Instruction manual

KONGSBERG

RPT

ROV Positioning Transponder

Base version

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.

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

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RPT
ROV Positioning Transponder

This is the Instruction manual for the Kongsberg Simrad ROV Positioning Transponder (RPT).

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Contents

Document logistics

Rev	Date	Written by	Checked by	Approved by
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A	Original issue.
B	Manual updated to implement a new type of backing ring, and to correct minor errors. Ref. 160748B.
C	Manual updated to implement an Index, floating collar information, a new figure on the front page, corrections on figure 14 and minor corrections in the text.
D	Removed model RPT 316.
E	Implemented battery safety instructions. Implemented Beam patterns. Updated spare parts lists. Reorganized PCBs and battery information. New layout. Ref. 857–160748E.
F	Updated spare parts lists. Ref. 857–160748F.

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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Warning !
Transponder containing a Lithium battery

TRANSPONDER IN USE

Handling in general

- When on deck, the transponder must be placed in a sturdy rack placed in a solid room with no other vital or delicate equipment.
- Before deployment, perform a visual inspection of the transponder.
- During deployment prevent the transponder from slamming against other solid objects.
- After retrieval of the transponder, check for damages that could cause water leakage and hence possible temperature increase.

Handling if failing

- If the transponder stops working during an operation, special care must be taken during retrieval. As soon as the transponder is above water, look for outer damages that could involve a water leakage. Then the temperature on the transponder housing must be checked to verify a possible temperature increase in the lithium battery. If a short circuit occurs due to water ingress while the battery still has much remaining energy, the energy will mainly be converted into heat.

Caution: *If the cells that form the battery reaches the critical temperature of 180_C they will explode.*

Caution: *When the transponder is to be opened, be aware that it might be a pressure built-up inside. Be sure to use protective glasses and take special precautions to avoid personnel injury.*

Handling if leaking

- If there is any reason to believe that the transponder battery has been exposed to sea water, the temperature on the transponder housing must be checked as soon as the transponder is off the water. If the temperature is normal the transponder should be opened.
- If the battery has been exposed to sea water, internal short circuits in the battery may be formed and it is important to disconnected the battery from the transponder electronics as soon as possible and dump it at sea.

Handling if heated or self-heated

If the temperature on the transponder housing for some reasons is increasing, we recommend that the transponder is immediately fastened to a rope and lowered into the sea, where it should stay for at least two hours. Back on deck the temperature must be checked again, and if it is stable, the transponder should be opened and the battery should be removed.

Safety

For detailed safety information on the batteries, read the *Battery safet*y section on page 19.

IN TRANSPORT

Caution: *Always ensure to follow the existing rules for transport of equipment containing lithium.*

During transport the lithium battery must always be disconnected from the electronics. Original transponder cages must be used. If not available be sure to label the goods correctly (Hazard label).

IN STORE

When the transponder is to be stored, it must be placed in a sturdy rack placed in a solid room with no other vital or delicate equipment.

Note: *The transponders must not be kept on the bridge or any other room where people are staying.*

Note: *The transponder should not be kept in any rooms containing vital or delicate equipment.*

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INTRODUCTION

Manual contents

This manual describes the Kongsberg Simrad RPT (ROV Positioning Transponder). It provides a general introduction, technical specifications, operating instructions and maintenance procedures. It also includes battery charger instructions.

General

How to handle a transponder

The transponders described in this manual may contain a Lithium Battery!

WARNING! **Due to safety rules, a transponder must be handle with care. For detailed information about handling the transponder including the battery, you must read:**
- Warning on page VII.
- Battery safety, section on page 19.

WARNING! **Do not point the transducer/end cap towards you self or others when you turn the RPT on.**

Important information

The channel switches on the RPT must be set accurately or, the RPT will not operate correctly.

1 Set the ON/OFF switch to off.

2 Set the channel switches to the required channel.

3 Wait 5 minutes to ensure the RPT has re-set correctly.

4 Set the power switch to ON.

5 Listen for two (2) transmission pulses.

6 If no transmission pulses are heard, repeat steps 1 to 5.

Caution: *If three (3) pulses are transmitted and repeated every 10 seconds, an illegal channel has been selected.*

When the channel switches are set correctly, the unit will “present itself” by transmitting two pulses. This can be checked by putting your fingers on the front of the transducer or by holding it close to your ear. You should be able to hear the two transmission pulses.

List of abbreviations

HiPAP	High Precision Acoustic Positioning
HPR	Hydroacoustic Position Reference
LED	Light Emitting Diode
MF	Medium Frequency
MPT	Multifunction Positioning Transponder
N / A	Not Applicable
ROV	Remotely Operated Vehicle
RPT	ROV Positioning Transponder
SSBL	Super-Short Base Line

General description

The Kongsberg Simrad RPT transponder is designed primarily for use with the Kongsberg Simrad topside HPR and HiPAP systems.

→ *Examples of RPT transponders are shown in the figure on page 3.*

The RPT transponder can work from its own internal battery pack or an external power supply, and can be interrogated acoustically through water or via a cable. Several models of RPT transponder are available.

Unless specified otherwise, the transponder housing is an aluminium cylinder which is anodised and Polyurethane coated to protect against corrosion and abrasion.

The unit is designed with a modular construction in that the electronics, battery pack, transducer and end cap can easily be replaced individually.

The RPT has the following features:

- External channel selection:
  - 14 HPR 300 channels.
  - 56 HPR 400 channels.
- Selection of the source level (to optimise battery life requirements).
- Selection of the receiver sensitivity.
- Fast battery charging.
- Both transponder and responder function.

There are two transducer beamwidths available:

- A 90° cone transducer
- A 180° hemispherical transducer.

There are two types of batteries available:

- A long life Lithium battery pack.
- A rechargeable NiMH battery pack

Figure 1 - RPT transponders

Available transponders

This manual covers the following transponder versions:

RPT 319	depth 1000 m, transducer ± 90_, Lithium battery
RPT 319 / N	depth 1000 m, transducer ± 90_, rechargeable battery
RPT 324	depth 2000 m, transducer ± 45_, Lithium battery
RPT 324 / N	depth 2000 m, transducer ± 45_, rechargeable battery

Transponder name principles

The transponder name consists of the model name, the model number, any option included and the housing material.

The name contains three letters followed by three numbers. The letters after the numbers describe the option and housing material (see example below).

Model name

RPT = ROV Positioning Transponder

Model number

The three digits number describe:

Digit 1: frequency band

Digit 2: depth rating

Digit 3: beamwidth

The following are available:

1st number	2nd number	3rd number
Frequency band	**Depth rating**	**Transducer beamwidth**
3 = 30 kHz	1 = 1000 m	4 = ± 45°
	2 = 2000 m	9 = ± 90°

Option

N = Rechargeable battery pack. If not N suffix, Lithium Battery pack is used.

Material:

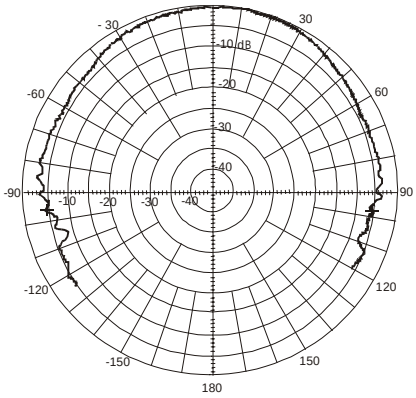
If aluminium is used, the housing material specification is left out.

Example: **RPT 319/N**

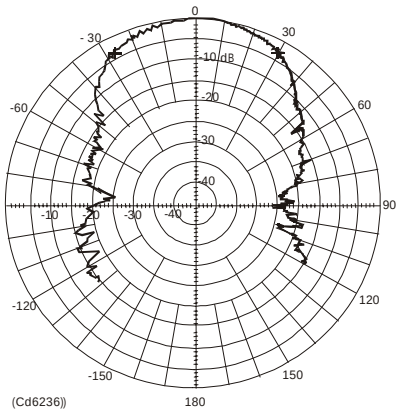
The example given (RPT 319/N) therefore indicates that the transponder unit is a mini-transponder, operating in the 30 kHz band, rated to 1000 meters depth, with a ±90° beamwidth and a rechargeable battery.

Beam patterns

The figure below shows the beam patterns. A beam pattern shows the transmit/receive sensitivity in the different directions.



RPT 319 series
Source level = 188 dB



RPT 324 series
Source level = 195 dB

Figure 2 - Examples of beam patterns

Accessories

A floating collar is available to fit around the transponder.

TECHNICAL SPECIFICATION

Common specifications

General

The technical details given in this paragraph are general for all the RPT transponder types.

Housing material	Anodised aluminium
Housing coating	Polyurethane
Outside diameter (with coating)	75 mm
Operating temperature	0°C to +30°C

Power supply

The following power supplies are available:

- Internal Nickel Metal Hydride rechargeable battery
- internal Lithium battery
- external 23 - 30 Vdc.

Transmitter

Power	maximum 100W
Frequency	25 kHz to 31 kHz
Transmitter pulse length	10 ms

Receiver

Receiver bandwidth (-3dB)	20 kHz to 27 kHz

Responder operation

- Responder trigger connection:
  - Via the external connector.
- Responder trigger signal:
  - Positive logic pulse
  - amplitude 5 V to 25 V
  - 2 ms to 6 ms duration.

Source level and receiver sensitivity

Model series	Source level - max (2 steps)	Receiver sensibility (2 steps)
RPT 319	188 dB* 185 dB	100 dB* 110 dB
RPT 324	195 dB* 192 dB	100 dB* 110 dB

* Factory pre-set.

RPT 319

Specific technical details for the RPT 319 basic unit:

Weight in air	2,3 kg
Weight in water	1.0 kg
Overall length	330 mm
Operating depth	1000 m maximum
Transducer beam	±90°

RPT 324

Specific technical details for the RPT 324 basic unit:

Weight in air	2.5 kg
Weight in water	1.2 kg
Overall length	350 mm
Operating depth	2000 m maximum
Transducer beam	±45°

Floating collar

Specific technical details for the floating collar:

Deep rating	2000 m
Weight in air	approx. 12 kg
Nett buoyancy	5 kg
Overall height with cage	approx. 530 mm
Diagonal diameter	275 mm
Colour	orange

OPERATION

The transponder is designed for operation in water only. However, the transponder may be operated in air for test purpose over a short period.

Switch settings

Caution: *The channel switches must be set accurately, or the RPT will not operate correctly.*

→ ***Refer to important information on page 1.***

Transducer handling

At transportation and storage, the transducer face and the O-ring groovers must be protected. Do not leave the transducer resting on the face, because even a small roughness on the support may cause a permanent destortion in the polyurethane face.

As a precaution at storage, short-circuit the electrical wires. This prevents unpleasant voltages, which otherwise may appear from temperature variations.

Pre-deployment checks

Prior to deployment of the transponder it is important that the following checks are made to ensure correct operation.

Basic check

1 Ensure the unit locking screw is fully tightened.

→ *Refer to figure on page 42.*

2 If no external responder signal or external power is to be used, ensure the end cap connector has a blanking cap fitted.

3 If the unit has been altered from the factory pre-sets, check that the unit is configured as per your requirements.

→ *Refer to paragraph Source level/Sensitivity settings, on page 29 and paragraph DIP switch settings on page 30.*

4 If the unit has a rechargeable battery, ensure the unit has been recently charged.

→ *Refer to page 17 for for details.*

5 For change of Lithium battery:

→ *Refer to page 15 for details.*

6 Select the channel required via the end cap switches.

Activate the transponder

1 Switch the unit ON via the end cap switch. The unit will ping twice to indicate it is activated.
If:
- The unit does not ping, switch the unit OFF and leave it for approximately 5 minutes. Switch the unit back ON and listen for the pings.
- The unit emits a triple ping, this indicates the channel switches are set to an illegal channel (for example 30). The triple ping will be emitted every 10 seconds until a legal channel is set.
Note that the triple ping will also be emitted if a switch is slightly off its number.

2 If several RPTs are powered up simultaneously, they may interrogate each other, causing uninterrogated replies.

3 Check that the unit replies in air as follows:
- Use the TTS 286 Transponder Test Set for HPR 300 channels.
- Use the HPR 400 and the test transducer for HPR 400/300 channels.
- Alternatively lower the unit into the water alongside the ship, and test with the topside system.

External supply and/or responder trig

If the external supply and/or responder trig are to be used, carry out the following additional checks:

1 Ensure the external connector is correctly mated. In some cases an air lock may be created when pushing the connector on. This may result in the connector failing to be water-tight and may cause the connector to become completely disconnected. To ensure correct mating, grease the end cap connector using Molykote 33 medium (or similar). Firmly push the free connector (checking correct orientation) on.
When properly mated there may be a 'popping' sound as any air lock is released through the grease, otherwise there will be a definite stop when mated. If the connection feels 'springy' or if the free connector moves away from the end cap after mating, there is possibly an air lock.

2 To remove the airlock, squeeze the sides of the free connector using small pliers as you push the free connector onto the end cap connector, taking care not to damage the connector or the end cap.

Note: *A connector blanking cap is available as an optional extra, see spare parts listing at chapter 7.*

3 Ensure any external supply to be used is a dc voltage of between 23V & 30V.

Note: *The voltage must not be below 23V into the RPT. If below, the RPT will take current from the internal battery.*

4 If the responder function is to be used, check the unit in air on deck, by using the topside system.

Deployment

When fitting the transponder to a vehicle/structure, the unit must be positioned with the transducer upright and there must be a clear line of sight between the transponder's head and the ship's transducer. A transponder may be fitted in two different ways as follows:

1 Use a hose clamp with rubber insolation.

2 Two screw holes are provided in the end cap. Fit two eye bolts into these holes, and use a rope to secure the transponder to the vehicle/structure.

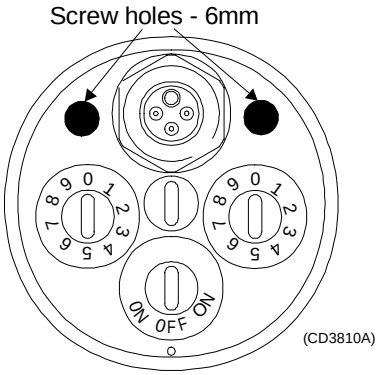


Figure 3 - Screw holes for eye bolts

Recovery checks

1 After recovery, switch OFF the unit.

2 Wash the unit thoroughly in warm fresh water to dissolve any salt deposits and clean off any sand or silt.

3 Carefully clean off the grease on the external connector, taking care not to contaminate the connector with sand or silt, and wash off, again in warm fresh water.

If a rechargeable unit is to be re-deployed imminently, put the unit on charge. Use the RPT 5382 battery charger to top-up the battery pack.

There is no discharge cycle on the RPT 5382 battery charger, therefore, the unit will always have a better capacity no matter how long it is put on charge.

Floating collar

The floating collar is divided lengthwise into two parts. These parts are placed around the transponder housing and bolted together. The collar is equipped with cages to protect the transducer and end cap.

Figure 4 - Example of transponder with floating collar

BATTERY

Battery lifetimes

All figures given in the table below are based on a transponder set to channel 33 and working at ambient room temperature.

Note: *Always allow a safety margin of error in any operation calculations.*

Setting	Rechargeable battery pack (fully charged)			Lithium battery pack		
	Quiescent	1 ping per sec	1 ping per 4 secs	Quiescent	1 ping per sec	1 ping per 4 secs
180° Transducer						
Normal source level	900 hours	20 hours	56 hours	3100 hours	70 hours	193 hours
Reduced source level	900 hours	33 hours	76 hours	3100 hours	115 hours	260 hours
90° Transducer						
Normal source level	900 hours	18 hours	53 hours	3100 hours	65 hours	182 hours
Reduced source level	900 hours	30 hours	72 hours	3100 hours	105 hours	247 hours

Battery storage

If the unit is not to be re-deployed in the near future, store it in a suitable environment.

The recommended temperature range for long-term storage of the rechargeable battery cells is -20°C to +35°C*. Stored capacity decreases over time due to the self-discharge of the rechargeable battery cells.

Self-discharge is dependent on temperature. The higher the temperature the greater the self-discharge over time. Long-term storage has no permanent effect on capacity. Losses in capacity due to self-discharge are reversible. After long-term storage (for example more than one year at room temperature) up to three full charge / discharge cycles may be necessary to obtain full capacity.

*The relative humidity should be < 50%.

Change of battery pack

To replace a battery pack, follow the procedure below:

1 Dismantle the transponder.

→ *Refer to page 31 for details.*

2 Disconnect the battery connector.

→ *For location - refer to figure 10.*

3 Unscrew the screw holding the battery clamp rod, and then remove the rod.

→ *For location - refer to figure 10.*

4 You may now remove the battery.

5 Assembly is basically the reverse of dismantling.

RPT 5382 battery charger

WARNING! **When you are charging the battery ensure:**

- **Good ventilation and stable temperature.**
- **The RPT/charger is not covered.**
- **No open fire, sparks or smoking in the area.**

Overview

Note: *It is not recommended that old type battery chargers are used on the* RPT *transponders.*

The RPT battery charger is designed around a fast-charge controller which monitors the state of the battery during charging. The controller provides a fixed current to the battery pack until it detects that the battery pack is fully charged, at which point it switches to a trickle charge current which can safely be applied indefinitely.

Full charge is detected by one of the following three methods:

1 **Negative voltage slope -** When fully charged, NiMH cells reach a peak voltage after which their voltage starts to fall. The controller measures the battery voltage every 84 seconds and, if it detects a measurement lower that the previous one, fast-charge is terminated.

2 **Battery pack temperature -** When fully charged the NiMh cells heat up quite rapidly. A temperature sensor inside the battery pack is used to detect this rise in temperature and triggers the controller to terminate fast-charge.

3 **Fast charge time-out -** The controller contains a timer which after 90 minutes of fast charge will time-out and terminate fast-charge.

After any one of these methods has terminated fast-charge, the battery charger goes to trickle charge and will not return to fast-charge unless the reset button is pressed, or the mains supply is turned off and back on.

Note: *If the old type MHT transponder is plugged into the 5382 Battery Charger, the controller will detect that there is no temperature sensor and will go into trickle charge and stay in that state.*

Note: *If an old type 242 or 243 battery charger is plugged into the RPT transponder, there will be no discharge cycle.*

Depending on the state of the battery under charge, the charger will either go into charge mode or ready mode (trickle charge). The battery pack will protect itself from damage, but full charge capacity will not be achieved.

The recommended temperature range for charging NiMh batteries is 0°C to 45°C and, if the temperature sensor inside the battery pack detects a temperature above +45°C, the battery pack will be isolated from the charger.

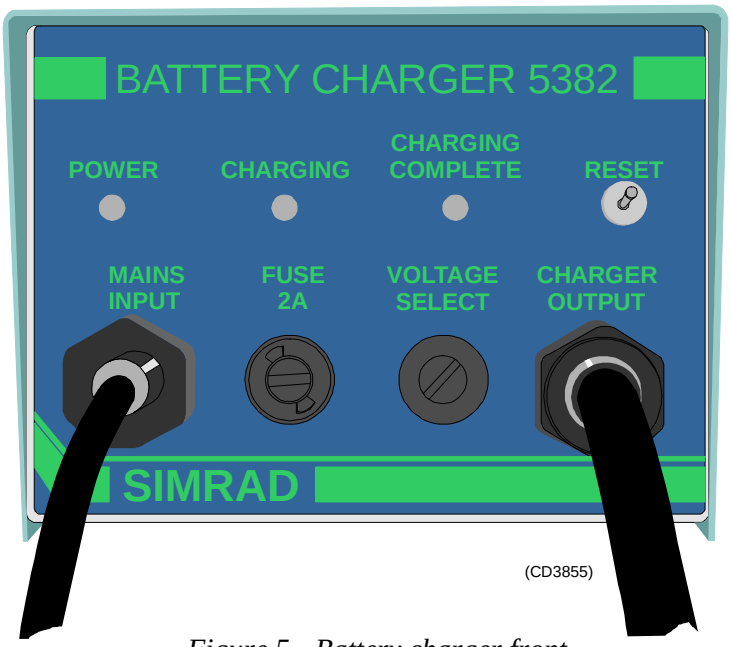


Figure 5 - Battery charger front

To recharge a battery

1 Turn the RPT transponder off.

2 Connect the flying lead onto the RPT end cap connector.

WARNING ! **Ensure the connector is plugged correctly into the base of the transponder. (You should hear a "click" when the plug has been properly inserted.)**
Refer to the figure and note on page 27.

3 Before connecting the charger to the mains, check that the mains voltage selection switch is set correctly.

4 Plug the charger into the mains and switch the mains supply on. The red LED (Power) on the front panel will light.

5 Press the reset switch. The yellow LED (Charging) on the front panel will light.
If, when charging, a negative voltage slope or an excessive battery temperature is detected, or if the charger has been charging for more than 90 minutes, the charger will not go into fast charge.
To turn the charger into fast charge at this stage:
- Turn the mains supply off and back on, or
- press the reset switch.

6 When the fast charge cycle is complete, (approx. 90 minutes with a fully discharged battery pack) the yellow LED will go off and the green LED (Charging complete) will light.

7 While the green LED is on, the battery will be trickle charged and may be left in this state indefinitely.

The battery charger is not working - fault finding

The procedures described below, checks the charger down to PCB level.

Red power LED fails to light

1 Check the main fuse at the front panel (2 amp).

2 If this is intact, check the fuse mounted on the battery charger's PCB (1 amp).

→ *Dismantling the battery charger see section below.*
- Fuse specification:

→ *Refer to page 46.*

Dismantling the battery charger

1 Unscrew the four fixing screws located at the lower part of each side of the battery charger.

2 Carefully remove the top housing.

3 The PCB is mounted at the front.

4 Assembly is basically the reverse of dismantling.

Yellow charging LED fails to light/Green charging complete LED is lit

1 Check the transponder is turned off.

2 Check the transponder is an RPT not an MHT.

3 Check the battery pack/transponder temperature is in the range 0°C to 45°C.

Yellow LED fails to light/Green LED fails to light

1 Check the connection between the charger and RPT is OK.

Battery safety

Directions for handling of lithium / thionyl chloride cells and batteries-Li / $SOCl_2$

General

The meaning of the word *cell* is the basic electrochemical unit used to generate or store electric energy.

A *battery* consists of a number of cells that are electrically connected. The cells/batteries to be discussed are of the type: **lithium/thionyl chloride - Li/$SOCl_2$**.

The energy density of this type of cell is 15 times higher than for a lead/acid cell. (for D size cells: approximately 430 Wh/kg versus 28 Wh/kg for lead).

Caution: *These types of cells/batteries must be handled with caution and in accordance with this procedure.*

In most cases where problems such as overheating, short circuit or leakage have been reported, these are almost always due to improper handling or storage.

Safe storage

The cells must be stored in their original packing material as this eliminates unintentional short-circuiting of the cells. Cells must never be placed or stored on metallic surfaces. Large quantities of batteries should always be stored in a separate building or separate room that is cool, dry and well ventilated.

The recommended storage temperature lies between 0_ C and +24_ C (max +50_ C, min -55_ C). The recommended relative air humidity should be in the range 40 to 70%.

Areas designated for the storage of lithium/thionyl chloride must be clearly marked.

The warehouse must be equipped with fire extinguishers for metal fires class D, dry sand, smoke diving equipment, protective helmet and gloves that can withstand heat.

WARNING! **Never use water to fight a lithium fire. It can result in the release of hydrogen that may cause an explosion.**

Safe handling

The proposed path the batteries follow through the production facility and at the subcontractors should be thoroughly reviewed by plant safety personnel. This is advisable in order to eliminate potential sources of electrical and physical damage to the batteries. Examples of such potential sources are heating above 90ºC, incineration, short circuiting, charging, force over-discharging, crushing, puncturing or disassembly.

All personnel working with or handling lithium/thionyl chloride batteries must know how to work with and handle these units in a safe manner.

Control of the physical dimensions of cells must be performed using all-plastic callipers, or by means of dedicated approved test equipment. All work bench surfaces that come in contact with the batteries must be of a non-conductive material.

All packing materials must be carefully removed from the battery. The cell's positive and negative terminals are fitted with flexible ribbon leads, but these can easily break. If leads break off during installation, do no attempt to re-attach them. Positive and negative leads must be cut separately to avoid short circuiting the cells. Keep the soldering time on terminals to a minimum; preferably below 10 seconds in order to avoid overheating.

Before batteries are connected to a circuit, the circuit must be tested to avoid short-circuiting or charging of the battery. The leads to be connected to the terminals must be tinned before they are soldered on. The battery terminals must never be connected by means of wave soldering. This can overheat the batteries and cause hazardous battery behaviour.

Safe transportation

Transportation of lithium/thionyl chloride cells containing more than 0.5 g of lithium and batteries containing more than 1 g of lithium are subjected to following international transport regulations.
UN (United Nations) - no. 3090 class 9.

Aircraft:	IATA DGR
Sea transport:	IMDG Code
Railway:	RID
Road transport:	ADR

All of Kongsberg Simrads lithium/thionyl chloride batteries contain more than 1 g of lithium.

The proper shipping name for these batteries are:
LITHIUM BATTERIES
LIQUID CATHODE (UN3090)
CLASS 9 MISCELLANEOUS
PACKING GROUP 2

The regulations state that the batteries must be packaged separately in order to prevent external short-circuiting. This can be done by packing the batteries together, but separating each battery by *inner* plywood containers. Maximum 500 g of lithium are allowed per *inner* container. Each inner container must be lined with at least one inch of a non-combustible packing material (for example vermiculite). The batteries should then be packaged in UN approved plywood boxes or steel drums.Transport of lithium batteries by air is only permitted onboard cargo aircraft.

The goods must be clearly labelled: **CARGO AIRCRAFT ONLY**.

Safe disposal

Lithium/thionyl chloride batteries do not contain any heavy metals, and are therefore not regarded as special waste (contains only biodegradable parts). No special regulations concerning disposal of these batteries have been released by authorities in European countries.

Used lithium batteries very often contains a significant amount of residual energy. It is the danger of explosion that presents a problem when disposing of these batteries. Used cells and batteries must therefore be handled with the same care as new ones. It is the manufacturer or the importers responsibility to advise the end user about the safe disposal of these types of batteries or cells. See enclosed list of companies which have been approved to collect and dispose of these types of cells and batteries.

Lithium batteries designated for disposal must be shipped in accordance with the same regulations as those valid for new lithium/thionyl chloride batteries. The batteries/cells must be labelled:

WASTE LITHIUM BATTERIES FOR DISPOSAL

These batteries must never be incinerated. Before any disposal of these batteries, a declaration must be issued. The lithium batteries' disposal number is 7094 with the EAK-code 16 06 05.

Emergency procedures

In the event of hazardous battery behaviour, the area must be evacuated immediately. If the batteries catch fire, it will result in the formation of thionyl/chloride, sulphur dioxide and chlorine. Qualified personnel only, wearing smoke diving equipment must be called in to deal with such a fire. Suitable extinguishing media are ”Lith-X“ class D (for metal fire) or by covering the fire batteries with large amounts of dry sand.

In case of leakage, leaking batteries must be removed from all personnel and equipment. The battery ingredients can form HCl, SO_2 and H_2 upon contact with water,
($SOCl_2+H_2O \rightarrow SO_2+HCl$).

Such batteries must only be handled by personnel wearing protective equipment consisting of: protective goggles, respiratory protection, hand protection, protective apron (rubber or plastic), protective boots (rubber or plastic) and eyewash. Electrolyte can be neutralised with common baking soda. Leaking batteries should therefore be placed in plastic bags containing baking soda. On board ships, hazardous battery behaviour can be handled by deploying the battery into the sea.

TRANSPONDER CONFIGURATION

Channel selection

Principles

Channel selection on the RPT transponder is performed via the two switches on the end cap.

→ *Refer to figure on page 42.*

Before you deploy the transponder, the required channel must be selected.

Note: *If the transponder is switched ON, or has recently been powered up, any change in channel may not be recognized by the transponder for about 90 seconds.*

HPR 400 channels

Note: *The following channel numbers are not allowed:*
- *"Twin-figured" B(11, 22, 33 ...99)*
- *B(01, 02, 03 ...09)*

Refer to table 1, HPR 400 channel numbers and operation frequencies.

The HPR 400 system interrogates the transponders by transmitting two pulses with frequencies according to the protocol. The transponder reply is determined by the second interrogation pulse.

A total of 56 positioning frequency channels are available. Refer to table 1 for frequencies.

When the first interrogation pulse is an odd number, the reply is 250Hz higher than it is when the pulse is an even number.

- Switch A is set to the first digit of the desired channel number - Rx1.
- Switch B is set to the second digit of the desired channel number - Rx2.

→ *Refer to the timing diagram on page 24.*

- **Example:**
  If channel B12 is to be selected, switch A must be set to position 1 and B to position 2. Referring to table 1, the first transmission frequency will then be 21,000 Hz and the second transmission frequency will be 21,500 Hz.
  To find the reply frequency: The second frequency number is 2 so go to rows Be2/Bo2, and the first frequency number is odd (1) therefore the Bo2 row is used. The reply frequency is therefore 29,250 Hz.

HPR 300 channels

The HPR 300 system interrogates the transponders by transmitting one pulse with frequency according to the protocol.

For the HPR 300 a total of 14 channel numbers (frequency combinations) are available.

Refer to table 2 for frequencies, and set switch A and switch B to the required interrogation frequency to achieve the desired transponder beacon transmission frequency.

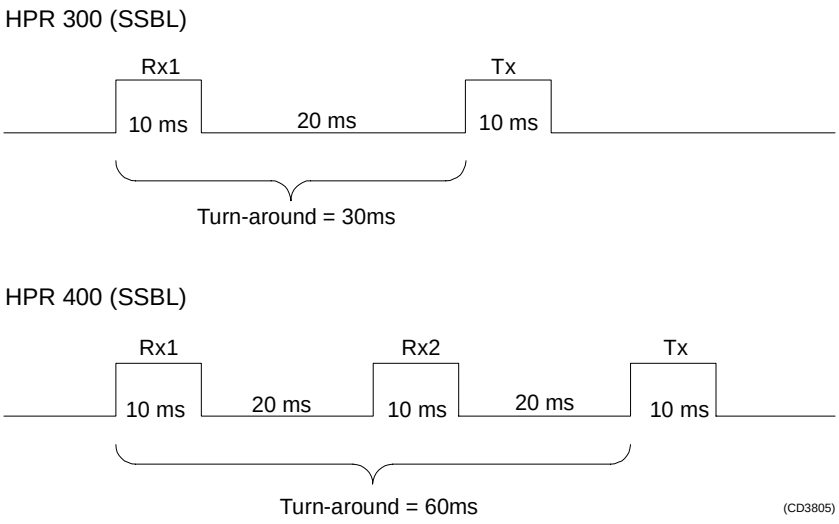


Figure 6 - Transponder reception and transmission signal timing diagram

HPR 400 channels and positioning frequencies table

Transponder channel number	Operating frequencies	
	Interrogation	Reply
Be1	21000	28500
Bo1	21000	28750
Be2	21500	29000
Bo2	21500	29250
Be3	22000	29500
Bo3	22000	29750
Be4	22500	30000
Bo4	22500	30250
Be5	23000	30500
Bo5	23000	30750
Be6	23500	27000
Bo6	23500	27250
Be7	24000	27500
Bo7	24000	27750
Be8	24500	28000
Bo8	24500	28250

Table 1 HPR 400 channel numbers and operating frequencies

Where:

B = Frequency band (30 KHz)

e = Even numbers (2, 4, 6, 8)

o = Odd numbers (1, 3, 5, 7)

HPR 300 channels and positioning frequencies table

Switch A setting	Switch B setting	Transponder channel number	Operating frequencies	
			Interrogation	Reply
0	1	1	20492	29762
0	2	2	21552	30488
0	3	3	22124	31250
0	4	4	22727	31847
0	5	5	23364	32468
0	6	6	24038	27173
0	7	7	24510	27777
0	8	8	25000	28409
0	9	9	26042	29070
1	1	11	21552	27173
2	2	22	22727	28409
3	3	33	23923	29762
4	4	44	25126	31250
5	5	55	26455	32468

Table 2 HPR 300 switch settings, channel numbers and operating frequencies

Functions

The Transponder includes the following functions:

- Transponder
- Responder
- External power

The Transponder function is default. To activate the responder or the external power functions, external connection is required.

Transponder function

The transponder function enables the unit to respond to a through-water acoustic interrogation signal from a compatible surface unit.

One of the available transponder channels must be selected via the transponder end cap switches, and the unit must be switched on. Once selected, the transponder will reply only to the corresponding interrogation channel.

If no valid interrogations are received after 65 seconds, the transponder unit will enter ‘sleep’ state whereby the drain on the battery pack will be at a minimum.

On receipt of a valid interrogation the unit will ‘wake up’ and reply to subsequent interrogations. The topside unit decodes the reply to give just the range, or the range and bearing, dependent on the type of surface unit employed.

Responder function

The responder function enables the unit to reply to a “Trigger” pulse via the external connector on the end cap. Proceed as follows:

1 Plug the connector tail into the base of the transponder.

2 Select the desired channel.

3 Switch the transponder ON.

4 Give a valid trigger pulse from the topside system, and the transponder will reply at the previously selected channel.

If the responder trigger signal is lost, the transponder will automatically revert to the transponder function after 65 sec. The responder function is automatically initiated by the presence of a valid “Trigger” pulse.

External power function

When the transponder is set to the external power function, it requires a dc supply of between 23 Vdc and 30 Vdc.

Proceed in the following order:

1 Plug the connector tail into the base of the transponder.

→ *Refer to figure 7.*

2 select the desired channel

3 switch the transponder ON.

Caution: *Take care when wiring the unit. Incorrect wiring may cause irreparable damage.*

The transponder will be powered from the external supply as long as the external supply voltage remains above 23V. If the external voltage falls below this level, or is lost (for example umbilical failure), the transponder will automatically revert to its internal battery pack (transponder function).

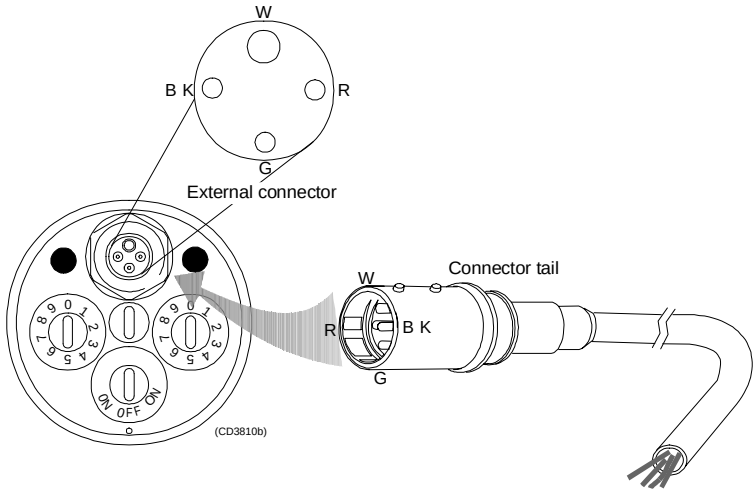


Figure 7 - Standard external connection

Note: *As indicated in the figure above, one of the four holes in the external connector is larger than the others. This hole corresponds to a larger pin in the connector tail. Note that the external connector may be rotated, placing this larger hole in a different position than is shown in the figure. You must check the position of the holes when plugging in the connector tail. Improper insertion of the connector tail can cause damage. See also warning on page 17.*

Abbreviation	Wire colour	Function	If an equivalent connector is used, wires may be numbered as below
W	White	External trigger line	1
BK	Black	External 0V (common)	2
G	Green	Battery Charger Input	3
R	Red	External +23V – +30V	4

Table 3 External connector description

Source level and sensitivity adjustment

For certain applications, you may need to adjust the source level and sensitivity settings.

Note: *If these are adjusted from their factory pre-sets, make a note to ensure units are not deployed with the wrong configuration at a later date.*

To reduce the factory pre-set source level

When working at short ranges in a quiet acoustic environment, you may require to reduce the factory pre-set source level. The effect of reduced source level will be to increase battery life.

→ *Refer to page 14 - Battery.*

To reduce the factory pre-set source level:

1 Dismantle the transponder.

→ *Refer to page 31 for details.*

2 Move the jumper to the required position.

→ *Refer to figure below.*

3 Assemble the unit.

→ *Refer to page 34 for details.*

To reduce the factory pre-set sensitivity setting

This can be performed when working at short ranges where there is high degree of low frequency acoustic or electrical noise at the transponder. To reduce these problems, you may reduce the factory pre-set sensitivity setting as follows:

1 Dismantle the transponder.

→ *Refer to page 31 for details.*

2 Move the jumper to the required position.

→ *Refer to figure below.*

3 Assemble the unit.

→ *Refer to page 34 for details.*

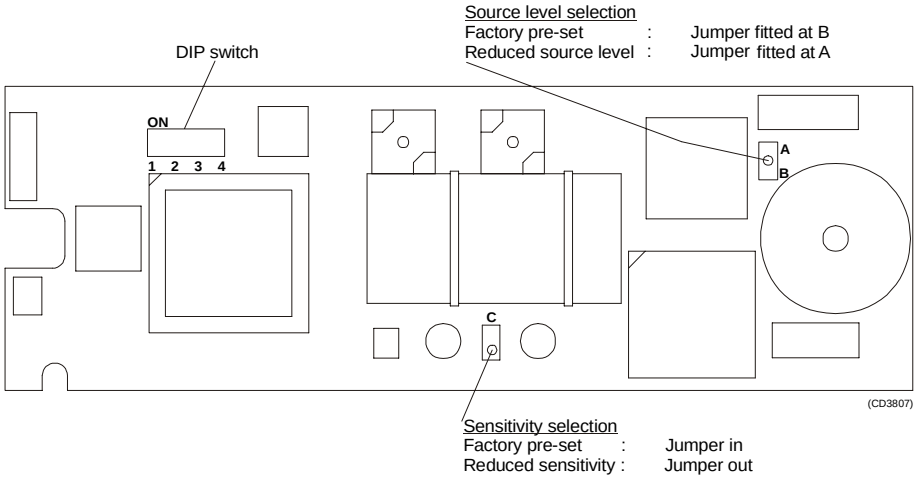


Figure 8 - Jumper configuration on the microcontroller board

DIP switch settings

Note: *These DIP switches are for factory test use only.*

If for any reason the unit is opened up, ensure that the DIP switch SW1 on the processor board is set as below (factory setting) prior to re-assembly.

DIP switch 1: ON

DIP switch 2: ON

DIP switch 3: ON

DIP switch 4: ON

MAINTENANCE

General

No maintenance is normally required, apart from charging the battery, and washing the unit.

To select the source level and sensitivity, and to change the battery pack, the unit must be dismantled.

Caution: *Electronic devices can be destroyed by static electricity. It is essential therefore that full protection against static is practised by service engineers.*
Although the unit is resistant to mechanical vibration and shock, every effort must be made to avoid careless handling when the unit is in use or being transported.
Conforms to EC directives 89/336/EEC Electromagnetic compatibility.

Anti-extrusion backing rings

In February 1998, a new type of anti-extrusion backing ring is implemented in the RPT transponder.

→ *Refer to figure on page 36 and the spare part lists.*

To keep them apart, we name the existing backing ring, **Type 1** and the new backing ring **Type 2**.

When it is required to replace the existing backing ring, replace it with the new backing ring type.

Transponder dismantling

For transponder assembly see figure 18, MST exploded view. To dismantle the transponder unit, follow the procedure below:

Before you start:

1 Switch OFF the unit.

2 Before opening the unit;

- Wash the unit thoroughly in fresh water, and dry off any moisture on the outside.
- Any work must be carried out in a clean, dry area.
- Ensure full anti-static precautions have been taken.

Dismantling:

1 Disconnect external cables (if any).

2 Carefully undo the unit locking screw about 2 - 3 turns, while protecting the locking screw, to keep the protective anodised coating intact.

3 Place the unit vertically on the transducer, and push the tube firmly downwards.

4 Unscrew the locking screw a further 2 - 3 turns and repeat as above until the screw is fully undone.

5 Carefully pull the end cap away from the unit.

6 Whilst firmly grasping the transducer and housing, gently pull one away from the other. (You may need to slightly rotate each to ease separation). Great care should be taken to ensure no components are knocked.
Its now possible to access the Microcontroller board, the Interconnection board and the Battery pack.

Replacement of the transducer

The transducer is a sealed unit and can not be opened. If the unit is not working, the whole unit must be replaced. To replace the transducer, follow the procedure below:

1 Dismantle the transponder.

→ *Refer to page 31 for details.*

2 Remove the soldering at the connections H and L.

→ *The wires location. - refer to the figure on page 33.*

Note: *Since MST unit serial number 350, the H and L pins on the processor board have been changed - the H connection closest to the processor board edge.*

3 Unscrew the two crews holding the transducer.

→ *The screw's location - refer to figure on page 33.*

4 You may now remove the transducer.

5 Assembly is basically the reverse of dismantling.

Replacement of the microcontroller board

To replace the microcontroller board, follow the procedure below:

1 Dismantle the transponder.

→ *Refer to paragraph 31 for details.*

2 Disconnect the battery pack and the transducer.

3 Unscrew the eight fixing screws.

→ *Fixing screws location. - refer to the figure on page 33.*

4 You may now remove the microcontroller board.

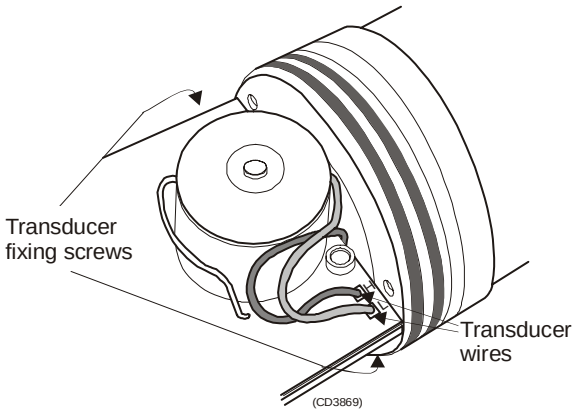


Figure 9 - Transducer wires and fixing screws

5 Assembly is basically the reverse of dismantling, but the edge connector must be carefully aligned to the end cap before tightening the board fixing screws.

Caution: *You may destroy the edge connector if you force the end cap into the housing.*

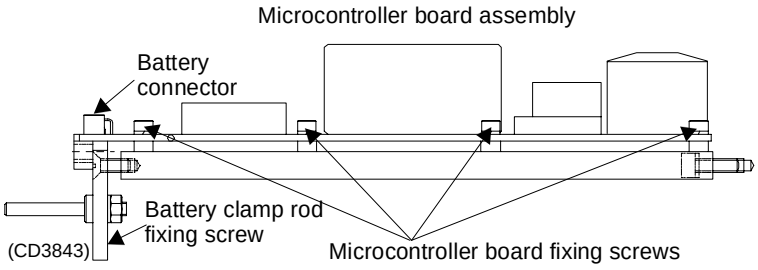


Figure 10 - Position of the microcontroller board fixing screws

Replacement of the interconnection board

To replace the interconnection board, follow the procedure below:

1 Dismantle the transponder.

→ *Refer to page 31 for details.*

2 Unscrew the four screws holding the interconnection board.

→ *The screws location - refer to figure below.*

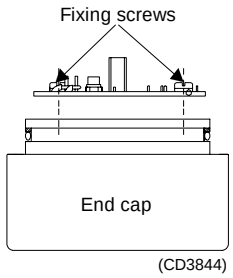


Figure 11 - Position of the interconnection board fixing screws

3 You may now remove the interconnection board.

4 Assembly is basically the reverse of dismantling.

Transponder assembling

Assembly is basically the reverse of dismantling, but take note of the following:

Note: *The condition of the* O*-rings and anti-extrusion backing rings must be checked. If there is any doubt as to their condition, or if they have been in use for more than 1 year, they should be replaced.*

Caution: *Ignoring these recommendations may result in flooding of the MST unit.*

Note: *The anti-extrusion backing rings are used on all seals on all the 324 transponders.*

Replacement of O-rings and anti-extrusion backing ring

Procedure for handling the O-rings and anti-extrusion backing rings:

1 Check the condition of the rings and carry out any necessary replacements.

2 Ensure the ring surfaces are clean and free from any foreign bodies or old grease.

3 Lightly grease the rings prior to assembly using Molykote 33 medium or similar.

4 Re-fit the O-rings (see figure below).

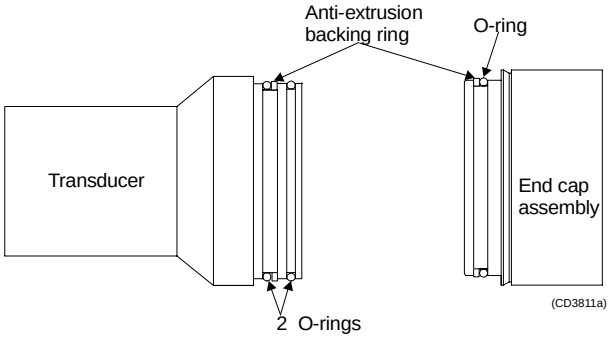


Figure 12 - O-rings and anti-extrusion backing rings location

5 Re-fit the anti-extrusion backing ring as follows (in the outer O-ring slot as indicated in the figure above).

Type 1 (old):

Both ends of the anti-extrusion ring are cut at an angle.

a Wind the ring around the transducer's mating surface.

b Ensure that the angled ends of the ring meet as shown in figure 13.

Type 2 (new):

a Place the ring with the curved side towards the O-ring as shown in figure 13.

6 Check that the ring is fitted correctly as follows:

b Carefully slide the transducer assembly into the housing till the housing meets the first O-ring.

c Ensuring the ends of the anti-extrusion ring are correctly positioned, press the transducer into the housing.

d Carefully withdraw the transducer assembly from the housing till you can just see the anti-extrusion backing ring (approx. 5 mm).

e Check that the ends of the anti-extrusion ring still are correctly located in the slot, then press the transducer fully into the housing.

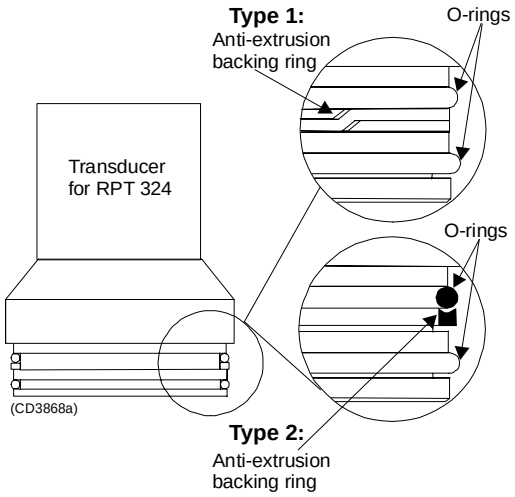


Figure 13 - Fitting the anti-extrusion backing rings

TRANSPONDER MAIN PARTS

The RPT transponder unit consists of the following main parts:

- Circuit boards
- Battery pack (described in a separate section)
- Transducer
- End cap
- Housing

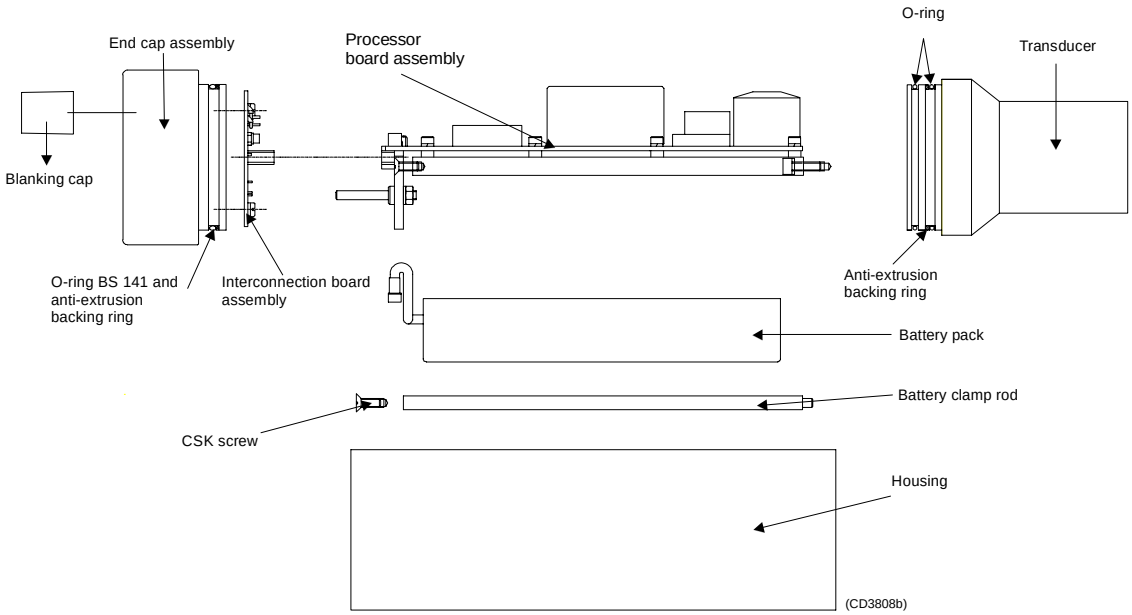


Figure 14 - RPT main parts

Circuit boards

Overview

The RPT transponder electronics consists of the following two printed circuit boards:

- Microcontroller board
- Interconnection board

The transponder schematic and interconnections are shown in figure 15.

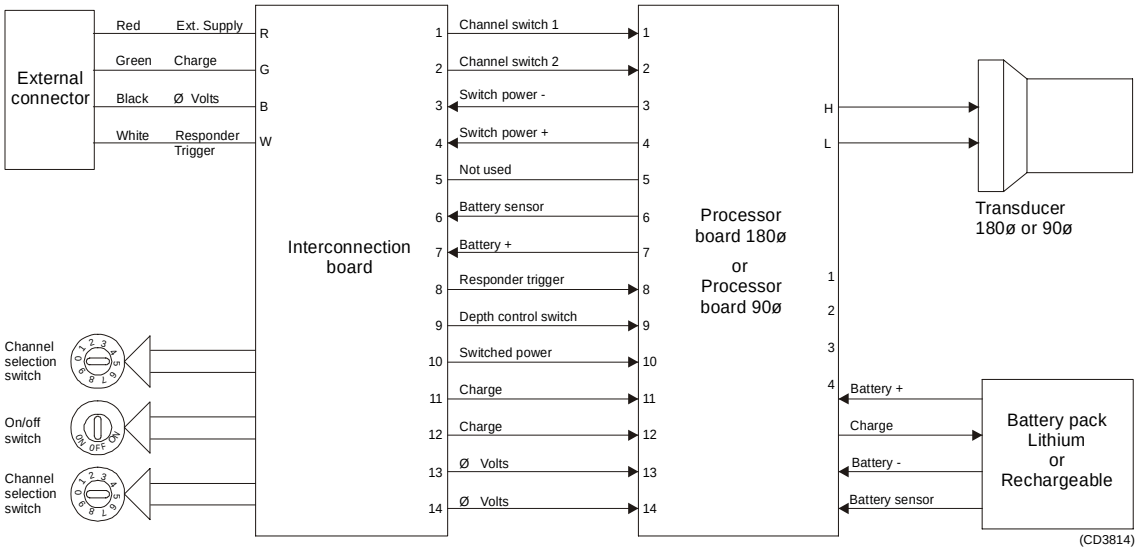


Figure 15 - RPT transponder schematic

Microcontroller board

A block diagram of the electronics is shown in figure 16.

The unit is controlled by a processor. During quiescent operation the processor is in power down mode (clock stopped) to minimise the power consumption.

Both the receiver and the transmitter are integrated in the processor board

Two parallel fully synthesized receiver channels are implemented to allow HPR 300 pulse command decoding and HPR 400 positioning support.

A separate transmission synthesizer is implemented to allow rapid frequency changing. A watchdog timer is incorporated, causing the logic signals generated by valid interrogation pulses to be re-routed to the processor's reset pin in the event of a processor powerdown state.

A serial port is available for code verification and board and unit production testing. In normal operation the unit is configured via the external channel select switches.

Receiver

The transducer is interfaced to the main gain block of the receiver via a 2nd order passive highpass filter. This will reject out-of-band signals before any amplification is performed, thus improving the transponders performance by preventing front end overload by high level out of band acoustic sources.

Under normal operation the processor will verify that the incoming pulse is of sufficient length to qualify as a valid interrogation pulse. The reply turn-around-delay will be timed by the processor, from the leading edge of the incoming pulse, that is the time that the amplitude first crosses the detector threshold. The second reception channel is powered-down if the operating mode does not require it.

Transmitter

The transmitter contains two frequency synthesizers. The first is for the HPR 300 frequencies and consists of a 10MHz oscillator and a programmable 8 bit divider. The second is for the HPR 400 frequencies and consists of a clocked successive adder. The hardware is implemented using an EPLD which also contains some of the watchdog/reset logic and the transmission gating circuitry. The transmission synthesizer is switched off when not in use to minimise supply current. The power amplifier is a transformer coupled push-pull design.

Interconnection board

The interconnection board is mounted on the connector end plate. This board contains all the input and output interfacing for the transponder. The Transducer and the Battery pack are connected directly to the processor board. Refer to figure 15 for details.

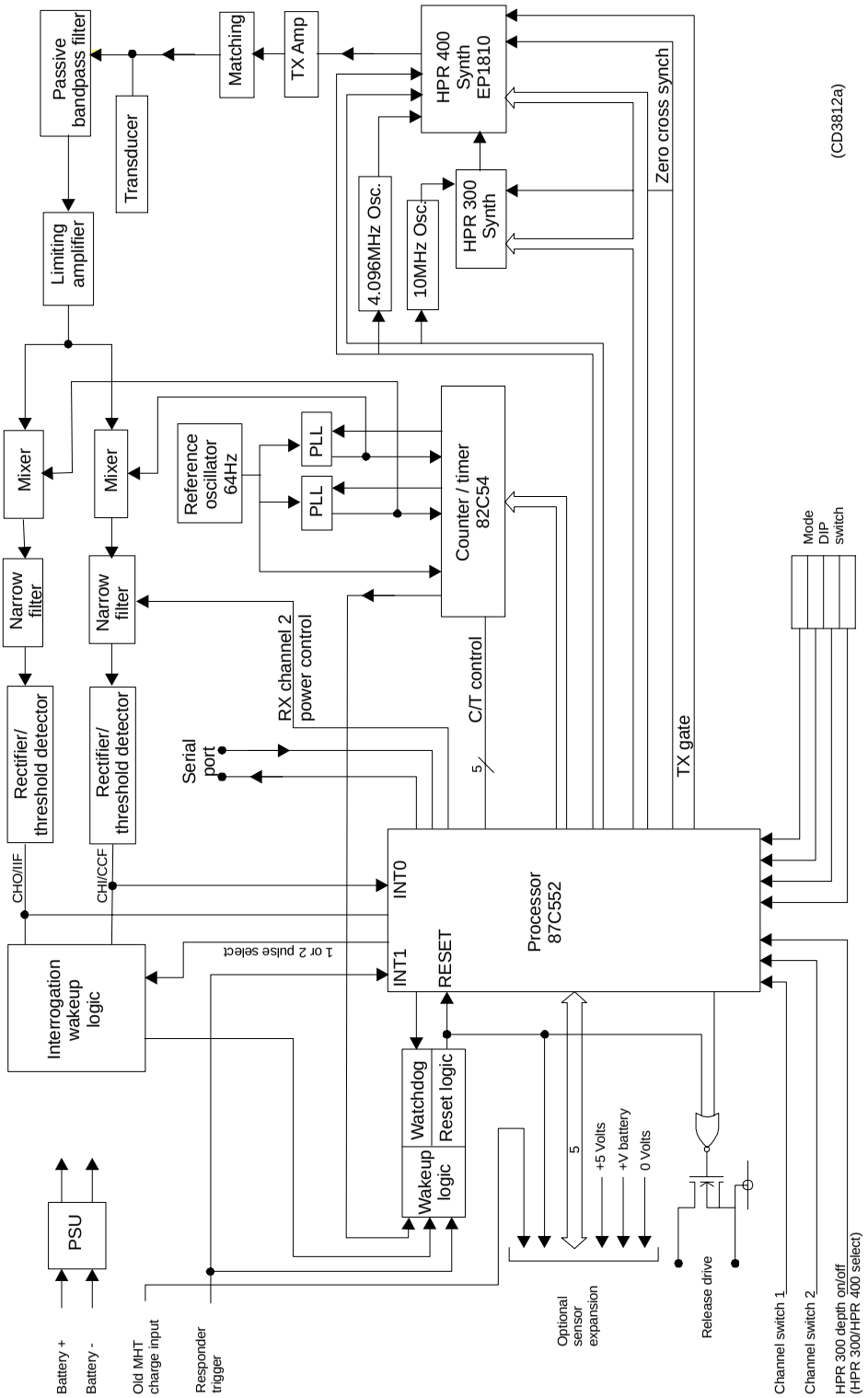


Figure 16 - Electronic schematic of the microcontroller board

Transducers

Overview

The RPT 319 and 324 are supplied with different transducer heads. The transducer is mounted in one end of the cylindrical transponder. The two transducers are mechanically interchangeable with each other. As a standard, two O-rings for water sealing between the transducer and the housing are provided.

Transducer 180

The transducer has a beam pattern covering one hemisphere. The two wires for electrical connection, run through a hole in the rear wall.

Transducer 90

The transducer has a 90 degrees conical beam. The transducer is oil filled to withstand the high pressure. The two wires for electrical connection emerge from the bottom.

In addition to the two O-rings for water sealing between the transducer and the housing, an anti-extrusion backup ring is provided.

End cap

The end cap holds the following:

- On/off switch
- Switches for channel selection
- Unit locking screw
- External connector
- Two screw holes which can be used for:
  - Fitting two eye bolts, to secure the unit using a rope.
  - Fitting two anodes to protect the unit against corrosion.

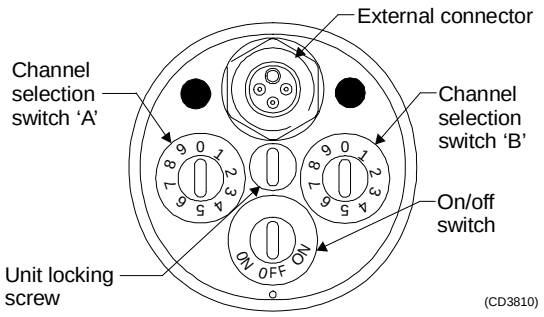


Figure 17 - End cap

SPARE PARTS

Introduction

This chapter lists the parts and modules defined by Kongsberg Simrad as *Line Replaceable Units (LRUs)* for the RPT transponder series. These LRUs are the individual parts and items which the manufacturers considered are replaceable by the local maintenance engineer. Exploded figures are included to assist you with part identification.

he required mounting components (such as nuts, bolts etc.) are not identified on the figures, and the order numbers are not allocated, 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.*

RPT transponder - exploded view

This paragraph displays an exploded view of the RPT transponder. The parts lists are presented on the following pages.

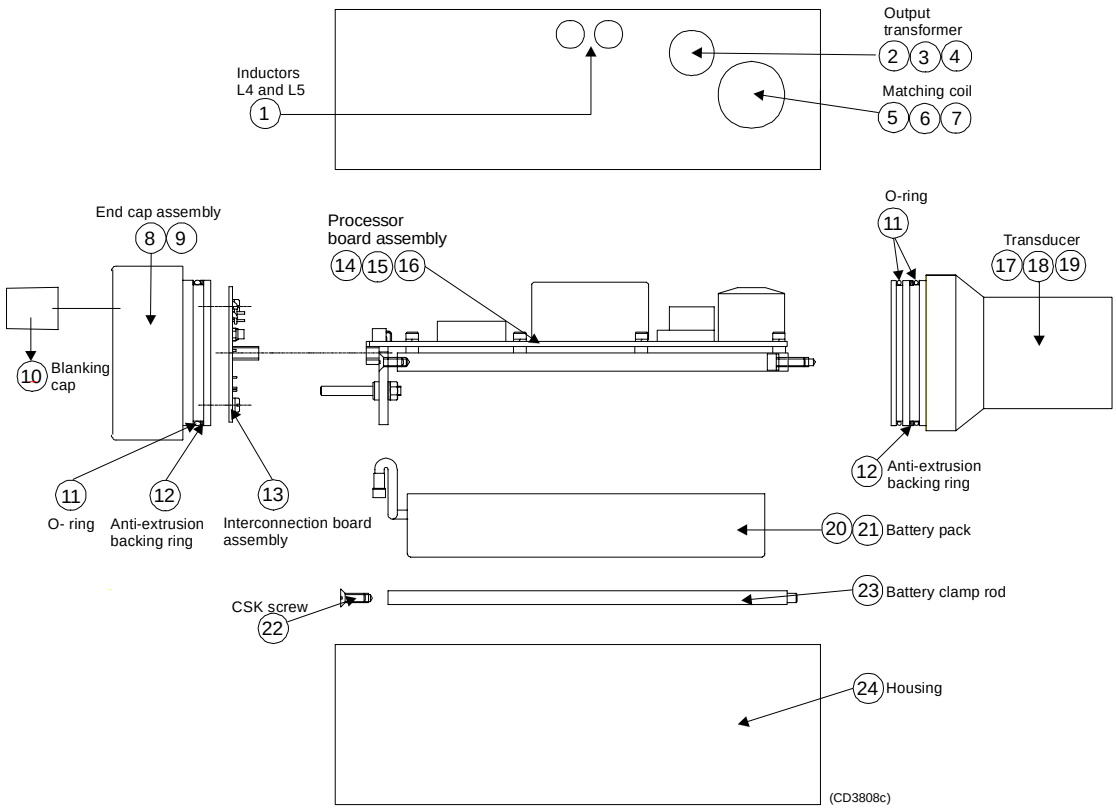


Figure 18 - RPT transponder - exploded view

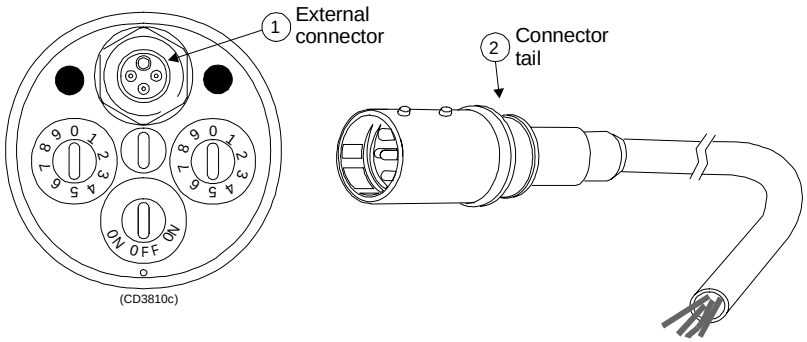


Figure 19 - RPT transponder end cap and connector tail

RPT transponder unit list

Part no.	Item name	Drw. ref.	No. in sys.
-	**Technical data**	**Drw. pos.**	**Rec. spares**
RPT-087067	RPT 319 Transponder unit	-	-
-	-	N/A	-
RPT-087068	RPT 319/N Transponder unit	-	-
-	-	N/A	-
RPT-087318	RPT 324 Transponder unit	-	-
-	-	N/A	-
RPT-087319	RPT 324/N Transponder unit	-	-
-	-	N/A	-

RPT transponder parts list

Part no.	Item name	Drw. ref.	No. in sys.
-	**Technical data**	**Drw. pos.**	**Rec. spares**
5382-6020	Inductor L4 and L5	Figure 18	2
-	-	1	-
5384-6008	90° Output transformer	Figure 18	1
(200130)	-	2	-
5383-6008	120° Output transformer	Figure 18	1
-	-	3	-
5382-6021	180° Output transformer	Figure 18	1
-	-	4	-
5384-6007	90° Matching coil	Figure 18	1
(200131)	-	5	-
5383-6007	120° Matching coil	Figure 18	1
-	-	6	-
5382-6019	180° Matching coil	Figure 18	1
-	-	7	-
5382-6001	End cap assembly	Figure 18	1
-	-	8	-
5382-4013	Blanking cap	Figure 18	1
-	-	10	1
53-0013	O-ring	Figure 18	3
-	-	11	2
211-0048	Anti-extrusion backing ring	Figure 18	2
-	-	12	1
5382-6015	Interconnection board assembly	Figure 18	1
-	-	13	-

Part no.	Item name	Drw. ref.	No. in sys.
-	**Technical data**	**Drw. pos.**	**Rec. spares**
5384-6006	90_ Processor board assembly	Figure 18	1
-	-	14	-
5383-6006	120_ Processor board assembly	Figure 18	1
-	-	15	-
5382-6006	180_ Processor board assembly	Figure 18	1
-	-	16	-
30-0324	90_ Transducer	Figure 18	1
(210173)	-	17	-
30-0001	120_ Transducer	Figure 18	1
(312-073877)	-	18	-
30-0002	180_ Transducer	Figure 18	1
-	-	19	-
5382-6009	Lithium battery pack	Figure 18	1
-	-	20	-
5382-6004	Rechargeable battery pack	Figure 18	1
(198-087169)	-	21	-
213-0010	Countersunk screw	Figure 18	1
-	M4 x 10mm	22	-
5382-2014	Battery clamp rod	Figure 18	1
-	-	23	-
5382-2000	Housing	Figure 18	1
-	-	24	-
37-0082	External connector	Figure 19	1
-	VSG-4-PBCLM	1	-
37-0083	Connector tail	Figure 19	1
-	approx. length 60 cm	2	-

5382 battery charger parts list

Part no.	Item name	Drw. ref.	No. in sys.
-	**Technical data**	**Drw. pos.**	**Rec. spares**
5382-6900	Battery charger	Figure 16	-
(LAD-087080)	-	-	-
151-499	Fuse 1 A T (slow) ceramic	-	1
(251-084784)	-	N/A	1
150-0053	Fuse 2 A T (slow) ceramic	-	1
(251-084785)	-	N/A	1

MAIN INDEX

The next pages presents the main index of this manual.

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