SOUND LEVEL METER

DEWESoft®

SOLUTION USER MANUAL

SOUND LEVEL METER V21-1

1. Table of contents

2. About this document

2.1. Legend

The following symbols and formats will be used throughout the document.

Important
It gives you important information about the subject.
Please read carefully!

Hint
It gives you a hint or provides additional information about a subject.

Example
Gives you an example of a specific subject.

3. Installation

3.1. Download

"Sound Level" is an option of DewesoftX®, so it already comes with the installation, you just require the license to activate it.

3.2. Licensing

In DewesoftX® an additional license for the option is needed, it can also be written into the DewesoftX® device.

To test it, you can use a *30-days-Evaluation license*.

3.2.1. Evaluation license

You can request an Evaluation license from our homepage: http://www.dewesoft.com/registration (1) Click on **Evaluation license** (2) Fill out all the required fields (3) Click the **Request** Dewesoft button	*Illustration 1: Request Evaluation License*
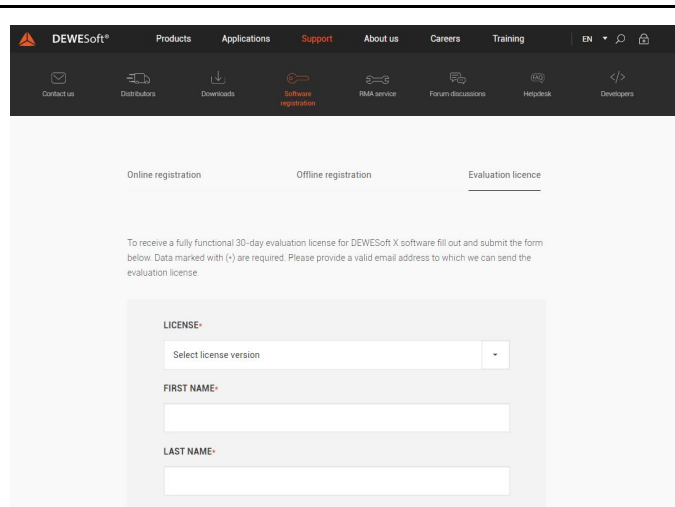
Activating the Evaluation license

When you have received your trial licence key, open DewesoftX®, go to *Options / Settings*, select the Registration tab sheet and enter the license code (if you already have other licenses, you may need to click the **Create** button).

Now enter the license code and click the **Register online** button.	Then your new license key will show up in the list and should have the *Status Valid*.
Illustration 2: Enter license key	*Illustration 3: Valid trial license*

4. Introduction

Per definition, sound is a mechanical wave that is an oscillation of pressure transmitted through some medium (like air or water), composed of frequencies within the range of hearing.

The human ear covers a range of around 20 to 20 000 Hz, depending on age. Frequencies below we call "infra-sonic", frequencies above "ultra-sonic".

Sound needs a medium to distribute, the speed of sound depends on the media:

- In air / gases: 343 m/s (1,230 km/h)
- In water: 1,482 m/s (5,335 km/h)
- In steel: 5,960 m/s (21,460 km/h)

To understand the proportions, we have to know that we are surrounded by constant atmospheric pressure, while our ear only picks up very small pressure changes on top of that.

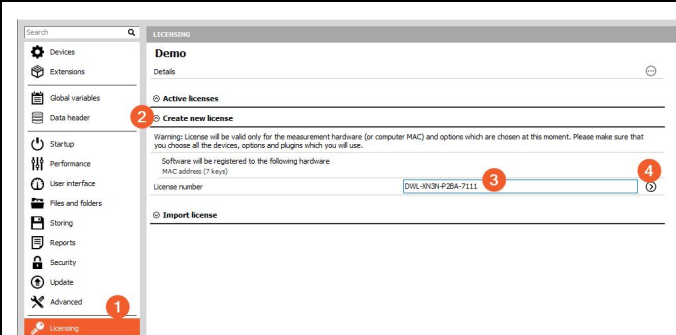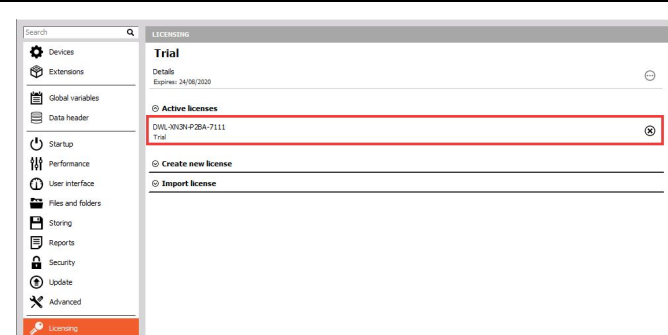The atmospheric (constant) pressure – depending on height above sea level – is 1013,25 hPa = 101325 Pa = 1013,25 mbar = 1,01325 bar. So a sound pressure change of 1 Pa RMS (equals 94 dB) would only change the overall pressure between 101323,6 and 101326,4 Pa.

Dewesoft Sound Level Meter calculation complies with the international IEC 61672:2013 standard and the SLM software together with our data acquisition systems can be calibrated according to IEC 61672 - ensuring maximum accuracy regardless of the type of measurement you are dealing with. For use with SLM software we recommend SIRIUS DualCoreADC® data acquisition systems.

4.1. Sound pressure level LP (SPL)

The most common parameter for characterization is the Sound pressure level, also called Acoustic pressure level or simply "Sound Level", noted in decibels (dB), and originally referred to the threshold of human hearing (which is by standard "a flying mosquito in 3m distance").

$$L_p = 20 \times log_{10}(\frac{p[RMS]}{p_{REF}})$$

DewesoftX® supports calculation according to ANSI S1.1-1994 for:

- air: pref = 20 μPa
- water: pref = 1 μPa

For example, the reference calibrator for microphones, where the microphone is put in before measurement, outputs 1 Pa at 1 kHz. From this we can calculate the dB level.

Illustration 5: Handheld reference calibrator

$$L_p = 20 \times log_{10}(\frac{1\,Pa}{20 \times 10^6\,Pa}) = 93,979\ dB$$

Illustration 6: Reference calibrator output

5. Setup

5.1. Microphone calibration

Connect the microphone(s), in Channel Setup select "Sound pressure" as Physical quantity, then the following scaling options will appear:
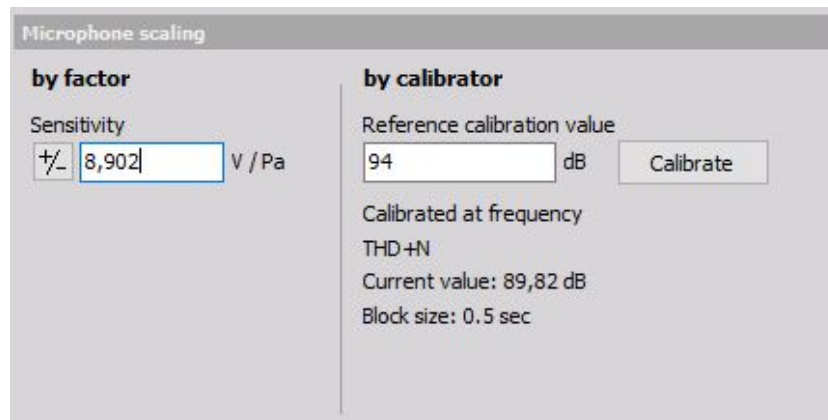
Illustration 7: Calibration options in DewesoftX® Channel setup

To calibrate the microphones there are two options:

- by factor:

Enter the sensitivity from the calibration chart of the microphone.

- by calibrator:

Put the microphone tip into a Sound Calibrator and click the "Calibrate" button; the Sensitivity will automatically be determined and written into the field on the left side.

Illustration 8: Calibration with Sound Calibrator (1 Pa = 94 dB at 1 kHz)

It is also possible to calibrate the microphone out of the Sound Level channel setup, please see the next page.

5.2. Channel Setup

The user interface for the Sound Level is splitted into following sections:

- input: select one or more microphones
- output: depending on your selection, check the output channels and units
- weightings: frequency and time, as well as linear
- main: Sound pressure level, Lpk, and weighted raw channels
- LCpk: C is default weighting, A and linear also selectable
- statistical channels: equivalent continuous sound levels, impulsivity, percentile levels, etc
- calibration: same function as in channel setup; select medium, put microphone into calibrator and press "Calibrate" button

Illustration 9: Channel setup of the Sound level option

5.3. Naming structure

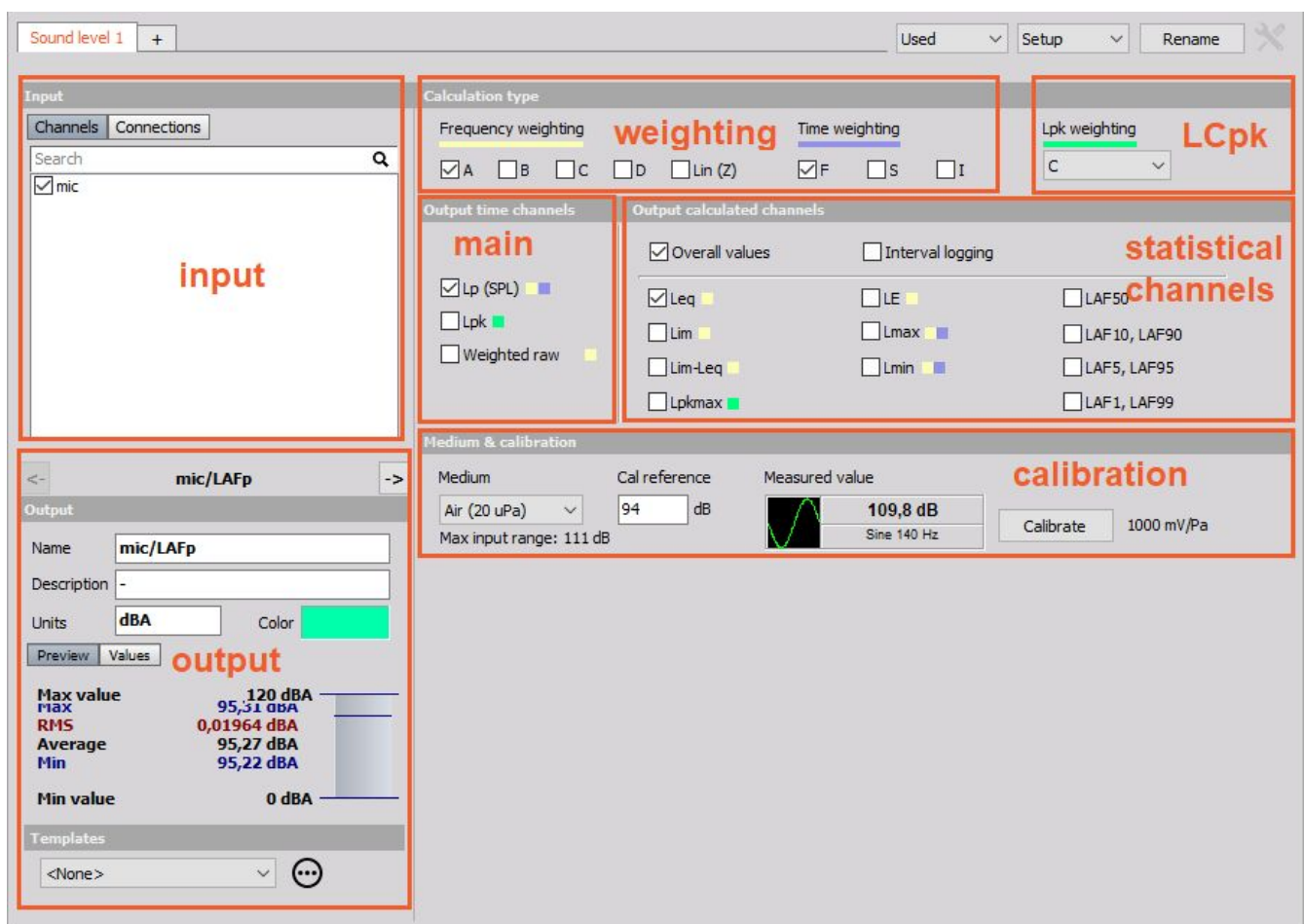The user can specify which time and frequency weightings he wants to combine for Sound pressure level, as well as for other parameters. The output format will be "input channel / parameter". To simplify the graphical user interface, the colors at the end of the parameters show which combinations are possible.

For example, in the Sound pressure level name "Lp" the letters "Z" for linear and "S" for slow are inserted, resulting in "LZSp".

Illustration 10: Colors for weightings in setup

5.4. Sampling rate

As the human ear covers a frequency range from around 20 to 20 000 Hz, we want to measure up to 20 000 Hz. Per theory, the sampling rate should be at least two times the highest frequency you want to measure (Nyquist). A typical used sampling rate is 50 000 Hz.

Due to the Sigma-Delta-ADC technology with anti-aliasing filter, at 50 kHz sampling rate the maximum usable bandwidth is 19,531 kHz. The useful range will adapt depending on the selected sampling rate in channel setup, as well as in the FFT instrument.
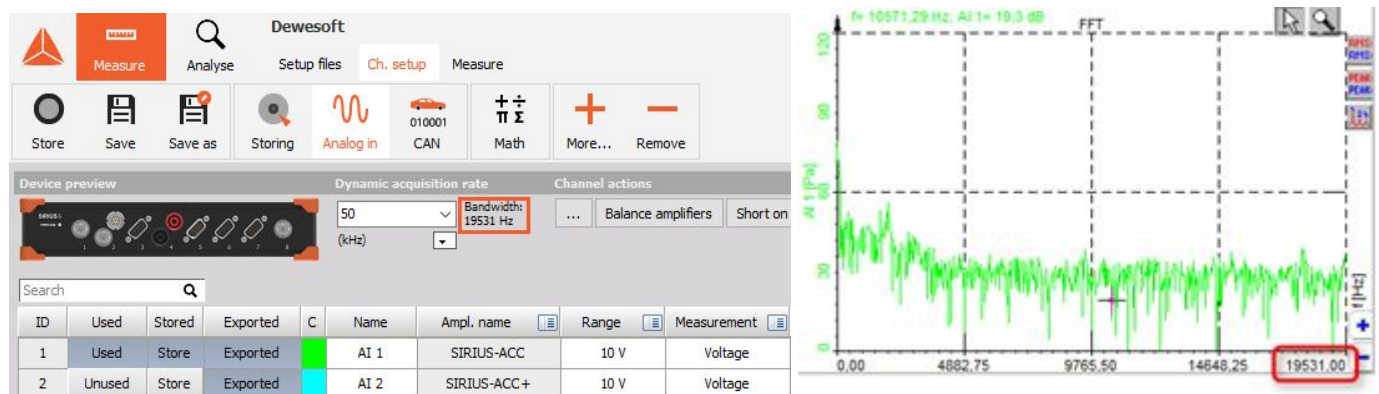
Illustration 11: Sampling rate and bandwidth

If you need to get a higher resolution for the upper frequency range, you can (currently) go up to 200 kHz with SIRIUS and 1 MHz with SIRIUS-HS hardware.

6. Output channels

6.1. Frequency weighting (A, B, C, D, Z)

As the human ear is non-linear (not all frequencies are subjectively recognized with the same loudness level), sound level meters provide the correction / weighting curves. Following corrections can be selected:

- A: mostly used (according to IEC 61672)
- B + D: more or less outdated (D was used for high-level aircraft noise)
- C: for testing purposes of high precision sound level meters
- Z: linear (without weighting)
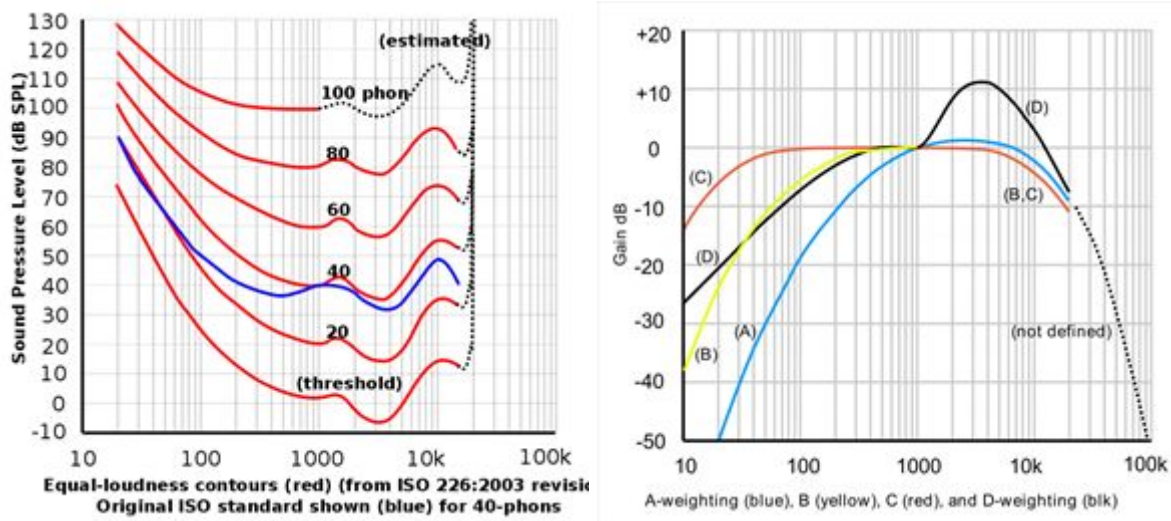
Illustration 14: Equal-loudness curves (©wikipedia)

6.2. Time weighting (F, S, I)

Time weighting settings date back to the analog instruments, where the time constants influenced the behaviour (inertia) of the needle, e.g. Impulse, to hold a peak value long enough that one was able to read it accurately.

DewesoftX® supports three weightings according to IEC 61672:

- Fast (125 ms)
- Slow (1 s)
- Impulse (rise 35ms, fall 1,5 s)
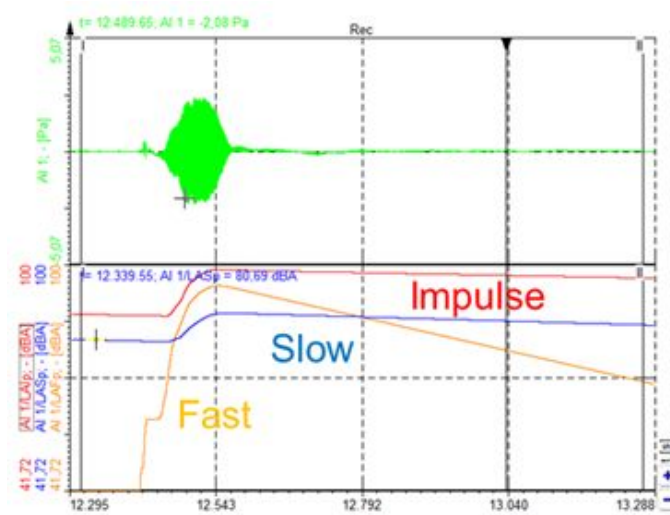
Illustration 16: Time weightings example

6.3. Sound Pressure Level (e.g. LAFp)

Sound pressure level, also called Acoustic pressure level, is maybe the most important parameter, as described in chapter 2.1 Sound pressure level LP (SPL).
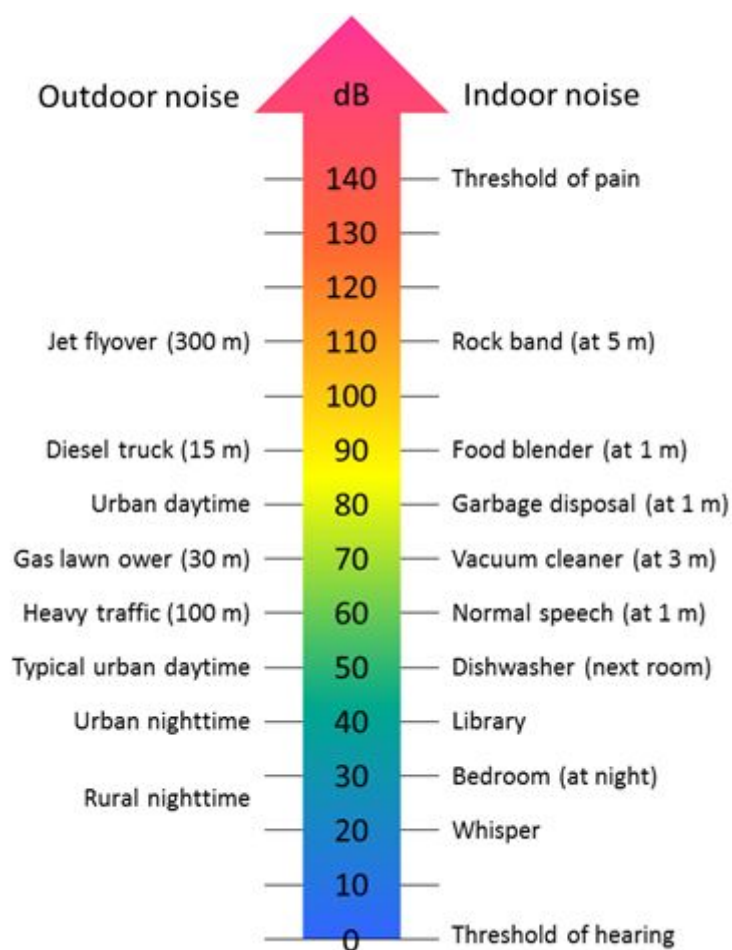
Illustration 17: Sound pressure level examples

The calculation reference in DewesoftX® can be chosen, based on air (20µPa) or on water (1 µPa):
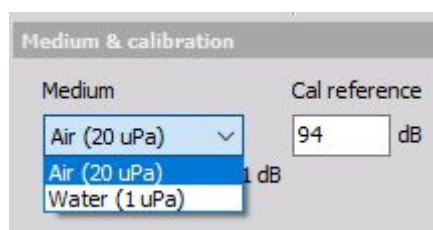
Illustration 18: Medium selection

Furthermore, the combination of time and frequency weighting can be freely selected.

The output rate will be the same as the selected analog input rate (sampling rate), therefore this is a synchronous channel.

6.4. True Peak Level (e.g. LCpk)

True peak level shows the real peak value of the input signal in dB. This should not be mixed up with the maximum Sound pressure level! Sound pressure level always contains a time weighting filter, which has an influence on the peak value.

Please see the example below, the raw signal shows a clear maximum at 19,338 Pa, which equals 119,7 dB. The SPL does not reach that high value, no matter if we select F, S or I time weighting. The LCpk however shows the "True peak" of 120,85 dB. (The remaining deviation is because of the C frequency weighting used here).
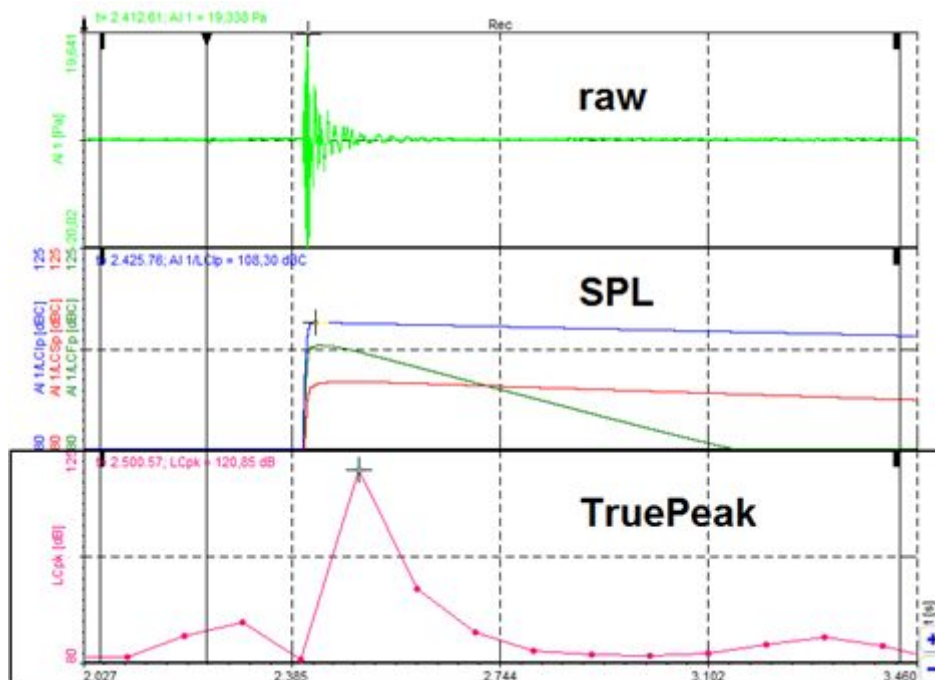
Illustration 19: True peak level example

6.5. Weighted raw

Sometimes it is needed to see the raw analog input signal, only with applied frequency weighting. This is provided by selecting the "weighted raw" checkbox. A, B, C, D or Lin(Z) can be used. The output rate equals the analog input (sampling) rate.

6.6. Equivalent Continuous Sound Level (e.g. LAeq)

Leq is the Sound Pressure Level in dB, equivalent to the total Sound Energy over a given period of time. It is also called average sound level, and used to describe the average noise. There are two common types:

- Leq (overall) → When checking the "Overall values" checkbox and e.g. A weighting, DewesoftX® calculates LAeq, one single value per measurement.

- Short Leq (interval)→ check the "Intervall logging" option, any custom time interval can be used, typically "0,125 sec"

6.7. Impulse-weighted Continuous Sound Level (e.g. LAim)

The impulse-weighted average sound level (also called "impulsivity of sound") is different from LAeq, as it weighs impulsive events (e.g. shooting noise or strikes). The parameter can be calculated using two time-bases:

- Lim (overall)
- Lim_t (interval)

6.8. Difference Lim-Leq

For more detailed analysis DewesoftX® also offers the difference between the just mentioned two parameters as separate channels, for both time bases:

- Lim-Leq (overall)
- Lim_t-Leq_t (interval)

6.9. Max of True Peak Level (Lpkmax)

This channel provides the maximum of the TruePeakLevel, described in 4.4 True Peak Level (e.g. LCpk), again on both time bases:

- Lpkmax (overall)
- Lpkmax_t (interval)

6.10. Sound Energy LE

The Sound Energy is frequency-weighted (A, B, C, D, Z) and has the unit [J] Joule; both time-bases available:

- LE (overall)
- LE_t (interval)

6.11. Max of Sound Level (Lmax)

The maximum of the Sound pressure level (time- and frequency-weighted) is provided as separate channel, again on both time bases:

- Lmax (overall)
- Lmax_t (interval)

6.12. Min of Sound Level (Lmin)

The minimum of the Sound pressure level (time- and frequency-weighted) is provided as separate channel, again on both time bases:

- Lmin (overall)

- Lmin_t (interval)

6.13. Percentile levels

To get more details of an e.g. noise situation, the "Percentile levels", also called „Exceedance levels" or „Statistical Noise Levels" have been introduced. Without looking at the time domain data, one can judge and compare measurements easily when looking at these parameters.

For example a LAF99 value of 40,90 dBA means: during 99% of the time the noise level was 40,9 dB(A).

Accordingly, a LAF1 value of 96,20 dBA means: during 1% of the time the noise was 96,2 dB(A).

Imagine two measurements: 1) done countryside, where there is only one train per hour passing by. Most of the time the noise level is very low. 2) along a main road, with a lot of traffic noise, with 2000 cars per hour passing by. When LAF90 and LAF10 values don't differ much, this indicates a stable situation.

Again, you can choose between two time bases:

- LAFx (overall)
- LAFx_t (interval)

1 train per hour, otherwise silence
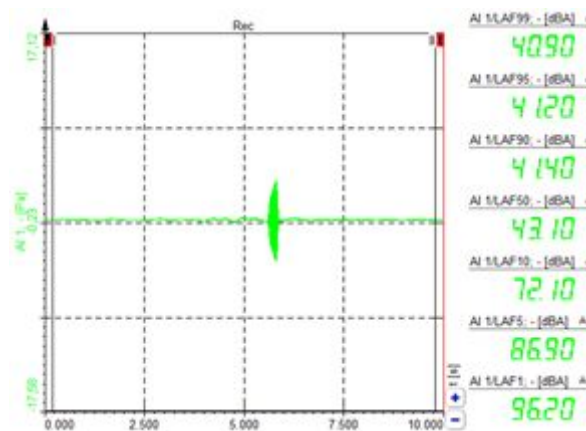
Illustration 20: Percentile example 1

2000 cars per hour
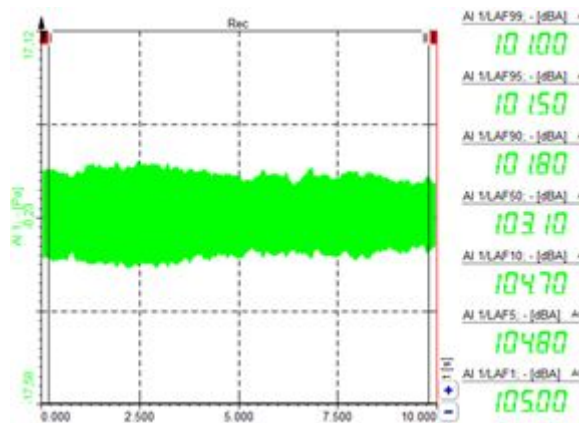
Illustration 21: Percentile example 2

6.14. Table of output channels

The following table gives an overview over the most commonly used output parameters (not all are shown because of the multiple time/frequency-weighting combinations). The analog input channel was named "Mic" for this example:

Channel name	Description	Unit	Output type	Output rate
Mic/LAFp	Sound Level (A-and F-weighted)	dBA	Sync	Full rate
Mic/LCpk	TruePeakLevel (C-weighted)	dB	Async	100 ms fixed
Mic/(A)	Raw signal (A-weighted)	Pa	Sync	Full rate
Mic/LAeq	Equivalent Cont. Sound Level (A-weighted)	dBA	Single value	One "overall" value per measurement
Mic/LAim	Impulse-weighted Cont. Sound Level (A-weighted)	dBA	Single value	One "overall" value per measurement
Mic/LAim-LAeq	Difference between the two previous values	dBA	Single value	One "overall" value per measurement
Mic/LCpkmax	Maximum of TruePeakLevel (C-weighted)	dB	Single value	One "overall" value per measurement

Mic/LAFmax	Maximum of Sound Level (A-and F-weighted)	dBA	Single value	One "overall" value per measurement
Mic/LAFmin	Minimum of Sound Level (A-and F-weighted)	dBA	Single value	One "overall" value per measurement
Mic/LAE	Sound Energy (A-weighted)	dBA	Single value	One "overall" value per measurement
Mic/LAF1, Mic/LAF5, Mic/LAF10, Mic/LAF90, Mic/LAF95, Mic/LAF99	Percentile Levels (A- and F-weighted)	dBA	Single value	One "overall" value per measurement
Mic/LAeq_**t**	Equivalent Cont. Sound Level (A-weighted), interval	dBA	Async	custom
Mic/LAim_**t**	Impulse-weighted Cont. Sound Level (A-weighted), interval	dBA	Async	custom
Mic/LAim-LAeq_**t**	Difference between the two previous values, interval	dBA	Async	custom
Mic/LCpkmax_**t**	Maximum of TruePeakLevel (C-weighted), interval	dB	Async	custom
Mic/LAFmax_**t**	Maximum of Sound Level (A-and F-weighted), interval	dBA	Async	custom
Mic/LAFmin_**t**	Minimum of Sound Level (A-and F-weighted), interval	dBA	Async	custom
Mic/LAE_**t**	Sound Energy (A-weighted), interval	dBA	Async	custom
Mic/LAF1_**t**, Mic/LAF5_**t**, Mic/LAF10_**t**, Mic/LAF90_**t**, Mic/LAF95_**t**, Mic/LAF99_**t**	Percentile Levels (A- and F-weighted), interval	dBA	Async	custom

7. Measurement & Visualisation

7.1. Auto-generated displays

When you add the Sound Level Module, specify the input channels and switch to Measure mode, automatically there is a screen called "Sound level meter" generated.

The screen will adapt the first time it is generated, e.g. when you have two input channels, it will place

- two digital meters (showing Sound pressure level),
- two CPB plots (showing frequency-domain Sound pressure level, 1/3 octave, display set to "Sound dB") and
- one recorder (showing time-domain Sound pressure level, both channels),

to quickly get started.

Accordingly, when using more Sound Level Modules (added with the plus button), there will be a screen for every instance (called "Sound level meter 1", "Sound level meter 2", etc).

Illustration 22: Auto-generated screen

7.2. Octave analysis

There are two ways for Octave calculation/visualisation of the Sound pressure level: per display or per math.

7.2.1. Octave analysis (display)

The quickest way is to do the visualisation only with the instrument called "Octave plot". You only need to set the y axis to "Sound dB" to display the result. Further options are:

1/1, 1/3 up to 1/24 octave resolution; weighting (A, B, C, D, Lin); Averaging (Lin, Exp, Peak) with overlap (0 to 75%).
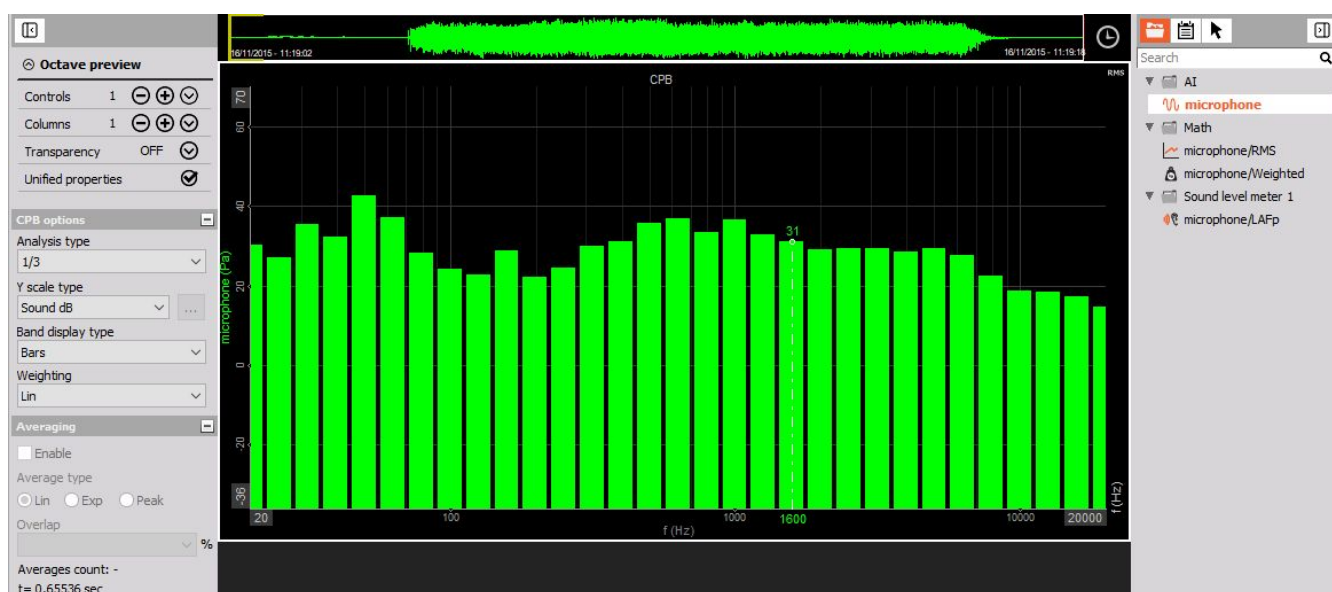

Illustration 25: Octave plot instrument

7.2.2. Octave analysis (math)

The other option is to do the octave calculation by math, which has the advantage that statistical values of the calculated array (e.g. max, average over specific bandwidth, extracting single lines) can be processed further in math.
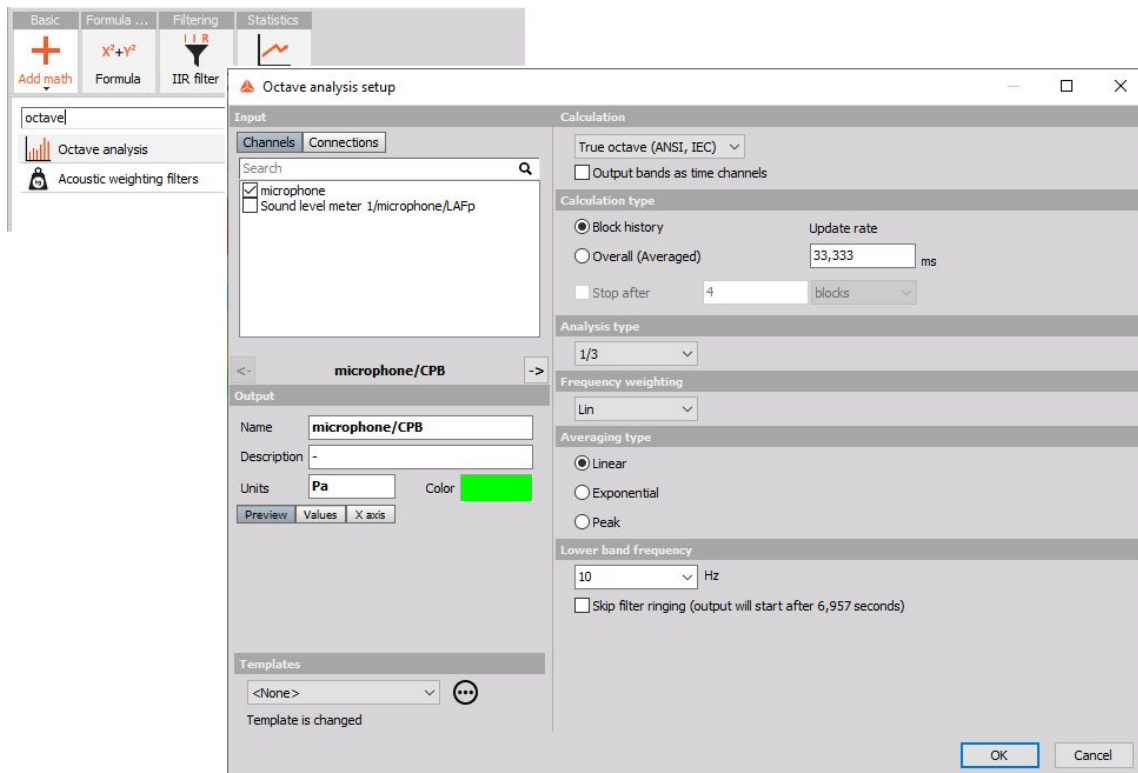
Illustration 26: Adding the math "Octave analysis"

Go to Math and add the "Octave analysis".

There are two ways: the calculation in frequency domain (Synthesized) or – commonly used: – by real-time filtering (True-Octave ANSI, IEC). Please select the analog input signal from the microphone (in Pa unit) as input.

Further settings for "True-Octave" are: 1/1, 1/3 up to 1/24 octave resolution and lower frequency;

Additional settings for "Synthesized": weighting (A, B, C, D, Lin); Averaging (Lin, Exp, Peak) with overlap (0 to 75%).

Illustration 27: Visualisation using 2D graph

The visualisation in Measure mode works using the 2D graph instrument, because the output is a 2-dimensional array. Set the y-axis scaling to "Sound dB" to get the A-weighted log scale.

7.3. Standard FFT

Also the standard FFT instrument provides a "Sound dB" y axis scaling and can therefore display the A-weighted SPL.
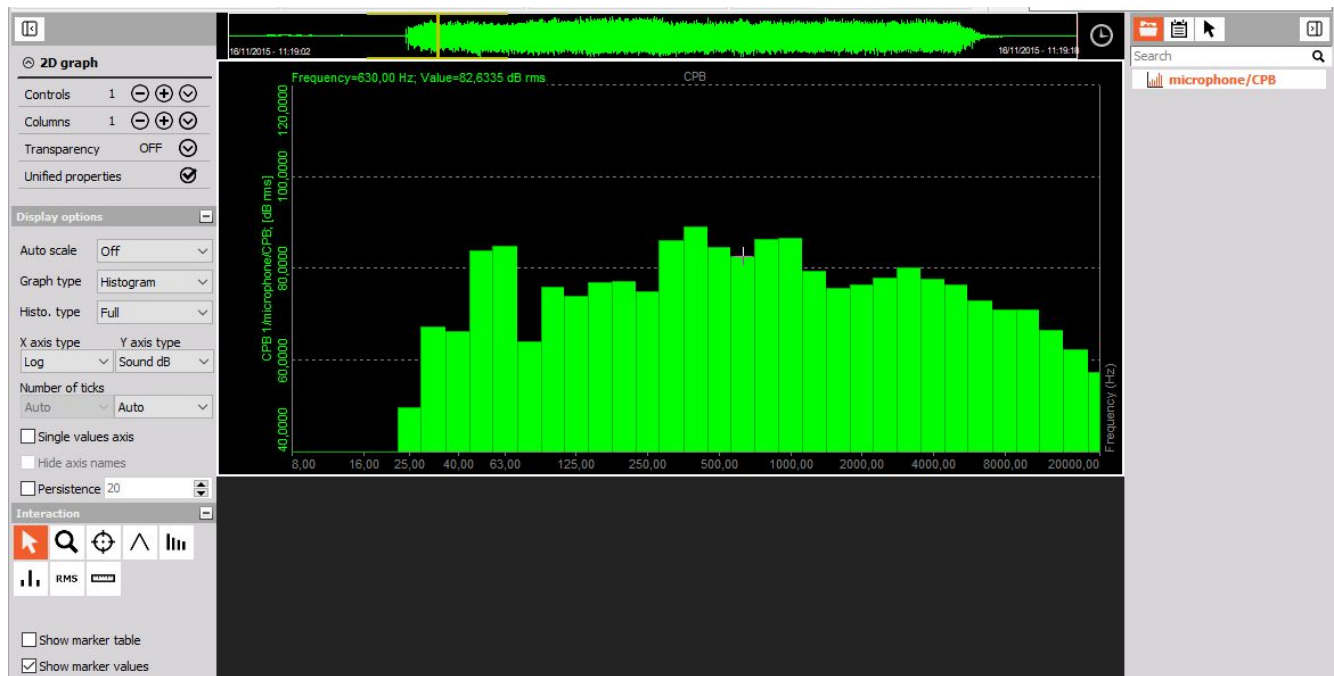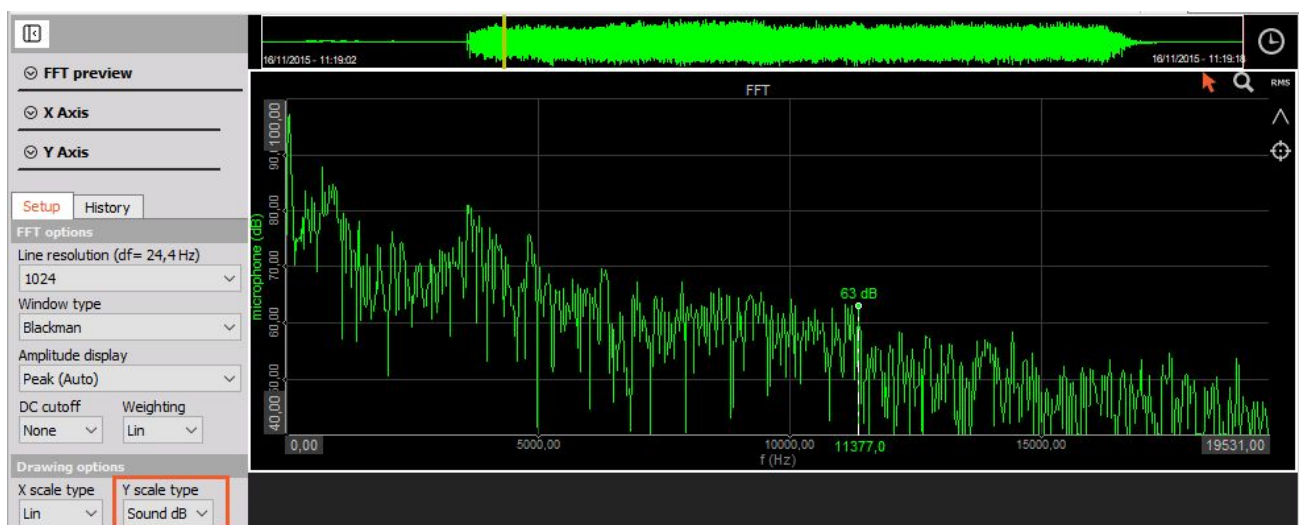

Illustration 28: FFT instrument

7.4. Sound Level Octave 3D waterfall diagram

A very common diagram is also the Sound Level waterfall diagram, where the FFT is displayed as Octave.

First, add an "Octave analysis" function in the math. Then make a math formula for calculating the Sound Level for each octave band by the formula 20*log10('mic/CPB'/0.00002). The array mathematics will automatically take care about the data format.

In Measure mode you can then display the array function in the "3D graph". The Octave plots will "run through" in real time continuously. With the "history count" you can increase the shown buffer.

Please see also chapter Waterfall FFT – extracting single lines.
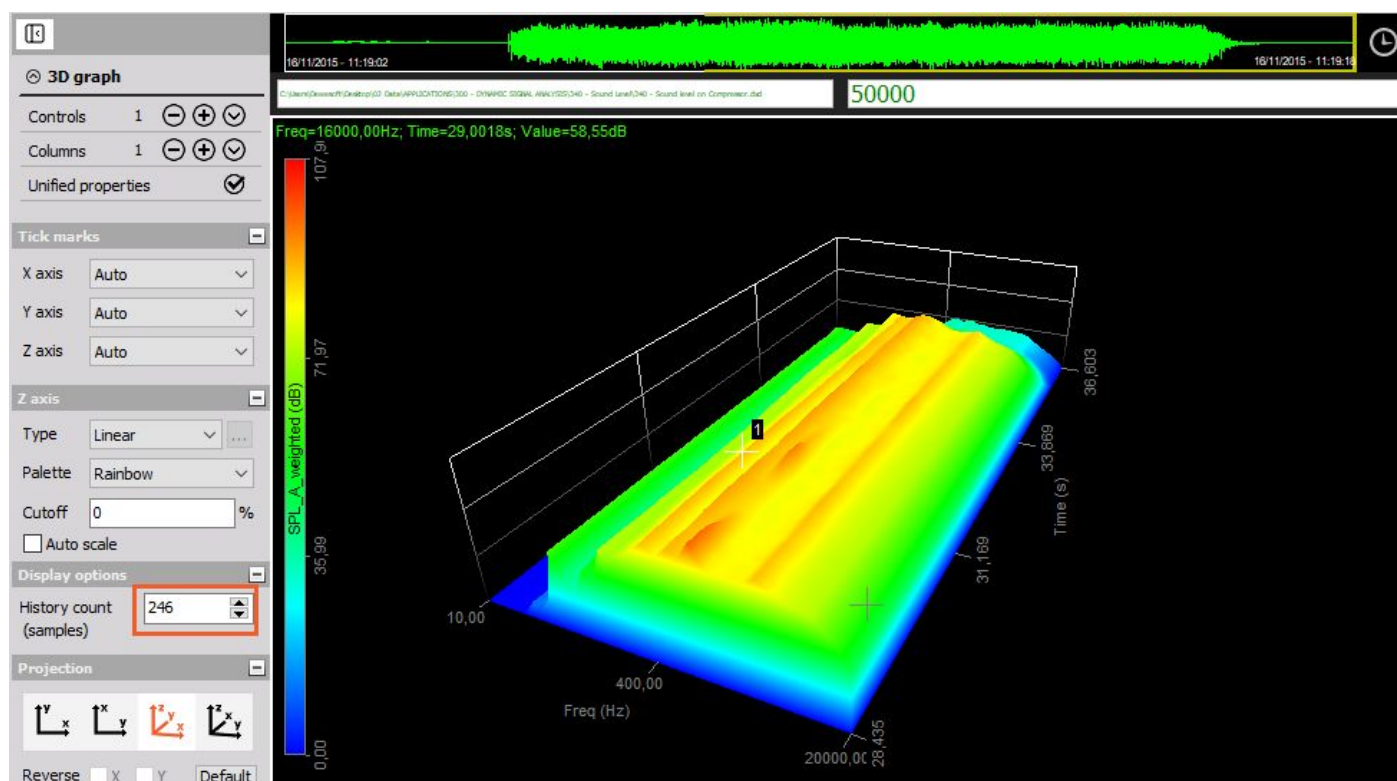
Illustration 30: Visualisation using 3D graph

8. Offline calculation

8.1. Introduction

As any other module in DewesoftX®, also Sound Level can be calculated offline. You only need to store the raw signals, and can do all calculations afterwards on the stored data file.

The procedure can be similar like that: Open the datafile, go to Math, go to the Sound Level Module, change parameters, click on "Review" and then on the button "Recalculate".

8.2. Waterfall FFT – extracting single lines

After you have recorded the waterfall FFT (actually this feature also works "live" during measurement), you may want to look at specific octave bands and visualise their time dependent course as single lines in a recorder.

To extract the single lines of the 3D waterfall, please go to Design mode, right-click on the 3D graph, select "Info channels" from the context menu and enable both X cut and Y cut.
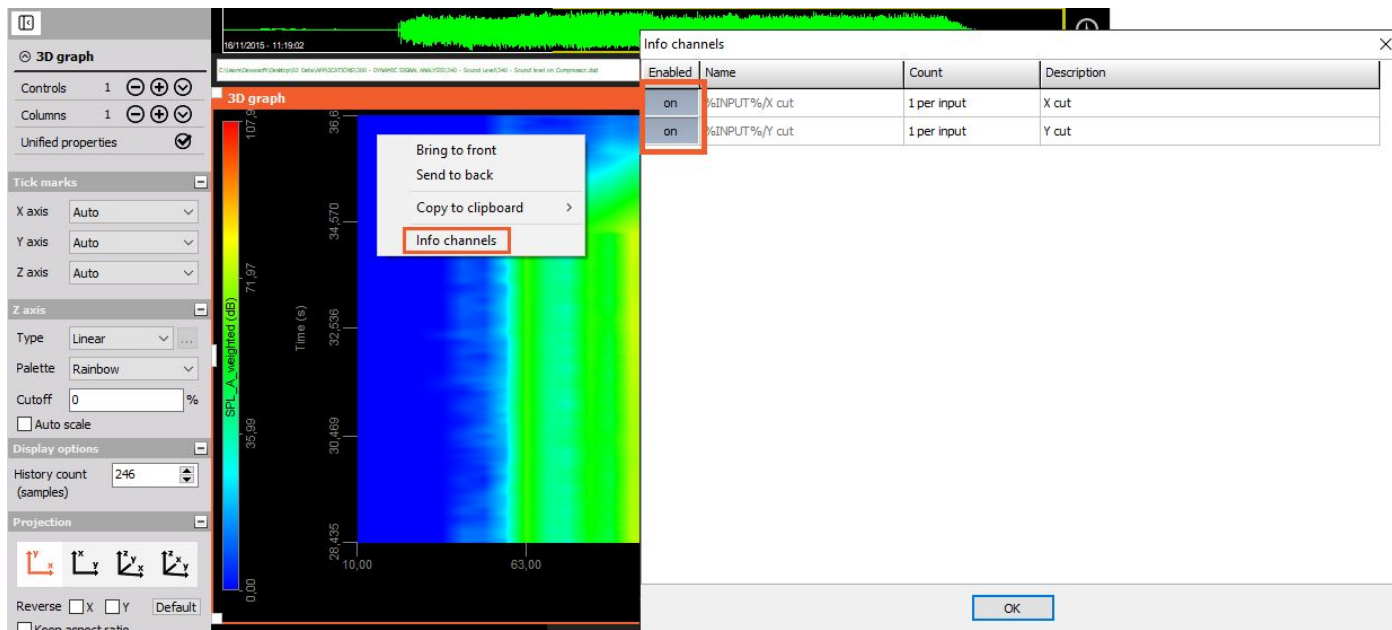
Illustration 31: Enable Info channels

New channels will be generated and shown in the channel list.

Please get a new 2D graph instrument from the instrument toolbar in design mode and assign one of the channels to it. Then exit design mode and left-click on the 3D graph on a frequency you are interested in. The info channel in the 2D graph will automatically update, because it is linked to the 3D graph.

To remove a marker in the 3D graph, please right-click on it.

Currently only one marker is supported. Multiple markers will show up, but the cut is only done on the position of the first marker.
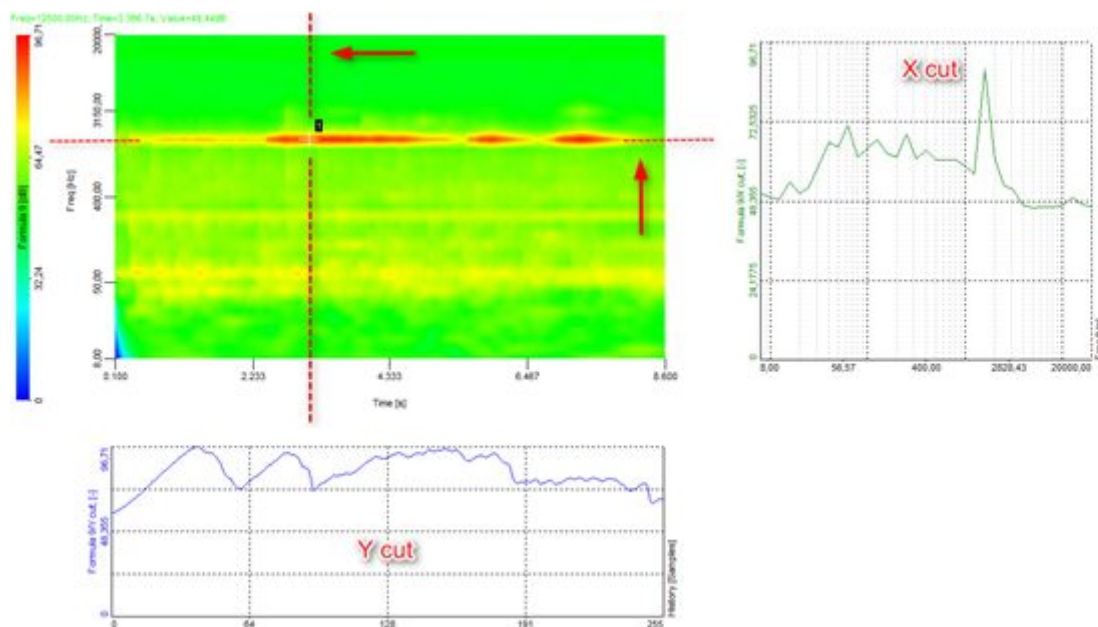
Illustration 32: Cut done on a waterfall signal of constant frequency with varying loudness

8.3. Acoustic replay / Analog out

Any recorded channel can be replayed through the loudspeakers or via Analog out voltage 0…10V (e.g. SIRIUS MULTI module or AO option).

Please open a data file, click on the loudspeaker symbol, select the channel you want to hear and click on Play. The replay speed can also be changed.
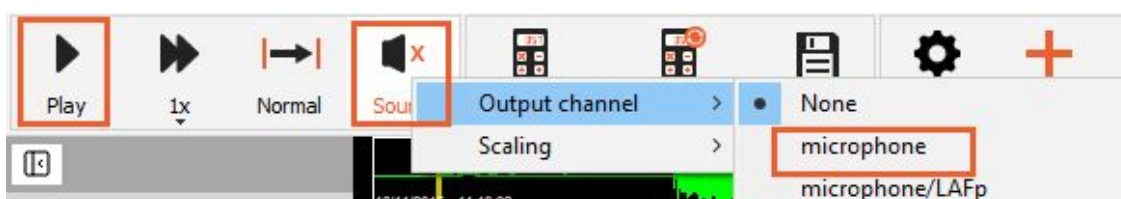
Illustration 33: Replay through sound card

9. Export

9.1. Print report

When the calculations are finished, there are multiple options on how to export the data out of DewesoftX®. We can either print the current display arrangement or export to clipboard or to external software.

For the first option just click on the button "Print", and select the printer, which can also be a PDF.
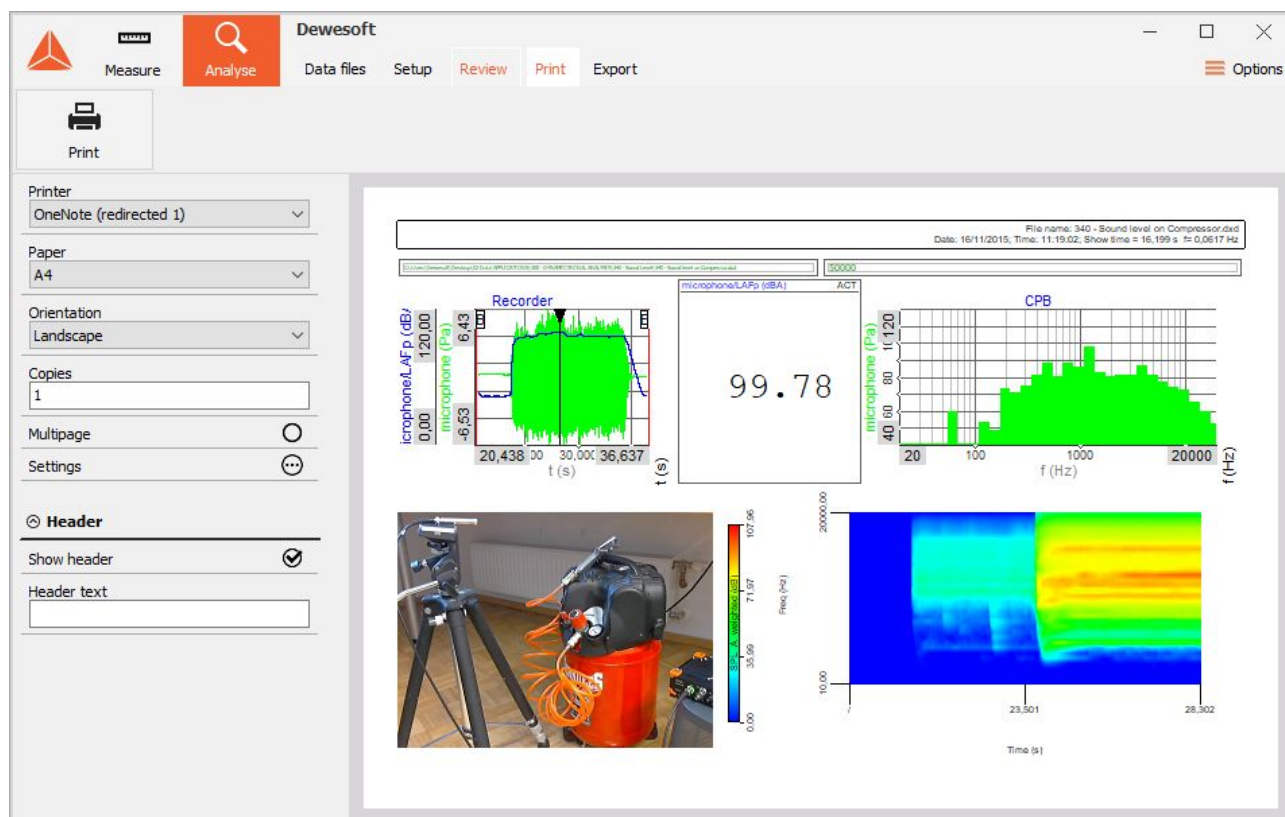
Illustration 34: Print current screen

9.2. Export instrument data to clipboard

A quick way to export the data is by using the clipboard. Click on the instrument, e.g. the Octave plot showing the Sound Level data, to set it active. Then select "Copy data to clipboard" from the Edit menu.

Start Excel and paste the data into, the columns and rows will be filled exactly with the data you see.
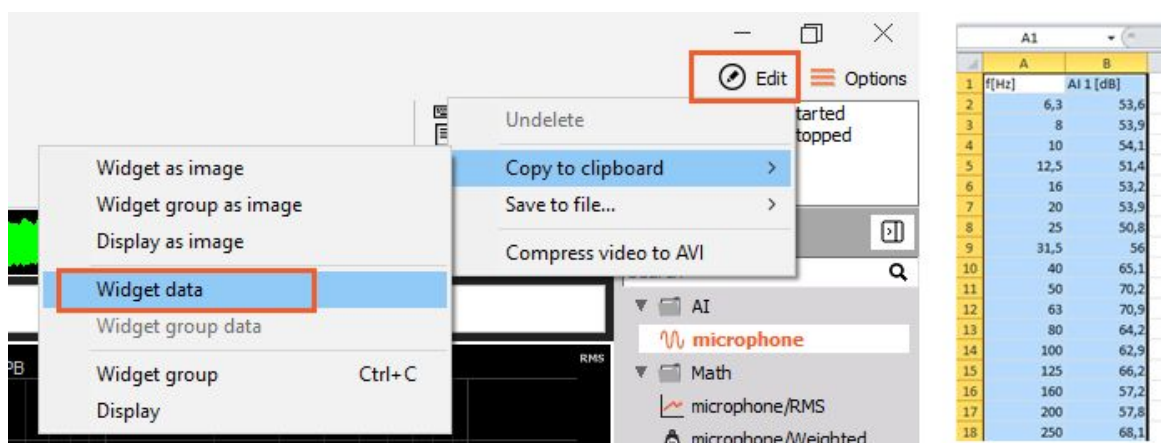
Illustration 35: Copy instrument data to clipboard

9.3. Export to Wav, Matlab, Excel…

Or use the default export into a lot of different file formats, such as Matlab, Excel, Diadem, RPCIII, CSV, etc..

For Flexpro and Excel there is also ActiveX support, providing export into predefined templates for one-click-report-generation.
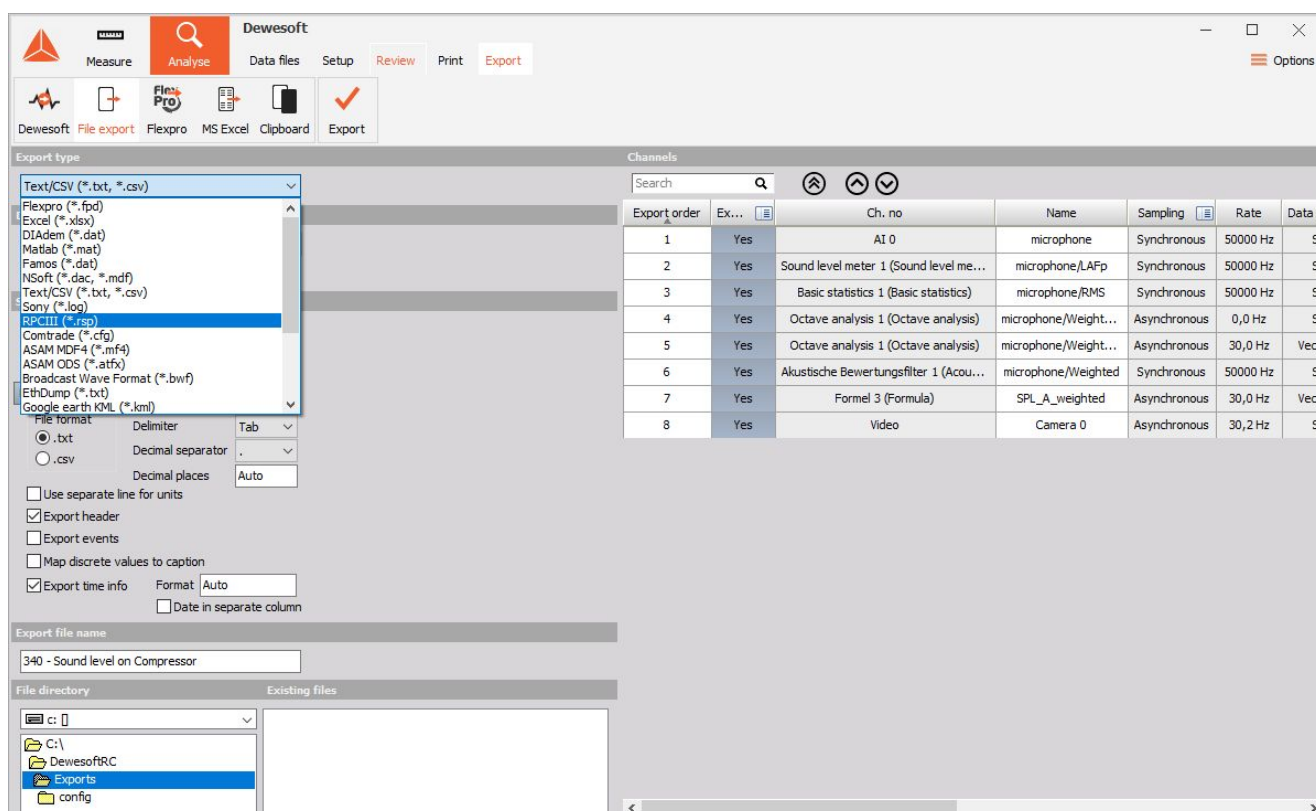
Illustration 36: Export formats

10. FAQ

The FAQ section on the web page should help you to find quick solutions for known problems. Link: https://support.dewesoft.com/

11. Warranty information

Notice
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The copy of the specific warranty terms applicable to your Dewesoft product and replacement parts can be obtained from your local sales and service office. To find a local dealer for your country, please visit https://dewesoft.com/support/distributors.

11.1. Calibration

Every instrument needs to be calibrated at regular intervals. The standard norm across nearly every industry is annual calibration. Before your Dewesoft data acquisition system is delivered, it is calibrated. Detailed calibration reports for your Dewesoft system can be requested. We retain them for at least one year, after system delivery.

11.2. Support

Dewesoft has a team of people ready to assist you if you have any questions or any technical difficulties regarding the system. For any support please contact your local distributor first or Dewesoft directly.

Dewesoft d.o.o.
Gabrsko 11a
1420 Trbovlje Slovenia

Europe Tel.: +386 356 25 300
Web: http://www.dewesoft.com
Email: Support@dewesoft.com
The telephone hotline is available Monday to Friday from 07:00 to 16:00 CET (GMT +1:00)

11.3. Service/repair

The team of Dewesoft also performs any kinds of repairs to your system to assure a safe and proper operation in the future. For information regarding service and repairs please contact your local distributor first or Dewesoft directly on https://dewesoft.com/support/rma-service.

11.4. Restricted Rights

Use Slovenian law for duplication or disclosure. Dewesoft d.o.o. Gabrsko 11a, 1420 Trbovlje, Slovenia / Europe.

11.5. Printing History

Version 2.0.0, Revision 217 Released 2015 Last changed: 23. July 2018 at 16:54.

11.6. Copyright

11.7. Trademarks

We take pride in our products and we take care that all key products and technologies are registered as trademarks all over the world. The Dewesoft name is a registered trademark. Product families (KRYPTON, SIRIUS, DSI, DS-NET) and technologies (DualCoreADC, SuperCounter, GrandView) are registered trademarks as well. When used as the logo or as part of any graphic material, the registered trademark sign is used as a part of the logo. When used in text representing the company, product or technology name, the ® sign is not used. The Dewesoft triangle logo is a registered trademark but the ® sign is not used in the visual representation of the triangle logo.

12. Safety instructions

Your safety is our primary concern! Please be safe!

12.1. Safety symbols in the manual

! **Warning**
Calls attention to a procedure, practice, or condition that could cause the body injury or death

Caution
Calls attention to a procedure, practice, or condition that could possibly cause damage to equipment or permanent loss of data.

12.2. General Safety Instructions

! **Warning**

The following general safety precautions must be observed during all phases of operation, service, and repair of this product. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the product. Dewesoft GmbH assumes no liability for the customer's failure to comply with these requirements.

All accessories shown in this document are available as an option and will not be shipped as standard parts.

12.2.1. Environmental Considerations

Information about the environmental impact of the product.

12.2.2. Product End-of-Life Handling

Observe the following guidelines when recycling a Dewesoft system:

12.2.3. System and Components Recycling

Production of these components required the extraction and use of natural resources. The substances contained in the system could be harmful to your health and to the environment if the system is improperly handled at its end of life! Please recycle this product in an appropriate way to avoid unnecessary pollution of the environment and to keep natural resources.

This symbol indicates that this system complies with the European Union's requirements according to Directive 2002/96/EC on waste electrical and electronic equipment (WEEE). Please find further information about recycling on the Dewesoft web site www.dewesoft.com

Restriction of Hazardous Substances

This product has been classified as Monitoring and Control equipment and is outside the scope of the 2002/95/EC RoHS Directive. However, we take care of our environment and the product is lead-free.

12.2.4. General safety and hazard warnings for all Dewesoft systems

Safety of the operator and the unit depend on following these rules.

- Use this system under the terms of the specifications only to avoid any possible danger.
- Read your manual before operating the system.
- Observe local laws when using the instrument.
- DO NOT touch internal wiring!
- DO NOT use higher supply voltage than specified!
- Use only original plugs and cables for harnessing.
- You may not connect higher voltages than rated to any connectors.
- The power cable and connector serve as Power-Breaker. The cable must not exceed 3 meters, the disconnect function must be possible without tools.
- Maintenance must be executed by qualified staff only.
- During the use of the system, it might be possible to access other parts of a more comprehensive system. Please read and follow the safety instructions provided in the manuals of all other components regarding warning and security advice for using the system.
- With this product, only use the power cable delivered or defined for the host country.
- DO NOT connect or disconnect sensors, probes or test leads, as these parts are connected to a voltage supply unit.
- Ground the equipment: For Safety Class 1 equipment (equipment having a protective earth terminal), a non-interruptible safety earth ground must be provided from the mains power source to the product input wiring terminals.
- Please note the characteristics and indicators on the system to avoid fire or electric shocks. Before connecting the system, please read the corresponding specifications in the product manual carefully.
- The inputs must not, unless otherwise noted (CATx identification), be connected to the main circuit of category II, III and IV.
- The power cord separates the system from the power supply. Do not block the power cord, since it has to be accessible for the users.
- DO NOT use the system if equipment covers or shields are removed.
- If you assume the system is damaged, get it examined by authorized personnel only.

- Adverse environmental conditions are Moisture or high humidity Dust, flammable gases, fumes or dissolver Thunderstorm or thunderstorm conditions (except assembly PNA) Electrostatic fields, etc.
- The measurement category can be adjusted depending on module configuration.
- Any other use than described above may damage your system and is attended with dangers like short-circuiting, fire or electric shocks.
- The whole system must not be changed, rebuilt or opened.
- DO NOT operate damaged equipment: Whenever it is possible that the safety protection features built into this product have been impaired, either through physical damage, excessive moisture, or any other reason, REMOVE POWER and do not use the product until the safe operation can be verified by service-trained personnel. If necessary, return the product to Dewesoft sales and service office for service and repair to ensure that safety features are maintained.
- If you assume a more riskless use is not provided anymore, the system has to be rendered inoperative and should be protected against inadvertent operation. It is assumed that a more riskless operation is not possible anymore if the system is damaged obviously or causes strange noises. The system does not work anymore. The system has been exposed to long storage in adverse environments. The system has been exposed to heavy shipment strain.
- Warranty void if damages caused by disregarding this manual. For consequential damages, NO liability will be assumed!
- Warranty void if damage to property or persons caused by improper use or disregarding the safety instructions.
- Unauthorized changing or rebuilding the system is prohibited due to safety and permission reasons (CE).
- Be careful with voltages >25 VAC or >35 VDC! These voltages are already high enough in order to get a perilous electric shock by touching the wiring.
- The product heats during operation. Make sure there is adequate ventilation. Ventilation slots must not be covered!
- Only fuses of the specified type and nominal current may be used. The use of patched fuses is prohibited.
- Prevent using metal bare wires! Risk of short circuit and fire hazard!
- DO NOT use the system before, during or shortly after a thunderstorm (risk of lightning and high energy over-voltage). An advanced range of application under certain conditions is allowed with therefore designed products only. For details please refer to the specifications.
- Make sure that your hands, shoes, clothes, the floor, the system or measuring leads, integrated circuits and so on, are dry.
- DO NOT use the system in rooms with flammable gases, fumes or dust or in adverse environmental conditions.
- Avoid operation in the immediate vicinity of high magnetic or electromagnetic fields, transmitting antennas or high-frequency generators, for exact values please refer to enclosed specifications.
- Use measurement leads or measurement accessories aligned with the specification of the system only. Fire hazard in case of overload!
- Do not switch on the system after transporting it from a cold into a warm room and vice versa. The thereby created condensation may damage your system. Acclimatise the system unpowered to room temperature.
- Do not disassemble the system! There is a high risk of getting a perilous electric shock. Capacitors still might be charged, even if the system has been removed from the power supply.

- The electrical installations and equipment in industrial facilities must be observed by the security regulations and insurance institutions.
- The use of the measuring system in schools and other training facilities must be observed by skilled personnel.
- The measuring systems are not designed for use in humans and animals.
- Please contact a professional if you have doubts about the method of operation, safety or the connection of the system.
- Please be careful with the product. Shocks, hits and dropping it from already- lower level may damage your system.
- Please also consider the detailed technical reference manual as well as the security advice of the connected systems.
- This product has left the factory in safety-related flawlessness and in proper condition. In order to maintain this condition and guarantee safety use, the user has to consider the security advice and warnings in this manual.

EN 61326-3-1:2008
IEC 61326-1 applies to this part of IEC 61326 but is limited to systems and equipment for industrial applications intended to perform safety functions as defined in IEC 61508 with SIL 1-3.

The electromagnetic environments encompassed by this product family standard are industrial, both indoor and outdoor, as described for industrial locations in IEC 61000-6-2 or defined in 3.7 of IEC 61326-1.

Equipment and systems intended for use in other electromagnetic environments, for example, in the process industry or in environments with potentially explosive atmospheres, are excluded from the scope of this product family standard, IEC 61326-3-1.

Devices and systems according to IEC 61508 or IEC 61511 which are considered as "operationally well-tried", are excluded from the scope of IEC 61326-3-1.

Fire-alarm and safety-alarm systems, intended for the protection of buildings, are excluded from the scope of IEC 61326-3-1.

13. Version History

Doc Version	Date [dd.mm.yyyy]	Notes
1.0	19.05.2015	initial revision
V20-1	03.09.2020	New template
V21-1	05.2.2021	Added compliances with standards and calibration procedues