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Audioscope Software

Online Electronics' Audioscope software plots the amplitude of audio signals against time allowing visual monitoring and interpretation of the audio signals generated by Acoustic or EM receivers

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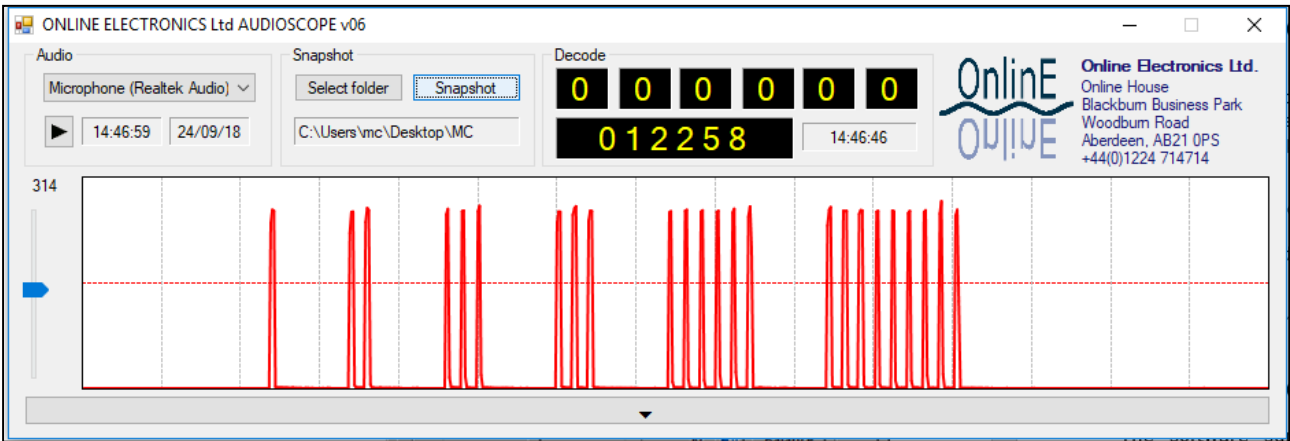
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1. DESCRIPTION

Online Electronics' AUDIOSCOPE software plots the amplitude of audio signals against time allowing visual monitoring and interpretation of the audio signals generated by Acoustic or EM receivers connected to the Line In or Microphone input of a laptop or PC. This is particularly useful when the signal being received consists of an amplitude modulated coded transmission.

The software has several intuitive and useful features such as a live 15 second buffered display, Y-Scale Adjustment, Pause/Play function, Screen Snapshot function, Audio Snapshot function and OEL Acoustic Data Transmitter decoding function.

Clicking on the button at the bottom of the window opens up an expanded view that offers the additional functionality of a Decode Log and Clock Drift Compensation Calculator.



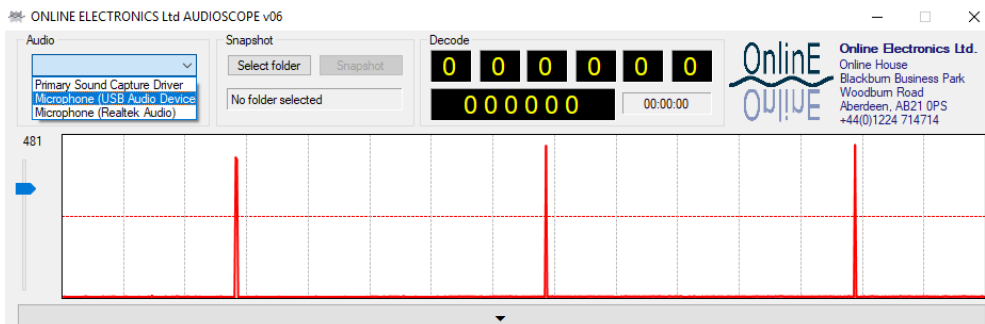
1.1. LIVE VISUAL DISPLAY

The live visual display is 15 seconds 'long' and the vertical grey gridlines represent 1 second intervals. New data appears on the RHS and scrolls towards the LHS. The figure above shows a Snapshot of some real data from an OEL Acoustic Data Transmitter.

The slide-bar on the left of the graph controls the Y-Scale of the graph. If it is moved up the pulses will get larger, if it is moved down the pulses will get smaller.

1.2. AUDIO GROUP

The drop-down menu at the top of the Audio group is used to select the PC audio input device to capture data from. If using the computer's built in audio connections, this will typically be the Line In or Microphone option, but this can vary depending on the computer's audio configuration. For simplicity, OEL can supply a USB Audio Dongle as pictured below. If using the USB Audio Dongle, simply connect it to a spare USB port on the computer and select "Microphone (USB Audio Device)" as shown in the screenshot below (note that the dongle is plug and play and doesn't need any additional drivers to be installed).



The audio output from the receiver should be connected to the relevant audio input (if using the USB Audio Dongle, this will be the pink 3.5mm audio jack).

The current PC time and date is shown within the Audio group, this provides a time stamp when using the Snapshot function.

The Play/Pause button starts or stops the visual display. The software starts a 15 second long buffer of the audio input as soon as a suitable audio device has been selected. If the Pause button is pressed, the visual display will pause, allowing the user to examine the signal at their leisure. The software will continue buffering the live audio in the background, so when Play is pressed again, the previous 15 seconds of buffered audio will be shown with the newest data on the RHS of the screen.

Note: If using the built-in audio connections on the computer, it is important to verify that the received signal is coming through the microphone/headset jack and not from the computer's built-in microphone. The easiest way to test this is to gently tap the computer casing adjacent to the built-in microphone and verify that this does not register as a significant signal on the live graph.

1.3. SNAPSHOT GROUP

If the user has selected a suitable folder using the Select Folder button, a screen snapshot of the current software window and current contents of the 15 second audio buffer can be captured at any point by pressing the Snapshot button. If the display has been paused, pressing the Snapshot button will take a snapshot of the paused screen and the paused audio corresponding to the captured, paused screen.

The screen snapshot will be saved into the selected folder as a *.PNG image with name <SNAPSHOT YYMMDD hhmmss.PNG> where "YYMMDD hhmmss" represents the current date (reversed) and time.

The 15 second audio snapshot will be saved into the selected folder as a *.WAV audio file with name <SNAPSHOT YYMMDD hhmmss.WAV> where "YYMMDD hhmmss" represents the current date (reversed) and time.

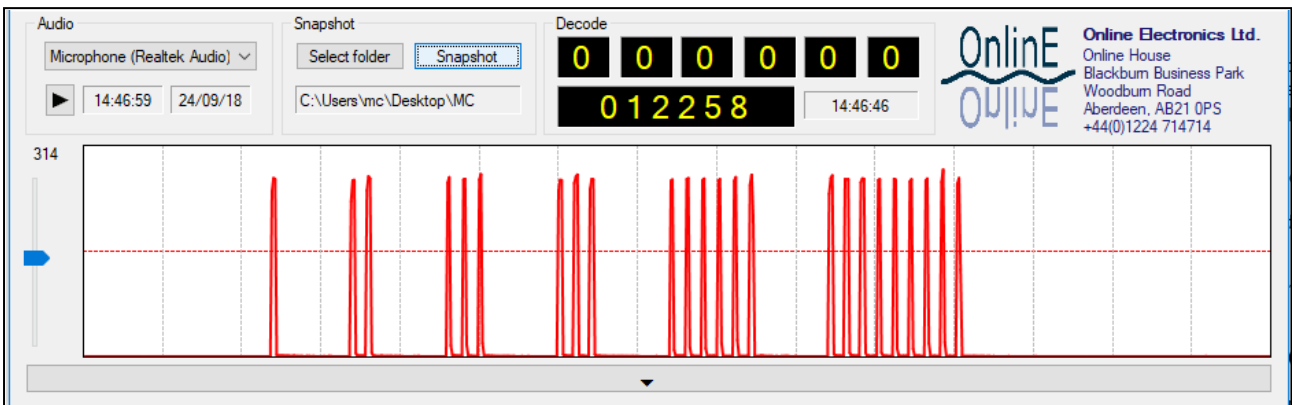
1.4. DECODE GROUP

The software includes an automatic decode function for use with standard OEL Acoustic Data Transmitters. The horizontal dotted red line shown on the graph represents a threshold level, whenever a pulse crosses this line one of the 6x counters on the top line within the Decode group will increment.

In order for the decode algorithm to function, the PC audio input level, acoustic receiver audio output level, and the software Y-Scale must be adjusted so that all pulses cross this line and all background noise is below this line.

When 6 valid groups of pulses have been received the data will be decoded and displayed in the window on the bottom-left of the Decode group. When a successful decode occurs the time at the bottom-right of the Decode group will update. This time can be used to predict when to expect the next periodic data transmission.

The standard OEL Acoustic Data Transmitters transmit 6 groups of pulses representing a 6 digit number (which may represent a time, pressure, temperature or any other data). Each group is separated by exactly 1.0 second of silence and each pulse within a group is separated by exactly 0.2 seconds of silence. By simply counting the pulses in each group and subtracting one, the data can be decoded. In the example shown below, the pulse counts are [1 2 3 3 6 9] representing the data [0 1 2 2 5 8].



This example shows a real signal received in good acoustic conditions where the receiving hydrophone was positioned approximately 10m from a high power transmitter installed inside a pipeline subsea. There was relatively little background acoustic noise caused by vessel thrusters and other sources of subsea noise. In such conditions the automatic decode function will work reliably and the user need not pay too much attention to the received signal. In more onerous conditions, some interpretation of the signal may be required by the operator.

1.5. DECODE LOG

Each time the Audioscope software successfully decodes data, the data is stored in the Decode Log along with the time and date it was received (the time is taken as the time of the first pulse of the first data digit).

When used to decode GRID data, having all the decoded data displayed at once makes it easier to identify TSS and TOE readings as well as the data rate(s).

1.6. DRIFT COMPENSATION

The AUDIOSCOPE software includes a drift compensation calculator that uses two TSS readings (taken at known times) to calculate the clock drift of a transmitter at the time a gauge plate event occurred. The calculator then presents the drift compensation outputs including the adjusted time of event (as shown in the screenshot below).

To use the calculator, the user inputs two TSS readings along with the exact time and date they were taken, along with the TOE reading and clicks the "CALCULATE DRIFT OUTPUTS" button. The calculator works best when you have TSS readings taken before and after the event occurred, although it can still be used with two TSS readings taken after the event, although they should be a number of days apart if possible.

Note: Click the "600 SERIES TRANSMITTER" checkbox if using data from a 600 unit as there is a slight difference between the 600 timing system and that of the 800/1200 units.

The screenshot displays the AUDIOSCOPE v06 software interface. At the top, there are controls for Audio (FrontMic), Snapshot (C:\Users\mc\Desktop\New), and Decode (000000, 000414). A central graph shows a red waveform with a vertical red line at 15:41:06. Below the graph is a 'Decode Log' table:

DAYS	HOURS	MINUTES	DATE	TIME
00	04	02	25/06/18	15:29:06
00	00	18	25/06/18	15:31:06
00	04	06	25/06/18	15:33:06
00	00	18	25/06/18	15:35:07
00	04	10	25/06/18	15:37:06
00	00	18	25/06/18	15:39:06
00	04	14	25/06/18	15:41:06

Below the log is the 'Drift Compensation Inputs' section with the following values:

	DAYS	HOURS	MINUTES	DATE AND TIME
TSS1	0	0	5	25/06/18 11:32:06
TSS2	4	2	26	29/06/18 13:53:08
TOE	1	23	18	

The '600 SERIES TRANSMITTER' checkbox is checked. To the right, 'Drift Compensation Outputs' are shown:

Calculated Start Time	25/06/2018 11:27:06
Adjusted Time of Event	27/06/2018 10:45:32
Total Clock Drift Between TSS Readings	-2
Average Clock Drift Per Day	-0.49
Clock Drift at Time of Event	-0.96

A graph titled 'Clock Drift Against Time Since Start' plots Clock Drift (s) on the y-axis (from 0 to -2.5) against Adjusted Time Since Start (s) on the x-axis (from 0 to 3E+05). Three points are marked: TSS1 at (0, 0), TOE at approximately (1.7E+05, -1.0), and TSS2 at approximately (3.5E+05, -2.0). A red line connects these points, showing a downward trend.

1.7. EXAMPLE 1 – DATA DECODE INTERPRETATION

The example below shows the real signal received in poor acoustic conditions when the receiving hydrophone was positioned several hundred metres from an acoustic transmitter installed inside a pipeline subsea. There was significant background acoustic noise caused by vessel thrusters, rough seas and other sources.

In this case the automatic decode function did not work reliably due to the effects of background acoustic noise (pulse 9 did not cross the threshold line) however with a little knowledge the operator successfully decoded the data.

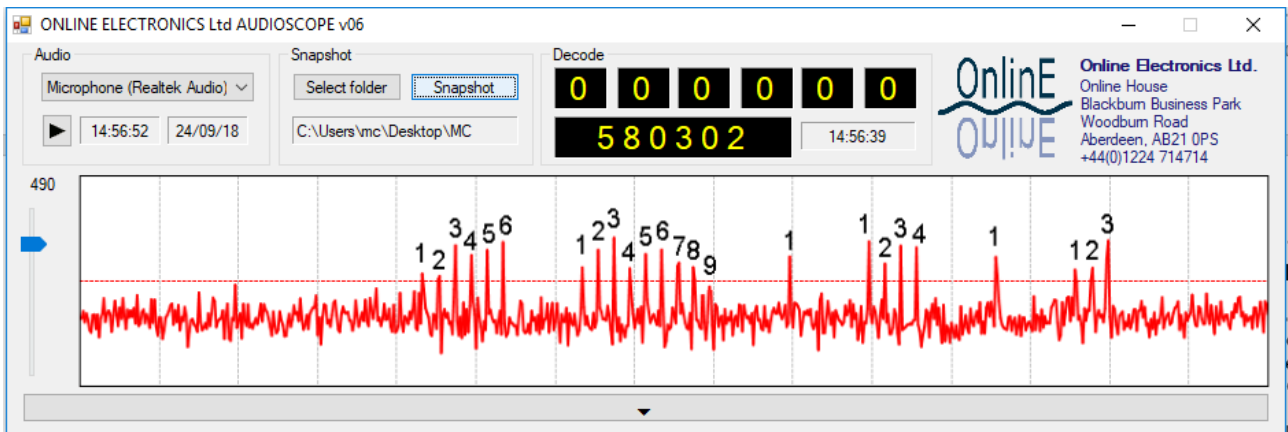
The 6x groups of pulses were relatively obvious.

The operator deduced that there was a missing pulse between pulse 8 of group 2 and pulse 1 of group 3 because there should be exactly 1.0 second between each group of pulses and exactly 0.2 seconds between pulses within a group. The vertical grey lines represent 1.0 second intervals so there is approximately 1.2 seconds between pulses 8 of group 2 and pulse 1 of group 3 so there is a missing pulse somewhere between them.

The operator used the audio Snapshot function to record the data transmission and listened to the recording repeatedly to help to interpret the signal, the human brain is exceptionally good at detecting patterns and rhythms.

By examining the waveform and listening repeatedly to the audio recording the operator deduced that there was a weak pulse which did not manage to cross the threshold at position 9 and the pulse count was [6 9 1 4 1 3] representing the data [5 8 0 3 0 2].

The operator was able to confirm that the interpretation was correct by waiting for the next data transmission and confirming there were indeed 9 pulses in the second group.



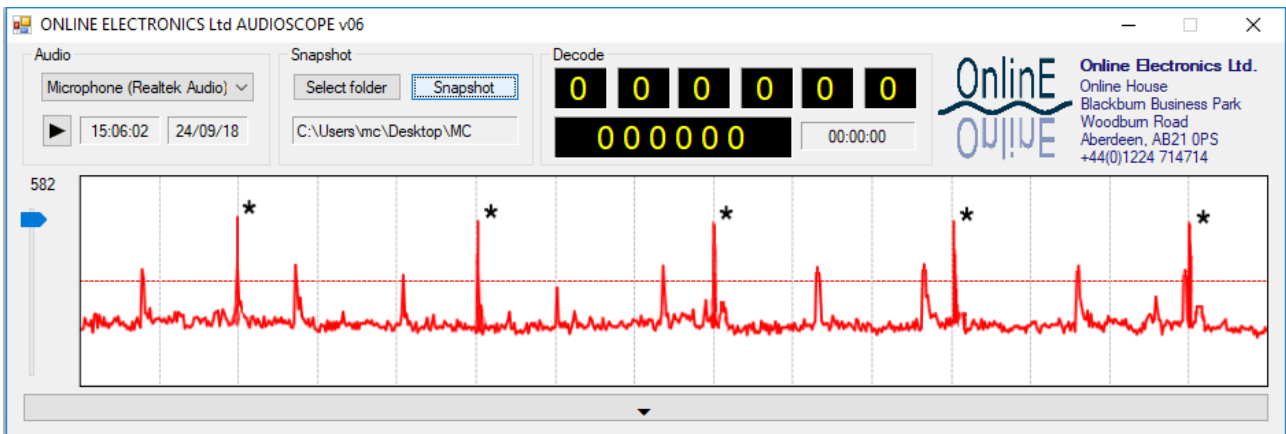
1.8. EXAMPLE 2 – SIGNAL INTERFERENCE INTERPRETATION

The example below shows the real signal received in average acoustic conditions when the receiving hydrophone was deployed from a vessel several kilometres from a 24kHz dual rate acoustic transmitter which was expected to be transmitting a pulse every 3 seconds indicating the working state of a piece of subsea equipment.

When the operator first deployed the hydrophone and listened to the audio alone there were a confusing number of pulses detected at a seemingly random repetition rate. The operator was not confident that a 3 second pulse was being received.

When AUDIOSCOPE was used it became clear that the expected 3 second pulse was present as indicated by the asterisks below however there were also a multitude of weaker pulses being received at a much faster and irregular rate.

AUDIOSCOPE showed an obvious difference in magnitude between the 3 second pulses and the weaker, irregular pulses which was not obvious by listening alone. It was later discovered that a nearby vessels' dynamic positioning system was working in the same frequency band as the 24kHz transmitter and causing these weaker, irregular pulses.

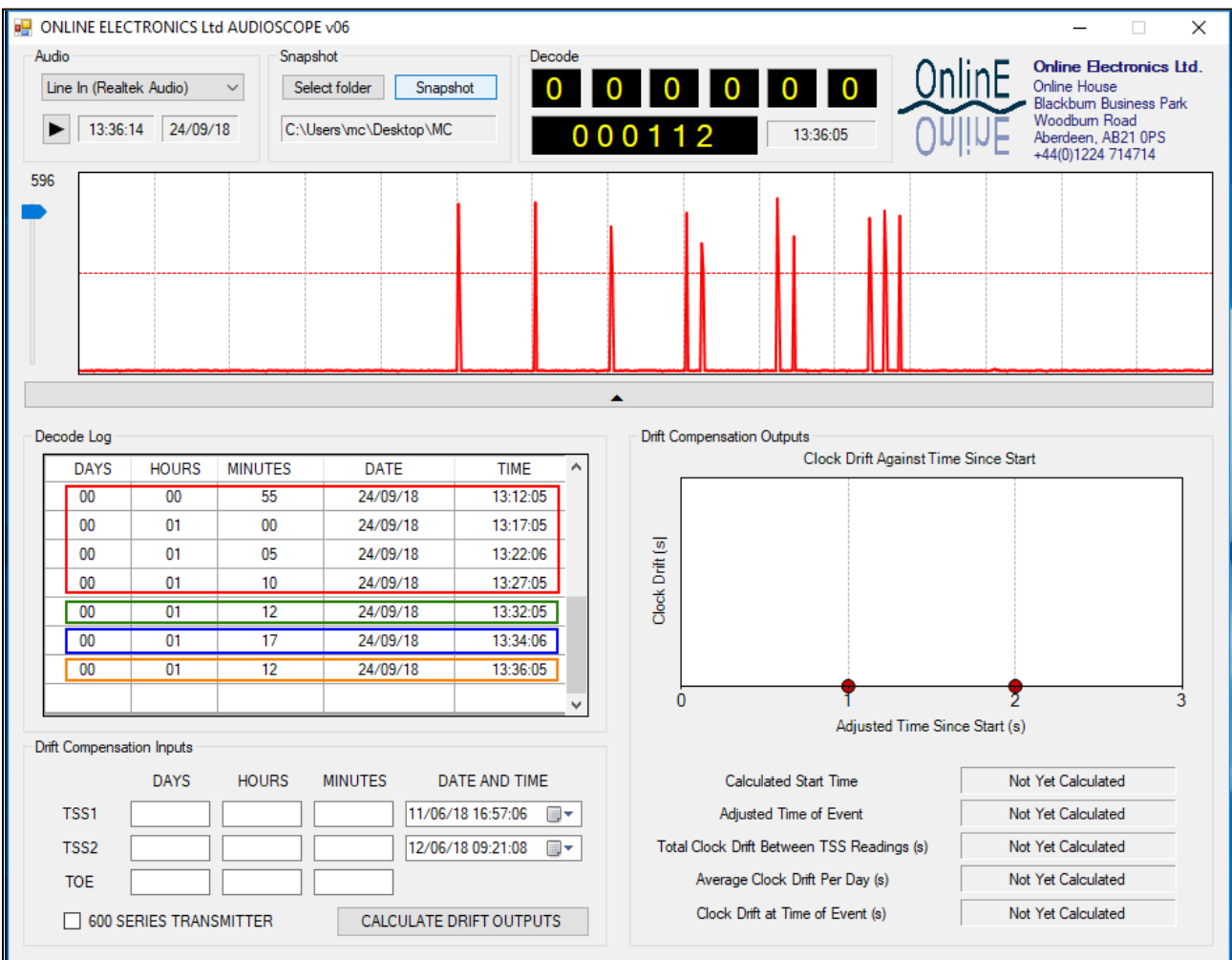


1.9. EXAMPLE 3 – DECODE LOG

The screenshot below shows data from a GRID unit that was set to transmit TSS (Time Since Start) every 5 minutes before a Gauge Plate Event occurs. The red box shows the decoded TSS data before the event occurs. As expected, the TSS data increments by 5 minutes each time and you can see that the received times are all 5 minutes apart.

The next data reading (in the green box) is the first TOE reading which identifies that a Gauge Plate Event occurred 1 hour and 12 minutes after activation. Note that the background ping rate will have switched from the PPR (Pass Ping Rate) to the FPR (Fail Ping Rate) to indicate that an event has occurred. After the first TOE data is sent, the data rate switches to the FDR (Fail Data Rate) which was set to 2 minutes.

The next data reading (in the blue box) is another TSS data reading, while the following reading (in the orange box) is a repeat of the TOE data reading. Note that the TSS readings increment each time, whereas the TOE reading will always be the same.

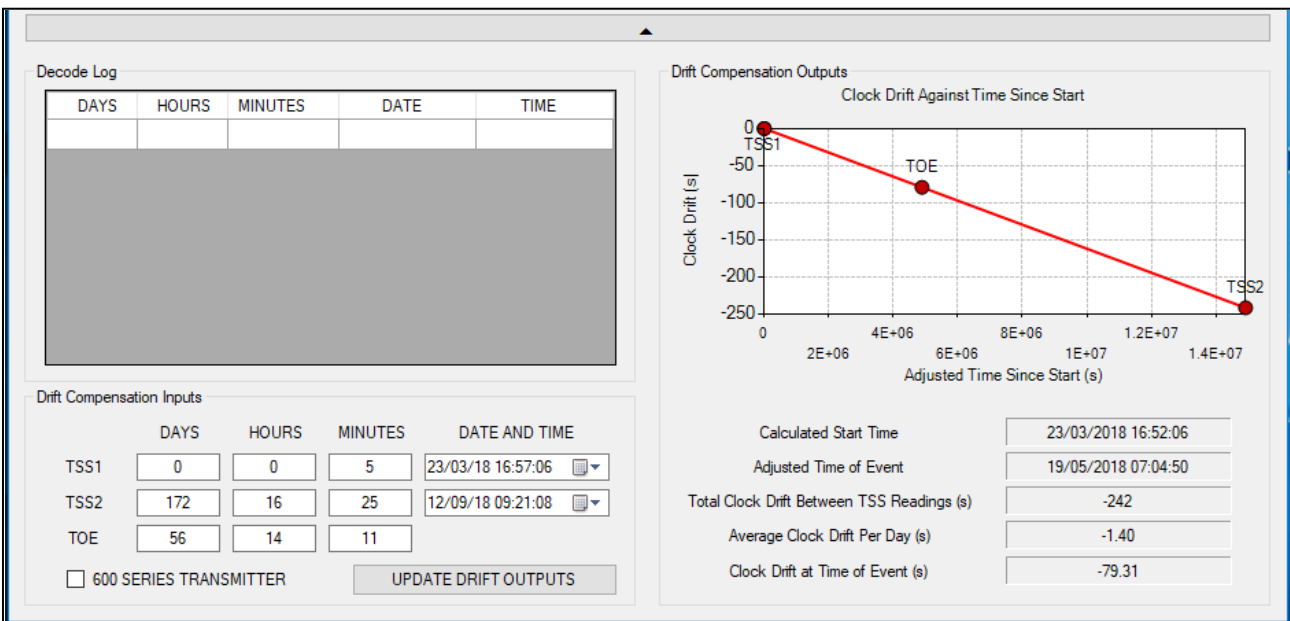


1.10. EXAMPLE 4 – DRIFT COMPENSATION

The screenshot below shows the Drift Compensation Outputs (on the right-hand side) that were generated from the Drift Compensation Inputs (on the lower left side).

The inputs consist of a single TOE (Time Of Event) reading and two TSS (Time Since Start) readings taken at known times. Clicking the "CALCULATE DRIFT OUTPUTS" button then generates the outputs on the right-hand side.

In this example, the first TSS reading was taken 5 minutes after activation and the second TSS reading was taken more than 172 days after activation. The clock drift between TSS readings is the difference between the TSS data readings and the difference between the times when the readings were taken. In this case this was calculated as -242 seconds, which equates to -1.4 seconds per day. Applying this drift rate to the time of the event (i.e. 56 days, 14 hours and 11 minutes after activation) the clock drift was calculated as -79.31s. Based on the time and date of the first TSS reading, this gives the adjusted time of event as 07:04:50 on 19/05/2018.



2. SETUP AND TEST

The instructions below describe how to connect an audio signal to a laptop running the AUDIOSCOPE software. Usually this signal will come from an Acoustic or EM receiver.

Before beginning ensuring that Microsoft .NET, Microsoft DirectX, and the AUDIOSCOPE software have been successfully installed on the laptop following the instructions provided in this manual.

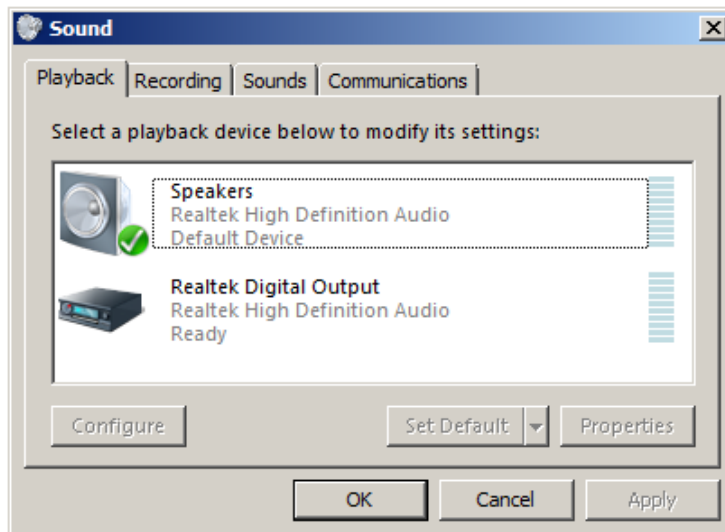
1. Following the relevant manuals set up the Acoustic or EM receiver frequency and gain so that a clear signal can be heard.
2. Connect the audio source from the receiver to the Line In or Microphone connection on the host PC. Plug a pair of headphones into the Headphone connection on the laptop.
3. Confirm that the same audio heard earlier from the receiver can now be heard in the headphones connected to the laptop. This confirms that the laptop is receiving a good quality signal and that the laptop settings and levels are configured correctly. If no audio is heard or you are unsure of the correct settings then refer to section 3 WINDOWS 7 AND 8 AUDIO CONTROLS for a starting point.
4. Start the AUDIOSCOPE software.
5. Select the audio device which the audio source has been connected to from the drop-down menu in the Audio group at the top-left of the window. Usually this will be the "Primary Sound Capture Device".
6. Press the Play button to start viewing the input signal amplitude against time. At this point the signal may or may not be too big to see.
7. Adjust the Y-scale slider within the AUDIOSCOPE software until pulses similar to those shown are received.
8. The horizontal red line shown on the graph represents the threshold level, whenever a pulse crosses this threshold, one of the 6x counters on the top line within the Decode group will increment.
9. Ensure that all levels are adjusted so that all pulses cross this line and all background noise is below this line. Fine adjustment of the Y-scale slider can be achieved by clicking on the slider and then using the keyboard up and down arrow keys.

3. WINDOWS 7 AND 8 AUDIO CONTROLS

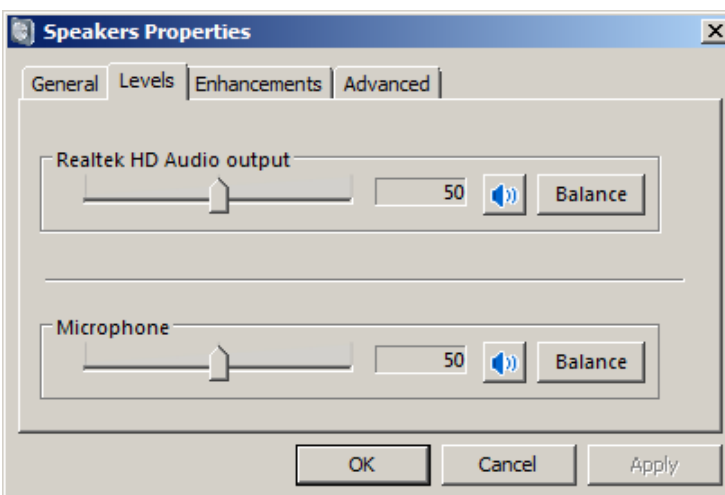
Note that these settings are relevant to Windows 7 and 8. Different operating systems will have similar controls and these instructions can be used to help understand them.

With the receiver turned on and plugged into the Microphone input on the laptop and a pair of headphones plugged into the Headphone output of the laptop, follow the steps below.

From the desktop, right click on the grey speaker symbol in the taskbar and click on Playback devices to open the Sound control panel shown.



From within the Sound control panel Playback tab, double click on the enabled Speakers device (green tick indicates the device is enabled) to access the Speakers Properties window as shown.

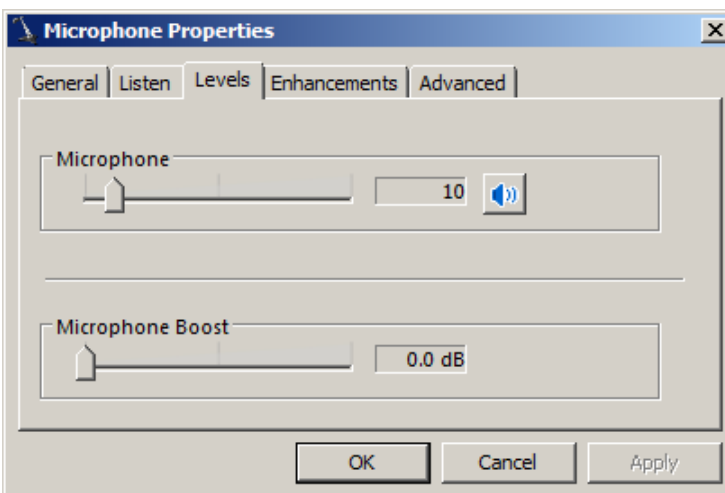


On the Speaker Properties, Levels tab, adjust the output volume and Microphone volume to 50% as shown. Ensure that neither are muted.

Move to the Enhancements tab and ensure "Disable all sound effects" has been selected.

Press OK to confirm changes and return to the Sound control panel.

From within the Sound control panel, Recording tab, double click on the enabled Microphone device to access the Microphone Properties window shown.



On the Microphone Properties Levels tab adjust the Microphone level to 10% and the Microphone Boost to 0.0 dB as shown. Ensure that the microphone is not muted.

Move to the Enhancements tab and ensure "Disable all sound effects" has been selected.

Move to the Listen tab and ensure "Listen to this device" has been selected.

You should now be able to hear the audio received by the microphone input over the headphones. If the sound is too loud then use the normal volume control on the laptop to reduce the volume.

4. INSTALLATION

There are three stages to the software installation described below. Ensure that the software has been installed and tested well in advance of when it will actually be required.

4.1. MICROSOFT .NET FRAMEWORK INSTALLATION

The software supplied by Online Electronics requires the Microsoft .NET Framework to be installed on the host PC. For more information about the .NET Framework, or to download the latest version, visit www.microsoft.com/net. The latest version can also be found on the memory stick supplied by Online Electronics and can be installed by following the instructions below.

1. Log into the host PC as an administrator with full administrator rights.
2. Execute the dotNetFx40_Full_x86_x64.exe file found in the .NET folder on the memory stick.
3. Follow all instructions provided on screen to complete the installation.

4.2. MICROSOFT DIRECTX INSTALLATION

The software supplied by Online Electronics requires the Microsoft DirectX Multimedia Application Programming Interfaces to be installed on the host PC. For more information about DirectX, or to download the latest version, visit <http://www.microsoft.com/en-gb/download>. The latest version can also be found on the memory stick supplied by Online Electronics and can be installed by following the instructions below.

1. Log into the host PC as an administrator with full administrator rights.
2. Execute the DXSETUP.exe file found in the DIRECTX folder on the memory stick.
3. Follow all instructions provided on screen to complete the installation.

4.3. AUDIOSCOPE SOFTWARE INSTALLATION

To install the software supplied by Online Electronics follow the instructions below.

1. Log into the host PC as an administrator with full administrator rights.
2. If a previous version of the AUDIOSCOPE software is already installed, uninstall it using Start menu > Control Panel > Programs > Uninstall a Program.
3. Execute the setup.exe file found in the AUDIOSCOPE folder on the memory stick.
4. Follow all instructions provided on screen to complete the installation.
5. The software will now be available in the Start menu.