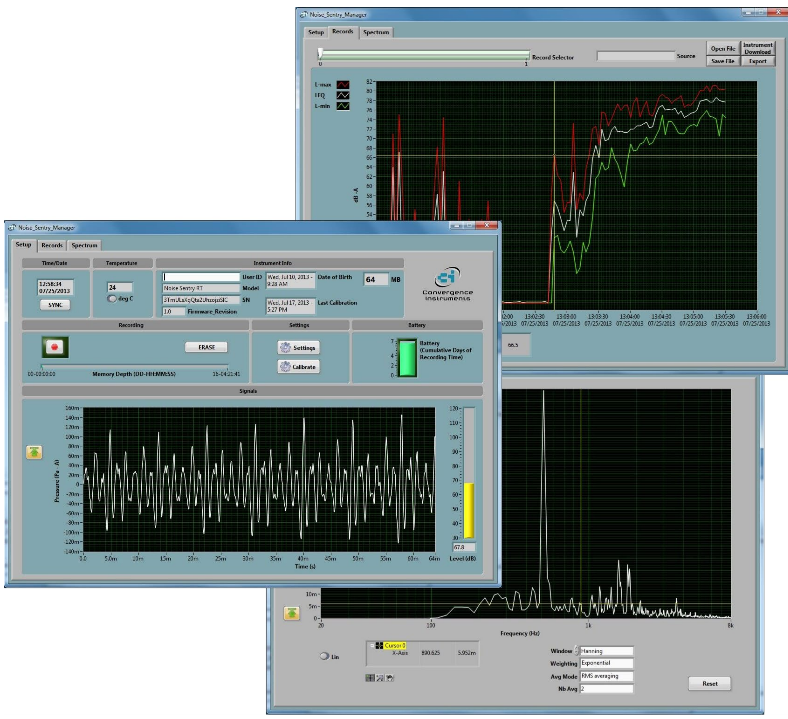
Convergence Instruments

NSRT_mk3 and NSRT_mk4 series

USB Audio Interface



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1 Introduction

The USB Audio Interface is offered as an option for the NSRT_mk3 series, and included with the NSRT_mk4 series. Instruments with that feature are composite USB devices. They offer two separate interfaces to the host computer:

- The *DDCI* interface. This is the same interface used on the non-USB-Audio devices. It allows all the Convergence Instruments tools and applications to recognize and control the instrument. Note that the *Instrument Manager* is still required to configure the instrument, and use it to record sound pressure levels as a normal *NSRT_mk3* or *NSRT_mk4 series*.
- A separate USB interface, compliant with the Audio Class 1.0 defined by the USB-IF. That interface binds to any generic audio driver present on the host computer.

Through that Audio-Class interface, the instrument is seen by the host computer as a generic USB microphone. This allows the use of off-the-shelf, as well as custom-designed signal recording and analysis software. Compared to a typical USB microphone, the stream coming from the instrument is spectrally corrected and calibrated in sound level pressure (Pa), and has the spectral weighting curve (A, C or Z) already applied. Therefore that signal can be processed directly and in real time to measure sound pressure levels.

2 Compatibility

The USB Audio Interface is compatible and has been tested on the following platforms:

- **Windows** (tested on Win 7, and Win 10).
- **Mac-OS** (tested on OS X “El Capitan”).
- **Linux** (tested on a Raspberry Pi 3b running Raspbian “Buster”).

3 Interface features and operation

The USB Audio function presents as a generic USB microphone, capable of streaming signal in real time to the host computer. That microphone has the following features:

- **A Volume Control:** Continuously adjustable between 0 dB and +40 dB
- **A Mute Control:** The stream can be muted on demand using that control.
- **Two Mono Streaming Formats:**
    - **IEEE 32-bit float:** That format has full resolution and is the best choice when it is supported by the host USB driver and applications.
    - **PCM 16-bit integer:** That format is offered for compatibility on systems that do not support the IEEE float format.
- **Two sampling frequencies:**
    - **32 kHz**
    - **48 kHz**

When streaming, the host computer’s USB driver will schedule one packet per USB frame (per 1ms). Depending on the sampling frequency, the packet will contain on average 32 samples when set to 32 kHz, or 48 samples when set to 48 kHz.

The microphone is defined as ***an asynchronous Audio Source***. That means that it is not synchronized to the USB frame-sync clock. As a consequence some packets may contain slightly more or slightly less samples than the average, to correct for the drift between the instrument clock and the USB frame-sync clock. The maximum packet size is 50 samples.

4 Signal and Scaling

4.1 32-bit IEEE float format

When that format is selected, the sample values represent the sound pressure waveform, calibrated in Pa. So a sample with a value of 1.0 represents a pressure of exactly 1 Pa.

Using that format the volume control can be adjusted but has no effect on the signal. This way the signal is guaranteed to be properly scaled.

The spectral weighting factor (A, C or Z), as set in *Instrument Manager*, has been applied to the signal that is streamed to the host computer.

4.2 16-bit PCM integer format

That format allows a representation between -32768 and +32767.

That format is provided for compatibility, on systems that do not support the IEEE float format. That signal has a slightly reduced resolution from the native signal that is processed in the instrument. Therefore a volume control is provided to adjust the dynamic range of the signal. The volume can take any value between 0 dB and +40 dB.

- With the volume set to 0 dB, the digital range of -32768 to +32767 represents +- 28.28 Pa. Therefore a sinusoidal signal would just begin to clip at 120 dB_{SPL}.
- With the volume set to +40 dB, the digital range of -32768 to +32767 represents +-0.2828 Pa. Therefore a sinusoidal signal would just begin to clip at 80 dB_{SPL}.