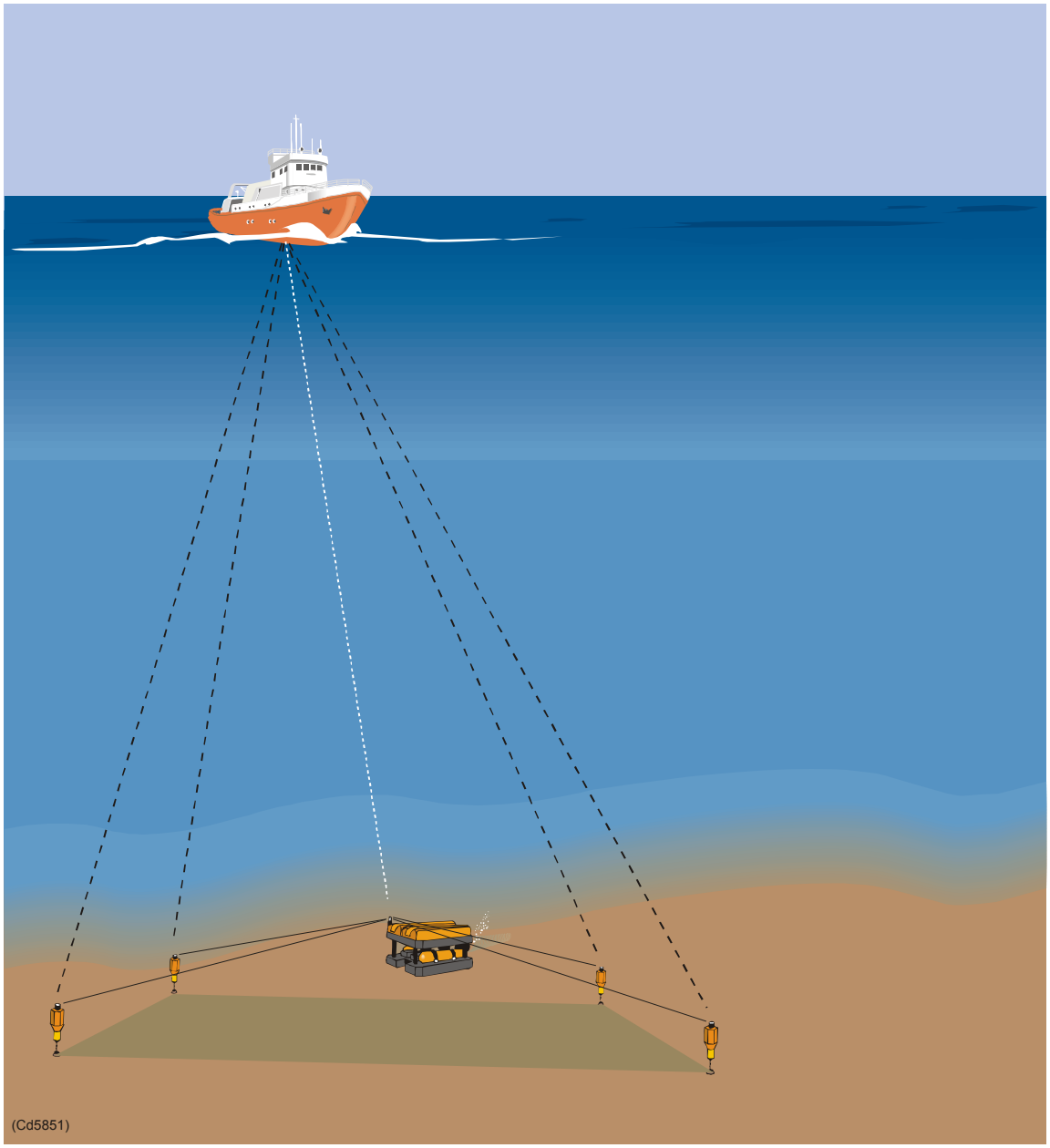
Technical training guide

HPR 400 series
Positioning Reference System

Base version



KONGSBERG

HPR 400 series

High Precision Acoustic Positioning

Technical training guide

859-164503 / AA000 / N/A

Note

Kongsberg Simrad AS makes every effort to ensure that the information contained within this document is correct. However, our equipment is continuously being improved and updated, so we cannot assume liability for any errors which may occur.

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 or injury to personnel. The user must be familiar with the contents of the appropriate manuals before attempting to install, operate or maintain the equipment.

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Sections

This book is the Technical training guide for the Kongsberg Simrad HPR 400 series.

HPR 400

1 HPR 400 system description

2 HPR 400 cable layout and interconnections

3 APC 10

4 HPR 400 Transceiver Unit

HL 3880

5 HL 3880 system description

6 HL 3880 cable Layout and interconnections

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2 Appendix Hydraulic Hull Unit

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Display manual

Separat manual supplied with the display. This is a Kongsberg Simrad document.

Remarks

References

Further information about the HPR 400 series may be found in the following manuals:

- APOS Instruction manual
- HPR 400 Maintenance
- HPR 400 Installation manual
- HL 3880 Hull Unit Instruction manual

The reader

The maintenance information is intended to be used by a trained maintenance technician or engineer, with experience of electronic and digital circuitry, computers and electromechanical design. The level of information is based on Kongsberg Simrad's maintenance philosophy: The onboard technical personnel shall, with the help of the documentation and the system's built-in test functions, be able to identify malfunctions, locate the fault, and replace major parts, modules and components on the "Line Replaceable Unit" (LRU) level. He/she will however not attempt to repair the LRUs.

Note

Distributed copies of this manual will not be updated. If your system software is updated, you will be provided with copies of the latest revision of the standard manuals.

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B				
C				
D				

(The original signatures are recorded in the company's logistic database)

Rev	Comments
A	Original issue. Based on standard HPR documentation.

To assist us in making improvements to the product and to this manual, we would welcome comments and constructive criticism. Please send all such - in writing or by e-mail - to:

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1 HPR 400 SYSTEM DESCRIPTION

Scope

This chapter presents a brief description of the Technical training guide. supplied with the HPR 400 series system.

APC 10 computer

The *Kongsberg Simrad APC 10 computer* is the main computer in the HPR 400 series display and control system. It holds all the operational software, and interfaces to the display, keyboard (including trackerball), network and other peripheral devices as required. A specially designed computer is used. It is based on a Pentium processor, and it has additional boards installed to suit the applicable system requirements.

Keyboard

A special keyboard incorporating function keys and a tracker ball is supplied with the APC 10 computer. The tracker ball and keys are used to control the HPR system.

LCD display

→ *Refer to the LCD Instruction manual.*

HPR 400 Transceiver Unit

The *HPR 400 Transceiver Unit* processes the acoustic signals, calculates the transponder position(s) and the acoustic telemetry data, and sends the information to the colour display. The transceiver can operate two transducers with up to 56 transponders simultaneously. The acoustic telemetry functions are also controlled from this unit, utilizing the same hull mounted transducer.

Transducers

A standard transducer, (medium/wide beam) is mounted on a hull unit installed in the keel of the vessel. The transducer has a multi-element array of transmission/reception elements, enabling both pulse and phase measurement for the calculation of the range and two axes angles to the transponder(s).

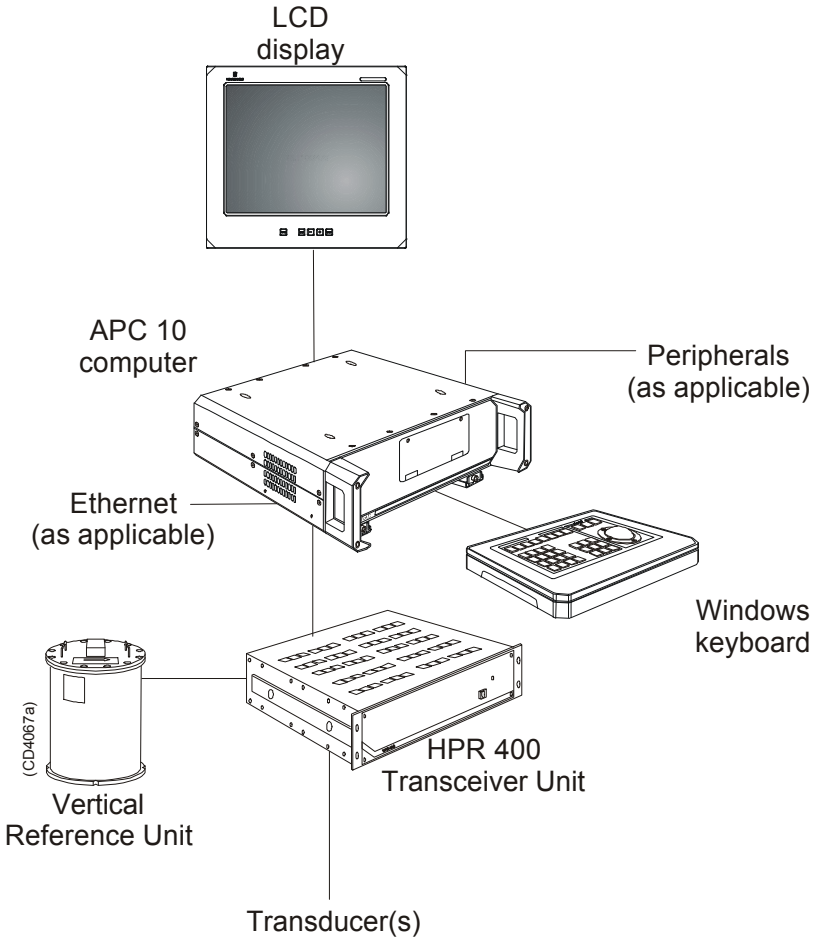


Figure 2 - System diagram with LCD display

Vertical Reference Unit (VRU)

The Vertical Reference Unit (VRU) is interfaced to the HPR 400 Transceiver Unit. The system can thereby automatically compensate for the vessel's roll and pitch movements. The HPR system can use the same VRU as the Dynamic Positioning (DP) system (if one is fitted).

The Vertical Reference Unit may or may not be a part of the Kongsberg Simrad delivery. In any case, the unit is documented separately by the applicable manufacturer.

Hull unit

→ *Refer HL3880 system description on page 137.*

2 HPR 400 CABLE LAYOUT AND INTERCONNECTIONS

Overview

This document describes the general installation requirements regarding cables, and then describes the cables used in the HPR 400 series system. It then explains how to perform the interconnections between the various units in the system. It also includes APC 10 Connector pin allocations.

Note: *The Hull Unit cables are described in the Hull Unit Instruction manual.*

Note: *All cable connections must be made in accordance with the guidelines laid down by the vessel's classification society.*

If no such guidelines exist, Kongsberg Simrad recommends that the *Den norske Veritas (DnV) Report No. 80-P008, "Guidelines for Installation and Proposal for Test of Equipment"* be used as a guide.

Cable specifications

Each individual cable is identified on the cable plans. The cables fall into two categories:

- Cables provided by the installation shipyard.
- System cables supplied with the delivery.

Shipyard cables

The cables to be provided by the shipyard are identified as such in the cable listing.

Note: *The cable specifications given are the minimum specifications.*

For each cable the following is provided:

- Connection to be made on each end of the cable (including system units, terminal block identification and plug/socket to be used).
- Number of cores.
- Recommended cable type.
- Minimum cable specifications.

Caution: *Any special requirements must be considered in addition to those listed. Kongsberg Simrad accepts no responsibility for damage to the system or reduced operational performance if this is caused by improper cabling.*

System cables

Several cables will be supplied with the system. Such cables normally comprise power cables for peripheral equipment, and interconnection cables for computers and/or workstations. These cables are normally packed with the units.

Cable connections

All cables must be terminated correctly. The required information is provided in the applicable interconnection drawings.

Special cables

Special system applications or requirements may result in additional or modified cable runs.

HPR series cable plan

General

The following pages describe the cabling required for a Kongsberg Simrad HPR 400 series system with the APC 10 computer.

Note: *Special system requirements, adaptions or components may introduce special drawings and cables.*

Note: *The hull unit cables are described in the Hull Unit Instruction manual.*

- Refer to this section for details of cable laying, requirements for conduits etc.
- Refer to the relevant cable plans and wiring diagrams for details of the terminations and connections.

All power must be switched off to the system prior to the cable installation.

All cables must be available at the units, properly installed in cable ducting. Care must be taken not to exceed the physical limitations of the cables.

Note: *In order to meet the EMC requirements, dedicated grounding cables have been used to connect the various system units to the vessel's ground. These cables are identified as "X" on the cable plan drawings. The braided grounding cable required is supplied with the system. These cables must not be longer than 1 metre.*

APC 10 cabling

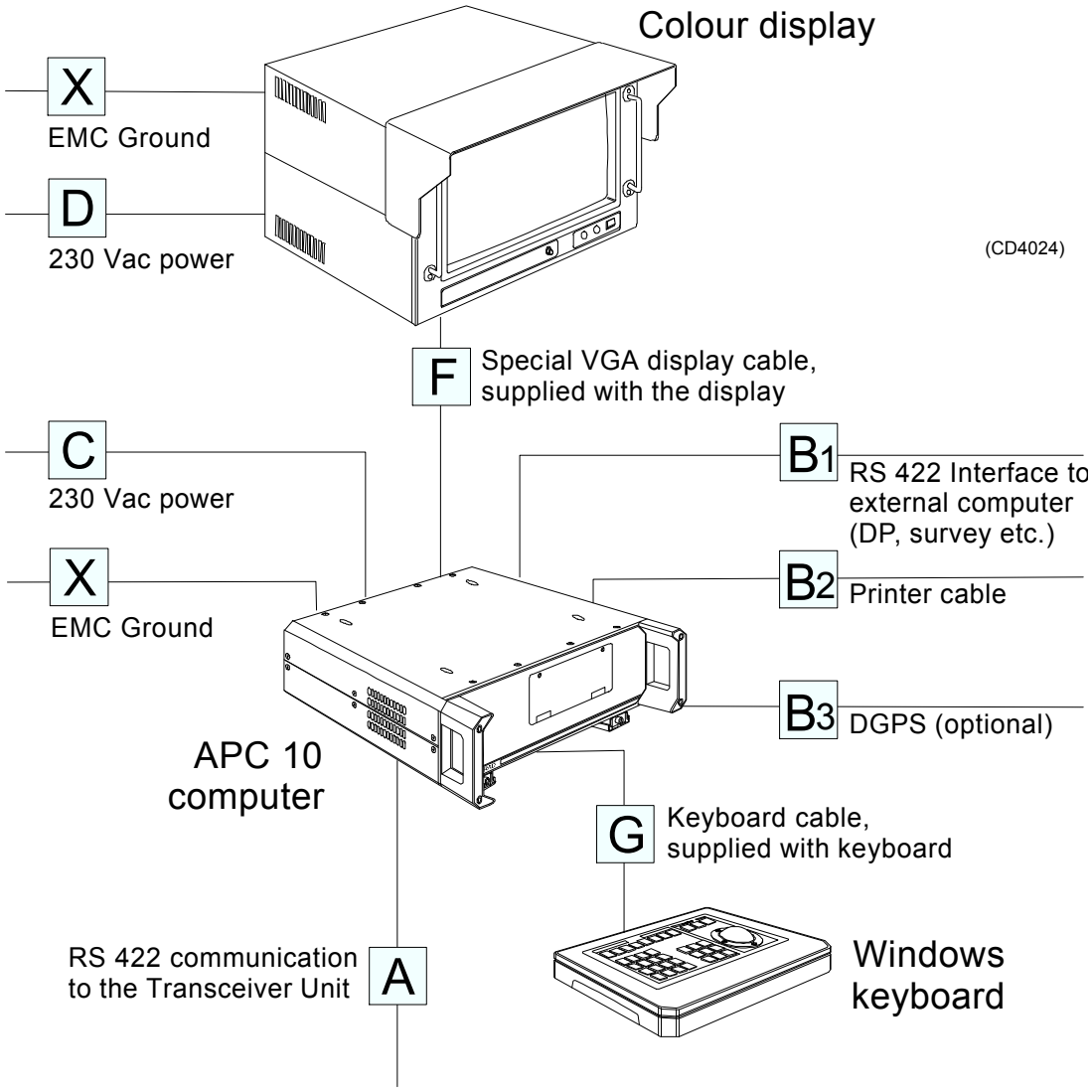


Figure 3 - APC 10 cabling

Cable A **RS 422 Serial line cable to the HPR Transceiver Unit**

- Shipyard supply.
- 3 x 2 / 0.5 mm^2, overall braided screen, 60 V.
- APC 10 end terminated in 9-pin Delta connector.
- RFI screen must be connected to the plug housing.
- Maximum length: 1000 m.

Cable B1 **RS 422 Serial line cable to external computer or other peripheral devices (optional)**

- Shipyard supply.
- 3 x 2 / 0.5 mm^2, overall braided screen, 60 V.
- APC 10 end terminated in 9-pin Delta connector.
- RFI screen must be connected to the plug housing.
- Maximum length: 1000 m.

Cable B2 **Parallel printer cable**

- Included with the printer.
- To be connected to parallel port.

Cable B3 **RS 422 Serial line cable to peripheral device (optional)**

- Shipyard supply.
- 3 x 2 / 0.5 mm^2, overall braided screen, 60 V.
- APC 10 end terminated in 9-pin Delta connector.
- RFI screen must be connected to the plug housing.
- Maximum length: 1000 m.

Cable C **230 Vac power supply to the APC 10.**

- Standard power cable included in delivery, 1.5 m.
- 3 x 1 / 1.5 mm^2 with ground as separate conductor, 750 V.
- APC 10 end terminated in standard 3-pin AC supply female connector.

Cable D **230 Vac power supply to the display.**

- Standard power cable included in delivery, 1.5 m.
- 3 x 1 / 1.5 mm^2 with ground as separate conductor, 750 V.
- Display end terminated in standard 3-pin AC supply female connector.

Cable F **Special VGA cable between APC 10 and display.**

- Included with the delivery.

Cable G **Signal cable between APC 10 and keyboard.**

- Included with the delivery.
- To be connected to:
  - Com 1: the trackball
  - Keyboard plug: the keyboard
  - Keyboard lightning: the power plug

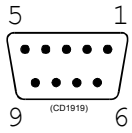
Cable X **Braided grounding cable**. See next section.

APC 10 Connector pin allocations

The APC 10 computer is configured with Com1 and Com2 as RS-232 ports. A DFlex board with two RS-422 ports (Com3 and Com4) is installed as standard. Additional DFlex board may be supplied if more serial ports are needed. These may either be of RS-232 or RS-422 type.

Serial lines 3 and 4 are normally the two lines on the DFlex board, and can be RS-232, RS-422 or 20 mA current loop depending on the optional SIMM module mounted on the DFlex board.

Serial lines (Com) RS-232



The two or four serial lines are connected to 9-pin Delta connectors. The pins are allocated as follows:

1	Carrier detect
2	Receive data
3	Transmit data
4	Data terminal ready
5	Ground
6	Data set ready
7	Ready to send
8	Clear to send
9	Ring indicator

Serial lines (Com) RS-422

The two or four serial lines are connected to 9-pin Delta connectors. The pins are allocated as follows:

1	Reception data +
2	Transmission data +
3	Transmission data -
4	Reception data -
5	Ground

Serial lines (Com) Current loop

The two or four serial lines are connected to 9-pin Delta connectors. The pins are allocated as follows:

1 Reception data -

2 Transmission data +

3 Transmission source

4 Transmission return

5 Ground

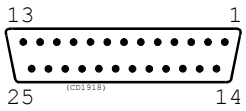
6 Reception return

7 Transmission data -

8 Reception data +

9 Reception source

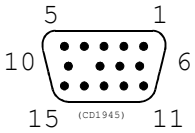
Line printer 1 (LPT1)



The line printer is a 25-pin Delta connector. The pins are allocated as follows:

1	Strobe (active low)
2	Data bit 0
3	Data bit 1
4	Data bit 2
5	Data bit 3
6	Data bit 4
7	Data bit 5
8	Data bit 6
9	Data bit 7
10	Acknowledge (active low)
11	Busy
12	Paper out
13	Select
14	Auto line feed (active low)
15	Error (active low)
16	Initialize printer (active low)
17	Select in (active low)
18 - 25	Ground

VGA to display



The VGA signal uses a standard VGA 15-pin Delta connector. The pins are allocated as follows:

1	Red analogue
2	Green analogue
3	Blue analogue
4	(Not connected)
5	Ground
6/7/8	Ground analogue
9	(Not connected)
10	Ground
11/12	(Not connected)
13	Horizontal synchronization
14	Vertical synchronization
15	(Not connected)

Transceiver unit cables

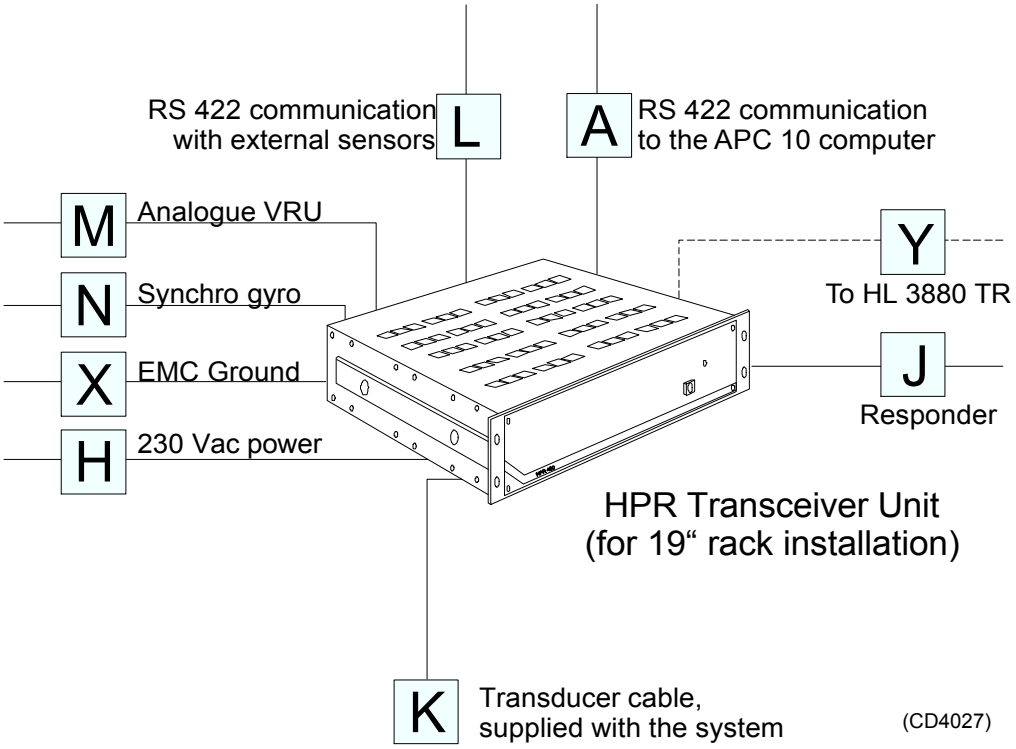


Figure 4 - Transceiver Unit cabling for unit in rack

Cable A **Defined in the previous paragraph**

Cable H **230 Vac power supply to the transceiver unit**

- Shipyard supply.
- 3 x 1 / 1.5 mm^2 with ground as separate conductor, 750 V.
- Transceiver end terminated in standard 3-pin AC supply female connector.
- Maximum length: No practical limits.
- Standard power cable delivered with 19” rack version.

Cable J **Signal cable to responder(s)**

- Shipyard supply.
- Maximum four responders may be connected, each will need a separate J cable.
- 3 / 0.5 mm^2, overall braided screen, 60 V.
- Transceiver end terminated in the transceiver’s terminal block, refer to the interconnection drawing.
- Maximum length: 1500 m including umbilical.

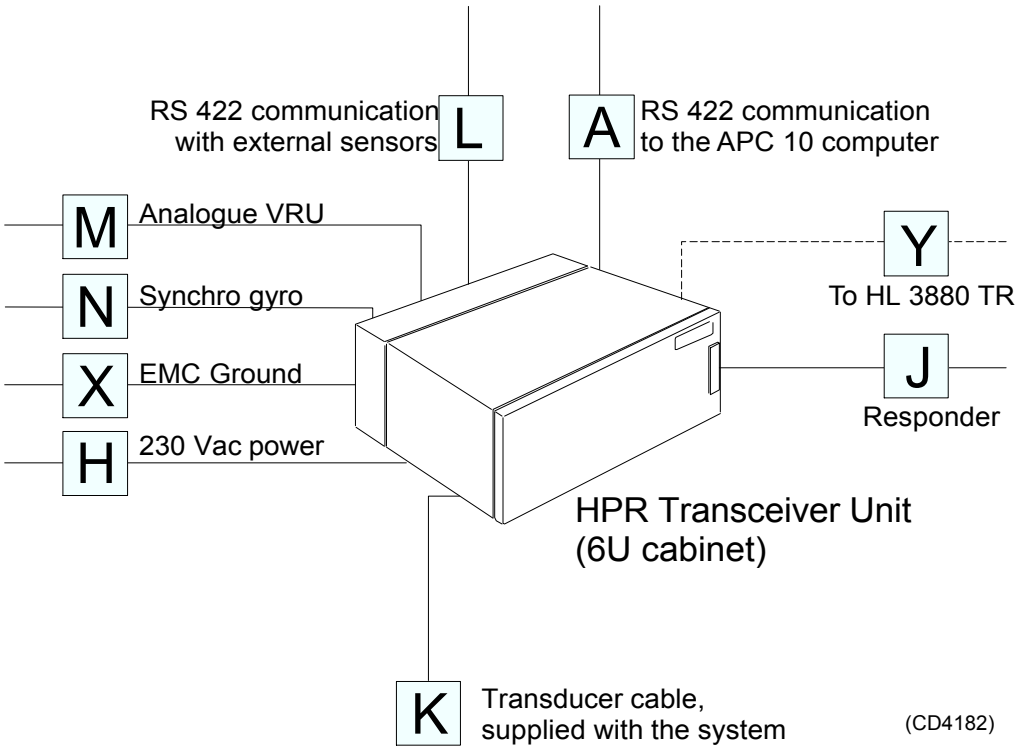


Figure 5 - Transceiver Unit cabling for unit in 6U cabinet

Cable K **Transducer cable from the transceiver unit to the transducer**

- Kongsberg Simrad supply.
- The transducer cable is screened and consists of 10 twisted pairs, each individual screened. Cable diam. = 19 mm.
- The Hull Unit end is connected to terminal blocks in the junction box, and the transceiver end is connected to the terminal block in the transceiver unit.
- Maximum length: 300 m (Extension cables may be used).

Cable L **RS 422 Serial line cable to external peripheral devices**

- Shipyard supply.
- 3 x 2 / 0.5 mm^2, overall braided screen, 60 V.
- Transceiver end terminated in the transceiver's terminal block, refer to the interconnection drawing.
- Maximum length: 1000 m.

Cable M **Analogue cable to VRU**

- Shipyard supply.
- 3 x 2 / 0.5 mm^2, overall braided screen, 60 V.
- Transceiver end terminated in the transceiver's terminal block, refer to the interconnection drawing.
- Maximum length: 1000 m.

Cable N **Analogue cable to synchro gyro**

- Shipyard supply.
- 3 x 2 / 0.5 mm^2, overall braided screen, 60 V.
- Transceiver end terminated in the transceiver's terminal block, refer to the interconnection drawing.
- Maximum length: 1000 m.

Cable X **Braided grounding cable to connect the cabinet to EMC ground**

- Included with the delivery (Simrad part no. 649-096720).
- 2 x 7 mm.
- Maximum length: 1 m.

Cable Y **Special cable with screen to connect the TRU to the Beam Control Unit**

- Included with the delivery (Simrad part no. 824-088333) as required.
- 1 x (2 x 1 mm^2) + 9 x (2 x 0.5 mm^2)
  (10 screened twisted pairs + overall screen).
- Maximum length: 1000 m.

Interconnections

Note: *If the Transceiver Unit is installed in a 6U cabinet, the terminal strips E401 and E402 will be used. Otherwise, the cables will pass directly into the Transceiver Unit.*

Standard cables

The following cables are regarded as *standard*, and are connected into the appropriate sockets on the rear of the APC 10 computer:

C 230 Vac to the APC 10

D 230 Vac to the display

F Special VGA cable

G Keyboard cable

Different connector types are used on the various cables to ensure the correct connections.

The following cables are included with the Transceiver Unit and Hull Unit:

H 230 Vac to the Transceiver Unit

K Transducer cable

Serial line cables

The APC 10 may be set up with one of three serial line solutions:

- 4 x RS 232 - Com 1 to Com 4
- 2 x RS 232 - (Coms 1 and 2) and
  2 x RS 422 - (Coms 3 and 4)
- 4 x RS 422 - Com 1 to Com 4

RS 232 may be replaced by 20 mA current loop.

Cable A

This serial line is an RS422 interface. The cable plugs into socket COM3 on the rear of the APC 10, and to Serial connector 1 on the Transceiver Unit.

Note: *RS-422 is the standard. RS-232 can be supplied on special order.*

The connections used are recorded in the system software.

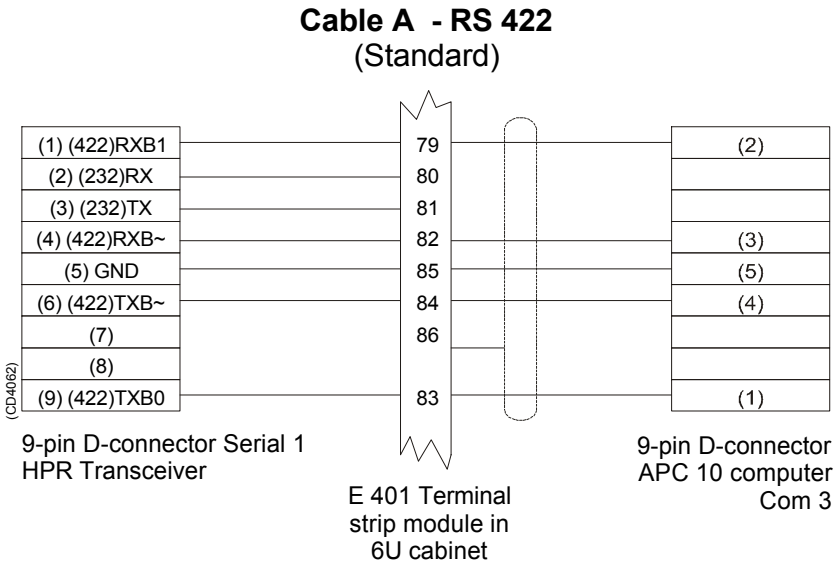


Figure 6 - The APC 10 - Transceiver connections RS 422

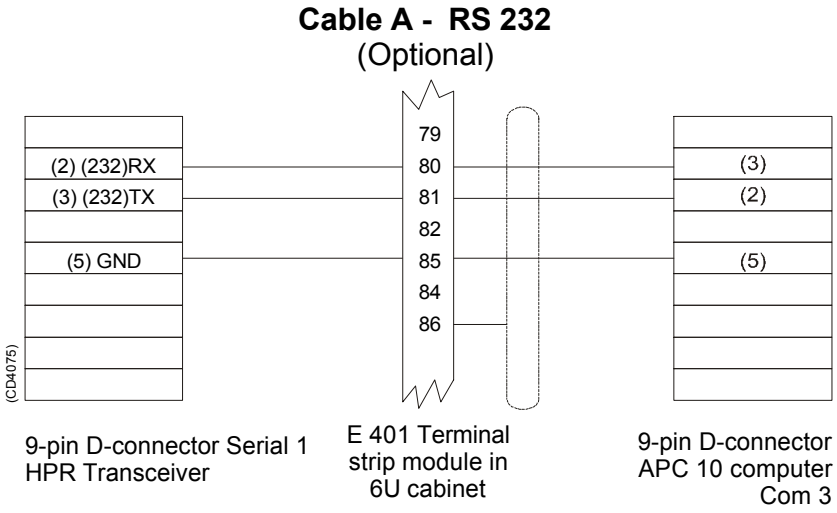


Figure 7 - The APC 10 - Transceiver connections RS 232

Cables B1 and B3

These serial line cables plug into the Com 1 to Com 4 sockets on the rear of the APC 10. The actual connections to the peripheral device will depend on the application.

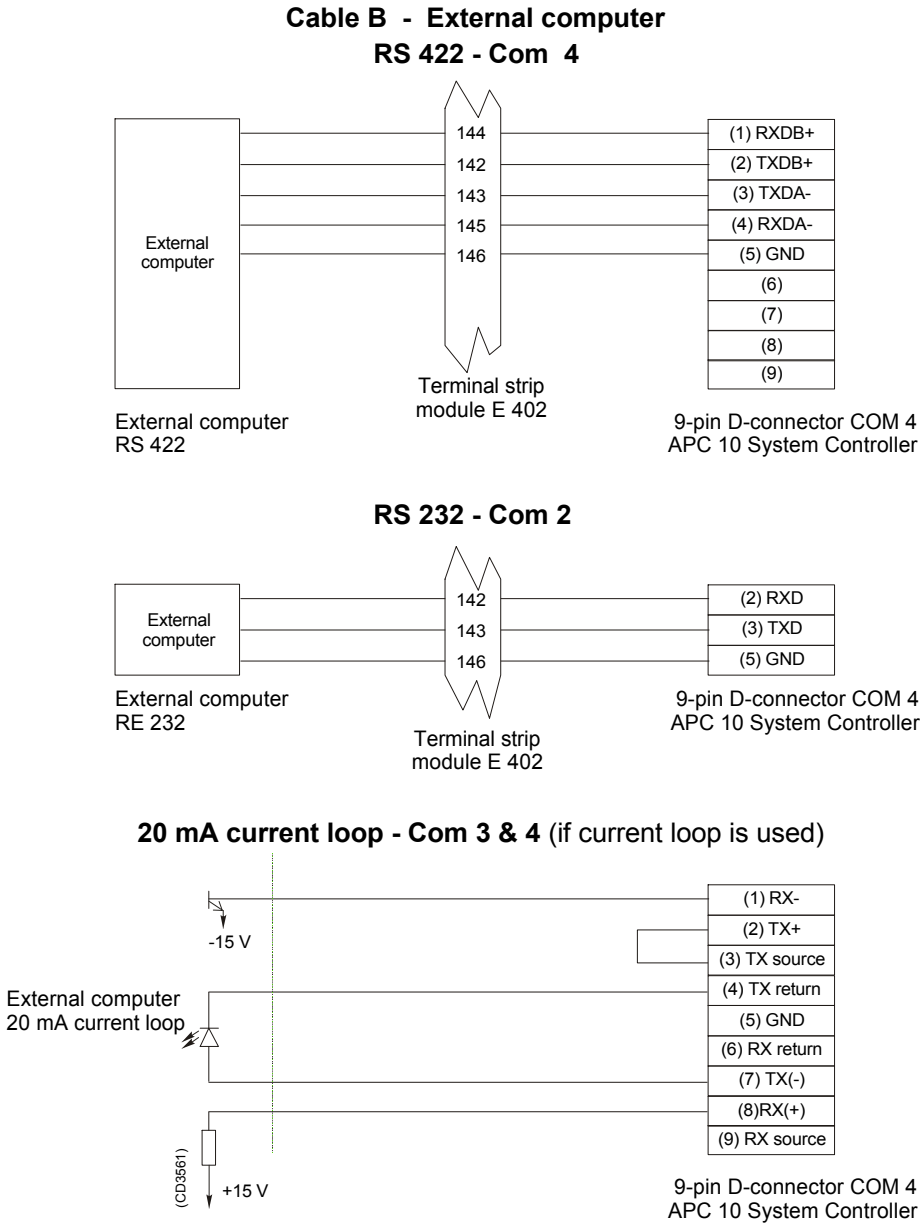


Figure 8 - The external computer connections

Power cable H

Power connection is either via a standard 3-pin mains connector or via a terminal block.

→ *Refer to drawing number 824-088895 in the Drawing* section.

Responder cables J

This cable is not indicated in the figure on page NO TAG.

The Responder function requires an optional responder PCB.

One separate cable is required for each responder to be connected to the transceiver. The transceiver end connects to one of the 4-pin amphenol connectors on the rear of the transceiver unit.

Note: *Links LK1 and LK2 located on the rear of the transceiver unit must be in place to power the Responder Controller Board (RPC) with +48 Vdc. This voltage is converted to +24 Vdc on the RPC board to supply*
the 24 V responder trigger pulse.
It is this +24 V that is available at pin 3 on the Responder 4-pin special connector. This power can be, but is normally not used to supply the responder with power.
Normally the responder is supplied from an external source, either a separate power supply unit or the ROV etc.

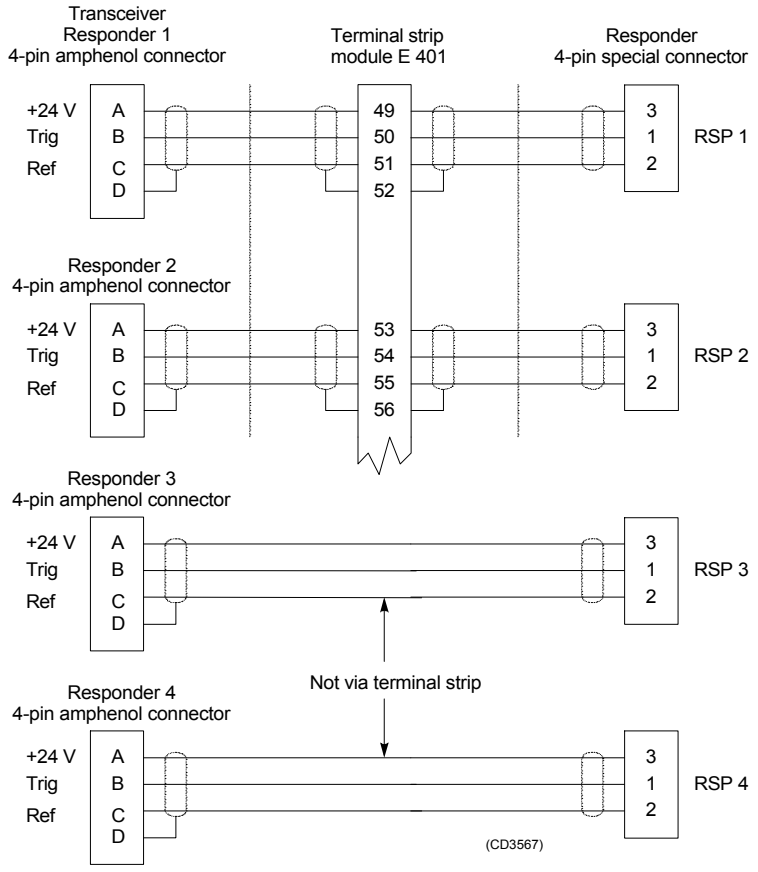


Figure 9 - Responder connections

Transducer cable K

The transducer connections are described as follows:

- Drawing number 824-088896 for the standard transducer.
- Drawing number 824-089439 for the Ex zone 1 transducer.

If a tracking hull unit is used, refer to paragraph NO TAG. The transducer connections are described on:

- Drawing number 824-089179 for transducer 1
- Drawing number 824-089178 for transducer 2.

The drawings are located in the *Drawing* section.

Transceiver unit - Cable L

External sensors such as a vertical reference unit or course gyro may be connected into the transceiver using a serial line as shown below:

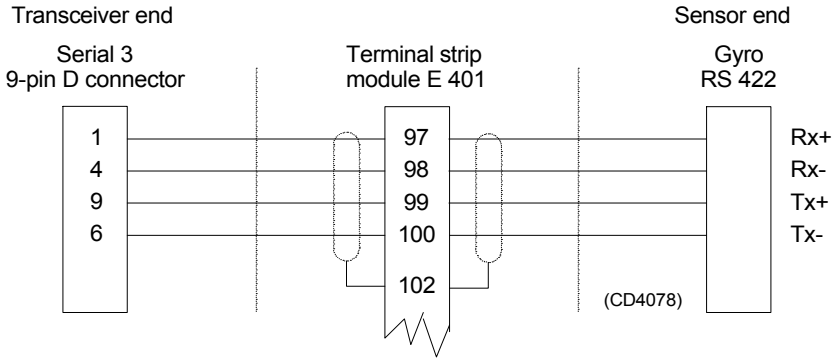


Figure 10 - Gyro connections

Cable M

An analogue vertical reference unit may be connected into the transceiver shown below:

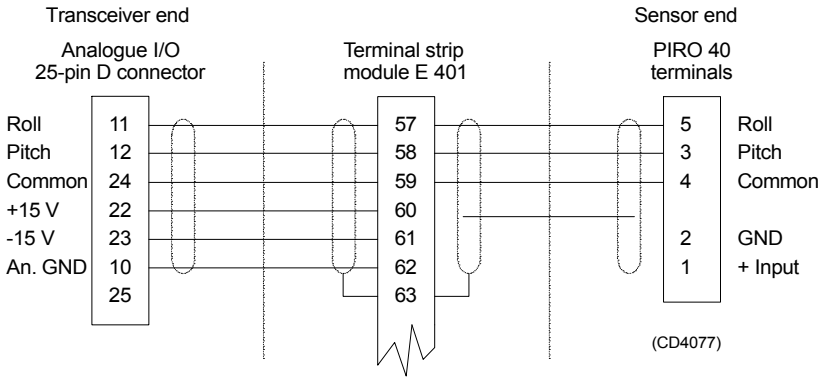


Figure 11 - Analogue VRU connections

Cable N

A synchro gyro may be connected into the transceiver as shown below:

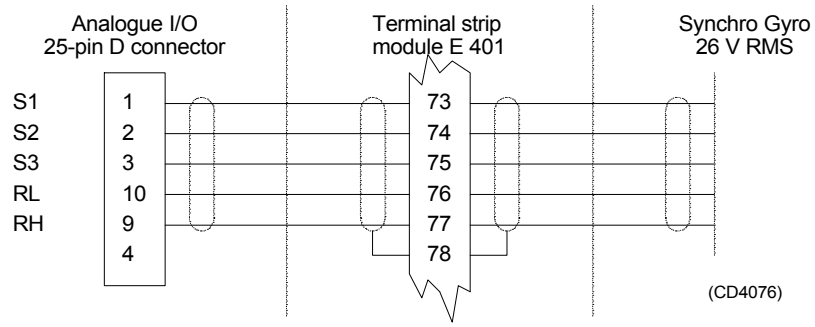


Figure 12 - Synchro gyro connections

Cable Y

This cable is the serial interface to a tracking transducer.

For the connections refer to:

- Drawing 824-089179 if connecting the transducer as Td 1.
- Drawing 824-089178 if connecting the transducer as Td 2.

The drawings are located in the *Drawing* section.

Drawing file

Overview

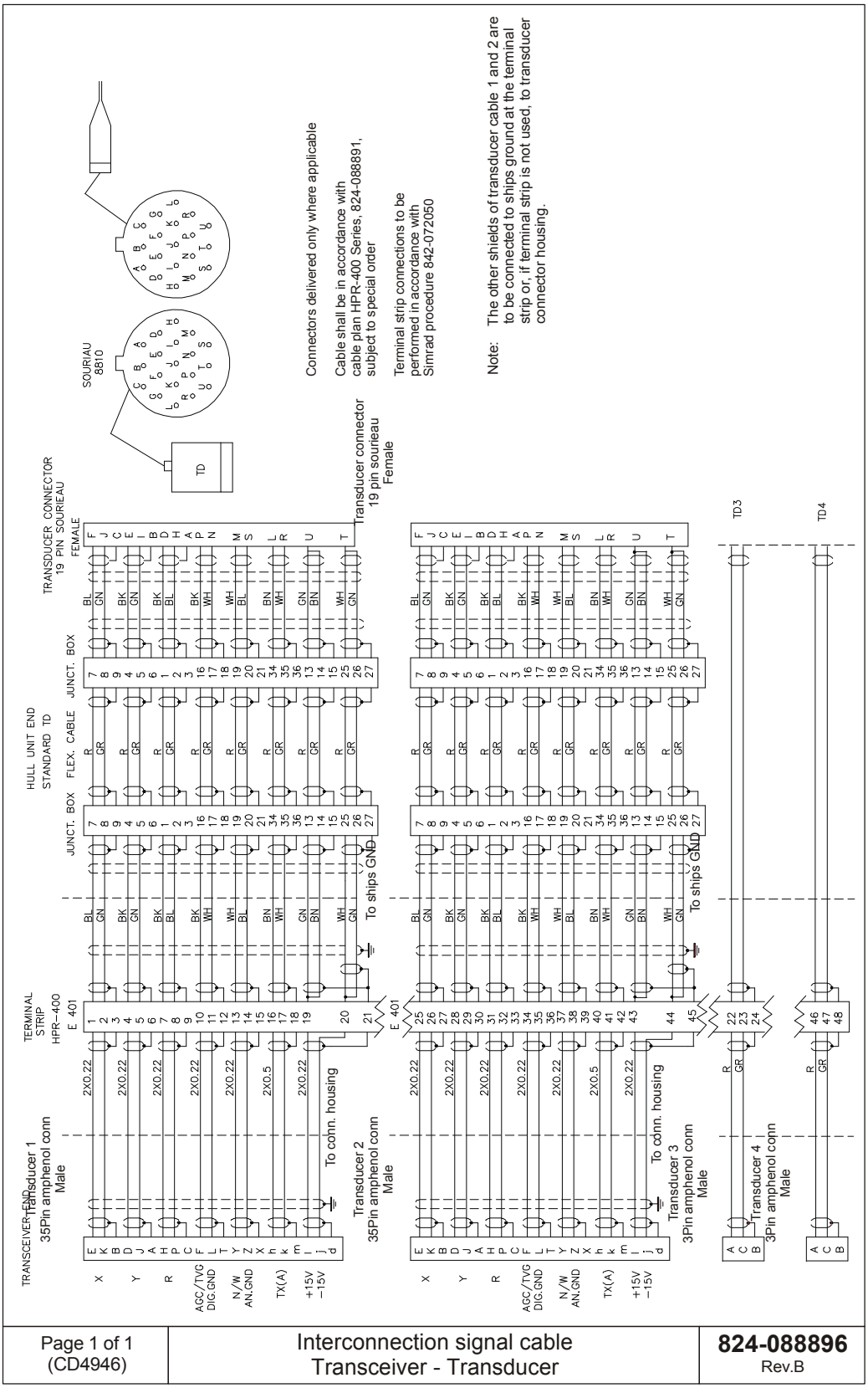
This section contains illustrations referred to in various sections in this manual. The illustrations are based on the original system drawings and wiring diagrams.

- The original drawings are available in electronic format (AutoCAD) upon request.

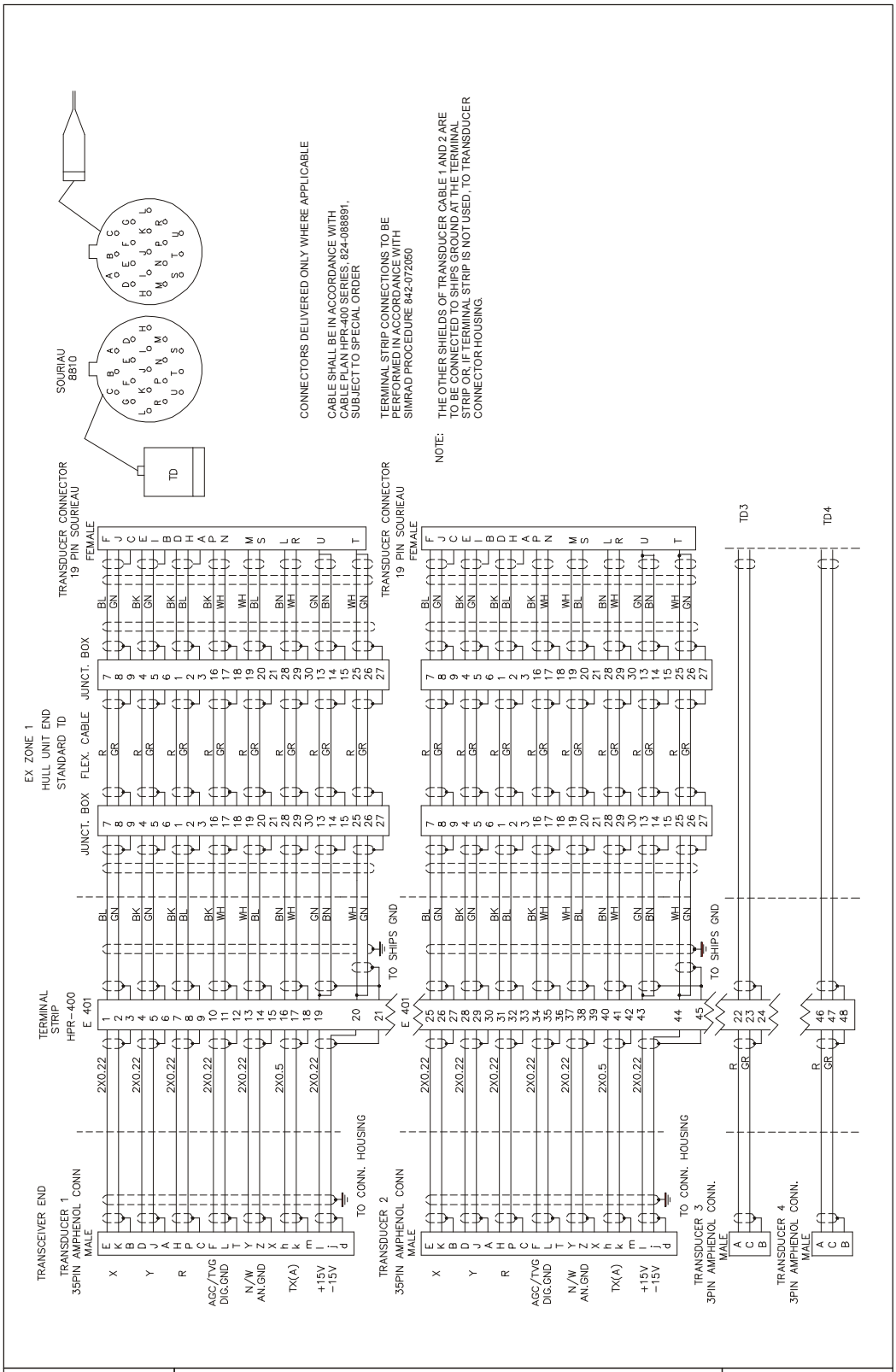
Drawings

The following illustrations are implemented:

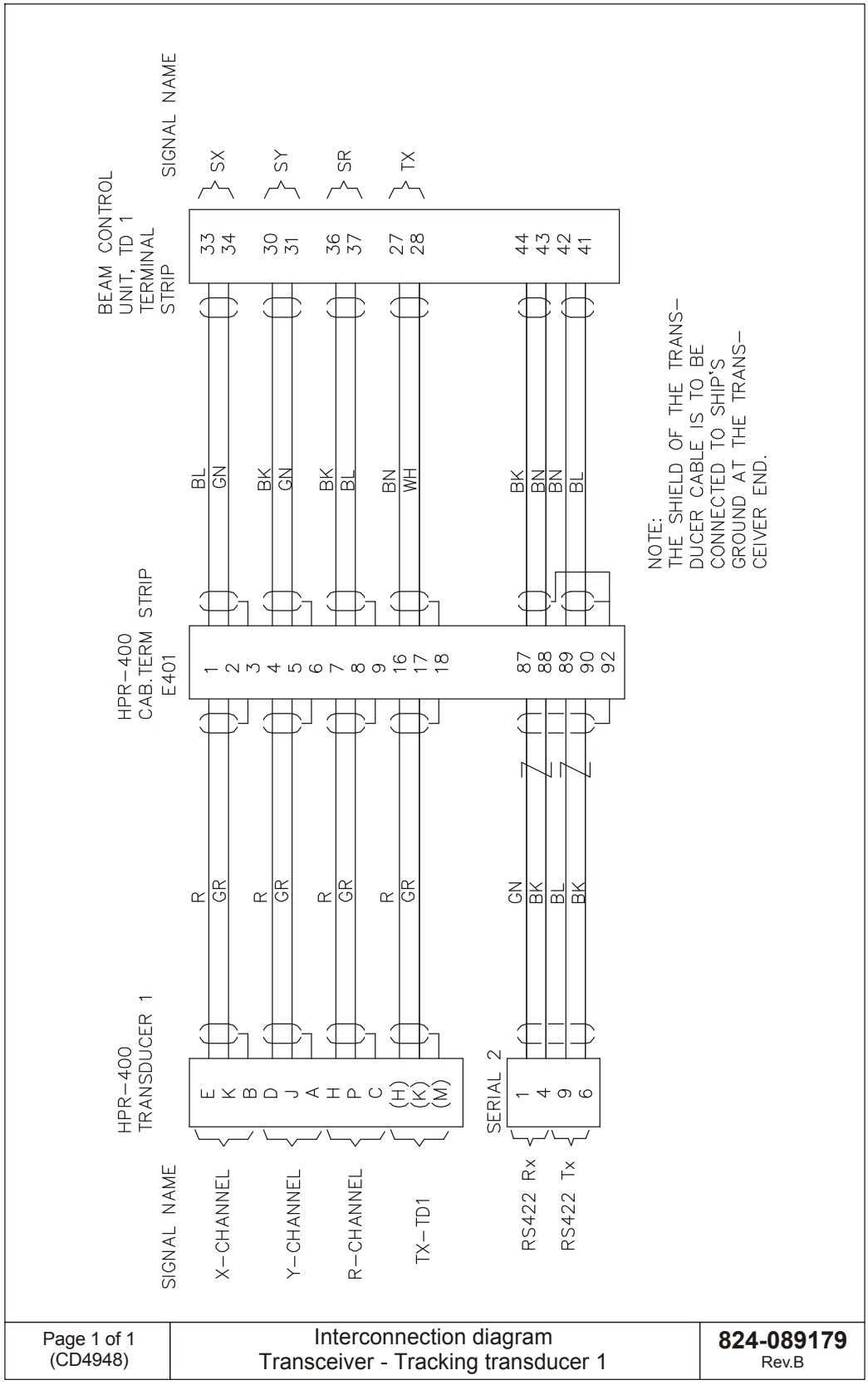
- Interconnection signal cable, Transceiver - Transducer, see page 22.
- Interconnection signal cable, Transceiver - Transducer Ex zone 1, see page 23.
- Interconnection signal cable, Transceiver - Tracking transducer 1, see page 24.
- Interconnection signal cable, Transceiver - Tracking transducer 2, see page 25.
- Power cable, power distribution, see page 26.
- Wiring diagram HPR 400, see page 27.



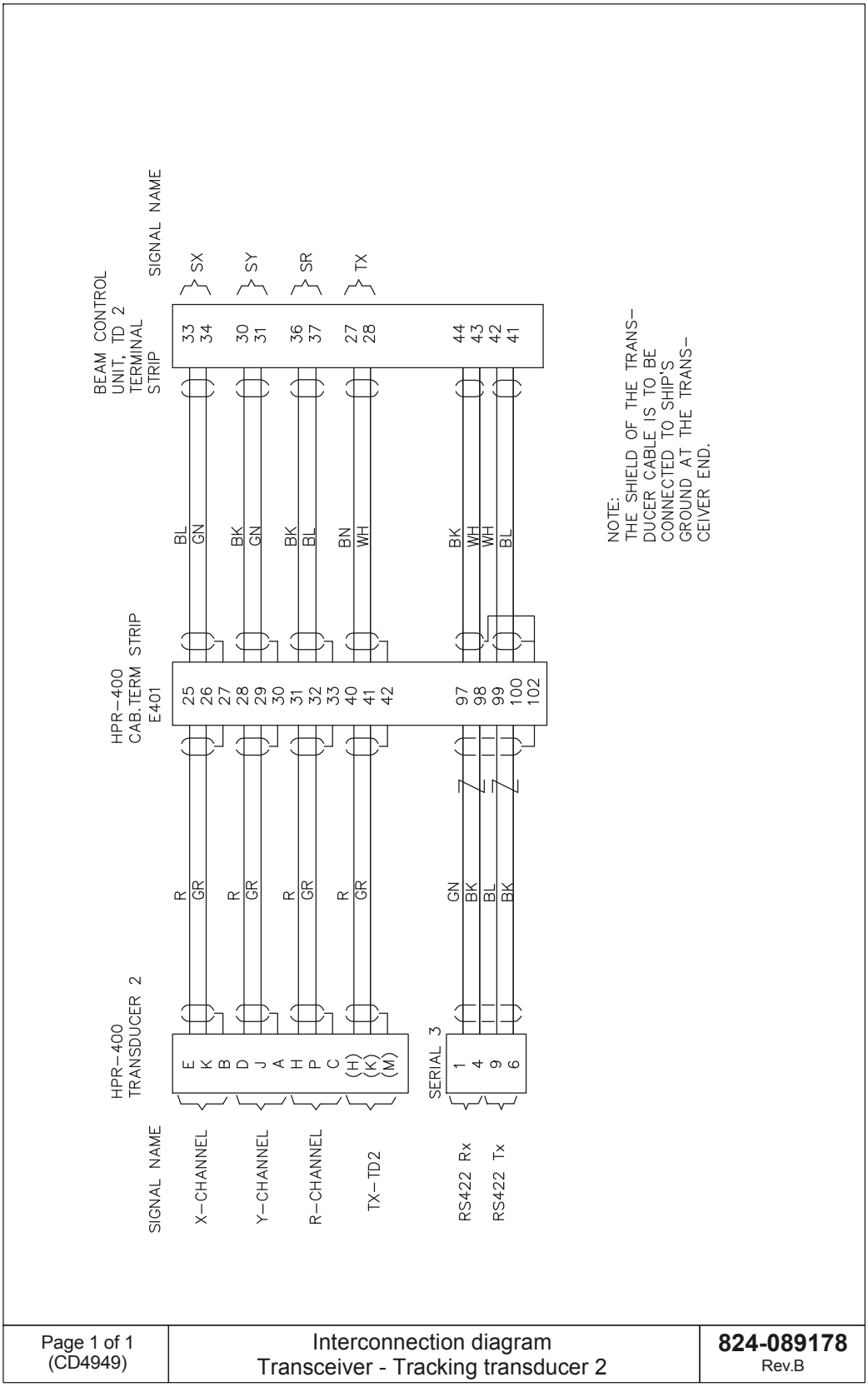
Page 1 of 1 (CD4946)	Interconnection signal cable Transceiver - Transducer	**824-088896** Rev.B



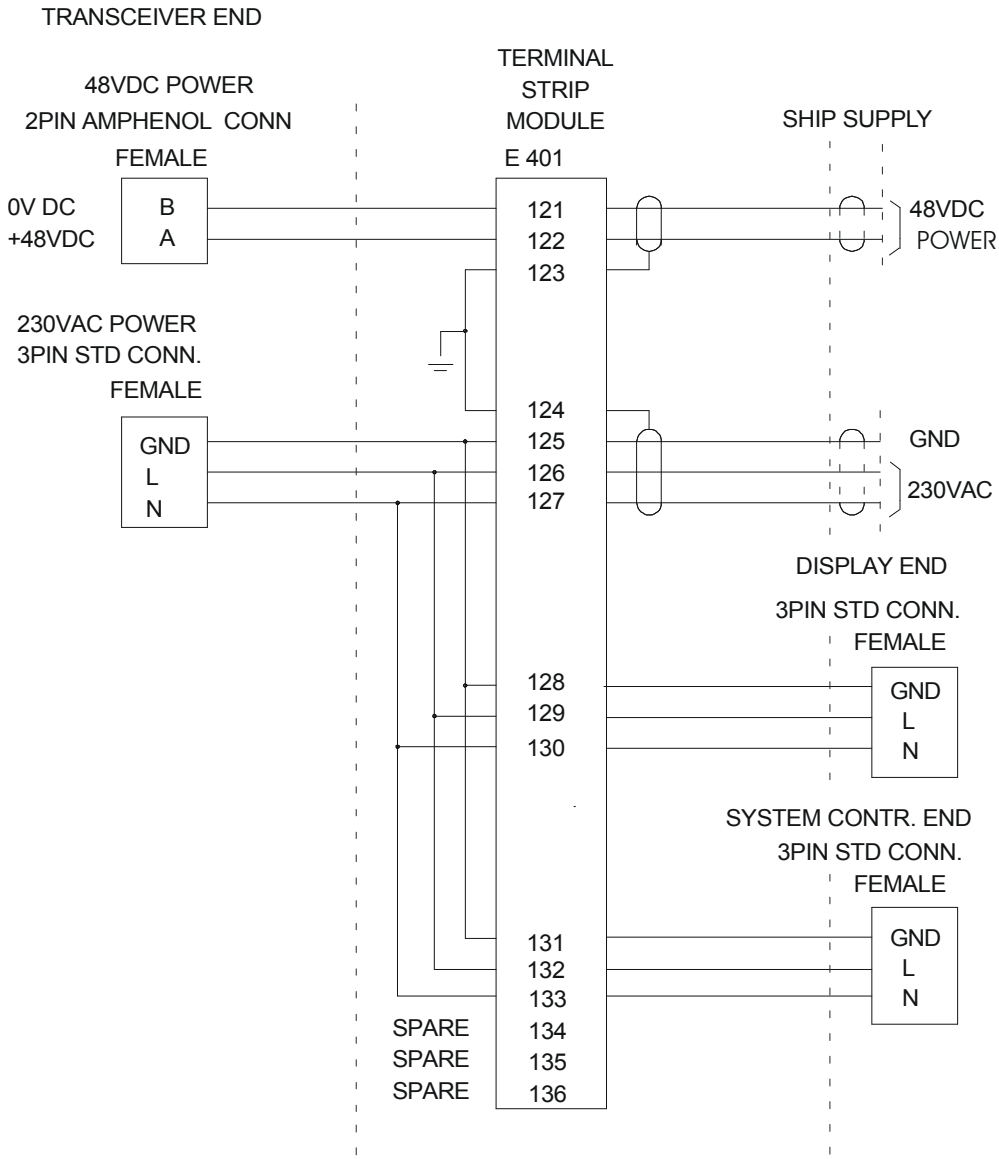
Page 1 of 1 (CD4947)	Interconnection signal cable Transceiver - Transducer Ex zone 1	**824-089439** Rev.A



Page 1 of 1 (CD4948)	Interconnection diagram Transceiver - Tracking transducer 1	**824-089179** Rev.B



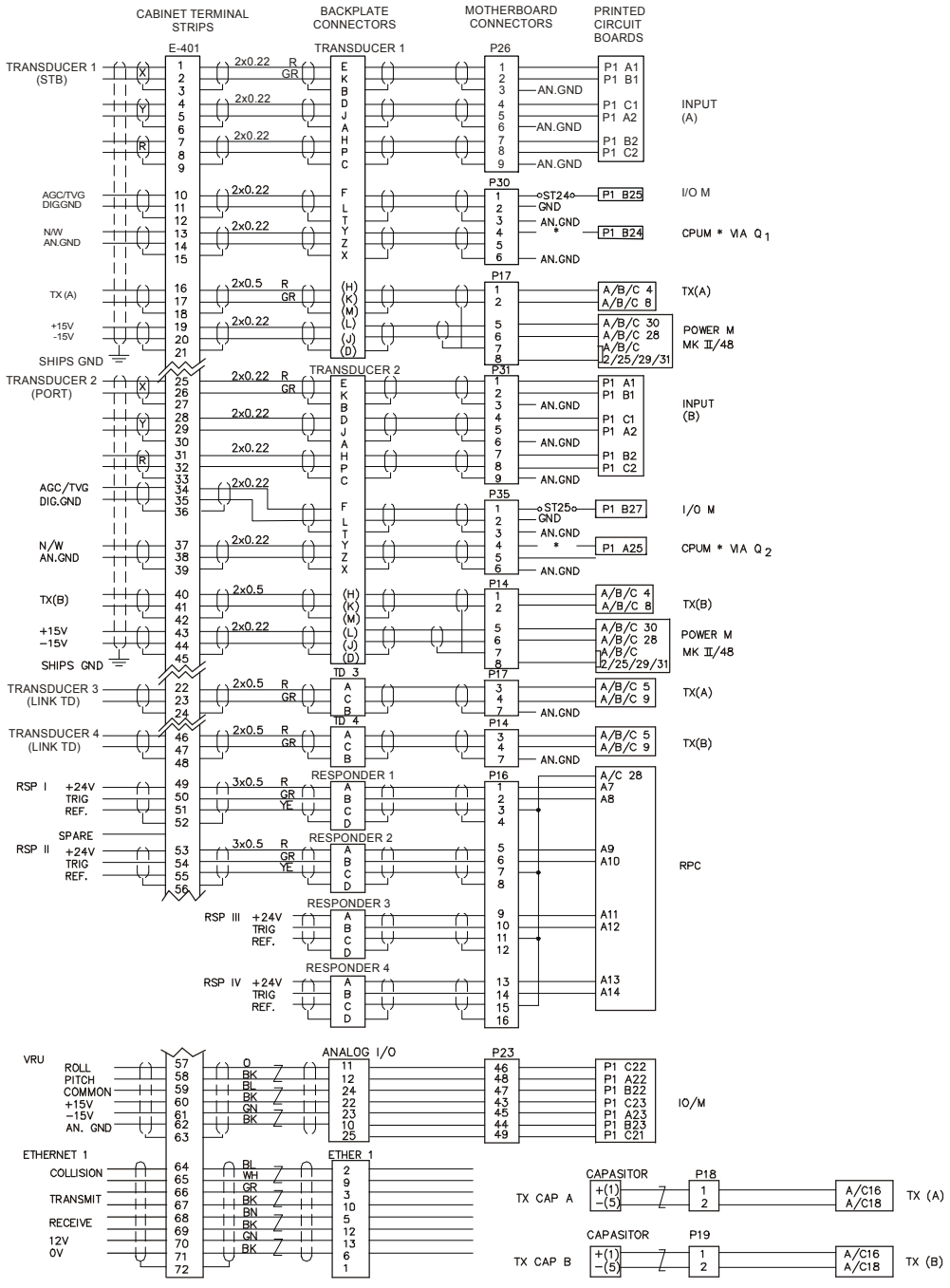
Page 1 of 1 (CD4949)	Interconnection diagram Transceiver - Tracking transducer 2	**824-089178** Rev.B



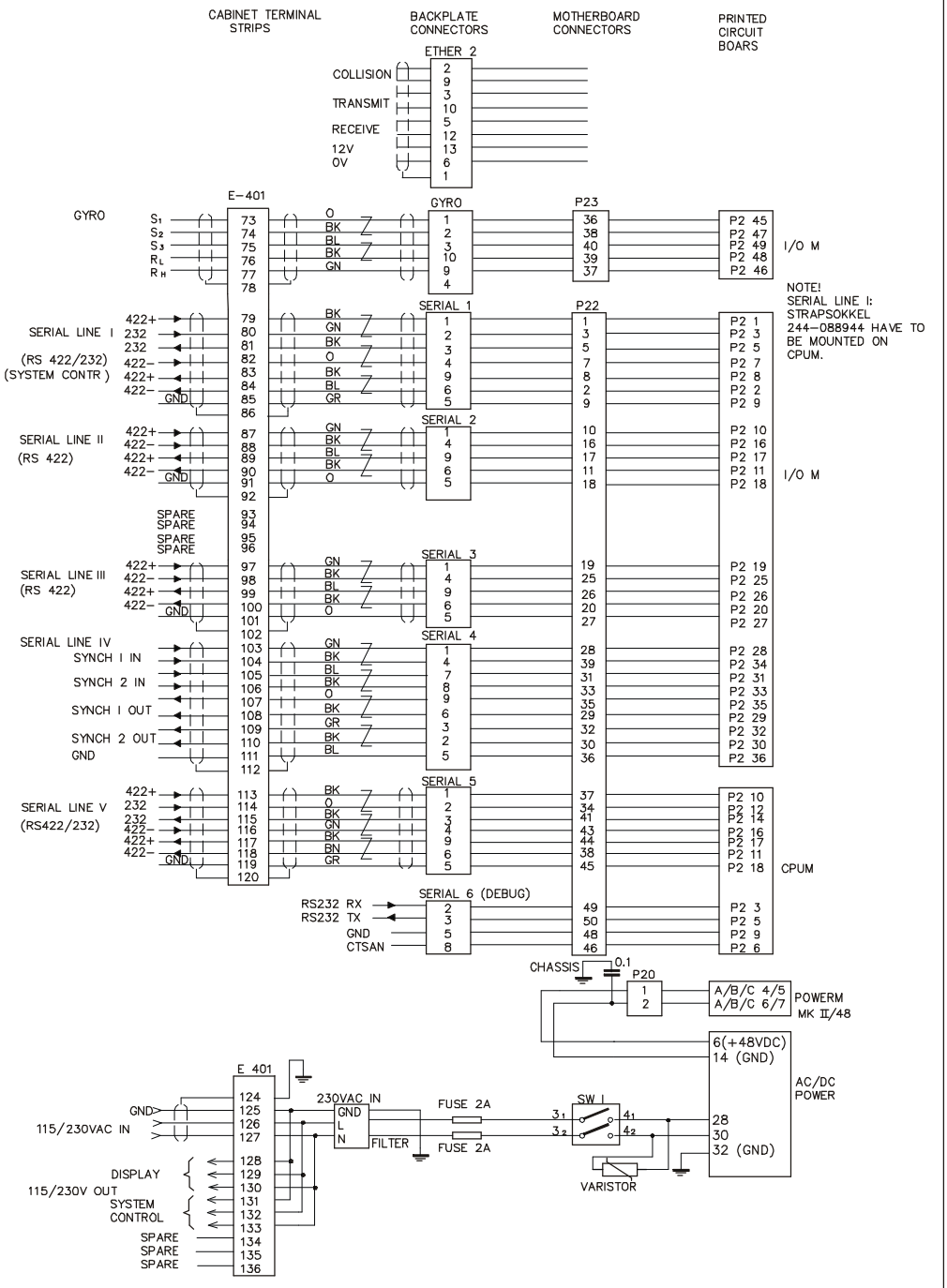
CONNECTORS W/CABLE DELIVERED ONLY WHERE APPLICABLE
COMMON POWER CABLE SHALL BE IN ACCORDANCE WITH
CABLE PLAN HPR 400 SERIES.

TERMINAL STRIP CONNENTIONS TO BE PERFORMED
IN ACCORDANCE WITH SIMRAD PROCEDURE 842-072050

Page 1 of 1 (CD4950)	Power cable, power distribution	**824-088895** Rev. C



Page 1 of 2 (CD4951)	Power cable - power distribution	**824-088708** Rev.D



Page 2 of 2 (CD4951)	Power cable - power distribution	**824-088708** Rev.D

3 APC 10

APC 10 description

Introduction

The APC 10 unit is constructed of steel and aluminium panels and machined aluminium sections. The same unit is used for all types of installation (desktop or rack), with additional mounting brackets or rails as required.



Figure 13 - APC 10 unit with mounting brackets

External connections

All external connections to the APC 10 unit are made via plugs located on the rear of the unit.

→ *Refer to page 30 for more information.*

Power initialization

The APC 10 unit can be powered from either a 115 Vac or 230 Vac supply.

Caution: *Ensure the switch is set to the power supply available before plugging the mains supply cable into the power outlet.*

The unit's power on/off switch is located behind the hinged cover on the front panel. The switch is of the "push-for-on, push-for-off" type.

APC 10 connections

All connections too and from the APC 10 are made on the rear of the unit. The rear panel is made up of three “areas” of connectors:

- **Mains power input:**
  - Power input (with voltage selector switch)
- **Motherboard connectors:**
  - Mouse connector (not used)
  - Keyboard PS/2 style connector
  - USB connector (not used)
  - 9-pin D-connector, serial port 2 (RS-232) COM 2
  - 25-pin D-connector, parallel port for printer
  - 9-pin D-connector, serial port 1 (RS-232) COM 1 for keyboard trackball
  - 9-pin D-connector for keyboard lighting, power and loudspeaker
- **PCB connectors:**
  - 15-pin D-connector, VGA video connector
  - 9-pin D-connector, COM 3
  - 9-pin D-connector, COM 4
  - Ethernet connector

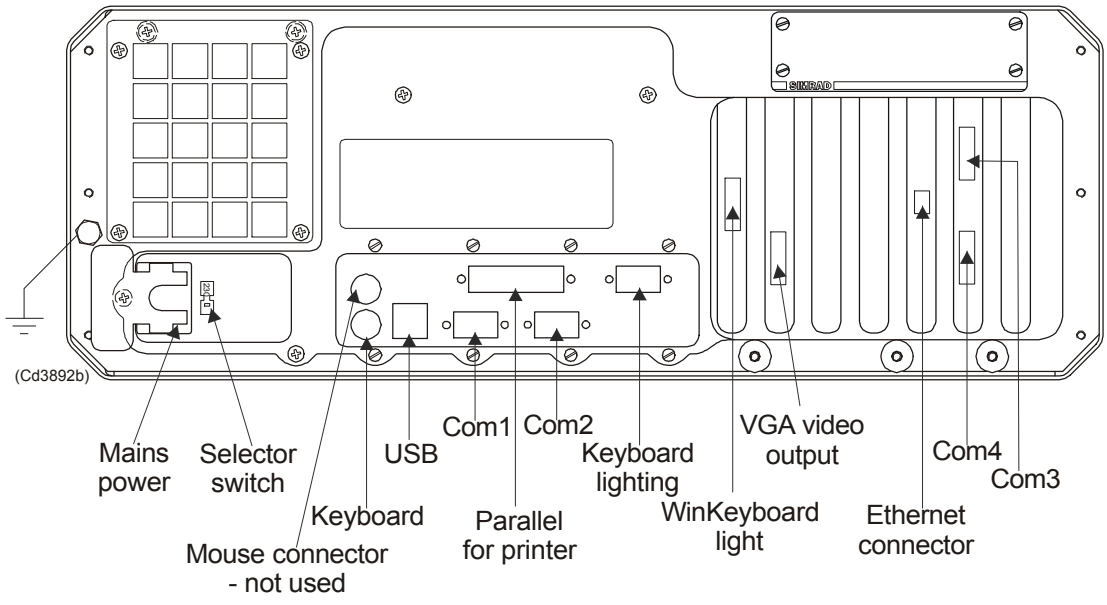


Figure 14 - APC 10 rear panel layout

APC 10

General maintenance information

Note: *The dismantling procedures described in this manual refer to a desktop installation - that is, the unit will need to be removed from a rack before commencing the procedures described here.*

Caution: *To prevent damage to sensitive electronic components caused by the build up of static electricity, always put on an grounding bracelet and ensure that both you and the workbench are effectively grounded to the vessel's ground before commencing work on the APC 10 unit.*

Internal layout

The APC 10 contains the following circuit boards and units:

- Serial line adapter
- Ethernet PCB (optional)
- Video adapter
- Motherboard
- Hard disk drive
- Processor cooling fan
- Power supply
- CD-ROM drive
- 3.5” floppy disk drive

The APC 10 is based on a commercially available motherboard, while the additional boards are standard plug-in circuit boards.

The placement of boards and units are shown in the figure below. All the boards and units can be replaced separately.

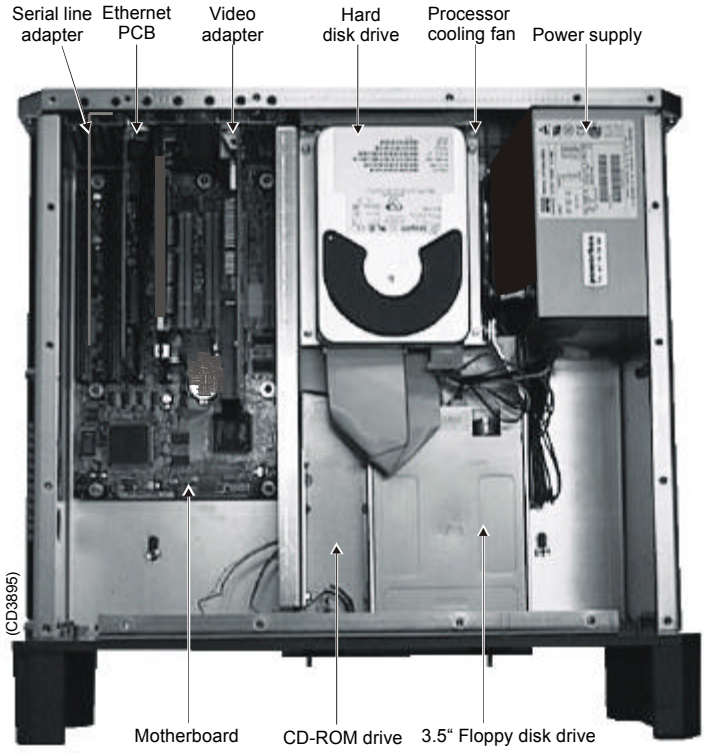


Figure 15 - APC 10 - internal layout

WinKeyboard description

Introduction

The WinKeyboard is constructed of aluminium. It consists of a small keyboard and a trackball.

The same unit is used for all types of installations. The background ligth may be adjusted. This is done at the APOS menu.



Figure 16 - WinKeyboard

External connections

All external connections to the WinKeyboard are on the 25 pin female D-connector at the rear of the unit.

→ *Refer to APC 10 wiring diagram on page 45.*

All external connections to the WinKeyboard are on the 25 pin female D-connector at the rear of the unit.

WinKeyboard

Introduction

The keyboard consists of two push-button circuit boards and a trackball mounted together on a front panel, and a buzzer unit, contained within a casing. The case is sealed by a base, which is secured into position by 22 screws. The buzzer unit sits in a holder, with its leads soldered directly into the keyboard connector.

Internal layout

The WinKeyboard contains the following:

- Two push-buttons circuit boards
- Trackball unit
- Buzzer

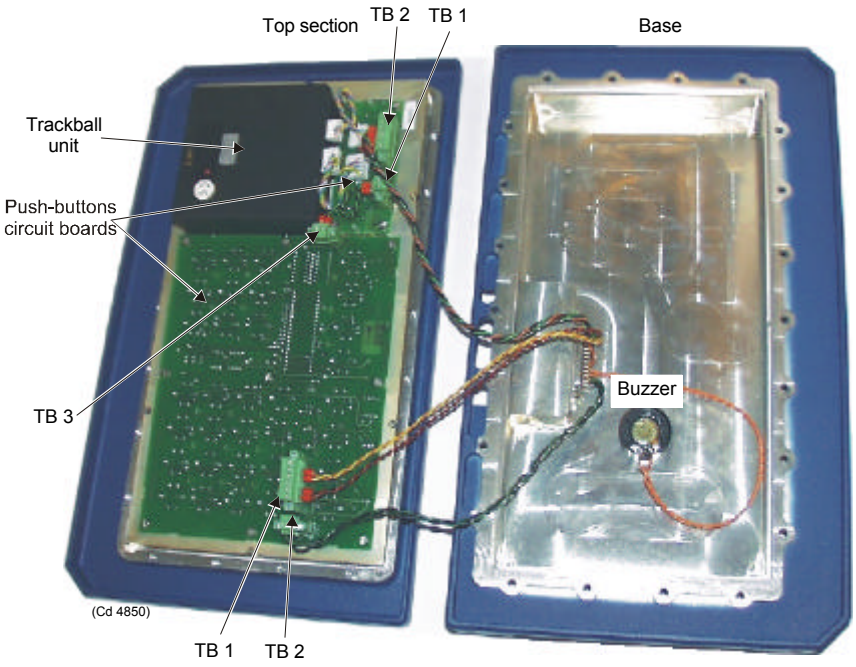


Figure 17 - WinKeyboard- internal layout

The WinKeyboard receives power from the APC 10, and power is turned on when the APC 10 is turned on.

→ *For external connections refer to the wiring diagram on page 45.*

As seen in the diagram, a cable with 3 connectors:

- MiniMouse
- COM 1
- Power, connects the WinKeyboard to the APC 10.

Maintenance

General

The following units and circuit boards in the APC 10 are defined by Kongsberg Simrad AS as *Line Replaceable Units (LRUs)*:

- Motherboard
- Processor
- Ethernet PCB
- Serial line adapter
- Video adapter
- Hard disk drive
- CD-ROM drive
- 3.5” floppy disk drive
- Power supply

Refer to the *Spare parts* chapter for order numbers etc.

The removal and replacement procedures for these units and boards are described in the following paragraphs.

Note: *The maintenance engineer **MUST** wear a grounding bracelet, which is securely connected to the vessel’s ground, at all times when performing maintenance on the APC 10 unit.*

Preventive maintenance

The preventive maintenance consists of keeping the units clean.

Note: *All other maintenance must be done by either the manufacturers or their representative.*

Note: *Use only a damp cloth.*

Use:

- Soft lint-free cloth
- Bucket
- Mild liquid detergent

Wet the cloth, then wring as much of the water out as possible. Ensuring that there is no possibility of water dripping into the units.

Maintenance schedule

Maintenance routines must be performed regularly and effectively to ensure that the equipment is kept in top condition.

The chart below states the **maximum** recommended intervals at which the various routines should be performed - the intervals should be decreased if the system is used excessively.

Maintenance chart

Unit	Weekly	Monthly	6 Months	Reference
All units - exterior	Clean		Check	
All cable connections			Check	
APC 10 filter			Check/Clean	Page 41

Tools

Standard tools

A standard mechanical tool set will be required for:

- Perform the majority of the maintenance described in this manual.
- Perform the installation, removal and replacement of modules and parts described in this manual.

This set should at the minimum contain the following tools:

- Standard screwdrivers in different widths and lengths
- Allen key in metric size
- Phillips screwdrivers in various sizes
- Pozidrive screwdrivers in various sizes
- Flat nosed pliers
- Lap jointed pliers
- Wire cutters
- Wire stripper
- Soldering iron
- Open ended and ring spanners in metric sizes
- Adjustable spanners
- Socket set
- Knife
- A standard electrical tool set may be required to perform repairs to cables etc.
- In addition, the normal heavy tools designed for installation work is required.

The following expendables are recommended:

- Grease gun with appropriate nipple connector.
- Solders
- Wire straps in different sizes
- Isolating plastic tape

Special tools

If special tools are required for a particular procedure, they will be listed at the beginning of that procedure.

Opening the APC 10 unit

To open the APC 10 unit, proceed as follows:

1 Switch of power to the APC 10.

2 Remove the power connector from the back of the unit.

3 Switch off power to all other units connected to the APC 10 (that is, display, transceiver, VRU etc).

4 Remove the 14 screws which secure the top cover onto the APC 10 (4 at the front and 4 at the back on the top, and 3 on each side).

5 Lift the top cover clear of the APC 10 chassis.

Closing the APC 10 unit

To close the APC 10 unit, proceed as follows:

1 Ensure all the required units and circuit boards are located correctly, and any securing screws and clips are tight.

2 Ensuring no wires or cables are trapped, carefully replace the cover onto the APC 10.

3 Once all the screw holes are aligned, replace the 14 securing screws.

Note: *Do not over-tighten the screws as you may strip the threads off either the screws or the tapped holes in the APC 10 chassis.*

4 Remount the APC 10 unit into its rack or desktop as required.

5 Check that the supply voltage change-over switch is set correctly, then plug the mains cable into the connector on the rear of the unit.

6 Apply power to the unit and peripherals.

Replacing the hard disk drive

To remove the hard disk unit, proceed as follows:

1 Remove the top cover from the APC 10.

2 Using a suitable box spanner, remove the four nuts securing the hard disk drive onto the disk drive chassis.

3 Lift the hard disk unit off the chassis.

4 Disconnect the two plugs.

The hard disk unit can now be removed from the APC 10.

To replace the unit, follow the above procedure in reverse.

Note: *For further details regarding formatting and configuration of the new hard disk, please contact Kongsberg Simrad.*

Replacing the floppy disk drive

To remove the floppy disk drive unit, proceed as follows:

1 Remove the top cover from the APC 10.

2 Using a pozidrive screwdriver, remove the six screws holding the disk drive chassis into the APC 10 unit.

- Four screws are located in the front of the unit behind the drive unit cover plate. Two screws are located in the rear of the unit above the connector panel.

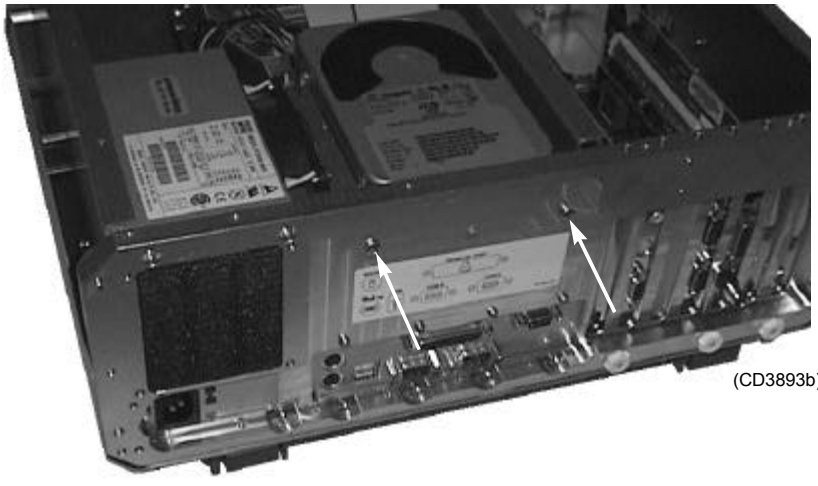


Figure 18 - The two screws supporting the rear of the disk drive chassis

3 Carefully lift the disk drive chassis out of the APC 10 unit.

4 Remove the six screws (three on each side) holding the floppy drive into the chassis, and lift the drive unit out of the chassis.

5 Disconnect the two plugs.

The floppy disk drive can now be removed from the APC 10.

To replace the unit, follow the above procedure in reverse.

Replacing the CD ROM disk drive

To remove the CD ROM disk drive unit, proceed as follows:

1 Remove the top cover from the APC 10.

2 Using a pozidrive screwdriver, remove the six screws holding the disk drive chassis into the APC 10 unit.

- Four screws are located in the front of the unit behind the drive unit cover plate. Two screws are located in the rear of the unit above the connector panel.

→ *Refer to figure on page 41.*

3 Carefully lift the disk drive chassis out of the APC 10 unit.

4 Remove the eight screws (four on each side) holding the CD ROM drive into the chassis, and lift the drive unit out.

5 Disconnect the two plugs.

The CD ROM drive can now be removed from the APC 10.

To replace the unit, follow the above procedure in reverse.

Replacing the power supply

To remove the power supply unit, proceed as follows:

1 Remove the top cover from the APC 10.

2 Using a flat-blade screwdriver, remove the four cheese-head screws holding the fan filter retaining plate onto the rear of the APC 10 unit, then remove the filter retaining plate.

3 Using a pozidrive screwdriver, remove the five screws holding the power supply unit into the APC 10 chassis.

- Four screws are located in the rear of the unit, one is located on the side.

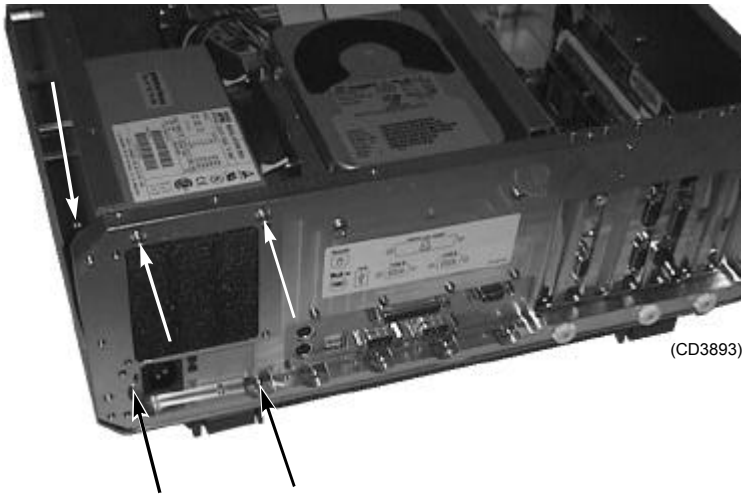


Figure 19 - Locations of the five power supply retaining screws

4 Carefully lift the power supply out of the APC 10.

5 Disconnect the plug from the motherboard.

The power supply can now be removed from the APC 10.

To replace the power supply unit, follow the above procedure in reverse.

Dust filter

A filter is fitted at the front of the power supply. When required the filter must be cleand, to avoid blocking of the air circulation within the unit.

To clean the filters proceed as follows:

1 Remove the filter from the unit.

2 Clean the filter in lukewarm water.

3 Leave it to dry before you reinstall it.

4 When cleaning is no longer sufficient, replace the dust filter. (Filter type SP 120.)

Note: *To ensure correct air flow, it is important to use the correct filter type.*

Replacing the circuit boards

To remove one of the circuit boards, proceed as follows:

1 Remove the top cover from the APC 10.

2 Remove the two screws holding the support block in position, then remove the support block.

3 Insert a small pozidrive screwdriver down through the appropriate hole in the APC 10 rear chassis plate, and remove the screw that secures the faulty circuit board into the chassis.

4 Slacken the three white plastic PCB clamping nuts located on the rear of the APC 10 chassis).

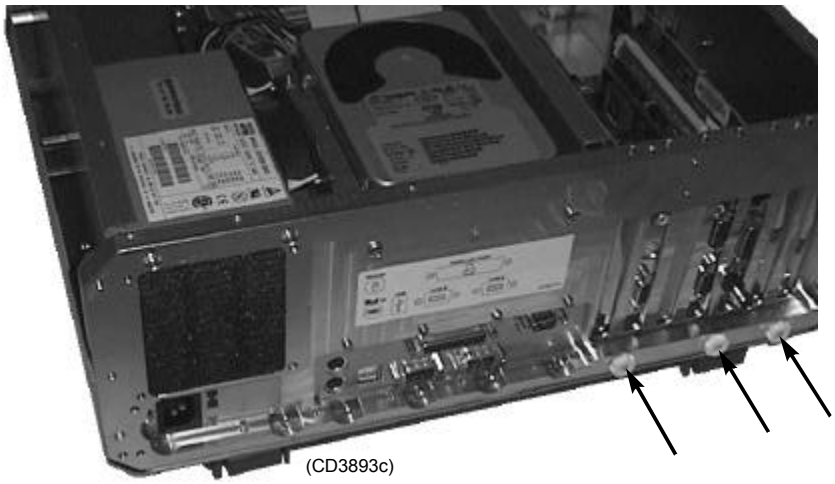


Figure 20 - The three PCB clamp nuts

5 Carefully lift the circuit board out of the APC 10.

To replace the board, follow the above procedure in reverse.

Replacing the motherboard

To remove the motherboard, proceed as follows:

1 Remove the top cover from the APC 10.

2 Remove the two screws holding the support block in position, then remove the support block.

3 Remove all the circuit boards.

4 Remove the entire disc drive chassis.

5 Remove the power supply unit. (This is not absolutely necessary, but will simplify the removal of the motherboard.)

6 Remove the six nuts that secure the parallel and two serial port D-connectors located on the “motherboard connector panel” on the rear of the APC 10.

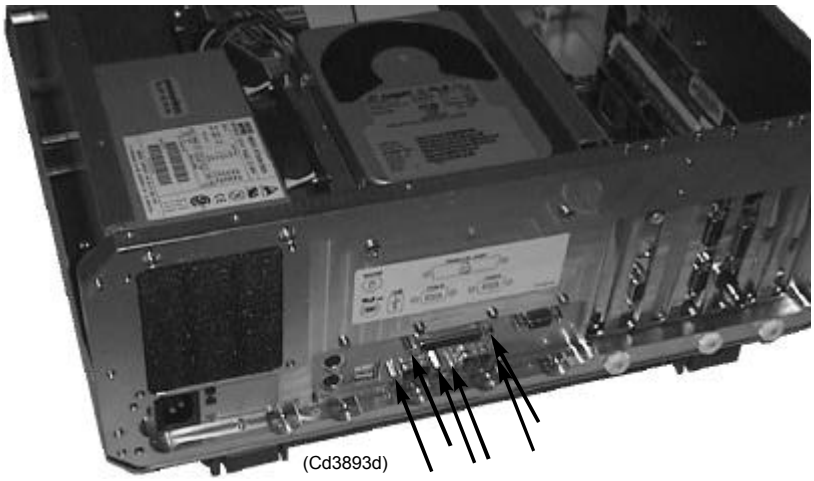


Figure 21 - The six connector-securing nuts

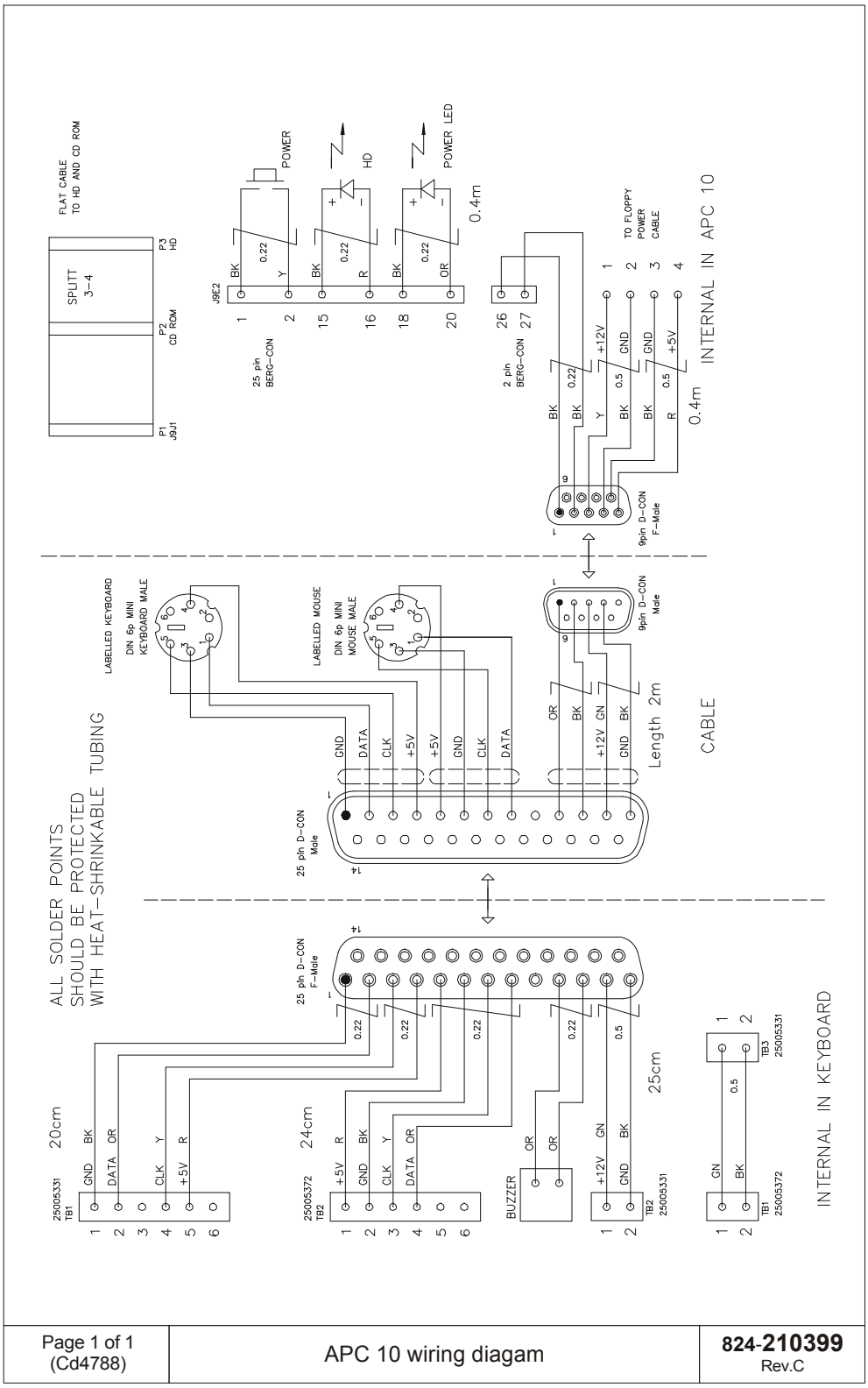
7 Remove the 7 screws securing the motherboard into the APC 10 unit.

8 Carefully lift the motherboard out of the unit.

Note: *Ensure that the RAM used is specified for the actual motherboard.*

To replace the board, follow the above procedure in reverse.

APC 10 and Keyboard wiring diagram



Maintenance of the WinKeyboard

Preventive maintenance

Opening the keyboard

The components within the keyboard can be accessed as follows:

→ *Refer to the figure on page 34.*

1 Switch off the APC 10.

2 Disconnect the keyboard.

3 Turn the keyboard over onto a padded surface so the trackball is not damaged, then remove the 22 securing screws. Lift off the base plate.

4 Disconnect all the connectors, then lift the trackball/circuit board unit out of the keyboard case.

Note: *The trackball/circuit board unit will usually be replaced as one unit. If so, ignore the remaining procedures and install a new unit by reversing the above procedure.*

Replacing the keyboard components

Replacing the trackball

Replace the trackball as follows:

1 Open the keyboard (see above).

2 Disconnect the two plugs connecting the trackball unit to the small circuit board.

3 Remove the four screws holding the trackball securing ring to the front of the key panel.

4 Remove the trackball unit from the circuit board unit.

- To replace the trackball, follow the above procedure in reverse.

Replacing the large circuit board

Replace the large circuit board as follows:

1 Open the keyboard (see above).

2 Disconnect the three plugs connecting the large circuit board to the small board and the APC 10 connector.

3 Remove the nine screws holding the large circuit board into the key panel.

4 Remove the circuit board from the key panel.

- To replace the large circuit board, follow the above procedure in reverse.

Replacing the small circuit board

Replace the small circuit board as follows:

1 Open the keyboard (see above).

2 Disconnect the four plugs connecting the small circuit board to the trackball and the APC 10 connector.

3 Remove the four screws holding the small circuit board into the key panel.

4 Remove the circuit board from the key panel.

- To replace the small circuit board, follow the above procedure in reverse.

Replacing the buzzer unit

Replace the buzzer unit as follows:

1 Open the keyboard (see above).

2 Un-solder the two orange wires connecting the buzzer to the 25-pin D-connector in the keyboard.

3 Lift the buzzer out of its holder in the key panel.

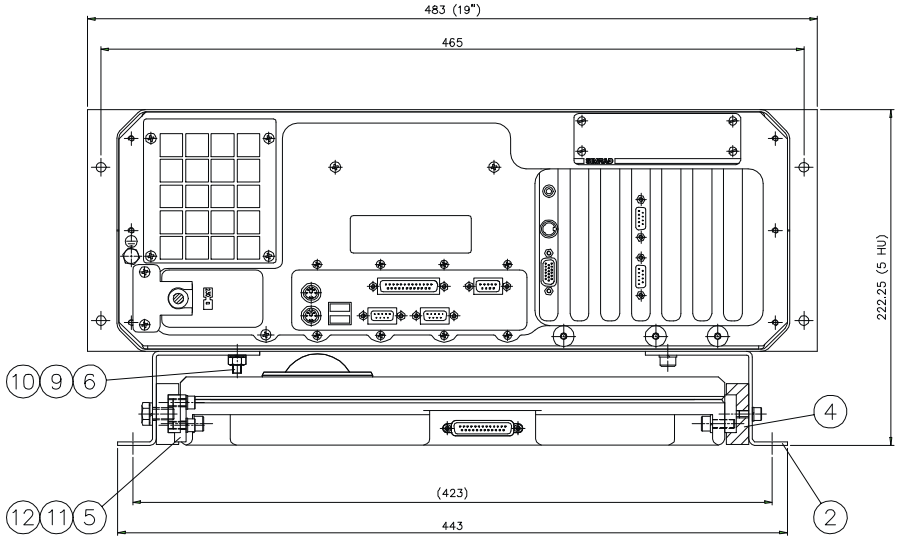
- To replace the buzzer, follow the procedure in reverse.

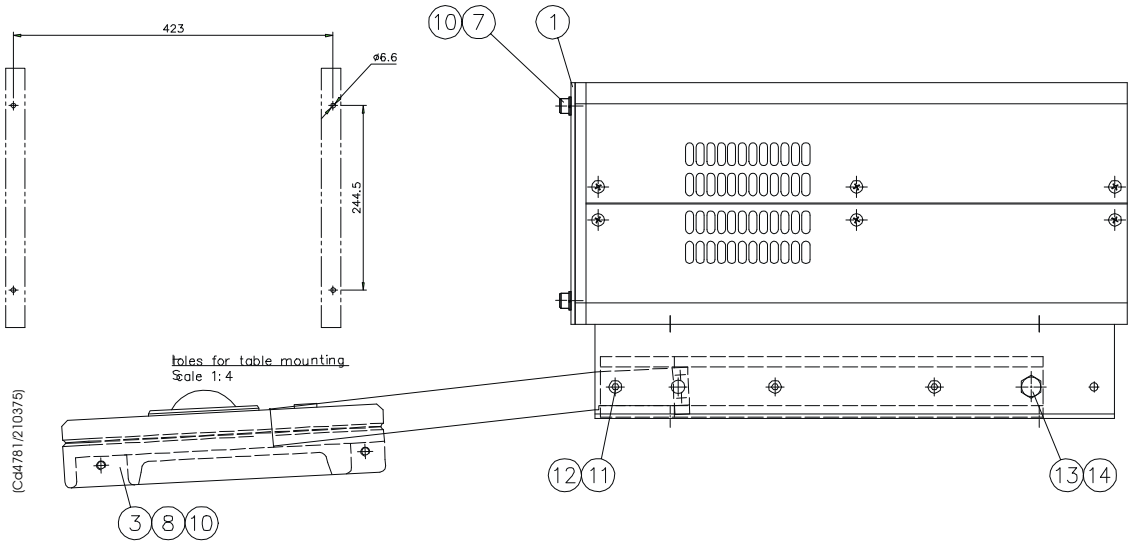
APC 10 outline dimensions

The following pages hold APC 10 drawings required for the various standard installation. Specific drawings needed for special installation requirements are not included, but solutions may be designed based on the drawings included here.

Rack mounting

Rack mounting . . . . . Drawing no. 210375 (661-98)





Parts list for rack mounting

1 Mounting brackets for 19” rack - computer

2 Support bracket 19” rack, - APC 10

3 Slide rail WinKeyboard

4 Slide rail WinKeyboard

5 Stop block

6 T-track screw, desktop computer

7 M6x10 Cyl.Hd. with internal hex. NS1832 SF

8 M6x16 Pan Hd. with X cut NS1805

9 Nuts, M6 NS1827 SF

10 Spring washer M/INV6 NS1832 SF

11 M5x10 SYLH M/INV6 NS1832 SF

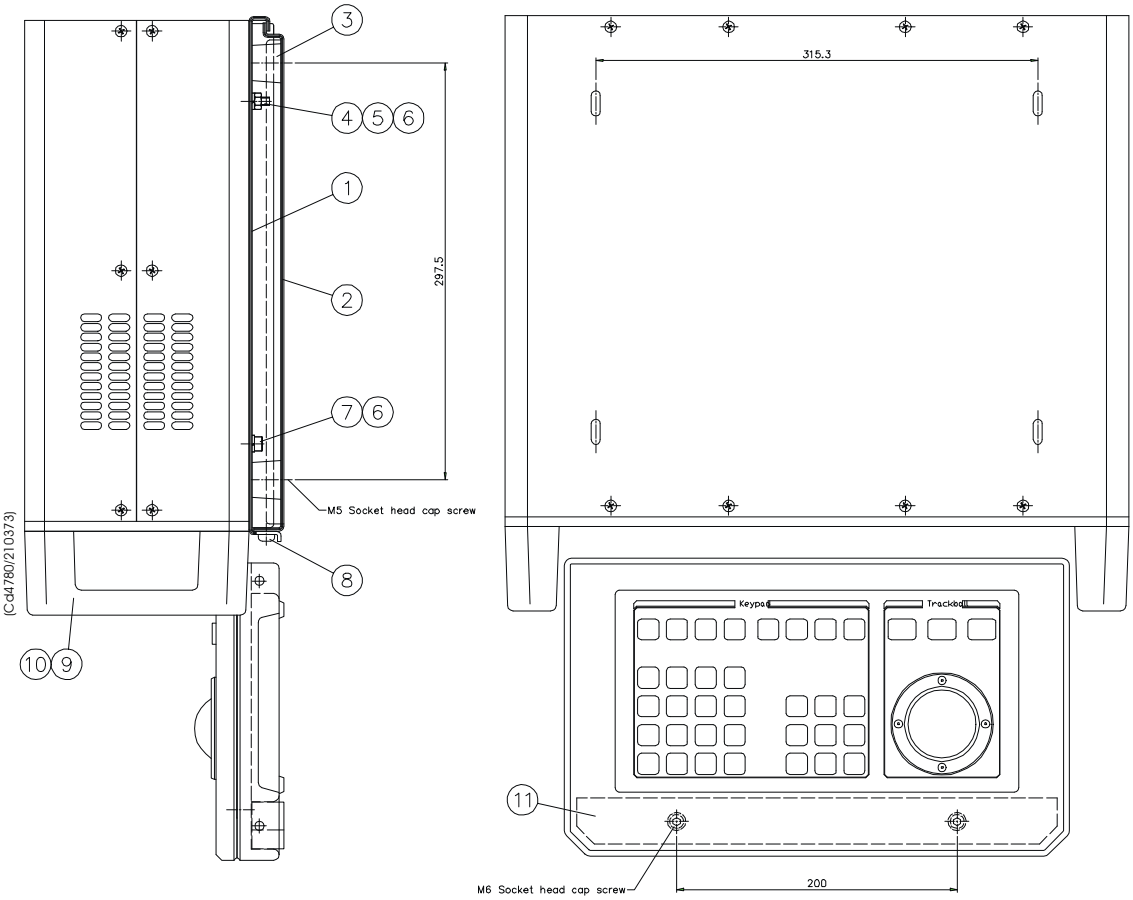
12 Spring washer F/M5 DIN127B SF

13 M8x16 6-KHSKR NS1224 SF

14 Spring washer F/M5 DIN127B SF

Desktop mounting

Desktop mounting . . . . . Drawing no. 210373 (661-97)



Parts list for desktop mounting

1 Mounting rails, computer
2 Mounting rails, display
3 Rubber foot TF10T-TRP8
4 T-track screw, desktop computer
5 Nuts, M6 NS1827 SF
6 Shake-proof washer, M6 DIN6798A SF
7 M6x10 Cyl.Hd. with internal hex. NS1832 SF
8 M6x16 Pan Hd. with X cut NS1805
9 M6x60 Cyl.Hd. with internal hex. NS1832 SF
10 Handle, desktop computer
11 Mounting block for windows keyboard

APC 10

The APC 10 unit is supplied with several standard cables. These cables limit the maximum distance between the APC 10 and the display unit.

Outline dimensions

- Unit for desktop installation:

Height of unit	160 mm
Height including mounting brackets	185 mm
Width	445 mm
Depth of unit	366 mm
Depth including handles	425 mm
Weight	approx. 17 kg

- Unit for rack installation (including rails and side plates):

Height	185 mm
Width	485 mm
Depth	365 mm
Weight	approx. 17 kg

Note: *In all cases, allow 100 mm space behind the unit for plug connections and cables.*

Power

Voltage	115 / 230 Vac

- Selector-switch beside power connector.
- The power supply must be kept within 10% of the unit's nominal voltage; 90-132 Vac/180-264 Vac.
- The maximum transient voltage variations on the main switchboard's bus-bars which could occur (except under fault conditions), are not to exceed -15% to +20% of the nominal voltage.

Frequency	50-60 Hz
Maximum current drawn	5 A
Normal current drawn	0.5 A
Nominal	80 W

Environment

Temperature:

Storage	-40 to +70°C
Operating	+10 to +55°C

Humidity:

Storage	95% relative
Operating	85% relative

Note: *The unit must be kept in an operational environment with the room temperature and humidity within the specified limits, and in a corrosive, salt and dust-free atmosphere.*

Vibration:

Range	5-100 Hz
Excitation level	5-13.2 Hz ±1.5 mm, 13.2-100 Hz 1 g

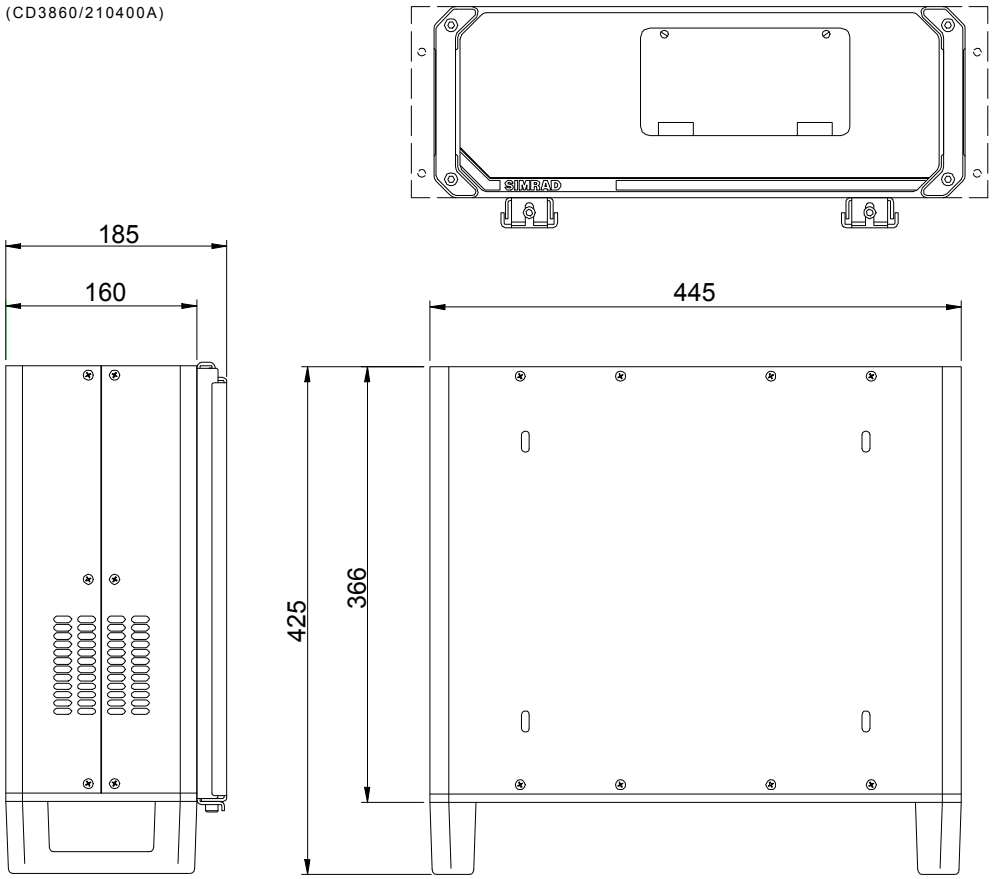


Figure 22 - APC 10 - outline dimensions

WinKeyboard

Dimensions:

Height max.	60 mm
Width	360 mm
Depth	212.5 mm
Weight	approx. 3 kg

A cable for connecting the keyboard into the APC 10 unit is provided.

Cable length	approx. 2 m

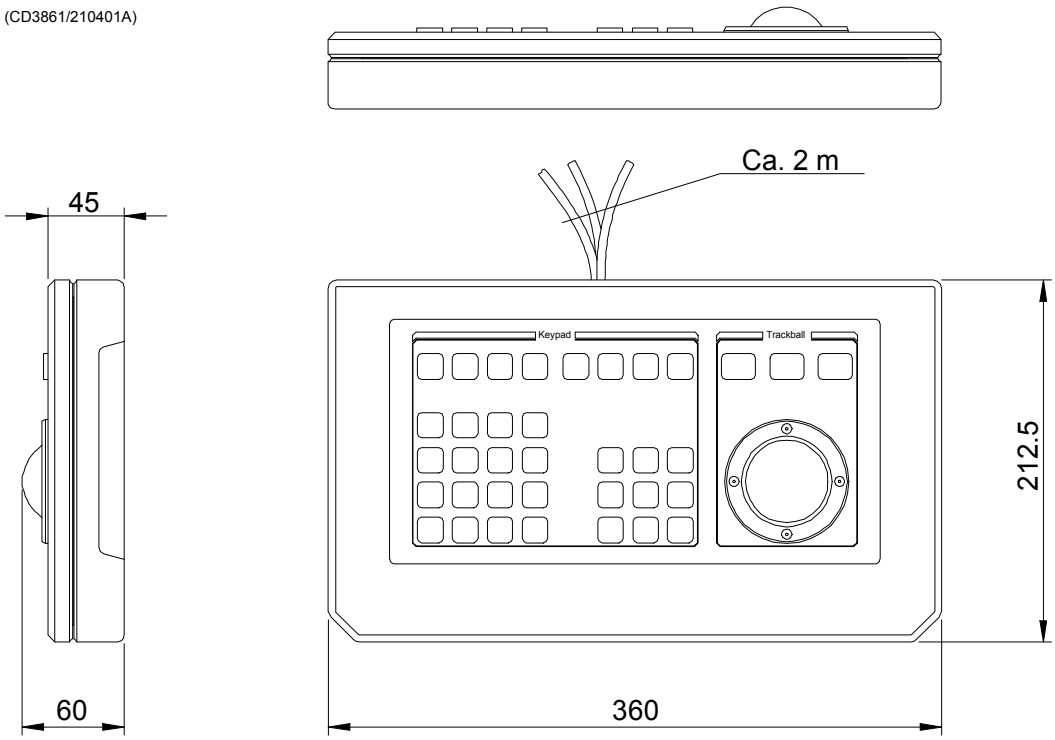


Figure 23 - WinKeyboard - outline dimensions

Circuit boards and power unit for the APC 10

This section provides a functional description of the circuit boards and power unit contained within the APC 10.

Note: *The APC 10 may be set up with various configurations of boards and units depending on the actual delivery. The "standard" boards and units are described here.*

The following circuit boards and units are described:

- Motherboard
- DFlex-2 Serial line adapter
- Ethernet PCB
- Power supply with internal cooling fan

→ *Refer to the figure on page 32.*

Note: *The actual boards and units used in the APC 10 may vary depending on availability.*

Motherboard SE440BX-2

For complete manual, refer to manufacturer;
fttp://download.intel.com/design/motherbd/se2/72163201.pdf

General

The motherboard is the main computer board in the APC 10 unit. It holds the microprocessor and supporting electronics, and controls all the input/output interfacing for the APC 10.

→ *The motherboard layout is shown in the figure on page 57.*

Facilities

LEDs

As indicated on the board front panel.

→ *Refer to the figure on page 57.*

Test points

None.

Links

The configuration jumper on the motherboard has three settings and three modes of operation as described in the table below. For placement of the configuration jumper.

→ *Refer to the figure on page 57.*

Configuration jumper		
Function	**Jumper J8A1**	**Description**
Normal (default)	1-2	BIOS uses current configuration and passwords for booting.
Configure	2-3	After POST runs, Setup runs automatically. The Maintenance menu is displayed. The menu displays options for setting the processor speed and clearing the passwords.
Recovery	None	The BIOS attempts to recover the BIOS configuration. A recovery diskette is required.

Table 1 Configuration jumper

Switches

Advanced Power Management (APM)

. . . . . Suspend/resume switch connected to the front panel sleep connector.

Advanced Configuration and Power Interface (ACPI)

. . . . . Support for a front panel power and sleep mode switch.

Front panel I/O connectors

The motherboard connectors and indicators located on the front panel are presented as follows:

→ *The placements of the connectors are illustrated in figure 24.*

→ *The pins layout are described in table 2.*

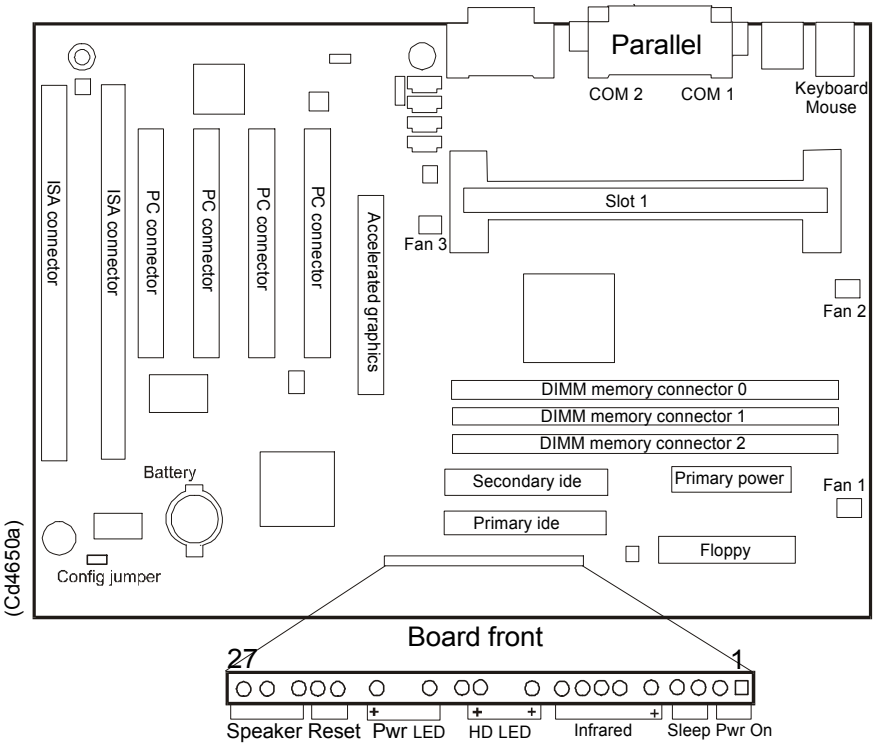


Figure 24 - Motherboard with front panel I/O connectors

Front panel I/O connectors					
Connector	**Pin**	**Signal name**	**Connector**	**Pin**	**Signal name**
Speaker	**27**	SPRK		**13**	HD_PWR +5 V (5 V, 15 mA max)
	26	SPRK	None	**12**	Key
	25	Key	Infrared (IfDA) (Infrared)	**11**	+5 V
	24	Ground		**10**	IR TX
Reset	**23**	FP_RESET#		**9**	Ground
	22	Ground		**8**	IR RX
None	**21**	Key		**7**	Key
Sleep/ power LED (Pwr LED)	**20**	PWR_LED1 (green)		**6**	+5 V
	19	Key	None	**5**	Key
	18	PWR_LED0 (yellow)	Sleep/ Resume (Sleep)	**4**	Ground
None	**21**	Key		**3**	SLEEP_REQ#
None	**17**	Key	Power On (Pwr On)	**2**	Ground
Hard Drive LED (HD LED)	**16**	HD_PWR (5 V, 15 mA max.)		**1**	SW_ON#
	15	HD Active #			
	14	Key			

Table 2 Front panel I/O connectors

Rear side I/O connectors

The motherboard connectors on the rear side are presented as follows:

→ *The placements of the connectors are illustrated in figure 25.*

→ *The use of each connector is stated in table 3.*

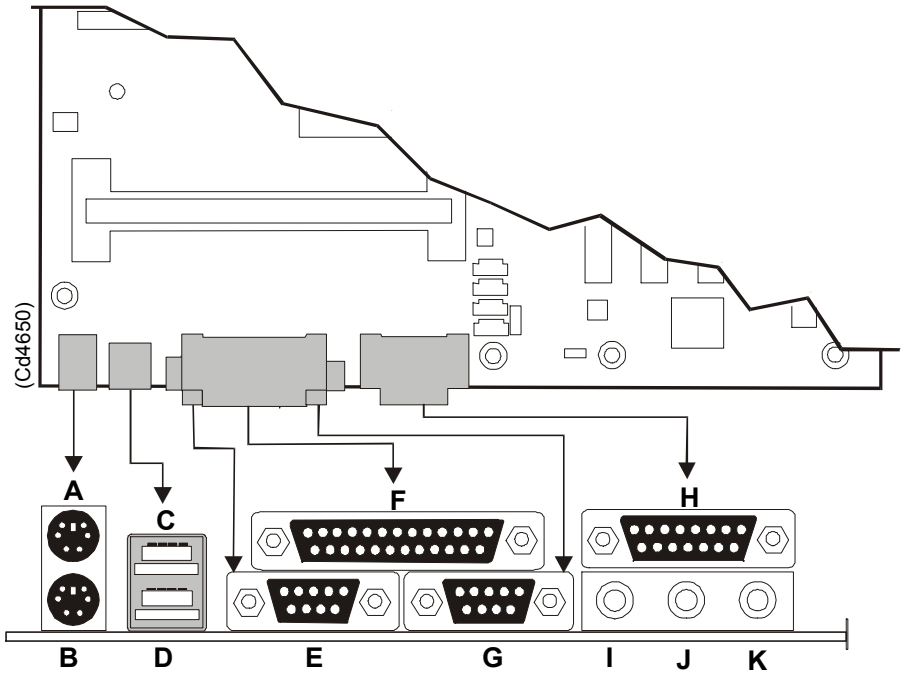


Figure 25 - Motherboard rear side I/O connectors

The rear side connectors are as follows:

A PS/2 keyboard or mouse	**G** Serial port B
B PS/2 keyboard or mouse	**H** Not used
C USB Port 1	**I** Not used
D USB Port 0	**J** Not used
E Serial Port A	**K** Not used
F Parallel Port	

Table 3 Rear side I/O connectors

Battery

General

When your computer is turned off, a lithium battery maintains the current time-of-day clock and the values in CMOS RAM current.

The battery should last about 7 years, but must be replaced when required (for example when the date and time is no longer accurate).

Changing the battery

To replace the battery proceed as follows:

1 Turn off all peripheral devices connected to the computer.

2 Remove the computer cover.

3 Locate the battery on the motherboard (see figure 26).

4 Use a medium flat-bladed screwdriver, and gently pry the battery free from its socket.
Note the orientation of the + and - on the battery.

5 Install the new battery correctly.

6 Replace the computer cover.

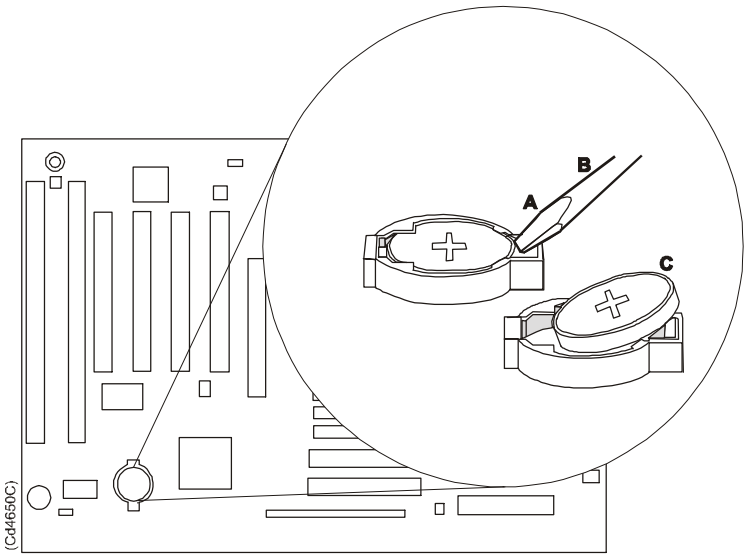


Figure 26 - Replacing the battery

→ *How to set the processor speed refer to page 60.*

→ *How to clear the password refer to page 61.*

How to set the processor speed

Set the processor speed after you have installed or upgraded the processor. The procedure assumes that the motherboard is installed and the configuration jumper block is set to **Normal mode**.

- How to open the computer:

→ *Refer to page 38.*

- Placing the jumpers:

→ *Refer to table on page 56.*

1 Locate the configuration jumpers block.

→ *Refer to figure on page 57.*

2 Place the jumper on pins 2-3.

3 Replace the computer cover.

4 Turn on the computer, and allow it to boot.
- The computer starts the Setup program.
- Setup displays the Maintenance menu.

5 Select **Processor Speed** and press **Enter**.
- The Setup displays a pop-up window with the available processor speeds. confirm clearing the password.

6 Select the required processor speed and press **Enter**.
(For example, select 266 for
a 266 MHz Pentium II Processor).
- The Maintenance menu reappears.

7 Press **F10** to save the current values and exit the Setup.

8 Turn off the computer.

9 Remove the computer cover.

10 Restore to normal operation, by placing the jumpers on pin 1-2.

11 Replace the computer cover.

12 Turn on the computer.

13 Verify the processor speed during POST.

How to clear the passwords

The procedure assumes that the motherboard is installed and the configuration jumper block is set to **Normal mode**.

1 Locate the configuration jumpers block

→ *Refer to figure on page 57.*

2 Place the jumper on pins 2-3.

3 Replace the computer cover.

4 Turn on the computer, and allow it to boot.
- The computer starts the Setup program.

5 Select **Clear Password** and press **Enter**.

- The Setup displays a pop-up window where you must confirm clearing the password.

6 Select **Yes** and press **Enter**.

- The Maintenance menu reappears.

7 Press **F10** to save the current value and exit the Setup.

8 Turn off the computer.

9 Remove the computer cover.

10 Restore to normal operation, by placing the jumpers on pin 1-2.

11 Replace the computer cover.

12 Turn on the computer.

DFlex-2 serial adapter

DFlex manufacturer; http://www.connecttech.com

Introduction

The DFlex-2 serial adapter is a 2-port asynchronous communications adapter board supplied by Connect Tech Inc. of Canada. It uses 16450 or 16550 UARTS, and incorporates electrical interface modules to provide flexible line interfaces. It holds one SIMM module mounted on brackets on the component side of the board.

The SIMM module enables you to select RS-232, RS-422 or 20 mA current loop interface to the board (only one can be selected).

Two cards can be used in the computer to increase the number of outputs available.

In the event of a fault occurring in the board or in the SIMM module, the faulty unit must be replaced.

DFlex Installation for Windows NT

The DFlex board uses a specific driver on Windows NT. This driver makes it possible to use a single interrupt from each board. The following items must be carried out when the board is installed.

- Set board DIP switches and links (see table 4 and 5)
- Reserve interrupt used by board in the BIOS
- Install the driver
- Test the board

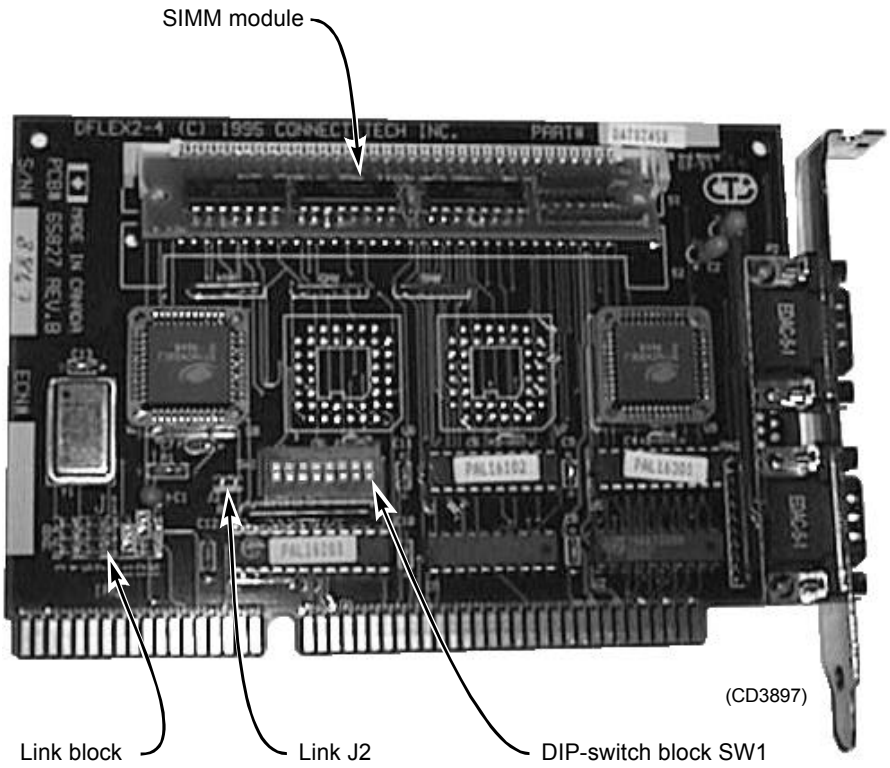


Figure 27 - DFlex-2 serial adapter board with its SIMM module

Switch settings

The DFlex-2 board holds one DIP switch block, SW1. This must be set as shown in the tables below to enable the required COM ports. See also the associated link settings.

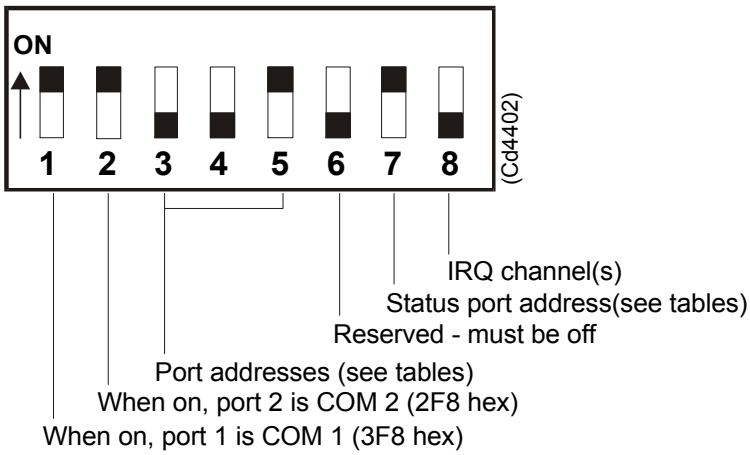


Figure 28 - DIP switch block SW1

DFlex-2 DIP switch SW1 as COM3 and COM4 on WinNT		
Switch	Position	Effect
1	Off	COM1 Off
2	Off	COM2 Off
3	On	COM3 address 280h COM4 address 288h
4	Off	
5	On	
6	Off	Reserved, must be Off
7	On	Status port address 2C0h
8	On	Interrupt on A channel

Table 4 DIP switch for standard selection of COM3 and COM4 using WinNT software

DFlex-2 DIP switch SW1 as COM5 and COM6 on WinNT		
Switch	Position	Effect
1	Off	COM1 Off
2	Off	COM2 Off
3	Off	COM5 address 290h COM6 address 298h
4	Off	
5	On	
6	Off	Reserved, must be Off
7	On	Status port address 2D0h
8	On	Interrupt on A channel

Table 5 DIP switch for standard selection of COM5 and COM6 using WinNT software

Switch			**Port Address**		
3	4	5	1	2	Status
On	On	On	200	208	240
On	On	Off	240	248	280
On	Off	On	280	288	2C0
On	Off	Off	2C0	2C8	300
Off	On	On	1B0	1B8	188
Off	On	Off	2B0	2B8	288
Off	Off	On	290	298	2D0
Off	Off	Off	190	198	1D0

Table 6 Address switch combination

Link settings

The DFlex-2 board holds:

→ *Refer to the figure on page 64.*

- One block of eight links.
  - Each link on the block can be open, or set to either position A or position B.
- One individual link (J2).
  - Link J2 must be open.

The figure below shows an example where J1 selected for IRQ 3 and 4 on channel B and A respectively.

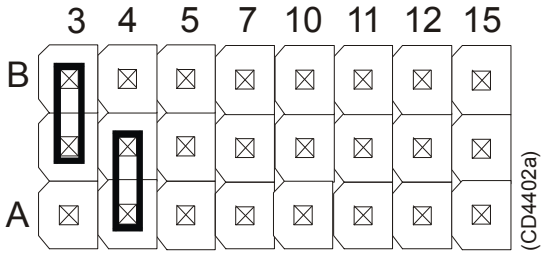


Figure 29 - Link block

When the DFlex board is used on Windows NT with a special driver, a single link in position A is used.

The link numbers correspond to IRQ no. Before selecting an IRQ, make sure that this IRQ is NOT used by any other hardware on the computer. Use programs/Administrative tools/Windows NT diagnostics to verify this. When the IRQ no has been selected, restart the computer, enter the BIOS setup and set this IRQ no to Reserved by ISA card.

Typically IRQ 12,11,10 and 5 is free. However, some of these may be in use by one or two network cards. The PS-2 mouse normally uses IRQ 12.

After the board has been installed, (only when it is installed for the first time) run the DFlex installation program:
\WINHPR\DFlex\disk1\SETUP.EXE

1 First install the driver.

2 When the DConf dialogue is displayed, press the Add new board button and set the addresses and IRQ no correct.

3 Press the OK/Exit button.

Connectors

The DFlex-2 card incorporates two edge connectors to connect it into the motherboard, and two 9-pin male D connectors for the serial lines.

→ *Refer to figure on page 64.*

In the figure, the upper D connector is port 1 while the lower connector is port 2.

Serial lines 3 and 4 are normally the two lines on the DFlex board, and can be RS-232, RS-422 or 20 mA current loop depending on the optional SIMM module mounted on the DFlex board.

Serial lines (Com) RS-232

The two or four serial lines are connected to 9-pin Delta connectors. The pins are allocated as follows:

1 Carrier detect

2 Receive data

3 Transmit data

4 Data terminal ready

5 Ground

6 Data set ready

7 Ready to send

8 Clear to send

9 Ring indicator

Serial lines (Com) RS-422

The two or four serial lines are connected to 9-pin Delta connectors. The pins are allocated as follows:

1 Reception data +

2 Transmission data +

3 Transmission data -

4 Reception data -

5 Ground

Serial lines (Com) Current loop

The two or four serial lines are connected to 9-pin Delta connectors. The pins are allocated as follows:

1	Reception data -
2	Transmission data +
3	Transmission source
4	Transmission return
5	Ground
6	Reception return
7	Transmission data -
8	Reception data +
9	Reception source

3Com 3C905-TX Ethernet board

Introduction

The 3Com 3C905-TX is a commercially available Ethernet card. A unit fitted with one of these boards will be able to communicate via Ethernet with other similarly equipped units in a system.

Note: *For the board to function correctly, the board's Input Address must be set up correctly.*

The Ethernet board is a "Repair-by-replacement" item. If the board develops a fault, the entire board must be replaced.

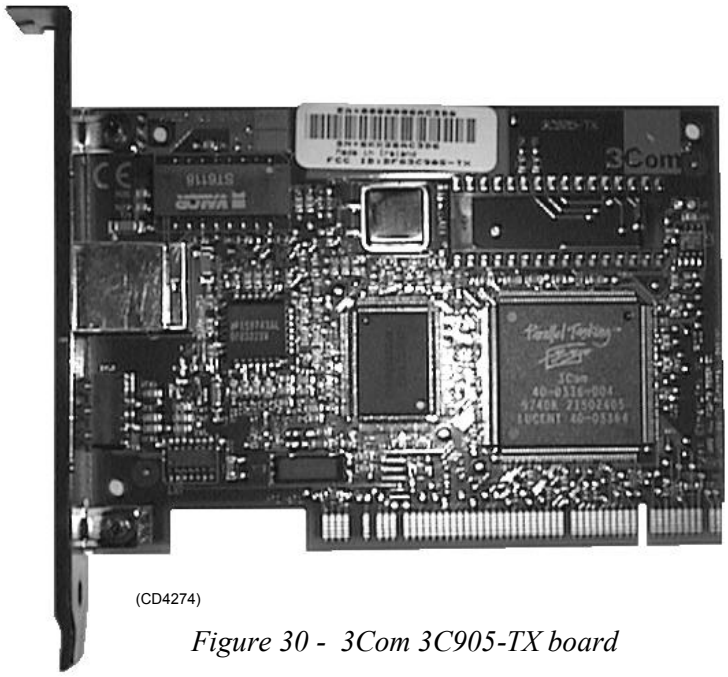


Figure 30 - 3Com 3C905-TX board

Links and switches

The 3Com 3C905-TX board holds no links or switches.

LEDs

The 3Com 3C905-TX board holds three LEDs. After installation, and before you install the network driver, the LEDs indicate the following:

Yellow (ACT)	OFF - until the network driver is installed
Green (10 LNK)	10 Mbps link integrity
Green (100 LNK	100 Mbps link integrity

Connectors

The board has two edge connectors to connect it into the motherboard, and one standard RJ45 socket for external ethernet connection.

ATX series power supply

Introduction

The **ATX200-3505-226** AC power supply enables the computer to be powered from a 115/230 Vac mains supply.

The ATX200 is a commercially available power supply, and is purchased complete from an external supplier.

The unit requires a supply of 230 Vac or 115 Vac (change-over is performed by a selector switch on the rear of the unit), and provides a range of outputs to power hard discs, floppy discs, CD ROMs and computer motherboards.

This power supply is a sealed unit. In the event of malfunction, replace the unit.

Technical details

Dimensions:

Height	146 mm
Width(including fan)	120 mm
Depth	170 mm
Weight	1.32 kg

Connectors:	P1, P2, P3, P4, P5, P6
Power requirements:	90-135 Vac / 180-265 Vac 47 - 63 Hz, 4 A at 115 Vac / 2 A at 230 Vac
Operating temperature	-10°C to +40°C
Storage temperature	-40°C to +70°C
Power outputs	+3.3 V, 0.3 - 14.0 A +5 V, 1.0 - 22.0 A+12 V, 0.05 - 6.0 A-12 V, 0.0 - 0.8 A-5 V, 0.0 - 0.5 A+5 VSB, 0.0 - 10 mA

Connectors

A wire loom holding six connector plugs is attached to the power supply.

- P1 carries the power supplies to the motherboard.
- P2, P3, P4 and P5 carry power supplies to the harddisc and CD ROM drives.
- P6 carries power supplies to the 3.5” floppy disc drive.

All the connectors are marked appropriately.

The connector pins in the plugs carry the supplies as follows:

Connector	Pin	Output	Mating connector
P1	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20	+3.3 V +3.3 V Common +5 V Common +5 V Common POK +5 VSB +12 V +3.3 V and +3.3 V sense -12 V Common PS ON Common Common Common -5 V +5 V +5 V	Molex 39-28-1203 or equivalent.
P2, P3, P4, P5	1 2 3 4	+12 V Common Common +5 V	Amp 1480426-0 or equivalent.
P6	1 2 3 4	+5 V Common Common +12 V	Amp 171825-4 Vertical MT or equivalent. Amp 171826 -4 Horizontal MT or equivalent

Spare parts

Introduction

This section lists the parts and modules defined by Kongsberg Simrad as *Line Replaceable Units (LRUs)*. The required mounting components (such as nuts, bolts, washers etc.) are identified on the diagrams, but have not been allocated order numbers as we regard these items as standard commercial parts available from retail outlets around the world.

Codes used

The following codes are used in the parts lists:

Part no. - Kongsberg Simrad's part number.

Item name -The name of the item.

Technical data - Technical specifications and any other relevant information.

Drw. ref. - Reference number of the production or illustration drawing where the item is included. If a number is given here, the drawing will be included in the manual's/document's drawing file.

Drw. pos. - The item's position number on the drawing referenced above.

No. in sys. - The quantity of the item used in the system. *Note that this information is not provided for standard components such as nuts, bolts and washers.*

Rec. spares - The quantity of the item recommended to be carried as spares onboard the vessel. *Note that this information is not provided for standard components such as nuts, bolts and washers.*

Supplier - The actual supplier or manufacturer of the item if different from Kongsberg Simrad. A blank field indicates items manufactured, altered or adjusted by Kongsberg Simrad.
GA = standard items generally available from many retail outlets.

Supp. code- The actual supplier or manufacturer part number if different from Kongsberg Simrad's.

List of spare parts

Part no.	Item name	Drw. ref.	No. in sys.	Supplier
	Technical data	**Drw. pos.**	**Rec.spares**	**Supp. code**
125-103300	Acoustic Positioning Computer		1	
	Complete			
719-087589	Power supply unit		1	
	SPI-235 HI			
211001	Processor motherboard		1	
	Intel AL 440 LX			
719-087381	Harddisk		1	
	Quantum Fireball 1.6 GB			
719-087382	Floppy drive		1	
	Mitsumi 3.5”			
719-087383	CD ROM drive		1	
	24X Mitsumi FX140			
719-077475	Ethernet PCB		1	
	3COM 3C905-TX			
719-086038	MLT-Port serial adapter PCB		1	
	DFlex-2			
719-086039	SIMM line interface module		1	
	RS-485/422			
719-086842	SIMM line interface module		1	
	RS-232			
719-086040	SIMM line interface module		1	
	20 mA current loop			
719-087591	VGA display PCB		1	
	100-411012-00			
210362	Keyboard complete		1	
47734108	Trackerball unit		1	
	Robertson P200, C-CPEC-659-0051			
25005323	Large circuit board (for keyboard)		1	
	Robertson			
25005364	Small circuit board (for keyboard)		1	
	Robertson			
311-087501	Beeper unit			
	DSH303LE Ø27			
210398	Keyboard cable			
	2 m.			
298-087488	Keyboard panel			

4 HPR 400 TRANSCEIVER UNIT

Design

The Transceiver Unit is constructed of aluminium panels and extruded strip. One of several different cover panel designs may be used depending on the type of installation (console, desk-top, rack, or portable). The dismantling procedures described in this manual refer to the unit as used in the console or 19" rack.

The majority of the circuit boards contained in the unit are standard single-Europa cards, accessible by opening the front of the unit. The cards are plug-in units, held in position by plastic clips.

3 mm Ø holes are drilled in the upper and lower front corners of each board. These are to attach the wire handle used to extract the board from the unit.

Maintenance actions

The corrective maintenance on the Transceiver Unit is limited to operational checks and circuit board replacements. An extension board will be required if the maintenance engineer wishes to perform measurements on the boards during system operation. This is delivered with the standard spare parts kit for the Transceiver Unit.

External connections

All external connections to the Transceiver Unit are made via plugs located on the rear of the unit. Refer to chapter NO TAG for further information.

Power supply

The Transceiver Unit can be powered from either a 115 Vac or 230 Vac supply. Links must be set inside the unit to adapt the unit to the voltage supply. A mains power switch is located on the front panel, together with a *Power on* indicator lamp.

1 Switching between 115Vac and 230 Vac is performed using straps inside the unit.

Theory of operation

Introduction

The HPR 400 Transceiver Unit is the central part of the HPR system. It contains the following:

- Electronic circuitry for transmission of acoustic pulses
- Amplifiers and filters for reception of acoustic signals
- Interfaces to external sensors
- Serial line for communication with the Beam Control Unit (for tracking systems)
- Serial line for communication with the System Controller (an Ethernet link will be available shortly).

The Transceiver Unit's main navigation function is to interrogate transponders and measure the range and bearing to them. The main telemetry function is to transmit and receive acoustic signals.

Navigation

The operator selects the active mode of operation. The system can then switch automatically between the selected mode and the other available mode(s). This means that the system can make use of several different types of transponder in the same operation.

SSBL

In this mode, both direction and range to the transponder(s) are computed.

When a transponder is switched on by the operator, the transceiver will start interrogation using frequencies corresponding to the applicable transponder channel. This is achieved by controlling the transmitter and receiver (preamplifier) boards. The Central Processing Unit (CPUEX) circuit board measures the time elapsed from the interrogation (transmission) till the pulse is detected by the Digital Signal Processor (DSPM) board.

The three "R", "X" and "Y" signals received from the HPR transducer will first enter the Input A or Input B preamplifier circuit boards where they are amplified and filtered. The signals are then sampled and converted to binary format by the Analogue/Digital Converter (ADCM) circuit board. The DSPM 50 reads the data on the ADCM output, detects the signals, and calculates the phase differences between the "R" and "X" input channels and the "R" and "Y" input channels.

The DSPM 50 transfers the received data to the CPUEX circuit board, which then calculates the “X”, “Y” and “R” coordinates to the transponder. In this calculation, the data from the external vertical reference unit and compass is used to compensate for the roll and pitch of the vessel. The sensor data is received and converted by the Input Output (IOM) circuit board. When the positioning calculations has been terminated, the current position is sent to the System Controller, and a new interrogation sequence can begin.

LBL positioning

In this mode, only the ranges to the transponders are computed, and several ranges are then used to triangulate the position.

The functional operation is basically the same as for SSBL. However, in the LBL mode the transceiver will await replies from all the transponders in the transponder array before it starts on a new interrogation sequence. The system uses the R channel to detect the range.

SSBL and LBL

In this mode, both range and direction to the transponder(s) are computed.

This mode is a combination of the SSBL and LBL modes described above, and the functional operation is basically identical to the SSBL. However, the transceiver will await replies from all the transponders in the array before starting a new interrogation sequence.

SBL positioning

The Short Base Line (SBL) system on Technical training guide is based on four 120° transducers onboard the vessel and one 180° transponder. The positions of the four transducers relative to the centre of the array must be known before positioning can commence.

The same algorithms as for LBL positioning are used to calculate the position of the transponder relative to the centre of the transducer array. Up to eight transponders can be positioned simultaniously when the SBL method is used.

A common interrogation signal is transmitted to all of the transponders, and each of them will reply with a specific reply signal. The reply signal will be received by all four of the transducers, and the position of each of the transponders can then be calculated.

Telemetry

The operator may select this mode when he/she wishes to send and receive telemetry messages, for example to read the battery status of a transponder. When the transceiver reads the telemetry message from the System Controller, it will convert the message into acoustic signals. This acoustic message contains bursts and pulses with different frequencies and fixed intervals. The transceiver transmits the message(s), and will await the telemetry reply.

The signal path is identical as for navigation mode. The DSPM 50 will calculate the frequency of the current reception, and report this to the CPUEX. The CPUEX will assemble the frequency data, and decode the message from acoustic pulses into digital values. The data is then passed on to the System Controller.

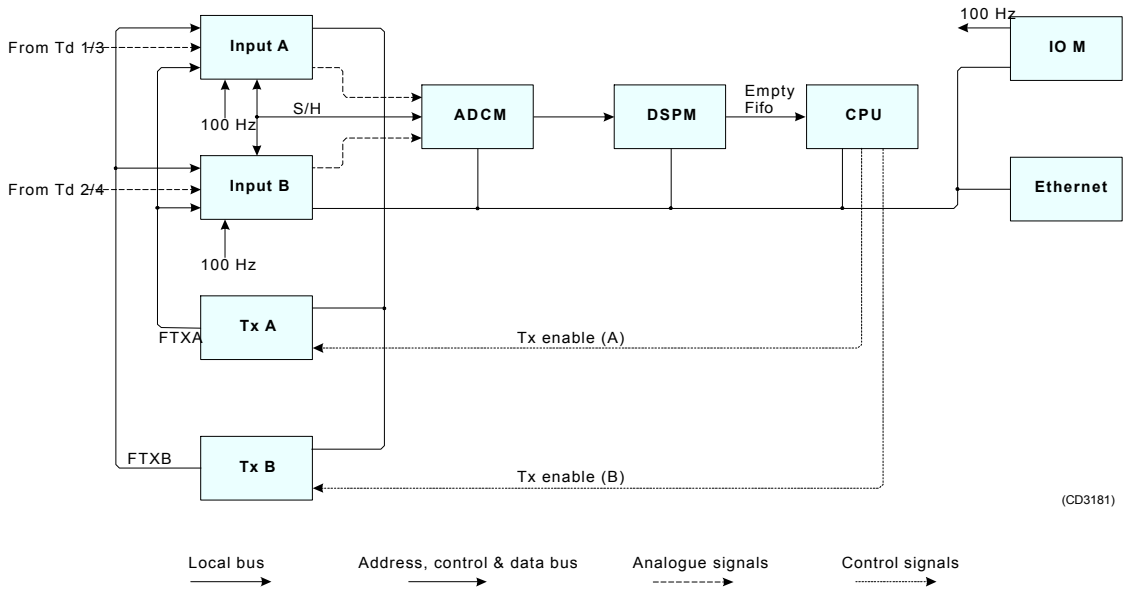


Figure 31 - HPR 400 Transceiver unit - functional block diagram

Circuit board identification and main functions

- **Central Processing Unit (CPUEX)**
  - Position calculation
  - Loads and controls the DSPM 50 program
  - Serial line to CDU
  - Controls Tx/Rx hardware

- **Digital Signal Processor (DSPM 50)**
  - Reads data from ADCM
  - Performs pulse detection
  - Performs digital filtering (Fast Fourier Transformations)
- **Analog Digital Converter (ADCM)**
  - Samples the data from INPUTM
  - Converts to binary format
- **Input (INPUTM)**
  - 8-channel receiver
  - 8-channel receiver (four channels used for Njord)
  - 8-channel receiver (four channels used for Visund)
  - Amplifies
  - Bandpass filtering
  - Sample/hold circuitry
- **Transmitter (TXM)**
  - Transmitter
  - Frequency generator for Rx and Tx frequency
- **Input & Output (IOM)**
  - Interface to vertical reference unit (analogue)
  - Interface to gyro (synchro and serial line)
  - TVG initialization
  - Clock for phase locked loop on INPUTM
- **Ethernet (ENET-M)**
- **Ethernet (ENET-M) (Not used in Njord)**
- **Ethernet (ENET-M) (Not used in Visund)**
  - Ethernet interface
- **Motherboard**
  - Connects all the individual circuit boards together

Connections

HPR 400 Transceiver Unit connectors

All connections to and from the HPR 400 Transceiver Unit are made on the connection panel on the rear of the unit. All connectors are male except where stated female.

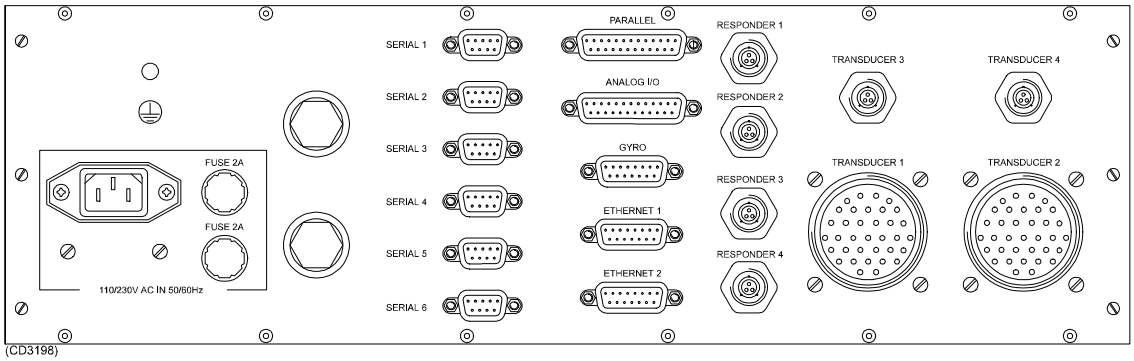


Figure 32 - Connectors on the HPR Transceiver Unit's rear panel

The transceiver unit holds the following connectors and fuses (top to bottom, left to right when looking at the rear panel):

1 Standard 3-pin, 230 Vac, 50/60 Hz mains power in.

2 Fuse, 230 Vac, 2 A.

3 Fuse, 230 Vac, 2 A.

4 9-pin D-connector for Serial line 1.

- This connector is used to communicate with the APC 10 computer.
- This connector is used to communicate with the computer on a RS422 serial line with optical isolation. Use either this or Serial line 5.

5 9-pin D-connector for Serial line 2.

- This connector is not used with the HPR 400 P.
- This connector is used when the HPR system is equipped with a HL 3880 TR Tracking Hull Unit. This serial line is then used to control the movements of transducer 1.

6 9-pin D-connector for Serial line 3.

- This connector is used to connect a serial line gyro, or any of the following Vertical Reference Unit types: SKR, STL or MRU5.

- This connector is used either when the HPR system is equipped with a HL 3880 TR Tracking Hull Unit; this serial line is then used to control the movements of transducer 2.
  On other HPR systems, this connector is used to connect a serial line gyro, or any of the following Vertical Reference Unit types: SKR, STL or MRU5.

7 9-pin (Seatex) D-connector for Serial line 4.

8 9-pin D-connector for Serial line 5.

- This connector is not used with the HPR 400 P.
- This connector is used to communicate with the APC 10 C computer on a standard RS422 serial line. Use either this or Serial line 1.

9 9-pin D-connector for Serial line 6.

- This connector is not used with the HPR 400 P.
- This connector is not used with the HPR 400. It is dedicated for software debugging purposes.

10 25-pin D-connector for Parallel input.

- This connector is not used with the HPR 400 P.
- This connector is not used with the HPR 400.

11 25-pin D-connector for Analogue input/output.

- This connector is used to connect an analogue Vertical Reference Unit. Any of the following types of VRU may be used:

12 15-pin D-connector for Gyro input.

13 15-pin D-connector for Ethernet 1.

- This connector is not used with the HPR 400P.

14 15-pin D connector for Ethernet 2.

- This connector is not used with the HPR 400P.

15 3-pin Amphenol connector for Responder 1.

16 3-pin Amphenol connector for Responder 2.

17 3-pin Amphenol connector for Responder 3.

18 3-pin Amphenol connector for Responder 4.

- The responder connectors are used with HMT responders.

19 3-pin Amphenol connector for Transducer 3.

20 3-pin Amphenol connector for Transducer 4.

21 35-pin Amphenol connector for Transducer 1.

22 35-pin Amphenol connector for Transducer 2.

- These transducer connectors are used with PMT-301, SSBL MF medium, SSBL MF narrow and SSBL LF medium transducers.

Note: *The two white plastic caps are the securing nuts for two capacitors located on the inside of the Transceiver Unit rear panel.*

All connectors are marked with labels as indicated on the previous drawing.

Internal layout

The Transceiver Unit holds the following circuit boards and power units:

From left to right:

- Input M - A/B.
- Input M - A/B (Njord uses A only).
- Input M - A/B (Visund uses A only).
- A/D Converter (ADCM).
- Digital Signal Processor (DSPM).
- Control Processing Unit (CPUM).
- Ethernet.
- Ethernet (Not used in Njord).
- Ethernet (Not used in Visund).
- Spare.
- Spare (Not used in Visund).
- Spare (Not used in Njord).
- Input/Output (IOM).
- Responder (RPC) (Option)
- Responder (Not used in Njord).
- Responder (Not used in Visund).
- Transmitter (TXM - A/B).
- DC Power supply (DC - PWR).
- AC Power supply (AC - PWR).

The backplane is located behind the circuit boards, and is accessible through the rear of the Transceiver Unit. All the circuit boards and power units must be removed through the front of the unit before the backplane can be removed. All connections to the backplane are made using plugs.

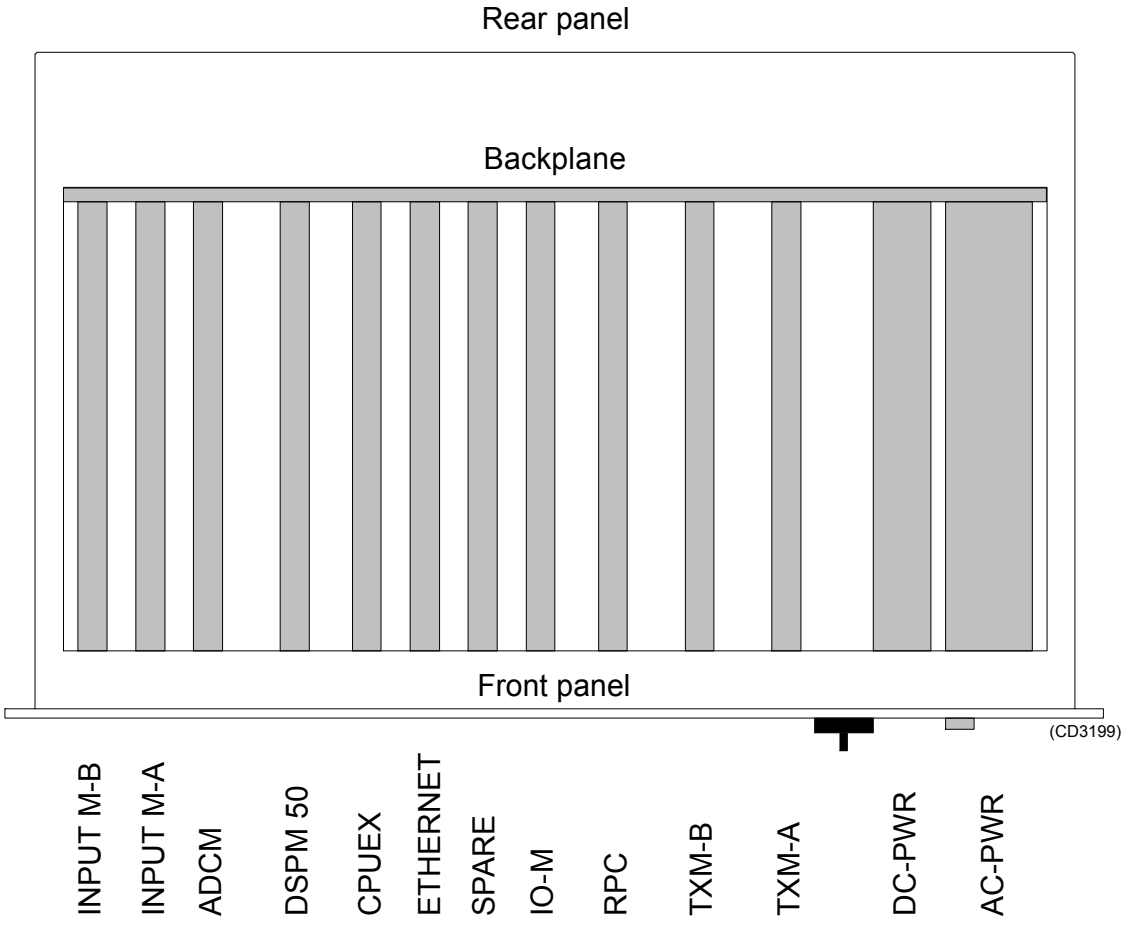


Figure 33 - HPR 400 Transceiver Unit - internal layout

Circuit boards description

General

This section provides a full functional description of each of the circuit boards contained within the HPR 400 Transceiver Unit.

Backplane

Board description

The backplane is located in the back of the Transceiver Unit. It is the interconnection circuit board, carrying connectors and wiring tracks to interconnect the other circuit boards in the Transceiver Unit. All the other circuit boards plug into the backplane.

Main components

The board holds the following three ICs:

- U01 . . 74HC240 Buffer, inverted on outputs
- U02 . . PAL 20V8 Address decoder. (For TX-PCBs only)
- U03 . . . 74HC123F Retriggerable monostable multivibrator

Socket mounted components

The board holds only one socket-mounted component:

- U02PAL 20V8 Address decoder. (For TX-PCBs only)

Connections

There are 37 connectors on the circuit board, mounted on both sides. Connectors J1 to J12 are 96-pin Europa connectors for the single Euro-card circuit boards in the unit. For the pin configurations, refer to the following drawing:

HPR 400 Backplane 824-108544 (SH-067)

J1 . . . . . Input-B
J2 . . . . . Input-A
J3 . . . . . ADCM
J4 . . . . . DSPM
J5 . . . . . CPUm
J6 . . . . . Ethernet
J7 . . . . . Spare
J8 . . . . . IO-M
J9 . . . . . RPC
J10 . . . . . TXM-B
J11 . . . . . TXM-A
J12 . . . . . POWERM
P14 . . . . . 8-pin Phoenix plug, male

P15 ..... 50-pin 3M, male, flat ribbon cable connector
P16 ..... 18-pin Molex, male
P17 ..... 8-pin Phoenix plug, male
P18 ..... 2-pin Phoenix plug, male
P19 ..... 2-pin Phoenix plug, male
P20 ..... 2-pin Phoenix plug, male
P21 ..... 34-pin 3M, male, flat ribbon cable connector
P22 ..... 50-pin 3M, male, flat ribbon cable connector
P23 ..... 50-pin 3M, male, flat ribbon cable connector
P24 ..... 2-pin Phoenix plug, male
P25 ..... 2-pin Phoenix plug, male
P26 ..... 9-pin Molex, male
P27 ..... 3-pin Molex, male
P28 ..... 9-pin Molex, male
P29 ..... 3-pin Molex, male
P30 ..... 6-pin Molex, male
P31 ..... 9-pin Molex, male
P32 ..... 3-pin Molex, male
P33 ..... 9-pin Molex, male
P34 ..... 3-pin Molex, male
P35 ..... 6-pin Molex, male
P36 ..... 3-pin Molex, male
P37 ..... 3-pin Molex, male
P38 ..... 3-pin Molex, male

Pin assignments

P14 pin assignments		
Pin	**Signal**	**Description**
1	TD 2, Tx+	Transducer 2, transmission +
2	TD 2, Tx-	Transducer 2, transmission –
3	TD 4, Tx+	Transducer 4, transmission +
4	TD 4, Tx-	Transducer 4, transmission +
5	+15 Vdc	
6	-15 Vdc	
7	AGND	Analogue ground
8	DGND	Digital ground

P15 pin assignments			
Pin	**Signal**	**Description**	**Ext.**
1	RS422_Rx1	RS422+ serial line. To CPU ..... Input	1
2	RS422_Tx1-	RS422- serial line. From CPU ..... Output	6
3	RS232_Rx	RS232 serial line. To CPU ..... Input	2
4			7
5	RS232_Tx	RS232 serial line. From CPU ..... Output	3
6			8
7	RS422_Rx1-	RS422- serial line. To CPU ..... Input	4
8	RS422_Tx1	RS422+ serial line. From CPU ..... Output	9
9	GND1	Galvanically isolated ground	5
10	RS422_Rx2	RS422+ serial line 2 ..... Input	1
11	RS422_Tx2-	RS422- serial line 2 ..... Output	6
12			2
13			7
14			3
15			8
16	RS422_Rx2-	RS422- serial line 2 ..... Input	4
17	RS422_Tx2	RS422+ serial line 2 ..... Output	9
18	GND	Ground	5
19	RS422_Rx3	RS422+ serial line 3 ..... Input	1
20	RS422_Tx3-	RS422- serial line 3 ..... Output	6
21			2
22			7
23			3
24			8
25	RS422_Rx3-	RS422- serial line 3 ..... Input	4
26	RS422_Tx3	RS422+ serial line 3 ..... Output	9
27	GND	Ground	5
28	SY1_in	External sync1+ ..... Input	1
29	SY1_out-	External sync1- ..... Output	6
30	SY2_out-	External sync2- ..... Output	2
31	SY2_in	External sync2+ ..... Input	7
32	SY2_out	External sync2+ ..... Output	3
33	SY2_in-	External sync2- ..... Input	8
34	SY1_in-	External sync1- ..... Input	4
35	SY1_out	External sync1+ ..... Output	9
36	GND	Ground	5

P15 pin assignments			
Pin	**Signal**	**Description**	**Ext.**
37	ANA_1	Analogue 1 ..... Input	14
38	AGND	Analogue ground	2
39	ANA_2	Analogue 2 ..... Input	15
40	AGND	Analogue ground	3
41			16
42			4
43			17
44			5
45	S1	Synchro gyro S1 ..... Input	1
46	R.Hi	Reference high R.Hi ..... Input	9
47	S2	Synchro gyro S2 ..... Input	2
48	R.L	Reference low R.L ..... Input	10
49	S3	Synchro gyro S3 ..... Input	3
50			11

Abbreviations: SY = Synch, ANA = Analogue

P16 pin assignment	
Pin	**Description**
1	+24 volt, responder 1
2	Trigger, responder 1
3	Digital ground
4	Analogue ground
5	+24 volt, responder 2
6	Trigger, responder 2
7	Digital ground
8	Analogue ground
9	+24 volt, responder 3
10	Trigger, responder 3
11	Digital ground
12	Analogue ground
13	+24 volt, responder 4
14	Trigger, responder 4
15	Digital ground
16	Analogue ground
17	-
18	-

P17 pin assignment		
Pin	**Signal**	**Description**
1	TD 1, Tx+	Transducer 1, transmission +
2	TD 1, Tx-	Transducer 1, transmission –
3	TD 3, Tx+	Transducer 3, transmission +
4	TD 3, Tx-	Transducer 3, transmission +
5	+15 Vdc	
6	-15 Vdc	
7	AGND	Analogue ground
8	DGND	Digital ground

P18 pin assignment		
Pin	**Signal**	**Description**
1	TxA CAP + ...	Capacitor A ..... +48 Vdc
2	TxA CAP -	Capacitor A ..... 0 V

P19 pin assignment		
Pin	**Signal**	**Description**
1	TxB CAP + ...	Capacitor B ..... +48 Vdc
2	TxB CAP -	Capacitor B ..... 0 V

P20 pin assignment	
Pin	**Description**
1	+48 Vdc from AC power supply
2	Analogue ground

P21 pin assignments			
Pin	**Signal**	**Description**	**Ext.**
1	RXAI	RS422+ serial line A ..... Input	1
2	TXA/	RS422- serial line A ..... Output	6
3	RXA	RS232 serial line A ..... Input	2
4	RXCB	RX clock TTL ..... Input	7
5	TXA	RS232 serial line A ..... Output	3
6	CTSA/	Clear to send A TTL ..... Input	8
7	RXA/	RS422- serial line A ..... Input	4
8	TXA0	RS422+ serial line A ..... Output	9
9	GND	Ground reference A	5
10	RXBI	RS422+ serial line B ..... Input	1
11	TXB/	RS422- serial line B ..... Output	6
12	RXB	RS232 serial line B ..... Input	2
13	TXCB	RX clock TTL ..... Input	7
14	TXB	RS232 serial line B ..... Output	3
15	CTSB/	Clear to send B TTL ..... Input	8
16	RXB/	RS422- serial line B ..... Input	4
17	TXB0	RS422+ serial line B ..... Output	9
18	GND	Ground reference B	5
19	IO1	Digital input/output ..... Input/Output	1
20	IO2	Digital input/output ..... Input/Output	2
21	IO3	Digital input/output ..... Input/Output	3
22	IO4	Digital input/output ..... Input/Output	4
23	IO5	Digital input/output ..... Input/Output	5
24	IO6	Digital input/output ..... Input/Output	6
25	IO7	Digital input/output ..... Input/Output	7
26	IO8	Digital input/output ..... Input/Output	8
27	RXCB	RX clock TTL ..... Input	9
28	TXCB	TX clock TTL ..... Input	10
29	CTSB/	Clear to send B TTL ..... Input	11
30	CTSA/	Clear to send A TTL ..... Input	12
31	GND	Power ground	13
32	GND	Power ground	14
33	+5 Vdc	+5 Vdc power supply ..... Output	15
34	+5 Vdc	+5 Vdc power supply ..... Output	16

P22 pin assignments			
Pin	**Signal**	**Description**	**Ext.**
1	RS422_Rx1	RS422+ serial line. To CPU ..... Input	1
2	RS422_Tx1-	RS422- serial line. From CPU ..... Output	6
3	RS232_Rx	RS232 serial line. To CPU ..... Input	2
4			7
5	RS232_Tx	RS232 serial line. From CPU ..... Output	3
6			8
7	RS422_Rx1-	RS422- serial line. To CPU ..... Input	4
8	RS422_Tx1	RS422+ serial line. From CPU ..... Output	9
9	GND1	Galvanically isolated ground	5
10	RS422_Rx2	RS422+ serial line 2 ..... Input	1
11	RS422_Tx2-	RS422- serial line 2 ..... Output	6
12			2
13			7
14			3
15			8
16	RS422_Rx2-	RS422- serial line 2 ..... Input	4
17	RS422_Tx2	RS422+ serial line 2 ..... Output	9
18	GND	Ground	5
19	RS422_Rx3	RS422+ serial line 3 ..... Input	1
20	RS422_Tx3-	RS422- serial line 3 ..... Output	6
21			2
22			7
23			3
24			8
25	RS422_Rx3-	RS422- serial line 3 ..... Input	4
26	RS422_Tx3	RS422+ serial line 3 ..... Output	9
27	GND	Ground	5
28	SY1_in	External sync1+ ..... Input	1
29	SY1_out-	External sync1- ..... Output	6
30	SY2_out-	External sync2- ..... Output	2
31	SY2_in	External sync2+ ..... Input	7
32	SY2_out	External sync2+ ..... Output	3
33	SY2_in-	External sync2- ..... Input	8
34	SY1_in-	External sync1- ..... Input	4
35	SY1_out	External sync1+ ..... Output	9
36	GND	Ground	5

P22 pin assignments			
Pin	**Signal**	**Description**	**Ext.**
37	RXBI	RS422+ serial line B ..... Input	1
38	TXB/	RS422- serial line B ..... Output	6
39	RXB	RS232 serial line B ..... Input	2
40	TXCB	RX clock TTL ..... Input	7
41	TXB	RS232 serial line B ..... Output	3
42	CTSB/	Clear to send B TTL ..... Input	8
43	RXB/	RS422- serial line B ..... Input	4
44	TXB0	RS422+ serial line B ..... Output	9
45	GND	Ground reference B	5
46			
47			
48			
49			
50			

Pins 1 through 9 will connect to the external plug Serial I, on backplane (from IOM, P2 pins 1 9 P15 pins 1 9).

Pins 10 through 18 will connect to the external plug Serial II, on backplane (from IOM, P2 pins 10 18 P15 pins 10 18).

Pins 19 through 27 will connect to the external plug Serial III, on backplane (from IOM, P2 pins 19 27 P15 pins 19 27).

Pins 28 through 36 will connect to the external plug Serial IV, on backplane (from IOM, P2 pins 28 36 P15 pins 28 36).

Pins 37 through 45 will connect to the external plug Serial V, on backplane (from CPU, P2 pins 10 19 P21 pins 10 19).

Pins 46 through 50 will connect to the external plug Serial VI (Debug), on backplane (from CPU, P2).

P23 pin assignments			
Pin	**Description**	**Pin**	**Description**
1	IO5, Digital input/output	26	GND
2	IO6, Digital input/output	27	PC0 (Analogue 1)
3	IO7, Digital input/output	28	PC1 (Ground)
4	IO8, Digital input/output	29	PC2 (Analogue 2)
5	CLK 0	30	PC3 (Ground)
6	GATE 1	31	PC4 (Analogue 3)
7	T0 out	32	PC5 (Ground)
8	T1 out	33	PC6 (Analogue 4)
9	GND	34	PC7 (Ground)
10	PB7	35	GND
11	PB6	36	DIFF 1- (S1, synchro)
12	PB5	37	DIFF 1 (Rh, ref. high)
13	PB4	38	DIFF 2- (S2, synchro)
14	PB3	39	DIFF 2 (Rl, ref. low)
15	PB2	40	DIFF 3- (S3 synchro)
16	PB1	41	DIFF 3
17	PB0	42	GND
18	PA7	43	AN_IN 8 (VRU +15 V)
19	PA6	44	AN_IN 7 (Analogue ground)
20	PA5	45	AN_IN 6 (VRU -15 V)
21	PA4	46	AN_IN 5 (Roll)
22	PA3	47	AN_IN 4 (Common)
23	PA2	48	AN_IN 3 (Pitch)
24	PA1	49	AN_IN 2 (Analogue ground)
25	PA0	50	AN_IN 1

Signal descriptions for P23				
Signal	**From**	**Via**	**Via**	**To**
Analogue 1	IO/M P2 37	P15 pin 37	P23 pin 27	ANALOGUE I/O pin 14
GND	IO/M P2 38	P15 pin 38	P23 pin 28	ANALOGUE I/O pin 2
Analogue 2	IO/M P2 39	P15 pin 39	P23 pin 29	ANALOGUE I/O pin 15
GND	IO/M P2 40	P15 pin 40	P23 pin30	ANALOGUE I/O pin 3
S1	IO/M P2 45	P15 pin 45	P23 pin36	GYRO pin 1
Rh	IO/M P2 46	P15 pin 46	P23 pin37	GYRO pin 9
S1	IO/M P2 47	P15 pin 47	P23 pin38	GYRO pin 2
R1	IO/M P2 48	P15 pin 48	P23 pin39	GYRO pin 10
S3	IO/M P2 49	P15 pin 49	P23 pin40	GYRO pin 3
VRU +15 Vdc	IO/M P1 c23	P23 pin 43		ANALOGUE I/O pin 22
GND	IO/M P1 b2	P23 pin 44		ANALOGUE I/O pin 10
VRU -15 Vdc	IO/M P1 a2	P23 pin 45		ANALOGUE I/O pin 23
Roll	IO/M P1 c22	P23 pin 46		ANALOGUE I/O pin 11
Common	IO/M P1 b2	P23 pin 47		ANALOGUE I/O pin 24
Pitch	IO/M P1 a2	P23 pin 48		ANALOGUE I/O pin 12
Analogue ground	IO/M P1 c21	P23 pin 49		ANALOGUE I/O pin 25

P24 pin assignment (DC input)	
Pin	**Description**
1	+48 Vdc backup
2	Analogue ground

P25 pin assignment (External responder power)		
Pin	**Signal**	**Description**
1	Ext. pwr RSP	Responder power
2	AGND	Analogue ground

P26 pin assignment (To Input-A pcb, channels 1 - 3)		
Pin	**Signal**	**Description**
1	A INA_1	Input A, channel 1 IN +
2	A INBA_1	Input A, channel 1 IN -
3	AGND	Analogue ground
4	A INA_2	Input A, channel 2 IN +
5	A INB_2	Input A, channel 2 IN -
6	AGND	Analogue ground
7	A INA_3	Input A, channel 3 IN +
8	A INB_3	Input A, channel 3 IN -
9	AGND	Analogue ground

P27 pin assignment (To Input-A pcb, channel 4)		
Pin	**Signal**	**Description**
1	A INA_4	Input A, channel 4 IN +
2	A INB_4	Input A, channel 4 IN -
3	AGND	Analogue ground

P28 pin assignment (To Input-A pcb, channels 5 - 7)		
Pin	**Signal**	**Description**
1	A INA_5	Input A, channel 5 IN +
2	A INB_5	Input A, channel 5 IN -
3	AGND	Analogue ground
4	A INA_6	Input A, channel 6 IN +
5	A INB_6	Input A, channel 6 IN -
6	AGND	Analogue ground
7	A INA_7	Input A, channel 7 IN +
8	A INB_7	Input A, channel 7 IN -
9	AGND	Analogue ground

P29 pin assignment (To Input-A pcb, channel 8)		
Pin	**Signal**	**Description**
1	A INA_8	Input A, channel 8 IN +
2	A INB_8	Input A, channel 8 IN -
3	AGND	Analogue ground

P30 pin assignment (For transducer 1)		
Pin	**Signal**	**Description**
1	ST 24, VC_B	Voltage control B, Td 1
2	DGND	Digital ground
3	AGND	Analogue ground
4	N/W-signal	Narrow/Wide Td 1
5	AGND	Analogue ground
6	Screen	

P31 pin assignment (To Input-B pcb, channels 1 - 3)		
Pin	**Signal**	**Description**
1	B INA_1	Input B, channel 1 IN +
2	B INBA_1	Input B, channel 1 IN -
3	AGND	Analogue ground
4	B INA_2	Input B, channel 2 IN +
5	B INB_2	Input B, channel 2 IN -
6	AGND	Analogue ground
7	B INA_3	Input B, channel 3 IN +
8	B INB_3	Input B, channel 3 IN -
9	AGND	Analogue ground

P32 pin assignment (To Input-B pcb, channel 4)		
Pin	**Signal**	**Description**
1	B INA_4	Input B, channel 4 IN +
2	B INB_4	Input B, channel 4 IN -
3	AGND	Analogue ground

P33 pin assignment (To Input-B pcb, channels 5 - 7)		
Pin	**Signal**	**Description**
1	B INA_5	Input B, channel 5 IN +
2	B INB_5	Input B, channel 5 IN -
3	AGND	Analogue ground
4	B INA_6	Input B, channel 6 IN +
5	B INB_6	Input B, channel 6 IN -
6	AGND	Analogue ground
7	B INA_7	Input B, channel 7 IN +
8	B INB_7	Input B, channel 7 IN -
9	AGND	Analogue ground

P34 pin assignment (To Input-A pcb, channel 8)		
Pin	**Signal**	**Description**
1	B INA_8	Input B, channel 8 IN +
2	B INB_8	Input B, channel 8 IN -
3	AGND	Analogue ground

P35 pin assignment (For transducer 2)		
Pin	**Signal**	**Description**
1	ST 25, VC_D	Voltage control D, Td 2
2	DGND	Digital ground
3	AGND	Analogue ground
4	N/W-signal	Narrow/Wide Td 2
5	AGND	Analogue ground
6	Screen	

P36 pin assignment (For transducer 3) Note ! External cable from P36 to Input-A pcb, channel 8		
Pin	**Signal**	**Description**
1	ALNK_A1	Telemetry (+) TxMB to input A
2	ALNK_A2	Telemetry (-) TxMB to input A
3	AGND	Analogue ground

P37 pin assignment (For transducer 4) Note ! External cable from P36 to Input-B pcb, channel 8		
Pin	**Signal**	**Description**
1	ALNK_B1	Telemetry (+) TxMB to input B
2	ALNK_B2	Telemetry (-) TxMB to input B
3	AGND	Analogue ground

P38 pin assignment		
Pin	**Signal**	**Description**
1	“ON”, (diode)	Power ON
2	GND	Ground
3	“CPU” (diode)	Not connected

Maintenance aids

Links

LK 1 ..... 0 V for responder power. Link **IN** means internal power

LK 2 . . . . . +48 V for responder power. Link **IN** means internal power
ST 1 . . . . . Link 1-2 for VC_B to Input-A P1 c7
ST 1 . . . . . Link 2-3 for VC_A to Input-A P1 c7 (Normally closed)
Seen from rear: ._. .

ST 2 . . . . . Link 1-2 for VC_D to Input-B P1 c7
ST 2 . . . . . Link 2-3 for VC_C to Input-B P1 c7 (Normally closed)
Seen from rear: ._. .

ST 7 . . . . . EXRDY- Normally out
ST24 . . . . . VC_B, (TVG), TD1. Normally in
ST25 . . . . . VC_D, (TVG), TD2. Normally in
ST26 . . . . . Link 1-2 for VEE(-5 V) to Input A/B P1 abc 28
ST26 . . . . . Link 2-3 for VCC(+5 V) to Input-A/B P1 abc 28 (Normally closed)
Seen from rear: . ._.

InputM

Purpose

The HPR 400 Transceiver Unit holds two InputM boards, B and A . These are located in the rack in the first and second slots from the left respectively. The purpose of the InputM circuit board is to amplify transducer signals, perform demodulation and narrow band filtering, and present the output signals via Sample and hold circuitry.

Physical description

The InputM board is a single Euro-card circuit board.

Circuit description

The InputM circuit board is designed for eight individual channels, using identical analogue channel hybrid circuits. However, only five are fitted. The first four (grouped) are used for the SSBL system, the fifth (set apart from the others) is for the LBL system. The board is also equipped with digital circuitry common to all the analogue channels.

The circuit board's eight inputs from the transducer(s) are balanced, and individual input transformers are implemented. Each channel has a broad-band amplifier with voltage-controlled gain. The maximum gain is 75 dB relative to 1 V. If the transducer has its own internal amplifier, the signals may be routed directly to the filters by hardware straps.

The demodulators operate either with a common modulator frequency, with a common frequency for each of the two groups, or with an external frequency. The frequency is generated on the Input-M board, but it is controlled by the Central Processing Unit (CPU) board.

The low pass filters operate with a pass-band. The filters are controlled by a clock on the board, which in turn is controlled by the CPU. All the filters operate with the same bandwidth.

The outputs from each channel are the sine and cosine (real and imaginary) vectors of the demodulated signals. The analogue range is 0 to 2.5 Vdc. All the outputs are sampled by an external sample signal, and the values are stored until the next sample command arrives.

There are two frequency generators for the demodulators. They operate at 4 times the signal frequency, in steps of 100 Hz.

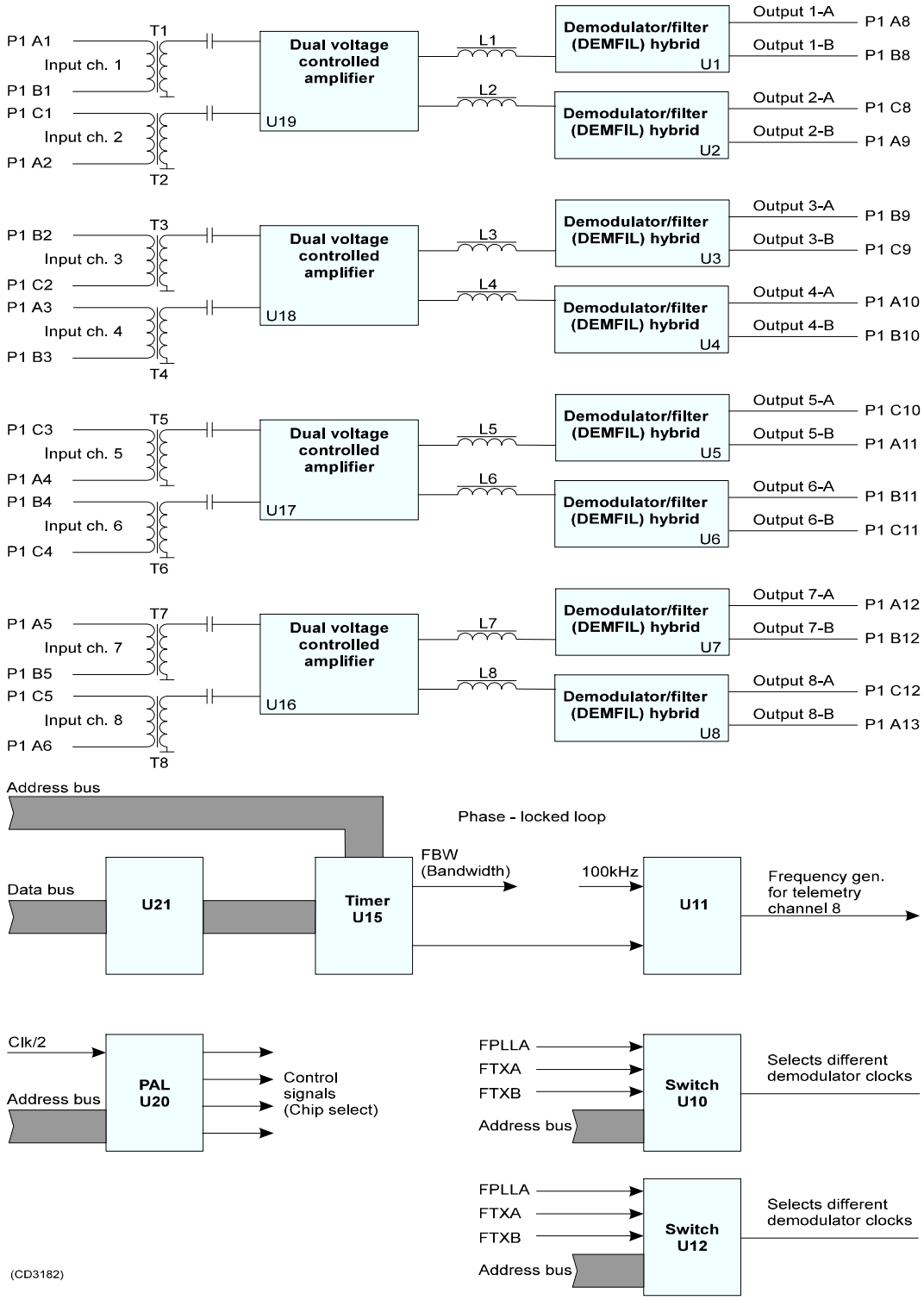


Figure 34 - The Input M A/B circuit board - block diagram

Connections

The InputM circuit board carries one connector. This is a 96-pin Europa connector mounted on the rear edge of the board, used to link the board into the backplane.

P1 pin assignment 96-pin Europa connector			
Pin	**A**	**B**	**C**
1	IN1-A	IN1-B	IN2-A
2	IN2-B	IN3-A	IN3-B
3	IN4-A	IN4-B	IN5-A
4	IN5-B	IN6-A	IN6-B
5	IN7-A	IN7-B	IN8-A
6	IN8-B		
7	VCA		VCB
8	OUT1-A	OUT1-B	OUT2-A
9	OUT2-B	OUT3-A	OUT3-B
10	OUT4-A	OUT4-B	OUT5-A
11	OUT5-B	OUT6-A	OUT6-B
12	OUT7-A	OUT7-B	OUT8-A
13	OUT8-B	TX_EN B~	TX_EN A~
14	RESET_IN		CLK/2
15	100 Hz		RESET
16	FTX A	FTX B	F IN
17	D0	D1	D2
18	D3	D4	D5
19	D6	D7	
20	A01	A02	
21	A16		A06
22	A07	A08	A09
23	A10	A11	A12
24	A13	A14	A15
25	S/H IN		
26	XIOW	RESET	XIOR
27	AVEE	AVEE	AVEE
28	AVCC	AVCC	AVCC
29	AGND	AGND	AGND
30			
31	GND	GND	GND
32	VCC	VCC	VCC

P1 Signal descriptions

IN1-A to IN8-B	Input channels from transducers
OUT1-A to OUT8-B	Output to ACM PCB
VCA	Voltage Control A from IO/M PCB
VCB	Voltage Control B from IO/M PCB
TX_EN A~	Transmit Enable A from CPU
TX_EN B~	Transmit Enable B from CPU
RESET IN	Not used
CLK/2	Clock input to PAL from CPU
100 Hz	Modulation frequency from IO/M
RESET	From CPU - resets DEMFIL circuit
FTX A	Transmitter frequency from TxMA
FTX B	Transmitter frequency from TxMB
F IN	Bandwidth via U15 to DEMFIL
D0 to D7	8-bit data bus
A01 to A16	16-bit address bus
S/H-IN	Sample and hold from ADCM
XIOW	I/O write strobe
XIOR	I/O read strobe
AVEE	Analogue -5 Vdc
AVCC	Analogue +5 Vdc
GND	Ground
VCC	Digital +5 Vdc

Maintenance aids

Test points

TP 1	Transducer signal channel 1, (X)
TP 2	Transducer signal channel 2, (Y)
TP 3	Transducer signal channel 3, (R)
TP 4	Same as channel 3. linked together on input
TP 5	Not fitted
TP 6	Not fitted
TP 7	Not fitted
TP 8	Transducer signal channel 8 (Telemetry)

- The demodulator frequency should be present at “Demfil” pins 1 and 2. The frequency should be two times the actual listening frequency. Note that the frequency will shift by the transmitter pulse after the reply is received. (50 Hz off).
- The bandwidth clock should be present on “Demfil” pin 14, and should be 50 times the actual bandwidth.
- The Sample/Hold clock should be present on U13 pin 13, and then go to pin 15 on all the “Demfil” packages.

The signal reply pulses (5 to 7 Vp-p) should be present on the test points in front of the “Demfils”. (TPs 1, 2, 3, 4 and 8).

- The signal pulse envelope should be present on “Demfil” pins 27 and 28. Maximum amplitude should be 4 V p-p.

Links

- LK1

Link 1-2	Not used
Link 2-3	2 x mod. freq. telemetry normally closed

- LK2

Link 1-2	Not used
Link 2-3	Not used

- LK3

Link 1-2	Not used
Link 2-3	Not used

- LK4 / LK5

Link 1-2	LK 4 pin 2 is linked toLK 5 pin 2 to set bandwidth for wide and telemetry

Analogue digital converter (ADCM)

Purpose

The purpose of the ADCM is to perform analogue to digital conversion. It offers conversion of 32 analogue input channels and temporary storage of data in dual port RAM. Up to eight conversion sequences can be programmed into an EPROM. Data sets are stored alternately in two banks of RAM.

Physical description

The ADCM is designed to the single Euro-card circuit board standard, with four layers. Two layers are used for the signals, two layers are used for the power supply. The board is equipped with two connectors, one located at each end. A 50-pin connector (P2) is the only front mounted device visible when the board is in position in the HPR 400 Transceiver Unit.

Circuit description

The ADCM circuit board provides 32 multiplexed analogue input channels. Dual 16-bit multiplexers are used to select analogue input signals obtained from the sample-and-hold outputs of the Input-M circuit board. Each output from the Input-M provides a real and imaginary analogue signal between 2.5 Vdc.

Real and imaginary inputs to the board are connected to two separate multiplexers. The input channels are selected by the multiplexer address lines. An amplifier system is used between each multiplexer and corresponding A/D converter to create a 0 to +5 V input signal range to the A/D from the 2.5V signal at the multiplexer input. The 12-bit A/Ds are both controlled by the sequence controller.

The conversions take place simultaneously to provide the shortest possible conversion time for two input signals. However, each A/D is started individually.

The digital outputs from the A/Ds are stored in dual port RAM. A full data set (data from conversion of all 32 input signals) is stored alternately in the two banks to allow the last converted data set to be read from the RAM whilst a new set of conversions is in progress.

Note: *The maximum time required to convert one data set (all 32 input signals) is 80 µs. This does not include the 4 µs settling time required in sample-and-hold circuits of the DEMFIL devices.*

A 16-bit bi-directional data bus interfaces the ADCM with the other circuit boards.

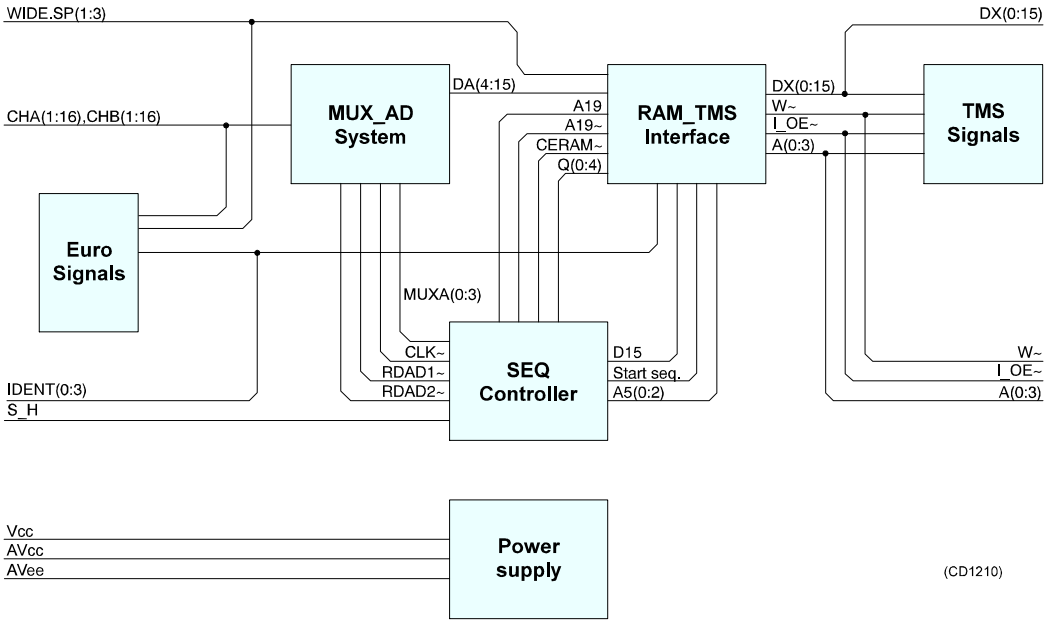


Figure 35 - A / D Converter (ADCM) - block diagram

The control lines IDENT(0:3) provide the board with a unique identification code which is set by jumpers S1 - S4. The external address lines A(0:3) must match this code to select the board.

Connections

The board carries two connectors, one located at each end of the board. **P1** is a 96-pin, male, right-angled connector. It connects the ADCM into the motherboard. **P2** is a 50-pin, male, right-angled connector with ejector/latch. It is located on the front edge of the board.

Maintenance aids

Test points

TP 1	ADC, IC4 input (real signal)
TP 2	ADC, IC4 BUSY~
TP 3	ADC, IC8 input (imaginary signal)
TP 4	ADC, IC8 BUSY~
TP 5	START_SEQ
TP 6	CLK~
TP 7	IC21 CK (multiplexer address latch)
TP 8	S_H
TP 9	+5 Vdc digital
TP 10	DGND
TP 11	+12 Vdc analogue
TP 12	Analogue ground
TP 13	-12 Vdc analogue

Digital signal processor (DSPM 50)

Location and purpose

The Digital Signal Processor (DSPM 50) board is located fourth from the left in the HPR 400 Transceiver Unit rack. It is designed as a general purpose single board computer, and its main task is to perform digital signal processing.

Physical description

The DSPM 50 is a single euro-card circuit board, constructed of eight layers. It holds two LEDs and one 50-pin connector, P2, on its front edge.

Circuit description

The DSPM 50 is a general purpose digital signal processor board. It utilizes the TMS 320C50 Digital Signal Processor manufactured by Texas Instruments. The DSPM 50 operates on a 50 MHz clock frequency, and holds a total of 128 kbyte memory for program and data storage. The program memory is loaded from a main control processor unit (the Central Processing Unit (CPUEX)) through a general bus interface in the 96-pin Europa connector P1.

The processed output from the DSPM 50 is sent through a FIFO (first in / first out) connected to this bus. External input and output signals are connected to the board through the DSPM 50's I/O expansion bus available on the front mounted 50-pin flat ribbon cable connector P2.

The DSPM 50 board comprises the following functional modules:

- Digital Signal Processor
- Memory
- I/O Expansion Bus
- FIFO Buffer
- 11 Digital Inputs
- 16 Digital Outputs
- Control circuitry
- Bus Interface
- Power +5 Vdc (250 mA typical)

The Texas Instrument signal processor is a fixed point 16-bit processor with a 16-bit address bus. The DSPM 50 has separate program and data addressing space.

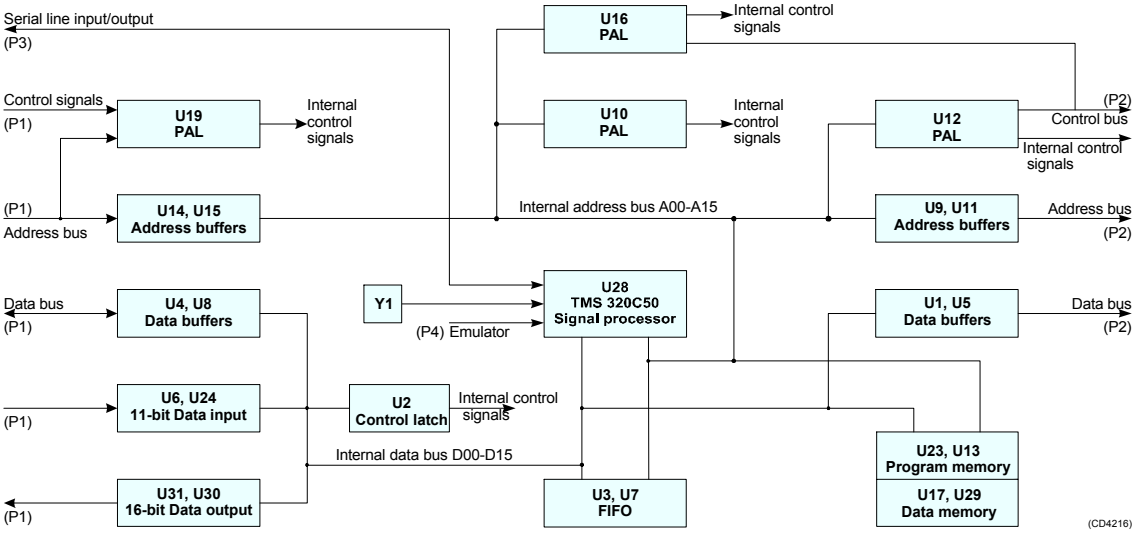


Figure 36 - Digital Signal Processor (DSPM 50) - block diagram

U13 and U23 are the program memory units, and U17 and U29 are the data memory. Both memories can be read or written to from an external computer.

The signals from the TMS320C50 and the PAL U10 supply all the control signals to the memories. U10 also controls the memory when a external computer is controlling the board, and the external computer can take control of the address bus by buffers U14 and U15. U4 and U8 are the data buffers transceivers. U19 decodes the external computer address bus and read write signals, and generates control signals (SEL1, SEL2, MWR/ and MRD/) to U10 to control the memory. U19 also supplies the latch signal to the control latch U2, and the read signal to the FIFO‘s U3 and U7. U19 also controls the enabling of the bus buffers and the direction of the data buffer transceivers.

The control latch U2 is written to by the external computer. DB00 controls the HOLD/ signal of the DSPM 50, and floats the DSPM 50 before an external computer takes control of the board’s internal bus. DB01 is used for resetting the DSPM 50 after a new program is loaded into the program memory from an external computer. DB07 resets the output FIFO buffer.

Y1 is a crystal oscillator supplying the frequency needed by the DSP.

Serial line signals CLKR, CLKX, DR, DX, TCLKR, TCLKX, TDR, TFSR, TFSX, TDX, FSR and FSX are connected directly from the DSP to P3.

The board requires +5 Vdc, and consumes approximately 250 mA.

Connections

The MUNAV Digital Signal Processor (DSPM 50) holds two connectors (with place for two more which are not used in the HPR 400 system):

P1 . . . . . 96-pin, male, right-angled Europa connector placed at the back edge of the circuit board

P2 . . . . . 50-pin, male, low-profile flat ribbon cable connector placed at the front edge of the circuit board

P3 . . . . . Serial line connector - not used

P4 . . . . . Emulator connector - not used

Maintenance aids

Test points

TP1 . . . . . FIFO Empty flag

The user may check basic functions by using an oscilloscope and measure on the following points:

- The HOLD/ signal on U2 pin-2 and RS/ on U2 pin-5. These must both be low when loading the program memory.
- The signal STRB/ on U16 pin-4. A pulse train will be observed when the signal processor is running.

Links

Lk 1 . . . . . Normally on - enables D1

Lk 2 . . . . . Normally on - connects HOLD/ to TMS320C50

Lk 3 . . . . . Normally on - enables D2

Lk 4 . . . . . Normally on - connects RS/ from U2

Lk 5 . . . . . Normally open - selects clock option

Lk 6 . . . . . Normally open - selects clock option

Lk 7 Used for test, Normally on - connects clock to TMS320C50

Lk 8 . . Normally open - selects MP or MC mode of TMS320C50

Lk 9 . . . . . GND

Lk 10 . . . . . +5 V

Lk 11 . . . . . Normally A. A selects A14, B selects A15 to program ram P3

LEDs

LED D1 . . . . . On when FIFO is empty

LED D2 . . . . . On when board is running

Transmitter (TXM)

Purpose

Two Transmitter (TXM) boards are used in the HPR 400 Transceiver Unit. These are TXM-A and TXM-B. The Transmitter board (TXM) is a general purpose transmitter, containing its own frequency generator, power control and power supply circuits (the board feeds both the Rx and CPU circuit boards when in the Mutran mode). The two boards used in the system are identical in all respects.

Board description

The TXM is designed to the single Euro-card standard, and comprises four layers.

Front mounted devices

The TXM board holds two test points and two factory-set links on its front edge.

Circuit description

The transmitter board holds two MAX663 voltage regulators which provide the voltages used in the transmitter. It also has a crystal oscillator which is used as the Tx frequency source and a direct numerical synthesizer for generating the correct Tx frequency. Driver stages with power control, an output stage with over-current protection, transducer matching circuits and a transducer relay complete the board.

The crystal oscillator runs at 3.2768 MHZ, and is switched on and off by the MCU (TXOSC). The oscillator frequency is fed to a counter chain via latches. The counter chain is also loaded with a 2 x 8 bit word from the MCU, determining the division factor in the chain. This method of generating transmitter frequencies makes it possible to alter the frequency instantaneously, a necessary feature in telemetry applications.

The output from the counter chain, called S8, is combined with the TX-EN signal and forms the tone-burst, normally 10 ms, to feed the driver and output stages.

The transistors in the output stage are switched on for varying fractions of the half-period of the output signal. Thus the area of each half-period can be varied to control the output power without varying the supply voltage to the output stage. As the half-periods are narrowed the energy contained in the signal is reduced, and after being shaped in the output transformer and the transducer matching circuits, the amplitude of the signal driving the transducer elements will be lower.

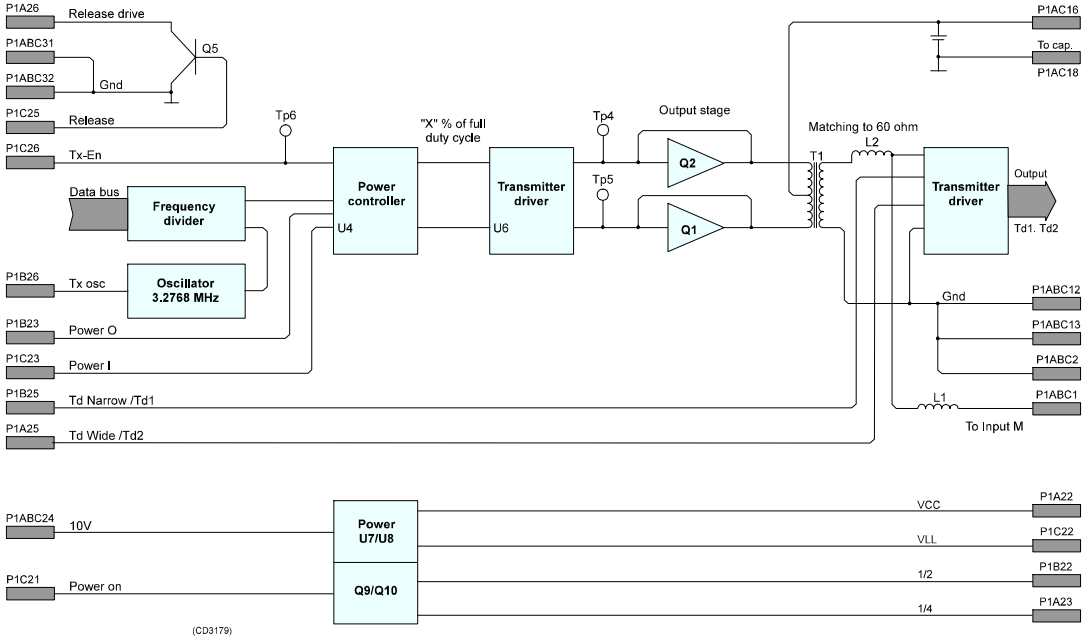


Figure 37 - The Transmitter circuit board - block diagram

The driver signals are fed to the output transistors via two paths which are 180 out of phase. This is because the output stage is a push-pull circuit where transistors Q1 and Q2 alternately pump current through transformer T1 for one half-period each.

The output from the transistor stage is fed through a relay, providing the possibility to choose between different transducer elements for beam selection. The relay is a bistable relay, i.e. it is stable in both positions and therefore does not consume any power in either position. The relay is operated by sending a current pulse through one of the internal coils. The beam switch control signals are generated by the micro-controller board.

The transmitter board also contains a release driver stage. Transistor Q5 acts a power switch for the release motor, controlled by the micro-controller.

Socket-mounted components

U5 (PAL) . . . . . Programmable I/O controller

Connections

The board has one 96-pin, male, right-angled connector (P1) located on the rear edge of the board to link the board into the backplane.

Maintenance aids

Oscilloscope test points

The following oscilloscope test points are available to assist the maintenance engineer:

TP1 . . . . . FTx, 50% duty cycle

TP2 . . . Transmitter pulse, 10 ms, voltage depending on power

TP3 . . . . . +10 V when POWERON is ON, (**Mutran**). +15 V for **Munav**

TP4 . . . . . 10 ms burst to Tx driver, duty cycle dep. on power control. +5 V when POWERON is ON

TP5 . . . . . 180 out of phase with TP4”

TP6 . . . . . +5 V, 10 ms pulse from CPUM

TP7 . . . . . GND

Links

The TXM board holds the following links:

LK1 . . . . . Link 1-2 if U5(Pal) is in use. Normally closed Link 2-3 for external frequency burst

LK2 . . . . . Link 1-2 if U5(Pal) is in use. Normally closed Link 2-3 for external frequency burst

Switches

The TXM board holds no switches.

"Powerbox" AC power supply

Purpose

The **POWERBOX ESA-K105U/XS** AC power supply enables the HPR 400 system to be powered from a 230 Vac supply.

Board description

The unit is purchased from an external supplier. It is based on a commercially available power supply, though has been altered to Simrad's specifications. The unit is open to allow cooling air around the componants, but is designated "Repair by replacement". It is designed to be installed in a standard 19 rack.

Technical specifications

The unit physical specifications are as follows:

Width	12 TE
Height	111 mm
Length	168.5 mm
Weight	700 g
Operating temperature	0°C to 80°C
Storage temperature	-25°C to +85°C
Efficiency	80% typical
Isolation and safety	To EN 60 950
EMI/RFI standards	To EN 55 022B (VDE 0871 B)

Electrical characteristics

The unit requires a supply of 230 Vac or 115 Vac, and provides an output of 48 Vdc, 2 A (4 A peak).

Note: *Switching between 115 Vac and 230 Vac is performed using straps inside the unit.*

Socket-mounted components

None - this power supply is a sealed unit and must not be "adjusted" by the system maintainer.

Connections

The power supply unit is plugged into the backplane by a connector comprising fifteen 5 mm spade terminals. The terminals are allocated as follows:

P1 pin allocation 15-pin connection block	
Pin	**Signal description**
4	+ Vo1
6	+ Vo1
8	+ Vo1
10	+ S
12	- S
14	- Vo1
16	- Vo1
18	- Vo1
20	
22	
24	
26	
28	230 Vac in (L)
30	230 Vac in (N)
32	GND

Maintenance aids

This power supply is a sealed unit. In the event of malfunction, replace the unit.

LEDs

The front of the unit holds 1 green LED which indicates the existence of the 48 Vdc output.

Fuses

The unit holds an input fuse, located in the rear of the unit. The fuse is:

- 5 mm x 20 mm, 250 V, 2.5 A, slow-blow

Caution: *Nothing else must be used.*

Control Processor Unit (CPUEX)

Purpose

The CPUEX is a single-board computer utilizing the 80386EX microprocessor. The purpose of the board is to control the operation of the Transceiver Unit.

Physical description

The CPUEX is a standard eight-layer single-Europe board. One edge connector connects to the motherboard. The front edge holds a 34-pin connector, four LEDs, two test points and link Lk7.

Circuit description

The CPUEX is designed as a Control Processor Unit using the 80386EX microprocessor from Intel. The board has sockets for an 80387SL numeric processor and flash memory. The board also holds RAM memory for program and data storage, serial lines, interrupt inputs, general I/O lines and a general bus interface (96-pin Europa connector).

The 80386EX CPU is the main controller on the circuit board. It is a 32-bit microprocessor, working internally with 16-bits, and it is software compatible with 80386 software used on normal personal computers. Addressing capability is up to 16 Mb. A 32 MHz crystal oscillator supplies the frequency making the 16 MHz CPU clock. A numeric coprocessor 80387SL is mounted.

Two 32-pin PLCC sockets support the flash memory part of the circuit, U6 and U7. These devices are 8-bit wide memory devices. The RAM memory consists of U8 and U9. One is for the 8-bit low byte and one for the 8-bit high byte.

The Bus Interface contains address buffers and bidirectional data buffers to the system bus, which is in the 96-pin Europa connector.

The board contains 6 TTL inputs (ID1 to ID6), 12 TTL outputs (ID9 to ID16 and OUT1 to OUT4), nine external interrupt inputs and six 16-bit timers.

Two separate serial lines with separate programmable baud-rate control are available. Selection between RS 232 and RS 422 is made by links on the inputs. Both serial lines supply RS 232 and RS 422 as outputs at the same time.

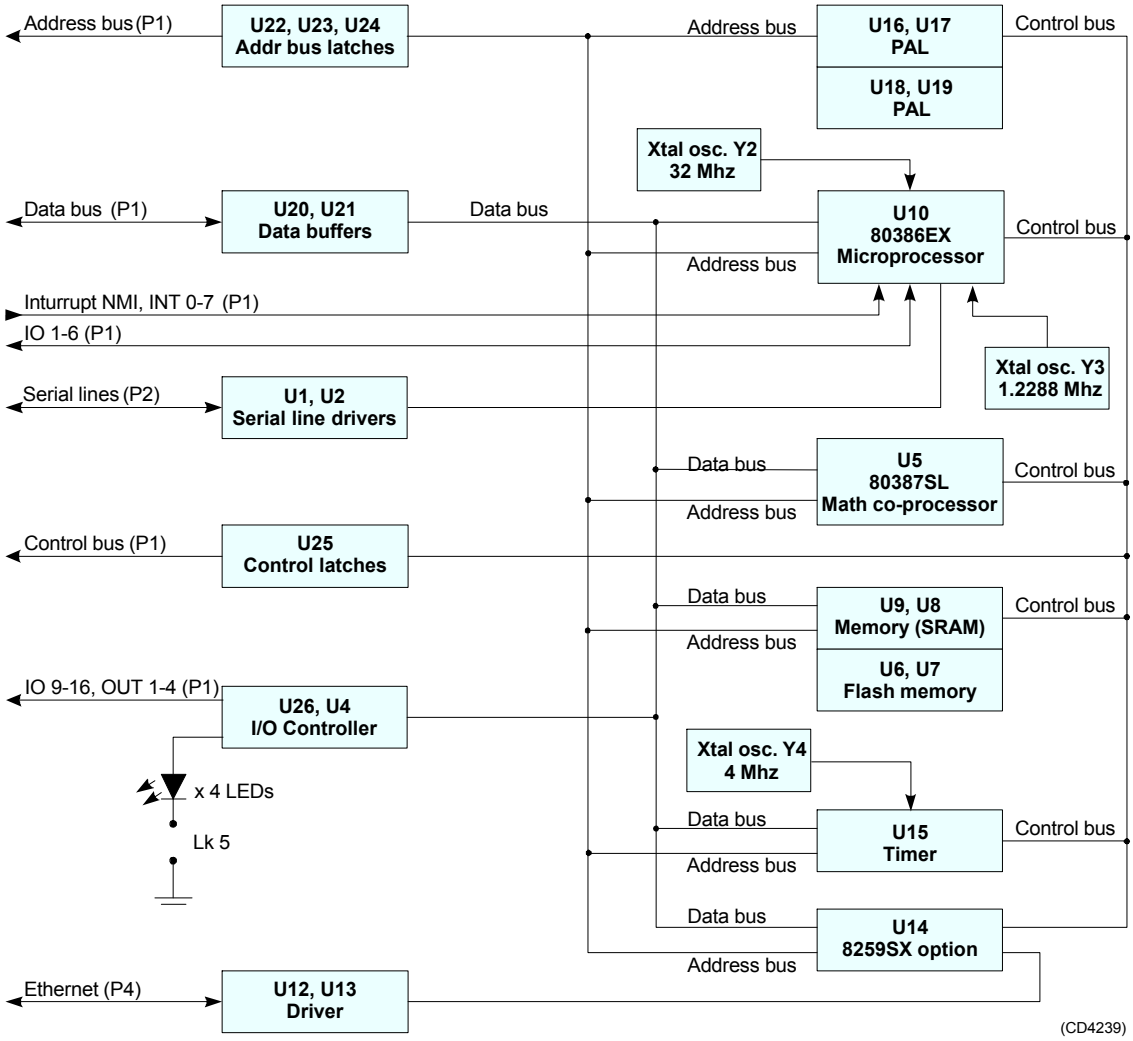


Figure 38 - Control processor unit (CPUEX) circuit board - block diagram

Connections

There are two connectors; one placed at each end of the circuit board.

P1	96-pin, male, right-angled Europa connector
P2	34-pin, male, flat ribbon cable connector

Maintenance aids

Test points

TP 1	GND
TP 2	+5 V

Links

LK 01	Link 1-2 for RS 422 input serial line A Link 2-3 for RS 232 input serial line A
LK 02	Link 1-2 for RS 422 input serial line B Link 2-3 for RS 232 input serial line B
LK 03	Normally closed, software control
LK 04	Ram dependent
LK 05	On = enables D1 - D4
LK 06	On = WD enable
LK 07	Reset connector

LEDs

D1 -D4	Software-controlled, front mounted

Oscilloscope check points

The maintenance engineer can check the basic functions by using an oscilloscope and measuring on the following points:

- The signal ADS/ on U16 Pin 3, observe the pulses when the board is (should be) running. Check for one positive pulse to start every instruction cycle.

Input/output board (IO/M)

Purpose

The Input/Output board (IO/M) is designed to the single Euro-card circuit board standard. It is designed to interface the most common SSBL and LBL inputs and outputs, such as a vertical reference unit, course gyro, external synchronization and serial lines.

Board description

The vertical reference unit, gyro and serial line 1 (to the system controller) are galvanically isolated. Serial lines 2 and 3 are dedicated to tracking interface. These serial lines are galvanically isolated on the Serial Interface board, SIF.

Serial line 1 is available with a programmable baud-rate control, coming from the CPU board. Selection between RS232 and RS422 is made using links on the inputs. The serial line may also be inverted by links on the board. The serial line may supply RS232 and RS422 as outputs simultaneously.

Serial lines 2 and 3 are RS422 only, controlled by U3, 82530.

Front mounted devices

A 50-pin connector, P2, is the only device mounted on the front edge of the board.

Circuit description

All decoding is implemented with PALs, and may thus be reconfigured. The PAL 22V10 (U11) is the main decoder in the system. It initiates Chip Select to all the different devices and functions, and also generates RD (read) and WR (write) strobes to the 82530.

U13 is the address buffer for the system bus. It contains two address bits. The bus is available on P1. U5 and U6 are the bidirectional data transceivers. The data bus is also available on P1.

The 82530 (U3) Serial Communication Controller contains two serial lines identified as 2 and 3".

Four analogue inputs are supported, made switchable by means of the U10 multiplexer. Two of the inputs are dedicated for Roll and Pitch inputs from an external vertical reference unit (VRU).

Four analogue outputs are provided. These are originally designated as TVG outputs (Time Varied Gain) to preamplifier boards and/or transducers. The analogue outputs are generated by the D/A converter U20.

One synchro input intended for a course gyro input, and two differential inputs, are provided.

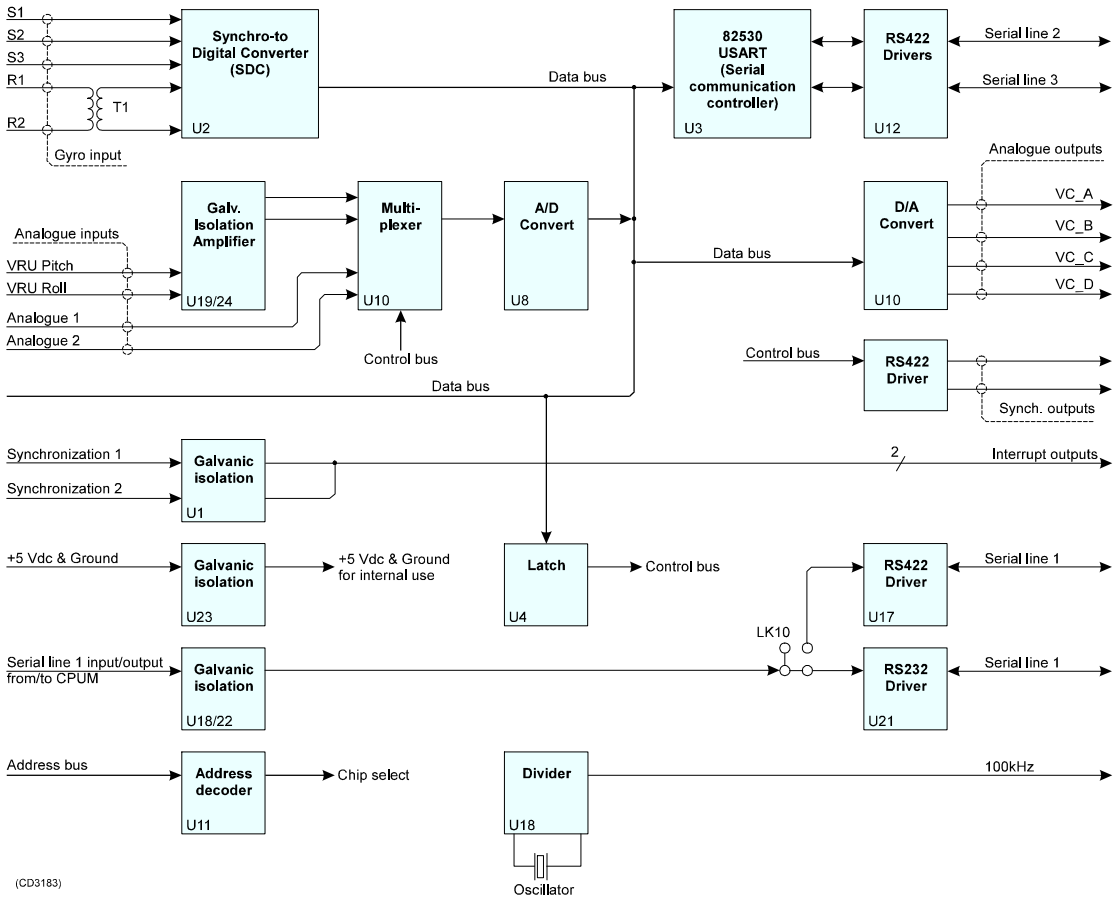


Figure 39 - The Input/Output circuit board (IO/M) - block diagram

Socket-mounted components

U 02	Synchro to digital converter SDC-19204-302. 26 Vac 50/60 Hz
U 03	Intel P82530-6 Serial communication controller
U 11	PAL 22V10 address decoder
U 12	DS 8922 RS422 Driver/Receiver
U 17	DS 8922 RS422 Driver/Receiver
U 21	MAX233 RS232 Driver/Receiver

Connections

There are two connectors; one at each end of the circuit board.

P1	96-pin, male, right-angled connector
P2	50-pin, male, flat ribbon cable connector

Maintenance aids

Test points

TP 01	GND
TP 02	Analogue inputs, between multiplexer and AD
TP 03	Pitch
TP 04	Roll
TP 05	VCC
TP 06	VCC1
TP 07	GND1
TP 08	Pitch input
TP 09	VRU common
TP 10	Roll input

Links

LK 01	Link 1-2 for direct Analog_1 input Link 2-3 for Analog_1 input via amplifier.
LK 02	Link 1-2 for direct Analog_2 input Link 2-3 for Analog_2 input via amplifier.
LK 03	Link between analogue and digital ground Normally closed.
LK 04	Digital ground to D/A converter. Normally closed.
LK 05	-5 Vdc to D/A converter.
LK 06	A/D converter 20 V input. Normally closed.
LK 07	A/D converter 10 V input.
LK 08	Link 1-2 for inverted Serial line 1, Tx. Link 2-3 for non-inverted Serial line 1, Tx. Normally closed.
LK 09	Link 1-2 for inverted Serial line 1, Rx. Link 2-3 for non-inverted Serial line 1, Rx. Normally closed.
LK 10	Link 1-2 for RS422 input serial line 1 Normally closed. Link 2-3 for RS232 input serial line 1.
LK 11	Analogue ground to D/A converter.
LK 12	200 Hz reference frequency.
LK 13	100 Hz reference frequency. Normally closed.

Potentiometers

R 13	Adjustment of bipolar offset, A/D converter.
R 14	Adjustment of reference voltage A/D converter.

Switches

The IO/M board holds no switches.

Responder Controller (RPC) board

Introduction

The location of the responder controller (RPC) is indicated on the figure below.

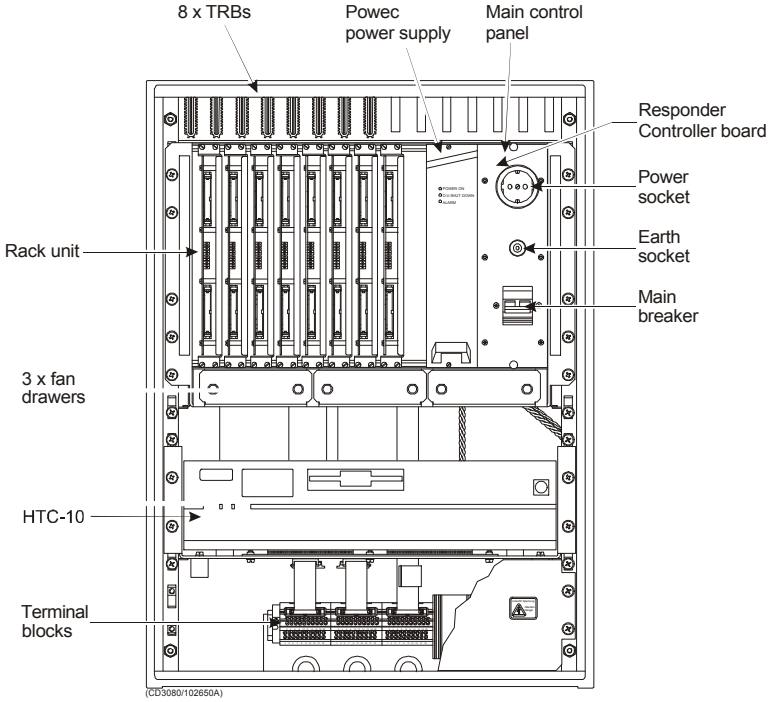


Figure 40 - Transceiver unit indicating RPC board

Purpose

The purpose of the responder controller (RPC) board is to provide responder trigger pulses as ordered by the Operator Unit.

Board description

The RPC board is located behind the main control panel. It is designed to the single Euro-card standard. The board holds four identical opto-isolated responder trigger circuits, and communicates with the TMC board in the PC via a flat cable.

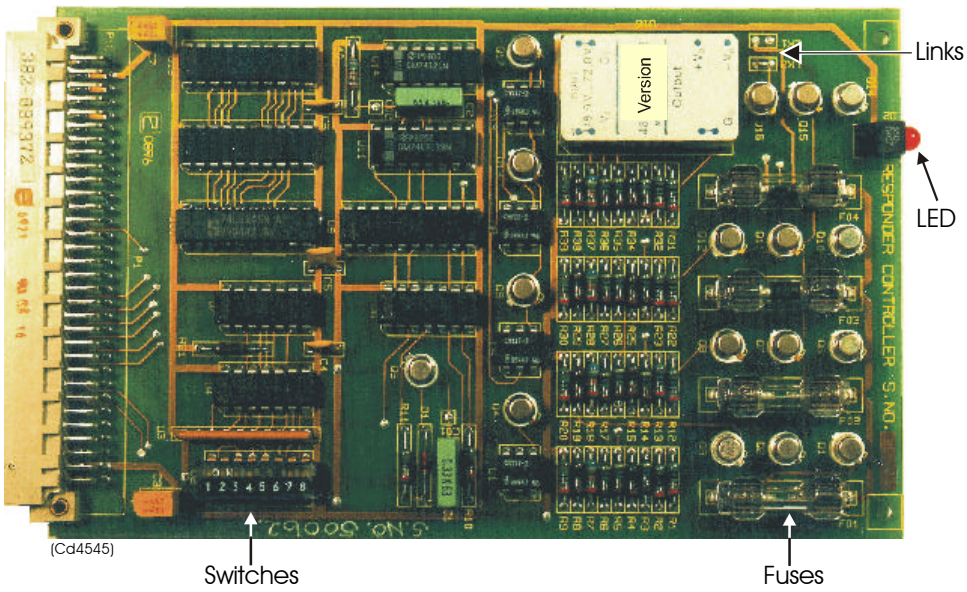


Figure 41 - RPC board

Front mounted devices

The RPC board carries four fuses and a diode mounted on its front edge.

Circuit description

Component U10 is the board's data buffer, and component U9 is its control buffer. Card selection is performed by U4, U7, U2 and U3. The card selector output goes high when the RPC has been selected, and flashes the LED D2. U12 is a test latch used to check the RPC board performance.

The RPC board's address is set by means of the DIL switch U2.

Pin 12 of U11 goes low whenever the direct address instruction is executed, causing the bit pattern on the data bus to be latched into U15. The code latched in U15 determines which of the trigger circuits is to be activated. When the trigger instruction is executed, the one-shot U14 applies a pulse of approximately 5.5 ms to pin 1 of U15. The outputs of U15 that are active will draw current through the associated opto-coupler, which again causes a trigger pulse to be generated.

Each trigger pulse circuit is protected by a fuse which also secures the supply voltage to the responder. The trigger pulses are brought out between terminals A/C28 and A8, A10, A12 and A14.

Socket-mounted components

The board carries no socket-mounted components.

Connections

The board holds one connector, P1, located on the back edge of the board. This connects the board into the Transceiver Unit backplane.

P1	64-pin, male, right-angled connector

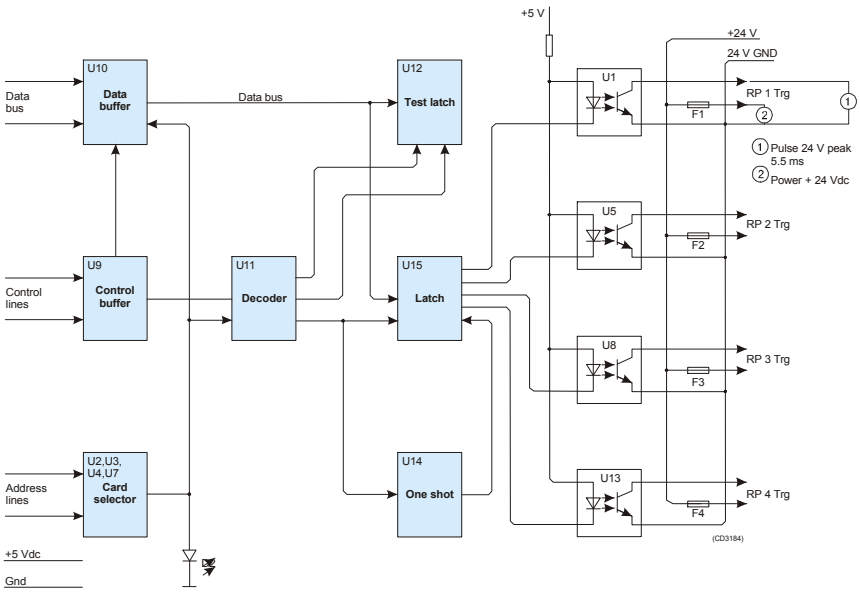


Figure 42 - Responder Controller circuit board - block diagram

Maintenance aids

Test points

The RPC has no specific test points for use by the maintenance engineer.

Links

LK1	Connected only when 24 V is supplied and U16 is not mounted
LK2	Always connected

Switches

Dil switch U2	Address switch block

LED

D2	Lights when board is transmitting

Fuses

The board carries four 0.1 A, slow-blow fuses, on the +24 Vdc lines.

DC power supply (DC - PWR)

The DC-PWR is located second from the right in the rack. The board is designed by Simrad, though the power converter units mounted on the board are bought from an external source.

Purpose

The purpose of the MUNAV Power Supply (POWERM) is to supply the electronic circuitry with low level DC voltages. The unit can provide several different voltages, in this system 15 Vdc is used.

Board description

This DC supply is based on EriPower DC-DC converters, which produce the following voltages:

- +5 Vdc
- +15 Vdc
- -15 Vdc

The 15 Vdc is converted to 5 Vdc by means of serial regulators.

Two converters are used, one mounted directly onto the board, the other mounted piggy-back fashion on the solder side of the board. The front of the board comprises a black aluminium heat sink. The 48 Vdc input power to the board can be supplied to two different input lines: DC-IN1 and DC-IN2. The board also holds a 2 A constant current output.

Circuit description

When a TTL level signal is applied to either POWER-ON or POWER-UP, the gate on Q1 will be forced to a low level by Q2. This will set the Q2 to a ON condition, and thus pass this power, supplied to input DC-IN1 or DC-IN2.

Note: *There is a start-up delay of approximately 40 ms between the arrival of a Power On pulse and a settled +5 Vdc output.*

The constant current block is based on a three-terminal voltage regulator (U1) LM317HVK and a serial resistor (R1). The output current will increase until the voltage across R1 is equal to $V_{REF.}$ (1.2 Vdc). A 1 Ω resistor gives a current of approximately 1.2 A.

The DC-DC converter used is a 25W EriPower PKA4000 series, requiring an input voltage between 39 Vdc and 64 Vdc.

The output data is as follows:

+5 Vdc output:

Nominal load . . . . . 3.1 A

Maximum load . . . . . 5 A

15 Vdc output:

Nominal load . . . . . 0.31 A

Maximum load . . . . . 0.8 A

WARNING ! **The total load must never exceed 25 W for each EriPower unit, i.e. 50 W in total.**

To generate the 5 Vdc analogue voltage (AVCC/AVEE) the 15 Vdc outputs from the DC-DC converter are fed to U2 and U3.

Socket-mounted components

The board holds no socket mounted components.

Connections

The board carries one 96-pin Europa connector to link it into the Transceiver Unit's backplane.

P1 pin assignment 96-pin Europa connector			
Pin	**A**	**B**	**C**
1	VCC	VCC	VCC
2	GND	GND	GND
3			
4	DC-IN1	DC-IN1	DC-IN1
5	DC-IN1	DC-IN1	DC-IN1
6	GND	GND	GND
7	GND	GND	GND
8	DC-IN2	DC-IN2	DC-IN2
9	DC-IN2	DC-IN2	DC-IN2
10	GND	GND	GND
11	GND		GND
12	U-STBY	GND	U-STBY
13		U-STBY	
14	CAP-POS		CAP-POS
15		CAP-POS	
16	GND		GND
17		GND	
18	POWER-ON		POWER-ON
19			
20			BATT
21			
22			
23			
24	AVCC (+5 Vdc)	AVCC (+5 Vdc)	AVCC (+5 Vdc)
25	GND	GND	GND
26	AVEE (-5 Vdc)	AVEE (-5 Vdc)	AVEE (-5 Vdc)
27			
28	AVFF (-15 Vdc)	AVFF (-15 Vdc)	AVFF (-15 Vdc)
29	GND	GND	GND
30	AVBB (+15 Vdc)	AVBB (+15 Vdc)	AVBB (+15 Vdc)
31	GND	GND	GND
32	VCC	VCC	VCC

Signal descriptions, inputs:

DC-IN1 . . . . . Main DC power source to the board

DC-IN2 . . . . . Backup DC power source to the board

Power-ON . . . . . Switches power ON (1) or OFF (0) TTL level signal

Power-UP ..... Switches power ON (1) or OFF (0) TTL level signal

Signal descriptions, outputs:

VCC ..... +5 Vdc, digital power max. 4 A (8 A)

AVBB ..... +15 Vdc power max 0.7 A (1.4 A)

AVFF ..... -15 Vdc power max 0.7 A (1.4 A)

AVCC ..... +5 Vdc analogue power max 0.7 A (1.4 A)

AVEE ..... -5 Vdc analogue power max 0.7 A (1.4 A)

U-STBY ..... Unswitched supply, outputs the highest input voltage - 1 Vdc

CAP-POS ..... Transmitter supply, constant charge circuit of 1.2 A

BATT ..... This output gives a high level when the main DC power source voltage drops below the backup DC power source voltage

Maintenance aids

Test points

TP1 ..... + 5 V digital

TP2 ..... Digital ground

TP3 ..... + 48 V analogue input

TP4 ..... Analogue ground input

TP5 ..... Analogue ground output

TP6 ..... - 15 V analogue output

TP7 ..... + 5 V analogue output

TP8 ..... + 15 V analogue output

Links

The board has a link field (LKI) comprising four links S1, S2, S3 and S4. These links are used to swap polarity on the DC-DC converted input pins.

A 48 volt supply requires S1 and S3 to be closed.

Switches

The board holds no switches.

Replacement of parts

General

The following circuit boards contained in the Transceiver Unit are defined as Line Replaceable Units (LRUs):

- The backplane.
- Input M - A/B.
- A/D Converter (ACM).
- Digital Signal Processor (DSPM).
- Control Processing Unit (CPUM).
- Ethernet.
- Input/Output (IOM).
- Responder (RPC).
- Transmitter (TxM - A/B).
- DC Power supply (DC - PWR).
- AC Power supply (AC - PWR).

The removal and replacement of these parts is described in the following paragraphs.

Note: *The maintenance engineer must wear a grounding bracelet which is securely connected to the vessel's ground at all times when performing maintenance on the Transceiver Unit.*

Replacement of circuit boards and software

The circuit boards in the Transceiver Unit are all plug-in modules which are easily replaceable. A special extraction tool (wire hooks) will considerably simplify the removal operation, and a small screw-driver may be required to open the front panel. All the boards and power units are replaced using the same procedure.

Removal of circuit boards

Removal of a board is performed according to the following procedure:

Note: *If the Transceiver Unit is installed in a console or a rack, the operation may be simplified by removing the unit to a work-bench before proceeding with the circuit board replacement.*

1 Ensure all power to the HPR system, and to other systems connected to the HPR system (e.g. DPS, vertical reference unit etc.) is switched off. Remove the system fuses if possible, and label the fuse panel with a tag stating that maintenance is being carried out on the system.

2 Using a small screw-driver if necessary, open the Transceiver Unit front panel. This is achieved by slackening the two captive screws in the upper corners and hinging the panel downwards. The panel must be allowed to swing below the horizontal if circuit boards are to be removed, so the unit may need to be supported on blocks.

3 Locate the desired circuit board and carefully remove any connectors which may be attached to the front of the board. This will not be easy.

4 Locate the extraction tool hooks into the holes in the upper and lower corners of the board's front edge and carefully pull the circuit board straight out from the Transceiver Unit rack.

Note: *Most of the circuit boards hold software in EPROMS, PROMs and PALs. If a board is to be replaced, the software will have to be moved over to the new board. Also, several links and switches must be set correctly to ensure proper operation. When replacing a circuit board, ensure that the new links and switches match the old .*

Software replacement

Replacing the software, or moving it to a new board, is a delicate job and must be handled with extreme care. The following precautions must be taken:

1 The replacement operation must be performed on a clean and stable workbench or table.

2 The table must be covered with an anti-static mat connected to the ship's ground.

3 The maintenance engineer MUST wear a grounding bracelet connected to the ship's ground.

4 Each software device is identified with a white label. This label holds the following information:

- Circuit board E.g. DSPM
- Device number E.g. U15
- Software version E.g. V1.1
- Date E.g. 92.09.15
- Check sum (in hexadecimal) E.g. 05A3

Removal

1 Identify the device to be removed, and write down the location of pin.1.

2 Using a small screwdriver or a special extraction tool, remove the device carefully from its socket on the source circuit board. Ensure the device is lifted as vertically as possible to prevent damage to the pins. Once removed, handle the device with care.

Insertion

Identify the socket where the device is to be located.

Place the device carefully into the socket, and ensure it is orientated correctly.

Check that all the pins are in the correct holes in the socket, then press the device firmly and evenly into the socket.

After insertion, check that all the pins are properly inserted into the socket and that no pins are bent.

Removal of the backplane

The backplane is located behind the circuit boards, and is accessible through the back of the unit. All the circuit boards and power units must be removed through the front of the unit before the backplane can be removed. All connections to the backplane are made using plugs.

Remove the backplane following the procedure below:

Note: *If the Transceiver Unit is installed in a console or a rack, the unit will need to be extracted and taken to a work-bench before proceeding with the backplane removal procedure.*

1 Ensure all power to the HPR system, and to other systems connected to the HPR system (e.g. DPS, vertical reference unit etc.) is switched off. Remove the system fuses if possible, and label the fuse panel with a tag stating that maintenance is being carried out on the system.

2 Label all the cables connected into the back of the Transceiver Unit, and disconnect them.

3 Remove all the circuit boards and power units using the procedure given in paragraph . Ensure the boards are placed in a safe place.

4 Using a small screw-driver, remove the 12 screws securing the Transceiver Unit rear panel in position. The panel is now attached to the unit only by the cables.

5 Using a suitable insulated tool or wire link, discharge the two large capacitors located towards the left side of the rear panel.

6 Remove all the connecters attached to the backplane. The backplane should now be readily accessible.

7 Slacken and remove the 18 screws securing the backplane into the Transceiver Unit. The backplane should now be loose, and the engineer can remove it carefully through the back of the unit.

If the backplane is going to be out of the Transceiver Unit for some time, it is recommended to replace the circuit boards into the front of the unit and close the unit to protect the boards.

Replacement of the backplane

Replacing the backplane is a reversal of the procedure given in paragraph .

Care should be exercised to ensure that parts fit together correctly before securing screws are tightened. Do not attempt to apply force to any of the parts. Do not over tighten the securing screws.

Replacement of circuit boards

When replacing a board into the rack, care must be exercised to ensure that the board is correctly positioned in the rails before any pressure is applied to the board. If the rear mounted connector pins are damaged, a replacement board will be required.

1 Ensure all power to the HPR system, and to other systems connected to the HPR system (e.g. DPS, vertical reference unit etc.) is switched off. Remove the system fuses if possible, and label the fuse panel with a tag stating that maintenance is being carried out on the system.

2 Locate the correct slot for the board in question. Note that the slots are identified by the board's initials, and the boards are identified by text written onto the component side. In all cases, the board must be located such that the components are to the right of the board.

3 Locate the board in the slots and carefully slide the board into the unit. Ensure that the board does not interfere with and cables as it is pushed in. If necessary, hold any cables which may be obstructing the board out from the unit.

4 When the connectors on the back of the board begin to mate with the connectors on the back plane, (approximately 5 mm before the board is fully home) check that the board is correctly located then apply even pressure over the front of the board and push it firmly home.

5 When the front of the board is fully home, the black plastic board retention clip will latch over the upper edge of the board to keep it in position.

6 Carefully replace the front connector (if applicable), ensuring it is pressed fully into the socket.

7 Once all the boards are in position, close the front of the Transceiver Unit. Ensure that the power cable towards the right side of the unit is not crimped as the panel is closed. Secure the panel closed using the two screws in the upper corners.

Replacement of fuses

Fuse locations

The Transceiver Unit has two mains input fuses, held in fuse holders located towards the left side of the rear panel (when seen from the rear). A further four fuses are located on the Responder board (though as this board is optional it may not be included in the Transceiver Unit), and the AC power supply holds one.

The fuses are as follows:

- On the rear panel
  - For 115/230 Vac supply - 5 mm x 30 mm, 2 A, slow-blow.
  - For 115/230 Vac supply - 5 mm x 30 mm, 2 A, slow-blow.
- On the Responder board

  Four fuse holders are mounted on the board. The fuses to be used are
  - 5 mm x 20 mm, 0.1 A, 24 Vdc, slow-blow.
- In the AC power supply

  The fuse is contained in a holder located on the rear of the unit. The fuse to be used is:
  - 5 mm x 20 mm, 250 V, 2.5 A, slow-blow.

Caution: *Never attempt to use any other size of fuses than those stated.*

Fuse replacement

1 Switch off the entire HPR system, including other external units which are connected to the HPR system.

2 If the suspect fuse is located on a circuit board, remove the board from the Transceiver Unit following the procedure described in paragraph . Replace the blown fuse(s) with the correct size and type of fuse.

Caution: *NEVER attempt to use anything except the correct size and type of fuse in the fuse holders. Irreparable damage may be caused to the Transceiver Unit if the wrong fuses (or anything else) are used.*

3 Return power to the HPR system, then to the other external units.

Note: *If, when a fuse is replaced, it blows again when power is switched on to the system, a more serious fault exists. Do not replace the fuses a second time till the fault has been located and corrected.*

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5 HL 3880 SYSTEM DESCRIPTION

Purpose

The purpose of the hull unit is to enable the transducer to be lowered out through the vessel's hull to a depth below aerated water and other sources of acoustic noise.

Caution: *Once the transducer is lowered, the depth of water under the vessel must be monitored closely. It is recommended that the vessel's speed be kept below 10 knots when the transducer is in the lowered position.*

Overview

This section presents the standard units of the HPR 400 series, for a standard configuration.

Hull unit system

The Kongsberg Simrad HL 3880 hull unit is a retractable hull unit system comprising the following main parts:

- Hull unit assembly
  - Hoist motor and gearbox
  - Gantry
  - Shaft sleeve
  - Mounting flange
  - Transducer shaft
  - Transducer
  - Gate valve including:
    - √ Position indicator (switch)
    - √ Electrical actuator (option)
- Hoist Control Unit
- Remote Control Unit
- Transducer dock

Other standard HPR hull units

The descriptions in this document also apply to the following hull units:

- HL 1030
- HL 1530
- HL 2300
- HL 3100
- HL 6230

These hull units are based on the same design as the HPR 400 series system, but differ in total height, transducer design and transducer depth.

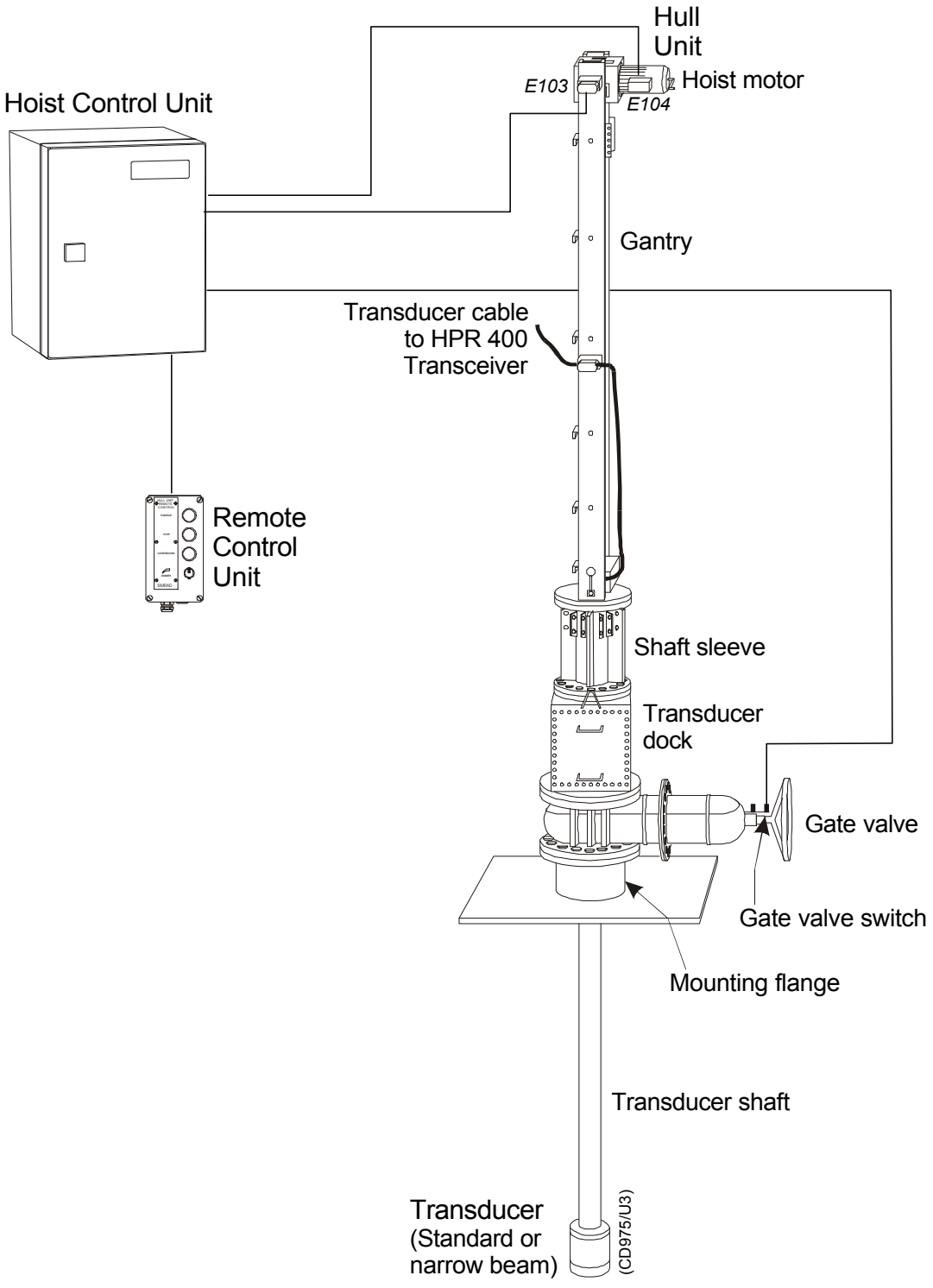


Figure 43 - HL 3880 hull unit - system configuration

Hull unit descriptions

Hoist motor and gearbox

The hoist motor and gearbox are mounted on the hoist platform. This platform is at the top of the hull unit, mounted between the tops of the gantry girders.

The transducer is raised and lowered by this electric motor, which has a lifting capacity of 1000 Kp.

A crank handle is provided, which can be attached to one end of the motor shaft, to enable you to raise or lower the transducer manually in the event of a power failure or for maintenance purposes.

The handle is stowed beneath the hoist platform, and must be fitted to the motor shaft for use.

Gantry

The hull unit gantry consists of two vertical, parallel steel girders, welded to a plate at their lower ends and with the hoist motor platform bolted to their upper ends. The girders support the transducer shaft when it is raised, and hold guide rails to ensure the shaft is correctly aligned. The upper and lower limit switches are mounted onto one of the girders.

Shaft sleeve

The shaft sleeve is located in the bottom of the hull unit gantry. The sleeve is bolted to the transducer dock, which in turn is to be bolted to the gate valve. The shaft sleeve absorbs the forces created by the water flow acting on the transducer and the transducer shaft.

To prevent water leakage and to ensure smooth raising and lowering of the transducer, the shaft sleeve is fitted with Lion twin-set packing seals at its upper end and a scraper at its lower end. The space between the seals is filled with grease to lubricate the seals and provide extra watertight security.

When the sleeve is sufficiently filled, a thin film of grease will be observable on the transducer shaft. Grease refilling and level checking screws are located on the shaft sleeve.

Note: *It is important that the shaft sleeve is kept watertight, and that the transducer shaft raising and lowering actions are as smooth as possible. If the system is in frequent use, the shaft sleeve may be exposed to sea growth, dirt and pollution as the transducer shaft is raised. Frequent inspections, and greasing when necessary, are strongly recommended.*

Transducer dock

The transducer dock (service dock) consists of a steel box which holds the transducer when the shaft is in the fully raised position. One side of the transducer dock comprises a service hatch. If the transducer is raised and the gate valve shut, the hatch may be opened to expose the transducer for maintenance or exchange. Zinc anodes are mounted inside the transducer dock.

Mounting flange

The mounting flange is welded to the vessels hull, and serves as a base for the transducer raise/lower arrangement. The height of the mounting flange varies according to the specific installation requirements of the vessel, though the standard height is 200 mm. The mounting flange carries the gate valve which permits onboard maintenance or replacement of the transducer.

Transducer shaft

The transducer shaft is a stainless-steel tube which supports the transducer at its lower end. It is supported at the top by guide rails and the raise/lower drive chains within the hull unit gantry, and it moves through the shaft sleeve. The signal cable between the transducer and the transceiver unit runs up the inside of the shaft, exiting at the top through sealing glands.

The transducer shaft is raised and lowered by drive chains, driven via a gearbox by the motor mounted on the hoist platform. The tension in the drive chain is adjusted using a threaded bolt mechanism.

Transducer

The transducer is bolted to the lower end of the transducer shaft. When the shaft is raised, the transducer is stored in the transducer dock. during these periods the gate valve can be closed to protect the transducer completely from the open sea environment.

Gate valve

The gate valve shuts off the opening in the vessel's hull when the transducer is raised. The gate valve is supplied with a position indicator.

- An electrical actuator is available as an option.

Gate valve position indicator

The purpose of the gate valve position indicator is to give a feedback indication of the position of the gate valve. The feedback is done by use of switches.

The gate valve position indicator is mounted directly onto the gate valve.

It consists of a slider sliding on a threaded spindle and two switches operated by the slider.

Switch A - is operated when the gate valve is fully open.

Switch B - is operated when the gate valve is fully closed. In the middle position no switch is operated.

The Hoist Control Unit uses the fully open indication (switch A) ***only!***

The Hoist Control Unit will not allow the hoist motor to move the Transducer shaft unless the gate valve is fully open.

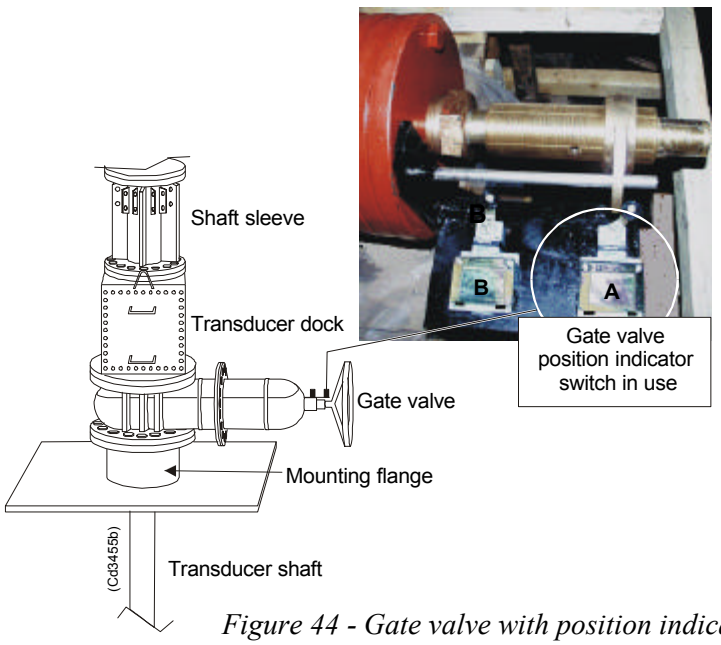


Figure 44 - Gate valve with position indicator

Hoist Control Unit

Introduction

The Hoist Control Unit (HCU) is standard unit used with all types of hull units. This unit is a steel cabinet with hinged front door.

The unit is designed to be mounted on a bulkhead close to the hull unit gantry. For safety reasons there must be a clear line of sight from the HCU to the hull unit.

External connections

All cables to the HCU enter the unit through cable gland located in the base of the unit.

The connections are as follows:

- Controlled mains supply to hull unit raise/lower motor.
- 7 x 2-core signal cable from Remote Control Unit (remote control).
- 4-core signal cable from the hull unit (limit switches etc.).

Remote Control Unit

General

The Remote Control Unit (RCU) is standard unit used with all types of hull units. This unit is an aluminium cabinet with removable front door.

It holds the control buttons and indicator lamps required to enable the safe operation of the hull unit from a remote location.

This unit is designed to be mounted on a bulkhead, and will usually be located in the vicinity of the system operator station. This enables the system operator to control the hull unit raising and lowering operations without being at the physical location of the hull unit.

External connections

The RCU is connected to the Hoist Control Unit via a cable. There are no practical restrictions on the distance between the two units.

The connection is as follows:

- 7 x 2-core signal cable to the Remote Control Unit (remote control).

Electrical system

Introduction

The raise/lower system for the hull unit comprises three main components:

- Hoist Motor
- Hoist Control Unit (HCU)
- Remote Control Unit (RCU)

Note: *The technical description of the HCU electrical system, and the connections to the other two main units, are described in this section.*

Hoist control unit

The HCU controls the hoisting and lowering of the hull unit. It uses a +24 Vdc linear power supply to provide control voltages for two relays; K02 and K03. These relays connect the 3-phase mains power to the hoist motor. The motor's direction of rotation depends on the mains supply phase sequence, and the HCU performs the hoist/lower function by using the relays to change the phase sequence.

The HCU contains a switch to operate the hull unit locally, while a RCU is connected in to the HCU.

Fuse F01 protects the 24 Vdc power supply used by the remainder of the electric circuits. Fuse F02 is mounted with relay K03 and protects the hoist motor.

Remote control unit

The RCU is an independent unit, usually mounted on the bridge in the vicinity of the system operator's console. This unit controls the power relays via relays K01 and K04 in the HCU.

Circuit description

References

Refer to the following drawings:

→ *Wiring diagram, Hoist Control Unit on page 239.*

→ *Wiring diagram, Remote Control Unit on page 240.*

→ *Interconnection diagram, hoisting system on page 238.*

Power supplies

The HCU can be supplied with 230, 380, 440 Vac 3-phase mains input. The acceptable mains voltage depends on links set within the HCU and the type of motor mounted on the hull unit.

The HCU can be supplied with 230, 380 or 440 (400) Vac 3-phase mains input. The acceptable mains voltage depends on links set within the HCU and the type of motor mounted on the hull unit.

+24 Vdc power supply

The +24 Vdc power supply is derived from a 1-phase voltage taken from the 3-phase mains input. It enters through the automatic circuit breaker F01 (2A), and is connected to transformer T01. Links on T01 must be set according to the mains voltage supplied. Refer to the HPR 400 series wiring diagram, which shows the links required for 380/440 Vac as default.

T01 delivers a voltage of 18 Vac, and D04 cuts off any voltages above this limit. The rectifier D05 delivers 24 Vdc across the decoupling capacitor C01 to the control circuits. The connections for the 24 Vdc power supply are made on the terminal block HUTB2.

Motor power supply

The 3-phase mains power enters on the motor protection fuse F02, and is passed to the relays K02 and K03. Activation of one of the relays will supply the 3-phase voltage to the hoist motor. K02 delivers the opposite phase sequence to that delivered by K03. This shifting of phases controls the direction of motor rotation.

- Activating K02 causes the motor to hoist the hull unit.
- Activating K03 causes the motor to lower the hull unit.

Relay K02 has two additional contacts, connected as a change-over contact. This can be used when sonar power must not be turned off before the hull unit is fully retracted. Contacts 21 and 22 on K02 and K03 prevent the relays being activated simultaneously.

Relay control

Before the relays K02 or K03 activate and start the motor, several independent events must take place simultaneously. The control circuit is a serial link of several switches with each switch representing one event. When all the switches are closed and the circuit is complete, the relay will be activated by supplying 24 Vdc across its coil. A break in the series circuit will halt the hoist/lower action. Refer to the figures on the following pages.

The designs of the lowering and hoisting circuits are identical for both local and remote control.

Hoist Control Unit

The Hoist Control Unit contains the relays to control the operation of the raise and lower motor.

The Hoist Control Unit is controlled either by:

- The selector switch located inside the unit, or
- the Remote Control Unit.

The Hoist Control Unit is designed to be installed on a bulkhead, and must be located in a position providing a free line of sight to the hull unit. it is important to make easy access to the unit's circuits services purposes.

Remote Control Unit

A Remote Control Unit is located close to the operator unit, to enable the operator to raise and lower the hull unit without having to go down to the hull unit compartment. The unit holds the control buttons and indicator lamps for the raiser/lower mechanism. The Remote Control Unit is connected to the Hoist Control Unit.

Lowering in remote control

The remote control unit uses relays K01 and K04 for control of K02 and K03 respectively.

- A1 on K03 connects to +24 Vdc through the following circuit:
  - S1 . . . . . (S1 set to REM)
  - to K04/4-7 . . . . . (closed when K04 activated)
  - to +24 Vdc
- A2 on K03 connects to ground through the following circuit:
  - K02/21-22 . . . . . K02 not active)
  - to HCTB1/18
  - to lower limit switch . . . . . (switch closed until activated)
  - to HCTB1/19
  - to motor protection relay F02/96-95
  - to ground in HCTB1/20, 21.

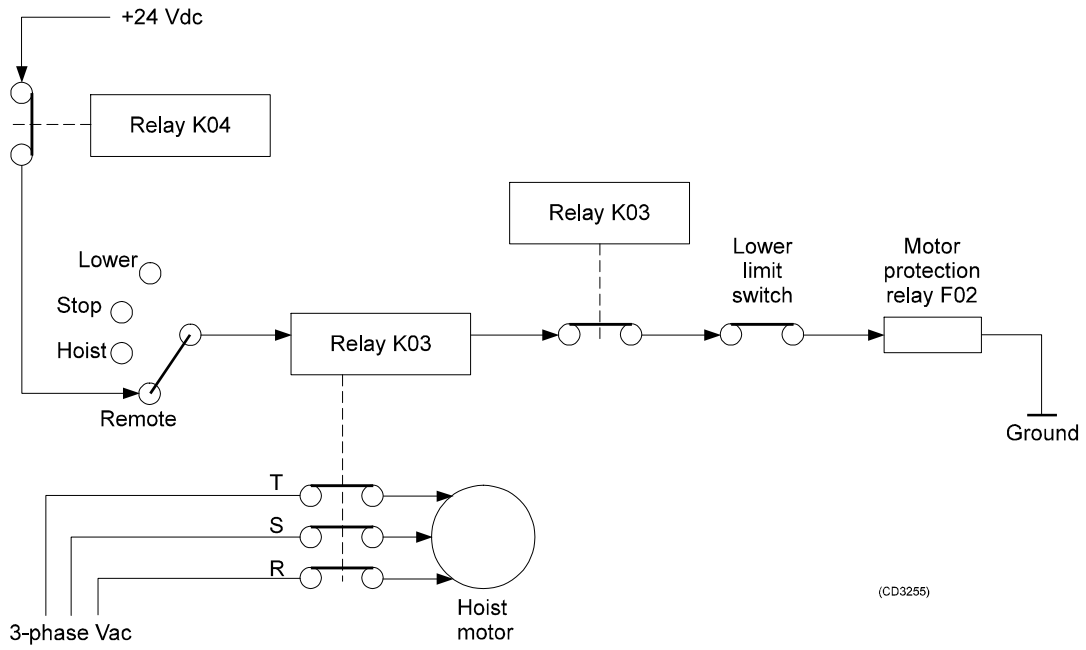


Figure 45 - Lowering in remote mode

Relay K04 circuit

When in the remote mode relay K04 must be activated to activate relay K03. To activate relay K04 the (DOWN) button (switch S3) on the Remote Control Unit must be closed. S3 has two switches working in opposition; one normally closed, the other normally open. These switch when S3 is pressed. Pressing S3 activates K04 and deactivates K01.

- A on K04 connects to +24 Vdc through the following circuit:
  - HCTB1/25 . . . . . (Down)
  - to RMTB/4 . . . . . (Down)
  - to DOWN switch S3/3-4 in Remote Control Unit (S3 activated)
  - to +24 Vdc via RMTB/1 and HCTB1/27.

The deactivated (UP) switch S1 provides +24 Vdc via relay K04 to keep relay K04 active when the (DOWN) button (S3) is pressed.

- A on K04 connects to +24 Vdc through the following circuit:
  - K04/6-9
  - to HCTB1/26 . . . . . (Down hold)
  - to RMTB/3 . . . . . (Down hold)
  - to HOIST switch S1/1-2 in Remote Control Unit (S1 inactive)
  - to STOP switch S2/1-2 in Remote Control Unit (S2 inactive)
  - to +24 Vdc via RMTB/1 and HCTB1/27.
- B on K04 connects to ground through the following circuit:
  - HCTB1/18
  - to lower limit switch . . . . . (switch closed until activated)
  - HCTB1/19
  - to motor protection relay F02/96-95
  - to ground in HCTB1/20, 21.

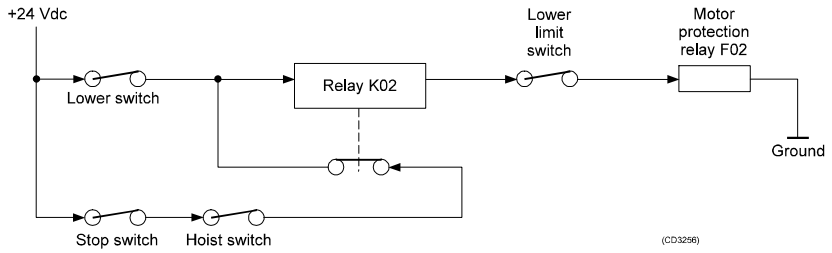


Figure 46 - K04 control

Hoisting in remote control

- A1 on K02 connects to +24 Vdc through the following circuit:
  - S1 . . . . . (S1 set to REM)
  - to K01/4-7 . . . . . (closed when K01 activated)
  - to +24 Vdc
- A2 on K02 connects to ground through the following circuit:
  - K03/21-22 . . . . . (K03 not active)
  - to HCTB1/15
  - to upper limit switch . . . . . (switch closed until active)
  - to HCTB1/16
  - to motor protection relay F02/96-95
  - to ground in HCTB1/20, 21.

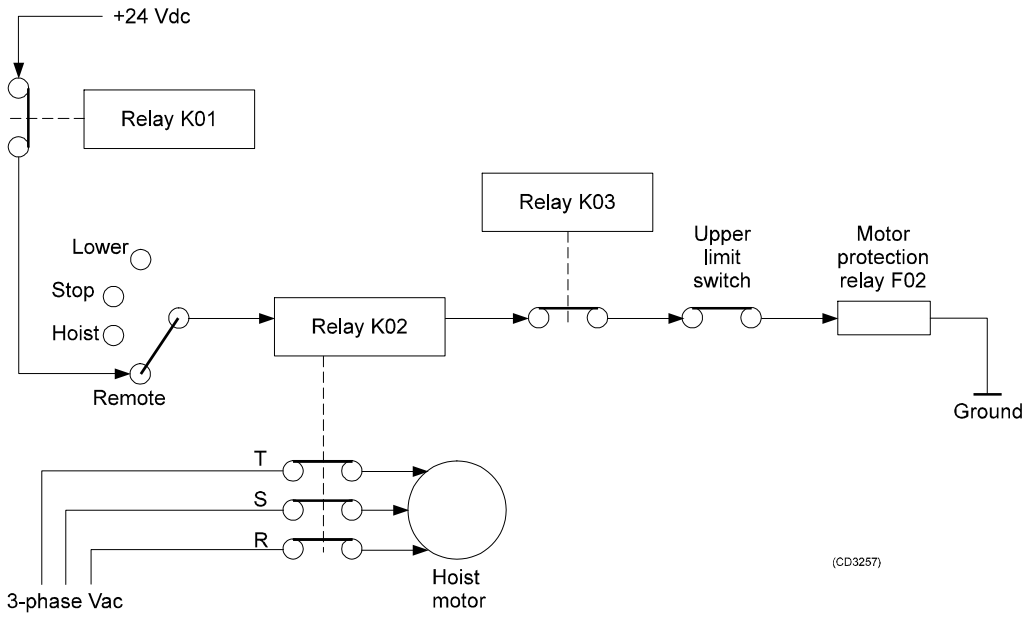


Figure 47 - Hoisting in remote mode

Stop

Pushing the (STOP) button breaks the +24 Vdc (up / down hold) needed to keep relay K01 and K04 active.

Relay K01

Relay K01 must be activated to activate relay K02 in remote mode.

To activate relay K01, the (UP) button (S1) in the remote control unit must be pressed. S1 has two switches working in opposition. One is normally closed, the other is normally open. These switch only when S1 is pressed. Pressing S1 activates K01 and deactivates K04.

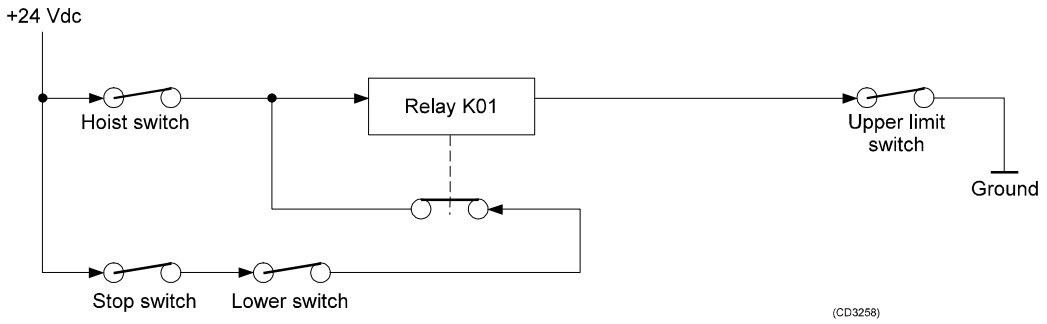


Figure 48 - K01 control

- A on K01 connects to +24 Vdc through the following circuit:
  - HCTB1/23 . . . . . (Up)
  - to RMTB/2 . . . . . (Up)
  - to HOIST switch S1/3-4 in Remote Control Unit (S1 activated)
  - to +24 Vdc via RMTB/1 and HCTB1/27

To keep relay K01 active when S1 is released, the (DOWN) button (switch S3) provides +24 Vdc via relay K01 itself.

- A on K01 connects to +24 Vdc through the following circuit:
  - K01/6-9
  - to HCTB1/24 . . . . . (Up hold)
  - to RMTB/5 . . . . . (Up hold)
  - to DOWN switch S3/1-2 in Remote Control Unit (S3 not active)
  - to STOP switch S2/1-2 in Remote Control Unit (S2 not active)
  - to +24 Vdc via RMTB/1 and HCTB1/27
- B on K01 connects to ground through the following circuit:
  - HCTB1/15
  - to upper limit switch . . . . . (switch closed until activate)
  - HCTB1/16
  - to motor protection relay F02/96-95
  - to ground in HCTB1/20,21

Lamps

There are three lamps on the Remote Control Unit to assist the operator:

Upper - The UPPER light burns when the hull unit is not in its lower position.

Lower - The LOWER light burns when the hull unit is not in its upper position.

Stop - The STOP light burns when relays K01 and K04 are deactivated. I.e. when the hull unit is not operated from the remote control unit.

All lamps are connected to a dimmer switch.

Upper

The UPPER light connects permanently, via dimmer potentiometer, to +24 Vdc on RMTB/1, and to ground through the following circuit:

- RMTB/7
- to HCTB1/17,18
- to lower limit switch . . . . . (switch closed until activated)
- to HCTB1/19
- to motor protection relay F02/96-95
- to ground in HCTB1/20, 21.

Lower

The LOWER light connects permanently, via dimmer potentiometer, to +24 Vdc on RMTB/1, and to ground through the following circuit:

- RMTB/8
- to HCTB1/14,15
- to upper limit switch . . . . . (switch closed until activated)
- to HCTB1/16
- to motor protection relay F02/96-95
- to ground in HCTB1/20, 21.

Stop

The STOP light connects permanently, via dimmer potentiometer, to +24 Vdc on RMTB/1, and to ground through the following circuit:

- RMTB/6
- to HCTB1/22
- to K01/2-8 . . . . . (K01 not activated)
- to K04/2-8 . . . . . (K01 not activated)
- to ground in HCTB1/28

Lowering in local control

S1 connects A1 on K03 to +24 Vdc.

- A2 connects to ground through the following circuit:
  - K02/21-22 . . . . . (K02 not active)
  - to HCTB1/18
  - to lower limit switch . . . . . (switch closed till activated)
  - to HCTB1/19
  - to motor protection relay F02/96-95
  - to ground in HCTB1/20, 21.

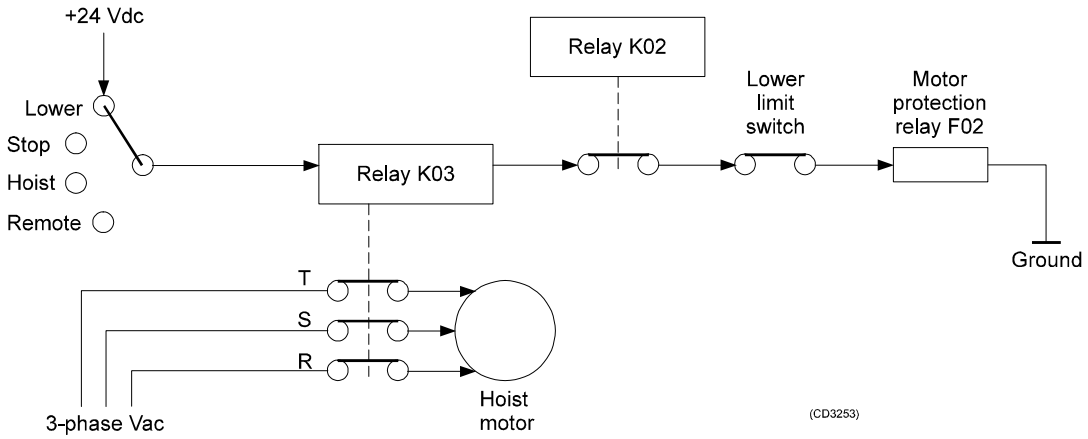


Figure 49 - Lowering in local mode

Hoisting in local control

S1 connects A1 on K02 to +24 Vdc.

- A2 connects to ground through the following circuit:
  - K03/21-22 . . . . . (K03 not active)
  - to HCTB1/15
  - to upper limit switch . . . . . (switch closed till activated)
  - to HCTB1/16
  - to motor protection relay F02/96-95
  - to ground in HCTB1/20, 21.

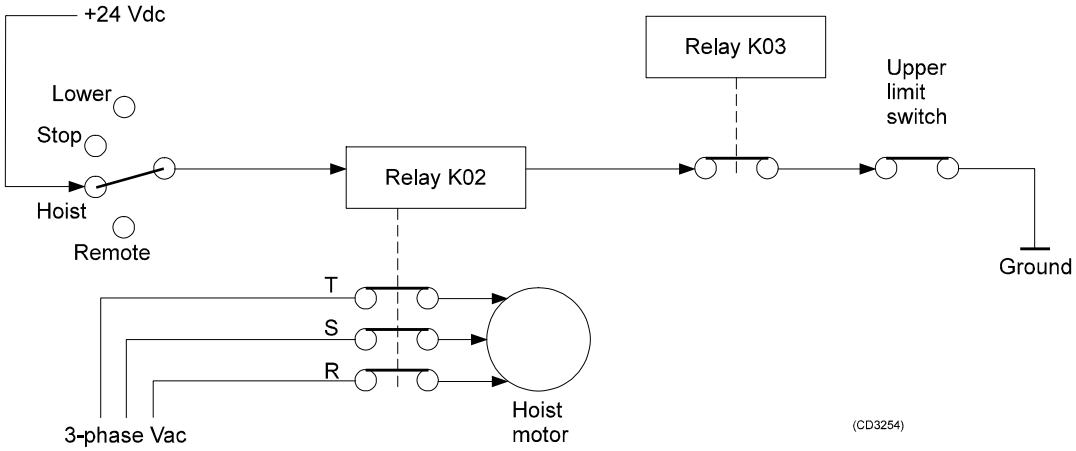


Figure 50 - Hoisting in local mode

Stop

When set to STOP, S1 disconnects the 24 Vdc supply from relays K02 and K03, preventing them from activating.

Electrical actuator (option)

General

The electrical actuator is used to open and close the gate valve automatically.

- The actuator is a high value electro-mechanical devise.
- The actuator is designed to be mounted directly on the gate valve.

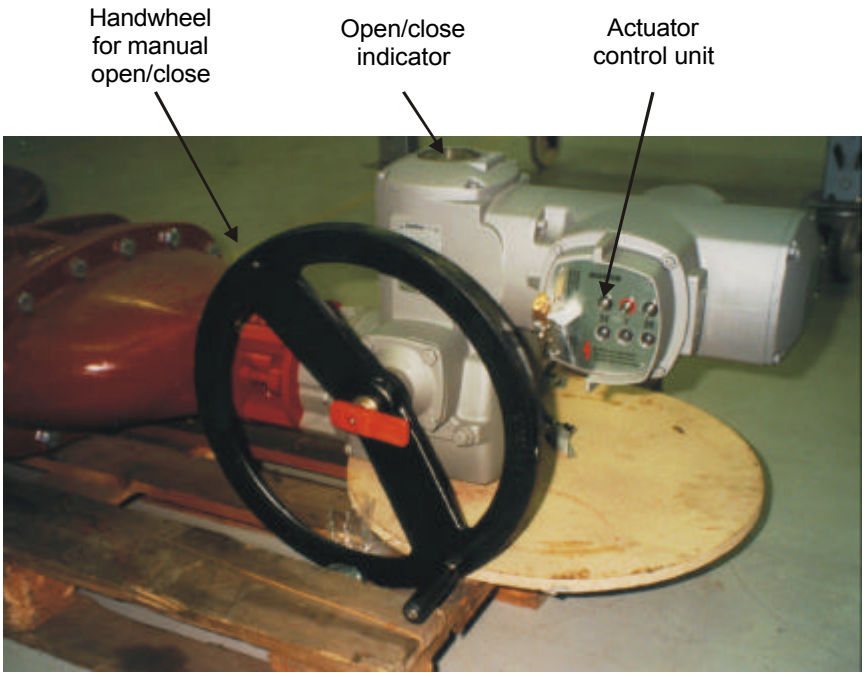


Figure 51 - Standard gate valve with electrical actuator

System

The electrical actuator system comprises of three main units:

- Actuator
- Remote station
- Local control unit

The system's electrical contains the electronic circuitry and relays required to open and close the gate valve. The actuator and control units are connected directly to the hull unit Remote Control Unit.

The gate valve can be operated manual by us of a hand wheel, or automatically by us of local/remote operation panels.

Interlocks prevents:

- To lower the hull unit if the gate valve is closed.
- The gate valve to be closed if the hull unit is lowered.

Selection of remote or local operation is done at:

- The actuator *local control unit*.

Local control unit

The actuator local control unit is used to open and close the gate valve in the vicinity of the hull unit. As illustrated on the figure the local control unit holds:

- Five lamps
- Two buttons
- A switch

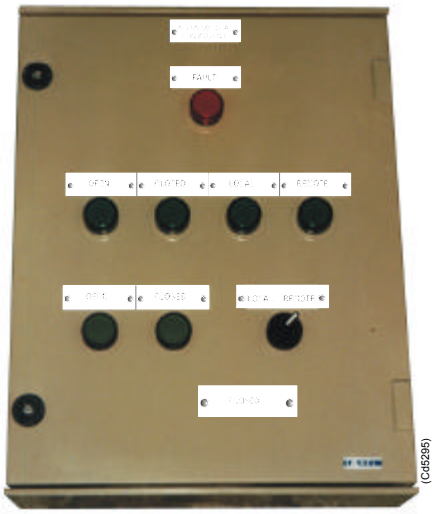


Figure 52 - Actuator local control unit

Lamps

The function of the lamps are as follows:

FAULT	When lit, it indicates torque overload.
OPEN	When you press the button, the light will extinguish (if lit). When the gate valve is fully open the lamp will lit.
CLOSED	When you press the button, the light will extinguish (if lit). When the gate valve is fully closed the lamp will lit.
LOCAL	When lit, it indicates LOCAL operation.
REMOTE	When lit, it indicates REMOTE operation.

Pushbuttons

The function of the pushbuttons are as follows:

OPEN	Push the button, and the gate valve is opening.
CLOSE	Push the button, and the gate valve is closing.

Switch

The function of the switch is:

LOCAL	Local position, activates local control of the gate valve operation.
REMOTE	Remote position, activates remote control of the gave valve operation.

Remote station

The actuator remote station is normally mounted close to the operators station. This enables the operator to operate the gate valve from the operator's room. As illustrated on the figure the local control unit holds:

- Five lamps
- Two buttons

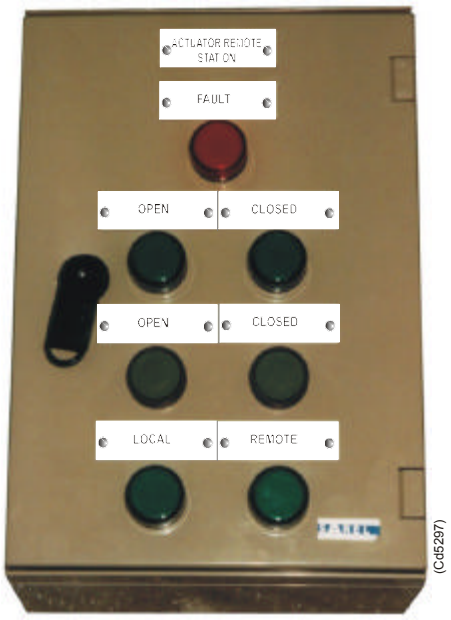


Figure 53 - Actuator remote station

Lamps

The function of the lamps are as follows:

FAULT	When lit, it indicates torque overload.
LOCAL	When lit, it indicates LOCAL operation.
REMOTE	When lit, it indicates REMOTE operation.

Pushbuttons

The function of the pushbuttons are as follows:

OPEN	When you press the button, the light will extinguish (if lit). When the gate valve is fully open the lamp will lit.
CLOSED	When you press the button, the light will extinguish (if lit). When the gate valve is fully closed the lamp will lit.

Electrical connections

The cables are connected to the actuator via the actuator terminal compartment. All cables are yard supply.

6 HL 3880 CABLE LAYOUT AND INTERCONNECTIONS

Overview

This section describes the general installation requirements regarding cables. It then describes all the cables connected to the HPR 400 series and associated units, and explains how to perform the interconnections between those units.

Note: *All cable connections must be made in accordance with the guidelines laid down by the vessel's classification society.*

If no such guidelines exist, Kongsberg Simrad recommends that the *Den norske Veritas (DnV) Report No. 80-P008, "Guidelines for Installation and Proposal for Test of Equipment"* be used as a guide.

Cable specifications

Each individual cable is identified on the cable plans. The cables fall into two categories:

- Cables provided by the installation shipyard.
- System cables supplied with the delivery.

Shipyard cables

The cables to be provided by the shipyard are identified as such in the cable listing.

Note: *The cable specifications given are the minimum specifications.*

For each cable the following is provided:

- Connection to be made on each end of the cable (including system units, terminal block identification and plug/socket to be used).
- Number of cores.
- Recommended cable type.
- Minimum cable specifications.

Caution: *Any special requirements must be considered in addition to those listed. Kongsberg Simrad accepts no responsibility for damage to the system or reduced operational performance if this is caused by improper cabling.*

System cables

Several cables will be supplied with the system. Such cables normally comprise power cables for peripheral equipment, and interconnection cables for computers and/or workstations. These cables are normally packed with the units.

Cable connections

All cables must be terminated correctly. The required information is provided in the applicable interconnection drawings.

Special cables

Special system applications or requirements may result in additional or modified cable runs.

Cable plan

This section describes only those cables associated with the hull unit and its control units.

The cable plan defines the main interconnection cables between the individual system cabinets an units. Each cable is then listed including the required cable specification.

All other system cables are fully described in the system *Installation manual*.

→ *Refer to page NO TAG for details of cable laying, requirements for conduits etc.*

→ *Refer to the relevant cable plans and wiring diagrams for details of the terminations and connections.*

Caution: *All power must be switched off to the system prior to the cable installation.*

All cables must be available at the units, properly installed in cable ducting. Care must be taken not to exceed the physical limitations of the cables.

Note: *Special system requirements, adaptions or components may introduce special drawings and cables.*

Note: *In order to meet the EMC requirements, dedicated grounding cables have been used to connect the various system units to the vessel's ground. These cables are identified as "X" on the cable plan drawings. The braided grounding cable required is supplied with the system. These cables must not be longer than 1 metre.*

Hull unit cables

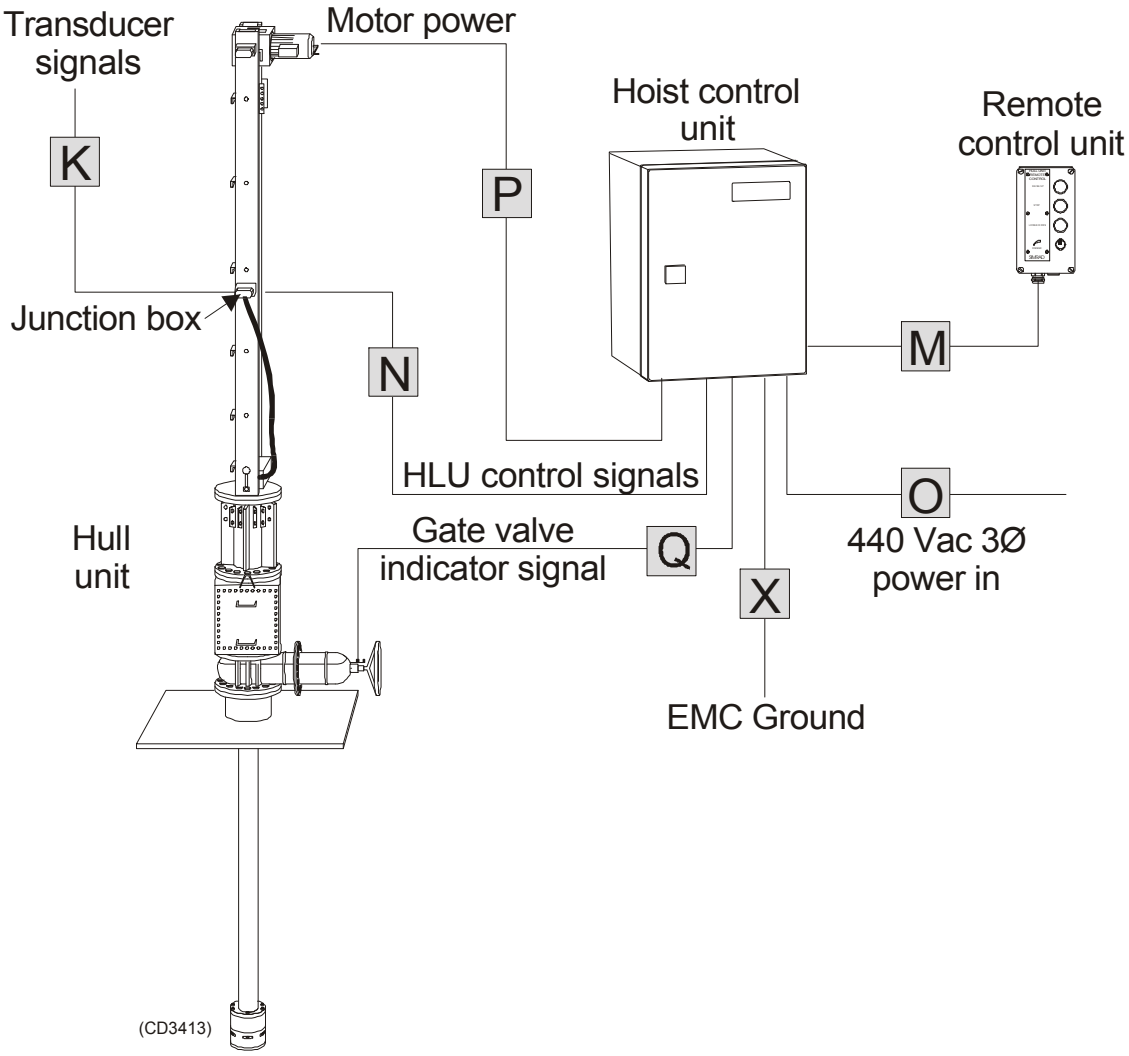


Figure 54 - Standard HPR hull unit cabeling

Cables

Cable K

Transducer cable from Transceiver Unit to Transducer

- Kongsberg Simrad supply.
- The transducer cable is screened and consists of 10 twisted pairs, each individual screened. Cable diam. 19 mm.
- The hull unit end is connected to terminal blocks in the junction box, and the transceiver end is connected to the terminal block in the transceiver unit.
- Maximum length: 300 m (extension cables can be used).

Cable M **Cable from Hoist Control Unit to Remote Control Unit**

- Shipyard supply.
- RCOP 7 x 2 / 0.5 mm^2 with overall braided screen, 60 V.
- Both ends terminated in terminal blocks, refer to the interconnection drawing.
- Maximum length: No practical limit.

Cable N **Cable from Hoist Control Unit to Hull Unit Junction Box**

- Shipyard supply.
- RCOP 4 / 1.5 mm^2 with overall braided screen, 750 V.
- Both ends terminated in terminal blocks, refer to the interconnection drawing.
- Maximum length: No practical limit.

Cable O **Cable from 440 Vac / 3-phase / 3A to Hoist Control Unit**

- Shipyard supply.
- RCOP 4 / 1.5 mm^2 with overall braided screen, 750 V.
- Hoist Control Unit end terminated in terminal block, refer to the interconnection drawing.
- Maximum length: No practical limit.

Cable P **Cable from Hoist Control Unit to Hoist Motor**

- Shipyard supply.
- RCOP 4 / 1.5 mm^2 with overall braided screen, 750 V.
- Hoist Control Unit end terminated in terminal block, refer to the interconnection drawing. The motor end connects to the dedicated power inlet tags on the motor.

Cable Q **Cable from Hoist Control Unit to Gate valve position indicator**

- Shipyard supply.
- RCOP 4 / 1.5 mm^2 with overall braided screen, 750 V.
- Hoist Control Unit end terminated in terminal block, refer to the interconnection drawing.
- Maximum length: No practical limit.

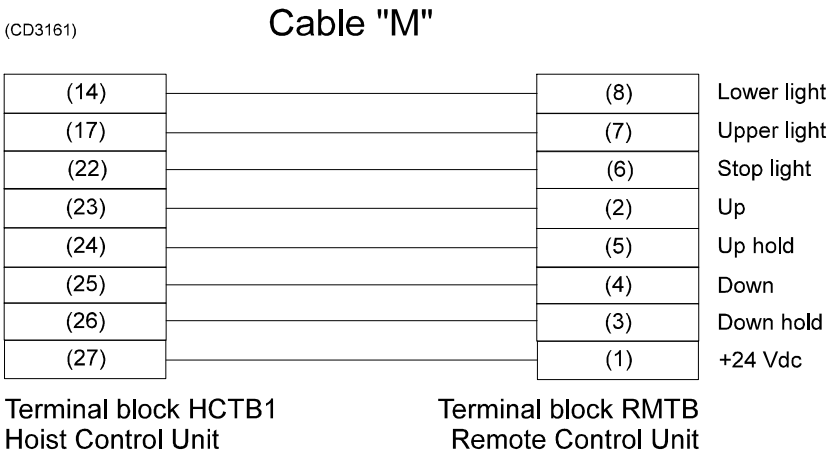
Cable X **Cable from Hoist Control Unit to EMC ground**

- Kongsberg Simrad supply.
- Braided copper wire.
- Both ends terminated at M8 screws.
- Length: 300 mm.

Cables interconnection

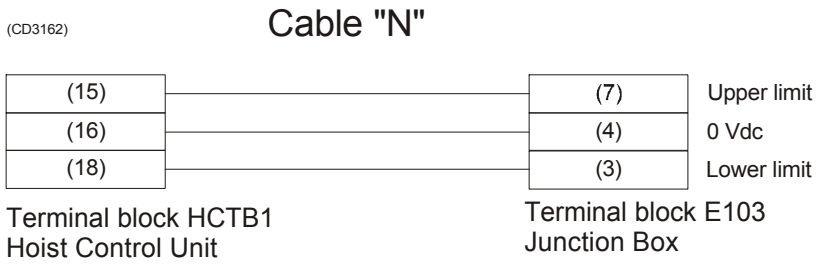
Cable M

This cable connects the Hoist Control Unit with the Remote Control Unit. Both ends are connected into terminal blocks within the respective units.



Cable N

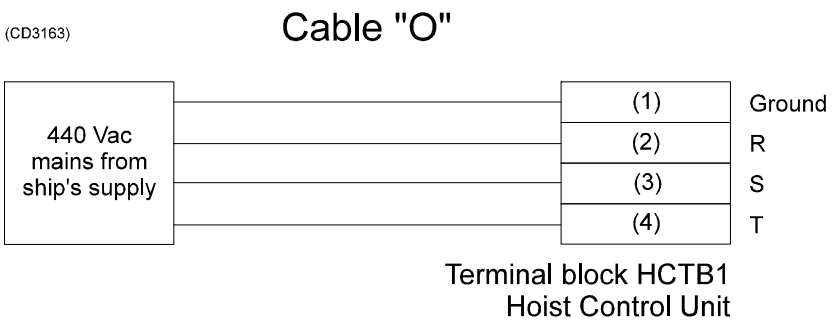
This cable connects the Hoist Control Unit to the Junction Box on the hull unit. The cable is supplied by the manufacturers, and is fitted with the appropriate terminations.



Cable O

This is the 440 Vac power cable from the vessel's main supply to the Hoist Control Unit. The cable is connected into the terminal block in the unit.

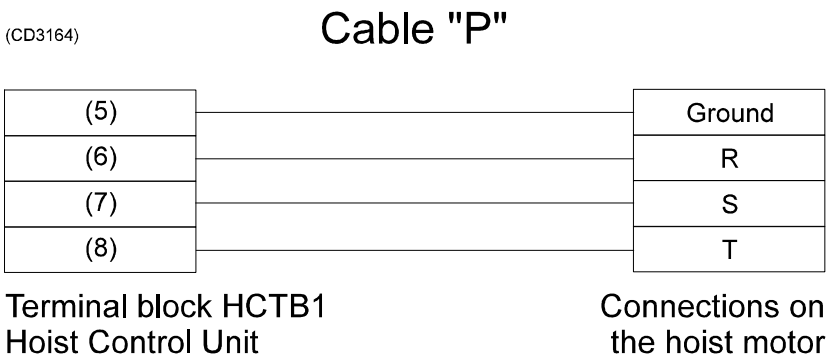
(CD3163)



Cable P

This is the 440 Vac power cable from the Hoist Control Unit to the Hoist Motor on the hull unit. The cable is connected to the terminal block in the Hoist Control Unit, and to the dedicated connection tags on the motor.

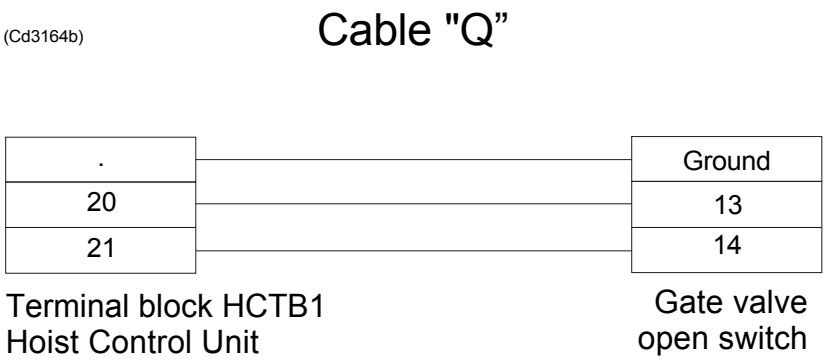
(CD3164)



Cable Q

This is the signal cable from the Hoist Control Unit to the Gate valve position indicator. The cable is connected into the Hoist Control Unit terminal block.

(Cd3164b)



Cable installation

This procedure describes how to install the cables between the a hull unit and the Hoist Control Unit.

Logistics

Safety - Refer to the general safety procedures.

Personnel - Trained electrical fitter.

Ship location - No special requirements. The watertight integrity of the vessel will not be effected.

Special tools - None

References

→ *Wiring diagram, Hoist Control Unit on page 239.*

→ *Wiring diagram, Remote Control Unit on page 240.*

→ *Interconnection diagram, hoisting system on page 238.*

Installation procedure

1 Remove the junction box lid.

2 Dismantle the appropriate cable gland.

3 Thread the various parts onto the cable in the correct order.

4 Pass the cable into the junction box.

5 Connect the cable terminations into the junction box terminal block.
- Ensure all connections are made firmly.
- Refer to the diagrams and drawings listed above.

6 Reassemble the cable gland and tighten it to ensure a water proof seal, ensuring enough slack is left in the cable so none of the wires is under tension.

7 When all cables have been connected, check the entire assembly to ensure all the connections are correct and tight.

8 Replace the junction box lid, using a thin film of silicon grease on the seal to ensure the box will be water proof.

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7 HL 3880 MAINTENANCE

Scope

This section of the manual contains information to enable the maintenance engineer to perform all normal preventive and corrective maintenance on the Hull Unit system.

It includes maintenance for:

- Hull Unit
- Gate valve including:
  - Position indicator

Drawings referred to in the text are listed as references, and are located in the *Drawing file* section.

Spare parts are defined according to Kongsberg Simrad's maintenance philosophy. They are listed in the *Spare Parts* section.

Safety

Working on live electrical equipment is dangerous. Refer to standard company/vessel safety procedures before commencing maintenance work.

Note: *After any maintenance work, the system must be checked to ensure it works correctly. Refer to the procedure in the* Test and alignment procedures *section.*

Caution: *Do not work on the hull unit while the system is operational. It may move without warning. Keep your hands away from the unit when the system is in use. The drive chain is exposed, and may cause serious personal injury. Access to the hull unit compartment should be restricted.*

Watertightness test

The hull unit compartment is of necessity located in the keel of the vessel below the water-line. Maintenance on the hull unit must therefore be carried out with care to ensure that no water leaks occur. If maintenance work must be performed on the "wet" sections of the hull unit, always perform a watertightness test before breaking the watertight integrity of the hull unit.

→ *Refer to page 175.*

Torques

All the nuts and bolts used in the system must be tightened to their recommended torques to prevent leaks or damage to the threads. The recommended tightening torques for the various sizes of threads are as follows:

Nut/bolt torques	
Thread size (mm)	**Torque (Nm)**
M4	2.7
M5	5.4
M6	9.3
M8	22
M10	44
M12	76
M16	187
M20	300
M24	629

Tools

Standard tools

A standard mechanical tool set will be required for:

- Perform the majority of the maintenance described in this manual.
- Perform the installation, removal and replacement of modules and parts described in this manual.

This set should at the minimum contain the following tools:

- Standard screwdrivers in different widths and lengths
- Allen key in metric size
- Phillips screwdrivers in various sizes
- Pozidrive screwdrivers in various sizes
- Flat nosed pliers
- Lap jointed pliers
- Wire cutters
- Wire stripper
- Soldering iron
- Open ended and ring spanners in metric sizes
- Adjustable spanners
- Socket set
- Knife
- A standard electrical tool set may be required to perform repairs to cables etc.
- In addition, the normal heavy tools designed for installation work is required.

The following expendables are recommended:

- Grease gun with appropriate nipple connector.
- Solders
- Wire straps in different sizes
- Isolating plastic tape

Special tools

If special tools are required for a particular procedure, they will be listed at the beginning of that procedure.

Preventive maintenance schedule

Introduction

Maintenance routines must be performed regularly and effectively to ensure that the equipment is kept in top condition. Effective maintenance is even more important with the equipment described in this manual, as a faulty unit could have disastrous consequences in the presence of an inflammable atmosphere.

The chart below states the **maximum** recommended intervals at which the various routines should be performed - the intervals should be decreased if the system is used excessively, or if the maintenance engineer considers it necessary.

Maintenance chart

Routine	Frequency
Hull unit general inspection	Annual
Filling motor gearbox	Annual
Filling shaft sleeve	Annual
Cleaning transducer	Annual
Lubricating drive chains/sprockets	2 months
Watertightness test	2 weeks
Cleaning transducer shaft	2 weeks
Hoist Control Unit general inspection	Annual
Remote Control Unit general inspection	Annual
Gate valve including positioning indicator general inspection	Annual

Lubrication

Several parts of the hull unit must be inspected to ensure the correct amounts of lubricants are present. The following points must be checked:

1 The gearbox - Oil level shall be to the top screw on the side of the unit.

- Oil type: *SAE 30 motor oil*

→ *Refer to the filling procedure on page 182.*

2 The shaft sleeve - The transducer shaft must be covered with a **thin** film of grease.

- Grease type: *Esso Cazar K1* (or equivalent)

→ *Refer to the filling procedure on page 197.*

3 The drive chains and sprockets - The drive chains must be lightly greased to ensure smooth operation and prevent corrosion.

- Grease type: *BIRAL VG/HT* (or equivalent).

→ *Refer to the procedure on page 186.*

4 The transducer shaft guide rails - The guide rails ensure the transducer shaft remains correctly orientated relative to the vessel at all times. These guides must be checked at regular intervals and adjusted as necessary.

- Grease type: *BIRAL VG/HT* (or equivalent).

→ *Refer to the procedure on page 188.*

5 **Limit switches** - The limit switches are activated by rotating arms. These arms are mounted on bearings, and are fitted with wheels to reduce friction. A few drops of oil on the moving parts at regular intervals will help to keep the switches trouble-free.

Special attention

Special attention must be given to the shaft sleeve and transducer shaft. The sleeve contains several seals, and these will wear as the transducer is lowered and raised. It is therefore important that you:

- Keep the transducer shaft clean, and remove growth and dirt.
- Keep the transducer shaft oiled at all times.
- Keep the shaft sleeve filled with oil at all times.

If the shaft becomes dirty or the shaft sleeve runs dry, the seals will wear faster. This will in turn lead to leaks, and the seals will then need to be replaced.

Corrective maintenance

Overview

Corrective maintenance for the following are included:

- Hoist motor
- Drive chains
- Opening the service dock
- Lifting the hull unit
- Transducer
- Transducer cables
- Shaft sleeve
- Transducer, marine growth removal
- Zinc anode
- Transducer shaft
- Limit switches
- Gate valve
- Hoist Control Unit
- Remote Control Unit
- Electrical actuator
- Test procedure

General

Corrective maintenance on the hull unit system will be required when the system malfunctions. The design does not include a built-in test system, so troubleshooting must be based on the manuals, drawings and diagrams.

Unless trained and experienced personnel are available, all major repair work must be carried out by Kongsberg Simrad or an appointed dealer.

Caution: *Neither Kongsberg Simrad nor our dealers will take responsibility for damage or injury to the ship, system or personnel resulting from incorrect maintenance performed on the system.*

Watertightness test

General

The hull unit compartment is of necessity located in the keel of the vessel below the water-line. Maintenance on the hull unit must therefore be carried out with care to ensure that no water leaks occur.

It is important to check that the gate valve below the hull unit is closed and watertight before any maintenance procedure is performed that involves breaking the watertight integrity of the hull unit.

Logistics

Safety - Refer to the general safety procedures.

Personnel - Anyone trained in the procedure.

Vessel location - Afloat.

Special tools - None.

Procedure

The procedure is as follows:

1 Fully raise the hull unit then switch off all power to the system.

2 Close the gate valve.

3 Check the gate valve is sealed by opening the air-vent cock on the top of the transducer dock.

- A small amount of water should flow out as the pressure within the transducer dock equalizes with the ambient air pressure.

4 When the water stops flowing, crack open the gate valve and close it again.

- Water should start flowing out of the air-vent when the valve is cracked open, and should cease soon after it is closed again. This action will prove that the lack of water flow is because the gate valve is sealed, and not merely because the air-vent cock is blocked.

Once the test has been performed satisfactorily, you can assume that it is safe to continue with the required maintenance routines.

Caution: *If for any reason there is a delay between performing the watertightness test and starting the maintenance, play safe - perform the test again.*

Hull unit general inspection

General

The hull unit must be inspected at regular intervals, and before use if it has not been used for an extended period.

Logistics

Safety - Refer to the general safety procedures.

Personnel - Trained maintenance/inspection engineer.

Vessel location - Afloat.

Special tools - None.

Spare parts - Depending on the results of the inspection.

Procedure

The inspection procedure is as follows:

1 Switch off power to the system in the Hoist Control Unit.

2 Check all power and signal cables for signs of damage or overheating.

3 Open all the junction boxes and check all cable terminations to ensure they are tight. Close the boxes firmly on completion.

4 Check all cable glands to ensure they seal correctly.

- Refer to the *Cable gland assembly procedure* in the *Cable layout and interconnections* section if a gland is found to be loose.

5 Check around the hull unit, especially around the mounting flange and gate valve, for signs of water leakage.

- If water is detected, find the leak. Tighten the bolts to close the leak, or refer to the appropriate procedure and replace the appropriate seals.

6 Check for signs of damage to the transducer shaft, for example scratches on the shaft surface, or sea growth. Clean as necessary.

- If serious damage is detected, the shaft may need to be replaced. If in doubt, consult Kongsberg Simrad or your dealer.

7 Check the motor gear box for signs of oil leaks.

8 Check the oil level in the gear box and fill as necessary.

→ *Refer to page 182.*

9 Check the transducer shaft to ensure that it is correctly lubricated.

- The shaft should be covered with a thin film of grease when it is raised. Refill the shaft sleeve as necessary.

→ *Refer to the procedure on page 197.*

10 Check the entire hull unit assembly for signs of corrosion.

- If required, clean the corroded areas and apply the appropriate preservation mediums.

11 Check the tension of the drive chains and adjust if necessary.

→ *Refer to page 188.*

12 Check that the upper and lower limit switches are securely and correctly located, and operate correctly.

13 On completion of the inspection (other units may also need to be inspected) re-apply power to the system.

14 Hoist the transducer array to its upper position.

15 Close and open the gate valve several times to remove marine growth.

16 Perform the watertightness test.

→ *Refer to page 175.*

17 Open the service dock and inspect the transducer and zinc anodes.

→ *Refer to page 196 for instructions on cleaning the transducer.*

→ *Refer to page 202 for instructions on replacing the zinc anode.*

If necessary, check that the system operates correctly by performing the system test procedure described in the *Test and alignments procedures* section.

Refer to the *Spare Parts* section for a full list of all the spares available for the hull unit.

Gate valve, replacement

General

This procedure explains how to replace the gate valve.

Note: *The vessel must be in a dry dock while this procedure is performed.*

Logistics

Safety - Refer to the general safety procedures. Note that the various parts are heavy.

Personnel - Three to four trained maintenance engineers/fitters.

Vessel location - Dry dock.

Special tools - 2 winches or cranes.
(1 for hull unit - 1500 kg, and 1 for gate valve - 500 kg.)

Spare parts -
Gate valve DN500 . . . . . HDV-088347
Gate valve DN350 . . . . . HDV-041672

Procedure

The hull unit must be lifted to enable the old gate valve to be taken out and a new valve to be fitted. Check that all electrical cables to the hull unit have enough slack such that they will not be placed under tension as the hull unit is lifted.

Note: *If an electrical actuator (option) is fitted,it must be removed before you take out the gate valve.*

1 Fully raised the transducer.

2 Place the vessel in dry dock.

3 Mount a suitable lifting apparatus to the deck head above the hull unit, and attach it to the top of the hull unit.

4 Remove all the gantry braces, and disconnect cables as necessary.

5 Take the weight of the hull unit on the lifting apparatus.

6 Remove the upper and lower mounting nuts/bolts to unbolt the gate valve from the transducer dock and the mounting flange.

7 Lift the hull unit clear of the gate valve.

8 Pull the old gate valve out.

- Note that the gate valve is heavy. Lifting apparatus will be required.
- Great care must be exercised to ensure the mating surfaces of the mounting flange and the transducer dock are not damaged.

9 Clean the mating surfaces and replace all O-rings.

10 Manoeuvre the new gate valve into position and lower it carefully onto the mounting flange.

11 Check that it is aligned correctly, then secure it into position.

→ *Refer to the torques listed on page 170.*

12 Lower the hull unit onto the gate valve.

13 Check that it is aligned correctly, then secure it into position.

→ *Refer to the torques listed on page 170.*

14 Replace all the gantry braces.

15 Check all electrical cables and connections.

16 Perform the system test described in the *Test and alignments procedures* section.

Replacement of the gate valve position indicator

General

This procedure explains how to replace the complete gate valve position indicator.

Logistics

Safety - Refer to the general safety procedures.

Personnel - Two trained maintenance engineers/fitters.

Spare parts - As required.

References

Procedure

The positioning indicator is standard. It is mounted directly on the gate valve with two bolts.

1 Fully raise the transducer.

2 Remove the switch unit.

→ *See procedure on page 181.*

3 Remove the gate valve wheel.

4 Unscrew the two bolts holding the positioning indicator (see figure below).

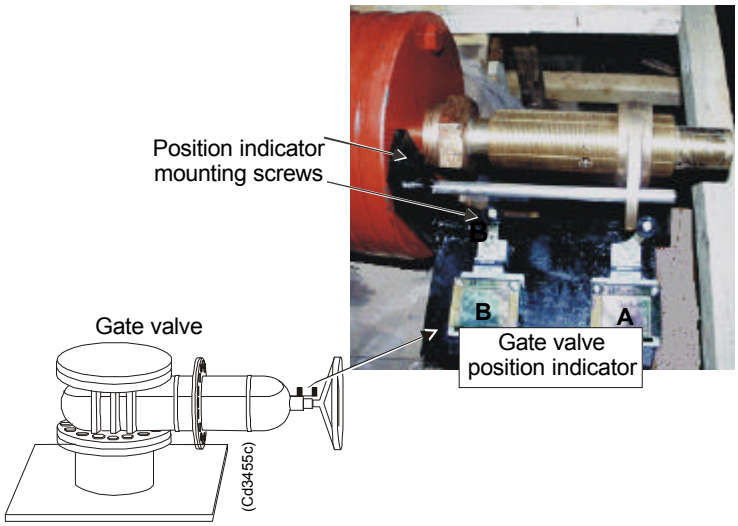


Figure 55 - Position indicator

5 To mount the new position indicator unit, proceed in revers order.

Replacement of a position indicator switch unit

General

This procedure explains how to replace a position indicator switch unit.

Logistics

Safety - Refer to the general safety procedures.

Personnel - One trained maintenance engineers/fitters.

Spare parts - As required. Switch, see mounted switch.

References

Procedure

1 Disconnect the switch cable. This is done as follows:

- Unscrew the two screws holding the lid on the top of the switch unit, see figure below (1).
- Open the switch unit lid, see figure below (2).
- Connection 13 and 14 is used. Refer to Interconnection diagram, hoisting system.

2 Unscrew the two switch unit fasting screws, see figure below(2).

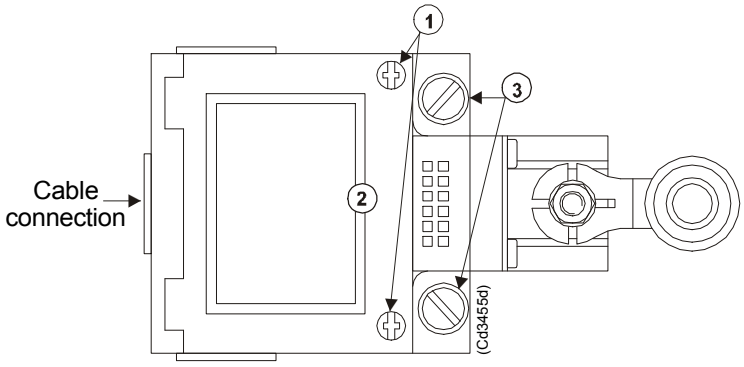


Figure 56 - Position indicator switch unit

3 Remove the defect switch unit.

4 Mounting the new switch unit, proceed in revers order.

Hoist motor, gear box lubrication

The oil level in the motor gearbox must be checked at regular intervals, and new oil must be added when required.

Logistics

Safety - Refer to the general safety procedures.

Personnel - Maintenance engineer.

Vessel location - N/A.

Special tools - None.

Spare parts - Oil type, SAE 30 motor oil.

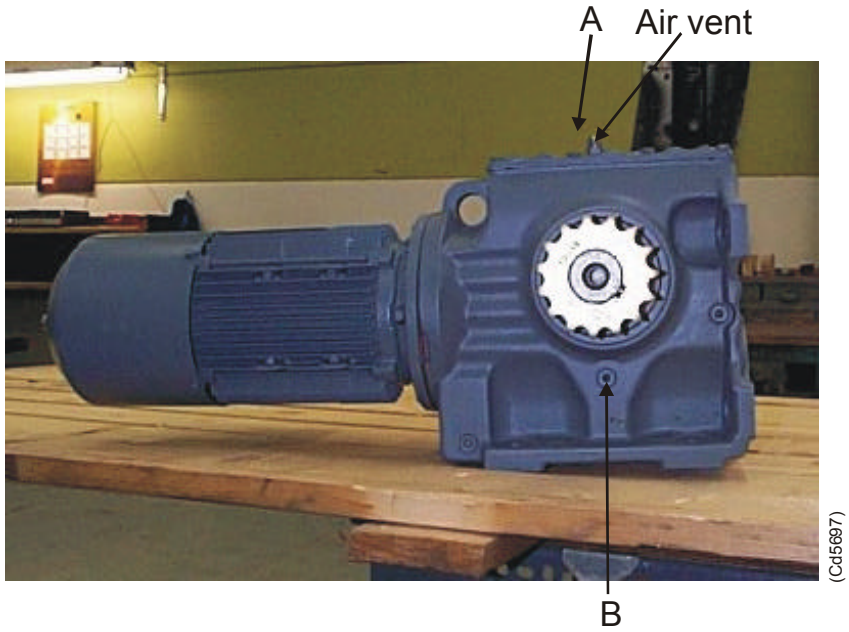


Figure 57 - Hoist motor and gearbox

Procedure

1. Switch off power to the system in the HCU.
2. Thoroughly clean the gearbox and the surrounding area, removing all dirt and loose debris (paint flakes etc).
3. Remove the filler cap (A) and the level screw (B).
4. Fill the gearbox with *SAE 30 motor oil*, to the level hole.
5. Replace the level screw and the filler cap.
6. Wipe off any excess oil or drips.

Hoist motor, replacement

Logistics

Safety - Refer to the general safety procedures.

Personnel - Two trained maintenance engineers.

Vessel location - N/A.

Special tools - Lifting apparatus may be required.

Spare parts -
Motor and gearbox: 331-045952
Motor (stand-alone): 331-084150
Four mounting nuts/washers for motor.

→ Centa -*motor manufacturer, http://www.centa.no.*

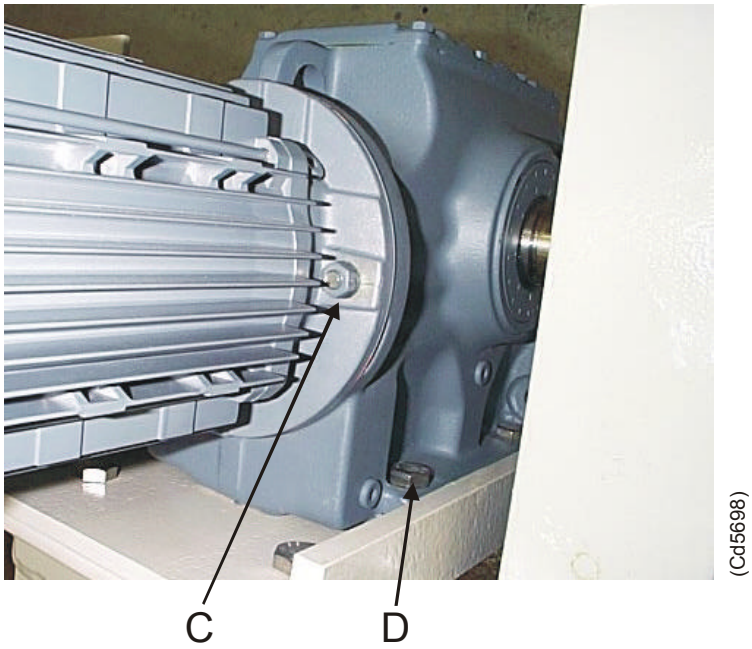


Figure 58 - Replacing the Hoist motor and/or gearbox

Procedure

1. Switch off power to the system in the HCU.
2. Clamp the transducer shaft to prevent it from sinking when the motor is disconnected.
3. Open the junction box on the motor, label and disconnect all the cables.
4. Unscrew the four mounting nuts (C).
5. Pull the motor straight off the gearbox.

If the motor is to be sent away for repair, close the gap in the motor brake by mounting the cover plate. (This cover plate was supplied initially with the hull unit, and was used for this purpose prior to the motor installation.)

Reassembly:

6 Insert the new motor, and secure it in position with the four nuts.

7 Reconnect the cables.

8 Remove the transducer shaft clamp.

9 Perform the system test as described in the *Test and alignment procedures* section.

Hoist motor, gear box replacement

The motor assembly on the top of the gantry comprises two main parts; the motor and the gearbox. This procedure explains how to replace the gear box.

Logistics

Safety - Refer to the general safety procedures. Note that the various parts are heavy.

Personnel - Two trained maintenance engineers.

Vessel location - N/A.

Special tools -A lifting apparatus may be required.

Spare parts -
Motor and gearbox: 331-045952
Gear box (stand-alone): . . . S62A B3 A+B 1:158.08 Ritzel Ø12
Four mounting bolts M12x50, M12 nuts, washers and spring washers.

Procedure

→ *Refer to figure on page 183.*

1 Switch off power to the system in the HCU.

2 Clamp the transducer shaft to prevent it from sinking when the motor is removed.

3 Slacken the drive chains and lift them off the drive sprockets.

4 Support the motor/gearbox unit then remove the four mounting nuts/bolts/washers (D) which secure the gearbox to the motor platform on the hull unit gantry.

5 Lift the motor/gearbox off the top of the hull unit and place it on a clean, stable work bench.

6 Remove the sprocket wheels from the drive shaft using a wheel puller.

7 Fit the sprocket wheels onto the new gearbox.

8 Move the motor to the new gearbox if necessary.

9 Lift the motor/gearbox assembly onto the hull unit motor platform and secure it in position using the four mounting nuts/bolts/washers (D).

10 Lift the drive chains onto the sprocket wheels, then check/adjust the tensions in the chains.

→ *Refer to procedure on page 186.*

11 Reconnect the electrical cables.

12 Remove the transducer shaft clamp.

Drive chains, lubrication

The drive chains must be kept lubricated to ensure smooth operation and to prevent corrosion. Inspect the chains at regular intervals, and before use if the hull unit has not been used for an extended period.

Logistics

Safety - Refer to the general safety procedures.

Personnel - Maintenance engineer.

Vessel location - N/A.

Special tools - None.

Spare parts - Grease type . . . . . BIRAL VG/HT or similar.

Procedure

1 Switch off power to the system in the HCU.

2 Inspect the drive chains looking for corrosion or dry areas.

- If old grease has congealed or is badly contaminated with dirt etc, clean the effected areas using a scraper, solvents and cloths.

3 Inspect the sprockets for signs of wear and corrosion.

4 Clean off any corrosion with a chemical rust remover.

5 Check the tension in the drive chains, adjust the tension if necessary.

→ *Refer to paragraph on page 188.*

6 Lubricate the chain and sprockets using grease type *BIRAL VG/HT* or similar. Apply using a suitable brush.

7 Wipe off excess grease and clean up any drips.

Drive chains, tension

To operate correctly without damaging the various shafts and bearings, the drive chains must be at the correct tension. The chains' tensioning devices are located on either side of the base of the hull unit gantry. There is one device for each drive chain. The devices raise or lower the lower sprocket bearings independently, so adjustment of one chain has no effect on the other.

Logistics

Safety - Refer to the general safety procedures.

Personnel - Trained maintenance engineers.

Vessel location - N/A.

Special tools - None.

Spare parts -None.

Test procedure

1 Ensure there is sufficient water below the vessel.

2 Open the gate valve.

3 Lower the transducer shaft to the fully lowered position.

4 Switch off power to the system in the HCU.

5 Grip the chain at the mid-point between the upper and lower chain sprockets. Using reasonable force, attempt to push and pull the chain horizontally in the directions in which the chain would normally bend.

- It should be possible to move the chain a <u>total</u> of between 1 and 2 cm.

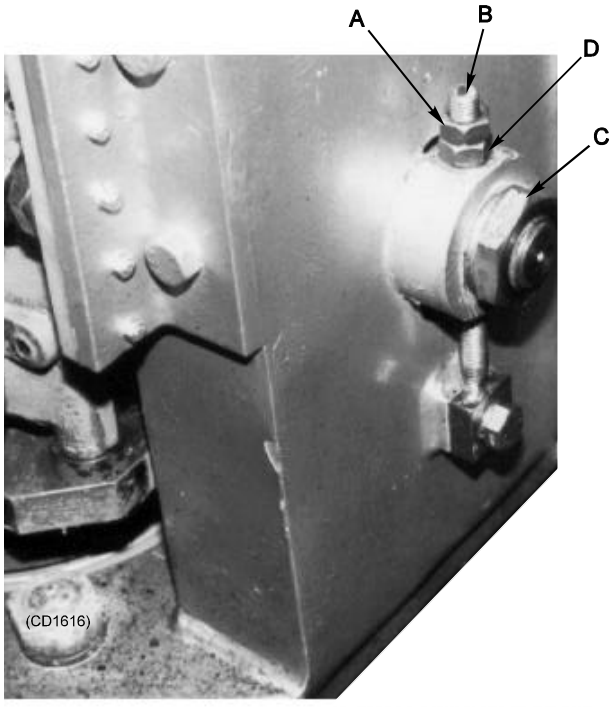


Figure 59 - Tensioning the drive chains

Adjusting the tension

1 Slacken lock-nut (A) on tension adjustment thread (B).

2 Slacken sprocket bearing nut (C) by 1/2 turn.

3 Adjust tension adjustment nut (D) to achieve the correct tension in the chain.

4 Tighten the sprocket bearing nut and the lock-nut.

5 On completion, check the chain tension. It may have altered as the nuts were tightened.

Drive chains, replacement

The drive chains transmit the force from the hoist motor to the transducer shaft, to raise or lower the shaft.

Logistics

Safety - Refer to the general safety procedures.

Personnel - Trained maintenance engineers/fitters.

Vessel location - N/A.

Spare parts -
Duplex chain (top) 529-047577
Duplex chain (bottom) 529-047575
Guide rail 599-051130
Guide rail 599-051126
Joint 529-047580

Procedure

Both drive chains should be replaced at the same time.

1 Slacken the chains.

2 Find and remove the joints, and disconnect the chains from the transducer shaft.

3 Replace the chain

4 Adjust the tension.

→ *Refer to paragraph on page 188.*

Opening the service dock

If the hull unit has a service dock, gaining access the transducer and the other “wet” parts of the hull unit is a simple operation.

Logistics

Safety - Refer to the general safety procedures. Perform a watertightness test before breaking the watertight integrity of the hull unit.

Personnel - Two trained maintenance engineers/fitters.

Vessel location - N/A.

Special tools - Length of hose pipe. Jubilee clip.

Spare parts - Hatch seal 540-084245

Procedure

1 Raise the transducer to the fully housed position.

2 Switch power off at the HCU.

3 Close the gate valve and perform the watertightness test.

→ *Refer to page 175.*

4 Secure one end of a suitable length of hose to the drain tap on the inspection hatch, and place the other end in the bilge or in a suitable container.

5 Open the air vent on the top of the inspection dock, and the drain tap, and drain the inspection dock.

6 Slacken and remove the retaining bolts/nuts around the inspection hatch perimeter, then using suitable lifting apparatus carefully remove the inspection hatch.

WARNING ! ***The hatch is heavy. If the operation is being conducted while the vessel is at sea, ensure the hatch is lashed to prevent it swinging should the vessel roll.***

7 Use a sponge or cloths to soak up any remaining water and wipe clean the interior of the dock and gate valve.

8 Perform the required maintenance routines.

9 On completion of the maintenance work, ensure that no rubbish, tools etc. have been left in the dock, then replace the inspection hatch.

10 Tighten all the hatch bolts to the correct torque.

11 Perform the system test as described in the *Test and alignment procedures* section.

Lifting the hull unit

If the hull unit does not have a service dock, the entire hull unit must be lifted off the gate valve to gain access to the transducer.

Logistics

Safety - Refer to the general safety procedures. Perform a watertightness test before breaking the watertight integrity of the hull unit.

Personnel - Three to four trained maintenance engineers/fitters

Vessel location - N/A.

Special tools - None.

Spare parts - None.

Procedure

1 Raise the transducer to the fully housed position.

2 Switch off power to the system at the HCU.

3 Close the gate valve, and perform the watertightness test.

→ *Refer to page 175.*

4 Write down the colour coding and connections, then remove all electrical cables to and from the hull unit.

5 Secure a tackle capable of lifting the entire hull unit (1500 kg) to the deckhead above the hull unit, and attach the tackle to the unit using the lifting eyes provided.

6 Tighten the lifting tackle, taking the weight of the hull unit.

7 Mark the positions of the bracing beams and the transducer dock relative to the gate valve to minimize changes in the hull unit alignment.

8 Remove the bracing beams supporting the hull unit.

9 Remove the bolts attaching the transducer dock to the gate valve flange.

- The water contents of the dock will leak out, but not under pressure. The dock must remain attached to the unit to protect the transducer.

10 Carefully hoist the hull unit off the gate valve.

- If there is not enough headroom above the unit to enable it to be raised high enough for the engineer to gain access to the transducer, the transducer dock may be pulled to one side and the unit laid on the deck alongside the gate valve.

- The hull unit must be supported to ensure it does not swing if the vessel moves. Protect the gate valve with a wooden cover to ensure the mating surface is not damaged during the operation.

11 Lower the transducer using the hand crank until the transducer is fully exposed.

- If the motor is not accessible for manual operation, the transducer dock may have to be removed to gain access.

12 Perform the required maintenance routines.

13 On completion of the maintenance work, ensure that no rubbish, tools etc. have been left in the dock, then replace the hull unit by following the above procedure in reverse.

14 Tighten all the bolts to the correct torques.

15 Reconnect all the electrical cables.

16 Perform the system test as described in the *Test and alignment procedures* section.

Transducer, replacement

The following procedure describes the removal of the transducer for repair or service under normal conditions.

- A new transducer can be installed by following the same procedure in reverse.

Caution: *The transducer locating pin and zero mark must be in the correct positions.*

Logistics

Safety - Refer to the general safety procedures. Note that the various parts are heavy.

Personnel - Three to four trained maintenance engineers/fitters.

Vessel location - N/A.

Special tools - Depending on procedure.

Spare parts - Depending on procedure.

Procedure

1 Gain access to the transducer.

2 Remove loose marine growth, seaweed or mud using a stiff, plastic-bristled brush and copious amounts of water.

3 Place suitable planks and pads onto the gate valve, then using the crank handle lower the transducer onto the pads so it will not fall as the bolts are removed.

- Ensure the transducer face is not damaged.

4 Flatten down the lugs on the retention plates and remove the bolts attaching the transducer to the shaft flange.

Caution: *The transducer weighs approximately 60 kg, and must be securely supported during the removal procedure.*

5 Using the crank handle, raise the shaft away from the transducer carefully till the cable connector inside the shaft is accessible. Disconnect the cable.

- The transducer may be retained on the shaft by a vacuum within the flange, and some force may be required to remove it.

6 Remove the transducer to an appropriate work area. Extreme care must be used to ensure the transducer face is not damaged during the operation.

7 Replace the transducer.

- The replacement procedure is the reverse of the removal procedure.
- Ensure that the transducer alignment pin is fitted to orientate the transducer correctly.
- Ensure that the O-rings and lock-plates are renewed, see figure below.

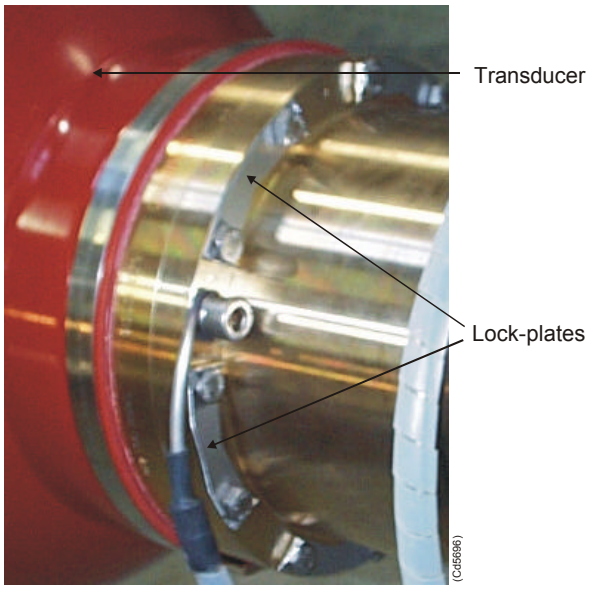


Figure 60 - Lock-plates

Transducer cable, replacement

The transducer cable is divided into three different lengths:

- *Transducer cable* from the transducer (watertight Souriau plug) to the junction box on the transducer shaft.
- *Flexicable* from the junction box on the transducer shaft to the junction box on the gantry.
- *Signal cable* from the junction box on the gantry to the transceiver unit.

Logistics

Safety - Refer to the general safety procedures.

Personnel - Two trained maintenance engineers/fitters.

Vessel location - N/A.

Special tools - None.

Spare parts -
Spare parts kit KIT-080782
(contains, junction boxes and flexicable)
Transducer cable with plug 380-067466
Signal cable . . . . . 642-053031 (or equivalent)

Procedure

Flexicable

The flexicable is connected between the junction boxes on the top of the transducer shaft and the top of the gantry.

1 Open the junction boxes.

2 Write down the colour coding and connections, then disconnect the transducer cable and the signal cable.

3 Replace the flexicable including junction boxes (spare kit).

Transducer cable

This cable is terminated with a waterproof plug in the transducer end, and into the junction box on the top of the transducer shaft on the other end. Gaining access to the transducer.

→ *Refere to page 192.*

Signal cable

This cable is used between the junction box on the gantry and the transceiver unit.

1 Open the junction box.

2 Write down the colour coding and connections, then disconnect the cables.

3 Write down the colour coding and connections, then disconnect the cables from the terminal block or plug in the transceiver unit.

4 Replace the cables.

Note: *Refer to the* Cable layout and interconnections *section for advice on cable installation.*

Transducer, marine growth removal

Any marine growths on the transducer face, such as weed or crustaceans, can dramatically reduce the efficiency and accuracy of the HPR system. The transducer must therefore be inspected and cleaned at regular intervals.

If the hull unit is fitted with a service dock, open the dock to gain access to the transducer. If the hull unit is not fitted with a transducer service dock and the vessel is not in a dry dock, the transducer must be checked for damage and marine growths either by lifting up the hull unit, or by sending a diver down.

Logistics

Safety - Refer to the general safety procedures. Perform a watertightness test before breaking the watertight integrity of the hull unit.

Personnel - Trained maintenance engineers/fitters.

Vessel location - N/A.

Special tools - Wooden or plastic scraper. Stiff, plastic-bristled brush.

Spare parts - None.

Procedure

1 Gain access to the transducer.

2 Remove loose marine growth, seaweed or mud using a stiff, plastic-bristled brush and copious amounts of water.

3 Carefully remove any crustaceans, for example barnacles, using a round-edged wooden or plastic scraper.

- Great care must be taken to ensure that the face of the transducer is not damaged.

Caution: *A wire brush or a high-pressure hose must not be used !*

4 When all accessible parts of the transducer, the shaft and the internal surfaces of the dock have been cleaned, dried and inspected, paint the internal surfaces of the dock with suitable preservation and anti-fouling paints.

Caution: *The transducer face, shaft and anodes must not be painted.*

5 Close the hull unit. Refer to point 1 in this procedure.

Shaft sleeve, lubrication

The transducer shaft must be inspected at regular intervals and the shaft sleeve filled with grease as necessary.

Logistics

Safety - Refer to the general safety procedures.

Personnel - Trained maintenance engineer..

Vessel location - N/A.

Special tools - None.

Spare parts - Grease type, ESSO CAZAR K1 or similar.

Procedure

1 Switch off power to the system at the HCU.

2 Clean the shaft sleeve, the filler and level/air vent screws and the surrounding area, removing all dirt and loose debris (paint flakes etc).

3 Remove the air vent screw.

Caution: *If the vent screw is not removed, the shaft seals can be damaged.*

4 Fill the sleeve with grease, type *ESSO CAZAR K1* or similar, until the grease appears at the air vent hole.

5 Replace the air vent screw.

6 Wipe off any excess grease.

Shaft sleeve, disassembly

Logistics

Safety - Refer to the general safety procedures.

Personnel - Two trained maintenance engineers / fitters.

Vessel location - N/A.

Special tools - Depending on required procedure.

Spare parts -
Oil type . . . . . ESSO CAZAR K1 or similar
Set of seals and bearings

Procedure

1 Switch off power to the system at the HCU.

2 Gain access to the transducer.

→ *Refer to page 189/ 190.*

3 Remove loose marine growth, seaweed or mud using a stiff, plastic-bristled brush and copious amounts of water.

4 Remove the transducer and the transducer adaptor from the end of the shaft.

5 Remove the transducer shaft from the shaft sleeve.

6 When the shaft sleeve is loose, drill out the three lock pins from the lower bearing.

- Drill size 8 mm.

7 Remove the old bearings and seals.

8 Install new seals and bearings in the shaft sleeve and insert new lock pins in the lower bearing.

9 Close the lock pin holes with plastic filler or similar.

10 Refit the transducer shaft into the shaft sleeve.

11 Replace the transducer and the transducer adaptor onto the end of the shaft.

12 Tighten the seals into the shaft sleeve to ensure a good seal between the shaft and the sleeve.

13 Fill the sleeve with grease.

→ *Refer to page 190.*

Transducer shaft, guide rails adjustment

Logistics

Safety - Refer to the general safety procedures.

Personnel - Trained maintenance engineer.

Vessel location - N/A.

Special tools - None.

Spare parts - None.

Procedure

The guide rails ensure the transducer is aligned correctly. When the shaft is fully lowered there should be no space between the guide rails and the adjustable sliders.

1 Fully lower the transducer shaft.

2 Slacken the lock nuts and adjust the sliders until they are tight against the guide rails.

3 Tighten the lock nuts and re-check the clearance.

4 Raise the transducer shaft and check the clearances at several places as it is raised.

- If the clearances between the sliders and the rails changes (2/3) as the shaft is raised, the rails will need to be adjusted.

Note: These adjustments could effect the system alignment. If in doubt, contact Kongsberg Simrad AS for assistance.

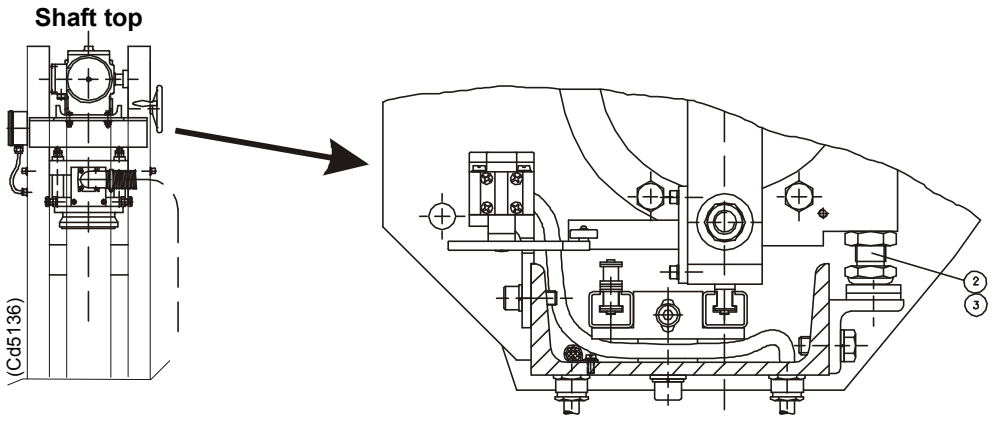


Figure 61 - Shaft top - indicating the adjustable sliders

Transducer shaft, removal at sea

Note: *This procedure is only to be performed in an emergency after the hull unit has been damaged, if the vessel cannot enter harbour with the hull unit lowered.*

When fully lowered, the hull unit will be extended some distance below the vessel's keel. This makes it very vulnerable to damage in the event of the vessel striking an underwater obstruction or coming into shallow water. The shaft may be bent or broken, or the transducer knocked off the bottom of the shaft.

The hull unit has been designed to enable it to be sealed if the shaft is broken or the transducer lost, but it may not be possible to retract the remains of the damaged unit.

Caution: *Do not attempt to hoist a bent or broken transducer shaft! This may cause further serious damage to the hull unit and/or major water leaks !*

In this case the remains of the shaft must be lowered out through the hull opening and removed externally.

Logistics

Safety - Refer to the general safety procedures. Note that the various parts are heavy.

Personnel - Three to fourTrained maintenance engineers/fitters.

Vessel location - N/A.

Special tools - Deck crane.
Diver
Others depending on the extent of the damage.

Spare parts - Depend on the extent of the damage. KIT-103370

Procedure

The blind flange and threaded bolt referred to in the text are supplied as an optional kit, available from Kongsberg Simrad AS. Part number KIT-103370.

1 Ensure all power to the system is switched off at the HCU.

2 Disconnect all electrical cables to and from the hull unit.

3 The transducer must be lowered to its fully down position.

4 A diver must inspect the visible parts of the transducer and shaft, and attach a lifting tackle to enable the unit to be recovered.

5 Cut the transducer cable above the cable gland, unscrew the socket-head screws and remove the upper clamping ring.

6 Raise the hoisting flange by approximately 15 cm using the hoist motor, and place the blind flange on the clamping ring.

7 Lower the hoisting flange until it rests against the blind flange.

8 Unscrew the three set-screws in the circumference of the top clamping ring by approximately 10 mm.

- The damaged shaft will now normally fall out from the hull and may be winched up on deck. If the shaft remains fast in the transducer dock, it may be forced out by applying water pressure to the valve on the blind flange (max pressure 10 kp/cm^2), and/or by using the threaded bolt delivered with the hull unit to push it out.

9 On completion of the removal procedure, close the gate valve.

If the remainder of the Hull Unit is not damaged, it may now be prepared for the installation of a new shaft. The vessel will need to be placed in a dry dock for inspection, and fitting of a new shaft.

Zinc anode, inspection and replacement

Logistics

Safety - Refer to the general safety procedures.

Personnel - Two trained maintenance engineers/fitters.

Vessel location - N/A.

Special tools - None.

Spare parts - Zinc anode, 629-076530

Procedure

1 Switch off power to the system at the HCU.

2 Open the service dock.

→ *Refer to page 189.*

3 Clean the transducer and service dock using a stiff, plastic-bristled brush and copious amounts of water.

4 Inspect the sacrificial anodes.

- The anodes are bolted to the underside of the shaft sleeve.
- If the anodes are severely corroded, replace them. If not, assess the extent of the corrosion and the time since the previous inspection, and estimate when the anodes will require replacing.
- Program another inspection for a date some time before the anodes will need to be replaced.

5 On completion, close the service dock.

Limit switches, replacement

Two limit switches are mounted on the gantry; one to stop the drive motor when the shaft is fully down, and one to stop the motor when the shaft is fully raised. The two limit switches are identical.

Logistics

Safety - Refer to the general safety procedures.

Personnel - Trained maintenance engineer.

Vessel location - N/A.

Special tools - None.

Spare parts - Limit switch 350-087309

Procedure

1 Switch off power from the system on the Hoist Control Unit.

2 Note the connections, then disconnect the cables from the limit switch.

3 Remove the mounting bolts and replace the switch.

4 Set up the switches as follows:

a Adjust the lower limit switch so that the springs are compressed 2-3 mm when the transducer shaft is fully lowered.

b Retract the transducer shaft fully and adjust the upper limit switch such that it operates when the shaft is approximately 15-20 mm below its highest possible position.

Test procedure

General checks

On completion of any maintenance on the hull unit, the system must be checked to ensure the maintenance was successful and to ensure the hull unit may be operated safely.

→ *Refer to the Hull unit raise/lower checks in the Test and alignment procedures.*

System alignment

One of the most important variables that will effect system accuracy is the alignment of the transducer with respect to the vessel's fore-and-aft axis. After any maintenance procedure which could effect the alignment of the transducer (removal of the transducer, adjustment of guide rails etc.), or if the maintenance engineer suspects that the transducer has moved out of alignment, an alignment test should be conducted. The system software can then be set up to take into account any misalignments in the system. Contact Kongsberg Simrad AS for assistance with the alignment checks.

One of the most important variables that will effect system accuracy is the alignment of the transducer with respect to the vessel's fore-and-aft axis. If the maintenance engineer suspects that the transducer has moved out of alignment, he should conduct the "Alignment procedure". This may require that the vessel goes into dry dock, so all other options should be thoroughly investigated first.

→ *Refer to the Hull unit installation alignment procedure.*

References

The following drawings and procedurse are referred to in the text, and are located in the drawing file:

Hull Unit installation alignment procedure 840-108200 (SG-091)

Interconnection diagram, hoist system 824-102993 (837-65)

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8 HL 3880 HULL UNIT SPARE PARTS

Introduction

This section lists the parts and modules defined by Kongsberg Simrad as *Line Replaceable Units (LRUs)*. The required mounting components (such as nuts, bolts, washers etc.) are identified on the diagrams, but have not been allocated order numbers as we regard these items as standard commercial parts available from retail outlets around the world.

Codes used

The following codes are used in the parts lists:

Part no. - Kongsberg Simrad's part number.

Item name -The name of the item.

Technical data - Technical specifications and any other relevant information.

Drw. ref. - Reference number of the production or illustration drawing where the item is included. If a number is given here, the drawing will be included in the manual's/document's drawing file.

Drw. pos. - The item's position number on the drawing referenced above.

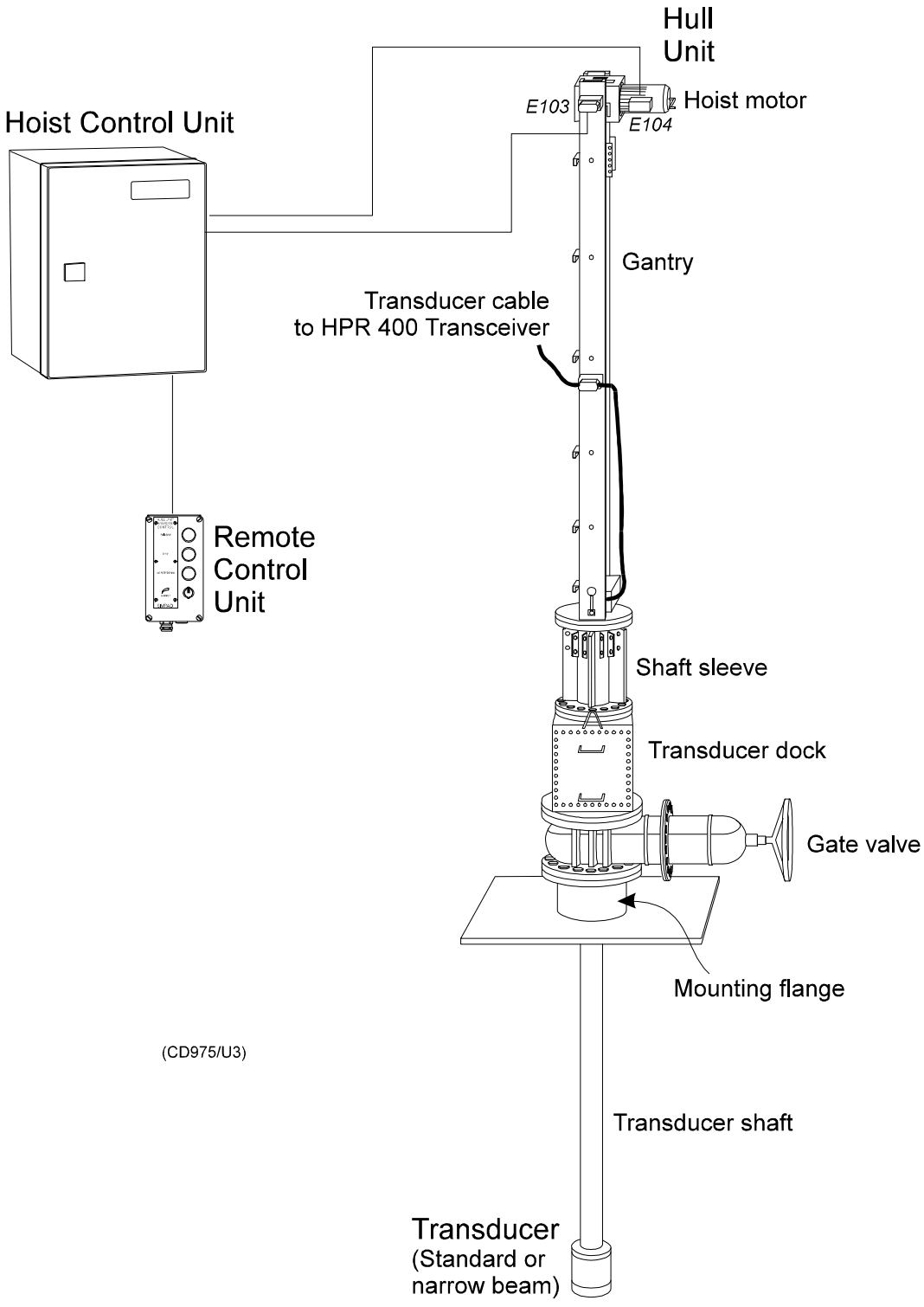
No. in sys. - The quantity of the item used in the system. *Note that this information is not provided for standard components such as nuts, bolts and washers.*

Rec. spares - The quantity of the item recommended to be carried as spares onboard the vessel. *Note that this information is not provided for standard components such as nuts, bolts and washers.*

Supplier - The actual supplier or manufacturer of the item if different from Kongsberg Simrad. A blank field indicates items manufactured, altered or adjusted by Kongsberg Simrad.
GA = standard items generally available from many retail outlets.

Supp. code- The actual supplier or manufacturer part number if different from Kongsberg Simrad's.

Main units


Hull
Unit
E103
E104
Hoist motor
Hoist Control Unit
Gantry
Transducer cable
to HPR 400 Transceiver
Remote
Control
Unit
Shaft sleeve
Transducer dock
Gate valve
Mounting flange
(CD975/U3)
Transducer shaft
Transducer
(Standard or
narrow beam)

Consumables and repair kits

Part no.	Item name	Drw. ref.	No. in sys.	Supplier
	Technical data	**Drw. pos.**	**Rec.spares**	**Supp. code**
N/A	SAE 30 motor oil	-	-	GA
-	For gearbox	-	-	-
654-095602	Esso Cazar K1	-	-	GA
-	For shaft sleeve	-	-	-
129-102738	Flexicable and junction boxes	-	-	-
-	Repair kit	-	-	-
N/A	Esso MP grease Beacon EP2	-	-	GA
-	For drive chains	-	-	-
KIT-103324	Set of seals and bearings	-	1	-
-	For shaft sleeve	-	0	-

Main units spare parts list

Part no.	Item name	Drw. ref.	No. in sys.	Supplier
-	Technical data	Drw. pos.	Rec.spares	Supp. code
HCU-102818	Hoist Control Unit	-	1	-
-	Complete assembly	-	0	-
RCU-102819	Remote Control Unit	-	1	-
-	Complete assembly	-	0	-
122-102982	Simrad HL3880 hull unit	-	-	-
-	See note below	-	-	-
122-048761	Simrad HL3100 hull unit	-	-	-
-	See note below	-	-	-
122-048762	Simrad HL2300 hull unit	-	-	-
-	See note below	-	-	-
122-048763	Simrad HL1530 hull unit	-	-	-
-	See note below	-	-	-
122-089790	HiPAP 500 HL3770 Hull Unit	-	-	-
-	See note below	-	-	-
122-213410	HiPAP 500 HL6120 Hull Unit	-	-	-
-	See note below	-	-	-
122-214181	HiPAP 350 HL3770 Hull Unit	-	-	-
-	See note below	-	-	-
HDV-080966	350 mm transducer dock with service hatch	-	1	-
-	-	-	0	-
HDV-103235	500 mm transducer dock with service hatch	-	1	-
-	-	-	0	-
599-042237	350 mm transducer dock without service hatch		1	-
-	-	-	0	-
139-041672	DN350 gate valve	-	1	-
-	-	-	0	-
HDV-088347	DN500 gate valve	-	1	-
-	-	-	0	-
N/A	Gate valve position indicator *	-	0	-
-	-	-	-	-

Note: *The hull unit part numbers are for complete systems. These systems include standard transducer, transducer shaft, transducer shaft sleeve, motor and standard transducer dock (without service hatch), but do not include the Hoist Control Unit and Remote Control Units, gate valve and mounting flange.*

* Depending on delivery.

Hull unit assembly

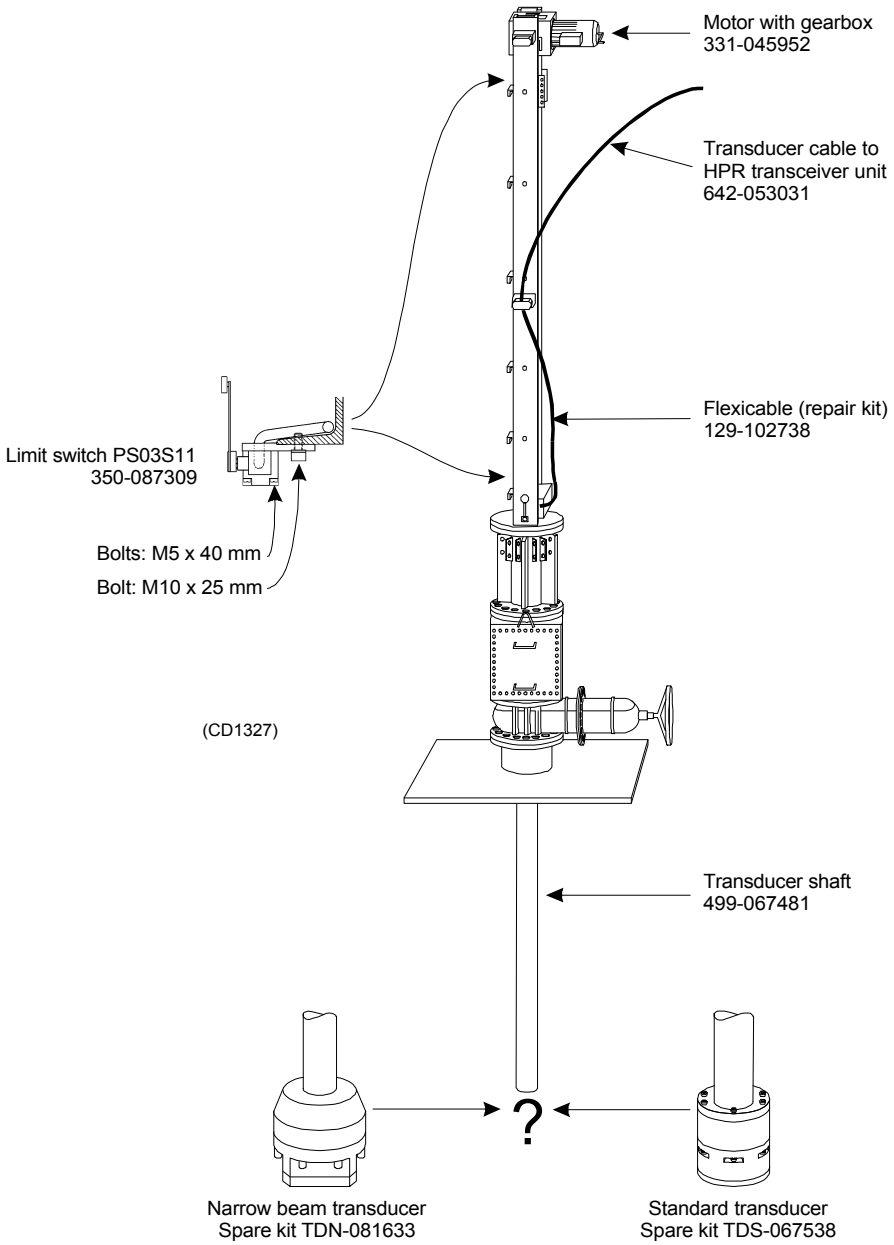


Figure 62 - HL 3880 hull unit assembly - main parts

Hull Unit assembly spare parts list

Part no.	Item name	Drw. ref.	No. in sys.	Supplier
-	Technical data	Drw. pos.	Rec.spares	Supp. code
331-045952	Motor with gearbox	-	1	SEW
-	S62 DT80N4BM/HF 2WE	-	0	See tech. data
331-084150	Motor alone	-	-	SEW
-	DFT80N4BM/HF 2WE	-	-	See tech. data
529-084151	Gearbox alone	-	-	SEW
-	-	-	-	-
350-087309	Limit switch	-	2	-
-	-	-	0	-
499-067481	Transducer shaft std. hull unit	-	1	-
-	-	-	0	-
TDN-081633	Narrow beam transducer	-	1*	-
-	Complete spare parts kit	-	0	-
TDS-067538	Standard transducer	-	1*	-
-	Complete spare parts kit	-	0	-
TDV-089935	20° adapter	-	1*	-
-	-	-	0	-
TDL-083420	12 kHz transducer	-	1*	-
-	Complete spare parts kit	-	0	-
129-102738	Flexicable repair kit	-	1	-
-		-	0	-
642-053031	Transducer cable	-	1	-
-	From hull unit to transceiver	-	0	-

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Chains

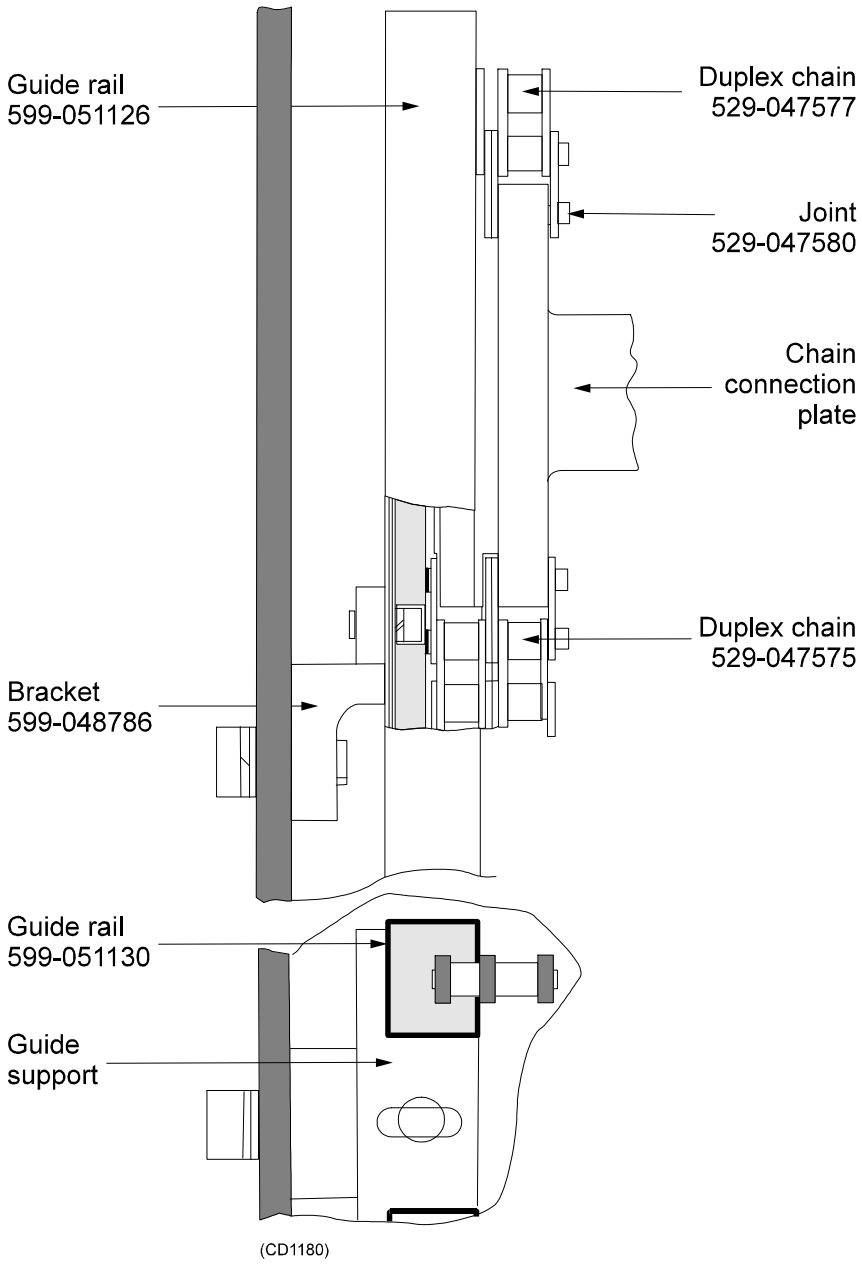


Figure 63 - Chains and guide rails

Chains spare parts list

Part no.	Item name	Drw. ref.	No. in sys.	Supplier
-	Technical data	Drw. pos.	Rec.spares	Supp. code
529-047575	Duplex chain	-	2	-
-	Length = 8305.24 mm (523 links)	-	0	-
529-047577	Duplex chain	-	2	-
-	Length = 206.44 mm (13 links)	-	0	-
529-047580	Joint no. 26	-	6	-
-	P = 0.625	-	0	-
599-051126	Guide rail	-	2	-
-	-	-	0	-
599-048786	Bracket	-	12	-
-	-	-	0	-
599-051130	Guide rail	-	2	-
-	-	-	0	-
599-048785	Guide support	-	2	-
-	-	-	0	-

Dock

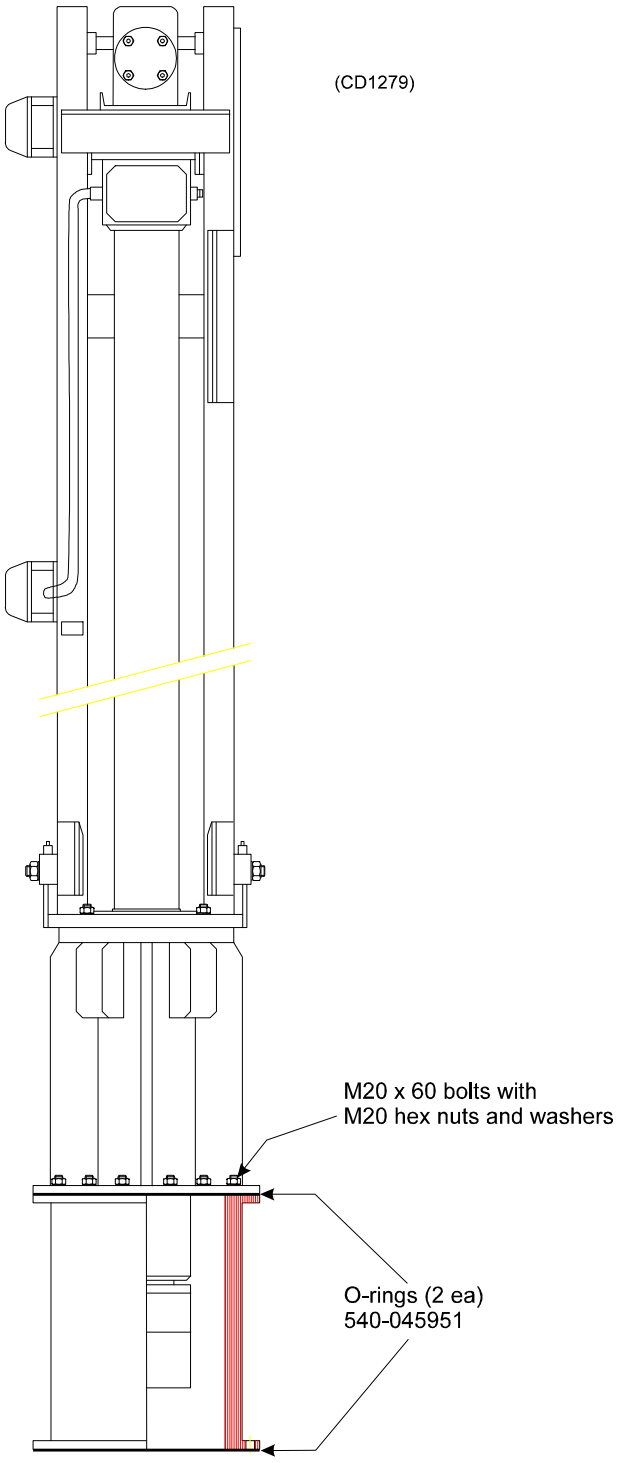
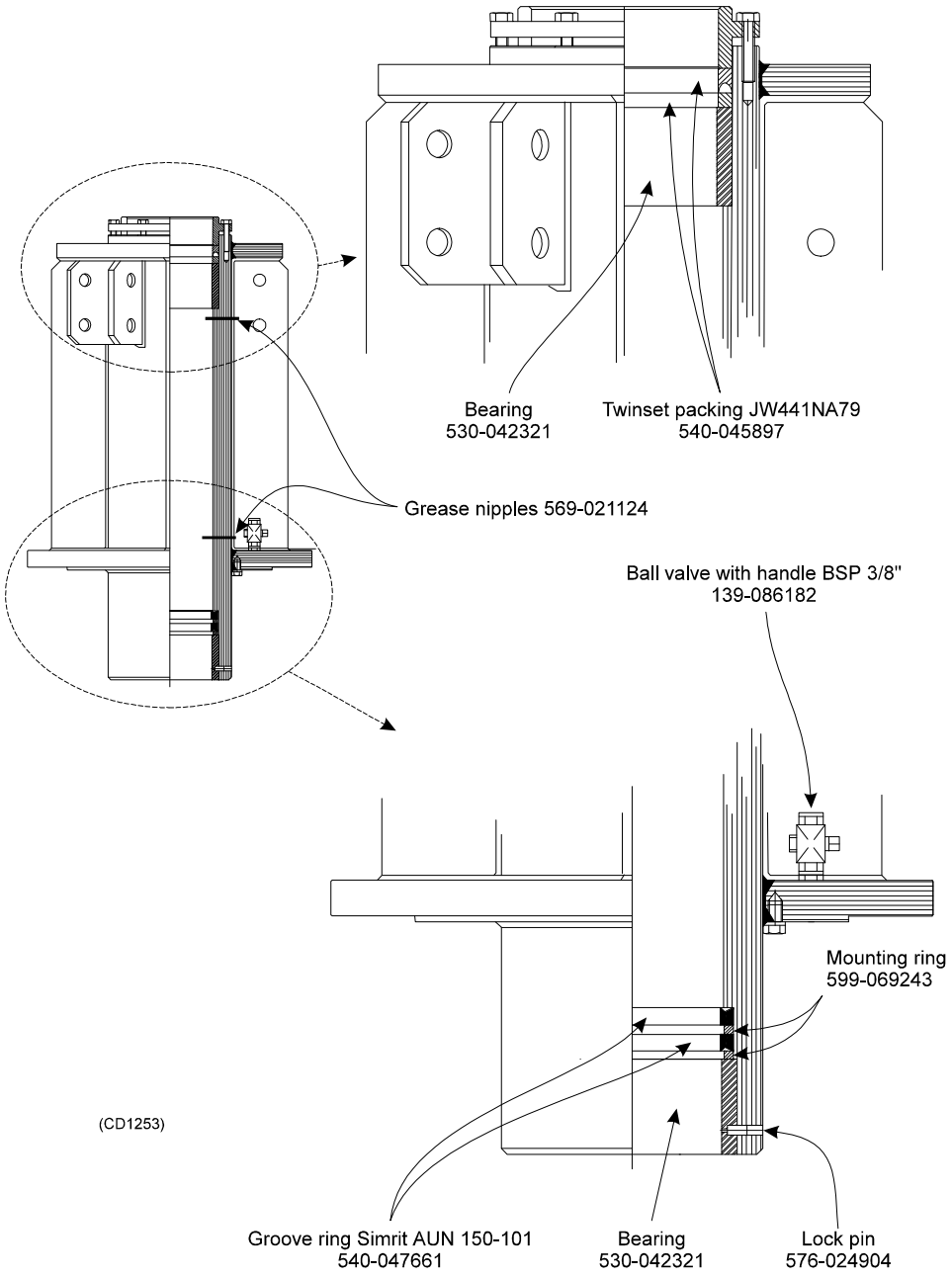


Figure 64 - Transducer dock O-rings

Dock spare parts list

Part no.	Item name	Drw. ref.	No. in sys.	Supplier
-	Technical data	Drw. pos.	Rec.spares	Supp. code
540-045951	O-ring	-	2	-
-	381.2 x 8.2 MIL413B	-	0	-

Transducer shaft sleeve



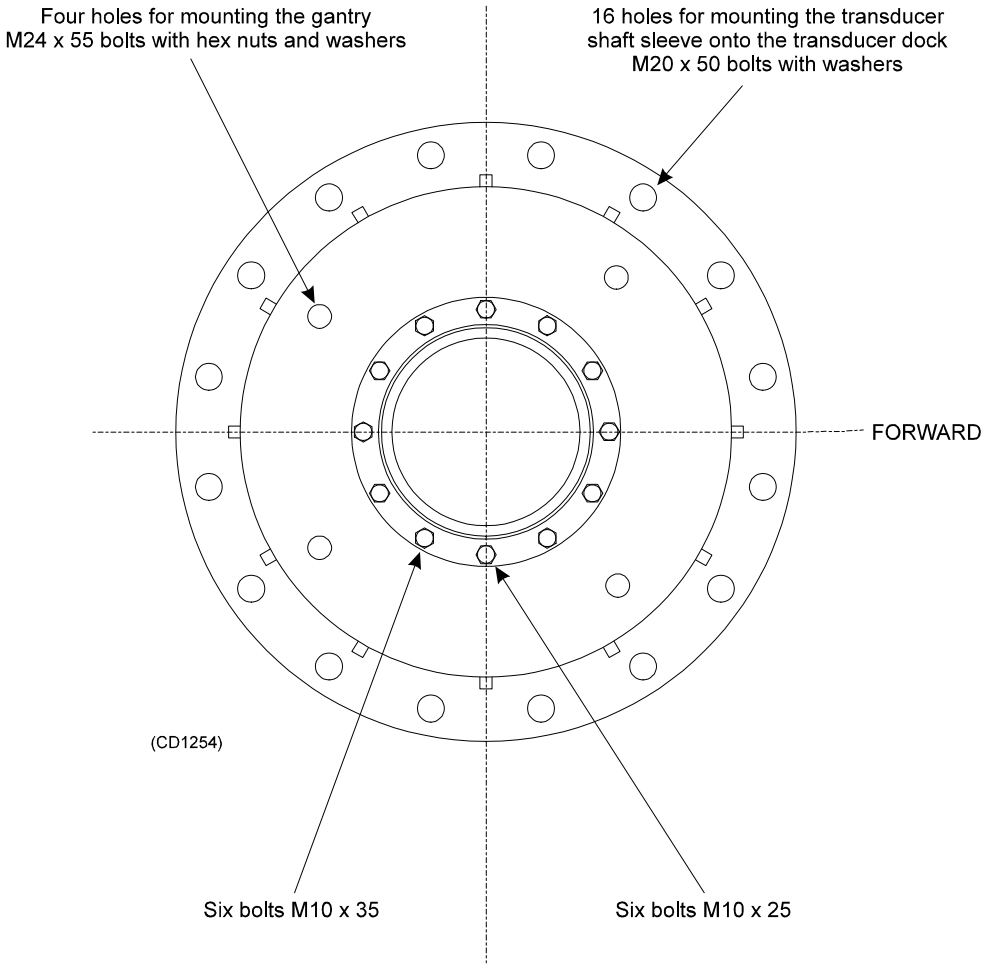
Transducer shaft sleeve spare parts list

Part no.	Item name	Drw. ref.	No. in sys.	Supplier
	Technical data	**Drw. pos.**	**Rec.spares**	**Supp. code**
530-042321	Bearing	-	2	-
-	One at top, one at bottom of shaft sleeve	-	0	-
540-045897	Twin-set packing	-	1	-
-	JW441NA79	-	0	-
569-021124	Grease nipple	-	2	-
-	R 1/4”	-	1	-
139-086182	Air vent / drain cock	-	2	-
-	Stainless steel SS316 3/8” with handle. Also used on transducer dock.	-	1	-
569-084212	Adapter 3/8”	-	2	-
-	Also used on transducer dock.	-	1	-
540-047661	Groove ring	-	2	-
-	AUN 150-101	-	0	-
576-024904	Lock pin	-	1	-
-	-	-	0	-
599-069243	Mounting ring	-	2	-
-	Between and below groove rings	-	0	-
KIT-083818	Transducer shaft casing, spare parts kit	-	1	-
-	See note below	-	0	-

Note: *A spare parts kit is available under order no. KIT-083818. This kit contains all the above items with the exception of the ball valve.*

Transducer shaft sleeve-top

Note: *The mounting components (nuts, bolts, washers etc.) on the drawing below are considered "standard" hardware items. Kongsberg Simrad order numbers are therefore not given.*



Top of the transducer shaft

Part no.	Item name	Drw. ref.	No. in sys.	Supplier
	Technical data	**Drw. pos.**	**Rec.spares**	**Supp. code**
540-048286	Cable gland gasket		1	
	28X \ 16/25 (EMNE 8976)		0	

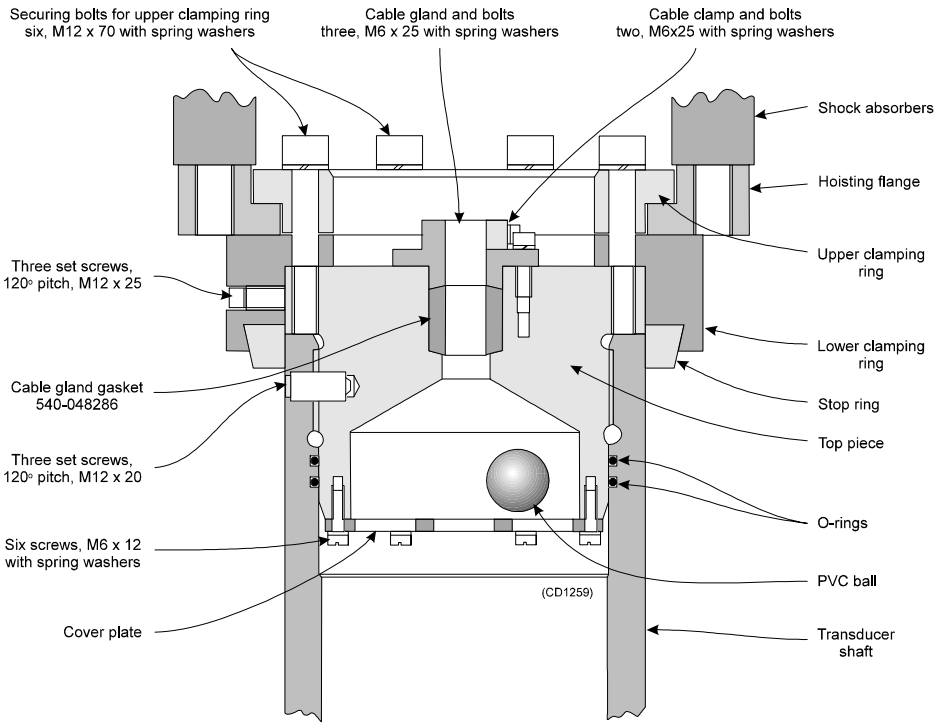


Figure 65 - Top of the transducer shaft

Transducer shaft joint

Part no.	Item name	Drw. ref.	No. in sys.	Supplier
	Technical data	**Drw. pos.**	**Rec.spares**	**Supp. code**
540-045550	O-ring		4	
	120.24 x 3.53 N		0	
380-067466	Transducer cable (16 m) with plug		1	
	From transducer to shaft junction box		0	

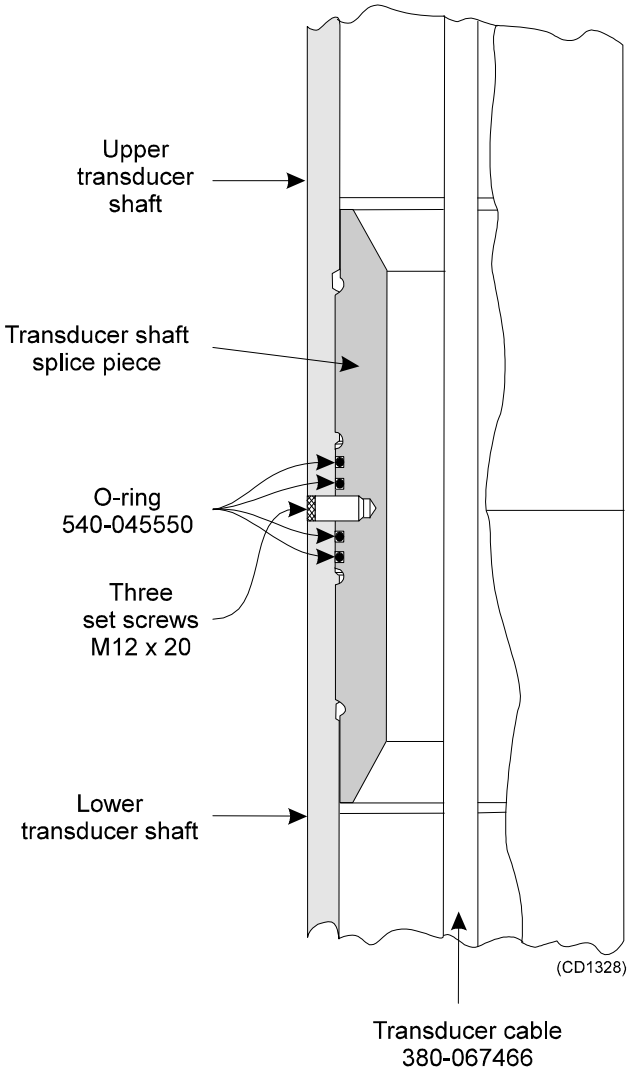
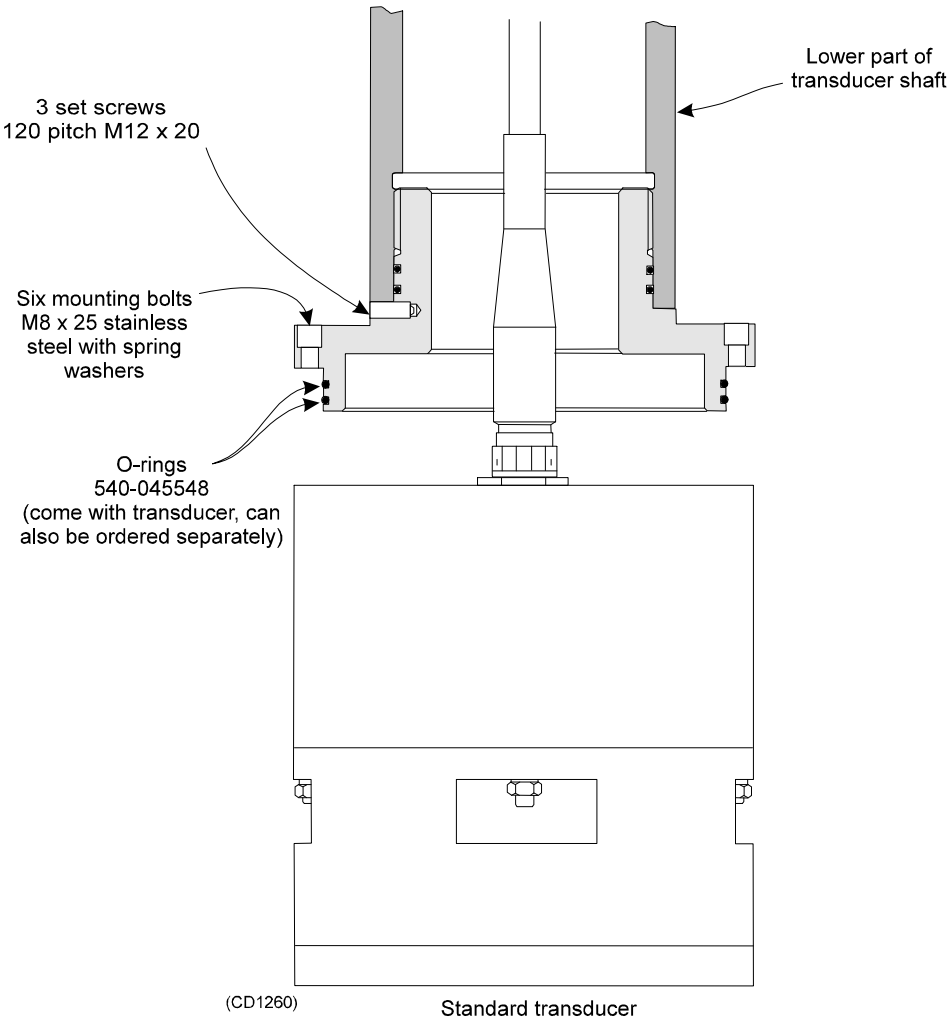


Figure 66 - Transducer shaft joint

Transducer

Standard transducer spare parts list

Part no.	Item name	Drw. ref.	No. in sys.	Supplier
-	Technical data	Drw. pos.	Rec.spares	Supp. code
540-045548	O-ring		2	
	189.5 x 3.0 MIL413B		0	



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9 DRAWING FILE

General

The drawings listed are included in the text. Most of these drawings are available in electronic format (AutoCAD) upon request.

- The illustrations are not in scale.
- Most of these drawings are available in electronic format (AutoCAD) upon request.

Arrangement drawings

- HL 3880, typical arrangement drawing

→ *Refer to pages 229 and 230.*

- Example of HPR Hull Unit drawing

→ *Refer to page 231.*

- HL 3880, HL 3100, HL 2300 and HL 1530 outline dimensions

→ *For HL 3880, HL 3100 refer to page 232, for HL 2300 refer to page 233, for HL 1530 refer to page 234.*

- HL 6230, outline dimensions

→ *Refer to page 235.*

Installation

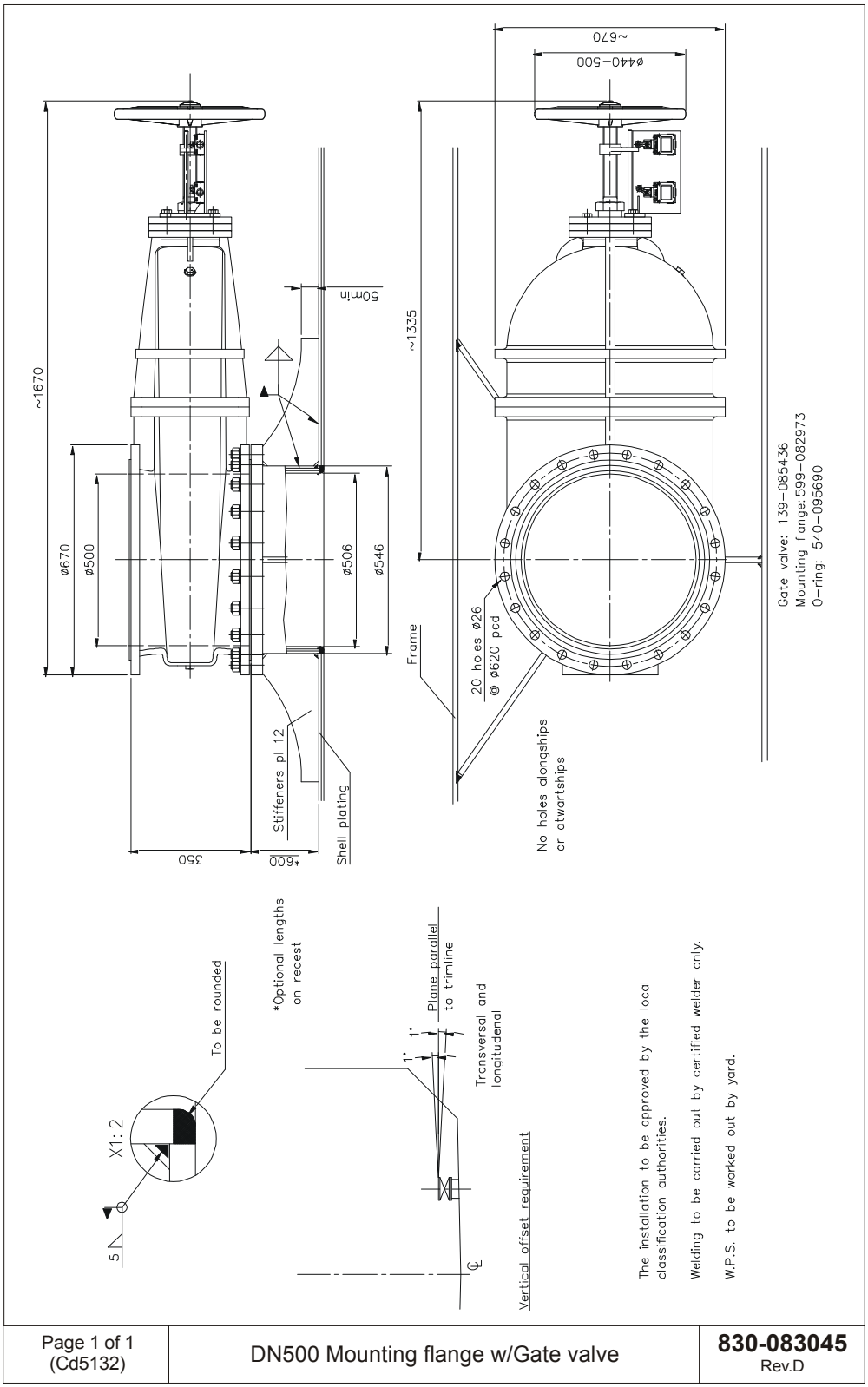
- DN500 mounting flange with gate valve, see page 227.
- DN350 mounting flange with gate valve, see page 228.

Mechanical construction

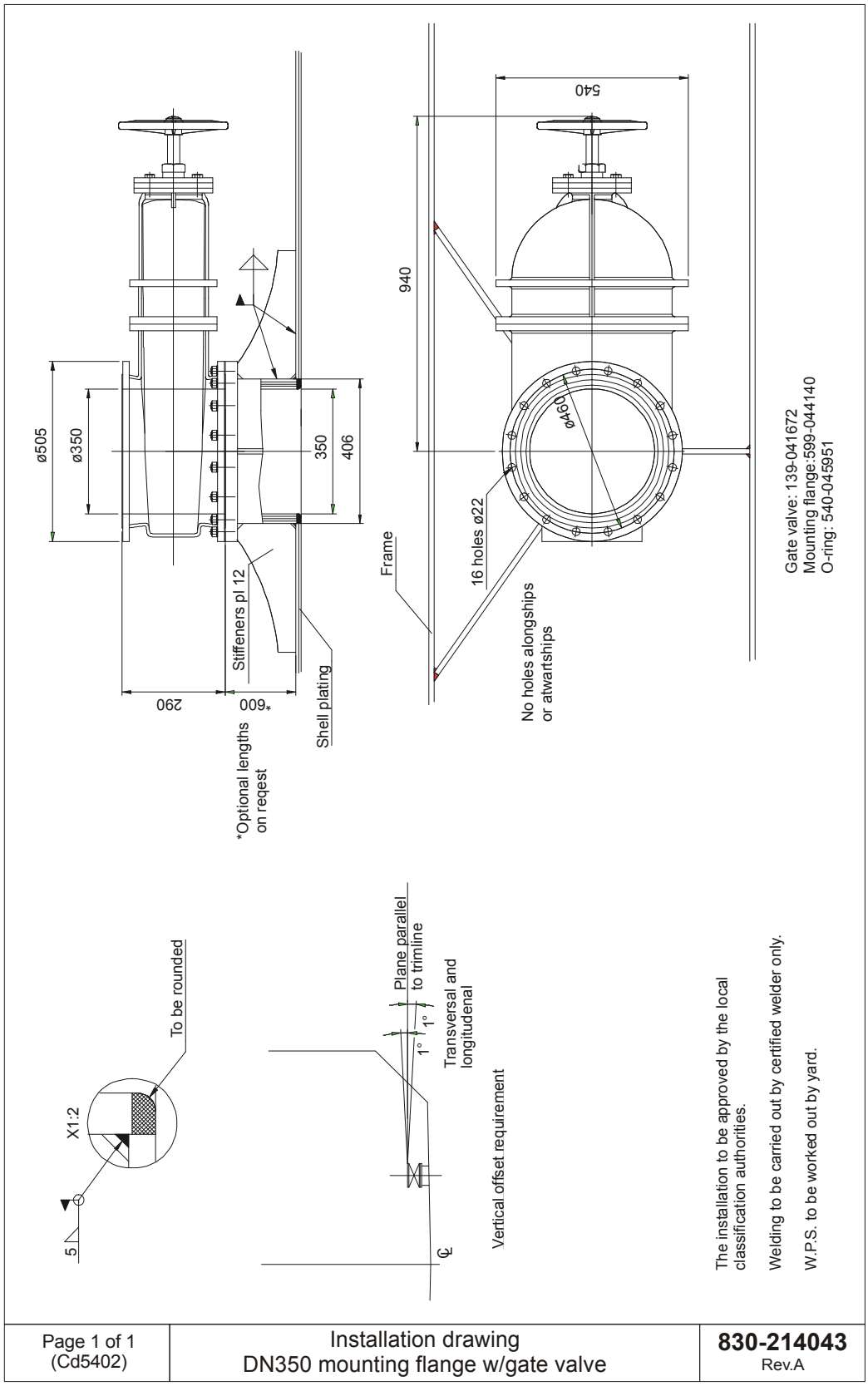
- 500 mm mounting flange, see page 236.
- 350 mm mounting flange, see page 237.

Interconnection and circuit diagrams

- Interconnection diagram, hoist system, see page 238.
- Wiring diagram, Hoist Control Unit, see page 239.
- Wiring diagram, Remote Control unit, see page 240.
- Ø500 mounting flange, se page 236.
- Ø350 mounting flange, see page 237.
- HPR Hull Unit, limit switches, see page 241.
- HPR Hull Unit, Transceiver - transducer, signal cable, see pages 242, 243 and 244.

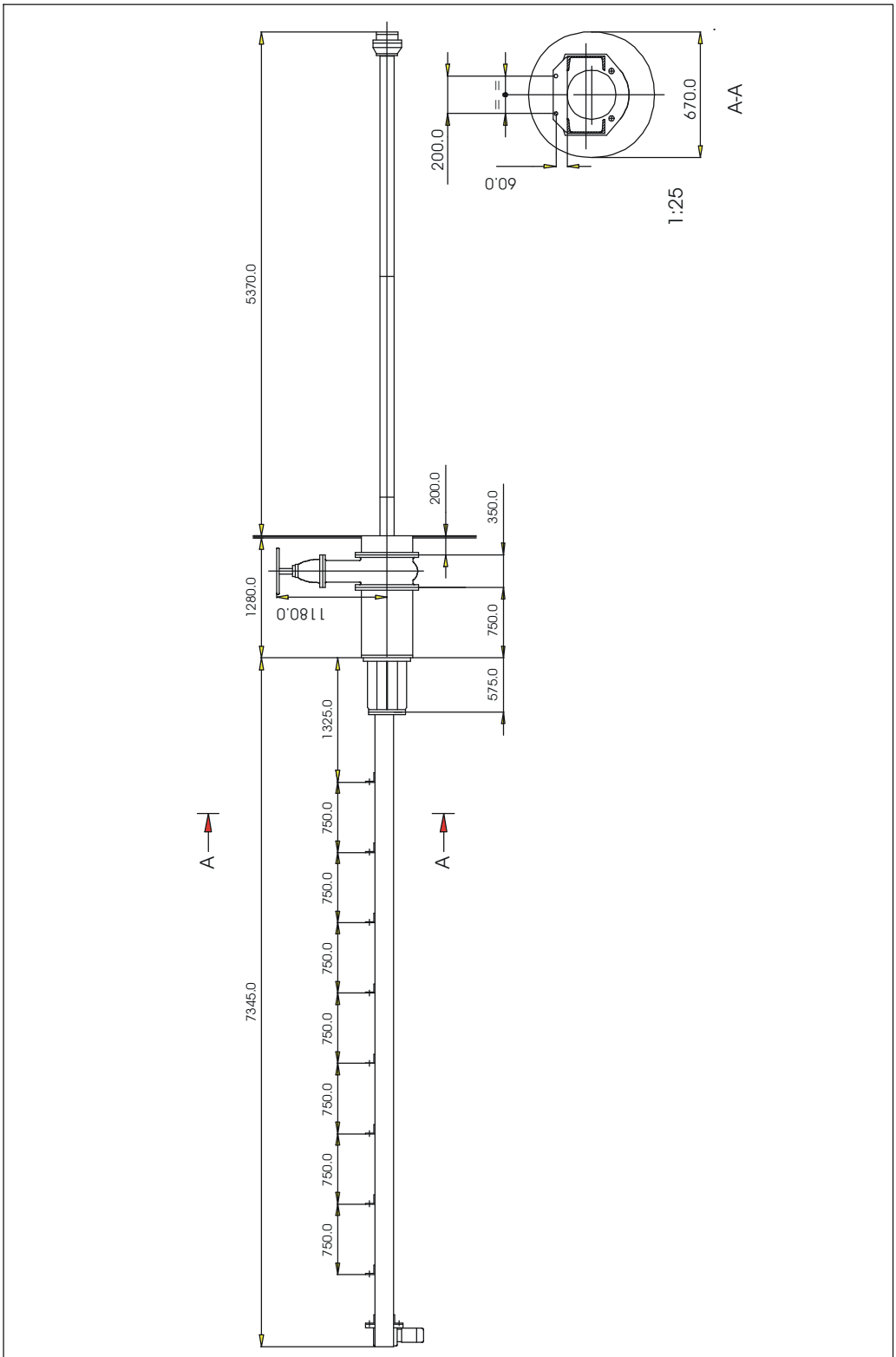


Page 1 of 1 (Cd5132)	DN500 Mounting flange w/Gate valve	**830-083045** Rev.D

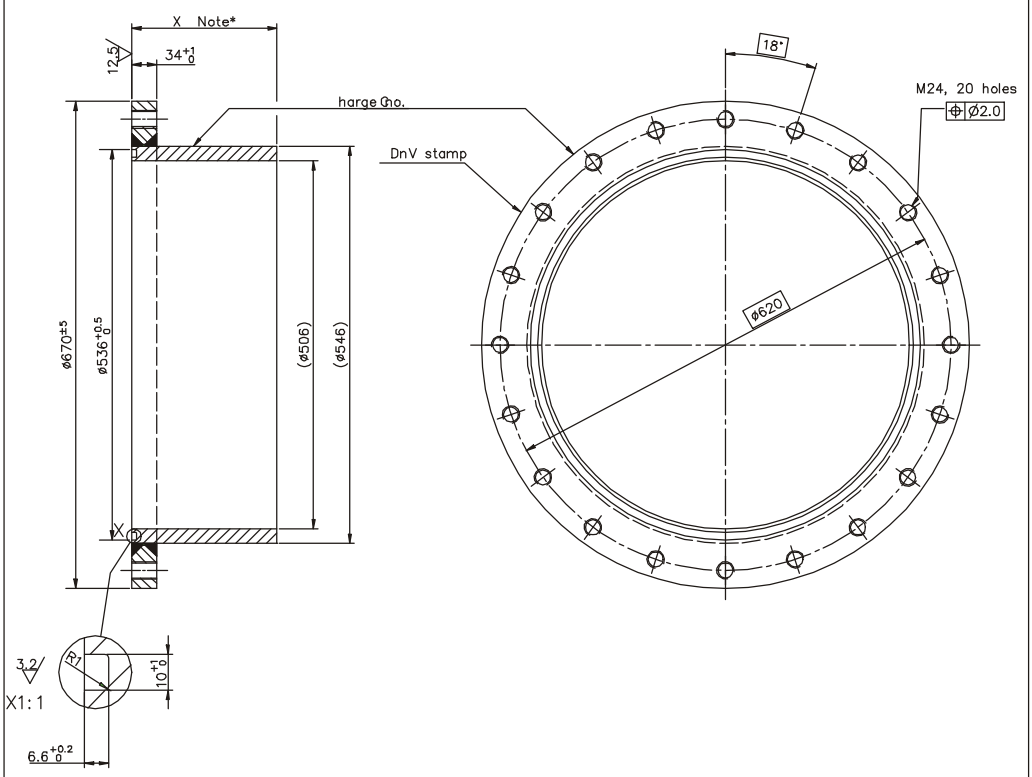

ø505
ø350
350
406
290
*600
Stiffeners pl 12
Shell plating
*Optional lengths
on reqest
940
540
ø940
Frame
16 holes ø22
No holes alongships
or atwartships
Gate valve: 139-041672
Mounting flange:599-044140
O-ring: 540-045951
X1:2
5
To be rounded
Plane parallel
to trimline
1°
1°
Transversal and
longitudenal
Vertical offset requirement
The installation to be approved by the local
classification authorities.
Welding to be carried out by certified welder only.
W.P.S. to be worked out by yard.
Page 1 of 1
(Cd5402)
Installation drawing
DN350 mounting flange w/gate valve
830-214043
Rev.A

Typical arrangement Hull Unit HL 3880

Example of HPR Hull Unit



Page 1 of 1 (Cd5409)	Outline dimensions - Hull Unit HL 6230	**830-089293** Rev.A



D

Note: length X specified in order.

C

Tube: ø546x20, DIN 17121, Material: S355J2G3 (St52-3N) EN10025.
Flange: Plate, Material: S355J2G3 (St52-3N) EN10025.

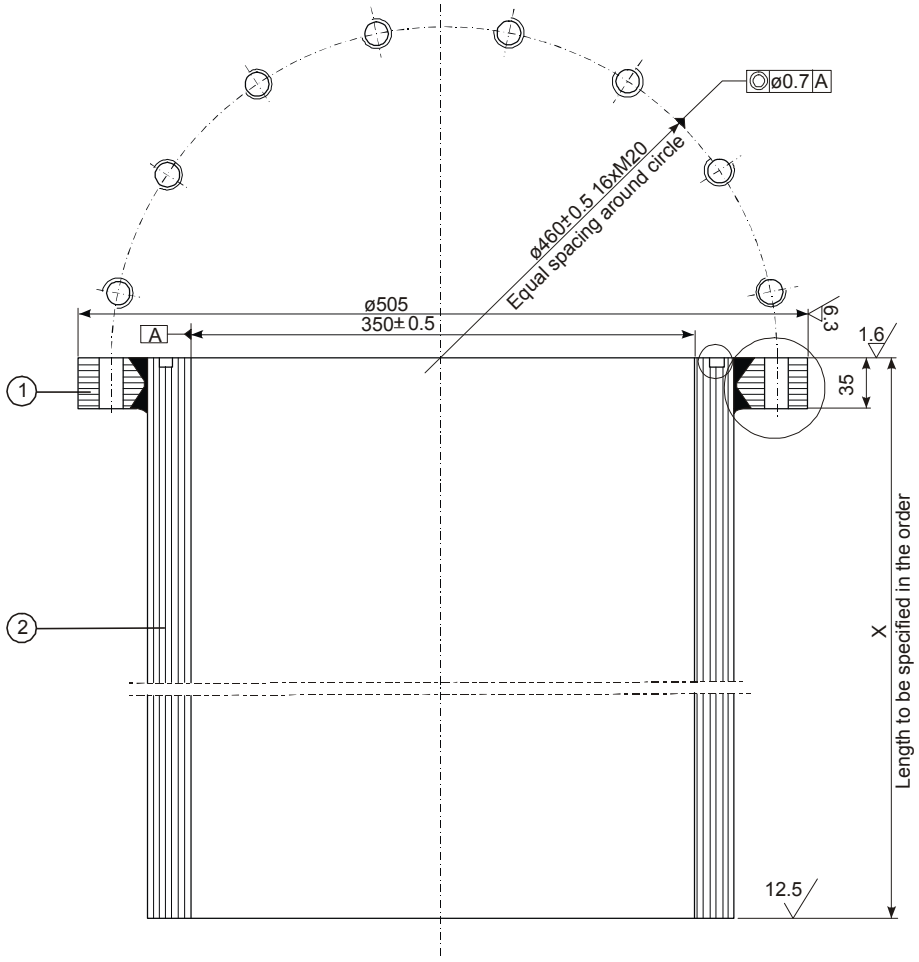
Attachments:
Material certificate 3.1.B EN10204.
DnV certificate.
Welders approval certificate NS478.

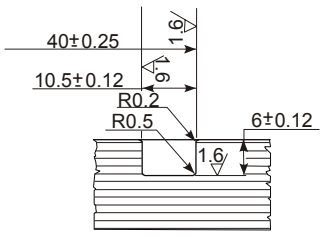
All welds to be performed by certified welder, and according to DnV "Rules for Classification" Pt.3 Ch.1 Sec.12.

Surface treatment: Sandblasting to Sa3, one coat of Shopprimer.

To be stamped with:
DnV approval
Charge no.

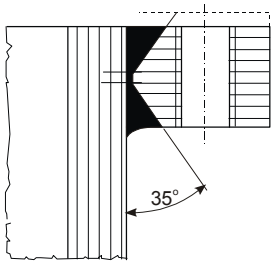
Page 1 of 1 (Cd5134)	Mounting flange Ø500	**599-082973** Rev.D





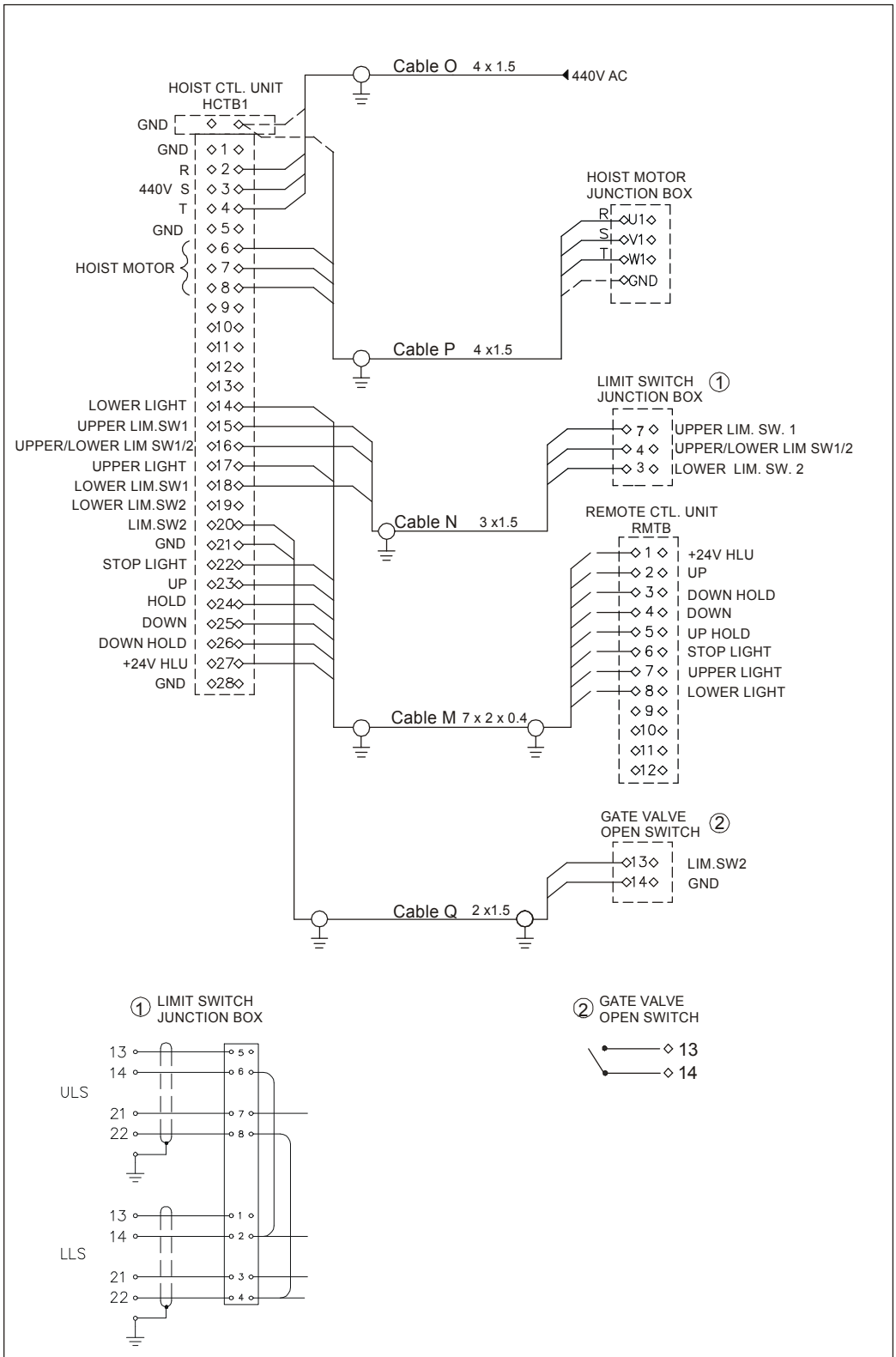
A minimum of 25% of the weld is to be tested using ultrasonic test equipment. The weld must satisfy, as a minimum, the requirements corresponding to standard IIW, grade 3, and be free of craks and inclusions.

To be welded with full burn-through

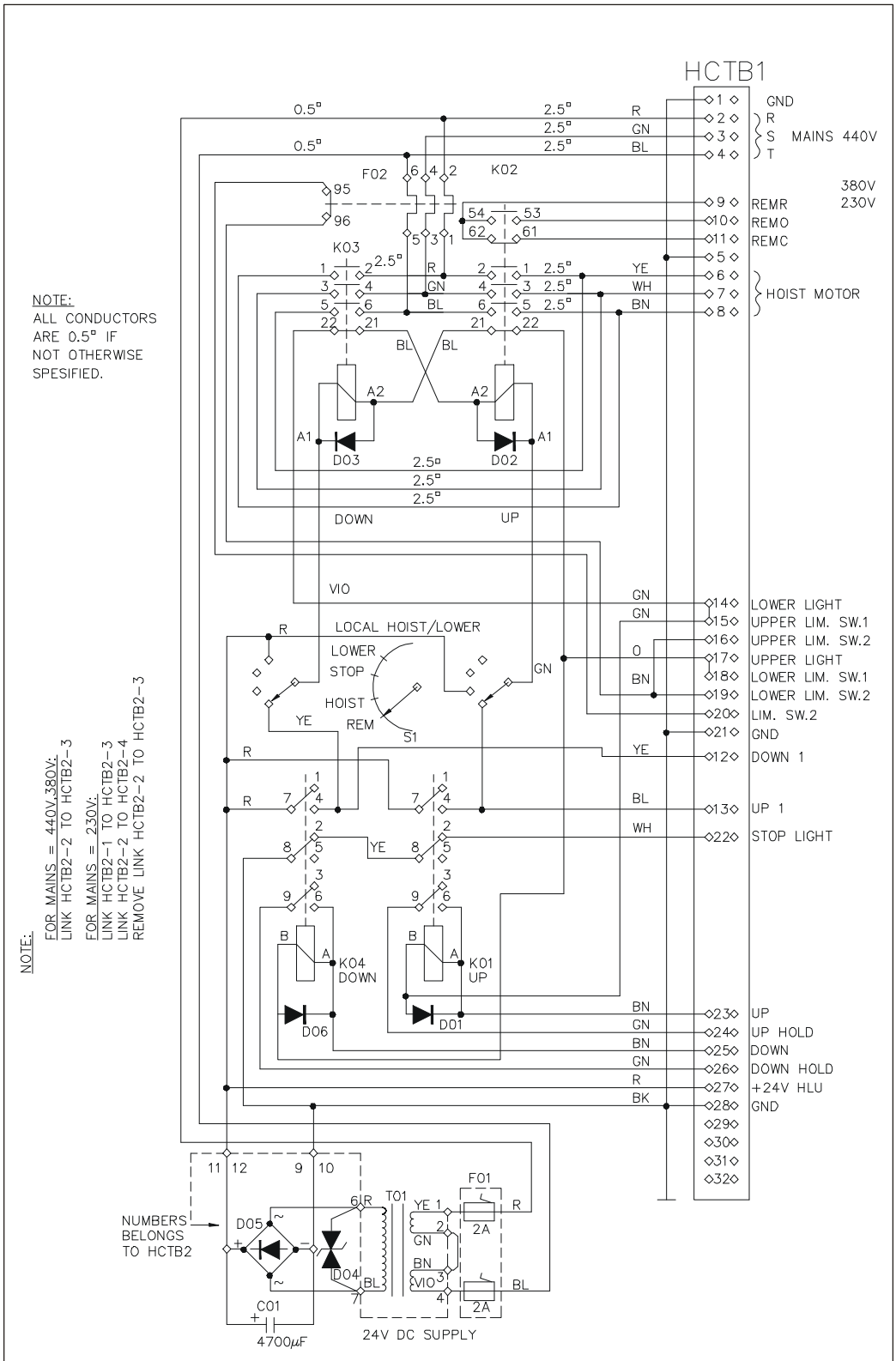


To be welded with electrodes classified by DNV or Lloyds.
To be sandblasted according to IVA standard Sa3.
One coat of iron oxide primer, instruction 840-036176.

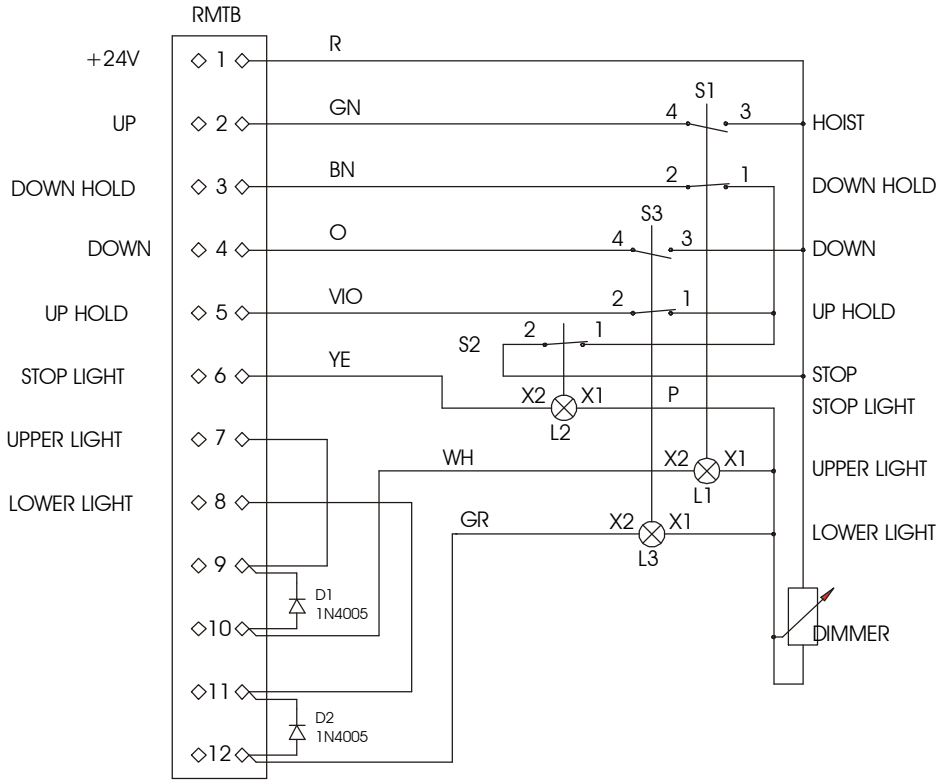
Page 1 of 1 (CD5404)	DN350 mounting flange	**599-044140** Rev.B



Page 1 of 1 (CD5139a)	Hoisting system - interconnection diagram	**N/A**

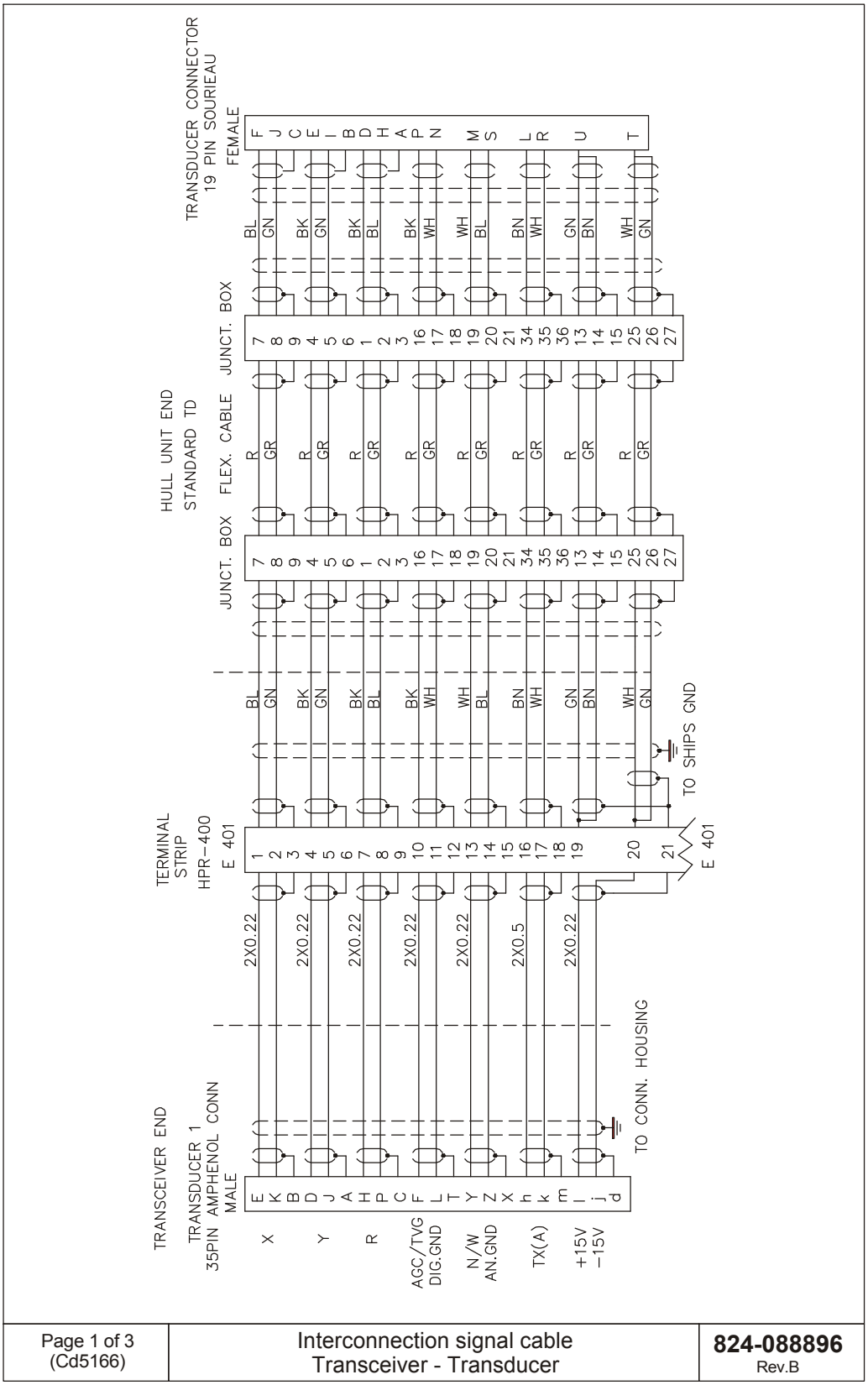


Page 1 of 1 (Cd5135)	Wiring diagram HCU	**824-102987** Rev.A

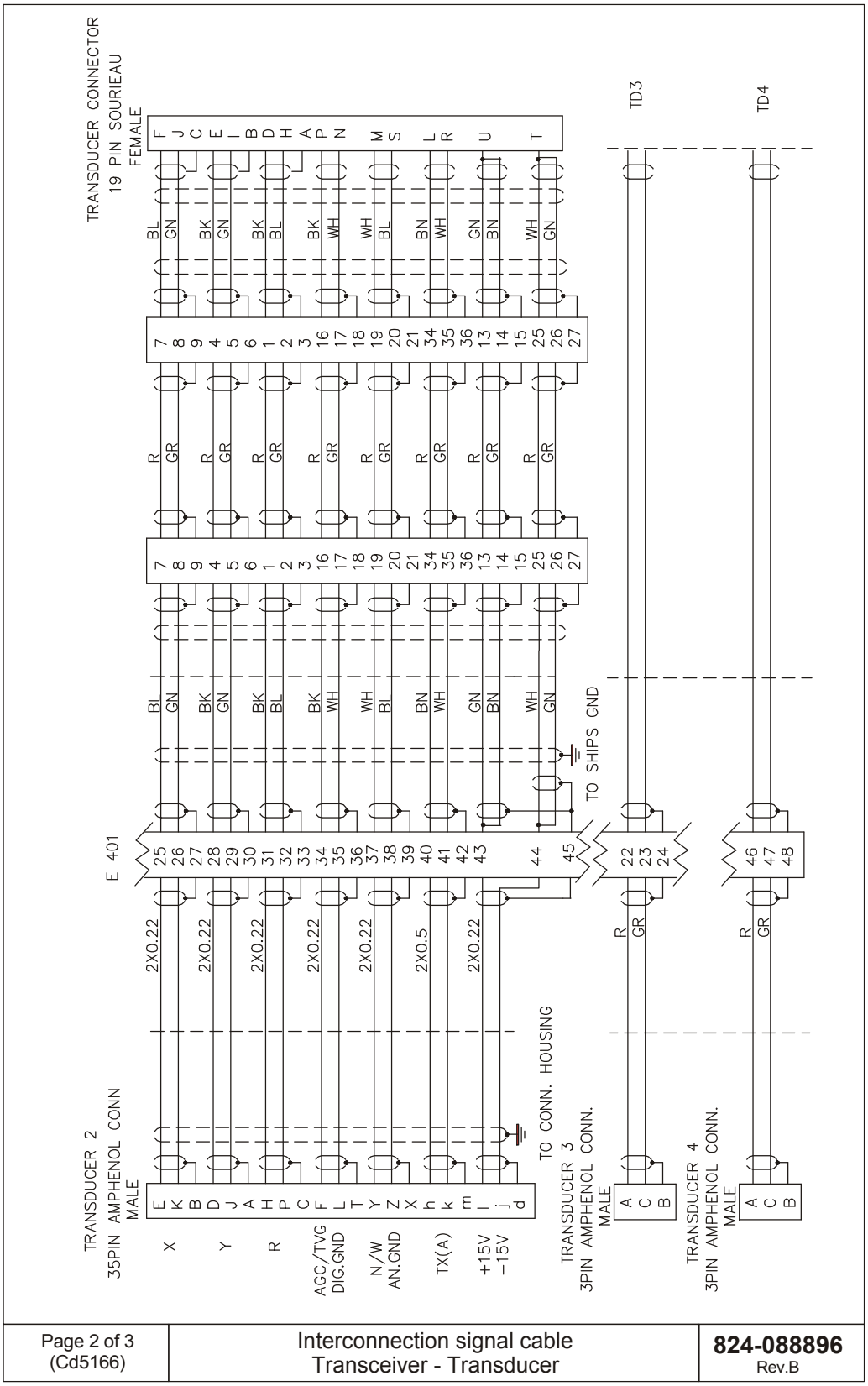


Note: All conductors, 0.5°

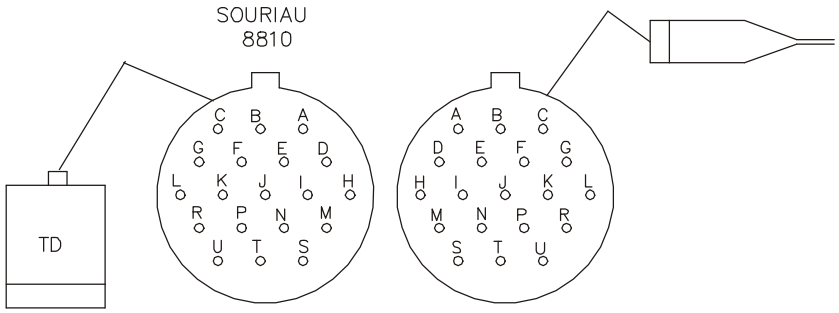
Page 1 of 1 (Cd5140)	Wiring diagram RCU	**824-094181** Rev.D



Page 1 of 3 (Cd5166)	Interconnection signal cable Transceiver - Transducer	**824-088896** Rev.B



Page 2 of 3 (Cd5166)	Interconnection signal cable Transceiver - Transducer	**824-088896** Rev.B



CONNECTORS DELIVERED ONLY WHERE APPLICABLE

CABLE SHALL BE IN ACCORDANCE WITH
CABLE PLAN HPR–400 SERIES, 824–088891,
SUBJECT TO SPECIAL ORDER

TERMINAL STRIP CONNECTIONS TO BE
PERFORMED IN ACCORDANCE WITH
SIMRAD PROCEDURE 842–072050

NOTE THE OTHER SHIELDS OF TRANSDUCER CABLE 1 AND 2 ARE TO BE CONNECTED TO SHIPS GROUND AT THE TERMINAL STRIP OR, IF TERMINAL STRIP IS NOT USED, TO TRANSDUCER CONNECTOR HOUSING.

Page 3 of 3 (Cd5166)	Interconnection signal cable Transceiver - Transducer	**824-088896** Rev.B

10 TRANSDUCER

This section is comprised by handouts provided by the instructors.

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11 SHIP INFORMATION

This section is comprised by handouts provided by the instructors.

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12 BACKGROUND INFORMATION

This section is comprised by handouts provided by the instructors.

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13 APOS EXERCISES

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14 COMMUNICATION PROTOCOL

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15 COM PORTS IN APOS

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16 COM PORTS IN HSC

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17 COM PORTS TROUBLESHOOTING

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18 NOTES

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1 APPENDIX - HULL UNIT EX-1

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2 APPENDIX - HYDRAULIC HULL UNIT

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