IMAGENEX MODEL 881L-GS
GYRO STABILIZED
MULTI-FREQUENCY IMAGING SONAR

APPLICATIONS:

- ROV, AUV, & UUV
- Manned Submersibles
- Search & Recovery
- Borehole/cave work
- Drop sonar
- Scientific Research

FEATURES:

- **Ethernet**
- Programmable (format available)
- Gyro stabilized transducer steering
- Simple set-up and installation
- Full scale range from 1 m to 200 m
- Orientation module

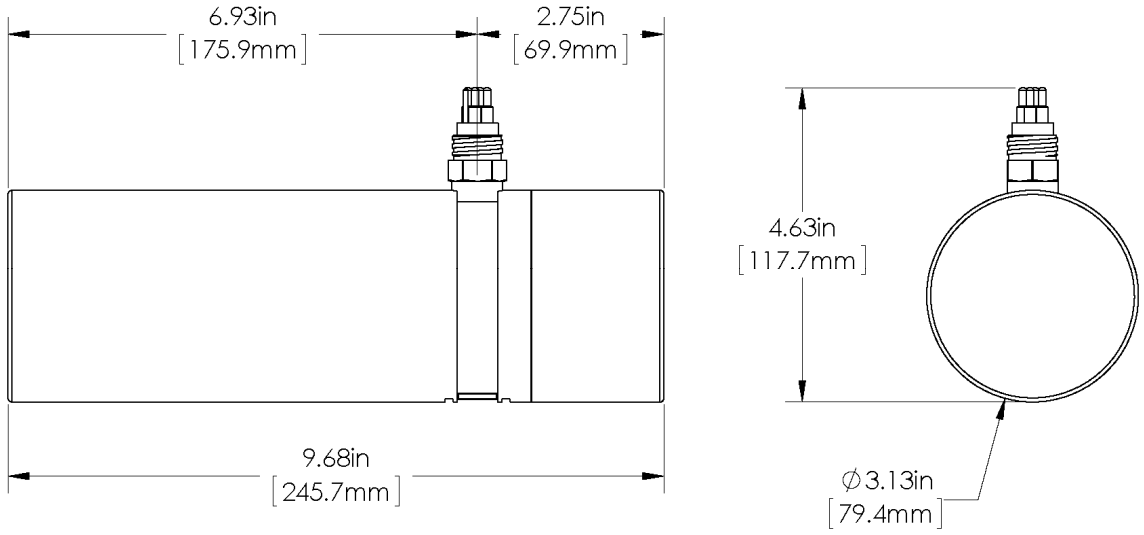
Gyro-stabilization of the Imagenex Model 881L-GS makes the high resolution 881L sonar into a system capable of crystal clear visualization of the ocean environment from moving platforms, no longer compromised by the blurring effects of host vehicle rotation. An advanced, low drift gyro is integrated directly into the sonar head, so the sonar can now compensate for vehicle motion in real time with unprecedented accuracy, stability, and robustness.

The enhanced capabilities of the 881L-GS have not compromised the performance of the 881L sonar. Using Ethernet communications, this all-in-one, high performance digital imaging sonar can still exceed 100 shots per second on short range at up to 2 mm range resolution, and can auto-adjust acoustic frequency and resolution to scan up to a 200 m radius, 360° surrounding area.

The Model 881L-GS still has low power, simple set-up, and small size that make it an ideal tool for large work ROV's and small inspection vehicles. On it's own it is now an amazingly simple drop sonar and borehole inspection package: just add a laptop computer and power supply and run the included Imagenex software.

HARDWARE SPECIFICATIONS:	
FREQUENCY	310 kHz, 675 kHz, or 1 MHz (standard 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”)
ORIENTATION MODULE (accuracies):	
PITCH & ROLL	± 0.1° typical
HEADING (Magnetic)	± 1.0° typical
MIN. DETECTABLE RANGE	150 mm (6”)
MAX. OPERATING DEPTH	1000 m and 3000 m available
MAX. CABLE LENGTH	Standard: 100 m on CAT5e Cable length may be increased up to ~9000 m using an Ethernet extender. Please enquire for more information.
INTERFACE	Standard: 10 Mbps Ethernet (10 BASE-T) using TCP/IP Bit rate may vary if an Ethernet extender is in use.
CONNECTOR	Side mounted, eight conductor, wet mateable (Subconn MCBH8M-AS) Optional right angle or end mount connector
POWER SUPPLY	20 – 32 VDC at less than 7 Watts
DIMENSIONS (for both depths)	79.5 mm (3.13”) diameter x 245.7 mm (9.68”) length
WEIGHT: In Air **In Water**	1000 m unit: 1.8 kg (4 lbs) 3000 m unit: TBA 1000 m unit: TBA 3000 m unit: TBA
MATERIALS	1000 m unit: 6061-T6 Aluminum & Polyurethane 3000 m unit: Titanium, Polyurethane & 300 series stainless steel
FINISH	Hard Anodize

SOFTWARE SPECIFICATIONS:	Win881AL.exe
WINDOWS™ OPERATING SYSTEM	Windows™ XP, Vista, 7, 8, 10
MODES	Sector, Polar and Side Scan
GYRO MODES	North Up, Heading Up, Target Steering
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).81R
RECOMMENDED MINIMUM COMPUTER REQUIREMENTS:	2 GHz Pentium 4 256 MB RAM 20 GB Hard Disk 1024 x 768 Screen Resolution



ORDERING INFORMATION:		
1000 m UNIT	Standard	881-000-500
3000 m UNIT	Standard	881-000-501
End mount connector	Option	-009
Right angle connector	Option	-010
IP Address*	Option	-020
Gyro Stabilization	Option	-048

*Note: Standard IP Address is 192.168.0.5
A different IP Address may be specified upon ordering.

IMAGENEX TECHNOLOGY CORP.

Model 881L-GS
Gyro Stabilized Scanning Sonar

(Ethernet Version)

Quick Start

Number	430 - 030	
Revision	**Date**	**Description**
0A	April 21, 2014	Initial Preliminary Release
00	May 6, 2014	Release
01	October 17, 2014	Software update
02	January 21, 2015	Added auto bias, and auto file size
03	July 7, 2015	Updated Gyro calibration description

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1.0 Introduction

The Model 881L-GS is an advanced gyro-stabilized, high-resolution scanning sonar system that has been designed to provide simple, reliable, and accurate representation of underwater images.

2.0 Getting Started:

The 881L-GS was designed to be user friendly and simple to set up in the field. It is generally recommended however to perform a preliminary setup before heading out into the field.

2.1 Step-By-Step Start Up Guide

1. Physically mount the sonar referring to S**ection 2.4** on **page 5** for details.
2. Ensure $24V_{DC}$@ 1A minimum power supply is off
3. Referring to **Appendix A – Ethernet Setup Guide**, configure the network cards IP address.
4. Connect the RJ45 (looks like a large telephone connector) to the PC's network card.
5. Plug the underwater connector to the sonar.
6. Deploy to stable, flat location
7. Power up the 881L-GS.
8. Wait for gyro calibration to complete. The sonar, upon power up, will calibrate the motor, delay for 30 seconds and automatically perform a gyro calibration. No communication to the gyro sub-system is available at this time.
9. Verify the "**Local Latitude**" setting in the ".ini" file and adjust if necessary. Refer to **Section 2.5.2** on **page 11** for details
10. Launch the "*Win881AL_GS.exe*" program

    - If file playback is desired, use the menu command "*File->Open File to Playback*".
    - If real-time operation is desired, use the menu command "*File->Connect to Sonar Head*".

11. Proceed to **Section** 2.5 on **page** 6 for software instructions.

2.2 Gyro Calibration

All gyros are sensitive to the environment (i.e. temperature, motion, Earth's rotation, etc.) and will naturally drift with time. Therefore, from time to time, it is recommended to issue a gyro calibration (in manual mode) or recalibrate the motor (auto mode) to remove the accumulated drift.

2.2.1 Automatic Gyro Calibration

Imagenex Gyro enabled scanning sonars now incorporate an automatic gyro biasing feature which is selectable in the user program. This mode continuously re-bias's the gyro in real time accommodating for temperature fluctuations and internal drift. Refer to Table 2.1 on page 6 for details on enabling / disabling this mode. When first starting the sonar, the bias adjustment will be very rapid as the temperature stabilizes. While the gyro will still internally drift, the sonar image will be coherent, allowing the operator to continue to work. Note that the absolute heading will not be exact during this time as the sonar does not differentiate between induced drift and real movement. After a few minutes, re-calibrate the motor to realign the sonar and the transducer. This will reset the accumulated drift that occurred during the warmup period. It is recommended to periodically re-issue the calibrate motor command to reset the accumulated drift.

2.2.2 Manual Gyro Calibration

The information below describes the manual biasing mode which may be necessary in strong magnetic field environments.
Do not calibrate the gyro until the internal temperature of the sonar has stabilized, approximately 30-60minutes underwater.

1. Mount sonar on a level, stable surface, or settle the ROV on a flat bottom.
2. Under the "*Options*" Menu, select "*Calibrate Gyro*".
3. Standard sonar operation is suspended during gyro calibration.
4. The message "*Calibrating Gyro*" will appear. Calibration takes approximately 30secs.
5. Once the message disappears, standard operation commences.

When using **MANUAL** biasing, It is **ESSENTIAL** that the sonar is completely stationary and at constant temperature during gyro calibration. **ANY** movement will cause undesirable drift in the gyro.

2.3 Overview

While traditional scanning sonars provide excellent imagery, they have a significant short coming...they rely on the sonar being perfectly still during data acquisition. Imagenex has developed the ideal solution...the 881L-GS. Figure 2.1, below, shows a non stabilized image taken while the sonar was spinning. Note the wavy lines. Now refer to the same area scanned with Gyro stabilization enabled (Figure 2.2). The image is well defined and straight.

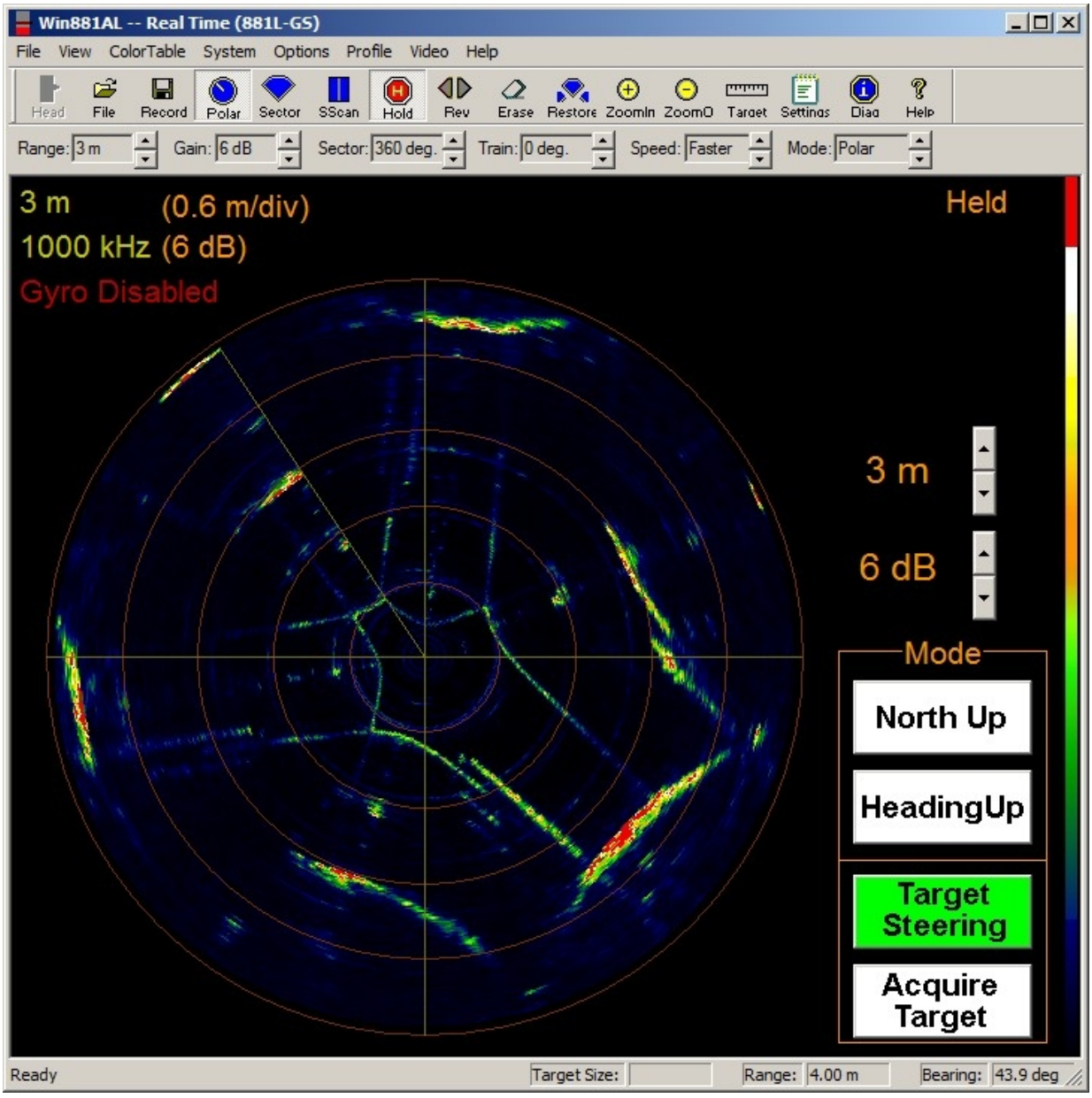


Figure 2.1: Unstabilized Image

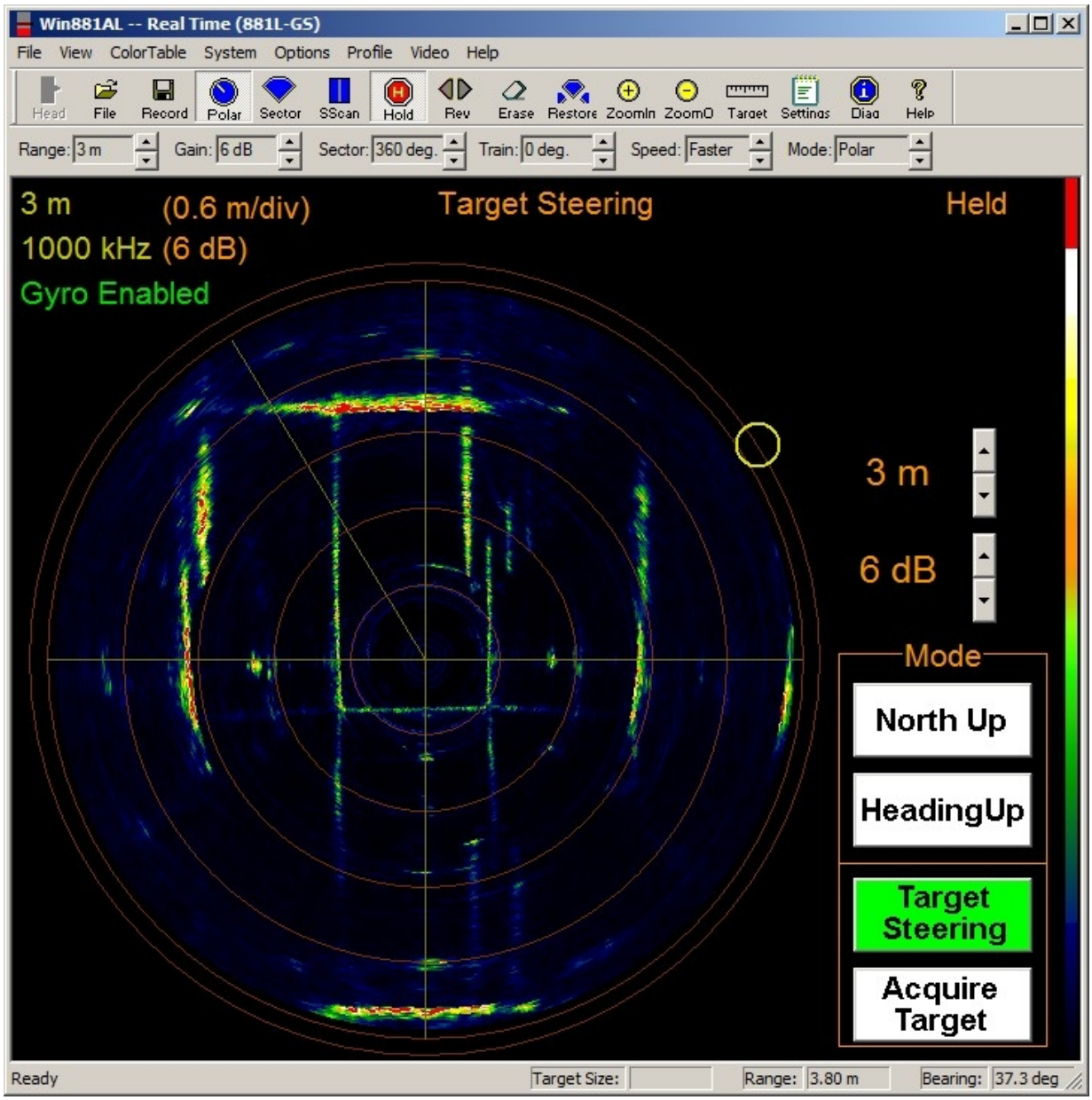


Figure 2.2: Stabilized Image

2.4 Hardware

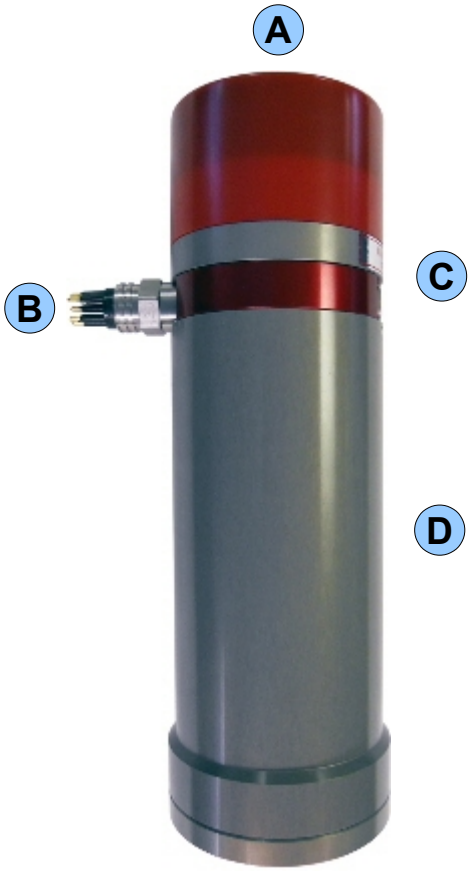


Figure 2.3: 881L-GS
External View

Figure 2.3, above, indicates the 881L-GS in the “Transducer Up” orientation.

A Transducer End. **FRAGILE**. This area MUST be exposed to the water with no obstruction. Do not mount sonar using this area.

B Connect sonar cable. Ensure locking sleeve is used. Do not bend pins.

C Oil filling port. Do not remove. Transducer “zero” position (Transducer Position = 600)

D Electronics Bottle. Use this area for mounting the sonar.

2.5 Software

After installing the "*Win881AL.exe"* program (generally "*C:\Program Files (x86)\Imagenex*"), load the program by double-clicking on its icon.

The program, which supports the 881A, 881L, 881A-GS, 881L-GS, 882A, and 882L will need to be told which sonar type is being connected. Choose 881L-GS from:

"System => Sonar Type => 881L-GS"

This configures the program to operate in 881L-GS mode.

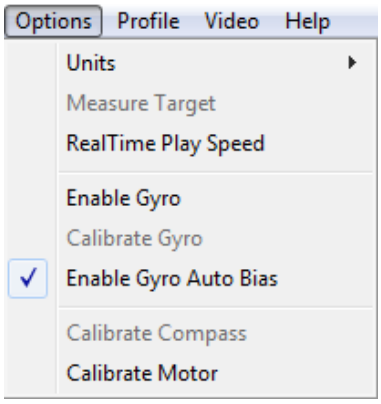


Figure 2.4: Options Menu

Ref	Item	Description
1	Enable Gyro	Enables Gyro Stabilized Image. Deselect to operate as standard 881L.
2	Calibrate Gyro	Calibrates gyro to compensate for drift.
3	Enable Gyro Auto Bias	Enabling this puts the sonar into auto bias mode where the sonar will continuously re-bias the gyro in real time. Disabling this mode requires a manual bias as described in Section 2.2.2 on page 2.
4	Calibrate Compass	Field Calibrates the internal Compass. To calibrate the compass, the sonar head MUST be rotated 360º (direction is irrelevant). Check "Calibrate Compass", rotate 360º, then un-check "Calibrate Compass" to store the settings.
5	Calibrate Motor	Calibrates Motor and realigns the sonar head position relative to the transducer position.

Table 2.1: Option Menu

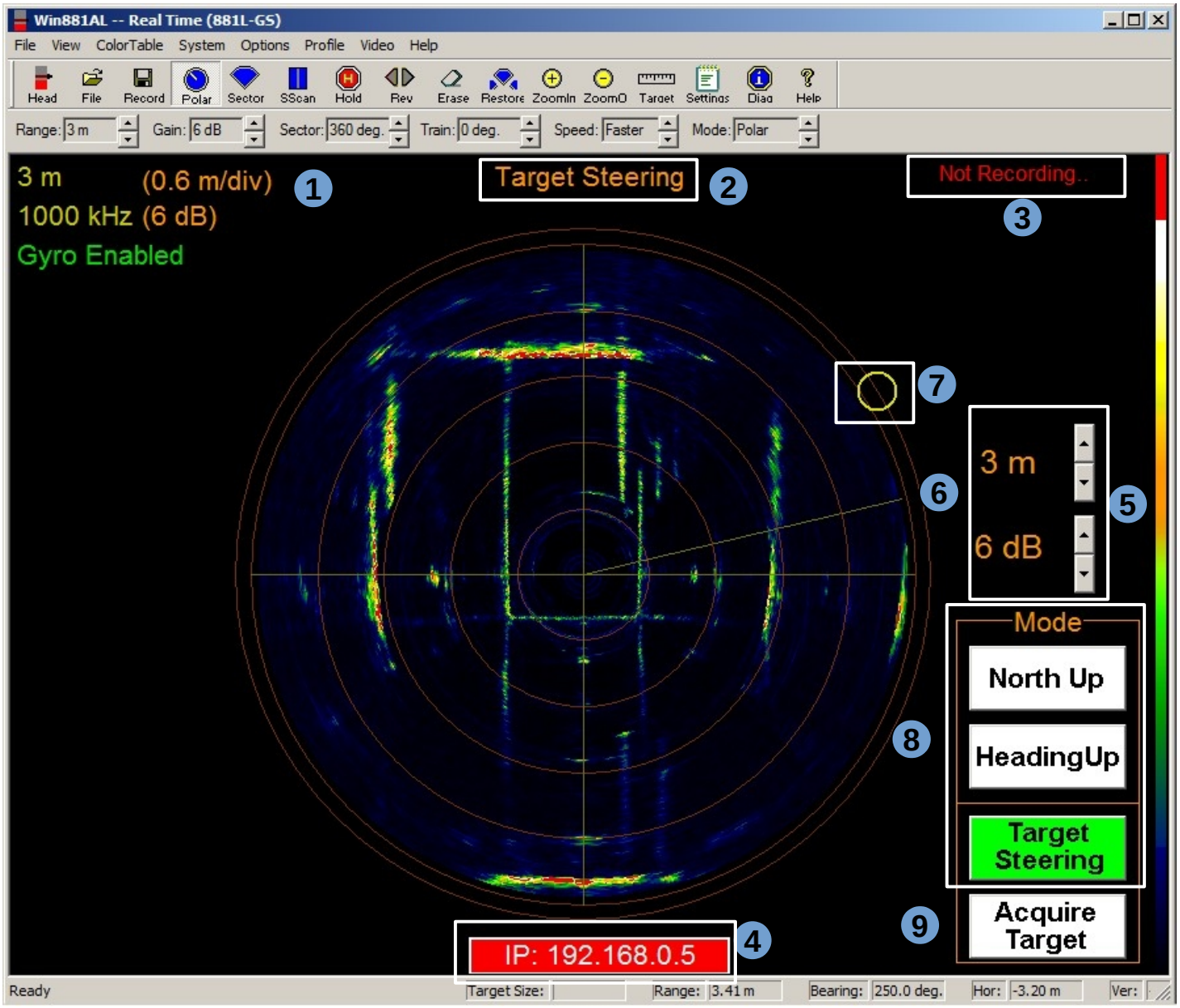


Figure 2.5: Standard 881L-GS Display

Ref	Item	Description
1	Range / Frequency Display	Display current acoustic range and frequency of sonar in yellow. Displays Grid scale and current gain in orange
2	Gyro stabilized operating mode	Displays only when Gyro Stabilized Image is enabled. One of: North Up, Heading Up, or Target Steering.
3	File Recording information	Displays “Not Recording” or “Recording...”
4	Communication Error Status	Displays “No Connection” when communication to the sonar is interrupted.
5	Quick Setting	Quick Setting for sonar range and gain
6	Wiper	Current transducer position for the “ping”
7	Sonar Position Indicator	The yellow circle indicates the current sonar position independent of the transducer position. In North Up mode, the circle will transverse around the perimeter of the sonar image which remains stationary in a North up orientation. In Heading Up mode, the circle will remain stationary at the top of the screen, while the sonar image rotates. In Target Steering mode, the circle will transverse around the perimeter of the sonar image which remains stationary
8	Gyro Stabilized Image mode selection	Selects the various modes of display. In North Up mode, the circle will transverse around the perimeter of the sonar image which remains stationary in a North up orientation. In Heading Up mode, the circle will remain stationary at the top of the screen, while the sonar image rotates according to the heading. In Target Steering mode, the circle will transverse around the perimeter of the sonar image which remains stationary
9	Acquire Target	Only active in “Target Steering mode, “Acquire Target” allow the user to select a target location. The sector will then be centred on the selected target and rotated to place the target at the top of the display. See Section 2.5.1, below for details.

Table 2.2: Main Display

2.5.1 Acquire Target

The 881L-GS has the ability to select a target of interest, and automatically centre and scan that target on screen. The procedure is as follows.

1. Ensure the gyro is enabled and in “Target Steering” mode. *The image will perform a full polar scan.*
2. Select the button “Acquire Target”. *The mouse cursor will change to* 
3. Select desired target on screen *The screen will automatically change to a top sector view with the target centred within the sector*

This is described further below.

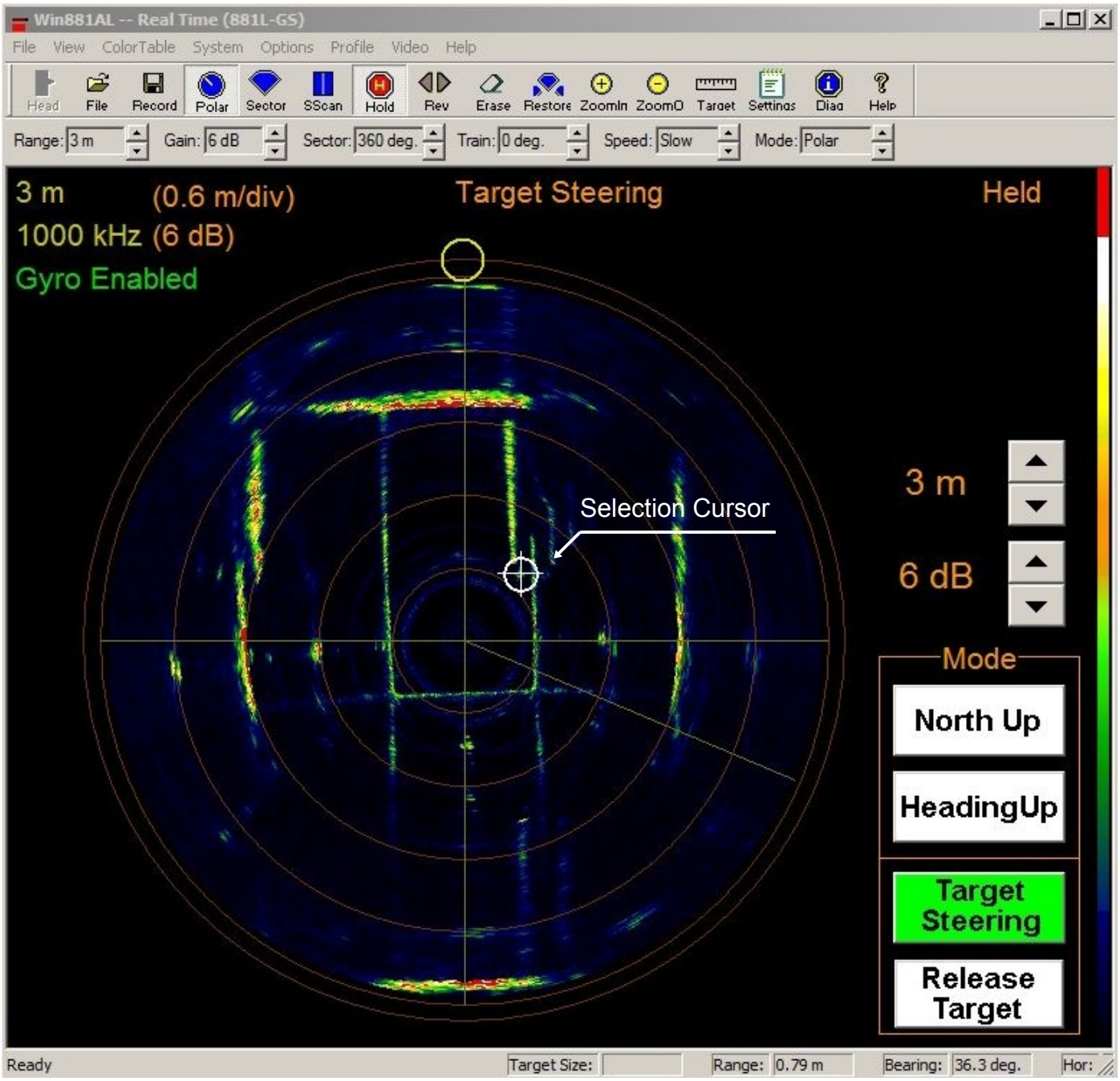


Figure 2.6: Acquire Target button has been selected

In Figure 2.6, above, the "Acquire Target" was selected and the mouse cursor changed to  . In this example, the target of interest is positioned under the target cursor.

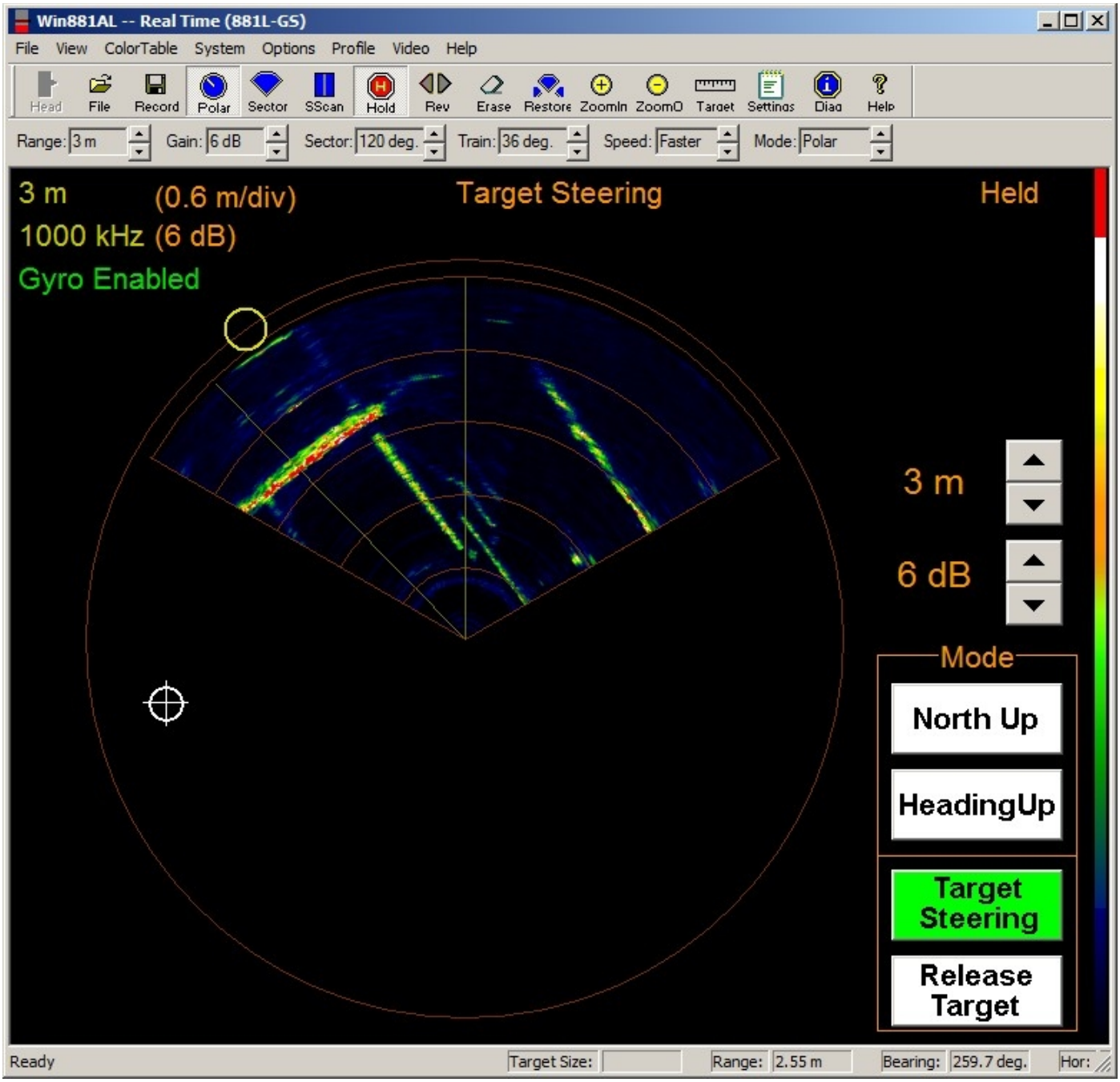


Figure 2.7: Target has been selected

In Figure 2.7, above, the desired target from Figure 2.6 was selected. The screen automatically centred the target within a sector and rotated the sector to the top of the screen. The sonar will now scan the sector with the centred target.

To return, select “Release Target” to remove the sector restrictions and train angle.

2.5.2 Latitude Adjustment and Compass Declination

The geographical local latitude compensates for drift caused by the Earth's rotation. To set the latitude of the current location, open the file "*Win881AL.ini*" in a text editor and edit the lines:

- Local Latitude=49.250000 → (0 to 90 for northern latitudes, 0 to -90 for southern latitudes)
- CompassDeclination=16.5 → (±180º, offset to Magnetic North. West is negative, East is positive).

To match the approximate location of the sonar.
Once these are set, run the "*Win881AL.exe*" program as per usual.

The "Local Latitude" will not take effect until a "**CALIBRATE GYRO**" command is initiated manually under the "*Options*" menu.

The compass declination angle is used for displaying the sonar image referenced to True North rather than Magnetic North.
The default values are for Vancouver, BC, Canada which has a latitude of 49.25º North and a magnetic compass declination of 16.5º East (as of 2014).

2.5.3 File Size Limits

Storing video can generate very large files, The software is able to automatically split the recorded file in predefined file sizes as shown below in Figure 2.8

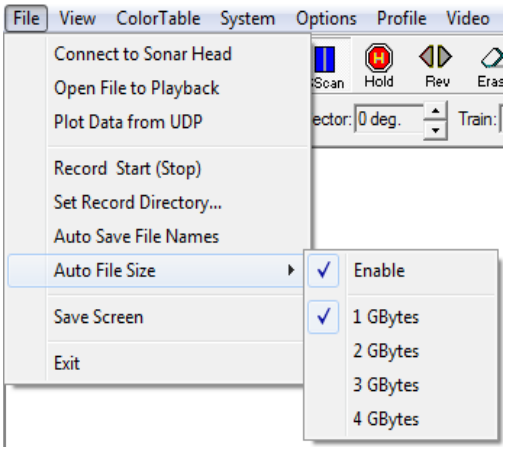


Figure 2.8: Auto File Sizes

In order to re-join two split files, from the command prompt type:

copy /b "Source1.81R"+"Source2.81R" "dest.81R"

without the quotes.

Appendix A – Ethernet Setup Guide

The Imagenex Model 881L-GS sonar system consists of an underwater sonar head connected via Ethernet directly (or indirectly) to a Windows© based computer.

This document covers the necessary setup procedures to enable your Windows© XP© based PC to communicate with the sonar.

Ethernet Cable
The included Ethernet cable specifications are:

- Cat 5e
- RJ-45
- 568B wiring scheme

If this cable needs to be replaced, ensure that the above specifications are met.

A1. Configuration of Windows XP Ethernet Communications

For the 881L-GS system, the following Address's are used

PC

IP Address	192.168.0.X
Subnet Mask	255.255.255.0

Where 'X' is a decimal number between 3 and 224. The number '1' is reserved for a network server '5' is reserved for the 881L-GS sonar head, and 255 is reserved for broadcasting.

The 881L-GS sonar head has a statically assigned IP Address of **192.168.0.5.** This is the number to enter for "*IP Address*" in the "*System*" menu of the 881L-GS program.

The Recommended PC's IP address and Subnet Mask on the PC are:

IP Address	192.168.0.3
Subnet Mask	255.255.255.0

On a Windows© XP© based machine, this is done as follows:

1. Navigate to the Control Panel and double click "Network Connections"
2. Right click on the Ethernet interface you wish to connect with and select "Properties"

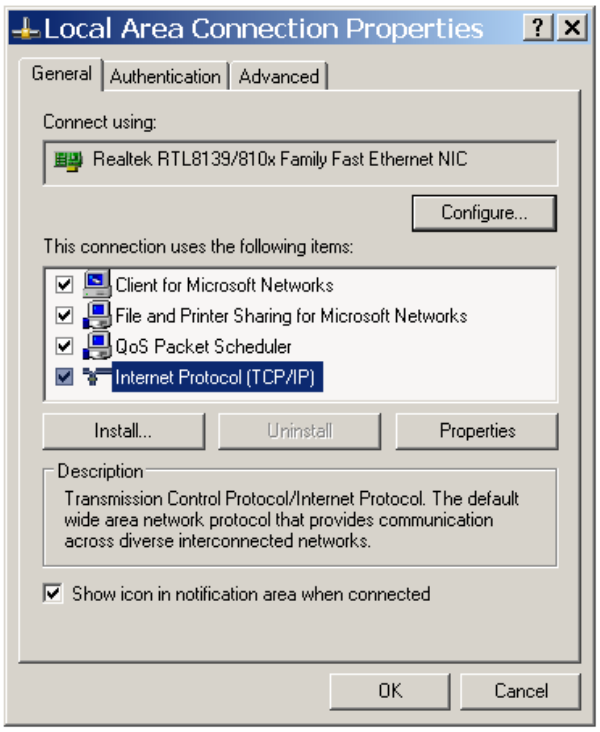


Figure A.1: Local Area Connection Properties Dialogue Box

3. Select Internet Protocol (TCP/IP) and select “Properties”

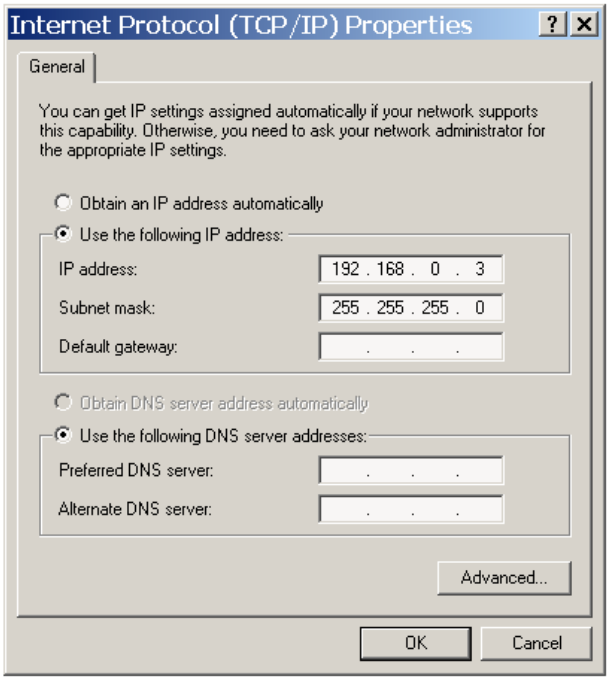


Figure A.2: TCP/IP Priorities Dialogue Box

4. Enter the information shown above in **Figure A.2** and click “OK” to accept the changes.
5. Click “OK” again to accept the changes.

Now your computer is on the same "*Network*" as the sonar head. When starting the "*Win881AL.exe*" program, the IP address stored in the "881L-GS.INI" file is read and a connection will be established.

The sonar head has a statically assigned IP Address of **192.168.0.2.** Enter this number in the menu item "*Setup -> IP Address*".

The sonar head will run fine. However, if communication to the head does not function properly, try the suggestions located on **page 16**.

A2. Configuration of Windows 7 Ethernet Communications

Windows 7 requires a few more steps than XP for network configuration, but is generally the same.

On a Windows© 7 based machine, this is done as follows:

1. Go to the Start Menu and select "Control Panel".
2. Select "Network and Sharing Center".

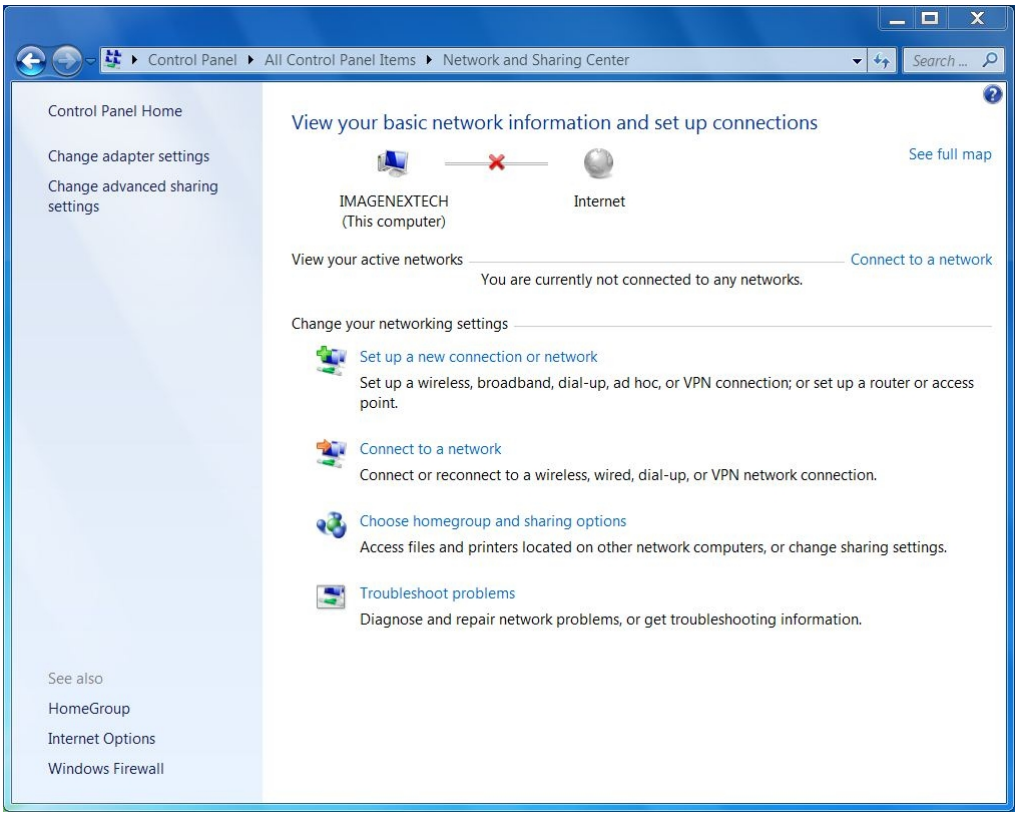


Figure A.3: Windows 7 - Network and Sharing Center

3. Select "Change adaptor settings".

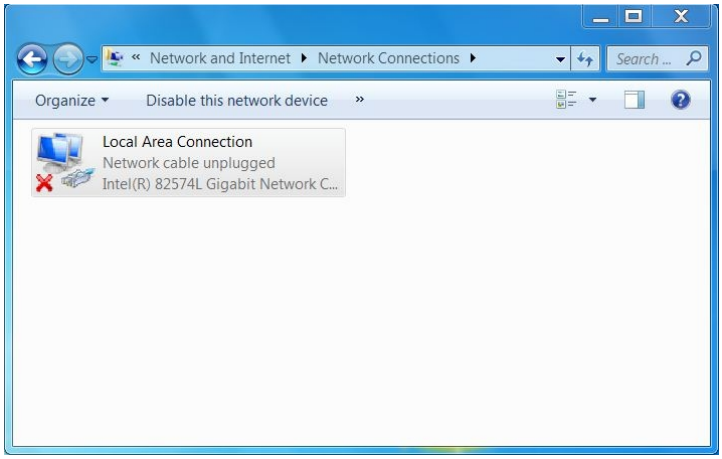


Figure A.4: Windows 7 - Network Connections

4. Right-click on “Local Area Connection” and select “Properties”.

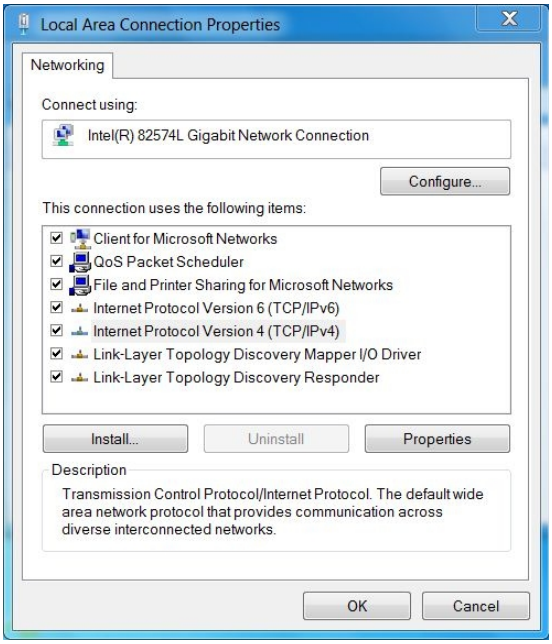


Figure A.5: Windows 7 - Local Area Connection Properties

5. Select “Internet Protocol Version 4 (TCP/IPv4)” and select “Properties”.
6. Continuing from item 4 and **Figure A.2**, on page **13**, enter the required information.

Appendix B – Troubleshooting Communications

Disable any network bridges that are present

- A network bridge allows a separate port, such as "USB", or "Firewire" to piggyback the Ethernet connection.
- Under "Network Connections", if there is a network bridge icon, disable it.

Disable any other network devices that are present on the computer

- Often, if there are multiple network cards present, Windows may get confused on which one to communicate through. This is more of an issue on laptops with wireless connections.
- Right-click on each connection and select "*Disable*".

Under "Network Connections", right-click on the Ethernet card and select properties.

Clear unnecessary network protocols

- De-select all services except for "*Internet Protocol (TCP/IP)*"

Remove any firewalls present (Note that Windows© has a rudimentary firewall built into it. Disable this one first).

- Select the "Advanced" Tab. De-select the Firewall option (if present).

Click on "Configure" (in the "General" tab) and a new dialogue box will appear.

Set Link speed to "Auto" or "10Mbps"

- In the "Advanced" tab, select "Link Speed / Duplex Mode" and set to either "*Auto Mode*" or "*10 Full Mode*".

Disable any power saving that shuts down the Ethernet card.

- In the "Advanced" tab, select "Link Down Power Saving" and set to "*Disable*".
- In the "Power Management" tab, de-select any power saving option.

Repair the Ethernet connection.

Windows remembers the hardware address for each socket. To clear the Windows settings:

- Right click on the Local Area Connection.
- Select "Repair".

IMAGENEX .81R RAW DATA FILE FORMAT

Version: 1.00

The .81R file format is used for the following gyro stabilized sonar heads:

Model 881A-GS
Model 881L-GS
Model 882A
Model 882L

For each sonar ping, the following sections are written to the .81R file.

1. Ping Header - 1024 bytes
2. Device List - 1024 bytes
3. Raw Sonar Data - variable length
4. Internal Sensor Data
5. External Sensor Data
6. Future Expansion
7. Video Frame (if available)

1. Ping Header
- contains overhead information such as total number of bytes this ping, byte offsets and lengths of each section, ping timestamp, frequency, range, gain, etc.

2. Device List
- contains information on all connected devices (i.e. sonar head, GPS, MRU, Gyro/Heading, Sound Velocity sensor, etc.). Includes the device name, transfer speed, rep-rate, mounting offsets, mounting angles and data latency. Information in this section is not required and may be zero filled.

3. Raw Sonar Data
- contains Switch Data Command, Sonar Return Header and Raw Sonar Data

4. Internal Sensor Data
- contains values from optional sensors installed inside the sonar head (i.e. MRU)

5. External Sensor Data
- contains values from external sensors

6. Future Expansion

7. Video Frame
- if video is available from a connected USB frame grabber, the video frame is written to the file after the current ping data

Storage Format

All data is stored LSB first (least significant byte first or "Little-Endian" mode). The following conventions are used:

char	1-byte signed value	
BYTE	1-byte unsigned value	
ASCII	1-byte unsigned value	
short	2-byte signed value	(LSB,MSB)
WORD	2-byte unsigned value	(LSB,MSB)
int	4-byte signed value	(LSB,MDL,MDH,MSB)
DWORD	4-byte unsigned value	(LSB,MDL,MDH,MSB)
float	4-byte single precision floating point value	(LSB,MDL,MDH,MSB)

Section 1: **Ping Header** (length = 1024 bytes)

Byte	Description	Format
0	'**8**' - Ping Header byte 0	ASCII
1	'**1**' - Ping Header byte 1	ASCII
2	'**R**' - Ping Header byte 2	ASCII
3	Sonar Type 0 = Model 881L-GS 1 = Model 881A-GS 2 = Model 882L 3 = Model 882A	BYTE
4-7	Total Bytes This Ping (including Ping Header)	DWORD
8 - 9	.81R File Version 0 = 1.00 - initial release	WORD
10 - 27	Ping Timestamp - (18 bytes) DDMMYYYYHHMMSSmmmh 10-11: DD - day, 01-31 12-13: MM - month, 01-12 14-17: YYYY - year 18-19: HH - hours, 00-23 20-21: MM - minutes, 00-59 22-23: SS - seconds, 00-59 24-26: mmm - milliseconds, 000-999 27: NULL	ASCII
28	Reserved - always 0 (1 byte)	BYTE
29 - 58	Sonar Control Program Version Number (30 bytes) i.e. "Version 1.0.1.5 (19Sept14)" plus zero fill	ASCII
59 - 62	Byte offset to previous 81R Ping Header **Note: all byte offsets are referenced to the beginning of the current Ping Header**	DWORD
63	Status Byte 1 Bit 0: 1 = internal sensors available Bit 1: 1 = external sensors available Bit 2-7: Reserved	BYTE
64	Status Byte 2 - Reserved - always 0	BYTE
65	Status Byte 3 - Reserved - always 0	BYTE
66	Status Byte 4 - Reserved - always 0	BYTE
67	Status Byte 5 - Reserved - always 0	BYTE
68	Status Byte 6 - Reserved - always 0	BYTE
69	Status Byte 7 - Reserved - always 0	BYTE
70	Status Byte 8 - Reserved - always 0	BYTE
71 - 74	Reserved - always 0 (4 bytes)	BYTE
75 - 78	Ping Header length - 1024	DWORD
79 - 82	Byte offset to Device List - 1024	DWORD
83 - 86	Device List length - 1024	DWORD
87 - 90	Byte offset to Raw Sonar Data - 2048	DWORD
91 - 94	Raw Sonar Data length - variable	DWORD

95 - 98	Byte offset to Internal Sensors (0 if not available)	DWORD
99 - 102	Internal Sensor length (0 if not available)	DWORD
103 - 106	Byte offset to External Sensors (0 if not available)	DWORD
107 - 110	External Sensor length (0 if not available)	DWORD
111 - 318	Reserved - always 0 (208 bytes)	BYTE
319	Transducer Up/Down, Display Mode Bits 0-2: 000 = North Up 001 = Heading Up 010 = Target Steering Bits 3-6: Reserved Bit 7: Transducer Up/Down 0 = Down, 1 = Up	BYTE
320	Start Gain (dB)	BYTE
321	Sector Width Command 0 to 120 = 0 to 360 Degrees in 3 degree increments	BYTE
322	Train Angle Command 0 to 119 = 0 to 357 Degrees in 3 degree increments	BYTE
323	Step Size Command 0 = No Step 1 = 0.3 Degrees (Slow) 2 = 0.6 Degrees (Medium) 3 = 0.9 Degrees (Fast) 4 = 1.2 Degrees (Faster) 8 = 2.4 Degrees (Fastest)	BYTE
324	Mode 0 = Sector 1 = Polar 2 = Sidescan	BYTE
325 - 328	Range Offset (meters)	float
329 - 332	Absorption (dB/meter)	float
333	Reserved - always 0	BYTE
334 - 337	Pulse Length (microseconds)	DWORD
338 - 341	Sound Velocity (meters/second)	float
342 - 345	Acoustic Transmit Frequency (Hz)	float
346 - 349	Sonar Ping Repetition Rate (seconds)	float
350 - 352	Reserved - always 0	BYTE
353 - 356	Samples per ping	DWORD
357 - 360	Sector Size (degrees)	float
361 - 364	Train Angle (degrees)	float
365 - 368	Step Size - Angle Increment (degrees)	float
369 - 372	Acoustic Range Setting (meters)	float
373 - 376	Range Resolution (meters)	float
377 - 380	Ping Number	DWORD
381	System Information Flag	BYTE
382	Gyro Status (0=Disabled, 1=Enabled)	BYTE
383 - 386	Mounting Angle Offset (-180 to +180 in decimal degrees)	float
387 - 390	Local Latitude (-90 South to +90 North in decimal degrees)	float
391 - 394	Compass Declination (-180 to +180 in decimal degrees)	float
395 - 1023	Reserved - always 0 (629 bytes)	BYTE

Section 2: **Device List** (length = 1024 bytes)

Note: information in this section is not required and may be zero filled.

Each connected device contains the following 64-byte structure:

Byte	Description	Format
0 - 15	Device Name (16 bytes) i.e. "881L-GS Sonar" plus zero fill	ASCII
16 - 19	Transfer Speed (bits per second)	DWORD
20 - 23	Repetition Rate (seconds)	float
24 - 27	Starboard mounting offset (meters, portside is negative)	float
28 - 31	Forward mounting offset (meters, aft is negative)	float
32 - 35	Vertical mounting offset (meters, up is negative)	float
36 - 39	Yaw - mounting offset (degrees, counter-clockwise is negative)	float
40 - 43	Pitch - mounting offset (degrees, nose down is negative)	float
44 - 47	Roll - mounting offset (degrees, portside roll is negative)	float
48 - 51	Latency (seconds)	float
52 - 63	Reserved - always 0 (12 bytes)	BYTE

Device 1 (Sonar Head):
- Byte 0 = Byte offset to Device List (from Ping Header, Bytes 79-82)
- note: sonar head transfer speed is 10 for 10Mbps or 100 for 100Mbps

Device 2 (GPS Antenna):
- Byte 0 = Byte offset to Device List + 64

Device 3 (MRU):
- Byte 0 = Byte offset to Device List + 128

Device 4 (Gyro/Heading):
- Byte 0 = Byte offset to Device List + 192

Section 3: **Raw Sonar Data** (length = Variable)

The Raw Sonar Data section contains the communications transfers to and from the sonar head for the current ping. The transfers consist of the Switch Data Command to the sonar head as well as the Sonar Return Header and Sonar Echo Data from the sonar head. The length of this section varies depending on the type of sonar head.

The following tables describe the total number of bytes stored for each sonar head type:

Sonar Type = Model 881L-GS
Ping Header Byte 3 = 0

1. Switch Data Command - 128 bytes
2. Sonar Return Header - 256 bytes
3. Sonar Echo Data - 500 bytes (IBX mode)
Total = 884 bytes

Byte Offset	**Description**	**Length**
0000 - 1023	Ping Header	1024
1023 - 2047	Device List	1024
2048 - 2175	Switch Data Command	128
2176 - 2431	Sonar Return Header	256
2432 - 2931	Sonar Echo Data	500

For IBX mode, the Sonar Echo Data starts at byte offset 2432 and consists of 500 range bins of 8-Bit (0-255) echo intensity values. Each range bin is (Range/500) in length. Range (in meters) is located in "Range" (Bytes 20-21) of the Sonar Return Header. Range bins assume a sound velocity of 1500m/s. The angular position of the ping echo is encoded in "Transducer Head Position" (Bytes 35-36) of the Sonar Return Header.

Please refer to document **"425-050-01 - 881L - GS Ethernet Specifcation.pdf"** for detailed information about the Sonar Return Data format for the Model 881L-GS sonar head.

Sonar Type = Model 881A-GS
Ping Header Byte 3 = 1

1. Switch Data Command - 40 bytes
2. Sonar Return Header - 32 bytes
3. Sonar Echo Data - 500 bytes (INB mode)
Total = 572 bytes

Byte Offset	Description	Length
0000 - 1023	Ping Header	1024
1023 - 2047	Device List	1024
2048 - 2087	Switch Data Command	40
2088 - 2119	Sonar Return Header	32
2120 - 2619	Sonar Echo Data	500

For INB mode, the Sonar Echo Data starts at byte offset 2120 and consists of 500 range bins of 7-Bit (0-127) echo intensity values. Each range bin is (Range/500) in length. Range (in meters) is located in "Range" (Byte 7) of the Sonar Return Header. Range bins assume a sound velocity of 1500m/s. The angular position of the ping echo is encoded in "Transducer Head Position" (Bytes 5-6) of the Sonar Return Header.

Please refer to document "**425-051-03 - 881A - gyro Serial Specifcation.pdf"** for detailed information about the Sonar Return Data format for the Model 881A-GS sonar head.

Sonar Type = Model 882L
Ping Header Byte 3 = 2

1. Switch Data Command - 128 bytes
2. Sonar Return Header - 256 bytes
3. Sonar Echo Data - 500 bytes (IBX mode)
Total = 884 bytes

Byte Offset	**Description**	**Length**
0000 - 1023	Ping Header	1024
1023 - 2047	Device List	1024
2048 - 2175	Switch Data Command	128
2176 - 2431	Sonar Return Header	256
2432 - 2931	Sonar Echo Data	500

For IBX mode, the Sonar Echo Data starts at byte offset 2432 and consists of 500 range bins of 8-Bit (0-255) echo intensity values. Each range bin is (Range/500) in length. Range (in meters) is located in "Range" (Bytes 20-21) of the Sonar Return Header. Range bins assume a sound velocity of 1500m/s. The angular position of the ping echo is encoded in "Transducer Head Position" (Bytes 35-36) of the Sonar Return Header.

Please refer to document **"425-xxx-xx - 882L - GS Ethernet Specifcation.pdf"** for detailed information about the Sonar Return Data format for the Model 882L sonar head.

Sonar Type = Model 882A
Ping Header Byte 3 = 3

1. Switch Data Command - 40 bytes
2. Sonar Return Header - 32 bytes
3. Sonar Echo Data - 500 bytes (INB mode)
Total = 572 bytes

Byte Offset	**Description**	**Length**
0000 - 1023	Ping Header	1024
1023 - 2047	Device List	1024
2048 - 2087	Switch Data Command	40
2088 - 2119	Sonar Return Header	32
2120 - 2619	Sonar Echo Data	500

For INB mode, the Sonar Echo Data starts at byte offset 2120 and consists of 500 range bins of 7-Bit (0-127) echo intensity values. Each range bin is (Range/500) in length. Range (in meters) is located in "Range" (Byte 7) of the Sonar Return Header. Range bins assume a sound velocity of 1500m/s. The angular position of the ping echo is encoded in "Transducer Head Position" (Bytes 5-6) of the Sonar Return Header.

Please refer to document **"425-054-0C - 882A - Serial Specifcation.pdf"** for detailed information about the Sonar Return Data format for the 882A sonar head.

Section 4: **Internal Sensor Data**

This section is reserved for future use.

Byte offset to Internal Sensors, (Ping Header, Bytes 95-98) = 0
Internal Sensor length, (Ping Header, Bytes 99-102) = 0

Section 5: **External Sensor Data**

This section is reserved for future use.

Byte offset to External Sensors, (Ping Header, Bytes 103-106) = 0
External Sensor length, (Ping Header, Bytes 107-110) = 0

Section 6: **Future Expansion**

This section is reserved for future use.

Section 7: **Video Frame** (length is variable)

Byte	Description	Format
	Bitmap Header	
0	'**B**' - Video Frame Header byte 0	ASCII
1	'**M**' - Video Frame Header byte 1	ASCII
2 - 5	Video Frame Filesize 14 + 40 + (ImageWidth x ImageHeight x 3) bytes	DWORD
6 - 7	Reserved1 - always 0	WORD
8 - 9	Reserved2 - always 0	WORD
10 - 13	Image Data Offset = 54	DWORD
	Bitmap Information Header	
14 - 17	HeaderSize = 40	DWORD
18 - 21	ImageWidth (in pixels)	DWORD
22 - 25	ImageHeight (in pixels)	DWORD
26 - 27	NumberOfImagePlanes = 1	WORD
28 - 29	BitsPerPixel = 24	WORD
30 - 33	CompressionMethod = 0	DWORD
34 - 37	SizeOfBitmap = (ImageWidth x ImageHeight x 3)	DWORD
38 - 41	HorzResolution = 0	DWORD
42 - 45	VertResolution = 0	DWORD
46 - 49	NumColorsUsed = 0	DWORD
50 - 53	NumSignificantColors = 0	DWORD
	24 Bit ImageData (stored as 3 bytes per pixel)	
54 - 57	Pixel 0 - Blue, Green, Red (lower-left corner of image)	BYTE
58 - 60	Pixel 1 - Blue, Green, Red	BYTE
.	.	.
.	.	.
Video Frame Filesize-3	Pixel N (ImageWidth x ImageHeight - 1) - Blue, Green, Red (upper-right corner of image)	BYTE

Imagenex Technology Corp.

IMAGENEX MODEL 881L

with GYRO STABLIZED Option

MULTI-FREQUENCY DIGITAL SONAR HEAD
Imager / Profiler

ETHERNET INTERFACE SPECIFICATION

Version 2.0

Document Number	425-050	
Revision	**Date**	**Description**
0A	November 13, 2013	New Format
0B	November 13, 2013	Added ReBias Gyro
0C	January 16, 2014	Adds Information Packet
0D	May 8, 2014	Information Packet update
00	July 21, 2014	Added variable gyro biasing time
01	October 10, 2014	Adds motion tolerent gyro biasing, gyro compass

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 128 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.

Byte	Description									
0-9	0xFE	0x55	Head ID	Packet Number	Sonar Command (LO)	Sonar Command (HI)	Sensor Command (LO)	Sensor Command (HI)	Data Format	*Reserved 0*
10-19	Range (LO)	Range (HI)	Range Offset (LO)	Range Offset (HI)	Min Profi Range (LO)	Min Profi Range (HI)	Frequency (LO)	Frequency (HI)	Gain	*Reserved 0*
20-29	Absorption (LO)	Absorption (HI)	Pulse Len (LO)	Pulse Len (HI)	LOGF	Train Angle	Sector Width	Step Size	*Reserved 0*	*Reserved 0*
30-39	Transmit Delay	Ext Trig. Delay (LO)	Ext Trig. Delay (HI)	Gyro Biasing	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*
40-49	Latitude	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*
50-59	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*
60-69	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*
70-79	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*
80-89	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*
90-99	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*
100-109	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*
110-119	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*
120-127	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*		

Table 1: ***Model 881L Switch Data Command To Sonar Head***

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 **0x55** (85 decimal)

Byte 2 **Head ID**
Normally 0x10

Byte 3 **Packet Number Request**
0

Bytes 4-5 **Sonar Command**

Byte 4								Byte 5							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
LO								HI							

Bit	Function
0	Transponder Mode (*Not Implemented*)
1	Positive External Trigger Control
2	Enable External Trigger Control
3	Disable transmitter
4	Disable TVG curve
5	Reverse Step Direction
6	Calibrate sonar head transducer
7	*Reserved*
8	*Reserved*
9	*Reserved*
10	*Reserved*
11	*Reserved*
12	*Reserved*
13	*Reserved*
14	*Reserved*
15	*Reserved*

Bytes 6-7 **Sensor Command**

Byte 6								Byte 7							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
LO								HI							

Bit	Function
0	Enable Gyro
1	Enable Pitch, Roll, Heading
2	Gyro Reset
3	Transducer = UP
4	ReBias Gyro
5	Start compass calibration
6	Stop compass calibration
7	*Reserved*
8	Store Latitude
9	Gyro Set Target Location
10	Motion Bias Enable
11	*Reserved*
12	*Reserved*
13	*Reserved*
14	*Reserved*
15	*Reserved*

Byte 8 **Data Format**

ASCII 'B'

- Header = 256Bytes
- Data Bits = 8
- Data Points = 500
- N = 750

ASCII 'O' *(Not Implimented)*

- Header = 256Bytes
- Data Bits = 8
- Data Points = 1000
- N = 1256

ASCII 'P'

- Header = 256Bytes
- Data Bits = 8
- Data Points = 0
- N = 256

Byte 9 **Reserved**

Always 0

Bytes 10-11 **Range**

Byte 10								Byte 11							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
LO								HI							

5, 10, 20, 30, 40, 50, 60, 80, 100, 150, 200

Byte 12-13 **Range Offset**

Byte 12								Byte 13							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
LO								HI							

1 to 200 meters in 1 meter increments

Byte 14-15 **Profile Minimum Range**

Minimum range for profile point digitization

Byte 14								Byte 15							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
LO								HI							

0 – 2000 → 0 to 200 meters in 0.1 meter increments

Byte 16-17 **Frequency**

Current operating Frequency of the Sonar in 100Hz increments

Byte 16								Byte 17							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
LO								HI							

280kHz to 1100kHz in 100Hz increments (Not all frequencies are permitted for every configuration)

Byte 18 **Gain** (dB)
0 to 40dB in 1dB increments

Byte 19 **Reserved**
Always 0

Bytes 20-21 **Absorption (two-way)**
absorption in dB/m * 1000
0.000dB/m to 3.000dB/m

Freq	Byte	20	21
		LO	HI
	0.000 dB/m	0x00	0x00
675kHz	0.39 dB/m	0x86	0x01
280kHz	0.13 dB/m	0x82	0x00
1100kHz	0.87 dB/m	0x66	0x03

Bytes 22-23 **Pulse Length (µs)**
Pulse Length in µs
Valid: 10µs - 6ms

Byte	22	23
	LO	HI
10µs	0x0A	0x00
6000µs	0x70	0x17

Byte 24 **LOGF** (*Not Implemented*)
0 = 10dB
1 = 20dB → Default
2 = 30dB
3 = 40dB

Byte 25 **Train Angle**
0 to 120 (-180 Deg to +180 Deg = 360 Deg Total) in 3 Degree steps.
Byte 25 = (train_angle_in_degrees + 180)/3
i.e.
0 = -180 Degrees
30 = -90 Degrees
60 = 0 Degrees
90 = +90 Degrees
120 = +180 Degrees

Byte 26 **Sector Width**
0 to 120 (0 Deg to 360 Deg) in 3 Degree steps
Byte 26 = sector_width_in_degrees/3
i.e.
0 = 0 Degrees
30 = 90 Degrees
60 = 180 Degrees
120 = 360 Degrees

Byte 27 **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

Bytes 28-29 **Reserved**
Always 0

Byte 30 **Switch Delay**
The head can be commanded to pause (from 0 to 510ms) before sending its return data to allow the commanding program enough time to setup for the return of the data.
0 to 255 in 2ms increments
Byte 30 = delay_in_milliseconds/2

Byte 31-32 **External Trigger Transmit Delay**
Delay from external trigger to sonar head transmit pulse
0 -10000 (in 100µs increments)

Byte	31	32
	LO	HI
100µs	0x01	0x00
1s	0x10	0x27

Byte 33 **Gyro Biasing Delay**
1 – 255 → 1sec to 255 seconds

Bytes 34-39 **Reserved**
Always 0

Byte 40 **Latitude**
Current Latitude of Sonar Location

Bits 0-6 = Latitude in Degrees = 0-90
Bit 7 = 0 = North
1 = South

Byte 41-127 **Reserved**
Always 0

SONAR RETURN DATA

Every shot, the head returns a 256 Byte header, 0, 500 or 1000 points of echo data. The **total number of bytes (N)** returned will be 256, 756 or 1256.

Byte #	Description									
0-9	ASCII 'I'	ASCII 'B', 'O', or 'P'	ASCII 'X'	Head ID	Packet Number	Total Number of Packets	Firmware Version	*Reserved 0*	*Reserved 0*	*Reserved 0*
10-19	*Reserved 0*	*Reserved 0*	*Reserved 0*	Status LO	Status HI	Sonar Command LO	Sonar Command HI	Sensor Command LO	Sensor Command HI	*Reserved 0*
20-29	Range LO	Range Hi	Range Offset LO	Range Offset HI	Prof Rng (LO)	Prof Rng (HI)	Frequency (LO)	Frequency (HI)	Gain	*Reserved 0*
30-39	Absorption (LO)	Absorption (HI)	Pulse Len (LO)	Pulse Len (HI)	LOGF	Transducer Head Pos (LO)	Transducer Head Pos (HI)	Sonar Pos (LO)	Sonar Pos (HI)	*Reserved 0*
40-49	Pitch (LO)	Pitch (HI)	Roll (LO)	Roll (HI)	Heading (LO)	Heading (HI)	Gyro Heading (LO)	Gyro Heading (HI)	*Reserved 0*	*Reserved 0*
50-59	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*
60-69	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*
70-79	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*
80-89	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*
90-99	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*
100-109	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*
110-119	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*
120-129	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*
130-255	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*	*Reserved 0*
256-N	Echo Data 0, 500, 1000 Data Bytes									

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 '**IBX**', '**IOX**', '**IPX**'
'I' = 0x49, 'B' = 0x42, 'O' = 0x4F, 'P' = 0x50, 'X' = 0x58

ASCII '**IBX**'
In response to a Switch Data Command with **Data Format** = 'B'
Header = 256Bytes
Data Bits = 8
Data Points = 500
N = 756

ASCII '**IOX**'
In response to a Switch Data Command with **Data Format** = 'O'
Header = 256Bytes
Data Bits = 8
Data Points = 1000
N = 1256

ASCII '**IPX**'
In response to a Switch Data Command with **Data Format** = 'P'
Header = 256Bytes
Data Bits = 8
Data Points = 0
N = 256

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

Byte 4 **Packet Number** (*Not Implemented*)
0

Byte 5 **Total Number of Packets for current ping** (*Not Implemented*)
1
This tells the PC program how many datagrams will be required to transfer entire data set.

Byte 6 **Firmware Version**
1 = Supports Motion Biasing (and corrects Backwards heading)

Bytes 7-12 **Reserved**
0

Bytes 13-14 **Status**

Byte 13								Byte 14							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
LO								HI							

Bit	Function
0	Range Setting error
1	Pulse Length Setting error
2	Gain Setting error
3	Frequency Setting error
4	*Reserved*
5	*Reserved*
6	Gyro Calibrating
7 -0	Transmit occurred after 2s timeout (no trigger found)
7 -1	Transmit occurred after trigger (trigger found)
8	Compass Calibrating
9	MRU Error
10	Automatic rebias has occured
11	*Reserved*
12	*Reserved*
13	*Reserved*
14	*Reserved*
15	*Reserved*

Bytes 15-16 **Sonar Command**

Reflection of Bytes 4 and 5 down

Byte 15								Byte 16							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
LO								HI							

Bytes 17-18 **Sensor Command**

Reflection of Bytes 6 and 7 down

Byte 17								Byte 18							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
LO								HI							

Byte 19 **Reserved**

0

Bytes 20-21 **Range**

Current operating range of sonar. Refer to bytes 10 and 11 down for format.

Byte 22-23 **Range Offset**

Current range offset of sonar. Refer to bytes 12 and 13 down for format.

Byte 24 - 25 **Profile Range**
First digitized range value above threshold in sample units
Prof Rng (LO), Prof Rng (HI)

Byte 24								Byte 25							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Profile Range (LO)								**Profile Range (HI)**							

Note: sample units = 2mm (if range < 5m)
sample units = 10mm (if range >= 5m)
* assuming a sound velocity of 1500m/s

Bytes 26-27 **Frequency**
Current operating frequency of sonar. Refer to bytes 16 and 17 down for format.

Byte 28 **Gain**
Current operating gain of sonar. Refer to byte 18 down for format.

Byte 29 **Reserved**
0

Bytes 30-31 **Absorption**
Current absorption of sonar. Refer to bytes 20 and 21 down for format.

Bytes 32-33 **Pulse Length**
Current pulse length of sonar. Refer to bytes 22 and 23 down for format.

Byte 34 **LOGF**
Current logf of sonar. Refer to byte 24 down for format.

Bytes 35 - 36 **Transducer Head Position**
Step Direction
Angular position of the transducer and Transducer step direction

Byte 35								Byte 36							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Head Pos (LO)								**D**	**Head Pos (HI)**						

Head Pos (LO), Head Pos (HI), Step Direction (D)
Head Pos Low Byte = Byte 35
Head Pos High Byte = Byte 36&0x7F
XDCR Head Position = (Head Pos High Byte<<8) | Head Pos Low Byte

XDCR Head Position = 0 to 1200 (-180 to +180 Degrees) in 0.3 Degree steps
0 = -180 Degrees
300 = -90 Degrees
600 = 0 Degrees (Centre 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 36 & 0x80)>>7
0 = counter-clockwise
1 = clockwise

Bytes 37 - 38 **Sonar Position**

Angular position of the physical unit

Byte 37								Byte 38							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Sonar Pos (LO)								**Sonar Pos (HI)**							

Sonar Pos (LO), Sonar Pos (HI)
Sonar Pos Low Byte = Byte 37
Sonar Pos High Byte = Byte 38
Sonar Position = (Sonar Pos High Byte<<8) | Sonar Pos Low Byte

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

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

Byte 39 **Reserved**

0

Bytes 40 - 41 **Pitch**

Byte 40								Byte 41							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Pitch (LO)								**Pitch (HI)**							

if Byte 41 - Bit 7 = 0:
Pitch = [((Byte 41 << 8) | Byte 40)] * 360/65536 in degrees

if Byte 41 - Bit 7 = 1:
Pitch = [((Byte 41 << 8) | Byte 40)-65536] * 360/65536 in degrees

Byte 42 - 43 **Roll**

Byte 42								Byte 43							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Roll (LO)								**Roll (HI)**							

if Byte 43 - Bit 7 = 0:
Roll = [((Byte 43 << 8) | Byte 42)] * 360/65536 in degrees

if Byte 43 - Bit 7 = 1:
Roll = [((Byte 43 << 8) | Byte 42)-65536] * 360/65536 in degrees

Byte 44 - 45 **Magnetic Heading**

Byte 44								Byte 45							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Magnetic Heading (LO)								Magnetic Heading (HI)							

if Byte 45 - Bit 7 = 0:
Heading = [((Byte 45 << 8) | Byte 44)] * 360/65536 in degrees

if Byte 45 - Bit 7 = 1:
Heading = [((Byte 45 << 8) | Byte 44)-65536] * 360/65536 in degrees

Byte 46 - 47 **Gyro Heading**

Byte 46								Byte 47							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Gyro Heading (LO)								Gyro Heading (HI)							

if Byte 47 - Bit 7 = 0:
Heading = [((Byte 47 << 8) | Byte 46)] * 360/65536 in degrees

if Byte 47 - Bit 7 = 1:
Heading = [((Byte 47 << 8) | Byte 46)-65536] * 360/65536 in degrees

Bytes 48-255 **Reserved**
0

Bytes 256 - N **Sonar Data**
0

If Byte 1 = 'B'
- 500 range bins of 8bit echo data (0min – 499max)

If Byte 1 = 'O'
- 1000 range bins of 8bit echo data (0min – 999max)

If Byte 1 = 'P'
- No echo data

INFORMATION REQUEST PACKET

The sonar heads accept a status request packet format which returns sonar information. The 10 byte Information Request Packet has a header of **0x55** and **0xAA**.

Byte #	Description									
0 – 9	0x55	0xAA	Reserved 0	Reserved 0	Reserved 0	Reserved 0	Reserved 0	Reserved 0	Reserved 0	Reserved 0

RETURN PACKET

Section 1: Header (length = 256 bytes)

Byte	Description	Format
0	' I' - Header byte 0	ASCII
1	' C' - Header byte 1	ASCII
2	' X' - Header byte 2	ASCII
3	Sonar Type *0 = 881L* *1 = 881LGS*	YTE
4-5	Total Bytes This Packet (including Header)	WORD
6	ICX Packet Version *2*	BYTE
10 - 31	Reserved *(22Bytes)*	BYTE
32-35	Status Byte *Bit 0: 1 = internal sensors available* *Bits 1-31: Reserved*	DWORD
36 - 37	Header length *256*	WORD
38 - 39	Byte offset to Device List ***Note**: all byte offsets are referenced to the beginning of the current Ping Header*	WORD
40 - 41	Device List length *768*	WORD
42 - 77	Reserved *(36Bytes)* *0x00*	
78 - 93	Ethernet Firmware Version (16 bytes) *Null Terminated* *i.e. "ITCP 3Ad" plus zero fill*	ASCII
94 - 97	Supported Ethernet Services (*See Below*)	DWORD
98 - 255	Reserved *(160Bytes)*	BYTE

Table 1: Section 1: Ping Header (length = 1024 bytes)

Bytes 94-97 **Supported Services**

Byte 94	Byte 95	Byte 96	Byte 97
LO			HI

Bit	Function
0	DHCP Server Capable
1	DHCP Client Capable
2	PING Capable
3	HTTP Web Server Capable
4	Programmable IP Address Capable
5	Programmable Network Address Capable
6 - 31	*Reserved*

Section 2: Device Lists (length = 768 bytes)

Each connected device contains a 128-byte structure (Device #1 is special for Sonar):

Device #1 – Sonar Head

Byte	Description	Format
0 - 31	Device Name (32 bytes) *Null Terminated* *i.e. "881L Scanning Sonar" plus zero fill*	ASCII
32 - 63	Model Number (32 bytes) *Null Terminated* *i.e. "881LGS-000-420" plus zero fill*	ASCII
64 - 71	Serial Number (8 bytes) *Null Terminated* *i.e. "1234" plus zero fill*	ASCII
72 - 103	Firmware Version (32 bytes) *Null Terminated* *i.e. "D533 1Ab" plus zero fill*	ASCII
104	Transducer Type 'I' = Imager 'P' = Profiler	ASCII
105	Gear Ratio *ex. 3 = 3:1*	BYTE
106 - 107	Minimum Range (mm) *ex. 125 = 12.5cm, 1000 = 1m, 50000 = 50m*	WORD
108 - 109	Maximum Range (m) *100 = 100m*	WORD
110 - 111	Minimum Frequency (kHz) *ex. 280 = 280kHz*	WORD
112 - 113	Nominal Frequency (kHz) *ex. 675 = 675kHz*	WORD
114 - 115	Maximum Frequency (kHz) *ex. 1100 = 1.1MHz*	WORD
116 - 119	Capability (see below)	DWORD
120 - 123	Packet Version Support (see below)	DWORD
124 - 127	Reserved *0x00*	BYTE

Table 1: Device #1 – Sonar (length = 128 bytes)

Device 1 (Sonar Head): *Byte 0 = Byte offset to Device List (Ping Header, Bytes 37-38)*

Bytes 116-119 **Capability**

Byte 116	Byte 117	Byte 118	Byte 119
LO			HI

Bit	Function
0	External Trigger Capable
1	Transmit Output Capable
2 - 31	*Reserved*

Bytes 120-123 **Packet Version Support**

Byte 120	Byte 121	Byte 122	Byte 123
LO			HI

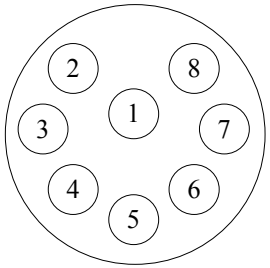
Bit	Function
0	IBX • Header 256Bytes • Data Bits = 8 • Data Points = 500 • N = 756
1	IOX • Header 256Bytes • Data Bits = 8 • Data Points = 1000 • N = 1256
2	IPX • Header 256Bytes • Data Bits = 8 • Data Points = 0 • N = 256
3-31	Reserved

Devices 2 - 6: *Byte 0 = Byte offset to Device List + (Device number-1 * 128)*

Byte	Description	Format
0 - 31	Device Name (16 bytes) *Null Terminated* *i.e. "Gyro" plus zero fill*	ASCII
32 - 63	Model Number (16 bytes) *Null Terminated* *i.e. "ABCD1234" plus zero fill*	ASCII
64 - 79	Serial Number (16 bytes) *Null Terminated* *i.e. "1234" plus zero fill*	ASCII
80 - 95	Firmware Version (32 bytes) *Null Terminated* *i.e. "D535_1Ab" plus zero fill*	ASCII
96 - 127	Reserved *0x00*	BYTE

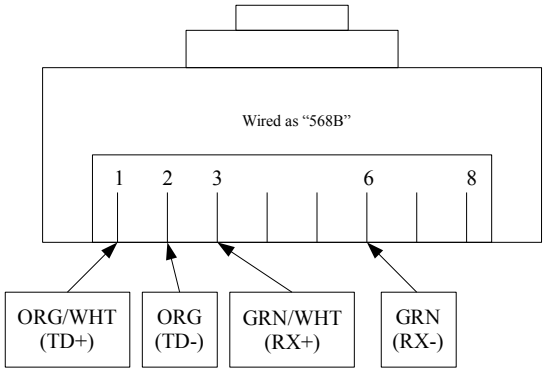
Table 2: Device #2 - 8 (length = 128 bytes)

SUBCONN MCIL8F
(F)

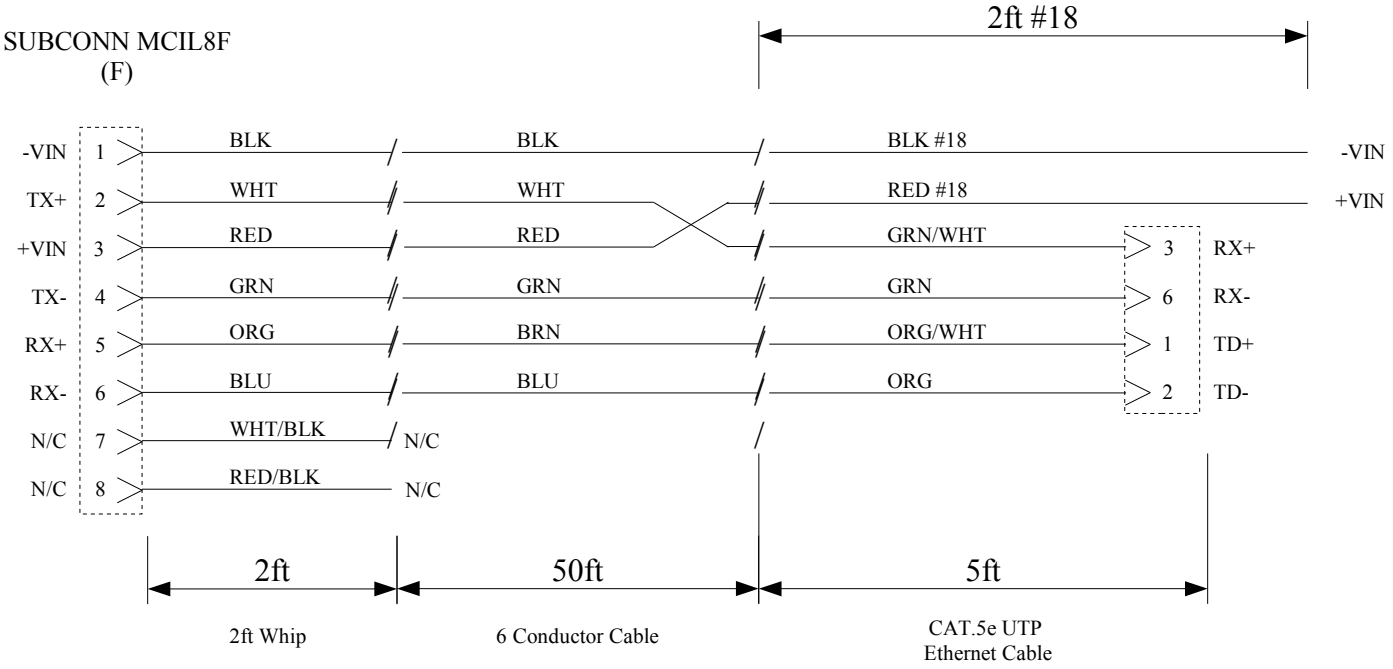


Socket View

RJ-45 Connector



SUBCONN MCIL8F
(F)



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Date: Jan 11, 2006	**Sheet** 1 **of** 1	