Imagenex Technology Corp.

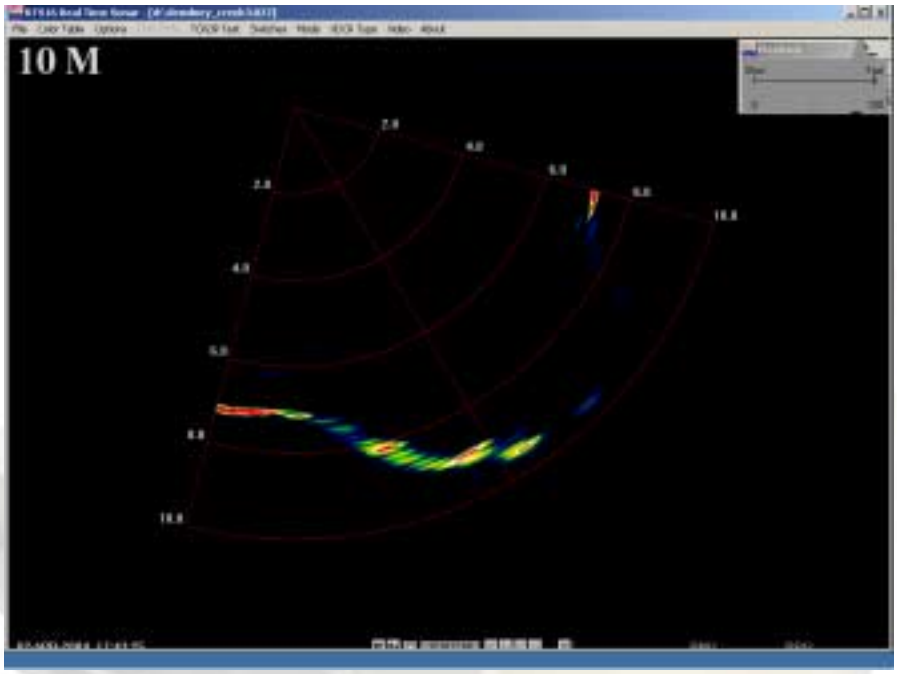
Imagenex technology designs, manufactures and sells sonar systems world wide to the underwater industry. Imagenex was incorporated in 1989. Prior to this, two of the principals of Imagenex were founders of Mesotech Systems Ltd., which was sold to Simrad in 1985. Upon completing a non-competition agreement with Simrad, Imagenex started to produce high definition sonar systems. In 1995 Imagenex introduced the first digital imaging sonar using a standard PC or Laptop computer for control and display of the sonar data. In September 2000 Imagenex introduced the first scanning sonar with digital multi-frequency capabilities providing a frequency range from 300 kHz to 1.2 MHz. In 5kHz increments. Imagenex has recently made a technological break through in Multibeam Technology (patents in process), The first use of this of this new technology is incorporated in the Model 837.

The Imagenex Model Delta T is a multiple receiver sonar system designed to provide video-like imaging with all the advantages of underwater sonar. Innovative digital signal processing is used to optimise data usage from all channels to achieve the best possible resolution at every point in the field of view. Recent advances in computing power have made it possible to transfer and process this data at resolutions equal to computer monitor resolution, and with image frame rates of better than 20 frames per second!

The Model Delta T system has been designed from the ground up with the most advanced, high accuracy, low power electronic components available to provide breakthroughs in system power consumption, package size, and price. This advanced electronics package has built in flexibility and programmability to accommodate a wide range of transducer arrays. Thus, the Model 837 is the first in a family of new technology products which will have imaging and profiling capabilities to suit your underwater application.

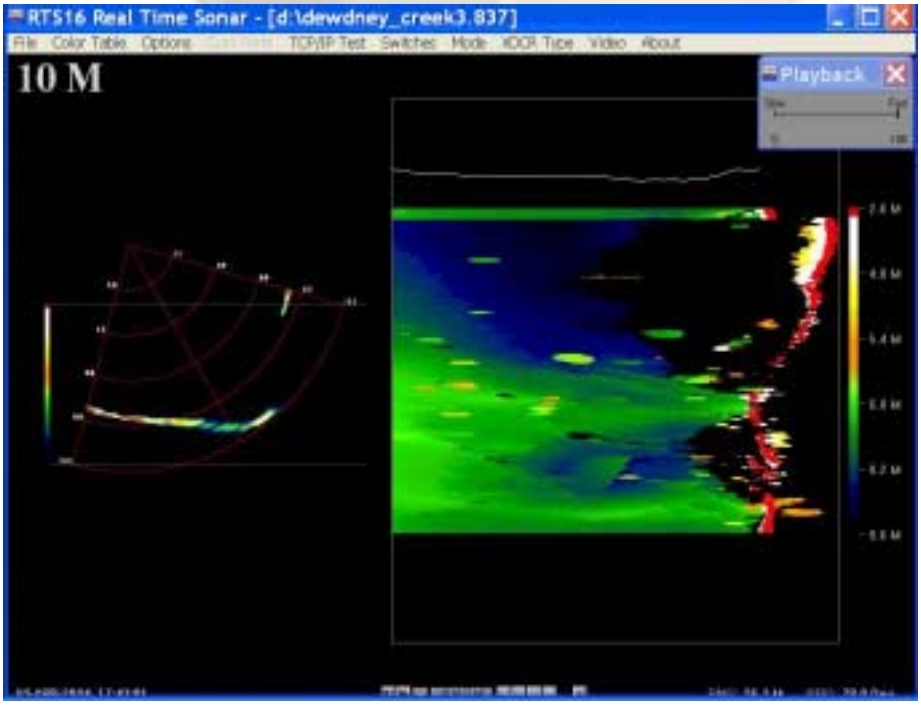
A range of new applications are now realities because of small size and low power requirements of the Delta T. The original design of the Delta T was to replace mechanical scanning sonar systems preasently installed on ROV's. The Delta T is well sutited for harbour security sea bed mapping and auv applications.

Imagenex Model Delta T electronic multi-beam examples
Bottom profile images



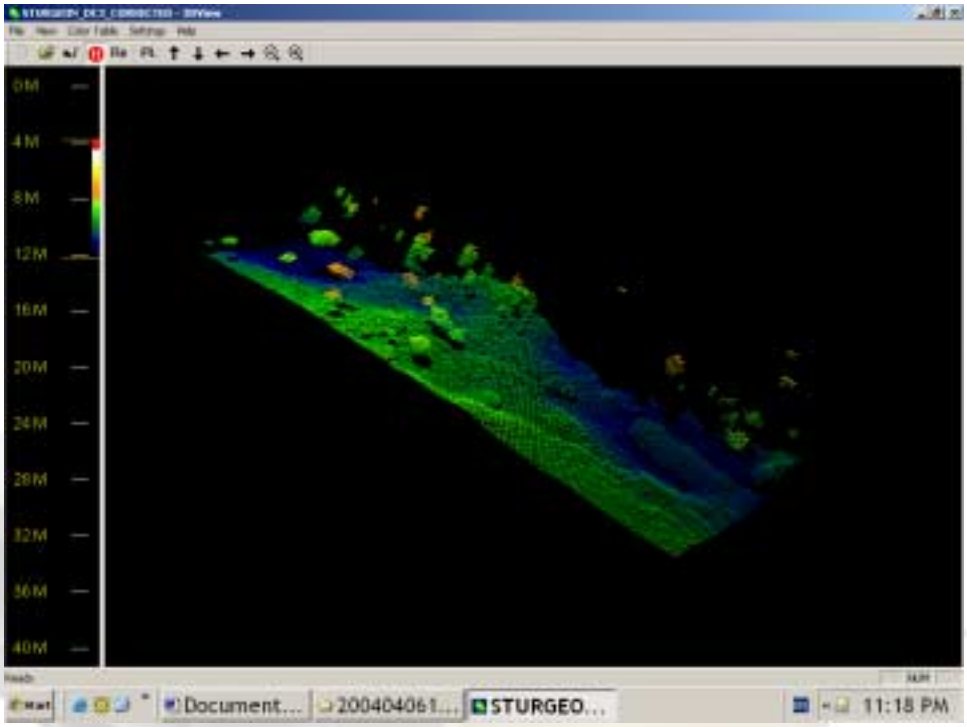
\

The above screen capture shows profile of Fraser river done April 2/04 2-3 miles north of Mission BC

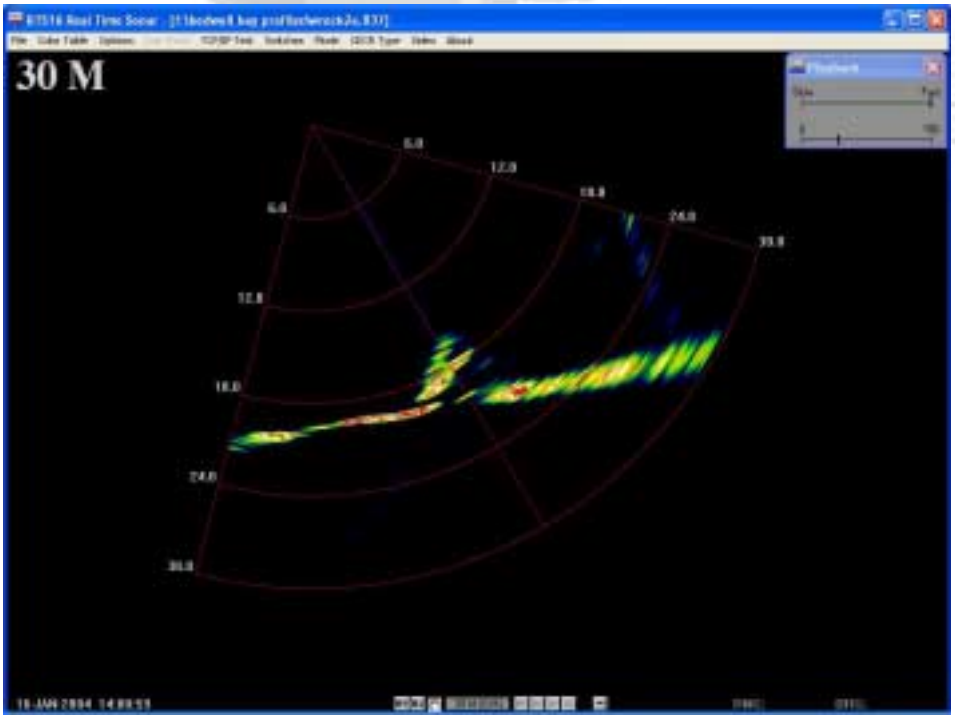


The above screen capture is mosaic of the profile showing detail of the river bottom, objects in the water column are Sturgeon

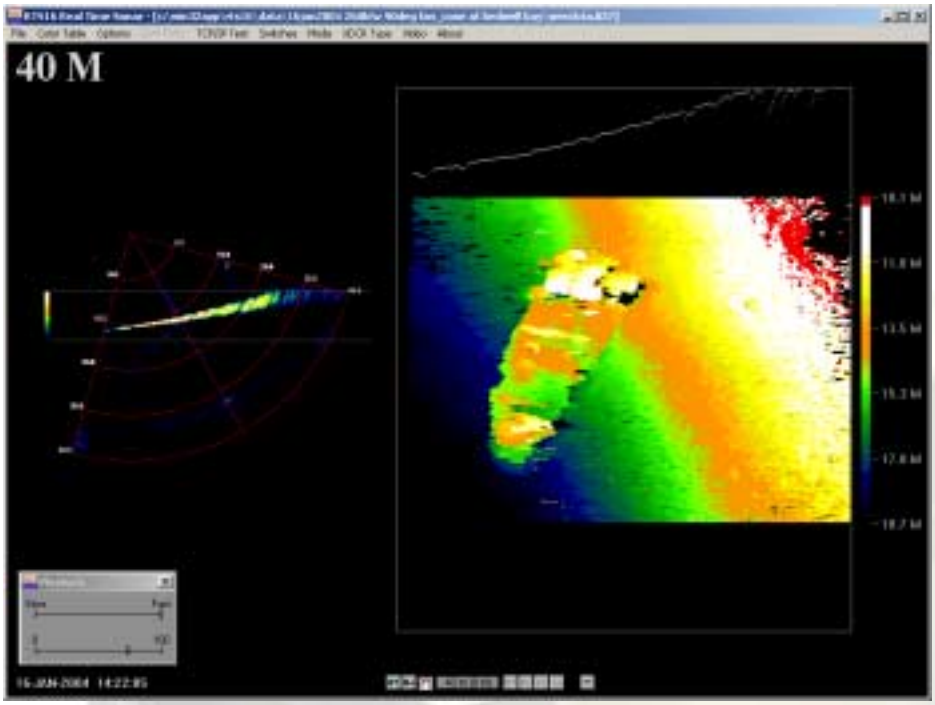
Imagenex Model Delta T electronic multi-beam examples
Bottom profile images



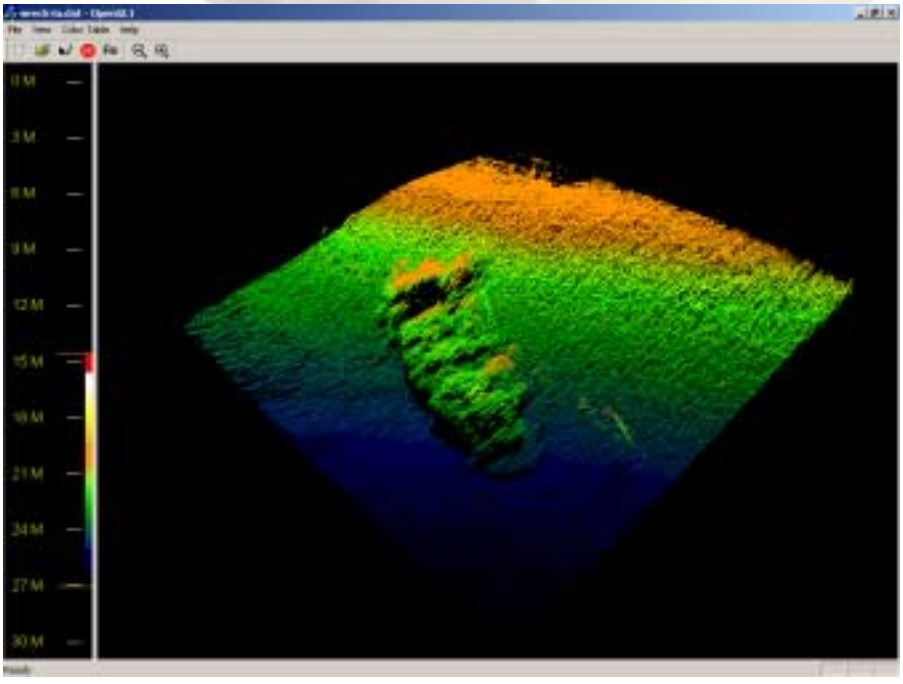
The above screen capture is a 3-D view of the river bottom showing contours and sturgeon. The sonar data in the mosaic image and the 3-D image is raw data no point s have been removed or added.



The above screen shows a bottom profile of a shipwreck located in Bedwell Bay



The above screen capture is mosaic of the profile showing detail of the seabed and ship wreck



3 D view of the shipwreck and sea floor

Imagenex Model 837b – Ethernet Multibeam Sonar Basic Configuration

ATEN UC-232A RS-232 <--> USB Converter
(Required if no built in serial port available)

Please refer to Document Number 410-013
"*USB Converters and the Windows OS*" for important information on USB <--> RS232 and USB <--> RS485 Converters running on Windows operating systems.

To USB Port

To RS232 Port on GPS Device

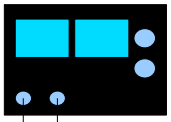
PC Running
DeltaT.exe

IP Address:
192.168.0.4

NOTE:
PC IP addresses
can not be 192.168.0.2

CAT 5e. Straight
Ethernet

24Vdc @ 1A



+24Vdc

COM

Optional GPS

Supported **NMEA**
GPS Strings :
- •RMC
- •GGL
- •GGA
- •VTG

4800, 8,N,1

* 6 Conductor Cable
Carrying Power and
Ethernet Signals

IP Address:
192.168.0.2

Maximum Depth = 3000m (9800')
Maximum Cable Length = 100m (320')*

* Maximum specified length of Ethernet cable is 100m (320').
for requirements greater than 100m, contact Imagenex.

DeltaT.exe is supported on:
Windows™ XP, Vista*

* Some known issues. Contact Imagenex.

Imagenex Model 837b – Ethernet Multibeam Sonar Processing Configuration

NOTE:
PC IP addresses
can not be 192.168.0.2

ATEN UC-232A RS-232 <--> USB Converter
(Required if no built in serial port available)

Please refer to Document Number 410-013
"*USB Converters and the Windows OS*" for important information on USB <--> RS232 and USB <--> RS485 Converters running on Windows operating systems.

To USB Port

To RS232 Port on GPS Device

PC Running
DeltaT.exe

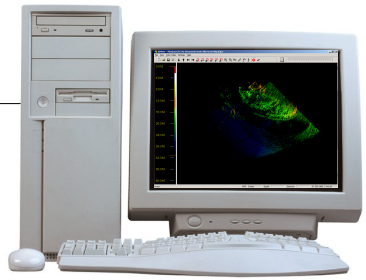
IP Address:
192.168.0.4

Ethernet Switch

CAT 5e. Straight
Ethernet (TCP / UDP)

CAT 5e. Straight
Ethernet (UDP)

PC Running
3DView.exe



IP Address:
192.168.0.5

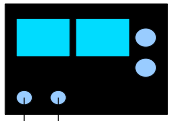
GPS

Supported **NMEA**
GPS Strings :
- •RMC
- •GGL
- •GGA
- •VTG

4800, 8,N,1

CAT 5e. Straight

24Vdc @ 1A



+24Vdc

COM

IP Address
192.168.0.2

* 6 Conductor Cable
Carrying Power and
Ethernet Signals

Maximum Depth = 3000m (9800')
Maximum Cable Length = 100m (320')*

* Maximum specified length of Ethernet cable is 100m (320').
for requirements greater than 100m, contact Imagenex.

DeltaT.exe and 3DView.exe are supported on:
Windows™ XP, Vista*

* Some known issues. Contact Imagenex.

410-018 rev00
Sept 25, 2007

Imagenex DeltaT – External Sensor Configuration

Sound Velocity at Transducer

Digibar Pro

Supported Format:
- •AML

Default: 19.2kbps, 8,N,1

Valeport

Supported Format:
- •AML

<= 115200bps, 8,N,1

Seabird SBE 37-SI

Supported Format:
- •V3

Default: 19.2kbps, 8,N,1

RS232 **

Orientation Sensors

TSS
Pitch / Roll / Heave

Supported Format:
- •TSS1

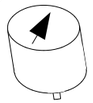
Default: 38.4kbps, 8,N,1

OCTANS
Pitch / Roll / Heave / Heading

Supported Format:
- •STD1

Default: 115.2kbps, 8,N,1

Imagenex Orientation Module
Pitch / Roll / Heading



Default: 38.4kbps, 8,N,1

RS232 **

Global Positioning System

GPS with RS232 Output

Supported **NMEA** Strings :
- •RMC
- •GLL
- •GGA
- •VTG
- •ZDA
- •HDT

Default: 4800bps, 8,N,1

Optional
HYPACK 1PPS Box
(for time Synchronization)

RS232 **

Note:

A dual antenna GPS such as the Hemisphere v101 or v111 must be used for NMEA HDT (Heading – True) to be valid

Note:

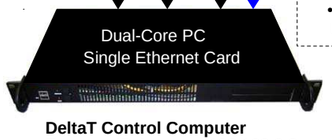
- If HYPACK 1PPS Box is required, a USB to RS232 converter is not advisable due to USB packet latency issues.
- If HYPACK 1PPS Box is **NOT** required, a USB to RS232 converter is acceptable.

CAT 5e. (Straight)

External Control Format From Survey Computer
- •EC – External Control Command using UDP/IP or optional TCP/IP

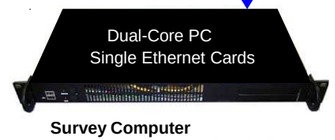
CAT 5e. (Straight)

Output Data Formats From DeltaT Control Computer
- •.83P – Profile Points with Intensities.
- •.83B – 120 Processed Beam Output.
- •.83A – Azimuth Drive XYZ Output (Azimuth Drive models only)



DeltaT Control Computer
Example IP Address: 192.168.0.3

Ethernet Switch
(Not a Hub)



Survey Computer
Example IP Address: 192.168.0.4

CAT 5e. (Straight)

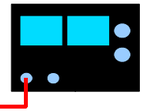
Model 837B Shown
(Optional Internal Pitch, Roll, Heading sensor available)

Standard IP Address: 192.168.0.2
Customizable upon order.

* Optional
External Trigger 2-wire Input

* 6 Conductor Cable
Carrying Power and
Ethernet Signals

24Vdc @ 1A Max



+24Vdc

Serial Interface Options

**

ATEN UC-232A RS-232 <--> USB Converter
(Required if no built in serial port available)

OR

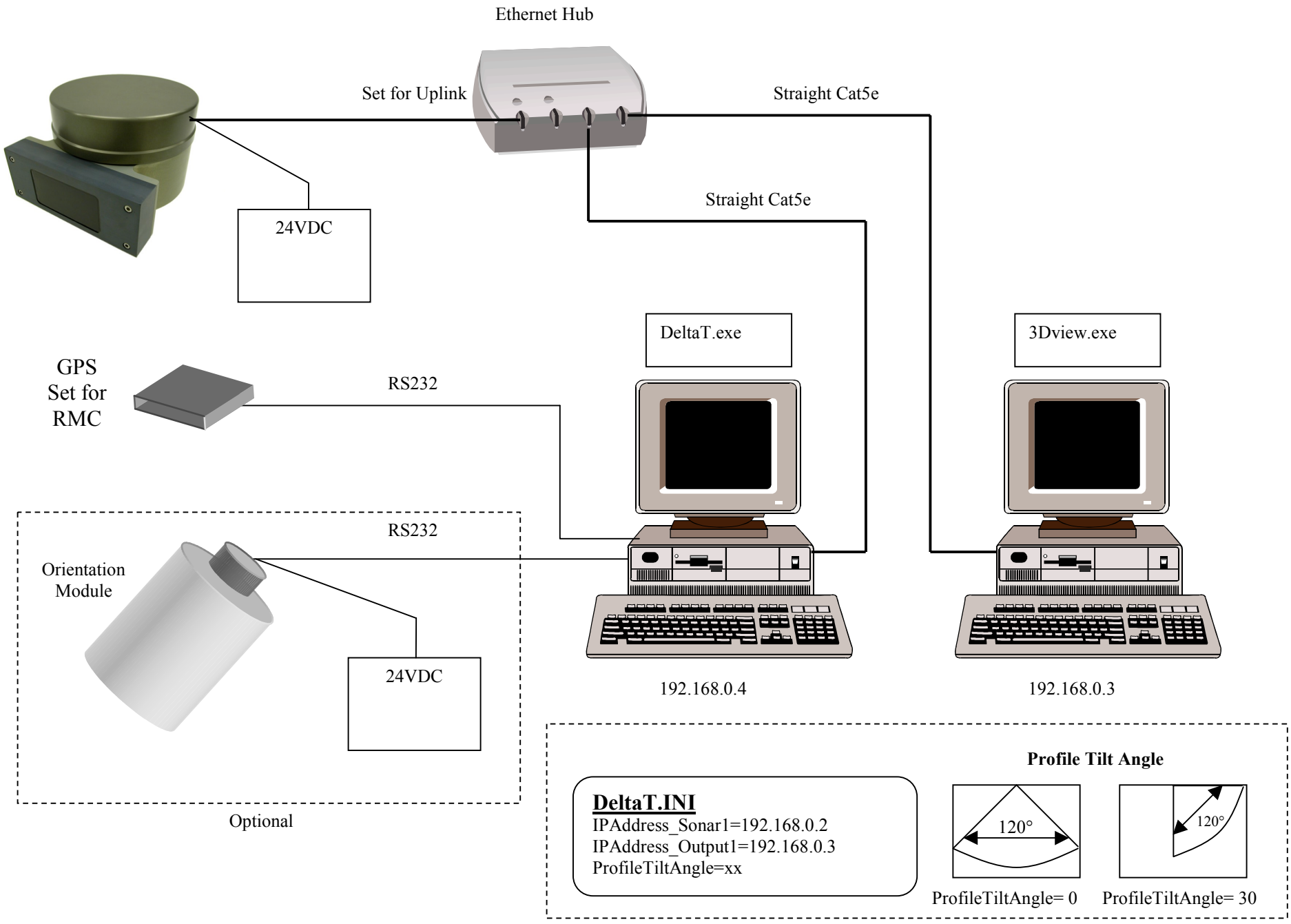
QUATECH QSP-100 (or similar) **PCMCIA RS-232**
(Required if no built in serial port available)

Please refer to Document Number 410-013
"*USB Converters and the Windows OS*" for important information on USB <--> RS232 and USB <--> RS485 Converters running on Windows operating systems.

DeltaT.exe and 3DView.exe are supported on:
Windows™ XP, Vista*
* Some known issues. Contact Imagenex.

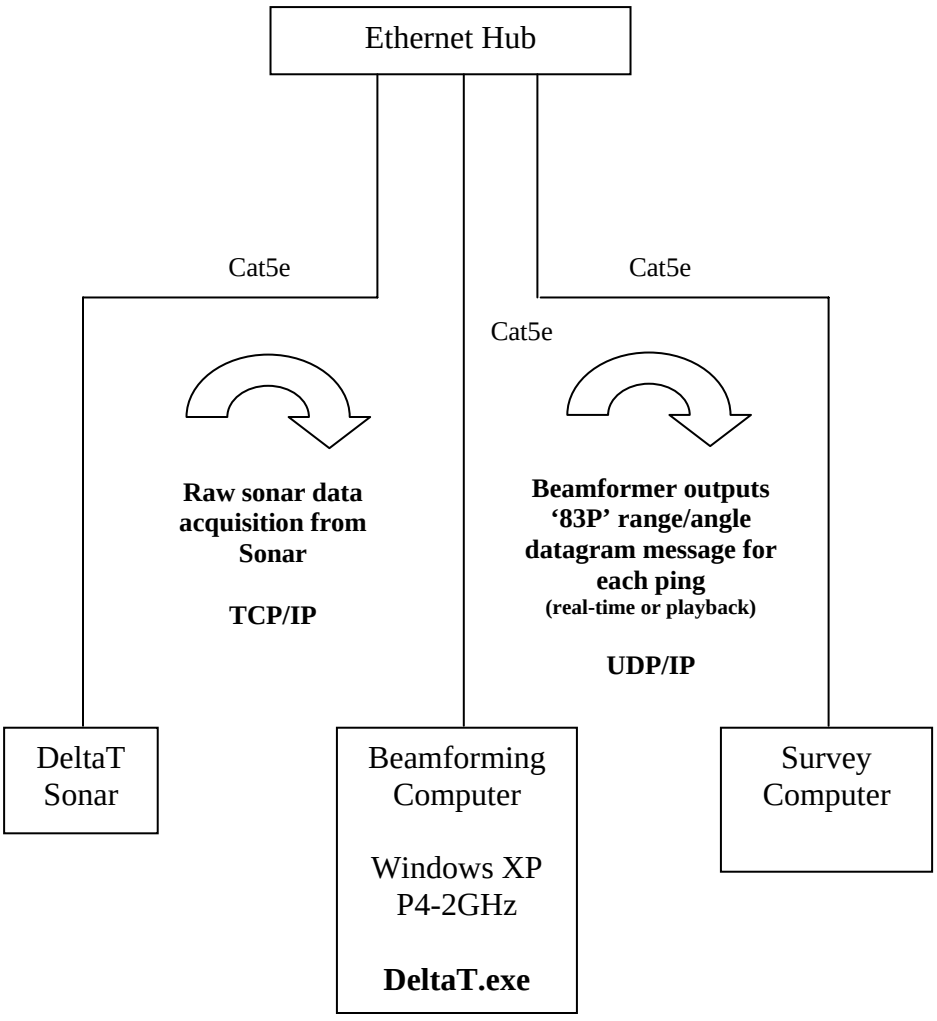
* Maximum specified length of Ethernet cable is 100m (328').
for requirements greater than 100m, contact Imagenex.

Real Time 3D Processing using the Imagenex DeltaT



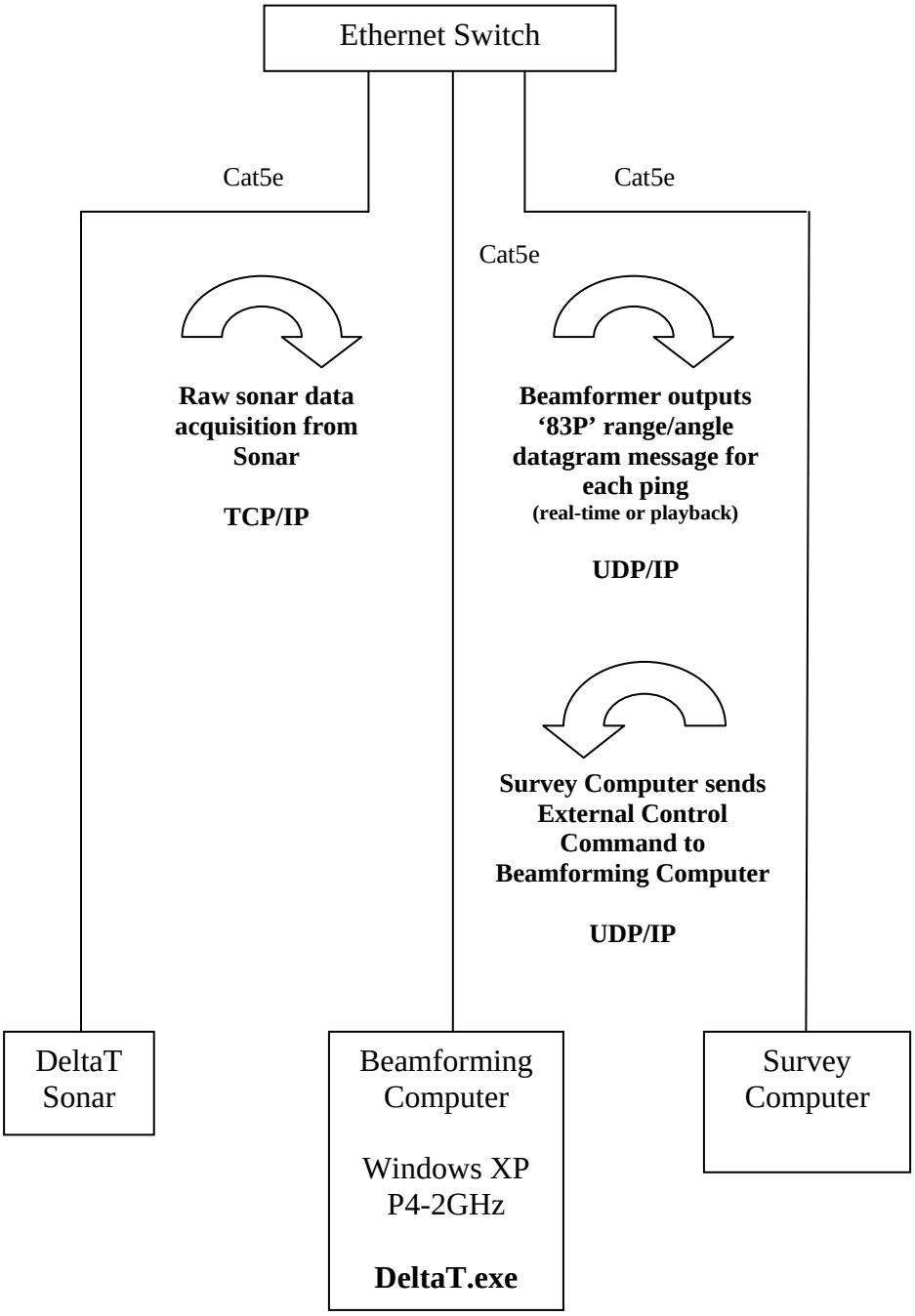
DeltaT 83P Output To Survey Computer

83P Profile Point Output via UDP/IP



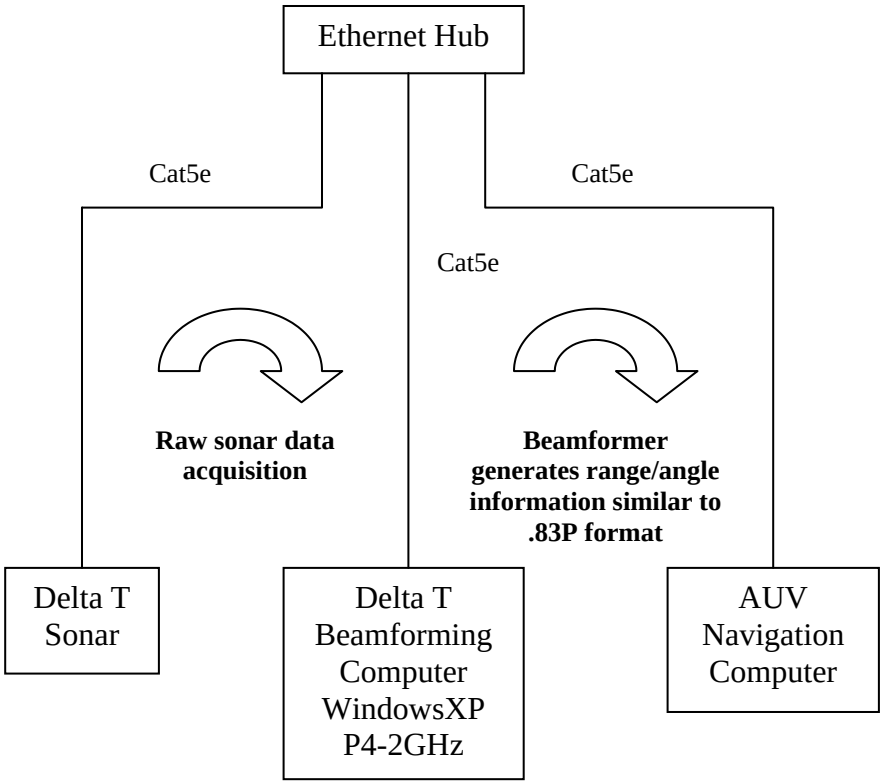
DeltaT 83P Output and External Control

83P Profile Point Output via UDP/IP



Delta T for Real Time AUV Navigation

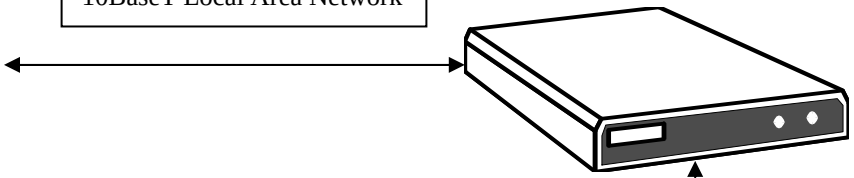
Real Time Output



Overview of the Imagenex DeltaT Sonar Real Time Operation in an Autonomous Underwater Vehicle (AUV) Application

Imagenex DeltaT Sonar waits for command, transmits, and sends Ethernet data back to computer.

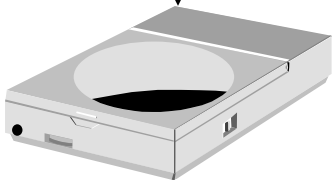
10BaseT Local Area Network



The Hub, switch or Router, forwards the Ethernet data to/from the sonar/computer.

The Embedded Computer, containing Imagenex Source code, controls the DeltaT settings, such as Range, and stores the .837 file to a local hard drive at a rate of ~5 MB per minute.
Minimum Requirements:
- Windows XP
- Pentium 300 MHz
- 128 MB RAM
- 20 GB Hard Disk

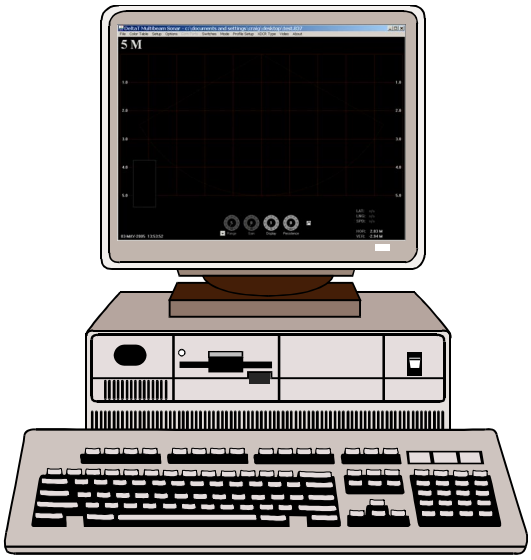
Recording Time	Resulting File Size
1Minute	5 MB
5 Minutes	25 MB
1 Hour	300 MB
5 Hours	1.5 GB



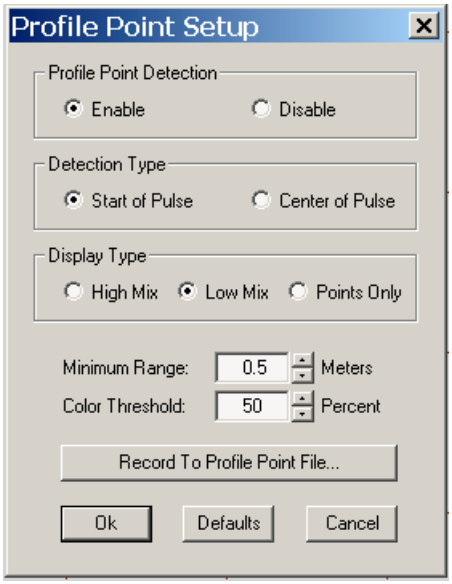
Hard Drive where the .837 file is stored.

Created on 05/03/05
Updated on 04/21/06

Overview of the Imagenex DeltaT Sonar Post Processing Preparation from File Play Back



The computer containing the Imagenex DeltaT.exe program reads the .837 file and displays the recorded data. From the .837 file, post processing may be performed.



Open the desired .837 file from the "File" Menu

↓

On the "Mode" Menu, select "Profile"

↓

On the "Profile Setup" Menu, select "Profile Point Setup"

↓

Select "Enable", and click "Record to Profile Point File". Enter the target file name and accept all changes

↓

When done, Re-enter the Profile Setup, and select "Close Profile Point File" to end recording.

↓

The newly created .83p file is now available for post processing, and can be viewed on the Imagenex 3-D view software.

Created on May 05, 2005
Updated on May 18, 2005

DeltaT - Profile Point Filter Description

Profile Point detection is the process of searching (in time) through each beam to determine the range value to output via the 83P or 83M datagrams. The detected range is valid if it lies between the minimum and maximum range or depth settings.

First Return

The First Return filter is mainly used for detecting targets in the water column. The detected range value for each beam is the first return (in time) which has an amplitude larger than an internal software threshold.

Maximum Return

The Maximum Return filter is used for detecting targets on or near the bottom without detecting too many targets in the water column. The detected range value for each beam is the return which contains the largest amplitude above an internal software threshold. Beams containing no range value are filled in based on the detected range values in adjacent beams.

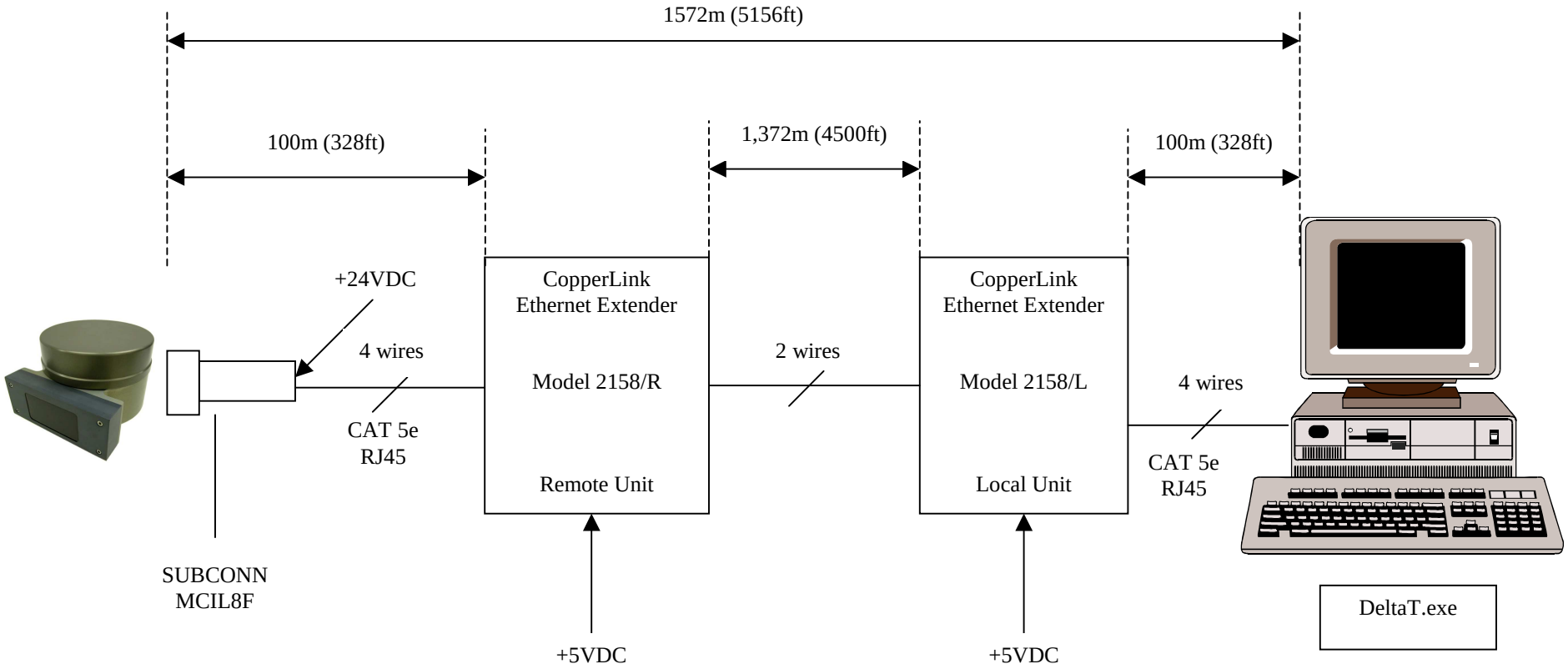
Bottom Following

The Bottom Following filter is used for detecting and smoothing bottom features while discarding targets in the water column. Across-track information from previous pings is used for determining the bottom trend. Beams containing no range value are filled in based on the detected range values in adjacent beams.

PipeLine

The PipeLine filter is used for detecting pipes in a highly reflective, complex acoustic environment. A number of pings are combined to build up a solid image of the pipe. Sudden vertical or lateral movements can adversely affect the detected pipe image. Beams containing no range value are filled in based on the detected range values in adjacent beams.

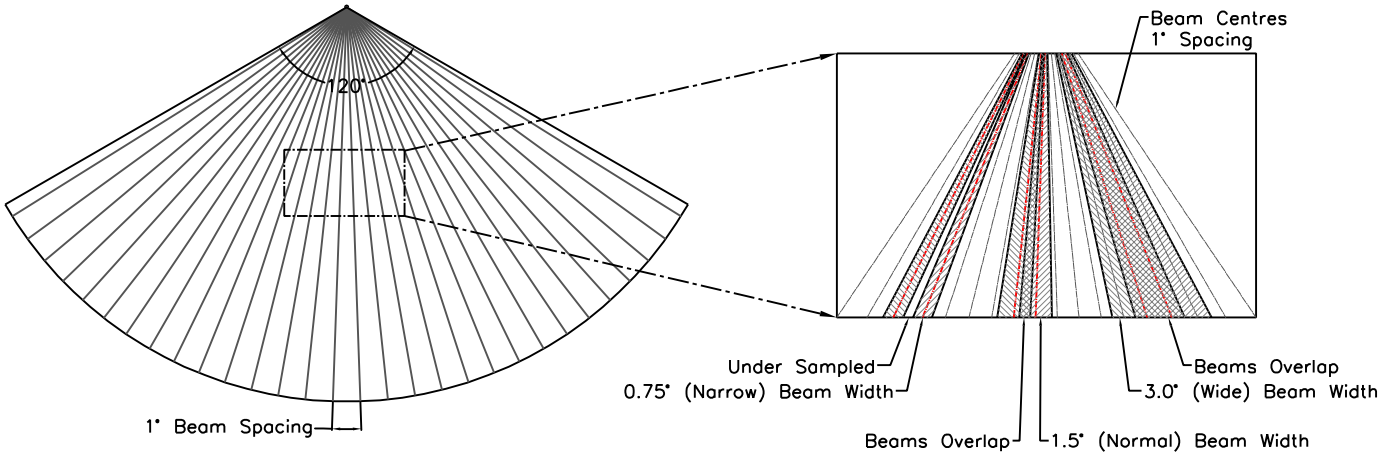
Model 837 DeltaT Sonar to Patton “CopperLink” Ethernet Extender Block Diagram



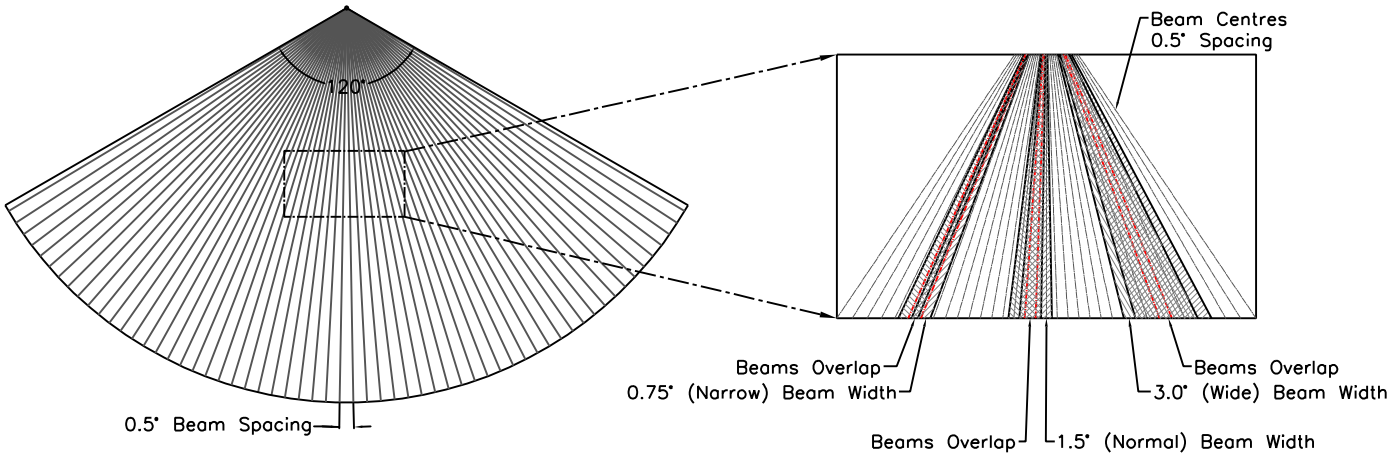
Note: Refer to wiring diagrams for pin outs

ZONE	REV.	DESCRIPTION	DATE	SIG.
ALL	NEW	NEW DRAWING CREATED	14/02/12	DC

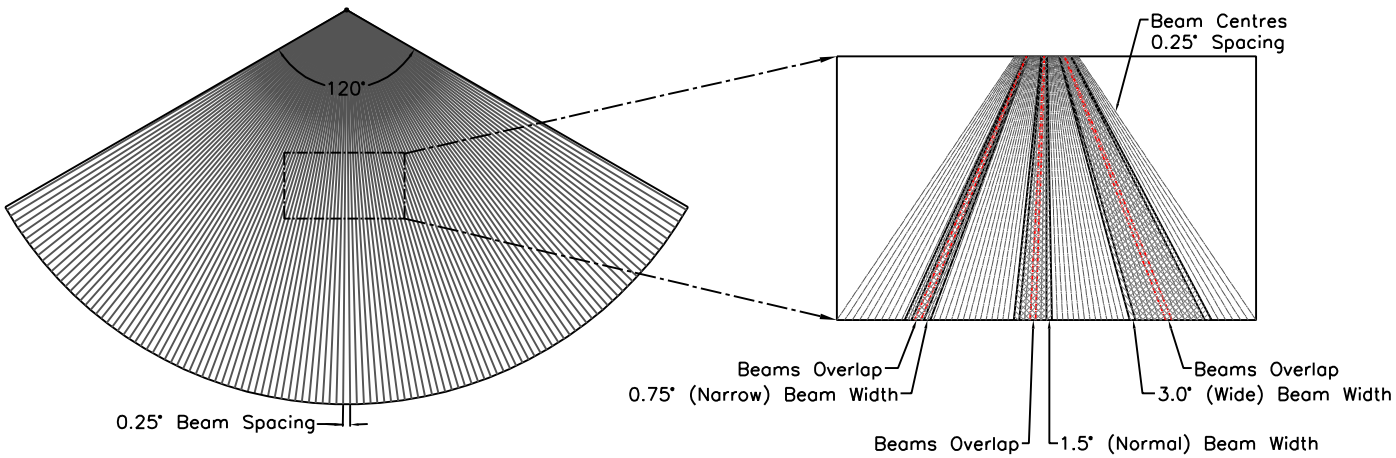
120 Beams



240 Beams



480 Beams



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

DELTA T – BEAM SPACING VS. BEAM WIDTH SETTINGS

SIZE	FSCM NO	DWG NO	REV
A	XXX	400-053	NEW

DESIGN BY: DC	DATE: 14FEB12	SHEET 1 OF 1

MODEL 837 DeltaT MULTIBEAM SONAR HEAD

ETHERNET INTERFACE SPECIFICATION (v1.04)

OVERVIEW

The Model 837 DeltaT Sonar Head communicates over an Ethernet communications link. To interrogate the head and receive echo data, a command program sends a Switch Data Command string to the sonar head. When the Switch Data command is accepted, the sonar head transmits, receives and sends one packet of echo data back to the command program. The command program must interrogate the sonar head multiple times in order to receive all packets of echo data before the data can be processed.

Unless otherwise specified, the DeltaT sonar head will have a statically assigned IP Address of **192.168.0.2** .

SWITCH DATA COMMAND

The 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 termination byte (**0xFD** HEX) must also be present for the head to process the switches.

Byte #	Description							
0 – 7	**0xFE**	**0x44**	Head ID	Range	Reserved 0	Nadir HI	Nadir LO	Reserved 0
8 – 15	Start Gain	Reserved 1	Absorp.	AGC Threshold	Reserved 0	Packet Number	Pulse Length	Reserved 0
16 – 23	External Trigger	Ext Trig. Delay HI	Ext Trig. Delay LO	Data Points	Data Bits	PRH Cmd	Run Mode	Reserved 0
24 – 26	Switch Delay	Freq-uency	Term. **0xFD**					

Table 1 Model 837 Switch Data Command To Sonar Head

SWITCH DATA COMMAND (con't)

BYTE DESCRIPTIONS

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

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

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

Byte 2 **Head ID**
0x10

Byte 3 **Range**
5 = 5m
10 = 10m
20 = 20m
30 = 30m
40 = 40m
50 = 50m
60 = 60m
80 = 80m
100 = 100m
150 = 150m (120kHz Heads Only)
200 = 200m (120kHz Heads Only)
201 = 250m (120kHz Heads Only)
202 = 300m (120kHz Heads Only)

Byte 4 **Reserved for Internal Use**
Always 0

SWITCH DATA COMMAND (con't)

Byte 5 - 6 **Nadir Offset Angle**
When using Automatic Gain Control (Byte 22, Bit 4), the sonar head must know if there is a physical mounting offset and/or a roll angle present.

Angle = Mounting angle + current roll angle, (in degrees)

If XDCR = Down, Angle = -(Angle)
Note: XDCR = Down if 837B connector is pointing aft

Nadir Offset Angle = [Angle / 360.0] * 65536
If (Angle < 0.0) Nadir Offset Angle |= 0x8000

Byte 5 = (Nadir Offset Angle & 0xFF00) >> 8
Byte 6 = Nadir Offset Angle & 0x00FF

Byte 5								**Byte 6**							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Nadir Offset Angle															

Byte 7 **Reserved for Internal Use**
Always 0

Byte 8 **Start Gain**
0 to 20dB in 1dB increments

Byte 9 **Reserved for Internal Use**
Always 1

Byte 10 **Absorption**
0 to 255 = 0.00dB/m to 2.55dB/m
Byte 10 = absorption_in_dB_per_m * 100

120kHz: Byte 10 = 0.03dB/m * 100 = 3
260kHz: Byte 10 = 0.10dB/m * 100 = 10
675kHz: Byte 10 = 0.20dB/m * 100 = 20
1.7MHz: Byte 10 = 1.70dB/m * 100 = 170

SWITCH DATA COMMAND (con't)

Byte 11 **AGC Threshold**
10 to 250
When using Automatic Gain Control (Byte 22, Bit 4), this number is used as a set point for adjusting the internal hardware gain. For strong bottom returns, use a low threshold value. For weak bottom returns, use a high threshold value. A value of 120 is a typical threshold value for a sandy bottom.

Byte 12 **Reserved**
Always 0

Byte 13 **Packet Number Request**
0 to 7 – for 8000 data point mode (IUX mode)
0 to 15 – for 16000 data point mode (IVX mode)

When the packet number request is 0, the sonar head will transmit, receive and send the first 1000 bytes of echo data (the '0' packet). The packet number request should then be incremented so that the sonar head will return the next 1000 bytes of echo data (the '1' packet). The sonar head does not transmit or receive if the packet number request is greater than 0. The packet number request should be incremented each time until the total number of echo data bytes have been returned. The packet number request should always follow the 0 to 7 (or 0 to 15) sequence.

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

The following pulse lengths are recommended for each range:

5m: 30µs
10m: 60µs
20m: 120µs
30m: 180µs
40m: 240µs
50m: 300µs
60m: 360µs
80m: 480µs
100m: 600µs
150m: 900µs
200m: 1200µs
250m: 1500µs
300m: 1800µs

Byte 15 **Reserved**
Always 0

Note:

The following External Trigger Control bytes are valid only for DeltaT 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

Byte 17 - 18 **External Trigger Transmit Delay**
Delay from external trigger to sonar head transmit pulse

Byte 17								Byte 18							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
0 to 10000 (in 100 µsec increments)															

SWITCH DATA COMMAND (con't)

Byte 19 **Data Points**

8 - 8000 data points are returned by the head
The return data will have an ASCII '**IUX**' header.

16 - 16000 data points are returned by the head
The return data will have an ASCII '**IVX**' header.

Byte 20 **Data Bits**

Resolution (number of data bits) of the returned echo data

8 - Data width = 8 Bits, 1 data point per byte

Byte 21 **PRH Command**

Optionally installed Internal Pitch / Roll / Heading Sensor

0x00 – No PRH sensor installed (no PRH sensor interrogation)
0x02 – Start compass calibration
0x03 – Stop compass calibration
0x04 – Start Pitch / Roll calibration
0x05 – Stop Pitch / Roll calibration
0x80 – Output gyro stabilized Euler angles

Byte 22 **Run Mode**

Byte 22							
7	6	5	4	3	2	1	0
0	0	0	1=Auto Gain	0	0	1=TVG Disable	1=Xmit Disable

Bit 0 – **Xmit Disable**, set to 1 to disable the transmitter
Bit 1 – **TVG Disable**, set to 1 to disable Time Varied Gain amplification
Bit 2 – Reserved for Internal Use
Bit 3 – Reserved for Internal Use
Bit 4 – **Auto Gain**, set to 1 to enable Automatic Gain Control. If the sonar head transducer is pointing at an angle other than straight down, the mounting angle and/or the roll angle must be loaded into **Nadir Offset Angle** (see description for Bytes 5-6). An AGC Threshold value must also be loaded into Byte 11.
Bit 5 – Reserved for Internal Use
Bit 6 – Reserved for Internal Use
Bit 7 – Reserved for Internal Use

SWITCH DATA COMMAND (con't)

Byte 23 **Reserved for Internal Use**
Always 0

Byte 24 **Switch Delay**
The 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**
58 = 120kHz
86 = 260kHz
169 = 675kHz
68 = 1.7MHz

Byte 26 **Termination Byte**
Always **0xFD** (253 decimal)

SONAR RETURN DATA

For every Switch Data Command, the head returns a 32 Byte header, 1000 bytes of echo data and a terminating byte value of 0xFC. The **total number of bytes** (**N**) returned will be 1033. For **IUX** data, a total of 8 Switch Data Commands are required to receive the full 8000 data points from the sonar head. For **IVX** or data, a total of 16 Switch Data Commands are required to receive the full 16000 data points from the sonar head.

Byte #	**Description**					
0 - 5	ASCII 'I'	ASCII 'U' or 'V'	ASCII 'X'	Head ID	Serial Status	Packet Number
6 - 11	Firmware Version	Range	Internal Use Only	Internal Use Only	Data Bytes (HI)	Data Bytes (LO)
12 - 16	Ext Trig. Status	PRH Status	Pitch (LO)	Pitch (HI)	Roll (LO)	
17 - 21	Roll (HI)	Heading (LO)	Heading (HI)	TimeTick (LO)	TimeTick (HI)	
22 - 26	Run Mode	Reserved 0	Gain	AGC Rng (HI)	AGC Rng (LO)	
27 - 31	AGC Val (HI)	AGC Val (LO)	Reserved 0	Reserved 0	Reserved 0	
32 – 1031	Echo Data 1000 Bytes					
1032	Term. **0xFC**					

Table 2 Model 837 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 '**IUX**' or '**IVX**'
'I' = 0x49, 'U' = 0x55', 'V' = 0x56, 'X' = 0x58

ASCII '**IUX**'
In response to a Switch Data Command with Data Points = 8
N = 1033, (32 Header bytes, 1000 Data bytes, 1 Terminating byte)
8 Switch Data Commands are required with Packet Number Request incrementing from 0 to 7 in order to receive all 8000 data bytes from the sonar head.

SONAR RETURN DATA (con't)

ASCII '**IVX**'
In response to a Switch Data Command with Data Points = 16
N = 1033, (32 Header bytes, 1000 Data bytes, 1 Terminating byte)
16 Switch Data Commands are required with Packet Number Request incrementing from 0 to 15 to receive all 16000 data bytes from the sonar.

Byte 3 **Head ID**
0x10

Byte 4 **Serial Status**
Bit 0 - 0 = OK, 1 = Switch Setting error
Bit 1 - 0
Bit 2 - 0 = OK, 1 = Internal PRH Sensor Timeout
Bit 3 - 0
Bit 4 - 0
Bit 5 - 0
Bit 6 - 1 = Switches Accepted
Bit 7 - 1 = Character Overrun

Byte 5 **Packet Number**
0-7 for 'IUX' data
0-15 for 'IVX' data

Byte 6 **Firmware Version**

Byte 6							
7	6	5	4	3	2	1	0
Reserved For Internal Use				Firmware Version			

0 – 12 Header bytes, 8000 Data bytes, 1 Terminating byte
1 – 32 Header bytes, 1000 Data bytes, 1 Terminating byte
using Packet Numbers 0 through 7
2 – not used
3 – not used
4 – same as type "1" but adds Overlapped I/O support
5 – same as type "4" but adds Automatic Gain Control (AGC) support

SONAR RETURN DATA (con't)

Byte 7 **Range**

5 = 5m
10 = 10m
20 = 20m
30 = 30m
40 = 40m
50 = 50m
60 = 60m
80 = 80m
100 = 100m
150 = 150m
200 = 200m
201 = 250m
202 = 300m

Byte 8 - 9 **For Internal Use Only**

Byte 10 - 11 **Data Bytes**

Number of Echo Data Bytes returned for current packet

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

Data Bytes = (Byte 10 << 8) | Byte 11

Byte 12 **External Trigger Status**

Bit 0 - 0 = External Trigger Not Supported
1 = External Trigger Supported
Bit 1 - 0 = External Trigger is configured as an Output
1 = External Trigger is configured as an Input
Bit 2 - 0
Bit 3 - 0
Bit 4 - 0
Bit 5 - 0
Bit 6 - 0
Bit 7 - 0 = xmit occurred after 2 second timeout (no trigger found)
1 = xmit occurred after trigger (trigger found)

SONAR RETURN DATA (con't)

Note: If PRH Command (Switch Data Command Byte 21) = 0x80, the following bytes (13 – 21, Packet 0 only) will contain information from the optionally installed Pitch / Roll / Heading Sensor:

Byte 13 Packet 0:
Internal Pitch / Roll / Heading Sensor Status

0 = No sensor installed
1 = PRH Sensor Installed (837A)
2 = PRH Sensor Installed (837B, signs are reversed)
3 = Reserved
4 = Reserved
5 = PRH Sensor Installed (837)
6 = Reserved

Byte 14 - 15 Packet 0:
Pitch

Byte 14								**Byte 15**							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Pitch (LO)								**Pitch (HI)**							

if Byte 15 - Bit 7 = 0:
Pitch = [((Byte 15 << 8) | Byte 14)] * 360/65536 in degrees

if Byte 15 - Bit 7 = 1:
Pitch = [((Byte 15 << 8) | Byte 14)-65536] * 360/65536 in degrees

Byte 16 - 17 Packet 0:
Roll

Byte 16								**Byte 17**							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Roll (LO)								**Roll (HI)**							

if Byte 17 - Bit 7 = 0:
Roll = [((Byte 17 << 8) | Byte 16)] * 360/65536 in degrees

if Byte 17 - Bit 7 = 1:
Roll = [((Byte 17 << 8) | Byte 16)-65536] * 360/65536 in degrees

SONAR RETURN DATA (con't)

Byte 18 - 19 Packet 0:
Heading

Byte 18								Byte 19							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Heading (LO)								Heading (HI)							

if Byte 19 - Bit 7 = 0:
Heading = [((Byte 19 << 8) | Byte 18)] * 360/65536 in degrees

if Byte 19 - Bit 7 = 1:
Heading = [((Byte 19 << 8) | Byte 18)-65536] * 360/65536 in degrees

Add 180 degrees for heading angles of 0 to 359 (clockwise)

Byte 20 - 21 Packet 0:
Timer Ticks

Byte 20								Byte 21							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Timer Ticks (LO)								Timer Ticks (HI)							

16-Bit counter (default is 6.5536ms per tick)
Timer Ticks = (Byte 21 << 8) | Byte 20

Byte 22 Packet 0:
Run Mode
Echo of Switch Data Command Byte 22 (down)

Byte 23 Packet 0:
Reserved for Internal Use

Byte 24 Packet 0:
Gain
If AGC is OFF: Echo of Switch Data Command Byte 8 (down)
If AGC is ON: Current Gain value of sonar head

SONAR RETURN DATA (con't)

Byte 25 - 26 Packet 0:
AGC Range Bin
0 – 499

Byte 25								Byte 26							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
AGC Range Bin (HI)								**AGC Range Bin (LO)**							

Byte 27 - 28 Packet 0:
AGC Maximum Value

Byte 27								Byte 28							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
AGC Maximum Value (HI)								**AGC Maximum Value (LO)**							

Bytes 29 - 31 Packet 0:
Reserved
Always 0

Bytes 13 - 31 Packets 1-7:
Reserved
Always 0

Byte 32-1031 **Echo Data** - 1000 Bytes of data for current packet (proprietary format)

Byte 1032 **Termination Byte**
0xFC

IMAGENEX TECHNOLOGY CORP.

MODEL 837 Delta T MULTIBEAM SONAR HEAD

DATA STORAGE FILE FORMAT (.837)

When recording the sonar data to a **.837** file, the following bytes are appended and saved to the file every 'shot':

Byte #	Description
0 to 99	**File Header** (100 Bytes)
100 to 111	**Sonar Return Data Header** (12 Bytes)
112 to **xxxx**	**Sonar Return Echo Data** (IUX mode: 8 * 1000 Bytes) (IVX mode: 16 * 1000 Bytes) **xxxx** = 8111 or 16111
xxxx+1	**Sonar Return Termination Byte** (always 0xFC)
xxxx+2 to **yyyy**	**Extra Bytes + Zero Fill** **yyyy** = 8191 or 16383
yyyy+1 to **zzzz**	**Video Frame** (if available)

FILE HEADER

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

0 **ASCII '8'**
1 **ASCII '3'**
2 **ASCII '7'**

3 **nToReadIndex** - Index for Number of Data Bytes
10 = 8000 Data Bytes (IUX data)
11 = 16000 Data Bytes (IVX data)

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

Byte 4								**Byte 5**							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
8192 (for IUX) or 16384 (for IVX)															

DATA STORAGE FILE FORMAT (.837) (con't)

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

Byte 6								Byte 7							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
8013 (for IUX) or 16013 (for IVX)															

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**"

Note: see Bytes 93-97 for Milliseconds

33-36 **Video Frame Length** (if available)
length = 54 + (video_window_width * video_window_height * 3)

Byte 33		Byte 34	Byte 35	Byte 36
7	6 - 0	7 – 0	7 – 0	7 - 0
1	**Video Frame Length**			

Bit 7 of Byte 33 is set to 1 if video frame available.

37 **Xdcr Up/Down, Display Mode**

Byte 37							
7	6	5	4	3	2	1	0
Rsvd	**Xdcr**	**Reserved**			**Display Mode**		
1	0=Dn 1=Up	0			0 = Sector 1 = Linear 2 = Perspective 3 = Profile 4 = Beamtest		

38 **Start Gain**
0 to 20 in 1 dB increments

DATA STORAGE FILE FORMAT (.837) (con't)

39-40 **Profile Tilt Angle**

Byte 39								Byte 40							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
T	**[Tilt Angle (in degrees) + 180] * 10**														

If '**T**' = 0, Tilt Angle = 0 degrees
If '**T**' = 1, Tilt Angle = [((Byte 39 & 0x7F)<<8) | (Byte 40)]/10 -180

41 **Reserved** – for internal use only

42 **Reserved** – for internal use only

43 **Number of Pings Averaged**
0 = N/A, 1, 3, 5, 7, 9, 15, 25

44 **Pulse Length**
Byte 44 = pulse_length/10 → 1-250 = 10 to 2500 microseconds

45 **User Defined Byte** – can be any value

46-47 **Sound Velocity**

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

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

48-61 **GNSS Ships Position Latitude** – text string (14 bytes)
"**_dd.mm.xxxxx_N**"
dd = Degrees
mm = Minutes
xxxxx = Decimal Minutes
_ = Space
N = North or S = South

62-75 **GNSS Ships Position Longitude** – text string (14 bytes)
"**ddd.mm.xxxxx_E**"
ddd = Degrees
mm = Minutes
xxxxx = Decimal Minutes
_ = Space
E = East or W = West

DATA STORAGE FILE FORMAT (.837) (con't)

76 **GNSS Ships Speed**
Speed = (Byte 76)/10 in knots

77-78 **GNSS Ships Course**

Byte 77								Byte 78							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Ships Course * 10 (in degrees)															

79 **Reserved** – Always 0

80-81 **Operating Frequency**

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

82-83 **Pitch**

Byte 82								Byte 83							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
P	**Pitch**														

If '**P**' = 0, Pitch Angle not available
If '**P**' = 1, Pitch Angle = [((Byte 82 & 0x7F)<<8) | (Byte 83) – 900] / 10

84-85 **Roll**

Byte 84								Byte 85							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
R	**Roll**														

If '**R**' = 0, Roll Angle not available
If '**R**' = 1, Roll Angle = [((Byte 84 & 0x7F)<<8) | (Byte 85) – 900] / 10

86-87 **Heading**

Byte 86								Byte 87							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
H	**Heading * 10**														

If '**H**' = 0, Heading not available
If '**H**' = 1, Heading = [((Byte 86 & 0x7F)<<8) | (Byte 87)]/10

DATA STORAGE FILE FORMAT (.837) (con't)

88-89 **Repetition Rate** – Time between pings

Byte 88								Byte 89							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Repetition Rate (ms)															

90 **Display Gain**
0 to 100 percent

91 **Reserved** – for internal use only

92 **Reserved** – for internal use only

93-97 **Milliseconds -** null terminated string (5 bytes)
"**.mmm**"

98-99 **Reserved -** always 0

DATA STORAGE FILE FORMAT (.837) (con't)

SONAR RETURN DATA HEADER

Bytes 100 through 111 contain bytes 0-11 of the **Sonar Return Data Header** that is acquired directly from the sonar head (refer to the DeltaT Ethernet Interface Specification):

100	**ASCII 'I'**
101	**ASCII 'U' or ASCII 'V'**
102	**ASCII 'X'**
103	**Head ID**
104	**Serial Status**
105	**Packet Number**
106	**Version**
107	**Range**
108	**Reserved**
109	**Reserved**
110	**Data Bytes (HI)**
111	**Data Bytes (LO)**

SONAR RETURN ECHO DATA

112 **Start of Echo Data**
IUX mode: 8000 byte block
IVX mode: 16000 byte block

xxxx **End of Echo Data**
IUX mode: xxxx = 8111
IVX mode: xxxx = 16111

SONAR RETURN TERMINATION BYTE

xxxx+1 **Termination Byte** – always 0xFC

DATA STORAGE FILE FORMAT (.837) (con't)

EXTRA BYTES + ZERO FILL

xxxx+2 **Sonar X-Offset** – 4 bytes, single precision IEEE floating point standard

xxxx+6 **Sonar Y-Offset** – 4 bytes, single precision IEEE floating point standard

xxxx+10 **Sonar Z-Offset** – 4 bytes, single precision IEEE floating point standard

xxxx+14 **Sensor Type** – 1 byte

xxxx+15 **Pitch** – 2 bytes

xxxx+17 **Roll** – 2 bytes

xxxx+19 **Heading** – 2 bytes

xxxx+21 **Timer Ticks** – 2 bytes

xxxx+23 **Azimuth Head Position** – 2 bytes

xxxx+25 **Azimuth Up/Down** – 1 byte

xxxx+26 **Heave** – 4 bytes, single precision IEEE floating point standard

xxxx+30 **Reserved** – for internal use only (7 bytes)

xxxx+37 **Zero Fill**
to yyyy IUX mode: yyyy = 8191
IVX mode: yyyy = 16383

VIDEO FRAME

yyyy+1 **Video Frame** (if available)
to zzzz

IMAGENEX TECHNOLOGY CORP.

DeltaT - 83P PROFILE POINT OUTPUT

(83P UDP/IP Ethernet Datagram, .83P File Format)

For each ping, the following bytes are output during the 83P UDP datagram. If recording to a .83P file, the following bytes are appended and saved to the file for each ping. The total number of bytes '**N**' for each ping will vary depending on the number of beams selected.

Byte #	Byte Description
0-255	**File Header** (256 bytes)
256-**nnn**	**Profile Ranges for current ping** (2 range bytes / beam) **nnn** = 256 + (2*number_of_beams) – 1 If **Intensity Bytes** are included (Byte 117 = 1), **nnn** = 256 + (4*number_of_beams) – 1

FILE HEADER

Bytes 0 through 255 contain the following **File Header** information:

0 **ASCII '8'**
1 **ASCII '3'**
2 **ASCII 'P'**

3 **.83P File Version**
10 = v1.10

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

Byte 4								**Byte 5**							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
N = 256 + (2*number_of_beams) → Byte 117 = 0 (No Intensity) **N = 256 + (4*number_of_beams) → Byte 117 = 1 (Intensity)**															

6 **Reserved** - always 0

7 **Reserved** - always 0

DeltaT - 83P PROFILE POINT OUTPUT (con't)

8-19 **Sonar Ping Interrogation Timestamp**
Date – system date, null terminated string (12 bytes)
"**DD-MMM-YYYY**"

20-28 **Sonar Ping Interrogation Timestamp**
Time – system time, null terminated string (9 bytes)
"**HH:MM:SS**"

29-32 **Sonar Ping Interrogation Timestamp**
Hundredths of Seconds – system time, null terminated string (4 bytes)
"**.hh**"

Note: see Bytes 112-116 for Milliseconds.

33-46 **GNSS Ships Position Latitude** – text string (14 bytes)
"**_dd.mm.xxxxx_N**"
dd = Degrees
mm = Minutes
xxxxx = Decimal Minutes
_ = Space
N = North or S = South

47-60 **GNSS Ships Position Longitude** – text string (14 bytes)
"**ddd.mm.xxxxx_E**"
ddd = Degrees
mm = Minutes
xxxxx = Decimal Minutes
_ = Space
E = East or W = West

61 **GNSS Ships Speed**
Speed = (Byte 61)/10 in knots

62-63 **GNSS Ships Course**

Byte 62								**Byte 63**							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Course * 10 (in degrees)															

DeltaT - 83P PROFILE POINT OUTPUT (con't)

64-65 **Pitch Angle (from Internal Sensor)**

Byte 64								Byte 65							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
P	**(Pitch Angle*10) + 900**														

If '**P**' = 0, Pitch Angle = 0 degrees
If '**P**' = 1, Pitch Angle = [[((Byte 64 & 0x7F)<<8) | (Byte 65)]-900]/10

66-67 **Roll Angle (from Internal Sensor)**

Byte 66								Byte 67							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
R	**(Roll Angle*10) + 900**														

If '**R**' = 0, Roll Angle = 0 degrees
If '**R**' = 1, Roll Angle = [[((Byte 66 & 0x7F)<<8) | (Byte 67)]-900]/10

68-69 **Heading Angle (from Internal Sensor)**

Byte 68								Byte 69							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
H	**Heading Angle*10**														

If '**H**' = 0, Heading Angle = 0 degrees
If '**H**' = 1, Heading Angle = [((Byte 68 & 0x7F)<<8) | (Byte 69)]/10

70-71 **Beams**

Byte 70								Byte 71							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Number of Beams															

72-73 **Samples Per Beam**

Byte 72								Byte 73							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Number of Samples Per Beam															

DeltaT - 83P PROFILE POINT OUTPUT (con't)

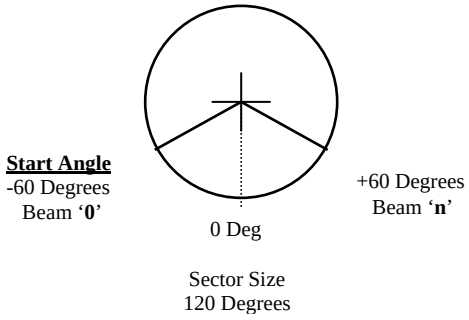
74-75 **Sector Size**

Byte 74								Byte 75							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Sector Size (in degrees)															

76-77 **Start Angle** (Beam 0 angle)

Byte 76								Byte 77							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
[Start Angle (in degrees) + 180] * 100															

Example:



78 **Angle Increment**
Angle spacing per beam = (Byte 78)/100 in degrees

79-80 **Acoustic Range**

Byte 79								Byte 80							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Acoustic Range (in meters)															

81-82 **Acoustic Frequency**

Byte 81								Byte 82							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Acoustic Frequency (in kHz)															

DeltaT - 83P PROFILE POINT OUTPUT (con't)

83-84 **Sound Velocity**

Byte 83								Byte 84							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
V	**Sound Velocity (in meters/second) * 10**														

If '**V**' = 0, Sound Velocity = 1500.0 m/s
If '**V**' = 1, Sound Velocity = [((Byte 83 & 0x7F)<<8) | (Byte 84)]/10.0

85-86 **Range Resolution**

Byte 85								Byte 86							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Range Resolution (in millimeters)															

87-88 **Reserved** – always 0

89-90 **Profile Tilt Angle** (mounting offset)

Byte 89								Byte 90							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Profile Tilt Angle (in degrees) + 180															

91-92 **Repetition Rate** – Time between pings

Byte 91								Byte 92							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Repetition Rate (in milliseconds)															

93-96 **Ping Number** – increment for every ping

Byte 93	Byte 94	Byte 95	Byte 96
7 – 0	7 – 0	7 - 0	7 - 0
Ping Number			

97-99 **Reserved** - always 0

DeltaT - 83P PROFILE POINT OUTPUT (con't)

100-103 **Sonar X-Offset** – 4-byte single precision floating point number

Byte 100	Byte 101	Byte 102	Byte 103
7 – 0	7 – 0	7 - 0	7 - 0
Sonar X-Offset (in meters)			

104-107 **Sonar Y-Offset** – 4-byte single precision floating point number

Byte 104	Byte 105	Byte 106	Byte 107
7 – 0	7 – 0	7 - 0	7 - 0
Sonar Y-Offset (in meters)			

108-111 **Sonar Z-Offset** – 4-byte single precision floating point number

Byte 108	Byte 109	Byte 110	Byte 111
7 – 0	7 – 0	7 - 0	7 - 0
Sonar Z-Offset (in meters)			

112-116 **Sonar Ping Interrogation Timestamp**
Milliseconds – system time, null terminated string (5 bytes)
"**.mmm**"

117 **Intensity Bytes Included**
0 = No
1 = Yes

118-119 **Ping Latency** – Time from sonar ping interrogation to actual ping

Byte 118								Byte 119							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Ping Latency (in units of 100 microseconds)															

120-121 **Data Latency** – Time from sonar ping interrogation to 83P UDP datagram

Byte 120								Byte 121							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Data Latency (in units of 100 microseconds)															

Time Since Ping = Data Latency – Ping Latency

Note: Data Latency is not available during file playback.

122 **Sample Rate**
0 = Standard Resolution (1 in 500)
1 = High Resolution (1 in 5000)

DeltaT - 83P PROFILE POINT OUTPUT (con't)

123 **Option Flags**
Bit 0 – 1 = data is corrected for roll
Bit 1 – 1 = data is corrected for ray bending
Bit 2 – 1 = sonar is operating in overlapped mode
Bit 3 – 0
Bit 4 – 0
Bit 5 – 0
Bit 6 – 0
Bit 7 – 0

124 **Reserved** - always 0

125 **Number of Pings Averaged**
0 to 25

126-127 **Center Ping Time Offset** – The Sonar Ping Interrogation Timestamp (Bytes 8-19, 20-28 and 112-116) is the timestamp for the current ping. But due to ping averaging, the ping time of the center ping (of a group of averaged pings) may be required (i.e. for roll stabilization). The Center Ping Time Offset is the time difference between the center ping interrogation and the current ping interrogation.

Byte 126								Byte 127							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Center Ping Time Offset (in units of 100 microseconds)															

Center Ping Time = Sonar Ping Interrogation Timestamp – Center Ping Time Offset + Ping Latency

Note: Profile data from the current ping should be used when subtracting the Center Ping Time Offset.

128-131 **Heave (from External Sensor)**
4-byte single precision floating point number

Byte 128	Byte 129	Byte 130	Byte 131
7 – 0	7 – 0	7 - 0	7 - 0
Heave (in meters)			

132 **User Defined Byte** – this is a copy of the 837 User Defined Byte (Byte 45 from the .837 File Header)

DeltaT - 83P PROFILE POINT OUTPUT (con't)

133-136 **Altitude** – 4-byte single precision floating point number

Byte 133	Byte 134	Byte 135	Byte 136
7 – 0	7 – 0	7 - 0	7 - 0
Altitude (in meters)			

137 **External Sensor Flags**

Bit 0 – 1 = external heading angle available
Bit 1 – 1 = external roll angle available
Bit 2 – 1 = external pitch angle available
Bit 3 – 1 = external heave available
Bit 4 – 0
Bit 5 – 0
Bit 6 – 0
Bit 7 – 0

138-141 **Pitch Angle (from External Sensor)**

4-byte single precision floating point number

Byte 138	Byte 139	Byte 140	Byte 141
7 – 0	7 – 0	7 - 0	7 - 0
Pitch (in degrees)			

142-145 **Roll Angle (from External Sensor)**

4-byte single precision floating point number

Byte 142	Byte 143	Byte 144	Byte 145
7 – 0	7 – 0	7 - 0	7 - 0
Roll (in degrees)			

146-149 **Heading Angle (from External Sensor)**

4-byte single precision floating point number

Byte 146	Byte 147	Byte 148	Byte 149
7 – 0	7 – 0	7 - 0	7 - 0
Heading (in degrees)			

DeltaT - 83P PROFILE POINT OUTPUT (con't)

150 **Transmit Scan Flag**
0 = manual scan
1 = auto-scan

151-154 **Transmit Scan Angle**
4-byte single precision floating point number

Byte 151	Byte 152	Byte 153	Byte 154
7 – 0	7 – 0	7 - 0	7 - 0
Transmit Scan Angle (in degrees)			

155-255 **Reserved** - always 0

DeltaT - 83P PROFILE POINT OUTPUT (con't)

START OF PROFILE RANGE POINTS (2 bytes/point)

256-257 **Profile Range : Beam 0**

Byte 256								Byte 257							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Profile Range (in samples)															

Standard Resolution samples: 0 – 499
High Resolution samples: 0 – 4999

Profile Range for Beam 0 (starting angle):
range = (Byte 256<<8 | Byte 257) * Range Resolution / 1000 (meters)
corrected range = range * Sound Velocity / 1500

***note: all ranges assume a sound velocity of 1500m/s**

258-259 **Profile Range : Beam 1**

Byte 258								Byte 259							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Profile Range (in samples)															

Profile Range for Beam 1 (starting angle + angle increment):
range = (Byte 258<<8 | Byte 259) * Range Resolution / 1000 (meters)
corrected range = range * Sound Velocity / 1500

nnn-1 to nnn **Profile Range : Beam N**

nnn = 256 + (2 * number_of_beams) – 1

Byte (nnn-1)								Byte nnn							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Profile Range (in samples)															

Profile Range for Beam N (starting angle + N*angle increment):
range = (Byte (nnn-1)<<8 | Byte nnn) * Range Resolution / 1000 (meters)
corrected range = range * Sound Velocity / 1500

DeltaT - 83P PROFILE POINT OUTPUT (con't)

If Byte 117 = 1 (Intensity Bytes Included), the following Intensity Bytes are added on after the Profile Range Bytes:

xxx = 256 + (2 * number_of_beams)
yyy = 256 + (4 * number_of_beams) – 1

xxx to xxx+1 **Intensity : Beam 0**

Byte xxx								Byte (xxx+1)							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Intensity (normalized amplitude)															

xxx+2 to xxx+3 **Intensity : Beam 1**

Byte (xxx+2)								Byte (xxx+3)							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Intensity (normalized amplitude)															

yyy-1 to yyy **Intensity : Beam N**

Byte (yyy-1)								Byte yyy							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Intensity (normalized amplitude)															

IMAGENEX TECHNOLOGY CORP.

ΔT BEAM OUTPUT FORMAT (83B)

After each sonar ping, the following bytes are output via ethernet to "IPAddress_Output1" as initialized in the DELTAT.INI configuration file. The total number of bytes '**N**' for each ping will vary depending on the number of beams used.

NOTE: as of this writing, number of beams is limited to 120

Byte #	Byte Description
0-255	**Header** (256 bytes)
256-**nnnnn**	**Beam Output for current ping** (500 range bins / beam) **nnnnn** = 256 + (500*number_of_beams) – 1

HEADER

Bytes 0 through 255 contain the following **Header** information:

0 **ASCII '8'**
1 **ASCII '3'**
2 **ASCII 'B'**

3 **83B Version**
2 = v1.02

4-6 **Total Bytes 'N'** - number of bytes that are output for this ping

Byte 4								Byte 5								Byte 6							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
N = 256 + (500*number_of_beams)																							

7 **Reserved** - always 0

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

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

29-32 **Hundreths of Seconds** – system time, null terminated string (4 bytes)
"**.hh**"

ΔT BEAM OUTPUT FORMAT (83B) (con't)

33-46 **GPS Ships Position Latitude** – text string (14 bytes)
"**_dd.mm.xxxxx_N**"
dd = Degrees
mm = Minutes
xxxxx = Decimal Minutes
_ = Space
N = North or S = South

47-60 **GPS Ships Position Longitude** – text string (14 bytes)
"**ddd.mm.xxxxx_E**"
ddd = Degrees
mm = Minutes
xxxxx = Decimal Minutes
_ = Space
E = East or W = West

61 **GPS Ships Speed**
Speed = (Byte 61)/10 in knots

62-63 **GPS Ships Heading**

Byte 62								**Byte 63**							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Heading * 10 (in degrees)															

64-65 **Pitch Angle (from Orientation Module)**

Byte 64								**Byte 65**							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
P	**(Pitch Angle*10) + 900**														

If '**P**' = 0, Pitch Angle = 0 degrees
If '**P**' = 1, Pitch Angle = [[((Byte 64 & 0x7F)<<8) | (Byte 65)]-900]/10

66-67 **Roll Angle (from Orientation Module)**

Byte 66								**Byte 67**							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
R	**(Roll Angle*10) + 900**														

If '**R**' = 0, Roll Angle = 0 degrees
If '**R**' = 1, Roll Angle = [[((Byte 66 & 0x7F)<<8) | (Byte 67)]-900]/10

ΔT BEAM OUTPUT FORMAT (83B) (con't)

68-69 **Heading Angle (from Orientation Module)**

Byte 68								Byte 69							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
H	**Heading Angle*10**														

If '**H**' = 0, Heading Angle = 0 degrees
If '**H**' = 1, Heading Angle = [((Byte 68 & 0x7F)<<8) | (Byte 69)]/10

70-71 **Beams**

Byte 70								Byte 71							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Number of Beams															

72-73 **Samples Per Beam**

Byte 72								Byte 73							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Number of Samples Per Beam															

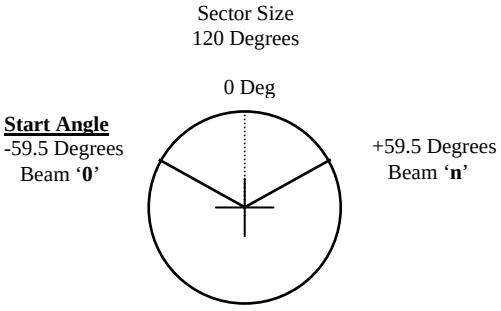
74-75 **Sector Size**

Byte 74								Byte 75							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Sector Size (in degrees)															

76-77 **Start Angle** (Beam 0 angle)

Byte 76								Byte 77							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
[Start Angle (in degrees) + 180] * 100															

Example:



ΔT BEAM OUTPUT FORMAT (83B) (con't)

78 **Angle Increment**
Angle spacing per beam = (Byte 78)/100 in degrees

79-80 **Acoustic Range**

Byte 79								Byte 80							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Acoustic Range (in meters)															

81-82 **Acoustic Frequency**

Byte 81								Byte 82							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Acoustic Frequency (in kHz)															

83-84 **Sound Velocity**

Byte 83								Byte 84							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
V	**Sound Velocity (in meters/second) * 10**														

If '**V**' = 0, Sound Velocity = 1500.0 m/s
If '**V**' = 1, Sound Velocity = [((Byte 83 & 0x7F)<<8) | (Byte 84)]/10.0

85-86 **Range Resolution**

Byte 85								Byte 86							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Range Resolution (in millimeters)															

87-88 **Pulse Length**

Byte 87								Byte 88							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Pulse Length (in microseconds)															

89-90 **Profile Tilt Angle** (mounting offset)

Byte 89								Byte 90							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Profile Tilt Angle (in degrees) + 180															

ΔT BEAM OUTPUT FORMAT (83B) (con't)

91-92 **Repetition Rate** – Time between pings

Byte 91								Byte 92							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Repetition Rate (in milliseconds)															

93-96 **Ping Number** – increment for every ping

Byte 93	Byte 94	Byte 95	Byte 96
7 – 0	7 – 0	7 - 0	7 - 0
Ping Number			

97-99 **Reserved** - always 0

100-103 **Sonar X-Offset** – 4-byte single precision floating point number

Byte 100	Byte 101	Byte 102	Byte 103
7 – 0	7 – 0	7 - 0	7 - 0
Sonar X-Offset (in meters)			

104-107 **Sonar Y-Offset** – 4-byte single precision floating point number

Byte 104	Byte 105	Byte 106	Byte 107
7 – 0	7 – 0	7 - 0	7 - 0
Sonar Y-Offset (in meters)			

108-111 **Sonar Z-Offset** – 4-byte single precision floating point number

Byte 108	Byte 109	Byte 110	Byte 111
7 – 0	7 – 0	7 - 0	7 - 0
Sonar Z-Offset (in meters)			

112-255 **Reserved** - always 0

START OF BEAM OUTPUT BYTES (500 range bins per beam)

256-755 **Beam 0:**
500 range bins (0-499), intensity value for each bin is 0-255

756-1255 **Beam 1**
500 range bins (0-499), intensity value for each bin is 0-255

nnnnn-499 to nnnnn **Beam N**

500 range bins (0-499), intensity value for each bin is 0-255

IMAGENEX TECHNOLOGY CORP.

ΔT MESSAGE OUTPUT FORMAT (83Z)

If an 83P or 83B ethernet output has not been enabled, the following DeltaT Message Output is sent to ethernet address "IPAddress_Output1" as initialized in the DELTAT.INI configuration file:

Byte #	Byte Description
0-31	**Header** (32 bytes)

HEADER

Bytes 0 through 31 contain the following **Header** information:

0 **ASCII '8'**
1 **ASCII '3'**
2 **ASCII 'Z'**

3 **83Z Version**
0 = v1.xx

4-31 **Reserved**
Always 0

IMAGENEX TECHNOLOGY CORP.

DeltaT MULTIBEAM SONAR

EXTERNAL CONTROL SPECIFICATION FOR UDP/IP (v1.04)

OVERVIEW

The standard Model 837 Multibeam Sonar Head beamforming program (**DeltaT.exe**) can be externally controlled via a second computer using a UDP ethernet communications link. After DeltaT.exe outputs a UDP message (83P, 83B, 83F or 83Z), an external control command '**EC**' can be sent to control many of the program functions (i.e. Range, Gain, Sector Size, Beamwidth, etc…).

Unless otherwise specified, the DeltaT sonar head has a statically assigned IP Address of **192.168.0.2**. This address is stored in the DeltaT.ini configuration file under the string name "IPAddress_Sonar1". The IP Address for the UDP output, string name "IPAddress_Output1", has an IP Address of **192.168.0.X**, where X is any number between 3 and 255. The external control computer must be running on the same Local Area Network (i.e. 192.168.0.X). All UDP communication is through the port number stored in "RemotePort_Output1" which has a default value of 4040.

EXTERNAL CONTROL COMMAND

The External Control command is 256 bytes in length and should be sent after receiving one of the DeltaT.exe UDP messages. All unused bytes should be set to 0.

Byte #	Description							
0 – 7	**'E'**	**'C'**	ID	Control Byte 1	Control Byte 2	Control Byte 3	Control Byte 4	Range
8 – 15	Gain	Display Gain	Gain EQ	Sector Size	Beam Width	Number of Beams	Averag-ing	Persist HI
16 – 23	Persist LO	Sound Vel. HI	Sound Vel. LO	Mode	83P/B/F Enable	Profile Pt. Enable	Profile Min Rng	Profile Min Lev
24 – 31	Xdcr Up/Dn	Profile Tilt	Roll Corr.	Units	Record .837	Record .83P	Record .83B	External Trigger
32 - 34	Ext Trig. Delay HI	Ext Trig. Delay LO	Profile Pt Filter					
35 - 255	Reserved 0							

Table 1 External Control Command for the DeltaT.exe beamforming program

EXTERNAL CONTROL COMMAND (con't)

BYTE DESCRIPTIONS

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

Byte 0 **Header Byte 1**
ASCII **'E'** (0x45)

Byte 1 **Header Byte 2**
ASCII **'C'** (0x43)

Byte 2 **ID**
0

Byte 3 **Control Byte 1**
Bit0: 0 = LocalControl, 1 = ExternalControl

Byte 4 **Control Byte 2**
Bit0: 0 = Transmit & Receive, 1 = Receive Only (Disable Transmitter)
Bit1: 0 = Enable Plotting, 1 = Disable Plotting (Run Minimized)

Byte 5 **Control Byte 3**
0

Byte 6 **Control Byte 4**
0

Byte 7 **Range**
2 = 5m
3 = 10m
4 = 20m
5 = 30m
6 = 40m
7 = 50m
8 = 60m
9 = 80m
10 = 100m
11 = 150m
12 = 200m
13 = 250m
14 = 300m

Note: units of meters only

EXTERNAL CONTROL COMMAND (con't)

Byte 8 **Gain**
0 to 20dB in 1dB increments

Byte 9 **Display Gain**
1 to 100 percent

Byte 10 **Gain Equalization**
0 = Off, 1 = On

Byte 11 **Sector Size**
0 = 30 Deg, 1 = 60 Deg, 2 = 90 Deg, 3 = 120 Deg

Byte 12 **Beamwidth**
0 = Wide, 1 = Normal, 2 = Narrow, 3 = Narrow Mixed

Byte 13 **Number of Beams**
0 = 480, 1 = 240, 2 = 120

Byte 14 **Averaging**
0,1 = Off, 2, 3, 4, …. 10 = number of shots to average

Byte 15-16 **Persistence**

Byte 15								**Byte 16**							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
0 to 600 (in seconds)															

Byte 17-18 **Sound Velocity**

Byte 17								**Byte 18**							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
14000 to 16000 (in decimeters/sec)															

A value of 15000 (1500.0 m/s) is typically used.

Byte 19 **Mode**
0 = Sector, 1 = Linear, 2 = Perspective, 3 = Profile, 4 = Beamtest

EXTERNAL CONTROL COMMAND (con't)

Byte 20 **83P / 83B / 83F Output Enable**
0 = 83P, 1 = 83B, 2 = 83F

For 83P Output:
Enable Profile Point Detection (Byte 21 = 1)

For 83B and 83F Outputs:
Sector Size must be 120 Degrees (Byte 11 = 3)
Number of Beams must be 120 (Byte 13 = 2)

Byte 21 **Profile Point Detection**
0 = Disable, 1 = Enable

Byte 22 **Profile Minimum Range**
0 to 100 meters
Note: units of meters only

Byte 23 **Profile Minimum Level**
10 to 90 percent

Byte 24 **Transducer Up/Down**
0 = Down, 1 = Up

Byte 25 **Profile Tilt Angle**
-30 to +30 degrees with on offset of 180
150 = -30 degrees
180 = 0 degrees
210 = +30 degrees

Byte 26 **Roll Correction**
0 = Off, 1 = On

Byte 27 **Measurement Units**
0 = Meters, 1 = Feet, 2 = Yards

Byte 28 **Record Start / Stop (.837)**
0 = Disable, 1 = Enable

EXTERNAL CONTROL COMMAND (con't)

Byte 29 **Record Start / Stop (.83P)**
Not implemented – always 0

Byte 30 **Record Start / Stop (.83B)**
Not implemented – always 0

Note:

The following External Trigger Control bytes are valid only for DeltaT Sonar Heads supplied with the External Trigger Hardware Option.

Byte 31 **External Trigger Control**
Bit0: Edge: 0 = NEG, 1 = POS
Bit1: Enable: 0 = Disable, 1 = Enable

Byte 32-33 **External Trigger Transmit Delay**
Delay from external trigger to sonar head transmit pulse

Byte 32								**Byte 33**							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
0 to 10000 (in 100 µsec increments)															

Byte 34 **Profile Point Filter**
0 = First Return
1 = Maximum Return
2 = Bottom Following

Byte 35-255 **Reserved**
Always 0

IMAGENEX TECHNOLOGY CORP.

DeltaT MULTIBEAM SONAR

EXTERNAL CONTROL SPECIFICATION FOR TCP/IP (v1.04)

OVERVIEW

An optional version of the Model 837 Multibeam Sonar Head beamforming program (**DeltaT.exe**) is available that can be externally controlled via a second computer using a TCP ethernet communications link. When enabled for external control (**ExternalControlEnableTCP=1** in the DeltaT.ini configuration file), the DeltaT.exe program acts as a server and waits for a connection from the client application. "Waiting For External Control Connection…" will be displayed until the client makes the connection. The client then sends an '**EC**' external control command to request one sonar ping. The sonar program replies with an **83P, 83B** or **83F** sonar data message. As shown below, the 'EC' command allows the user to change many of the program functions (i.e. Range, Gain, Sector Size, Beamwidth, etc…).

Unless otherwise specified, the DeltaT sonar head has a statically assigned IP Address of **192.168.0.2**. This address is stored in the DeltaT.ini file under the string name "IPAddress_Sonar1". The IP Address of the external control computer is stored in "IPAddress_Output1" which can have an IP Address of **192.168.0.X**, where X is any number between 3 and 255. Communication to/from the external computer is through the port number located in "RemotePort_Output1".

EXTERNAL CONTROL COMMAND

The External Control command is 256 bytes in length and must be sent to receive data from the DeltaT.exe program. All unused bytes should be set to 0.

Byte #	**Description**							
0 – 7	**'E'**	**'C'**	ID	Control Byte 1	Control Byte 2	Control Byte 3	Control Byte 4	Range
8 – 15	Gain	Display Gain	Gain EQ	Sector Size	Beam Width	Number of Beams	Averag-ing	Persist HI
16 – 23	Persist LO	Sound Vel. HI	Sound Vel. LO	Mode	83P/B/F Enable	Profile Pt. Enable	Profile Min Rng	Profile Min Lev
24 – 31	Xdcr Up/Dn	Profile Tilt	Roll Corr.	Units	Record .837	Record .83P	Record .83B	External Trigger
32 - 34	Ext Trig. Delay HI	Ext Trig. Delay LO	Profile Pt Filter					
35 - 255	Reserved 0							

Table 1 External Control Command for the DeltaT.exe beamforming program

EXTERNAL CONTROL COMMAND (con't)

BYTE DESCRIPTIONS

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

Byte 0 **Header Byte 1**
ASCII **'E'** (0x45)

Byte 1 **Header Byte 2**
ASCII **'C'** (0x43)

Byte 2 **ID**
0

Byte 3 **Control Byte 1**
Bit0: 0 = LocalControl, 1 = ExternalControl

Byte 4 **Control Byte 2**
Bit0: 0 = Transmit & Receive, 1 = Receive Only (Disable Transmitter)
Bit1: 0 = Enable Plotting, 1 = Disable Plotting (Run Minimized)

Byte 5 **Control Byte 3**
0

Byte 6 **Control Byte 4**
0

Byte 7 **Range**
2 = 5m
3 = 10m
4 = 20m
5 = 30m
6 = 40m
7 = 50m
8 = 60m
9 = 80m
10 = 100m
11 = 150m
12 = 200m
13 = 250m
14 = 300m

Note: units of meters only

EXTERNAL CONTROL COMMAND (con't)

Byte 8 **Gain**
0 to 20dB in 1dB increments

Byte 9 **Display Gain**
1 to 100 percent

Byte 10 **Gain Equalization**
0 = Off, 1 = On

Byte 11 **Sector Size**
0 = 30 Deg, 1 = 60 Deg, 2 = 90 Deg, 3 = 120 Deg

Byte 12 **Beamwidth**
0 = Wide, 1 = Normal, 2 = Narrow, 3 = Narrow Mixed

Byte 13 **Number of Beams**
0 = 480, 1 = 240, 2 = 120

Byte 14 **Averaging**
0,1 = Off, 2, 3, 4, …. 10 = number of shots to average

Byte 15-16 **Persistence**

Byte 15								**Byte 16**							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
0 to 600 (in seconds)															

Note: not active if Mode = Profile

Byte 17-18 **Sound Velocity**

Byte 17								**Byte 18**							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
14000 to 16000 (in decimeters/sec)															

A value of 15000 (1500.0 m/s) is typically used.

Byte 19 **Mode**
0 = Sector, 1 = Linear, 2 = Perspective, 3 = Profile, 4 = Beamtest

EXTERNAL CONTROL COMMAND (con't)

Byte 20 **83P / 83B / 83F Output Enable**
0 = 83P, 1 = 83B, 2 = 83F

For 83P Output:
Enable Profile Mode (Byte 19 = 3)
Enable Profile Point Detection (Byte 21 = 1)

For 83B and 83F Outputs:
Sector Size must be 120 Degrees (Byte 11 = 3)
Number of Beams must be 120 (Byte 13 = 2)

Byte 21 **Profile Point Detection**
0 = Disable, 1 = Enable

Byte 22 **Profile Minimum Range**
0 to 100 meters
Note: units of meters only

Byte 23 **Profile Minimum Level**
10 to 90 percent

Byte 24 **Transducer Up/Down**
0 = Down, 1 = Up

Byte 25 **Profile Tilt Angle**
-30 to +30 degrees with on offset of 180
150 = -30 degrees
180 = 0 degrees
210 = +30 degrees

Byte 26 **Roll Correction**
0 = Off, 1 = On

Byte 27 **Measurement Units**
0 = Meters, 1 = Feet, 2 = Yards

Byte 28 **Record Start / Stop (.837)**
0 = Disable, 1 = Enable

EXTERNAL CONTROL COMMAND (con't)

Byte 29 **Record Start / Stop (.83P)**
Not implemented – always 0

Byte 30 **Record Start / Stop (.83B)**
Not implemented – always 0

Note:

The following External Trigger Control bytes are valid only for DeltaT Sonar Heads supplied with the External Trigger Hardware Option.

Byte 31 **External Trigger Control**
Bit0: Edge: 0 = NEG, 1 = POS
Bit1: Enable: 0 = Disable, 1 = Enable

Byte 32-33 **External Trigger Transmit Delay**
Delay from external trigger to sonar head transmit pulse

Byte 32								**Byte 33**							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
0 to 10000 (in 100 µsec increments)															

Byte 34 **Profile Point Filter**
0 = First Return
1 = Maximum Return
2 = Bottom Following

Byte 35-255 **Reserved**
Always 0

IMAGENEX DELTA T MULTIBEAM SONAR

PULSE REPETITION RATES

	120 BEAMS	**240 BEAMS**	**480 BEAMS**
RANGE Meters	**REP-RATE** ms (Hz)	**REP-RATE** ms (Hz)	**REP-RATE** ms (Hz)
100	195 (5.1)	214 (4.7)	254 (3.9)
80	167 (6.0)	187 (5.3)	226 (4.4)
60	140 (7.1)	161 (6.2)	200 (5.0)
50	128 (7.8)	148 (6.8)	187 (5.3)
40	114 (8.8)	134 (7.5)	175 (5.7)
30	100 (10.0)	120 (8.3)	160 (6.3)
20	87 (11.5)	107 (9.3)	148 (6.8)
10	73 (13.7)	93 (10.8)	134 (7.5)
5	67 (15.0)	87 (11.5)	128 (7.8)

Using DELTAT.EXE v1.01.23b, Pentium 4 (3.4 GHz), Windows XP

Mode:	Profile
Beamwidth:	Narrow Mixed
Sector Size:	120 Degrees
Averaging:	3 Shots
Gain EQ:	On
UDP Output:	On

GPS String Formats for DeltaT.exe

GLL: Geographical **L**atitude and **L**ongitude (Ship's Position)

$GPGLL,ddmm.xxxxx,N,dddmm.xxxxx,W<CR><LF>

where dd = Degrees
mm = Minutes
xxxxx = Decimal Minutes
N = North or S = South
W = West or E = East

*Note: if using GPGLL string, use GPVTG for ship's speed and heading

VTG: **V**ector **T**rack and **G**round Speed (Ship's Speed SOG and Heading)

$GPVTG,ttt.t,T,mmm.m,M,nn.n,N,kk.k,K<CR><LF>

where ttt.t = Track in Degrees (True)
mmm.m = Track in Degrees (Magnetic)
nn.n = Ground Speed (Knots)
kk.k = Ground Speed (Km/Hr)

GGA: Geographical (Ship's Position)

$GPGGA,uuuuuu.uu,ddmm.xxxxx,N,dddmm.xxxxx,W,q,s,hhh,aaa,M,gggg,M<CR><LF>

where uuuuuu.uu = UTC of Position
dd = Degrees
mm = Minutes
xxxxx = Decimal Minutes
N = North or S = South
W = West or E = East
q = Quality Indicator (0 = GPS not available, 1 = GPS available)
s = Number of satellites being used
hhh = Horizontal dilution of precision (HDOP)
aaa,M = Antenna Height in Meters
gggg,M = Geodial Height in Meters

*Note: if using GPGGA string, use GPVTG for ship's speed and heading

GPS String Formats for DeltaT.exe (con't)

RMC: (Ship's Position)

$GPRMC,tttttt,A,ddmm.xxxxx,N,dddmm.xxxxx,W,kk.k,ccc.c,ddmmyy,vv,E<CR><LF>

where tttttt = UTC Time
A = Status (A = valid, V = invalid)
dd = Degrees
mm = Minutes
xxxxx = Decimal Minutes
N = North or S = South
W = West or E = East
kk.k = Speed over Ground in knots
ccc.c = COG (Track) in Degrees True
ddmmyy = Date (day, month, year)
vv = Variation sense (E = East, W = West)

*Note: GPVTG is not required when using the GPRMC string

Serial Port Settings:

4800bps, No Parity, 8 Data Bits, 1 Stop Bit