Spectralissime

High Definition Frequency Analyzer For Any Acoustic Measures.

USER MANUAL

OFFICIAL WEBSITE
www.spectralissime.com

INSTALLATION:
Run setup program and follow instructions.

Fair Trade, Affordable For Everyone

Spectralissime is distributed as a donationware! It means you can adjust the license price according to your means or usage!

For Spectralissime Application, price range is around 5 to 100 Euro / Dollar. A registration code is given to activate your license. The Challenge Code is given by your application running on your computer (see Menu > About Box).

Windows XP, VISTA, WIN7, WIN8, WIN8.1, WIN10 32/64 bits (MME, DX, WDM/WASAPI, KS, ASIO).
www.spectralissime.com / www.vb-audio.com

Table of Content

INTRODUCTION:

Spetralissime is a standalone Spectrum Analyzer application based on high precision band pass filter bank, more adapted to the human audition. Spectralissime gives a more consistent spectrum analysis and allows better understanding of any audio phenomena thanks to its constant precision, from 20 Hz to 20 kHz. It can analyze any audio sources, coming from any audio interface and VBAN stream (Ethernet).
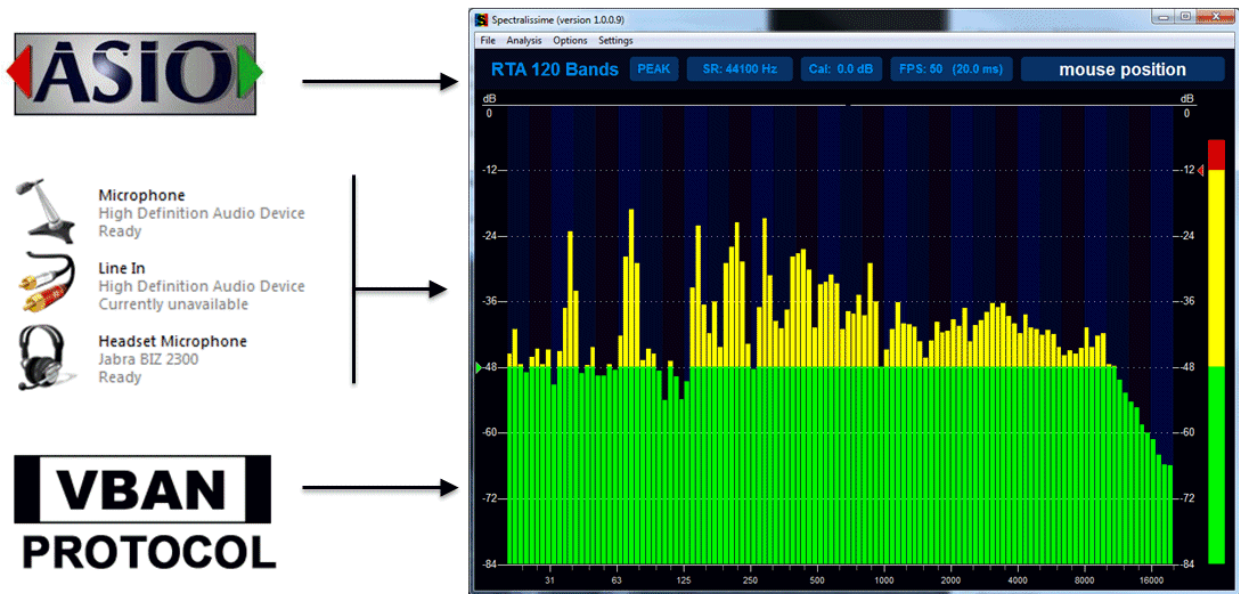
On first start, Spectralissime uses the windows default recording device to get audio signal and analyze it.

Audio interfaces type supported by Spectralissime.

Interface Type	Description
MME	The MME API or the Windows Multimedia API (also known as WinMM) was the first universal and standardized Windows audio API. This audio interface type is expected to work with whatever audio device but with latency time possibly around 100ms.
WDM	That we call WDM (Windows Driver Model) audio interface in voicemeeter is handled by WASAPI : the Latest Microsoft Audio Functions to get best audio performances and small latency (< 30ms) – available since Windows VISTA
KS	Kernel Streaming or Direct Kernel streaming API allows low latency audio streaming, since Windows XP, but unfortunately not all audio devices provides this interface.
ASIO	Audio Stream Input/Output (ASIO) is a computer sound card driver protocol for digital audio specified by Steinberg, providing a low-latency and high fidelity interface between a software application and a computer's sound card.
VBAN	Ethernet Protocol developed by Vincent Burel, to transport audio over local network in real time and native PCM format (without loss).

We recommend to use ASIO driver for better performances, WDM/KS interface otherwise, MME as last choice.

Analysis type:

Spectralissime provides 60, 120 and 240 bands frequency analysis through two kinds of filters: FAST Analysis and RTA Analysis on a 24 bit resolution range (-140 to 0 dBfs).

FAST Analysis is based on simple biquad filter (for better reaction time precision) .
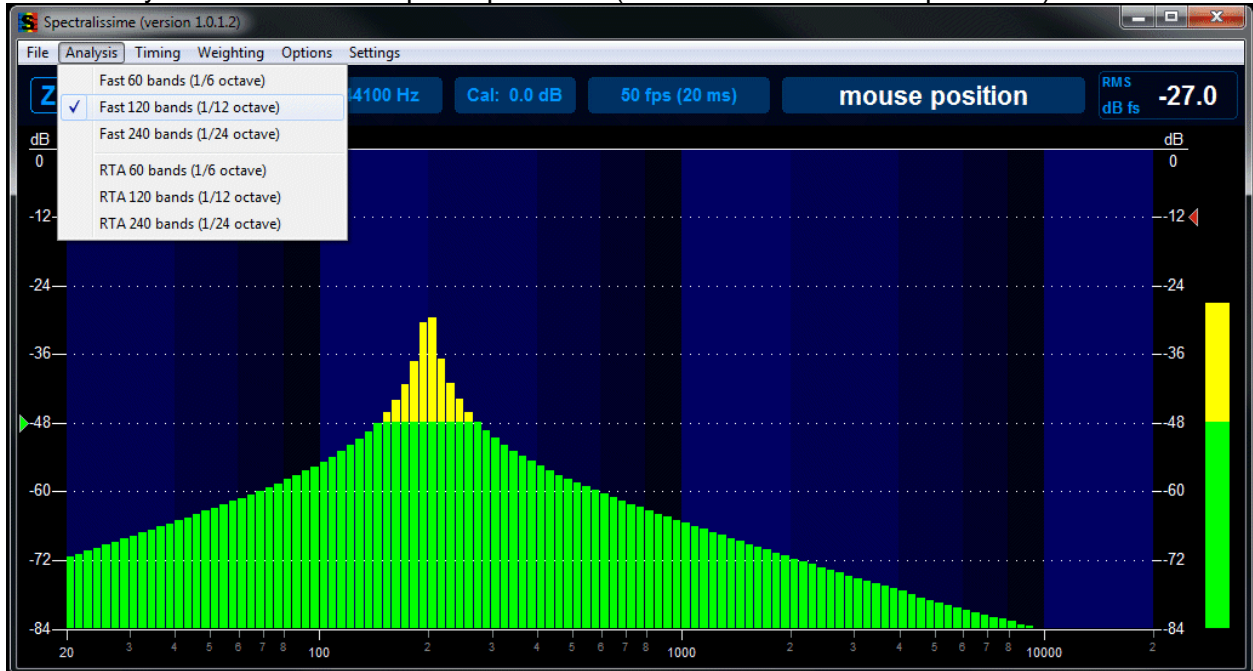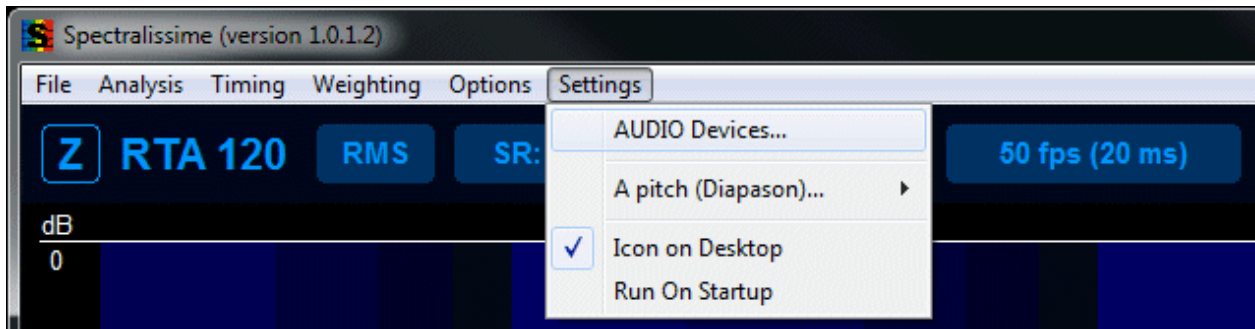

(-24 dB 200 Hz Sinus analysis)

RTA analysis is based on high precision band pass filter (for better frequency separation).
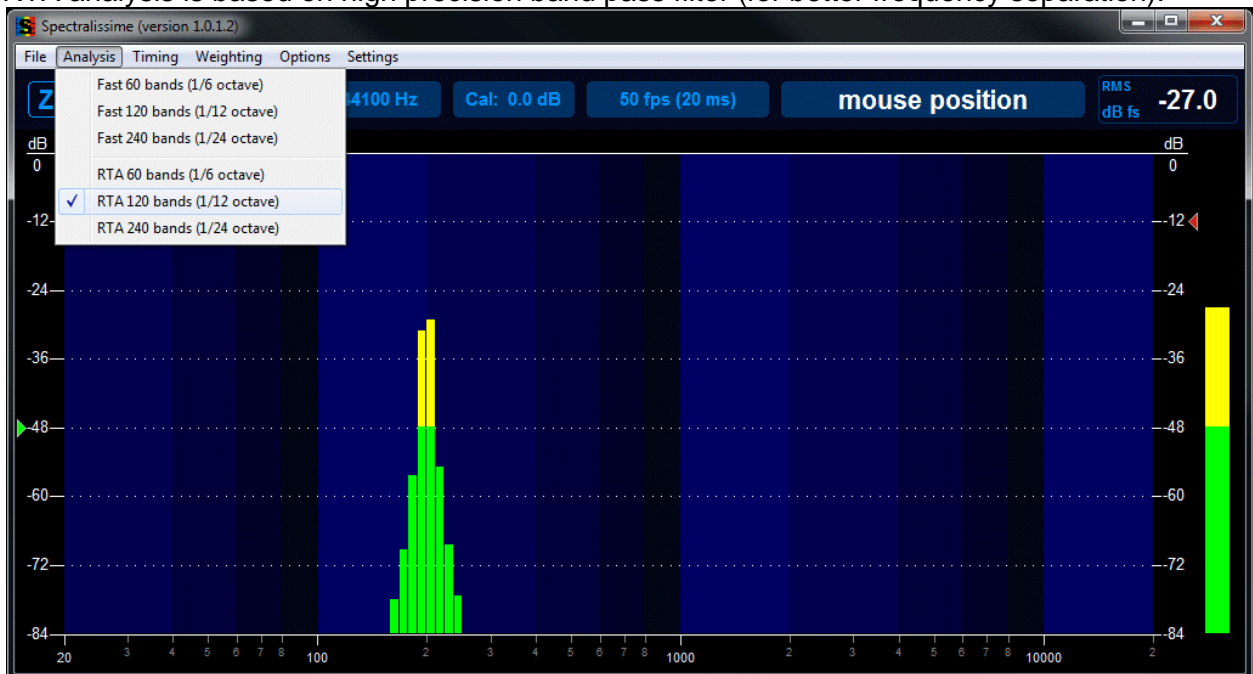

(-24 dB 200 Hz Sinus analysis)

Select Audio Source:

Audio source can be selected in the AUDIO Devices Dialog box (see menu "Settings / Audio Devices…") and must be running in the following sample rate: 44.1, 48, 88.2 or 96 kHz.

Spectralissime allows selecting any Windows Devices or any ASIO devices as audio source. Alternatively it is possible to get audio from a VBAN Stream. In all cases audio source is master (stream sampling rate will be applied to the analysis in 44.1, 48, 88.2 or 96 kHz).
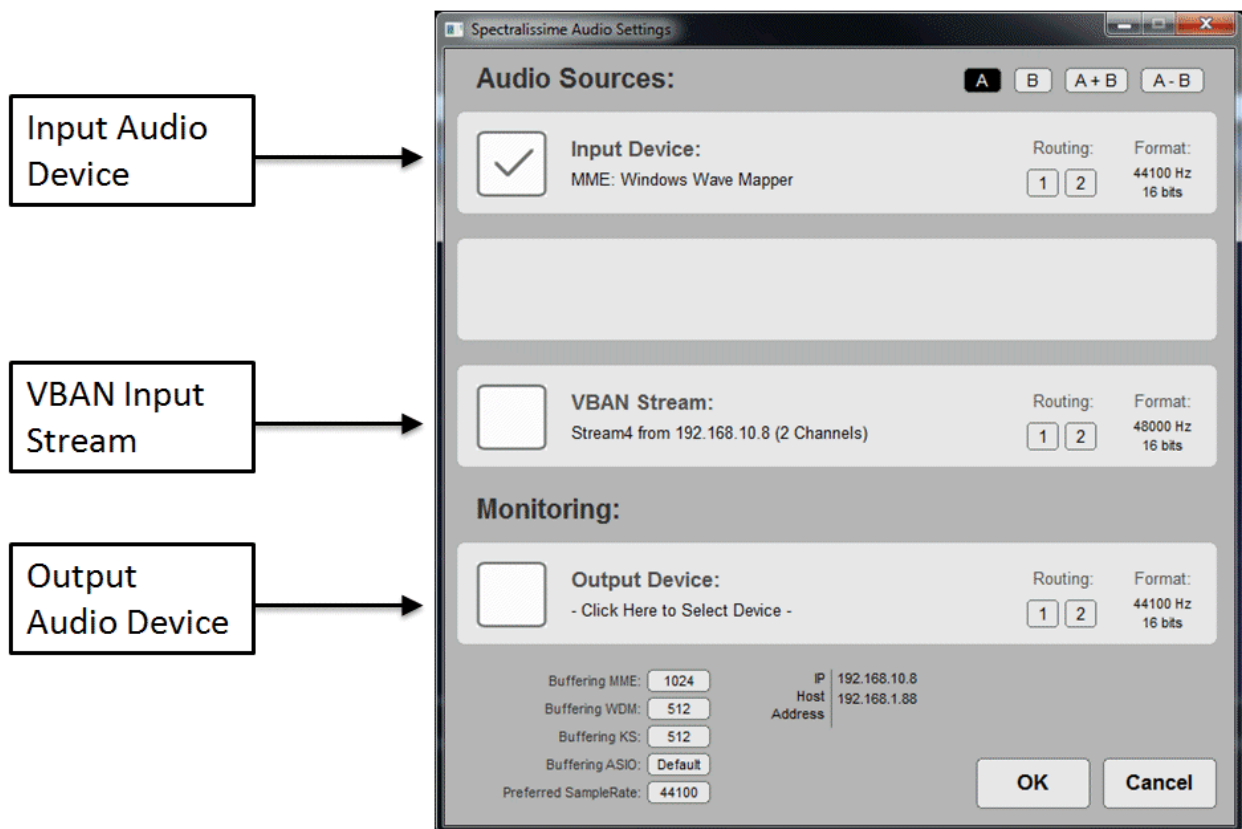

Routing box allows selecting 2 channels (called A and B) and patch input device channel to the current analyze. Then it is possible to analyze A signal or B signal or A+B or A-B.

Monitoring box allows playing back signal being analyzed (including Weighting if any) in any output device type (including ASIO devices, possibly not the same device than selected as source).

Display Options:

All display options are given in the Options menu. They allow configuring analysis view according to the signal type to analyze or measure.
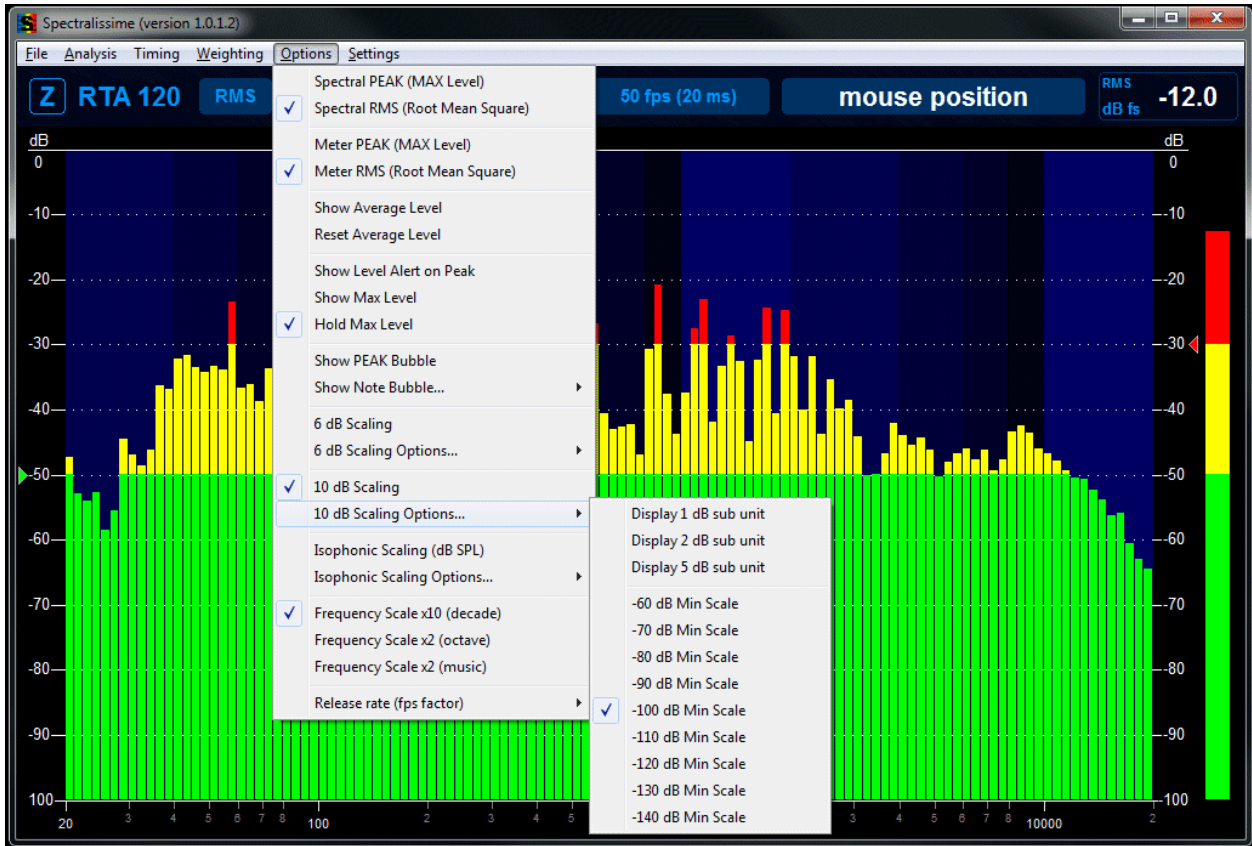
Display Options and sub-options allow setting scale limits and sub unit display.

Green cursor (on the left scale) allows setting nominal level threshold (displayed in yellow). Red cursor (on the right scale) allows setting max level threshold (displayed in red). Just click on the scale to set threshold on desired level.
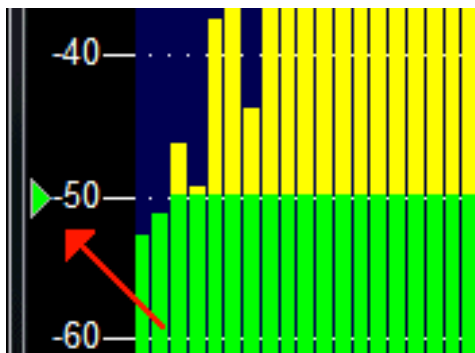
Set Nominal Level Threshold

Set Max Level Thresold

PEAK or RMS:

Spectralissime can display PEAK or RMS measure, on the spectral analysis and on the meter view (displayed on the right). Then it is possible to set PEAK or RMS for both by selecting Spectral PEAK or Spectral RMS. And it is possible to select a different measure for Meter by selecting after the Meter PEAK or Meter RMS options..

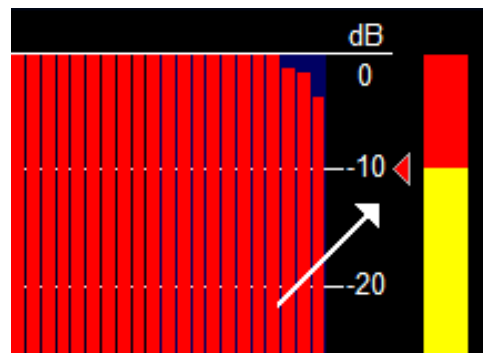PEAK measure gives the max level of the digital signal (modulo meter). RMS gives the root means square value on the integration time given by timing options (to be compared to "effective" voltage value). FPS is the number of frame per second and it is related to the integration time by the following formula: FPS = (1000ms / integration time in ms) = 1/dt.

$$PEAK = Max(x_i)$$

$$RMS = \frac{1}{n}\sum_{i=0}^{n}(x_i)^2$$

('n' is the number of sample on the integration time, xi are input signal samples).

The difference between PEAK & RMS value are remarkable on a sinus signal:
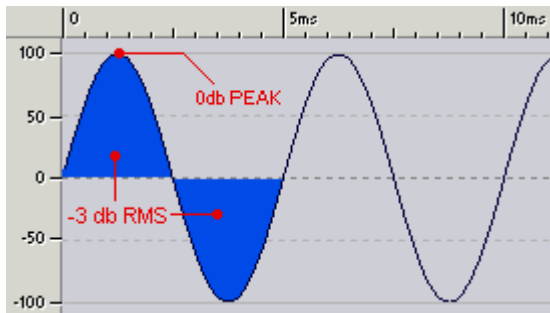
RMS is related to the surface of the signal.
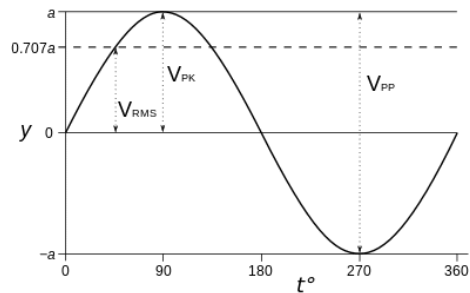
For a sinus signal RMS value is around 3dB below PEAK value (20LOG(1/SQR(2)) = -3 dB)

PEAK measure is more adapted to digital domain since it allows keeping signal under 0dB FS (theoretical limit of encoding).

RMS measure is more adapted to physical measure of signal. (Volt-meter or Analog VU-Meter for example are measuring RMS value of the current).

Average and MAX level.

Spectralissime offers the possibility to display AVERAGE level (since last reset) and MAX level detected (with a HOLD option). Average level is given by a small bar on each frequency bar and the MAX level is displayed behind the current measure in dark blue (or dark green):
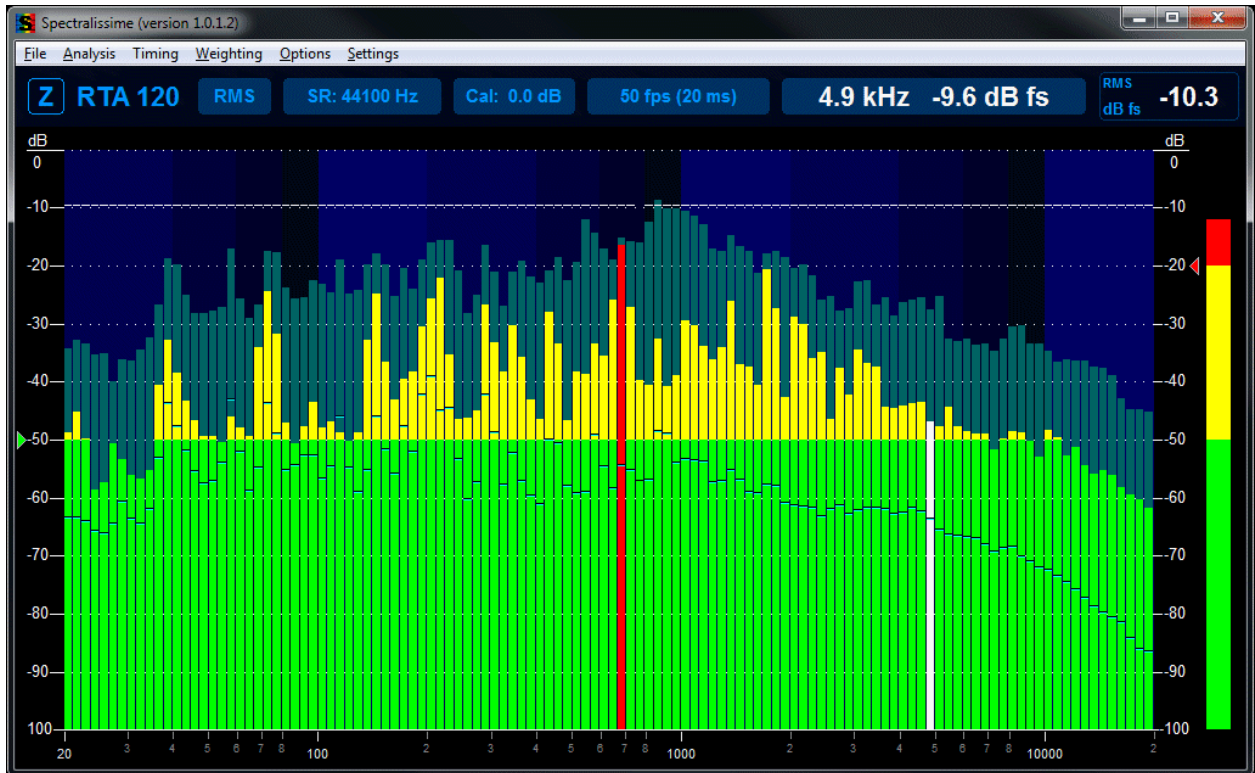
Yellow and red range can be defined simply by moving cursor on the left (green arrow) or on the right side (red arrow).

PEAK Bubbles

Spectralissime can display 3 bubbles showing 3 peak detections in 3 frequency ranges: (20 Hz – 200 – 2000 – 20 kHz).
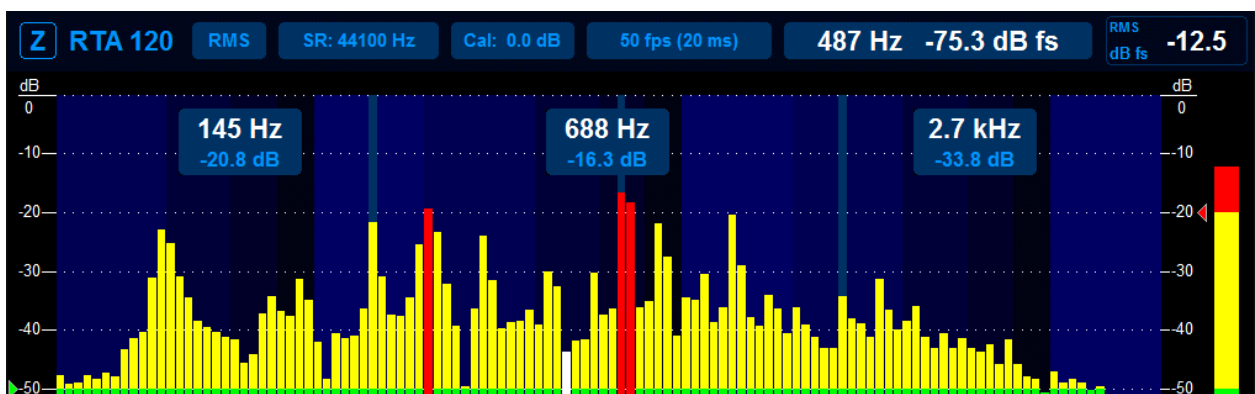
Musical Bubble.

Spectralissime also proposes to display musical Bubble showing the musical note related to the frequency peak. If frequency scale (music) is selected a piano keyboard will be displayed as frequency scale and the musical level notation will be displayed in the dB SPL scale (on the right).
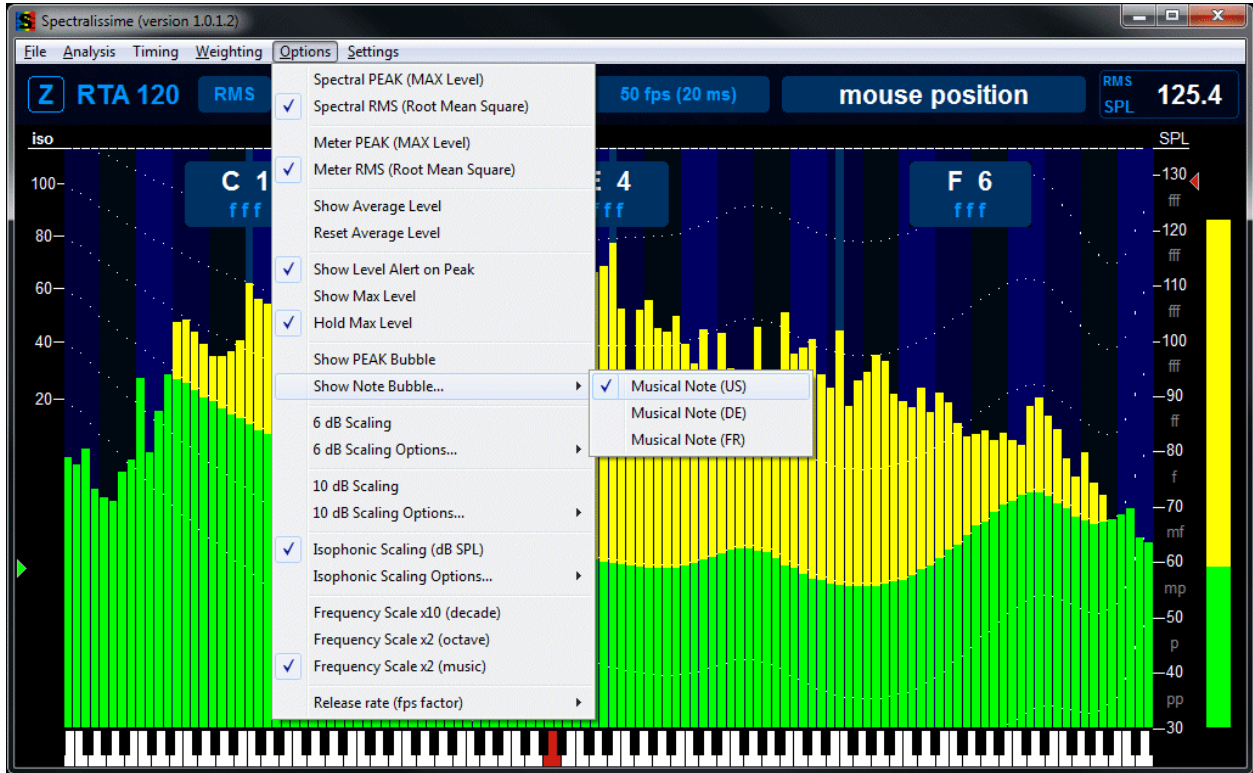
If the Isophonic scale is selected, the musical Bubble will also display level in musical notation:

fff	100 dB SPL	> 95 dB
ff	90 dB SPL	85 à 95 dB
f	80 dB SPL	75 à 85 dB
mf	70 dB SPL	65 à 75 dB
mp	60 dB SPL	55 à 65 dB
p	50 dB SPL	45 à 55 dB
pp	40 dB SPL	35 à 45 dB
ppp	30 dB SPL	< 35 dB

The red keyboard note on the piano scale is the A-Note (Diapason), and can be adjusted in the Settings menu (440 Hz per default).

Scale Type.

Spectralissime offers 3 scales in gain: 6 dB scale, 10 dB scale or isophonic scale (displaying dB SPL). For each scale type, a sub menu allows selecting additional option to display sub unit and set min / max dB range.
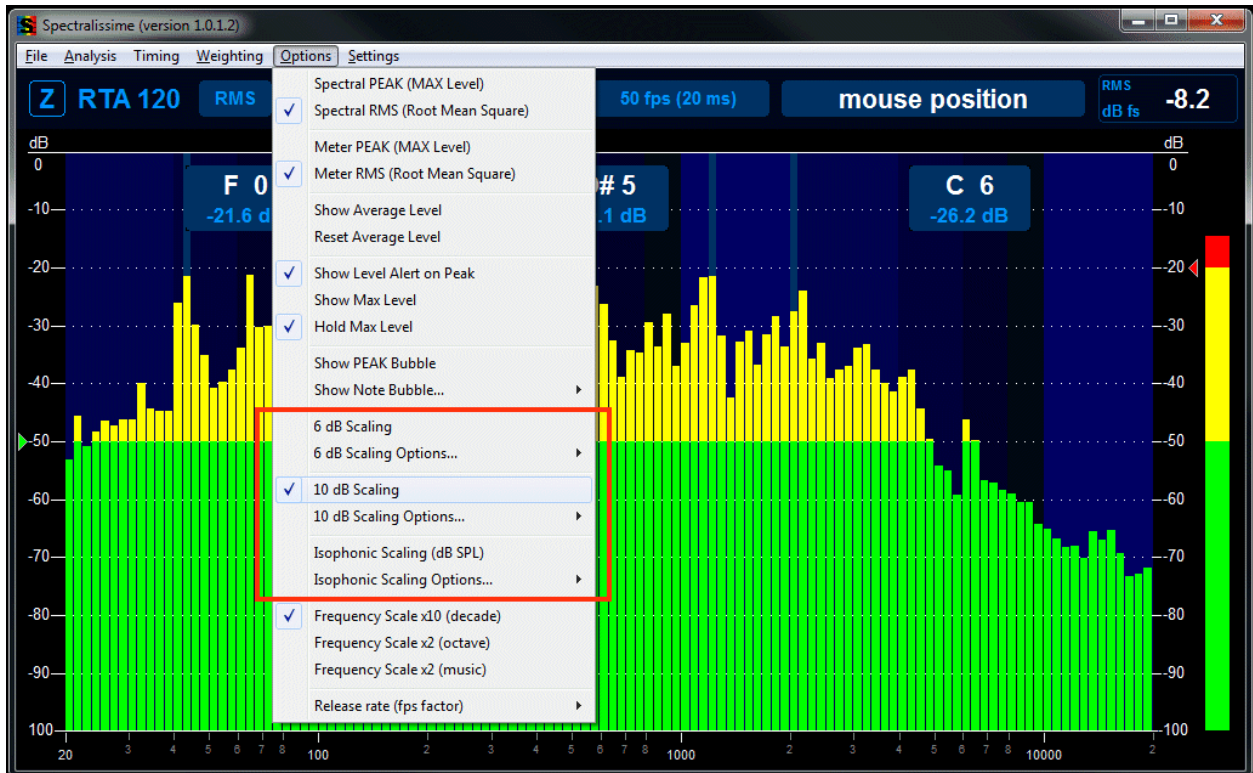
Frequency Scale.

Spectralissime also offers 3 frequency scales: the decade scale (more used in electronic), the octave scale (adapted to music analysis) and the musical scale (displaying a keyboard).
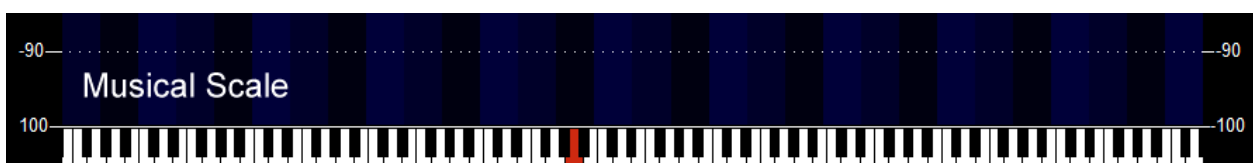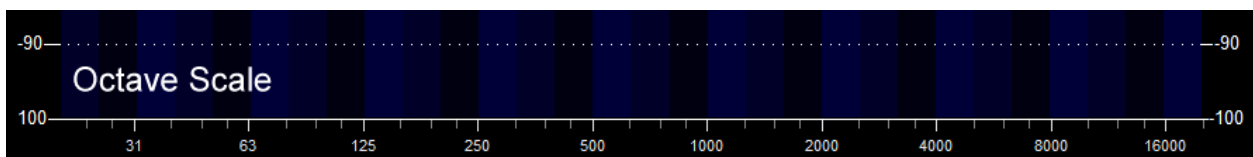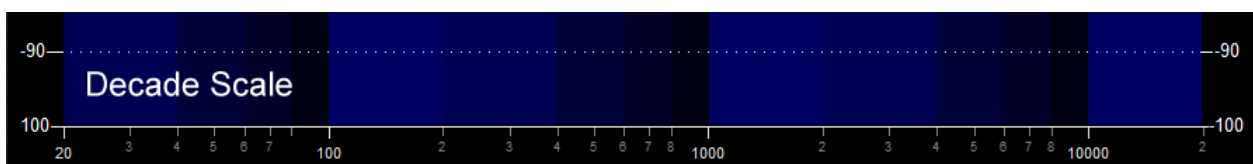
Isophonic Scale.

Isophonic scale displays dB SPL unit (Sound Pressure Level) and the equal-loudness contours curves for the human ear on following main units: 20, 40, 60, 80, 100, 120 dB SPL. In this scale, nominal level (yellow) and peak level (red) are following the equal-loudness contours curves.

WIKI NOTE: common to see the term 'Fletcher–Munson' used to refer to equal-loudness contours generally, even though a re-determination was carried out by Robinson and Dadson in 1956, which became the basis for an ISO 226 standard. It is now better to use the generic term "equal-loudness contours", especially as a recent survey by ISO redefined the curves in a new standard.

This scale is also made to be used for acoustic measures, with any microphones. The CAL field allows defining a dB offset to adjust the scale to the microphone sensibility.
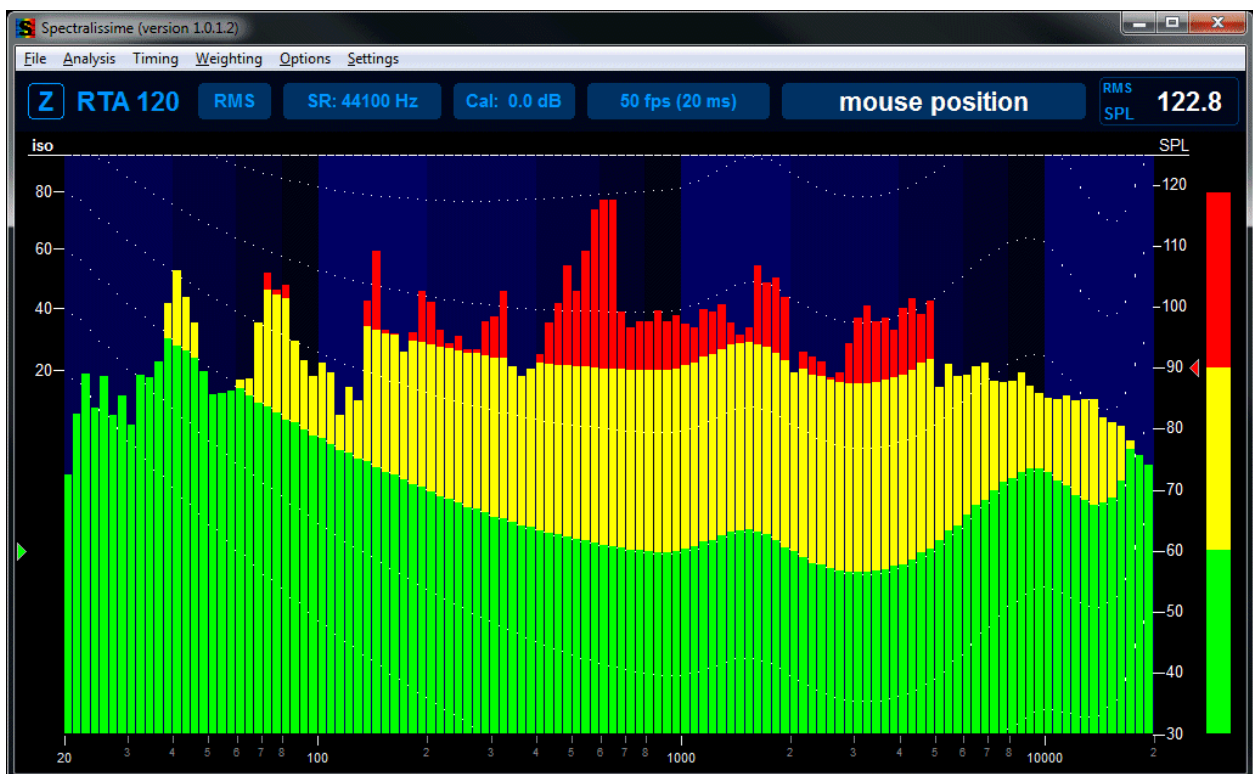
Release Rate.

Release rate gives the speed factor to let the level fall down frame after frame, more or less fast (display parameter). This parameter can be adjusted to your convenience without any impact on the measure (just for display).

Timing: FPS & Integration time.

Timing menu offers different integration time through FPS selection (frame per second and integration time). For dB SPL measures, standard integration times are SLOW, FAST & IMPULSE. Otherwise we recommend to stay around 50 to 60 FPS to fit the capabilities of your display and default audio buffering (per default 512 sample is limiting FPS to 80)
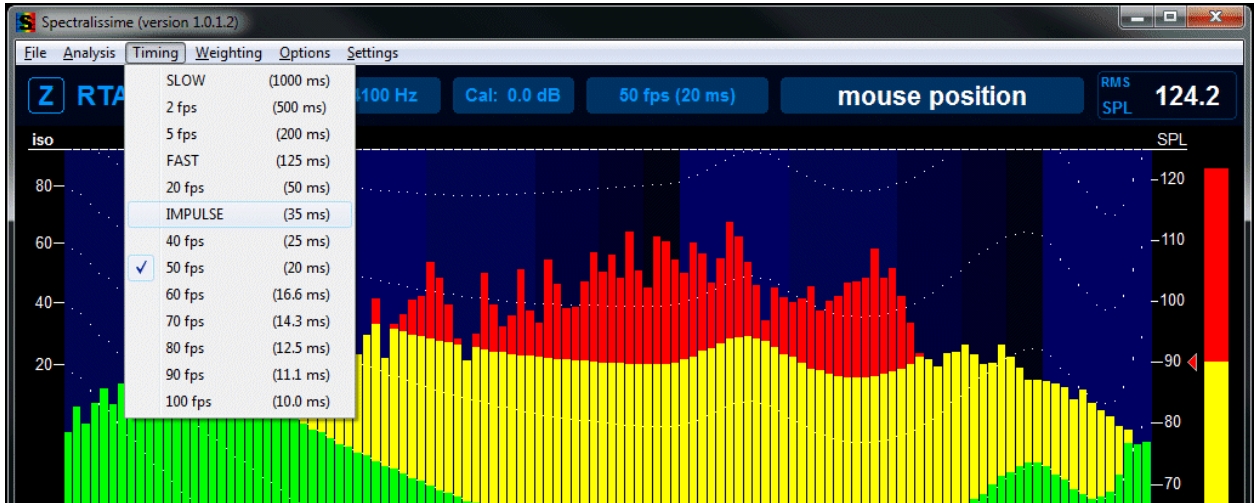
Weighting:

Weighting menu allow selecting A-Weighting or Z (neutral per default).
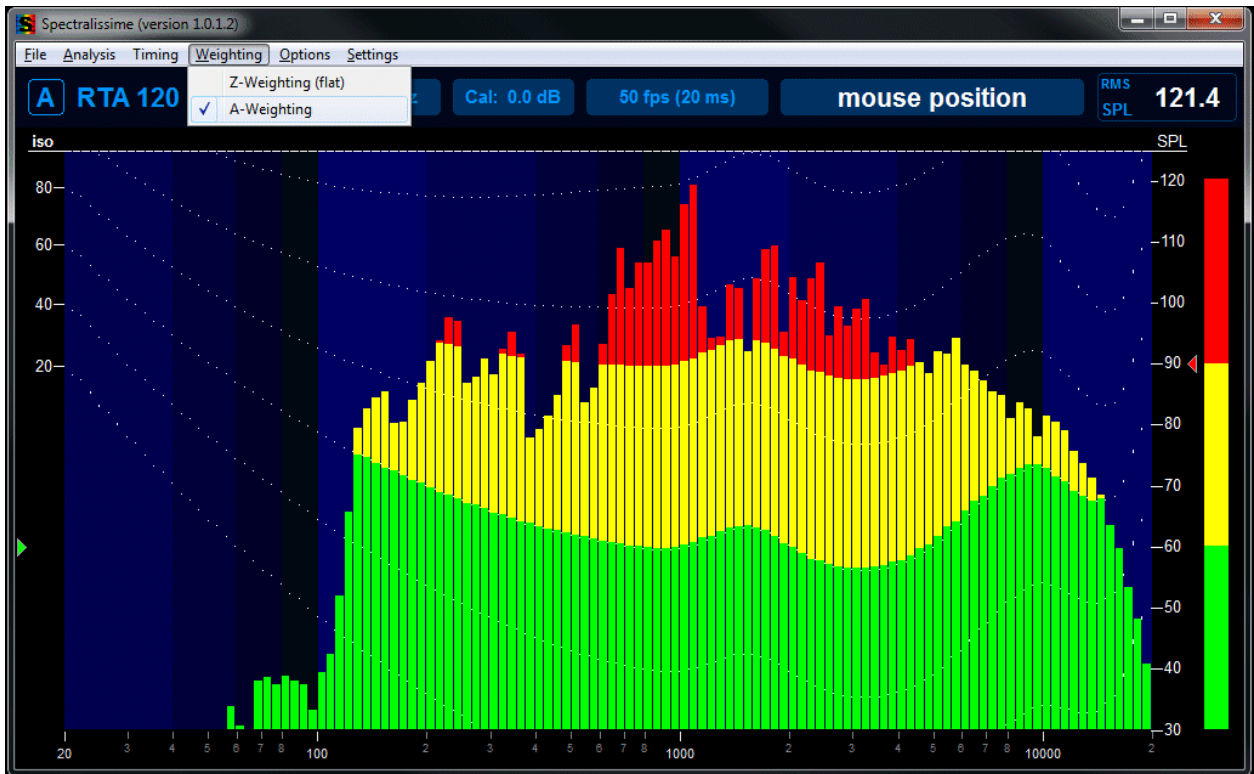
Manage Settings Files:

The file menu provides the regular functions to save or load the entire configuration in a file (display options, system options). It is also possible to launch Spectralissime with a particular configuration file (see below).
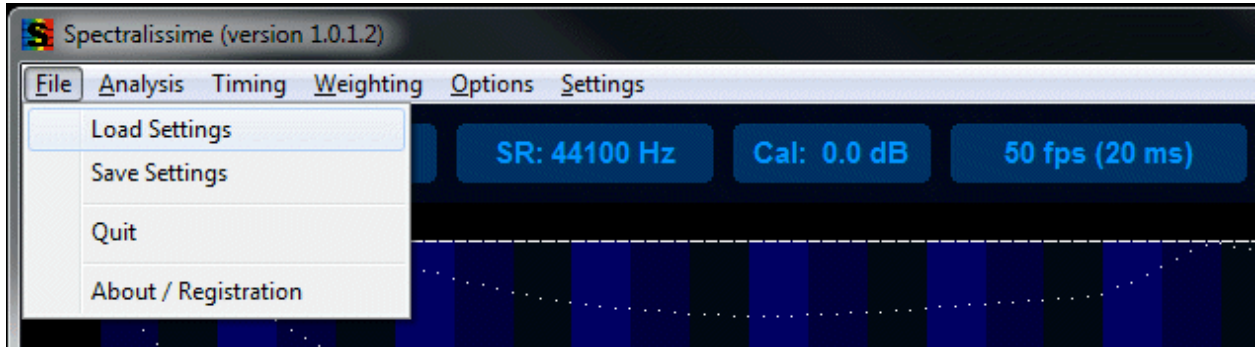
Spectralissime Command Line:

To run Spectralissime with a specific configuration file, use these following command lines:

```
-l"filename.xml" or -L"filename.xml"
```

If the xml is in the same directories of spectralissime.exe
```
-l"filename.xml" or -L"filename.xml"
```

If the xml is in the same sub directories of spectralissime.exe
```
-l"subfolder\filename.xml" or -L"subfolder\filename.xml"
```

Or you can use absolute patch
```
-l"c:\folder\filename.xml" or -L"c:\folder\filename.xml"
```

CASE STUDY #1

SPL meter + calibration

Calibrate your microphone for dB SPL measure

A very interesting use of Spectralissime is the ability to measure and analyze the sound levels. The SPL measurement allows knowing quantitatively the sound pressure in real time.

Spectralissime innovates in the spectral representation of the signal by introducing the **isophonic scale**: it is coherent to the auditory system and makes it possible to better understand the analysis of the audio signal, to visualize the audible frequencies or not and the balance of the spectrum.

For this purpose it will be necessary to use a Measurement Calibrated Microphone.

The quality of the SPL measurement depends on different parameters which can lead to drift or measurement bias compared to other measuring instruments:
- Measurement Calibrated Microphone
- Computer sound card (and more especially the Analog to Digital Converter ADC)
- Quality of calibration

But the most important component of the chain is the quality of the microphone, hence the use of a calibrated measuring microphone. For this use case, we will use the Minidsp Umik-1 USB
https://www.minidsp.com/products/acoustic-measurement/umik-1

SPL Measure norms

SPL metering is done today with two normalized parameters:

- The Weighting : filtering the signal before analysis to remove some part of it (A, B,C... Z). Spectralissime uses Z-Weighting per default (also called "Flat" or "Linear" frequency weighting).
- The integration time: giving the RMS analyze time (1000ms, 125ms, 35ms). Spectralissime provides different integration time through the FPS Options menu.

The standardized SPL measures are Norm IEC 61672-1:
- A-weighting + slow (= 1 sec time constant)
- A-weighting + Fast (= 125 ms time constant)

A-Weighting: the inconsistent norm.

A-Weighting is filtering the signal to remove bass and high frequency before analysis (LPF 200 Hz – HPF 10 kHz). This filter is based on the 40 dB SPL equal-loudness contour (isophonic curve) but is used to measure 100 dB SPL sound (not adapted). For example the comparison of the ISO 40 and ISO 100 curve is leading us to underestimate Sub frequency by 20 dB (typical problem of P.A. system setup)...
More information on WIKI: https://en.wikipedia.org/wiki/A-weighting

A-weighting (blue), B (yellow), C (red), and D-weighting (blk)
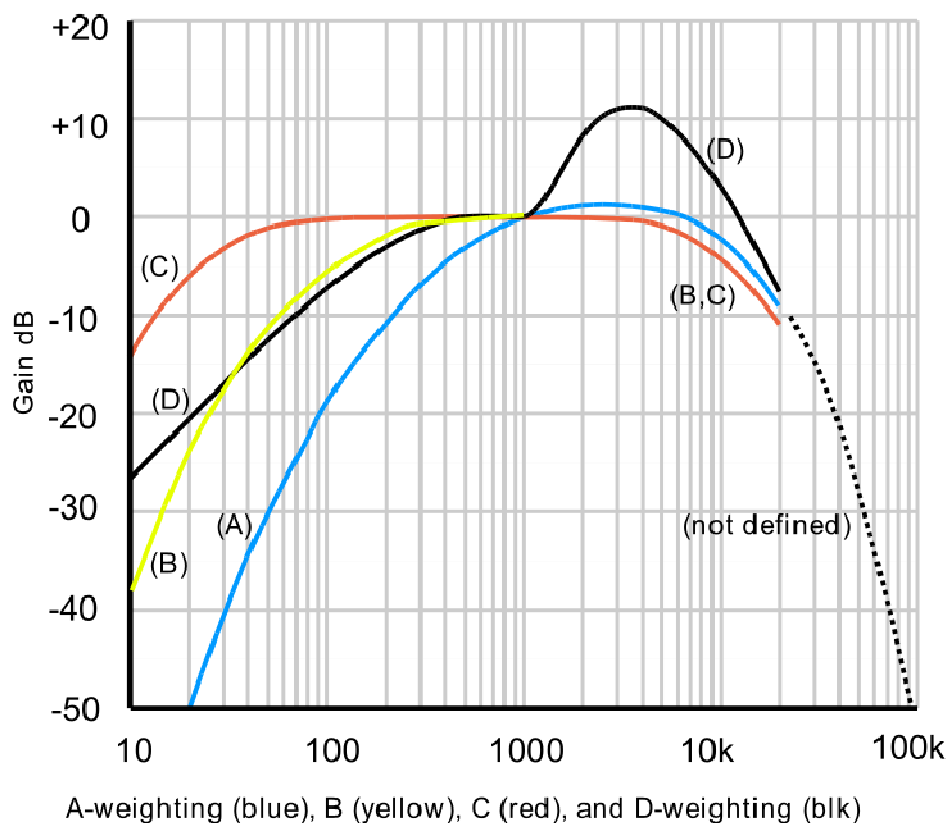
The purpose of Spectralissime is to provide a neutral analysis of the signal and let Sound Engineers interpret the result according the context and experience. On the musical point of view, the D-Weighting is maybe the most interesting curve because more fitting the 100 dB isophonic curve and taking in account the extreme sensibility of the human ears in the high medium frequency range.

Calibrate your microphone for SPL measure.

In this use case we will show two different methods to calibrate Microphone, one with Sound Level Meter, one with a Sound Level Calibrator.

Step 1: Select the right device and the right display options.

The first step is to select your Microphone device as audio source:
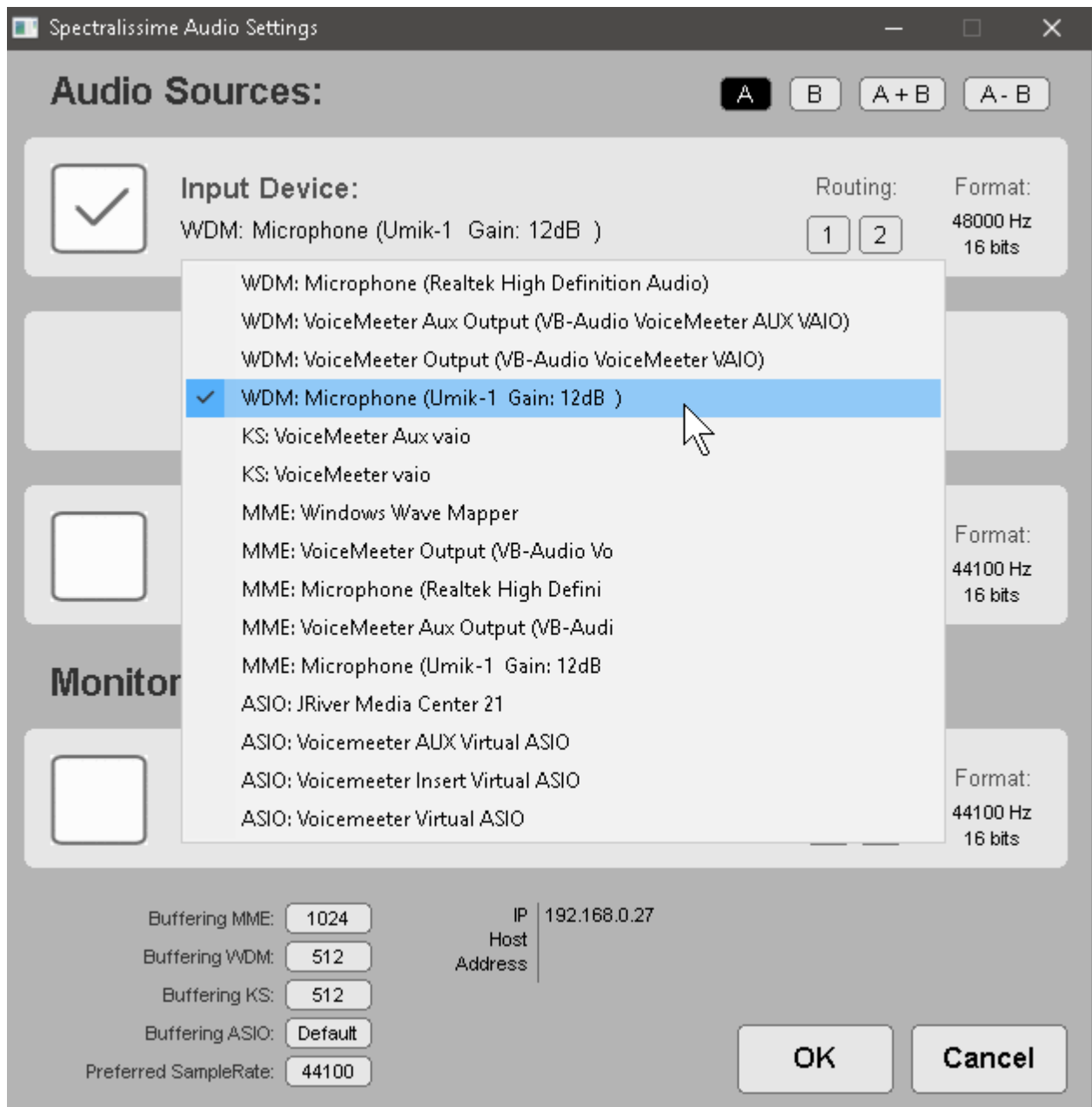
Then you will have to select the Isophonic Scale to display dB SPL scale.

After having selected the Isophonic Scale, we also recommend to adjust the following options:

- Spectral RMS (display RMS level).
- Meter RMS (display RMS level).
- FPS (Integration Time) = 20 fps (50 ms)
- Release rate (fps factor) = fast (x 0.7)

Step 2: Calibrate your microphone.

To calibrate the microphone selected as audio source, we need a level reference. This level reference can be given by two methods, by using a Sound Level Calibrator or by using a Sound Level Meter. Then you will just have to adjust the Spectralissime CAL value to fit the reference sound level.

Method A: By Sound Level Calibrator

The first method is based on a Sound Level Calibrator. This method is the most accurate and simple to implement but a good calibrator can be very expensive. For this use case, we will use the Center-326 Sound Level Calibrator = SLC346

Position the Sound Level Calibrator on the Measurement Microphone:

Switch the calibrator on the first level: 94 dB.

Adjust the level Cal (with the mouse wheel) to achieve the desired level to the SPL meter RMS (top right)
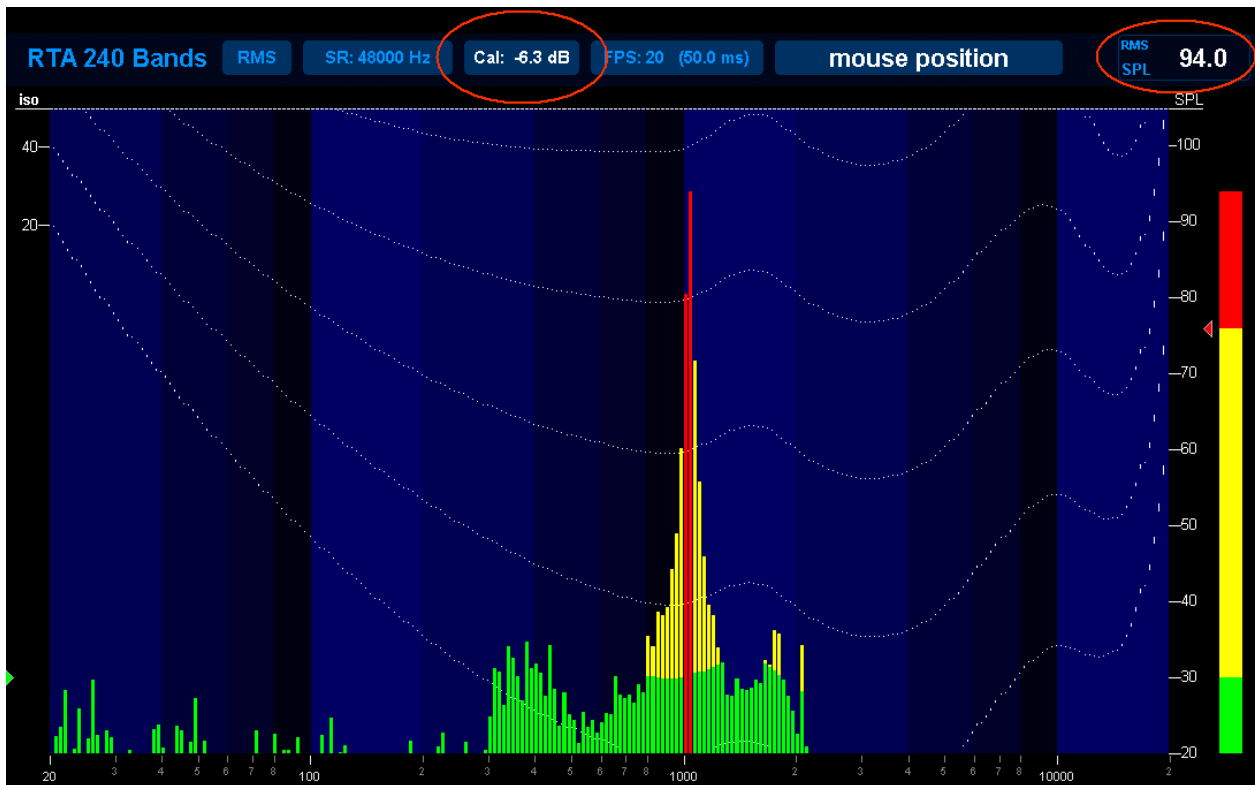
We can notice the generator does not have a good spectral purity but this is not very important for our calibration. The goal is to fit the general level by adjusting the CAL parameter. Optionally a second checking can be done with the second level: 114 dB.

When the calibration level is adjusted, you can use Spectralissime as a Sound Level Meter and Spectrum Analyzer!

Method B: By Sound Level Meter

This second method is based on a Sound Level Meter which is much less expensive than a Sound Level Calibrator but also less accurate. In this use case we will use the Voltcraft SL-200.

The Sound level meter must be configured in Fast Mode with Weighting A or C (or Z). This has no influence on calibration since we will use a 1 kHz Sinus (not affected by these weightings).

Then we have to generate a 1 kHz pure Sinus signal (or with a sinus generator or by playing back an audio file containing this 1 kHz Sinus signal) with a level between 80 and 85 dBSPL (given by the Sound Level Meter). So you will need to adjust your speaker level to reach this 80 to 85 dB SPL.

Then, just place the microphone like the Sound Level meter (same place, same direction, as close as possible) and adjust CAL parameter to get same level on both Spectralissime and Sound-Meter.
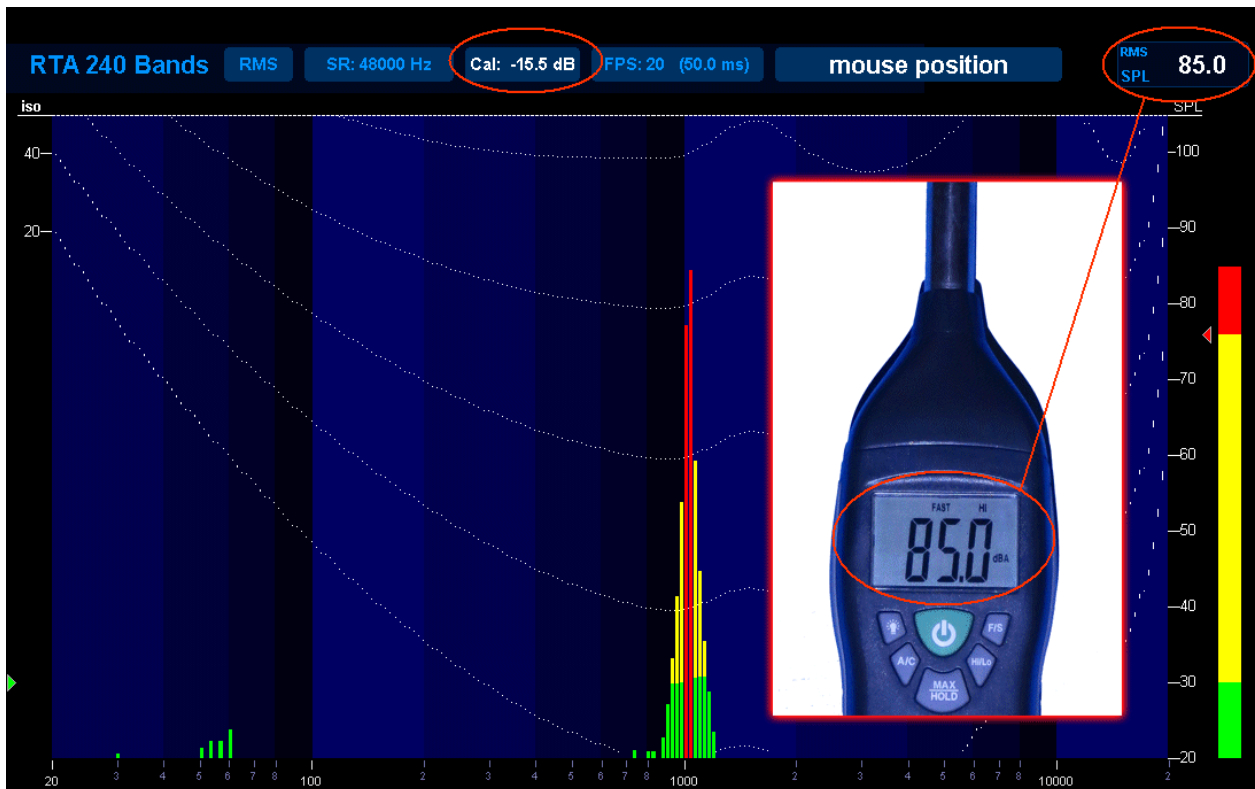
When the calibration level is adjusted, you can use Spectralissime as a Sound Level Meter and Spectrum Analyzer!

Specifications:

Application Type:	Audio Digital Measure Tool Application
Compatibility:	Windows XP, VISTA, WIN7, WIN8, WIN8.1, WIN10 (32 / 64 bits)
PC Configuration:	Min: Celeron / Duo Core 1.8 GHz - 512 MB RAM - Disk < 100 MB
Audio Engine Capabilities:	44.1, 48, 88.2 or 96 kHz DSP Processing
Monitoring Output:	WDM, KS, MME, ASIO (32 kHz to 96 kHz) - 1 to 8 channels
Physical Inputs:	WDM, KS, MME, ASIO (44.1 kHz to 96 kHz) - mono or stereo.
Virtual Input:	-none-
VBAN Input:	VBAN Stream (44.1 kHz to 96 kHz)
M.I.D.I. Implementation (remoting):	-none-
Bands Number:	60, 120, 204 bands (FAST or RTA).
Measure Number:	Single analysis possibly coming from stereo signal (A, B, A+B, A-B).
Timing :	10 to 1000ms (including standard SLOW, FAST, IMPULSE).
Weighting	A, Z(Flat).
Level Scale	6dB,10dB and Isophonic scale(140 dB dynamic).
Frequency Scale :	Decade (x10), Octave (x2) and Music (20Hz to 20 kHz).
Display options :	Max, Average, PEAK, RMS, Peak detector (Bubble).
Preset File	XML file.

Standard & Norms

RTA filters are following the ANSI S1.11-2004 and IEC 61260:1995 standards
FAST analysis filters are based on IIR order 2 with the same frequencies than RTA filters.

Isophonic curves are given by ISO 226:2003 standard

A-weighting process is following the ANSI S1.42.2001 and IEC 61672-1:2002

Additional equipment for SPL measure:

Example of Microphones to be used as calibrated Microphone:

USB Microphones:
- Minidsp Umik-1 USB

XLR Microphones:
- Behringer ECM8000
- T.bone MM-1
- Dayton Audio EMM-6
- Monacor ECM-40
- Superlux ECM999
- Beyerdynamic MM1
- Sonarworks XREF 20 Mic
- DBX DriveRack RTA-M

Example of USB Interface with XLR Microphone connector:
- Shure X2U XLR-to-USB
- Fame MicroPort EX MIC-USB-Adaptateur XLR-USB
- Senal XU-1648 XLR-to-USB Interface
- Behringer UM2
- Presonus Audiobox Ione
- Focusrite Scarlett 2 SOLO

Example of Sound Level Calibrator:

- Center-326 Sound Level Calibrator = SLC346
- Reed Instruments R8090
- SLC 1356
- Nd9b Calibrator
- Cem Sc-05

Example of Sound Level Meter:

- Voltcraft SL-100
- Voltcraft SL-200
- Galaxy Audio CM130
- Digital Sound 8928
- Digital Sound 8922
- Trotec SL300

How to purchase license / Register your application?

Spectralissime is a donationware with a registration process. After purchase, a response code is sent by e-mail to activate the application license. Simply click on button "Buy Online" and follow the process on our webshop.

Go in menu File / About to display the Credit / Registration info dialog box:

Enter the e-mail used for purchase and the response code given by e-mail. Then click on "Activate" button.

Link to VB-Audio Online Shop: https://shop.vb-audio.com

KNOWN ISSUES / RECOMMENDATIONS

Spectralissime has been validated on different levels and should work 100% in most configurations. However we have some notified issues.

Display Refresh

In some system configurations, moving Spectralissime Window outside of the screen could disturb the display refresh, just resize it to force the display refresh.