# ROGA Instruments INTELLIGENT TESTING EQUIPMENT www.roga-instruments.com

# **RogaDAQ 4** Four Channel USB Data Acquisition System



#### **TECHNICAL DATA:**

Analog Inputs differential & single	4 BNC Input Channels, e ended, optically decoupled
Decolution 24 hits for each ch	annal simultaneous complias
Resolution 24bits for each ch	annei, simultaneous sampling
Frequency range	DC - 80 kHz
Sample rate per channel	8/16/24/32/48/92/192 kHz
Input voltage range	±10 V / ±1 V selectable
Input coupling	DC/AC/IEPE selectable
Sensor supply	4 mA @ 24 V
Impedance of input	1 MΩ, 20 pF
Over voltage protection	±40 V
Anti alias filterer	800 dB / octave
Dynamic range	free of distortion > 123 dB
Precision of amplitude	better 0.1 %

Tachometer inputTwo inputsResolution32bitsInput voltage range±30 VBasic frequency10 MHz

Miscellaneous	
Interface	USB 2.0
Connectors	BNC receptacles, counter Lemo Type
	EPG.0B.303.HLN
Power supply	AC/DC power supply 230 V AC / 5 V DC
Rugged aluminum c	ase closed on all sides
Dimensions	180 x 118 x 64 mm
Weight	400 g
Operating temperat	ure range 0 - 55 °C

Preamplification is realized with noise reduced instrument amplifiers with extremely low distortion. For IEPE compatible sensors a constant current source can be activated by software.

#### **User Software**

The RogaDAQ4 front end can be operated directly out of DASYLab This allows to perform complexmonitoring tasks like final checks in production lines ormonitoring of a frequency range with signaling if predefined intervals are left. And all of this without writing a single line of code. Beside these drivers are available for customer specific programming for .NET, ANSI C, Visual C++ 6.0, Delphi, DASYLab, LabView, and MatLab.

ROGA-Instruments, Im Hasenacker 56, D-56412 Nentershausen Phone: +49 (0) 6485-8815803, E-Mail: info@roga-instruments.com

**RogaDAQ4 Front End is a high precision portable data acquisition system.** Four simultaneously sampled 24bits resolution channels measure precisely any signals with frequencies up to 80kHz. RogaDAQ4 combined with PC or notebook is a perfect measurement solution. It offers high levels of precision, and it is very easy to use.

gaDAG 4

# **Possible Applications**

- PC based portable data acquisition.
- Frequency analysis in the range 0 80kHz
- Structural analysis
- Modal analysis
- Machine maintenance
- Building acoustics and building oscillation analysis
- Process monitoring
- EOL check

# **Properties**

- Four high precision inputs with 24bits A/D converter
- 8 192 kS/s selectable sample rate
- Integrated anti alias filter ensures perfect signal integrity
- AC, DC coupling or IEPE for direct power supply
- Tachometer input
- 5 Volt power supply
- Rugged aluminium case

# **Technical Details**

RogaDAQ4 high precision inputs are designed for measuring dynamic signals. They are sampled simultaneously. Signals are digitized at a maximum of 192kS/s with 24bits resolution.



# 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 posttime. You can also use math formulas to generate more complex conditions. Triggers possible on any channel (analog, digital, math...)!

	ASIO Driver Technology by Steinberg Media Technologies ASIO is a trademark and software of Steinberg Media Technologies GmbH
FRF-Measurement	0
Vibration Orderanalysis and	Acoustics
Dual Plane Balancing	0
Monitoring Measurement	0
	Select

# **USER INTERFACE**

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



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,...)





ROGA Instruments www.roga-instruments.com

# **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 (frequencydomain), 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	r	60				s	M	lax. 313 s	
Sample Rate		96	000		~	H	z		
Maximal Recordin	ng time	10				s			
Recording with	out FFT / O	rde	r						
Channel Setup									
Full-Scale	6.467								
Channel	2	~							
Status	ON	~		1	rom cha	nne 1	~	to channel 2	~
Window	Hanning	~							
Channel-Text	Accelerometer	-					СН 1	CH 2	
0.00	Accelerometer	-			Status		ON	ON	
Unset	0.000	_			Window	-	Hanning	Hanning	
1 Inia					Channel	-lext	Microphone	Accelerometer	
Unit	m/s^z	~			Unit		0.000 Pa	m/s^2	
mV / Unit	1.10840				mV/Uni	ı	49.92981	1.10840	
Unit / mV	0.90220				Unit / mV	,	0.02003	0.90220	
	0.00002				Value of	0 dB	0.00002	0.00002	
Value for 0 dB	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.

)agr.	Function		Cha	nnel	Operator		Filt	er
1	Signal	~	1	~	direct	~	Lin	~
2	FFT-Spectrum	~	1	~	direct	×	Lin	~
3	FRF-Ref 1 Mag.	~	2	~	Ref. 1 ~			
4	Signal	~	2	~	direct	~	Lin	~
5	FFT-Spectrum	~	2	~	direct	~	Lin	~
6	FRF-Ref 1 Phase	~	2	~	Ref 1 v	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				Sampl	ling Frequency	96000.0 Hz
Type Low pass High pass	<b>0</b>	Frequency	100.0	Hz	Order 2 nd 4 th 6 th	

**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.

# ROGA Instruments INTELLIGENT TESTING EQUIPMENT www.roga-instruments.com

# **ROTATING MACHINERY**



#### 12.5 10.5

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 tacho sensor an accelerometer(s). Depending on the rotating part, both single-plane and dual-plane balancing is supported.

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**

**ORBIT GRAPH** 

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.



# ROGA Instruments INTELLIGENT TESTING EQUIPMENT www.roga-instruments.com

# **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

FFT-Analysis	
Sample-Rate 16000 Hz	
Bandweite 6667 Hz	
FFT-Blockgröße	3201 ~
FFT-Delta f 1,953 Hz	
Mittelung Aktiv	
Mittelung	1
Trigger	
Trigger-Typ	Positive ~
Kanal	1 ~
Pegel N	300,0000
Trigger (%) of FFT-Block	-5,00
Pre (-) Post (+)	

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

Sound Power			2 [40]
Sound-Power -	Lever [dbA] + Sur	iace (ub) - K i (ub) - K	είασι
Surface 7.00 dB	K1-Factor	2.00 dB K2-Facto	or 4.00 dB
Channel 1	70.3 dB /	Channel 9	22.6 dB A
Channel 2	25.1 dB /	Channel 10	22.1 dB A
Channel 3	22.7 dB /	4	
Channel 4	22.6 dB /	1	
Channel 5	22.7 dB /	4	
Channel 6	22.8 dB /	N N	
Channel 7	22.6 dB /	1	
Channel 8	22.7 dB /	4	
Average-Level	60.3 dB /	1	
Sound-Power	61.3 dB /	4	

#### 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	1.002 g
	Dev.	0.17 %	

REALTIME DATA PROCES	SING GRAPHICS AND VISUALISATION
User interface	Configurable graph screens
Time domain	Recorder (1 to 16 Ch. real-time autoscaling)
	Scope (trigger, persistence, envelope). Analog/digital meter, tabular display, overload indicator
Multi domain	XY recorder (Lissajous), 2D graph, Orbit graph, Bode plot (amplitude/phase/real/imaginary vs frequency)
Application specific	FRF geometry, Modal circle, Rotor balancer, Harmonic FFT, Vector scope – Auto-generating of displays with typical application setup
FILTERING	
lir	Low pass/high pass/band pass/ 2 <sup>nd</sup> to 6 <sup>th</sup> order, Butterworth
STATISTICS	
Calculation base	Time based
Types	RMS, Average, Peak-Peak
Data range	Running, Triggered, Start-stop
REFERENCE CURVES	
Types	time, value, dual-value, vector, XY, frequency domain with interpolation
TIME DOMAIN	ANALYSIS
Integration/derivation	single/double with adjustable filter, automatic unit conversion (e.g. acceleration to velocity to displacement)
FFT ANALYSER	
General	multiple independent FFT analyzers at the same time
Amplitude types	Amplitude FFT (Ampl, RMS, Power, PSD, RMS SD), Complex FFT (Real/Imag/Ampl/Phase)
Windowing	Hanning / Hamming
Window overlap	0, 10, 25, 50, 66, 75, 90 %
Triggered FFT	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
DC cut off	0,5 Hz
FFT block size	26, 51, 101, 201, 401, 801, 1601, 3201, 6401, 12801, 25601
Acoustic weighting	A, B, C, Lin (Z)
Octave	1/3, type; Lin/A/B/C weighting, Lin/Pk avg with overlap
Visualization	amplitude axis with real-time autoscaling: Lin/log/0dB/reference dB/Sound(A) dB
Post processing	possible to add/change all calculations offline on the stored raw data
Spectrum markers	Free
Order tracking	
Frequency source	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
Input Ch. for analysis	any analog input channel, e.g. IEPE accelerometer, microphone, etc
	3D graph, Order and Frequency spectrum, Waterfall FFT
Visualization	real time extraction of single spectral lines of matrix

 Calculation criteria
 Runup / Coast down / Both directions with RPM limits and Delta RPM and/or Delta Time

 Order FFT
 from 8 to 256 orders, resolution from 1 to 1/64

 Harmonics
 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

 Post processing
 possible to add/change all calculations offline on the stored raw data

Data export Complex data (Real/Imag/Ampl/Phase) in any format, see Software Export section

Orbit plot, XY recorder, Bode plot, Nyquist plot of any order, any signal vs RPM



TORSIONAL VIBRATION	with LTT24-4
General	high precision rotational and torsional vibration and slippage measurement, by use of 2 rotary encoders
Frequency source	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
Angle accuracy	up to 0,00075° at 10 000 rpm
Angle resolution	up to 0,06° at 10 000 rpm
Features	Rotational DC filter (0,1 to 10 Hz), compensation of uncentered encoder mounting
Output	Rotational angle/velocity, Torsional angle/velocity
Visualization	angle based view, time domain
MODAL TEST	
Impact hammer method	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
Free-run mode	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)
FRF	Receptance, Effective Mass, Mobility, Impedance, Dynamic Compliance, Dynamic Stiffness, Transmissibility

FKF	Receptance, Effective Mass, Mobility, Impedance, Dynamic Compliance, Dynamic Scirriess, Transmissibility
Modal Parameters	Mode Indicator Function (MIF), extract exact frequencies and damping factors with Modal circle fit (Option)
Post processing	FRF from stored raw data, in free-run mode
Geometry	Geometry editor, load, save, import models in UFF (UNV) format (Option)
Animation	movement of nodes for selected frequency (place marker), change speed and amplitude (Option)
Data export	Complex data (Real/Imag/Ampl/Phase) in UFF (UNV) format or any other, see Software Export section

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

SOUND LEVEL

Frequency weighting	A, B, C, Lin (Z)
Time weighting	Fast, Slow, Impulse
Octave plot	1/3 Lin/A/B/C/ weighting, Lin/Pk avg with overlap
Supported standards	IEC 60651, IEC 60804, IEC 61672
Outputs	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 %)
More features	real-time narrow band FFT, frequency weighted raw channel
Calibration	auto-calibration of scaling factor with reference calibrator (1kHz, 94dB, 114 dB acc to IEC 60942:2003)

BALANCING	
Application	for rigid rotor running below its resonance frequency, based on order tracking (amplitude & phase), single- and dual-plane
Supported tacho inputs	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
Visualization	Vector polar plots of 1st order of all runs
Sequence	step-by-step guidance through procedure: initial run, trial mass run, correction mass run, repeat steps if needed
Features	x and y direction balancing at the same time, when using triaxial sensor

SOUNDPOWER	
Standards	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)
Geometries	Parallelepiped, Cylindric, Hemisphere, Sphere
Microphones	10+ number of microphones; positions will be calculated according to entered geometry and size, floor / 1 wall / 2 wall setup
Measurement	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
Octave	1/3 octave
Correction methods	C1 and C2 meteorological, K1 background noise and, K2 room noise (mean absorption grade, reverberation time, K2 editor)