PULSE Reflex Acoustic Camera

Consisting of Acoustic Camera Type 9712-W-FEN and PULSE Reflex Array Analysis Type 8781

PULSE Reflex™ Acoustic Camera is a complete system for real-time noise source identification (NSI) that can be used for both stationary and non-stationary measurements. It is a versatile tool designed for use in the aerospace and automotive industries, but has applications in many other industrial environments. PULSE Reflex Acoustic Camera is equally suited to NSI troubleshooting in aircraft; buzz, squeak, and rattle (BSR) detection in vehicle cabins; and high-frequency leak detection.

Use PULSE Reflex Acoustic Camera to locate and view transient sound sources on site using an aim, shoot and measure procedure. The system allows you to take, save and share screenshots using the functionality of your tablet; make, save and review recordings using PULSE Reflex Array Analysis; and analyse recordings using PULSE Reflex Core (available separately.)

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Uses, Benefits, Features

Uses

- NSI troubleshooting in aircraft cabins, cockpits, avionics and cargo bays
- NSI on industrial machinery and household appliances
- Detection and documentation of BSR in vehicle cabins
- Leak detection
- Measure and record an event
- Non-stationary measurements, walk and stream
- Stationary measurements, mount the array on a tripod

Benefits

- Easy to use, minimal training required
- View measurements on site in real time
- Locate sound sources, take screenshots of problem areas
- Make and review recordings, adjust the frequency range
- Perform both beamforming and acoustic holography measurements with one system
- Analyse recordings in PULSE Reflex Core (available separately)
- Capture screen as picture or video for rapid reporting

Features

- Complete system, includes hardware and software
- Spectrogram displays sound frequencies as a function of time
- Portable, hardware comes in custom-made case
- Battery life of up to 2½ hours
- Source map superimposed on video images
- PULSE Reflex Array Analysis Type 8781
  - Up-and-running in under 10 seconds (from PULSE Reflex main menu)
  - Continuous buffering provides real-time images
  - Simple, easy-to-use interface
  - Optional remote control mode via tablet
  - Transfer recordings to PULSE Array Acoustics Post-processing
- Hand-held Array
  - Small size for use in confined spaces, diameter 35 cm
  - Removable reflective plate allows measuring 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

Brüel & Kjær

Description

PULSE Reflex Acoustic Camera is a portable solution for transient noise detection in almost any acoustic environment. It is capable of stationary and non-stationary measurements in both near and far acoustic fields.

This complete system allows you to collect and view sound measurements and video images using Acoustic Camera Type 9712-W-FEN and PULSE Reflex Array Analysis Type 8781. PULSE Reflex Acoustic Camera can be used as either a detection tool or a measurement device.

PULSE Reflex Acoustic Camera – A Complete System

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

The PULSE Reflex Acoustic Camera consists of both software and hardware.

The software components are PULSE Reflex Array Analysis Type 8781 and PULSE LAN-XI Multiple Front-end Driver Type 3099-A.

The hardware component, Acoustic Camera Type 9712-W-FEN, includes Hand-held Array WA-1764-W-001 and the requisite LAN-XI data acquisition hardware which includes the frame, modules and front panels. The hardware is delivered in a custom-made, waterproof case for easy transportation to and from measurement sites.
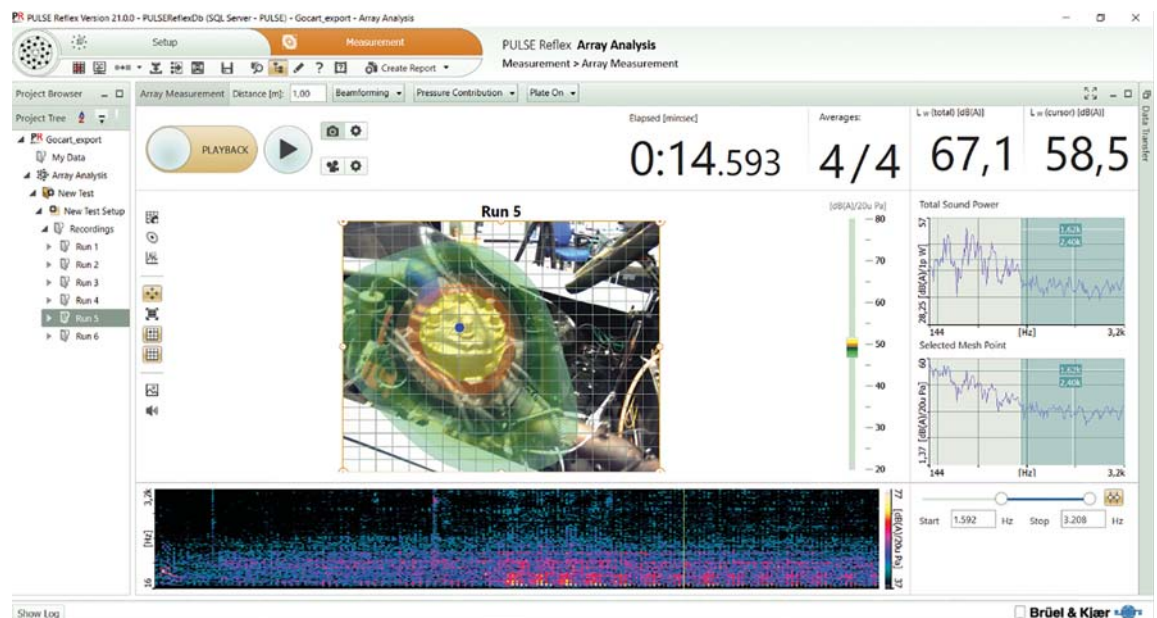

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Software – PULSE Reflex Array Analysis Type 8781

PULSE Reflex Array Analysis Type 8781 is a component of the PULSE Reflex system and features the same ease-of-use achieved through the innovative graphical user interface (GUI) and logical workflow.

Fig. 2
Interface of the Measurement tab in Type 8781 showing the acoustic map, spectrogram and sound power

Type 8781 is a stand-alone software platform to view, record and playback sound source data collected with Acoustic Camera Type 9712-W-FEN. Source maps and video images are superimposed to create an acoustic map. Continuous buffering provides real-time images which enables you to quickly pinpoint problem areas. Display options include graphs of sound pressure, sound intensity and sound power.

The software is up-and-running in under 20 seconds from the start of PULSE Reflex or under 10 seconds from the main menu of PULSE Reflex. It has three operating modes: streaming (from which screenshots can be made), recording and playback.

Streaming is the default operating mode of the software, making it perfect for troubleshooting applications. Locate a sound source, save a screenshot and use it to fix the issue – no post-processing necessary.

Once an area of interest is located in streaming mode, a recording can be made for further analysis. Recordings are automatically stored in the PULSE Reflex Array Analysis Project Tree. You can record multiple areas of interest since each recording is automatically stored separately in the project tree.

Playback allows you to view recordings immediately within Type 8781. This feature can be used to determine if another recording is necessary or to investigate the sound source further. You can adjust the frequency range during playback.

Note: If you have Acoustic Test Consultant Type 7761 and a valid service contract, you will receive Type 8781 as part of the maintenance update.

Using a Tablet
With a wireless connection, PULSE Reflex Array Analysis can be displayed on a tablet that runs Windows®, Apple®, or Android™ operating systems[*]. Enable the remote control mode to control the system from the tablet. This features makes it possible for one person to operate the entire system.

PULSE Reflex Core
Recordings made using Type 8781 can be analysed in PULSE Reflex. Simply enter PULSE Reflex Core from the PULSE Reflex main menu. Recordings are in the project tree, ready for analysis. See Product Data BP 2258 for more information about PULSE Reflex Base Type 8700, PULSE Reflex Data Viewer Type 8701 and the various PULSE Reflex Core modules.

PULSE Array Acoustics
Recordings made using Type 8781 can be analysed in PULSE Array Acoustics applications. Transfer the data from the recording to access all the relevant calculations and display possibilities in, for example, PULSE Array Acoustics Refined Beamforming Calculations BZ-5639 (Product Data BP 2543).

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[*] Requires software for remote support and online meetings, such as TeamViewer or similar. Commercial use of TeamViewer requires a license

Hand-held Array

Array WA-1764-W-001 is a 30-channel, sliced wheel array with integral cables and a removable reflective plate. It features an integrated handle with a built-in tablet holder. In the centre of the array is a video camera that films 15 to 20 frames per second.

Fig. 3
Maximum side lobe (MSL) level of WA-1764-W-001
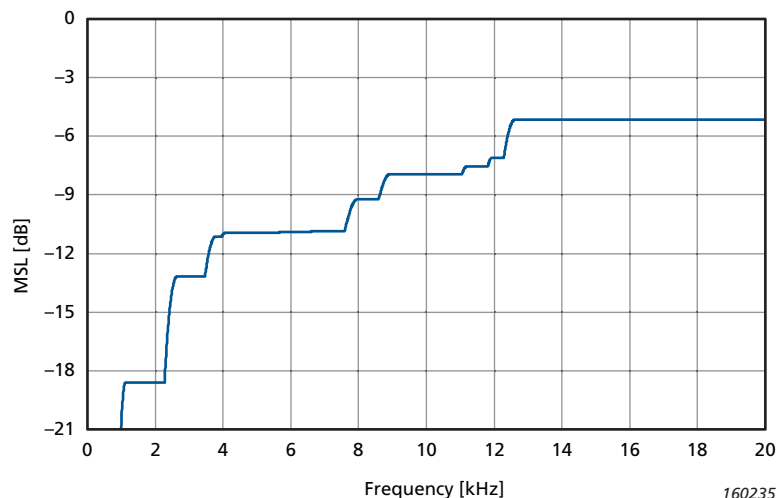
The array is a sliced wheel array with irregular microphone placement. It is optimized for both acoustic holography and beamforming measurements. Brüel & Kjær uses a patented numerical optimization method to design arrays with optimal performance for the frequency range and number of microphones. See Fig. 3 for the dynamic range, or maximum side lobe (MSL) level, of the array.

Microphones
The microphone used in Array WA-1764-W-001 is Type 4959. It is 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.

Cabling
The array has two integral cables – one that connects the array to the LAN-XI hardware and one (USB) that connects the camera to the computer. The cable that connects the array to the hardware consists of five cables that are bound together to keep the system tidy. The connectors are numbered to make connection to the LAN-XI front panels quick and easy.

Reflective Plate
The 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 (see Fig. 4). Without the reflective plate, measurements can be made in the near field using the acoustic holography algorithm (see Fig. 4). 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) *Hand-held Array WA-1764-W-001 with reflective plate for use in beamforming measurements and (**right**) without reflective plate for use in acoustic holography measurements*

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

Tablet Holder
The built-in tablet holder will work with a variety of tablet sizes and manufacturers. The recommended size is 20 × 13 cm (8 × 5 in).

Note: When using the hand-held 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.

LAN-XI Data Acquisition Hardware
All of the necessary LAN-XI hardware for the PULSE Reflex Acoustic Camera is included in Type 9712-W-FEN. Information regarding the LAN-XI components can be found in Product Data BP 2215, which describes LAN-XI data acquisition hardware (frame and modules), and BP 2421, which describes LAN-XI front panels.

Powering LAN-XI Data Acquisition Hardware
Battery Module Type 2831 can power the hardware for up to 2½ hours. The battery module is located in the fifth slot (far-right module in Fig. 5) of the LAN-XI front-end frame. The battery-life indicator on this module is always visible. The exact length of battery life is given in minutes in the far-left LAN-XI front-panel display upon start up. Both features are shown in Fig. 5.

Fig. 5
Portable LAN-XI module with battery-life indicator

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Supported Arrays

PULSE Reflex Array Analysis Type 8781 can be used with other Brüel & Kjær Sliced Wheel Arrays (see Table 1) and all other planar, irregular arrays and regular grid arrays. Type 8781 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 8 dB

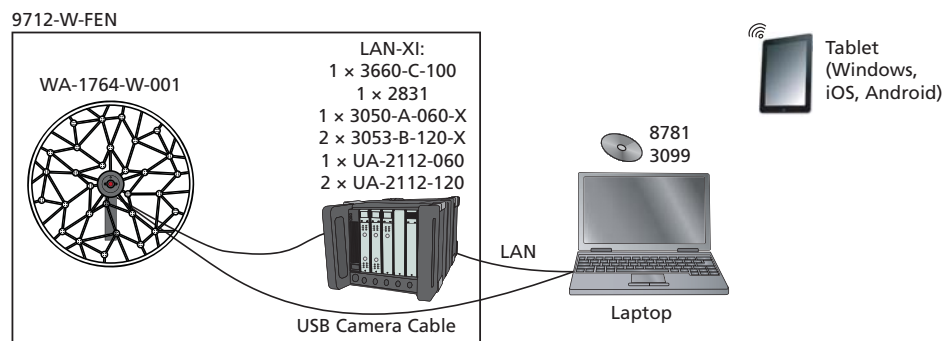| Number of Channels	Physical Diameter (in metres)	Type Number	Frequency Range (in hertz)	Resolution at Optimal Distance (in metres)
18	0.40	WA-1558-W-021	125 to 5.4 k	0.09 to 0.08
	0.55	WA-1558-W-019	100 to 3.9 k	0.13 to 0.07
30	0.35	WA-1764-W-001	100 to 12 k	0.05 to 0.03
36	0.55	WA-1558-W-020	100 to 8.4 k	0.09 to 0.04
	0.70	WA-1558-W-004	100 to 6.6 k	0.12 to 0.05
	1.05	WA-1558-W-014	100 to 4.4 k	0.17 to 0.07
	1.22	WA-1558-W-017	100 to 3.8 k	0.20 to 0.07
60	0.55	WA-1558-W-003	100 to 19 k	0.07 to 0.01
	0.75	WA-1558-W-010	100 to 14 k	0.09 to 0.02
	1.05	WA-1558-W-006	100 to 10 k	0.13 to 0.03
84	0.55	WA-1558-W-023	100 to 20 k	0.06 to 0.01
	1.05	WA-1558-W-022	100 to 20 k	0.11 to 0.01
	1.10	WA-1558-W-009	100 to 20 k	0.11 to 0.01
108	0.78	WA-1558-W-015	100 to 20 k	0.14 to 0.01

Microphone Verification and Calibration

On-site microphone verification can be preformed using Sound Calibrator Type 4231 and Single Channel Array Adaptor WA-0728-W-006. It is also possible to check each transducer using a verification function in PULSE Reflex Array Analysis Type 8781 and make adjustments accordingly.

If needed, factory standard calibration is also available.

System Setup

Fig. 6
PULSE Reflex Acoustic Camera System

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Compliance with Standards

HAND-HELD ARRAY TYPE WA-1764-W-001

CE ☒ (symbols)	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 Product Data sheet
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

Specifications – PULSE Reflex Acoustic Camera

Configuration

OPERATING SYSTEM REQUIREMENTS
- **Computer:** as for PULSE, see System Data BU 0229
- **Tablet:** Windows®, Apple®, or Android™ operating system

OTHER SOFTWARE REQUIREMENTS
- **Computer:** as for PULSE, see System Data BU 0229
- **Tablet:** TeamViewer or similar software

COMPUTER CONFIGURATION
As for PULSE, see System Data BU 0229

DATA ACQUISITION FRONT END CONFIGURATION
As for LAN-XI, see Product Data BP 2215

General Specifications

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

HAND-HELD ARRAY WA-1764-W-001[*]
Frequency Range: 140 Hz to 12 kHz
- Near field, without reflective plate (SONAH): 100 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°

TABLET
Recommended size: 20 × 13 cm (8 × 5 in)

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

PULSE Reflex Acoustic Camera

HARDWARE
9712-W-FEN   PULSE Reflex Acoustic Camera
Including:

- **WA-1764-W-001**: 30-ch. Hand-held Array
  - 1 × Array frame with handle, integral cable and tablet stand
  - 1 × Camera
  - 30 × Type 4959: Short 20 kHz Array Microphone
  - 1 × Reflecting panel
  - 1 × WE-0313: Storm Case, 60 × 34 × 64 cm, waterproof, weight (hardware and case) 22 kg

- **LAN-XI Data Acquisition System**
  - 1 × Type 3660-C-100: 5-module LAN-XI Front-end Frame with GPS
  - 1 × Type 3050-A-060-X: 6-ch. Input Module LAN-XI 51.2 kHz (Mic, CCLD, V), excluding accessories
  - 2 × Type 3053-B-120-X: 12-ch. Input Module LAN-XI 25.6 kHz (CCLD, V), excluding accessories
  - 1 × UA-2112-060: LAN-XI Front Panel, detachable, 6-ch., mic. arrays, 1 × circular 7-pins (F) connector
  - 2 × UA-2112-120: LAN-XI Front Panel, detachable, 12 ch., mic. arrays, 2 × circular 7-pins (F) connectors
  - 1 × Type 2831: Battery Module for LAN-XI

SOFTWARE
Type 8781-X01 [*]   PULSE Reflex Array Analysis
Type 3099-A-X [‡]   PULSE LAN-XI Multiple Front-end Driver

SOFTWARE MAINTENANCE AND SUPPORT (REQUIRED)
M1-8781-X01 [‡]   PULSE Reflex Array Analysis Software Maintenance and Support Agreement
M1-3099-A-X [‡]   PULSE LAN-XI Multiple Front-end Driver Software Maintenance and Support Agreement

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

Options

Custom arrays are ordered through the Customized Projects Department or Project Sales Office [†]
Individual components of the PULSE Reflex Acoustic Camera can be purchased as needed

SOFTWARE
Type 8608-X [‡]   PULSE Array Acoustics, Beamforming
Type 8607-X [‡]   PULSE Array Acoustics, Acoustic Holography
Type 8701-X [‡]   PULSE Reflex Data Viewer

HARDWARE
UA-1251   Tripod
Type 4231   Sound Calibrator
WA-0728-W-006   Single Channel Array Adaptor for Type 4231

Services

4595-CFF   Factory Standard Calibration

Software Maintenance and Support

Available for all software packages
See the PULSE Software Maintenance and Support Agreement Product Data (BP 1800) for further details

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

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