IMAGENEX TECHNOLOGY CORP.

MODEL 852-000-145
ULTRA-MINIATURE DIGITAL
ECHO SOUNDER

ECHO SOUNDER S/N _____

IS CONFIGURED FOR:

_____ VDC INPUT

_____ @ 115.2 kbps

IMAGENEX TECHNOLOGY CORP.
209-1875 BROADWAY STREET
PORT COQUITLAM, B.C.
CANADA, V3C 4Z1

TEL: (604) 944-8248
FAX: (604) 944-8249

IMAGENEX MODEL 852
ULTRA-MINIATURE 11000 m ECHO SOUNDER

APPLICATIONS:

- ROV Navigation
- Diving Support
- Inspection
- Search & Recovery

FEATURES:

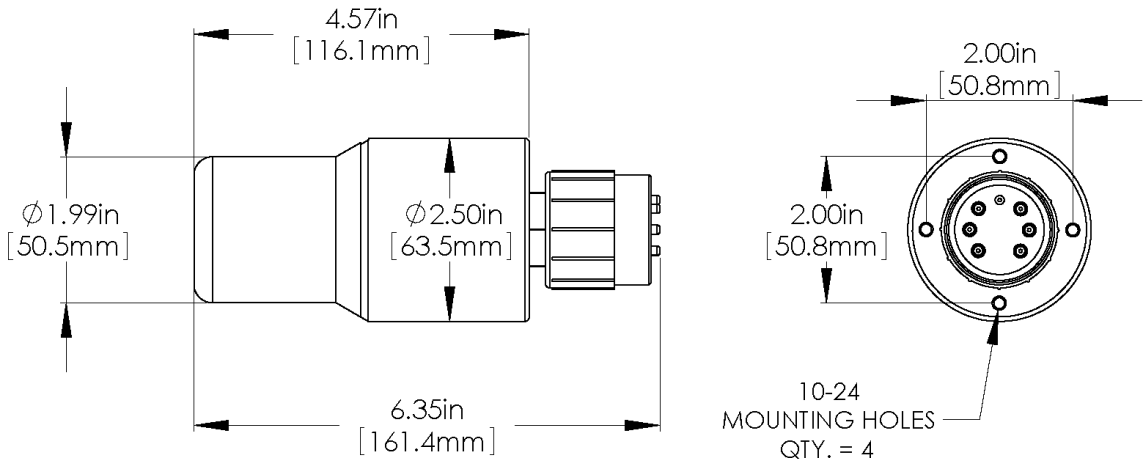
- Ultra-miniature size is ideal for mounting on today's micro ROV's
- Low cost
- Direct connection to laptop computer
- External trigger available

The Model 852 Digital Echo Sounder was designed for use with the smallest of ROV's. For maximum flexibility, the unit requires approximately 1.5 Watts from 24 VDC, or optional 48 VDC. Serial communication is utilized, RS-485 or RS-232 at 115.2 kbps. The maximum operating range is 50 meters.

HARDWARE SPECIFICATIONS:	
FREQUENCY	330 kHz
TRANSDUCER BEAM WIDTH	30° Conical
RANGE RESOLUTION	20 mm
MIN. DETECTABLE RANGE	500 mm
MAX. OPERATING DEPTH	11000 m
MAX. CABLE LENGTH	1000 m on typical twisted shielded pair
INTERFACE	RS-485 @ 115.2 kbps (RS-232 optional)
CONNECTOR	BH6M-Titanium
POWER SUPPLY	22 – 30 VDC at less than 1.5 Watts Optional 40 – 56 VDC
DIMENSIONS	See drawing
WEIGHT: In Air **In Water**	~913 g (~2 lbs) ~0.75 kg (~1.7 lbs)
MATERIALS	6AL4V Titanium, PVC, Epoxy
FINISH	Natural

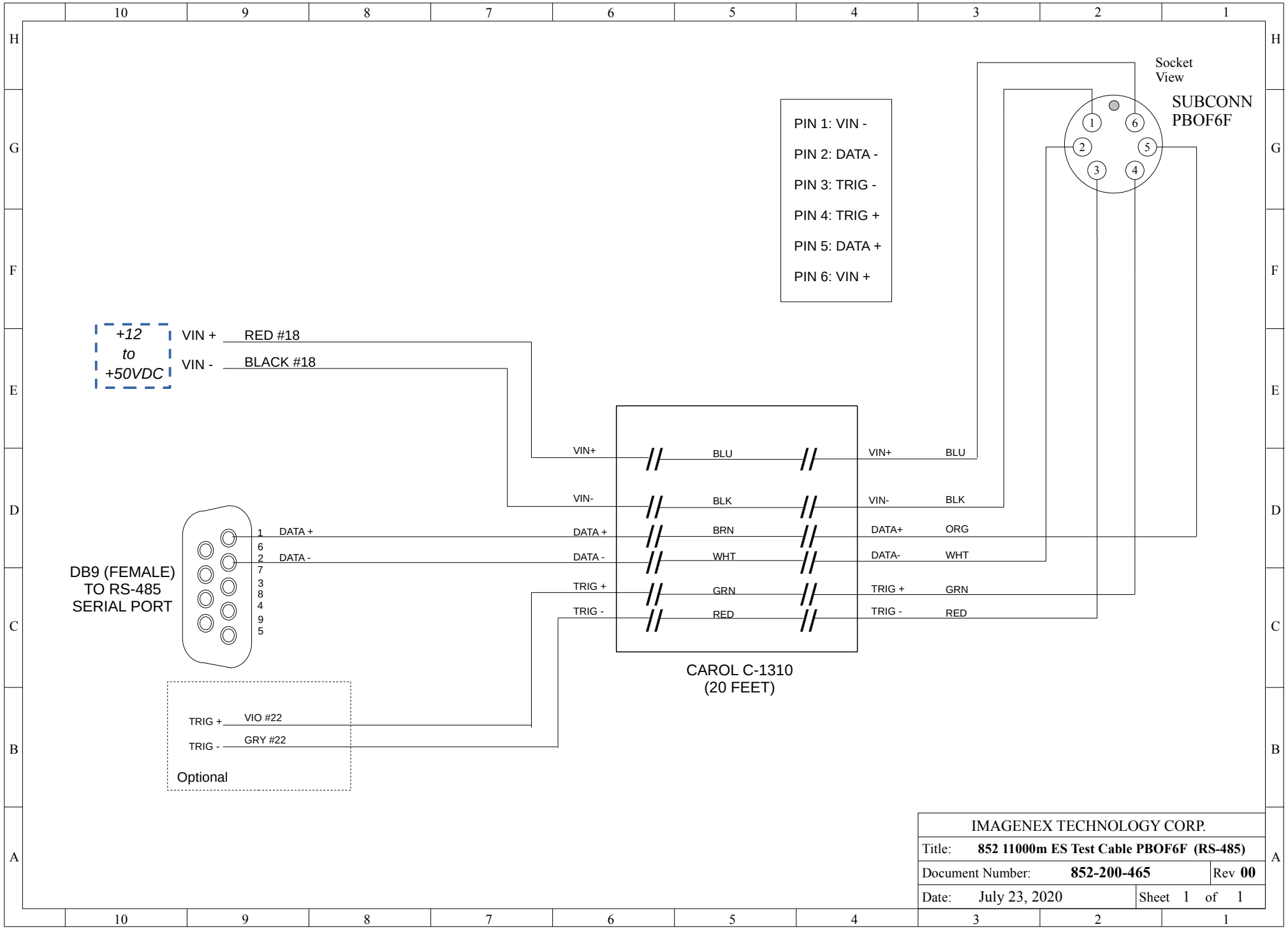
Copyright © 2009 - 2019
Imagenex Technology Corp.

SOFTWARE SPECIFICATIONS:	Win852.exe
WINDOWS™ OPERATING SYSTEM	Windows™ XP, Vista, 7, 8, 10
MODES	Echosounder
RANGE SCALES	5 m, 10 m, 20 m, 30 m, 40 m, 50 m
EXTERNAL INPUT	Depth, Heading, Turns
FILE FORMAT	(filename).852
RECOMMENDED MINIMUM COMPUTER REQUIREMENTS:	100 MHz Pentium 16 MB RAM 1 GB Hard Disk 800 x 600 x 256 colour graphics

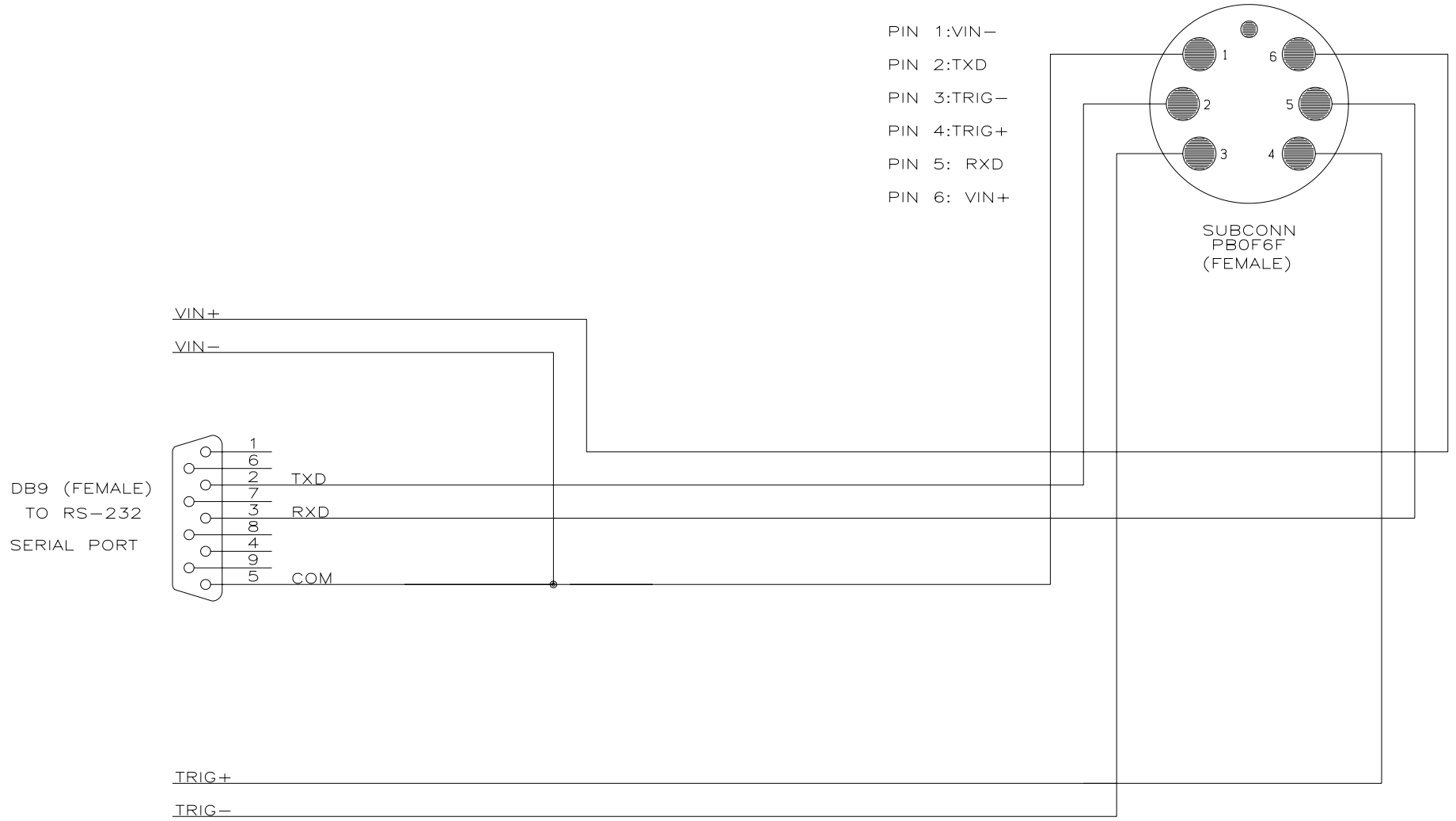


ORDERING INFORMATION:		
11000 m UNIT	Standard	852-000-145
RS-232	Option	-006
40 – 56 VDC	Option	-013

Product and company names listed are trademarks or trade names of their respective companies.



IMAGENEX TECHNOLOGY CORP.		
Title:	**852 11000m ES Test Cable PBOF6F (RS-485)**	
Document Number:	**852-200-465**	Rev **00**
Date:	July 23, 2020	Sheet 1 of 1



IMAGENEX Technology Corp.		
Title: 852 11000M TEST CABLE (RS232)		
Size: A	Document Number: 852−200−243	REV: 01
Date: March 2, 2009	Sheet 1 of 1	

IMAGENEX TECHNOLOGY CORP. **18FEB16**

MODEL 852 ULTRA-MINIATURE DIGITAL SCANNING SONAR HEAD and ECHO SOUNDER

WIN852.EXE: Display Software For Windows XP/Vista/7/8/10

VERSION 2.09

OVERVIEW

WIN852 is a Windows program that controls, displays and records data from the Model 852 Ultra-Miniature Digital Scanning Sonar Head and/or the Model 852 Ultra-Miniature Digital Echo Sounder. The program uses a 2-Wire RS-485 COM port (115200,N,8,1) to communicate with the heads and an RS-232 COM port (38400,N,8,1) for receiving Remotely Operated Vehicle (ROV) information such as Depth, Heading and Turns Count. The heads can be operated at different ranges, gains, pulse lengths, etc. The Windows display mode must be at least 800 x 600 pixels with a small font.

SCREEN LAYOUT

The main screen of WIN852 comprises of a sonar data window on the left side with various sonar head controls and a sector size icon on the right side. The echo sounder window overlays the sonar window and is expandable. Other items include a x2 Pixel Zoom window, date/time readout, Depth/Heading/Turns readout, sonar head range/bearing readout to one or two cursors and a control for displaying real time data from the heads or playback data from a file. A pop-up window is available for displaying diagnostics. A compass rose can be displayed in place of the pixel zoom window.

OPERATION

To operate the sonar head and echo sounder, ensure that the head cable is connected to the 2-Wire RS-485 serial port or an RS-485 to RS-232 converter is installed in-line. Connect 22 to 30VDC to the power wires (+V to RED, -V to BLACK) using a DC power supply capable of supplying a current of 1 Amp. Run the program WIN852.EXE and select the button DATA FROM '**HEAD**' on the right-hand side of the display. Ensure that the correct COM port is selected (Com Ports Menu) and depending on the RS-485 serial i/o card installed in your computer, select AUTO Enable or RTS (Request To Send) Enable. Also ensure that the sonar head and/or echo sounder is enabled via the Set Switches Dialog Box. To allow other programs to use available CPU time, WIN852 can be put into standby mode simply by minimizing the main window.

MAIN MENU

File Menu

Record Start (Stop)...	opens a File Name Dialog Box so the user can input a filename for logging sonar and/or echo sounder data (shot by shot) complete with date/time stamp. The file extension is always '**.852**'. The filename and current size (kbytes) of the file are displayed at the top of the screen. File recording continues until Record Stop is selected. Available only when DATA FROM '**HEAD**' is active.
Playback...	opens a File Name Dialog Box so the user can select and playback a previously recorded '**.852**' Sonar file. Available only when DATA FROM '**FILE**' is active.
Copy Start (Stop)...	opens a File Name Dialog Box so the user can enter a filename for a new **'.852'** file that can be used for making smaller data files from large pre-recorded sonar files. The filename and current size (kbytes) of the file are displayed at the top of the screen. File copying continues until Copy Stop is selected. Available when DATA FROM '**FILE**' is active.
Save Screen...	opens a File Name Dialog Box so the user can enter a filename for saving the screen as a '.**BMP**' bitmap file.
Exit	writes current configuration to file (WIN852.INI), closes the program and exits to Windows.

Color Table Menu

Norm Hi	normal high intensity color table used for mapping the echo data amplitude to a color for display. Color depth is 107 colors ranging from Black (low level) through Blue, Green, Orange, Yellow, White and Red (max level).
Norm Lo	normal low intensity color table.
Green	107 shades of green.
Grey	107 shades of grey (White on Black).
Rev Grey	107 shades of grey (Black on White).
Brown/Yellow	107 mixed shades of brown and yellow.
Green/Blue	107 mixed shades of green and blue.
Green/Yellow	107 mixed shades of green and yellow.
Blue	107 shades of blue.

MAIN MENU (con't)

Options Menu

Units	to change the units of measurement from Meters to Feet.
Xdcr Position	to adjust the display of the sonar head echo data relative to the physical mounting of the sonar head. If the xdcr (transducer) is physically mounted down (red side down), this switch should be set to '**Down**'. If the xdcr is mounted up (red side up), '**Up**' should be selected. If this switch is set incorrectly, the sonar display will appear as a mirror image; targets which are actually on the right side will appear on the left, and vice-versa.
Noise Filter	to minimize noise in the displayed return data.
Sound Velocity	to change the speed of sound number used in range measurements. This number can have a range of 750 m/s (2461 ft/s) to 2250 m/s (7381 ft/s). The default is 1500 m/s (4921.3 ft/s).
User Text	to enter a text string for display in the User Text Window.
Calibrate Sonar Head	to adjust the motor to the center or zero position.

Com Ports Menu

Sonar Head	to select the serial communications port (COM1-COM32) for communicating with the connected sonar head and/or echo sounder. Ports that are already used or unavailable are greyed out. The port that is selected must be a 2-Wire RS-485 serial port. Alternatively, you could use an RS-232 port with an external RS-485 to RS-232 converter connected in-line. All communication through this port is at 115200 bits per second, No Parity, 8 Data Bits and 1 Stop Bit.
AUTO Enable	use this mode if your RS-485 serial i/o card or converter can automatically enable its' transmit driver. Two excellent converters are the SeaLink +485I (**P/N 2104**) from www.sealevel.com and the **Model 9365** from www.telebyteusa.com which automatically enable the transmit driver when sending data as opposed to controlling the driver via RTS (Request To Send).

MAIN MENU (con't)

RTS Enable

use this mode if your RS-485 serial i/o card or converter requires RTS (Request To Send) to enable its' transmit driver.

Depth/Heading/Turns

to select the serial communications port (COM1-COM32) for receiving Depth, Heading and Turns Count information generated from an ROV computer system. This port accepts the following comma deliminated ASCII serial string at 38400,N,8,1:

dddd.d,F,hhh.h,-tt<CR><LF>

dddd.d is the ROV depth (0000.0 to 9999.9)
F for depth in Feet or **M** for depth in Meters
hhh.h is the ROV compass heading in degrees (000.0 to 359.9)
–tt is the ROV turns counter (-99 to 99). Negative numbers contain a leading minus sign, positive numbers contain a leading space character (no plus sign).
<CR> - carriage return
<LF> - line feed

If the program detects only one available COM port (i.e. on a laptop computer), this port will be reserved for communications with the sonar head only and the Depth/Heading/Turns input will not be available.

As default on older computers, COM1/COM3 share IRQ4 (interrupt request #4) and COM2/COM4 share IRQ3. Ensure that the COM port you select for the Depth/Heading/Turns input does not share its IRQ with the sonar head COM port. This could cause the program to hang up!

Enable/Disable

use this selection to enable or disable the Depth/Heading/Turns serial port input.

MAIN MENU (con't)

Set Switches Menu

Sonar Head

Enable / Disable	to enable or disable sonar head communications.

The following parameters can be controlled:

Range	5, 10, 20, 30, 40, 50 Meters or equivalent Feet
Gain	0 to 40 dB
Train Angle	not available
Sector Size	0 to 360 degree in 3 degree increments
Speed	Normal (3 degrees/step), Fast (6 degrees/step)
Pulse Length	10 to 250 microseconds in 10 microsecond increments
Switch Delay	0 to 500 milliseconds in 2 millisecond increments
Frequency	675kHz or 850 kHz

Echo Sounder

Enable / Disable	to enable or disable echo sounder communications. Enabling the echo sounder will display the Echo Sounder data window.

The following parameters can be controlled:

Range	5, 10, 20, 30, 40, 50 Meters or equivalent Feet
Gain	0 to 40 dB
Pulse Length	10 to 250 microseconds in 10 microsecond increments
Profile	Off, Points, Low-Mix, Med-Mix or High-Mix
Profile Min. Range	0 to 25 Meters in 0.1 Meter increments
Switch Delay	0 to 500 milliseconds in 2 millisecond increments
Frequency	675kHz only

Select the Default button to quickly return to factory default settings.

MAIN MENU (con't)

Misc Menu

Grid On/Off	to display the range rings on the sonar display.
Pixel Zoom (x2)	displays a x2 pixel zoom window in the lower right hand corner of the screen. A rectangular area about the cursor is displayed in this window. If the left mouse button is pressed anywhere in the sonar image window, the zoom window will be captured (held). Pressing the button a second time releases the capture.
Compass Rose	displays a circular compass rose in place of the pixel zoom window (if Depth/Heading/Turns is enabled).
Clear Screen Now	to clear all echo data from the sonar display.
Diagnostics	displays the Diagnostics Pop-Up Window. This window displays the header information from the sonar head.
ES Profile Mode	Off, Points Only, Low Mix, Med Mix, High Mix
ES External Trigger Enable	to enable or disable the Echo Sounder External Trigger function
ES External Trigger Edge	select Positive or Negative trigger edge
ES External Trigger Mode	select Manual or Automatic Trigger function
Sonar External Trigger Enable	to enable or disable the Sonar Head External Trigger function
Sonar External Trigger Edge	select Positive or Negative trigger edge
Sonar External Trigger Mode	select Manual or Automatic Trigger function

MAIN MENU (con't)

Sonar On When Minimized	when this item is checked, the sonar head and/or echo sounder will continue to operate and log data when the sonar screen is minimized. If not checked, the serial port is closed while communication and data logging are put on hold until the screen is maximized. This allows other programs to use the serial port and available CPU time

Help Menu

About...	displays an about box showing the software version and date of this program.

ON SCREEN SWITCHES

DATA FROM '**HEAD**'	to display data from the connected sonar head and/or echo sounder
DATA FROM '**FILE**'	to display data from a previously recorded '**.852**' Sonar file.
Hold	to hold or freeze the display.
Rev	to reverse the current scanning direction of the sonar head. Available only when DATA FROM '**HEAD**' is active.
TrackBar	to re-position the file pointer during file playback. Available only when DATA FROM '**FILE**' is active.
Plot Speed	to adjust plotting speed during file playback. Available only when DATA FROM '**FILE**' is active.

The following switches are available only when DATA FROM '**HEAD**' is active:

Range	to change the sonar operating range. Ranges available are: 5m (15ft), 10m (30ft), 20m (60ft), 30m (90ft), 40m (120ft) and 50m (150ft)
Mode	to change the sonar display mode. Modes available are: Sector, Polar and Sidescan.
Start Gain	to change the starting gain of the sonar head. Increase to get higher return levels, decrease to get lower return levels. The Start Gain can be adjusted from 0dB to 40dB in 1dB increments.
Speed	to change the stepping speed of the sonar. Speeds available are: Normal (3 deg/step) and Fast (6 deg/step)
Sector	to change the sector size (sweep angle). Sector Mode (0 to 180 degrees in 18 degree increments) Polar Mode (0 to 360 degrees in 18 degree increments) Two hot swap buttons are available for changing the sector size from 90 to 180 degrees in Sector Mode or from 90 to 360 degrees in Polar Mode.

ON SCREEN SWITCHES (con't)

Train	always 0 degrees in Sector and Polar Modes. Up, Down, Port and Stbd settings are available for Sidescan Mode.

KEYBOARD SWITCHES

The following switches are selected via keyboard entry (case insensitive):

C	to clear the sonar screen display.
G	to change the Start Gain of the sonar head. When the '**G**' key is pressed, the Key Command Entry Box displays the prompt: **Gain: ? dB**. Type in a valid start gain number (0-40dB) and press <Enter> to change to the new start gain value. If the entered gain is not valid or the <Esc> key is pressed, the current gain will be used. Available only when DATA FROM '**HEAD**' is active.
H	to hold or freeze the display.
R	to change the operating range of the sonar head. When the '**R**' key is pressed, the Key Command Entry Box (below the DATA FROM buttons) is displayed with the following prompt: **Range: ? M** (meters) or **Range: ? FT** (feet). Type in a valid range number: 5(15), 10(30), 20(60), 30(90), 40(120) or 50(150) in meters or (feet) using the numeric keys and then press <Enter> to change to the new range. If the entered range is not valid or the <Esc> key is pressed, the current range will be used. Available only when DATA FROM '**HEAD**' is active.
Space Bar	to reverse the current sonar head scanning direction. Can also be used to reverse the file playback direction.

ONE CURSOR MEASUREMENT

One Cursor Measurement is used for measuring the distance and relative bearing to a target with respect to the transducer origin. When the mouse is moved into the sonar image display area, the cursor changes from an arrow to a square target cursor. The range and bearing to the target cursor is displayed in the Range/Bearing Display Box underneath the sonar image display. If a compass heading is present at the second serial port, the displayed cursor bearing will include the copmpass heading. The area about the target cursor is also displayed in the Pixel Zoom window. Clicking the left mouse button while the cursor is in the sonar image display area captures (freezes) the zoom window image. Clicking the left button a second time allows normal zoom window updating.

TWO CURSOR MEASUREMENT

Two Cursor Measurement is used for measuring the distance and relative bearing between two targets. To invoke two cursor measurement, position the mouse cursor over a target in the sonar image display area and press the right mouse button. A target origin cursor is placed at this location. When the mouse is moved, a rubber banded line is drawn from the target origin cursor to the target cursor. The Range/Bearing Display Box shows the range and bearing from the transducer origin to the target cursor (**Tar**) and the range and bearing difference (**Diff**) between the two cursors. If a compass heading is present at the second serial port, the displayed cursor bearing will include the copmpass heading. The displayed range and bearing between the two cursors is always relative to the target origin cursor. Press the right mouse button again to return to One Cursor Measurement.

MESSAGES

No Data at COM?

- no power to the sonar head and/or echo sounder
- cable not connected
- Sonar Head COM port set to the wrong port number
- computer not fast enough to keep up with the head increase Switch Delay.

Depth **'n/a'**
Heading **'n/a'**
Turns Counter **'n/a'**

- ROV computer not connected to serial port
- ROV computer is not sending data
- ROV computer not set for 38400,N,8,1
- Depth/Heading/Turns COM port set to the wrong port number
- ROV computer not sending correct ASCII string

IMAGENEX TECHNOLOGY CORP. **16SEP15**

MODEL 852 DIGITAL SONAR HEAD
MODEL 852 DIGITAL ECHO SOUNDER

DATA STORAGE FILE FORMAT (.852)

When recording the sonar and/or echo sounder data to a **.852** file, the following bytes are appended and saved to the file every 'shot':

Byte #	Description
0 to 99	**File Header** (100 Bytes)
100 to 111	**Sonar / Echo Sounder Return Data Header** (12 Bytes)
112 to **xxxx**	**Sonar / Echo Sounder Return Echo Data** (0, 252 or 500 Bytes) **xxxx** = 112+above number Byte **xxxx** always = **0xFC** (Termination Byte from sonar or echo sounder)
xxxx+1 to **yyyy**	**Zero Fill** **yyyy** = 127, 383 or 639

FILE HEADER

Bytes 0 through 99 contain the following **File Header** information:

0 **ASCII '8'**
1 **ASCII '5'**
2 **ASCII '2'**

3 **nToReadIndex -** Index for Number of Data Bytes
0 = 0 Data Bytes (IPX data)
2 = 252 Data Bytes (IMX data)
3 = 500 Data Bytes (IGX data)

4-5 **Total Bytes -** number of bytes that are written to the disk for this shot

Byte 4								**Byte 5**							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
128 (for IPX), 384 (for IMX) or 640 (for IGX)															

DATA STORAGE FILE FORMAT (.852) (con't)

6-7 **nToRead** - Number of Bytes from the sonar or echo sounder

Byte 6								Byte 7							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
13 (for IPX), 265 (for IMX) or 513 (for IGX)															

8-19 **Date** - null terminated date string (12 bytes)
"**DD-MMM-YYYY**"

20-28 **Time** - null terminated time string (9 bytes)
"**HH:MM:SS**"

29-32 **Hundredth of Seconds** - null terminated string (4 bytes)
"**.hh**"

33-36 **Reserved** – always 0

37 **Dir, Xdcr, Mode, Step**

For Sonar Head (Head ID = 0x10):

Byte 37							
7	6	5	4	3	2	1	0
Dir	**Xdcr**	**Mode**			**Step Size**		
0=ccw 1=cw	0=Dn 1=Up	0 = Sector (IGX) 1 = Polar (IMX)			0 = 2.25 Deg (Slow) 1 = 4.5 Deg (Fast)		

For Echo Sounder (Head ID = 0x11):

Byte 37							
7	6	5	4	3	2	1	0
N/A	**N/A**	**Mode**			**N/A**		
0	0	0 = IGX 1 = IMX			0		

38 **Start Gain**
0 to 40 in 1 dB increments

39 **(Sector Size)/3**

For Sonar Head (Head ID = 0x10):
0 to 102 = 0 to 306 Degrees in 3 degree increments

For Echo Sounder (Head ID = 0x11):
Reserved – always 0

DATA STORAGE FILE FORMAT (.852) (con't)

40 **(Train Angle)/3**

For Sonar Head (Head ID = 0x10):
10 to 130 = -180 to +180 Degrees in 3 degree increments
70 = 0 degrees

For Echo Sounder (Head ID = 0x11):
Reserved – always 0

41 **Reserved** – always 0

42 **Reserved** – always 20

43 **Reserved** – always 9

44 **Pulse Length**
1 to 250 in microseconds

45 **Profile**
0 = Off
1 = Points Only
2 = Low Mix
3 = Medium Mix
4 = High Mix

46-47 **Sound Velocity**

Byte 46								**Byte 47**							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
V	**Sound Velocity (in meters/second) * 10**														

If '**V**' = 0, Sound Velocity = 1500.0 m/s
If '**V**' = 1, Sound Velocity = [((Byte 46 & 0x7F)<<8) | (Byte 47)]/10.0

48-79 **User Text** - null terminated text string (32 bytes)

DATA STORAGE FILE FORMAT (.852) (con't)

80-81 **ROV Depth**

Byte 80								Byte 81							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
D	**ROV Depth * 10**														

If '**D**' = 0, ROV Depth not available
If '**D**' = 1, ROV Depth = [((Byte 80 & 0x7F)<<8) | (Byte 81)]/10

82 **ROV Depth Units**
'M' = Meters
'F' = Feet

83-84 **ROV Heading**

Byte 83								Byte 84							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
H	**ROV Heading * 10**														

If '**H**' = 0, ROV Heading not available
If '**H**' = 1, ROV Heading = [((Byte 83 & 0x7F)<<8) | (Byte 84)]/10

85-86 **ROV Turns Counter**

Byte 85								Byte 86							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
T	**ROV Turns Counter + 100**														

If '**T**' = 0, ROV Turns Counter not available
If '**T**' = 1, ROV Turns Counter = [((Byte 85 & 0x7F)<<8) | (Byte 86)] - 100

87 **Operating Frequency**
For Sonar Head (Head ID = 0x10):
0 = 675kHz
1 = 850kHz
For Echo Sounder (Head ID = 0x11):
0 = 675kHz

88 **Head ID**
0x10 = Sonar Head
0x11 = Echo Sounder

89-99 **Reserved** - always 0

DATA STORAGE FILE FORMAT (.852) (con't)

SONAR / ECHO SOUNDER RETURN DATA HEADER
SONAR / ECHO SOUNDER RETURN ECHO DATA
ZERO FILL

The following bytes contain the **Sonar / Echo Sounder Return Data** that is acquired directly from the sonar head or echo sounder serial COM port (refer to the Model 852 Serial Interface Specification):

If Header is ASCII '**IPX**':

Bytes 100 through 112 (13 bytes)
Bytes 113 through 127 (15 bytes – **Zero Fill**)

If Header is ASCII '**IMX**':

8-Bit
Bytes 100 through 364 (265 bytes)
Bytes 365 through 383 (19 bytes - **Zero Fill**)

If Header is ASCII '**IGX**':

8-Bit
Bytes 100 through 612 (513 bytes)
Bytes 613 through 639 (27 bytes - **Zero Fill**)

MODEL 852 DIGITAL ECHO SOUNDER

SERIAL INTERFACE SPECIFICATION (v1.04)

OVERVIEW

The Model 852 Digital Echo Sounder communicates over a 2-wire differential RS-485 serial data transmission line or optionally a half-duplex RS-232 data line. To interrogate the echo sounder and receive echo data, a Switch Data Command string is sent via a serial command program at a baud rate of **115200 bps, No Parity, 8 Data Bits and 1 Stop Bit**. When the Switch Data command is accepted, the echo sounder transmits, receives and sends its return data back to the commanding program.

SWITCH DATA COMMAND

The echo sounder accepts up to 27 bytes of switch data from the serial interface and must see the switch data header (2 bytes: **0xFE** and **0x44** HEX) in order to process the switches. The echo sounder will stop accepting switch data when it sees the termination byte (**0xFD** HEX). The termination byte must be present for the echo sounder to process the switches.

> **Note: the Termination Byte is the only switch value allowed to have a value of 0xFD. All other switches should be set higher or lower than 0xFD (253 Decimal) so they are not interpreted as a termination byte!**

Byte #	Description							
0 – 7	**0xFE**	**0x44**	Head ID	Range	Reserved 0	Reserved 0	Master/ Slave	Reserved 0
8 – 15	Start Gain	Reserved 0	Absorp-tion	Reversed 0	Reserved 0	Reserved 0	Pulse Length	Profile MinRange
16 – 23	Reserved 0	Reserved 0	External Trigger	Data Points	Reserved 0	Reserved 0	Profile	Reserved 0
24 – 26	Switch Delay	Freq-uency	Term. **0xFD**					

Table 1 Model 852 Switch Data Command To Echo Sounder

SWITCH DATA COMMAND (con't)

BYTE DESCRIPTIONS

Note: All Byte values are shown in decimal unless noted with a '0x' (hexadecimal) prefix.

Byte 0 **Switch Data Header (1st Byte)**
Always **0xFE** (254 decimal)

Byte 1 **Switch Data Header (2nd Byte)**
Always **0x44** (68 decimal)

Byte 2 **Head ID**
0x11, 0x12, 0x13, 0x14 or 0x15

Byte 3 **Range**
5 to 50 Meters
5,10,20,30,40,50 Meters supported

Byte 4 **Reserved**
Always 0

Byte 5 **Reserved**
Always 0

Byte 6 **Master / Slave**
The echo sounder can be operated as a master or as a slave. The default mode on power-up is Slave mode (Bit 6 = 1). Slave mode allows the user to command the unit to transmit then send its return data at any given time. **Currently, the echo sounder only supports slave mode operation.**

Bit 0 - 1 = Transmit if Bit 6 = 1 (Slave Mode)
Bit 1 - 1 = Send Data if Bit 6 = 1 (Slave Mode)
Bit 2 - 0
Bit 3 - 0
Bit 4 - 0
Bit 5 - 0
Bit 6 - 0 = Master, 1 = Slave
Bit 7 - 0

Byte 7 **Reserved**
Always 0

SWITCH DATA COMMAND (con't)

Byte 8 **Start Gain**
0 to 40dB in 1dB increments

Byte 9 **Reserved**
Always 0

Byte 10 **Absorption**
20 = 0.2 dB/m 675 kHz

Byte 11 **Reserved**
Always 0

Byte 12 **Reserved**
Always 0

Byte 13 **Reserved**
Always 0

Byte 14 **Pulse Length**
Length of acoustic transmit pulse.
1-255 → 1 to 255 μsec in 1 μsec increments

Byte 15 **Profile Minimum Range**
Minimum range for profile point digitization
0 – 250 → 0 to 25 meters in 0.1 meter increments
Byte 15 = min range in meters / 10

Byte 16 **Reserved**
Always 0

Byte 17 **Reserved**
Always 0

SWITCH DATA COMMAND (con't)

The following External Trigger Control byte is valid only for 852 Echo Sounders supplied with the External Trigger Hardware Option. The external trigger must be a 0 to 5 volt TTL pulse with a minimum length of 100 microseconds.

Byte 18 **External Trigger Control**

Bit0: Trigger Edge: 0 = NEG, 1 = POS

Bit1: Trigger Enable: 0 = Disable, 1 = Enable

Bit 2: Trigger Mode:

0 = Manual

- in manual mode, the unit must be "armed" every ping by sending a Switch Data Command with Trigger Enable= 1. When a valid trigger pulse is detected, the echo sounder will transmit, send data (if Send Data in Byte 6 = 1), then wait for the next Switch Data Command. If a trigger pulse is not detected within 100 milliseconds of being armed, the unit will transmit as normal then wait for the next Switch Data Command.

1 = Automatic

- in automatic mode, the unit is "armed" with a single Switch Data Command (with Trigger Enable = 1). When a valid trigger pulse is detected, the echo sounder will transmit, send data (if Send Data in Byte 6 = 1) and then automatically re-arm itself and wait for the next trigger pulse. A Switch Data Command can be sent at any time to change parameters such as range, gain, pulse length, etc.

Byte 19 **Data Points**

25 - 250 data points are returned by the echo sounder
The return data will have an ASCII '**IMX**' header.

50 - 500 data points are returned by the echo sounder
The return data will have an ASCII '**IGX**' header.

Byte 20 **Reserved**

Always 0

Byte 21 **Reserved**

Always 0

Byte 22 **Profile**

0 = OFF

1 = ON --> The return data will have an ASCII '**IPX**' header.

SWITCH DATA COMMAND (con't)

Byte 23 **Reserved**
Always 0

Byte 24 **Switch Delay**
The echo sounder can be commanded to pause (from 0 to 510 msec) before sending its return data to allow the commanding program enough time to setup for serial reception of the return data.
0 to 255 in 2 msec increments
Byte 24 = delay_in_milliseconds/2
Do not use a value of 253!

Byte 25 **Frequency**
0 = 675 kHz

Byte 26 **Termination Byte**
The echo sounder will stop looking for Switch Data when it sees this byte.
Always **0xFD** (253 decimal)

ECHO SOUNDER RETURN DATA

Every ping, the echo sounder returns a 12 Byte header, up to 500 points of echo data (depending on the Switch Data command that was sent) and a terminating byte value of 0xFC. The **total number of bytes** (**N**) returned will be 13, 265 or 513.

Byte #	**Description**					
0 to 5	ASCII 'I'	ASCII 'M','G' or 'P'	ASCII 'X'	Head ID	Serial Status	Reserved 0
6 to 11	Reserved 0	Range	Prof Rng (LO)	Prof Rng (HI)	Data Bytes (LO)	Data Bytes (HI)
12 to (N-2)	Echo Data 0, 252, 500 Data Bytes					
N-1	Term. **0xFC**					

Table 2 Model 852 Echo Sounder Return Data

BYTE DESCRIPTIONS

Note: All Byte values are shown in decimal unless noted with a '0x' prefix.
N = total number of return bytes

Byte 0 - 2 **Imagenex Return Data Header**
ASCII '**IMX**', '**IGX**' or '**IPX**'
'I' = 0x49, 'M' = 0x4D', 'G' = 0x47, 'P' = 0x50, 'X' = 0x58

ASCII '**IMX**'
In response to a Switch Data Command with Data Points = 25
N = 265, (252 Data Bytes, 252 Points)

ASCII '**IGX**'
In response to a Switch Data Command with Data Points = 50
N = 513, (500 Data Bytes, 500 Points)

ASCII '**IPX**'
In response to a Switch Data Command with Profile = ON
N = 13, (0 Data Bytes, 0 Points)

Byte 3 **Head ID**
0x11, 0x12, 0x13, 0x14 or 0x15

ECHO SOUNDER RETURN DATA (con't)

Byte 4 **Serial Status**

Bit 0 - 1 = Echo sounder
Bit 1 - 0
Bit 2 - 1 = Automatic External Trigger Mode available
Bit 3 - 0
Bit 4 - 0
Bit 5 - 0
Bit 6 - 1 = Switches Accepted
Bit 7 - 1 = Character Overrun

Byte 5 **Reserved**

Always 0

Byte 6 **Reserved**

Always 0

Byte 7 **Range**

Echo Sounder Range: 5 to 50 Meters

Byte 8 - 9 **Profile Range**

First digitized range value above threshold in centi-meters
Prof Rng (LO), Prof Rng (HI)

Byte 8								**Byte 9**							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
0	**Prof Rng (LO)**							**0**	**Prof Rng (HI)**						**L**

Prof Rng High Byte = (Byte 9 & 0x7E)>>1
Prof Rng Low Byte = [((Byte 9 & 0x01)<<7) | (Byte 8 & 0x7F)]
Profile Range = (Prof Rng High Byte<<8) | Prof Rng Low Byte

Byte 10 - 11 **Data Bytes**

Number of Echo Data Bytes returned
Data Bytes (LO), Data Bytes (HI)

Byte 10								**Byte 11**							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
0	**Data Bytes (LO)**							**0**	**Data Bytes (HI)**						**L**

Data Bytes High Byte = (Byte 11 & 0x7E)>>1
Data Bytes Low Byte = [((Byte 11 & 0x01)<<7) | (Byte 10 & 0x7F)]
Data Bytes = (Data Bytes High Byte<<8) | Data Bytes Low Byte

ECHO SOUNDER RETURN DATA (con't)

Byte 12 **Start of Echo Data**

If Header is ASCII **'IMX':**
N = 265, (252 Data Bytes, 252 Points)
1st Range Point = Byte 12
2nd Range Point = Byte 13
3rd Range Point = Byte 14
4th Range Point = Byte 15

If Header is ASCII **'IGX':**
N = 513, (500 Data Bytes, 500 Points)
1st Range Point = Byte 12
2nd Range Point = Byte 13
3rd Range Point = Byte 14
4th Range Point = Byte 15

If Header is ASCII '**IPX**':
There is no echo data and this byte is the termination byte **0xFC** (N = 13). Use Profile Range Bytes from the Header.

Byte (N-2) **End of Echo Data**

Byte (N-1) **Termination Byte**
0xFC

IMAGENEX TECHNOLOGY CORP. **09FEB16**

MODEL 852 DIGITAL ECHO SOUNDER

WIN852.EXE

c/w External Trigger Option

Special Notes:

Before using the external trigger feature, ensure that your 852 Echo Sounder has been supplied with the External Trigger Hardware Option. The external trigger must be a 0 to 5 volt TTL pulse with a minimum length of 100 microseconds.

To enable the Model 852 echo sounder for external trigger mode, the WIN852.INI provides the following control:

[ES Settings]

ESExternalTriggerControl	Bit 0: Trigger Edge: 0 = NEG, 1 = POS
	Bit 1: Trigger Enable: 0 = Disable, 1 = Enable
	Bit 2: Trigger Mode: 0 = Manual, 1 = Automatic

When enabled for external trigger, the echo sounder will transmit as soon as it detects the external trigger pulse. If a trigger pulse has not been found after a period of 100 milliseconds, it will transmit as normal.

Please refer to Imagenex Document "852 echo sounder spec.pdf" for more information.

SONAR THEORY AND APPLICATIONS

EXCERPT FROM IMAGENEX MODEL 855

COLOR IMAGING SONAR USER'S MANUAL

IMAGENEX TECHNOLOGY CORP.
#209 - 1875 BROADWAY ST.
PORT COQUITLAM, B.C. V3C 4Z1
CANADA

TEL: (604) 944-8248
FAX: (604) 944-8249

ABOUT YOUR SONAR

TERMINOLOGY:

The following is an explanation of the basic terms used by Imagenex to describe their sonar techniques.

Color: The different colors used to represent the varying echo return strengths.
Echo: The reflected sound wave
Echo Return: The time required for the echo to return to the source of the sound
Sonar: The principle used to measure the distance between a source and a reflector (target) based on the echo return time
Target: The object that you wish to obtain information about.

IMAGING:
Fan shaped beam
Scans surfaces at shallow angles, usually through a horizontal angle
Displays color images or pictures
Complete echo strength information for each point
Primarily for visual interpretation

In **Imaging** a fan-shaped sonar beam scans a given area, by either rotating or moving in a straight line, through a series of small steps, (see **Figure 1**). The beam's movement through the water generates points that form a sonar image of the given area. The different colored points, representing the time (or slant range) of each echo return, plot a line on a video display screen. The image, consisting of the different colored lines, depicts the various echo return strengths. The following characteristics are necessary to produce a visual or video image of the sonar image:

- the angle through which the beam is moved is small
- the fan-shaped beam has a narrow angle
- the transmitted pulse is short
- the echo return information is accurately treated

These visual images provide the viewer with enough data to draw conclusions about the environment being scanned. The operator should be able to recognize sizes, shapes and surface reflecting characteristics of the chosen target. The primary purpose of the imaging sonar is as a viewing tool.

PROFILING:
Narrow pencil shaped beams
Scans surfaces at a steep angle usually on a vertical plane
Displays individual points or lines
Accurately cross-sections a surface
Echo strength for each point higher than a set threshold
Digitizes a data set for interfacing with external devices
Data set is small enough to be manipulated in a small computer
Primarily a measurement tool

In **Profiling** a narrow pencil-shaped sonar beam scans across the surface of a given area generating a single profile line on the display monitor, (see **Figure 2**). This line, consisting of a few thousand points, accurately describes the cross-section of the targeted area. A key to the

Profiling process is the selection of the echo returns for plotting. The sonar selects the echo returns, typically one or two returns for each "shot", based on a given criterion for the echo return strength and the minimum profiling range. The information gathered from the selection criteria forms a data set containing the range and bearing figures. An external device, such as a personal computer or data logger, accesses the data set through an RS-232 interface with the sonar.

The profile data is useful for making pen plots of bottom profiles, trench profiles, internal and external pipeline profiles. The primary purpose of the profiling sonar is as a quantitative measuring tool.

USING AN IMAGING SONAR ON AN ROV

The imaging sonar is a useful substitute for a positioning system on an ROV. Without an imaging sonar, an ROV relies on traveling underwater to bring new targets into view. With an imaging sonar, instead of traveling it is more useful to spend some time with the vehicle sitting on the bottom while the sonar scans the surrounding area. Scanning a large area takes only a short time, and the vehicle pilot can quickly assess the nature of the surrounding area. The ability to "see" a long distance underwater allows the pilot to use natural or man-made features and targets as position references.

The combination of an imaging sonar and an ROV leads to fast and effective training in sonar interpretation. If the ROV pilot is searching for a particular object, recognition can take place directly from the sonar image. In other cases a number of potential targets may be seen. A pilot can sharpen his sonar interpretation skills by viewing these targets with the vehicle's video camera and correctly identify them.

INTERPRETATION OF SONAR IMAGES

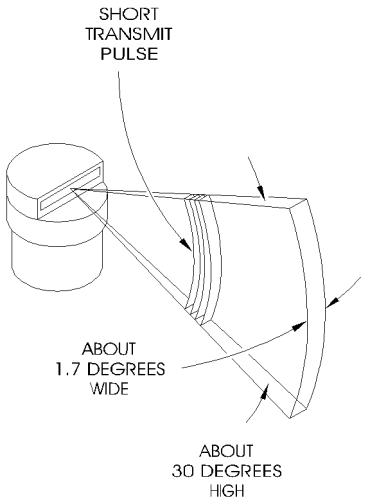
In many cases the sonar image of a target will closely resemble an optical image of the same object. In other cases, the sonar image may be difficult to interpret and quite unlike the expected optical image. The scanning process used to create a sonar image is different from the process used by the human eye or a camera to produce optical images. A sonar image will always have less resolution than an optical image, due to the nature of the ultrasonic signals used to generate it.

Generally, rough objects reflect sound well in many directions and are therefore good sonar targets. Smooth angular surfaces may give a very strong reflection in one particular direction, but almost none at all in other directions. Some objects, such as smooth plane surfaces, may be difficult to see with a sonar. They can act as a perfect mirror (so called specular reflectors), reflecting the sonar pulse off in unexpected directions, never to return. This happens to people visually, when they see an object reflected in a window. The human eye deals with such reflections daily but it is surprising to see the same thing occur with a sonar image. As with normal vision, it is often useful to scan targets from different positions, to help identify them. A target which is unrecognizable from one direction may be quite easy to identify from another.

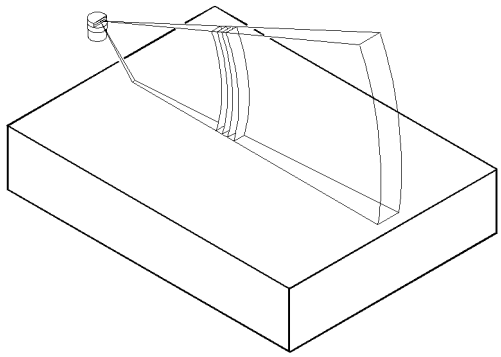
It is very important to note that the ranges shown to the targets on the sonar image are "slant" ranges. Usually the relative elevations of the targets are not known, only the range from the transducer. This means that two targets, which are displayed in the same location on the screen may be at different elevations. For example, you might see a target on the bottom, and a target

floating on the surface in the same place. By analyzing the shadows you can estimate the height of objects above the bottom. An example of this calculation is shown in **Figure 4**.

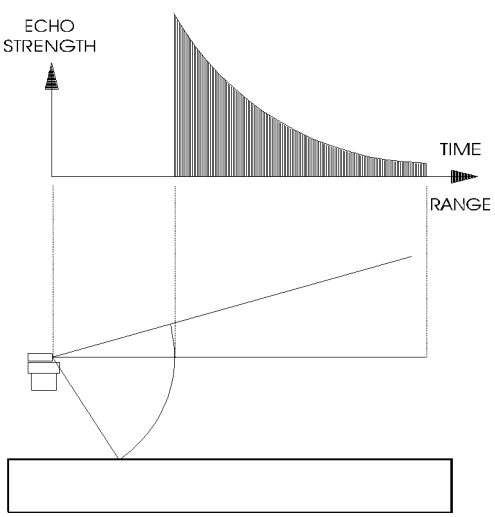
The diagrams following this chapter are examples of the sonar scanning process. Studying the diagrams will help you to better understand the images that you see. A basic knowledge of this process will help users to interpret what otherwise might be confusing images.



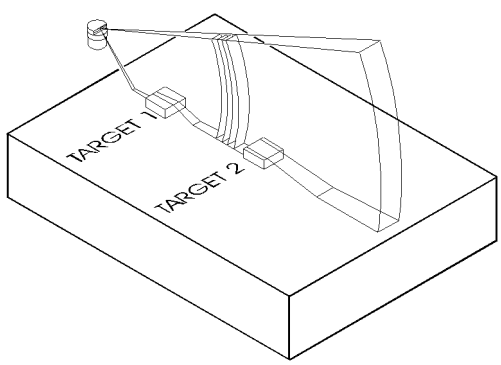
TYPICAL FAN SHAPED BEAM
AS USED ON IMAGING SONARS



FAN SHAPED SONAR BEAM
INTERSECTS WITH A FLAT BOTTOM

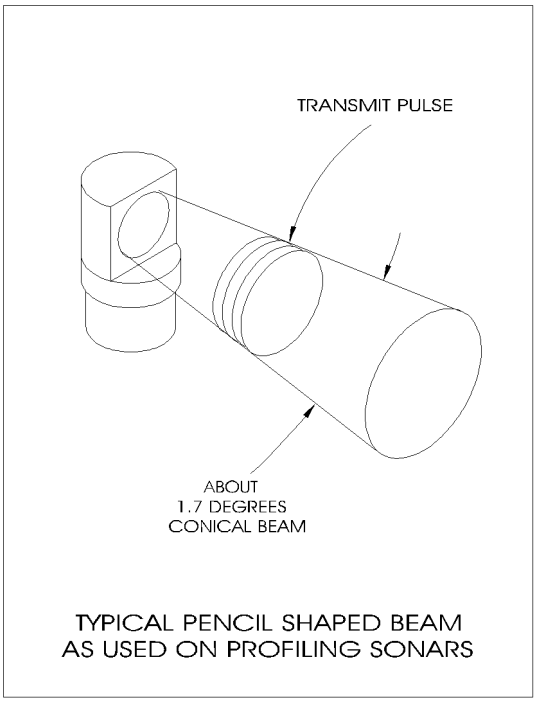


ECHO STRENGTH VS TIME WHEN
FAN SHAPED SONAR BEAM
INTERSECTS WITH A FLAT BOTTOM

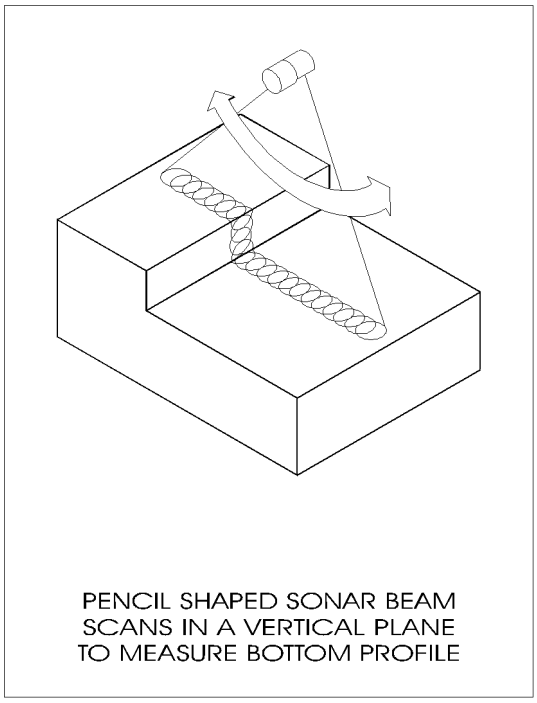


FAN SHAPED SONAR BEAM
INTERSECTS WITH A FLAT BOTTOM
AND TARGETS

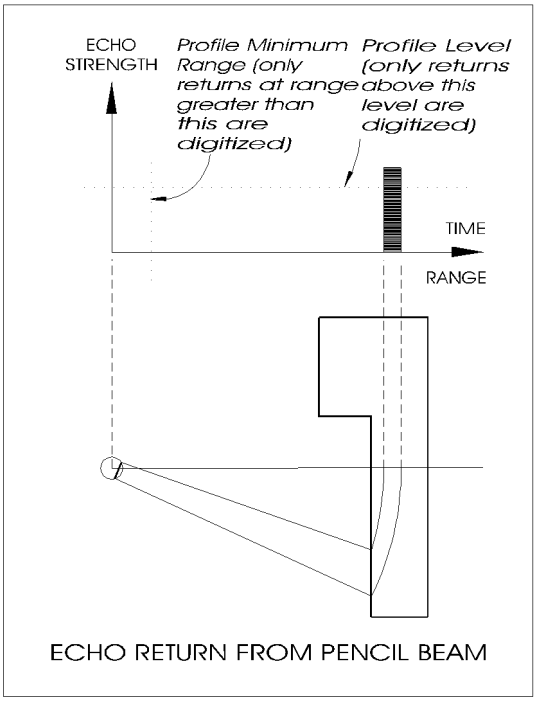
FIGURE 1



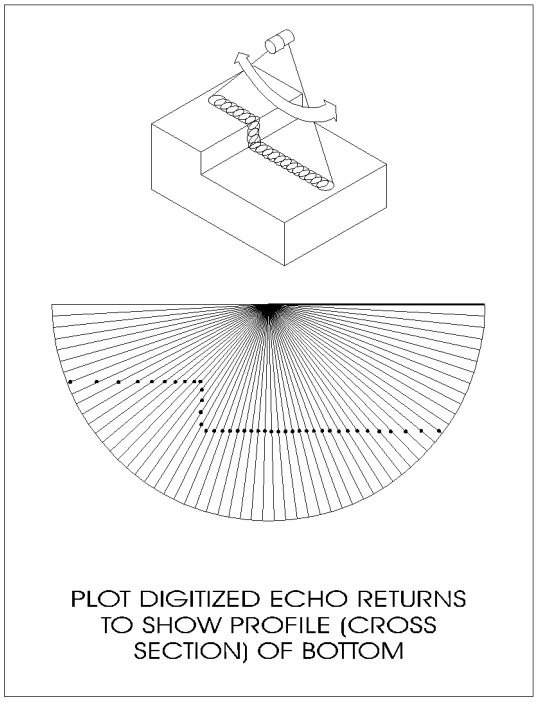
TYPICAL PENCIL SHAPED BEAM
AS USED ON PROFILING SONARS



PENCIL SHAPED SONAR BEAM
SCANS IN A VERTICAL PLANE
TO MEASURE BOTTOM PROFILE

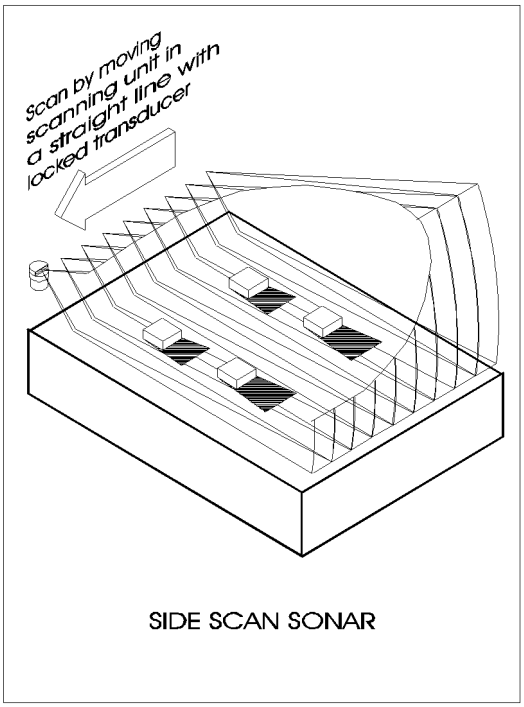


ECHO RETURN FROM PENCIL BEAM

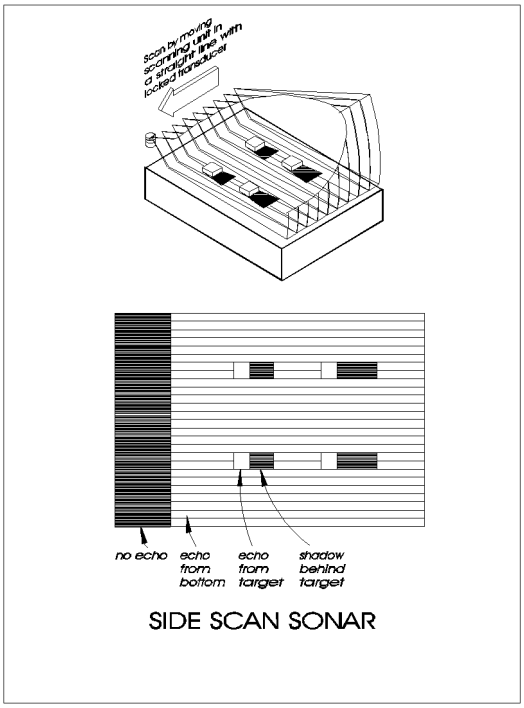


PLOT DIGITIZED ECHO RETURNS
TO SHOW PROFILE (CROSS
SECTION) OF BOTTOM

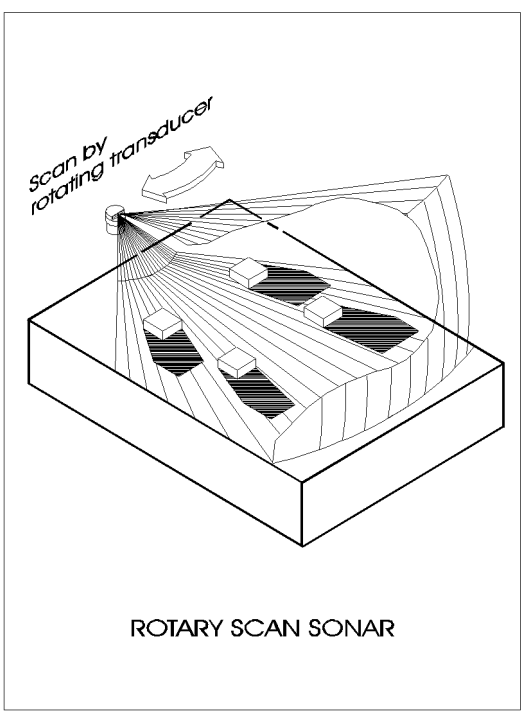
FIGURE 2



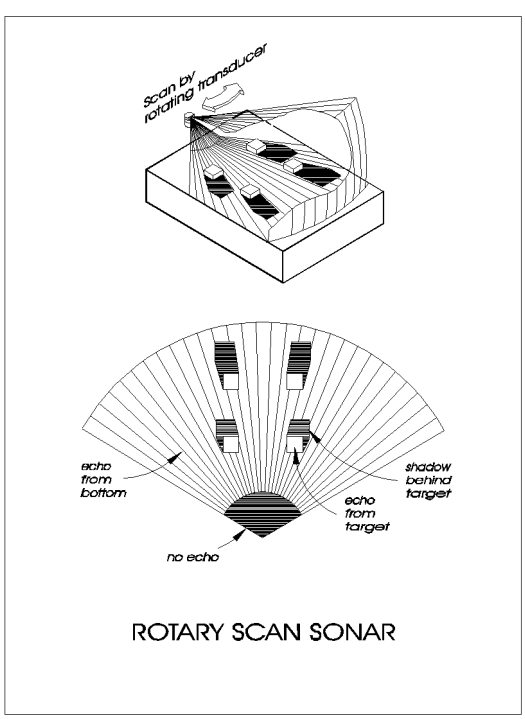
SIDE SCAN SONAR



SIDE SCAN SONAR

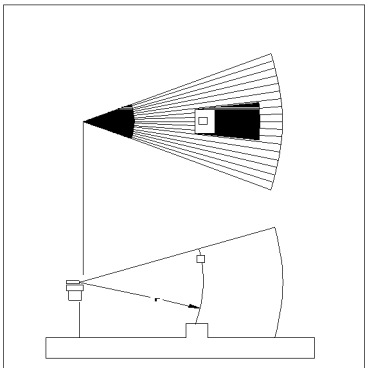


ROTARY SCAN SONAR

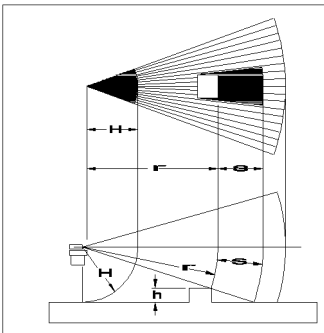


ROTARY SCAN SONAR

FIGURE 3



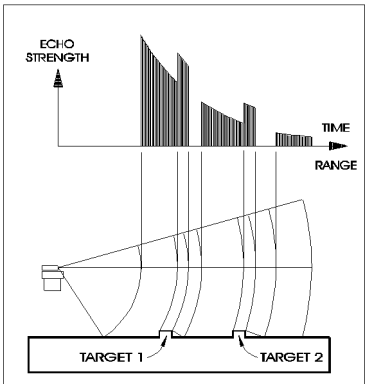
TARGETS AT THE SAME SLANT RANGE
BUT DIFFERENT ELEVATIONS PLOT AT THE
SAME LOCATION ON THE DISPLAY



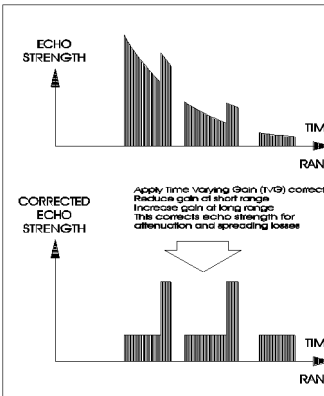
Target Height h = $\frac{H \times s}{r + s}$

(true only on flat, level bottom)

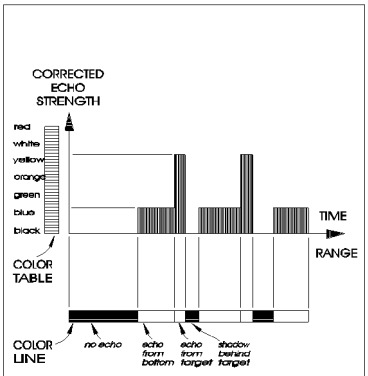
USE SHADOW LENGTH
TO CALCULATE TARGET HEIGHT



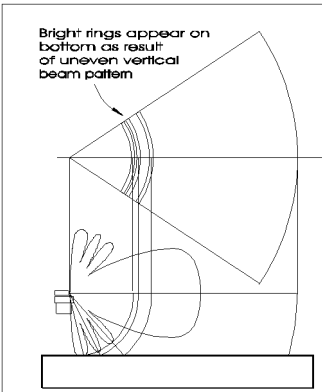
ECHO STRENGTH VS TIME WHEN
FAN SHAPED SONAR BEAM
INTERSECTS WITH A FLAT BOTTOM
AND TARGETS



CORRECT ECHO STRENGTH
FOR CHANGES DUE TO RANGE



CONVERT CORRECTED ECHO
STRENGTH TO COLOR LINE



ACTUAL SONAR BEAM WITH
WITH UNEVEN PATTERN

FIGURE 4