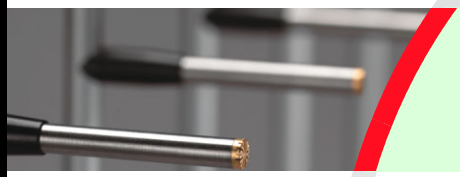


PRODUCT DATA

PULSE Sound Power — Type 7799

PULSE™ Sound Power Type 7799 is software for determining noise emission quantities of machinery, equipment and their sub-assemblies.

It includes the determination of sound power levels as described in international standards, as well as the measurement of emission sound pressure levels at specified positions in the vicinity of a machine.

Moreover, to evaluate the annoyance of tonal components in noise emissions, the calculation of two complementary parameters, Tone-to-Noise Ratio and Prominence Ratio, is seamlessly integrated in the solution.

USES AND FEATURES

USES

- To determine whether a product complies with noise specifications (legislation, voluntary awards)
- To compare the noise emissions of machinery and equipment of the same and different types (for example, when benchmarking, or in engineering work, when developing quieter products)
- To analyse product sound in terms of identification and evaluation of prominent discrete tones and impulsive noise

FEATURES

- Comprehensive solution for determining noise emission quantities such as sound power levels and emission sound pressure levels
- Measurement procedures and calculations based on basic International Standards ISO 3741 to ISO 3743 (comparison method), ISO 3744 to ISO 3746, ISO 9614-2 and ISO 11201, and noise test codes for information technology ISO 7779 and ECMA 74
- With the help of the interactive measurement setup and information windows, the user is guided through the measurement process
- Measurement data and results can be conveniently saved to familiar Microsoft® Excel® workbooks for customised reporting and further post-processing
- PULSE platform ensures exceptional measurement accuracy
- Scalable solution

Legislation

Noise emission quantities of machinery and equipment are increasingly becoming the subject of national and international regulations for a safer and healthier working place and for the protection of the environment. For example, the European Union laid down Directives 98/37/EEC (Machinery) and 2000/14/EC (Outdoor Equipment), which require manufacturers of many types of machinery and equipment to declare noise emissions (determined according to standardised methods) as a prerequisite for placing them on the EU market.

Such noise declarations are meant to help interested buyers (for example, employers who are required to reduce noise risks at the workplace to a minimum) to compare machinery on the market on the basis of noise emissions and thus to choose comparatively quiet machines. At the same time, any company that manufactures certified products fulfilling the EU noise emission requirements, has the opportunity to enter a bigger market with fewer import barriers.

Voluntary Awards

The process of globalisation and economic liberalisation has led to the creation of new global markets for companies who are striving to be competitive. At the same time, awareness among consumers regarding noise issues has substantially increased. It is no surprise then that voluntary awards for companies who meet acoustical criteria (for example, the German eco-label Blue Angel) are becoming an element of global strategy for companies in order to differentiate their products, especially in the consumer products market (appliances and information technology).

Voluntary awards are intended to provide effective means of making known the noise emissions determined according to standardised methods. They serve as a sign to consumers and business partners that the product meets certain quality standards and they also make it possible for purchasers to make buying decisions according to the criterion of low-noise emission. Voluntary awards represent an innovative approach to addressing the concerns of consumers and at the same time helping companies to be more competitive.

Product Sound

When speaking of product sound and sound quality, noise emissions are not the only cause for concern. Characteristics of sound (prominent discrete tones and impulsive noise) can also cause great human discomfort. Discrete tones are audible sounds of a single frequency; impulsive noise is noise of short duration and relatively high amplitude.

In cases where the noise emissions of products have been significantly reduced (for example, in the information technology and telecommunications industries), customer acceptability of the product is mostly related to absence/minimal presence of tonal components.

Description of Type 7799

This section describes how Type 7799 software allows you to determine, store and report noise emission quantities, using five different PULSE templates.

Free-field: for Sound Power Determination in a Free or Essentially Free Sound Field

This solution provides measurement and calculation procedures based on ISO 3744, ISO 3745 and ISO 3746. This set of basic International Standards give the methods for determining the sound power of noise sources operating in a free (or essentially free) sound field.

Sound pressure levels have to be measured at a number of microphone positions over a measurement surface enveloping the noise source. Depending on the number of microphones, measurements can be carried out simultaneously at all microphone positions, or in several steps. If the number of microphone positions required by the selected standard is greater than

the available number of microphones, you can move the microphones or test object between measurements.

Moreover, the software application provides flexible access to different stages of the procedure for optimising time and to avoid unnecessary time-consuming measurement repetitions (for example, background noise measurements).

An interactive setup table guides you through the measurement setup (for an example, see Fig. 1). Measurement setup, calibration values and background noise measurements can be stored in PULSE projects for future use.

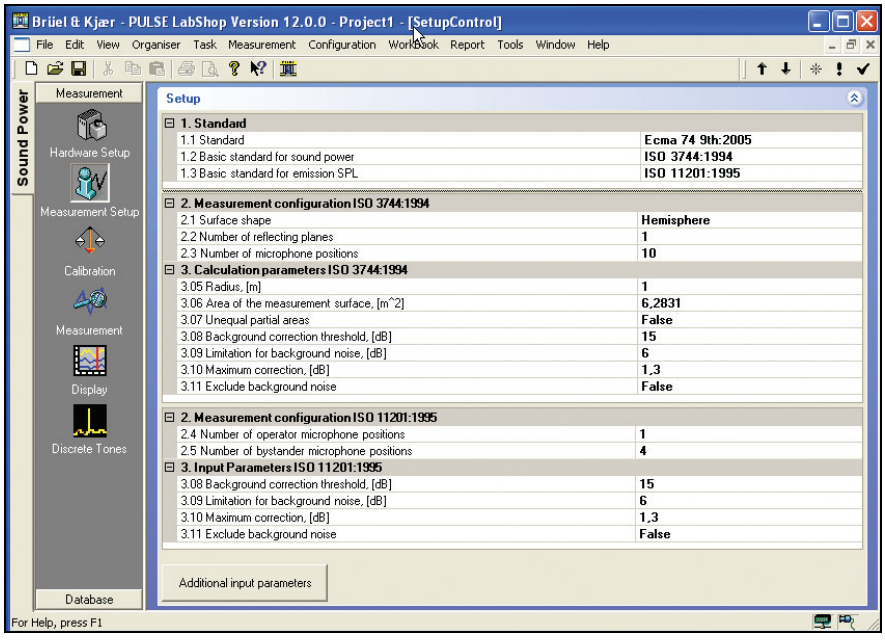


Fig. 1
An interactive setup table, shown here for the Free-field with Emission SPL template, assists with the measurement setup phase

Measurement data and results can be saved to Microsoft® Excel® workbooks where they are clearly organised in a series of worksheets.

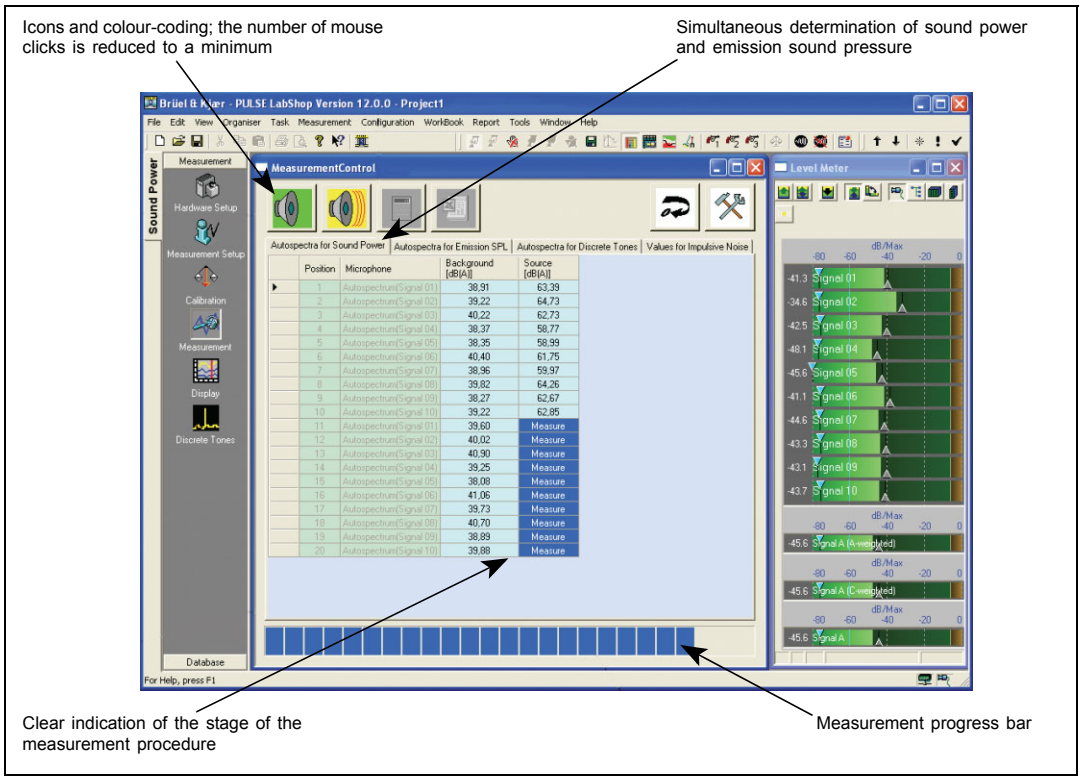
In addition to archiving using Excel® workbooks, data can be stored in a dedicated database for easy search/retrieve. Using PULSE Data Manager Type 7767, statistical quantities can be calculated on batch measurements stored in the database (such as mean and standard deviation).

Free-field with Emission SPL: for Sound Power and Emission Sound Pressure Determination in a Free or Essentially Free Sound Field

This solution combines the determination of sound power levels based on ISO 3744, ISO 3745, ISO 3746 (see above) and the measurement of emission sound pressure levels (at specified positions in the vicinity of the machinery, in an essentially free-field) based on ISO 11201.

Depending on the number of microphones, measurements can be carried out simultaneously at all microphone positions over a measurement surface enveloping the noise source, and at all operator and/or bystander positions, see Fig. 2.

Fig. 2
Graphic user interface is seamlessly integrated into PULSE Labshop



Along with the emission sound pressure levels, the Tone-to-Noise Ratio and Prominence Ratio are also calculated to identify and evaluate prominent discrete tones. Quantities used to identify impulsive noise are also measured.

Directive 2000-14-EC

This solution provides measurement and calculation procedures for the determination of the sound power in accordance with provisions of the EU Directive 2000/14/EC relating to the noise emission in the environment by equipment for use outdoors.

A predefined Excel® workbook containing Visual Basic® for Applications macros serves to enter measurement setup parameters, to control PULSE during the measurement process, to store data and to make the report.

For those types of equipment where measurements at different operating conditions are required, formulas are used to calculate the total sound power levels from measurements at each operating condition. The required weighting factor for each operating condition can be adjusted accordingly in the Excel® workbook.

Reverberation Room: for Sound Power Determination in Reverberation or Special Rooms

This solution provides measurement and calculation procedures based on the comparison method[1] as described in ISO 3741, ISO 3743-1 and ISO 3743-2. This set of basic International Standards give methods and specify the acoustical conditions for determining the sound power of noise sources operating in a reverberation or special room.

Depending on the number of microphones, such measurements can be performed simultaneously at all microphone positions, or in several steps. If the number of microphone positions required by the selected standard is greater than the available number of microphones, you can move the microphones or test object between measurements.

1. The comparison method requires the use of a reference sound source.

A predefined Excel® workbook containing Visual Basic® for Applications macros serves to enter measurement setup parameters, to control PULSE during the measurement process, to store data and to make the report.

Both microphone array and traversing microphone methods are supported. You are guided in the determination of additional microphone and/or source positions to meet the selected standard.

Intensity-based: for Sound Power Determination using Intensity (Scanning Method)
This solution, based on the scanning method as described in ISO 9614-2, provides measurement and calculation procedures for the determination of the sound power using sound intensity.

A predefined Excel® workbook containing Visual Basic® for Applications macros serves to enter measurement setup parameters, to control PULSE during the measurement process, to store data and to make the report.

A tree structure allows you to edit the measurement surface geometry by adding new, user-defined, planar surfaces, and by segmenting previously defined surfaces. Surfaces can be sub-segmented up to seven times to obtain the desired accuracy. This is also possible between individual measurements during the measurement procedure.

The pressure-residual intensity index can be calculated, and the dynamic capability index stored. The surface pressure-intensity indicator, F_{pI}, and the negative partial-power indicator, $F_{+/-}$, for the measurement surface are calculated and compared with the standard requirements. When the repeated scan method is selected, a partial-power repeatability check is performed for each segment. The measurements are recorded automatically, following the structure of the tree, or manually, and a display indicates the status of each measurement position.

Making a Complex Process Simple
Graphical features, such as pop-up text, colour coding and warnings, allow quick updates on measurement status, determination of pending actions, and validation of specific parameters within the standard. The flexibility of the program allows you to skip repetitive tasks.

Customisable Reports
Measurement data and results can be exported to pre-defined Microsoft® Excel® workbooks where they are clearly organised in a series of worksheets, including a predefined report. Using Excel, the report can be easily adapted to accommodate corporate styles and personal touches.

Scalable Solution, Common Plaform
PULSE Sound Power Type 7799 software runs with various configurations, making the solution scalable to match current budgets and requirements. Built on the powerful PULSE platform, it is quite feasible to combine Type 7799 with other PULSE sound and vibration measurement applications for a complete and flexible product testing program aimed at standards compliance and non-conformance problem resolution.

Specifications – PULSE Sound Power Type 7799

Type 7799 is an application for use with PULSE

System Requirements

The PC requirements for PULSE must be fulfilled.
The following licenses are required:
- PULSE CPB Analysis Type 7771
  or
- PULSE FFT and CPB Analysis Type 7700 (for the identification of prominent discrete tones and narrow-band analysis (FFT))
- Microsoft® Office 2000 or 2003

Screen resolution of 1400 × 1050 pixels (or better) is recommended

Calibration

Calibration is performed using PULSE's integrated Calibration Master, which automatically initiates calibration while moving the calibrator from one microphone to the next. The full calibration history for a transducer can be retained in the Transducer Database, which allows monitoring calibration data variations over a period of time. Global calibration allows building up a calibration database that is shared across all PULSE projects

Free-field (PULSE Template)

Provides measurement and calculation procedures for the determination of the sound power of noise sources as described in the following international standards.

STANDARDS
ISO 3744:1994
ISO 3745:2003
ISO 3746:1995

SUITABLE TEST ENVIRONMENTS
- Anechoic or hemi-anechoic rooms as specified in ISO 3745:2003
- Essentially free-field over a reflecting plane as specified in ISO 3744:1994

MEASUREMENT

$L'_{p(B)\,i}$ [a]	time-averaged sound pressure level produced by background noise
$L'_{p(S)\,i}$	time-averaged sound pressure level from the noise source under test

a. Throughout these specifications subscript *i* means that the quantity is measured or calculated at the *i*th microphone position over the measurement surface

Quantities Specific to ISO 3745:

$L'_{E(B)\,i}$	single-event sound pressure level produced by background noise
$L'_{E(S)\,i}$	single-event sound pressure level from the noise source under test

- All quantities can be measured in 1/3-octave band for any range with nominal midband frequencies from 50 Hz to 20 kHz[1], in 1/1-octave band for any range with nominal midband frequencies from 63 Hz to 16 kHz[1] or in narrow-band (FFT) for any range with nominal midband frequencies from 50 Hz to 20 kHz[1]

1. If microphone frequency range and available number of beats allow. For information on microphone frequency range, please refer to the respective microphone Product Data

CALCULATION

$\overline{L}_{pf}$	surface time-averaged sound pressure level
L_W	sound power level

Quantities Specific to ISO 3744 and ISO 3746:

$\overline{L'}_{p(B)}$	mean measured time-averaged background noise level over the measurement surface
$\overline{L'}_{p(S)}$	mean measured time-averaged sound pressure level for the noise source under test over the measurement surface
K_1	background noise corrections for the surface sound pressure level

Quantities Specific to ISO 3745:

K_{1i}	background noise corrections
L_{pi}	sound pressure level corrected for background noise
L'_W	sound power level under alternate meteorological conditions
DI_i	directivity index
Q_i	directivity factor

- A-weighted values are calculated from 1/1-octave or 1/3-octave values as specified in, for example, Annex H of ISO 3745:2003 or from narrow-band values (FFT)

VALIDATION
Criterion for background noise
Requirement evaluation for additional microphone positions

STATISTICS[2]
Mean and standard deviation of any measured or calculated quantity on batch measurements

2. PULSE Data Manager Type 7767 license required

Free-field with Emission SPL (PULSE Template)

All specifications given for the Free-field method apply plus the following standards

STANDARDS
ISO 11201:1995
ISO 7779:1999 (sound power levels are determined under free-field or essentially free-field conditions only)
ECMA 74 (9th edition, sound power levels are determined under free-field or essentially free-field conditions only)

MEASUREMENT

$L'_{p(B)\,j}$ [a]	measured time-averaged sound pressure level produced by the background noise, A-weighted
$L'_{p(S)\,j}$	measured time-averaged sound pressure level during operation of the source under test, A-weighted
$L'_{p(S)\,j(\mathrm{FFT})}$	measured time-averaged sound pressure level during operation of the source under testing, in narrow band

a. Throughout these specifications subscript *j* means that the quantity is measured or calculated for the *j*th operator or bystander position

CALCULATION

L_{pj} time-averaged sound pressure level corrected for the background noise, A-weighted

$L_{pCpeakj}$ C-weighted peak sound pressure level

IDENTIFICATION OF PROMINENT DISCRETE TONES

Tone-to-Noise Ratio criteria according to ISO 7779:1999 and ECMA 74 (9th edition)

Prominence Ratio method according to ECMA 74 (9th edition)

Directive 2000/14/EC (PULSE Template)

Provides measurement and calculation procedures for the determination of the sound power of noise sources in accordance with provisions of the EU Directive 2000/14/EC relating to the noise emission in the environment by equipment for use outdoors

SUITABLE TEST ENVIRONMENTS

- Typically outdoor on a reflecting surface of concrete or non-porous asphalt
- In cases where the equipment cannot be operated on such surface, a suitable environment is defined and max environmental correction K_{2A} is given in the Directive 2000/14/EC (or in the noise test codes referenced in the Directive)

MEASUREMENT

$L'_{p(B)\,i}$ time-averaged sound pressure level produced by the background noise

$L'_{p(S)\,ikn}$ time-averaged sound pressure level from the noise source under test for the *k*th operating mode and the *n*th run

- All quantities can be measured in 1/3 octave band for any range with nominal midband frequencies from 50 Hz to 20 kHz[1] or in 1/1-octave band for any range with nominal midband frequencies from 63 Hz to 16 kHz[1]

CALCULATION

$\overline{L'}_{p(B)}$ mean measured time-averaged background noise level over the measurement surface

$\overline{L'}_{p(S)\,kn}$ mean measured time-averaged sound pressure level for the noise source under test over the measurement surface for the *k*th operating mode and the *n*th run

K_1 background noise corrections for the surface sound pressure level

$\overline{L}_{pf\,kn}$ surface time-averaged sound pressure level for the *k*th operating mode and the *n*th run

$\overline{L}_{pf\,k}$ surface time-averaged sound pressure level for the *k*th operating mode[a]

$\overline{L}_{pf}$ surface time-averaged sound pressure level calculated using the appropriate equation for the specific type of equipment under test[b] given in the Directive 2000/14/EC (or in the corresponding noise test code)

L_W sound power level

a. Calculated as the arithmetic mean of the two highest values from three or more runs, which do not differ by more than 1 dB according to Annex III Part A of Directive 2000/14/EC

b. The equation, which combines the $\overline{L}_{pf\,k}$ test results from k, is manually entered in the user interface

- A-weighted values are calculated from 1/1-octave or 1/3-octave values as specified in Annex H of ISO 3745:2003

VALIDATION

Criterion for background noise

Automatic determination of surface time-averaged sound pressure level values from three or more runs, which do not differ by more than 1 dB

STATISTICS

Mean and standard deviation of sound power level on batch measurements

1. If microphone frequency range and available number of beats allow. For information on microphone frequency range, please refer to the respective microphone Product Data.

Reverberation Room (PULSE Template)

Provides measurement and calculation procedures for the determination of the sound power of noise sources using the comparison method as described in the following international standards[2]

STANDARDS

ISO 3741:1999 (Comparison method only)
ISO 3743–1:1994 (Comparison method only)
ISO 3743–2:1994 (Comparison method only)

SUITABLE TEST ENVIRONMENTS

- Reverberation rooms as specified in ISO 3741:1999
- Reverberant fields as specified in ISO 3743–1:1994 or ISO 3743–2:1994

MEASUREMENT

$L'_{p(B)\,ij}$ time-averaged sound pressure level produced by the background noise

$L'_{p(R)\,ij}$ time-averaged sound pressure level from the reference sound source

$L'_{p(S)\,ij}$ time-averaged sound pressure level from the noise source under test

- All quantities are measured in 1/3-octave band for any range with nominal midband frequencies from 50 Hz to 20 kHz or in 1/1-octave band for any range with nominal midband frequencies from 63 Hz to 16 kHz
- A-weighted values calculated from 1/1-octave or 1/3-octave values as specified in Annex H of ISO 3745:2003

CALCULATION

K_1 background noise corrections

$\overline{L}_{p(R)\,j}$ mean corrected time-averaged sound pressure level from the reference sound source over all source positions

$\overline{L}_{p(S)\,j}$ mean corrected time-averaged sound pressure level from the noise source under test over all source positions

2. The comparison method requires a reference sound source meeting the requirements of ISO 6926 (e.g., Reference Sound Source Type 4204)

N_M	number of necessary microphone positions or separate microphone traverses for each source position
N_S	number of necessary source positions
L_W	sound power level

VALIDATION
Criterion for background noise
Requirement evaluation for additional microphone positions
Requirement evaluation for additional source positions

Intensity-based (PULSE Template)

Provides measurement procedure, calculation procedure and reporting in accordance with the following international standards

STANDARDS
ISO 9614–2:1996
ECMA 160:1992

SUITABLE TEST ENVIRONMENTS
Any

MEASUREMENT

$<I_{ni}>$	mean segment-averaged normal sound intensity component measured on the ith segment of the measurement surface
L_d	dynamic capability index[a]

a. Requires a Sound Intensity calibrator (e.g., Sound Intensity Calibrator Type 4297)

All quantities are measured choosing between the following options:
- 1/1-octave band for any range with nominal midband frequencies from 63 Hz to 4 kHz
- 1/3-octave band for any range with nominal midband frequencies from 50 Hz to 6.3 kHz
- 1/12-octave band for any range with nominal midband frequencies from 51.58 Hz to 6.131 kHz
- 1/24-octave band for any range with nominal midband frequencies from 50.85 Hz to 6.043 kHz

CALCULATION

P_i	partial sound power for the ith segment of the measurement surface
L_W	sound power level
F_{pI}	surface pressure-intensity field indicator
$F_{+/-}$	negative partial power field indicator F_{pI}

VALIDATION
Adequacy of the measurement equipment[1]
Limit on negative partial power
Partial-power repeatability check

1. Based on comparison between the dynamic capability index L_d with field indicator F_{pI}

Ordering Information

Type 7799–X[2]	PULSE Sound Power

Accessories Recommended

Type 7767–X[2]	PULSE Data Manager

FREE-FIELD METHODS

Type 4190-L-001	Free-field ½″ Microphone with 2669-L, TEDS
Type 4955	½″ Low-noise Free-field TEDS Microphone
Type 4188-A-021	Prepolarized Free-field ½″ Microphone with 2671-L, TEDS
Type 4950	Prepolarized Free-field ½″ Microphone
Type 2671	DeltaTron Microphone Preamplifier
Type 4204	Reference Sound Source
Type 4231	Sound Calibrator

REVERBERANT-FIELD METHODS

Type 4943-L-001	Diffuse-field ½″ Microphone with 2669 L, TEDS
Type 4188-A-021	Prepolarized Free-field ½″ Microphone with 2671-L, TEDS
Type 4942-A-021	Prepolarized Diffuse-field ½″ Microphone with 2671-L, TEDS
Type 4204	Reference Sound Source
Type 4231	Sound Calibrator
Type 3923	Rotating Microphone Boom
UA-0587	Heavy Duty Tripod for Type 3923
AO-0488-Y-XXX[3]	Cable, Brüel & Kjær Female to LEMO 1 B Connector
ZQ-0350	LEMO Brüel & Kjær Socket Adaptor

SOUND INTENSITY METHOD

Type 3599	Sound Intensity Probe Kit
Type 4297	Sound Intensity Calibrator
UA-1451	Telescopic Boom Kit

2. Where 'X' indicates the license model, either N: node-locked, or F: floating

Other Accessories

UA-0801	Lightweight Tripod
UA-1317	½″ Microphone Holder
AO-0087-Y-XXX[3]	Screened Signal Cable, BNC to BNC Connector
AO-0414-Y-XXX[3]	7-pin LEMO Microphone Ext. Cable
UA-0459	Windscreen for ½″ Microphone, 65 mm diameter
UA-0237	Windscreen for ½″ Microphone, 90 mm diameter

3. Cables are available in different lengths, specified by Y-XXX, where:
Y = D (decimetres) or M (metres)
XXX is the length in the given units
Please specify

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Canada (+1) 514 695-8225 · China (+86) 10 680 29906 · Czech Republic (+420) 2 6702 1100
Finland (+358) 9-755 950 · France (+33) 1 69 90 71 00 · Germany (+49) 421 17 87 0
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Local representatives and service organisations worldwide

BP 2093 – 13 2007-10 Rosendahls Bogtrykkeri