PRODUCT DATA

BK Connect Acoustic Camera Type 9712-W-FEN

BK Connect® Acoustic Camera together with BK Connect® software is a portable turnkey solution for real-time noise source identification (NSI) that can be used for both stationary and non-stationary measurements. It is a versatile tool well-suited for use in many different industrial environments with applications that include buzz, squeak, and rattle (BSR) detection in vehicle cabins, troubleshooting in aircraft and testing of household appliances such as washing machines.

Use the BK Connect Acoustic Camera with BK Connect software to locate and view transient sound sources on-site or make and save recordings for subsequent analysis.

Uses, Benefits and Features

Uses

- NSI on industrial machinery and household appliances
- Detection and documentation of BSR in vehicle cabins
- Leak detection on weather seals, firewalls and cladding
- Event measurement and recording
- Non-stationary measurements: Handheld
- Stationary measurements: Mount the array on a tripod

Benefits

- Complete system solution
- View measurements on-site in real time
- Locate transient sound sources and capture audio and visual recordings of the problem area
- Adjust the frequency range during and after recording
- Perform both beamforming and acoustic holography measurements with one system
- Capture screen as picture or video for rapid reporting

Hardware Features – Acoustic Camera

- Small-sized array that can fit in confined spaces (∅ 35 cm)
- Removable reflective plate – allows measurements in either the near or far acoustic field
- Microphones flush with reflective plate
- Integrated video camera – films 15 to 20 frames per second
- Integral cables – keep system tidy, mobile, and easy to set up
- Built-in tablet holder
- Front-end battery life of up to 2½ hours
- Portable with a custom-made case

Software Features – BK Connect

- Spectrogram displays level and frequency as a function of time
- Source map superimposed on video images
- Up-and-running in under ten seconds (from project launch)
- Continuous buffering provides real-time images
- Simple, easy-to-use interface
- Tablet mode for portable measurements
- With BK Connect Array Analysis Type 8430:
  - Transfer recordings to PULSE™ NSI Array Acoustics Post-processing suite
  - Analyse recordings in BK Connect Data Processing (available separately)

Brüel & Kjær

Fig. 1
Acoustic Camera Type 9712-W-FEN in its carrying case

Hardware

The system hardware consists of:

- a handheld array with a detachable carbon-fibre reflective backplate
- LAN-XI data acquisition hardware
- a custom-made, waterproof carrying case

Software

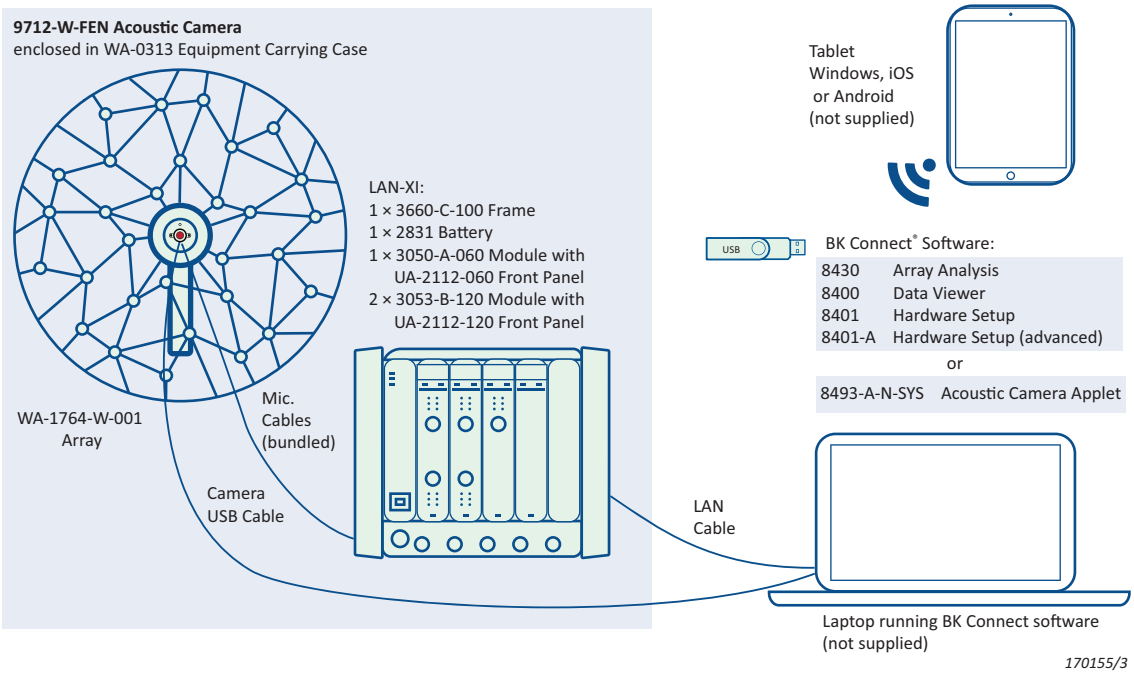
The BK Connect software is the heart of the system, controlling the hardware and enabling streaming, recording, measurement, playback, analysis and processing of data.

The system software consists of one of the following:

- BK Connect Array Analysis Type 8430 (standard solution with full functionality)
- BK Connect Acoustic Camera Applet Type 8493-A-N-SYS (measurement and playback only)

The BK Connect Acoustic Camera System

Fig. 2
BK Connect Acoustic Camera System



System Hardware – Acoustic Camera Type 9712-W-FEN

The Handheld Array

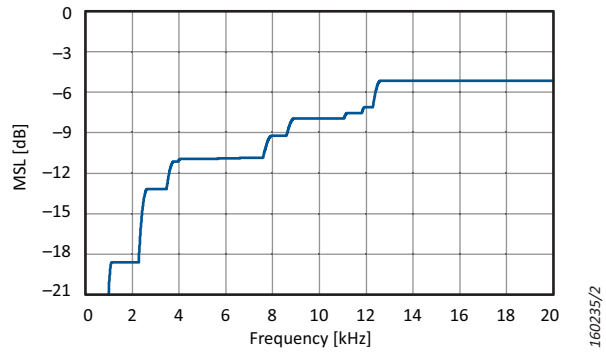
The Acoustic Camera Type 9712-W-FEN includes the Array WA-1764-W-001 (30-channel, sliced wheel array with irregular microphone placement), integral cables and a detachable reflective plate. It features an integrated handle with a built-in tablet holder (recommended tablet size 20 × 13 cm (8 × 5 in)). In the centre of the array is a video camera that films 15 to 20 frames per second.

The microphone type used on the array is Short 20 kHz Array Microphone Type 4959; a ¼″ prepolarized microphone with TEDS. It has a frequency range of 50 Hz to 20 kHz and a built-in CCLD* preamplifier. See product data BP 2202 for more information.

* CCLD: Constant current line drive, also known as DeltaTron® (ICP and IEPE compatible).

The integral cables connect the array microphones to the LAN-XI data acquisition hardware and the array camera to the computer. A single cable bundle consisting of five microphone cables bound together, keep the system tidy. The connectors are numbered to make connection to the LAN-XI hardware quick and easy.

Fig. 3
Maximum side lobe (MSL) level of WA-1764-W-001



The array is optimized for both acoustic holography and beamforming measurements. Brüel & Kjær uses a patented numerical method to optimize performance for the frequency range and number of microphones. See Fig. 3 for the dynamic range, or maximum side lobe (MSL) level, of the array. For more information consult technical review, BV 0056.

The detachable reflective plate is made of a hard, vibration-damped material. With the reflective plate in place, the array is suitable for measurements in the far field using the beamforming algorithm (Fig. 4, left). Without the reflective plate, measurements can be made in the near field using the acoustic holography algorithm (Fig. 4, right). As a comparison, a typical measuring distance for beamforming is around 40 cm, while a typical measuring distance for acoustic holography is around 5 cm.

Fig. 4 Left: *Array WA-1764-W-001 with reflective plate for use in beamforming measurements*
Right: *Without reflective plate for use in acoustic holography measurements*

NOTE: When using the handheld array without the reflective plate (as for acoustic holography measurements) noise will reflect off of the tablet. Remove the tablet from the holder to prevent the detection of such sounds.

The LAN-XI Data Acquisition Hardware

Type 9712-W-FEN includes all the necessary LAN-XI hardware:

- 1 × Front-end Frame with GPS Type 3660-C-100 (5-module)
- 2 × 12-ch. Input Module Type 3053-B-120 with Array Connector Front Panel UA-2112-120
- 1 × 6-ch. Input Module Type 3050-A-060 with Array Connector Front Panel UA-2112-060
- 1 × Battery Module Type 2831 – powers the hardware for up to 2½ hours. The battery-life indicator on this module is always visible

Information regarding the LAN-XI components can be found in product data BP 2215, which describes the LAN-XI frame and modules, and BP 2421, which describes the interchangeable LAN-XI front panels.

Licencing Options

Depending on your measurement needs, there are two different software licensing options for the Acoustic Camera. For those requiring access to the full suite of features and functionalities, a solution based on BK Connect Array Analysis Type 8430 is recommended. For those who only need to use the Acoustic Camera as a stand-alone troubleshooting tool, then BK Connect Acoustic Camera Applet Type 8493-A-N-SYS should be sufficient.

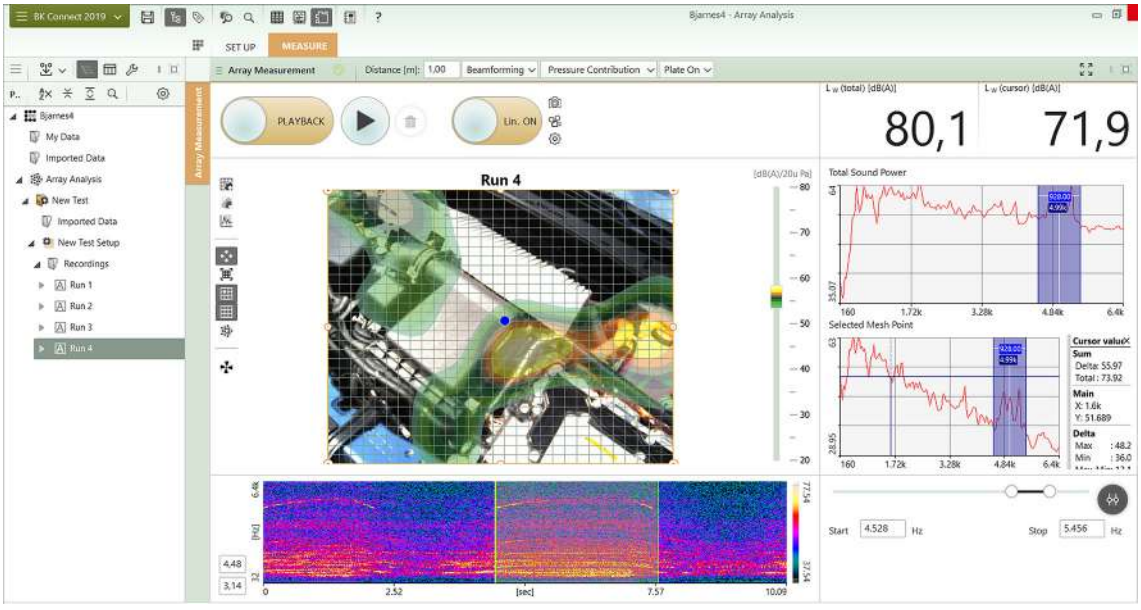


Fig. 5
Interface of BK Connect Array Analysis Type 8430. The acoustic map, spectrogram and sound power are shown

Standard Software Based on BK Connect Array Analysis Type 8430

To set up the hardware, control measurements, and stream, play back and record data with the Acoustic Camera, the following standard software configuration is needed:

- BK Connect Array Analysis Type 8430
- BK Connect Data Viewer Type 8400
- BK Connect Hardware Setup Type 8401
- BK Connect Hardware Setup (advanced) Type 8401-A

The licences can be either node-locked to a PC host ID or dongle or floating, locked to a network server.

For those who simply want to view and analyse recorded data in an Acoustic Camera project, only Types 8430 and 8400 licences are required.

A system configuration with Type 8430 allows for modular use, meaning the application can be used with other BK Connect applications, where relevant. The software can be upgraded as well.

Targeted Solution BK Connect Acoustic Camera Applet Type 8493-A-N-SYS

An alternative licencing option for users with well-defined measure and recording requirements is the BK Connect Acoustic Camera Applet Type 8493-A-N-SYS. Applets are perfect for single users where a full BK Connect licence is not needed. The applet offers users the same streaming, recording and playback functionality as the standard solution above with the following limitations:

- No auto-detection of hardware
- Self-contained, node-locked licence (no software prerequisites or sharing with other BK Connect modules)
- No post-processing (no transfer to NSI Array Acoustics Post-processing software)
- No advanced functionality or options such as wind speed corrections

Streaming Mode

In Streaming mode, continuous buffering enables streaming of images to create an acoustic map for real-time troubleshooting of problem areas, allowing you to evaluate noise emissions. This acoustic map is based on the algorithm selected by you, either the beamforming algorithm or statistically optimised near-field acoustic holography (SONAH). The Type 8430 displays, which are optimised for both PC and tablet screens, include graphs of sound pressure, sound intensity and sound power superimposed with images of the measurement object.

Playback Mode

Should an area be identified that warrants closer investigation, data can be recorded and subsequently analysed in Playback mode. Recordings are automatically stored in the software's Project Browser where they can be reviewed and the frequency range settings adjusted, if necessary. If a recording is made together with a tacho signal, then order mapping can be shown with 1 to 100 contiguous orders. An interactive spectrogram is also displayed for full information on time, level and frequency. Linear averaging can be applied on selected regions of the spectrogram allowing the user to zoom in on areas of interest.

Post-processing Data from Type 8430

If your data requires advanced analysis, you can of course import the recording into other BK Connect applications.

Post-processing can also be handled in the PULSE LabShop-based environment, if you have a valid PULSE NSI Array Acoustics Post-processing licence, such as Spherical Beamforming Type 8606, Acoustic Holography Type 8607 or Beamforming Type 8608. Data transfer to the Array Acoustics database is built-in the BK Connect Array Analysis user interface, allowing you to use your Acoustic Camera data in specialised applications such as wind tunnel measurements using multiple arrays.

BK Connect Array Analysis with Other Supported Arrays

BK Connect Array Analysis Type 8430 can be used with other Brüel & Kjær sliced wheel arrays (see Table 1) and all other planar, irregular arrays and regular grid arrays. Type 8430 does not work with double layer or half-wheel arrays. For multi-armed, foldable arrays (such as the pentangular array), only beamforming is supported.

Table 1
Beamforming and holography are supported with sliced wheel arrays. Frequency range is for an MSL level of at least 7 dB

Item Number	Number of Channels	Mechanical Diameter (m)	Array Diameter (m)	Average Microphone Spacing (m)	Frequency Range (Hz)	Resolution at Optimal Distance (m)	Lowest Frequency (Hz)
WA-1558-W-021	18	0.40	0.35	0.073	120 to 7 k	0.09 to 0.045	123
WA-1558-W-019	18	0.55	0.50	0.104	85 to 3.9 k	0.12 to 0.075	86
WA-1558-W-026	18	1.00	0.98	0.205	40 to 2.3 k	0.22 to 0.135	44
WA-1764-W-001	30	0.35	0.30	0.049	140 to 12 k	0.06 to 0.025	143
WA-1558-W-020	36	0.55	0.45	0.066	95 to 8.4 k	0.08 to 0.035	95
WA-1558-W-004	36	0.70	0.67	0.099	60 to 6.6 k	0.12 to 0.045	64
WA-1558-W-014	36	1.05	1.00	0.148	40 to 4.4 k	0.17 to 0.07	43
WA-1558-W-017	36	1.22	1.15	0.170	35 to 3.8 k	0.20 to 0.08	37
WA-1558-W-025	42	0.40	0.36	0.049	115 to 12 k	0.06 to 0.025	119
WA-1558-W-003	60	0.55	0.49	0.056	85 to 19 k	0.07 to 0.015	88
WA-1558-W-010	60	0.75	0.73	0.084	55 to 14 k	0.09 to 0.02	59
WA-1558-W-006	60	1.05	0.96	0.110	40 to 10 k	0.13 to 0.03	45
WA-1558-W-023	84	0.55	0.5	0.048	80 to 20 k	0.06 to 0.015	86
WA-1558-W-022	84	1.05	0.95	0.092	40 to 20 k	0.11 to 0.015	45
WA-1558-W-009	84	1.10	1.06	0.102	35 to 20 k	0.12 to 0.015	40
WA-1558-W-015	108	0.78	0.75	0.064	55 to 20 k	0.08 to 0.015	57

Microphone Verification

Microphone verification can be performed prior to a measurement task. Use either Pistonphone Type 4228 or Sound Calibrator Type 4231 with Type 4228/4231 Calibrator Hose-fitted Adaptor for Verification of Single ¼″ Microphone WA-0728-W-006. This adaptor is included in Type 9712-W-FEN as standard.

If needed, factory standard calibration at Brüel & Kjær is available for the array microphones.

Compliance with Standards

ARRAY WA-1764-W-001

	The CE marking is the manufacturer's declaration that the product meets the requirements of the applicable EU directives RCM mark indicates compliance with applicable ACMA technical standards – that is, for telecommunications, radio communications, EMC and EME 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 WEEE mark indicates compliance with the EU WEEE Directive
Safety	EN/IEC 61010−1: Safety requirements for electrical equipment for measurement, control and laboratory use ANSI/UL 61010−1: Safety requirements for electrical equipment for measurement, control and laboratory use
EMC Emission	EN/IEC 61000−6−3: Generic emission standard for residential, commercial and light industrial environments EN/IEC 61000−6−4: Generic emission standard for industrial environments CISPR 22: Radio disturbance characteristics of information technology equipment. Class B Limits FCC Rules, Part 15: Complies with the limits for a Class B digital device This ISM device complies with Canadian ICES−001 (standard for interference-causing equipment)
EMC Immunity	EN/IEC 61000−6−1: Generic standards – Immunity for residential, commercial and light industrial environments EN/IEC 61000−6−2: Generic standards – Immunity for industrial environments EN/IEC 61326: Electrical equipment for measurement, control and laboratory use – EMC requirements **Note:** The above is only guaranteed using accessories listed in this document
Temperature	IEC 60068−2−1 & IEC 60068−2−2: Environmental Testing. Cold and Dry Heat Operating Temperature: −10 to +55 °C (14 to 131 °F) Storage Temperature: −25 to +70 °C (−13 to +158 °F)
Humidity	IEC 60068−2−78: Damp Heat: 93% RH (non-condensing at 40 °C (104 °F))
Mechanical	Non-operating: IEC 60068−2−6: Vibration: 0.3 mm, 20 m/s^2, 10 – 500 Hz IEC 60068−2−27: Shock: 1000 m/s^2 IEC 60068−2−29: Bump: 1000 bumps at 250 m/s^2

LAN-XI DATA ACQUISITION HARDWARE
See product data BP 2215

Acoustic Camera Type 9712-W-FEN

ARRAY WA-1764-W-001*
Frequency Range: 140 Hz to 12 kHz
- Near field, without reflective plate (SONAH): 140 Hz to 3 kHz
- Far field, with reflective plate (beamforming): 1 kHz to 12 kHz†

Weight: 1 kg (2.2 lb)
Diameter: 35 cm (13.8 in)
Number of Microphones: 30
Camera:
- Frame rate: 15 per second
- Pixels: 1280 × 1040
- Angle of view: 76°

WATERPROOF CARRYING CASE
Dimensions: 60 × 34 × 64 cm (24.6 × 13.4 × 25.2 in)
Weight (hardware and case): 22 kg (48.5 lb)

FRONT END
Specifications for LAN-XI data acquisition hardware used in BK Connect Acoustic Camera are given in product data BP 2215

BK Connect Array Analysis Type 8430 or BK Connect Acoustic Camera Type 8493-A-N-SYS

MEASUREMENTS
Analysis (Narrow band): 1/1-, 1/3-, 1/12-octave
Acoustical Weighting: Linear, A, C
Time Constant (Exponential): 1/8 s (fast), 1 s (slow), 8 s

* Specifications for MSL of at least 7 dB
† Frequency range can be extended up to 20 kHz, with reduced MSL

System

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® 2017 or SQL Server® 2019

RECOMMENDED SYSTEM CONFIGURATION
- Intel® Core™ i7, 3 GHz processor or better
- 32 GB RAM
- 480 GB Solid State Drive (SSD) with 20 GB free space, or better
- 1 Gbit Ethernet network‡
- Microsoft® Windows® 10 Pro or Enterprise (x64) with CB
- Microsoft® Office 2016 (x32)
- Microsoft® SQL Server® 2017
- Screen resolution of 1920 × 1080 pixels (full HD)

TABLET REQUIREMENTS
Operating System: Windows®, iOS®, or Android™
Recommended Size: 20 × 13 cm (8 × 5 in)

REMOTE CONTROL/DISPLAY REQUIREMENTS
TeamViewer or similar

‡ 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

BK Connect Acoustic Camera

HARDWARE

Type 9712-W-FEN **Acoustic Camera**

Including:

- **WA-1764-W-001**: 30-ch. Handheld Array
  - 1 × Array Frame with handle, integral cable and tablet stand
  - 1 × Camera
  - 30 × Type 4959: Short 20 kHz Array Microphone
  - 1 × UA-4139: 350 mm Reflective Plate with black polyurethane foam windscreen layer
  - 1 × WE-0313: Storm Case
  - 1 × WL-3654-D-050: USB 2.0 cable, 5 m (16.4 ft)
  - 1 × WA-0728-W-006: Type 4228/4231 Calibrator Hose-fitted Adaptor for verification of single ¼″ microphone
- **LAN-XI Data Acquisition System**
  - 1 × Type 3660-C-100: 5-module LAN-XI Front-end Frame with GPS
  - 1 × Type 3050-A-060: 6-ch. Input Module 51.2 kHz (Mic, CCLD, V), excluding accessories
  - 2 × Type 3053-B-120: 12-ch. Input Module 25.6 kHz (CCLD, V), excluding accessories
  - 1 × UA-2112-060: Detachable Front Panel, 6-ch. mic. array, 1 × circular 7-pin (F) connector
  - 2 × UA-2112-120: Detachable Front Panel, 12-ch. mic. array, 2 × circular 7-pin (F) connectors
  - 1 × Type 2831: Battery Module, excluding accessories

SOFTWARE

Type 8430-X* **BK Connect Array Analysis**

or

Type 8493-A-N-SYS **BK Connect Acoustic Camera Applet (node-locked)**

* 'X' indicates the licence module, either: node locked (N) or floating (F)

Required Software

With BK Connect Array Analysis Type 8430:

Type 8400-X*	BK Connect Data Viewer
Type 8401-X*	BK Connect Hardware Setup
Type 8401-A-X*	BK Connect Hardware Setup (advanced)
M1-8430-X*	Software Maintenance and Support Agreement for Type 8430
M1-8400-X*	Software Maintenance and Support Agreement for Type 8400
M1-8401-X*	Software Maintenance and Support Agreement for Type 8401
M1-8401-A-X*	Software Maintenance and Support Agreement for Type 8401-A

With BK Connect Acoustic Camera Applet Type 8493-A-N-SYS:

M1-8493-A-N-SYS	Software Maintenance and Support Agreement for Type 8493-A-N-SYS

NOTE: Applets cannot be upgraded to full-version applications or added to other applets and modules

Options

Custom arrays are ordered through the Customized Projects Department or Project Sales Office†

Individual components of the BK Connect Acoustic Camera can be purchased as needed

† Contact information for local Brüel & Kjær offices can be found at bksv.com/contact

Supported Brüel & Kjær Products

HARDWARE

UA-4139	350 mm Reflective Plate, with black polyurethane foam windscreen layer
UA-0750	Tripod with ball head, 40 to 131 cm (15.7 to 51.6 in)
Type 4228	Pistonphone
Type 4231	Sound Calibrator
WA-0728-W-003	Type 4228 Calibrator Hose-fitted Adaptor for simultaneous verification of six ¼″ microphones
WA-0728-W-006	Type 4228/4231 Calibrator Hose-fitted Adaptor for verification of single ¼″ microphone

Calibration Services

ANA-LNXI-CAF	Accredited Calibration of LAN-XI Modules
WA-1764-W-001-TCF	Standard Factory Calibration of WA-1764-W-001, includes calibration and TEDS update of 30 × Array Microphones Type 4959, and a (BK Connect Acoustic Camera) system test

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