



KONGSBERG

Instruction Manual

# $\mu$ PAP 201-C

Portable acoustic positioning system







KONGSBERG

***μPAP 201-C***  
***Portable Acoustic Positioning system***  
***Instruction Manual***

494326/C

February 2024 © Kongsberg Discovery AS

## Document information

- **Product:** Kongsberg µPAP 201-C
- **Document:** Instruction Manual
- **Document part number:** 494326
- **Revision:** C
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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 Discovery disclaims any responsibility for damage or injury caused by improper installation, use or maintenance of the equipment.*

## Disclaimer

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

## Support information

If you require maintenance or repair, contact Kongsberg Discovery's support organisation. You can also contact us at the following email address: [support.hpr@kd.kongsberg.com](mailto:support.hpr@kd.kongsberg.com). If you need information about our other products, visit <https://www.kongsberg.com/discovery/>.

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# About this manual

This manual includes all necessary documentation to safely install, operate and maintain the system.

## **Target audience**

This manual is intended for all users of the system.

## **Online information**

All end-user documentation can be downloaded from our website.

<https://www.kongsberg.com/discovery/>

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# Introduction

## Topics

[System description, page 7](#)

[System diagram, page 8](#)

[System units, page 9](#)

[Scope of supply, page 11](#)

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[Support information, page 13](#)



## System description

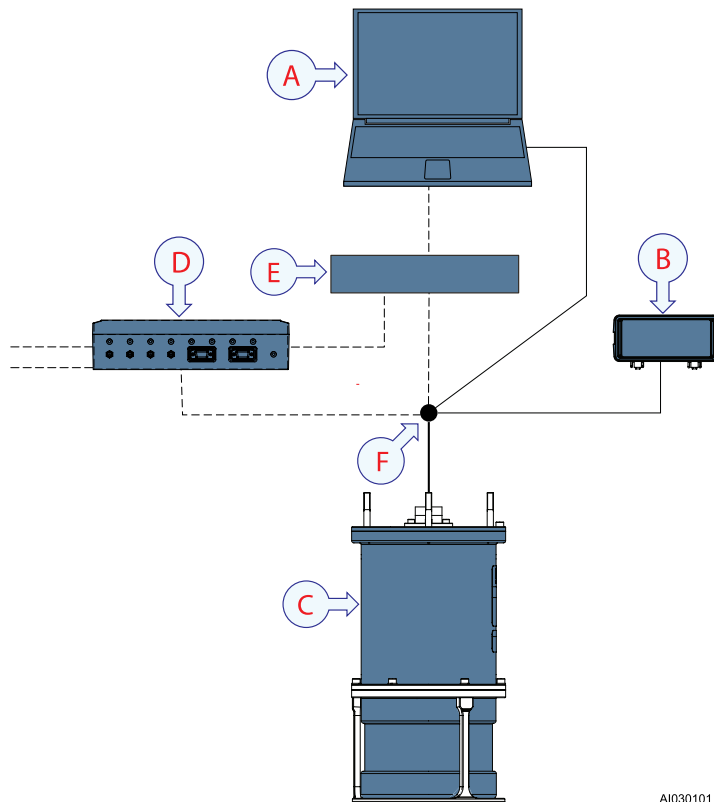
The product range consists of several models.

$\mu$ PAP is a portable and compact acoustic positioning system for tracking ROVs, tow fish, divers or other subsea objects at several thousand metres range. The system is housed in a compact transducer casing, making it well suited for installation onboard an Uncrewed Surface Vehicle (USV). It is remotely operated from an external computer over Ethernet and the user selects and controls the transponders to be used, or sends data for acoustic modem transfer to a modem onboard a subsea vehicle.



## System diagram

The system diagram outlines the standard configuration of a μPAP portable acoustic positioning system and its main units. Only the main connections between the units are included in the diagram.



A1030101\_003\_002

- A Customer's computer
- B Customer's power supply unit
- C Transducer
- D Responder Driver Unit (optional)
- E Ethernet switch (optional)
- F Junction box (optional)

## System units

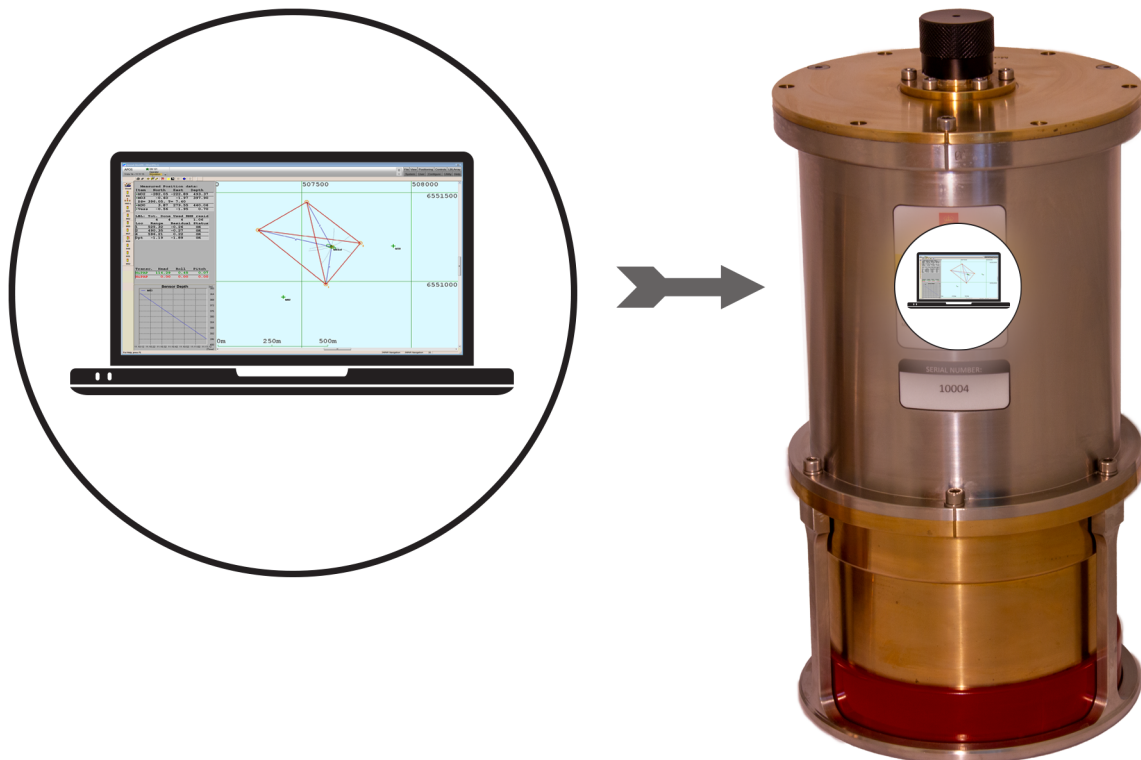
### μPAP 201-C transducers

The transducer's casing is made of stainless steel and bronze in order to obtain optimal anti-corrosion properties. The casing encloses and protects the electronics and the acoustic transducer elements needed for transmitting and receiving acoustic signals, as well as the roll and pitch motion sensor and the power supply. In addition, the μPAP 201-C transducer has a built-in PC running Windows OS with APOS software pre-installed. A frame fitted to the casing protects the lower part of the transducer and its underside, or face, from accidental damage. The frame also functions as a stand and supports the transducer when it is placed on deck or on any other level surface. The transducer has mounting brackets for easy mounting on a pole and can be tilted sideways if needed during operations.

The transducer is delivered in a sturdy transport case.

#### Note

*Care must be taken to avoid accidental damage to the transducer's lower part and its underside, or face. The transducer **must not** be placed in direct sunlight when stored on deck.*



## Responder Driver Unit (optional)

The Responder Driver Unit controls and distributes responder trigger signals to responders.

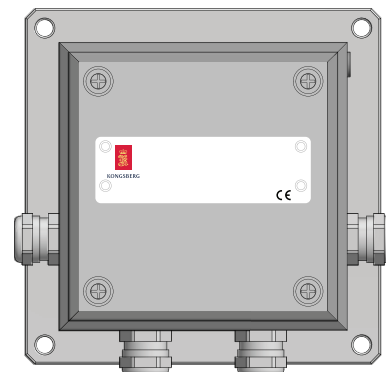
The Responder Driver Unit is a stand-alone unit. The Responder Driver Unit is connected to the transducer. APOS controls and activates the designated drive prior to reception of the sync/timing signal from the transceiver.



## Junction box (optional)

The junction box is designed for surface mounting. It includes built-in terminals for the joining of wires between the transducer and the customer's power supply, and between the transducer and the customer's computer.

A Responder Driver Unit and an ethernet switch can also be connected to the junction box.



## APOS - the $\mu$ PAP 201-C operator system

A  $\mu$ PAP 201-C transducer is operated from an acoustic positioning operator station (APOS). The acoustic positioning operator station, or APOS for short, is a PC running Windows OS with dedicated acoustic positioning software (APOS software).

The  $\mu$ PAP 201-C transducer has a built-in PC running Windows OS with an APOS pre-installed. Use the following logon credentials to logon to a  $\mu$ PAP 201-C' built-in PC. Remote desktop logon: IP 192.169.200.81/255.255.255.0

The computer you logon from must have an adapter configured on the same subnet, for example 192.169.200.90/255.255.255.0

Username: dpos

Password: dpos

## Scope of supply

All main units needed are included in the standard delivery.

When unpacking the  $\mu$ PAP 201-C system delivery, make sure the following items are included:

- Transducer

Optional items

- Pigtail cable
- Responder Driver Unit
- Ethernet switch
- Junction box

## General supply conditions

General supply conditions apply to this μPAP 201-C delivery.

### Receipt, unpacking and storage

Upon accepting shipment of the equipment, the shipyard and/or the dealer must ensure that the delivery is complete and inspect each shipping container for evidence of physical damage.

If the inspection reveals any indication of crushing, dropping, immersion in water or any other form of damage, the recipient should request that a representative from the company used to transport the equipment be present during unpacking.

All equipment must be inspected for physical damage, i.e. broken controls and indicators, dents, scratches etc. during unpacking. If any damage to the equipment is discovered, the recipient must notify both the transportation company and Kongsberg Discovery so that Kongsberg Discovery can arrange for replacement or repair of the damaged equipment.

Once unpacked, the equipment must be stored in a controlled environment with an atmosphere free of corrosive agents, excessive humidity or temperature extremes.

The equipment must be covered to protect it from dust and other forms of contamination when stored.

### Equipment responsibility

Unless otherwise stated in the contract, the shipyard doing the installation and/or equipment dealer becomes fully responsible for the equipment upon receipt.

The duration of responsibility cover:

- The period of time the equipment is stored locally before installation
- The entire installation process
- Commissioning
- The period of time between commissioning and the final acceptance of the equipment by the end user or owner

Unless other arrangements have been made in the contract, the Kongsberg μPAP 201-C warranty period (as specified in the contract) begins when the acceptance documents have been signed.

## Support information

Should you need technical support for your  $\mu$ PAP 201-C system you must contact a Kongsberg Discovery office. A list of all our offices is available on our website. You can also contact our main support office in Norway.

Manuals and technical information can be downloaded from our support website.

<b>Company name</b>	Kongsberg Discovery AS
<b>Address</b>	Strandpromenaden 50, 3183 Horten, Norway
<b>Telephone 24hr Support</b>	+47 33 03 24 07
<b>Website</b>	<a href="https://www.kongsberg.com/discovery/">https://www.kongsberg.com/discovery/</a>
<b>Support website</b>	<a href="#">Product support A to Z</a>
<b>E-mail address</b>	<a href="mailto:support.hpr@kd.kongsberg.com">support.hpr@kd.kongsberg.com</a>

Kongsberg Discovery support is also available in the KM-Support App. Our support application is available for free in the App Store and Google Play. Search for KM-Support. The use of our support application is free of charge. Your mobile phone provider may charge you the cost of the communication.

# Installation

## Topics

[Installing the transducer, page 15](#)

[Installing the Responder Driver Unit \(optional\), page 16](#)

[Converting from fibre optical to electrical signal, page 17](#)



## Installing the transducer

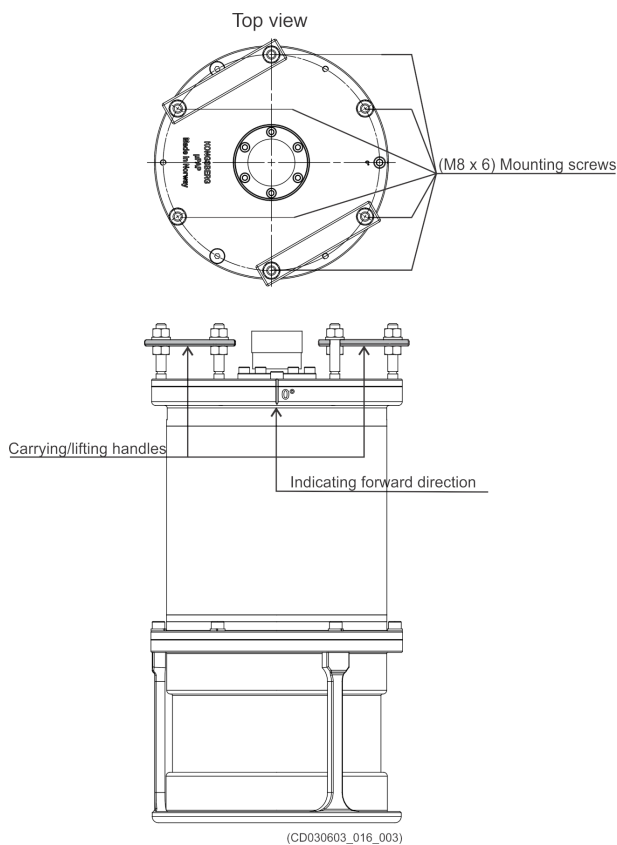
μPAP is designed for easy installation onboard ships and other surface units.

### Prerequisites

#### Caution

*The cabling must be done before installing the transducer.*

### Context



The transducer is mounted on the ship's arrangement for the transducer. This may be on a pole lowered through a moon pool or a hull unit.

The location of the transducer arrangement must be as far away as possible from thrusters, aerated water, noise sources or other equipment sensitive to acoustic noise in the water.

[Installing the transducer to the ship's side pole, page 39](#)

### Procedure

- 1 Remove the lifting handles.

- 2 Mount the transducer with the forward indicator pointing forward.
- 3 Fasten the stud bolts.

## Installing the Responder Driver Unit (optional)

The Responder Driver Unit is a stand-alone unit and can be mounted either horizontally or vertically.

### Prerequisites

The unit should be located where it is most suitable for connecting the cables to the responders. This can be close to the Remote Operating Vehicle (ROV) operation room. The unit must be installed so it is easily accessible for operators to check the working condition of the responder trigger status diodes.

### Procedure

- 1 Remove the four screws securing the lid.
- 2 Lift off the lid and locate the four mounting holes, one in each corner.
- 3 Mount the responder driver unit where suitable.  
Mounting screws, nuts and washers are included.
- 4 Close the unit.

#### Note

---

*Keep the protecting caps on the fibre-optic connectors to avoid accidental damage and contamination when not in use.*

---

## Converting from fibre optical to electrical signal

The converter works both ways and can be used to create an optical isolation between high voltage equipment and a transceiver.

### **Context**

You need one kit for each responder signal. Connectors are included to lengthen the cable if needed.

### **Procedure**

- 1 Produce the cable from the responder driver unit to the converter in accordance with drawing 308850 in the drawing file chapter. The connectors are included in the converter kit.
- 2 Secure the cable and connect it.
- 3 For an optical isolation, produce the cable from the converter to the ROV in accordance with drawing 308850 in the drawing file chapter. The connector is included.
- 4 Secure the cable and connect it.
- 5 Continue with fibre optical or electrical cables as needed.

# Cabling

## Topics

[Cable plan, page 19](#)

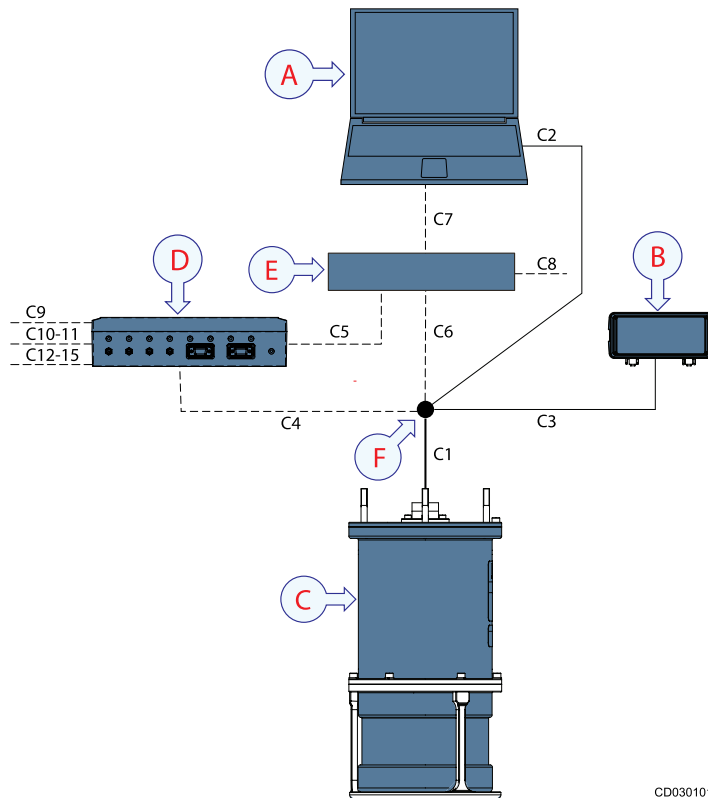
[Cable list, page 20](#)

[μPAP 201-C pinout, page 21](#)

[Connecting the system cables, page 22](#)

## Cable plan

The cables are not part of the delivery with the main units.



CD030101\_002\_002

- A** Customer's computer
- B** Customer's power supply unit
- C** Transducer
- D** Responder Driver Unit (optional)
- E** Ethernet switch (optional)
- F** Junction box (optional)

## Cable list

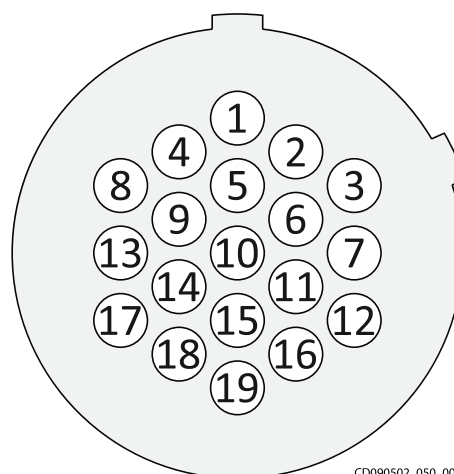
Cables C1-C3 are required to make the system operational. Cables C4-C15 are required if an optional Responder Driver Unit together with an Ethernet Switch are part of the system. An optional special pigtail cable is available upon request.

Cable	Type	From/To
C1	Pigtail cable	
C2	Ethernet cable	From pigtail to customer's computer
C3	DC Power cable	From customer's power supply unit to pigtail
C4, optional	Responder sync cable	From pigtail to Responder Driver Unit
C5, optional	Ethernet cable	From Ethernet Switch to Responder Driver Unit
C6, optional	Ethernet cable	From pigtail to Ethernet Switch
C7, optional	Ethernet cable	From Ethernet Switch to computer
C8, optional	AC Power cable	From Ethernet Switch to power outlet
C9, optional	AC Power cable	From Responder Driver Unit to power outlet
C10-11, optional	Serial cables	From Responder Driver Unit to Responder
C12-15, optional	Fibre optic cables	From Responder Driver Unit to Responder

## μPAP 201-C pinout

This is the pin configuration for a male connector, as seen towards the connector (face view).

The connector is a Gisma 10.00.4.19.2.10-Y 19 pin male with keyway 66°.



CD090502\_050\_002

Pin number	Signal
1	Ethernet Tx –
2	Ethernet Rx +
3	Ethernet Rx –
4	Ethernet Tx +
5	COM1 Tx
6	COM1 Rx
7	COM2 Rx +
8	1PPS
9	GND
10	Not connected
11	COM2 Tx –
12	COM2 Rx –
13	Responder sync +
14	Responder sync –
15	COM2 Tx +
16	0 V
17	+24 V
18	0 V
19	+24 V

## Connecting the system cables

All relevant wires in the pigtail cable must be terminated before connecting the system units. Make sure all wire terminations have been performed correctly.

### Procedure

- 1 Connect the pigtail cable to the transducer. (C1)
- 2 Connect the ethernet cable to the pigtail and to the Computer. (C2)
- 3 Connect the DC power cable to the pigtail and to the Power Supply Unit. (C3)  
An optional Responder Driver Unit together with an Ethernet Switch may be part of the system. If this is the case, see steps 4-10.
- 4 Connect the responder sync cable to the Responder Driver Unit and to the pigtail. (C4)
- 5 Connect the Ethernet cable to the Responder Driver Unit and to the Ethernet Switch. (C5)
- 6 Connect the Ethernet cable to the Ethernet Switch and to the pigtail. (C6)
- 7 Connect the Ethernet cable to the Computer and to the Ethernet Switch. (C7)
- 8 Terminate the responder trigger signal cables with D-sub connectors. (C10-11)  
For more information, see [Pinout responder trigger signal cables with D-sub connectors, page 23](#)
- 9 Connect the responder trigger signal cables to the Responder Driver Unit and to the responders. (C10-11)
- 10 Connect the responder trigger signal cables to the Responder Driver Unit and to the responders. (C12-15) Use fibre to electrical signal converters if necessary.



## Pinout responder trigger signal cables with D-sub connectors

The responder trigger signal cables connecting the Responder Driver Unit and the responders are not included in the delivery and must be supplied by the installation shipyard.

Pinout Responder drive signal 1 to 4 for Responder Drive Unit	
<b>Responder 1</b>	<b>9p D-sub</b>
Power 1 +24V	1
Drive signal 1	2
Ground	3
<b>Responder 2</b>	<b>9p D-sub</b>
Power 2 +24V	6
Drive signal 2	7
Ground	8
<b>Responder 3</b>	<b>9p D-sub</b>
Power 3 +24V	1
Drive signal 1	2
Ground	3
<b>Responder 4</b>	<b>9p D-sub</b>
Power 4 +24V	6
Drive signal 2	7
Ground	8

RDU Front view

Male 9-pin D-sub connector

The diagram shows a front view of a male 9-pin D-sub connector. The pins are arranged in two rows: the top row contains pins 1, 2, 3, 4, 5 and the bottom row contains pins 6, 7, 8, 9. Arrows point to pins 1, 5, 6, and 9, which are labeled with their respective numbers.

CD0801\_003\_004

Terminate the responder trigger signal cables as illustrated with D-sub connectors.

# Operating procedures

## **Topics**

[Accessing APOS online help on a μPAP 201-C, page 25](#)

[Positioning principles and processing, page 26](#)

## Accessing APOS online help on a $\mu$ PAP 201-C

A  $\mu$ PAP 201-C transducer is operated from an acoustic positioning operator station (APOS). The acoustic positioning operator station, or APOS for short, is a PC running Windows OS with dedicated acoustic positioning software (APOS software).

### **Context**

The  $\mu$ PAP 201-C transducer has a built-in PC running Windows OS with an APOS pre-installed. Use the following logon credentials to access APOS online help on a  $\mu$ PAP 201-C' built-in PC.

### **Procedure**

- 1 Remote desktop logon: IP 192.169.200.81/255.255.255.0
- 2 The computer you logon from must have an adapter configured on the same subnet, for example 192.169.200.90/255.255.255.0
- 3 Username: dpos
- 4 Password: dpos

## Positioning principles and processing

### μPAP Processing

The μPAP system identifies the position of a subsea target, either a transponder or a responder, by directing a reception beam towards the target and measure the heading and range to the target. The target's position is displayed on the APOS' display either as a 2D or a 3D position projection of the target relative to the ship.

The system's digital beam-former receives data from every element within the transducer and uses the data to measure the horizontal and vertical angle to the target. The range to the target is calculated by timing the delay between interrogation and reception. The reception beam is controlled in real time using data from built in motion sensors and data from a gyrocompass, ensuring the reception beam stays fixed on the target unaffected by target movement and ship motion.

The μPAP transceiver can operate with several hundred transponders channels.

### Telemetry

The unit transmits acoustic telemetry messages, and receives and decodes acoustic telemetry messages from a transponder.

# Maintenance

## Topics

[Preventive maintenance schedule, page 28](#)

[Inspecting and cleaning the transducer, page 29](#)

[Creating a backup, page 29](#)

## Preventive maintenance schedule

Preventive maintenance must be carried out periodically in order to preserve reliability and ensure safe operation during the system's service life. The preventive maintenance activity is broken down into specific tasks and the tasks are organized periodically in a *preventive maintenance schedule*. The preventive maintenance schedule detailed below is for portable systems only.

- Maintenance tasks carried out after every use
  - Clean the transducer and remove marine growth.
  - Lubricate the connectors.
  - Make sure all bolts and nuts are tightened.
  - Check the unit for physical damage.
- Maintenance tasks carried out every month
  - Gently wipe the dust off all system units.
  - Make a backup of the APOS configuration.
- Maintenance tasks carried out every six months
  - Check all cable connections.
  - Check all system units for physical damage.

## Inspecting and cleaning the transducer

The transducer must always be handled correctly in order to preserve its accuracy and prolong its service life.

### Context

A transducer is a delicate precision instrument and must be treated as such. Incorrect handling may damage the transducer beyond repair.

### Procedure

- 1 Clean the unit thoroughly with a lot of fresh water.

*Caution* \_\_\_\_\_

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

---

- 2 Inspect for damages or growth.
- 3 Remove any growth and dirt with a stiff brush, or with a wooden scraper or with a plastic scraper.  
Be careful not to damage the unit.
- 4 Lubricate the connector.

## Creating a backup

For backup procedures, refer to the backup files document. This is a separate manual supplied with the system delivery.

Take a backup of all operator stations at regular intervals (1-3 months), and every time major changes have been performed in the configuration and/or user settings.

**Important** \_\_\_\_\_

A backup must be performed when the software has been upgraded.

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# Spare parts

## Topics

[μPAP 201-C spare parts, page 31](#)

[Responder driver unit spare part, page 32](#)

[Junction box spare part, page 32](#)



## μPAP 201-C spare parts

- **Part name:** μPAP 201-C
- **Part number:** 468079
  
- **Part name:** μPAP 201-C-m30
- **Part number:** 465865
  
- **Part name:** μPAP 201-C-X
- **Part number:** 468078



## Responder driver unit spare part

- **Part name:** Responder driver unit spare part
- **Part number:** 321990

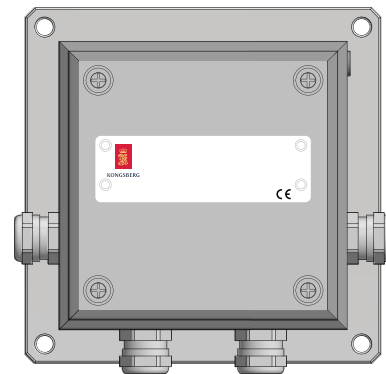
The spare part kit consists of:

- Responder Driver Unit
- AC/DC Power supply
- Trigger cable
- 4 M4x25 Bolts
- 4 M4 Spring lock washers
- 4 M4 Nuts
- 3 D-sub connectors
- Ethernet switch
- 3 Ethernet cables



## Junction box spare part

- **Part name:** Junction box
- **Part number:** 484278



# Technical specifications

## **Topics**

[Performance specifications, page 34](#)

[Power specifications, page 35](#)

[Environmental specifications, page 36](#)

[Weights and outline dimensions, page 37](#)

## Performance specifications

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

### Transducer

- **Frequency:** 20-30 kHz
- **Range capability:** 4000+ m. Range capability is depending on line of sight, transponder's transmit power setting, ship's acoustic system and influence of ambient noise and ray bending.
- **Operational coverage:**  $\pm 90^\circ$ . Operational coverage defines the sector where acoustic positioning and communications are operational.
- **Main coverage:**  $\pm 80^\circ$ . Main coverage is the sector where maximum range and angular accuracy can be achieved. Outside the main coverage range and elevation angular accuracy are reduced, therefore a depth input for aiding is recommended.
- **Receiver beam:**  $22^\circ$
- **Source level (re 1μPa):** 190 dB
- **Navigation channels:** cNODE compatible with 560 Cymbal channels and 56 FSK channels.
- **Operation mode:** SSBL (Super short baseline), LBL (Long baseline) and acoustic modem.
- **Ethernet cable length:**  $\leq 75$  m
- **Transducer deployment depth:**  $< 100$  m

### Position accuracy

Model	Motion sensor accuracy	System position accuracy (in X and Y direction)
μPAP 201-C Part number: 465079	N/A	0.25° / 0.45 %, Range: 0.02 m
μPAP 201-C-X Part number: 465078	Roll & Pitch: 0.02° Heading: 0.2° Range: $\pm 180^\circ$	0.32° / 0.56 %, Range: 0.02 m
μPAP 201-C-m30 Part number: 465865	Roll & Pitch: 0.01° Heading: 0.1° Range: $\pm 180^\circ$	0.26° / 0.44 %, Range: 0.02 m

## Power specifications

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

### **μPAP 201-C**

- **Voltage requirement:** 24 VDC nominal (18-36 VDC)
- **Power consumption:** Max. 75 W, nominal 25 W

### **μPAP 201-C-m30**

- **Voltage requirement:** 24 VDC nominal (18-36 VDC)
- **Power consumption:** Max. 75 W, nominal 25 W

### **μPAP 201-C-X**

- **Voltage requirement:** 24 VDC nominal (18-36 VDC)
- **Power consumption:** Max. 75 W, nominal 25 W

### **Responder Driver Unit**

- **Make and model:** HiPAP Responder Driver Unit
- **Voltage requirement:** 88-264 VAC, 47-63 Hz
- **Maximum current draw:** 0.4 A
- **Normal current draw:** 0.06 A
- **Nominal power consumption:** 15 W

## Environmental specifications

These environmental specifications summarize the temperature and humidity specifications for the system.

### **μPAP unit**

- **Operating temperature:** 0° C to +35° C
- **Storage temperature:** -20° C to + 70° C

### **Responder Driver Unit**

- **Operating temperature:** 0° C to +55° C
- **Storage temperature:** -40° C to +75° C
- **Relative humidity:** 15% to 95% relative non-condensing
- **Vibration range:** 5-100 Hz
- **Excitation level:** 5-13.2 Hz ±1.5 mm, 13.2-100 Hz 1 g
- **Ingress protection:** IP44

### **Junction box**

- **Operating temperature:** 0° C to +55° C
- **Storage temperature:** -40° C to +75° C
- **Relative humidity:** 15% to 95% relative non-condensing
- **Ingress protection:** IP44

## Weights and outline dimensions

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

### Transducers

Model	Height	Diameter	Weight
μPAP 201-C	404 mm	199 mm	16.0 kg
μPAP 201-C-X	404 mm	199 mm	16.0 kg
μPAP 201-C-m30	404 mm	199 mm	16.0 kg

### Other system units

Unit	Height	Width	Depth	Weight
Responder Driver Unit	73 mm	280 mm	200 mm	2.8 kg
Junction box	93.1 mm	196.2 mm	190.6 mm	2.2 kg

# Drawing file

## Topics

[Installing the transducer to the ship's side pole, page 39](#)

[μPAP 201-C series outline dimensions, page 40](#)

[Responder Driver Unit dimensions, page 41](#)

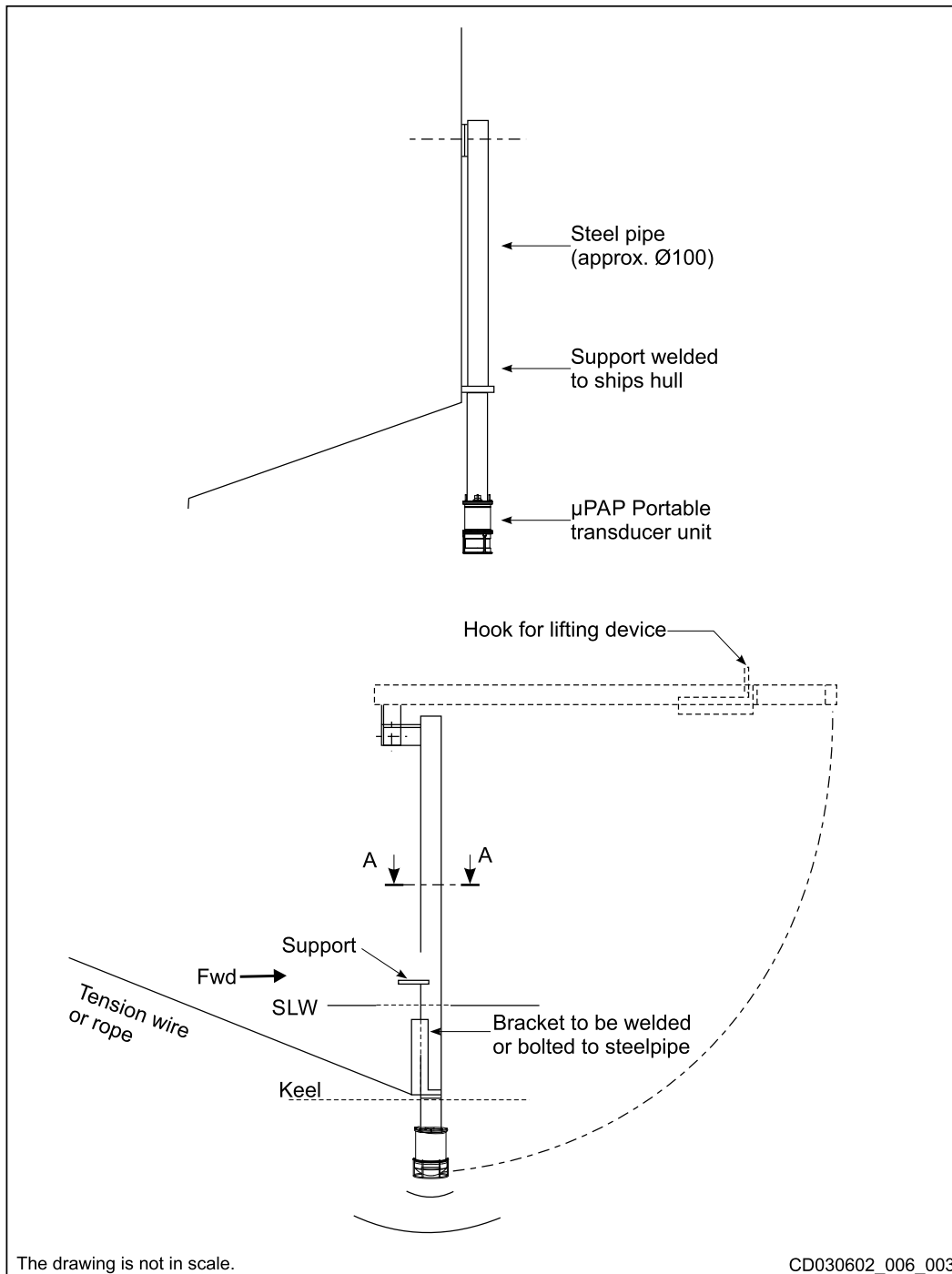
[μPAP 201-C junction box dimensions, page 42](#)

[Fibre to responder drive converter, wiring diagram, page 43](#)

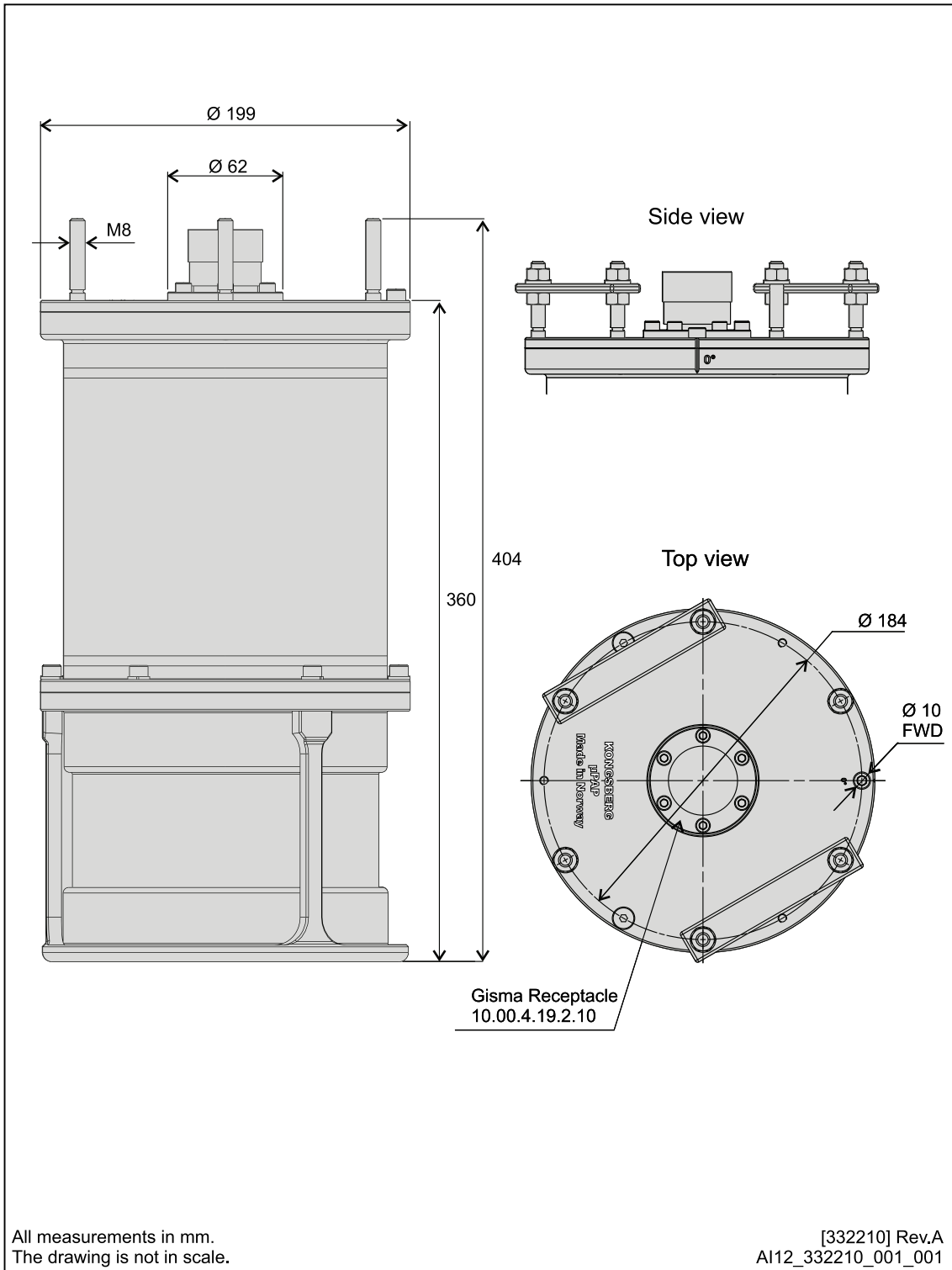


# Installing the transducer to the ship's side pole

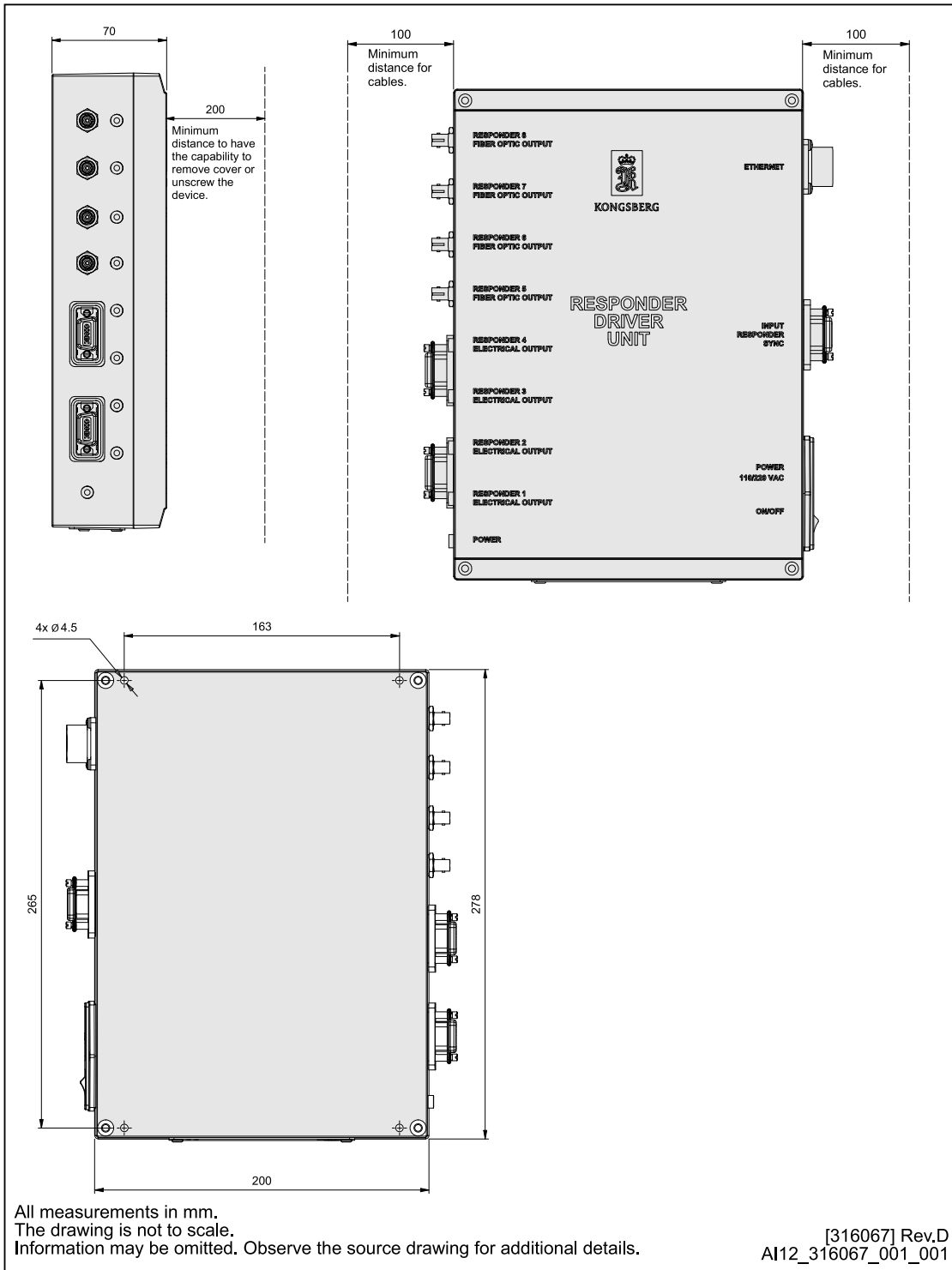
This is an example of how to install the  $\mu$ PAP transducer to the pole.



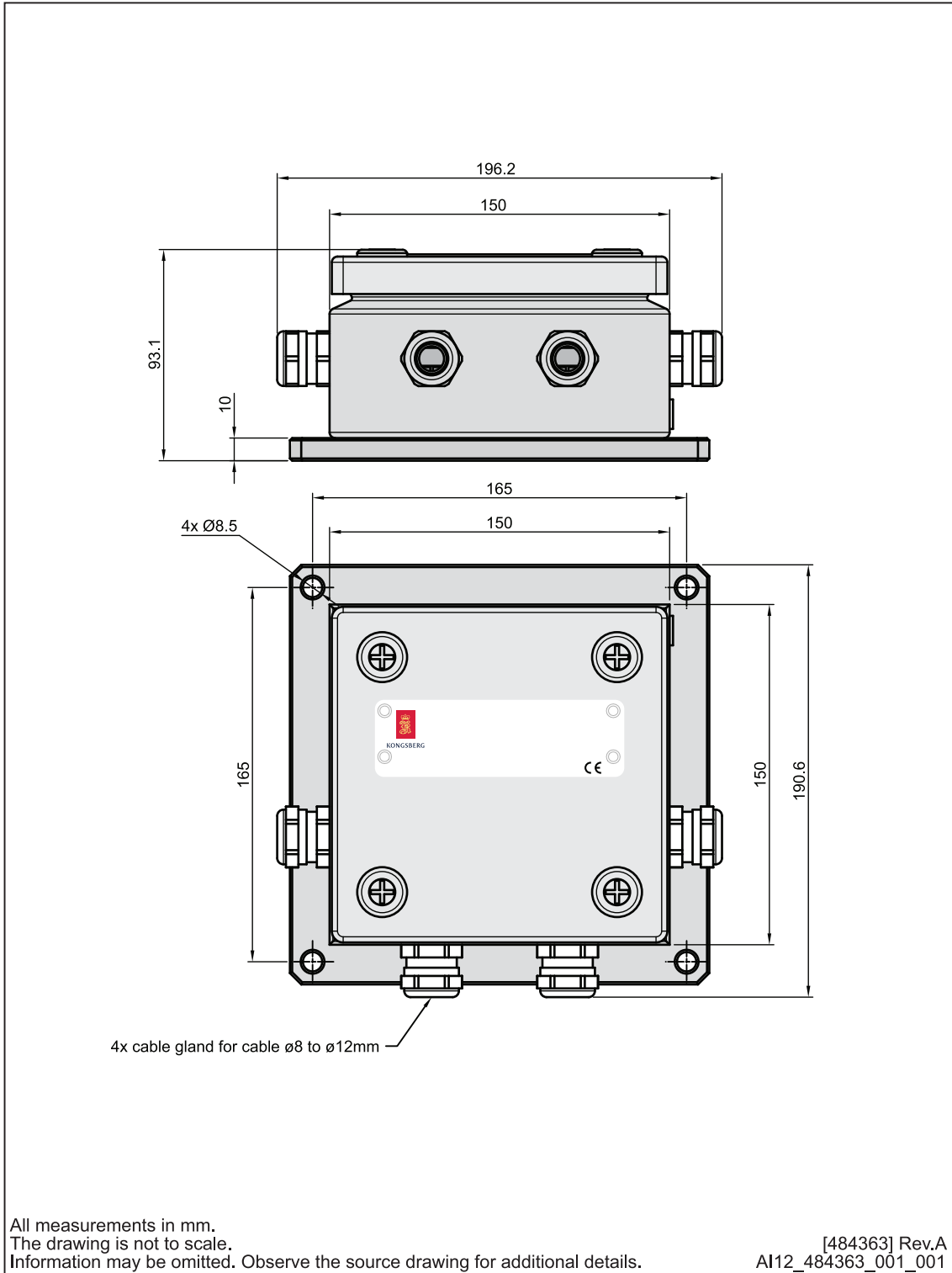
## μPAP 201-C series outline dimensions



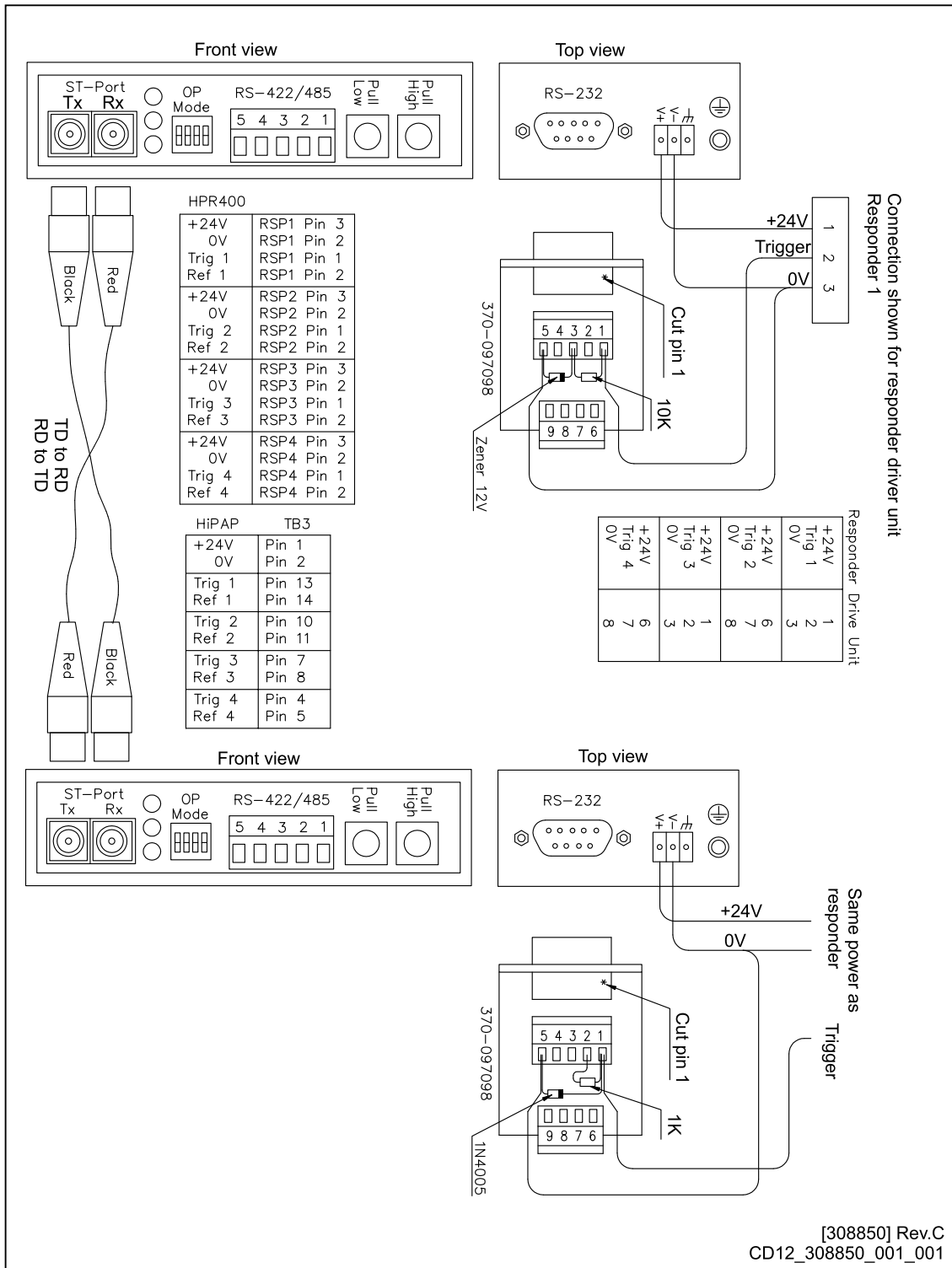
# Responder Driver Unit dimensions



## μPAP 201-C junction box dimensions



# Fibre to responder drive converter, wiring diagram



[308850] Rev.C  
CD12\_308850\_001\_001



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