CARoLINE

Acoustic testing based on airborne and structure-borne sound

- use in development, testing and series production
- synchronous recording of up to eight acoustic measurement channels
- I/O resources for triggering, gate control and synchronization
- standard interfaces for integration into complex production lines or end-of-line testing systems
- comprehensive visualization and analysis functions including machine learning (AI)
- monitoring option of acoustic data recording using headphones
- offline version to create or edit test sequences with the help of recorded measurement data

GOPEL electronic

Application

Airborne sound

- analysis of sounds generated by the UUT
- recording of the UUT during the test (acoustic chamber required)
- positioning of the sensors on the test bench

Analysis

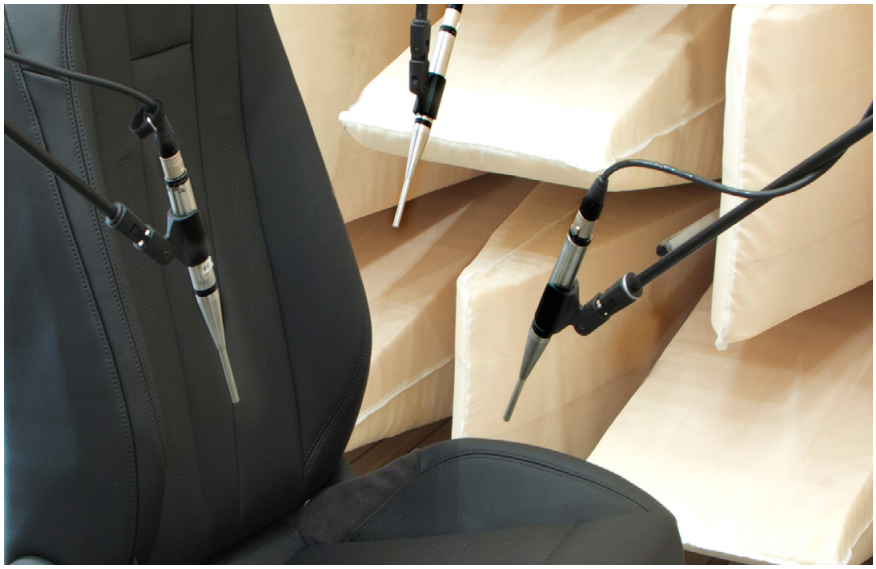
- analysis and evaluation of the data with the help of classical mathematical methods
- order analysis, bandpass, third-octave analysis, roughness, tonality etc.

Acoustic testing

- testing of acoustics, function and assembly quality of noise-generating components

Machine learning

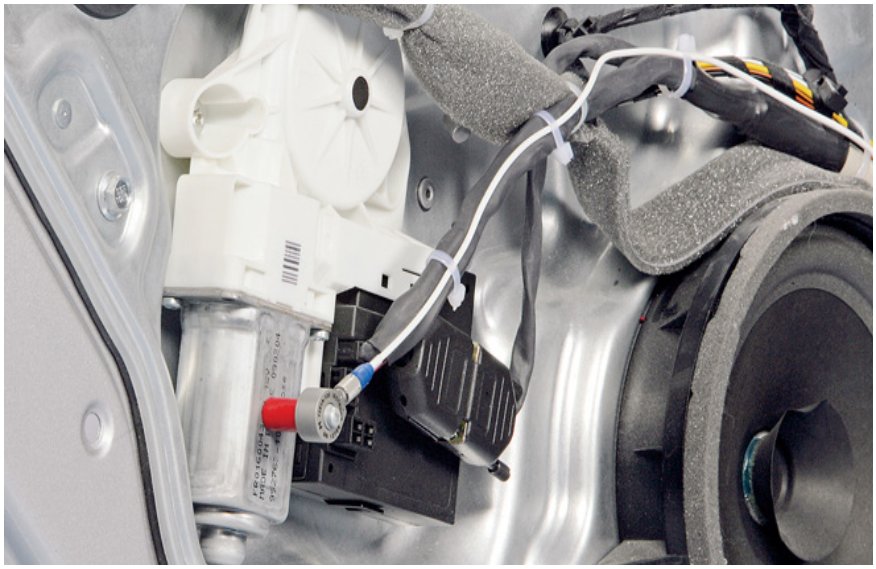
- analysis and evaluation of data with the help of machine learning
- neural networks, SVM, autoencoders, and much more



Test setup with microphones

Data acquisition

- testing of assemblies in various operating states and load modes
- recording of data for signal analysis using the CARoLINE advanced system



Window lift with structure-borne sound sensor

Structure-borne noise

- analysis of vibrations and natural frequencies on electromotor-driven assemblies
- insulation of the test specimen from external noise during the test
- magnetic or spring-loaded attachment of the sensors

Hardware & Sensors

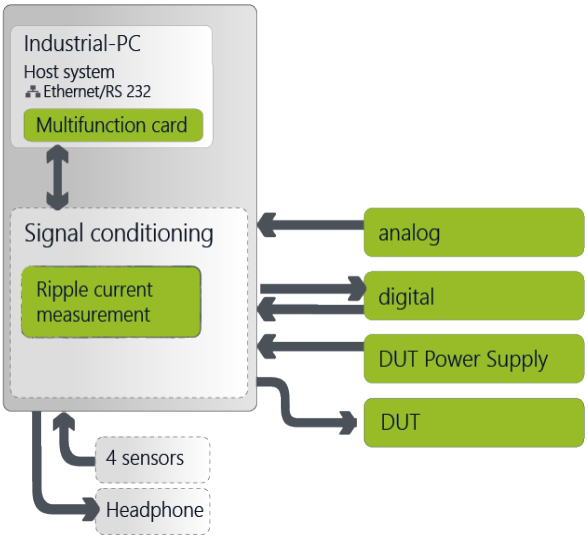
Various structure-borne sound sensors and microphones

Sensors

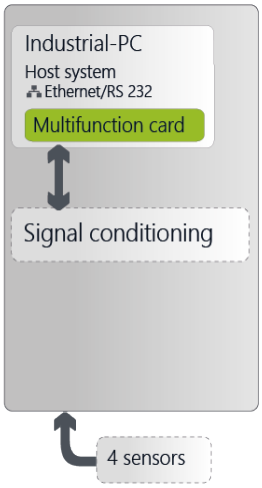
- sensors with integrated IEPE amplifier
- power supply can be switched off by the system
- connection of different sensors
- positioning of structure-borne sound sensors magnetically or by spring force on the test object
- positioning of microphones on the test rig near the test object
- sensors must be acoustically decoupled from the base frame and the environment of the test rig

Measurement method

- direct measurement of sensor signals
- determination of drive speed by measuring the current ripple or Hall signal via the signal conditioning module



Overview hardware CARoLINE advanced

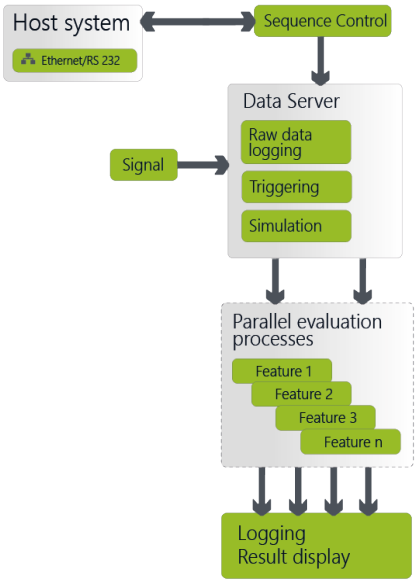


Overview hardware CARoLINE smart

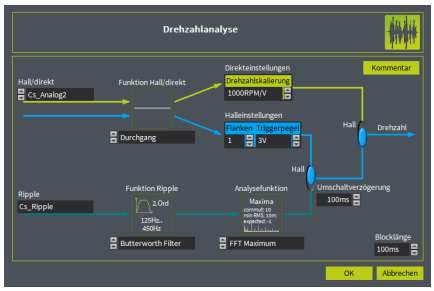
Parameters

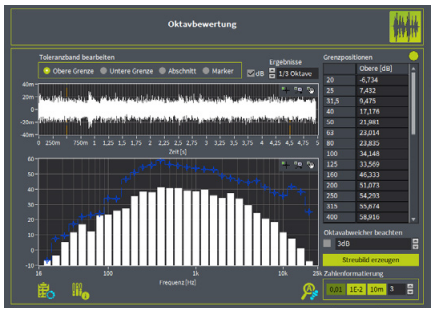
	CARoLINE advanced	CARoLINE smart
A/D converter	16 bit	16 bit
sampling rate	51,2 kHz	51,2 kHz
sensor inputs	8, IEPE supplied	4, IEPE supplied
analog inputs	2 pieces, ±100 V differential	-
digital inputs	2 pieces, 30 V potential-free	-
sensor supply IEPE	4 mA, individually switchable	2 mA, individually switchable
sensors	microphones, structure-borne sound sensors, laser vibrators, force sensors, and much more	

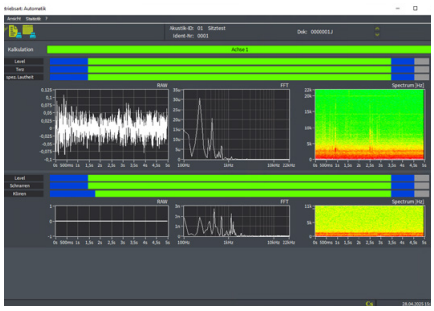
Analysis & Software



Software concept







CARoLINE software

Preparation

- generation of individual test programs with integrated and customer-specific modules and analysis functions
- user guidance for the creation of custom characteristics
- setting of reference variables and trigger conditions

Analysis functions

- classic mathematical calculations and frequency filtering
- speed determination from Hall signal or current ripple
- order analysis, third-octave analysis
- psychoacoustic evaluations (roughness, tonality)
- ready-made analyses according to OEM standards
- automatic tolerance band creation based on a defined number of test specimens
- statistics function, scatter plot display
- machine learning models

Trigger sources

- level of the incoming noise signal
- threshold value at analog inputs
- status change at digital inputs
- command from the higher-level system via the host interface
- specified time interval

Evaluation

- evaluation of results during a test run parallel to data recording
- visualization of a completely evaluated data block every 100 ms
- choice between time-dependent or position-dependent display (e.g., adjustment travel or angle of rotation)
- recorded noise signals are evaluated using analysis indices (ANI)

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