



KONGSBERG

HiPAP 352P
High Precision Acoustic Positioning
system
Instruction manual

422971/C

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Document information

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- **Document:** Instruction 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.

Disclaimer

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

Support information

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

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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/maritime/>

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HiPAP 352P

Topics

[System description, page 7](#)

[System diagram, page 8](#)

[Main system units, page 9](#)

[Scope of supply, page 11](#)

[General supply conditions, page 12](#)

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System description

The HiPAP 352P is a portable system designed for tracking ROV's, tow fish, divers and other subsea objects at several thousand metres range.

The HiPAP 352P systems calculates the accurate positions of subsea objects such as Remotely Operated Vehicles (ROVs), Autonomous Underwater Vehicles (AUV's), towed bodies or fixed seabed transponders.

The system offers the user a wide range of transponder channels and cNODE transponder models for depths rating down to 11000 metres.

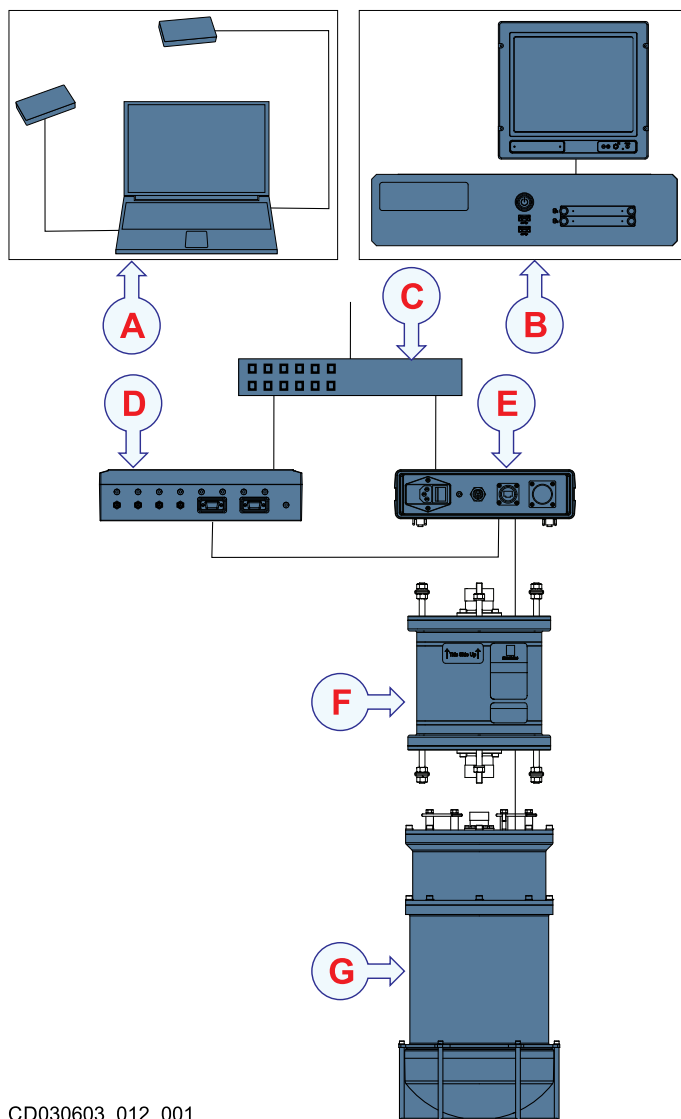
HiPAP Portable is available in several models with respect to motion and heading sensors. Calibration of roll and pitch alignments are not necessary on these models, but it might be necessary to calibrate for alignment with the vessels' gyro compass. The transducers are designed to be mounted on a shaft for installation over-the-side or through a moon-pool of a vessel.

HiPAP 352P-H has a motion sensor for roll and pitch compensation, and no heading information. HiPAP 352P-5 also has a roll and pitch motion sensor, with no heading information and a better accuracy.

HiPAP 352P-MGC-Rx has a motion gyro compass sensor.

System diagram

The system diagram identifies the main components of a basic HiPAP 352P system. Only the main connections between the units are shown.



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- A Laptop computer
- B Stationary computer
- C Ethernet switch
- D Responder Driver Unit
- E Interface unit
- F Repeater unit
- G Transducer

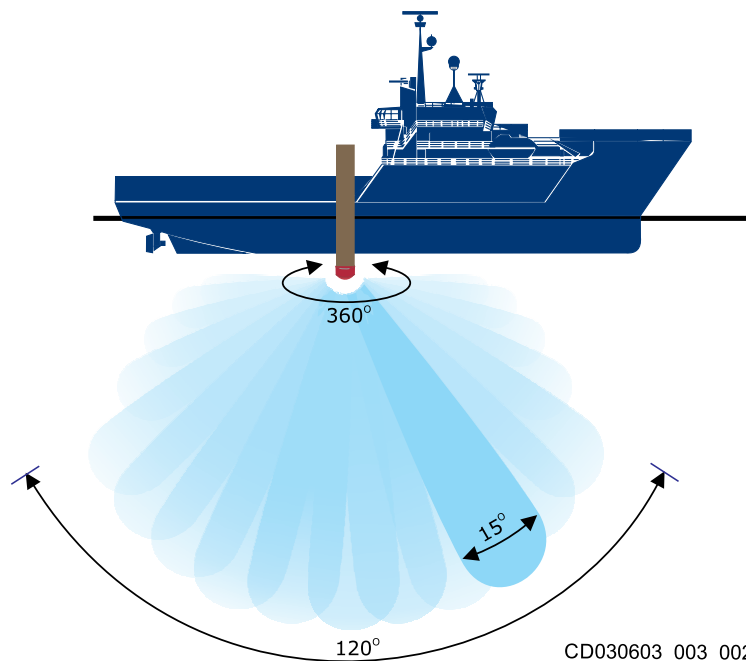
Main system units

Transducer description

The transducer converts the electric energy generated by the transmitter circuitry to physical vibrations. These vibrations alter the water pressure, and create an acoustic pulse that is sent into the water.

The transducer integrates the transmitter and receiver acoustic elements, and electronics in one unit. The unit also includes a motion sensor and an optional heading sensor.

The transducer has an operational coverage of $\pm 90^\circ$ while the main coverage is $\pm 60^\circ$.



Caution

The transducer should NOT be left with power on for more than one hour in air. It needs to be deployed in water for proper cooling.

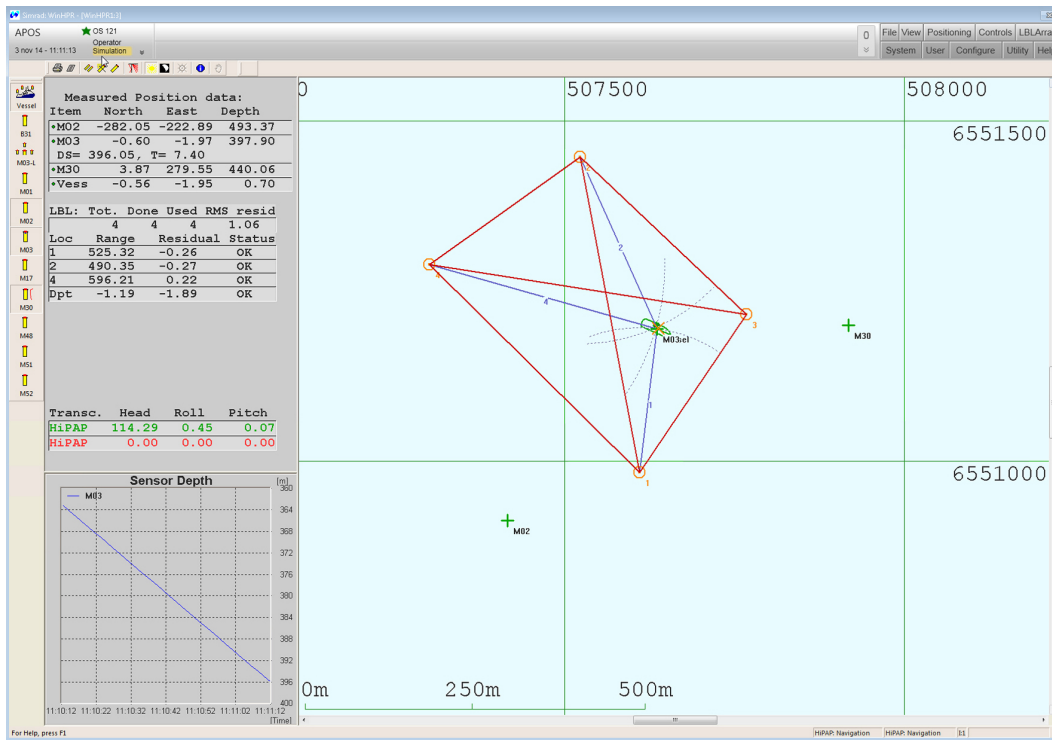
It should also be protected against direct sunlight when placed on deck.

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Operator station

The system can be delivered with a laptop, a computer with display or a touch screen computer.

The laptop is delivered with USB to serial line and USB to Ethernet converters.



HiPAP interface unit description

The HiPAP interface unit connects the HiPAP transducer and the APOS operator station.

The HiPAP interface unit includes a power supply that also powers the transducer. It connects to the transducer, the computer (or a switch) and optionally to a responder.



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 interface unit. APOS controls and activates the designated drive prior to reception of the sync/timing signal from the transceiver.



Repeater unit (optional)

Use a repeater unit to amplify the signals when the transducer cable has to be longer than 70 metres.

The subsea repeater unit amplifies the signals between the transducer and the interface unit.



Scope of supply

The main units you need are provided with the standard delivery.

When you unpack the parts provided with the HiPAP 352P system delivery, make sure that the following items are included.

- Transducer
- Transducer cable
- Operator station
 - Laptop computer
 - USB to serial line unit
 - USB to Ethernet unit
 - Stationary computer
 - Display
 - Keyboard
- Interface unit
- Instruction Manual

Optional items

- Responder Driver Unit
- Ethernet switch
- Repeater unit

General supply conditions

General supply conditions apply to this HiPAP 352P 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 Maritime so that Kongsberg Maritime 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 HiPAP 352P warranty period (as specified in the contract) begins when the acceptance documents have been signed.

Support information

Should you need technical support for your HiPAP 352P system you must contact a Kongsberg Maritime 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.

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Support website	Product support A to Z
Email address	km.support.hpr@kongsberg.com

Installation

Topics

[Installing the transducer, page 15](#)

[Installing the repeater unit, page 15](#)

[Installing the Responder Driver Unit, page 15](#)

[Converting from fibre optical to electrical signal, page 16](#)

Installing the transducer

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, page 38](#)

Procedure

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

Installing the repeater unit

The transducer cables should be connected before mounting the repeater unit.

Prerequisites

Mount the repeater unit to make sure it is not hanging by the cable. There are stud bolts for mounting at the top and the bottom of the unit.

Procedure

- 1 Mount the unit with the arrow pointing upwards.
- 2 Fasten the bolts.

Installing the Responder Driver Unit

The Responder Driver Unit provides responder trigger signals to responders. The RDU is a stand-alone unit and can be mounted 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 Open the unit by removing the four screws that secures the lid.
- 2 Lift off the lid and see the four mounting holes, one in each corner.
- 3 Mount the responder driver unit where suitable.
The mounting screws with nuts and washers are delivered with the unit.
- 4 Close the unit.

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

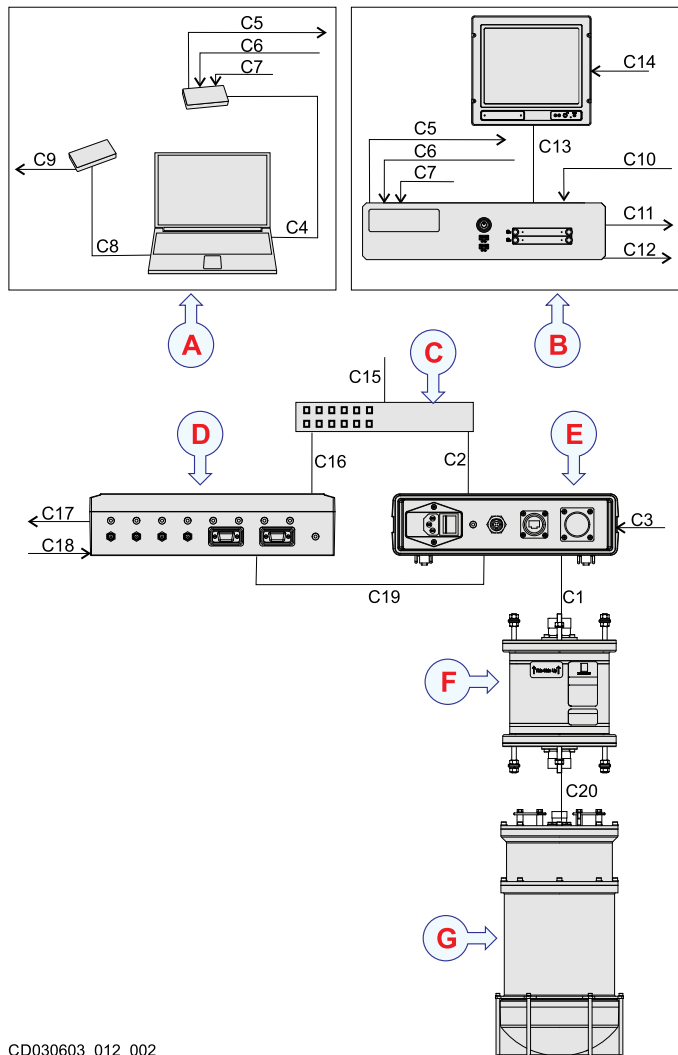
[Cable plan, page 18](#)

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Cable plan

The cables are part of the delivery with the main units.



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- A** Laptop computer
- B** Stationary computer
- C** Ethernet switch
- D** Responder Driver Unit
- E** Interface unit
- F** Repeater unit
- G** Transducer

List of cables

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

Cable	Type	From/To
C1	Transducer cable	From Interface Unit to Transducer or Repeater
C2	Ethernet cable	From interface unit to Ethernet switch/ From computer to interface unit
C3	AC Power cable	From interface unit to AC power outlet
C4	USB cable	From laptop to serial line converter
C5	Serial cable/Ethernet cable	From computer to customer's system/ From converter to customer's system
C6	Serial cable	From computer to GNSS system/ From converter to GNSS system
C7	Serial cable	From computer to heading sensor/ From converter to heading sensor
C8	USB cable	From laptop to Ethernet converter
C9	Ethernet cable	From converter to customer's system
C10	AC Power cable	From computer to AC power outlet
C11	Computer cable	From computer to keyboard
C12	Computer cable	From computer to mouse (or other pointing device)
C13	Video cable	From computer to display
C14	AC Power cable	From display to AC power outlet
C15	Ethernet cable	From computer to Ethernet switch
C16	Ethernet cable	From Responder Driver Unit to Ethernet switch
C17	Serial cable/Fibre optic cable	From Responder Driver Unit to external device(s)
C18	AC Power cable	From Responder Driver Unit to AC power outlet
C19	Ethernet cable	From Responder Driver Unit to interface unit
C20	Transducer cable	From transducer to repeater

Installing the HiPAP 352P cables

Installing the system cables

To ensure correct use of cables and connectors, lubrication procedure and proper cable handling must be followed.

Prerequisites

This procedure includes all optional units.

Use a repeater unit to amplify the signals when the transducer cable has to be longer than 70 metres.

Procedure

- 1 Connect the transducer cable from the Interface Unit to the Transducer or the repeater. (C1)
[Lubricating and mating the underwater connectors, page 25](#)
- 2 Connect the cable from the transducer to the repeater. (C20)
- 3 Connect the power cable from the interface unit to the AC power outlet. (C3)
- 4 Connect the cable from the interface unit to the computer or the Ethernet switch. (C2)
- 5 Connect the USB cable from the laptop to the serial line converter. (C4)
- 6 Connect the USB cable from the laptop to the Ethernet converter. (C8)
- 7 Connect the power cable from the computer to the AC power outlet. (C10)
- 8 Connect the cable from the computer to the mouse (or other pointing device). (C11)
- 9 Connect the cable from the computer to the keyboard. (C12)
- 10 Connect the power cable from the display to the AC power outlet. (C14)
- 11 Connect the video cable from the computer to the display. (C13)
- 12 Connect the cable from the computer to the customer's system. (C5, C9)
- 13 Connect the serial cable from the converter to the GNSS system./Connect the serial cable from the computer to the GNSS system. (C6)
- 14 Connect the serial cable from the converter to the heading sensor./Connect the serial cable from the computer to the heading sensor. (C7)
- 15 Connect the Ethernet cable from the computer to the Ethernet switch. (C15)
- 16 Connect the cable from the Responder Driver Unit to the Ethernet switch. (C16)
- 17 Connect the cable from the RDU to the external device. (C17)
- 18 Connect the power cable from the RDU to the AC power outlet. (C18)

- 19 Connect the cable from the Responder Driver Unit to the interface unit. (C19)

Connecting the Responder Driver Unit to the responder

The Responder Driver Unit provides responder trigger signals to responders. These cables must be provided by the installation shipyard.

Prerequisites

The signal cables to the responder consists of 2 dsusb connectors for electrical signals for responders 1–4 and four connectors for fibre optic connection to responders 5–8.

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

RDU Front view

Male 9-pin D-sub connector

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Procedure

- 1 Manufacture the cable.
- 2 Secure the cable from the responder driver unit to the responder.
Use a fibre to electrical signal converter if necessary.
- 3 Connect the cable.

Operating procedures

See APOS online help.

Maintenance

Topics

[Preventive maintenance schedule, page 24](#)

[Inspecting and cleaning the transducer, page 24](#)

[Lubricating and mating the underwater connectors, page 25](#)

[Creating a backup, page 26](#)

Preventive maintenance schedule

In order to secure a long and trouble-free operation of the HiPAP 352P system, certain specific preventive maintenance tasks must be done. The tasks are organized in a *preventive maintenance schedule*.

- Actions to be taken after every use
 - Clean the transducer and remove marine growth.
 - Clean the repeater unit.
 - Lubricate the connectors.
 - Make sure that all the bolts are tightened.
 - Check for physical damage to the unit.
- Actions to be taken every month
 - Dust the units.
 - Make a backup of the APOS configuration.
- Actions to be taken every six months
 - Check all cable connections.
 - Check all units for physical damage.

Inspecting and cleaning the transducer

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

Context

A transducer must always be handled as a delicate instrument. Incorrect actions 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.

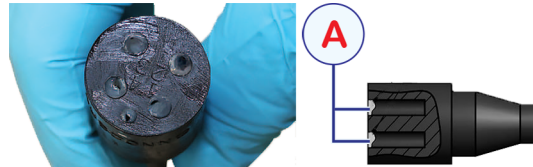
- 2 Inspect for damages or growth.
- 3 Remove any growth and dirt with a stiff brush, or with a wooden scraper or with a plastic scraper.
Be careful not to damage the unit.
- 4 Lubricate the connector.

Lubricating and mating the underwater connectors

The underwater connectors must be lubricated before mating.

Context

A Recommended amount of grease



Procedure

- 1 Remove old grease and any accumulated sand or mud, and clean the connector using isopropyl alcohol.
- 2 Apply a layer of Parker Super O-Lube or Molykote 44M grease on the female connector corresponding to a minimum of 1/10 of the socket.
Check that the inner edge of all sockets is completely covered, and a thin transparent layer of grease is visible on the face of the connector.
- 3 Fully mate the male and female connector in order to secure optimal distribution of grease on pins and in sockets.
- 4 Disconnect the connector and verify that sufficient grease has been applied.
- 5 Fully mate the male and female connectors again.

Creating a backup

For backup procedures, refer to the backup files document, doc. no. 476331. 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.

Spare parts

Topics

[Portable operator station spare part, page 28](#)

[Operator station spare part, page 28](#)

[HiPAP 352P-H/5 spare parts, page 28](#)

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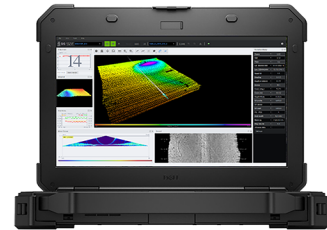
[HiPAP interface unit spare part, page 29](#)

[Repeater unit spare part, page 29](#)

[Responder driver unit spare part, page 30](#)

Portable operator station spare part

- **Part name:** Portable operator station spare part
- **Part number:** 448755



Operator station spare part

- **Part name:** Operator station spare part
- **Part number:** 472733



HiPAP 352P-H/5 spare parts

- **Part name:** HiPAP 352P-H
- **Part number:** 408811

- **Part name:** HiPAP 352P-5
- **Part number:** 422580



HiPAP 352P-MGC-x spare parts

- **Part name:** HiPAP 352P-MGC-R2
- **Part number:** 467638

- **Part name:** HiPAP 352P-MGC-R3
- **Part number:** 422584



HiPAP interface unit spare part

- **Part name:** HiPAP interface unit spare part
- **Part number:** 300134



Repeater unit spare part

- **Part name:** Repeater unit spare part
- **Part number:** 399779

The cable is supplied with the unit.



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



Technical specifications

Topics

[Performance specifications, page 32](#)

[Weights and outline dimensions, page 33](#)

[Power specifications, page 33](#)

[Environmental specifications, page 34](#)

Performance specifications

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

	HiPAP 352P-H	HiPAP 352P-5	HiPAP 352P-MGC-R2	HiPAP 352P-MGC-R3
Motion sensor [°]	0.05 Range ±180°	0.02 Range ±180°	0.02 Range ±180°	0.01 Range ±180°
HiPAP only [°] S/N [dB rel. 1µPa]	0.1	0.1	0.1	0.1
Total [°], [1 σ]	0.11	0.1	0.1	0.1
% of slant range [1 σ]	0.19	0.17	0.17	0.17
Range accuracy, Cymbal [m]	0.02	0.02	0.02	0.02
Receiver beam [°]	15			
Operational coverage [°]	±90			
Main coverage [°]	±80			

Angular accuracy (X & Y direction) is the accuracy in each of the x and y axes.

Position accuracy is the combined accuracy of both axes $\sqrt{(x^2 + y^2)}$

Operational coverage defines the sector where acoustic positioning and communications are operational.

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, and a depth input for aiding is recommended. When in the main coverage, range is up to 13000 m, operational tests show ranges out to 3500 m at 86 degrees or near the horizontal.

Operational coverage defines the sector where acoustic positioning and communications are operational. 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. Whilst within the main coverage, range is up to 5000 m, operational tests show ranges out to 1000 m at 80 degrees or near the horizontal. The signal to noise ratio 20 dB is within the signal bandwidth.

	HiPAP 352P-MGC-R2	HiPAP 352P-MGC-R3
Roll/pitch accuracy	0.02 @ > 1 h (1 σ)	0.01 @ > 1 h (1 σ)
Heading accuracy (Speed aided)	0.15 @ > 1 h [° sec lat] (1 σ)	0.08 @ > 1 h [° sec lat] (1 σ)

@ > 1 h: obtained after one hour of operation.

For 352P-H – See Kongsberg MRU H specification.

For 352P-5 – See Kongsberg MRU 5 specification.

Weights and outline dimensions

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

Transducer

Model	Diameter	Height	Weight
HiPAP 352P, HiPAP 352P-5	338 mm	550 mm	40 kg
HiPAP 352P-MGC-x	341 mm	700 mm	49 kg
Repeater unit	199 mm	279 mm	12 kg

Model	Depth	Width	Height	Weight
Display	82 mm	483 mm	444 mm	11.5 kg
Stationary computer	360 mm	380 mm	89 mm	7.5 kg
Laptop computer	214 mm	322 mm	20 mm	2 kg
Transport case for transducer, laptop, interface unit and cables	242 mm	650 mm	510 mm	15 kg
Interface unit	324 mm	258 mm	78 mm	4 kg
Responder Driver Unit	200 mm	280 mm	73 mm	3 kg

Power specifications

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

Stationary computer

- **Make and model:** HSC 1-i5 HA
- **Voltage requirement:** 100/240 VAC, 50 to 60 Hz, autosensing
- **Nominal power consumption:** 70 W

Laptop computer

- **Make and model:** HP ProBook 640G8
- **Voltage requirement:** 100/240 VAC, 50 to 60 Hz, autosensing
- **Normal current draw:** 1.7 A

Interface unit

The interface unit powers the transducer and the repeater unit.

- **Voltage requirement:** 85-264 VAC
- **Frequency:** 47-63 Hz
- **Output power:** 48 VDC
- **Nominal power consumption:** 350 W
- **Maximum current draw:** 4.4 A at 115 VAC / 2 A at 230 VAC
- **Normal current draw:** 0.5 A

Responder Driver Unit

- **Voltage requirement:** 85-264 VAC
- **Frequency:** 40-440 Hz
- **Maximum current draw:** 0.4 A
- **Normal current draw:** 0.06 A
- **Nominal power consumption:** 15 W

Repeater unit

- **Voltage requirement:** 48 VDC

Environmental specifications

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

Transducer

- **Operating temperature:** 0°C to +35 °C
- **Storage temperature:** -40 to 70 °C
- **Depth rating:** 50 m
- **Vibration range:** 5-100 Hz
- **Excitation level:** 5-13.2 Hz \pm 1.5 mm, 13.2-100 Hz 1 g

Stationary computer

- **Operating temperature:** 0 to +55 °C
- **Storage temperature:** -20 to 70 °C
- **Relative humidity:** 5 to 95% relative, non-condensing

Laptop computer

- **Operating temperature:** 5 to 35 °C
- **Storage temperature:** -20 to 70 °C
- **Relative humidity:** 10 to 90 % relative non-condensing

Interface unit

- **Operating temperature:** 10 to +55 °C
- **Storage temperature:** 10 to +70 °C
- **Relative humidity:** 5 to 95% relative, non-condensing
- **Vibration range:** 5-100 Hz
- **Excitation level:** 5-13.2 Hz \pm 1.5 mm, 13.2-100 Hz 1 g

Responder Driver Unit

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

Repeater unit

- **Operating temperature:** -10 °C to + 45 °C
- **Storage temperature:** -20 to 70 °C
- **Relative humidity:** 5 to 95% relative, non-condensing
- **Depth rating:** 50 m

Drawing file

Topics

[Computer dimensions, page 37](#)

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[HiPAP 352P -H/5 dimensions, page 39](#)

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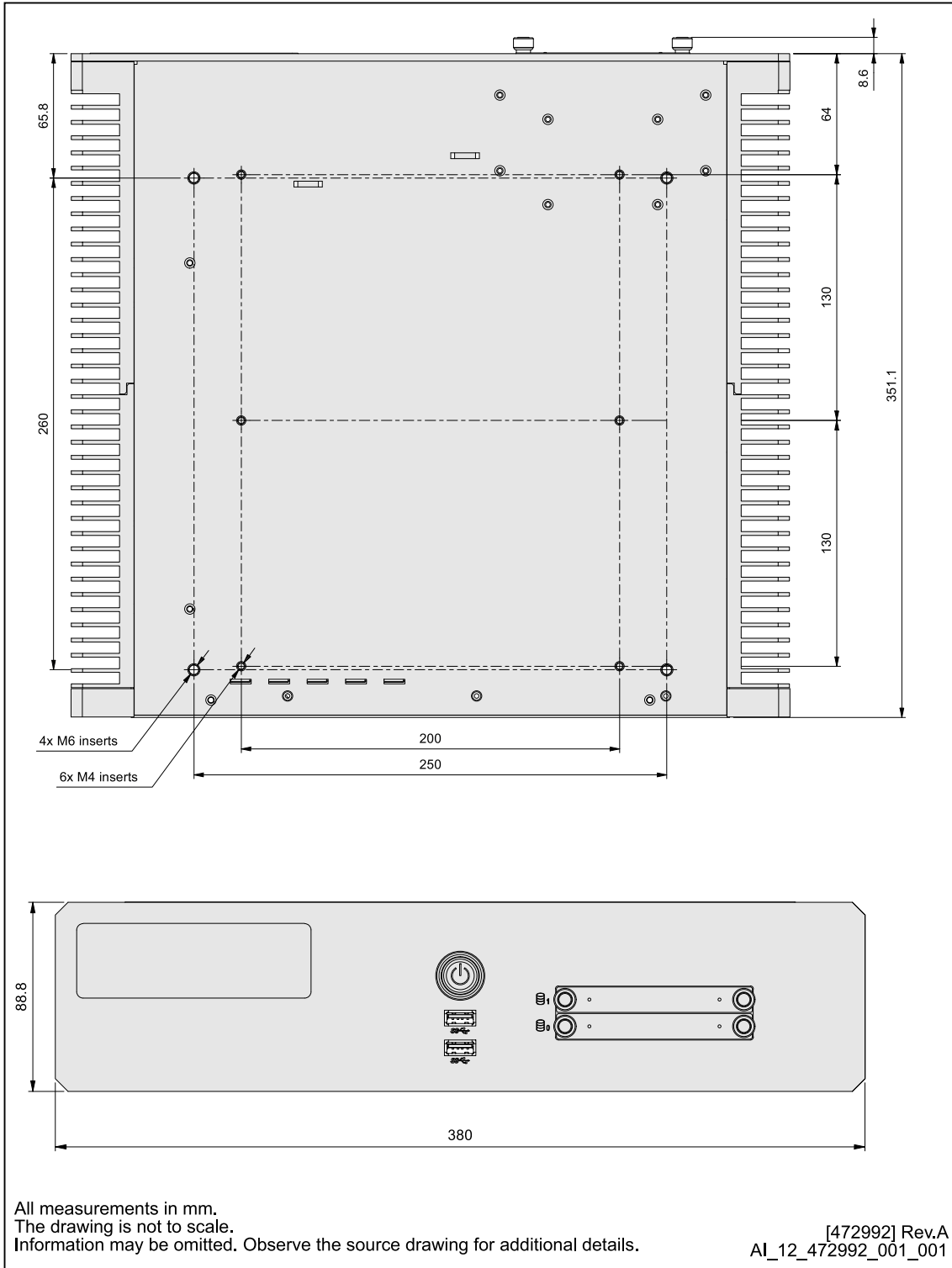
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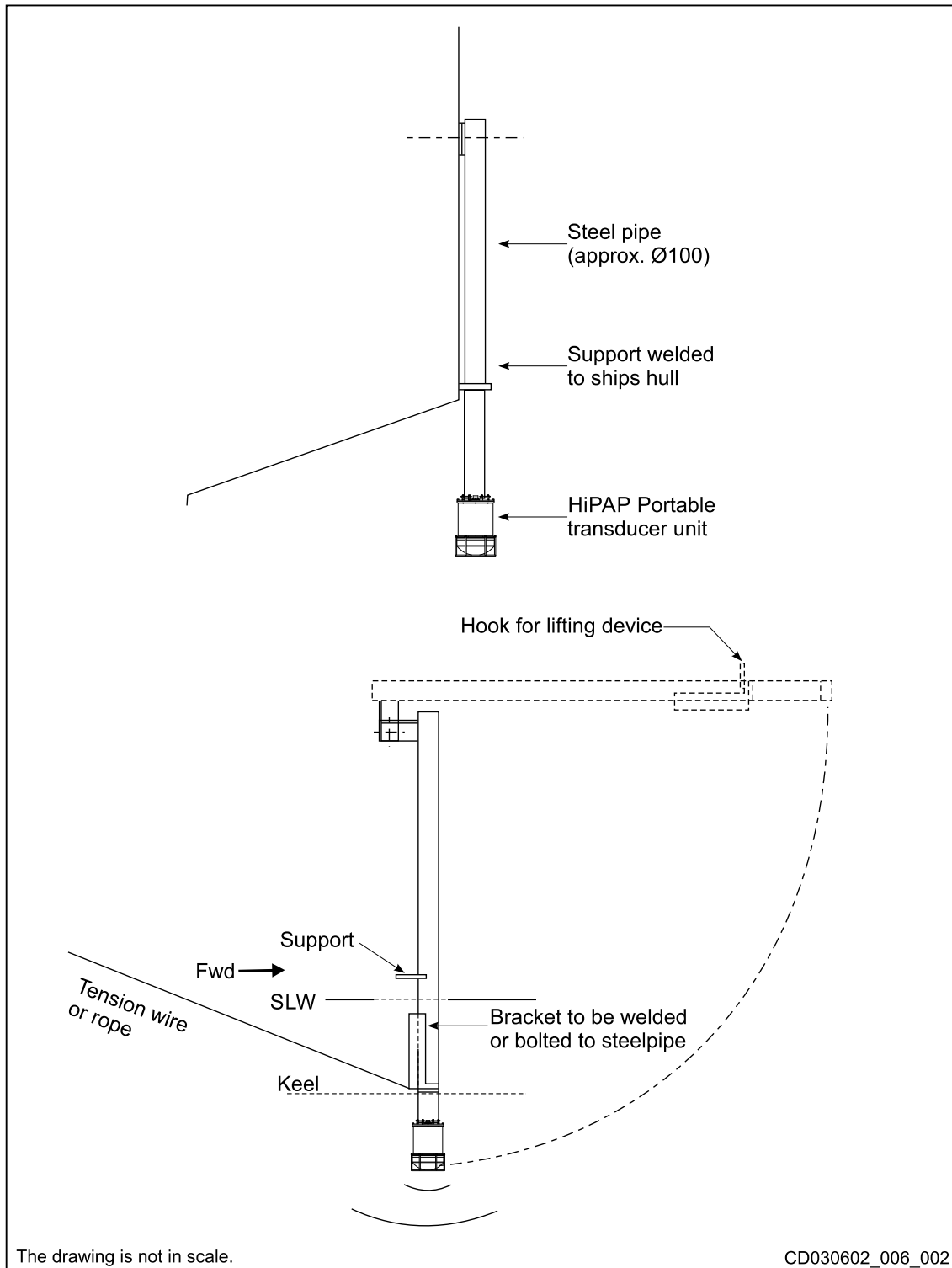
[Responder Driver Unit dimensions, page 43](#)

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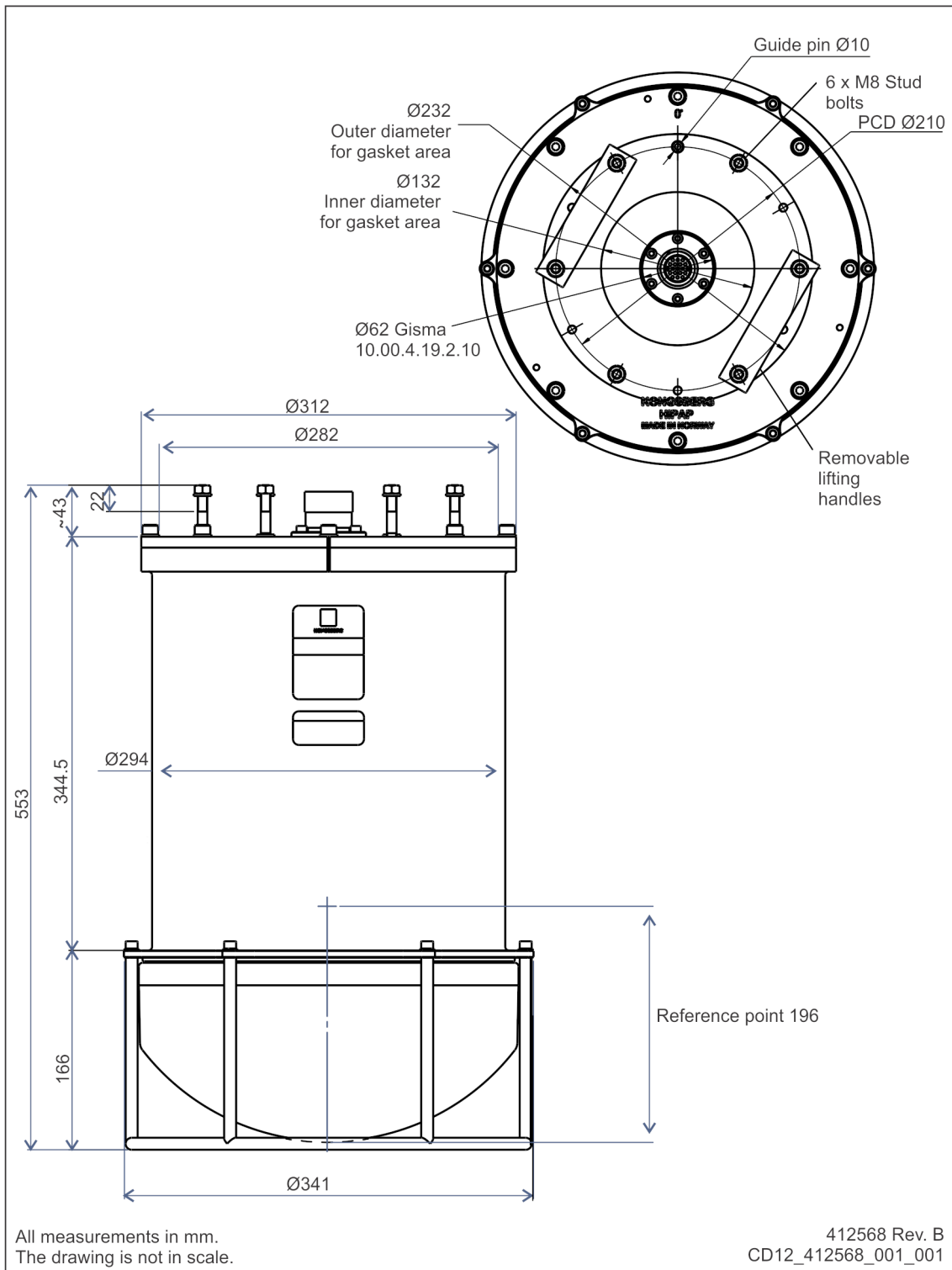
Computer dimensions



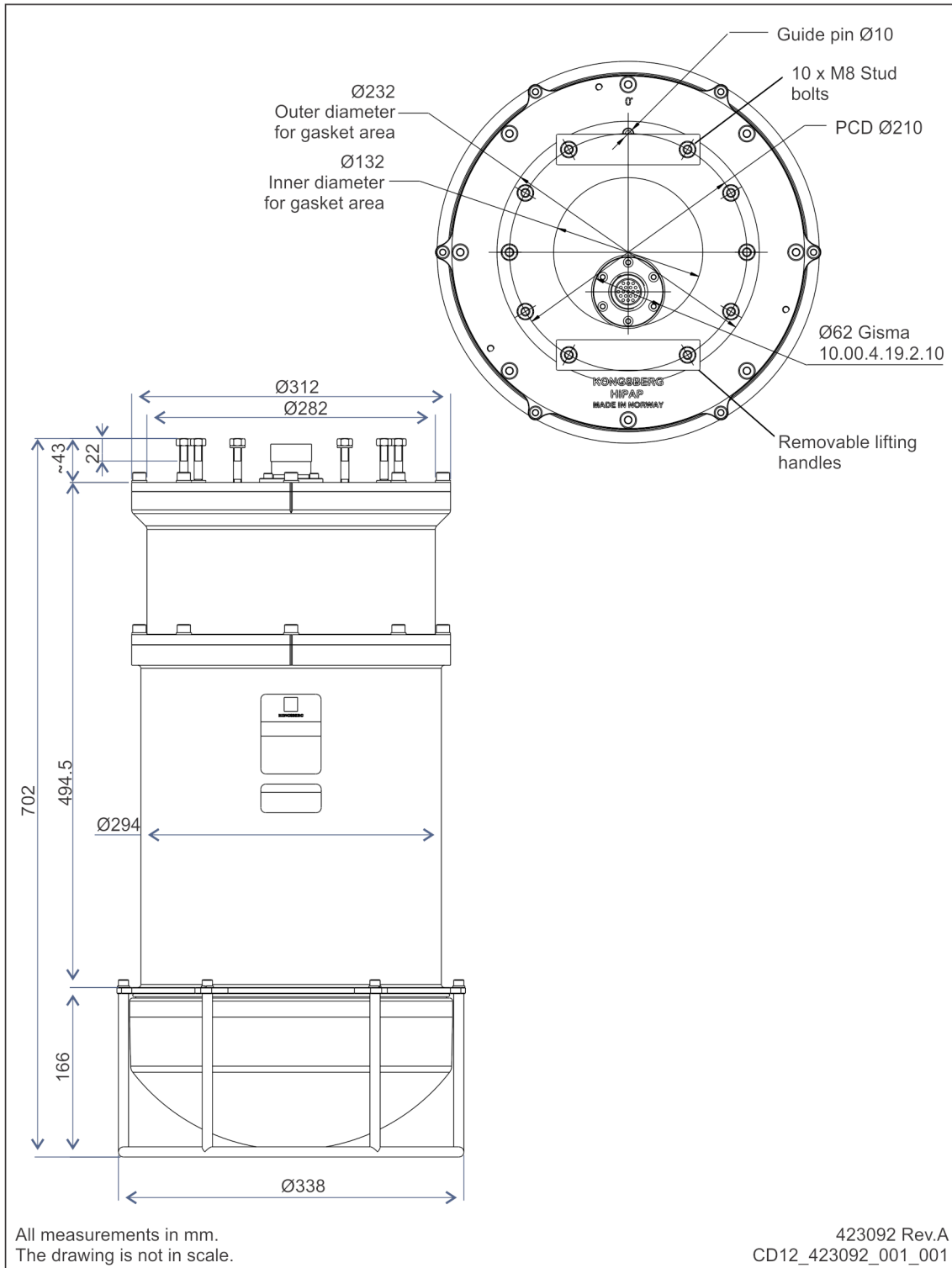
Installing the transducer



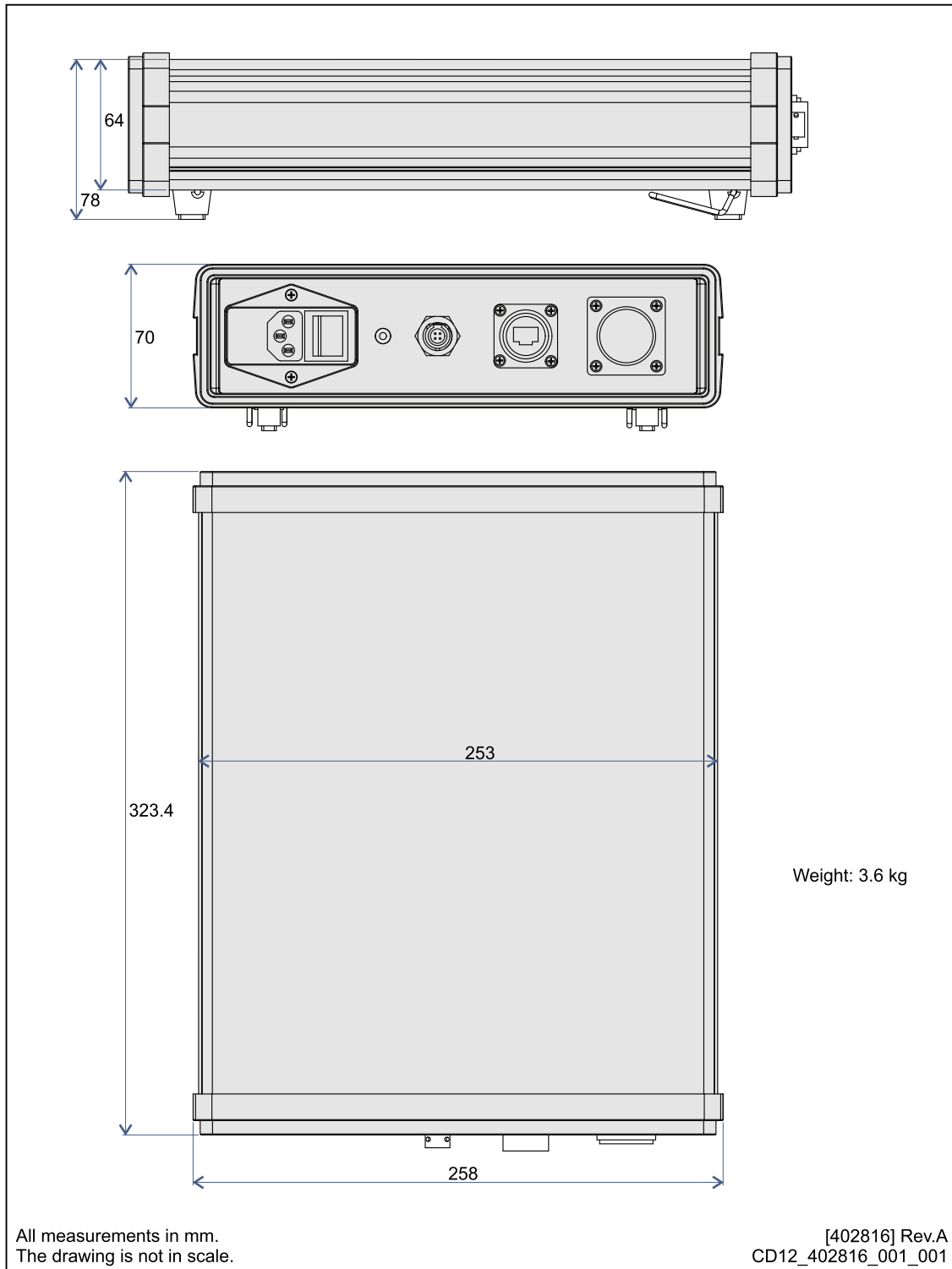
HiPAP 352P -H/5 dimensions



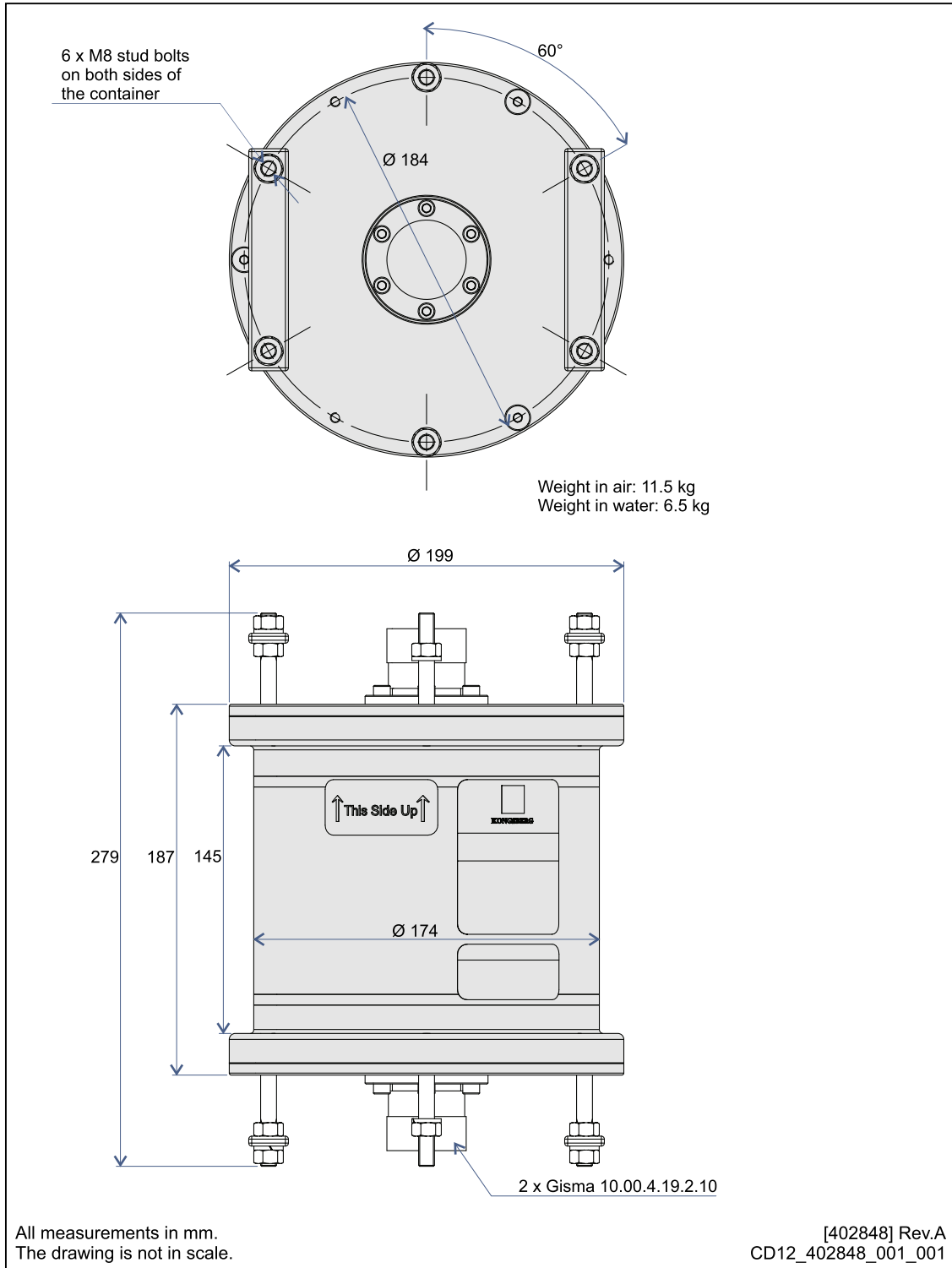
HiPAP 352P -MGC-x dimensions



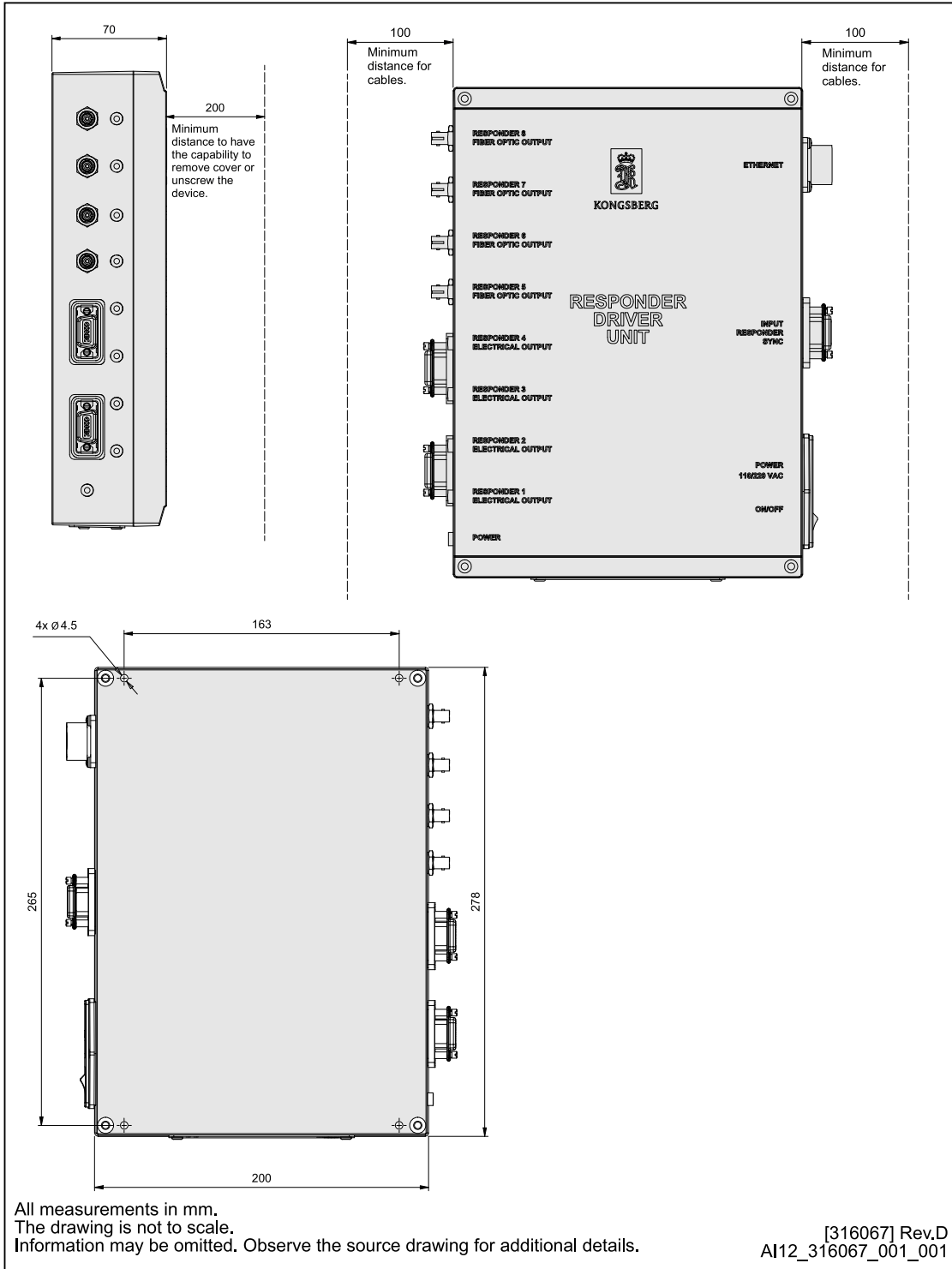
Interface unit dimensions



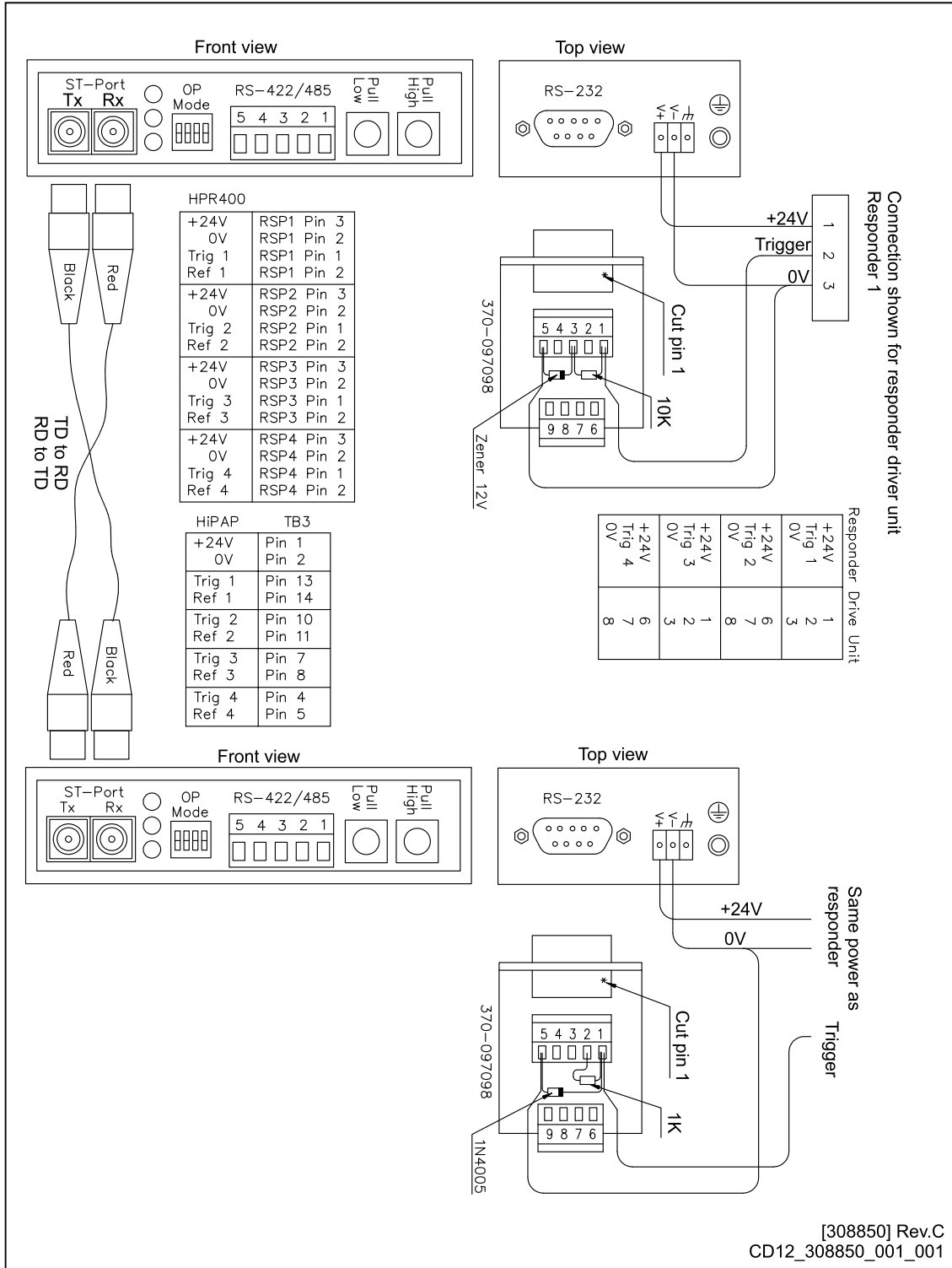
Repeater unit dimensions



Responder Driver Unit dimensions



Fibre to responder drive converter, wiring diagram



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