UM-7973

User Manual for Type 7973 Super Sub-Mini (SSM) Transponder

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UM-7973

USER MANUAL

FOR THE

TYPE 7973 SUPER "SUB-MINI" TRANSPONDER

ISSUE B

REVISION 1

IMPORTANT SAFETY INFORMATION OVERLEAF

This Document Contains Safety Precautions at Revision 5

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SAFETY

It is essential that all personnel involved in the operation and servicing of this product are familiar with the details below.

This product contains hazardous voltages and must only be opened by qualified service personnel. There are no operator adjustable components inside.

SUBSEA EQUIPMENT GENERAL OPERATIONAL & SAFETY PRECAUTIONS

Operators and Service personnel must be familiar with the information below.

Not all sections will apply to all instruments.

Additional information, if applicable, is included in the relevant sections of the product operating and maintenance manuals

CONTENTS

1. HAZARD APPRECIATION

Subsea equipment remains safe in use when operated and handled within standard operating procedures and written guidelines, therefore in normal operation little threat is posed to the safety of individuals or instruments. However all subsea units are capable of posing a threat to personnel safety, particularly when pressure housings become internally pressurised. Great care must be taken when this happens, or is even suspected to have happened, since the pressures present within the instrument are likely to be **extremely** high. Internal pressure problems may also be aggravated by unknown chemical hazards if battery breakdown has also occurred.

The following non-exhaustive list gives examples of typical hazardous situations:

- a pressure housing becomes internally pressurised by water pressure, following a leak
- a pressure housing becomes internally pressurised due to battery malfunction
- attempts are made to charge non-rechargeable battery packs/cells
- using an instrument outside its design parameters
- using an instrument beyond its load bearing limits
- failing to maintain the equipment can reduce its load bearing capability
- using unauthorised components or inferior parts in critical assemblies, e.g. release systems

2. GENERAL HANDLING OF EQUIPMENT

Do not allow instruments to be dropped or exposed to shock damage which can cause sensitive internal components to fail. Note that minor damage to metal finishes often creates burrs which can present a hazard to unprotected hands or other parts of the body. Control the local environment by preventing personnel stepping into the bight of haphazardly laid ropes or cables which are attached to a unit. Do not allow an instrument to block an access or impede normal traffic flows in a gangway or on a stairway.

Water tightness of instruments depends on fine surface finishes, accurate dimensional tolerances and cleanliness of components. Generally when dismantling equipment care should always be taken, the disassembly process should be carried out in a well-ventilated area with as few personnel in the vicinity as possible. Servicing must always be carried out by competent personnel with appropriate training.

3. DISMANTLING SUB-SEA EQUIPMENT

3.1 INTRODUCTION

All sub-sea equipment fitted with pressure housings are subject to a vast range of externally applied pressures and are susceptible to internal pressure rise if, for example, a leak occurs or the unit's battery destructs. Internal pressure presents a **potentially dangerous situation** and all appropriate **safety measures must be enforced**. Note that fumes given off by deteriorated batteries, particularly lithium based types, pose a health hazard. Apply precautions as appropriate to the circumstances prevailing at the time.

Note (1) that there is likely to be *no prior indication of the presence of internal pressure*, first indications being that the endcap(s) of the unit are being forced out of the housing under pressure during the dismantling process. Symptoms that indicate a higher risk of internal pressure include:

- Equipment that failed when deployed, in transit or storage
- Equipment stored for a long time with batteries connected
- Equipment having suffered physical damage.

Note (2) that when a unit has leaked it often behaves like a valve, i.e. water pressure causes a rise in internal pressure which cannot then escape because the point of leakage becomes sealed. Complete removal of an endcap's retaining mechanism means that it becomes unconstrained and therefore free to be discharged from its housing under high internal pressure - **an uncontrolled and potentially dangerous situation**.

DO NOT TRANSPORT EQUIPMENT WHICH IS INTERNALLY PRESSURED

The following precautions & procedures are recommended.

3.2 INSTRUMENTS FITTED WITH SPRUNG VENT PLUGS

Pressure Vent Plugs are fitted into all subsea equipment housings containing batteries and incorporate a red or green bung with dual O rings and a vent hole behind the second O ring. The vent plug is designed so that it can be partially withdrawn using a M4 screw to the point where its relief hole, positioned inboard of the second O ring, becomes open to atmosphere and thus allows internal pressure to dissipate. The vent plug cannot be totally removed (and forgotten) because of a retaining spring holding the red or green bung in place.

A normal unit may emit an audible rush of air when the vent plug is retracted, but it will typically only last for 1 second maximum. A longer rush of air/gas indicates a pressurised unit, in which case ventilate the area, and let the remaining pressure out of the unit. Internal pressure dissipates to atmosphere in a very short time and may be accompanied by water, debris, noise etc. Do not allow unnecessary personnel to enter the vicinity of the work or to be anywhere near dissipating gases and debris.

3.3 PRECAUTIONS (INSTRUMENT FULLY FUNCTIONING)

The techniques for retaining endcaps in the pressure housings differ from product to product, and detailed instructions on opening the pressure housing are given in the servicing section of the individual product manuals.

To ease dismantling and release any slight internal pressure that may have built up during normal operation, the vent plug should be operated as described in 3.2.

When removing the endcap it is recommended to stand to one side, and not inline. This will avoid potential injury if the endcap is ejected by any remaining internal pressure.

3.4 PRECAUTIONS (INSTRUMENT KNOWN OR SUSPECTED TO BE PRESSURISED)

If an instrument is known, or suspected to be internally pressurised through water ingress or battery venting additional precautions must be taken.

Remove the instrument to a well - ventilated location away from other working personnel.

If the housing is hot, indicating recent or current active internal chemical action, do not attempt to open. Lower overboard into water for several hours minimum or into a secure area away from all personnel. Do not attempt to dismantle until it has cooled.

Wear protective clothing, safety glasses and gloves, and refer to battery manufacturer's material safety data sheet (MSDS).

Release the safety vent as described in section 3.2. If there is no significant pressure dissipation and no fumes indicating a battery malfunction, the unit can be dismantled using the precautions described in section 3.3 and the relevant product servicing manual.

If there are any chemical fumes when the vent plug is released, or signs of deposit around the vent exterior, these are signs that the battery has vented due to water ingress or electronic/battery malfunction. In these circumstances the battery pack and internal electronics may have been severely damaged.

Take extreme care when removing the end cap, using any additional precautions detailed in the individual product manuals. There may be a possibility of some residual pressure remaining, within the housing, if during operation of the vent valve, it becomes blocked with the products of the internal chemical reaction.

When the battery is removed it should be covered with dry sand, or preferably sodium carbonate, or a mixture of 1:1 soda ash and slaked lime. It should be placed in an approved container (after cooling if necessary) and disposed in accordance with local regulations.

The electronics, end caps and pressure housings should be thoroughly hosed down

4. ELECTRONIC HAZARDS

4.1 HIGH VOLTAGES

WARNING

High Voltages

Operation of this equipment does not present any danger to users in normal use. If the internal electronics chassis is removed from it's housing for maintenance, the user should be aware that high voltages are present, particularly on the transmitter PCB and transducer.

Storage Capacitors

Note that subsea equipment incorporates capacitors which are capable of storing large quantities of electrical energy. Avoid inadvertent discharge during dismantling.

4.2 HANDLING OF ELECTRONIC COMPONENTS

Most of the circuits in subsea equipment use CMOS logic, which is easily damaged by static discharge or excessive supply voltage. The best handling for electronics is NO HANDLING. Field servicing cannot compare in efficiency and accuracy with the original factory calibration and therefore field servicing should be limited to checking correct calibration/operation (within the limits of the test gear available) and repair by exchange of PCB's or modules.

4.3 SAFETY PRECAUTIONS FOR LITHIUM BATTERIES

WARNING

Lithium based batteries become hazardous (fire and corrosion) if exposed to air and water. If damaged they may also emit **thionyl chloride**. Consult battery manufacturer's Material Safety Data Sheets (MSDS) prior to operating lithium based battery products.

Additional information applicable to lithium cells (model LSH20) is available from:

SAFT Ltd
River Drive
South Shields
TYNE AND WEAR
NE33 2TR
UK

Tel: +44 (0) 191 456 1451
Web Site: www.saftbatteries.com

4.4 LITHIUM BASED BATTERIES, GENERAL

Special precautions and regulations apply to transport, handling and disposal of lithium based products.

Lithium batteries are powerful sources of electrical energy and should be handled with care to avoid short-circuiting.

Where a battery powered underwater instrument is suspected of flooding, extreme caution must be exercised in opening the instrument in case an internal pressure has developed, which might cause the components to fly apart, causing damage or injury. Release of cell contents within the pressure vessel is very unlikely to cause hazard but the following safety procedures should be followed.

4.5 LITHIUM BASED BATTERIES, STORAGE TEMPERATURE

Cells and batteries, and hence the whole Sonardyne instrument, should not be exposed to temperatures in excess of 70°C. Instruments should not be left on deck in strong sunlight such that they become hot to the touch.

Lithium battery packs should be stored at +20°C, and in a humidity-controlled atmosphere to prevent passivation developing, which can reduce actual operating life, and in extreme cases may cause the unit to malfunction once deployed.

Instruments should be cooled to normal room temperature or lower before being opened.

4.6 OPENING A LITHIUM POWERED INSTRUMENT

The normal procedure before opening any underwater instrument is to wash in fresh water, remove salt deposits and dry it. The instrument should only be opened in clean, well-ventilated, dry surroundings.

All **precautions outlined in paragraph 3.4 above** should be applied during dismantling processes if it is suspected that internal pressure is present.

4.7 FAULT PROCEDURES

If a cell or battery is shorted or starts to heat up, it should be disconnected from the transponder immediately and removed to the outdoors or to a well-ventilated area to cool down. Tongs, or a shovel, are recommended for this purpose. Once the temperature has dropped and it is deemed safe to do so, the cell or battery can be disposed of as below. Suitable protection clothing should be worn when handling suspect cells/batteries and if the skin has come into contact with the electrolyte, it should be washed thoroughly with water.

If a cell is ruptured, potentially flammable materials may be exposed.

WARNING

For Lithium battery packs, Class D fire extinguishers should be used. Water, CO2, Halon, dry chemical or foam extinguishers are not suitable.

4.8 DISPOSAL OF LITHIUM BASED BATTERIES

Cells and batteries in small quantities can be disposed of in a secured landfill. If a secured landfill is not immediately available then appropriate safety precautions should be taken to temporarily secure the items. Packaging suitable for the storage and transport of lithium cells/batteries must be used at all times when not installed in an instrument.

DO NOT DISPOSE OF LITHIUM BATTERIES IN A FIRE.

4.9 TRANSPORTING LITHIUM BASED PRODUCTS

The current regulations and information below is provided for guidance only. Note that data sheets concerning quantities of lithium per cell are available from cell manufactures and these may change without prior notice, therefore the quantities of lithium per battery pack cannot be verified by Sonardyne Ltd. When transporting lithium based products it is the operators responsibility to comply with local, national and international regulations in force at the time of transport.

By Road: ADR European Agreement concerning the International Carriage of Dangerous Good by Road Regulations.

By Sea: International Maritime Dangerous Goods Code

By Air: IATA Regulations UN 3090 and UN 3091

5. BATTERIES GENERAL

5.1 USE OF APPROPRIATE BATTERY TYPES

Sonardyne equipment uses a variety of battery types. In some instrument designs only one type of battery pack is authorised for use but others will accommodate NiCad rechargeable, alkaline or lithium based packs. Instruments must **NOT** be fitted with alternative battery pack types unless they are specifically designed to use them.

DO NOT FIT UNAUTHORISED BATTERY PACK TYPES INTO AN INSTRUMENT

NOTE THAT DAMAGE CAUSED BY USING BATTERY PACKS WHICH ARE NOT AUTHORISED OR ARE NOT CONSTRUCTED TO SONARDYNE'S BUILD STANDARDS INVALIDATES ANY WARRANTY

5.2 CHARGING OF BATTERIES IN SEALED CONTAINERS

Batteries/Cells may give off gases when recharged. As a general rule, sealed containers MUST be allowed to vent to atmosphere during the charging process.

Some instruments may be fitted with safety features which prevent the possibility of problems caused by gasses vented by batteries. Detailed charging procedures for the particular instrument should be carefully followed.

5.3 ATTEMPTING TO CHARGE NON-RECHARGEABLE BATTERY PACKS

DO NOT ATTEMPT TO CHARGE NON-RECHARGEABLE BATTERIES PACKS OR CELLS

All **PRIMARY BATTERIES**, i.e. alkaline-manganese dioxide, lithium-manganese dioxide, silver oxide, zinc air, zinc carbon and zinc chloride batteries are NOT designed to be charged.

Non-rechargeable cells exhibit a range of unpredictable characteristics if any attempt is made to charge them, **Very high pressures and temperatures** can occur in an instrument often some time after the attempt to charge them has terminated.

Attempts to charge a primary battery may lead to an imbalance within the cell potentially leading to gas generation and in extreme cases explosion.

Battery packs **MUST NOT** be reconfigured from one type to another, e.g. NiCad to alkaline or lithium. Alkaline or lithium cells may be inadvertently charged.

5.4 HANDLING OF USED BATTERIES

Batteries should not be discharged below their end point voltage. To do so can lead to internal corrosion and leakage of electrolyte in certain types of sulphur dioxide cells. Although there is very little gas to cause a pressure rise under these conditions, the electrolyte leakage will cause severe corrosion.

After recovering an instrument from the sea it should be opened, and the battery voltage(s) checked while still connected to see if above the end point voltage for that type of cell. Disconnect and mark as usable or not with date of disconnection noted both on the pack and in written records. Check the instrument for signs of corrosion, such as at solder joints, as a sign of any slight leakage.

The remaining life of a battery depends on both time and, for a transponder, the number of times it has been interrogated. Normally transponders keep their own record of battery usage, but users must maintain a separate record of time elapsed whilst battery is installed and connected, plus estimates of the number of interrogations.

5.5 RE-CONNECTING A PARTIALLY USED BATTERY

Calculate if the remaining battery life will allow your next mission to be safely accomplished. If so, note the date of re-connection, both on the battery label and in written records, against the serial number of the instrument.

5.6 FITTING A NEW BATTERY

Note the date it is connected and therefore starts to supply current. Write this date on the battery label and also in your written records.

5.7 BATTERY PACK FUSES

A number of Sonardyne battery packs have carefully selected, high-reliability fuses soldered onto the diode-board of the pack. These are "Littlefuse" devices. If you have blown a fuse due to mishandling, it may be replaced by an identical type, but the rating must not on any account be increased.

6. EQUIPMENT ENVIRONMENTAL LIMITATIONS

6.1 STORAGE TEMPERATURE LIMITS

Equipment may be stored at temperatures in the range -20 to + 60°C. It should be noted however that lines connecting pressure transducers to a transponder may become partly filled with seawater during service. This cannot easily be expelled and may therefore freeze if transponders are stored at sub-zero temperatures after recovery from the sea.

Spare battery packs should be stored at room temperature, in an environment with a controlled humidity level.

7. INSTRUMENT LOAD BEARING CAPABILITY

Navigational Transponders are NOT normally designed to take in-line loads greater than the maximum upthrust applied by the floatation equipment. The carrying straps, if fitted, are for ease of manual handling and the range of transducer guards selected for their acoustic properties.

The Safe Working Load (SWL) capability of the release mechanism, built into most instruments, can only be used for in-line lifting operations if a suitably - rated, approved, lifting strap, transducer guard, buoyancy collar eyes or other safe method is selected.

It is the operators responsibility to ensure the condition of the equipment and that a safe lifting method has been devised for any particular operation.

Sonardyne's range of Oceanographic Release Transponders have been designed specifically for in-line lifting operations.

Appropriate shackles must be used in release systems to ensure freedom from corrosion. It is important to note that instruments, their release mechanisms and shackles form part of an integrated and complete system.

8. FLOATATION EQUIPMENT

8.1 INTRODUCTION

Floatation equipment is fitted to subsea transponders in order to aid their recovery once a deployment is complete. A nett upthrust requirement is given in manuals and technical data for any particular instrument. The following guidelines are given to assist operators in their understanding of the general requirements.

8.2 MINIMUM NETT BUOYANCY OF FLOATS

Floats are described as having a minimum nett buoyancy in seawater and this is the figure quoted in Sonardyne Float Technical Data and by the float manufacturer. Total upthrust can be calculated by knowing this figure, e.g., a float with 30kgs nett buoyancy in sea water supporting a load with weight in sea water of 30kgs would result in neutral buoyancy, i.e. no nett upthrust.

8.3 FLOAT INSERTS

Float collar Inserts are used to allow floats of larger internal bore to be used with housings of nominal 6" diameter. The weight *in water* of an insert is usually slightly positive and this will be additional to the weight of the instrument being supported by the float. Two inserts will result in approximately 0.5kg reduction in nett upthrust.

8.4 NETT UPTHRUST

The difference between the nett buoyancy of the float and the total weight of an object, or objects, in water that it is supporting, e.g.

Nett Upthrust =

(Minimum nett buoyancy of the Float) - (the weight of the instrument + inserts in water)

e.g. 30 kgs - (11.2+ 0.5) kgs = 17.3 kgs nett upthrust

8.5 FLOAT STORAGE CONDITIONS

Special storage conditions are not called for if due care and attention is applied to a float. Floats are not hygroscopic and should not therefore be affected by moisture in air.

8.6 FLOAT OVER-PRESSURE

The maximum water depth quoted for a float must not be exceeded. Over-pressured floats are forced to absorb water and their weight in air thus increases. All floats should be weighed prior to use to check that they are maintaining their original manufactured weight.

9. DEFINITIONS OF VARIOUS LOADS AND LOADING TERMS

9.1 A STATIC LOAD

An unvarying long term load.

9.2 A DYNAMIC LOAD

A time varying load resulting from the motion and inertia of connected masses and forcing functions such as wave action on the vessel. This may include transient and steady state harmonically alternating loads.

9.3 MAXIMUM ULTIMATE STATIC LOAD OR BREAKING LOAD OR PARTING LOAD

The load that induces structural failure in one or more parts of the instrument causing the load to part with the release.

9.4 MAXIMUM PROOF STATIC LOAD OR MAXIMUM RATED STATIC LOAD

The maximum in-line static load the instrument can bear without suffering an unacceptable degree of permanent deformation. Ideally this should correspond with the load at which the maximum stress at any point in any component is the 0.2% proof stress for the material used in that component (in the condition that it is used).

9.5 SHOCK LOAD OR SNATCH LOAD

A time transient load generally caused by the sudden acceleration (positive or negative) of the load. Examples are the sudden snatch of a load off the deck or a sudden arrest of a load falling under gravity.

9.6 SAFE WORKING LOAD

A load set as a proportion of the Ultimate Static Load to allow for factors such as corrosion, fatigue, shock loads, harmonic loads, manufacturing defects, material defects etc. Various figures may be adopted according to the practise of the industry, risk to health and applicable legislation. Typical factors are $^{1}/_{6}$ to $^{1}/_{3}$ of the Ultimate Load.

9.7 PROOF LOAD

Normally a Load that is periodically applied to the load bearing device to demonstrate that it is still safe. Generally this is 2 times the Safe Working Load.

9.8 RELEASE LOAD

The maximum in-line load the instrument can withstand and successfully release without overloading any part of the release mechanism or demanding an unsupportable quantity of energy from the battery supply (at its specified end point).

10. IF IN DOUBT

Contact Sonardyne for advice.

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Our facsimile number is (UK) +44 (0) 1252 876100

Our email address is **support@sonardyne.co.uk**

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AMENDMENT RECORD

All amendments and additions will be issued with a copy of this sheet, recording the history of amendments.

Revision	Date	Comments
1	26.10.96	Initial Issue
2	21.03.02	
3	19.04.02	CN 7167 Modified to allow transponders to be charged in a closed environment provided safety features are provided
4	14.03.03	CN 7699 Updated to ensure safety precautions cover more general equipment
5	24.02.04	CN 8104. Transportation regulations updated. Dismantling method removed and refers to unit manual. Carrying strap not to be used for mechanical lifting.

Authorised : P V Williams

Date of Issue : 24 Feb. 2004

CONTENTS

LIST OF APPENDICES

LIST OF FIGURES

AMENDMENT RECORD

All amendments and additions will be issued with a new copy of this sheet, recording the history of amendments.

Issue	Revision	Date	Comments	Section	Page
A	0	19.07.99	Initial Issue	All	All
A	1	09.09.99	Minor corrections New Appendix E for upgraded software	3, A, G App E	All All
A	2	14.10.99	Minor corrections	1,3,6,A	All
A	3	01.11.99	Updated Appendix E for new software issue Changes to reflect V.107S firmware	App E 0.3.5. App C,G	
A	4	06.12.99	Depth scaling information added Additional spare parts listed	3.2.5 App A	3/3 A/1
A	5	13.07.01	CN6728 – Appendix B changed	All	All
A	6	19.04.02	Incorporating Special Instructions and Technical Bulletins Safety Procedures removed from Appendices Subsequent appendices amended accordingly New Appendix G for Dual Personality New Appendix H for Special Instructions for Alkaline Batteries Minor Corrections CN 7042	All	All
A	7	29.04.02	New CPU PCB fitted CN 7193 Appendix G updated New test software Minor corrections	5 G E All	All All All All
A	8	11.12.02	CN 7538 Minor Correction to Battery voltage Checks	5.4.1	9
A	9	17.03.04	CN8127 Appendix E updated to reflect WINSSM V1.04	E	All
A	10	05.06.04	Appendix E updated to reflect WINSSM V1.07	E	All

Issue	Revision	Date	Comments	Section	Page
B	0	20.07.04	Remote Transducer added Alkaline Battery packs added Sonardyne Frequency table added Switchless Endcap added Appendix E updated to reflect WINSSM V1.08 Minor changes to all sections	All	All
B	1	21.12.04	Ant Programming clarified Appendix E reflects latest software – V1.09 CN 8425 refers	App C App E	All All

SECTION 1

1. INTRODUCTION

1.1 SAFETY

W A R N I N G

Operators and service personnel must be familiar with the normal operating and safety procedures for Subsea equipment.

SEE THE SAFETY PRECAUTIONS PRECEDING THIS SECTION

W A R N I N G

There are no parts inside the unit which are accessible to the equipment operator.

High voltages can be present within the transponder.

Opening the transponder, internal adjustments and replacement of parts must only be carried out by trained maintenance personnel and the procedure detailed in Section 4 must be carefully followed.

W A R N I N G

Strict rules must be followed when charging the equipment.

These are detailed in Appendix B.

1.2 PURPOSE OF SYSTEM

The Type 7973 Super Sub-Mini Transponder/Responder is designed for use with the SIMRAD “HPR” And Sonardyne LUSBL families of range-bearing acoustic navigation systems. By means of external rotary Channel Selection switches, it may be switched to any of the regular “HPR-300” or HPR-400” series channels.

Despite its high power output and its small size and weight, it has an operating life (at 1 pulse/second) of up to 14 hours - provided by a compact, Nickel Metal Hydride rechargeable battery pack. A typical application is for marking a small ROV. Alternatively, the Super Sub-Mini can be powered by an external DC supply for continuous operation as a Transponder or Responder.

In addition to these features, the Super Sub-Mini is fitted with a depth sensor to report the depth by sending dual, time-coded reply pulses to each interrogation.

1.3 FEATURES

Sonardyne's latest Super Sub-Mini Transponder offers improved performance and convenience when used with "HPR" and LUSBL families of range-bearing acoustic navigation systems. The acoustic signal level transmitted is omni-directional and useful over a ±120 degree cone. It is usually mounted with the transducer pointing upwards - typically for marking small ROV's. In circumstances where operation is known to be vertically beneath the surface vessel or in deep water (>1000m), the directional response of the Type 7970 Directional Transponder is recommended.

Type 7973 offers the following benefits to the user:

1. Rechargeable battery with 14 hour operating life at 1 pulse/second and rapid-charge capability by external connector.
2. Externally selectable frequency channel by rotary selectors for all "HPR-300" and "HPR-400" channels.
3. Sonardyne frequencies are available using shorter pulses, this giving extended battery life.
4. Optional channel selection by serial comms link.
5. Remote Transducer option enabling the Transponder to be fitted anywhere on the ROV or structure. Refer to Fig 2.2 and Fig 2.3 in section 2 for details.
6. External connector for "Responder" mode trigger, external power supply, charger and communications interface.
7. 1000 metre depth rating.
8. Depth sensor
9. High Capacity Nickel Metal Hydride battery
10. ON/OFF feature via connector
11. Acoustic commands to Enable and Disable the transponder and to Enable the Depth Data reply.

1.4 LAYOUT OF MANUAL

The manual includes an Operation Section comprising a physical description and a description of operation followed by a Maintenance Section covering general maintenance points (Section 4) and fault finding and test procedures (Section 5). The fault finding procedures given in Section 5 are sufficient to enable diagnosis to major assembly level.

A spares list (with full order information) and the battery charging procedure are given in appendices. A table of channel frequencies is given as Appendix D.

1.5 LIST OF ABBREVIATIONS

ANT	Acoustic Navigation Tester
CPU	Central Processing Unit
DAS	Data Acquisition System
HPR	Hydro-Acoustic Position Reference
LUSBL	Long and Ultra Short Base Line
PSU	Power Supply Unit
ROV	Remotely Operated Vehicle
USBL	Ultra Short Base Line

SECTION 2

2. DESCRIPTION

The Transponder is housed in a hard-anodised aluminium alloy tube with a directional acoustic transducer built into the flat-faced endcap. The other endcap of hard-anodised aluminium alloy shields the electrical charging socket and controls – see figures 2.1 and 2.3. The endcaps are retained to the tubular housing by flexible plastic rods inserted in slots at each end of the housing. Adhesive tape covers the slots and housing/endcap joint to prevent ingress of silt.

The controls on the connector endcap are the two rotary channel selection switches for selection of the frequency channel. All HPR-300 channels, 01 through 09 plus 11, 22, 33, 44 and 55, are available as well as all the HPR-400 channels. Setting the channel selectors to a desired channel sets both the receiving and transmitting frequencies. A full table of frequencies for each valid selector position are given in Appendix D.

Acoustic commands are available to enable and disable the transponder and to switch on the depth reply.

The Transponder is switched ON by linking pins 2 and 5 of the connector. This can be achieved by fitting the ON - Blanking Plug if running on batteries, by connecting Sonardyne external power cable 7970-054 or by connecting the fast Charger, Type 7972. With no connection to the connector the Transponder is switched OFF to maximise battery life.

The connector is a special Subconn Micro Connector (MCIL5M Type) manufactured for Sonardyne by MacArtney A/S and operates with a standard in-line connector MCIL5F as fitted to the Sonardyne External Power cable and Fast Charger.

Should the transponder be deployed in the OFF state a standard Subconn non-shorting blanking plug should be fitted to prevent the water accidentally shorting pins 2 and 5 and switching the transponder ON.

Unless the unit is damaged or fails to function correctly after charging, there is no need to open the pressure housing. If access to the electronics or battery is required, this must be carried out by **qualified maintenance personnel** and the procedures set out in Sections 4 and 5 of this manual should be followed.

The Type 7973 Transponder is designed to be operated in both transponder and responder modes. An electrical trigger input pin is provided on the external connector to enable operation in responder mode.

The maximum operating depth of the Type 7973 housing is 1000 metres but this may be limited by the full-scale depth of the pressure sensor. A label on the connector endcap states the maximum depth to avoid damage to the sensor. Versions of the connector endcap are available with different pressure sensor scaling - contact Sonardyne for details.

FIG 2.1 SUPER SUB-MINI TRANSPONDER TYPE 7973

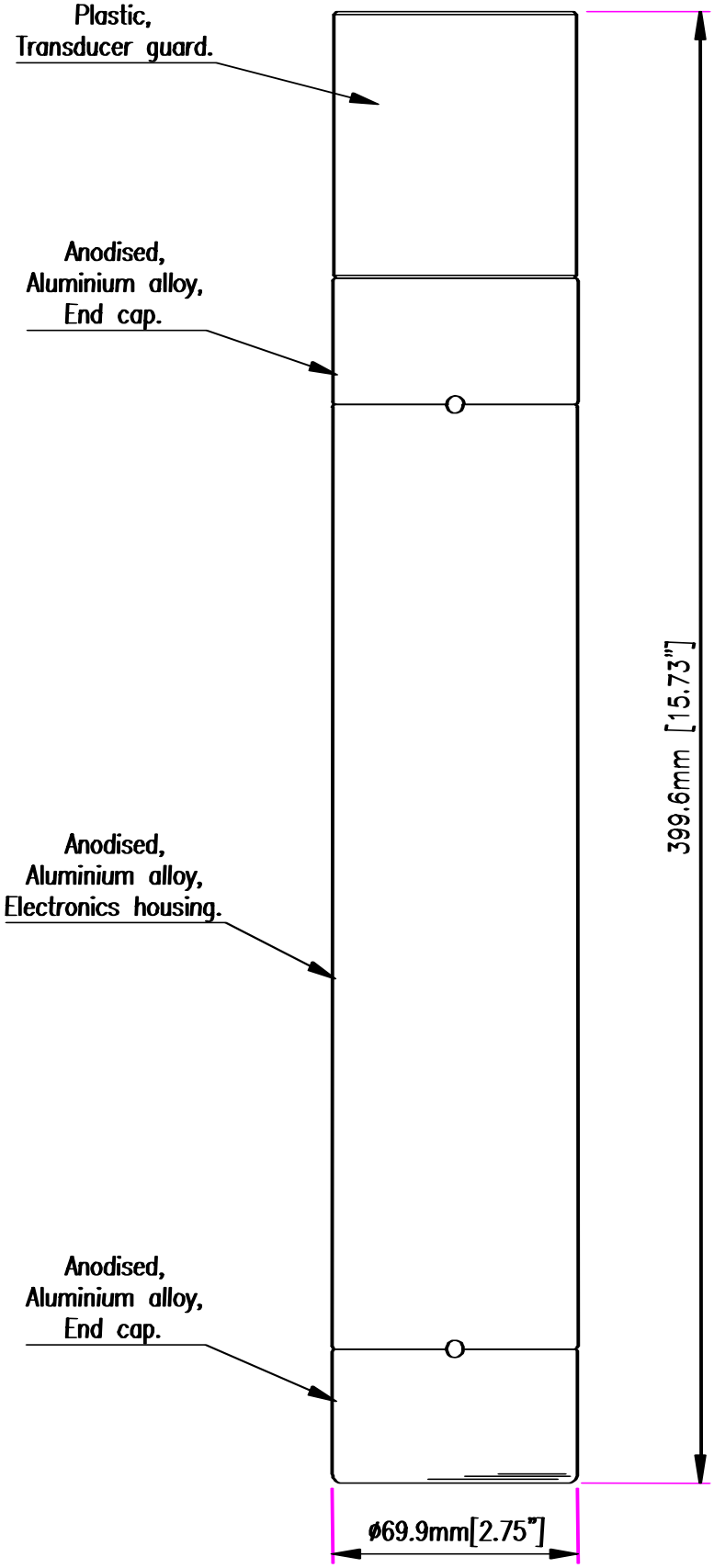


FIG 2.2 SUPER SUB-MINI TRANSPONDER TYPE 7973-000-05

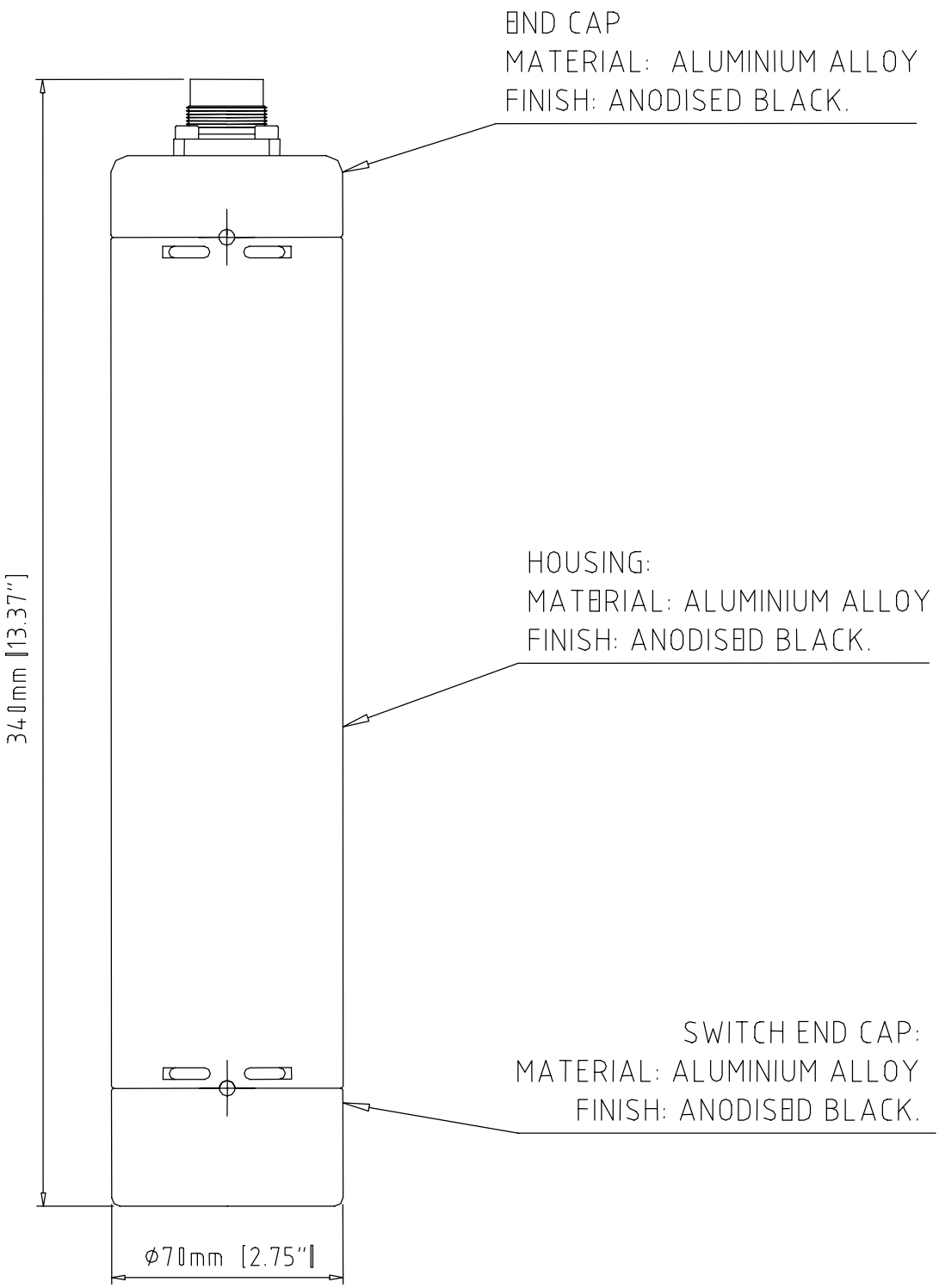


FIG 2.3 REMOTE TRANSDUCER TYPE 7995-003-01

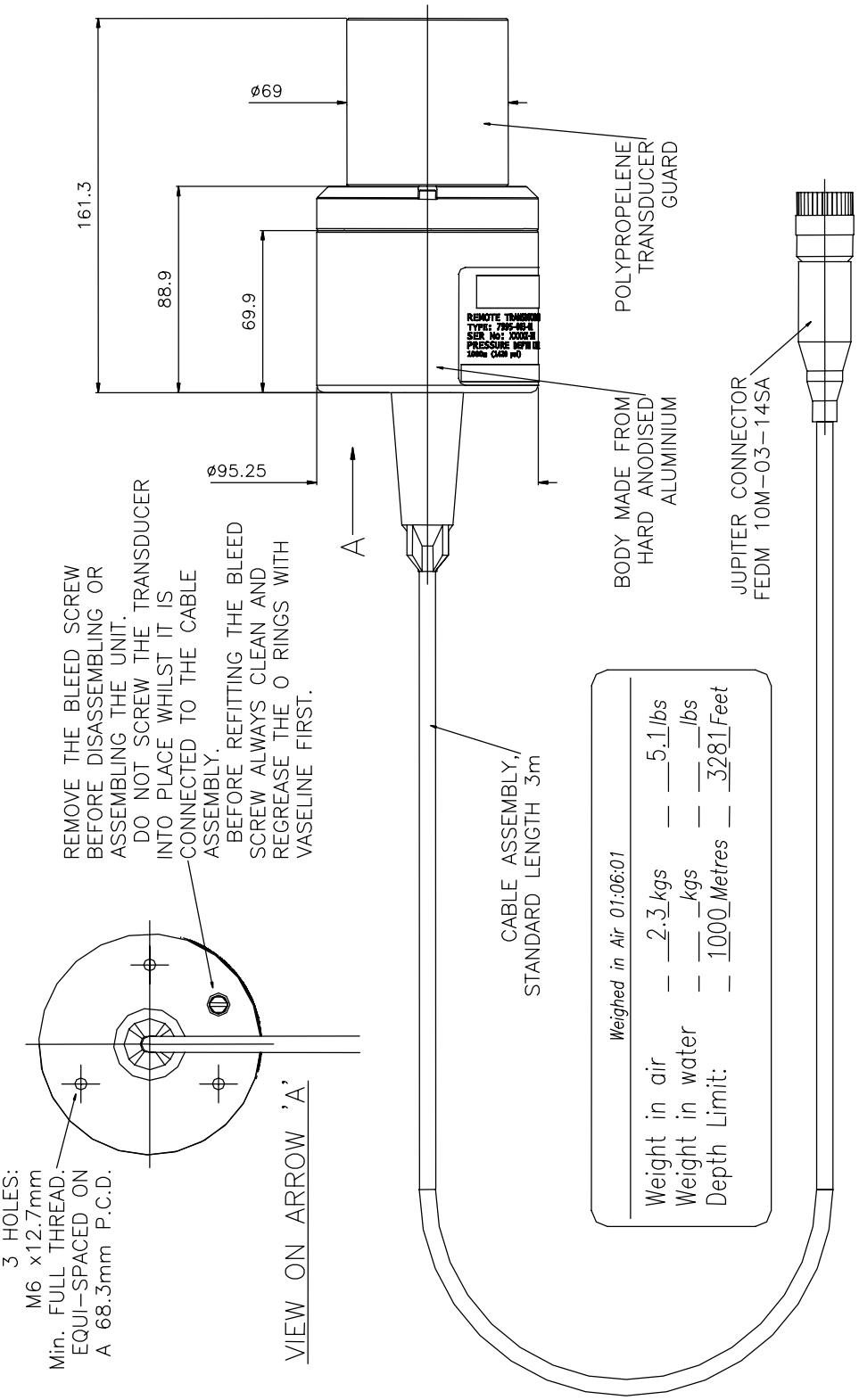


FIG 2.4 SWITCHED ENDCAP CONTROLS

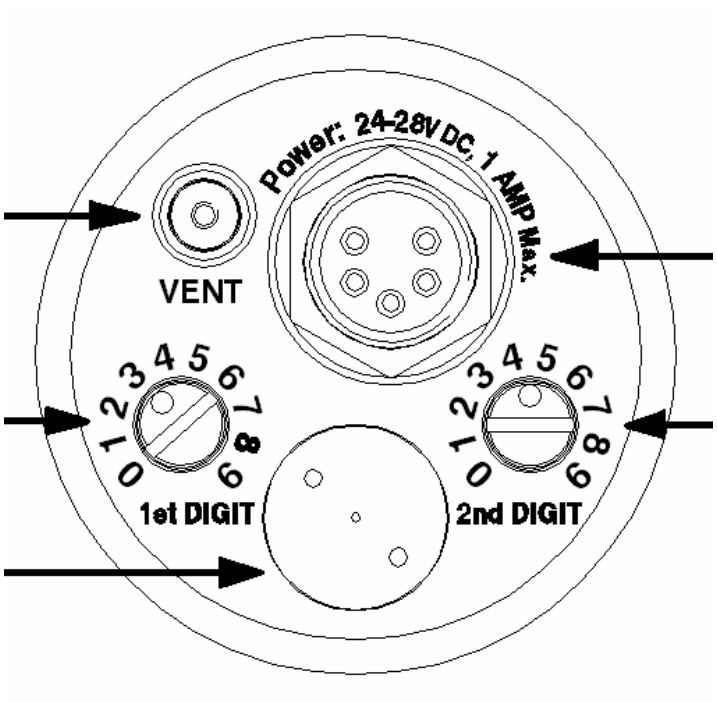
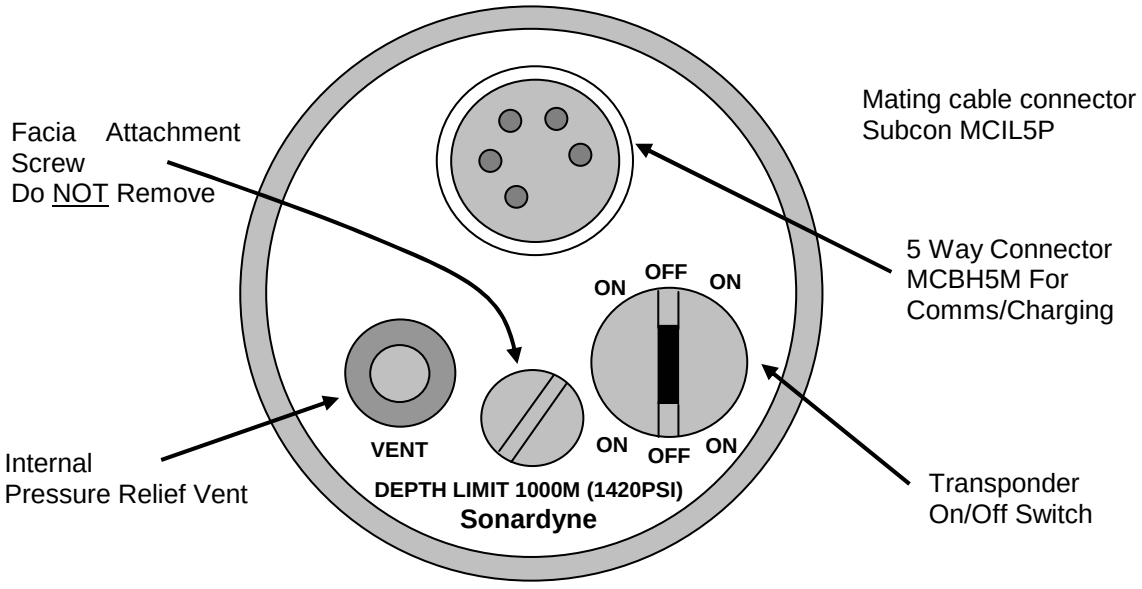


FIG 2.5 UNSWITCHED ENDCAP (7973-07)



SECTION 3

3. OPERATION

3.1 OPERATIONAL MODES

The Type 7973 transponder is capable of two modes of operation, and may be powered either internally or externally:-

- Transponder Mode - triggered (interrogated) by an acoustic signal.
- Responder Mode - triggered by an electrical signal via the external connector.

The latter mode is recommended for use on noisy ROV's or whenever an electrical trigger signal is available via an umbilical from the ship's HPR or LUSBL unit.

These modes are described in more detail below. In all cases, the normal operational state is achieved with the appropriate channel selected on the Channel Selection switch and the ON/OFF link made at the external connector.

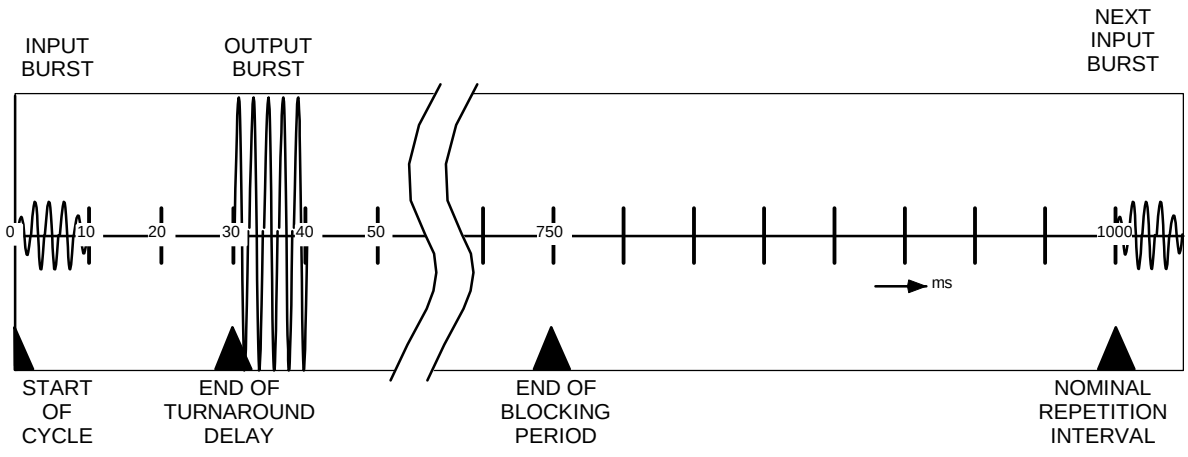
3.1.1 Transponder Mode

In this mode, the transponder is interrogated by an acoustic input. If there is no external power connection, the connector must be fitted with the ON - Blanking Plug to switch the unit ON and protect the connector pins.

As shown in Fig 3.1, the transponder will respond 30 milliseconds after recognising an incoming acoustic burst of the selected frequency and of sufficient magnitude/duration. If the ambient noise level is too great for the interrogation signals to be heard, the 7973 may not reply to interrogations or may reply erratically.

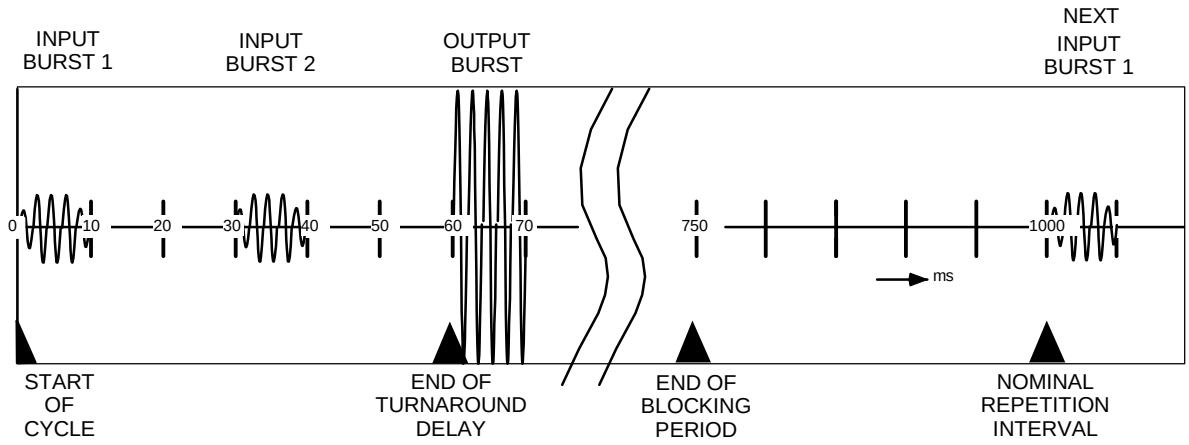
HPR Series 300 systems send a single interrogation signal as shown below:

FIG 3.1 OVERALL ACOUSTIC SEQUENCE - HPR 300 SERIES CHANNELS



HPR Series 400 systems use a coded sequence of two interrogation pulses, separated in time by 30 ms. The reply pulse starts 60 ms from the start of the first interrogation pulse as shown below:

FIG 3.2 OVERALL ACOUSTIC SEQUENCE - HPR 400 SERIES CHANNELS

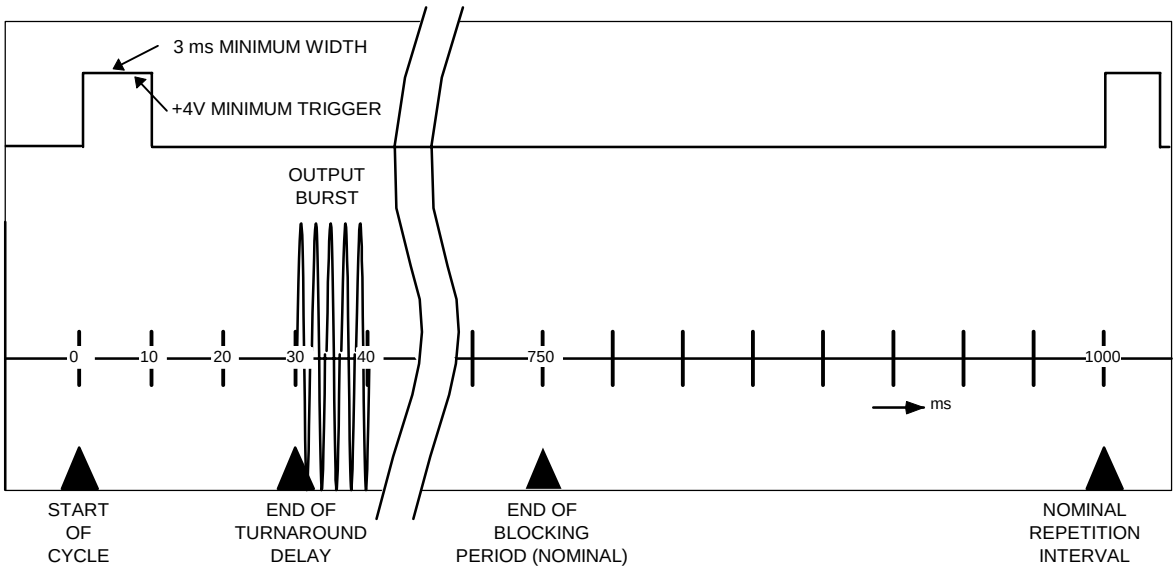


3.1.2 Responder Mode

In this mode, the transponder is triggered to transmit on the designated reply frequency by an electrical trigger signal applied to the external connector. Following the reply, the transponder will be inhibited from responding to acoustic interrogations for the period of the blocking period after which it will respond to either acoustic or electrical triggers.

As shown in Fig 3.3, the trigger pulse waveform is a positive going pulse with a pulse width between 3 and 25 ms and voltage levels between 4V minimum and 24V.

FIG 3.3 RESPONDER SEQUENCE



3.2 PUTTING THE TRANSPONDER INTO SERVICE

3.2.1 Transmission Power Level

The power level is factory set to Low Power.

Before fitting the transponder in its operating position, consider the power level required for the operation. Two levels are available, selected by a link inside the transponder. It is therefore a task for qualified service personnel to open the transponder and change the link, following the procedures in section 4. High power will normally be selected when operating using ROV power. If a long duration operation is required while running on internal battery power, the low power setting may be selected, providing the unit is not operating at the limit of the range capability. In shallow or enclosed water operations low power may be an advantage to reduce acoustic reverberation.

3.2.2 Location on ROV

The unit should be positioned in an upright attitude, with the transducer endcap uppermost, pointing towards the sea surface. Adhesive tape should cover the housing/endcap joint and closure slots to prevent ingress of silt. If clamped to a metal structure, rubber should be used to isolate the transponder from the structure both electrically (to prevent corrosion) and mechanically (to damp conducted acoustic noise). As the transducer has an Omni directional beam pattern, it must be located with the transducer above the level of the ROV's syntactic foam buoyancy.

Connections to the transponder connector are shown in Section 6.

3.2.3 Check Pressure Relief Valve

Check that the red pressure relief valve is flush with the endcap. If not, it could indicate a pressure build-up during previous operations due to a fault developing in the battery pack. The unit should be investigated by qualified service personnel and should not be deployed.

3.2.4 Charge the Battery

If the transponder is fitted with **Nickel Metal Hydride** batteries, it is recommended that the battery pack is fully charged before being put into service, otherwise time can be wasted if the battery becomes discharged before the mission ends. The Type 7972 Fast Charger allows the battery to be charged in approximately 90 minutes. The comms lead to the PC should not be connected at this time. Full details of the charging procedure and important safety information are given in Appendix B.

3.2.5 Enable Depth Telemetry

After charging is complete and while the Charger is still connected to the transponder, **disconnect or switch off the AC power.** Connect the Charger / comms Interface to a PC and run the Super Sub-Mini Configuration and Test software (see Appendix E). Check and record the Firmware Version fitted and check that the depth telemetry facility is enabled or disabled as required.

If changing the depth ON / OFF status, the transponder must be switched OFF (remove plug from connector endcap) and ON again (replace plug) for the change to take place.

Alternatively, wait up to 2 minutes for the Watchdog Interrupt to apply the new depth status.

While the serial link is connected, check the command address is the same as on the label and make a note in the test log. Ensure the address is suitable for the command transceiver which will be used (see sections 3.2.10 and 3.2.11). See sections Appendix E (sectionE.4.15) has details of how to change the command address.

The Set-up software described in Appendix E allows the operator to change the scaling of the depth telemetry transmissions. For example, if operating in deep water, the time difference between the two acoustic pulses can be reduced be changing the scale factor (milliseconds per metre) to a lower number. However, it is essential that the transponder and surface system agree on the scale factor or the wrong depth will be calculated. Some surface systems cannot change the scale factor so the transponder default settings should not be changed. The default settings are:

HPR-300 channels: 0.5 ms / m

HPR-400 channels: 1.0 ms / m (indicated as Gain = 0.3)

3.2.6 Switch-on and Electrical Connections

Ensure the transponder is ON. The external connector **must be covered** while the transponder is submerged, either by the protective ON - Blanking Plug (Part No. 641-0272) or by the free plug of an external power cable (see below). [If it is required to submerge the transponder with it switched OFF, it is recommended that a Blanking Connector without the ON-link is fitted to protect the connector pins from corrosion]

If the unit is to operate in “Responder” mode or with external power, a 5-pin free plug with appropriate wiring (Part No. 820-5171, see Fig 3.4), including the ON-link, must be mated with the external connector. An adapter cable is available (Part No. 820-5084, see Fig 3.5) with the ON- link to connect to ROVs already fitted with a 4-pin Seacon VSG connector. The TRIGGER pin and COMMON must be connected via an umbilical to the HPR or USBL system on the vessel. When in “Responder” mode, the acoustic transmissions from the transponder will not be affected by ROV noise.

3.2.7 Set the Channel

The desired channel is selected by rotating the CHANNEL SELECTORS (see Figure 2.2), using a screwdriver with the correct thickness and width of blade. Take care to align the white dot as closely as possible to the channel number required. There is a reasonable tolerance on the position setting but if set half-way between the channel numbers, the channel cannot be guaranteed. Note that to maximise battery life, the selectors are only scanned every two minutes. **There may therefore be a short delay after moving the selectors before the transponder switches to the channel selected**.

Alternatively, the channel may be set using the serial comms link (see Appendix E). In this case the Channel Selectors **must** be set to 00.

3.2.8 Test the Transponder

Test the transponder by interrogating with a test unit such as the Sonardyne ANT (Acoustic Navigation Tester) as described in Appendix C. When operating with external power, also test the emergency transponder mode by switching off the external supply, if possible. The transponder should revert to its internal battery supply and should continue to reply to interrogations (or to electrical triggers if in Responder mode).

3.2.9 After Use

After in-water operations, the Transponder should be thoroughly soaked in warm fresh water, to dissolve salt and wash off sand or silt, especially around the channel selectors and the external connector. The cable or dummy plug can be removed to wash the external socket. When dry, lubricate the connector with a light coating of lubricant (the connector manufacturer recommends Molycote 44 medium). Switch OFF before charging or storing.

If the unit is believed to be serviceable, it should not require any attention apart from charging and washing, and should therefore not be dismantled.

3.2.10 Acoustic Command Functions

The 'Command' concept refers to the remote control of the operating modes of a transponder by coded acoustic signals, generally transmitted from a surface vessel. The basic applications are to 'ENABLE' and 'DISABLE' the transponder. The essential requirement is high security with a very low probability of false actuation. The traditional technique is a pulse position code using three tone bursts of different frequencies. The three pulses uniquely define the address of the commanded SSM, and the command function to be executed. The COMMAND ADDRESS of the unit is defined on the label, typically a four digit number. This is the factory setting. If necessary, the command address can be changed using the test software and a serial link cable. See Appendix E for details (section E.4.15).

The first two digits of the address are known as the command code. Two different command schemes are used. If the command code is 01 to 31 (addresses 01xx to 31xx) the command scheme is identical to that of Sonardyne Compatt transponders and any Sonardyne command transceiver will be able to send these commands. Command codes from 32 to 63 (addresses from 32xx to 63xx) use a scheme with a different frequency for the third pulse. This provides independence from other navigation systems but can only be commanded by command transceivers which are programmed to do so.

Codes 01-31 may be commanded by all versions of:-

7145 MF PAN,

7663 MF LCU,

7807 MF RovNav 4,

7343 ANT,

7769 USBL,

8010 MF RovNav 5 or

8021/3 Digital USBL

Codes 32 – 63 may only be commanded by :-

7343 ANT with firmware V2.25 or greater,

7663 MF LCU with firmware 4.00 or greater,

7574 MF Directional LCU with firmware 4.00 or greater

8010 MF RovNav 5 with firmware V6.10.00.00 or greater

8021/3 Digital USBL with firmware V6.10.00.00 or greater

The SSM can be set by acoustic command into one of three separate interrogation modes.

- Command "PEN" :- Interrogation replies ENABLED - each valid interrogation results in a single pulse reply as set by the channel switches.

- Command “PDE” :- Interrogation Depth replies ENABLED - each valid interrogation results in a two pulse reply as set by the channel switches. The second pulse carries the encoded depth information.

- Command “PDS” :- Interrogation replies DISABLED - unit will not reply to any interrogations.

Older command transceivers may not support the above commands. In that case, standard Compatt commands can be used as defined in the table below. However, the transceiver will expect a Compatt data telemetry reply which the SSM does not generate. The transceiver will thus report telemetry errors. These should be ignored if commanding a SSM transponder.

SSM command	Equivalent Compatt Command	Command function
PEN	EN	Enable
PDE	TC	Depth Enable
PDS	DS	Disable

3.2.11 Interrogators

Various transceiver units are capable of interrogating SSM’s, including all HPR 300, 400 and HiPAP® systems. Only Sonardyne MF transceiver systems can be used to send acoustic commands to SSM’s.

A Sonardyne Type 7343 Acoustic Navigation Test unit (ANT) can be used to interrogate SSM’s and also send commands, but is only designed for pre-deployment testing and fault diagnosis. To command a 7970-000-05 SSM with address codes in the range 32 -63 the ANT firmware must be V2.25 or later. To interrogate a unit the command HIInn is used where nn is the HPR300 or HPR400 channel number.

A Type 7145 MF PAN or 7807 MF RovNav 4 can command the unit provided the address codes are in the range 1 – 31, although they cannot be used to interrogate on the HPR channels.

The 7574 MF Directional LCU may be used to command the unit using address codes in the range 1 -63. The 7574 MF Directional LCU may also be used as a range-only interrogator provided the unit channel is set to a HPR300 channel. Interrogate command HIInn where nn is 1 – 9 for HPR 1 – 9 and 10 for Square(11), 11 for Circle(22), 12 for Delta(33), 13 for X(44) and 14 for Y(55).

A 7769 USBL/LUSBL may be used to command the unit provided the address code is in the range 1 – 31. The 7769 USBL/LUSBL can also position the unit provided the end cap switches are set to a HPR300 channel.

A Type 8010 MF RovNav 5 may be used to command and interrogate the unit. To be able to command units with address codes in the range 32-63 the 8010 RovNav 5 must be fitted with V6.10.00.00 or greater. To interrogate a unit the command HIInn is used where nn is the HPR300 or HPR400 channel number.

A Type 8021 or 8023 Digital USBL/LUSBL system has HPR 300 and HPR 400 navigation processing capability and therefore provides range and direction to the unit as well as being able to command the unit. To be able command units with address codes in the range 32-63 the Digital USBL/LUSBL must be fitted with V6.10.00.00 or greater.

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PRE-DEPLOYMENT CHECKLIST

Type Number:	**7973**	**Serial Number:**	
Channel:		**Firmware Version:**	
Date:		**Tested By:**	

	Test	**Tick / Comment**
1	Secure Mounting checked	
2	Check Pressure Relief Valve	
3	Charge battery	
4	Switch ON	
5	Enable / Disable Depth Telemetry	
6	Note command address	
7	Set Channel	
8	Test on battery power: Transponder Operation	
9	Test on battery power: Responder Operation	
10	Test on external power: Transponder Operation	
11	Test on external power: Responder Operation	

W A R N I N G

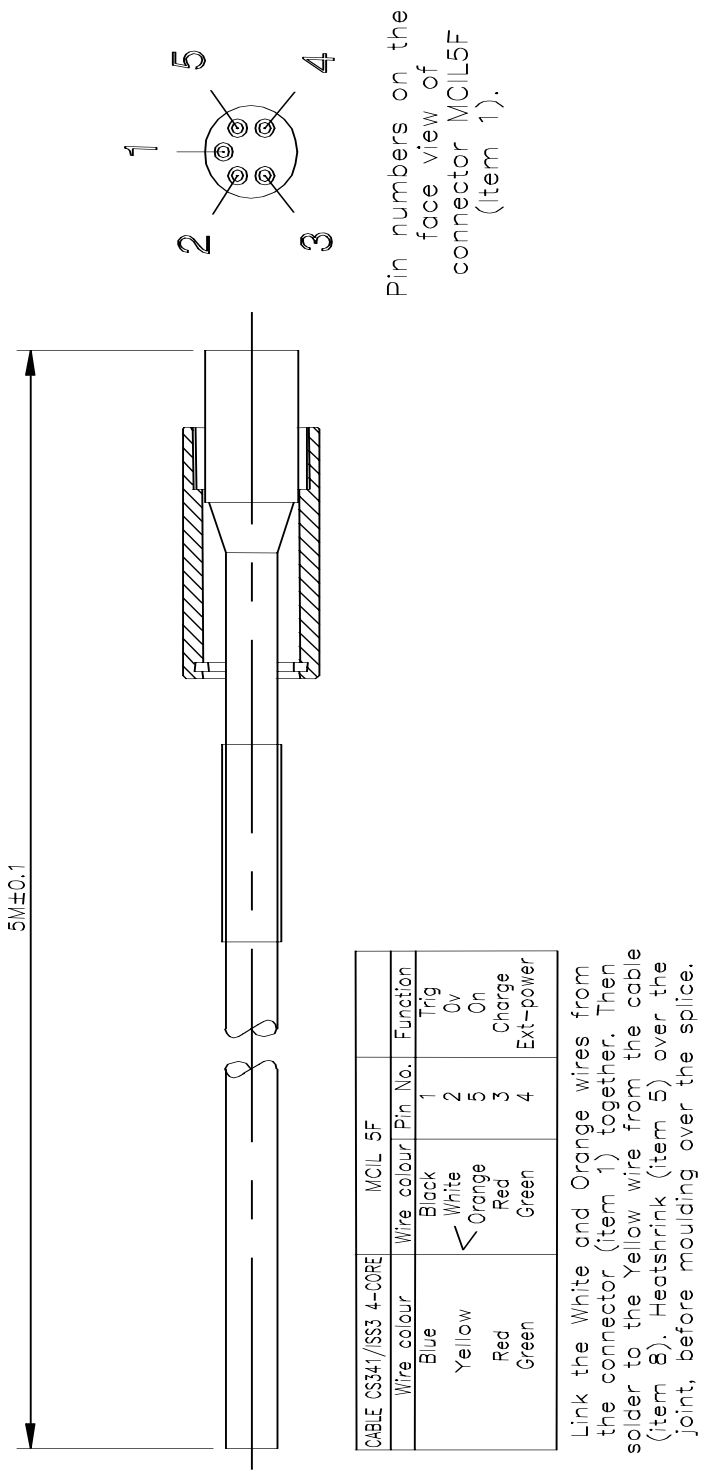
If the relief vent is not flush when inspected, it indicates that a pressure build up has occurred causing the unit to vent. Residual internal pressure may still be present.

DO NOT DEPLOY THE UNIT AND REFER TO THE MANUFACTURER.

FIG 3.4 ROV CABLE ASSEMBLY

Drawing No: 7970-054

Part No: 820-5171



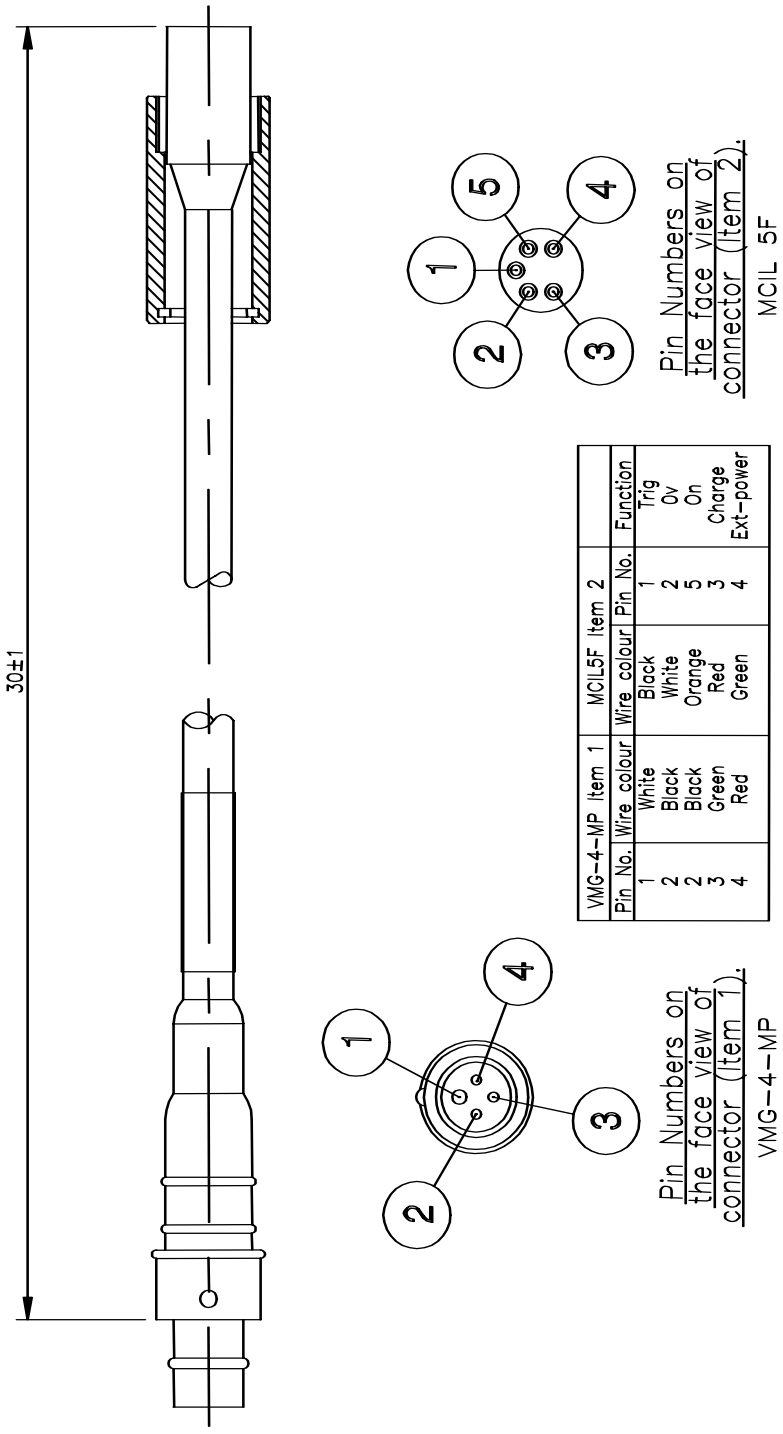
CABLE CS341/SS3 4-CORE		MCIL 5F		
Wire colour	Wire colour	Pin No.	Function
Blue	Black	1	Trig
Yellow	White	2	0v
	Orange	5	On
Red	Red	3	Charge
Green	Green	4	Ext-power

Link the White and Orange wires from the connector (Item 1) together. Then solder to the Yellow wire from the cable (Item 8). Heatshrink (Item 5) over the joint, before moulding over the splice.

FIG 3.5 ROV ADAPTOR CABLE

Drawing No: 7970-052

Part No: 820-5084



VMG-4-MP Item 1		MCIL5F Item 2		
Pin No.	Wire colour	Wire colour	Pin No.	Function
1	White	Black	1	Trig
2	Black	White	2	0v
2	Black	Orange	5	On
3	Green	Red	3	Charge
4	Red	Green	4	Ext-power

SECTION 4

4. MAINTENANCE

W A R N I N G

There are no parts inside the unit which are accessible to the equipment operator.

High voltages can be present within the transponder.

Opening the transponder, internal adjustments and replacement of parts must only be carried out by trained maintenance personnel.

4.1 GENERAL MAINTENANCE

After in-water operations, the Transponder should be thoroughly soaked in warm fresh water, to dissolve salt and wash off sand or silt, especially around the channel selectors and the external connector. The cable or dummy plug can be removed to wash the external socket. When dry, lubricate the connector with a light coating of lubricant (the connector manufacturer recommends Molycote 44 medium). Switch OFF before charging or storing.

If the unit is believed to be serviceable, it should not require any attention apart from charging and washing, and should therefore not be dismantled.

Following the above actions and if the unit has been returned because it is believed to be unserviceable, it is good practice to put it on charge for at least two hours before proceeding with any maintenance activity - assuming that it will take charge at all. Procedures for charging the battery are set out in Appendix B.

Should internal attention be required, the unit can be dismantled easily and the battery exchanged or any of the major assemblies replaced. There are no adjustable components determining frequencies of reception or transmission. A trimmer potentiometer sets a receiver parameter. A jumper link selects high or low transmission power level.

During the Warranty Period, the 7973 must be returned to Sonardyne or one of its overseas representatives if in need of attention. Thereafter, the customer may decide to service the unit and should refer to the maintenance procedures set out below and in Section 5.

A list of spares is given in Appendix A.

4.2 CAUTIONS

It is important to make sure you are familiar with Section 4.5 - Dismantling and Re-Assembly - before attempting to carry out any work on the transponder's internal assembly.

4.3 CIRCUIT FUNCTION

The primary function of the circuit is to respond to an incoming acoustic burst at one particular, selected "interrogate" frequency (or pair of tone bursts on different frequencies in the case of HPR-400 channels). Having detected the incoming burst and checked that it is at the selected frequency, the circuit responds, after a set interval of time, by transmitting an outgoing acoustic burst at a corresponding "reply" frequency.

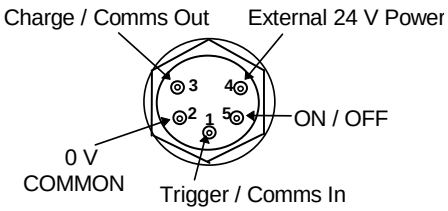
The transponder also has a responder mode - in which it can be triggered into an output burst by an externally-applied electrical signal.

The way in which the circuit achieves these functions is described by reference to Fig 4.1.

4.3.1 External Connections

External connections to the transponder are made via a 5 pin connector - as illustrated in the external view of the connector to the right. If the transponder is to be powered externally, a +24 V dc supply is applied to the +24 V DC pin with respect to the COMMON pin. The minimum permitted voltage at the socket is 22 V and the maximum permitted voltage is 28 V. With the transponder switched ON position, the 7973 will operate from the external supply so long as the output from the internal voltage regulator is above the internal battery voltage. The battery voltage is nominally 18.75 V, but can be above 20 V immediately after charging. If the external power supply voltage falls below 22 V or fails, or the electrical connection to the 7973 is broken, the transponder continues operating from the internal battery. This provides an emergency transponder facility if an ROV's umbilical breaks.

Bulkhead Plug Contact View



NOTE

The transponder is switched ON by linking pins 2 and 5 of the external connector. This can be achieved inside the ROV junction box, by using a Sonardyne Cable (Part No 820-5171, see Fig 3.4) or a Blanking Plug (Part No. 641-0272) which have the link permanently made.

An external supply connected as described above will cause the battery to be trickle-charged.

Connections to a battery charger (see Appendix B for battery charging procedures) and to an external trigger circuit are made also through the same 5-pin connector. As before, the COMMON 0 V pin is used as the circuit return for power, trigger and communications.

A PC can be connected to the transponder using the Type 7972 Charger / Interface Unit. Connect a standard 9-way cable between the PC and the Charger as shown in Appendix B. The power pack must be switched off or disconnected from the Charger to enable PC communications. The PC communications allows test programs to be run to assist in calibration and testing of the transponder. The operation of the test programs is explained in Appendix E.

4.3.2 Power Supplies

The circuit is powered either from an external 24 V source or from the internal 18 V Nickel Metal Hydride battery. A simple diode OR circuit ensures that the external supply, if connected, takes over from the internal battery. This supply feeds the output stage of the transmitter circuit directly and also provides the input for two regulators. The first provides an output of 12.5 V and this is further regulated down to 5 V to supply the receiver and logic circuits.

4.3.3 Receive Chain

Only incoming acoustic bursts at particular, selected frequencies will cause a response from the transponder. Series 300 channels use single frequency interrogations but Series 400 systems use two tone bursts on different frequencies separated by a fixed delay. The channels and frequencies are fully described in Appendix D. The channel on which the transponder is set to receive is determined by the Channel Selectors shown Fig 4.1. The two selectors give one hundred possible states of which fourteen are valid Series 300 channels and 56 are valid Series 400 channels. The micro-controller reads the position of the channel selectors using an internal A to D converter and controls two Frequency Synthesisers, which in turn provide frequency references to a homodyne receiver.

The incoming acoustic burst is detected by the transducer and amplified through the pre-amplifier - which incorporates a band-pass filter to reduce unwanted noise. The pre-amplifier output provides a second input to the homodyne receiver. The output of the receiver is rectified and compared to a detection level using a comparator. The detection level is a reference voltage set by potentiometer RV1. If the receiver output is high enough to trigger the comparator, the comparator output interrupts the micro-controller.

If the channel selectors are set to a single interrogation channel, the micro-controller initiates a reply sequence. In the case of HPR-400 channels, the receiver reference frequency is switched to the second interrogation frequency. Only if this is received at the correct time window will the micro-controller initiate a reply sequence.

4.3.4 Reply Chain

The first task in the reply sequence is to set the synthesiser to the transmission reference frequency. The transponder then times a turn-around delay before enabling the transmitter to transmit the reply tone burst. Both HPR-300 and HPR-400 systems use a single tone burst reply signal. However, if depth telemetry is enabled (see below) a second signal on a different frequency is transmitted after a time proportional to the depth reading.

The synthesiser output is a multiple of the final reply frequency. The Pulse Width Controller divides this frequency down to the final reply frequency and acts as a low impedance buffer to the Output Driver. The Output Driver drives through a step-up transformer to a series-tuned output circuit which generates a 3kV peak-to-peak output signal to drive the transducer.

4.3.5 External Responder Trigger

As illustrated in Fig 4.1, an externally-applied trigger signal (in the form of a pulse of 4 to 24 V for 3 to 25 ms) will initiate the reply sequence independent of the receiver operation.

4.3.6 Serial Communication

A unique feature of Super Sub-Mini is the ability to communicate with the micro-controller via a serial data link. The input signal is shared with the responder trigger line. Providing baud rates over 1200 are used the micro-controller can distinguish between a trigger pulse and a serial data character.

Serial replies are superimposed on the Charge Line so communication is only possible when the unit is not being charged. External power input, however, does not affect this function.

Sonardyne supply PC software to assist the operator to set up the transponder and to help maintenance personnel to test transponder operation. Details of the PC software programs are given in Appendix E.

4.3.7 Depth Measurement

Another unique feature of Super Sub-Mini is the depth sensor fitted to the connector endcap. If enabled (using a serial data command), the depth is measured at each interrogation and a second reply signal is transmitted at a time delay from the first reply which is proportional to the depth reading.

The micro-controller switches power to the Data Acquisition System (DAS) section of the PCB on the connector endcap. A constant current supply is provided for the depth sensor. The temperature compensated sensor output is fed to a conditioning amplifier and then to an A-to-D converter. This communicates the reading to the micro-controller.

4.3.8 EEPROM Data Storage

Calibration data for the depth sensor and the channel selectors is stored in EEPROM located on the PCB fitted to the connector endcap. This communicates serially with the micro-controller, sharing the serial bus with the A-to-D converter.

4.4 INSPECTION

Inspect the outside of the transponder for mechanical damage before attempting to dismantle. Particular points to watch for are:

- If the pressure relief vent is proud of the connector endcap surface, it is possible that the battery has developed a fault, or has been damaged by water ingress, causing the production of gas inside the transponder. The pressure relief vent must always be removed before disassembly of the transponder.

- Damage to, or erosion of, the hard-anodised surface treatment to the housing. If this is not in good condition and significant signs of severe corrosion are evident, it may be necessary to change the housing. Failure to do so could cause the transponder housing to collapse when next operated at full working depth. In cases of slight corrosion, clean with a degreaser and treat with Alocrom for 2 minutes, or until the aluminium goes golden brown, then wash off with water. Dry and cover the exposed metal with 2 part epoxy.

- Signs of corrosion on the connector - this may result in problems charging or operating the unit on external power, using responder trigger or using serial comms.

- Check to see if the connector is secure by fitting a locking sleeve (from the mating half of the connector) and check for rotation of the connector. If movement is detected, then refer to the dismantling procedure for correction.

- Mechanical damage and/or corrosion in the jointing faces between the endcaps and the main housing - this may indicate leakage of seawater into the transponder. This is particularly a risk if the sealing tape, which should be wrapped around each join, is missing.

4.5 DISMANTLING AND RE-ASSEMBLY

4.5.1 External Electrical Tests

Before starting work on the dismantling of the transponder, external electrical tests should be carried out. The procedures for these tests are given in Section 5.4, but the tests involved are listed here together with an indication of possible causes for any failure which may be detected.

Battery Charging Performance. If the battery does not take current when the Type 7972 charger is plugged in, this could indicate failure of the battery itself, the Charge Control circuit or the wiring. If fast charging operates normally but no trickle charge is taken after fast charge switches off, the external power supply wiring or the trickle charge regulator may be at fault.

Transponder Operation. Given that battery performance is normal, the transponder's acoustic performance, tested in conjunction with its response to an electrical trigger can provide some clue to the circuit area which may have failed. A transponder which responds normally to an electrical trigger over the full range of channels but does not respond to an acoustic input has probably failed somewhere in the acoustic receive chain, either in the preamplifier or in the homodyne receiver.

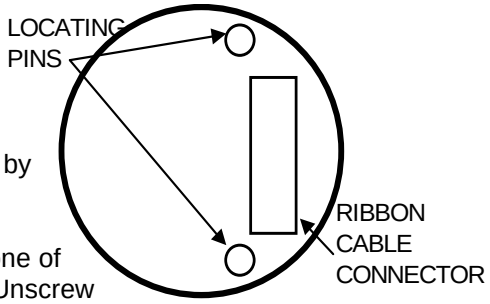
4.5.2 Dismantling Procedure

Care must be taken to follow the procedure exactly as set out below. Failure to do so may necessitate additional repair cost before the unit can be restored to a serviceable condition.

- ❑ Disconnect all cables and blanking plugs to switch the transponder OFF
- ❑ Check the pressure relief vent. If it is proud of the connector endcap surface, this could indicate an internal pressure, possibly due to vented gasses from the battery pack. In this case proceed with extra caution.
- ❑ Remove the protective plastic sleeve. This can be assisted by blowing compressed air from an air line between the housing and sleeve. If no air line is available, liquid detergent may be used as a lubricant. If it is necessary to cut the sleeve, take great care not to damage the anodising of the transducer housing or endcaps.
- ❑ Unwrap the sealing tape around each endcap seal and discard. If there is a gap between the endcaps and the housing, this again could indicate internal pressure and extra caution should be observed.
- ❑ REMOVE THE PRESSURE VENT PLUG CAREFULLY. Stand to one side of the transponder, not in line with its axis and ensure that no other personnel are in the vicinity. Extinguish all naked flames (gas produced by a faulty battery can form an explosive mixture) and ensure good ventilation in the area. Screw an M3 bolt into the tapped hole in the surface of the vent plug and carefully withdraw it. There is a retaining device fitted to prevent the plug from being lost. Check the 'O' rings are clean and wrap a short length of electrical tape around the plug to keep the 'O' rings clean.
- ❑ Place the transponder vertically on a firm surface with the connector endcap downwards.

  - A flexible plastic retaining rod is used to hold the connector endcap in place.
  - Insert the tapered end of a tie-wrap (or similar) under one end of the retaining rod holding the connector endcap in place - so that the rod end is lifted clear of its groove. Using a tool with a narrow rounded end, push on the other end of the retaining rod, causing it to slide out of its groove. When clear of the groove, grip the end of the rod with a pair of pliers and pull out completely. Discard the rod if it shows any sign of damage or stressing.

    Take care in this operation not to scratch, or mark in any way, the surface finish of the housing.
  - Without twisting the connector endcap, rock it to and fro while pulling firmly on it to withdraw it from the housing. Take care not to jerk it as it comes free, otherwise damage may occur to the internal wiring. Take care also not to damage the seal surfaces on the inside of the housing bore.
  - Lay the housing and endcap down on the surface with the internal side of the endcap facing up.
  - Remove the ribbon cable connector by rocking it gently out from its socket.
  - There is a nylon retaining cord fitted to one of the connector endcap locating pillars. Unscrew the pillar to release the cord.



- The transponder may now be turned upside down so that it stands on the transducer endcap. Release this endcap using the same process as described above.

- The transducer endcap is an integral assembly with the electronics assembly and the battery pack. As this whole internal assembly comes free of the O-ring seals it should be possible to slide it out until it is free of the housing.

- Lay the internal assembly down on a clean surface with the battery pack downwards. Set the housing to one side.

- Having separated the major components, clean the grease from all sealing surfaces and examine the sealing surfaces on the internal bore of the housing. If there is any sign of significant damage to these sealing surfaces, then the housing should be replaced before the unit is re-assembled.

- If the transponder has been opened to change the transmission power link, proceed to the next Section 4.5.3, and then re-assemble the transponder.

- If the transponder has been opened to refit a loose end cap connector, proceed to Section 4.5.4, and then re-assemble the transponder.

- As may be required by the fault-finding procedure, the battery pack may be removed by undoing the screw into the battery pack release clamp (at the connector endcap end of the assembly). Lever the retaining tab of the battery connector on the Rx/Tx PCB gently to one side and pull the connector out. To finally release the battery it may be necessary also to cut through the small fillet of silicon rubber which helps to retain the battery pack in position.

- As may be required by the fault-finding procedure, the upper board may be removed by unscrewing the central white nylon fixing nut holding the upper board to the lower board and prising the board away from the two connectors.

- As may be required by the fault-finding procedure, the lower board may be removed by disconnecting the lead on PL4 (to the transducer) and unscrewing the six fixing screws holding the lower board to the chassis.

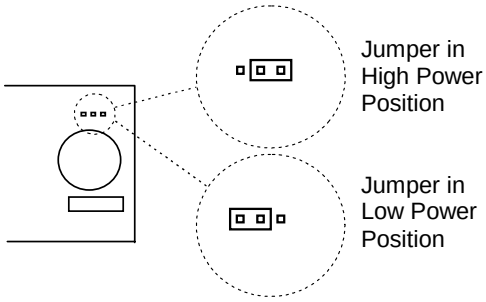
- Two M4 bolts fix the electronics chassis to the transducer endcap. Remove these and also remove the 5-pin Molex connector close to the transducer end of the chassis. Take care at this point as high voltages are present on this connector during transmission. As the transponder should be switched OFF, no transmission can be initiated by the micro-controller.

- Carefully separate the electronic chassis and the transducer endcap. The tuning coil is fitted to the end of the chassis and fits into a recess in the transducer endcap. It is recommended that replacement of the transducer or the coil assembly be carried out at Sonardyne premises.

4.5.3 Transmission Power Selector

The transmission power link is located close to the transformer at the transducer end of the Rx/Tx PCB - see diagram below. Three pins are fitted to the PCB. A jumper is used to short the centre pin to one of the outer pins. The unused pin is covered by a short length of silicon sleeve.

To change the link, remove and retain the silicon sleeve from the unused pin. Remove the jumper and relocate in the desired position. Replace the silicon sleeve on the unused pin.



4.5.4 Endcap Connector Tightening Procedure

Tools required: Torque wrench. (Suitable for applying 5Nm - 3.7lbf-ft.)
22mm Socket. (with long internal clearance, more than 36mm)
17mm Open ended Spanner.

1. Dismantle the unit as detailed in Section 4.5.2.

2. Place the socket over the external part of the connector, the long internal clearance is required to avoid damage to the pins. Ensure that the socket is well seated on the hexagonal part of the connector.

3. Place the open-ended spanner over the internal locking nut to prevent it from rotating.

4. If the connector wires have already started to become twisted, loosen the locknut slightly and rotate the connector so as to untwist the wires. Tighten the locknut to moderate tightness without rotating the connector. If connector wires are found to be damaged, replace connector. Refer to Appendix A for parts list.

5. Connect the torque wrench to the socket and tighten the socket to a torque setting of 5Nm (44.3lbf-in. or 3.7lbf-ft.)

6. Re-assemble the unit as described in the following section.

4.5.5 Re-Assembly Procedure

- Before re-assembling the unit, remove the O-rings and clean them and the grooves in which they are located. Examine the O-rings and use new ones if they appear to be flattened more than superficially or cut. Re-grease the O-rings and the grooves lightly with petroleum jelly and fit the O-rings back into the grooves.

- The assembly procedure is then the reverse of the dismantling procedure given. Remember to apply a fillet of silicon rubber each side of the battery pack to help hold it in place. Briefly the order of re-assembly is as follows:

  - Ensure that no cable or blanking plug is connected to the external connector.
  - Reconnect the battery plug to the CPU PCB.
  - Insert the transducer / chassis assembly into the housing and insert the flexible plastic retaining rod to fix the transducer endcap to the housing.
  - Screw the pin on the end of the nylon retaining cord to the stud on the connector endcap, forming the second locating pin.
  - Connect the ribbon cable to the connector endcap PCB.
  - Offer the connector endcap to the housing using the notches in the endcap and housing to ensure correct alignment. As the endcap is inserted into the housing, the ribbon cable should fold down neatly without needing any special action. Insert the flexible plastic retaining rod to fix the connector endcap to the housing.

- Finish the re-assembly by taping over the housing/endcap joints - using the adhesive tape recommended in the Spares List - see Appendix A.

- Unless the battery is to be charged immediately, remove the protective tape from the pressure vent plug, clean and lightly grease the ‘O’ rings and push the vent plug carefully home.

- Fit the plastic sleeve over the whole unit by placing over the transducer and pushing downwards.

- Ensure that the connector is lubricated with a light coating of lubricant covering the mating rubber parts (the connector manufacturer recommends Molycote 44 medium). The application of lubricant should be a light one as over application can lead to a build-up of grease in the female connector, which can affect connection integrity after lubrication has been applied a number of times.

FIG 4.1 CIRCUIT DIAGRAM

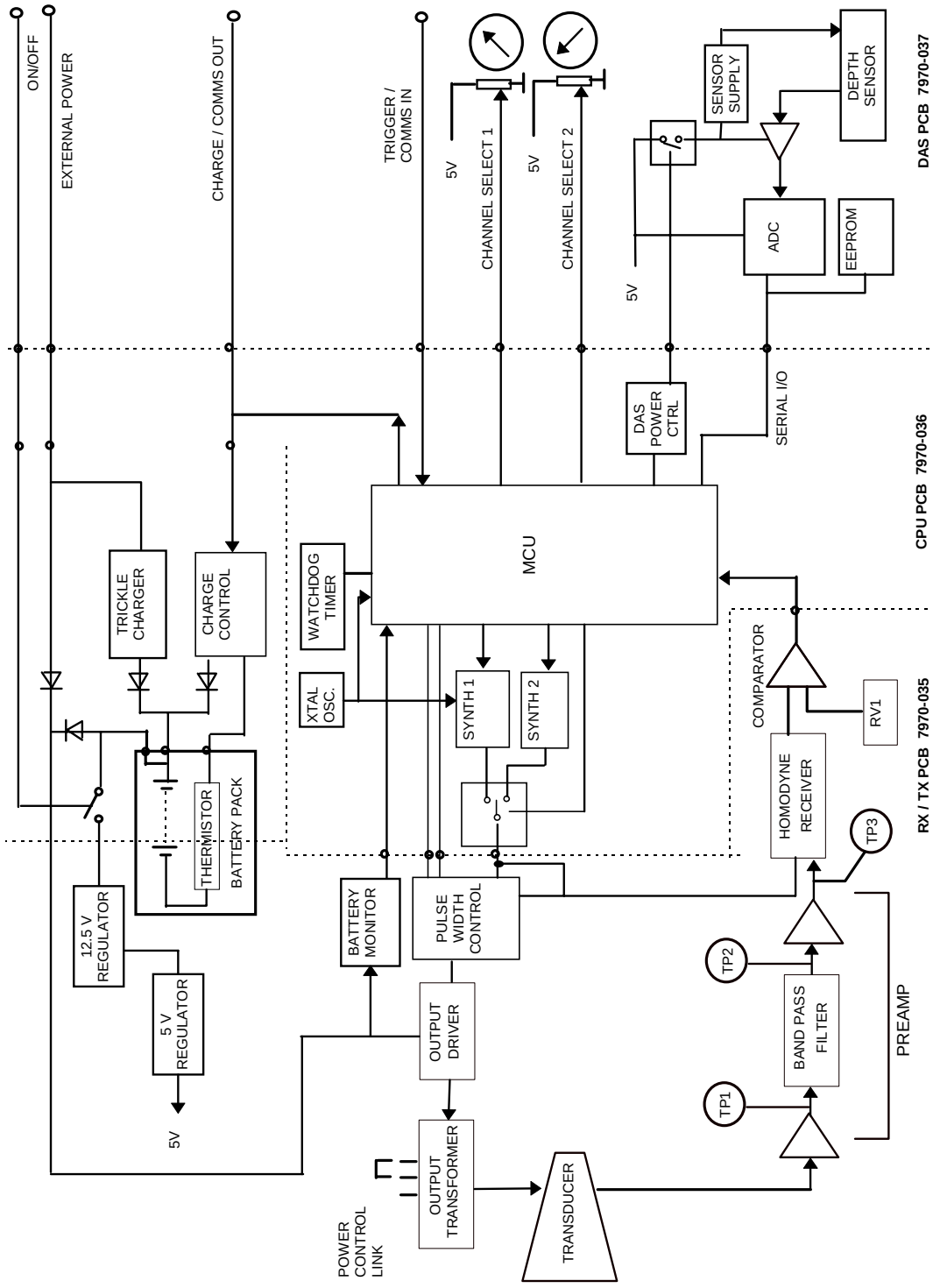
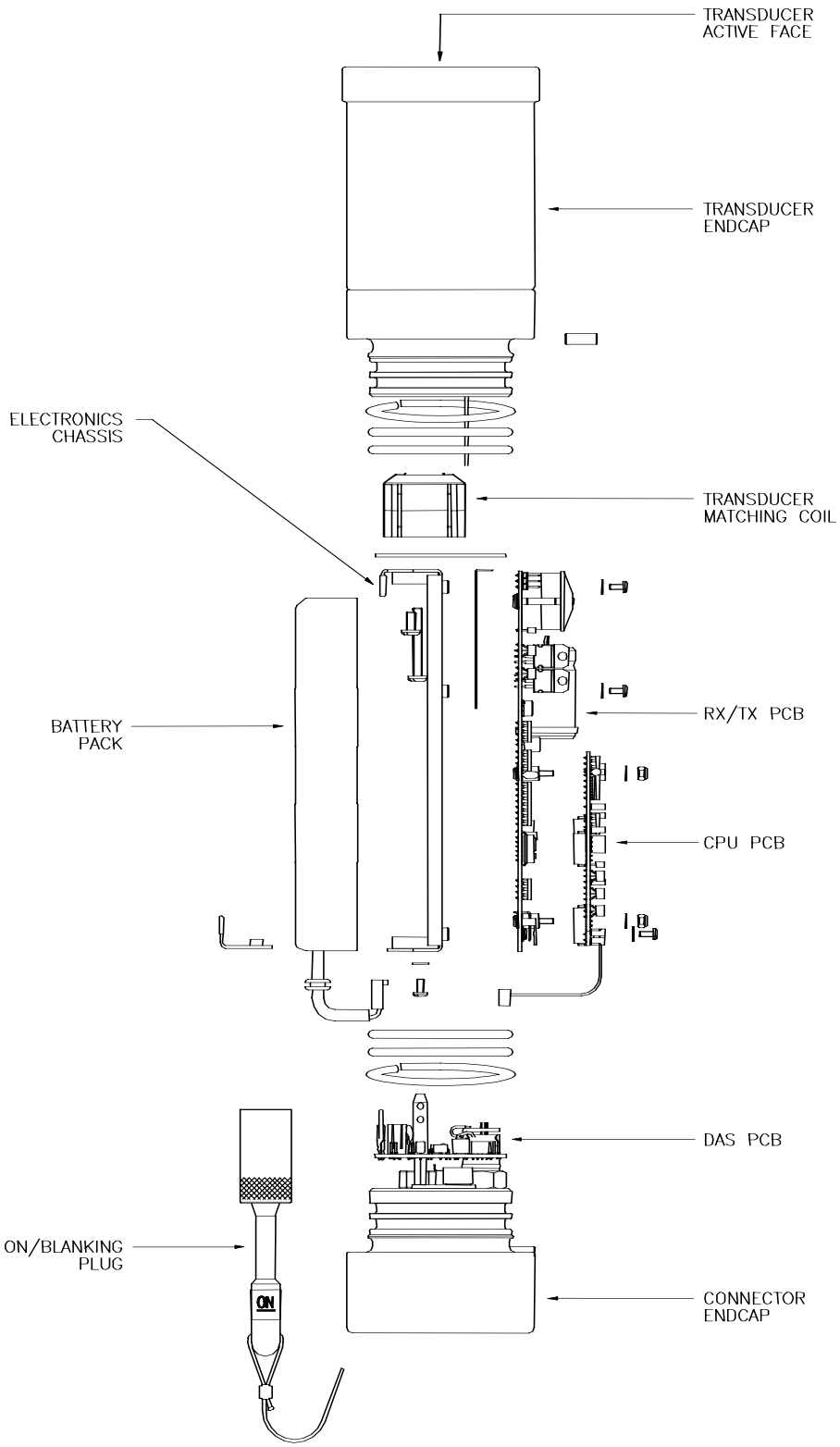


FIG 4.2 ASSEMBLY



SECTION 5

5. FAULT FINDING

5.1 TEST EQUIPMENT

- Sonardyne ANT Type 7343, firmware version 2.10 or greater, with ANT/COMPATT interface cable 7343-042B or ANT test transducer Type 7935-000-B.
- Power Supply Unit - which can be set to any output voltage over a range up to at least 25 V dc and with a current limit facility which can be set to 100 mA.
- Digital Multimeter capable of reading at least 25V and 100 mA dc.
- Dual Channel Oscilloscope - minimum 10 MHz bandwidth, 10 mV/division minimum sensitivity, with a x10 probe plus a x100 probe capable of use up to 4kV. A guarded probe tip for connection to integrated circuit legs is strongly recommended.
- Frequency Counter capable of measuring up to 200kHz minimum, accuracy 0.1%
- Test cable 1 - a Type MCIL5F connector with a switch between pins 2 and 5. The switch should be marked ON when the switch is closed, OFF when it is open.
- Test cable 2 - PSU to the battery connector (4-pin Molex, pin 2= PSU +18V, pin 4= 0V).

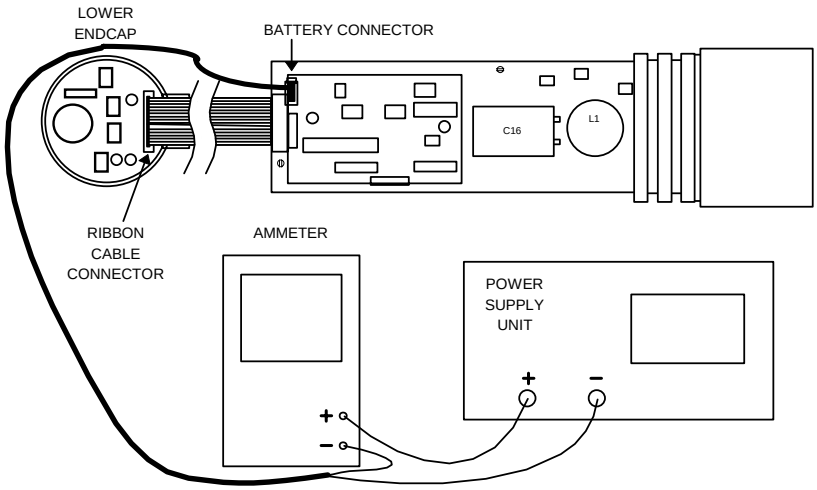
5.2 TEST SET-UP

Ensure that the Power Supply Unit (PSU) is off and Test Cable 1 is switched to OFF and then connected to the external connector on the endcap. Disconnect the battery pack using the connector between the PCBs on the main chassis.

Using the battery connector test cable and observing correct polarity, connect the +18 V and 0 V pins in the battery connector (between the two PCBs) to the PSU via the Multimeter - set up as an ammeter on a 100 milli-amp dc range - see Fig 5.1 below. The connection to an ammeter will not be necessary if the PSU has a built-in ammeter or output current display.

Re-connect the endcap to the main electronics assembly via the ribbon cable. Set the current limit on the psu to 100 milli-amps and its voltage to 18V.

FIG 5.1 INITIAL TEST CONFIGURATION



5.3 DIAGNOSTIC PROCEDURES

WARNING

Each of the checks described in this section will involve some re-positioning of test connections. In order to avoid risk of damage to the circuit by the test procedure, it is **very important** to start all testing with the ON/OFF switch on the Test Cable set to OFF and to switch it ON only for the duration of the test. The procedures given below assume that this practice is followed - no further reminder to switch ON and OFF is given.

Note

To carry out full diagnostic checks the upper board has to be removed to access all of the test points. Two flying leads (Test cable 3) are used to connect the two boards together PL2 to SKT2 and PL4 to SKT4.

5.3.1 Quiescent Checks

5.3.1.1 Quiescent Current

Set endcap to Channel 01 switch ON the PSU. Check the quiescent current on the Multimeter. This should be less than 1.1 mA - it may be necessary to wait for a minute or two if the circuit has not been switched on for some time and the electrolytic capacitors need time to re-form. A steady-state current higher than this confirms that a fault condition exists. Occasional excursions above this value are normal. If the current is much higher than this, a fault has occurred in the electronics.

5.3.1.2 18 V Supply Voltage

Reconnect the Multimeter, set up as a voltmeter on a 25 V dc range, to monitor the voltage on the positive tag of the large capacitor (C16) on the lower PCB (printed circuit board) - positive terminal to C16, negative to TP0 - see Fig 5.2 which follows.

This voltage should be approximately 17.4 V. If it is zero, the lower board is faulty.

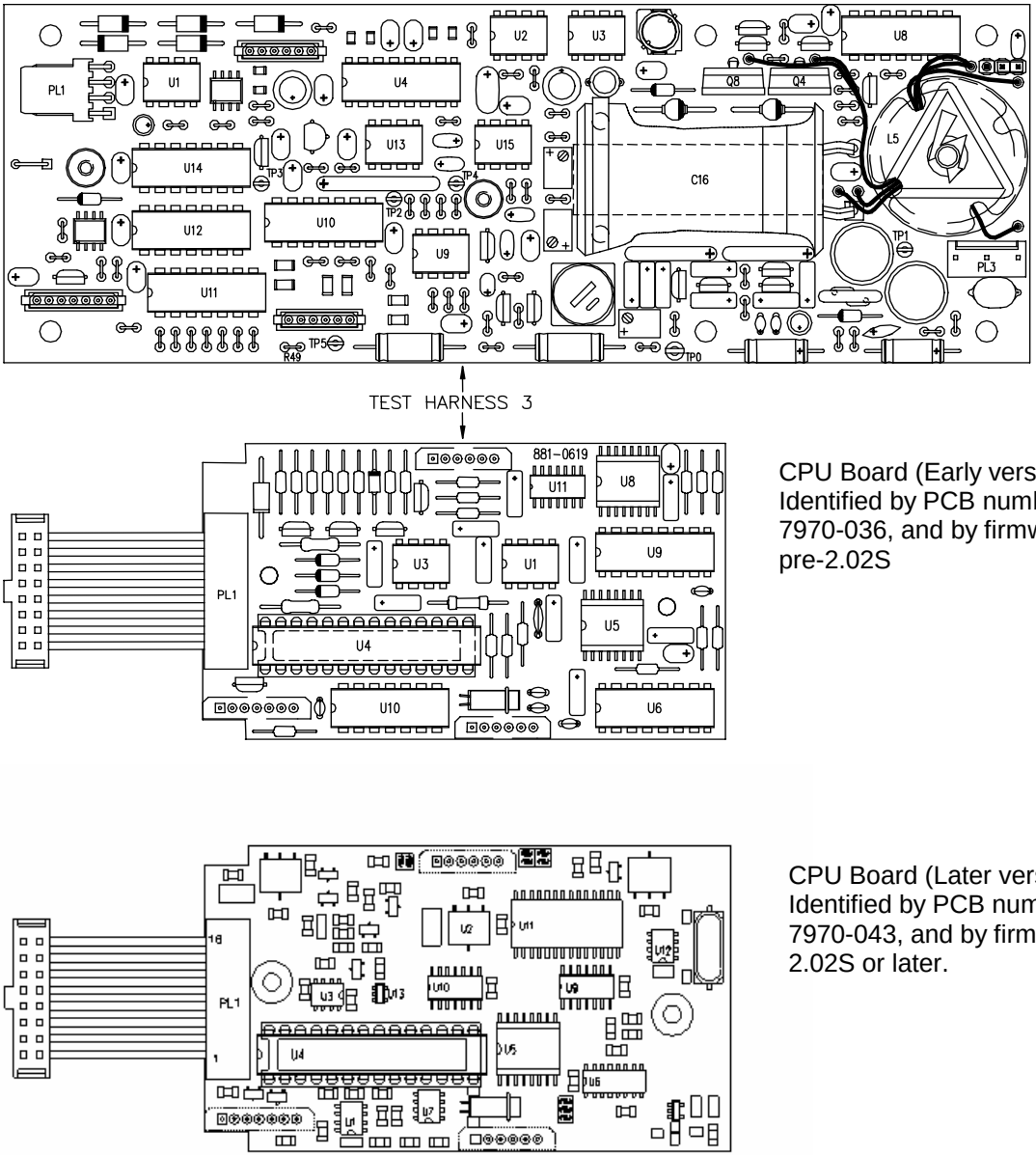
If the C16 voltage is less than 17 V, but not zero, a fault on the lower board is indicated.

5.3.1.3 5 V Regulator Output

Transfer the positive lead of the Multimeter to pin 1 of U3. This voltage should be 5 V $\pm$ 0.2 V dc.

If this voltage is outside these limits, either the 5 V regulator or some part of the circuit loading the 5 V regulator could be faulty. The only way to resolve this is to remove the upper board and repeat the test. If the fault persists, the lower board is faulty. If it clears, the upper board is faulty.

FIG 5.2 PRINTED CIRCUIT BOARD SCHEMATIC



CPU Board (Early version) Identified by PCB number 7970-036, and by firmware pre-2.02S

CPU Board (Later version) Identified by PCB number 7970-043, and by firmware 2.02S or later.

5.3.1.4 **Synthesiser Output**

Using the x10 probe, connect the frequency meter to U6, pin 4 on the upper (CPU) board.

Set the transponder to channel 01 and check the frequency output at this point is 81.968 kHz (±15 Hz). Transfer the x10 probe to the oscilloscope. The waveform should be a square wave of >4 V p/p amplitude with a duty cycle of 50% +/- 10%. If not, replace the upper (CPU) board.

Check the same signal at the input to the homodyne receiver at U14, pin 3 & 11 on the lower board. The frequency and shape of the signal should be identical. If not, replace the lower (Rx/Tx) board.

The same points should be checked for a variety of channels to ensure that the frequency of the receiver is changing. The table below shows the frequency for each HPR-300 channel for each of the channel selection switch positions.

Note the power should be turned off then back on again after changing the channel setting. Alternatively, wait up to 2 minutes for the Watchdog Interrupt to apply the new setting.

Channel Number	Frequency at TP2, in kHz (+/- 150Hz)	Channel Number	Frequency at TP2, in kHz (+/- 150Hz)
01	81.968	08	100.000
02	86.204	09	104.168
03	88.496	11	86.204
04	90.908	22	90.908
05	93.456	33	95.692
06	96.152	44	100.504
07	98.040	55	105.820

5.3.1.5 **24 V Input Test**

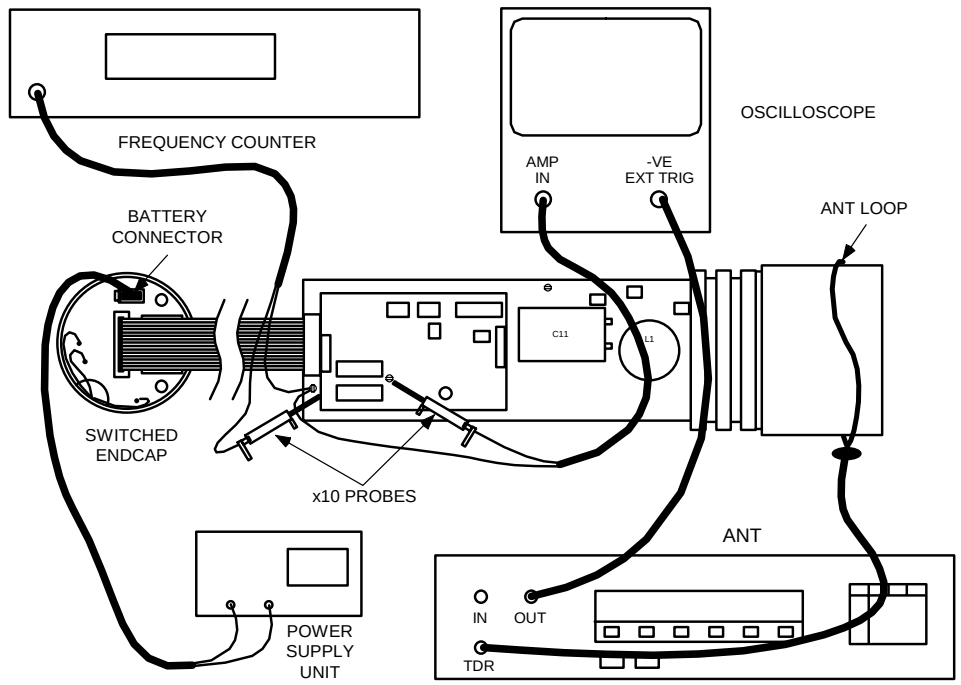
Using the Type MCIL5F test cable, connect the +24 V (pin 4 - red wire) to the PSU +ve output and the 0 V (pin 2 -black wire) to the PSU -ve output. Set the PSU voltage to 24 V and check the voltage on C16 again (as described in paragraph 5.3.1.2). This voltage should be approximately 23.4 V, and the circuit should be drawing a current of approximately 37 mA.

If less than 23.4 V, or zero, a fault on the lower board or connections via the endcap upper board is indicated.

5.3.2 Operational Checks - Transponder Mode

Change the test configuration to include the ANT as shown in Fig 5.3 which follows.

FIG 5.3 OPERATIONAL TEST CONFIGURATION



Switch the transponder to channel 33. Program the ANT to produce a continuous sequence of tone bursts at the 33 frequency (see Appendix C.1 - “TONE BURST SEQUENCE”). On pressing the START key, the ANT will produce the following sequence of interrogation signals:

- Tone burst 10 ms wide
- Frequency 23923Hz (channel 33)
- Amplitude 15 V p/p (0 dB attenuation)
- Repetition Rate 750 ms

Pressing the STOP key on the ANT at any time will stop the sequence. If programmed as described in Appendix C, the ANT will also produce a trigger output for the oscilloscope, referred to the start of the simulated burst. Connect the Trigger OUT terminal on the ANT to the trigger input of the oscilloscope and switch the oscilloscope to negative trigger. Tighten the coupling loop supplied with the ANT around the transducer endcap and connect the other end of the loop cable to the TDR output of the ANT. The position of the loop on the endcap may have to be adjusted during the following tests to achieve optimum coupling.

Use the oscilloscope to check the waveforms obtainable at the various points around the circuit described in the following paragraphs. Adjust the position of the ANT loop on the endcap if good coupling is not being achieved and output amplitudes are very small.

These checks should be carried out in the order given. Failure at any point will then indicate the source of the fault.

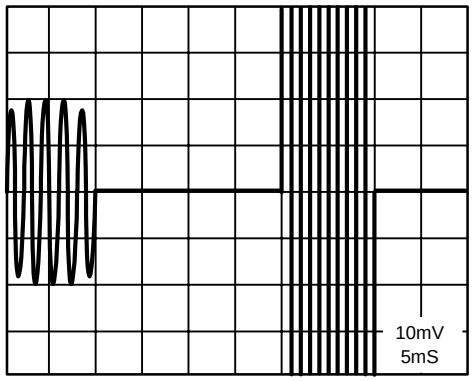
NOTE All of the oscilloscope screen sketches which follow ignore the scaling change which a x10 or x100 probe would cause.

5.3.2.1 Input Burst at Input Network

Using the x10 probe, monitor this waveform on the anode of diode D13 on the lower board. The waveform should resemble that given here as Fig 5.4. Both input and reply signals should appear here - the input one starting at 0 ms and the reply starting at approximately 30 ms. The input signal is the smaller of the two - at approximately 40 Mv P/P Amplitude. The reply signal, if present, should be at 1.2 V P/P (clipped).

If the input signal is not present, then either PL3/SK3 or the transducer assembly in the endcap is faulty. If the reply signal is not present, the result is inconclusive at this stage.

FIG 5.4 TRANSDUCER INPUT WAVEFORM

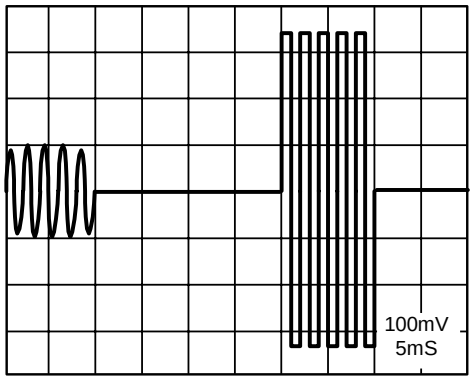


5.3.2.2 Pre-amplifier First Stage Output

This waveform may be monitored at TP2 on the lower board. It should resemble that given here as Fig 5.5. Again, both input and reply signals should appear here - the input one starting at 0 ms and the reply starting at approximately 30 ms. The signals are on a level of 2.5 V and >2 V in amplitude.

If the input signal is not present, then it is most likely that U15 or one or both of the long tailed pairs (Q10,11 & Q12,13) are faulty. There is a small possibility that the CPU board or connector SKT2 & 4 (or its mating connector) may be faulty instead and the easiest way of checking this is to change the upper board anyway and observe the result. Again, the absence or otherwise of the reply signal is inconclusive at this stage.

FIG 5.5 PRE-AMP 1ST STAGE WAVEFORM



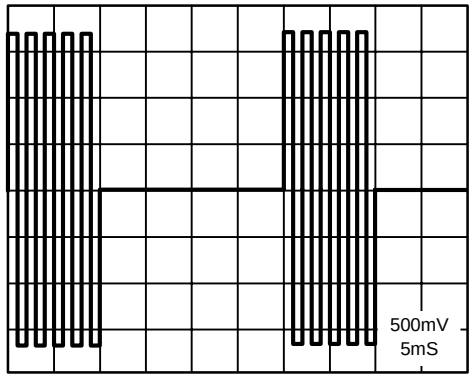
5.3.2.3 Squarer Stage Output

This waveform may be monitored at TP3 on the lower board. It should resemble that given here as Fig 5.6.

Again, both input and reply signals should appear here - the input one starting at 0 ms and the reply starting at approximately 30 ms. Both signals should have reached saturation level at the amplifier output - at an amplitude between >4.0 V p/p.

If the input signal is not present, then U13 or the upper board is faulty.

FIG 5.6 PRE-AMP 2ND STAGE WAVEFORM



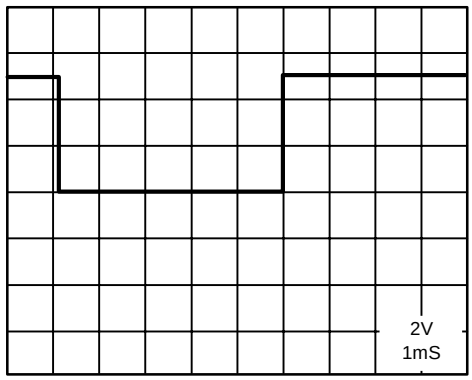
5.3.2.4 Envelope Detector Output

This waveform may be monitored at TP4 on the lower board (see Fig 5.2). It should resemble that given here as Fig 5.7.

If it does not, and assuming that the homodyne receiver circuit was found to be working correctly (paragraph 5.3.1.4), then the lower board is faulty.

If the waveform is substantially as shown, but the 1 ms threshold delay is not correct, this may be adjusted using RV1.

FIG 5.7 COMPARATOR O/P WAVEFORM



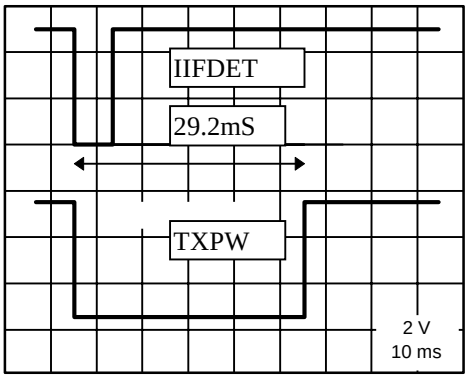
5.3.2.5 IIFDET and TXPW Output

Early CPU PCB. These waveforms may be monitored respectively on pins 12 & 13 of U4 on the upper board. It should resemble that given here as Fig 5.8. The time between the falling edge of IIFDET and the rising edge of TXPW should be 29.2 ms +/- 200 µs.

If it does not, then it is most likely that the upper board is faulty.

There is a small possibility that the lower board or PL4 (or its mating connector) is faulty and the easiest way of checking this is to change the lower board and observe the result.

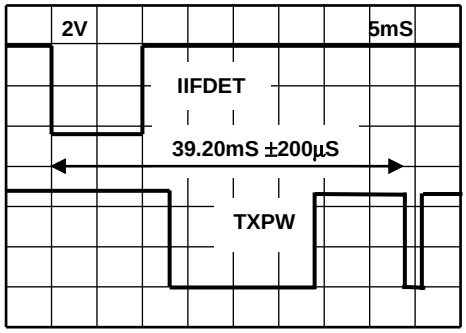
FIG 5.8 IIFDET AND TXPW WAVEFORM



Later CPU PCB. These waveforms may be monitored respectively on pins 12 & 13 of U4 on the upper board. It should resemble that given here as Fig 5.8. The time between the falling edge of IIFDET and the 2nd falling edge of TXPW should be 39.2 ms +/- 200 µs.

If it does not, then it is most likely that the upper board is faulty.

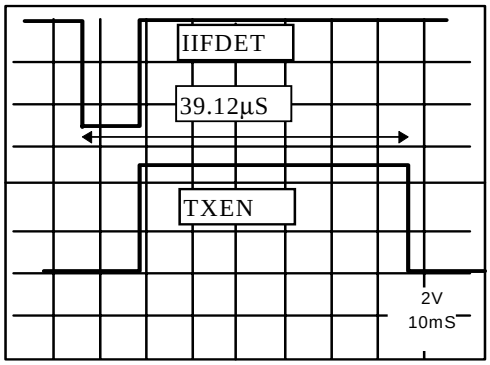
There is a small possibility that the lower board or PL4 (or its mating connector) is faulty and the easiest way of checking this is to change the lower board and observe the result.



5.3.2.6 IIFDET and TXEN Output

This waveform may be monitored respectively on pins 12 and 22 of U4 on the upper board (see Fig 5.2). It should resemble that given here as Fig 5.9. The time between the falling edge of IIFDET and the falling edge of TXEN should be 39.12 ms +/- 200 µs. If the waveform does not resemble Fig 5.9, then it is most likely that the upper board is faulty. There is a small possibility that the lower board or PL2 (or its mating connector) is faulty and the easiest way of checking this is to change the lower board and observe the result.

FIG 5.9 IIFDET AND TXEN WAVEFORM



NOTE: (See Appendix C.1 -"TONE BURST SEQUENCE")

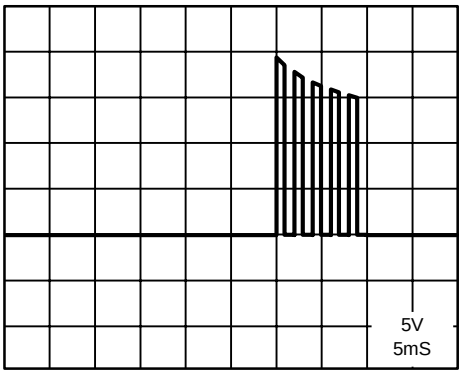
For a more accurate setting of turnaround delay use the ANT internal adjustable Trigger OUT delay to trigger the oscilloscope. Set the ANT Trigger OUT delay for 29.5 ms and the oscilloscope timebase to 0.2 ms/div giving a screen range of 29.5 ms - 31.5 ms.

5.3.2.7 Drive Amplifier Input

This waveform may be monitored on the Gates of Q4 and Q7 on the lower board. It should resemble that given here as Fig 5.10.

If it does not, then the lower board is faulty.

FIG 5.10 DRIVE AMP I/P WAVEFORM



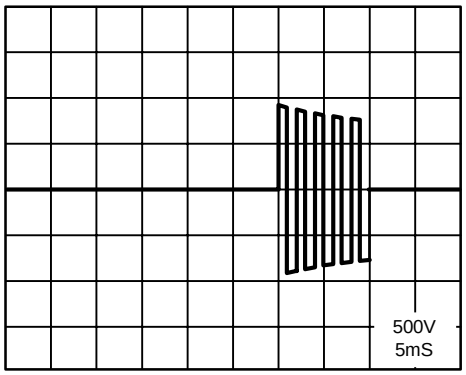
5.3.2.8 Drive Amplifier Output

This waveform may be monitored, using the x100 probe, on PL3 pin 3 on the lower board (as shown earlier on Fig 5.2). Note that the voltage is very high at this point (1800 V p/p). The waveform should resemble that given here as Fig 5.11.

If it does not, then the lower board is faulty.

If this waveform is present, it should be possible to hear the transducer "pinging" twice per second as it produces the reply burst. If there is no sign of transducer output then the transducer is faulty.

FIG 5.11 DRIVE AMP O/P WAVEFORM



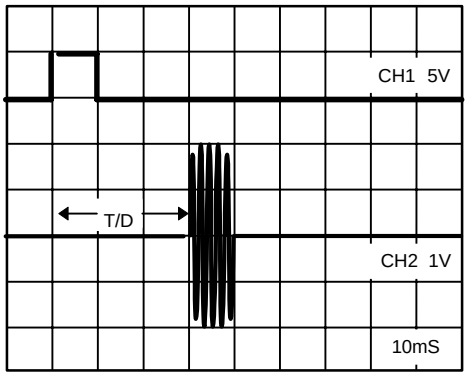
5.3.2.9 Responder Mode

Using test cable 1 apply a +ve going pulse to (black wire) wrt 0V (white wire) 5 V in amplitude with a duration of 10 ms and a repetition rate of 750 ms. (See Appendix C.2).

The 10 ms trigger waveform and a normal output waveform, as shown here on Fig 5.12, should be present. If the output waveform is not present, then the upper board is faulty.

If the waveform is present, repeat the test for the full range of channel selection switch settings.

FIG 5.12 O/P FROM COUPLING LOOP



If all test results are now satisfactory, re-assemble the transponder as described in Section 4.5.5 and proceed to the Acceptance Test.

5.4 ACCEPTANCE TEST

Carry out the sequence of tests described below. At the conclusion of each test, complete the Test Results sheet given at the end of this section.

5.4.1 Battery Off Load Voltage

On the TX Board, measure from D7 Cathode wrt TP0. This should be greater than 20 Volts on a fully charged unit..

5.4.2 Battery Trickle Charge Circuit Function

Make power supply connections to the transponder's external 5 pin connector using the MCIL5F test cable - charging input (green wire) to +24V; common (white wire) to 0V. Apply 24V supply via the test cable. Check that the correct 37 mA charging current flows and note the on-load voltage of the supply (nominally 20.5V, depending on the charge condition of the battery).

Assemble the Transponder for the remainder of tests.

5.4.3 Transponder Response

Connect the ANT TDR output to the transducer endcap using the coupling loop. Programme the ANT as described in Appendix C.3 - "CHANNEL STEPPED SEQUENCE". Select channel 01 and turn on the transponder.

Check for a VALID REPLY message and delay - 30.1 ms approximately. Switch the transponder to the next channel as soon as you have read the VALID REPLY message and re-program the ANT to the corresponding frequency (see Appendix D for a Table of Channel Frequencies).

5.4.4 Responder Response

Set up the test configuration and general procedure of paragraph 5.3.2.9 with the complete transponder and with the power supply left connected as in the previous test. Repeat the test for all channels.

5.4.5 Current Demand Test

Increase the supply current limit to maximum and observe that the current increases every time the transponder replies.

5.4.6 Trickle Charge Function

Remove the trigger pulse from the black wire and observe that the current drops back to a steady reading of approximately 37 mA with a fully charged battery, or higher if the battery is low.

Switch all off. Disconnect the test cable from the transponder. Fit a non-shorting dummy plug for long term storage.

COMPLETED ASSEMBLY ACCEPTANCE TEST

Type	7973	Unit Serial No. :	

5.4.1 Battery off load voltage _____ V

5.4.2 Battery Charge Circuit Function - 37 mA (typical) _____ mA

Supply voltage drops to 20.5 V (typical) _____ V

5.4.3 Transponder Response - all channels receive and reply correctly _____

5.4.4 Responder Response - all channels _____

5.4.5 Current Demand Test - input current pulse with transponder replying _____

5.4.6 Trickle Charge Function - 37 mA (typical) with charged battery _____

Fit rubber cover on connector _____

Tester ..... Date _____

SECTION 6

6. TECHNICAL SPECIFICATION FOR TYPE 7973

Frequency Channels	:	All HPR-300 Channels All HPR-400 Channels Sonardyne Frequencies. (see Appendix D)
Pulse Width	:	10 ms (4ms on Sonardyne Frequencies)
Battery Types	:	Nickel Metal Hydride rechargeable (Standard) Alkaline (Option)
Turnaround Delay	:	Replies 30 ms after arrival of interrogation pulse or responder trigger
Maximum Repetition Period	:	750 milli-seconds
Responder Trigger, voltage	:	Rising edge (from < +0.5 V to > +4 V) triggers transmission after 30 ms. Maximum input 24 V
Responder Trigger, pulse width	:	3 to 25 ms
Dimensions (Standard unit)	:	Length 401 mm Clamping Diameter 70 mm with protective sleeve Refer to dimension drawings (Section 2)
Dimensions (Remote Tdr)	:	Length 340 mm Clamping Diameter 70 mm with protective sleeve Refer to dimension drawings (Section 2)
Depth Rating, housing	:	1000 metres
Depth Sensor, Linearity	:	0.25% FSD typical
Weight in air	:	2.7 kg
Weight in water	:	1.4 kg
Mating Connector	:	Subconn MCIL5F
Transducer Type	:	Omni-Directional, ±120 degrees
TX Source Level 24V ext power Battery power	:	 190 dB//µPa.m (typical) 188 dB//µPa.m (typical)
TX Beam Pattern	:	±120 degrees
Rx Sensitivity	:	<100 dB//µPa

Battery Operation NiMH

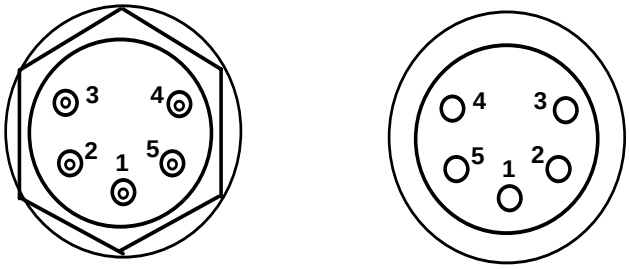
Quiescent Life,	42 Days
No of replies	50,000
Life (@ 1/sec rate)	14 hours
Charging time	2 hours using Sonardyne Charger Type 7972 (Temperature must be between 10 and 40 deg. C)

Battery Operation Alkaline

Quiescent Life,	90 Days
No of replies	100,000
Life (@ 1/sec rate)	30 hours

Externally Powered	:	Indefinite Life
External Power	:	Voltage: 24 V DC nominal, 28 V DC maximum
Requirement	:	Current: Average 100mA when transmitting 1 pulse/sec Maximum 5 Amp for 10 ms (voltage should not drop below 22.5 V)
External Connector	:	Subconn MCBH5M with special housing
Mating cable connector	:	Subconn MCIL5F

Pin Numbering



Bulkhead Cable

Connections	:	Pin 1	Trigger / Comms In
		Pin 2	0 V
		Pin 3	Charge / Comms Out
		Pin 4	External Power (24 V)
		Pin 5	ON / OFF (ON if connected to Pin 2)

APPENDIX A

A. SPARES LIST - 7973 TRANSPONDERS

Part No.	Dwg No	Description	QTY
LOWER ENDCAP			
641-0461	7973-006	Lower endcap assembly	1
631-4324	7970-037	Depth PCB assembly	1
317-2799		Connector Subconn MCBH5M AL/20	1
581-2271		Depth sensor Keller PA-20SR-200 bar	1
770-1749	7970-017	Pressure Relief Vent body	1
200-0081		Seal 'O' ring 200-008-5560 for pressure vent	2
200-8347		Seal 'O' ring 200-834-5560 for endcap	2
650-1354	7970-064	MCIL5F Dummy Plug with ON-link and locking sleeve	1
BATTERY			
641-0332	7970-002	Nickel Metal Hydride Battery pack	1
641-0842	7970-003	Alkaline Battery pack	1
TRANSDUCERS			
750-0869	7656-076	Transducer Guard	1
640-5365	7752-000	MF Omni Transducer	1
700-4344	7970-112	Transducer Endcap (bare)	1
700-4936	7973-024	Remote Transducer Endcap (bare, optional)	1
200-8347		Seal 'O' ring 200-834-5560 for endcap	2
200-1179		Transducer 'O' Ring 200-117-5560	2
620-6246	7995-003	Remote Transducer (optional)	1
PCBs			
631-4773	7970-035-02	Rx/Tx PCB	
631-4432	7970-036	CPU PCB	
631-6377	7970-043	CPU PCB (Later Version)	
631-4324	7970-037	Depth Endcap PCB	
850-8204	5550-020	Coil Assembly	
MECHANICAL PARTS			
710-2087	7970-023	Housing Super Sub-Mini	1
720-3034	7970-027	Chassis Plate	1
222-2500		SCREW-PH-SL-MSZP M2.5x5 (PCB to chassis)	6
230-175A		Washer crinkle B/CU M2.5 (PCB to chassis)	6
110-0487/ 185mm		RM nylon cord 3mm (housing/endcap retainer), 185 mm each	2
289-0133		Adhesive tape for housing seal protection Heavy duty PVC, 50 mm wide	1

Part No.	Dwg No	Description	QTY
CABLE OPTIONS			
820-5171	7970-054	ROV cable tail, 5 m, **with** ON-link and locking sleeve	1
820-5163	7970-053	ROV cable tail, 5 m, with locking sleeve but **without** ON-link	1
650-1354	7970-064	Dummy Connector with ON link	1
820-5084	7970-052	ROV Jumper Cable: 4-pin Brantner to 5-pin Subconn	1
BATTERY CHARGING / PC COMMS			
Early Systems:			
620-5386	7972-01A	Comms / Charger Unit	1
265-542B	---	DC Power Pack	1
317-5063	---	Power Pack AC cable, UK plug	1
317-5044	---	Power Pack AC cable, US plug	1
317-5057	---	Power Pack AC cable, European plug	1
280-4175	---	PC Cable	1
602-0145	---	Comms Charger Kit including: – Comms / Charger Unit – DC Power Pack – AC Cable (plug to be specified with order) – PC Cable	1
Later Systems:			
620-5644	7972-01C	Comms / Charger Unit	1
272-0026	---	DC Power Pack	1
272-0345	---	Power Pack AC cable, UK plug	1
272-036C	---	Power Pack AC cable, US plug	1
272-0352	---	Power Pack AC cable, European plug	1
280-4175	---	PC Cable	1
602-0223	---	Comms / Charger Kit including: – Comms / Charger Unit – DC Power Pack – AC Cable (plug to be specified with order) – PC Cable	

APPENDIX B

B. BATTERY CHARGING

Note : The safety precautions at the front of this manual **MUST** be read and understood before starting work on the disassembly of any subsea unit. Further safety information is included below. Take particular care of sections in bold text.

The following instructions apply to transponders fitted with Nickel Metal Hydride rechargeable batteries. Transponders fitted with Alkaline batteries cannot be recharged – see Appendix H for notes on alkaline batteries.

The Nickel Metal Hydride battery pack must only be charged with the Sonardyne Type 7972 charger. This provides a constant current charge of 1200 mA into pin 3 of the external connector. The current is controlled by electronics inside the transponder. When the battery nears a full charge the current is switched OFF.

A flat battery will charge for approximately 60 minutes at the full rate (The Fast Charge LED will illuminate). After that the charger will switch to Trickle Charge (38 mA into the External Power connection - pin 4 of the connector), with occasional pulses of the fast charge current. This will continue for approximately 30 minutes after which the unit will switch to Trickle Charge only.

B.1 CHARGING PROCEDURE

1. A pressure relief vent is provided to ensure there is no build-up of gas inside the transponder caused by the charging process. The battery manufacturer recommends that batteries are charged in an open environment. However, they also specify that no gas is vented by the batteries, providing the recommended charging procedures are followed. The Type 7973 includes special circuitry to monitor the battery pack during charging. This safety feature ensures that the battery cannot be overcharged. For this reason it is not deemed necessary to remove the safety vent during charging of a fully operational instrument.

   Should there be any reason to suspect that there is pressure inside the unit, or that the charging circuitry may be faulty, it is recommended that the pressure relief vent is extracted prior to charging. Use an M3 bolt to give purchase and carefully withdraw the vent plug.

   Keep well clear of the transponder endcap while withdrawing the vent and do not stand in line with the transponder axis. Toxic gasses or corrosive liquids may be forcibly expelled in the event of serious battery failure. There is a retaining device to prevent loss of the plug. Take care to avoid dirt contaminating the ‘O’ ring seals on the plug or entering the hole in the endcap.

2. Check that the temperature is between 10 and 40 degrees Celsius. The battery will not accept charge outside these limits.

3. Connect the Type 7972 to an AC power source using the power pack supplied. The power pack plugs into the charger via a 2.1mm power socket. The standard figure-of-eight power leads are available with UK, US or European plugs.

4. Check that the Fast Charge LED is illuminated.

5. When the battery is nearing full charge (approximately one hour for a flat battery) the Fast Charge LED will go out and the Trickle Charge LED will illuminate. Every few seconds the Fast Charge LED will illuminate briefly (the Trickle Charge LED will go out) as a pulse of high current is supplied to top-up the charge. This will continue for approximately 30 minutes.

6. When top-up is complete the Trickle Charge LED will remain illuminated continuously.

7. Remove the AC power from the Charger to terminate the charging process. **Do not re-connect until the battery has been used or left standing for at least 24 hours.**

8. Carefully push the pressure relief vent fully home so that it does not protrude from the endcap face.

The Fast Charge feature is controlled by electronics inside the transponder which monitors the voltage and *temperature* of the battery pack to decide when to stop charging. The parameters are first monitored some six minutes after connection so connecting the fast charger to a fully charged battery will allow the full charging current to flow for that length of time. **Repeatedly connecting the fast charger will reduce the life of the battery and may cause damage.**

If it is necessary in an emergency to charge the Type 7973 by means other than the Type 7972 dedicated charger, then the charge supply should be 24V at 100mA **constant current** for 16 hours maximum. Note that the charging time must be reduced if the battery pack has been charged recently.

Various components inside the transponder are designed to limit damage due to misconnection of the external signals. However, some damage to the electronic components may result. Under no circumstances should mains AC power be applied to the transponder.

Do not:

1. **Charge battery packs in any way other than that which is recommended. Failure to follow guidelines may result in a reduction of battery pack life, cause damage to the battery pack and may endanger operators.**

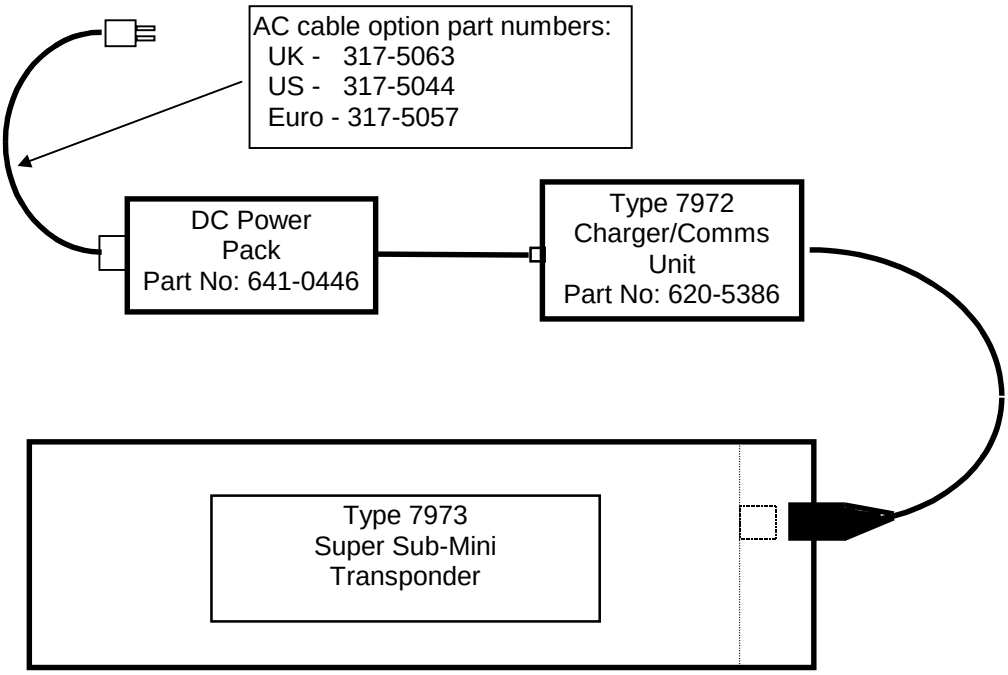
2. **Allow the Type 7973 transponder to be cooled or heated during the charging process because the over-current protection component characteristics may change adversely.**

3. **Fast charge/discharge the Type 7973 battery pack other than when using the Type 7972 charger.**

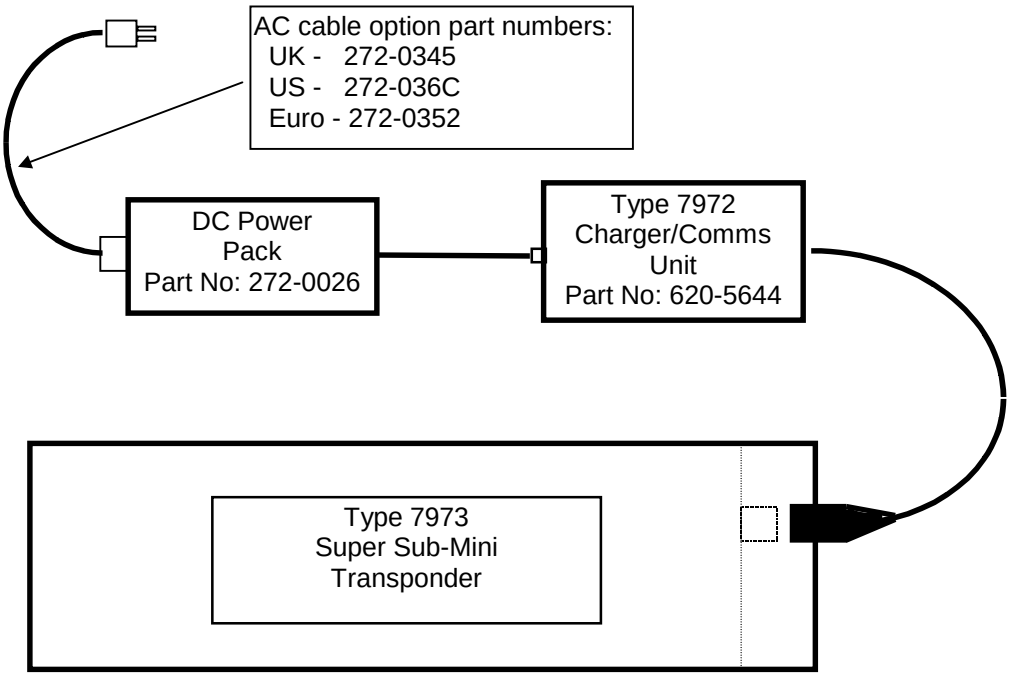
4. **Repeatedly connect the Fast Charger to the transponder when the battery is fully charged.**

The diagram below shows the two sets of charging equipment delivered with Type 7973 transponders. Note that the DC power packs are **NOT INTERCHANGEABLE** between the two systems.

Charger Connections: Earlier Systems (up to late 2000)



Charger Connections: Later Systems (from late 2000)



APPENDIX C

C. PROGRAMMING THE ANT

This Appendix contains three ANT programming procedures:-

- TONE BURST SEQUENCE. For producing a continuous sequence of tone bursts at a repetition period of 750ms. This is useful during diagnostic testing.
- RESPONDER TRIGGER SEQUENCE. For producing a continuous sequence of "responder only" trigger outputs, again at a repetition period of 750ms. This enables the transponder's response to an electrical trigger input to be checked.
- CHANNEL STEPPED SEQUENCE. For producing a single output burst at a frequency which can be programmed. This enables transponder response over the full range of selectable frequencies to be checked.

C.1 TONE BURST SEQUENCE

Switch the ANT OFF, then ON, and key in the following sequence of commands on the ANT keypad (square brackets [] indicate keypad keys):-

[ON]	
[2]	PULSE
[2]	SET
[2]	FREQ
[2] [3] [9] [8] [1]	interrogation frequency for channel 33
[ENTER]	
[4]	PW - pulse width set - in ms
[1] [0] [ENTER]	
[5]	TRIG
[2]	SET TRIG IN
[2]	REP PERIOD - in ms
[7] [5] [0] [ENTER]	
[1]	EXIT
[3]	SET TRIG OUT
[2]	PULSE WIDTH - in ms
[1] [ENTER]	
[3]	O/P DELAY - in ms
[0] [ENTER]	
[1]	EXIT
[1]	EXIT
[1]	EXIT
[5]	START
[6]	STOP

NOTE

For section 5.3.2.6, when a delay of 29.5ms is required for the 'scope trigger, the O/P DELAY - in ms - can be entered instead of the 0 at this point. Be sure to remove this delay when no longer required, however.

C.2 RESPONDER TRIGGER SEQUENCE

Switch the ANT OFF, then ON, and key in the following sequence of commands on the ANT keypad (square brackets [] indicate keypad keys):-

- [ON]
- [2] PULSE
- [2] SET
- [2] FREQ
- [2] [3] [9] [8] [1] interrogation frequency for channel 33
- [ENTER]
- [4] PW - pulse width set - in ms
- [1] [0] [ENTER]
- [5] TRIG
- [2] SET TRIG IN
- [2] REP PERIOD - in ms
- [7] [5] [0] [ENTER]
- [1] EXIT
- [1] EXIT
- [1] EXIT
- [5] START
- [6] STOP

The ANT TRIGGER OUT signal will now produce a negative going pulse of 10ms duration, every 750ms. The transponder will trigger off the positive edge.

C.3 CHANNEL STEPPED SEQUENCE

Switch the ANT OFF, then ON, and key in the following sequence of commands on the ANT keypad (square brackets [] indicate keypad keys):-

- [ON]
- [3] MULTI
- [3] OLD PAN
- [2] INTERROGATE
- [2] SET
- [2] TX INT'G'N
- [6] MF
- [2] CHAN
- [H] [1] where [H] is either of the blank keys on the keypad, followed by a channel number - [1] in this case
- [ENTER]
- [1] EXIT
- [5] START

The ANT will then display (briefly): **INTERROGATING CHAN 1 (HPR TPDR)**

followed by (if working):- **VALID REPLY DETECTED AFTER 30.0 to 30.5ms**

or, (if not working):- **NO REPLY DETECTED, SELECT MENU OPTION**

To repeat test, key [5]

If working, switch transponder on to next channel, change ANT channel frequency to match, as follows, and repeat test:-

- [2] SET
- [2] TX INT'G'N
- [6] MF
- [2] CHAN
- [H] [2] or whichever channel number is required (see Appendix D)
- [ENTER]
- [1] EXIT
- [5] START
- [6] STOP

C.4 SELECTING CHARACTERS G-Z FROM THE ANT FRONT PANEL

To select a letter in the range G-Z from the Ant front panel, the **Down** and **Up** arrow keys (8 & 9) are used until the desired letter is displayed. Key **7** is then used to lock the letter. Once a valid command is entered, keys 7, 8, & 9 revert to being numeric keys. Keys 8 & 9 do not sound the bleeper.

APPENDIX D

D. FREQUENCY TABLES

D.1 HPR – 300 FREQUENCY TABLE

ANT CHANNEL REFERENCE	HPR CHANNEL REFERENCE	INTERROGATION FREQUENCY Hz	REPLY FREQUENCY Hz
H1	01	20492	29762
H2	02	21552	30488
H3	03	22124	31250
H4	04	22727	31847
H5	05	23364	32468
H6	06	24038	27173
H7	07	24510	27777
H8	08	25000	28409
H9	09	26042	29070
H10	11 (□ - Square)	21552	27173
H11	22 (O - Circle)	22727	28409
H12	33 (Δ - Delta)	23923	29762
H13	44 (X)	25126	31250
H14	55 (Y)	26455	32468

Note: The ANT key for “H” is either of the two blank keys situated in the top right hand corner of the ANT keypad.

D.1.1 HPR - 400 Frequency Table

Chan	First Rx Freq.	Second Rx Freq	First Reply Freq.	Chan.	First Rx Freq.	Second Rx Freq	First Reply Freq.
B12	21000	21500	29250	B51	23000	21000	28750
B13	21000	22000	29750	B52	23000	21500	29250
B14	21000	22500	30250	B53	23000	22000	29750
B15	21000	23000	30750	B54	23000	22500	30250
B16	21000	23500	27250	B56	23000	23500	27250
B17	21000	24000	27750	B57	23000	24000	27750
B18	21000	24500	28250	B58	23000	24500	28250
B21	21500	21000	28500	B61	23500	21000	28500
B23	21500	22000	29500	B62	23500	21500	29000
B24	21500	22500	30000	B63	23500	22000	29500
B25	21500	23000	30500	B64	23500	22500	30000
B26	21500	23500	27000	B65	23500	23000	30500
B27	21500	24000	27500	B67	23500	24000	27500
B28	21500	24500	28000	B68	23500	24500	28000
B31	22000	21000	28750	B71	24000	21000	28750
B32	22000	21500	29250	B72	24000	21500	29250
B34	22000	22500	30250	B73	24000	22000	29750
B35	22000	23000	30750	B74	24000	22500	30250
B36	22000	23500	27250	B75	24000	23000	30750
B37	22000	24000	27750	B76	24000	23500	27250
B38	22000	24500	28250	B78	24000	24500	28250
B41	22500	21000	28500	B81	24500	21000	28500
B42	22500	21500	29000	B82	24500	21500	29000
B43	22500	22000	29500	B83	24500	22000	29500
B45	22500	23000	30500	B84	24500	22500	30000
B46	22500	23500	27000	B85	24500	23000	30500
B47	22500	24000	27500	B86	24500	23500	27000
B48	22500	24500	28000	B87	24500	24000	27500

D.1.2 Channel Select Switches

Digit 1→	0	1	2	3	4	5	6	7	8	9
Digit 2↓										
0	Note 1	X	X	X	X	X	X	X	X	X
1	H01	H11	B21	B31	B41	B51	B61	B71	B81	X
2	H02	B12	H22	B32	B42	B52	B62	B72	B82	X
3	H03	B13	B23	H33	B43	B53	B63	B73	B83	X
4	H04	B14	B24	B34	H44	B54	B64	B74	B84	X
5	H05	B15	B25	B35	B45	H55	B65	B75	B85	X
6	H06	B16	B26	B36	B46	B56	X	B76	B86	X
7	H07	B17	B27	B37	B47	B57	B67	X	B87	X
8	H08	B18	B28	B38	B48	B58	B68	B78	X	X
9	H09	X	X	X	X	X	X	X	X	X

Note: The Transponder will default to Channel 1 after a maximum time of 2 minutes.

D.1.3 Sonardyne Frequency Interrogations

The following interrogation and reply channels can be selected to use Sonardyne frequency channels. These use shorter pulses and will more than double the number of reply pulses available from a single battery charge. All Sonardyne transceivers can interrogate on these channels which are compatible with the Sonardyne family of underwater navigation and positioning systems.

If a depth reply is selected, the SSM will reply on a special additional frequency which will not overlap other Sonardyne channel signals.

N.B. CIF = Common Interrogation Frequency

SSM channel	Sonardyne Interrogation Channel	Sonardyne Reply Channel
90	CIF	0
91	CIF	1
92	CIF	2
93	CIF	3
94	CIF	4
95	CIF	5
96	CIF	6
97	CIF	7
98	CIF	8
89	CIF	9
10	CIF	10
19	CIF	11
29	CIF	12
39	CIF	13
49	CIF	14
20	1	2
30	1	3
40	1	4
70	1	7
80	7	8
60	7	11
66	7	12
69	7	13
50	14	8
59	14	11
77	14	12
79	14	13

D.1.4 AODC channels

SSM is able to act as an AODC emergency beacon on either of the two defined channels in the table below. A depth reply will not be actioned on these channels even if selected.

SSM channel	AODC Channel
88	A
99	B

APPENDIX E

E. TEST SOFTWARE (V1.09)

E.1 TEST SOFTWARE - GENERAL

Sonardyne provides software to run on a PC to assist with Test and Calibration checks of the following Transponders:

- Type 7970 Super Sub-Mini Transponder - Omni-directional transducer
- Type 7973 Super Sub-Mini Transponder - Directional transducer
- Type 7971 PGT - Programmable Generic Transponder - Omni-directional transducer
- Type 7977 PGT - Programmable Generic Transponder - Directional transducer
- Type 7978 PGT - Programmable Generic Transponder - Super-directional transducer

The program is named WINSSM and is supplied on a CD or Floppy Discs.

Using the software implies acceptance of Sonardyne's standard software licence agreement. A copy is included at the end of this section.

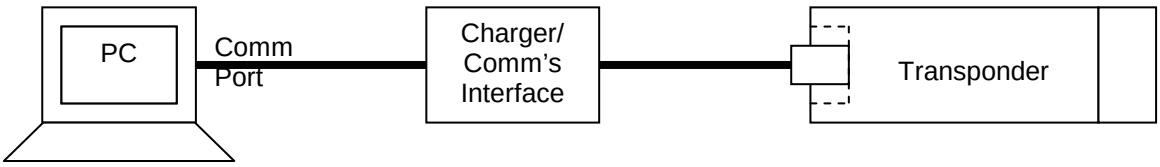
The program will run under Windows 95 or later.

E.2 SOFTWARE INSTALLATION

1. Insert the CD or Floppy Disc 1.
2. Access **My Computer** or **Windows Explorer**.
3. Access the drive containing the software.
4. Run **Setup.exe**.
5. During the setup process, a message may appear advising that a file being copied is older than on the host system. Click **Yes** to keep the newer version.
6. If the default setup locations were accepted, then the program can be run from **Programs**, **Sonardyne**, **Super Sub-Mini V1.0x** via the **Start** button.

E.3 ELECTRICAL CONNECTIONS

Connect the PC to the Transponder via the Type 7972 Charger/Comm's Interface as shown in the diagram below. **Ensure that the charger Power Pack is NOT connected** to the Charger/Comm's Interface, as this will inhibit the communication link.



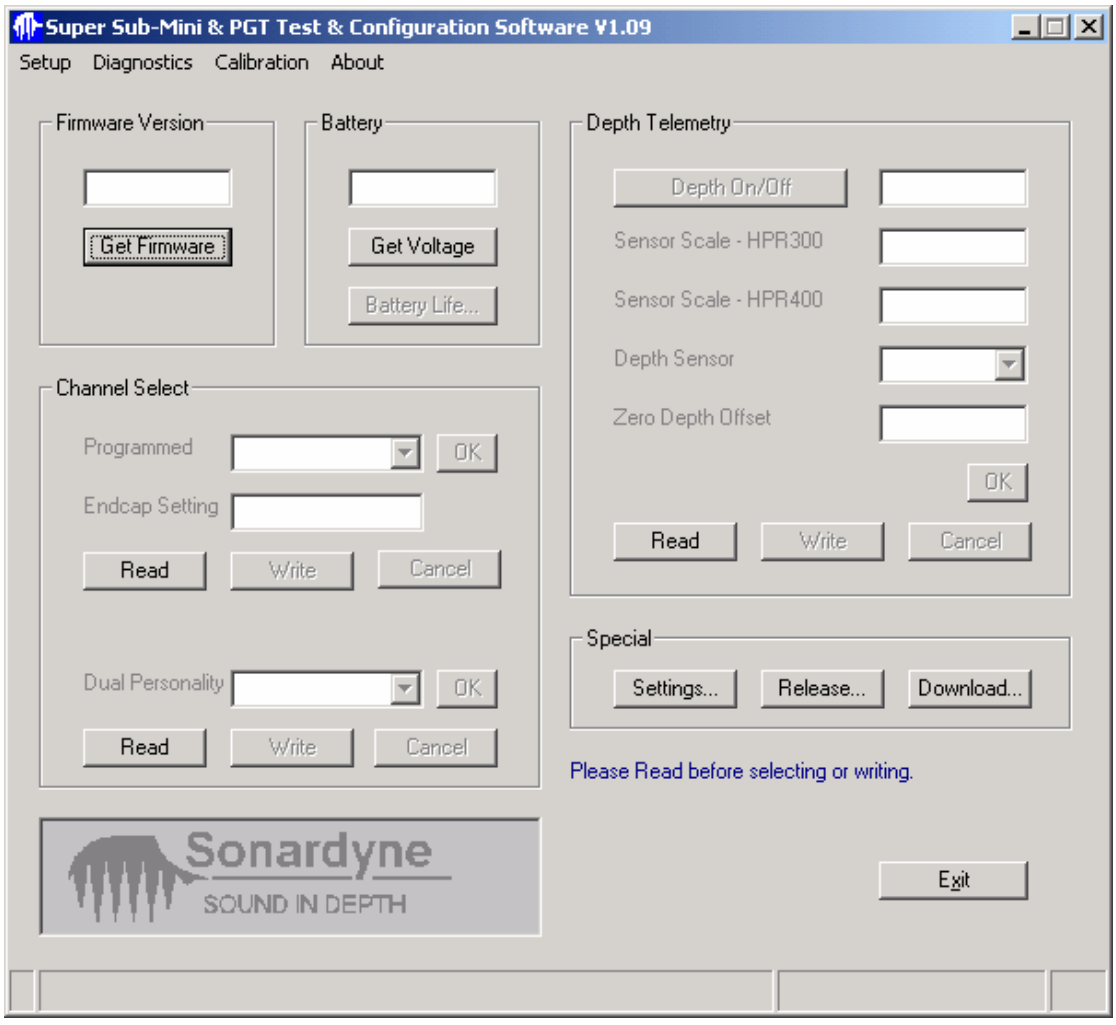
E.4 SOFTWARE OPERATION

Install the software as detailed in E.2 and connect the Transponder to the PC as detailed in E.3.

E.4.1 Running the software

If the default setup locations were accepted during installation, then the program can be run from **Programs**, **Sonardyne**, **Super Sub-Mini V1.0x** via the **Start** button.

When run, the Main Form appears as shown below.

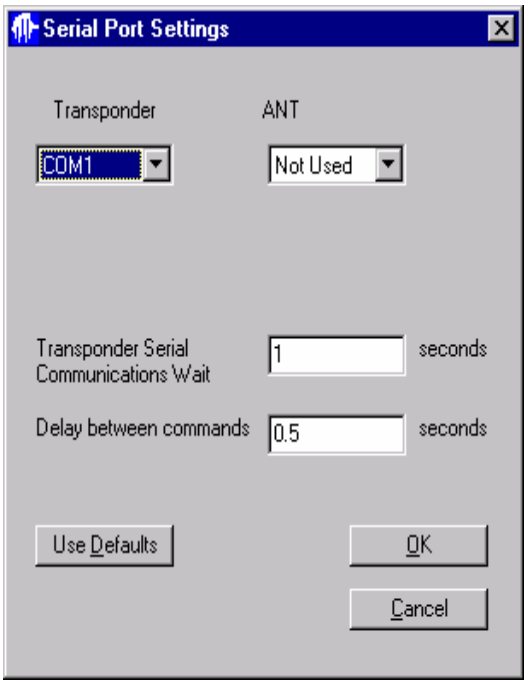


From here, every Transponder function can be accessed - even those not supported by the currently-selected Transponder's firmware. For these unsupported functions, the user will be notified if an attempt is made to access them.

For those functions with a **Write** command (e.g. Channel setting), the user is forced to operate the **Read** button first.

The **Write** button will be greyed before a **Read**, and immediately following a successful **Write**. It is only ever enabled following a **Read**, and when the user selects a parameter different to that just read.

E.4.2 Serial Port Settings.



Select the **Setup** menu option from the main form, and then **Serial Port Settings...** to display the window opposite.

Select the Transponder and ANT Comm Ports from the appropriate pull-down boxes (the ANT is used for diagnostic checks).

Transponder Serial Communications Wait is the maximum time allowed for the Transponder to reply to an RS232 command.

Delay between commands provides a delay between adjacent commands.

For example, when the Channel Selector is read, the software reads the Firmware Version followed by the Channel Selector. This delay time provides a short gap between such adjacent commands, and may need to be increased for fast PCs.

E.4.3 Firmware version

From the Main Form, pressing **Get Firmware** reads the Firmware Version of the currently-connected Transponder.

Every Transponder supports this function, and it therefore provides an ideal communications check between Transponder and PC.

If OK, a successful reply will display something like **V4.00P**.

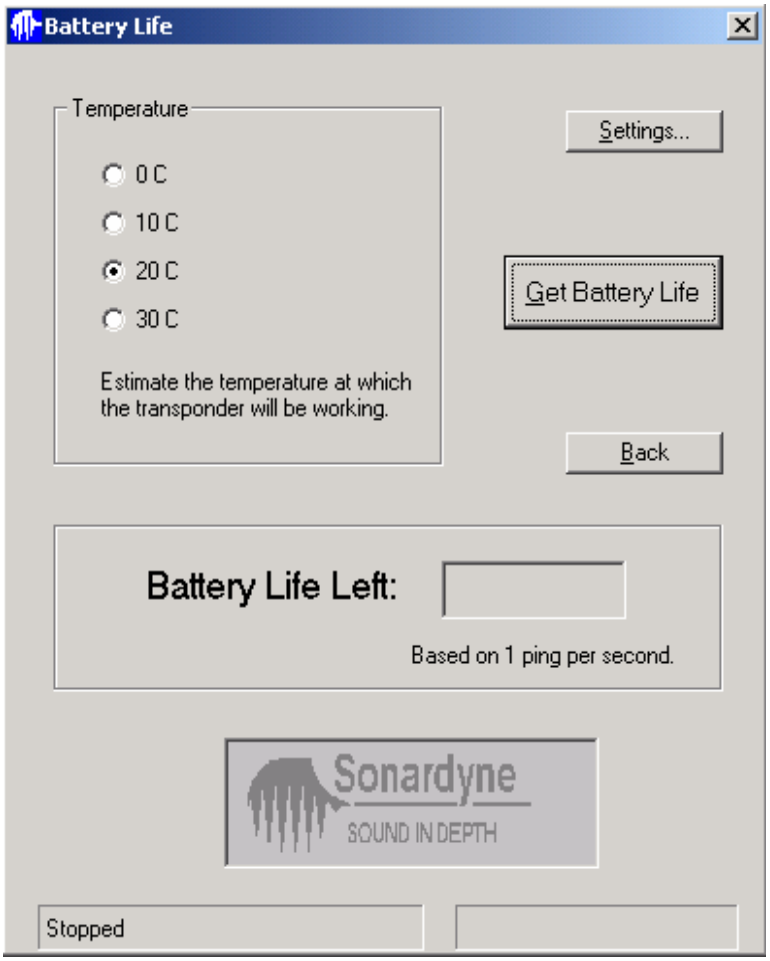
An unsuccessful attempt would produce a Message Box saying “No reply from Transponder”, and then display **Unrecognised**.

If unsuccessful, check the link between PC, 7972 Charger/Comm’s Interface, and Transponder, and check that the correct Comm Port has been set, by selecting the **Setup | Serial Port Settings...** menu option (see Section E.4.2).

E.4.4 Battery Voltage

From the Main Form, selecting **Get Voltage** reads the battery voltage (in Volts) if supported by firmware.

From the Main Form, selecting **Battery Life** displays the following window:



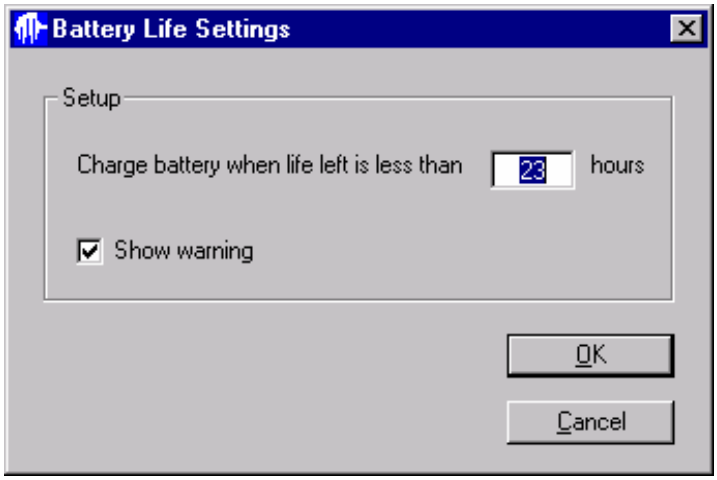
Important Note

- Due to the nature of the battery, it is difficult to accurately predict the remaining capacity, temperature and age both having an impact
- The **Battery Life Left** should therefore be regarded very much as an approximation only.

Pressing **Get Battery Life** does the following:

1. "Pings" the Transponder three times in succession.
2. Reads the battery voltage if the Transponder firmware allows.
3. Displays the Life Left, based on a look-up table in software.

At the bottom of the window, either “Charge Battery!” or “No need to charge” will be displayed, according to the setting in the **Battery Life Settings** window, accessed by pressing **Settings...**.



The “Charge Battery!” or “No need to charge” message on the previous window will not be displayed if **Show Warning** is unchecked.

E.4.5 Channel Select

The Transponder is capable of supporting two types of Channel:

- Normal HPR300 & HPR400.
- Dual Personality channels.

Normal HPR300 & HPR400 channels respond to an HPR300/400 interrogation with a corresponding reply.

The Dual Personality channel is often chosen to be an HPR300 channel (although it can be an HPR400), but the channel referenced is that displayed in the **Dual Personality** box.

Important Note 1

- The Dual Personality channel is only applicable if the Transponder has received a CCF pulse.
- Continuous interrogations will keep the Dual Personality channel active; otherwise the Transponder will revert back to its Normal channel after a maximum time of 2 minutes.

Important Note 2

- If Normal HPR300 or HPR400 Channels are required, it may be prudent to set the Dual Personality channel to **Not Set**.
- If set to a channel, then the first reception of a CCF will switch the Normal channel off, and the Dual Personality channel on (e.g. talking to a Compatt would do this).

E.4.6 Programmed / Endcap setting

The Normal HPR300/400 channel is updated either by:

- Setting the Endcap Channel Selectors, or
- Sending an RS232 command via the 7972 Charger Interface.

Pressing **Read** under the **Endcap Setting** box, does the following:

- Reads the firmware version.
- For older versions, only the Endcap Setting is read, and then displayed.
- For newer versions, both Endcap Setting, and Programmed channel is read, and then displayed.

Endcap Setting will display permanently 00 if the Transponder is not fitted with Channel Selection switches on the Endcap. Otherwise it will reflect the channel set by the Endcap Channel Selectors.

The Programmed channel is the channel currently held in the Transponder's EEPROM, which can be read to or written from via RS232.

Following the first read cycle, the Programmed window pull-down menu is accessible. This menu contains all channels available for programming the Transponder.

Pressing **Write** (following a **Read** and a change of parameter) does the following:

- Writes the Programmed channel to EEPROM, if firmware version allows.
- Endcap Setting is read-only.

Note the following points:

1. If the Channel Selectors are set to "00", then writing a Programmed channel sets the Transponder to that channel indefinitely.
2. If the Channel Selectors are set to "00", the Transponder will default to Channel 1 two minutes after power-up, providing a Programmed channel is not written.
3. If the Channel Selectors are set to anything other than "00", then writing a Programmed channel sets the Transponder to that channel for a maximum of 2 minutes. The Channel Number would then default to the Channel Selector setting.

E.4.7 Dual Personality

Pressing **Read** under the **Dual Personality** box, does the following:

- Reads the firmware version.
- For older versions, the Dual Personality channel is not supported.
- For newer versions, the Dual Personality channel is read, and then displayed in the Dual Personality window

Following the first read cycle, the Dual Personality pull-down menu is accessible. This menu contains all channels available for programming the Transponder.

Pressing **Write** (following a **Read** and a change of parameter) does the following:

- Writes the Dual Personality channel to EEPROM, if firmware version allows.

E.4.8 Depth Telemetry

- For all Depth Options, following a **Read**, select the appropriate parameter, change if required, select **OK,** and then **Write** to configure the Transponder.

E.4.9 Depth On / Off

Selecting **Depth On/Off** toggles the Depth On & Off.

Transponders fitted with a Depth Sensor can be instructed to send depth information at each interrogation.

When set to **ON**, the Transponder transmits a reply signal to each interrogation as normal, plus a second signal on a different frequency at a later time. The time difference between the two transmission signals is dependent on the depth measured by the sensor in the Bottom Endcap.

When **OFF**, the Transponder transmits only a single reply signal to each interrogation.

Note 1: When the Depth option is changed, Transponders fitted with Firmware Version 1.05 or earlier must be turned off, then turned on again, for the new option to take effect. Alternatively, wait up to 2 minutes for the Watchdog Interrupt to set-up the unit.

Transponders fitted with Firmware Versions 1.06 onwards apply the new option immediately.

Note 2: It is prudent to turn Depth OFF to preserve battery life when not required.

Depth / Status On / Off

Some firmware versions support an additional option: **Status**, indicated on the push-button as **Depth/Status On/Off**.

In this case, the operator can select either: **Depth On**, **Status ON**, or **OFF** (both Depth and Status OFF).

Selecting **Depth ON** works identically to that described in E.4.6.1.

Selecting **Status ON** will cause the Transponder to request status information from an attached package when appropriately acoustically interrogated. The data will then be encoded by the Transponder as pulse position telemetry and transmitted to the surface.

E.4.10 Sensor Scale – HPR300

Sensor Scale for HPR300 channels cannot be changed – it is fixed at 0.5ms/m.

Time difference is given as 125ms + (Sensor Scale x depth in metres)

where Sensor Scale = 0.5ms/m.

For example, for a depth of 100m would cause a difference of 50ms, plus a constant 125ms turn-around-time.

E.4.11 Sensor Scale – HPR400

Sensor Scale for HPR400 channels can be changed, but default to 1ms/m.

Time difference is given as 125ms + (Sensor Scale x depth in metres)

For example, for a depth of 100m would cause a difference of 100ms, plus a constant 125ms turn-around-time.

The maximum resolution (or max Sensor Scale) for the three Depth Sensors is:

- 1000m 2.48 ms/m
- 2000m 1.24 ms/m
- 4000m 1.00 ms/m
- 6000m 0.4 ms/m

E.4.12 Depth Sensor

Allows the Operator to select the Depth Sensor fitted to the Transponder (if one is fitted). The options are:

- 1000m
- 2000m
- 4000m
- 6000m

To avoid accidental overwriting, a password is required prior to writing if the value is different to that previously read.

The password is **super** (note lower case).

E.4.13 Zero Depth Offset

Typically in the region of 0 to 5, this value represents the number of counts on an internal Analogue-to-Digital converter with the Transponder at zero depth (atmospheric pressure).

Note: This value is usually set in the factory and is never changed.

To avoid accidental overwriting, a password is required prior to writing if the value is different to that previously read.

The password is **super** (note lower case).

E.4.14 Special

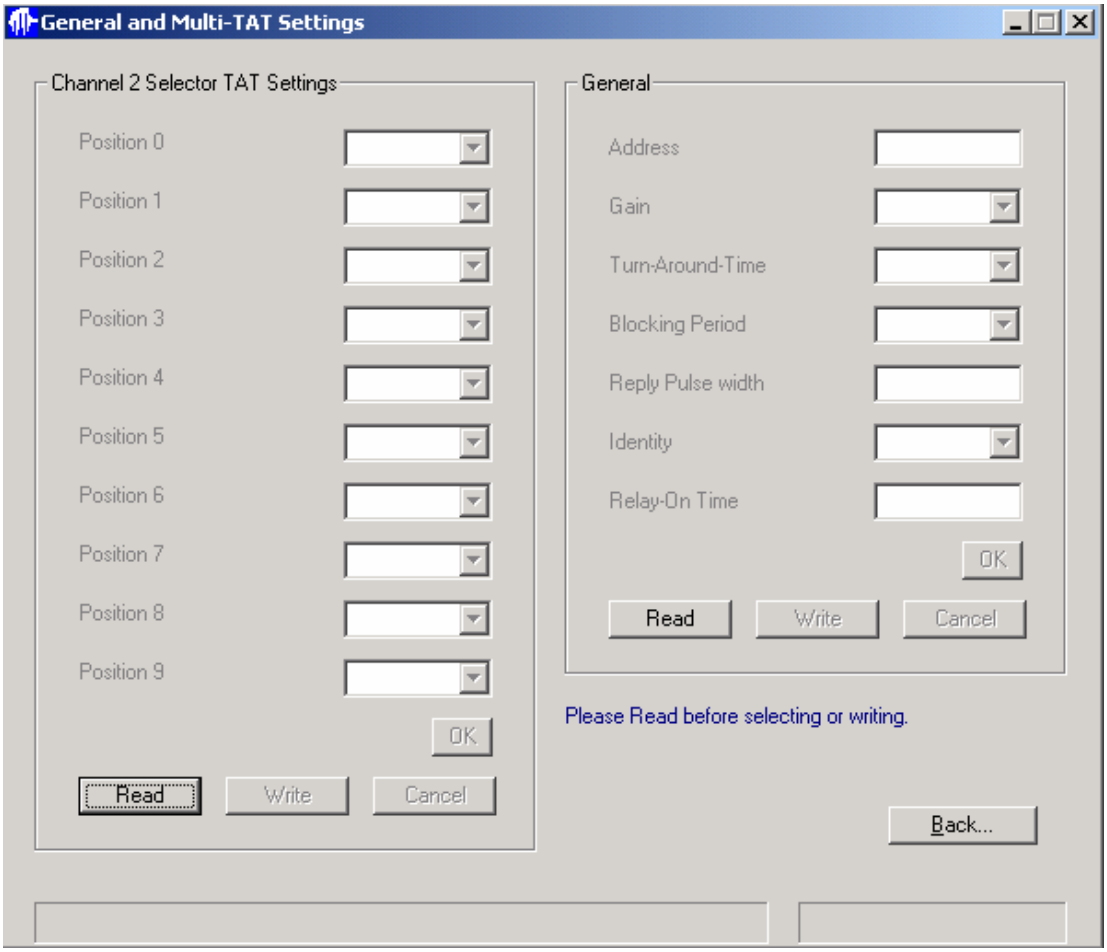
This comprises the **Settings...**, **Release...**, and **Download…** options.

E.4.15 General Settings

From the **Main Menu** select **Settings...**

The Transponder can be configured with Compatt-type commands when fitted with certain firmware versions.

When pressed, the following screen is displayed:



Pressing **Read** reads the Firmware Version, followed by all the General parameters.

Following a Read, any parameter can be changed, and then Written.

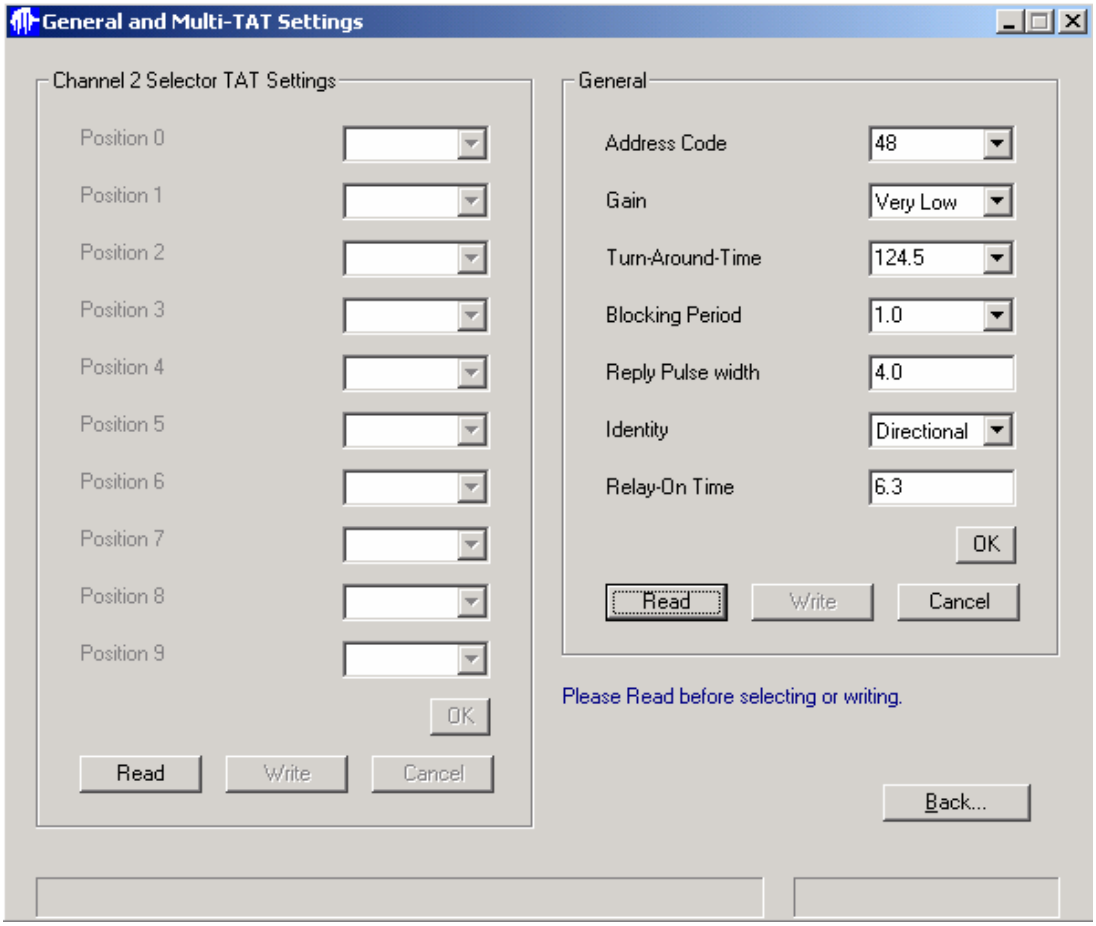
Note that only those parameters that have been changed will be written.

Note that the **Address** is a 3 or 4 digit representation of **Address Code** and **Channel Code**,

where the first 1 or 2 digits represent the **Address Code**,
and the last 2 digits the **Channel Code**.

Earlier firmware versions do not recognise this “combined” **Address**, and accept only **Address Code**.

An example of this is shown below.



E.4.16 Channel 2 Selector TAT Settings

From the **Main Menu** select **Settings...**

Press **Read** to read the Firmware Version, then all ten Turn-Around-Times (TATs) associated with Endcap Channel Selector 2.

This option is only supported by a limited number of firmware versions, and allows the Transponder to store ten TATs to correspond to Channel Selector 2.

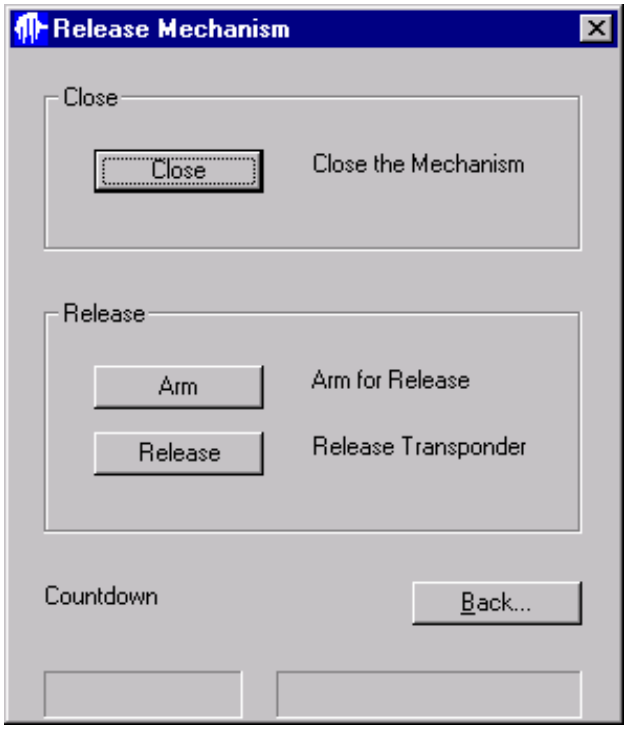
Note also that for these firmware versions, the Endcap Channel and Programmed Channel are not normal HPR30/400 types, but correspond to Sonardyne channels as follows:

- Channel Selector 1: Interrogation Channel
- Channel Selector 2: Reply Channel

E.4.17 Release

From the **Main Menu** select **Release...**

- **Note that this option is not fitted to Types 7970 or 7973 Super Sub-Mini Transponders, and is an option on PGT Transponders.**



- Press **Close** to screw the block onto the Transponder.
- Press **Arm** to prime the Release.
- Press **Release** within 10 seconds of Arm to release the block/shackle.

Note that the operator has the authority to over-ride if the Transponder reports an unsupported firmware version.

E.4.18 Download Firmware

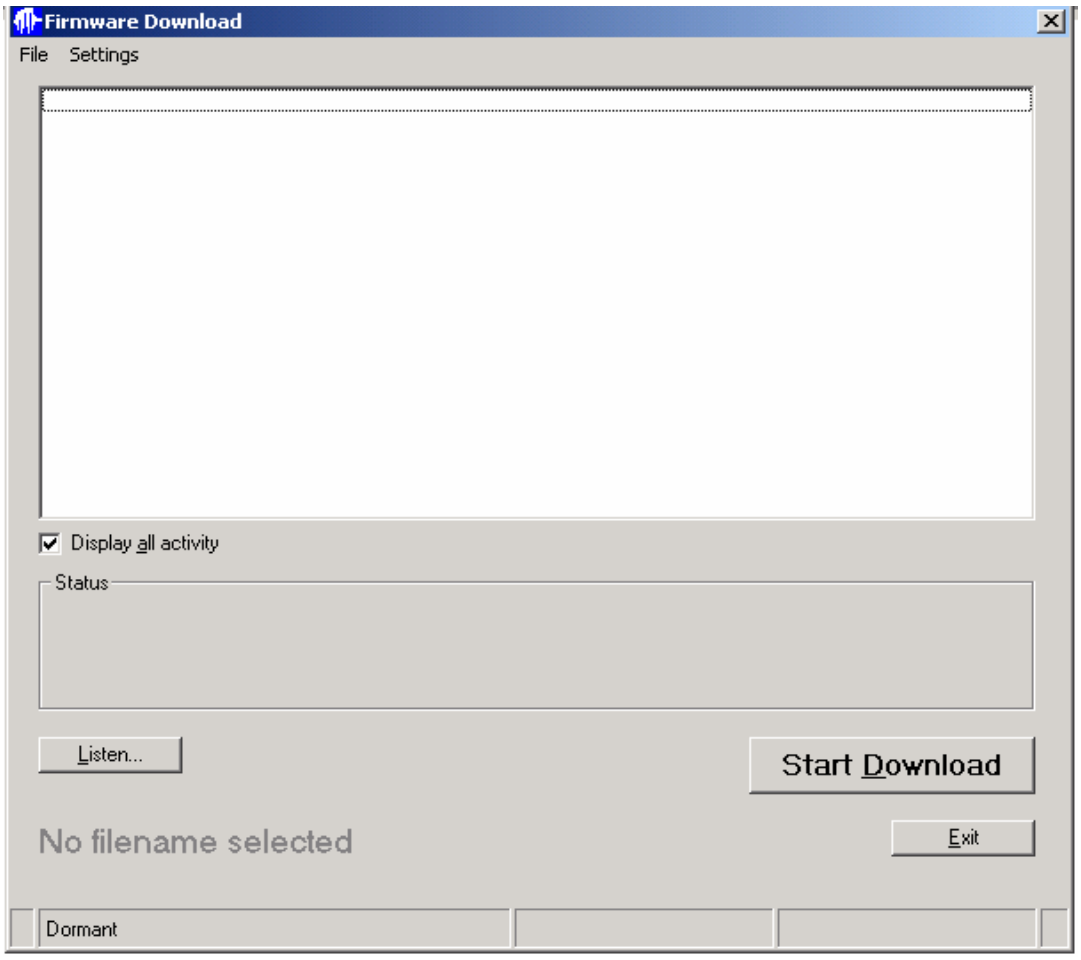
From the **Main Menu** select **Download...**

Transponders fitted with Firmware Version 3.00S (and later) or V2.00P (and later) are capable of accepting firmware upgrades from a PC, via the Type 7972 Charger/Interface, thus eliminating the need to dismantle the Transponder

When **Download…** is selected, the following password-prompt screen is displayed:

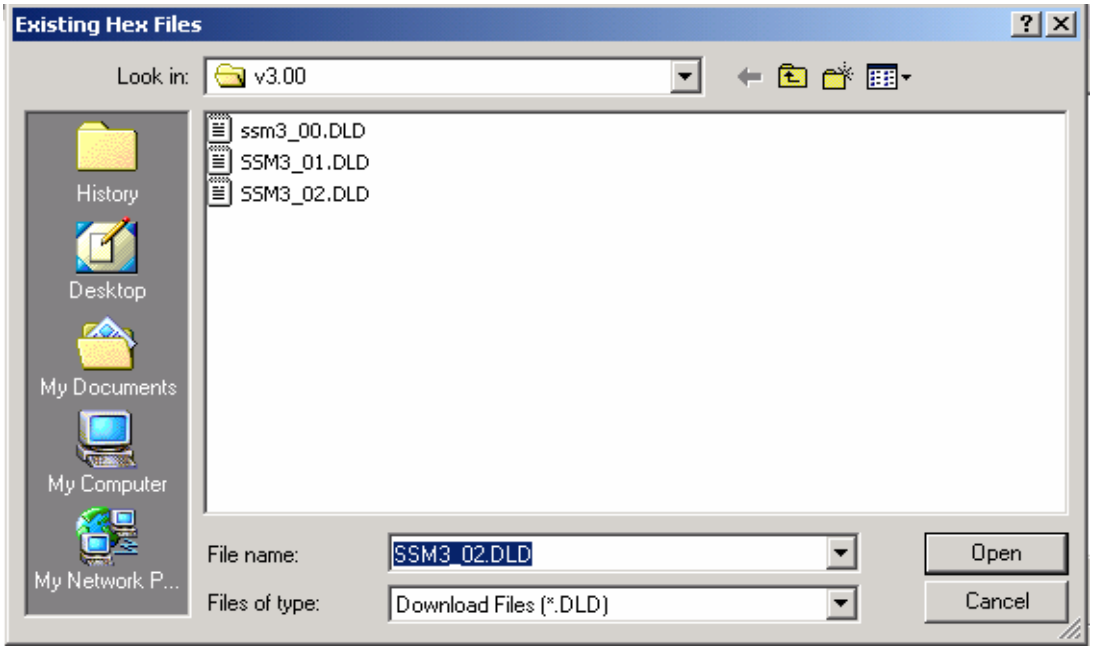
The password is “super” (note lower case).

Then the **Firmware Download** screen…



Selecting the Firmware to Download

- Select the **File** option from the Menu bar, and choose the appropriate **.DLD** file.



When the Download file has been selected, it is reflected on the **Firmware Download** screen.

- Note that a Download file must be selected before attempting to download.

Download Settings

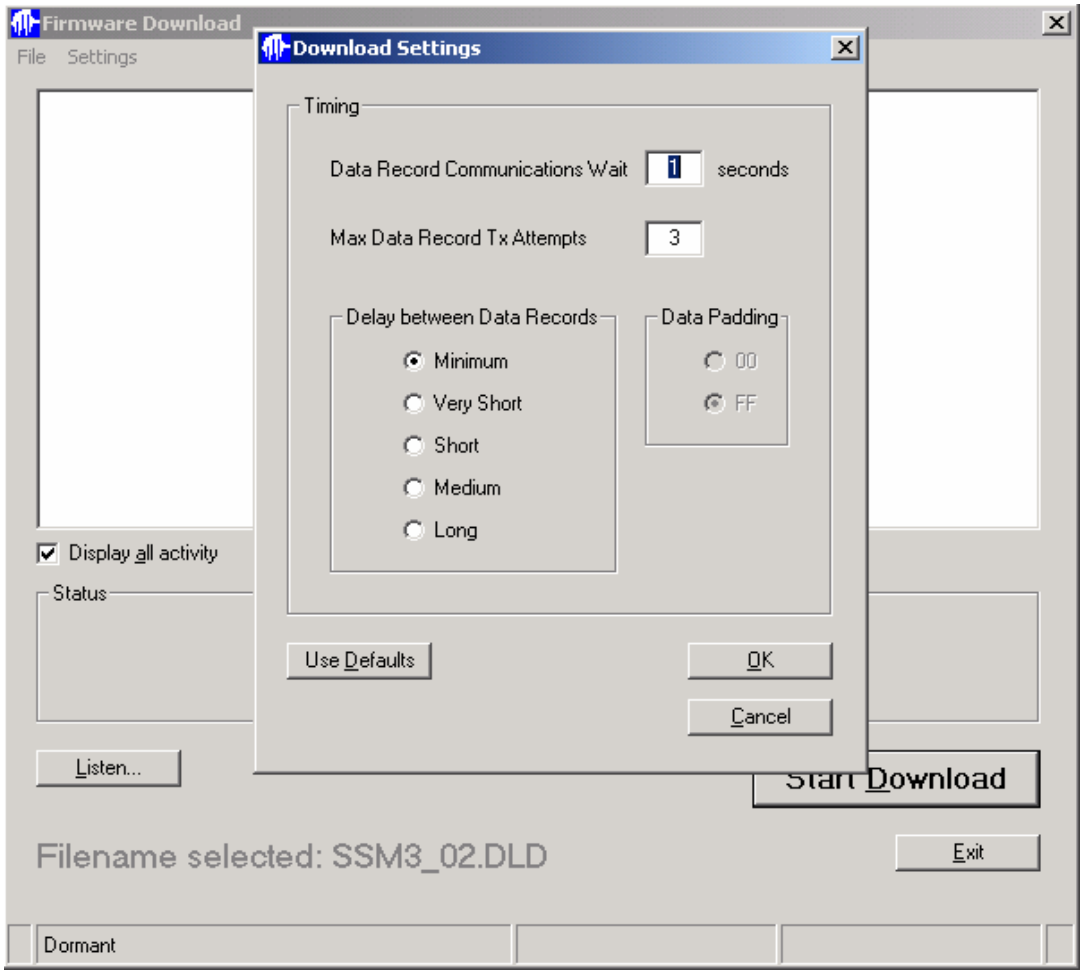
- Select the **Settings** option from the Menu bar, and choose the appropriate Download settings.

Data Record Communications Wait is the maximum time the software waits for a Transponder reply following transmission of each line of code.

Max Data Record Tx Attempts is the number of attempts the software makes to transmit (and receive a valid Transponder reply) to a line of code.

Delay between Data Records is the time between transmission of lines of code, in order to cater for different PC speeds.

The **Use Defaults** button resets all parameters to those shown below.

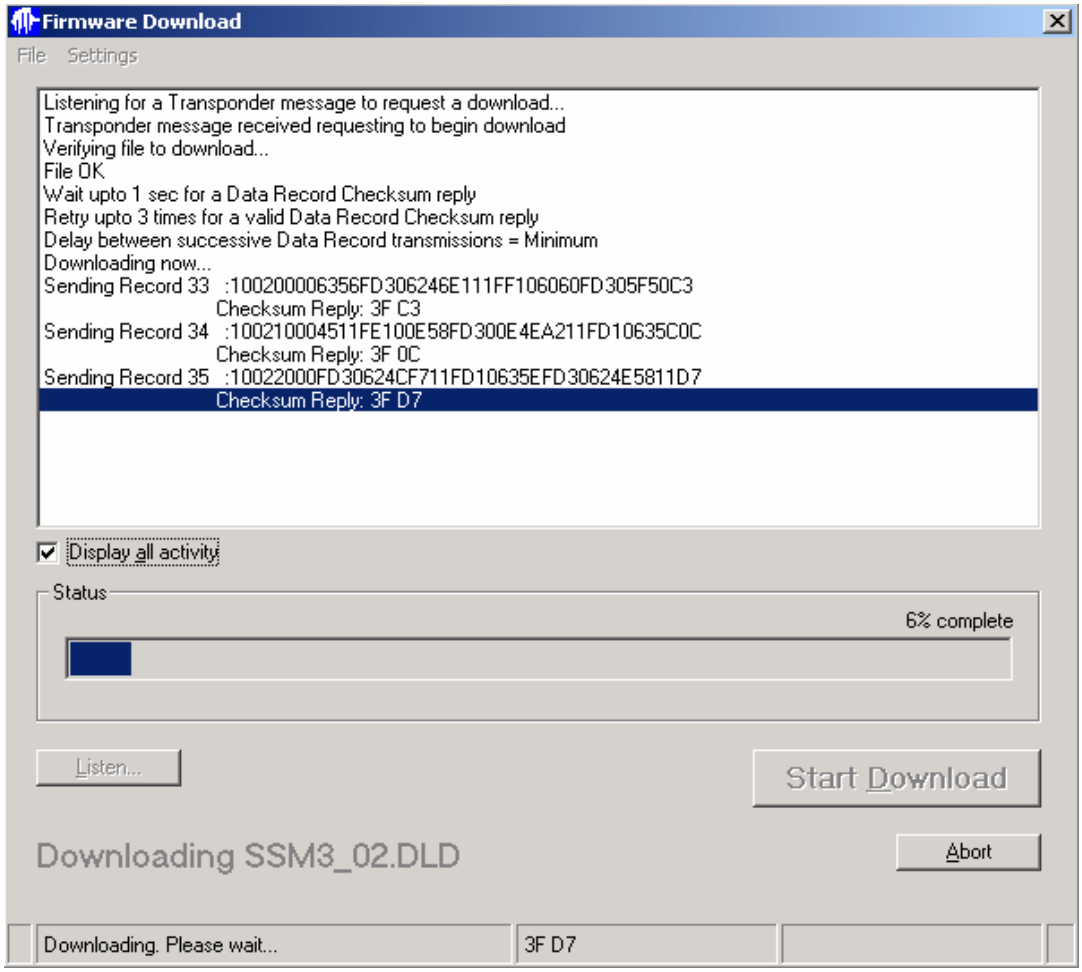


Downloading

With a **.DLD** filename selected, and Download Settings confirmed, press **Start Download** to begin the firmware download.

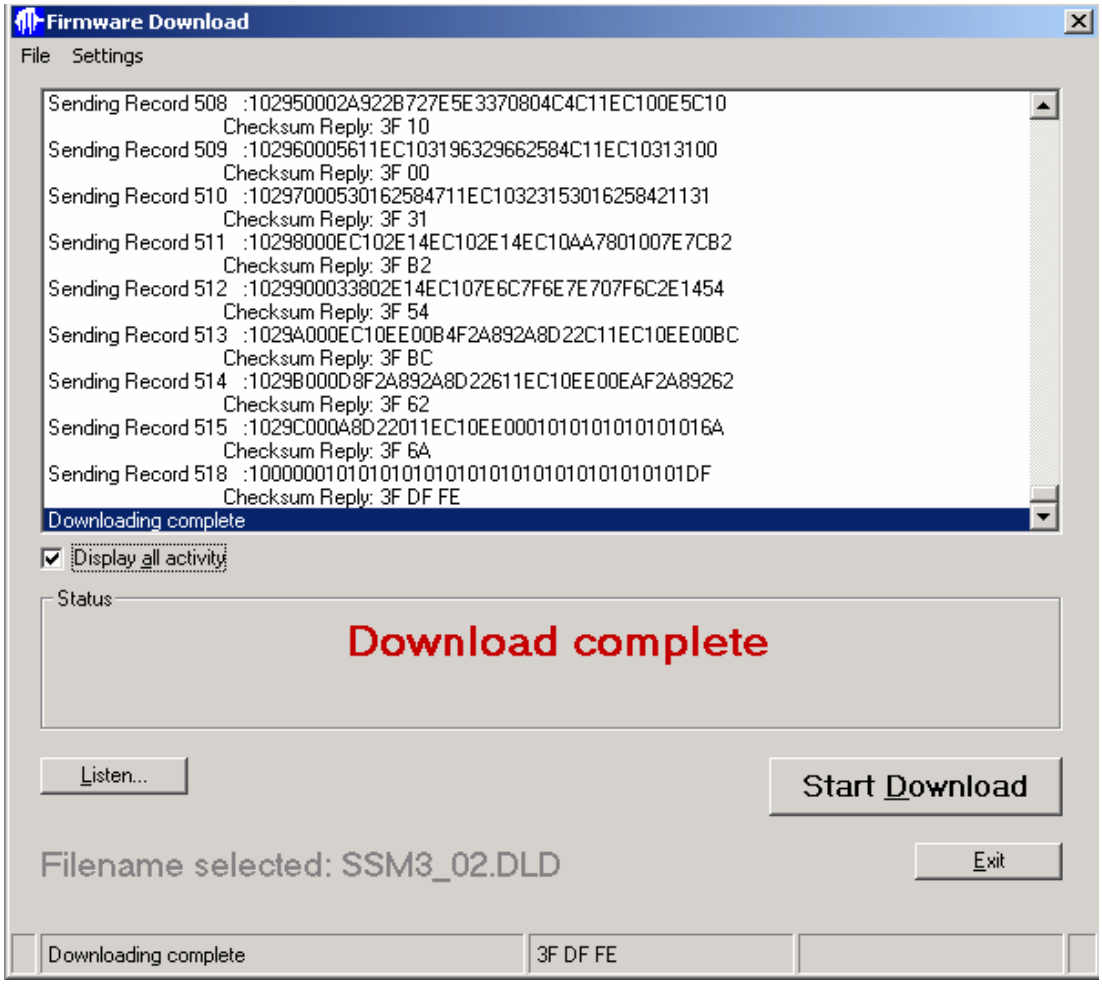
Assuming the Transponder firmware supports the Downloading function, the Transponder will reply to the **Download** request following the erasure of its Program memory in EEPROM, a few seconds later.
Note that its bootload code will remain intact.

Following erasure, the Transponder requests the PC for new code, at which point the PC sends one line of encrypted hex code, and the Transponder replies with confirmation of that line's checksum.



With the **Display all activity** box ticked, all communication between Transponder and PC will be displayed.
For slightly faster downloads, un-check this box. Although activity is now disabled, any errors will still be displayed.

When all lines have been sent (typically a few minutes), the operator will be informed that the download is complete.



Checking a successful download

Following download, return to the Main menu, and press the **Get Firmware** button to confirm that the new firmware has been implemented.

Downloading to an already-erased Transponder

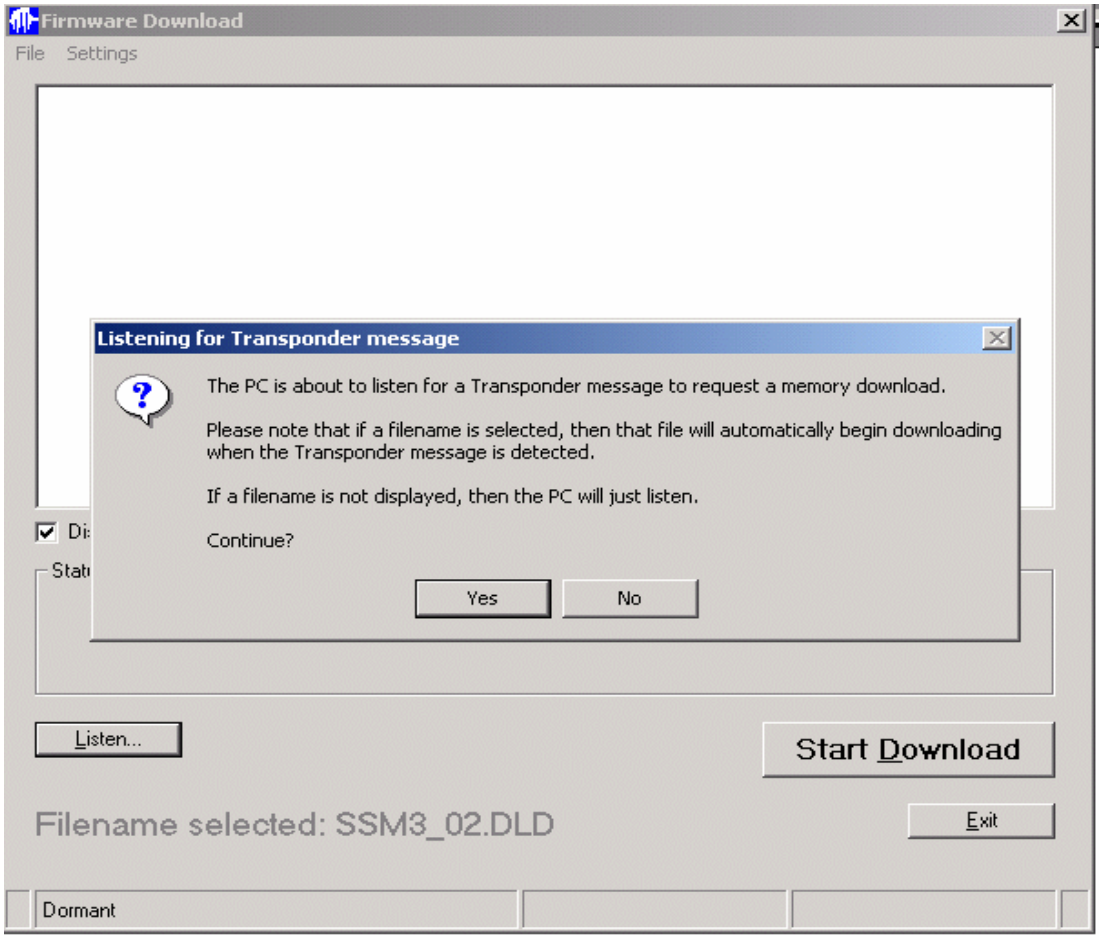
If a Transponder's EEPROM has already been erased but firmware has not been downloaded (probably due to a previously unsuccessful Download attempt), the Transponder will transmit a message every few seconds from its RS232 output.

This indicates to the PC that the Transponder is ready for download.

Note that the normal procedure of pressing the **Start Download** button will not work in this condition - it will not even reply to the simple **Get Firmware** command.

Instead, press the **Listen** button.

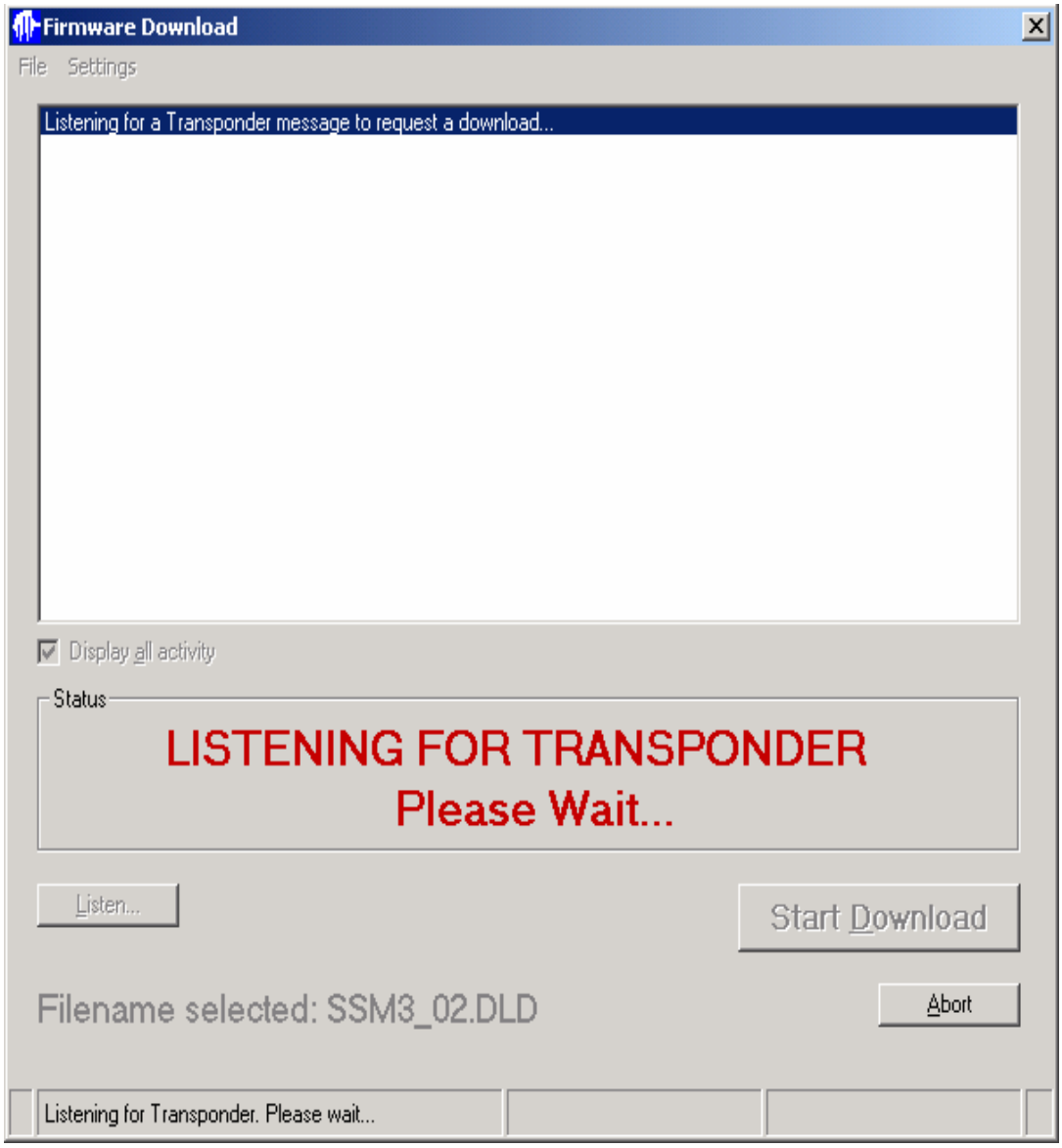
The following message is displayed.



To begin downloading, press **OK**.

- Note: remember to have selected the appropriate .DLD file.

The software now listens for the next Transponder command, and on reception starts the download procedure in the normal way.

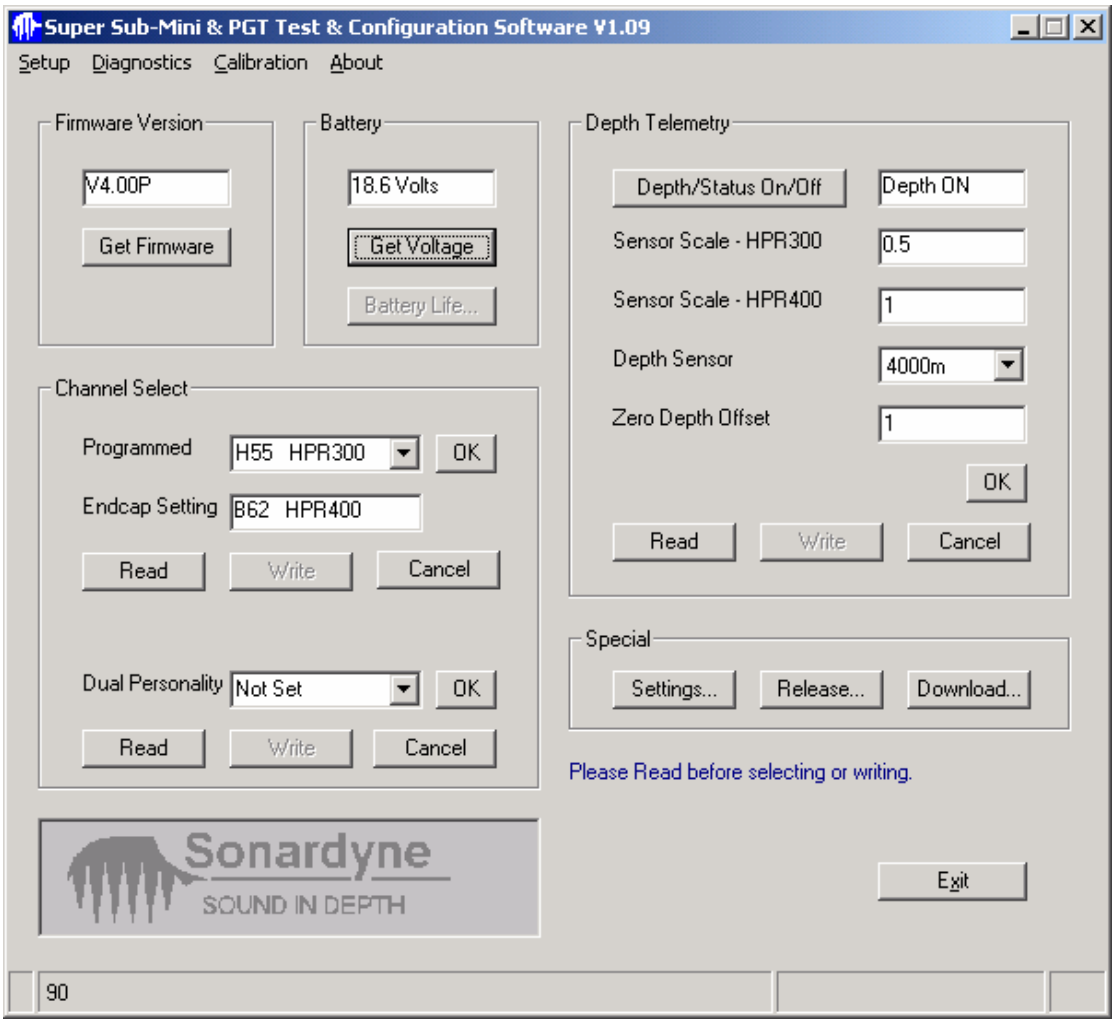


E.4.19 Read / Write / Cancel

Writing is only allowed following a Read, AND only if one or more parameters are different to those read.

Very early Transponders require the unit to be turned off and on again for the new settings to take effect - or to wait up to two minutes for the Watchdog to apply.

A fully read Transponder should look something like this:

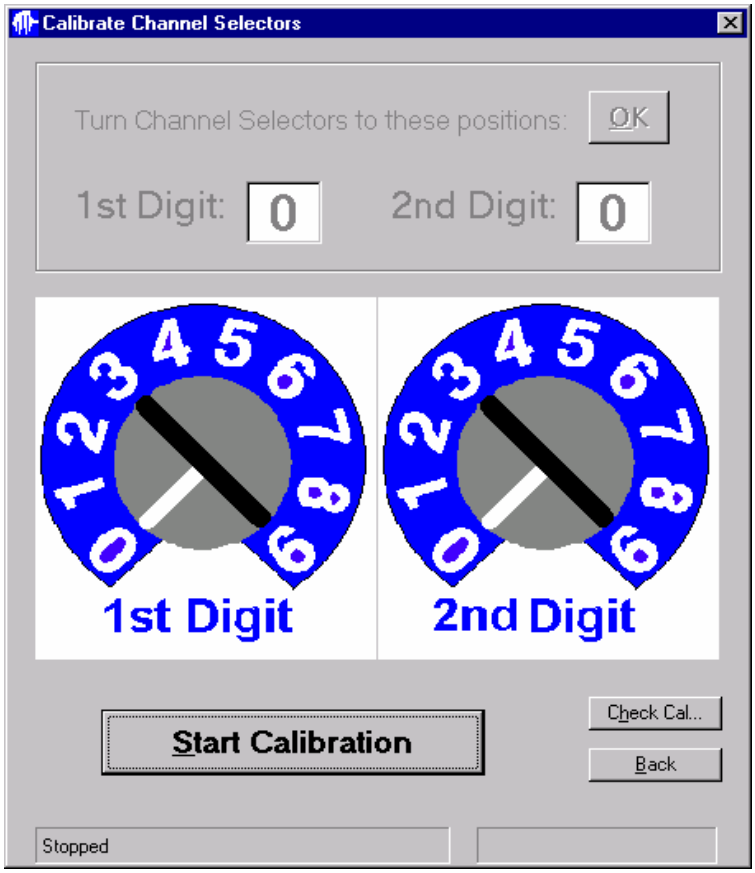


E.4.20 Calibrate Channel Selectors

From the **Main Menu**, select **Calibration | Channel Selectors...**

This Calibrates the Channel Selectors on the Endcap.

When selected, the following screen is displayed:



Press **Start Calibration** to begin the calibration procedure, and follow the instructions.

Note that a password is required to avoid accidental Channel Selector data corruption.

The password is **super** (note lower case).

The operator is prompted to set both Channel Selectors to each value in turn and then to press **OK** and **Calibrate**. When the sequence is complete, the Transponder will write the Calibration Data to its EEPROM.

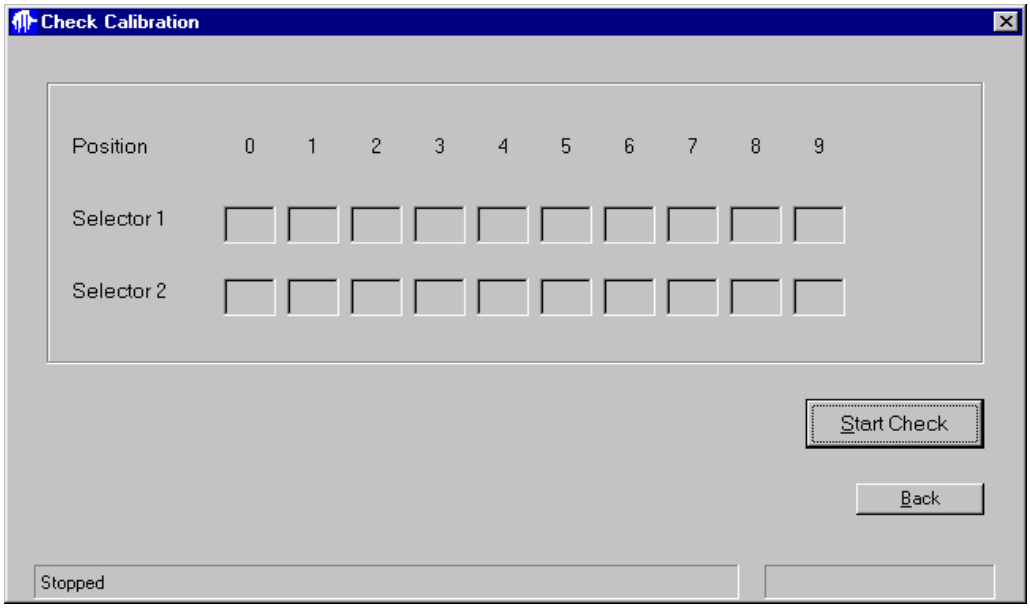
It is essential to follow the instructions and to calibrate each pair of selectors when prompted, starting at Channel 0 and finishing at Channel 9. Failing to complete the sequence in order will prevent data being stored in EEPROM.

E.4.21 Verify Channel Selector EEPROM Setting

From the **Calibrate Channel Selectors** window**,** select **Check Cal...**

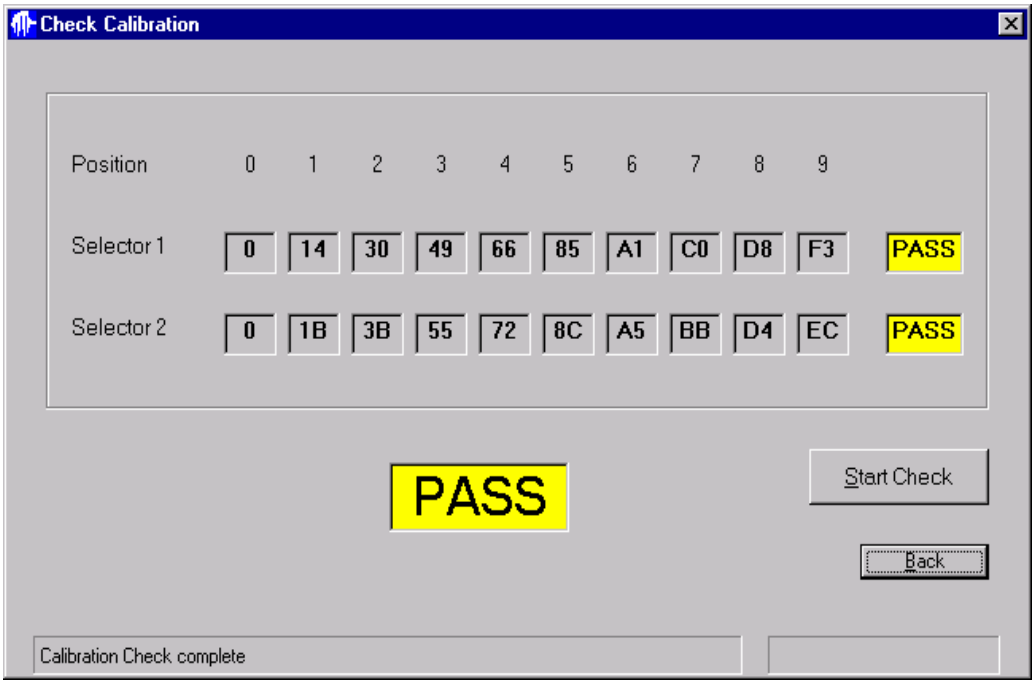
This Checks the Channel Selector EEPROM settings

When pressed, the following screen is displayed:



Select **Start Check** to check the calibration.

Expect to see a successful result like the one below:

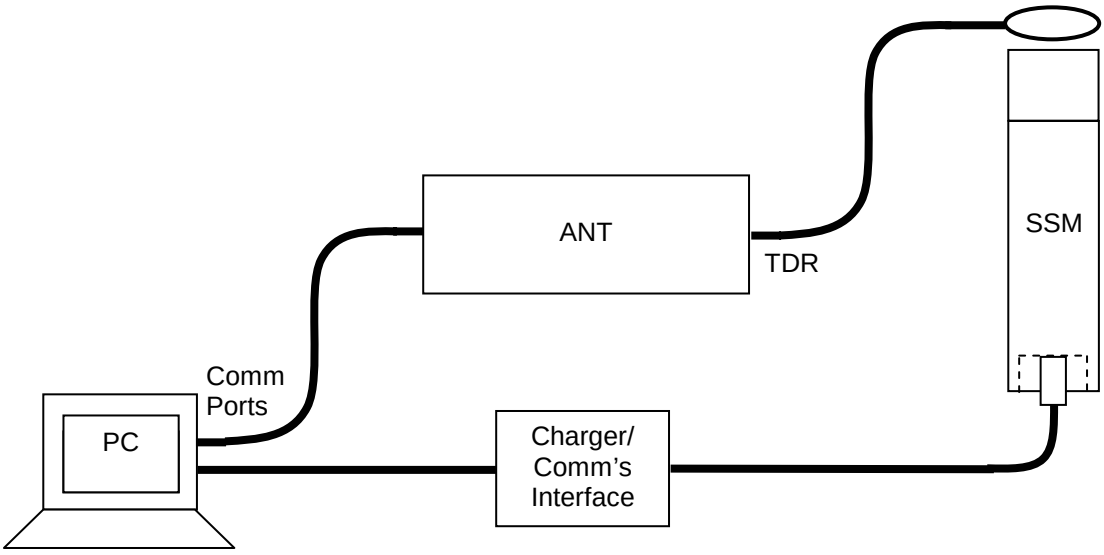


The Channel Zero value will be close to 00 and the Channel 9 value close to FF.

A PASS/FAIL criterion checks that the difference between successive channels is greater than 15 decimal (0F hex). If this is not true the figures should be carefully inspected. Marginal failures will still operate quite acceptably but may point to a developing problem.

E.4.22 Transponder Testing

A type 7343 Acoustic Navigation Tester (ANT) is required to carry out Diagnostics tests, connected as follows:



E.4.23 ANT Setup & Diagnostics

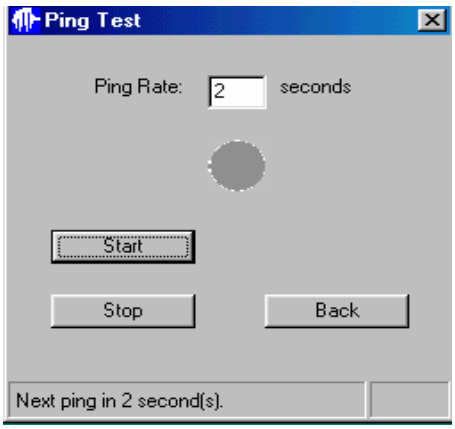
Connect the ANT to a free Comm port as shown in E.4.2.

From the **Main Menu,** Select **Diagnostics** to display the following options:

- Continuous Ping (does not require an ANT)
- Channel Range Test.
- Channel Depth Test.
- Transponder-to-Transponder Test (does not require an ANT)

E.4.24 Continuous Ping

Select **Continuous Ping...** to display the window opposite. The **Ping Rate** window is used to set the repetition rate in seconds.



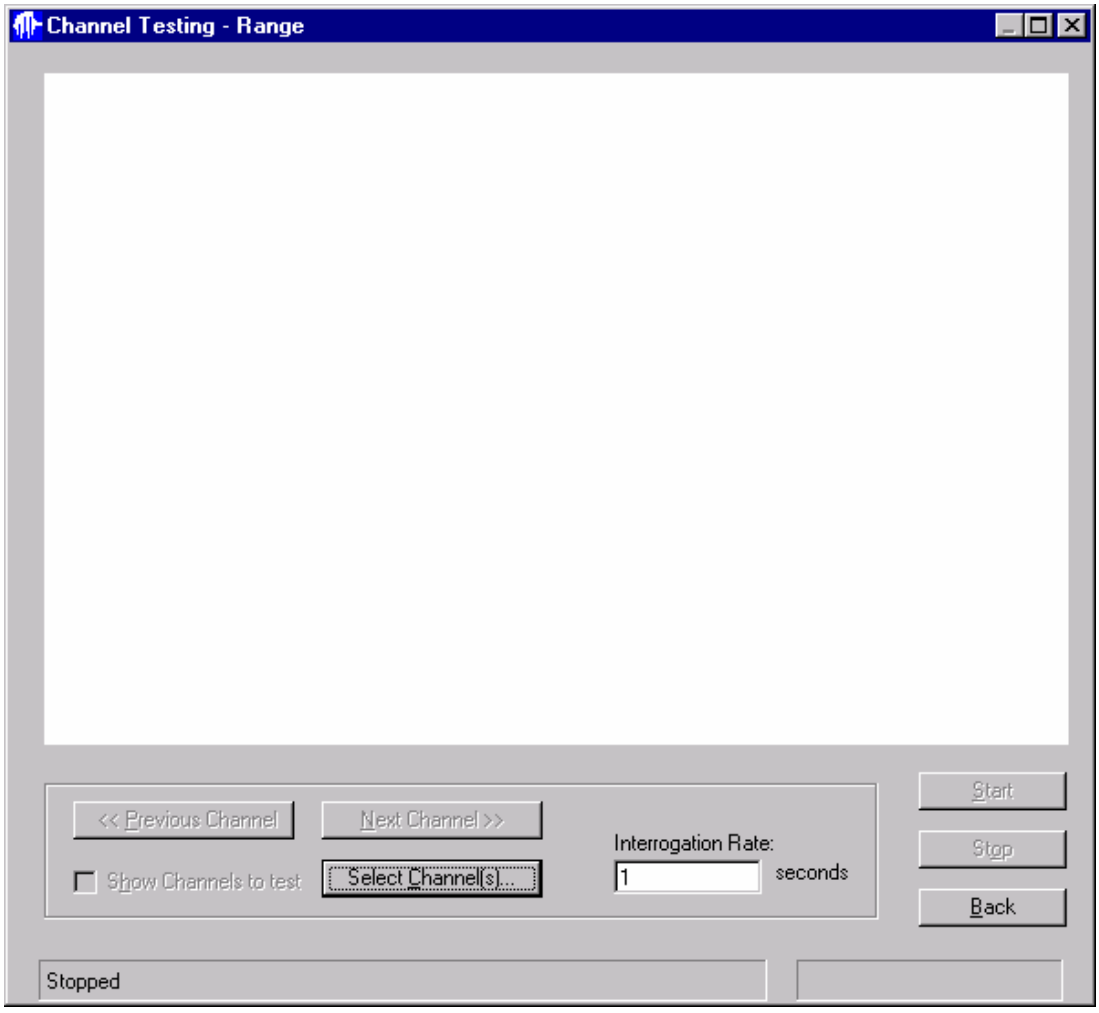
Once the desired rate is set, select **Start** to ping in Responder mode, triggered by use of the Transponder RS232 serial data link.

Press **Stop** to stop pinging. Channel Range Test.

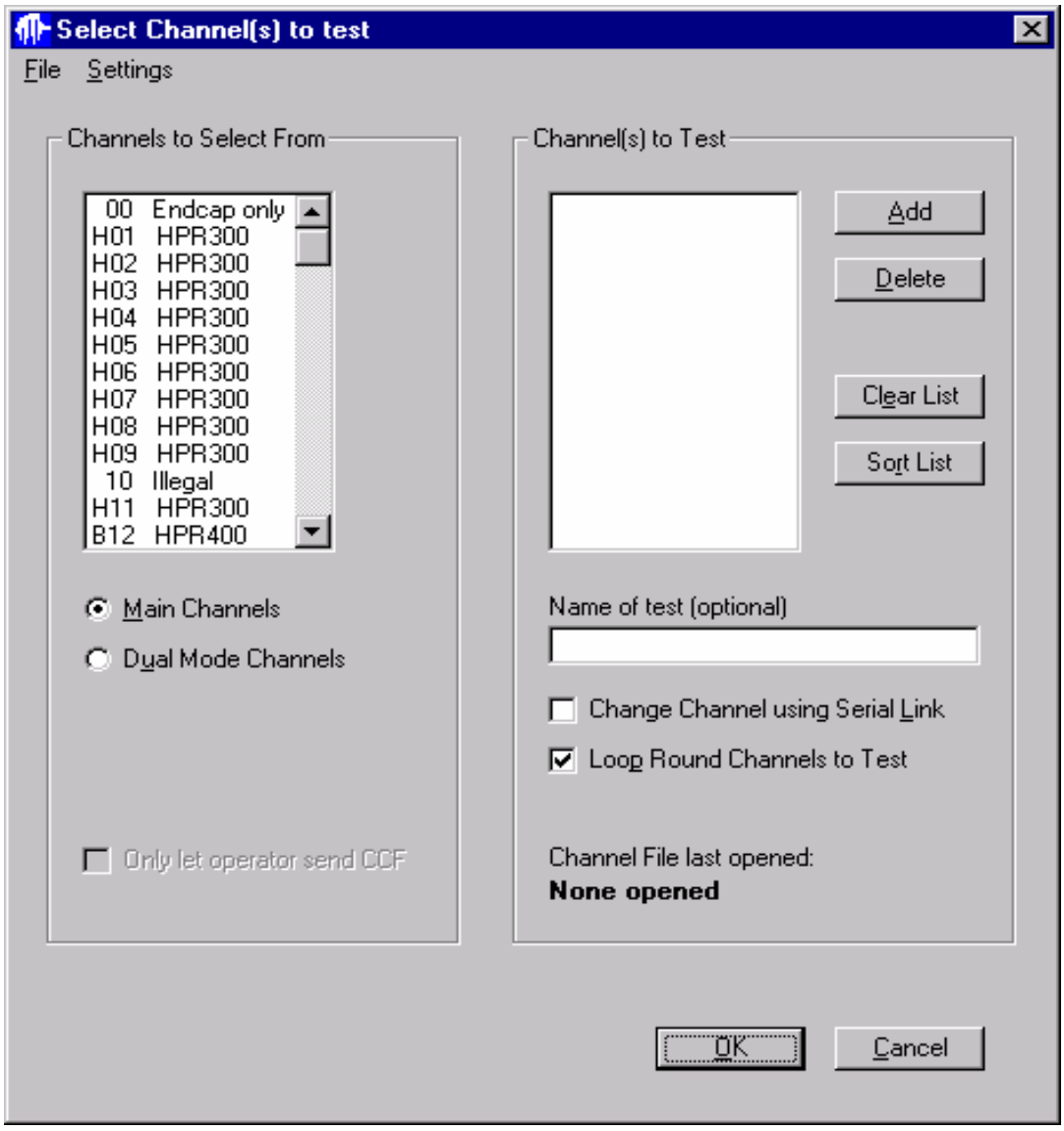
Note that this does not require an ANT.

E.4.25 Channel Range Test

Select **Channel Range Test** to display the window below:



Press **Select Channel(s)...** to select channels-to-test.



The Channel-to-Test can be either a Normal channel, or a Dual Personality channel, as defined by the appropriate option buttons, **Main Channels** and **Dual Mode Channels** respectively.

To select a Channel-to-Test, click on a **Channel-to-Select-From**, and press **Add**, or simply double-click a Channel-to-Test.

Alternatively, select the **File | Open** menu option to load a custom Channel .DAT file.

Use buttons **Delete** to delete a highlighted Channel-to-Test, **Clear List** to clear all channels, and **Sort List** to sort the Channels-to-Test in ascending order.

The **Name of test** text box is an optional text string to label a custom list of Channels-to-Test.

For example, “Tank-Test channels” may be entered, or “Channel List 1” etc.

Choose **File | Save**, or **File | Save As** to save the list of channels to a .DAT file.

The operator is prompted to Save after pressing **OK**, if the **Channel file last opened** contains a list which is different to that currently selected.

Check **Loop Round Channels to Test** to test each channel in turn and then loop back to the first channel in the list.

Check **Change Channel using Serial Link** to automatically set the correct channel-under-test via the PC. Unchecked implies that the Endcap Channel Selectors need to be physically adjusted according to the channel-under-test.

If the **Dual Mode Channels** option is selected, the check box, **Only let operator send CCF** will be active.

When checked:

- The operator must send a CCF pulse.

When unchecked:

- CCF pulses will be sent automatically.

The **Settings** menu option is for advanced diagnostics, and is not covered here.

When Channels-to-Test have been selected, press **Start** on the **Channel Testing** window.

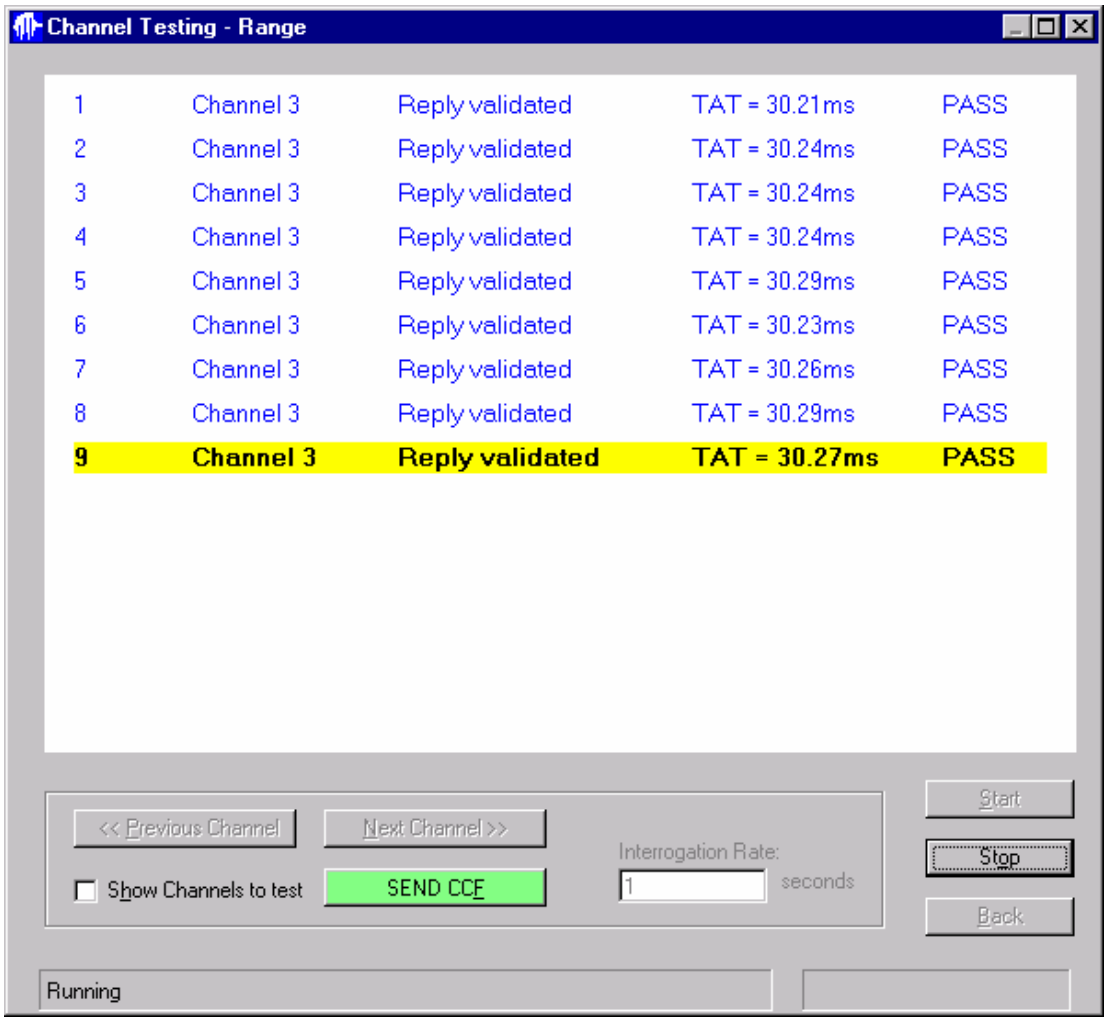
The ANT will be initialised and configured with the first Channel-to-Test, before actual interrogations begin.

For each interrogation, the Transponder will either reply with a Turn-Around-Time, or indicate an invalid reply.

Press **Previous Channel** or **Next Channel** to respectively select lower and higher ones in the list (assuming more than one), or temporarily stop testing by checking **Show Channels to test** and display the current list of channels.

Press **Stop** to stop testing, and **Back** to return to the Main window.

If a **Dual Mode Channel** has been selected, a **SEND CCF** button is available to manually send a CCF pulse at any time.



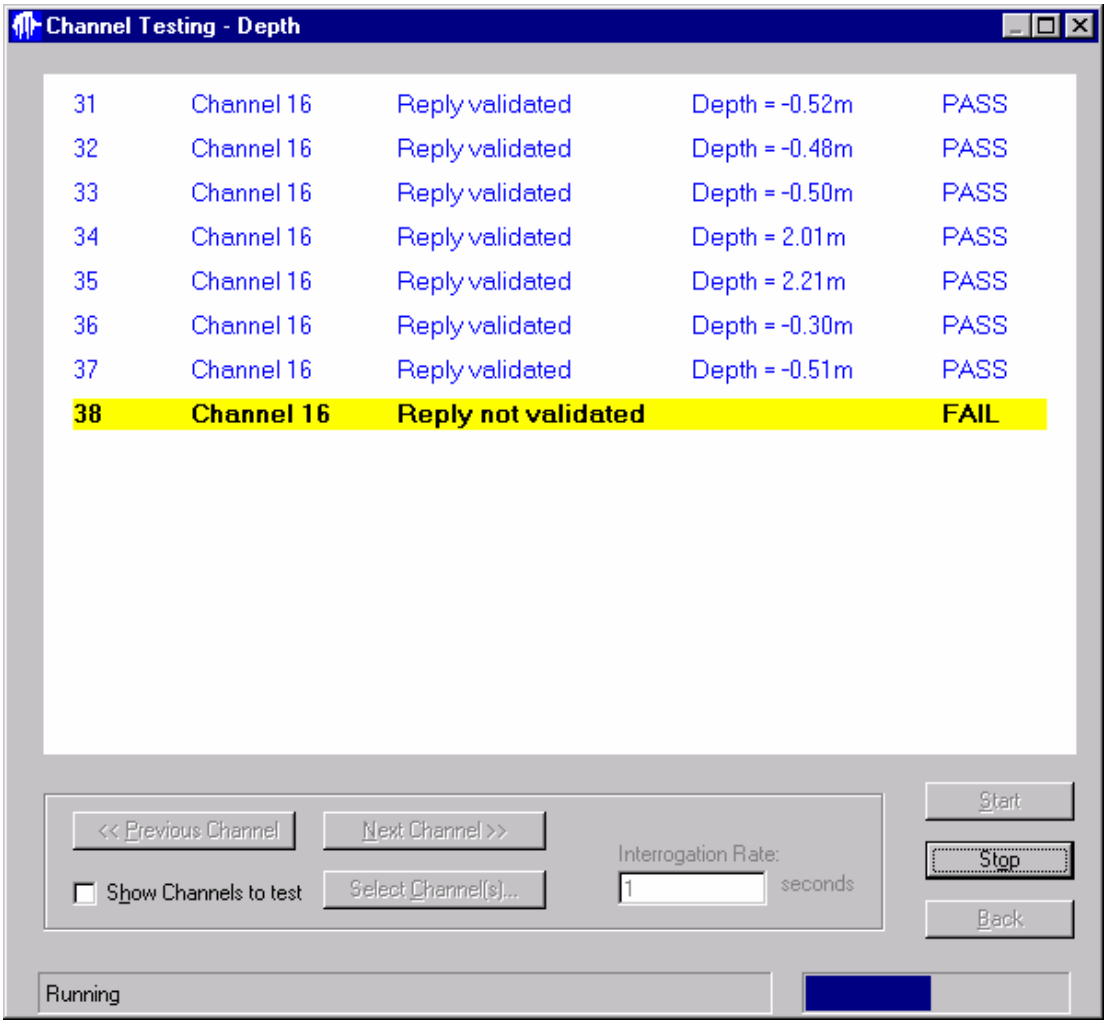
E.4.26 Channel Depth Test

The following tests are only applicable if the transponder is fitted with a depth sensor.

Select **Channel Depth Test** to display the window below:

Identical to Range Test, except that either the Transponder depth, or the raw time between two reply pulses is displayed.

A typical display is shown below:

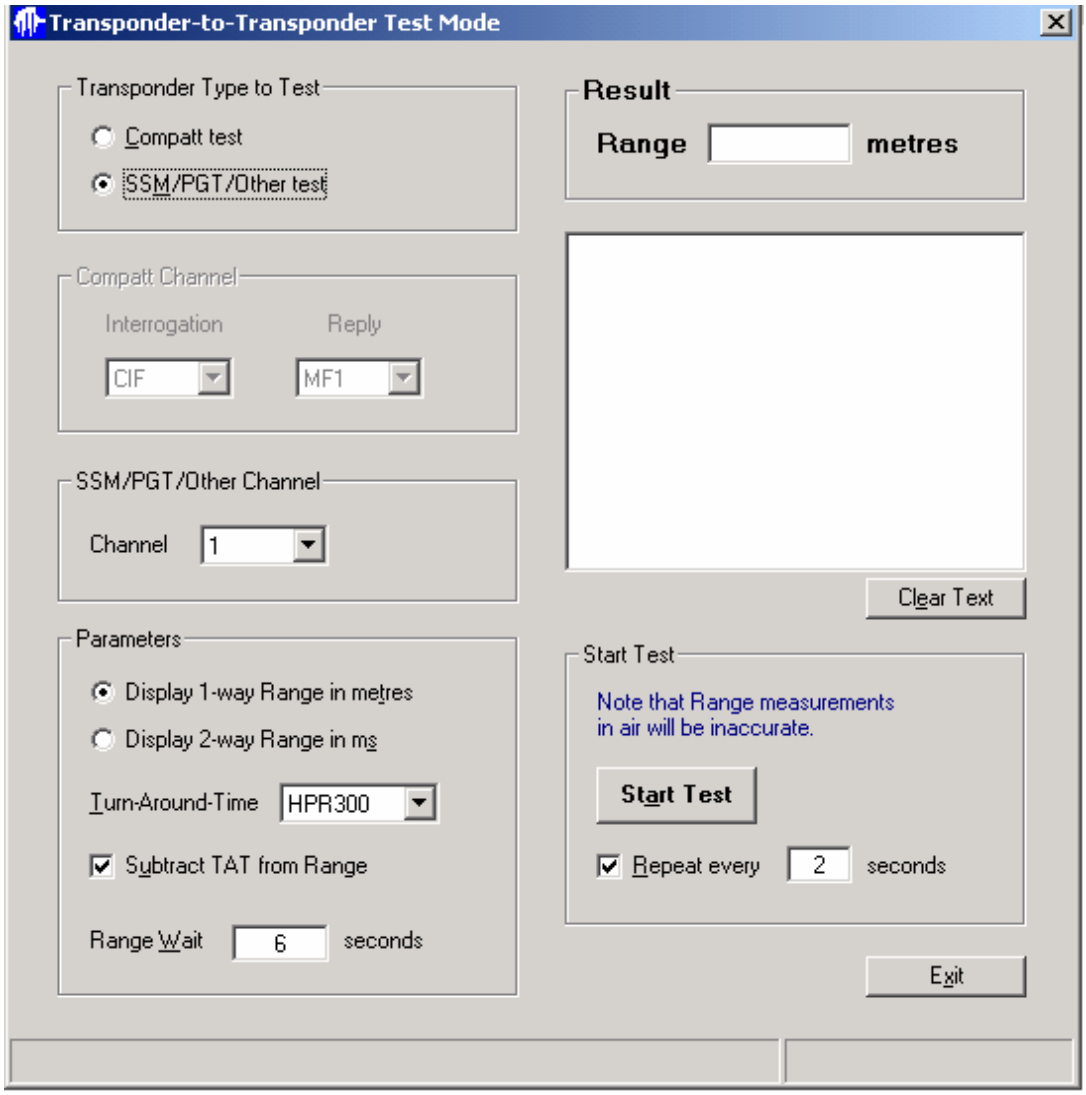


E.4.27 Transponder to Transponder Test

This uses the PC-controlled (via Type 7972 Charger/Interface) Transponder to range to a remote Target Transponder to check the Target.

Note that this does not require an ANT.

Select **Transponder-to-Transponder Test...** to display the following screen.



Transponder Type to Test

The Target Transponder may be either a Compatt (or Compatt equivalent) or a Super Sub-Mini, PGT, or other HPR Transponder.

Check either **Compatt test** or **SSM/PGT/Other test** respectively.

Target Test Channels

For a Compatt test, select the Target Compatt's Interrogation and Reply channels from the **Compatt Channel** pull-down boxes.

For a Super Sub-Mini, PGT, or other HPR Transponder test, select the Target Transponder's channel from the **SSM/PGT/Other Channel** pull-down box.

Note that some non-HPR channels are valid "Sonardyne" channels.

Test Parameters

When the test is run, the display can be either the one-way Range in metres, or 2-way range in milli-seconds (select the appropriate option).

The Target transponder's Turn-Around-Time (TAT) is selected from the **Turn-Around-Time** pull-down box, automatically defaulting to the standard HPR300 or HPR400 TAT if an HPR test channel is selected.

The **Subtract TAT from Range** automatically subtracts the TAT form the calculated range. It may be useful to un-check in order to check the Target's TAT in air at zero range.

The **Range Wait** box sets the maximum time the PC-controlled Transponder waits for a Target Transponder reply.

2.14.4 Running the Test

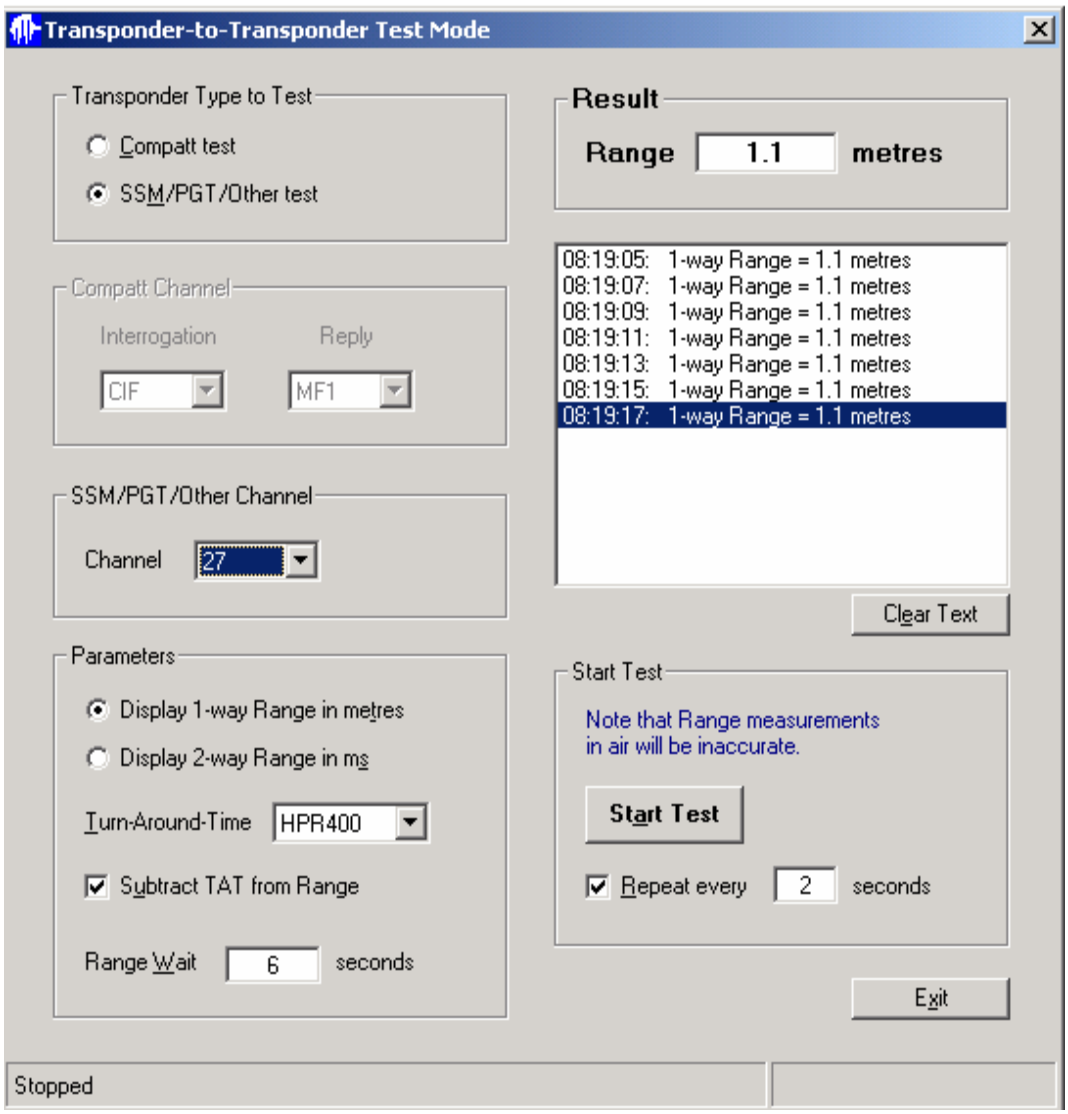
To begin testing, press **Start Test**.

For repeat testing, every N seconds, tick the **Repeat every** box and select the repeat time.

During testing, a scrolling record will be displayed.

To erase the record at any time, press **Clear Text**.

A typical example of a repeat-test is shown below.

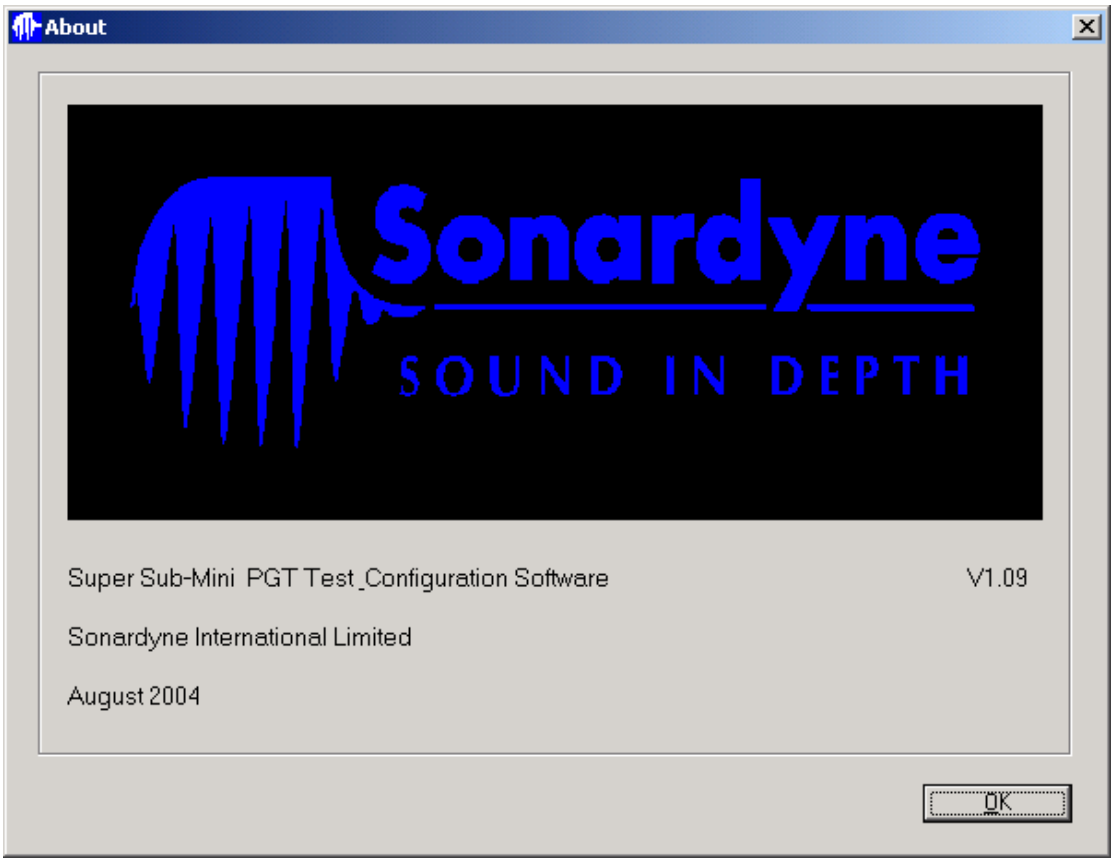


E.4.28 About

From the **Main Menu**, select **About**.

This displays program information.

When selected, the following screen is displayed:



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SPECIAL CONDITIONS

The user is allowed to modify data files, as described in the operating instructions, to suit his own custom test routines.

APPENDIX F

F. FIRMWARE HISTORY

Version	Date	Description
1.05	01/03/99	First Issue HPR-300 Compatible HPR-400 Compatible Depth telemetry
1.06		HPR-300 Compatible HPR-400 Compatible Depth telemetry Adjustable Depth Scaling for HPR-400
1.07S	01/11/99	HPR400 responder trigger delay was 60ms, now 30ms Minimum interrogation interval was 500ms, now 750ms
1.08S	15/11/99	Improve frequency settling time in Responder Mode Channel 65 frequency adjusted
1.09S	07/12/99	Allow 1 ms/m depth scaling for 4000 m sensor. Not applicable to 7973 but fitted for compatibility with 7970
1.10S	11/04/00	Dual Mode added
2.02S	29/04/02	New CPU PCB added
2.03S	16/12/02	Responder turn-around trimmed
3.00S	16/02/04	New issue CPU, firmware now downloadable
3.01S	03/03/04	Special version (non standard)
4.00S	28/04/04	Special version (non standard)
4.01S	20/05/04	Acoustic Command capability added for Enable, Disable, and Data (depth) Enable. Full Acoustic Command Address stored in EEPROM, changeable via serial port
4.02S	20/07/04	Command reply for actuation commands (special systems) modified for compatibility with older Transceivers

APPENDIX G

G. INSTRUCTIONS FOR USING THE DUAL PERSONALITY FEATURE OF THE SUPER-SUB MINI TRANSPONDER

G.1 INTRODUCTION

Super-Sub Mini Transponders, fitted with V1.10 firmware and above, have a special feature allowing them to be deployed with a Dual Personality. This means that they have two independent Interrogation and Reply channels, switched on reception of a special Switching Frequency signal.

The Default Channel setting is set up on the endcap channel selectors as normal. A second (Alternative) channel is programmed into EEPROM. The factory setting of this Alternative Channel is shown on the Transponder label.

In operation, the Transponder normally operates on its default (endcap selector) channel. This would typically be an HPR-400 channel selected from the list below.

If a Sonardyne USBL system needs to utilise the Transponder on an HPR-300 channel, a special frequency signal is transmitted. This switches the Transponder to use its Alternative Channel for a limited time. Provided the Transponder sees at least ten interrogations on its Alternative Channel within a two-minute period, or sees further signals on the Switching Frequency within that period, it will remain switched to the Alternative Channel.

When the USBL system stops interrogating or travels out of range, the Transponder will revert to its Default Channel automatically.

The Switching Frequency signal is generated by the Sonardyne USBL signal in response to an input on a serial port from a PC running a special Sonardyne-supplied program. At an operator specified interval, the PC will instruct the USBL system to transmit the Switching Frequency Signal. This will be automatically inserted between navigation cycles with minimal effect on the update rate.

G.2 SETTING THE TRANSPONDER FREQUENCIES

As a precaution, it is recommended that the HPR-300 and HPR-400 channels are selected from the tables below. These have been selected to minimise interference between the two systems.

G.2.1 HPR-400 Channels

The following channels are recommended to minimise interference between the two Transponder operating modes:

		B13	B14	B15	B16		B18
B31			B34	B35	B36		B38
B41		B43		B45	B46		B48
B51		B53	B54		B56		B58
B61		B63	B64	B65			B68
B81		B83	B84	B85	B86		

G.2.2 HPR-300 Channels

The following channels are recommended to minimise interference between the two Transponder operating modes:

01	02				06		08	09	11	22	33	44	55

It should be noted that, when planning the deployment positions of HPR-300 Transponders, the following pairs of channels have very close interrogation frequencies. Interrogating one of the pair will cause both to reply. This will not cause a positioning problem as they have different reply frequencies but it will cause the batteries of the non-selected Transponder to run down quicker than might be otherwise expected.

Clashing channels are:

02 and 11 (square)
04 and 22 (circle)
06 and 33 (delta)
08 and 44 (X)
09 and 55(Y) – marginal interference.

G.2.3 Setting the Default Channel

It is recommended that the default channel is set to an HPR-400 channel using the endcap channel selectors.

If the SSM is not fitted with endcap channel selectors, set the default channel as described in section 2.4.1.

G.2.4 Setting the Alternative Channel

The Alternative Channel is stored in EEPROM using the following procedure

G.2.4.1 **Test Programs are supplied on CD-ROM**

Connect the SSM to the PC via the Type 7982 Charger/Comms. Unit. DO NOT CONNECT the DC Power Pack to the Charger/Comms. Unit.

Install the software as described in Appendix E, section E.2.

Check that the correct COM port is selected (see Appendix E, section E.4.2).

Check connections by requesting the SSM Firmware Version (see Appendix E, section E.4.3).

Check the Default Channel as described in Appendix E, section E.4.5. [Note that it may take up to 2.5 minutes for the channel set on the endcap selectors to be confirmed]. If the SSM is not fitted with endcap channel selectors, the Default channel can be set as described in section E.5.

Set the Alternative Channel as described in the Dual Personality section of Appendix E (section E.4.6)

Disconnect the SSM from the Charger/Comms unit.

G.2.4.2 **Test Programs are supplied on floppy disk**

Connect the SSM to the PC via the Type 7982 Charger/Comms. Unit. DO NOT CONNECT the DC Power Pack to the Charger/Comms. Unit.

Run test program PKH1-1.EXE (COM port 1) or
PKH1-2.EXE (COM port 2)

Enter the following data :

1 second integration time
!W (first character is an exclamation mark)
A4
00
07
01
55 Channel to be selected : 01 to 09, 11, 22, 33, 44, 55 are valid (or FF for no alternative channel)
Q ENTER Confirm 3F Returned for correct Programming :

Confirm the Channel programmed with:

1 second integration time
!R (first character is an exclamation mark)A4
00
07
01
XX Channel Programmed Above :
Q ENTER Confirm 3F Returned for correct Programming :

Disconnect the SSM from the Charger/Comms unit.

G.3 INTERFACING THE SSM DUAL PERSONALITY PC SOFTWARE TO THE USBL SYSTEM

Note: The USBL software must be V6.03 or later to incorporate the feature to transmit the Switching Frequency signal.

The PC connects to the USBL system by one of the serial ports (ports 4, 5 or 6 are recommended). Connect the cable (7784-163-02) to an unused serial port and plug the other end into the PC COM port.

On the USBL control panel, from the power-on menu:

1. Select 4 – Installation

2. Select 4 – I/O Port Allocation and Set-Up.

3. Move the cursor down to the serial port used to connect the PC. Check that it is not allocated (If it is allocated, move to an un-allocated port and move the PC cable to the appropriate Port connector). Press ENTER.

4. Move the cursor to PAN Emulation and press ENTER.

5. Check that the comms parameters are set to 9600 Baud, 8 data, 1 stop bit, no parity, no flow control.

6. Press ESC

7. Set up and run navigation as normal.

If the PC software named “SSM Dual Personality Control System” has not yet been installed on the PC, close all Windows applications and install the software as described in the notes in section 6.2.

If the software is already installed, close all Windows applications and launch the program by clicking on the **DUAL SSM** menu entry under the menu group Start\Programs\Sonardyne.

1. Select **CONFIGURE** and check:
    - Pulse width is set to 4 ms (or other value agreed with Sonardyne)
    - Update period is set to 30 seconds (or other value found to be practical)
    - COM Port is set to that in use on the PC
    - Comms parameters are the same as selected on the USBL.
2. Press the **Apply** button, when the configuration is correct, to return to the main control screen.
3. Press **Manual Tx** for a single transmission
4. Press **Start Auto Tx** for regular transmissions of the Switching Frequency at the rate selected.
5. When USBL operations are complete, press **Stop Auto Tx** and then press **Exit**

G.4 RUNNING THE SSM DUAL PERSONALITY PC SOFTWARE

G.4.1 Summary

This section relates to the PC Software distributed to assist operations utilising the Dual Personality feature of the Sonardyne Super Sub-Mini Transponder.

The software is a small windows based application intended to interface to a USBL Navigation Processor via the PC's serial port.

The program can be configured to either continuously send at a defined rate a special serial command into the Navigation Processor or may be used to send this command manually on operator input.

The serial command will cause the Navigation Processor to transmit a defined acoustic command to a deployed, modified SSM, which will trigger it to operate in HPR-300 mode. If this command is not received after a defined period of time the SSM will default back to operating in HPR-400 mode.

G.4.2 Distribution / Installation

The distribution media for this program is a single CD-ROM, and is available from Sonardyne as drawing no 7970-055-A1.

The application program and all necessary support files are packaged together in a self extracting, self installing bundle on the distribution media.

The operating systems that the application supports are win 95 and win98.

To Install the application onto a PC load the CD ROM and navigate using windows explorer to the CD-ROM drive and double click on the file setup.exe.

If the default options are chosen at the prompts provided during the installation process then the application program and any necessary support files will be installed in a sub-folder of the Program Files folder called ssm_v0. The system and dependant files will usually be installed into the windows\system or winnt\System32 folder.

The installation process will create a new menu group called Sonardyne under the Programs menu group of the operating system Start menu button.

To launch the application, navigate to the new Sonardyne menu group and click on the menu item called DUAL SSM.

Should the target PC not have a CD drive then the installation files on the CD need to be copied onto two floppy disks:

> Copy onto the first floppy the following files: setup.exe, setup.lst and ssm_v02.CAB and onto the second floppy copy the file ssm_v01.CAB. These disks can then be used to install the application onto a machine which does not have a CD drive.

The application may be uninstalled at any time by selecting Settings | Control Panel from the Windows Start menu and double clicking on the Add/remove Programs icon. The SSM DUAL PERSONALITY CONTROL PROGRAM will appear in the list of applications available for removal.

G.4.3 Configuration File

A program support file SETUP.DAT contains a record of the latest configurable parameter settings. This data is loaded whenever the main application program is launched.

To this end the application program expects this file to exist in the same directory/folder as itself. If this is not the case the program will crash when launched.

If the SETUP.DAT file does not exist, a simple Text editor such as Notepad can be used to create the required file with the following number data: (Note the leading space before each data and a 'return' char after the last data value).

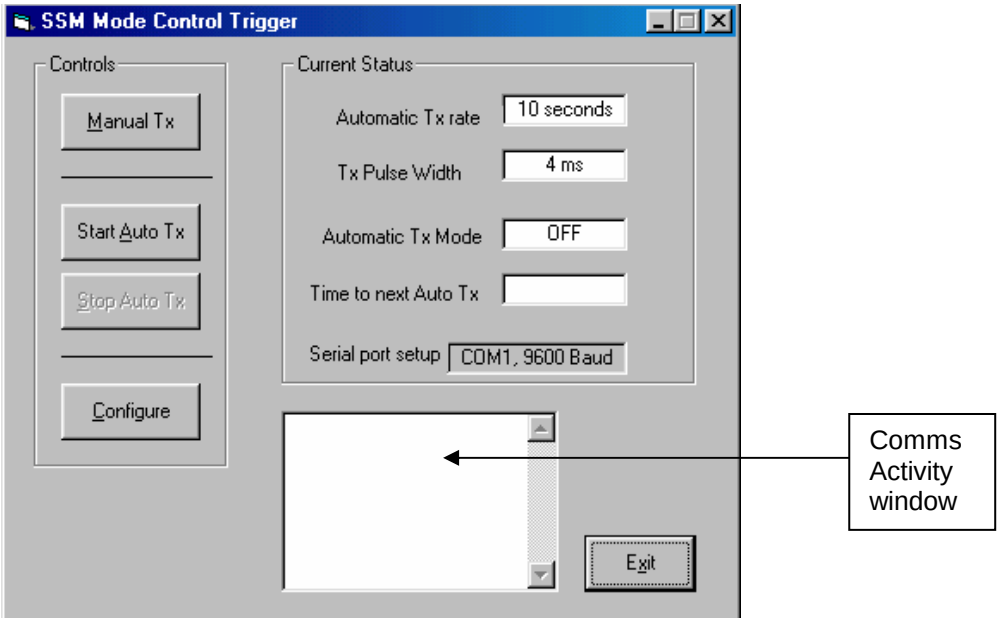
```
2
0
1
0
1
1
```

This will initialise the configurable parameters to the following:

> Serial comms on port 1 at 9600 baud
> Automatic command Tx rate at 30 seconds
> Acoustic command pulse width of 4ms

Enable Display of Serial comms activity.

G.4.4 General Operation



To launch the application, navigate to the Start\Programs\Sonardyne menu group and click on the menu item called DUAL SSM. The program window will be displayed:

Once the Manual Tx command has been selected the serial Rx COM port on the PC is opened and any subsequent serial input received will be displayed in the serial comms activity window.

The same is true once the Start Auto Tx function is activated. Actioning the button to stop the Auto Tx function will however cause the serial port to close. Any received serial Rx data will not now be detected and so will not be displayed in the activity window. This is not a problem but is highlighted here for reference only.

The correct response to the SSM Dual personality serial command is two serial characters, carriage return & line feed. To allow the operator to identify this response and therefore confirm valid system operation the program will display an asterisk in the activity window each time this reply is detected.

It is possible to change the transmission period for the Auto Tx mode, while Auto Tx is active. Press **Configure** and change the selection as required. The program will still continue to automatically transmit serial commands at the old rate until the Apply button is pressed.

G.4.5 Troubleshooting

The correct COM port must be selected. The comms activity window displays the serial command string each time the program tries to send it but if the wrong COM port is set then no actual serial data will be output.

Ensure the application baud rate is configured to be the same as that of the Navigation Processor's COM port. The default value for this is 9600 baud.

APPENDIX H

H. SUPER SUB MINI'S FITTED WITH ALKALINE BATTERIES

The 7973 Super Sub Mini is fitted as standard with re-chargeable, Nickel Metal Hydride batteries. Alkaline battery packs are available as an option providing a 90 day listening life in the event of failure of the external DC power supply.

References in the manual to battery charging should be ignored for units fitted with Alkaline battery packs.

Alkaline batteries must not be charged.

Attempting to charge Alkaline batteries can cause the battery cells to vent potentially explosive gasses. Should a charger be connected, there is no danger of accidentally charging the battery in situ - the charge line is not connected inside the Alkaline battery pack.

Alkaline Battery Life

Alkaline batteries have a recommended shelf life of 3 years from manufacture. The expiry date of an unused pack is written on the pack label. After this date, the pack should not be fitted to equipment as the remaining life will not provide the required listening life.

Once fitted to the transponder, a very small current (a few micro-Amps) is drawn to monitor the ON/OFF connection. This current will reduce the life of the battery pack, once fitted, to 18 months. It is therefore recommended that the battery pack is replaced at least once in 18 months if the full listening life is required.

A communication cable is provided to allow connection to a PC for set-up and test functions. While this cable is connected the transponder will be powered from the battery so PC comms should be kept to a minimum in normal operations. Every hour of connection will lose an hour of listening life. Should the test functions be used to cause the transponder to transmit an acoustic signal, additional battery life will be lost. As a guide, 1000 acoustic transmission pings is very approximately equivalent to 1 day's listening life.

Use with External Power

A typical application is to use the battery pack to supply a long-life emergency relocation function in the event of ROV umbilical failure.

It is expected that the external DC power input will provide power in normal use. A new battery will provide a listening life of 90 days but this time will be reduced if the external power is switched off while the transponder is turned ON. Every hour of connection will lose an hour of listening life. The transponder is turned ON by connecting either the ON-blanking plug (supplied on a lanyard) or a power/responder trigger cable. Either of these connections link pins 2 and 5 of the transponder connector which switch the transponder ON. If the external power is to be switched OFF, it is essential to disconnect the transponder to prevent battery drain.

In order to ensure that no charge is taken from the battery in normal operation, the external DC power supply should provide a voltage of 24 - 28 volts and must not drop below 24 V while supplying a current of 5 Amps. This current will only be drawn during the 10 milliseconds of acoustic transmission. Average current, assuming one transmission pulse every second is approximately 100 mA.

Customer Support

This product is covered by Sonardyne's normal customer support. Please ensure that the fact that Alkaline batteries are fitted is made clear in any communication regarding this instrument.

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