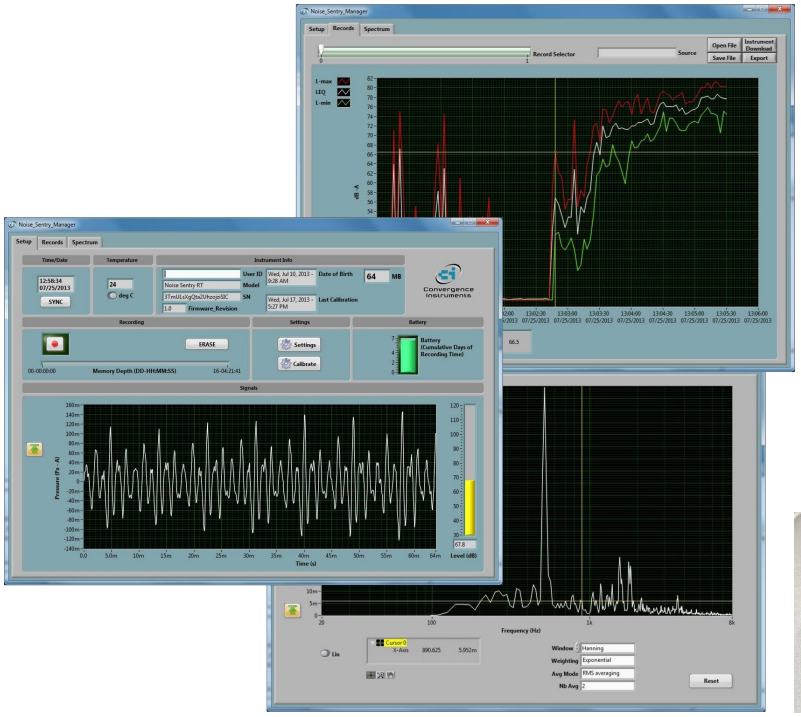
Convergence Instruments

NSRT_mk4 and NSRTW_mk4

User's Manual





April 10 2023

Bruno Paillard

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1 Introduction

NSRTW_mk4 is the fourth generation of Convergence Instrument's *WiFi*™ enabled smart integrating sound-level meter/datalogger. It includes a type 1 digital MEMS microphone, an accurate date/time clock, a non-volatile 128 Mb recording memory and *wireless* connectivity with fast USB and *WiFi*™ download ("*W*" model only).

Running on battery, it can record sound pressure levels and report them through *WiFi*™ for a week. Connected to an external USB charger it can record and report for months. Its very small size allows it to be attached to or embedded within the monitored equipment.

The *NSRTW_mk4* includes the following features:

- Type I precision.
- A, C and Z weighting curves.
- *Integrating* Sound-Level Meter, records L-peak *(new)*, L-max, L-min and Leq levels.
- Log interval adjustable from 125 ms (8 points per second) up to hours.
- Individual Manufacturer's Certificate of Calibration from Convergence Instrument provided with every instrument purchased.
- *WiFi*™ connectivity to report measured levels remotely and automatically at preset intervals (*"W"* model only).
- Email alarms on sound level, and LEQ *(new)* over specified threshold, as well as low-battery. Email alarms to multiple addresses *(new)*.
- Digital very sensitive MEMS microphone (30 dBA typical noise floor).
- Completely sealed weatherproof enclosure designed for outdoors applications.
- All-digital design.
- Ultra-stable sensitivity (field recalibration is easily done, but seldom required).
- Very low sensitivity variation due to temperature changes.
- Very low sensitivity to vibrations.
- Software function calculates global Leq and/or dose, according to ISO and OSHA methods.
- Adjustable response time.
- Preprogrammed recording start date/time.
- Integrated oscilloscope function that can show the acoustic signal in real time.
- Integrated spectral analyzer function that can show the spectrum (or 3rd-octave bands) in real time.
- Can be used as a high-quality USB digital microphone.
- Allows the observation of recorded levels while the recording is ongoing.
- Works standalone, or USB connected.
- Long life internal rechargeable battery that recharges from USB and most USB chargers.
- Can be field-calibrated.
- Observes and records 100% of the acoustic signal (no missed samples).
- Editable individual custom ID for easier instrument management.
- All settings are stored in non-volatile memory. So the instrument will regain full functionality and *WiFi*™connection from hard-reset or battery loss.
- Compatible with Convergence Instrument's Cloud service.
- WiFi connection can use nearby open access point if specified access point does not work *(new)*.
- USB Audio interface is included *(new)* (see appendix A). With that interface, the instrument presents to the host computer as a generic USB microphone.

2 Applications

- Sound level and acoustic dose measurement and recording.
- Monitoring of safe working conditions.
- 24/7 noise monitoring on construction sites.
- Email Alarms when the noise is too loud.
- Activity detection and logging.
- Long-term measurement and recording of acoustic levels for environmental impact studies.
- Specially designed for long-term outdoors applications.

3 Warnings



Never blow air at or near the microphone.



When calibrating, insert and remove the instrument into/from the calibrator as slowly as possible to give as much time as possible for the pressure to equalize. An over or under-pressure can damage the MEMS microphone.



Never block the vent that is at the back if the instrument (see https://convergenceinstruments.com/mounting-directions/).



Avoid over-discharging the battery.

- *Recharge the instrument immediately if the LED indicates a low-battery condition.*
- *Even if the instrument is Idle all or most of the time, recharge it fully at least once every 6 months.*
- *When leaving the instrument idle for a long time, make sure the WiFi™ periodic connection is disabled.*



Do not store or operate the instrument at temperatures exceeding the following limits

- *-20 °C to 60 °C (-4 °F to 140 °F)*



When using the instrument outdoors, make sure the USB connector is facing down. *This way rain will not accumulate in the connector and microphone port.*

4 Getting Started

4.1 Software Installation

- On the PC that is used to setup the instrument, run *Instrument_Manager_Installer.exe*. This installs the *Instrument_Manager* application, as well as its USB driver and documentation.

Note: You will need admin privileges to install the application.

- On the PC that is used as a server, to collect data over the network (*""W"* model only), run *Instrument_Listener_Installer.exe*. This installs the listener application that is used to respond to instrument's incoming connections, and create and fill the corresponding data files.

Note: The same PC can be used for both applications.

Note: Perform the software installation above BEFORE connecting the instrument to the PC for the first time.

4.2 Hardware Installation

1. Connect the instrument to an available USB port on the PC

2. Verify that the PC properly detects the instrument and loads the driver. In case of doubt see section ***Troubleshooting***.

4.3 Initial Test and Configuration

1. Upon connection to the PC, the *charge* LED should light-up yellow (charging) or green (charged). The *operating* LED should blink once per second.

2. Go into *Start\All Programs\Convergence_Instruments\Instrument_Manager* and run *Instrument_Manager.exe*. The front-panel described in ***Figure 2*** appears, and the application tries to connect to the instrument. If it fails to find the instrument it indicates *No Device Found*. If this is the case see section ***Troubleshooting***

3. Otherwise the application switches-on the *NSRTW_mk4* and starts communicating with it.

4. If the Time and Date in the upper right corner of the application window are not properly adjusted the application asks if you want the instrument time to be synchronized to the PC time. Only say YES if the PC time is correct.

5. In addition, the application detects if the time zone of the instrument is different from the time zone of the PC. If it is, the application asks to set the instrument to the same time zone as the PC.

   Note: If (in rare cases) the instrument is not intended to be used in the same time zone as that of the PC used to configure it, we suggest to temporarily change the PC's time zone to the time zone where the instrument will be recording, let the application set the instrument to the PC's time zone, and change the PC's time zone back after that initial setting. Afterwards if/whenever the application asks to change the instrument time zone back to the PC's time zone, simply choose to cancel the adjustment.

6. In the front-panel of the application you should see the acoustic signal display in real-time.

5 Instrument Functions and Description

The instrument connects to a PC on a USB port. The *Instrument_Manager* application is used to set its operating parameters and download recorded data.

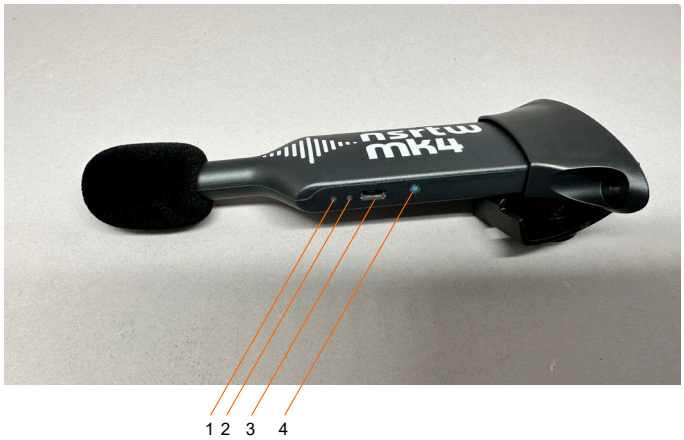


Figure 1 ***NSRTW_mk4***

1. Charge LED
2. Operation LED
3. USB Connector
4. Reset Button

6 Principle of Operation

6.1 Power Consumption

The *NSRTW_mk4* is always on. However, when not in operation it only measures time, which only takes a tiny operating current. In that *Idle* state it can stay on for up to 6 months. When the *NSRTW_mk4* is actively measuring, its power consumption allows it to record for up to 1 week.

The *NSRTW_mk4* can be configured to connect to a server at regular intervals. When that function is enabled, the *NSRTW_mk4* will activate its *WiFi*™ interface at the defined interval, and attempt to connect via *WiFi*™ for up to 1 minute. During that time, the instrument's power consumption will be increased. If the connection fails the *NSRTW_mk4* will fall back to its previous state (Sleep or Recording).

Note: *WiFi*™ communications consume battery, so when leaving the *NSRTW_mk4* unused for a long time, it is important to disable the *WiFi*™ periodic connection feature.

In applications where the *NSRTW_mk4* must record for longer periods of time, it can be connected to a USB charger https://convergenceinstruments.com/product/universal-usb-wall-charger-usbw-001\ . For outdoor-use, a USB-output solar panel, such as the one found in https://convergenceinstruments.com/product/data-logger-accessories-solar-pannel/ is an ideal solution that will power the instrument indefinitely.

6.2 Battery Charging

The battery charges whenever the following conditions are met:

- The battery has not reached full charge.
- The instrument is connected to a PC's USB port and the PC is not in standby, or
- The instrument is connected to a USB charger.

While charging on a PC's USB port, the charge LED is orange. When charging on a dedicated USB charger the charge LED is blinking orange. When fully charged, the LED changes to green and the charging stops.

The charge time from a completely discharged state varies with the amount of power the PC allows the instrument to draw. Charge time is normally around 2H30. If the PC only allows 300 mA, the charge time can increase up to 5 to 6 hours.

Note: When connected to a PC, battery charging stops while the PC is in standby.

Note: It is OK to leave the instrument connected to a PC or USB charger all the time. The smart charger inside the instrument will stop charging as soon as the battery reaches full-charge.

6.3 Modes of Operation

The *NSRTW_mk4* has four modes of operation:

Mode	Operation	Power Consumption
Idle	Disconnected from USB and not actively recording - Only keeps time.	Minimal: can stay on for up to 6 months.
Active	Connected to USB – Not recording – Instrument is fully on and measuring	Instrument draws power from USB to power itself, and if necessary recharge its battery. Battery is not depleted.
Recording	USB-connected or not - Fully on and recording.	If USB-connected, power comes from USB. If not, power comes from the internal battery. If not connected the instrument can record for up to 7 days.
Periodic *WiFi*™ Connect ("W" model only)	From any state, including *Idle* and *Recording*, the instrument can periodically wake up its *WiFi*™ interface and attempt to connect to a server. If the connection is not established after 1 minute it falls back to its original state until the next connection time.	If USB-connected, power comes from USB. If not, power comes from the battery. The *Periodic Connect* feature consumes battery. This is especially the case if the connection interval is set to be short so it occurs often.

Table 1

6.4 LED Indicators

The *NSRTW_mk4* has two LED indicators:

6.4.1 Charge LED

The charge LED is on when the instrument detects that it is connected to a power source. It is off when the instrument is not connected to a power source.

LED State	Meaning
Off	Instrument is disconnected, or is connected to a PC that is in standby.
Steady Green	Instrument is connected to a PC, and the battery is full.
Steady Orange	Instrument is connected to a PC, and the battery is charging.
Blinking Green	Instrument is connected to a USB charger, and the battery is full.
Blinking Organge	Instrument is connected to a USB charger, and the battery is charging.

Table 2

6.4.2 Operation LED

The operation LED is always blinking.

LED State	Meaning
Off	Instrument is in *Idle* mode.
1-blink/second	Instrument is in *Active* mode but is not actively recording.
2-blinks/second	Instrument is actively recording.
1-blink/second (off-beat)	Instrument is presently communicating with a server via *WiFi*™
4-rapid blinks/second	Battery is low. Recharge as soon as possible. If the battery level becomes critical the instrument will go to *Idle* mode (LED-off) in order to safeguard the battery against over-discharge as much as possible.

Table 3

6.5 Sound Level Calculation

After extracting the signal power, the calculated sound levels are low-pass filtered (smoothed) using an adjustable time constant. This time constant is applied to the calculation of *L-min* and *L-max*, but not *Leq*. A typical short “Fast” time constant (125 ms) allows the measurements to track sharp changes, while a longer “Slow” time constant (1s) provides more stable (cleaner) RMS values that averages-out short transients.

The *Leq* is integrated linearly over the specified log interval, irrespective of the time constant setting.

The L-peak is the maximum of the absolute value of the pressure, detected over the specified log interval.

The sound level statistics (*L-peak*, *L-min*, *L-max* and *Leq*) are gathered for the specified *log-interval* before being written to the recording memory. The log-interval represents the interval at which the selected statistics are written to memory. Therefore, a longer log-interval uses less memory, while a shorter log-interval provides better time resolution and allows the user to distinguish between events that occurred close together. The statistics (*L-peak*, *L-min*, *L-max* and *Leq*) are reset at the beginning of each log-interval. Then the statistics are gathered sample-by-sample during the log-interval. At the end of each log interval the calculated statistics are written to memory, and the next log-interval is started. No portion of the signal is overlooked.

The log interval is set to 1 second by default. It can be set to as short as 1/8 s.

Note: The time constant only affects the calculation of Lmin and Lmax. The Leq is integrated linearly over the specified log interval.

6.6 Manual Recording

Every time a recording is started, a new record is created in memory and filled until the recording is stopped. That record is time-stamped, so the signals can be displayed with respect to absolute date/time. Records are stored sequentially in the instrument's memory. There is no limit to the number of records that the memory can contain, only a limit to the total size of the data recorded. The *Instrument_Manager* application shows the total memory recording time as a function of the various setup parameters.

After (or while) recording, the records contained in memory can be downloaded from the instrument and observed or exported. In case a recording is ongoing the last record is only displayed up to the current time.

The recording is stopped automatically when the recording memory is full. This way a new record will not overwrite an old one.

The recording memory is non-volatile, so there is no risk of losing the data that has already been recorded, even in the case of a reset or battery failure.

Note: It is perfectly legal to find empty records in memory. That occurs typically when a recording is started and stopped quickly (for a time shorter than the log interval), before any data had time to be written to memory. In that case only the time-stamp is written to memory.

An empty record can also occur when a recording was started but no data (L-peak, L-min, Lmax or Leq) was selected to be recorded.

To record sound levels proceed as follows:

1. Select the statistics to be recorded (*L-peak*, *L-min*, *L-max* and/or *Leq*).

2. Select the log-interval. Note that the total recording time is automatically calculated and shown by the *Instrument_Manager* application, as a function of the log-interval and statistics selected. The log-interval is adjustable in 125 ms increments, from 125 ms up to 2H.

3. Select the time constant used to smooth the measured sound levels for *L-min* and *L-max*. Choose the *Fast* time constant (125 ms) to be able to detect short peaks and valleys. Choose

the *Slow* time constant (1 s) to provide cleaner more stable sound levels. Or adjust to another value, as required by the application.

4. When ready to start a recording immediately, simply press the *Record* button. Press *Record* again to stop the recording.

5. Or to set a start date/time:

   - Check to make sure that the instrument time is correct. If that is not the case press the Sync button in order to automatically set the instrument time to the PC time.

   - Press the *Timer* button. Set a start time and date using the calendar.

   - Click OK to arm the trigger.

6.7 Automatic Recording with *WiFi™* Connection (*"W"* model only)

The *NSRTW_mk4* supports a mode of operation where it periodically connects to a server (a Windows PC running the *Instrument_Listener* application) through *WiFi™, or Convergence Instrument's cloud solution*. This feature is designed to let the instrument record autonomously, periodically report the levels recorded since the last connection, and optionally send emails with noise-level or low-battery alerts. When set, this feature will work, even if the instrument is reset, or if it loses and regains battery power (for instance if the instrument is reconnected to a charger after the battery has been completely drained).

This PC-server being connected-to does not have to be in the vicinity of the instrument. It can be a continent apart, as long as it is reachable through the internet, and all firewalls have been set to allow the connection.

The instrument connects to a *WiFi™* Router or *Access Point* that is in its vicinity. From there, it will find the server to connect to, either by its IP address, or by its domain name.

6.7.1 *WiFi™* Connectivity

6.7.1.1 *WiFi™* Reporting Without Cloud Service

Note: When using the instrument with WiFi™ connectivity, do not start a recording manually, or via the timer. The instrument will be completely controlled by the server, including starting the recording, erasing memory if required, and resetting the time.

When using the *WiFi™* feature, the instrument will try to connect to a known server at regular intervals, or immediately in case of alarm.

Whenever it connects, the instrument will talk to a special *Instrument_Listener* application running on the server. That application will do the following:

- If the instrument was recording:

  - Upload the latest recorded data from the instrument and updates a growing file with that data (create the file if it was not already created).

- If the instrument was not recording (for instance if the recording was stopped earlier because the memory was full):

  - Upload the latest recorded data from the instrument (if any) and update the recording file.

- Adjust the instrument time (does not adjust the time zone of the instrument, just precisely readjust the Universal-Time-Code running in the instrument).

- Delete all data in the instrument's memory (all that data has already been safely stored in the recording file on the server).

- Start a new recording.

6.7.1.2 Email Alarms

In addition to trying to connect to the server at regular intervals, the instrument will try to connect immediately to the specified email server in case of alarm. The alarm function does not require the use of a server or *Listener* application. The instrument will typically connect to an email server, such as a *Sendgrid* account.

In order to be able to send an alarm email, the instrument must have the following setup:

- A *WiFi*™ Router or *Access Point* must be in the instrument's vicinity, and the instrument must have been configured with that router's connection parameters. That is part of the *WiFi Setup* of the instrument.

- The instrument must have been configured with an outgoing email account and connection parameters. That is part of the *Email Setup* of the instrument.

Three alarms can be enabled:

- An instantaneous noise level over a preset threshold. That noise level is subject to the time constant of the instrument. So if the instrument is set with a longer time constant, it will take a level that is sustained for a longer time period to trigger the alarm.

- An LEQ over a preset threshold. The alert will be sent as soon as the aggregated LEQ is certain to be over the threshold. The instrument does not need to wait until the end of the current LEQ calculation interval to send the alert. The alert is sent as soon as the current LEQ calculation is such that it is sure to be over the threshold by the end of the interval.

- The battery is close to being depleted.

6.7.1.3 *WiFi™* Reporting Via Cloud Service

Reporting and email alerts via the cloud service work exactly like reporting without the cloud service, except that it uses *Convergence Instrument's* servers, and the user does not have to deploy their own server for the instruments to be able to connect. In addition, the user can view and download their instrument's data from anywhere in the world, using any platform that has a web browser, including PCs, phones, tablets… etc., and the instruments can be reconfigured "over-the-air", simply by changing their configuration in the cloud.

More information about the cloud service can be found at:

https://convergenceinstruments.com/data-collection/

7 Instrument_Manager Application

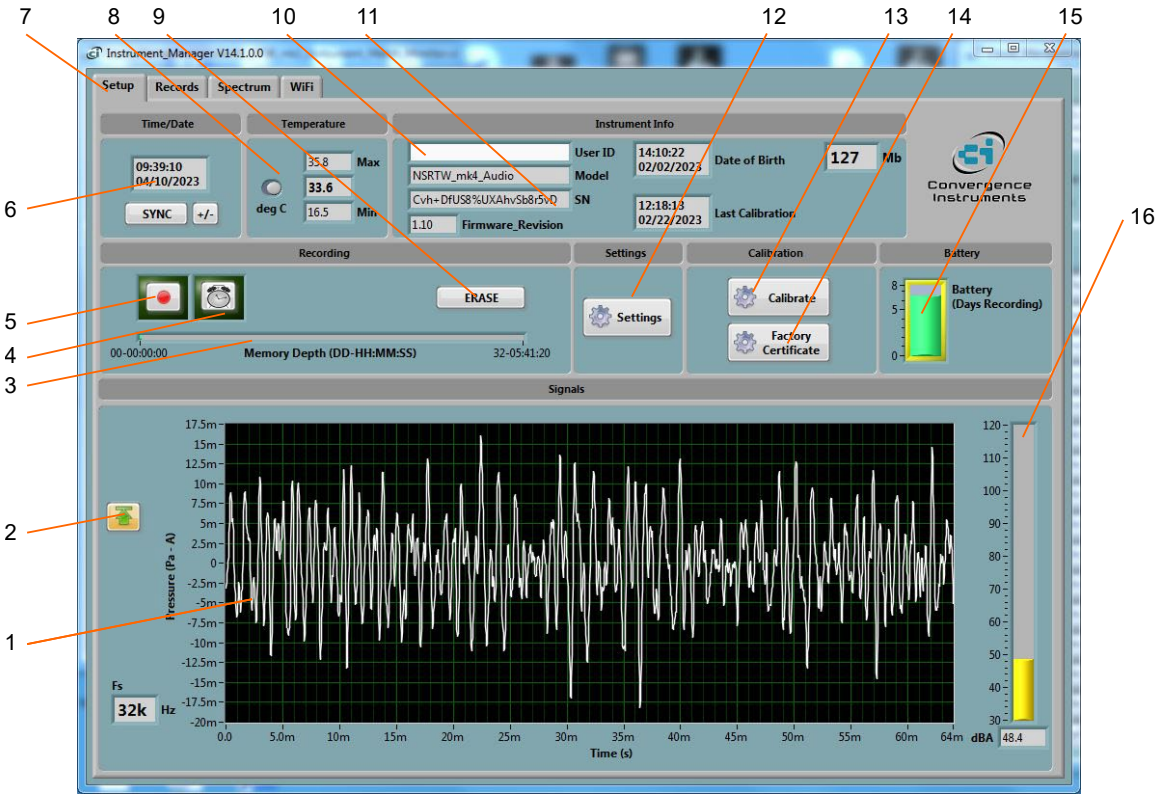


Figure 2 Setup Tab

1. Real-Time Acoustic signal
2. Auto-Scale button
3. Memory fill indicator
4. Timer button
5. Manual Record button
6. Instrument Time indicator
7. Tab selector
8. Instrument Temperature indicator
9. Erase button
10. Instrument User ID
11. Instrument Information
12. Settings button
13. Field calibration button
14. Calibration certificate button
15. Battery Condition, Charge and Recording Time Field
16. Sound Level indicator

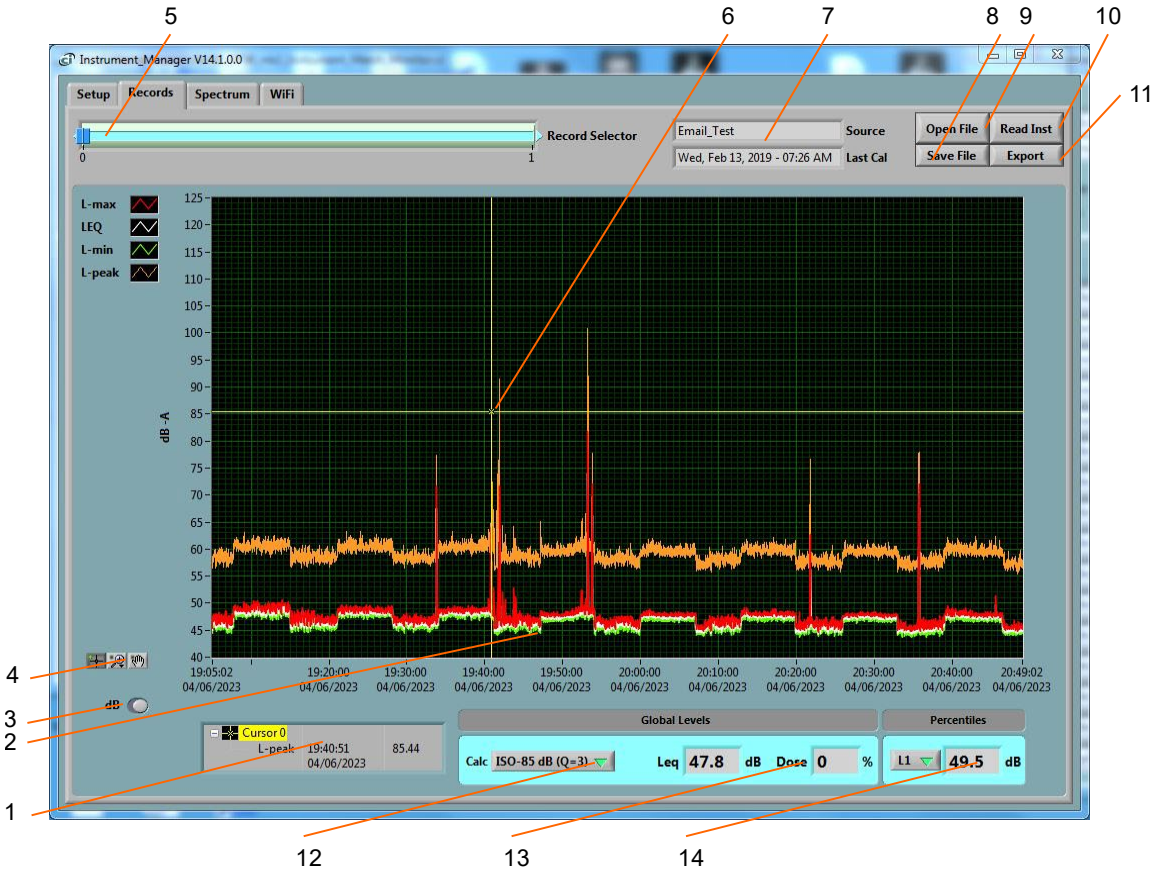


Figure 3 Record Tab

1. Cursor field
2. Recorded levels
3. dB/Lin button
4. Pan and zoom buttons
5. Record number selector
6. Cursor
7. Data source
8. File Save button
9. File Open button
10. Instrument Download button
11. Export button
12. Global level/dose calculation method
13. Global Level/Time-Weighted-Average value
14. Percentiles

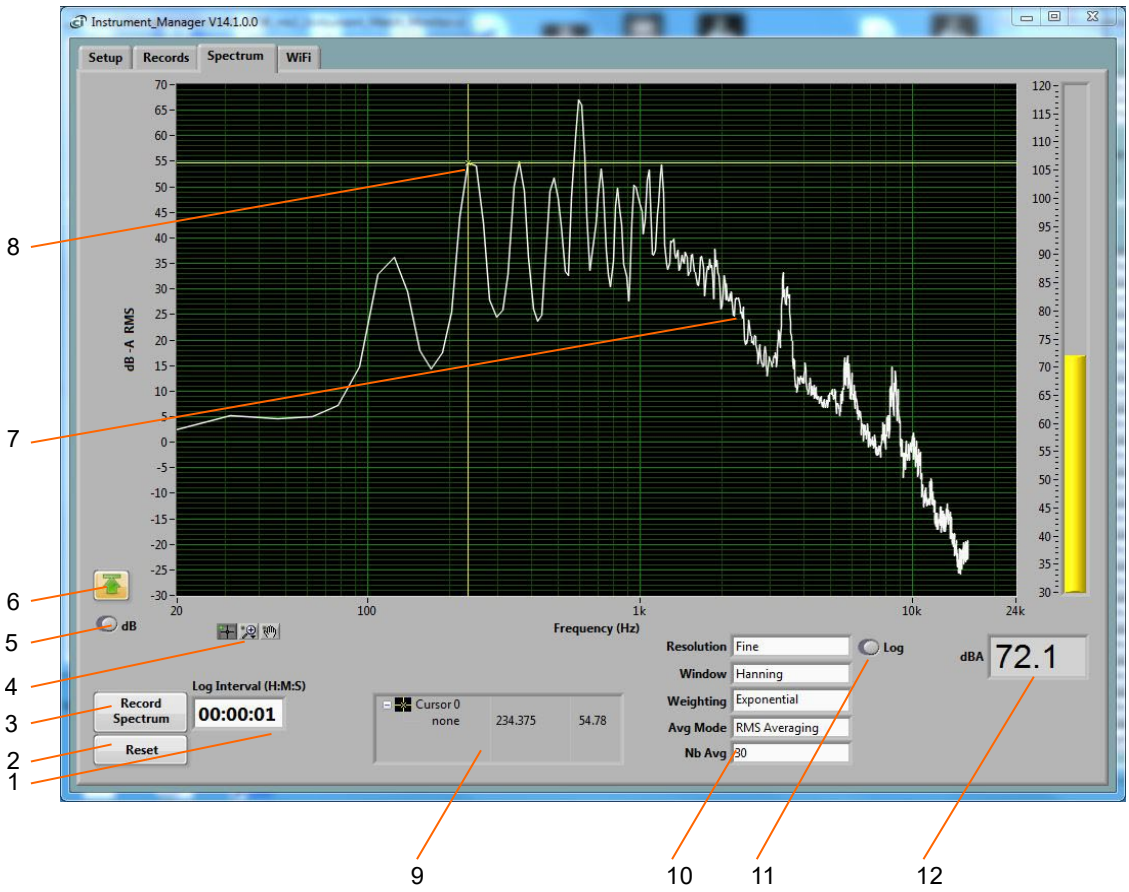


Figure 4 Spectrum Tab

1. Recording Interval
2. Spectrum Reset button
3. Record button
4. Cursor, Zoom and Pan controls
5. dB/Lin button
6. Auto-scale button
7. Spectrum
8. Cursor
9. Cursor values display
10. Spectral controls
11. Frequency scale control
12. Global level indicator

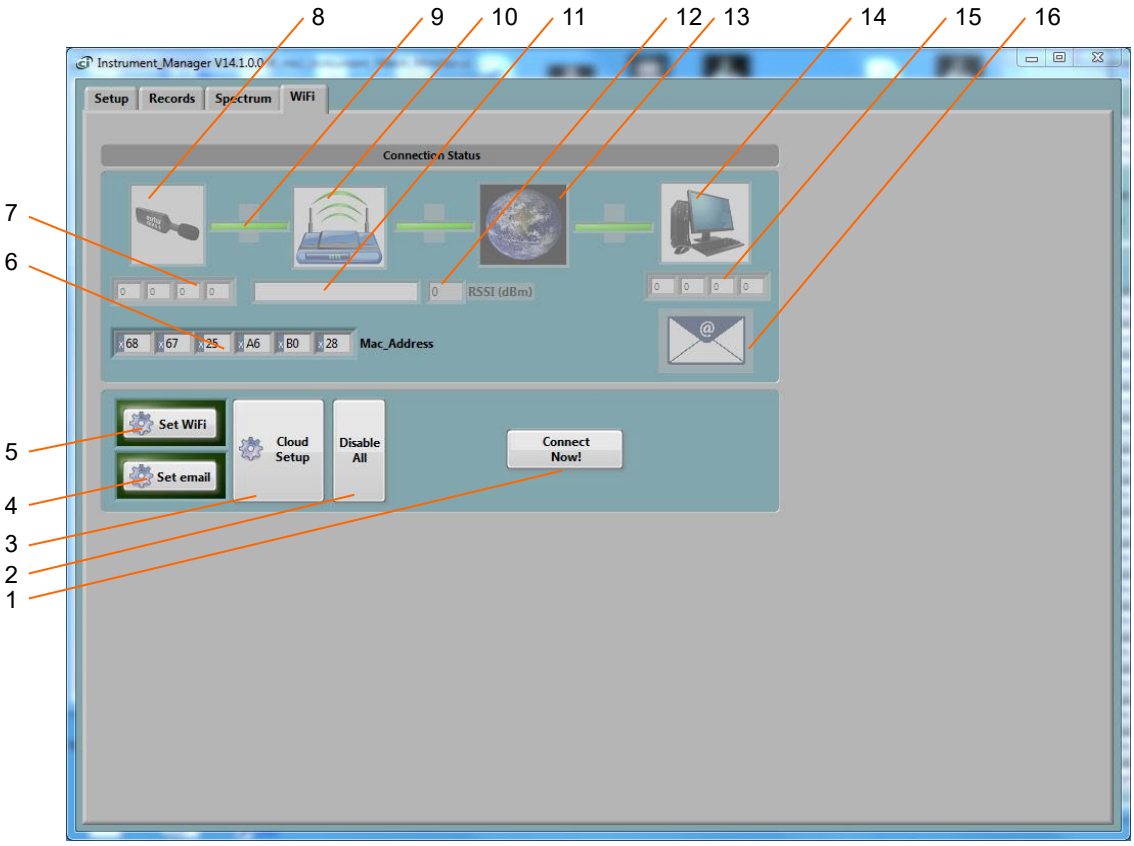


Figure 5 WiFi Tab

1. Connection Test button
2. Disable All WiFi button
3. Cloud Setup button
4. Email Setup button
5. WiFi Setup button
6. MAC address of instrument
7. IP address of the instrument
8. WiFi Active Indicator
9. Link Indicator
10. Router or Access Point Connected Indicator
11. SSID of access point
12. RSSI (Received Signal Indicator) of current connection
13. Network Connected Indicator
14. Server Connected Indicator
15. Server IP address
16. Email Active Indicator

7.1 Starting the Application

Note: The application can be run with or without an *NSRTW_mk4* connected. When an *NSRTW_mk4* is not connected the application can only be used to display and analyze a previously saved log file. All the controls and indicators related to the instrument are grayed out.

To control an *NSRTW_mk4* using the *Instrument_Manager,* proceed as follows:

1. Connect the instrument to an available USB connector on the PC.

2. Make sure that the charge LED lights-up yellow or green, and that the operation LED starts blinking. If not, review the installation procedure, or see section ***Troubleshooting.***

3. Go to *Start\All-Programs\Convergence_Instruments\Instrument_Manager* and run *Instrument_Manager.exe*.

4. The front-panel described in ***Figure 2*** appears, and the application tries to connect to the instrument. If it fails to find the instrument it indicates *No Device Found*. If this is the case, see section ***Troubleshooting***.

5. Otherwise, the application immediately starts communicating with the *NSRTW_mk4*.

7.2 Main Functions

The application has four main tabs:

- **The *Setup* Tab:** Is used to setup the instrument and monitor real-time signal (see ***Figure 2***).
- **The Records Tab:** Is used to download, display and export the data from the NSRTW_mk4 (see ***Figure 3***).
- **The Spectrum Tab:** Is used to display or record a real-time power spectrum from the NSRTW_mk4 (see ***Figure 4***).
- **The WiFi Tab:** Is used to display the present connection state of the NSRTW_mk4, and to setup its connection parameters (SSID, Security, Password…etc.) (see ***Figure 5***).

7.3 Setup Tab

The setup tab is seen in ***Figure 2***. It is divided into eight fields.

7.3.1 Time and Date Field

This field displays the internal time of the instrument. If the instrument time is not properly adjusted, press *Synchronize*. This synchronizes precisely the instrument time to the PC time. Make sure the PC time is accurate before synchronizing the instrument.

Additionally, that field can be used to finely adjust the instrument's internal clock (make it slightly faster or slower).

Note:	*Time synchronization is not allowed while the instrument is recording.*

7.3.2 Temperature Field

This field is used to display the instrument's internal temperature in °C or °F. It is normal for the internal temperature to rise slightly while the instrument is charging (up to 10 to 15 deg C above ambient temperature). When the instrument is not charging this field indicates the ambient temperature.

7.3.3 Instrument Info Field

The instrument info field provides instrument information, such as instrument model, serial number and firmware revision. In addition, the *User-ID* field may be used to assign a custom identifier to the instrument.

To set, modify or delete the *User-ID*, simply place the cursor in the *User-ID* box and write a new identifier or clear the text. The new identifier is written to the instrument's memory as soon as *return* or *enter* is pressed, or if the mouse is left-clicked outside of the box.

The *User-ID* is written to non-volatile memory, so it is retained even in the event of a reset or battery failure.

7.3.4 Recording Field

Note: When using the instrument with WiFi™ connectivity, do not use any of the controls in the Recording field. The instrument will be completely controlled by the server, including starting the recording, erasing memory if required, and resetting the time.

The recording field has three buttons:

- **Record** The *Record* button is used to immediately create a new record and start recording. The new record is placed in memory immediately following the last one. The recording stops when the memory is full, or when the *Record* button is pressed again. The recording parameters, such as number and types of values recorded…etc. must be adjusted prior to starting the recording.

- **Timer** The *Timer* button is used to set a time and date to start the recording automatically. This is only allowed when a recording is not already in progress. To set the timer, press the *Timer* button. Then set the recording date and time and press the *OK* button to arm the timer.

- **Erase** The *Erase* button unconditionally erases all the data that has been recorded in the instrument, making room for new records.

The *Memory Depth* bar provides two indications:

- The percentage of memory already used (indicated by the green bar). The bar is completely grey when the memory is empty and completely green when the memory is full.
- The total memory time, in Days-Hours-Minutes-Seconds. The total memory time is displayed at the right end of the scale. It is calculated as a function of the instrument settings, such as log interval, statistics recorded…etc. Therefore, it will change dynamically as the settings are modified, to reflect the new overall memory time.

7.3.4.1 Timer Setting

When the *Timer* button is pressed, the timer settings panel appears.

Either use the direct entry field (***Figure 6*** (4)), or press the *Calendar View* button (***Figure 6*** (3)) to set the date and time when the recording must start.

Press the *OK* button to exit and arm the timer.

Press the *Cancel* button, or the *Window-Close* button to exit without arming the timer.

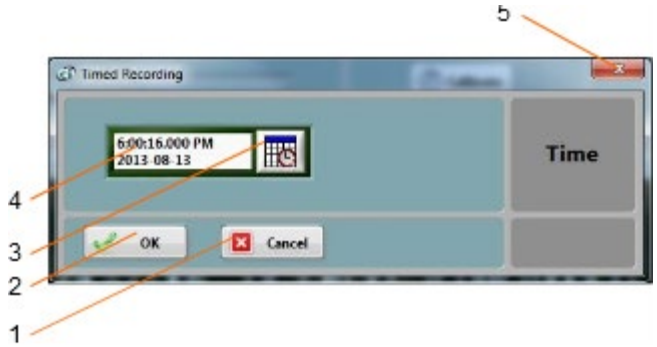


Figure 6 Timer Settings Panel

1. Cancel button – Closes the window without arming the timer
2. OK button – Closes the window and arms the timer
3. Calendar button – Brings the calendar view to enter date and time
4. Date/Time field – Can be used to enter date and time directly
5. Window close button - Closes the window without arming the timer

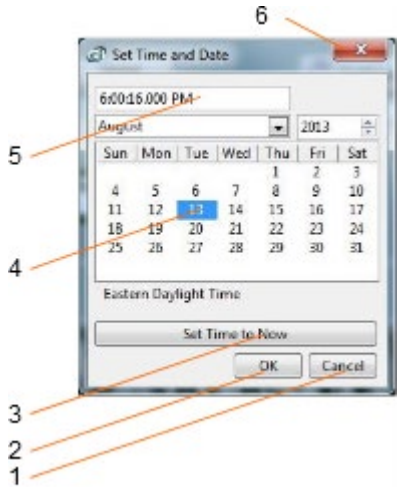


Figure 7 Calendar View

1. Cancel button – Closes the window without changing the date/time setting
2. OK button – Closes the window and accepts the newly set date/time
3. Set to Now button – Set the time and date to the present time
4. Date setting field – Click a date to set
5. Time setting field – Use the field to set a new time
6. Window close button - Closes the window without changing the date/time setting

7.3.5 Settings Field

The settings field contains the *Settings* and *Calibration* buttons.

7.3.5.1 Instrument Settings Panel

The instrument settings panel opens when the user presses the *Settings* button. Changing the settings is only allowed when the instrument is not actively recording.

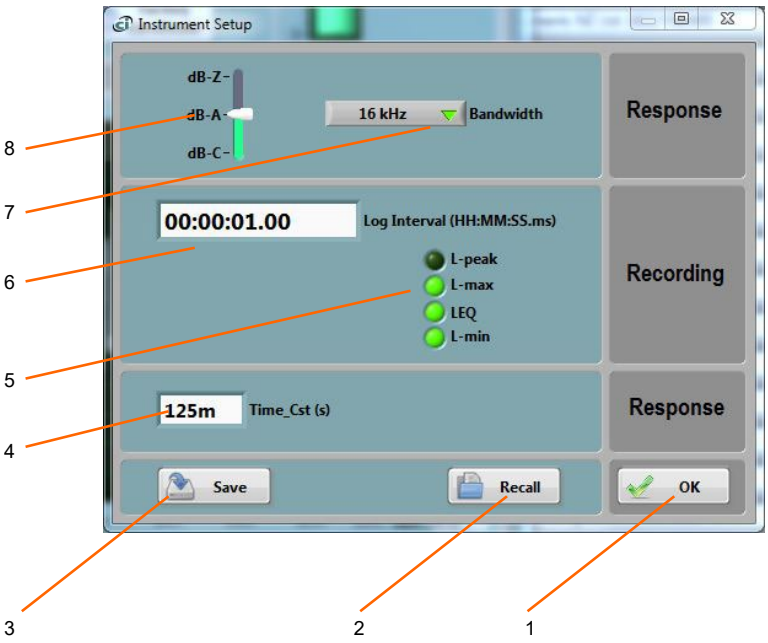


Figure 8 Instrument Settings Panel

1. OK button Implements the changes and closes the window
2. Recall Button Recalls a configuration from a configuration file
3. Save Button Saves a configuration to a configuration file
4. Time constant for sound level measurement (only affects Lmin and Lmax)
5. Recorded Data selector
6. Log interval control
7. Bandwidth Selector
8. dB-A/dB-C/dB-Z selector

7.3.5.1.1 dB-A/dB-C/dB-Z Selector

Use this selector to choose the weighting curve. The default is dB-A, which approximates the sensitivity of human hearing.

7.3.5.1.2 Bandwidth Selector

Use this selector to choose the sampling frequency/bandwidth.

- 16 kHz bandwidth (32 kHz sampling frequency)
- 24 kHz bandwidth (48 kHz sampling frequency)

Note: The frequency response is very similar for both sampling frequencies. The 32 kHz sampling frequency will provide a 10 to 25% lower power consumption.

7.3.5.1.3 Log Interval

The log interval defines the time between two successive recorded points. That also defines the integration period for the LEQ, and the observation period for L-min and L-max and L-peak.

The log interval can be adjusted from 125 ms (1/8th s) to 2 H in increments of 125 ms.

The amount of memory consumed is inversely proportional to the log interval. The *Memory-Depth* indicator in the *Setup* panel automatically calculates the overall recording time as a function of the selection.

7.3.5.1.4 Recorded Data Selectors

The recorded data selector specifies the type of statistic to record. To select a type of data, simply check the corresponding checkbox. By default, all statistics (L-min, L-max and Leq) are selected.

The amount of memory consumed while recording is proportional to the number of data types selected. The *Memory-Depth* indicator in the *Setup* panel automatically calculates the total recording time as a function of the selection.

7.3.5.1.5 Time Constant

When calculating the L-min and L-max levels, the instantaneous RMS levels are first low-pass-filtered with an adjustable time constant.

A shorter time constant should be chosen to be able to track rapid changes. Otherwise the measurements will be smoothed out. On the other hand, when the RMS levels are slowly varying, a longer time constant will provide more precise values.

The traditional *Fast* time constant is 125 ms. The traditional *Slow* time constant is 1s. An *Impulse* time constant of 35 ms is sometimes used to capture L-max on very short transients.

Note: The time constant is not used for the calculation of Leq. In the case of LEQ, the sound energy is averaged linearly over the specified log interval.

7.3.5.1.6 Closing the Window

Each adjustment is implemented in the instrument when the *OK* button is pressed. If the window is closed without clicking *OK*, then the settings are not implemented.

7.3.5.1.7 Save/Recall

Once the parameters are adjusted, the whole setup can be saved to a file, to be later recalled for easier configuration.

7.3.5.2 Calibration field

7.3.5.2.1 Calibration

Two options are available for calibration:

- Using a 94 dB calibrator: This is a normal field calibration using a 94 dB-1kHz calibrator.
- Calibration from Server: This retrieves the original factory calibration from Convergence Instruments server and (re)applies it to the instrument. This is useful when for any

reason the instrument has lost a valid calibration. That can be because it has been field calibrated using a wrong calibrator for instance.

Note: Calibration should only be attempted if a 94dB calibrator is available. Attempting a calibration without a calibrator on the microphone will result in a complete decalibration of the instrument. When that occurs the factory calibration must be restored.

The instrument can be field-calibrated using a 94 dB calibrator with a standard 1/2" opening.

Field calibration is performed by the *Instrument_Manager* application. Follow these steps:

1. Pull the wind-screen off the instrument
2. Place the instrument's microphone in the calibrator
3. Start the calibrator
4. Press the *Calibrate* button on the application window and follow the on-screen instructions.

Calibration advice: When calibrating the instrument using a 94 dB calibrator, please follow the advice below:

- Only use a calibrator that has a reference microphone and a feedback loop. Some low-cost calibrators work in open loop and rely on the volume of air in the cavity to provide an accurate level. Since the microphone in the NSRT series does not have a typical geometry, these calibrators typically provide an inaccurate pressure that can be off by a few dB.
- Make sure the opening in the calibrator is wide enough to accept the NSRT's microphone without too much friction. If that is the case there is a risk of the grille becoming unsealed and staying in the calibrator when the instrument is removed.
- When inserting and removing the instrument from the calibrator, proceed as slowly as possible, do not twist the instrument, make sure not to pull the instrument off-axis. The absolute maximum rating of the microphone is 160 dB. That sounds like a very large level, but in terms of atmospheric pressure it only represents a few percent. It is easy to reach that pressure if the instrument is inserted or removed from the calibrator too fast… Which can lead to microphone damage.

7.3.5.2.2 Factory certificate

That button will pull the calibration data for the instrument off Convergence Instrument's server, and print a calibration certificate. The PC must be connected to the internet to be able to get the data from the server.

7.3.6 Battery Field

This battery condition field indicates the remaining battery capacity. The indicator is surrounded by a yellow indicator that lights-up when the battery is charging.

The indicator is red if the battery was at zero when the instrument was connected to the PC. That may indicate a problem with the battery, but this is not always the case. Other conditions include an instrument that is reset while connected to the PC.

The battery condition indicator is scaled to indicate the approximate number of days of recording time remaining in the battery.

7.3.7 Signals Field

The signals field provides information about the acoustic signal and sound level.

- The graph presents the acoustic signal as it is measured in real-time. When selected, the auto-scale button allows the scale to be dynamically adjusted so that the signal always fits in the graph. When deselected, the scale is fixed. When using a fixed scale, the scale can be adjusted manually by double-clicking and writing new values directly in the top-most and bottom-most marker values on the vertical scale. The acoustic signal is scaled in *Pascals.*
- The vertical bar to the right of the graph show the sound level measured in real time. The sound level is scaled in dB (dB-A, dB-C or dB-Z, depending on the weighting curve).

7.4 Records Tab

The *Records* tab is seen in ***Figure 3***. It is used to retrieve the recorded information from the *NSRTW_mk4* or from a saved file, and to display and optionally export the recorded logs.

7.4.1 Instrument Download

To download data from the instrument, press the *Instrument Download* button. The whole contents of the instrument's memory are downloaded, and the newest record is displayed in the graph.

The *Record Selector* at the top-left of the page (***Figure 3*** (5)) indicates how many records have been downloaded. It shows one separate tick per record downloaded. Use the white slider to select the desired record. When selecting a record, the indication *No-Data* is displayed on top of any empty graph.

Note: It is legal for a record to contain no data at all. This may mean that the recording was started and stopped before any data had time to be recorded. It can also be the case if no data type (L-peak, Lmin, Lmax, LEQ) was selected to be recorded. In such a case the time-stamp is still valid and can be used to determine when that recording occurred.

The *Source* indicator shows the *User-ID* of the instrument, if any has been set.

The Y-scale can be displayed in dB or linear (Pa) scale.

The graph shows up to 4 curves:

- L-max in red
- LEQ in white
- L-min in green
- L-peak in amber

7.4.2 File Save

Pressing the *Save File* button saves all the records downloaded from the instrument to a file on the PC. In addition to the whole contents of the recording memory the file also contains ancillary information, such as calibration, instrument information…etc.

The file is saved in a proprietary format with the extension *.cil*.

By default, the file is saved with a name that contains the *User-ID* of the instrument, if any has been set, as well as the present date and time.

7.4.3 File Open

Pressing the *Open File* button recalls all the records previously saved to a *.cil* or *.wlg* file. The function works very much like the *Instrument Download* function, except that the data comes from a previously saved file.

Two types of files can be opened and displayed:

- **.cil** This type of file is created by the *Instrument_Manager* application. It contains all the data that has been downloaded from the instrument.

- **.wlg** This type of file is created by the *Instrument_Listener* application. It contains data that is sent by an instrument over the network. When a *.wlg* file is opened the *Instrument_Manager* application asks to convert it to a .cil file.

The *Source* field shows the *User-ID* of the instrument the data comes from.

That function works even when no instrument is connected to the PC, so it can be used to examine data that was recorded elsewhere and sent to the user as a file.

7.4.4 Exporting Data

The data of the record being presently viewed can be exported for further display or processing. The data is exported to a tab-delimited text format that can be imported in *Excel* and other spreadsheet applications.

7.4.5 Global Level Calculations

The application automatically calculates the global levels or equivalent dose corresponding to the displayed data.

The global values can be calculated according to several methods. At the time of this writing we offer the linear ISO (Q=3) method, as well as the OSHA (Q=5) method. Other methods may follow.

These global values are calculated from the LEQ curve (white curve). In order to obtain the global values, the LEQ MUST BE among the recorded statistics.

The global values are calculated from the visible part of the graph only. Play with the zoom and pan functions to eliminate portions at the beginning and end of the recording from the calculation.

7.4.6 Graph Controls

The graph can be adjusted and analyzed using the following techniques:

7.4.7 Cursor Control

A cursor can be used to precisely measure the level at a particular point in time.

To the bottom-left of the graph is a three-button control. The left-most looks like a cross. In order to use the cursor, proceed as follows:

- Press on the button that looks like a cross (see ***Figure 3*** (4))
- Place the mouse over the point where the X and Y cursor lines meet and left-click. This grabs the cursor.
- Drag the cursor to the specific curve and time of interest. The cursor can jump from one curve to the other.
- Read the X and Y values in the cursor field underneath the graph.

7.4.7.1 Zoom Control

To use the zoom control, simply press the button that looks like a magnifying glass and choose one of the following zoom functions:

- Zoom X-Y
- Zoom X
- Zoom Y
- Zoom-Extents

After choosing the function, the cursor changes to a magnifying glass. Click and drag on the graph to apply the required zoom.

7.4.7.2 Pan Control

To pan a graph left, right up or down, first press on the *Hand* button to the left of the graph. Then position the mouse over the graph. Left-click to "grab" the graph, and move the mouse to pan the graph as desired.

7.4.7.3 X-Y-Scale Direct Modification

Another way to zoom a graph is to directly change its scale. To do that, simply click on the value for left-most or right-most marker of the X-scale, and select its value. Type a new value to replace the old one. The scale is adjusted so that that new value is used at the beginning or end of the scale.

The same technique can be applied to the bottom-most or top-most values of the Y-scale of the graph.

7.5 Spectrum Tab

The *Spectrum* tab is shown on ***Figure 4***. When that tab is selected the time-domain signals captured by the instrument are presented in the form of averaged power spectra. The processing is as follows:

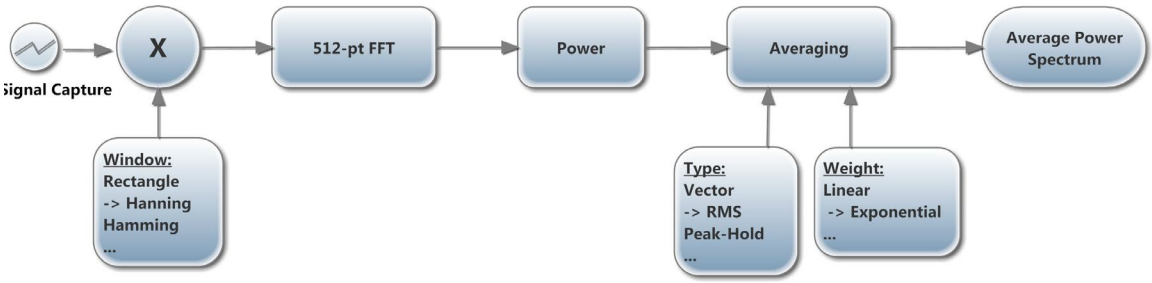


Figure 9 ***(-> shows the defaults)***

7.5.1 Window

The type of window chosen has an impact on the spectral resolution. The *Hanning* window is generally a good choice that provides good spectral selectivity.

7.5.2 Weighting

The averaging can be exponential or linear.

- **Exponential Averaging** is comparable to a low-pass time filtering of the spectrum. In other words, each spectral line is low-pass filtered so that the resulting spectrum is smoothed out over time. In that case the *Nb_Avg* represents an equivalent averaging time constant, expressed in number of successive spectra. The averaging is continuous and does not stop. Each successive spectrum is considered in the calculation. A larger value of *Nb_Avg* produces a spectrum that is more stable, but also averages-out short-lived transients.

- **Linear Averaging** takes an equal-weight average of *Nb_Avg* successive spectra. After the *Nb_Avg* spectra have been observed the result is frozen.

In both cases the *Reset* button discards the present display and restarts the averaging from zero.

The *Averaging Mode* can be chosen from several choices:

- **RMS Averaging** RMS averaging reduces signal fluctuations but not the noise floor. The noise floor is not reduced because RMS averaging averages the power of the signal. *RMS Averaging* is the most common type.

- **Peak-Hold** Peak hold averaging retains the peak levels of the measured spectra. Peak hold averaging is performed at each frequency line separately, retaining peak levels from one FFT record to the next.

Note: All the FFT calculations are performed on the PC. The raw time-signals are transferred from the instrument to the PC, where the FFT and averaging calculations are performed.

7.5.3 Resolution

The resolution can be chosen to be fine (power spectrum) or 3rd octave.

7.5.4 Scale

The power spectra can be displayed in dB or linear (Pa) scale. Changing the scale does not restart the averaging.

7.5.5 Record Spectrum button

When that button is pressed the successive spectra are recorded and stored in a text file. Press the button again to stop the recording.

Note: In order to appear in the record, the spectra must be visible on the screen. If/when the user switches to another tab, the spectra that are not visualized because the screen shows other information will not be recorded either.

7.5.6 Cursor, Zoom and Pan

Cursor, Zooming and Panning is done the same way as in the *Records* graphs. See section ***Graph Controls***

The auto-scale button can be pressed or released to obtain an automatic or fixed vertical scale. When the graph is in fixed scale, writing directly in the values of the end-scale markers sets the scale to fit those values.

7.6 *WiFi* Tab (*"W"* model only)

The *WiFi* tab has all the indicators showing the instrument's present state of connection, as well as controls to configure *WiFi*™ and email settings.

7.6.1 Connection Status

7.6.1.1 Levels of Connection

When trying to connect, either at the preset interval, or for an email alarm, the instrument will do it in two stages:

- The instrument first tries to connect to a *WiFi*™ router or access-point in its vicinity.
- Once connected to the network through the router or access-point, the instrument will then try to connect to a server (either the specified email server, or the server running the *Instrument_Listener* application, depending on if that is an alarm or part of the regular reporting of recorded levels. The server connection can be done to a specified IP address, or to a domain name. Connecting using a domain name is preferable because IP addresses are often subject to change.

The instrument has a total time of 1 minute to go through the two stages. If the final stage is not established by the end of that minute, the instrument stops trying in order to preserve battery. It will then retry at the next preset interval, or if a new email alarm is triggered.

Note: In order to maximize data throughput and minimize power consumption, it is best to locate the router or access point close to the instrument so WiFi™ communications are reliable. However if/when the router is too close to the instrument's antenna (less than 1 ft or 30 cm), WiFi signal levels can be so high as saturating the receiver's input. That condition often results in a large error rate.

Note: If the Instrument_Listener application is not running on the server, the instrument will not be able to download any data.

Note: The panel shown in Figure 5 will display the progression of the connection when the instrument is connected through USB. It is designed to help debugging connection problems

The *Connection Status* field indicates graphically the different stages of connection. Each icon (8, 9, 10, 11, 12, 13, 14, 15 and 16 in *Figure 5*) indicates a different connection stage:

- Indicator 8 blinking: The instrument is actively trying to connect to a Router or Access-Point
- Indicator 14 or 16 blinking: The instrument is trying to connect to report new data (14), or to send an email alert (16).
- Indicators 9 and 10 Active: The instrument is connected to a Router or Access Point. In this case the SSID of the Router or Access Point is written in indicator 7, the IP address of the instrument is written in indicator 11 and the RSSI of the connection is indicated in 12.
- Indicator 13 Active: The instrument is on the network.
- Indicators 13 to 15 Active: The instrument has connected to the server and is talking to the *Instrument_Listener* application, or to *Convergence Instrument's* cloud servers. In that case the server's IP address is written in indicator 15.
- Indicators 13 to 16 Active: The instrument has connected to the email server and is sending an email. In that case the server's IP address is written in indicator 15.

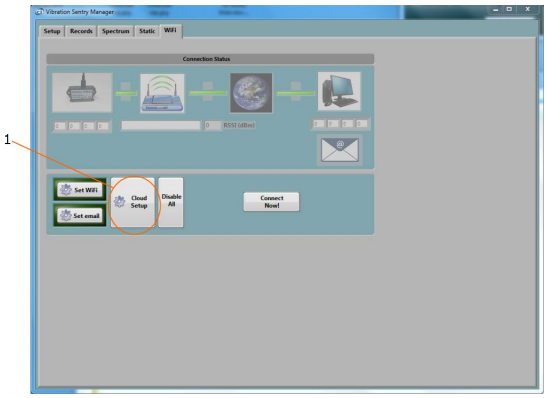
7.6.2 Cloud Setup

The cloud setup is demonstrated in the video at: https://youtu.be/XZBDfR1RrUk

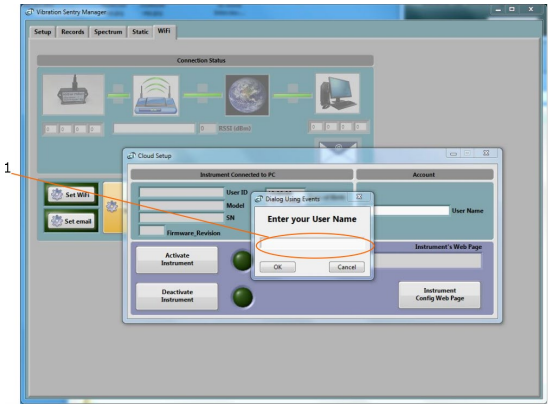
When using cloud reporting, the instrument must be configured, activated and deactivated using that *Cloud-Setup* function. In addition to simplifying the configuration process, it insures that there is no discrepancy between the internal configuration of the instrument and the *Cloud* database.

When the instrument is used on the cloud, the normal *WiFi-Setup*, *Email-Setup* and *Disable-All* functions of the *Instrument Manager* should not be used.

In addition, recording should never be started using the manual recording button. The cloud server will manage the instrument completely, including adjusting its time, erasing memory and starting the recording. All that is required is preparing the instrument settings in the instrument's web page (see below) and setting up its connection parameters.



1. Press the *Cloud-Setup* button (1), the panel below is presented. Enter the account user name. This is the name of the account that must have been previously created in the cloud service.



2. At this point the instrument connected to the PC may already be associated to that account. Otherwise the subscription must allow for one additional instrument. If that is the case, the instrument is automatically associated to the account, and there is no error message. The panel below is presented to the user.



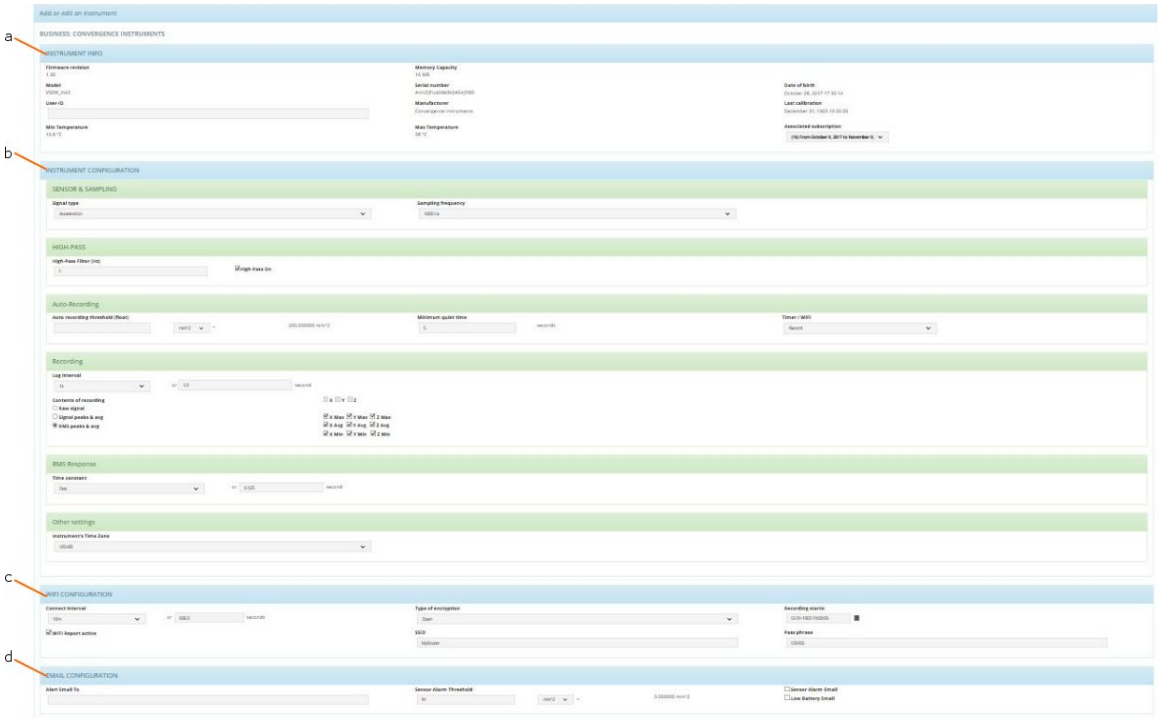
3. Press the *Instrument-Config-Web-Page* button (1). That action opens the default web browser on the PC and navigates to the configuration page for that particular instrument. If that instrument was already associated to the account, that page presents the current configuration of that instrument. For a new instrument, it presents a default configuration that still needs to be adjusted (see below). That configuration page contains ALL the settings of the instrument, including its measurement settings, its *WiFi* settings, and its email alarm settings. You must adjust all required settings and press the *Submit* button at the bottom of the web page.

a. *Instrument-Info:* Add/change the user-ID for that instrument, if one is required.

b. *Instrument-Configuration:* Adjust all the measurement parameters for the particular instrument. The setup for a *VSEW_mk2* is presented. Measurement setup options will be different for another type of instrument. For a *VSEW_mk2* it is important to set the *WiFi* action to *Recording* or *Auto-Recording*. The former begins recording immediately when the instrument initially connects to the cloud. While the latter prepares the instrument for a triggered recording, and the recording will only start when the signal passes the specified threshold.

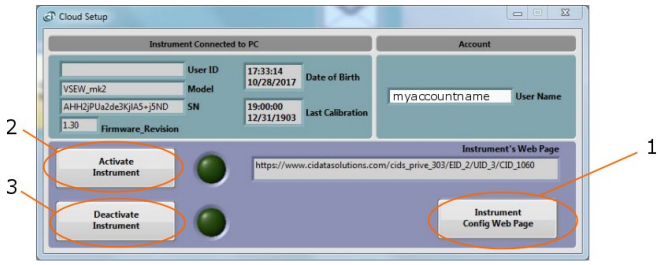
c. *WiFi-Configuration:* Adjust the connection parameters for the *WiFi* access point or router to which the instrument must connect. That includes *SSID* (the name of the router or Access Point), the type of encryption, and the password if any. That also includes the connection interval. The *WiFi-Report-Active* box must be checked for the instrument to connect at regular intervals.

d. *Email-Configuration:* Optionally enable email alarms for battery and/or level. If level alarms are enabled, adjust the threshold.



4. Press the *Submit* button at the bottom of the web page and go back to the *Cloud-Setup* window.

5. Press the *Activate-Instrument* button (2). At that time the instrument is completely configured, and the window disappears. The green ring around the *Set-WiFi* button is lit, as well as the green ring around the *Set-Email* button if emails have been configured. The instrument may try to connect immediately, or it may try to connect after the connection interval time has elapsed. If the instrument is not actively trying to connect right away, simply press the *Connect-Now* button.



6. Once the instrument has successfully connected to the server, the *Manager* can simply be closed and the instrument disconnected from USB. The instrument will keep connecting at least at the connection intervals. It will also connect to send an alarm, or in *Auto-Recording* mode whenever a signal has been recorded.

Note that the procedure above can be applied to configure a brand new instrument, or to modify the configuration of an instrument that is already reporting to the cloud.

7.6.3 *WiFi* Settings (Without Cloud Service)

The WiFi setup is demonstrated in the video at: https://youtu.be/lebE20WER2E

The *WiFi* settings panel appears when the *Set WiFi* button is pressed. The *WiFi* settings are used to configure the Router(s) or Access Point(s) to connect to, the Server's IP address or domain name, and the periodic connection schedule.

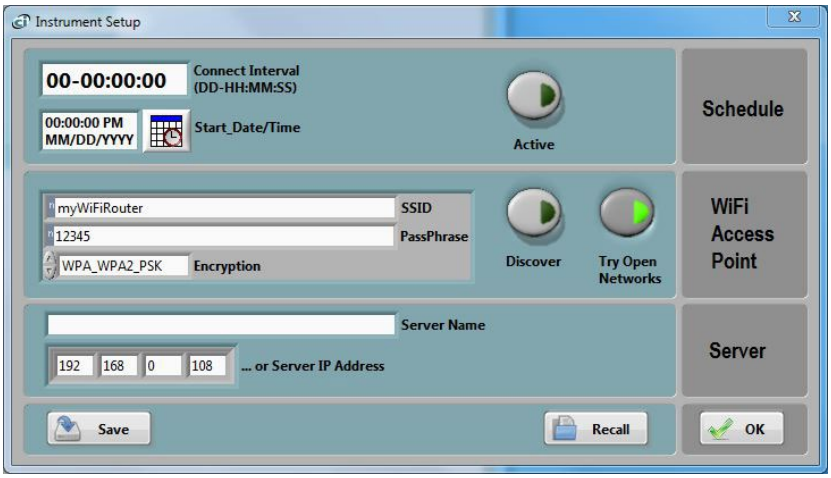


Figure 10 WiFi Settings

7.6.3.1 Schedule

Whether it is recording or idle, the instrument can activate its *WiFi*™ interface and try to connect to a server at regular intervals. The connection schedule is defined in that field. In order to enable that behavior, the following must be setup:

- **The Connect Interval must be set:** The interval is often chosen as once per hour, or once per 10 min. Setting a very small interval will let the instrument report much more often, but that will drain the battery faster. Setting a much longer interval (several days, a week or more) will risk losing data if the connection cannot be established at its scheduled time. The interval must not be set as 0. We do not advise setting a schedule interval lower than 2 min.

- **The *WiFi-Report-Active* button must be pressed:** When the button is released the instrument will not try to connect at the set interval.

- **A start date and time must be set:** The periodic connection attempts will only begin at the set date and time.

7.6.3.2 Access Point

The coordinates of the access point or *WiFi*™ router can be set, together with its security method, password, and priority. Each router or access point is defined by its *SSID*.

When security other than *OPEN* is used, a password must be entered.

Note: By clicking on the little grey block at the left of the pass-phrase field, several input methods can be selected:

- *Password (P) is used to conceal the password being entered*

- *Hex (H) is normally used in conjunction with WEP security*

- *Normal (N) is normally used in conjunction with WPA and WPA2 security*

The *Discover* button listens for access points in the instrument's environment and lists them. Then clicking on (highlighting) one of them and clicking OK will bring SSID and security mode back to the WiFi settings panel.

Pressing the *Try-Open-Networks* button will let the instrument try any open (unsecured) access point in its vicinity if the specified access point is not available or responding.

7.6.3.3 Server

The server can be defined by its IP address, or its domain name. This server can reside on the local network, or on the internet. Once the instrument is connected to the access point, it will attempt to contact the IP address or domain name of the server.

Note: When a domain name is specified, the IP address field is ignored.

Note: When the server is not on the local network, the configuration of the router it is connected to is more complicated. See section 7.6.5.

7.6.4 Manual Connection

In order to test the *WiFi*™ connection, after setting up the Router or Access-Point and/or the server's IP address or domain name, but prior to setting a connection schedule, press the *Connect-Now* button. The connection status will show that the instrument is immediately trying to connect and will show all the connection stages in sequence.

For the last stage (Server Connected) to be reached the server must be working, must be reachable, and must be running the *Instrument_Listener* application.

7.6.5 Setting Up the Server to Work in a Local or Wide Area Network.

Setting up a server to run on the same local network the instrument is in is relatively easy. In addition to the steps above, one should make sure of the following:

- The IP address of the PC working as a server must be fixed. To that end, the router that the PC is connected to must be set to use "Static DHCP" for that PC. This way the IP address cannot change.

- The PC working as a server must be always on and must be running the *Instrument_Listener*. Otherwise the connection can't be established when the instrument tries to connect.

Setting up a server to work in a Wide Area Network (in a different city for instance) is a little more complicated. One option is to use a corporate server running the *Instrument_Listener*. In that case it usually makes sense to use a domain name to represent the server's address.

When the server is a simple PC in an office, the following configuration may be used:

- The router that the PC is connected to is configured for "Port Forwarding". Port Forwarding must be enabled on port 50 000, for TCP/IP, to the local IP address of the PC.

- Static DHCP must be configured on that PC, so its local IP address will not change.

- Ideally the router must be setup to use a DDNS service, such as *noip.com*. This way the instrument can use a domain name registered through the DDNS service in order to contact the server. Alternately the instrument's server setup can use the WAN IP address of the router that the server is connected to. That is a less optimal solution because that WAN IP address is often subject to change by the internet provider, and when it changes the instrument won't be able to connect to the server anymore.

7.6.6 Email Setup (Without Cloud Service)

Email alarms can be setup by pressing the *Set* email button.

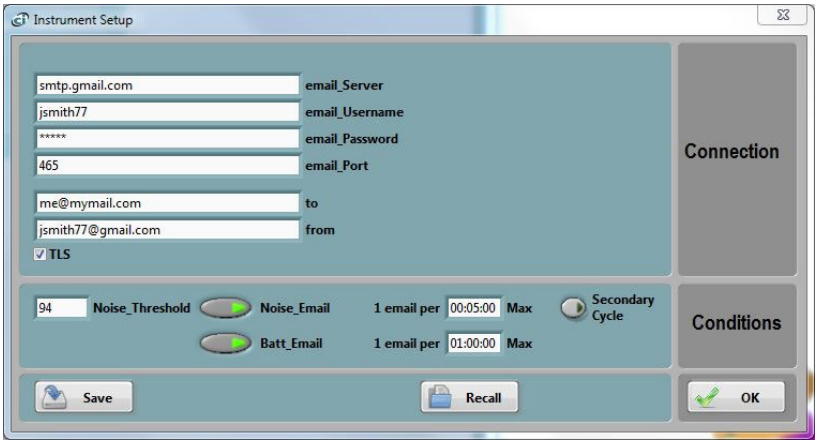


Figure 11 Email Setup

Email alarms require the following conditions:

- The *WiFi* setup must have already been done so the instrument can connect to a router or access point.

- That router or access point must be connected to the internet.

- The user must have an email account to use for outgoing email. A good solution is to use a *Sendgrid* account, or to use our cloud service.

The complete email setup is similar to the configuration of any email application. It includes the following:

- **Email server** The internet name of the outgoing email server. For gmail this is *smtp.gmail.com*
- **Port number** The TCP port number of the email service. This is usually:
    - **25** for an "open" (no security) account.
    - **465** for SSL security
    - **587** for TLS security
- **User-name** The account name.
- **Password** The account password (leave blank for an "open" (no security) account).
- **TLS** The encryption setting. This is the only secure mode supported. Uncheck for an "open" (no encryption) account. The name of that control is not well chosen. Email connections can be started using the STARTTLS prompt, or with a normal connection procedure over an SSL encrypted connection. When that control is checked, the SMTP server will be connected using a normal connection procedure over an SSL encrypted connection. The instrument does not support the STARTTLS prompt.

In addition to these settings, the email alarms settings let you set:

- **One recipient** The recipient line (*to* line in ***Figure 11***).
- **More than one recipient** Separate each email address by a ";"
- **The sender's address** The sender line (*from* line in in ***Figure 11***).

The application by default shows the settings for a fictitious secure *gmail* account (see ***Figure 11***). These settings of course need to be changed to reflect the user's own email account settings.

Three types of alarms can be sent:

- An alarm when the instantaneous level exceeds a set threshold.

- An alarm when the calculated LEQ exceeds a set threshold. The alarm is sent as soon as the LEQ aggregated over time is sure to exceed the threshold at the end of the calculation interval. The instrument does not need to wait for the end of the calculation interval to send the alarm.

- An alarm when the battery level is too low. The level cannot be adjusted. It is set so the instrument has enough reserves to send at least one alarm.

7.6.6.1 Email Rate Limits

The rate at which the alarm emails are sent can be limited. By default, it is 1 email per 5 min for a noise alert, and 1 email per hour for a battery email. These limits can be increased or decreased by writing new values in the respective fields.

7.6.6.2 Secondary Noise Alarm Thresholds

By default, the level and LEQ alarms are triggered by the same threshold at all times. But it is possible to set-up a secondary threshold cycle, so that alarms are triggered on a different threshold at different times. That makes it possible for instance to:

- Set a more sensitive threshold at night
- Set a less sensitive threshold or disable the alarms altogether on the weekends.

In order to do that, press on the *Secondary Cycle*. The following window opens:

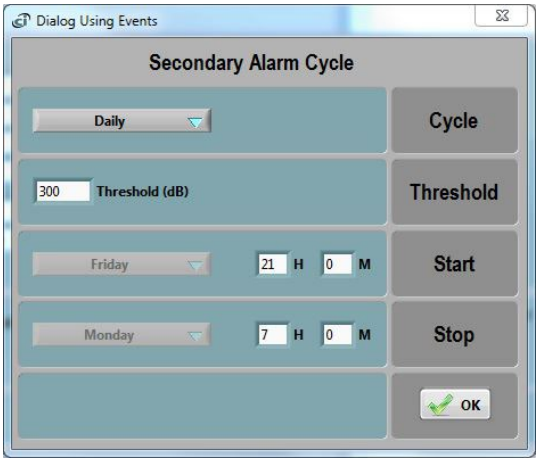


Figure 12 Secondary Email Setup

Select Hourly, Daily or Weekly cycle (or No Secondary Cycle to disable it). Then select the threshold to apply during the secondary cycle. Finally select when the secondary cycle begins and when it ends.

The Start and End of the secondary cycle are defined by:

- A Start minute and Stop minute for an hourly cycle
- A Start hour/minute and Stop hour/minute for a daily cycle
- A Start day/hour/minute and Stop day/hour/minute for a weekly cycle

When the instrument time is between the Start and Stop times, the secondary threshold is applied. Otherwise, the primary threshold is applied. That secondary threshold can be lower than the primary (for instance for a more sensitive setting at night). It can also be higher. In order to disable alarms during certain time periods, use a very high threshold, such as 200 dB.

Note: For the secondary threshold to be applied, the instrument time must be set. So after a reset of the instrument, and before the time is set by running the Instrument Manager, or the instrument connecting to a server, the secondary threshold cycle will not be in effect, even if it was programmed. This is because any secondary threshold is based on the instrument internal time, and that cannot operate properly until the proper time is set.

7.6.7 *WiFi™* Battery Drain

Connecting to a network drains the battery. Even if the instrument is idle, if the periodic connection is enabled, the instrument will regularly wake up and attempt to connect to the server. Trying to connect at regular intervals will drain the battery in a short amount of time.

When that behavior is unwanted (for instance when the instrument is unused and in storage) pressing the *Disable All* button (see 2 *Figure 5*) will completely disable *WiFi*™ and email connectivity. If the instrument is idle with all its *WiFi*™ connectivity disabled, it can keep its battery for at least 6 months.

8 Instrument_Listener Application

In order to report recorded data, and send alarm emails, the instrument must connect to a remote PC (a server) that is running the *Instrument_Listener* application. The *Instrument_Listener_Installer_Vxxx* must be installed on the PC (*Vxxx* represents the version number of that application).

The remote PC (the server) must:

- Be running
- Be reachable over the network, either by an instrument on the local network, or on a global network. In the case of a global network, all firewalls must allow the server to receive incoming connections.
- Be running the *Instrument_Listener* application. It may be useful to setup that application so that it runs automatically when the PC boots.

The *Instrument_Listener* application (see *Figure 13*) always listens to incoming connection attempts from instruments in the field. Whenever an instrument tries to connect, it opens an *NSRTW_Server* window (see *Figure 14*). That window briefly opens to show the communications with the instrument, battery level and temperature. It manages all operations that the instrument needs to perform and then closes back down.

Note: When several instruments try to connect at the same time, the Instrument_Listener application will open multiple NSRT_Server windows.



Figure 13 Instrument_Listener Application

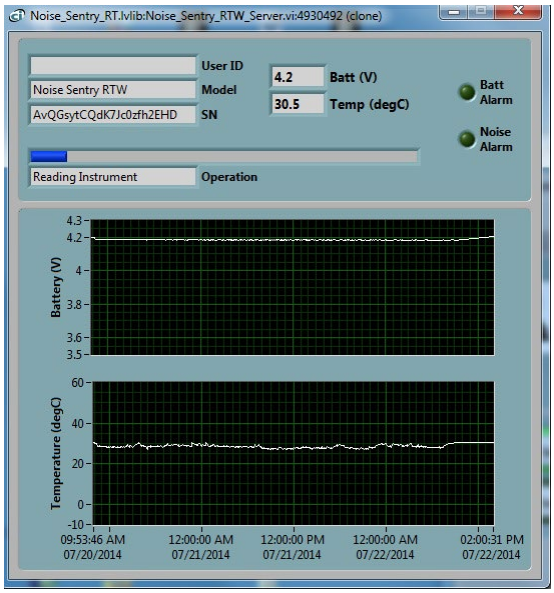


Figure 14 NSRTW_Server Window

The *NSRTW_Server* window performs the following operations:

- If data is in the instrument, it creates a *.wlg* file to hold that data or appends the data to the file if one has already been created.
- If the instrument is not currently recording, it then erases the instrument's memory, adjusts the time, and starts recording. If the instrument is recording it closes as is and lets the recording continue.

8.1 File Storage

The *.wlg* files that are created by the *NSRTW_*Server are stored in *C:\Users\username\Documents\Convergence_Instruments\All_Instruments\Records\NSRTW_mk4*, where *username* is the name of the user currently logged. In the context of a particular user's account, this folder is normally designated:

Libraries\Documents\My Documents\Convergence_Instruments\All_Instruments\Records\NSRTW_mk4

These *.wlg* files can be opened for viewing by the *Instrument_Manager* application. When they are opened the application will ask to convert them to a *.cil* file. The *.cil* format is easier to open and can be opened by other applications in the suite.

9 USB Audio Interface Option

The USB Audio Interface is always included for the *NSRT_mk4* and *NSRTW_mk4*, but not the *NSRT_mk4_Dev*. With that option the instruments are composite USB devices. They offer two separate interfaces to the host computer at the same time:

- 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_mk4* or *NSRTW_mk4*.

- 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 *NSRT_mk4* 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.

9.1 Compatibility

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

- **Windows** (tested on Win 7, Win 10 and Win11).
- **Mac-OS** (tested on OS X "El Capitan").
- **Linux** (tested on a Raspberry Pi 3b running Raspbian "Buster").

9.2 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 has slightly reduced dynamic range. It 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.

9.3 Signal and Scaling

9.3.1 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 is present 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.

9.3.2 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}.

10 Maintenance

10.1 Battery Care

The following factors affect battery life:

- Prolonged use at extreme temperatures (close to the limits of *-20 °C and +60 °C (-4 °F to 140 °F)* will shorten the life of the battery.
- Over-discharge of the battery will shorten the life of the battery. Always fully recharge the battery when it is low or at least every 6 months, whichever comes first.
- Never leave the instrument in storage with the *WiFi*™ set to periodically connect.

10.2 Reset Procedure

In the unlikely case where the instrument's firmware crashes, a hardware reset can be performed by inserting a small rod into the reset hole and pushing until a slight click is felt. There is no risk of losing any recorded data or settings by resetting the instrument. However, a hardware reset will reset the instrument's time and date to January 1st 1904 at midnight.

10.3 Operation Outdoors

The *NSRTW_mk4* is weather-proof. It can safely be used outdoors provided that the temperature is always within the safe limits. However, when using it outdoors with a risk of rain or snow, make sure its USB connector is facing down, so water will not accumulate in the connector and microphone port. Please see https://convergenceinstruments.com/mounting-directions/ for mounting directions.

10.4 Cleaning

Use a damp sponge or soft cloth.

Note:	*Do not use solvents.* *Do not submerge in water.* *Do not blow onto or near the microphone*

10.5 Software and Firmware Upgrades

Software upgrades are found on our web site: www.convergenceinstruments.com.

After upgrading the software, if a firmware upgrade is required it will be applied automatically when the upgraded *Instrument_Manager* application is started. In that case do not disconnect the instrument until the upgrade is completely over. Failure to do that will place the instrument in a state where it no longer works.

Note: A firmware upgrade will not lose any recorded data but will reset the instrument's settings.

Note: When upgrading the instrument's firmware always make sure that only one instrument is connected to the PC at a time.

11 Troubleshooting

11.1 USB Power Limitation

In some instances, a PC will not allow the instrument to connect to one of its USB ports because it cannot provide the battery charge current requested by the instrument. If you suspect that this may be a factor, try connecting the instrument to the output of an externally-powered USB hub that is capable of providing a full USB load (500 mA).

11.2 USB Driver Installation

If the *Instrument_Manager* application is unable to communicate with the *NSRTW_mk4* it may be because the USB driver failed to install properly. To check the USB driver installation, follow the procedure below:

1. Disconnect the USB cable.
2. If necessary, take the PC out of stand-by.
3. Reconnect the instrument to an available USB port on the PC.
4. Make sure the charge LED lights-up green (charged) or yellow (charging). If not, make sure that the PC's USB port is functional, and that the USB cable is not damaged. If necessary, try on a different PC, and/or with a different USB cable. The charge LED is just an indication that the port is powered. It should light-up, even if the USB driver is not installed properly.
5. Make sure that the operation LED starts blinking. If not go to step 6.
6. Open the *Device Manager* on the PC. This is usually found in *Control Panel – System and Maintenance*.
7. Just after connecting the instrument to the PC, observe that the *Device Manager* window refreshes.
8. Verify that an item named *DDCI Platform* or *NSRTW_mk4* has been created in the list of devices.
9. If an unknown item appears, or an item named *DDCI Platform* or *NSRTW_mk4* is found but has an exclamation mark (indicating a problem) beside it, disconnect the device and try re-installing the driver (see step 10).
10. To re-install the driver disconnect the *instrument from the PC*. Then Go into *Start\All Programs\Noise_Sentry_RT_Management\Driver*, and run *DDCI_Driver_Install.exe*. This re-installs the USB driver. You need to have admin privileges to be able to install the driver.

11.3 Connection Problems

Failure to communicate with the PC can also be caused by poor USB cable contacts. Make sure the USB connector is fully inserted into the socket of the *NSRTW_mk4.* Inspect the inside of the socket in the instrument. If dirt is lodged in the socket, use dry compressed air to expel it.

Make sure not to blow air at or near the microphone!