INDUCTIVE TELEMETRY SYSTEM INTERFACE CONTROL DOCUMENT

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Document Control Sheet

Version	Date	Description	Originator
0-01	2011/01/24	Initial Draft	K. McMonagle, J. Lund
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Table of Contents:

1 Introduction

1.1 Identification

This Interface Control Document (ICD) applies to the interfaces of the inductive telemetry system for the Global Surface Moorings, Global Sub-surface moorings, Global Hybrid Profiler moorings and Coastal Wire Following Profiler moorings.

1.2 Ocean Observatories Initiative (OOI) System Overview

The Ocean Observatories Initiative (OOI) consists of sensors, networks, and support systems that will collect and make available ocean and seafloor data in a coordinated fashion to provide persistent observations over ranges of minutes up to years and decades. OOI will enable researchers to make simultaneous, interdisciplinary measurements to investigate a spectrum of phenomena including episodic, short-lived events (tectonic, volcanic, oceanographic, biological, and meteorological), and more subtle, longer-term changes and emergent phenomena in ocean systems (circulation patterns, climate change, ocean acidity, and ecosystem trends). For additional information on OOI, the reader is directed to the OOI Final Network Design (FND) document.

1.3 Document Scope and Organization

This document is organized into the following four sections:

1. Introduction – provides the scope, document organization and change control procedure for this document.
2. Related Documentation – cites other documents that provide input and reference for this ICD.
3. Description of Interfaces – provides details of the interfaces.
4. Notes – contains general information that aids in the understanding of this document.

1.4 Change Control

This Interface Control Document is subject to the policies and procedures called out in the OOI Configuration Management Plan, 1000-00000, Section 3 and the CGSN CMP (3101-00047). Changes to the released version of this document may only be made via an Engineering Change Request (ECR) that has been approved by the CGSN Change Control Board (CCB).

The most recent document revision of this ICD maintained in the OOI Document Management System (DMS) is the authoritative version, as printed hard copies are not controlled. Prior revisions of this document may be maintained in the OOI DMS for reference reasons, but are not authoritative.

2 Related Documentation

2.1 Parent Documents

The following documents are the parents from which this document's scope and content derive:

N/A	L4 CG Telemetry System Requirements Module
3312-00013	Inductive Modem module Specification

2.2 Reference Documents

The following documents or drawings are referenced herein and are directly applicable to this document. In the event of conflict between any of these documents and this ICD, this document shall take precedence.

2.3 Informational Documents

The following documents amplify or clarify the information presented in this document, but are not binding.

Sea-Bird Inductive Modem Module (IMM) User's Manual. Version 1.09, 2008-09-10.
Sea-Bird Electronics Application Note No. 92

3 Description of Interfaces

3.1 Overview

The inductive modem (IMM) is part of an underwater telemetry system which is critical to the realization of the mission objectives, which includes near real-time access to data measured by instrumentation below the water. The interfaces involved are electrical and mechanical and transmit standard serial data. The electronic components involved are the inductive modem contained within the buoy or separate remote pressure vessel, the inductive sensors mounted to the mooring riser, and the mooring riser itself. The inductive modem serves to transmit the sensor data to the main data logger and other telemetry systems (Figure 1).

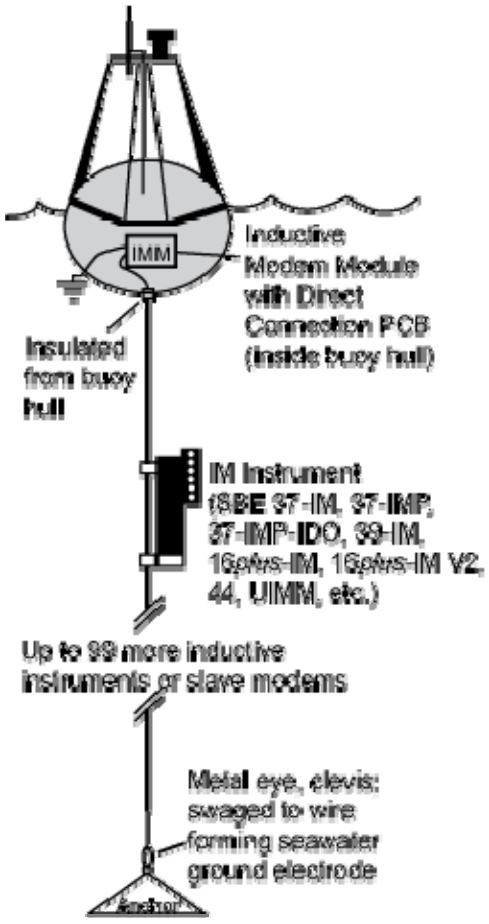

Figure 1: Typical inductive mooring configuration (SeaBird Application Note 92) where the application uses a direct connection to the IMM and does not use an inductive coupler.

3.2 IMM – Inductive Modem module interface

The inductive modem module and the IMM adapter PCB are housed within the buoy well in close proximity to the STC (profiler mooring) or Platform controller (platcon). The modem module connects to the supporting adaptor board via the 10-pin connector and four 2-56 machine screws. The adapter board is mounted using standoffs and four 4-40 machine screws in either a box or board that resides close to the STC or platform controller.

3.2.1 Electrical

The inductive modem uses the mooring riser as an isolated current loop. The top and bottom of the mooring riser are in contact with the sea water making an effective electrical ground hence completing a 'loop' (Figure 2). Transformers in the instruments and on the IMM Adaptor PCB are magnetically coupled to the mooring cable and induce a small current in the mooring riser strength member. A signal is modulated and demodulated using DPSK (Differential Phase Shift Keying) to transmit the data along the riser 'loop'. This technique takes advantage of the mooring cable strength member and saves the designer the need to include complicated and expensive cabling to individual sensors.

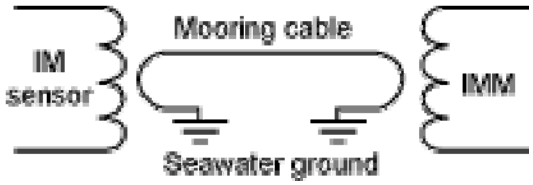

Figure 2: Schematic of the inductive coupling between the sensors and the IMM in the buoy (Application Note No. 92).

The modem requires 6-30 Volts DC input. Detailed power requirements and estimations of power consumption are detailed in the section 13 of the manual (See Appendix B).

The direct connect method of wiring is facilitated by using the Adaptor PCB. Included on the board is a transformer (T1) which eliminates the need to use an inductive cable coupler (ICC). As shown in Table 1, the seawater ground and mooring riser conductors are directly connected to J5 pins 1 and 2 using a SubConn underwater connector.

Table 1: 41546 PCB Adaptor Board Connections

Connector	Solder Pad Label	Description
	IM Flag	Hardware Handshake signal. Pull down only. 100ohm series resistor and 330pF load. Static protected with 12V TVS.
J1-1	GND	Power supply return
J1-2	+V in	6-24 Volts (30 Volt Max)
J1-3	Host Flag	Hardware Handshake signal. 1.5V to 12V input with internal 4.7K series resistor.
J2-2	TX to PC	Serial transmit
J2-3	RX from PC	Serial receive
J5-1	Inductive Loop 1	Seawater return
J5-2	Inductive Loop 2	Inductive loop (mooring strength member)

Table 2: 41546 PCB Board Jumper Settings

Jumper	Function
JP2 & JP3	Install to remove T1 from the inductive loop
JP2 & JP3	Remove jumper to employ T1 in inductive loop (deployed setting)
JP1	Install jumper to remove R1 (1K Ohm) from inductive loop (deployed setting)
JP1	Remove jumper to employ R1 (1K Ohm) in the inductive loop

Below shows a diagram of the serial communication and handshaking interface suggested by the manufacturer.

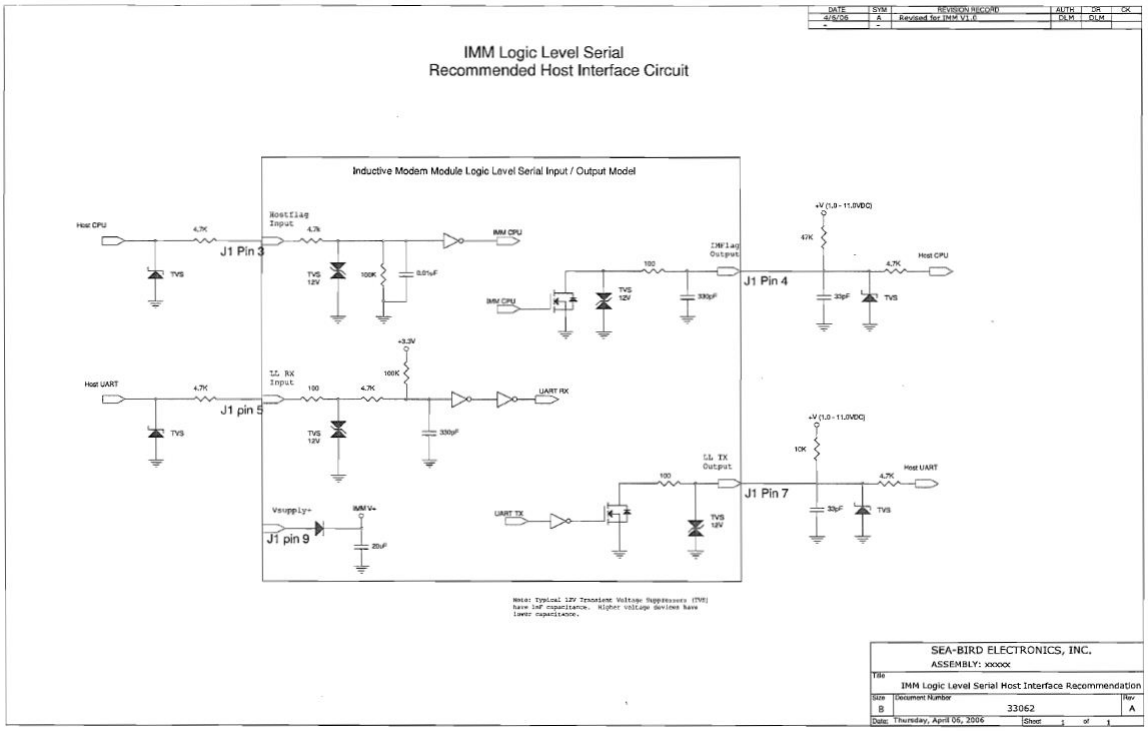

Figure 3: Suggested logic level Serial Host Interface

3.2.2 Mechanical

Figure 4 shows the Inductive Modem Specifications including the mechanical details and hole patterns of the modem module. The IMM plugs into the 10 pin female connector (J3) on the IMM Adaptor Board and is held in place with four 3/8" 2-56 screws at each corner (Figure 5). The IMM and the adaptor board together are photographed in Figure 6. The Adaptor board (2.5" X 4.25" X .75") is attached with standoffs and four 4-40 machine screws inside the buoy or pressure vessel. The adaptor board provides serial, power, and data connections. These connections can be made with the provided terminal blocks or solder points.

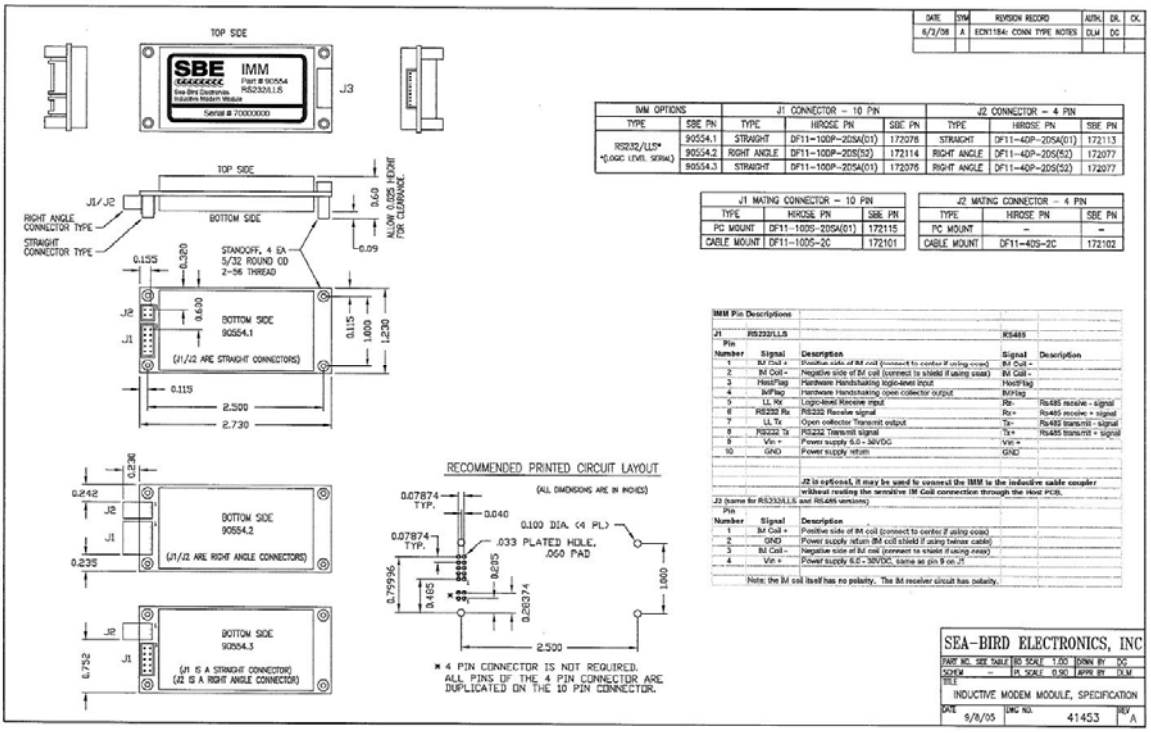

Figure 4: Seabird drawing of the Inductive Modem Module Specification.

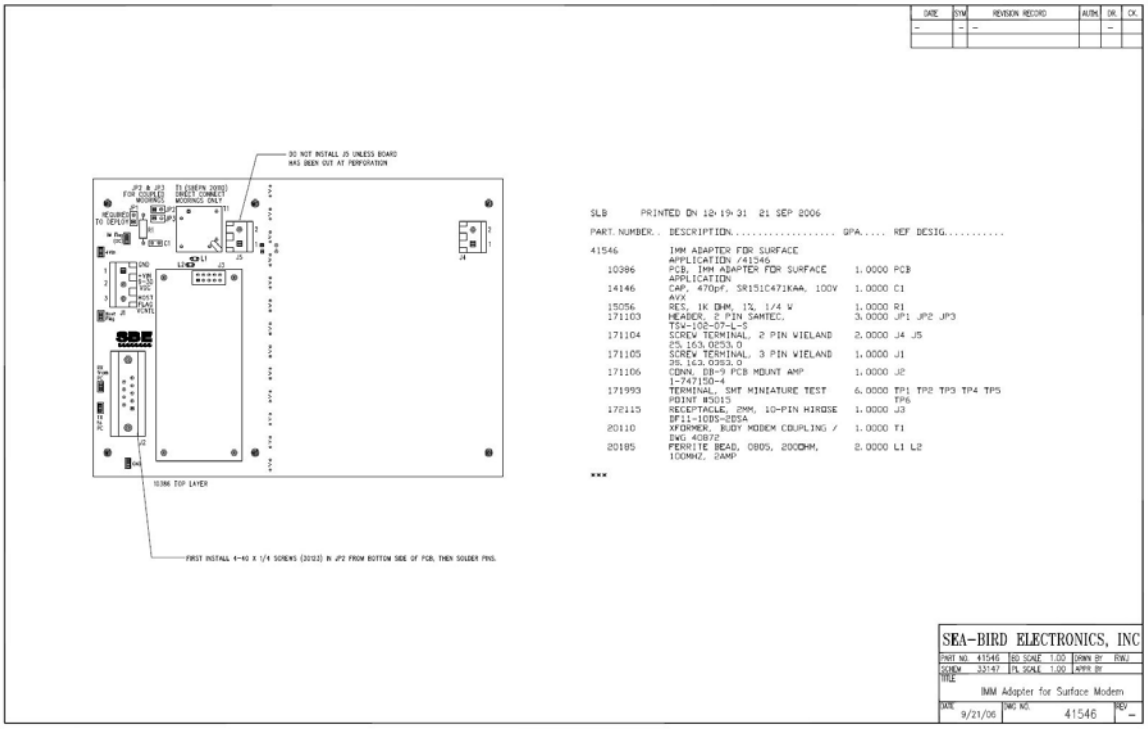

Figure 5: IMM adapter board seabird part number 41546. Note the board is perforated and only the left side of the board is used.

Figure 6: IMM attached to the Adapter Board.

As stated, the Inductive Modem technology takes advantage of the mooring riser strength member to transmit data. Jacketed wire used in mechanical riser components requires an inductive coupler or in the case of a direct connection, a specially designed termination to magnetically couple the instruments to the modem. The OOI program has elected to use a direct connect method. A special cable termination was designed which isolates the mechanical termination (ground) from the swaged cable connector (Figure 7). A standard underwater pigtail is potted into the mechanical termination to electrically connect both the seawater ground and the mechanical strength member. An 8-pin SubConn micro series pig tail is attached and potted into the termination. Since only 2 conductors are required the individual conductors of the 8 pin were bundled together to build in redundancy (Figure 8).

The 8-pin SubConn connector pinouts shall conform to the requirements of Table 3:

Table 3: 8-pin SubConn connector pinouts

Pin	Function
1	Seawater return
2	Seawater return
3	Seawater return
4	Seawater return
5	Inductive loop (mooring strength member)
6	Inductive loop (mooring strength member)
7	Inductive loop (mooring strength member)
8	Inductive loop (mooring strength member)

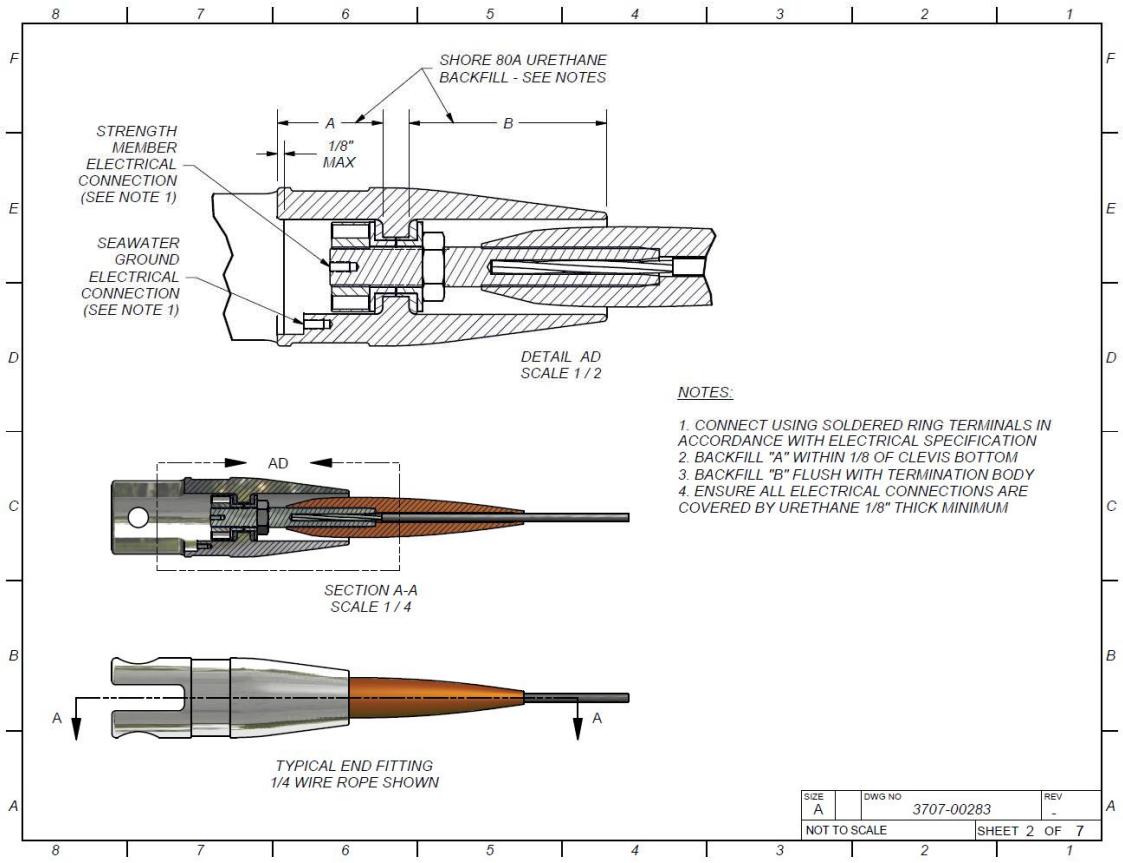

Figure 7: Special inductive termination isolates the strength member from the seawater ground (mechanical body).

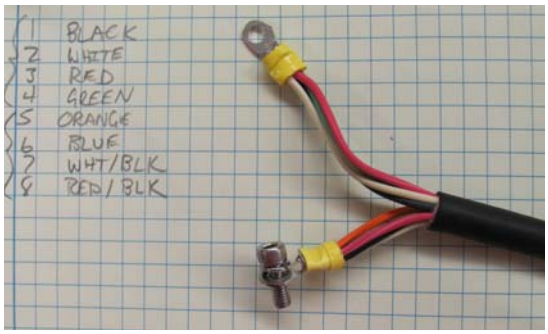

Figure 8: Conductors of the pigtail bundled together and crimped on to ring terminals. Four conductors each go to the strength member and the seawater ground.

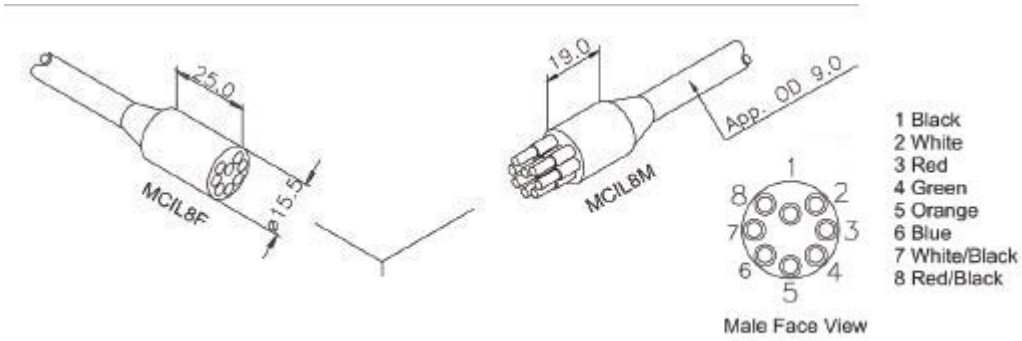

Figure 9: SubConn micro series pigtails are used to make waterproof connections between the riser and the buoy.

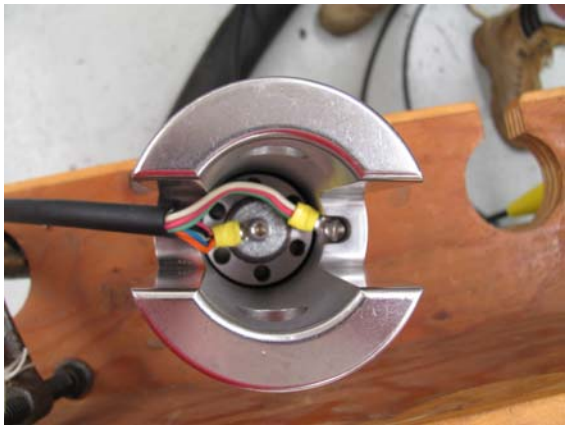

Figure 10: Photo showing the Inductive termination prior to potting with the underwater pigtail attached to the stud and the case or seawater ground. The stud is swaged to the strength member cable and is electrically isolated from the case using Delrin bushings.

3.2.3 Logical/Data

The IMM has several modes of operation in which commands can be sent to configure the IMM (host Service Mode). The IM Service mode executes valid commands until completed and returns a 'busy' reply to additional command sent including commands sent from the host. IM receive mode put the modem into a state that listens to the line for signals and if none are found returns to Sleep mode. Communication to the IMM and the attached instrumentation on the inductive line is covered in section 12 of the manual (see Appendix B). Command syntax and definitions are also explained.

3.2.4 Error Handling and Recovery

Does not apply to this interface.

3.2.5 Privacy and Security

Does not apply to this interface.

4 Notes

Does not apply to this interface.

5 Appendices

Appendix A. Sea-Bird Application Note No. 92
http://www.seabird.com/application_notes/AN92.htm

Appendix B. Inductive Modem Module (IMM) User's Manual version 1.09 2008-09-10 Firmware Version 1.09 and later.
http://www.seabird.com/pdf_documents/manuals/IMMSpec_011.pdf