3200-XS SUB-BOTTOM SYSTEM

USER HARDWARE MANUAL

0004840_REV_E

7/2/2018

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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.

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.

HARDWARE VARIATIONS AND COMPATIBILITY

The 3200-XS Sub-Bottom Bottom Profiling System 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 3200-XS Sub-Bottom Profiling System. 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 3200-XS. Although this manual encompasses the latest operational features of the 3200-XS, 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 3200-XS 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.

Revision History

REVISION	DESCRIPTION	DATE	APPROVAL
A	Release to Production	03/09/2015	RM
B	Pin-out diagram updated	07/15/2015	RM
C	Updated drawings	08/25/2017	HS
D	Updates	05/01/2018	TS
E	Updates to Drawings	07/02/2018	TS

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 from **CUSTOMER SERVICE**.

RMA Purpose

The RMA Number identifies returned equipment when it arrives at our receiving dock and enables tracking while at our facility. Refer to RMA number on all documentation and correspondences.

All returned materials must be shipped prepaid. Freight collect shipments will not be accepted. All equipment should be adequately insured for shipping, but equipment belonging to EdgeTech must be insured for full value.

If there is more than one item per consignment, include a packing with the shipment. An invoice can double as a packing slip only when the contents are clearly numbered and identified on the invoice.

CAUTION!

Never attempt to ship a Portable Topside 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. Shipping in this manner will void any warranties.

NOTE: All shipping charges shall be the responsibility of the customer, unless under warranty, as EdgeTech will pay for return shipping.

NOTE: For International Shipments valued over $1000, the following Shipper's oath must be sent with the invoice.

Shipper's Oath:

"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 _____

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:

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

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

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.

EdgeTech responds to the needs of the Scientific, Naval, and Offshore communities by providing industry-leading 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 consistently anticipates and responds to future needs with an active Research and Development Program. Current efforts are focused on adapting new cutting-edge acoustic technology.

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1.0: OVERVIEW

The 3200-XS Sub-Bottom Profiling System is a high resolution wideband frequency modulated (FM) sub-bottom profiler that uses EdgeTech's proprietary Full Spectrum CHIRP technology to generate cross-sectional images of the seabed and collect digital normal incidence reflection data over many frequency ranges. The 3200-XS transmits an FM pulse (also called "CHIRP pulse") that is linearly swept over a full spectrum frequency range.

The reflections measured by the system are displayed as shades of gray or color on a computer monitor and may be printed on a continuous feed thermal printer. Data are stored in real time onto a large capacity hard drive and can be archived to DVD.

1.1 Advantages of Full Spectrum CHIRP Technology

EdgeTech's Full Spectrum CHIRP technology has several distinct advantages over conventional sub-bottom profiling systems: The use of separate acoustic projectors and receivers enable:

- Simultaneous transmission and reception of acoustic signals
- High repeatability of the transmitted signals to enable sediment classification
- High signal-to-noise ratio (SNR) for improved acoustic imagery
- High resolution for measurement of fine sediment layering
- Additional processing gain for energy efficiency
- Gaussian shaped amplitude spectrum of the outgoing pulse to preserve resolution with sediment penetration
- Reduction of side lobes for minimal destructive signal scattering caused by the sediment when profiling near the bottom

1.1.1 Separate Acoustic Projectors and Receivers

The 3200-XS Sub-Bottom Profiling System uses acoustic projectors and receivers mounted in a towed vehicle to transmit and receive acoustic FM pulse signals. The projectors are wide band piston type transducers, and the receivers are hydrophone arrays composed of lead zirconate titanate (PZT) crystals. The transducers are mounted in the forward section of the tow vehicle, and the hydrophone arrays, which are designed for profiling at ship speeds up to seven knots, are mounted aft.

The use of separate transmitting transducers and receiving hydrophone arrays preserves linearity, and allows the simultaneous transmission and reception of the acoustic signals. The transducers and hydrophone arrays are mounted beneath acoustic baffles, which minimize direct path, tow vehicle, and surface reflections. A preamplifier in the tow vehicle amplifies and drives the received signals through a tow cable to the surface.

1.1.2 High Repeatability

The FM pulses are generated by a digital-to-analog (D/A) converter with a wide dynamic range and a transmitter with linear components. This allows the energy, amplitude, and phase characteristics of the acoustic pulses to be precisely controlled. This precision produces high repeatability and signal definition required for sediment classification.

The frequency range of operation is determined by the acoustic characteristics of the transmitter transducers and receiving hydrophone arrays mounted on the tow vehicle. Each tow vehicle can transmit acoustic pulses with different center frequencies and bandwidths.

The selection of this frequency is made by the operator while profiling to achieve the best imagery, and the tow vehicle is selected based on the sub-bottom conditions at the survey site, along with the type of sub-bottom features that need to be imaged. EdgeTech technical support can provide assistance in selecting the best tow vehicle for your application.

1.1.3 High Signal-to-Noise Ratio

Full Spectrum CHIRP technology does not use a conventional matched filter (the correlation filter that is widely used to compress FM signals) to process wide band signals. Rather it uses proprietary amplitude and phase weighting functions for the transmitted pulse and a pulse compression filter that maximizes the 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 pulse and CHIRP sonars with band limited components that are limited in dynamic range.

1.1.4 High Resolution

Signals received at the surface from the hydrophone arrays in the tow vehicle pass through a software-controlled, programmable, gain amplifier before being digitized with a 16-bit analog-to-digital (A/D) converter at a sampling rate of 20, 25, 40, or 50 kHz. The FM pulse is then compressed using a digital compression filter. This correlation process is implemented in real time with forward and inverse Fast Fourier Transforms.

The compressed pulse has a time duration approximately equal to the inverse of the bandwidth of the FM pulse which results in a high temporal resolution. This high resolution enables the measurement of fine layering in the sediment, an important factor in sediment classification, as it provides a more realistic picture of the true geologic variability of the sea floor and an accurate determination of the depositional processes.

1.1.5 Additional Processing Gain

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 a full spectrum pulse with a time-bandwidth product of 100.

1.1.6 Gaussian Shaped Amplitude Spectrum Outgoing Pulse

Another important feature of Full Spectrum CHIRP technology is that the signal processing 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 characteristic, the amplitude spectrum of the outgoing pulse is chosen to be approximately Gaussian in shape 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. Therefore, even after being attenuated by sand, the acoustic pulse has approximately the same resolution as an unattenuated pulse.

1.1.7 Reduction of Side Lobes

Use of Full Spectrum CHIRP technology reduces the 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 a full spectrum 2–10 kHz signal, for example is 20 degrees measured at the -3db points.

1.2 Full Spectrum CHIRP Technology Applications

Applications of Full Spectrum CHIRP Technology used in the 3200-XS Sub-Bottom Profiling System include:

- EEZ resource development
- 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
- Hazard surveys
- Mining and dredging surveys
- Bridge and shoreline scour surveys

- Imaging biologics in water column
- Mapping clam populations
- Beach re-nourishment
- Military and offshore oil applications
- Full ocean depth sub-bottom imaging (hull mount systems)
- Environmental site investigations

1.3 Main System Components

The 3200-XS Sub-Bottom Profiling System is composed of three main components: a 3200 Rack Mount Processor; an SB-424, SB-216S or SB-512i Tow Vehicle; and a Tow Cable.

1.3.1 3200 Rack Mount Processor

The 3200 Rack Mount processor is shown in **FIGURE 1-1** and consists of a 3200-XS Topside Processor and a 4.7-kW Power Amplifier that is mounted in a portable 19-inch rack type enclosure and shipped in a heavy-duty reusable transport case. The processor and the amplifier can also be removed and mounted in any standard 19-inch rack.

The processor includes a Mother board and a Sonar Interface board (Tiger board) as shown in **FIGURE 1-2**. The Tiger board interfaces to the Mother board via USB. It also includes an LCD monitor, a DVD R/W drive, a keyboard, and a trackball.

The Tiger board stores the transmit waveform and the correlation filter as well as performs correlation processing and spherical range correction. At periodic intervals, the Tiger board sends the transmit waveform to a 16-bit D/A converter, which generates an analog pilot signal that is amplified by the Power Amplifier to drive the transducer in the tow vehicle.

The acoustic returns from the sea floor are received by the hydrophone arrays in the tow vehicle and then amplified by a preamplifier, which is also mounted in the tow vehicle. The output of the preamplifier connects through the tow cable to a digitally-controlled amplifier on the Tiger board, and is sampled by a 16-bit A/D converter.

The Tiger board also performs the correlation processing, corrects for spherical spreading, and transfers the data to the Mother board. For additional information on the Tiger board, refer to sub-section **2.1.4.**

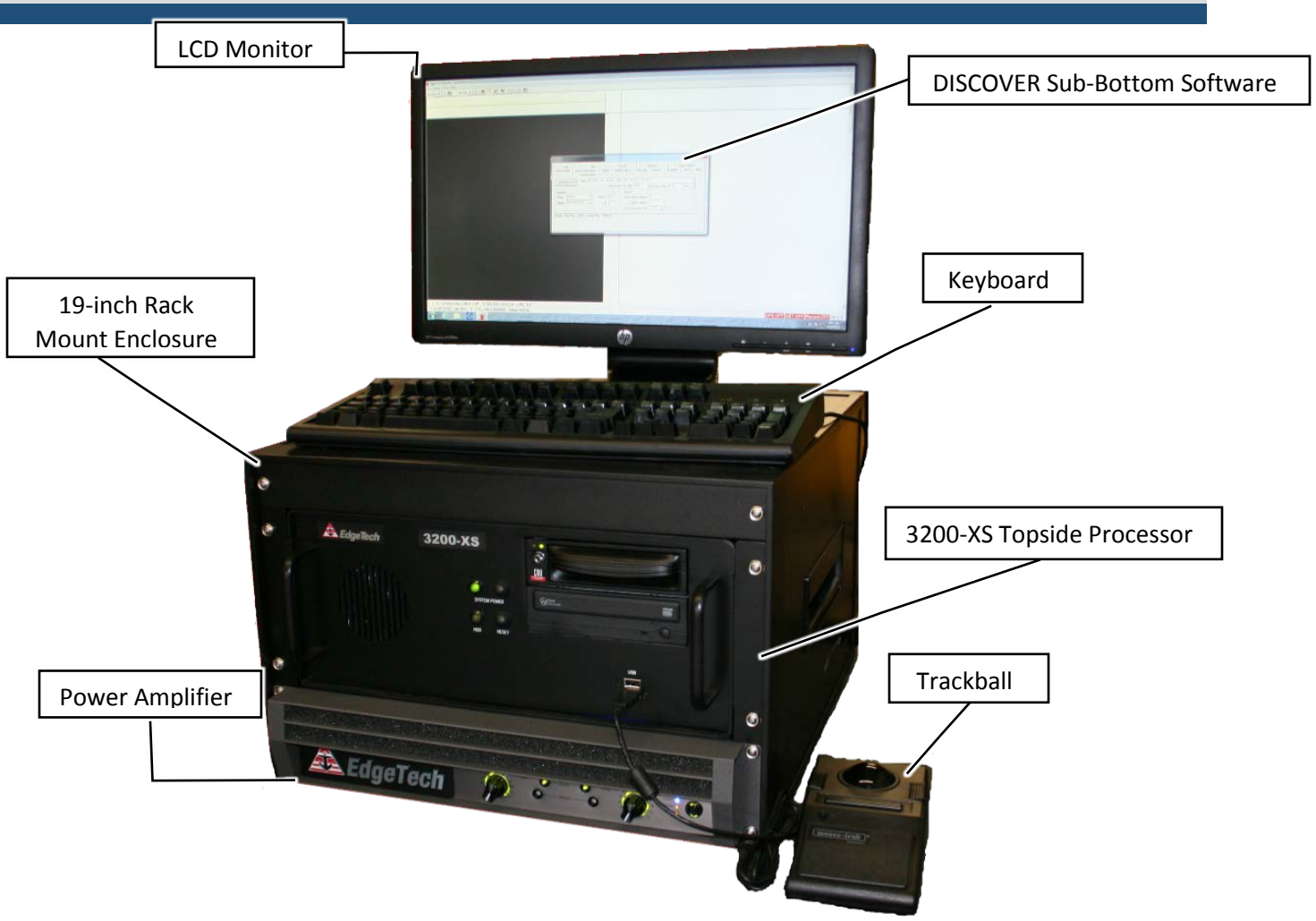


Figure 1-1: 3200 Rack Mount Processor

The 3200 Rack Mount processor also includes the EdgeTech DISCOVER 3200SB software preinstalled on the 3200-XS Topside Processor. DISCOVER 3200SB is a data acquisition and processing program designed exclusively for EdgeTech Full Spectrum CHIRP sonar systems. The program, which runs on the Microsoft Windows 7 operating system, verifies that the sonar system is working properly prior to deployment by providing data displays, diagnostics, data recording, playback, and printer outputs.

The program supports sonar data inputs, along with sonar command and control outputs over a TCP/IP connection, a NMEA navigation input through an RS-232 serial port, and a printer connection through an Ethernet port.

For compatibility with other EdgeTech products, DISCOVER 3200SB interfaces with a second software program, SONAR.EXE which runs in the background and controls the sub-bottom sonar system, performs a self-test on startup, and generates reports and diagnostic information. It automatically launches when the processor is switched on. SONAR.EXE interfaces with the Tiger board to generate and transmit CHIRP pulses.

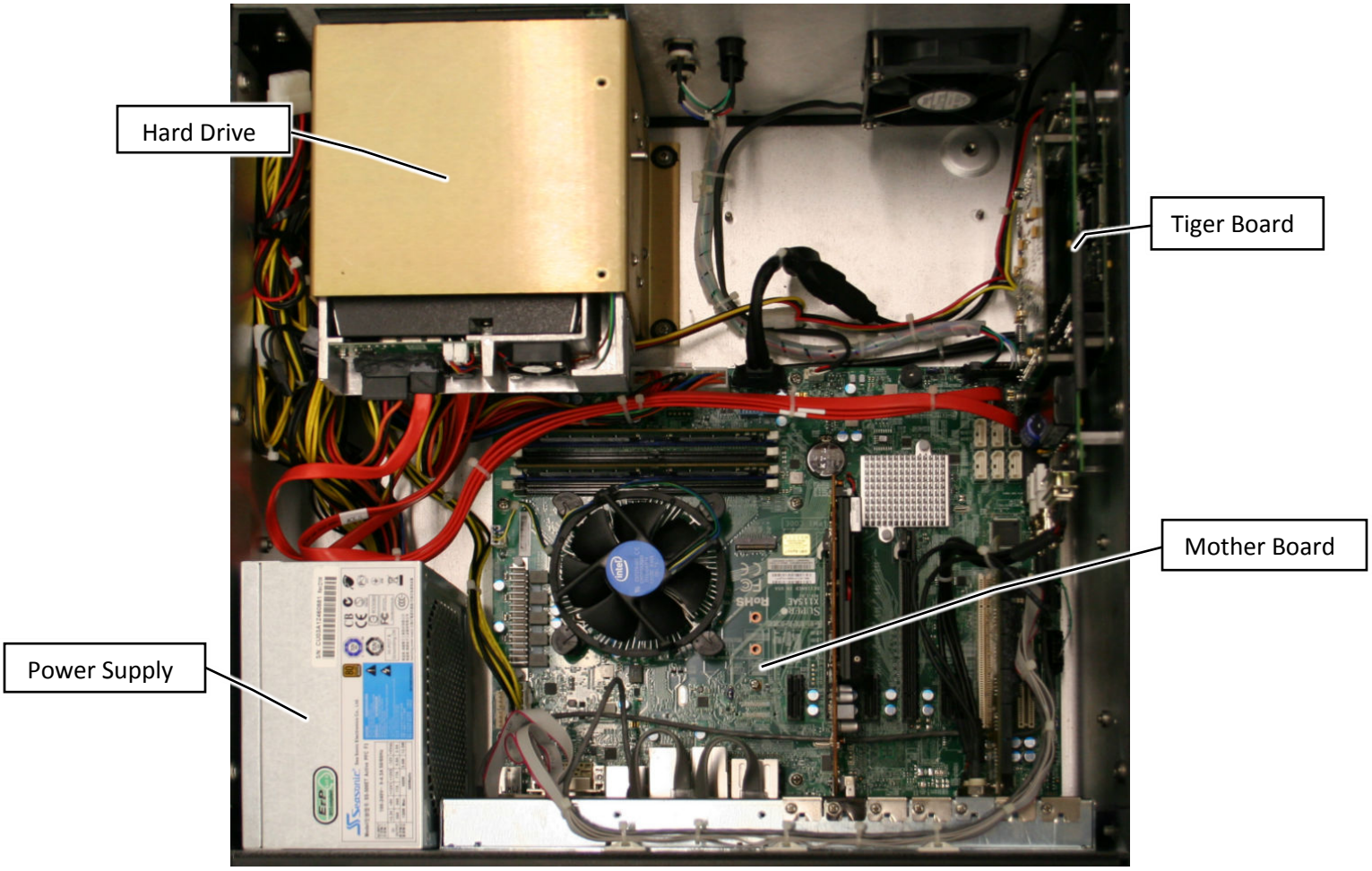


Figure 1-2: Tiger and Mother Boards inside 3200-XS Topside Processor

1.3.2 SB-424, SB-216S, and SB-512i Tow Vehicles

The SB-424, SB-216S, and SB-512i Tow Vehicles are each designed to operate over a specific frequency range, and as lower operating frequencies generally require longer hydrophone arrays and larger transducers, the vehicles differ primarily in size and weight.

The SB-424 Tow Vehicle, which is the smallest of the three, operates over a frequency range of 4–24 kHz, followed by the SB-216S at 2–16 kHz, and then the SB-512i at 0.500–12 kHz. All three tow vehicles are shown in **FIGURE 1-3**.

Each is hydrodynamically stable, with the transducers and hydrophone arrays mounted under an acoustic baffle to reject downward traveling multiple echoes. These components, along with "spider" cable harnesses and a preamplifier, are enclosed in a two-piece fiberglass shell that is fitted with stabilizing fins and lead ballast.

A hinged U-framed tow bridle is used for towing, and the tow point location can be adjusted to accommodate different towing speeds and depths. The tow vehicles are each shipped in a wooden crate.

SB-424 Tow Vehicle

SB-216S Tow Vehicle

SB-512i Tow Vehicle

Figure 1-3: SB-424, SB-216S, and SB-512i Tow Vehicles

1.3.3 Tow Cable

The 3200-XS does not come standard with a specific type of cable, but requires one to operate, and must be specified at the time of purchase. EdgeTech has multiple lengths and cable material types available. The maximum cable length available for the 3200-XS system is 600 Meters. Contact **EDGETECH CUSTOMER SERVICE** for more information.

A popular option is the 75-Meter Kevlar Reinforced Cable that includes three twisted shielded wire pairs. This cable, shown in **FIGURE 1-4**, is available separately and used to connect to and tow the SB-424, SB-216S, and SB-512i Tow Vehicles. However, because of the weight and drag exhibited by the larger SB-512i Tow Vehicle, a separate steel cable is recommended for towing this tow vehicle.

Figure 1-4: 75-Meter Kevlar Reinforced Tow Cable

The steel cable can be attached to the tow cable. In addition, to increase the life of the tow cable, which has a tensile strength of 650 pounds, a separate steel cable can also be used with the SB-424 and SB-216S Tow Vehicles.

All tow cable options include a cable grip for attaching to the tow bridle of the tow vehicle and are shipped in a wooden crate with the tow vehicle.

2.0: SPECIFICATIONS

Specifications for the 3200-XS Sub-Bottom Profiling System include electrical, mechanical, and environmental characteristics for the Rack Mount Topside, the SB-424, SB-216S and SB-512i Tow Vehicles, and the Tow Cable.

> **NOTE:** All specifications are subject to change without notice.

2.1 3200 Rack Mount Processor

The Rack Mount processor is made up of a processing unit and power amplifier enclosed in a 19-inch rack.

> **CAUTION!**
> The Deck Unit is application specific. It should not be used for purposes other than that for which it was intended.

2.1.1 Rack Mount General Specifications

The general specifications for the 3200-XS Rack Mount Processor are shown in **TABLE 2-1**.

SPECIFICATION	VALUE
Operating temperature	0-40°C (32°-104°F)
Operating humidity	5-95% relative
Vibration	Normal ship environment
Weight	51 kg (112 lb)
Enclosure type	Portable aluminum 19-in rack type enclosure
Enclosure size	49.5 cm (19.5 in.) W 54.6 cm (21.5 in.) H 33.0 cm (13.0 in.) D
Shipping container size	71 cm (28.0 in.) W 79 cm (31.0 in.) H 109 cm (43.0 in.) D
Shipping weight	93 kg (205 lbs)
Input Power Requirement	SB-424 Towfish – 195 W SB-216 Towfish – 264 W SB-512i Towfish – 300 W

Table 2-1: Rack Mount General Specifications

2.1.2 Processor Unit Specs

The specifications for the Processing Unit within the rack mount topside are shown in **TABLE 2-2**.

SPECIFICATION	VALUE
Mother Board	Intel I7 6700 Quad Core 3.4GHz. 8 MB Cache
Sonar Interface	Sonar Interface board (Tiger board) composed of carrier board, Acquisition board, and Sonar board
Memory	8 GB DDR4 RAM
Hard Drives	500 GB minimum (operating system) 1 TB minimum (Removable Drive [Hot Swappable])
DVD-R/W drive	10x4x32 minimum speed
Operating system	Windows 7 64 Bit
Application software	DISCOVER Sub-Bottom
Display	High resolution 23-inch flat panel LCD monitor
Keyboard	High impact industrial
Trackball	High impact industrial
I/O ports	(4) RS-232 Front: (2) Ethernet Ports (2) USB2 Rear: (2) USB2 (2) USB3 (2) USB3.1
Analog input	16-bit resolution, 200 kHz max sampling rate
Analog Output	16-bit resolution, 200 kHz max sampling rate
Pulse type	Full Spectrum CHIRP FM
Pulse length	5-100 ms, depending on tow vehicle and application
Bandwidth	0.5-15 kHz, depending on tow vehicle and application
Trigger in	TTL negative edge triggered
Trigger out	TTL negative edge triggered, 5ms ling pulse minimum
Sampling rate	20, 25, 40, or 50 kHz, depending on the transmit upper frequency
Acoustic power	212 dB re1 NPa @ 1 meter peak (approx.) at center frequency
Input voltage	120-220 VAC, 50/60 Hz, auto sense

Table 2-2: 3200-XS Topside Processor Specs

2.1.3 Power Amplifier

The specifications for the Power Amplifier are show in **TABLE 2-5**, **TABLE 2-4**, and **TABLE 2-5**.

2.1.3.1 Power Output

SPECIFICATION	VALUE
2-ohm Dual (*per channel*)	20 mS BURST: 4,700 W 20 Hz – 20 kHz: 2,800 W 1 kHz: 2,800 W
4-ohm Dual (*per channel*)	3,500 W
8-ohm Dual (*per channel*)	1,500 W
4-ohm Bridge	5,600 W
8-ohm Bridge	6,000 W

Table 2-3: Power Amplifier Specs: Power Output

2.1.3.2 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. (<1500 watts)

Table 2-4: Power Amplifier Specs: Performance

2.1.3.3 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 (*W x H x D*)	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 Amplifier Specs: Construction

2.1.4 Tiger Board Description

The Sonar Interface board (Tiger board) is the real-time controller for sonar processing. It includes transmit waveform tables and multiple channels of 10-bit high speed digital-to-analog (D/A) converters, support for external and internal triggers, and support for multiple sonar analog-to-digital (A/D) converters.

The Tiger board was designed to support a combined sonar system (with both sub-bottom as well as multi-frequency side-scan capability), or to be used single channel as a basic sub-bottom controller. At periodic intervals, the board generates the transmit waveform(s), and it continuously buffers ADC data.

The Tiger board represents a new generation of re-engineered and optimized sonar electronics. It is designed to address a broad spectrum of sonar applications from a common and well tested base of components. Among the features of this generation are lower power consumption, higher speeds, smaller form factors, and high analog sensitivity-to-minimum noise electronics for improved operating ranges.

The Tiger board is actually composed of a set of three boards as shown in **FIGURE 2-1**: a Carrier board, an Acquisition board, and a Sonar/IDE board. All three boards are connected electrically and mechanically as a single assembly that interfaces to the MB via USB.

2.1.4.1 Carrier Board

This board has the same physical size as an industry standard full slot PCI card. There are two BNC connectors, TRIGGER IN and TRIGGER OUT, and female connectors on either side for mating with the other two boards in the board set. An onboard DC/DC converter provides +12 VDC to the preamplifier in the tow vehicle.

2.1.4.2 Acquisition Board

The Acquisition board contains band pass filtering and up to eight 24-bit A/D converters, where only two channels are used. The first channel is for the received acoustic data from the preamplifier, and the second channel is used for power-up diagnostics.

2.1.4.3 Sonar Board

The sonar/IDE board is composed of two RAM memories, an acquisition memory and a CHIRP memory, and six 10-bit D/A converters for generating transmit waveforms. The transmit ping rate and sampling clock are generated from this board. The IDE portion of the board provides the interfacing circuitry required to communicate between the Mother board and the Tiger board.

The Figures below show the individual boards within the Tiger board set:

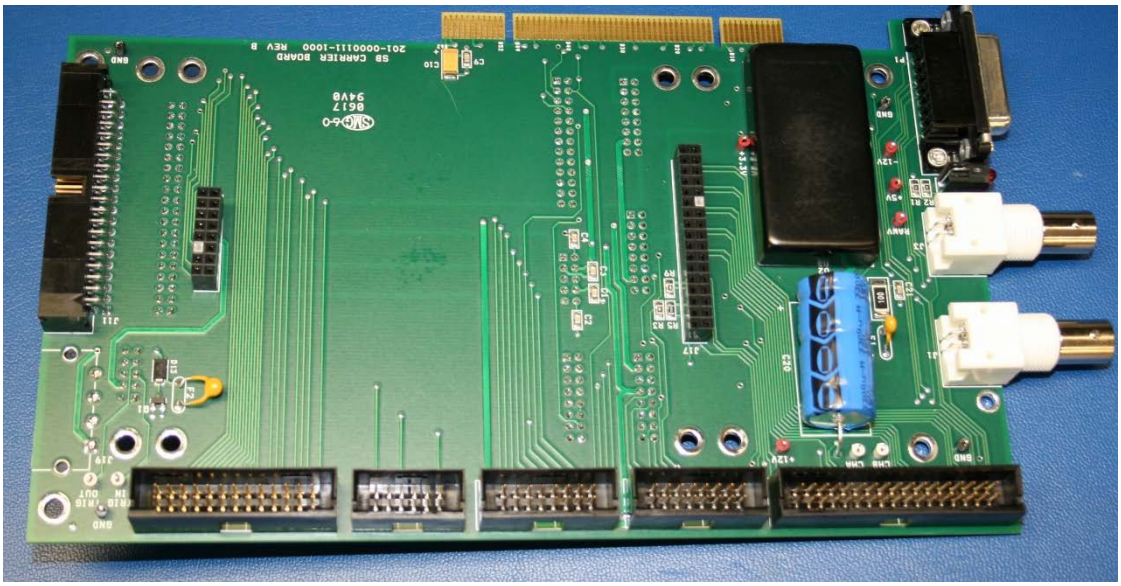


Figure 2-1: Tiger Board Set: Carrier (Front view) – 0006013

Figure 2-2: Tiger Board Set: Carrier (Rear View) – 0006013

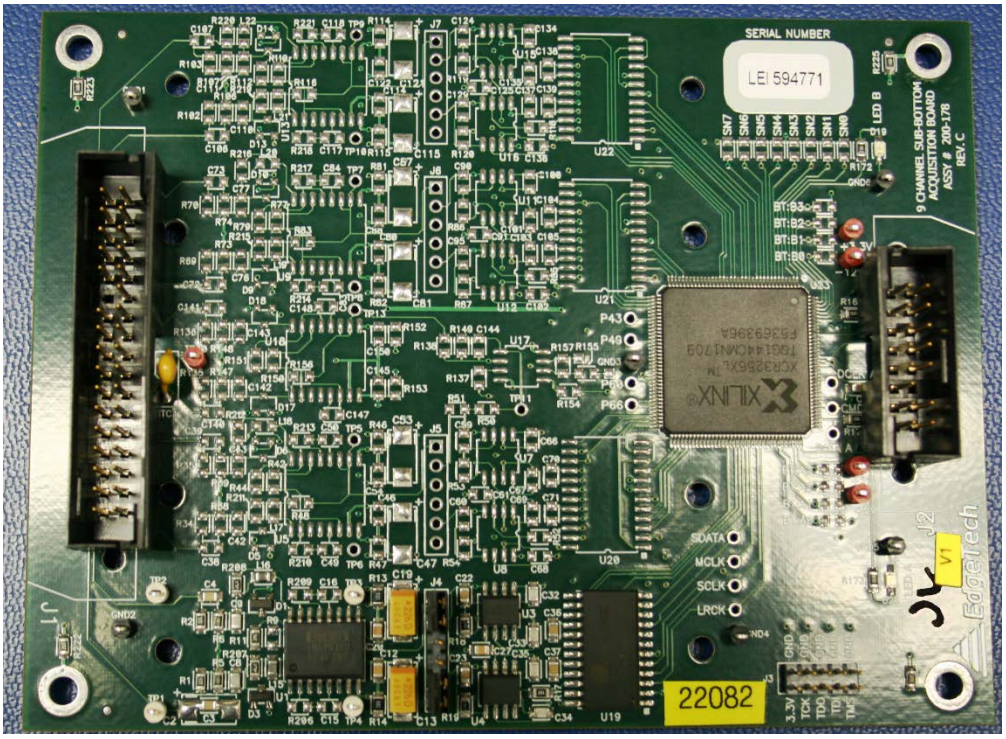


Figure 2-3: Tiger Board Set: Acquisition PCB - 0014231

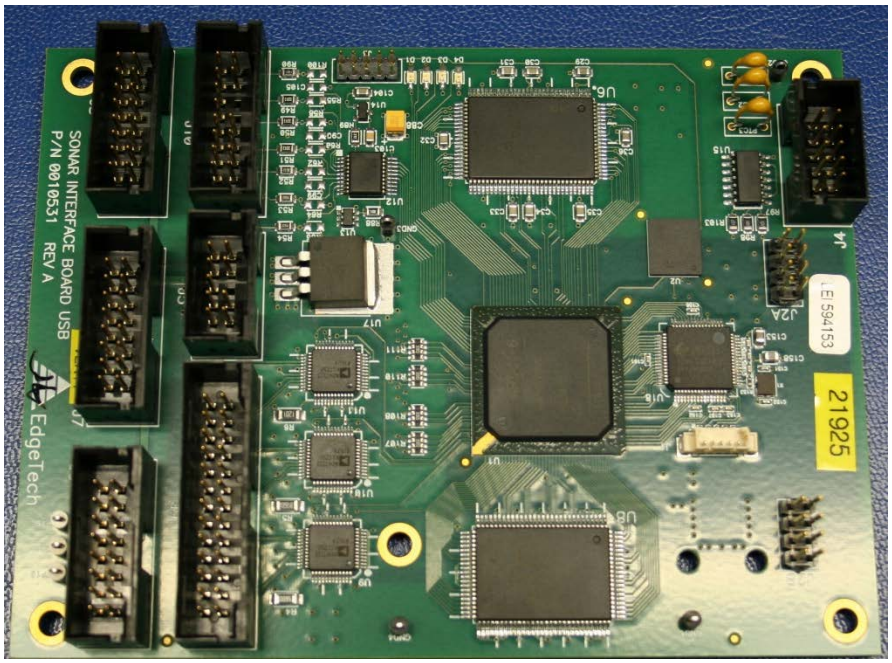


Figure 2-4: Tiger Board Set: SIBU aka Sonar Interface Board – 0011637

2.1.5 SB-424, SB-216S, and SB-512i Tow Vehicles

The general specifications for the SB-424, SB-216S, and SB512i Tow Vehicles are show in **TABLE 2-6**.

SPECIFICATION	SB-424 VALUE	SB-216S VALUE	SB-512i VALUE
Frequency range	4-24 kHz	2-16 kHz	0.5-12 kHz
Pulse type	FM	FM	FM & WB (wide band)
Pulse bandwidth/pulse length	4-24 kHz/10 ms 4-20 kHz/10 ms 4-16 kHz/10 ms	2-15 kHz/20 ms 2-12 kHz/20 ms 2-10 kHz/20 ms	0.5-8.0 kHz/5 ms FM 0.5-2.7 kHz/40 ms WB 0.5-6.0 kHz/20 ms WB 0.5-4.5 kHz/50 ms FM 0.5–6.0 kHz/9 ms FM 0.5–6.0 kHz/18 ms FM 0.5–7.2 kHz/30 ms FM 0.7–12.0 kHz/20 ms FM 2.0–12.0 kHz/20 ms FM
Calibration:	Gaussian-shaped pulse spectrum	Gaussian-shaped pulse spectrum	Gaussian- and rectangular-shaped pulse spectrum
Vertical resolution[a]	4 cm (4–24 kHz) 6 cm (4–20 kHz) 8 cm (4–16 kHz)	6 cm (2–15 kHz) 8 cm (2–12 kHz) 10 cm (2–10 kHz)	19 cm (1–5.0 kHz) 12 cm (1.5–7.5 kHz) 8 cm (2–12 kHz)
Penetration in course and calcareous sand[b]	2 m (typ)	6 m (typ)	30 m (typ)
Penetration in soft clay[b]	40 m	80 m	250 m
Beam width	16°, 4–24 kHz 19°, 4–20 kHz 23°, 4–16 kHz	17°, 2–15 kHz 20°, 2–12 kHz 24°, 2–10 kHz	41°, 0.5–5 kHz 32°, 1–6 kHz 24°, 1.5–7.5 kHz 16°, 2–12 kHz
Optimum tow vehicle pitch/roll[c]	<7°, 4–24 kHz <8°, 4–20 kHz <10°, 4–16 kHz	<7°, 2–15 kHz <8°, 2–12 kHz <10°, 2–10 kHz	<16°, 0.5–5 kHz <13°, 1–6 kHz <10°, 2–8 kHz <8°, 2–10 kHz <7°, 2–12 kHz
Optimum tow height	3-5m above sea floor	3-5 m above sea floor	3-5 m above sea floor
Transmitters	1	1	2
Receive arrays	2	2	4
Output power	2000 W	2000W	2000 W
Tow vehicle size	77 cm (30 in.) L 50 cm (20 in.) W 34 cm (13 in.) H	105 cm (41 in.) 67 cm (26 in.) W 46 cm (18 in.) H	158 cm (62 in.) L 134 cm (53 in.) W 46 cm (18 in.) H
Shipping container size	91 cm (36 in.) L 66 cm (26 in.) W 64 cm (25 in.) H	117 cm (46 in.) L 79 cm (31 in.) W 61 cm (24 in.) H	173 cm (68 in.) L 137 cm (54 in.) W 71 cm (28 in.) H
Weight in air	35 kg (78 lb)	72 kg (160 lb)	186 kg (410 lb)
Shipping weight	110 kg (243 lb)	162 kg (357 lb)	356 kg (783 lb)
Tow cable requirements	3 shield-twisted wire pairs	3 shield-twisted wire pairs	3 shield-twisted wire pairs
Depth rating	300 m (984 ft) max	300 m (984 ft) max	300 m (984 ft) max

Table 2-6: Tow Vehicle Specifications

a. 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 back to the sonar system when the transmitted pulse encounters a change in density. 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 750 m/s). For example, a full bandwidth pulse from an SB-424 Tow Vehicle has a vertical resolution of 3.75 cm (1/20,000 x 750).

b. 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 that the sediment is gas free (no organic materials), that the lowest frequency of the pulse spectrum is transmitted and that the vehicle is within 5 meters of the seabed (range for maximum penetration). Lower frequencies reduce attenuation (absorption of sound). Towing the vehicle close to the sea floor reduces the acoustic footprint thereby reducing scattering (interfering reflections) from the sea floor and within the sediments.

c. At the -3 dB points, depending on the center frequency.

2.2 Mechanical Drawings

The following pages contains Drawings for the SB-216, SB-424, and SB-512i.

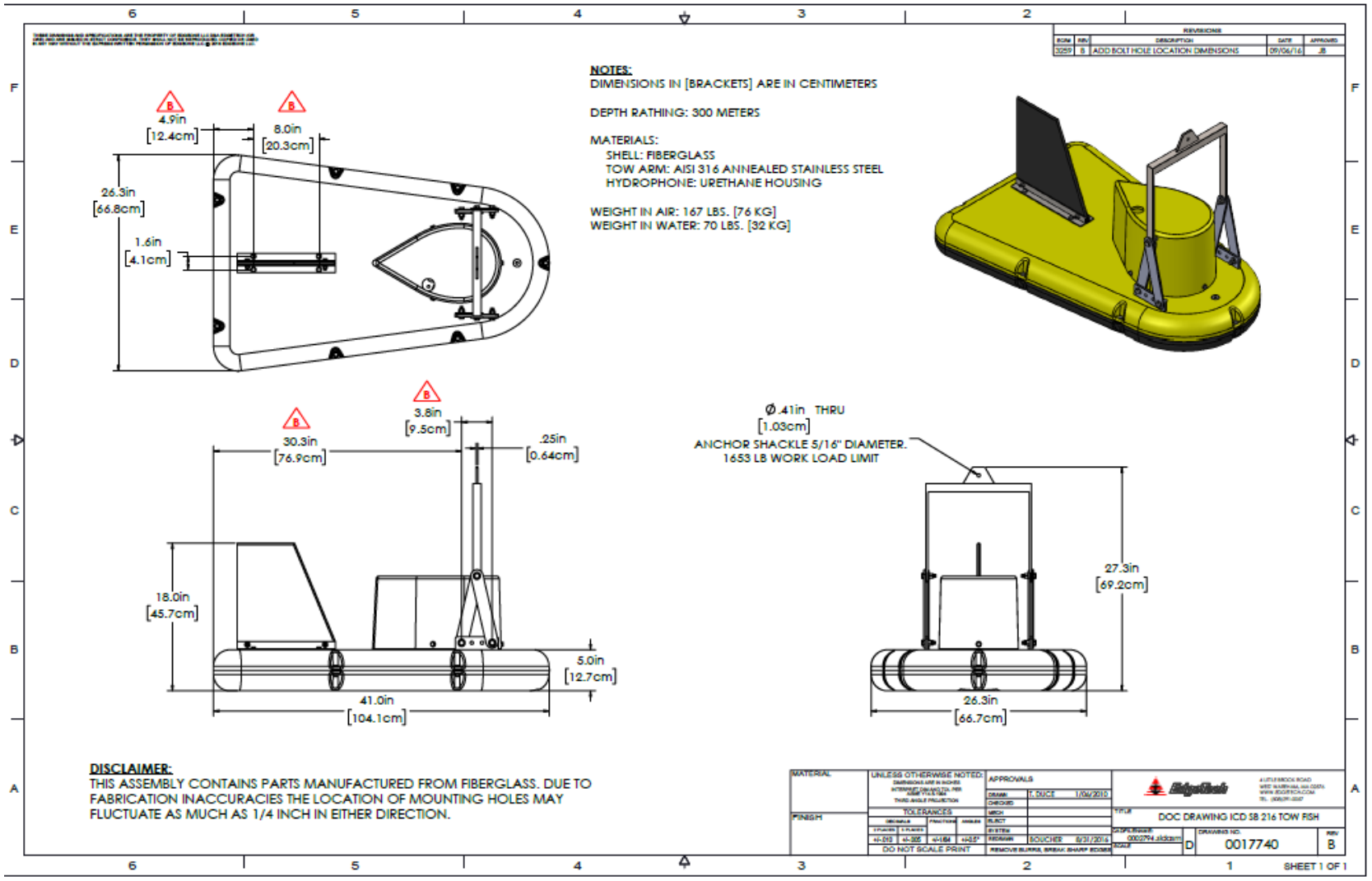


Figure 2-5: SB-216 Towfish Outline Drawing

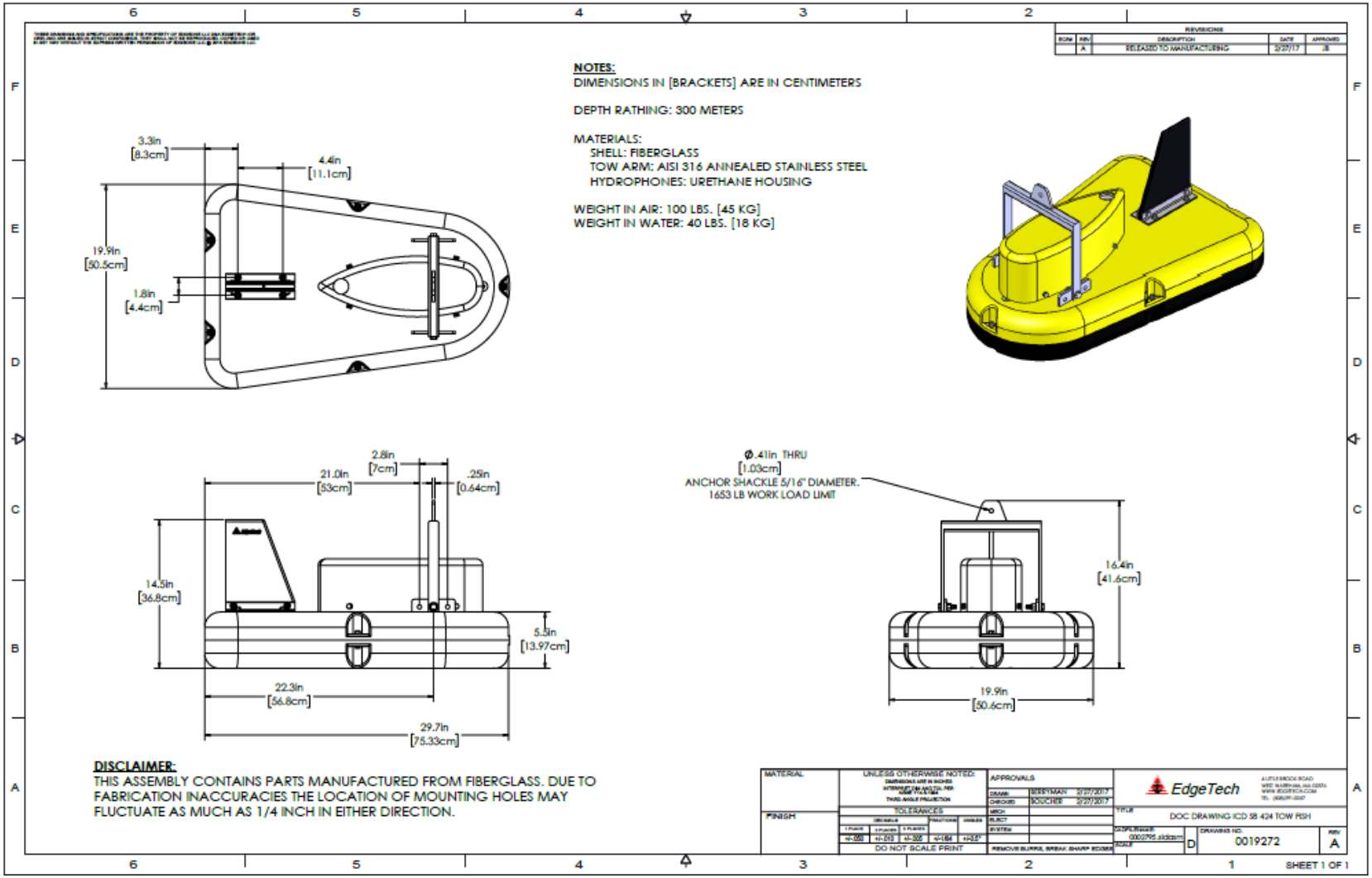


Figure 2-6: SB-424 Towfish Outline Drawing

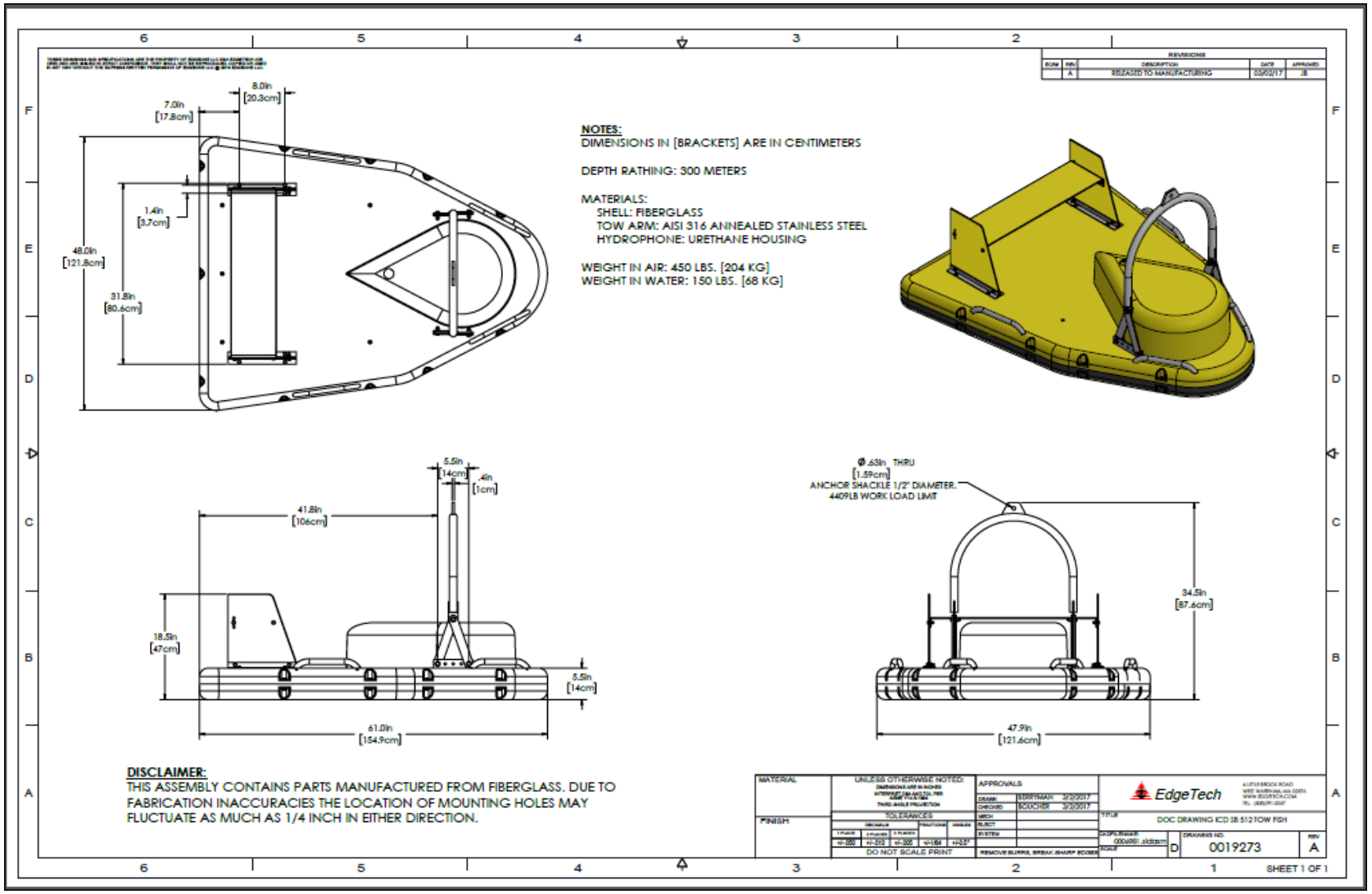


Figure 2-7: SB-512i Towfish Outline Drawing

2.2.1 Kevlar Reinforced Tow Cable Specifications

The general specifications for the Kevlar Reinforced Tow Cable are shown in **TABLE 2-7**. The 75meter length is not the only cable option for the 3200-XS system, but it is the most popular.

SPECIFICATION	VALUE
Twisted-shielded wire pairs	(1) #16 AWG (2) #20 AWG
Braking strength	1600 kg (3500 lb)
Working strength	295 kg (650 lb)
Weight in air	30.8 kg/100 m (207 lb/1000 ft)
Voltage rating	600 volts
Bending radius	25.4 cm (10.0 in.) minimum
Length	75 m (245 ft) standard

Table 2-7: 75-Meter Kevlar Reinforced Tow Cable Specifications

NOTE: Cables do not come standard with the system and must be specified upon purchase. For more information about cable options, contact **EDGETECH CUSTOMER SERVICE**.

3.0: SETUP AND ACTIVATION

Setup and test of the EdgeTech 3200-XS Sub-Bottom Profiling System involves:

1. Unpacking, inspecting, and connecting the system components
2. Connecting a navigation system
3. Activating the system
4. Verifying operation using the EdgeTech DISCOVER Sub-Bottom software

This section provides instructions on how to perform these tasks, as well as information on how to deploy and tow the tow vehicle.

3.1 Unpacking and Inspection

The rack mount topside; SB-424, SB-216S, or SB-512i Tow Vehicle are shipped in separate, reusable, heavy-duty transport cases. Essential cables and documentation are also included. Tow cables must be purchased separately, but are shipped in a similar manner.

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. 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 3200-XS Sub-Bottom Profiling System typically includes the following:

- Topside Unit and Monitor
- SB-424, SB-216S or SB-512i Tow Vehicle
- Tow Cable (length and type specified by user)
- AC power cords (2)
- Software USB
- Electronic 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.

3.2 Power Requirements

The 3200-XS requires a 120–220 VAC, 50/60 Hz (<1500 watts). The input voltage is auto sensing for the topside, and the power amplifier makes use of a universal power input.

3.2.1 Use of an Uninterruptable Power Supply

The AC power source should be continuously free of high amplitude and high frequency transients. 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 power source should never be the same as that being used to power electric motors, such as pumps and winches, on the survey vessel.

3.2.2 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. Refer to **TABLE 3-1** for connection information.

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

Table 3-1: AC Power Cord Wiring

3.3 Navigation Interface

The 3200-XS Sub-Bottom Profiling System accepts all standard National Marine Electronics Association (NEMA) 0183 message sentence formats from a connected Global Positioning System (GPS) or Integrated Navigation System.

3.4 Topside Placement

The rack mount processor should be located and set up 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 be difficult. The location should also enable direct communications with the deck crew that is handling the tow vehicle.

Secure the rack mount topside in place, using tie-downs if necessary, near the required AC power source. If you are mounting the 3200-XS 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.

3.4.1 Rack Mount Controls and Indicators

The Rack Mount includes controls and indicators on the front and back as shown in **FIGURE 3-1** and **FIGURE 3-2.** Several test points are also provided for voltage measurements. The Rack Mount controls and indicators are the following:

POWER SUPPLY:	Rocker switch. Turns on the power supply in the 3200-XS Topside Processor. This switch can be left in the on position at all times.
SYSTEM POWER:	Push button toggle switch. Turns on 3200-XS Topside Processor.
POWER:	Blue indicator lights up when amplifier is on.
RESET:	Momentary Push-button switch. Resets 3200-XS Topside Processor.
HARD DISK:	Red indicator. Indicates the 3200-XS Topside hard drive is active.
SYSTEM:	Green indicator. Illuminates when 3200-XS Topside is on.
READY:	Green indicators. Illuminates when system ready to transmit. Upon power up, wait one to two minutes for indicator to illuminate.
12 VDC OUT TO PREAMP:	Test point. Measures 12 VDC voltage applied to preamplifier on the tow vehicle.
TOWFISH PREAMP 5 VDC:	Test point. Measures 5 VDC voltage preamplifier feedback voltage from the tow vehicle.
PREAMP COMMON:	Test point. Common ground for the preamplifier -5 VDC and 12 VDC test points.
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 performance or function of 3200-XS system in any way.

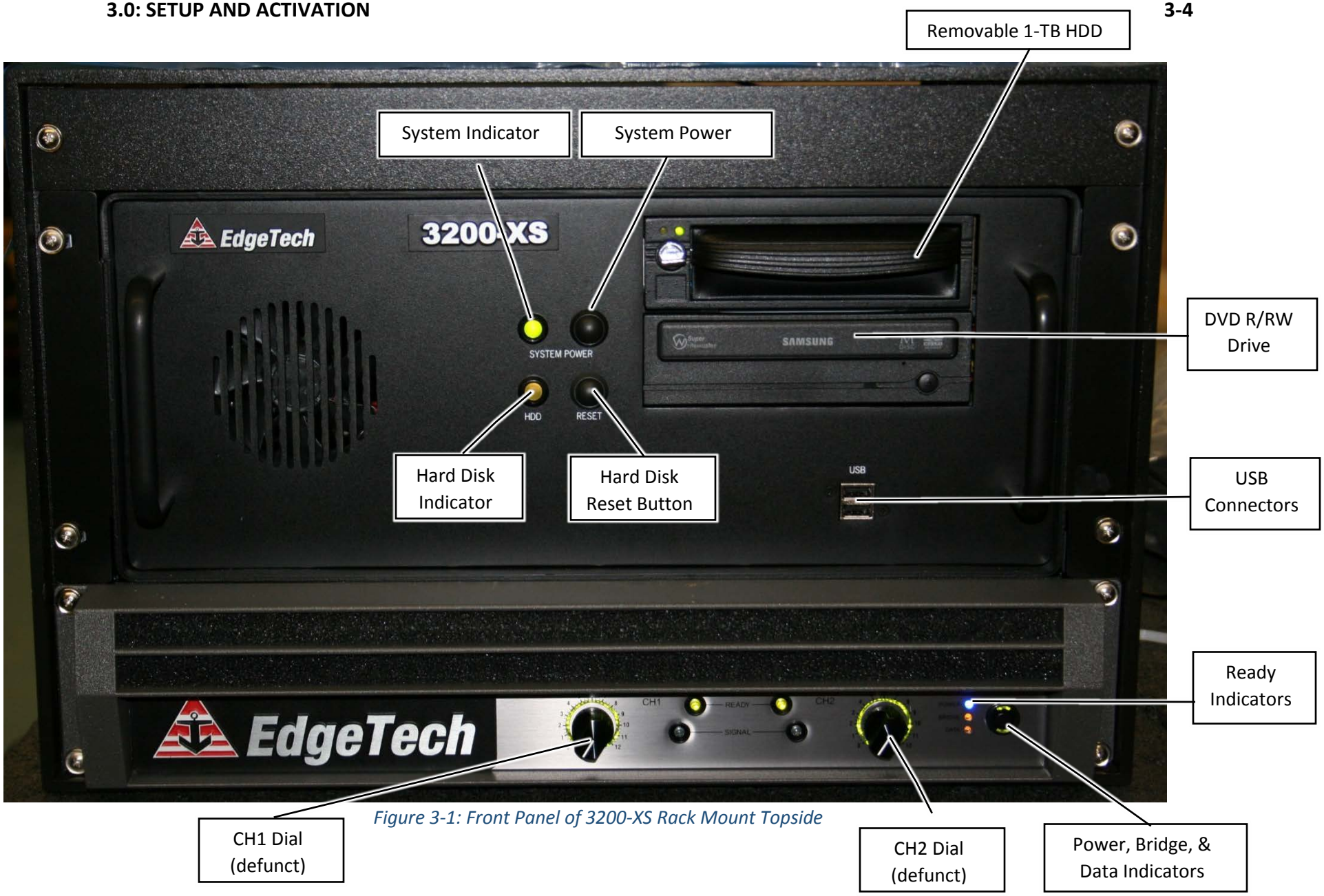


Figure 3-1: Front Panel of 3200-XS Rack Mount Topside

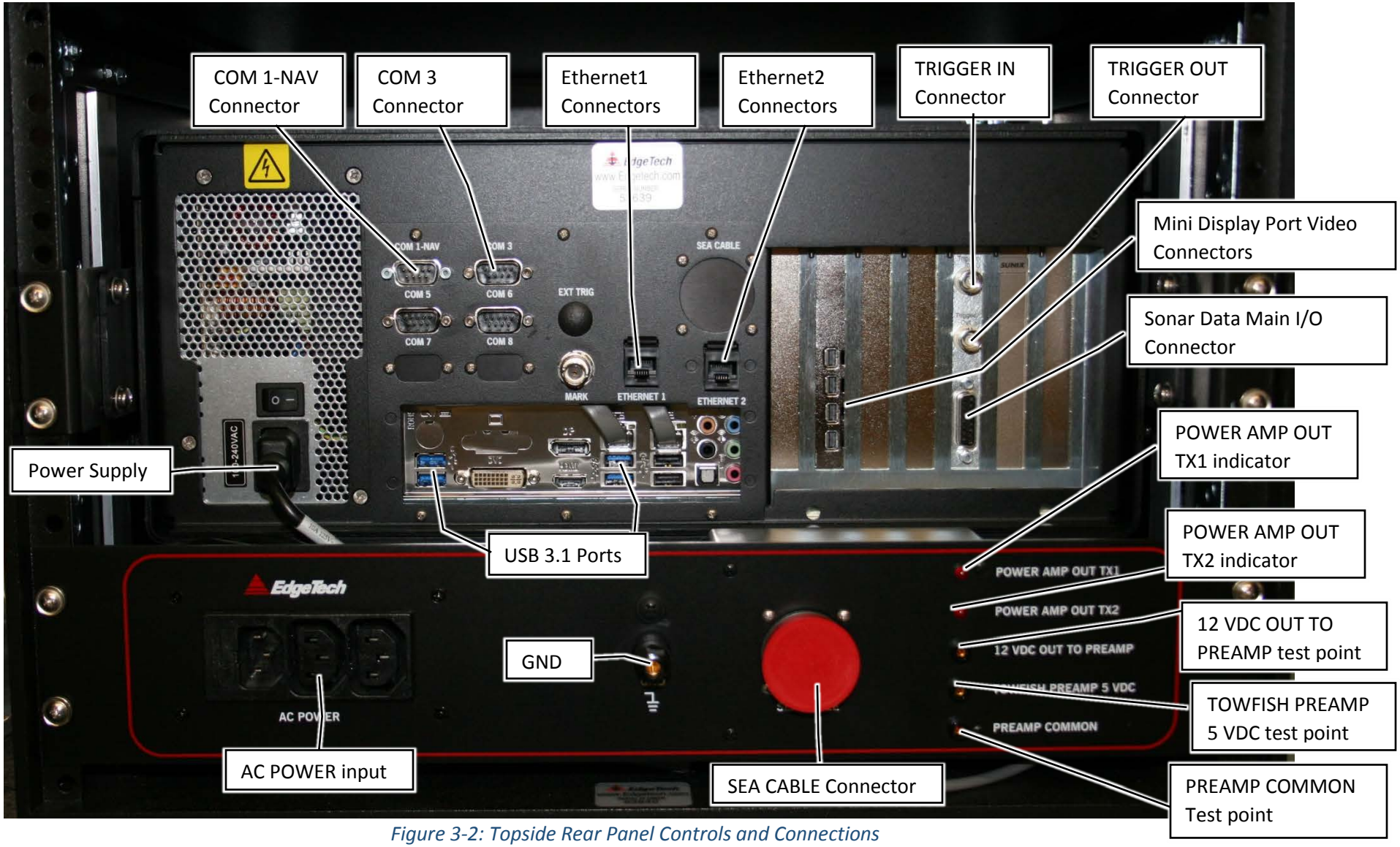


Figure 3-2: Topside Rear Panel Controls and Connections

3.5 Rack Mount Deck Unit Connections

Most of the connections to the Rack Mount Deck Unit are made using connectors on the back. These connectors are shown in **FIGURE 3-1**. The trackball and keyboard connections are made using connectors on the front of the Deck Unit.

The Deck Unit connections are the following:

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 that connects to the navigation system

COM 3, 5, 6: DB-9 female connectors

RS-232 serial ports that can be used to connect to navigation system

TRIGGER IN: BNC connector

Connects to an external trigger source to trigger the sonar.

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

ETHERNET: (2) RJ-45 connector

Available for connection to a local area network (LAN) and/or printer

USB: Front Panel:

- (2) USB

Rear Panel:

- (2) USB2
- (2) USB3
- (2) USB3.1

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

3.6 Connecting the System Components

All of the 3200-XS Sub-Bottom Profiling System components, including optional components, such as a printer, a navigation system, and external sonar systems, are made to the Rack Mount processor.

> **WARNING!**
> Do not connect the tow cable to the Rack Mount before connecting it to the tow vehicle, otherwise injury or death can occur if the exposed connector on the tow cable is energized. Always connect the tow cable to the tow vehicle first.

When connecting the system components, refer to sub-section **3.4.1: RACK MOUNT CONTROLS AND INDICATORS** for the location and description of the connectors.

3.6.1 Connecting and Attaching the Tow Cable to the Tow Vehicle

A Kevlar Reinforced Tow Cable is shown connected and attached to a SB-216S Tow Vehicle in **FIGURE 3-3**, and is similar to that for the SB-424 and SB-512i Tow Vehicles. Shown in **FIGURE 3-4** is the recommended method for dressing and strain relieving the tow cable.

To connect and attach the tow cable to the tow vehicle:

1. Verify that the tow cable is not connected to the Deck Unit.
2. Coil the tow cable in a figure eight (over/under) configuration.
3. Verify that the tow cable and tow vehicle connectors are free of corrosion or dirt. If dirty, clean them with an alcohol wipe.
4. Apply a thin film of silicone grease to the pins of the tow vehicle tow cable connector.
5. Mate the connectors by pressing them firmly together. Do not wiggle the connectors.
6. Mate the connector locking sleeves.
7. Connect the eyelet of the cable grip to the shackle on the tow bridle and secure them with seizing wire or a tie wrap.
8. Secure the tow cable/pigtail to the tow bridle using tie wraps ensuring that there is proper strain relief and that the connector does not strum or move in the water current. Electrical tape can also be used for this purpose.

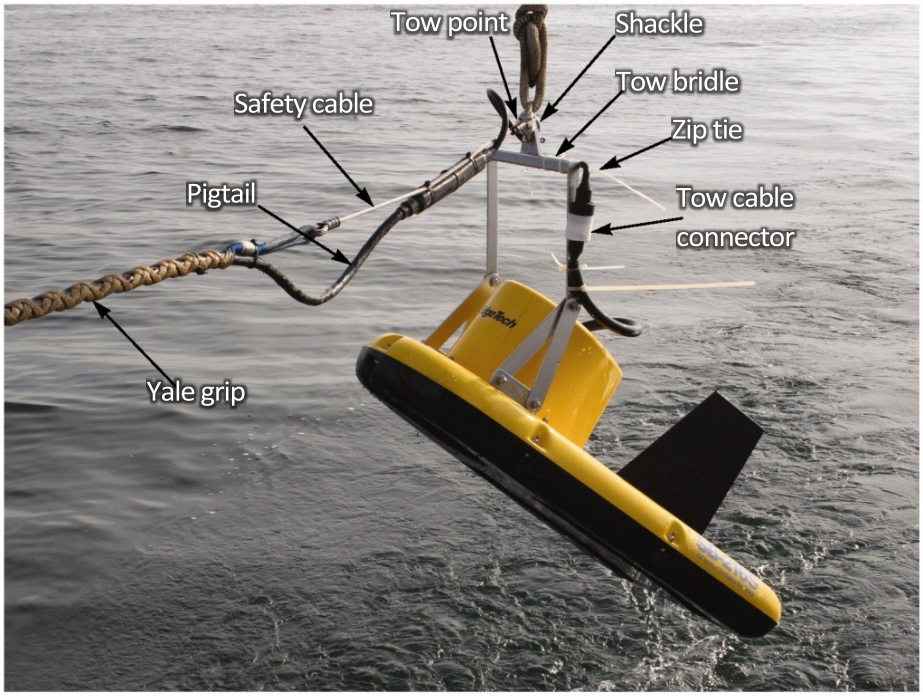


Figure 3-3: Reinforced Cable Attached to SB-216S Tow Vehicle

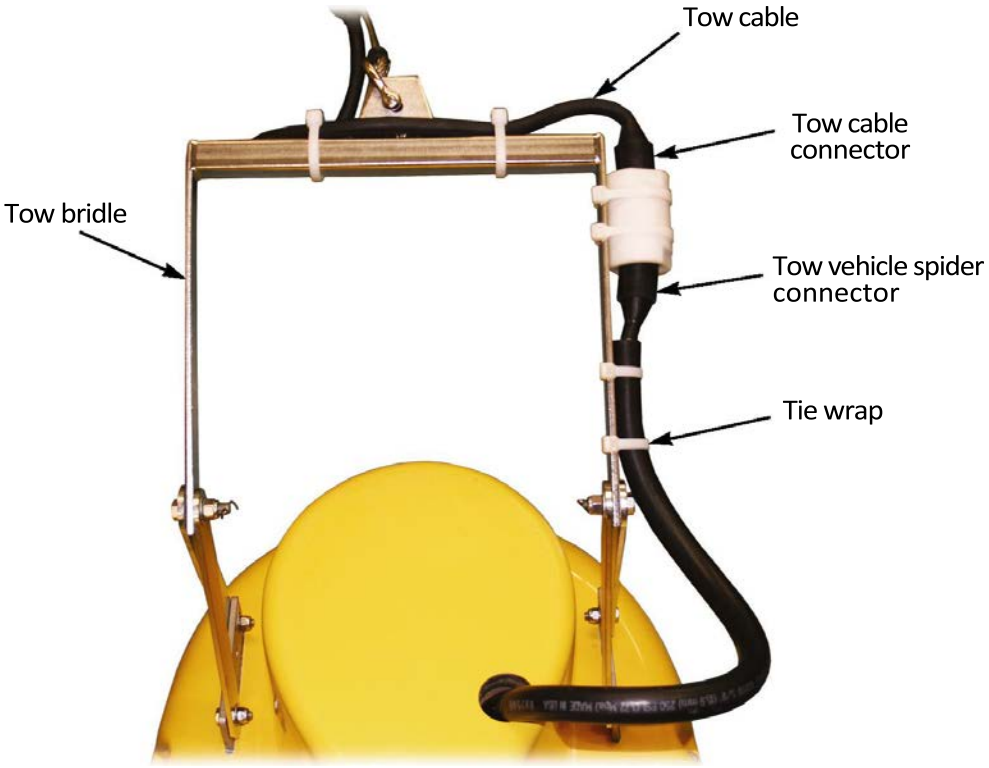


Figure 3-4: Recommended Method for Dressing and Strain Relieving Tow Cable

3.6.2 Connecting the Rack Mount Topside

1. Verify that the Rack Mount Deck Unit AC power.
2. Refer to **2.0: SPECIFICATIONS** and select or verify the correct input power voltage for the topside.
3. Verify that the tow cable is properly connected and attached to the tow vehicle, and then connect the tow cable to the SEA CABLE connector.
4. Connect the LCD monitor to the MONITOR connector.
5. Connect the trackball to the TRACKBALL connector.
6. Connect the keyboard to the KEYBOARD connector.
7. If a navigation system is to be used, connect the navigation system output to the COM 1-NAV connector.
8. If an external source is to be used to trigger the 3200-XS Sub-Bottom Profiling System, connect the trigger output of this source to the TRIGGER IN connector.
9. If an external sonar system is to be triggered by the 3200-XS Sub-Bottom Profiling System, connect the trigger input of this system to the TRIGGER OUT connector.
10. Connect an AC power cord to an AC POWER out connector and to the LCD monitor.
11. Connect an AC power cord to the AC POWER input connector and to the AC power source.

3.7 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 3200-XS Topside Processor.
4. The SYSTEM indicator on the 3200-XS 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.

3.8 Pre-Deployment Tests

Pre-deployment checks should be performed ***before*** the tow vehicle is deployed and ***after*** the system is activated. Pre-Deployment checks involve:

1. Listening for the transmitted pulses from the transducers on the tow vehicle
2. Tapping the fiberglass shell with a hand or, gently, with a screwdriver handle near the hydrophone arrays while observing the Waterfall Display in DISCOVER, ensuring it plays back and navigation is present. DISCOVER is shown in **FIGURE 3-5**. An example Tap Test is shown in **FIGURE 3-9**.

> **NOTE:** See EdgeTech DISCOVER Sub-Bottom software manual, 0019800, for additional software information.

Based on default installation, DISCOVER and SONAR.EXE start automatically.

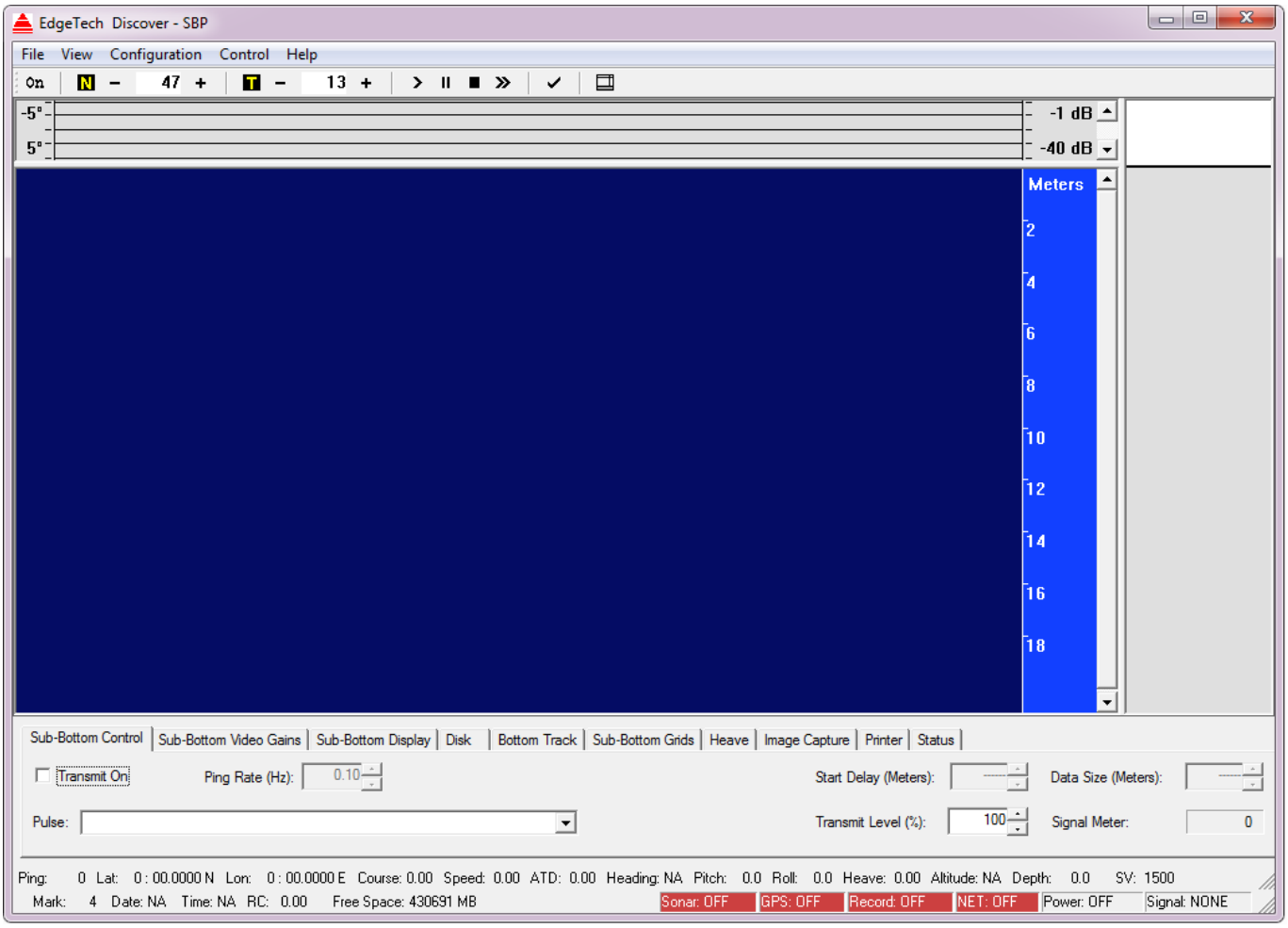


Figure 3-5: The DISCOVER Sub-Bottom Main Window

To perform the pre-deployment checks:

1. Follow the instructions in **ACTIVATING THE SYSTEM**.
2. SONAR.EXE runs a self-test, with an audible chirp, indicating the test passed. A successful test is shown in **FIGURE 3-6**.
    a. If the test fails, the SONAR.EXE window will remain on the desktop, and the failure mode will be described in the window.

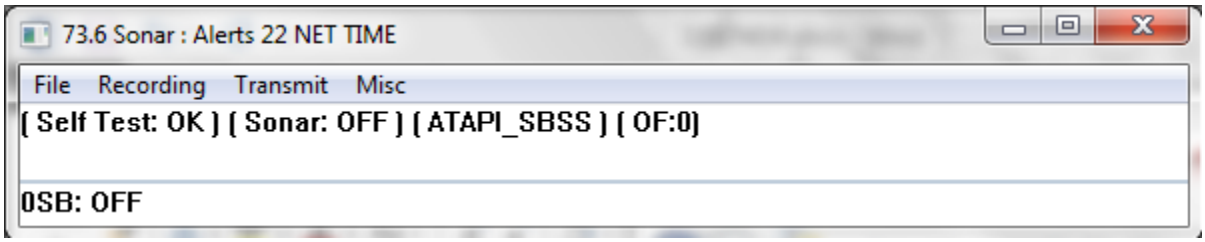


Figure 3-6: Successful Self-Test

3. The NET status in DISCOVER should change from NET OFF to NET ON, as shown in **FIGURE 3-7**.

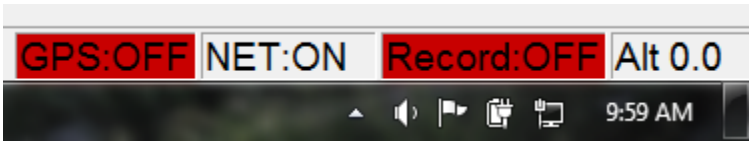


Figure 3-7: NET: ON

4. Next, you should run a Tap Test. To do this, navigation to the Sub-Bottom Control Tab, shown in **FIGURE 3-8.**

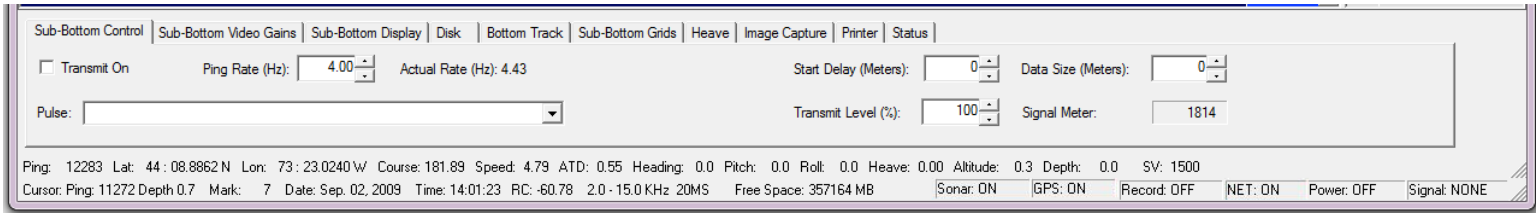


Figure 3-8: The Sub-Bottom Control Tab

5. In the Shortcut Toolbar, set Gain to either 0 or -3 dB, and then click Normalize Gain Button.

> **CAUTION!**
> Do not allow the transducers on the tow vehicle to continuously transmit in air for an extended period, as damage to the transducers could occur.

6. In the Sub-Bottom Control Tab, select a Transmit Pulse using the “Pulse” drop down. Set “Transmit Level (%)” to “0”. Select the “Transmit On” checkbox.

7. The transducers on the tow vehicle should begin transmitting (at zero power) and receive data should begin scrolling on the display in the DISCOVER Main window from right to left.

8. Tap the underside of the tow vehicle near the hydrophones with the handle of a screw driver, while observing the Waterfall Display in the DISCOVER window. Streaks or noise spikes should be visible in the Waterfall Display, as shown in **FIGURE 3-9**. This verifies the receive channel is operating.

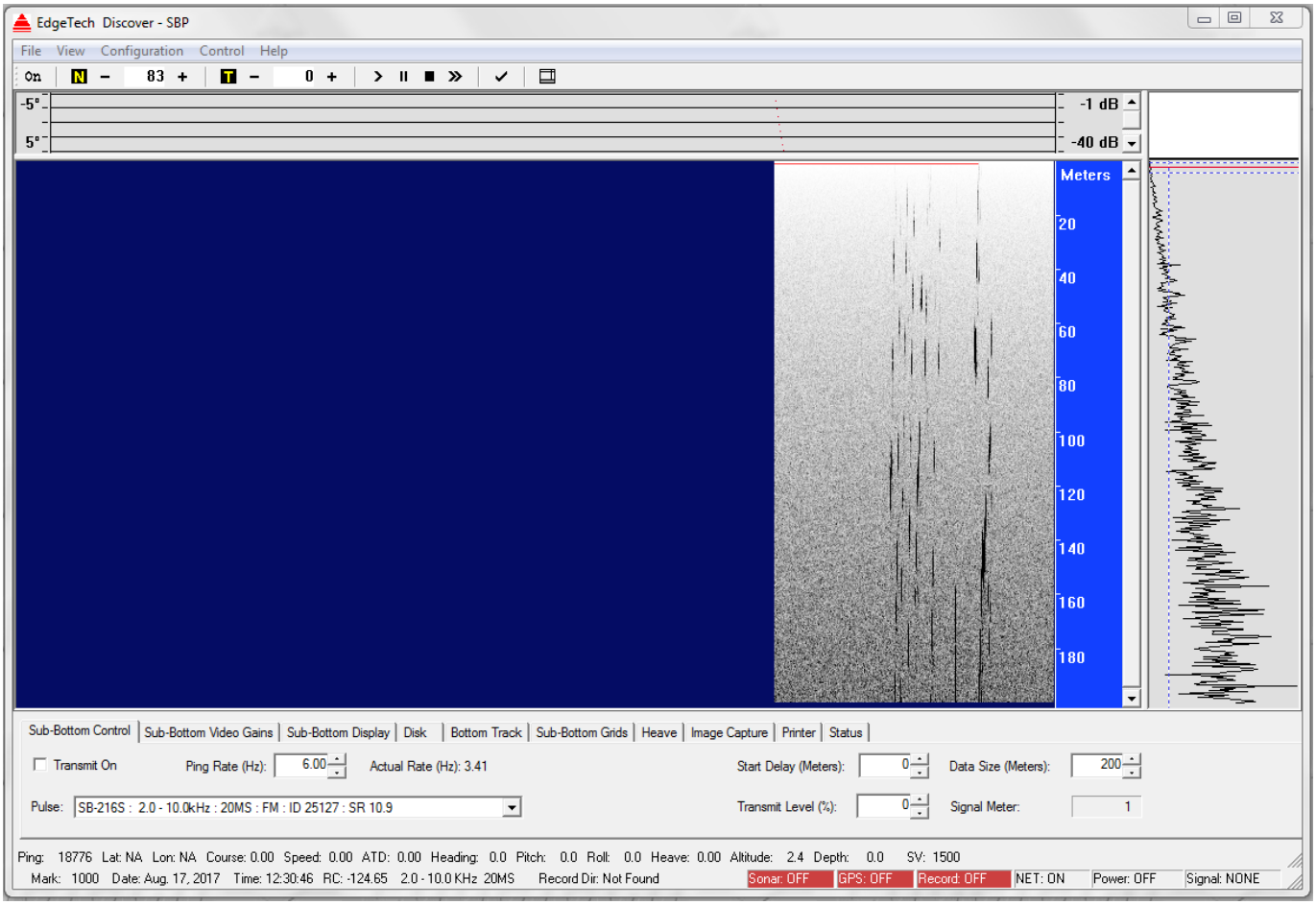


Figure 3-9: Tap Test

3.9 Tow Vehicle Deployment

The SB-424, SB-216S, and SB-512i Tow Vehicles can be towed using a Kevlar Reinforced Tow Cable that is available separately with the 3200-XS Sub-Bottom Profiling System. However, for the larger SB-0512i tow cable, a steel cable with a minimum 500 Kg (1100 lb.) working strength is recommended instead.

The steel cable can be secured to the tow cable using electrical tape, making sure there is enough built-in slack in the tow cable so that the entire load is supported by the steel cable. A steel cable could also be used in the same manner with the two smaller SB-424 and SB-216S Tow Vehicles to increase the life of the tow cable. For towing in deep water, a single, armored tow cable is required.

CAUTION!

Do not tow the tow vehicle too close to the survey vessel. Towing in this manner can cause the tow vehicle to be pulled in against the hull of the ship due to the low pressure of the propeller wash and the effect of the water flowing by the hull. In addition, sonar reflections from the hull may be evident in the records.

The tow vehicle may be towed at speeds of up to 10 knots. However, to optimize performance and minimize flow noise, it is recommended that the tow vehicle be towed at speeds of less than 5 knots. Lead ballast in the nose of the tow vehicle provides towing stability by allowing the tow point to be placed as far forward as possible and by making the tow point well above the center of gravity of the tow vehicle. The tow point is factory adjusted so the tow vehicle is level when it is towed in the water at 3 to 5 knots.

CAUTION!

Do not tow the tow vehicle with the nose angled up or down, as this can degrade sonar imagery. Before starting the survey, verify the Tow vehicle is as level as possible when towing at 3 to 5 knots.

3.9.1 Obtaining the Best Sonar Imagery When Towing

To generate good sonar imagery, the pitch of the vehicle, which is how much in degrees the nose is angled up or down, must be less than one half of the -6dB beam width of the acoustic pulse at its highest frequency—and less at lower frequencies. As a rule of thumb, for a 0.5-meter long hydrophone array, the -6dB beam width at 10 kHz is 20 degrees. For example, if you are transmitting a 2 to 15 kHz FM pulse using a tow vehicle with a 0.5-meter long receiving array, such as in the SB-216S or SB-216D Tow Vehicle, you must keep the tow vehicle from pitching more than about 7 degrees in either direction, or:

$$\frac{\frac{1}{2} x\ 20\ degrees\ x\ 10\ kHz}{15\ kHz} = 6.6\ degrees$$

Equation 1

The same criteria apply to vehicle roll, which is how much in degrees it is listing to port or starboard. Sensors can be installed on the tow vehicle to measure its pitch and roll under various towing conditions.

3.9.2 Conducting Sediment Classification Surveys When Towing

To conduct sediment classification surveys, the reflection coefficient should be measured with better than 10% accuracy. The normal component of the sea floor reflection must arrive within the angle corresponding to one half of the -1dB beam width of the acoustic axis of the vehicle at the center frequency of the pulse, the frequency where most of the acoustic energy is concentrated and where the reflection coefficient is measured. As a rule of thumb, for a 0.5-meter long hydrophone array, the -1dB beam width at 10 kHz is 4 degrees.

For example, if the sea floor is expected to have slopes of up to 5 degrees during the survey, and a vehicle with a 0.5-meter hydrophone array and a 2 to 10 kHz FM pulse is selected, the -1dB beam width should be at least 10 degrees at 6 kHz. For this pulse and receiving array, the -1dB beam width at 6 kHz is about 7 degrees, or:

$$\frac{4\ degrees\ x\ 10\ kHz}{6\ kHz} = 6.6\ degrees$$

Equation 2

Therefore, only reflection coefficient measurements made when the sea floor slope is within 3.5 degrees of horizontal will be accurate within 10% (1dB).

The attitude of the tow vehicle with respect to the horizontal plane must meet the -1 dB criteria described above for sediment classification surveys. Rough sea conditions tend to move the vehicle up and down vertically, causing oscillations in the images. DISCOVER Sub-Bottom has a swell filter that will help reduce the heave effect on the record. Refer to the “DISCOVER Sub-Bottom Software User’s Manual” for details.

For sediment classification, the tow fish pulses must be calibrated by the end user. Contact **EDGETECH CUSTOMER SERVICE** to obtain the calibration procedure.

4.0: MAINTENANCE

The 3200-XS Sub-Bottom Profiling System is ruggedly designed and built, therefore requiring little maintenance. To ensure long lasting and reliable service, however, some periodic maintenance is recommended. This section provides some maintenance recommendations and includes instructions on how to disassemble and reassemble a tow vehicle should it be required to replace internal components.

4.1 Periodic Maintenance

Maintenance on the 3200-XS Sub-Bottom Profiling System should be performed on a regular basis, as often as necessary, depending on use. However, most of the maintenance is performed after each deployment and recovery cycle of the tow vehicle. Other maintenance, such as cleaning of the air filter in the 3200-XS Topside Processor, can be performed as necessary.

4.1.1 Cleaning the 3200-XS Topside Processor

The 3200-XS Topside Processor in the Deck Unit Should be cleaned inside periodically using a grounded vacuum cleaner.

4.1.2 Cleaning the Tow Vehicle and Tow Cable after Use

After retrieving the tow vehicle from the water, use a hose to wash it down, along with the tow cable, with clean, fresh water. Thoroughly spray the transducers and the hydrophone arrays from underneath the tow vehicle and remove any buildup of debris that may have been trapped inside.

Once dry, inspect the inside of the tow vehicle, especially the transducers, the hydrophone arrays and the cables for any damage and for any loose connectors. Also inspect the tow cable and the connectors on each end. Attach dummy plugs to Tow cable and tow fish connectors. Then, clean the transducers and hydrophone arrays using a mild, non-abrasive detergent and water. Do not use any abrasive detergents or ammonia based cleaners. After cleaning, thoroughly spray the transducers and hydrophones again with fresh water.

4.1.3 Inspecting and Cleaning the Underwater Connectors

Regularly inspect the contacts on the male pins of each underwater connector in the tow vehicle and on the tow cable for corrosion or oxidation. To remove any oxidation, rub the contacts lightly with 800 grit emery cloth cut into strips equal to or less than the width of a contact. A pencil eraser can also be used for this purpose. The female sockets can be cleaned using a cotton swab and rubbing alcohol. A .22 caliber bore brush with only nylon bristles can be used to remove light oxidation.

To extend the life and increase the reliability of the connectors, apply a thin film of silicone dielectric grease, such as Novagard G624 general purpose silicone grease or an equivalent, to the entire surface of each male pin. A small amount of grease should also be applied to the opening of each female socket.

> **NOTE:** Remember to always install dummy connectors on the connectors of the tow cable and the tow vehicle tow cable connector.

4.1.4 Storage

When not in use, all the components of the 3200-XS Sub-Bottom Profiling System should be packed in their original shipping containers, in the same manner in which they were originally shipped, and stored in a dry area.

4.1.5 Restoring the Operating System

The 3200-XS Topside Processor contains an 80-GB hard drive for both the operating system and the application software. A separate 1-TB hard drive is also included for data recording. An image file of the 80-GB hard drive is provided on a thumb drive. This thumb drive can be used to completely restore the 80-GB hard drive to its original shipped factory configuration in the unlikely event of its failure. For instructions on how to restore the operating system hard drive, refer to the provided user software manual.

4.2 Disassembling and Reassembling a Tow Vehicle

The procedures below describe how to disassemble and reassemble a tow vehicle to access the transducers, hydrophones, transformers, inductors, spider boxes, spider arrays, and preamplifiers. The tools required are a socket wrench, 7/16 and 1/2-inch sockets, and a small flat screw driver.

> **CAUTION!**
> Disassembling a tow vehicle may void its warranty. If in doubt, contact EdgeTech Customer Service for more information.

4.2.1 Disassembling a Tow Vehicle

To disassemble a sub-bottom tow vehicle:

1. Using the blade of a screw driver, pry out the retaining ring from the locking sleeve as shown in **FIGURE 4-1**.

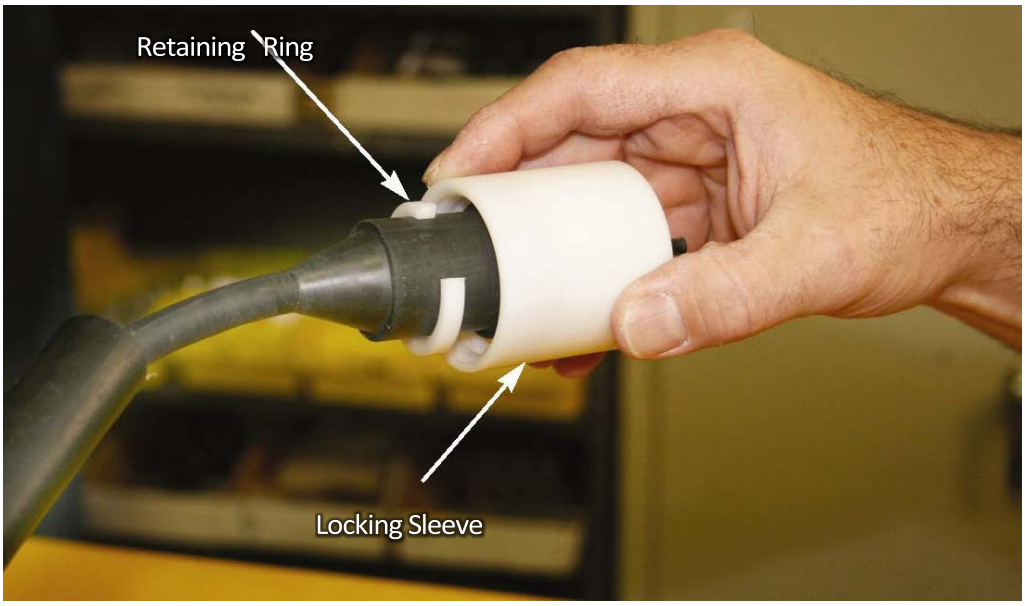


Figure 4-1: Retaining Ring and Locking Sleeve Removed

2. Remove the retaining ring and the locking sleeve from the connector as shown in **FIGURE 4-2**.

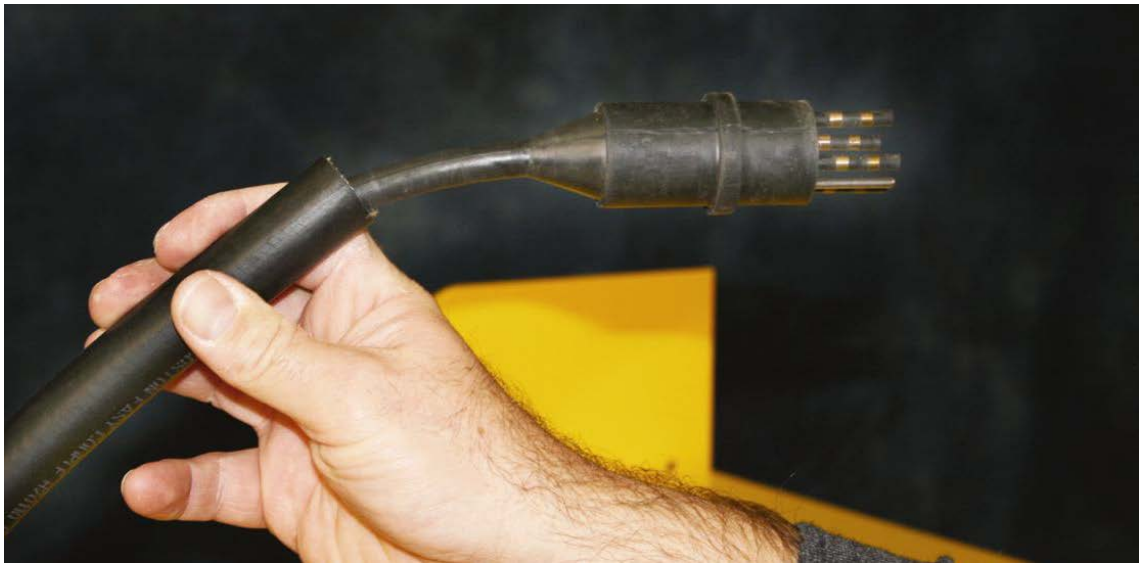


Figure 4-2: Male Connector

3. Using the socket wrench with the 7/16-inch socket, remove all the bolts securing the teardrop cover to the body of the tow vehicle as shown in **FIGURE 4-3**.

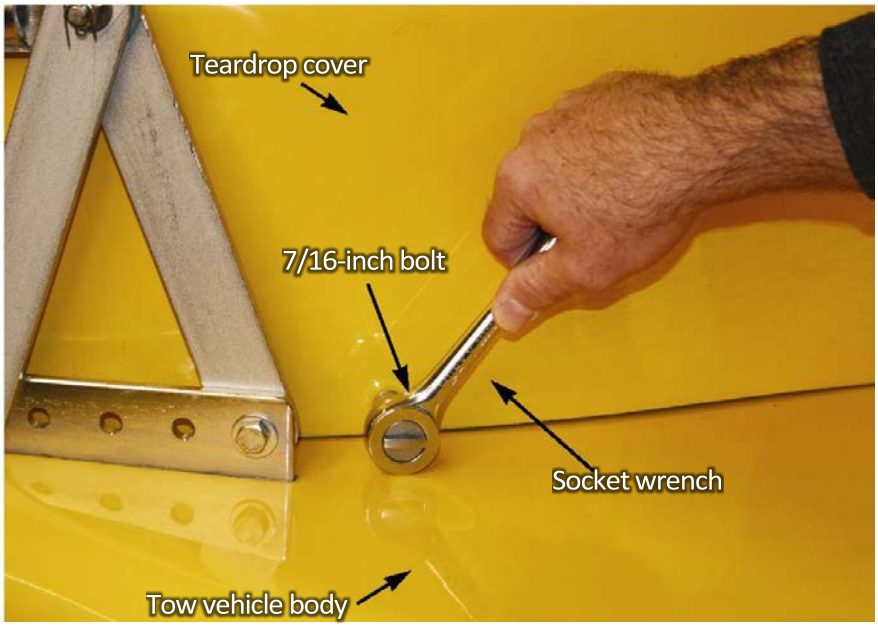


Figure 4-3: Removing the 7/16-Inch Bolts Securing the Teardrop Cover to the Tow Vehicle

4. Remove the teardrop cover as shown in **FIGURE 4-4**.

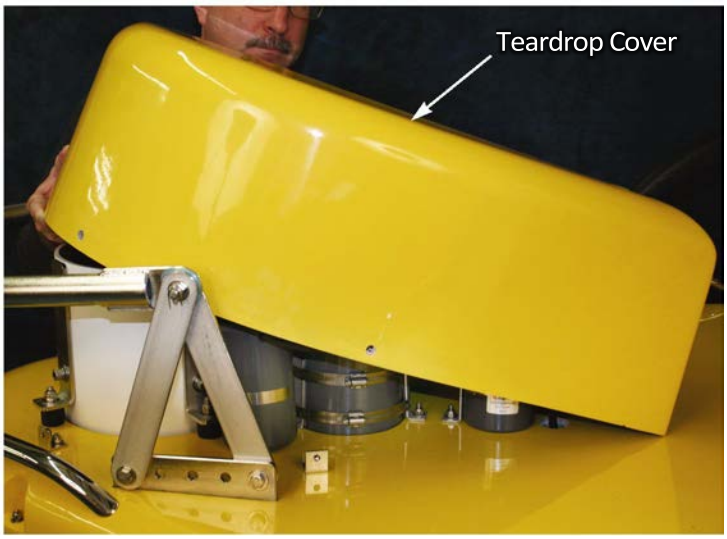


Figure 4-4: Removing the Teardrop Cover

5. Disconnect the spider cable from the components as shown in **FIGURE 4-5**.

Figure 4-5: Teardrop Cover Removed

6. Using the socket wrench with the 7/16th-inch socket, remove all of the bolts and nuts securing the front half of the top cover of the tow vehicle body as shown in **FIGURE 4-6**. Continue with the rear half using a 1/2 –inch socket.

Figure 4-6: Removing 7/16 and ½ Inch Bolts and Nuts

7. Lift the top cover off, turn it over, and disconnect the spider cable from the hydrophones and the preamp components.

4.2.2 Reassembling a Tow Vehicle

To reassemble the tow vehicle, reverse the disassembly procedure described above.

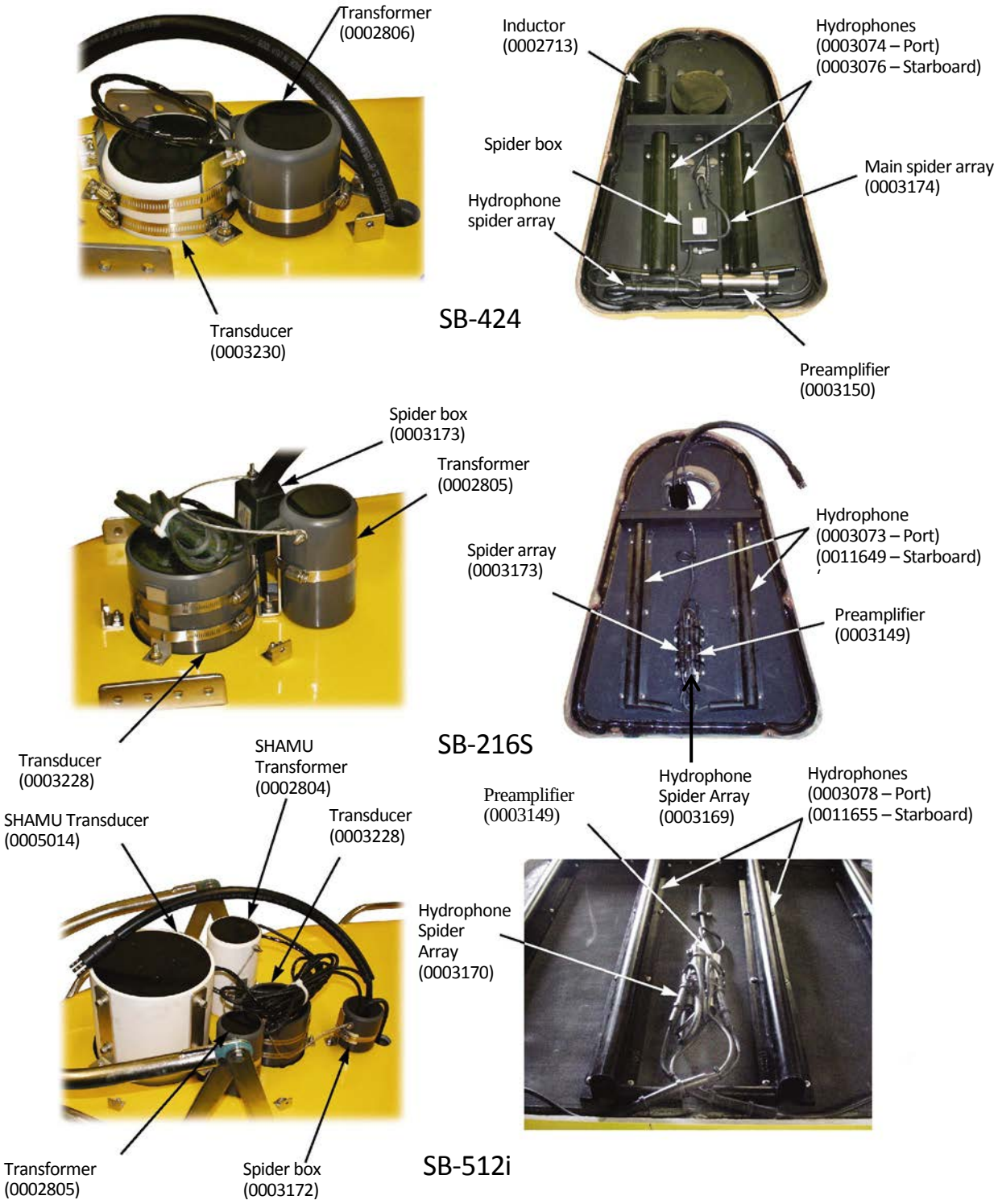


Figure 4-7: SB-424, SB-216S and SB-512i Tow Vehicle Internals

5.0: TROUBLESHOOTING

Should some operational or performance problems occur with the 3200-XS Sub-Bottom Profiling System, it may be possible to correct them using the troubleshooting guide provided in **TABLE 5-1**. This troubleshooting guide identifies some symptoms that could occur and presents one or more possible causes, along with the recommended corrective action, for each. When using the troubleshooting guide, perform the corrective action for any given symptom in the order of possible causes, which generally corresponds to the degree of troubleshooting difficulty, from the simple to the more complex.

Before proceeding with any corrective action, verify the following:

- The topside is plugged into an appropriate power source (see **3.2: POWER REQUIREMENTS**)
- The AC cables inside the Deck Unit are plugged into the 3200-XS Topside Processor and the Power Amplifier and to the AC power outlet
- The 3200-XS Topside Processor and the Power Amplifier are switched on

> **NOTE:** Be sure to also verify that all the cables in the topside and the tow vehicle are properly mated and are not loose or damaged. Most causes of operational or performance problems are a result of poor connection.

5.1 Rack Mount Deck Unit Troubleshooting

A table of troubleshooting procedures for the Rack Mount Deck Unit is provided below:

SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
Green power indicator on Amp is not on	Rear panel switch on the amp is off	Turn on the rear panel switch
	Amp is not plugged into AC	Plug the Amp into the AC
	Light bulb is burnt out	Power Amplifier will operate with burnt out bulb.
	Power outlet fuse is blown	Check the fuse in AC power outlet at the back of Deck Unit. If blown, replace fuse. Use a 12.5 A, 250 V, slow blow, 5 x 20 mm fuse (PN 0014581).
Blue light on Amp is off when front panel power switch is pressed	Power Amp is failed	Contact EDGETECH CUSTOMER SERVICE, as the unit must be returned to EdgeTech for Service
Green SYSTEM indicator on Computer does not illuminate when processor is turned on	AC power is not connected	1. Check AC power cables 2. Verify Deck Unit is connected to AC power and rear Power switch is turned on 3. Verify rear Panel Power Switch is turned on
	Indicator is not operating	Open 3200-XS Topside Processor to check indicator and wiring.
Amber HARD DISK indicator does not flash when processor is turned on	Operating System does not boot-up	Open 3200-XS Topside Processor and verify Hard Drive is connected to power and ribbon cable is properly plugged in Verify HDD SATA cable is properly plugged into Motherboard.
	Indicator is not operating	Open 3200-XS Topside Processor to check indicator and wiring.
When performing pre-deployment tests, transmissions from transducers are not heard	Power Amplifier is switched off	Turn on Power Amplifier.
	Tow cable is disconnected	Check tow cable and verify it is properly connected on both ends
	Tow cable is damaged	Check tow cable connectors for excessive corrosion or a broken pin. If corrosion or a broken pin is not found, check continuity of conductors in tow cable. If damaged, repair or replace tow cable
	Power Amplifier input or output, or both are disconnected	Verify red banana plug (amplifier output) on back of Power Amplifier is fully inserted into **red/red** (not **red/black**) sockets.
	Tow vehicle cable Top Spider connections are loose	Verify all tow vehicle's cable harness connectors are properly mated
	Power Amplifier has failed	Replace the Power Amplifier.
	Test pulse file is corrupted or missing.	Contact EDGETECH CUSTOMER SERVICE for instructions on how to recover the test pulse file.
	Tiger board has failed	1. Check SONAR.exe to see reporting for fault, if any. 2. If these solutions fail, contact EDGETECH CUSTOMER SERVICE about replacing the Tiger Board

When performing pre-deployment tests, signals in Sonar display are not present	Tow vehicle cable harness connections are loose	Verify all cable harness connectors in tow vehicle are properly mated.
	12 VDC power for preamplifier is not present.	Measure voltage between 12 VDC OUT TO PREAMP test point and PREAMP COMMON test point on back of Deck Unit. Voltage should be 12 VDC. If 12 VDC is not present, verify it is present on Tiger board in 3200-XS Topside Processor. If 12 VDC is not present on Tiger board, repair or replace Tiger board.
	5 VDC from preamplifier in tow vehicle is not present.	Measure voltage between TOWFISH PREAMP 5 VDC test point and PREAMP COMMON test point on back of Deck Unit. Voltage should be 5 VDC.If 5 VDC is not present, check tow cable and spider mold in tow vehicle, repair or replace as needed. If 5 VDC still not present, replace tow vehicle's preamplifier.
Vertical black streaks are present in Sonar display	One or more underwater connectors are loose or have corroded contacts	Refer **4.1.3: Inspecting and Cleaning the Underwater Connectors.** Reconnect connectors, if needed, secure them using duct tape.
	Extended use has caused a conductor in the tow cable or the cable harness in the tow vehicle to break	Check continuity of conductors in tow cable and cable harness.
	Loose or flooded connector	Wiggle tow cable connections and connectors of cable harness in tow vehicle while watching Sonar display for white streaks. If white streaks are present, refer to **Inspecting and Cleaning the Underwater Connectors**. Reconnect connectors, and if necessary, secure them using electrical tape or locking sleeves.
Periodic streaks in Sonar display from AC noise	System is not properly grounded	Check the continuity between the GND connection on the back of Deck Unit to ship's ground.
Noise appears in Sonar display	Engine noise is coupling into the sonar frequency band	Isolate the engine noise
	Tow vehicle is in or near ship's wake	Tow the tow vehicle at a deeper depth and farther away from ship
	Tow vehicle is not level when being towed	512i ONLY - adjust the trim tab
	Tow vehicle is towed too fast	Lower the speed of the Vessel

Table 5-1: Rack Mount Troubleshooting

5.2 Connector Pinouts

Pinout information is provided for the SEA CABLE connector on the back of the Deck Unit in **FIGURE 5-1** and **TABLE 5-2**, and the tow vehicle/ tow cable connector in ERROR! REFERENCE SOURCE NOT FOUND. and **TABLE 5-3**.

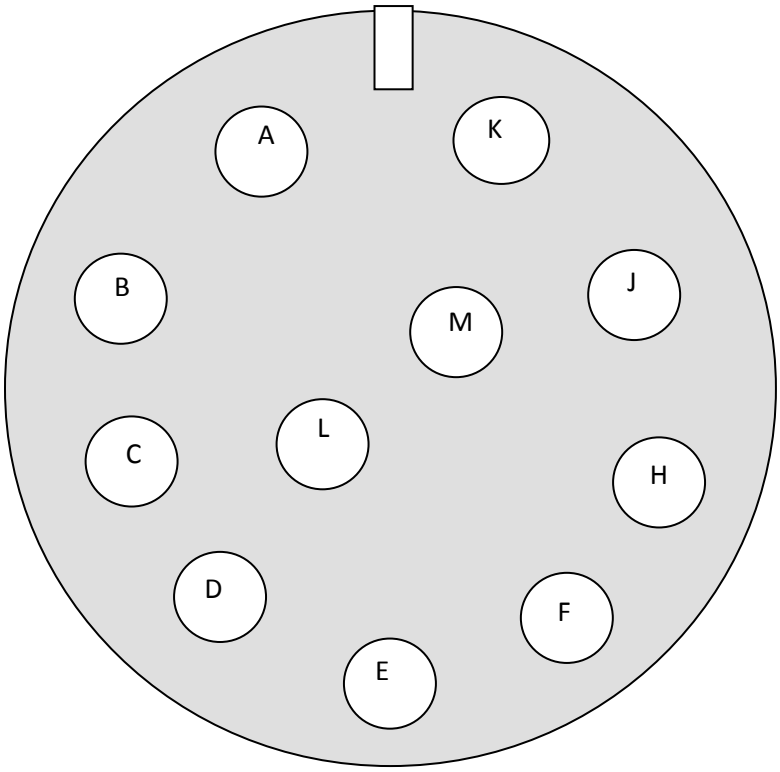
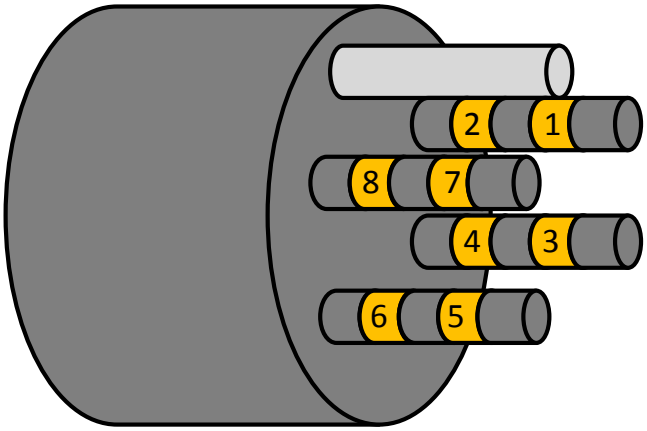


Figure 5-1: SEA CABLE Connector—Female Face View

PIN	FUNCTION
A	Transmitter output shield
B	+12 VDC
C	Sea ground
D	NC
E	Transmitter out 1
F	NC
H	Transmitter out 2
J	Preamplifier output
K	Preamplifier Common
L	NC
M	Preamplifier Common

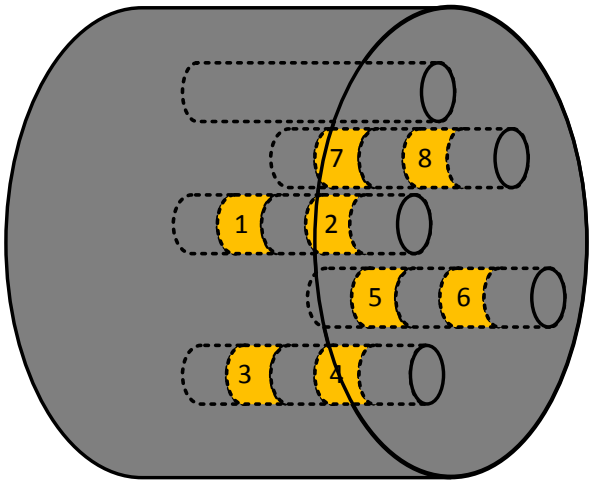
Table 5-2: SEA CABLE Connector Pinouts



PIN	FUNCTION
1	Transmitter out 1
2	Transmitter out 2
3	Preamplifier common
4	Preamplifier output
5	NC
6	+12 VDC
7	Sea ground
8	NC

Table 5-3: Tow Cable Connections

Figure 5-2: Male Marshal Connector – 86-5MC (Tow Vehicle to Tow Cable 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 5-4: SEA CABLE Female Connector

Figure 5-3: Female Marshal Connector – 86-5FC (Tow Cable to Tow Vehicle Connection)

5.3 Wiring and Connector Pinout Drawings

The 3200-XS Sub-Bottom Profiling System wiring and connector pinout drawings for the Deck Unit and the SB-424, SB-216S, and SB-512i Tow Vehicles are included in the following pages. For the Deck Unit, a wiring harness diagram and connector pinout information are provided. For each of the tow vehicles, spider mold and tow vehicle wiring diagrams are provided. The spider mold wiring diagrams also include connector pinout information. In addition, a wiring diagram with connector pinout information for the 75-Meter Kevlar Reinforced Tow Cable (available separately) is included.

Rack Mount Deck Unit Wiring Harness:

FIGURE 5-4: WIRING HARNESS, RACK MOUNT DECK UNIT

SB-424:

FIGURE 5-5: WIRING DIAGRAM, SPIDER BOX, SB-424 TOW VEHICLE

FIGURE 5-6: WIRING DIAGRAM, SB-424 TOW VEHICLE

SB-216S:

FIGURE 5-7: WIRING DIAGRAM, SPIDER BOX, SB-216S TOW VEHICLE

FIGURE 5-8: WIRING DIAGRAM, SB-216S TOW VEHICLE

SB-512i:

FIGURE 5-9: WIRING DIAGRAM, SPIDER BOX, SB-512I TOW VEHICLE

FIGURE 5-10: WIRING DIAGRAM, SB-512I TOW VEHICLE

75-Meter Kevlar Reinforced Tow Cable Wiring diagram:

FIGURE 5-11: WIRING DIAGRAM, 75-METER KEVLAR REINFORCED TOW CABLE

200-Meter Kevlar Reinforced Tow Cable Wiring diagram:

FIGURE 5-12: WIRING DIAGRAM, 200-METER KEVLAR REINFORCED TOW CABLE

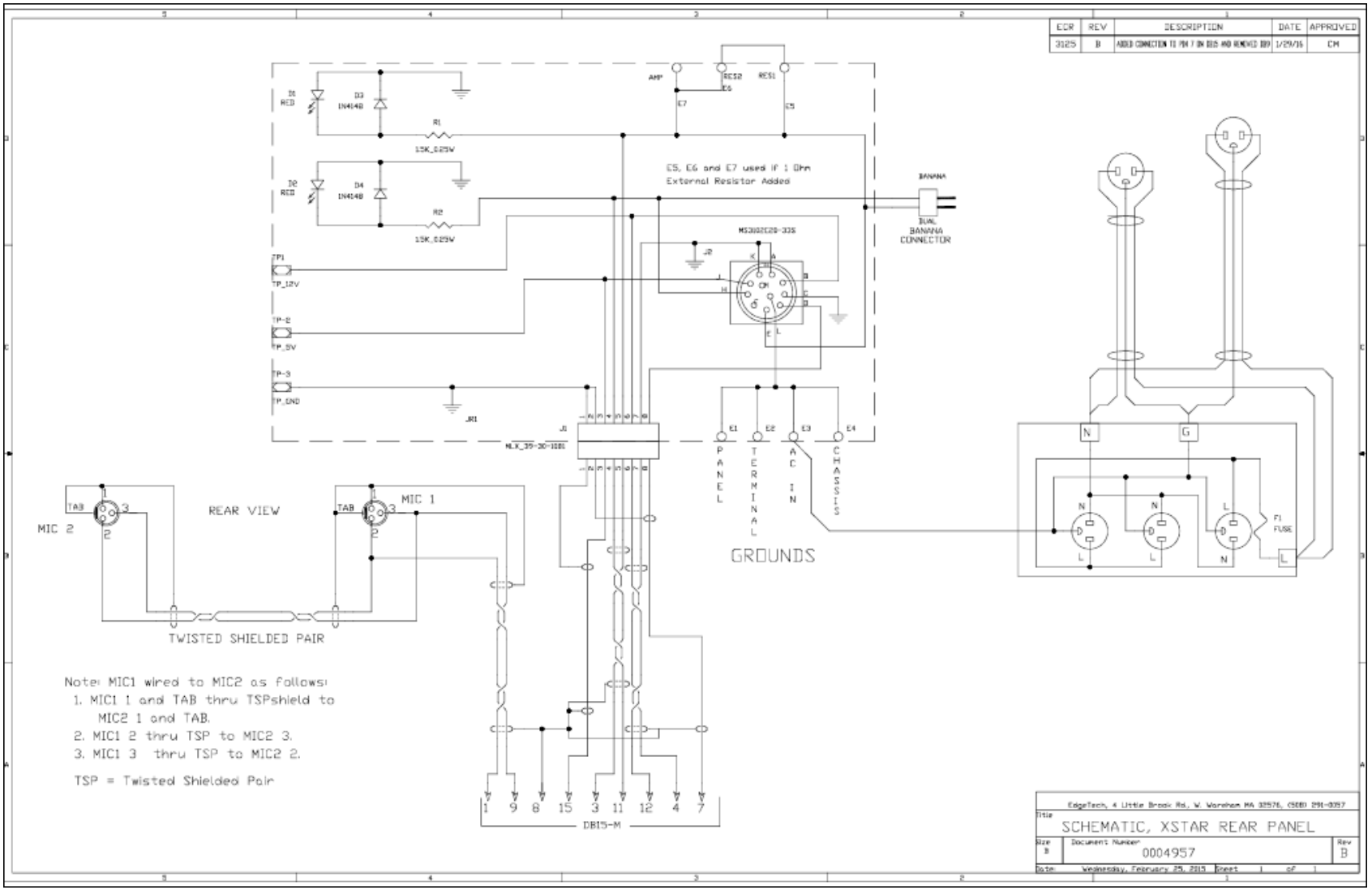


Figure 5-4: Wiring Harness, Rack Mount Deck Unit – 0004957

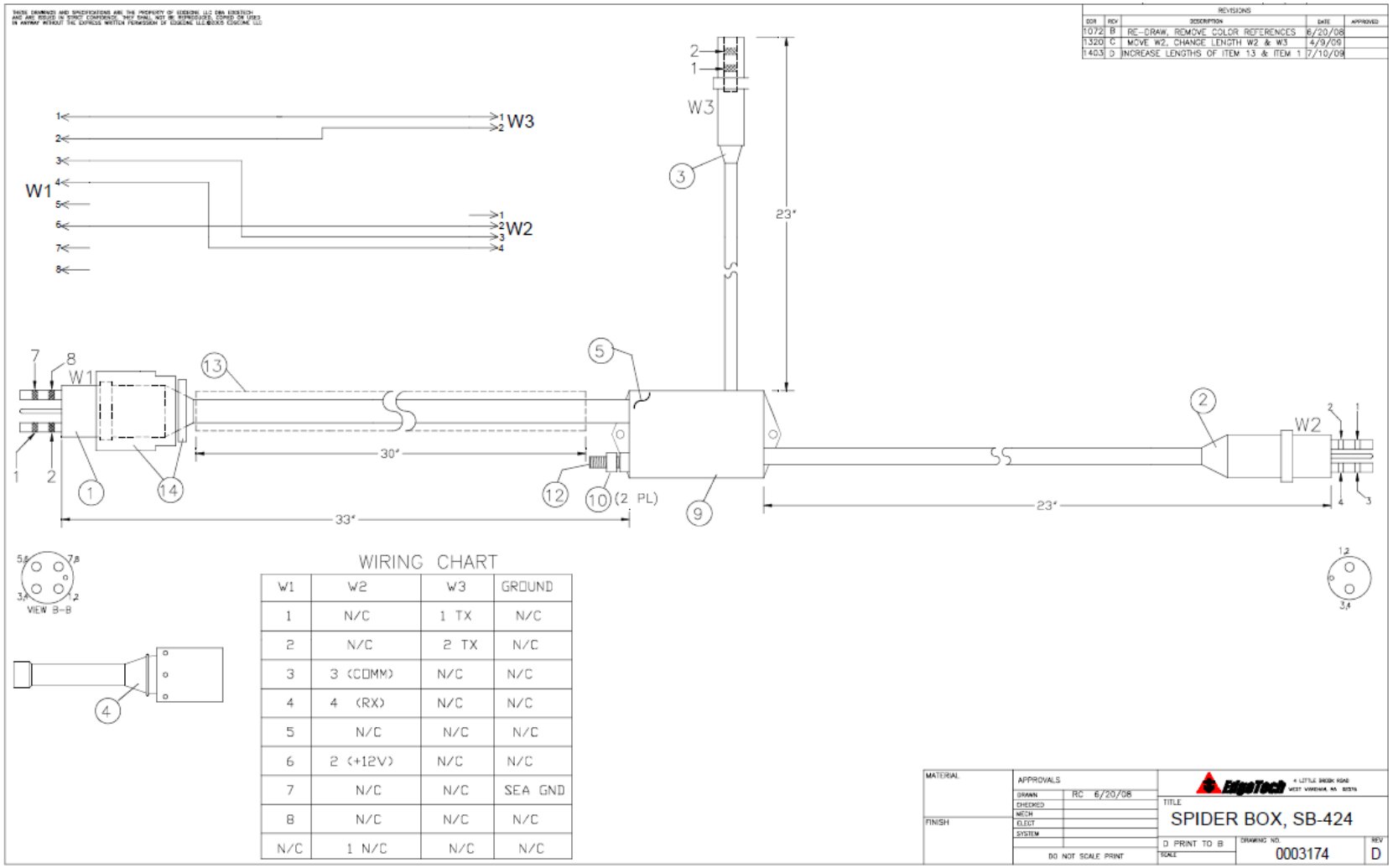


Figure 5-5: Wiring Diagram, Spider Box, SB-424 Tow Vehicle – 0003174

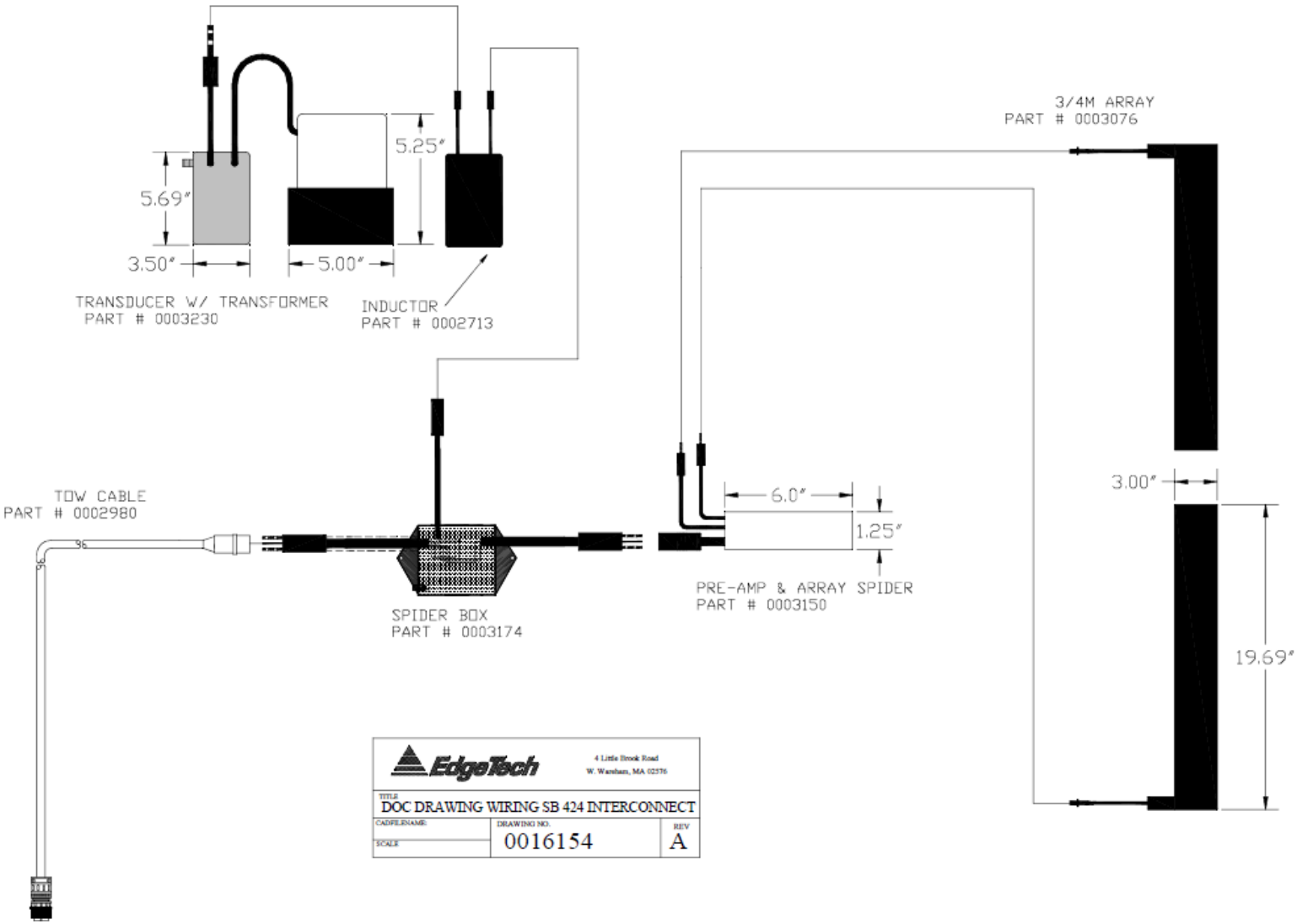


Figure 5-6: Wiring Diagram, SB-424 Tow Vehicle – 0016154

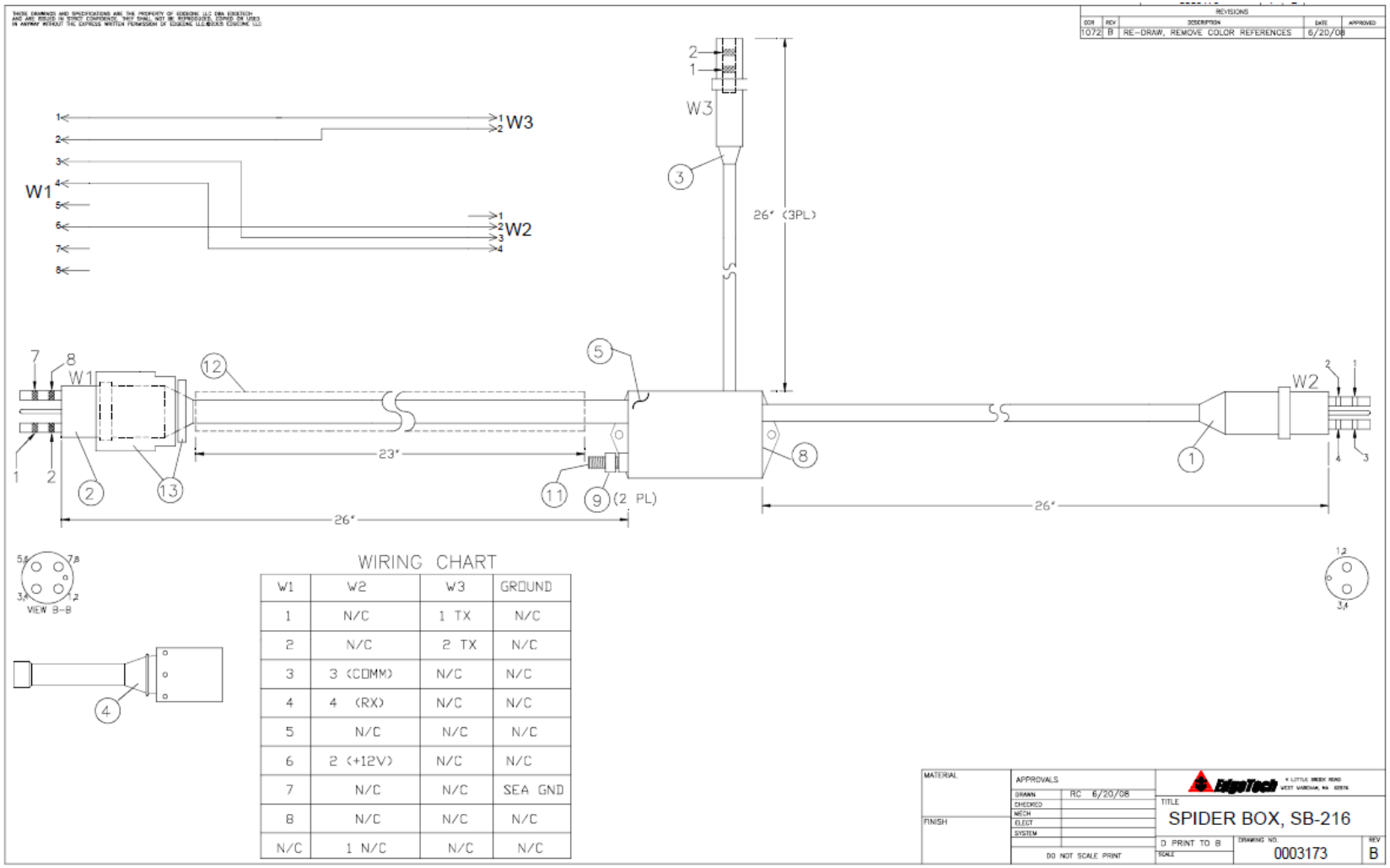


Figure 5-7: Wiring Diagram, Spider Box, SB-216S Tow Vehicle – 0003173

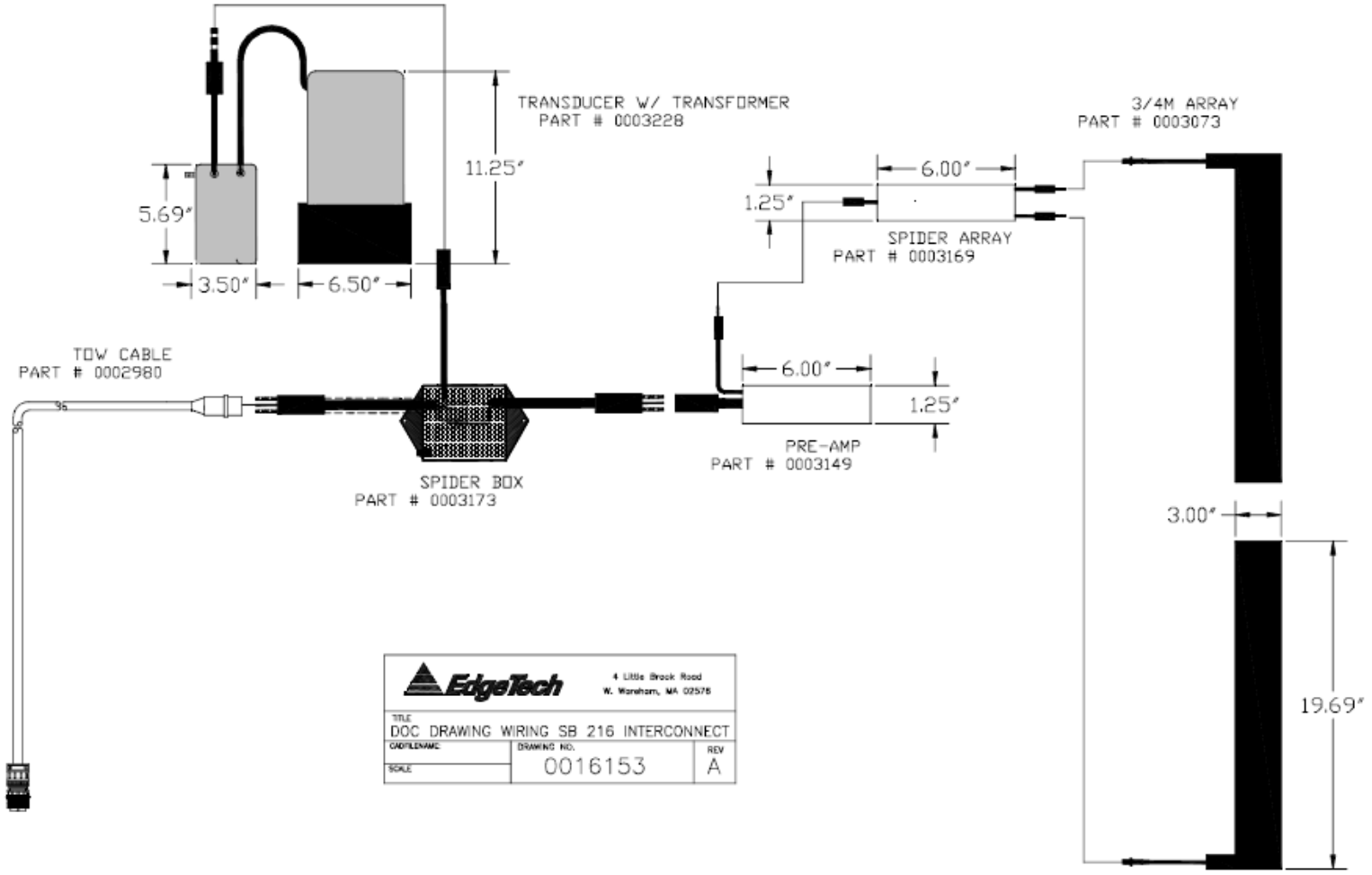
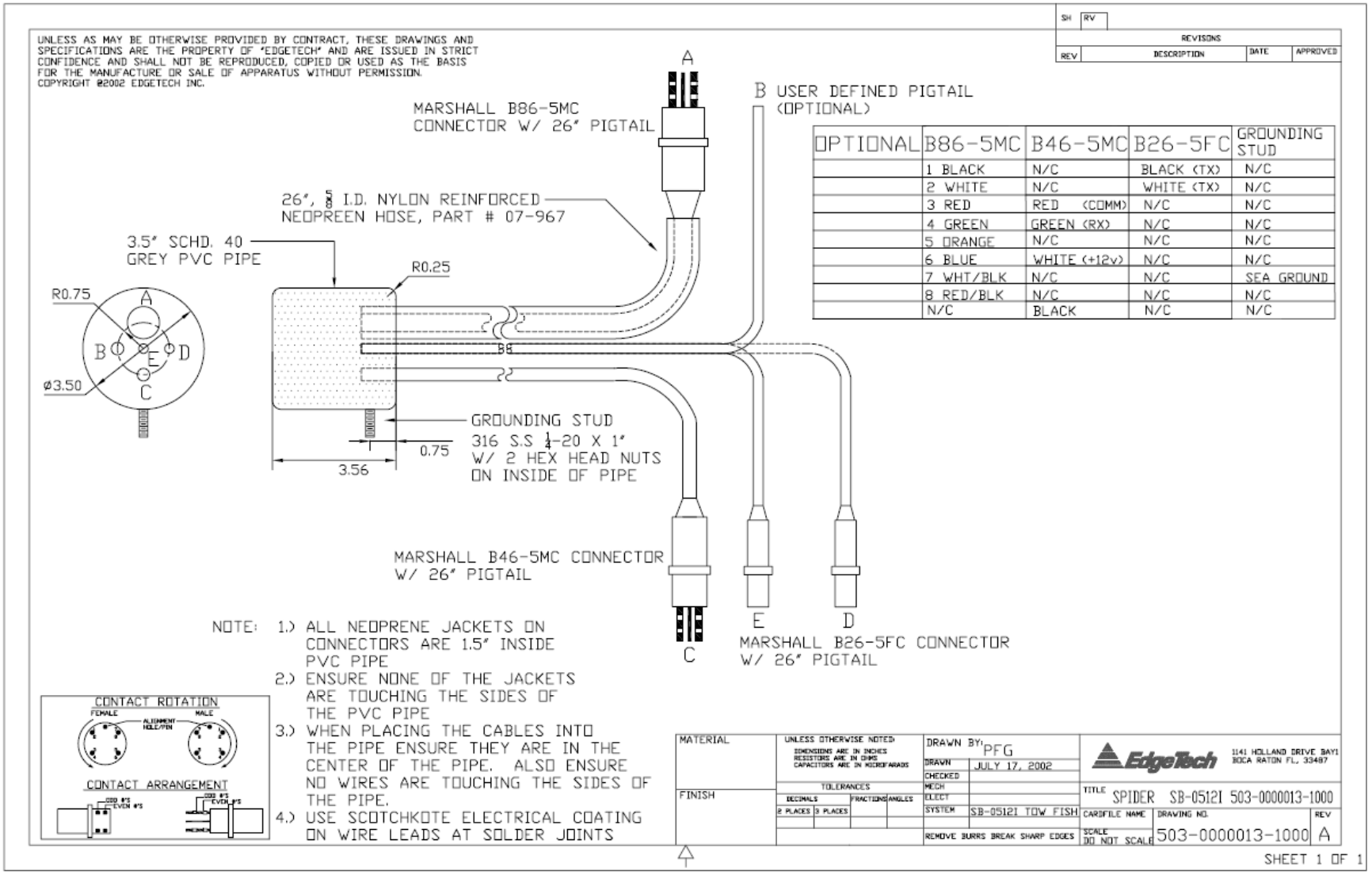


Figure 5-8: Wiring Diagram, SB-216S Tow Vehicle – 0016153



OPTIONAL	B86-5MC	B46-5MC	B26-5FC	GROUNDING STUD
	1 BLACK	N/C	BLACK (TX)	N/C
	2 WHITE	N/C	WHITE (TX)	N/C
	3 RED	RED (COMM)	N/C	N/C
	4 GREEN	GREEN (RX)	N/C	N/C
	5 ORANGE	N/C	N/C	N/C
	6 BLUE	WHITE (+12v)	N/C	N/C
	7 WHT/BLK	N/C	N/C	SEA GROUND
	8 RED/BLK	N/C	N/C	N/C
	N/C	BLACK	N/C	N/C

Figure 5-9: Wiring Diagram, Spider Box, SB-512i Tow Vehicle - 0003172

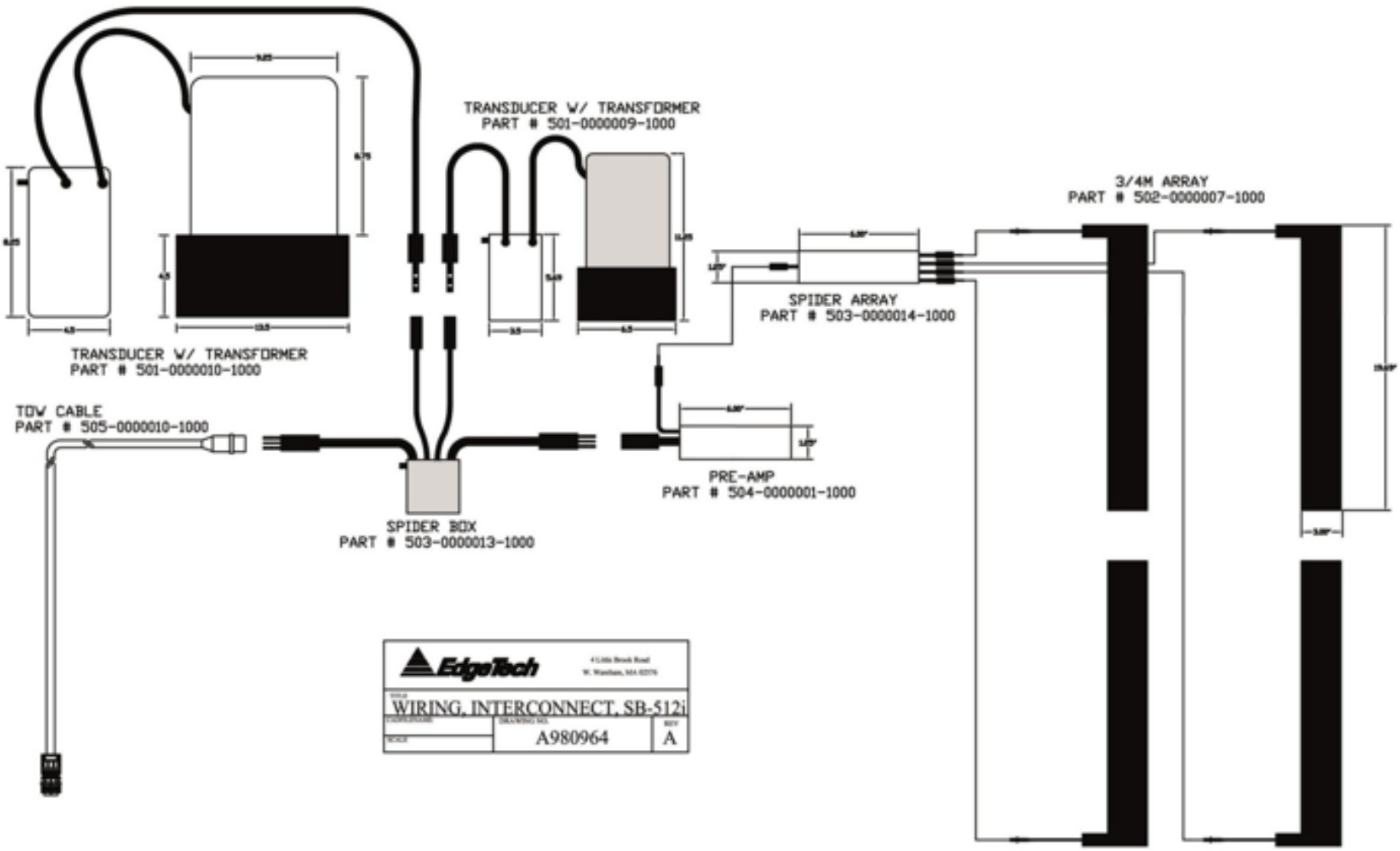


Figure 5-10: Wiring Diagram, SB-512i Tow Vehicle

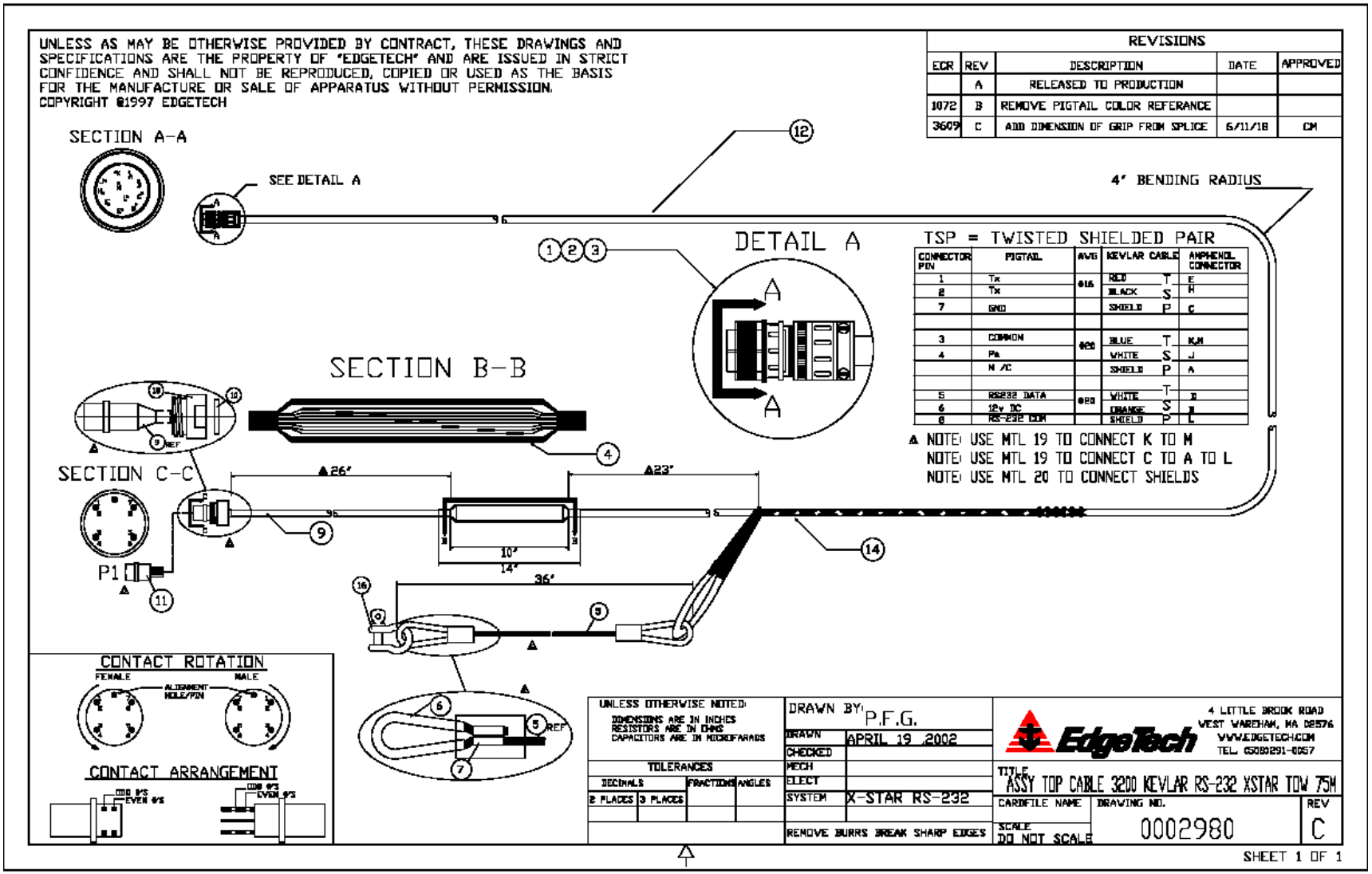


Figure 5-11: Wiring Diagram, 75-Meter Kevlar Reinforced Tow Cable – 002980

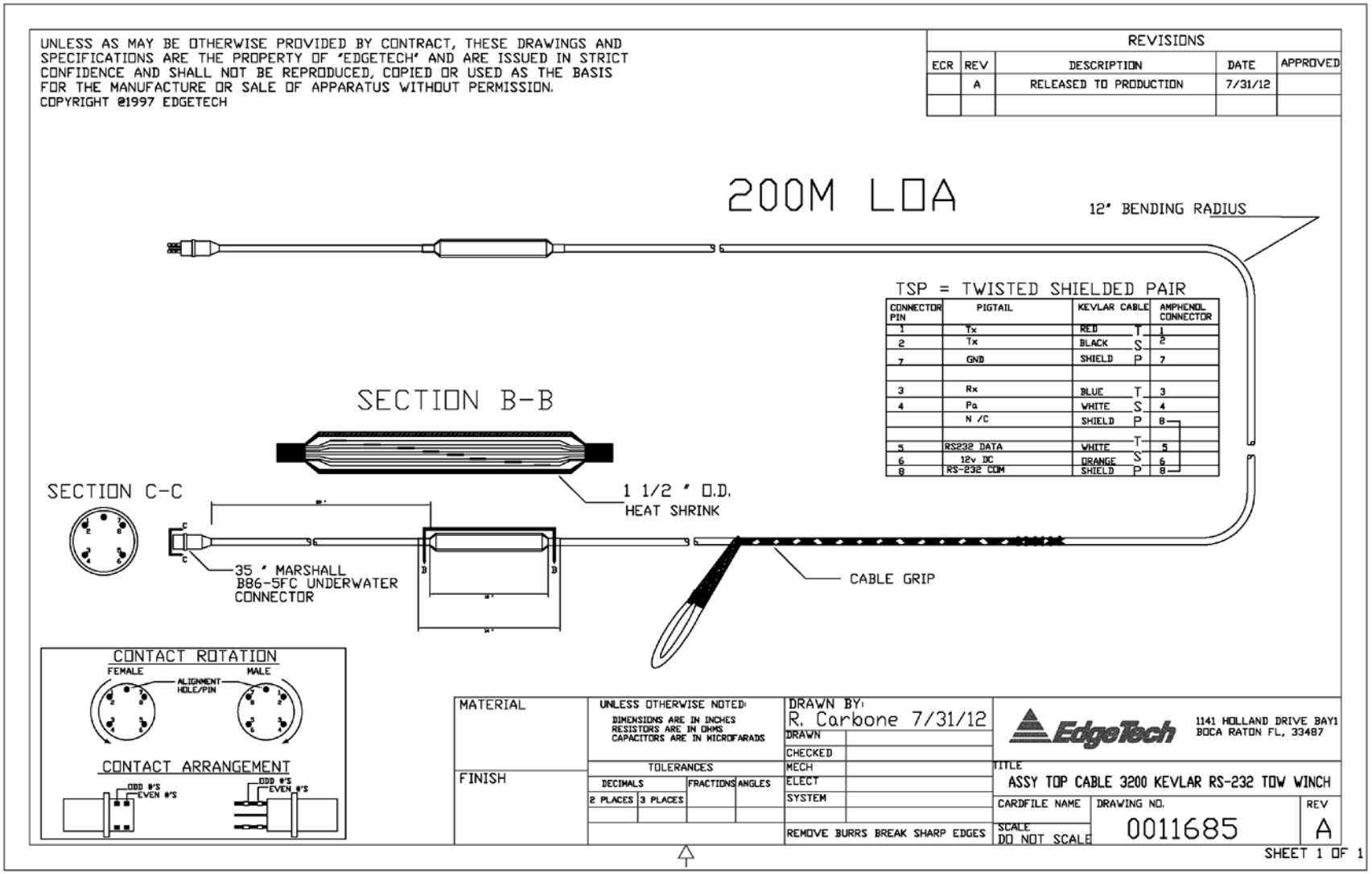


Figure 5-12: Wiring Diagram, 200-Meter Kevlar Reinforced Tow Cable – 0011685

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 Θ 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. Reboot 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

Below are some frequently asked questions about the 3200-XS Sub-Bottom Profiling System. They encompass most of the questions asked by EdgeTech customers; however, should other questions arise, please contact **EDGETECH CUSTOMER SERVICE** directly.

1. **What are the tow vehicle tow cable requirements?**

   The tow cable must include three shielded twisted wire pairs. One set must be 18-gauge wire and is used for the transmitted signal. The other two sets must be 20-gauge wire and are used for the received signal, 12 VDC, common, and a spare.

2. **Can a Rochester 301301 (3 core coax) armored cable be used?**

   A 500-meter maximum length armored cable can be used. Contact **EDGETECH CUSTOMER SERVICE** for the wiring recommendation.

3. **Can you interface a 3200-XS Sub-Bottom Profiling System to a transmit/receive hull mounted array that is customer supplied?**

   This can be done; however, special engineering and calibration is required for optimum results. EdgeTech can provide these services. In short, the output impedance of the Power Amplifier in the Deck Unit must match the input impedance of the transducer array. This match will maximize the power to the transducers; otherwise power will be lost in the amplifier instead of being output to the transducers.

   Matching is done with a transformer with the correct turns ratio. In addition, a hydrophone has to be temporarily placed below the transmitting transducers so that the system can be calibrated. Based on the calibration information, the system can be tuned in such a manner as to flatten the spectrum to improve the resolution of the records.

4. **How long a tow cable can I use?**

   Up to a 500-meter factory-approved tow cable can be used.

5. **How close to the bottom do I need to tow?**

   Unlike side scan sonar, it is not always necessary to tow the tow vehicle near the sea floor to get good results. Depending on which tow vehicle is used, it is possible to get good results with hundreds of meters of water column. Towing the tow vehicle close to the bottom reduces the area of the sea floor insonified and therefore reduces the scattering. A focused, narrow beam also produces better spatial resolution

6. **How does the 3200-XS Sub-Bottom Profiling System interface to a navigation device?**

   Any available serial port can be used to interface with a NMEA standard navigation device.

7. How do environmental conditions affect performance of the 3200-XS Sub-Bottom Profiling System?

There are several environmental factors that affect performance:

Geological conditions 3200-XS Sub-Bottom Profiling System operating parameters and listed specifications are greatly affected by the geologic conditions that the acoustic energy transmitted from the tow vehicle encounters. A very dense geologic interface, such as rock, coral, sand, stone, shell beds, and so on, will limit the sound penetration into the sub-bottom. This limitation is caused by the density interface reflecting most, if not all, normal incidence acoustic energy back to the receiving hydrophone which results in little penetration.

Air/water interface Air/water interface reflects 99.8 percent of the acoustic energy it receives. Therefore, when air or gas is encountered in the water column or in the sub-bottom, almost all of the transmitted acoustic energy will be reflected back to the tow vehicle resulting in little or no penetration into the seabed.

Survey vessel's wake Ship's wake is a very turbulent area that is located immediately behind the ship. When towing the tow vehicle in or near this wake, the transmitted acoustic energy encounters highly charged aerated water caused by the cavitation of the ship's propellers. If the tow vehicle is operated in this area, most of the acoustic energy from the aerated water reflect to its source, similar to that exhibited by an air/water interface. The tow vehicle is designed to operate in a horizontal position relative to the sea floor. The turbulence encountered when operated in or near the ship's wake will cause instability in the tow vehicle and reduce the effectiveness of the output energy in penetrating the sub-bottom sediments.

Noise Operating other nearby acoustic devices at frequencies within the operating frequency bandwidth of the 3200-XS Sub-Bottom Profiling System can result in data distortion.

Survey vessel's motion Tow vehicle is designed to tow in a stable horizontal plane. Excessive ship motion can cause instability in the tow vehicle attitude resulting in reduced performance. Rough sea conditions, sharp turns of the ship and any similar external induced motions on the tow vehicle will have a similar effect on the system operation.