

COMMERCIALLY CONFIDENTIAL



SCOPE OF SUPPLY
V2.0

Provision of an EdgeTech
120/410 Side Scan and
106 Sub-Bottom Profiler System
For use on an AUV

Customer:

MBARI

***** NOTE *****

Delivery schedule begins upon receipt of this signed Interface Control Document (ICD). Work will not commence without this acceptance.

Company: _____

Signed: _____ Date: _____

EdgeTech Ref.	SO 14386		
Version	Reason for Issue	By	Date
1.0	Customer Clarification and Approval	DMD	12/20/19
2.0	Changed voltage to 24v and added Opto Isolated Triggers. Added Hard Drive	DMD	12/20/19

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1.0 Project Outline

EdgeTech understands that the requirement is for a side scan/sub-bottom sonar system that can be fitted to a Customer AUV or similar. All drawings are found in Appendix A.

- The System is configured as a 120/410 kHz Side Scan with 106 Sub-Bottom Profiler
- No transducers are provided with this system. All transducers/extension cables will be Customer Furnished Equipment (CFE).
- The system is designed to operate over a voltage range of 20-36vdc (24vdc nominal).
- A Gigabit Ethernet interface is provided on the Main I/O
- A single **Optically Isolated** trigger is provided on the Main I/O.
- A single **Optically Isolated** trigger, bidirectional serial port and +12vdc/1amp interface is provided on a MCBH8F User Bulkhead.
- The electronics will be placed in a titanium pressure housing rated to 6000m
- All exterior sensors are rated to a minimum operating depth of 6000m.

2.0 Outstanding Issues

- a) System production cannot begin until a signed Scope of Supply (SOS) is received by the EdgeTech Representative. In order to ship the system on or before 01 April 2019, a signed SOS must be received by 10 January 2020.
- b) ~~Customer selection as to whether or not the Trigger interface should use Opto-Isolation (section 3.8)~~ **Optical Isolation is selected 12/20/19**

2.1 Outline Scope of Supply

The generalized Bill of Materials is provided in Table 2-1 and depicted in System Block Diagram 0023000_1.

BOM Number	Qty	Description
10	1	Electronics Chassis
50, 60	1	Documentation / Software
110,120,130	1	2205 Pressure Housing, Connector & Rear End Caps
190	1	Main I/O cable assembly (Power/Telemetry) to Electronics assembly J1 (TBD Assy)
200	1	Sub-Bottom Transmit Bulkhead Assy
230	1	Sub-Bottom Receive Bulkhead Assy
210	2	Sidescan Bulkhead Assy
220	1	User Interface (1xTrig, 1xCOM, +12vdc)
240	1	DBH13F Pigtail
260	1	MCIL8M Pigtail

Table 2-1. Bill of Materials (Overview).

Per Line 2 of the Sales Order, a spare electronics chassis will be provided. This populated chassis is identical to the chassis assembly (BOM #10) provided as part of the complete system. All boards will be mounted to the chassis and wired. The embedded CPU will be programmed in the same manner as the chassis assembly. No external bulkhead assemblies will be provided but the final Technical Guide will identify where the external bulkheads should be connected.

3.0 Customer Specific Scope of Supply

3.1 Estimated Power Consumption

External power is to be provided by the customer. The operational range is from a minimum of 20vdc to a maximum of 36vdc. At start-up, a 24vdc side scan and sub-bottom system will draw 3.2 amps (nominal) with an idle current (no transmission) of 1.8 amps. The system has an estimated average power rating of 60 watts while transmitting the lowest frequencies and longest pulse lengths. The nominal operating voltage is 24vdc.

EdgeTech internal power systems provide power to the system's signal amplifiers and hotel functions. Capacitors are used to provide on-demand power storage for the signal amplifiers. These capacitors are re-charged quickly in order to support the variety of repetition rates available. While the 2205's Power Supply Unit (PSU) handles the system's power distribution and the aforementioned capacitor charging, the user's power system must also be able to respond to the system's instantaneous current demands. An external power supply, with the above average ratings, may be insufficient if it droops during peak loads. An alternative to a larger power supply is to place an electrolytic storage capacitor on the output of the user's power supply to provide the instantaneous current. Typical external capacitor values are on the order of 20,000 to 40,000uf.

3.2 Estimated Range and Ping Rate

Side scan performance range can be affected by the environment (spherical spreading loss and temperature), vehicle altitude and array tilt relative to the horizontal. Using an altitude that is 10% of the estimated range and an array tilt of 26 degrees +/- 1 deg, the estimated ranges for this system are shown in Table 3-1. If these conditions are changed, the measurement range will be impacted. For example, if the array tilt is less than 26 degrees, the acoustic signal may impact the bottom at a greater range at the expense of not acoustically ensonifying the region beneath or in close proximity to the vehicle. However, a shallower angle may still not increase the actual horizontal range if the transmission loss (spherical spreading plus absorption) is too great. For angles greater than 26 degrees, the area beneath the vehicle will have greater emphasis but at the possible expense of range. It should also be noted that Temperature, Depth (Pressure) and Salinity impact the acoustic absorption, and in turn the operational range, to varying degrees based on the environmental conditions. EdgeTech can assist in determining the expected range based on a particular set of operational conditions.

Freq (kHz)	Max Range (m) (each side)	Pulse Width Used for Max Range	Maximum Ping Rate (Hz) (Max Operational Rate)
75kHz	800m	50.0 ms	30Hz @ PW=1ms
105	600	12.0	7.5 @ PW=4ms
120	500	16.0	15 @ PW=2ms
230	250	8.0	30 @ PW=1ms
410	180	4.9	75 @ PW=0.4ms
540	150	3.7	60 @ PW=0.5ms
850	75	2.8	75 @ PW=0.4ms
1610	40	1.12	250 @ PW=0.1ms

Table 3-1. 2205 SS Range Estimate

3.3 Pressure Housing

A 6000m pressure housing is provided with this system. The dimensional drawing for the pressure housing is depicted on drawing 0017887. Note that the end cap connector arrangement is a representative generalization.

3.4 Connector End Cap Configuration

The proposed end cap configuration is shown on page 2 of the System Drawing (0023000). All connectors are from Subconn's microcircular line with the exception being the 13 pin J1 connector from Subconn's Ethernet series. Blanking plugs (if required) are designed to have the same O-ring seal as the standard connectors.

3.5 Bulkhead Configuration – Main I/O

The vehicle I/O interface is via connector J1 (Table 3-2). The internal Ethernet connection is wired using the T568B standard. Using the standard Gbit interface, a single input trigger is provided on Pins 12/13. Optionally, the Gbit interface can be replaced by a 10/100 Ethernet interface such that the now two unused Ethernet pairs can be freed up for additional triggers or low voltage sensors.

A 13 pin Subconn Power/Ethernet Female pigtail is provided to aid the user in connecting their interface cable to the sonar pressure vessel. Information on the pigtail can be found at: https://www.macartney.com/media/4250/power_circular_13_contacts.pdf

The CPU's Ethernet Interface Port is set, in the Windows OS, for a Gigabit data rate or 10/100 data rate (dependent on the selected interface). If the user's interface has difficulty achieving a network link, it is suggested that this interface be changed to "AUTO" and the same be done for the customer's interface. In a high noise environment, it may be difficult to maintain a Gigabit Ethernet interface and require a change to a 10/100 Full Duplex data rate. The EdgeTech data transfer will not exceed a 10/100 interface.

Connector J1 (DBH13M)	Default Wiring	Gbit Interface Standard	10/100Base-T Wiring Optional Interface
1	+Vdc	+Vdc	+Vdc
2	N/C	N/C	N/C
3	0Vdc	0Vdc	0Vdc
4	Ethernet (Brown)	BI_DD-	Trig 0 (A) Output
5	Ethernet (White/Brown)	BI_DD+	Trig 0 (A) GND
6	Ethernet (Blue)	BI_DC+	Trig 1(B) / 1pps
7	Ethernet (White/Blue)	BI_DC-	Trig 1 (B) GND
8	Ethernet (Orange)	BI_DA-	Transmit-
9	Ethernet (White/Orange)	BI_DA+	Transmit+
10	Ethernet (Green)	BI_DB-	Receive-
11	Ethernet (White/Green)	BI_DB+	Receive+
12	Trig 1(B) / 1pps	Trig 1(B) / 1pps OPTO	N/C
13	Trig GND	Trig GND	N/C

Table 3-2. Main I/O Bulkhead Pin Definition

The CPU's Ethernet Interface Port is set, in the Windows OS, for a Gigabit data rate. If the user's interface has difficulty achieving a network link, it is suggested that this interface be changed to "AUTO" and the same be done for the customer's interface. In a high noise environment, it may be difficult to maintain a Gigabit Ethernet interface and require a change to a 10/100 Full Duplex data rate. The EdgeTech data transfer will not exceed a 10/100 interface.

3.6 Additional I/O Bulkhead Connectors

The Secondary I/O interface is via connector J4 (Table 3-3). One serial communications port, one programmable trigger (non-opto isolated) and +12vdc power is available from this connector. A mating pigtail is provided.

Connector J4	Default Wiring
1	Shield (if applicable)
2	COM3 Rx (TO SONAR CPU)
3	COM3 Tx (FROM SONAR CPU)
4	Serial GND
5	Trig GND
6	Trig 0(A) OPTO
7	+12VDC
8	+0VDC; Power Return

Table 3-3. Secondary I/O Bulkhead Pin Definition

3.7 System Timing Interface

The SONAR system is configured to accept an external ZDA string on its network port for timing synchronization. It is recommended that this message be transmitted in conjunction with a 1pps time synchronization signal as network messages are asynchronous.

3.8 Trigger Interface

A maximum of 3 triggers are available within the system but the actual available number is limited to the bulkhead pins available (see bulkhead configurations for the proposed trigger distribution). The trigger direction is software configurable through the SONAR.INI file **when opto-isolation is not used (Table 3-4, default)**. **If opto-isolation is required, the trigger configuration is hardware restricted (not software programmable) and can only operate as outlined in Table 3-5.** As depicted in Table 3-5, Triggers are optically isolated and are hardwired to be an Input (Trigger B) and Output (Triggers A & C), relative to the SONAR System.

With Opto-Isolation ... Trigger IN voltage range is 3.3 – 15vdc @ 0.9 – 8ma. Trigger Pulse Width (minimum) is 50us @ 3.3vdc and 10us @ 10vdc.

Without Opto-Isolation (default) ... Trigger IN voltage range is 3.3 – 5vdc. Trigger Pulse Width (minimum) is 10us.

Trigger	Function
A/0	Output FROM Electronics
B/1	Input TO Electronics
C/2	un-configured

~~Table 3-4. Trigger Configuration (Opto-Isolation DISABLED, default)~~

Trigger	Function
A/0	Output FROM Electronics
B/1	Input TO Electronics
C/2	Input TO Electronics

Table 3-5. Trigger Configuration (Opto-Isolation ENABLED)

The selection of Opto-Isolation is most easily implemented during pre-production. Please identify selection under Outstanding Issues **IF** the Trigger configuration differs from the DEFAULT.

3.9 Side Scan Assembly

No Side Scan assembly is provided with this system. Side Scan Arrays are CFE and should match the bulkhead pin out shown in Table 3-6.

Connector MCBH5F	Default Wiring
1	Shield
2	Side Scan High (SSH) +
3	SSH -
4	Side Scan Low (SSL) +
5	SSL -

Table 3-6. Side Scan Bulkhead Pin Out

3.10 Sub-bottom Assembly

No Sub-bottom assembly is provided with this system. Sub-Bottom transmit and receiver sensor are CFE and should match the bulkhead pin outs shown in Tables 3-7 and 3-8.

Connector MCBH6F	Default Wiring
1	Shield
2	Transducer +
3	Transducer -
4	n/c
5	n/c
6	n/c

Table 3-7. Sub-Bottom Transmit Bulkhead Pin Out

Connector MCBH3M	Default Wiring
1	Shield
2	Receiver +
3	Receiver -

Table 3-8. Sub-Bottom Receive Bulkhead Pin Out

3.11 Test and Interface Cables

Not applicable

3.12 Topside Hardware/Software

No topside hardware will be supplied. Discover and J-Star Maintenance/Diagnostic software will be provided for installation on customer's topside Windows based computer.

3.13 Data Storage

A 500GB solid state internal hard drive is included for data storage. The average data rate for a side scan is 500k bytes/s and 60k bytes/s for sub-bottom. Utilizing 80% of the storage device, the system can operate continuously for approximately 198 hours.

4.0 Discover/AUV Interface

The DISCOVER AUV Interface Support software is designed to operate EdgeTech's Hosted Sonar Products on-board autonomous platforms such as Autonomous Underwater Vehicles (AUVs) and Autonomous Surface Vessels (ASVs). DISCOVER AUV also stores data using EdgeTech's native binary format: ***.JSF** to the hosted platform's local hard disk or internal data drive provided with the 2205 electronics. For further information regarding the JSF file format, please refer to the *JSF Data File Description* (EdgeTech Part No 0004824).

DISCOVER AUV communicates and controls the sonar systems via a remote interface on-board the hosted platform and usually does not require input directly from the user. Typically, the DISCOVER AUV software runs in a minimized mode, and does not contain any imagery displays

in order to save processing power and memory for long term deployments. DISCOVER AUV is usually maximized only to check the system's health prior to deployment and to configure mission parameters.

In the event that there is no external interface available on the vehicle, DISCOVER AUV can also control the sonar system automatically by using the default settings and a limited configuration file called the AUVConfig.ini file. To alter these default settings (if desired) such as recording directory, file naming, default sub-bottom pulse, and bathymetric processing parameters, the DISCOVER AUV software is utilized to produce the AUVConfig.ini file based on the user's performance selections.

This is an option that EdgeTech offers but can be turned OFF if the user is comfortable with communicating directly with SONAR or already has 3rd party software to accomplish this task.

5.0 Sea Ground

EdgeTech's internal boards are isolated from the system's pressure housing. Internally, the path between the isolated electronics and sea ground consists of a 2.2Mohm resistor in parallel with a 0.1uF & 10uF capacitor. For systems with Ground Fault detection circuitry, the resistor can be removed to eliminate the DC path. When operating the system, the pressure housing must be in contact with seawater or earth ground in order to minimize the electronic noise floor. The chance for system noise to occur is increased when this isolation is not achieved. This ground minimizes the noise within our system and aids in maximizing the dynamic range.

6.0 System Integration

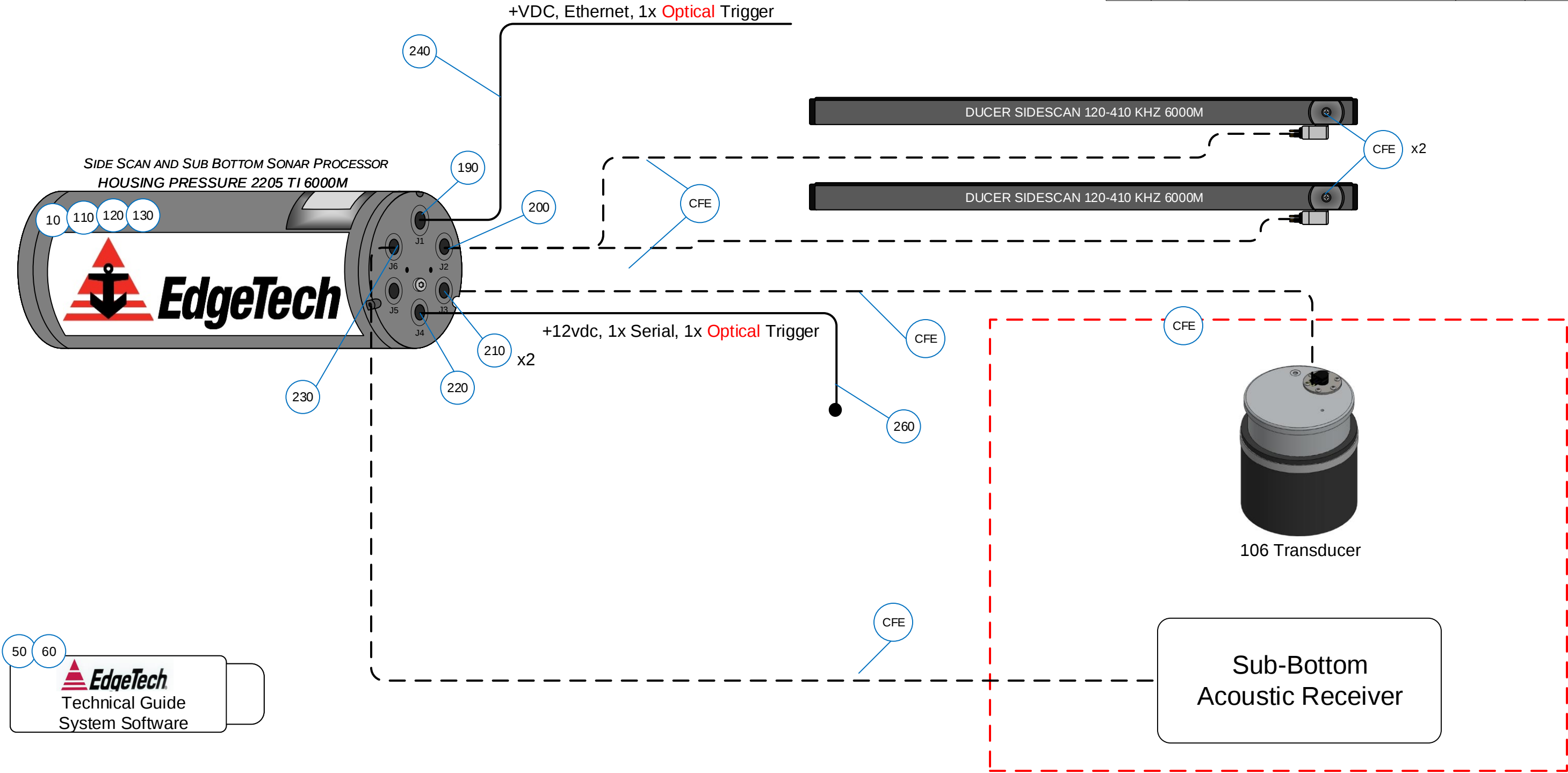
Prior to system delivery, EdgeTech personnel verify that the system's operational noise floor has been minimized and that it successfully passes a sea trial. These tests are conducted within our ocean measurement environment and do not necessarily reflect the final mechanical or electrical configuration of the user's platform. Mechanical installation is discussed under the array mounting section and is generally straightforward. Electrical installation is often complicated in terms of power and grounding configurations which will directly impact system noise floors and ultimately the sonar performance. EdgeTech can provide recommendations as to the physical relationship between components and how to minimize electrical and acoustic interference. EdgeTech can provide remote technical support to the user when network access to the equipment is available.

7.0 Appendix A - Drawings

Title	Reference	Ver
ASSY TOP SYSTEM 2205 120-410 SS / 106 SB BOTTLE 6000M MBARI	0023000	1
DOC DRAWING ICD 2205 ELECTRONICS BOTTLE SS / SB 5.75 INCH OD TI 6000M	0017887	A

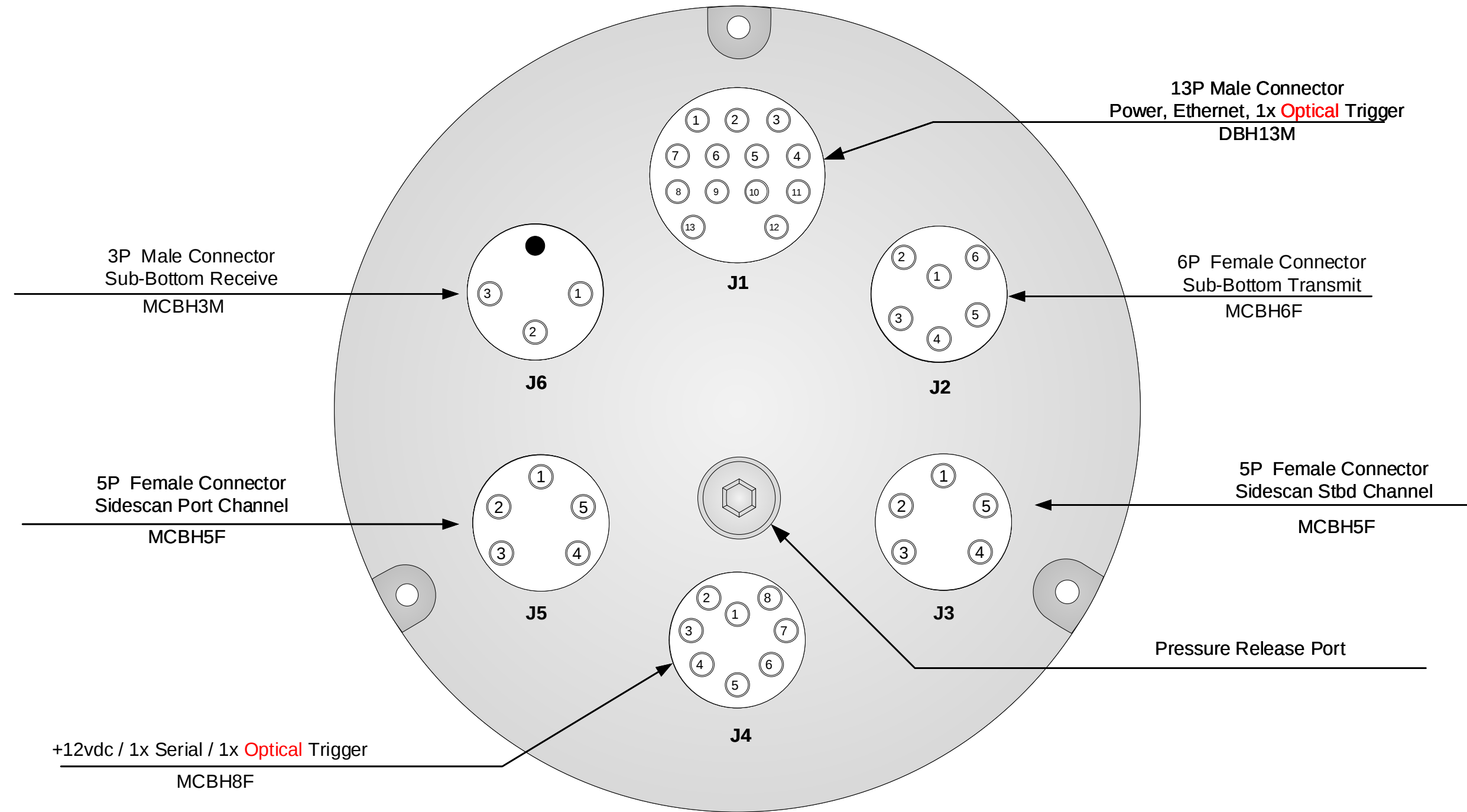
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REVISIONS				
ECR	REV	DESCRIPTION	DATE	APPROVED
	1	Initial Release	12/20/19	DMD
	2	Added Optical Trigger	12/20/19	DMD



APPROVALS		DATE	 4 Little Brook Road West Wareham, MA 02576 Tel: (508) 291-0057 / Fax: 356-9760 Email: info@EdgeTech.com		
DRAWN: D.Deveau		12/20/19			
CHECKED:			ASSY TOP SYSTEM 2205 120-410 SS / 106 SB BOTTLE 6000M MBARI		
ENG:					
SYSTEM	2205	CARDFILE NAME		DRAWING NO. 0023000	REV 2
		SCALE	page 1 of 2		

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Notes:
1) Unused connectors are sealed using dual O-Ring Blanking Plugs.
2) Connectors are of the same material as the end cap and rated to the same pressure depth at a minimum.

APPROVALS		DATE	 4 Little Brook Road West Wareham, MA 02576 Tel: (508) 291-0057 / Fax: 356-9760 Email: info@EdgeTech.com		
DRAWN: D.Deveau		12/20/19			
CHECKED:			ASSY TOP SYSTEM 2205 120-410 SS / 106 SB BOTTLE 6000M MBARI		
ENG:					
SYSTEM	2205	CARDFILE NAME		DRAWING NO. 0023000	REV 2
		SCALE	page 2 of 2		

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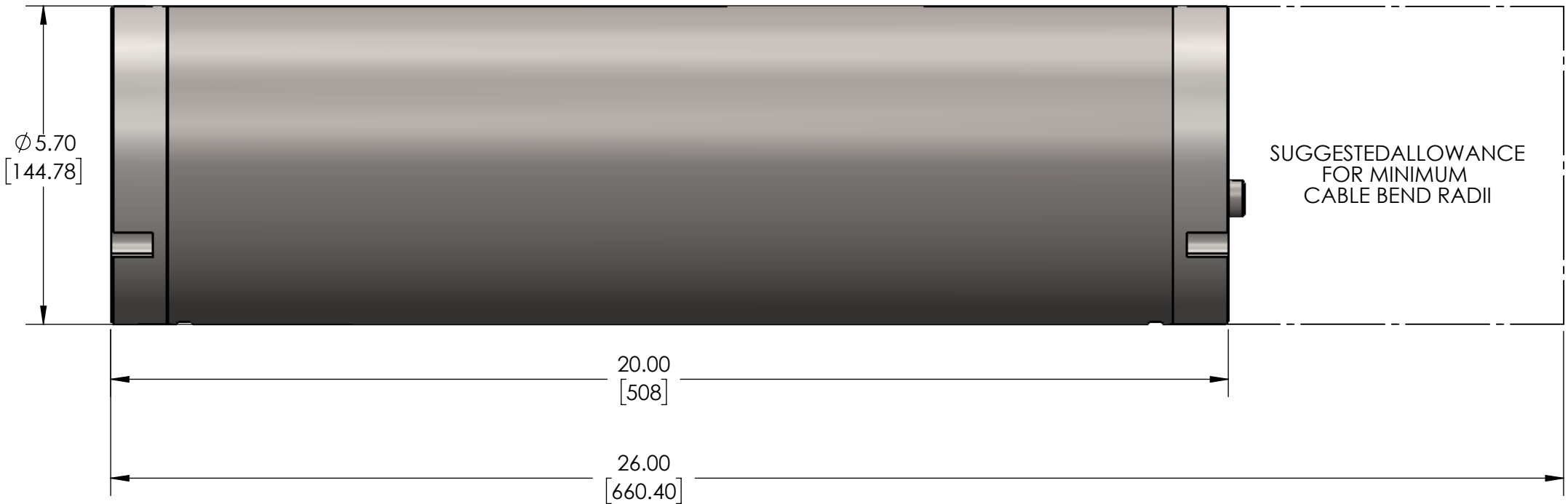
NOTES:

DIMENSIONS IN [BRACKETS] ARE IN MM

MATERIAL: TITANIUM TI-6AL-4V
DEPTH RATING: 6000M
WEIGHT IN WATER: ~26.7LBS [12.1 KG]
WEIGHT IN AIR: ~46.0LBS [20.9 KG]

REVISIONS				
ECR#	REV	DESCRIPTION	DATE	APPROVED
	A	RELEASED TO PRODUCTION	1/06/16	JB

CONNECTOR ARRANGEMENT IS NOTIONAL ONLY



MATERIAL	UNLESS OTHERWISE NOTED: DIMENSIONS ARE IN INCHES INTERPRET DIM AND TOL PER ASME Y14.5M-1994 THIRD ANGLE PROJECTION				APPROVALS		SIGNATURE & DATE		 4 LITTLE BROOK ROAD WEST WAREHAM, MA 02576 WWW.EDGETECH.COM TEL. (508)291-0057
					DRAWN	BOUCHER	1/06/2016		
FINISH	TOLERANCES				CHECKED				TITLE ICD 2205 ELECTRONICS BOTTLE SS/SB, 5.75 INCH OD TI 6000M
	DECIMALS		FRACTIONS	ANGLES	MECH				
	2 PLACES	3 PLACES			ELECT				
	+/- .010	+/- .005	+/- 1/64	+/- 0.5°	SYSTEM				
DO NOT SCALE PRINT					REMOVE BURRS, BREAK SHARP EDGES				CADFILENAME:
									DRAWING NO.
									REV
									A