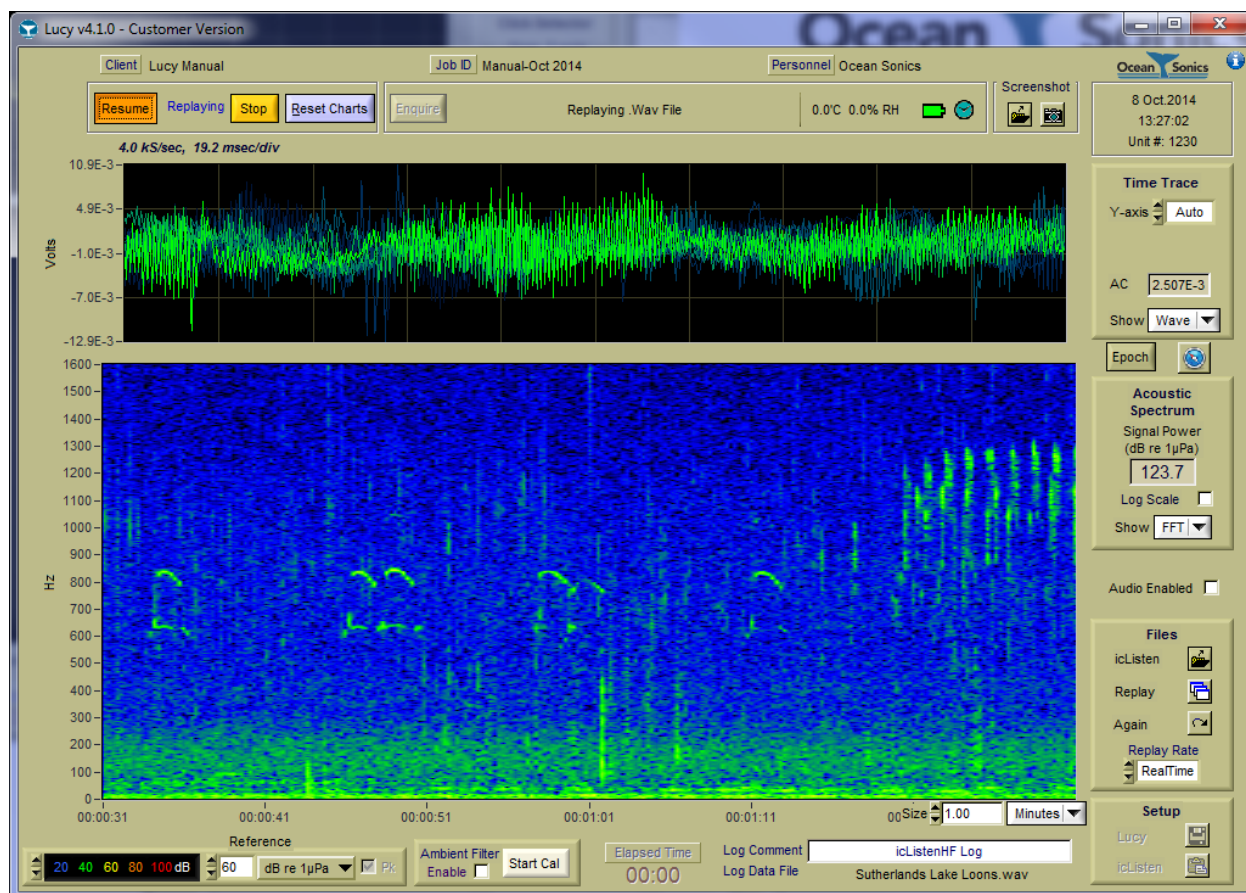


Lucy 4.1 User's Guide

Oct. 10, 2014



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1 Using the Lucy™ Software

The software used to talk to the **icListen** family of instruments is called **Lucy**. It is a PC program that presents data to the operator in a graphical and numerical format.

The interaction of the software has been designed for field operations personnel, making it highly task focused.

This document outlines the operation of the **Lucy** 4.1 software.

2 Getting started

This section describes how to start the program and connect to an **icListen** unit.

2.1 Starting the Program

If the software is not yet installed, run the **Lucy** installer provided with your **icListen**.

Start-up of **Lucy**, as with other Windows applications, can be done from the Windows 'Start' menu, or a shortcut can be created to start directly from the desktop. It can be found on the start menu under:

Start->All Programs->Ocean Sonics->Lucy.

It is important to note that **Lucy** remembers the state of the program as it is being used. This means that if the program must be stopped for some reason, settings and options are remembered. This saves the operator from the worry of having to reconfigure those settings whenever the program is started.

One or two settings are not remembered, by design, at startup to prevent possible confusion. Currently the ambient noise filter is turned off at startup, regardless of its previous status.

2.2 Using Lucy

Lucy can be used in both online and offline mode.

The main mode is online mode, which includes a connection to an **icListen** instrument. In this mode all options applicable to the connected instrument are available, including: collecting, logging and triggering from live data in real time. For instructions on how to connect to an **icListen** see the *Link Setup* section.

Offline mode is used to replay previously logged files, logged either by **Lucy** or by an **icListen** unit. All data viewing options are available while replaying files. Epoch triggering is also available on replayed data. For more details on offline operation, see the *File Replay – Offline Operation* section.

3 Main Display

The main display contains two charts, and the controls needed during offline/online operation. This is the screen that appears at program start-up. This section details the display options and their controls.

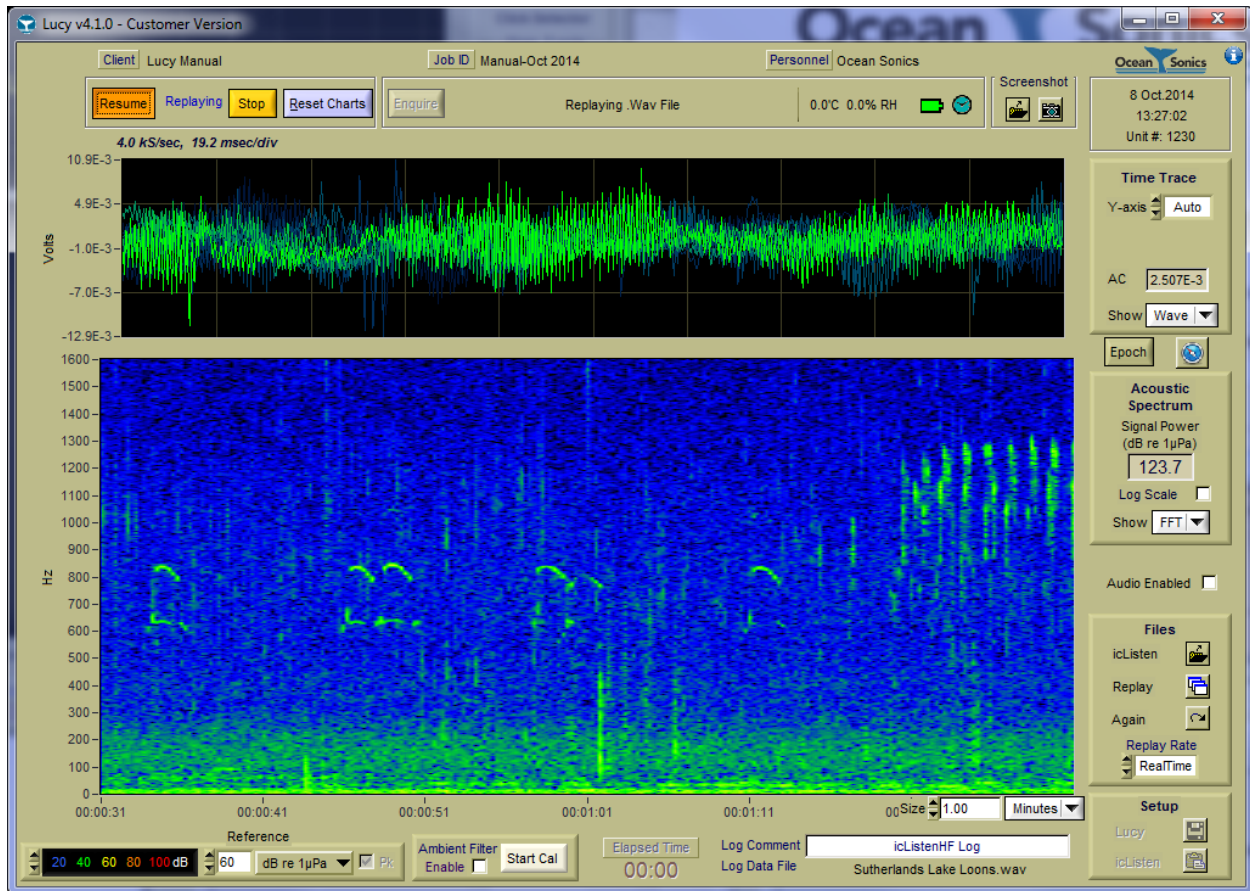


Figure 3-1: Lucy Main Display

3.1 Charts

The display contains up to two charts. There are dropdown menus to the right of each chart position, to select which charts are visible. There are multiple chart options in **Lucy**. The upper chart can be set to Wave, Single FFT, Click Detector, or RMS/ pk-pk and the lower chart displays FFT spectrogram data. If either of the charts is set to off, the other chart will fill the display. All charts are updated at the refresh rate specified in the **Lucy** Setup panel.

3.1.1 Waveform Chart

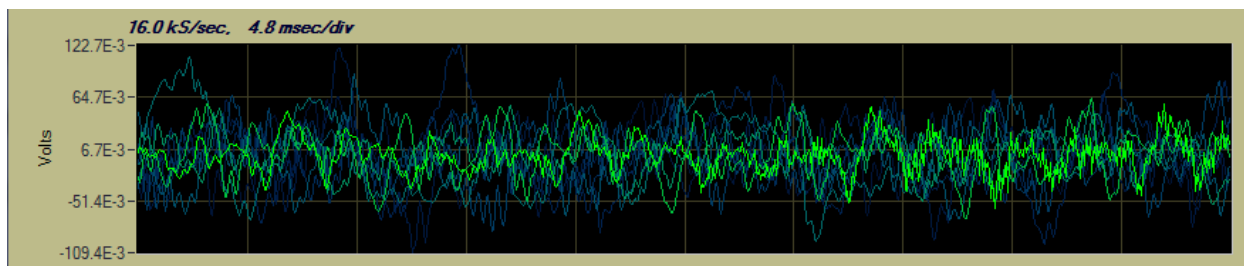


Figure 3-2: Waveform Chart

The waveform chart shows recent waveform data in volts. The waveform corresponds to the sound pressure sensed at the hydrophone, at the sample rate shown in the upper left corner. The time scale of the chart is also shown in the upper left corner in milliseconds per division. This chart is made up of 10 divisions.

The Waveform chart options are seen in the figure below. The 'Scan' box enables the collection of waveform data from the **icListen**.

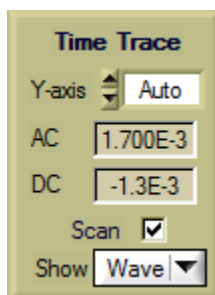


Figure 3-3: Time Trace Options

There are two options for the y-axis size

- Auto Scale
- Manually Scale

The advantage of auto scale is that the displayed data is never clipped. However this can make interpreting the data difficult, since the scale may change every time the display is refreshed.

Manually Scaling makes the y-axis scale constant, allowing for better comparative readings.

The AC field displays the average AC voltage component of the measured signal, in RMS Volts.

Advanced: The DC field must be enabled on the **Lucy** Setup panel in advanced mode. This displays the DC offset (in volts) which has been removed from the displayed data.

This chart will display the fading history of the previous waveform data results. The most recent data is plotted in green, and as the data ages it fades to dark blue before disappearing.

3.1.2 Single FFT Chart

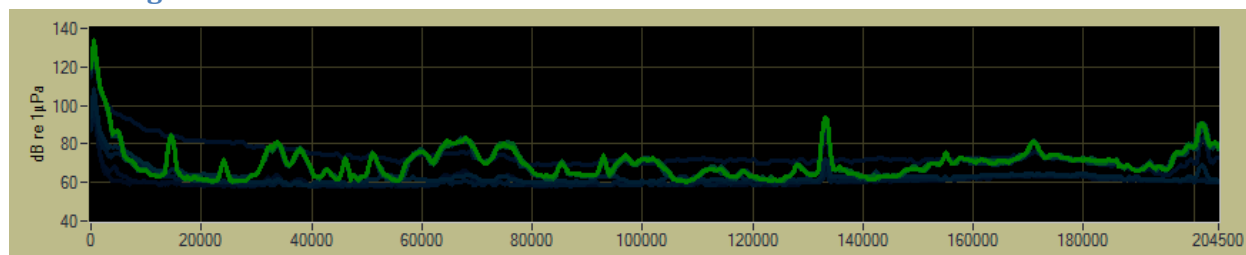


Figure 3-4: Single FFT Chart

The Single FFT chart displays the most recently received FFT data. This data will correspond with the most recent data on the *Spectrum Chart*.

The x-axis of this chart is the frequency range, which varies based on the sample rate selected. Frequency may also be plotted on a logarithmic scale, by using the log scale option to the right of the spectrum chart.

The y-axis of the chart is the amplitude. This is scaled using the reference scaling options in the lower left of the display. These scaling options are detailed in the *Spectrum Reference* section. There is also an auto-scale option selectable on the right of the chart.

Like the Waveform chart, this chart will display the fading history of the previous FFT results. New data is plotted in green, and it fades to dark blue before disappearing.

The Single FFT chart will also display thresholds for epoch triggers if configured in **Lucy** as shown below. For more information on epoch triggers, see *Epoch Triggering*.

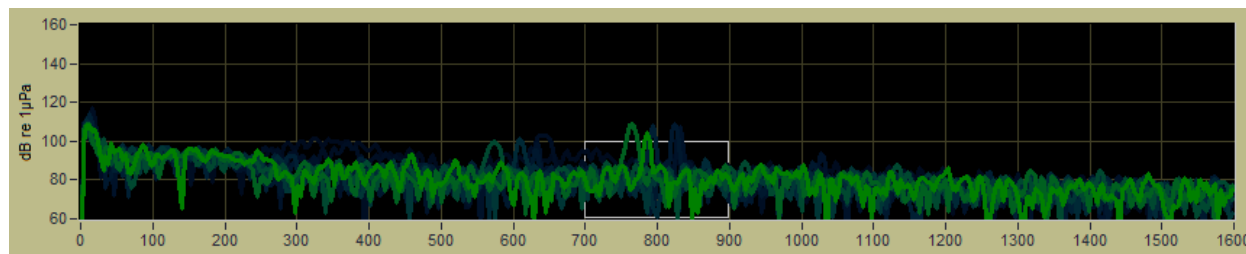


Figure 3-5: Single FFT with Epoch Trigger

3.1.3 Click Detector Chart

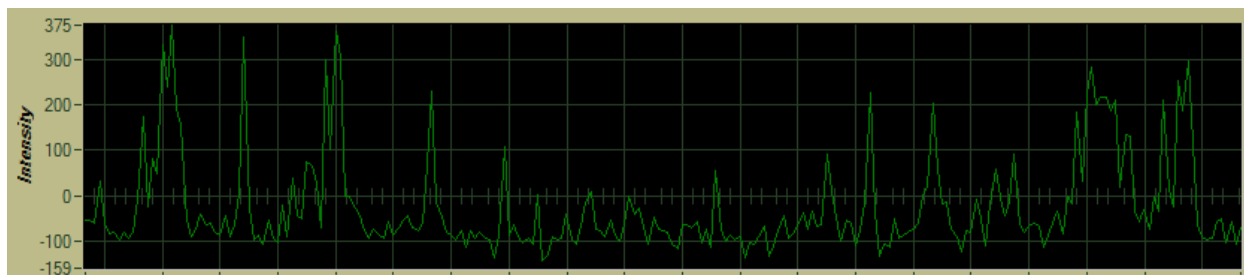


Figure 3-6: Click Detector Chart

The click detector chart shows the result of the Spectrum (FFT) data normalized and compared with the click model loaded into **Lucy**. The higher the resulting value, the closer the data is to the model. A small or negative result means the data is very different from the model. The x-axis of the chart is time, and is aligned with the Spectrum chart below. The new data points correspond with the comparison of the new spectrum data, seen on the spectrum chart. See *Click Detector* for more details.

3.1.4 RMS/pk-pk Chart

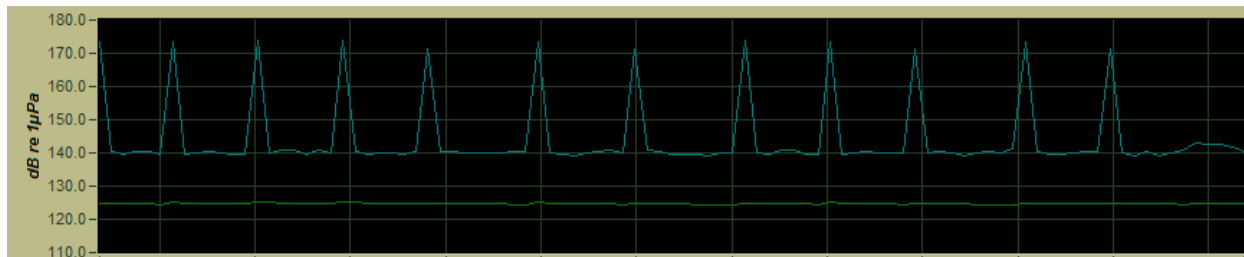


Figure 3-7: RMS/pk-pk chart

The RMS/pk-pk chart shows the RMS and Peak to Peak (pk-pk) amplitude of the waveform data. The data is displayed in dB relative to the spectrum reference as detailed in the *Spectrum Reference* section. The x-axis is time and is aligned with the spectrum chart. The most recent values of the RMS and pk-pk data are found to the right of the chart. An example of this display is shown below.

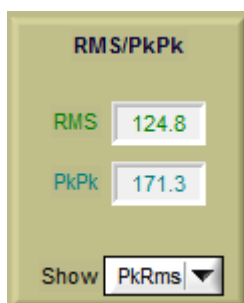


Figure 3-8: RMS/pk-pk Details

3.1.5 Spectrum Chart

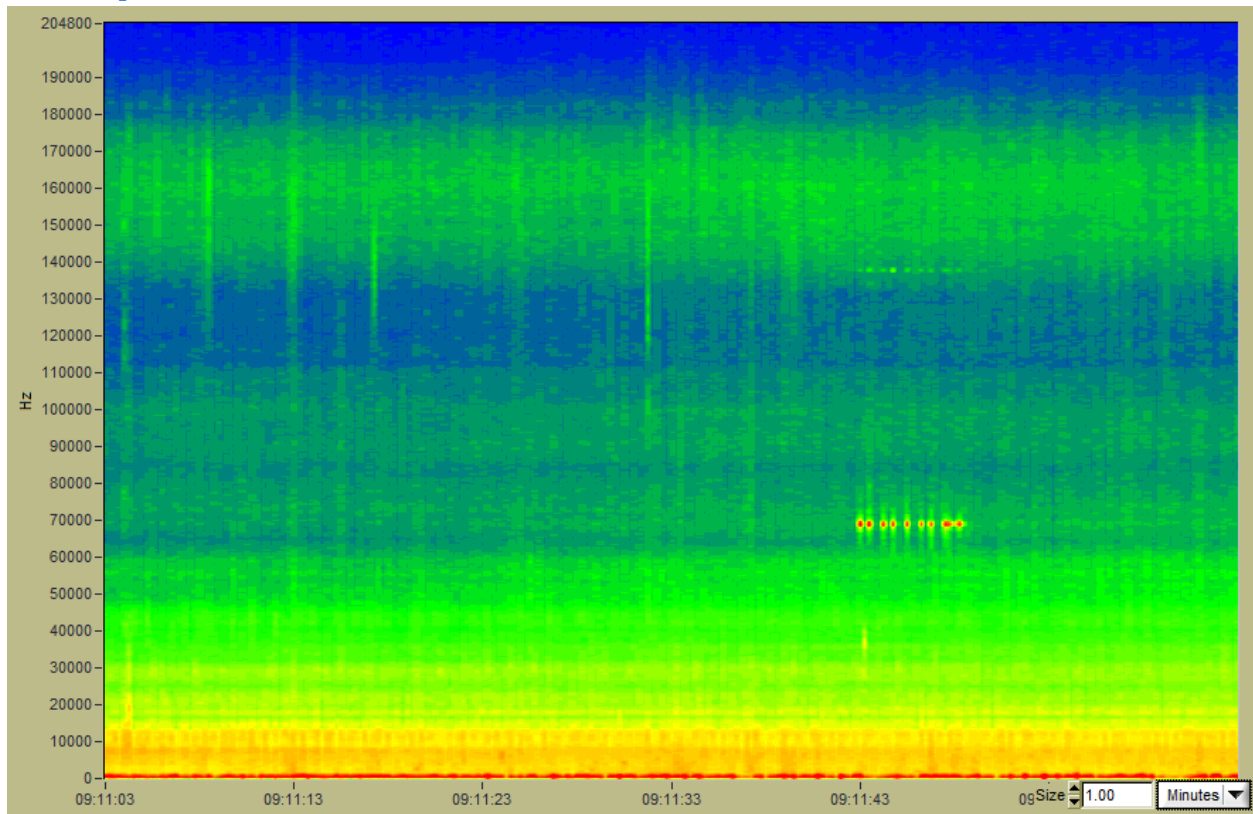


Figure 3-9: Spectrum Chart

The Spectrum chart is a waterfall display of the power spectrum data returned by **icListen**. This is a 3D chart showing time on the x-axis, frequency on the y-axis, and intensity of the signal on the z-axis.

3.2 Viewing the Spectrum Chart

This section describes how to optimize the Spectrum Chart display settings.

3.2.1 Size

The x-axis (time axis) of the spectrum chart is controlled by the “Size” fields, in the bottom right of the chart. There are 2 settings for the size. The first is the resolution of the axis. The options for this are Minutes, Hours and Days. The second is the amount of data shown at the selected resolution. Data is averaged to allow the longer durations to be displayed.



Figure 3-10: Spectrum Size Options

The maximum size for this value varies depending on the FFT averaging settings and the sample rate to a maximum of 1 week (7 days) of data.

3.2.2 Spectrum Reference

The Spectrum chart lets the operator make detailed measurements from the display. The chart can display spectral data in V or μPa , and as spectral density data in V^2/Hz and $\mu\text{Pa}^2/\text{Hz}$, as required.

The baseline reference can be adjusted to avoid cluttering the display with data below the noise floor. The arrows adjust by the colour step size, and specific values may be typed in.

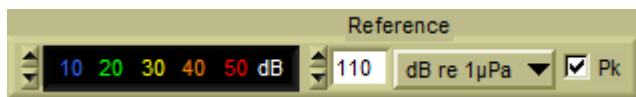


Figure 3-11: Spectrum Reference Options

The transition from one colour to the next is assigned a value, according to the coloured numbers in the lower left. The range can be changed by clicking the up or down arrows to give the best display of events in the chart.

Note that once selected, the arrow keys on the PC keyboard can be used to ‘animate’ the chart and help identify subtle events.

When viewing large time spans of data, the display will be averaged. The peak (maximum) values will be displayed when the Pk (Peak) checkbox is checked, and the mean averaged values will be displayed if it is not checked. The full display may be toggled at any time without data loss.

3.2.3 Ambient Noise Cancellation

A powerful operational tool comes with **Lucy** that allows the operator to model the ambient noise environment, and then remove that noise while looking for a specific signal.

When enabled, the current ambient noise model is used to remove unwanted signal. The noise model is stored, allowing it to be used over extended periods.

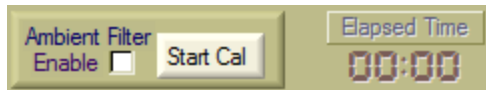


Figure 3-12: Noise Cancellation Options

To create a new ambient noise model, click the 'Start Cal' button, and watch the elapsed time display. When at least 30 seconds of time has passed, click the 'Stop Cal' button.

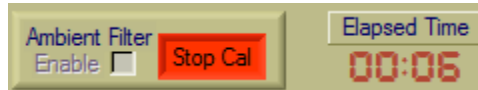


Figure 3-13: Active Calibration

This new noise model is stored, and used for noise cancellation. This calibration is remembered and reloaded when **Lucy** is started, which allows the same model to be used through multiple jobs if desired.

3.2.4 Spectrum Control Box

To the right of the Spectrum Chart is the control box that controls some of the chart's settings. This is shown in the following figure.

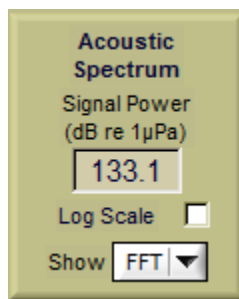


Figure 3-14: Spectrum Control Box

Checking the 'Scan' box enables collection of the Spectrum data for **icListen LF**.

The frequency axis can be displayed logarithmically by checking the 'Log Scale' box. This provides greater resolution at low frequencies.

The 'Signal Power' is calculated by combining the spectral data for each sample over the full spectrum. This represents the total power over any sample.

3.3 General Controls

This section describes the general controls of **Lucy**.

3.3.1 Scanning Controls

The data collection process begins when the 'Start' button is clicked. Note that whenever scanning starts, the charts are cleared.

When scanning is inactive, the 'Start' button is visible, and the 'Pause' and 'Stop' buttons are hidden. When scanning is active, the 'Stop' and 'Pause' buttons are visible, and the start button is hidden.

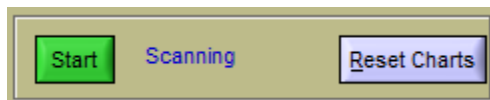


Figure 3-15: Scanning Inactive

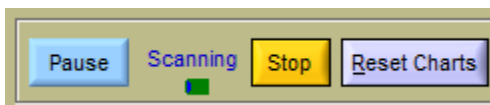


Figure 3-16: Scanning Active

When scanning is paused and resumed, a black section is added to the display equal to the duration of the pause, and the chart is continued at the appropriate point in the chart.

The "Reset Charts" button is used to clear the displays.

3.3.2 Unit Status Controls

The Unit Status shows the status of **icListen**, and any link issues that occur when active.

When testing **icListen**, clicking the 'Enquire' button returns the status of the link and the instrument. This is the most direct way of testing the instrument.

All units report the Temperature and Humidity in the status field. **icListen AF/HF** (hardware rev. 2 and newer) report the battery charge, and charging state (a lightning bolt through the battery indicates that the battery is charging).

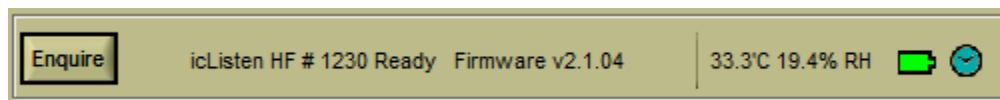


Figure 3-17: Enquire Response Example

3.3.3 Screenshot Controls

To the right of the unit status controls is the screenshot area, shown in the figure below.

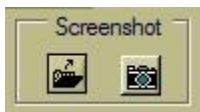


Figure 3-18: Screenshot Controls

The screenshot controls have two parts. The folder button (left) selects the folder for the screenshots to be placed, and the camera button (right) takes the screenshot.

The name of the screenshot file is Screenshot_YYMMDD_hhmmss, where:

YY = Year

MM = Month

DD = Day

hh = Hour

mm = Minute

ss = Second

The camera icon will appear green when data is being collected and auto screenshots are enabled. See *Auto Screenshots* for more details.

3.3.4 Audio Playback

This section describes the audio playback function of **Lucy**.

Lucy has the ability to play the audio contained in live waveform data, as well as replayed WAV files. Audio playback can be enabled by clicking the “Audio Enabled” check box. Audio playback in **Lucy** is always 16 bit, regardless of the original waveform data resolution.

The volume of the audio playback is controlled by the *Spectrum Reference* controls. The red value in the FFT display corresponds to the maximum audio amplitude which can be played back. To maintain accurate audio playback, the FFT display should be adjusted so that all displayed spectrum data is below the red level. The speaker volume in Windows will also affect the playback volume.

3.3.5 Other Displays

This section describes the remaining items on the main panel.

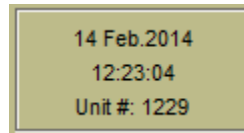


Figure 3-19: Current Details

In the top right corner there is a Current Details box (shown in the figure above), which displays the current date, time and the connected unit's serial number.



Figure 3-20: Job Details

Along the top of the main display there are the job details ('Client', 'Job ID' and 'Personnel'), which are shown in the figure above. These are filled in on the **Lucy** Setup tab (see *Lucy Setup*).



Figure 3-21: Logging Comment and File

Below the lower right corner of the spectrum chart, there are the 'Logging Comment' and the 'Log Data File' fields. The logging comment is entered by the user, and is written into the **Lucy** TXT log files. The log data file displays the current file being logged or replayed by **Lucy**.

4 Setup

At the beginning of each project or job, the setup of the program and instrument should be checked and changed as required. The setup buttons are found in the lower right corner of the display. This is shown in the following figure.



Figure 4-1: Setup Options

The setup panel is divided into tabs for individual configuration types. Only configurations tabs applicable to the connected unit are displayed.

Advanced Settings: Many setup tabs also contain some settings for advanced users. These options can be revealed by selecting 'Advanced' mode, in the lower left corner of the setup panel. All advanced settings will be labeled '**Advanced**' in this section.

This section covers:

- Link Setup
- **Lucy** Setup
- **icListen LF** Configuration Setup
- **icListen AF/HF** Configuration Setup

For Epoch event setup see the *Epoch Triggering chapter*.

4.1 Lucy Setup

The **Lucy** setup panel is split into 3 tabs. These tabs are Lucy Logging, Lucy Setup, and Epoch Setup.

4.1.1 Lucy Logging

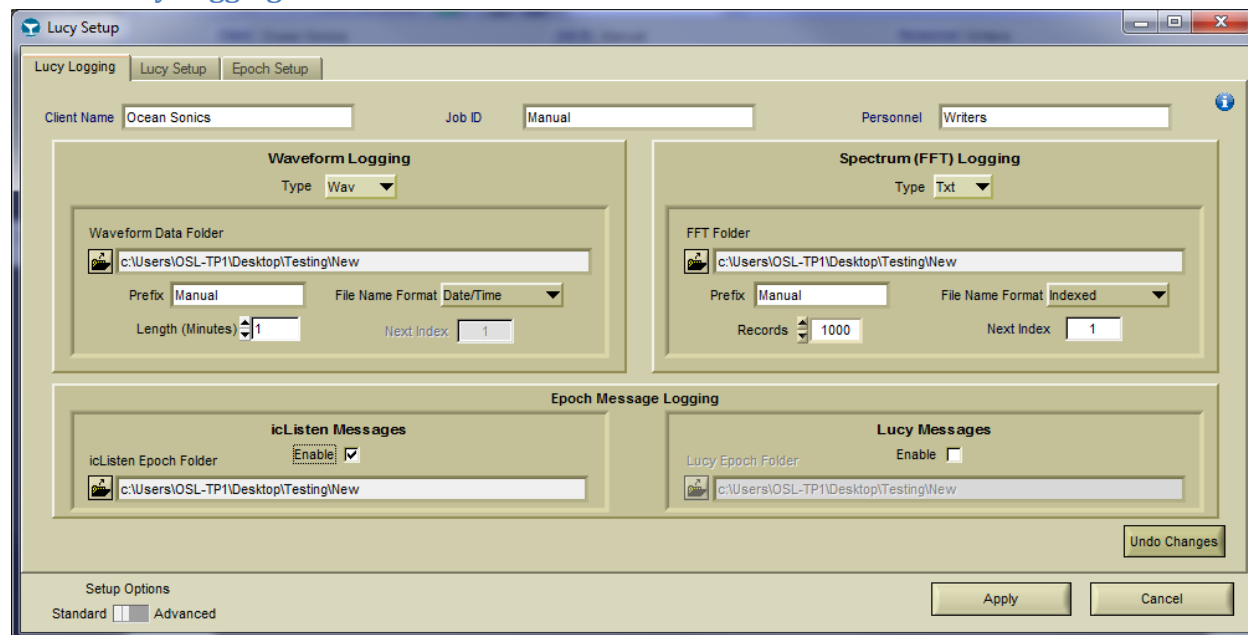


Figure 4-2: Lucy Logging Tab

The **Lucy** Logging tab is responsible for the configuration of logging and details which are entered in logs within **Lucy**.

The job details consist of the 'Client Name', 'Job ID', and 'Personnel'. These values, once accepted, update the values along the top of the main display. These are useful for keeping track of the details of a job, as they appear in both the screenshots and **Lucy** txt log files.

The Logging options relate to **Lucy** logging only. For instrument logging options see *icListen LF Setup* or *icListen AF/HF Setup*.

Lucy can perform three types of logging simultaneously:

- Spectrum Data (FFT)
- Waveform Data (Time Series)
- Epoch Message Data for **icListen** and **Lucy**

The FFT logging stores data as a human readable TXT log format, which can be imported into a spreadsheet. These files also include temperature, and humidity data.

Waveform data is logged as standard WAV audio files. These files are playable in any standard audio player, such as Audacity.

Epoch message data is logged as human readable TXT logs, which can be imported into a spreadsheet. There are two types of epoch message logs which can be configured on the **Lucy** setup panel. These are the **icListen** epoch stream log and the **Lucy** epoch message log. The **icListen** epoch stream consists of the epoch messages that arrive from a connected **icListen AF/HF**. The **Lucy** epoch message log consists of the epoch messages and active time messages from the **Lucy** configured epoch triggers.

4.1.2 Lucy Setup

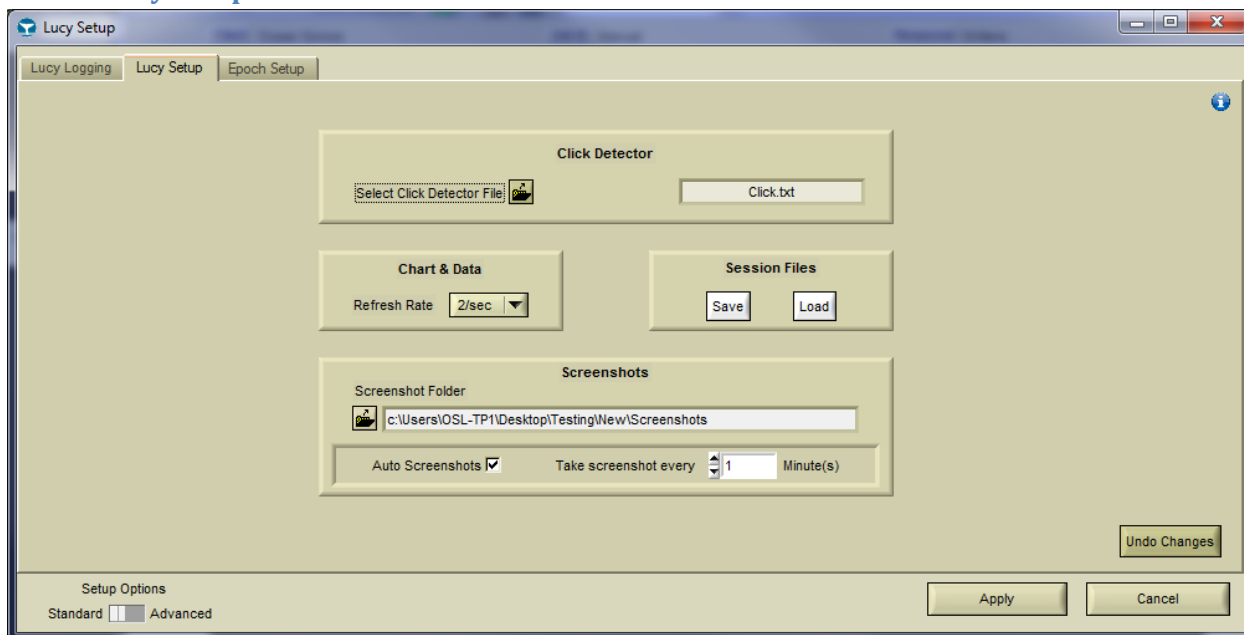


Figure 4-3: Lucy Setup Tab

The **Lucy** setup tab is used for setting up the click detector, screenshots, charts and also session storing.

Click Detector: The Select Click Detector File option is used to load a click model file. When a click file is loaded, the file name is shown below the select button, as seen with “Click.txt” in the screenshot above. For more details on the use of this file see *Click Detector*.

Chart & Data: The refresh rate option allows users to reduce the CPU resources used, by reducing the number of display updates performed by **Lucy**. Reducing the refresh rate does not cause any data to be lost or discarded.

Lucy allows the user to save their current session, which includes the display and connection settings, by pressing the “Save Session” button. A previous session may also be loaded using the “Load Session” button. This allows the user to store different **Lucy** configurations for different test environments or jobs.

Screenshots: The screenshot options allow users to set the path of the **Lucy** screenshots. Auto screenshots are screenshots of the main display which are taken at a configured rate. Auto screenshots are enabled and the rate is set on the Lucy Setup tab.

Advanced: The scan rate option adjusts the rate at which **Lucy** requests data from an **icListen**. **Lucy** typically sets this to an optimal rate for the current instrument configuration. This option overrides the calculated rate. It is important to note that if the scan rate is set lower than the incoming data rate, then data will be lost.

Advanced: The option to show the DC voltage, when checked, enables the DC offset display for Time Trace data on the main **Lucy** display.

4.1.3 Lucy Epoch Setup

Lucy epoch triggers are configured from the Epoch setup tab. Epoch trigger files may also be loaded or saved. For more details on configuring epoch triggers see *Epoch Triggering*.

4.2 icListen Setup

The icListen setup panel is split into 3 tabs. The available tabs vary depending on the type of hydrophone connected. The Link tab is always available and is used to connect to a hydrophone. The **icListen** setup tab changes based on the connected unit. The third tab is the epoch setup tab, for units which support epoch triggering.

4.2.1 Link Setup

To connect to an **icListen** instrument, select the 'Link' option, to bring up the Link Panel. There are two selectable connection types: Serial/USB and Ethernet, shown respectively below.

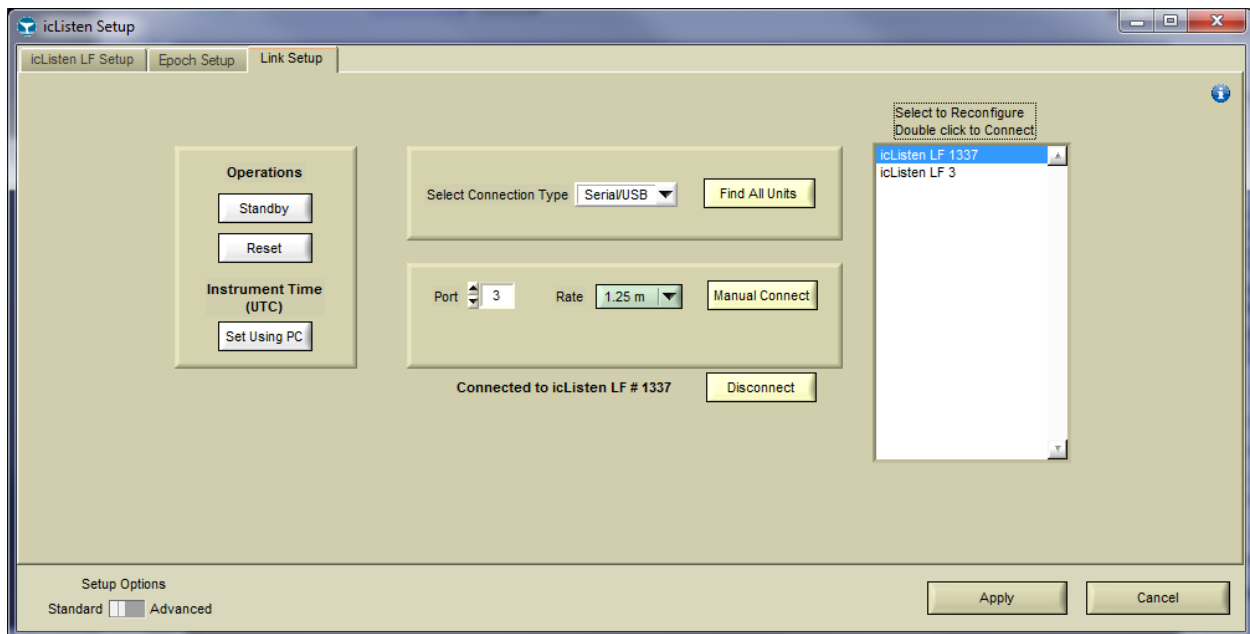


Figure 4-4: Serial/USB Link Tab

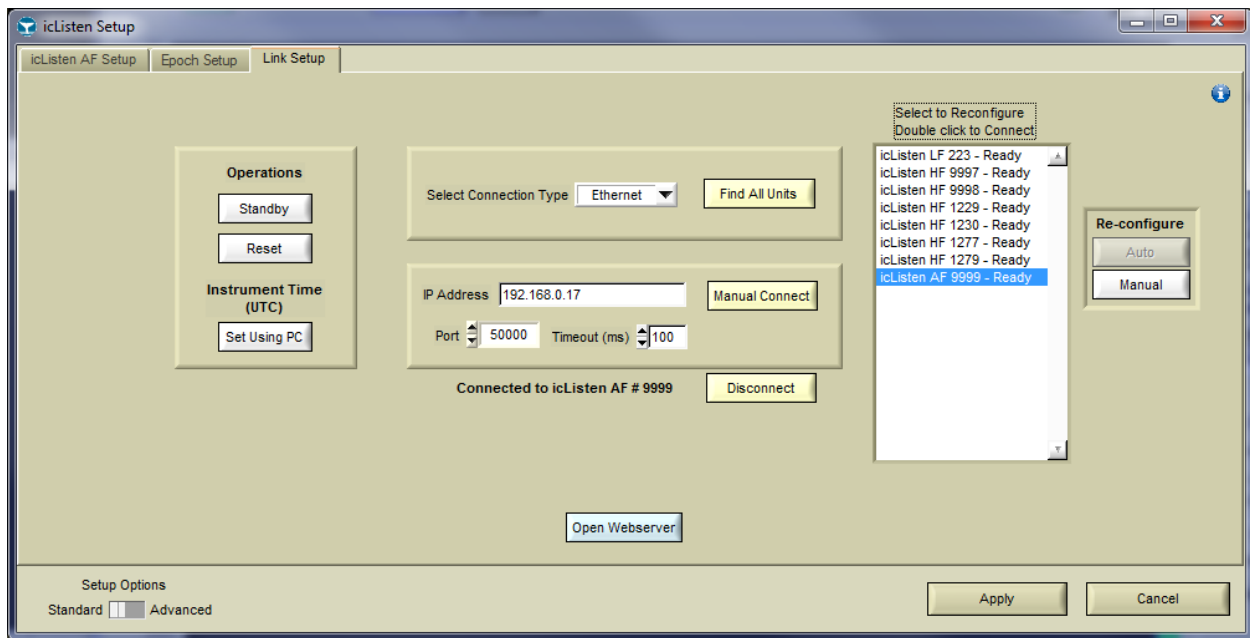


Figure 4-5: Ethernet Link Tab

Link Setup can either be done manually, or automatically.

4.2.1.1 Manual Link Setup

If the connection information for your instrument is known, enter the details and press 'Manual Connect'. If successful, the details of the connected instrument will be displayed beneath the setup.

4.2.1.2 Find All Units

Find All Units is used to automatically discover the units available.

For Serial/USB connections, port search scans from port 1 to port 100 at all available baud rates, displaying all of the discovered units in the box on the right of the display.

For Ethernet connections, this sends a broadcast message out on the network, to which the hydrophones respond.

For either connection type, the available units will appear in the unit list. These units can be connected to by double clicking on the entry in the list. Ethernet units may also be reconfigured using the buttons to the right of the unit list.

4.2.1.3 Port Search (Advanced)

Port Search is used to search for multiple Ethernet units at the same IP Address.

Port Search searches the ports commonly used for **icListen** at the entered IP/Web address. Ports 23, 50000, 50100, 50200, 50300, 50400, and 50500 are searched. Port 50000 is the default command and control ports for **icListen**. Older **icListen LF** units use port 23. The remaining ports are commonly used when connecting to multiple units at the same IP/Web address via the port forwarding settings of a router. See the *FAQ* for more details on this configuration.

4.2.1.4 Additional options

Reset/Standby: When a connection is established to a unit which supports the reboot command (all **icListen AF/HF** units, and **icListen LF** units with firmware 2.5 or greater), these options are available. When this option is selected and the **icListen** is externally powered, the unit will reset. If the unit is not externally powered, the unit will enter standby mode until the next time external power is applied.

Instrument Time: The “Set Using PC” button syncs the time of the connected **icListen** to the PC time. Note that **icListen** uses UTC for all logged files and timestamps. Note that if **Lucy** detects that **icListen** has not been synchronized to the correct time, the time will be set automatically.

Disconnect: When a connection is established to a unit, there is an option to disconnect from the unit. This closes **Lucy**’s connection to the unit.

Reconfigure: Ethernet units may have their network settings reconfigured in order to become connectable under certain network conditions. This can be done by selecting the unit you would like to reconfigure on the unit list, and then clicking one of the reconfigure buttons. ‘Auto’ searches for an address which is compatible with the computer’s network configuration, while manual brings up a panel resembling the Windows network reconfigure panel to allow the user to set their desired settings.

Open Webserver: This button opens the web interface of Ethernet hydrophones, in the default web browser. The web interface may be used to view/configure hydrophone settings, and in **icListen AF/HF** can view live spectrum data and retrieve logged data.

Advanced: Serial/USB units have the ability to set a custom timeout. Typically **Lucy** selects the timeout value which is judged to be appropriate. However, when using a radio modem, or running at a very fast data rate, it may be necessary to adjust the timeout for better performance.

Advanced: Serial **icListen** units have the ability to change the baud rate of the connection. With a connection established at the current baud rate, select the new baud rate and click update. This will change the baud rate of the unit and reconnect at the new baud rate. If a connection is not established at the new baud rate, both the **icListen** and **Lucy** will revert to the previous baud rate and re-establish a connection.

4.2.2 icListen LF Setup

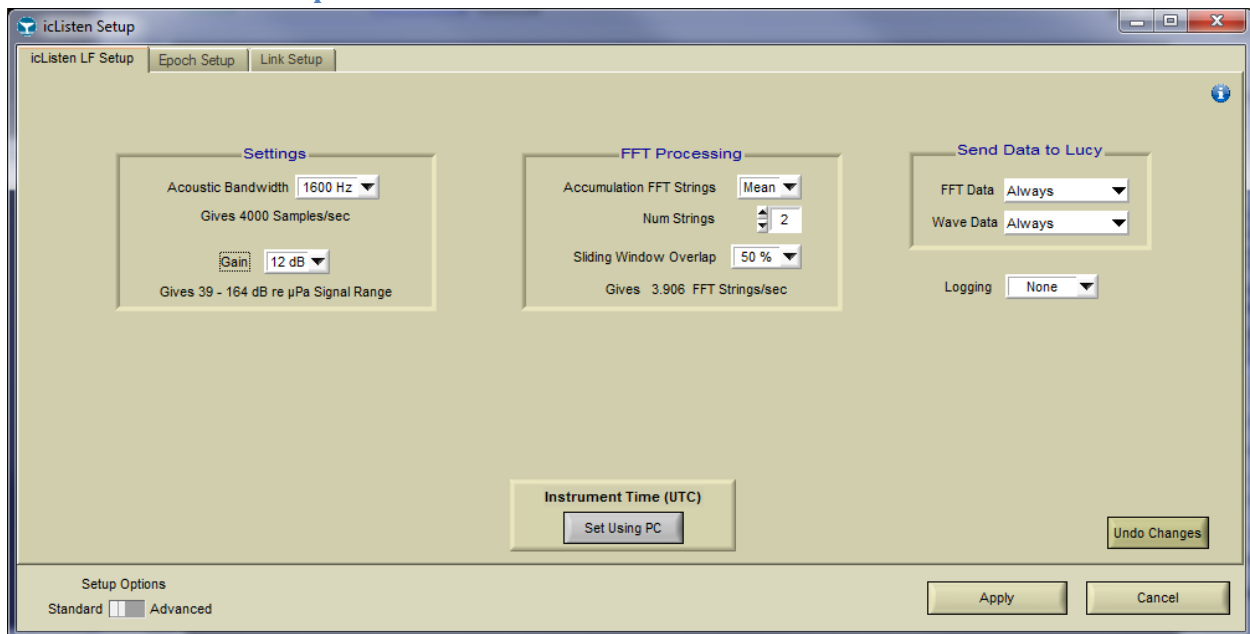


Figure 4-6: icListen LF Setup Tab

The **icListen LF** Setup tab displays the current configuration of **icListen LF**, and allows this configuration to be updated.

The current configuration of the connected **icListen** is displayed on the **icListen LF** setup tab as soon as the tab is opened.

The following **icListen LF** settings can be changed:

- Data Collection
- Gain
- Bandwidth
- Internal Logging
- Internal Time
- FFT Processing

4.2.2.1 Data Collection

The Data collection setting has three options, which can be set independently for both waveform and spectrum data. Note that if FFT data is set to "Data Off" and waveform data is collected then **Lucy** will take FFTs of the waveform data to display.

These options are:

- Always
 - Data of this type is always sent to **Lucy** when scanned.
- On Epoch Trigger
 - Data of this type is sent to **Lucy** when scanned, only when an Epoch event has triggered (see *Epoch Triggering*).
- Data Off
 - Data of this type will not be collected by Lucy.

4.2.2.2 Gain

The Gain is used to increase the sensitivity of the **icListen**. Gain values are in steps of 6 decibels (dB) and range from 12 to 24. For best performance, Ocean Sonics recommends using a gain value of 12dB.

Advanced: Gain options in advanced mode range from 0-72dB.

4.2.2.3 Bandwidth

The bandwidth is the range of frequencies available. The higher the desired bandwidth, the higher the sample rate required. The possible values are:

Bandwidth (Hz)	Sample Rate (S/s)
100	250
200	500
400	1000
800	2000
1600	4000
3200	8000
6400	16000

4.2.2.4 Internal Logging

The internal logging selection allows the user to set the type of logs that **icListen** will create.

The options are:

- .wav files
 - Standard audio file format. Playable in most 3rd party audio players.
 - **Note:** .wav logging can only be performed up to 1600Hz bandwidth setting.
- .FFT logs
 - Ocean Sonics FFT format files. The format of these files can be found in the **icListen Log File Formats** document.
- Triggered logging
 - Logging is done based on Epoch event triggers.
 - **Note:** Triggered logging is only available up to 1600Hz bandwidth setting.

All logged files can be replayed in **Lucy** (see *File Replay*).

4.2.2.5 Instrument Time (UTC)

Using the 'Set Using PC' button, the internal time of the **icListen** can be set to match that of the PC running **Lucy**. Setting the time is required, for accurate file creation times of the internal logs.

4.2.2.6 FFT Processing

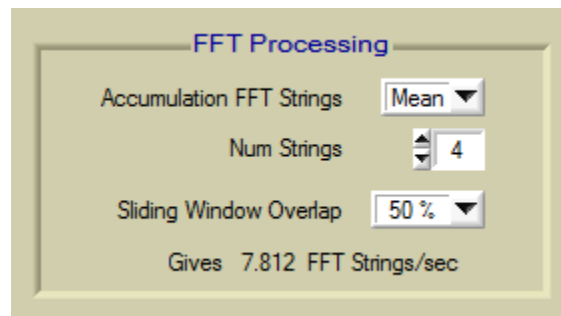


Figure 4-7: FFT Processing Settings

The processing performed on frequency domain data can be configured by adjusting the accumulation type, and the sliding window overlap.

Three types of FFT processing are available to **icListen LF**. These are Mean, Peak, and Filter. The sliding window overlap can be adjusted for any of these processing types.

For “Mean” and “Peak” processing, the “Num Strings” field indicates the number of FFT data sets that are used for each processed result. For “Filter”, the “Num Strings” field is used both for determining how many FFT data sets must be processed before returning a result, and to determine the weighting factor (“Num Strings” / 3). If FFT accumulation mode is set to “Off”, no averaging is performed. Switching the accumulation mode to “Off” does not affect the sliding window overlap.

For a more detailed description of how the FFT processing works, please refer to the ***icListen Operations Guide***.

4.2.3 icListen AF/HF Setup

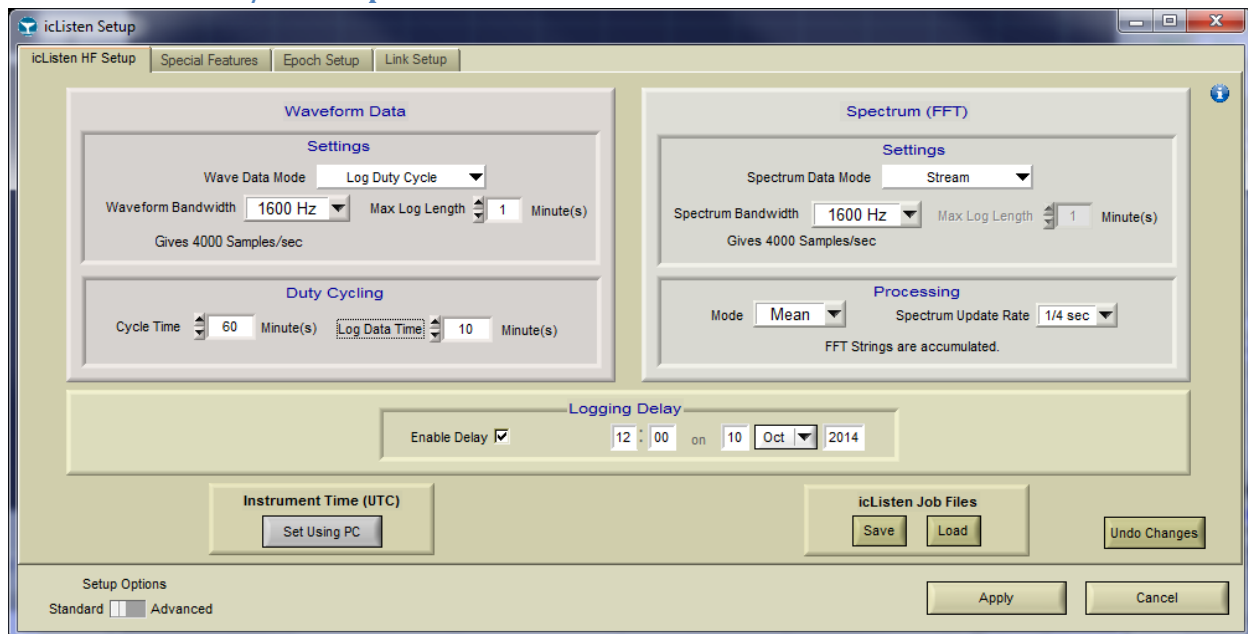


Figure 4-8: icListen AF/HF Setup Tab

The **icListen AF/HF** Setup tab displays the current configuration of **icListen AF/HF**, and allows this configuration to be updated.

The current configuration of the connected **icListen** is displayed on the **icListen AF/HF** setup tab as soon as the tab is opened.

The following **icListen AF/HF** settings can be changed:

- Data Collection Mode
- Log File Length
- Internal time
- Bandwidth
- Duty Cycling
- Data Format (**Advanced**) *
- Gain (**Advanced**) *
- Spectrum Processing
- Spectrum Reference Level (**Advanced**)
- Logging Delay

*Note: Data Format and Gain are available for HF release 14 and newer.

4.2.3.1 Data Collection Mode

There are many available data collection modes. Waveform and spectrum data collection modes are set independently, and not all modes are available to each type of data. Note that if waveform data is streamed and FFT is set to "Data Off", Lucy will take FFTs of the waveform data to display.

Available options are:

- Data Off
 - Data of this type is not sent to **Lucy**.
- Scan
 - Only available for spectrum data.
 - Data is available to be scanned over the command and control port, but is sent only by request.
- Stream
 - Available for both waveform and spectrum data.
 - Live data is streamed from **icListen AF/HF**'s Streaming TCP ports.
- Log Continuous
 - Available for both waveform and spectrum data.
 - All data of selected type is logged internally.
 - Spectrum data is also available to be scanned from the command and control port when logging is enabled.
- Log Duty Cycle
 - Only available for waveform data.
 - Data is logged internally for the selected duration, and then for the remainder of the cycle duration data is skipped. This cycle repeats continuously.
- Epoch
 - Available for both waveform and spectrum data.
 - Data is logged based on epoch trigger settings.
- Epoch & Log Duty Cycle
 - Available for waveform data only.
 - Data is logged based on epoch triggers and the duty cycle. This means data will be logged both during the cycle time, and if a trigger occurs.

4.2.3.2 Log File Length

This feature allows the user to configure the length (in minutes) of files internally logged by the **icListen** unit.

4.2.3.3 Instrument Time (UTC)

Using the 'Set Using PC' button, the internal time of the **icListen** can be set to match that of the PC running **Lucy**.

Time synchronization should always be performed prior to applying the rest of the setup, as changing the time could affect when logging begins if a start delay is set. This is only an issue prior to firmware release 16.

4.2.3.4 Bandwidth

The bandwidth is the range of frequencies available. The higher the desired bandwidth, the higher the sample rate required. The possible values are:

Bandwidth (Hz)	Sample Rate (S/s)
400	1000
800	2000
1600	4000
3200	8000
6400	16000
12800	32000
25600	64000
51200	128000
102400	256000
204800	512000

icListen AF's max bandwidth is 12800 Hz.

4.2.3.5 Data Format (Advanced)

The data format is adjustable when using waveform data. Data can be returned as 16 bit, 24 bit, or 32 bit, and in big or little endian.

As the resolution of the hydrophone is 24 bit, the 32 bit setting will actually return 24 bit data packed into 32 bit (the low byte is always 0 and can be ignored for this data).

Due to the fact that WAV files are defined as little endian, all requests for big endian logged data will also be modified to little endian before sending the setup to the instrument.

Note: 512 kS/s data must be set to 16 bits for Release 27 and below.

Note: If not in advanced mode, the data format is automatically set to 24 bit Little Endian.

4.2.3.6 Gain (Advanced)

In **icListen AF/HF**, the configurable gain setting applies digital gain to the waveform data. Gain is adjustable in steps of 6 dB, ranging from 0 dB to 48 dB.

This setting can only be adjusted for 16bit data, where it can be used to increase the sensitivity of the unit to compensate for the reduced resolution.

Note: If not in advanced mode, gain is automatically set to 0.

4.2.3.7 Duty Cycling

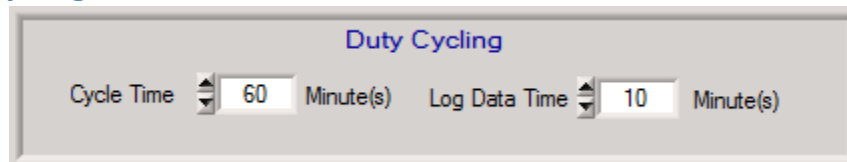


Figure 4-9: icListen AF/HF Duty Cycling Setup

Duty cycling is available when waveform data is being logged. The logging cycle used is determined by the 'Cycle Time' and 'Log Data Time' fields. Data will be logged for the first "Log Data Time" minutes of the complete "Cycle Time". In the screenshot above, this means that the first 10 minutes will be logged and the next 50 minutes will not, for the total of a 60 minute cycle. This cycle will be repeated continuously.

4.2.3.8 Spectrum Processing

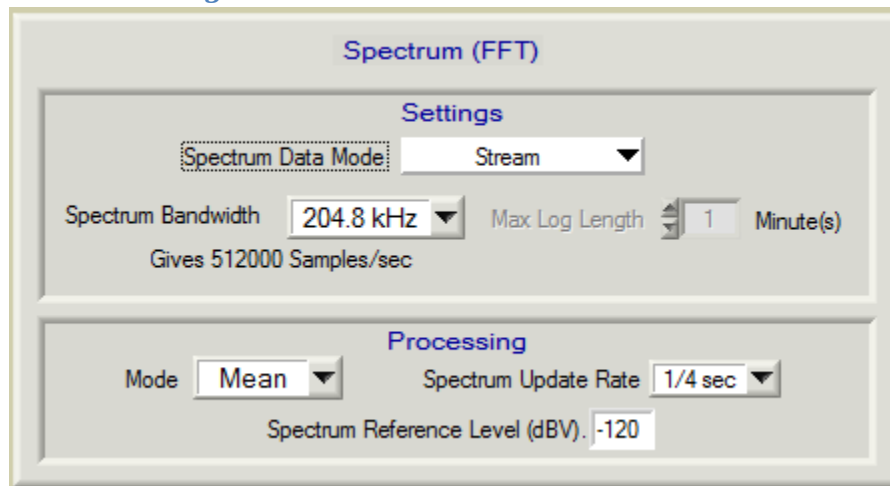


Figure 4-10: Spectrum Processing Settings

The processing performed on frequency domain data can be configured by adjusting the processing mode, and the spectrum update rate.

Three types of FFT processing are available to **icListen AF/HF**: Mean, Peak, and Filter. Lucy will adjust the processing settings based on the update rate.

For a detailed description of how the FFT processing works, please refer to the **icListen Operations Guide**.

Advanced: **icListen AF/HF** returns spectral data relative to the Spectrum Reference Level, which is equal to the minimum spectral density measurement **icListen** can return. Valid values are between -120 and -180 dBV. Ocean Sonics recommends maintaining this at -120dBV, unless making low noise/low amplitude measurements.

4.2.3.9 Logging Delay

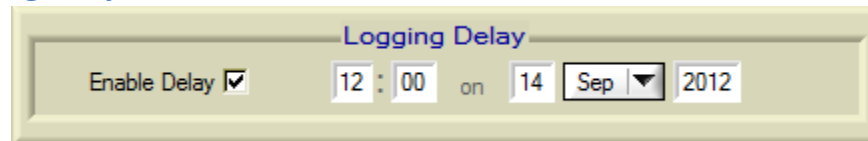


Figure 4-11: Logging Delay

The logging delay is used to set the time at which logging is started. This is applied to both waveform and FFT data logging (including triggered logging). If “Enable Delay” is not selected, data logging starts immediately. Prior to HF firmware release 16, any time sync must be done before this setting is applied in order to maintain the proper delay.

4.2.4 Special Features Setup

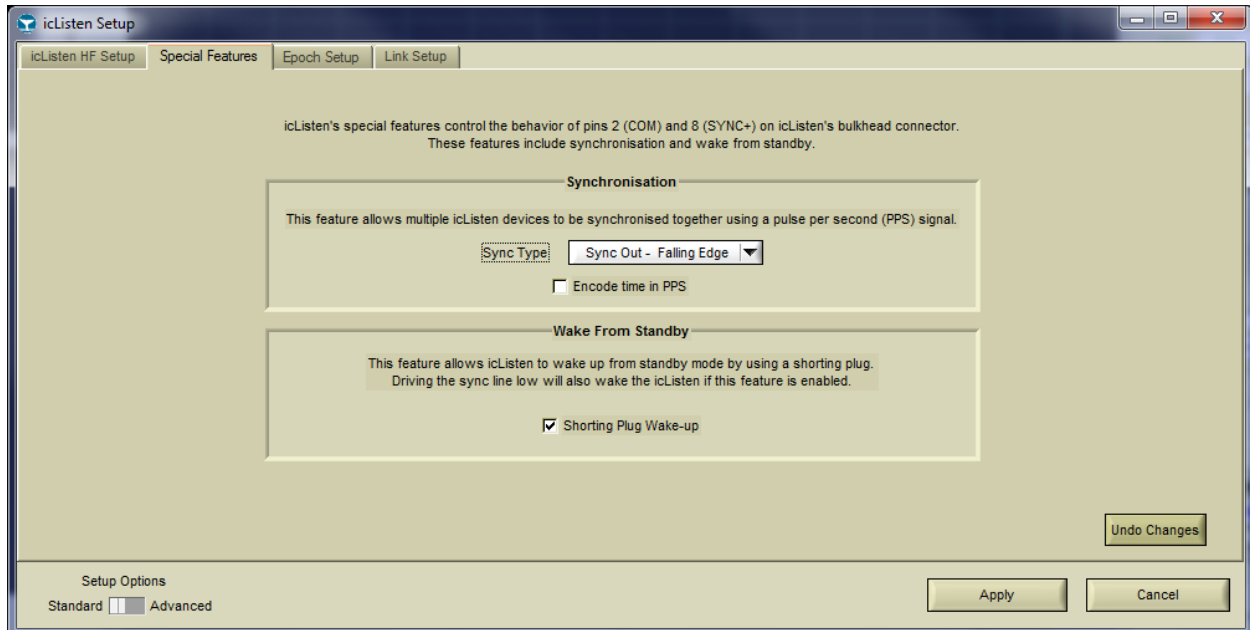


Figure 4-12: Special Features Setup

The special features setup is available for **icListen AF/HF (R23+)**.

The available options are:

- Synchronisation
 - PPS
 - Time Encoding/Decoding (R28+)
- Wake From Standby (R28+)

4.2.4.1 Synchronisation

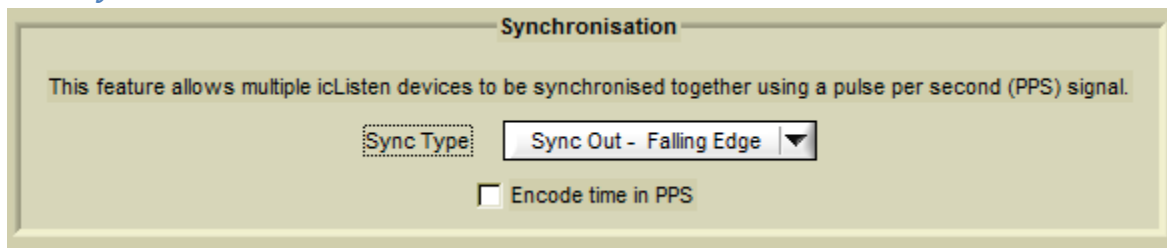


Figure 4-13: Synchronisation

The Synchronisation options are used to configure **icListen** (R23+) to synchronize with other **icListen** devices or devices producing a Pulse Per Second (PPS) output. If you would like **icListen** to be a PPS master and synchronize other units to this **icListen**, select "Sync Out". If you would like **icListen** to be a PPS slave and synchronize to an existing source/another **icListen**, select "Sync In" and the correct polarity (Rising Edge/Falling Edge) of the signal. Select "Sync Disabled" if you would like no synchronization.

icListen (R28+) may also be configured to Encode/Decode the time from the PPS signal. This is done with the "Encode time in PPS" and "Decode time from PPS" checkbox.

4.2.4.2 Wake from Standby

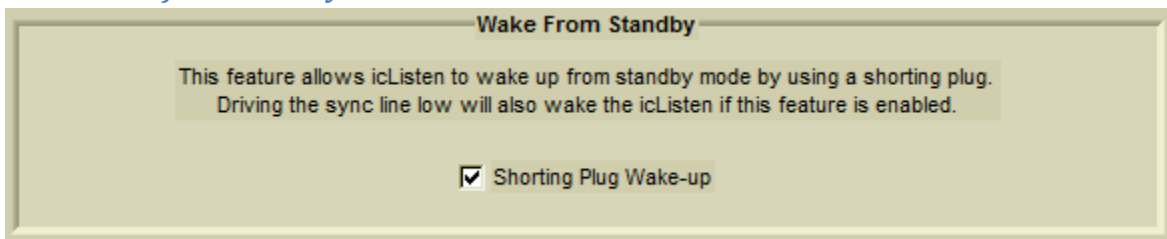


Figure 4-14: Wake from Standby

The Wake from Standby option is used to configure an **icListen** (R28+) to wake from standby mode when the shorting plug is connected. When this option is enabled, the unit may also be woken by driving the sync line low.

4.2.5 icListen Epoch Setup

icListen epoch triggers are configured from the Epoch setup tab. Epoch trigger files may also be loaded or saved for **icListen AF/HF**. For more details on configuring epoch triggers see *Epoch Triggering*.

5 File Replay – Offline Operation

Lucy provides the operator with the ability to replay previously logged files including:

- Files created by **icListen** in WAV, FFT, or TXT format
- Files created by **Lucy** while collecting real-time data from **icListen**

The format of all of these files can be found in the ***icListen Log File Formats*** document.

Select the 'Replay' button from the **Lucy** main panel to start the replay process. This will open a popup which allows selection of files. Multiple files may be selected. The files will be played in the order shown in the selection window. Files of different types may be played in the same sequence and the screen will be cleared when switching between file types.

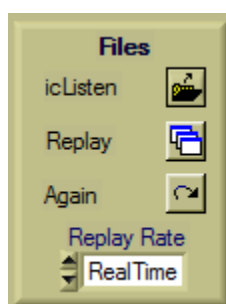


Figure 5-1: Replay Options

A previously replayed file can be viewed once more by clicking the "Again" button, using the same settings. If multiple files have been replayed, pressing the "Again" button will play the most recently played file. The 'icListen' button is for the file utility which will be covered in the *File Utility* section.

The speed of the replay is set with the 'Replay Rate' field. This ranges from 'Real Time' to 'Max' with 3 speeds in between. The display is still updated at the set refresh rate during replay; however the amount of new data per refresh is changed by the replay rate. 'Real Time' is the rate which the data was initially displayed at, and the speed increases respectively from there.

When a file is replaying, it may be paused or stopped using the controls shown below.



Figure 5-2: Replay Options

5.1 TXT Replay

TXT log files are stored in tab separated value (TSV) format. These files can be viewed by a spreadsheet viewer (such as Excel) as well as through **Lucy**. When replayed, the data is displayed as it was when initially received.

Certain settings (such as noise cancelling and chart scaling) are viewing aids only, and are not stored with the data.



Figure 5-3: Example Replay Panel

On the replay panel the user has the ability to view the source of the file, which opens the file in the user's default text editor.

Once the 'Replay' button is pressed, the Replay Setup window disappears and the data starts to replay, at the selected rate. The TXT log files contain Spectrum data.

5.2 Wav Replay

After pressing the Replay button on the main panel and selecting a .wav file, the file will immediately start to play. This includes the waveform data, and also an FFT of the data at a rate of 4 FFTs per second. Audio playback may also be used. For more details on audio playback see *Audio Playback*. Display enhancement tools may be used as usual.

5.3 icListen LF FFT Replay

When an .FFT file is selected for replay, the file starts replaying immediately. These files only contain FFT data, and thus only the spectrum chart will contain data. The time series chart will either be blank or hidden, based on user settings. Display enhancement tools may be used as usual.

6 File Utility

The file utility is available for the **icListen LF** and **icListen AF/HF** (release 23+). It is used to navigate through the instrument's filing system, and allow the operator to retrieve or delete logged data files. Configuration files and instrument firmware may be updated here as well. Data from **icListen AF/HF** (release 22 and earlier) is retrieved using SFTP/SCP with a program such as FileZilla, or through the web interface.

The file utility is opened by pressing the 'icListen' button in the 'Files' section of the main display. For **icListen AF/HF** units running release 22 and below, this button will open the unit's data page in the default web browser.

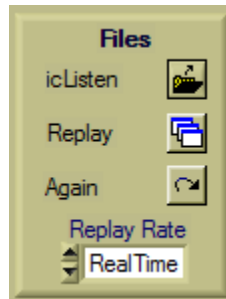


Figure 6-1: File Utility Button

6.1 icListen LF File Operations

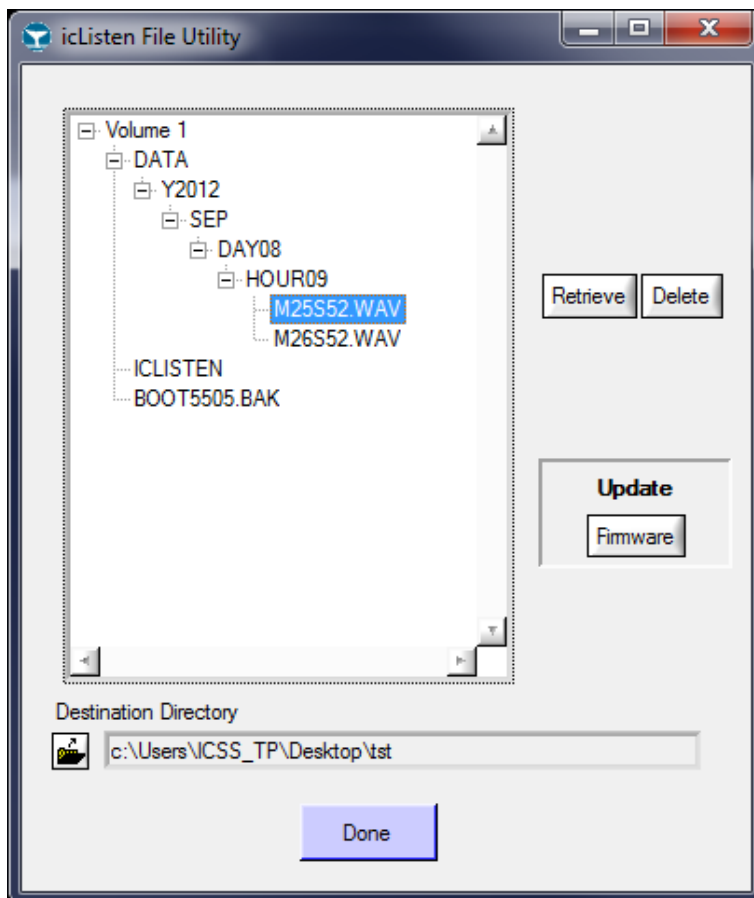


Figure 6-2: LF File Utility Panel

Once the file utility panel has opened, the last viewed directory structure will be displayed. If this is the first time the utility has been open since **Lucy** was started, the connected volumes will be displayed. Some important system files are hidden from view, to prevent accidental loss. To view the contents of a directory, double click the directory name and the contents will be requested and shown.

To download a file/directory, double click on the file in the selection tree; or single click to make the options on the right available, for retrieving or deleting the selected file/directory.



Figure 6-3: File Options Example

Clicking 'Delete', deletes the file/directory permanently from **icListen** after a confirmation popup. For directories this may take some number of minutes, if there are a lot of files. Completion is confirmed when the cursor stops spinning.

Clicking 'Retrieve' saves a copy of the file/directory to the PC. When in progress, the following panel appears, showing the progress of the retrieval for each individual file.

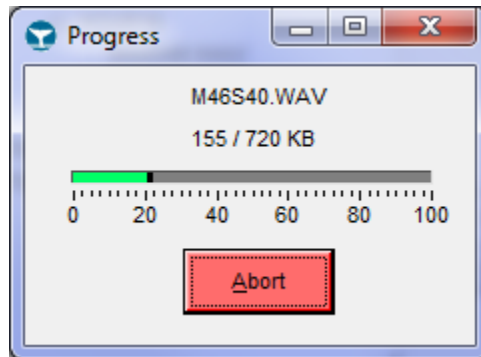


Figure 6-4: Progress Panel

Files may take a few minutes to retrieve, and at any point during the process, the file retrieval can be cancelled. This will leave a partial file on the user's computer, but will not harm the file in the unit.

6.2 icListen AF/HF File Operations

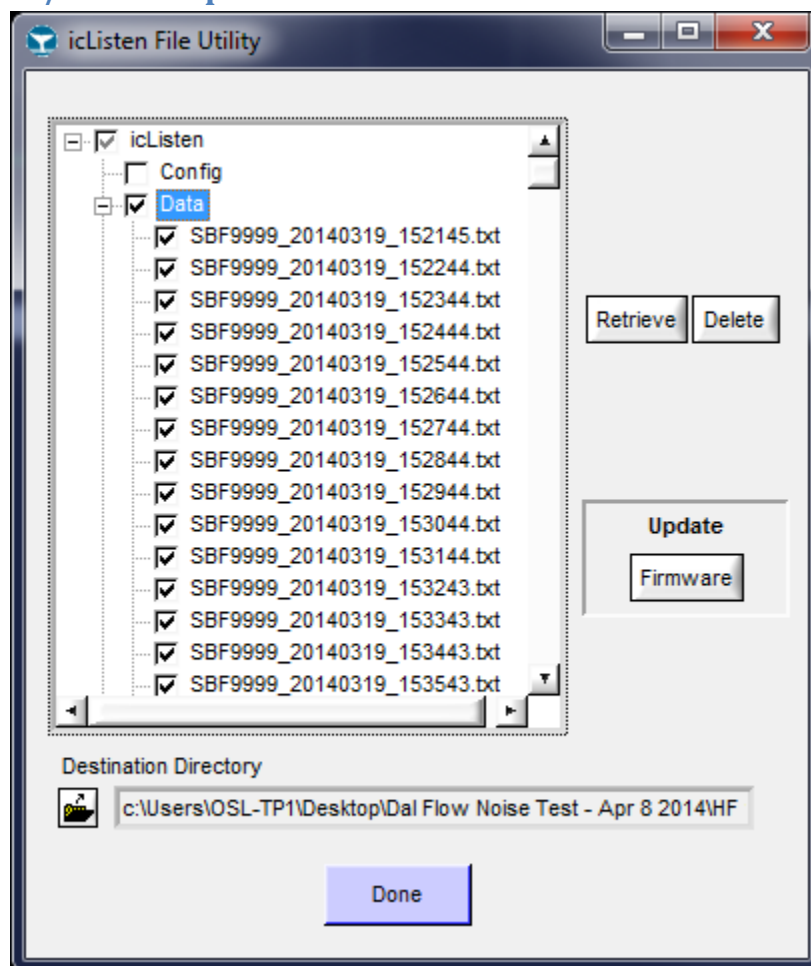


Figure 6-5: AF/HF File Utility Panel

Once the file utility panel has opened, the contents of the Data directory will be displayed.

To view the contents of a directory, click the directory name and the contents will be requested and shown. The contents will also be checked if the directory is checked.

To download files to the PC, check the box beside the desired files and then click “Retrieve” on the right side of the panel, as shown below.



Figure 6-6: File Options Example

Clicking ‘Delete’, deletes any checked file permanently from **icListen** after a confirmation popup. Files will disappear from the display as they are deleted, and the progress panel will close upon completion. The delete process may be cancelled, but only the files not yet deleted will remain.

When a download, upload or delete is in progress, the following panel appears, showing the progress of the retrieval for each individual file.

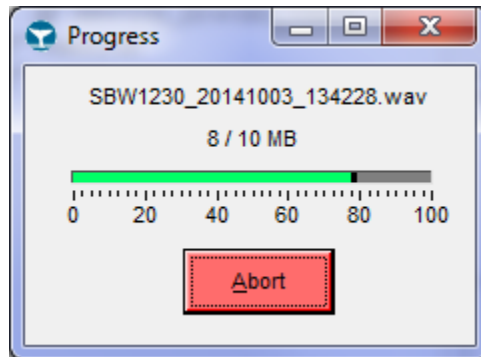


Figure 6-7: Progress Panel

Files may take a few minutes to download, and at any point during the process, the file retrieval can be cancelled. Cancelling will not harm the files in the unit. If an upload is cancelled, the partial file on the unit is deleted.

6.3 Updates

Occasionally, **icListen** may need a firmware update. This should only be done with assistance from Ocean Sonics.

This section covers the process of updating the firmware.

6.3.1 icListen LF Firmware Update

Care is required when updating the instrument firmware. First ensure that only valid **icListen** firmware is used during the update. Power must not be removed from the instrument during the update process. When the 'Firmware' button is pressed, a password prompt appears. Once the correct password is entered, a file select window opens. The password will be sent with any update file.



Figure 6-8: Password Prompt

Once a firmware file is selected, the progress window appears. A second progress window appears during the verify stage. Before the final update step, there is a final warning and chance to cancel.



Figure 6-9: Critical Stage Warning

Once this is accepted the critical operation occurs in the **icListen LF**, and confirmation of completion is displayed.

To have the update apply, the **icListen LF** unit must be power cycled (unplug, wait 10 seconds, plug back in). Note that a reset is not sufficient; the unit must be powered off (unplugged).

Once the **icListen LF** boots, an enquire command should list the new firmware version.

6.3.2 icListen AF/HF Firmware Update

An **icListen AF/HF** is updated by uploading the update (.icu) file to the update folder on the hydrophone. This is done in Lucy by pressing the “Update” button and selecting the correct file. Once the file is successfully updated the hydrophone must be rebooted. About 5 minutes after the reboot, the unit will be ready to use with its new firmware.

Note: Updating an **icListen AF/HF** will clear all data logged internally to the hydrophone. Ensure any desired data has been retrieved before performing the update.

7 Epoch Triggering

In Epoch mode, **icListen** can be configured to detect specific signals in the real-time data, and perform a number of tasks based on those signals. When replaying data, **Lucy** can also be configured to detect specific signals. **Lucy** and **icListen** can each check the data with up to 5 independent triggers, as shown in the following figure.

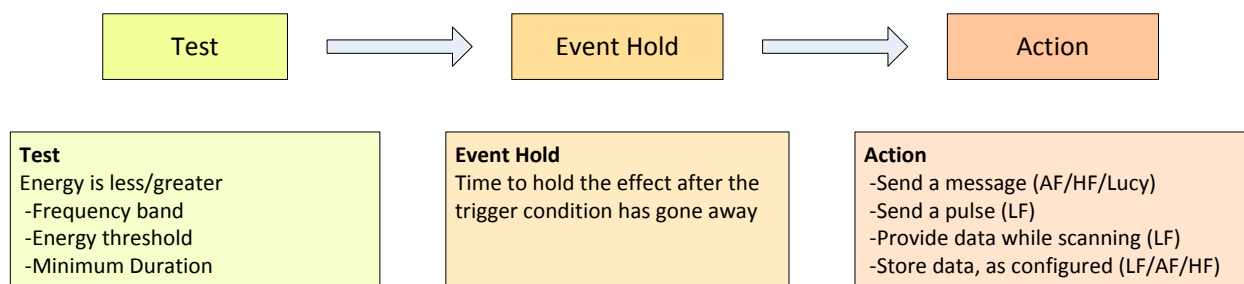


Figure 7-1: Epoch Overview

Each epoch event consists of 3 parts as detailed in the figure above.

This section will cover the setup and removal of epochs from **icListen** or **Lucy**.

Note: It is important to complete the **icListen LF** configuration before the Epoch settings, as some of the Epoch settings (frequencies, durations and logging) are dependent on the unit's configuration. For **icListen AF/HF** any trigger out of frequency range will be disabled, all others will be adjusted for the new settings automatically, to maintain the same trigger.

Note: **Lucy** may round entries to the nearest values supported by **icListen**.

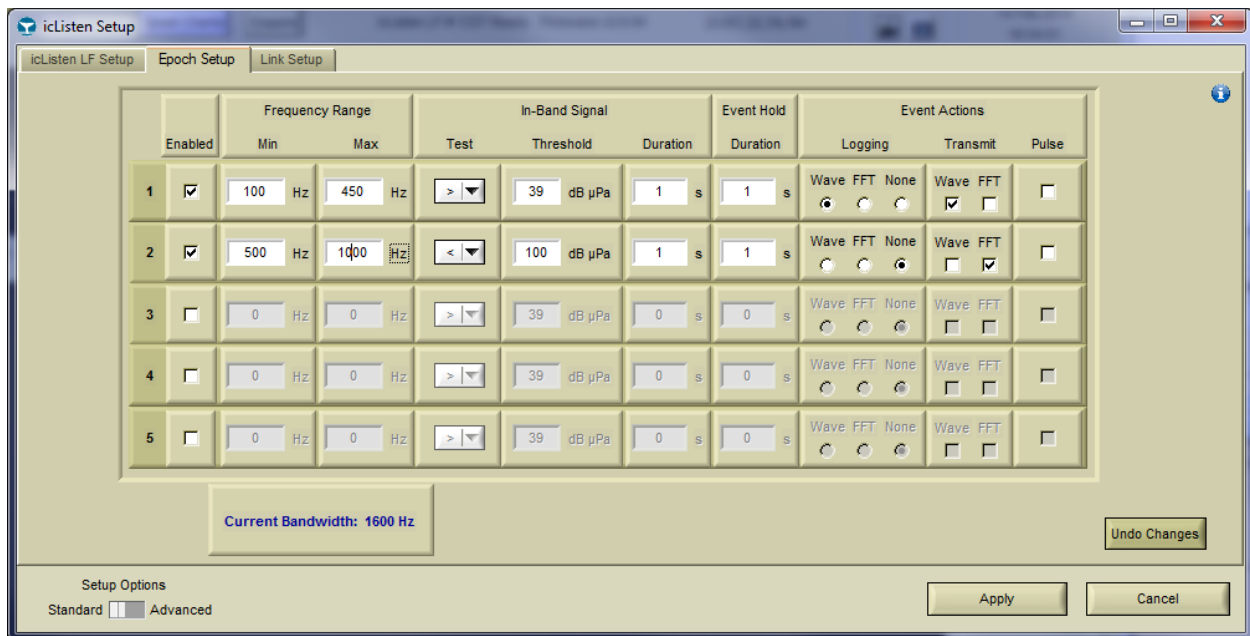


Figure 7-2: Epoch Setup Tab

The epoch setup tab is divided into 5 rows, with each row representing an epoch trigger.

Note: **icListen LF** does not maintain event numbers when enquired. This means that if you have 3 triggers and you remove number 2, and then enquire the setup again, only positions 1 and 2 will be filled. **icListen AF/HF** and **Lucy** maintain trigger numbering.

7.1 Trigger Conditions

Frequency Range		In-Band Signal		
Min	Max	Test	Threshold	Duration
100 Hz	450 Hz	>	39 dB μ Pa	1 s

Figure 7-3: Trigger Conditions

The trigger conditions section is where users set up the details of a particular epoch. These settings are what the **icListen/Lucy** checks the new data against to decide if an event has occurred.

The frequency range is the range in Hz over which the data is checked for the other signal conditions.

The signal conditions are the amplitude of the signal to check against (in μ Pa), the duration that the signal must be present/gone for (in seconds), and the condition field which must be met (whether we are checking for a signal to become present (Greater) or disappear (Lower)).

7.2 Event Hold

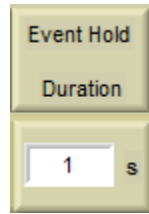


Figure 7-4: Event Hold

The event hold is the duration (in seconds) which the event actions will remain for after the trigger signal has ended.

7.3 Event Actions

The event actions are the tasks performed by the **icListen** when a trigger occurs.

7.3.1 icListen LF Event Actions

The options for actions in **icListen LF** are:

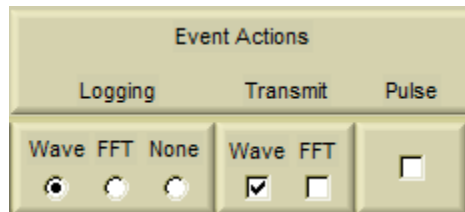


Figure 7-5: icListen LF Event Actions

- Transmit FFT Data:
 - Prepares a message containing FFT data for **Lucy** to retrieve when scanning.
 - **Note:** **icListen** must be configured to “On Epoch Trigger” mode for FFT data.
- Transmit Wave Data:
 - Prepares a message containing Wave data for **Lucy** to retrieve when scanning.
 - **Note:** **icListen** must be configured to “On Epoch Trigger” mode for Wave data.
- Trigger Pulse
 - Sends a pulse on the sync wire pair.
 - **Note:** **icListen** must be equipped with the optional sync interface for a pulse to be sent.
- Logging
 - Log either wave data or FFT data.
 - **Note:** **icListen** must be configured to “On Epoch Trigger” mode for logging.
 - **Note:** If another trigger is already logging Wave data, FFT logging will not occur.

Note: Triggered logging is not permitted above a bandwidth setting of 1600Hz (4kS/sec Sample Rate).

7.3.2 icListen AF/HF Event Actions

The options for actions in **icListen AF/HF** are:

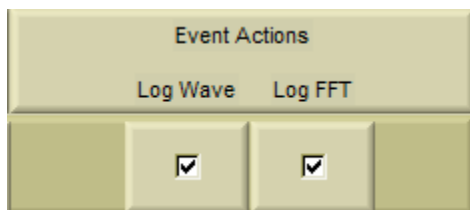


Figure 7-6: icListen AF/HF Event Actions

- Log Wav data
 - Logs a .wav file containing the Wav data during the trigger's duration.
 - **Note: icListen's** Wave setup must be configured to "Epoch" or "Epoch & Log Duty Cycle" mode.
- Log FFT data
 - Logs a .TXT file containing the FFT data during the trigger's duration.
 - **Note: icListen's** FFT setup must be configured to "Epoch" mode.
- Epoch Messages (Always active)
 - Logged and streamed by **icListen AF/HF**.

7.3.3 Lucy Event Actions

The options for actions in **Lucy** are:

- Epoch Messages (Always active)
 - Can be Logged and Displayed by **Lucy**.

7.4 Lucy Click Detector Trigger

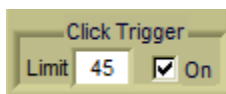


Figure 7-7: Click Detector Trigger

The Lucy click detector trigger is an epoch trigger, which checks if the click detector data has exceeded the configured threshold. This threshold can be set on the main panel when the click detector chart is active, as shown above. For more details see *Click Detector*.

7.5 Epoch Stream/Message Display

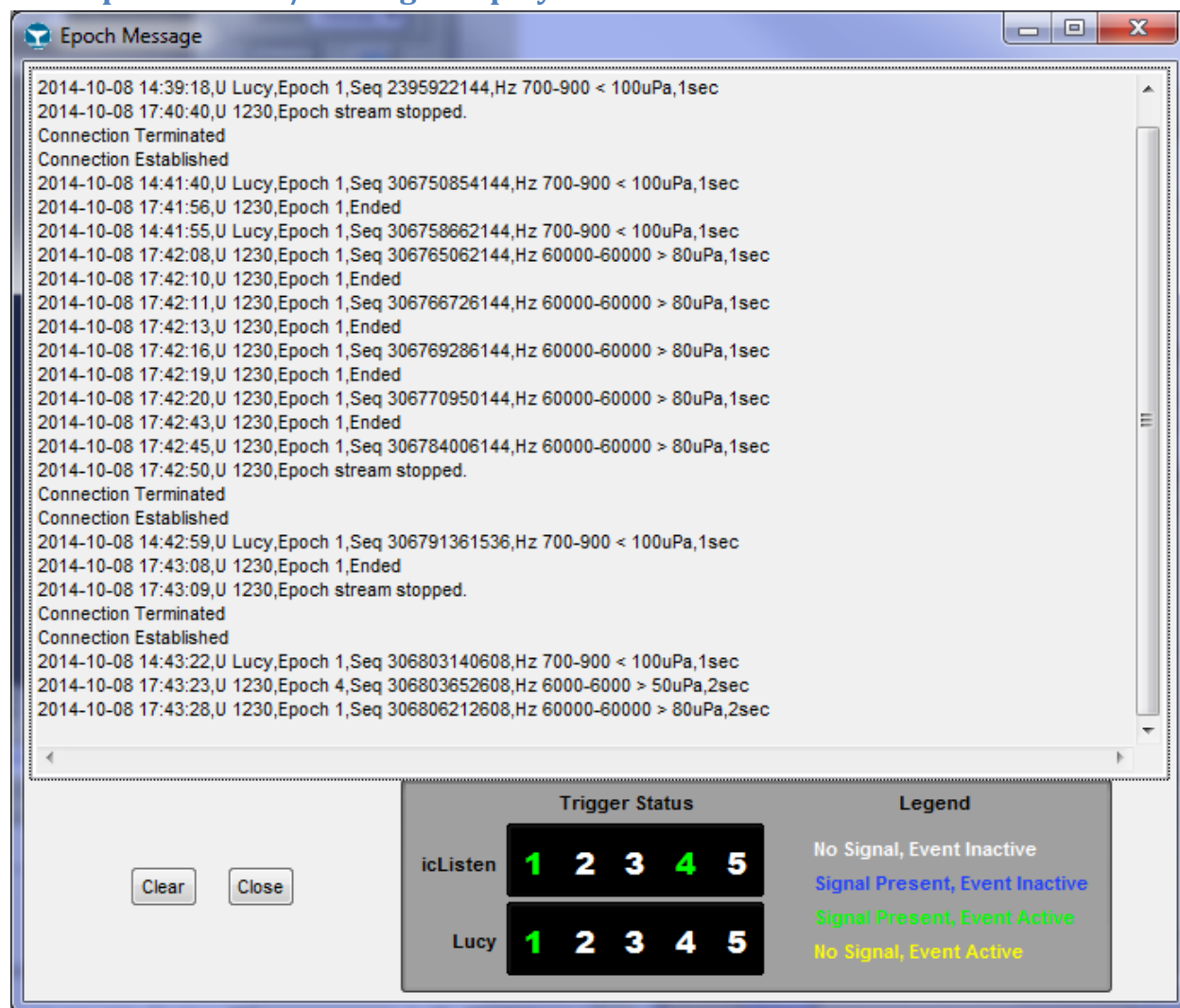


Figure 7-8: Epoch Message Display

The epoch stream is a message stream which sends an ASCII string every time an event is triggered. This panel is opened from the "Epoch Messages" button which appears on the right side of the main display. This feature is available for **icListen AF/HF** and in **Lucy**.

The returned string includes the timestamp in the format YYYY-MM-DD HH:mm:ss, which is Y=year, M=month, D=day, H=hour, m=minutes, S=seconds.

The unit's serial number is identified by the U ####, where # is the serial number, or "U Lucy" if the trigger was in **Lucy**.

The number of the Epoch which triggered is identified by Epoch #, where # is the trigger number.

The data sequence number is identified by Seq #, where # is the sequence number of the data point at which the trigger occurred.

The frequency range, test, amplitude, and duration being checked by the trigger are shown at the end of the line. The test is '>' for greater than, and '<' for less than the selected amplitude. For click detection triggers this will read "Click > x" where x is the click detector limit of the trigger.

When **Lucy** or **HF/AF** (R28+) epoch detection is being used, there are epoch status indicators in the lower right corner of the Epoch Message panel. These indicators are numbers for each epoch which change colour for the status of the trigger. The colours are:

- Blue
 - Trigger signal present, pending duration.
- Green
 - Trigger active
- Yellow
 - Trigger signal gone, pending extension period.
- White
 - Trigger inactive

7.6 Event Active Time



Figure 7-9: Active Time Setup

The **Lucy** epoch detection can also calculate the percentage of time in a set duration where the trigger signal is present. One resulting line for each active epoch is sent as an epoch message to be both displayed and logged at the end of the duration, as shown below. The active time is shown as a percentage, such as “Active 23%”. The active time is calculated using the number of FFTs during the duration which contained the desired signal, divided by the total number of FFTs during the duration, and multiplied by 100 to form a percentage.



Figure 7-10: Active Time Messages

8 Click Detector

In **Lucy**, the click detector takes a loaded in click model, and performs a cross correlation on the live or replayed FFT data. The click model is the same format as an FFT txt log. By default a harbour porpoise click model is provided and loaded. When an FFT text log is loaded for the click model, the first FFT result is used for the model signal. A new click model may be loaded from the *Lucy Setup* page. When FFT data is received/replayed by Lucy, the new data is normalized and summed with the normalized signal from the click model. The result is then graphed. The click detector result may also be used for epoch triggering. The higher the resulting value, the closer the data is to the model. A small or negative result means the data is very different from the model. See *Click Detector Chart* for more details on the graphed data.

9 Accelerometer/Magnetometer

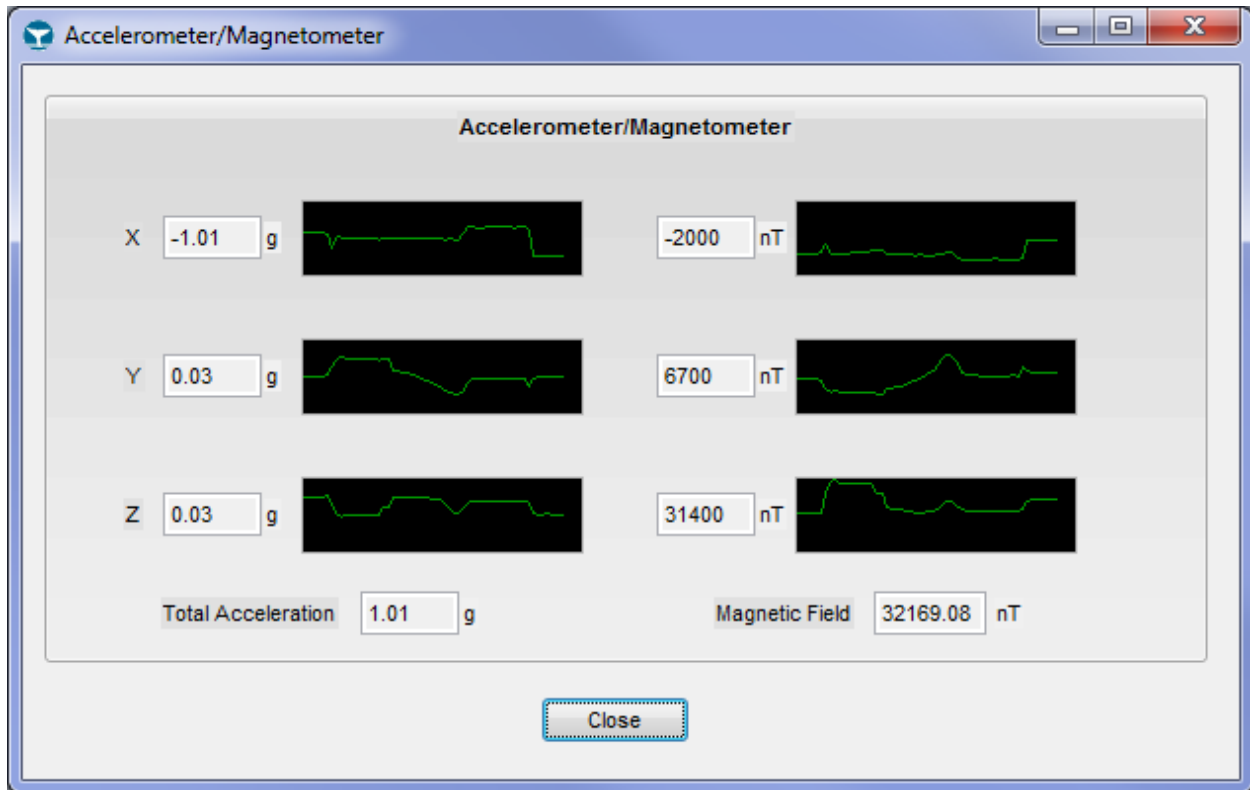


Figure 9-1: Accelerometer/Magnetometer

The Accelerometer/Magnetometer data is accessed using the Compass icon on the right side of Lucy as shown below. This data contains the x, y and z components of both Acceleration (in g) and the Magnetic Field (in nT). The graphs each show the minute of history for the each value.



Figure 9-2: Accelerometer/Magnetometer Icon

10 Runtime Logs

During operation, **Lucy** stores two additional files. These are the Job History file and Job Status file. These files are located in "C:\User*****\My Documents\Ocean Sonics\ Lucy" where ***** is the username of the computer.

10.1 Job History File

The Job History File logs the current job details. This includes the date/time, the instrument's serial number and firmware version, the version of **Lucy** being used, current temperature and humidity, the current log file name, and the entered Client, Job ID and Personnel. This file is updated whenever scanning is started.

Example Job History File Excerpt (generally viewed as a spreadsheet):

Date	Time	Data	Serial and FW	SW	Temp	Hum.
18/11/10	13:51:21	Acou/Time	unit 504 v2.1.02	Lucy V2.1.0	24.2 C	29.4
18/11/10	14:11:00	Acou/Time	unit 504 v2.1.02	Lucy V2.1.0	23.8 C	30.4
18/11/10	14:15:57	Acou/Time	unit 504 v2.1.02	Lucy V2.1.0	24.2 C	29.4

DataFile	Client	JobId	Personnel
Lucy1.TXT	Lucy	"Lucy"	"Lucy"
Lucy1.TXT	Lucy	"Lucy"	"Lucy"
Lucy1.TXT	Lucy	"Lucy"	"Lucy"

10.2 Job Status File

The Job Status File logs the status bar updates to ensure none are missed. This includes events such as device configurations, data errors, and file system usage. To ensure the file doesn't get too large, if a connection is lost for an extended period of time, the data error will only be recorded every 30 seconds. In this scenario it will be recorded when a successful connection is again established.

Example Job Status File Excerpt:

Date	Time – Status
18/11/10	14:31:58- Scanning Started
18/11/10	14:32:00- Directory Command Sent
18/11/10	14:32:07- icListen Configured Successfully
18/11/10	14:32:10- Scanning Stopped
18/11/10	14:32:11- Application Shutdown

11 FAQs

This section will go through some common questions and their answers.

Q. Why didn't "Find All Units" find anything?

A1. Check to verify that your unit is connected to your computer/network properly and is powered. For Ethernet units, verify that the computer is connected to the same network as the hydrophone. If your **icListen** is plugged directly into your computer, it must be connected before **Lucy** is started. Restart **Lucy** and try again.

A2. "Find All Units" uses network broadcast messages, which may be blocked by some firewalls. To initially find your hydrophone you may want to disable your firewall. You may also want to add an exception to your firewall for **Lucy**.

Q. Why does my IP address not work for connecting to **icListen**?

A. Make sure that there are no leading 0's in any of the address fields. For example, an address of 10.10.10.1 should not be typed as 010.010.010.001. This is because leading 0's will cause the address to be interpreted as base 8 (octal) instead of base 10 (010 is treated as 8, not 10).

Q. How can I test that **icListen** is functioning properly before deployment?

A. Connect **icListen** to your computer and an appropriate power source and run **Lucy**. Once **Lucy** is started, click to open the **icListen** Setup panel (bottom right). On the Link Tab click "Find All Units" or enter the correct Port and Baud Rate (or Port and IP Address for Ethernet). The enquire status should report "Ready". If desired, some data can be collected to further test the unit by pressing the start button at the top left of the main panel.

Q. I am connected to my unit, but cannot get data, how can I collect data?

A. While connected to the instrument, in the setup panel, check to ensure that the unit is configured to send data. For **icListen LF** this is changing to data "Always" on mode. For **icListen AF/HF** this can be done via streaming (FFT and Waveform) or scanning (FFT only). For more details on configuring your instrument see ***icListen LF Setup*** or ***icListen AF/HF Setup***.

Q. My **icListen** is configured to send data, and Lucy is scanning, why am I not getting data?

A. Ensure you have the correct charts displayed to view the data. Also for Spectrum data check the time scale in the lower right, if the time scale is long (greater than an hour) it can take a long time for samples to appear. To test your unit, reduce the time scale to 1 minute to ensure you are receiving data. For waveform data, try reducing the sample rate while testing to ensure the link is working.

Q. How can I view the .wav files outside of **Lucy**?

A. Both **Lucy** and **icListen** .wav files follow the .wav file standards and can be viewed in most audio viewing/editing programs. Ocean Sonics recommends the free utility Audacity available at <audacity.sourceforge.net>.

Q. How can I view **Lucy's** .txt logs outside of **Lucy**?

A. **Lucy's** .txt logs can be opened in any spreadsheet editor, such as Microsoft Excel.

Q. What Operating System is required to run **Lucy**?

A. **Lucy** can run on Windows XP/Vista/7. Windows 8 is not officially supported; however, preliminary tests have shown it working.

Q. My **icListen** status reads "Waiting For Data". How can I get data?

A. Firstly, wait 30 seconds and enquire again. If the status has not changed then check the **icListen LF** configuration to see if the unit is configured to send any data to **Lucy**. Setting the unit to send data to **Lucy** should change the status.

Q. The Spectrum chart is dominated by red (or it's all black), how can I view my data?

A. Change the Reference display settings for the Spectrum Chart (see *Spectrum Reference*).

Q. The Desired chart is not visible on the display, how can I find the chart.

A. Any missing chart can be enabled using the “Show” selection to the right of the desired chart. See *Charts* for more info.

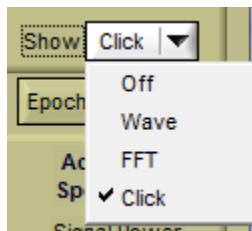


Figure 11-1: Show Chart

Q. How can I connect to multiple Ethernet instruments through a router/radio?

A. This is done via port forwarding settings in the router/radio. The ports used by **icListen** for communication are:

icListen AF/HF:

50000 – Command & Control
51678 – Waveform Data Stream
51679 – Spectrum (FFT) Data Stream
51680 – Epoch Message Stream
51681 – Status Stream

icListen LF:

50000(default, but can be configured, older **LF** units default to 23) – Command & Control

For **icListen LF**, only one port is used for communications, so simply connect to the port that your router has been configured to forward to **icListen**’s command & control port.

For **icListen AF/HF**, additional consideration must be given when forwarding ports for **Lucy** to be able to communicate with the instrument. **Lucy** will attempt to connect to all streaming ports by their relative port address from the command and control port, so all forwarded ports must have the same offset added to them for **Lucy** to communicate with them.

For example, if port 50100 is forwarded from the router to port 50000(Command & Control) on **icListen**, then **Lucy** will expect an offset of 100 for all of the other streaming ports as well ($50100 - 50000 = 100$). This means that port 51768 must be forwarded to 51678 (Waveform Stream), 51769 must be forwarded to 51679 (Spectrum Stream) and 51780 must be forwarded to 51680 (Epoch Stream).

Please refer to your router’s documentation for setting up port forwarding rules.

Glossary

ADC	Analog to Digital Converter
dB	Decibels
FFT	Fast Fourier Transform
Hz	Hertz
PPS	Pulse per Second
UI	User Interface
pk-pk	Peak to Peak