

# PRODUCT DATA

## PULSE™ Moving Source Option for Beamforming — BZ-5496

*PULSE Moving Source Option for Beamforming BZ-5496 is an option for PULSE Beamforming Type 8608.*

*Beamforming is a method of mapping noise sources by differentiating sound levels based on the direction from which they originate.*

*Moving Source Beamforming follows linear movement parallel to the planar microphone array and enables speed-position calculation from a radar signal, GPS or photocells. BZ-5496 also enables a display of mapping versus position and pressure contribution versus position and frequency at the same time.*

*BZ-5496 can also be operated as a stand-alone acquisition and analysis system with PULSE Acoustic Test Consultant (ATC) Type 7761.*



### Uses and Features

#### Uses

- Troubleshooting contribution during pass-by measurements
- Noise source location of noise radiated from moving vehicles, for example, cars, lorries and trains
- Mapping planes from the side (optionally, also from front and top) of the target vehicle
- Mapping higher frequencies than standard noise source location methods
- Presenting and communicating results and ideas through features such as AVI files
- Component pressure contribution analysis

#### Features

- Outward-looking array, which allows mapping targets much larger than the array itself
- Automatic Doppler correction
- Linear and A-weighted sound maps
- AVI file capabilities
- Results can be presented as an averaged function of displacement

### Beamforming

The sound field radiating from the test object is measured at a number of microphone positions at some distance from the object. The microphones are arranged in a planar array facing towards the centre of the target area. By introducing a specific delay on each microphone signal and adding the result, it is possible to computationally create an acoustical antenna equivalent to a parabolic reflector with a main lobe of high sensitivity along a particular angle of incidence. By repeating the calculation process on the same set of measured data for a large number of angles, a full map of the relative sound pressure contribution at the observation point can be generated.

The beamforming algorithm works in both a free-field mode and a mirror-ground mode. In the mirror-ground mode, a totally reflective ground plane is assumed to be in a certain position compared to the array.

Apart from the main lobe, any beamforming array will also have a number of undesired side lobes. If these are not well attenuated compared to the main lobe, they can (particularly in narrow-band results) lead to unreal 'ghost' images in the final map. The patented Brüel & Kjær arrays suppress ghost images by numerically optimising the microphone positions to give a high side-lobe attenuation over a wide frequency range.

### Moving Source Beamforming BZ-5496

Moving Source Beamforming operates as described above, with the addition of tracking a moving target. In other words, rather than focusing on a point, the array is tracking the moving vehicle by continuously adjusting the time delays. The test area is set up as either a straight stretch of road or railway track. The data acquisition functions according to the relationship between the global coordinates (the test area) and the local coordinates (the vehicle), and the calculated data are expressed in terms of the local coordinate system.

Moving Source Beamforming offers several methods to detect position and speed:

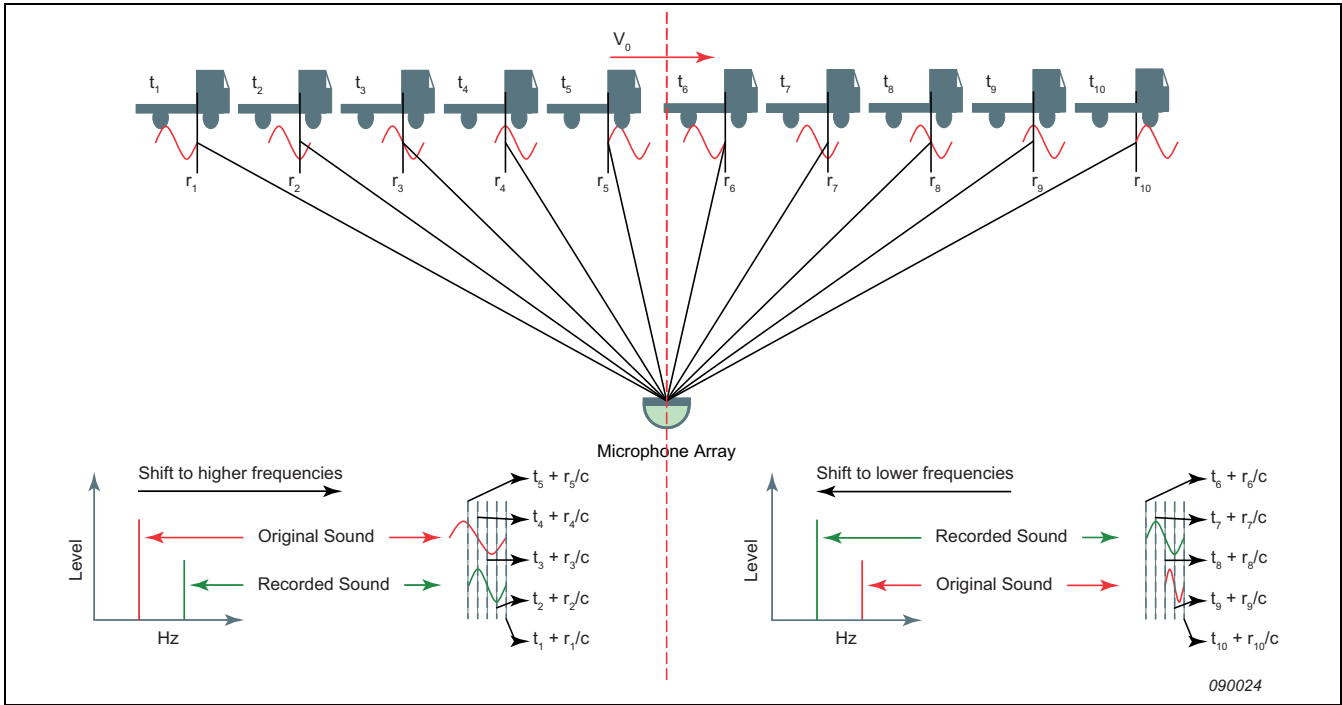
- **Position Trigger and Speed Pulses** – for variable speed detection using photocells, radar or GPS (used for an accelerating vehicle, for example)
- **Position Trigger and Manually Set Speed** – for fixed speed detection, using a single photocell
- **Dual-position Triggers** – for fixed speed detection using two photocells (used for a train running at constant speed, for example)

As a customised project, BZ-5496 can also be integrated into an ISO 362 Pass-by System.

### Doppler Effect

The vehicle (local coordinate system) moving towards, past and away from the array setup creates a Doppler effect. BZ-5496 continuously adjusts the focus point to compensate for the Doppler effect (see Fig. 1).

**Fig. 1** Pass-by doppler effect correction calculation



### Processing

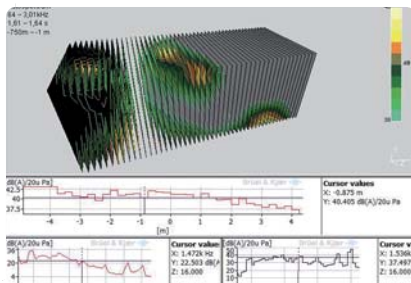
BZ-5496 utilises up-sampling rather than unnecessarily devouring massive amounts of data storage space. For example, measurements recorded with 8192 samples/s are up-sampled by a factor of 16. This method produces less than 10% phase error at 3 kHz (or <0.1 dB error).

Not only does up-sampling save storage space, but it simplifies setup and incurs negligible error.

Measurement intervals are user-definable. For pass-by, the measurements are typically taken every 25 cm. Spectra are stored as a function of displacement for each calculation point in the sound map. The results saved are only the calculated spectra.

### Extended Beamforming Calculations WT-9719

**Fig. 2**  
Vehicle cross-section displayed in height x width planes



WT-9719 is an additional license available for use with BZ-5496. This feature enables the collation of multiple planes in the calculation setup display. It also enables the display of 3D data in mapping. This license is particularly useful when working with open structures, for example, trucks.

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## Ordering Information

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BZ- 5496 PULSE Moving Source Option for Beamforming

### PREREQUISITES

One of the following:

Type 7700 PULSE FFT & CPB Analysis

Type 7770 PULSE FFT Analysis

Type 7771 PULSE CPB Analysis

Plus:

Type 7761 PULSE Acoustic Test Consultant

Type 8608 PULSE Beamforming

### OPTIONAL ACCESSORIES

WT-9719 Extended Beamforming Calculations

### PC REQUIREMENTS

Pentium® IV 2.6 GHz or better with 2 GB RAM

Microsoft® Windows® XP (Service Pack 2) or Windows Vista® operating system, Office XP or Office 2003

### Service and Support Products

M1-5496-F Software Maintenance and Support Agreement for PULSE Moving Source Option for Beamforming, Floating License

M1-5496-N Software Maintenance and Support Agreement for PULSE Moving Source Option for Beamforming, Node-locked License

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HEADQUARTERS: Brüel & Kjær Sound & Vibration Measurement A/S · DK-2850 Nærum · Denmark  
Telephone: +45 7741 2000 · Fax: +45 4580 1405 · [www.bksv.com](http://www.bksv.com) · [info@bksv.com](mailto:info@bksv.com)

Local representatives and service organisations worldwide

Brüel & Kjær 

