USER GUIDE

Visual Acquisition™ 5.0

BioSonics, Inc.

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Style Conventions used in this Guide

This Users Guide uses special terminology, symbols, and conventions, described here:

Terminology

Embedded Processor (also called "Embedded PC") – This is an embedded computer stack inside all X-Series Echosounder Surface Units.

User PC – This is, in most cases, a notebook/laptop computer used to configure and initialize operation of the X-Series Echosounder System. In most configurations, data is also recorded on the User PC.

> Throughout this User Guide you will find information side bars, like this one. These contain information of importance or interest, in the context of the main body of the text.

Visual Acquisition – BioSonics easy-to-use Windows© software for control of the BioSonics X-Series Digital Scientific Echosounders and real-time visualization of streaming hydroacoustic data. Visual Acquisition must be installed on the User PC.

Toolbar – The row of colored buttons at the top of the main Visual Acquisition window.

References to commands:
- **BOLD** in capital letters: Commands available from a button in the toolbar. All toolbar commands are also available from the menu.
- **Bold** w/ underline: Commands available either in a window or from the menu. Nested menu commands are denoted by slashes. For example **Setup / Initialize DTX** indicates the Initialize DTX command in the Setup menu. The underlined characters indicate keyboard equivalents, which allow you to navigate windows and menus without using the mouse or touchpad.

The BioSonics DT-X™ Echosounder and Visual Acquisition 5.0 Software

Chapter 1: Introduction

The DT-X™ is the next generation in the evolution of the scientific digital echosounder. This system can be configured for many different applications in both marine and freshwater environments. Bathymetry, biology, habitat assessment and monitoring, population dynamics, behavior, plant and sediment distributions are just a few of the many applications that BioSonics users have found for BioSonics scientific echosounders.

Based on the BioSonics DT-series digital echosounder designs, field-proven by hundreds of users, the new DT-X moves ahead to provide unparalled control and reliability for serious underwater acoustic assessment and monitoring. Incorporation of a dedicated processor (embedded processor / single-board computer) into the echosounder design provides the user with reliable operation under the most demanding conditions.

Previous generation echosounders rely on analog signals and external computers to operate the echosounder. This approach has inherent limitations, especially in sharing computer use between the computer operating system (OS), other applications, and the echosounder. This often resulted in sharing conflicts between the echosounder, the computer, and other hardware and software components of the system. BioSonics' new embedded processor design provides a computer and low-overhead operating system dedicated to a single task – ensuring that the DT-X Echosounder operates at optimum performance.

DT-X Design Philosophy

Improving on the design strengths of the BioSonics DT and DE-series echosounders, the goals of the DT-X design team were to:

- Maintain the components and attributes of the BioSonics Digital Transducer system that users have found to be desirable and important to their applications.
- Provide significant performance improvements in system reliability.

- Provide significant improvements in hardware interface (with computers and external sensors and I/O devices).
- Provide an improved user interface and control for echosounder operation and data acquisition.
- Provide improved "time stamping" of data to allow coordination of data and keep pace with the increasing use and capabilities of GPS systems, essential to utilizing acoustic data for mapping and spatial analysis.
- Provide enhanced capacity for system utility within varied user applications and conditions, including remote and autonomous operation.

The design team's vision was to achieve these goals, while maintaining the reliable, compact, versatile scientific echosounder that the professional natural resource community has come to expect from BioSonics.

A continuing philosophy, from the inception of the DT-Series (which preceded the DT-X), is to simplify the collection of high quality underwater acoustic data. To this end, the system of hardware and software has been designed to move as many decisions as possible from the data collection environment to "post-collection" data processing. By minimizing data collection decisions, data collection errors are also minimized. For example, the wide dynamic range of the digital transducer allows one setting for receiver gain and transmit power, eliminating signal clipping. TVG and bottom tracking are applied during analysis, allowing accurate calculation of absorption and manual correction of the automatic bottom tracking algorithms. However, system versatility is not compromised because the raw digital data can be stored to electronic media (*e.g.*, to the hard disk drive of the User PC). Resolution of echo-integration cells is selected during analysis and is not built into the collected data set. The digital data format provides an accurate, objective, legally and scientifically defensible data set.

The DT-X Scientific Echosounder System

The DT-X system is a computer-controlled, calibrated, scientific echosounder, utilizing digital transducer design. All the components necessary to perform underwater acoustic surveys of aquatic organisms and habitat are included:
- Digital echosounder with integrated, dedicated computer control (embedded processor technology) in a portable, weather-protected case
- Signal Cable
- Digital Transducer[1]
  - Single Beam Technology – or –
  - Split beam Technology
- Integrated (or external input) GPS
- BioSonics Visual Acquisition (VISACQ) software

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[1] BioSonics no longer utilizes dual beam technology for standard systems. Some users will have systems that include dual beam technology, and BioSonics will continue to support those users. In addition, split beam technology allows users to select dual beam operation as a valid operating mode.

GPS

**DT-X Echosounder
with embedded processor
(dedicated LINUX operating
system and control program)**

DT-X Digital Transducer Cable

DT-X Digital Transducer

**External
Communication Device
(notebook computer)
with BioSonics Visual
Acquisition Software**
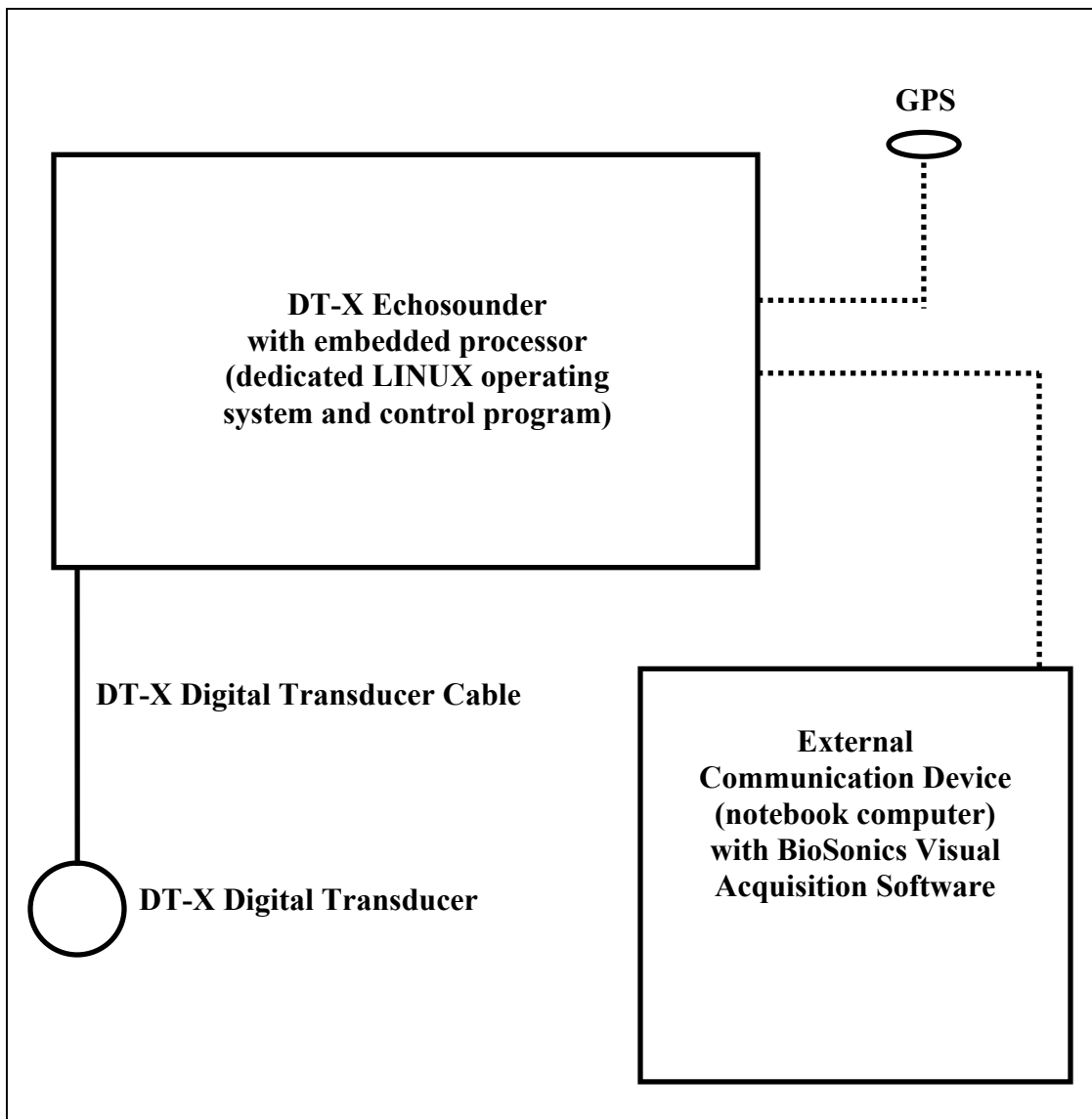
Figure 1. Schematic of BioSonics the DT-X Echosounder system. The echosounder surface unit contains dedicated processor for echosounder operation. One, or more, digital transducers are connected to the surface unit by a digital signal cable. Echosounder operational parameters are uploaded to the DT-X from the external communication device. The external communication device is also used to display and store digitized acoustic data received from the DT-X *via* ethernet interface. GPS input to the surface unit provides geographic reference for acoustic data

Acoustic data analysis is performed after data has been collected (post-processing), utilizing BioSonics software, or other analysis software or tools from third-party vendors. BioSonics analysis software includes:

- **Visual Analyzer**: Used to determine size distribution and densities of fish and other aquatic organisms.
- **VBT**: For analysis and classification of bottom surface sediments.
- **EcoSAV**: For detection and analysis of submersed aquatic vegetation, canopy height and plant coverage.

Chapter 2: DT-X System Components

Overview

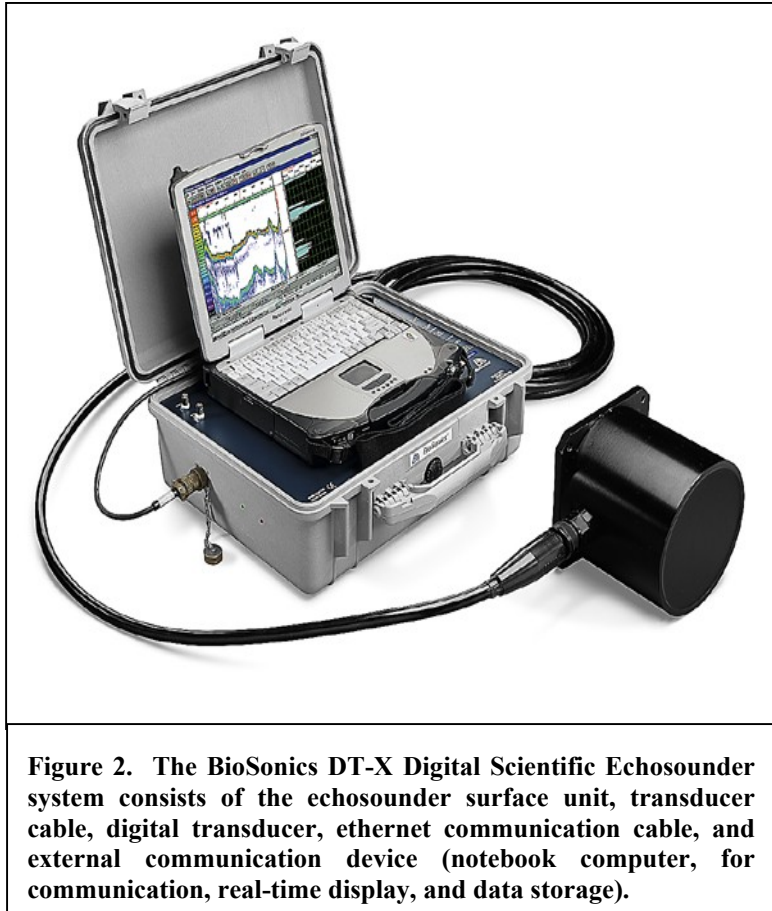The standard DT-X Echosounder system consists of a surface unit, one or more digital transducers, transducer cable(s), a Global Positioning System (GPS) Receiver, and an external communication device (usually a notebook computer) running BioSonics Visual Acquisition (VISACQ) software.

The surface unit is the main component of the echosounder, and generates the signal and controls the operation of the transducer. The echosounder system generates and receives information through the transducer, processes the signal into a usable format, combines external sensor data (most commonly GPS) and transmits the data through the ethernet communication port of the surface unit. Power is supplied to the surface unit as either AC or DC current, enhancing the field operational capabilities of the system. The ethernet communication port provides the 2-way interface for the external communication device. A single DT-X Echosounder

Figure 2. The BioSonics DT-X Digital Scientific Echosounder system consists of the echosounder surface unit, transducer cable, digital transducer, ethernet communication cable, and external communication device (notebook computer, for communication, real-time display, and data storage).

surface unit is capable of controlling and operating multiple transducers (multiplexing) in a variety of configurations.

The Transducer converts the electrical signal from the transmitter into an acoustic pulse, and transmits that energy into the water. In reciprocal fashion, the transducer receives acoustic echoes (from targets in the water column and the bottom) and converts them to electrical signals. DT-X transducers contain both receiver and analog-to-digital conversion circuitry, very different from analog transducers found in traditional or other scientific echosounder systems. DT-X digital echosounders can operate both single beam and split beam transducers of a variety of frequencies and beam-angles and patterns.

This ensures that the appropriate frequency and beam-pattern are available to best address the specific needs of our users.

Since DT-X transducers are digital, all of the calibration components and information are stored within the individual transducer. This allows the user to "swap" transducers of different frequencies, beam-widths, or other characteristics without having to recalibrate the echosounder system.

The GPS Receiver is incorporated into the DT-X system and the data is combined with the acoustic data set. Alternatively, the user may use their GPS (contact BioSonics for proper settings and connection requirements). The GPS greatly enhances the ability of the user to correlate underwater observations to geographic location. The DT-X's accurate time stamping of data, combined with accurate GPS measurements, enables powerful temporal and spatial analysis of the data collected. It also enables sample repetition, as the user can return to, virtually, the same position time-after-time for comparative analysis. The GPS may be integrated within the surface unit or interface through an external connection.

The User PC (External Communication Device) is, most conveniently, a field-ready notebook computer. The echosounder requires values for a set of parameters that establish the operational characteristics specific to each application. These include such settings as pulse frequency (ping rate), pulse duration, power level, target strength (TS) level, and more. The User PC provides the means to define and pass these parameters to the echosounder. BioSonics Visual Acquisition™ software provides an easy to use interface for input of the operational parameters for the echosounder and to transmit them to the embedded processor of the DT-X echosounder surface unit.

In addition to communicating the operational parameters to the echosounder, the notebook computer provides a means for the user to view and monitor the acoustic data generated and sent by the echosounder. This is done by means of the Visual Acquisition echogram and oscilloscope display components. These functions provide the user with a real-time graphical interpretation of the acoustic data being received.

Finally, the notebook computer provides a convenient storage device for the raw acoustic data. The data can be written to the hard disk drive (or other media device) of the computer for storage, analysis, and distribution. The actual operation of the echosounder is independent from the external communication device, other than receiving, displaying, and storing acoustic data.

The BioSonics DT-X Echosounder is a scientific device comprised of electronic and mechanical components. The system is portable, and although designed to be weatherproof and rugged, reasonable care should be exercised in handling and storage. The surface unit should never be submerged in water. All connections should be firmly secured and be covered when not in use.

Details

The Surface Unit
The surface unit is contained in an environmental case that houses the transmitter and provides various power and data connections for the DT-X System. Although the system is designed to be weatherproof and rugged, reasonable care should be exercised in handling and storage.

The transmitter generates the pulse shape and sends the resulting electronic signal to the transducer. The Surface Unit also manages communication between the controlling PC and the digitizing engine. The Surface Unit itself may operate on either AC or DC power. The following is a short discussion of the function of the input/output connections and monitors in the Surface Unit.

The DT-X front panel, inside of the surface unit, right side

ON/OFF switch
The on/off switch (Figure 3) controls power to the internal components of the surface unit. When the transducer and cable are connected to the surface unit, power will also be supplied to the transducer through the cable.

Laptop Power 12VDC
The "cigarette lighter" connection provides the option of powering the computer through the surface unit. To use this connection an "auto adapter" is required (These types of adapters are available from the computer manufacturer or other third party electronics suppliers). An alternative, which is the recommended method when running the surface unit on DC power, is to utilize a power inverter (DC to AC converter), external to and separate from, the surface unit and surface unit power supply.

> **Laptop and AUX Power:** DC power supplied to the surface unit is passed through to two output connections on the front panel. These connections are labeled **Laptop Power 12 VDC** and **AUX. Power 12VDC**. If you are operating the surface unit on a 12 VDC source, these two connections will also supply (pass through) 12 VDC.
> **If you are running the surface unit with a DC voltage supply higher than a nominal 12 VDC, do not attach accessories to the two output connections on the surface unit.**

AUX Power 12VDC
This connection is provided to supply 12VDC power to auxiliary devices, such as GPS units. Power supply voltage should never exceed 17 VDC at 5 amps.

Low Battery
The LOW BATTERY light will illuminate if the DC power supply is not adequate for the requirements of the DT-X system and external devices. Care should be exercised when utilizing DC power. As the batteries drain, current will increase to compensate for the drop in voltage. Excessive current can damage the echosounder unit.

DC Fuse

The DC Fuse is located within this housing. Access to the fuse is possible using a small screwdriver to twist the slotted cap 1/8 turn in a counter-clockwise direction. Replacement fuses are provided in the support pouch.

AC Power ON

When illuminated, this light indicates that the echosounder is ON and that AC power is being supplied.

AC Fuse

The AC Fuse is located within this housing. Access to the fuse is possible using a small screwdriver to twist the slotted cap 1/8 turn in a counter-clockwise direction. Replacement fuses are provided in the support pouch.

Serial port

The serial port provides the external sensor data stream to the computer. If an external GPS system is to be connected to the surface unit, it must be connected through the GPS input, located on the rear panel of the surface unit. The serial cable, provided in the support pouch, enables the user to connect the notebook computer to the surface unit serial port for input into third-party navigation (or other) software, which may be running on the computer. Note that receiving and logging GPS data in Visual Acquisition does not require your laptop to be connected to this port.

The DT-X front panel, inside of the surface unit, left side

Trig Out

The surface unit has the option of supplying a synchronization pulse to operate other electronic devices. A BNC cable can be connected from this output port to the device to be synchronized. The surface unit can be configured to function as a master triggering system. It sends out a pulse at the start of each ping.

Figure 3. The DT-X front panel, inside of the surface unit, right side.

Sync In

The surface unit has the option of receiving an external synchronization pulse. A BNC cable can be connected from this input port to the device providing the synchronization pulse. The surface unit can be configured in this way to function as a "slave". This feature is not yet implemented in the current version of the DT-X.
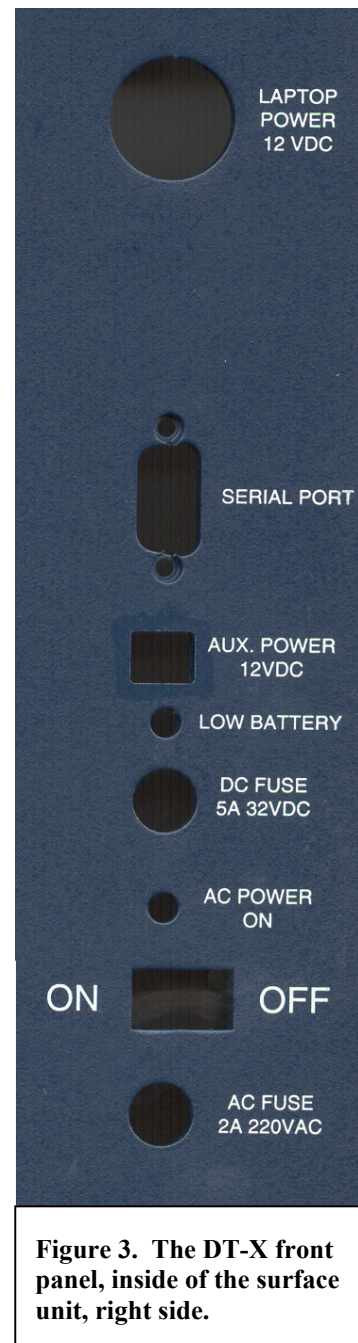
The back of the surface unit case

AC Input

The AC power supply input connection point utilizes the connector and power cord supplied by BioSonics. The user may need additional terminal adapters to enable connection to their power supply. Voltage must be within the range of 85-264 VAC, 47-440 Hz, at 2 Amps (maximum).

DC Input

The DC power supply input connection point, utilizes the connector and power cord supplied by BioSonics. The user may need additional terminal adapters to enable connection to their power supply. Voltage must be within the range of 11-14 VDC at 5 Amps (maximum).

External Power Supply

The surface unit can be operated on either AC or DC power.
Do not attach both simultaneously!

GPS Input

The GPS input connection point utilizes the connector and power cord supplied by BioSonics. The user may need additional terminal adapters to enable connection to their GPS receiver. The BioSonics DT-X Echosounder system requires the GPS data stream to conform to the NMEA (National Marine Electronics Association) 0183 standard.

The side of the surface unit case

Status Indicator Lights

These indicator lights are provided for users who require verification that the surface unit is operating when (1) the case is closed, or (2) the echogram is not within the user's view. The red and green colored LED (Light-Emitting Diode) lights on the side of the surface unit indicate the power and pinging status of the echosounder. When the red light is glowing, power is ON. The green light is triggered by the operation of the transducer and corresponds to the ping rate. When the green light is blinking, the transducer is operating.

Ethernet Connection

The plug on the side of the case is for connection of the surface unit to the external communication device (most commonly a notebook computer). One end of the (provided) communication cable terminates in a screw-lock plug, the other in an RJ-45, standard network jack. If BioSonics provided the User PC, the network communication features will have been set and tested prior to shipping the echosounder.

External components

DT-X Digital Transducers

The transducers contain a ceramic element housed in one end and covered with an acoustically transparent material. Within the transducer housing, behind the ceramic elements, are the electronic components that provide several functions: amplification, analog bandpass filtering, analog to digital conversion, digital filtering, data thresholding, and data compression. The received acoustic/electrical information is sent, in digital

format, through the transducer cable, to the surface unit via a high-speed serial line. The analog to digital conversion features high dynamic range and high sampling resolution.

Although the transducers are manufactured of durable materials, care should be taken in handling and installation to ensure that the connector(s) and transducer face are protected from abrasion and impact.

The connectors, provided on most DT transducers, have an O-ring installed in the bore of the connector at the base of the pins.   The O-ring should be inspected regularly for signs of wear or cracking.   The O-ring should also be cleaned and lubricated with a light coating of silicone grease to ensure good sealing characteristics.

If used in salt water, be sure to rinse the transducer and cable in fresh water after use, this will help reduce corrosion.

Do not transmit on these transducers if they are not submerged in the water. These transducers use a piezo-electric ceramic element to generate the underwater acoustic signal. This results in the conversion of energy from electrical to acoustic form, with byproducts of mechanical movement and heat. Water density and temperature help offset the movement and heat generated by this energy conversion process. If the transducer surface is not underwater, there is a high risk of mechanical damage to the transducer element and the associated electronics within the system. **Always** ensure that the transducer is submerged in water any time the echosounder is in operation.

Digital Transducer Cable
BioSonics digital transducer cables are manufactured to exacting specifications for use with your transducer(s) and surface unit. Each cable has been tested to ensure that the acoustic information is transmitted between the surface unit and transducer with reliability and accuracy.

Although the transducer cables are manufactured of durable materials, care should be taken in storage, handling, and installation to ensure that the connector(s) and cable sheath are protected from abrasion and impact.

User PC (External Communication Device)
The most convenient method of communicating with the BioSonics DT-X Echosounder is to use a notebook computer and ethernet connection. BioSonics normally supplies the computer for each system. This ensures that the entire system is set up, tested, and calibrated at BioSonics' manufacturing and test facility.

Recommended configuration for the External Communication Device
- Pentium III processor, 600 MHz clock speed
- 256MB RAM (min.)
- 30 MB Hard Drive (min.)
- Ethernet Communication capable (mandatory)
- High Color (16-bit) graphics, at least 800 x 600 pixel screen resolution
- CD-R/W drive

The computer must have a NIC (Network Interface Card) and use the TCP-IP communication standard. The NIC must be configured properly to enable 2-way communication through this port.

If your computer was set up by BioSonics, the NIC and communications protocol will have been configured properly for operation with the DT-X Echosounder system. If you must set up your own system, the configuration requirements are described in the appendices of this manual. Configuration requirements may vary, depending on the version of the Windows® operating system on your computer.

Chapter 3: Hardware Setup

Component Connections

The bold, italicized letters in the following discussion refer to the input and output connections indicated on the surface unit and equipment setup diagrams in Figure 3.

Surface Unit

Connections to all external devices are achieved through weatherproof plugs and jacks located on the outside of the surface unit. This ensures protection of the surface unit working components from adverse environmental conditions such as dirt and water.

Do not over-tighten surface unit connectors. The sealing mechanism of the external connectors requires that the surfaces be mated firmly, but not with excessive force. Excessive force may result in damage to the connector and to the plug of the surface unit. Damage to connectors can lead to damage of the surface unit, transducer cable, or the transducer.

External Power Supply

The surface unit can be operated on either AC or DC power. **Do not attach both simultaneously!**

The AC power cable provided in the support pouch is attached to the connector on the back panel labeled AC power **(C)** and connected to an appropriate AC power source (85-264 VAC, 47 – 440 Hz, 2 A max.). AC power is the recommended option for operation of the DT-X Echosounder. AC power sources have been observed to provide for operation that is more reliable.

The DC power cable provided in the support pouch is attached to the connector on the back panel labeled DC power **(D)** and connected to an appropriate power source (11- 14 VDC, 5A max.). Care should be taken when utilizing DC power, as current and voltage fluctuations may result in improper power being supplied to the DT-X and could damage your echosounder. BioSonics' warranty does not cover damage caused by improper power supply to the echosounder.

Figure 4. Back-panel view of DT-X surface unit. Surface unit connections for AC power (C), DC Power (D), GPS (E), and transducer(s) (F), are shown.
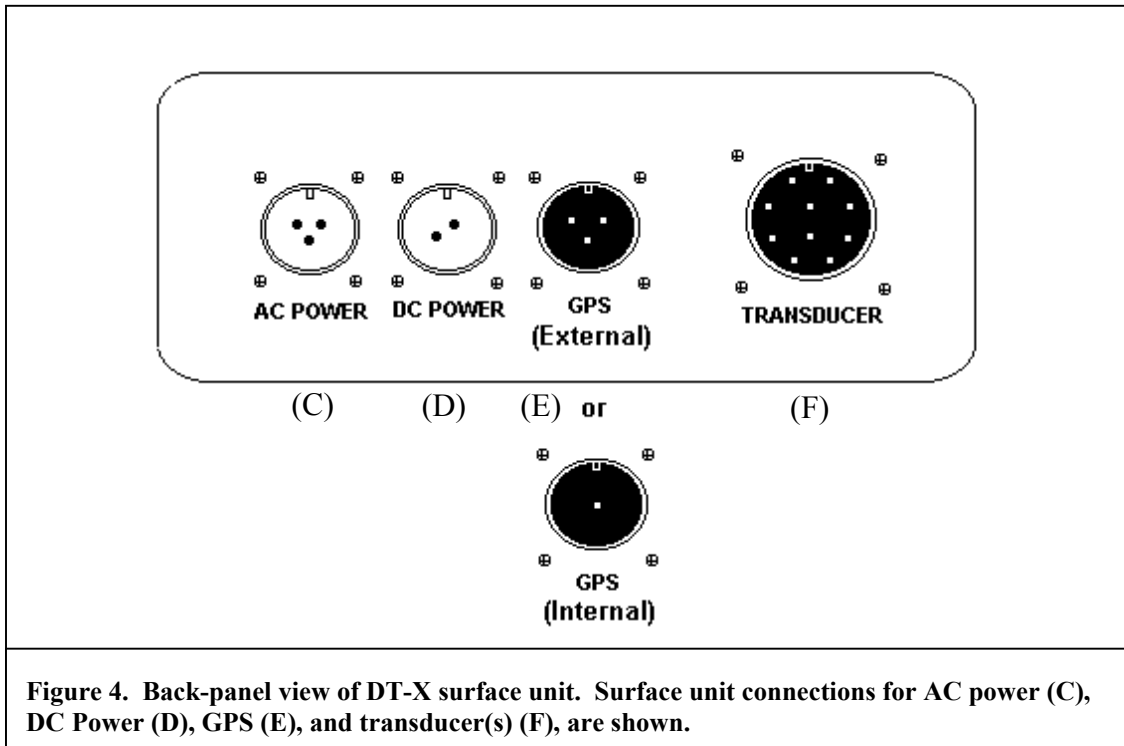
Auxiliary Power Attachments

The "cigarette lighter" connection, located on the interior faceplate of the surface unit, provides an option for powering the User PC through the surface unit. To use this connection an "auto adapter" is required. BioSonics recommends that a voltage inverter, or 12VDC to 115VAC converter, be used to power the computer from a separate power supply.

When the surface unit is connected to DC power, power is supplied to the digital transducer and external devices once the power switch is in the ON position. The LOW BATTERY light will illuminate if the DC power available is not adequate for the requirements of the DT System and any external devices. *If you experience power supply problems, please refer to the Troubleshooting section in Appendix C for help and Appendix E for system specifications.*

Laptop and AUX Power: DC power supplied to the surface unit is passed through to two output connections on the front panel. These connections are labeled "**Laptop Power 12 VDC**" and "**AUX. Power 12VDC**".

If you are operating the surface unit on a 12 VDC source, these two connections will also supply (pass through) 12 VDC. If the surface unit is being operated on a higher DC voltage, up to a maximum of 16 Volts DC, the two connections on the front panel will give the higher input voltage, not the 12 VDC as labeled. **If you are running the surface unit with a DC voltage supply higher than a nominal 12 VDC, do not attach accessories to the two output connections on the surface unit.**

Transducer Connection
Connection between the surface unit and the transducer(s) is achieved by using a digital transducer cable. The "dry" end of the transducer cable is connected to the surface unit by aligning the metal plug of the cable with the socket **(F)** on the back panel of the surface unit. The retaining ring of the cable plug should be carefully threaded onto the receiving end (on the surface unit) and <u>hand</u> tightened. This plug and socket are "keyed" to assure proper alignment. Align the metal tab on the back panel connector to the slot in the cable connector, and then tighten the locking sleeve.

The "wet" end of the transducer cable is constructed to ensure watertight connection and protection for the interface with the digital transducer. Carefully align the plug on the wet-end of the cable with the transducer plug and firmly insert the cable into the transducer. Carefully thread the retaining ring onto the transducer and <u>hand</u> tighten the retaining ring, to ensure a proper seal.

BioSonics makes several different types of multiplex systems (systems that can have multiple transducers connected at the same time). If you have a multiplex system, it may have more than one transducer connector **(F)** on the back panel. In this case, it is important to connect each transducer to the correct transducer connector. The transducers and the transducer connectors are labeled to facilitate this. If you connect the transducers to the wrong transducer connectors, then during collection the transmit pulses will not go to the correct transducers, and the data you collect will always look as if it was collected in passive (or listen-only) mode.

If your multiplex system has only one transducer connector **(F)** on the back panel, then you will have either a "Y" transducer cable or a "daisy-chain" transducer cable. In either case, the cable will have one connector that fits onto the surface unit back-panel connector, and the rest of the cable connectors will fit onto your transducers. It does not matter which transducer goes on which cable connector.

GPS Receiver Input
The three-pin connector labeled GPS on the back panel (*E* in Fig. 4, above) is connected internally to the serial port on the faceplate of the surface unit (*B*). This internal connection incorporates a circuit that converts signals from RS485 (electrical specification of NMEA 0183) to RS232 (standard specification for PC serial ports). The GPS cable is attached to the back panel. The cable may need modification for the specific GPS used. The GPS data are received by the embedded PC in the surface unit, and sent over Ethernet to your PC.

External Device Synchronization
The **TRIG OUT** and **SYNC IN** BNC-type connectors on the faceplate allow the DT-X System to be synchronized with another electronic device. With this option, the DT-X can act as a master for another device through the **TRIG**ger **OUT** (*H*). Specific considerations for connecting synchronized devices are device dependent.

User PC (External Communication Device)

The User PC (typically a notebook computer) is connected to the surface unit by means of a CAT-5 ethernet communication cable, supplied with the surface unit. Connect the computer to the echosounder by inserting the RJ-45 plug into the ethernet connection of the computer and using the screw-lock connector on the other end of the cable to connect to the TRANSDUCER socket on the back of the DT-X surface unit.

Transducer Deployment

The transducer must be fully submerged, with no obstructions immediately in front of the transducer face, when in operation. Care should be taken to protect the transducer face from impact and abrasion. The transducer can be mounted on a pole, on a towed body (such as the BioSonics BioFin), or in many other physical arrangements, determined by user needs.

Simple Mounting Technique
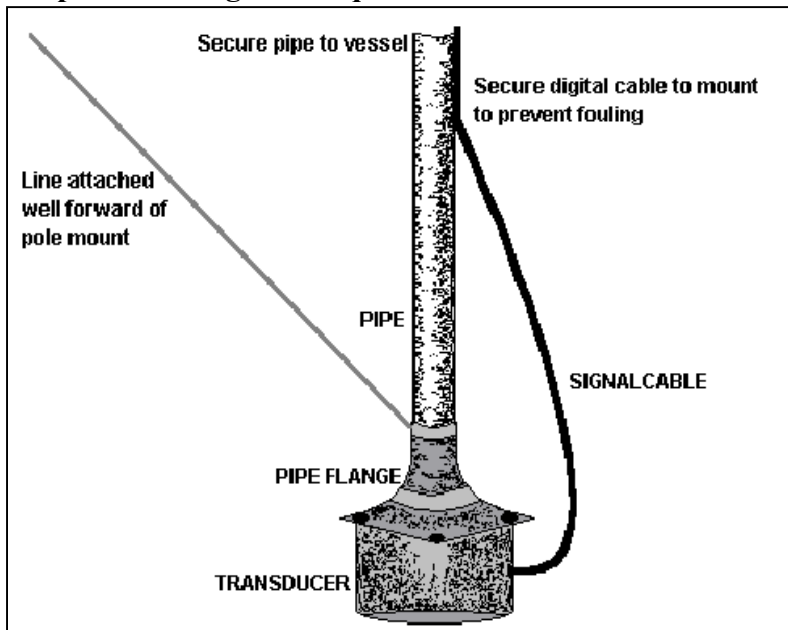
Figure 5. The transducer can be mounted to a pipe-mount which can be secured to the vessel or structure. This enables adjustment to meet specific user requirements. This example is for illustrative purposes only.

The transducer may be mounted to a pipe, which has been fitted with a flat plate on one end. Holes in the plate, matching the spacing of those on the transducer, allow for quick mounting of the transducer. The pipe may then be fastened to the gunwale of a vessel or to a structure, depending on user requirements. If the pole is subjected to flowing water, it may vibrate. A line attached to the pole and fastened up-current will help to stabilize the pole and eliminate vibration.

Mounting on Towed Bodies

BioSonics BioFins are rugged, deadweight towing bodies designed for towing transducers and other sensors. Based on the deadweight principle, they perform well in heavy seas, at various depths and towing speeds.

The BioFin with attached transducer(s), sensors, and cable should be adjusted to balance horizontally in the air before deployment (see figure 6). The BioFin will then hold its

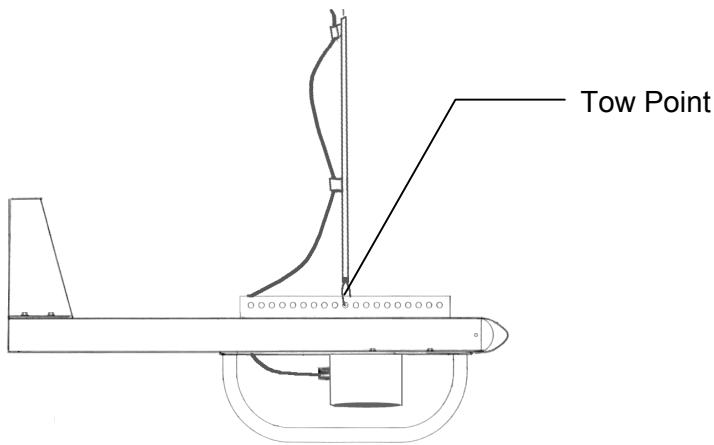horizontal position during towing. If the transducer is leaning nose down then the tow point should be moved forward. If the transducer is leaning nose up then the tow point should be moved backward.

Figure 6. BioSonics tow fin-mounted transducer. The deadweight tow body provides a stable platform for transducer deployment.

For transducers deployed with unarmored signal cable, the cable should be attached to the steel towing cable, leaving a small amount of slack above the BioFin. There should be no mechanical stress on the signal cable or the connector on the transducer. The steel cable should be secured to the tow point on the BioFin and to the boat.

Transducers deployed with an armored tow cable should be secured to the tow point on the BioFin and to the boat. There should be no mechanical stress on the portion of the signal cable between the steel tow finger attached to the BioFin and the connector on the transducer.

Chapter 4: Visual Acquisition Software

Overview

Visual Acquisition (**VISACQ™**) has been designed to enable the user to interface with the new BioSonics DT-X digital scientific echosounder system. VISACQ allows complete control of the operational settings and functions of the surface unit and the transducer(s) attached to the system.

VISACQ software has been designed to provide an interface that is efficient, logical, and addresses the needs of both experienced and new users of the DT-X system. Primary access to the interface is provided through clearly marked function buttons.

Installation of the Visual Acquisition software is normally performed when your system is set up by BioSonics. However, in case you need to re-install or install the software on another computer, you should refer to the detailed file listing and additional setup in the appendices to this guide.

To understand the role of the Visual Acquisition software, it is important to understand the basic DT-X Echosounder design.

The DT-X Echosounder is capable of stand-alone operation, requiring only a power source, surface unit, transducer cable, and transducer. This basic system will transmit and receive acoustic data according to user-defined parameters loaded into the embedded processor via the DT-X Configuration features of the VISACQ program.

In a typical configuration, VISACQ is used to upload the operational parameters to the embedded processor (inside the surface unit). A notebook computer is typically used to display, monitor, and store the data that is produced by the echosounder. This is done utilizing the GUI (Graphical User Interface) of VISACQ software.

Echosounder operations are divided into two categories: (1) echosounder setup and (2) signal monitoring and data storage.

Conventions used for software setup and operation:

References to commands:
- **BOLD** in capital letters: Commands available from a button in the toolbar. All toolbar commands are also available from the menu.
- **Bold** w/ underline: Commands available either in a window or from the menu. Nested menu commands are denoted by slashes. For example **Setup / Initialize DTX** indicates the Initialize DTX command in the Setup menu. The underlined characters indicate keyboard equivalents, which allow you to navigate windows and menus without using the mouse or touchpad.
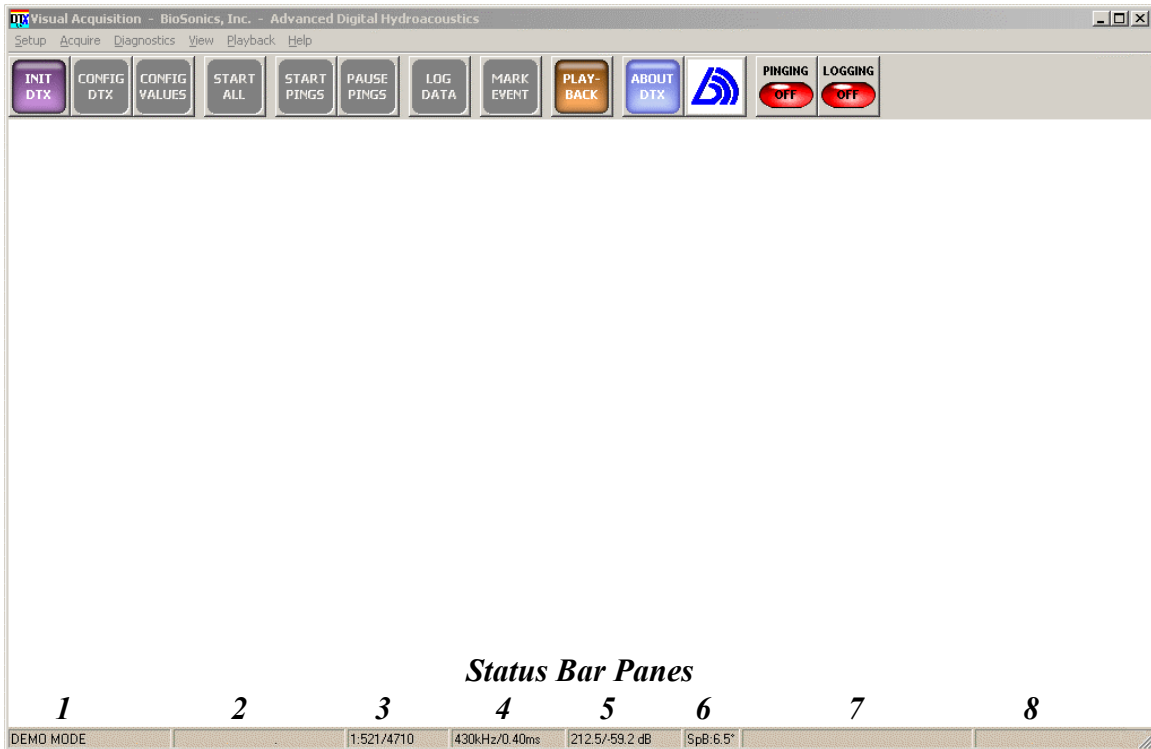
Step-by-Step System Setup and Operation

This section will guide you through the operation of Visual Acquisition, primarily utilizing the toolbar buttons. Additional features available from the menu (above the toolbar) are presented in an indented format, using the command name with an underlined shortcut letter, such as **E**<u>x</u>**it**, to distinguish them from button commands.

Turn on the DT-X Echosounder (after ensuring that appropriate power is supplied to the echosounder), using the rocker switch located on the interior faceplate of the DT-X. The Power On light will glow, indicating that power is being provided to the surface unit. You may hear a high-pitched "squeal" of the capacitors being charged. At this time, the operating system of the embedded processor is being loaded; this setup takes approximately 45 seconds. When this is complete, you will hear three ascending tones from the surface unit – the "startup beeps". This means the unit is ready to be used.

Start the VISACQ Program by clicking on the DT-X icon located on the Windows Desktop, by selecting Start > Programs > Visual Acquisition > Visual Acquisition, or by selecting the file VisualAcquisition.exe from the folder C:\BioSonics\DTX\ (within the disk drive file structure).

Figure 7. Initial screen display when BioSonics Visual Acquisition software is activated. Only those commands that make sense with the current system status are colored and available. Logical sequencing of setup and operation is one of the important features of Visual Acquisition. Commands are available either from the menu or from the toolbar buttons at the top of the screen. The current pinging state (OFF, ON, or PAUSED) and logging state (OFF or ON) are clearly shown by the state indicators at the right end of the toolbar. System settings and status are displayed in the Status Bar at the bottom of the screen. The VISACQ program also includes a rapid-viewer feature for DT4 format files, accessed by using the PLAYBACK button.

The initial VISACQ screen presents the user with a menu of available options, at the top of the screen, for operation of the software. The toolbar buttons provide convenient access to the most common functions, while the menu (above the buttons) provides access to these functions as well as other, less frequently used, functions. At this stage of system setup, only those menu options which are logically available are enabled (see Fig. 7): **INIT**ialize **DTX** and **PLAYBACK.** The other buttons that are enabled are **ABOUT DTX**, which provides version information about VISACQ, and the BioSonics logo, which provides access to information about BioSonics products. Other menu buttons are "grayed out" and inactive at this stage of system setup.

At the bottom of the Visual Acquisition screen, a "status bar" provides the user with information about the system, operating parameters, and conditions – the status of the system. Status pane numbers, below, refer to the status pane numbers shown in Fig. 7, above.

Status pane #1 (left-most pane) displays the "mode" in which the system is operating. When you start VISACQ, this pane says "Init or Playback (F1 for Help)" to remind you what your options are. If you playback a DT4 file, this pane says "Playback Mode". If

you have done **INIT DTX** to initialize the system, this pane says "Ready (F1 for Help)" to indicate that the system is ready to start pinging. When you are pinging, this pane says either "*NOT LOGGING*" or "LOGGING…" to indicate whether your data is being logged to disk. This information is also provided by the **LOGGING** state indicator at the right of the toolbar.

Status pane #2 displays the name of the current playback or logging file. If you are playing back a DT4 file, then this pane displays the name of the DT4 file. If you are pinging and logging data, this pane displays the name of the RTP file you are logging data to. If you are pinging and not logging data, this pane is blank.

Status pane #3 indicates which transducer configuration you are viewing data for (this is explained more later). It also indicates the current ping number, and, in playback mode, the total number of pings. For example, if you are pinging, you might see something like "2:50/…". This indicates that you are looking at the data from transducer configuration 2, and ping number 50 was the last one received. The ping number updates as data is received, *whether or not it is being logged*. The "…" indicates that the total number of pings is unknown until you stop pinging. In playback mode, you would see something like "2:50/2000", which indicates that you are looking at ping number 50 and there are 2000 pings for transducer configuration 2. The ping number would update only when you use the commands to move around in the file.

Status pane #4 displays the transducer frequency and pulse duration for the transducer configuration currently being displayed. These values are read-in from the system, once activated.

Status pane #5 displays the source level and receiver sensitivity parameters for the transducer configuration currently being displayed. These values are read-in from the system, once activated.

Status pane #6 indicates the operating mode (single, dual, or split) and beam angle for the transducer configuration currently being displayed. These values are read-in from the system, once activated. Note that the operating mode is not necessarily the same as the transducer type. For example, a split-beam transducer can also be run in single-beam or dual-beam mode. The beam angle displayed is the narrow-beam minor axis beam-width.

Status window #7 indicates the Latitude and Longitude readings from the GPS unit (if present). These values are monitored and displayed when the echosounder is in operation. Note: currently, when you are playing back a DT4 file, the latitude and longitude readings displayed are the ones coming from the echosounder, not the ones in the file you are playing back.

Status window #8 is currently unused.

Step-by-Step Echosounder Operation

To operate the echosounder, using the Visual Acquisition interface, the user must define the conditions for acoustic interrogation and recording. This is accomplished through a series of logical steps:

- Establish a link between the echosounder and the user PC
- Determine the current system components and settings
- Make any desired changes to the system settings
- Initiate operation of the echosounder, and finally,
- Record the resulting data.

The Visual Acquisition software aids in the logical progression through these steps by making options available only when each prior step has been successfully completed. This is in keeping with the philosophy of making the collection of high-quality, rich-content data a straightforward operation.

Initialize the DT-X system by selecting the "**INIT DTX**" button , by **single-clicking** the left-most menu button. This will cause the Visual Acquisition software to check the computer communication port (T-10/100 ethernet connection), establish communication with the DT-X embedded processor, check embedded processor operations, check for external sensors (such as transducers) and determine their identity and characteristics, set the DT-X clock to match the PC clock, and communicate the status of the echosounder system to the Visual Acquisition program.

While this is occurring, a progress bar will appear in the upper-left portion of the screen, indicating that the activity is in progress. During this process, the DT-X controller is interrogated and the DT-X system clock is set to match the notebook computer clock.

Upon completion of this system initialization task, the user is presented with a report of the system status, as shown in Figure 8. Review the **DT-X System Information** by examining the report (the report can also be activated later by selecting from the text menu: **View** / **System Information**). The report is divided into the following categories:

> **Receiver:** Serial number, transducer type, logical device address, transducer frequency, transducer beam pattern, digital sampling rate, and the date of the last calibration (by BioSonics). The serial number field is a drop-down menu. If you have multiple transducers connected, you can see the parameters for each transducer by selecting them in this menu.
>
> **Embedded Processor:** Serial number and the system network IP address (assigned to the embedded processor, within the DT-X).
>
> **Transmitter / Surface Unit:** DT-X surface unit serial number, latest adjustment date (by BioSonics), transmitter frequencies (capabilities), Transmit power reduction (capabilities).

Performance Characteristics: Surface unit / Transducer signal source level, Receiver sensitivity, System noise floor.

Figure 8. DTX System Information window. Visual Acquisition interrogates the system and determines the identity and characteristics of the components of the system. These characteristics and values are important to setting and operating the echosounder.

On closing this window (selecting OK), the CONFIG DTX button ![CONFIG DTX] becomes available on the menu (and equivalent text commands from the **Setup** command). This command is now available because of the VISACQ logic, which recognizes the identity and reported characteristics of the echosounder system components. The user can now begin to configure the echosounder operational parameters.

The following commands are available only from the **Setup** menu (not available from the toolbar).

> **Reset Surface Unit.** Closes down DT-X surface unit operations, Interrogates the echosounder, then reloads the last set of system parameters. Can be used to

recover from power failure to the surface unit or if the surface unit "hangs" and becomes unresponsive.

Reboot Embedded Controller. In the event of a "system lockup" or other malfunction, this command will reset the DT-X embedded controller system. This command is not equivalent to **Reset Surface Unit**. This command affects ONLY the embedded processor.

Shutdown Embedded Controller. This command should be used whenever you want to completely cease operation of the DT-X surface unit. This command is necessary for the proper shutting down of the LINUX operating system, used by
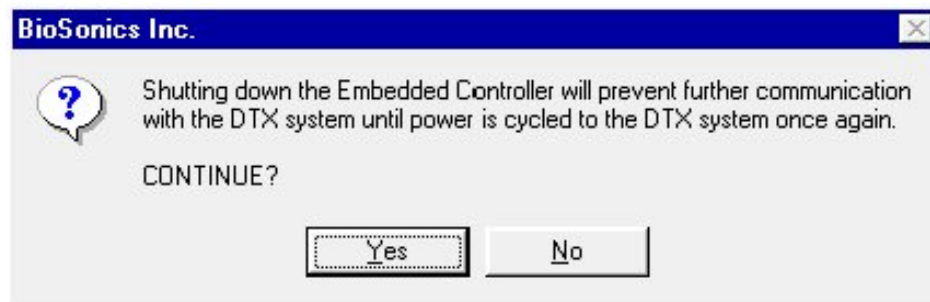
Figure 9. "Shutdown Embedded Controller" command confirmation window.

the DT-X echosounder system. Upon using this command, you will see a confirmation screen to ensure that this is the desired action; selecting **Yes** will initiate the LINUX shutdown sequence for the DT-X embedded processor. Echosounder activity will cease. When the DT-X embedded processor has successfully shut down, the shut down notice will appear. At this point, it is safe to power-down the system using the **ON/OFF** switch.

Figure 10. "Shutdown Embedded Controller" process confirmation window.

Exit command (or the **ALT + F4** key combination) will shut down the Visual Acquisition program. If you have a file open for logging or for playback, it is cleanly closed before the program exits. You should **always** issue the **Shutdown**

Embedded Controller command before you power down the echosounder surface unit.

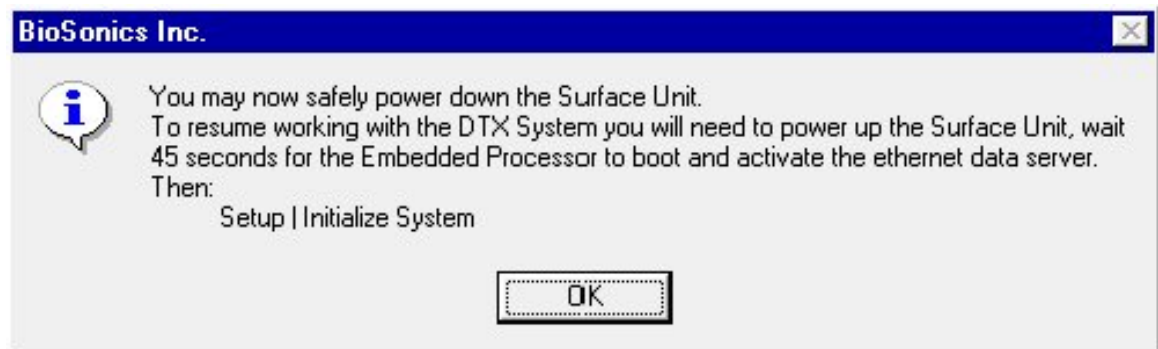NOTE: To resume communication between Visual Acquisition and the X-Series surface unit, cycle power to the surface unit, wait for the startup beeps to sound, then from the "Diagnostics" Menu, select "Network Layer". Upon confirmation of the network connection, Visual Acquisition will be ready for use once again.

Configuring Your Echosounder

CONFIG DTX. This button presents the user with the option to set operational parameters for the operation of the DT-X Echosounder. The way this is done depends on whether you have one transducer connected to the system (single-plexing), or more than one (multiplexing).

Single-plex Configuration
If you have one transducer connected to your surface unit, then the **CONFIG DTX** button brings up the single-plex configuration window (see Fig. 11). The first time you bring up this window after doing **INIT DTX**, the parameters are filled in with factory defaults. Subsequently, until you do **INIT DTX** again, the window comes up filled in with the last settings you entered.

Available configuration parameters are divided into four categories: Receiver, Data Collection Parameters, Pulse Control and Acoustic Mode. Additional options include loading a pre-existing configuration file, saving the displayed settings to a configuration file for future use, setting the clock in the embedded processor, and viewing information about your transducer and surface unit.
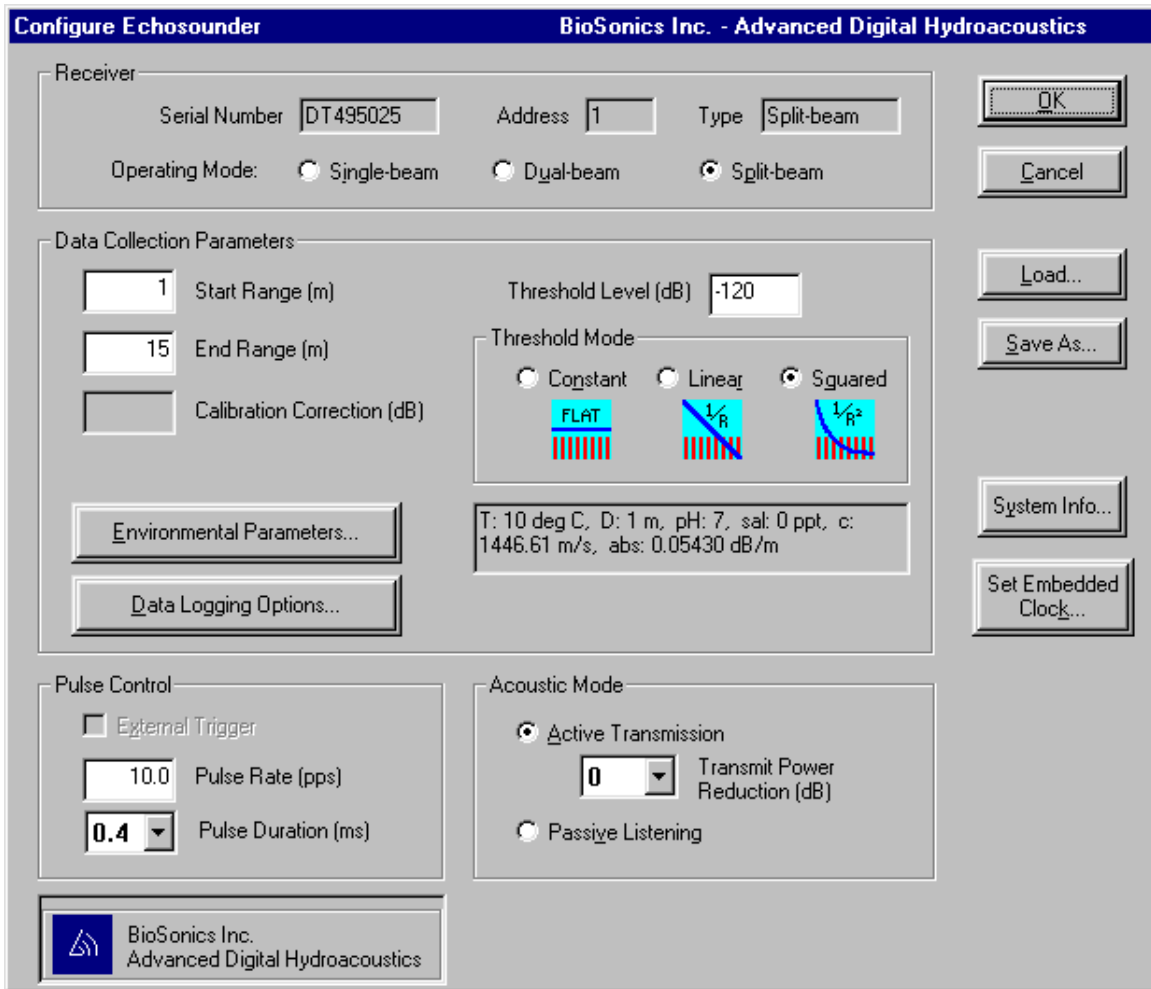
Figure 11. Single-plex "Configure Echosounder" window. Parameters which can be set are in the white windows, fixed values or values which cannot be set are "grayed out". Additional windows are available by clicking <u>E</u>nvironmental Parameters, <u>D</u>ata Logging Options, <u>L</u>oad, <u>S</u>ave As, S<u>y</u>stem Info, or Set Embedded Cloc<u>k</u>.

These settings indicate the user-controlled parameters that will be sent to the DT-X echosounder, used in various calculations, and written to data files. To set the parameters to a previously established (and saved) configuration, see the **<u>L</u>oad** command, below.

Once all settings have been established, the user may accept configuration settings by selecting the **OK** button in the **Configure Echosounder** window, modify these settings, or **<u>L</u>oad** previously saved settings.

> **<u>O</u>K** saves the displayed parameters in the notebook computer's memory. They will remain until you exit Visual Acquisition, do **INIT DTX**, or load another configuration.

> **<u>L</u>oad** prompts the user for the name of a previously saved file, containing a previously established and saved set of values for all variables.

Save As... prompts the user for a file name in which to save the settings displayed in this window. This allows the user to develop a set of conditions and save them for future use. Files saved using this command are available to the **Load** command (above).

Once the operational parameters for the echosounder operation and for data storage have been established, more toolbar buttons are activated. The echosounder system is now ready for operation.

Data Collection Parameters.

> **Receiver Settings.** Select whether you want to collect data in Single beam, Dual beam, or Split beam mode (options determined by the type of transducer being used). Parameters not logically available (e.g., operating a single beam transducer as a split beam) will not be available and will be grayed out. The Serial Number, Address, and Type are determined by Visual Acquisition during the **INIT DTX** process.

> **Range.** Establish the Start Range (from the transducer face), and End Range (from the transducer face) for data collection. The range appropriate to each user application may vary. Consider the transducer "near field" when setting the Start Range. The end range must be greater than the start range and the start range must not be less than zero.

> **Calibration Correction.** Under certain conditions, field calibration may indicate that a correction factor should be applied to the data collection process. This option will allow the user to enter that value into the echosounder. It is not yet implemented in this version of Visual Acquisition.

> **Threshold Level.** Provide the desired value for target threshold filtering. This is the target strength (TS) level below which echo signals should not be recorded. Setting the threshold enables the user to filter the data for targets at or above the appropriate TS and reduce or eliminate signals from undesirable targets and other "noise" in the aquatic environment. This can also help reduce data file size.
>
> Care should be taken in selection

> It is important to remember that echosounder settings are controlled by the laws of physics, the physical constraints of the DT-X, and of the other system components. Sound travels at a fixed speed, depending on the water temperature, salinity, depth, pH, and other variables.
>
> These factors must be considered when entering values for echosounder operation. Suggested values and limitations are presented in Appendix E.

of the threshold level. Setting the threshold level too high could result in missing targets of interest, while setting it too low could result in masking desirable targets with environmental "noise".

Threshold Mode. Three options are available: Constant, Linear, or Squared. Each mode is appropriate for different acoustic applications. Examples and suggestions for settings are provided in the BioSonics Software manuals for Visual Analyzer, EcoSAV, and VBT.

<u>E</u>nvironmental Parameters. A convenient method for calculating the appropriate speed of sound and sound absorption coefficient and entering that value into the acoustic equation. This window provides for input of salinity, temperature, depth, and pH, all important components of the calculations.

Environmental variables can significantly impact acoustic calculations. The user should determine the relative importance of these variables to the data that they are collecting and their associated analyses. References are provided (by selecting the **<u>R</u>eferences** button from within this window) for information on the formulas used and guidance in determination of the importance of these variables to specific situations.

Enter the appropriate values, and then calculate the speed of sound and absorption coefficient by clicking on the **Com<u>p</u>ute** button. The values are automatically entered into the configuration file. When finished with this window, click on the **<u>O</u>K** button.
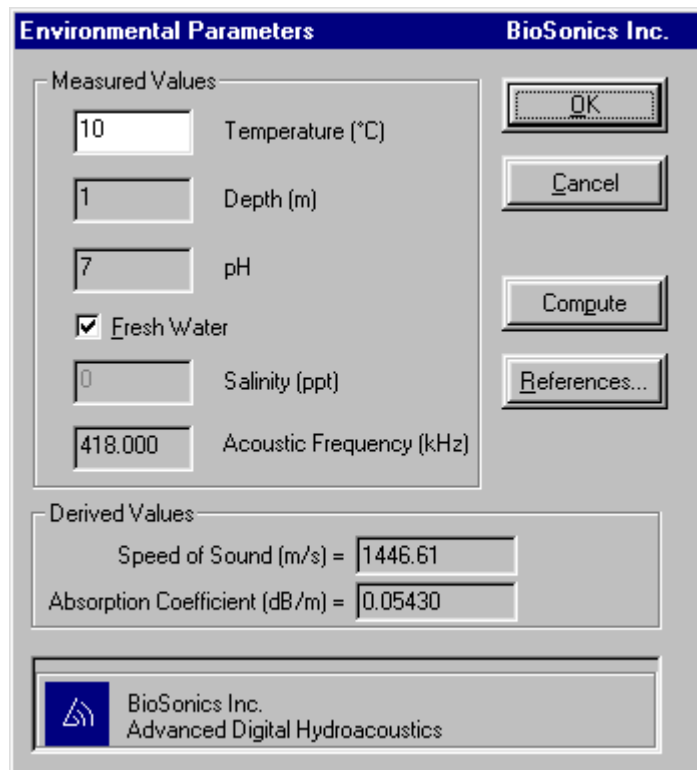
**Figure 12. Environmental Parameters window.
Unchecking the <u>F</u>resh Water box allows Salinity values to be entered.**

<u>D</u>ata Logging Options. The user can set several options for recording the data and controlling data storage. Selection of this button will open a new window for user input and information.
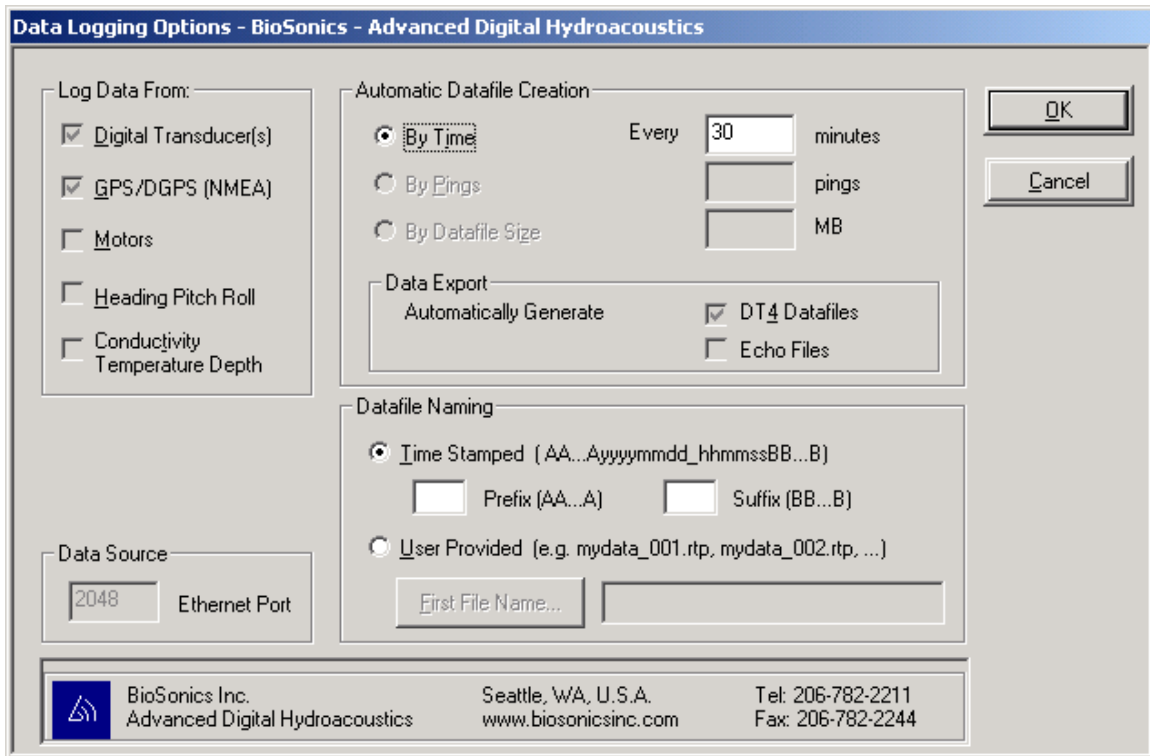
Figure 13. "Data Logging Options" window. Values available for setting are in the white windows, those values which may not be changed are grayed out.

Log Data From: This section lists the sensors that will provide data that can be recorded. Currently these cannot be changed – the transducer and GPS items are always selected.

Automatic Data Creation: Each data logging file is automatically closed, and a new one opened, based on a time limit. This can be used to keep each data file to a reasonable size. In the **Every ____ Minutes** field you can enter what you want the time limit to be (between 1 and 30 minutes).

File Size. Each user should examine the conditions under which they are working and the resultant file sizes. Low data volume conditions (such as low ping rates, high target threshold levels, or low target abundance) will produce smaller data files per period of time than will high data volume (high ping rates, low target threshold, or high target abundance) conditions.

Data Export: The raw data produced by the transducer is stored as .RTP and .NME files. The data is also automatically converted to .DT4 files for use in various analysis packages.

Datafile Naming: Automatic file creation requires a standardized method for name generation. The default "time-stamped" method constructs each file name as follows: The first four characters are the year (e.g., 2002), followed by the 2-digit month and 2-digit day (e.g., 1106), an underscore character, followed by the 2-digit hour, 2-digit minute, and 2-digit second (e.g., 142302). The resulting file name, for a file started at 14:23:02 on 06 November 2002, would be 20021106_142302 (with the file type; RTP, DT4 or other appropriate extension, appended).

The user can also select a numeric or text prefix and/or suffix to append to the automatically generated file name. The appropriate file extension will be appended to the file. If the user chose "LAK" as a suffix, for example, the example RTP file would be named "20021106_142302LAK.RTP". The prefix and suffix can each be of any length.

Timestamped files are stored in a designated data directory which is "C:\BioSonics\DTX\Data" by default. All software defaults can be changed.

An alternative naming scheme is the "User-provided" scheme. If you select this, then you must choose the "First File Name" button to define the file name you want to start with. This name must be of the form "myfile_001.rtp", where instead of "myfile" you can have anything you like. The files generated will then be: myfile_001.rtp, myfile_002.rtp, etc. With this scheme you can store the files in any directory. This method is a temporary over-ride of the time-stamped file naming that remains in effect the next time you stop pinging.

Once you have set and confirmed the Data Logging Options, **OK** or **Cancel** may be selected. If **OK** is selected, the parameters will be stored and the window will close. Otherwise, the parameters will revert to the previous values.

Note that the file time limit is saved in the configuration file, but the prefix and suffix, or user-provided file name, are not. The user-provided file name remains active only until the next time you stop pinging. The file prefix and suffix remain in effect until you exit Visual Acquisition, or change them in this window.

Pulse Control. Settings for the Pulse Rate (ping rate, **p**ings **p**er **s**econd, pps) and the pulse duration are specific to the purpose for which the data is being collected. Typical settings for detection and analysis of small fish might be 10 pps and 0.4

ms, while for aquatic plant detection and analysis might be 4 pps and 0.1 ms. The user should review the appropriate analysis software manual (and the work of other acoustic users) to determine the initial settings for each application. Each user will find the combination of settings which best provide for specific applications.

Acoustic Mode allows the user to select whether acoustic pulses should be generated (active mode) or the receiver should simply listen to the ambient acoustic environment (passive mode). If active mode is selected, the user has the option of selecting high or low transmit power.

System Info provides the user with information about the surface unit and the transducers connected to it. The button brings up the same window that is displayed when the user performs the **INIT DTX** command (see Fig. 8).

Set Embedded Clock provides the user with options for manually setting the time clock on the DT-X embedded processor. This allows the user to confirm that the computer clock and the DT-X internal clock are synchronized. Time synchronization is important for naming data files, when processing data, and when coordinating acoustic data with other data, collected independently of the DT-X system.
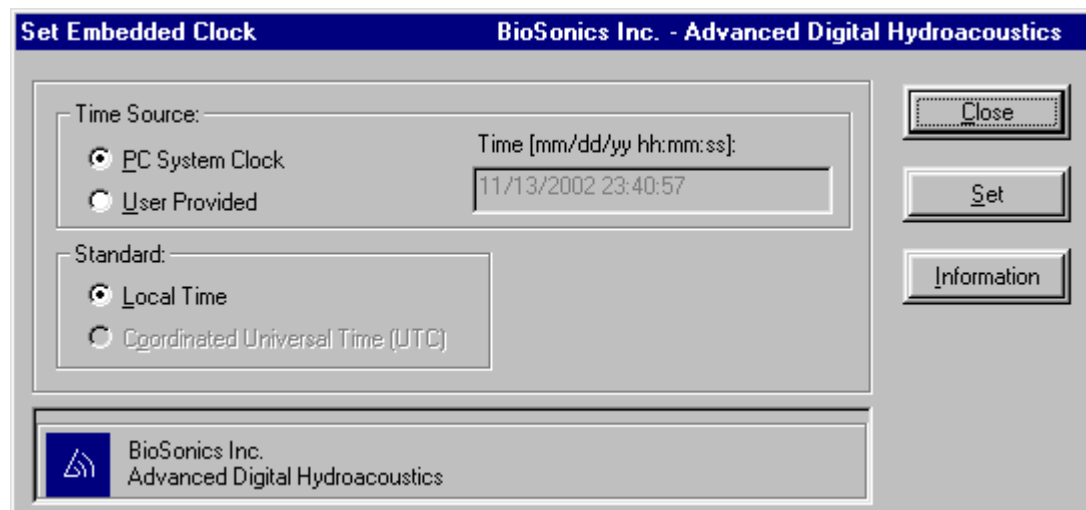
Figure 14. DT-X Set Embedded Clock window.

Additional reference information is provided for the user if they desire to synchronize the computer clock with a calibrated reference standard. After setting, select Close and you will return to the main configuration window.

Multiplex Configuration
If you have more than one transducer connected to your surface unit, then the configuration process is slightly more involved, because you need to specify the sequence in which you want your transducers to fire. In this case, the **CONFIG DTX** button brings up the **Configure Echosounder (Multiplexing System)** window (see Fig. 15).
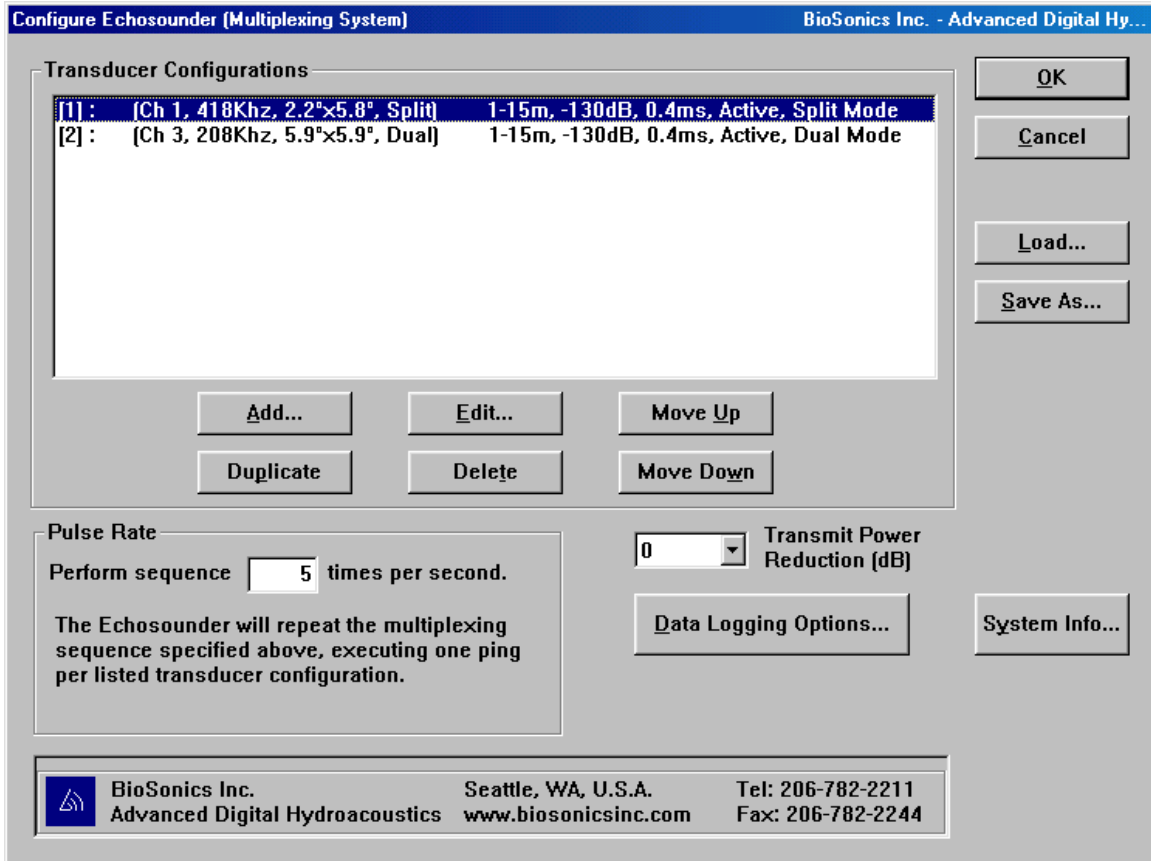
Figure 15. DT-X Multiplexing Configuration Window. This window has a large font and large buttons to make it easier to use in the field.

This window allows you to set up a sequence of transducer configurations. When you start pinging, the system cycles through this sequence, doing one ping for each transducer configuration each time through the sequence. It is important to note that you can have several different transducer configurations in your sequence that use the same transducer.

The first time you bring up the multiplex configuration window after doing **INIT DTX**, it will show a sequence with one transducer configuration for each transducer you have connected to the system. Each configuration will have default settings for its parameters. Subsequently, when you bring up the window, it will show whatever sequence you defined the previous time.

There are six buttons in the window that allow you to build your sequence of transducer configurations:

Add. This button creates a new transducer configuration. A window comes up that allows you to select which transducer you want to use for the new configuration (see Fig. 16). If you click OK, a new transducer configuration is created using the selected transducer, with default parameters. The new configuration is inserted into the sequence immediately after the configuration that was highlighted when you pressed the **Add** button.
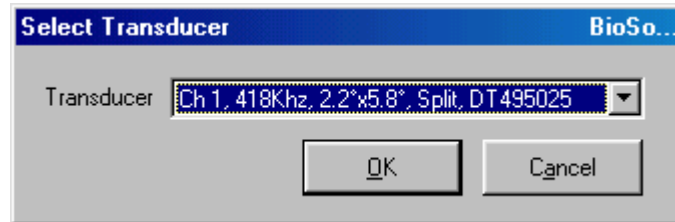
Figure 16. Select Transducer Window.

Duplicate. This button creates an exact copy of the configuration that is highlighted, and inserts it into the sequence immediately after the highlighted configuration.

Delete. This button deletes the highlighted configuration from the sequence. A confirmation window appears before the configuration is actually deleted.

Move Up / Move Down. These buttons move the highlighted configuration up or down in the sequence. The configuration remains highlighted.

Edit. This button brings up the **Configure Transducer** window, which allows you to set the parameters for the highlighted transducer configuration. See Fig. 17. This window is very similar to the single-plex **Configure Echosounder** window described above (see Fig. 11). The differences are as follows:

- The **Load**, **Save As**, **System Info,** and **Data Logging Options** buttons are not in the **Configure Transducer** window – they are in the **Configure Echosounder (Multiplexing System)** window since their functions logically belong there.
- The **Set Embedded Clock** button is not in the **Configure Transducer** window – this function is available from the **Setup** menu.
- The **Configure Transducer** window allows you to set Environmental Parameters without bringing up a separate window.
- The Pulse Rate field is not in the **Configure Transducer** window – it is in the **Configure Echosounder (Multiplexing System)** window since its function logically belongs there.
- The Transmit Power Reduction field is not in the **Configure Transducer** window. It is in the **Configure Echosounder (Multiplexing System)** window. Even though one could imagine switching between high and low transmit power within a cycle, the current DT-X hardware is not able to switch this setting quickly enough to make this feasible. Therefore, the interface restricts you to a single power setting that applies to all transducer configurations in your cycle.

The other buttons in the **Configure Echosounder (Multiplexing System)** window (**Load, Save As, System Info, Data Logging Options**) behave the same as the corresponding buttons in the single-plex **Configure Echosounder** window.
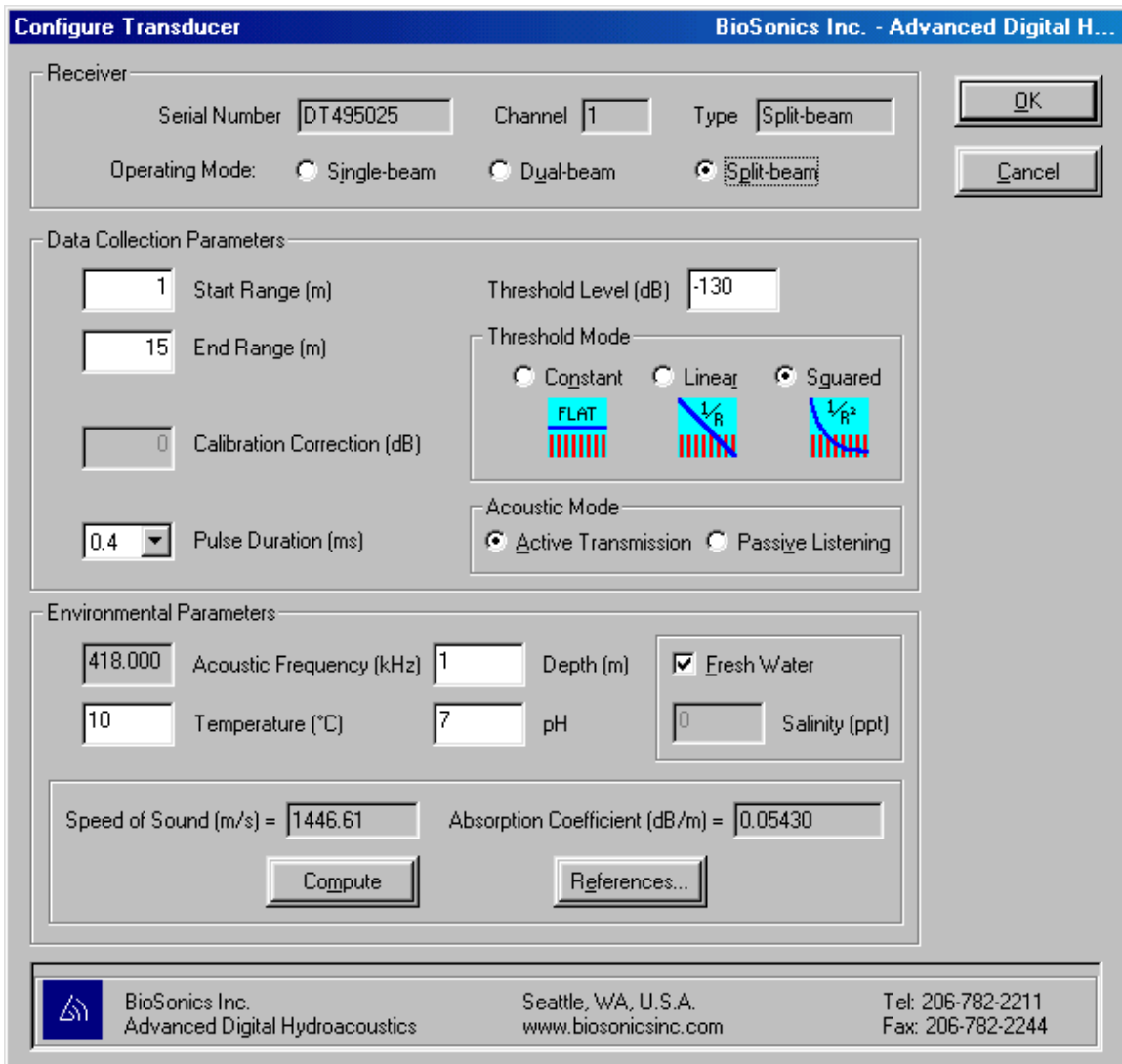
Figure 17. Configure Transducer Window.

The **Pulse Rate** field determines how many times the echosounder will execute the complete sequence each second. If you specify a number larger than what the system is capable of, the system will go as fast as it can. The system behaves as follows. Suppose you have three transducer configurations in your cycle. The system will do one ping using transducer configuration 1, as soon as that is complete it will do one ping using transducer configuration 2, as soon as that is complete it will do one ping using transducer configuration 3. Then, it will pause until it is time to start the sequence over, and then it will do one ping with transducer configuration 1, etc. The system goes through this loop until you tell it to stop pinging.

When you are done setting up your configuration, you can save the settings to a file with the **Save As** button. If you click **OK** in the **Configure Echosounder** window, the configuration displayed in the window becomes the current configuration, which will be used when you start pinging. If you click **Cancel**, then Visual Acquisition goes back to the configuration that was current when you opened the window.

Echosounder Operation

START PINGS. This button activates the DT-X Echosounder transmit and receive function. Electrical signals (conforming to the settings provided by the user and the system characteristics) generated by the surface unit are sent to the transducer, which converts the signals to acoustic energy and transmits those signals into the water. The returning signals (the echoes) are received by the transducer elements, processed and digitized, and sent to the surface unit. The DT-X processes the data and transmits it out of the surface unit ethernet port.

Visual Acquisition "listens" for appropriately formatted data and, upon finding such data, processes it to produce the graphical presentation in an echogram and oscilloscope format on the computer screen (at this point, data is not necessarily being written to a file).

Before the echosounder actually begins pinging, you will see a window reminding you to make sure that your transducers are submerged before continuing (see Fig. 18). **DO NOT** continue unless the transducers are submerged – you can permanently damage your transducers and surface unit.
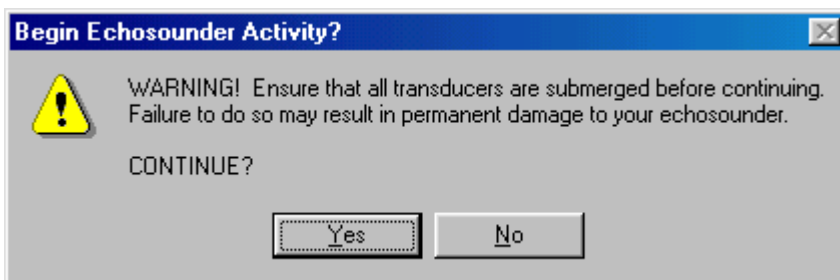
Figure 18. Warning Window.

At this point, if you have used the multiplex configuration interface and your multiplexing sequence has more than one transducer configuration, you will see a window asking you which transducer configuration you want to view data for in the echogram and oscilloscope displays (see Fig. 19).

Figure 19. Transducer Configuration Display Selection Window.

The data for the transducer configuration you select will be displayed in the echogram and oscilloscope. Once you are pinging, you can change which transducer configuration is being displayed at any time by pressing F10 or choosing **Select Transducer Configuration…** in the **View** menu. NOTE: regardless of which configuration is being displayed, when you log data the data from ALL configurations is logged.

When the echosounder begins pinging, you will see the echogram and oscilloscope appear on the screen. The PINGING status indicator at the right of the toolbar will change to green to indicate that you are pinging. The Visual Acquisition status bar (in particular, the ping numbers in pane #3) will be updated as data arrives.

The Ping Number will change at a rate consistent with the ping rate established in the **CONFIG DTX** setup. This is the indicator that the computer is receiving (or "hearing") data. In addition, the green light on the side of the DT-X surface unit will flash, indicating that the transmitter function of the echosounder is operating.

Once the echosounder is in operation, the user options on the toolbar now change to include: **STOP ALL, STOP PINGS, PAUSE PINGS,** and **LOG DATA.**

LOG DATA. This button immediately opens a file and begins writing data to that file. File names will correspond to the user selected options (entered under **CONFIG DTX**) and will be stored in the folder C:\BioSonics\DTX\Data\. The **LOGGING** state indicator at the right of the toolbar will change to green to indicate that you are logging data. The **LOG DATA** button will change to **CLOSE LOG.** Both acoustic and GPS data will be logged until you select **CLOSE LOG, STOP PINGS,** or **STOP ALL.** Each log file will be closed after the time limit you specified in your configuration, and a new file immediately started, until you choose to stop logging.

Files are transmitted from the DT-X surface unit using RTP (real-time transport protocol) and are stored directly to the computer hard-drive. The RTP data stream is also read by Visual Acquisition and displayed as an echogram and oscilloscope output on the computer screen. Once the preset ping or time limit for files has been reached, the program closes the RTP file, opens and names the next RTP file, and then converts the newly closed RTP data into a BioSonics DT4 file format. The DT4 file format allows the data files to be processed by BioSonics Visual Analyzer™, VBT™, and EcoSAV™ (for fish, bottom classification, and submersed aquatic vegetation analyses) software.

START ALL. This button starts pinging and logging at the same time. Note that, when you change your transmit power setting from high to low, or vice versa, the first few seconds of data after you start pinging will not be correct. This is because it takes the system a few seconds to complete the power setting change. In this case, **START ALL** will log some of the incorrect data. If this is a problem, you should do **START PINGS**, wait a few seconds, and then do **LOG DATA**. You will be able to see on the echogram

when the power setting has been completed and the data has stabilized at the correct level.

STOP ALL / STOP PINGS. These buttons have the same function. They immediately terminate the operation of the echosounder and the transmission of signals from the echosounder to the transducer. If a data file is open it is closed. Both the **PINGING** and **LOGGING** state indicators will go back to red.

PAUSE PINGS. This button immediately stops the transmission of signals from the echosounder to the transducer. If a data file is open (data is being logged), the data file is NOT closed and continues to wait for input. When selected, the button function changes to **RESUME PINGS**. This command is helpful when the transducer face needs to be cleared of weeds, or you wish to pause operation without closing the file for some other reason. While you are paused, the **PINGING** state indicator is yellow.

CLOSE LOG. This button will immediately close the active data file and stop logging of all data. The **LOGGING** state indicator changes to red to indicate that data is not being logged. This button changes to **LOG DATA** to give you the option of starting logging again.

MARK EVENT. (Feature not present in this version.) This button will allow the user to annotate received acoustic data during the operation of the echosounder. An example would be in the case of an unexpected observation on the echogram, the user might wish to make a note of the observation and any other conditions noted – such as vessels in the area, marine mammal activity, sea state, etc. Look for this feature in an upcoming release of Visual Acquisition.

PLAYBACK. This button activates a software module that enables you to quickly view DT4-format files. This utility is provided for convenience and is not intended for serious data analysis. BioSonics has several data analysis packages available. See the **Current and New Products…** command in the Visual Acquisition **Help** menu for more information about these. You can also use SonarData's EchoView package.

Selection of this button will prompt you to select a file for playback. Upon identification of a valid DT4-format file, you will be asked which transducer configuration you want to view the data for. The utility will then load the data file and draw the echogram, one screen at a time. The ping that is displayed in the oscilloscope is indicated with a small

blue arrow at the top of the echogram. You can use the commands in the **Playback** menu, or the keyboard equivalents, to move around in the file or to get information about the file. Note that to change which transducer configuration is being displayed from a multiplex DT4 file, you must close the file and re-open it.

OTHER COMMANDS

The following commands have not yet been described. Many are available only through the menus and not from the toolbar.

<u>View</u>. This menu allows the user to modify the layout of the echogram and oscilloscope displays. These options are not available from the toolbar.

    System Information. Displays the system information report (same as displayed after initializing the echosounder, **INIT DT-X**).

    Select Transducer Configuration. When pinging, this allows you to change which transducer configuration is being displayed.

    Oscilloscope Options.

        Toggle Grid. Oscilloscope grid present or absent.

        Toggle Signal Trace Modes. Options for oscilloscope display of signal trace include: color envelope, signal outline and black envelope. Function Key **F2** will also toggle between these modes.

        Amplitude Scaling. The oscilloscope amplitude may be increased or decreased, as necessary for proper viewing. The function keys **F3** and **F4** increase and decrease the scaling, respectively.

        Range Scaling. The end range of the oscilloscope display can be increased (function key **F5**) or decreased (function key **F6**). The begin range of the oscilloscope display can also be increased (function key **F7**) or decreased (function key **F8**).

        Reset Oscilloscope. This resets the oscilloscope to its default amplitude and range scaling.

Diagnostics.

    Network Layer. This command tests communication between VISACQ and the embedded processor. A window informs you whether the attempt was successful. This can be useful for determining whether your network connection is functioning properly.

Help.

    Online User Guide. This command brings up this manual in electronic form.

    X-Series Echosounder Interactive Tour. This brings up a presentation with information about the X-Series Echosounder, and a tour of Visual Acquisition.

    Current and New Products. This brings up information about other BioSonics products.

    About Visual Acquisition. This brings up version and credit information about Visual Acquisition. This is also accessible from the **ABOUT DTX** toolbar button.

Chapter 5: DT-X Echosounder - Quick-Start

This section is intended to provide the experienced user with a reference for setting up and using the DT-X echosounder. Many of the important considerations for equipment settings, file nomenclature, and other items are not discussed here.

Hardware Setup

1. Connect the surface unit to an appropriate external power supply. See Appendix D for specifications.
2. Connect the external communication device (notebook computer) to the surface unit *via* the BioSonics ethernet cable.
3. Connect the transducer(s) to the surface unit **and verify** that the transducers are in the water. If you have more than one transducer connector on the back of your surface unit, make sure that each transducer is connected to the correct connector.
4. If using an external GPS unit, make sure that it is properly connected and then turn on the GPS unit.
5. Turn on the surface unit power switch (inside of the surface unit). The red power light on the side of the surface unit should illuminate. Once the power is ON, the system will load the embedded processor operating system and perform a series of system tests. This process takes approximately 45 seconds. When the embedded processor is ready to receive commands from the User PC, you will hear three short ascending beeps.
6. Turn on the User PC, and wait for the Windows operating system (OS) to fully load.

Data Acquisition

7. Activate the Visual Acquisition program by double clicking the Desktop icon .

8. When presented with the initial Visual Acquisition user interface screen, select the **INTI**ialize **DTX** button and allow the communication link between the computer and the surface unit to be established. Once established (approximately 5 seconds), you will see the DT-X **System Information** report screen. Review the information for consistency with your system.

9. Set the operational parameters for the echosounder by selecting the **CONFIG DTX** button from the toolbar. Fill in the necessary information or recall previous setting by using the **Load** action button (right margin of the window); save the configuration (if desired) and accept the configuration by selecting OK from the action buttons.

10. Ensure that the transducer(s) are in the water and begin pinging by selecting the **START PINGS** button from the toolbar. This will initialize pinging and the DT-X will begin sending and receiving underwater acoustic signals. The status bar at the bottom of the computer screen will indicate both fixed and dynamic information about the operation of the echosounder. The Visual Acquisition echogram and oscilloscope will appear and display the acoustic data as it is received. At this point, data is being written to the screen, but not stored to file. Operation can be confirmed by the blinking green status light on the outside of the echosounder. If you are multiplexing, then before pinging starts you will be asked which transducer configuration you want to display data for.

11. To begin logging the data to file (on the User PC), select the **LOG DATA** button from the toolbar. This will open a data file and begin recording data on the User PC. The **LOG DATA** option changes to **CLOSE LOG** . Note: instead of selecting **START PINGS** and **LOG DATA** separately, you can select **START ALL** to start pinging and logging at the same time.

12. While in operation, there are options for **STOP PINGS (**to stop the operation of the echosounder and close the data file) , **PAUSE PINGS** (to temporarily suspend transmission of acoustic signals from the transducer, leaving the data file open) , **STOP ALL** (to stop all logging and echosounder operation).

System Shutdown

13. To stop pinging and logging data to file, select the **STOP ALL** button. The data file will be closed, and all transmission and reception of acoustic data will cease. The transducer may be safely removed at this time.

14. Select **Setup** / **Shut Down Embedded Controller** from the text menu.

15. Select **Setup** / **Exit VISACQ** from the text menu.

16. Turn off the surface unit by using the rocker switch on the interior face of the echosounder. The red power indicator light will extinguish.

Playback

17. Select the **PLAYBACK** button from the toolbar. Select the file that was created when you logged your data. You will be asked which transducer configuration you want to see the data for. The echogram and oscilloscope will appear. The ping in the oscilloscope will be indicated by a small blue arrow at the top of the

echogram. Use the commands in the **Playback** menu, or their keyboard equivalents, to navigate around the file.

This Quick-Start section is intended to provide the user with a reference for operation of the DT-X Echosounder system. To ensure collection of quality data and to avoid damage to the system, BioSonics recommends that you read this entire user guide and become familiar with all of the operational requirements of the DT-X.

Appendices

Appendix A: Visual Acquisition (VISACQ) Directory and File Structure

The BioSonics Visual Acquisition software is normally installed on your computer by BioSonics and tested with the complete DT-X echosounder system.

Should you need to install the software on a new computer, the following method will enable proper operation of the software.

Insert the BioSonics software CD into an accessible CD drive. The installer should run automatically. If not, browse to the drive, using Windows Explorer®. Double click on the file named Setupvx.x.x.x.exe (where the x's are actually numbers, the build of VisAcq that is being installed).

> *Do not attempt to upgrade an existing system to Visual Acquisition 5.0.2 without assistance from BioSonics. We will connect to your computer via the internet and perform the installation for you. This will ensure preservation of your data files.*

The installation process will guide you through the setup. You will be asked for your registration code. This should be on your CD, in a file called something like "Reg Code xxxx.txt". Use the Browse button to find this file. Visual Acquisition is installed in the folder C:\BioSonics\DTX.   Your data files by default are stored in the folder C:\BioSonics\DTX\Data.

Appendix B: Network Communications Settings

The external communication device, most commonly a notebook computer running under the Windows operating system, must be set up to enable network communication with the DT-X echosounder. The computer must be equipped with a network interface card[*] (NIC). If BioSonics installed your Visual Acquisition software, then the network parameters will already be set up correctly. Note that the standard configuration for the DT-X is that the echosounder and notebook computer share a direct Ethernet connection and neither is connected to any other network.

> **WARNING**: Connecting any part of your X-Series Echosounder System (User PC or Surface Unit) to the Internet poses the usual, potentially serious, security risks. Commercially available internet firewall software can lessen this risk.

This installation guide assumes that you have already successfully installed your network interface card or other ethernet communication device.

Windows enables the user to set up the communication parameters, but each version of Windows has a slightly different set of requirements and menus. The following sections describe the setup procedure for Windows 98/ME and for Windows 2000.

---

[*] A network interface card is used to connect a computer to an ethernet network.

Network Setup for Windows 98/ME

From the Windows **START** menu, select **Settings** / Control **Panel** / **Network.**
The window that opens will be titled **Network**
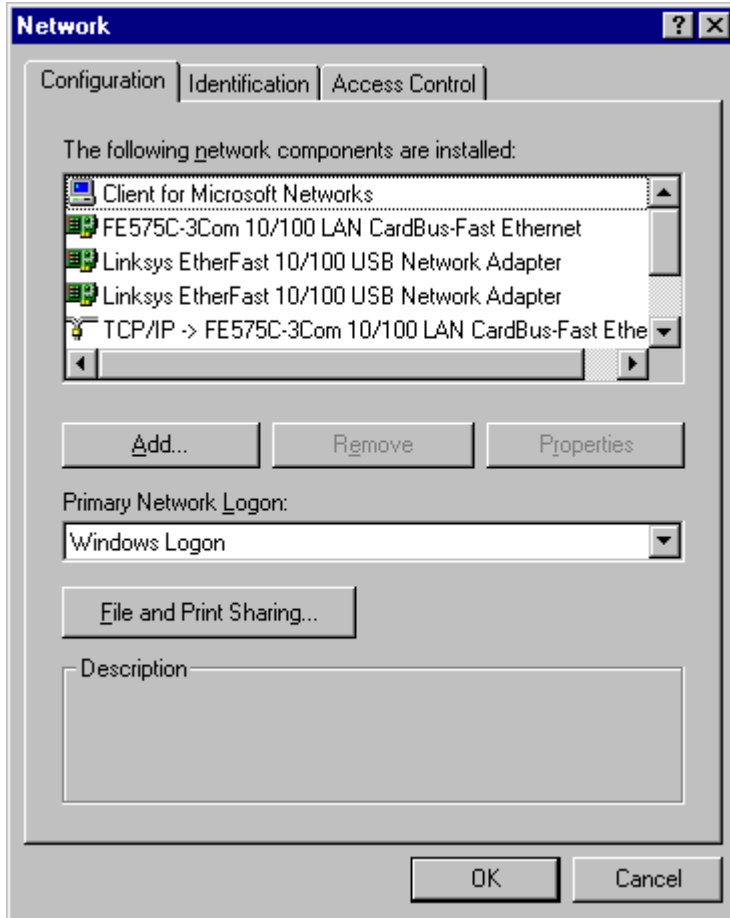
From the list of installed network components, locate the appropriate ethernet communication device (in this case it is the FE575c-3Com 10/100 LAN Card Bus-Fast Ethernet). Scroll down the list until you locate the TCP/IP protocol for your ethernet device (in this case TCP/IP -> FE575c-3Com 10/100 LAN Card Bus-Fast Ethernet). Highlight this line (click with the mouse), and then click the **Properties** button.
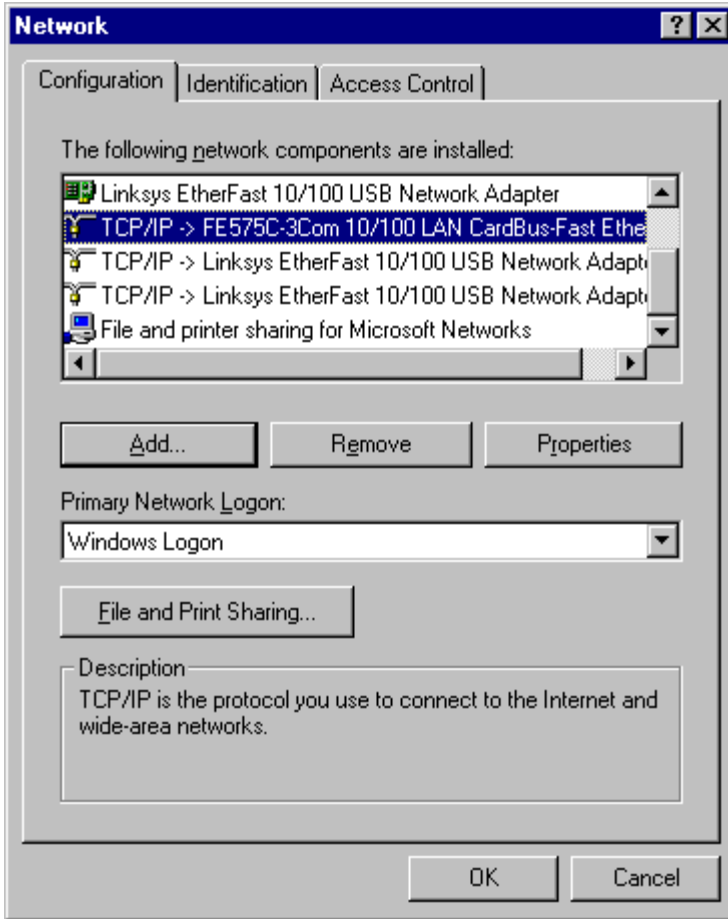
Another window will open and you will be presented with several network options.
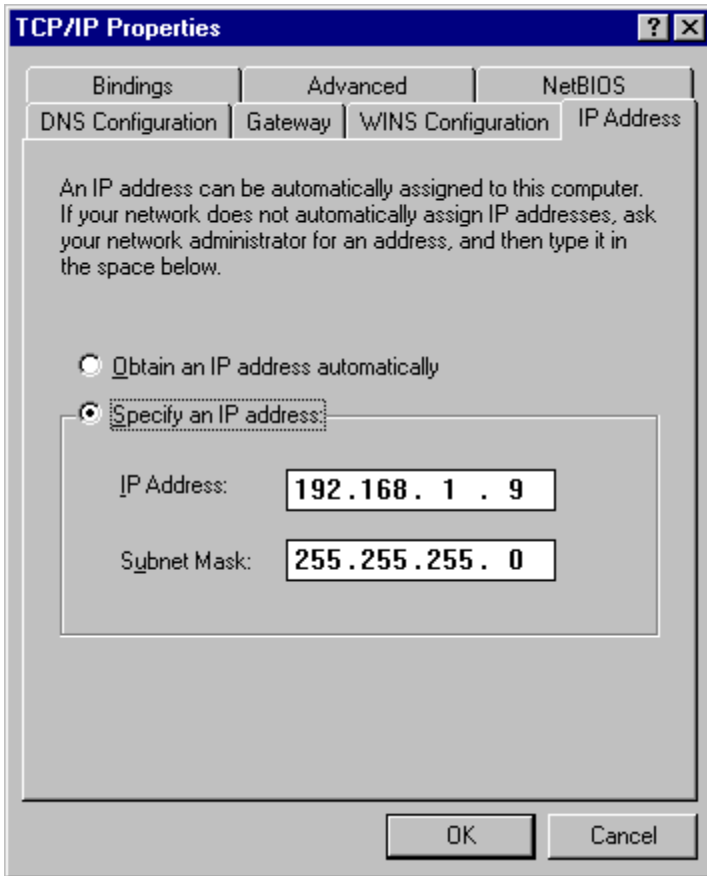
Select the **IP Address** tab. Click on the **<u>S</u>pecify an IP address** button (a black circle will appear and the window below the line will become active). Enter the **<u>I</u>P address** value of 192.168.1.9, as shown above, and the **S<u>u</u>bnet Mask** value of 255.255.255.0. Accept these values by clicking the **OK** button.

You may be asked to insert your operating system CD to complete the setup. If you don't have your CD available, these files are often already loaded on your computer, but you must direct Windows to look in the proper directory on your hard drive.

You will have to reboot your computer for these values to take effect.

You are now ready to test your system (see Quickstart).

Network Setup for Windows 2000

From the Windows Start menu, select Settings > Network and Dial-up Connections. That will bring up the following window.

On most computers, there is only one ethernet connection available. The icon for an ethernet connection looks like the highlighted icon above. Most computers only have one ethernet connection available. If you have more than one, you must decide which one you want to use to communicate with the echosounder. Double-click on the ethernet connection icon. That brings up the following window.
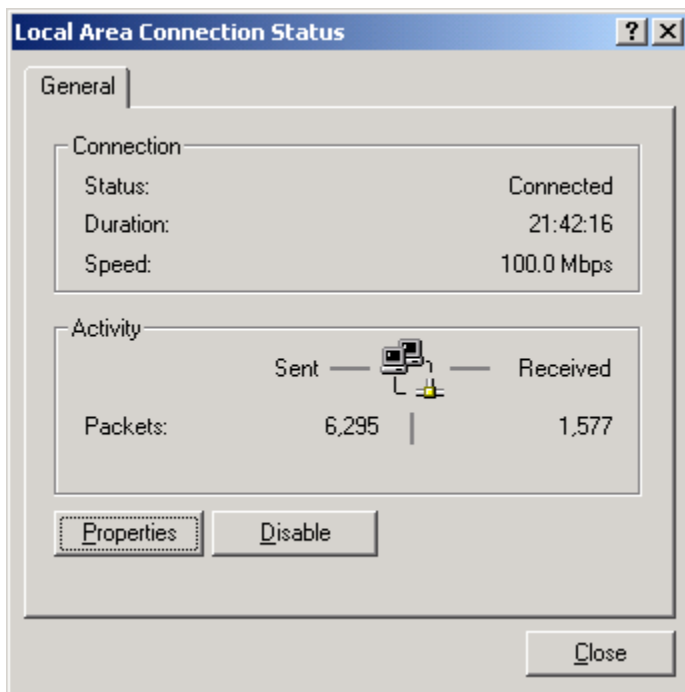
Click Properties, and then, in the window that comes up, select Internet Protocol (TCP/IP). The window should look like this:
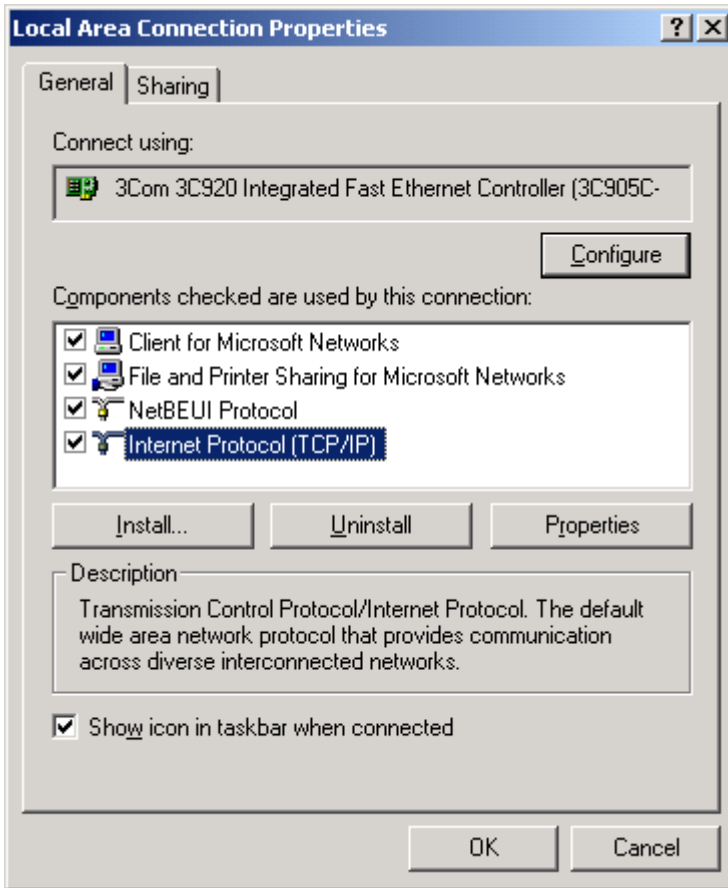
Click Properties, and then enter values as follows:
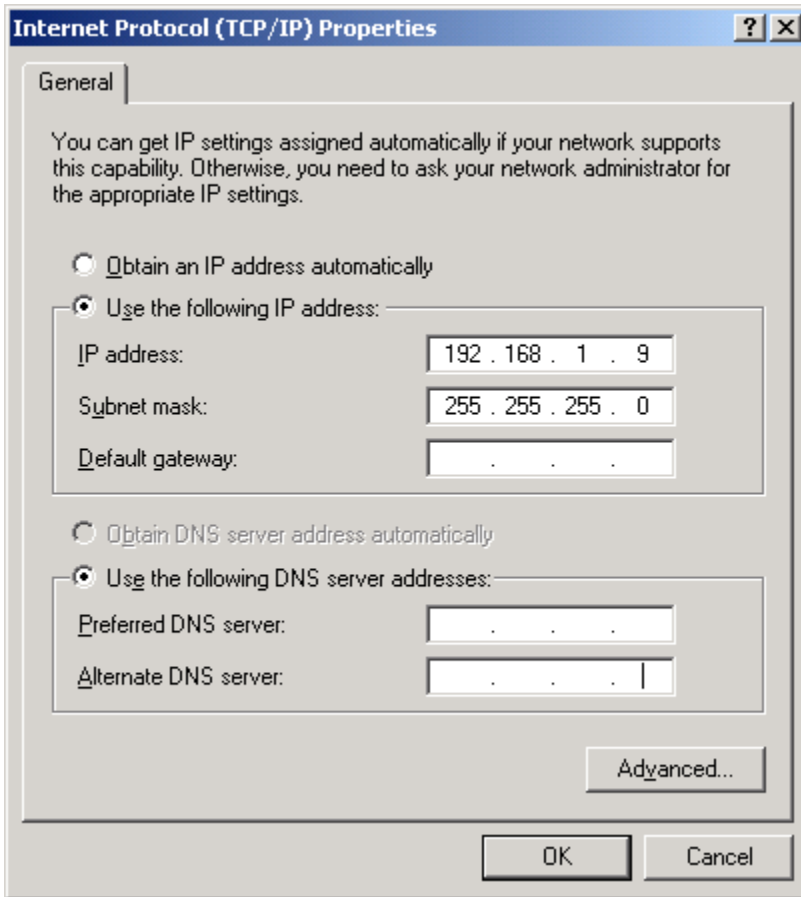
Click OK in this window, OK in the Local Area Connection Properties window, and Close in the Local Area Connection Status window. Restart your computer if it asks you to.

You are now ready to test your system (see Quickstart).

Appendix C: System Troubleshooting

The operation of Visual Acquisition and the BioSonics DT-X and DE-X echosounders has been designed to provide the user with operational cues and feedback to enable reliable setup and operation. The complex nature of the equipment and hardware, which allows for extensive user control and reliable operation, requires that the user be familiar with the theory and application of hydroacoustics, as well as the operation of Visual Acquisition and the BioSonics Digital Scientific Echosounders.

Our Troubleshooting Appendix is currently being expanded. We encourage you to call our X-Series support staff: (206) 782-2211 9 a.m. – 5 p.m. PST, or email software@biosonicsinc.com.

Surface unit power lights do not come on when switch is in the ON position.
> Check appropriate (AC or DC) power connections at the surface unit and at the power source. Make sure that there is AC power or DC power meets the system requirements. See Appendix D.

When Initializing DTX **, the message "Cannot Establish Connection" appears.**
> The VISACQ program has failed to establish a connection with the DT-X echosounder. This can be caused by several issues.
>
> The first to check is that your network settings (TCP/IP) are correct. See Appendix B.
>
> Next, check the ethernet connections at the surface unit and at the computer. Make sure that the connections are good. Reboot the computer.
>
> Make sure that the echosounder is powered on and you have heard the three ascending beeps that indicate the embedded processor is ready to accept commands.

When pinging, there are no GPS coordinates displayed in the VISACQ status bar.
> Ensure that the GPS connections are good.
>
> Ensure that the GPS is on.
>
> If you are using a GPS receiver NOT supplied by BioSonics, make sure that the data output string conforms to NMEA 0183 (see your GPS owner's manual).

Appendix D: Technical Specifications

1) Power supply:
Power can be supplied from:
    85-264 VAC, 47 – 440 Hz, 2 A (max.) or
    11- 14 VDC, 5A (max.)

2) Grounding (Earthing)

Equipment grounding is through the power supply cord. Protective grounding should be connected to the power supply unit when operating this equipment.

3) Environmental conditions

The DT-X echosounder is designed for working on permanent installations and from boats and ships. The Surface Unit is designed to be used on deck or inside the boat and transducer and transducer cable are designed to be deployed in the water. The Surface Unit is weather resistant but should be protected from flowing water.

Temperature:
Operating: -10 ° F to 130 ° F (-23 ° C to 54 ° C)
Storage: -40 ° F to 158 ° F (-40 °C to 70 ° C)

Maximum transducer deployment depth (standard design):
a) up to 100 meters (below surface) for digital transducers (DT-X series)
b) up to 30 meters (below surface) for analog transducers (DE-X series)

4) WARNING
a) Users of this equipment should follow the procedures and guidelines presented in the BioSonics Users Manual. Equipment should be not be used for purposes other than specified by the manufacturer.
b) The power cord should be connected to the Surface Unit **before** connecting/disconnecting instrument to/from the power supply.
c) Transducer(s) **must be submerged in water** when the echosounder transmitter is turned on. The transducer and surface unit components can be damaged if not submerged when activated.
d) Only qualified, trained service personnel should remove the cover from the instrument. User opening of the echosounder unit or transducer housing may invalidate BioSonics warranty.
e) For continued protection of the echosounder against fire, replace the fuse only with an identical type and rating.
f) Do not install substitute parts or perform any unauthorized modification to the instrument. Return the instrument to BioSonics, Inc for service and repair to ensure that safety features are maintained.
g) Do not expose transducer or any other parts of instrument to excessive heat.

Appendix E: Recommended Settings and Limits

The BioSonics scientific echosounders use the physical constants of sound and time to perform their SONAR tasks. Precise measurement of these values enables the collection and analysis of reliable acoustic data.

Without a basic knowledge of acoustic science, it is possible to configure the echosounder in such a way as to "try" to ignore the laws of physics – such as attempting to exceed the speed of sound in water.

In addition, the physical construction and the electronics comprising the BioSonics scientific echosounders impose their own limitations on what the system can be expected to do. For these reasons, BioSonics provides the following recommendations for operation of the echosounder.

Recommended Limits

Maximum ping rate: 30 pps (depending on operational mode, range, and target threshold).

Maximum range [(end range) – (start range)]:
        Not to exceed 995 meters for single beam transducer (operating mode).
        Not to exceed 497 meters for dual beam transducer (operating mode).
        Not to exceed 248 meters for split beam transducer (operating mode).

Total maximum distance (from transducer face):
        Not to exceed 1137 meters for all transducers (operating mode).

Appendix F: Glossary of Terms Important to Underwater Acoustics

A/D Conversion

Analog to Digital (A/D) Conversion. A device used to convert a continuous time (analog) signal into digital form. Specified by the number of bits per sample and the number of samples per second (sampling rate).

Absorption

Loss of acoustic signal strength due to conversion of acoustic energy into heat. The dominant cause of absorption below 100 kHz is due to ionic relaxation of the magnesium sulfate (MgSO4) molecules in seawater.

Absorption Coefficient

The rate of Absorption per unit distance. Represented by the letter α, the absorption coefficient gives the attenuation of the sound level in dB/m during the transmission of the signal through water. This attenuation can vary according to the seawater conditions (particularly salinity). For example, the absorption in sea water at frequencies between 5 and 50 kHz has been found to be up to 30 times that in distilled water. It also increases with the square of the frequency.

Acoustics

The branch of the science of physics that deals with sound.

Acoustic Axis

The center of the acoustic sound field characterized by the highest intensity. The direction of maximum in-phase condition or maximum correlation.

Acoustic Beam

The cone shaped volume of water which is filled with pulses of sound when a transducer is transmitting.

Acoustic Calibration

A method of measuring the acoustic transmission and receiving characteristics of the echosounder and the directivity function of the transducer.

Ambient Noise

The minimum level of noise present from biological and electro-mechanical sources.

Attenuation

The decrease in signal strength due to several factors, including geometric spreading, absorption, shading, and multiple scattering. Total attenuation is typically a function of range, and must be accurately compensated for in quantitative processes.

Back-scattering Cross Section

A measure of the reflectivity of a target. Target strength is equal to 10 times the $\log_{10}$ of the Back-scattering cross section (sigma or σ_{BS}).

Background Noise

Sound or electrical energy in the acoustic system from sources other than the desired targets.

Bandwidth

The bandwidth of an amplifier is given as a difference between the two frequencies (in Hz) where a drop of 3 dB occurs in the amplification on each side of the center frequency. Bandwidth of an echosounder should be set to approximately 2/pulse length. For example, a transmitted pulse of 1 msec. should be received through a 2 kHz bandwidth.

Beam Width

A nominal value in degrees describing the full angular width of the acoustic sound cone, usually determined by the angle at which the transducer directivity pattern is 3 dB down for one way transmitting or receiving. The accepted symbol is θ.

Beam Width (½ power)

A theoretical cone that is confined by the angle at which the transmitted energy of a transducer has dropped by one half. It is used to compare expected sample volume among transducers.

Beam Width (effective)

The angular width of the underwater sound beam in degrees (dependent on many factors, including transducer electronics, echosounder transmit power, echosounder receiving sensitivity, and target strength of the organism being sampled.

Bioacoustics

The study of the relationship between living organisms and sound.

Calibration

Scientific measurement of the transmitting and receiving performance of an acoustic system, including transducer directivity measurements.

Decibel

A logarithmic system for expressing the wide range of values in the sonar equation. Intensity level in decibels (dB) is defined as $10 \log (I_1/I_{st})$, where I_1 is the intensity of sound at a given point in an acoustic field, and I_{st} is a standard or reference intensity. For power, a 3 dB change corresponds to a factor of 2. For voltage gain (voltage squared is proportional to power), a 6 dB change corresponds to a factor of 2, since voltage level in dB is $20 \log (V_1/V_{st})$.

Directivity Pattern

A map of relative sensitivity or efficiency of a transducer in transmitting or receiving acoustic signals. Highest sensitivity of 0 dB is on axis, and sensitivity falls off (directivity function becomes negative) as the angle from the axis increases.

Dynamic Range

The range of signals that can be simultaneously and instantaneously processed without clipping large signals and losing small targets in the noise. Higher values are beneficial.

Echo

Sound energy transmitted by the echosounder and reflected by a target of density differing from the medium in which the sound is traveling.

Echogram

A (paper or electronic) display of a time series of received echo pulses. The Y axis is range or depth, while the X axis represents a time series (minutes).

Echosounder

Electronic instrument comprised of an acoustic transmitter and echo receiver which, when connected to an underwater transducer, detects underwater targets.

EEPROM

Electrically **E**rasable **P**rogrammable **R**ead-**O**nly **M**emory. An integrated circuit or "chip" that can have programming instructions dynamically loaded. Systems with EEPROMS can easily be upgraded when software changes or new algorithms are introduced.

Fisheries Acoustics

Acoustics applied to fisheries research and management.

Frequency

The number of pressure maxima (or minima) passing a fixed point in one second. Units are Hertz (Hz) or kilohertz (kHz). Deep-water marine echosounders typically operate at frequencies of 20-70 kHz. Riverine sonar systems usually operate in the 100-500 kHz range. Systems for studying plankton operate in the 400-2000 kHz range.

Geometric Spreading

The increase in the ensonified cross-sectional area with distance traveled by the sound wave. This process can be visualized by watching the rings spread when a rock is thrown into still water.

GPS

Global Positioning System. GPS receivers track satellites and provide current data on time, Latitude and Longitude.

Hertz

A unit of frequency equivalent to one cycle per second. It is also used to characterize the A/D sampling rate (samples per second). Kilohertz (kHz) is 1000 Hertz or 1000 cycles per second.

Hydroacoustics

Hydroacoustics is the application of controlled sound energy in water to remotely obtain information about the physical characteristics of the water body, its bathymetry, or biotic populations.

Hydrophone

An instrument used for listening to sound transmitted through water.

In-Situ

"In the original location". Used to describe fish targets in their free-swimming, undisturbed state.

Intensity

The power (amount of energy per second) crossing a unit area.

Kilobytes

One thousand bytes, used to measure storage space for computer files.

MicroPascal

Standard unit of pressure often used in scientific sonar systems, equal to 1 millionth of a Pascal. A Pascal is a unit of pressure equal to the pressure resulting from a force of 1 Newton, acting uniformly over an area of 1 square meter.

Multiple Targets

More than one target within the pulse resolution volume.

Multiplexing

The use of two or more transducers with a single X-Series Echosounder surface unit. The BioSonics X-Series Echosounder supports multiplexing up to sixteen transducers.

Near Field

The distance from the transducer within which the sound pressure wave is not coherently formed. Quantitative measurements should not be made inside this range due to fluctuating intensity.

Noise

Unwanted signals that interfere with the signals to be quantified. Sources include self (internally generated) noise, received noise radiated into the system through the transducer cable, flow noise from water passing across the transducer at high velocity, volume reverberation noise from unwanted particles, bubbles, or animals distributed throughout the sound field or from the sound field grazing a boundary, and false targets (such as rocks, debris, resident fish, etc.).

Noise Floor

The self-noise expressed as an on-axis target strength, i.e. the smallest target strength of an organism that can be detected at the closest range.

Oscilloscope

An instrument for displaying and measuring signals (voltages).

"Parameter-plexing"

Pinging from a single transducer while alternating between two or more configurations. For example: Parameter-plexing three configurations (A,B,C) on a single transducer would yield the following ping sequence: A | B | C | A | B | C | ...

PC Card

A standardized input/output format for plug in memory cards designed for laptop computers as defined by the **P**ersonal **C**omputer **M**emory **C**ard **I**nternational **A**ssociation (PCMCIA). The cards themselves are also referred to as PC Cards.

PCMCIA
<u>P</u>ersonal <u>C</u>omputer <u>M</u>emory <u>C</u>ard International <u>A</u>ssociation. Commonly called PC cards, these credit card sized units plug into slots in computers to provide connectivity to a wide variety of other devices (modems, Ethernet, SCSI, etc). Some modern acoustic systems connect to the computer via the PCMCIA slot.

Phase
The time relationship of one sine wave to another (symbol ϕ, units in degrees).

Power
Amount of energy per second. A typical unit of acoustic power is the watt.

Pressure
A type of stress that is exerted uniformly in all directions; its measure is the force exerted per unit area. A typical unit is a dyne per square centimeter.

Pulse Rate
Number of pulses transmitted per unit time. Since traditional echosounders must receive echoes before transmitting the next pulse, pulse rate is limited by range of ensonification.

Pulse Width
The duration in time (usually milliseconds) of the transmitted pulse. Also called pulse duration or pulse length.

Range
Distance from the transducer face to the target. Often used synonymously with depth in vertical sounding. Typically expressed in meters, but often expressed in terms of the time interval between transmission and reception of the echo (in msec).

Range Resolution
The minimum range separation between distinguishable targets. For a monotone pulse acoustic system, the range resolution is equal to $c\tau/2$, where c is the velocity of sound through the medium and τ is the pulse length transmitted by the echosounder.

Receiver
The component of an echosounder that receives and conditions the signals from the transducer.

Receive Sensitivity
Number of dB volts or dB counts (relative to 1 volt or 1 count) coming out of the receiver for a given acoustic pressure at the transducer face.

Reverberation
Acoustic interference caused by scattering of objects other than those of interest. The main sources of reverberation in fisheries acoustics are the bottom, surface, other boundaries, air bubbles, plankton, and particles in the water.

Root Mean Square (RMS)
The square root of the averaged sum of all squared values of a waveform (symbol RMS).

Side Lobe

All transmit\receive beams of a transducer except the main beam.

Signal-to-Noise Ratio

The amount by which a signal exceeds noise, or is below noise (symbol SNR, unit dB).

Single beam Sonar

An echosounder designed to measure range to a target, using acoustic energy to generate an echo. Sound is transmitted (through a medium, such as water) and the SONAR measures the time energy takes to travel to and return from the target.

"Single-plexing"

The simplest use of an X-Series Echosounder: one surface unit, one transducer.

Sonar

All SOund NAvigation and Ranging systems, but usually reserved for near horizontally directed beams.

Source Level

The transmitted sound pressure in dB relative to 1 µPa measured 1 meter from the face of the transducer.

Split beam Sonar

An echosounder designed to directly measure target strength. The position of a target in the sound field is calculated by accurately measuring the differences in an echo's arrival time to individual elements in the transducer.

Standard Target

A target with known acoustic size. Standard targets are designed to be omni-directional, and have stable reflective properties with depth and temperature. Examples include tungsten carbide and copper spheres.

Target

An object to be detected, located or measured.

Target Strength

A measure of the reflecting power of a target expressed in decibels. The ratio of the acoustic intensity I_R reflected from a fish and measured 1 m away, to the incident acoustic intensity I_i, $10 \log I_R/I_i$. The technical definition of target strength is based on a perfectly reflecting sphere of 2 meters radius having a target strength of 0 dB.

Threshold

The least value of a voltage, pressure, current, or other quantity that produces the minimum detectable response in an instrument or system. A chosen signal level below which no signals are processed.

Time Varied Gain (TVG)

An instantaneous amplification with range (time) applied to a received ping to compensate for transmission losses, including spreading loss and absorption. The TVG may be applied in hardware in analog systems and in software in digital systems.

Transducer

A transducer converts electrical energy into acoustic energy in transmission mode and converts acoustic energy to electrical energy during receiving. The efficiency in this conversion process is a function of angle is called directivity. Transducers for most scientific sounders are very efficient through a narrow frequency range.

Transmitter

The component of the echosounder that produces the high-energy electrical pulse at the required frequency to be converted to acoustic energy by the transducer.

Trigger Pulse

A pulse generated either by an external device or internally by hardware or software, occurring at the time of transmission, and used to synchronize processes in all system components.

Velocity of Sound

The speed of sound traveling through a medium. Usually expressed in units of meters per second, the velocity of sound in water is about 1500 m/sec.

Wavelength

The distance traveled by a sinusoidal wave of the acoustic frequency in a time equal to the period of the sine wave. The wavelength, represented by λ, is important in determining the directivity of the transducers and the scattering characteristics of various sized targets.

Appendix G: Frequently Asked Questions (FAQ's)

Q1: How can I change the setup of my echosounder while it is running?

A2: It is not possible to manually change the settings on the fly. Since the operational parameters are constructed on the external communication device (notebook computer) and sent to the embedded processor (within the surface unit) upon selecting **OK** from within the **CONFIG DTX** window, the echosounder ignores input for operational changes, until the current activity is stopped.

The user can set and load a new set of operational parameters and then re-initialize the echosounder *via* the following sequence: enter the new parameters using the **CONFIG DTX** window and select **OK**. Then select **STOP PINGS** to finish pinging with the old configuration, and **START PINGS** to start pinging with the new configuration.

Q2: I am working in a "weedy" environment. Often, the transducer will become covered with loose plant material and I am afraid of degrading my acoustic data. What should I do?

A2: You are correct: anything, other than targets of interest, within the acoustic beam can degrade the ability to detect and record accurate target data. While collecting data in such an environment, you should try to keep plant material (or other surface matter) from accumulating on the transducer face. You might devise a mechanical means for this (e.g., a deflector up-current from your transducer), or you may need to physically handle the transducer and clear this material. **DO NOT BRING THE TRANSDUCER OUT OF THE WATER WHILE IT IS PINGING!** Doing so will damage your transducer, possibly your surface unit, and void your warranty.

The Visual Acquisition function **PAUSE PINGS** is useful in such an instance. Simply select PAUSE **PINGS** from the menu, wait until you receive the message that the DT-X has temporarily ceased activity, clear the debris from your transducer and return the transducer to the water. You may then select the **RESUME PINGS** option from the menu and the echosounder will resume pinging. During this process, your data file will remain open and the "pause" will result in a data gap for the time (and distance if you are moving), that the system was paused.

Q3: I can't find my data files!

A3: Data files are stored, by default, in the directory: C:\BIOSONICS\DTX\DATA. You will find data with **DT4**, RTP, and NME file name extensions. The **DT4** format is that used by BioSonics analysis software packages (Visual Analyzer, VBT, and EcoSAV). The RTP format is that used to send acoustic data from the echosounder to the computer. The NME format is that used to send NMEA0183 data, such as GPS, from the echosounder to the computer. For file maintenance, see the next question.

Q4: My hard drive is getting full, what should I do?

A4: Do NOT delete the **RTP** and **NME** files – they are the raw data files. As explained in Question 3, data files are stored in three formats. Each format has a purpose and a value. The **RTP** and **NME** formats are used to communicate data between the echosounder and the external computer, for display and storage purposes. The **DT4** format is used by BioSonics (and other vendors') analysis software.

It is always wise to back up your data, and this is no exception. It is sufficient to back up the **RTP** and **NME** files (to another hard drive, CD, or other media).

The BioSonics utilities **RTP2DT4.exe** and **_convert.bat** (subdirectory: BioSonics\DTX\execs) can be used to convert **RTP** and **NME** files to **DT4** files. Therefore, if space is short, the **DT4** files can be deleted and recreated later. Again, do NOT delete the **RTP** and **NME** files – they are the raw data files.

Q5: How do I report bugs?

A5: The best way is to email bug reports to software@biosonicsinc.com.
Including the information below will help us to reproduce your observations more easily:
1. Your system setup: (transducer(s) frequency & mode, cable length(s),system settings, operational parameters, etc.)
2. What you observed (the problem)
3. Steps necessary to reproduce the problem (if possible)
4. What you expected to happen.
5. What happened instead.
6. Any other information that you feel is pertinent, including a copy of the data, if relevant.

Alternatively, or in addition, you may call BioSonics at (206) 782-2211 during normal business hours (US Pacific Coast time), Monday through Friday.