IMAGENEX MODEL 881A
DIGITAL MULTI-FREQUENCY IMAGING SONAR

APPLICATIONS:

- ROV, AUV, & UUV
- Offshore Oil & Gas
- Sunken Timber Recovery
- Diving Support
- Surveying
- Search & Recovery
- Inspection
- Underwater Archaeology
- Scientific Research

FEATURES:

- Programmable
- Multi-frequency
- High performance
- Lower cost
- Low power
- Simple set-up and installation
- Digital telemetry
- Full scale range from 1 m to 200 m
- Compact size
- Communication format available to user

Now with Multi-frequency Sonar, operators can generate highly detailed full-scale images with just one unit. The 881A is a programmable multi-frequency digital imaging sonar that you can operate using default frequency settings or customize the configurations for your own situation. High performance, lower cost, low power and simple set-up and installation, make this sonar perfect for the largest ROV's to the smallest inspection ROV's, plus AUV or UUV applications.

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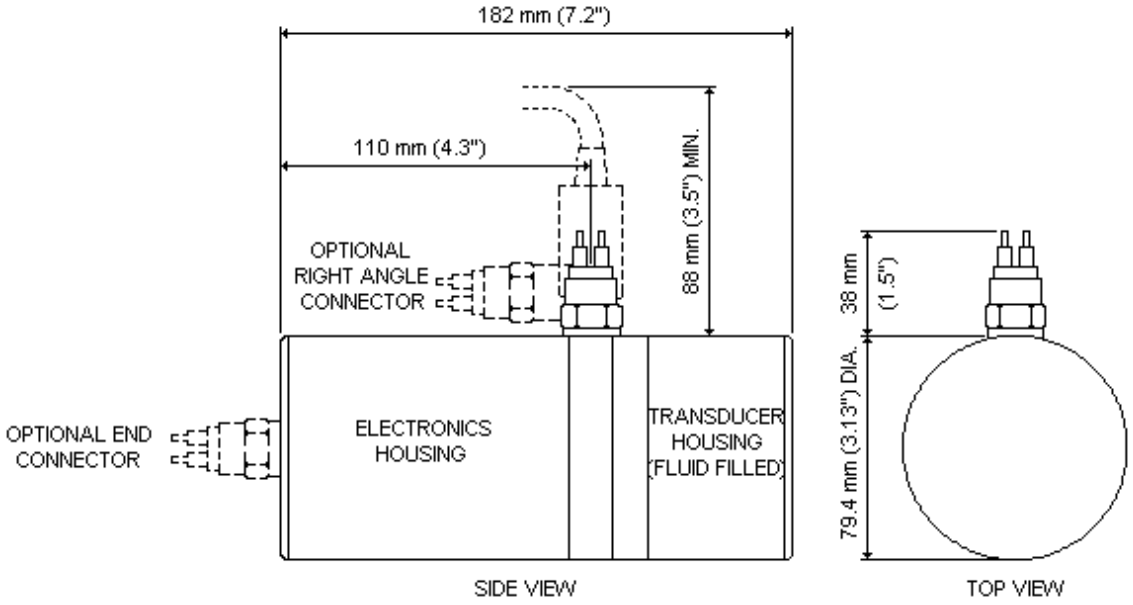
HARDWARE SPECIFICATIONS:	
FREQUENCY	310 kHz, 675 kHz, or 1 MHz (default settings) -Other frequencies can be selected through programmable software configurations (Tunable from 280 kHz to 1.1 MHz in 5 kHz steps)
TRANSDUCER	Imaging type, fluid compensated
TRANSDUCER BEAM WIDTH	310 kHz: 4° x 40° 675 kHz: 1.8° x 20° 1 MHz: 0.9° x 10°
RANGE RESOLUTION	1 m – 4 m: 2 mm (0.08") 5 m & up: 10 mm (0.4")
MIN. DETECTABLE RANGE	150 mm (6")
MAX. OPERATING DEPTH	1000 m and 3000 m available
MAX. CABLE LENGTH	1000 m on typical twisted shielded pair (RS-485)
INTERFACE	RS-485 serial interface @ 115.2 kbps (or optional RS-232)
CONNECTOR	Side mounted, four conductor, wet mateable (Impulse MCBH-4-MP-SS) Optional right angle or end mount connector
POWER SUPPLY	20 – 36 VDC at less than 5 Watts
DIMENSIONS (for both depth ratings)	79.4 mm (3.125") diameter x 182 mm (7.125") length
WEIGHT: In Air **In Water**	1000 m unit: 1.5 kg (3.3 lbs) 3000 m unit: 2 kg (4.4 lbs) 1000 m unit: 0.6 kg (1.3 lbs) 3000 m unit: 1.1 kg (2.4 lbs)
MATERIALS	1000 m unit: 6061-T6 Aluminum & Polyurethane 3000 m unit: Titanium, Polyurethane & 300 series stainless steel
FINISH	Hard Anodize

SOFTWARE SPECIFICATIONS:	**Win881A.exe**
WINDOWS™ OPERATING SYSTEM	Windows™ 95, 98, Me, NT*, 2000*, XP*, Vista*
MODES	Sector, Polar and Side Scan
RANGE SCALES	1 m, 2 m, 3 m, 4 m, 5 m, 10 m, 20 m, 30 m, 40 m, 50 m, 60 m, 80 m, 100 m, 150 m, 200 m
TRAIN ANGLES	Continuous rotation, 3° increments
SECTOR SIZE: **SECTOR MODE** **POLAR MODE**	 0° – 180°, 3° increments 0° – 357°, 3° increments, or Continuous rotation
STEP SIZES	Slow (0.3°), Medium (0.6°), Fast (0.9°), Faster (1.2°), Fastest (2.4°)
GRID TYPES	Polar and rectangular
FILE FORMAT	(filename).81a
RECOMMENDED MINIMUM COMPUTER REQUIREMENTS:	100 MHz Pentium 16 MB RAM 1 GB Hard Disk 800 x 600 x 256 colour graphics

* Requires Win881A.exe v2.00 or higher (Free upgrade available for older versions – Contact Imagenex)



ORDERING INFORMATION:		
1000 m UNIT	Standard	881-000-400
3000 m UNIT	Standard	881-000-401
RS-232	Option	-006
End mount connector	Option	-009
Right angle connector	Option	-010
Interface source code in “C” (TEST881A.C)	Option	-018

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

IMAGENEX MODEL 881A
DIGITAL MULTI-FREQUENCY PROFILING SONAR

APPLICATIONS:

- Profiling
- ROV, AUV & UUV
- Offshore Oil & Gas
- Surveying
- Dam Face Inspection
- Pipeline Inspection
- Underwater Archaeology
- Scientific Research

FEATURES:

- Programmable
- Multi-frequency
- High performance
- Lower cost
- Low power
- Simple set-up and installation
- Digital telemetry
- 1 to 100 m operation (full scale)
- Compact size
- Communication format available to user

Now with Multi-frequency Sonar, operators can fine-tune their profiling range resolution. The Model 881A Profiling Sonar Head is a programmable multi-frequency digital scanning sonar that you can operate using default settings or customize the configurations for your own situation. High performance, lower cost, low power and simple set-up and installation, make this sonar perfect for all profiling applications.

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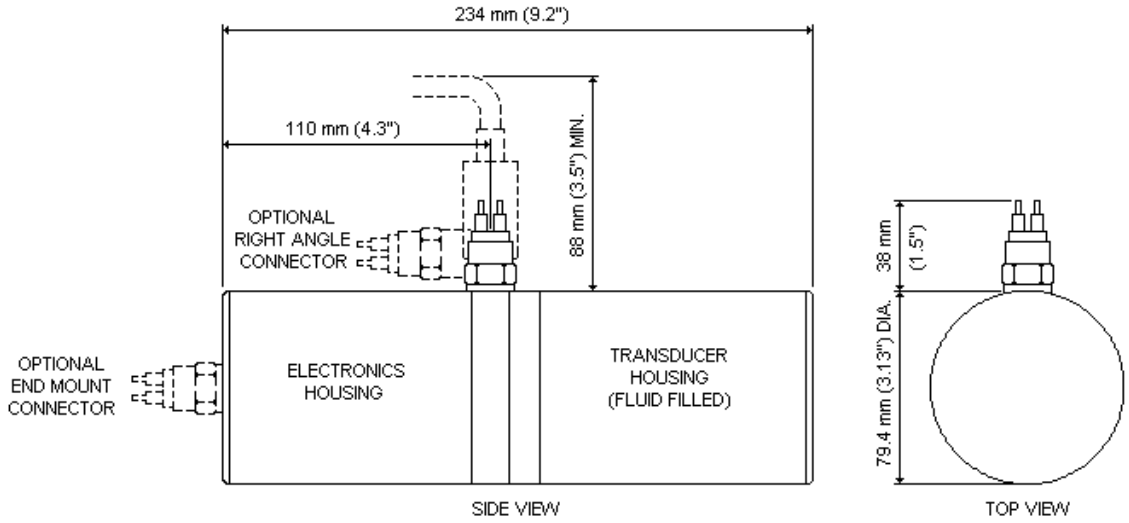
HARDWARE SPECIFICATIONS:	
FREQUENCY	675 kHz -Other frequencies can be selected through programmable software configurations (Tunable from 600 kHz to 1 MHz in 5 kHz steps)
TRANSDUCER	Profiling type, fluid compensated
TRANSDUCER BEAM WIDTH	600 kHz: 2.4° 675 kHz: 2.1° 1 MHz: 1.4°
RANGE RESOLUTION	1 m – 4 m: 2 mm (0.08") 5 m & up: 10 mm (0.4")
MIN. DETECTABLE RANGE	150 mm (6")
MAX. OPERATING DEPTH	1000 m and 3000m available
MAX. CABLE LENGTH	1000 m on typical twisted shielded pair (RS-485)
INTERFACE	RS-485 serial interface @ 115.2 kbps (or optional RS-232)
CONNECTOR	Side mounted, four conductor, wet mateable (Impulse MCBH-4-MP-SS) Optional right angle or end mount connector
POWER SUPPLY	20 – 36 VDC at less than 5 Watts
DIMENSIONS (for both depth ratings)	79.4 mm (3.125") diameter x 234mm (9.2") length
WEIGHT: In Air **In Water**	1000 m unit: 1.8 kg (4 lbs) 3000 m unit: 2.2 kg (4.8 lbs) 1000 m unit: 0.6 kg (1.3 lbs) 3000 m unit: 1 kg (2.2 lbs)
MATERIALS	1000 m unit: 6061-T6 Aluminum & Polyurethane 3000 m unit: Titanium, Polyurethane & 300 series stainless steel
FINISH	Hard Anodize

SOFTWARE SPECIFICATIONS:	**Win881A.exe**
WINDOWS™ OPERATING SYSTEM	Windows™ 95, 98, Me, NT*, 2000*, XP*, Vista*
MODES	Side Scan, Polar, and Sector
RANGE SCALES	1 m, 2 m, 3 m, 4 m, 5 m, 10 m, 20 m, 30 m, 40 m, 50 m, 60 m, 80 m, 100 m
TRAIN ANGLES	Continuous rotation, 3° increments
SECTOR SIZE: **SECTOR MODE** **POLAR MODE**	 0° – 180°, 3° increments 0° – 357°, 3° increments, or Continuous rotation
STEP SIZES	Slow (0.3°), Medium (0.6°), Fast (0.9°), Faster (1.2°), Fastest (2.4°)
GRID TYPES	Polar and rectangular
FILE FORMAT	(filename).81a
RECOMMENDED MINIMUM COMPUTER REQUIREMENTS:	100 MHz Pentium 16 MB RAM 1 GB Hard Disk 800 x 600 x 256 colour graphics

* Requires Win881A.exe v2.00 or higher (Free upgrade available for older versions – Contact Imagenex)



ORDERING INFORMATION:		
1000 m UNIT	Standard	881-000-420
3000 m UNIT	Standard	881-000-421
RS-232	Option	-006
End mount connector	Option	-009
Right angle connector	Option	-010
Interface source code in “C” (TEST881A.C)	Option	-018

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IMAGENEX MODEL 881A
AZIMUTH DRIVE

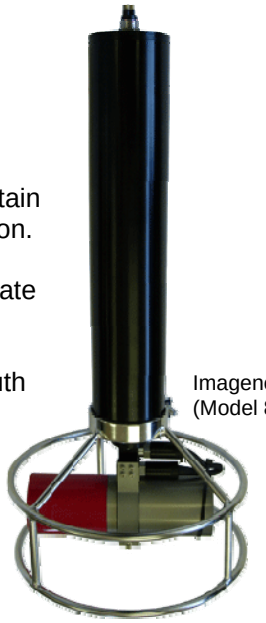
APPLICATIONS:

- 3D Precision Surveying
- Sediment Transport Research
- Marine Geology
- Scientific Research

FEATURES:

- Programmable
- Continuous Rotation
- Suitable for Autonomous or Remote Deployment

The Model 881A Azimuth Drive is a rugged and powerful rotary actuator drive that can be coupled to an Imagenex Model 881A Profiling Sonar. The two axes of rotation in this combined unit provide the capability to obtain accurate, high resolution range information in any direction. In standard applications, profiles may be made in any direction by simply commanding the Azimuth Drive to rotate the attached profiling sonar anywhere in a circle. The profiling sonar can then perform a cross-sectional scan before being rotated to a new azimuth angle. The Azimuth Drive uses the same RS-485 serial communications line and command structure as the profiling head. A single, simple to use PC compatible computer program operates both, and full communications protocol specifications are provided for designing customized software.



Imagenex Model 881A Profiling Sonar
(Model 881-000-420) not included

HARDWARE SPECIFICATIONS:	
MAX. OPERATING DEPTH	1000 m and 3000 m available
MAX. CABLE LENGTH	1000 m on typical twisted shielded pair (RS-485)
INTERFACE	RS-485 serial interface @ 115.2 kbps
CONNECTOR	Four conductor, wet mateable (Impulse MCBH-4-MP-SS)
STANDARD ACCESSORIES	Azimuth Drive to Sonar Head Interconnect Cable
POWER SUPPLY	20 – 36 VDC at 1 Amp max.
DIMENSIONS	89 mm (3.5”) diameter x 445 mm (17.5”) length 291 mm (11.5”) Cage diameter
WEIGHT: In Air **In Water**	1000 m unit: 7.7 kg (17 lbs) 3000 m unit: TBA 1000 m unit: 2.7 kg (6 lbs) 3000 m unit: TBA
MATERIALS	6061-T6 Aluminum & 300 Series Stainless Steel
FINISH	Anodized

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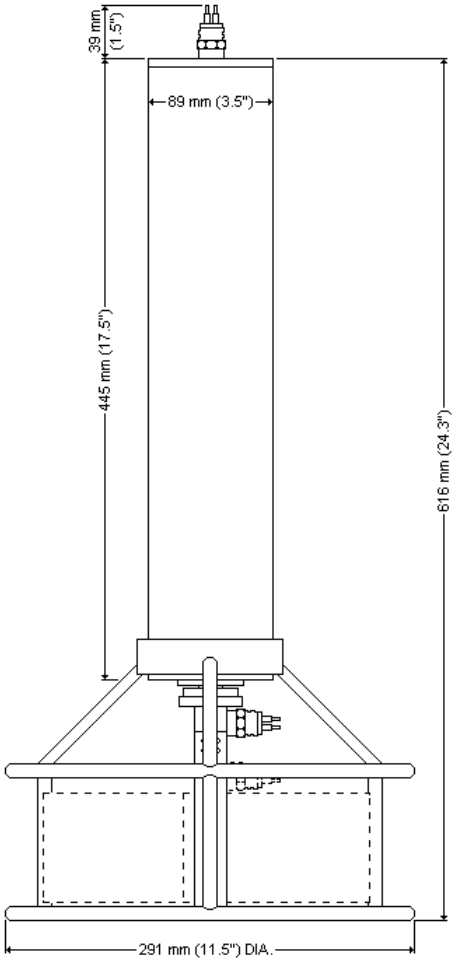
SOFTWARE SPECIFICATIONS:	Win881A.exe
WINDOWS™ OPERATING SYSTEM	Windows™ 95, 98, Me, NT*, 2000*, XP*, Vista*
AZIMUTH ANGLE	0° – 359.7°, 0.3° increments
FILE FORMAT	(filename).81a, (filename).xyz
RECOMMENDED MINIMUM COMPUTER REQUIREMENTS:	100 MHz Pentium 16 MB RAM 1 GB Hard Disk 800 x 600 x 256 colour graphics

* Requires Win881A.exe v2.00 or higher (Free upgrade available for older versions – Contact Imagenex)



ORDERING INFORMATION:		
1000 m UNIT	Standard	881-000-450
3000 m UNIT	Standard	881-000-451
Interface source code in “C” (TESTAZIM.C)	Option	-018

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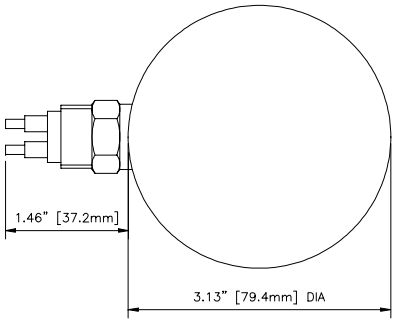
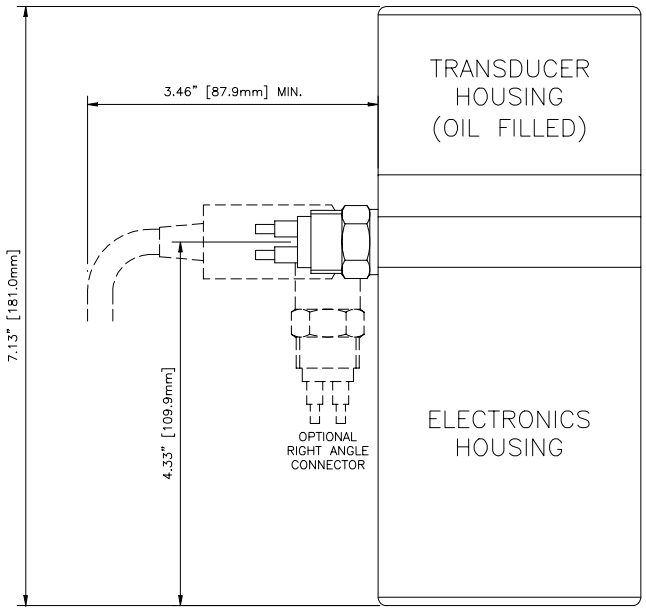
ZONE	REV.	DESCRIPTION	DATE	SIG.



PLAN VIEW



SIDE VIEW

SPECIFICATIONS

FREQUENCY: Tunable. Three default settings of 330kHz 675kHz or 1MHz.

TRANSDUCER: Oil filled protective transducer housing.
- Operater can select a frequency of his own choosing other than the default settings.
- 360 degree continuous rotation.
- Polar mode, sector mode, single side scan mode.

RANGE: Full scale range is from 1M – 200M

POWER: 24 VDC less than 5 Watts

INTERFACE: RS–485 @ 115.2 KBaud or optional RS–232

DEPTH: 1000M Aluminium housing or 3000M Titanium Housing

MATERIALS: 6061T6 Aluminum, Polyurethane, 300 series stainless steel, Epoxy resin.

FINISH: Hard Anodised

DIMENSIONS: 3–1/8 in (79.4mm) Diameter 7–1/8 in (181mm) Length

WEIGHT: 3.3 lbs (1.5kg) in air 1.3 lbs (0.6kg) in the water

IMAGENEX
TECHNOLOGY CORPORATION
209-1875 BROADWAY STREET, PORT COQUITLAM, B.C. CANADA, V3C 5W2
TEL: (604) 944-8248 e-mail imagenex@npsnet.com

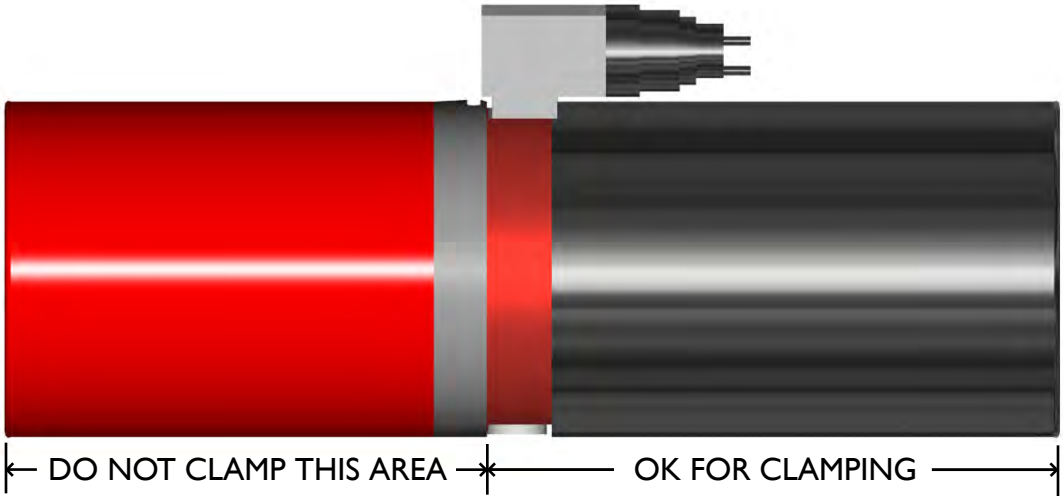
ROV SONAR DATASHEET

DWG NO	REV
881A	NEW

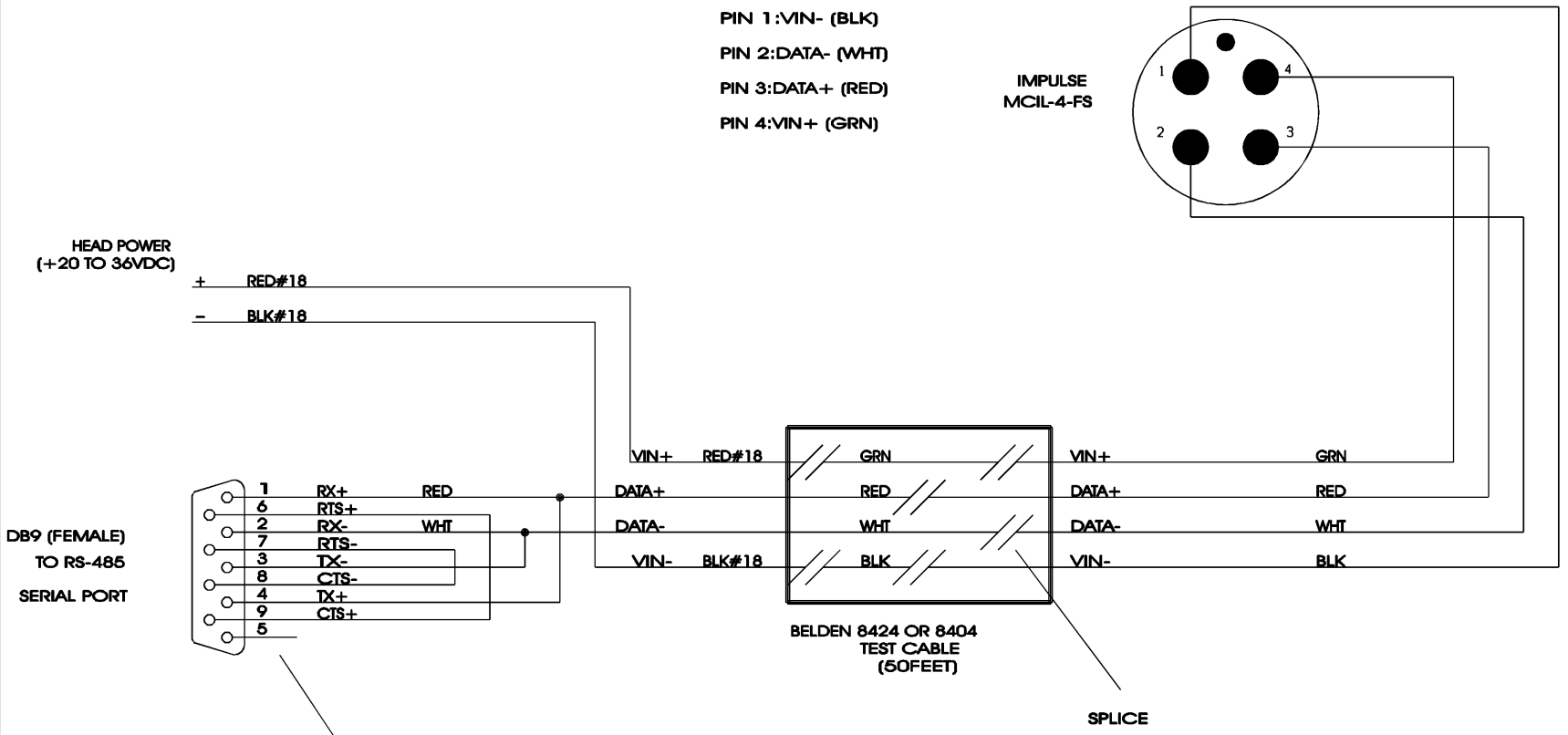
DRAWING NOT TO SCALE | SHEET 1 OF 1

DWG NO 331A REV –

AZIMUTH DRIVE



IMAGENEX TECHNOLOGY CORP. 209-1875 BROADWAY ST.
PORT COQUITLAM B.C. CANADA V3C 4ZI
TEL 604 944 8248 / FAX 604 944 8249



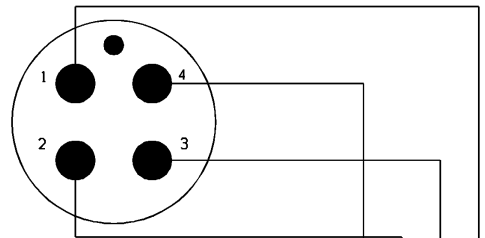
IMAGENEX Technology Corp.		
Title: MODEL 881A SONAR HEAD TEST CABLE		
Size: A	Document Number: 881-200-110	REV: 01
Date: April 9, 2002	Sheet 1 of 1	

PIN 1:COM (BLK)

PIN 2:TXD (WHT)

PIN 3:RXD (RED)

PIN 4:VIN+ (GRN)



HEAD POWER

(+20 TO 36VDC)

\+ RED#18

– BLK#18

DB9 (FEMALE)
TO RS-232
SERIAL PORT

1			VIN+	RED#18	GRN	VIN+	GRN	
2	TXD	WHT	TXD		WHT	TXD	WHT	
3	RXD	RED	RXD		RED	RXD	RED	
5	COM	BLK	COM	BLK#18	BLK	COM	BLK	

BELDEN 8424/8404
OR CAROL C-1305
(4-COND. SHIELDED)

TEST CABLE
(50FEET)

SPLICE

IMAGENEX Technology Corp.		
Title: MODEL 881A SONAR HEAD TEST CABLE (RS-232)		
Size: A	Document Number: 881-200-120	REV: 01
Date: May 25, 2001	Sheet 1 of 1	

IMAGENEX MODEL 881A SONAR
RS-232/RS-485 SELECTION

1. Remove the green nylon cord that secures the electronics housing. Don't remove the cord that secures the red polyurethane dome as it contains oil.

2. Gently wiggle the electronics housing away from the middle bulkhead section ensuring that the O-Ring remains clean and intact.

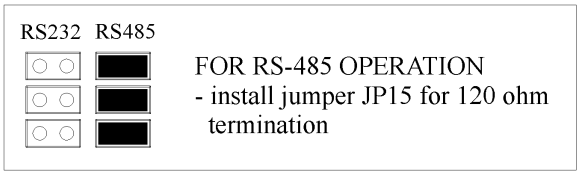
3. Locate all suitcase jumper positions on the top circuit board (PCB 130-008.V2).

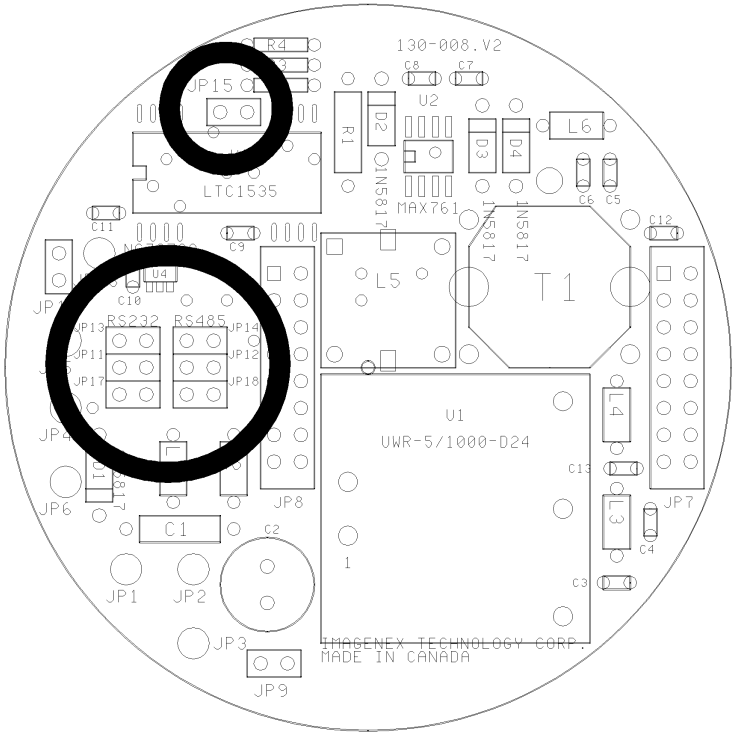
   For RS-232 operation:
   - install jumpers JP11, JP13 and JP 17. Remove all other jumpers.

   For RS-485 operation:
   - install jumpers JP12, JP14, JP15 and JP18. Remove all other jumpers.

4. Ensure that the O-Ring and O-Ring surfaces are clean and replace the housing.

5. Insert the green nylon cord and push it in all the way to secure the housing to the bulkhead.





PCB 130-008.V2

MODEL 881A DIGITAL SONAR HEAD (Multi-Frequency)

WIN881A.EXE: Display Software For Win 95/98/Me/NT/2000/XP

VERSION 2.36

OVERVIEW

WIN881A is a Windows 95/98/Me/NT/2000/XP program that controls, displays and records data from the multi-frequency Model 881A Digital Sonar Head c/w an interface to control the optional Model 881A Azimuth Drive for profiling applications. The program uses a 2-Wire RS-485 COM port (115200,N,8,1) to communicate with the head and an RS-232 COM port (4800,N,8,1) for receiving GPS Lat/Lng coordinates. The head can be operated at different ranges, gains, speeds, frequencies, etc. The Windows display mode must be at least 800 x 600 pixels with small fonts selected.

SCREEN LAYOUT

The main screen of WIN881A comprises of a sonar data window on the left side with various sonar head controls and a sector size icon on the right side. Other items include an operating frequency display, a x2 Pixel Zoom window, date/time readout, Lat/Lng readout, sonar head range/bearing readout to one or two cursors and a control for displaying real time data from the head or playback data from a file. Pop-up windows are available for controlling the Azimuth Drive and for displaying sonar head diagnostics.

OPERATION

To operate the sonar head, ensure that the head cable is connected to a 2-Wire RS-485 serial port or an external RS-485 to RS-232 (or RS-485 to USB) converter is installed in-line. Apply 20 to 36VDC to the sonar head power wires (+V to RED, -V to BLACK) using a DC power supply capable of supplying a current of 0.5 Amps (or 1 Amp with the Azimuth Drive connected). Run the program WIN881A.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. To allow other programs to use available CPU time, WIN881A 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 data (shot by shot) complete with date/time and Lat/Lng coordinates. The file extension is always '**.81A**'. 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 '**.81A**' 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 **'.81A'** 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**' Windows Bitmap file.
Auto Frame Capture	allows the user to automatically create screen captures for time-lapsed movie file creation. Whenever there is is scan direction change or whenever the sonar scans a full 360 degrees, a '.**BMP**' file of the screen is automatically generated. An incrementing number is appended to the filename for each successive screen capture, the format is "filename-nnnn.bmp". Select 'Auto Frame Capture Start…' to begin the capture process, then select 'Auto from Capture Stop…' to finish. Available when DATA FROM '**FILE**' is active.
Exit	writes current configuration to file (WIN881A.INI), closes the program and exits to Windows.

MAIN MENU (con't)

Heads Menu

Disable Sonar Head	this feature is not implemented.
Enable Azimuth Drive	used to enable/disable interrogation of the optional Model 881A Azimuth Drive. When enabled, the Azimuth Pop-up window is displayed showing the current azimuth angle setting. The message '**Detecting Azimuth Drive…**' will flash until communications are established with the azimuth drive. After 40 seconds, if the Azimuth Drive has not replied, the message 'Azimuth Drive Not Found' is displayed. If the this message is displayed and the Azimuth Drive has not finished calibrating, re-enable the drive in order to begin another detection process. If the Azimuth Drive will not be used, disable this setting. The profiling sonar connected to the Azimuth Drive must have its Xdcr Position set to **Fwd** and **Zero Down** must be selected in the Profile Menu.
Simulate Azimuth Drive	allows the user to manually operate the Auto-Azimuth function without having an Azimuth Drive connected.
Change Azimuth…	displays the Azimuth Pop-up window and allows the user to change the Azimuth angle from 0 to 359.7 degrees in 0.3 degree increments.

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 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. If **Profile Grid** is enabled via the **Profile Menu**, the Xdcr Position names change to '**Fwd**' and '**Aft**' for profiling applications. The Fwd position must be selected if using a profiling sonar with an Azimuth Drive.
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 re-calibrate the sonar head transducer to the center position.

MAIN MENU (con't)

Com Ports Menu

Sonar Head	to select the serial communications port (COM1-COM8) for communicating with the connected head. 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).
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.
GPS Input	to select the serial communications port (COM1-COM8) for receiving Lat/Lng ships position coordinates from a GPS receiver. This port accepts the NMEA 0183 $GPGLL string or the $GPGGA string at 4800,N,8,1. 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 GPS Input will not be available. As default on most computers, COM1/COM3 share IRQ4 (interrupt request #4) and COM2/COM4 share IRQ3. Ensure that the COM port you select for GPS Input does not share its IRQ with the sonar head COM port. This could cause the program to hang up!
GLL	to use Lat/Lng coordinates from the $GPGLL string
GGA	to use Lat/Lng coordinates from the $GPGGA string

MAIN MENU (con't)

MULTI-FREQUENCY OPERATION

The default configuration for Win881A automatically adjusts the operating frequency, absorption and pulse length with range. The following Table describes this relationship:

Range (m)	Frequency (kHz)	Absorption (dB/m)	Pulse Length (μs) Polar Mode	Pulse Length (μs) Sector/Sidescan
1	1000	0.6	20	10
2	1000	0.6	20	10
3	1000	0.6	20	10
4	1000	0.6	20	10
5	1000	0.6	60	30
10	675	0.2	60	30
20	675	0.2	100	50
30	675	0.2	160	80
40	675	0.2	220	110
50	675	0.2	260	130
60	675	0.2	320	160
80	675	0.2	420	210
100	675	0.2	540	270
150	310	0.1	800	400
200	310	0.1	1000	530

The frequencies in the above table are designed for use with the Fan Beam Imaging Sonar (Model 881-000-400/401) only!

The Fan Beam Imaging Sonar (Model 881-000-402) has a fixed frequency of 675 kHz.

The Pencil Beam Profiling Sonar (Model 881-000-420/421) has a frequency limit of 600 kHz to 1 MHz.

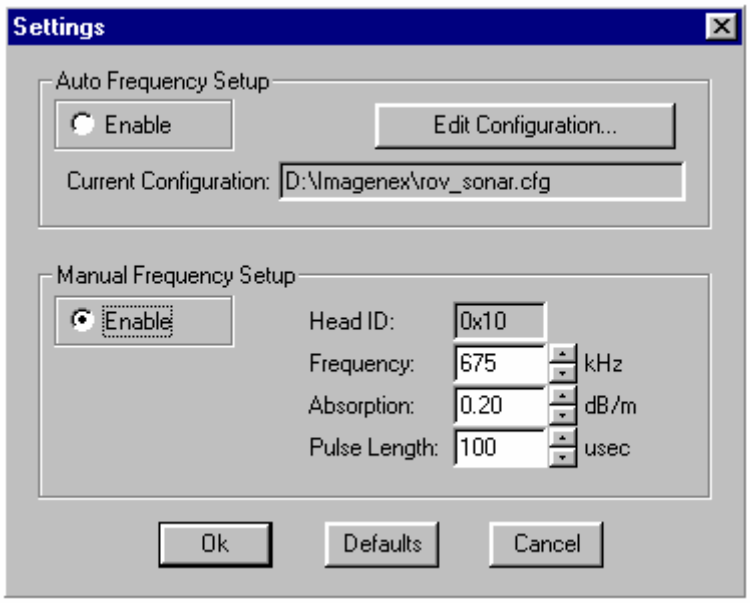
MAIN MENU (con't)

Settings Menu

Allows the user to manually or automatically adjust the sonar head's operating frequency, absorption and pulse length.

Manual Frequency Setup — select **Enable** to adjust the following parameters for the current range:

Frequency (280-1100kHz in 5kHz increments)
Absorption (0.01-2.55dB/m in 0.01 dB increments)
Pulse Length (10-1000µs in 10µs increments)

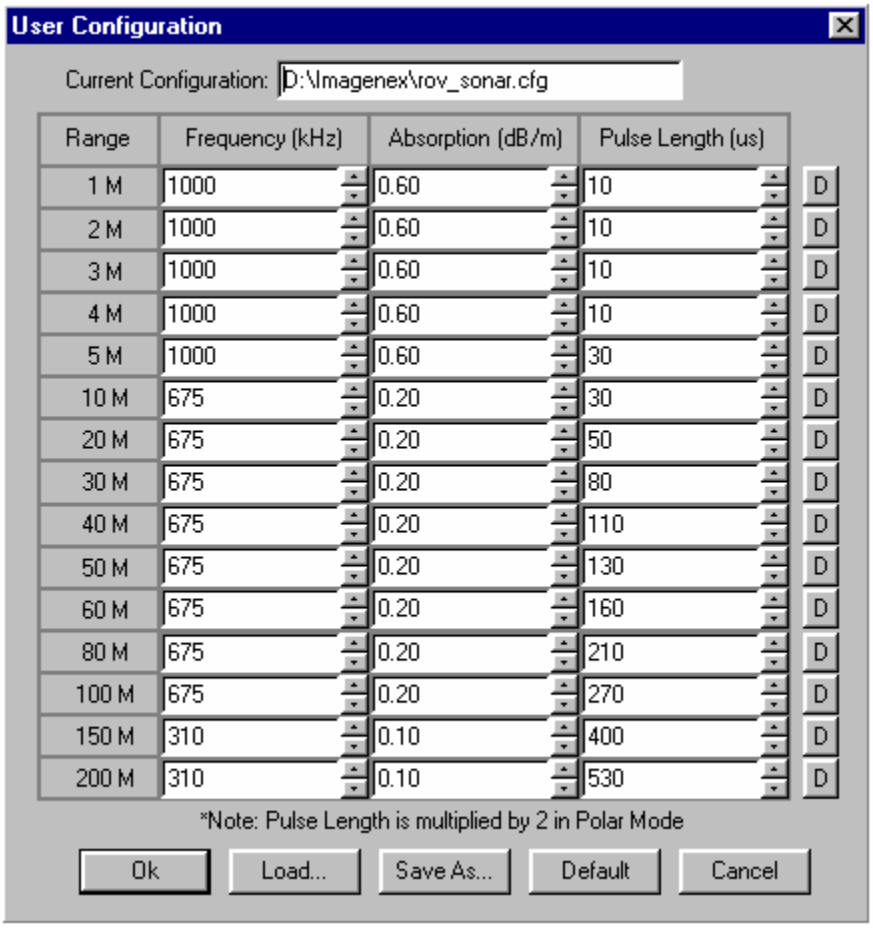


Auto Frequency Setup — select **Enable** to use the pre-programmed frequencies, absorptions and pulse lengths from the displayed Current Configuration.

MAIN MENU (con't)

Edit Configuration — to display the following User Configuration dialog box. The following parameters can be modified for each range:

Frequency (280-1100kHz in 5kHz increments)
Absorption (0.01-2.55dB/m in 0.01 dB increments)
Pulse Length (10-1000µs in 10µs increments)



Load… — to load a previously saved user configuration from disk.

Save As… — to save the current user configuration to disk.

Default — to load the factory default configuration. The default values for each individual range can be selected by pressing the button labeled ‘D’ beside each range row.

MAIN MENU (con't)

Misc Menu

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.
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 connected sonar head and optional Azimuth Drive.
Sonar On When Minimized	when this item is checked, the sonar head will continue to operate and log data when the sonar screen is minimized. If not checked, the serial port is closed and communication with the sonar head and data logging is put on hold until the screen is maximized. This allows other programs to use the serial port and available CPU time

MAIN MENU (con't)

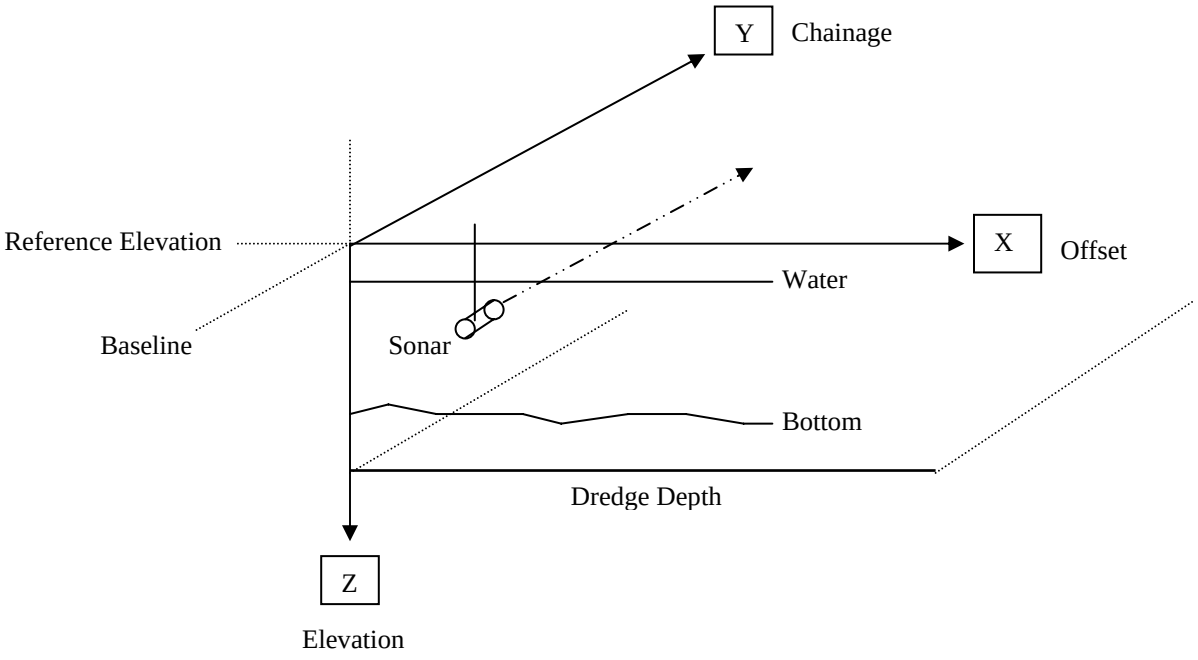
Profile Menu

Profile Mode	to set the mode of operation for the display of the digitized profile range points. The following modes are available: **Off** No profile range point is plotted, echo data is plotted normally. **Points Only** Only the profile range points are plotted, no echo data is sent from the head. **Low Mix** The profile range point is plotted along with the echo data. The echo data is plotted at 1/4 level so the profile point stands out. This mode can be useful for making Start Gain adjustments to optimize the profile points before switching to Points Only mode. **Med Mix** Same as Low Mix but the echo data is plotted at 1/2 level. **High Mix** Same as Low Mix but the echo data is plotted at full level.
Profile Grid	to display a rectangular grid for profiling applications.
Zero Down	to enable plotting of profile data with the zero reference of the sonar head pointing down rather than pointing up. This allows plotting the seafloor in its correct orientation. This item is available only if **Profile Grid** is enabled. Zero Down must be selected if using a profiling sonar with an Azimuth Drive.

MAIN MENU (con't)

Profile Setup…	allows the user to alter the detection scheme used to generate the digitized profile range points.
Digitization Source	the profile range point for each ping is digitized in the sonar head and sent to the surface in the 12 byte header. The data is sampled with a resolution of 2mm for the 1, 2, 3 and 4 meter operating ranges. All other operating ranges have a 10mm sampling resolution. The surface detection resolution is (Operating Range/250) for Polar Mode and (Operating Range/500) for Sector Mode. You could select 'Surface' if you would like to alter the profile points during playback (and record to a new file using the Copy Start… function).
Detection Type	use Start of Pulse to display the profile points at the beginning of the echo pulse. Use Center of Pulse to display the profile point in the middle of the pulse. The Detection Type can only be changed when Surface Detection is used as the Sonar Head always uses Center of Pulse detection.
Minimum Range	used to set the starting range for profile digitization. Ranges less than this setting will not be digitized. The minimum range can be adjusted from 0 to 25 meters in 0.1 meter increments.
Minimum Level	used to set the detection level for profile digitization. This level can be adjusted from 10 to 90 percent of the color scale. Levels less than this setting will not be digitized. The Minimum Level can only be changed when Surface Detection is used as the Sonar Head uses its own internal level threshold.
Auto-Profile…	allows the user to automatically command the sonar to do a scan and save the digitized profile points including offsets to two different files. The first file is an ASCII file with xyz information. The second is a screen capture to a Windows bitmap file. The scan limits are based on the current angles set via the Sector and Train switches and a new ASCII file and screen capture are automatically generated for every new scan.

MAIN MENU (con't)



Chainage (y)	this number represents the horizontal down range distance along the Y-Axis for the current profile cross-section.
Sonar Elevation (z)	this number represents the height of the sonar head in relation to the Reference Elevation along the Z-Axis.
Sonar Offset (x)	this number represents the horizontal distance of the sonar head from the baseline along the X-Axis.
Dredge Line	this number is used to display a horizontal line on the display which represents the desired dredge depth (distance below the reference elevation). The number entered here is the depth below the sonar head.

MAIN MENU (con't)

Auto-Profile Enable — when the Auto-Profile Enable is checked, pressing the Ok button will invoke 1 scan using the current sonar settings (i.e. range, gain, sector size, train angle, sound velocity). The sonar will automatically move to its' counter-clockwise position and begin scanning. When the sonar reaches its' clockwise position, the following will occur:

A message box appears asking if you would like to save the current profile. If you select Yes, a screen capture is made and an ASCII XYZ file is generated for the current scan with the profile points adjusted by the above x, y and z offsets. The Auto-Profile Dialog Box is then displayed allowing you to change the offset numbers for the next scan. When you want to stop the Auto-Profile scanning, simply disable the Auto-Profile Enable check box and press Ok. You can invoke the Auto-Profile Dialog Box at any time during a scan. When this dialog box is active, the sonar head is put on hold until the Ok button is pressed.

It is recommended that you record all data to a .81A file via the Record Start… function in the File menu as the XYZ ASCII file can not be displayed via this program.

After each scan… — you can customize the scanning process by enabling or disabling the XYZ and BMP file generation. You can also omit the save scan confirmation and Auto-Profile Dialog Box display in order to gain hands-free operation.

The automatic filenames used for the ASCII file and the screen capture file are based on the current system date:

DDMMMYYYY-nnnn.BMP
DDMMMYYYY-nnnn.XYZ

DD = day (1-31), MMM = month (Jan, Feb, Mar…), YYYY = year
nnnn (0001-9999), this number automatically increments for each new file (each new scan).

MAIN MENU (con't)

The **XYZ ASCII file** contains the following information:

YYYY.YY,M<CR><LF> - Chainage, M=meters, F=feet
ZZZZ.ZZ<CR><LF> - Sonar Elevation
XXXX.XX<CR><LF> - Sonar 'X' Offset
VVVV.VV<CR><LF> - Sound Velocity

dd-mmm-yyyy	hh:mm:ss.hh	rrr.rrr	aaa.aaa	bbb.bbb	xxx.xxx	yyy.yyy	zzz.zzz<CR><LF> - 1st Point
dd-mmm-yyyy	hh:mm:ss.hh	rrr.rrr	aaa.aaa	bbb.bbb	xxx.xxx	yyy.yyy	zzz.zzz<CR><LF> - 2nd Point
.							
.							
dd-mmm-yyyy	hh:mm:ss.hh	rrr.rrr	aaa.aaa	bbb.bbb	xxx.xxx	yyy.yyy	zzz.zzz<CR><LF> - Last Point

where:
dd-mmm-yyyy = current system date
hh:mm:ss.hh = current system time
rrr.rrr = profile range
aaa.aaa = 0 (not used)
bbb.bbb = vertical scanning angle
xxx.xxx = sonar_offset + profile_range * sin (vertical angle)
yyy.yyy = chainage
zzz.zzz = sonar_elevation – profile_range * cos(vertical angle)

The above fields are TAB delimited.

The Chainage, Sonar Elevation, Sonar Offset and Dredge Line numbers are saved in the WIN881A.INI file but are not saved in the .81A data files. The Auto-Profile function is available only when DATA FROM '**HEAD**' is active.

MAIN MENU (con't)

Auto-Azimuth…	to command the azimuth drive to automatically move to a new azimuth angle and invoke a scan with the profiling sonar head. The digitized profile points can automatically be saved to an ASCII xyz file. The profiling sonar scan limits are based on the current angles set via the Sector and Train switches.
Azimuth Start	the azimuth angle for the first profile scan.
Azimuth Stop	the azimuth angle for the last profile scan
Azimuth Increment	the azimuth angle increment for each profile scan.
Auto-Azimuth Enable	when the Auto-Azimuth Enable is checked, pressing the Ok button will command the Azimuth Drive to move to the Azimuth Start Angle and invoke 1 scan using the current sonar settings (i.e. range, gain, sector size, train angle, sound velocity). The sonar will automatically move to its' counter-clockwise position and begin scanning. When the sonar reaches its' clockwise position, an ASCII XYZ file is generated for the current scan. The Azimuth Drive will then automatically rotate the profiling sonar by the Azimuth Increment amount and start a new scan. At the end of this scan, the data is appended to the XYZ file. This process will continue until the Azimuth Stop angle has been reached. At this point, the XYZ file is closed, the Auto-Azimuth mode is disabled and the "Scan Complete" message is displayed. Pressing Ok simply acknowledges the message and allows the sonar to continue scanning at the current azimuth angle. If you want to abort an Auto-Azimuth scan, select the Auto-Azimuth menu and simply disable the Auto-Azimuth Enable check box and press Ok. You can invoke the Auto-Azimuth Dialog Box at any time during a scan. When this dialog box is active, the sonar head is put on hold until the Ok button is pressed.

MAIN MENU (con't)

It is recommended that you record all data to a .81A file via the Record Start… function in the File menu as the XYZ ASCII file can not be displayed via this program.

The automatic filename used for the XYZ ASCII file is based on the current system date:

DDMMMYYYY-nnnn.XYZ

DD = day (1-31), MMM = month (Jan, Feb, Mar…), YYYY = year
nnnn (0001-9999), this number automatically increments for each new file. Unlike the Auto-Profile mode which increments the file number every scan, the Auto-Azimuth XYZ file contains multiple scans.

The **XYZ ASCII file** contains the following information:

dd-mmm-yyyy hh:mm:ss.hh rrr.rrr aaa.aaa bbb.bbb xxx.xxx yyy.yyy zzz.zzz<CR><LF> - 1st Point
dd-mmm-yyyy hh:mm:ss.hh rrr.rrr aaa.aaa bbb.bbb xxx.xxx yyy.yyy zzz.zzz<CR><LF> - 2nd Point
.
.
dd-mmm-yyyy hh:mm:ss.hh rrr.rrr aaa.aaa bbb.bbb xxx.xxx yyy.yyy zzz.zzz<CR><LF> - Last Point

where:
dd-mmm-yyyy = current system date
hh:mm:ss.hh = current system time
rrr.rrr = profile range
aaa.aaa = azimuth angle
bbb.bbb = vertical scanning angle
xxx.xxx = profile_range * cos(azimuth angle) * sin (vertical angle)
yyy.yyy = -profile_range * sin(azimuth angle) * sin (vertical angle)
zzz.zzz = – profile_range * cos(vertical angle)

The above fields are TAB delimited and the scans are grouped by azimuth angle and seperated by a <CR><LF>.

The Auto-Azimuth function is available only when DATA FROM '**HEAD**' is active.

MAIN MENU (con't)

Grid Menu

Grid On/Off	to display the range rings (or squares) on the sonar display.

About Menu

About WIN881A	displays an about box showing the software version and date of this program. Contact information for Imagenex Technology Corp. is also displayed.

ON SCREEN SWITCHES

DATA FROM '**HEAD**'	to display data from the connected sonar head.
DATA FROM '**FILE**'	to display data from a previously recorded '**.81A**' Sonar file.
Hold	to hold or freeze the display.
Rev	to reverse the current scanning direction. Available only when DATA FROM '**HEAD**' is active.
Reverse	to reverse the file playback plotting direction. Available only when DATA FROM '**FILE**' 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: 1m (3ft) 2m (6ft) 3m (9ft) 4m (12ft) 5m (15ft) 10m (30ft) 20m (60ft) 30m (90ft) 40m (120ft) 50m (150ft) 60m (180ft) 80m (240ft) 100m (300ft) 150m (450ft) 200m (600ft)

ON SCREEN SWITCHES (con't)

Mode	to change the sonar display mode. Modes available are: Sector Polar SideScan
Start Gain	to change the starting gain of the 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: Slow (0.3 deg/step) Medium (0.6 deg/step) Fast (0.9 deg/step) Faster (1.2 deg/step) Fastest (2.4 deg/step)
Sector	to change the sector size (sweep angle). Sector Mode (0 to 180 degrees in 3 degree increments) Polar Mode (0 to 360 degrees in 3 degree increments) Sidescan Mode(0 degrees)
Train	to change the training angle relative to the sonar's zero or center angle. Sector Mode (0 to 357 degrees in 3 degree increments) Polar Mode (0 to 357 degrees in 3 degree increments) Sidescan Mode (90 or 270 degrees)

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: 1(3), 2(6), 3(9), 4(12), 5(15), 10(30), 20(60), 30(90), 40(120), 50(150), 60(180), 80(240), 100(300), 150(450) or 200(600) 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 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. 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. The range and bearing to this cursor becomes the new origin for future measurements. 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 to the new origin (**Org**), the range and bearing to the target cursor (**Tar**) and the range and bearing difference (**Diff**) between the two cursors. 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
- cable not connected
- Sonar Head COM port set to the wrong port number
- computer not fast enough to keep up with the head (increase SwitchDelay in the WIN881A.INI file).

GPS Lat/Lng Not Available
- GPS receiver output not connected to serial port
- GPS receiver is not sending data
- GPS receiver not set for 4800,N,8,1
- GPS Input COM port set to the wrong port number
- GPS receiver not sending $GPGLL or $GPGGA

Azimuth Drive Not Found
- no power to the Azimuth Drive
- cable not connected
- Detecting Azimuth Drive… timed out before Azimuth Drive calibration complete

DATA STORAGE FILE FORMAT (.81A)

When recording the sonar data to a **.81A** 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 Return Data Header** (12 Bytes)
112 to **xxxx**	**Sonar Return Echo Data** (0, 128, 250, 252 or 500 Bytes) **xxxx** = 112+above number Byte **xxxx** always = **0xFC** (Termination Byte from sonar head)
xxxx+1 to **yyyy**	**Zero Fill** **yyyy** = 127, 255, 383 or 639
yyyy+1 to **zzzz**	**Extended Bytes** If Byte #34 (in the File Header) is greater than zero, multiply Byte #34 by 128 to derive the number of Extended Bytes for this shot. i.e. if Byte #34 = 0x01, Extended Bytes = 128 zzzz = yyyy+Number of Extended Bytes
N-1 N-2	**Pointer To Previous Shot** The last 2 bytes of this shot contain a 16-Bit number that is the sum of the number of bytes for this shot and the number of bytes for the previous shot. This number is used for reverse playback synchronization. **N** = (128 or 256 or 384 or 640) + Extended Bytes Number of bytes to previos shot = ((N-2)<<8) | (N-1)

FILE HEADER

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

0 **ASCII '8'**
1 **ASCII '1'**
2 **ASCII 'A'**

3 **nToReadIndex** - Index for Number of Data Bytes
0 = 0 Data Bytes
1 = 128 Data Bytes
2 = 250 or 252 Data Bytes
3 = 500 Data Bytes

DATA STORAGE FILE FORMAT (.81A) (con't)

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, 256, 384 or 640 + Number of Extended Bytes															

6-7 **nToRead** - Number of Bytes from the sonar head

Byte 6								Byte 7							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
13, 141, 263, 265 or 513															

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 **Reserved** – always 0

34 **Extended Bytes**
Used for adding extra information to the .81A file format (i.e. GPS Lat/Lng) Multiply this number by 128. The resulting number of Extended Bytes is appended to the current file shot.
0: 0 * 128 = 0 Bytes
1: 1 * 128 = 128 Bytes
2: 2 * 128 = 256 Bytes, etc.

35-36 **Reserved** - always 0

DATA STORAGE FILE FORMAT (.81A) (con't)

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

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 1 = Polar 2 = Sidescan			0 = 0.3 Deg (Slow) 1 = 0.6 Deg (Medium) 2 = 0.9 Deg (Fast) 3 = 1.2 Deg (Faster) 4 = 2.4 Deg (Fastest)		

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

39 **(Sector Size)/3**
0 to 120 = 0 to 360 Degrees in 3 degree increments

40 **(Train Angle)/3**
0 to 119 = 0 to 357 Degrees in 3 degree increments

41 **Range Offset**
0 to 255 in 1m increments

42 **Absorption**
1 to 255 = 0.01 to 2.55dB/m in 0.01dB/m increments

43 **Profile Grid, Zero, Data Bits, LOGF**

Byte 43							
7	6	5	4	3	2	1	0
Profile Grid	**Zero**	**Data Bits**			**LOGF**		
0=OFF 1=ON	0=Up 1=Dn	0 = 4 Data Bits 1 = 8 Data Bits 2 = 14 Data Bits			0 = 10 dB 1 = 20 dB 2 = 30 dB 3 = 40 dB		

44 (**Pulse Length)/10**
0 to 100 = 0 to 1000µs in 10µs increments

DATA STORAGE FILE FORMAT (.81A) (con't)

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)

80-81 **Operating Frequency**

Byte 80								Byte 81							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Operating Frequency (in kHz)															

82-83 **Azimuth Drive Head Position**

Byte 82								Byte 83							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
A	**Azimuth Head Pos (0-1199)**														

If '**A**' = 0, Azimuth Head Pos not available
If '**A**' = 1, Azimuth Head Pos = [((Byte 82 & 0x7F)<<8) | (Byte 83)]
Azimuth Angle = (0.3 * Azimuth Head Pos) – 180 (in degrees)

84-90 **Reserved** - always 0

91-92 **Vertical Angle Offset**

Byte 91								Byte 92							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
(Vertical Angle Offset + 180) * 10															

93-99 **Reserved** - always 0

DATA STORAGE FILE FORMAT (.81A) (con't)

SONAR RETURN DATA HEADER
SONAR RETURN ECHO DATA
ZERO FILL

The following bytes contain the **Sonar Return Data** that is acquired directly from the sonar head serial COM port:

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**)

DATA STORAGE FILE FORMAT (.81A) (con't)

EXTENDED BYTES (starting at yyyy+1)

0-11 **GPS Ships Position Latitude** – null terminated text string (12 bytes)
"**dd.mm.xxx_N**"
dd = Degrees
mm = Minutes
xxx = Decimal Minutes
_ = Space
N = North or S = South

12-24 **GPS Ships Position Longitude** – null terminated text string (13 bytes)
"**ddd.mm.xxx_E**"
ddd = Degrees
mm = Minutes
xxx = Decimal Minutes
_ = Space
E = East or W = West

32-41 **KP POINT** – null terminated text string (10 bytes)
"**xxxx.xx_M**"
xxxx.xx = Meters
_ = Space

----------$GPGGA Fields ----------

48-59 **UTC Time** – null terminated text string (12 bytes)
"**HH:MM:SS.hh**"

60 **Fix Quality**

61 **Number of Satellites**

62-65 **Horizontal Dilution of Position** – four bytes (floating point)

66-69 **Altitude** – four bytes (floating point)

70-73 **Height of Geoid** – four bytes (floating point)

February 14, 2003

IMAGENEX MODEL 881A
MULTI-FREQUENCY DIGITAL SONAR HEAD (V5)
Fan Beam (3:1) and Pencil Beam (6:1)

SCANNING SPEEDS

RANGE (Meters)	SLOW (°/sec)	MEDIUM (°/sec)	FAST (°/sec)	FASTER (°/sec)	FASTEST (°/sec)
200	1.0	2.0	3.0	4.0	8.1
150	1.3	2.6	3.9	5.2	10.5
100	1.9	3.7	5.6	7.4	14.8
80	2.2	4.4	6.7	8.9	17.8
60	2.8	5.6	8.3	11.1	22.2
50	3.2	6.3	9.5	12.6	25.3
40	3.7	7.4	11.1	14.8	29.6
30	4.4	8.8	13.2	17.6	35.3
20	5.5	10.9	16.4	21.8	43.6
10	7.3	14.6	22.0	29.3	58.5
5	8.6	17.1	25.7	34.3	68.6
4	9.4	18.8	28.1	37.5	75.0
3	9.7	19.3	29.0	38.7	77.4
2	10.3	20.7	31.0	41.4	82.8
1	10.7	21.4	32.1	42.9	85.7

STORAGE (MByte/hr)
4.4
5.8
8.1
9.8
12.2
13.9
16.3
19.4
24.0
32.1
37.7
41.2
42.5
45.5
47.1

RANGE (Meters)	SLOW (sec/360°)	MEDIUM (sec/360°)	FAST (sec/360°)	FASTER (sec/360°)	FASTEST (sec/360°)
200	355.2	177.6	118.4	88.8	47.0
150	274.8	137.4	91.6	68.7	36.9
100	194.4	97.2	64.8	48.6	27.0
80	162.0	81.0	54.0	40.5	22.8
60	129.6	64.8	43.2	32.4	18.9
50	114.0	57.0	38.0	28.5	16.8
40	97.2	48.6	32.4	24.3	14.8
30	81.6	40.8	27.2	20.4	12.7
20	66.0	33.0	22.0	16.5	10.8
10	49.2	24.6	16.4	12.3	8.8
5	42.0	21.0	14.0	10.5	7.8
4	38.4	19.2	12.8	9.6	7.5
3	37.2	18.6	12.4	9.3	7.2
2	34.8	17.4	11.6	8.7	7.0
1	33.6	16.8	11.2	8.4	6.7

Using WIN881A.EXE v2.12, on Pentium III (500MHz) running Windows 98
Polar Mode, **8-Bit Data (Full Echo)**, 115200 bps, SwitchDelay=0

Step Sizes: Slow (0.3°), Medium (0.6°), Fast (0.9°), Faster (1.2°), Fastest (2.4°)

February 14, 2003

IMAGENEX MODEL 881A
MULTI-FREQUENCY DIGITAL SONAR HEAD (V5)
Pencil Beam (6:1) – Profile Points Only

SCANNING SPEEDS

RANGE (Meters)	SLOW (°/sec)	MEDIUM (°/sec)	FAST (°/sec)	FASTER (°/sec)	FASTEST (°/sec)	STORAGE (MByte/hr)
200	1.1	2.2	3.2	4.3	8.2	1.6
150	1.4	2.9	4.3	5.6	10.8	2.1
100	2.1	4.3	6.3	8.2	15.3	3.1
80	2.7	5.3	7.7	10.0	18.5	3.9
60	3.4	6.8	10.0	12.9	23.3	5.0
50	4.1	8.1	11.7	15.0	26.7	6.0
40	5.0	9.8	14.0	17.9	31.6	7.3
30	6.5	12.5	18.0	22.6	38.1	9.6
20	9.1	17.6	24.3	30.8	49.0	13.3
10	15.8	28.6	39.1	46.2	66.7	23.1
5	20.0	40.0	52.9	63.2	82.6	29.3
4	20.0	40.0	60.0	70.6	88.9	29.3
3	20.0	40.0	60.0	75.0	92.3	29.3
2	20.0	40.0	60.0	80.0	100.0	29.3
1	20.0	40.0	60.0	80.0	104.0	29.3

RANGE (Meters)	SLOW (sec/360°)	MEDIUM (sec/360°)	FAST (sec/360°)	FASTER (sec/360°)	FASTEST (sec/360°)
200	328.8	165.0	111.2	84.0	43.7
150	248.4	124.8	84.4	63.9	33.5
100	168.0	84.6	57.6	44.1	23.5
80	135.6	68.4	46.8	36.0	19.5
60	104.4	52.8	36.0	27.9	15.5
50	87.6	44.4	30.8	24.0	13.5
40	72.0	36.6	25.6	20.1	11.4
30	55.2	28.8	20.0	15.9	9.5
20	39.6	20.4	14.8	11.7	7.4
10	22.8	12.6	9.2	7.8	5.4
5	18.0	9.0	6.8	5.7	4.4
4	18.0	9.0	6.0	5.1	4.0
3	18.0	9.0	6.0	4.8	3.9
2	18.0	9.0	6.0	4.5	3.6
1	18.0	9.0	6.0	4.5	3.5

Using WIN881A.EXE v2.12, on Pentium III (500MHz) running Windows 98
IPX Mode (Profile Points Only), 115200 bps, SwitchDelay=0

Step Sizes: Slow (0.3°), Medium (0.6°), Fast (0.9°), Faster (1.2°), Fastest (2.4°)

MODEL 881A DIGITAL MULTI-FREQUENCY SONAR HEAD

SERIAL INTERFACE SPECIFICATION (v1.03)

OVERVIEW

The Model 881A Digital Sonar Head communicates over a 2-wire differential RS-485 serial data transmission line or optionally a half-duplex RS-232 data line. To interrogate the head 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 head moves to a new step angle, transmits, receives and sends its return data back to the command program.

SWITCH DATA COMMAND

The head 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 head will stop accepting switch data when it sees the termination byte (**0xFD** HEX), or 28 bytes (whichever comes first). The termination byte must be present for the head 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	Rev/ Hold	Master/ Slave	Reserved 0
8 – 15	Start Gain	LOGF	Absorp-tion	Train Angle	Sector Width	Step Size	Pulse Length	Profile MinRange
16 – 23	Reserved 0	Reserved 0	Reserved 0	Data Points	Data Bits	Up Baud	Profile	Calibrate
24 – 26	Switch Delay	Freq-uency	Term. **0xFD**					

Table 1 Model 881A Switch Data Command To Sonar Head

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**
16 Head ID's allowed: 0x10 to 0x1F

Byte 3 **Range**
1 to 200 Meters in 1 Meter increments

Byte 4 **Reserved**
Always 0

Byte 5 **Rev / Hold**
Bit 0 - 1 = Hold (or pause) Head, 0 = Resume
Bit 1 - 0
Bit 2 - 0
Bit 3 - 0
Bit 4 - 0
Bit 5 - 0
Bit 6 - 1 = Reverse Step Direction, 0 = Normal Operation
Bit 7 - 0

Byte 6 **Master / Slave**
The sonar head 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 head to transmit and send its return data at any given time.

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

SWITCH DATA COMMAND (con't)

Byte 7 **Reserved**
Always 0

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

Byte 9 **LOGF**
0 = 10dB
1 = 20dB
2 = 30dB
3 = 40dB

Byte 10 **Absorption**
0 to 255 = 0.00dB/m to 2.55dB/m
Byte 10 = absorption_in_dB_per_m * 100
Do not use a value of 253!

Byte 11 **Train Angle**
0 to 120 (-180 Deg to +180 Deg = 360 Deg Total) in 3 Degree steps.
Byte 11 = (train_angle_in_degrees + 180)/3
i.e.
0 = -180 Degrees
30 = -90 Degrees
60 = 0 Degrees
90 = +90 Degrees
120 = +180 Degrees

Byte 12 **Sector Width**
0 to 120 (0 Deg to 360 Deg) in 3 Degree steps
Byte 12 = sector_width_in_degrees/3
i.e.
0 = 0 Degrees
30 = 90 Degrees
60 = 180 Degrees
120 = 360 Degrees

SWITCH DATA COMMAND (con't)

Byte 13 **Step Size**
0 to 8 in 0.3 Degree increments
i.e.
0 = No Step
1 = 0.3 Degrees/Step
2 = 0.6 Degrees/Step
3 = 0.9 Degrees/Step
4 = 1.2 Degrees/Step
8 = 2.4 Degrees/Step

Byte 14 **Pulse Length**
Length of acoustic transmit pulse.
1-100 → 10 to 1000 μsec in 10 μsec increments
Byte 14 = pulse_length_in_microseconds / 10

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

Byte 18 **Reserved**
Always 0

Byte 19 **Data Points**
25 - 250 data points are returned by the head
The return data will have an ASCII '**IMX**' header.
50 - 500 data points are returned by the head
The return data will have an ASCII '**IGX**' header.

Byte 20 **Data Bits**
Resolution (number of data bits) of the returned echo data
4 - Data width = 4 Bits, 2 data points per byte
8 - Data width = 8 Bits, 1 data point per byte
16 - Data width = 16 Bits, 2 bytes per data point

SWITCH DATA COMMAND (con't)

Byte 21 **Up Baud**

****** NOTE: THIS FEATURE IS NOT YET AVAILABLE ******

The head receives switch data at 115200 baud, but can transmit its return data at various baud rates. The Up Baud value sets the head to transmit at a new baud rate. The default Up Baud value on power-up is 115200 baud.

0x0B - 9600 baud
0x03 - 14400 baud
0x0C - 19200 baud
0x04 - 28800 baud
0x02 - 38400 baud
0x05 - 57600 baud
0x06 - 115200 baud

Byte 22 **Profile**
0 = OFF
1 = ON --> The return data will have an ASCII '**IPX**' header.

Byte 23 **Calibrate**
0 = Normal Operation
1 = Calibrate sonar head transducer (move to 0 degrees).

Byte 24 **Switch Delay**
The head 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**
675kHz +/- 500kHz
0 – 200 → 175kHz to 1175khz in 5kHz increments
Byte 25 = (frequency_in_khz - 675)/5 + 100

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

SONAR RETURN DATA

Every shot, the head 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, 141, 265 or 513.

Byte #	**Description**					
0 to 5	ASCII 'I'	ASCII 'M','G' or 'P'	ASCII 'X'	Head ID	Serial Status	Head Pos (LO)
6 to 11	Head Pos (HI)	Range	Prof Rng (LO)	Prof Rng (HI)	Data Bytes (LO)	Data Bytes (HI)
12 to (N-2)	Echo Data 0, 128, 252, 500 Data Bytes					
N-1	Term. **0xFC**					

Table 2 Model 881A Sonar Head 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
If Data Bits was set to 4: N = 141, (128 Data Bytes, 256 Points)
If Data Bits was set to 8: N = 265, (252 Data Bytes, 252 Points)
If Data Bits was set to 16: N = 513, (500 Data Bytes, 250 Points)

ASCII '**IGX**'
In response to a Switch Data Command with Data Points = 50
If Data Bits was set to 4: N = 265, (252 Data Bytes, 504 Points)
If Data Bits was set to 8: N = 513, (500 Data Bytes, 500 Points)
If Data Bits was set to 16: N = 513, (500 Data Bytes, 250 Points)

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

SONAR RETURN DATA (con't)

Byte 3 **Head ID**
16 Head ID's allowed: 0x10 to 0x1F

Byte 4 **Serial Status**
Bit 0 - 1 = V5 firmware, (0 = V4 or lower)
Bit 1 - 0
Bit 2 - 0
Bit 3 - 0
Bit 4 - 0
Bit 5 - 0
Bit 6 - 1 = Switches Accepted
Bit 7 - 1 = Character Overrun

Byte 5 - 6 **Head Position**

Byte 5								**Byte 6**							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
0	**Head Pos (LO)**							**0**	**D**	**Head Pos (HI)**					**L**

Head Pos (LO), Head Pos (HI), Step Direction (D)
Head Pos High Byte = (Byte 6 & 0x3E)>>1
Head Pos Low Byte = [((Byte 6 & 0x01)<<7) | (Byte 5 & 0x7F)]
Head Position = (Head Pos High Byte<<8) | Head Pos Low Byte

Head Position = 0 to 1200 (-180 to +180 Degrees) in 0.3 Degree steps
0 = -180 Degrees
300 = -90 Degrees
600 = 0 Degrees (Center Position)
900 = +90 Degrees
1200 = +180 Degrees

Example angle calculation:
Angle = 0.3 * (Head Pos - 600)
Head Pos = 900
Angle = 0.3 * (900 - 600)
Angle = +90 Degrees

Step Direction = (Byte 6 & 0x40)>>6
0 = counter-clockwise
1 = clockwise

SONAR RETURN DATA (con't)

Byte 7 **Range**
Sonar Head Range: 1 to 200 Meters

Byte 8 - 9 **Profile Range**
First digitized range value above threshold in sample units
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

For ranges < 5m, one sample unit = 2mm
For ranges >= 5m, one sample unit = 10mm

Sample units are based on a sound velocity of 1500m/s

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

Byte 12 **Start of Echo Data**
(N-13) Bytes of data

SONAR RETURN DATA (con't)

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

If Data Bits was set to 4: N = 141, (128 Data Bytes, 256 Points)
1st Range Point = (Byte 12 & 0x0F)
2nd Range Point = (Byte 12 & 0xF0)>>4
3rd Range Point = (Byte 13 & 0x0F)
4th Range Point = (Byte 13 & 0xF0)>>4
etc. ...

If Data Bits was set to 8: 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
etc. ...

If Data Bits was set to 16: N = 513, (500 Data Bytes, 250 Points)
1st Range Point = (Byte 13<<8) | Byte 12
2nd Range Point = (Byte 15<<8) | Byte 14
3rd Range Point = (Byte 17<<8) | Byte 16
4th Range Point = (Byte 19<<8) | Byte 18
etc. ...

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

If Data Bits was set to 4: N = 265, (252 Data Bytes, 504 Points)
1st Range Point = (Byte 12 & 0x0F)
2nd Range Point = (Byte 12 & 0xF0)>>4
3rd Range Point = (Byte 13 & 0x0F)
4th Range Point = (Byte 13 & 0xF0)>>4
etc. ...

If Data Bits was set to 8: 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
etc. ...

SONAR RETURN DATA (con't)

If Data Bits was set to 16: N = 513, (500 Data Bytes, 250 Points)
1st Range Point = (Byte 13<<8) | Byte 12
2nd Range Point = (Byte 15<<8) | Byte 14
3rd Range Point = (Byte 17<<8) | Byte 16
4th Range Point = (Byte 19<<8) | Byte 18
etc. ...

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

MODEL 881A AZIMUTH DRIVE

SERIAL INTERFACE SPECIFICATION (v1.00)

OVERVIEW

The Model 881A Azimuth Drive communicates over a 2-wire differential RS-485 serial data transmission line or optionally a half-duplex RS-232 data line. The Azimuth Drive is designed to operate in conjuction with a Model 881A Multi-Frequency Digital Scanning Sonar Head over the same 2 wires. To interrogate the drive, 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 drive moves to the new azimuth step angle and sends its return data back to the command program.

SWITCH DATA COMMAND

The drive 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 drive will stop accepting switch data when it sees the termination byte (**0xFD** HEX), or 28 bytes (whichever comes first). The termination byte must be present for the drive 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	Reserved 0	Reserved 0	Hold	Master/ Slave	Reserved 0
8 – 15	Reserved 0	Reserved 0	Reserved 0	Azimuth LO	Azimuth HI	Reserved 0	Reserved 0	Reserved 0
16 – 23	Reserved 0	Reserved 0	Reserved 0	Reserved 0	Reserved 0	Up Baud	Reserved 0	Calibrate
24 – 26	Switch Delay	Reserved 0	Term. **0xFD**					

Table 1 Model 881A Azimuth Drive Switch Data Command

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**
Always **0x1F** (31 decimal)

Byte 3 **Reserved**
Always 0

Byte 4 **Reserved**
Always 0

Byte 5 **Hold**
Bit 0 - 1 = Hold (or pause) Azimuth Drive, 0 = Resume (Normal)
Bit 1 - 0
Bit 2 - 0
Bit 3 - 0
Bit 4 - 0
Bit 5 - 0
Bit 6 - 0
Bit 7 - 0

Byte 6 **Master / Slave**
The Azimuth Drive must be operated as a slave device. The default mode on power-up is Slave mode (Bit 6 = 1). Slave mode allows the user to command the drive at any given time.

Always **0x43** (67 decimal)

SWITCH DATA COMMAND (con't)

Byte 7 **Reserved**
Always 0

Byte 8 **Reserved**
Always 0

Byte 9 **Reserved**
Always 0

Byte 10 **Reserved**
Always 0

Byte 11-12 **Azimuth Step Angle (LO and HI)**
0 to 1199 (-180.0 Deg to +179.7 Deg) in 0.3 Degree steps.
Azimuth Step Angle = (angle_in_degrees+180)/0.3
0 = -180.0 Degrees
300 = -90.0 Degrees
600 = 0 Degrees
900 = 90 Degrees
1199 = 179.7 Degrees

Byte 11 = Azimuth Step Angle & 0x7F
Byte 12 = (Azimuth Step Angle & 0x3F80)>>7

Byte 13 **Reserved**
Always 0

Byte 14 **Reserved**
Always 0

Byte 15 **Reserved**
Always 0

Byte 16 **Reserved**
Always 0

Byte 17 **Reserved**
Always 0

Byte 18 **Reserved**
Always 0

SWITCH DATA COMMAND (con't)

Byte 19 **Reserved**
Always 0

Byte 20 **Reserved**
Always 0

Byte 21 **Up Baud**
Always 0x06 - 115200 baud

Byte 22 **Reserved**
Always 0

Byte 23 **Calibrate**
0 = Normal Operation
1 = Calibrate Azimuth Drive motor (move to 0 degrees).

Byte 24 **Switch Delay**
The drive 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 **Reserved**
Always 0

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

AZIMUTH DRIVE RETURN DATA

After it processes the Switch Data command, the Azimuth Drive returns a 12 Byte header and a terminating byte value of 0xFC. The total number of bytes returned will be 13.

Byte #	Description					
0 to 5	ASCII 'I'	ASCII 'A'	ASCII 'X'	Head ID	Serial Status	Azimuth (LO)
6 to 11	Azimuth (HI)	Reserved 0	Reserved 0	Reserved 0	Reserved 0	Reserved 0
12	Term. **0xFC**					

Table 2 Model 881A Azimuth Drive Return Data

BYTE DESCRIPTIONS

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

Byte 0 - 2 **Imagenex Return Data Header**
ASCII '**IAX**'
'I' = 0x49, 'A' = 0x41', 'X' = 0x58

Byte 3 **Head ID**
Always 0x1F

Byte 4 **Serial Status**
Bit 0 - 0
Bit 1 - 0
Bit 2 - 0
Bit 3 - 0
Bit 4 - 0
Bit 5 - 0
Bit 6 - 1 = Switches Accepted
Bit 7 - 1 = Character Overrun

Byte 5 - 6 **Azimuth Angle**

Byte 5								**Byte 6**							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
0	**Azimuth (LO)**							**0**	**Azimuth (HI)**						

Azimuth Angle = 0.3 * ([(Byte 6<<7) | (Byte 5)] -600), in degrees

AZIMUTH DRIVE RETURN DATA (con't)

Byte 7	**Reserved** Always 0
Byte 8	**Reserved** Always 0
Byte 9	**Reserved** Always 0
Byte 10	**Reserved** Always 0
Byte 11	**Reserved** Always 0
Byte 12	**Termination Byte** **0xFC**

Imagenex Model 881A Care Guide and Operational Specifications

This document describes the general care of the Model 881A sonar and it's operating environmental Specifications including depth and temperature.

General Care and Usage

Model 881A sonar's are designed to be operated in many types of operating environments. However to prolong the life of the equipment, simple maintenance is required.

Routine Maintenance

Fresh Water Rinse	After each immersion of the underwater unit, rinse the sonar thoroughly in fresh water. This will prevent the accumulation of salt or other contamination, and help prevent corrosion of the aluminum and stainless steel parts.
Clean Transducer Dome	The red polyurethane transducer dome should be cleaned with a detergent solution such as dishwashing liquid to remove any oil, grease, or other deposits which may reduce the acoustic performance of the unit.
Clean and Lubricate Connector	The cable and connector should be washed and coated with a **thin** film of silicon grease to protect the rubber. The connector should be protected from prolonged exposure to sunlight, ozone, solvents, hydrocarbon greases, and oils to avoid deterioration of the rubber.
Underwater Unit Storage	After being thoroughly cleaned and dried, the underwater unit should be stored in a dry, stable location to prevent moisture corrosion and damage from impact.
Cable Storage	The cable should be protected from prolonged exposure to sunlight, ozone, solvents, hydrocarbon greases, and oils to avoid deterioration of the rubber.

Do not use any solvents on the cable or underwater unit as they will compromise the physical integrity of the sonar

Service

There are no user serviceable components in the sonar and as such all repairs must be directed to:

Imagenex Technology Corp.
209-1875 Broadway Street
Port Coquitlam, BC, Canada
V3C 4Z1

Tel : (604)944-8248
Fax : (604)944-8249

Safety

Before each use, inspect the red polyurethane dome for any damage from impact and for any air bubbles or oil leakage. Inspect the cable connector on both the sonar head and cable for any damage such as bent or broken pins, or cuts in the cable. Ensure that the mating connection is secure and that the locking ring is in place.

Operational Environmental Specifications

While the Model 881A is designed to operate in a wide variety of environments, there are limitations.

Table 1 - Model 881A (881-000-400) Specifications

	Minimum	Maximum	Units
Temperature	-5	35	°C
Depth [1]	0	1000	m
Storage	-40	50	°C
Salinity [2]	30	40	ppt

[1] 3000m maximum operating depth available on model 881-000-401 only.

[2] The operation specification on Salinity is for acoustic properties only (i.e. the speed of sound in the medium). Salinity has no effect on mechanical operations if the unit is thoroughly cleaned after use.

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
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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

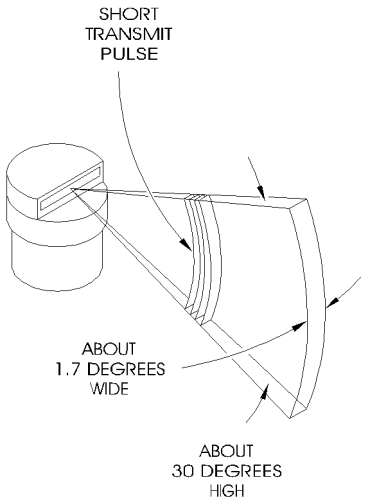
In many cases the sonar image of a target will closely resemble an optical image of the same object. In other cases, the sonar image may be difficult to interpret and quite unlike the expected optical image. The scanning process used to create a sonar image is different from the process used by the human 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.

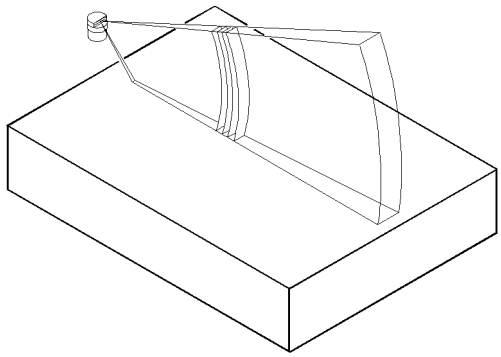
It is very important to note that the ranges shown to the targets on the sonar image are "slant" ranges. Usually the relative elevations of the targets are not known, only the range from the transducer. This means that two targets, which are displayed in the same location on the screen may be at different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

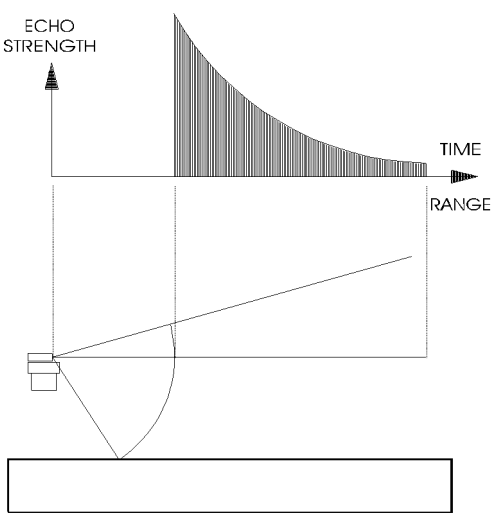
The diagrams following this chapter are examples of the sonar scanning process. Studying the diagrams will help you to better understand the images that you see. A basic knowledge of this process will help users to interpret what otherwise might be confusing images.



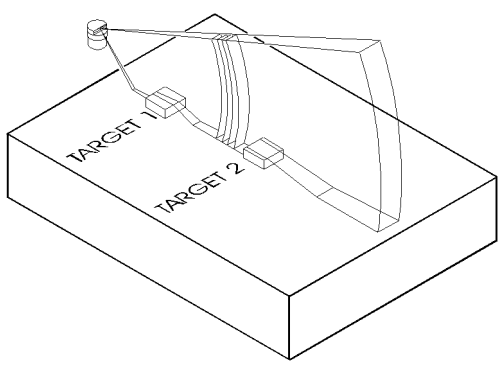
TYPICAL FAN SHAPED BEAM
AS USED ON IMAGING SONARS



FAN SHAPED SONAR BEAM
INTERSECTS WITH A FLAT BOTTOM

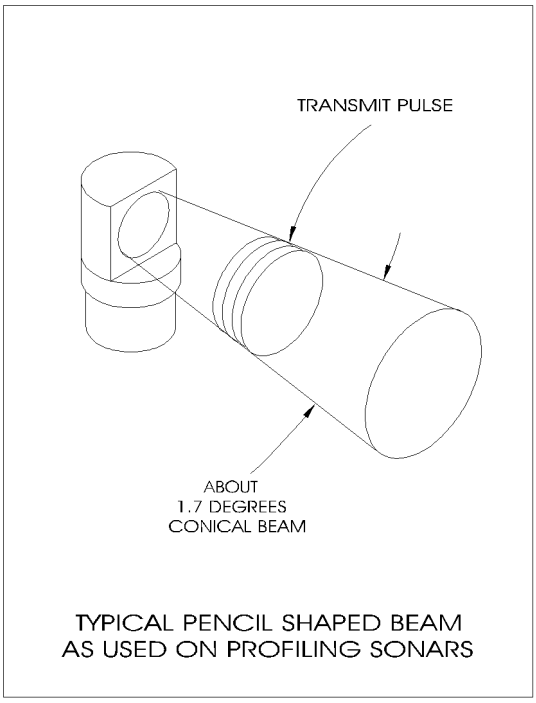


ECHO STRENGTH VS TIME WHEN
FAN SHAPED SONAR BEAM
INTERSECTS WITH A FLAT BOTTOM

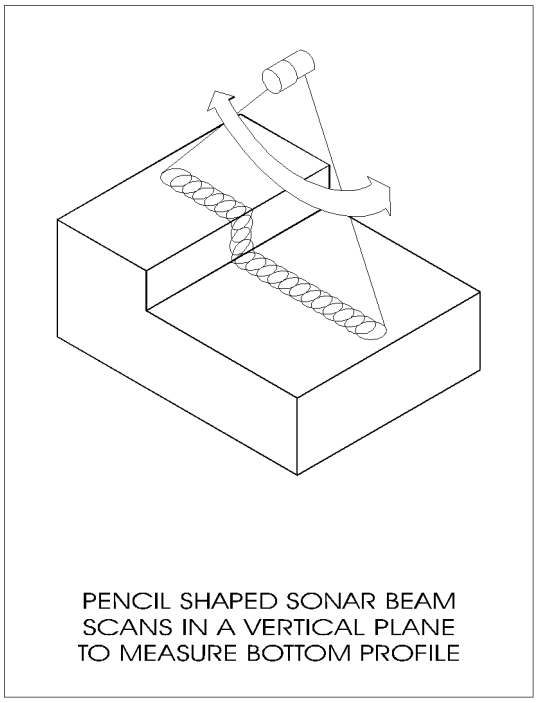


FAN SHAPED SONAR BEAM
INTERSECTS WITH A FLAT BOTTOM
AND TARGETS

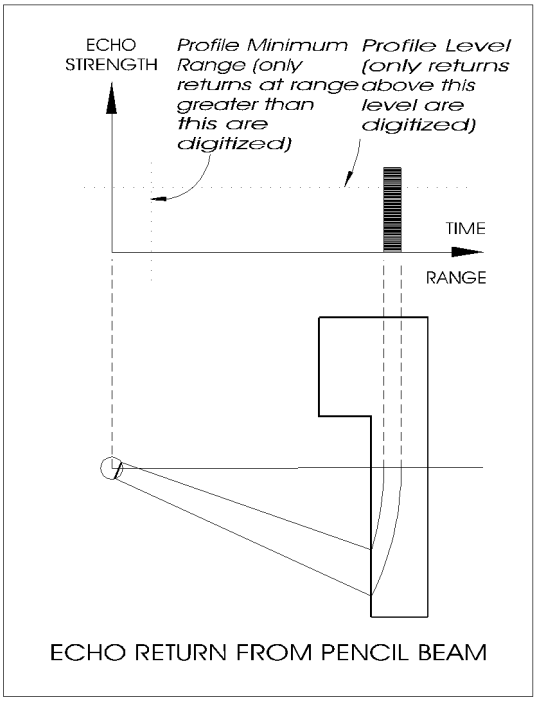
FIGURE 1



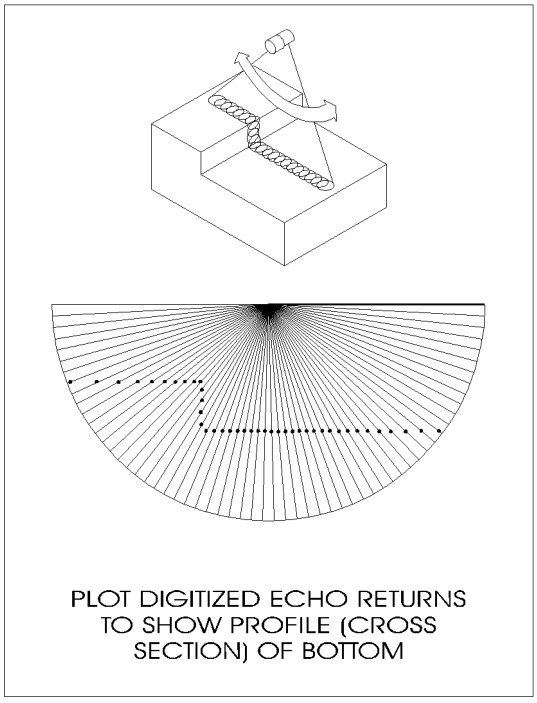
TYPICAL PENCIL SHAPED BEAM
AS USED ON PROFILING SONARS



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

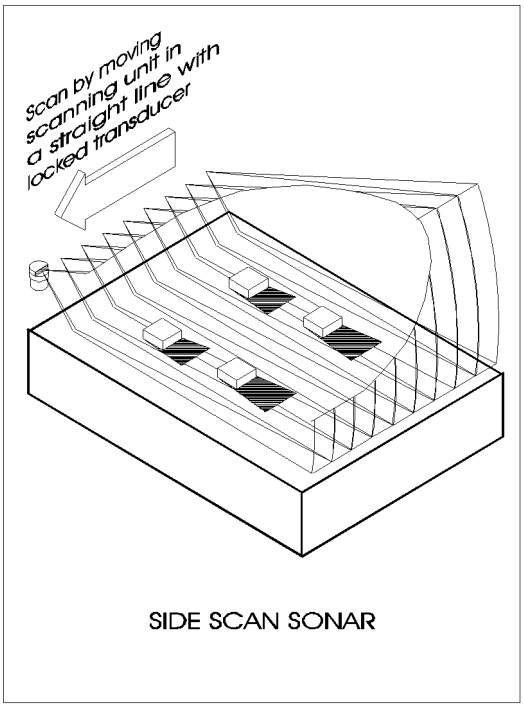


ECHO RETURN FROM PENCIL BEAM

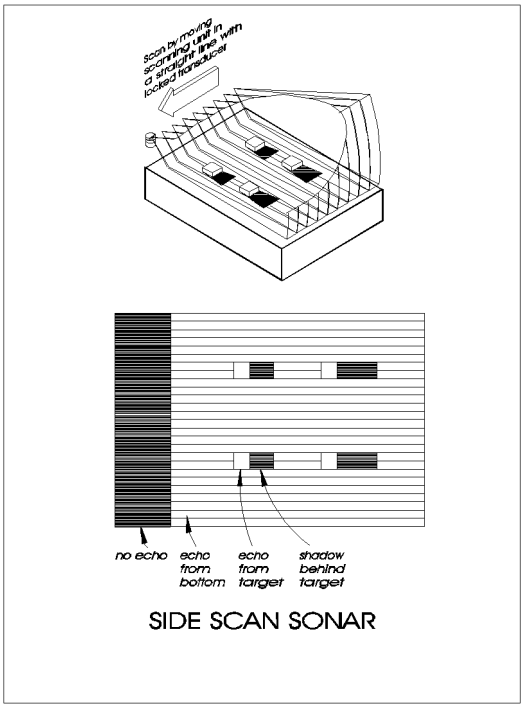


PLOT DIGITIZED ECHO RETURNS
TO SHOW PROFILE (CROSS
SECTION) OF BOTTOM

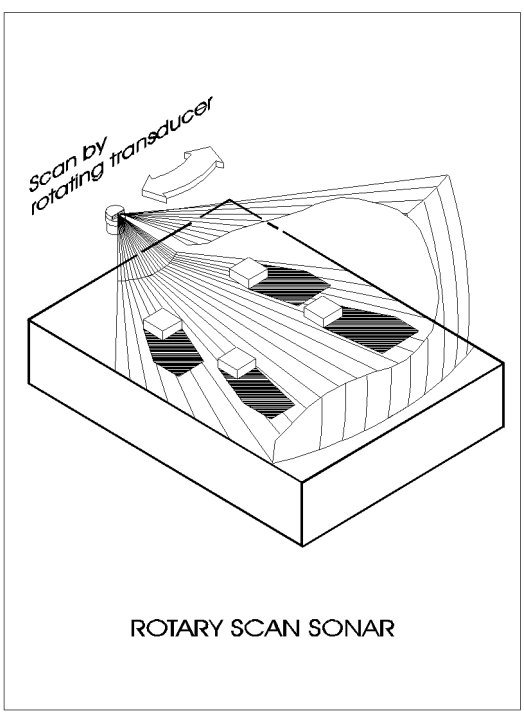
FIGURE 2



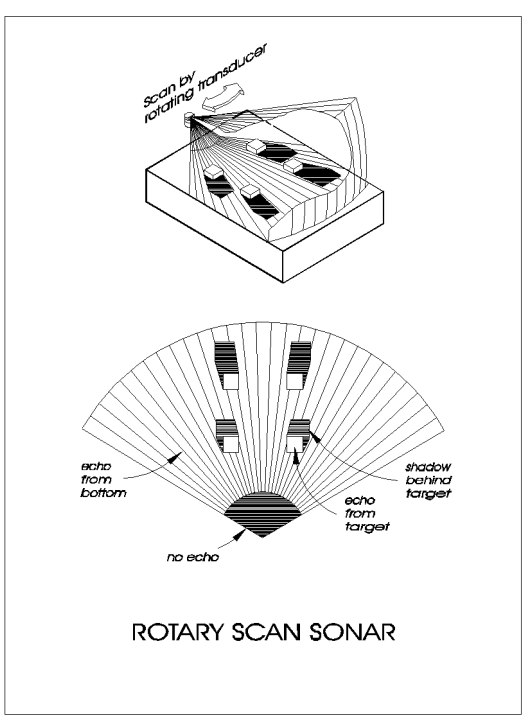
SIDE SCAN SONAR



SIDE SCAN SONAR

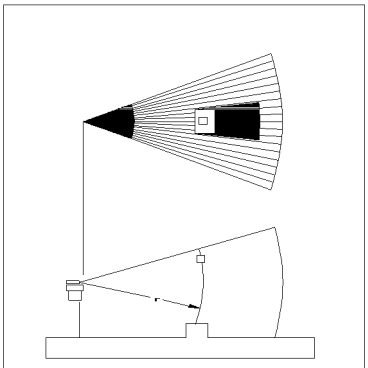


ROTARY SCAN SONAR

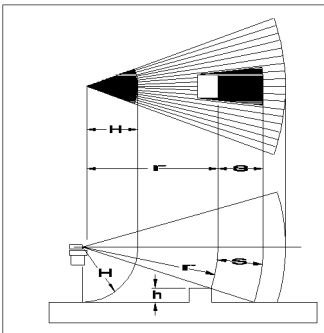


ROTARY SCAN SONAR

FIGURE 3



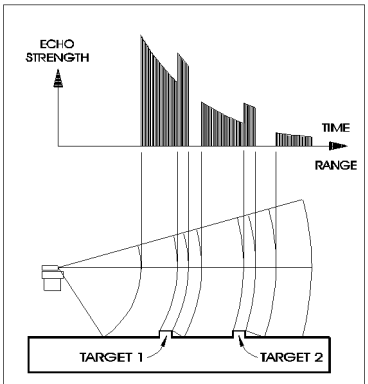
TARGETS AT THE SAME SLANT RANGE
BUT DIFFERENT ELEVATIONS PLOT AT THE
SAME LOCATION ON THE DISPLAY



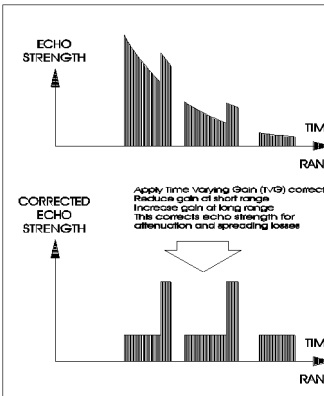
Target Height h = $\frac{H \times s}{r + s}$

(true only on flat, level bottom)

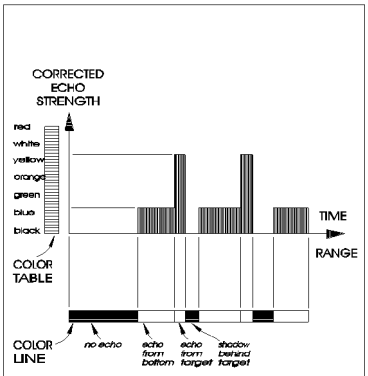
USE SHADOW LENGTH
TO CALCULATE TARGET HEIGHT



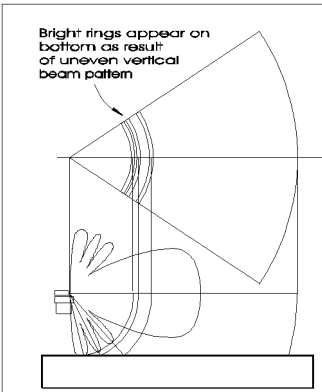
ECHO STRENGTH VS TIME WHEN
FAN SHAPED SONAR BEAM
INTERSECTS WITH A FLAT BOTTOM
AND TARGETS



CORRECT ECHO STRENGTH
FOR CHANGES DUE TO RANGE



CONVERT CORRECTED ECHO
STRENGTH TO COLOR LINE



ACTUAL SONAR BEAM WITH
WITH UNEVEN PATTERN

FIGURE 4