3300 HULL MOUNT SUB-BOTTOM PROFILER

USER HARDWARE MANUAL

0016732_REV_B

August 2017

EdgeTech
4 Little Brook Road
West Wareham, MA 02576

Tel: (508) 291-0057
Fax: (508) 291-2491
www.EdgeTech.com

ATTENTION – READ THIS FIRST!

All personnel involved with the installation, operation, or maintenance of the equipment described in this manual should read and understand the warnings and cautions provided below.

CAUTION! This equipment contains devices that are extremely sensitive to static electricity. Therefore, extreme care should be taken when handling them. Normal handling precautions involve the use of anti-static protection materials and grounding straps for personnel.

WARNING! High Voltage may be present in all parts of the system. Therefore, use caution when the electronics are removed from their containers for servicing.

CAUTION! Operation with improper line voltage may cause serious damage to the equipment. Always ensure that the proper line voltage is used.

HARDWARE VARIATIONS AND COMPATIBILITY

The 3300 Hull Mount Sub-Bottom Profiler contains both standard and proprietary hardware. At times, EdgeTech may change the standard components due to their availability or performance improvements. Although the component manufacturers—along with their models and styles—may change from unit to unit, replacement parts will generally be interchangeable.

EdgeTech will make every effort to see that replacement components are interchangeable and use the same software drivers (if applicable). At times, however, direct replacements may not exist. When this happens, EdgeTech will provide the necessary drivers with the replacement part, if applicable.

EdgeTech may also change certain hardware per customer requirements. Therefore, portions of this manual, such as parts lists and test features, are subject to change. These sections should be used for reference only. When changes are made that affect system operation, they will be explicitly noted. Also, some options and features may not be active in the customer's unit at time of delivery. Upgrades will be made available when these features are implemented.

Contact EDGETECH CUSTOMER SERVICE with any questions relating to compatibility.

ABOUT THIS DOCUMENT

We, the employees at EdgeTech, would like to thank you for purchasing 3300 Hull Mount Sub-Bottom Profiler. At EdgeTech, it is our policy to provide high-quality, cost-effective products and support services that meet or exceed your requirements. We also strive to deliver them on-time, and to continuously look for ways to improve them. We take pride in the products we manufacture, and want you to be entirely satisfied with your equipment.

Purpose of this Manual

The purpose of this manual is to provide the user with information on the setup and use of EdgeTech's 3300 Hull Mount Sub-Bottom Profiler. Although this manual encompasses the latest operational features of the 3300 Hull Mount Sub-Bottom Profiler, some features may be periodically upgraded. Therefore, the information in this manual is subject to change and should be used for reference only.

Liability

EdgeTech has made every effort to document the 3300 Hull Mount Sub-Bottom Profiler in this manual accurately and completely. However, EdgeTech assumes no liability for errors or for any damages that result from the use of this manual or the equipment it documents. EdgeTech reserves the right to upgrade features of this equipment, and to make changes to this manual, without notice at any time.

Warnings, Cautions, and Notes

Where applicable, warnings, cautions, and notes are provided in this manual as follows:

WARNING! Identifies a potential hazard that could cause injury or death.

CAUTION! Identifies a potential hazard that could damage equipment or data.

NOTE: Recommendations or general information that is particular to the material being presented.

Revision History

REVISION	DESCRIPTION	DATE	APPROVAL
A	Release to Production	03/09/2015	RM
B	Updates	08/25/2017	RM

WARRANTY STATEMENT

All equipment manufactured by EdgeTech is warranted against defective components and workmanship for a period of one year after shipment. Warranty repair will be done by EdgeTech free of charge.

Shipping costs are to be borne by the customer. Malfunction due to improper use is not covered in the warranty, and EdgeTech disclaims any liability for consequential damage resulting from defects in the performance of the equipment. No product is warranted as being fit for a particular purpose, and there is no warranty of merchantability. This warranty applies only if:

i. The items are used solely under the operating conditions and in the manner recommended in Seller's instruction manual, specifications, or other literature.

ii. The items have not been misused or abused in any manner, nor have repairs been attempted thereon without the approval of EdgeTech Customer Service.

iii. Written notice of the failure within the warranty period is forwarded to Seller and the directions received for properly identifying items returned under warranty are followed.

iv. The return notice authorizes Seller to examine and disassemble returned products to the extent Seller deems necessary to ascertain the cause for failure.

The warranties expressed herein are exclusive. There are no other warranties, either expressed or implied, beyond those set forth herein, and Seller does not assume any other obligation or liability in connection with the sale or use of said products. Any product or service repaired under this warranty shall be warranted for the remaining portion of the original warranty period only.

Equipment not manufactured by EdgeTech is supported only to the extent of the original manufacturer's warranties.

SOFTWARE SERVICE OVERVIEW

EdgeTech provides software services free of charge. This software agreement does not address customer-specified modifications or enhancements. These services may be ordered separately. Furthermore, EdgeTech software upgrades are meant for the sole use of EdgeTech customers. Any reproduction of EdgeTech-supplied software or file sharing is strictly prohibited.

Software Updates and Enhancements

EdgeTech customers can download new software releases with all modifications and enhancements from the EdgeTech ftp site. Major software issues, should they occur, will be reported directly to the customer. New software releases consist of the following:

- Software enhancements that are not on the price list
- Software fixes and changes
- Product integration
- Documentation updates to on-line help
- Tests for compatibility with other modules

Software patches consist of software that has undergone the following:

- Minor software enhancements
- Software fixes and changes

EdgeTech customers are entitled to contact EDGETECH CUSTOMER SERVICE by telephone, facsimile, or e-mail to report a difficulty, to discuss a problem or to receive advice on the best way to perform a task. When contacted, EdgeTech Customer Service will do the following:

- Respond within 24 hours via Telephone, Facsimile, and E-mail Support
- Immediately attend to serious problems affecting operations
- Attempt to find an immediate work-around

RETURNED MATERIAL AUTHORIZATION

Prior to returning any equipment to EdgeTech, a Returned Material Authorization (RMA) number must be obtained. The RMA will help us identify your equipment when it arrives at our receiving dock and track the equipment while it is at our facility. The material should be shipped to the address provided in the EDGETECH CUSTOMER SERVICE section. Please refer to the RMA number on all documents and correspondences as well.

All returned materials must be shipped prepaid. Freight collect shipments will not be accepted. EdgeTech will pay freight charges on materials going back to the customer after they have been evaluated and/or repaired.

> **CAUTION!** If your product is a portable topside, never attempt to it in its Storm Case™ alone. Although rugged, these cases are not intended to be used as shipping containers, and the delicate internal components could be damaged if used in this manner.

The following steps apply only to material being returned from outside the Continental United States. Follow them carefully to prevent delays and additional costs.

1. All shipments must be accompanied by three copies of your proforma invoice, showing the value of the material and the reason for its return. If the reason is for repair, it must be clearly stated in order to move through customs quickly and without duties being charged. Whenever possible, please send copies of original export shipping documents with the consignment.
2. If the value of the equipment is over $1000, the following Shipper's oath must be sent with the invoice. This oath can be typed on the invoice, or on a separate letterhead:

> "I, _____, declare that the articles herein specified are the growth, produce, or manufacture of the United States; that they were exported from the United States from the port of _____, on or about _____; that they are returned without having been advanced in value or improved in condition by any process of manufacture or any other means; and that no drawback, or allowance has been paid or admitted hereof."
>
> Signed _____

3. If there is more than one item per consignment, a packing list must accompany the shipment. It is acceptable to combine the proforma invoice and packing list as long as the contents of each carton are clearly numbered and identified on the invoice.
4. Small items can be shipped prepaid directly to EdgeTech by FedEx, DHL, UPS, Airborne, etc.
5. If the equipment is the property of EdgeTech (formerly EG&G Marine Instruments Division), please insure for full value.
6. Fax one invoice, packing list, and a copy of the airway bill to EdgeTech upon shipment.

CUSTOMER SERVICE

Customer service personnel at EdgeTech are always eager to hear from users of our products. Your feedback is welcome, and is a valuable source of information which we use to continually improve these products. Therefore, we encourage you to contact EdgeTech Customer Service to offer any suggestions or to request technical support:

E-mail:	service@edgetech.com
Mail:	4 Little Brook Road West Wareham, MA 02576
Telephone:	(508) 291-0057
Facsimile:	(508) 291-2491
24-Hour Emergency Technical Support Line:	(508) 942-8043

NOTE: Please have your system Serial Number available when contacting Customer Service.

For more information please go to www.EdgeTech.com.

COMPANY BACKGROUND

EdgeTech (formerly EG&G Marine Instruments) traces its history in underwater data acquisition and processing back to 1966. EdgeTech has designed, developed, and manufactured products, instruments, and systems—for the acquisition of underwater data, including marine, estuarine, and coastal applications—for over 50 years.

The company has responded to the needs of the scientific, Naval, and offshore communities by providing equipment—such as sub-bottom profilers, side scan sonar, acoustic releases, USBL positioning systems, and bathymetric systems—that have become standards in the industry.

EdgeTech has also consistently anticipated and responded to future needs through an active research and development program. Current efforts are focused on the application of cutting-edge CHIRP and acoustic technology.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1.0: OVERVIEW

The 3300 Hull Mounted Sub-Bottom Profiler (3300-HM SBP) Full Spectrum Sonar is a versatile, wideband, FM sub-bottom profiler that generates cross-sectional images of the seabed and collects digital normal incidence reflection data over a wide variety of frequency ranges.

The system transmits an FM pulse that is linearly swept over a full spectrum frequency range (also called a “CHIRP pulse”). The reflections, measured by the system, are displayed as shades of gray or color on a computer monitor. Data is stored real-time into a large capacity hard drive, and can be archived to a CD/DVD ROM or thumb drive.

1.1 Advantages of Full Spectrum CHIRP Technology

EdgeTech’s Full Spectrum Technology has several distinct advantages over conventional sub-bottom systems, including increased penetration and higher resolution. The tapered wave form spectrum results in images that have virtually constant resolution with depth.

The 3300-HM SBP system generates virtually no side lobes, due to the wide bandwidth of the sweep frequency. This bandwidth has an effect of smearing the side lobes of the transducer, resulting in a beam pattern with almost no side lobes.

Because the FM pulse is generated by a digital-to-analog converter with a wide dynamic range and a transmitter with linear components, the energy, amplitude, and phase characteristics of the acoustic pulse can be precisely controlled. This precision produces the high repeatability and signal definition required for sediment classification.

The operating frequency range is determined by the acoustic characteristics and mounting schematic of the transducers. EdgeTech offers various transducer configurations that can transmit acoustic pulses with different center frequencies and bandwidths. Pulse selection is made by the operator while profiling to achieve the best imagery.

For detailed information regarding configuration options, contact EDGETECH CUSTOMER SERVICE.

1.1.1 Compared to Older Technology

EdgeTech’s 3300-HM SBP Full Spectrum sonar system transmits FM pulses. FM pulses have been used in radar and sonar systems for over 40 years and are sometimes referred to as CHIRP or Swept-frequency pulses. The advent of modern digital signal processing components has provided tools for realizing the potential of these methods.

Full Spectrum signal processing technology does not use a conventional matched filter (the typical correlation filter used to compress FM signals) to process wide band signals. It uses proprietary amplitude and phase weighting functions for the transmitted pulse and a pulse compression filter that maximizes the Signal-to-Noise Ratio (SNR) of the acoustic images over a wide band of operating frequencies. These functions provide a significant SNR improvement in the acoustic image over other impulse and CHIRP sonar with band-limited components that are limited in dynamic range.

1.1.2 Transducer Array

Acoustic projectors in the 3300-HM SBP system are constructed from wideband, piston-type transducers and the acoustic receivers are a discrete line array of PZT crystals. The acoustic hull-mounted transducers are designed for profiling at ship speeds varying from zero (drifting) to 7 knots.

The transducer array receives the low amplitude sub-bottom reflections, while a 24-dB gain preamplifier amplifies and drives the signal through a 50-meter cable. A software-controlled, programmable gain amplifier provides a final amplification stage before the signal is digitized with a 16-bit Analog-to-Digital (A/D) converter at a sampling rate of 24, 40, 50, and 66 kHz. To achieve the theoretical temporal resolution predicted by the inverse of the bandwidth, the FM pulse is compressed using a digital compression filter.

The correlation process is implemented in real-time, with forward and inverse Fast Fourier Transforms. The compressed pulse resulting from this signal processing procedure has a time duration approximately equal to the inverse of the bandwidth of the FM pulse.

1.1.3 Resolution

High temporal resolution allows for the measurement of fine layering. Good resolution is an important factor in sediment classification, as it provides a more precise impulse response of the sediment, and, in turn, a realistic picture of the true geologic variability of the seafloor and accurate determination of the depositional processes. When the time duration of the processed pulse is too large, individual reflections will be lumped together with random phase causing constructive and destructive interference, thereby making it difficult to estimate the impedance and examine the geologic processes.

1.1.4 Processing Enhancements

In addition to the resolution improvement, correlation processing achieves a signal processing gain over the background noise. This gain is approximately ten times the log of the time-bandwidth product. This improvement is due to the signal having a time duration longer than the inverse of the bandwidth, thus increasing signal energy without increasing the power of the outgoing pulse. To equal the typical performance of the Full Spectrum sonar pulse, conventional pulse sonar would have to operate at a peak pulse power of 100 times greater than the Full Spectrum pulse with a time-bandwidth product of 100.

Another important feature of the Full Spectrum Sub-Bottom Sonar is that the computer generates a signal that optimizes the performance of the system. The sonar contains many components, each with a unique dynamic range and linearity characteristic, which are frequency dependent.

In addition to this, the amplitude spectrum of the outgoing pulse is chosen to be approximately Gaussian in shape in order to limit the side lobe level and temporal resolution losses due to attenuation. As a wavelet with a Gaussian-shaped spectrum is attenuated by the sediment, energy is lost but its bandwidth is nearly preserved. Thus, even after being attenuated by sand, the acoustic pulse has approximately the same resolution as an un-attenuated pulse.

1.1.5 Reduction of Side Lobes and High Repeatability

Full Spectrum sonar has the unique ability to reduce side lobes in the effective transducer aperture. The wide bandwidth of the sweep frequency has the effect of smearing the side lobes of the transducer and thus achieving a beam pattern with virtually no side lobes. The effective spatial beam width obtained after processing the 2-10 kHz signal is 20 degrees measured to -3db points.

Since the transmitted Full Spectrum pulse is highly repeatable, and its peak amplitude is precisely known, the sediment reflectivity values can be estimated from the peak pulse amplitude measurements of the bottom returns.

1.2 Major Components

The hull mounted configuration consists of the topside unit, deck cable, T-R box, spider box assembly, and the transducer arrays (see an example of a 2x2 system configuration is shown in FIGURE 1-1.

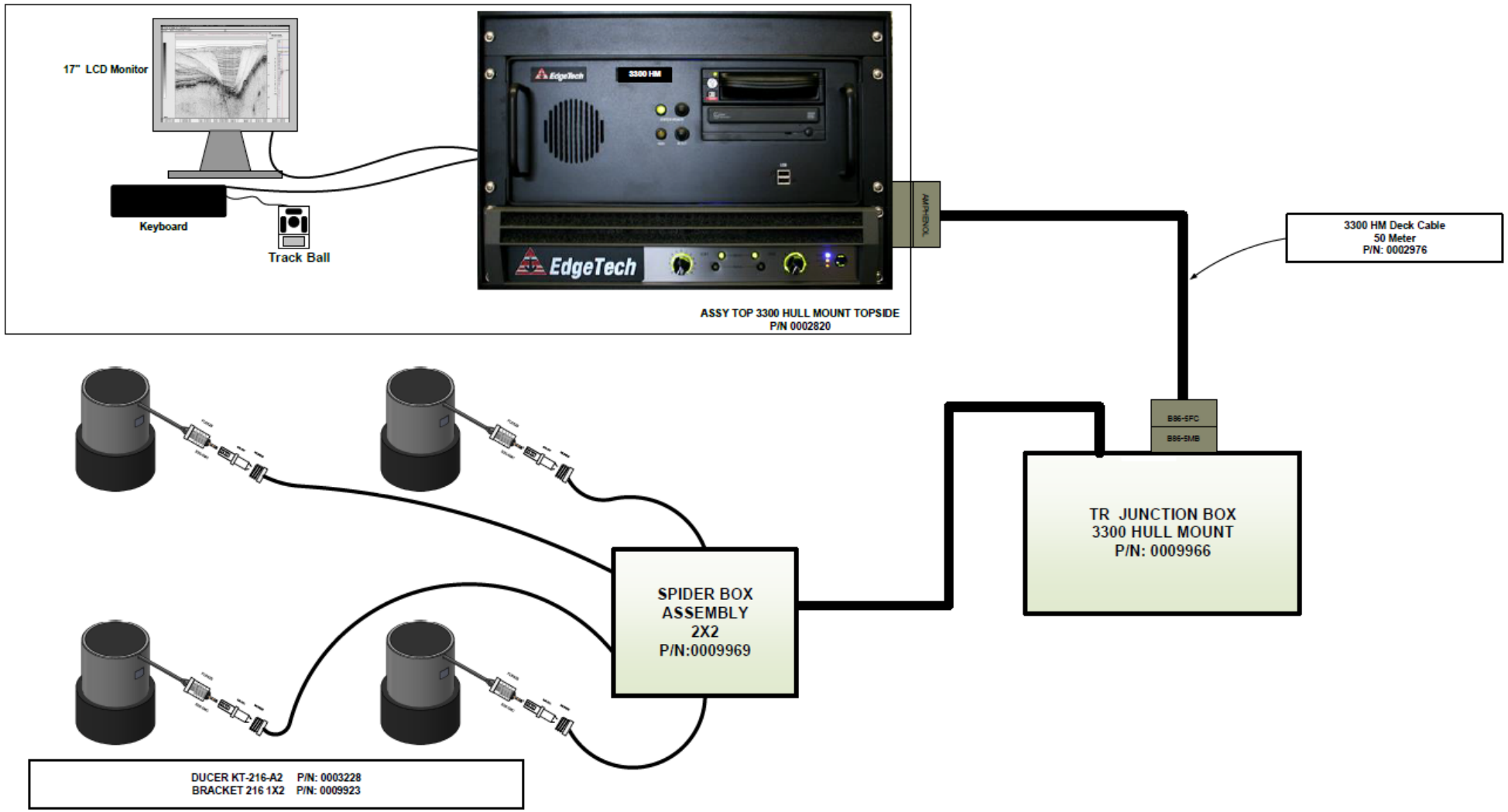


Figure 1-1: Overall System Diagram (2x2 Configuration)

1.2.1 Deck Unit

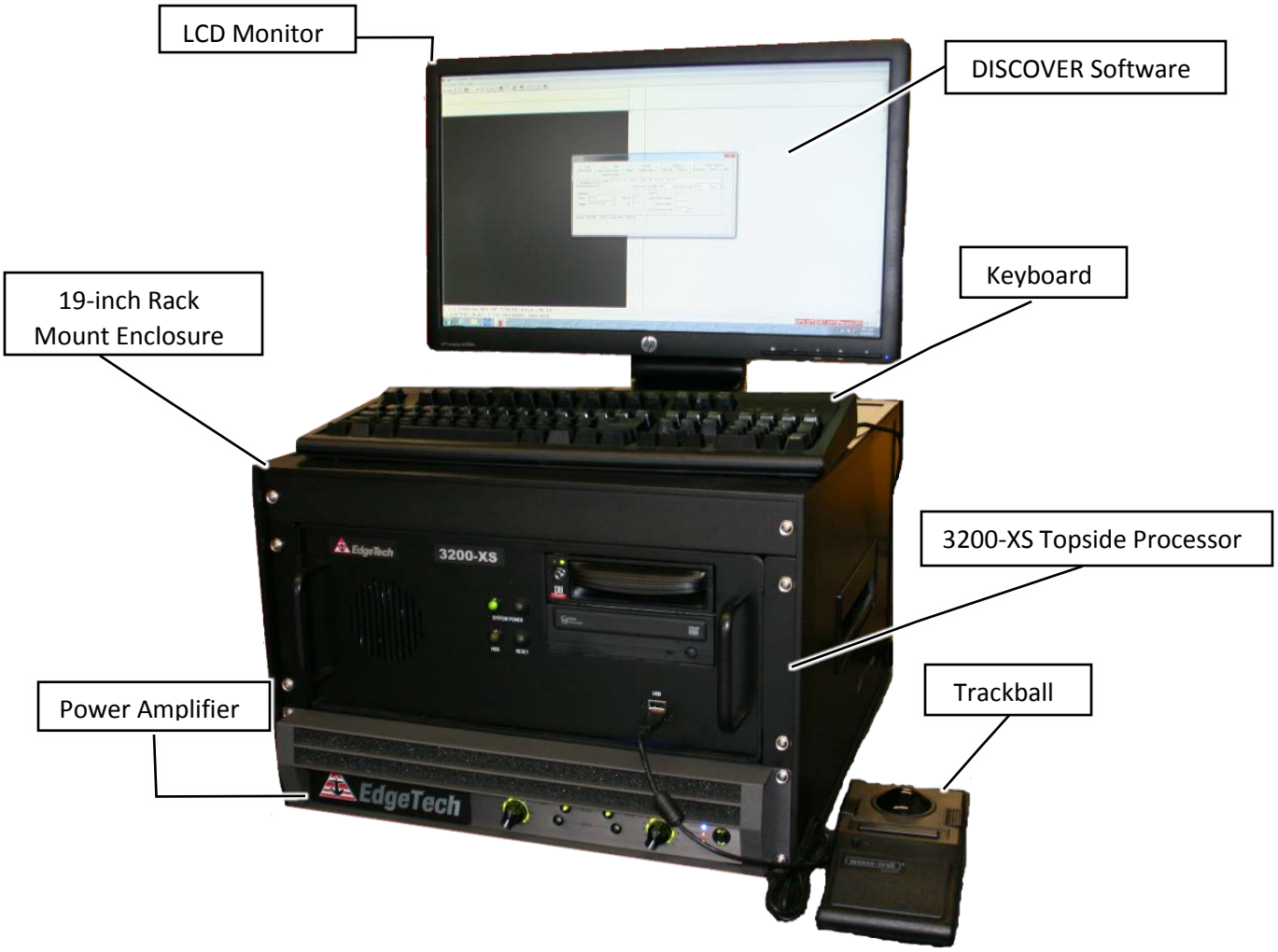


Figure 1-2: 3200 Rack Mount Processor

The Deck Unit consists of a processor, amplifier, and monitor as shown in FIGURE 1-2. The 19-inch Tack Mount enclosure consists of a computer-based controller containing a Sonar Interface Board (SIB). The SIB stores the transmitted waveform and the correlation filter, and performs the correlation processing and spherical range correction. At periodic intervals, the SIB sends the transmitted waveform to the 16-bit digital-to-analog converter, which generates an analog pilot signal that is amplified by a 2 kW power amplifier. This amplifier drives the transducer.

The acoustic signal returns from the seafloor are measured by the receiving arrays, and are then increased by a preamplifier. The output of the preamplifier is connected via the underwater signal cable to a digitally-controlled amplifier on the sub-bottom board (mounted on the SIB) before being sampled by a 16-bit analog-to-digital converter. The SIB board performs the correlation processing, corrects for spherical spreading, and transfers the data to the system board.

The DISCOVER Sub-Bottom software is supported on Windows 7 OS. The data and control connections to the DISCOVER Sub-Bottom program are entirely through TCP/IP connections.

EdgeTech's Full Spectrum sonar systems employ advanced CHIRP technology to obtain high resolution, low-noise data records. EdgeTech's advanced CHIRP technology employs long-duration, wide-band, frequency-modulated transmit pulses. Return sonar echo data is processed to remove the FM carrier, and produce high-resolution images of the echo field. DISCOVER Sub-Bottom allows monitoring of this normal, de-CHIRPed, sub-bottom data, as well as raw, CHIRPed data. This latter data type is often useful for diagnostic purposes.

For compatibility with other EdgeTech products, the DISCOVER Sub-Bottom program interfaces to a second program that is run in the background called sonar.exe. Sonar.exe interfaces with both the SIB and the analog interface boards to generate and transmit CHIRP pulses. A startup file launches the sonar.exe program automatically every time the system is booted.

The 3300-HM SBP interfaces with the ship's Navigation (GPS, IMU, etc), triggers, motion and heave sensors, echo sounder, and printers.

The 3300-HM SBP's computer-based controller and amplifier components are mounted in a rugged Optima Case. The computer-based controller and amplifier can be removed from Optima case and installed in a 19-inch rack.

1.2.2 T/R Box Assembly

The T/R Box connects the topside to the transducers array. It contains a pre-amp, a matching transformer, and the T/R switch. See FIGURE 1-3 below:

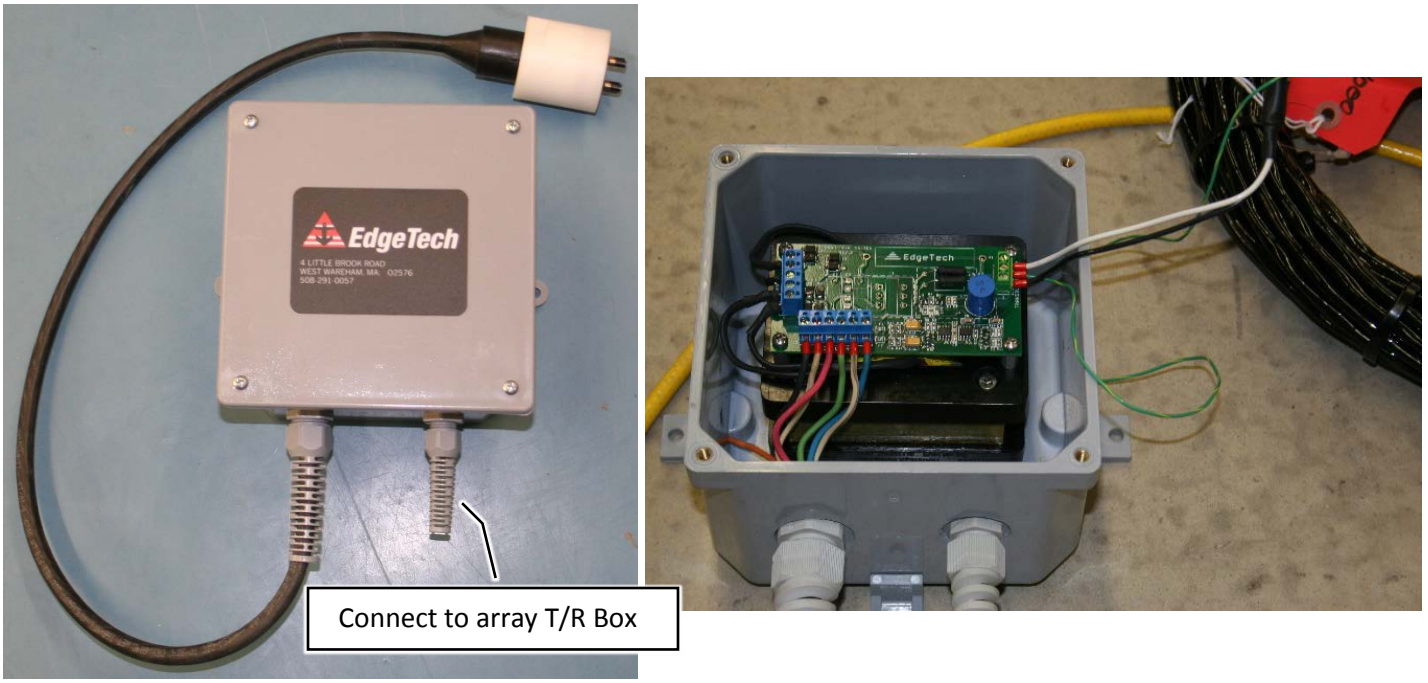


Figure 1-3: T/R Box (Interior & Exterior)

1.2.3 Transducer Array

The transducers for the 3300-HM SBP are mounted in a two-dimensional array inside a closed well on board a survey vessel. These transducers act as both projectors and hydrophones.

EdgeTech offers a range of transducer arrays, each designed to provide various beam widths. In general, lower operating frequencies require multiple receiving arrays and larger transducers, therefore requiring different array sizes.

Figure 1-4: Spider Array

Figure 1-5: Single Transducer

Figure 1-6: 2x2 Sea Chest Array

NOTE: Each transducer is fitted with an 81 cm (32 in.) pigtail with a single pin (2 contacts) connectors. All Transducer Cables connect to a T/R Box.

1.3 Applications

The 3300-HM SBP has the unique ability to strip-away the world's oceans during imaging and provide high resolution sub-bottom images.

This tool lends itself to various tasks that include:

- Imaging fluidized mud to a resolution of 8 cm
- Sediment classification
- Buried pipeline and cable location and routing
- Dredging studies for inlets
- Scour/erosion surveys in rivers and streams
- Marine geotechnical surveys
- Bridge erosion surveys
- Hazardous waste target location
- Geological surveys
- Archeological surveys
- Imaging biologics in water column
- Mapping shellfish populations
- Beach re-nourishment
- Military and Offshore Oil applications
- Full ocean depth sub-bottom imaging

2.0: SPECIFICATIONS

The 3300-HM SBP system is composed of a deck unit, T/R Box, and hull-mounted transducer array. This section details the sub-components of the system and provides their specifications. For information related to the provided DISCOVER software, refer to 0019800 in the Manual Folder.

2.1 Deck Unit Specifications

The Deck Unit is composed of a computer processor, trackball, keyboard, LCD monitor, and a power amplifier, as shown in FIGURE 1-2. The physical specifications for the entire deck unit are provided in TABLE 2-1, and the minimum specifications for the individual parts are given in the sub-sections that follow.

SPEC TYPE	SPECIFICATION	VALUE
Environment	Temperature	0 to 40°C (32 to 104°F)
	Humidity	5% to 95% relative
	Vibration	Normal ship environment
Enclosure	Portable aluminum case suitable for transit. Unit can be removed from case and mounted in a 19" rack.	
	Size	50W x 60D x 33H cm (19.5x23.5x13 in)
	Weight	46 kg (102 lbs.)
Shipping Containers	Deck Unit (No topside Processor)	
	Size	76L x 71W x 50H cm (30x28x20 in)
	Weight	82 kg (330 lbs.)
	Material	Sealed high impact polyurethane case

Table 2-1: Overall Physical Deck Unit Specs

2.1.1 Processor Specifications

SPECIFICATION	VALUE	
Main Processor	Intel I7 Quad Core 3.4GHz 8MB Cache	
Memory	8GB DDR4 RAM	
Hard drive	500GB capacity minimum (operating system)	
CDRW	10x4x32 min speed	
Operating System	Windows 7 64 bit	
Input Power	120 or 220 VAC auto sense	
I/O	Front Panel: (2) USB2 Rear Panel: (2) USB2 (2) USB3.1 (2) USB3 (2) Ethernet (4) port RS-232	
Data Acquisition SIB & A/D-D/A	Analog Input	16-bit resolution, 200 kHz max. sampling rate
	Analog Output	16-bit resolution, 200 kHz max. sampling rate

Table 2-2: Processor Specifications

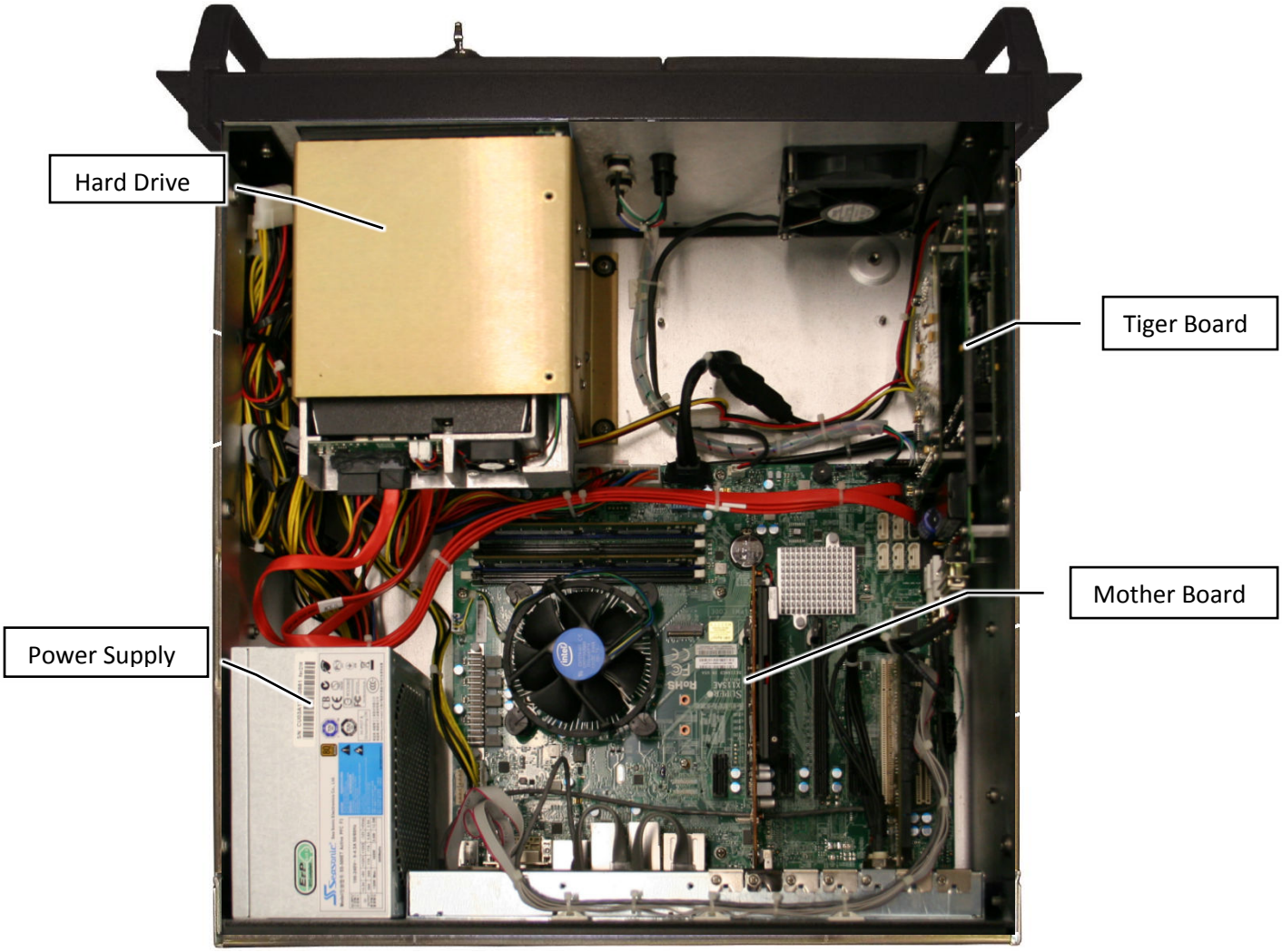


Figure 2-1: Topside Processor Internals

2.1.2 Amplifier Specifications

The amplifier is designed for mounting in standard 19-inch Computer Rack. The power amplifier must stay close to the topside processor due to the short cables connecting the two units. The amplifier requires at least 10 cm (4 in.) of clearance behind the heat sink array to permit vertical air flow through the array. In the rack mount, ensure the environmental operating temperature **does not** exceed 55°C (131°F).

CAUTION!

Inadequate ventilation can cause overheating. Should this occur, the thermal protection circuit automatically protects the amplifier. If this occurs, the system will stop transmitting and DISCOVER will display a 'HOT' error message. When a safe operating temperature is restored, the amplifier will resume normal operation.

The specifications for the Power Amplifier (PN 0010855) are shown in TABLE 2-3, TABLE 2-4, and TABLE 2-5.

2.1.2.1 Power Output

SPECIFICATION	VALUE
4-ohm Bridge	5,600 W
8-ohm Bridge	6,000 W

Table 2-3: Power Amp Specifications: Power Output

2.1.2.2 Performance

SPECIFICATION	VALUE
Frequency Response (*at 1 watt, 20 Hz – 20 kHz into 8 ohms*)	± 0.25 dB
Signal to Noise Ratio (*below rated full bandwidth power, A-weighted*)	> 108 dB
Total Harmonic Distortion (THD) (*at 1 watt into 8 ohms*)	< 0.1%
THD plus Noise (at full rated power)	< 0.35%, 20 Hz to 20 kHz
Intermodulation Distortion (*60 Hz and 7kHz at 4:1, from full rated output to -30 dB*)	< 0.35%
Damping Factor (*20 Hz to 100 Hz at 8 ohms*)	> 5000
Crosstalk (*below rated power, 20 Hz to 1 kHz*)	> 80 dB
Common Mode Rejection (*20 Hz to 1 kHz*)	> 55 dB, typically > 70 dB
DC Output Offset (*Shorted input*)	< ± 3 mV
Input Impedance (*Nominal*)	10 kilohms balanced, 5 kilohms unbalanced
Maximum Input Level	+20 dBu typical
Load Impedance (*Safe with All Types of Loads*)	Stereo: 1/2/4/8/16 ohms Bridge Mono: 2/4/8 ohms
Input Sensitivity (*Referenced to 8 ohm rated output*)	1.4V, 32 dB gain, and 26 dB gain
Voltage Gain (*Referenced to 8 ohm rated output*)	37.9 dB to 23.0 dB
Required AC Mains	Universal AC input, 100-240VAC, 50/60 Hz (±10%). Maximum AC mains voltage 264VAC.

Table 2-4: Power Amp Specifications: Performance

2.1.2.3 Construction

SPECIFICATION	VALUE
Cooling	Dual-zone, microprocessor controlled, continuously variable speed fans, front-to-back airflow
Front Panel	Cast aluminum with integrated handles
Weight	28 pounds (12.7 kg) net, 36 pounds (16.3 kg) shipping.
Dimensions	19 in. (48.3 cm) W x 3.5 in. (8.9 cm) H x 16.2 in. (41.1 cm) D.
Protection	Amplifier is protected against reactive loads, faults and shorts. If one channel experiences a catastrophic failure, the entire amplifier will shut down.

Table 2-5: Power Amp Specifications: Construction

2.1.3 Display, Keyboard, and Mouse Specifications

SPECIFICATION	VALUE
Video Display	One High resolution 17” flat panel monitor
Keyboard	High impact industrial keyboard
Trackball	High impact industrial trackball

Table 2-6: Display, Keyboard, and Mouse Specifications

2.2 T/R Box Specifications

SPECIFICATION	VALUE
Weight:	1.8 kg
Dimensions (WxDxH):	18 cm x 18 cm x 12 cm

Table 2-7: Physical Specifications of T/R Box

2.3 Technical Drawings

An assembly drawing of the T/R Box is provided in FIGURE 2-2.

A wiring diagram of the T/R Box is provided in FIGURE 2-3.

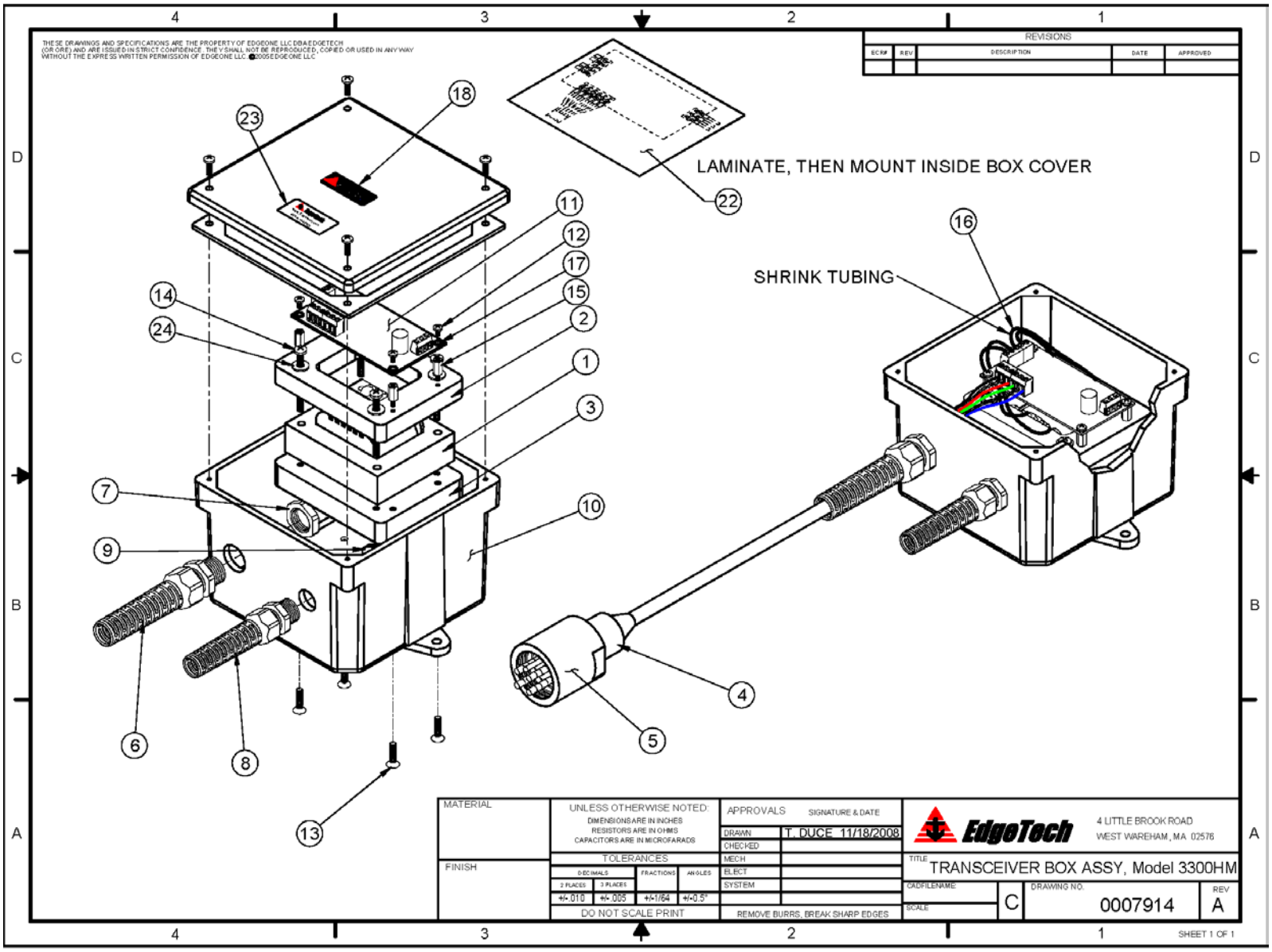


Figure 2-2: T/R Box Assembly Drawing - 0007914

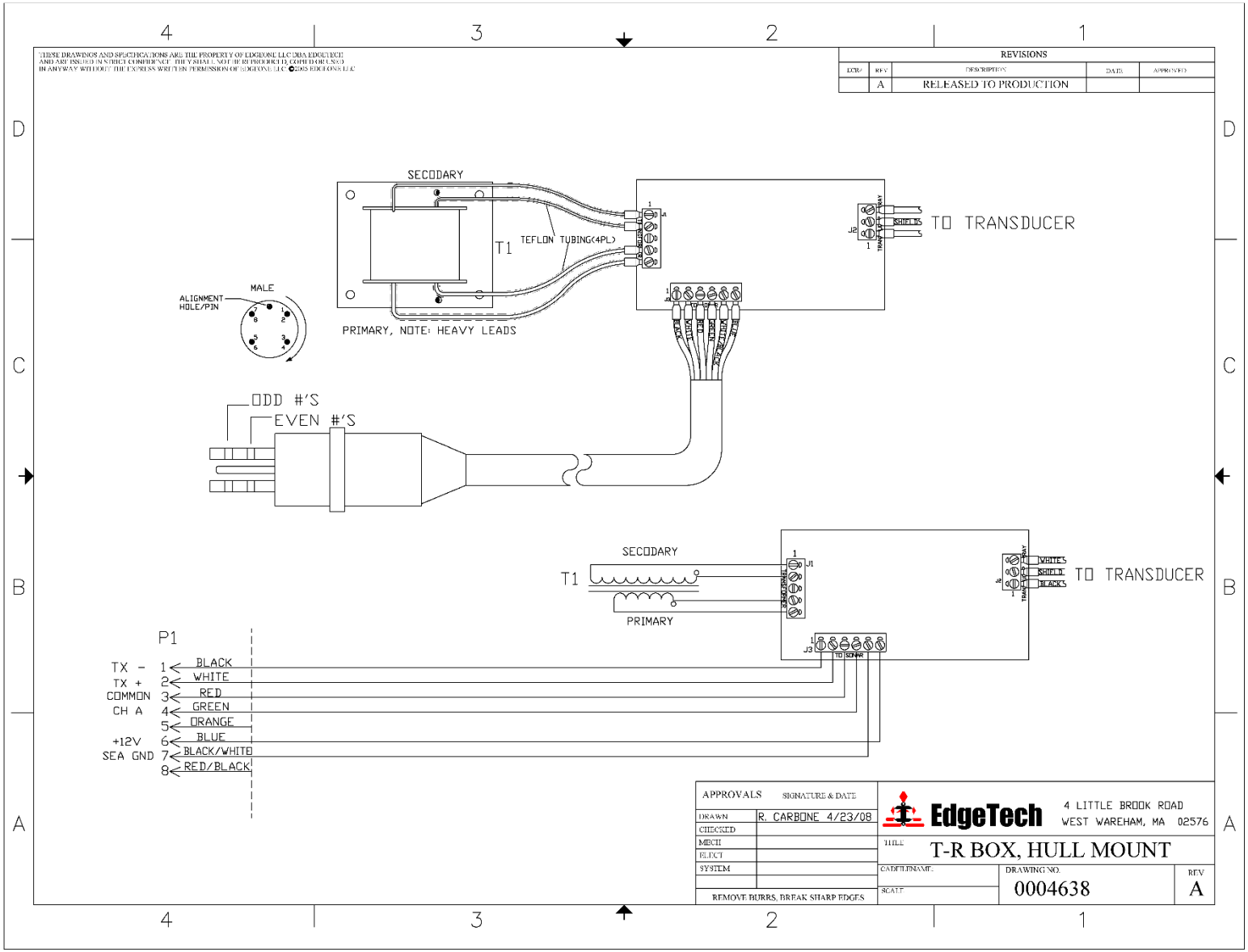


Figure 2-3: T/R Box Wiring Diagram - 0004638

2.4 Spider & Array Specifications

The standard transducers for the 3300-HM SBP system have a good frequency response from 2 kHz to 16 kHz. Multiple transducers are mounted to give various beam width options. Specifications for the array are given in TABLE 2-6 and a wiring diagram for the spider box is provided in FIGURE 2-4.

SPECIFICATION	VALUE
Pulse Type	Full Spectrum CHIRP FM
Pulse Length	From 5 to 100 ms
Bandwidth	From 500Hz to 12kHz depending on application
Trigger In	TTL negative edge triggered
Trigger Out	TTL negative edge triggered. Minimum 5ms long pulse (Lower BNC)
Sampling Rate	20, 25, 40,50 kHz depending on the pulse upper frequency
Acoustic Power	About 212 dB ref 1µPa peak at center frequency of system
Resolution	From 4 to 50 cm of vertical resolution depending on pulse vehicle and pulse bandwidth
Beam width	20 to 40 degrees depending on transducer configuration
Minimum array height	5 meters above seafloor

Table 2-8: General Array Specifications

> **NOTE:** The 3300-HM SBP system is an application-specific unit; using it for purposes other than sonar data acquisition is strongly discouraged. The above information is for documentation purposes only. Specifications are subject to change without notice.

2.5 Technical Drawings

A wiring diagram of the spider box in a 2x2 configuration is shown in FIGURE 2-4.

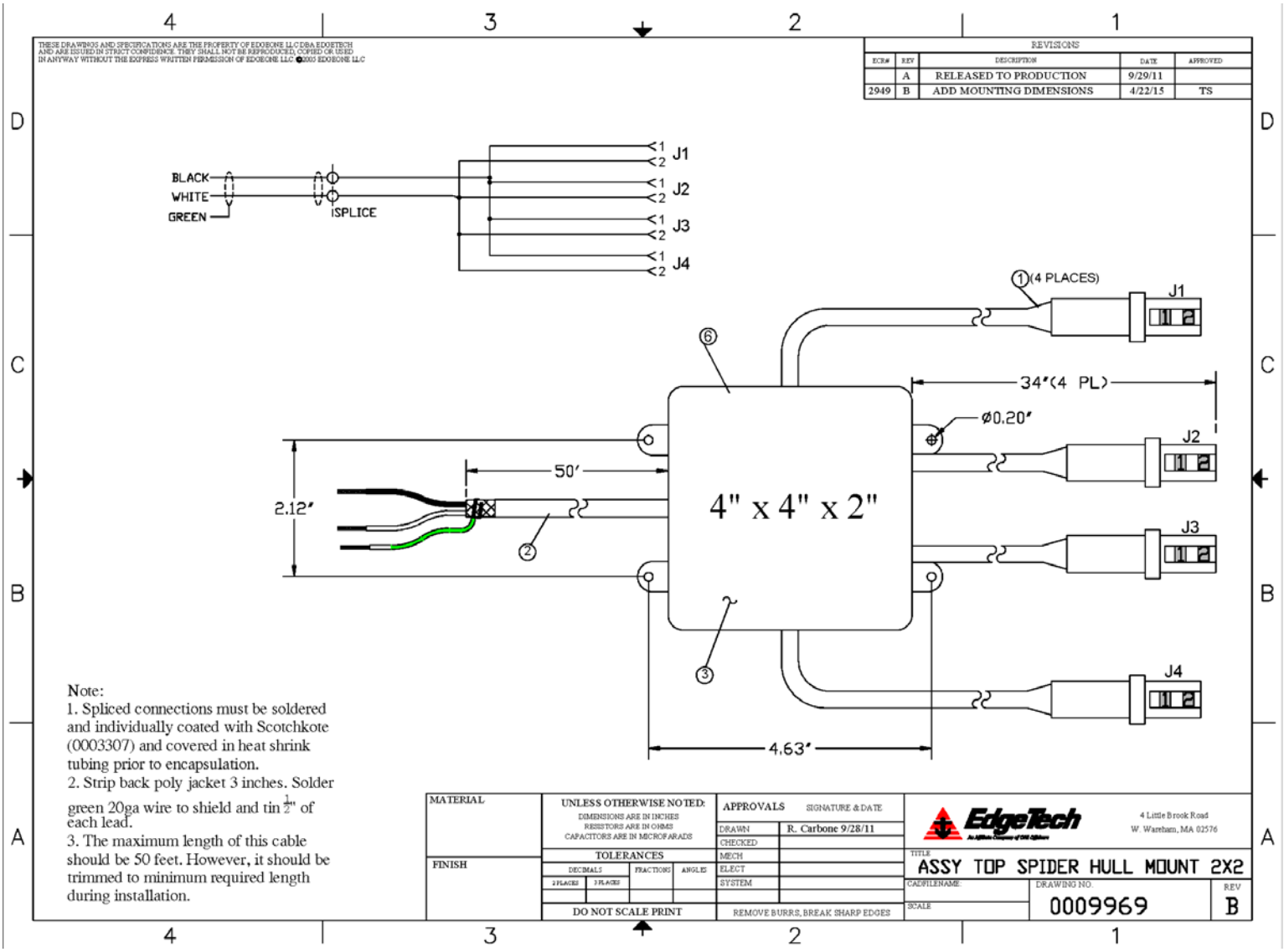


Figure 2-4: Spider Wiring Diagram - 0009969

TABLE 2-7 and TABLE 2-8 show the specifications for the KT-216H and KT-106D arrays, respectively:

KT-216H Specifications:

SPECIFICATION	VALUE			
Frequency Range:	2 - 12 kHz			
Pulses (user selected):	2 - 5 kHz, 100 ms 2 - 6 kHz, 40 ms 2 - 8 kHz2 - 8 kHz, 40 ms, Wide Band (WB) 2 - 10 kHz, 20 ms 2 - 12 kHz, 20 ms 2 - 12 kHz, 3 ms			
Vertical Resolution (depends on pulse selected):	6 - 10 cm			
Penetration (typical):	In Course Calcareous Sand: 6 m		In Clay: 80 m	
Directivity Index (per Array Size):	2 X 2 15 dB	3 X 3 18 dB	4 X 4 21 dB	5 X 5 23 dB
Beam Width (per Array Size): 4.5 kHz Center Frequency	2 X 2 40°	3 X 3 30°	4 X 4 24°	5 X 5 20°
Beam Width (per Array Size): 6 kHz Center Frequency	2 X 2 33°	3 X 3 25°	4 X 4 20°	5 X 5 17°

Table 2-9: KT-216A2H Array Specifications

KT-106D Specifications:

SPECIFICATION	VALUE				
Frequency Range:	1 - 6 kHz				
Pulses (user selected):	1.2 - 5.0 kHz, 66 ms 1.5 - 4.5 kHz, 33 ms 1.5 - 4.5 kHz, 12 ms 1.5 - 5.5 kHz, 12 ms 1.5 - 6.0 kHz, 20 ms 1.5 - 6.5 kHz, 12 ms				
Vertical Resolution (depends on pulse selected):	6 - 10 cm				
Penetration (typical):	In Course Calcareous Sand: 6 m		In Clay: 80 m		
Directivity Index (per Array Size):	2 X 2 13 dB	5† 15 dB	7† 16 dB	3 X 3 17 dB	4 X 4 20 dB
Beam Width (per Array Size): *3.75 kHz Center Frequency*	2 X 2 38°	5† 26°	7† 29°	3 X 3 24°	4 X 4 18°

Table 2-10: KT-106D Array

† See FIGURE 2-5

NOTES: Vertical resolution is the smallest distinguishable distance between the peaks of two reflections that can be displayed on the screen as separate reflectors. Sound energy is reflected to the sonar system when the transmitted pulse encounters a change in density, and the resolution of a sonar system is measured by its ability to distinguish between two adjacent targets. The vertical resolution is dependent on the transmitted CHIRP pulse bandwidth. It is theoretically calculated by the product of the transmitted pulse length (inverse of the bandwidth) and half the speed of sound in water (approximately 750m/s).

The value for sub-bottom penetration is the maximum distance beneath the sea floor that a step change of 10% in density can be seen on the sub-bottom display. This assumes the sediment is gas-free (without organic materials), and the lowest frequency of the pulse spectrum is transmitted. Lower frequencies reduce attenuation (sound absorption).

Many factors contribute to the penetration performance of a Hull Mounted system. However, one of the essential factors in determining the performance of a CHIRP pulse, along with the expected penetration and resolution, is the center frequency of the CHIRP pulse? Therefore, for example if you have a pulse of 1-8 kHz then you use the center frequency (4.5 kHz) to determine resolution and penetration. The size of the array is another contributing factor, as low frequency efficiency goes up as the side of the array is increased due to increased directivity.

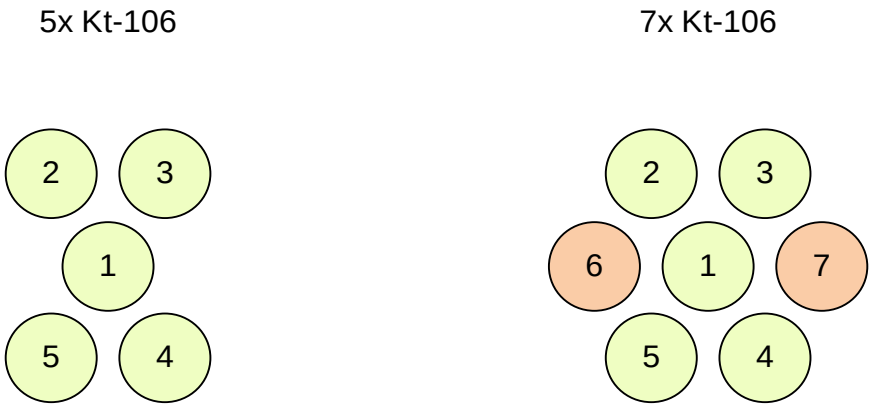


Figure 2-5 : KT-106 Non-Symmetrical Array Configurations

2.5.1 Array Sizes

Selection of array size depends on transducer type (KT-216 or KT-106) and the geological survey application. The important decision parameter is the water depth in which the system is to be used. For most deployments to 3000 meters, a 4 x 4 array will provide the needed performance. A 2 x 2 array should be considered only for coastal application and water depths to 300 meters. Only a 5 x 5 array can be used for full ocean depth.

The following is a matrix of Signal to Noise Ratio for each array size. It assumes sea state 5, flow noise of 70 dB (about 10-knots), a loss in typical seafloor sediments of 10 dB, a 20 ms pulse length, and a bandwidth of 5 kHz. Several other variables are not included in this matrix. They include hull type and thickness, self-noise, variations in flow noise, other ship's speeds, other sea states, and roll and pitch. Nor does it consider other conditions that could affect the performance, such as a bubble screen.

ARRAY SIZE	EXPECTED SNR
2 X 2	28 dB
3 X 3	31 dB
4 X 4	34 dB
5 X 5	37 dB

Table 2-11: Array Size vs. Expected Signal-to-Noise Ratio (SNR)

> **NOTE:** The 2-way transmission coefficient for a 4 kHz center frequency over a 0.5 inch steel acoustic window is 0.5 (i.e. 50% of the acoustic pulse amplitude is lost due to the 2-way travel of sound through the plate). The coefficient reduces with higher frequencies and thicker steel hull.

See the following figures for images of the various array configurations:

- FIGURE 2-6: DECK CABLE, T/R BOX, AND SPIDER WIRING DIAGRAM (2X2 CONFIGURATION)
- FIGURE 2-7: SINGLE TRANSDUCER DRAWING
- FIGURE 2-8: 2X2 TRANSDUCER CONFIGURATION
- FIGURE 2-9: 3X3 TRANSDUCER CONFIGURATION
- FIGURE 2-10: 4X4 TRANSDUCER CONFIGURATION
- FIGURE 2-11: 5X5 TRANSDUCER CONFIGURATION

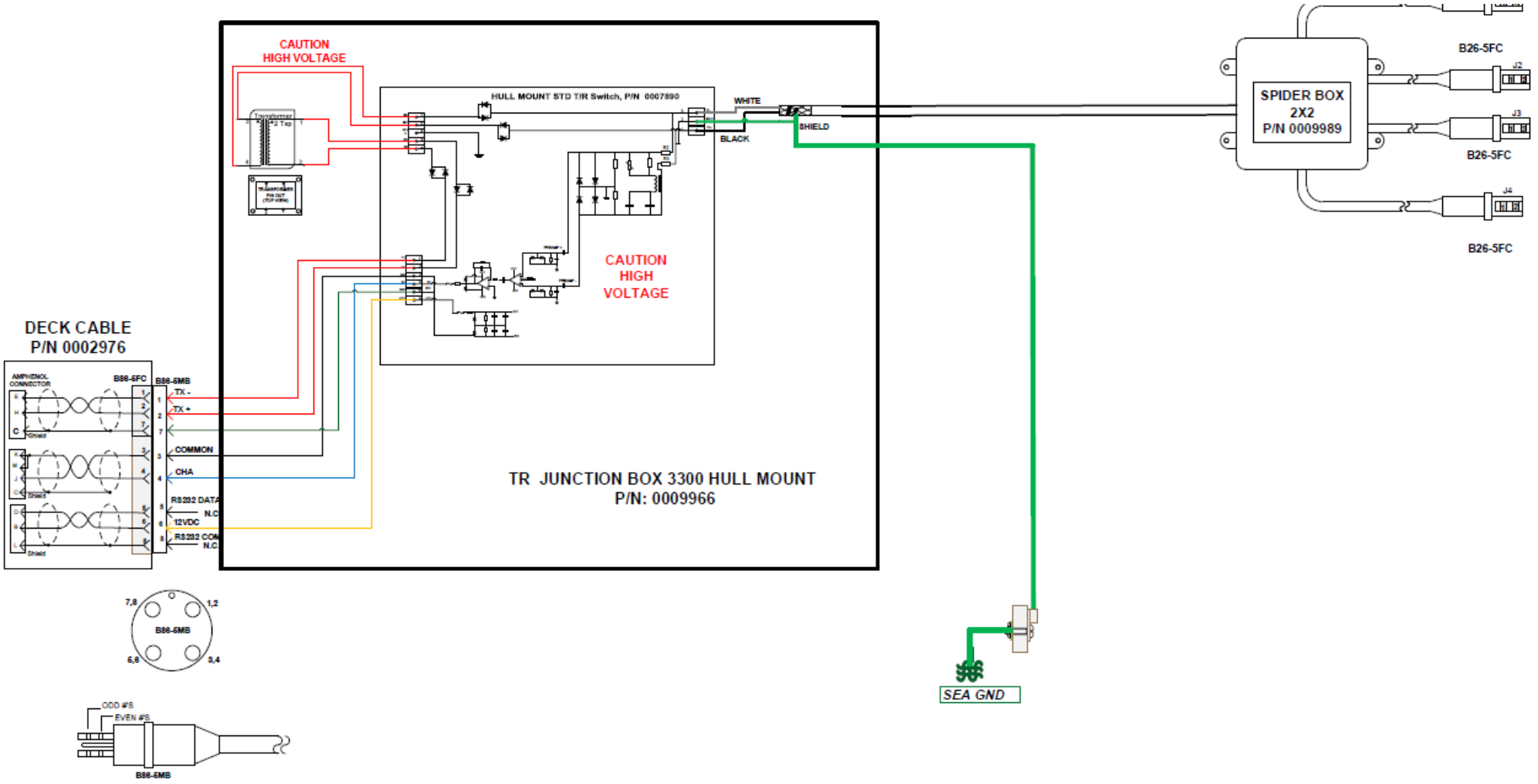


Figure 2-6: Deck Cable, T/R Box, and Spider Wiring Diagram (2x2 Configuration)

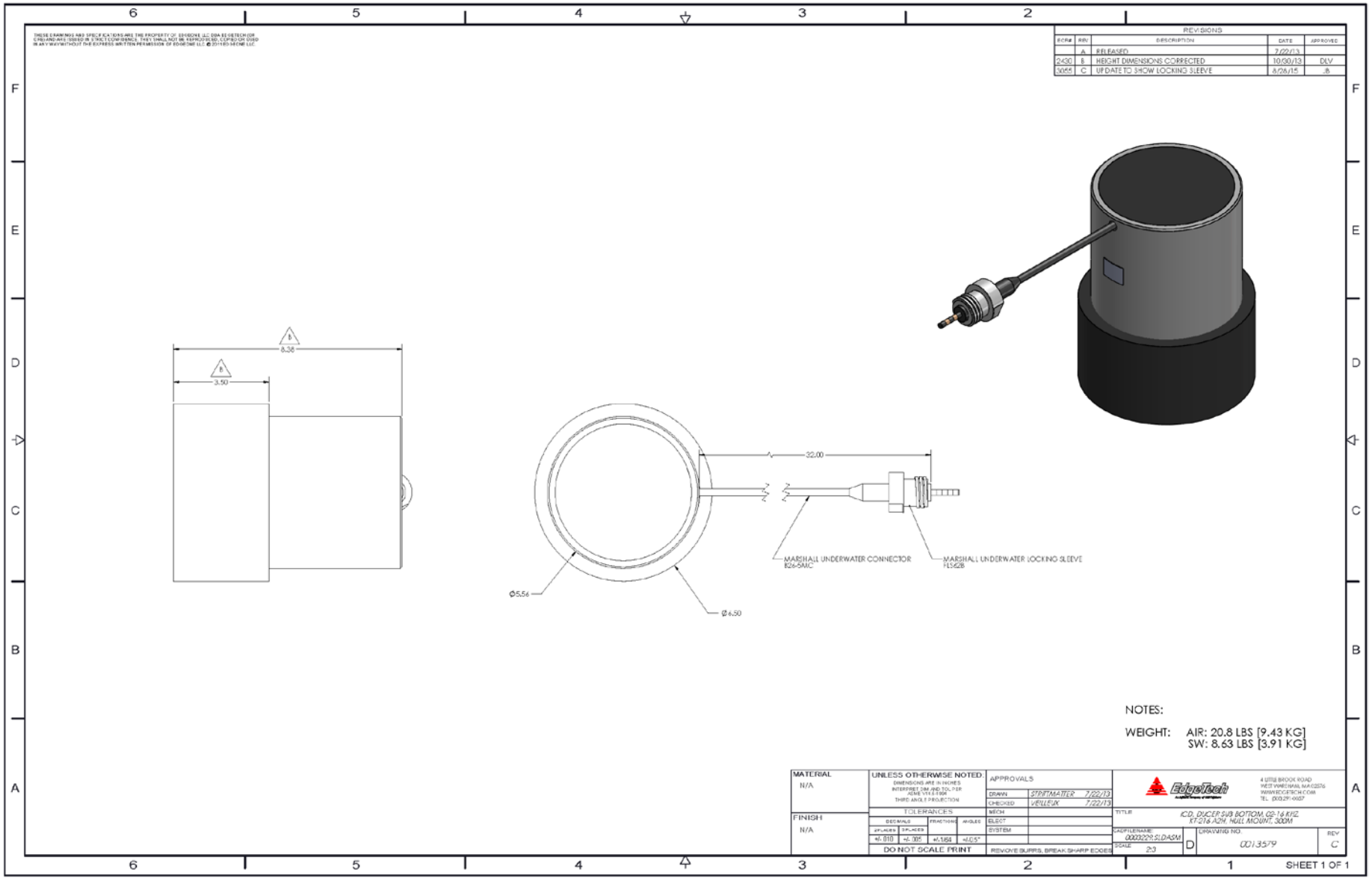


Figure 2-7: Single Transducer Drawing - 0013579

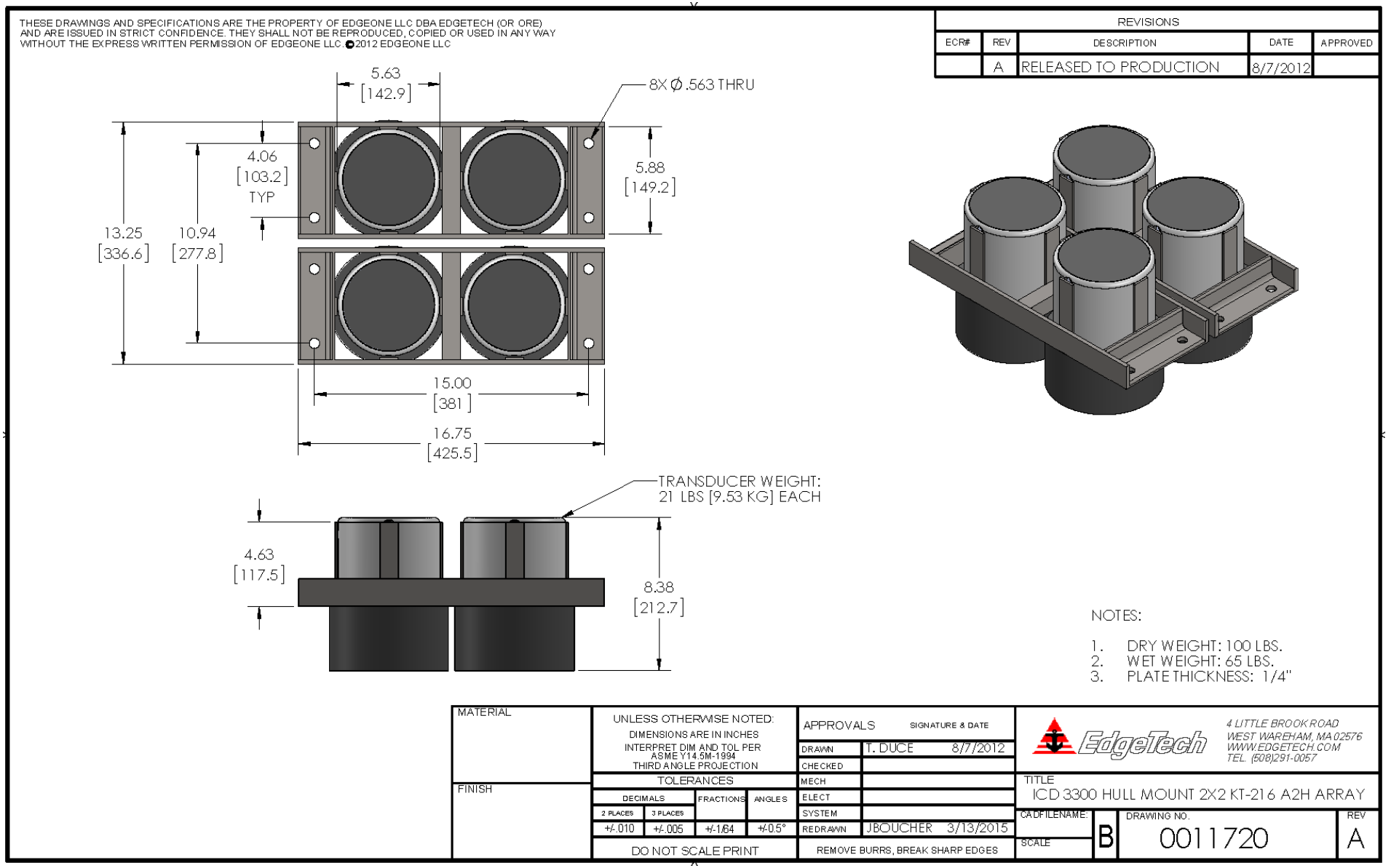


Figure 2-8: 2x2 Transducer Configuration - 0011720

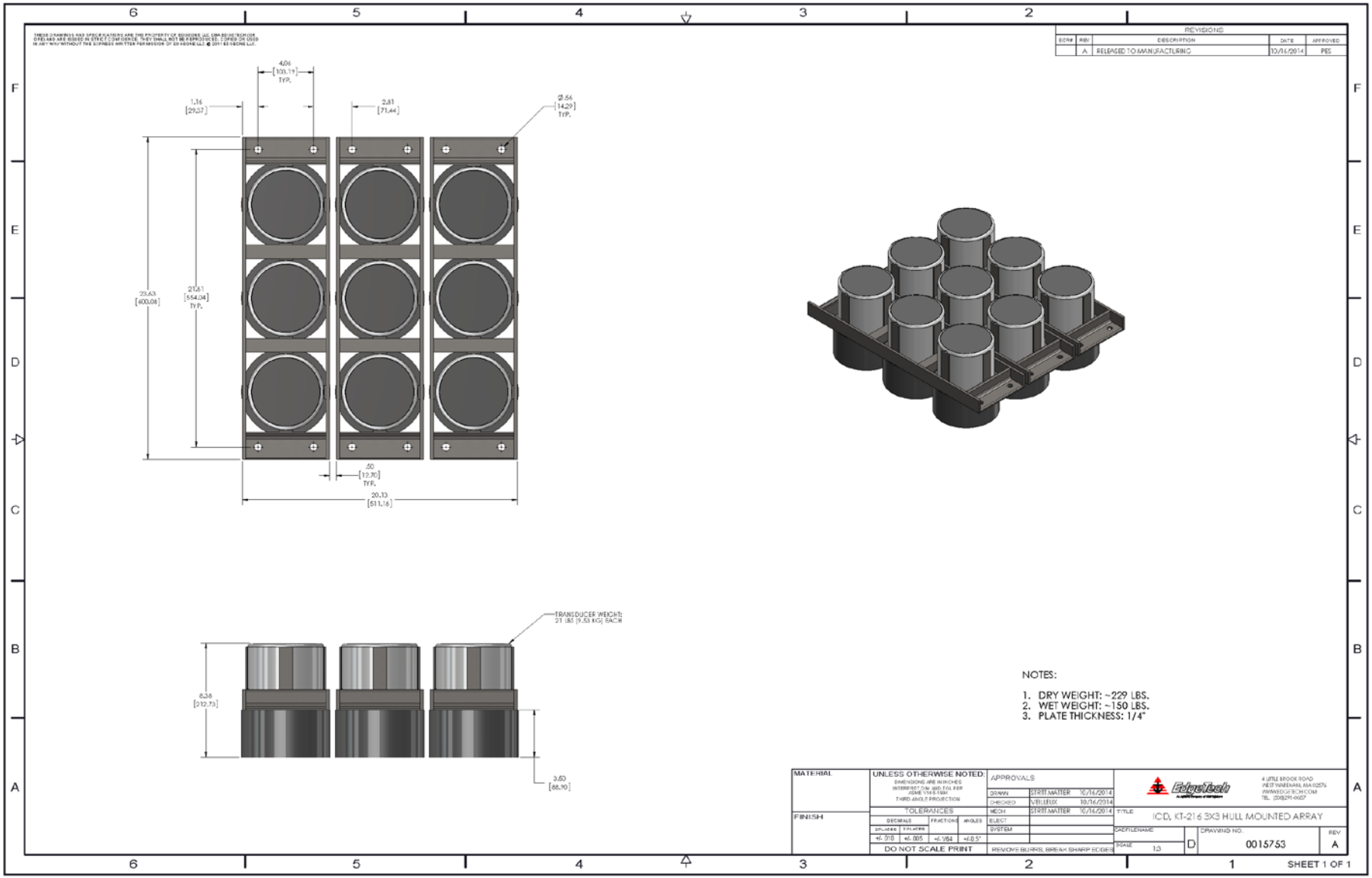


Figure 2-9: 3x3 Transducer Configuration - 0015753

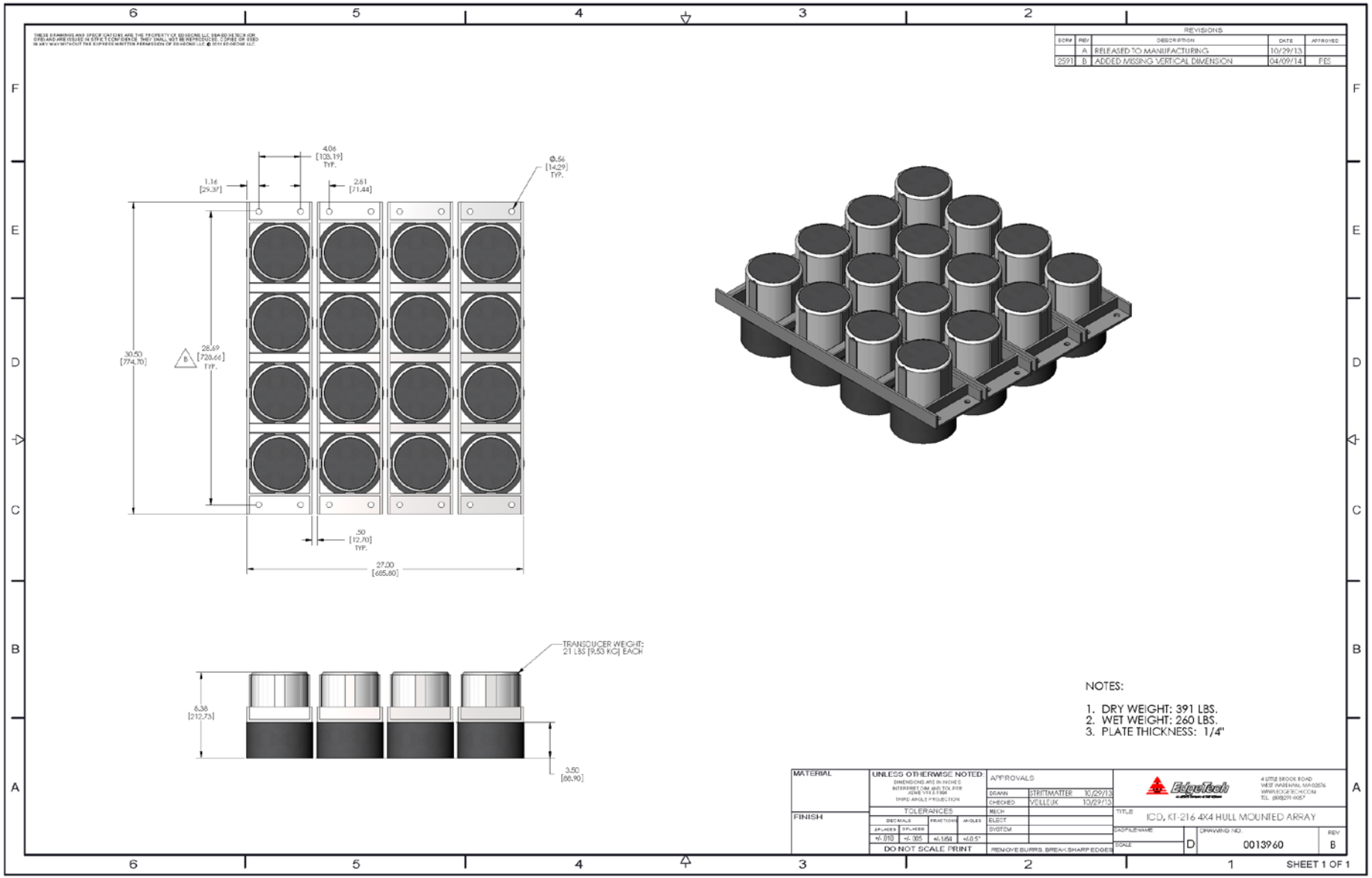


Figure 2-10: 4x4 Transducer Configuration - 0013960

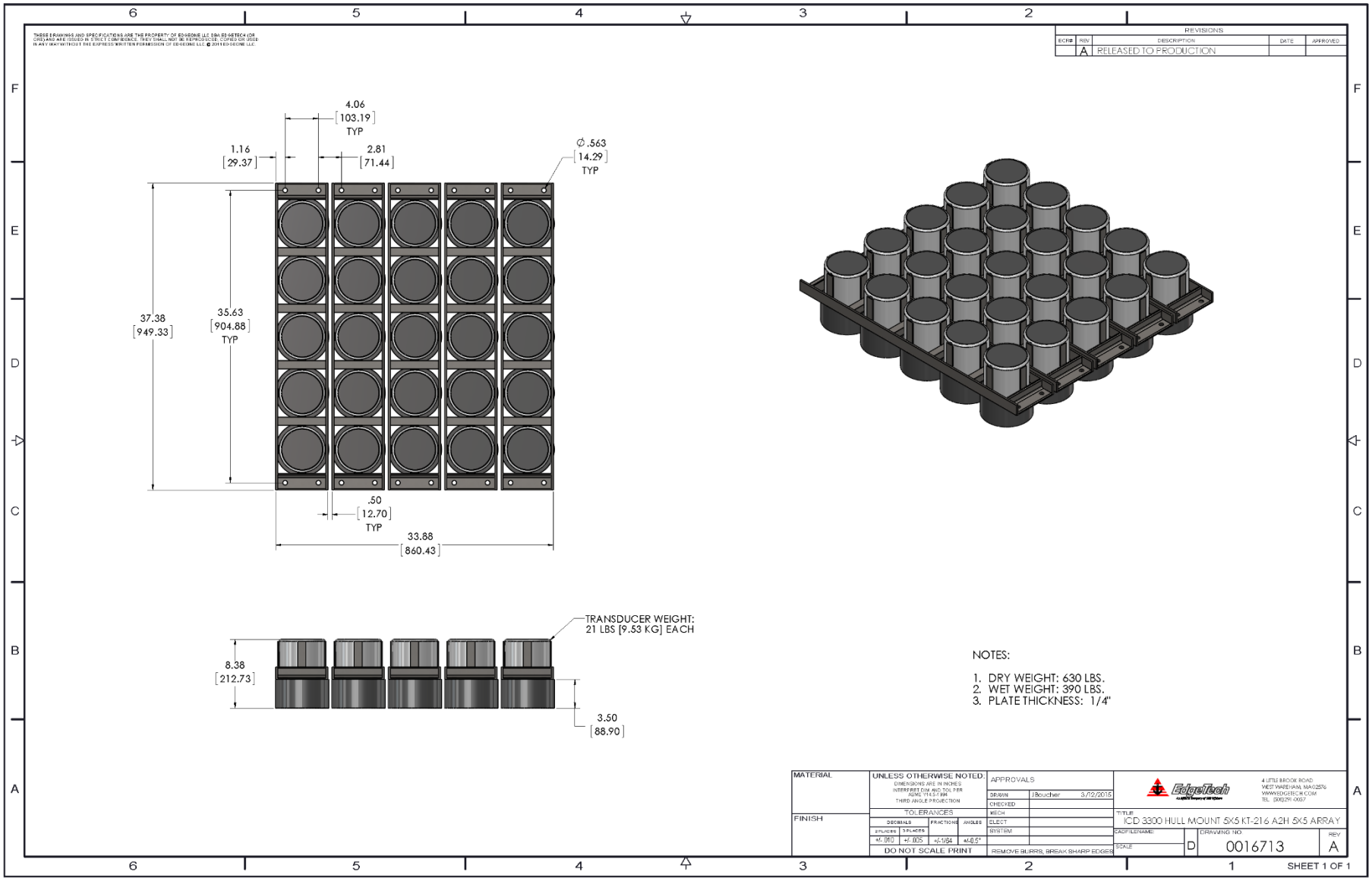


Figure 2-11: 5x5 Transducer Configuration - 0016713

2.6 Signal Cable Specifications

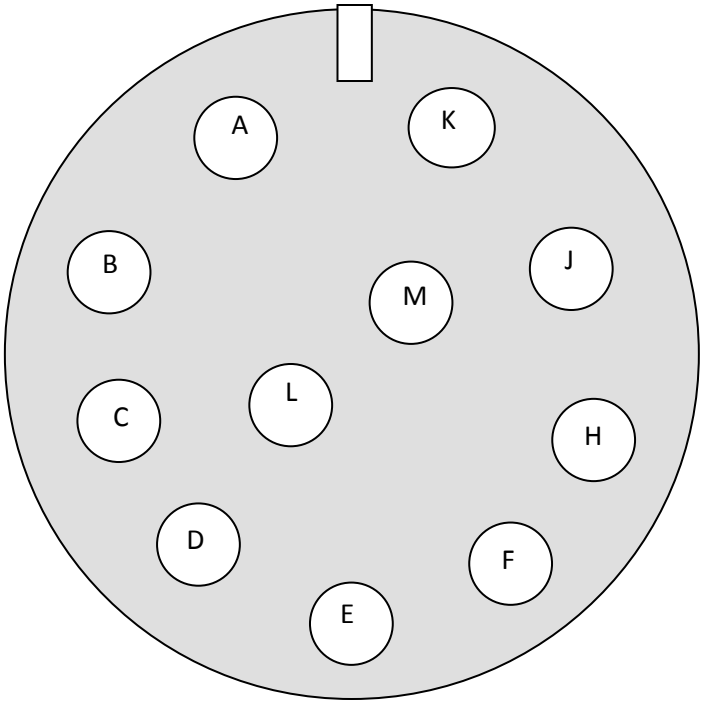
The deck cable is made of six wires twisted and shielded in pairs. The cable has a Kevlar strength member that provides a 1600 kg (3500 lb.) minimum breaking strength and 295 kg (650 lb.) working strength. See TABLE 2-12:

SPECIFICATION	VALUE
Nominal Cable Weight:	30.8 kg per 100 m (207 lb/1000 ft.)
Voltage Rating:	600 Volts.
Bending Radius:	10 cm (4 in)
Length:	50, 60, or 75 meters (164, 197, or 245 ft.)

Table 2-12: Signal Cable Specifications

The deck cable is terminated at the topside with a military type Amphenol connector and at the T/R Box with a Marshal underwater wet pluggable connector. The Pinout Diagrams for the signal cable can be found in FIGURE 2-12, FIGURE 2-13, and FIGURE 2-14.

FIGURE 2-15 provides the wiring diagram for the signal cable.



PIN	FUNCTION
A	AMPLIFIER OUTPUT SHIELD
B	+12 VDC
C	SEA GROUND
D	DF1000 SHIELD (SUBSCAN ONLY)
E	AMPLIFIER OUTPUT 1
F	DF1000 DATA (SUBSCAN ONLY)
H	AMPLIFIER OUTPUT 2
J	PRE-AMPLIFIER INPUT CHANNEL A
K	PRE-AMPLIFIER COMMON
L	NC
M	NC

Table 2-13: Deck Cable Pinouts

Figure 2-12: Topside Unit Deck Cable for Hull Mount Systems (Female) Amphenol #97-3106A-20-33F

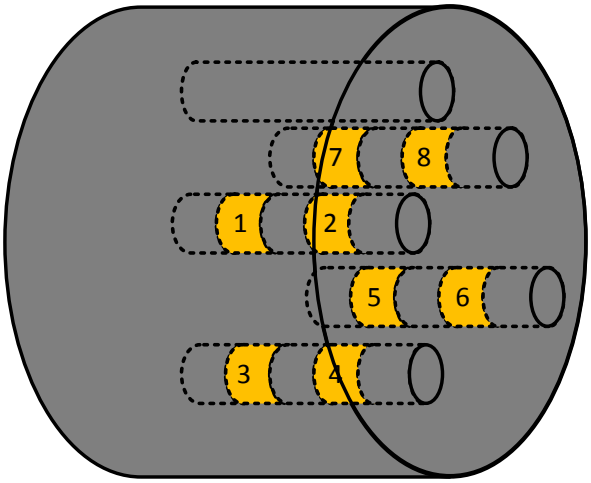


Figure 2-13: Female Marshal Connector – 86-5FC
(Deck Cable to T/R Box Connection)

PIN	FUNCTION
1	AMPLIFIER OUTPUT 1
2	AMPLIFIER OUTPUT 2
3	PREAMPLIFER COMMON
4	PRE-AMPLIFIER SIGNAL
5	RS-232 DATA
6	+ 12 VDC
7	SEA GROUND
8	RS-232 COMMON

Table 2-14: Deck CABLE Connector Pinouts

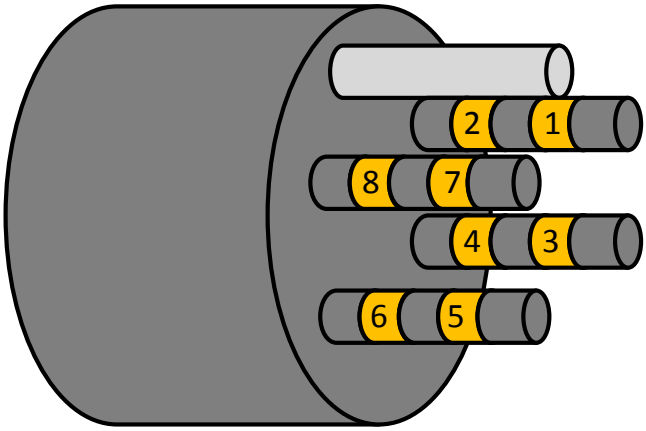
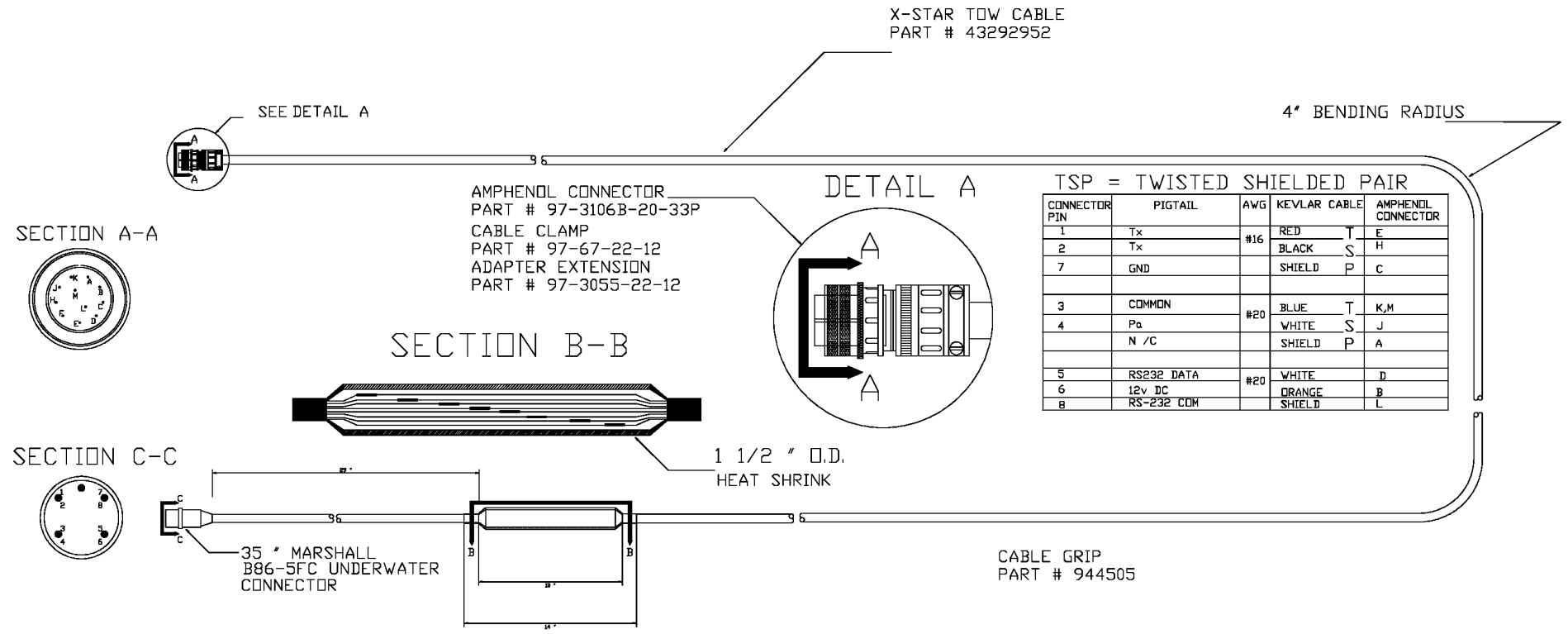


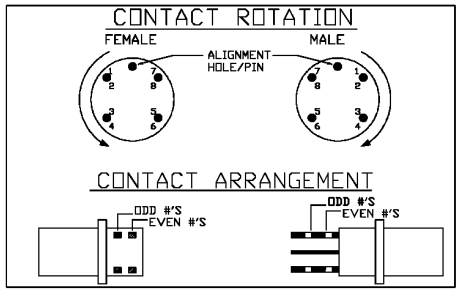
Figure 2-14: Male Marshal Connector – 86-5MC
(T/R Box to Deck Cable Connection)

REVISIONS				
ECR	REV	DESCRIPTION	DATE	APPROVED
	A	RELEASED TO PRODUCTION	12/3/09	TFW



TSP = TWISTED SHIELDED PAIR

CONNECTOR PIN	PIGTAIL	AWG	KEVLAR CABLE		AMPHENOL CONNECTOR
1	Tx	#16	RED	T	E
2	Tx		BLACK	S	H
7	GND		SHIELD	P	C
3	COMMON	#20	BLUE	T	K,M
4	Pa		WHITE	S	J
	N /C		SHIELD	P	A
5	RS232 DATA	#20	WHITE		D
6	12v DC		ORANGE		B
8	RS-232 COM		SHIELD		L



MATERIAL	UNLESS OTHERWISE NOTED: DIMENSIONS ARE IN INCHES RESISTORS ARE IN OHMS CAPACITORS ARE IN MICROFARADS	DRAWN BY: R. Carbone	EdgeTech 1141 HOLLAND DRIVE BAY1 BOCA RATON FL, 33487
		DRAWN 12/3/09	
		CHECKED	
	TOLERANCES: DECIMALS 2 PLACES, 3 PLACES; FRACTIONS; ANGLES	MECH	TITLE: DECK CABLE, 3300 HULL MOUNT SYSTEM, 50M
FINISH		ELECT	
		SYSTEM X-STAR RS-232	CARDFILE NAME
		REMOVE BURRS BREAK SHARP EDGES	SCALE DO NOT SCALE
			DRAWING NO. 0002976
			REV A

Figure 2-15: Deck Cable Schematic - 0002976

3.0: CONTROLS & CONNECTIONS

This section describes the controls and indicators, along with the connections for the 3300-HM SBP.

3.1 Deck Unit Controls and Indicators

The deck unit controls and indicators are as follows, and are shown in FIGURE 3-1:

POWER SUPPLY: Rocker switch. Turns on the power supply in the 3300-HM SBP Topside Processor. This switch can be left in the on position at all times.

SYSTEM POWER: Push button toggle switch. Turns the 3300-HM SBP Topside Processor on.

POWER: A blue indicator lights up when amplifier is on.

RESET: Momentary push button switch. Resets 3300-HM SBP Topside Processor.

HARD DISK: Red indicator. Indicates when a hard drive on the 3300-HM SBP Topside Processor is active.

SYSTEM: Green indicator. Illuminated when 3300-HM SBP Topside Processor is on.

POWER AMP OUT TX1: Red indicator. Flashes when Channel 1 of the Power Amplifier transmits.

POWER AMP OUT TX2: Red indicator. Flashes when Channel 2 of Power Amplifier transmits.

READY: Green indicators. Illuminate when the system is ready to transmit. Upon power up it will take one to two minutes for indicator to illuminate.

12 VDC OUT TO PREAMP: Test point. Used to measure the 12 VDC voltage applied to the preamplifier in the T/R Box.

PREAMP 5 VDC: Test point. Used to measure the 5 VDC voltage preamplifier feedback voltage from the T/R Box.

PREAMP COMMON: Test point. Common ground for the preamplifier.

GND: System ground connection.

DATA: Amp Indicator lights up and blinks when data is being transmitted

CH1 & 2: Defunct dials on the amplifier. Turning these will not affect the performance or function of the 3300-HM SBP system in any way

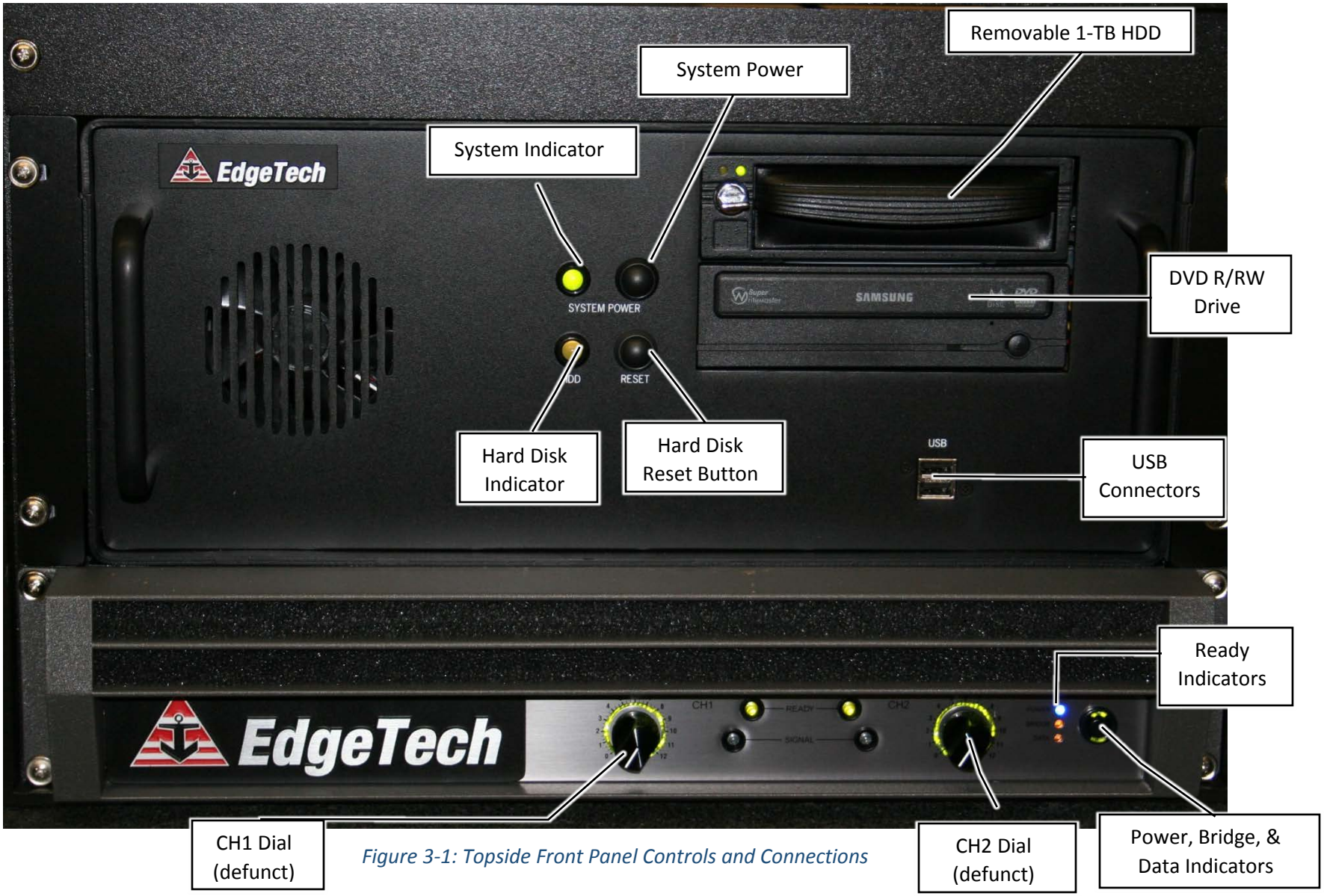


Figure 3-1: Topside Front Panel Controls and Connections

3.2 Deck Unit Connections

The topside deck unit connections are as follows, and are shown in FIGURE 3-2 . The wiring diagram can be seen in FIGURE 3-3:

TRACKBALL: USB on front or rear panel connects to the trackball.

KEYBOARD: USB on front or rear panel connects to the keyboard.

SEA CABLE: 11-Pin female bulkhead connector. Connects to the deck cable.

MONITOR: Mini display port on rear panel connects to the LCD monitor.

COM 1-NAV: DB-9 female connector. RS-232 serial port connects to the navigation system.

COM 3, 5, 6: DB-9 female connectors. RS-232 serial ports can be used to connect to the navigation system.

TRIGGER IN: BNC connector. Connects to an external trigger source to enable and disable the sonar.

TRIGGER OUT: BNC connector. Connects to an external sonar system to trigger it.

MARK: Creates a short that makes a mark in the sonar record

ETHERNET: (2) RJ-45 connector. Available for connection to a local area network (LAN) and/or printer.

USB: **Front Panel:**

(2) USB2

Rear Panel:

(2) USB2

(2) USB3

(2) USB3.1

AC POWER: CEE-type AC input and output connectors. The AC input connector connects to the AC power source, and the AC output connectors are available for powering LCD monitor and other equipment, if required.

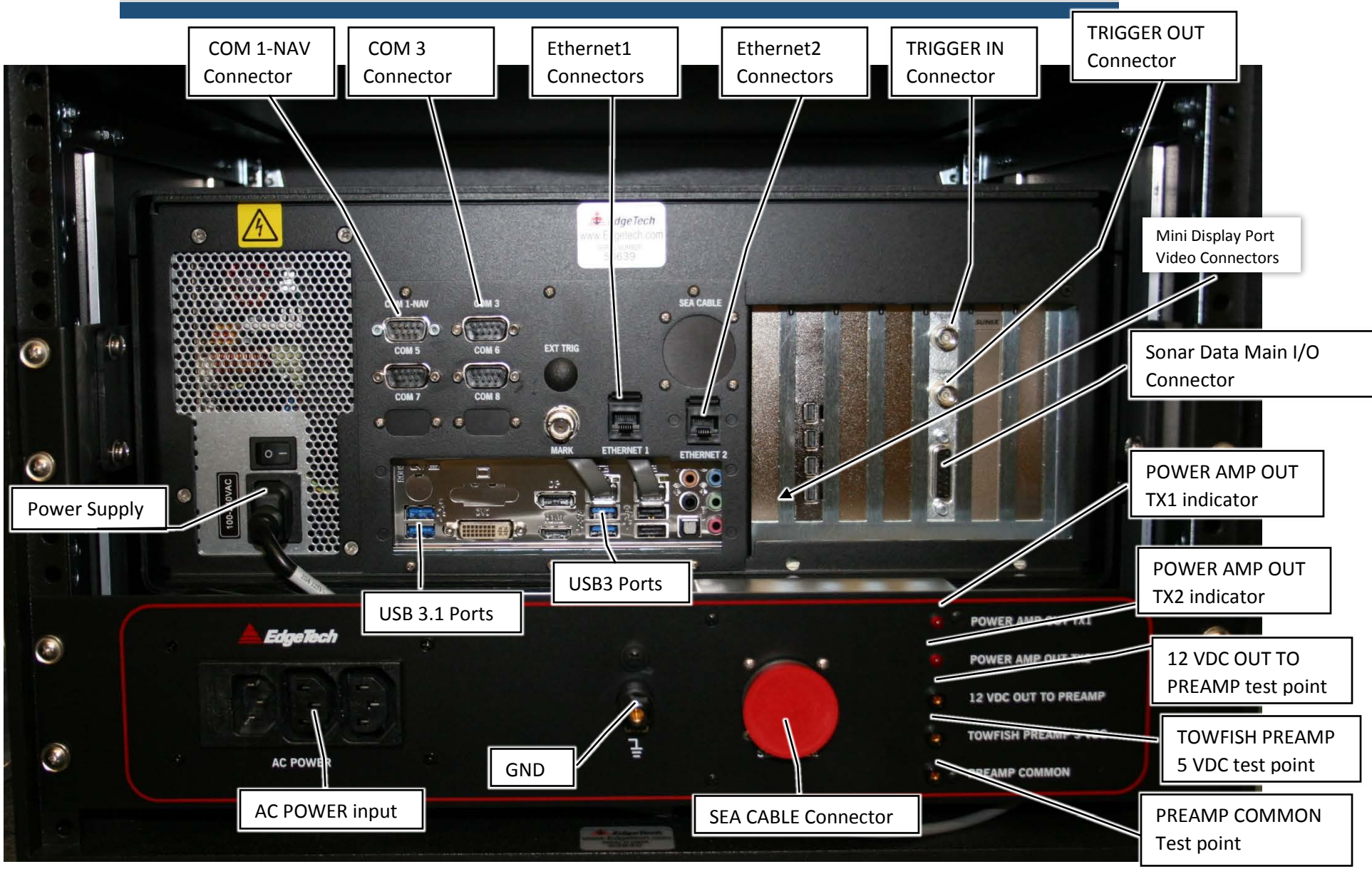


Figure 3-2: Topside Rear Panel Controls and Connections

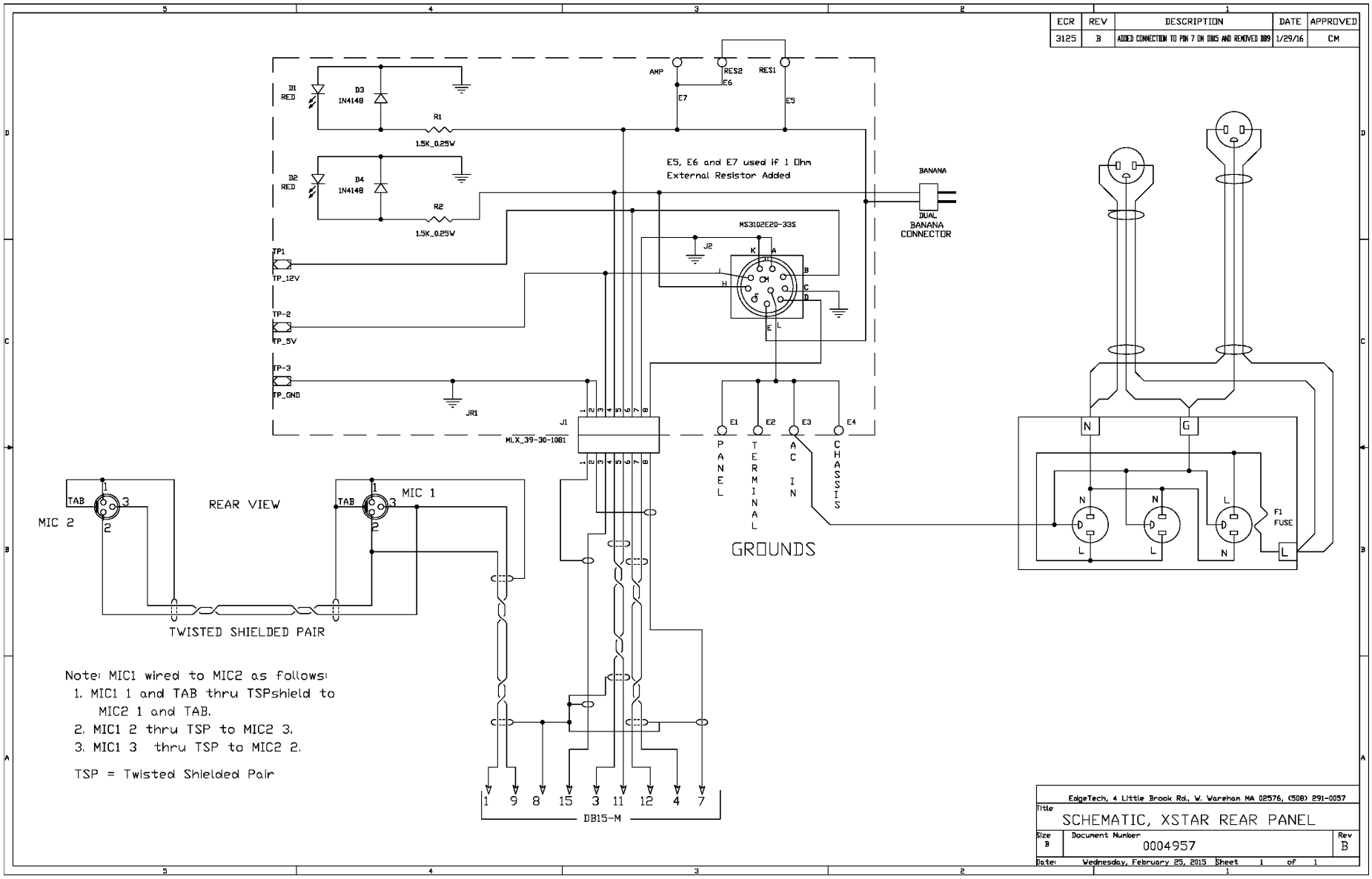


Figure 3-3: Rear Panel Schematic - 0004957

4.0: INSTALLATION

This section explains how to unpack, inspect, and install the 3300-HM SBP system. It describes placement considerations for the topside and transducer arrays, along with power requirements.

Refer to the PN 0016695 for a more detailed explanation of 3300-HM SBP installation.

For information on connecting a navigation device or printer, please refer to B.0: NAVIGATION SYSTEMS.

4.1 Unpacking & Inspecting

The EdgeTech 3300-HM SBP system is supplied complete with all necessary cables. The system components are individually packed in reusable shipping containers.

Before unpacking the system components, inspect the shipping containers for any damage. Report any damage to the carrier and to EDGETECH CUSTOMER SERVICE, who will provide additional guidance.

If the shipping containers appear free of damage, carefully unpack the components and inspect them for damage. Again, if any damage is found, report it to the carrier and to EDGETECH CUSTOMER SERVICE. Also check the packing list and verify that all the items on the list are included. If any items are missing, immediately contact EDGETECH CUSTOMER SERVICE. Do not install or operate any equipment that appears to be damaged.

Although the items shipped may vary, depending on the customer requirements, the 3300-HM SBP typically includes the following:

- Topside Unit
- Hull Mount Transducer Arrays
- Connection Cable
- AC power cords (2)
- Software USB
- Manuals

After unpacking the system components, be sure to safely store the shipping containers – including any packing materials – for later use. When transporting or storing the system, all items should be packed in their original shipping containers in the same manner in which they were originally shipped, and always store the system in a dry environment when not in use.

4.2 Topside Installation

Once unpacked, the topside unit could be installed in a standard 19-inch rack, but can be set on any level surface, as in the Optima case. Several requirements are necessary for proper placement of the unit, and are addressed below:

4.2.1 Power Supply

The system power requirements are 120–220 VAC, 50/60 Hz. For the 3300-HM SBP Topside Processor, the input voltage is auto sensing. For the Power Amplifier, you must select 120 VAC or 220 VAC operation manually.

4.2.2 Use of an Uninterruptable Power Supply

The AC power source should be continuously free of high-amplitude, high-frequency transients, as this type of interference could cause degraded performance or damage to the equipment. An uninterruptable power supply (UPS) with power surge protection is recommended for powering the equipment.

However, whether or not a UPS is used, the AC power source should never be the same as that being used to power electric motors, such as pumps and winches, on the survey vessel.

4.2.3 Selecting the Power Amplifier Input Power Voltage

To select the Power Amplifier input power voltage, first remove the amplifier from the rack. Then remove the top cover, locate the board at the lower right corner, and switch it to the required input power voltage as indicated by the arrow.

4.2.4 Changing to a Non-US Power Plug

An AC power cord is provided for connecting the Deck Unit to a standard U.S. 3-pronged outlet. For non-U.S. power outlets, you can modify this cord by cutting off the 3-pronged plug and attaching the appropriate plug. For connection information, refer to TABLE 4-1.

AC POWER CORD WIRE COLOR	FUNCTION
Black	AC line
White	AC neutral
Green	Earth ground

Table 4-1: AC Power Cord Wiring

NOTE: Each Deck Unit is shipped configured to country voltage requirements per each end-user.

4.2.5 Navigation Interface

The 3300-HM SBP system accepts all standard National Marine Electronics Association (NEMA) 0183 message sentence formats from a connected Global Positioning System (GPS) or Integrated Navigation System.

4.2.6 Deck Unit Placement

The Deck Unit should be set up and situated in a dry, sheltered area that is protected from weather and water spray. The placement area should also have a temperature that is consistently between 0°C and 40°C (32°F and 104°F). Avoid areas of direct sunlight, especially in tropical environments, as heat buildup could occur and viewing the LCD monitor and status indicators could prove difficult. The 3300-HM SBP Topside Unit should be placed in on a surface that is flat and free from vibrational interference.

Secure the Deck Unit in place, using tie-downs if necessary, near the required AC power source. If you are mounting the 3300-HM SBP Topside Processor and the Power Amplifier in a 19-inch rack other than the supplied rack mount enclosure, ensure that there is ample room behind the rack for connecting the cables. Support the components inside the rack using appropriate mounting brackets and secure the front panels using standard 19-inch rack front panel mounting hardware.

4.3 Hull Mount Array Installation

> **NOTE:** This section is a summarized version of the full installation guide, provided in EdgeTech document PN 0016695.

The transducer arrays for the 3300-HM SBP system are mounted to the bottom of the survey vessel in a "Sea Chest." This chest is filled with fresh water in order to protect the array from corrosion, while providing a medium for the sub-bottom sonar signal to travel through.

A hatch on the top of the chest allows the deck crew to access the array in order to inspect or remove it between surveys. The bottom of the Sea Chest (facing the sea floor) is an "acoustic window," which is made of a material that allows the signal to pass through it while still protecting the array.

Stainless steel trays are available from EdgeTech for mounting the transducers inside the user-provided Sea Chest. However, the user may also construct the trays themselves by following the proper spacing requirements listed below (for transducer array specifications, see sub-section 2.3):

- Install the transducer array parallel to the sea surface within a flooded steel enclosure
- For best results, use an acoustic window made of a material such as a high-quality fiberglass with no air pockets (e.g., 'G10' glass board), 'Lexan', or a polycarbonate material. Construct the Sea Chest so the acoustic window can be bolted to the sea chest using a bezel to secure it in place.

- The steel enclosure is a steel box welded to a section of the hull that is flat and parallel to the sea surface. The sides of the enclosure should be high enough to allow inspection of the array; EdgeTech recommends the sides of the box be at least 30 cm higher than the top of the transducers. There should be a minimum of 5 cm between the sides of the transducers and the sides of the sea chest.

- A sea chest for a 4 x 4 array (of KT-216 transducers) will have the following minimum inside dimensions:

  Inside height: 22 inches / 56 cm
  Inside width: 28.25 inches / 72 cm
  Inside length: 31.25 inches / 80 cm

- Locate the steel box away from vibrating equipment and sufficiently deep below the water line to prevent air bubbles passing along the hull and under the array during high sea states.

- Line all four vertical sides and the removable cover plate with a foam material such as ¼ inch (0.64 cm - minimum) diver's wetsuit neoprene. Attach it with a good neoprene cement (such as 3M 5200 moisture cured) to the sides and top of the Sea Chest.

- Bolt the transducer array to an angle bracket that is welded to the inside of the box so that the faces of the transducers are within 2 cm of the hull plate, but not touching it. The array is installed in the box one row (rack) of transducers at a time.

- The steel box should have a removable cover to allow installation and removal of the transducer array. The cover should bolt to the top of the box and have a gasket to prevent leakage. The Cover Plate should have a fill pipe to fill the Sea Chest with fluid and a bleeder valve to exit the air from the Sea Chest. The Sea Chest must be free of any air pockets or bubbles for the transducers to properly operate.

- Fill the tank with fresh water (preferably distilled) from the ship's fresh water supply. If the system will be operated at temperatures near or below fresh water's freezing point, antifreeze may be added so that the freezing point is below that of sea water. EdgeTech recommends Propylene Glycol antifreeze or an equivalent.

- Drain the tank and pipes when the ship is in dry dock if there is a risk of freezing weather. Vent all air from pipes and tank after filling and before operating the sonar to prevent signal degradation.

- Install a stuffing tube and gland nut to allow a 0.8 cm diameter electrical cable to pass through the tank. This cable connects the transducer array to a water-resistant T/R Box that is mounted to a bulkhead within 3 meters of the tank. The T/R Box contains a pre-amp, matching transformer, and T/R switch. The T/R Box enclosure is plastic and approximately 18 cm high by 18 cm wide by 12 cm deep. A standard 50-meter 3300-HM SBP deck cable connects the T/R Box to the 3300-HM SBP Topside Processor.

4.4 Connecting the System

> **WARNING!**
>
> Do not attach any cables or wires while the system is connected to the ship's power, as severe electrical shock may occur.

Once the transducer arrays have been mounted, the Sea Chest has been filled and vented of air, and the topside unit has been unpacked and secured, the user may proceed with connecting the 3300-HM SBP system components in preparation for use:

1. Ensure the AC voltage selection switch in the amplifier is set to the proper voltage.
2. Connect the deck cable to the Hull Mount.
3. Connect the underwater cable to the Amphenol connector at the back of the amplifier unit.
4. Connect the video monitor.
5. Connect the keyboard and trackball to the front panel of the system.
6. [Optional] Connect a thermal printer

> **CAUTION!**
>
> Always connect the T/R box end connector before connecting the cable to the deck unit to prevent connecting an energized connector. This may cause damage to components in the T/R box.

5.0: OPERATION

The purpose of this section is to provide general information on the interface between the 3300-HM SBP transducers and the 3300-HM SBP topside unit. The interface between the 3300-HM SBP and the DISCOVER Sub-Bottom software can be found in the DISCOVER Sub-Bottom Software Manual.

5.1 Activating the System

1. Turn on the POWER SUPPLY switch on the back of the Deck Unit. This switch can be left in the on position at all times if desired.
2. Turn on the POWER switch on the Power Amplifier.
3. Turn on the SYSTEM POWER switch on the 3300-HM SBP Topside Processor.
4. The SYSTEM indicator on the 3300-HM SBP Topside Processor should illuminate and remain on, and the HARD DISK indicator should flash for two to three minutes while a self-test is run. After this test is completed, the HARD DISK indicator will flash periodically.
5. Turn on the LCD monitor.

5.2 File Format

Data is archived to the hard drive of the system in two formats, EdgeTech's native format JSF and the SEG-Y format. The SEG-Y recording can be turned on or off in the software but the EdgeTech Format is always recorded. This is because the JSF format stores a much greater amount of information than the standard SEG-Y.

5.2.1 EdgeTech's Native JSF Format

Please refer to EdgeTech JSF File Format Manual (document 0004824) for more detailed information.

5.2.2 Standard SEG-Y Format

In the standard SEG-Y format, all sonar data in traces is represented via IEEE 32-Bit floating point numbers (as per the standard). All fields are byte oriented as per the standard (Big Endian). That is, for a 32-bit integer, the 8 MSBs are in the first byte. The EBCDIC header is really in EBCDIC (or ASCII).

For Intel based processors, all of the above are not standard and will require conversions. For example, the sonar data must be converted from IBM to IEEE floating point. Integers must be converted from Big Endian to Little Endian, and the EBCDIC header must be converted to ascii. ONLY envelope data is saved (one float per sample).

5.2.3 Palette File Format

Each display channel can have a color palette, which is specified by a .jsp file. These files are text files with numbers separated by white space. The numbers must be ordered in groups of 4.

For each group, the values are:

- Index (0 to 255)
- Red Intensity (0 to 255)
- Green Intensity (0 to 255)
- Blue Intensity (0 to 255)

The indices must be increasing in value. If there are gaps in the index then intermediate color values will be interpolated. Here is an example table for a linear gray step wedge type palette:

```
  0     0     0     0
255   255   255   255
```

5.3 Triggering and Coupling

To avoid interference, the 3300-HM SBP system supports the following different type of triggering Modes:

Internal Trigger: In this mode, the user may specify the ping rate in Hertz (e.g. 3Hz) or ping range (in Meters). The system will use the closest available inter-ping interval (e.g. 332.99ms), and repeatedly re-trigger the system at the expiration of this period.

Coupled Mode: This mode only applies to combined sub-bottom and side scan systems. In coupled mode, the applicable subsystem is triggered when the master subsystem triggers. The trigger timing for coupled systems takes account of differing transmit pulse lengths and minimizes inter channel interference.

External Trigger: In this mode, the system is triggered by the external event received via the Trigger IN BNC connector in the back of the system. When the hardware trigger is asserted (active log) a new ping occurs.

> **NOTE:** There is a minimum trigger interval (maximum rate) of each subsystem which is dependent on the Pulse Type used, and is proportional to the pulse length. That is, a longer pulse will also set a longer minimum interval, to keep the ON/OFF duty cycle of the Power Amplifier below the maximum allowed, typically 1:10. The actual trigger interval used will be the LARGER of the user interval and the Power Amplifier imposed limit.

6.0: MAINTENANCE

The EdgeTech 3300-HM SBP system is ruggedly designed and built from reliable, long lasting components to reduce maintenance to a minimum. To insure proper and continuing service of the system some periodic maintenance is recommended.

6.1 Hard Drive Disk

The system contains a standard SATA hard drive for storing programs and configuration information. An image of the hard drive is provided on a thumb drive disk. See A.0: SYSTEM RESTORE for more information.

6.2 Array Connectors

To extend the life and increase the reliability of the connectors, apply a thin film of silicone dielectric grease to the entire surface of each male pin. Grease should also be applied at the entrance of each socket. Re-lubrication is recommended every three to five mating cycles. EdgeTech recommends the use of Novagard G624 silicone compound or equivalent for lubrication.

Inspection should be performed regularly to check for corrosion on the contacts. Oxidation may be removed from the male contacts by using no less than #800 wet/dry emery paper cut in strips equal to or less than the width of the contact and rubbing lightly. A pencil eraser can be used instead. Female sockets may be cleaned using a cotton swab and rubbing alcohol. A .22 caliber bore brush with only nylon bristles may be used to remove light oxidation.

Connections inside the hull mount chest only need to be checked once every year.

Remember to always install the dummy connectors on the sea cable and the pigtail when not in use.

7.0: TROUBLESHOOTING

The following tests and solutions are meant to assist with basic troubleshooting. Contact EDGETECH CUSTOMER SERVICE if these fixes fail to address the problems with your system.

7.1 Freq. Plots and Raw Data Time Series Analysis Using J-STAR

The ability of the J-STAR program to request and display raw data (directly from the ADC converter) is invaluable in diagnosing many potential failure modes. Raw data (as opposed to processed and CHIRPed data) allows direct interpretation (via scope like display). This helps to determine noise levels, and the proper operation of, transmit power electronics. The J-STAR program also assists interpretation with FFT analysis that show interfering noise sources by frequency distribution and spectral amplitude.

The J-STAR program may also be used to acquire raw data, and log this data to disk for offline analysis. Having recorded raw data available for analysis by EdgeTech engineers will often speed up the resolution of suspected problems. Such files may be sent to EdgeTech in USB or if small as email attachments. Many system control and setup parameters are recorded in these raw data files which will assist in problem diagnosis.

The Graph tab on the Control Panel will display any channel of data and its FFT (frequency spectrum).

1. Start J-STAR
2. Turn pinging on
3. Go to the Graph Tab in the Control Panel
4. You should now see something like FIGURE 7-1.

FIGURE 7-1 show a typical raw data display for a side scan channel. The left half of the graph display shows one thousand samples of the raw ADC (analogue to digital converter) output, plotted as time vs. amplitude on the X –Y axes.

The right half shows a frequency analysis (FFT) of the time series in the top half. The axes are Frequency (Hz) vs. Amplitude (x - y).

This raw data display was obtained by first setting the sub-bottom system to send raw data (as opposed to de-CHIRPed envelope data).

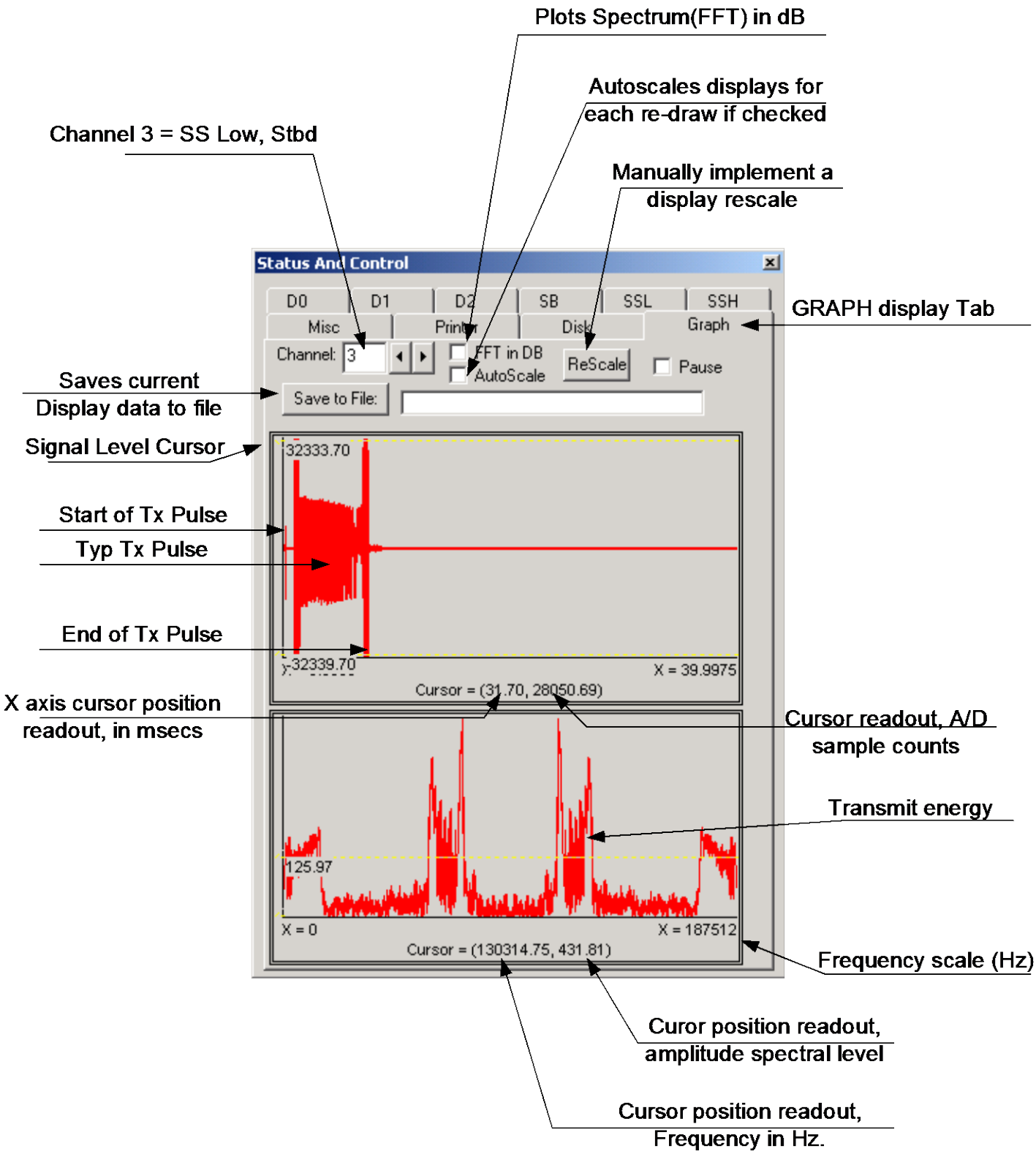


Figure 7-1: Graph Display Tab

Display Description: (Refer to FIGURE 7-1 for item/check box locations).

Channel Selector [Edit Box]: Accessed using mouse / cursor. Type in desired data channel to display:

0 = SB - sub-bottom

2 = SSL - Side Scan Low Port

3 = SSL - Side Scan Low Starboard

4 = SSH - Side Scan High Port

5 = SSH - Side Scan High Starboard

FFT in dB [Check Box]: If checked displays the FFT amplitudes in dB (a logarithmic display scale). If unchecked displays vertical scale as linear spectral amplitudes.

Autoscale [Check Box]: If checked the displays are re-scaled for EACH redraw / data update, so that the min / max amplitudes of the current data span the available display range. This can be confusing to the eye if the amplitudes of the signals vary greatly from ping to ping, as each display will appear to have the same amplitude unless the axes values are carefully observed. It is SAFEST to leave this unchecked, and manually ReScale as required.

Rescale [Push Button]: A one-time (for each push) activation of the display re-scale function. (See description in FIGURE 7-1).

Save to File [Push button and Edit Window]: The displayed graph data can be saved to a disk file for sending to EdgeTech Technical Support, for analysis. Enter a file save name in the edit window.
(Hint: Use pause check box to freeze display, to make sure of the data being saved.)

> **NOTE:** ONLY the data being displayed is saved, i.e. channel 3 in this case. No other channels are saved.

Signal Level Cursor: These 2 yellow lines can be dragged vertically to mark and display amplitude levels. For raw data, the amplitudes are in A/D counts. The ADC values are represented in 16 bits, which allows for 65536 discrete levels. These are interpreted as bipolar signals with an amplitude range of +/-32767.

Raw Data Display: All the raw data acquired by the A/D subsystem is displayed in the top window. The A/D capture sequence begins immediately prior to the start of the Transmit pulse for the channel ($\tau = 0$). The entire transmit pulse (which is unavoidably coupled into the receive channel) is visible in the early part of the display.

Following the transmit pulse (τ = 8.3msecs in this case) the lower amplitude received echo data is visible. The A/D converter is overloaded during the Transmit pulse by the extremely large amplitude signals injected into the receiver. For this reason, the signal may appear to collapse slightly during the Transmit pulse, but the display should show +32767 and –32767 amplitudes during the Transmit interval. See the figure below for raw data display where the Transmit power for the channel is set to zero.

In this case transmit power for the side scan channel has been set to zero in the SSL control tab. The Power Amplifier turn on and turn off transients, are still visible in the time record and indicate that the power to the amplifiers is good, and that the power amplifier on/off control is working correctly. The absence of transmit energy would indicate a failure in the transmit signal generator, if the power were not intentionally set to zero.

7.2 System Does Not Operate

This section will guide you through a series of symptoms and actions that you should follow if the sonar is not operating at all. Go to the second section if performance or image quality is poor.

Before continuing with this section, please check the following setup and connections have been completed:

- Power the Internal Rear Panel Power Cables from the inside of the power outlet (in the rear of the system) are connected to both the amplifier and 3300-HM SBP Control Unit.
- The main power cable is installed and connected to a clean power source.
- Power is switched on (power amplifier and control unit).

> **NOTE:** Loose or disconnected cables are the most likely causes of system failure.

7.2.1 Symptom / Probable Cause

Based on the symptoms found during the startup process in Chapter 3 check the following items:

SYMPTOM	PROBABLY CAUSE(S)	TESTS & SOLUTION(S)
Blue Switch on the Power Amplifier does not turn on	Bad lightbulb	Bulb cannot be serviced by the user. Return for repair. System will operate with a bad bulb.
	Bad power outlet fuse	Check fuse in the Power Input Module on Rear Panel. Fuse is 12.5.
	Bad power amplifier	Check that the power switch is turned on in the rear of the Amplifier.
Green POWER light does not turn on	Power switch on rear of Amp is either off or the amp is not plugged into AC No power or damaged LED	Check LED connections outside control unit
No audible heartbeat CHIRP from 3300-HM SBP		Run topside software in the acquire mode. If no audible CHIRP sound can be heard, perform the following:
	Transmit signal not getting to T/R box	Check deck cable to T/R box
	Cable disconnected or damaged	Confirm that the red banana plug (amplifier output) is fully inserted in the Red/Red sockets (not Red/Black sockets). Confirm that the input to both amplifier channels is secure. The Configuration LED at the back of the amplifier should be set to Bridge.
	Amplifier input connectors disconnected	Check all the connections on rear of Amp and terminations on the hull mount.
	Inside 3300-HM SBP processor, connections loose	If the Sonar Application doesn't make the transducer chirp, the test pulse may have been corrupted, call EDGETECH CUSTOMER SERVICE
	Damaged amplifier	Measure each output with scope o-scope
	Damaged Tiger SB acquisition PCB	Re-seat and then swap in spare PCB.
Unit generates audible pulses, communicates with the topside, but does not receive signal	Bad connection	Tap on the 3300-HM SBP transducers to confirm the problem. Under normal operation, there should be some effect on the display.
	Damaged Tiger SB Acquisition board	Check connections and re-seat/replace Tiger SB Acquisition board.
	Damaged preamplifier	Measure both outgoing 12vdc and 5vdc return PA voltage on Rear Panel.

Table 7-1: Troubleshooting Causes and Solutions

7.2.2 Poor Image Quality or Performance Issues

TABLE 7-2 will guide the user through a series of symptoms and actions that he or she should follow if there are performance or image quality problems.

SYMPTOM	PROBABLE CAUSE(S)	TESTS & SOLUTION(S)
Vertical black streaks in sonar profile	Bad or loose deck cable or T/R box and spider connections	Apply silicone grease and secure connectors
	Corroded connector pins	Polish the contact using a pencil eraser
	Bad cable or spider	Replace
White Data Dropout	Loose or flooded connection	Wiggle deck cable, T/R box cabling and spider splice while watching for white streaks in display to check for fatigue failure of wire near connection or in splice
	Broken wire in splice or cable	Replace or repair cable (see wiring diagram IN SUB-SECTION 2.3.
AC Noise (Periodic Streaks on screen)	Undergrounded generator casing Return signal is being clipped	Reduce preamplifier gain, and/or reduce pulse power
Noise in sonar data display	Engine noise is coupling to the sonar band	Use a dedicated power source for SB and possibly a UPS

Table 7-2: Image Quality or Performance Issues

7.3 Sonar Errors

TABLE 7-3 explains how to troubleshoot sonar errors:

SYMPTOM	PROBABLY CAUSE(S)	TESTS & SOLUTION(S)
HMSENSORS	12vdc not getting to T/R box	Check wiring
	T/R box PCB faulty	Swap in spare T/R box
SBO_AMP	Amp not turned on, plugged in or bad	Check all including TX with o-scope
IF_DIAG	Tiger SB Acquisition board issue	Check Errors in Sonar, Consult EdgeTech
NO_SONAR_DEVICE	Tiger SB Acquisition board cable issue	Check PCB and cabling

Table 7-3: Troubleshooting Sonar Errors

A.0: SYSTEM RESTORE

The following section outlines the procedures for backing up and restoring the system drive.

> **CAUTION!**
> All data will be lost upon restoring the system to factory settings. Be sure to backup all data before preforming the procedure below.

1. Ensure that topside is off.
2. Insert USB3 flash drive in blue USB3 port.
3. Start topside and be prepared to press F⋆⋆ key when prompted:
    a. If the topside is rack mount, press F11.
    b. If the topside is a laptop, press F12.
4. Under Please select boot device: By using up/down arrow keys, select EUFI: Corsair Voyager 3.0 000A, then press Enter.
5. Wait for Paragon Backup & Recovery 14 Home screen to appear, then click Restore icon.
6. On Welcome to the Restore Wizard screen click Next.
7. Browse for Archive and click specific image (the file ending with the extension ".pbf"). When Archive File Details window appears, click Next.
8. At What to restore window, click Basic MBR Hard Disk 0, click Next.
9. At Where to restore window, ensure that Basic MBR Hard Disk 0 is already selected (brown box around it). If it is not, use up/down arrow keys to select. Click Next.
10. At Restore results window, make no selection and click Next.
11. At the Ready to restore from the archive window, select Yes, apply the changes physically. Click Next. *Restoring will begin.*
12. At completing the restore wizard, click Finish. Click Shutdown.
13. Remove USB3 flash drive and restart topside.
14. Re-boot and click on the Windows icon and navigate to Control Panel > System. Activate Windows using the supplied key code on rear of laptop.

B.0: FAQ: FREQUENTLY ASKED QUESTIONS

1. **What are the 3300-HM SBP data cable requirements?**

Three shielded twisted pairs. One set is used for the transmitter and is 18-gauge wire. Two 20-gauge sets are used for receiving. The receiver set is used for 12 VDC, pre-amp power, common, signal, and spare.

2. **Can you interface DISCOVER Sub-Bottom to a transmit/receive Customer-supplied hull mounted array?**

This can be done, but the following special engineering and calibration must be accomplished so that you will get the very best results from the interface. The output impedance of the DISCOVER Sub-Bottom power amplifier needs to match the input impedance of the transmitting array. This will maximize power transmission; otherwise, power is wasted/lost in the amplifier without getting to the transmitters. The transformer must be supplied with the correct turns ratio. A hydrophone must be placed below transmitters temporarily so the system can be calibrated. Based on the calibration, the system needs to be tuned to flatten the spectrum to improve the record resolution. EdgeTech provides engineering services to do this.

3. **How does the system interface to a navigation device?**

3300-HM SBP system interfaces to Navigation inputs via one of the available RS-232 communication ports.

4. **How do the environmental conditions affect the performance of the system?**

There are several environmental factors that affect performance:

Geological Conditions 3300-HM SBP operating parameters and specifications are greatly affected by geologic conditions that the 3300-HM SBP's transmitted acoustic energy encounters. A very dense geologic interface such as rock, coral, sand, stone, shell beds, etc., limit sub-bottom penetration. This is caused by density interface reflecting most, if not, all normal incidence acoustic energy back to transmitter / receiver resulting in little penetration.

Air / Water Interface Air/water interface reflects 99.8 percent of all acoustic energy it receives. Therefore, when air or gas is encountered in the water column or sub-bottom geology, the acoustic energy transmitted by transducer's array reflect to the transducers resulting in little or no penetration into seabed.

Ship's Wake Ship's wake is a very turbulent area just behind the ship. When operating an acoustic device in or near the wake the transmitted acoustic energy encounters highly charged aerated water caused by the cavitation of the ship's screws. If the

3300-HM SBP is operated in this area, the acoustic from the aerated water is reflected back to its source, as in the case discussed in the preceding paragraph.

3300-HM SBP is designed to operate in a horizontal position relative to the sea floor. Turbulence encountered when operated in or near the ships wake will cause instability in 3300-HM SBP reducing output energy effectiveness in penetrating sub-bottom sediments.

Noise

Operating other acoustic instruments at frequencies within system bandwidth simultaneously with 3300-HM SBP system can result in data distortion.

Ship's Motion

3300-HM SBP is designed to work in a relatively stable horizontal plane. Excessive ship motion can cause instability in the reception of sound waves resulting in reduced performance. Rough sea conditions, sharp ship turns, and any similar external induced motions will have a similar effect on the system operation. For more information, see DISCOVER Sub-Bottom’s Software Manual - Heave Compensator.

C.0: NAVIGATION SYSTEMS

Connect any industry-standard NMEA 0183 GPS to the Navigation COM port on the EdgeTech Processor (Com 1 is default). Most GPS receivers made in the past 5+ years output the NMEA 0183 (version 1.5, 2.0/2.1, or 2.3) data language. GPS receivers can be connected by a serial cable (provided by the GPS manufacturers) to the EdgeTech topside through a standard 9- pin serial port. Refer to sub-section B.5 Serial Port Connections for the pin out of the 9-pin serial connector.

The following information describes the serial port interface parameters for acquiring navigation strings from a connected GPS unit or integrated navigation computer to the DISCOVER processor serial port. The system will also accept Annotation and Event mark strings in accordance.

Several of the messages conform to the NMEA 0183 protocol. For additional information refer to:

NATIONAL MARINE ELECTRONICS ASSOCIATION NMEA 0183

STANDARD FOR INTERFACING MARINE ELECTRONICS NAVIGATIONAL DEVICES

Version 3.01

January 1, 2002

C.1 NMEA Approved Sentence Structure

The following provides a summary explanation of the approved sentence structure:

$aabbb,c---c*hh<CR><LF>

ASCII	HEX	DESCRIPTION
"$"	24	Start of Sentence
aa		Dummy characters to start the Address Field (e.g. GP), not used by EdgeTech products.
bbb		Sentence Formatter. Mnemonic code identifying the data type and the string format of the successive fields.
","	2C	Field Delimiter. Starts each field except Address and Checksum fields. If it is followed by a null field, it is all that remains to indicate no data in the field.

Table C-1: NMEA Approved Sentence Structure

C.2 Port Parameters

PARAMETER	DESCRIPTION
Interface	RS-232C
COM Port	User choice limited to installed serial ports Baud Rate: 4800/9600
Data Bits	8
Start Bits	1
Stop Bits	1
Parity	None
Handshaking	None

Table C-2: Port Parameters

C.3 Port Selection

The port assigned to receive the navigation messages is assigned in a supporting file for the DISCOVER application or any other user named *.jni file. This is a simple text file with many system settings and parameters, to set the assigned port, edit the file and make the changes as below:

The section and syntax for the serial port assignment and configuration is:

```
[Nav0]
Baud=4800
Port=1
Enable=1
```

The file is large so it is easiest to search for the Keyword [Nav0] to find this section.

The baud rate and port number to use are set here. Valid Baud rates are 4800 to 19200 depending on your NMEA source.

The DISCOVER software will support up to 3 serial ports for connecting to any sources of these serial data strings. The messages may come in on any enabled port, or they may all be input via one port. No distinction or priority is given to any port over another. It is safest to only enable those ports you need that are supplying valid data.

The format for the remaining ports is as above with the keywords, [Nav1, Nav2].

C.4 Inputs

The following are approved NMEA sentences recommended for use with the DISCOVERY based systems.

The list of NMEA and Edge Tech messages are:

GLL, GXY, GGU, GGA, RMA, RMC, VTG, ZDA, HDG, EVT, and EMA.

The list of compatible, but not discussed NMEA and Edge Tech messages are:

DBT, DPT, EMA, ETC, GDA, HDT, and MTW.

> **NOTE:** The minimum recommended NMEA message that should be used ought to be a position message such as GGA, GLL, GGU, GXY, or RMC. RMC is best, as it contains both time and date, whereas the other position strings do not. If a ZDA message is used as well, this will not matter. However, for a single message, RMC is the best choice

C.4.1 GLL – Geographic Position – Latitude/Longitude

$--GLL,xxxx.xxx,a,yyyyyy.yyy,b,hhmmss.ss,A*hh<CR><LF>

ASCII	DESCRIPTION
xxxx.xxx	Degrees|Minutes.decimal - 2 fixed digits of degrees, 2 fixed digits of minutes and a variable number of digits for decimal fractions of minutes. Leading zeros always included for degrees and minutes to maintain fixed length.
a	N for North Latitude or S for South Latitude
yyyyy.yyy	Degrees|Minutes.decimal - 3 fixed digits of degrees, 2 fixed digits of minutes and a variable number of digits for decimal fractions of minutes. Leading zeros always included for degrees and minutes to maintain fixed length.
b	E for East Longitude or W for West Longitude
hhmmss.ss	Time of position fix. Hours|Minutes|Seconds.decimal - 2 fixed digits of hours, 2 fixed digits of minutes, 2 fixed digits of seconds and a variable number of digits for decimal fractions of seconds. Always pad with leading zeros. This field is optional.
A	Status. Single character field: A = Yes, Data Valid, Warning Flag Clear V = No, Data Invalid, Warning Flag Set

Table C-3: GLL Geographic Position – Latitude/Longitude

> **NOTE:** Other supported navigation strings for position are: GGA, RMA, RMC.

C.4.2 GXY Geographic Position X and Y Coordinates

X and Y coordinates of the present vessel position, time of position fix and status.

$--GXY,xxxxxx.xxx,a,yyyyyy.yyy,b,hhmmss.ss,*hh<CR><LF>

ASCII	DESCRIPTION
xxxxxx.xxx	Double floating point numeric, may have leading negative sign. Represents horizontal axis of plane (X coord)
a	Character label for X (Must be valid ASCII character, but value is ignored)
yyyyyy.yyy	Double floating point numeric, may have leading negative sign. Represents horizontal axis of plane (Y coord)
b	Character label for Y (Must be valid ascii character, but value is ignored)
hhmmss.ss	Time of position fix. Hours|Minutes|Seconds.decimal - 2 fixed digits of hours, 2 fixed digits of minutes, 2 fixed digits of seconds and a variable number of digits for decimal fractions of seconds. Always pad with leading zeros.

Table C-4: GXY Geographic Position X and Y Coordinates

> **NOTE:** The hhmmss.ss field is optional.

C.4.3 GUU – Geographic Position – X and Y Coordinates

X and Y coordinates of the present vessel position, time of position fix and status.

> **NOTE:** GGU string has a similar format as GXY but provides support for larger planes.

$--GGU,xxxxxxxx.x,a,yyyyyyyy.y,b,hhmmss.ss,*hh<CR><LF>

ASCII	DESCRIPTION
xxxxxxxx.x	Double floating point numeric, may have leading negative sign. Represents horizontal axis of plane (X coordinate).
a	Character label for X (Must be a valid ASCII character, but value is ignored).
yyyyyyyy.y	Double floating point numeric, may have leading negative sign. Represents vertical axis of plane (Y coordinate).
b	Character label for Y (Must be a valid ASCII character, but value is ignored).
hhmmss.ss	*Time of position fix. Hours|Minutes|Seconds.decimal - 2 fixed digits of hours, 2 fixed digits of minutes, 2 fixed digits for seconds and a variable number of digits for decimal fractions of seconds. Always pad with leading zeros.*

Table C-5: GUU – Geographic Position – X and Y Coordinates

> **NOTE:** The hhmmss.ss field is optional.

C.4.4 GGA – Global Positioning System Fix Data

Time, Position and fix data for a GPS receiver.

$--GGA,hhmmss.ss,llll.ll,a,yyyyy.yy,a,q,nn,d.d,a.a,M,g.g,M,e.e,rrrr,*hh<CR><LF>

ASCII	DESCRIPTION
xxxxxxxx.x	Double floating point numeric, may have leading negative sign. Represents horizontal axis of plane (X coordinate).
a	Character label for X (Must be a valid ASCII character, but value is ignored).
yyyyyyyy.y	Double floating point numeric, may have leading negative sign. Represents vertical axis of plane (Y coordinate).
b	Character label for Y (Must be a valid ASCII character, but value is ignored).
hhmmss.ss	*Time of position fix. Hours|Minutes|Seconds.decimal - 2 fixed digits of hours, 2 fixed digits of minutes, 2 fixed digits for seconds and a variable number of digits for decimal fractions of seconds. Always pad with leading zeros.*

Table C-6: GGA – Global Positioning System Fix Data

C.4.5 RMA – Recommended Minimum Specific Loran-C Data

Position, course, and speed from a Loran-C receiver

$--RMA,A,llll.ll,a,yyyyy.yy,a,d.d,.e.e,f.f,g.g,h.h,j,k*hh<CR><LF>

For fields see NMEA 0183 Specification

C.4.6 RMC – Recommended Minimum Specific GNSS Data

Time, Date, Position, course and speed provided from a GNSS receiver

$--RMC,hhmmss.ss,A,llll.ll,a,yyyyy.yy,a,d.d,e.e,ddmmyy,g.g,j,k*hh<CR>

<LF>

For fields see NMEA 0183 Specification

C.4.7 VTG – Track Made Good and Ground Speed

The actual track made good and speed relative to the ground

$--VTG,x.x,T,x.x,M,x.x,N,x.x,K*hh<CR><LF>

ASCII	DESCRIPTION
x.x	Floating point numeric
T	Degrees True
M	Degrees Magnetic
N	knots
K	Kilometer/hour

Table C-7: VTG – Track Made Good and Ground Speed

NOTE: Magnetic heading corrected for local deviation and Easterly/Westerly variation would provide more accurate True vessel heading in degrees.

C.4.8 ZDA – Time & Date

UTC, day, month, year, and local time zone

$--ZDA,hhmmss.ss,dd,mm,yyyy,ll,zz*hh<CR><LF>

ASCII	DESCRIPTION
hhmmss.ss	Universal Time Coordinated (UTC). Hours|Minutes|Seconds.decimal - 2 fixed digits of hours, 2 fixed digits of minutes, 2 fixed digits of seconds and a variable number of digits for decimal fractions of seconds. Always pad with leading zeros.
dd.mm	Day(01 to 31)|.Month(01 to 12)
yyyy	Year
ll	Local zone description, 00 to ±13 hour. This field is optional and ignored.
zz	Local zone minutes' description, same sign as local hours. This field is optional.

Table C-8: ZDA – Time and Date

NOTE: Zone description is the number of whole hours added to local time to obtain GMT, Zone description is negative for East longitudes. The GLL string provides a more accurate time reference since it is related to the position fix.

Time and date from the computer CPU are also recorded and could be displayed if GPS time and date are not available.

Fix marks are bars across the time zero line in all channels.

C.4.9 HDG - Heading, Deviation and Variation

Heading (magnetic sensor reading), which if corrected for deviation, will produce Magnetic heading, which if offset by variation will provide True heading.

$--HDG,x.x,x.x,a,x.x,a*hh<CR><LF>

ASCII	DESCRIPTION
HDG	Magnetic sensor heading, degrees
x.x	Magnetic deviation, degrees E/W1,3
x.x, a	Magnetic variation, degrees, E/W2,3

Table C-9: HDG: Heading, Deviation, and Variation

NOTES: To obtain Magnetic Heading:
- Add Easterly deviation (E) to Magnetic sensor Reading
- Subtract Westerly deviation (W) from Magnetic Sensor Reading

To obtain True Heading:
- Add Easterly variation (E) to Magnetic Heading
- Subtract Westerly variation (W) from Magnetic Heading

Variation and deviation fields shall be null fields if unknown.

C.4.10 EVT – Event * Annotation (EdgeTech Custom)

Event mark and related annotation provided by an integrated navigation system

$EGEVT,S,<Message>,*hh<CR><LF>

ASCII	DESCRIPTION
S	ASCII character status flag. M = Print and Store event mark
Message	Event annotation or just annotation message up to 80 characters long with a maximum number of messages being 10

*Table C-10: EVT – Event * Annotation (EdgeTech Custom)*

NOTES: This message should only be used if it is imperative that the event mark number be externally controlled, otherwise the $EGEVT message should be used. If the mark number sent is the same as the current mark number the message will be ignored.

A shortcut to the Windows HyperTerminal application is provided to check the navigation input. You must quit the DISCOVER application before running, and may need to modify the properties if not running at 4800 baud. A sample display is shown below.

```
$GPGLL,2600.0100,N,800000.0000,W,151228.99,A*67
$GPVTG,315.65,T,314.15,M,3.8,N,7.0,K*48
$GPZDA,151229.25,28.08,1997,06,00*45
$EGEVT,M,EventNo,Time,Position,Annotation,*73
```

```
$GPGLL,2600.0125,N,8000.0025,W,151229.50,A*84
$GPVTG,316.65,T,315.15,M,3.9,N,7.1,K*33
$GPZDA,151229.75,28.08,1997,06,00*45
$EGEVT,M,EventNo,Time,Position,Annotation,*48
```

```
$GPGLL,2600.0150,N,800000.0050,W,151229.99,A*12
$GPVTG,315.85,T,314.65,M,3.8,N,7.0,K*58
$GPZDA,151230.25,28.08,1997,06,00*72
$EGEVT,M,EventNo,Time,Position,Annotation,*48
```

NOTE: The number of incoming strings should be limited to the four mentioned above. For accurate fixes, the navigation strings should be updated once a second (1 Hz) or faster.

C.4.11 EMA: Event, Set Mark & Annotation (EdgeTech Custom)

Event mark number and annotation provided by an integrated navigation system

$ETEMA,NNNNNN, <Message>,**hh<CR><LF>

ASCII	DESCRIPTION
NNNNNN	Mark number to use for this event.
Message	Event annotation message up to 23 characters long

Table C-11: EMA: Event, Set Mark & Annotation

> **NOTE:** This message should only be used if it is imperative that the event mark number be externally controlled, otherwise the $EGEVT message should be used. If the mark number sent is the same as the current mark number the message will be ignored.

```
$GPGLL,2600.0100,N,800000.0000,W,151228.99,A*67
$GPVTG,315.65,T,314.15,M,3.8,N,7.0,K*48
$GPZDA,151229.25,28.08,1997,06,00*45
$EGEVT,M,EventNo,Time,Position,Annotation,*73
```

```
$GPGLL,2600.0125,N,8000.0025,W,151229.50,A*84
$GPVTG,316.65,T,315.15,M,3.9,N,7.1,K*33
$GPZDA,151229.75,28.08,1997,06,00*45
$EGEVT,M,EventNo,Time,Position,Annotation,*48
```

```
$GPGLL,2600.0150,N,800000.0050,W,151229.99,A*12
$GPVTG,315.85,T,314.65,M,3.8,N,7.0,K*58
$GPZDA,151230.25,28.08,1997,06,00*72
$EGEVT,M,EventNo,Time,Position,Annotation,*48
```

> **NOTE:** The number of incoming strings should be limited to the five mentioned above. For accurate fixes, the navigation strings should be updated once a second or faster.

C.5 Serial Port Connections

The following chart depicts the pin out of the male DB9, RS232 connector found on the computer.

PIN #	ROLE
Pin 1	Carrier Detect (CD) **input**
Pin 2	Receive Data (RD) **input**
Pin 3	Transmitted Data (TD) **output**
Pin 4	Data Terminal Ready (DTR) **output**
Pin 5	Signal Ground
Pin 6	Data Set Ready (DSR) **input**
Pin 7	Request To Send (RTS) **output**
Pin 8	Clear To Send (CTS) **input**
Pin 9	Ring Indicator (RI) **input**

Table C-12: 9 Male Pin Out

The following outlines the different pins from the comport connection that EdgeTech processor uses for communication:

Pin # 2: (usually brown) is Receive (which would connect to the transmit pin on the GPS). This connection will take the position data from the GPS for use in the DISCOVER software. This is a necessary connection for GPS communications

Pin # 5: (usually green) is Ground. This can be connected to the common ground from the GPS wiring. This is a necessary connection for GPS communications

Pin # 3: (usually red) is Transmit. This connection will go back to the GPS. Pin # 3 is not a necessary connection for using DISCOVER software for Real-Time positioning. Only proper connections to pins number 2 and 5 are needed for to log navigation data.

C.6 Troubleshooting

Problem: When connected to a GPS, the computer's trackpad acts erratically and seems to be 'jumping' around.

Solution: A Windows bug discovered by Microsoft where Windows detects a connected GPS as a mouse--this produces a jumping cursor problem. The following are the directions supplied by Microsoft support to correct the problem:

1. Turn off the GPS and close DISCOVER Software.
2. Right-click on the My Computer icon and select Properties.
3. Select the Hardware tab, and click the Device Manager button.
4. Next to "Mice and other pointing devices," click the plus button to expand this list. You should see at least two items listed. One is the mouse you normally use, and the other will probably be listed as "Microsoft Serial Ball Point."

5. Highlight "Microsoft Serial Ball Point" and click the Disable button at the top of the window (it is usually the second button from the right; hover the cursor over it and read the Tool Tip to verify).
6. In the confirmation message window that appears, click Yes.
7. Close the Device Manager.
8. Plug in/turn on your GPS.
9. Restart DISCOVER Software.

Problem: No communications between GPS and DISCOVER Software

Solution: When DISCOVER isn't getting the GPS data during data acquisition, it's a good idea to check outside of DISCOVER to be sure the serial port is receiving the data. If the ports do not see any GPS data coming in, then DISCOVER will not be able to see the signal. HyperTerminal, one of the programs which come with Windows, is a useful troubleshooting utility, since it reads any information being received by the system through any available COM port.

> **NOTE:** DISCOVER and all other programs, especially any that use COM ports for other connections, should be closed while running the HyperTerminal program. The GPS should be set to its NMEA mode in its Interface Setup area for this test. The GPS should be set to its Simulator mode if indoors or having difficulty obtaining the GPS Sat. fix.

1. Click Start, then Programs, then Accessories, then Communications, then HyperTerminal
2. In the window that opens titled HyperTerminal, double-click on the icon which says "Hyperterm", the one with the monitor sitting next to a phone.
3. If a window comes up asking if you want to configure a modem now, select "No" or "Cancel". Otherwise, proceed to the next step.
4. Another window titled "Connection Description" appears. In the Name: box, type in the letter t for "test". Click on OK.
5. Another window pops up with the title "Phone Number". The only field of interest here is Connect Using:, which must be set to "Connect to COM1". Click on OK.
6. The window "COM1 Properties" appears. The editable field is Bits per second, which should be set to "4800", since the NMEA 0183 standard specifies 4800 baud rate. Click on OK.
7. The main white HyperTerminal window becomes completely visible, hopefully with GPS data scrolling upward. Every sentence must begin with a dollar sign and five letters. If the screen is blank, this means no data is coming in through the port.
8. When finished viewing the screen, select "Exit" from the File menu. When asked if you want to disconnect now, click on Yes. When asked if you want to save session, click on No.

Repeat the above steps for other COMs, replacing COM1 with COM2, COM3 and COM4. If none of these will reveal GPS input, then the problem lies in the physical serial port, the GPS receiver, or the connection between the two.

At this point, one of three things can happen:

1. An error message appears:

   This means that the COM port selected is not available or functioning properly. Close HyperTerminal and repeat the process, trying a different COM port. If you are certain that you are selecting the proper COM port, contact EDGETECH CUSTOMER SERVICE for further troubleshooting tips.

2. The screen goes blank screen with a flashing cursor.

   The chosen COM port is not currently receiving NMEA data. Close HyperTerminal and repeat the process, trying a different COM port. If you are certain that you are selecting the proper COM port, check the output settings on the GPS. If you are certain that the GPS is outputting NMEA strings, use a Null Modem to swap pin 2 and 3 (TX & RX).

3. A screen with text scrolling upward appears.

   The GPS unit is successfully connected. Good GPS data will look like the following:

```
$GPRMC,201502,A,4251.2939,N,07054.4254,W,000.0,000.0,291002,016.3,W*7C
$GPGGA,201502,4251.2939,N,07054.4254,W,1,07,1.7,55.6,M,-32.7,M,,*4A
$GPGLL,2600.0100,N,800000.0000,W,151228.99,A*67
$GPVTG,315.65,T,314.15,M,3.8,N,7.0,K*48
$GPZDA,151229.25,28.08,1997,06,00*45
```

The data you see scrolling by indicates current position (among other things). Note the COM port used and exit HyperTerminal. When asked if you want to disconnect now, click on Yes. When asked if you want to save session "Test", click OK.