HBK HOTTINGER BRÜEL & KJÆR

BRÜEL & KJÆR® Acoustic Analysis Software

BK Connect Indoor Pass-by

Pass-by Viewer Type 8441 and Indoor Pass-by Type 8441-C

The indoor pass-by noise test is a recognised alternative to the standard outdoor test for certifying road vehicles for exterior noise emission. The test is performed indoors on a chassis dynamometer (dyno) enabling repeatable operating conditions all-year round without weather interruptions. The indoor test is also accepted under UN regulations for type approval and conformity of production.

BK Connect Indoor Pass-by helps you to set up and perform measurements simulating pass-by noise in an indoor pass-by facility. To simplify operation and ensure high quality, pass-by standards and regulations are built into the user interface. Results are easily shared and visualised across organisations using the Team Server file-based data management system

Uses and Features

Uses

- Combines with LAN-XI data acquisition hardware and precision microphones to simulate pass-by noise measurements
- Type approval and conformity of production testing in accordance with international regulations
- Tyre noise correction using measurements on the road or ISO-compliant test track
- Measurements for Pass-by Source Path Contribution analysis to support design optimisation
- Development testing or problem troubleshooting testing in smaller rooms than required by ISO standard
- 24/7 measurements all year round, unaffected by outdoor weather conditions

Features

- Task-oriented, operator-friendly software
- Simulation of field pass-by measurements according to ISO 362-3 and UN/ECE regulation R51, including all mandatory metadata, operating constraints, and noise calculations
- Option for off-line setup using Microsoft® Excel® with one-step import for quick start-up in test facility
- System calibration with visual feedback on pass/fail status
- Results presented in identical fashion to regulation field (outdoor) pass-by noise test including overall results
- Report to Excel for flexibility of downstream reporting
- Ability to import field pass-by data for results comparison and tyre noise correction
- Tyre noise correction
- Doppler effect simulation
- Suitable for smaller rooms when not conducting homologation measurements; for example, development testing in a dyno chamber that is too narrow for 7.5 m spacing
- Flexible choice of acoustic centre on each side of the test vehicle
- Results management via Team Server file repository enabling comparison of pass-by results from any pass-by data source
- Ability to set up or load SPC model (sources and indicators) for Pass-by SPC operating and acoustic transfer function (ATF) measurements

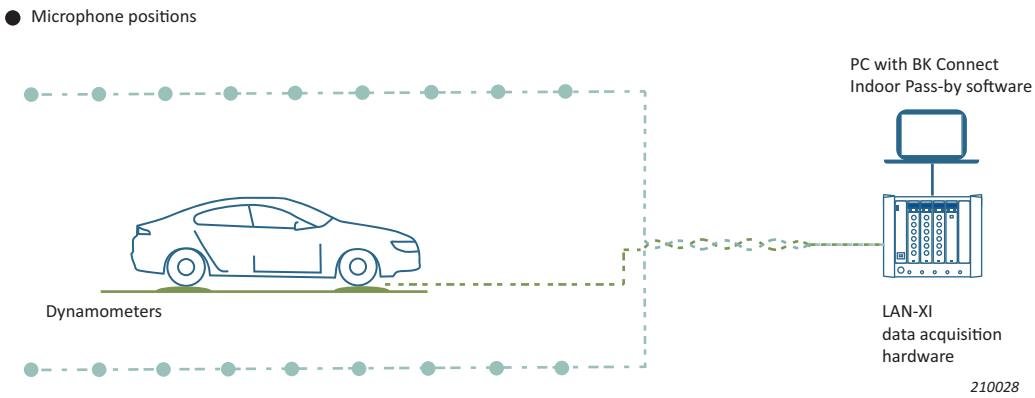
Description

With indoor pass-by, instead of the vehicle driving past two stationary microphones as in the field pass-by test, the test vehicle is stationary with a line of microphones on either side of it. The vehicle is run on a chassis dynamometer (dyno) and driven in the same way as it would be for a field pass-by measurement. Time histories from the microphones are measured in parallel with vehicle parameters and dyno drum speed.

A sophisticated algorithm uses information from the dyno to calculate a vehicle position relative to the microphones as a function of time. This is then used to extract the contributing sections of the time histories that correspond to times when the vehicle would have passed the standard pass-by microphone positions had the vehicle been moving. A synchronised single time history per line of microphones is created by stitching the time history sections together and interpolating across their boundaries.

The stitched sound pressure time histories, combined with the dyno drum speed profile, are analysed to produce a profile of sound pressure vs position equivalent to that from a field pass-by measurement.

Fig. 1 *Data from the individual microphones and dynos are processed and stitched together to produce a profile equivalent to that of a field pass-by measurement*



ISO 362-3 mainly defines the test equipment and procedure for pass-by testing whilst UNECE regulations, or local country regulations, specify the use of the ISO procedure and the noise emission limits for different categories of road-going vehicle.

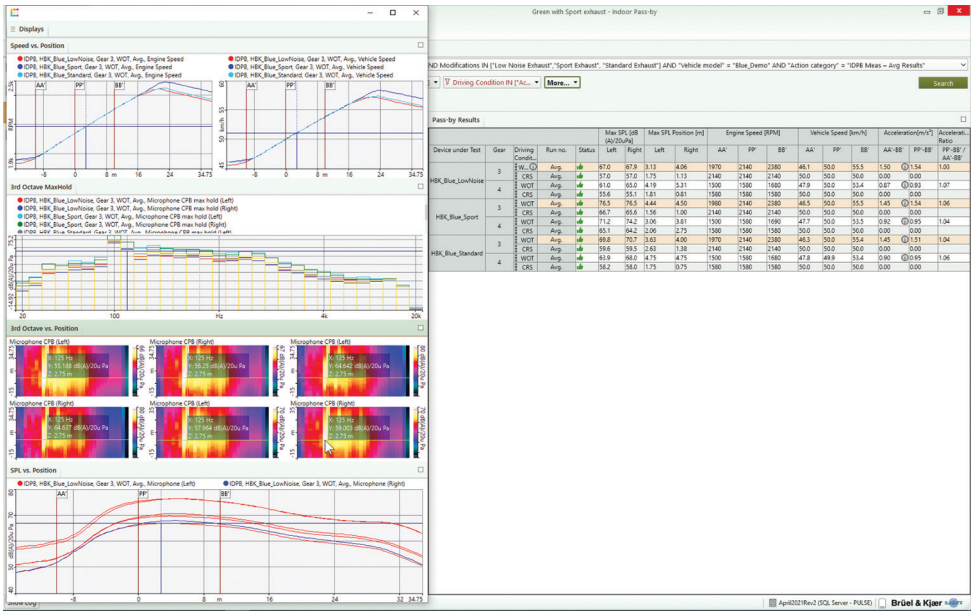
Downstream processing depends on the chosen procedure which may require different numbers of runs per condition for averaging and calculation of overall urban noise. General NVH analysis, for example order analysis or narrow band FFT analysis, may be performed when more detailed information is needed.

BK Connect Pass-by Viewer Type 8441

At the core of the HBK pass-by solution is the Pass-by Viewer, which works directly with stored data files in the HBK Team Server. It is tailored specifically for presentation of pass-by data whether from indoor testing, outdoor testing, or pass-by source path contribution (SPC) analysis.

The Pass-by Viewer user interface presents a table of overall pass-by results from which any selected cell enables graphical presentation of the relevant SPL curves and 1/3-octave spectra. Key pass-by track positions, P-P', A-A', and B-B', are overlaid on any graph vs position. At any time, a Microsoft Excel report can be made of the results in the table.

Fig. 2 *Type 8441 Pass-by Viewer user interface*



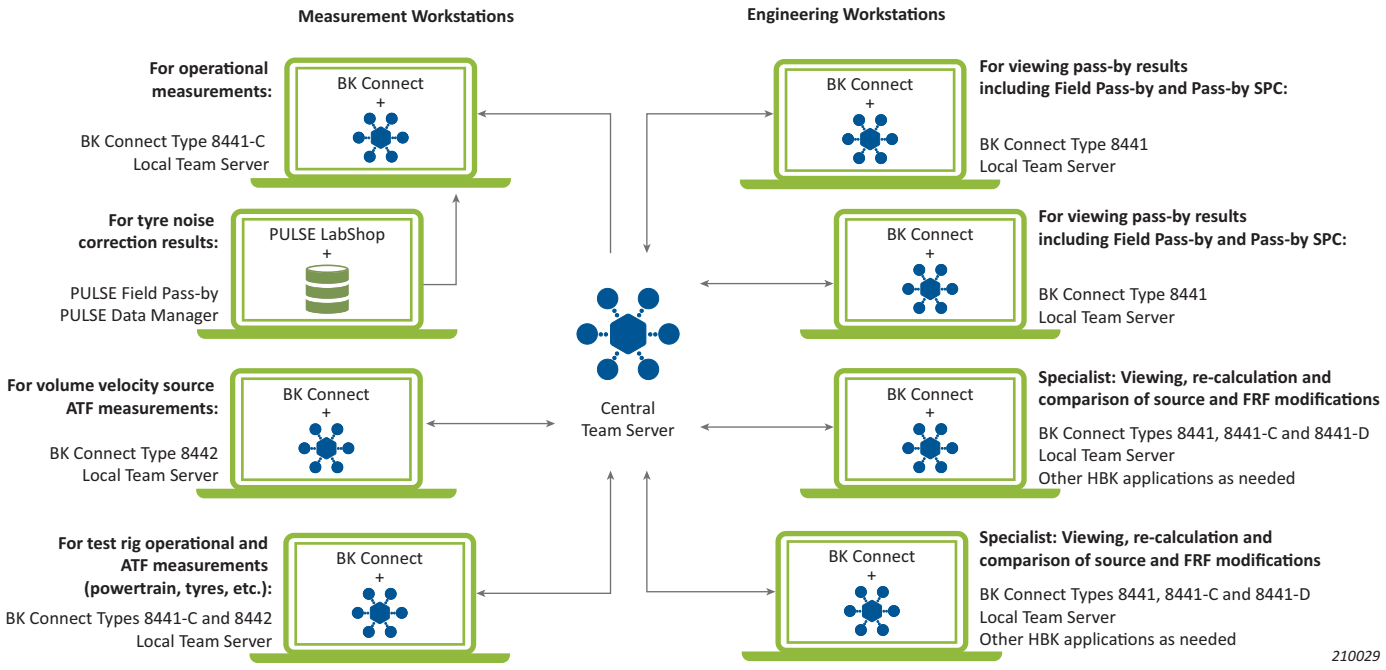
Type 8441 is the prerequisite for BK Connect Indoor Pass-by Type 8441-C and BK Connect Pass-by SPC Type 8441-D.

Team Server Concept

The Team Server concept enables data to be shared easily across organisations by storing data files in a central shared file repository that is accessible using standard Windows profiles. With Team Server automatically integrated in the Pass-by Viewer interface, results can be effortlessly inspected by any tester or engineer with access to the shared file repository – including those working remotely. The file repository is, by default, local on the measurement PC, but it can also be in a shared folder on the network which enables collaborative working across the organisation. Access can be extended to engineers from partner companies if access privileges have been granted.

The repository, whether local or shared, is automatically indexed by the Team Server to enable powerful data searches in BK Connect.

Fig. 3 *The Team Server integration in the BK Connect Indoor Pass-by suite*



BK Connect Indoor Pass-by Type 8441-C

BK Connect Indoor Pass-by is designed for easy operator setup and execution of indoor pass-by measurements. It is designed around the standard test method described in ISO 362-3, and specified in UN regulation R51, but can also be used in smaller, non-standard test chambers when type certification is not required, for example in development testing or troubleshooting.

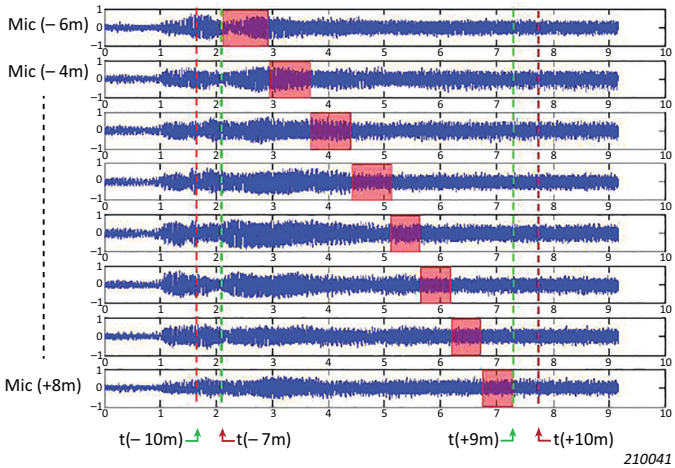
The measurement process is based on a test plan which is created automatically from the test setup and which can be automated to minimise interaction by the operator during the test. If manual interaction is preferred, for example when troubleshooting, automation can be switched off.

The operator follows the test plan and is given feedback to help ensure that a full set of valid data is acquired. At any time during or after the execution of the test plan, the operator can inspect the underlying data – speed curves, sound vs position, or 1/3-octave spectra vs position - from any run to assess data validity and quality.

All data is stored automatically in the Team Server file repository, which may be local to the test PC or in a shared location on the network.

Synthesizing of Time Signals

Fig. 4 *Example of time signal synthesis*



The time signals from the individual pass-by array microphones are added together and Doppler corrected to synthesize the two (left and right) ISO microphone signals.

A normal pass-by calculation is subsequently done on the synthesized signals.

The software has an intuitive, task-oriented workflow:

- **Model task**: For definition of microphone layouts, acoustic centres, and vehicle dimensions
- **Set Up task**: For setting parameters for measurement hardware, data acquisition and signal processing
- **Measure task**: For making, storing, and sharing measurements
- **View task**: For viewing, comparing, and reporting results

Model Task

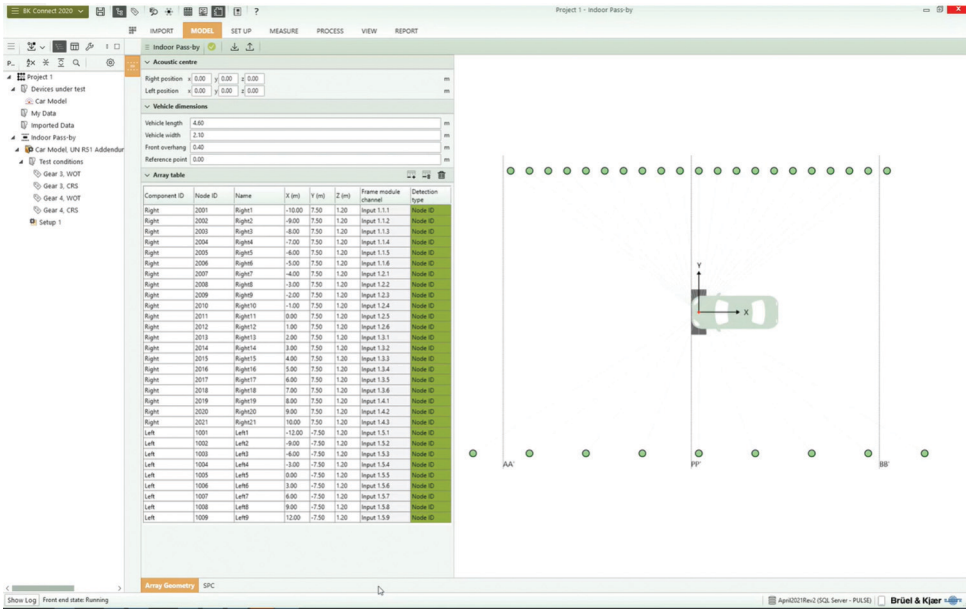
The Model task is used to define the microphone layouts, acoustic centres and vehicle dimensions.

Model definition can be performed directly in the Indoor Pass-by software, or off-line in Microsoft® Excel® allowing you to define the setup in advance of the physical test or from another workstation. The test operator can simply import the predefined Excel file for quick setup at test time.

When details are known ahead of time, you can start defining the model in the Indoor Pass-by software then export the data in Excel format for editing and storing, and later imported to BK Connect in one step. This helps avoid error-prone manual entry of vehicle and test information.

If acquiring additional data for SPC, the model expands to include similar information about the indicators and sources. This model is used by BK Connect VVS Measurement for ATF measurements and BK Connect Pass-by SPC for building the SPC data model.

Fig. 5 *The indoor pass-by model as presented in the user interface*



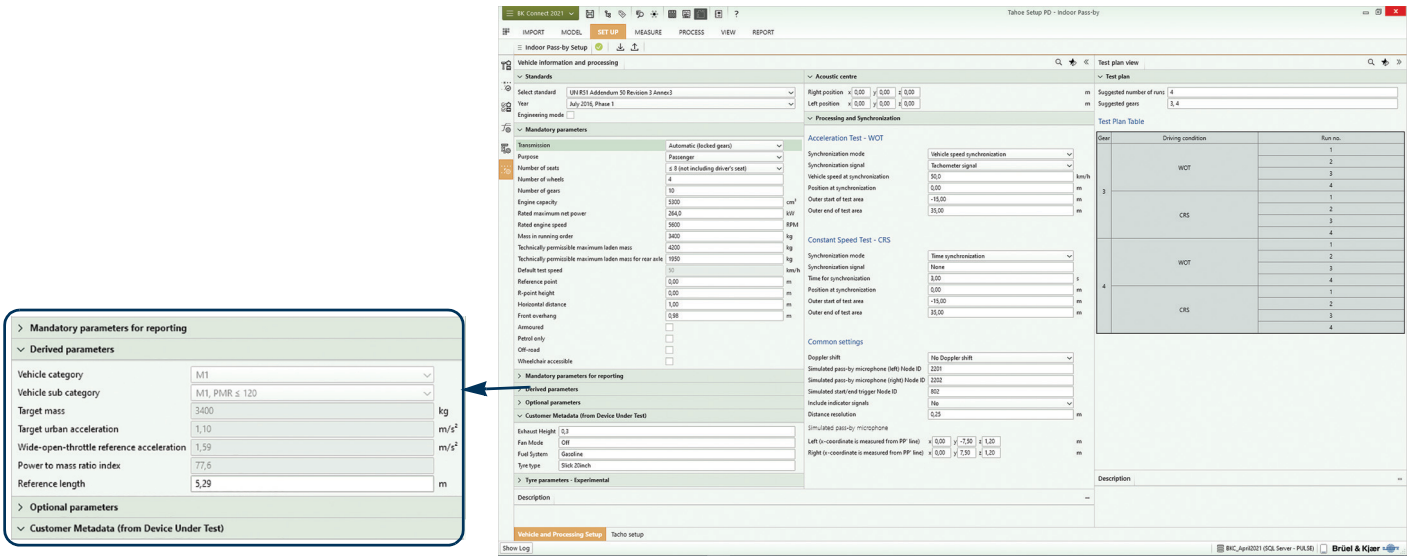
Set Up Task

The Set Up task is where you will define:

- **The test procedure:** Based on regulation R51 or using an ad hoc Engineering mode, which may itself be based on a regulation
- **Mandatory parameters:** As required by the selected regulation
- **Additional user- defined parameters**
- **Processing parameters:** The type of speed signal (tachometer pulse train or speed profile) to be used, the triggering method for defining virtual track position, and whether to use Doppler effect simulation, etc.
- **Vehicle operating conditions:** The gears to be used, acceleration conditions, required number of runs, etc.
- **Instrumentation setup:** Measurement hardware, data acquisition and signal processing

As seen in the Model task, the setup parameters can be exported to and imported from Microsoft Excel allowing you to prepare the setup ahead of time outside the Indoor Pass-by software.

Fig. 6 *The setup screen for defining vehicle information and processing parameters. All of this information can be exported to an Excel file. The highlighted section is the Derived Parameters used in reporting*



All mandatory parameters required by the regulations are defined as default values. The derived parameters, which are used for reporting purposes, are calculated based on the mandatory input. For example, the power to mass ratio index is calculated from the power and mass parameters entered in the mandatory parameter section.

As speed information is critically important for pass-by data processing, there is a dedicated sub-task, Tacho Setup, for tachometer and speed signal setup. The software works either with a tachometer pulse train from the dynamometer or from an analogue speed signal.

Fig. 7 *The Tacho Setup sub-task showing real-time monitors for validation*

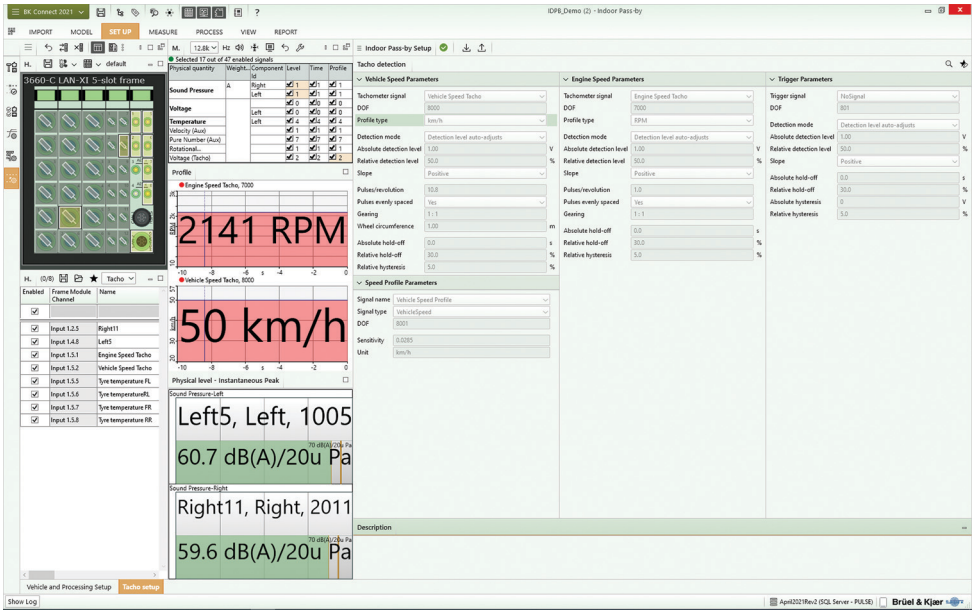
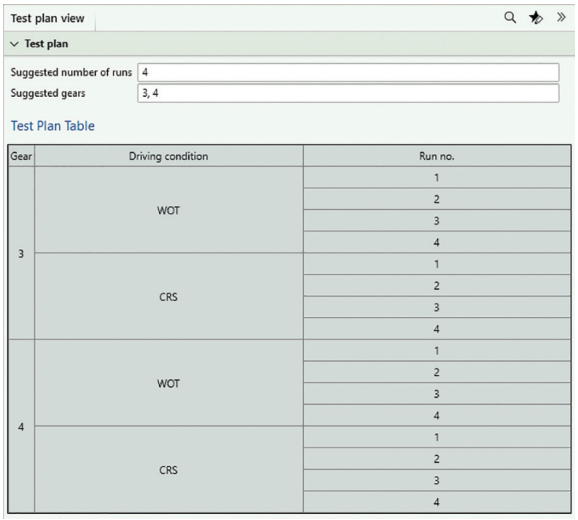


Fig. 8 *The Test Plan in the Set Up task*



Gear	Driving condition	Run no.
3	WOT	1
		2
		3
		4
	CRS	1
		2
		3
		4
4	WOT	1
		2
		3
		4
	CRS	1
		2
		3
		4

With setup complete, the vehicle operating conditions are used to generate a test plan for the complete set of measurements.

Calibration Check

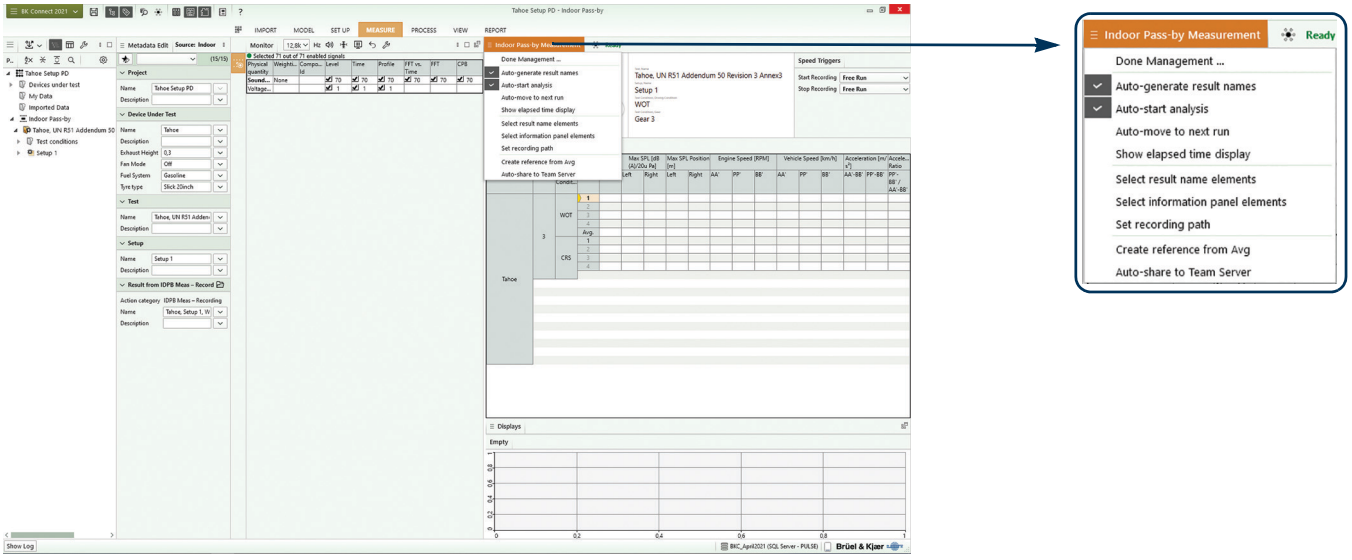
With the Transducer Verification setup task, you can perform a calibration check and verify that transducers are functioning correctly.

Measure Task

The measurement user interface, see Fig. 9 and Fig. 10, shows the test plan with the list of runs that are required to fulfil the test. A simple set of controls enables the start of recording after which, depending on the trigger setup, processing starts. Once processing is completed, the table updates to show a set of pass-by noise parameters, including:

- Max A-weighted SPL on left and right side
- Max SPL position on left and right side
- Engine Speed at AA', PP' and BB' lines
- Vehicle Speed at AA', PP' and BB' lines
- Acceleration from AA' to BB', and from PP' to BB'
- Acceleration ratio PP'-BB'/AA'-BB'

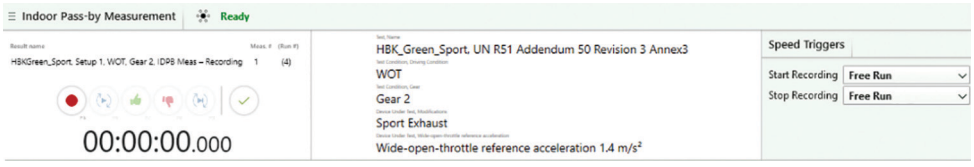
Fig. 9 *The measurement user interface including the test plan run table, linked displays, measurement controls, key metadata display (which can be customised) and trigger setup for the recording. Click the header menu to set up the measurement interface to suit your needs and automate measurement steps*



You can set up elements in the measurement interface (time display, result name display, recording path, etc.) as well as activate measurement automation such as auto-start, auto-generation of names, and auto-sharing to Team Server, to customize and simplify the measurement process.

During measurement, you can also tear-off, resize and move the control panel and result displays as needed. You can even move the torn off displays to another PC monitor.

Fig. 10 *The measurement user interface including the test plan run table, linked displays, measurement controls, key metadata display (which can be customised) and trigger setup for the recording*



Processing and calculations are performed automatically after each recorded run. If the run is valid according to the regulations, a green thumbs-up symbol appears in the status column and the operator can continue with the next run. If not, then a red thumbs-down symbol appears and colour-coded icons indicate which parameters are causing the problem. An explanation, including a reference to the relevant section in the regulations, can be found by hovering over an icon. Different icon colours indicate whether the information is advisory (grey icon), a warning (blue icon) or cause for an invalid run (red icon). This helps the operator to decide what corrective action is needed.

As successive runs of a driving condition are performed, they are averaged together as a group and the averaged results are shown in the run table. Only valid runs are included in the group average with warning icons if the runs fail to meet the required run-to-run consistency. The software auto-selects runs (green check mark symbol) that meet the criteria set out in the regulations; for example, UN R51 requires four successive runs within 2 dB(A) of each other.

The underlying data (speed profiles and 1/3-octave spectra) are viewed by selecting individual cells in the table. The displayed data depends on which cell is selected. If, for example, a speed parameter is selected, the speed profile vs position is displayed. If a noise level is selected, the SPL curve and third octave spectra vs position are displayed. If more than one run is selected, the data are overlaid.

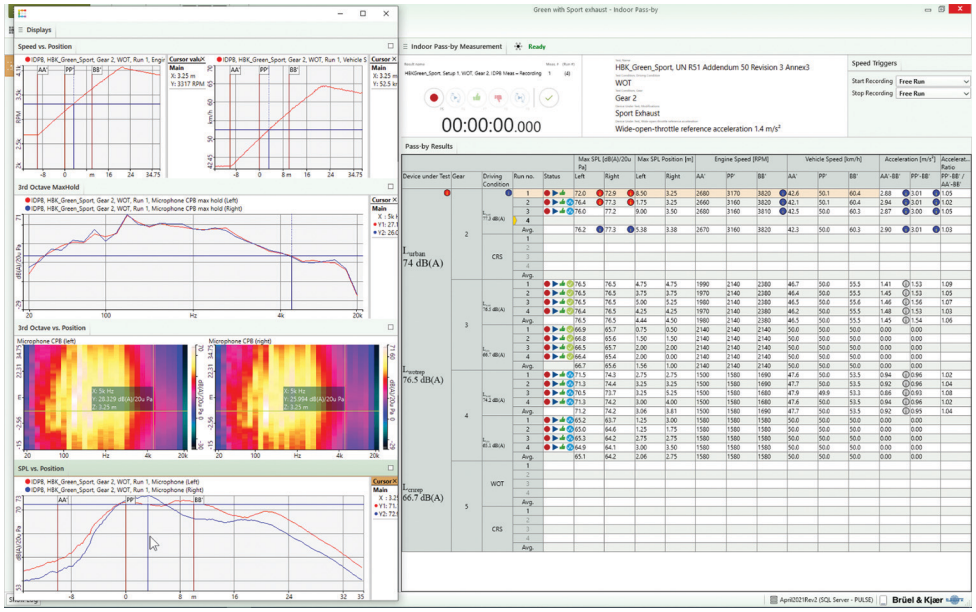
The storage location of test data and results is defined during setup so that as soon as a measurement run is completed, the data is stored and available in that repository.

Stored data includes:

- Raw recording
- Stitched recording of simulated pass-by test
- A-weighted SPL vs position, 1/3-octave waterfalls vs position
- Calculated scalars and 1/3-octave maximum:
  - Maximum A-weighted SPL on left and right sides
  - Position at maximum SPL on left and right sides
  - Engine speed at AA', PP' and BB' lines
  - Vehicle speed at AA', PP' and BB' lines
  - Acceleration from AA' to BB' and from PP' to BB'
  - Acceleration ratio PP'-BB'/AA'-BB'
- 1/3-octave spectrum at position of maximum SPL
- Average results: Average result of processed 2D, 3D and calculated scalars and average 1/3-octave at max
- Total results: L_{urban}, L_{WOT}, L_{CRS} calculations according to regulation

Processed results, once stored in the Team Server file repository can be viewed in the Pass-by Viewer task.

Fig. 11 Test plan after completing all necessary measurements. The green check mark icons show that the third gear runs are sufficient for the regulation. The other runs are not needed for the regulation but help give a more complete picture of the vehicle's pass-by noise performance



Data (re-)processing

BK Connect Indoor Pass-by can also be used just for the processing of pass-by data. A tester can use the software to run measurements and record data, then later import the recordings for processing. Alternatively, an engineer in another office can import the recordings from the repository and process the data.

After importing a set of recordings, the indoor pass-by measurements task presents the test plan and enables processing to be done, either on all runs automatically, or run by run if more control is desired. The user interface functions just as it does during live measurements. The setup can also be modified, in case changes in metadata are required, or processing parameters need to be changed.

Tyre noise correction

Indoor pass-by simulation has been shown to correlate well with outdoor pass-by when track-based tyre noise is taken into account. This requires a procedure for adjusting the indoor result using an outdoor measurement on an ISO-compliant road surface. This is known as tyre noise correction (TNC). As tyre noise on dyno rollers is different by nature from that on a test track, the ISO standard requires a set of outdoor measurements on a pass-by track that is processed into a set of parameters to correct the noise curve from the indoor test.

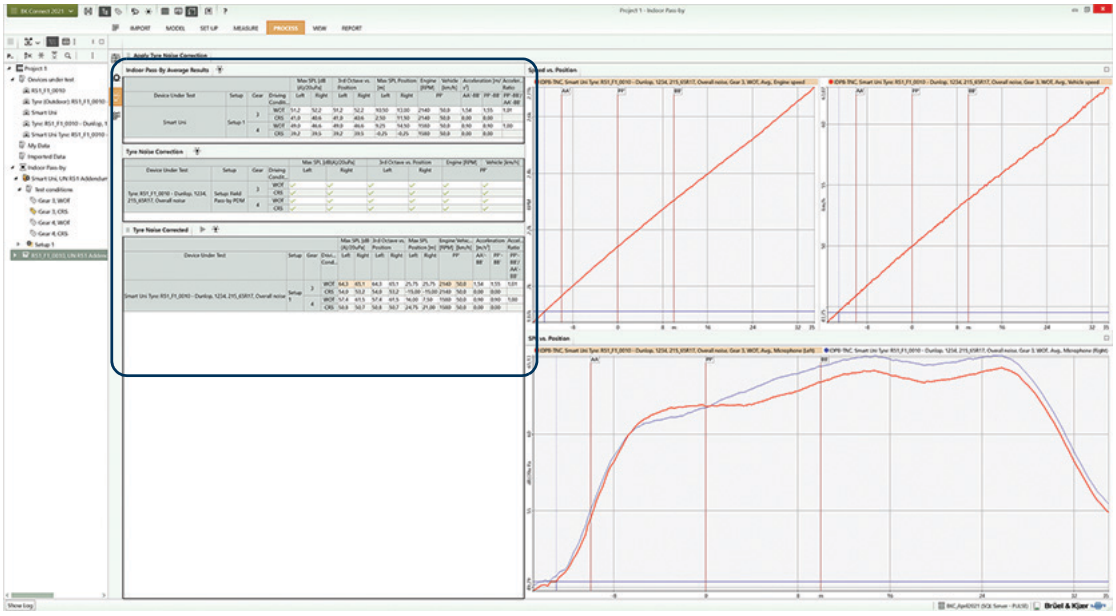
BK Connect Indoor Pass-by supports three TNC methods allowing you to obtain results that are comparable to typical pass-by type approval tests and to correct for tyre noise during development or design optimisation:

- **Standard-based method:** As described in ISO 362-3:2016, this method entails outdoor measurements that are similar to a pass-by noise test, except an electrically powered vehicle and low-noise/slick tyres are typically used to minimize noise emissions (except for tyre/road noise). The TNC coefficients are calculated by regression analysis (in PULSE Vehicle Pass-

by Type 7788) and used in the Indoor Pass-by software to correct all runs in the active test plan. A library of TNC coefficients can be created so that the indoor result can be corrected for different tyres

- The other two methods are purely for vehicle development and design optimisation purposes and may be simpler to use:
  - **Overall method:** This method subtracts the indoor pass-by curve from an outdoor pass-by result performed in the same driving condition on the same (or similar) test vehicle. The tyre noise contribution in the indoor test can be minimized using low-noise/slick tyres
    The resulting TNC curve can then be applied as above on a complete test plan provided all the relevant correction curves are available from the different gears and driving conditions
  - **Source-indicator method:** This method uses a complete SPC model with all source indicators for the indoor measurement, and only the tyre indicators for the outdoor measurement. The same test vehicle and tyres are used, and the indicator microphone positions must be identical. Unlike the other two methods, as SPC is used to calculate individual contributions, regular tyres can be used for both the indoor and outdoor tests.
    The crosstalk from all non-tyre sources in the indoor test is then subtracted from the tyre noise contribution in the outdoor test. The outdoor test, having only the tyre indicators, includes crosstalk from the other sources, so the end result is the outdoor tyre noise contribution itself with crosstalk removed. This TNC curve can then be applied as in the overall method

Fig. 12 *Tyre Noise Correction sub-task. The highlighted section comprise: (from the top): the original indoor pass-by results; the tyre noise correction data; the corrected indoor pass-by results*



Further post-processing of pass-by data

To aid deeper investigation into specific noise problems, additional signals, either from extra transducers on or around the vehicle or from the vehicle CAN bus, may be acquired and processed along with the pass-by data. General NVH analysis, such as narrow-band FFT analysis or order analysis, may be performed in the Time Data Processing task directly in the software or by opening the Data Processing application to gain insights in problem areas. Both options require a BK Connect Data Processing (advanced) Type 8403-A licence.

Source path contribution (SPC) analysis is a powerful method for breaking down the measured sound into contributions from suspected sources such as the engine (or motor), drive train, exhaust, and tyres. Groups of indicator microphones to be placed around each suspected source so that their operating data, combined with acoustic transfer functions are measured from sources to indicators and from sources to pass-by array microphones are combined to calculate each source contribution to the overall pass-by result.

Having found the dominant source, or sources, development efforts are then focused on achieving an optimum engineering solution bringing the pass-by levels to target. This may involve modifying sources, or modelling them using simulation techniques before using them in an SPC vehicle model to predict the overall pass-by result.

Specifications – BK Connect Pass-by Software

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

Supported Standards

Pass-by noise testing of accelerating road vehicles according to ISO 362-3 for M and N category vehicles (light vehicles, buses, and trucks) plus L category vehicles (two and three wheelers).

Conformance to UN regulation R51.03, noise emission of M1, M2 (below 3500 kg) and N1 category vehicles

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 8441-C: 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 8441-C: 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). Required for real-time measurements and recording

* 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 – BK Connect Pass-by Viewer Type 8441

Software Prerequisites

- BK Connect Data Viewer Type 8400 or 8400-NT

Team Server

EXPORT	• Measurement and analysis files saved and exported to folder via the Project Browser • Does not require Microsoft SQL database
IMPORT	• Import data directly in BK Connect project
FILE FORMAT	• Works for all of file types supported by BK Connect, however the .bkc file has more attributes available to be indexed
SEARCH DATA	• Search using multiple attributes (metadata) • Two search methods: – Basic: Select search criteria from dropdown menu – Advanced: Build search string using standard query syntax • Search strings can be stored as favourites for future reuse • Get overview of query results in Results Matrix • Select one or more results in matrix and view and inspects data in Results Display

Import/Export

IMPORT/ EXPORT	Based on Team Server
SUPPORTED FILE TYPES	• .bkc (BK Connect native format) – both function and time data • .csv (based on a predefined format) for vehicle model • .xls (based on a predefined format) for vehicle model
IMPORT FROM PULSE DATA MANAGER (PDM)	• Data in PDM database must include PULSE pass-by data

Data Display

VIEWER

Designed specifically to show and compare pass-by data from Indoor Pass-by, Field Pass-by and Pass-by SPC

Data Selection	• Uses Team Server to query data in files stored in the Team Server file repository
Data Viewing	• Queried data automatically sorted into a test plan view that shows the numerical results and status icons associated with each run and run group average in a table • Can view and compare multiple data sets from different tests on different vehicles or different vehicle variants • Display panel can be undocked and moved to another computer screen • Displays: – Speed curves – 1/3-octave spectra at max SPL position – A-weighted SPL vs position – 1/3-octave waterfall spectra vs positions
Data Comparison	• Select cells in the table to view underlying data • Select a row to view all the data for the selected run • Cursors between the SPL vs position curves and 1/3-octave plots are linked • Selecting from multiple rows compares (overlays) data for those runs
Data Reporting	• Results can be exported to CSV files for reporting

GRAPHS

Graph Types	Display of functions in a range of graph types including: • Colour contour • Bar • Curve • Curve (step) • Overlay • Overlay (all) • Line
Superimposed Graphs	A number of functions can be superimposed on the same curve graph
Axes	• X-axis Scale: Linear, logarithmic and CPB • Y-axis Scale: Linear, logarithmic and dB • Z-axis Scale: Linear and logarithmic
Alignment	Cursors in different displays can be synchronized to allow the changes to one display to be reflected in other displays showing the same or different functions

Specifications – BK Connect Indoor Pass-by Type 8441-C

Software Prerequisites

- BK Connect Native File Importer Type 8400-B – for access to PULSE Data Manager
- BK Connect Pass-by Viewer Type 8441
- 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

Import/Export

IMPORT	• Import model from Microsoft Excel • Import time and function data via Team Server (.bkc format)
EXPORT	• Export model to Microsoft Excel for off-line editing • Export recording and processed data (.bkc format)

Stored Data

Data Type	• Raw recording of all channels • Stitched recording of simulated pass-by test • A-weighted SPL vs position, 1/3-octave waterfalls vs position • Calculated scalars and 1/3-octave maximum: – Maximum A-weighted SPL on left and right side – Position at maximum SPL on left and right side – Engine speed at AA', PP' and BB' lines – Vehicle speed at AA', PP' and BB' lines – Acceleration from AA' to BB' and from PP' to BB' – Acceleration ratio PP'-BB'/AA'-BB' • 1/3-octave spectrum at position of max SPL • Average results: Average result of processed 2D, 3D and calculated scalars and average 1/3-octave at maximum • Total results: L_{urban}, L_{WOT}, L_{CRS} calculations according to regulation

Model

The model in indoor pass-by consists of:

ARRAY GEOMETRY

Vehicle Geometry	• Length • Width • XYZ location relative to the room coordinate system
Acoustic Centre	• Locations relative to the room coordinate system
Microphone Array Information	• Node ID information (component ID, node ID and name) • XYZ locations relative to the room coordinate system • Connectivity to the data acquisition front end

SPC

If acquiring additional data for source path contribution (SPC), the model expands to include similar information about the indicators and sources. This model is used by BK Connect VVS Measurements for acoustic transfer function (ATF) measurements and BK Connect Pass-by SPC for building the SPC data model

Model Creation	• Define within software or load from Microsoft Excel. Define/show: – IDs, DOFs, and XYZ locations of SPC sources – IDs and DOFs of SPC indicators – Measurement method for ATF measurement • The model can be stored to Excel for further editing and/or future use • Show connection status of all source and indicator microphones to the measurement hardware

Setup

The setup has a number of tasks and sub-tasks to set up the instrumentation: LAN-XI front end, transducers and CAN bus. Instrumentation setup and calibration check is done using the standard features of BK Connect Hardware Setup

VEHICLE AND PROCESSING SETUP

The following is applicable whether testing according to regulations (R51) or using the ad hoc engineering mode, which may be based on regulations

Mandatory Parameters	As required by the selected regulation
Processing Parameters	Such as: • Type of speed signal (tachometer pulse train or speed profile) • Triggering method for defining virtual track position • Use of doppler effect simulation
Vehicle Operating Conditions	• Gears to be used • Acceleration conditions • Required number of runs (used to generate a test plan for the complete set of measurements)
Additional	User-defined parameters

TACHO SETUP

Tacho Setup task helps ensure good quality speed information by allowing you to adjust the tachometer settings while observing their effect on the speed signals in real time

CALIBRATION CHECK

With the Transducer Verification setup task, perform a calibration check and verify that transducers are functioning correctly

Measurement

USER INTERFACE	Test plan with the list of runs that are required to fulfil the test
CONTROLS	• Start of recording
RESULTS	Set of pass-by noise parameters, including: • Max A-weighted SPL on left and right side • Max SPL position on left and right side • Engine Speed at AA', PP' and BB' lines • Vehicle Speed at AA', PP' and BB' lines • Acceleration from AA' to BB', and from PP' to BB' • Acceleration ratio PP'-BB'/AA'-BB'

Post-Processing

Post-process Indoor Pass-by recordings in Pass-by Viewer task. Import recording to test plan interface. The recordings appear as multiple runs in the test plan

Tyre Noise Correction (TNC)

METHOD	• Standard method – ISO 362-3 Appendix B Variant A (referenced by UN ECE R51-03) requires a set of outdoor measurements on a pass-by track that is processed into a set of parameters to correct the noise curve from the indoor test. Uses the TNC coefficients derived from regression analysis of acceleration and constant speed measurements in an outdoor test on an ISO 10844 surface • Overall noise method – a simple correction in which the indoor pass-by measurement, configured to minimize tyre noise (e.g. using slick tyres), is combined with and an outdoor pass-by measurement, using a silent powertrain (usually electric propulsion) with the desired set of tyres • SPC source-Indicator method – a more sophisticated correction using a full SPC model of indoor pass-by noise combined with a partial SPC model of outdoor pass-by noise
MEASUREMENTS	• For the standard method, outdoor measurements are made with a quiet powertrain or electric vehicle • For the two non-standard methods, measurements are made on the same (or similar) test vehicle both indoors and outdoors. Speed profiles for both indoors and outdoors must match • Driving conditions are those of the standard pass-by test: constant road speed and/or full (WOT) acceleration,

Ordering Information

Type 8441	**BK Connect Pass-by Viewer**
Type 8441-C	**BK Connect Indoor Pass-by**

REQUIRED SOFTWARE

Type 8400-X	BK Connect Data Viewer
Type 8400-B-X	BK Connect Native File Importer – for access to PULSE Data Manager
Type 8401-X	BK Connect Hardware Setup – for real-time recording and measurement
Type 8401-A-X	BK Connect Hardware Setup (advanced) –for real-time recording and measurement using more than two LAN-XI data acquisition modules
Type 8403-A-X	BK Connect Data Processing (advanced) – required for the Time Data Processing task for general analysis and post-processing

OTHER PASS-BY SOFTWARE

Type 8441-D	BK Connect Pass-by SPC
Type 8442	BK Connect VVS Measurements

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-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

DATA RECORDING APPLICATION MODULES

Type 8402-X	BK Connect Time Data Recorder

DATA PROCESSING APPLICATION AND OPTION MODULES

Type 8403-X	BK Connect Data Processing
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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