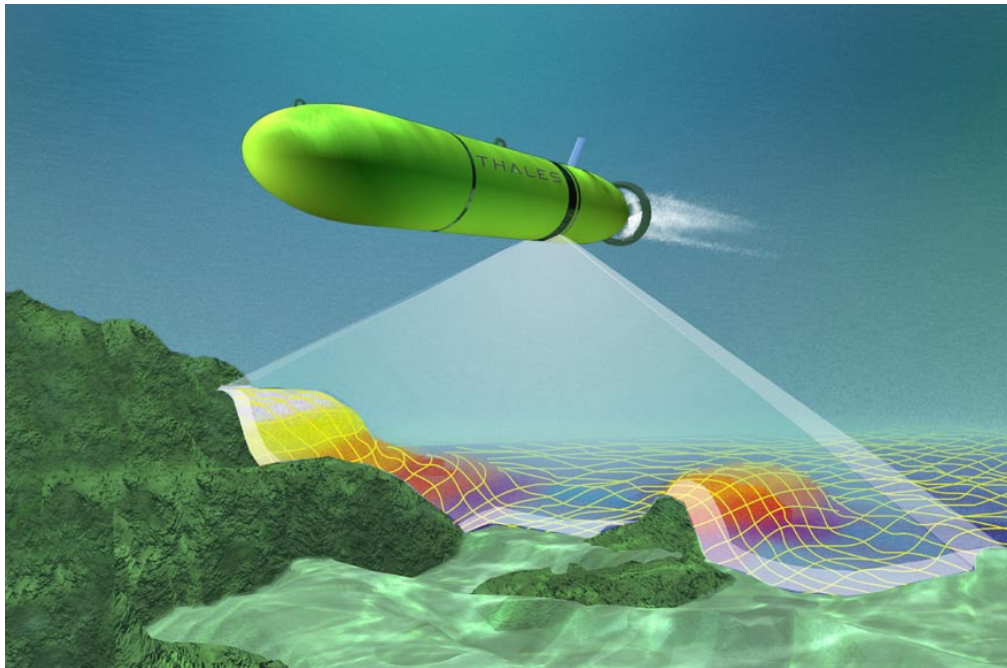


Preliminary Interface Control Document for THALES AUV



August 2, 2001

**Prepared by
RESON Inc.
Goleta, CA**



**Preliminary Interface Control Document
for
SeaBat 7100 and Thales AUV**

Project: Thales
Date: 8/2/2001

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REVISION HISTORY

Date	Rev:	Change from:	Change to:	Reason:	Resp.:
06-22-01	1	New document	-	-	JV
08-02-01	2		Preliminary Release for Thales Comment	Additional data is required.	DFS



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1. Scope

This Interface Control Document (ICD) specifies the design of all interfaces between the Thales Autonomous Underwater Vehicle (AUV) and the RESON SeaBat 7100 system (SeaBat 7100).

The SeaBat 7100 Sonar System comprises four (4) Line Replaceable Units, as shown in the top level SeaBat 7100 System Block Diagram, Figure 1-1. These are:

A Model TC 2156 100 kHz Projector Unit, which transmits sound into the water

A Model TC 2158 200 kHz Projector Unit, which transmits sound into the water

A Model EM 7201 Receiver Unit which receives acoustic signals that are formed into 320 narrow beams at 200 kHz and 160 beams at 100 kHz

A Model 7-I Integrated Control and Processor Unit (ICPU) which processes the received signals and communicates with the AUV Controller. All necessary Applications Software is resident on the ICPU. Customer-furnished PC cards to format and transmit data from an EdgeTech Model TBD Sidescan sonar are integrated within the ICPU.

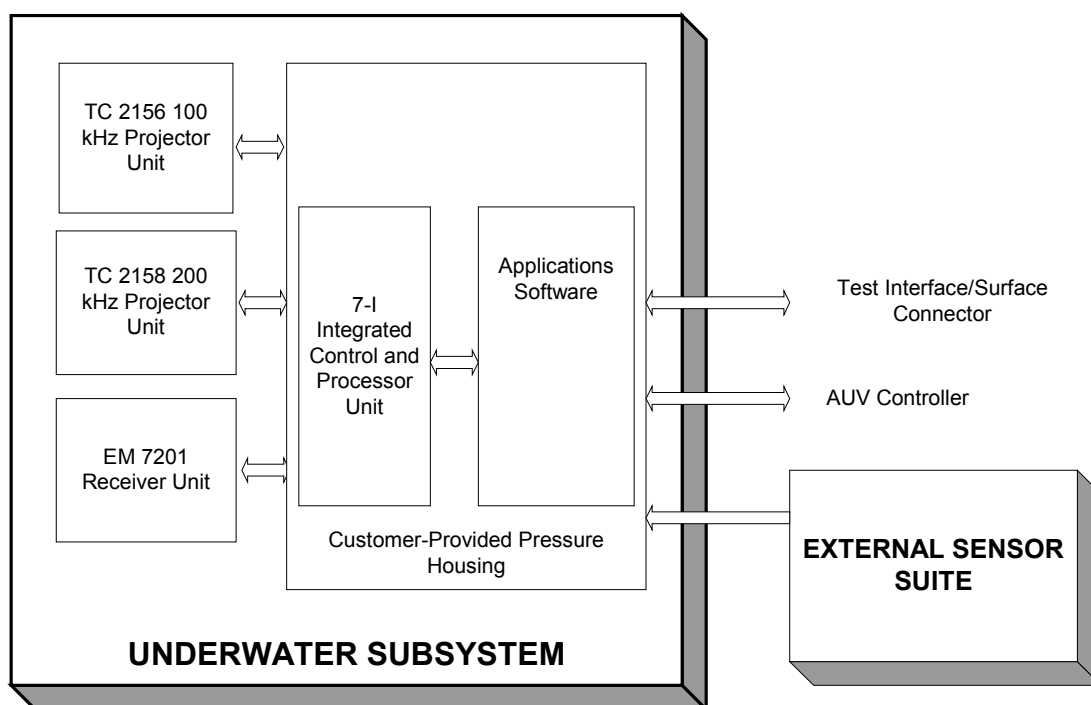


Figure 1-1. SeaBat 7100 Sonar Top Level Block Diagram

The following SeaBat 7100 interfaces are defined in this document:



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1) Interfaces between the TC 2158 Projector Unit and the Ocean

Acoustical and Physical

2) Interfaces between the TC 2158 Projector Unit and the AUV

Mechanical and Electrical

3) Interfaces between the TC 2156 Projector Unit and the Ocean

Acoustical and Physical

4) Interfaces between the TC 2156 Projector Unit and the AUV

Mechanical and Electrical

5) Interfaces between the EM 7201 Receiver Unit and the Ocean

Acoustical and Physical

6) Interfaces between the EM 7201 Receiver Unit and the AUV

Mechanical and Electrical

7) Interfaces between the 7-I Integrated Control and Processor Unit and the AUV

Mechanical, Electrical and Power

The information contained in this document is preliminary and subject to revision. The document will be kept current and revised as new information becomes available.



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2. Interface Between TC 2158 Projector Unit and the Ocean

2.1 Acoustical Interface

The TC 2158 Projector Unit generates an acoustic signal in the water column beneath the AUV. The signal is coupled to the water through a polyurethane window. The characteristics of this signal are shown in Table 2-1.

Frequency	200 kHz
Along-Track Beamwidth (-3 dB)	1° @ 200 kHz
Across-Track Beamwidth (-3 dB)	150° @ 200 kHz
Maximum Sound Pressure Level	+220 dB re 1μPa at 1 meter
Waveform	Gated CW
Maximum and Minimum Pulse Length	200 microseconds and 33 microseconds
Maximum Pulse Repetition Rate	40 pulses/second

Table 2-1. TC 2158 Projector Unit Outputs

2.2 Physical Interface to the Environment

The TC 2158 Projector Unit interfaces with the ocean through a polyurethane acoustic window affixed to an aluminum base.

When mounted in the AUV, the TC 2158 will successfully withstand exposure to 6,500 meters depth (9,250 psi hydrostatic pressure). It will operate within specifications at depths to 6,000 meters (8,540 psi).

3. Interface Between TC 2158 Projector Unit and the AUV

3.1 Mechanical Interface

The TC 2158 Projector Unit is shown in Figure 3-1. Its dimension are 100 mm (H), 100 mm (W), and 462 mm (L). Its weight in air is 13 kg, and its weight in sea water is 8 kg (TBR).

The TC 2158 Projector Unit interfaces to the AUV via 4 M10 x 1.5 15mm screws (TBR). The screw holes are located at the corners of a 433 mm by 82 mm rectangle, as shown in Figure 3-2.

A single, male, right-angle bulkhead connector (Impulse Model LPMBH-8-MP) is fastened to the bottom plate about 20 mm (TBR) from the edge.

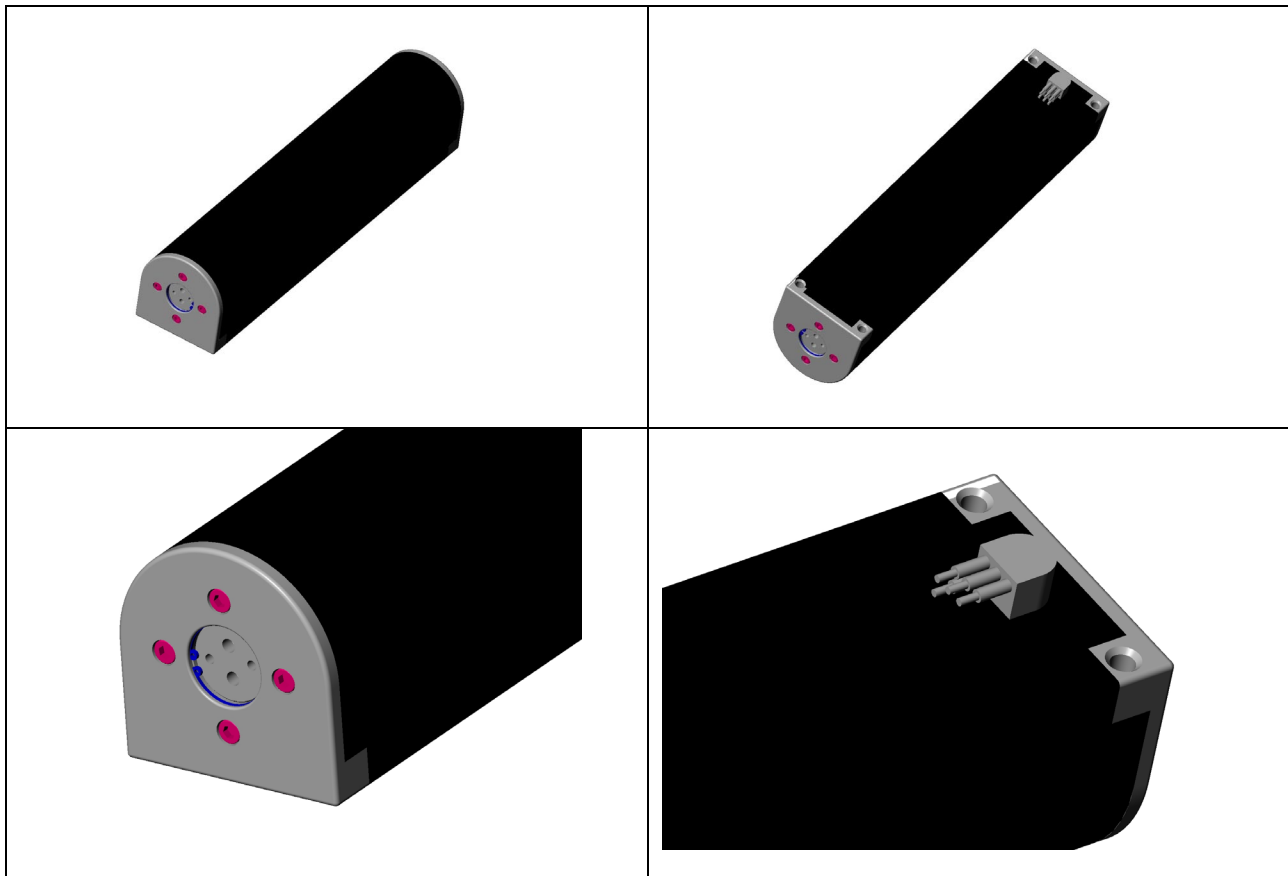


Figure 3-1. TC 2158 Projector Unit



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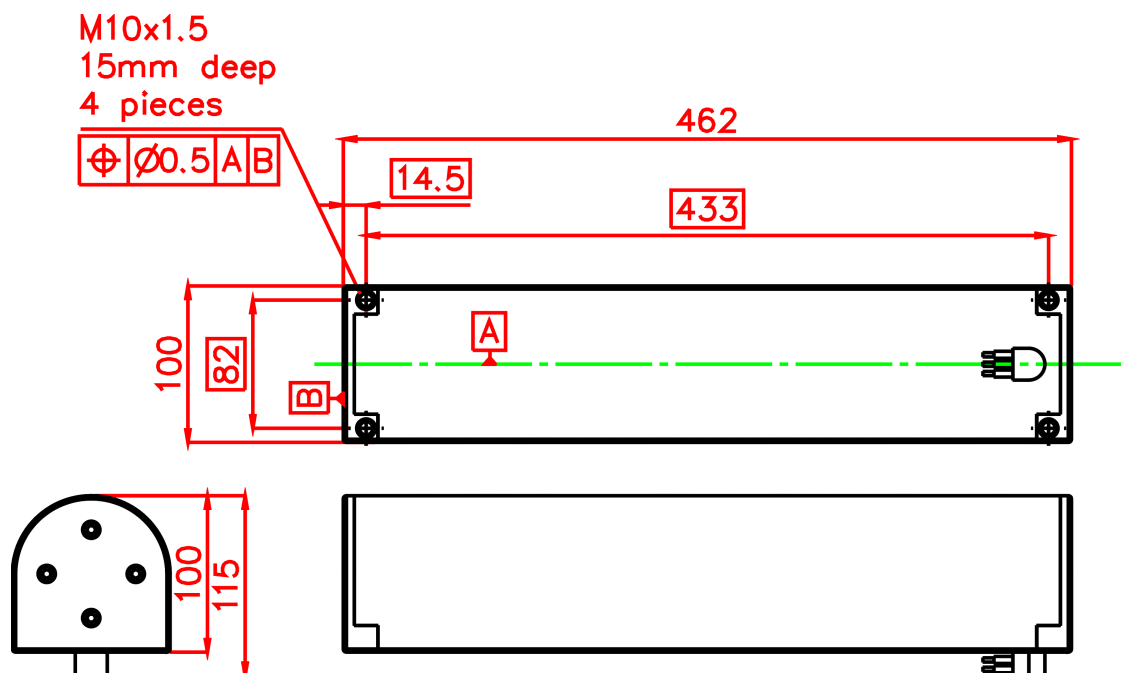


Figure 3-2. Outline Dimensions of 200 kHz Projector Unit TC2158.

3.2 Electrical Interface

The TC 2158 Projector Unit interfaces electrically to the AUV through a single cable (RESON, Inc. Dwg. No. 11391-X). At the Projector Unit end of the cable, there is a female 8-pin connector (Impulse Model LPMIL-8-FS). At the end of the cable that interfaces with the Bluefin-supplied Pressure Vessel, there is a male connector (Impulse Model MCIL-8-MP). The connections are shown in Table 3-1.

Pin 1	Pin 2 of id Chip (Negative)
Pin 2	Pin 1 of id Chip (Positive)
Pin 3	Not Used
Pin 4	Not Used
Pin 5	Transmit Drive Voltage (Positive) in Parallel with Pin 7
Pin 6	Transmit Drive Voltage (Negative) in Parallel with Pin 8
Pin 7	Transmit Drive Voltage (Positive) in Parallel with Pin 5
Pin 8	Transmit Drive Voltage (Negative) in Parallel with Pin 6

Table 3-1. TC 2158 Electrical Interface Connections



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4. Interface Between TC 2159 Projector Unit and the Ocean

4.1 Acoustical Interface

The TC 2159 Projector Unit generates an acoustic signal in the water column beneath the AUV. The signal is coupled to the water through a polyurethane window. The characteristics of this signal are shown in Table 4-1.

Frequency	100 kHz
Along-Track Beamwidth (-3 dB)	2° @ 100 kHz
Across-Track Beamwidth (-3 dB)	150° @ 100 kHz
Maximum Sound Pressure Level	+220 dB re 1 μ Pa at 1 meter
Waveform	Gated CW
Maximum and Minimum Pulse Length	100 and 67 microseconds
Maximum and Minimum Pulse Repetition Rate	40 pulses/second

Table 4-1. TC 2159 Projector Unit Outputs

4.2 Physical Interface to the Environment

The TC 2159 Projector Unit interfaces with the ocean through a polyurethane acoustic window affixed to an aluminum base.

When mounted in the AUV, the TC 2159 will successfully withstand exposure to 6,500 meters depth (9,250 psi hydrostatic pressure). It will operate within specifications at depths to 6,000 meters (8,540 psi).



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5. Interface Between TC 2159 Projector Unit and the AUV

5.1 Mechanical Interface

The mechanical interface of the TC 2159 100 kHz Projector Unit is identical to that of the TC 2158 Projector Unit described in Section 3.1. This interchangeability allows Thales to reconfigure the AUV easily between missions.

5.2 Electrical Interface

The electrical interface of the TC 2159 100 kHz Projector Unit also is identical to that of the TC 2158 Projector Unit (described in Section 3.2). This interchangeability allows Thales to reconfigure the AUV easily between missions. All 7100 system LRUs contain an ID chip, which allows the ICPU to sense which Projector Unit has been connected and to select the appropriate parameter set automatically.



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6. Interface Between EM 7201 Receiver Unit and the Ocean

6.1 Acoustical Interface

The EM 7201 Receiver Unit receives acoustic signals from the water column beneath the AUV and forms them into narrow beams that sector 150 degrees wide. The acoustic signals are received through a polyurethane window that surrounds the structure. The beams of the EM 7201 have the following characteristics, as shown in Table 6-1.

Characteristic	Parameter	Parameter
Frequency	200 kHz	100 kHz
Altitude range	5 meters to 500 meters	5 meters to 500 meters
Number of beams across track	320 beams	160 beams
Vertical beamwidth (along track)	27 degrees (-3 dB)	27 degrees (-3 dB)
Across-track coverage	150 degrees	150 degrees
Horizontal beamwidth (across track)	1 degree (-3 dB)	2 degrees (-3 dB)

Table 6-1. EM 7201 Acoustical Interface

6.2 Physical Interface to the Environment

The EM 7201 Receiver Unit interfaces to the ocean through a polyurethane acoustic window bonded to an aluminum base.

When mounted in the AUV, the EM 7201 will successfully withstand exposure to 6,500 meters depth (9,250 psi hydrostatic pressure). It will operate within specifications at depths to 6,000 meters (8,540 psi).



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7. Interface Between EM 7201 Receiver Unit and the AUV

7.1 Mechanical Interface

The EM 7201 Receiver Unit is shown in Figure 7-1, along with the TC 2158 Projector Unit. The EM 7201 is packaged as a 21" (533.4 mm) outer diameter hollow cylinder 122 mm high. In air, the EM 7201 weighs 33 ± 2 kg (TBR). In water, it weighs 19 ± 2 kg (TBR). The center of gravity is 5 mm (TBR) below the center line. Dimension detail is shown in Figure 7-4.



Figure 7-1. EM 7201 Receiver Unit and TC 2158 Projector Unit

Receiver EM 7201:	
Housing Materials:	Aluminum (AlMg5), hard anodized and painted. Delrin, Polyurethane
Temperature range	-30°C to +70°C
Depth rating:	6,000 meters operational (8,540 psi) 6,500 meters survival (9,250 psi)

Figures 7-2 and 7-3 show a small oil reservoir that is used to equalize the pressure within the housing. The location shown is TBR, and can still be relocated if required. Mounting it in the location shown produces the best center of gravity.

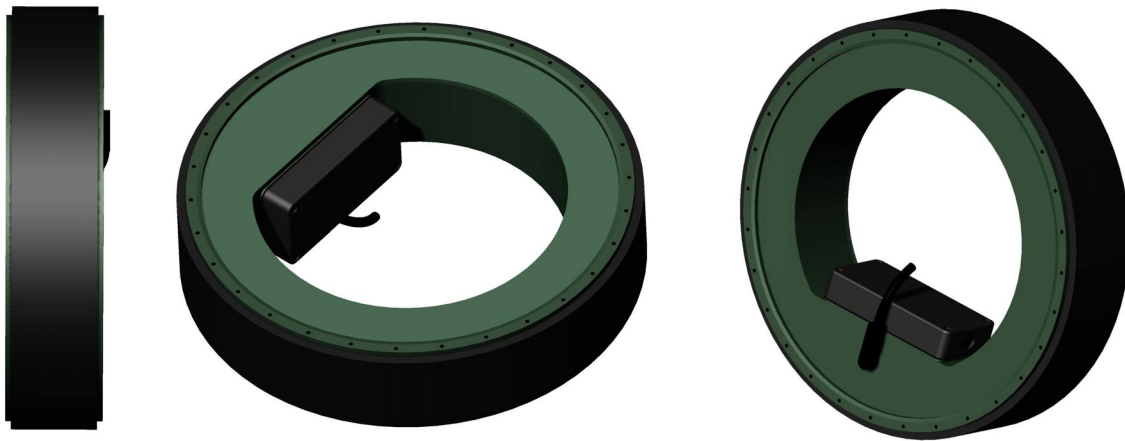


Figure 7-2. EM 7201 Receiver Unit

Note: The box on the back is for pressure equalization, and could be placed elsewhere. The connection between the box and the receiver unit would then be through a hose or pipe.

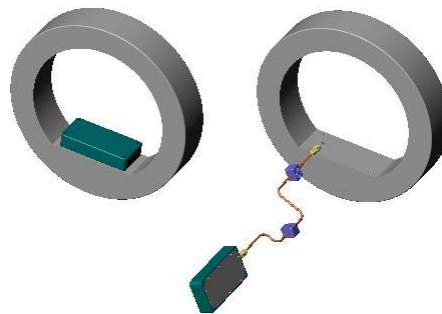


Figure 7-3. Possible Pressure Equalization Reservoir Installations

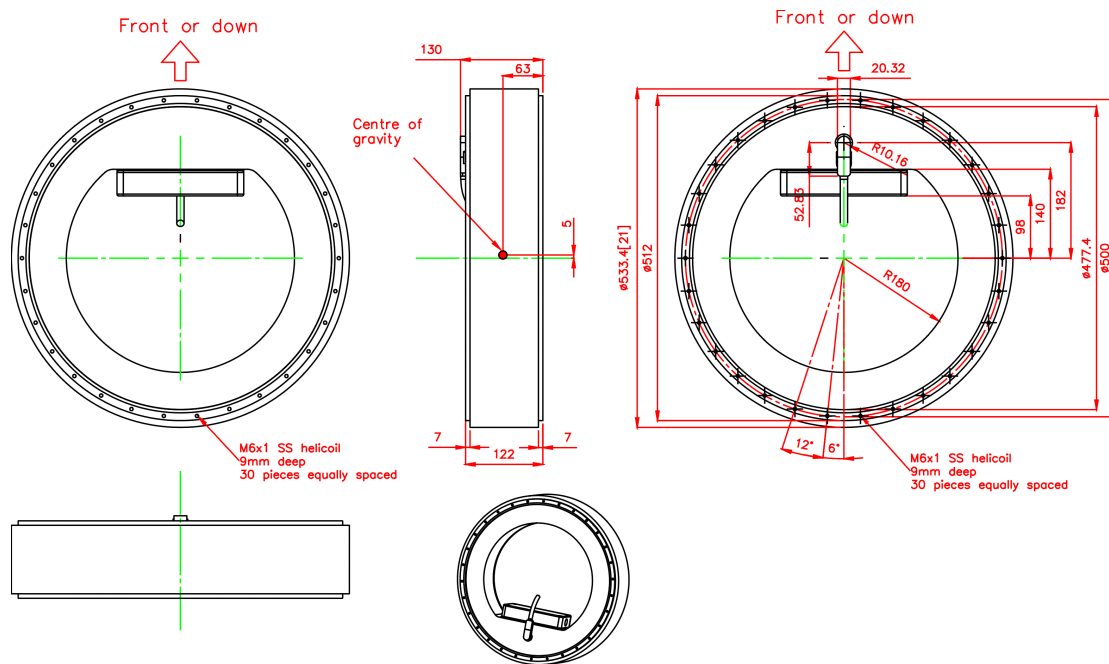


Figure 7-4. Outline Dimensions of EM 7201 Receiver Unit

The unit is shown with the external oil reservoir placed directly on the housing. Notice the arrow indicating orientation of the receiver. Center of gravity is still TBR but very close. Except for the 2x30 pieces of M6 threaded holes equally spaced on a 500 mm diameter, there will be no additional holes for suspension.

Figures 7-5 through 7-7 show how the EM7201 Receiver Unit is supposed to be installed on the AUV.

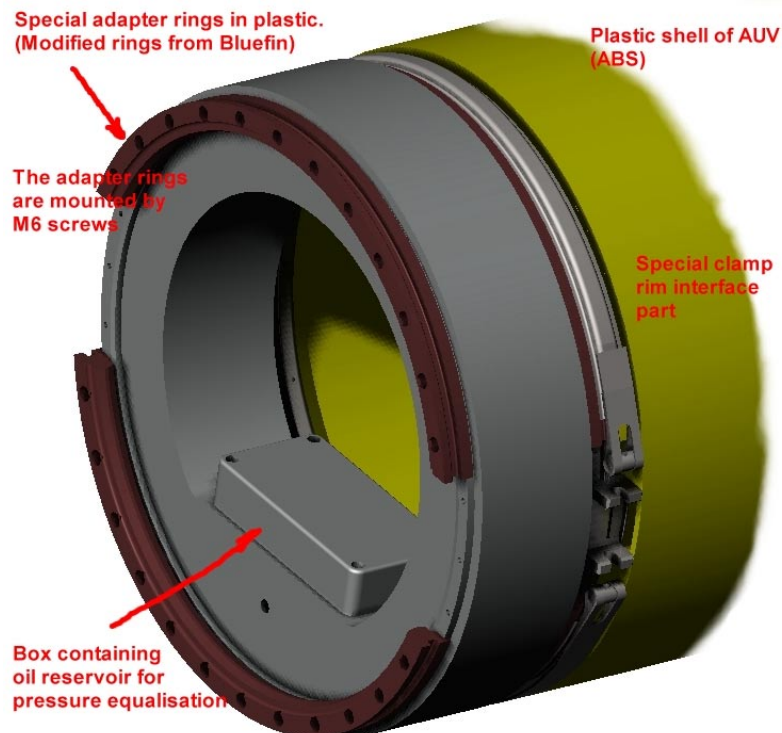


Figure 7-5. Special Adapter Rings

Note: It is likely that a fiber-reinforced plastic material will be used as the interface between the AUV section rings. Figure 7-6 shows how the sections are put together.

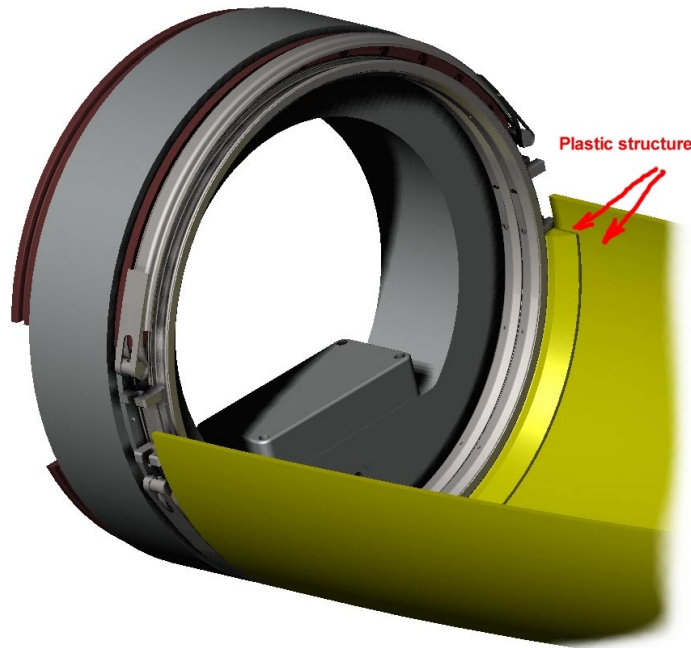


Figure 7-6. Assembly Method

Bicycle rims are welded together and combined with a special tension band, which holds the sections together. Due to the very large cross-sectional area, the plastic is sufficiently strong to carry the load. One advantage of this approach is that the receiver unit is electrically insulated from the AUV structure. Another advantage is that the plastic rings are unlikely to damage the surface of the housing.

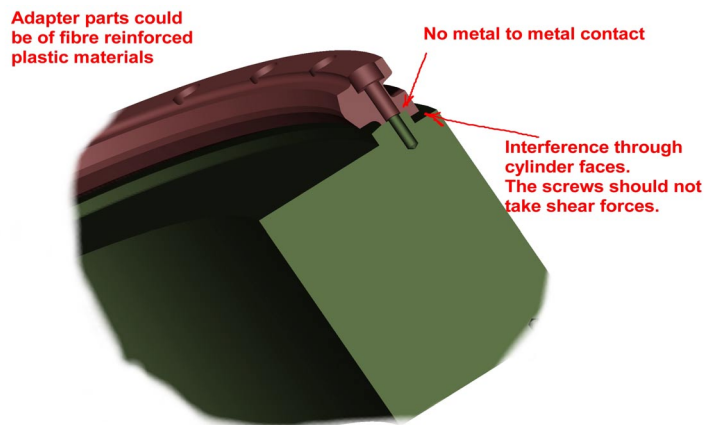


Figure 7-7. Interface Between Housing and Adapter Rings

The shear force at the interface between the housing and the ring will be carried by cylinder-face interference. The screws will not take shear forces.



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7.2 Electrical Interface

The EM 7201 Receiver Unit interfaces electrically to the AUV through a single cable (RESON, Inc. Dwg. No. 11392-X). At the Receiver Unit end of the cable, there is a male 8-pin connector (Impulse Model LPMIL-8-MP). At the end of the cable that interfaces with the Bluefin-supplied Pressure Vessel, there is a female connector (Impulse Model MCIL-8-FS).

The connections are as follows:

Pin 1	Received Signal (Positive)
Pin 2	Received Signal (Negative)
Pin 3	Control Signals (Positive)
Pin 4	Control Signals (Negative)
Pin 5	DC Power (Positive)
Pin 6	DC Power (Negative)
Pin 7	Sense Signal
Pin 8	Common

Table 7-1. Receiver Unit Pinout



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8. Interface Between 7-I Integrated Processor and Control Unit and the AUV

8.1 Assumptions and Unknowns

8.1.1 Electronics Housing Dimensions

The preliminary ICPU design assumes that the inner diameter of the Bluefin-provided Electronics Pressure Housing is at least 11.0 inches (279.4 mm) and that the length of the cylindrical portion of the housing is at least 16.0 inches (406.4 mm). These dimensions allow 0.5 inches at each end of the cylinder for the pressure seal to the end caps.

This design, and the interface to the Bluefin Pressure Housing, cannot be finalized until final pressure housing drawings have been received.

8.1.2 Internal Interconnect Cables

It is assumed that all eight (8) bulkhead connectors and unterminated cables from the inside of the Bluefin-provided pressure housing will be provided to RESON as part of the housing. For test purposes, it will be necessary for Bluefin to provide RESON with a 1 meter long test cable of each type no later than **TBD**.

All of the information currently possessed by RESON regarding pinout of the internal interconnect cables is shown on the System Block Diagram (RESON Drawing 11391 Revision P1, dated 10 July 2001), provided as Appendix A. **We still need the pinout data for connector 6).**

8.2 Mechanical Interface

The 7-I Integrated Processor and Control Unit is housed within a pressure housing provided by Bluefin. The preliminary dimensions of the ICPU (including the EdgeTech electronics) are: OD = 11 inches and length 15 inches.

Roy – Need to describe the package, and how it is mounted. - Can't. Still the subject of much discussion with Bluefin. Not yet defined.

8.3 Electrical and Power Interfaces

8.3.1 Electrical Interface

Both the RESON electronics and the EdgeTech SSS electronics are connected to a single Ethernet hub that provides the interface to the Thales controller through node 2 and to the Shipboard Data Docking System through node 3. The network ports are connected to separate



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Impulse MHDL-16-BCR connectors. Node 3 is connected to connector number 8. Node 2 is connected to connector number 2. The following pin connections are assumed:

Pin	MHDL-16-BCR	Function
1	Ethernet Transmit (Positive)	Connects to RJ45, Pin 1 in MEH
2	Ethernet Transmit (Negative)	Connects to RJ45, Pin 2 in MEH
3	Ethernet Receive (Positive)	Connects to RJ45, Pin 3 in MEH
4	Ethernet Receive (Negative)	Connects to RJ45, Pin 6 in MEH
5	RS 232 Transmit	
6	RS 232 Receive	
7	RS 232 Common	
8	Sonar PPS	
9	Sonar Doppler Velocity Log (DVL) Trigger	
10	Sonar PPS/DVL Common	
11	Spare	
12	Shield/Chassis	
13	Battery Buss Common	
14	Battery Buss +48 Vdc	
15	Battery Buss +48 Vdc	
16	Battery Buss Common	

Table 8-1. ICPU Connections

8.3.2 Power Interface

The ICPU requires +48V DC, TBD amperes, at pins 14 and 15 of connector number 2.



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8.3.3 Data Interface

The SeaBat™ 7100 sonar offers a wide variety of data formats for different input and output tasks. The data output formats, remote control formats, hardware trigger specification, software triggers, and network packet formatting are described in Attachment A.