Manual

Naxys Ethernet Hydrophone
Model no.02345

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2. Spesifications

Parameters	Value	Units/ Comments
Hydrophone sensitivity	-179	dB rel V/µPa
Element sensitivity, typical	-211	dB rel V/µPa
Frequency range	5 – 300 k	Hz
Operational depth	3000	m
Directivity pattern	Omni directional	Ref to axis
Digital resolution	16	bit
Power supply recom. value	9 – 18	V
Power prot.shut off voltage	24	V
Short circuit protection	0,5	A
Current drain, average	230	mA
Sensitivity accuracy	+/- 3	dB
Sampling frequency	6-12-24-48-96-192-384-768	kHz
Gain levels	0-10-20-40	dB (from April 08, or 30dB)
Analogue output	0 to +/-2.5 (max)	V (from April 08)
Analogue output sensitivity		(from April 08)
Digital Interface	Ethernet 100BASE-Tx	
Temperature range	-2 to +45 / -25 to +85	deg C (operational/storage)
Dimensions	357 / 64	mm (length / diameter)
Weight, in water	1,9	kg
Weight, in air	2,6	kg
Connector type, on cable	55A1-1508 Burton	Stainless steel/polyurethane
Connector type, on housing	5507 1508 BCR Burton	Stainless steel/polyurethane
Cable, jacket mater. &dim	Polyurethane, 13,3	Diameter in mm
Cable, electr. characteristic	Power pair,1x AWG18pair	21,5Ω /km
Cable, electr. characteristic	Cat 5, 2x AWG26 pairs	CAT 5 standard (142 Ω/km)
Cable, depth rating	3000	M
Cab stre.memb.break. load	408 / 4000	kg / kN
Cable min bending radius	180	Mm
Cable weight in water	0,044	kg/m
Cable weight in air	0,185	kg/m
Housing of electronics	Stainless steel	316L

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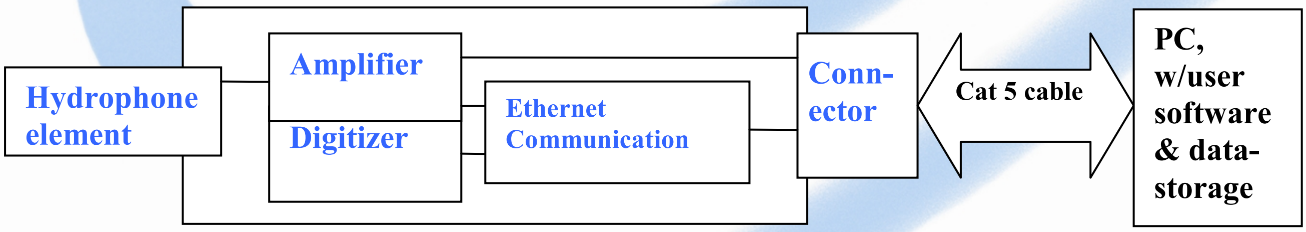
3. Functional view, with recommendations for use.

General:
The Naxys Ethernet hydrophone and cable (standard length of 10m always included if not specified otherwise), is manufactured to take the pressure of 3000m water depth. In such depths it requires of cause a waterproof termination in the pig tail of cable, that is qualified for actual depth. Standard delivery has a cable with open end on the external termination side. The max cable length for a Naxys E.Hydrophone is 100m independent of depth. (the same as a Cat5 cable for indoor installation).
Using the Ethernet terminal of the PC, makes the end user able to run a very field friendly acoustic monitoring system, by one or several Hydrophone units. Concerning the correlation between number of Hydrophone's and sampling frequency(total amount of data handled and stored in a PC), Naxys have tested up to 5 Ethernet hydrophones connected through 100m Cat5 cables to one Ethernet switch, and all at a sampling frequency of 768 kHz, without any loss of data.
The standard E.Hyd.has the frequency range of 5 Hz to 300 kHz.(Wide Band), and the hydrophone element is placed in an acoustically transparent compound, providing omni directional characteristics. The electronics have a 16 bit resolution, presentation of data is done by the Naxyx software and data analyzes can be done with any software like Matlab, Mathcad, Cooledit or LabVIEW. Sampling rate is selectable, as well as the gain. The hydrophone(s) can be armed for a specific monitoring period or can be manually started and stopped by operator. All displayed data can be stored by operator, in specified file names, identified by serial no and time of start recording.
Due to the heavy duty design, examples of applications within rough conditions are:

- **ROV operations**
- **Dredging operations**
- **Remote process monitoring, like oil or gas seabed platforms, including sub sea pumps and valves**
- **Trencher monitoring**
- **Background noise monitoring**
- **Cavitations measurement**
- **Marine research, safety in sea traffic, permanent port and coastal monitoring in real time.**
- **Environmental concerns due to activity that effect local environmental.**
- **Tsunami Early Warning System**



Block schematic description of Hydrophone

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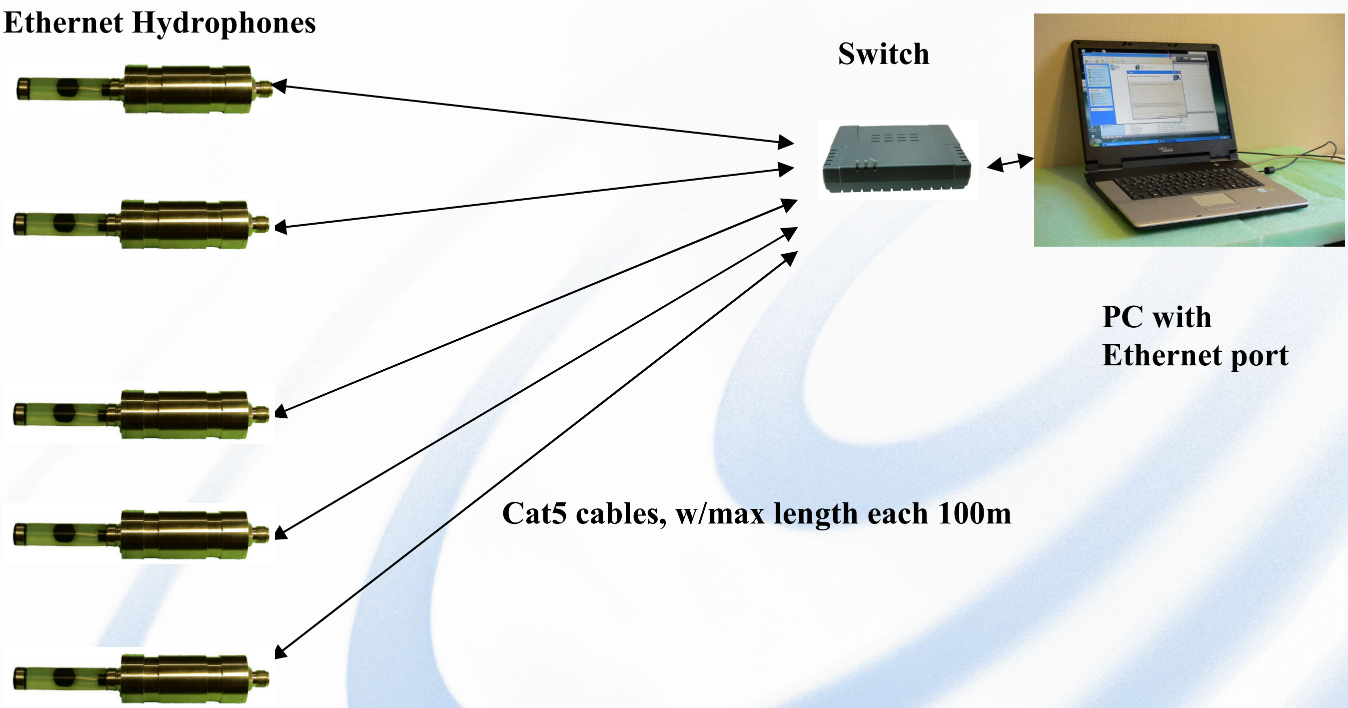
Below is shown an array of 5 Ethernet Hydrophones.
The cable lengths will not be effected by number of hydrophones, cable lengths are all individual concerns.
An array of several hydrophones can be a requirement for searching information enough to state the direction of a leakage whistle, or to collect a sound pattern consisting of several sources. The E.Hyd 02345 has also an Analogue signal output. This signal has a real time signal presentation, and can distribute the the signal on i.e. a load speaker. It requires a specially ordered cable, to support the analogue signal.



If installing the hydrophone when using frames or mechanical structures etc as support, be aware of possible noise by the mechanical vibration. POM as a material for clamps or similar, can be used to make a barrier against mechanical noise, that will limit this effect.
The stainless steel housing of the E.Hyd is electrically insulated from any electrical potential of the E.Hyd electronics, and no precautions is therefore necessary due to galvanic insulated clamps or fastening materials.
Acoustically considerations to limit unwanted shadow areas, must also be a part of the issues to obtain the best possible position for signal receipt. As long as an open location with free space around is not in conflict with other moving parts, the effort must be to utilize such a location. Generally, only the engineer that have the responsibility for the installation and also have access to the data, will be the expert of the actual installation and have the best recommendations for eventually a better position of a fixed hydrophone position.

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4. The Ethernet Hydrophone Manager software 02344

With the Ethernet Hydrophone Manager software you can configure and record acoustic data from one or more ethernet hydrophones. In a user friendly interface, you can configure each hydrophone with it's serial number, IP address, UDP port, sampling frequency, etc. A log session is started by pressing a button, or can be configured to start at a specified time.

The acoustic data is stored in the industry standard WAV audio file format. Additional information about the log sessions is stored in a text file named session.log. This file contains start and stop times for the log sessions, information about the hydrophones used and the amount of data recorded.

This chapter will guide you through the configuration and operation of the software.

Installation

The Ethernet Hydrophone Manager software requires Microsoft Windows XP or Microsoft Windows Server 2000 or newer with Microsoft .NET 2.0 installed.

To install the Ethernet Hydrophone Manager software, run setup.exe. This will guide you through the setup process. If the system lacks Windows Installer or Microsoft .NET 2.0, the setup program will ask if you want to install it. Provided you're connected to the internet, the setup program will automatically start the installation of these packages. After installing Windows Installer or Microsoft .NET 2.0, you must start setup.exe for the Ethernet Hydrophone Manager again.

When the installation is complete, the Ethernet Hydrophone Manager can be started from the *Start* menu's *All Programs* menu.

Getting started

This section will guide you through the process of configuring and running a simple log session using one single Ethernet Hydrophone. To run a log session you need the following:

- a PC with the Ethernet Hydrophone Manager software installed
- an ethernet switch
- a CAT5 ethernet cable
- an Ethernet Hydrophone
- an Ethernet Hydrophone cable
- a power supply

To avoid any network problems, we use our own separate network for this log session.

Connecting the hydrophones

Adjust the power supply to 12V DC. Connect the Ethernet Hydrophone to the power supply and the ethernet switch via the ethernet cable.

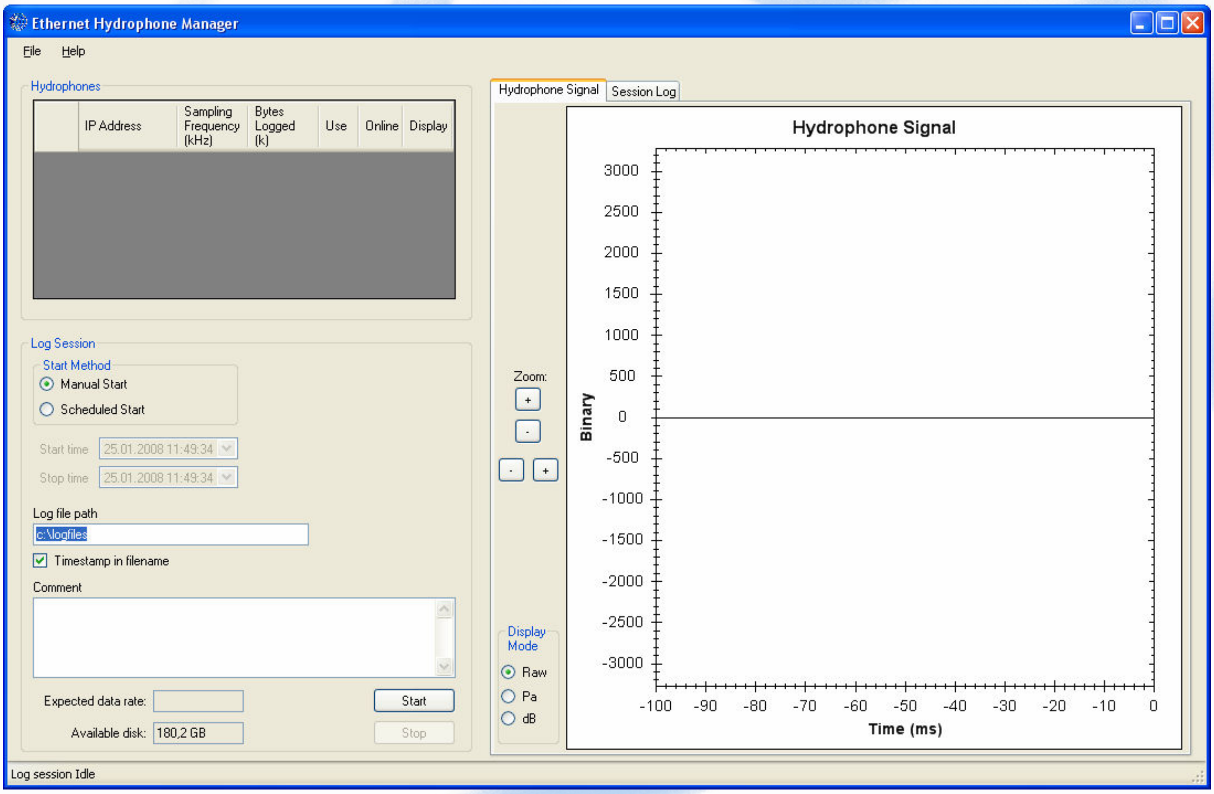
Connect the PC to the ethernet switch. To be sure the PC's IP address is within the correct range, we disable any DHCP settings and specify the PC's address manually:

1. Open Network Connections from the Start Menu, right-click the LAN connection and select Properties.
2. Select Internet protocol (TCP-IP) from the network elements list, and click the Properties button.
3. Click the "Use these IP addresses" and enter these addresses:

   IP address 10.0.0.14
   Subnet mask 255.255.255.0
   Default Gateway
4. Click the "Use these DNS server addresses. Leave the DNS Server fields blank.

Turn on the power supply. Start the Ethernet Hydrophone Manager program, by clicking 'EHyd' from the All Programs list in the Start menu. The first time the Ethernet Hydrophone Manager is started, you will see error messages informing you that it doesn't find the eHydConfig.xml and eHydData.xml files. This is just a warning telling you that the Ethernet Hydrophone Manager doesn't find any configuration and will use default values.

The Ethernet Hydrophone Manager's main window looks like this.



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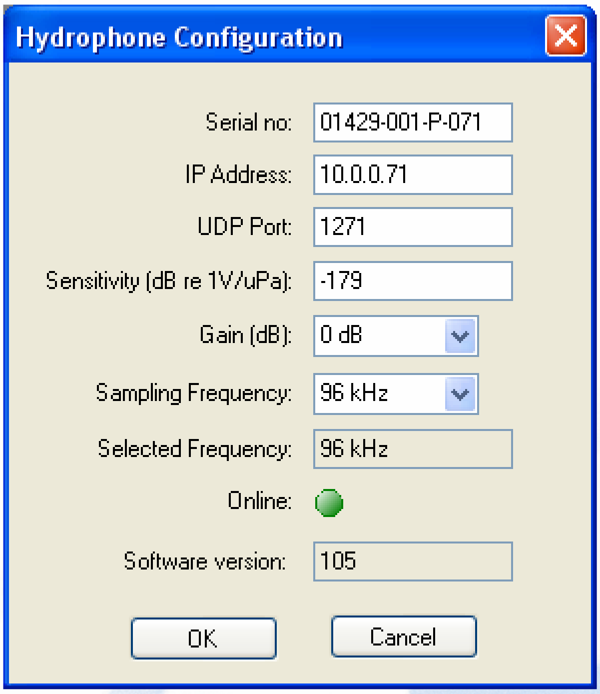
In the upper left area of the main window there is an empty hydrophone config box. To add a new hydrophone to the list, right-click in the Hydrophones list and select New. This will open a Hydrophone Configuration dialog:



Fill in the fields according to your hydrophone's specification. Pay special attention to the IP address and UDP Port fields: these must be correct in order to receive any data from the hydrophone.

Note that when you change the Sampling Frequency, the Ethernet Hydrophone Manager will try to connect to the hydrophone and try to configure the selected frequency. If the sampling frequency was successfully configured, the 'Online' indicator will turn green. The hydrophone's software version will be displayed as well. Press OK to accept the changes and return to the Ethernet Hydrophone Manager's main window.

Back in the main window, check the hydrophone's 'Use' field.

Make sure the 'Manual Start' start method is selected and that the log file path is set to a path you have write access to. In the 'Comment' field you may enter any text you want to appear in the session log. The 'Expected Data Rate' field contains the data rate the hydrophone will generate with the selected sampling frequency. The 'Available disk' field shows how much disk space is available for log data in the specified log file path. The main window will be displayed as below.

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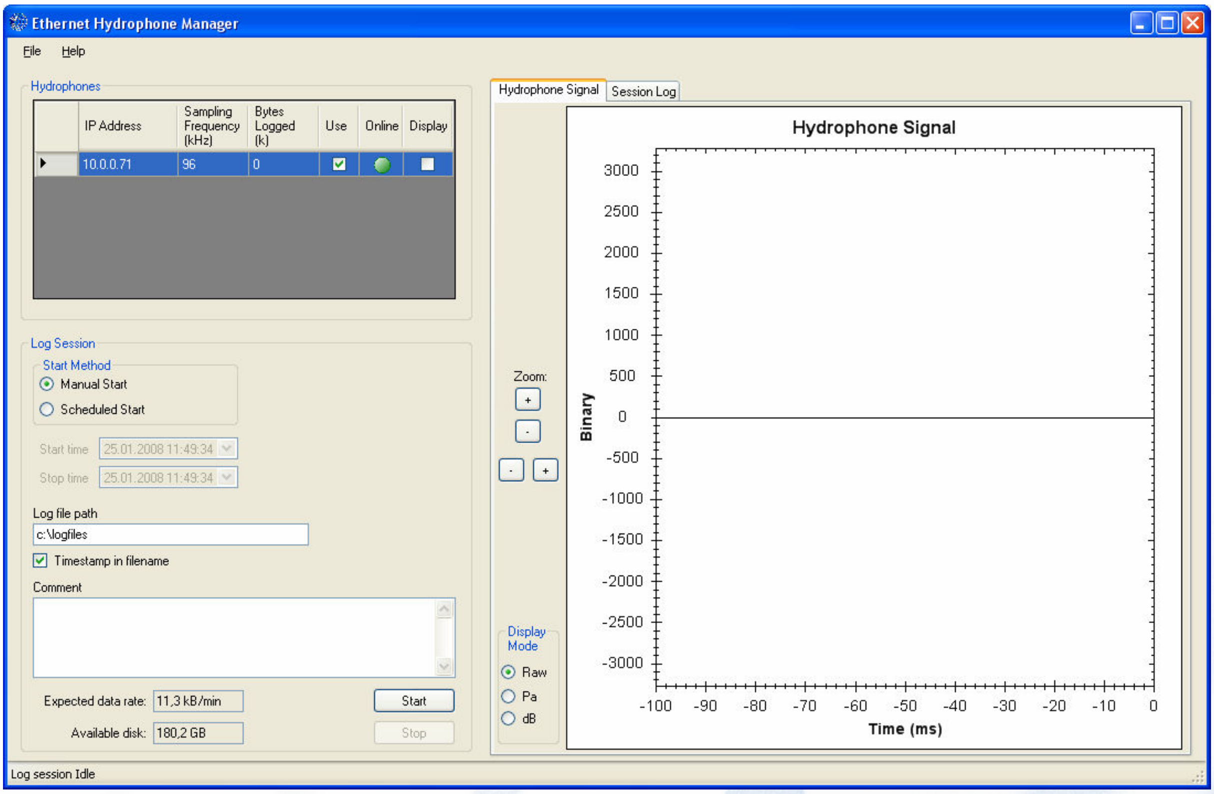
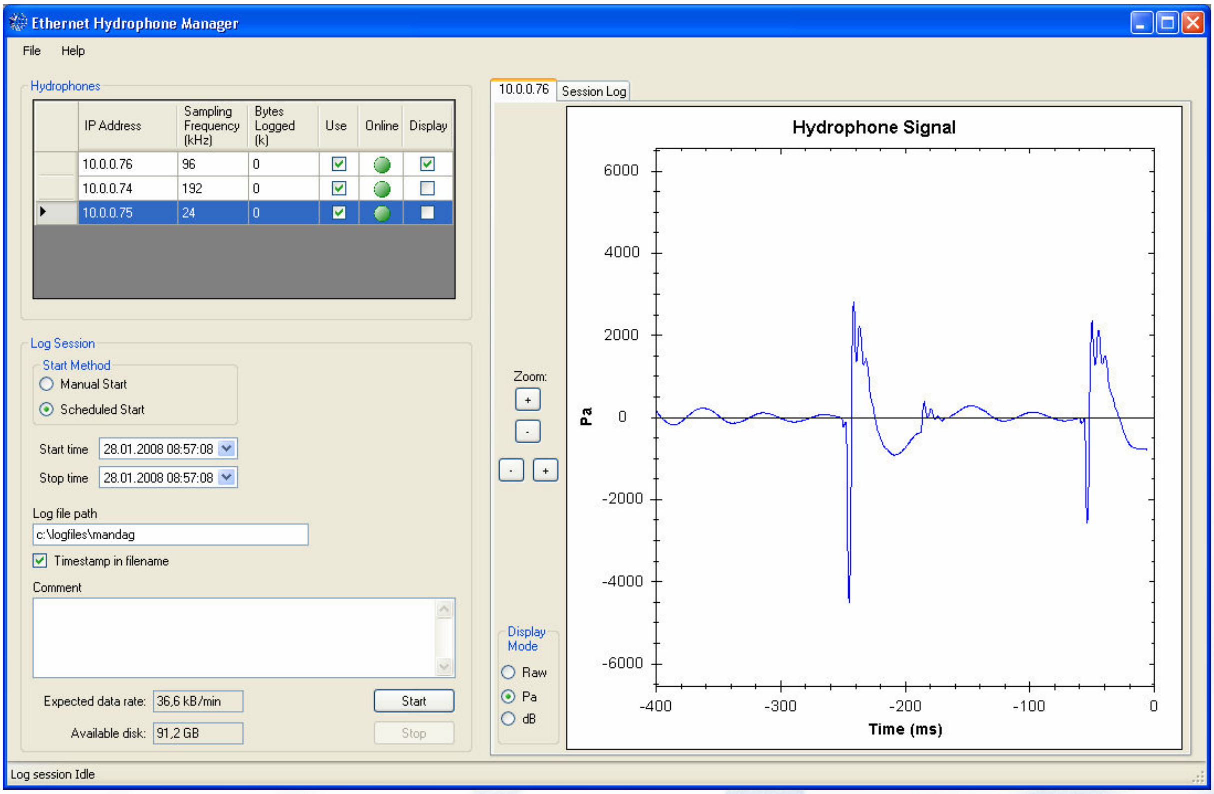


Press the 'Start' button to start the log session. If the specified log file path doesn't exist, the Ethernet Hydrophone Manager will ask if you want it to be created. Press 'Yes' to create the directory. The 'Start' button and the 'Log Session' fields will be disabled and the 'Stop' button will be enabled. After a few seconds, the 'Hydrophone Signal' window will show the signal being recorded. The hydrophone's 'Bytes Logged' column in the Hydrophones list will continuously be updated to show the amount of data logged.



The hydrophone signal is displayed in the right hand side of the window. Use the zoom buttons to scale the display to suit the signal.

Press ‘Stop’ to stop the log session. The recording will stop, the ‘Stop’ button will be disabled and the ‘Start’ button and the ‘Log Session’ fields will be enabled.

Press the ‘Session Log’ tab in the upper right part of the window. The Session Log contains detailed information about the log session, like the start and stop times, which hydrophones was used, and the amount of data logged.

```
14.01.2008 14:07:58 Starting Log Session
      Comment:
      My first Ethernet Hydrophone log session.
14.01.2008 14:07:58 Hydrophone(s):
      IP Address     Serial Number                    Samp.Freq.   Gain
      10.0.0.71      01429-001-P-071                   96 kHz       0 dB
14.01.2008 14:07:58 File(s):
      c:\logfiles\01429-001-P-071_20080114-140758.wav
14.01.2008 14:09:53 Hydrophone log session stopped
```

The name of the log files consists of the hydrophone’s serial number plus the date and time the log session started.

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Use Windows Explorer to open the log file directory (c:\logfiles in the session displayed in figure x.x). This directory will now contain two files: session.log and 01429-001-P-071-20080114-140758.wav. Session.log contains the same information as the 'Session Log' part in the Ethernet Hydrophone Manager. Information from new log sessions will be added to this file. 01429-001-P-071-20080114-140758.wav contains the recorded data from the hydrophone. The file name is constructed from the hydrophone's serial number and a timestamp defining the start time of the log session.

Networking considerations

Even though it is possible to run Ethernet Hydrophones in a LAN with other computers, it is recommended that Ethernet Hydrophone log sessions are run in a separate LAN. The Ethernet Hydrophones requires high bandwidth, especially when the sampling rate is high. Other network traffic uses some of the bandwidth, and may result in loss of data.

Ethernet Hydrophone Manager Reference

Main Window

The Ethernet Hydrophone Manager's main window contains three main parts:

Hydrophones	A list of hydrophones available for logging. The hydrophones that will actually be used in a logging section are selected from this list.
Log Session	Configuration for a log session, how and when it will be started, where the recorded files are stored etc.
Graphical Section	This part of the screen contains two tabs: a graphical view of the hydrophone's signal and a detailed session log with information about each log session.

Columns in the Hydrophones list

Name	**Access**	**Description**
IP Address	r/o	The hydrophone's IP address.
Sampling Frequency	r/o	The frequency at which the hydrophone will sample the data.
Bytes Logged	r/o	The amount of data logged in the current/last session.
Use	r/w	Check this field to include the hydrophone in the log session.
Online	r/o	Green – the hydrophone is online Red – no contact with the hydrophone.
Display	r/w	Selects the hydrophone that will be displayed in the 'Hydrophone Signal' window. Only one hydrophone can be displayed at a time: selecting a different hydrophone will deselect the current hydrophone.

Selecting a hydrophone in the list and right clicking the mouse in the Hydrophones list will display a context menu:

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New…	Add a new hydrophone to the hydrophone list. This opens the Hydrophone Configuration dialog.
Edit…	Open the Hydrophone Configuration dialog for this hydrophone.
Delete	Delete this hydrophone.

Fields and buttons:

Start Method	Select 'Manual Start' or 'Scheduled Start'. When 'Manual Start' is selected, the recording will start immediately when the Start button is pressed. When 'Scheduled Start' is selected, the recording will start at the time specified in 'Start time' and stop at the time specified in 'Stop time' or when the 'Stop' button is pressed.
Start time	The time a log session is started when 'Scheduled Start' is selected.
Stop time	The time a log session is stopped when 'Scheduled Start' is selected.
Log File Path	The path to the directory where the recorded files are stored.
Timestamp in filename	If checked the log file names will consist of the hydrophone's serial number + a timestamp. If not checked the log file names will consist of only the hydrophone's serial number.
Comment	The content of this field is included in the session log at the start of a log session.
Expected data rate	The total data rate that will be generated by the selected hydrophones with the configured sampling frequencies.
Available disk	The disk space available for data logging, i.e. the free disk space on the disk specified in the log file path.
Start	Starts a log session. If the Start Method is set to Manual Start, the log session is started immediatly. If the Start Method is set to Scheduled Start, the log session is started at the time defined by Start Time.
Stop	Stops a log session. A running log session is stopped regardless of what Start Method is chosen.

Hydrophone Signal

This is a graphical view of a hydrophone's signal. The signal is displayed in near real-time when a log session is running. The hydrophone is selected by the Display column in the Hydrophones list. If no hydrophone is selected when a log session is started, the first 'used' hydrophone in the list is displayed.

The graphical view contains 2 buttons for vertical zoom and 2 buttons for horizontal zoom. These can be used to scale the display to suit the measured signal.

The display mode alternatives are

Raw	Display the signal as raw binary data as received recorded by the hydrophone.
Pa	Display the signal as pressure in Pascal. The value is calculated using the value of the *Sensitivity* as specified in the *Hydrophone Configuration Dialog*
dB	Display the signal in decibel.

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Session Log
The Session Log contains a series of events that occurred during a log session. Each event consists of a time stamp and a descriptive text.

The level of details of the Session Log is determined by the *Session Log level* in the *Preferences* dialog. The default *Session Log level* is *Warning*.

Hydrophone Configuration Dialog

Serial no	r/w	The hydrophone's serial number as supplied by Bjørge Naxys.
IP Address	r/w	The hydrophone's IP address.
UDP Port	r/w	The UDP port number that will be used for sending hydrophone data from the hydrophone to the PC.
Sensitivity	r/w	The hydrophone's sensitivity in dB re 1V/uPa. The value is used when displaying the hydrophone signal in Pa or dB mode.
Gain	r/w	The setting for the hydrophone's programmable gain. If the hydrophone is online, the values in the drop-down list reflect the gain setting supported by the hydrophone. Not all versions of the hydrophone supports programmable gain.
Sampling Frequency	r/w	The hydrophone's sampling frequency. If the hydrophone is online the values in the drop-down list reflect the sampling frequencies supported by the hydrophone.
Selected Frequency	r/o	The configured sampling frequency returned by the hydrophone.
Online	r/o	Green – the hydrophone is connected to the network Red – no contact with the hydrophone
Software version	r/o	The version of the hydrophone's software version.

Preferences Dialog

UDP Receiver priority	r/w	The UDP Receiver process's priority. The default value is *High*
Graph update interval	r/w	The time in ms between each update of the hydrophone signal graph.
Default Hydrophone Sensitivity	r/w	The default hydrophone sensitiviy used in the *Hydrophone Sensitivity* dialog
Session Log level	r/w	The detail level of the Session Log. *Minimum* is the lowest level of details, *Trace* gives the highes level of details. Normally the Session Log level should be set to *Warning*.
Date in Session Log timestamp	r/w	If checked, the timestamps in Session Log contain the date as well as hours, minutes and seconds.

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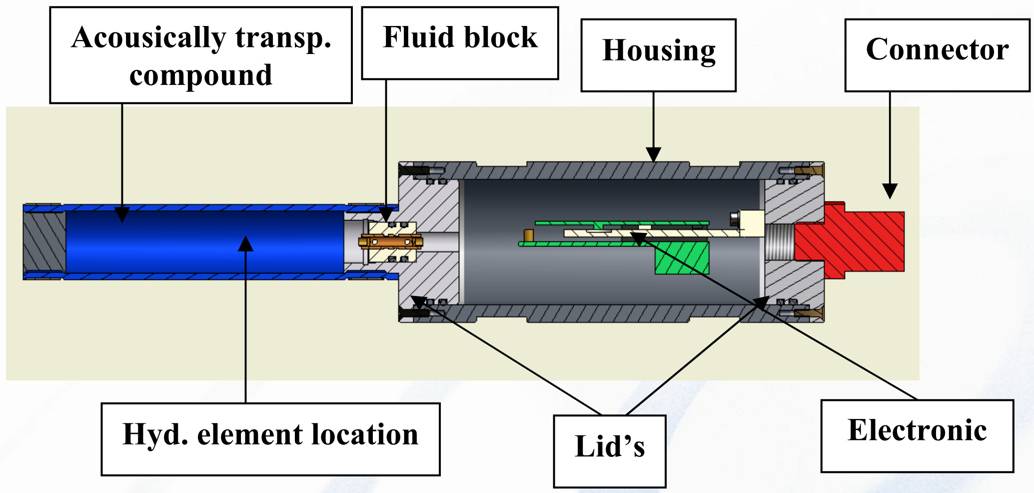
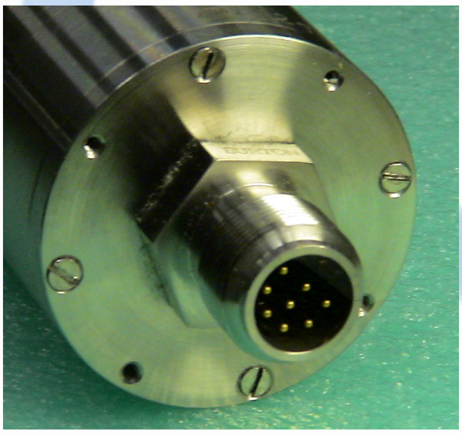
5. Hardware, materials, cable

Main components in the NAXYS Ethernet Hydrophone

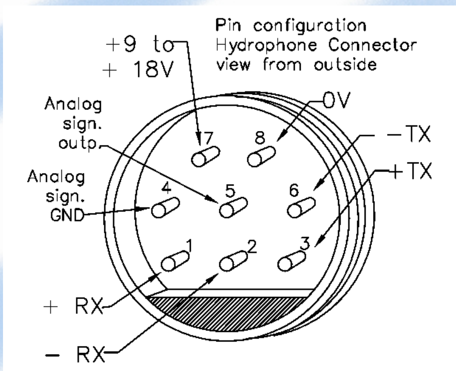


Length 357mm.. Diameter 64mm
Weight 2,6Kg

Construction:
The sensor element of the Naxys E.Hyd. is encapsulated in an acoustical transparent compound, providing Omni directional caracteristics. A 8 pin chassis connector is attached at the rear end of the housing leading power and TX/RX signals. All parts are specified to a depth of 3000m, Housing made of stainless steel.



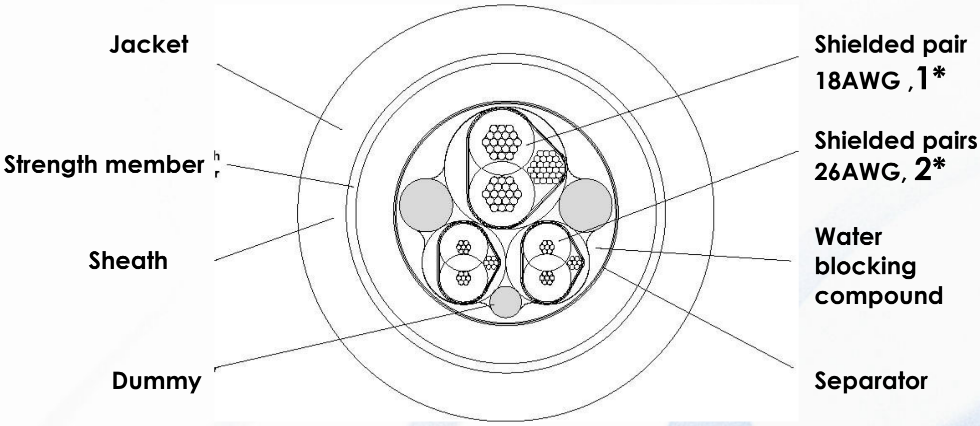
Pin config; Burton connector



Hydrophone Cable, cross section seen at **open end side.**

Cable Cat5; INTERCOND code : 11 - PSB18Z06P - A1

(recommended cable type, also standardized by Naxys for the Eternet Hydrophones)



Colours/polarity, PAIR ref **1***

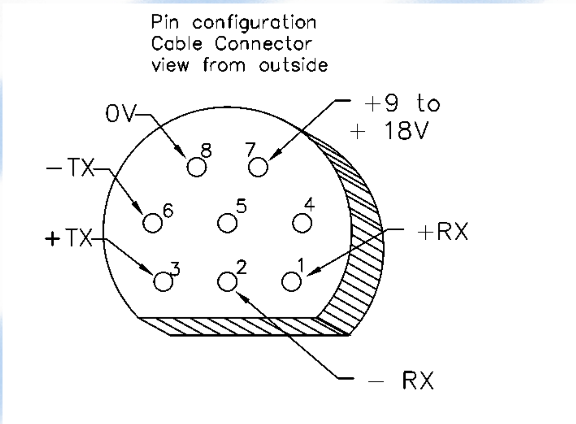
AWG 18	Red	**Power +**(+9 to +18V)
AWG 18	Blue	**Power -** (0V)

Colours/polarity, PAIR ref **2***

AWG 22	**White**	(from Hyd) **TX -**
AWG 22	**White/blue**	(from Hyd) **TX +**

Colours/polarity, PAIR ref **2***

AWG 22	**White**	(from Hyd) **RX -**
AWG 22	**White/red**	(from Hyd) **RX +**



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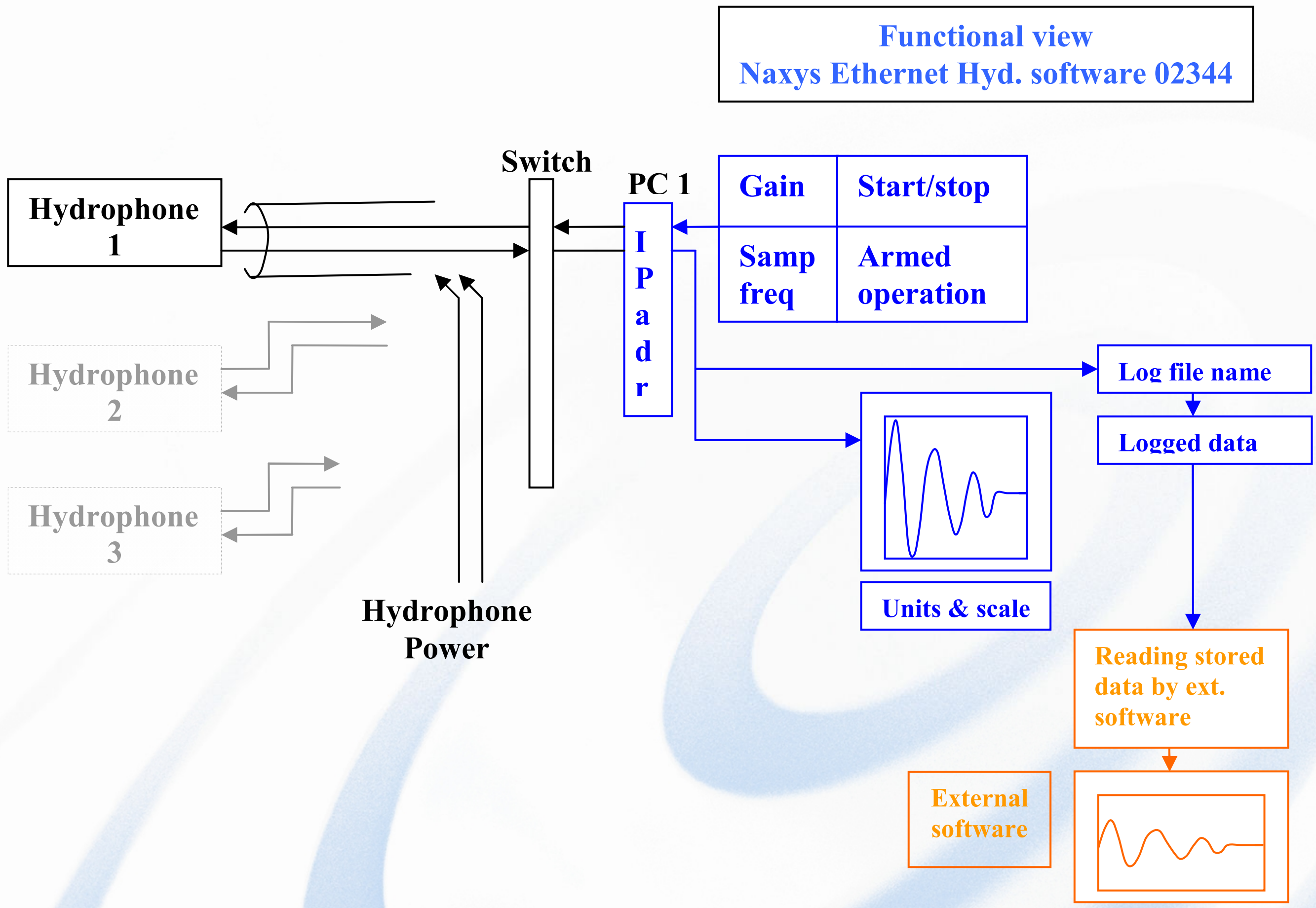

Appendix A. WAW header format

”RIFF” file description header	4 bytes	The ascii text string RIFF
Size of file	4 bytes	The file size less the size of the RIFF description and the size of file description. This is usually file size – 8.
“WAVE” description header	4 bytes	The ascii text string WAVE
fmt description header	4 bytes	The ascii text string fmt + trailing space
Size of wave section chunk	4 bytes	The size of the wave type format (2 bytes) + mono/stereo flag (2 bytes) + sample rate (4 bytes) + bytes/sec (4 bytes) + block alignment (2 bytes) + bits/sample (2 bytes). This is usually 16 (or 0x10).

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Wave type format	2 bytes	Type of wave format. This is a PCM header, or a value of 0x01.
Mono/stereo	2 bytes	Mono (0x01) or stereo (0x02)
Sample rate	4 bytes	Sample rate
Bytes/sec	4 bytes	Bytes/second (sample rate * block align)
Block alignment	2 bytes	Block alignment
Bits/sample	2 bytes	Bits/sample (16bit, 24bit …)
"PAD"	4 bytes	The ascii text string PAD + trailing space
Size of pad section chunk	4 bytes	The size of the pad section chunk
PAD section data|	32 bytes	The date and time of file creation and some control bytes. 4 bytes day 4 bytes month 3 bytes date 2 bytes hour 1 byte ascii colon character (:) 2 bytes minutes 1 byte ascii colon character (:) 2 bytes seconds 1 byte ascii dot character (.) 3 bytes milliseconds 1 bytes Packet counter 1 byte Rec mode
Data description header	4 bytes	The ascii text string data
Size of data chunk	4 bytes	Number of bytes of data is included in the data section. Size of file – 76.
Data	Unspecified data buffer	Your data.

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Appendix B. Ethernet Hydrophone UDP Data Format

This is a description of the UDP packages that the ethernet hydrophone is sending.

Byte No.	Content
0	Packet counter. This is a counter that increases with one for each UDP package that is sent.
1	This is a bit map with information about the number of channels, gain setting and sampling rate. Bit 0, 1 Channels Bit 2, 3 Gain setting: xxxx11xx = 0 dB xxxx10xx = 10 dB xxxx01xx = 20 dB xxxx00xx = 40 dB Bit 4 – 7 Sampling rate: 1110xxxx = 768 kHz 1101xxxx = 384 kHz 1100xxxx = 192 kHz 1011xxxx = 96 kHz 1010xxxx = 88.2 kHz 1001xxxx = 48 kHz 1000xxxx = 44.1 kHz 0111xxxx = 24 kHz 0110xxxx = 12 kHz 0100xxxx = 11.025 kHz 0011xxxx = 8 kHz 0010xxxx = 6 kHz 0001xxxx = 5.5125 kHz 0000xxxx = 2 kHz
2 .. 1025	Hydrophone data. 2 bytes per sample. 1 package contaisn 512 samples.

The total size of a data packet is 1026 bytes.

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Appendix C. Ethernet Hydrophone Communication Protocol

The ethernet hydrophone communicates over ethernet using the HTTP protocol. This gives the user the ability to change the configuration of the hydrophone and to start or stop it through this java applet. You can use a regular HTTP POST call to the hydrophone with the right text string of information to it and the hydrophone will do as it is told. The information you can send to it is the sample rate and information to start or stop sending data via UDP. Examples of text strings are:

- sample_rate=768kHz --> Change sample frequency to 768kHz
- sample_rate=6kHz --> Change sample frequency to 6kHz
- startstop=1 --> Switch to UDP mode and start sending data

The example below uses Java to configure hydrophone, but it is also possible to use similar techniques in other programming languages.

```
private void updateEHydSettings(String sampleRate) throws Exception{
String utf = "UTF-8";
URL url;
URLConnection urlConn;
DataOutputStream printout;
DataInputStream input;
String ipAddress = "10.0.0.71";
url = new URL("http://" + ipAddress);
urlConn = url.openConnection();
urlConn.setDoInput(true);
urlConn.setDoOutput(true);
urlConn.setUseCaches(false);
urlConn.setRequestProperty("Content-Type","application/x-www-form-
urlencoded");
printout = new DataOutputStream(urlConn.getOutputStream());
String data = URLEncoder.encode("sample_rate",utf) + "=" +
                URLEncoder.encode(sampleRate,utf) + "&" +
                URLEncoder.encode("submit",utf) + "=" +
                URLEncoder.encode("Submit",utf);
printout.writeBytes(data);
printout.flush();
printout.close();
String str;
input = new DataInputStream(urlConn.getInputStream());
BufferedReader reader = new BufferedReader(new InputStreamReader(input));
while(null != ((str = reader.readLine()))){
}
reader.close();
input.close();
startEHyd();
}
```


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The line numbers are used only to ease the explanation of the code and to refer to the line numbers as we describe the code.
Line numbers 1 through 8 represent initializing of variables. We establish a set of objects to read and write to a data stream. We also create a object for URL communication. In addition we create a text string with the text UTF-8 as value. UTF-8 stands for Unicode Transformation Format and is the format used to send data via URL communication. UTF-8 has a more comprehensive character set than the ASCII character set has and is used very widespread in internet communications because internet is used by many different languages (character sets).
On the lines 11 through 15 the connection is opened and a few parameters for the type of communication are set. Line 15 is used to tell the program to use URL encoded form request for this communication.
Line 17 opens a data output stream, the stream to the hydrophone.
Line 18 through 21 creates the string we wish to send to the hydrophone. The string contains information about the sample rate we want to use and that it is a submit request we are sending. The string will look like this when its sent: Sample_rate=44,1kHz&submit=Submit
In line 25 through 27 the string is sent to the hydrophone and the stream is closed afterwards.
The lines 31 through 36 take care of the response from the hydrophone in this case only read it and ignores it. The hydrophone will always send its main web page as response to a POST call. The streams are closed afterwards.
In line 38 a call is made to make the hydrophone start sending UDP data. The only difference in the code here from that explained earlier is the string sent to the hydrophone which now contain the string startstop=1&submit=submit instead.

Stopping the hydrophone data transmission is done by sending a UDP message containing the string “STOP”. When the hydrophone is transmitting data, it is in UDP mode, and ignores all TCP packages, including HTTP requests.

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