



IMAGENEX MODEL 831L DIGITAL PIPE PROFILING SONAR

APPLICATIONS:

- Profiling
- Pipeline Inspection
- Scientific Research

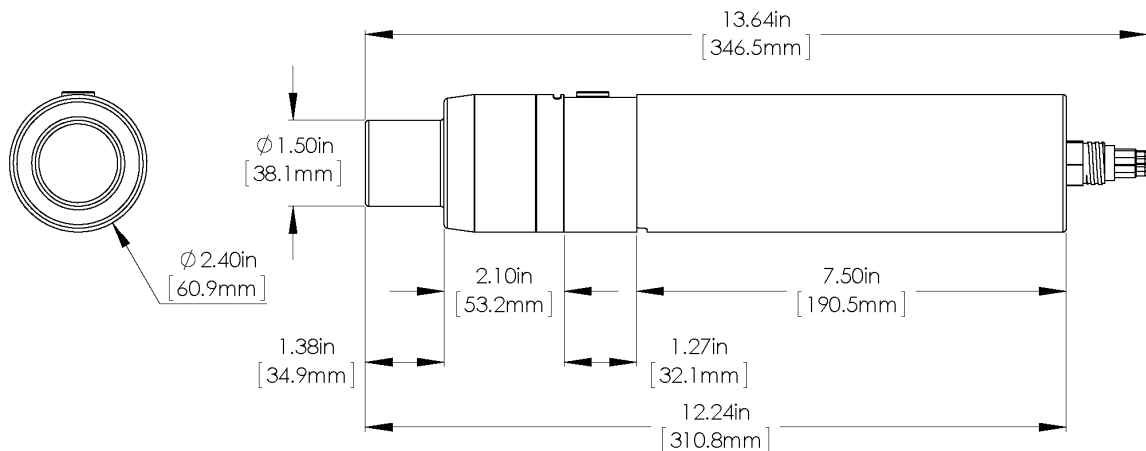
FEATURES:

- **Ethernet**
- Programmable
- High performance
- Scans 360° in 1.3 sec (up to 1 m range)
- Low power
- 0.125 m to 6 m operation (full scale)
- Compact size
- Communication format available to user
- Built in Pitch/Roll sensor



HARDWARE SPECIFICATIONS:	
FREQUENCY	2.25 MHz
TRANSDUCER	Profiling type, fluid compensated
TRANSDUCER BEAM WIDTH	1.4° conical
RANGE RESOLUTION	0.5 mm
MIN. DETECTABLE RANGE	50 mm (~ 2")
MAX. OPERATING DEPTH	1000 m
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	End mounted, eight conductor, wet mateable (Subconn MCBH8M-AS)
POWER SUPPLY	20 – 32 VDC at less than 5 Watts
DIMENSIONS	61 mm (2.4") diameter x 347 mm (13.64") overall length
WEIGHT: In Air	1.2 kg (2.6 lbs)
In Water	0.4 kg (0.8 lb)
MATERIALS	6061-T6 Aluminum & Polyurethane
FINISH	Hard Anodize

SOFTWARE SPECIFICATIONS:	PipeSonarL.exe
WINDOWS™ OPERATING SYSTEM	Windows™ XP, Vista, 7, 8, 10
MODES	Polar
RANGE SCALES	0.125 m, 0.25 m, 0.50 m, 0.75 m, 1 m, 2 m, 3 m, 4 m, 5 m, 6 m
TRAIN ANGLES	Continuous rotation, 9° increments
SECTOR SIZE	0° – 351°, 9° increments, or Continuous rotation
STEP SIZE	0.9°
GRID TYPES	Polar and rectangular
FILE FORMAT	(filename).31L
RECOMMENDED MINIMUM COMPUTER REQUIREMENTS:	2 GHz Pentium 4 256 MB RAM 20 GB Hard Disk 1024 x 768 screen resolution

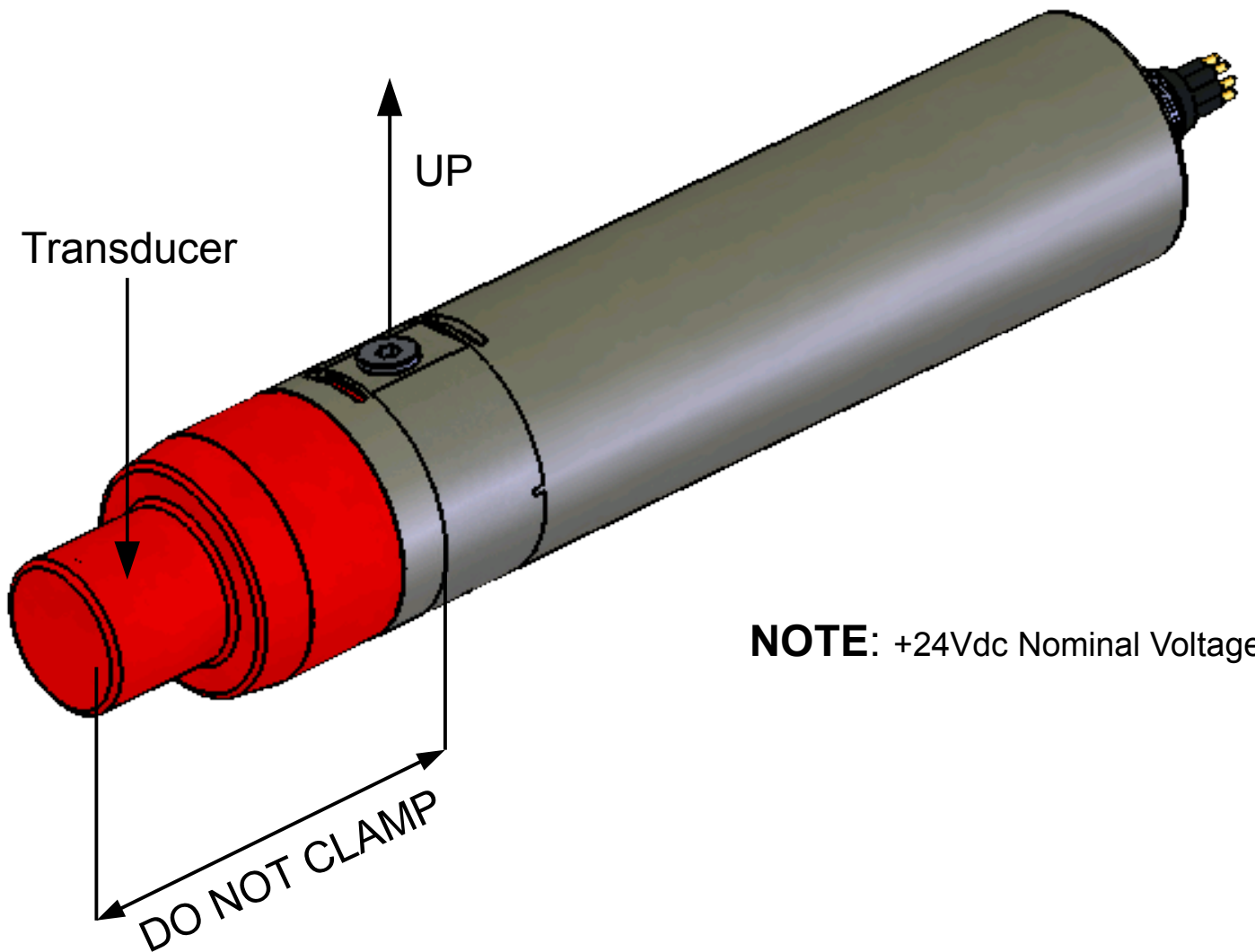


ORDERING INFORMATION:		
1000 m UNIT	Standard	831L-000-200
IP Address*	Option	-020

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

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Orientation of the Imagenex Model 831L “Pipe Sonar”





Imagenex Technology Corp.

MODEL 831L DIGITAL HIGH-FREQUENCY PIPE INSPECTION SONAR HEAD

FILE FORMAT SPECIFICATION (v1.00)

Document Number	425-020	
Revision	Date	Description
01	March 01, 09	
02	July 16, 2009	Formatting
03	May 21, 2010	Formatting

OVERVIEW

When recording the sonar data to a **.31L** file, the following bytes are appended and saved to the file every 'shot': (total bytes per shot 512)

Byte #	Description
0 to 99	File Header (100 Bytes)
100 to 227	External Sensor Info (128 Bytes)
228 to 259	Sonar Return Data Header (32 Bytes)
260 to 509	Sonar Data (250 Bytes)
510	Term Byte = 0xFC
511	0

FILE HEADER

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

Byte 0 **ASCII '3'**
 Byte 1 **ASCII '1'**
 Byte 2 **ASCII 'L'**

Byte 3 **nToReadIndex** - Index for Number of Data Bytes
 2 = 250 bytes for sonar data

Bytes 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
512															

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

Byte 6								Byte 7							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
283 = (32 + 250 + 1)															

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

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

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

Byte 33 **Reserved** – always 0

Byte 34 **External Sensor Available**
 0 = No External Pitch / Roll / Distance present
 1 = External Pitch / Roll / Distance present

Bytes 35-36 **Reserved** - always 0

Byte 37 **Direction, Transducer, Mode, Step**

Byte 37							
7	6	5	4	3	2	1	0
Dir	Xdcr	Mode			Step Size		
0=ccw 1=cw	0=Dn 1=Up	0 = Sector 1 = Polar 2 = Sidescan			0 = 0.3 Deg (Slow) 1 = 0.6 Deg (Medium) 2 = 0.9 Deg (Fast) 3 = 1.2 Deg (Faster) 4 = 2.4 Deg (Fastest)		

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

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

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

Byte 41 **Range Code**
2 : 0.125 m
4: 0.25 m
6 : 0.5 m
8: 0.75 m
10: 1 m
20: 2 m
30: 3 m
40: 4 m
50: 5 m
60: 6 m

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

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

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

Byte 44 **Pulse Length**
Byte 44 = (Pulse Length)/10
1 to 100 = 1µs to 1000µs in 1µs increments

Byte 45 **Not used**

Bytes 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

Bytes 48-79 **Not used**

Bytes 80-81 **Operating Frequency**

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

Bytes 82-83 **Real Time PRF (in Hz)**

Byte 82								Byte 83							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
	Real time prf * 100														

Bytes 84-99 **Reserved** - always 0

Byte 100 **External Sensor Information**

bit 0 == 1 pitch valid

bit 1 == 1 roll valid

bit 2 == 1 distance valid

Bytes 101-104 **Pitch Value** (float)

Bytes 105-108 **Roll Value** (float)

Bytes 109-112 **Distance Value** (float)

Bytes 228-259 **Sonar Return Data Header** – 32 bytes (*Refer to Document 425-019*)

Bytes 260-509 **Sonar Data** – 250 bytes

Byte 510 **Term Byte = 0xFC**

Byte 511 0



Imagenex Technology Corp.

MODEL 831L DIGITAL SONAR HEAD

ETHERNET INTERFACE SPECIFICATION (v1.01)

Document Number	425-019	
Revision	Date	Description
00	November 2, 2011	Initial Draft
01	November 29, 2011	Modified frequency, added Sonar Type

OVERVIEW

The Model **831L** Digital Sonar Head communicates over a 10Mbps (10BaseT) Ethernet data transmission line. To interrogate the head and receive echo data, a Switch Data Command string is sent via an Ethernet command program. When the Switch Data command is accepted, the head moves to a new step angle, transmits, receives and sends its return data back to the command program.

Unless otherwise specified, the 831L sonar head will have a statically assigned IP Address of **192.168.0.5**

The 831L sonar head also supports the Universal Status Packet format.
Refer to document number “**425-014**” for details.

SWITCH DATA COMMAND

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

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

Byte #	Description							
0 – 7	0xFE	0x44	Reserved 0	Range Index	Reserved 0	Reverse	Reserved 0	Reserved 0
8 – 15	Start Gain	Reserved 0	Absorption	Train Angle	Sector Width	Step Size	Pulse Length	Profile MinRange
16 – 23	Reserved 0	Reserved 0	Reserved 0	Data Points	Data Bits	Sensor Command	Profile	Motor Calibrate
24 – 26	Reserved 0	Freq- uency	Term. 0xFD					

Table 1 Model 831L 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 0x44 (68 decimal)
Byte 2	Reserved Always 0
Byte 3	Range Index 12.5cm to 6 meters 2 = 12.5cm 4 = 25.0cm 6 = 50.0cm 8 = 75.0cm 10 = 1.0m 20 = 2.0m 30 = 3.0m 40 = 4.0m 50 = 5.0m 60 = 6.0m
Byte 4	Reserved Always 0
Byte 5	<i>(ignored in Fixed transducer sonars – Sonar Type = 1)</i> Reverse Bit 0 - 0 Bit 1 - 0 Bit 2 - 0 Bit 3 - 0 Bit 4 - 0 Bit 5 - 0 Bit 6 - 1 = Reverse Step Direction, 0 = Normal Operation Bit 7 - 0
Bytes 6-7	Reserved Always 0
Byte 8	Start Gain 0 to 40dB in 1dB increments

Byte 9	Reserved Always 0
Byte 10	Absorption 0 to 255 = 0.00dB/m to 2.55dB/m Byte 10 = absorption_in_dB_per_m * 100 Do not use a value of 253!
Byte 11	<i>(ignored in Fixed transducer sonars – Sonar Type = 1)</i> Train Angle 0 to 120 (-180 Deg to +180 Deg = 360 Deg Total) in 3 Degree steps. Byte 11 = (train_angle_in_degrees + 180)/3 i.e. 0 = -180 Degrees 30 = -90 Degrees 60 = 0 Degrees 90 = +90 Degrees 120 = +180 Degrees
Byte 12	<i>(ignored in Fixed transducer sonars – Sonar Type = 1)</i> Sector Width 0 to 120 (0 Deg to 360 Deg) in 3 Degree steps Byte 12 = sector_width_in_degrees/3 i.e. 0 = 0 Degrees 30 = 90 Degrees 60 = 180 Degrees 120 = 360 Degrees
Byte 13	<i>(ignored in Fixed transducer sonars – Sonar Type = 1)</i> Step Size Fixed Step Size i.e. 0 = No Step 3 = 0.9 Degrees/Step • All other values are invalid.
Byte 14	Pulse Length Length of acoustic transmit pulse. 1-100 → 1μs to 100μsec in 1μs increments Byte 14 = pulse_length_in_microseconds
Byte 15	Profile Minimum Range Minimum range for profile point digitisation 0 – 250 → 0 to 2.5 meters in 0.01 meter increments Byte 15 = min range in meters * 100

Bytes 16 - 18 **Reserved**
Always 0

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

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 **Pitch Roll Command**
Bit 0 - 1 = Interrogate PR sensor
Bit 1 - 0
Bit 2 - 0
Bit 3 - 0
Bit 4 - 0
Bit 5 - 0
Bit 6 - 0
Bit 7 - 1 = Calibrate Pitch / Roll

- Before issuing a PR calibrate command, ensure that the sonar is motionless, and level in all directions.

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

Byte 23 *(ignored in Fixed transducer sonars – Sonar Type = 1)*
Motor Calibrate
0 = Normal Operation
1 = Calibrate sonar head transducer (move to 0 degrees).

Byte 24 **Reserved**
0

Byte 25 **Frequency**
2.25MHz +/- 100kHz (*Sonar Type = 0*)
80 – 120 → 2.15MHz to 2.35MHz in 5kHz increments
Byte 25 = (frequency_in_khz - 2250)/5 + 100
1.00MHz +/- 100kHz (*Sonar Type = 1*)
80 – 120 → 900kHz to 1.10MHz in 5kHz increments
Byte 25 = (frequency_in_khz - 1000)/5 + 100

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

SONAR RETURN DATA

Every shot, the head returns a 32 Byte header, 0 or 250 points of echo data, and a terminating byte value of 0xFC. The **total number of bytes (N)** returned will be 33, or 283.

Byte #	Description							
0 to 7	ASCII 'T'	ASCII 'M', or 'P'	ASCII 'X'	Sonar Type	Status	Head Pos (LO)	Head Pos (HI)	Range Index
8 to 15	Prof Rng (LO)	Prof Rng (HI)	Data Bytes (LO)	Data Bytes (HI)	Reserved 0	Reserved 0	Reserved 0	Reserved 0
16 to 23	Roll Angle (LO)	Roll Angle (HI)	Pitch Angle (LO)	Pitch Angle (HI)	Roll Acc (LO)	Roll Acc (HI)	Pitch Acc (LO)	Pitch Acc (HI)
24 to 31	Reserved 0	Reserved 0	Reserved 0	Reserved 0	Reserved 0	Reserved 0	Reserved 0	Reserved 0
32 to (N-2)	Echo Data 0, 250 Data Bytes							
N-1	Term. 0xFC							

Table 2 Model 831L 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

Bytes 0 - 2 **Imagenex Return Data Header**

ASCII **'IMX'** or **'IPX'**

'**T**' = 0x49, '**M**' = 0x4D, '**P**' = 0x50, '**X**' = 0x58

ASCII **'IMX'**

In response to a Switch Data Command with Data Points = 50
N = 283, (250 Data Bytes, 250 Points)

ASCII **'IPX'**

In response to a Switch Data Command with Profile = ON
N = 33, (0 Data Bytes, 0 Points)

Byte 3

Sonar Type

0 = Scanning Sonar (2.25MHz)

1 = Fixed Position Sonar (1.00MHz)

Byte 4

Status

- Bit 0 - 1 = Range Error
- Bit 1 - 1 = Frequency Error
- Bit 2 - 1 = Internal Sensor Error (or not present if interrogated)
- Bit 3 - 0
- Bit 4 - 0
- Bit 5 - 0
- Bit 6 - 0
- Bit 7 - 1 = Switches Accepted

Bytes 5 - 6

(Fixed transducer sonars – Sonar Type = 1 returns 0)

Head Position

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

Head Pos (LO), Head Pos (HI), Step Direction (D)

Head Pos High Byte = (Byte 6 & 0x3E)>>1

Head Pos Low Byte = [((Byte 6 & 0x01)<<7) | (Byte 5 & 0x7F)]

Head Position = (Head Pos High Byte<<8) | Head Pos Low Byte

Head Position = 0 to 1200 (-180 to +180 Degrees) in 0.3 Degree steps

0 = -180 Degrees

300 = -90 Degrees

600 = 0 Degrees (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 6 & 0x40)>>6

0 = counter-clockwise

1 = clockwise

Byte 7 Range Index
 Sonar range from 12.5cm to 6 meters
 2 = 12.5cm
 4 = 25.0cm
 6 = 50.0cm
 8 = 75.0cm
 10 = 1.0m
 20 = 2.0m
 30 = 3.0m
 40 = 4.0m
 50 = 5.0m
 60 = 6.0m

Bytes 8 - 9 Profile Range
 First digitised range value above threshold in centimetres
 Prof Rng (LO), Prof Rng (HI)

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

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

Bytes 10 - 11 Data Bytes
 Number of Echo Data Bytes returned
 Data Bytes (LO), Data Bytes (HI)

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

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

Bytes 12-15 Reserved
 Always 0

Bytes 16-17 **Roll Angle**

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

The Roll angle is a 14bit **two's compliment** number with 0.025° per bit.

ND = New Data Flag

EA = Error Alarm

Roll Angle = [(Byte17 &0x3F) <<8] | Byte16

Bytes 18-19 **Pitch Angle**

Byte 18								Byte 19							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Pitch Angle (LO)								ND	EA	Pitch Angle (HI)					

The Pitch angle is a 14bit **two's compliment** number with 0.025° per bit.

ND = New Data Flag

EA = Error Alarm

Pitch Angle = [(Byte19 &0x3F) <<8] | Byte18

Bytes 20-21 **Roll Acceleration**

Byte 20								Byte 21							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Roll Acceleration (LO)								ND	EA	Roll Acceleration (HI)					

The Roll Acceleration is a 14bit **two's compliment** number with 0.24414mg per bit.

ND = New Data Flag

EA = Error Alarm

Roll Acceleration = [(Byte21 &0x3F) <<8] | Byte20

Bytes 22-23 **Pitch Acceleration**

Byte 22								Byte 23							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Pitch Acceleration (LO)								ND	EA	Pitch Acceleration (HI)					

The Pitch Acceleration is a 14bit **two's compliment** number with 0.24414mg per bit.

ND = New Data Flag

EA = Error Alarm

Pitch Acceleration = [(Byte23 &0x3F) <<8] | Byte22

Bytes 24 – 31 **Reserved**
Always 0

Byte 32 **Start of Echo Data**
(N-33) Bytes of data

If Header is ASCII **IMX**:

N = 283, (250 Data Bytes, 250 Points)

1st Range Point = Byte 32

2nd Range Point = Byte 33

3rd Range Point = Byte 34

4th Range Point = Byte 35

etc. ...

If Header is ASCII **IPX**:

There is no echo data and this byte is the termination
byte **0xFC** (N = 33). Use Profile Range Bytes from the Header.

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

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

**IMAGENEX MODEL 831L
DIGITAL SONAR HEAD**

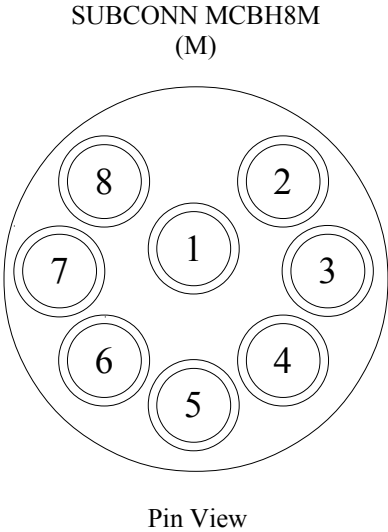
SCANNING SPEEDS

RANGE (Meters)	SPEED (°/sec)	SPEED (sec/360°)	STORAGE (MByte/hr)
6	90	4.0	~180
5	103	3.5	~200
4	120	3.0	~250
3	144	2.5	~300
2	180	2.0	~390
1	257	1.4	~540
0.75	277	1.3	~600
0.50	300	1.2	~600
0.25	300	1.2	~600
0.13	300	1.2	~600

Using PipeSoanrL.EXE v1.0.0.3, on Intel Core2 6600 (2.4GHz), 2GB Ram,
GeForce 7950GT running Windows XP Home, Service Pack 3.

831L Pin-Out

PIN	FUNCTION
1	VIN -
2	TX +
3	VIN +
4	TX -
5	RX +
6	RX -
7	N/C
8	N/C

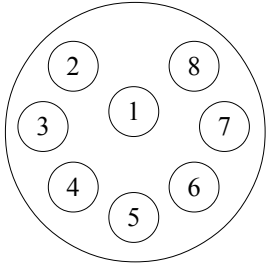


* Mates with SUBCONN MCIL8F

IMAGENEX TECHNOLOGY CORP.		
Title: 831L Pin-Out Drawing		
Document Number: 831-200-332		Rev 00
Date: March 13, 2014	Sheet 1 of 1	

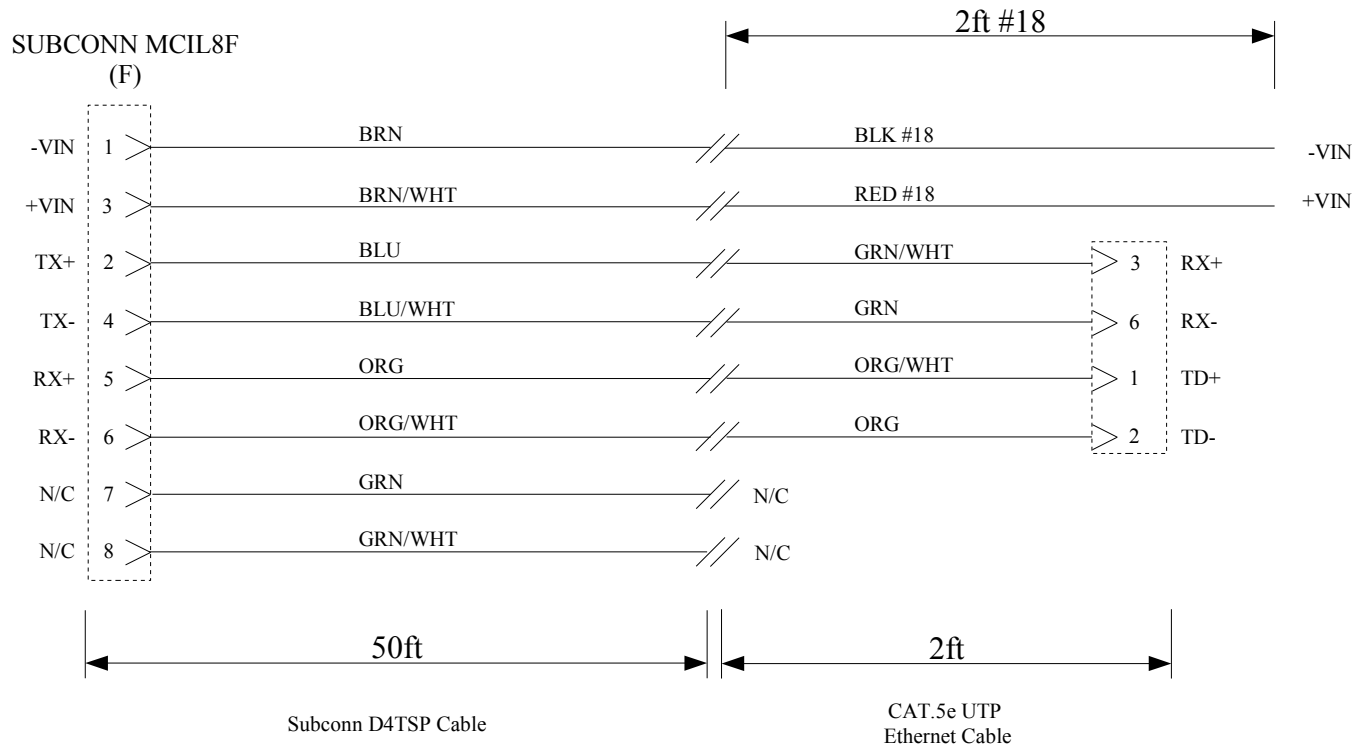
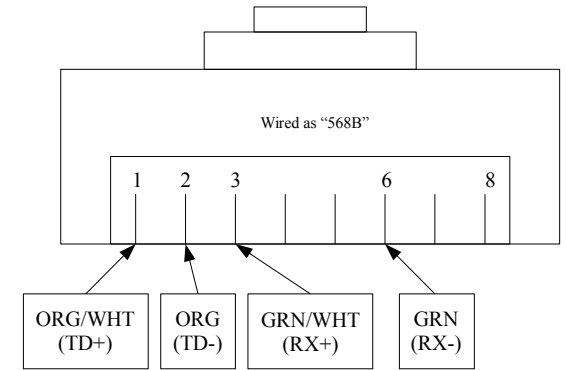
SUBCONN MCIL8F

(F)



Socket View

RJ-45 Connector



IMAGENEX TECHNOLOGY CORP.		
Title:	Model 831L Cable (Subconn D4TSP)	
Document Number:	837-200-260	Rev 00
Date:	January 18, 2013	Sheet 1 of 1