

BRÜEL & KJÆR® Acoustic Analysis Software

BK Connect Indoor Pass-by VVS Measurements Type 8442

Volume velocity sources (VVS) are used as 'acoustical shakers' to measure acoustic transfer functions (ATF) typically in connection with noise source contribution analysis. Uniquely, HBK volume velocity sources use a special dual-microphone probe to measure accurate volume velocity directly in real time.*

BK Connect VVS Measurements is designed to work with HBK VVS devices to help you make high-precision ATF measurements quickly and efficiently based on a pre-loaded test plan that guides you through the measurements to ensure the best quality results.



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Uses and Features

Uses

- Real-time measurement of acoustic transfer functions (P/Q)
- Real-time measurement of acoustic volume velocity
- Pass-by source path contribution analysis
- Airborne source path contribution analysis
- Cabin acoustic sensitivity analysis

Features

- Works with HBK-patented dual-microphone volume velocity probes for direct measurement of volume velocity
- Capable of setup and guided measurements from an Indoor Pass-by source path contribution (SPC) model consisting of pass-by array microphones, sources and indicators
- Off-line setup of SPC DOF model in Microsoft® Excel® with one-step import to BK Connect for quick start-up
- Volume velocity probe selectable as a transducer in the BK Connect Transducer Manager
- Hardware channel table updated automatically by dragging and dropping volume velocity transducer onto the desired channel in the hardware matrix
- Real-time monitor shows calibrated volume velocity
- Network-based data file sharing in Team Server using a common file repository

* Equals sound pressure/volume velocity

HBK Volume Velocity Sources

As transfer function measurements require accurate measurement of the applied excitation signal, HBK's patented volume velocity sources (VVS) use a dual-microphone probe to measure volume velocity. The patented principle uses a single high-power loudspeaker radiating through a conical coupler to a circular orifice. The size of the orifice and the shape of the VVS have been carefully engineered to radiate sound evenly in all directions.

The two phase-matched microphones, measure the direct output volume velocity. Within the operating frequency range of the VVS, high order modes in its tube (with non-zero pressure on the axis) are not contributory.

Fig. 1 Left: Top-view of a HBK volume velocity source showing the phase-matched microphone arrangement. Right: Side-view of the VVS



Using a Volume Velocity Source with BK Connect

HBK VVS devices are included by default as a transducer type in the BK Connect transducer database so that individual devices, with their microphone calibrations, can be added.

Channel setup with a VVS, as with all transducers in BK Connect, is a simple matter of drag and drop to the Hardware Matrix. The microphone sensitivities are applied to the selected channels. Some VVS probes include TEDS microphones so that the LAN-XI hardware detects them automatically and applies the calibrated sensitivity information in the hardware setup table.

VVS Measurements

Uniquely in BK Connect VVS Measurement, you can monitor volume velocity in real time. The two microphone signals are converted to a volume velocity signal which is available to monitor alongside all the other signals.

From there, you can perform noise source contribution analysis with tasks for setup, measurement and post-processing fully embedded.

Measurement setup, execution and validation can be performed manually, table-based or geometry-guided.

BK Connect VVS Measurement Workflow

Test Plan Setup

The software is designed to work with a pass-by SPC model to simplify measurements of source-to-indicator and source-to-array ATFs. The model is common to both Indoor Pass-by and Pass-by SPC. The model is simply imported from a Microsoft Excel file containing definitions of the sources, indicators and pass-by arrays which automatically sets up the test plan.

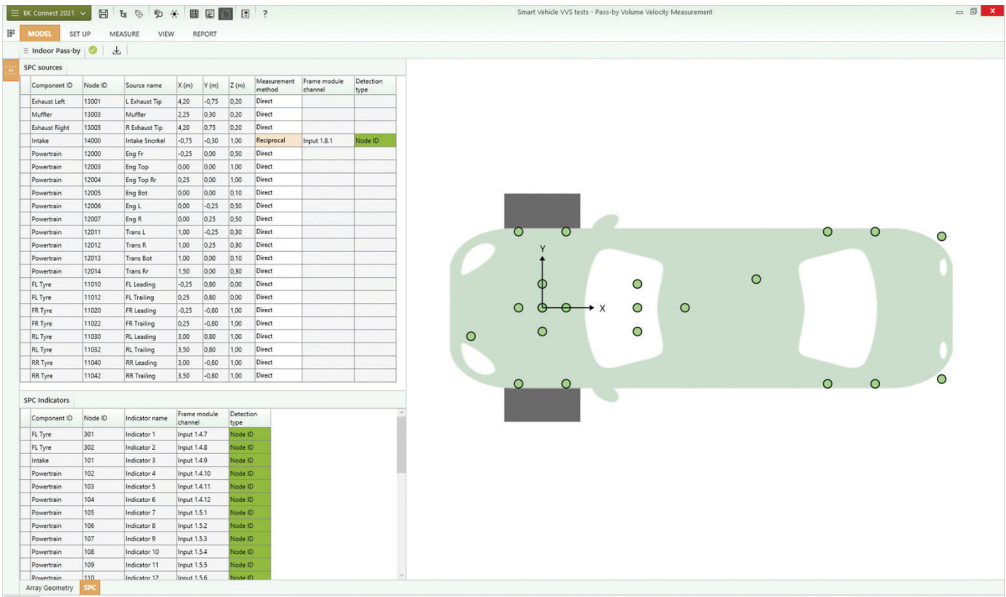
Supporting Various Test Methods

The most efficient way to measure ATFs is by positioning the VVS at the individual source locations and measuring the ATFs to the various indicator and array microphones. This is the direct

method. However, in some situations, the source locations may be too limited in space for the VVS probe to fit. In this case, the reciprocal method is used where the VVS is positioned at the individual indicator and array locations, and microphones are fitted at the source locations. Both direct and reciprocal methods are possible within the same test plan.

For applications other than Pass-by SPC, for example vehicle interior noise SPC where the VVS is typically positioned on a seat inside the vehicle, the Excel file can be adapted with the required source and indicator definitions for generating the test plan.

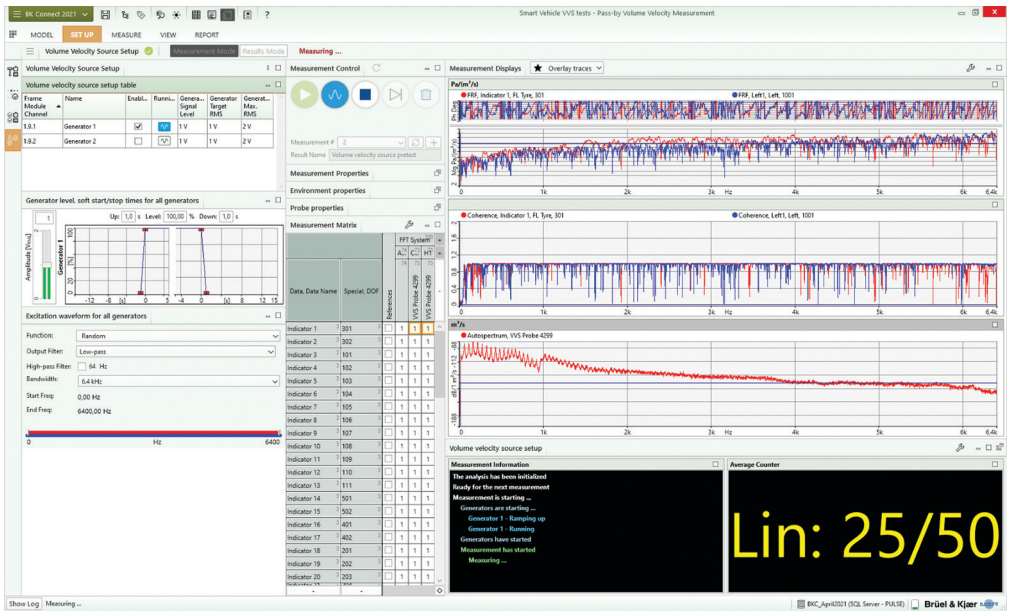
Fig. 2 Example of the test plan in the Model task, where you import and edit sources, indicators and pass-by arrays



Pretest Measurement Setup

The VVS Setup task is where you set up the LAN-XI signal generator and validate the overall setup by making pre-test measurements. Real-time feedback is given to help set and adjust the signal type, level and frequency limits for the signal generator. Parameters for the analysis setup can be validated by making pretest measurements.

Fig. 3 VVS Setup task: Running a pretest



Geometry-guided Measurements

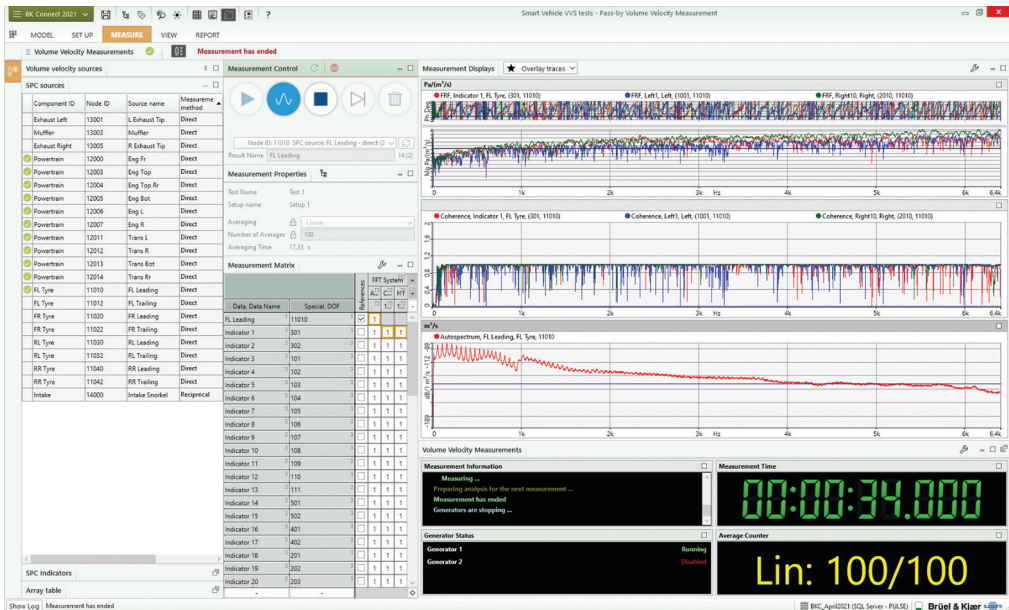
The VVS Measurements task enables you to select the measurement you wish to make from the test plan. This sets up the VVS DOF so that the measured FRFs are correctly annotated. The signal generator and analysis settings are inherited from the VVS Setup task so that the operator needs only to start the measurement, monitor its progress, then check the results.

During the measurement, the test plan indicates which measurement is currently in process. A green check mark

indicates which measurements have been completed so that you can see progress as you complete the test plan.

Once the test plan has been completed, the final set of ATFs is shared to the file repository for further use. The file repository can be local to the measurement PC, or it can be in a shared folder on the network so that colleagues can use it via the Team Server.

Fig. 4 VVS Measurement task: Using the VVS DOF list to guide you through the measurement setup points



Data Management using Team Server

The BK Connect VVS Measurement software is seamlessly integrated with the Indoor Pass-by (Type 8441-C) and Pass-by SPC (Type 8442) software, with a shared data model enabling them to work together as an integrated whole. If all three applications are installed on the same computer, data integration can be handled, either directly in a BK Connect project or by means of a local file repository and Team Server.

With the Team Server approach, there is more freedom to build and work with projects using a variety of different data sources. It also allows multiple users in different work environments, perhaps with different tasks, to use the same data.

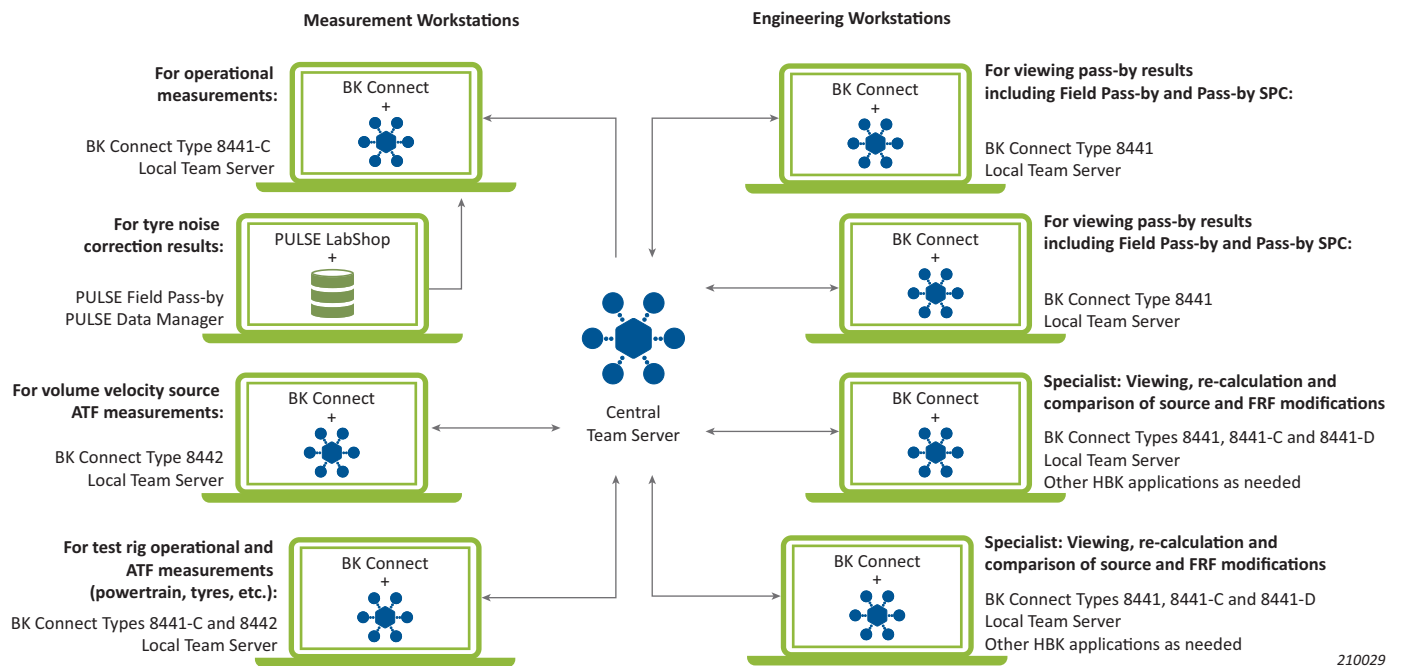
A common scenario is where analysis is performed away from the engineering lab in an office setting. In this case, the data

files can either be transferred across the network to the analysis computer's own local file repository, or they can be shared to a common file repository accessible across the network. In each case, the Team Server enables powerful data searches using any available metadata.

VVS Measurement Results Viewing and Storage

The FRF results from the VVS measurements can be viewed, analysed and reports created directly in the software's Result Matrix Viewer. Alternatively, connect to Team Server via BK Connect to store, view and compare the results alongside any other type of pass-by data such as SPC results, field pass-by and indoor pass-by.

Fig. 5 The Team Server integration in the BK Connect Indoor Pass-by suite



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Specifications – BK Connect VVS Measurement Type 8442

This Windows®-based analysis software is delivered via download option or USB installation media. The licence is either: node-locked to a PC host ID or dongle; or floating, locked to a network server

System

PC SYSTEM REQUIREMENTS

- Microsoft® Windows® 10 Pro or Enterprise (x64) with either Current Branch (CB) or Current Branch for Business (CBB) servicing model
- Microsoft® Office 2016 (x32 or x64) or Office 2019 (x32 or x64)
- Microsoft® SQL Server® 2019
- When using with Type 8402: Windows®-compatible sound card in order to play back signals

RECOMMENDED PC SYSTEM

- Intel® Core™ i9, 3 GHz processor or better
- 32 GB RAM
- 1 TB Solid State Drive (SSD) with 100 GB free space, or better
- 1 Gbit Ethernet network*
- Microsoft® Windows® 10 Pro or Enterprise (x64) with CB
- Microsoft® Office 2019 (x32)

- Microsoft® SQL Server® 2019
- Screen resolution of 1920 × 1080 pixels (full HD)
- When using with Type 8402: PC optimized for CPU and hard disk intensive operations

FRONT-END SUPPORT

One or more LAN-XI data acquisition modules (stand-alone or in frame) with built-in generator. Required for real-time measurements and recording

- Input/Output Module Type 3160, 51.2 kHz
- High-frequency Input/Output Module Type 3161, 204.8 kHz

* A dedicated data acquisition network (LAN or WAN) is recommended. A network that only handles data from the front end improves the stability of the data

Specifications

Software Prerequisites

- BK Connect Data Viewer Type 8400
- BK Connect Hardware Setup Type 8401 – for measurement and recording using up to two LAN-XI modules
- BK Connect Hardware Setup (advanced) Type 8401-A – for measurement and recording using more than two LAN-XI modules

Modelling

ARRAY GEOMETRY	<ul style="list-style-type: none">• Load model from Microsoft® Excel® – model previously created in BK Connect Indoor Pass-by or by editing existing Excel file• Review model geometry• Edit the acoustic centre as needed
SPC	<ul style="list-style-type: none">• Define source measurement method:<ul style="list-style-type: none">– Direct: VVS positioned at individual source locations and ATFs measured to the various indicator and array microphones– Reciprocal: VVS positioned at the individual indicator and array locations, and microphones are fitted at the source location• Check whether FRFs are missing – red or green status• Operating data (multiple runs on a specific vehicle), full test plan if required

Setup

CHANNEL

Set up using [Hardware Setup](#) tools

Connection	Add the VVS probe as a new device (type: VVS) in Transducer Manager with physical parameters: <ul style="list-style-type: none">• Nominal microphone sensitivity• Length• Radius• Microphone spacing Drag and drop to the HW Matrix to allocate to the correct channels and to set up transducer settings
Signal Detection	Volume velocity automatically calculated as a real-time signal in the Monitor
Calibration	Checked/validated in Transducer Validation task

MEASUREMENT

Set up the generator(s) and FFT properties before measurement

Generator Control	Graphical tools can be used for setting up excitation type, frequency parameters, output level, level ramp up/down times, and whether burst excitation is to be used Generator Signal Types: <ul style="list-style-type: none">• Sine (fixed frequency)• Continuous and Burst Random• Periodic and Pseudo-random• Periodic chirp
Analysis Setting	FFT properties are adjusted to match generator settings, but can be independently adjusted if desired. Interface tools are highly interactive, enabling engineers to quickly assess when the settings are appropriate for the structure under test
Pretest	Experiment with different FFT settings (bandwidth, number of spectral lines) and perform trial measurements for display and (optional) storage to the database
Result Mode	Pretest measurement results can be viewed and overlaid with previous measurements before storing to the database

VVS Measurements

MEASUREMENT MODE	Includes a measurement control panel that is detachable and resizable Control Buttons: <ul style="list-style-type: none">• Initialize analysis system• Generator start/stop• Measurement start/stop• The averaging setup can be adjusted from within this mode
GEOMETRY - GUIDED MEASUREMENT	Define source measurement method in the Model task during test plan editing. Either: <ul style="list-style-type: none">• Direct• Reciprocal The test plan is shown in the Measurement task as guide through all required FRF measurements
RESULT MODE	Measurement results can be viewed and overlaid previous measurements

Data Table Viewer

DATA SOURCE	• Drag and drop from Project Browser
DATA OVERVIEW	<ul style="list-style-type: none"> • Data table with user-configurable columns. Can contain a wide range of data descriptors, including user-defined metadata • Advanced filtering and sorting capabilities using a combination of columns, providing a powerful way to focus on any data of interest
DATA SELECTION	<ul style="list-style-type: none"> • Controls in header bar enables table selections to be automatically incremented for quick and easy scanning through the entire data set • Automatic data presentation in graphical displays. Auto-filled based on data selection in the table
DATA HANDLING	• Automatic report generation based on the data selection in the table

Result Matrix Viewer

RESULT SOURCE	• Drag and drop from Project Browser
RESULT OVERVIEW	<ul style="list-style-type: none"> • Result layout as a matrix of signals versus analyses • Smart results grouping – each individual cell in the matrix represents a group of similar results for which comparison is valid
RESULT SELECTION	• Automatic result data presentation – selecting a cell presents the results, either in a table view for scalars, or graphical display for function data
RESULT HANDLING	<ul style="list-style-type: none"> • Automatic report generation – reports can be generated in either Microsoft® Word or PowerPoint®, either from blank documents, or from templates prepared in advance. Template creation is controlled directly from the Data Viewer and is both flexible and easy to perform

Ordering Information

Type 8442 BK Connect VVS Measurement

REQUIRED SOFTWARE

Type 8400-X	BK Connect Data Viewer
Type 8401	BK Connect Hardware Setup – for real-time recording and measurement
Type 8401-A	BK Connect Hardware Setup (advanced) – for real-time recording and measurement using more than two LAN-XI data acquisition modules

OTHER PASS-BY SOFTWARE

Type 8441	BK Connect Pass-by Viewer
Type 8441-C	BK Connect Indoor Pass-by
Type 8441-D	BK Connect Pass-by SPC

Other Available BK Connect Software

Type 8400-NT	BK Connect Data Viewer (free viewer)
Type 8400-A-X	BK Connect Data Viewer (advanced)
Type 8400-B-X	BK Connect Native File Importers
Type 8400-C-X	BK Connect External File Importers
Type 8400-D-X	BK Connect Nastran Interface
Type 8400-E-X	BK Connect Ansys Interface
Type 8400-F-X	BK Connect Abaqus Interface

DATA ACQUISITION APPLICATION MODULES

Type 8401-V-X	BK Connect Virtual Hardware Setup
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DATA RECORDING APPLICATION MODULES

Type 8402-X	BK Connect Time Data Recorder
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DATA PROCESSING APPLICATION AND OPTION MODULES

Type 8403-X	BK Connect Data Processing
Type 8403-A-X	BK Connect Data Processing (advanced)
Type 8405-B-X	BK Connect Advanced Frequency Analysis Option
Type 8405-C-X	BK Connect CPB Option
Type 8405-E-X	BK Connect Order Analysis Option
Type 8405-F-X	BK Connect Order Tracking Option
Type 8405-G-X	BK Connect Sound Quality Metrics Option

Software Maintenance and Support Agreements*

M1-8400-X	Agreement for Type 8400
M1-8400-A-X	Agreement for Type 8400-A
M1-8400-B-X	Agreement for Type 8400-B
M1-8400-C-X	Agreement for Type 8400-C
M1-8400-D-X	Agreement for Type 8400-D
M1-8400-E-X	Agreement for Type 8400-E
M1-8400-F-X	Agreement for Type 8400-F
M1-8401-X	Agreement for Type 8401
M1-8401-A-X	Agreement for Type 8401-A
M1-8401-V-X	Agreement for Type 8401-V
M1-8402-X	Agreement for Type 8402
M1-8403-X	Agreement for Type 8403
M1-8403-A-X	Agreement for Type 8403-A
M1-8405-B-X	Agreement for Type 8405-B
M1-8405-C-X	Agreement for Type 8405-C
M1-8405-E-X	Agreement for Type 8405-E
M1-8405-F-X	Agreement for Type 8405-F
M1-8405-G-X	Agreement for Type 8405-G
M1-8441	Agreement for Type 8441
M1-8441-C	Agreement for Type 8441-C
M1-8441-D	Agreement for Type 8441-D
M1-8442	Agreement for Type 8442

* Agreement expiration date to be agreed at time of contract

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