

4ch BEAM FORMING

Sound Source Visualization System



ONOSOKKI

Where does this sound

Evolved probe microphone meets the demands you want to see, and you want to know.

Small and lightweight

Use it anytime, anywhere

▶ Achieves wide analysis frequency range

Sound source visualization from 500 Hz to 8 kHz* of frequency range

*Recommended frequency. Refer to [Specification] in page 7.

▶ Visualizing sound source using only 4 microphones

4ch Beam Forming System localizes sound source position with minimum microphones by "Beam Forming" and new calculation method.

▶ Monitors sound source in real-time (5 times/sec.)

You can monitor sound occurring and confirm the sound source position in the field

▶ Enables detailed analysis even transient/impulsive sound

As for sounds that are changing very quickly, offline analysis is effective.

It enables further analysis of transient/impulsive sound by recorded sound and video.

4ch BEAM FORMING S

Sound source visualization method: Beam Forming

Beam forming is one of the sound visualization techniques that calculates the distribution of sound pressure and sound intensity from the data recorded with microphone array system, and superimposes the resulting view with the video through the camera.

This technique produces an easily understandable result because it shows the result in a color map.

The microphone array size has been apt to become large. This is because the number of microphones used in beam forming occasionally exceeds 100 and they are randomly positioned so that they can handle wide range of sounds.

Ono Sokki's 4ch Beam Forming System has achieved sound visualization in real-time by minimum number of microphones.

come from?



SYSTEM

Sound Source Visualization
Probe Microphone MI-5420

System example

The measurement system includes DS-3200 series as a measurement unit, MI-5420 as a microphone. Microphone interval of MI-5420 can be changed according to analysis frequency (120 mm or 60 mm).

BF-3100 and OS-2000 series software are used for measurement and analysis.

Other than 4 channels connected to MI-5420, 4 more channels can be added. You can connect an accelerometer and a rotation detector to see vibration waveform and rotation speed.

MI-5420 4ch Beam Forming System



Wide variety of sensor connection*

Rotation

Optical detector
LG-9200

Magneto-electric rotation detector
MP-981/9820

Signal cable
MX-7100 series

Digital Tachometer
TM-3100 series

Signal cable **MX-603+MX-100 series**

Handheld Digital Tachometer
HT-5500

Signal cable **AX-501**

Vibration

Accelerometer with built-in amplifier
NP-3000 series

Miniature/BNC conversion adapter
NP-0021

Signal cable
NP-0120/0130/0150/0170 series

Charge output type accelerometer
NP-2000 series

Charge converter
CH-6130/6140

Signal cable **NP-0120/0130/0150/0160 series**

Tri-axial accelerometer with built-in amplifier
NP-3500 series

Signal cable for tri-axial **NP-0232/0262**

Acoustics

Sound Level Meter
LA-3570/3560/3260
(High function type)
LA-1410/1440/4440
(Integrated type)

Signal cable **AX-501**

1/4-inch Measurement microphone
MI-1235
+
Microphone preamplifier
MI-3111

Signal cable **AG-2000 series**

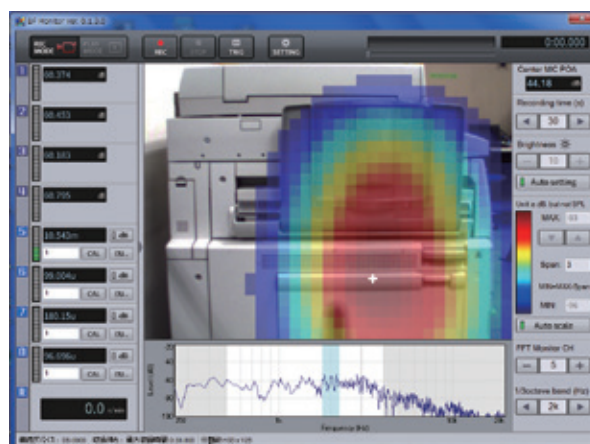
*This example includes DS-0364 additional unit. *For more information on DS-3200 series or OS-2000 series, please refer to the each brochure.

BF-3100

BF-3100 supports both real-time and offline analyses

Real-time monitor software

This software performs and displays sound source visualization processing of a sound occurring from the measurement object in real-time (5 times/sec.). You can find a sound source position while moving probe microphone and changing analysis frequency band.



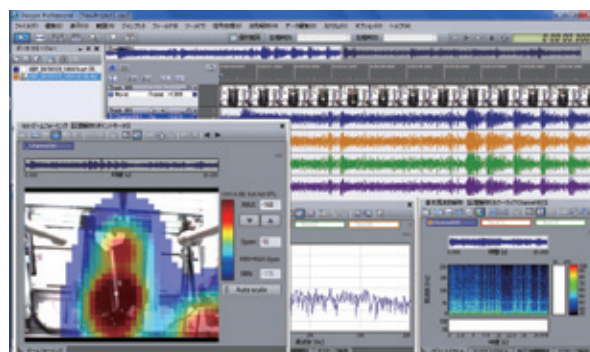
Real-time monitor software screen

Offline analysis software

This is software which is plugged in the OS-2000 series. Offline analysis is effective for the sound that is difficult to reproduce or changing very quickly. By recording sound and images, the analysis of those sound can be performed repeatedly.

Because there is no data loss, it is surely possible to analyze and visualize the sound source position of an unexpected sound, such as transient or impulsive sound.

- ◆Offline analysis processing: 25 times/sec or more of time resolution
- ◆OS-2000 series (Time-series data analysis software) FFT analysis package and video playback option are required.



Offline analysis software screen

OS-2000 series

Time-series Data Analysis Software

OS-2000 series

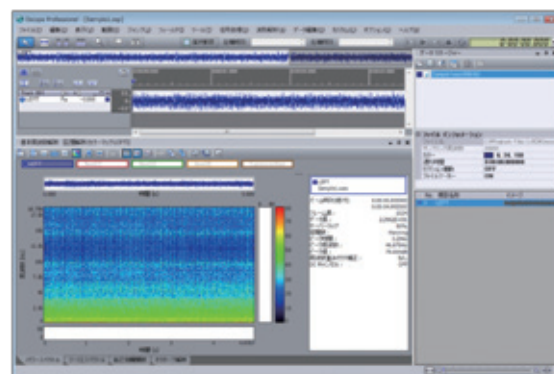
Software

OS-2000 series edits and analyzes the time-series data which is too long to be used on Microsoft® Excel® flexibly and freely. It supports a wide variety of data formats, not only general formats such as CSV and WAV files, but also unique format of each recording device.

OS-2000 series has many useful functions including overlay of waveforms of different formats, division, moving, and zooming in and out. Smooth linking to Microsoft® Excel® is also available.

Various other functions, such as video playback function, FFT analysis function, filter functions and sound quality evaluation are available.

*For more information, please refer to the brochure of OS-2000 series.



FFT analysis screen

Applications

The following shows each example of before and after measures by using 4ch Beam Forming Sound Source Visualization System.

1 Operating sound of a multifunctional printer

[Measurement procedure]

Record the sound from central open area of the multifunctional printer during paper feeding.

Decide the place to take noise reduction measures referring to the recorded sound data (finding the place from which the sound is occurring)

Paste shielding tapes and record the sound during paper feeding again.

Analyze the recorded data by offline analysis software (BF-3100), and compare the result before and after the noise reduction measures. (without or with the shielding tape)

[Analysis result]

Color maps and sound pressure levels measured by a Sound Level Meter tell the change of the sound radiated from open area.

Compare the sound source position (red area) on color maps Fig.1 and Fig.2. After that the shielding tapes are pasted, there is no red area in Fig.2.

The sound pressure level (A-weighting) has been reduced about 10 dB compared to the noise before measures, from 72.2 dB to 62.6 dB.

Fig.1 Before measures (without shielding tapes)
A-weighting sound pressure level: 72.2 dB

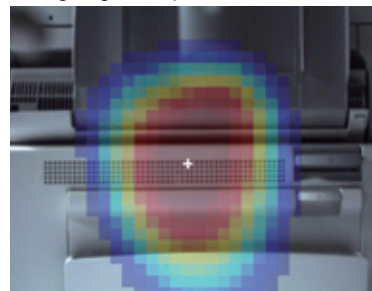


Fig.2 After measures (with shielding tapes)
A-weighting sound pressure level: 62.6 dB



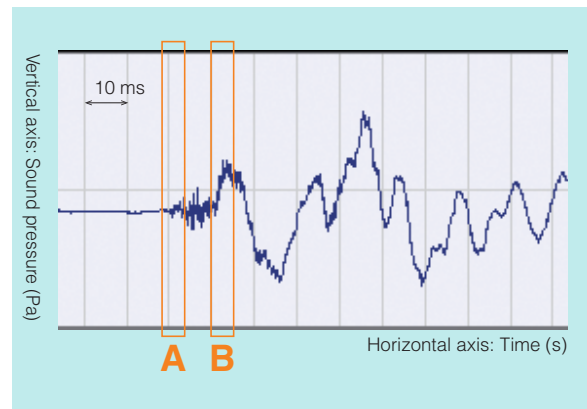
2 Time Sequence Analysis of Vehicle Door Closing Sound

[Analysis result]

You can see that sounds continuously have occurred from two places in a very short time (see A, B). The red area shows that the sound pressure is high. The highest sound pressure point is indicated with white cross.

A: High pitched door latching sound (from the rear upper of the front door) → B: Hitting sound (from the rear lower of the front door)

Even if a sound is heard as one sound in human ears, it includes various types of sound that are overlapped and mixed. It is possible to visualize the sequence that a sound is changing with time.



A Door latching sound (rear upper of the front door)
(Analyzed in 8 to 12 kHz)*



B Door hitting sound (rear lower of the front door)
(Analyzed in 8 to 12 kHz)*



*Beyond the recommended band of BF-3100 Offline analysis

Specification of 4ch Beam Forming System

MI-5420 Sound Source Visualization Probe Microphone

		With 60 mm probe head	With 120 mm probe head
Sound Source	Outer Dimensions*1	74.3 (W) × 174.5 (H) × 311.0 (D) mm	141.0 (W) × 174.5 (H) × 349.0 (D) mm
Visualization	Mass (probe head+main body+grip)*2	Approx.615 g	Approx.725 g
Probe Microphone	Operating temperature range	0 to 50 °C	
	Operating humidity range	85 % RH or less (with no condensation)	
	Storage temperature range	-10 to 60 °C	
	Storage humidity range	90 % RH or less (with no condensation)	
	CE marking	EMC Directive 2014/30/EU Standard EN61326-1 *Visit to our web site (https://www.onosokki.co.jp/English/english.htm) for more details.	
	Power supply	Supplied from DS-3200/3100/2100A	
Supplying system		CCLD	
Voltage		DC24 V	
	Current	4 mA×4	

*1 When a grip is mounted vertically (not including a cable), not including a protruded section.

*2 Not including a cable

Probe head	Gap between microphones	
	Visualization frequency band*3	60 mm (±1 mm) / 120 mm (±1 mm)
Microphone*4	Diameter	7 mm
	Max. sound pressure level	110 dB (1 kHz, THD=3 %)
Connection of probe head and main body		Finger screw (slotted knurling screw)*5

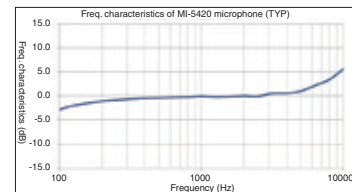
*3 Definition of visualization frequency band

Definition 1: When the distance of a sound source and the microphone is 1m at the free sound field, the space resolution until the frequency is damped -6 dB from the center of the sound source should be within the wavelength or 30 cm.

Definition 2: Vertical sound source does not appear in the camera viewing angle. (Analysis which 1/3 octave band center frequency is from 315 Hz to 16 kHz is possible even though it is out of guaranteed range.)

*4 Refer to the specification of the microphone for more details.

*5 Recommended tightening torque : 0.7 Nm



Main body	Camera*6	CMOS USB camera	Imaging device	
			CMOS 1/3 color	VGA (640×480) (fixed)
			Number of pixels	6 mm
			Focal point distance	F 1.2 to 16
			Aperture	bfm file format (Ono Sokki original format)
			Moving file	5 fps (at real-time monitoring)
			Frame rate	25 fps (at recording)
			Camera viewing angle	Horizontal: 42 °vertical: 26 ° (TYPE value)
			Interface	USB 3.0
			Power supply	USB bus-power
Main body		Top surface mounting screw hole x2	1/4-20UNC 6 mm	For accessory*7
		Undersurface mounting screw hole x 2	1/4-20UNC 6 mm	For grip*7
		Grip undersurface mounting screw hole x 1	1/4-20UNC 6 mm	For accessory*7
MI-5420 composite cable		Exclusive cable	Approx. 3 m long	
		Diameter	Approx. φ20 mm*8	
		Covering	Resin mesh sleeve*9	
		Minimum bending radius	Approx. 70 mm	

Accessory	4ch Beam Forming Microphone	1
	Acoustic Correction File CD	1
	Microphone position checking plate	1
	Carrying case	1
	Mount *10	1
	BNC cable (0.2 m)	1
	BNC-JPJ adaptor	1
	Instruction manual	1

*6 Lens cannot be replaced.

*7 Measurement using grip/lighting made by other than Ono Sokki may give large affect on the result. Please consult your nearest distributor or onosokki sales office nearby.

*8 When a cable is put through a hole, it should be more than φ30 mm in view of a connector part.

*9 Plural cables are bundled up by polyester and nylon.

*10 Used for placement of a probe microphone.

BF-3100 Beam Forming Software

Real-time monitor	Beam Forming calculation	Number of color map display divisions	
		33×25 (fixed)	33×25 to 161×121
	Window function	Rectangular (fixed)	
	Visualization setting band	Every 1/3 octave band	
FFT monitor	Frame length	40 ms (2048 points fixed)	
	Display frequency band*11	250 Hz to 20 kHz	
Recording function*12	Sampling frequency	51.2 kHz (fixed)	
	Recording frequency range	20 kHz (fixed)	
	A/D conversion	24 bit (fixed)	
	Number of input channels	Max. 8ch :for microphone (1 to 4ch), for general purpose (5 to 8ch)	
	Internal trigger	Settings of slope and level	
	External sampling	Used for display and recording of rotation speed	
	Recording file format	bfm file (Ono Sokki original format)	
	Max. recording time	1200 seconds	
Offline Analysis (OS-2000 series plugin function)*13	Number of color map display divisions	33×25 to 161×121	
	Frame length	40 ms (2048 points fixed)	
	Window function	Rectangular/Hanning/Force	
	Visualization frequency band	Every 1/3 octave band/custom (specified frequency section)	
	Output function	AVI/BMP/CSV	
*13 Vide playback function (option) is required.			
Accessory	Installation manual	1	Instruction on the installation procedure
	BF-3100 Installation CD	1	Installation CD of BF-3100 4ch Beam Forming Software and camera driver
	DS-3000 Installation CD	1	CD for updating of DS series DSP

*11 Differs from the frequency band of Beam Forming Visualization.

*12 Recording condition can be checked right after the recording completion by using play mode.

Operating Environment

Conforming analysis device: DS-3200/3100/2100A (Input: 4ch or more, 8ch max.*14)

	Main unit	Interface cable	Signal output	Remote control
DS-2000 series	DS-2100*15	DS-0299	DS-0271A/DS-0272A	DS-0295
DS-3000 series	DS-3100	DS-0399	DS-0371/DS-0372	DS-0395
	DS-3200	USB cable attached	DS-0371/DS-0372	

*14: BF-3100 does not support 100 kHz unit. BF-3100 can be used on the 10ch or more of main unit. However, the maximum number of channels to record by real-time monitor is 8.

*15: Only DS-2000 series A version is available.

Personal Computer	OS	Microsoft® Windows® 7 Professional (64-bit)
	CPU	Intel® Core™ i5 2.70 GHz or more (Intel® Core™ i7 is recommended.)
	Memory	4 GB or more
	Required HDD capacity	16 GB or more of free space
	Optical drive	Optical drive that can reproduce the installation CD.
	Display	Required 1280 × 768 or more
	USB port	USB 3.0 × 1 (Camera*16), USB 2.0 or more × 1 (license key), USB 3.0 × 1 (DS-3200*16) or USB 2.0 × 1 (DS-0299/0399) *16*17
	Others	Sound device
	Software	Required installation of OS-2000 series ver.2.8 or higher version.

*16: USB HUB cannot be used.

*17: Communication error may occur with some personal computers if DS-0299/0399 is connected to the USB 3.0 port.

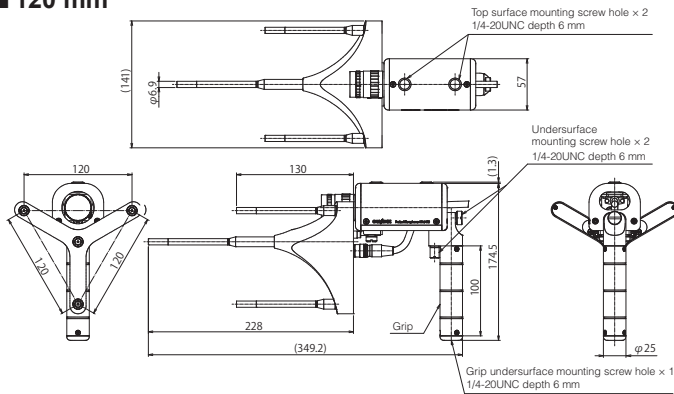
4ch BEAM FORMING SYSTEM

Outer Dimensions

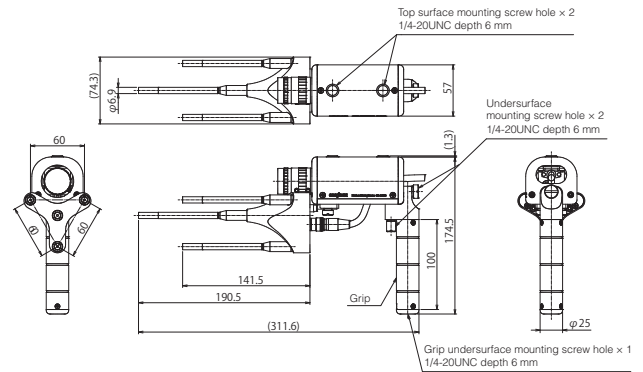
MI-5420

(Unit: mm)

120 mm



60 mm



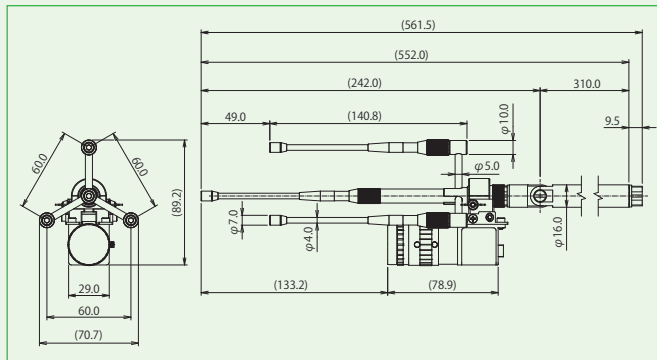
System example

Model name	Product name
MI-5420	Sound Source Visualization Probe Microphone Including microphone probe head x 2 (120 mm, 60 mm), camera, cable for camera and microphone (3 m)
BF-3100	4ch Beam Forming software
OS-2720	OS-2000 series FFT Analysis package
OS-0281	OS-2000 series video playback function (option)
DS-3204, DS-0371	Data Station (4ch), signal output (option)
	Personal Computer

Sound Source Visualization System using MI-6420 3D SI probe

BF-3100 4ch Beam Forming software can be used with the MI-6420 3D SI probe. Using MI-6420 has advantages of supporting wide range of sound visualization measurement methods including BF, EI*, and SI*.

*EI: Envelope Intensity SI: Sound Intensity



Specification of MI-6420 (60 mm)

Distance between microphones	60 mm (regular tetrahedron)
Analysis frequency range	1 kHz to 5 kHz
Length	560 mm
Mass (excluding a cable)	Approx. 300 g
Operating temperature range	0 to +40 °C
Storage temperature range	-10 °C to +60 °C
Connection cable	approx. 5 m

System example

Model name	Product name
BF-3100	4ch Beam Forming software
OS-2720	OS-2000 series FFT Analysis package
OS-0281	OS-2000 series video playback function (option)
DS-3204/DS-0371	Data Station (4ch)/signal output (option)
MI-6420	3D SI probe
MX-101	Signal cable 1.5 m (BNC-BNC) x 4
CF-0610	Microphone amplifier
Others	Camera kit (Camera, USB cable (3 m), synchronization cable (5 m))
	Personal Computer

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* Outer appearance and specifications are subject to change without prior notice.

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