







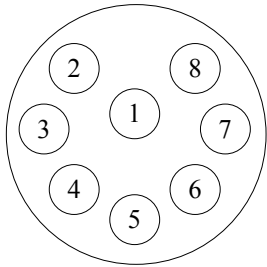






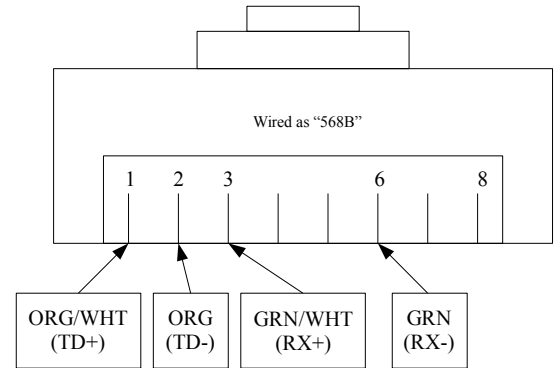
SUBCONN MCIL8F

(F)

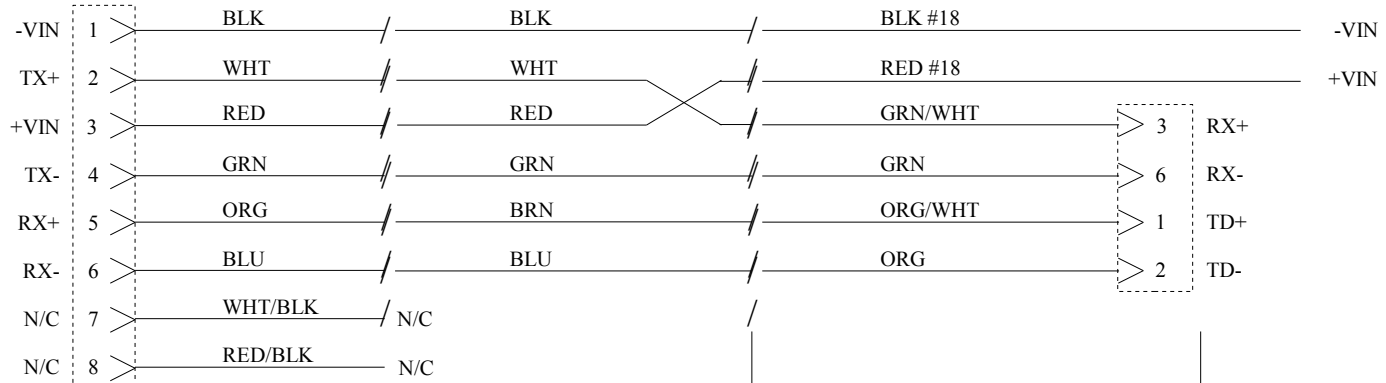


Socket View

RJ-45 Connector



SUBCONN MCIL8F  
(F)



2ft #18

2ft  
2ft Whip

50ft  
6 Conductor Cable

5ft  
CAT.5e UTP  
Ethernet Cable

IMAGENEX TECHNOLOGY CORP.

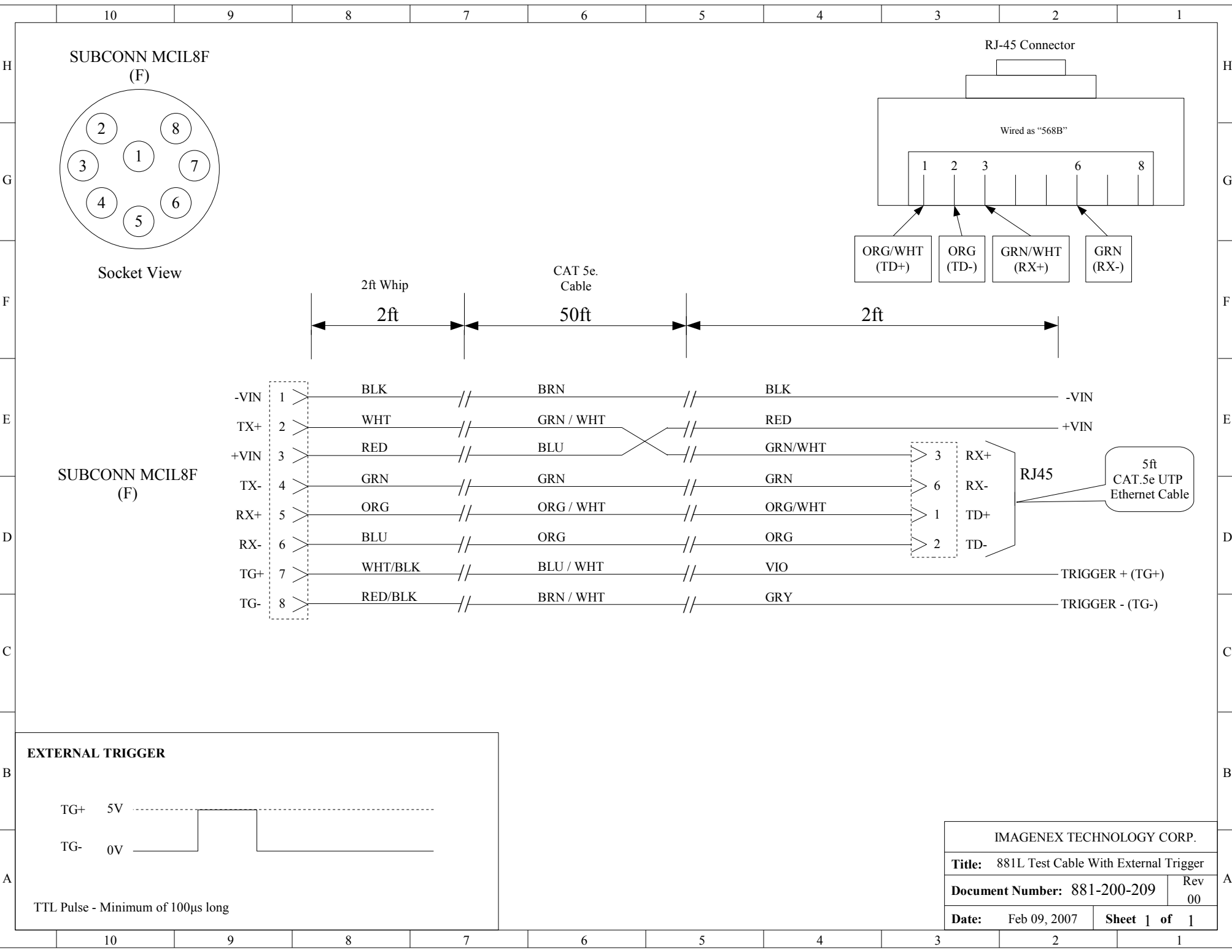
Title: Model 881L Test Cable

Document Number: 881-200-187

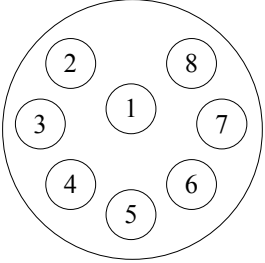
Rev  
01

Date: Jan 11, 2006

Sheet 1 of 1

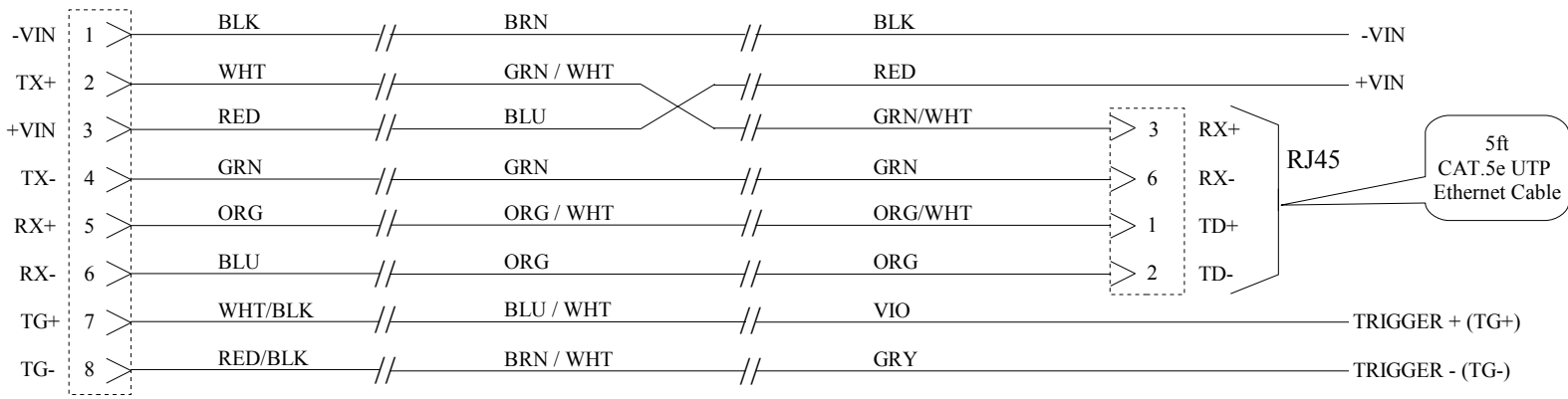
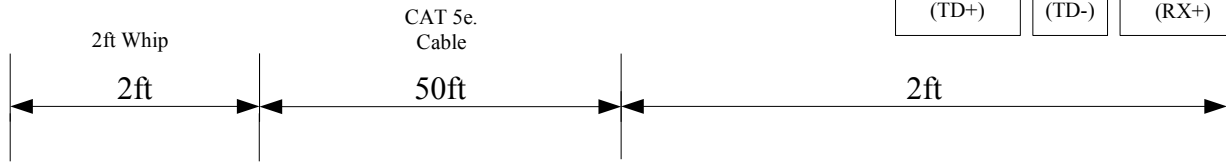
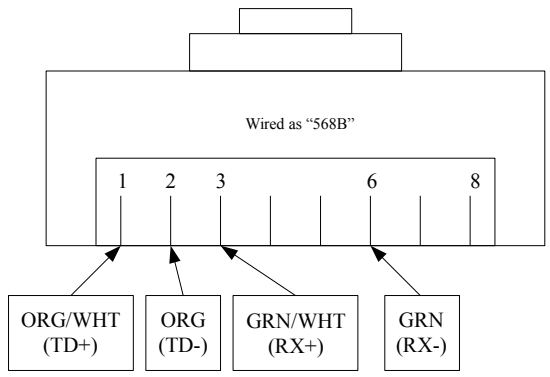


SUBCONN MCIL8F  
(F)

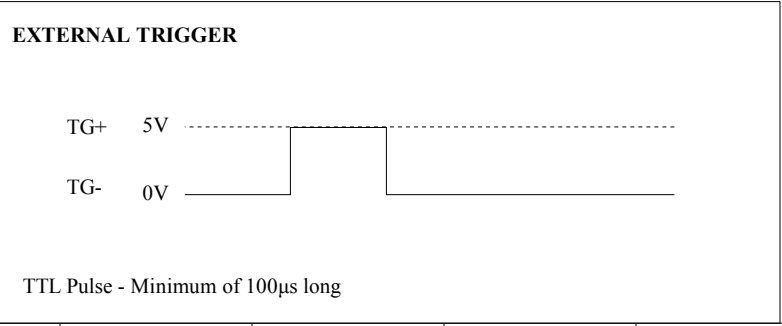


Socket View

RJ-45 Connector



SUBCONN MCIL8F  
(F)



IMAGENEX TECHNOLOGY CORP.	
Title: 881L Test Cable With External Trigger	
Document Number: 881-200-209	Rev 00
Date: Feb 09, 2007	Sheet 1 of 1



**MODEL 881L ETHERNET SONAR HEAD (Multi-Frequency)**

**WIN881L.EXE**

**c/w External Trigger Option**

**Special Notes:**

Refer to Imagenex Drawing Number 881-200-209 for External Trigger information

To enable the 881L sonar head for external trigger mode, the Win881L.INI configuration file provides the following control:

[Settings]

**ExternalTriggerControl**

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

Bit 1: Enable: 0 = Disable, 1 = Enable

When enabled for external trigger, the sonar head will transmit as soon as it detects the external trigger pulse. If a trigger pulse has not been found after a period of 2 seconds, the sonar will transmit as normal.

## **MODEL 881L ETHERNET SONAR HEAD (Multi-Frequency)**

### **WIN881L.EXE: Display Software For Win 95/98/Me/NT/2000/XP**

#### **VERSION 1.04**

### **OVERVIEW**

WIN881L is a Windows 95/98/Me/NT/2000/XP program that controls, displays and records data from the multi-frequency Model 881L Ethernet Sonar Head. The program communicates with the sonar head via a 10 Mbps Ethernet connection and uses an RS-232 COM port at 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 WIN881L 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. A Pop-up window is available for displaying sonar head diagnostics.

### **OPERATION**

To operate the sonar head, connect the RJ45 ethernet connector from the sonar head cable into the LAN (Local Area Network) card on your PC. The sonar head needs to run with a static IP (Internet Protocol) Address for both head and PC. The IP Address of the PC must be set to **192.168.0.X** where X is any number between 6 and 255. Also set the subnet mask to **255.255.255.0**. In Windows XP, these settings can be found in the 'Network Connections' menu under 'Settings' in the 'Start' menu, then click on properties of the LAN adapter, and properties of the TCP/IP. There is also a settings box for default gateway, but it can be left blank. The IP Address of the sonar head is fixed at **192.168.0.5** (optional IP Address's can be specified at time of order). 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. Run the program WIN881L.EXE and select the button DATA FROM '**HEAD**' on the right-hand side of the display.

## 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 timestamp. The file extension is always **.81L**. 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 **'81L'** 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 **'81L'** 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 a 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 (WIN881L.INI), closes the program and exits to Windows.

## MAIN MENU (con't)

### 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.

### 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 ' <b>Down</b> '. If the xdcr is mounted up (red side up), ' <b>Up</b> ' 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 <b>Profile Grid</b> is enabled via the <b>Profile Menu</b> , the Xdcr Position names change to ' <b>Fwd</b> ' and ' <b>Aft</b> ' for profiling applications.
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

GPS Input	to select the serial communications port (COM1-COM32) 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.
Enable	select to initialize the serial communications port for reception of Lat/Lng coordinates
Disable	to close the serial communications port
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 Win881L 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 881-000-500/501) only!**

**The Pencil Beam Profiling Sonar (Model 881-000-520/521) 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.

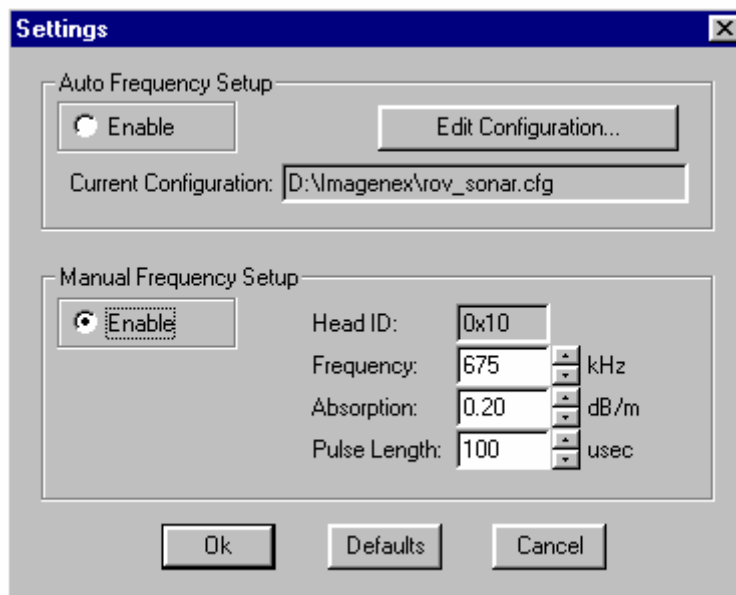
#### Manual Frequency Setup

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 (10-1000 $\mu$ s in 10 $\mu$ s 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)

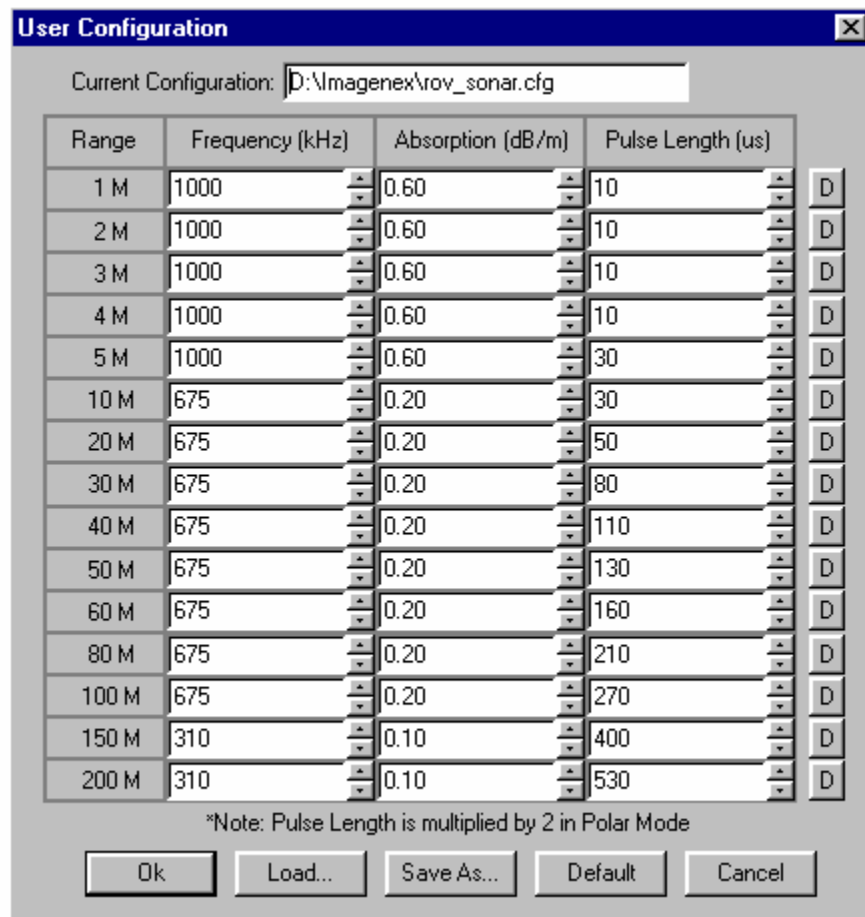
Edit Configuration

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 (10-1000 $\mu$ s in 10 $\mu$ s increments)



The dialog box is titled "User Configuration" and shows the current configuration file path as "D:\Imagenex\rov\_sonar.cfg". It contains a table with the following data:

Range	Frequency (kHz)	Absorption (dB/m)	Pulse Length (us)	
1 M	1000	0.60	10	D
2 M	1000	0.60	10	D
3 M	1000	0.60	10	D
4 M	1000	0.60	10	D
5 M	1000	0.60	30	D
10 M	675	0.20	30	D
20 M	675	0.20	50	D
30 M	675	0.20	80	D
40 M	675	0.20	110	D
50 M	675	0.20	130	D
60 M	675	0.20	160	D
80 M	675	0.20	210	D
100 M	675	0.20	270	D
150 M	310	0.10	400	D
200 M	310	0.10	530	D

\*Note: Pulse Length is multiplied by 2 in Polar Mode

Buttons: Ok, Load..., Save As..., Default, Cancel

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.

## MAIN MENU (con't)

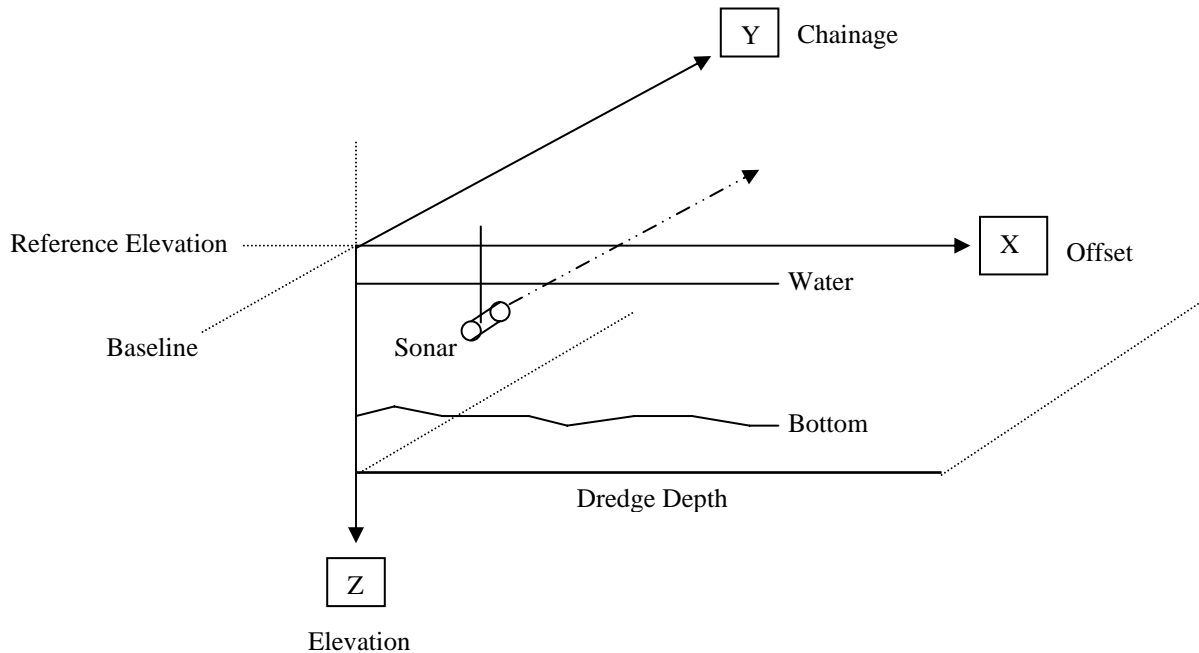
### **Profile Menu**

- 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.

## MAIN MENU (con't)

<b>Profile Setup...</b>	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/500. 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.
<b>Auto-Profile...</b>	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 coordinates. 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 each 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> - 1<sup>st</sup> Point

dd-mmm-yyyy hh:mm:ss.hh rrr.rrr aaa.aaa bbb.bbb xxx.xxx yyy.yyy zzz.zzz<CR><LF> - 2<sup>nd</sup> 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)**

### **Grid Menu**

Grid On/Off                      to display the range rings on the sonar display.

### **About Menu**

About WIN881L                      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 ' <b>HEAD</b> '	to display data from the connected sonar head.
DATA FROM ' <b>FILE</b> '	to display data from a previously recorded ' <b>.81L</b> ' Sonar file.
Hold	to hold or freeze the display.
Rev	to reverse the current scanning direction. Available only when DATA FROM ' <b>HEAD</b> ' is active.
Reverse	to reverse the file playback plotting direction. Available only when DATA FROM ' <b>FILE</b> ' is active.
TrackBar	to re-position the file pointer during file playback. Available only when DATA FROM ' <b>FILE</b> ' is active.
Plot Speed	to adjust plotting speed during file playback. Available only when DATA FROM ' <b>FILE</b> ' 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)
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## **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: <b>Gain: ? dB</b> . 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 ' <b>HEAD</b> ' 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: <b>Range: ? M</b> (meters) or <b>Range: ? FT</b> (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 ' <b>HEAD</b> ' 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 Connection**

- no power to the sonar head
- cable not connected
- IPAddress\_Sonar1 setting in the WIN881L.INI file is not the same as the sonar head IP Address

### **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

## DATA STORAGE FILE FORMAT (.81L)

When recording the sonar data to a **.81L** file, the following bytes are appended and saved to the file every 'shot':

Byte #	Description
0 to 99	<b>File Header</b> (100 Bytes)
100 to 111	<b>Sonar Return Data Header</b> (12 Bytes)
112 to xxxx	<b>Sonar Return Echo Data</b> (0, 128, 250, 252 or 500 Bytes) xxxx = 112+above number Byte xxxx always = <b>0xFC</b> (Termination Byte from sonar head)
xxxx+1 to yyyy	<b>Zero Fill</b> yyyy = 127, 255, 383 or 639
yyyy+1 to zzzz	<b>Extended Bytes</b> 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	<b>Pointer To Previous Shot</b> 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. $N = (128 \text{ or } 256 \text{ or } 384 \text{ or } 640) + \text{Extended Bytes}$ Number of bytes to previos shot = $((N-2) \ll 8)   (N-1)$

### FILE HEADER

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

- 0      **ASCII '8'**
- 1      **ASCII '1'**
- 2      **ASCII 'L'**
  
- 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 (.81L) (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
<b>128, 256, 384 or 640</b> + 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
<b>13, 141, 263, 265 or 513</b>															

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**

Byte 37							
7	6	5	4	3	2	1	0
<b>Dir</b>	<b>Xdcr</b>	<b>Mode</b>			<b>Step Size</b>		
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

**DATA STORAGE FILE FORMAT (.81L) (con't)**

41 **Reserved** - always 0

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
<b>Profile Grid</b>	<b>Zero</b>	<b>Data Bits</b>			<b>LOGF</b>		
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

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
<b>V</b>															
<b>Sound Velocity (in meters/second) * 10</b>															

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
<b>Operating Frequency (in kHz)</b>															

82-99 **Reserved** - always 0

## DATA STORAGE FILE FORMAT (.81L) (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 Ethernet 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



**MODEL 881L DIGITAL SONAR HEAD (881-000-50x)**

**ETHERNET INTERFACE SPECIFICATION (v1.00)**

**OVERVIEW**

The Model 881L Digital Sonar Head communicates over an Ethernet communications link. To receive echo data, a command program must interrogate the sonar head by sending a Switch Data Command. All Ethernet communications are via TCP/IP at 10Mbps. When the Switch Data command is accepted, the sonar head transmits, receives and sends its return data back to the command program.

Unless otherwise specified, the 881L Sonar Head will have a statically assigned IP Address of **192.168.0.5** .

**SWITCH DATA COMMAND**

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

Byte #	Description							
0 – 7	<b>0xFE</b>	<b>0x44</b>	Head ID	Range	Reserved 0	Rev/ Hold	Reserved 0	Reserved 0
8 – 15	Start Gain	LOGF	Absorption	Train Angle	Sector Width	Step Size	Pulse Length	Profile MinRange
16 – 23	External Trigger	Reserved 0	Reserved 0	Data Points	Data Bits	Reserved 0	Profile	Calibrate
24 – 26	Switch Delay	Freq- uency	Term. <b>0xFD</b>					

*Table 1 Model 881L Sonar Head 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	<b>Switch Data Header (1st Byte)</b> Always <b>0xFE</b> (254 decimal)
Byte 1	<b>Switch Data Header (2nd Byte)</b> Always <b>0x44</b> (68 decimal)
Byte 2	<b>Head ID</b> Always 0x10
Byte 3	<b>Range</b> 1, 2, 3, 4, 5, 10, 20, 30, 40, 50, 60 ,80, 100, 150 and 200 Meters
Byte 4	<b>Reserved</b> Always 0
Byte 5	<b>Hold</b> 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	<b>Reserved</b> Always 0
Byte 7	<b>Reserved</b> Always 0
Byte 8	<b>Start Gain</b> 0 to 40dB in 1dB increments

## **SWITCH DATA COMMAND (con't)**

- Byte 9        **LOGF**  
1 = 20dB  
No other values available at this time.
- Byte 10       **Absorption**  
0 to 255 = 0.00dB/m to 2.55dB/m  
Byte 10 = two way absorption\_in\_dB\_per\_m \* 100  
Recommended values:  
330kHz: 10 (0.1dB/m)  
675kHz: 20 (0.2dB/m)  
1MHz: 60 (0.6dB/m)
- 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
- 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

## **SWITCH DATA COMMAND (con't)**

- 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

### **Note:**

**The following External Trigger Control byte is valid only for 881L Sonar Heads supplied with the External Trigger Hardware Option.**

- Byte 16      **External Trigger Control**  
Bit0: Edge: 0 = NEG,      1 = POS  
Bit1: Enable: 0 = Disable,      1 = Enable

The sonar head will transmit as soon as it detects the external trigger pulse. If a trigger pulse has not been found after a period of 2 seconds, the sonar will transmit as normal.

- Byte 17      **Reserved**  
Always 0
- Byte 18      **Reserved**  
Always 0
- Byte 19      **Data Points**  
50      - 500 data points are returned by the sonar head  
          The return data will have an ASCII 'IGX' header.  
No other values available at this time.
- Byte 20      **Data Bits**  
Resolution (number of data bits) of the returned echo data  
8      - Data width = 8 Bits, 1 data point per byte  
No other values available at this time.

## **SWITCH DATA COMMAND (con't)**

- Byte 21      **Reserved**  
Always 0
- 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 sonar head can be commanded to pause (from 0 to 500 msec)  
before sending its return data to allow the commanding program  
enough time to setup for the return of the data.  
0 to 250 in 2 msec increments  
Byte 24 = delay\_in\_milliseconds/2
- 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 sonar head will stop looking for Switch Data when it sees this byte.  
Always **0xFD** (253 decimal)

## SONAR HEAD RETURN DATA

Every shot, the sonar head returns a 12 Byte header, 0 or 500 bytes of echo data and a terminating byte value of 0xFC. The **total number of bytes (N)** returned will be 13 or 513.

Byte #	Description					
0 to 5	ASCII T	ASCII '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 or 500 Data Bytes					
N-1	Term. <b>0xFC</b>					

*Table 2 Model 881L 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**'  
 T' = 0x49, 'G' = 0x47, 'P' = 0x50, 'X' = 0x58

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

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

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

## SONAR HEAD RETURN DATA (con't)

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

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								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

Byte 7      **Range**  
 Sonar Head Range:  
 1, 2, 3, 4, 5, 10, 20, 30, 40, 50, 60, 80, 100, 150 or 200 Meters

## SONAR HEAD RETURN DATA (con't)

### 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

**Note:** sample units = 2mm (if Byte 7 < 5m)

sample units = 10mm (if Byte 7 >= 5m)

\* assuming 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



## **SONAR HEAD RETURN DATA (con't)**

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

If Header is ASCII **IGX**:

If Data Bits was set to 8: N = 513, (500 Data Bytes)

1st Range Point = Byte 12

2nd Range Point = Byte 13

3rd Range Point = Byte 14

4th Range Point = Byte 15

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**



# Imagenex Technology Corp.

**IMAGENEX MODEL 881L  
MULTI-FREQUENCY DIGITAL SONAR HEAD  
Fan Beam (3:1)**

## SCANNING SPEEDS

<b>Document Number</b>	425-001
<b>File Name</b>	881L Scanning Speeds.doc
<b>Revision</b>	<b>Date</b>
02	March 1, 2006

# SCANNING SPEEDS

RANGE (Meters)	SLOW (°/sec)	MEDIUM (°/sec)	FAST (°/sec)	FASTER (°/sec)	FASTEST (°/sec)	STORAGE (MByte/hr)
200	1.1	2.2	3.3	4.3	8.4	8.1
150	1.5	2.9	4.3	5.7	10.9	10.7
100	2.2	4.3	6.4	8.4	15.7	15.9
80	2.7	5.4	7.9	10.3	18.9	19.8
60	3.5	7.1	10.3	13.3	24.0	25.9
50	4.2	8.5	12.2	15.8	27.9	30.9
40	5.2	10.3	15.0	19.0	32.9	37.9
30	6.7	13.3	19.1	24.0	40.0	48.8
20	9.4	18.8	26.5	33.3	52.2	68.7
10	16.7	33.3	45.0	54.5	75.0	122.1
5	25.0	50.0				183.1
4	15.0					109.9
3	18.8					137.3
2	25.0					183.1
1	30.0					219.7

RANGE (Meters)	SLOW (sec/360°)	MEDIUM (sec/360°)	FAST (sec/360°)	FASTER (sec/360°)	FASTEST (sec/360°)
200	326.4	163.2	109.6	82.8	42.9
150	246.0	123.0	82.8	63.0	33.0
100	165.6	83.4	56.4	42.9	23.0
80	133.2	67.2	45.6	34.8	19.1
60	102.0	51.0	34.8	27.0	15.0
50	85.2	42.6	29.6	22.8	12.9
40	69.6	34.8	24.0	18.9	11.0
30	54.0	27.0	18.8	15.0	9.0
20	38.4	19.2	13.6	10.8	6.9
10	21.6	10.8	8.0	6.6	4.8
5	14.4	7.2			
4	24.0				
3	19.2				
2	14.4				
1	12.0				

Using WIN881L.EXE v1.01, on Pentium 4 (2.8GHz), 512MB RAM, running Windows XP®  
**Polar Mode, 8-Bit Data**, Ethernet 10Mbps, 10BaseT.

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

# **SONAR THEORY AND APPLICATIONS**

**EXCERPT FROM IMAGENEX MODEL 855  
COLOR IMAGING SONAR USER'S MANUAL**

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CANADA**

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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.

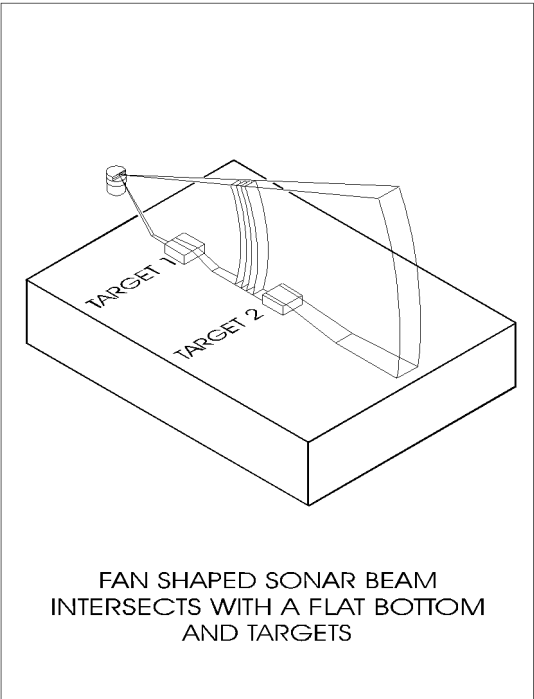
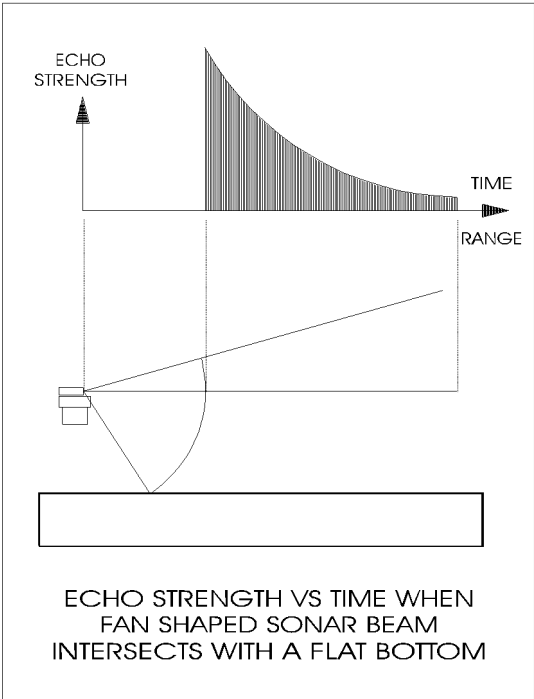
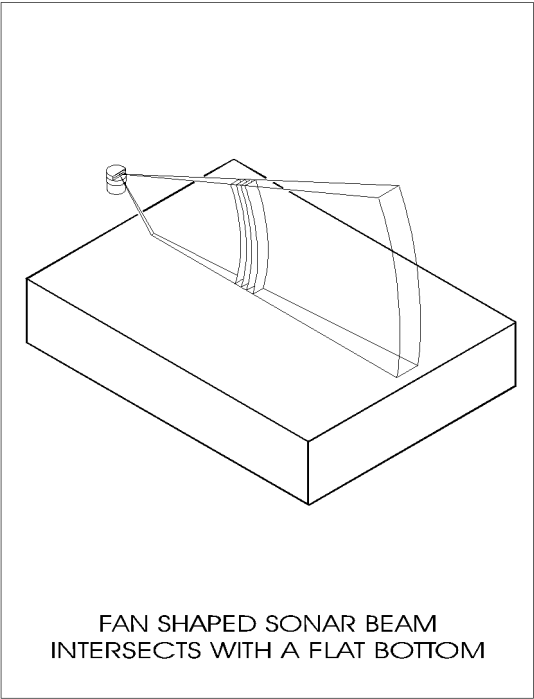
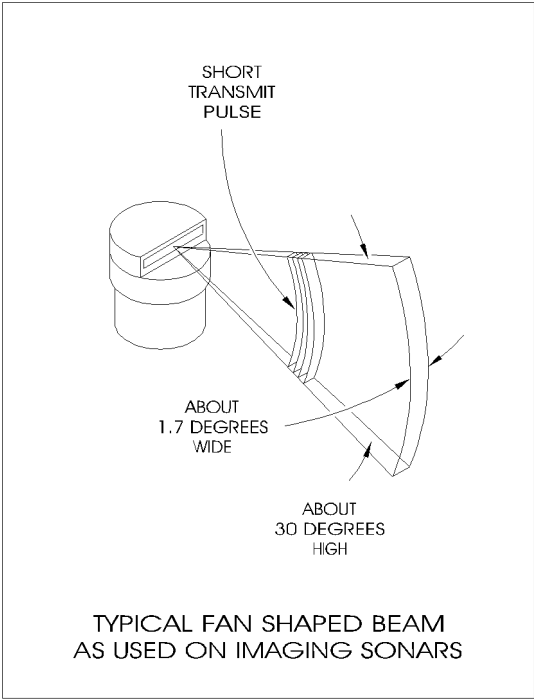


FIGURE 1



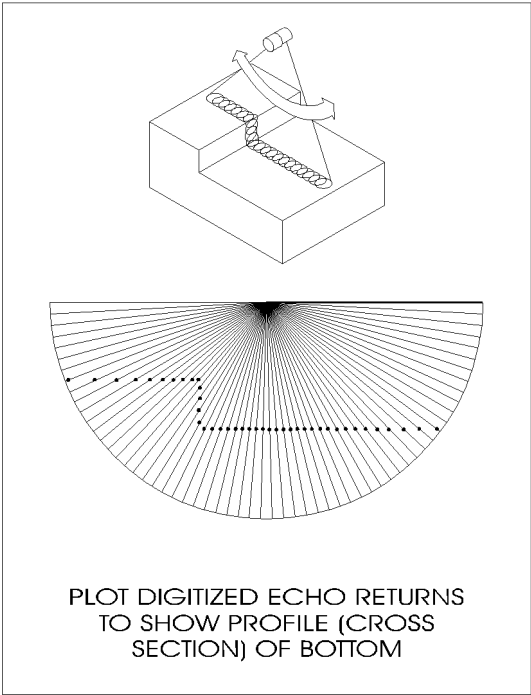
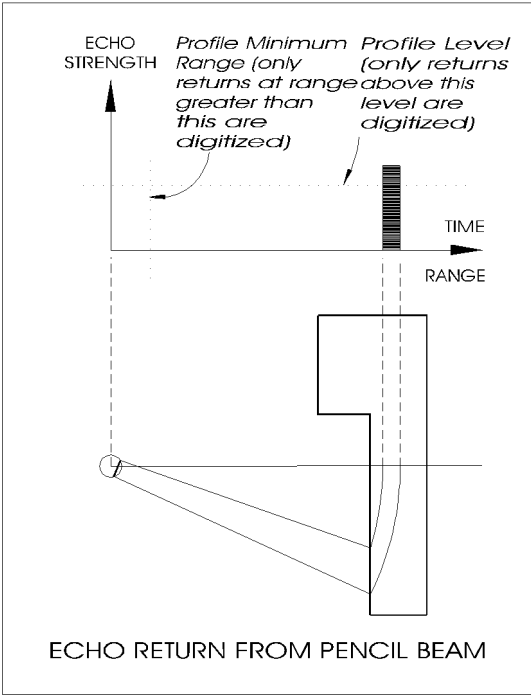
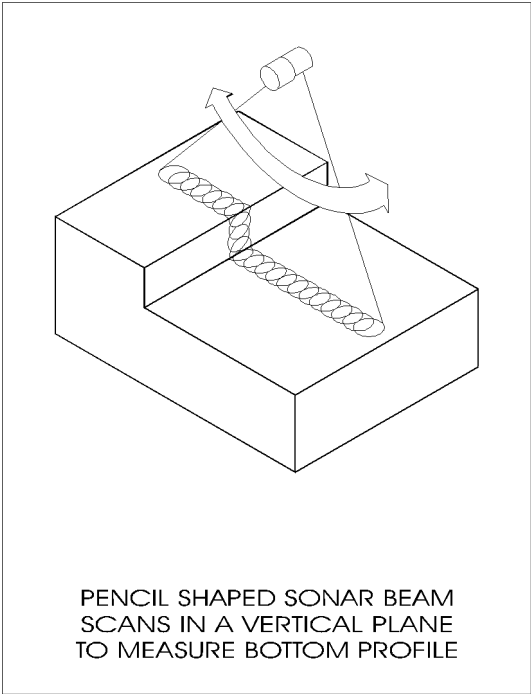
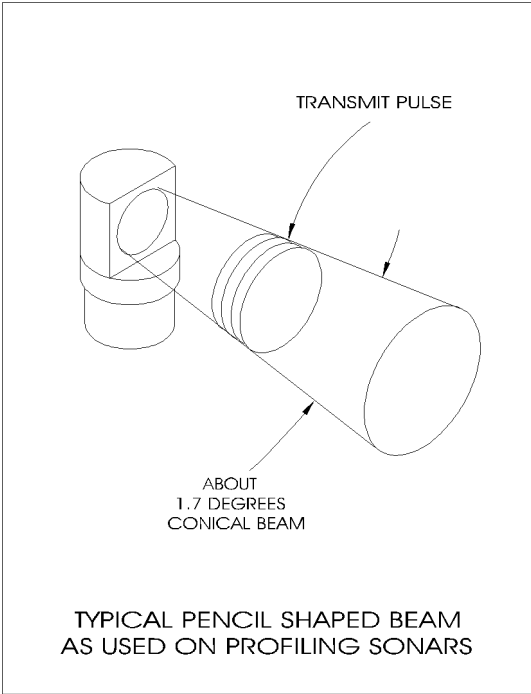


FIGURE 2

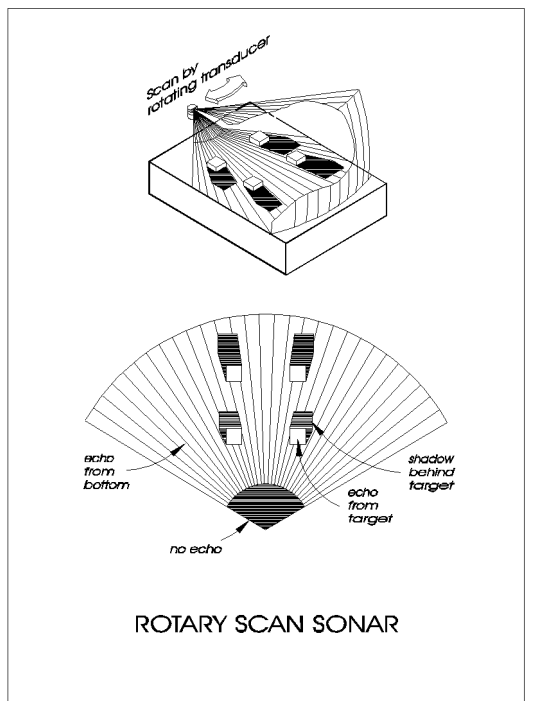
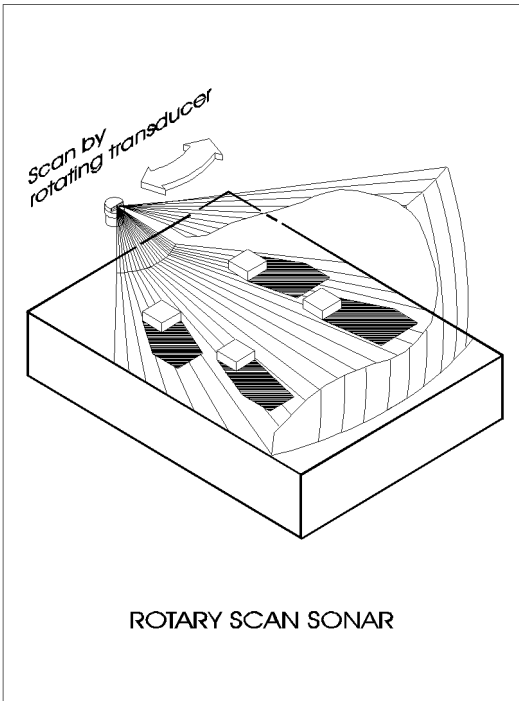
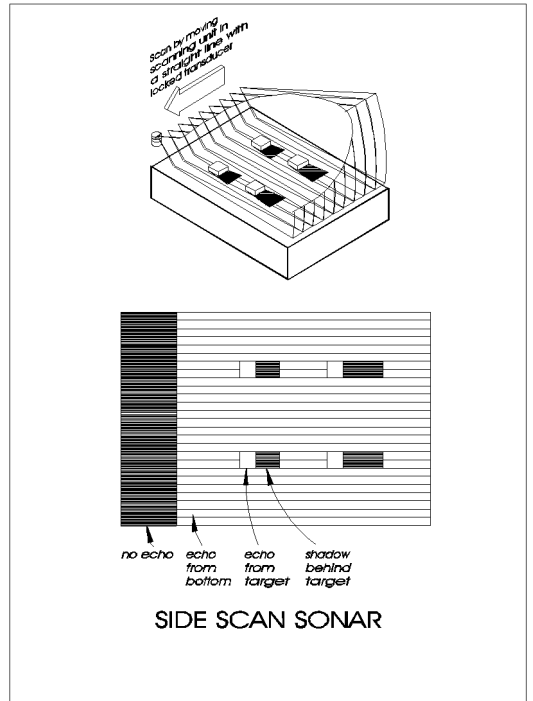
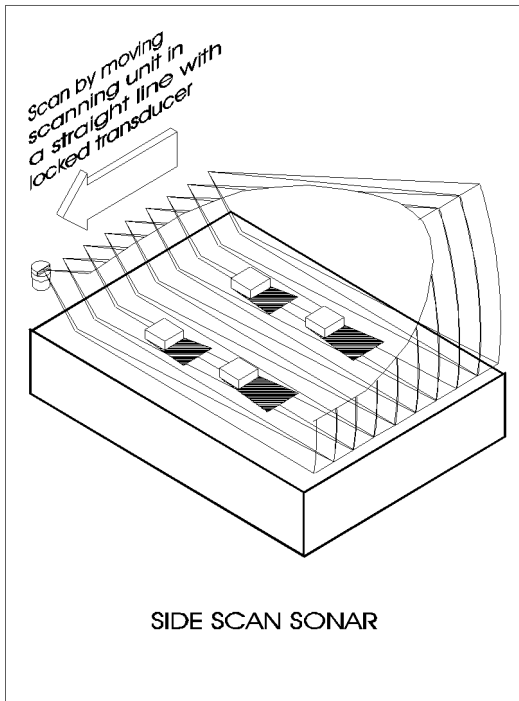


FIGURE 3

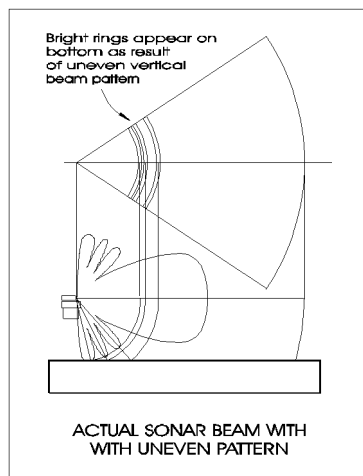
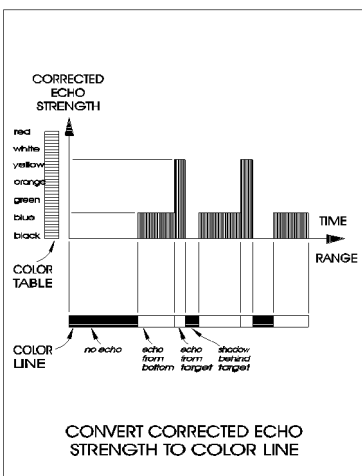
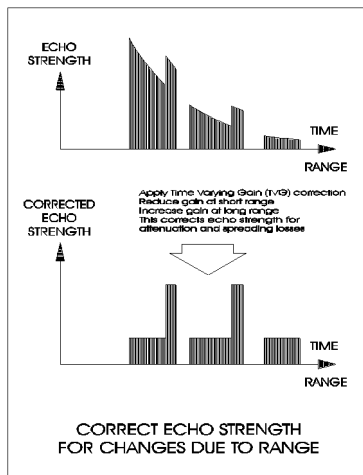
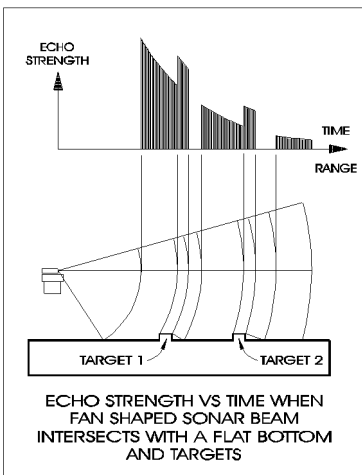
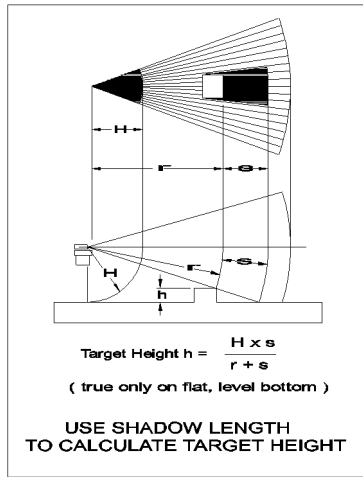
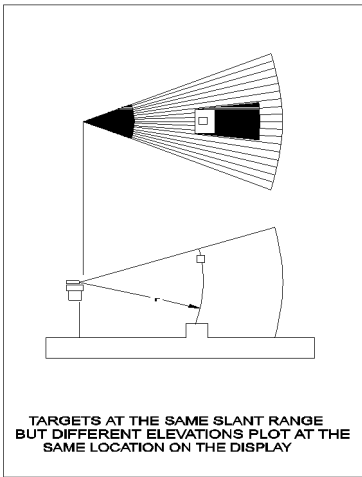


FIGURE 4



