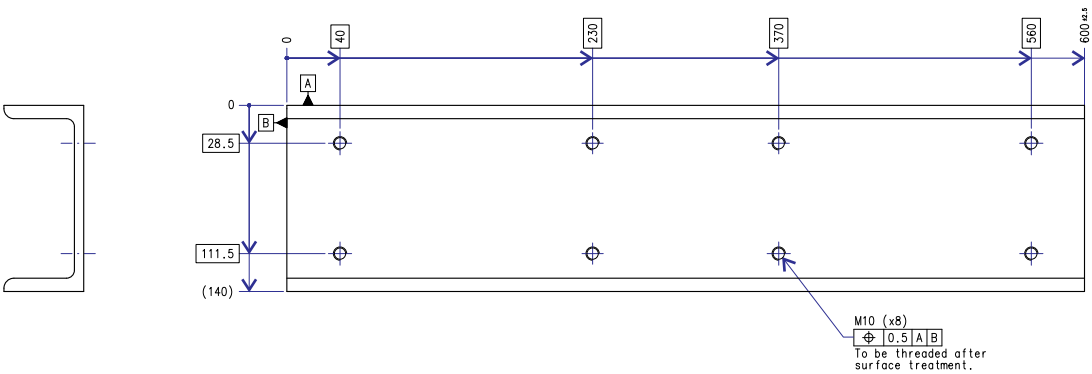
396402 EM 712 Transmitter Unit dimensions

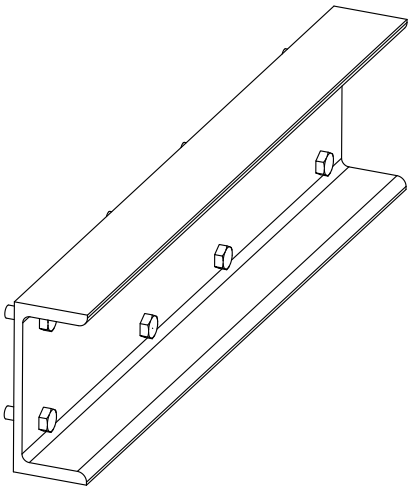


All measurements in mm.
The drawing is not in scale.

[396402] Rev.A
CD12_396402_001_001

212984 EM 712 Optional Mounting bracket

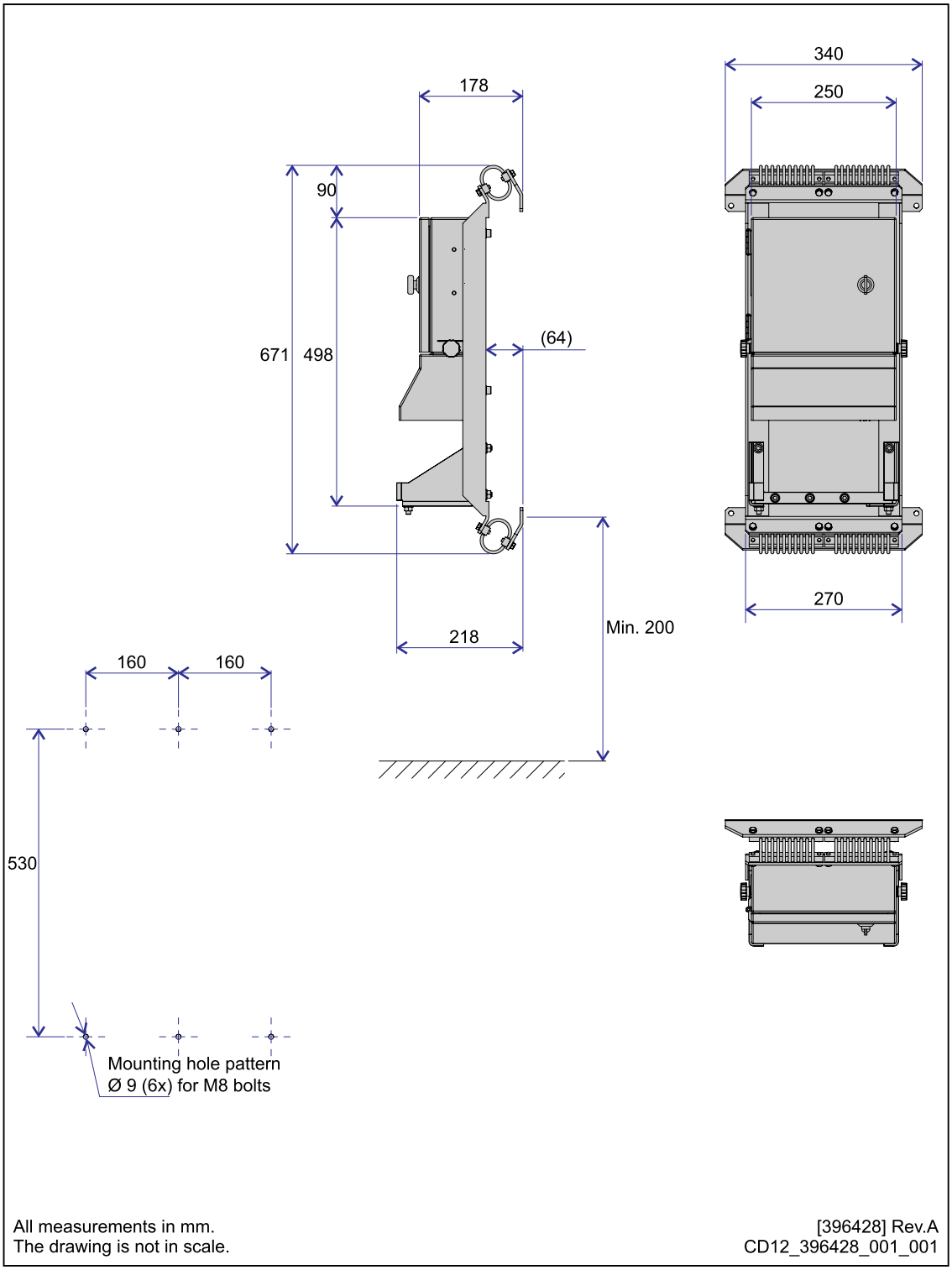




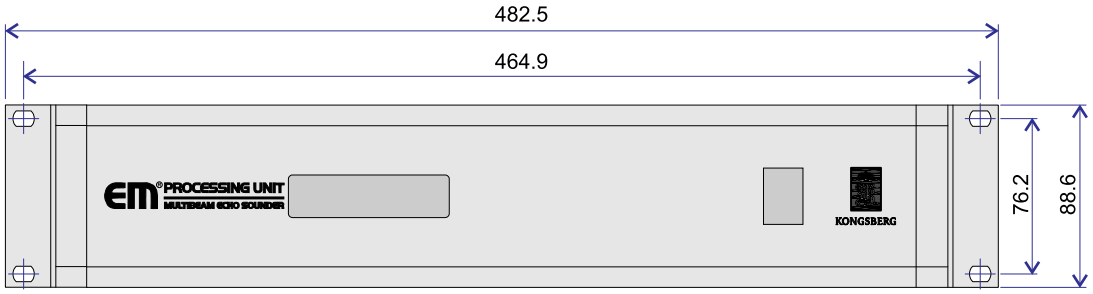
All measurements in mm.
The drawing is not in scale.
Information may be omitted. Observe the source drawing for additional details.

[212984] Rev.A
CD12_212984_001_001

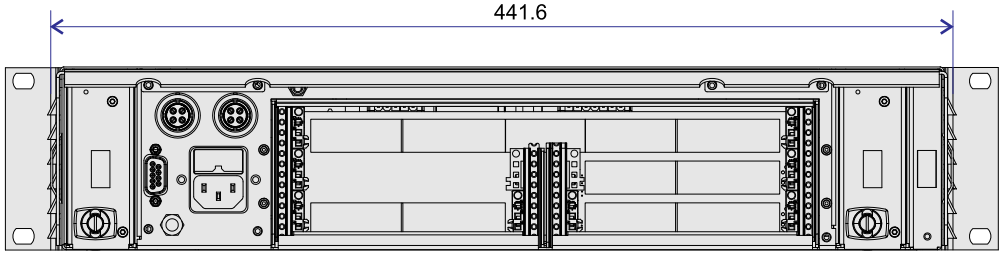
396428 EM 712 Receiver Unit dimensions



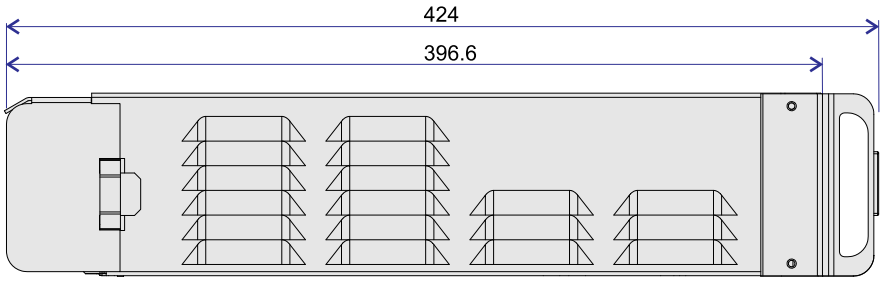
385422 Processing Unit dimensions



Front View



Rear View



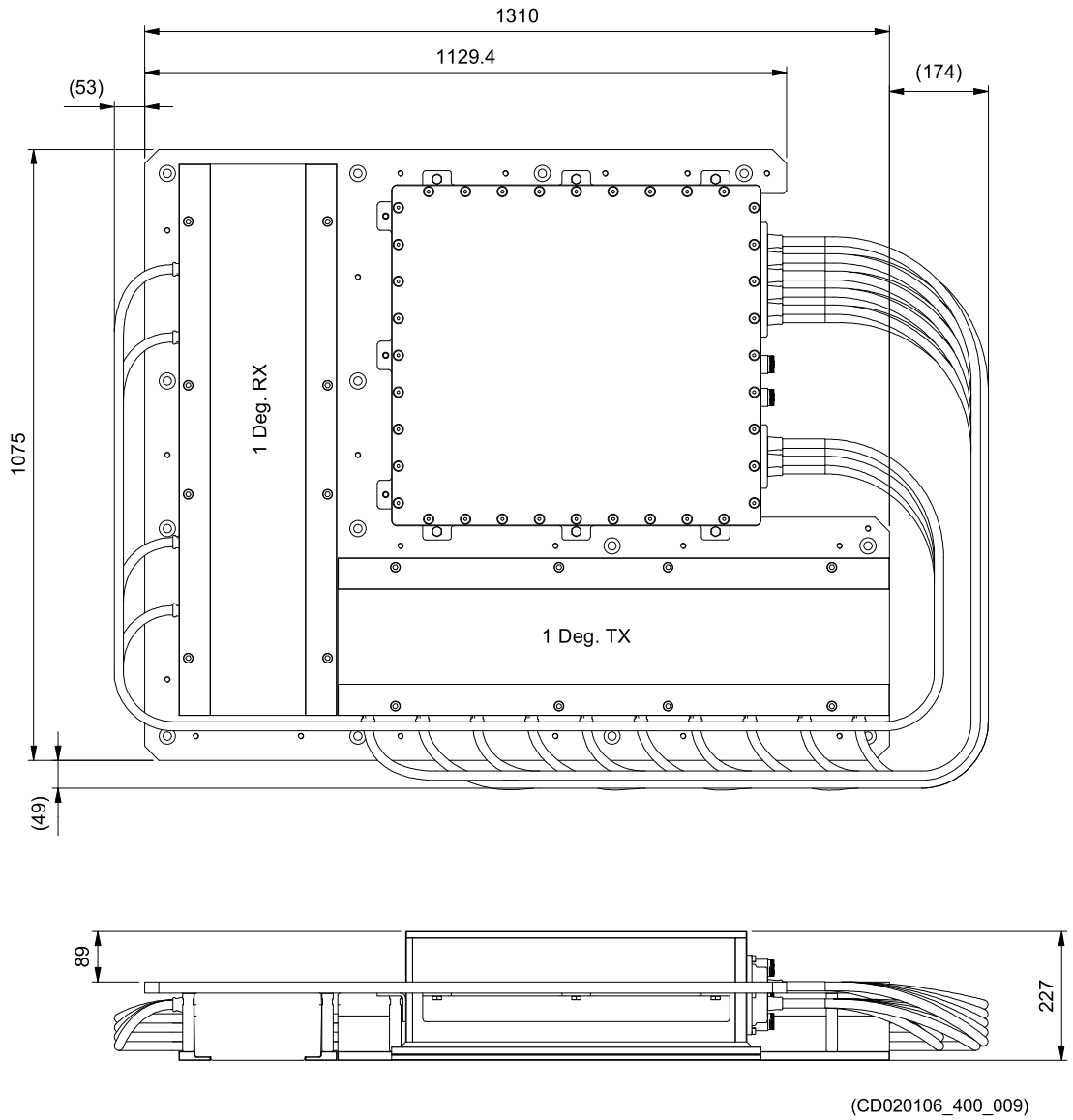
Side View

Weight: 10.5 kg

All measurements in mm.
The drawing is not in scale.

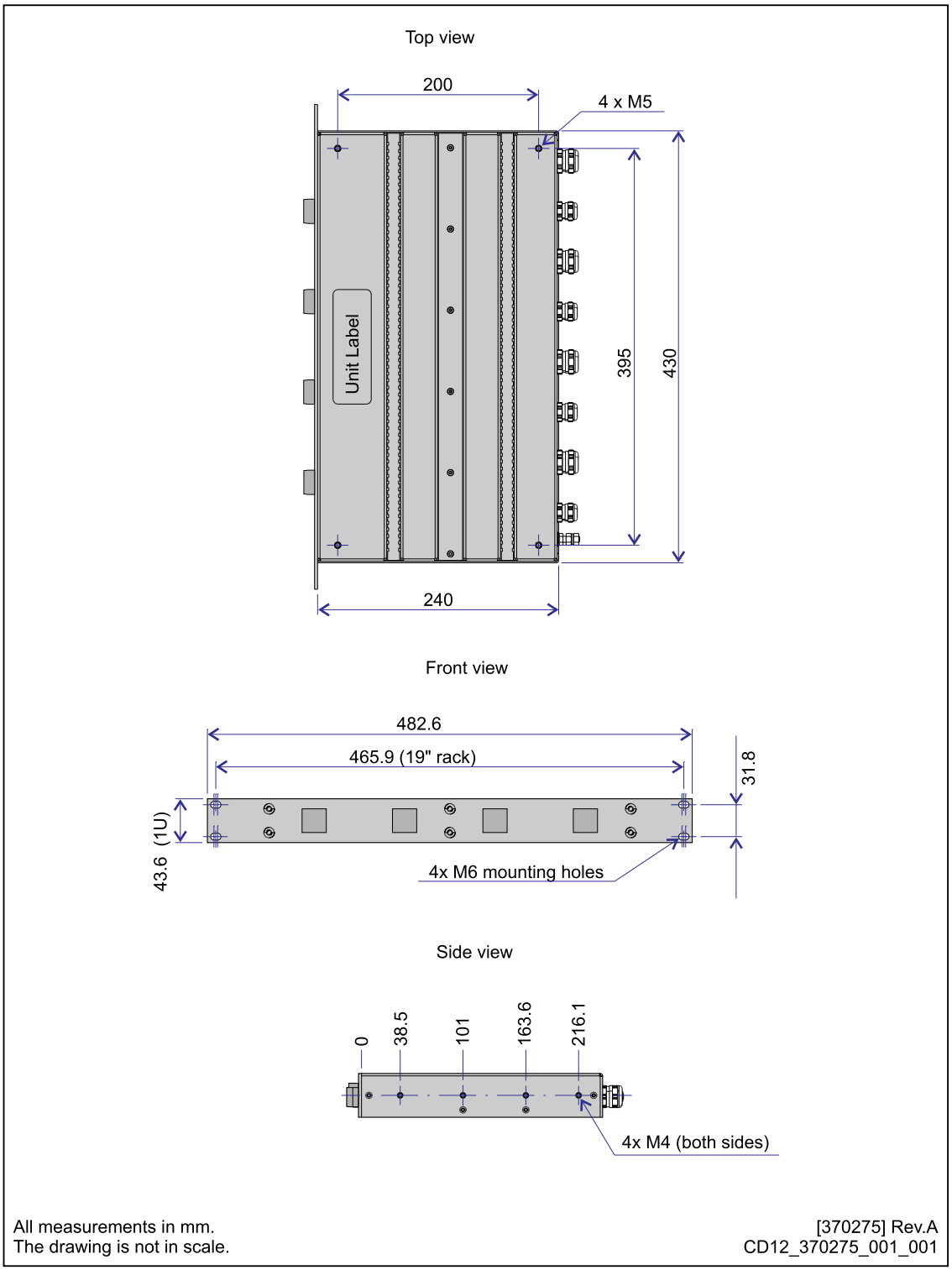
[385422] Rev.B
CD12_385422_001_001

1x1 EM 712 USV dimensions



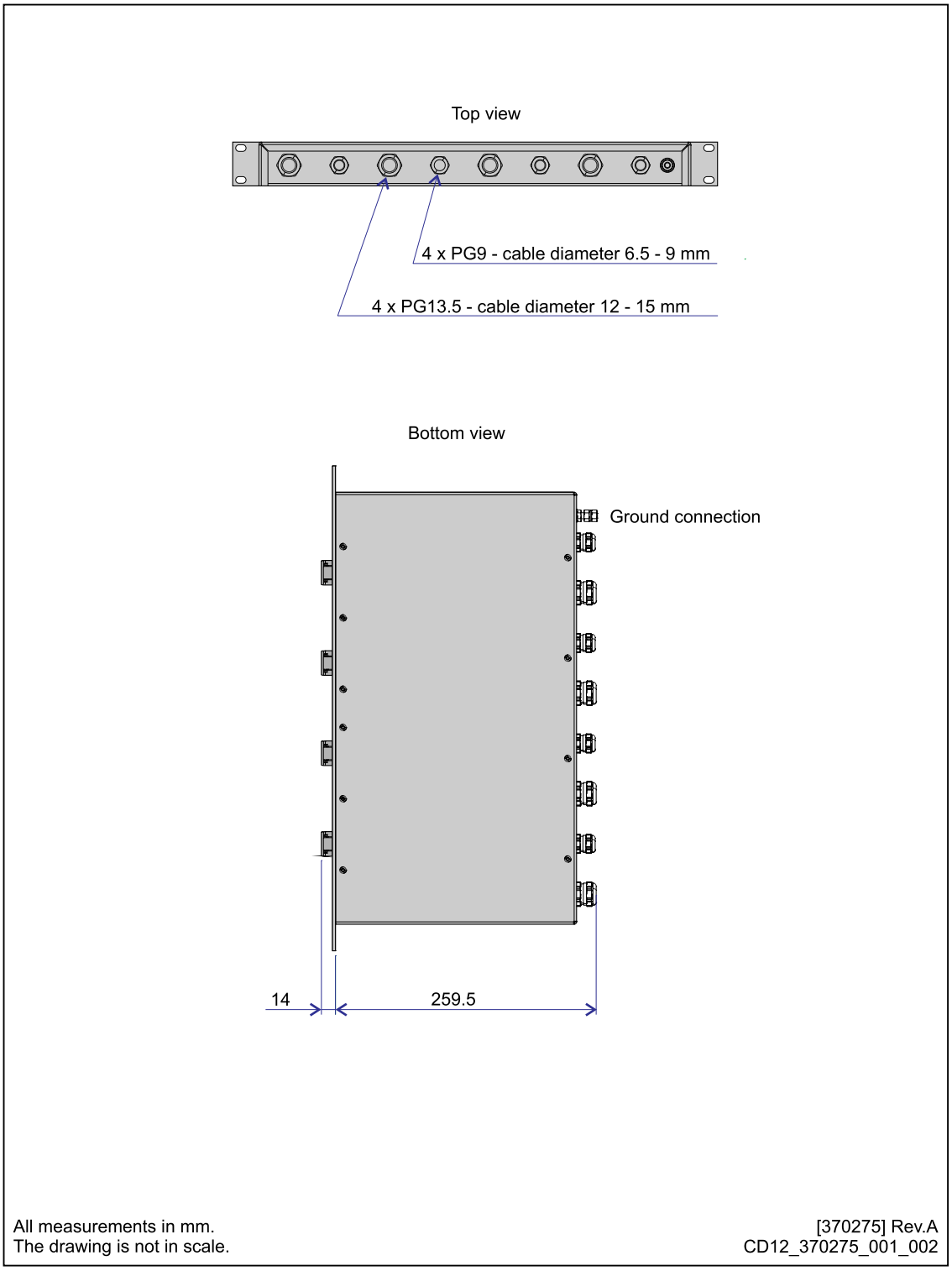
(CD020106_400_009)

370275 Remote Control Unit (K-REM) dimensions

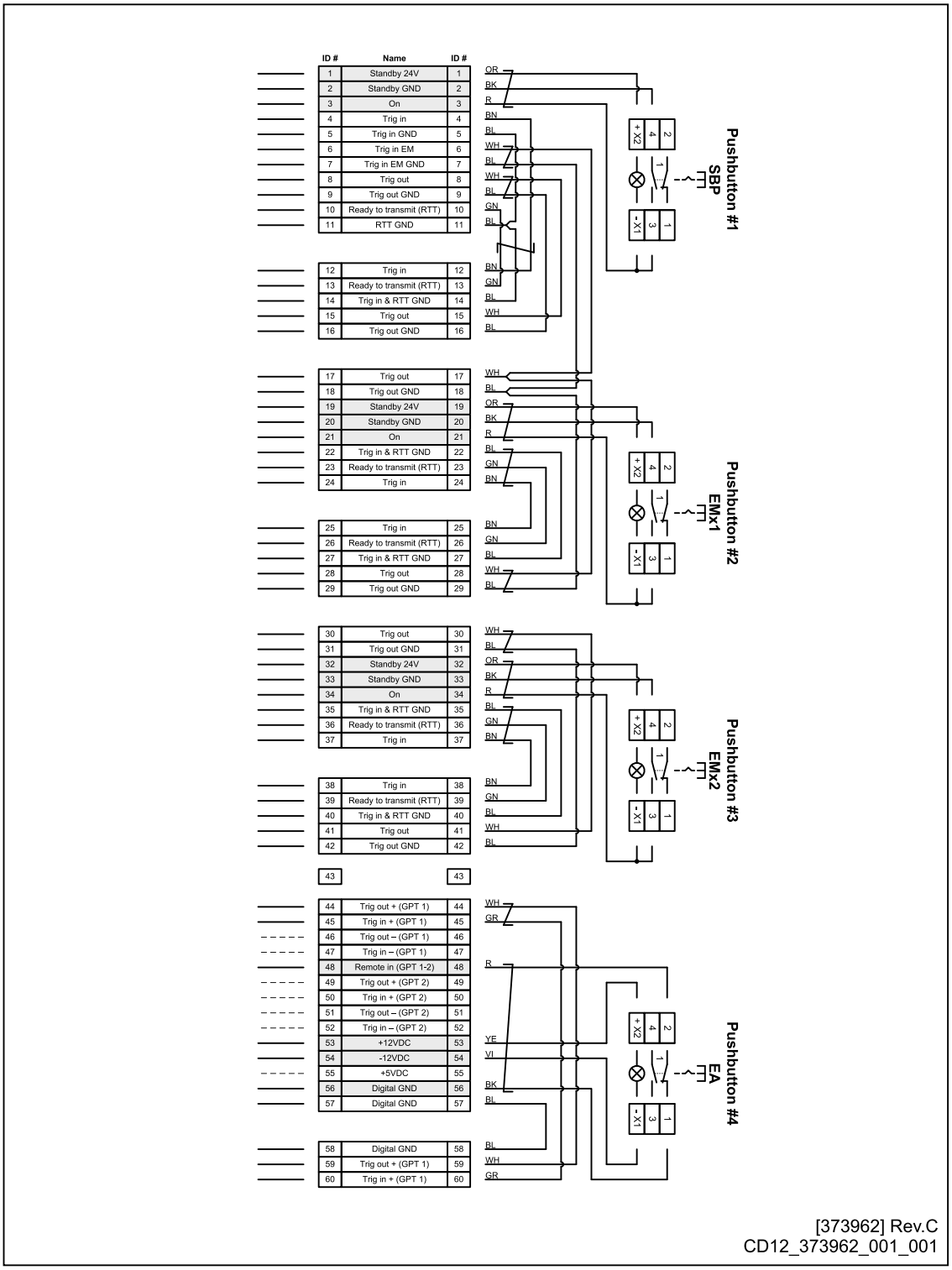


All measurements in mm.
The drawing is not in scale.

[370275] Rev.A
CD12_370275_001_001

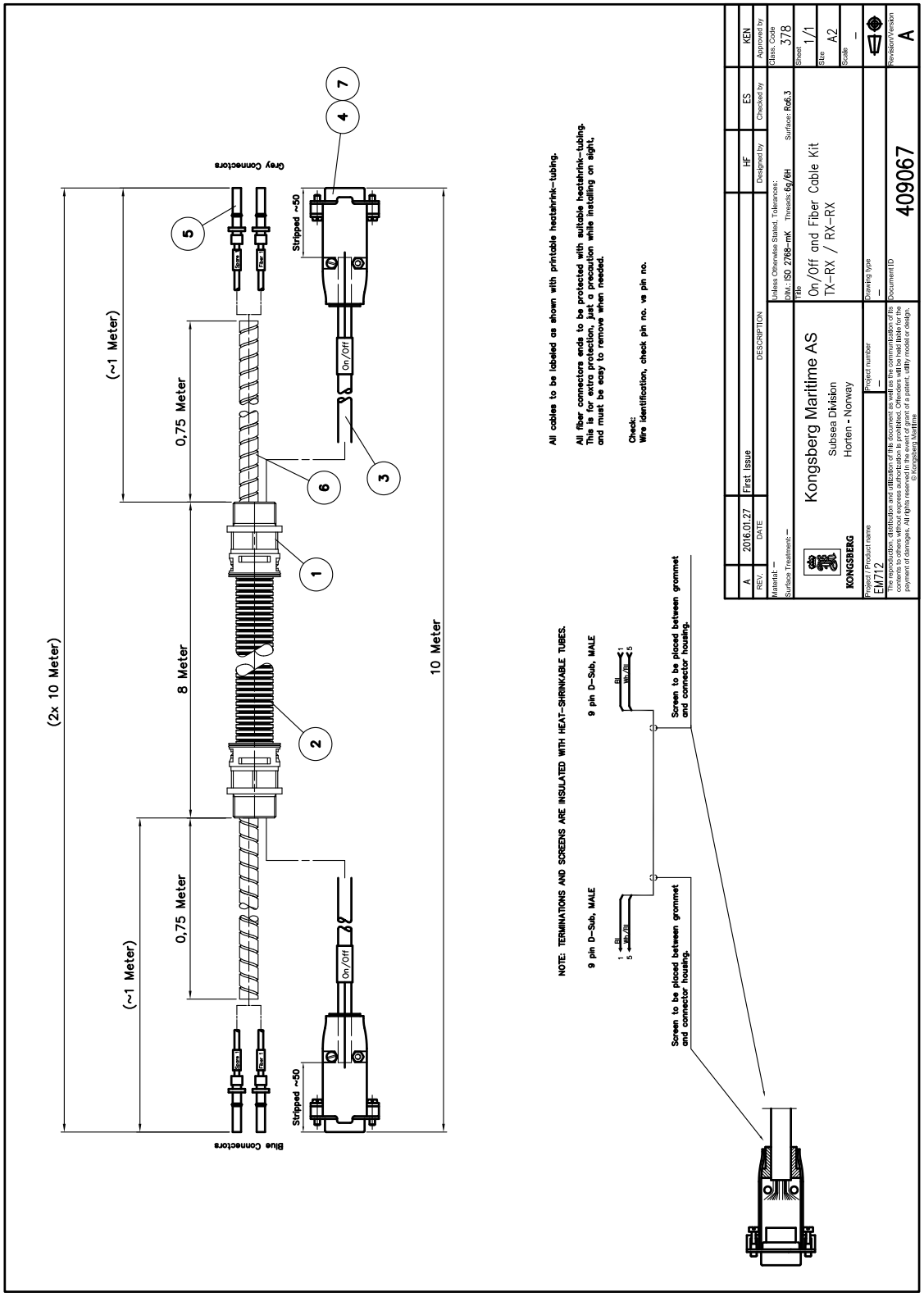

Top view
4 x PG9 - cable diameter 6.5 - 9 mm
4 x PG13.5 - cable diameter 12 - 15 mm
Bottom view
Ground connection
14
259.5
All measurements in mm.
The drawing is not in scale.
[370275] Rev.A
CD12_370275_001_002

373962 Remote Control Unit (K-REM) wiring diagram



[373962] Rev.C
CD12_373962_001_001

409067 Fibre cable kit



Dimensional surveying and alignment

Topics

About dimensional surveying and alignment

The EM 712 Multibeam echo sounder is a precision instrument for high quality data collection.

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 system prior to use. Modest accuracy requirements apply when your EM 712 system is only used to investigate objects in the water column.

The quality assurance tasks required for the EM 712 system include:

- Aligning the transducer during installation
- Dimensional surveying
- Calibration

The alignment and dimensional surveying must be done during the system 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 intervals, 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 the EM 712 system include:

1 Define the vessel coordinate system.

2 Define the location of the *origin* in the coordinate system.

3 Define the waterline with reference to the origin of the coordinate system.

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

5 Define the vessel's centre line.If required, identify the line with physical markings.

6 Measure the physical location and installation angle of all relevant sensors (or sensor antennas).

7 Measure the physical location and orientation of the transducer. Place it in the coordinate system.

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

The information provided by the dimensional survey is entered into the EM 712 software as installation parameters.

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.

The Dimensional survey measurement requirements are summarized in the chapter *Technical specifications*.

Alignment

To ensure a successful installation of the EM 712 system, all alignment and measurements must be done to the highest possible accuracy.

The alignment tasks required for the EM 712 transducer 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 do the dimensional surveying. They have no means of verifying the results until calibration at sea has been finalized.

Related topics

Alignment specifications, page 201

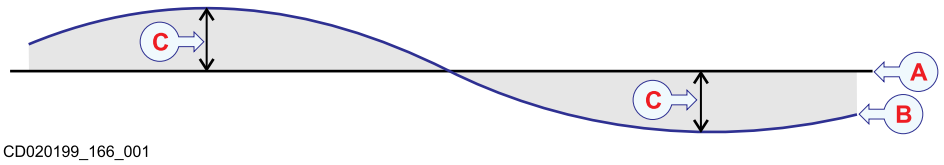
Transducer array flatness

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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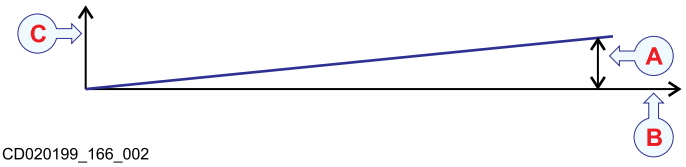
A *Ideal plane*

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.

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.

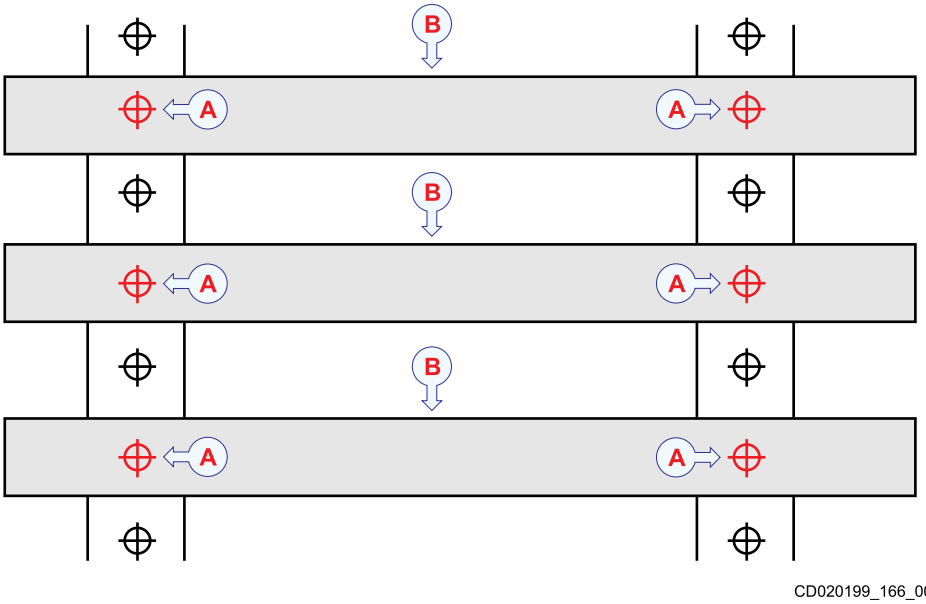
Context

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.



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

Calibration

Calibration surveys are required during the sea trials. The calibration procedures are provided in the relevant end user documentation.

We strongly recommend that calibration surveys are done at regular intervals. As a minimum, calibration must be done prior to any large and/or important 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.

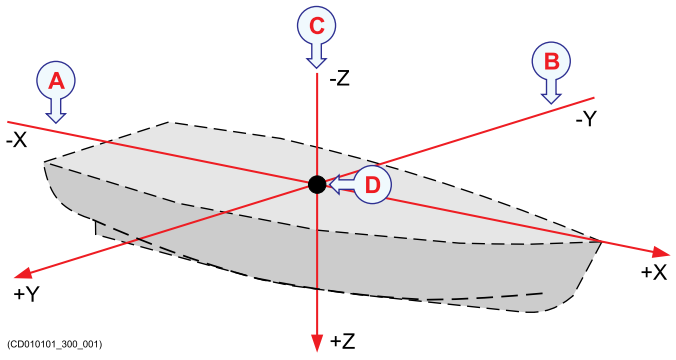
Vessel coordinate system

The vessel coordinate system is established to define the relative physical locations of system units 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)*

Vessel 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 sensor

Cable layout and interconnections

Topics

Read this first

Detailed information about cable specifications, termination and connectors is provided. Unless otherwise specified, all cables are supplied by Kongsberg Maritime as a part of the delivery.

Detailed information about relevant cable specifications, termination and connectors is provided. Each drawing provides additional information, and may, when applicable, include minimum specifications, connector terminations and the required number of cores. Drawings are generally not provided for standard commercial cables. Cables fall into three categories.

System cables

System cables are provided by Kongsberg Maritime as a part of the delivery.

Shipyard cables

Shipyard cables must be provided by the shipyard doing the installation, or the shipowner. The cables must meet the minimum specifications provided in this publication.

Commercial cables

Commercial cables may be provided by Kongsberg Maritime as a part of the delivery. The cables may also be included with third party items that are used with the EM 712 system.

All electric installations and corresponding wiring must be in accordance with the vessel's national registry and corresponding maritime authority and/or classification society.

Note

It is very important that all cables are properly installed and correctly terminated. Observe the relevant regulations and work standards. Always leave enough cable slack close to system units and cabinets to allow for maintenance.

Only skilled and authorized personnel can install the EM 712 cables.

Kongsberg Maritime accepts no responsibility for damage to the system, or reduced operational performance, when this is caused by improper wiring.

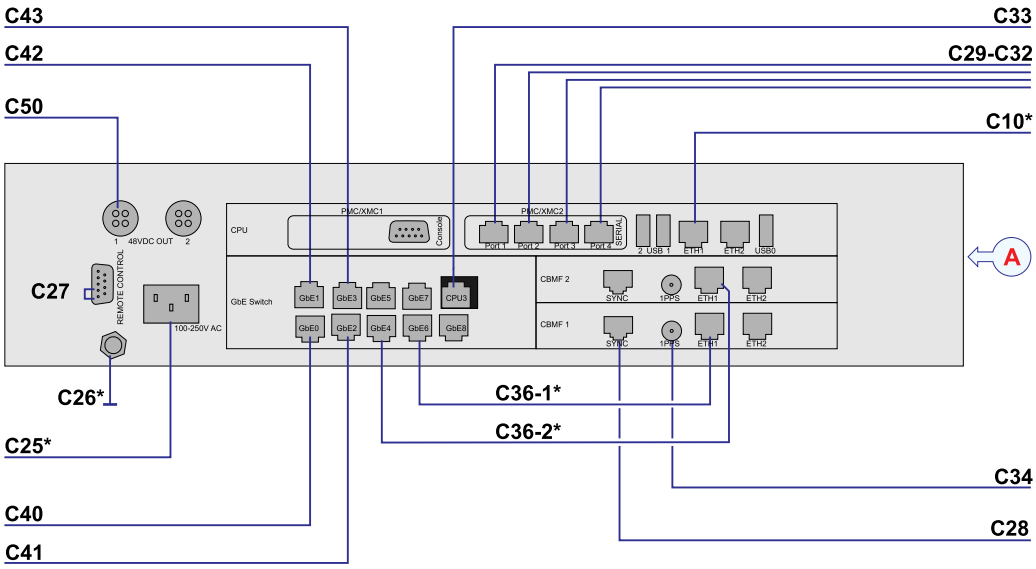
Before you install or maintain the system cables, make sure that the AC mains circuit breaker for the system is disconnected.

Cable plans

Topics

Cable plan - Processing Unit

The Processing Unit cables include those used to connect the EM 712 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.



(CD020106_200_002)

Cables identified with an asterisk (*) are system cables. These cables are supplied with the EM 712 delivery.

A Processing Unit

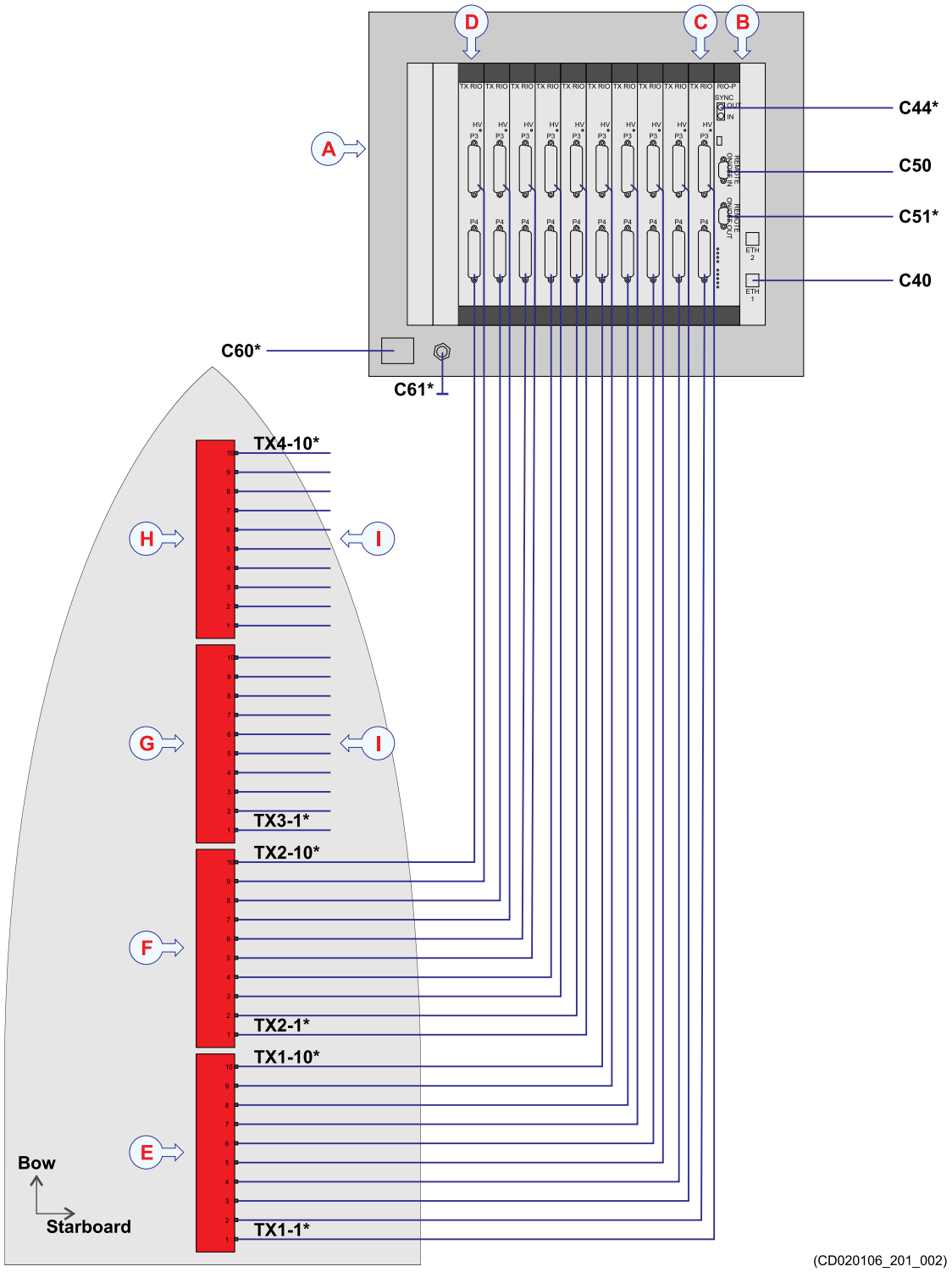
Cable plan - Transmitter Unit

The transmitter (TX) Unit cables include those used to connect the EM 712 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 712 system can have one or two Transmitter Units (TXUs), depending on the system configuration. A system with 0.25 degrees transmitter array will need 4 Transmit Transducer modules and two Transmitter Units.

The illustrations show the Transmit Transducer array mounted in the default orientation, with the cables pointing towards starboard.

Transmitter Unit 1



Cables identified with an asterisk (*) are system cables. These cables are supplied with the EM 712 delivery.

A *Transmitter Unit 1*

B *RIO-P board*

C *TX RIO board 1*

D *TX RIO board 10*

E *Transmit transducer module number 1*

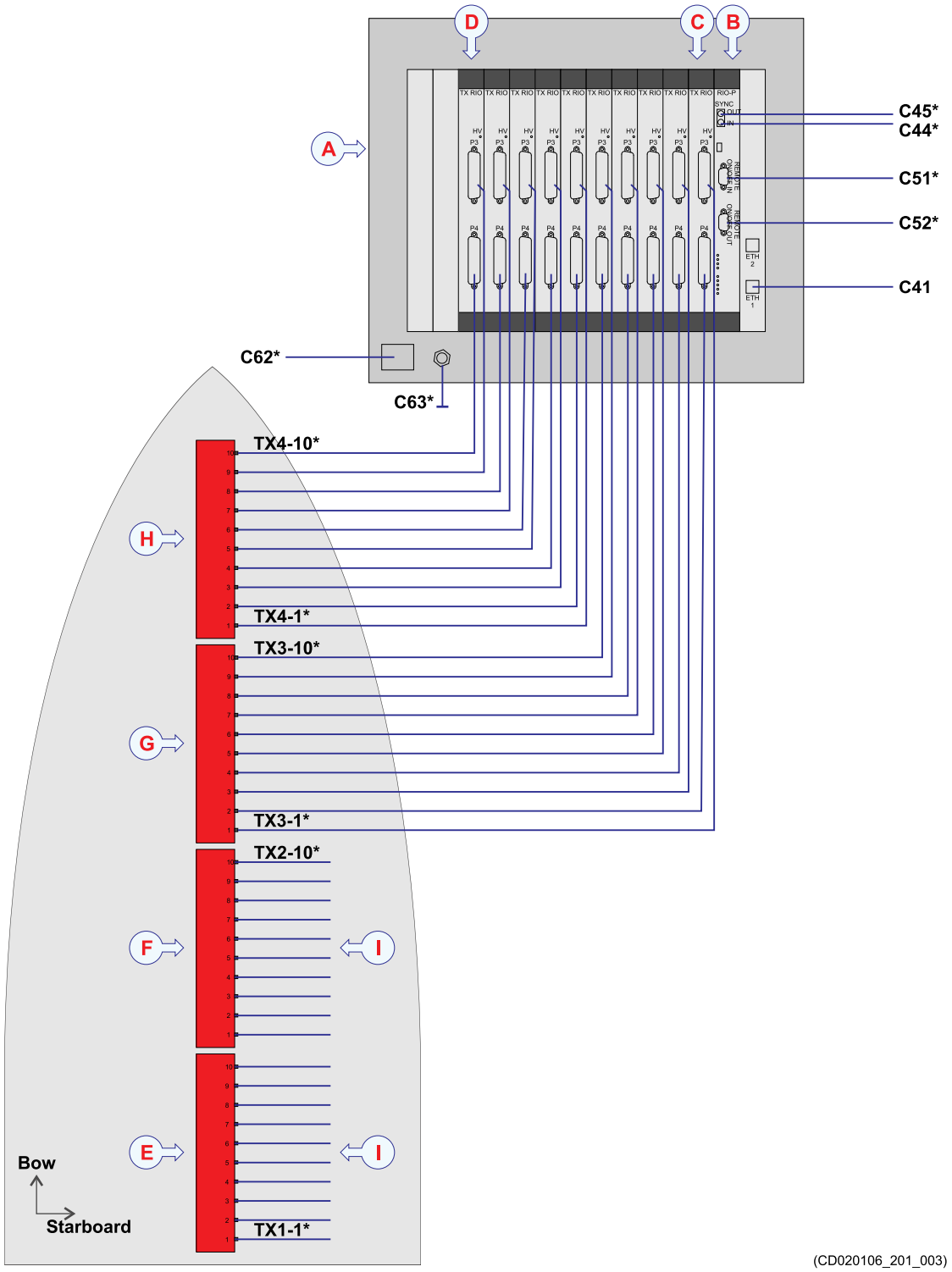
F *Transmit transducer module number 2*

G *Transmit transducer module number 3*

H *Transmit transducer module number 4*

I *Cables from Transmit Transducer 3 and 4 are connected to Transmitter Unit 2 according to the cable identification table*

Transmitter Unit 2



Cables identified with an asterisk (*) are system cables. These cables are supplied with the EM 712 delivery.

A *Transmitter Unit 2*

B *RIO-P board*

C *TX RIO board 1*

D *TX RIO board 10*

E *Transmit transducer module number 1*

F *Transmit transducer module number 2*

G *Transmit transducer module number 3*

H *Transmit transducer module number 4*

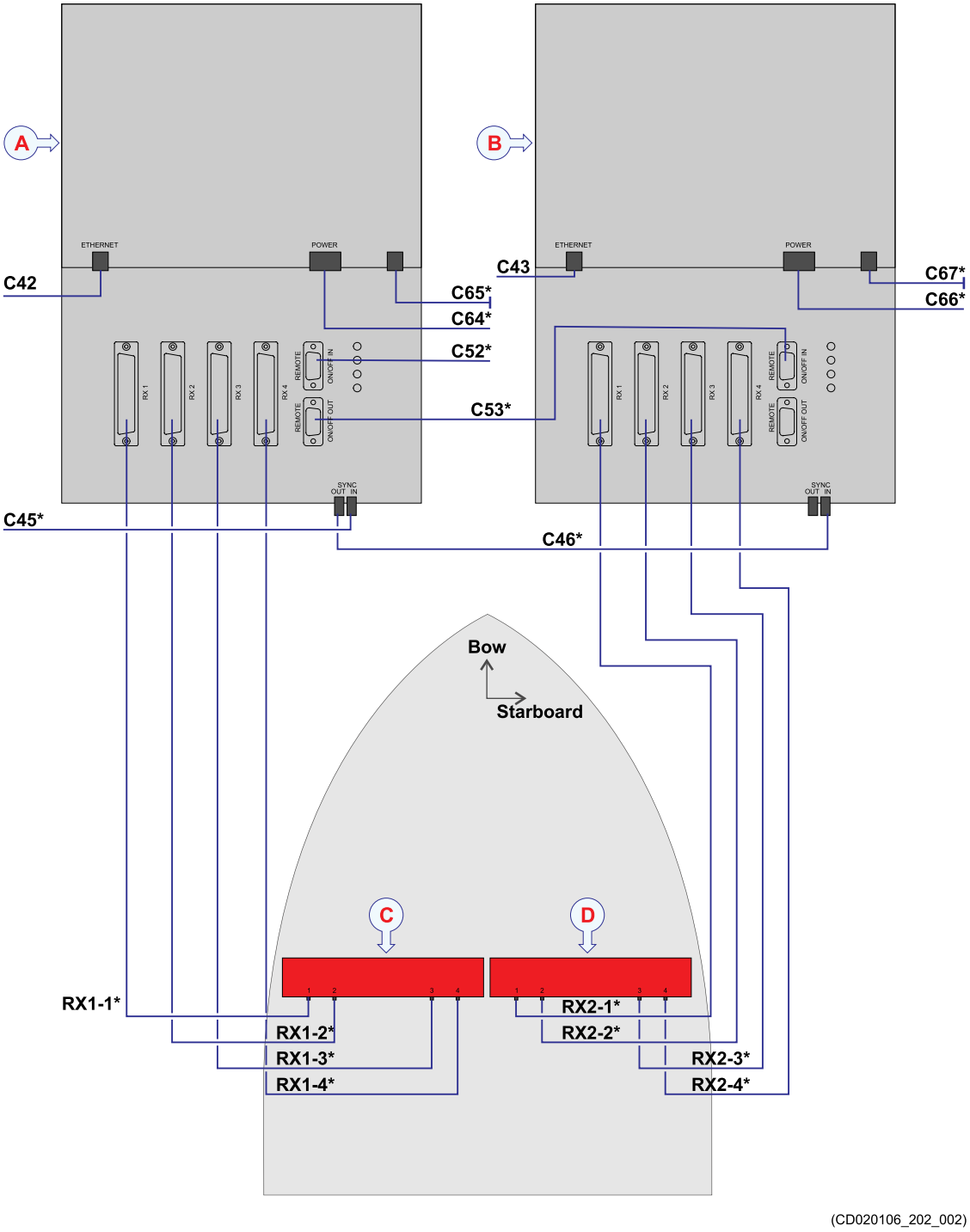
I *Cables from Transmit Transducer 1 and 2 are connected to Transmitter Unit 1 according to the cable identification table*

Cable plan - Receiver Unit

The receiver (RX) Unit cables include those used to connect the EM 712 RX Unit(s) to AC mains power, to the transmitter (TX) Unit, to the Processing Unit and to the transducers. If there are more than one RX Unit they have to be connected to each other with a fibre optic cable.

The EM 712 system can have one or two Receiver Units (RXUs), depending on the system configuration. A system with 0.5° receiver array will need two Receive Transducer modules and two Receiver Units.

The illustrations show the Receive Transducer array mounted in the default orientation, with the cables pointing towards stern.



Cables identified with an asterisk (*) are system cables. These cables are supplied with the EM 712 delivery.

A *Receiver Unit 1*

B *Receiver Unit 2*

C *Receive transducer module number 1*

Cables from Receive Transducer module 1 are connected to Receiver Unit 1 according to the cable identification table

D *Receive transducer module number 2*

Cables from Receive Transducer module 2 are connected to Receiver Unit 2 according to the cable identification table

Note

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

The number of cables depends on the chosen system configuration.

- *0.5° receive transducer: 8 cables*
- *1° receive transducer: 4 cables*
- *2° receive transducer: 2 cables*

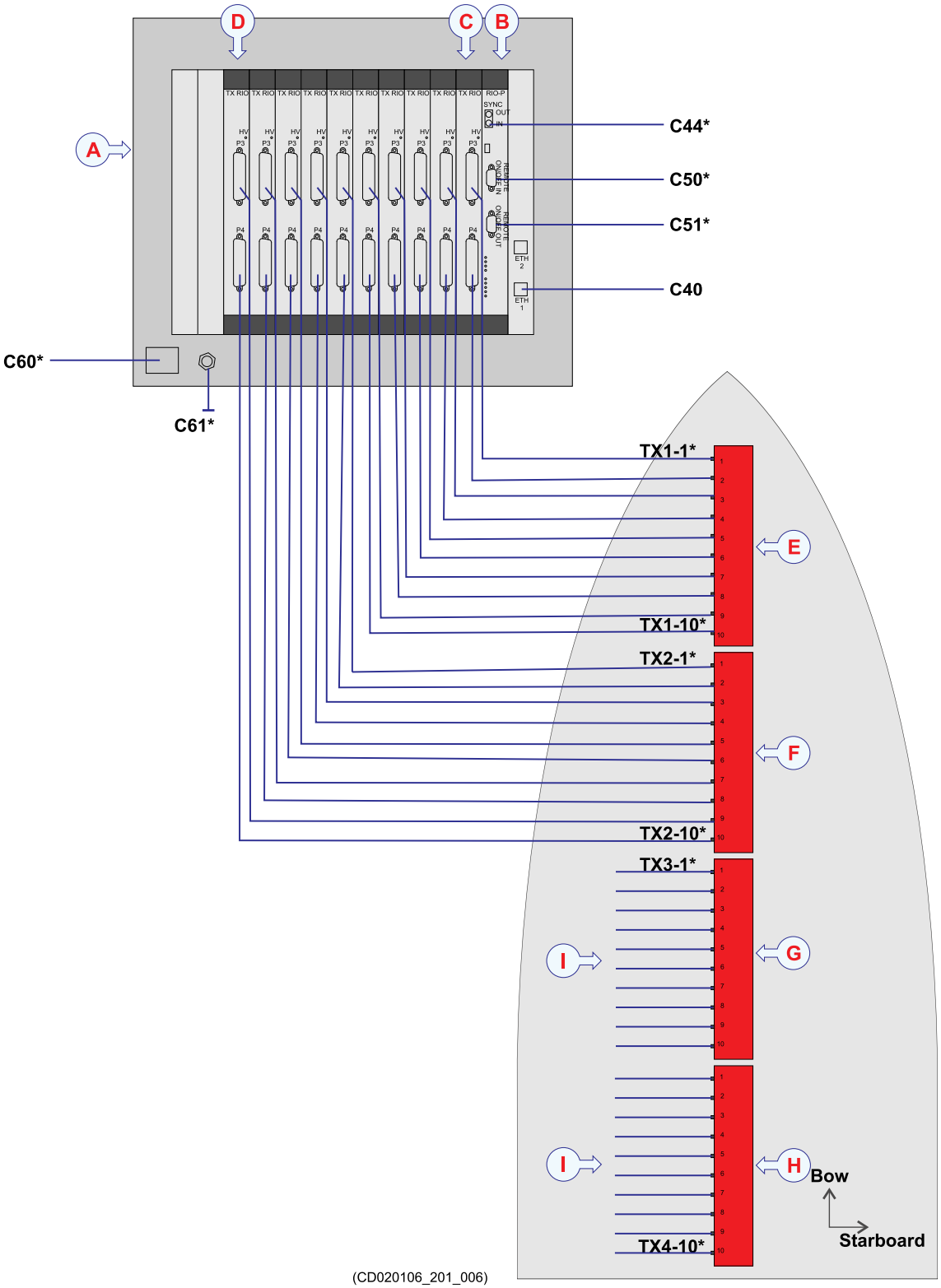
Cable plan - Transmitter Unit rotated

The transmitter (TX) Unit cables include those used to connect the EM 712 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 712 system can have one or two Transmitter Units (TXUs), depending on the system configuration. A system with 0.25 degrees transmitter array will need 4 Transmit Transducer modules and two Transmitter Units.

The illustrations show the Transmit Transducer array mounted in the rotated orientation, with the cables pointing towards port.

Transmitter Unit 1 rotated



Cables identified with an asterisk (*) are system cables. These cables are supplied with the EM 712 delivery.

A *Transmitter Unit 1*

B *RIO-P board*

C *TX RIO board 1*

D *TX RIO board 10*

E *Transmit transducer module number 1*

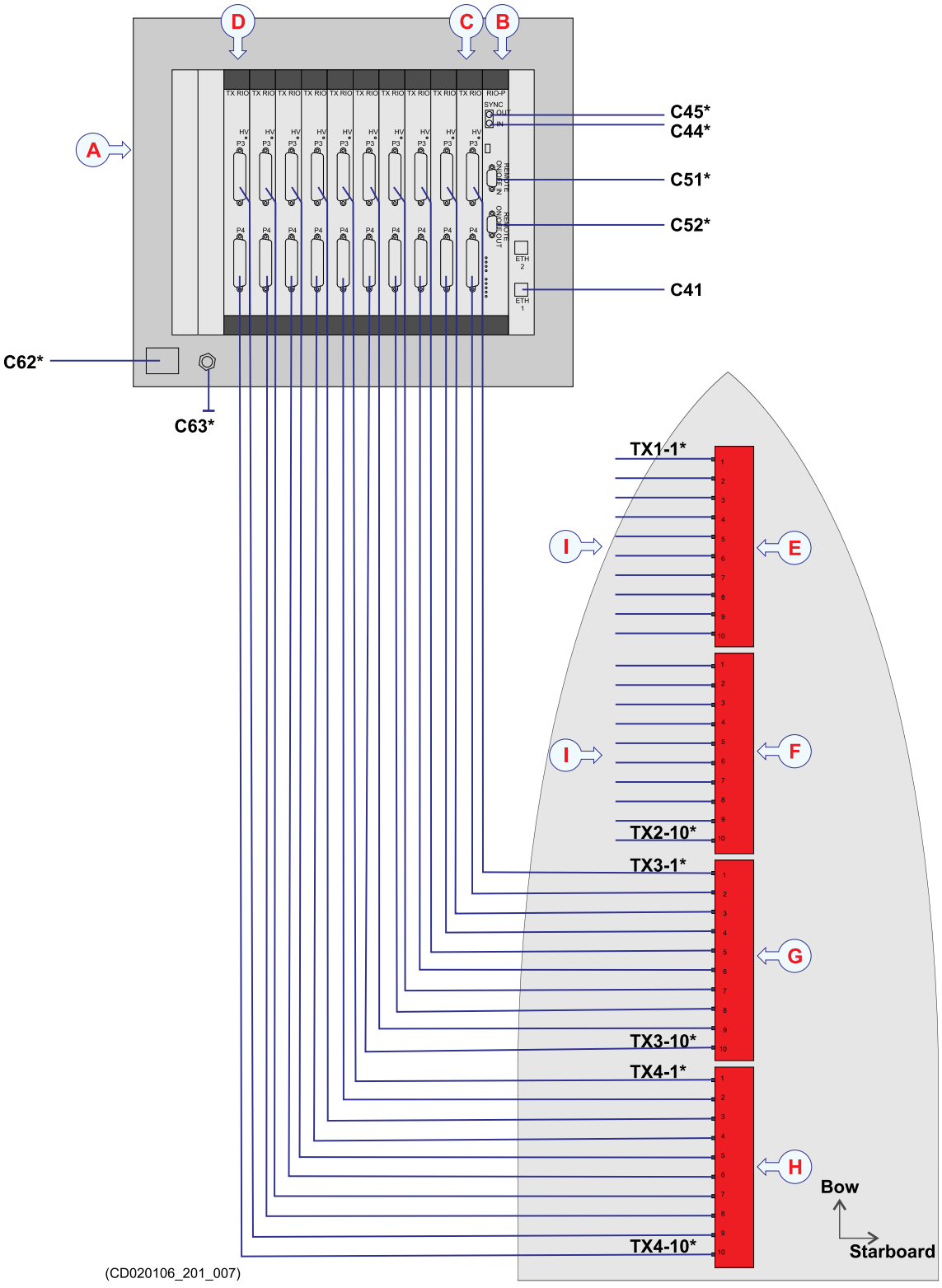
F *Transmit transducer module number 2*

G *Transmit transducer module number 3*

H *Transmit transducer module number 4*

I *Cables from Transmit Transducer 3 and 4 are connected to Transmitter Unit 2 according to the cable identification table*

Transmitter Unit 2 rotated



Cables identified with an asterisk (*) are system cables. These cables are supplied with the EM 712 delivery.

A *Transmitter Unit 2*

B *RIO-P board*

C *TX RIO board 1*

D *TX RIO board 10*

E *Transmit transducer module number 1*

F *Transmit transducer module number 2*

G *Transmit transducer module number 3*

H *Transmit transducer module number 4*

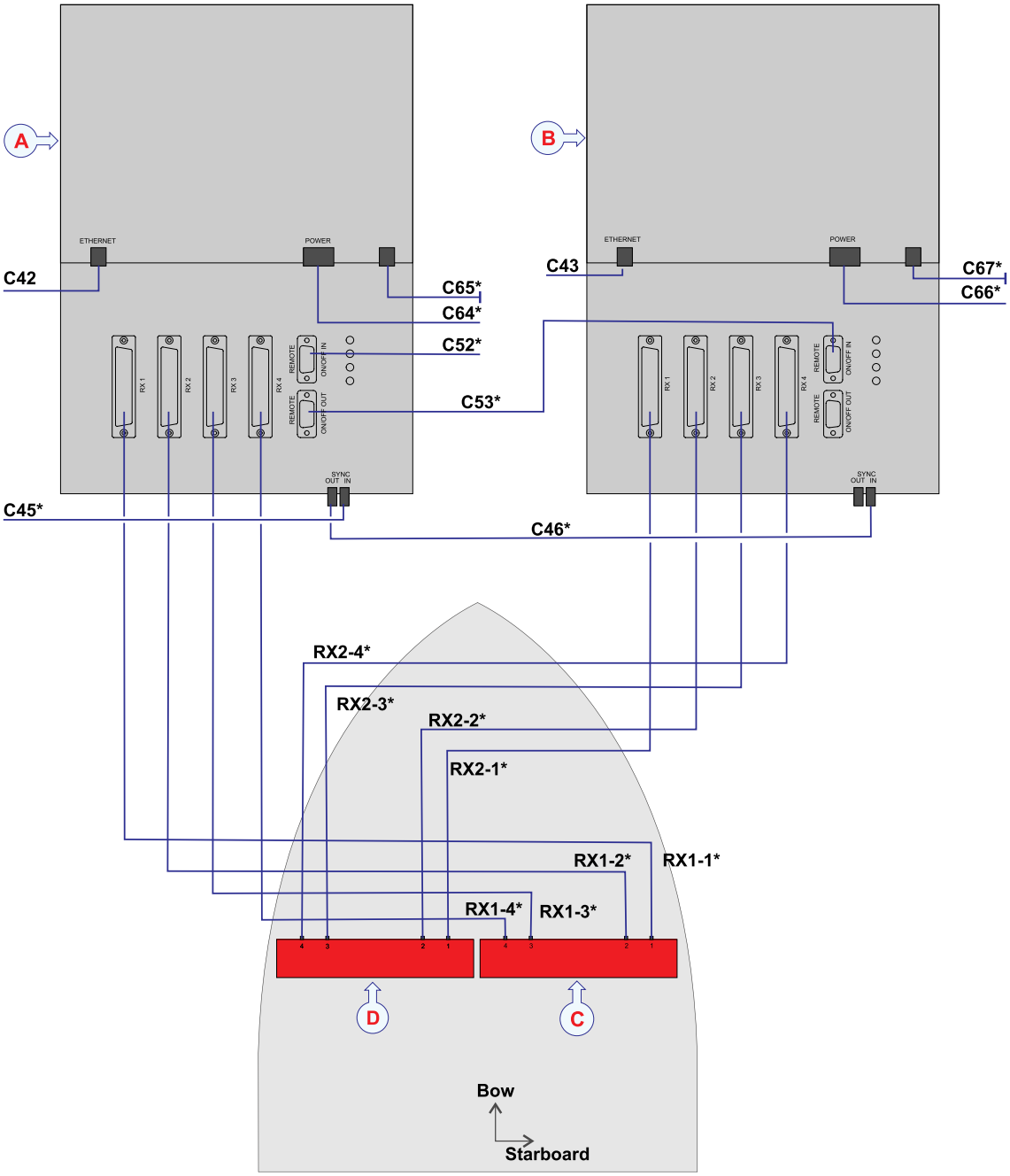
I *Cables from Transmit Transducer 1 and 2 are connected to Transmitter Unit 1 according to the cable identification table*

Cable plan - Receiver Unit rotated

The receiver (RX) Unit cables include those used to connect the EM 712 RX Unit(s) to AC mains power, to the transmitter (TX) Unit, to the Processing Unit and to the transducers. If there are more than one RX Unit they have to be connected to each other with a fibre optic cable.

The EM 712 system can have one or two Receiver Units (RXUs), depending on the system configuration. A system with 0.5° receiver array will need two Receive Transducer modules and two Receiver Units.

The illustration shows the Receive Transducer array mounted in the rotated orientation, with the cables pointing towards bow.



Cables identified with an asterisk (*) are system cables. These cables are supplied with the EM 712 delivery.

A *Receiver Unit 1*

B *Receiver Unit 2*

C *Receive transducer module number 1*

Cables from Receive Transducer module 1 are connected to Receiver Unit 1 according to the cable identification table

D *Receive transducer module number 2*

Cables from Receive Transducer module 2 are connected to Receiver Unit 2 according to the cable identification table

Note

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

The number of cables depends on the chosen system configuration.

- *0.5° receive transducer: 8 cables*
- *1° receive transducer: 4 cables*
- *2° receive transducer: 2 cables*

Cable plan - USV Container

A RXU Network Communication

B TXU Network Communication

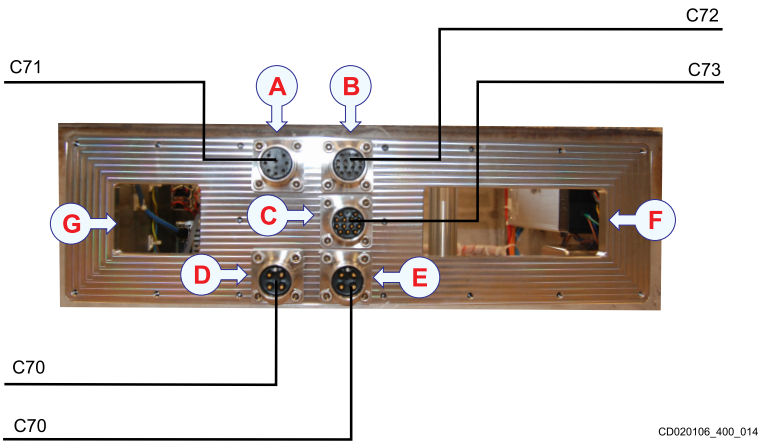
C Temp/Leak Connector

D RXU Power

E TXU Power

F Hole for RX cables

G Hole for TX cables



Cables from Transmitter and Receiver are moulded and have no connectors to the USV container.

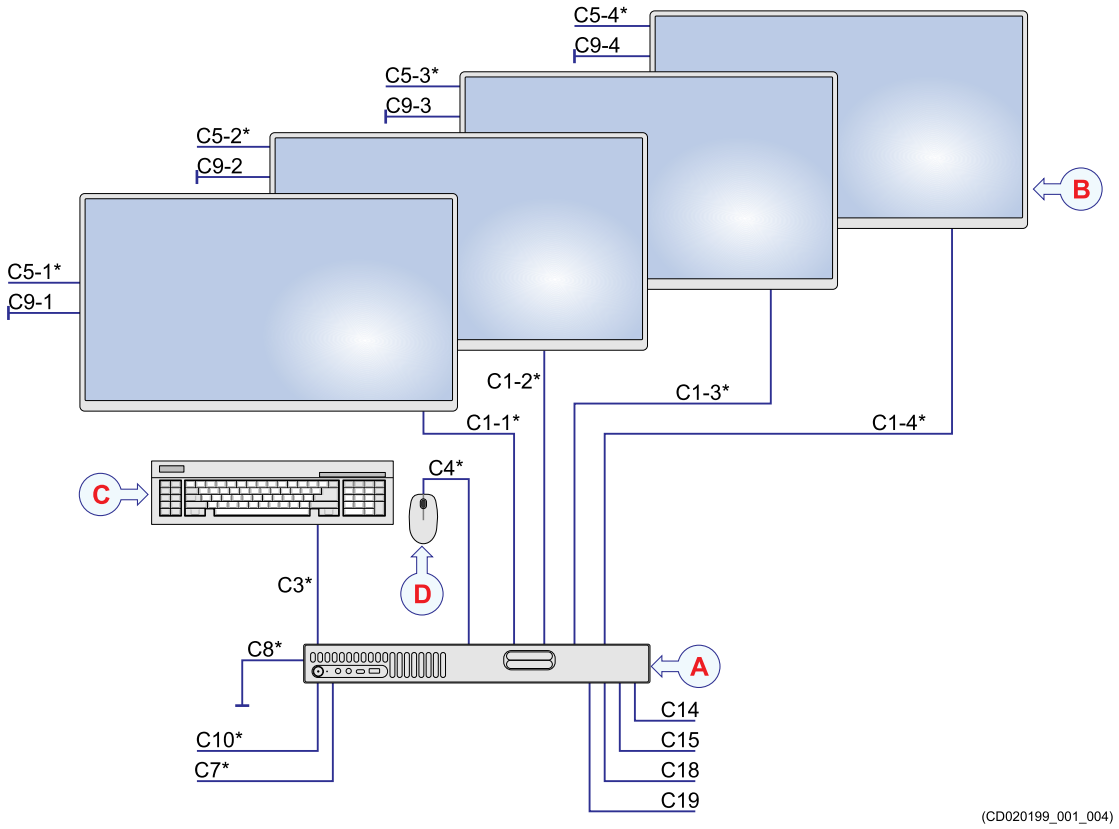
Dry compartment with HWS and PU to Subsea container are Project specific and not described in this manual.

Cable list - USV Container

Cable	Signal	From/To
C70	TXU/RXU Power	From USV container to customer installation
C71	RXU Network Communication	From USV container to Processing Unit (PU)
C72	TXU Network Communication	From USV container to customer installation
C73	Temp/Leak Connector	From USV container to customer installation

Cable plan - Hydrographic Work Station

The topside/bridge cables include those used to connect the computer and the display to each other, to AC mains power, and to external devices.



A *Hydrographic Work Station (HWS)*

B *Display*

The Hydrographic Work Station supports three or four displays. The number of displays depend on the computer model used.

C *Computer keyboard*

D *Computer mouse or trackball*

Cables identified with an asterisk (*) are system or commercial cables. These cables are supplied with the EM 712 delivery.

List of cables

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

The following cables are used when the EM 712 is set up.

Cable	Signal	From/To	Minimum requirements
C1	Display cable	From computer to display	
	This is a commercial cable. It is normally provided with the display.		
C3	Computer cable	From computer to keyboard	
	This is a commercial cable. It is normally provided with the keyboard.		
C4	Computer cable	From computer to mouse (or other pointing 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 computer to AC power outlet	
C8	Ground cable	From computer to vessel ground	
C9	Ground cable	From display to vessel ground	1 x 6 mm^2
C10	Ethernet cable	From computer to transceiver	Cat 5e 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 computer to external device(s)	
C15	Serial cable	From computer to external device(s)	
C18	Ethernet cable	From computer to external device(s)	
C19	Ethernet cable	From computer to external device(s)	
C25	AC Power cable	From Processing Unit to AC power outlet	
C26	Ground cable	From transceiver to vessel ground	

Cable	Signal	From/To	Minimum requirements
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. Remote control, page 168 Remote Control using K-Rem, page 169 Dummy plug for not using remote control, page 170		
C28	Control cable	From Processing Unit to synchronization device	
	External synchronization External synchronization cable, page 165		
C29–C32	Serial cable	From Processing Unit to external device(s)	
	RS-232 serial line using three wires and RJ45 connector, page 161 RS-422 serial line using five wires and RJ45 connector, page 162		
C33	Ethernet cable	From Processing Unit to external device(s)	Cat 5e 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. Clock synchronization (1PPS) using a coax cable, page 164		
C36	Ethernet cable	Processing Unit internal connection	Cat 5e STP (Shielded Twisted Pair)
C40	Ethernet cable	From Processing Unit to Transmitter Unit 1	Cat 5e STP (Shielded Twisted Pair)
C41	Ethernet cable	From Processing Unit to Transmitter Unit 2	Cat 5e STP (Shielded Twisted Pair)
C42	Ethernet cable	From Processing Unit to Receiver Unit 1	Cat 5e STP (Shielded Twisted Pair)
C43	Ethernet cable	From Processing Unit to Receiver Unit 2	Cat 5e 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.		

Cable	Signal	From/To	Minimum requirements
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.		
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	
C70	TXU/RXU Power	From USV container to customer installation	
C71	RXU Network Communication	From USV container to customer installation	

Cable	Signal	From/To	Minimum requirements
C72	TXU Network Communication	From USV container to customer installation	
C73	Temp/Leak Connector	From USV container to customer installation	
TX1-1 - - - TX1-10	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.		
TX2-1 - - - TX2-10	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.		
TX3-1 - - - TX3-10	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.		
TX4-1 - - - TX4-10	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.		
RX1–1 RX1–2 RX1–3 RX1–4	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.		
RX2–1 RX2–2 RX2–3 RX2–4	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.		

The standard length of the transducer cables is 15 metres. There is an option for cable length of 25 metres.

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

Identifying EM 712 cables on a project cable drawing

The EM 712 system 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 712 system cables may be identified as **EM 712/Cx**.

Transmit transducer cables

The cables between the EM 712 transmit transducer array and the Transmitter Unit are supplied by Kongsberg Maritime. The number of cables depends on the chosen system configuration.

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

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

Note

Kongsberg Maritime recommends not to dismount the connector during the installation.

- Cable length: 15 or 25 metres
- Maximum outer diameter: 16.2 mm
- Minimum bending radius: 95 mm

Marking of transmit transducer cables

Each transducer cable is identified with transducer type, transducer part number, cable number and transducer serial number.

It is possible to mount the transmit transducers with the cables pointing to the port or to the starboard side. The default orientation is to the starboard side, this should be used if possible.

It is essential to connect the transducer cables successively to the TX RIO boards in the Transmitter Unit, see the cable identification table for details.

Default orientation of transducer modules, top view, 0.5 x 0.5 degrees system.

Each transducer module is identified by its physical location in the array. If mounting is in accordance with the default orientation, the most aft module is transmit transducer number 1 The location of the transducer modules must be recorded during installation and written down in the cable identification table.

A Transmit transducer (TX) number 1

B Transmit transducer (TX) number 2

C Receive transducer (RX) number 1

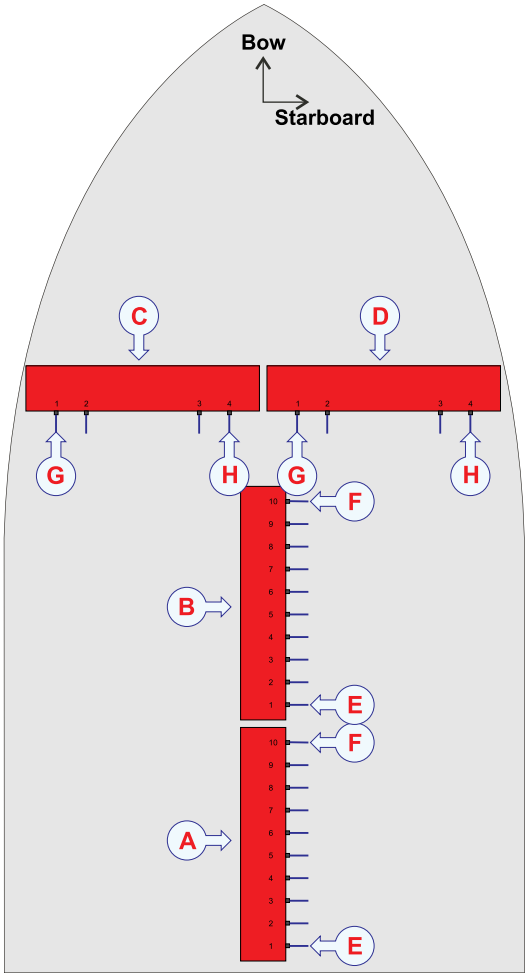
D Receive transducer (RX) number 2

E TX cable number 1

F TX cable number 10

G RX cable number 1

H RX cable number 4



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Optional orientation of transducer modules, top view, 0.5 x 0.5 degrees system.

Each transducer module is identified by its physical location in the array. If optional orientation is used, the most forward module is transmit transducer number 1. The location of the transducer modules must be recorded during installation and written down in the cable identification table.

A Transmit transducer (TX) number 1

B Transmit transducer (TX) number 2

C Receive transducer (RX) number 1

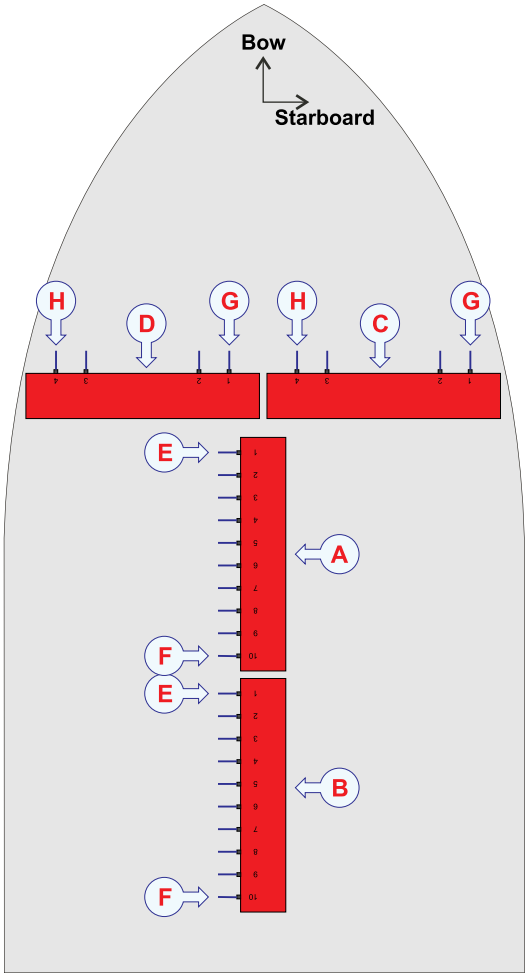
D Receive transducer (RX) number 2

E TX cable number 1

F TX cable number 10

G RX cable number 1

H RX cable number 4



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Connection of transmit transducer cables

The number of cables depends on the chosen system configuration.

- 0.25° transmit transducer: 40 cables
- 0.5° transmit transducer: 20 cables
- 1° transmit transducer: 10 cables
- 2° transmit transducer: 5 cables

Note

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

Table 1 Cable identification table

TX module			TX Unit			Size of system			
Position	Transducer serial number (fill in)	Cable	Unit	TX RIO board	Socket				
1		1	1	1	P3	2°	1°	0.5°	0.25°
		2	1	1	P4				
		3	1	2	P3				
		4	1	2	P4				
		5	1	3	P3				
		6	1	3	P4				
		7	1	4	P3				
		8	1	4	P4				
		9	1	5	P3				
		10	1	5	P4				
2		1	1	6	P3				
		2	1	6	P4				
		3	1	7	P3				
		4	1	7	P4				
		5	1	8	P3				
		6	1	8	P4				
		7	1	9	P3				
		8	1	9	P4				
		9	1	10	P3				
		10	1	10	P4				
3		1	2	1	P3				
		2	2	1	P4				
		3	2	2	P3				
		4	2	2	P4				
		5	2	3	P3				
		6	2	3	P4				
		7	2	4	P3				
		8	2	4	P4				
		9	2	5	P3				
		10	2	5	P4				
4		1	2	6	P3				
		2	2	6	P4				
		3	2	7	P3				
		4	2	7	P4				

TX module			TX Unit			Size of system			
		5	2	8	P3				
		6	2	8	P4				
		7	2	9	P3				
		8	2	9	P4				
		9	2	10	P3				
		10	2	10	P4				

Receive transducer cables

The cables between the EM 712 receive transducer array and the Receiver Unit are supplied by Kongsberg Maritime. The number of cables depends on the chosen system configuration.

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

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

Note

Kongsberg Maritime recommends not to dismount the connector during the installation.

- Cable length: 15 or 25 metres
- Maximum outer diameter: 16.2 mm
- Minimum bending radius: 95 mm

Marking of receive transducer cables

Each transducer cable is identified with transducer type, transducer part number, cable number and transducer serial number.

It is possible to mount the receive transducers with the cables pointing to the stern or to the bow. The default orientation is astern, this should be used if possible.

It is essential to connect the transducer cables successively to the Receiver Unit, see the cable identification table for details.

Default orientation of transducer modules, top view, 0.5 x 0.5 degrees system.

Each transducer module is identified by its physical location in the array. If mounting is in accordance with the default orientation, the port side module is receive transducer number 1. The location of the transducer modules must be recorded during installation and written down in the cable identification table.

A Transmit transducer (TX) number 1

B Transmit transducer (TX) number 2

C Receive transducer (RX) number 1

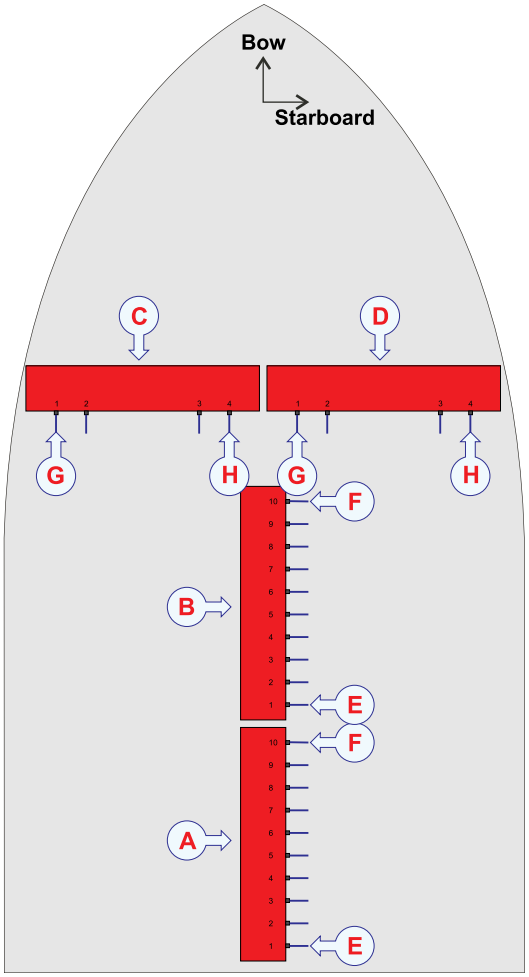
D Receive transducer (RX) number 2

E TX cable number 1

F TX cable number 10

G RX cable number 1

H RX cable number 4



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Optional orientation of transducer modules, top view, 0.5 x 0.5 degrees system.

Each transducer module is identified by its physical location in the array. If optional orientation is used, the most starboard fide module is receive transducer number 1. The location of the transducer modules must be recorded during installation and written down in the cable identification table.

A Transmit transducer (TX) number 1

B Transmit transducer (TX) number 2

C Receive transducer (RX) number 1

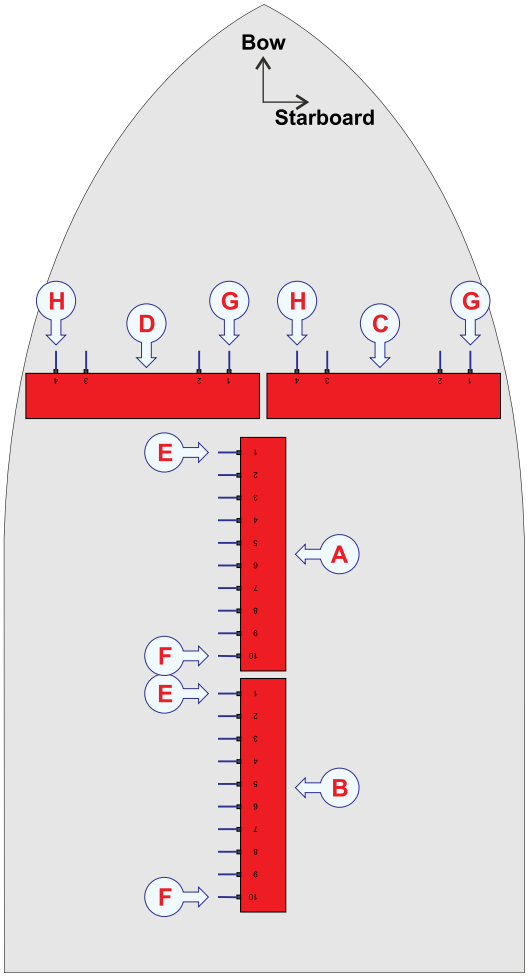
D Receive transducer (RX) number 2

E TX cable number 1

F TX cable number 10

G RX cable number 1

H RX cable number 4



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Connection of receive transducer cables

Note

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

The number of cables depends on the chosen system configuration.

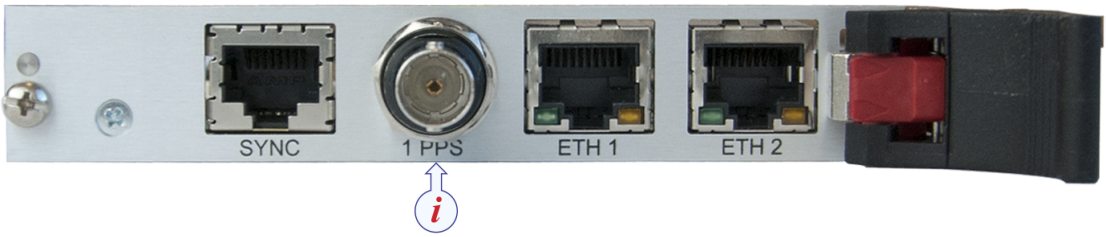
- *0.5° receive transducer: 8 cables*
- *1° receive transducer: 4 cables*
- *2° receive transducer: 2 cables*

Table 2 Cable identification table

Position	RX module number identification		RX Unit		Size of system		
	Transducer serial number (fill in)	Cable	Receiver Unit	Socket			
1		1	1	RX 1	2°	1°	0.5°
		2	1	RX 2			
		3	1	RX 3			
		4	1	RX 4			
2		1	2	RX 1			
		2	2	RX 2			
		3	2	RX 3			
		4	2	RX 4			

Clock synchronization (1PPS)

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



This is a generic photo. The CBMF board used by the EM 712 may look slightly different due to minor design changes on the protective lid and/or the front panel.

It can be selected in the operator software SIS whether 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).

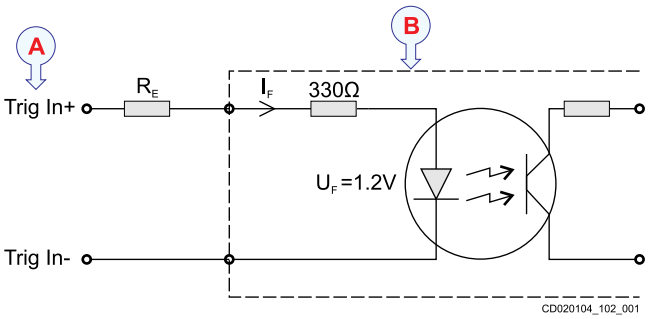
Optically isolated input signals

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.

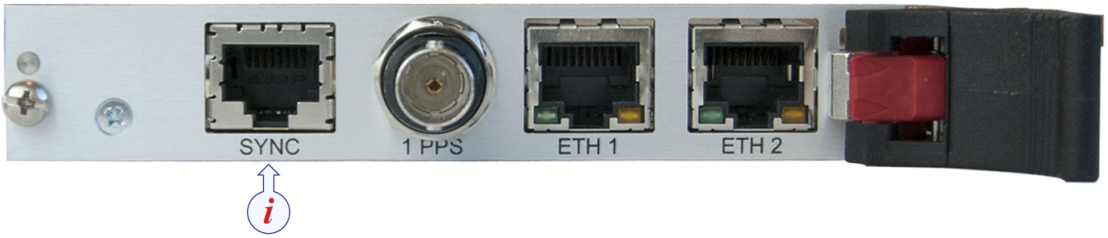
- $$R_{TOT} = \frac{12V - 1.2V(U_F)}{10mA} = \frac{10.8}{0.010} = 1080\Omega$$

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

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

External synchronization

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



This is a generic photo. The CBMF board used by the EM 712 may look slightly different due to minor design changes on the protective lid and/or the front panel.

This connection is for interface to an external synchronization system, for example K-Sync. An external synchronization system is 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 -

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Pin 3 and 6 are used by Kongsberg Maritime only.

External synchronization signal characteristics

Signal	Description	Type	Active
RTS	Ready To Send - Output from EM 712 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 712 is transmitting	Open collector output from isolation unit	Low
TRIG IN	Trigger in - Input to EM 712 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.

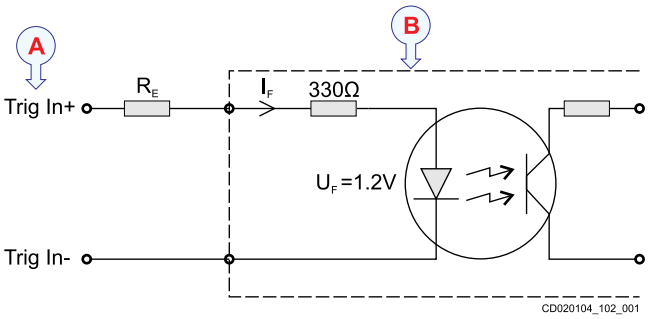
Optically isolated input signals

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.

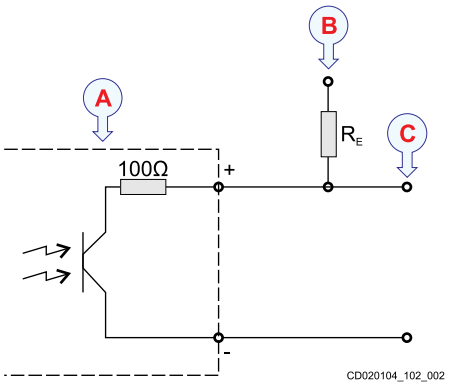
Optically isolated output signals

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.



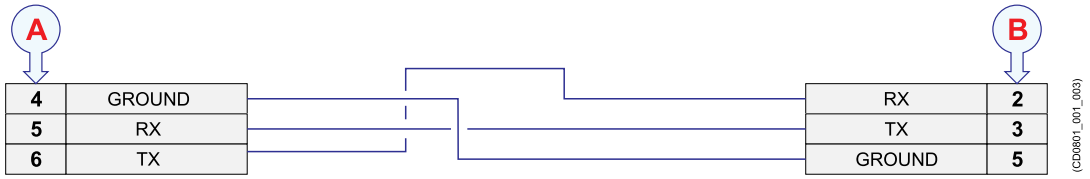
Power	Resistor value	Minimum effect
5 V	0.38 kΩ	0.1 W
12 V	1.08 kΩ	0.15 W
24 V	2.28 kΩ	0.25 W

Cable drawings and specifications

Topics

RS-232 serial line using three wires and RJ45 connector

An RS-232 serial line connection is a common way to connect the EM 712 system to external devices.



A *Local connection*

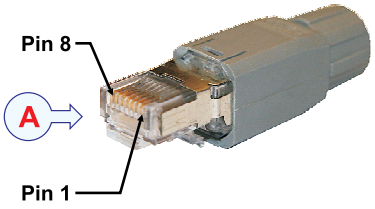
RJ45 connector

B *Connection on remote device*

9-pin D-Subminiature connector

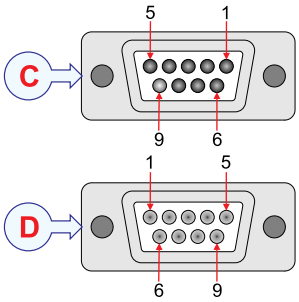
C *Female 9-pin D-Subminiature connector*

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.



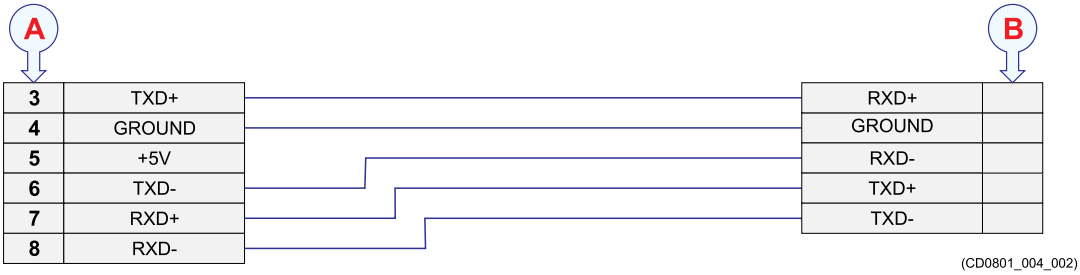
Minimum cable requirements

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

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

RS-422 serial line using five wires and RJ45 connector

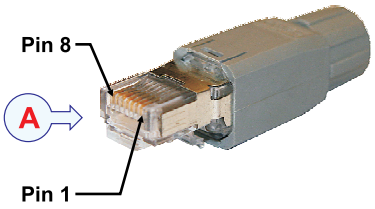
An RS-422 serial line connection is a common way to connect the EM 712 system to external devices. An RS-422 serial line connection can transmit data at rates as high as 10 million bits per second, and may be sent on cables as long as 1500 meters.



A *Local connection*

RJ45 connector

B *Connection on remote device*



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

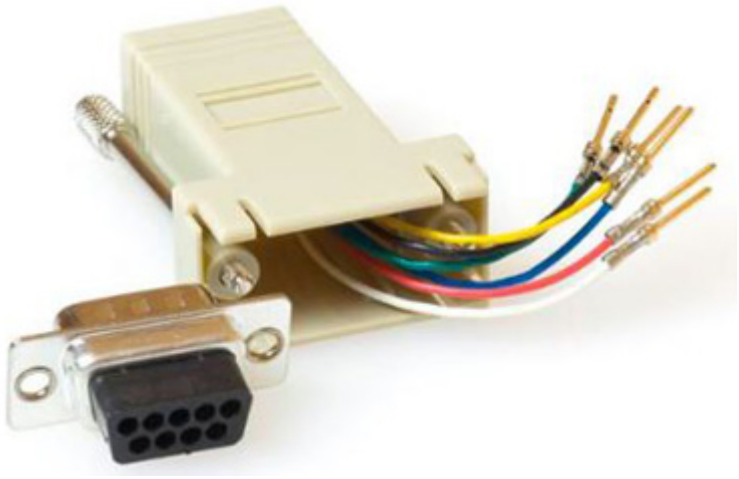
Minimum cable requirements

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

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

Adapter for D-connector to RJ45 connector for RS-422

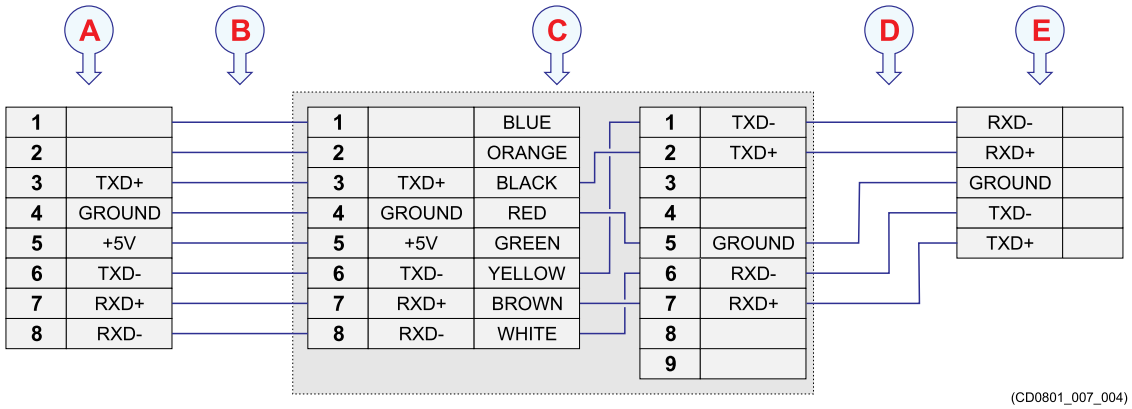
You can use an adapter if you need to connect a serial cable with a D-connector to the Processing Unit.



The Processing Unit has four serial ports with RJ45 connectors. The ports can be configured to be RS-232 or RS-422.

You can use an adapter if you need to connect a serial cable with a D-connector to the Processing Unit. Two adapters and two standard Cat6 patch cables are provided with a standard delivery.

The adapter has RJ45 female connector at one end and 9-pin male D-connector at the other end. The wiring at the RJ45 side is fixed, and the wire ends have crimp contacts to be placed in the desired position of the D-connector without any tools.



A Local connection (Processing Unit)

RJ45 connector

B Standard patch cable

C Adapter Part number 357235

Wired for RS-422

D Standard RS-422 cable

E Connection on remote device

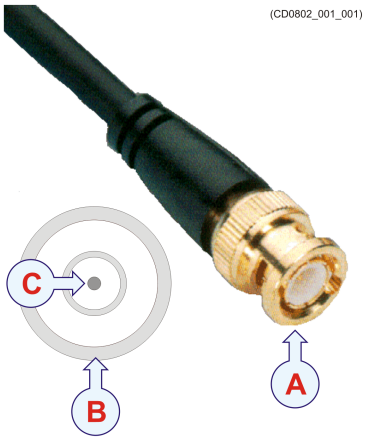
Clock synchronization (1PPS) using a coax cable

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

A *Male BNC connector*

B *Ground*

C *1PPS signal*



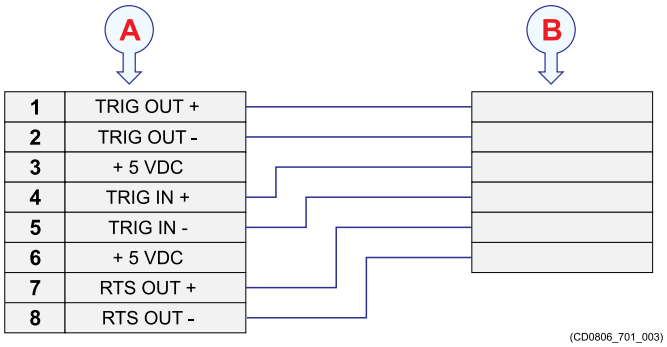
This cable must be provided by the installation shipyard.

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

External synchronization cable

The Processing Unit (PU) is equipped with 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 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 mm^2
- **Screen**: Overall braided
- **Voltage**: 30 V
- **Maximum outer diameter**: Defined by the plugs and/or the gable gland

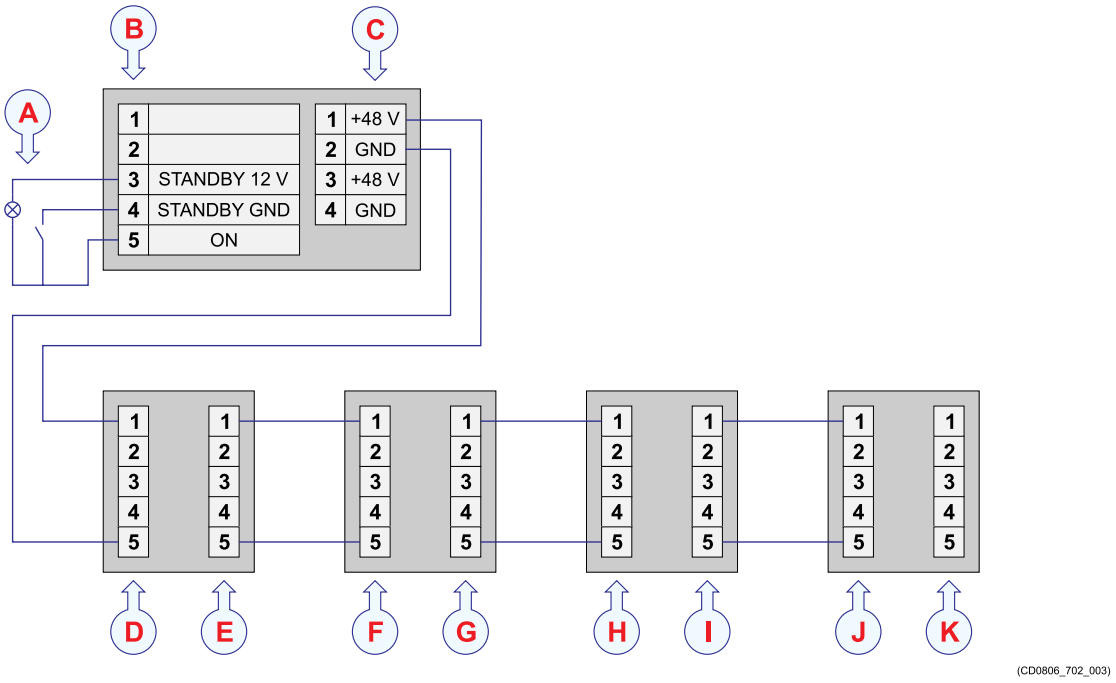
We recommend using a shielded CAT-6A quality or better cable.

Remote control overview

The EM 712 system can be switched on/off with a central control switch.

An EM 712 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.

Remote control

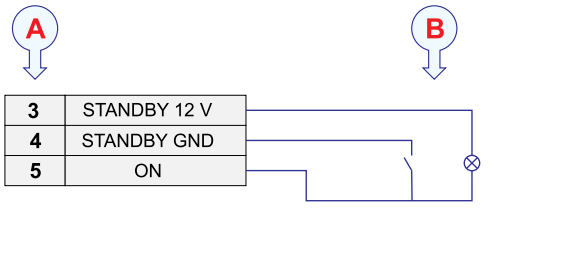
The Processing Unit can be switched on/off with a remote switch. This switch is connected to a 9–pin D-connector on the Processing Unit.

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

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

C *Female 9–pin D-connector*

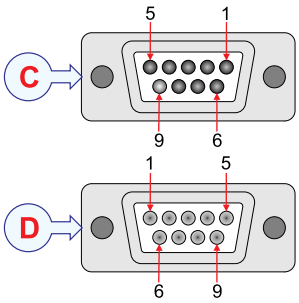
D *Male 9–pin D-connector*



Minimum cable requirements

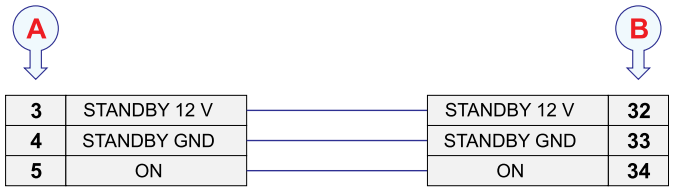
- **Conductors**: 3 x 0.5 mm²
- **Screen**: Overall braided
- **Voltage**: 60 V
- **Maximum outer diameter**: Defined by the plugs and/or the gable gland

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).

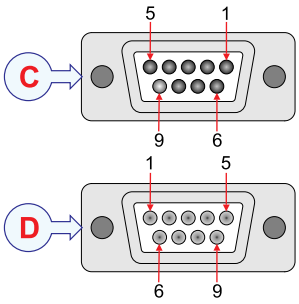


A *Local connection, male 9–pin D-connector*

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

C *Female 9–pin D-connector*

D *Male 9–pin D-connector*



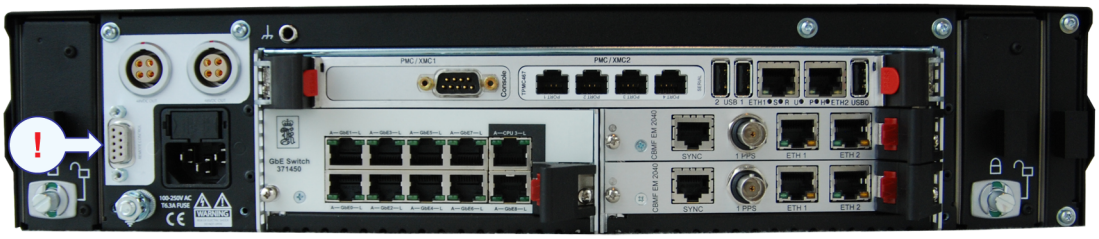
Minimum cable requirements

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

This cable must be provided by the installation shipyard.

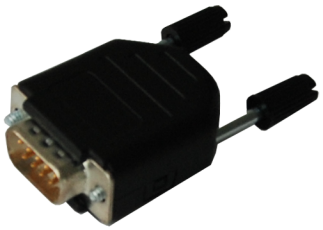
Dummy plug for not using remote control

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

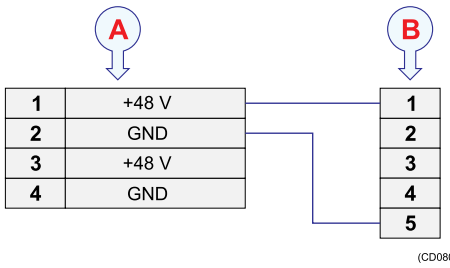
*If remote control is not used, the enclosed remote control dummy plug has to be inserted in the **Remote Control** connector in the Processing Unit. The Processing Unit will not work without this dummy plug.*



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 .

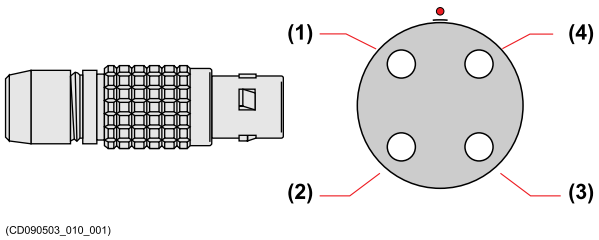
Kongsberg Maritime part number: 348015

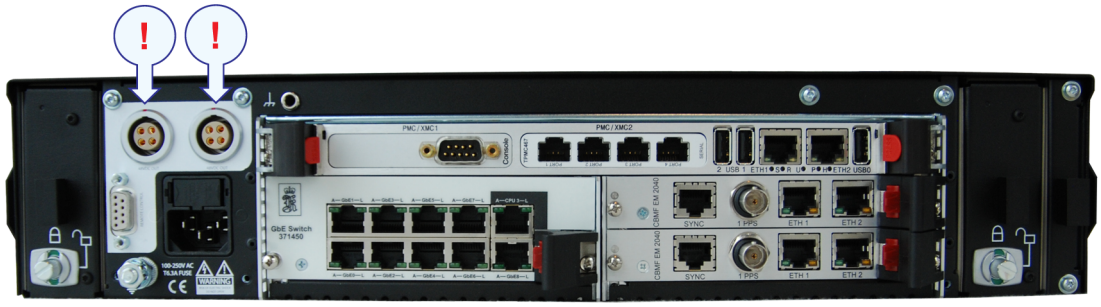
B *Transmitter Unit end, male 9–pin D-connector*

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.

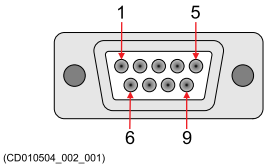




Transmitter Unit end

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

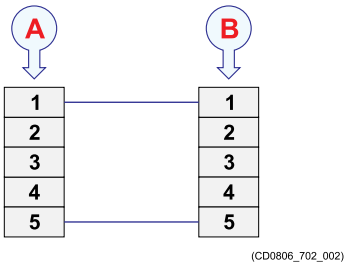
- **Conductors**: 2 x 0.5 mm²
- **Screen**: Overall braided
- **Voltage**: 60 V
- **Maximum outer diameter**: Defined by the plugs

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.



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

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

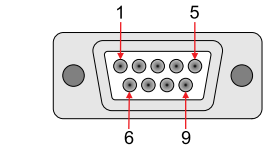
B *Receiver Unit end, male 9–pin D-connector*

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

Transmitter Unit end

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.

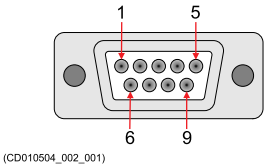


(CD010504_002_001)

Receiver Unit end

Pin layout male 9–pin D-connector.

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



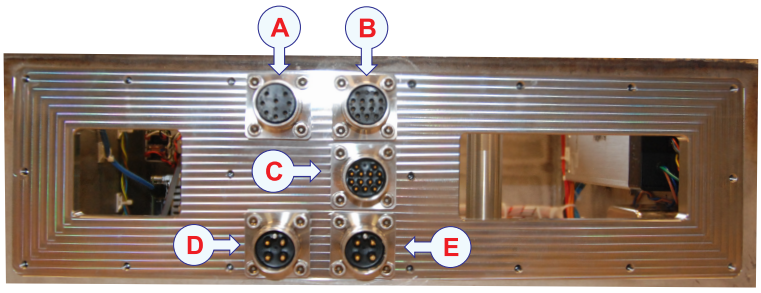
Minimum cable requirements

- **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.

Cables for USV container



CD020106_400_020

A RXU Network Connector

B TXU Network Connector

C Temp/Leak Connector

D RXU Power Connector

E TXU Power Connector

The EM 712 USV Multibeam Echosounder is delivered with 15m cables. These cables can be shortened to suit the customer installation.

Topics

RXU network connector, page 178

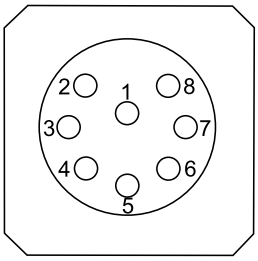
TXU Network Connector, page 179

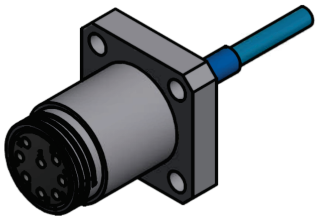
Temp/Leak Connector , page 180

TXU/RXU Power Connector, page 181

RXU network connector

Female connector





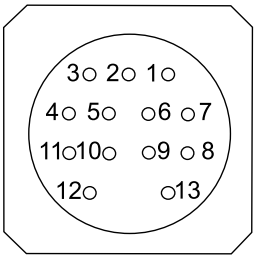
Female connector

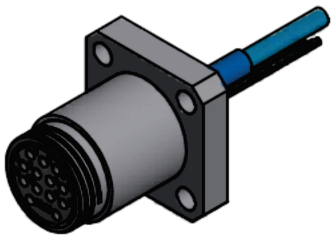
1	Ethernet TX+
2	Ethernet TX-
3	Ethernet RX+
4	Ethernet N/C
5	Ethernet N/C
6	Ethernet RX-
7	Ethernet N/C
8	Ethernet N/C

(CD020106_400_015)

TXU Network Connector

Female connector





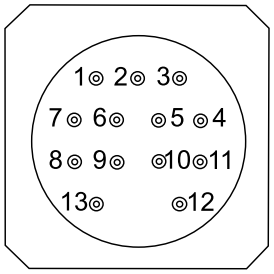
Female connector

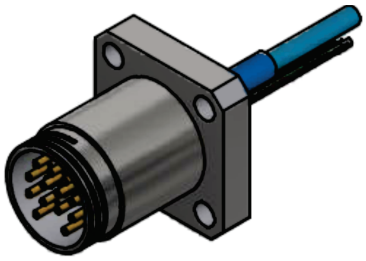
1	N/C
2	Screen
3	N/C
4	1-Ethernet TX+
5	2-Ethernet TX-
6	3-Ethernet RX+
7	4-Ethernet N/C
8	5-Ethernet N/C
9	6-Ethernet RX-
10	7-Ethernet N/C
11	8-Ethernet N/C
12	N/C
13	N/C

(CD020106_400_017)

Temp/Leak Connector

Male connector





Male connector

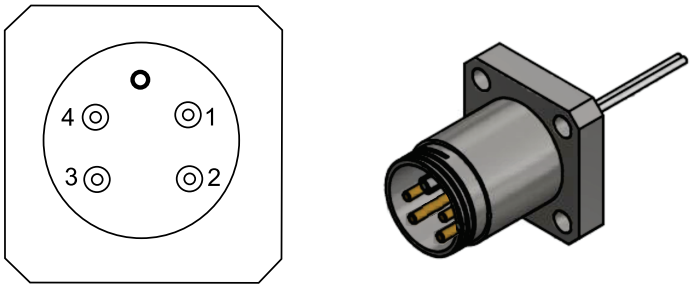
1	24V+
2	Screen
3	GND
4	1-Ethernet TX+
5	2- Ethernet TX-
6	3-Ethernet RX+
7	4-Ethernet N/C
8	5-Ethernet N/C
9	6-Ethernet RX-
10	7-Ethernet N/C
11	8-Ethernet N/C
12	DIO0
13	ISO.GND

(CD020106_400_016)

TXU/RXU Power Connector

Power connector at the USV container for Transceiver and Receiver.

Male connector with guide pin.



Male connector with guide pin

1	Live
2	Neutral
3	GND
4	NC

(CD020106_400_018)

Technical specifications

Topics

Performance specifications

These performance specifications summarize the main functional and operational characteristics of the EM 712 system.

- Maximum ping rate: More than 30 Hz
- Number of swaths per ping: 2
-

Number of beams and soundings				
System version	**0.25 x 0.5**	**0.5 x 0.5**	**0.5 x 1 and 1 x 1**	**1 x 2 and 2 x 2**
Number of soundings/ping	1600	1600	800	400
Number of soundings/swath	800	800	400	200

- Beamwidths: 0.25 x 0.5, 0.5 x 0.5, 0.5 x 1, 1 x 1, 1 x 2 or 2 x 2 degrees
- Beam spacing: Equidistant, Equiangle, High Density
- Coverage sector: Up to 140°
- Transmit beam steering: Stabilized for roll, pitch and yaw
- Receive beam steering: Stabilized for roll
- Depth range from transducers: 3 to approximately 3600 metres
- Pulse lengths: 0.2, 0.5 and 2 ms CW and FM (chirp) up to 120 ms
- Range sampling rate: 15 kHz (5 cm) at data output
- Source level:
  - 1° TX: Up to 225 dB re 1 µPa ref 1 m
  - 0.5° TX: Up to 231 dB re 1 µPa ref 1 m
  - 0.25° TX: Up to 237 dB re 1 µPa ref 1 m

Available beamwidths at the given frequencies

	40 kHz	**50 kHz**	**70 kHz**	**100 kHz**
0.25° TX	0.6	0.5	0.35	0.24
0.5° TX/RX	1.2	1.0	0.7	0.5
1.0° TX/RX	2.4	2.0	1.4	1.0
2.0° TX/RX	4.8	4.0	2.8	2.0

Maximum coverage and depth

Beamwidth	**0.25 x 0.5**	**0.5 x 0.5**	**0.5 x 1**	**1 x 1**	**1 x 2**	**2 x 2**
Maximum coverage						
Winter *	3800	3600	3450	3250	3050	2850

Beamwidth	0.25 x 0.5	0.5 x 0.5	0.5 x 1	1 x 1	1 x 2	2 x 2
Summer *	4400	4200	3950	3700	3550	3250
Maximum depth						
Winter *	3400	3200	3000	2900	2700	2600
Summer *	3600	3400	3200	3100	2900	2800

Estimated depth and coverage for EM 712, based on BS= -20dB, NL= 35 dB, f = 40 kHz

Dual swath restrictions

FM mode is used to extend the maximum range capability.

Since the relative ping rate increases at large depths (caused by reduced angular coverage), the need for dual swath decreases with depth. In the Very Deep and Extra Deep modes long FM pulses are prioritized, so dual swath is not available in these modes.

Reduced power output (Mammal protect)

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 712 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

Different datagram formats

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

Table 3 Data format supported by Multibeams

KMall format	all format	Both formats
EM 304	EM 710	EM 2040
EM 124	EM 302	EM 2040C
	EM 122	EM 2040P
		EM 712

KMall format

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 data 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.

Newer generation multibeams will only have support for KMall format, and as such will require K-Controller and SIS 5.

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 page to download the Doxygen document: https://www.kongsberg.com/maritime/support/document-and-downloads/software-downloads/.

all format

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

The all output datagram format is described in a separate document *EM Datagram formats* document number 160692, and can be downloaded from the Kongsberg websites.

See this page and select the relevant product to download the document: Product support A to Z.

Both formats

For multibeams that supports both formats, Kongsberg will continue to do maintenance and bug fixing for all and SIS 4. Any new feature development will only be available for KMall and SIS 5. Upgrading to the new format, K-Controller and SIS 5 is free, but new features might be licensed.

Change between data formats

How to change PU SW from SIS 4 with all format to SIS 5 with KMall format or from SIS 5 with KMall format to SIS 4 with all format.

From the installation medium, follow the instructions to install SIS on the work station and EM 712.

From SIS 4 to SIS 5, start program `C:\Program Files\Kongsberg Maritime\EMSystem\K-Controller\PU\EMxxxx\Update\EMSWUpgrade.exe`

From SIS 5 to SIS 4, start program `C:\Program Files(86)\Kongsberg Maritime\SIS\PU\EMxxxx\Update\EMSWUpgrade.exe`

Do this steps to change PU SW to match SIS and data format.

1 Compare the SW versions. Difference will be marked.

2 Upgrade the selected SW items.

3 Set system to Factory setting.

Make sure all files are downloaded. Pay attention to the message window, no error messages should appear.

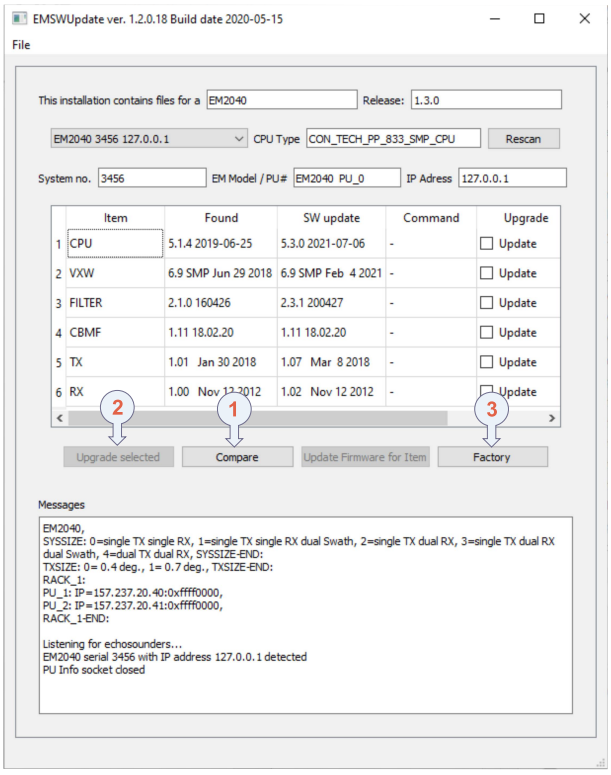
After upgrade reboot PU.

Note

Do not reboot PU until all files are successfully downloaded.

In doubt contact KM.hydrographic.support@km.kongsberg.com for advice.

If it fails try to restart the program EMSWUpgrade.exe do the upgrade again.



CD020104_400_001

Interface specifications - Processing Unit - all format

The EM 712 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 the all format.

Supported datagram formats for GPS (position) information

The EM 712 system supports the following datagram format for position information:

These datagram formats are received using a serial communication line.

- **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).

- **NMEA GGA**

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

- **Simrad 90**

  The Simrad 90 datagram is a proprietary format created by Kongsberg Maritime to interface position sensors.

Supported datagram formats for external clock

The EM 712 supports the following datagram format from an external clock.

This datagram format is received using a serial communication line.

- **NMEA ZDA**

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

Supported datagram formats for heading information

The EM 712 system supports the following datagram formats for vessel heading and/or gyro information:

These datagram formats are received using a serial communication line.

- **NMEA HDT**

  The NMEA HDT datagram provides the true vessel heading. The information is normally provided by a course gyro.

- **SKR82 Heading**

  This is a third-party proprietary datagram format for heading. It was created by Simrad Yachting (https://www.simrad-yachting.com) for use with their Simrad Robertson SKR80(82) gyrocompass.

Supported datagram formats for depth information

The EM 712 system supports the following datagram formats for depth information from an echo sounder:

These datagram formats are received using a serial communication line.

- **NMEA DBS**

  The NMEA DBS datagram provides the current depth from the surface. The datagram is no longer recommended for use in new designs. It is frequently replaced by the NMEA DPT datagram format.

- **NMEA DPT**

  The NMEA DPT datagram provides the water depth relative to the transducer, and the offset of the measuring transducer.

- **Simrad EK500 Depth**

  Simrad EK500 Depth is a proprietary datagram format created by Kongsberg Maritime. It was originally defined for the Simrad EK500 scientific echo sounder. It provides the current depth from three channels, as well as the bottom surface backscattering strength and the athwartships bottom slope. This telegram has been designed for output on either a serial line or a local area network Ethernet connection.

Supported datagram formats for motion information

The EM 712 system supports the following datagram format from a motion sensor:

These datagram formats are received using a serial communication line.

- **Kongsberg EM Attitude 3000**

  The Kongsberg 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 attitude velocity and Doppler correction

The EM 712 system supports the following datagram formats from a motion sensor:

- **Seapath Binary 11**

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

- **Seapath Binary 23**

  The Seapath Binary 23 is a proprietary datagram format created by Kongsberg Maritime (https://www.kongsberg.com/maritime/), former Kongsberg Seatex, to provide position, motion and heading data from a Seapath sensor system.

- **Seapath Binary 26**

  This is a proprietary format created by Kongsberg Maritime (https://www.kongsberg.com/maritime/), former Kongsberg 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.

- **Coda Octopus MCOM**

  The Coda Octopus MCOM is a third party proprietary datagram format created by Oxford Technical Solutions Limited (http://www.oxts.com) for efficient communication of marine navigation measurements and other data. This format is used by Coda Octopus for transmitting position, attitude and sound speed data.

Special interfaces

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

Interface specifications - Processing Unit - KMall format

The EM 712 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 the KMall format.

Supported datagram formats for GPS (position) information

The EM 712 system supports the following datagram format for position information:

- **NMEA GGA**

  The NMEA GGA datagram transfers 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 712 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 depth information

The EM 712 system supports the following datagram formats for depth information from an echo sounder:

These datagram formats are received using a serial or Ethernet (LAN) line.

- **NMEA DPT**

  The NMEA DPT datagram provides the water depth relative to the transducer, and the offset of the measuring transducer.

- **NMEA XDR**

  The NMEA XDR datagram provides measurement data from transducers that measure physical quantities such as temperature, force, pressure, frequency, angular or linear displacement, etc.

  In this context the XDR datagram is used as XDR-P to provide the depth from waterline.

- **Digiquartz pressure sensor**

  This datagram from Digiquartz contains depth from waterline and pressure.

Supported datagram formats for motion information

The EM 712 system supports the following datagram format from a motion sensor:

- **Kongsberg EM Attitude 3000**

  The Kongsberg 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 712 system supports the following datagram format from a motion sensor:

- **KM Binary**

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

- **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.

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 synchronization
- 1 pulse per second (1PPS) clock synchronization signal
- Temp/Leak signal from EM USV Transceiver container

Output datagram formats

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 page to download the Doxygen document: https://www.kongsberg.com/maritime/support/document-and-downloads/software-downloads/.

External sensor requirements

The external sensors must fulfil these requirements to achieve the specified performance for the EM 712 system.

Sensor accuracy

Velocitiy sensor accuracy requirements

- Velocity: 0.03 m/s RMS
- Roll, pitch and yaw rate: 0.03 deg/s RMS
- Latency: Maximum 5 ms
- Update rate: 100 Hz

Motion sensor accuracy requirements

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

- **Roll:** 0.02 degrees RMS
  - An accuracy of 0.05 degrees RMS can be accepted unless you have very long pulse length and large beam angles.
- **Pitch**: 0.05 degrees RMS
- **Heading**:
  - 0.1 degrees RMS for 0.5 ° TX transducer
  - 0.2 degrees RMS for 1° TX transducer
  - 0.4 degreesRMS for 2° TX transducer
- **Heave**: 5 cm or 5% whichever is highest (real-time output)

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

Interface specifications - Hydrographic Work Station - all format

The EM 712 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 the all format.

- Input of sound speed at transducer
- Output to Printer/plotter
- Input of sound speed profile (Ethernet or serial line)
- Input of tide input (Ethernet or serial line)
- Input of 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)

Interface specifications - Hydrographic Work Station - KMall format

The EM 712 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 the KMall format.

- Input of sound speed at transducer (Ethernet or serial line)
- Output to Printer/plotter
- Input of sound speed profile (Ethernet or serial line)
- Input of tide input (Ethernet or serial line)
- Input of 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)

Weights and outline dimensions

These weights and outline dimension characteristics summarize the physical properties of the EM 712 system.

Transmit transducer module – TX1 – 1 degree

- **Outline dimensions**:
  - **Length**: 970 mm
  - **Width**: 224 mm
  - **Height**: 118 mm
- **Weight**: 98 kg (with 10 cables)

Transmit transducer module – TX2 – 2 degrees

- **Outline dimensions**:
  - **Length**: 490 mm
  - **Width**: 224 mm
  - **Height**: 118 mm
- **Weight**: 50 kg (with 5 cables)

Receive transducer module – RX1 – 1 degree

- **Outline dimensions**:
  - **Length**: 970 mm
  - **Width**: 224 mm
  - **Height**: 118 mm
- **Weight**: 56 kg (with 4 cables)

Receive transducer module – RX2 – 2 degrees

- **Outline dimensions**:
  - **Length**: 490 mm
  - **Width**: 224 mm
  - **Height**: 118 mm
- **Weight**: 28.5 kg (with 2 cables)

EM 712 USV Subsea Unit

- **Outline dimensions**:
  - **Length**: 1537 mm
  - **Width**: 1124 mm

  - **Height**: 227 mm
- **Weight**: 390 kg (total)

Processing Unit

- **Make and model**: Kongsberg Maritime, EM PU
- **Outline dimensions**:
  - **Depth**: 424 mm
  - **Width**: 482.5 mm (19" rack)
  - **Height**: 88.6 mm (2U)
- **Weight**: 10.5 kg

Transmitter Unit

- **Outline dimensions:**
  - **Height**: 608 mm
  - **Width: 568 mm**
  - **Depth: 644 mm**
- **Weight**:
  - 0.5 degrees: 73 kg
  - 1 degree: 67.5 kg
  - 2 degrees: 62.5 kg

Receiver Unit

- **Outline dimensions**:
  - **Height: 671 mm**
  - **Width: 340 mm**
  - **Depth: 218 mm**
- **Weight: 11 kg**

Hydrographic Work Station

For more detailed information about the different models of Hydrographic Work Station see the separate manual:

- *495770 - Hydrographic Work Station Instruction Manual*

Power requirements

These power characteristics summarize the supply power requirements for the EM 712 system.

TX Unit

- **Voltage requirement**:
  - 110V/230 VAC, 50 to 60 Hz
  - 150-300 VDC
- **Maximum voltage deviation : 15%**
- Maximum power consumption: Less than 300 W

RX Unit

- **Voltage requirement**:
  - 110V/230 VAC, 50 to 60 Hz
  - 150-300 VDC
- **Maximum voltage deviation : 15%**
- **Maximum power consumption**: Less than 50 W

USV, Power for TX Unit and RX Unit

- **Voltage requirement**:
  - 110/230 VDC

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 (without transducer)**: 125 W

Hydrographic Work Station

Note

The use of an Uninterruptible Power Supply (UPS) is highly recommended for the Hydrographic Work Station.

Environmental requirements

These specifications summarize the temperature requirements and other environmental standards for the EM 712 system.

Transducer

- **Operational temperature**: -5 to +50 °C
- **Storage temperature**: -30 to +70 °C
- **Depth rating** : 250 m

Processing Unit

- **Make and model**: Kongsberg Maritime, EM PU
- **Operating temperature**: 0 to +50 °C
- **Storage temperature**: -30 to +70 °C
- **Relative humidity**: 5 to 95% Non-condensing
- **Ingress protection (IP) code**: IP22
- **Certificates**:
  - IEC 60945:2002 and CORRIGENDUM 1:2008
  - IACS E10:2006

Transmitter 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

Receiver 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

For more detailed information about the different models of Hydrographic Work Station see the separate manual:

- *495770 - Hydrographic Work Station Instruction Manual*

Alignment specifications

These alignment specifications summarize the alignment accuracy requirements of the EM 712 system.

Note

The following accuracy requirements are minimum requirements. Higher accuracy will provide better results and should therefore always be aimed at.

Transducer alignment accuracy

TX array

- **Position (x)**: ± 0.05 m
- **Position (y)**: ± 0.05 m
- **Position (z)**: ± 0.02 m
- **Pitch**:
  - TX transducer: ± 0.05 degrees
  - RX transducer: ± 0.20 degrees
- **Roll**:
  - TX transducer: ± 0.20 degrees
  - RX transducer: ± 0.02 degrees
- **Heading**: ± 0.10 degrees
- **Relative heading between RX and TX transducer**: ± 0.05 degrees
- **Flatness**: ± 0.2 mm
  - The mounting structure must not deviate from a flat surface more than ± 0.2 mm.

Motion sensor alignment accuracy

- **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 alignment accuracy

- **Heading**: ± 0.10 degrees

Position sensor alignment accuracy

- **Position (x)**: ± 0.05 m
- **Position (y)**: ± 0.05 m
- **Position (z)**: ± 0.02 m

Waterline determination accuracy

- **Position (z)**: ± 0.02 m

Equipment handling

Observe these basic rules for transportation, storage and handling of units. In this context, a *unit* may be any large or small part of the system. It can be supplied as part of the initial delivery, or as a spare part. The phrase *box* is used to describe all kinds of cases, wooden or cardboard boxes etc used to hold the *unit*.

Topics

Transporting Kongsberg Maritime equipment

Unless otherwise stated in the accompanying documentation, electronic, electromechanical and mechanical units supplied by Kongsberg Maritime can be only transported using methods approved for delicate and fragile equipment.

Prerequisites

Transportation methods approved for delicate equipment includes transportation by road, rail, air or sea.

Context

The units are to be transported in accordance with general or specific instructions for the appropriate unit(s), using pallets, transport cases, wooden boxes, or carton boxes as appropriate.

Observe the packing instructions.

Note

Special local restrictions concerning air transportation may be applied to units containing certain types of batteries. These units must be checked properly, and the regulations must be investigated by the packer/shipper before the unit is dispatched.

Procedure

1 Ensure that all local transportation is done according to the same specifications as for the initial delivery.

2 Make sure that the box containing the unit is kept dry at all times, and sheltered from the weather.

It must not be subjected to shocks, excessive vibration or other rough handling. The box will normally be marked with text or symbols indicating which way it is to be placed. Follow the instructions provided, and make sure that the box is always placed with its “top” facing upwards.

3 Make sure that the box is not used for any purpose for which it was not intended (step, table, etc.).

In the absence of other information, no other boxes must be stacked on top of it.

4 Handle all boxes and units with care.

Note

Due to the nature of Kongsberg Maritime’s products, and the extensive use of delicate electronic parts, all units and boxes must be regarded and handled as fragile equipment.

Lifting units and transportation boxes

Some of the boxes used to hold equipment units may be heavy. Use caution when lifting.

Prerequisites

Units and boxes may be heavy. Make sure that you have the necessary equipment required for lifting heavy items. Persons using the lifting equipment must be skilled and have the relevant certificate(s).

Context

A heavy box will normally be marked with its weight. The weights of other boxes in the shipment will normally be entered on the packing list(s).

Heavy units may be equipped with dedicated lifting lugs for transportation by crane within the workshop or installation area.

Note

Observe the local rules and regulations related to the use of lifting equipment.

Procedure

1 Check the weight of the box or unit before you attempt to lift it.

2 Make sure that you have the relevant lifting apparatus required, and that this equipment is approved and certified for the load.

3 If you need to use a crane:

   a Check the applicable weight certificate for the crane.

   b Check the security of the lifting lugs.

   c If the unit to be lifted is provided with dedicated lifting lugs, make sure that all available lugs are used.

   d Make sure that the unit remains under full control during the lifting operation.

   This is important to avoid damage to the unit, equipment or personnel.

4 If you need to use a forklift truck:

   a Check the applicable weight certificate for the truck.

   b Check the limitations for lifting height and angles.

   c Pay special attention to the position of the unit's centre of gravity.

   d Make sure that the unit is properly secured to the truck during the lifting and transportation operations.

5 Handle all units and boxes with care.

Note

Due to the nature of Kongsberg Maritime's products, and the extensive use of delicate electronic parts, all units and boxes must be regarded and handled as fragile equipment.

Inspection of units and transportation boxes after arrival

A visual inspection must be done immediately after the box(es) have arrived at their destination.

Prerequisites

If you suspect that the equipment has been damaged during the transport, request that a representative of the carrier is present during the inspection.

Procedure

1 Check all boxes (wooden or cardboard boxes, plastic bags and/or pallets) for physical damage.

Look for signs of dropping, immersion in water or other mishandling.

2 If external damage is detected, open the box to check its contents.

Request that a representative of the carrier to be present while the box is opened, so any transportation damage can be identified and documented.

3 If a unit has been damaged, prepare an inspection report stating the condition of the unit and actions taken.

Describe the damage, and collect photographic evidence if possible. Return the inspection report to Kongsberg Maritime as soon as possible.

4 If units are not damaged, check the humidity absorbing material.

If required, dry or replace the bags, then re-pack the unit(s) according to the packing instructions.

Specifications for storage prior to installation or use

When a system, a unit or a spare part has been delivered to the customer, it may be subject to long time storage prior to installation and use.

General specifications

During this storage period, certain specifications must be met. The equipment must be preserved and stored in such a way that it does not constitute any danger to health, environment or personal injury.

1 The equipment must be stored in its original transportation box.

2 Ensure that the units are clearly separated in the shelves and that each unit is easily identifiable.

3 The box must not be used for any purpose for which it was not intended (work platform, steps, table etc.).

4 Boxes must not be placed on top of each other, unless specific markings permit this.

5 Boxes must not be placed directly on a dirt floor.

6 Do not open a box for inspection unless special circumstances permit so.

"Special circumstances" may be suspected damage to the box and its content, or inspections by civil authorities.

a If a unit is damaged, prepare an inspection report stating the condition of the unit and the actions taken. Describe the damage and collect photographic evidence if possible. Re-preserve the equipment.

b If the unit is not damaged, check the humidity absorbing material. If required, dry or replace the bags, then re-pack the unit according to the packing instructions.

7 If a box has been opened, make sure that is it closed and sealed after the inspection. Use the original packing material as far as possible.

8 The storage room/area must be dry with a non-condensing atmosphere. It must be free from corrosive agents.

9 The storage room/area's mean temperature must not be lower than -10° C, and not warmer than +50° C. If other limitations apply, the crates will be marked accordingly.

10 Boxes must not be exposed to moisture from fluid leakages.

11 Boxes must not be exposed to direct sunlight or excessive warmth from heaters.

12 Boxes must not be subjected to excessive shock and vibration.

13 If the unit contained in a box holds normal batteries, these may have been disconnected/isolated before the unit was packed. These must only be reconnected before the installation starts. Units containing batteries are marked.

Caution

Units containing lithium or alkaline batteries must be handled separately and with care. Such units are marked accordingly. Do not attempt to recharge such batteries, open them, or dispose of them by incineration.

Refer to the applicable product data sheets or battery handling procedures for further details.

Temperature protection

Any units that requires protection against extreme temperatures are identified as such in the applicable documentation. The box used to transport and store such units are clearly marked, for example:

Must not be transported or stored in temperatures below -5 °C.

Other temperature limits may be used if applicable.

If a unit needs temperature protection, the box to be used for storage and transportation must be lined on all walls, base and lid, using minimum 5 cm thick polyurethane or polystyrene foam.

Most system units can normally be stored in temperatures between -30° C and +70° C. Refer to the relevant technical specifications for details.

Note

Unless otherwise specified, transducers and hydrophones must not be stored in temperatures below −10°C and above +50°C.

Unpacking instructions

Prior to installation or use, electronic, electromechanical and mechanical units must be unpacked from their transport boxes. It is important that this unpacking is done according to the relevant instructions, and without inflicting damage to the equipment.

Topics

Unpacking standard parts and units

Prior to installation or use, parts and units must be inspected, and then unpacked from their transport boxes. It is important that this unpacking is done without inflicting damage to the equipment.

Context

This procedure provides the basic tasks of unpacking units (main unit, spare parts etc) from boxes shipped from Kongsberg Maritime.

Note

If the unit in question is not unpacked for immediate use, you may consider storing it unopened in its original box. However, it may be useful to open the box to check its contents for damage and retrieve any accompanying documentation.

Do not use a knife to open cardboard boxes - the contents may be located close to the surface, and can then be damaged by the blade.

Procedure

1 Check the carton before opening it to ensure it shows no signs of dropping, immersion in water or other mishandling.

   1 If external damage is detected, open the box to check its contents.

   2 Request that a representative of the carrier to be present while the box is opened, so any transportation damage can be identified and documented.

   3 If a unit has been damaged, prepare an inspection report stating the condition of the unit and actions taken.

     Describe the damage, and collect photographic evidence if possible. Return the inspection report to Kongsberg Maritime as soon as possible.

2 Place the box on a stable work bench or on the floor with the top of the box facing upwards.

3 In the absence of other instructions, always open the top of the carton first.

   The contents of the box will normally have been lowered into the carton from above, so this will usually be the easiest route to follow. Be careful when you open the box, and make sure that the contents are not damaged. Do not use a knife to open cardboard boxes.

4 If the box has been closed using staples, remove the staples from the carton as you open it.

   This will reduce the possibilities of scratch injury to yourself and damage to the contents.

5 If a wooden box has been closed using screws, always remove them using a screwdriver.

   Do not attempt to force the lid open with a crowbar or similar tool.

6 Once the carton is open, carefully remove all loose packing and insulation material.

7 Check for user manuals and other documents that may have been added to the carton during packing.

8 Check also for special tools, door keys etc.

Unpacking mechanical units

Prior to installation or use, mechanical units must be unpacked from their transport boxes. It is important that this unpacking is done without inflicting damage to the equipment.

Prerequisites

Observe the procedure for unpacking of standard parts and units.

Context

Mechanical and electromechanical units may be heavy.

Procedure

1 Obtain the necessary lifting equipment, and make sure that the equipment is certified for the weight.

2 Lift the unit out of the transportation box.

3 Place it in a stable position on the floor/work bench.

4 Inspect the unit for visual damage.

5 Remove any packing material that may be inside the unit.

6 Collect and keep the relevant user manuals and/or documents provided with the unit.

Unpacking electronic and electromechanical units

Prior to installation or use, electronic and electromechanical units must be unpacked from their transport boxes. It is important that unpacking is done without inflicting damage to the equipment.

Context

Electronic and electromechanical units are normally wrapped in clear antistatic plastic bags.

Do not break the seal to open a printed circuit board, an electronic module or a unit before it shall be used. If the unit is returned with a broken seal we will assume that it has been used. You will then be billed accordingly.

Note

Beware of Electrostatic Discharge (ESD)!

When you handle electronic circuit boards and modules, you must beware of the dangers of electrostatic discharge (ESD), both to yourself and to the equipment. In order to ensure safe transport and storage, circuit boards and other electronic units will always be wrapped in a clear plastic protective bag, and the bag will be sealed.

Procedure

1 Lift the unit, in its protective bag, out of the transport box.

Note

You must never use the cables to lift or carry a unit.

2 Place it in a stable position on the floor or on the workbench.

3 Inspect the unit for damage.

a If a unit has been damaged, prepare an inspection report stating the condition of the unit and actions taken.

b Describe the damage, and collect photographic evidence if possible. Return the inspection report to Kongsberg Maritime as soon as possible.

4 Assuming all is well, open the bag and remove the unit.

5 Take out and keep the documentation.

You will need the documentation if the item shall be returned to us.

6 If applicable, open the unit and check inside.

7 Remove any packing and desiccant material that may be found inside the shipping container or bag.

8 Collect and keep the relevant user manuals and/or installation documents provided with the unit.

Unpacking transducers

Prior to installation or use, transducers, sonar heads and hydrophones must be unpacked from their transport boxes. It is important that this unpacking is done without inflicting damage to the equipment.

Prerequisites

Observe the procedure for unpacking of standard parts and units.

Context

Transducers may be supplied mounted to a hull unit (if any), or packed separately. Sonar heads and hydrophones are normally packed and shipped in separate boxes. Boxes are identified by the order number and the serial number of the unit inside.

Note

Once a transducer, sonar head or hydrophone is unpacked, make sure that the body and the cabling are not exposed to any mechanical stress. Protect the transducer face with a padded cover plate to prevent damage.

Transducers may be heavy.

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

Observe these transducer handling rules:

- **Do not** activate the transducer when it is out of the water.
- **Do not** lift the transducer by the cable.
- **Do not** step on the transducer cable.
- **Do not** handle the transducer roughly. Avoid impacts.
- **Do not** expose the transducer to direct sunlight or excessive heat.
- **Do not** use high-pressure water, sandblasting, metal tools or strong solvents to clean the transducer face.

Procedure

1 Obtain the necessary lifting equipment, and make sure that the equipment is certified for the weight.

2 Lift the transducer, sonar head or hydrophone out of the transportation box.

3 Place it in a stable position on the floor/work bench.

4 Inspect the unit for visual damage.

5 Make sure that the relevant protection is kept in place until the final stages of the installation.

6 Collect and keep the relevant user manuals and/or documents provided with the unit.

7 Observe the handling rules for transducers.

Specifications for storage after unpacking

The unit must whenever possible be stored in its original transportation crate until ready for installation.

General specifications

During storage, each box must not be used for any purpose for which it was not intended (work platform, table, steps etc.).

Once unpacked, all equipment must be kept in a dry, non-condensing atmosphere, free from corrosive agents and isolated from sources of vibration.

Note

Do not break the seal to open a circuit board package before the board is to be used. If the board package is returned to Kongsberg Maritime with the seal broken, we will assume that the unit has been used and you will be billed accordingly.

Each unit must be installed in its intended operating position as soon as possible after unpacking. If the unit contains normal batteries, these may have been disconnected/isolated before the unit was packed. These must then be reconnected during the installation procedure. Units containing batteries are marked.

Caution

Units containing lithium or alkaline batteries must be handled separately and with care. Such units are marked accordingly. Do not attempt to recharge such batteries, open them, or dispose of them by incineration.

Refer to the applicable product data sheets or battery handling procedures for further details.

Temperature protection

Any units that requires protection against extreme temperatures are identified as such in the applicable documentation. The box used to transport and store such units are clearly marked, for example:

Must not be transported or stored in temperatures below -5 °C.

Other temperature limits may be used if applicable.

If a unit needs temperature protection, the box to be used for storage and transportation must be lined on all walls, base and lid, using minimum 5 cm thick polyurethane or polystyrene foam.

Most system units can normally be stored in temperatures between -30° C and +70° C. Refer to the relevant technical specifications for details.

Note

Unless otherwise specified, transducers and hydrophones must not be stored in temperatures below −10°C and above +50°C.

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