

CATALOGUE

2017 EDITION

ANALYZER SOLUTIONS

WELCOME

Brüel & Kjær is unique in the sound and vibration industry, producing all the elements for the most technologically advanced and complete sound and vibration solutions designed to save time and eliminate errors in the measurement process. In fact, Brüel & Kjær equipment and knowledge are behind thousands of achievements, from high performance cars and smartphones to quieter airports, higher performance satellites and beyond – even helping with the Mars landings.

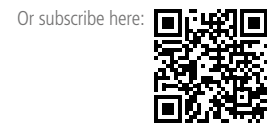
This catalogue features our analyzer and data recorder solutions. Ranging from simple, single-channel, hand-held analyzers to large, advanced, multichannel PULSE™ systems, these solutions are built on more than 75 years of experience, knowledge and innovation and meet the exacting measurement and analysis demands of our customers.

PULSE Reflex™ analysis software allows in-depth analysis of measured data while our industry-leading LAN-XI data acquisition hardware naturally teams up with PULSE or Sonoscout™ providing an unbeatable combination. Furthermore, real-time measurement and analysis, intuitive time-data acquisition and powerful post-processing are complemented with optional embedded recording capabilities. Different workflows – from ad hoc troubleshooting to targeted performance optimization – are all supported across applications as diverse as telephone testing and scaled model wind tunnel testing.

New

- The latest additions to our analyzer solutions portfolio include:
- Page 14: PULSE Reflex software for LabShop users
 - Page 15: Preconfigured software packages
 - Page 31: PULSE Reflex structural measurements – stepped sine
 - Page 34: Operational modal analysis
 - Page 36: Structural health monitoring
 - Page 43: PULSE sound power determination of fans
 - Page 73: LAN-XI front panel for testing of headphones, small loudspeakers and receivers

For case stories, features and news related to sound and vibration, please subscribe to our customer magazine Waves on: www.bksv.com/waves



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LAN-XI DATA ACQUISITION HARDWARE



LAN-XI modules can be combined in racks that use a single LAN cable for data transfer. All racks can be combined to make systems up to 1000+ channels

One platform is all you need

The simplest set-ups and the most complex systems are all possible with LAN-XI, which is based on independent front end modules. These work independently or combined with others, so you can easily add more modules to expand your system, and can divide and distribute it as necessary.

Wired or wireless, forget cable confusion

The only cable you need is the network cable – a standard LAN cable used for both power and data transfer. This is useful in distributed systems, making large cable bundles a thing of the past, while bringing valuable installation flexibility.

When using a LAN-XI Wi-Fi module, you do not need cables – ideal when a cable connection to the LAN-XI module is not practical.

Always aligned

The LAN-based architecture of LAN-XI allows the use of PTP (Precision Time Protocol) for synchronization, guaranteeing absolute phase alignment between all the measurement channels in the system.

For applications where data from independent measurement systems needs to be synchronous, LAN-XI offers the option to use a GPS signal as time reference, guaranteeing absolute phase alignment between all the measurement channels across the independent systems.

Quality measurements the first time

Our unique Dyn-X technology avoids overloads and level-setting runs. It gives a market-leading, 160 dB dynamic range that means LAN-XI is always ready to capture your measurements.

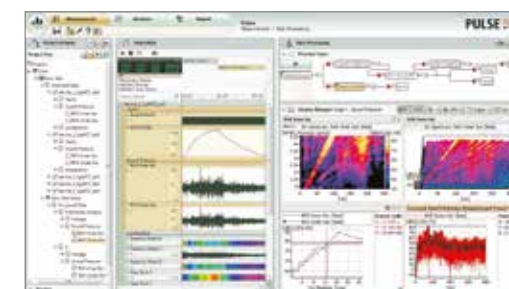
Built for field and lab use

Small and tough, LAN-XI modules are made of cast magnesium and can withstand being dropped, shaken and subjected to demanding environmental conditions. The interchangeable front panels are easy to replace should connectors become damaged.

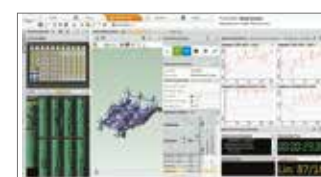
LAN-XI is a versatile system of modular data acquisition units that can be combined in a multitude of ways to satisfy test requirements. Every module can be used individually as a small system front end, or become part of a large distributed-module set-up.

LAN-XI is the common acquisition platform of PULSE systems, as well as the iPad-based Sonoscout system.

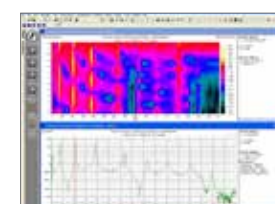
ANALYZER SOLUTIONS



PULSE Reflex post-processing and analysis



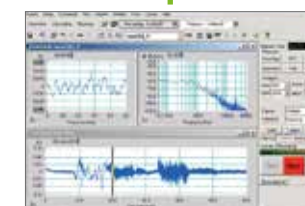
PULSE Reflex measurements



PULSE LabShop real-time analysis



Time data recorder for PC



RT Pro™



Measurement Partner Suite



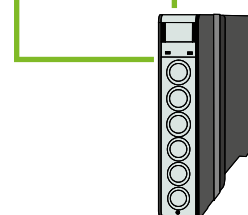
Sonoscout – Time data recorder for iPad



PHOTON+



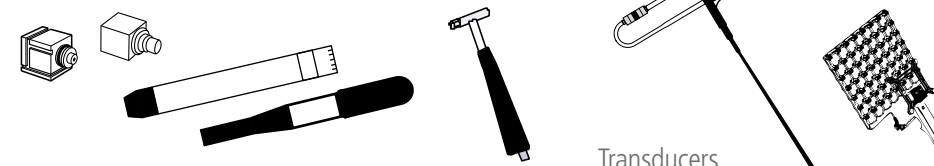
Hand-held



LAN-XI data acquisition hardware



LAN-XI stand-alone recorder – Notar™



Transducers

HAND-HELD ANALYZERS

Compact, all-in-one system

The smallest and lightest analyzer from Brüel & Kjær, ever. All the power of our earlier generations of real-time analyzers (for example, Type 214x family) built into a sound level meter.

The entire measurement chain in one box:

- Conditioning for one or two microphones, accelerometers and tacho probes
- Large display that can be read even in bright sunlight
- Advanced analysis including FFT, 1/3-octave analysis and simultaneous recording
- Built-in battery that lasts an entire working day

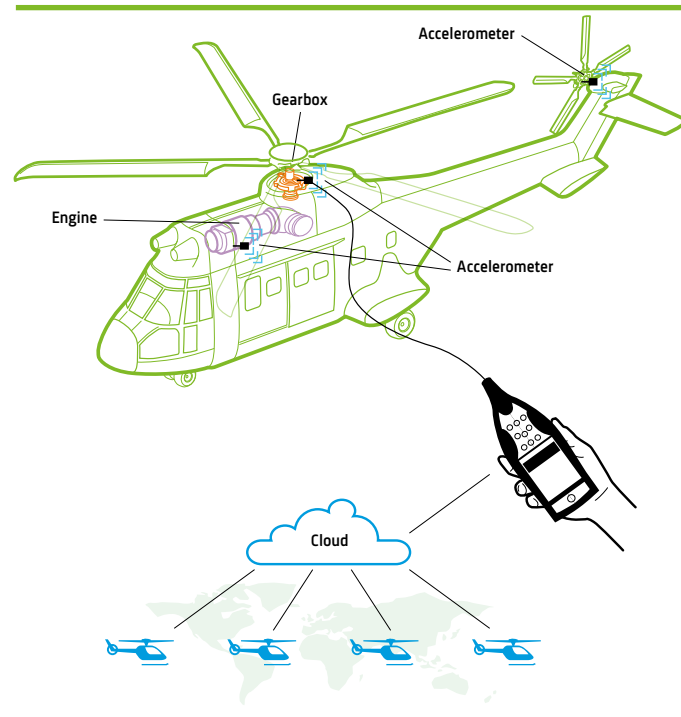
The perfect tool for technicians

It is also easy for non-specialists to make good noise and vibration measurements:

- User-interface in over 20 local languages
- Password protection ensures consistent measurement settings
- Fast and easy reporting to Microsoft® Excel® using included PC software

Work in a connected world

- Document measurements with videos, pictures, and annotations from iPhone or Android phones
- Upload data back to R&D through wireless connection with a smartphone
- Calibrated recordings for advanced post-analysis by specialists back in R&D



Field audit test

3656-A

What if there's a problem in the field and the specialist isn't there? You can either put the specialist on a plane or send the product back, or use your hand-held analyzer which:

- Can test against predefined limits with clear PASS/FAIL indication
- Is small enough to take as carry-on luggage
- Can listen to signals through headphones to easily verify measurement chain
- Has built-in metadata entry to document each test for use in filtering and reporting
- Can upload data to cloud through smartphone's connection

End-of-line production validation

2250-H

For audit of noise and vibration performance where a vehicle is taken to the factory test track:

- Internal battery and transducer – faster installation and removal
- Dedicated solution, no PC or tablet needed, means it's ready when you are
- If advanced analysis is required, transfer recordings by Wi-Fi or Ethernet for automated post-analysis

Audiometer calibration

BZ-7223, BZ-7230

Annual verification of audiometer system used for hearing testing:

- Conforms with international standards
- Built-in conditioning for artificial ears and mastoids
- Email data back from the field to easily share data
- Create customized reports in Microsoft® Excel®

Sound level measurements

2250, 2270

Standards and legislation require use of a Class 1 for some measurements:

- Occupational noise assessment
- Environmental noise assessment and logging
- Vehicle pass-by and exhaust noise



Fast and easy in-vehicle measurement of sound at the driver's right ear reference location



Calibration of a TDH-39 headphone with Artificial Ear Type 4152



Measure sound exposure and evaluate hearing protection

PHOTON+ ANALYZER

All-in-one solution

Whether noise and vibration testing takes you to the field or the lab, PHOTON+ provides an integrated solution for data recording, post-processing, and real-time analysis with up to 4 input channels.

A compact, light and rugged design makes PHOTON+ ideal for testing anywhere you need to make measurements.

Fast real-time analyzer

Fast real-time processing combined with a quick measurement set-up, gives you results instantly, and makes it possible to validate data quality while in the field.

Easy-to-use data recorder

The intuitive operation of the RT Pro software allows you to focus on results – rather than trying to master a complex user interface.

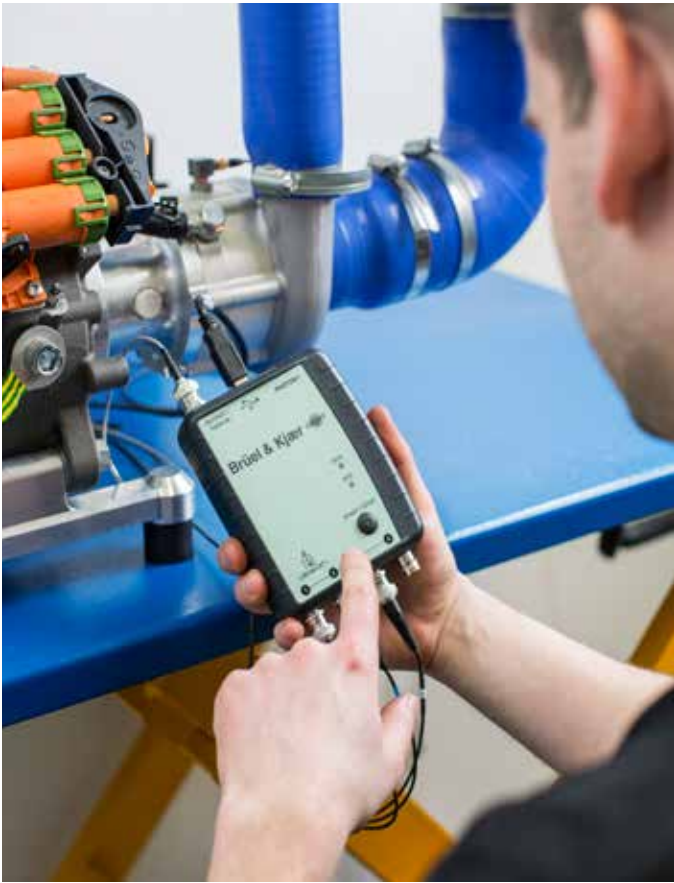
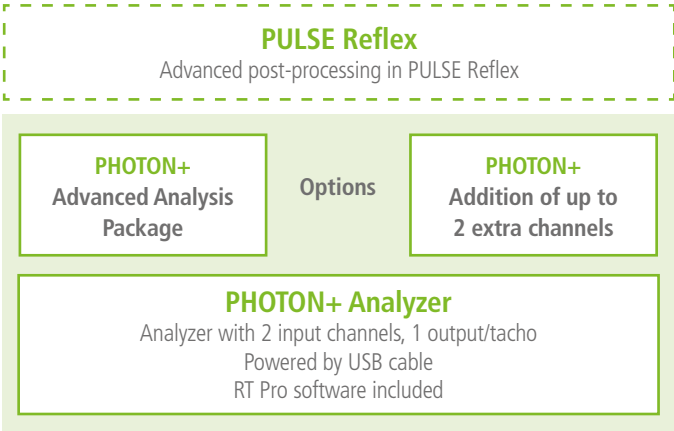
PHOTON+ with data recorder software provides the convenience of traditional tape recorders, with features such as voice annotation and high-accuracy performance.

Powerful post-processor

Just one click takes you from recording to post-processing. You can use RT Pro to play back and analyse the data as if making live measurements.

In RT Pro you can rapidly generate a professional report, which opens in Microsoft® Word.

For more advanced analysis requirements, PHOTON+ is an ideal companion for PULSE Reflex.



PHOTON+ is easy to use and recordings can be started and stoppped directly on the device

PHOTON+ analyzer

986A0186

The perfect solution for simple acoustic or vibration measurements, for example, hammer based Frequency Response Function measurements, where you only need two channels.

- Data recording, real-time analysis, simple post-processing
- High-precision FFT analysis

PHOTON+ advanced analysis software package

DSA-300

For more advanced structural testing, acoustic analysis, etc.

- Environmental data reduction (Shock Response Spectrum analysis)
- Real-time order tracking
- Swept-sine measurement
- Automated test

PHOTON+ addition of extra channels

845-084100

If you need to measure on more than two transducers you can add up to two extra channels.

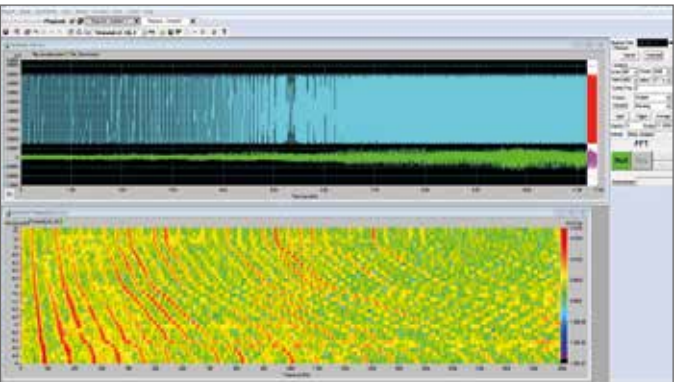
- More accelerometers for hammer test
- Measure with triaxial accelerometers
 - Single channel analogue input
 - Possible to add one or two channels



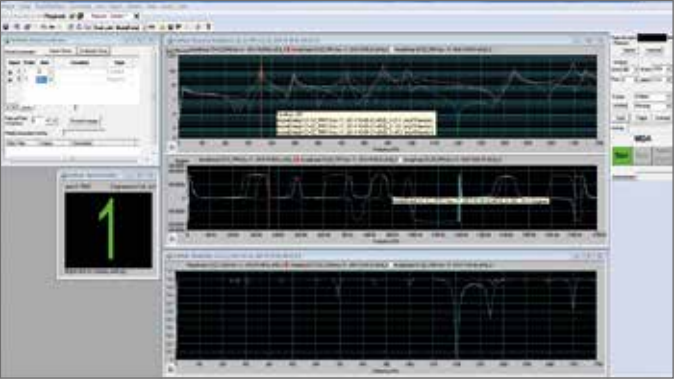
Video: Basic FRF measuring using PHOTON + and RT PRO



PHOTON+ and a Windows® PC makes a very compact and powerful system



Advanced analysis can be done either real-time in the field or from recordings back in the office



Extra channels allow multiple-reference impact testing (MRIT) to detect repeated or closely spaced modes

PULSE REAL-TIME DATA ACQUISITION

PULSE platform

At the heart of a PULSE system lies PULSE LabShop and PULSE Reflex Core, which are the main data acquisition and post-processing components.

PULSE LabShop

Our well-established flagship for real-time data acquisition from 2 to 1000+ channels. Equipped to perform fundamental analysis software tasks as standard, it is limited only by the computer running it.

PULSE LabShop is the real-time acquisition and multi-analysis platform for many of the other PULSE solutions presented in this catalogue. By itself, PULSE LabShop is one of the most popular stand-alone recording, FFT, CPB and order analyzers in the world, with more than 11,000 installations to date.

PULSE LabShop is built on:

- Powerful analysis capabilities
- Multi-analysis
- Best-in-class real-time performance
- Customization and programmability
- Modular data acquisition hardware – LAN-XI

Solid foundation

The flexibility of PULSE, combined with its industry-specific solutions, has made it the best-selling analyzer platform in a wide range of industries, including:

- Automotive
- Electroacoustics
- Telecommunications
- Aerospace and defence
- Consumer products

Powerful analysis capabilities

Standard PULSE LabShop analysis tools are:

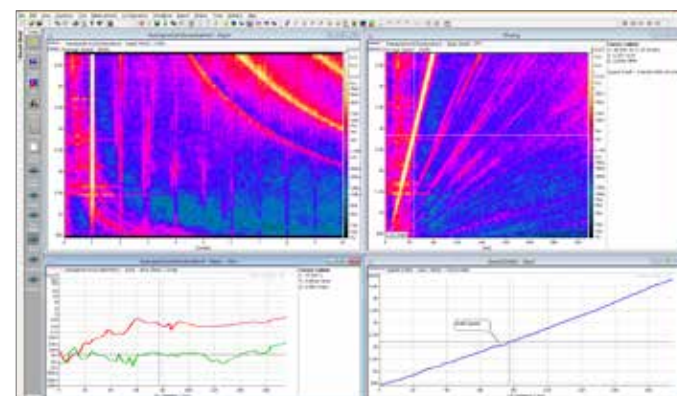
- FFT analysis
- CPB real-time 1/n-octave analysis
- Order tracking analysis
- Envelope analysis
- Cepstrum analysis
- Steady-state response (SSR) analysis
- Time-capture analysis
- Time data recording option

Multi-analysis

Since most tests can only be run once with the same conditions, with PULSE LabShop's multi-analysis capability you can:

- Capture test data and run it through PULSE LabShop's multiple analyzers in parallel
- Combine any kind of analysis and recording tools to analyse your data simultaneously, based on the same raw time-data samples
- Display consistent results in real-time
- Get immediate confidence in the achieved test results
- Save significant time

Multi-analysis capability is a great strength of PULSE LabShop.



PULSE real-time data acquisition system, for performing mechanical satellite qualification and acceptance testing, where vibration, shock and acoustic fatigue testing are used to simulate the environment experienced during satellite launch



Best-in-class real-time performance

PULSE LabShop continuously keeps pace with advances in computing power, adapting to get the most from your PC's performance.

- Runs on Microsoft® Windows® 32-bit and 64-bit operating systems
- Allows use of standard office PCs for measurement tests
 - Analyses 132-channel data up to a 50 kHz bandwidth /131 kHz sampling frequency
 - Analyses typically 160 FFT signals or 80 CPB signals up to 25 kHz
- Proven extremely high real-time performance with dedicated high-end PCs and LAN switches
 - Analyses 320-channel data up to a 100 kHz bandwidth/262 kHz sampling frequency
 - Analyses more than 600-channel data up to a 50 kHz bandwidth/131 kHz sampling frequency

Customization and programmability

Versatile and highly customizable, PULSE LabShop can be tailored to your needs. Its built-in 'Smart Start' concept:

- Eases the set-up of new analyses
- Automatically presents the results on screen
- Stores often-used set-up and results views for recall at the click of a button

PULSE LabShop includes an extensively programmable interface.

- PULSE LabShop integrates with your application, test cells and third-party solutions
- Built-in VBA (Visual Basic® for Applications) allows easy customization
- Supports Microsoft® Visual Studio® environment (C++, C#, Visual Basic® .NET, as well as MATLAB®)

Modular data acquisition hardware

LAN-XI data acquisition hardware is a versatile system of modular units. Every module can:

- Be used individually as a small system front end with up to 12 channels (depending on module)
- Become part of a distributed-module set-up connected via LAN
- Be arranged with many others in convenient racks to make systems of any size
- GPS synchronization, supporting sample-synchronous data acquisition between distributed systems

LAN-XI features:

- Dyn-X technology, which eliminates the need for input ranging giving a single measuring range of 160 dB
- Interchangeable front end panels

Integrated system features include:

- Cable-break detection
- Automatic transducer identification using TEDS (IEEE 1451.4)
- Automatic calibration sequence for transducers

Data acquisition and handling software

The DAQ-H solution typically handles very large channel counts and includes the following functionality:

- System set-up and calibration
- Measurement process
- Data acquisition and data validation during acquisition
- Data storage, analysis and reporting



Video:
Satellite
test system

PULSE BASIC ANALYZERS



At the core of PULSE are a series of basic analyzers that represent the beating heart of any PULSE system. A few examples of basic analyzer configurations are shown here.

Our PULSE basic analyzer solutions contain all you need for simple sound and vibration tests, and operate competently as stand-alone applications. They are easily expanded to fit larger, industry-specific solutions.

- FFT analyzer**
- Simple, real-time FFT analysis is available from 2+ channels for mobility measurements, vibration diagnostics, or narrow-band analysis of acoustic signals, featuring:
- Autospectrum and cross-spectrum
 - Waterfall spectrum
 - Resonance and damping estimation
 - Harmonic and sideband detection
 - Pure tone detection and sound intensity
 - Zoom FFT
 - Cepstrum analysis

- CPB 1/n-octave analyzer**
- Real-time, Constant Percentage Bandwidth (CPB) standardized digital filter-based analysis using 1/1, 1/3, 1/12 and 1/24 octaves for analysing noise, determining sound power levels, measuring sound intensity, and monitoring machine vibration. Basic CPB 1/n-octave analysis is available from 2+ channels, featuring:
- Sound level meter – octave spectrum
 - L_{eq} logging – sound levels versus time
 - Sound intensity – pure tone location while measuring
 - Reverberation time calculation – using a loudspeaker or gunshot
 - Machine vibration level monitoring – including pass/fail tolerance check

PULSE multi-analysis allows you to combine FFT and CPB analysis and recording tools to analyse your data simultaneously and display consistent results in real-time.

- FFT analyzer and recorder**
- 8729-A**
- Live Level and FFT Spectra Monitoring, before, during and after the measurement
 - Background recording while measurement is active
 - FFT resolution up to 102,400 lines
 - FFT analysis bandwidth standard up to 50 kHz (or higher depending on the LAN-XI module)
 - Exponential, Linear and Max Hold averaging
 - Spectrum averaging as well as Time averaging signal enhancement
 - Integrated with the Reflex post-processing application
 - Graphical set-up of hardware and analysis

- 2-channel FFT analyzer**
- 7770-N2**
- Smart Start – a quick, three-step, start-up guide
 - FFT resolution up to 6400 lines
 - FFT analysis bandwidth standard up to 50 kHz (or higher depending on LAN-XI hardware module used)
 - Multi-buffer spectrum logging
 - Triggered FFT analysis
 - Exponential and linear averaging
 - Time-averaging signal enhancement
 - Frequency weighting: A, B, C, and D
 - Integration and differentiation



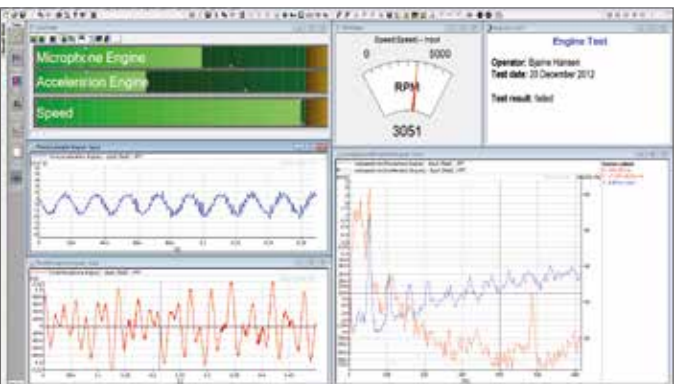
4-channel real-time FFT and Level monitoring with a single microphone and triaxial accelerometer. This measurement includes a recording in addition to the real-time measurement. This recording can be automatically post-processed through PULSE Reflex Core for additional types of analysis

- 6-channel FFT analyzer**
- 7770-N6**
- Contains all features of 2-channel FFT analyzer
 - Dyn-X technology, which eliminates the need for input ranging, giving a single measuring range of 160 dB
 - Ultra-compact system
 - Uses one LAN-XI module
- Optional:
- More than 7 hours of autonomous use with LAN-XI Battery Module Type 2831-A add-on
 - Expandable with Time Data recorder Type 7708

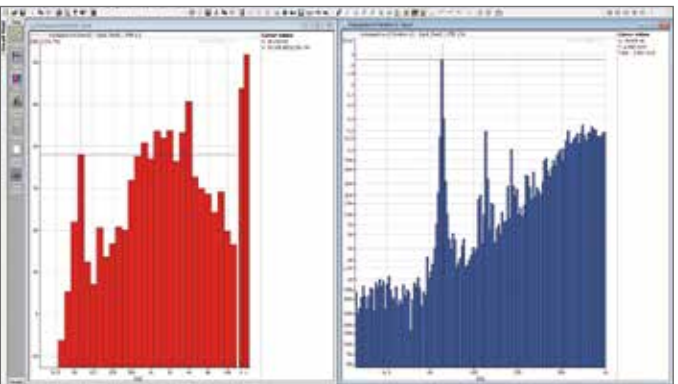
- 2-channel CPB analyzer**
- 7771-N2**
- Smart Start – quick three-step, start-up guide
 - CPB 1/n-octave analysis up to 1/24-octave
 - Multi-buffer spectrum logging
 - Linear – L_{eq} logging
 - Exponential averaging – including slow and fast
 - Exponential confidence level averaging for accurate measurements
 - Exponential minimum and maximum hold
 - Gated CPB analysis
 - Frequency weighting: A, B, C and D

- FFT and CPB analyzer**
- 7700-N, unlimited channels**
- Multi-analysis allows you to use FFT and CPB analysis simultaneously
 - Based on modular LAN-XI data acquisition hardware, this is the foundation for a multi-channel system
 - Up to 60 channels in one portable LAN-XI C-frame module rack

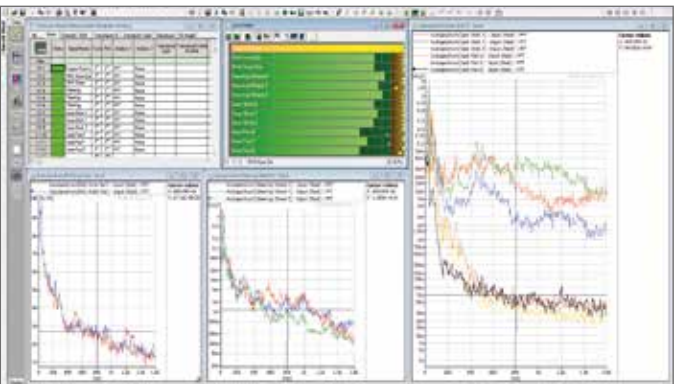
- Optional:
- Up to 3 hours of autonomous use with LAN-XI Battery Module Type 2831-A added to LAN-XI C- or D-frame module rack
 - Expandable with Time Data recorder Type 7708



Basic FFT including overall level meter and time-and-speed monitor, comparing sound and vibration FFT results in one plot for observing vibroacoustic effects



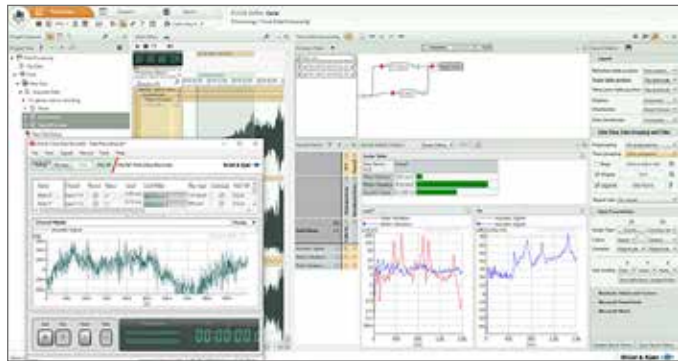
Basic 2-channel CPB comparing 1/3-octave analysis from the engine's sound with detailed 1/24-octave analysis from the engine's real-time vibration levels



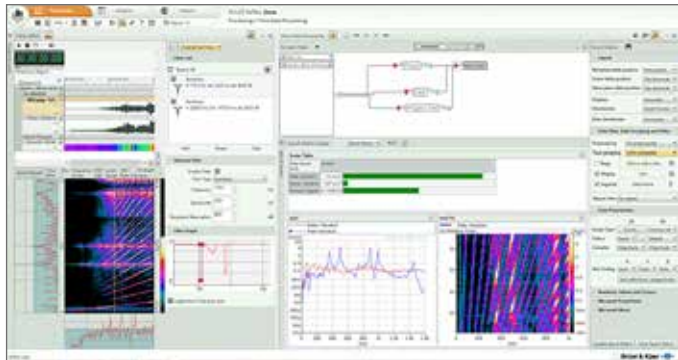
Basic FFT and CPB analyzer featuring easy set-up using Smart Start, spreadsheet type table, overall level monitor giving a quick overview of all channels, and easy data comparison in customizable displays

PULSE REFLEX SOFTWARE FOR LABSHOP USERS

New



Automated post-processing in PULSE Reflex of time recordings generated by the PULSE Time data recorder



Recording review validation in the Time Editor using the spectrogram and interactive filters. Post-processing in the process chain for final results

PULSE LabShop users have free access to equivalent features in PULSE Reflex Core, our next generation real-time measurement, recording and post-processing software, allowing you to do real-time analysis and post-processing with only one license. You can even liberate the PULSE Reflex Core functionality from the PC running LabShop and run it on a different PC, which in effect gives you an independent, real-time system AND a post-processing and reporting system.

Free access to LabShop-equivalent functionality in PULSE Reflex Core – Like-for-Like

With a PULSE LabShop license, you get access a range of PULSE Reflex capabilities. We call this Like-for-Like because, wherever possible, the corresponding PULSE Reflex Core functionality is included with your PULSE LabShop software Types 7700, 7770, 7771, 7702, 7951 or 7952.

In simple terms, if you can perform an FFT calculation in LabShop, you can perform the similar calculation in PULSE Reflex. The Reflex software is already available in your software package. All you need to do is to install it.

Liberate your LabShop license to PULSE Reflex Core

When using PULSE Reflex functionality available in the Like-for-Like-programme, you run both LabShop real-time analysis and the Reflex post-processing functionality on the same computer.

To help you use your PULSE LabShop data acquisition system more efficiently, we offer you the option of processing your time data recordings, and viewing and reporting results on a different computer by liberating your PULSE Reflex functionality from your PULSE LabShop system. Liberating allows re-hosting of the full PULSE Reflex functionality to another PC/Host ID.

However, after the Reflex licenses are liberated the original Like-for-Like functionality is still included with the LabShop licenses, so in a sense you really end up with two Reflex capable systems. Liberating your PULSE Reflex Like-for-Like functionality from your PULSE LabShop system also gives you access to additional functionality available in the standard Reflex licenses.

Extra functionality

Liberating your PULSE Reflex Like-for-Like functionality from your PULSE LabShop system gives you access to additional functionality available in the standard Reflex licenses.

Note:

- There is additional functionality in Reflex that is not accessible with your LabShop license
- Currently, not all Reflex functionality available in Like-for-Like is available for liberation. Some capabilities, such as the Reflex Standard and Structural Measurements, can only be used with your existing LabShop licenses

PRECONFIGURED SOFTWARE PACKAGES



New



Batch post processing of multiple recordings through a user defined process chain consisting of Overall, CPB and sound quality analysis

Our general-purpose signal analyzer packages are generally low-channel count analysis systems with easy-to-use software, together with suitable data acquisition hardware. We call them packages because they include data viewing and management software for PC, and a maintenance agreement that keeps your software up-to-date and gives you access to our knowledgeable support team. All you need to do is select the LAN-XI hardware module that meets your testing needs.

The software is preconfigured for typical acoustical or vibration test requirements, so each package contains all the basic tools you need to begin sound and vibration testing and analysis, from in-field recording or laboratory analysis through to reporting results and archiving your data.

Managing your data is critical

Even systems with a few channels can generate a lot of data. Managing it effectively is what gives long-term value to your testing. The intuitive data management and viewing tools in each package make it easy to archive results and get an overview of thousands of tests, for easy data comparison.

	Photon+ package	Sonoscout package	PULSE* packages
Input channels	Up to 4	Up to 12	Up to 12

Real-time			
FFT	x	x	x
Time data recording	x	x	x
Overall level		x	x
Real-time 1/n-octave analysis**			x
Tolerance curve with pass/fail check			x
FFT-based order analysis		x	x
Order tracking			x

Post-recording analysis			
FFT		x	x
1/n-octave analysis		x	x
FFT-based order analysis		x	x
Order tracking			x

Data handling and reporting			
Data management and viewing		x	x
Advanced reporting		x	x
Time data editing and listening		x	x
Batch post-processing			x
Smart transducer set-up			x

* There are many alternative PULSE packages, so not every one has all capabilities indicated here
** Also known as Constant Percentage Bandwidth (CPB)

PRECONFIGURED SOFTWARE PACKAGES

PULSE Reflex Spectral Analysis and Data Viewer Pack

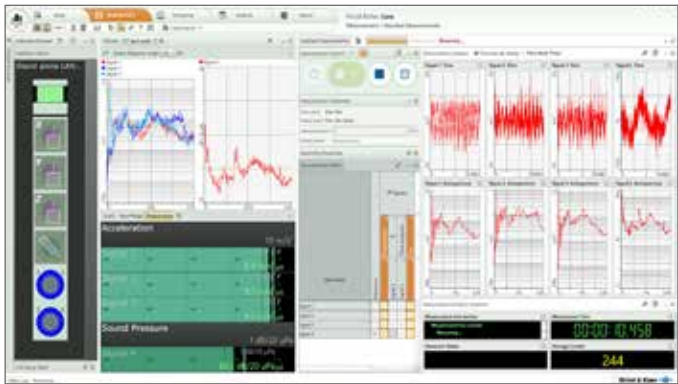
7960-NS

- Stationary FFT spectral measurements
 - System FFT analysis
 - Free running or signal triggered
 - Auto-spectrum, FRF, Coherence, etc.
 - With MIMO calculation of FRFs
- Recording of streamed time data while measuring

PULSE Reflex Spectral Analysis, Time data recorder and advanced processing FFT, CPB, Order, Data Viewer and PULSE LabShop Like-for-Like Pack

7961-NS

- Real-time FFT and Order Analysis
- Background recording or stand-alone recording
- Complete post-processing suite including Time Editor through intuitive graphical workflow
- Data viewing and integrated reporting
- Includes additional measurement capability in PULSE LabShop
- **Optional:** 7961-A



4-channel real time FFT analysis with recording including pretrial and level monitors

PULSE LabShop 2-channel FFT, Reflex Data Viewer and Reporting Pack

7950-NS2

- Basic LabShop-based, 2-channel Overall and FFT analysis
- Data management in the Reflex Database
- Data Comparison and Reporting tools as part of the Reflex Data Viewer and Results Matrix tasks
- Integrated Reporting in Word, Excel® and PowerPoint®

Does **not include** Like-for-Like with PULSE Reflex

PULSE LabShop 4- or 6-channel FFT, Time data recorder, Reflex Core Like-for-Like and Data Viewer Pack

7951-NS4, 7951-NS6

- Basic LabShop based 4- or 6-channel Overall and FFT analysis
- Time data recorder both inside of LabShop as well as stand-alone
- Data management in the Reflex Database
- Data Comparison and Reporting tools as part of the Reflex Data Viewer and Results Matrix tasks
- Integrated Reporting in Word, Excel® and PowerPoint®

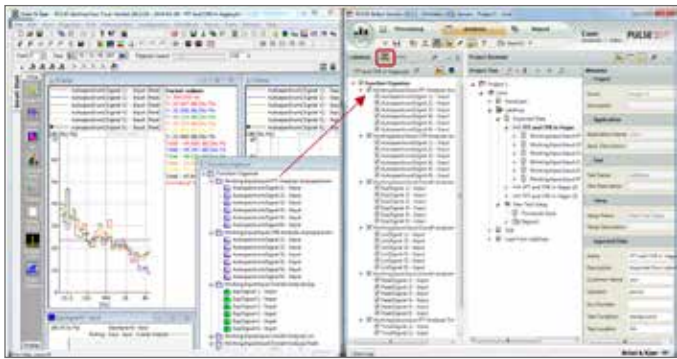
Includes Like-for-Like with PULSE Reflex, which can be liberated for a full post-processing solution.

PULSE LabShop 6-channel FFT and CPB, Time data recorder, Reflex Core Like-for-Like and Data Viewer Pack

7952-NS6

- Basic LabShop based 4- or 6-channel Overall and FFT analysis and CPB analysis
- Time data recorder both inside of LabShop as well as stand-alone
- Data management in the Reflex Database
- Data Comparison and Reporting tools as part of the Reflex Data Viewer and Results Matrix tasks
- Integrated Reporting in Word, Excel® and PowerPoint®

Includes Like-for-Like with PULSE Reflex, which can be liberated for a full post-processing solution.



Use the built-in LabShop browser to import function result data into Reflex. Add metadata to the results before archiving in the SQL database. Create reports in PULSE Reflex and include metadata

PHOTON	
986A0186	PHOTON+ All-in-one 2-channel system includes DSA-100 RT Pro software for real-time measurements, DSA-107 data recorder software, DSA-104 Waveform Recorder, and DSA-110 RT Pro Playback software for post-processing
Sonoscout	
BZ-5951-L-N01-	Sonoscout with LAN-XI input channel streaming and PULSE Reflex Data Viewer and Reporting Pack (8700-N, 8701-N), Node-locked License
Preconfigured software packages	
7950-NS2	PULSE LabShop 2-channel FFT and Reflex Data Viewer and Reporting Pack (3099-A-N1, 7770-N2, 8700-N, 8701-N), Node-locked License
7951-NS4	PULSE LabShop 4-channel FFT, Time data recorder and Reflex Core L4L and Data Viewer Pack (3099-A-N1, 7708-N, 7770-N4, 8700-N, 8701-N, 8702-L-N), Node-locked License
7951-NS6	PULSE LabShop 6-channel FFT, Time data recorder and Reflex Core L4L and Data Viewer Pack (3099-A-N1, 7708-N, 7770-N6, 8700-N, 8701-N, 8702-L-N), Node-locked License
7952-NS6	PULSE LabShop 6-channel FFT & CPB, Time data recorder and Reflex Core L4L and Data Viewer Pack (3099-A-N1, 7700-N6, 7708-N, 8700-N, 8701-N, 8702-L-N), Node-locked License
7960-NS	PULSE Reflex Spectral Analysis and Data Viewer Pack (3099-A-N1, 8700-N, 8701-N, 8729-A-N), Node-locked License
7961-NS	PULSE Reflex Spectral Analysis, Time data recorder and advanced processing FFT, CPB, Order, Data Viewer and PULSE LabShop L4L Pack (3099-A-N1, 8700-N, 8702-N, 8703-N, 8704-N, 8706-N, 8729-A-N, 7700-N6, 7708-N, 7702-N1), Node-locked License
Optional 7961-A-NS	PULSE Reflex Advanced Order Analysis option and PULSE LabShop L4L Pack (8705-N, 7702-N), Node-locked License

Note: For Sonoscout, LabShop and Reflex preconfigured software packages, you add the hardware of your choice

Data Management and Reporting

The Sonoscout and PULSE preconfigured software packages all include Type 8701 PULSE Reflex Data Management and Reporting built on an SQL database and featuring the Data Viewer. This makes these packages unique as we believe handling large amounts of data and producing extensive reports is the biggest pain point for today's sound and vibration engineer.

Even for a customer with an entry-level system, these strong data management tools will sooner or later be of benefit to him. It is not the number of channels, but really the amount of data (and the significance of the data) that counts.

PULSE Reflex Database, Viewing and Reporting boosts productivity through automation and more efficient reporting

- Easy to create and repeat standard processes using the built-in automation features
- Data comparison and reporting for multiple tests can be performed in a single automated operation

Data viewer

- Review and report project data. Compare results from multiple tests or projects. Step automatically through data with intelligent overlay of similar data.

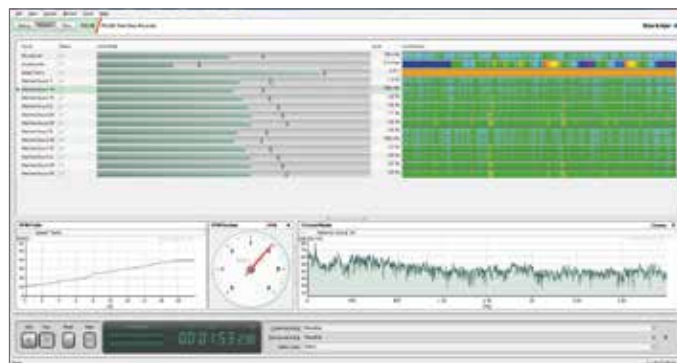
Result Matrix viewer

- Providing a structured overview of results from a large number of tests, making selection and comparison very easy.

Reporting

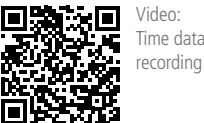
- A natural part of the workflow with integrated subtasks for Microsoft® Word, Excel® or PowerPoint®
- Supporting automatic batch reporting of hundreds or thousands of results

TIME DATA RECORDER FOR PC



PULSE Time data recorder with a level meter indicating overload occurrences, and coloured level history keeping track of optimal dynamic range selection

The channel monitor allows you to see time or frequency content and includes a tachometer RPM and RPM profile readout



Video:
Time data
recording

Recording time data and then post-processing the results allows you to decide the analysis parameters later and manipulate the raw data at leisure. In circumstances such as troubleshooting – when the exact nature of a problem is unknown – important information in the results can otherwise be missed due to the assumptions made when setting up the analyzer.

Time data acquisition and post-processing can also be essential when real-time analyses are impossible due to the number of measurement channels required, even with the continuing increases in computing power.

While recording data, the flexibility of PULSE Time data recorder allows you to transfer data to another computer or server for post-processing and analysis. PULSE Time data recorder allows recording and analysing data on separate computers, or combining computers into one system as a measurement and analysis workstation, to further optimize processing capability.

The flexibility of the LAN-XI data acquisition hardware platform allows configuration of any recording solution from 2 to 600+ channels, for mobile or lab-based use. Battery- and DC-powered options combined with LAN connection to the host PC provide maximal efficiency and minimal test set-up time.

Post-processing is easy to perform in PULSE Reflex, our intuitive post-processing software.

Time data recorder

7708

- Simple and intuitive controls
- Dynamic range up to 160 dB using Dyn-X input technology
- Easy hardware set-up in spreadsheet style with save/load configuration from xml file
- Metadata support for PULSE Reflex database
- Live monitoring of signals – listen to your signals during recording
- Event markers – for automatic region selection in PULSE Reflex Time Editor
- Choice of manual or triggered recording
- Multiple recording modes
- Automatic indexing of files for efficient post-processing
- Time history profiles for verification of recorded data
- Optional data review and trim before saving
- Export in a wide variety of formats
- Automatic time data import and immediate post-analysis in PULSE Reflex Core



TIME DATA RECORDER FOR iPad®

Sonoscout

The Sonoscout app for iPad works in combination with a wireless LAN-XI data acquisition hardware module. This connects to measurement transducers, a binaural microphone headset and a vehicle CAN bus reader, and transmits the data to the iPad – or records directly onto an SD card



Sonoscout is an ultra-portable, multichannel, wireless NVH recorder. It allows real-time recording validation with a simple touch of an iPad® screen. Sonoscout continuously displays test information such as tachometer output, to maximize confidence during testing, and brings simple control and analysis to tasks such as comparing vehicle and data sets.

The Sonoscout system is a combination of an iPad app and a battery-powered acquisition front end based on any LAN-XI hardware module. This can be placed anywhere and connects up to 12 measurement transducers, from which it transmits data to the app for recording. A binaural microphone headset captures cabin sound in real-time and replays recordings immediately.

In use, Sonoscout uses GPS to track your test routes and event markers, which can later be uploaded into Google Earth™. Interfacing with analogue CAN bus signals from the test vehicle allows you to display parameters such as speed, RPM and throttle position.

For other simple analysis functions, like rotating machinery validation and benchmarking, Sonoscout is the perfect first step. Once you are positive that data is valid, you can export it for further analysis in PULSE Reflex, or other post-processing software.

The system runs on iPad (iOS 10 or newer) and streams data directly to the iPad or records to the SD card on the LAN-XI module. You can try out the full recording and analyzer functionality for free, by downloading the app and using the 'virtual front end' demonstration feature.

Record and validate on the spot, in a vehicle or in the field

BZ-5950 software, BZ-5951 software (includes all of BZ-5950 plus Reflex Data Management), 3663 Sonoscout kit

- Completely portable
- Records up to 12 channels
- Dual-channel playback for listening and evaluation
- FFT, order analysis, spectrogram analysis, sound quality metrics
- Narrowband and 1/3-octave band analysis (synthesized)
- Pre-triggering and auto-stop functions
- Time history markers
- Automated calibration procedure
- TEDS support
- No input ranging with Dyn-X technology
- Record to iPad or SD card
- Analogue CAN bus support – reader available from Brüel & Kjær



Video:
Sonoscout
NVH Recorder



Please be aware that driving a vehicle whilst operating electronic devices can be dangerous and is prohibited in some countries. Brüel & Kjær reminds you to follow all traffic laws and to drive responsibly. Brüel & Kjær Sound & Vibration Measurement A/S shall not be liable for any unlawful or irresponsible use of the equipment.

Apple, the Apple logo and iPad are trademarks of Apple Inc., registered in the U.S. and other countries. App Store is a service mark of Apple Inc.

POST-PROCESSING

PULSE Reflex Core is our post-processing software for fast and efficient analysis, viewing and reporting of sound and vibration data. At the heart of the system is a relational database for managing test projects and their associated sound and vibration data. PULSE Reflex Core is native 64-bit allowing you to gain the full benefit of your 64-bit operating system and all available memory. It is thus prepared for a future where dataset sizes are ever increasing.

Simple and intuitive

An innovative GUI controls a workflow concept that is easy to learn and consistent across applications, making PULSE Reflex Core genuinely easy to use. It deals with both repetitive (test bench) procedures and ad hoc troubleshooting by including automation in the workflow without constraining the user to a predefined sequence of operations.

Powerful analysis capabilities

Multiple parallel analyses can be performed simultaneously, including stationary and non-stationary spectral analysis, order analysis, statistics, and sound quality metrics. Results are automatically sorted for easy post-processing.

High productivity

Batch processing is included as standard in PULSE Reflex Core, enabling many recordings to be processed in a single batch operation. No matter how many tests or data types, the results from any number of tests are automatically sorted for quick comparison and reporting.

Flexible data management

Test data and processed results can either be entirely managed inside the PULSE Reflex Core database or stored in external files. Metadata is used throughout the workflow for easy data searching, display annotation and automated report generation.

Data viewing and reporting

8700, 8701

PULSE Reflex Data Viewer provides automated viewing and reporting tools that are both flexible and easy to use. The Result Matrix provides you with an easy overview of large data sets, allowing simple overlay of logically similar results. This software is designed to take data from any source, making it the ideal viewing and reporting hub for sound and vibration engineers.

Stationary and non-stationary test data analysis

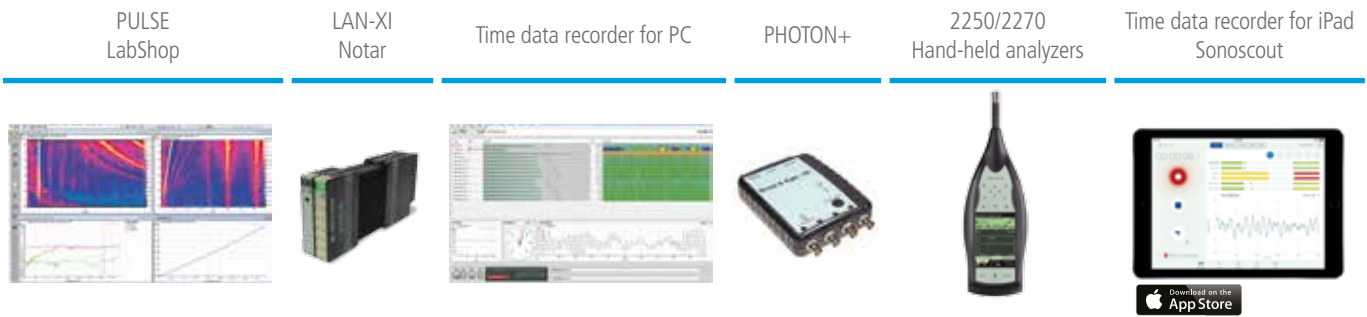
8700, 8702

PULSE Reflex Basic Processing is an analysis toolbox for FFT and overall level analysis of recorded data, including acoustic and human vibration filtering. Time data can automatically be imported from, for example, a network drive and batch processing enables collections of time files to be processed in one operation, and includes the option of automatic reporting. PULSE Data Viewer, including the Result Matrix, provides you with powerful tools to compare results and create extensive reports. PULSE Reflex Time Editor provides a powerful tool for quickly evaluating data before analysis.



The Result Matrix provides an easy overview and simple comparison of large data sets from any number of tests or test runs

PULSE Reflex post-processing



Datafiles: *.pti, *.dat/rec, *.wav, *.wv, *.ati, *.unv, *.uff, *.bunv, *.buff, *.hdf, *.bkc, *.afu, *.sie, *.DATx, *.atfx

Advanced processing

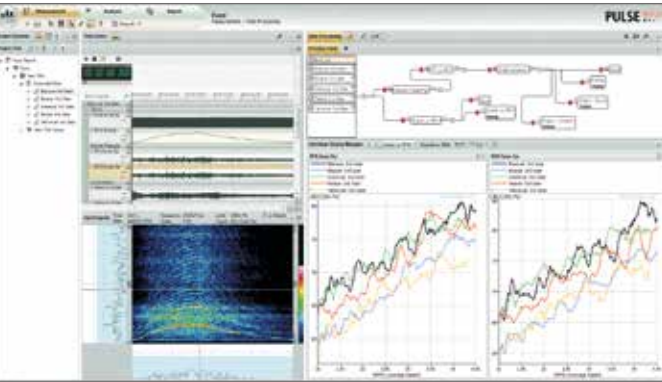
8700, 8702, 8703

PULSE Reflex Advanced Processing adds advanced analysis capabilities enabling visual and aural investigation of frequency and order characteristics. It includes spectrogram and interactive filters for listening to data as well as Batch statistics for calculating min, max or mean of results from multiple recording files.

Advanced order analysis

8700, 8702, 8704, 8705

PULSE Reflex Advanced Order Analysis includes both fixed bandwidth and tracked resampled FFT analysis using a tachometer speed reference. Special tools include the graphical auto-tracker for deriving speed information without a tachometer, and tachometer repair in the Time Editor.

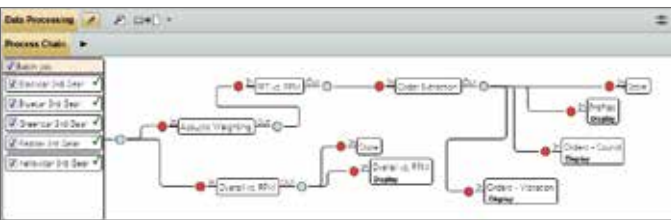


Recordings can be previewed and edited in preparation for analysis. The spectrogram display allows quick evaluation of frequency and order content

Sound quality metrics

8700, 8702, 8710

PULSE Reflex Sound Quality Metrics adds a comprehensive range of commonly used metrics to the basic processing module. Metric calculations can run in parallel with other analyses such as FFT or overall analysis, and can easily be set up to process a large number of recordings in a single batch operation.

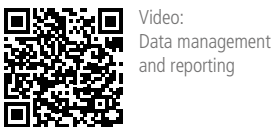


Automation is built into the workflow. Batch processing and automatic reporting are included as standard



Microsoft® PowerPoint® and Microsoft® Word are embedded to enable seamless report generation

DATA MANAGEMENT sound and vibration



Following data acquisition and analysis comes the second vital half of the measurement process. Analysing results is where the in-depth engineering work starts, where conclusions need to be drawn and decisions made. Examining the large amounts of data generated across an entire organization requires a clear overview and sophisticated capabilities.

PULSE Reflex Data Management streamlines data handling, test documentation and archiving, and encompasses our extensive experience of data management.

- Safe and orderly data storage
- Efficient searching and inspection of historic data
- Simplified data sharing across the test organization
- Cross-project data comparisons and calculations
- Fast and efficient reporting

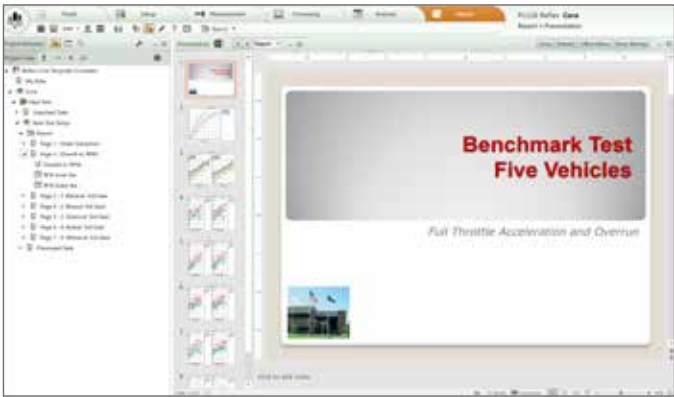
Metadata information of any kind can be attached to label sound and vibration measurements and application data. Intuitive database searching ensures easy data retrieval for display, comparison, additional calculation, and reporting.

Databases can be hosted on a laptop for field measurements, or on a network for cross-organizational use, allowing them to be accessed throughout the organization. Storage is in a standard Microsoft® SQL database.

Data viewing and reporting
8700, 8701

PULSE Reflex Data Viewer provides automated viewing and reporting tools that are both flexible and easy to use. The Result Matrix provides you with an easy overview of large data sets, allowing simple overlay of logically similar results. This software is designed to take data from any source, making it the ideal viewing and reporting hub for sound and vibration engineers.

- Included features**
- A report generator allows you to create report templates in the layout of your choice. The reports can be generated in your preferred Microsoft® Office application – Microsoft® Word, Microsoft® Excel® or Microsoft® PowerPoint®
 - A calculator provides a dynamic post-processing environment for arithmetical calculations and statistical operations on test data



Microsoft® PowerPoint® report integrated into the Reflex workflow

NVH TESTING



Noise Vibration and Harshness (NVH) testing is critical for refining the human experience of vehicles, making NVH a key vehicle area of concern, and a vital differentiator between comparable models.

To achieve the desired attributes, the vehicle must be engineered to specified NVH targets from its inception, and subsequently validated to see that these targets are met following the development process.

Failure to meet targets necessitates troubleshooting to find the root cause of the problem and eliminate it in a cost-effective manner – where cost is also measured in terms of weight and therefore fuel economy.

For an analysis system to suit NVH testing it needs to be portable and robust for in-vehicle use, scalable and easy to use.

For standardized or repeated tests, real-time multi-analysis gives results as soon as you have completed a measurement. Avoiding the additional steps required for post-processing ensures high productivity and allows you to validate your results on-site.

Our data-centric architecture means the systems are built around the data flow, so tests and results are documented from start to finish. Consequently, storing, retrieving and reporting are efficient processes that do not require additional tools or applications. Additional time can be saved by automating report generation in whatever measurement report format your company uses.

- Automotive test manager**
7796-A
- A complete NVH toolbox covering stationary and run-up/run-down order tracking, time signal inspection, filtering and analysis, narrow-band analysis and mobility testing, featuring:
- Real-time multi-analysis across all channels, covering FFT, 1/n-octave, order tracking and overall levels
 - Option of recording time data and saving automatically to database
 - Time domain filtering and manipulation
 - Virtual tacho support for Continuously Variable Transmission (CVT)
 - Sideband extractor for Hybrid Electrical Vehicles (HEV) switching noise
 - Sound power determination for engine testing



Validator provides targeted automatic retrieval of test results for averaging, reporting and comparison to other relevant measurements or target data

ORDER ANALYSIS

In rotating and reciprocating machines, varying load conditions and imperfections in the moving parts cause vibrations and associated sounds. The vibrations are shaped by the structural properties of the moving and stationary parts of the machine.

Order analysis relates measurements to revolutions of a rotating part, improving knowledge about machinery such as aircraft and automotive engines, powertrains, pumps, compressors and electric motors.

Typical uses

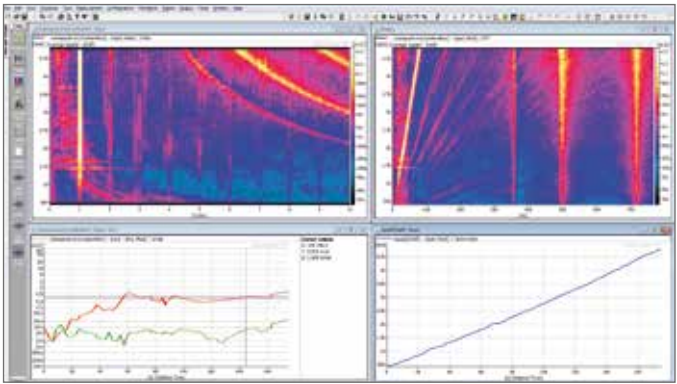
- Separation of rotational and structural noise and vibration phenomena
- Identification of noise generated by rotational vibrations
- Determination of critical speeds and excited resonances
- Investigation of instabilities in rotating machinery caused by varying load

Order analysis methods

- Without tracking – for analysis of lower orders and moderate RPM slew rates, based on fixed bandwidth frequency spectra from FFT analysis
- With tracking – for analysis of higher orders or higher RPM slew rates, based on order and tracked resampled FFT analysis using a tachometer as speed reference

Both methods provide spectra, 3D plots like ‘colour contour’ or ‘Campbell diagram’, individual order, and structural slices versus RPM of one or more rotating parts. All methods support the use of multiple tacho signals as references, and with the Autotracker functionality it is possible to extract the tacho signal directly from a measurement input, for example, in cases where a tacho signal is not directly available.

All data can be tagged with process data such as temperature, oil pressure, position, wind speed, and all order analysis results can be shown in relation to these auxiliary parameters.



Order analysis with and without tracking, first and second order cut versus time and run-up speed profile versus time

Real-time order analysis with tracking

7770-N, 7702-N, unlimited inputs

This configuration provides FFT-based order analysis as well as order tracking on an unlimited number of channels. Order tracking is useful when frequency smearing will compromise the FFT-based analysis, and when:

- Higher orders are of interest
- Orders are not well separated
- RPM ranges are wide
- Slew rates are high

Real-time order analysis without tracking

7770-N, 7702-N2, unlimited inputs

This basic configuration provides FFT-based order analysis on an unlimited number of channels with up to 2 tacho signals. FFT-based order analysis is an attractive solution when:

- Only lower orders are of interest
- Orders are well separated
- RPM ranges are limited
- Slew rates are moderate
- Processing resources are scarce

Recording and order analysis

7708, 8700, 8702, 8704

Combining Time data recorder and PULSE Reflex order analysis provides you with a mobile and easy to use solution for:

- Basic fixed bandwidth rotating machinery analysis
- Quick, qualitative assessment of order content
- Determination of critical speeds and resonances
- Signature analysis of machines with rotating components
- Pre-study for tracked order analysis
- Vehicle NVH benchmarking

The solution supports automatic processing of time data recording, and includes powerful data preparation tools like Tachometer repair and Autotracker creating an RPM profile when a Tacho reference signal is not available. Powerful analysis and report tools include Colour contour as well as order-slice extraction plots.

Advanced order analysis

7708, 8700, 8702, 8703, 8704, 8705

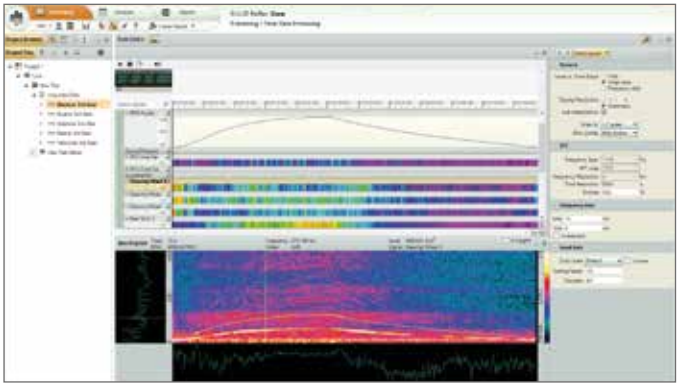
This solution adds advanced processing and tracked resampling to order analysis for:

- Leakage-free, high-accuracy order analysis
- Dealing with fast speed-sweeps and high order numbers
- Assessment of aircraft or automotive engine vibration
- Determination of critical speeds and resonances
- Root cause analysis of tonal sound quality issues
- Vehicle NVH benchmarking

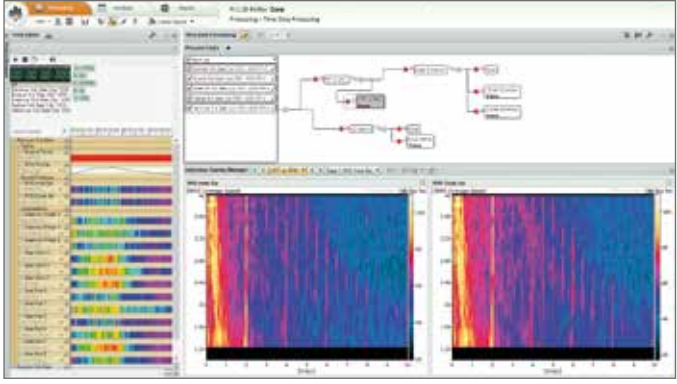
The solution supports automatic processing of time data recording, and includes additional powerful pre-analysis features like spectrogram and interactive filters. Tracked resampling and batch statistics for calculating min, max or mean of results from multiple recording files are one of the advanced features added to the analysis and reporting tools.



PULSE Time data recorder with coloured level history and channel monitor viewing time or frequency content. Tachometer and RPM profile readout as well as RPM triggers are essential recording tools used during a run-up/coast-down

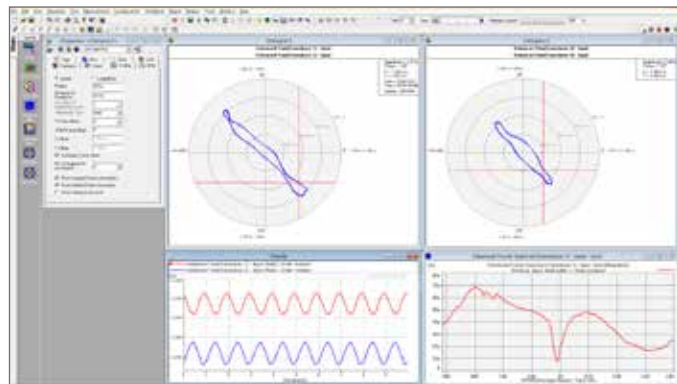


Time data is automatically imported as the recording proceeds. Use the Time Editor to listen and pre-analyze your recordings. The spectrogram shows the instantaneous spectrum and frequency or order slice at the cursor location

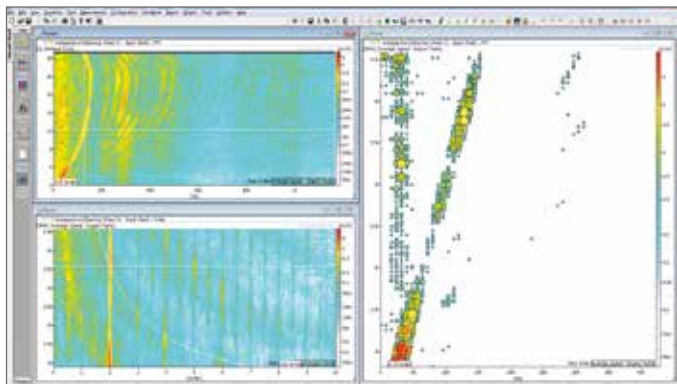


Batch processing of five time data recordings. The same RPM range 1000 – 4000 has automatically been selected for each recording prior to analysis in the process chain

MACHINE DIAGNOSTICS



WT-9695 Orbit Plot allows you to display the shaft displacement relative to its bearing using the two time signals of an X-Y proximity probe pair measured by an FFT or Order analyzer



Order analysis with Campbell diagram and colour contour plots with custom colours

Moving parts in any rotating machine will eventually cause annoying vibrations that ultimately lead to breakdowns due to production and assembly tolerances, wear, and load variation.

Machine diagnostics is the PULSE configuration for addressing vibration problems in rotating machines. Our tools can be used in run-up/down sessions, and combined to diagnose multiple faults – such as performing cepstrum analysis of order spectra or envelope spectra.

All analyses can be performed simultaneously, and the raw signals can be recorded for subsequent analysis using the extension PULSE Time data recorder. Diagnostics on transient phenomena is then performed with PULSE Time Capture.

All data can be tagged with auxiliary parameters such as temperature, oil pressure, position, and wind speed, and all results shown in relation to these.

- Machine diagnostics**
7770-N, 7702-N, 7773, WT-9695
- System includes:
- Multi-tachometer
 - FFT order analysis
 - Order tracking
 - Signal enhancement
 - Envelope analysis on bearings
 - Cepstrum analysis on gearboxes
 - Process data/auxiliary parameter logging

And the following displays: waterfall, colour contour, Campbell diagram, order and frequency slices, RPM profiles, order and spectral data as function of process data. WT-9695 adds Orbit Plot, Polar Plot and Shaft Centre Line Plot.

The configuration comprises Order Analysis Type 7702-N. See Order Analysis on page 24 of this catalogue for properties and capabilities. Any LAN-XI data acquisition hardware module is suitable for machine diagnostics, giving from 2 to 12 input channels. Auxiliary parameter logging requires LAN-XI module Type 3056.

BALANCING



Imbalance results from an uneven distribution of mass in a rotor, causing vibrations that are transmitted to the bearings and other parts of the machine. Imperfect mass distribution can be due to material faults, design errors, manufacturing and assembly errors, and especially faults occurring during operation.

Reducing these vibrations achieves better performance and more cost-effective operation, and avoids deterioration and fatigue failure. This requires the rotor to be balanced by adding or removing mass at certain positions.

Our system determines balance quality for single-plane and two-plane balancing according to the ISO1940–1 standard. Multi-plane Balancing Consultant Type 7790-B adds three- and four-plane balancing.

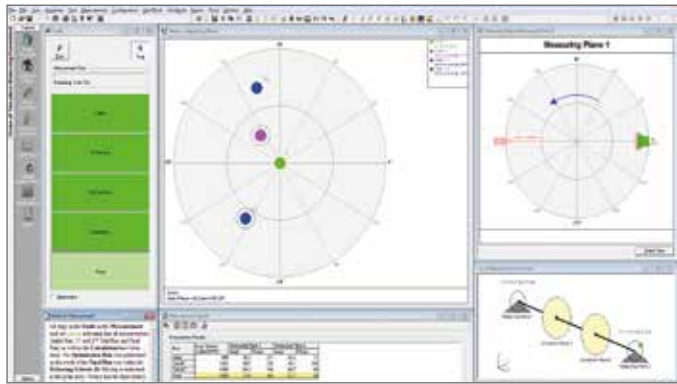
Balancing Consultant has an intuitive, task-oriented user interface that leads you quickly through the necessary tasks for set-up, measurement and reporting.

The balancing process can either be performed in situ, where the rotor is balanced in its own bearings and supporting structure, or by balancing the rotors in separate balancing machines.

Trim balancing is also supported, using rotor data stored from previous balancing sessions. This ensures fast correction of small residual imbalances in cases where balancing has to be repeated.

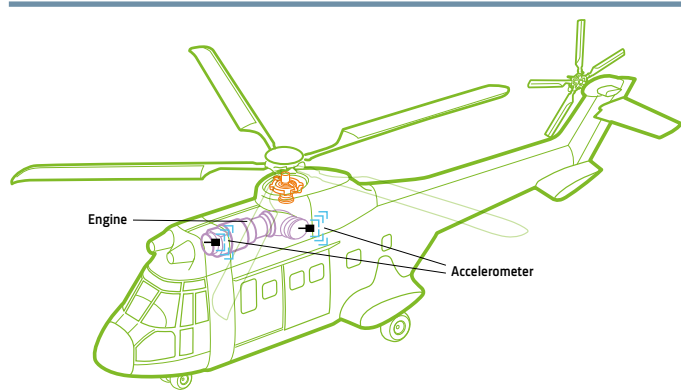
Balancing FFT and tracking
7770-N3, 7702-N3, 7790-A, 2 inputs, 1 tach input

Balancing can be based on either frequency spectra (FFT) or order spectra (order tracking). Traditional FFT-based balancing is sufficient in many measurement situations. However, in cases with unstable machinery speed and/or high frequency resolution requirements, order tracking should be used to eliminate frequency smearing and provide more accurate results. Balancing using order tracking requires Order Analysis Type 7702.



Five-stage, two-plane balancing including shaft vibration level and shaft centre position, sensor and trial masses layout

VIBRATION CHECK for aircraft engines



To guarantee the maintenance of aircraft engines and optimize aircraft uptime, our vibration check systems perform field verification on specific engines. Measurements are made according to the procedures specified by the engine manufacturer's maintenance manual.

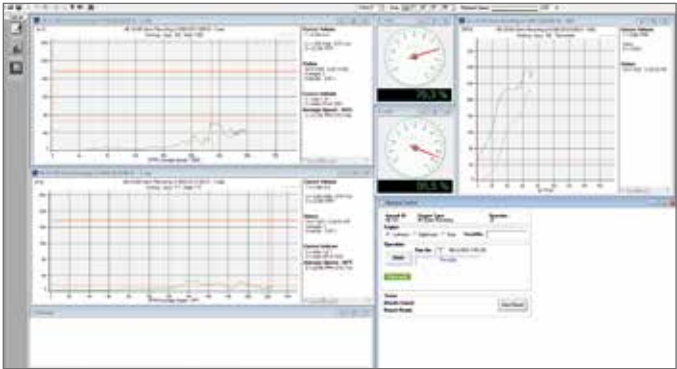
Turbomeca-based engine maintenance systems are available for 22 different variants, covering Arriel, Makila, Arrius, Turmo, Ardiden and RTM 322 engines among others. New systems for other engine types can easily be developed by our Customized Project Department.

All verification of vibration levels is performed in one engine run-up, with reference to two tachometer signals – one from the gas generator and one from the power turbine (free turbine). A warning is given if level limitations are exceeded.

Results are automatically stored in a database and displayed in a contour plot showing frequency, speed and level, in order to aid fault diagnosis. A report is produced immediately, according to the manufacturer's template.

- Vibration check system for aircraft engine**
8324-100, 4 inputs
- PULSE Vibration Check System including:
- Necessary software, portable PC, etc.
 - Accelerometer with high-temperature cable, integrated charge converter/filter and TEDS (10 m in all)

- Engine-specific set-up**
UA-1678-A-0XX
- PULSE Vibration Check System for Turbomeca engines, node-locked license.
- Annual software maintenance and support agreement
 - Tacho harness
 - Shoulder bag for cables



Vibration referenced to the two tachos, engine run-up speed profile, and test and pass/fail information

TRANSDUCER SMART SET-UP



The Transducer Smart Setup app helps you work smarter by providing a portable wireless link between the transducers in the test set-up and the hardware set-up table in PULSE Reflex Measurements. Typical applications include multichannel sound and vibration measurements such as large-scale structural testing

The Transducer Smart Setup app is designed to make transducer set-up as simple and automated as possible by reading data matrix codes on Brüel & Kjær transducers and seamlessly transferring the information to PULSE Reflex measurements.

Using the smartphone's camera, you can perform a quick scan of the transducer's data matrix to read the transducer data and its orientation. The data matrix code also gives you instant access to specifications, documentation and calibration data. In addition, you can scan customized 2D labels attached next to the transducers to read transducer position and node ID.

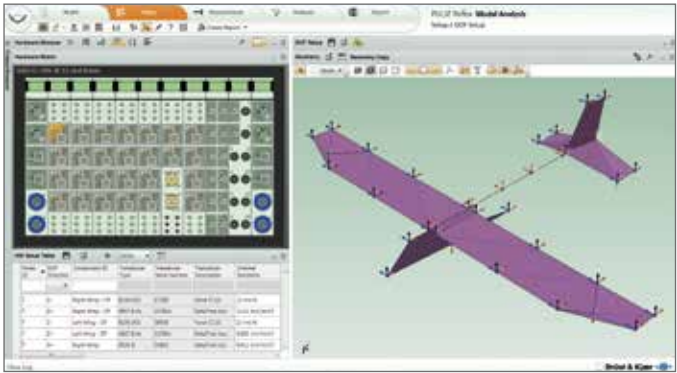
For transducers without data matrix codes, the app will recognize the transducer and its orientation and allow you to add associated data, minimizing the risk of data entry errors.

Projects containing the test set-up are exported as .xml files using an email account, a cloud storage service or iTunes and uploaded to the Hardware Setup Table in PULSE Reflex measurements. In addition, PULSE Reflex measurements recognizes which transducer is plugged into which input connector, eliminating the need to trace cables.

The Transducer Smart Setup app is available for iOS 8.0 or newer devices (iPhone®, iPad® and iPod touch®) and is available free from the App Store.



Scanning the data matrix code on the transducer (transducer information and orientation) and the label next to the transducer (transducer position and node ID) using the Transducer Smart Setup app ensures fast and correct DOF information for the measurement



Test Setups are easily exported to the Hardware Setup Table in PULSE Reflex Measurements

Video:
User interface



Video:
Creating a test set-up project



MODAL ANALYSIS

Modal analysis is vital to understand and optimize the inherent dynamic properties and behaviour of many diverse kinds of structures, leading to lighter, stronger and safer constructions, less energy consumption, greater comfort and better performance.

In modal analysis, a mathematical model of a structure's dynamic properties and behaviour is obtained, consisting of a set of modal parameters, each with a mode shape and an associated natural frequency and modal damping value. Experimental modal analysis finds these modal parameters by testing, and it can be performed as classical modal analysis or operational modal analysis.

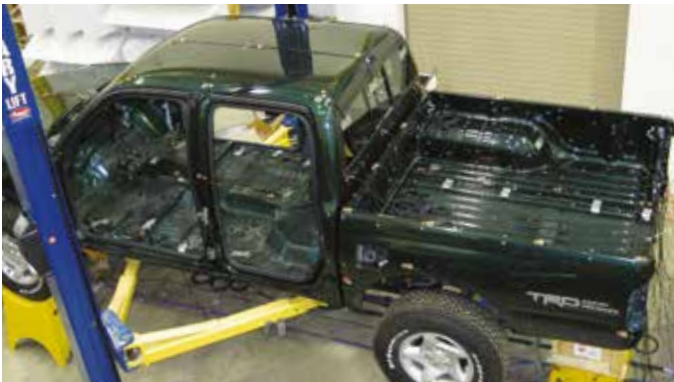
Classical modal analysis uses measured input forces and output responses from a structure to calculate frequency response functions, while operational modal analysis only measures output responses, as the natural ambient and operating forces are used as unmeasured input.

Classical modal analysis ranges from simple mobility tests with impact hammers to multi-shaker testing of large structures. The results are used in a vast range of applications including:

- Optimizing the dynamic properties and behaviour of structures
- Predicting the dynamic behaviour of components and assembled structures
- Predicting responses due to complex excitation
- Predicting effects of structural modifications
- Inclusion of modal damping in Finite Element (FE) models
- Correlation of test models with FE models
- Updating of FE models using test results
- Damage detection and assessment

Our comprehensive classical modal analysis solutions are expandable so they can grow with your requirements.

Modal analysis on a partly trimmed truck with engine, transmission, etc., using 3 modal exciters and 110 triaxial accelerometers

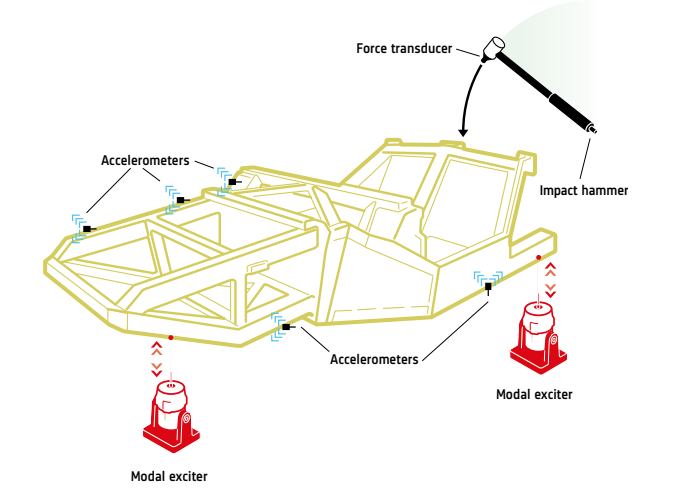
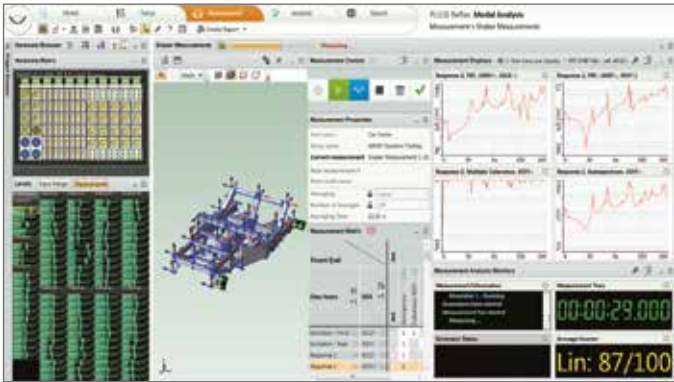


Entry-level configuration – single reference

8700, 8729-A, 8729-B, 8720-A, 2 inputs, 1 output

An entry-level configuration ideal for both impact testing and smaller size shaker testing. The complete process of setting up the measurements, executing and validating the measurements and performing the modal parameter extraction and validation is done within the PULSE Reflex Modal Analysis application.

PULSE Reflex Structural Measurements provides a unique GUI with geometry-guidance for setting up and controlling hammer and shaker measurements inside PULSE Reflex Modal Analysis



Standard configuration – single reference

8700, 8729-A, 8729-B, 8720-A, unlimited inputs, 1 output

As the previous configuration, but with more inputs for enhanced shaker testing capabilities and higher data consistency. More DOFs can be easily measured using multiple data sets with roving transducers.

Standard configuration – multiple references

8700, 8729-A, 8729-B, 8721-A, 4 inputs, 1 output

A configuration that enables users to solve cases with repeated roots and closely coupled modes by performing impact testing using a triaxial or multiple uniaxial accelerometers as references. Includes a targeted set of best-in-class mode indicator functions, curve-fitters and validation tools for producing quality results with maximum confidence.

Advanced configuration – multiple references

8700, 8729-A, 8729-B, New 8729-C, 8721-A, unlimited inputs and outputs

As in the previous configuration, but with the added functionality of performing stepped sine measurements and Multiple-Input Multiple-Output (MIMO) analysis. Ideal for testing large, complex and symmetrical structures in demanding situations such as those featuring weakly excited, heavily damped or local modes and for non-linearity studies and control.

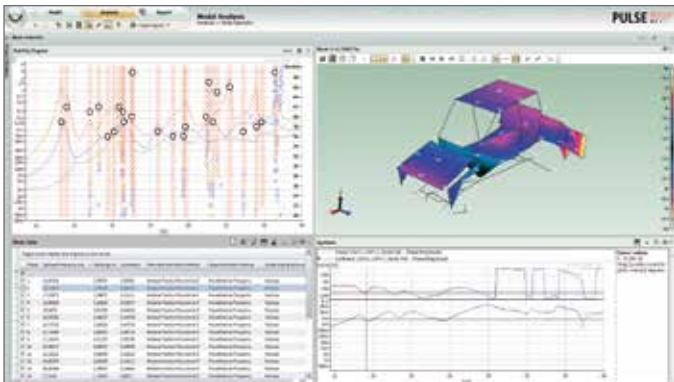
Videos:
PULSE Reflex
Stepped
Sine



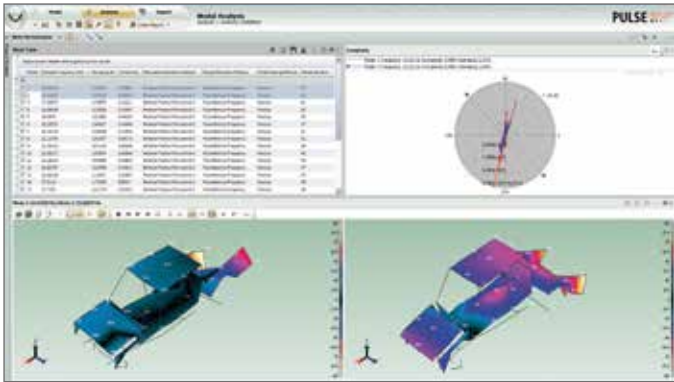
Videos:
PULSE Reflex
Structural
Dynamics



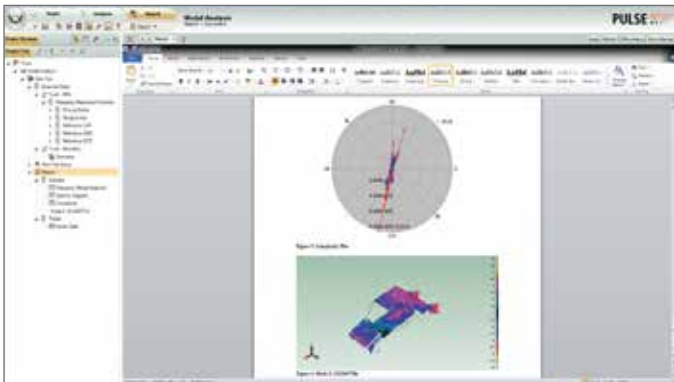
PULSE Reflex Modal Analysis ensures you always have the right curve-fitter at hand with low-order and high-order curve-fitters in the time and frequency domains



PULSE Reflex Modal Analysis guides you efficiently through measurement validation, parameter estimation set-up, mode selection, analysis validation, and reporting



Reports can be prepared in parallel with the analysis process, linking important results as they are produced. High-quality reports are easy to create in Microsoft® Word, Microsoft® Excel® or Microsoft® PowerPoint®



MODAL ANALYSIS – exciters and transducers

Our solutions cover the entire measurement and analysis chain including accelerometers and force transducers, impact hammers, modal exciter systems, data acquisition front ends and measurement, analysis and Test-FEA integration software.

Impact Hammers

8206 Hammer
8203 + 2647-B
8204
8207
8208
8210

Uniaxial Accelerometers

CCLD TEDS 4507-B

CCLD 4394

8001 + 2647-B x 2 Impedance Head

Triaxial Accelerometers

CCLD TEDS 4529-B

CCLD TEDS 4524-B

CCLD 4527

CCLD 4517

Shaker

8230 Force Transducer

UA-1607 UA-1608 Modal Exciter Stand

5961 Hand-held Exciter

Modal Excitation Systems

Modal Shaker

Power Amplifier

UA-1598 UA-1599 WZ-0066 Stinger Kit

Additional Accessories

4294 Calibration Exciter

DV-0460 Calibration Clips

DV-0459

UA-1478 Set of 100 Swivel Bases

UA-1480 Spirit Level

020226/7

Impact hammer guide

Type	Description	Max force [N, (lbf)]	Overall length [m, (in)]
8203	Force transducer/Impact hammer	1250 (281)	0.106 (4.2)
8204	Miniature impact hammer	220 (50)	0.122 (4.8)
8206	General purpose impact hammer	220 (50) – 4448 (1000)*	0.22 (8.72)
8207	Heavy duty impact hammer – One pound head	22.2k (5k)	0.30 (11.7)
8208	Heavy duty impact hammer – Three pound head	22.2k (5k)	0.39 (15.2)
8210	Heavy duty impact hammer – Twelve pound head	22.2k (5k)	0.90 (35.3)

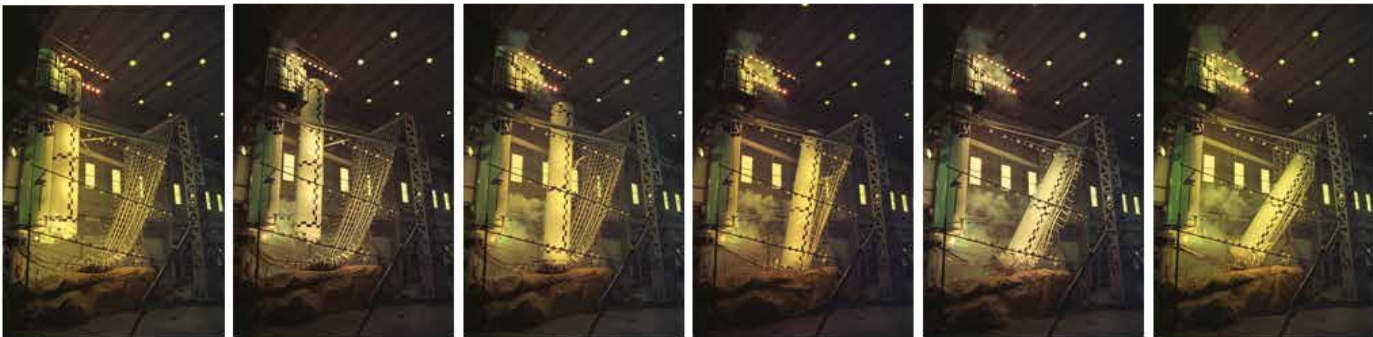
*Available in four different versions

Exciter guide

Type	Description	Max force [N, (lbf)]		Max displacement Pk-Pk [mm, (in)]
		Sine peak	Random RMS	
4808	Permanent magnetic vibration exciter	187 (42)	–	12.7 (0.5)
4809	Vibration exciter	60 (13.5)	–	8.0 (0.32)
4810	Mini shaker	10 (2.25)	–	4.0 (0.16)
4824	Modal exciter	100 (22)	70 (15)	25.4 (1)
4825	Modal exciter	200 (45)	140 (31)	25.4 (1)
4826	Modal exciter	400 (90)	280 (63)	25.4 (1)
4827	Modal exciter	650 (146)	420 (94)	50.8 (2)
4828	Modal exciter	1000 (225)	650 (146)	50.8 (2)

Table shows selected modal exciters only. Exciters above 1000 N are available. Modal excitation systems with matching power amplifiers are available.

SHOCK RESPONSE SPECTRUM ANALYSIS



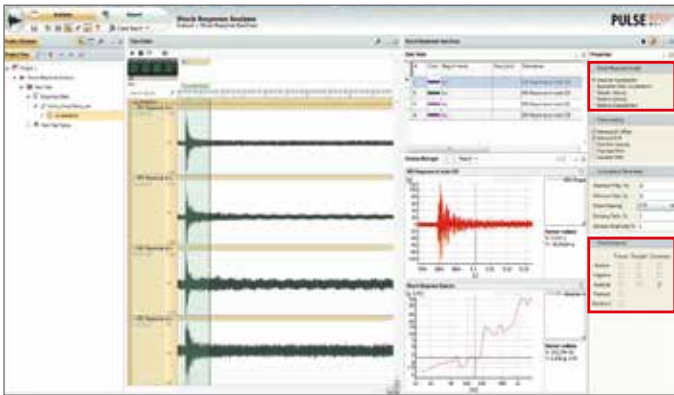
Separation testing

A single transient shock event such as a pyroshock or a structural impact can damage components in a structural system. Similarly, earthquakes can cause catastrophic failures in bridges and buildings. And with any motion input into a system, the response can be amplified by structural resonances, increasing the damage.

Shock Response Spectrum (SRS) analysis software computes the shock response spectrum from transients in the time domain. It converts motion input to a set of Single Degree of Freedom (SDOF) damped oscillator responses. The response amplitudes of the oscillators are plotted as a function of SDOF frequency to produce the shock response spectrum.

The frequencies are generally logarithmically spaced, typically with 1/n-octave spacing. The amplitudes of the SRS are derived from the individual SDOF responses (at user-defined frequencies) by taking the maximum response either during the primary shock event or during the residual response to the event. Most commonly, the overall maximum response is used, which includes both primary and residual responses, called 'maximax'.

All five of the SRS models mentioned in the ISO 18431– 4:2007 standard are available, and with these five SRS models and nine ordinary criteria for amplitude calculation (shock instances), you can configure up to 45 different response types to match your requirements.



Four time histories (left) with an SRS for the first time history

Shock Response Model

☒ Absolute Acceleration

☐ Equivalent Static Acceleration

☐ Pseudo Velocity

☐ Relative Velocity

☐ Relative Displacement

Five SRS models

Shock Instances

	Primary	Residual	Composite
Positive	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Negative	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Absolute	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Preshock	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Postshock	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Shock instances

Videos:
Shock
response
analysis



OPERATIONAL MODAL ANALYSIS



Operational modal analysis on a wind turbine blade using hammer excitation randomly in space and time. Only accelerometer responses are measured

Picture courtesy of SSP

In Operational Modal Analysis (OMA) only the output of a structure is measured, using the ambient and operating forces as unmeasured input. OMA is used instead of classical modal analysis for accurate modal identification under actual operating conditions, and in situations where it is difficult or impossible to artificially excite the structure.

Many civil engineering and mechanical structures are difficult to excite artificially due to their physical size, shape or location. Civil engineering structures are also loaded by ambient forces such as the waves against offshore structures, the wind on buildings, and traffic on bridges, while mechanical structures such as aircraft, vehicles, ships and machinery exhibit self-generated vibrations during operation. In OMA, these forces that would produce erroneous results in classical modal analysis are instead harnessed as input forces.

As OMA can be performed in situ during normal operation, set-up time is reduced and downtime can be eliminated. Adding further value, our OMA systems are also scalable, making both hardware and software easy to upgrade. Patents protect the core technology behind our OMA software, including the efficient and powerful Frequency Domain Decomposition (FDD), Enhanced Frequency Domain Decomposition (EFDD) and Curve-fit Frequency Domain Decomposition (CFDD) techniques.

OMA software is available in three versions – Basic, Standard and Pro, which differ mainly in the number of techniques they provide.

Calibrator

4294
Calibration Exciter

DV-0460

DV-0459
Calibration Clips

Miscellaneous

UA-1473 Set of 100 Swivel Bases

UA-1478 Set of 100 Swivel Bases

UA-1480 Spirit Level

2981 Tacho Probe

Uniaxial Accelerometers

CCLD TEDS 4507-B

CHARGE 4393

CCLD 4394

CCLD TEDS 8344

PR(DC) 457X

Triaxial Accelerometers

CCLD TEDS 4529-B

CHARGE 4326-A

CCLD TEDS 4524-B

CCLD 4527

Charge to CCLD Converter 2647-A/B/C

020234/5

OMA Basic

7770-N6, 7753, New 8760, 6 inputs

Entry-level configuration based on the efficient and intuitive Frequency Domain Decomposition (FDD) technique for quick and easy identification of natural frequencies and mode shapes. Ideal for small-scale and basic modal testing not requiring damping estimates. Includes Time and Spectral ODS analysis as well. More than six DOFs can easily be measured using multiple data sets with roving transducers.

OMA Standard

7770-N, 7753, New 8761-S, unlimited inputs

Standard configuration including Time and Spectral ODS analysis and the three frequency-domain techniques FDD, Enhanced FDD (EFDD) and Curve-fit FDD (CFDD). In addition to mode shape identification, the EFDD and CFDD techniques determine damping and give an improved natural frequency estimation with a minimum of additional user interaction. Includes automatic detection and removal of harmonic components.

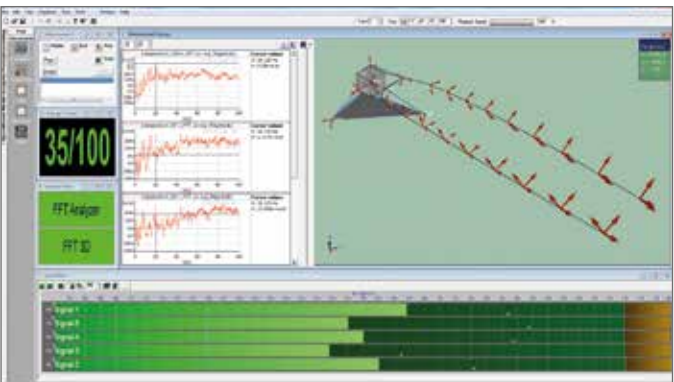
OMA Pro

7770-N, 7753, New 8762-S, BZ-8527, unlimited inputs

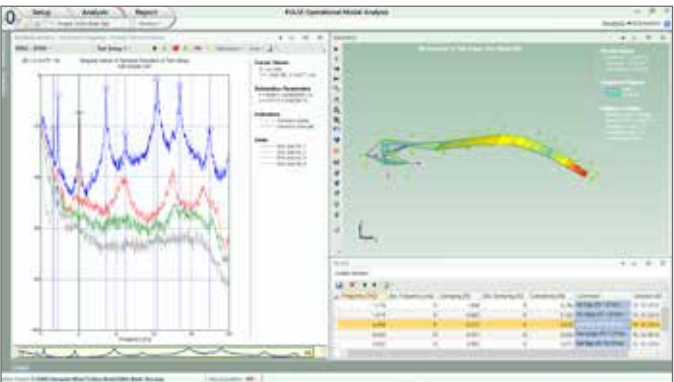
State-of-the-art configuration with the most powerful and accurate techniques available today, including Time and Spectral ODS analysis, three frequency-domain techniques (FDD, EFDD and CFDD) and four unbiased time-domain techniques based on Stochastic Subspace Identification (SSI). The crystal-clear SSI stabilization diagrams and automatic mode estimation make modal parameter estimation straightforward and robust. The Extended UPC (UPCX) SSI technique includes estimation of the modal parameters uncertainties for increased confidence in results. The configuration offers the best possible validation by comparing the results of the different techniques with each other.

With the BZ-8527 Batch Processing Option for OMA Pro, it is possible to perform SSI analysis on a large amount of time files without user interaction. The configuration is ideal for demanding large-scale modal testing.

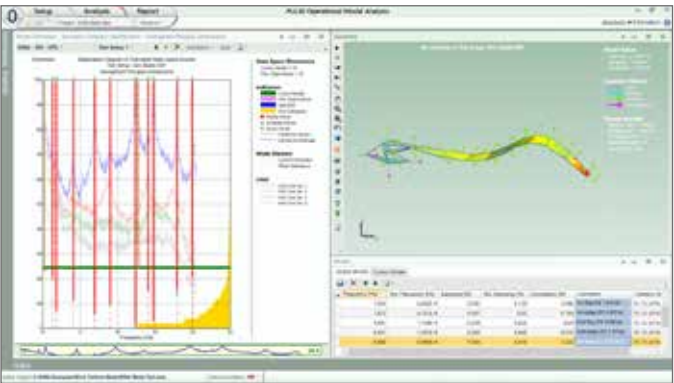
OMA Pro provides the basis for our Structural Health Monitoring solutions. See page 36.



PULSE Modal Test Consultant is used for geometry creation, geometry-guided data acquisition, measurement validation and seamless transfer of data to the OMA software for modal parameter estimation



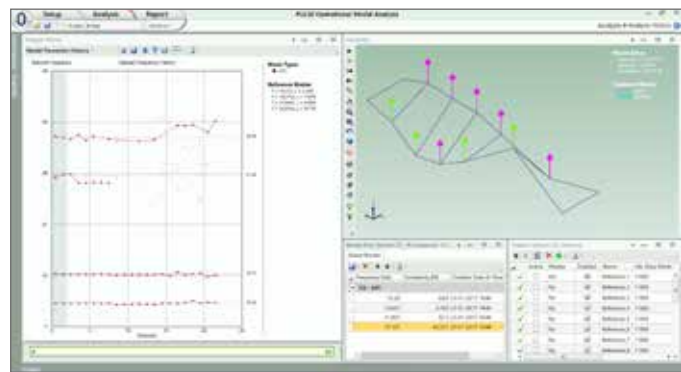
The peak-picking method used in the three FDD techniques lets you manually extract the modes using a fast snap-to-peak facility. Automated mode estimation is also supported



A special implementation of the SSI techniques produces crystal clear stabilization diagrams for easy selection (manual or automatic) of stable modes

STRUCTURAL HEALTH MONITORING

New



Mode tracking on a bridge.
The two first modes are not affected by the damage, but the 3rd and 4th are. The natural frequency for the 3rd tracked mode changes significantly as a function of analysis session and suddenly disappears. Animation of the 4th mode in session 22 (last session).



Damage detection on a bridge.
The 8 reference measurements of the undamaged bridge (green bars) stay below the damage threshold. The subsequent 14 measurements of the damaged bridge (red bars) all exceed the damage threshold. Reference state validation in lower display.

Structures degrade over time due to usage, harsh environmental conditions and accidental events. Using continuous, long-term Structural Health Monitoring (SHM) makes it possible to follow the structural state and determine the required health management of the structure such as organization of maintenance and repair.

SHM is a very important objective for end-users, manufacturers and maintenance teams as it:

- Allows for an optimal use of structures
- Minimizes downtime
- Can avoid catastrophic failures
- Helps improve the design of structures
- Helps optimize the organization of maintenance services

Consequently, SHM is increasingly used in a wide range of industries and academics including aerospace, space, wind energy and civil engineering.

Our SHM solutions are based on damage detection in the physical domain using state space models instead of in the reduced modal domain for highest possible accuracy.

- Structural Health Monitoring**
7770-N, 7753, BZ-8527, New 8762-S, New BZ-8550-53, unlimited inputs
Configuration for state-of-the-art Operational Modal Analysis (OMA) and Structural Health Monitoring (SHM). Includes:
- OMA measurement, analysis and validation using the most powerful and accurate techniques available today*
 - Support of multiple analysis sessions (measurements) for SHM
 - Historical measurement statistics such as min., max., median, mean, variance, skewness and kurtosis
 - Automatic measurement file upload and processing from a specific folder on a specific interval
 - Automatic mode tracking (natural frequencies, damping ratios and mode shapes) as a function of the analysis sessions
 - Classic and Robust damage detection indicators for long-term monitoring of structures. Both robust to changes in ambient conditions
 - Notification (alert) services such as visual, auditive, email and web services

*See OMA section on previous pages

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www.bksv.com/courses

OPERATING DEFLECTION SHAPES



ODS analysis is a very versatile application for determining the vibration patterns of machinery and structures under various operating conditions

Picture courtesy of Rolls-Royce Plc.

Operating Deflection Shapes (ODS) analysis determines the vibration patterns of a structure under given operating conditions. The vibration patterns are shown as animated geometric models of the structure that display a combination of the forcing function acting on the structure and the dynamic properties of the structure.

The forcing function depends on the operating conditions, which for machinery can be influenced by factors such as engine speed, load, pressure, temperature and flow. For civil engineering structures, ambient forces from wind, waves and traffic might also apply.

ODS analysis can be divided into three types:

- Time ODS – where the vibration pattern for an analysed frequency range is determined as a function of time
- Spectral ODS – where the vibration pattern is determined for specific frequency or order components
- Run-up/down ODS – where the vibration pattern is determined for specific frequency and order components as a function of rotational speed

Our scalable ODS systems provide complete guidance throughout set-up, measurement, validation and animation for each ODS type, and allow analysis in real-time or during post-processing of time histories.

Calibrator

4294
Calibration Exciter

DV-0460

DV-0459
Calibration Clips

Miscellaneous

UA-0801
Lightweight Tripod

WQ-2350
Engine Speed Sensor

2981
Tacho Probe

Uniaxial Accelerometers

CCLD TEDS 4507-B

CHARGE 4393

CCLD 4394

CCLD TEDS 8344

PR(DC) 457X

Triaxial Accelerometers

CCLD TEDS 4529-B

CHARGE 4326-A

CCLD TEDS 4524-B

CCLD 4527

Charge to CCLD Converter 2647-A/B/C

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Time and Spectral ODS

7770-N2, 7765-A, 2 inputs

Entry-level configuration especially suited for Spectral ODS using multiple data sets. Applicable for:

- Stable machine speed
- Analysing lower and/or well-separated spectral components

Order Analysis Type 7702 option is recommended in cases of slight instability and for analysing higher and close spectral components, in order to eliminate smearing.

Time and Spectral ODS

7770-N, 7765-A, unlimited inputs

This configuration allows simultaneous response measurements in more DOFs, offering additional advantages such as:

- Shorter test time
- Higher data consistency
- Time ODS in multiple DOFs

See comments on Order Analysis Type 7702.

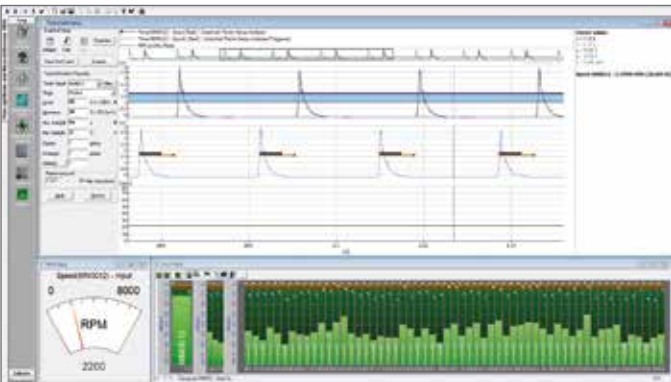
Run-up/down ODS

7770-N, 7702-N, 7765-B, unlimited inputs

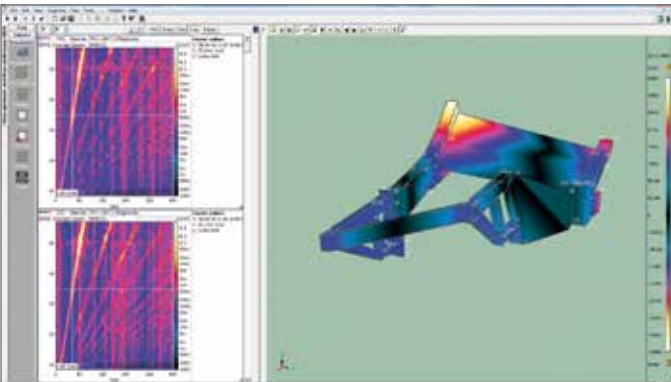
State-of-the-art configuration with the full range of ODS techniques: Time ODS, Spectral ODS (frequency- or order-based) and Run-up/down ODS analysis. Supports analysis of stationary, quasi-stationary and transient signals.

The configuration is ideal for advanced large-scale ODS analysis.

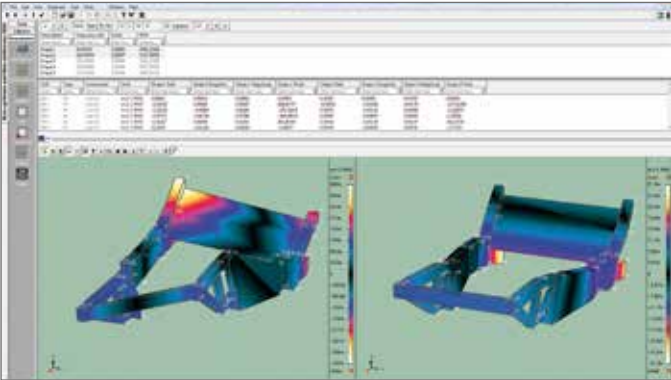
PULSE ODS Test Consultant incorporates time-saving tools to give maximum data reliability in the shortest possible test time. One example is the Graphical Tacho Setup for straightforward tacho detection



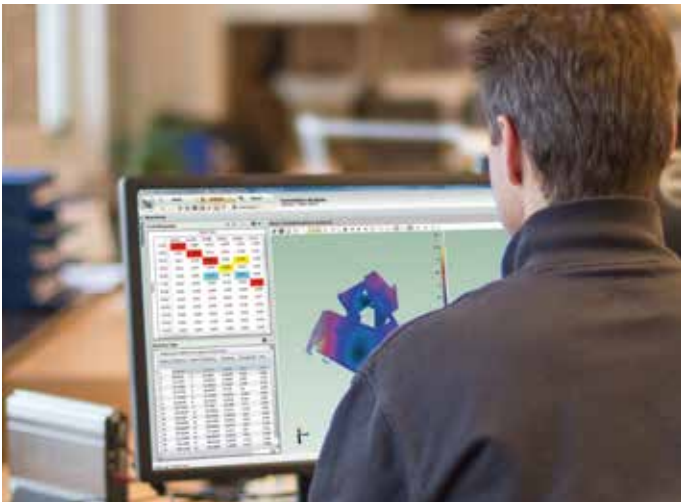
Run-up/down ODS analysis allows determination of the vibration pattern for frequency and order components versus RPM. Contour plots are available for easy detection and separation of orders and structural resonances



Shapes can be saved in a table in terms of acceleration, velocity and displacement. Different animation types and views are supported including side-by-side, overlaid and difference animation



TEST-FEA INTEGRATION



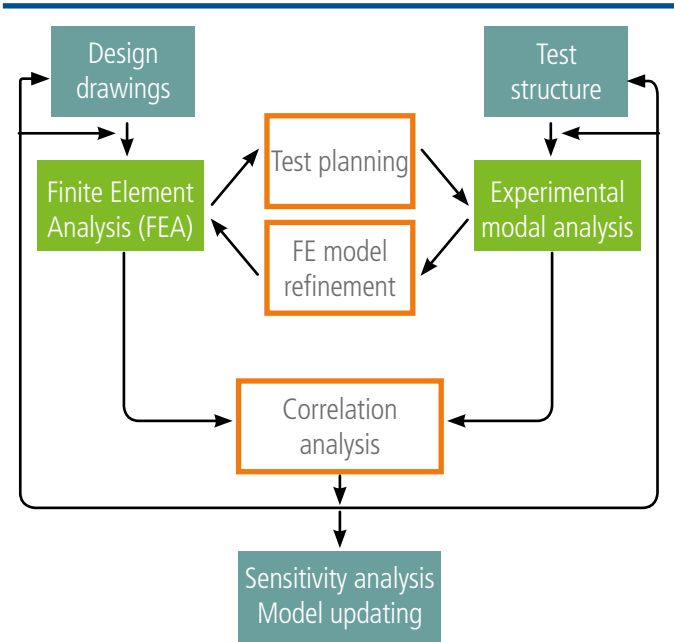
Using baseline FE models you can optimize your structural tests early in a project and then improve these FE models using the enhanced test results

Integrating testing and Finite Element Analysis (FEA) helps to cut development costs, reduces the amount of physical prototypes, and shortens the time from concept to production – all by optimizing strategies for testing structures and improving the development of Finite Element (FE) models. Using baseline FE models you can optimize your structural tests early in a project and then improve these FE models using the enhanced test results.

PULSE Reflex offers powerful tools to gain better confidence in the test and simulation results and to improve essential engineering judgement skills, benefitting test engineers, analysts and management.

With our PULSE Reflex Finite Element Interfaces software you can import FE models into PULSE Reflex Modal Analysis for performing test planning (pretest analysis) and test validation.

Using PULSE Reflex Correlation Analysis you can perform a complete correlation analysis of two modal models to identify shortcomings in modal tests and any areas of insufficient modelling quality in FE models. This helps to easily design optimal test conditions and evaluate different modelling strategies.



A schematic overview of test-FEA integration

Test planning and validation

8700, 8718, 8719, 8720/21

Using PULSE Reflex Finite Element Interfaces and PULSE Reflex Modal Analysis enables:

- Import and visualization of FE models from leading programs like NASTRAN® (MSC, NX, NEi), Ansys®, Abaqus® or as UFF files
- Animation of FE models to investigate frequency range of interest, mode density, mode order, critical modes, etc.
- Animation of FE models to select optimal excitation and response points and directions for modal testing
- Use of A-set from FE model to optimally select response test nodes
- Node selection on FE models while investigating how the AutoMAC builds up for the reduced geometry consisting of the selected nodes in order to optimally select response test nodes
- Decimation of FE models to accurate test models for modal testing
- Comparison of modal test results with FEA results

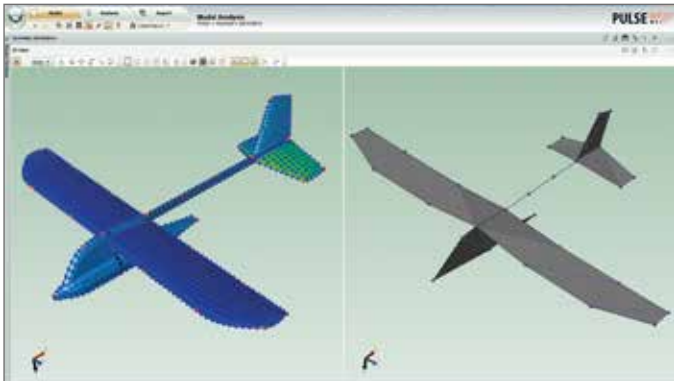
Model correlation

8700, 8718, 8719, 8722

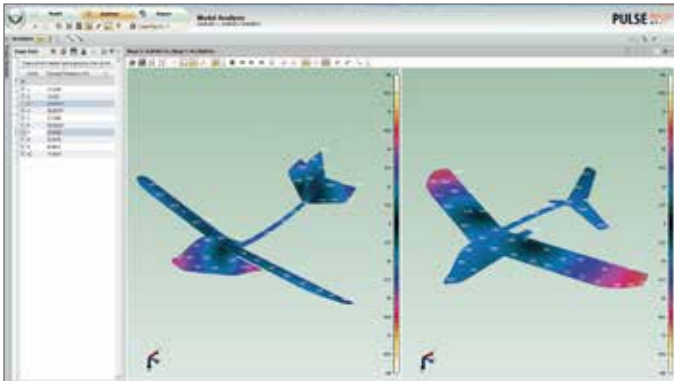
Using PULSE Reflex Correlation Analysis allows you to perform a complete visual and numerical correlation analysis of two modal models (test versus FE, test versus test or FE versus FE) including:

- Geometry alignment and DOF mapping between models
- Comparison of models based on mode table values and mode shape animations
- Mode shape correlations based on AutoMAC, CrossMAC, AutoOrthogonality and CrossOrthogonality calculations
- Mode pairing based on frequency, damping and mode shape correlations

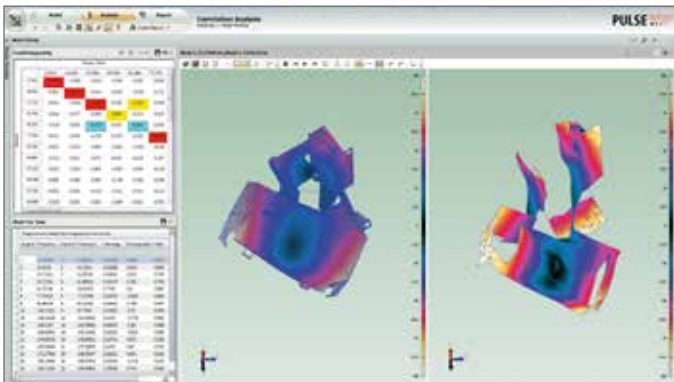
PULSE Reflex Modal Analysis: decimation of a FE model to a test model by selecting points on the FE model (manually, using A-set from FE model or AutoMAC method)



PULSE Reflex Modal Analysis: animation of FEA modes provides useful information for setting up and performing modal tests



PULSE Reflex Correlation Analysis: complete model correlation of test and FEA results



SOUND POWER



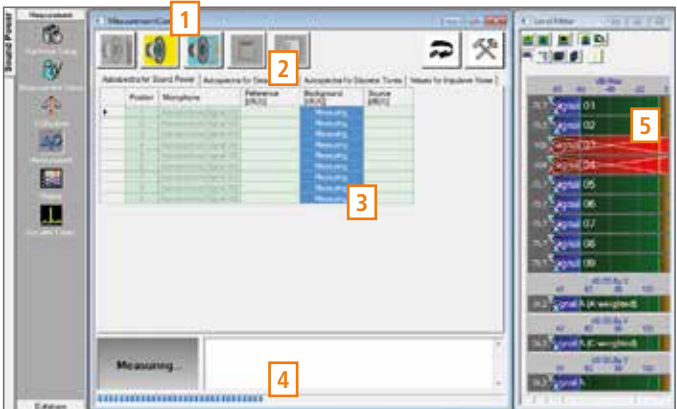
Learning about standardized methods for determining sound power at a Brüel & Kjær acoustics seminar



Video:
Sound power
on EU energy
labels

Standards supported

Free field	ISO 3744	ISO 7779
	ISO 3745	ECMA 74
	ISO 3746	EU 2000/14/EC
	ISO 3747	EU 2009/125/EC
	ISO 6393	IEC 60704-2-1
	ISO 6394	IEC 60704-2-3
	ISO 6395	IEC 60704-2-4
	ISO 6396	IEC 60704-2-14
Reverberation room	ISO 3741	
	ISO 3743-1	
	ISO 3743-2	
	ISO 3747	
Sound intensity based	ISO 9614-1	
	ISO 9614-2	
	ISO 9614-3	
	ECMA 160	



The graphic user interface is seamlessly integrated into PULSE LabShop

1. Icons and colour coding – the number of mouse clicks is reduced to a minimum
2. Simultaneous determination of sound power and emission sound pressure
3. Clear indication of the stage of the measurement procedure
4. Measurement progress bar
5. Indication of overload

Free field

7799

Enables the determination of sound power in essentially free-field environments according to relevant ISO standards, ECMA and EU Directives. Simplifies the EU required measurement procedure right up to the final report, in accordance with EU Directive 2009/125/EC. All household appliances sold in the EU, from vacuum cleaners to refrigerators, must feature an energy label including sound power information. For washing machines, for example, this must cover both wash and spin cycles.

Sound intensity based

7882

Enables sound power to be determined according to ISO 9614 parts 1, 2 and 3. Both the discrete point (part 1) and the scanning method (parts 2 and 3) are supported. The advantage of using intensity methods is that there are fewer demands on the test room and background noise; source localization and source ranking are also possible.

Earth-moving machinery

7883

Enables sound power determination of most types of earth-moving machinery under static and dynamic conditions.

Reverberation room

7884

Enables precision grade sound power determination to be made in laboratory class reverberation chambers. Engineering grade determinations can be obtained in special reverberation rooms; particularly useful for small noise sources.

Noise emission, outdoor machinery

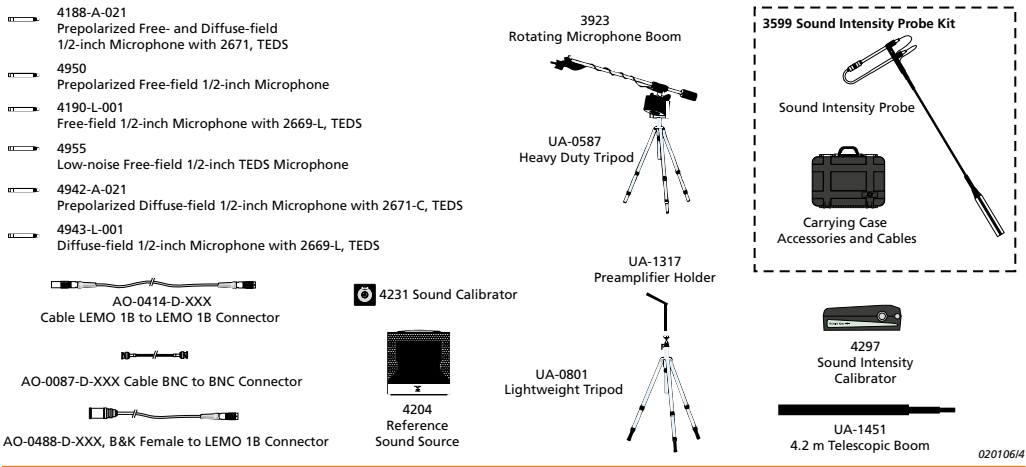
7885

Supports EU Directive 2000/14/EC. Helps manufacturers declare noise emissions according to ISO 3744, 3745 and 3746 as a prerequisite for placement on the EU market.

Fans

New 7886

Enables determination of sound power of fans and air-moving devices both at inlet and output. Supports ISO 3744, 3745 and 3746. Supports simultaneous testing in one, two or three room measurement suite.



Sound power and sound pressure level values used for labelling on a back hoe loader



Use of tablet for remote control of sound power for earth-moving machinery application



NSI – ARRAY-BASED



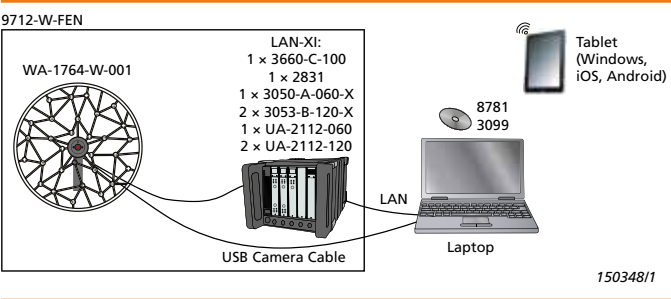
Reflex Acoustic Camera screen shot when used for troubleshooting on a hybrid motor

Noise Source Identification (NSI) techniques help to optimize the noise emissions of products and their components – on vehicles, aircraft, powertools, household goods, wind turbines and much more. Identifying the most important sub-sources of noise in terms of position, frequency content and sound power radiation helps decide where design changes can most effectively reduce overall noise radiation.

Array-based NSI provides the fastest measurement process and the highest quality results, and our range of arrays varies enormously in size and shape to suit the task at hand.

The three main array software applications are Acoustic Holography Type 8607, Beamforming Type 8608 and Spherical Beamforming Type 8606, which can all be enhanced with a large number of options. All calculation and post-processing is performed in the same user interface.

For a specific challenge, our customized project department will tailor an optimal solution, drawing on over 30 years' experience of designing and installing hundreds of array-based solutions. Whether the test object is a hearing aid mounted on a test bench, a high-speed train racing from city to city, or an aircraft flying overhead, Brüel & Kjær can provide a complete, turnkey solution.



Reflex acoustic camera

8781

Easy-to-use, hand-held troubleshooting tool. Measures and records acoustical maps with video. Wide range of frequencies using both SONAH and Beamforming based on Reflex Array Analysis. Transfer of data to array acoustics post-processing for further analysis.

Acoustic holography

8607, 7770-N, 7761, BZ-5635, BZ-5636, BZ-5638, BZ-5644

For measurements close to a source, this application provides fast and accurate acoustic maps of sound pressure, sound intensity and other sound-field parameters at low to medium frequencies (100 Hz to 2 kHz). Our patented algorithms 'SONAH' and 'ESM' allow accurate measurement with relatively small arrays without encountering edge effects. Acoustic holography also allows results to be calculated closer to and further away from the source, and the capability of the system can be augmented with an automatic positioning system, transient and quasi-stationary calculations and sound quality metrics. Wideband holography extends the use of holography far beyond the usual frequency range limit.



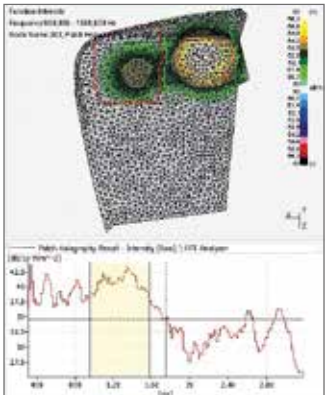
Video: Conformal mapping



Video: 132-channel array front panel connected in 3 seconds



Video: Reflex Acoustic Camera set up in 3½ minutes



A conformal sound intensity map of the ventilation vents on a vehicle console. Sound power contributions for the vents are shown

Array acoustics post-processing

Options		Spherical Beamforming 8606	Beamforming 8608	Acoustic Holography 8607
Quasi-stationary Calculations	BZ-5635	•	•	•
Transient Calculations	BZ-5636	•	•	•
Conformal Calculations	BZ-5637	•	•	•
Sound Quality Metrics Calculations	BZ-5638	•	•	•
Wideband Holography	BZ-5644		•	•
Refined Beamforming	BZ-5639	•	•	
Road Vehicles Moving Source Beamforming	BZ-5943		•	
Rail Vehicles Moving Source Beamforming	BZ-5939		•	
Wind Turbines Moving Source Beamforming	BZ-5941		•	
Panel Contribution	BZ-5640			•
Intensity Component Analysis	BZ-5641			•
In situ Absorption	BZ-5642			•
Plug-in Manager	BZ-5652	•	•	•
Proximal Holography	BZ-5963			•
Flyover Moving Source Beamforming	BZ-5940		•	

Patch holography

8607, 7770-N, 7761, BZ-5637, BZ-5640, BZ-5641, BZ-5642

Creates conformal maps of pressure, velocity, sound intensity or sound quality metrics at low to medium frequencies (150 Hz to 5 kHz), using a single- or double-layer hand-held array. The geometry of the source under test is obtained from either a 3D positioning system or an imported IGES or mesh model. For in-cabin applications such as inside cars, trains and aircraft, additional options can supply in situ absorption, intensity component analysis and panel contribution – all of which are two-step measurements requiring operational and FRF measurements.

Beamforming

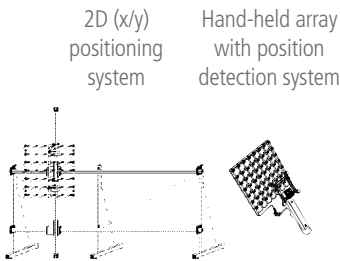
8608, 7761, 7770-N, BZ-5639, BZ-5644

An easy, one-shot measurement process for mapping the relative sound pressure and sound intensity contribution from a source. The solution is well-suited for large objects such as vehicles in wind tunnels, where the array is placed relatively far from the source, outside the turbulent airflow. The number of microphones in the array can vary from 18 to 144. An integrated camera provides simple and intuitive documentation. The refined beamforming techniques can be used to improve the spatial resolution, that is, CLEAN-SC, NNLS. Beamforming is valid for medium to high frequencies (500 Hz to 20 kHz). When used close to sources such as engines in a test cell, the patented wideband holography can be used to measure over a very wide frequency range. The addition of a transient option enables averaging in the domains of time, RPM and angle, making it ideal for powertrain analysis.

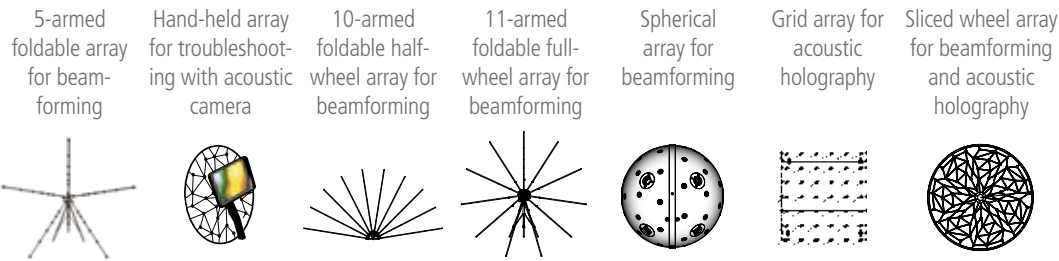
NSI – ARRAY-BASED



Positioning system



Microphone arrays



NSI spherical beamforming

8606, 7761, 7770-N

A quick method to map relative sound pressure and sound intensity arriving from all directions; ideal for in-cabin noise and leak detection. The array consists of 36 or 50 microphones distributed across the surface of a solid sphere, in which there are also 12 integrated cameras. The acoustical parameters measured over the surface of the sphere are then projected onto a 2D surface in the same way that information on a globe is represented on a flat map in an atlas. The algorithms used are 'SHARP' and our patented 'Filter and Sum' algorithm, which increases the dynamic range of the array and suppresses virtual images caused by sidelobes.

A low-frequency extension means that the system can be used over a wide frequency range.

NSI moving source beamforming

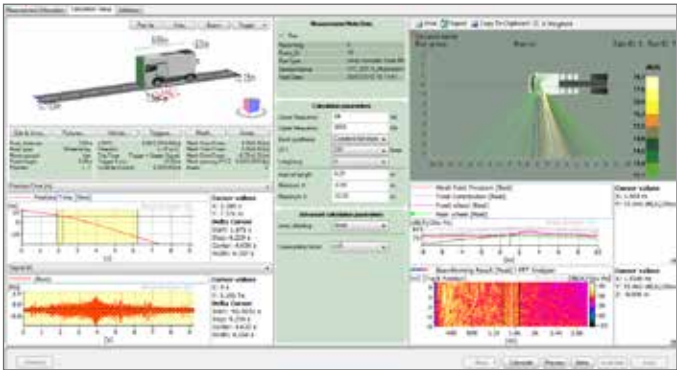
8608, 7761, 7770-N, BZ-5939, BZ-5941, BZ-5943

Maps moving noise sources such as lorries, trains, aircraft and wind turbines by detecting the direction from which sound arrives at the microphone array, using special measurement techniques, algorithms and array designs.

For measurements on wind turbines and aircraft during flyover we have developed dedicated solutions that meet the specific needs of our industrial partners, using large ground-based arrays.

The solution for road vehicles can be used alongside a standardized pass-by measurement, providing R&D engineers with immediate information on any test runs that exceed pass-by limits. Rail vehicle moving source beamforming provides an efficient troubleshooting and monitoring system for trains and trams.

Calculation set-up for PULSE Road Vehicle Moving Source Beamforming showing site set-up, a microphone signal and position profile



NSI – INTENSITY MAPPING



Learning the sound intensity mapping technique at a Brüel & Kjær seminar

NSI intensity mapping

7761, 7700-N2, 2 inputs for a sound intensity probe, 3 inputs are required for selective intensity measurements

Measurement and mapping of sound pressure, sound intensity and other directly measured sound field parameters.

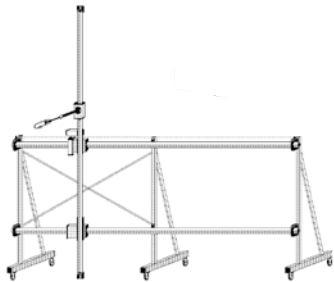
- Calculation of partial sound power for ranking of sub-sources
- Easy, geometry-guided measuring process
- Intuitive documentation using image overlay
- Expandable with:
 - Selective intensity mapping
 - Automated positioning system

Sound intensity mapping is a versatile tool to measure the magnitude and direction of energy in a sound field for a variety of applications such as determining sound power, sound absorption and sound transmission.

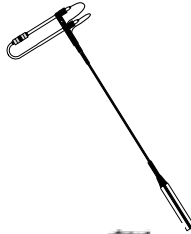
Sound direction and noise 'hot spots' can be quickly determined regardless of background noise, with visual and aural feedback during measurements allowing convenient, on-the-spot results for operational sound sources.

Colour-contour noise maps provide intuitive documentation and easy communication of results with others, and the selective sound intensity option can further identify the internal root sources and radiation mechanisms involved.

When measuring a large number of points, robotic systems can accurately automate microphone positioning, while for use on-site or inside moving vehicles we offer hand-held systems based on a sound level meter.



Two-dimensional positioning system for a sound intensity probe or array



A sound intensity probe with remote-control handle



The sound intensity front end LAN-XI module has a third input for a reference signal, a socket for the remote control, and a generator output for leak detection tasks

ACOUSTIC APPLICATIONS FOR WIND TURBINES

Result of sound intensity mapping from a beamforming measurement



The enormous growth of the wind turbine industry makes noise problems ever-more pertinent to personnel in design, R&D and production. We continuously develop solutions to address these new challenges, helping to optimize operation, increase product quality and simplify measurement procedures.

A uniform methodology to ensure consistency and accuracy in the measurement and analysis of acoustical emissions is provided by the international standard 'IEC 61400-11 Wind turbine generator systems: Acoustic noise measurement'.

Brüel & Kjær supports the standard with a complete system to determine sound power and tonality.

For manufacturers of wind turbine components, our sound and vibration systems ensure quality control in gearbox and generator test rigs, and our data acquisition and analysis systems are equally suited for on-site troubleshooting, production, and R&D facilities.

Improvements in acoustical array design and calculation algorithms have led to our current rugged, battery-operated systems that are ideal for outdoor use and quick to set up. Large, ground-based arrays for precision noise source identification help researchers and blade designers locate troublesome areas on full-scale test turbines.

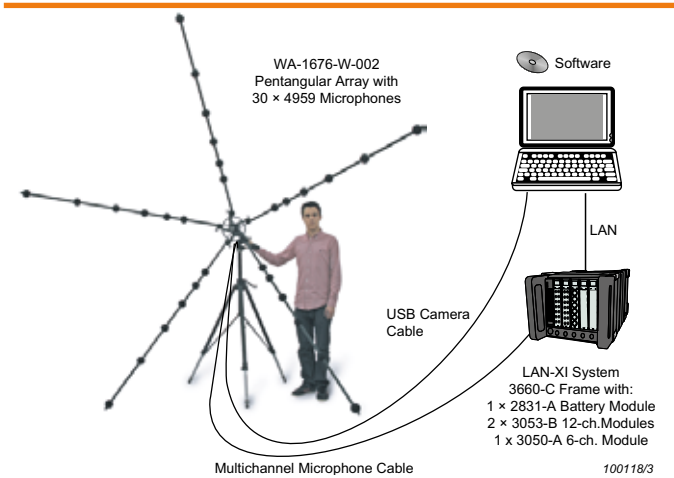
In wind tunnels, array technology is widely used on scale models, while our flat surface microphones are ideal for blade profile investigations.

Noise Sentinel

7871, Single or multiple inputs

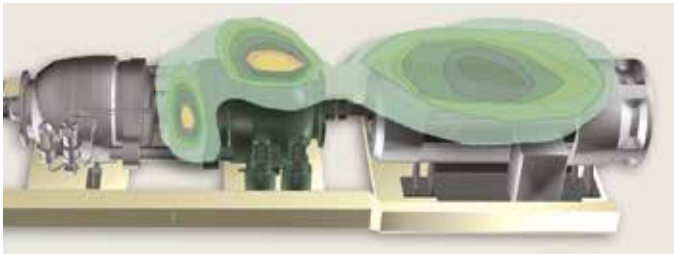
Permanent and semi-permanent solutions for gathering accurate data for planning and noise management of wind turbines and wind farms. Reliable data enables noise complaints and regulation compliance to be dealt with in a cost-effective manner.

- Web-based subscription solution
- Supply – we install and maintain the noise monitoring equipment
- Operation – we collect, verify and manage the noise data, sound recordings, weather data and video
- Presentation – we provide data that is ready to incorporate into site-specific compliance reporting



Pentangular array system for rapid outdoor beamforming measurements

Sound intensity map of a gearbox test rig



Wind turbine noise

7700, 7708, 7914, 1 microphone input

Dedicated solution supports IEC 61400-11 standard.

- Sound power
- Tonality
- Low-frequency noise, infrasound
- Full measurement report including wind turbine operating details, third-octave and octave spectra for sound pressure and sound power at the various wind speeds

Sound power of components

7700-N2, 7761, 2 inputs for sound intensity probe and 1 optional reference input

Sound intensity mapping system for measurement and mapping of sound pressure, sound intensity and other field parameters.

- Calculation of partial sound power for ranking sub-components
- Mapping of sound pressure, sound intensity and selective sound intensity
- Expandable with automated positioning system
- Standardized sound power determination using 7882

Small wind turbines

7700, 7708, 7915, 1 microphone input

Supports AWEA, BWEA and IEC 61400-11 Annex F.

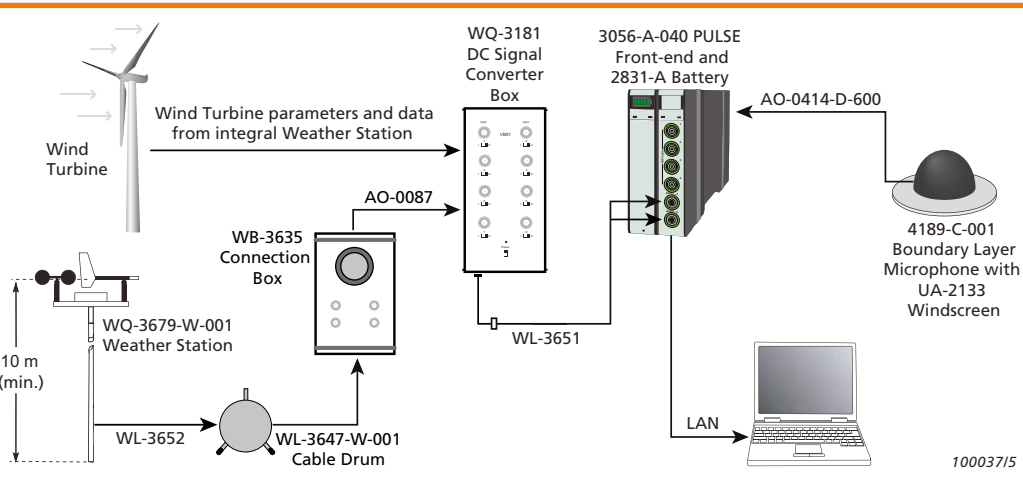
- Sound power
- Noise levels
- Emission map

Acoustical array systems

8608, BZ-5636, BZ-5638, BZ-5639, BZ-5941, 30 to 108 inputs for array microphones

Pentangular array for rapid outdoor beamforming measurements using delay-and-sum beamforming and refined beamforming for improved spatial resolution.

- Rugged and easy to use
- Mapping of sound pressure, sound intensity, loudness and other sound field parameters as a function of time
- Customized arrays for blade tracking
- Customized, large ground-based arrays for improved spatial resolution – to distinguish between the leading and trailing edge of blades



Set-up for small wind turbine noise measurements according to AWEA, BWEA and IEC 61400-11 Annex F

ACOUSTIC MATERIAL TESTING



Noise control materials can be tested in terms of their sound absorption and transmission properties in a plane wave tube to guarantee highly repeatable test conditions. This provides information of materials' acoustic properties for validating and calibrating computational methods used to predict the acoustic performance of multi-layer systems

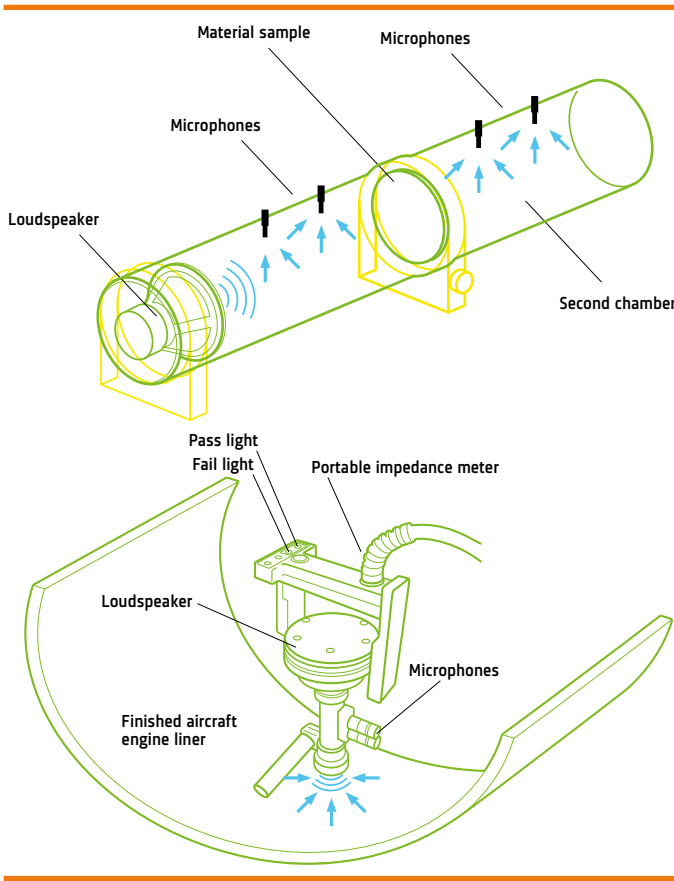
Growing focus on noise control issues combined with the emergence of sound quality in product design makes acoustic material testing increasingly relevant to engineers, designers and manufacturers from a broad range of industries.

Acoustic material testing is the process for determining the acoustic characteristics of materials in terms of absorption, reflection, impedance, admittance and transmission loss.

A range of standards covers acoustic material testing, prescribing well-defined acoustical conditions and special instrumentation to ensure accuracy and repeatability.

Our complete acoustic material testing systems make measurements on small samples according to ISO 10534-2, ASTM E1050 and ASTM E2611-10 international standards. They calculate transmission loss based on transfer matrix representation.

Simulation software can then help to predict the impact of specific noise control materials at an early stage in product development, once the acoustic characteristics of the materials are accurately known.



Single-sided

7770-N2, 7758, 2 inputs, 1 output

- Sound absorption coefficient and impedance measurements based on the two-microphone transfer-function method (ISO 10534-2 and ASTM E1050 standards)

Double-sided

7700-N4, 7758, 4 inputs, 1 output

- Normal incidence transmission loss and other acoustical properties
- Ratio of dissipated energy to incident energy
- Characteristic impedance and complex wave number
- Two-load transmission loss measurement method (ASTM E2611-10)

Portable impedance meter

9737

- Measurement of acoustic properties of engine nacelle liner and aircraft interior
- Turnkey system for easy operation during calibration, measurement and data export
- Measure at overall SPLs up to 150 dB
- Measurement viewable in real-time for easy monitoring
- Calculation of non-linear resistance variation with acoustic velocity
- Automated Pass/Fail Impedance Quality Control routine for use by non-acoustic specialists

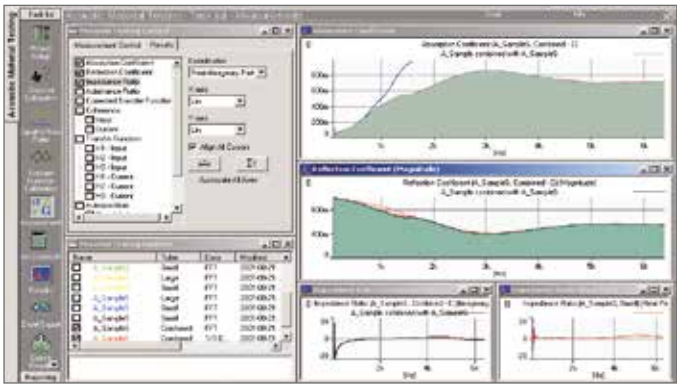
Road surface absorption

9740

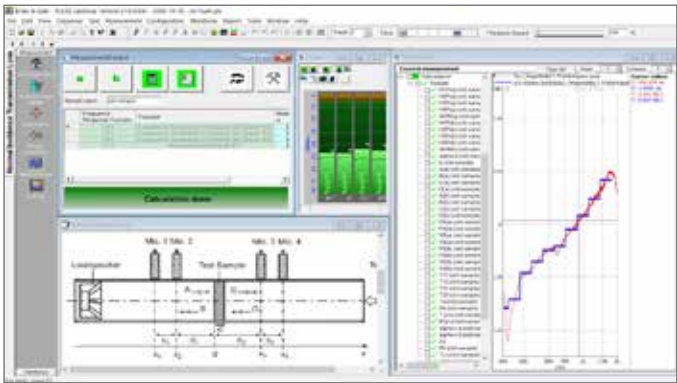
- Measurements if the acoustic properties of ISO 10844 designed test tracks according to the ISO 13472 test method
- Measurement of absorption coefficient, acoustic reflection and normalized impedance
- Based on two-microphone transfer function method

		Type 4206	Type 4206-A	Type 4206-T
Frequency range	50 – 1600 Hz	x		x
	100 – 3200 Hz	x	x	x
	500 – 6400 Hz	x		x
Standard	ISO 10534 – 2	x		
	ASTM E1050 – 08	x	x	
	ASTM E2611 – 10			x
Parameters	Sound absorption coefficient	x	x	x
	Reflection coefficient	x	x	x
	Acoustic impedance	x	x	x
	Acoustic admittance	x	x	x
	Transmission loss coefficient			x

* WA-1599-W-004 High Frequency Measurement Tube, usable frequency range 1kHz – 12.8kHz, also available

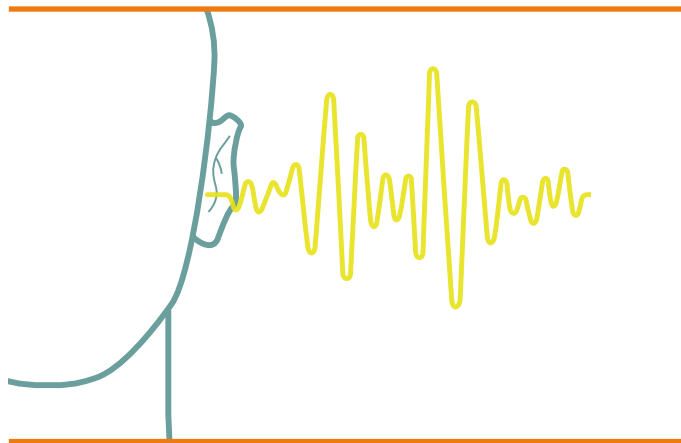


Typical results of absorption measurements



Transmission loss measurement

SOUND QUALITY



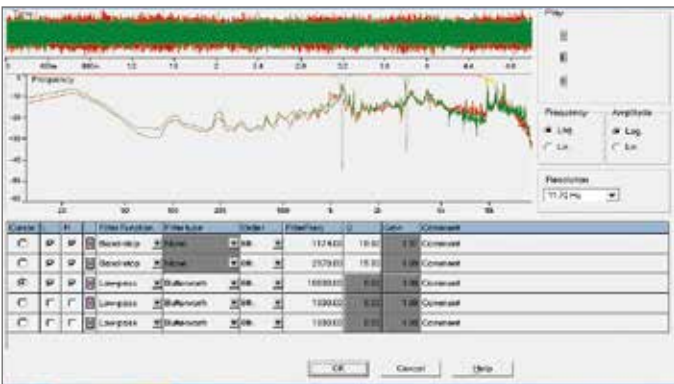
Consumers identify the sound of any product as a major component of its overall quality, and while sound quality has been important to the automotive industry for decades, it is now a primary concern for manufacturers of items as diverse as consumer appliances, office equipment, power tools, marine equipment, and heavy machinery.

Achieving desirable sound quality requires tools to identify those key characteristics of sound that correlate to consumer perceptions of quality. Jury evaluation tools then allow developers and consumers to experience and evaluate the sounds.

PULSE Sound Quality Type 7698 provides tools for recording, playback, analysis, comparison, modification and characterization, and it can be extended with the software options Zwicker Loudness BZ-5265, Order Analysis BZ-5277 and Psychoacoustic Test Bench BZ-5301.

Automotive Sound Quality Bundle BZ-6047 contains an extensive tool set for recording, analysing, auditioning, dissecting, and synthesizing sounds, and enables objective and achievable sound quality targets that are specified in engineering terms.

Starting a new family of sound quality software, PULSE Reflex Sound Quality Metrics Type 8710 offers a full suite of metrics integrated into the high productivity PULSE Reflex Core environment.



PULSE Sound Quality Software Type 7698 provides many ways to edit or modify sound signals. You can listen to the change in sound immediately after modifying it

Binaural recording

7698, BZ-6047, 7708, LAN-XI

Multichannel, 160 dB dynamic range recording with Time data recorder Type 7708 and PULSE LAN-XI data acquisition hardware.

- 2 sound channels + 2 tachometer channels via sound card (Type 7698/BZ-6047)
- Head and Torso Simulator (HATS) Type 4100 or Binaural Microphone Type 4101-A for ultra-realistic binaural recording

Interactive evaluation

7698, BZ-5265, BZ-6047

- Analyses signals in time and frequency domains
- Plays back sounds and compare sounds back-to-back
- Modifies sounds with filter types: high-pass, low-pass, band-pass, band-stop, notch and more
- Order-based analysis and filtering
- In Automotive Sound Quality Bundle Type BZ-6047, advanced tools include interactive playback displays, drag-and-drop-filtering, and transient analysis

Metric calculation

7698, BZ-5265, BZ-6047, 8710

- Metrics include loudness, sharpness, roughness, fluctuation strength, tonality, prominence and tone-to-noise ratio
- Binaural loudness; Moore-Glasberg model (Type 8710), Robinson and Whittle (Types 8710 and 7698), for mean loudness between ears
- Concurrent spectral and overall broadband analysis
- Batch processing of multiple sound recordings (Type 8710)

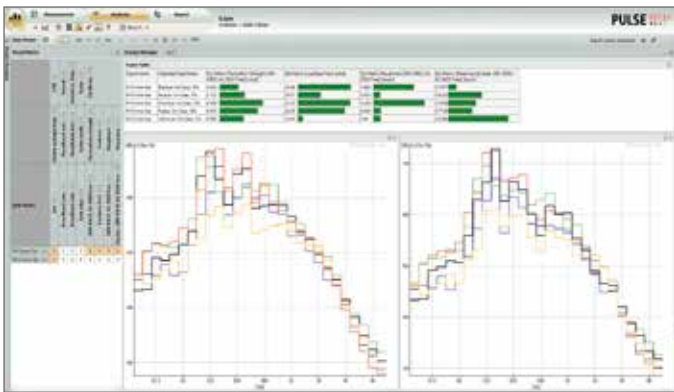
Jury evaluation

BZ-6054, Options: BZ-6055, BZ-6056

Jury evaluation is an easy method of measuring human responses to sound characteristics, and is available for use in both individual and group jury evaluations. It enables sound characteristics to be controlled precisely, record responses, detect errors in real-time, and analyse responses.



Interactive filtering, as shown here in BZ-6047, is an integral part of basic sound quality engineering

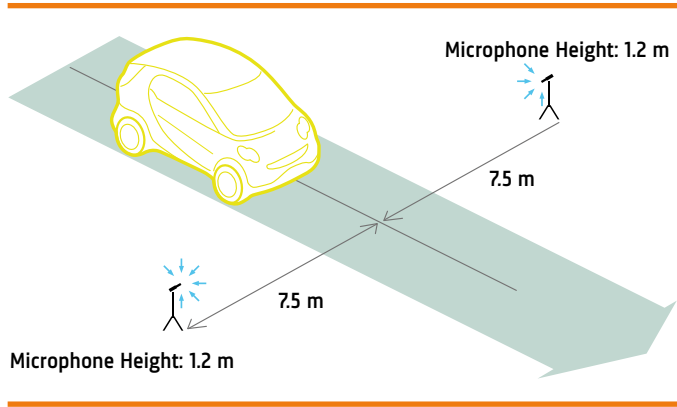


Sound quality metrics calculations are integrated into the standard workflow of PULSE Reflex alongside overall, 1/n-octave, FFT and order analysis



Subjective assessments are captured in jury evaluations to measure human responses to sound

VEHICLE PASS-BY NOISE TESTING



Certifying that vehicles comply with noise emission specifications requires measuring according to procedures defined by international standards. These specify a test of powertrain and tyre/road noise under typical urban traffic conditions, putting stringent demands on pass-by and coast-by noise testing.

Test equipment must support the specialized measurement methods and validate the defined values dictated by the test standard.

Our solutions cover the full spectrum of pass-by testing – from simple conformance testing to multichannel diagnostics. All of our pass-by solutions (outdoor or indoor) support the most common international standards, including ISO 362, SAE J1470, ISO 13325 and ISO 5130.

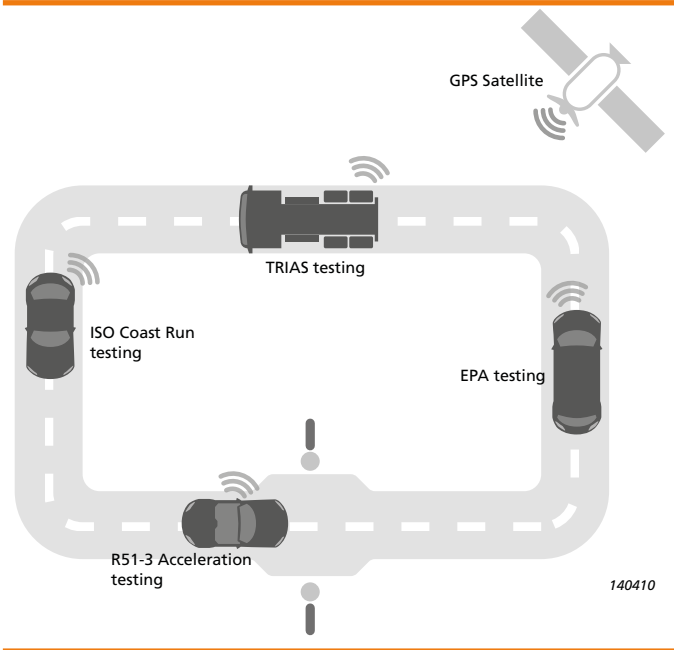
In addition, our beamforming array selection provides outdoor sound mapping, helping to accurately locate the sound sources that contribute to the vehicle’s sound.

Ground system

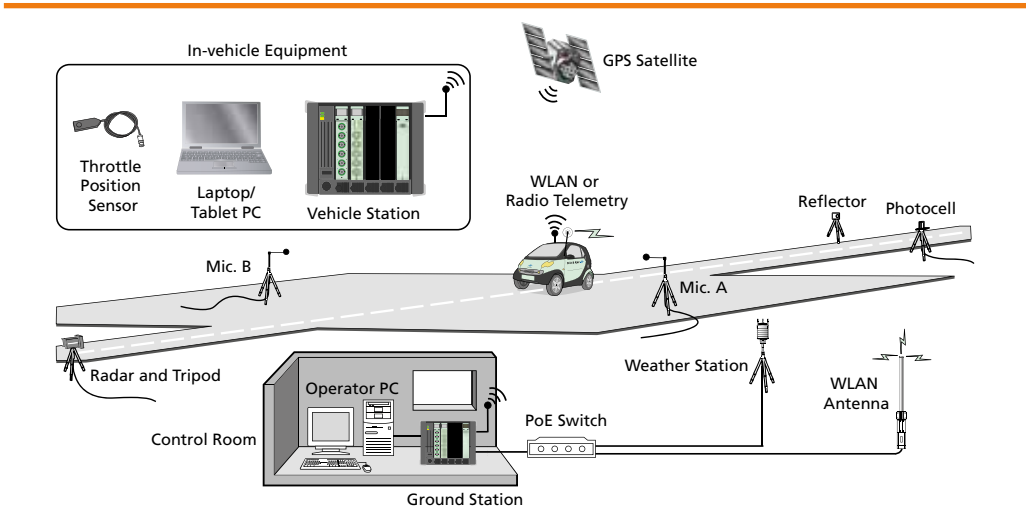
7788-G

The Ground Station measures exterior pass-by noise using two microphones placed on both sides of the test track. Vehicle speed, absolute position reference, and meteorological conditions are measured as well.

The Ground Station is compulsory in all pass-by configurations.



Multi-vehicle testing with various vehicle measurement schemes



Overview of a PULSE Vehicle Pass-by system (multi-vehicle set-up)

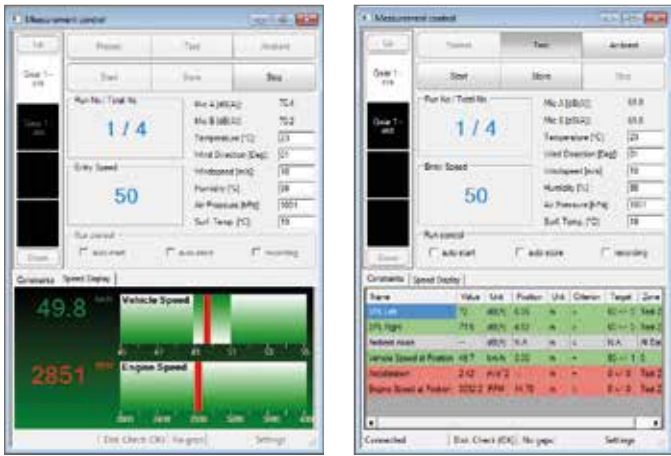
Vehicle system

7788-V

The Vehicle Station measures in-vehicle data such as engine RPM, noise and vibration, and other optional parameters like vehicle speed and CAN signals.

Vehicle Stations are only required in some pass-by configurations.

- Uses:
- System for pass-by measurements including exterior noise measurements such as tyre and exhaust noise
 - Single and multi-vehicle testing
 - Real-time acquisition of noise levels, vehicle position, velocity, RPM (optional), and weather station data (optional)
 - Single-person operation
 - Scalable solution
 - User-definable calculations of final result to adapt to different standards and regulations
 - Data-centric solution for organizing all aspects of the measurement
 - Export of results in common data formats
 - Advanced graphical displays with live cursor functionality when embedded in Microsoft® Office applications
 - Easy configuration of customized procedures including modifications to international standards
 - Advanced reporting to Microsoft® Word and Excel®
 - Storing of raw time data documented, including metadata



Two examples of the Measurement Control's Drivers Aid interface

INDOOR PASS-BY NOISE TESTING

Measuring a vehicle's interior and exterior noise during operation is far simpler indoors, using large hemi-anechoic chambers containing chassis dynamometers – as many automotive manufacturers and sub-suppliers do. Eliminating variables such as weather and site variations makes measurements more reproducible, while the stationary vehicle allows more instrumentation.

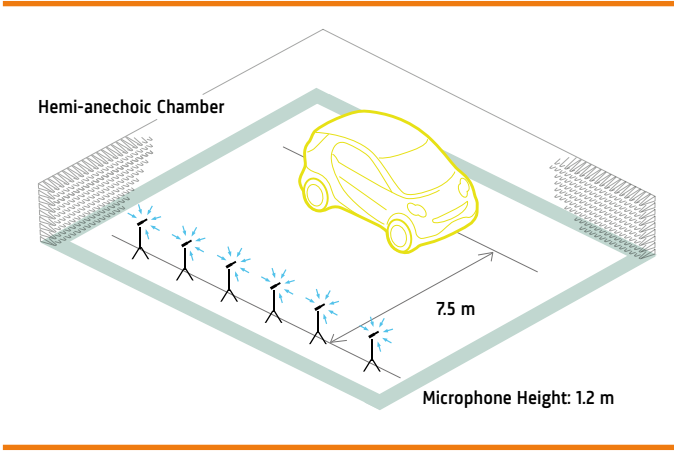
Simulation of normal pass-by noise is achieved by placing a row of microphones alongside the test vehicle so that there is no need to drive the test vehicle past stationary microphones, as is standard in a conventional outdoor pass-by measurement. Instead the vehicle is accelerated in the same way on a chassis dynamometer.

Simultaneous recordings are taken of a tachometer signal from the dynamometer, the vehicle's exterior noise at all microphone positions, and any additional vehicle parameters. Tyre noise correction then assists accurate comparisons with field pass-by measurement results.

Smaller rooms that lack the spatial dimensions dictated by the current ISO 362 pass-by standard are also suitable environments for indoor pass-by testing. Even where the required 7.5 m width from the vehicle centre-line and more than 20 m length will not fit in an anechoic room, our software accurately extrapolates the measurements.

The time-domain-based calculations enable Doppler-effect correction, as well as audible playback analysis with recorded and synthesized signals – helping you to quickly identify areas of interest.

The measurement and calculation procedure satisfies the ISO 362 pass-by standard and is ready for the new standard that will replace it, which will make indoor pass-by noise testing a standard conformance test alongside field pass-by testing.



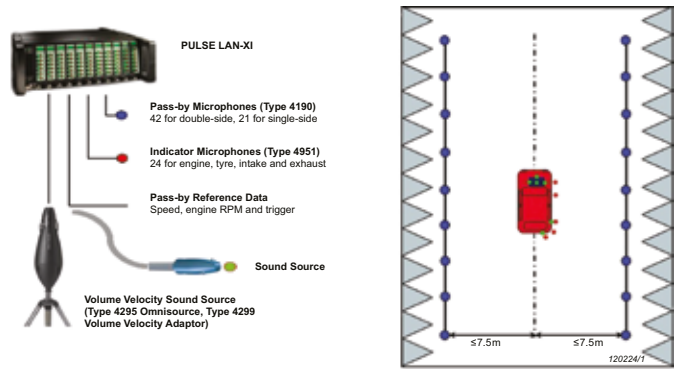
Indoor pass-by test

7700-N, 7793

- Simulation of vehicle pass-by noise testing in hemi-anechoic rooms for product development and troubleshooting.
- Test set-up can be created in Microsoft® Excel® and later imported into the system
 - Support of non-optimal room size through flexible definition of microphone array
 - Simulation of Doppler effect
 - Tyre noise correction allows substitution with tyre noise measured on the test track
 - Pass-by values automatically calculated upon completion of measurement
 - Exterior noise contribution analysis is available with indicator microphones and volume velocity sound source
 - Full range of pass-by measurements according to ISO standards, as well as in smaller rooms with microphone array modifications
 - Tree architecture, with only a few mouse clicks required from set-up to results
 - Results can be viewed immediately after the measurement
 - Indoor pass-by results can be shared with the outdoor pass-by; exterior noise contribution can also be shared with the SPC result: both under an evaluation procedure with understandable results

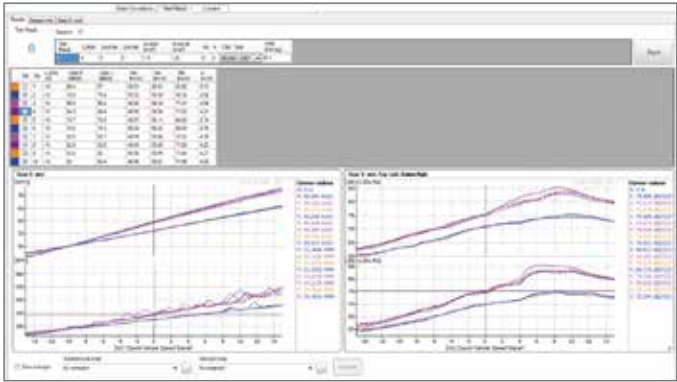
Exterior noise contribution analysis

- Calculation of exterior noise contribution in time-domain from the various noise sources.
- Sum of contributions may be compared with the measured total level to validate the component contributions
 - Source modelling of components such as engine, transmission, exhaust/intake, tyres
 - Contribution results may be exported to Microsoft® Word or Microsoft® Excel® for further analysis and reporting

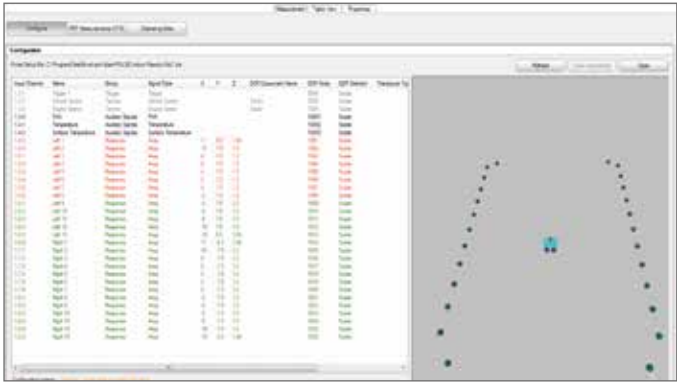


System configuration for indoor pass-by and exterior noise contribution analysis

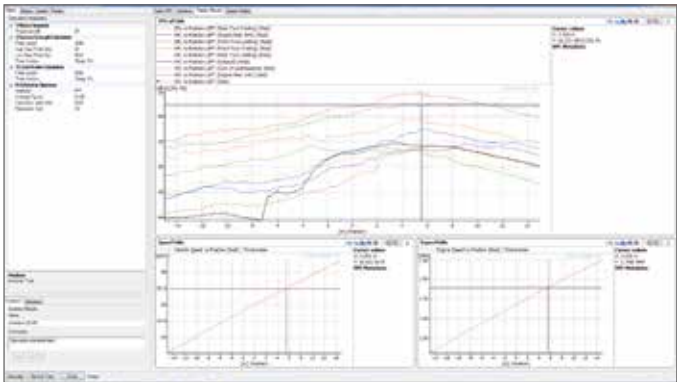
The typical test result of indoor pass-by: vehicle speed, engine RPM, SPL for both sides, together with Table view



The microphone array for indoor pass-by set-up can be configured in Microsoft® Excel® and then imported



Exterior noise contribution results of individual sound source components



NVH SIMULATOR

The NVH simulator family of products enables virtual NVH prototyping and allows experiencing of the NVH characteristics of vehicles, real or virtual, through accurate reproduction of the sound and vibration in a realistic, interactive driving environment. Data from a wide range of test and CAE sources can be synchronized and mixed in a real-time driving scenario.

Set, control and achieve your NVH targets with confidence. Faster, more certain decision-making throughout a vehicle development program is realized with the NVH simulator products, from competitor evaluation and concept design through target cascading and component evaluation to final sign-off and production optimization.

Engineering vehicle sound to match brand and customer expectations is assisted with a range of jury evaluation and engineering interfaces that allow assessors and engineers to collaborate and interact with the NVH data in real time.

PULSE NVH vehicle simulator versions

- Insight – Entry level NVH simulator for fixed test condition, no free-driving. It requires no specialized hardware to use
- Desktop NVH simulator – Adds interactive driving and experience of virtual vehicles using a steering wheel, pedals, gear shift lever/paddles while comparing, modifying, and designing the sound of the vehicle
- Full-vehicle NVH simulator – Adds the vibration dimension to the NVH experience while driving in a stationary real vehicle
- DTS On-road simulator – Transfers the functionality of the Desktop NVH simulator to a real vehicle driven on the road for a truly immersive experience
- VSound – A hardware device that allows the assessment of virtual sounds through the infotainment system in a real car and synchronized to the engine/road speed through CanBus
- DTS Exterior Sound simulator – Design the exterior sound of the vehicle and assess the vehicle sound in a number of different exterior soundscapes from the viewpoint of a pedestrian.



The NVH desktop simulator allows sound from vehicles, components, target levels and CAE data to be accurately evaluated in an interactive, realistic environment

Insight

8601-S

Insight allows you to play back, analyze and modify time-domain data, typically SPC results from test or CAE. It allows in-depth, root-cause analysis, changes to source levels and path sensitivities to reflect possible design changes, sets target levels and compares measurements side-by-side.

Desktop NVH simulator

3644, 8601

Data preparation software enables NVH and vehicle performance data to be extracted from recordings made on the road, a test bench (or any other source of NVH data) and prepared for free driving in an NVH simulator. Available modules include:

- Core and visuals module – enables the user to configure data into vehicle models, build virtual vehicles for assessment, choose which vehicles to compare in a test
- Jury evaluation module – structured jury evaluation of sound
- Engineering module – modify and save individual sounds representing components of the vehicle



The DTS On-road simulator is used for back-to-back evaluations of benchmarked vehicles or proposed targets, while driving a real 'mule' vehicle

Exterior sound simulator

8601-T

Exterior sound simulator utilizes the powerful capabilities of the NVH simulator for sound creation, modification and evaluation, and applies these to exterior vehicle sound. Ideal for EV/HEV pedestrian sound warning development or exterior sound quality development.

DTS on-road simulator

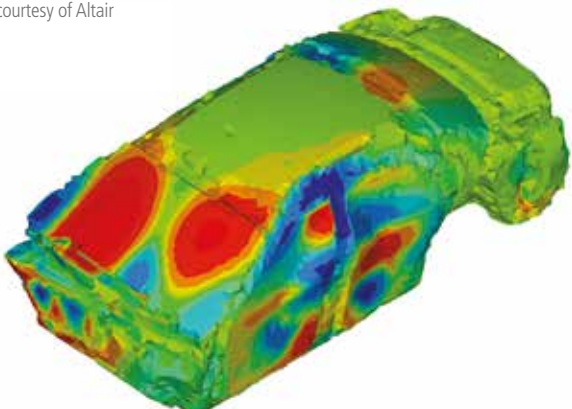
8601-N

DTS on-road simulator allows vehicle sounds created using the desktop NVH simulator to be experienced in a real car while driving on the road. The sounds of the existing vehicle are modified rather than replaced, resulting in a very natural presentation of the target sounds.



Video: NVH vehicle simulator

Picture courtesy of Altair



The CAE Auditor makes it straightforward to include CAE data in the interactive evaluation process in the simulator

SimSound

8601-U, 8601-W

SimSound is used to upgrade the audio performance of third-party driving simulators to the standard of the NVH simulator. In addition to enhancing realism, it gives unsurpassed flexibility in acoustic dynamics that match the driver's actions exactly.

DTS CAE Auditor

8601-X

DTS CAE Auditor quickly incorporates source strengths and transfer functions from common CAE programs into interactive NVH simulations that everybody can experience in the right context seamlessly mixed with test data.

A variety of visual road scenarios can be selected. Custom scenarios featuring real-world test tracks and roads can be easily created

Real-time spectral analysis, modification, and recording of subjective preference (and the driver's actions) are always available while driving and interacting with sound contributions

TIME-DOMAIN SOURCE PATH CONTRIBUTION

How will each component contribute to the overall sound of a product? How can you tell where the sound is coming from? How does it travel to where you hear it? And what can you do to improve the sound of the vehicle?

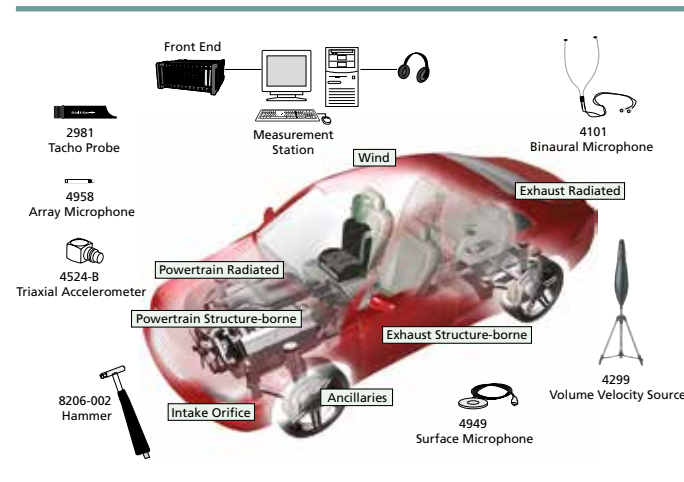
Whether assessing the contributions of an engine on a test bed, or identifying operational contributions on the road, Time-domain Source Path Contribution (SPC) allows you to assess transfer paths and contributions to quickly evaluate the noise and vibration perceived by vehicle occupants.

Our unique time-domain technology allows you to listen to and compare data sets back-to-back, and assess the effects that developments will have on the final products through SPC models. The system can also inspect data in the frequency domain, giving great flexibility.

Understanding how noise and vibration is transmitted through different paths in and around the vehicle allows you to rank contributions using various NVH methods such as mount-stiffness and impedance matrix methods for structure-borne NVH, and source-substitution for airborne NVH.

Using data recorded in the time domain means you can solve any potential problems during analysis from a safely captured data set, while you are listening to or evaluating the calculated time signals.

SPC also offers a bridge between real-world experimental data and analytical data generated from CAE models. Combine test and CAE results in SPC to produce hybrid models or virtual prototypes. Use Insight to experience the results of experiment, hybrid or purely analytical CAE-based SPC data through interactive playback and analysis of the results.



SPC viewer

7798-A

General base license for all SPC methods.

SPC mount stiffness and impedance matrix methods

7798-B

Frequency-domain structure-borne and airborne contribution analysis (mount stiffness and impedance matrix). Post-processing analysis of contributions, source strengths and path sensitivities.

SPC matrix method with principle component decomposition

7798-C

Frequency-domain quantification of non-correlated contributions to the receivers. Identifies source strengths of airborne sources via microphone indicator positions and the use of principal component analysis to derive proper acoustic source models.

SPC multiple coherence method

7798-D

The SPC Multiple Coherence module allows the quick assessment of contributions from multiple uncorrelated or partially correlated sources, such as tyre noise in a vehicle.

Time-domain SPC

7798-E

Time-domain SPC calculates contributions, source strengths and forces using matrix inversion, source substitution and mount stiffness methods in the time-domain. The time-domain SPC results can be replayed and viewed in the SPC software. Typically they are analysed using SPC Insight to rapidly evaluate, analyse, modify, compare and communicate the results. They can be further analysed using PULSE Reflex to quickly and efficiently view orders, spectra, waterfall spectra, compare source and contribution levels, and generate test reports. The time-domain results can also be used in the Desktop NVH simulator as part of a fully interactive driving simulation.

Insight

8601-S

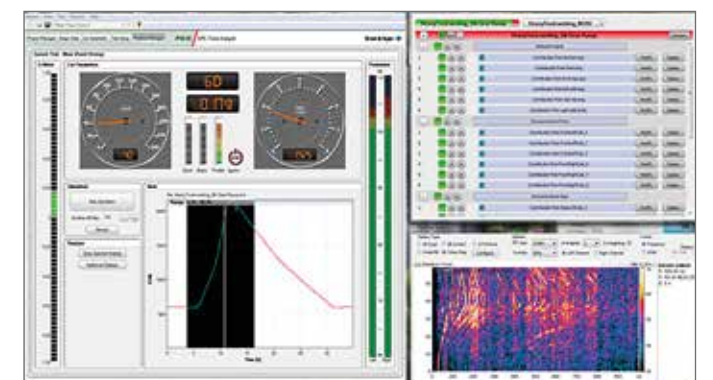
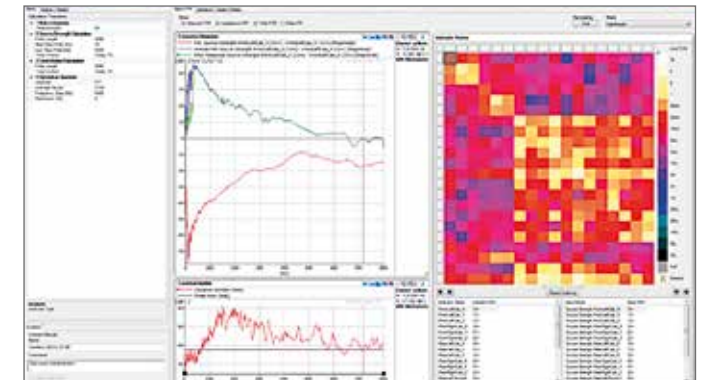
Insight allows you to play back, analyse and modify time-domain SPC results. It performs in-depth root-cause analysis, changes source levels and path sensitivities to reflect possible design changes, sets target levels, and compares measurements side-by-side. Users can observe and analyse data in real-time or off-line, and easily evaluate and communicate results.

DTS CAE auditioner

8601-X

The DTS CAE auditioner quickly incorporates source strengths and transfer functions from common CAE programs into the Insight evaluation tool.

- Import CAE design alterations into the CAE Auditioner and evaluate them in Insight
- Calculate change filters as the ratio of two CAE-based models and apply them to test-based models for early evaluation of CAE design changes



ANGLE DOMAIN ANALYSIS

Rising fuel costs and growing environmental concerns put pressure on manufacturers to develop higher efficiency engines and powertrains with lower emissions. This development direction would traditionally lead to lower horsepower and degraded NVH performance:

Tougher emissions legislation

- In existing engines, this can result in higher combustion noise and an increase in the contribution from powertrain noise to overall vehicle noise

Demand for better fuel economy

- Leads to new and lighter engines with smaller water passages and less damping of powertrain noise
- Requires lightweight and low-friction gearboxes with increased gear noise and gear rattle
- Increasing use of 2- and 3-cylinder engines with inherent imbalance

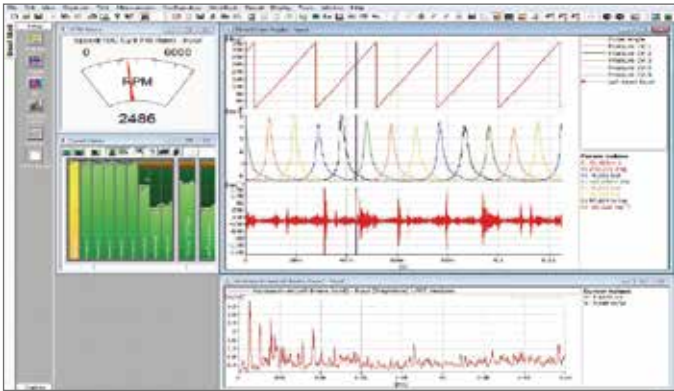
The market, however, still expects good driving performance and superior comfort – thus increasing the challenge for NVH engineers.

The PULSE platform provides a wide range of tools for general powertrain NVH analysis and simulation in the context of the whole vehicle. Our systems perform angle domain analysis alongside other types of analysis, such as FFT and 1/3-octave noise analysis.

The angle domain offers a different perspective on NVH issues where the angular position of a rotating component (often the engine crankshaft) can reveal noise sources which are cyclic in nature, such as the firing of a particular cylinder, or a mechanical excitation occurring at a fixed point in the duty cycle.



Dodge Viper 8.3L V10 engine fitted with transducers for crank angle analysis

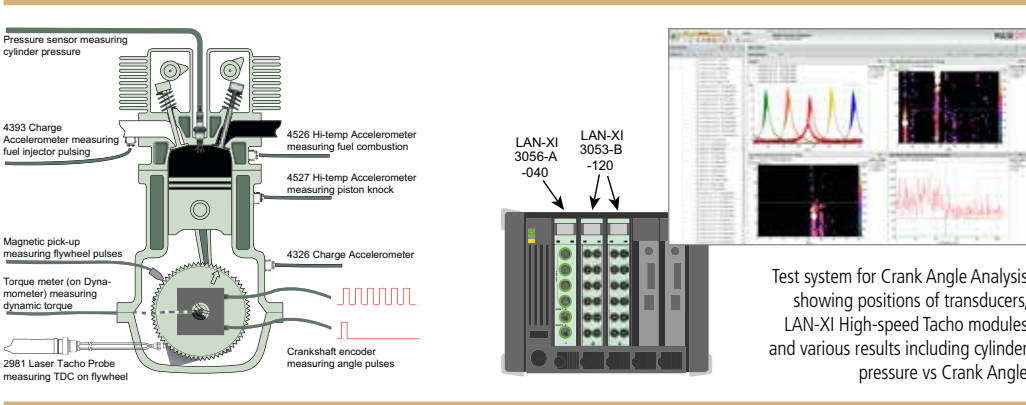


Data acquisition

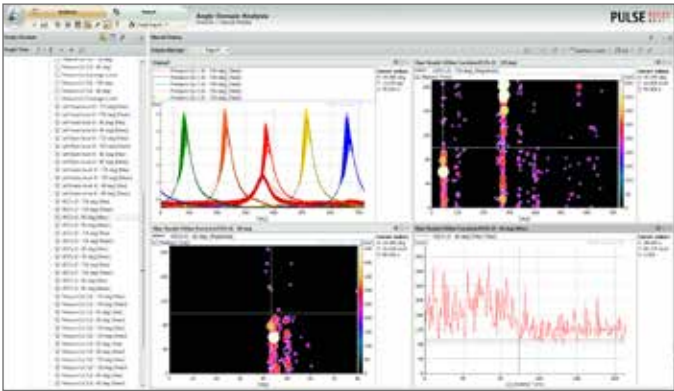
7700, 7702, 7708

A typical monitoring view during data acquisition includes:

- RPM and level meter for each channel
- Angle profile
- Cylinder pressure signals for five cylinders
- Time and frequency signatures of a vibration signal



Test system for Crank Angle Analysis showing positions of transducers, LAN-XI High-speed Tacho modules and various results including cylinder pressure vs Crank Angle



Angle domain post-processing

8740

Processes time data recordings into the angle domain, presenting results as:

- 3D displays of cycle versus time or cycle number
- 2D displays of cycles (either overlaid or single)
- Gated statistics versus cycle number

Data can be stored in the PULSE Reflex database for further processing and reporting in PULSE Reflex Core.



Angle and cycle extraction

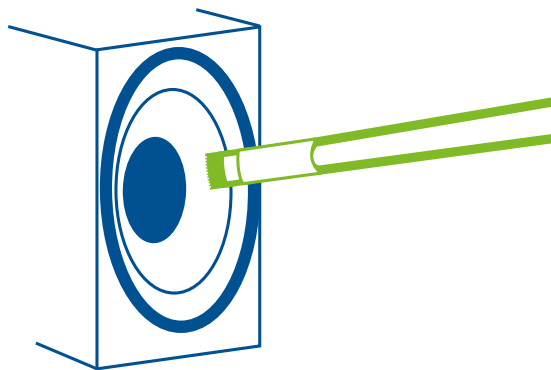
8740

An angle versus time signal can be included in the recorded data if measured using LAN-XI module Type 3056. Otherwise it can be calculated in Time Editor.

Up to three signals can be used to determine absolute crank angle position. For example, in 4-stroke engines, the unique crank angle in a 720° cycle can be calculated from:

- A tachometer (encoder) pulse signal with multiple pulses/rev
- A one pulse/rev tachometer signal for identifying the 0° point or Top Dead Centre (TDC)
- A signal with one trigger point per cycle to find the absolute starting point of each cycle

ELECTROACOUSTIC TESTING



Manufacturers of electroacoustic equipment such as loudspeakers, microphones, telephones, headsets, hearing aids and hydrophones consistently deliver high-quality acoustic designs by continuously innovating their products and processes.

Measuring and documenting acoustic performance is a key element in this improvement process, during both the development and the manufacture of new products.

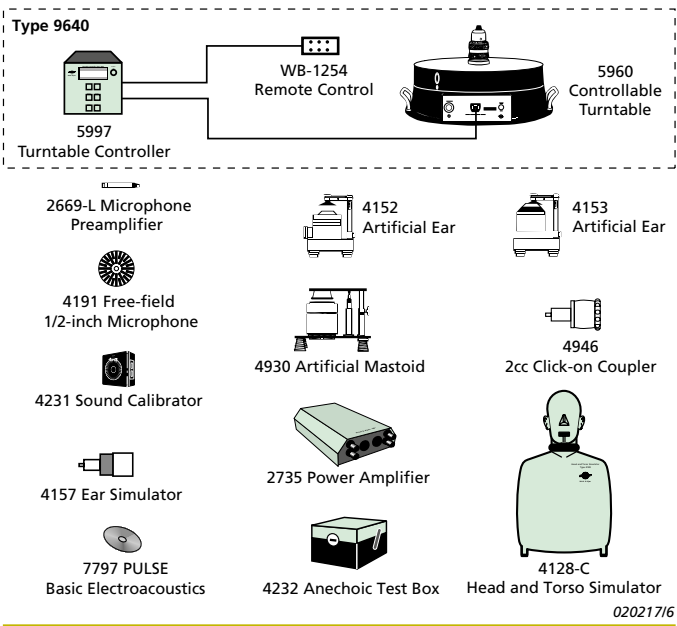
In the future, the ability to characterize electroacoustic equipment using traditional performance specifications such as frequency response, distortion, linearity, directivity, and delay will be combined with a wide range of other acoustical and vibration measurements.

Acoustic and vibration measurements such as those performed in material testing and modal analysis are expected to become an important prerequisite for continued innovation and improvement within the development and manufacturing of electroacoustic equipment.

Audio analyzer, basic electroacoustics

7797, 3160-A-042

- Frequency response
- Near-field measurements
- Simulated free-field measurements
- Tolerance check
- Data manager
- Reporting using Microsoft® Word, Microsoft® Excel® or Microsoft® PowerPoint® templates
- Automation using Visual Basic®



Professional audio analyzer, advanced electroacoustics

7907-S1, 3160-A-042

Features as Basic Electroacoustics, plus:

- Harmonic distortion measurements
- Intermodulation distortion for near-field measurements
- DIFF distortion measurement for near-field measurements
- Directional response measurements and polar plot
- Thiele-Small parameters
- PULSE sequencer for automation

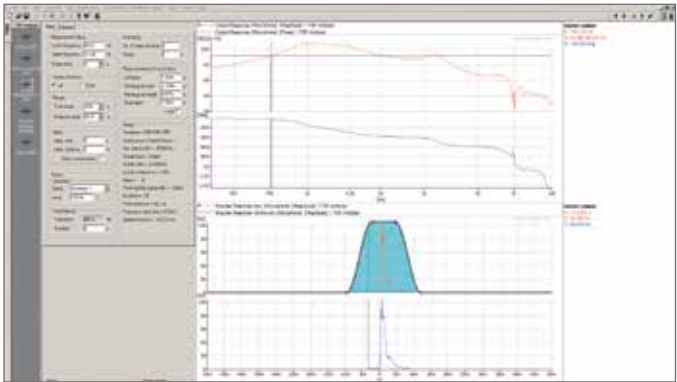
Wide range audio analyzer

7797, 3161-A-011

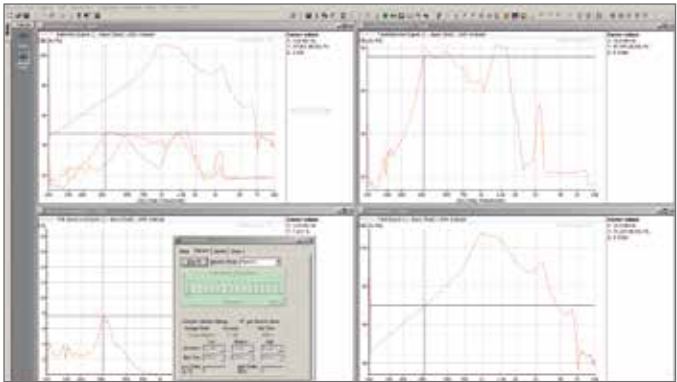
For measurement of loudspeakers and hydrophones.

- Frequency response
- Reporting using Microsoft® Word, Microsoft® Excel® or Microsoft® PowerPoint® templates
- Sequencing using Visual Basic®
- Distortion analysis

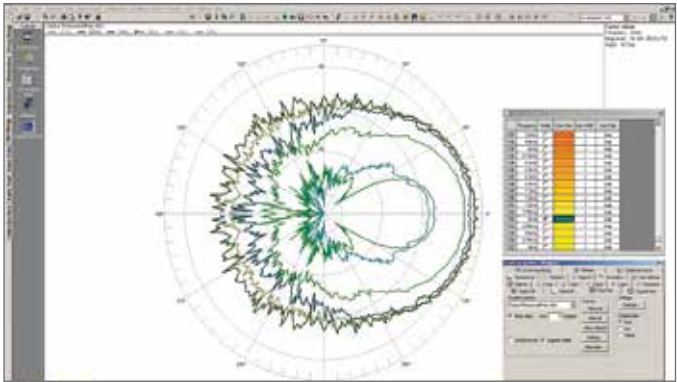
Simulated free-field measurements using TSR analysis for determining frequency response and harmonic distortion



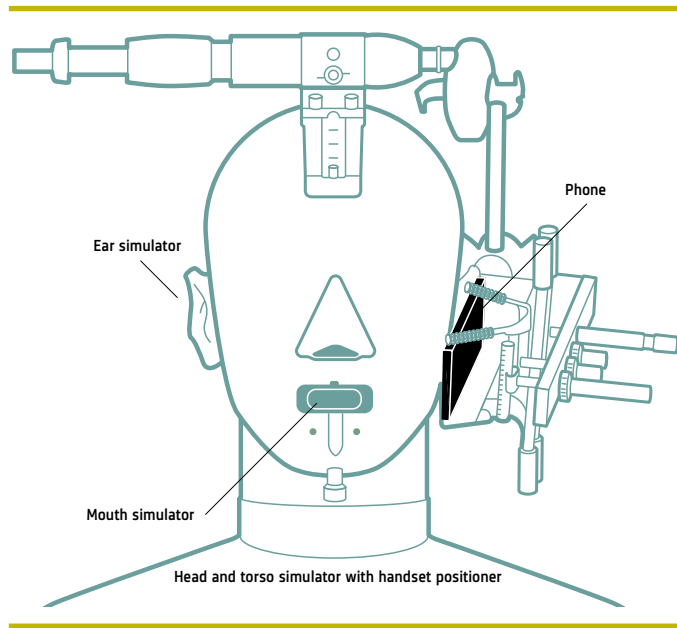
Frequency response and distortion measurements are performed using SSR analysis, revealing results with a known high accuracy



Directivity measurements are performed using Steady State Response (SSR) or Time Selective Response (TSR) analysis, with the results displayed as a polar plot



TELEPHONE TESTING

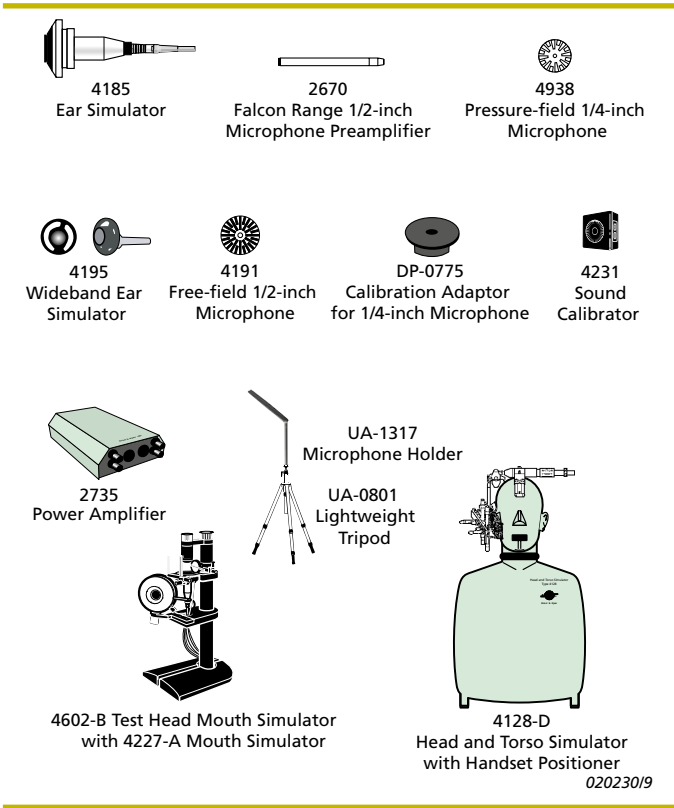


Mobile conversations can take place almost anywhere – from quiet offices to noisy outdoor environments. And since users demand high voice quality in all situations, the acoustic perception of devices is critical. Corded handset/headset telephones and mobile devices alike need advanced acoustic and electronic signal processing combined with superior design.

We offer two standardized test configurations, with one configuration based on a telephone test head equipped with a stand-alone mouth simulator and ear simulator. The second configuration is based on a Head and Torso Simulator (HATS), with an integrated mouth simulator and one or two integrated ear simulators.

Thanks to several decades of playing an active part in standardization within the telecommunication industry, Brüel & Kjær is regarded as the worldwide industry reference, setting standards for telephone testing worldwide.

Our experience of providing high-quality acoustic solutions provides us with a solid foundation from which to develop new products for emerging telephone technologies and markets.



Telephone testing using standardized procedures

8770, 8771, 8772, 3160-A-042

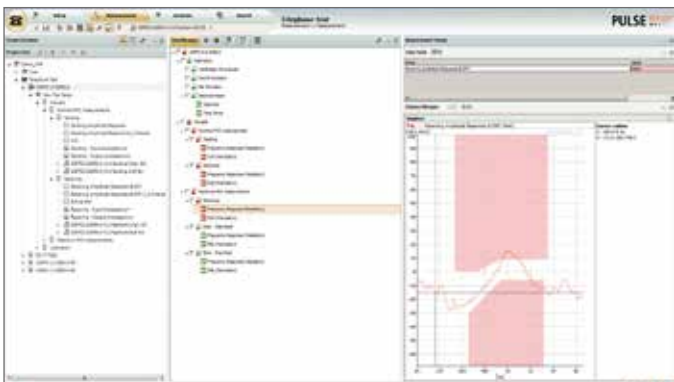
- For performing measurements in compliance with international and national standards for frequency response, loudness rating, noise, distortion, echo, switching, etc.
- Perception-based evaluation of speech quality
 - Measurements on handsets, headsets and hands-free communication devices
 - Imitates the use of communication devices in everyday life
 - Supports Head and Torso Simulator (HATS) and telephone test head configuration
 - Automated calibration procedures
 - Easy control of measurements
 - Imports measurements from legacy telephone testing software
 - Ear and mouth simulator conforms to ITU-T P.51, P.57, P.58, P.64, IEEE 269 and IEEE 661 standards
 - Automatic reporting in Microsoft® Word, Microsoft® Excel® or Microsoft® PowerPoint®

Telephone testing in simulated noise environments

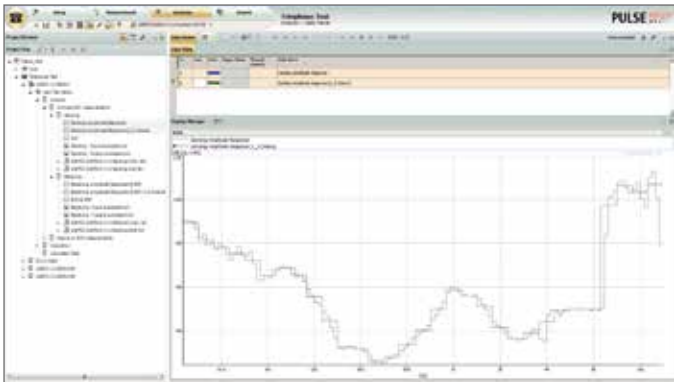
BZ-5830, BZ-5831, BZ-5832, BZ-5833

- Evaluates noise suppression and speech enhancements techniques under controlled conditions, using real speech signals and environmental noises as background sound.
- Creation of simulated noise environment using standardized loudspeaker configurations
 - Measurements of PESQ, POLQA, SNRI, NPLR, ASL, etc.
 - Measurements of S-MOS, N-MOS and G-MOS
 - Automated calibration procedures
 - Easy control of measurements
 - Automatic reporting in Microsoft® Word, Microsoft® Excel® or Microsoft® PowerPoint®

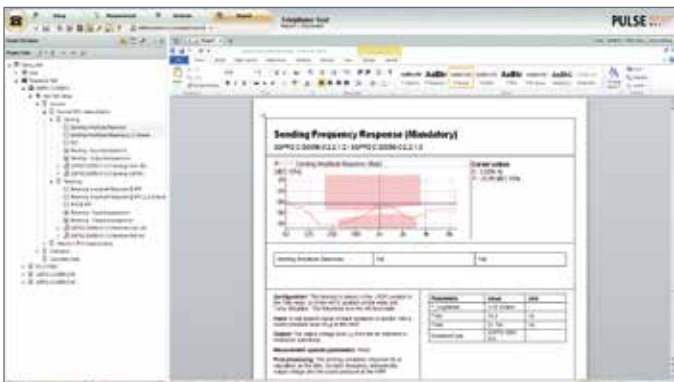
Automated measurement execution and presentation of results including pass/fail indication are provided in a single screen view



Data from various measurements, which have been produced by the telephone test application, can be compared with measurement data imported from the previous-generation telephone test application



Full documentation of the complete suite of tests is provided in a Microsoft® Word document exhibiting live curves and pass/fail indication



PRODUCTION TESTING

Protecting brand value increasingly requires living up to the quality expectations of customers, and whether it be an aerospace/defence, automotive or telecom/audio product, manufacturers must constantly enhance production test.

Brüel & Kjær's core competences in sound and vibration are based on more than 75 years of experience within design and production of equipment for measuring sound and vibration.

Applying our knowledge and systems to production testing gives a competitive advantage to products, while, at the same time, helping to save costs.

We supply complete systems covering a range of vibration and acoustic production testing, from a single and flexible hand-held tester to complete turnkey test stations and fully serviced production site systems.

Our comprehensive offering includes everything you need from design and set-up services, measurement systems including microphones, accelerometers, preamplifiers, couplers, measurement front ends, analyzers to databases, report generators and statistical tools.

Brüel & Kjær's well-known sound and vibration expertise from our core markets – Aerospace/Defence, Automotive, Telecom/Audio and Environmental – provides a unique advantage to all customers, leveraging measurement techniques and analysis knowledge across market segments.

Based on our standard products and analysis tools, Brüel & Kjær has provided dedicated sound and vibration test solutions for quality control and production test across all our markets ranging from high- to low-volume requirements.

Systems for material and component inspection, sub-assembly testing and final product testing

High-volume production

Typical products

- Mobile phones
- Tablet PCs
- Earphones
- Televisions
- Hi-Fi audio systems

Key needs

- Short test time
- Simple operator interface
- High uptime
- Low channel count
- Integrated systems

Medium-volume production

Typical products

- Brake discs
- Windshield wipers
- Generators
- Exhaust systems
- Gearboxes

Key needs

- Medium test times
- Automated systems
- Technical operators
- Medium channel count
- Advanced analysis

Low-volume production

Typical products

- Gas turbines/gearboxes
- Wind turbine blades/gearboxes
- Satellites
- Multi-axis machining centres
- Semiconductor manufacturing machines

Key needs

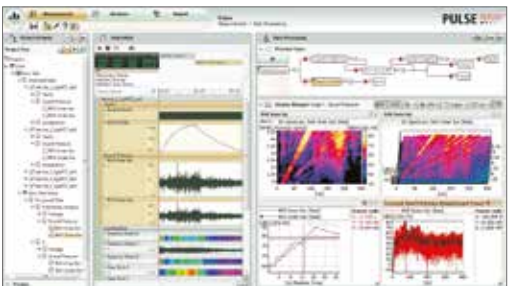
- Complex analysis
- High channel count
- Long test time
- Data recording
- Post-processing



Cloud-based data management

Low- and medium-volume

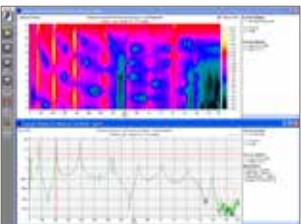
High-volume



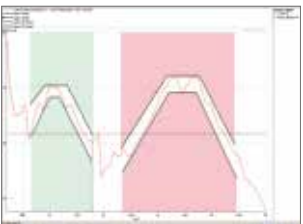
Post-processing and analysis



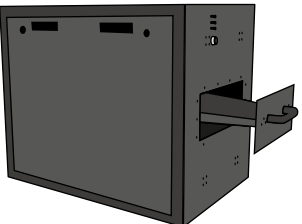
Pass/fail test



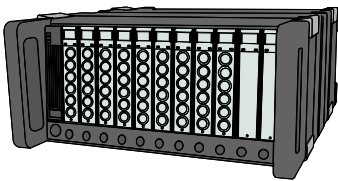
Real-time analysis



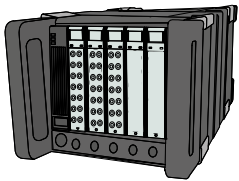
Limit testing



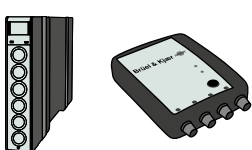
Acoustic test station



Multichannel data acquisition

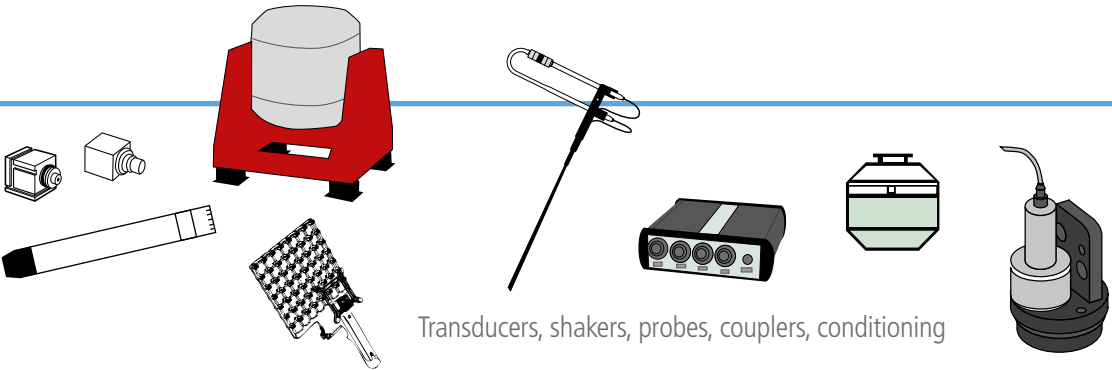


Data acquisition



Data acquisition

Hand-held



Transducers, shakers, probes, couplers, conditioning

VIBRATION TEST AND CONTROL

Ensuring reliability and durability requires accurate replication of real-life vibration conditions during R&D and production operations. Testing strategies include accelerated lifetime testing, accelerated stress testing, durability testing, life cycle testing, package testing, and squeak and rattle detection.

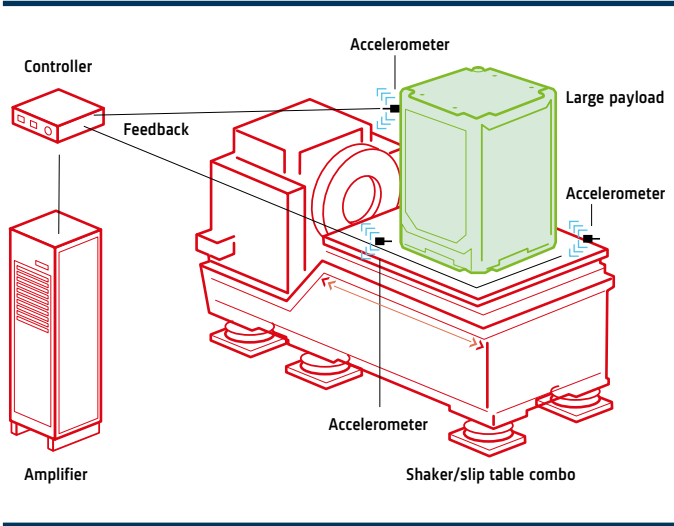
From mobile phone sub-assemblies through to complete satellite systems, our comprehensive solutions cover applications throughout the entire spectrum of vibration testing – covering payloads up to 5000 kg, with force ranges from 9 N to 289 kN.

The unbeatable performance of our systems combines with their versatility to make them highly efficient for R&D and production testing. All shakers offer the widest achievable range of test levels.

Our technical experience is frequently in demand to tailor customer-specific solutions for the most exacting requirements, in markets including aerospace, automotive, space, defence, electronics and machinery production.

Global support, service and training is part of our unique appeal, and draws on both our unrivalled experience and global coverage. On-site service and maintenance contracts are offered globally for all vibration test system configurations.

The range we offer includes vibration controllers, LDS shakers, slip-tables and energy-efficient amplifiers, providing all of the components you need to meet virtually any test requirement in the world today. This allows you to acquire all your measurement and testing components from one supplier, and to enjoy all the benefits of capability, scale and resilience that we offer.



Permanent magnet shakers

V101 – V455

Peak force ratings from 9 N to 489 N

- Modal and structural analysis
- Electronic assembly test
- Calibration systems

Efficient armature design allows for delivery of impressive peak forces and acceleration over a very wide frequency range.

Air-cooled, electrodynamic shakers

V555 – V780

Peak force ratings from 0.94 kN to 5.1 kN

- Automotive component testing
- Aerospace component testing
- Electronic assembly testing
- Structural testing and analysis
- Vibration stress testing under varied environmental conditions
- In-house test and calibration facilities

With a combination of a wide frequency range, high force and high acceleration, this range of air-cooled shaker systems delivers excellent all-round capabilities for testing all types of components and smaller assemblies.

Built on a new technology platform, the XPA-K amplifier offers unbeatable performance at the touch of a finger



Air-cooled, high-force, electrodynamic shakers

V830 – V8900

Peak force ratings from 6.5 kN to 80 kN

- Automotive parts and systems – qualification testing
- Electronic assembly, computer equipment testing
- Avionics and military hardware testing
- Satellite component testing
- Product and package testing
- General stress screening
- Low-frequency and shock pulse testing
- Multi-shaker, multi-axis application

The industry standard for automotive, military and electronic testing. Full versatility and capability as demanded for research and development, product qualification and stress screening.

Water-cooled, very high-force, electrodynamic shakers

V9x – V994

Peak force ratings from 89 kN to 289 kN

- High-force, long-duration automotive testing using V9x
- Space, avionics and military hardware testing
- Low-frequency and shock pulse testing
- Product and package testing
- 3-axis testing of complete satellite systems
- Multi-shaker, multi-axis application
- Ideal for clean room environments (excluding V9x)

Perfect for long duration testing of large devices, satellite and aircraft components and full satellite or defence hardware assemblies.

Vibration controllers

COMET and LASER

Multi-point control of complex structures with an intuitive user interface to support workflows from basic tests like sine, random and shock, up to advanced system tests for the most challenging scenarios.

- Automated reporting
- Waveform replication
- Resonance search track and dwell



SOFTWARE

PULSE platform

7700/70/71	FFT and CPB Analysis	8701	Reflex Data Viewer	8710	Reflex Sound Quality Metrics
7705	Time Capture	8702	Reflex Basic Processing	BZ-5610	CAN Bus
7708	Time data recorder	8703	Reflex Advanced Processing	BZ-5950	Sonoscout LAN-XI License
7709	Viewer License	8706	Reflex Standardized CPB Option	BZ-7848	Notar LAN-XI Stand-alone Recorder License
8700	Reflex Base				

Test and data management

Machine diagnostics

7702	Order Analysis	7795	Vibration Check for Aircraft Engines	8705	Reflex Advanced Order Analysis
7773	Envelope Analysis	8704	Reflex Order Analysis	8740	Reflex Angle Domain Analysis
7790	Multi-plane Balancing Consultant				

Structural dynamics

7753	Modal Test Consultant™	8720	Reflex Modal Analysis	8729-C	Reflex Structural Measurements
7765	ODS Test Consultant	8721	Reflex Advanced Modal Analysis		— Stepped Sine New
7764	Multiple-Input Multiple-Output Analysis	8722	Reflex Correlation Analysis	8730	Reflex Shock Response Analysis
8718	Reflex Finite Element Interfaces	8729-A	Reflex Spectral Analysis	8760	Operational Modal Analysis New
8719	Reflex Geometry	8729-B	Reflex Structural Measurements	BZ-8527	Batch Processing for OMA Pro
			— Hammer and Shaker	BZ-8550	Structural Health Monitoring New

Acoustics

3644	NVH Vehicle simulator	5781	Reflex Array Analysis
7698	Sound Quality	BZ-5635	Array Acoustics Quasi-stationary Calculations
7758	Acoustic Material Testing	BZ-5636	Array Acoustics Transient Calculations
7761	Acoustic Test Consultant and Noise Source Identification	BZ-5637	Array Acoustics Conformal Calculations
7788	Vehicle Pass-by	BZ-5638	Array Acoustics Metrics Calculations
7793	Indoor Pass-by	BZ-5639	Array Acoustics Refined Beamforming Calculations
7799	Sound Power	BZ-5640	Array Acoustics Panel Contribution
7882	Sound Power using Sound Intensity	BZ-5641	Array Acoustics Intensity Component Analysis
7883	Sound Power of Earth Moving Machinery	BZ-5642	Array Acoustics In Situ Absorption
7884	Sound Power in Reverberation Rooms	BZ-5644	Array Acoustics Wideband Holography
7885	Noise Emission, Outdoor Machinery	BZ-5652	Array Acoustics External Plug-in Manager
7886	Sound Power Determination of Fans New	BZ-5939	Array Acoustics Rail Vehicles Moving Source Beamforming
7914	Wind Turbine Sound Power	BZ-5940	Array Acoustics Flyover Moving Source Beamforming
7915	Small Wind Turbine Acoustic Testing	BZ-5941	Array Acoustics Wind Turbines Moving Source Beamforming
8606	Array Acoustics Spherical Beamforming	BZ-5943	Array Acoustics Road Vehicles Moving Source Beamforming
8607	Array Acoustics Acoustic Holography	BZ-5963	Array Acoustics Proximal Holography
8608	Array Acoustics Beamforming	BZ-6047	Automotive Sound Quality


Vibroacoustics

7798 Source Path Contribution

Electroacoustics

6712	Telephone Test on PULSE	BZ-5548	SSR Analysis – Harmonic Distortion	BZ-5602	PULSE Receiver Test Application
7797	Basic Electroacoustics	BZ-5549	SSR Analysis – Intermodulation Distortion	BZ-5603	PULSE Loudspeaker Test Application
8770	Reflex Telephone Test	BZ-5550	SSR Analysis – Difference Frequency Distortion	BZ-5604	PULSE Thiele Small Parameter Calculation
BZ-5137	Telephone Test	BZ-5551	Directivity and Polar Plot	BZ-5742	PULSE TSR Analysis – Harmonic Distortion
		BZ-5600	PULSE Sequencer	BZ-5473	PULSE Microphone Test Application
		BZ-5601	PULSE Data Manager for Electroacoustics	BZ-5744	PULSE Headset Test Application

LAN-XI HARDWARE

Get an overview of all the interchangeable front panels here: 



3660-A
1-module wireless LAN frame



2831
Battery module



3050-A-060
6-ch. input
50 kHz



3050
4/6-ch input
50 kHz



3660-C-100
5-module LAN-XI front end frame
with GPS sync input



3052
3-ch input
100 kHz



3053
12-ch input
25 kHz



3056
4-ch input, 50 kHz
HS Tacho, Aux inputs



3660-D-100
11-module LAN-XI front end
frame with GPS sync input



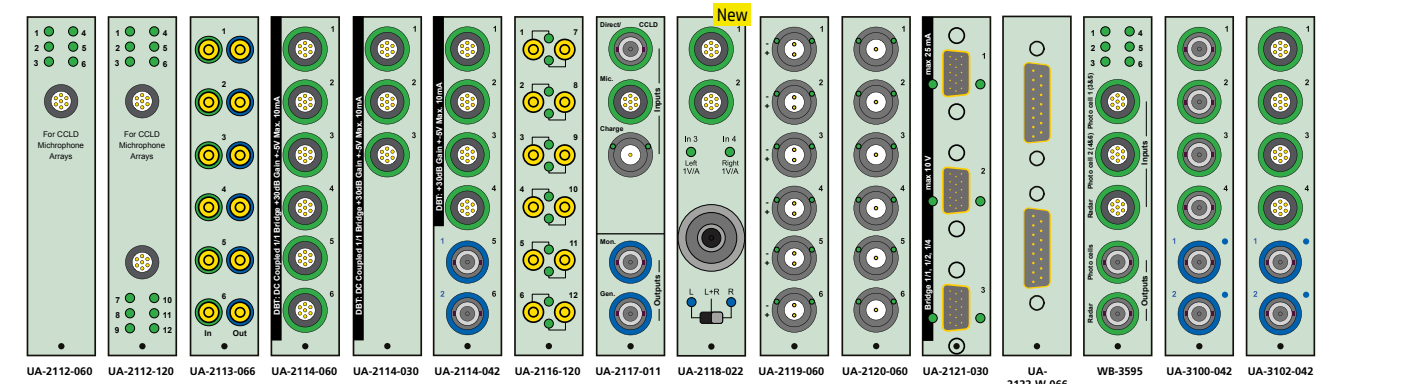
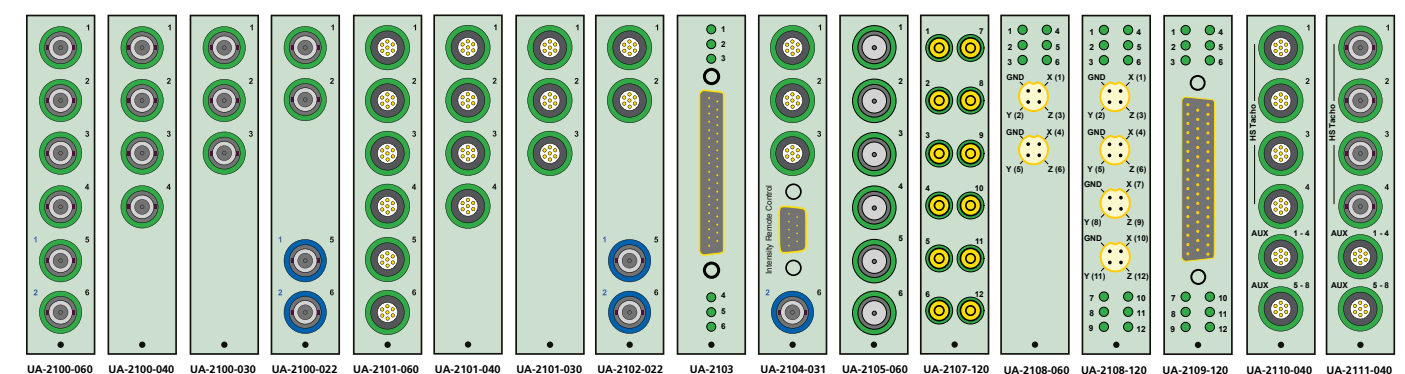
3057
3-ch Bridge input,
100 kHz



3160
2/4-ch input, 2-ch output
50 kHz



3161-A
1-ch input, 1-ch output
200 kHz



















Interchangeable front panels

HARDWARE

















Input type	Product name	Type number	Input channels	Front panel	Generator output channels	Frequency range		Front panel connectors						
								Included	Optional					
Direct CCLD ^a Mic. Preamp. (0 or 200V polarization voltage) Charge ^b	3-ch. Input module LAN-XI 102.4 kHz (Mic, CCLD, V)	3052-A-030 ^e	3		—	0 Hz to 102.4 kHz		BNC: UA-2100-030	LEMO: UA-2101-030	Sound Int: UA-2104-031	DBT: UA-2114-03			
	4-ch. Input module LAN-XI 51.2 kHz (Mic, CCLD, V)	3050-A-040 ^e	4		—	0 Hz to 51.2 kHz		BNC: UA-2100-040	LEMO: UA-2101-040		Sound Int: UA-2104-031			
	6-ch. Input module LAN-XI 51.2 kHz (Mic,CCLD, V)	3050-A-060 ^e	6		—			BNC: UA-2100-060	LEMO: UA-2101-060	Sound Int: UA2104-031	Charge Amp: UA-2105-060 ^c	Sub D: UA-2103		Triax: UA-2108-060
									6-ch. Array: UA-2112-060	Monitor: UA-2113-066	DBT: UA-2114-060	Differential charge: UA-2119-060		Charge input: UA-2120-060
	4-ch. Input module/HS Tacho + 8 ch. LAN-XI 51.2 kHz (Mic, CCLD, V, HS Tacho, Aux)	3056-A-040 ^e	4+8		—			AUX BNC: UA-2111-040	AUX LEMO: UA-2110-040		Sound Int: UA-2104-031			
	Generator, 4/2-ch. Input/Output module LAN-XI 51.2 kHz (Mic, CCLD, V)	3160-A-042 ^e	4		2			BNC: UA-3100-042	LEMO/BNC: UA-2102-042		Sound Int: UA-2104-031			
											DBT: UA-2114-042			
Generator, 2/2-ch. Input/Output module LAN-XI 51.2 kHz (Mic, CCLD, V)	3160-A-022 ^e	2		2	BNC: UA-2100-022	LEMO/BNC: UA-2102-022								
1-ch. Input + 1-ch. Output module LAN-XI 204.8 kHz (Mic, CCLD, V)	3161-A-011 ^e	1		1	0 Hz to 204.8kHz		BNC/LEMO/TNC: UA-2117-011	—						
Direct CCLD ^a Charge ^b	12-ch. Input module LAN-XI 25.6 kHz (CCLD, V)	3053-B-120 ^e	12		—	0 Hz to 25.6 kHz		SMB: UA-2107-120	Triax: UA-2108-120		12-ch. Array: UA-2112-120		Charge input: UA-2116-120	
Direct CCLD ^a Bridge	3-ch. Bridge input module LAN-XI 102.4 kHz	3057-B-030 ^e	3		—	0 Hz to 102.4 kHz		SUB-D: UA-2121-030	—					
Battery module														
Battery module		2831-A	—		The battery module is a rechargeable Li-Ion battery with a nominal output voltage of 14.8 V and a capacity of 91 Wh. On the front, 5 LED status indicators show the remaining capacity.									
LAN-XI frames														
1-module wireless LAN frame Type 3660-A		3660-A-200/201 ^d	Creates a wireless data acquisition front end by connecting one LAN-XI input module and one LAN-XI battery together		Mains (90–264 V AC, 47 – 63 Hz) or DC powered (10 – 32 V). Using PTP or GPS sync. Plug-and-play modules can be removed for field measurements using a single module, or swapped for calibration or repair. Modules can be locked or screwed in place. Operation is silent as long as the temperature of the unit is within safety limits. If the maximum operating temperature is reached, cooling fans start. Their SPL is < 30 dB at 1 m.			Notes: a Constant Current Line Drive for CCLD accelerometers or microphone preamplifiers b Via Charge to CCLD Converter Type 2647-A, -B, -C, or -D c UA-2105-060 requires a Type 2647-A, -B, -C, or -D per channel d Japanese variant e Available in a -X version, that is, delivered without front panel, power supply and cables. Ideal for use with our frames						
5-module LAN-XI front end frame with GPS sync input Type 3660-C		3660-C-100	Houses up to 5 LAN-XI modules (up to 2 LAN-XI batteries)											
11-module LAN-XI front end frame with GPS sync input TYPE 3660-D		3660-D-100	Houses up to 11 LAN-XI modules (up to 2 LAN-XI batteries)											

MICROPHONE firsts

1956	Type 4131		World's first volume-produced measurement microphones, Types 4131 (free-field) and 4132 (pressure-field), developed, amongst others, by Dr Per V. Brüel
1967	Type 4138		World's first 1/8" measuring microphone. Due to on-going product improvements, this type is still available
1975	Type 4160		Brüel & Kjær is requested to produce a replacement for the Western Electric WE 640 AA Reference Microphone. As a result, Type 4160 and later the 1/2" Type 4180 were introduced (still the world de facto acoustical standards)
1980	Type 4155		Brüel & Kjær launches the world's first high-stability, measurement grade, electret microphones
1984	Type 4179		Using advanced modelling and clever design, this microphone has a noise floor of -2.5 dB(A), still unbeaten after more than 30 years!
1987	Type 4182		Brüel & Kjær introduces probe microphone for measurement in extremely confined spaces and up to more than 600 °C
1993	Type 4188 *		Falcon series is introduced. Featuring stainless steel, press-fitted diaphragms, these microphones result in a step change in microphone technology
1994	Type 4189		Falcon series at peak performance. Type 4189 is probably the world's most popular 1/2" free-field microphone
2000	Type 4297		The world's only one-unit Sound Intensity Calibrator enables calibration without dismantling the probe
2003	Type 4948 *		Surface Microphone – a Brüel & Kjær first: an "all titanium" sensor originally developed for aerospace applications
2004	Type 4949 *		Surface microphones now also find their way into the automotive industry, where they break new frontiers in wind-tunnel testing
2005	Type 4952 *		World's first outdoor microphone where all parts exposed to the weather are made from polymer materials
2006	Type 4955 *		Continuing the "all titanium" concept, this TEDS microphone has 1.1 V/Pa sensitivity and a typical noise floor of 5.5 dB
2009	Type 4961		Multi-field Microphone – world's first 1/4" measurement microphone that guarantees accurate and error-free measurements in both free and diffuse fields and at any angle
2012	Type 1706		World's first microphone preamplifier that can handle temperatures up to +125 °C/+257 °F
2015	Calibration in cloud		Access calibration data anytime. Calibration data is stored in the cloud for every microphone serviced at a Brüel & Kjær calibration laboratory. Furthermore, correction files for each individual Brüel & Kjær microphone are accessible via the web

ACCELEROMETER firsts

For more information on microphones and accelerometers go to www.bksv.com/transducers

1943	Type 4301		World's first commercial piezoelectric accelerometer made from Rochelle salt crystals and developed by Dr. Per V. Brüel
1957	Type 4310		Brüel & Kjær's first lead zirconate titanate (PZT) accelerometer
1971	Type 8305		Brüel & Kjær's standard reference accelerometer based on an inverted, centre-mounted compression design with quartz crystal piezoelectric element, ensured a high degree of accuracy for calibration
1974	Type 4366		This all-titanium accelerometer was the first based on Brüel & Kjær's patented DeltaShear™ design. Still in use today, the construction is regarded as one of the all-time, classic accelerometer constructions
1977	Type 4374		The first miniature accelerometer with a PlanarShear design – extending the frequency range of Brüel & Kjær Shear design
1985	Type 4390		World's first accelerometer with constant voltage line-drive (CVLD) built-in preamplifier
1985	Type 8317		Brüel & Kjær's first and highly reliable industrial DeltaShear™ accelerometer suitable for permanent vibration monitoring in potentially explosive environments
1996	Types 4507 and 4508		World's first dedicated modal shear accelerometer family
1998	Type 4506		The world's first OrthoShear™ triaxial accelerometer – one seismic mass for optimized noise floor and orthogonality
1999	Type 4507-B		Another world first – an accelerometer with integrated TEDS (Transducer Electronic Data Sheet)
2005	Type 4524-B		The first miniature triaxial accelerometer with integrated TEDS
2008	Type 4526		A ThetaShear™ CCLD accelerometer for applications up to 180°C (356°F) – the highest temperature for an accelerometer with built-in preamplifier in the industry
2012	Type 8347-C		Wide temperature range (-321 to +900°F (-196 to +482°C)) industrial accelerometer with superior temperature transient performance from Shear design
2012	Type 4527		This universal CCLD triaxial accelerometer never sits still on the shelf, and has the widest temperature and dynamic range Brüel & Kjær becomes AS/EN 9100 certified within the scope of development, production and service of customer-specific accelerometers
2015	Type 4527-C		The first triaxial charge accelerometer with one connector
2015	Type 4535-B		The first accelerometer with data matrix for Transducer Smart Setup for seamless transfer of transducer data to PULSE Reflex

SERVICE AND SUPPORT



360-degree services

1: Installation to get you up and running

Our skilled engineers will not leave you until you are up and running. From software to comprehensive systems, their expertise will save you time.

2: Training – efficiency from the start

Get instruction from the people who know the Brüel & Kjær products best. We offer extensive national and international training programmes that give you the opportunity to improve and increase your capabilities.

3: Support – help is always at hand

If you need help, just call our support line during normal working hours to talk to experienced Brüel & Kjær engineering support teams.

4: Software updates and revisions

Ensure you are always up-to-date with a Software Maintenance and Support contract that grants holders exclusive access to licensed software products including tested version upgrades and updates.

5: Expert calibration

Planned, regular calibration assures measurement data quality and validity. We offer a comprehensive range of calibration services including accredited calibration, traceable calibration and verification – performed at your site or in our laboratories. To make things easier for you, all calibration certificates are available online. Just login to www.bksv.com to get access.

6: Hardware maintenance – no unpleasant surprises

Under the maintenance scheme we test your instruments according to their original specifications and bring them up to standard.

7: Repair – authorized service staff and original parts

Our highly skilled service engineers use original equipment and spare parts to ensure repair quality and to extend your product’s working life, on-site or in our workshop.

8: Rental – a realistic option

For short-term projects, or when your instrumentation is being repaired, why not rent from us? This means you can always say yes to sound and vibration measurement opportunities.

Brüel & Kjær employees are committed to three golden rules governing the way we provide service and support:

Uptime is paramount

Our employees strive to ensure maximum uptime of your systems where Brüel & Kjær components are included by responding rapidly and efficiently.

Dialogue

We keep you informed of where in our system your service or support request is, so you can plan your work efficiently.

Highly skilled professionals

Support staff are continuously trained to serve you in the best possible way, allowing us to always meet you on your own terms.

Software Maintenance and Support contract

Keeping pace with evolving business requirements means that you need to ensure your PULSE system remains up-to-date. Brüel & Kjær Software Maintenance and Support keeps your PULSE system at the forefront of this evolution and provides access to expert technical user-support when you need it.

What’s included in your contract

Tested to work with Microsoft® Windows® – keep PULSE secure and reliable

We ensure your PULSE application remains secure and reliable with each Microsoft® update by continuously testing our products on the latest versions of the Microsoft® Windows® operating system, including all critical updates.

Upgrade – benefit from the newest technology

Our development department constantly improves the functionality and user-interface of PULSE, spending thousands of hours improving our software based on customer feedback. With a valid Software Maintenance and Support contract you will benefit from these very latest developments.

Exclusive access to support line

Your local Brüel & Kjær support team is committed to helping you when technical expertise is required. The support line is backed up by our global team of skilled product specialists and application engineers. With a contract you will receive support, and be our service and support organization’s highest priority.

Unify the versions of PULSE software – become more flexible

If you have more than one PULSE system, it is likely that they are different versions. This gives you less flexibility and/or higher cost, as operators need to know how to use different programs and interfaces. With the Software Maintenance and Support contract, all versions will be updated to the latest version.

Receive attractive offers during the year

With a Software Maintenance and Support contract you will receive attractive offers made especially for contract holders, giving you substantial savings during the year.

One-year programme

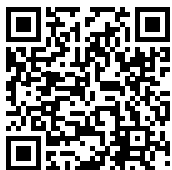
Software Maintenance and Support (M1), entitles you to receive priority technical user-support for the current software version and any version released within 12 months, as well as direct and immediate access to all software upgrades and updates issued by Brüel & Kjær for licensed products.

Multi-year renewal programme

Besides all the contract benefits, the multi-year version of M1 gives ongoing compatibility with the latest Microsoft® operating systems and unifies software versions, always keeping you up-to-date. Additionally, our calibration service (including collection and delivery) can be bundled into the contract for improved data quality and cost savings. A multi-year agreement saves you time and money. The more years you sign up for, the more you save. And no more worrying about your agreement expiring or having to renew on an annual basis.



Who we are



How we can help



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Local representatives and service organizations worldwide

Brüel & Kjær 

BEYOND MEASURE



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