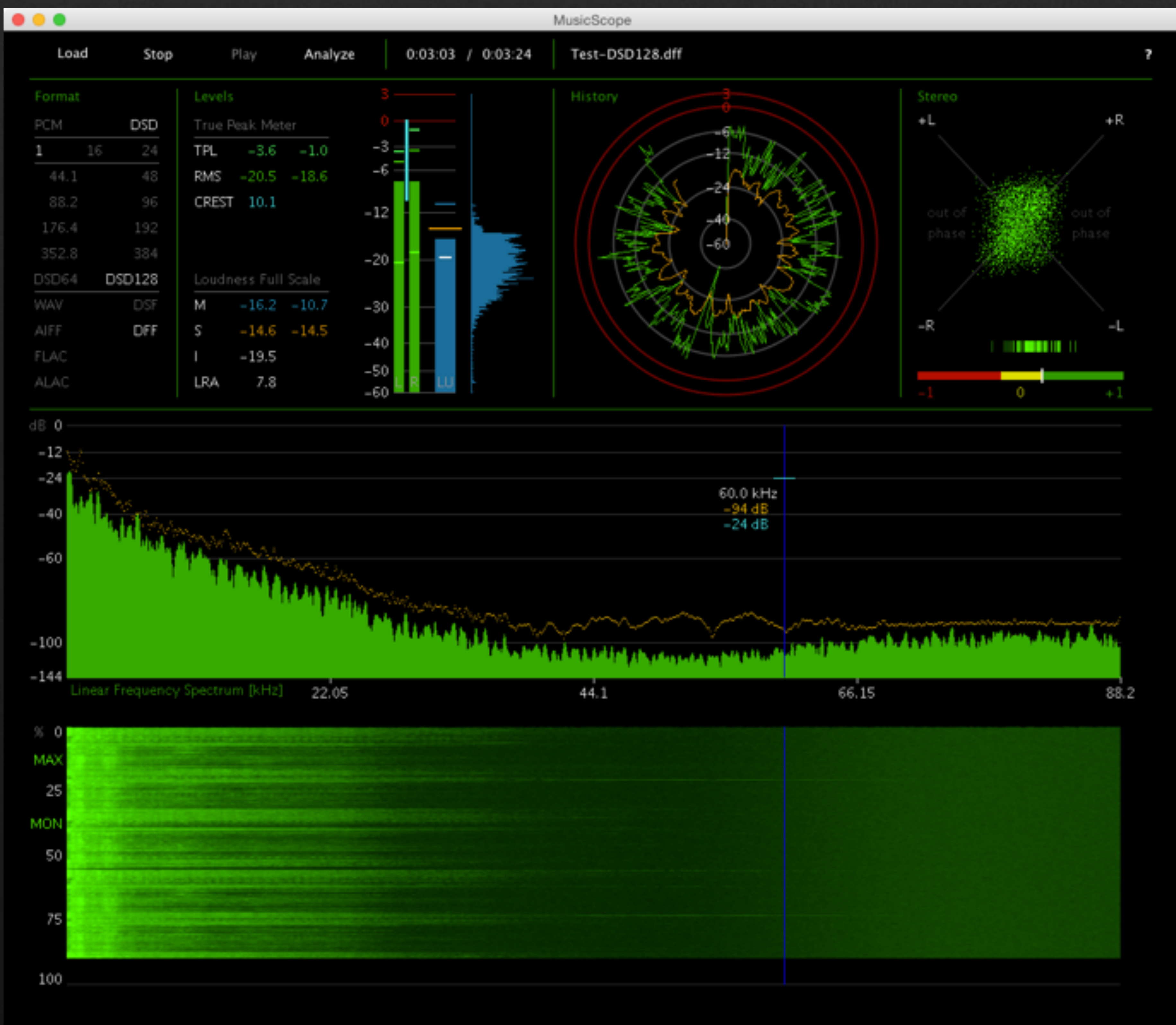
The MusicScope

www.xivero.com

MANUAL



Introduction

We love music and the experience of the best possible music reproduction.
Our hearing is the primary aid to assess the quality of the musical performance.
Visualizing the music extends the perception with a further sense.

We beliefe that our ears and therefore our acoustical perception are the best tools to decide over the quality of a HiFi system.

During our daily work with different music formats, the desire of visualizing several aspects of the music arose.
A visualization opens up the music for another sense to get a more complete picture of the music quality itself.

The idea of an audio microscope was born, with the goal to provide the same views an audio engineer has at hand during studio recordings.

The MusicScope provides several studio grade tools to analyze the audio quality, but it is extremely easy to use without deep expert knowledge usually necessary for digital audio workstations and their arsenal of plug-ins.

Of course the MusicScope implements all audio standards (e.g. EBU R128) to allow a full comparison with the measurement results of professional studio software.

It is our belief that the music record is the most important quality determining factor of the whole HiFi chain.
If we have to sort the HiFi components in the order of their quality impact then we would end up with the following list:

1. Music Track
2. Listening Room
3. Loudspeaker
4. Amplifier / Pre-Amplifier

5. Digital to Analog Converter
6. Player (CD, Computer)

The Music Scope covers serveral use cases. Let us introduce a couple them.

High Resolution Audio

The sales of High Resolution Audio Tracks are growing with a significant rate. In comparison to a standard CD-Track (16 Bit / 44.1 kHz) a High Resolution Studio Master should at least provide a resolution of 24 Bit with a sampling rate between 88.2 kHz - 384 kHz.

Furthermore, to avoid artifacts caused by lossy compression formats (e.g. MP3) all High Resolution Audio Tracks are compressed with a lossless format like FLAC, ALAC or even WAV.
The Music Scope supports all of them as well as DSD64 and DSD128 (Direct Stream Digital) in the DFF and DSF file format.

Unfortunately, it can happen that a so called High Resolution Track has been upsampled from a CD source.
You just need seconds with the Music Scope to identify such fakes.

Audio Quality

Many factors influence the quality of a recording. Especially the trend to produce fast and loud isn‘t the best approach to audio quality.

a.) Loudness War
In the last couple of years most music productions applied extreme compression and limiting to increase the loudness of the music believing that the customer would accept those tracks over lively and dynamic music.
The Music Scope analyzes and displays all standardized Loudness Parameters.

Crest Factor:
The crest factor provides information about the short term dynamic. Extreme compressed music can reach values below 3 dB.

Loudness:
In the last couple of years two organizations, the ITU (International Telecommunication Union) and the EBU (European Broadcast Union) established methods to quantify the loudness in a reproducible way.
The MusicScope displays all loudness values (Momentary, Short Term, Integrated and Loudness Range).

b.) Recording Errors

Due to the high time pressure within the studio environment it can happen that different recording and mixing errors influence the audio quality.

Inter Sample Peaks:

The digital leveling and limiting is extremely difficult because it makes no sense to limit to 0 dB full scale without the right tools, which could produce extreme inter sample peaks up to +3 dB in the analog domain causing strong distortions.

Periodical Signals:

Periodical interfering signals are easily detectable by the spectrogram as continuous vertical lines.

Stereo Image:

Strong phase shifts between the left and right channel can be interesting but in most cases they cause problems in setting up a good and stable stereo image. The MusicScope Stereo Meter displays all relevant information to assess the stereo information of the audio track under examination.

DSD-Recordings:

Recording a DSD track is especially difficult. It is extremly important to stick to a maximum level of +3 dB SACD (0 dBfs) to achieve the highest possible quality.

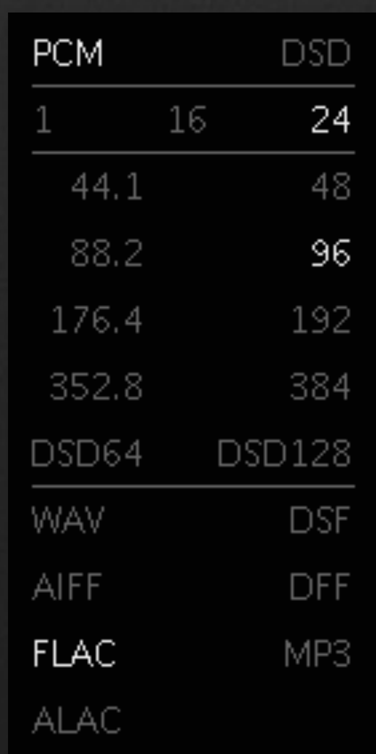
KAPITEL 2

Features

The Music Scope and its Features.

The current version of the MusicScope supports Windows and Mac OS X.

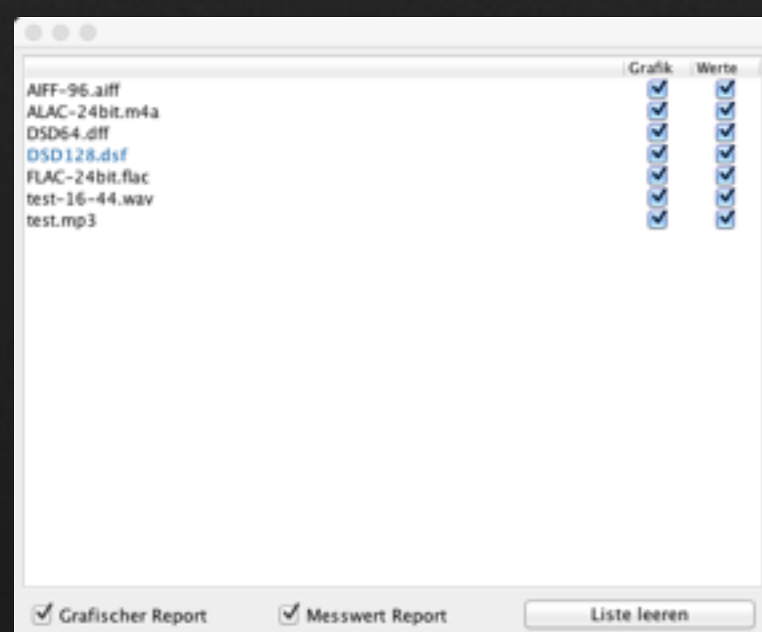
The software handles several audio formats (WAV, AIFF, FLAC, ALAC, DSF, DFF and MP3) from 1 Bit to 24 Bit with sampling rates between 44.1 and 384 kHz as well as DSD64 and DSD128.



The design is focused on the simplicity of the control elements.

A music track can be loaded by clicking on „Load" or just by drag & drop of the audio file into the user interface.
Click on „Play" starts the playback, whereas „Analyze" starts the fast analyze mode.
It is possible to switch anytime between „Play" and „Analyze" to go quickly through the track or to start the audio monitoring of dedicated parts.

A Playlist supporting the playback and analyzing of several tracks can be opened by clicking on the track name field or by loading multiple files via the Load dialog or via Drag & Drop.
The report type for each audio file can be selected.



ATTENTION: The MusicScope does not provide a volume control!
The audio samples are transparently transferred to the operating system's audio layer to achieve a bit transparent playback for MAC OS X. The volume

needs to be controlled by the amplifier or the operating system.

The audio monitoring supports material of up to 24 Bit / 384 kHz.

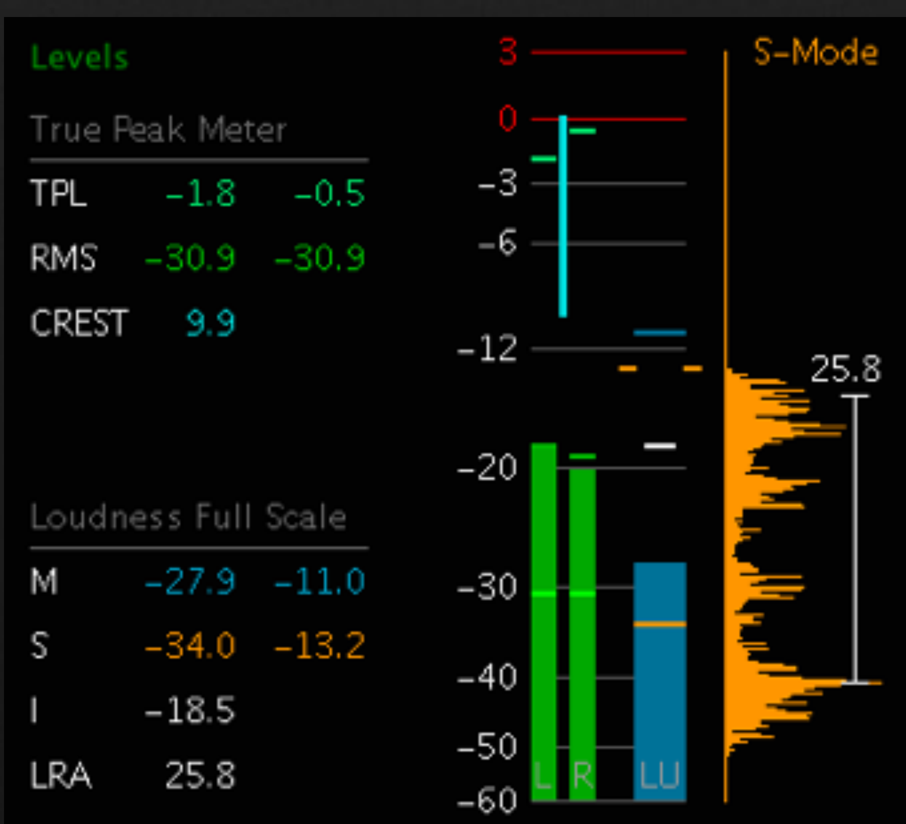
Direct Stream Digital (DSD) data are transformed to PCM to allow audio playback without using a special DSD capable Digital to Analog Converter (DAC).

<u>Levels:</u>

The Levels display is one of the core measurement tools.

All displayed values are color coded to map them between the numbers and their graphical representation.

Measurements are presented in decibel (dB) to allow the handling of huge loudness ranges.



The True Peak Meter is able to measure inter sample peaks which cause distortions in the analog domain. It can happen that inter sample peaks produce overs of up to +3 dB.
Current peak values are presented by vertical green bars, whereas the falling horizontal bars indicate the peaks reached.
The absolute True Peak Level (TPL) is represented by numbers and bars.
The TPL is green as long as it stays below 0 dB. If inter sample peaks push it above 0 dB then it becomes red.
Extreme leveled DSD tracks, which push the TPL above 0 dBfs, cause distortions in the analog domain.

The RMS (Root Mean Square) was the method of measuring the perceived loudness until the newer method of Momentary Loudness has been introduced.
The level meter shows the 400 ms averaged RMS as light green bars within the vertical peak bars.

The CREST Factor indicates the current dynamic to estimate the amount of compression the music went through during production. At the end of the analysis the minimum and maximum CREST Factor is displayed.
Extreme compressed music can reach values below 4 dB. A good studio master

should have a CREST better than 8 dB to be more dynamic and lively.
To use the same scale the CREST is drawn from 0 dB down to -x dB as light blue vertical bar.

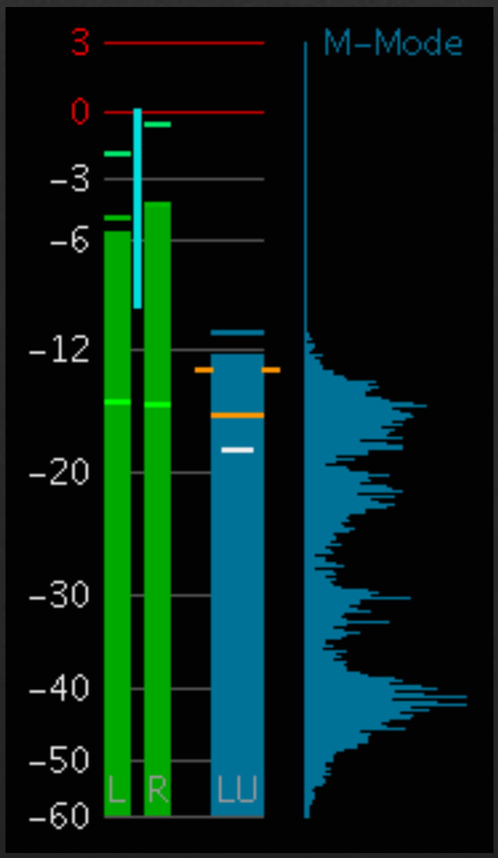
Loudness (LU):
The Music Scope measures all loudness values defined by the standardization EBU R 128 and ITU-R BS-1770.

LU values differ in their averaging times:
M = Momentary = 400 ms (blue)
S = Short Term = 3 s (orange)
I = Integrated = Whole Music Track (white)

The maximum values of the M- and S-Loudness are displayed as numbers and graphically.

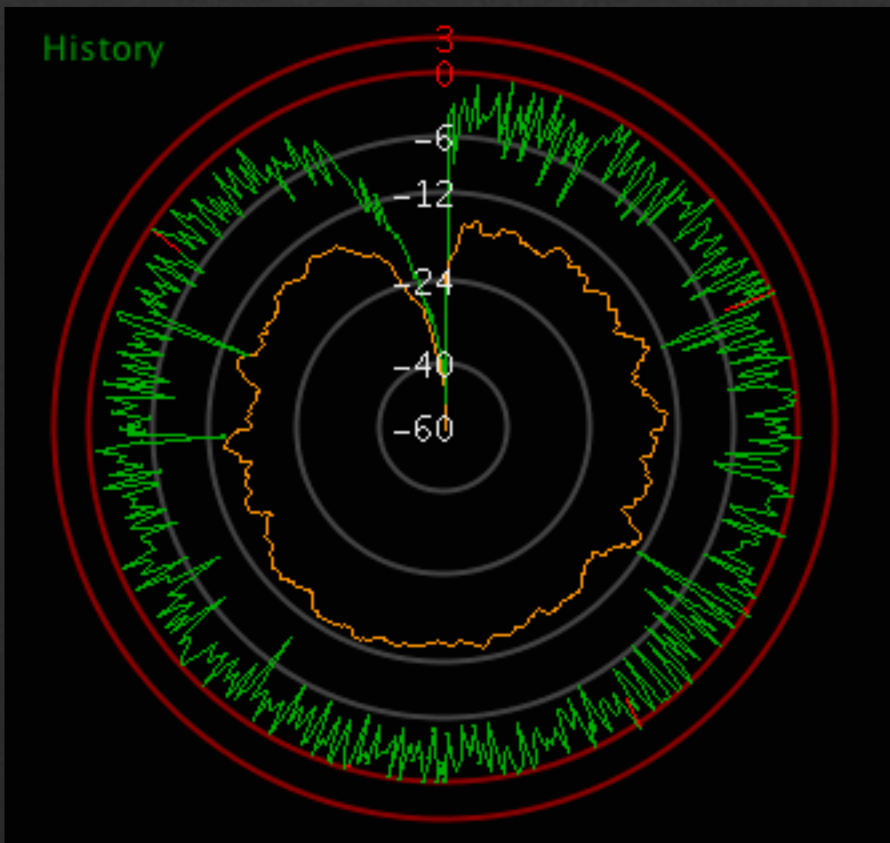
Especially the Loudness Range (LRA) is a great representation of the perceived loudness fluctuations and therefore the dynamic of the music track. Pop records show an LRA below 4 dB, whereas classical recordings can be quite dynamic with LRAs above 20 dB.
Heavily compressed music is easily identified by low LRA values.

The Loudness Histogram represents, similar to a photo histogram, the distribution of momentary loudness (M-Mode) or short term loudness (S-Mode) and is therefore a further measurement beside of the LRA to assess the extend of loudness.
Just click on S-Mode or M-Mode to switch between the different modi.



History:
The circular diagram shows the evolution of the peak values (green) and S-Loudness (orange) over the whole music track.

Red colored peaks, caused by inter sample peaks, exceed 0 dB.
Frequent inter sample peaks cause audible distortions degrading tremendously the music reproduction.

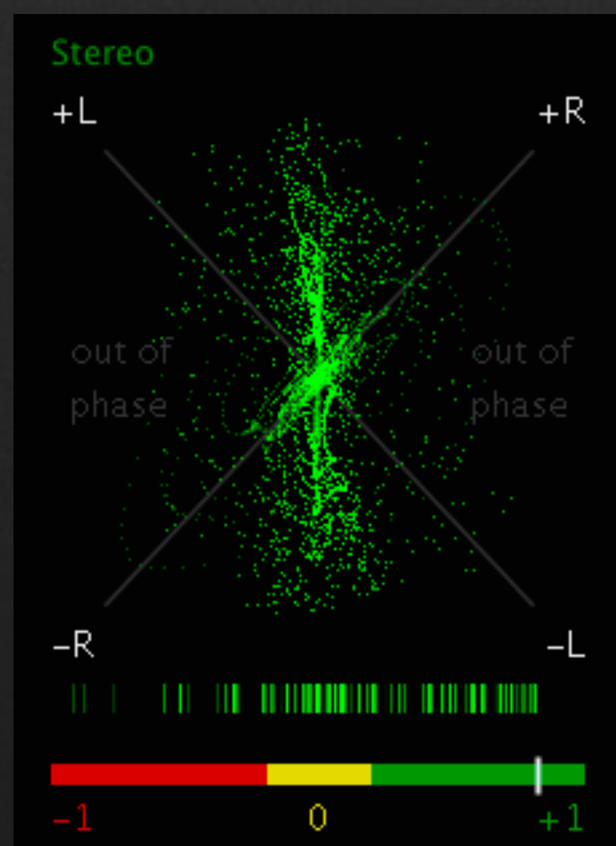


The number of inter sample Peaks per channel are detailed in the text report (pls. see report chapter).

<u>Stereo Meter</u>

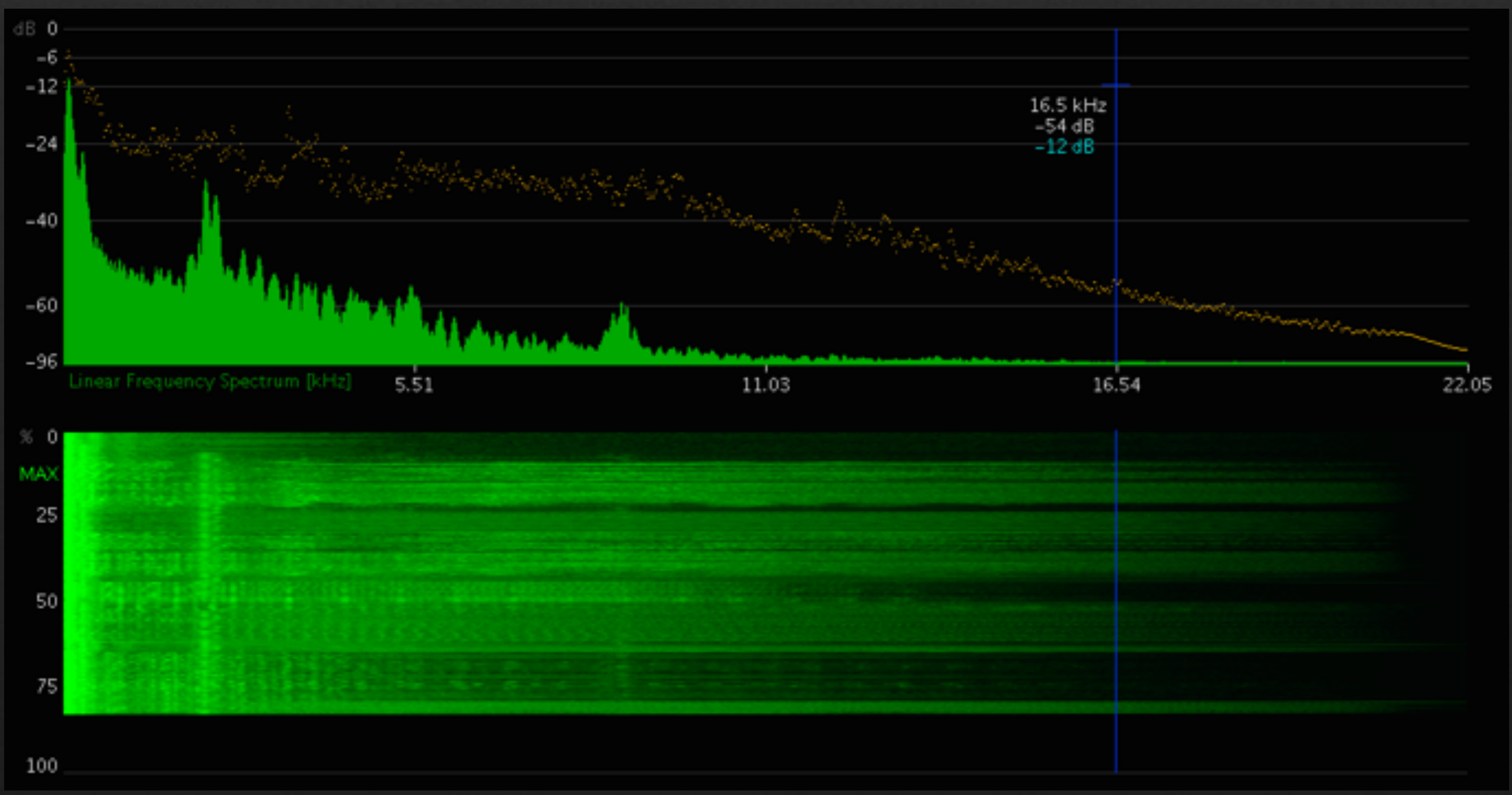
The different stereo meter displays provide the means to get a better understanding of the stereo image.
The upper part resembles a vector scope which allows the evaluation of the signal distribution between the left and the right channel.
A vertical green line would indicate a mono signal, whereas a horizontal line would be caused by a completely out of phase signal.

Below the Vector Scope is a Balance Indicator. This instrument indicates the current signal position in the stereo plane and shows how wide it is. The Correlation Meter helps to check the mono compatibility of the music track.
As long as it shows green values the signal can be reproduced in mono without having destructive interferences.
Even for the stereo reproduction it would be good to stay most of the time in the green area assuring a good localisation of instruments within the stereo image.



Linear Frequency Spectrum

The different frequencies of the music are displayed in a spectrum.
A linear frequency scale with a resolution of 100Hz/Bar supports the use case of high resolution audio analysis.
Mouse markers display the frequency, maximum amplitude of that frequency as well as the amplitude below the mouse pointer in decibel [dB].



Vertical mouse dragging on the spectrum changes the decibel scale and therefore the resolution. A double click resets the scale to default.

Spectrogram

The spectrogram, as a representation of the spectrum over time, supports the detection of periodical interfering signals as well as the determination of the highest frequencies containing music signals to analyze High Resolution Audio tracks.

The amplitude spectrum is represented by the intensity of the color green (monochrom) or as color range.
Hovering the mouse pointer over the spectrogram displays the absolute values in decibel below the mouse pointer.
Displayed data can be toggled between maximum and averaging mode, just by clicking on the „MAX“ label.

Reporting

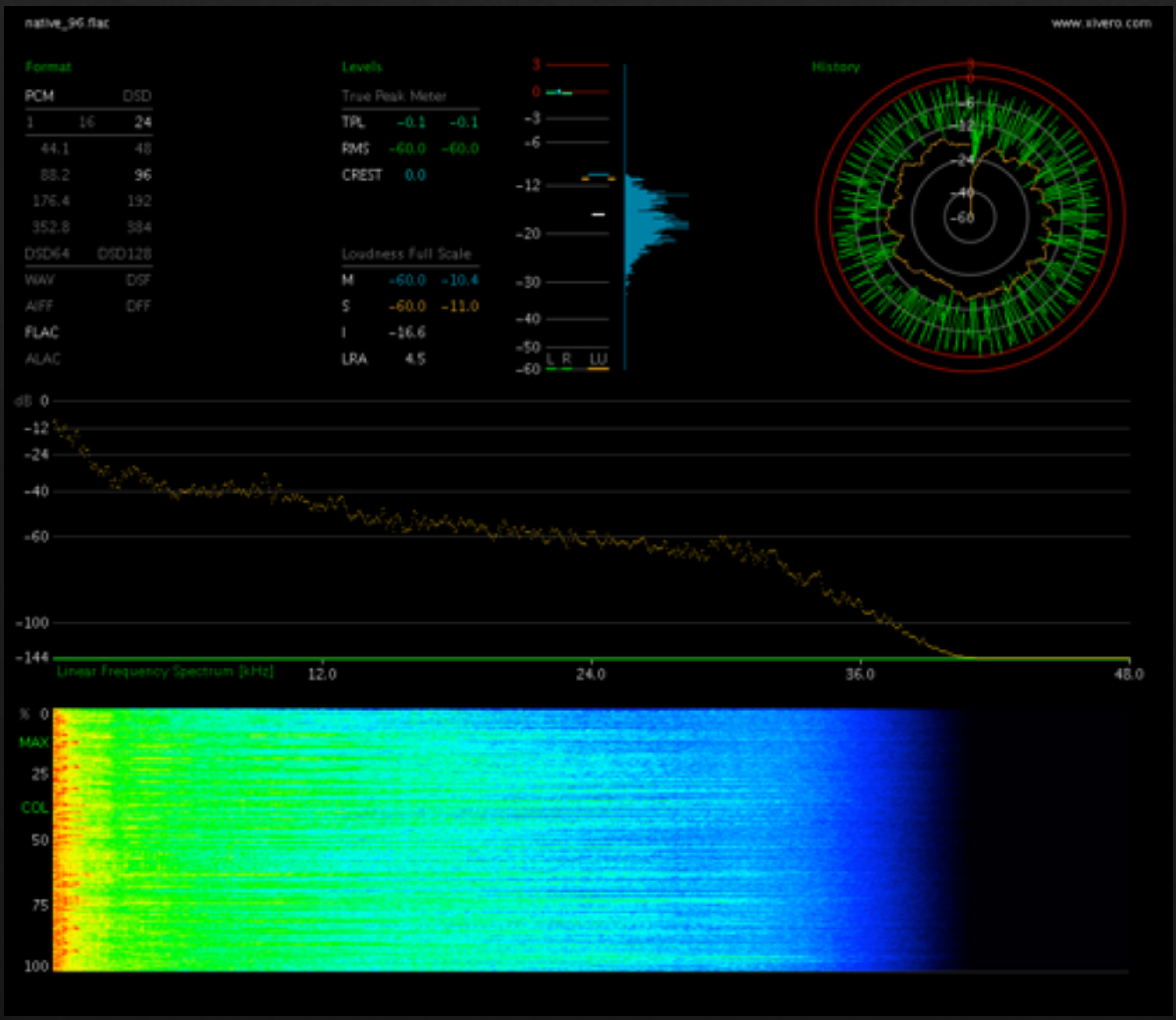
At the end of the music track analysis the measurement results stay in the display for further investigation.

To save those data a reporting function exports them as .png and .txt files.
Just click the „Report“ button which replaces the progress time information display at the end of a full analysis.

Text based report example:

```
Report generated by the MusicScope - www.xivero.com

File:                          test2-16-44.1.wav

Audio format:                    PCM
Bit depth:                        16 bit
Sample rate:                    44.1 kHz

TPL Left:                        2.5 dB
TPL Right:                       2.8 dB
IS Left:                          50
IS Right:                        217

Max. M-Loudness:                -6.9 dB
Max. S-Loudness:                -9.6 dB
Integrated Loudness:           -12.8 dB
Loudness Range:                  4.8 dB

Spectrum:
[kHz]                          [dB]
1                              -15.3
2                              -22.5
3                              -28.8
4                              -23.4
5                              -24.9
6                              -31.3
7                              -34.2
8                              -32.6
9                              -37.1
10                             -34.0
11                             -35.1
12                             -38.3
13                             -35.8
14                             -33.6
15                             -38.3
16                             -39.1
17                             -35.4
18                             -41.7
19                             -42.7
20                             -42.2
21                             -57.5
22                             -61.0
```

The picture shows the .png report:



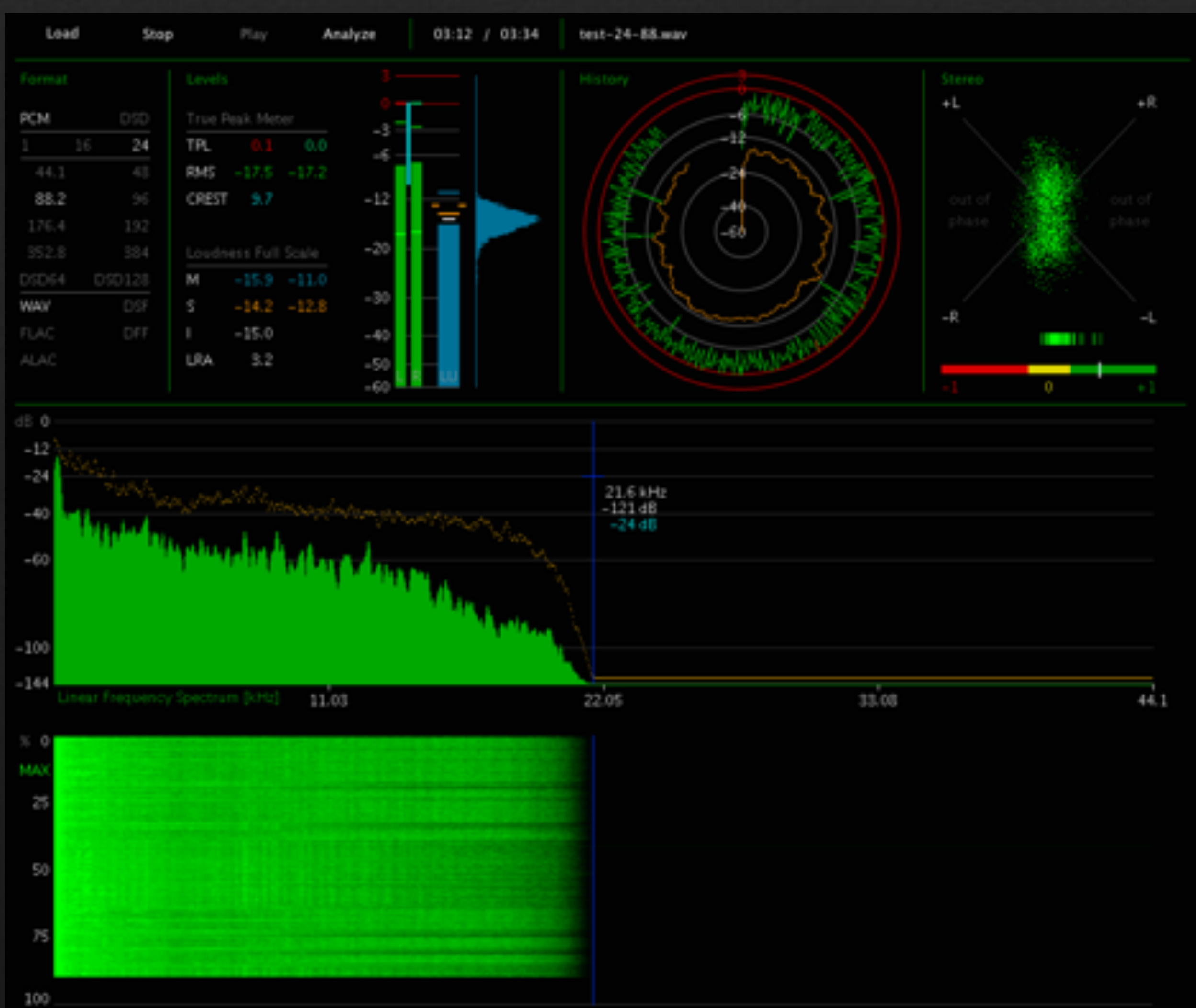
KAPITEL 3

Tutorial

Demonstration of different Use Cases of the MusicScope.

Case 1 - High Resolution Audio

We want to analyse a high resolution audio track where we have the suspicion that it is just an up-sampled version of a CD source.



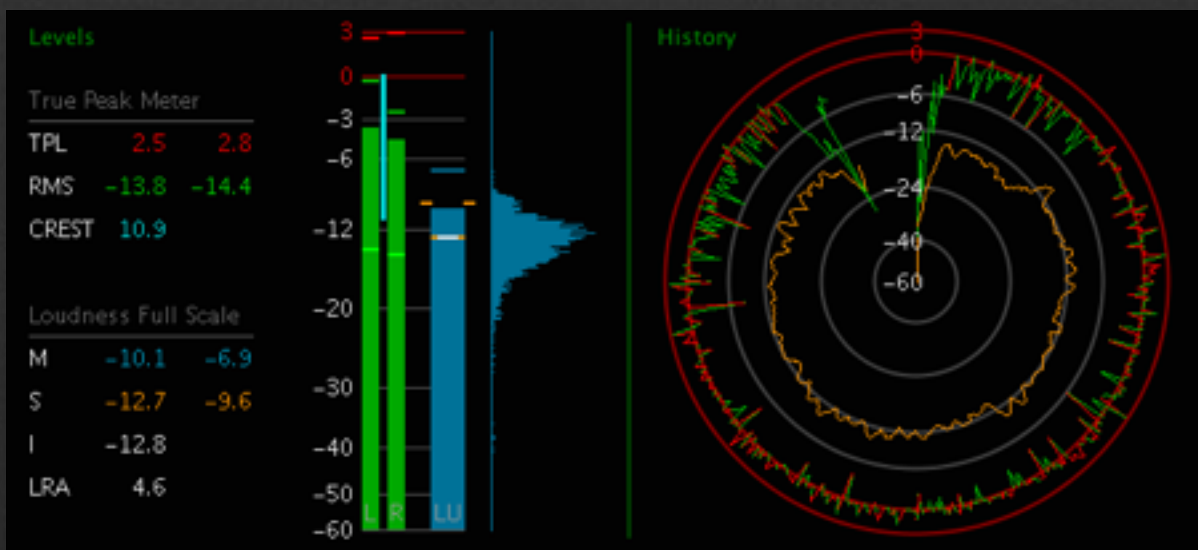
The Format Display tells us that the audio file contains data in the format of 24 Bit / 88.2 kHz.

If we check the spectrum and spectrogram then we see that the music just contains frequencies up to around 21 kHz. Furthermore, by hovering over the spectrogram we read values mostly above -100 dB indicating that this was originally a 16 Bit recording.

Well, we simply proved that this was a CD recording with 16 Bit / 44.1 kHz, upsampled with dedicated software, pretending being a high resolution audio track.

Case 2 - Recording Errors

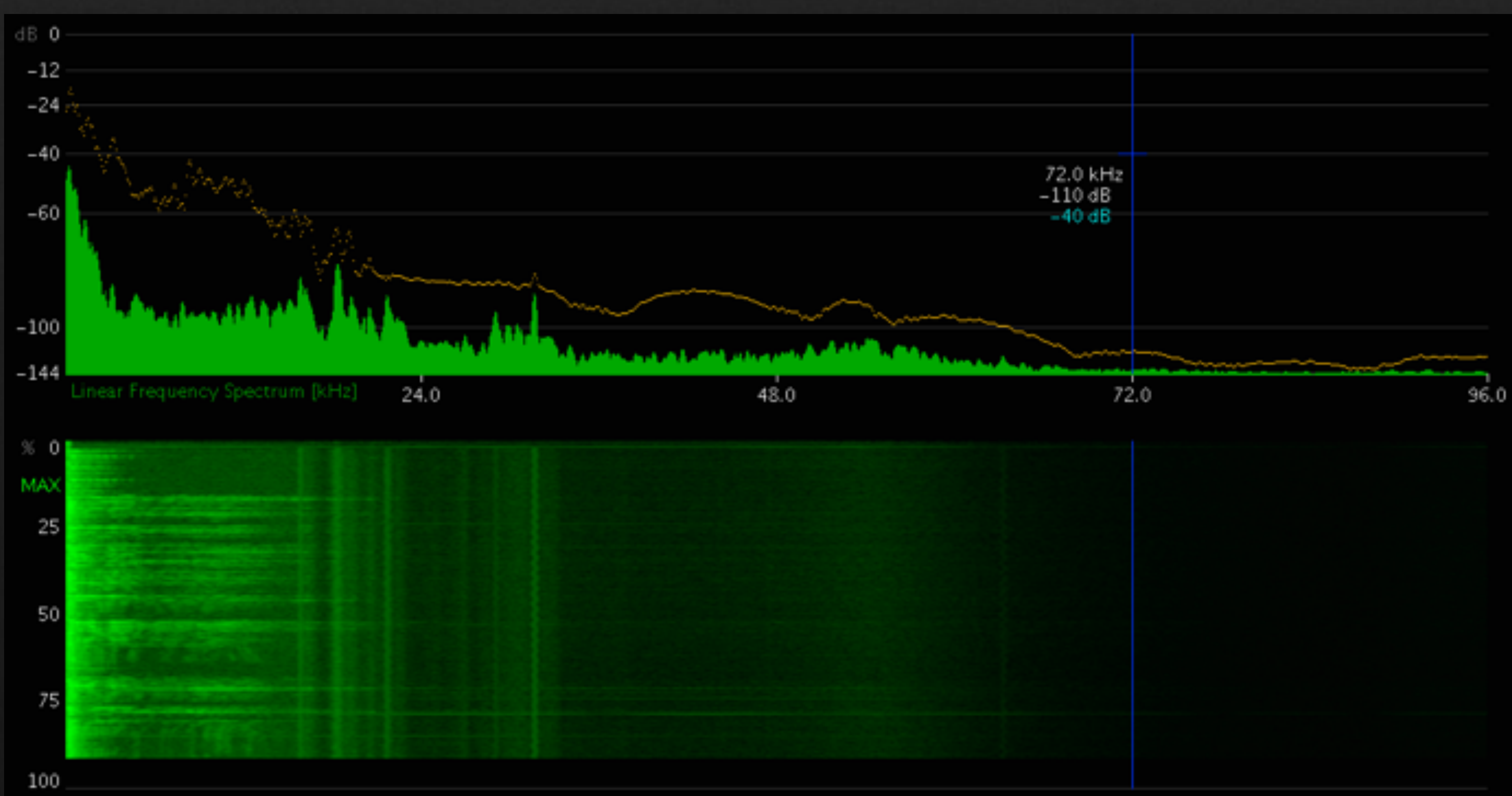
a.) Inter Sample Peaks



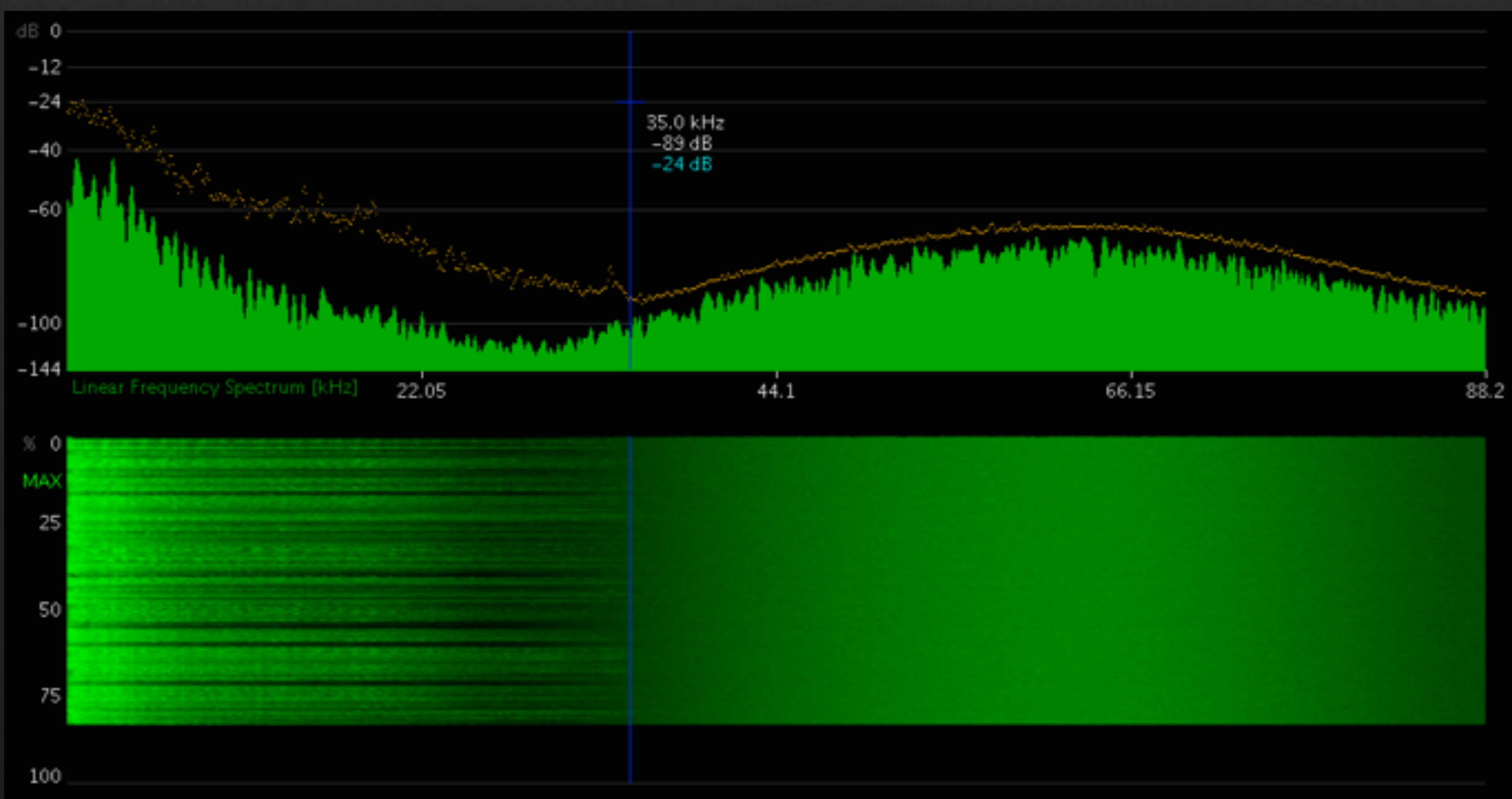
The recording shows several inter sample peaks (pls. see History above) which cause up to around +3 dB overs (pls. see TPL)
It is easy to imaging that those distortions are easily audible.

b.) Periodical Interfering Signals

Several vertical lines in the spectrogram and peaks within the spectrum (pls see below) indicate periodical distortions.
The record has been digitized (24 Bit / 192 kHz) from a studio master tape.



Case 3 - Direct Stream Digital (DSD 64)
The following example is a DSD64 (1 Bit / 2.8224 MHz) track.
The Music Scope is able to analyze and playback the record. For audio monitoring the DSD 1 Bit Stream gets converted to PCM (24 Bit / 176.4 kHz) to enable playback without the need for a dedicated DSD capable Digital to Analog converter.



The measurement confirms that the DSD64 track contains music up to 35 kHz which goes over into the quantization noise given by the 1 Bit digitization method.

Case 4 - Direct Stream Digital (DSD 128)

The example is a DSD128 (1 Bit / 5.6448 MHz) audio track.

The DSD128 sample rate moves the increase of quantization noise to higher frequencies.

The spectrogram confirms frequency parts of music up to 48 kHz.