

# 16-XLR-NVH



**16-XLR-NVH** is a high-precision portable data acquisition system. 16 simultaneously sampled channels with 24-bit resolution precisely measure all IEPE sensor signals with frequencies from 10 Hz to 20 kHz.

The measuring range with 6.7 volt peak is optimized for the measuring range of IEPE sensors at a bias voltage of 12.5 volts.

The 16-XLR-NVH comes with NVH Analyzer Pro software and is a perfect measurement and analysis solution for the professional NVH engineer.

The 16-XLR-NVH system is an affordable investment as it combines the functions of the measurement data recorder and post-process analysis with real-time analysis functions in one device.

## Included Professional Software Analysis Features

- Flexible IEPE channel count up to 16 channel + 2 RPM
- SPL measurements (A, B, C, Z weighting) S, F, I – Leq
- ISO 9614 sound power measurements
- Machinery vibration measurements
- Noise and vibration monitoring
- Human vibration measurements
- Quality assurance EOL
- Engineering services
- Environmental noise
- Impulse Hammer Test
- Structural analysis
- Frequency analysis
- Modal analysis
- Order analysis

## TECHNICAL DATA

<b>Analog inputs</b>	16 IEPE BNC Input Channels
<b>Resolution</b>	24 bit Sigma Delta ADC
<b>Frequency range</b>	10 Hz to 22 kHz
<b>Dynamic range @ 48 kHz</b>	114 dB
<b>A-weighted</b>	106 dB
<b>Unweighted</b>	103 dB
<b>Input voltage range</b>	±6,7 Volt Peak
<b>Input coupling</b>	AC/IEPE selectable
<b>IEPE Sensor Supply</b>	4 mA @ 24 Volt
<b>IEPE Sensor input impedance</b>	5 kΩ
<b>A/D dynamic range, IEPE to converter (typical)</b>	109 dB
<b>2 Line Input / Tacho</b>	±6,7 Volt Peak

## Power

<b>Switch-mode power supply Autorange</b>	100-240 V, (50/60 Hz)
<b>Power consumption</b>	30 W

## Physical

<b>Standard operating temperature range</b>	5°C – 40°C (41°F – 104°F)
<b>Dimensions</b>	333 x 157 x 95 mm (13.1 x 6.2 x 3.7 in)
<b>Weight</b>	3,9 kg

## SOFTWARE NVH Analyzer Pro

*The NVH Analyzer Pro data acquisition software is the solution to acquire signals simultaneously from different sources, and to display and store them into one file. With the postprocessing feature, all the powerful mathematic and analysis functions can also be used on the already stored data.*

With the focus on powerful ROGA and ASIO compatible hardware from professional studio world, the release of the innovative NVH Analyzer Pro software leads to improved, intuitive operability, shortened setup time and reduced setup mistakes. This allows repeating measurements, which easily saves you time and money.

### INPUTS

Analog:  
AC, DC & IEPE Coupled  
Digital: Counter



### STORING

NVH Analyzer Pro offers extensive trigger features for the start/stop of the measurement, in addition with pre-and post-time. You can also use math Formulas to generate more complex conditions. Triggers possible on any channel (analog, digital, math...)!

Trigger Channel	1	
Trigger Level	0.800	Pa
PreTrigger Start-Recording	2.0	s
Recording duration	6.0	s

### THE CONCEPT OF FLEXIBILITY

### OUTPUTS

- Sound output: replay any channel via the soundcard.
- File replay: replay the stored channels on the sound output.

### DATA-PROCESSING

Realtime data processing – See everything in real time! Over the past years we have covered lots of application areas with expert modules, so that the user is only a click away from the total solution. But many more applications can be covered using the powerful mathematic features. Post-Processing – change/add everything later in the office! Only store the raw data, and back in the office add all the calculations (like filters, statistics, FFT 's, logical conditions,...)



ASIO Driver Technology by Steinberg Media Technologies

ASIO is a trademark and software of Steinberg Media Technologies GmbH

FRF-Measurement

Vibration Orderanalysis and Acoustics

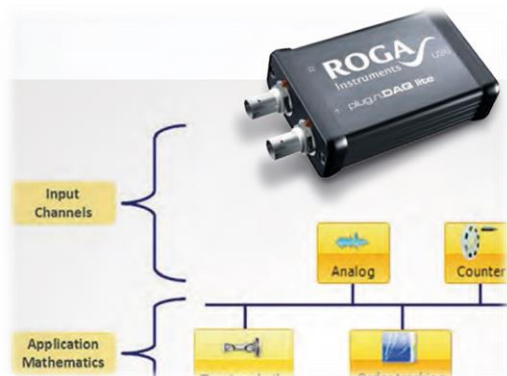
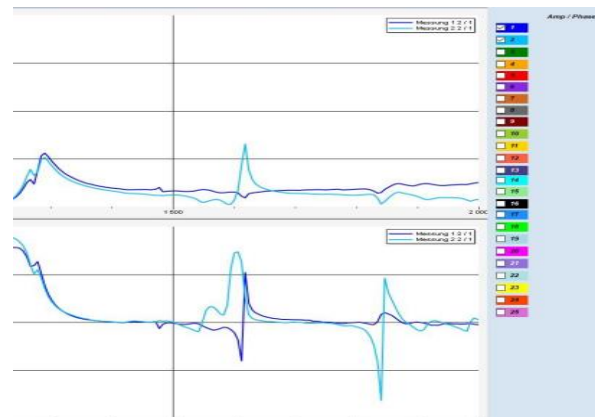
Dual Plane Balancing

Monitoring Measurement

Select

### USER INTERFACE

Select the appropriate measurement method for your application. Impulse Hammer Test FRF-Measurement – FFT Vibration - Order Analysis and Acoustics.



## PUBLISHING AND EXPORT

If the powerful integrated post processing features of NVH Analyzer Pro are not enough, you can even export the data to several different file formats. WAV and CSV. Implementation of custom file formats on request.

## NOISE & VIBRATION

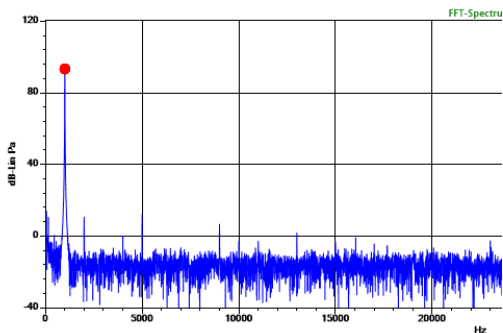
General NVH applications combine the data of miscellaneous sensors (as accelerometers, microphones, impulse hammers etc.), display and correlate them.

NVH Analyzer Pro enables you to capture all sources synchronously. Besides the possibility of online data evaluation in real time, the powerful post-processing feature allows to only collect the raw data at the proving ground and do all the calculations in the office on the stored data.

**Recorder:** allows to show raw time data. This always give you the ability to post-process data later, also down-sampling of data is possible if necessary.

**FFT Analyser:** provides all main functions for spectral analysis with advanced averaging, selectable resolution (64000 lines and more) or direct specification of the bandwidth (e.g. 0,01 Hz). Multiple channels can be displayed in one FFT instrument for easy comparison.

Multipurpose Cursors  
Envelope  
Auto- & Cross-Correlation  
FRF and many more...



**Max Marker:** Usually every analysis starts with the peak search. Simply find the highest peaks in the spectrum with one click and list them in the cursor table. So, you can quickly verify if values are similar to kinematic frequencies.

**Time Domain Analysis:** In vibration and acoustics, the raw data contains a lot of information. With the basic statistic math, you can have a first step to make a diagnosis: Min, Max, RMS, AVG, Peak-to-Peak, and more... even Min, Max, RMS of array data, such as an FFT spectrum, can be added easily.

Statistical Calculations either time or sample based, from one value per dataset (overall), over block based (e.g. every 0.1 sec) or running to triggered blocks, that start/ stop on certain conditions (even on another channel).

**Multi-domain analysis:** Recorder (time-domain), FFT (frequency-domain), XY recorder (channel vs channel, e.g. angle-domain) and many more dedicated instruments provide data visualization according to your needs. Reference curves for all various domains provide a useful tool for Acceptance tests.

Size of Ringbuffer  s Max. 313 s  
 Sample Rate  Hz  
 Maximal Recording time  s  
 Recording without FFT / Order

Channel Setup

Full-Scale

Channel   
 Status   
 Window   
 Channel-Text   
 Offset

Unit   
 mV / Unit   
 Unit / mV   
 Value for 0 dB

	CH 1	CH 2
Status	ON	ON
Window	Hanning	Hanning
Channel-Text	Microphone	Accelerometer
Offset	0.000	0.000
Unit	Pa	m/s^2
mV / Unit	49.92981	1.10840
Unit / mV	0.02003	0.90220
Value of 0 dB	0.00002	0.00002

**Global level:** (Broad band, 10-1000Hz for ISO 2372, customer specific GL). This scalar indicator characterizes the signal content given for acceleration, velocity, or displacement at a specific bandwidth.

**Octave Band Analysis:** is given in constant percentage band filters in compliance with IEC61260.

Display Physical functions

Diagr.	Function	Channel	Operator	Filter
1	Signal	1	direct	Lin
2	FFT-Spectru	1	direct	Lin
3	FRF-Ref 1 Mag.	2	Ref. 1	
4	Signal	2	direct	Lin
5	FFT-Spectru	2	direct	Lin
6	FRF-Ref 1 Phase	2	Ref. 1	

**Filters:** Chose between IIR low pass/high pass/band pass/ band stop filters with selectable 2<sup>nd</sup> to 6<sup>th</sup> order, different characteristics, custom coefficients, Zeroes & poles plot, or FIR filters (no phase delay) or frequency domain filters.

Filter on Ringbuffer Sampling Frequency  Hz

Type  
 Low pass   
 High pass

Order  
 2<sup>nd</sup>   
 4<sup>th</sup>   
 6<sup>th</sup>

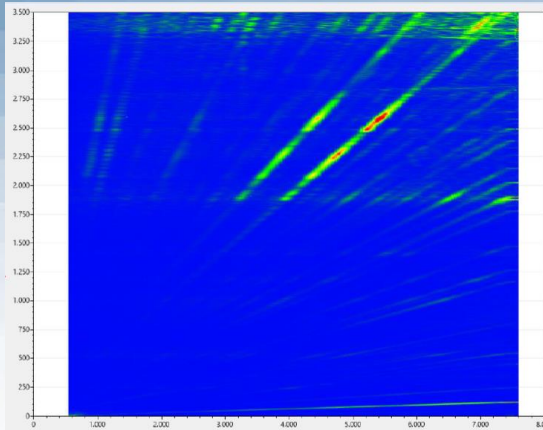
Frequency  Hz

**Sideband marker:** Useful for detecting armature field faults, such as bar breakage, fracture or looseness and gear deformation.

**Compare data files:** Easily compare data files by importing them, the time alignment can be done by manual time shift, on trigger time, or on absolute time.

Overlay the signals for e.g. consecutive vibration tests into one FFT analyzer for post-processing.

## ROTATING MACHINERY



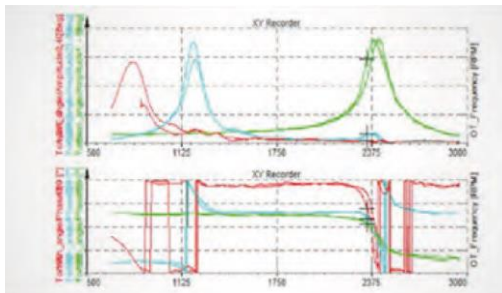
### ORDERTRACKING

The Ordertracking module is the main function for measurements with varying speeds. Any input can be used: microphone, accelerometer, even the output of the torsional vibration module. Clearly separate engine related harmonics from other frequencies like structural resonances. The high precision digital counters of the ROGA instrument provide accurate and repeatable measurements. Result are represented in 3D, color spectrogram but also in 2D view for selected order and phase extraction over RPM.

### CAMPBELL PLOT – HEAT MAP

This instrument works based on classification of the measured values, with several options like rainbow, greyscale and adjustable classes. It can be applied on TimeFFT as well as OrderFFT.

### TORSIONAL VIBRATION

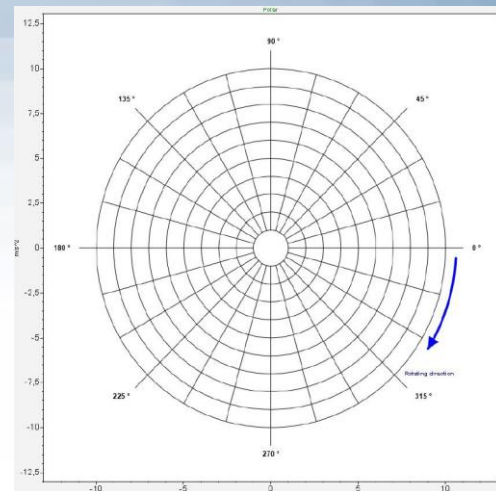


With the high-precision digital counters of the LTT24-4 instrument, based on an 800 MHz time base, rotational and torsional vibration angles and velocities (with two encoders) can also be exactly determined at high RPM speeds. Constant angle offset, uncentered mounting and sensor errors can be compensated, gearbox ratios are supported and additional filters can be applied.

### BALANCING

To cancel out the vibration caused by the first order (unbalance), NVH Analyzer Pro offers the balancing module. It is very easy to setup, just specify tachometer sensor an accelerometer(s). Depending on the rotating part, both single-plane and dual-plane balancing is supported.

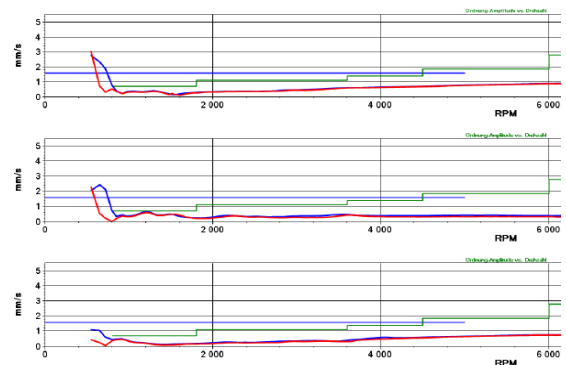
### ORBIT GRAPH



For displaying the axis movement NVH Analyzer Pro offers the orbit plot. Integration/double integration can easily be done directly in the channel configuration setup, for calculation of displacement based on accelerometer input. The output of the Ordertracking module can be used for displaying single orders as well as cyclic averages.

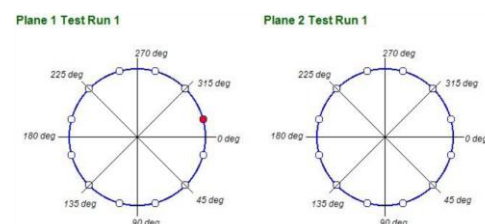
### MULTI-DOMAIN

Analyses machines with repetitive processes and resample the data to any other channel base (e.g. angle-domain) to calculate e.g. concentricity errors of shafts (min, max, avg...) per cycle or over all cycles.



### AUTO & CROSS CORRELATION

For quantification of signals related to each other or to get the relevant information out of noisy data, the powerful NVH Analyzer Pro mathematics provides all the necessary tools. Similar to Matlab you can work and calculate with the array data to display the result already during measurement.



## STRUCTURAL ANALYSIS



- Frequency response function (FRF)
- Coherence
- Excitation and response spectra, windowing
- Double hit detection
- Repeat selectable points
- Averaging of hits
- SISO, MISO, SIMO, Response group alignment
- Mode indicator function (MIF)
- Circle-fit method for extracting modal parameters (to check with simulation)

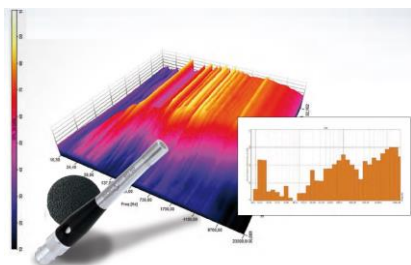
## ANALYSIS, IMPACT TEST

NVH Analyzer Pro provides an efficient solution, time for setup and measurement is very short. The structure can be imported or drawn in the geometry editor, hereby the points are defined. For measurement move the modal hammer or the response accelerometers, whatever you prefer. In analyze mode click on the resonant frequencies and check the animated shape.

## BUMP TEST

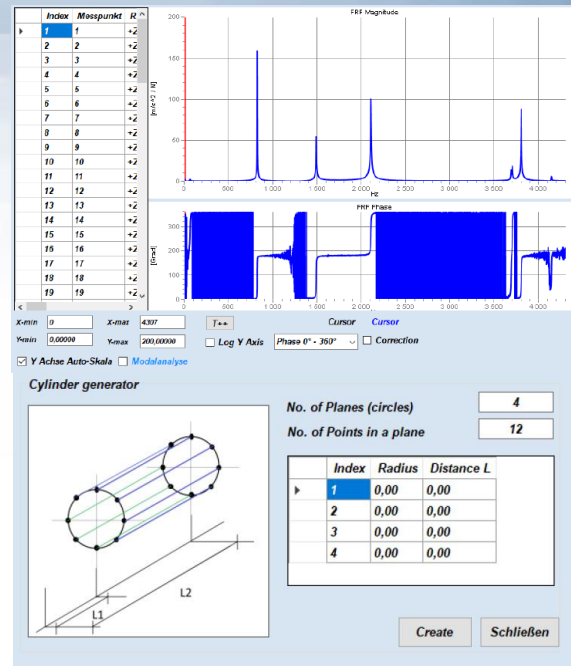
This is a quick test done to determine the resonance (natural) frequencies of a structure. No modal hammer is needed, only one accelerometer, just knock on the structure. Of course, the impact tip influences the usable frequency range, but for a quantification measurement this is fine. With the FFT Analyser the FFT spectra over a certain time window (impact +/- pre/post time) can be averaged.

## ACOUSTIC ANALYSIS



## STANDARDS

NVH Analyzer provides real time sound level calculations according to the international standards IEC61672, IEC 60651, IEC 60804. Any combination of Frequency and Time weighting can be calculated. The statistical values are calculated over the whole range or with the custom specific entered time.



## FINITE ELEMENT ANALYSIS

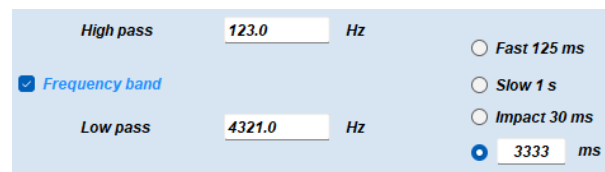
For further investigation and analysis in modal packages, like NVH Analyzer -MODAL, the FRF complex data (Real/Imag/Ampl/ Phase), coherence, excitation and responses can be exported to the UFF (Universal File Format).

## HUMAN BODY VIBRATION

This module measures the effect of vibration to the human body, the extracted parameters allow the judgement of risk. NVH Analyzer Pro supports whole-body and hand-arm measurement according to the standards ISO 5349, ISO 8041; ISO 2631-1; ISO 2631-5.

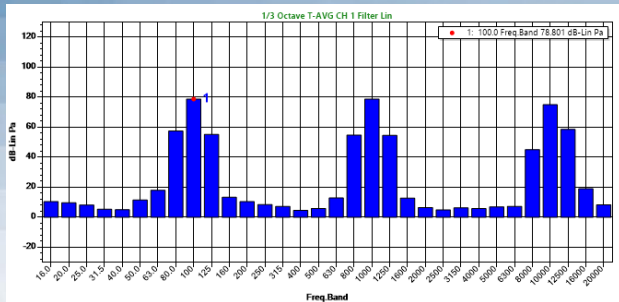
## SOUND LEVEL

The multi-channel sound level meter is very easy to use. Simply click the parameters you want to see in real-time.



- Lp Sound pressure level
- LAeq, LCpk, ...
- Real time narrow band FFT
- A-, B-, C-, Z- frequency weighting
- Fast-, slow-, impulse time weighting
- Percentile levels (e.g. LA10, LA90...)
- Automatic scaling with Reference calibrator (according to ISO 60942) supported.

## OCTAVE ANALYSIS



The constant percentage band filters work in real-time and provide 1/3 band octave spectrum. With the array statistic mathematics it's easy to extract max / min / avg values over the whole spectrum or a specific frequency range.

## FREE AUDIO REPLAY

Replay any stored channel of the datafile via the loudspeakers. Export to WAV format can also be done free of license.

## TRIGGER

Trigger on sound events to start/stop the measurement. Furthermore you can also trigger on a certain frequency band in FFT, on reduced data (RMS of accelerometer) or on time. Trigger types such as simple edge, window, slope, and more are possible.

## SENSOR CALIBRATION

In addition to manual input of the sensor sensitivity from the manufacturer's factory calibration certificate, the NVH Analyzer Pro offers sensor calibration with a microphone calibrator or vibration calibrator as an indispensable tool for checking the measurement chain from sensor to analysis.

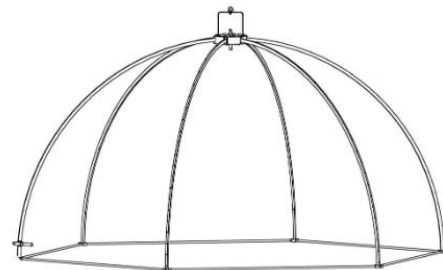
## SOUND POWER

NVH Analyzer Pro supports the calculation of the Sound power by measurement of the Sound level. According to standard ISO 3744 (engineering grade, free field over reflective plane), ISO 3745 (precision grade, anechoic or hemi-anechoic room) and ISO 3741 (noise source in reverberation test room) the microphones are placed around the sound source.

The microphone positions are calculated by software (depending on size of the object and configuration (such as sphere, hemisphere, cylinder...)). The measurement is done synchronously for all channels to save time.

If there are less microphones available than requested by the standard, you can build groups, the routine enables you to change positions between measurements.

The user is guided step-by-step, next to background noise measurement (K1, K2) there is also a repeatability check and the visualization by third-octave band analysis for the report.



## Main Features:

- Sound Power
- ISO 3744, ISO 3745, ISO 3741
- 1/n Octave band
- C1, C2 correction (temperature, air pressure)
- K1, K2 background noise measurement
- Sound level
- Warning messages during routine
- Repeatability check
- Grouping of microphones

Surface	7.00 dB	K1-Factor	2.00 dB	K2-Factor	4.00 dB
Channel 1	70.3	dB A	Channel 9	22.6	dB A
Channel 2	25.1	dB A	Channel 10	22.1	dB A
Channel 3	22.7	dB A			
Channel 4	22.6	dB A			
Channel 5	22.7	dB A			
Channel 6	22.8	dB A			
Channel 7	22.6	dB A			
Channel 8	22.7	dB A			
Average-Level	60.3	dB A			
Sound-Power	61.3	dB A			

The result of the calibration is used for further analysis

Calibration factor	98.513 mV / g	Level
98.595	mV / g	98.763 mV/g
	Dev.	1.002 g
		0.17 %

## REALTIME DATA PROCESSING GRAPHICS AND VISUALISATION

<b>User interface</b>	Configurable graph screens
<b>Time domain</b>	Recorder (1 to 16 Ch, real-time autoscaling) Scope (trigger, persistence, envelope), Analog/digital meter, tabular display, overload indicator
<b>Multi domain</b>	XY recorder (Lissajous), 2D graph, Orbit graph, Bode plot (amplitude/phase/real/imaginary vs frequency)
<b>Application specific</b>	FRF geometry, Modal circle, Rotor balancer, Harmonic FFT, Vector scope – Auto-generating of displays with typical application setup

## FILTERING

<b>IIR</b>	Low pass/high pass/band pass/ 2 <sup>nd</sup> to 6 <sup>th</sup> order, Butterworth
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## STATISTICS

<b>Calculation base</b>	Time based
<b>Types</b>	RMS, Average, Peak-Peak
<b>Data range</b>	Running, Triggered, Start-stop

## REFERENCE CURVES

<b>Types</b>	time, value, dual-value, vector, XY, frequency domain with interpolation
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## TIME DOMAIN

## ANALYSIS

<b>Integration/derivation</b>	single/double with adjustable filter, automatic unit conversion (e.g. acceleration to velocity to displacement)
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## FFT ANALYSER

<b>General</b>	multiple independent FFT analyzers at the same time
<b>Amplitude types</b>	Amplitude FFT (Ampl, RMS, Power, PSD, RMS SD), Complex FFT (Real/Imag/Ampl/Phase)
<b>Windowing</b>	Hanning / Hamming
<b>Window overlap</b>	0, 10, 25, 50, 66, 75, 90 %
<b>Triggered FFT</b>	triggered time-range with pre- and post-trigger as input, auto calculation of window resolution, averaging of triggered FFT's, e.g. for bump test application
<b>DC cut off</b>	0,5 Hz
<b>FFT block size</b>	26, 51, 101, 201, 401, 801, 1601, 3201, 6401, 12801, 25601
<b>Acoustic weighting</b>	A, B, C, Lin (Z)
<b>Octave</b>	1/3, type; Lin/A/B/C weighting, Lin/Pk avg with overlap
<b>Visualization</b>	amplitude axis with real-time autoscaling: Lin/log/0dB/reference dB/Sound(A) dB
<b>Post processing</b>	possible to add/change all calculations offline on the stored raw data
<b>Spectrum markers</b>	Free

## Order tracking

<b>Frequency source</b>	Counter: optical tachometer, proximity, pick-up probe (1 pulse/rev), optical strip tape probe (with bl/wh tape, algorithm for determining number of pulses), 1-, 2-, 3- tracks encoder, gear tooth with missing teeth (e.g. 60-2), CDM, CDM with zero RPM channel: any analog speed channel, virtual (synthesized RPM channel, also in post-processing) Analog pulses: analog signal (e.g. 60-2) / analog tachometer + angle sensor math
<b>Input Ch. for analysis</b>	any analog input channel, e.g. IEPE accelerometer, microphone, etc...
<b>Visualization</b>	3D graph, Order and Frequency spectrum, Waterfall FFT real time extraction of single spectral lines of matrix Orbit plot, XY recorder, Bode plot, Nyquist plot of any order, any signal vs RPM
<b>Calculation criteria</b>	Runup / Coast down / Both directions with RPM limits and Delta RPM and/or Delta Time
<b>Order FFT</b>	from 8 to 256 orders, resolution from 1 to 1/64
<b>Harmonics</b>	extract overall RMS and amplitudes/phases/Real/Imag of selectable orders (from sub-orders e.g. 0.1x, 1x, 2x, 3x to max order) in Time domain & RPM domain
<b>Post processing</b>	possible to add/change all calculations offline on the stored raw data
<b>Data export</b>	Complex data (Real/Imag/Ampl/Phase) in any format, see Software Export section

### TORSIONAL VIBRATION with LTT24-4

<b>General</b>	high precision rotational and torsional vibration and slippage measurement, by use of 2 rotary encoders
<b>Frequency source</b>	optical strip tape probe (with bl/wh tape, algorithm for determining number of pulses), 1-, 2-, 3- tracks encoder, gear tooth with missing teeth (e.g. 60-2), CDM, CDM with zero
<b>Angle accuracy</b>	up to 0,00075° at 10 000 rpm
<b>Angle resolution</b>	up to 0,06° at 10 000 rpm
<b>Features</b>	Rotational DC filter (0,1 to 10 Hz), compensation of uncentered encoder mounting
<b>Output</b>	Rotational angle/velocity, Torsional angle/velocity
<b>Visualization</b>	angle based view, time domain

### MODAL TEST

<b>Impact hammer method</b>	roving hammer/roving accelerometer moving through points, averaging of multiple hits, double hit rejection, rejecting of hits (action buttons), grouping of sensors, adjustable excitation, and response window
<b>Free-run mode</b>	Function generator (Apollo Series) for shaker excitation (swept sine, burst, chirp...) Hanning/Hamming windowing with overlap 0, 25, 50, 66, 75 % operating deflection shapes (Spectral ODS)
<b>FRF</b>	Receptance, Effective Mass, Mobility, Impedance, Dynamic Compliance, Dynamic Stiffness, Transmissibility
<b>Modal Parameters</b>	Mode Indicator Function (MIF), extract exact frequencies and damping factors with Modal circle fit (Option)
<b>Post processing</b>	FRF from stored raw data, in free-run mode
<b>Geometry</b>	Geometry editor, load, save, import models in UFF (UNV) format (Option)
<b>Animation</b>	movement of nodes for selected frequency (place marker), change speed and amplitude (Option)
<b>Data export</b>	Complex data (Real/Imag/Ampl/Phase) in UFF (UNV) format or any other, see Software Export section

### HUMAN BODY VIBRATION

<b>General</b>	module for judging vibration levels for risk of damage to the human body
<b>Supported types</b>	whole body and arm
<b>Compliance</b>	to ISO 8041, ISO 2631-1, ISO 2631-5, ISO 5349 standards

### SOUND LEVEL

<b>Frequency weighting</b>	A, B, C, Lin (Z)
<b>Time weighting</b>	Fast, Slow, Impulse
<b>Octave plot</b>	1/3 Lin/A/B/C/ weighting, Lin/Pk avg with overlap
<b>Supported standards</b>	IEC 60651, IEC 60804, IEC 61672
<b>Outputs</b>	Sound pressure level, any combination of Frequency and Time weighting, Leq, Lpk, Lim, LE overall or on custom statistical rate, percentile levels (1, 5, 10, 50, 90, 95, 99 %)
<b>More features</b>	real-time narrow band FFT, frequency weighted raw channel
<b>Calibration</b>	auto-calibration of scaling factor with reference calibrator (1kHz, 94dB, 114 dB acc to IEC 60942:2003)

### BALANCING

<b>Application</b>	for rigid rotor running below its resonance frequency, based on order tracking (amplitude & phase), single- and dual-plane
<b>Supported tacho inputs</b>	Counter: optical tacho, proximity, pick-up probe (1 pulse/rev), optical strip tape probe (with bl/wh tape, algorithm for determining number of pulses), 1-, 2-, 3- tracks encoder, gear tooth with missing teeth (e.g. 60-2), CDM, CDM with zero RPM channel; any analog speed channel, virtual (synthesized RPM channel, also in post-processing) Analog pulses: analog signal (e.g. 60-2) / analog tacho + angle sensor math alarm output if velocity exceeds predefined value weight splitting
<b>Visualization</b>	Vector polar plots of 1st order of all runs
<b>Sequence</b>	step-by-step guidance through procedure: initial run, trial mass run, correction mass run, repeat steps if needed
<b>Features</b>	x and y direction balancing at the same time, when using triaxial sensor

### SOUNDPOWER

<b>Standards</b>	ISO 3741 (noise source in reverberation test room), ISO 3744 (engineering grade, free field over reflective plane), ISO 3745 (precision grade, anechoic or hemi anechoic room)
<b>Geometries</b>	Parallelepiped, Cylindric, Hemisphere, Sphere
<b>Microphones</b>	10+ number of microphones; positions will be calculated according to entered geometry and size, floor / 1 wall / 2 wall setup
<b>Measurement</b>	Guided sequence, previous/next group (action buttons), background noise/sound measurement, with repeatability check, minimum measurement duration & level plausibility check and warnings, grouping of microphones
<b>Octave</b>	1/3 octave
<b>Correction methods</b>	C1 and C2 meteorological, K1 background noise and, K2 room noise (mean absorption grade, reverberation time, K2 editor)