Opus Suite

Building Acoustics Suite

User Guide – v1.2
2014-01-21

- 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 Provided by a Closed Room (ASTM E 2638)
- Speech Privacy in Open Offices (ASTM E 1130)

Compatible Hardware:

Alto

Concerto

Conductor

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1 Introduction

Congratulations on your purchase of the ***Opus Building Acoustics Suite*****.** This sub suite contains several building acoustics related modules and is itself part of the ***Opus Software Suite***.

The ***Opus Software Suite*** is a sound and vibration software that contains several measurement 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 Acoustics Suite
  - 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)
- Hammer Impact module
- Power Transformer Suite

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 presents the modules of the **Building Acoustics Suite**:

Module Name	Description	Standards	Section
STC	Airborne Sound Isolation between Rooms	ASTM E 336 ISO 140-4	Section 4, page 8
IIC	Impact sound insulation of floors	ASTM E 1007 ISO 140-7	Section 5, page 29
Room Noise	Room noise	ANSI/ASA S12.2-2008	Section 6, page 51
RT-60	Reverberation Time	ISO 3382	Section 7, page 67
E2638	Speech Privacy Provided by a Closed Room	ASTM E 2638	Section 8, page 84
E1130	Privacy Speech Privacy in Open Offices	ASTM E 1130	Section 9, page 102

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

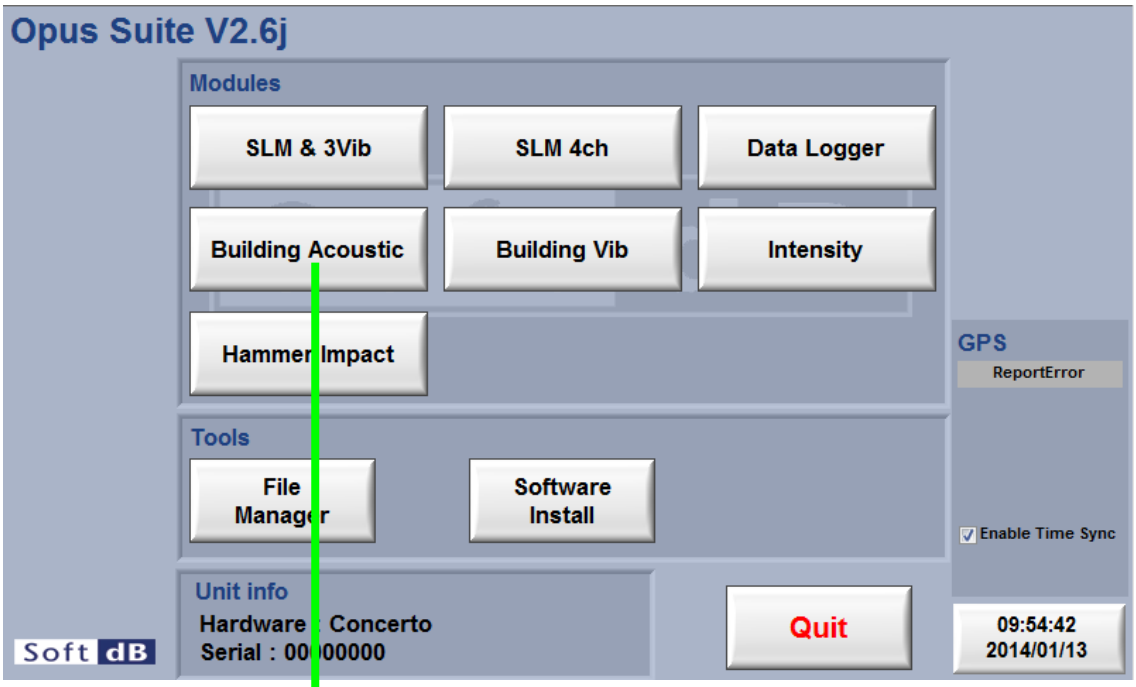
6 or 4 24-Bit asynchronous inputs and 2 outputs
Compact, low-consumption, and flexible
Needs to be connected to a PC.
Competitive price.
http://www.softdb.com/en/acoustic/products/alto.php

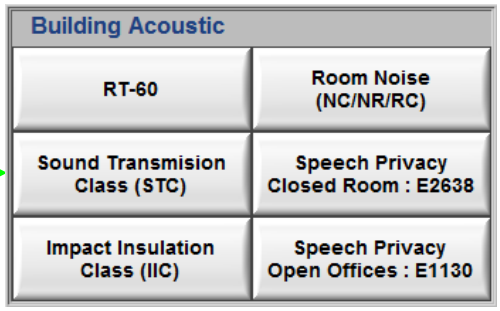
Conductor

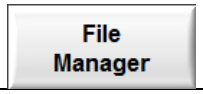
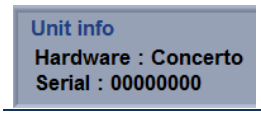
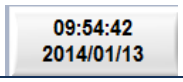
Rugged platform for acoustics and vibration measurements.
Mainly used for the I-Track sound intensity mapping system.
http://www.softdb.com/en/acoustic/products/conductor.php

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 module buttons launches the associated module. When the license of a module is not found, the text of its button is greyed, but the module can still be opened to access measurement files.
	The File Manger button launches the File Manager Utility (see section 11, p. 124)
	The Software Install button launches a browser from which an Opus software installer can be launched.
	The Network Manager button launches the Network Manager interface. This tools is only available on a Concerto unit
	The Unit info gives the information about the hardware type (Concerto, Alto or Conductor) and the serial number of the unit.
	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 quits 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 STC module

General Specifications

Standards	**Test Method ASTM E336-05** and **Test Method ISO 140-4** Standard Test Method for Measurement of Airborne Sound Attenuation between Rooms in Buildings. Both standards are designed to measure the sound isolation a partition between two rooms. The result is expressed as a Sound Transmission Class (STC) index. The two standards differ slightly in the frequency range that is considered for the evaluation. The ASTM ranges from 125 to 4000 Hz. The ISO ranges from 100 to 3150 Hz.
Software Features	• Intuitive interface for STC measurement • Embedded noise generator (white or pink noise) • Real time 1/3 octave band spectrum (IEC 1260 Type 1) • Reverberation evaluation with auto interrupted method • Automated calculation of the STC Index • Expendable interface to allow repetitions of a measurement type. • Multiple partitions in the same file • Save, load and export measurement files

4.1 STC Quick Start

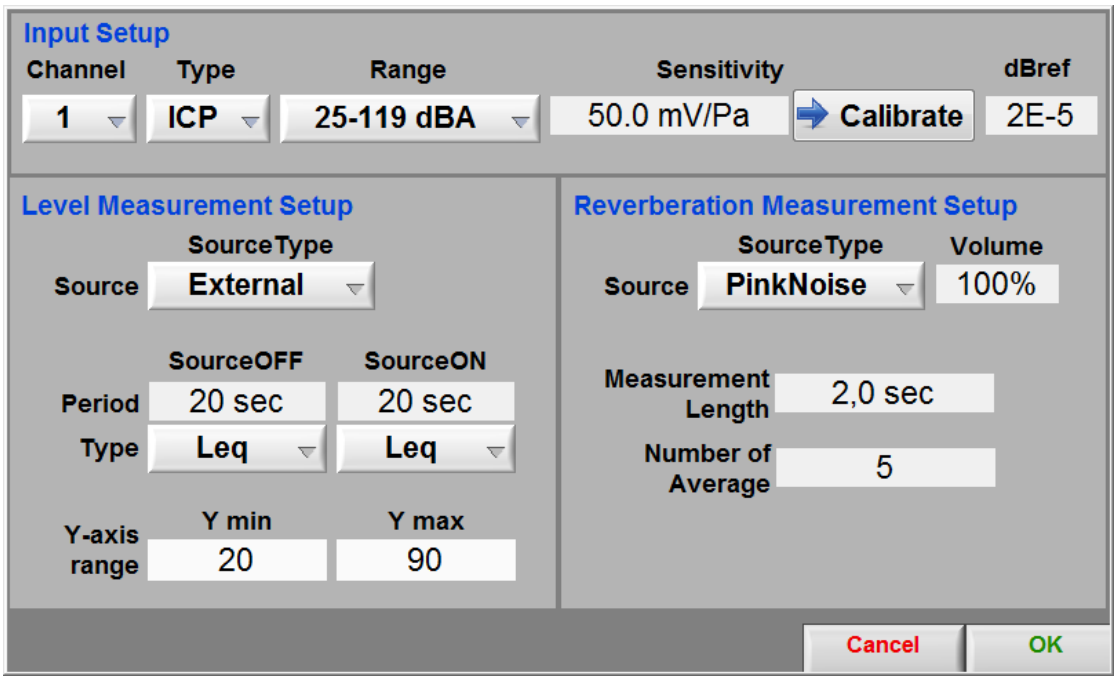
The STC module is part of the Building Acoustics. It can be accessed in the Building Acoustics menu of the Opus Suite panel.

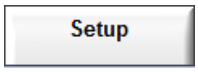
Measurement tab

What you should know…

- The partition area and the receiving room volume are used to evaluate de STC.
- You need at least 4 measurements: level in the source room (source on), level in the receiving room (source on), background level in the receiving room (source off) and reverberation time in the receiving room.
- The main interface let do an unlimited quantity of measurements for every type of data.
- Select the corresponding column header to see the average of the different measurements of a type of data.
- The selected element of the table shows a green background. The details of the selection are displayed on the right side of the table.
- The elements still to measure display a question mark (?) as a value and have a yellow background.

Step 1 Setup the unit



Click on the 

button to access the setup interface. The parameter should typically be set as shown on figure above.

Before a measurement, the operator should set the sensitivity of the sensor used. This sensitivity can be set manually if it is known. Preferably, the sensor sensibility should be set by using the software calibration tool and a calibrator. To do so, click on

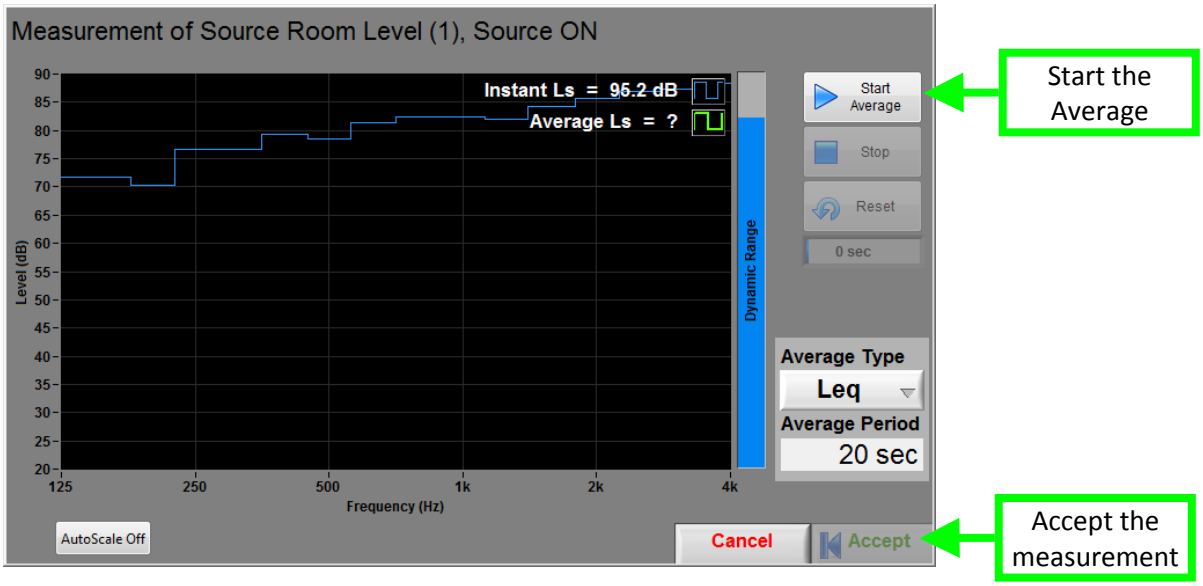
and follow the instructions of the Sensor Calibration (section 4.3.1, p.18).

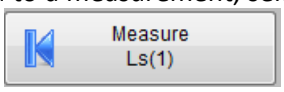
The level measurement can be made using an external generator or the internal generator (pink or white noise).

Click

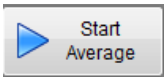
to return to the main panel.

Step 2 Do a Level Measurement

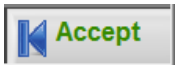


To proceed to a measurement, select an element to measure in the table of the main panel and click the button 

to open the measurement interface.

Once in the measurement panel, click on the 

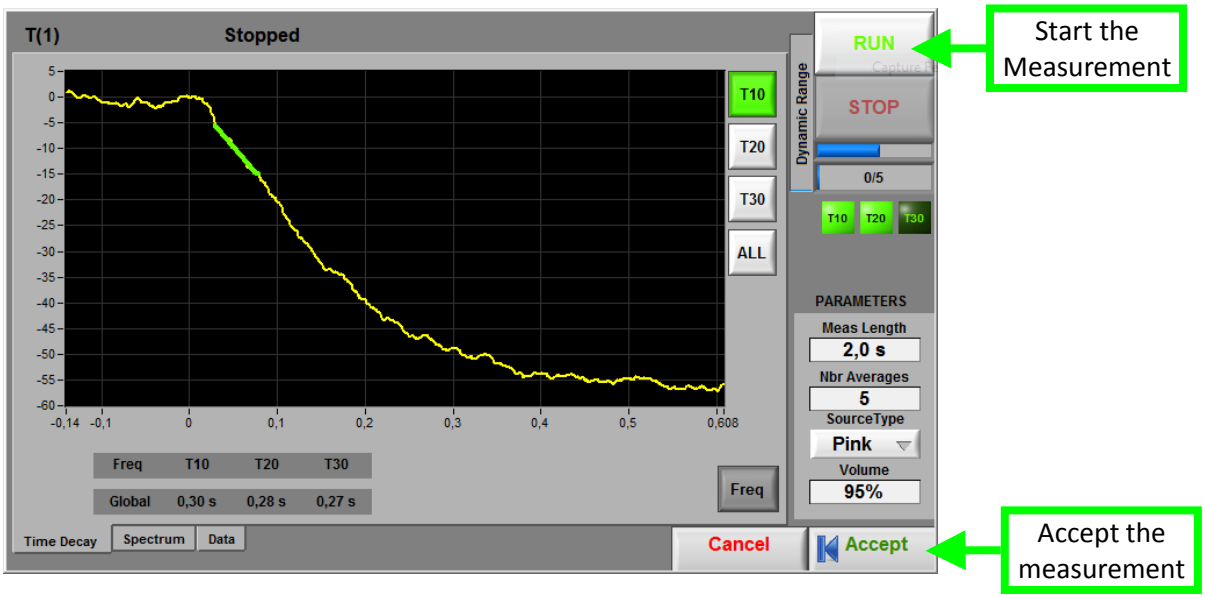
button to start the average measurement. The acquisition end by itself once the average period is reached (as set in setup) and can be stopped at any time.

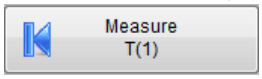
Click on the 

button to accept the measurement.

- An omnidirectional should be used
- Source at least 5 m away from the partition if possible. Otherwise, in the opposite corners of the room.
- If several source positions, the distance between positions should be at least 2 m.
- For a fixed position measurement, the averaging time should be at least 10 seconds.
- For a moving average measurement, the averaging time should be at least 30 seconds.
- The microphones must be kept more than 1 m away from the tested partition.
- If possible, the microphones should be kept more than 1 m away from all other major extended surface or 0.5 m away otherwise.
- The microphones should be kept way from the source: >1m if room <25m³, >1.5m if room <100m³, >2m if room >100m³.
- If fixed microphone positions is used, at least 6 positions (as least 1 m apart) should be used for each room.
- If moving microphones is used, the microphone speed should not exceed 0.5 m/s.

Step 3 Do a Reverberation Measurement

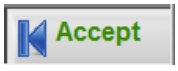


To proceed to a reverberation measurement, select an element to measure in the table of the main panel and click the button 

to open the measurement interface.

Once in the measurement panel, click on the

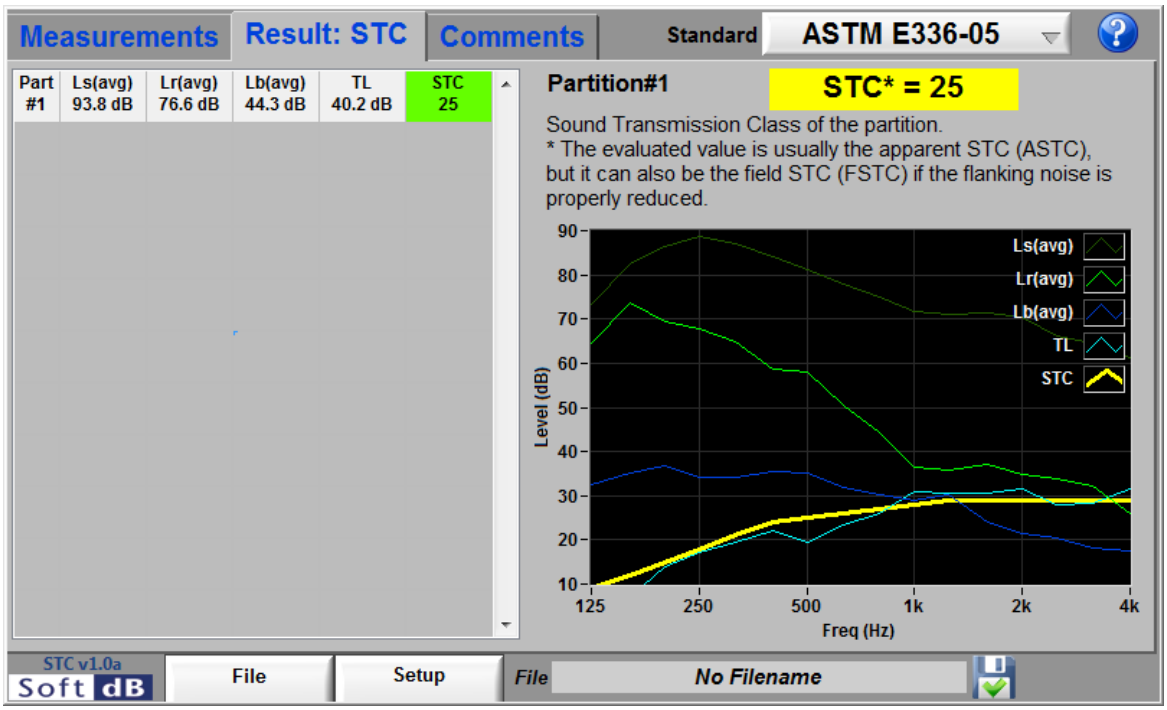
button to start the reverberation measurement. The acquisition end by itself once the number of averages is reached.

Click on the 

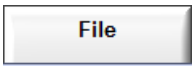
button to accept the measurement.

- An omnidirectional should be used
- A first source position should be in center of the receiving room.
- Several fixed microphone locations should be used.
- Keep the microphone at least 1 meter away from any major extended surface.
- Keep the microphone at least 1 meter away from the source.
- The more source positions and the more microphone position, the more the reverberation time will be representative.

Step 4 Analyze the results



The result tab displays the results of the sound transmission class to the evaluated partitions.

The measurements can be saved and exported through the menu of the  button.

4.2 STC Main Interface

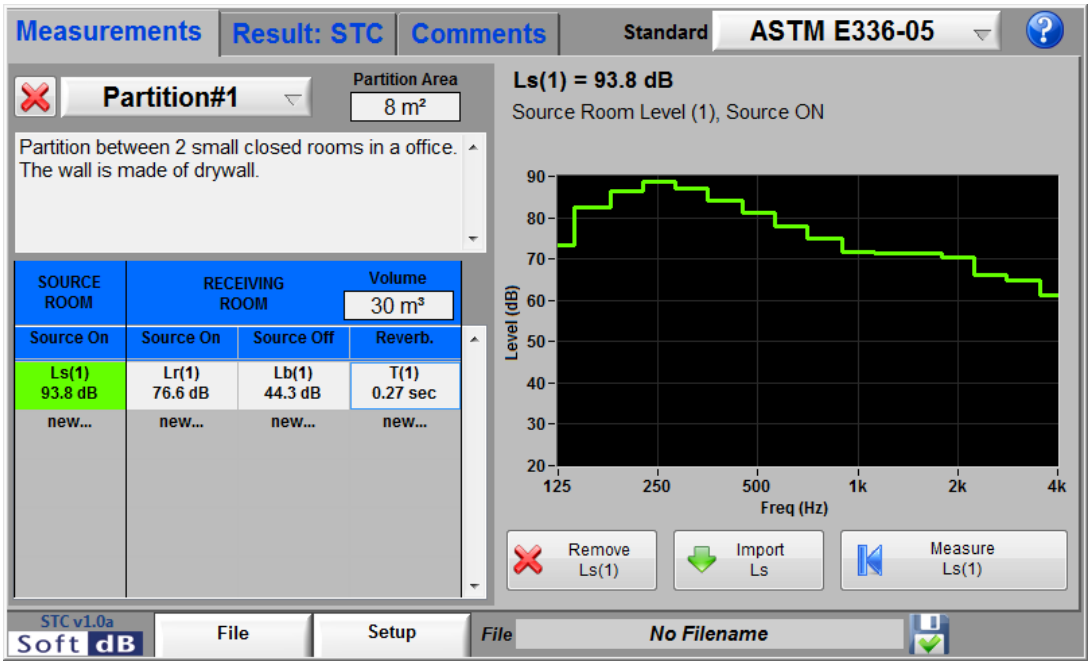
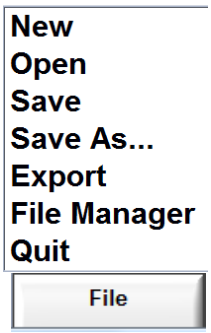


Figure 1: Main interface

Main controls and indicators

Standard ASTM E336-05 ↓ ASTM E336-05 (125-4000Hz) ISO 140-4 (100-3150Hz)	Standard used for the STC evaluation. The standard can be changed at any time. The only difference is the frequency span used for the display and for the global value evaluation. • ASTM E336-05, bands from 125 to 4000 Hz • ISO 140-4, bands from 100 to 3150 Hz
Measurements Result: STC Comments	Main interface tabs: • Measurements tab (section 4.4, p.19) • Result tab (section 4.5, p.27) • Comments tab (section 4.6, p.28)
File	File Menu button (see the following table).
Setup	Setup button that calls the setup interface (section 4.3, p.16).
STC v1.0a Soft dB	Module name and version number.
File Example.stc	File name of the measurement. A green check on the disk icon indicates that the data are saved.
	Click this button to display the help window. This help is a reminder of the steps and the rules to follow.

File Menu



New	Creates a brand new measurement session.
Open	Opens a previous measurement file.
Save	Saves the current measurement into the specified file.
Save As…	Saves the current measurement into a new file.
Export	Exports the measurement data into a text file. The file is saved as .xls extension and can be opened with Microsoft Excel or any text editor.
File Manager	Launches the File Manager (see section 11, p.124)
Quit:	Allows to quit the module and to return to the Opus Suite Interface.

4.3 STC Setup Interface

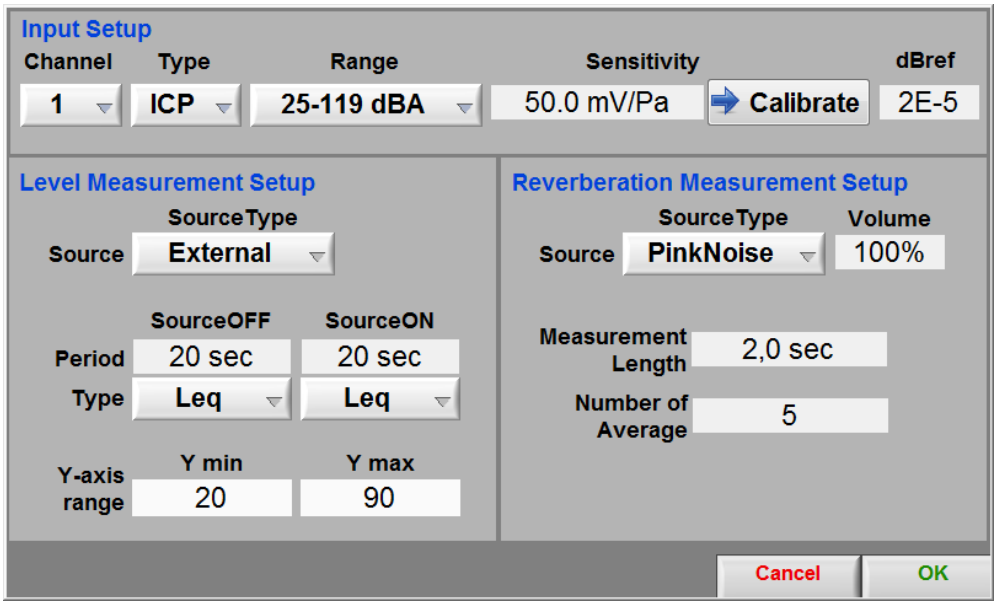
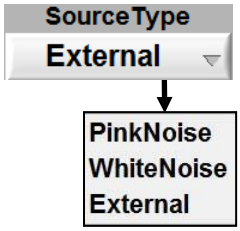
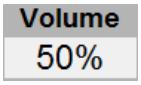
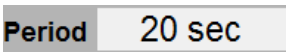
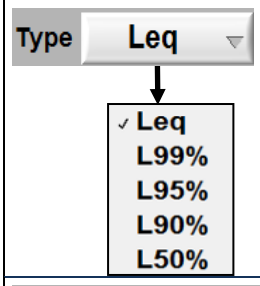
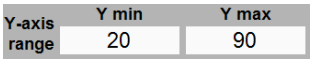


Figure 2: Setup interface

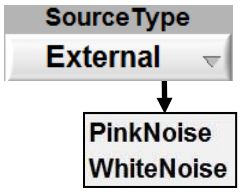
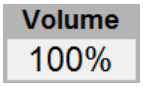
Input Setup

Channel 1	The input channel used for the measurements
Type ICP (AC / ICP)	The available input types are AC and ICP sensors.
Range 25-119 dBA	Selection of the dynamic range. For a microphone sensitivity of 50mV/Pa. - Low Range: 25 to 119 dBA - High Range: 37-130 dBA Concerto: the input 1 and 2 have two range settings (Low or High) while inputs 3 and 4 have a single fixed range (Low). Alto and Conductor: only the low range is available.
Sensitivity 50.0 mV/Pa Calibrate	The sensor sensitivity can be entered manually or the Calibration interface can be used (see section 4.3.1, p.18).
dBref 2E-5	The dB reference is the unit reference from which the decibel (dB) is calculated.

Level Measurement Setup

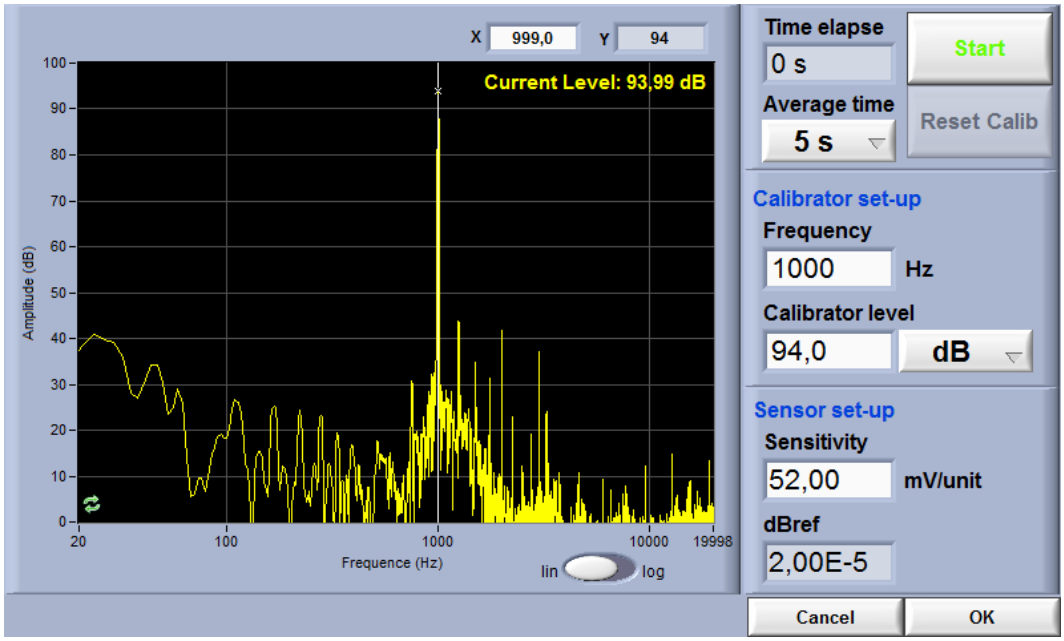
	The unit can be used to generate a pink noise or a white noise. The output signal is balanced on output 1 and output 2. If an external generator is used, the source type can be set to external. This disables the outputs.
	When an internal generator is used, the volume can be adjusted from 0 to 100%.
	The average period of the two types of level measurement can be adjusted independently.
	The average type of the two types of measurement can be adjusted independently. It can be adjusted to be a plain average (Leq) or a statistic level (Lx%). Using the statistics instead of the Leq can minimize the punctual noise events that may occur during a measurement (especially for the background noise).
	The Ymin and Ymax parameters set the vertical scale (levels in dB) of the spectrum graphs of the current module.

Reverberation Measurement Setup

	The unit is used to generate a pink noise or a white noise. The output signal is balanced on output 1 and output 2.
	The volume of the internal generator can be adjusted from 0 to 100%.
	The measurement length is the duration of the noise emission of one iteration of the reverberation evaluation.
	The number of average is the number of iterations used for the reverberation evaluation.

4.3.1 Sensor Calibration

The input sensitivity can be calibrated using the calibration function and a sensor calibrator. Click the **Calibrate** button on the Setup interface to launch the Calibration interface.



Step 1 Adjust the calibration parameters

The defaults values are:

- Averaging time: 5 s
- Frequency: 1 kHz
- Calibrator Level: 94 dB

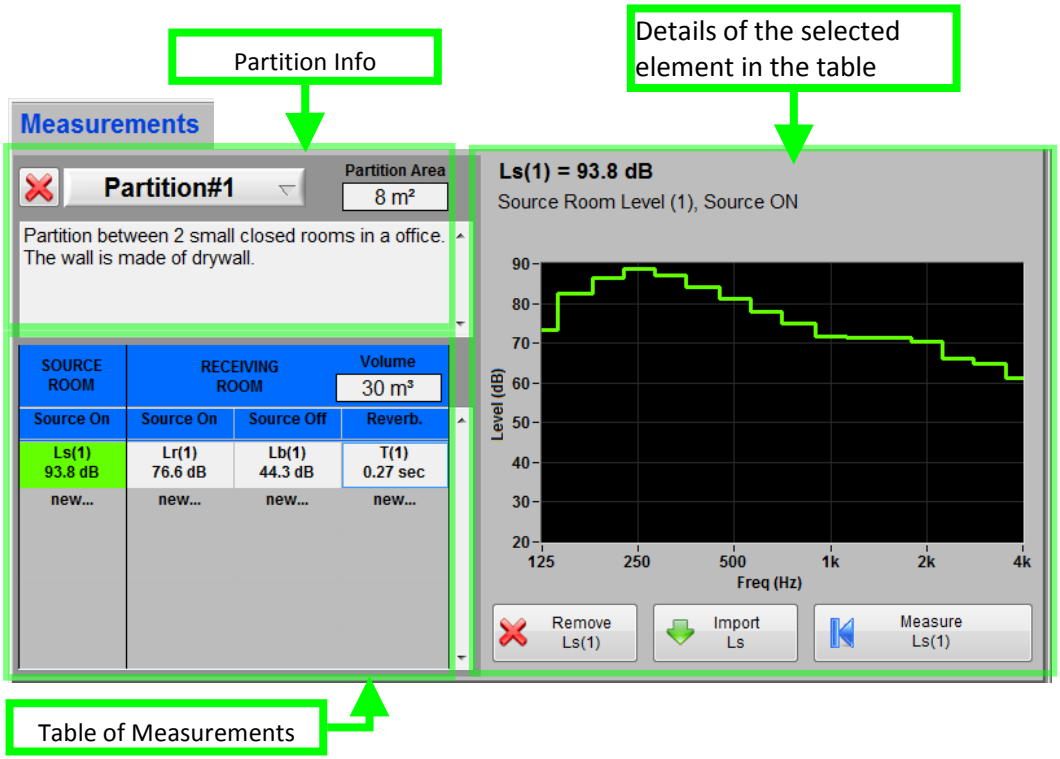
Step 2 Install the calibrator device on the microphone

Step 3 Click START

After the average time is elapsed, the sensitivity value will update.

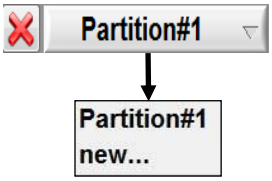
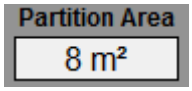
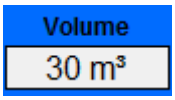
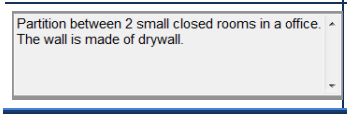
Step 4 Click OK to accept the sensitivity value

4.4 STC Measurements tab



The Measurements tab can be divided in three parts. The partition information is in upper left corner. Just under is the table of measurements. Finally, the details of the selected element are on the right side.

Measurements controls

	The partition menu let you select the partition to measure. To add a new partition, select the last element ("new…") of the menu ring. To delete a partition, select the partition and press the button
	The area (m²) of the partition to be qualified.
	The volume (m³) of the receiving room.
	The partition description let the user enter some basic information on the partition being qualified.

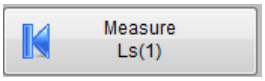
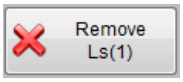
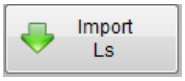
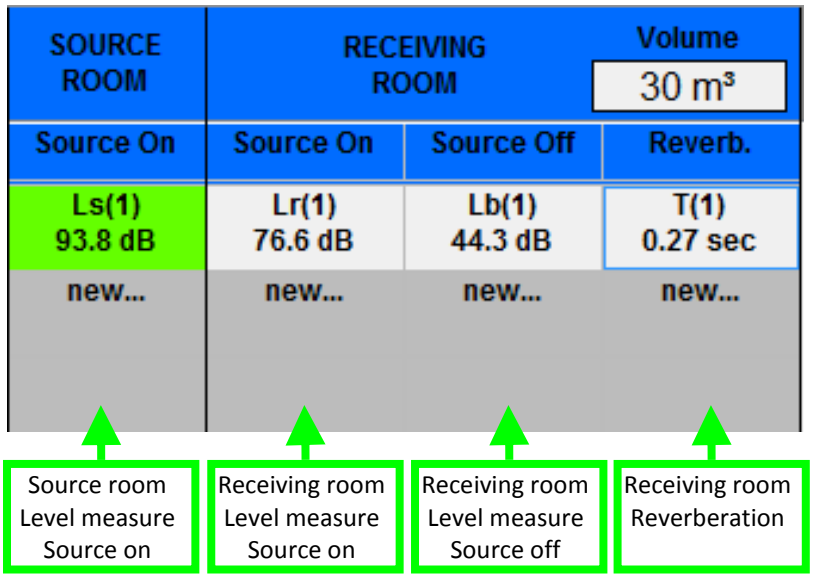
	If an element of the table is selected, the measurement interface will be called (see the following subsections).
	Click this button to delete the selected table element.
	The import feature allows the user to load one column of data (one of the 4 data types) from another partition of the same file. It is then possible to avoid repeating the same measurements when several partitions share data with each other.

Table of Measurements

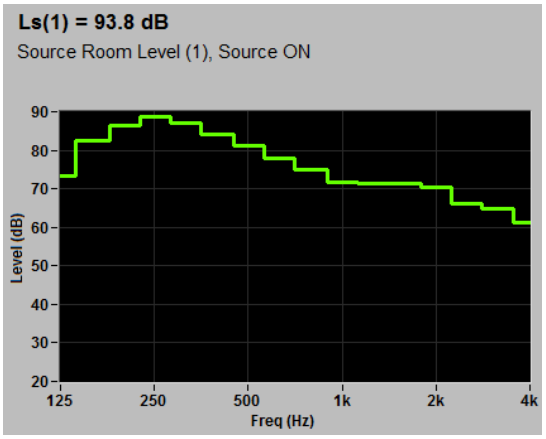


The measurement table contains four columns for the four types of measurement:

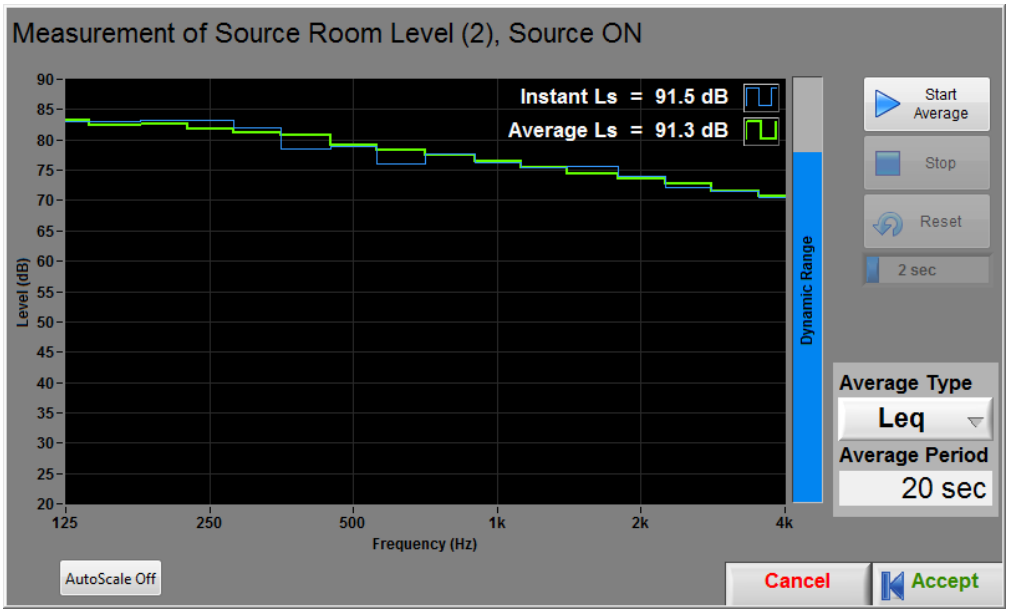
- Source room, level measurement, source on
- Receiving room, level measurement, source on
- Receiving room, level measurement, source off
- Receiving room, reverberation time measurement

Several measurements can be done for each of the four types. To add a new element in the table, simply press on “new…” in the proper column. The average value of those measurements will later be used in the STC evaluation. To see the average from the measurement tab, click on the header element above the first measurement element of a column.

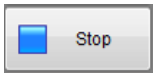
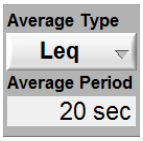
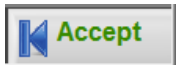
Details of the selected element in the table

	Name and global level of the selected element. Description of the selected element Spectrum graph of the selected element in the table.

4.4.1 STC Level Measurement Interface



Level Measurement controls

	The Start/Pause button starts/pauses the average measurements. The measurement will stop by itself at the end of the average period.
	The Stop button stops the average process
	The Reset button restarts the average measurement.
	Progress bar of the average time.
	The average parameters of Average type and Average Period can be modified directly on the Measurement Interface. The values will be updated in the corresponding value of the Setup Interface (see section 4.3, p.16)
	The dynamic range gives the information of the usage of the input range. When saturation occurs the indicator turns red. The word 'Sat' will also be displayed over the indicator as soon as saturation is detected during an average. Such a measurement should be rejected.
	Once the measurement is acceptable, press the Accept button to return to the main interface.

4.4.2 STC Reverberation Measurement Interface

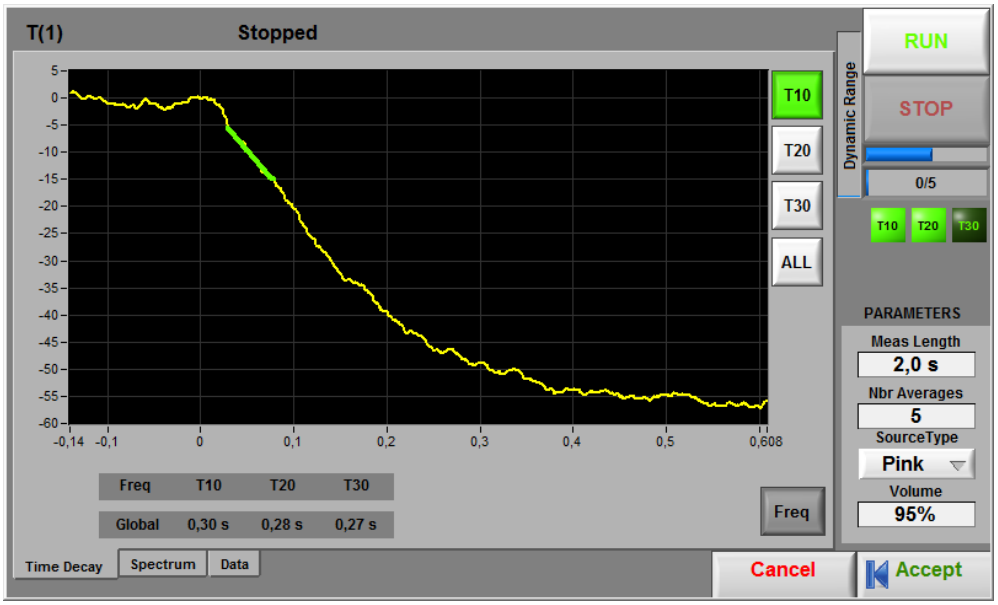
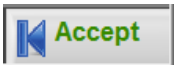


Figure 3: Reverberation Measurement Interface

Reverberation Measurement controls

RUN PAUSE	The Run/Pause button starts/pauses the average measurements. The measurement will stop by itself at the end of the average period.
STOP	The Stop button stops the average process.
3/5	The upper progress bar is the progression of the current iteration. The bottom progress bar is the progression of the iterations relative to the requested “Nbr Averages”.
T10 T20 T30	This indicator displays which reverberation indexes are met (i.e. if T10 is on, it means that T10 was reached for every frequency bands and global).
PARAMETERS Meas Length 2,0 s Nbr Averages 5 SourceType Pink Volume 95%	The reverberation parameters can be modified directly on the Measurement Interface. The values will be updated in the corresponding value of the Setup Interface (see section 4.3, p.16)
Sat Dynamic Range	The dynamic range gives the information of the usage of the input range. When saturation occurs the indicator turns red. The word ‘Sat’ will also be displayed over the indicator as soon as saturation is detected during an average. Such a measurement should be rejected.

	Once the measurement is acceptable, press the Accept button to return to the main interface.

4.4.2.1 Reverberation: Time Decay

This display shows the response to a noise interruption. It also superimposes the curves used to evaluate the reverberation time values and the averaged successive responses.

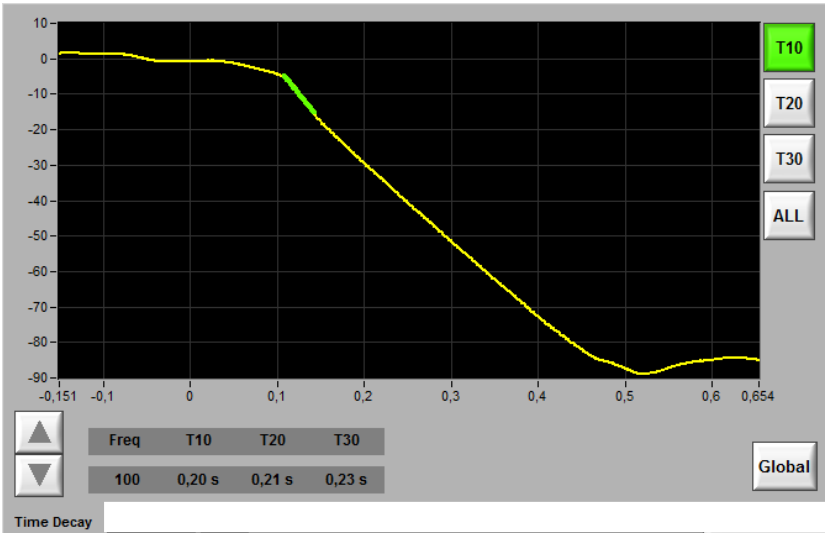
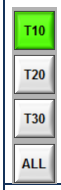
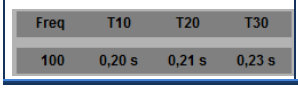
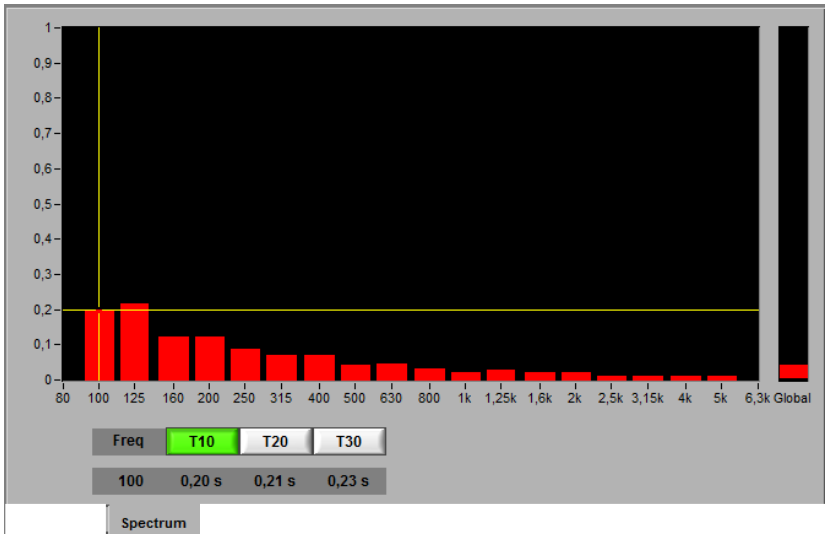


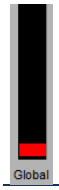
Figure 4: Time Decay tab of the reverberation

Time Decay Graph	This graph displays the time decay curves for the selected frequency band or global.
	These buttons are used to select the visible curves on the time decay graph. **T10**, **T20** and **T30** are the straight lines used to determine the reverberation times. **All** shows all the iterations in the averaging process.
	These buttons are used to display the next or previous frequency band on the time decay graph and in the results.
	This button is used to switch between frequency bands and global.
	This array displays the computed results for the selected frequency band or global.

4.4.2.2 Reverberation: Spectrum

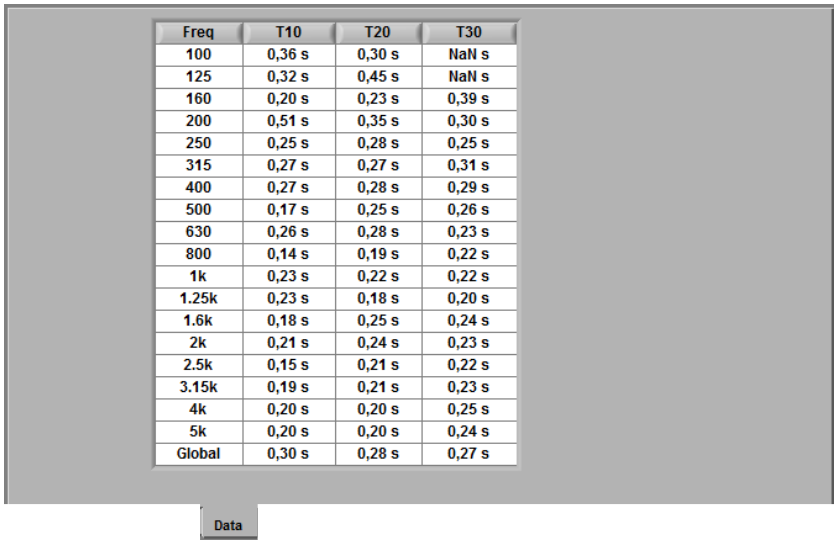
This display shows a selected result for each frequency band and global using a bar graph. To select a frequency or the global, simply click the corresponding bar.



	These buttons are used to select the result to display on the spectrum graph and Global Bar.
	This indicator displays the selected result for the global.
	This array displays the computed results for the selected frequency band or global. To select a frequency band, click on the spectrum at the desired frequency to move the cursor. To select the global, click on the global bar.

4.4.2.3 Reverberation: Data

This display shows all data for all frequency bands and global in a table form.



Freq	T10	T20	T30
100	0,36 s	0,30 s	NaN s
125	0,32 s	0,45 s	NaN s
160	0,20 s	0,23 s	0,39 s
200	0,51 s	0,35 s	0,30 s
250	0,25 s	0,28 s	0,25 s
315	0,27 s	0,27 s	0,31 s
400	0,27 s	0,28 s	0,29 s
500	0,17 s	0,25 s	0,26 s
630	0,26 s	0,28 s	0,23 s
800	0,14 s	0,19 s	0,22 s
1k	0,23 s	0,22 s	0,22 s
1.25k	0,23 s	0,18 s	0,20 s
1.6k	0,18 s	0,25 s	0,24 s
2k	0,21 s	0,24 s	0,23 s
2.5k	0,15 s	0,21 s	0,22 s
3.15k	0,19 s	0,21 s	0,23 s
4k	0,20 s	0,20 s	0,25 s
5k	0,20 s	0,20 s	0,24 s
Global	0,30 s	0,28 s	0,27 s

Data

4.5 STC Result tab

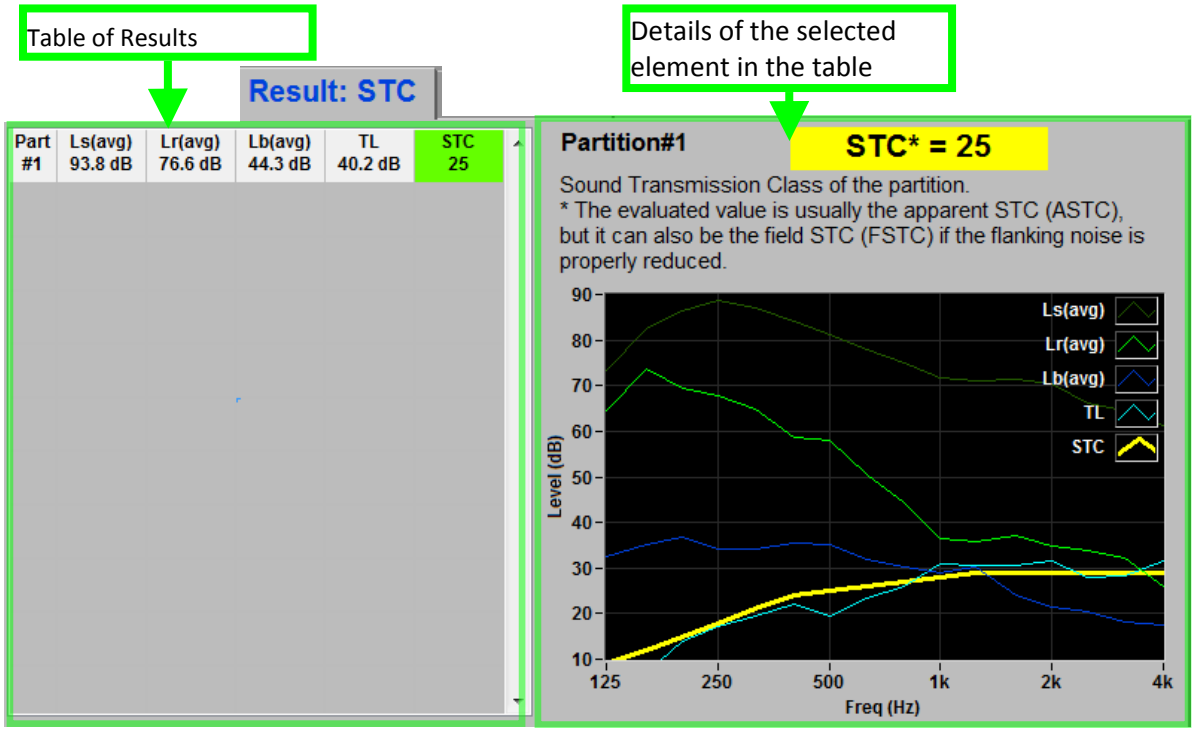


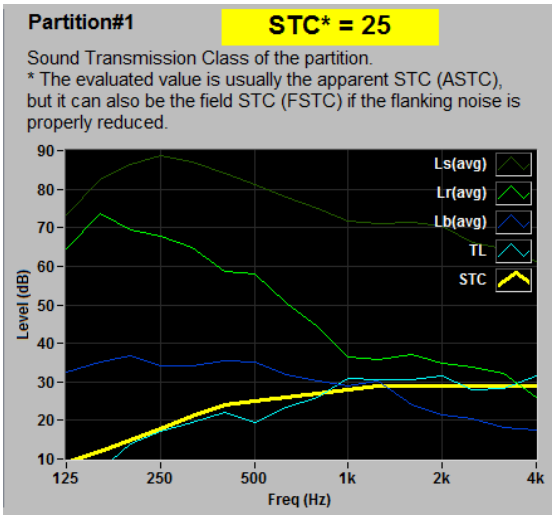
Figure 5: Result tab

The Result tab of the main interface contains the table of result (left side) and the details (right side). The table is expendable vertically as partitions are added (in the Measurements tab). Therefore, each line of the table gives the result of one partition.

Table of Results

Part #1	Partition index.
Ls(avg) 93.8 dB	Average level in the source room while the source is turned on.
Lr(avg) 76.6 dB	Average level in the receiving room while the source is turned on.
Lb(avg) 44.3 dB	Average background level in the receiving room while the source is turned off.
TL 40.2 dB	Transmission loss of the partition.
STC 25	Sound Transmission Class. This STC value is usually the apparent STC (ASTC), but can also be the field STC (FSTC) if the flanking noise is properly reduced.

Details of the selected element in the table

	Name and value of the selected element. Description of the selected element Spectrum graph of the selected partition.

4.6 Comments tab

The Comments tab on the main panel can be used as a general note pad that will be saved along with the measurement data.

5 IIC module

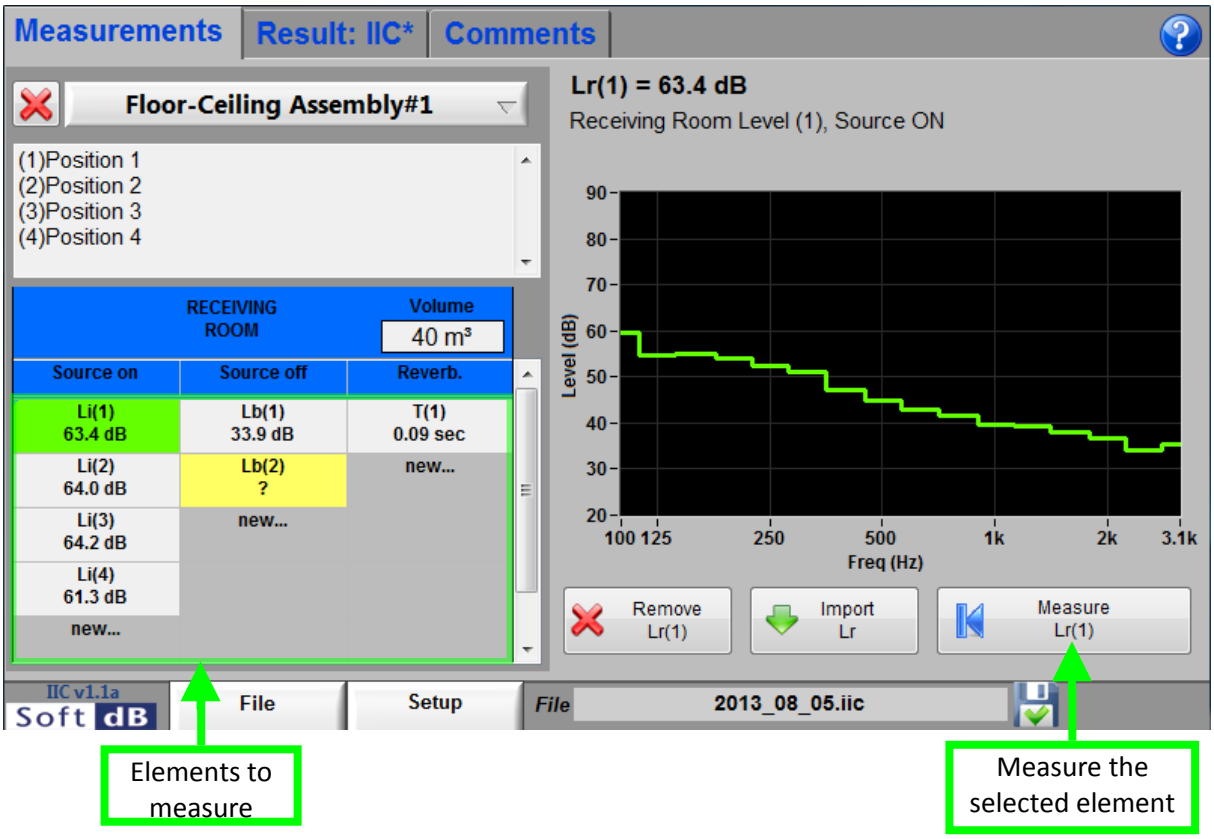
General Specifications

Standards	**Test Method ASTM E1007** and **Test Method ISO 140-7** Standard Test Method for Measurement of Tapping Machine Impact Sound Transmission Through Floor-Ceiling Assemblies and Associated Support Structures. Both standards are designed to measure the impact isolation between through floor-ceiling assemblies. The result is expressed as an Impact Insulation Class (IIC) index. The two standards have the same frequency range that is considered for the evaluation. The ASTM and ISO ranges from 100 to 3150 Hz.
Software Features	• Intuitive interface for IIC measurement • Embedded noise generator (white or pink noise) • Real time 1/3 octave band spectrum (IEC 1260 Type 1) • Reverberation evaluation with auto interrupted method • Automated calculation of the IIC Index • Expendable interface to allow repetitions of a measurement type. • Multiple Floor-Ceiling Assemblies in the same file • Save, load and export measurement files

5.1 IIC Quick Start

The IIC module is part of the Building Acoustics. It can be accessed in the Building Acoustics menu of the Opus Suite panel.

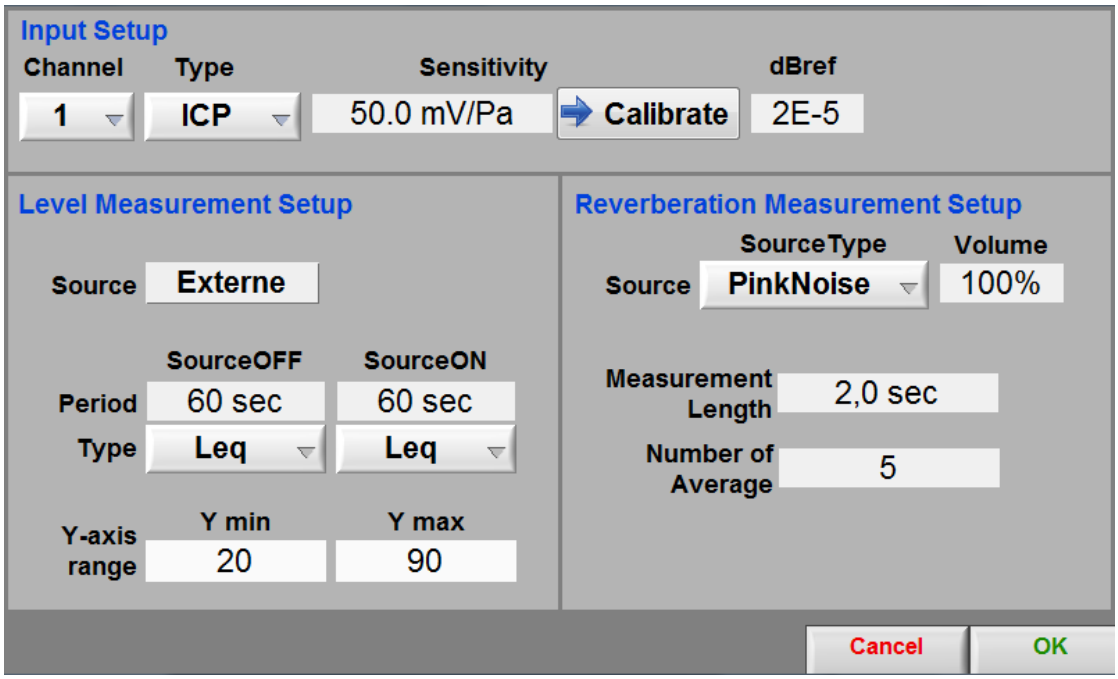
Measurement tab



What you should know…

- The receiving room volume is used to evaluate de IIC.
- You need at least 6 measurements: 4 levels in the receiving room (source on), 1 background level in the receiving room (source off) and 1 reverberation time in the receiving room.
- The main interface let do an unlimited quantity of measurements for every type of data.
- Select the corresponding column header to see the average of the different measurements of a type of data.
- The selected element of the table shows a green background. The details of the selection are displayed on the right side of the table.
- The elements still to measure display a question mark (?) as a value and have a yellow background.

Step 1 Setup the unit



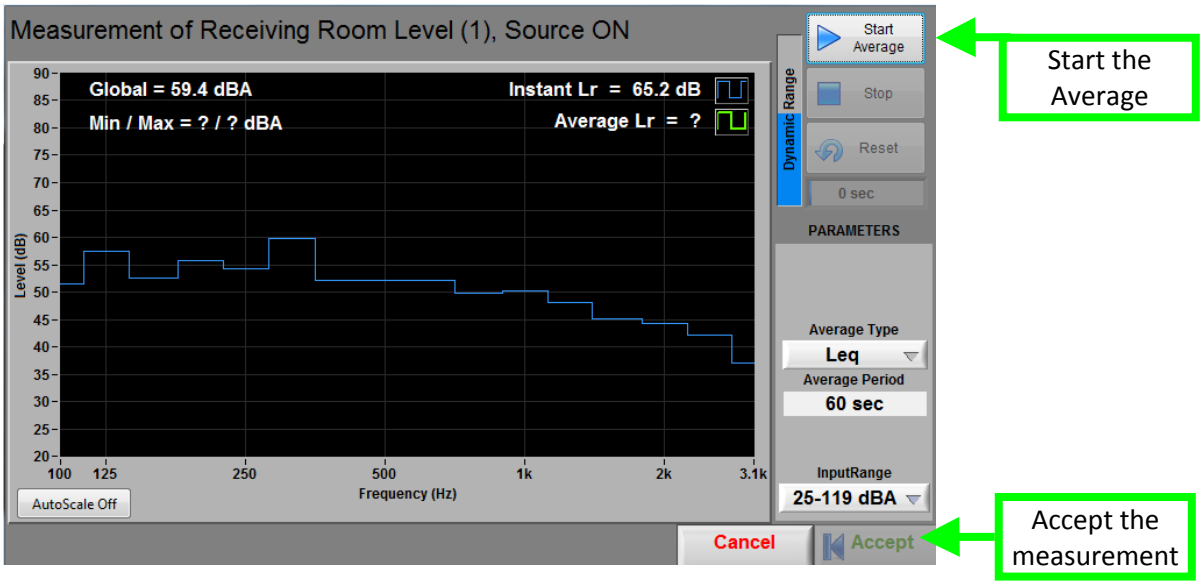
Click on the Setup button to access the setup interface. The parameter should typically be set as shown on figure above.

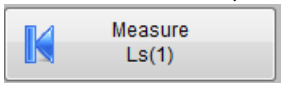
Before a measurement, the operator should set the sensitivity of the sensor used. This sensitivity can be set manually if it is known. Preferably, the sensor sensibility should be set by using the software calibration tool and a calibrator. To do so, click on Calibrate and follow the instructions of the Sensor Calibration (section 5.3.1.1, p.39).

The level measurement can be made using an external generator or the internal generator (pink or white noise).

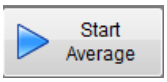
Click OK to return to the main panel.

Step 2 Do a Level Measurement

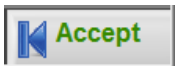


To proceed to a measurement, select an element to measure in the table of the main panel and click the button 

to open the measurement interface.

Once in the measurement panel, click on the 

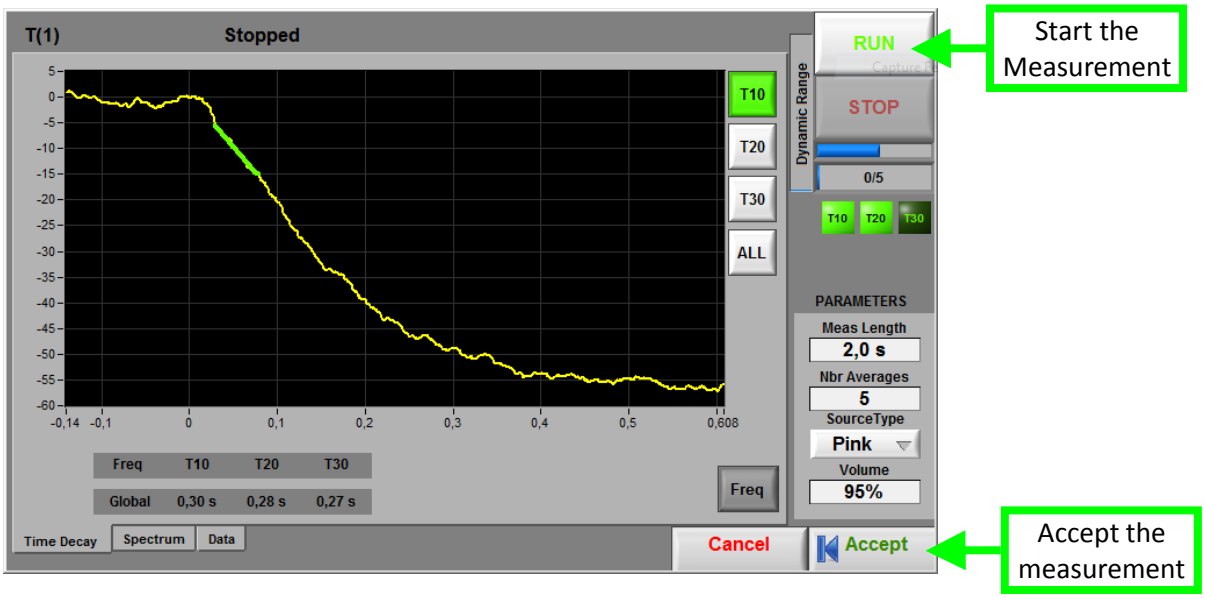
button to start the average measurement. The acquisition end by itself once the average period is reached (as set in setup) and can be stopped at any time.

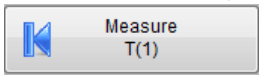
Click on the 

button to accept the measurement.

- - An omnidirectional should be used (A13mm[0,5''])
- - For a fixed position measurement, the averaging time should be at least 10 sec.
- - For a moving average measurement, the averaging time should be at least 30 sec.
- - The microphones must be kept more than 1 m away from the tested top surface.
- - The microphone must be at 0,7m away from another microphone.
- - The microphone must be at 0,5m away from the part limits.
- - If fixed microphone positions is used, at least 4 positions (as least 1 m apart) should be used.
- - If moving microphones is used, the microphone speed should not exceed 0.5 m/s.
- -The tapping machine must be placed at 4 several positions.

Step 3 Do a Reverberation Measurement

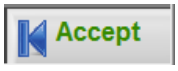


To proceed to a reverberation measurement, select an element to measure in the table of the main panel and click the button 

to open the measurement interface.

Once in the measurement panel, click on the

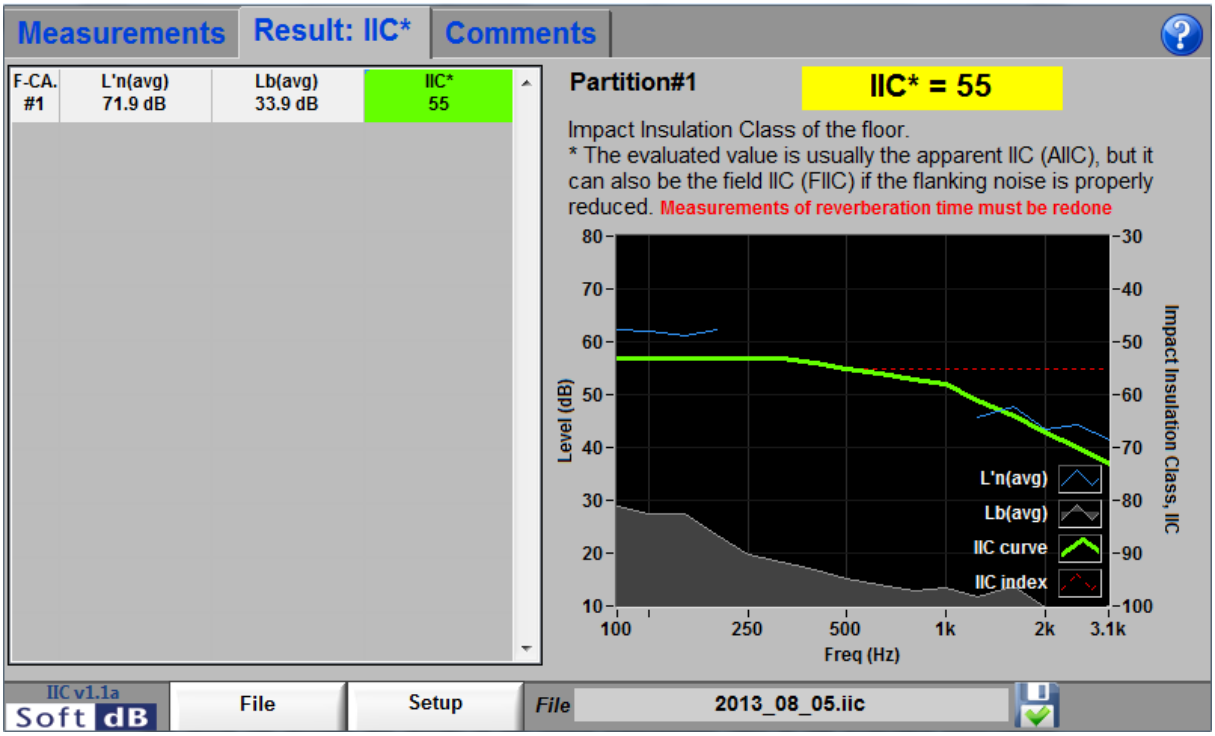
button to start the reverberation measurement. The acquisition end by itself once the number of averages is reached.

Click on the 

button to accept the measurement.

- An omnidirectional should be used
- A first tapping machine position should be in center of the receiving room.
- Several fixed microphone locations should be used.
- Keep the microphone at least 1 meter away from any major extended surface.
- Keep the microphone at least 1 meter away from the tapping machine.
- The more source positions and the more microphone position, the more the reverberation time will be representative.

Step 4 Analyze the results



The result tab displays the results of the sound transmission class to the evaluated Floor-Ceiling Assembly.

The measurements can be saved and exported through the menu of the File button.

5.2 IIC Main Interface

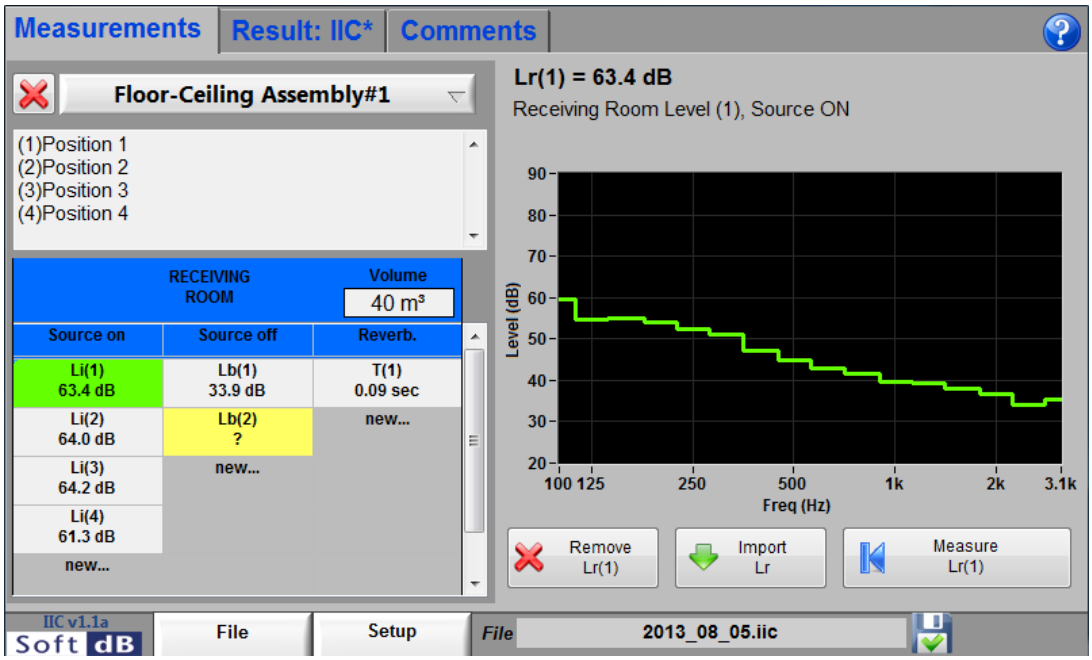
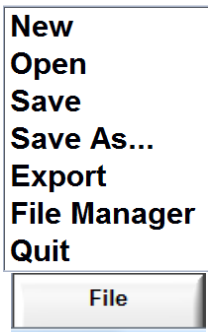


Figure 6: Main interface

Main controls and indicators

Measurements Result: IIC* Comments	Main interface tabs: • Measurements tab (section 5.4, p.43) • Result tab (section 5.5, p.48) • Comments tab (section 5.6, p.50)
File	File Menu button (see the following table).
Setup	Setup button that calls the setup interface (section 5.3, p.37).
IIC v1.1a Soft dB	Module name and version number.
File Example.e1130	File name of the measurement. A green check on the disk icon indicates that the data are saved.
	Click this button to display the help window. This help is a reminder of the steps and the rules to follow.

File Menu



New	Creates a brand new measurement session.
Open	Opens a previous measurement file.
Save	Saves the current measurement into the specified file.
Save As…	Saves the current measurement into a new file.
Export	Exports the measurement data into a text file. The file is saved as .xls extension and can be opened with Microsoft Excel or any text editor.
File Manager	Launches the File Manager (see section 11, p.124)
Quit:	Allows to quit the module and to return to the Opus Suite Interface.

5.3 IIC Setup Interface

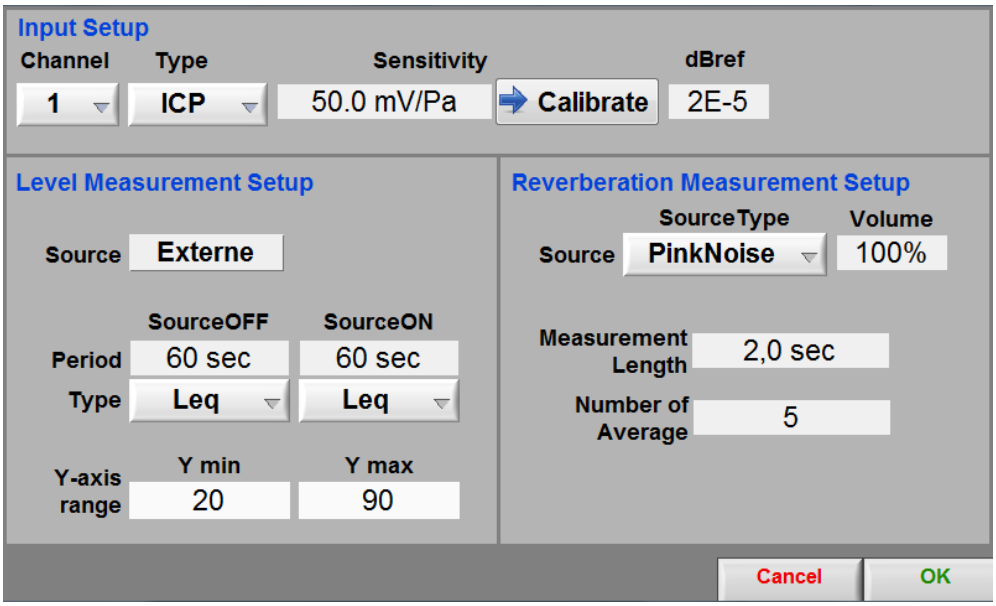
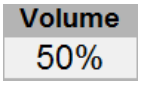
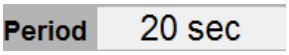
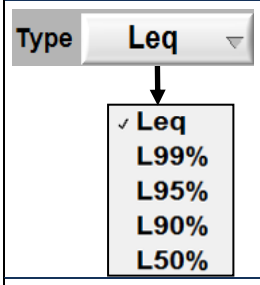
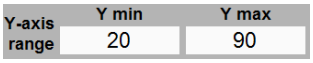


Figure 7: Setup interface

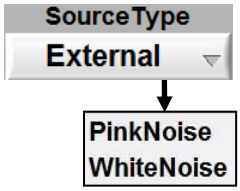
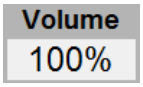
Input Setup

Channel 1	The input channel used for the measurements
Type ICP (AC / ICP)	The available input types are AC and ICP sensors.
Range 25-119 dBA	Selection of the dynamic range. For a microphone sensitivity of 50mV/Pa. - Low Range: 25 to 119 dBA - High Range: 37-130 dBA Concerto: the input 1 and 2 have two range settings (Low or High) while inputs 3 and 4 have a single fixed range (Low). Alto and Conductor: only the low range is available.
Sensitivity 50.0 mV/Pa Calibrate	The sensor sensitivity can be entered manually or the Calibration interface can be used (see section 5.3.1.1, p.39).
dBref 2E-5	The dB reference is the unit reference from which the decibel (dB) is calculated.

Level Measurement Setup

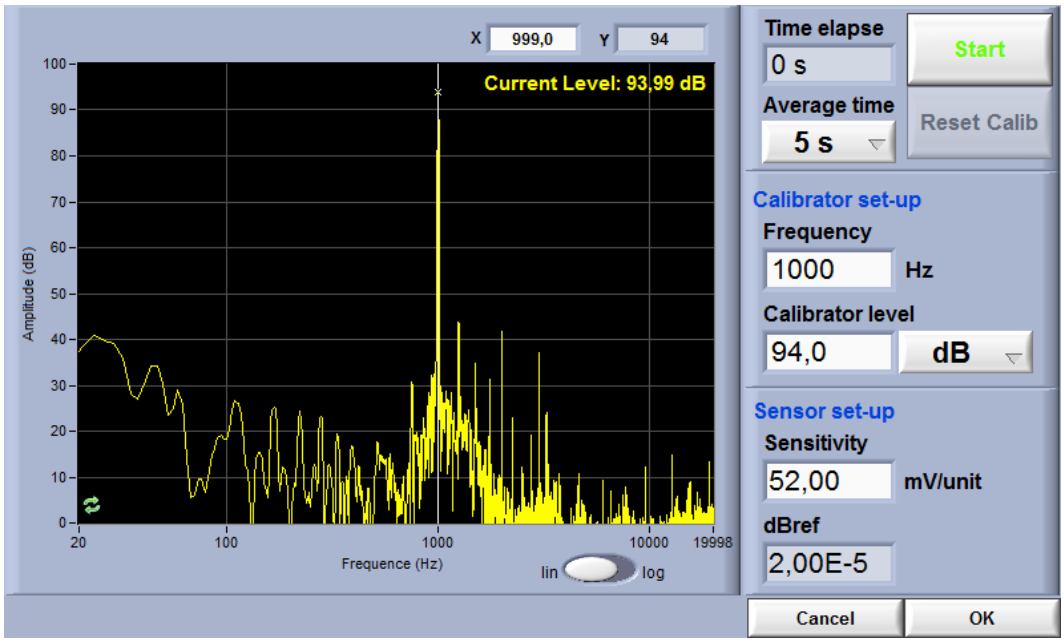
	When an internal generator is used, the volume can be adjusted from 0 to 100%.
	The average period of the two types of level measurement can be adjusted independently.
	The average type of the two types of measurement can be adjusted independently. It can be adjusted to be a plain average (Leq) or a statistic level (Lx%). Using the statistics instead of the Leq can minimize the punctual noise events that may occur during a measurement (especially for the background noise).
	The Y min and Y max parameters set the vertical scale (levels in dB) of the spectrum graphs of the current module.

Reverberation Measurement Setup

	The unit is used to generate a pink noise or a white noise. The output signal is balanced on output 1 and output 2.
	The volume of the internal generator can be adjusted from 0 to 100%.
	The measurement length is the duration of the noise emission of one iteration of the reverberation evaluation.
	The number of average is the number of iterations used for the reverberation evaluation.

5.3.1.1 Sensor Calibration

The input sensitivity can be calibrated using the calibration function and a sensor calibrator. Click the **Calibrate** button on the Setup interface to launch the Calibration interface.



Step 1 Adjust the calibration parameters

The defaults values are:

- Averaging time: 5 s
- Frequency: 1 kHz
- Calibrator Level: 94 dB

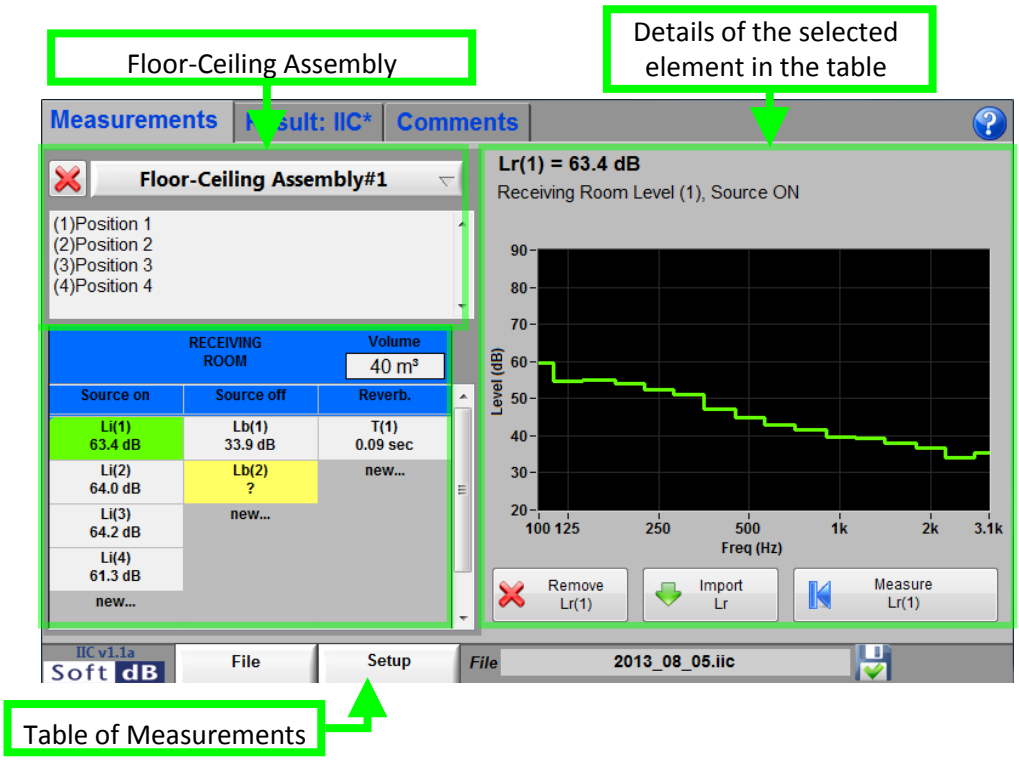
Step 2 Install the calibrator device on the microphone

Step 3 Click START

After the average time is elapsed, the sensitivity value will update.

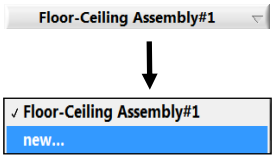
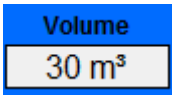
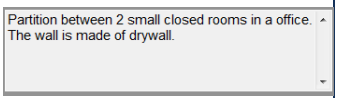
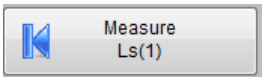
Step 4 Click OK to accept the sensitivity value

5.4 IIC Measurements tab



The Measurements tab can be divided in three parts. The Floor-Ceiling Assembly information is in upper left corner. Just under is the table of measurements. Finally, the details of the selected element are on the right side.

Measurements controls

	The Floor-Ceiling Assembly menu let you select the partition to measure. To add a new partition, select the last element (“new…”) of the menu ring. To delete a partition, select the partition and press the button
	The volume (m³) of the receiving room.
	The partition description let the user enter some basic information on the partition being qualified.
	If an element of the table is selected, the measurement interface will be called (see the following subsections).

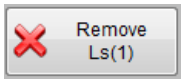
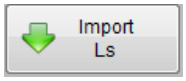
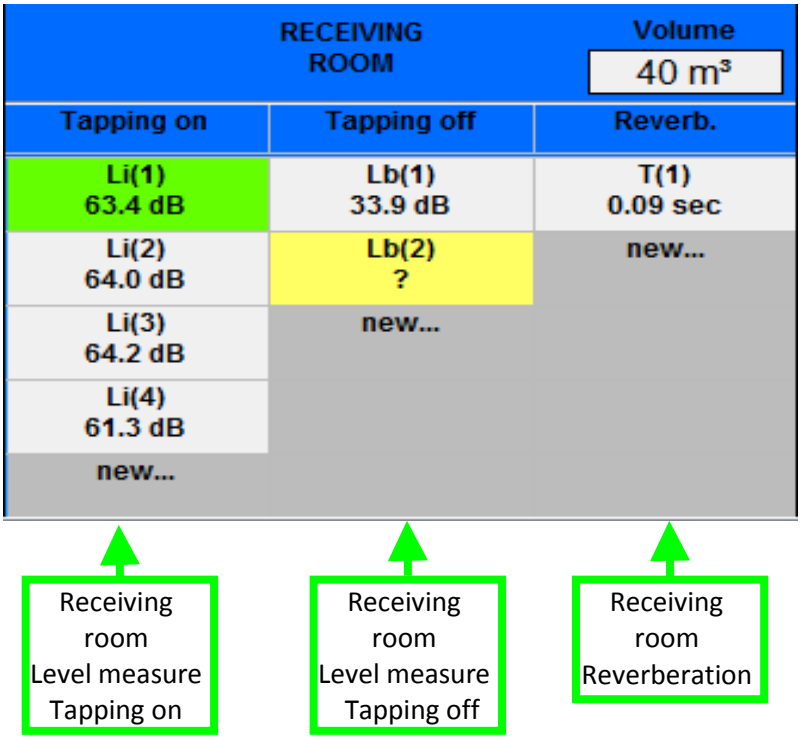
	Click this button to delete the selected table element.
	The import feature allows the user to load one column of data (one of the 3 data types) from another partition of the same file. It is then possible to avoid repeating the same measurements when several partitions share data with each other.

Table of Measurements

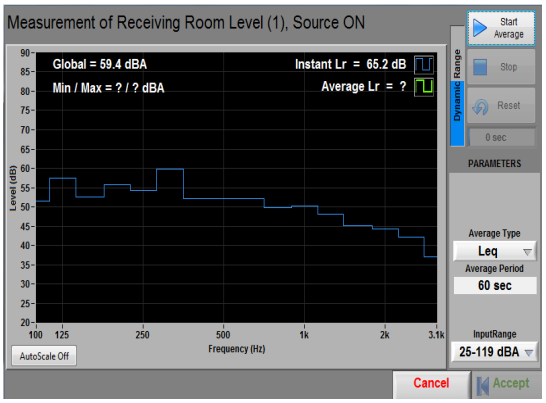


The measurement table contains four columns for the four types of measurement:

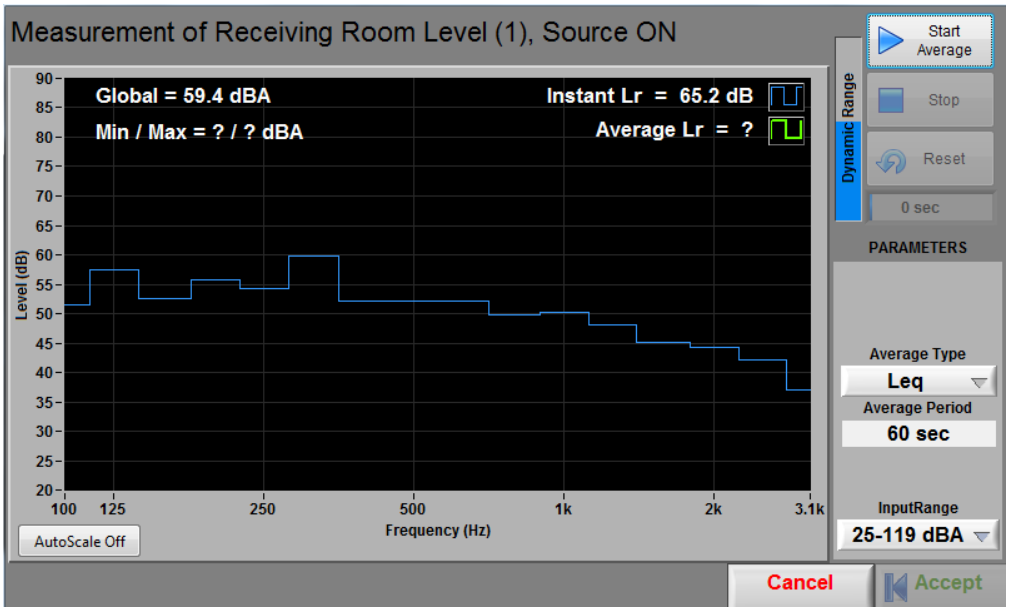
- Receiving room, level measurement, source on
- Receiving room, level measurement, source off
- Receiving room, reverberation time measurement

Several measurements can be done for each of the four types. To add a new element in the table, simply press on “new…” in the proper column. The average value of those measurements will later be used in the IIC evaluation. To see the average from the measurement tab, click on the header element above the first measurement element of a column.

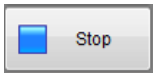
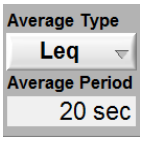
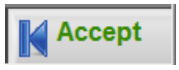
Details of the selected element in the table

	Name and global level of the selected element. Description of the selected element Spectrum graph of the selected element in the table.

5.4.1 Level Measurement Interface



Level Measurement controls

	The Start/Pause button starts/pauses the average measurements. The measurement will stop by itself at the end of the average period.
	The Stop button stops the average process
	The Reset button restarts the average measurement.
	Progress bar of the average time.
	The average parameters of Average type and Average Period can be modified directly on the Measurement Interface. The values will be updated in the corresponding value of the Setup Interface (see section 5.3, p.37)
	The dynamic range gives the information of the usage of the input range. When saturation occurs the indicator turns red. The word 'Sat' will also be displayed over the indicator as soon as saturation is detected during an average. Such a measurement should be rejected.
	Once the measurement is acceptable, press the Accept button to return to the main interface.

5.4.2 Reverberation Measurement Interface

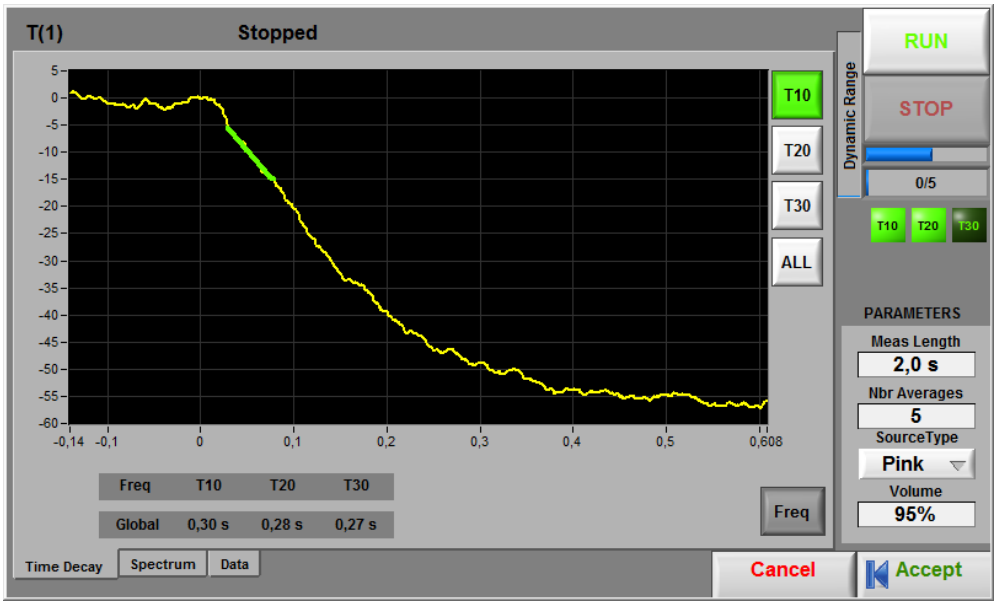
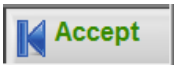


Figure 8: Reverberation Measurement Interface

Reverberation Measurement controls

RUN PAUSE	The Run/Pause button starts/pauses the average measurements. The measurement will stop by itself at the end of the average period.
STOP	The Stop button stops the average process.
3/5	The upper progress bar is the progression of the current iteration. The bottom progress bar is the progression of the iterations relative to the requested “Nbr Averages”.
T10 T20 T30	This indicator displays which reverberation indexes are met (i.e. if T10 is on, it means that T10 was reached for every frequency bands and global).
PARAMETERS Meas Length 2,0 s Nbr Averages 5 SourceType Pink Volume 95%	The reverberation parameters can be modified directly on the Measurement Interface. The values will be updated in the corresponding value of the Setup Interface (see section 5.3, p.37)
Sat Dynamic Range	The dynamic range gives the information of the usage of the input range. When saturation occurs the indicator turns red. The word ‘Sat’ will also be displayed over the indicator as soon as saturation is detected during an average. Such a measurement should be rejected.

	Once the measurement is acceptable, press the Accept button to return to the main interface.

5.4.2.1 Reverberation: Time Decay

This display shows the response to a noise interruption. It also superimposes the curves used to evaluate the reverberation time values and the averaged successive responses.

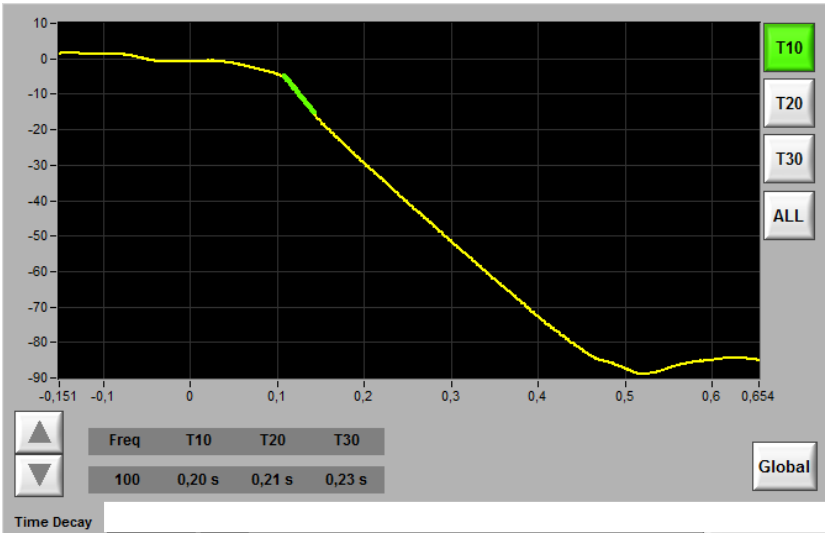
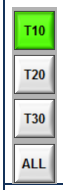
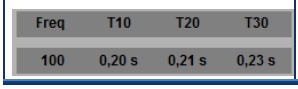
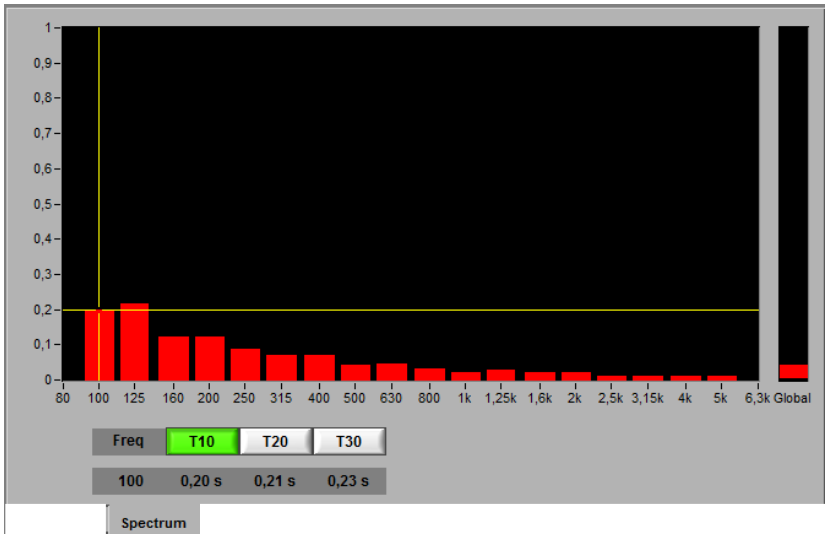


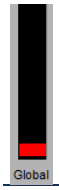
Figure 9: Time Decay tab of the reverberation

Time Decay Graph	This graph displays the time decay curves for the selected frequency band or global.
	These buttons are used to select the visible curves on the time decay graph. **T10**, **T20** and **T30** are the straight lines used to determine the reverberation times. **All** shows all the iterations in the averaging process.
	These buttons are used to display the next or previous frequency band on the time decay graph and in the results.
	This button is used to switch between frequency bands and global.
	This array displays the computed results for the selected frequency band or global.

5.4.2.2 Reverberation: Spectrum

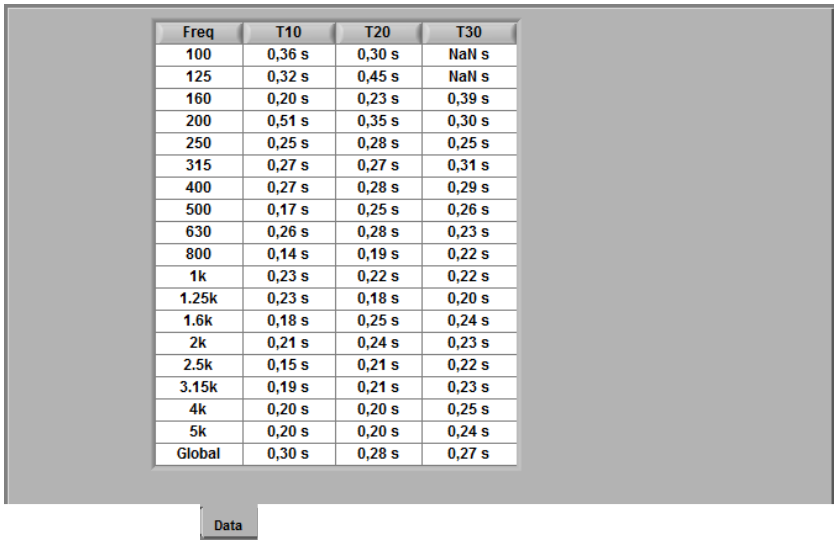
This display shows a selected result for each frequency band and global using a bar graph. To select a frequency or the global, simply click the corresponding bar.



	These buttons are used to select the result to display on the spectrum graph and Global Bar.
	This indicator displays the selected result for the global.
	This array displays the computed results for the selected frequency band or global. To select a frequency band, click on the spectrum at the desired frequency to move the cursor. To select the global, click on the global bar.

5.4.2.3 Reverberation: Data

This display shows all data for all frequency bands and global in a table form.



Freq	T10	T20	T30
100	0,36 s	0,30 s	NaN s
125	0,32 s	0,45 s	NaN s
160	0,20 s	0,23 s	0,39 s
200	0,51 s	0,35 s	0,30 s
250	0,25 s	0,28 s	0,25 s
315	0,27 s	0,27 s	0,31 s
400	0,27 s	0,28 s	0,29 s
500	0,17 s	0,25 s	0,26 s
630	0,26 s	0,28 s	0,23 s
800	0,14 s	0,19 s	0,22 s
1k	0,23 s	0,22 s	0,22 s
1.25k	0,23 s	0,18 s	0,20 s
1.6k	0,18 s	0,25 s	0,24 s
2k	0,21 s	0,24 s	0,23 s
2.5k	0,15 s	0,21 s	0,22 s
3.15k	0,19 s	0,21 s	0,23 s
4k	0,20 s	0,20 s	0,25 s
5k	0,20 s	0,20 s	0,24 s
Global	0,30 s	0,28 s	0,27 s

Data

5.5 IIC Result tab

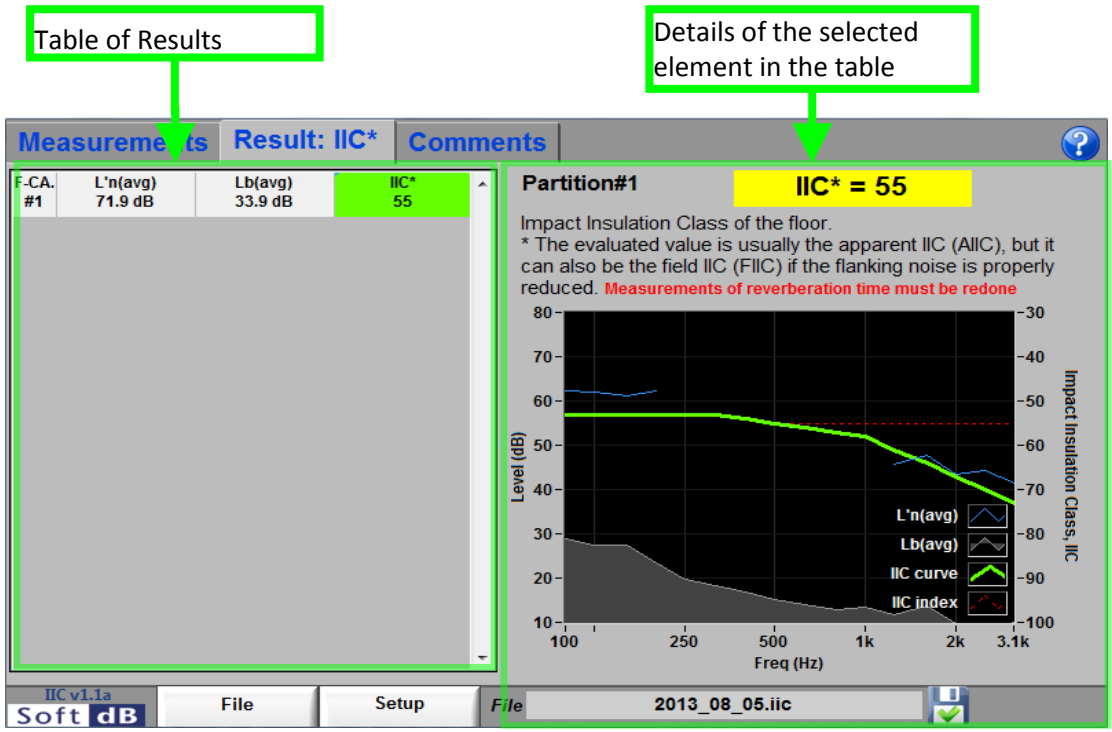


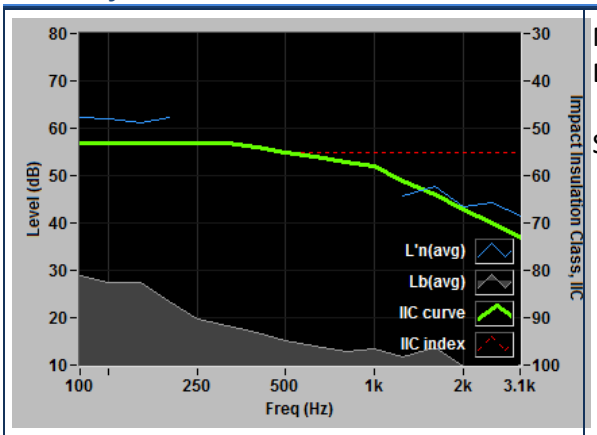
Figure 10: Result tab

The Result tab of the main interface contains the table of result (left side) and the details (right side). The table is expendable vertically as partitions are added (in the Measurements tab). Therefore, each line of the table gives the result of one partition.

Table of Results

F-CA. #1	Partition index.
L'n(avg) 71.9 dB	Average level in the source room while the source is turned on.
Lb(avg) 33.9 dB	Average background level in the receiving room while the source is turned off
IIC* 55	Impact Insulation Class. This IIC value is usually the apparent IIC (AIIC), but can also be the field IIC (FIIC) if the flanking noise is properly reduced.

Details of the selected element in the table



Name and value of the selected element.
Description of the selected element

Spectrum graph of the selected partition.

5.6 IIC Comments tab

The Comments tab on the main panel can be used as a general note pad that will be saved along with the measurement data.

6 Room Noise module

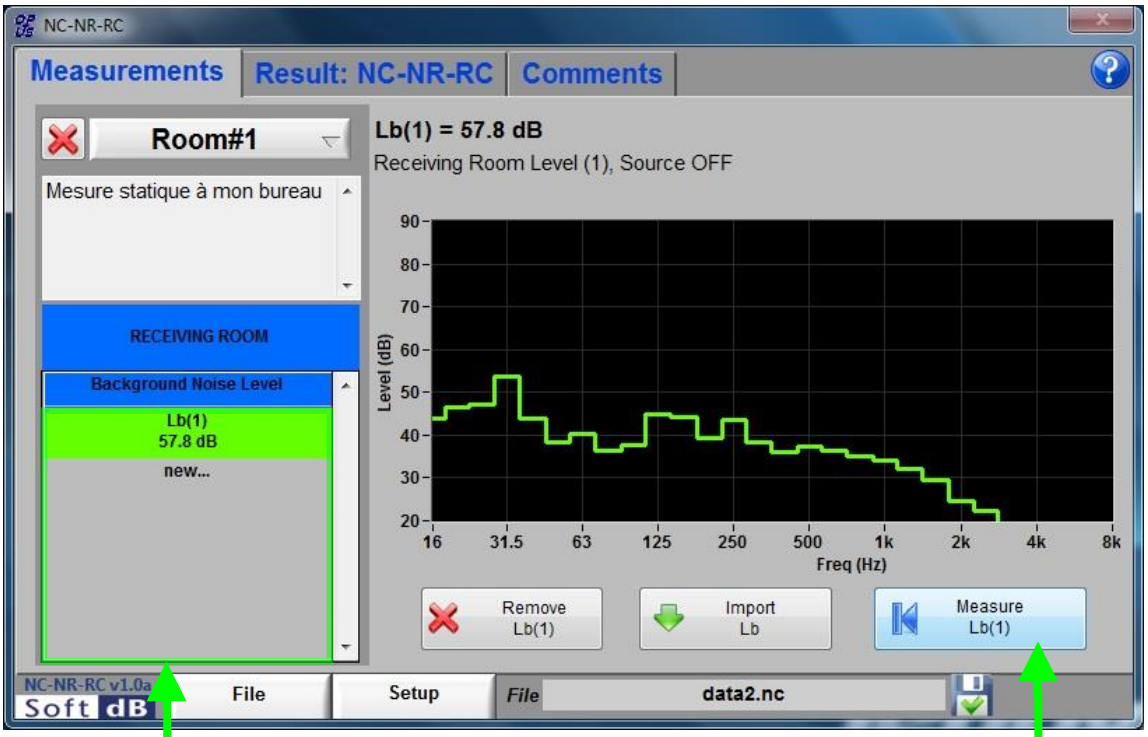
General Specifications

Standards	**ANSI/ASA S12.2-2008** Standard provides three primary methods for evaluating room noise: a survey method that employs the A-weighted sound level; an engineering method that employs expanded noise criteria (NC) curves; and a method for evaluating low-frequency fluctuating noise using room noise criterion (RNC) curves.
Software Features	• Intuitive interface for NC /NR /RC measurement • Multiple room in the same file • Save, load and export measurement files

6.1 Room Noise Quick Start

The Room Noise module is part of the Building Acoustic. It can be accessed in the Building Acoustic menu of the Opus Suite panel.

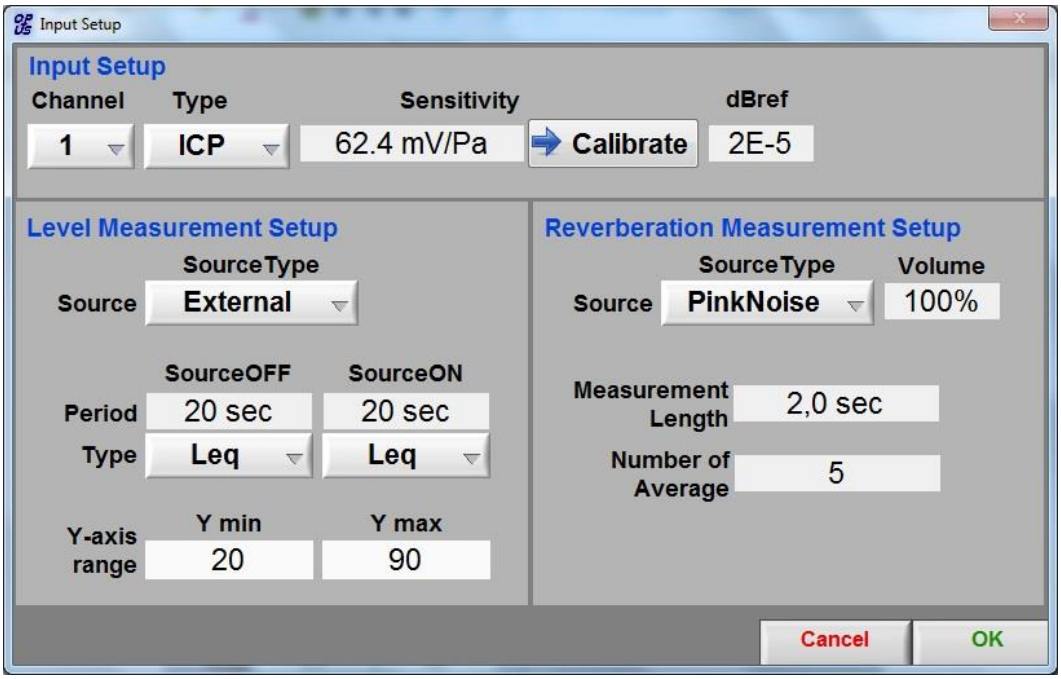
Measurement tab



What you should know…

- You need only one measurement: 1 background level in the receiving room.
- The main interface let do an unlimited quantity of measurements for every type of data.
- Select the corresponding column header to see the average of the different measurements of a type of data.
- The selected element of the table shows a green background. The details of the selection are displayed on the right side of the table.
- The elements still to measure display a question mark (?) as a value and have a yellow background.

Step 1 Setup the unit



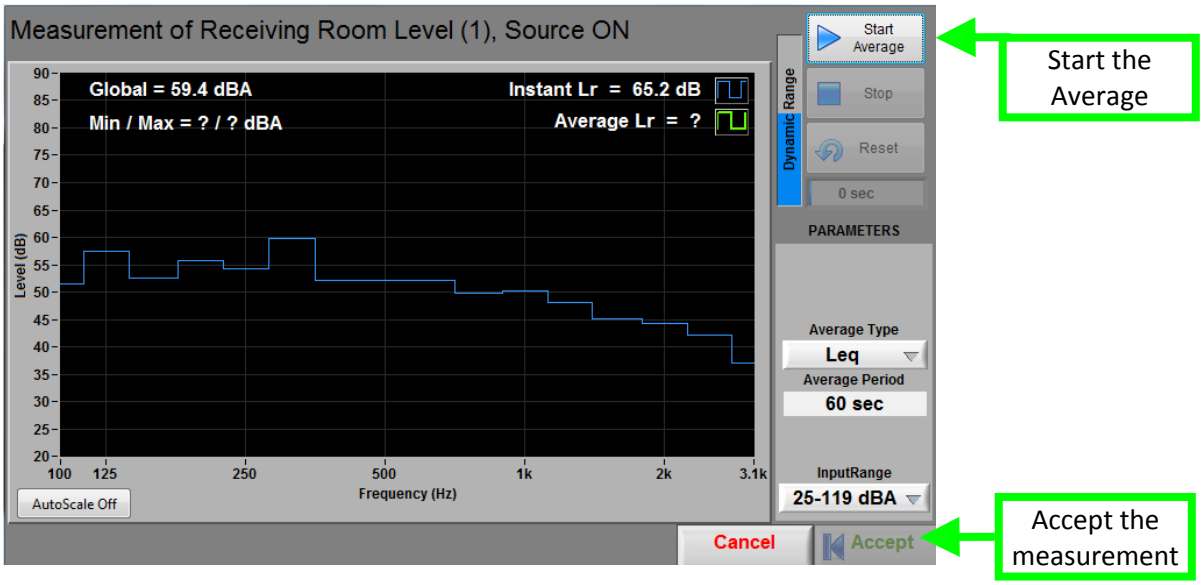
Click on the Setup button to access the setup interface. The parameter should typically be set as shown on figure above.

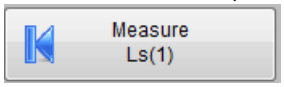
Before a measurement, the operator should set the sensitivity of the sensor used. This sensitivity can be set manually if it is known. Preferably, the sensor sensibility should be set by using the software calibration tool and a calibrator. To do so, click on Calibrate and follow the instructions of the Sensor Calibration (section 6.3.1, p.60).

The level measurement can be made using an external generator or the internal generator (pink or white noise).

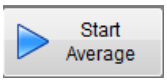
Click OK to return to the main panel.

Step 2 Do a Level Measurement

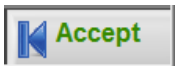


To proceed to a measurement, select an element to measure in the table of the main panel and click the button 

to open the measurement interface.

Once in the measurement panel, click on the 

button to start the average measurement. The acquisition end by itself once the average period is reached (as set in setup) and can be stopped at any time.

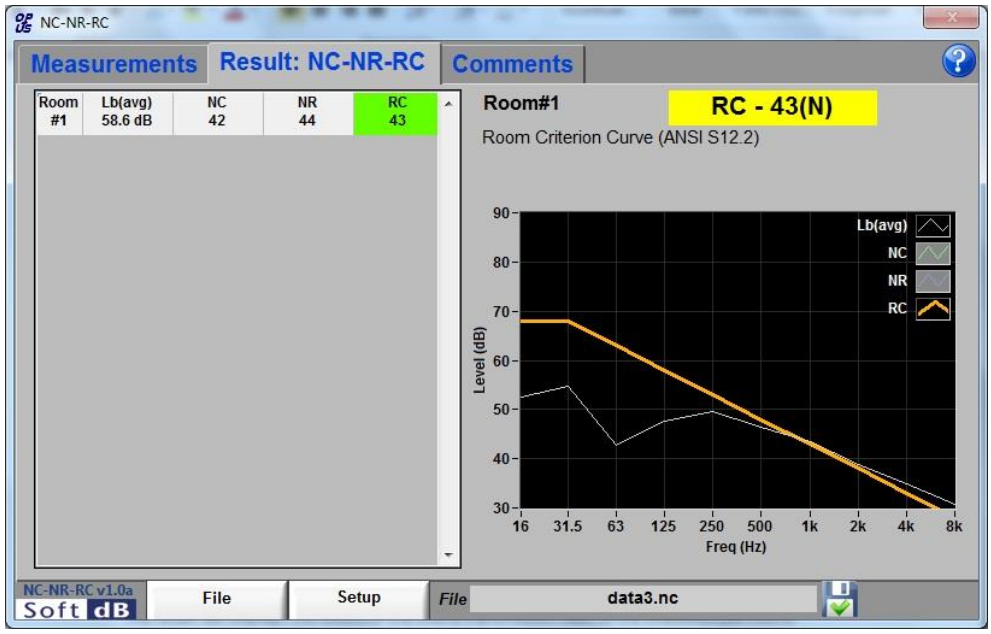
Click on the 

button to accept the measurement.

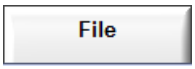
- Measurements must be taken at normal standing height or at a normal seated amplitude (minimum of 5' 6" high for standing measurements and at 4' 0" for seated measurements)

- The microphone must be at 2' away from any reflecting surface or 4' from the intersection of two intersecting reflecting surfaces or 8' from the intersection of three intersecting reflecting surfaces.

Step 3 Analyze the results



The result tab displays the results of the Noise Criteria, Noise Rating Curves and the Room Criteria to the evaluated the Room.

The measurements can be saved and exported through the menu of the 

button.

6.2 Room Noise Main Interface

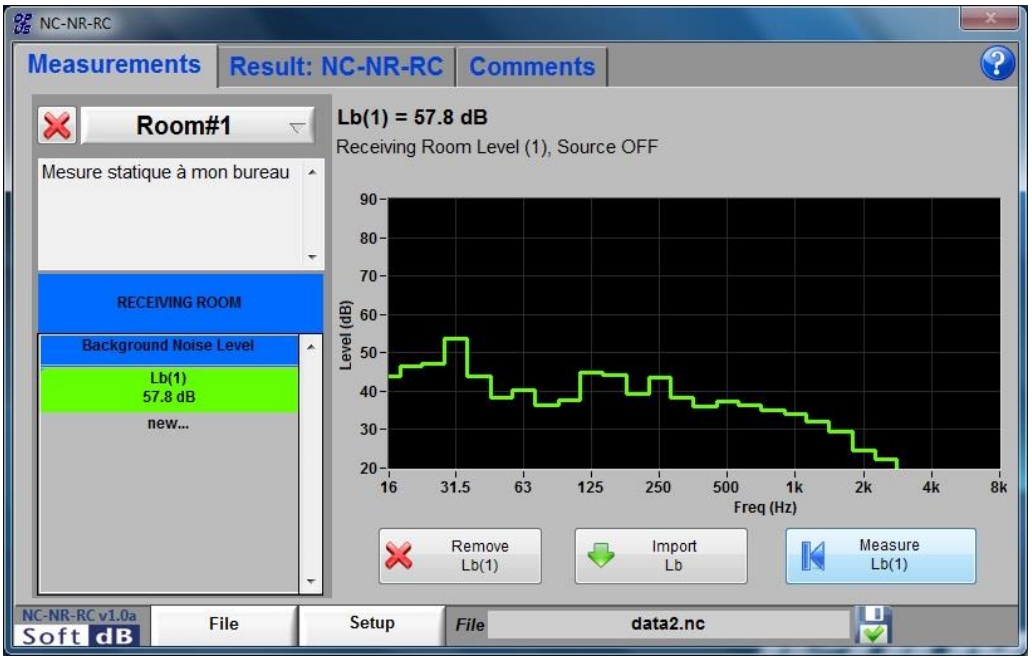
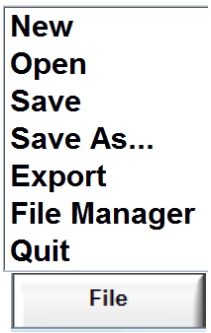


Figure 11: Main interface

Main controls and indicators

Measurements Result: NC-NR-RC Comments	Main interface tabs: • Measurements tab (section 6.4, p.61) • Result tab (section (6.5, p.65) • Comments tab (section 6.6, p.66)
File	File Menu button (see the following table).
Setup	Setup button that calls the setup interface (section 6.3, p.58).
NC-NR-RC v1.0a Soft dB	Module name and version number.
File Example.e1130	File name of the measurement. A green check on the disk icon indicates that the data are saved.
	Click this button to display the help window. This help is a reminder of the steps and the rules to follow.

File Menu



New	Creates a brand new measurement session.
Open	Opens a previous measurement file.
Save	Saves the current measurement into the specified file.
Save As…	Saves the current measurement into a new file.
Export	Exports the measurement data into a text file. The file is saved as .xls extension and can be opened with Microsoft Excel or any text editor.
File Manager	Launches the File Manager (see section 11, p.124)
Quit:	Allows to quit the module and to return to the Opus Suite Interface.

6.3 Room Noise Setup Interface

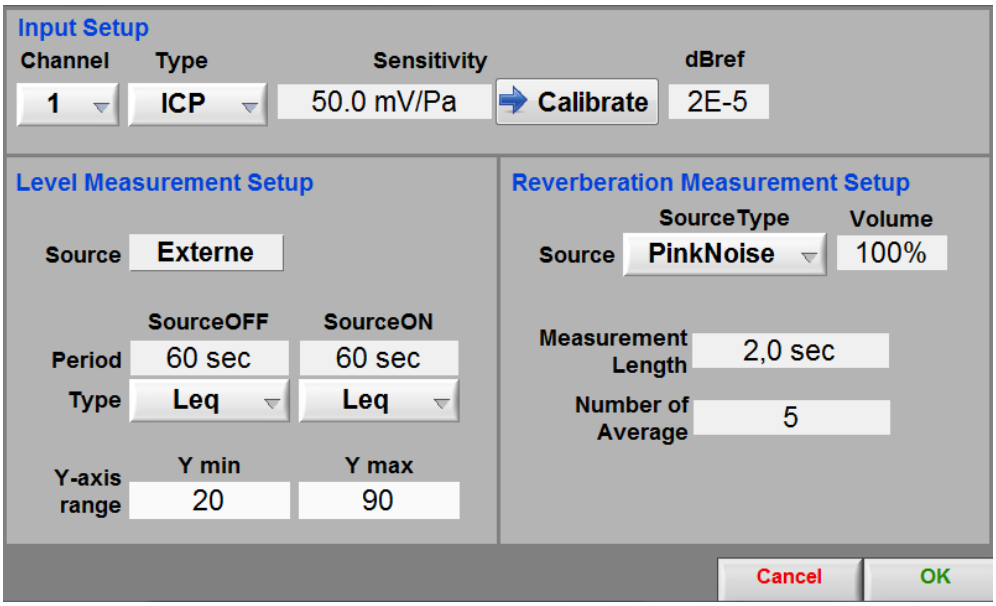
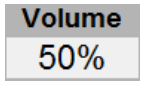
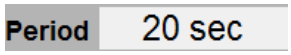
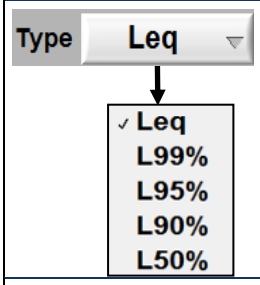
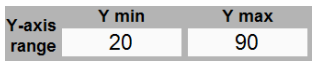


Figure 12: Setup interface

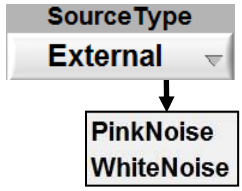
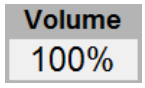
Input Setup

Channel 1	The input channel used for the measurements
Type ICP (AC / ICP)	The available input types are AC and ICP sensors.
Range 25-119 dBA	Selection of the dynamic range. For a microphone sensitivity of 50mV/Pa. - Low Range: 25 to 119 dBA - High Range: 37-130 dBA Concerto: the input 1 and 2 have two range settings (Low or High) while inputs 3 and 4 have a single fixed range (Low). Alto and Conductor: only the low range is available.
Sensitivity 50.0 mV/Pa Calibrate	The sensor sensitivity can be entered manually or the Calibration interface can be used (see section 6.3.1, p.60).
dBref 2E-5	The dB reference is the unit reference from which the decibel (dB) is calculated.

Level Measurement Setup

	When an internal generator is used, the volume can be adjusted from 0 to 100%.
	The average period of the two types of level measurement can be adjusted independently.
	The average type of the two types of measurement can be adjusted independently. It can be adjusted to be a plain average (Leq) or a statistic level (Lx%). Using the statistics instead of the Leq can minimize the punctual noise events that may occur during a measurement (especially for the background noise).
	The Y min and Y max parameters set the vertical scale (levels in dB) of the spectrum graphs of the current module.

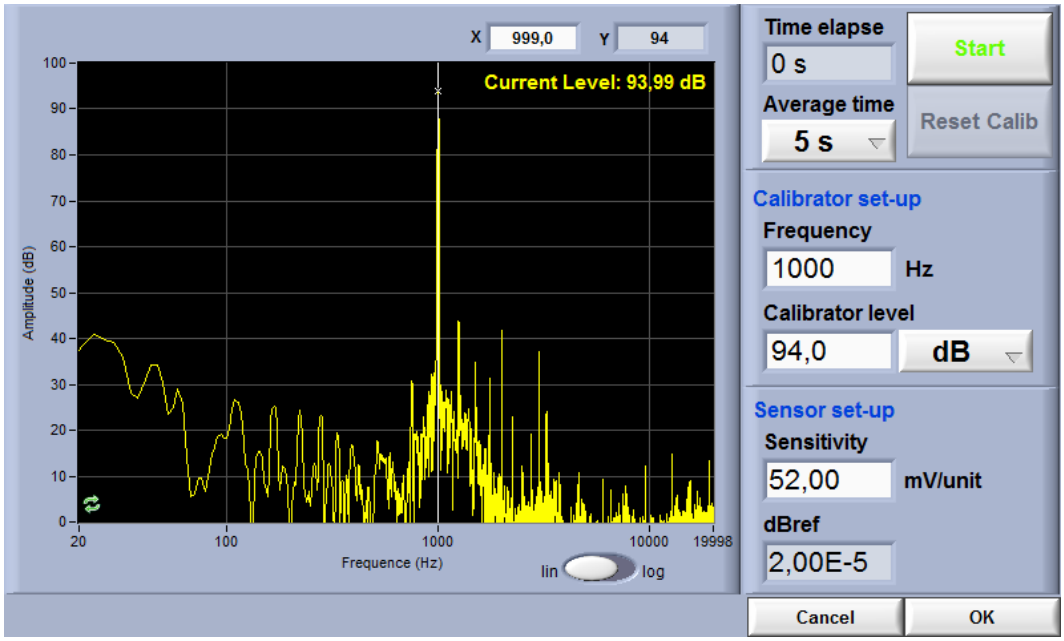
Reverberation Measurement Setup

	The unit is used to generate a pink noise or a white noise. The output signal is balanced on output 1 and output 2.
	The volume of the internal generator can be adjusted from 0 to 100%.
	The measurement length is the duration of the noise emission of one iteration of the reverberation evaluation.
	The number of average is the number of iterations used for the reverberation evaluation.

The Reverberation Measurement Setup should not be useful for NC / NR / RC measurements.

6.3.1 Sensor Calibration

The input sensitivity can be calibrated using the calibration function and a sensor calibrator. Click the **Calibrate** button on the Setup interface to launch the Calibration interface.



Step 4 Adjust the calibration parameters

The defaults values are:

- Averaging time: 5 s
- Frequency: 1 kHz
- Calibrator Level: 94 dB

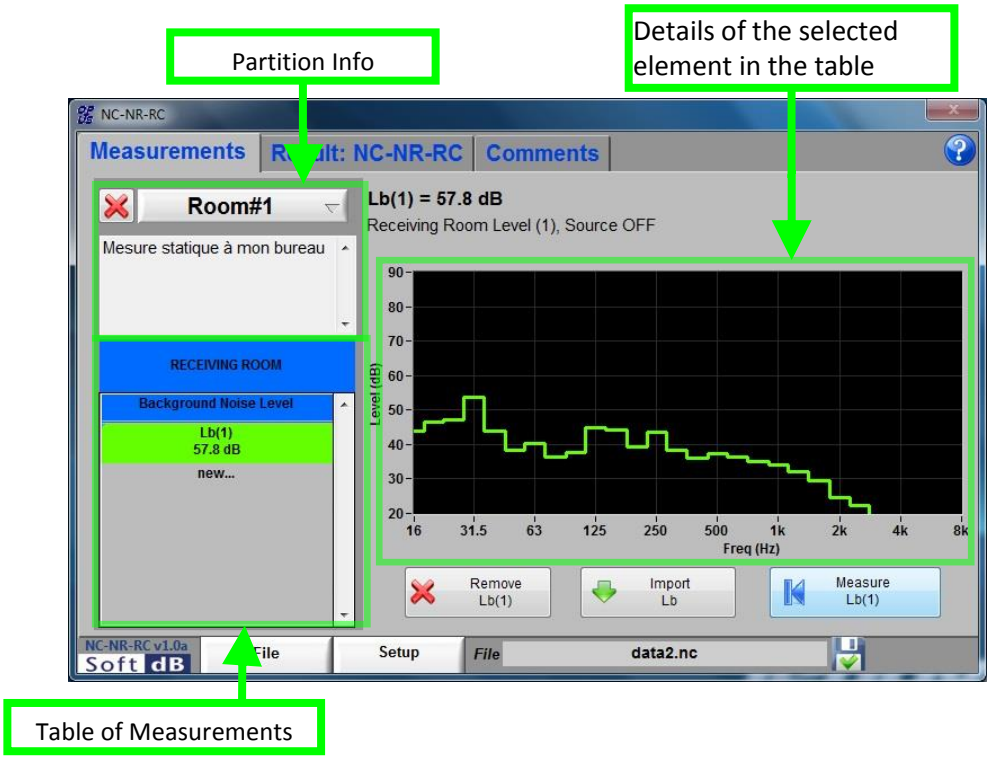
Step 5 Install the calibrator device on the microphone

Step 6 Click START

After the average time is elapsed, the sensitivity value will update.

Step 7 Click OK to accept the sensitivity value

6.4 Room Noise Measurements tab



The Measurements tab can be divided in three parts. The room information is in upper left corner. Just under is the table of measurements. Finally, the details of the selected element are on the right side.

Measurements controls

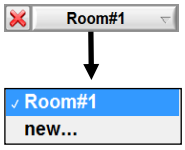
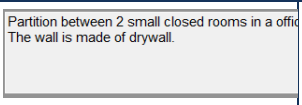
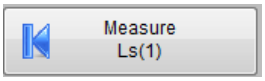
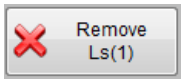
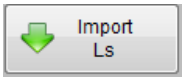
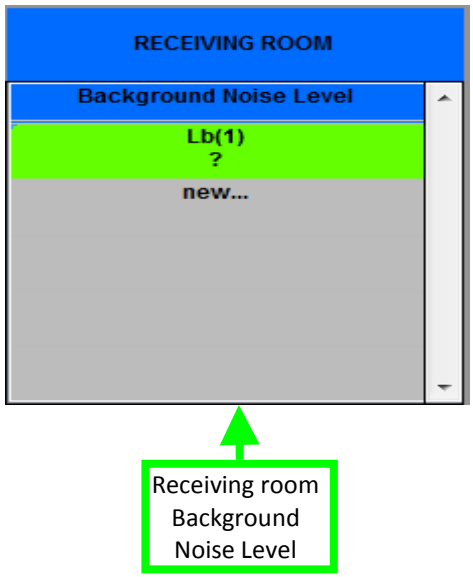
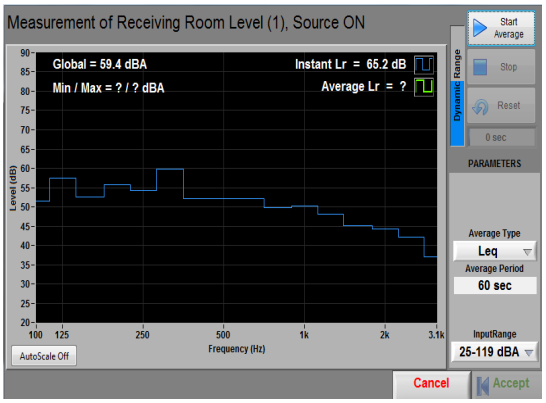
	The room menu let you select the partition to measure. To add a new room, select the last element ("new…") of the menu ring. To delete a room, select the partition and press the button
	The partition description let the user enter some basic information on the partition being qualified.
	If an element of the table is selected, the measurement interface will be called (see the following subsections).
	Click this button to delete the selected table element.
	The import feature allows the user to load one column of data from another partition of the same file. It is then possible to avoid repeating the same measurements when several rooms share data with each other.

Table of Measurements



To add a new element in the table, simply press on “new…” in the proper column. The average value of those measurements will later be used in the NC/NR/RC evaluation. To see the average from the measurement tab, click on the header element above the first measurement element of a column.

Details of the selected element in the table

	Name and global level of the selected element. Description of the selected element Spectrum graph of the selected element in the table.

6.4.1 Level Measurement Interface

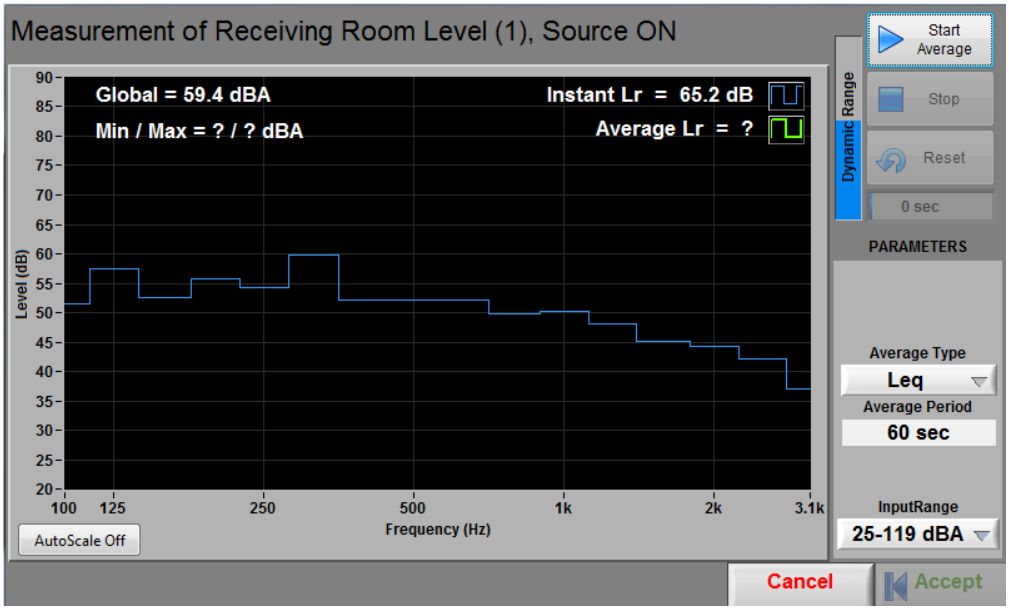
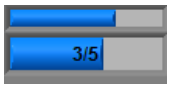
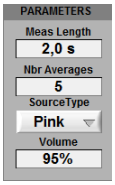
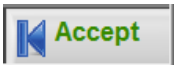


Figure 13: Reverberation Measurement Interface

Level Measurement controls

Start Average / Pause	The Start/Pause button starts/pauses the average measurements. The measurement will stop by itself at the end of the average period.
Stop	The Stop button stops the average process
Reset	The Reset button restarts the average measurement.
6 sec	Progress bar of the average time.
Average Type: Leq; Average Period: 20 sec	The average parameters of Average type and Average Period can be modified directly on the Measurement Interface. The values will be updated in the corresponding value of the Setup Interface (see section 6.3, p.58)
Sat / Dynamic Range	The dynamic range gives the information of the usage of the input range. When saturation occurs the indicator turns red. The word 'Sat' will also be displayed over the indicator as soon as saturation is detected during an average. Such a measurement should be rejected.
Accept	Once the measurement is acceptable, press the Accept button to return to the main interface.

Reverberation Measurement controls

	The Run/Pause button starts/pauses the average measurements. The measurement will stop by itself at the end of the average period.
	The Stop button stops the average process.
	The upper progress bar is the progression of the current iteration. The bottom progress bar is the progression of the iterations relative to the requested “Nbr Averages”.
	This indicator displays which reverberation indexes are met (i.e. if T10 is on, it means that T10 was reached for every frequency bands and global).
	The reverberation parameters can be modified directly on the Measurement Interface. The values will be updated in the corresponding value of the Setup Interface (see section 6.3, p.58)
	The dynamic range gives the information of the usage of the input range. When saturation occurs the indicator turns red. The word ‘Sat’ will also be displayed over the indicator as soon as saturation is detected during an average. Such a measurement should be rejected.
	Once the measurement is acceptable, press the Accept button to return to the main interface.

6.5 Room Noise Result tab

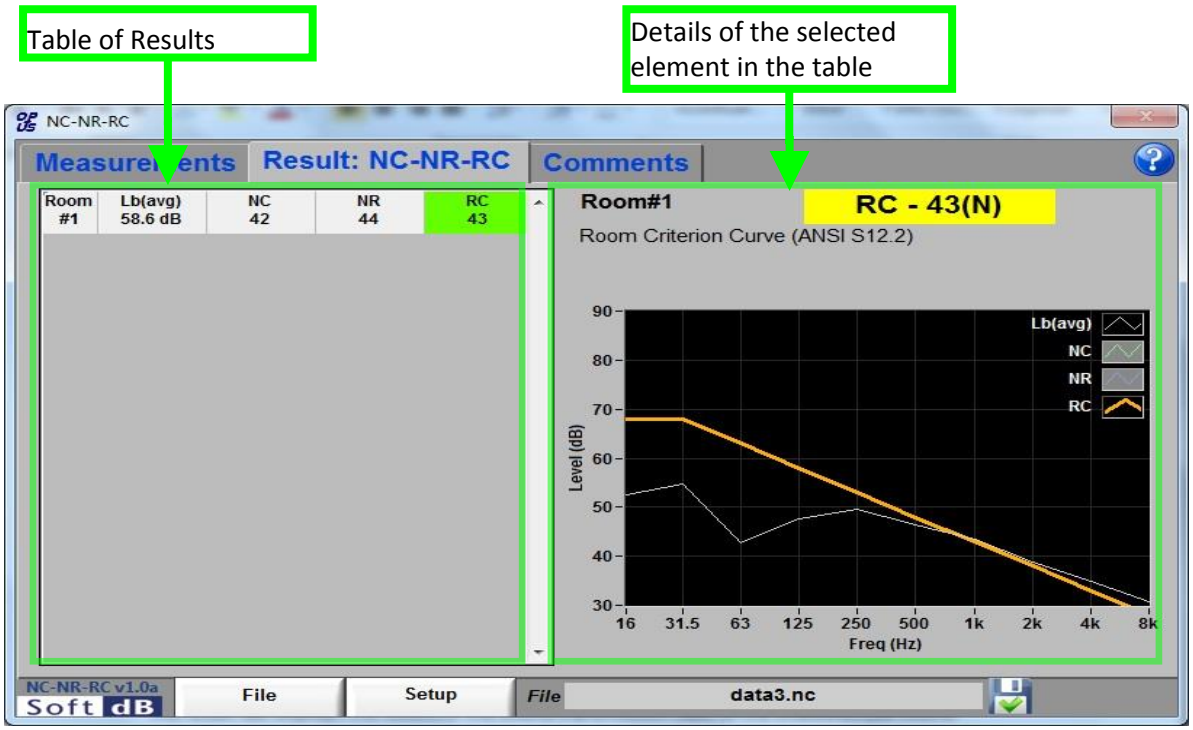


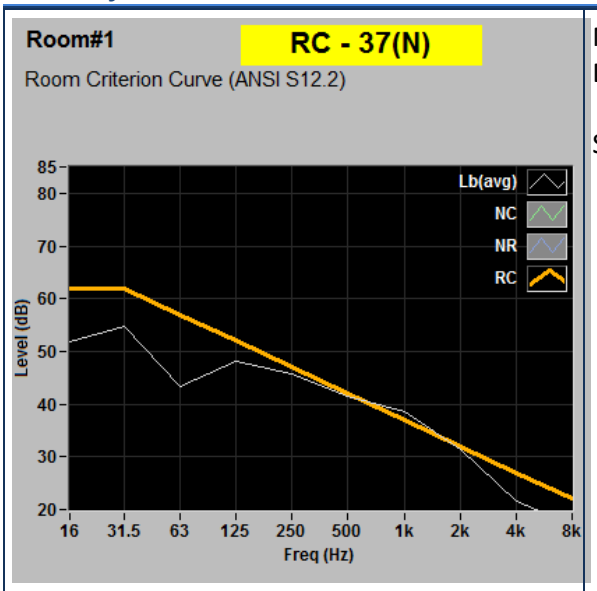
Figure 14: Result tab

The Result tab of the main interface contains the table of result (left side) and the details (right side). The table is expendable vertically as partitions are added (in the Measurements tab). Therefore, each line of the table gives the result of one room.

Table of Results

Room #1	Room index.
Lb(avg) 57.8 dB	Average background level in the receiving room while the source is turned off.
NC 37	Noise Criteria Index.
NR 39	Noise Rating Curves Index.
RC 37	Room criteria curves.

Details of the selected element in the table

	Name and value of the selected element. Description of the selected element Spectrum graph of the selected room.

6.6 COMMENTS tab

The Comments tab on the main panel can be used as a general note pad that will be saved along with the measurement data.

7 RT-60 module

General Specifications – RT-60 Module

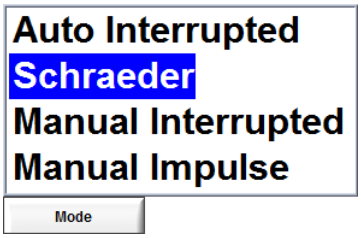
Measurement modes	• Automatic interrupted noise mode with built-in noise generator • Automatic Schroeder mode using impulse response reconstruction • Manual interrupted noise mode using auto-detection of an external noise source interruption • Manual impulse mode using auto-detection of an impulse noise
Spectrum Bands	• 1/1 Octave bands (125 Hz to 4 kHz) • 1/3 Octave bands (100 Hz to 5 kHz) • Global
Available Results	• T10 • T20 • T30 • Early Decay Time (EDT) • Dynamic • Clarity (C80)[1] • Central Time (Ts)* • Definition (D50)*

[1] Only available with the automatic Schroeder method

7.1 RT-60 Quick Start

Step 1 Select Measure Mode

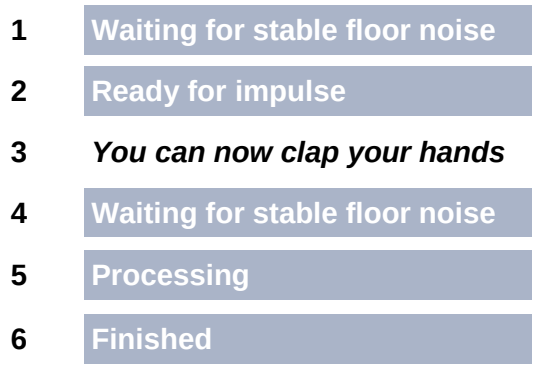
Click on the Mode button to select the measure mode from the menu. The measure modes are:



For purposes of example, select **Manual Impulse** from the menu. This mode does not require a sound source and can be performed simply by clapping hands.

Step 2 Start the Measurement

Click on the RUN button to start the measurement. Follow the instructions in the status bar at the top of the main interface.



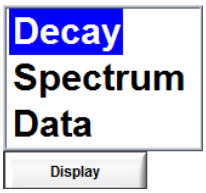
Once the measurement process is complete, click on the STOP button to stop the measurement.

Step 3 Save the Measurement

Click on the SAVE button to save the measurement. The measurement file will be saved as a .rt6 file in the file save directory. Its name will appear as a four digit number displayed in the File info section of the main interface.

Step 4 Visualize the Measurement

Click on the Display button to select the display from the menu. The available displays are:



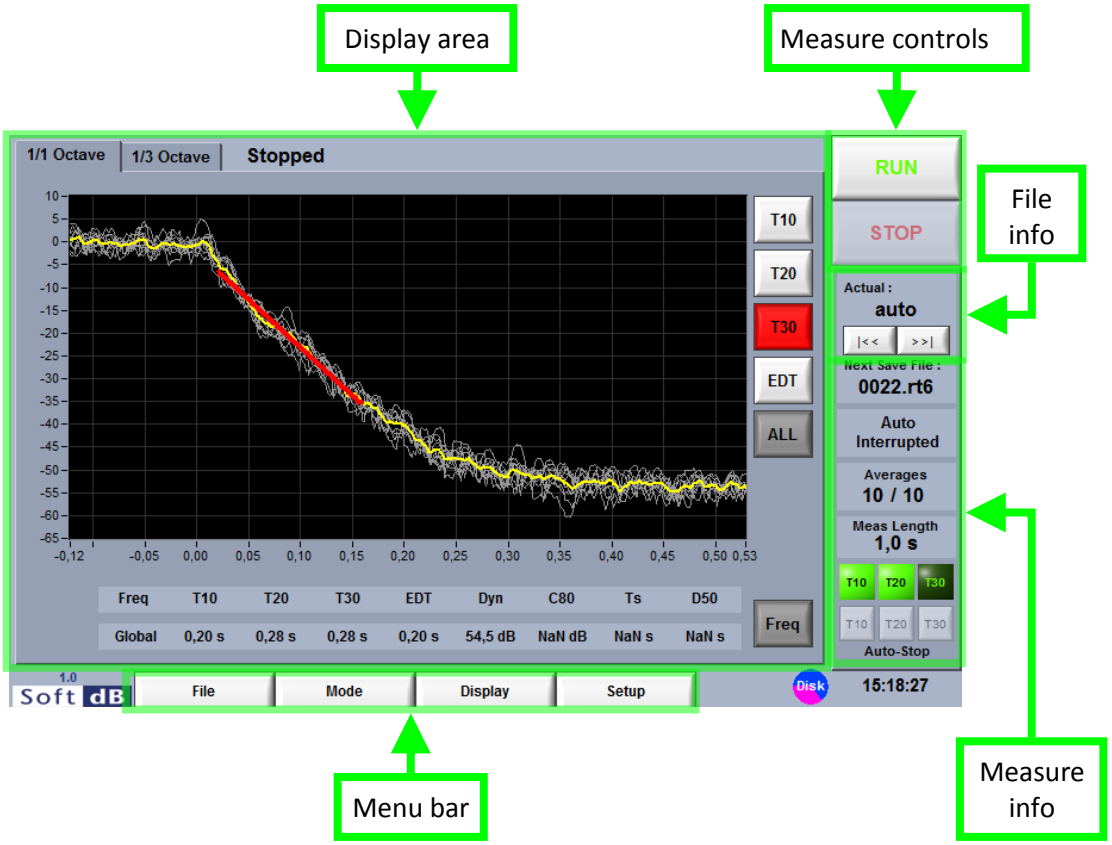
Decay	This display shows the time decay for a given frequency band or for the global.
Spectrum	This display shows a selected value from each frequency band in a bar graph form.
Data	This display shows all values for all frequency bands in an array.

Further information about each display is available in section 7.2.5, p. 73.

7.2 RT-60 Main Interface

The main interface is divided into five sections:

1) Measure controls (see section 7.2.1, p. 71)
2) File info (see section 7.2.2, p. 71)
3) Measure info (see section 7.2.3, p. 71)
4) Menu bar (see section 7.2.4, p. 72)
5) Display area (see section 7.2.5, p. 73)



The following operations can be performed using the main interface:

- Perform a measurement according to the current measure mode
- Modify the setup using the Setup menu
- Save, Export and Open data using the File menu

7.2.1 Measure Controls

RUN/PAUSE/CONTINUE (Automatic mode)

	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
	When the user clicks this button, the measurement process continues from where it was suspended. The **CONTINUE** button then automatically becomes the **PAUSE** button.

RUN/ADD (Manual mode)

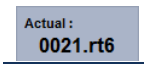
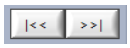
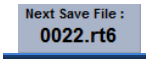
	When clicked, this button starts the measurement. This button is then disabled until an average iteration is complete. When an average iteration is complete, this button becomes the **ADD** button.
	This button is displayed and enabled while the manual measurement process is waiting for another average iteration. When the user clicks this button, another average iteration is launched. This button is the disabled until the average iteration is complete.

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.

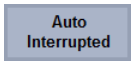
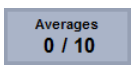
7.2.2 File Info

File Save

	This indicator displays the current measurement file.
	Theses two buttons are used to open the next and previous files (respectively) in the measurement save directory.
	This indicator displays the next file to be saved.

7.2.3 Measure Info

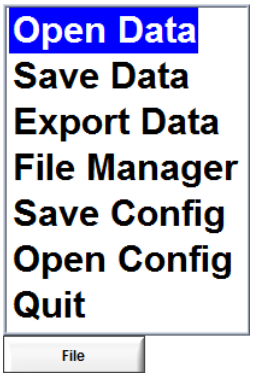
Measure Info

	This indicator displays the current measure mode. Clicking on this indicator launches the setup interface, which allows the user to select a different measure mode.
	This indicator displays the current average iteration and the specified average number. Clicking on this indicator launches the setup interface where the average number can be changed.

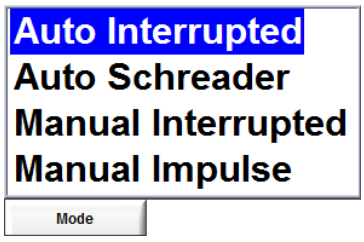
	This indicator displays the specified measure length. Clicking on this indicator launches the setup interface where the measure length can be changed.
	This indicator displays which reverberation indexes are met (i.e. if **T10** is light on, it means that T10 was reached for every frequency bands and global).
	This control allows the software to automatically stop a measurement once the specified reverberation index is met. This control is only available in automatic Schroeder mode.

7.2.4 Menu Bar

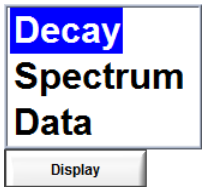
File Menu

	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 11, p. 124)
	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.

Mode Menu

	Auto Interrupted:	Changes software configuration to automatic interrupted noise mode (section 7.4.1, p. 78).
	Auto Schroeder:	Changes software configuration to automatic Schroeder mode (section 7.4.2, p. 79).
	Manual Interrupted:	Changes software configuration to manual interrupted noise mode (section 7.4.3, p. 80).
	Manual Impulse:	Changes software configuration to manual impulse mode (section, 7.4.4 p. 82).

Display Menu

	Decay:	This item sets the interface to display the time decay for a specified frequency band or global.
	Spectrum:	This item sets the interface to display a specified reverberation index for all frequency bands and global on a bar graph.
	Data:	This item sets the interface to display all the reverberation indexes for all frequency bands and global in an array.

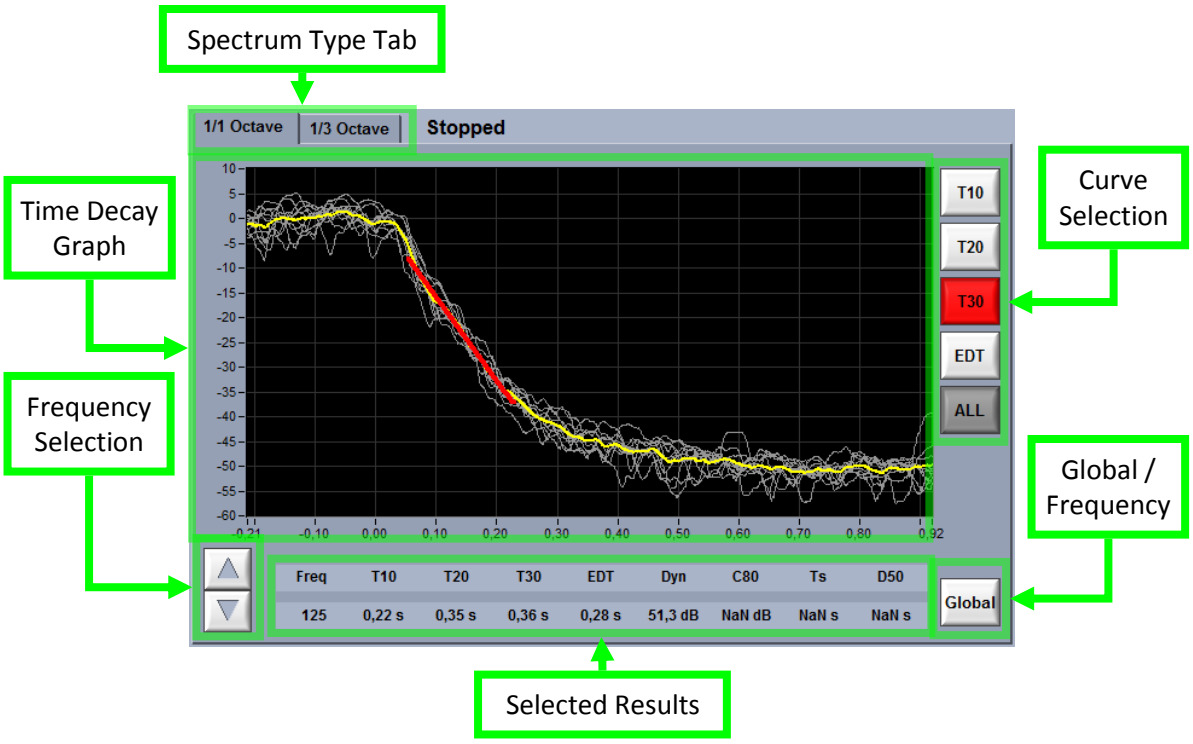
7.2.5 Display Area

Data can be presented using one of three available displays:

- Decay (see section 7.2.5.1, p. 74)
- Spectrum (see section 7.2.5.2, p. 75)
- Data (see section 7.2.5.3 p.76)

7.2.5.1 Decay

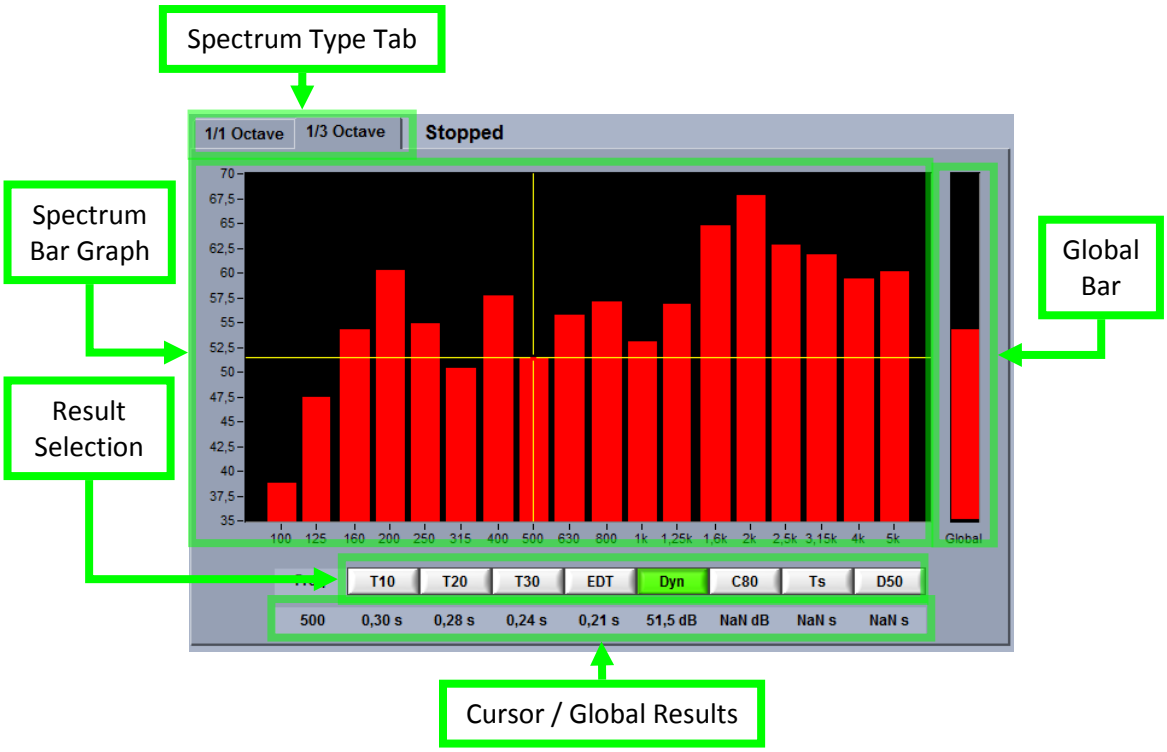
This display shows the response to a noise interruption or impulse. It also superimposes the curves used to evaluate RT values and the averaged successive responses.



Spectrum Type Tab	This tab switches between 1/1 octave bands 1/3 octave bands results.
Time Decay Graph	This graph displays the time decay curves for the selected frequency band or global.
Frequency Selection	These buttons are used to display the next or previous frequency band on the time decay graph and in the results (Selected Results).
Curve Selection	These buttons are used to select the visible curves on the time decay graph. **T10**, **T20** and **T30** are the straight lines used to determine the reverberation times. **EDT** is the straight line used to determine the Early Decay Time. **All** shows all the iterations in the averaging process (unavailable in Auto Schroeder mode).
Global / Frequency	This button is used to switch between frequency bands and global.
Selected Results	This array displays the computed results for the selected frequency band or global.

7.2.5.2 Spectrum

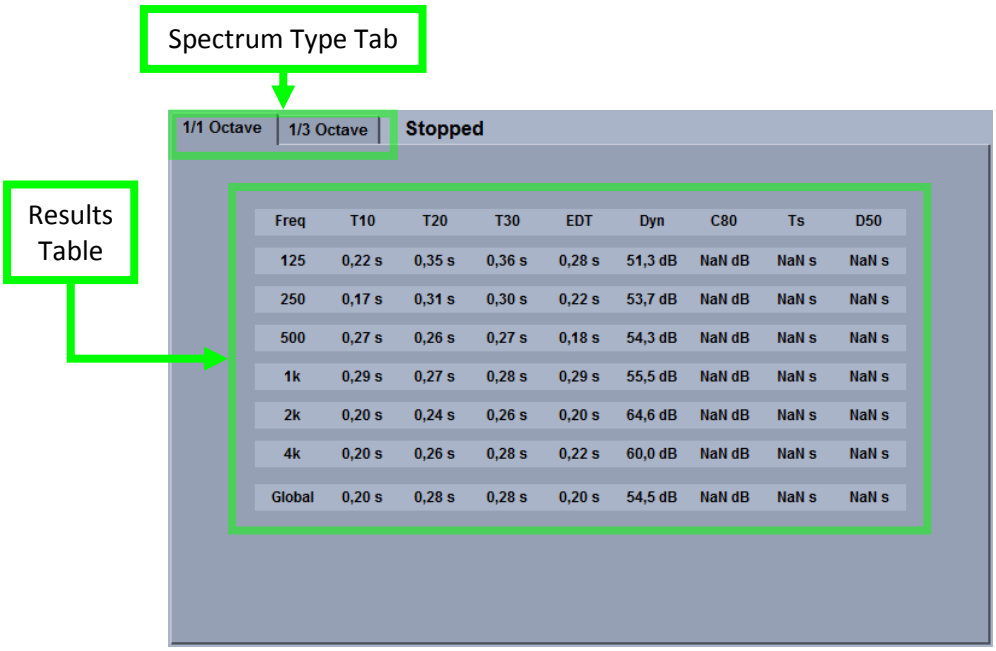
This display shows a selected result for each frequency band and global using a bar graph.



Spectrum Type Tab	This tab switches between 1/1 octave bands 1/3 octave bands results.
Spectrum Bar Graph	This graph displays the selected result for every frequency band.
Result Selection	These buttons are used to select the result to display on the spectrum graph and Global Bar.
Global Bar	This indicator displays the selected result for the global.
Cursor/Global Results	This array displays the computed results for the selected frequency band or global. To select a frequency band, click on the spectrum at the desired frequency to move the cursor. To select the global, click on the global bar.

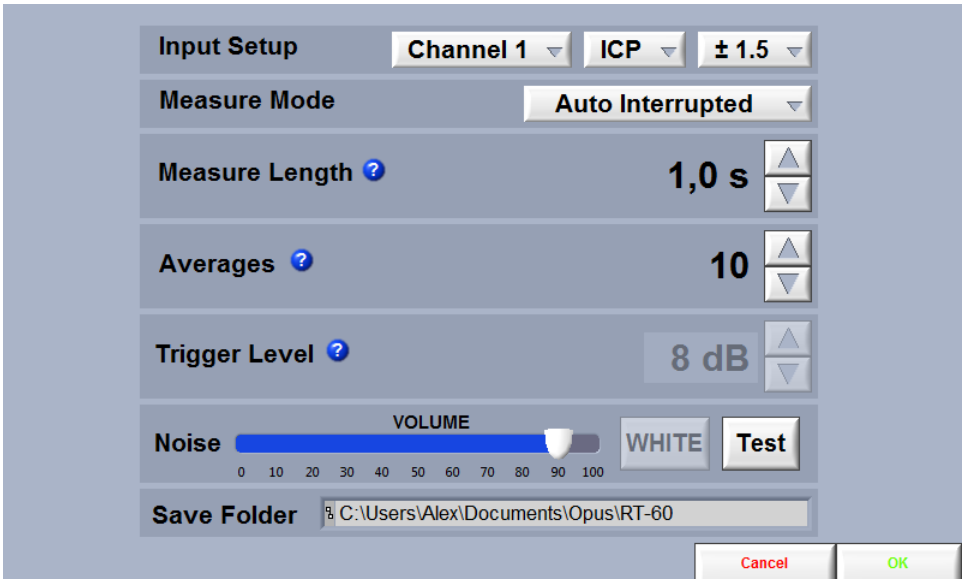
7.2.5.3 Data

This display shows all data for all frequency bands and global in a table form.



Spectrum Type Tab	This tab switches between 1/1 octave bands 1/3 octave bands results.
Results Table	This array displays all available results for every frequency band and global.

7.3 RT-60 Setup



Input Setup	These controls allow selecting the input channel, the input type and the input range from drop down lists.
Measure Mode	This drop down list is used to select the measure mode.
Measure Length	This control is used to select the measure length in automatic mode. In manual mode, this control is unavailable.
Averages	This control is used to select the number of averages to perform. This control is unavailable in automatic Schroeder mode.
Trigger Level	This control is used to select the trigger level used to detect a noise interruption or an impulse in manual mode.
Noise	These controls are used to select the noise generator volume and noise type (pink/white). A test button is used to momentarily generate noise in order to set these parameters.
Save Folder	This indicator displays the measurement save directory. Clicking on this indicator displays a dialog window to browse for a new location.

7.4 RT-60 Measurement modes tutorials

7.4.1 Automatic Interrupted Noise

This method evaluates the reverberation time by analysing the noise level decay occurring after a noise interruption. The noise interruptions are automatically generated using the internal noise generator. The result is a highly reproducible measurement that produces high precision results and allows a large number of averages.

Step 1 Noise Source Set-Up

Connect the ***Concerto*** output to the noise source using the appropriate cable.

Step 2 Software Set-Up

1) Click the

button on the menu bar to access the setup interface.
2) Select **channel 1**, **ICP** input and **±1,5V** on the **Input Setup**
3) Select **Auto Interrupted** on the **Measurement mode** drop down list.
4) Select the appropriate **Measure Length**[2] for the room under test.
5) Select the number of **Averages** you want to perform.
6) Select the appropriate **Noise Volume** and click on **Test** to hear a sample of this sound level.
7) Click **OK** to return to the main interface.

Step 3 Running the Measurement

Click the

button to launch the measurement process.

The noise should turn on and off at regular intervals. Between each interval, the time decay curves are processed and averaged. Evaluated results will be displayed. While the measurement is running, the display mode can be modified to view to view different aspects of the measurement in progress.

*If the selected **measure length** is below the measured T20, the measure length indicator*

will be coloured in red. When this occurs, it is recommended to resume the measurement with a longer measure length.

[2] The measure length in the auto interrupted method is the noise on and off time. This duration must be as long as the expected T20 of a room (i.e. in a room with a T20 of 0.5 s the measurement must executed using a measure length of at least 0.5 s)

Step 4 Stopping the Measurement

The measurement stops when the specified number of **Averages** has been completed. However, the user can stop the measurement process any time by clicking the

button.

Step 5 Saving the Measurement

The measurement is saved by clicking the

button. When done, the current file indicator

will display the current file name.

7.4.2 Automatic Schroeder

This method evaluates the reverberation time by performing an impulse response reconstruction by analysing the transfer function of a particular room. In addition to the reverberation time, it also computes the C80, Ts and D50 results which are unavailable in the other methods.

This method is achieved by performing the FRF on the input and output signals. As the signal blocks are processed, the reconstructed impulse response converges and measure dynamic increases.

Step 1 Noise Source Set-Up

Connect the ***Concerto*** output to the noise source using the appropriate cable.

Step 2 Software Set-Up

1) Click the

button on the menu bar to access the setup interface.
2) Select **channel 1**, **ICP** input and **±1,5V** on the **Input Setup**
3) Select **Auto Schroeder** on the **Measurement mode** drop down list.
4) Select the appropriate **Measure Length**[3] for the room under test.
5) Select the appropriate **Noise Volume** and click on **Test** to hear a sample of this sound level.
6) Click **OK** to return to the main interface.

[3] The measure length in the Auto Schroeder mode must be as long as the expected T20 of a room (i.e. in a room with a T20 of 0.5 s the measurement must executed using a measure length of at least 0.5 s) This length is used to select the appropriate signal block length on which to compute the FRF.

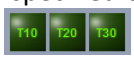
Step 3 Running the Measurement

Click the

button to launch the measurement process. The noise will begin and the average number should increase periodically.

You can follow the measurement process by displaying the **Dynamic** view on the **Spectrum** display. As the measurement proceeds, the dynamic should increase. Required dynamic for each reverberation time index are showed in the following table:

T10	25 dB
T20	35 dB
T30	45 dB
EDT	25 dB

Once the specified dynamic has been reached for every frequency band and global, the reached TX indicator 

should light up.

Step 4 Stopping the Measurement

The measurement stops when the TX specified in the auto-stop setting

has been reached.

The user can stop the measurement process any time by clicking the

button.

Step 5 Saving the Measurement

The measurement is saved by clicking the

button. Once complete, the current file indicator

will display the current file name.

7.4.3 Manual Interrupted Noise

This method evaluates the reverberation time by analysing the noise level time decay occurring after a noise interruption. The noise interruptions are manually generated using an external noise generator.

Step 1 Software Set-Up

1) Click the

button on the menu bar to access the setup interface.
2) Select **channel 1**, **ICP** input and **±1,5V** on the **Input Setup**
3) Select **Manual Interrupted** on the **Measure mode** drop down list.
4) Select the number of **Averages** you want to perform.

5) Select the appropriate **Trigger Level**[4] necessary to detect the noise interruption.
6) Click **OK** to return to the main interface.

Step 2 Running the Measurement

1) Turn on the external noise generator and adjust the volume to the desired level.
2) Click the

button to launch the measurement process.
3) The measurement status should go through these steps:

1	Waiting for stable noise
2	Ready for noise interruption
3	***You can now turn off the noise generator***
4	Waiting for stable floor noise
5	Processing
6	Finished

At this point, 1 average iteration is complete and the process is waiting for another average iteration.

Step 3 Adding More Average Iterations

When an average iteration is finished, turn on the noise generator again and click the

button. The process should go through the same steps described in **Step 2**.

Step 4 Stopping the Measurement

The measurement stops when the specified **Average Number** is reached. The user can stop the measurement process at any time by clicking the

button.

Step 5 Saving the Measurement

The measurement is saved by clicking the

button. Once complete, the current file indicator

will display the current file name.

---

[4] The trigger level is used to detect the noise interruption (i.e. if the trigger level is set to 5 dB, a noise interruption will be detected when the noise level is 5 dB lower than the activated noise level).

7.4.4 Manual Impulse

This method evaluates the reverberation time by analysing the noise level time decay occurring after an impulse. The impulses are produced manually by clapping pieces of wood together or by bursting a balloon.

Step 1 Software Set-Up

1) Click the Setup button on the menu bar to access the setup interface.
2) Select **channel 1**, **ICP** input and **±1,5V** on the **Input Setup**
3) Select **Manual Impulse** on the **Measurement mode** drop down list.
4) Select the number of **Averages** you want to perform.
5) Select the appropriate **Trigger Level**[5] necessary to detect the noise interruption.
6) Click **OK** to return to the main interface.

Step 2 Running the Measurement

1) Click the RUN button to launch the measurement process.
2) The measurement status should go through following steps:

1	Waiting for stable floor noise
2	Ready for impulse
3	***You can now generate the impulse***
4	Waiting for stable floor noise
5	Processing
6	Finished

At this point, 1 average iteration is complete and the process is waiting for another average iteration.

Step 3 Adding More Average Iterations

When an average iteration is finished, click the ADD button. The process should go through the same steps described in **Step 2**.

Step 4 Stopping the Measurement

[5] The trigger level is used to detect the impulse (i.e. if the trigger level is set to 5 dB, an impulse will be detected when the noise level is 5 dB higher than the floor noise level).

The measurement stops when the specified **Average Number** has been reached. The user can stop the measurement process any time by clicking the

button.

Step 5 Saving the Measurement

The measurement is saved by clicking the

button. When complete, the current file indicator

will display the current file name.

8 E2638 Module

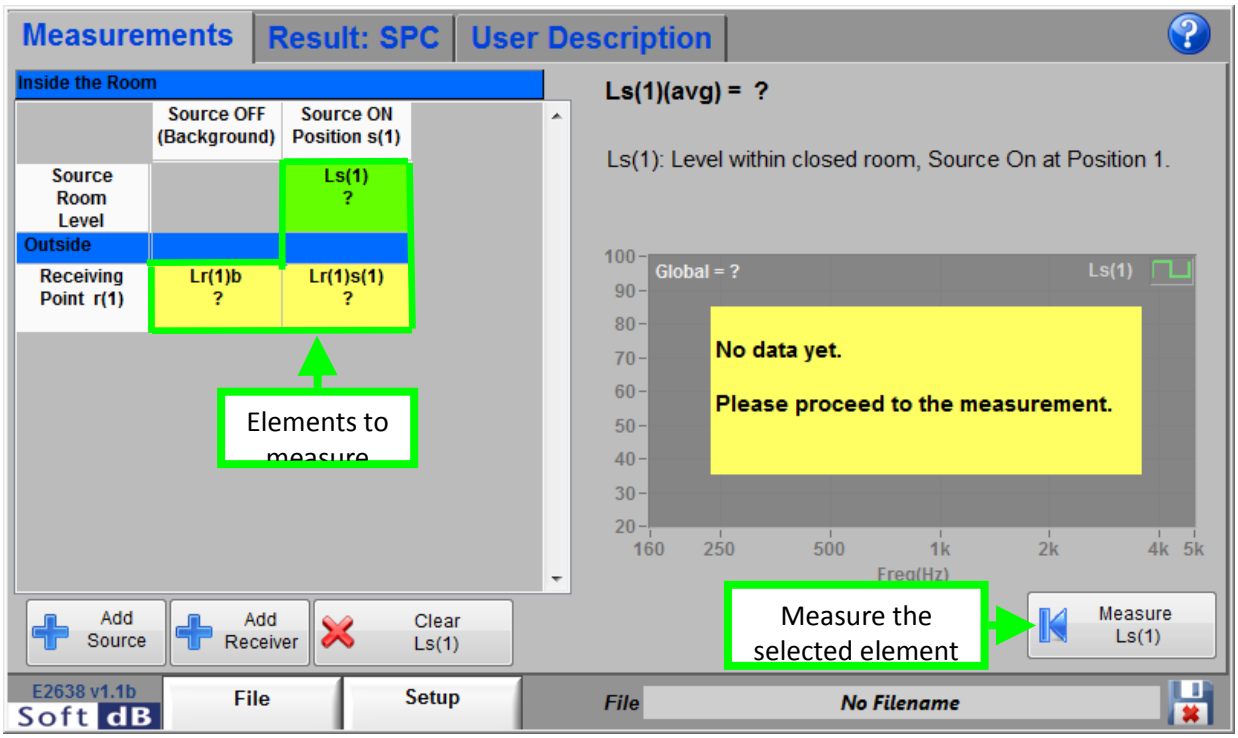
General Specifications

Standard	Test Method E2638-10, by ASTM International **Standard Test Method for Objective Measurement of the Speech Privacy Provided by a Closed Room.** It is designed to measure the degree of speech privacy provided by a closed room, indicating the degree to which conversations occurring within are kept private from listeners outside the room
Software Features	Intuitive interface for E2638 measurement Embedded noise generator (white or pink noise) Real time 1/3 octave band spectrum (IEC 1260 Type 1) Automated calculation of the Speech Privacy Class (SPC) Expendable interface for multiple source positions and receiving points Save, load and export measurement files

8.1 E2638 Quick Start

The E2638 module (Speech Privacy provided by a Closed Room) is part of the Building Acoustics Suite. It can be accessed in the Building Acoustics menu of the Opus Suite panel (see **Erreur ! Source du renvoi introuvable.**).

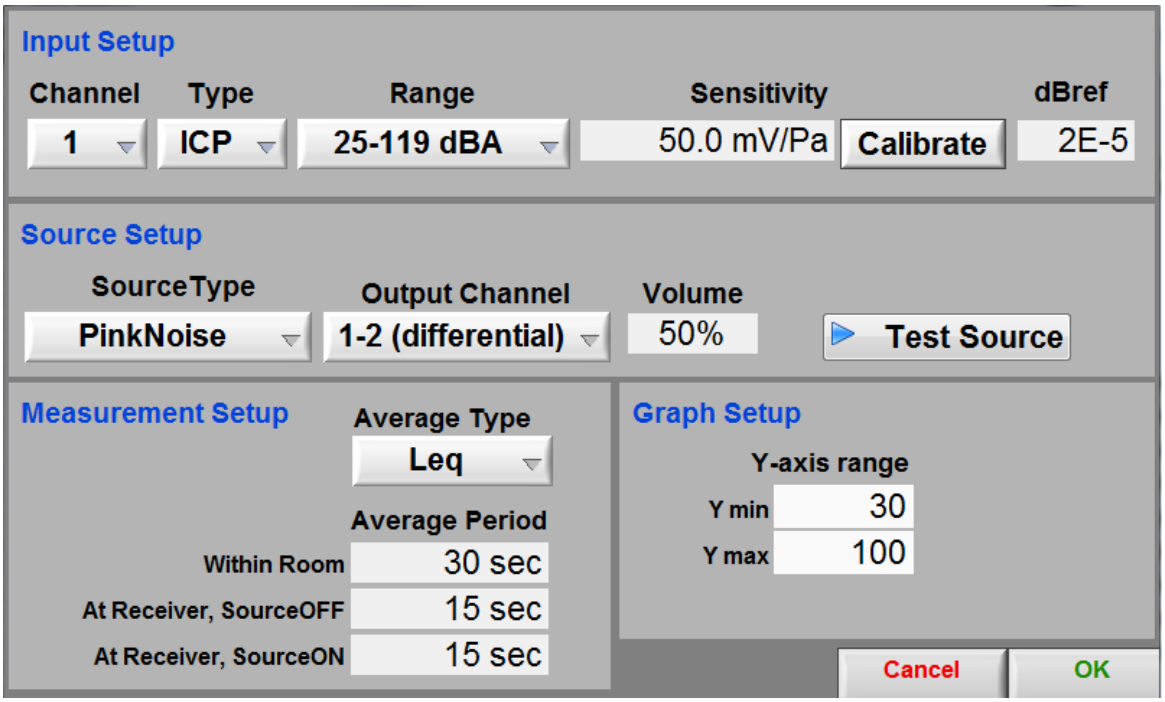
Measurement tab



What you should know…

- The main interface let you add/remove source positions and receiving points.
- A text description can be entered for each receiving point and each source position. Click on the corresponding header in the table to display the text box.
- The selected element of the table shows a green background. The details of the selection are displayed on the right side of the table.
- The elements still to measure display a question mark (?) as a value and have a yellow background.

Step 1 Setup the unit



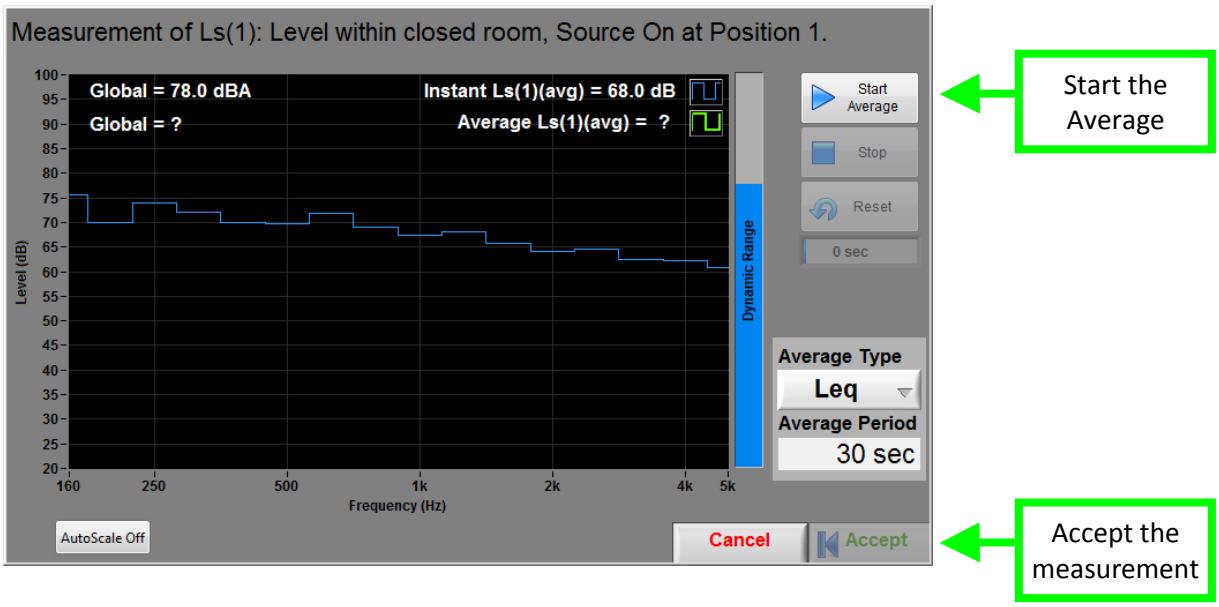
Click on the Setup button to access the setup interface. The parameter should typically be set as shown on figure above.

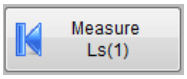
Before a measurement, the operator should set the sensitivity of the sensor used. This sensitivity can be set manually if it is known. Preferably, the sensor sensibility should be set by using the software calibration tool and a calibrator. To do so, click on Calibrate and follow the instructions of the Sensor Calibration (section 8.3.1, p.94).

Adjust the source output volume. The source should be loud enough to measure well above the background level at the receiving point(s).

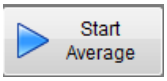
Click OK to return to the main panel.

Step 2 Do a Measurement

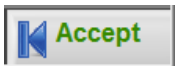


To proceed to a measurement, select an element to measure in the table of the main panel and click the button 

to open the measurement interface.

Once in the measurement panel, click on the 

button to start the average measurement. The acquisition end by itself once the average period is reached (as set in setup) and can be stopped at any time.

Click on the 

button to accept the measurement.

You are now ready to follow the measurement procedure.

Step 3 Select the source position(s) in the room

- An omnidirectional loudspeaker should be used
- Positions representative of typical locations of talkers
- Positions 1.5 m above the floor
- At least 2 positions have to be tested according to the E2638-10 standard
- Positions apart at least 1.2 m from each other

If a conventional directional loudspeaker is used, the source positions should be selected in the opposite corners of the wall being used for receiving points. Additional positions will be needed to reduce the uncertainty.

Step 4 Measure the room levels for the source position(s), source ON

The operator should survey the room using a path that is representative of the room volume while keeping a good time distribution over the room volume.

- Microphone at least 0.5 m from the operator
- Microphone speed slow and as constant as possible
- Microphone at least 1.5 m from the sound source
- Microphone at least 1 m from the walls of the room
- The recommended average time is 30 seconds according to the E2638-10 standard

Step 5 Select the receiving point(s) in the room

Select receiving points outside the closed room under consideration. Consider the points near the followings:

- Doors,
- Windows
- Other weak spots
- Other location of interest

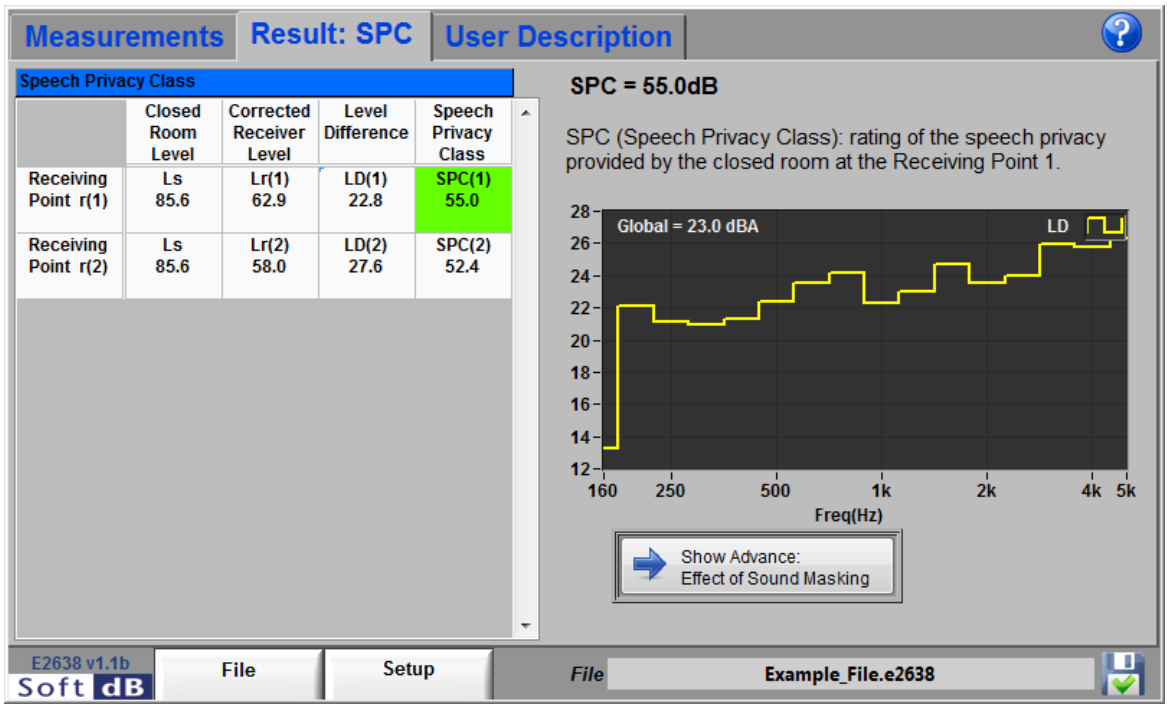
Step 6 Measure the levels at the desired receiving point(s), source ON

- Microphone at least 0.25 m from the outer surface of the closed room
- Microphone between 1.2 and 2 m above the floor
- The recommended average time is 15 seconds according to the E2638-10 standard

Step 7 Measure the levels at the desired receiving point(s), source Off

- Repeat last step with source turned off.

Step 8 Analyze the results



The Result Tab displays the results of the speech privacy of the room.

The measurements can be saved and exported through the menu of the File button.

The following table gives some indications on how to interpret the Speech Privacy Class (SPC).

65dB < SPC < 70dB low speech privacy	
70dB < SPC < 75dB Minimal Speech Privacy	One or two words will be intelligible at most once each 3 minutes, and speech sounds will frequently be audible (at most once each 0.6 minutes).
75dB < SPC < 80dB Standard Speech Privacy	One or two words will be occasionally intelligible (at most once each 18 minutes) and frequently audible (at most once each 2 minutes).
80dB < SPC < 85dB Standard Speech Security	One or two words will rarely be intelligible (at most once each 2.3 hours) and occasionally audible (at most once each 12.5 hours).
85dB < SPC < 90dB High Speech Security	Speech essentially unintelligible (at most once each 16 hours) and very rarely audible (at most once each 1.5 hours)
SPC > 90dB Very High Speech Security	Speech not intelligible and very rarely audible (at most once each 11 hours)

8.2 E2638 Main Interface

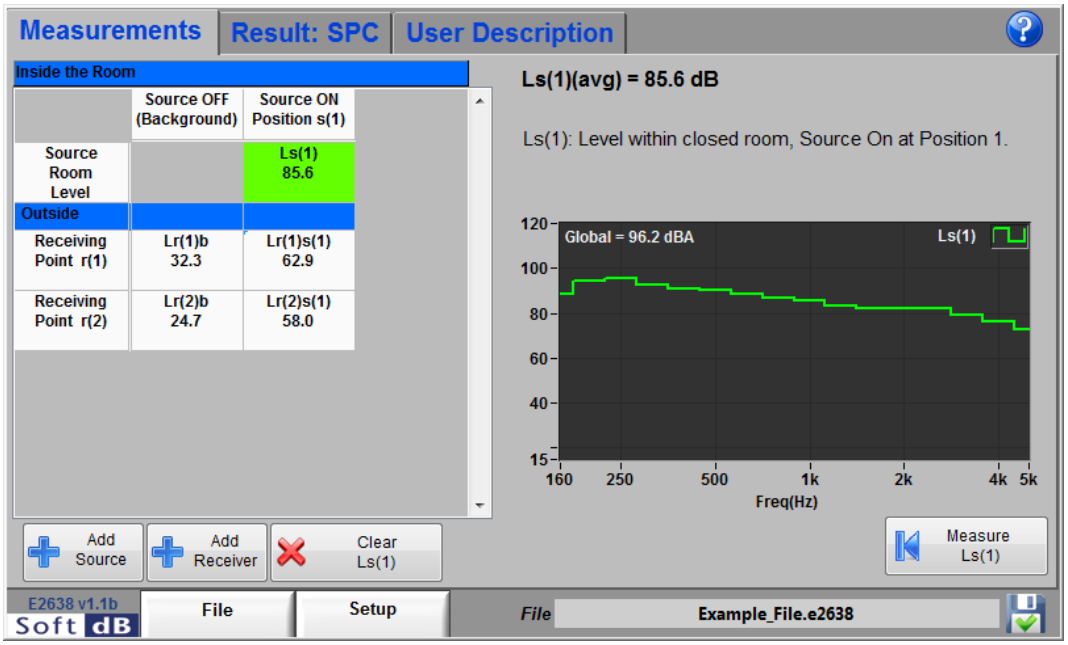


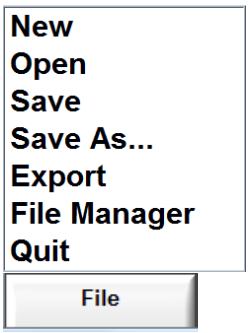
Figure 15 : Main interface

The main interface mainly contains three tabs and a menu bar.

Main controls and indicators

Measurements Result: SPC User Description	Main interface tabs: Measurements tab (section 8.4, p.95) Result tab (section 8.5, p.99) User Description tab (section 8.6, p.101)
File	File Menu button (see the following table).
Setup	Setup button that calls the setup interface (section 8.3 , p.92).
E2638 v1.1b Soft dB	Module name and version number.
File Example_File.e2638	File name of the measurement. A green check on the disk icon indicates that the data are saved.
	Click this button to display the help window. This help is a reminder of the steps and the rules to follow.

File Menu



New	Creates a brand new measurement session.
Open	Opens a previous measurement file.
Save	Saves the current measurement into the specified file.
Save As…	Saves the current measurement into a new file.
Export	Exports the measurement data into a text file. The file is saved as .xls extension and can be opened with Microsoft Excel or any text editor.
File Manager	Launches the File Manager (see section 11, p.124)
Quit:	Allows to quit the module and to return to the Opus Suite Interface.

8.3 E2638 Setup Interface

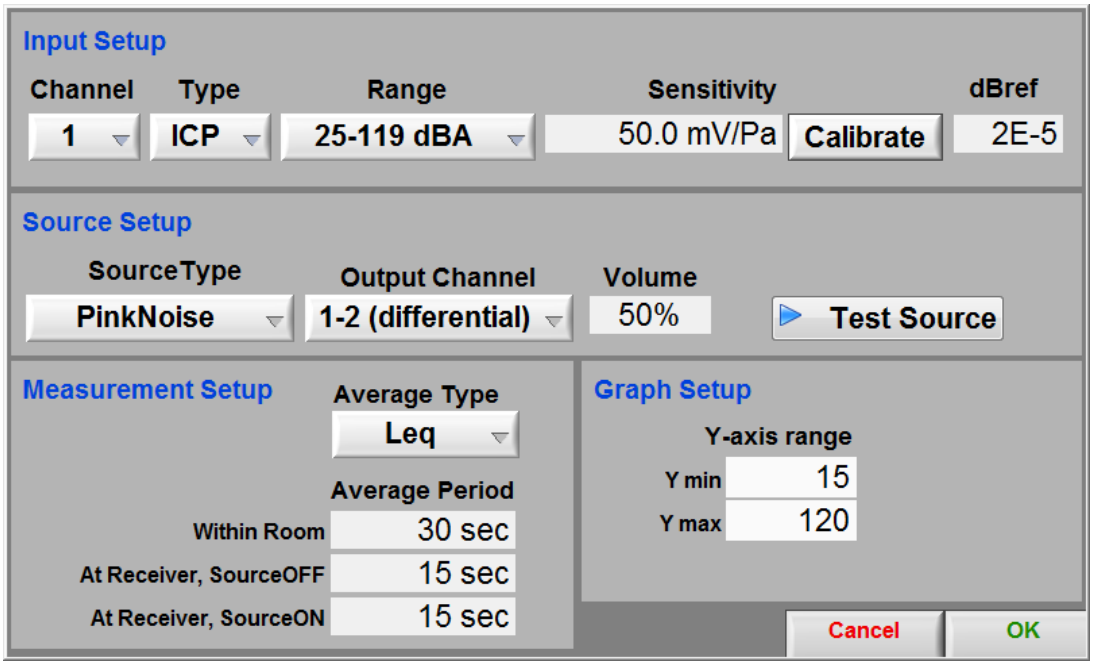
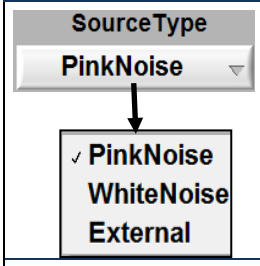
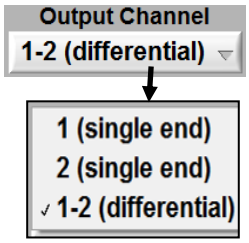
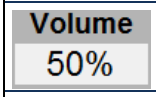


Figure 16 : Setup interface

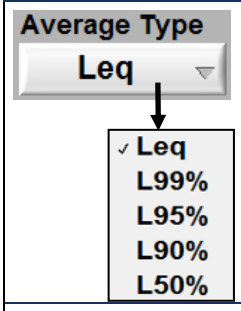
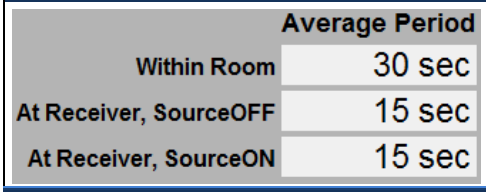
Input Setup

Channel 1	The input channel used for the measurements
Type ICP (AC / ICP)	The available input types are AC and ICP sensors.
Range 25-119 dBA	Selection of the dynamic range. For a microphone sensitivity of 50mV/Pa. • Low Range: 25 to 119 dBA • High Range: 37-130 dBA Concerto: the input 1 and 2 have two range settings (Low or High) while inputs 3 and 4 have a single fixed range (Low) Alto and Conductor: only the low range is available.
Sensitivity 50.0 mV/Pa **Calibrate**	The sensor sensitivity can be entered manually or the Calibration interface can be used (see section 8.3.1, p.94).
dBref 2E-5	The dB reference is the unit reference from which the decibel (dB) is calculated.

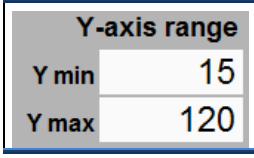
Source Setup

	There is a noise generator on the unit that can generate either pink noise or white noise. If an external generator is used, the source type can be set to External to disable the internal generator.
	The internal generator can be outputted in single end on channel 1 or channel 2. The differential output using both channels can also be used.
	The volume of the internal generator can be adjusted from 0 to 100%.
	The Test Source button allows the user to test the source by using the standard measurement interface.

Measurement Setup

	The average type of the measurement can be adjusted to be a plain average (Leq) or a statistic level (Lx%). Using the statistics instead of the Leq can minimize the punctual noise events that may occur during a measurement (especially for the background).
	The average period of each of the three types of measurement can be adjusted independently.

Graph Setup

	The Ymin and Ymax parameters set the vertical scale (levels in dB) of the spectrum graphs of the current module.

8.3.1 Sensor Calibration

The input sensitivity can be calibrated using the calibration function and a sensor calibrator. Click the **Calibrate** button on the Setup interface to launch the Calibration interface.

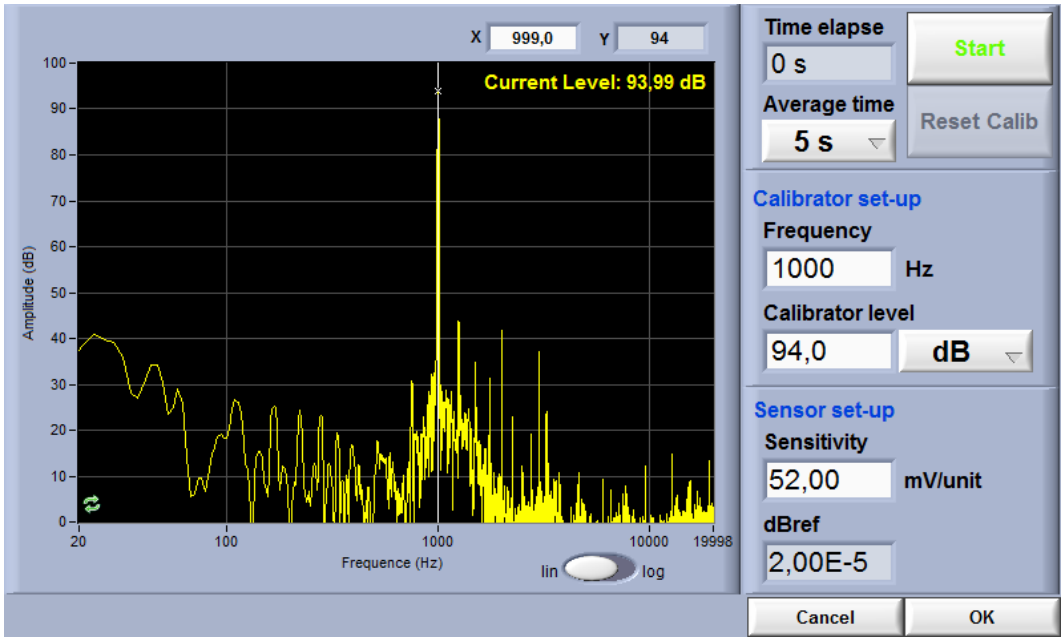


Figure 17: Sensor Calibration Interface

Step 1 Adjust the calibration parameters

The defaults values are:

- Averaging time: 5 s
- Frequency: 1 kHz
- Calibrator Level: 94 dB

Step 2 Install the calibrator device on the microphone

Step 3 Click START

After the average time is elapsed, the sensitivity value will update.

Step 4 Click OK to accept the sensitivity value

8.4 E2638 Measurements tab

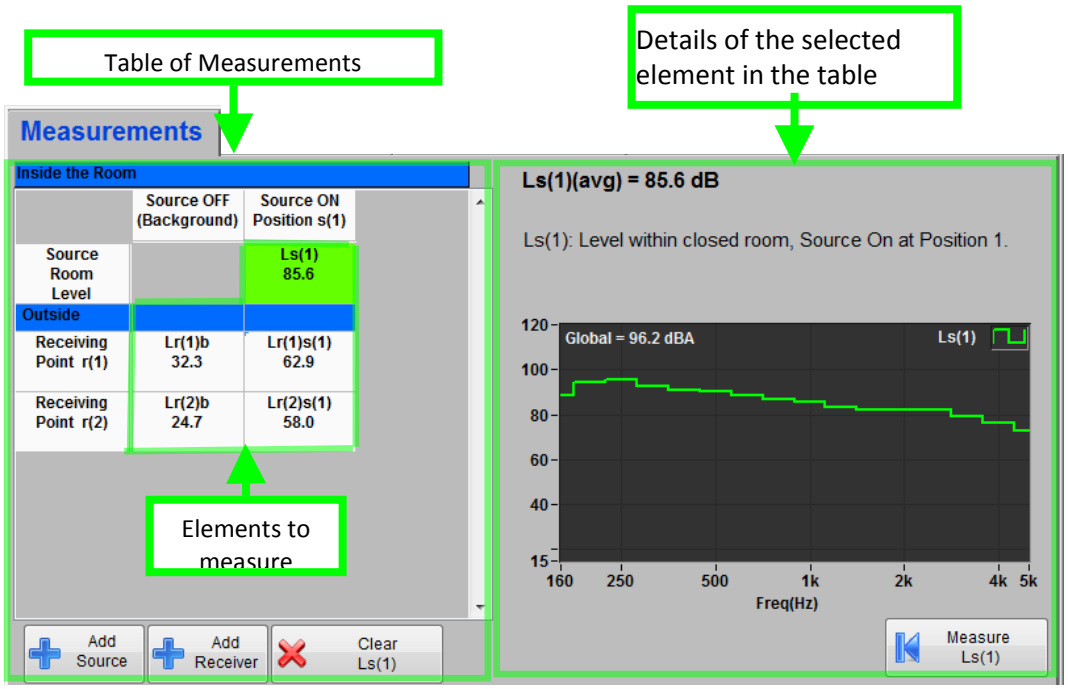


Figure 18: Measurements tab

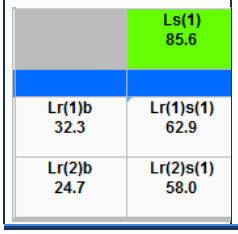
The Measurements tab can be divided in two parts. The Measurements Table is on the left side and the details on the right side. The user can select an element in table and its details will be displayed.

Measurements tab buttons

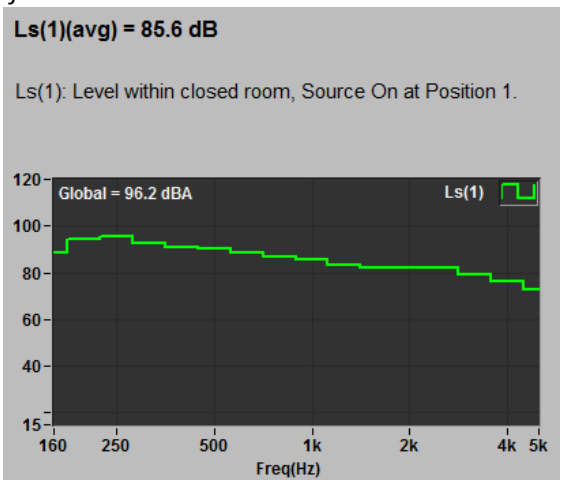
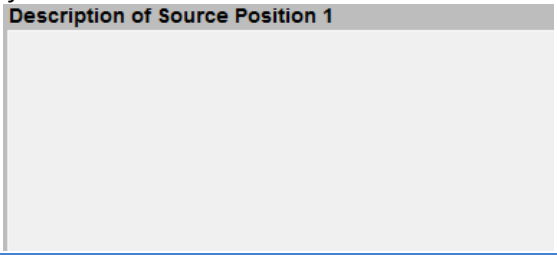
Measure Ls(1)	Open the measurement interface (see section 8.4.1, p.97). The selected element in the table (in green) will be measured.
Add Source	Add a source position in the closed room.
Add Receiver	Add a receiving point outside the closed room.
Clear Ls(1)	Click this button to clear/remove the selected table element. To remove a source position or a receiving point, select the corresponding header. To clear a measurement, select the corresponding element in the upper table.

The table of measurements contains a row of headers, a column of headers and the elements to measure. The table is expendable horizontally and vertically as source positions and receiving points are added.

Table of Measurements

Source Room Level	Header of room levels (Ls) measured within the closed room while the source is activated.
Receiving Point r(1)	Header of a receiving point. Click this element to access the description of the receiving point.
Source OFF (Background)	Header of the background noise at each receiving point.
Source ON Position s(1)	Header of a source position. Click this element to access the description of the source position.
	All other elements of the table are measurements to complete.

Details of the selected element in the table

If a measurement element is selected… 	Data name and average value in dB of the selected element. Description of the selected element Spectrum graph and global value of the selected element.
If a Header element is selected… 	A description of every source position and receiving point can be entered by selecting the corresponding header in the table.

8.4.1 Measurement Interface

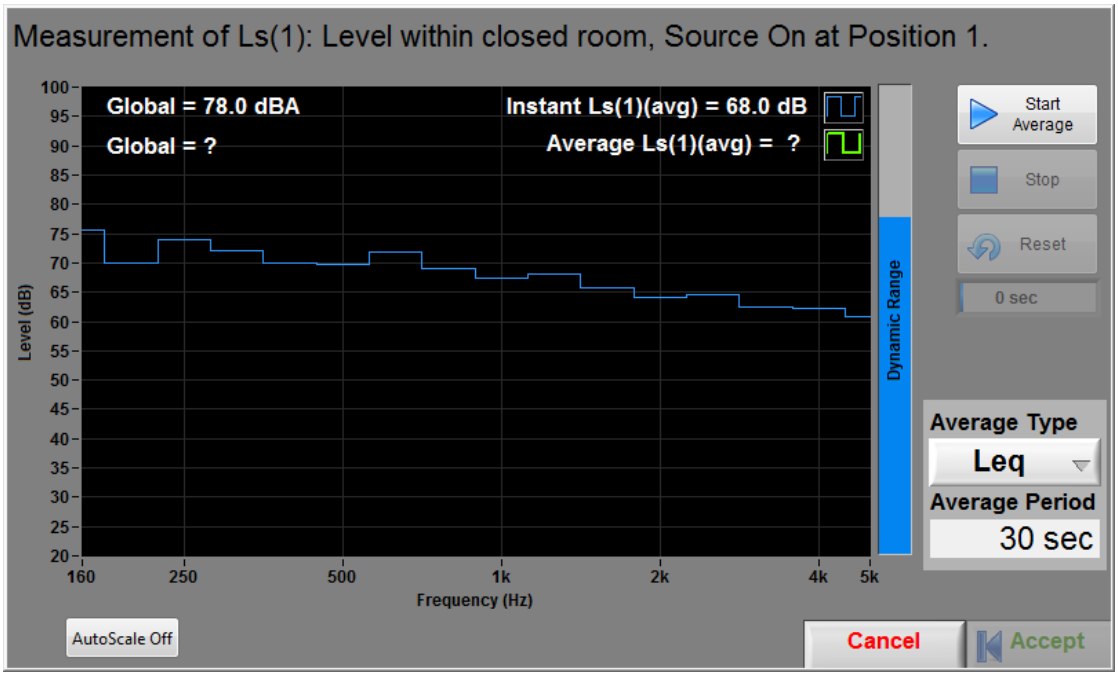
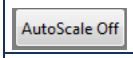
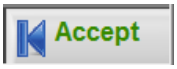


Figure 19: Measurement Interface

Table of Measurements

Start Average / Pause	The Start Average button starts the average measurements. Once pressed, the button becomes a Pause button. The measurement will stop by itself at the end of the average period.
Stop	The Stop button stops the average process
Reset	The Reset button restarts the average measurement.
6 sec	Progress bar of the average time.
Average Type: Leq; Average Period: 30 sec	The average parameters of Average type and Average Period can be modified directly on the Measurement Interface. The values will be updated in the corresponding value of the Setup Interface (see section 8.3, p.92)

	The dynamic range gives the information of the usage of the input range. When saturation occurs the indicator turns red. The word 'Sat' will also be displayed over the indicator as soon as saturation is detected during an average. Such a measurement should be rejected.
	If enabled the graph will rescale as an average ends.
	Once the measurement is acceptable, press the Accept button to return to the main interface.

8.5 E2638 Result tab

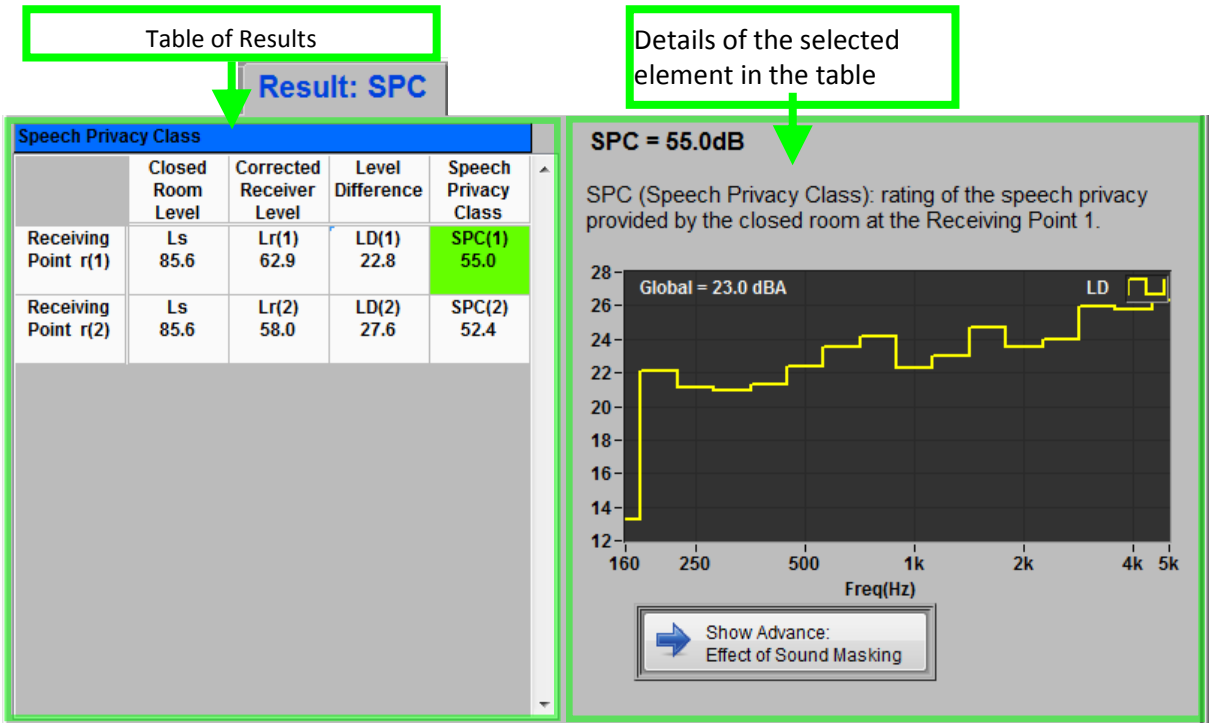


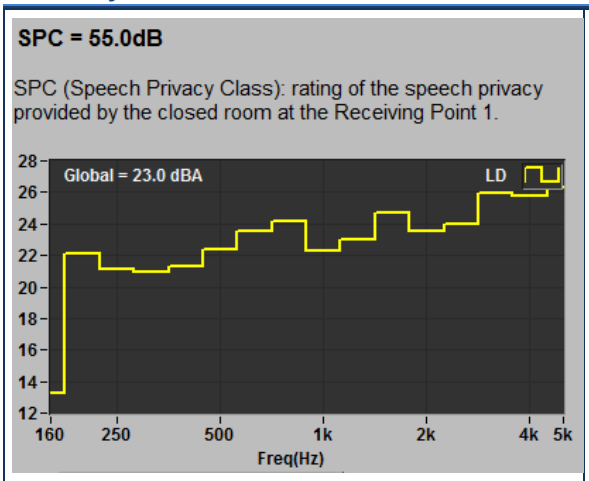
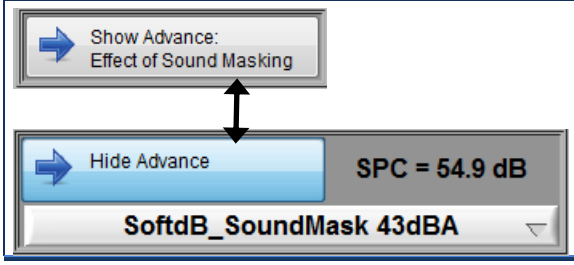
Figure 20: Result tab

The Result tab contains the table of results and the details on the right side. The table is expendable vertically as receiving points are added (in the Measurements tab).

Table of Results

Closed Room Level	Header of average room level (Ls) measured within the closed room while the source is activated. By definition, the same room level is used for every receiving point.
Corrected Receiver Level	Header of average level at a receiving point while the source is activated. The level may have been corrected for the background noise if the measurement with the source activated was too close of the background.
Level Difference	Header of level differences (the difference in average source room level and average level at a receiving point).
Speech Privacy Class	Header of Speech Privacy Class (rating of the speech privacy provided by the closed room). Refer to the section 8.5.1 (p.100) for the interpretation of the SPC result. If at least two source positions have been used, a confidence interval will also be displayed.
Receiving Point r(1)	Header of receiving points. Each row of the table contains the result for a receiving point.

Details of the selected element in the table

	Name and value in dB of the selected element. Description of the selected element Spectrum graph and global value of the selected element.
	This button is only available when a SPC element is selected. Click on the 'Show Advance' to simulate the effect of changing the background noise. A new SPC result is calculated according to the background selected.

8.5.1 Interpretation of the Speech Privacy Class

65dB < SPC < 70dB **Low Speech Privacy**	
70dB < SPC < 75dB **Minimal Speech Privacy**	One or two words will be intelligible at most once each 3 minutes, and speech sounds will frequently be audible (at most once each 0.6 minutes).
75dB < SPC < 80dB **Standard Speech Privacy**	One or two words will be occasionally intelligible (at most once each 18 minutes) and frequently audible (at most once each 2 minutes).
80dB < SPC < 85dB **Standard Speech Security**	One or two words will rarely be intelligible (at most once each 2.3 hours) and occasionally audible (at most once each 12.5 hours).
85dB < SPC < 90dB **High Speech Security**	Speech essentially unintelligible (at most once each 16 hours) and very rarely audible (at most once each 1.5 hours)
SPC > 90dB **Very High Speech Security**	Speech not intelligible and very rarely audible (at most once each 11 hours)

8.6 E2638 User Description tab

Figure 21: User Description tab

The User Description tab on the main panel can be used as a general note pad that will be saved along with the measurement data.

9 E1130 Module

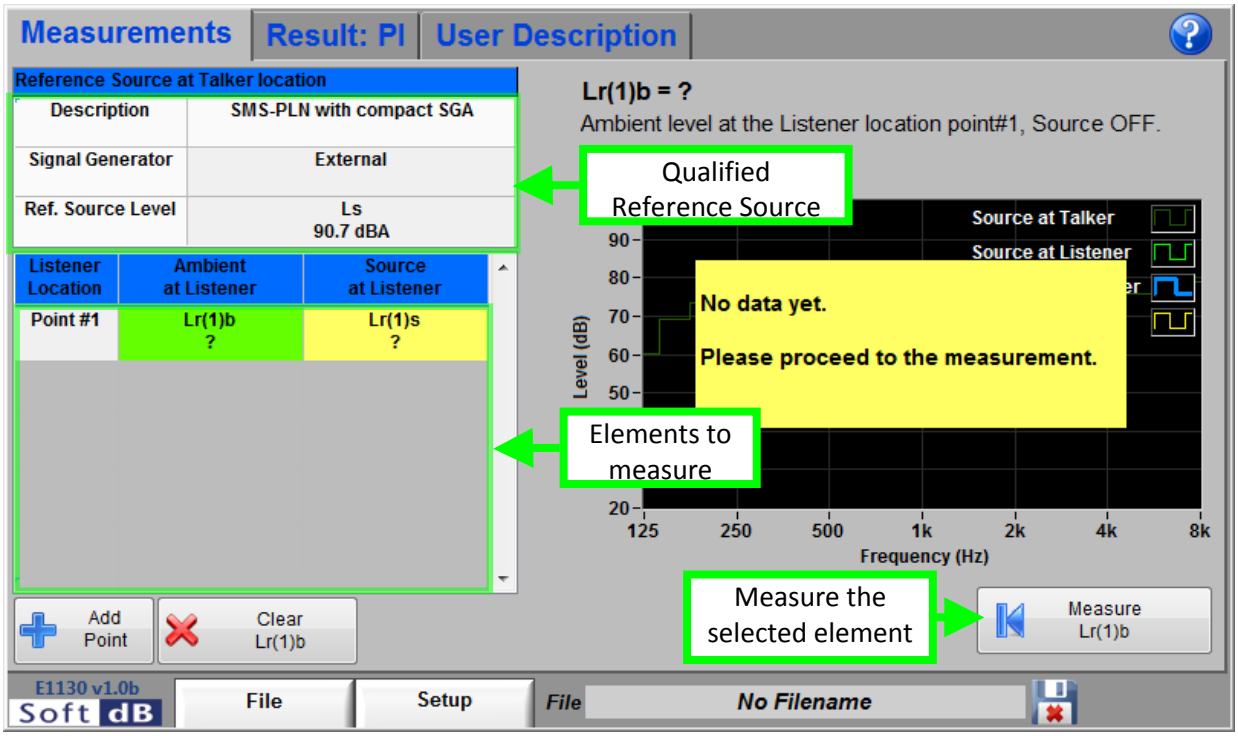
General Specifications

Standard	**Test Method E1130-02, by ASTM International** **Standard Test Method for Objective Measurement of the Speech Privacy in Open Offices using Articulation Index.** It is designed to measure the degree of speech privacy between locations in open offices, indicating the degree to which a conversation occurring at a talker location is kept private from the listener at a listener location.
Software Features	Intuitive interface for E1130 measurement Embedded noise generator (white or pink noise) Real time 1/3 octave band spectrum (IEC 1260 Type 1) Automated calculation of the Privacy Index (PI) Expendable interface for multiple listener locations Save, load and export measurement files

9.1 E1130 Quick Start

The E1130 module (Speech Privacy in Open Offices) is part of the Building Acoustics. It can be accessed in the Building Acoustics menu of the Opus Suite panel (see **Erreur ! Source du renvoi introuvable.**).

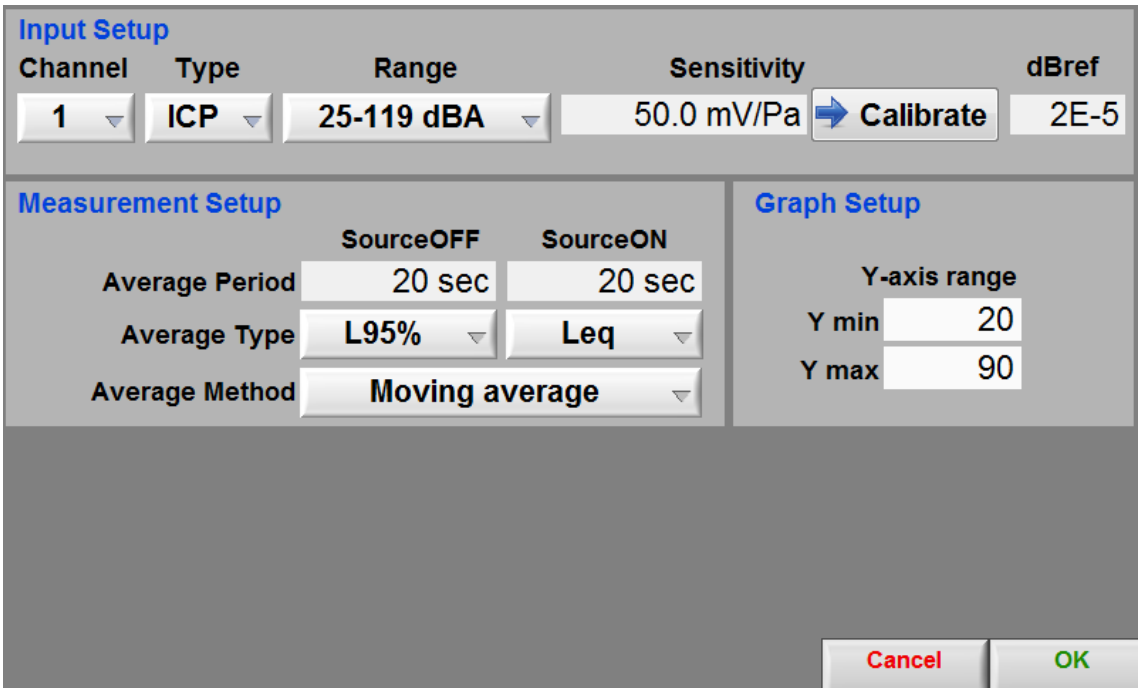
Measurement tab



What you should know…

- The main interface let you add/remove listener location points.
- A text description can be entered for each point. Click on the corresponding header in the table to display the text box.
- The selected element of the table shows a green background. The details of the selection are displayed on the right side of the table.
- The elements still to measure display a question mark (?) as a value and have a yellow background.

Step 1 Setup the unit

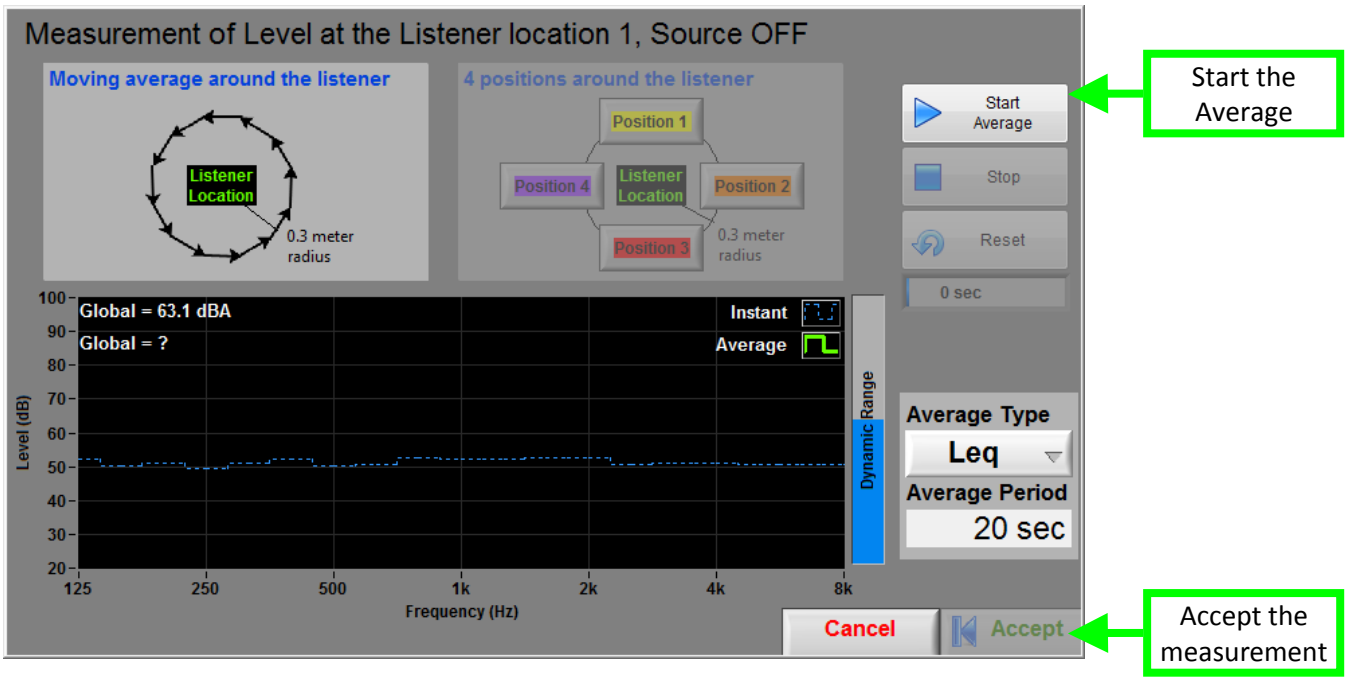


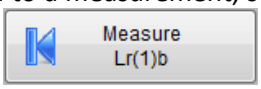
Click on the Setup button to access the setup interface. The parameter should typically be set as shown on figure above.

Before a measurement, the operator should set the sensitivity of the sensor used. This sensitivity can be set manually if it is known. Preferably, the sensor sensibility should be set by using the software calibration tool and a calibrator. To do so, click on Calibrate and follow the instructions of the Sensor Calibration (section 9.3.1, p.112).

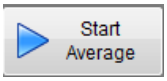
Click OK to return to the main panel.

Step 2 Do a Measurement

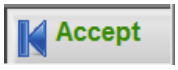


To proceed to a measurement, select an element to measure in the table of the main panel and click the button 

to open the measurement interface.

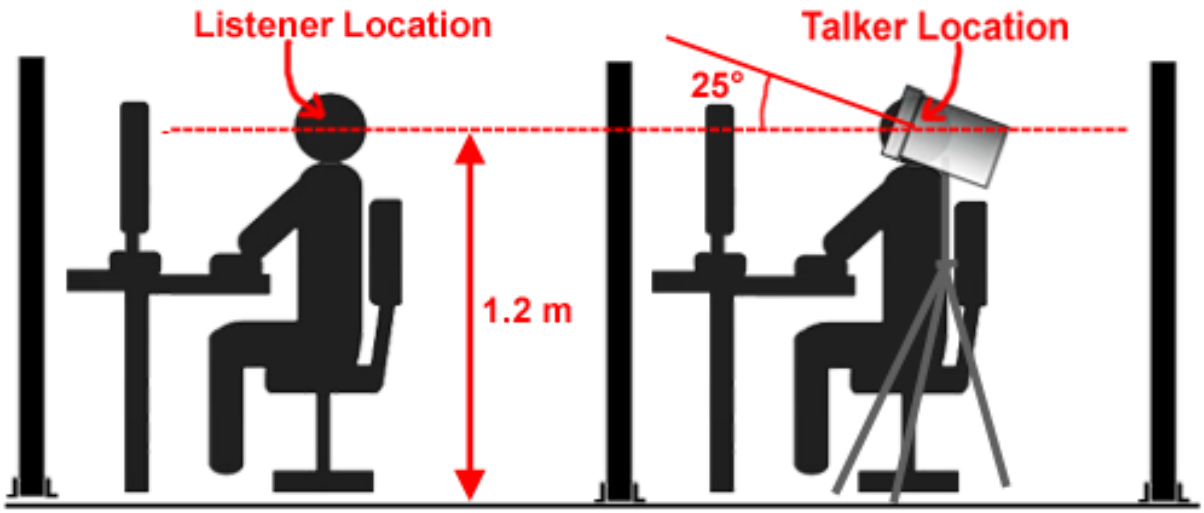
Once in the measurement panel, click on the 

button to start the average measurement. The acquisition end by itself once the average period is reached (as set in setup) and can be stopped at any time.

Click on the 

button to accept the measurement.

You are now ready to follow the measurement procedure.



Step 3 Talker Location Setup

- A qualified conventional directional loudspeaker should be used
- Location 1.2 m above the floor
- Speaker directed toward the listener location.
- Speaker inclined 25° above the horizontal

Step 4 Ambient Measurement

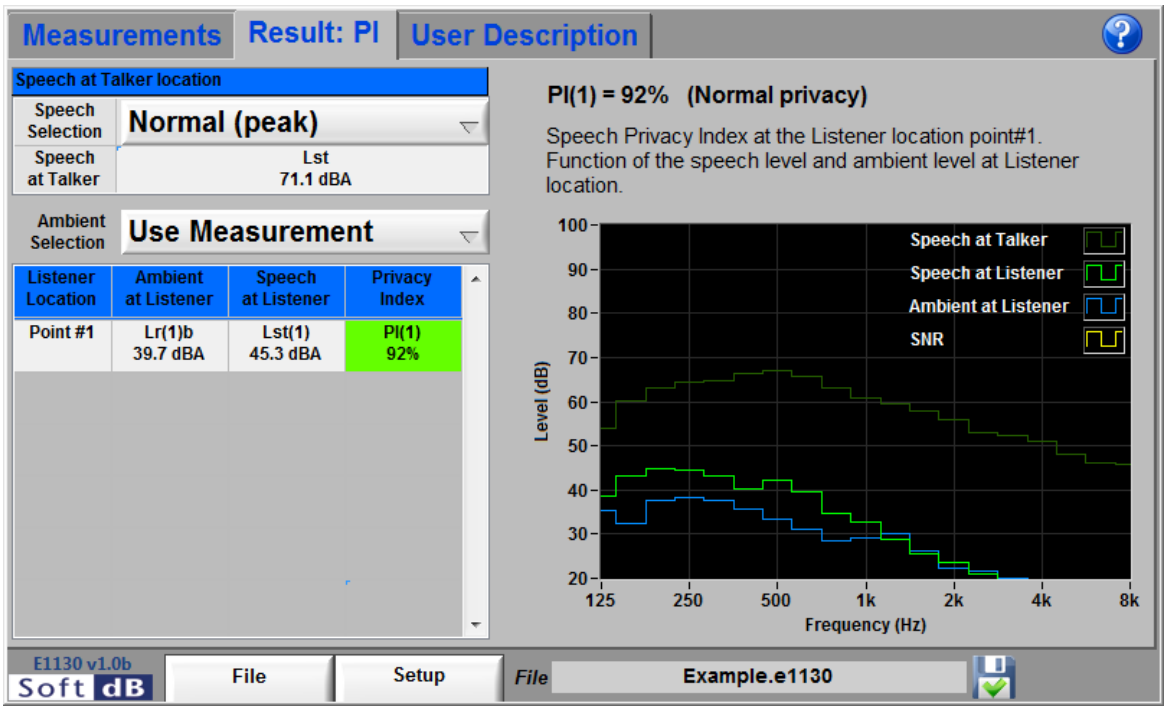
Measure the sound level at the listener location while the source is off.

- Average of 4 positions around the defined listener location (E1130 standard). Measurement at 4 equally spaced positions around a virtual circle of 0.3 m radius centered on the defined location. Use at least 4 seconds average time.
- Optionally, the single moving average can be done instead of the 4 position method. A average time of at least 15 seconds should be used
- Measured level must exceed Ambient level by 10 dB in each band
- 1.2 m above the floor
- If the preceding conditions cannot be met, the usual worker's position is used
- Microphone directed upwards

Step 5 Level Reduction Measurement

Measure the sound level at the listener location while the source is on. Repeat previous step with source on.

Step 6 Analyze the results



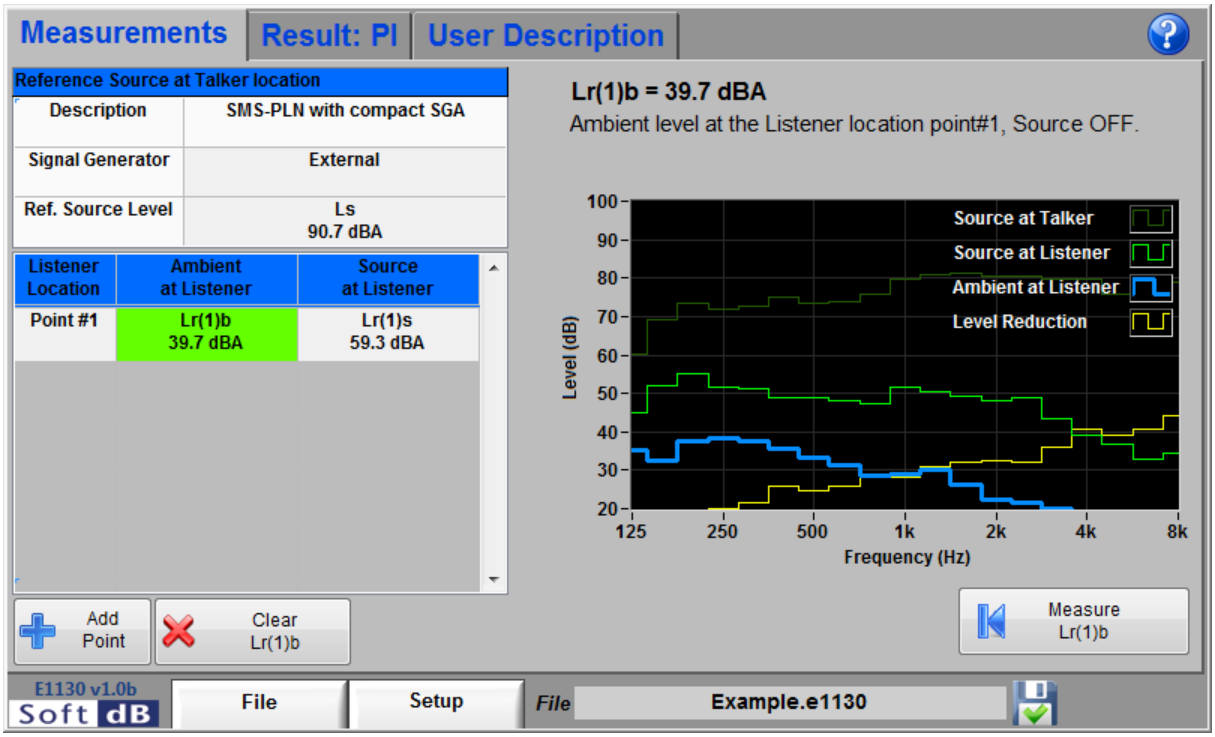
The Result Tab displays the results of the speech privacy of the room.

The measurements can be saved and exported through the menu of the File button.

The following table gives some indications on how to interpret the Speech Privacy Class (SPC).

0% < PI < 60%	Essentially no privacy.
60% < PI < 70%	Unacceptable privacy
70% < PI < 80%	Poor privacy. Speech becomes more readily understood
80% < PI < 95%	Normal privacy. Understanding speech requires concentrated effort
95% < PI < 100%	Confidential speech privacy. Speech cannot be understood

9.2 E1130 Main Interface

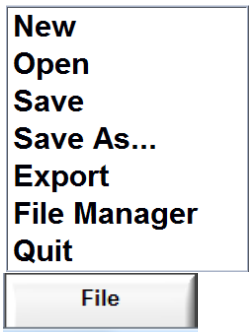


The main interface mainly contains three tabs and a menu bar.

Main controls and indicators

Measurements Result: PI User Description	Main interface tabs: • Measurements tab (section 9.4, p.113) • Result tab (section 9.5, p.120) • User Description tab (section 9.6, p.122)
File	File Menu button (see the following table).
Setup	Setup button that calls the setup interface (section 9.3, p.110).
E1130 v1.0b Soft dB	Module name and version number.
File Example.e1130	File name of the measurement. A green check on the disk icon indicates that the data are saved.
	Click this button to display the help window. This help is a reminder of the steps and the rules to follow.

File Menu



New	Creates a brand new measurement session.
Open	Opens a previous measurement file.
Save	Saves the current measurement into the specified file.
Save As…	Saves the current measurement into a new file.
Export	Exports the measurement data into a text file. The file is saved as .xls extension and can be opened with Microsoft Excel or any text editor.
File Manager	Launches the File Manager (see section 11, p. 124)
Quit:	Allows to quit the module and to return to the Opus Suite Interface.

9.3 E1130 Setup Interface

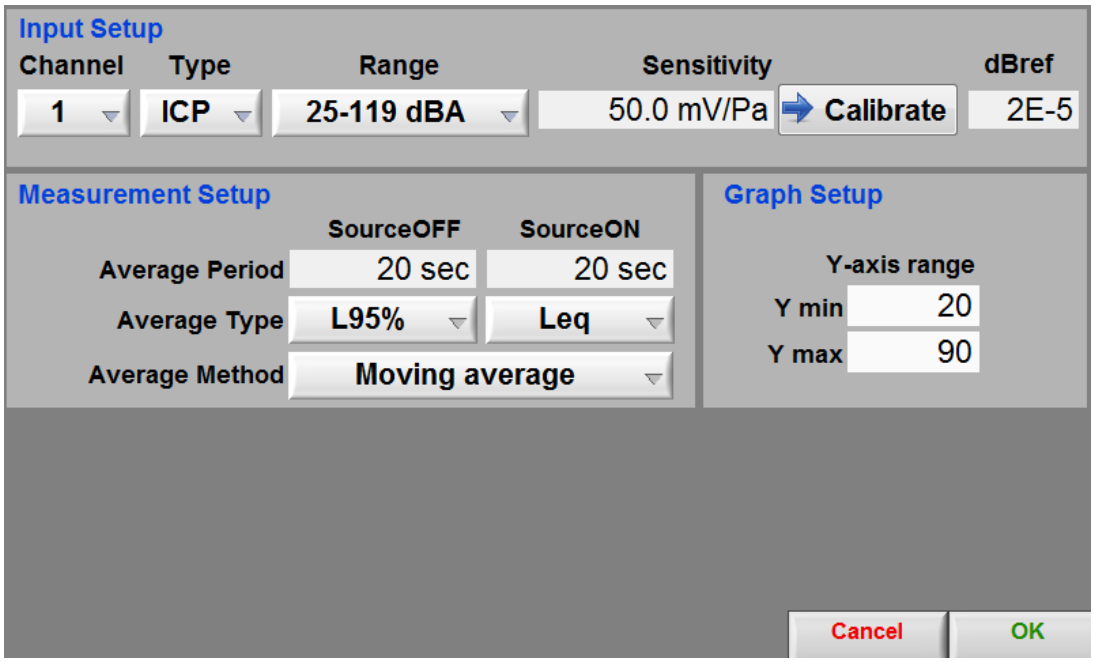
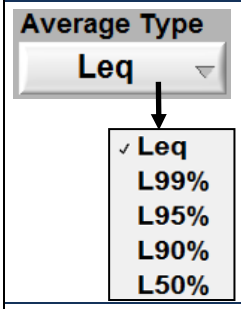


Figure 22: Setup interface

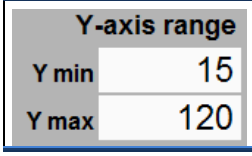
Input Setup

Channel 1	The input channel used for the measurements
Type ICP AC ICP	The available input types are AC and ICP sensors.
Range 25-119 dBA	Selection of the dynamic range. For a microphone sensitivity of 50mV/Pa. • Low Range: 25 to 119 dBA • High Range: 37-130 dBA Concerto: the input 1 and 2 have two range settings (Low or High) while inputs 3 and 4 have a single fixed range (Low). Alto and Conductor: only the low range is available.
Sensitivity 50.0 mV/Pa Calibrate	The sensor sensitivity can be entered manually or the Calibration interface can be used (see section 9.3.1, p.112).
dBref 2E-5	The dB reference is the unit reference from which the decibel (dB) is calculated.

Measurement Setup

	The average period of the two types of measurement can be adjusted independently.
	The average type of the two types of measurement can be adjusted independently. It can be adjusted to be a plain average (Leq) or a statistic level (Lx%). Using the statistics instead of the Leq can minimize the punctual noise events that may occur during a measurement (especially for the background).
	The standard method would normally use the 4 Positions method. However, a moving average around the listener location would do as well.

Graph Setup

	The Ymin and Ymax parameters set the vertical scale (levels in dB) of the spectrum graphs of the current module.

9.3.1 Sensor Calibration

The input sensitivity can be calibrated using the calibration function and a sensor calibrator. Click the **Calibrate** button on the Setup interface to launch the Calibration interface.

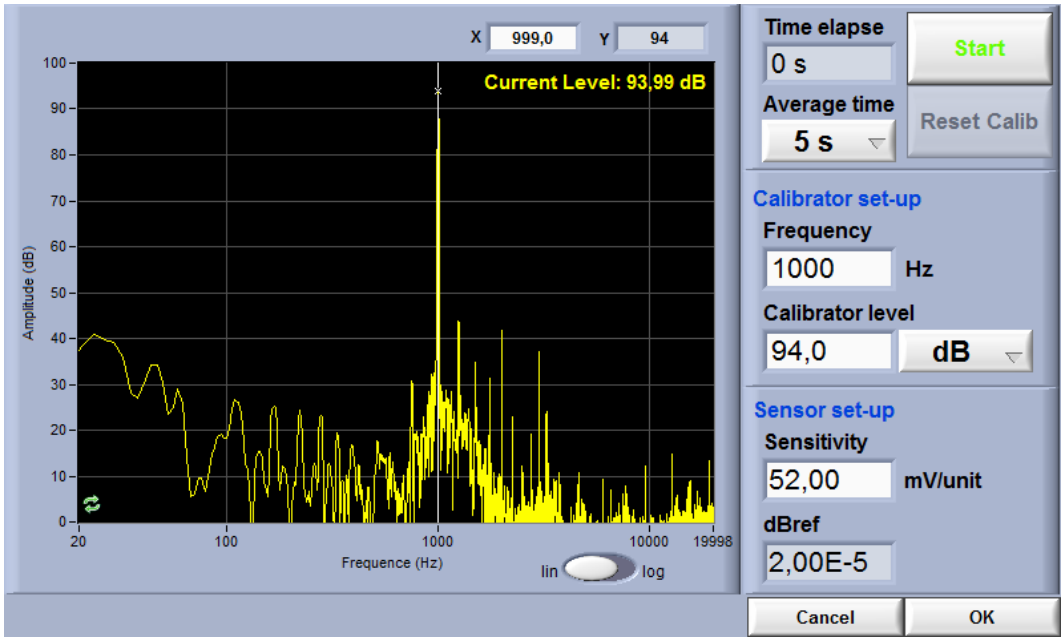


Figure 23: Sensor Calibration Interface

Step 1 Adjust the calibration parameters

The defaults values are:

- Averaging time: 5 s
- Frequency: 1 kHz
- Calibrator Level: 94 dB

Step 2 Install the calibrator device on the microphone

Step 3 Click START

After the average time is elapsed, the sensitivity value will update.

Step 4 Click OK to accept the sensitivity value

9.4 E1130 Measurements tab

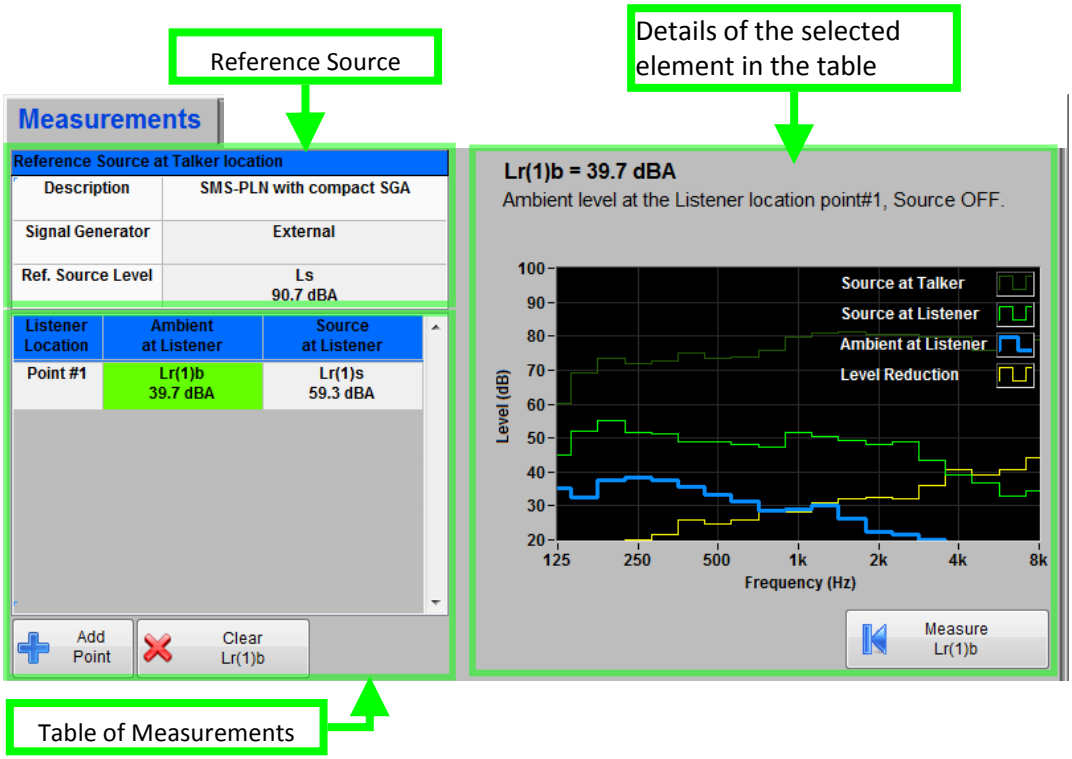


Figure 24: Measurements tab

The Measurements tab can be divided in three parts. The reference source is in upper left corner. Just under is the table of measurements. Finally, the details of the selected element are on the right side.

Measurements tab buttons

Measure Lr(1)b	If a element of the table is selected, the measurement interface will be called (see section 9.4.3, p.118). If the Reference Source is selected, the Reference Sound Source setup will be called (see section 9.4.1, p.115).
Add Point	Add a listener location point.
Clear Lr(1)b	Click this button to clear/remove the selected table element. To remove a listener location point, select the corresponding header. To clear a measurement, select the corresponding element.

Reference Source

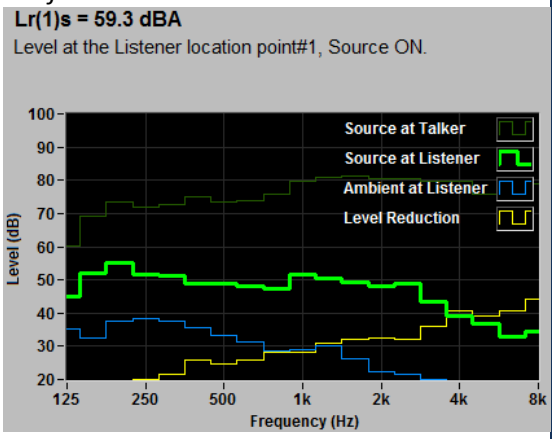
Reference Source at Talker location **Description** — **SMS-PLN with compact SGA**	Description of the qualified sound source used.
Signal Generator — **External**	Setting of the embedded noise generator of the unit.
Ref. Source Level — **Ls** **90.7 dBA**	Global level of the reference sound source.

Table of Measurements

Listener Location **Point #1**	Header of a listener location point. Click this element to access the description of the point.
Ambient at Listener **Lr(1)b** **39.7 dBA**	Background level at a listener location point while the source is turned off.
Source at Listener **Lr(1)s** **59.3 dBA**	Level at a listener location point while the reference sound source is activated.

The table of measurements contains a row of headers and the elements to measure. The table is expendable vertically as listener location points are added.

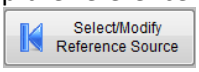
Details of the selected element in the table

If a measurement element is selected… 	Name and global dBA level of the selected element. Description of the selected element Spectrum graph of the selected point. The plot line width of the selected element appears thicker. The level reduction is the difference between the source level at the talker location (reference source) and the source level at the listener location (measurement with source on).
If a point header is selected…	A description of the selected listener location point is displayed and can be edited.

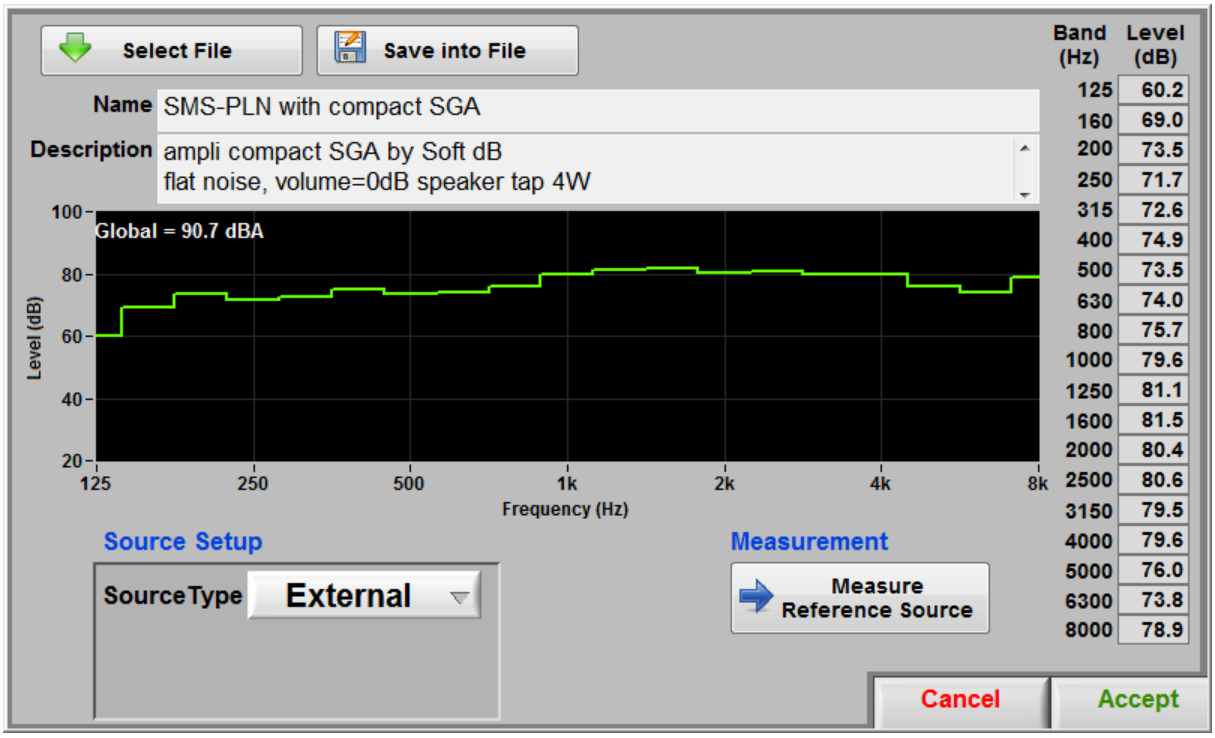
Listener Location Point#1	

9.4.1 Reference Sound Source Setup

The E1130 test method requires a qualified reference sound source. The qualification of this reference source should be done in an anechoic chamber. On the field, the operator must ensure that all the parts of equipment (noise generator, amplifier, speaker) and the settings (volume, noise shape) are the same as in the qualification.

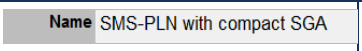
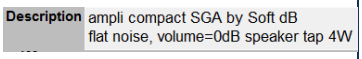
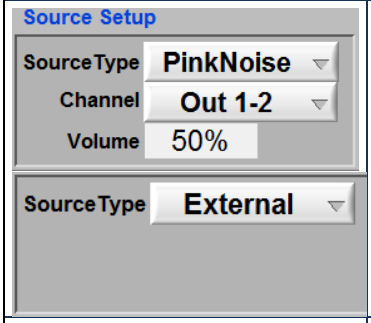
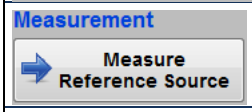
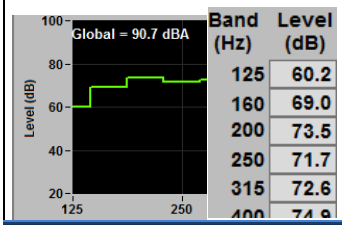
In order to setup the reference source, click on the reference source area on the measurement tab and click on the 

button. The following interface will be called.



Reference source interface

Select File	The measurement and settings of the qualified sound source can be load from a file if previously saved. The software installer also includes a few reference files (directory path: 'My Documents\Opus\E1130_Reference')

	It is strongly suggested to save any qualification into a file for further use.
	The name of the reference should clearly identify the qualified system. This name is also the default name when saving into file.
	Enter the full description of the system used to generate the reference sound source.
	The unit can be used as a noise generator. This signal can further be amplified and output on a speaker. This offers the advantage that the software will turn on/off the source as needed. An external system can also be used to generate the noise.
	This button will call the measurement interface of the reference sound source.
	The spectrums graph and numerical values of the qualified sound source.

9.4.2 Qualification of the Reference Sound Source

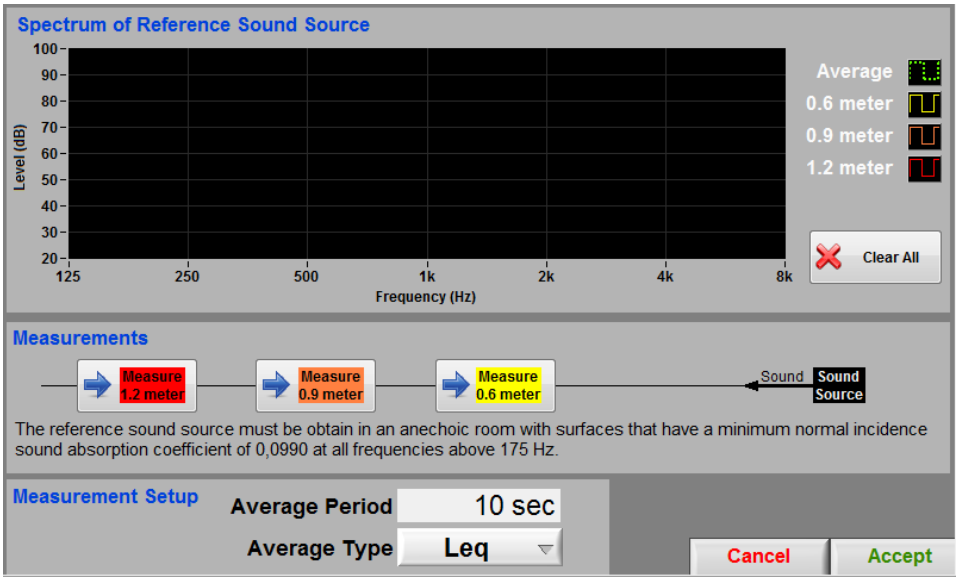
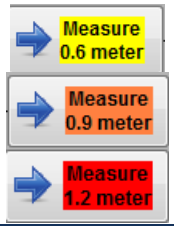
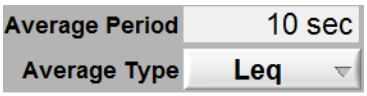


Figure 25: Qualification Interface

Qualification Interface

	Each of the three measure button will launch the measurement interface. The average of the 3 spectrums will be used as the reference signal.
	The measurement setup let you adjust the average period and average type that will be used during the qualification measurements.

9.4.3 Measurement Interface

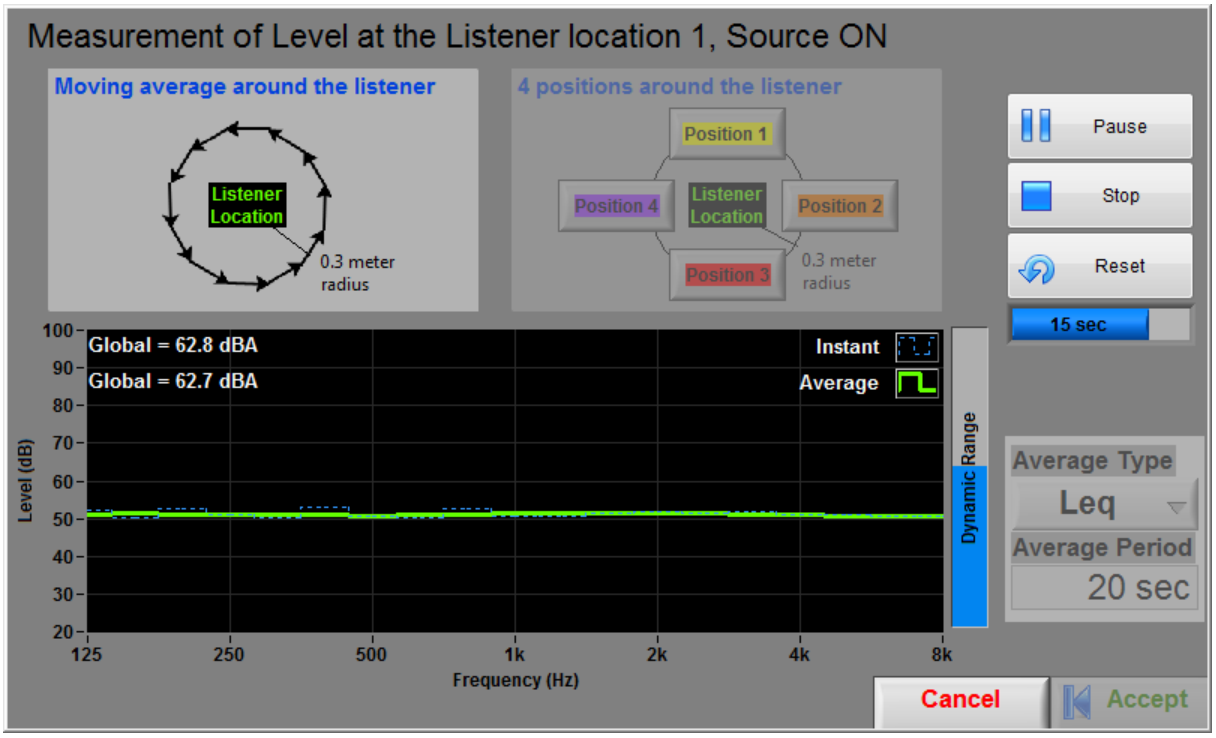
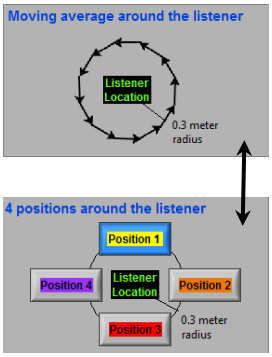
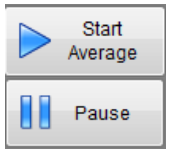
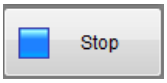
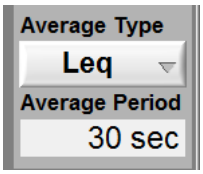
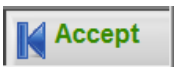


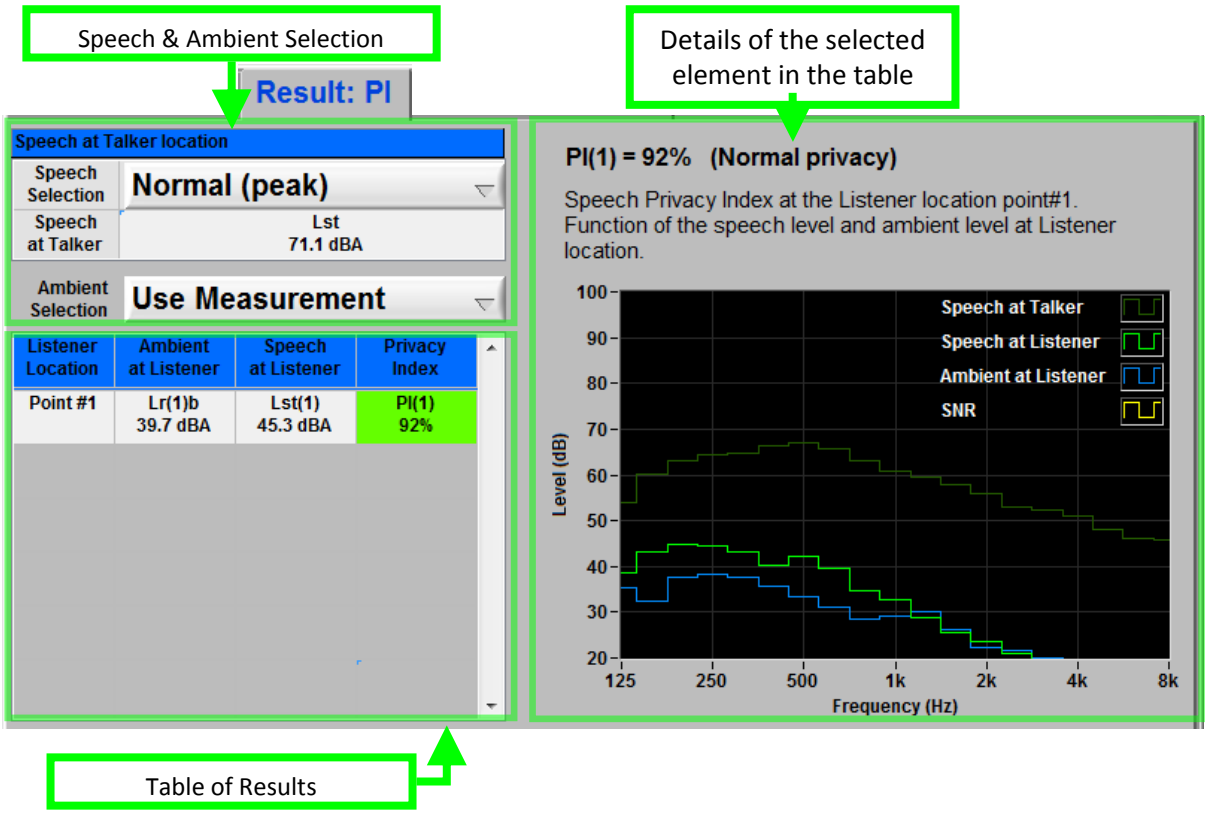
Figure 26: Measurement Interface

Table of Measurements

	One of the two average methods can be used for the measurement. This parameter is also available in the Setup Interface (see section 9.3, p.110). Moving average • A single measurement is necessary for this method. • The average time should be adjusted to at least 15 seconds. • Measurement while moving the microphone on a virtual circle of 0.3 meter radius around the listener location. 4 positions • Average of 4 positions around the defined listener location (E1130 standard). • The average time should be adjusted to at least 4 seconds. • Measurement at 4 equally spaced positions around a virtual circle of 0.3 meter radius around the defined location.
	The Start Average button starts the average measurements. Once pressed, the button becomes a Pause button. The measurement will stop by itself at the end of the average period.

	The Stop button stops the average process
	The Reset button restarts the average measurement.
	Progress bar of the average time.
	The average parameters of Average type and Average Period can be modified directly on the Measurement Interface. The values will be updated in the corresponding value of the Setup Interface (see section 9.3, p.110)
	The dynamic range gives the information of the usage of the input range. When saturation occurs the indicator turns red. The word 'Sat' will also be displayed over the indicator as soon as saturation is detected during an average. Such a measurement should be rejected.
	Once the measurement is acceptable, press the Accept button to return to the main interface.

9.5 E1130 Result tab



The Result tab contains the speech selection and ambient selection that will be used to evaluate the privacy index. The tab also contains the table of result and the details on the right side. The table is expendable vertically as listener location points are added (in the Measurements tab).

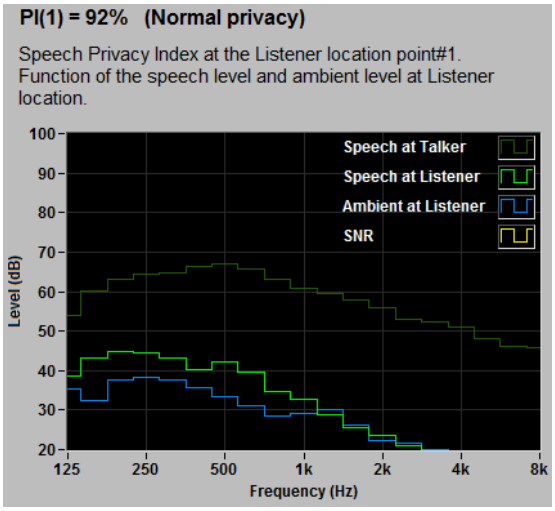
Speech & Ambient Selection

Speech at Talker location Speech Selection: Normal (peak) Speech at Talker: Lst 71.1 dBA	The speech selection is used in the calculation of the privacy index to simulate a conversation at the talker location. Normal speech is usually used for this purpose.
Ambient Selection: Use Measurement	The ambient level is required for the calculation of the privacy index. Normally the measured ambient level is used for this purpose. However, it may be interesting to simulate the effect of changing the background noise on the privacy index.

Table of Results

Listener Location Point #1	Header of a listener location point.
Ambient at Listener Lr(1)b 39.7 dBA	Background level (according to the Ambient Selection) at a listener location point while the source is turned off.
Speech at Listener Lst(1) 45.3 dBA	Simulated speech level (according to the Speech Selection) at the listener location point.
Privacy Index PI(1) 92%	Privacy Index. Refer to the section 9.5.1 (p.121) for the interpretation of the SPC result.

Details of the selected element in the table

	Name and value of the selected element. Description of the selected element Spectrum graph of the selected listener location point. The SNR is the Sound-to-Noise Ratio, which is the difference between the speech level and the ambient level at the listener location.

9.5.1 Interpretation of the Speech Privacy Class

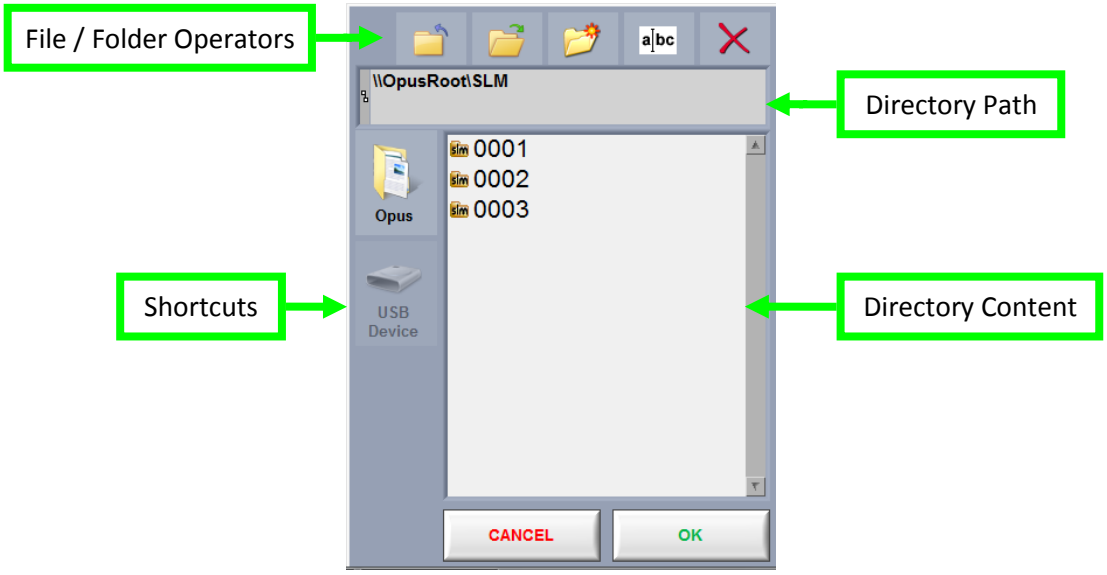
The following table gives some indications on how to interpret the Speech Privacy Class (SPC).

0% < PI < 60%	Essentially no privacy.
60% < PI < 70%	Unacceptable privacy
70% < PI < 80%	Poor privacy. Speech becomes more readily understood
80% < PI < 95%	Normal privacy. Understanding speech requires concentrated effort
95% < PI < 100%	Confidential speech privacy. Speech cannot be understood

9.6 E1130 User Description tab

The User Description tab on the main panel can be used as a general note pad that will be saved along with the measurement data.

10 Explorer Dialog



Explorer Window Controls and Indicators

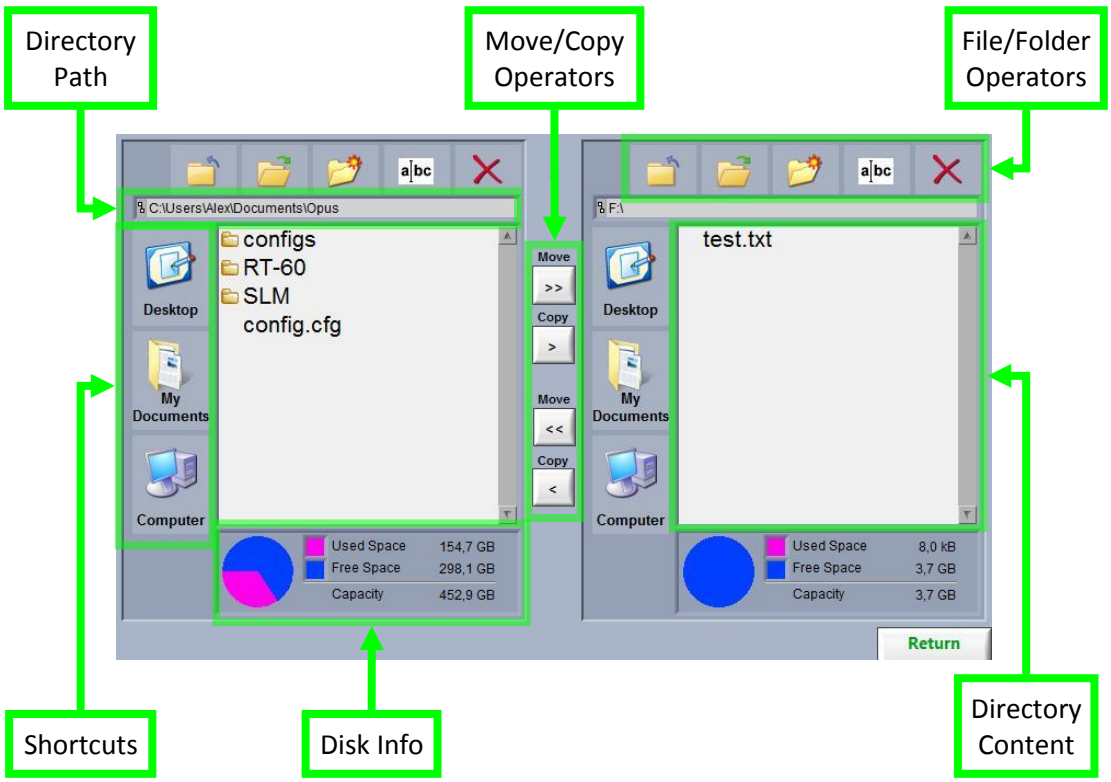
File/Folder Operators	• Go to parent directory • Open directory • Create new folder • Rename folder or file • Delete folder or file
Directory Path	Displays the path of the active directory.
Shortcuts	Accesses to **common directories**. When used on a stand-alone computer, those shortcuts are linked to: • 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.

11 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

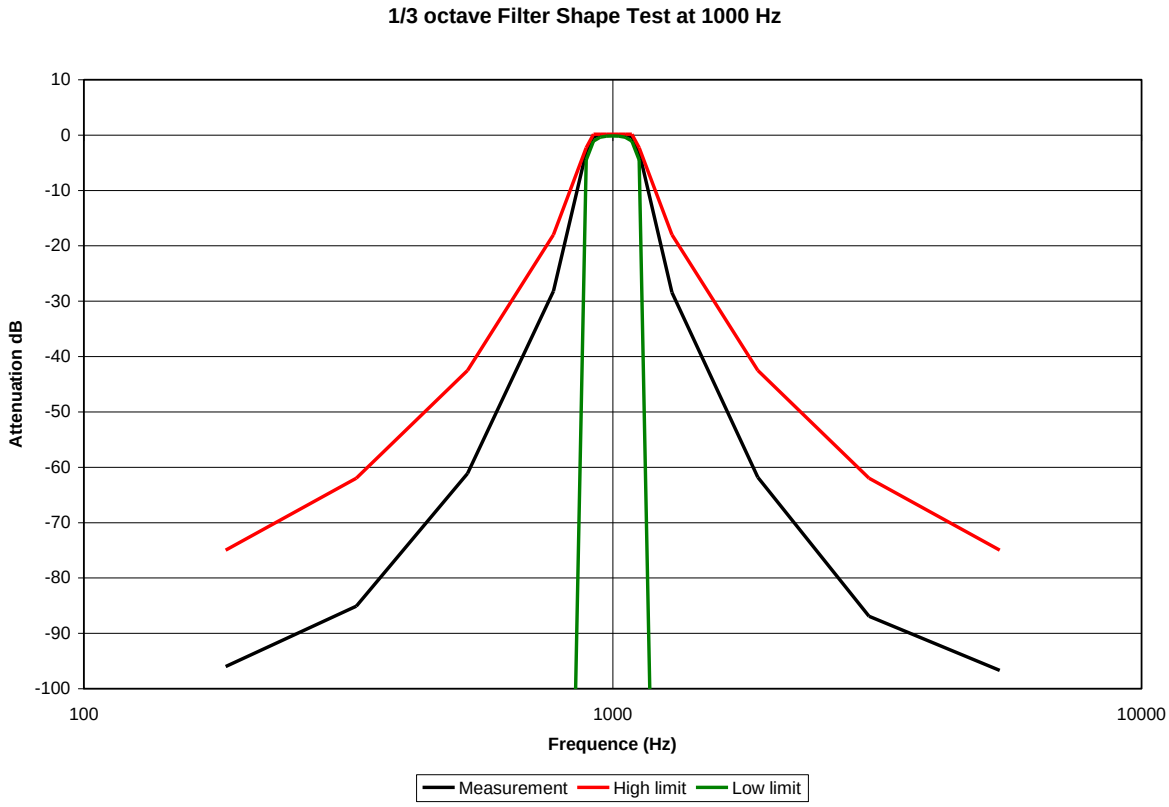
The 1/3 octave filters are computed at low-level in real time (at 48 kHz) on the digital signal processor (DSP) of the Concerto system. The filters comply with all requirements of IEC 61260 for Class 1.

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

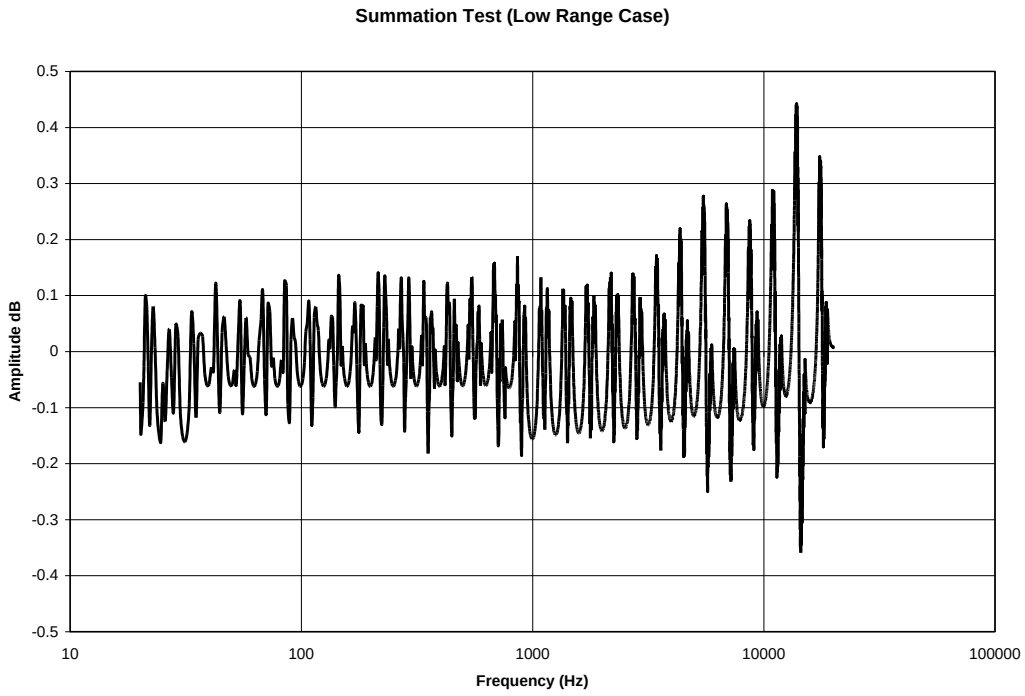
Filter Linearity (High Range)

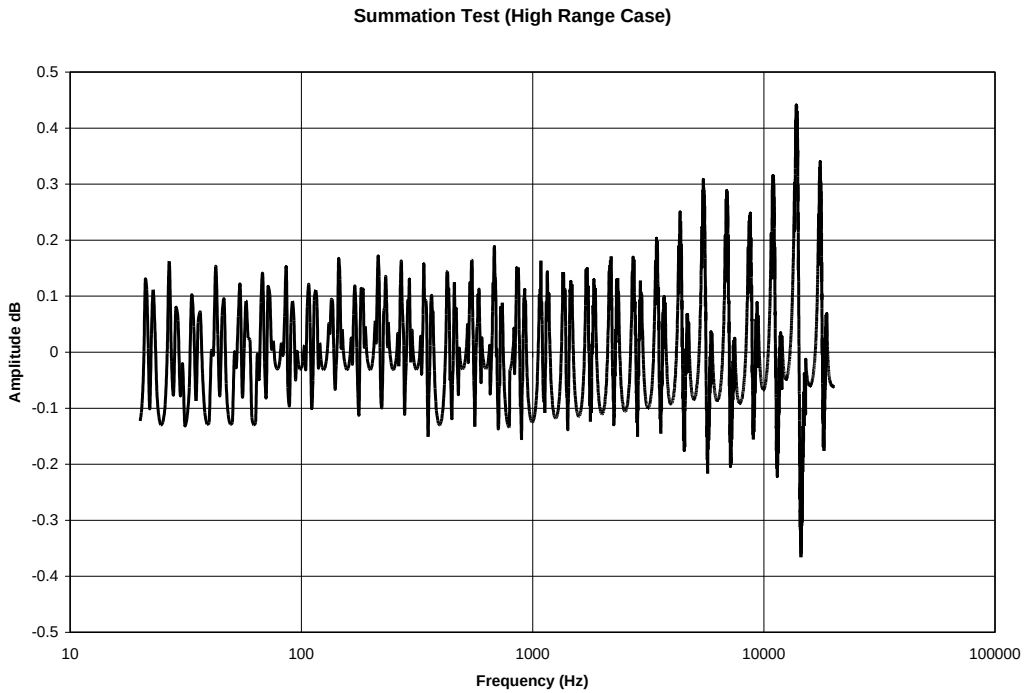
Frequency (Hz)	Saturation Level (dB)	Minimum Linear Level (dB)	Linear Dynamic Range (dB)	Noise Floor (dB)
20	132.5	51.5	81.0	7.3
25	132.5	49.2	83.3	5.3
31.5	132.5	47.1	85.4	2.0
40	132.5	44.2	88.3	7.9
50	132.5	41.8	90.7	9.3
63	132.5	39.1	93.4	9.1
80	132.5	37.1	95.4	10.6
100	132.5	32.6	99.9	10.6
125	132.5	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)