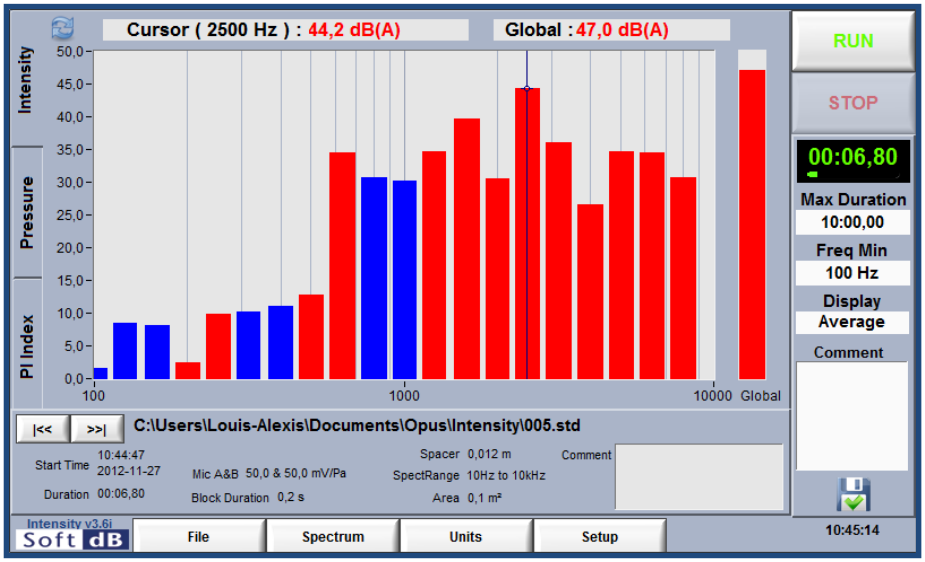
Opus Suite

Intensity Module

User Guide – v1.5b
2014-01-21



Compatible Hardware:

Alto

Concerto

Conductor

Soft dB Inc.
1040, Belvedere Avenue, Suite 215
Quebec (Quebec) Canada G1S 3G3
Toll free: 1-866-686-0993 (USA and Canada)
E-mail: *info@softdb.com*

Soft dB
WWW.SOFTDB.COM

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1 Introduction

Congratulations on your purchase of the ***Opus Suite Intensity Module***.

The ***Opus Software Suite*** is a Sound and Vibration software that contains several modules:

- SLM 4-ch module : 4-channels, Class 1 (IEC 61672 and ANSI S1.43)
- SLM & 3Vib module : 1 SLM channel (same as SLM 4-ch module) and 3 vibration channels (ISO 8041 and ISO 2631)
- Data Logger module
- Building Acoustic module
  - Sound Transmission (ASTM E 336/ISO 140-4)
  - Impact Insulation (ASTM E 1007/ISO 140-7)
  - Room noise (ANSI/ASA S12.2-2008)
  - Reverberation Time (ISO 3382)
  - Speech Privacy (ASTM E 2638 and ASTM E 1130)
- Building Vibration module (DIN 45669-1 and ANSI S2.46)
- Intensity module (IEC 1043)
- Impact Hammer module

The ***Opus Suite*** is intended to run on a ***Concerto.*** The software can also be installed on a Conductor unit or on any PC if using an Alto unit. Moreover, some post-processing functions are available on a PC even if no compatible unit is detected.

The current user's manual describes the **Intensity Module**.

General Specifications – Intensity Module

Measurement Types	Sound Intensity Sound Pressure PI Index
Spectrum Types	1/1, 1/3, 1/6 and 1/12 Octave bands FFT
Units	dB A, C or Z weight

The sound intensity module conforms to IEC 1043.

2 Compatible Hardware

Every hardware option has an embedded state of the art Soft dB SR-MK3 DSP board allowing real-time and precise measurement with very low energy consumption.

Concerto

Handy, lightweight, fully rugged military tablet
All in one instrument
WLAN communication allows using the Concerto as a monitoring station with remote access.
http://www.softdb.com/en/acoustic/products/concerto.php

Alto

6 or 4 24-Bit asynchronous inputs and 2 outputs
Compact, low-consumption, and flexible
Needs to be connected to a PC.
Competitive price.
http://www.softdb.com/en/acoustic/products/alto.php

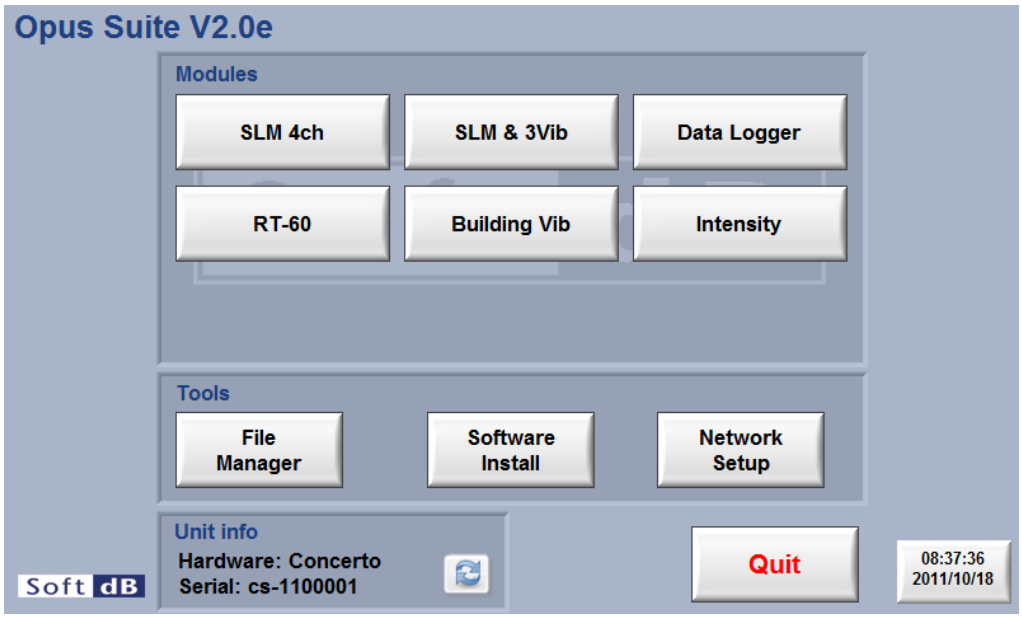
Conductor

Rugged platform for acoustics and vibration measurements.
Mainly used for the I-Track sound intensity mapping system.
http://www.softdb.com/en/acoustic/products/conductor.php

The Intensity module implements the measurement of sound intensity using a pressure-pressure sound intensity probe. Several hardware configurations are possible, contact Soft dB for more information.

3 Opus Environment

The ***Concerto*** unit comes equipped with the **Opus** Environment. This environment acts as a main interface that gives access to the different modules and tools.



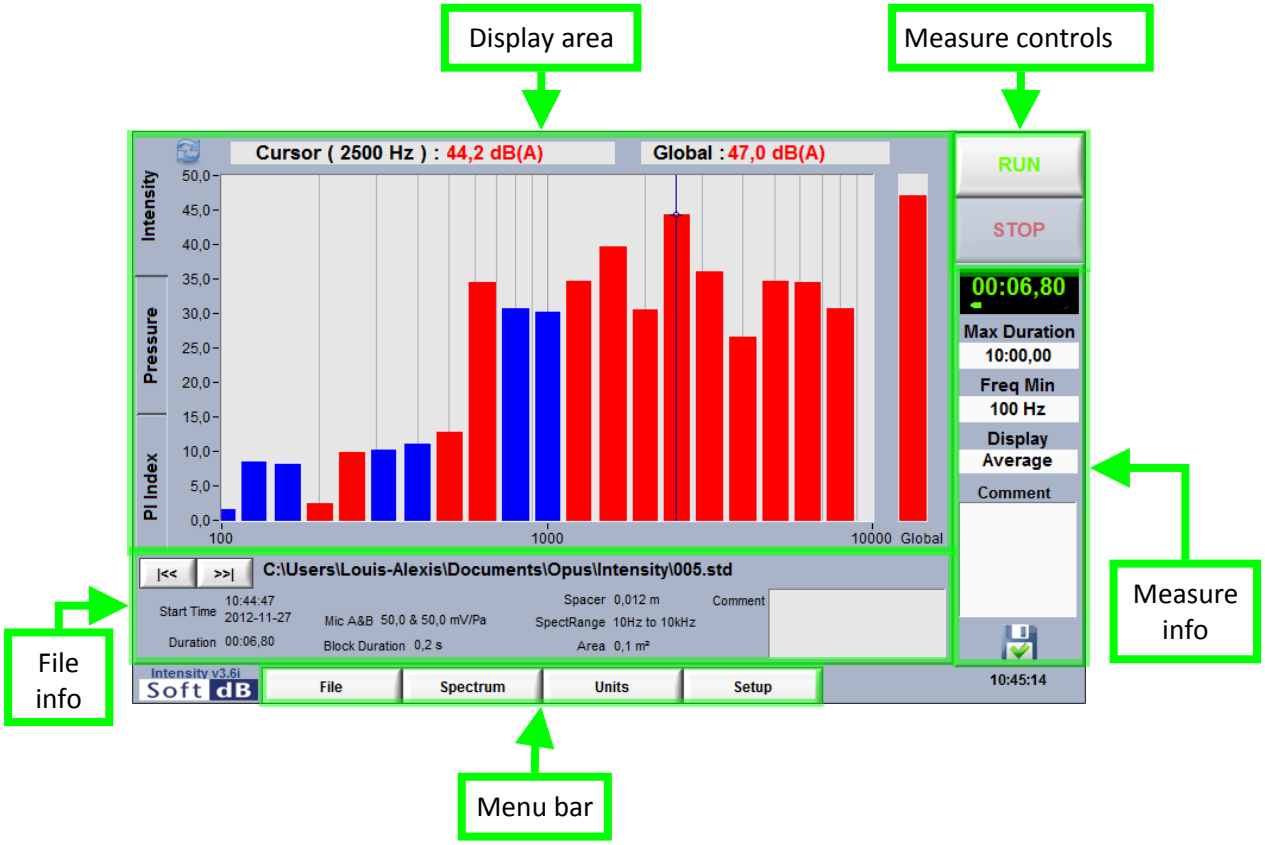
Modules	The modules buttons will launch the associated module. When a module is opened, a license verification check is done. If no license is found for that module, a message will indicate the limitations.
File Manager	The File Manger button will launch the File Manager Utility.
Software Install	The Software Install button will launch a browser from which an Opus software installer can be launched.
Network Setup	The Network Setup button will close the Opus software and access Windows. Then, the network can be set trough Windows.
Unit info Hardware: Concerto Serial: cs-1100001	The Unit info gives the information about the hardware type (Concerto, Alto or Conductor) and the serial number of the unit. The refresh button allows resetting the connection with the acquisition board (useful with an Alto unit).
08:37:36 2011/10/18	The Clock indicator displays the time and date on the unit. To change time, simply click on the indicator to display a dialog window.

	The Quit button will quit the application differently according to the hardware used. Concerto hardware: • Hold 5 sec to shut down the unit. • Press and release to enter standby mode. Alto or Conductor hardware: • Press and release to close the application and return to Windows.

4 Main Interface

The main interface is divided into five sections:

1) Measure controls (see section 4.1, p. 7)
2) Measure info (see section 4.2, p. 7)
3) Menu bar (see section 0, p. 8)
4) Display area (see section 0, p. 9)



The following operations can be performed using the main interface:

- Perform a measurement
- Modify the setup using the Setup menu
- Save/Open/Export data, Save/Open config and Quit using the File menu

4.1 Measure Controls

RUN/PAUSE/CONTINUE

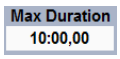
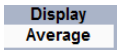
	When the user clicks this button, the measurement process is launched. The **RUN** button then automatically becomes the **PAUSE** button.
	When the user clicks this button, the measurement process is suspended. The **PAUSE** button then automatically becomes the **CONTINUE** button

STOP/SAVE

	When the user clicks this button, the measurement stops. The **STOP** button then becomes the **SAVE** button.
	When the user clicks this button, the active measurement is saved. The **SAVE** button is then disabled until another measurement is complete.

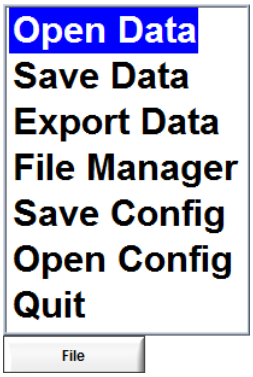
4.2 Measure Info

Measure Info

	This indicator displays the elapsed time and the buffer status bar.
	This indicator displays the maximum measurement length. After the specified duration, the measurement is automatically stopped. However, the user can stop the measurement manually by clicking the STOP button. To change this value click on this indicator to display a numeric keyboard.
	This indicator displays the first frequency that is available on the spectrum. Clicking on this indicator launches the block length interface.
	This control allows switching the display mode between Instantaneous values and time-averaged values during a measurement. When the measurement stops, the time-averaged mode is automatically selected and the instant mode is unavailable.
	This control allows writing a comment about the measurement. Any text written in this filed will be included in the next measurement. To modify the comment of a previous measurement, use the Measure Info Comment field. To modify the comment, click on the text field to display a keyboard.

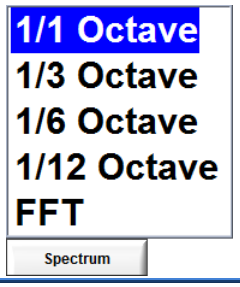
4.3 Menu Bar

File Menu



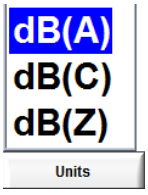
Open Data:	This item allows the user to open a measurement file (.rt6).
Save Data:	This item allows the user to save a measurement file (.rt6). When the user saves a measurement, its file number is automatically generated and saved in the measurement save directory.
Export Data:	This item allows the user to export the data in a tab delimited file (.txt .xls).
File Manager:	This item launches the File manager (see section **Erreur ! Source du renvoi introuvable.**, p. **Erreur ! Signet non défini.**)
Save Config:	This item allows the user to save the software interface configuration in a .cfg file.
Open Config:	This item allows the user to open a .cfg file to restore the saved interface configuration.
Quit:	This item allows the user to quit the RT-60 module and return to the Opus Suite interface.

Spectrum Menu



This menu allows changing the spectrum appearance.

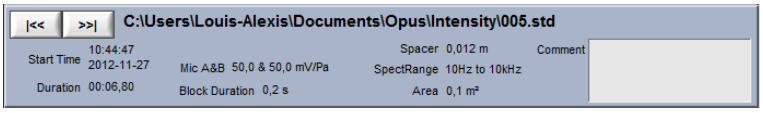
Units Menu



This menu allows changing the units.

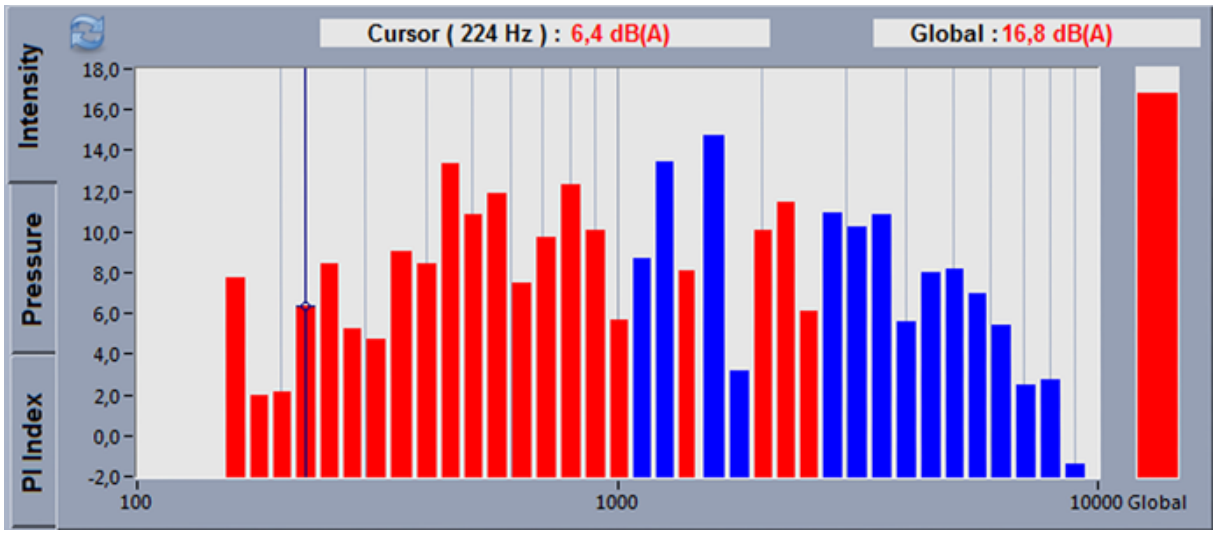
4.4 File Info

File Info



This area displays relevant information about the current file.
It also contains controls allowing to go to the previous or next file in the current directory

4.5 Display Area



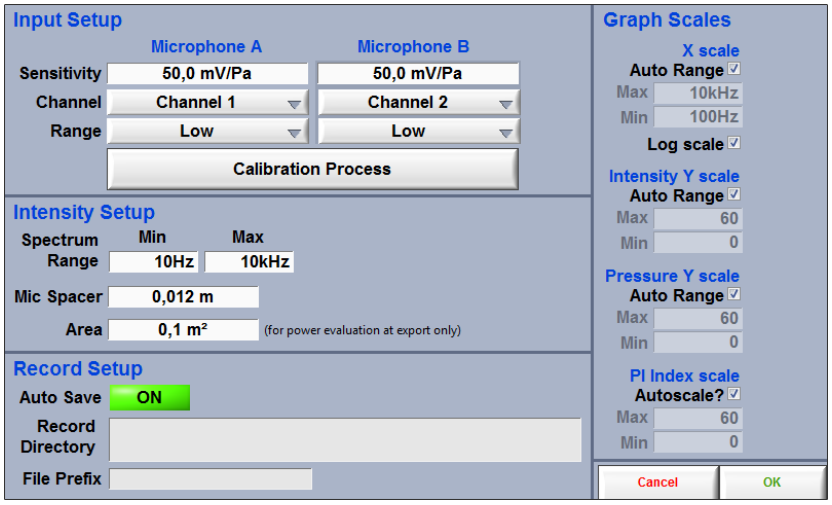
The display area shows the spectrum and the global level in real-time during a measurement or of a file when it is loaded.

The tabs at the left allow to switch between Intensity, Pressure and PI Index.

The refresh arrows at the top-left corner allow rescaling the graph axis to the data contained in the spectrum and the global level bar.

Note: When displaying intensity, the red color represents positive intensity and blue represents negative intensity vector.

5 Setup



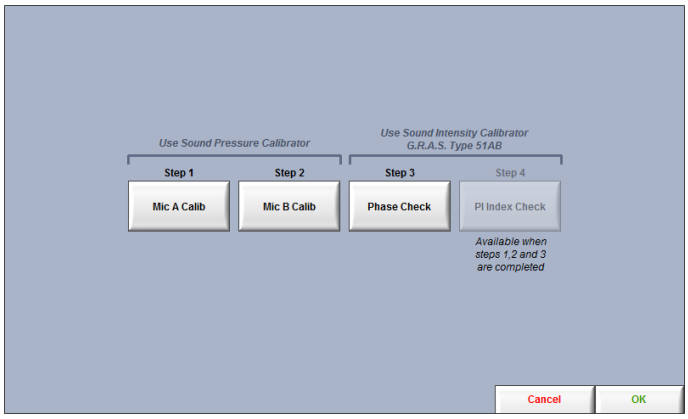
Input Setup	These controls allow selecting the microphone spacer, input channel, the input type and the input range from drop down lists.
Record Setup	These controls allow selecting the record directory, to write a custom file prefix to the file names and to select the auto-save mode that automatically records measurements when they end. Their names are automatically incremented in the record directory.
Spectrum Range	This control is used to define the spectrum range. This range will be used to compute the global level and to restrict the spectrum display to this specific range. This tool is commonly used to restrict the spectrum range to the specifications associated to a specific microphone spacer as described in the following table:

Microphone Spacer	Error < |2 dB|	Error < |4 dB|
50 mm	60 Hz – 1.8 kHz	20 Hz – 2 kHz
12 mm	100 Hz – 10 kHz*	63 Hz – 10 kHz*
8 mm	200 Hz – 10 kHz	125 Hz – 10 kHz

5.1 Calibration Process

The calibration process includes the amplitude calibration of microphones, a phase check and a PI Index check. The amplitude calibration is performed using a sound pressure calibrator and the phase and PI Index check is performed using the G.R.A.S. 51AB sound intensity calibrator wired to the output 1 of the Concerto.

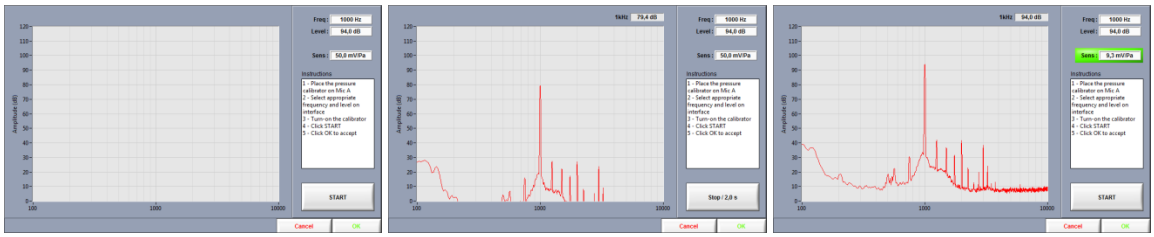
Amplitude calibration is usually performed first, then Phase check is performed and only then the PI Index check will become available.



5.1.1 Pressure Calibration

To perform pressure calibration of a microphone:

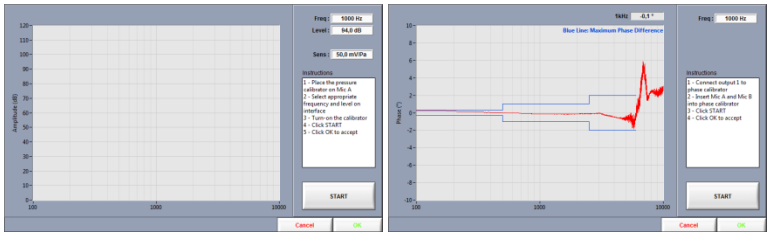
1. Insert Microphone A in the pressure calibrator.
2. Click on the Mic A Calib button on the Calibration Process interface to launch the Pressure Calibration interface.
3. Turn On the calibrator and select the appropriate frequency and amplitude on the interface.
4. Click START to begin calibration. An averaging is performed on the signal and the resulting spectrum is displayed on the interface.
5. When averaging is done, the sensitivity is updated.
6. Click OK to accept.
7. Repeat steps 1 to 6 to calibrate microphone B.



5.1.2 Phase Check

To perform phase check:

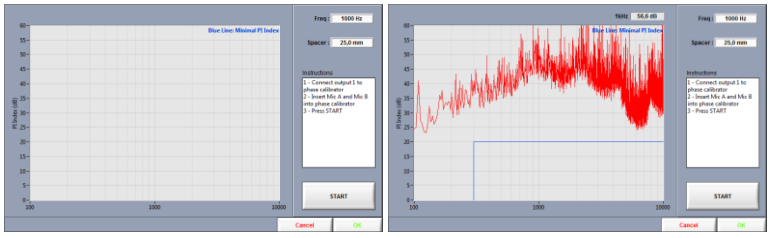
1. Connect the intensity calibrator to the output 1 of the Concerto.
2. Insert both microphones calibrator cavity.
3. Click on the Phase Check button on the Calibration Process interface to launch the Phase Check interface.
4. Click START to begin the test. An averaging is performed on the signal and the resulting phase response is displayed on the interface. An acceptable tolerance is also displayed on the graph.
5. When averaging is done, click OK to accept.



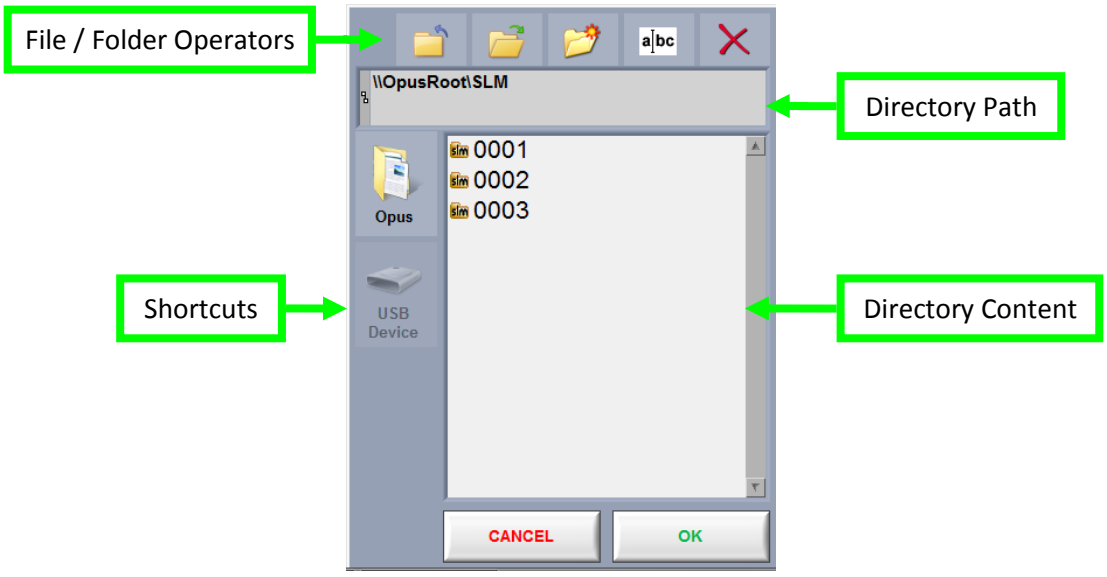
5.1.3 PI Index Check

To perform PI Index check:

1. Perform Amplitude calibration and Phase check priorly.
2. Connect the intensity calibrator to the output 1 of the Concerto.
3. Insert both microphones calibrator cavity.
4. Click on the PI Index Check button on the Calibration Process interface to launch the PI Index Check interface.
5. Click START to begin the test. An averaging is performed on the signal and the resulting PI Index response is displayed on the interface. A minimal value is also displayed on the graph.
6. When averaging is done, click OK to accept.



6 Explorer Dialog



Explorer Window Controls and Indicators

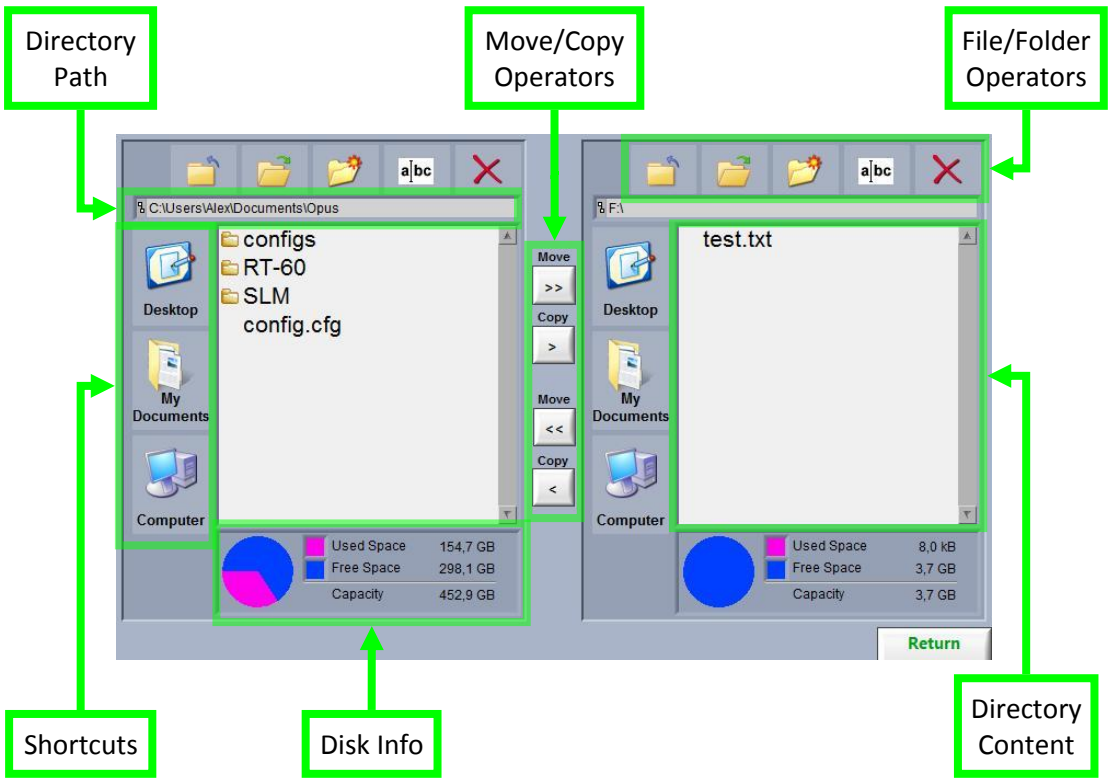
File/Folder Operators	• Go to parent directory • Open directory • Create new folder • Rename folder or file • Delete folder or file
Directory Path	Displays the path of the active directory.
Shortcuts	Accesses to **common directories**. When used on a stand-alone computer, those shortcuts are linked to: • Desktop • My Documents • Computer When used on a ***Concerto***, the shortcuts are linked to: • Opus Root • USB Device.
Directory Content	Displays the content of a directory and responds to common actions: • Single clicking on an element selects it. • Double clicking on a directory opens it.

7 File Manager

The File manager is used to perform most file operations:

- Navigate the directory structure
- Create folders
- Rename files and folders
- Move or copy files and folders from one place to another
- Delete a file or a folder

Although not very useful on a stand-alone computer, this manager is necessary on the *Concerto,* on which Windows explorer is unavailable. Its primary function is to allow the user to manage the *Concerto* directory structure and to export files and folders to a USB memory stick.



Directory Path	Displays the path of the active directory.
Shortcuts	Allows easy access to common directories. When the **File Manager** is used on a stand-alone computer, these shortcuts are linked to: • Desktop • My Documents • Computer When the **File Manager** is used on a ***Concerto***, the shortcuts are linked to: • Opus Root • USB Device.
Move/Copy Operators	Copies or moves a file or folder from a source to its destination.
File/Folder Operators	Allows user to: • Go to parent directory • Open directory • Create new folder • Rename folder or file • Delete folder or file
Directory Content	Displays the content of a directory and responds to common actions from the user: • Single clicking on an element will select it • Double clicking on a directory will open it • Dragging an element from one side to the other will copy it.
Disk info	Displays the disk information of the associated hardware.

Appendix 1: Concerto Hardware

Connections

Power on/off

Turn On	Press the trigger button located at the back of the unit This key has two (2) functions: 1. To turn the unit ON. 2. Start a measurement once the SLM Module is loaded After a few seconds, the **Opus Environment Interface** will appear.
Stand-by	The **stand-by** mode allows fast load time. • To put the unit on **stand-by**, click the **Turn Off** button. Note: The unit can be in stand-by for more than three days without recharging, provided batteries are fully charged prior to storage.
Shutdown	To **Shut down** the unit, click and **hold** the **Turn Off** button for five seconds.

Power Reset

If the Concerto happens to crash and it is not possible to take back the control, a power reset might be necessary. To complete the power reset, the three buttons on the front of the Concerto must be used.

Here is the procedure:

Step 1 ***Press and hold the Function, Enter and Down Arrow button for 5 seconds until the Concerto shuts down***

Step 2 ***Wait 5 seconds and press the power button***

Step 3 ***Wait 5 seconds and press the power button a second time to restart the Concerto from a power reset.***

Step 1

Press and hold to trigger the power reset

Step 2 and 3

Press 2 times to restart from power reset

Inputs and Signal Processing Specifications (Embedded Signal Ranger MK3 DSP Board)

DSP Processor	Texas Instruments TMS320C6424
Inputs	4
Outputs	2
Linear Range	2 x (25-120 dBA or 30-130 dBA) + 2 x (25-120 dBA)
Conditioning	AC, DC, ICP (4 mA)

Physical (DAP Tech 9000 Tablet PC)

Operating system	Intel Atom E660T 1.3 GHz
Storage	16 GB SSD
Data Transfer	USB
Display	180 mm (7 inches) WVGA (800 x 480)
Dimensions	230 x 185 x 60mm (9.0 x 7.3 x 2.4 inches)
Weight	1350 g (2.96 lb)
Battery	2 x Li-ion battery, 7.4 V, 3100 mAh, (1 internal + 1 hot-swappable)
Power	10-20 VDC, 2A
Protection rating	IEC 68-2-32 method 1 (Multiple 1m drops on concrete) IP67 (Rain, Humidity, 1 meter immersion) MIL-STD-810F method 506.4 procedure I (windblown rain) Humidity: 95% non-condensing Temperature: MIL-STD-810-F (-20 °C ... +50 °C); Vibration: MIL-STD 810E 514.5

Appendix 2: 1/3 Octave Filters – IEC 61260 Class 1/ANSI S1.11

1/3 Octave Filters

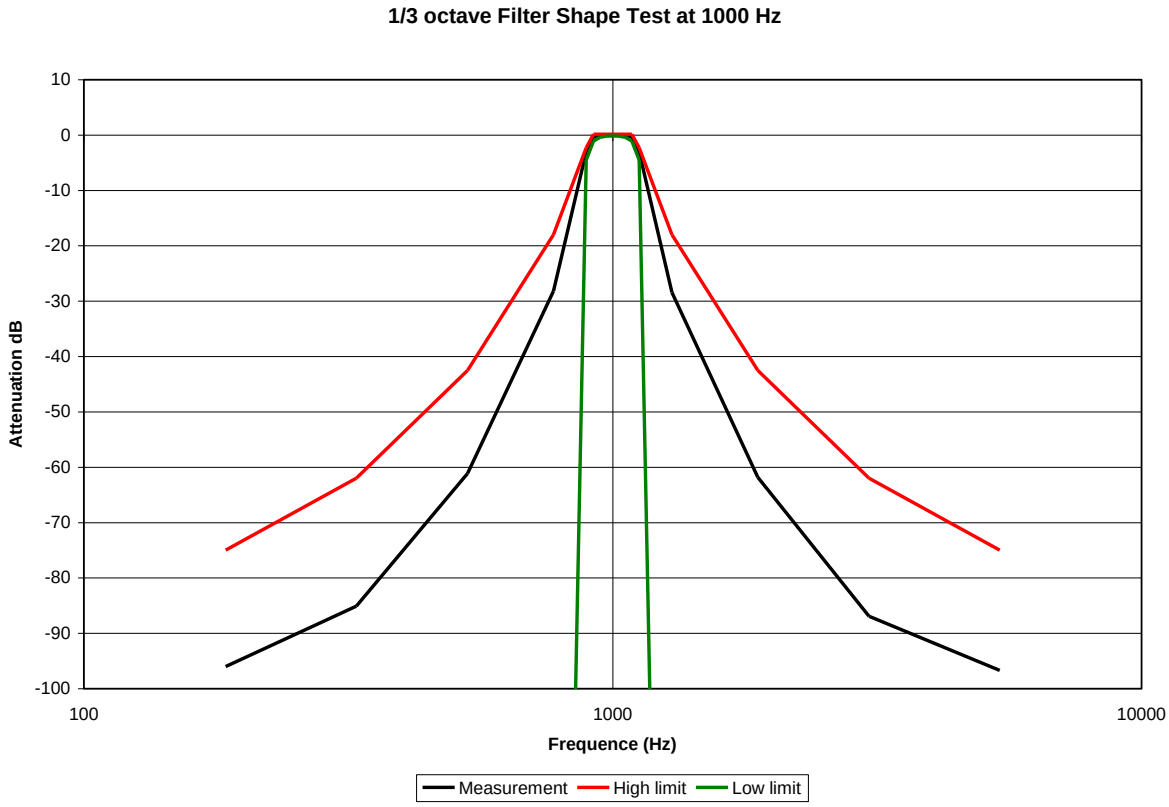
The 1/3 octave filters are computed at low-level in real time (at 48 kHz) on the digital signal processor (DSP) of the Concerto system. The filters comply with all requirements of IEC 61260 for Class 1.

Frequency Range

20 Hz to 20 kHz.

Filter Shape

The following curve presents the filter shape test done for the 1000 Hz 1/3 octave band. The red and green curves represent the limits associated with the IEC standard (Class 1).



Shape Test Numerical Results at 1 kHz

The following table presents the numerical results of the shape test at 1 kHz:

Frequency (Hz)	Low limit (dB)	Measurement (dB)	High limit (dB)
185.5	-inf	-96.0	-75.0
327.5	-inf	-85.1	-62.0
531.4	-inf	-61.1	-42.5
772.6	-inf	-28.2	-18.0
891.3	-4.5	-3.0	-2.3
919.6	-1.1	-0.3	0.15
947.0	-0.4	0.0	0.15
974.0	-0.2	0.0	0.15
1000.0	-0.15	0.0	0.15
1026.7	-0.2	0.0	0.15
1055.8	-0.4	0.0	0.15
1087.5	-1.1	-0.3	0.15
1122.0	-4.5	-3.0	-2.3
1294.4	-inf	-28.4	-18.0
1881.7	-inf	-61.8	-42.5
3053.7	-inf	-86.9	-62.0
5392.0	-inf	-96.7	-75.0

1/3 Octave Filter Linearity

The linearity of the 1/3-octave filter has been measured for both ranges (low and high). The experimentation is done with an adaptor (ADP092) and an electric signal. The results in dB are for an input sensitivity of 50 mV/Pa. The maximum and the minimum linear levels are measured for each 1/3 octave band along with the noise floor.

Filter Linearity (Low Range)

Frequency (Hz)	Saturation Level (dB)	Minimum Linear Level (dB)	Linear Dynamic Range (dB)	Noise Floor (dB)
20	120.5	39.5	81.0	1.3
25	120.5	34.2	86.3	0.7
31.5	120.5	33.2	87.3	2.0
40	120.5	30.6	89.9	1.2
50	120.5	30.0	90.5	1.1
63	120.5	28.1	92.4	3.2
80	120.5	27.8	92.7	0.4
100	120.5	27.4	93.1	-0.4
125	120.5	27.2	93.3	1.4
160	120.5	27.0	93.5	0.0
200	120.5	26.7	93.8	0.4
250	120.5	23.4	97.1	0.7
315	120.5	24.1	96.4	1.3
400	120.5	23.5	97.0	1.8
500	120.5	23.5	97.0	2.3
630	120.5	24.0	96.5	3.2
800	120.5	24.1	96.4	3.4
1000	120.5	24.1	96.4	4.3
1250	120.5	24.5	96.0	5.2
1600	120.5	24.5	96.0	6.1
2000	120.5	24.2	96.3	7.1
2500	120.5	24.5	96.0	8.2
3150	120.5	24.6	95.9	9.2
4000	120.5	24.7	95.8	10.1
5000	120.5	25.1	95.4	11.3
6300	120.5	25.2	95.3	12.6
8000	120.5	25.8	94.7	14.0
10000	120.5	26.3	94.2	16.9

Frequency (Hz)	Saturation Level (dB)	Minimum Linear Level (dB)	Linear Dynamic Range (dB)	Noise Floor (dB)
12500	120.5	27.0	93.5	17.5
16000	120.5	27.6	92.9	19.5
20000	120.5	28.3	92.2	19.7

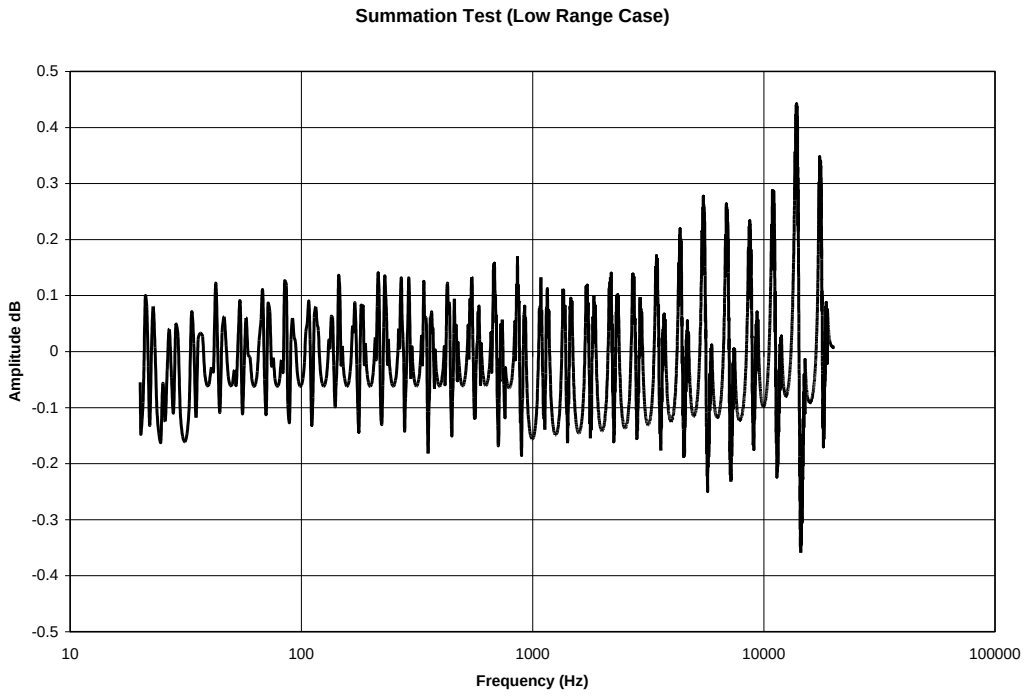
Filter Linearity (High Range)

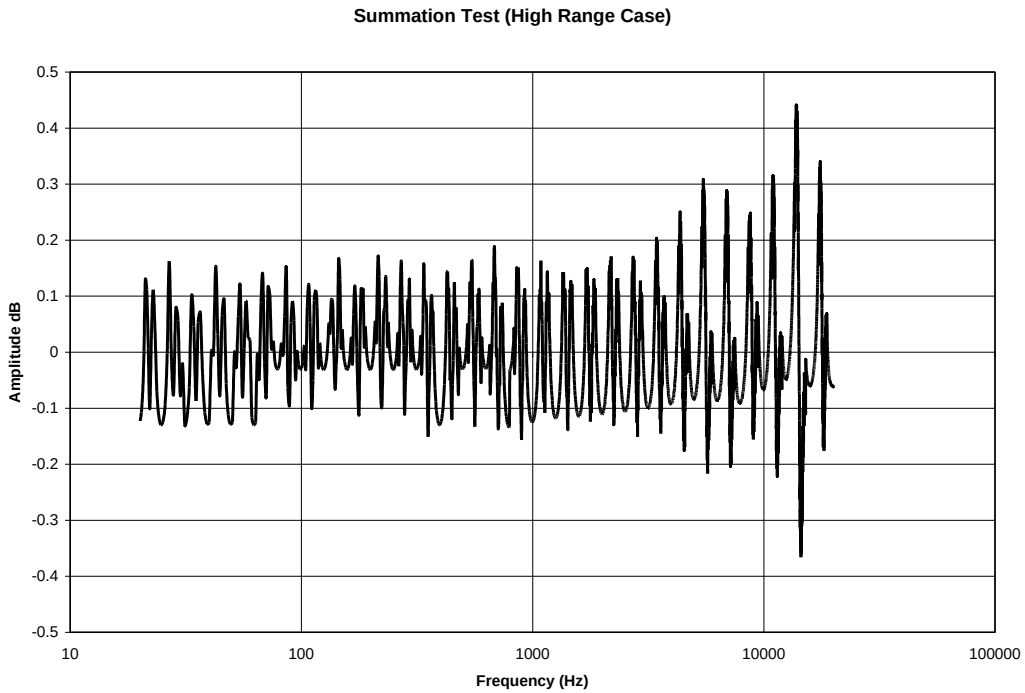
Frequency (Hz)	Saturation Level (dB)	Minimum Linear Level (dB)	Linear Dynamic Range (dB)	Noise Floor (dB)
20	132.5	51.5	81.0	7.3
25	132.5	49.2	83.3	5.3
31.5	132.5	47.1	85.4	2.0
40	132.5	44.2	88.3	7.9
50	132.5	41.8	90.7	9.3
63	132.5	39.1	93.4	9.1
80	132.5	37.1	95.4	10.6
100	132.5	32.6	99.9	10.6
125	132.5	31.4	101.1	11.6
160	132.5	31.0	101.5	11.9
200	132.5	30.7	101.8	12.7
250	132.5	30.1	102.4	12.8
315	132.5	28.7	103.8	12.9
400	132.5	28.5	104.0	13.5
500	132.5	28.2	104.3	13.4
630	132.5	27.2	105.3	13.6
800	132.5	27.0	105.5	13.6
1000	132.5	26.8	105.7	14.1
1250	132.5	27.1	105.4	14.8
1600	132.5	27.0	105.5	15.4
2000	132.5	27.4	105.1	16.2
2500	132.5	27.6	104.9	17.0
3150	132.5	28.1	104.4	18.0
4000	132.5	30.1	102.4	19.1
5000	132.5	30.4	102.1	20.1
6300	132.5	31.8	100.7	21.0
8000	132.5	32.7	99.8	22.4

Frequency (Hz)	Saturation Level (dB)	Minimum Linear Level (dB)	Linear Dynamic Range (dB)	Noise Floor (dB)
10000	132.5	33.5	99.0	23.5
12500	132.5	34.1	98.4	25.2
16000	132.5	35.8	96.7	27.3
20000	132.5	37.1	95.4	27.7

1/3 Octave Filter Summation

For this test, sine waves from 20 Hz to 20 kHz are measured with the Concerto system. For each sine wave the summation of the 1/3 octave filters is computed to form the following curves. The sine waves are electrical signals at 1 VRMS. The next figures present the results for both input range.




Summation Test (High Range Case)
0.5
0.4
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
-0.4
-0.5
Amplitude dB
10
100
1000
10000
100000
Frequency (Hz)