

## BRÜEL & KJÆR® NVH Solutions

### VSound Type 3115 In-vehicle Virtual NVH Prototype Evaluation System

VSound™ is a sound-generating system for experiencing new vehicle sounds from both a vehicle interior and exterior perspective. Its primary purpose is in-vehicle virtual NVH prototype evaluation.

VSound delivers exceptionally high-quality audio signals – from complete engine sounds to simple looped sounds – using similar audio algorithms as the Brüel & Kjær NVH Simulator. To control the sound output, VSound uses vehicle parameters such as throttle, rpm and speed from the CAN bus system.

The multi-channel digital signal processor (DSP) in the VSound system can be used to provide synchronized signals for speakers or other dynamic actuators and simultaneously generate independent sounds both inside and outside the vehicle.

Seamlessly integrated with the NVH Simulator's Desktop Simulator (DTS) and Exterior Sound Simulator (ESS), VSound is part of a suite of tools engineers use to design, check, evaluate and deliver interior and exterior vehicle sounds for vehicles of any configuration, including electric, hybrid, conventional internal combustion (IC) power trains, and any other vehicle/power train design.



#### Uses and Features

##### Uses

- Back-to-back NVH comparison of benchmark vehicles in one vehicle
- Virtual NVH prototype evaluation of sounds in the context of a real vehicle
- Evaluate targets, candidate sounds and sound delivery strategies on a real vehicle for:
  - Final tuning
  - Demonstration
  - Sign-off by senior management
  - Long-term trial on public roads

##### Features

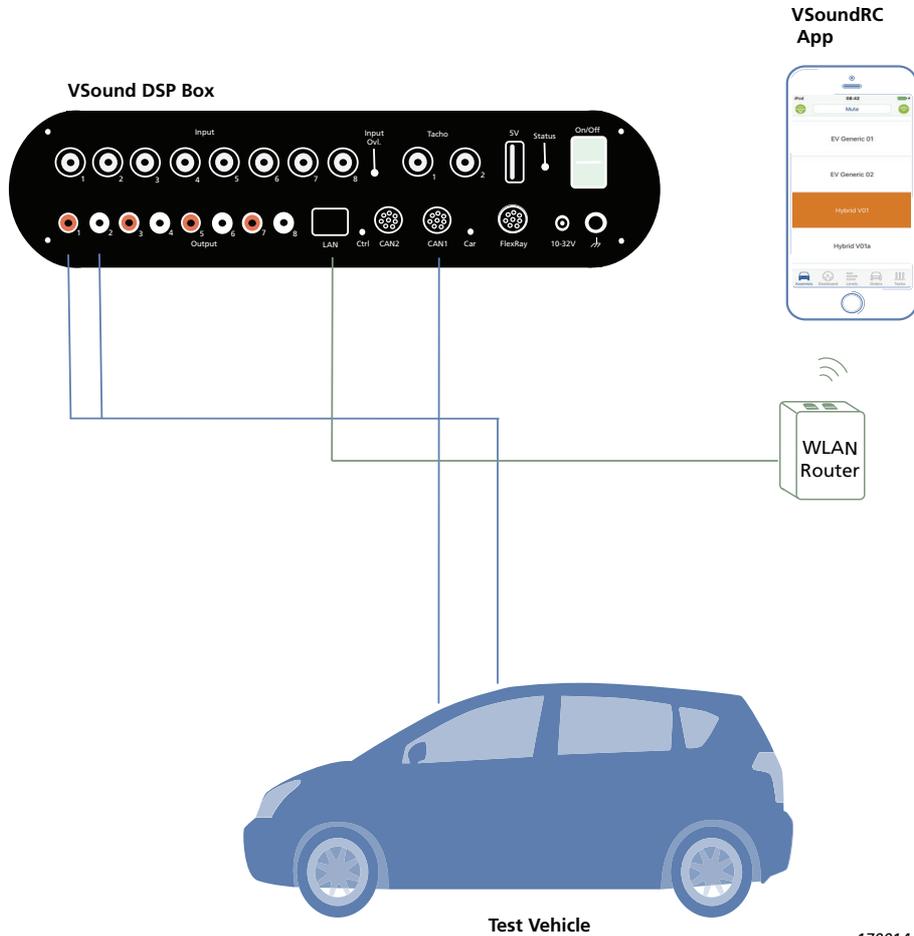
- Easy switch between a series of loaded sounds using a remote control app on an iOS mobile device (iPod touch® or iPhone®)
- Easy interaction between VSound and the NVH Simulator
- Stand-alone simulation (no PC required in vehicle)
- Pseudo vehicle performance model

## The VSound System

The heart of the VSound system is the VSound DSP Box. The DSP Box connects to the vehicle CAN bus system for parameters such as vehicle speed, engine and/or motor rpm, pedal position, gear selection, and other parameters as needed. One to eight outputs are then sent to the existing audio system of the vehicle, a completely separate set of speakers or dynamic

actuators. Operation of the VSound system, including selecting the virtual vehicle sound and monitoring the functions, is performed via a wireless connection to an iPhone or iPod touch that has the VSoundRC app installed.

Fig. 1 The in-vehicle virtual NVH prototype evaluation system

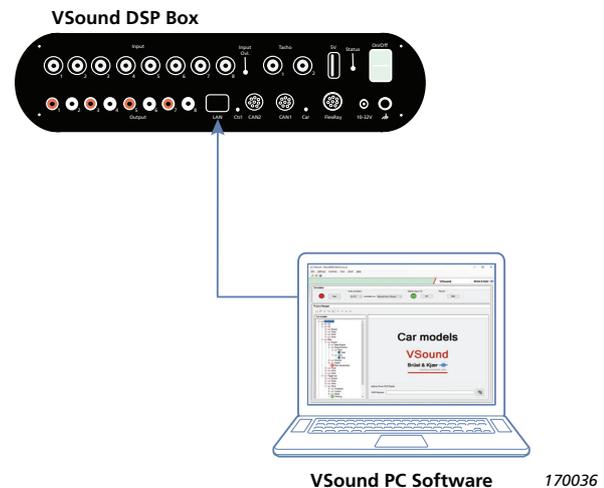


### Configuration of the System

VSound PC Software Type 8601-V is used to configure and fine-tune the virtual vehicle sound models. Then with the PC connected to the VSound DSP Box via LAN cable or wireless connection, you can upload the data and place the virtual vehicle sounds in the box.

You can also connect to the DSP Box in the office via the VSound PC Software interface. Then, attaching a speaker or headphones to DSP Box outputs allows you to validate the sound models before installation in the vehicle (as shown in Fig. 3).

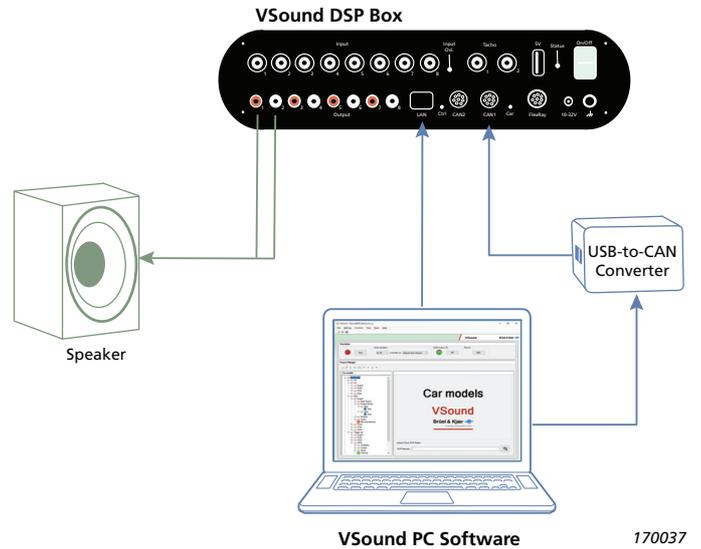
Fig. 2 Upload virtual vehicle sounds from the VSound PC Software to the VSound DSP Box



If you connect the PC to the DSP Box's CAN channel using a USB-to-CAN converter, you can send CAN-based vehicle parameters for virtual simulation on the VSound PC Software user interface. You can then adjust and configure the sounds as needed.

All hardware accessories mentioned here, namely the USB-to-CAN converter and WLAN router, are provided together with the VSound DSP Box Type 3115. The complete system solution includes VSound PC Software and VSoundRC (remote control) app. See Ordering Information on page 6 for accessory details.

Fig. 3 Try out and adjust the sounds at your desk before installing in a vehicle



## Using the System

### Digital Signal Processing with the VSound DSP Box

The box is the DSP unit for the system. It allows you to upload and download settings for use during simulation and includes:

- 8 input channels with CCLD\* power
- 8 output channels
- 2 tacho connectors
- 2 CAN bus connectors
- FlexRay™ bus connector

During set-up and configuration, connect the VSound DSP Box to the PC installed with VSound PC Software to update firmware and upload the following data:

- Sound data
- General simulation parameters
- CAN bus set-up
- CAN signals

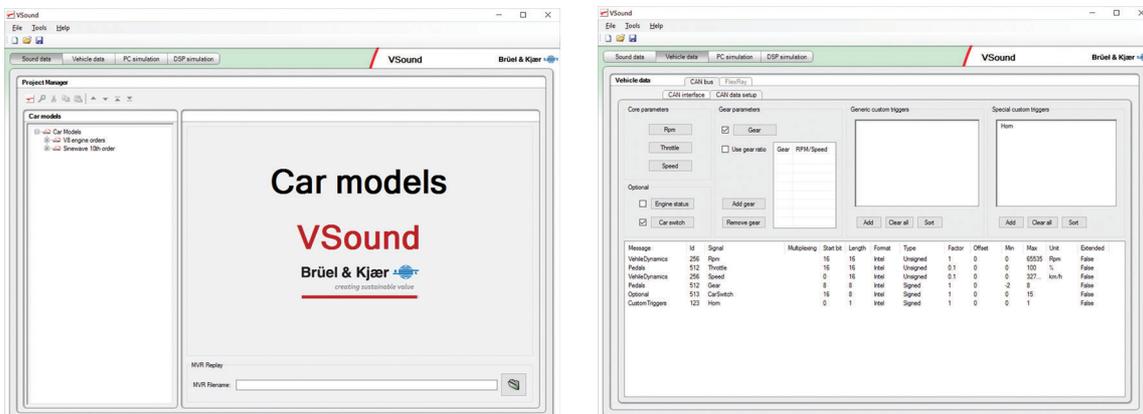
During simulation, the VSound DSP Box's powerful capabilities are similar to the Desktop NVH Simulator (DTS) for sound generation and evaluation. Data is shared between the CAN bus, VSound PC Software and the VSoundRC app, allowing you to easily control the simulation and monitor results.

### Configuration and Management of Data Using VSound PC Software

VSound PC Software is integral to configuring the system. With the PC connected to the VSound DSP Box, you can upload and set various parameters such as:

- Drive control
- Analogue tacho input
- Input channel selection
- Edge detection threshold
- Signal specification
- Analogue tacho output
- Routed analogue input versus simulation tacho
- Custom triggers
- Binary CAN data (for example, confidential data)
- Signal specification
- RPM
- Throttle
- Vehicle speed
- Engine status
- Car switch
- Gear
- Signal parameters

Fig. 4 Examples of the user interface of VSound PC Software. Select the vehicle model and sound data (left image) and vehicle data from CAN bus or FlexRay (right image)

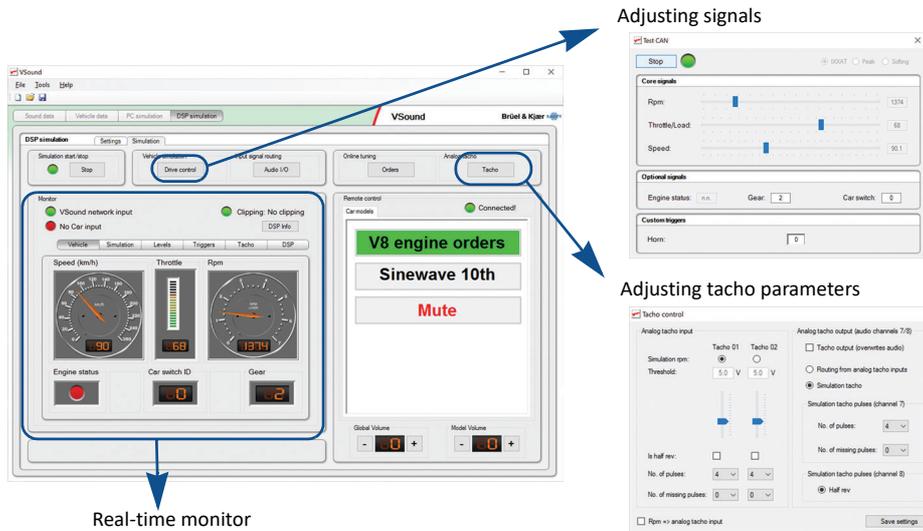


\* CCLD: Constant current line drive, also known as DeltaTron™ (IEPE compatible)

If changes need to be made, simply tune the settings such as tacho, CAN drive controls, and volume and vehicle assembly selection. The on-screen displays allow you to monitor changes as you make them, and if a speaker or set of headphones is attached, you can listen to the changes in real time.

The PC Software interface shows the same simulation controls that are available on the remote control app, VSoundRC, allowing for monitoring and control from a central location during testing, if needed.

Fig. 5 DSP controls via the VSound PC Software



In addition, you can import models from NVH Simulator software DTS (in-vehicle sounds) and ESS (external sounds) software. Together, this suite of applications enable an efficient process for designing and confirming interior and exterior sounds of vehicles.

### Simulation Using the VSoundRC App

For a truly immersive and uncomplicated test scenario, control and monitoring of the simulation has been placed in the palm of

your hand. With the VSoundRC app installed on an iPhone or iPod, you can easily switch between vehicle sounds, adjust the volume, load specific vehicle data, and adjust tachometer parameters.

The VSoundRC app is available for free download on the App Store<sup>SM</sup>.

Fig. 6 Examples of control interfaces available via the VSoundRC app on an iPod touch with iOS 10.2.1



## Compliance with Standards

	<p>The CE marking is the manufacturer's declaration that the product meets the requirements of the applicable EU directives</p> <p>RCM mark indicates compliance with applicable ACMA technical standards – that is, for telecommunications, radio communications, EMC and EME</p> <p>China RoHS mark indicates compliance with administrative measures on the control of pollution caused by electronic information products according to the Ministry of Information Industries of the People's Republic of China</p> <p>WEEE mark indicates compliance with the EU WEEE Directive</p>
<b>Safety</b>	<p>ISO 16750–2:2012: Road vehicles – Environmental conditions and testing for electrical and electronic equipment -- Part 2: Electrical loads</p> <p>VW 80000:2013: Electric and Electronic Components in Vehicles up to 3.5 t – General Requirements, Test Conditions and Tests</p>
<b>EMC Emission</b>	<p>EN/IEC 61000–6–3: Generic emission standard for residential, commercial and light industrial environments</p> <p>EN/IEC 61000–6–4: Generic emission standard for industrial environments</p> <p>CISPR 22: Radio disturbance characteristics of information technology equipment. Class B Limits</p> <p>FCC Rules, Part 15: Complies with the limits for a Class B digital device</p> <p>This ISM device complies with Canadian ICES–001 (standard for interference-causing equipment)</p>
<b>EMC Immunity</b>	<p>EN/IEC 61000–6–1: Generic standards – Immunity for residential, commercial and light industrial environments</p> <p>EN/IEC 61000–6–2: Generic standards – Immunity for industrial environments</p> <p>EN/IEC 61326: Electrical equipment for measurement, control and laboratory use – EMC requirements</p> <p><b>Note:</b> The above is only guaranteed using accessories listed in this document</p>
<b>Temperature</b>	<p>IEC 60068–2–1, IEC 60068–2–2 Dry heat, IEC 60068–2–14 Thermal Shock:</p> <p>Operating Temperature: –10 to +50 °C (+14 to 122 °F)</p> <p>Storage Temperature: –25 to +70 °C (–13 to +158 °F)</p>
<b>Mechanical</b>	<p>Non-operating:</p> <p>IEC 60068–2–27: Shock: 500 m/s<sup>2</sup></p> <p>IEC 60068–2–53: Random Vibration with Temperature Change</p> <p>IEC 60068–2–64: Broadband Noise Vibration</p>

## Specifications – Hardware

### VSound DSP Box Type 3115

#### ANALOGUE INPUT

8 × analogue input channels:

**Input Impedance:** >500 kΩ // <100 pF, single-ended

**Input Voltage (0 dB):** 5 V<sub>rms</sub> (0 dBV) with less than 0.1% THD @ 1 kHz

**Dynamic Range:** >105 dBA with 50 Ω input, re 1 V<sub>rms</sub> (equal to 5.6 μV)

**Input Frequency Range:** 10 Hz to 20 kHz ±1 dB

**Input Linearity:** 20 Hz to 15 kHz ±0.5 dB re 1 kHz

**Input Voltage Protection:** Up to ±35 V without destruction

**Overload Signal:** Enabled if input voltage is higher than 5 V<sub>rms</sub>

**CCLD Support:** All inputs support CCLD transducers with at least a 3.5 mA, ±1 mA current with an impedance of more than 100 kΩ @ 1 kHz. On/off switchable on each channel

#### TACHO INPUT

2 × analogue tacho inputs:

- Single-ended each on BNC connector
- Electrical DC-coupled
- Comparator with software controllable threshold voltage (individual for both channels) implements edge detection of input signal
- Each channel individually switchable to channel #7/#8 of analogue input (A/D conversion of waveform)

**Voltage Range:** –11 to +25 V

**Edge Detection Voltage Range:** 0 to +15 V

**Impedance:** 200 kΩ

**Effective Edge Detection Precision:** 1/(2,822,400 Hz) = 354.3 ns @ 44.1 kHz system sample rate

**Threshold Voltage:** 0 to +15 V, 4096 steps (3.66 mV) software controllable

**Waveform to Analogue Inputs #7/#8:** (24-bit/44.1 kHz) By relays, under software control

**Protection Max.:** ±35 V stationary, ESD protection

#### ANALOGUE OUTPUT

8 × analogue output channels:

- Single-ended, each on RCA connector
- Electrical AC coupled
- D/A conversion implemented in 8-channel Cirrus Logic® CS4385 (114 dB, 192 kHz, 24-bit, delta-sigma)

**Level:** 1 V<sub>rms</sub> (0 dBFS)

**Bandwidth:** 20 Hz to 20 kHz (±1 dB)

**Dynamic Range:** >110 dBA (for full bandwidth, –60 dBFS THDN method)

**Crosstalk Attenuation:** >105 dB (for full bandwidth, –1 dBFS, first output to others)

**THD+N:** <–95 dB (400 Hz to 20 kHz, –1 dBFS)

**Impedance:** 50 Ω

**D/A Conversion:** 24-bit/44.1 kHz

**Protection Max.:** ±35 V stationary, ESD protection

#### CONNECTORS

**Analogue Input Connectors:** Standard BNC

**Analogue Output Connectors:** RCA

**Tacho Input Connectors:** Standard BNC

**LAN Connector:** Type RJ45 with built-in LEDs showing Link and Activity

**Power Connector:** +5 V Power Out: USB Type A jack (4 position);

Capable of supplying 500 mA with short-circuit protection

**Ground Connector:** Can handle a standard banana plug and a wire

**CAN Bus Connector:** LEMO Type: 8-pin LEMO, ECG.1B.308.CLV

- Pin 3: CAN High

- Pin 4: CAN Low

- Pin 5: CAN\_VIN+

- Chassis: GND

- Pins 1, 2, 6, 7 and 8 – not connected

**FlexRay Bus Connector:** LEMO Type: 8-pin LEMO, ECG.1B.308.CLV

- Pin 1: BB\_P

- Pin 2: BB\_N

- Pin 3: BA\_P

- Pin 4: BA\_N

- Pin 5: FlexRay\_VIN+

- Chassis: GND

- Pins 6, 7 and 8 – not connected

### VSound PC Software Type 8601-V

#### RECOMMENDED PC CONFIGURATION

- Intel® Core™ i5 2.5 GHz processor, or faster
- At least 4 GB of memory
- 160 GB Solid State Drive (SSD) with 20 GB free space, or better
- 1 Gbit Ethernet connection
- Microsoft® Windows® 10 (x64)
- Adobe® Reader® 11
- RME Fireface UC external USB sound card

### Ordering Information

#### Type 3115 VSound Box

includes the following accessories:

- 2 × AO-0087-D-020: BNC-to-BNC Cable, 2 m (6.6 ft)
- 1 × AO-0803-D-020: Phono-to-Phono Stereo Cable, 2 m (6.6 ft)
- 1 × AO-0508-D-020: Phono-to-Mini Jack Cable
- 1 × ZG-0429: Standard LAN-XI Power Supply
- 1 × AO-0546: Car Utility Power Supply Cable
- 1 × AO-0797-D-020: VSound CAN Cable, circular-1B, 8-pin (M) to Sub-D 9-pin (F), 2 m (6.6 ft),
- 1 × AO-0799-D-030: CAN-to-OBD-II Cable, 8-pin LEMO to 16-pin OBD-II, 3 m (9.8 ft)
- 1 × AO-0798-D-002: CAN-to-CAN Emergency Reboot Cable, 8-pin LEMO, 0.2 m (0.6 ft)
- 1 × AO-1450-D-020: LAN Cable, 2 m (6.6 ft)
- 1 × UL-1028: ASUS® Portable Wireless N Router, model WL-330N, with cables
- 1 × ZG-0429: Standard LAN-XI Power Supply
- 1 × ZH-0716: IXXAT® USB-to-CAN<sup>V2</sup> Interface

#### Type 8601-V-N VSound Software Suite (node-locked licence)

includes the following:

- USB stick with software
- Quick guide
- Licence info
- Dongle

M1-8601-V-N Annual Software Maintenance and Support Agreement for Type 8601-V-N (required)

### VSoundRC App

Available for free download from iTunes® App Store

#### COMPATIBILITY

Requires iOS 10.0 or later. Compatible with Apple iPod touch® and iPhone® mobile devices

#### OPTIONAL ACCESSORIES

- AO-0796-D-020 FlexRay-to-Sub-D Cable, 8-pin LEMO to 9-pin Sub-D, 2 m (6.6 ft)
- UL-1057 iPod touch, model A1574, 4-in Retina display, 64 GB, space grey

#### RECOMMENDED THIRD PARTY ACCESSORIES

RAM® Mounts ([www.rammount.com](http://www.rammount.com)) iPod/iPhone car mounts, such as RAM-B-166-UN7U Suction Mount – for attaching mobile device to car windscreen



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