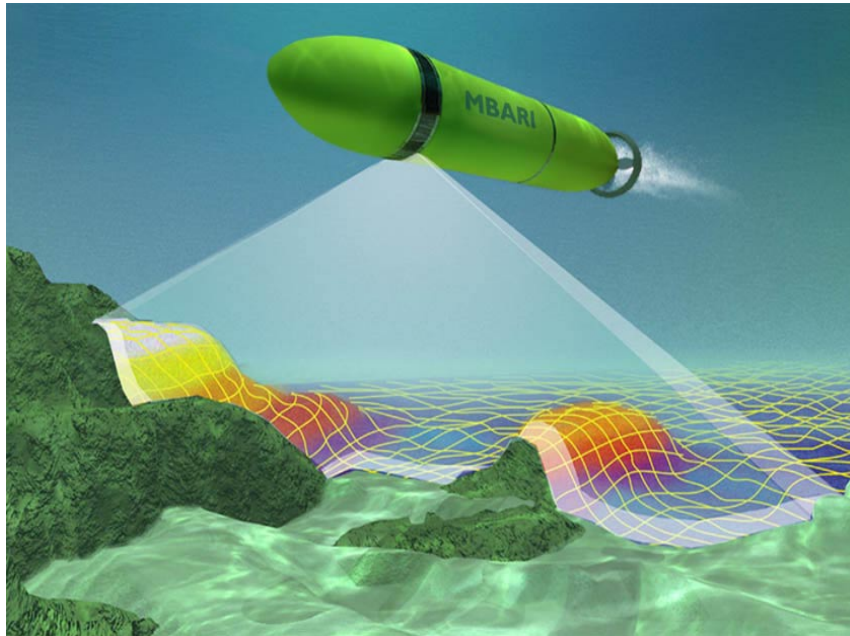


# **Preliminary Interface Control Document for MBARI AUV**



**August 3, 2001**

**Prepared by**

**RESON Inc.  
Goleta, CA**



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

Project: MBARI  
Date:8/03/01

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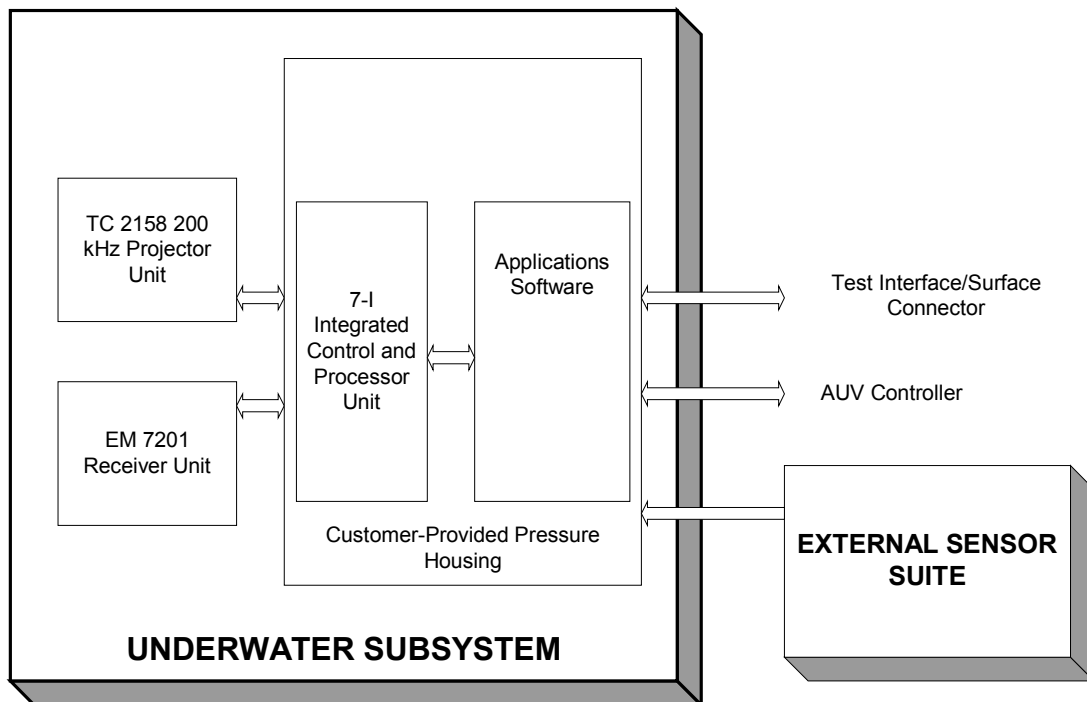
## REVISION HISTORY

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## 1 Scope

This Interface Control Document (ICD) specifies the design of all interfaces between the MBARI Autonomous Underwater Vehicle (AUV) and the RESON SeaBat™ 7100 system. The SeaBat 7100 Sonar System comprises three (3) Line Replaceable Units, as shown in the top level SeaBat 7100 System Block Diagram, Figure 1-1. These are:

- 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.
- 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.



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



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The following SeaBat 7100 interfaces are defined in this document:

- 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 EM 7201 Receiver Unit and the Ocean  
Acoustical and Physical
- 4) Interfaces between the EM 7201 Receiver Unit and the AUV  
Mechanical and Electrical
- 5) 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.



## **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. This signal has the following characteristics.

|                                  |                                      |
|----------------------------------|--------------------------------------|
| Frequency                        | 200 kHz                              |
| Along-Track Beamwidth (-3 dB)    | 1 degree @ 200 kHz                   |
| Across-Track Beamwidth (-3 dB)   | 150 degree @ 200 kHz                 |
| Maximum Sound Pressure Level     | +220 dB re 1 $\mu$ Pa at 1 meter     |
| Waveform                         | Gated CW                             |
| Maximum and Minimum Pulse Length | 100 microseconds and 33 microseconds |
| Maximum Pulse Repetition Rate    | 40 pulses/second                     |

**Table 2-1. Projector Unit Characteristics**

### **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 meter 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. It is 100 mm high, 100 mm wide, and 462 mm long. The weight in air is 13 kg, and the weight in sea water is 8 kg (TBR).

The TC 2158 Projector Unit interfaces to the AUV via four M10 x 1.5 15 mm 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.

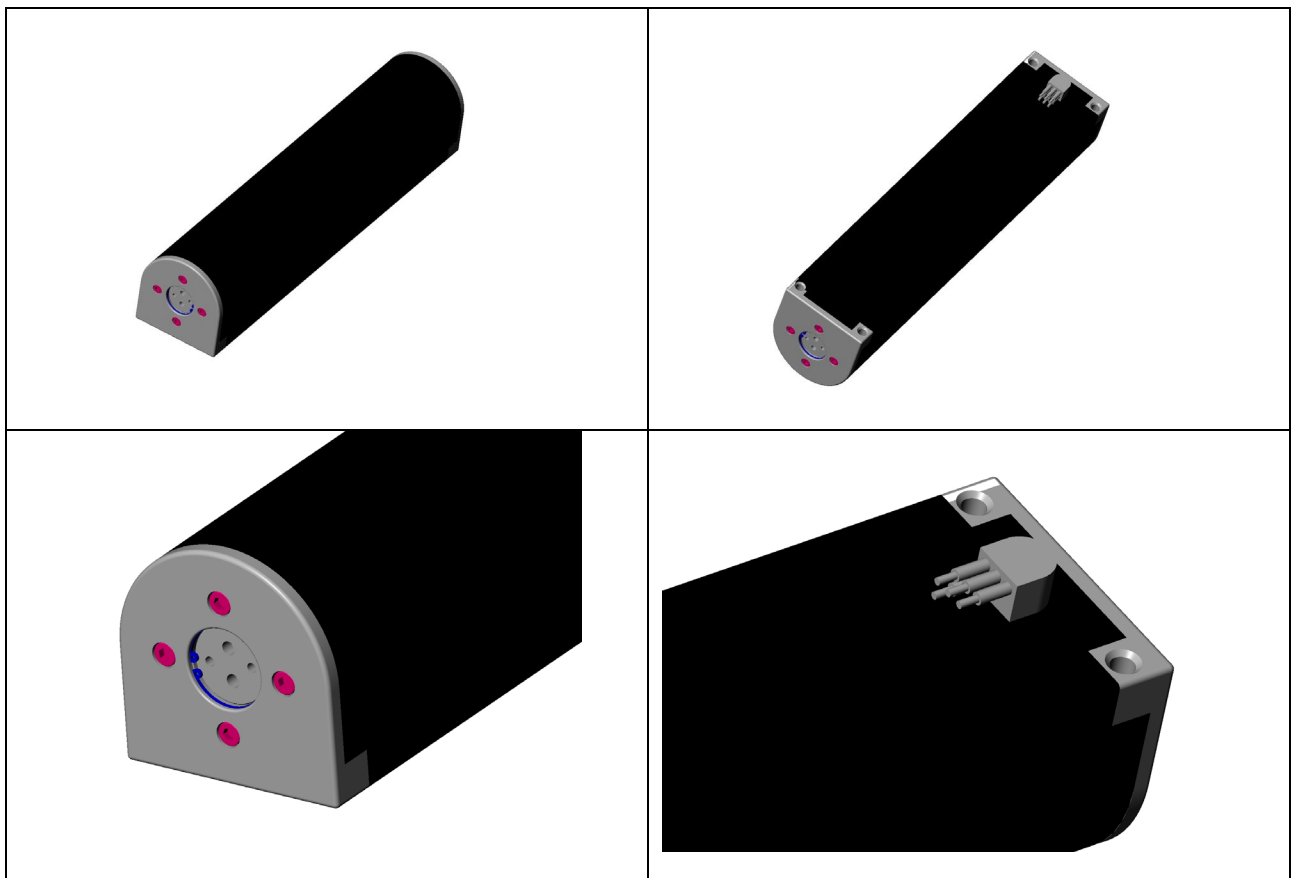
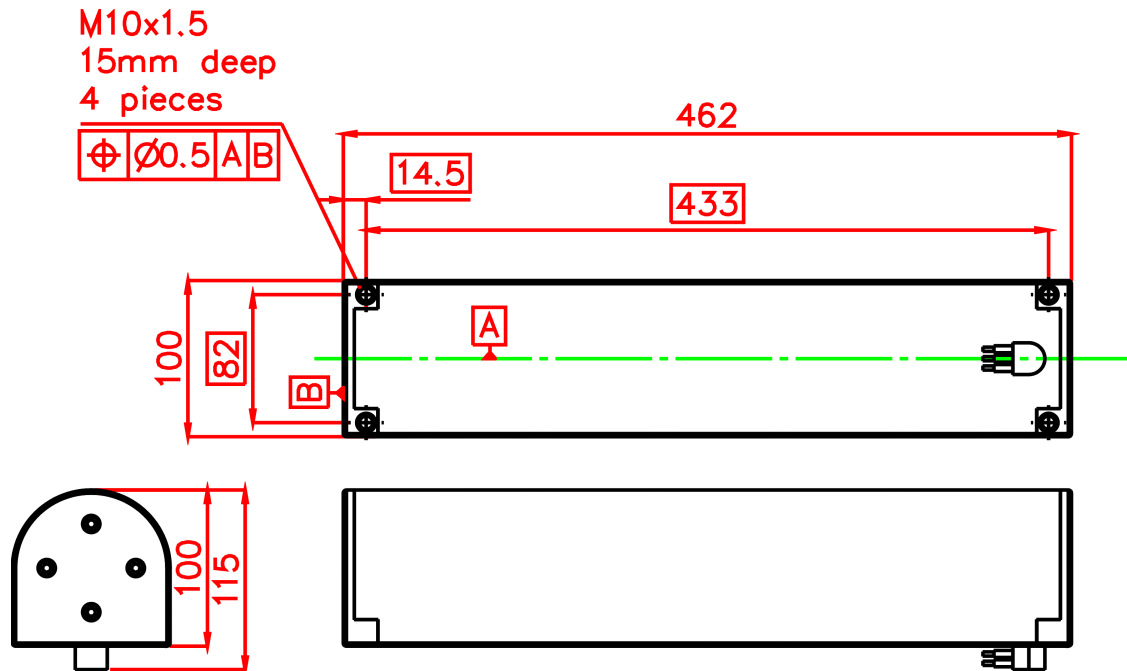


Figure 3-1. TC 2158 Projector Unit



**Figure 3-2. Outline Dimensions of 200 kHz Projector Unit TC 2158**

### 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, is a female 8-pin connector (Impulse Model LPMIL-8-FS). At the end of the cable that interfaces with the customer-supplied Pressure Vessel, there is a male connector (Impulse Model MCIL-8-MP). The connections are as follows:

|       |                                                          |
|-------|----------------------------------------------------------|
| 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. Projector Unit Connector Pinout**



## **4 Interface Between EM 7201 Receiver Unit and the Ocean**

### **4.1 Acoustical Interface**

The EM 7201 Receiver Unit receives acoustic signals from the water column beneath the AUV and forms them into narrow beams that cover a 150-degree wide sector. The acoustic signals are received through a polyurethane window that surrounds the structure. The beams formed by the EM 7201 have the following characteristics.

| <b>Characteristic</b>                | <b>Parameter</b>       |
|--------------------------------------|------------------------|
| Frequency                            | 200 kHz                |
| Altitude range                       | 5 meters to 500 meters |
| Number of beams across-track         | 320 beams              |
| Vertical beam width (along track)    | 27 degrees (-3 dB)     |
| Across-track Coverage                | 150 degrees            |
| Horizontal beam width (across track) | 1 degrees (-3 dB)      |

**Table 4-1. Receiver Unit Characteristics**

### **4.2 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).

## 5 Interface Between EM 7201 Receiver Unit and the AUV

### 5.1 Mechanical Interface

The EM 7201 Receiver Unit is shown in Figure 5-1, along with the TC 2158 Projector Unit. The EM 7201 is packaged as a 21" (533.4 mm) outer diameter hollow cylinder that is 122 mm in height. In air, the EM 7201 weighs  $33 \pm 2$  (TBR) kg. In water, it weighs  $19 \pm 2$  (TBR) kg. The center of gravity is 9 (TBR) mm below the center line. Dimension detail is shown in Figure 5-4.

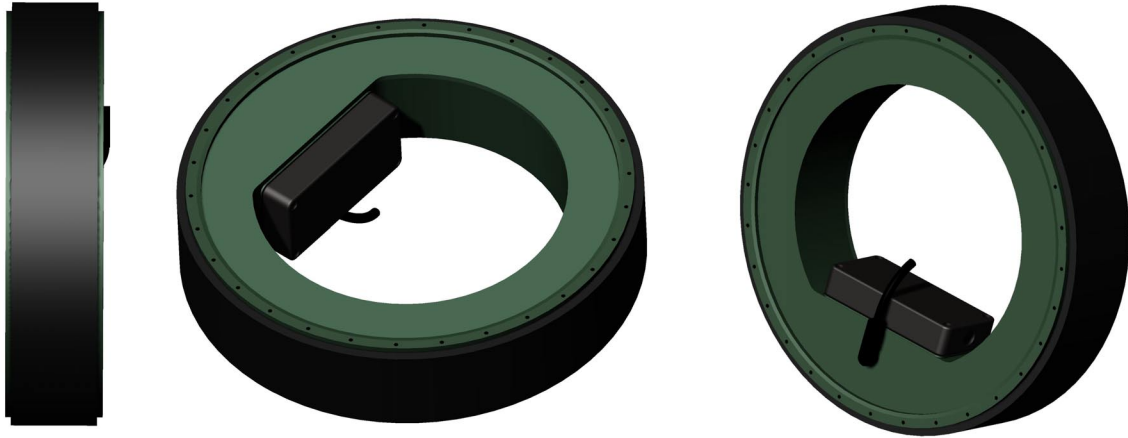


**Figure 5-1. EM 7201 Receiver Unit and TC 2158 Projector Unit**

| <b>Receiver EM 7201:</b> |                                                                           |
|--------------------------|---------------------------------------------------------------------------|
| Housing materials:       | Aluminum (AlMg5), hard anodized and painted.<br>Delrin, polyurethane.     |
| Temperature range        | -30°C to +70°C                                                            |
| Depth rating:            | 6,000 meters operational (8,540 psi)<br>6,500 meters survival (9,250 psi) |

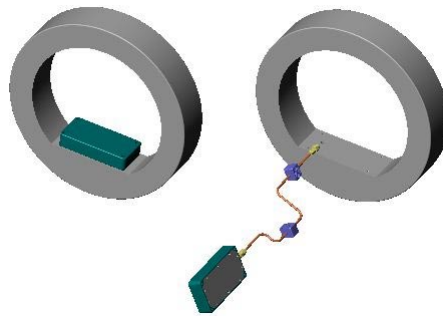
**Table 5-1. Receiver Unit Properties**

Figures 5-2 and 5-3 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.

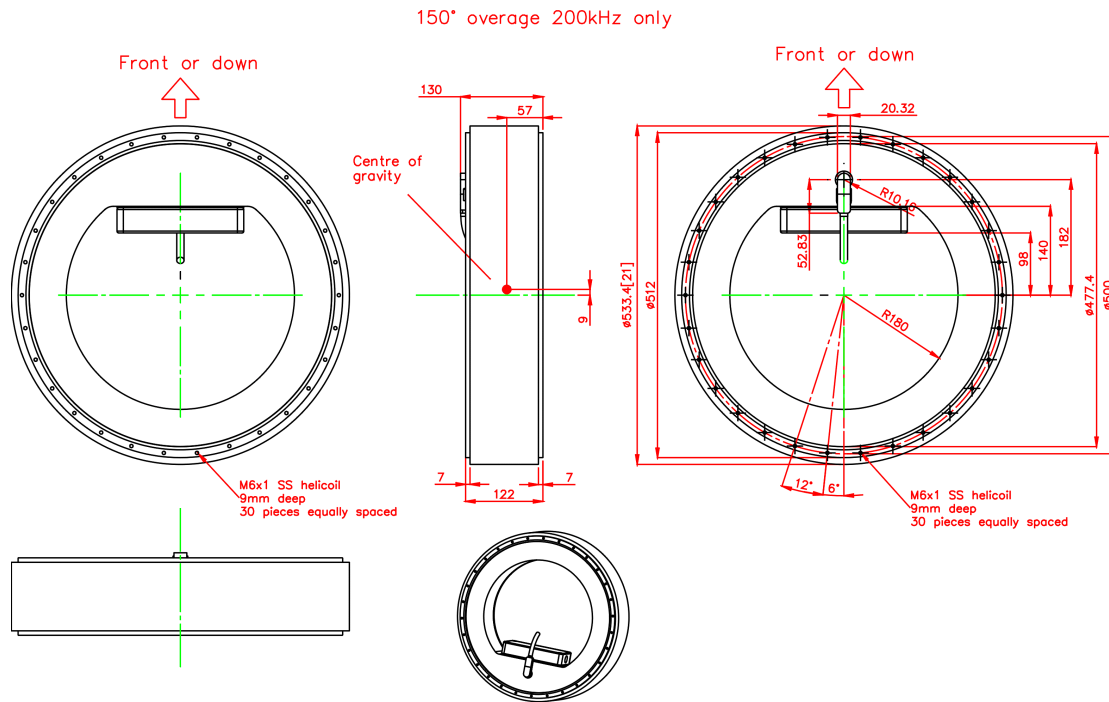


**Figure 5-2. EM 7201 Receiver Unit**

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



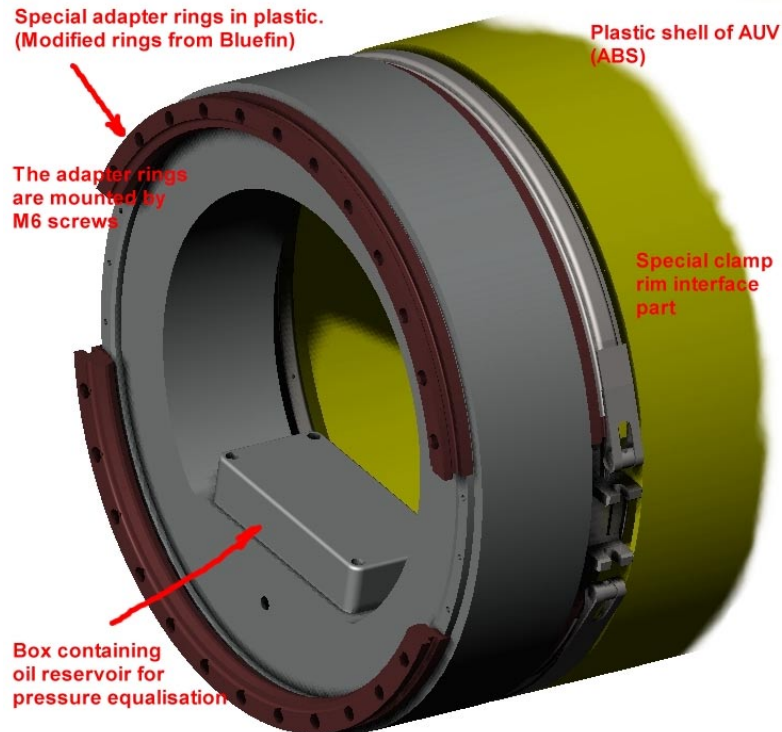
**Figure 5-3. Possible Pressure Equalization Reservoir Installations**



**Figure 5-4. Outline Dimensions of EM 7201 Receiver Unit**

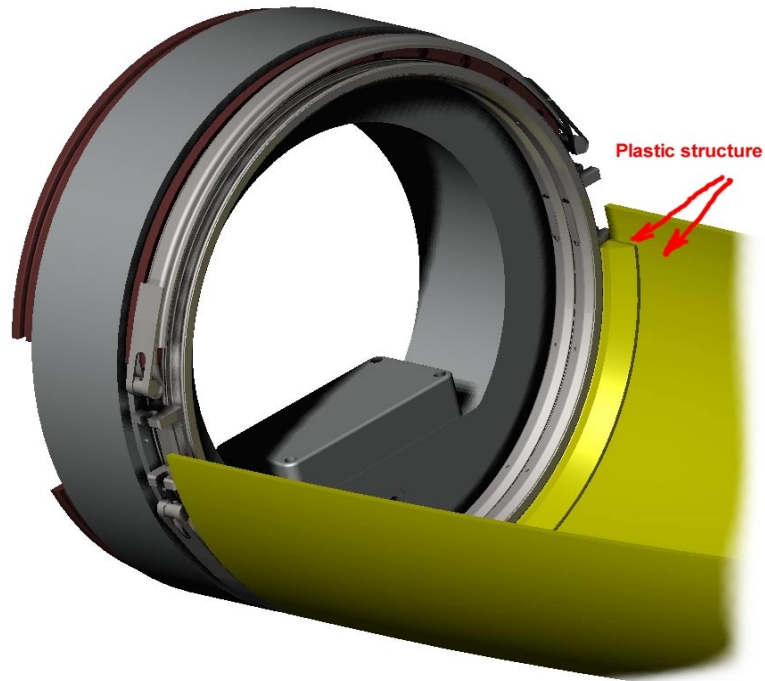
In Figure 5-4, the unit is shown with the external oil reservoir placed directly on the housing. Notice the arrow indicating orientation of the receiver. Center of gravity is still TBR, but very close to the ultimate value. Except for the 2 x 30 pieces of M6 threaded holes equally spaced on a diameter of 500mm, there will be no additional holes for suspension.

Figures 5-5 through 5-7 show how the EM 7201 Receiver Unit is supposed to be installed on the AUV.



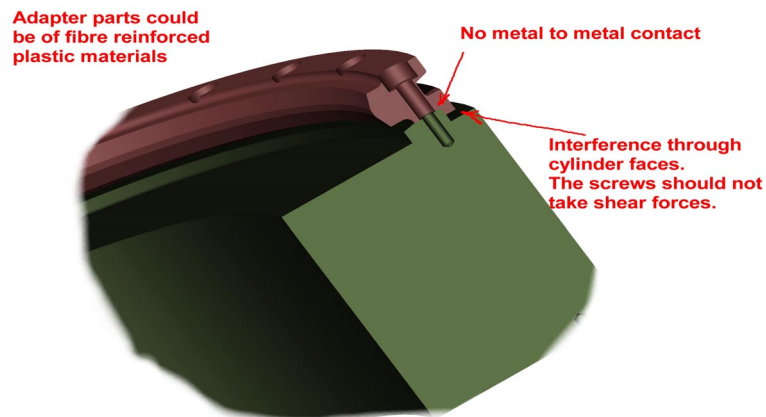
**Figure 5-5. Adapter Ring Interface**

**NOTE:** Special adapter rings (most likely a fiber-reinforced plastic material) will be used as interfaces between the AUV section rings. Figure 5-6 shows how the sections are put together.



**Figure 5-6. Tension Band Assembly View**

Bicycle rims are welded together and combined with a special tension band, which holds the sections together. Due to the 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 housing surface.



**Figure 5-7. 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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## **5.2 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 customer-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 5-2. Receiver Unit Pinout**



## 6 Interface Between 7-I Integrated Processor and Control Unit and the AUV

### 6.1 Assumptions and Unknowns

#### 6.1.1 Electronics Housing Dimensions

The preliminary ICPU design assumes that the inner diameter of the customer-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. **Note: Assumed same as Thales.**

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

#### 6.1.2 Internal Interconnect Cables

It is assumed that all **quantity TBD** bulkhead connectors and unterminated cables from the inside of the Customer-provided pressure housing will be provided to RESON as part of the housing. For test purposes, it will be necessary for MBARI 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. **Note: Data represents the THALES configuration. MBARI external sensors still TBD.**

### 6.2 Mechanical Interface

The 7-I Integrated Processor and Control Unit is housed within a pressure housing provided by MBARI. The preliminary dimensions of the ICPU are: OD = 6 inches and length 15 inches.

**Roy – Need to describe the package, and how it is mounted. - Can't. Not yet defined. Need more data on housing pressure deformation.**



## 6.3 Electrical and Power Interfaces

### 6.3.1 Electrical Interface

The RESON electronics are connected to a single Ethernet hub that provides the interface to the MBARI controller through node 2 and to the Shipboard Data Docking System through node 3. The network ports are connected to separate 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)             |
| 2   | Ethernet Transmit (Negative)             |
| 3   | Ethernet Receive (Positive)              |
| 4   | Ethernet Receive (Negative)              |
| 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 6-1. Pinout of Connector Number 2 and 8

### 6.3.2 Power Interface

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

### 6.3.3 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 all described in Attachment A.