PRODUCT DATA

2250 Reverberation Time Software BZ-7227 for Hand-held Analyzer – Type 2250-F and Post-processing Software: Qualifier Light Type 7831

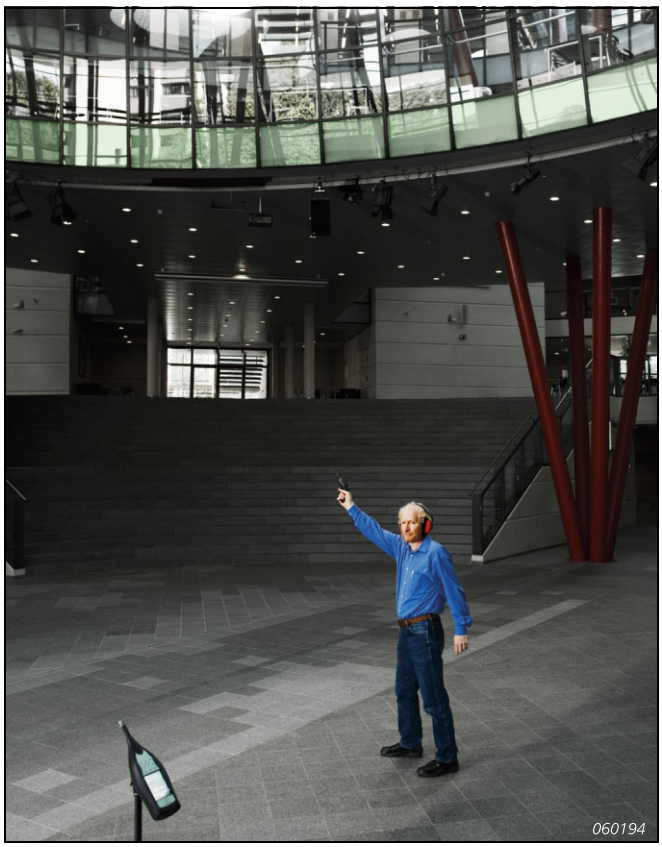
Reverberation Time Software BZ-7227 extends the "Easy, Safe and Clever" mantra of Hand-held Analyzer Type 2250 to include Reverberation Time (RT).

Press the Start/Pause pushbutton, clap your hands – that's all it takes to do a basic measurement. The "traffic light" shows measurement status at a glance, and the resulting RT spectrum is shown as well as the average RT for the room.

Keep track of measurement positions in the colour map display, check the "smiley" indicators for measurement quality, and add spoken or text comments to positions or projects.

Measurements comply with the relevant parts of ISO standards including ISO 140, ISO 3382, and ISO 354.

Type 2250 is the innovative 4th generation hand-held analyzer from Brüel & Kjær. It comes fully equipped as a sound level meter with PC software for data transfer, archiving and export (see Product Data BP 2025).



USES AND FEATURES

USES

- Workplace acoustics
- Acoustics in auditoria, halls, public spaces, etc
- Building acoustics room correction
- Sound power room correction
- Absorption coefficient

FEATURES (2250-F)

- Hand-held reverberation time analysis
- Wide dynamic range – no range switching
- 1/3 or 1/1-octaves
- Impulse (Schroeder) Method
- Interrupted Noise Method
- Built-in pink and white noise generator
- Measurement position management
- Measurement quality indicators
- Voice or text annotations
- Displays RT spectrum, decay and ensemble average decay
- Calculates wide band average reverberation time
- PC software available for post-processing and reporting

FEATURES (7831)

- Calculates reverberation time
- Edits measurement results, including manual input of data
- Documentation and reporting facilities

Brüel & Kjær

Reverberation Time Defined

RT is the most important parameter describing the acoustic quality of a room or space. It is important for sound levels, speech intelligibility and the perception of music. In addition, it is used to correct for the effects of RT on building acoustics and sound power measurements.

RT is the decay time for sound in a room after the excitation stops. It is the time for a 60 dB drop in level, but the decay is usually measured over a 10, 20 or 30 dB drop and then extrapolated to the 60 dB range, see Fig. 1.

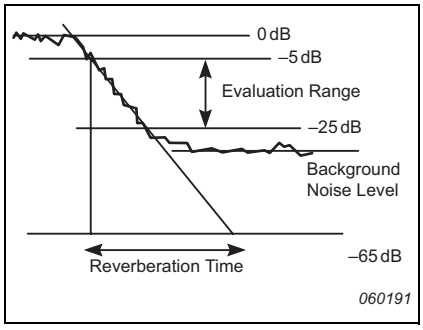


Fig. 1
Reverberation Decay Curve and Reverberation Time

RT may be labelled EDT, T20 and T30 respectively for those three evaluation ranges. EDT is used in room acoustics only, while T20 and T30 may be used in all applications. RT is measured in 1/1- or 1/3-octave frequency bands, some of which may be averaged to provide a single-number result for the most significant bands.

RT may range from 0.1 seconds (or less) in anechoic chambers, to 10 or more seconds in large public spaces.

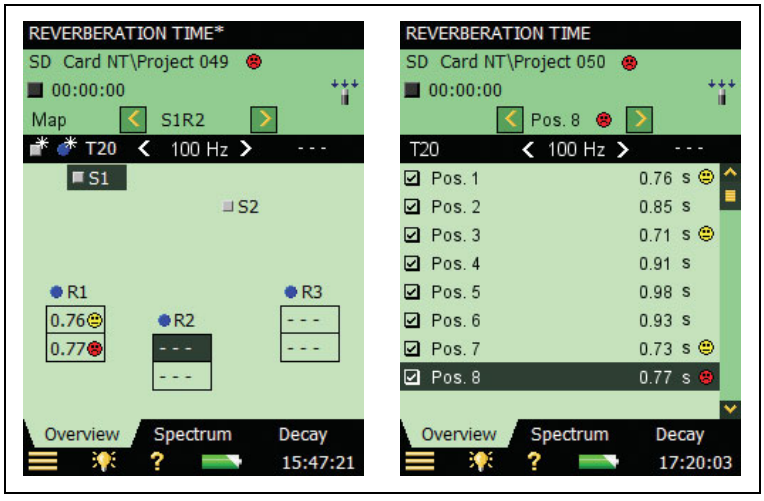


Fig. 2
Typical displays from a Type 2250-F running RT software: the left-hand display shows how sources and receivers are mapped; the right-hand display shows an example of a receiver position table

RT varies between positions in a room, so it is usually measured at several positions. The average for all positions gives an overall assessment, and the position results may be used to indicate the acoustic quality as a function of location, see the example displays in Fig. 2.

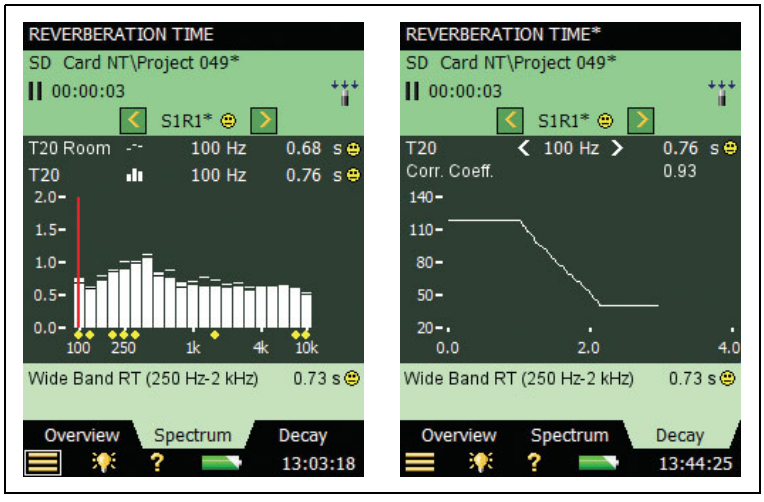


Fig. 3
Typical displays from a Type 2250-F running RT software: the left-hand display shows a Reverberation Time spectrum; the right-hand display shows a Reverberation Decay display

The average can be made for the RT spectra, or the decays for each frequency band may be averaged and the RT spectrum calculated for the averaged decays (ensemble average).

How Do We Measure Reverberation Time?

RT can be measured using either Impulsive Excitation (Schroeder Method), such as from a pistol or balloon burst (see Fig. 4), or by using Interrupted Noise, with the built-in noise generator, (see Fig. 5).

Impulsive Excitation Method

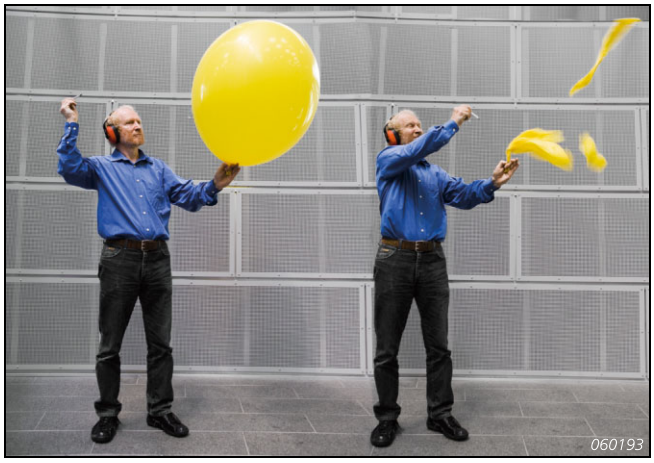


Fig. 4
Reverberation Time in the blink of an eye!

With Impulsive Excitation, all you need to carry is Type 2250-F, a tripod and a balloon (or other impulsive source, such as a starting pistol). After you pop the balloon, 2250-F will start measuring, analyse the decay and present the RT as well as the decay curves for all frequency bands.

It will also display the average RT for the bands you select.

The single input range means that trial measurements are not necessary when using the impulsive excitation method.

Interrupted Noise Method

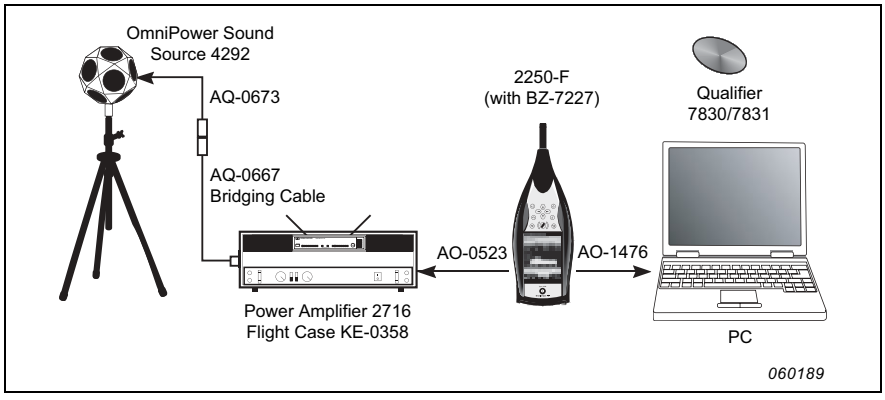


Fig. 5
Typical measurement setup using a loudspeaker source

When using a power amplifier and loudspeaker sound source, Type 2250-F/BZ-7227 will turn it's noise generator on and off, then measure and display the RT spectrum and decays.

The measurement can be in octaves or 1/3-octaves in parallel over a selectable frequency range, allowing you to focus sound power on the relevant range. In each frequency band, the decay is sampled 200 times each second, for reverberation times as long as 20 seconds. An example of a Reverberation Display is provided in Fig. 3.

The single input range speeds up the interrupted noise measurements by avoiding autorange.

Measurement Displays

RT is shown as T20, T30 and EDT, and as decay curves with slope line and evaluation range. The room average RT is based on T20, T30 and EDT, or on the average decay for all positions (ensemble average).

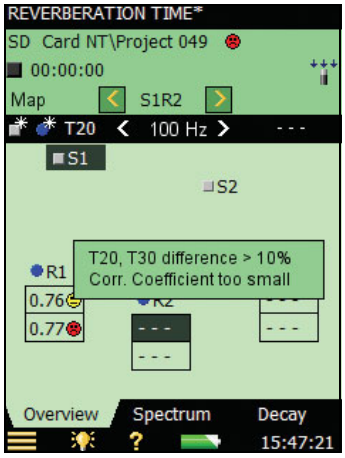


Fig. 6
Typical display, with quality indicators

Display Quality Indicators

To ensure user confidence, display quality indicators are provided in the form of 'smileys' on the display. If you tap on a smiley, the relevant details are displayed in a pop-up (see Fig. 6).

Status Codes

In addition, status codes are provided, which are saved with each measurement.

Accessories

A wide range of accessories including power amplifier, sound sources, and wireless transmission kit is available. And, of course, PC software for post-processing and reporting.

Who Should Use Reverberation Time Software?

The software has been designed specifically for use by professionals in the following industries:

- Occupational Health Officers assessing noise levels at workplaces. RT is often a contributing cause of high noise levels
- Environmental Officers or Consultants assessing sound insulation in new or renovated buildings. RT is one of the parameters for this assessment
- Consultants or Acousticians assessing room acoustics in classrooms, auditoria, workspaces and public spaces
- Manufacturers or Consultants estimating the sound power level for CE-labelling of tools or machinery, using RT for room correction

Where Can Reverberation Time Be Used?

RT software can be used in a variety of different applications:

Room Acoustics

RT is used in its own right for assessing the acoustics of workplaces, classrooms, auditoria, concert halls and public venues – to check or troubleshoot acoustical comfort or workplace health issues.

Building Acoustics

Sound levels measured in a receiving room are affected by the absorption in the room, by measuring RT you can correct level measurements for the absorption.

Sound Power Measurement

Tools, appliances and machinery must be CE-labelled with their sound power level. RT is part of a sound pressure based power measurement, made in a test room. RT is used to correct for the absorption of the test room.

Absorption Coefficient

RT is used to determine the absorption coefficient of building materials or building elements. In a specially designed reverberation chamber the RT is measured with and without a sample of material or building element. From this data the absorption coefficient (α) is calculated. The absorption coefficient is the ratio of reflected to incident sound energy. It is 0 for a totally absorbing material, and 1 for a totally reflecting material.

PC Software

Hand-held Analyzer Type 2250 comes with Utility Software BZ-5503. It will control Type 2250 from a PC, manage and archive your measurement data, and keep your Type 2250 software up to date.

For analysing and reporting RT data, you can export your data from the BZ-5503 archive to Qualifier Light Type 7831 for viewing, editing and reporting.

For building acoustic applications (sound insulation), you need to measure RT *and* the source room/receiving room levels, using Frequency Analysis software BZ-7223. Then you can export your data from the BZ-5503 archive to Qualifier Type 7830 for viewing, editing, calculating sound insulation and reporting.

Note that Type 7831 and Type 7830 both include licenses for Noise Explorer™ Type 7815.

For details on, and specifications for Type 7831 and Type 7830, please refer to Product Data BP 1691.

Hand-held Analyzer Type 2250 – Compliance with Standards

CE, C-Tick	CE-mark indicates compliance with: EMC Directive and Low Voltage Directive. C-Tick mark indicates compliance with the EMC requirements of Australia and New Zealand.
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.
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. **Note 1:** The above is guaranteed using accessories listed in this Product Data sheet only. **Note 2:** The above is guaranteed only when the AC output is not in use.

Specifications – Reverberation Time Software BZ-7227

The specifications given below are in addition to those for the Type 2250 Platform – see the Product Data for Hand-held Analyzer Type 2250 (BP 2025)

Conforms with the relevant parts of the following:
- IEC 61672–1 (2002–05) Class 1
- IEC 60651 (1979) plus Amendment 1 (1993–02) and Amendment 2 (2000–10), Type 1
- ANSI S1.4–1983 plus ANSI S1.4A–1985 Amendment, Type 1
- IEC 61260 (1995–07) plus Amendment 1 (2001–09), 1/1-octave Bands and 1/3-octave Bands, Class 0
- ANSI S1.11–1986, 1/1-octave Bands and 1/3-octave Bands, Order 3, Type 0–C
- ANSI S1.11–2004, 1/1-octave Bands and 1/3-octave Bands, Class 0
- ISO 140
- ISO 3382
- ISO 354

CORRECTION FILTERS
For Microphone Types 4189, 4191, 4193 and 4952, BZ-7227 is able to correct the frequency response to compensate for sound field and accessories:

Broadband Measurements

DETECTORS
A- and C-weighted broadband detectors with F exponential time weighting
Overload Detector: Monitors the overload outputs of all the frequency weighted channels

MEASUREMENTS
L_{AF} and L_{CF} for Display as Numbers or Quasi-analogue Bars

MEASURING RANGES
When using Microphone Type 4189:
Dynamic Range: From typical noise floor to max. level for a 1 kHz pure tone signal, A-weighted: 16.6 to 140 dB
Primary Indicator Range: In accordance with IEC 60651, A-weighted: 23.5 dB to 123 dB
Linear Operating Range: In accordance with IEC 61672, A-weighted: 1 kHz: 24.8 dB to 140 dB

Frequency Analysis

CENTRE FREQUENCIES
1/1-octave Band Centre Frequencies: 63 Hz to 8 kHz
1/3-octave Band Centre Frequencies: 50 Hz to 10 kHz

MEASUREMENTS
L_{ZF} spectrum for display only
L_{Zeq} spectra sampled at 5 ms intervals

MEASURING RANGES
When using Microphone Type 4189:
Dynamic Range: From typical noise floor to max. level for a pure tone signal at 1 kHz 1/3-octave: 1.7 to 140 dB
Linear Operating Range: In accordance with IEC 61260: ≤ 20.5 dB to 140 dB

Internal Generator

Built-in pseudo-random noise generator
Spectrum: Selectable between Pink and White
Crest Factor:
Pink noise: 4.4 (13 dB)
White noise: 3.6 (11 dB)
Bandwidth: Follows measurement frequency range
Lower limit: 50 Hz (1/3-oct.) or 63 Hz (oct.),
Upper limit: 10 kHz (1/3-oct.) or 8 kHz (oct.)
Output Level: Independent of bandwidth
Max.: $1V_{rms}$ (0 dB)
Gain Adjustment: –60 to 0 dB
When bandwidth is changed, the level for all bands is automatically adjusted to comply with the set output level
Turn-on time and Turn-off time: Equivalent to RT = 70 ms
Repetition Period: 175 s
Output Connector: Output Socket
Control: See Measurement Control

External Generator

Selectable as alternative to Internal Generator
For controlling external noise generator
Levels: 0 V (Generator off), 4.5 V (Generator on)
Rise-time and Fall-time: 10 μs
Control: See Measurement Control

Reverberation Time

EDT, T20 and T30 in octave or 1/3-octave bands
Decays: Measured and stored using averaging time of 5 ms
Evaluation Range: –5 to –15 dB for EDT, –5 to –25 dB for T20 and –5 to –35 dB for T30
Measurement Time: Automatic selection of measurement time for the decays based on the actual reverberation time of the room
Maximum Measurement Time: from 2 to 20 s
Averaging: EDT, T20 and T30 measurements can be averaged (arithmetic averaging or ensemble averaging)
EDT, T20 and T30 calculation: From slope in evaluation range
Slope Estimation: Least squares approximation

Quality Indicators: Quality Indicators with status information like Overload, T20 – T30%, Correlation Coefficient, etc.; extensive list of Status information
Quality Indicators are available on reverberation time spectra for each frequency band, and as overall quality indicators for each measurement position and for the total project (room)
Reverberation Time Range: Max. 20 s, min. 0.1 – 0.7 s, depending on bandwidth and centre frequency
Wide Band Reverberation Time: The arithmetic average of the Reverberation Time within a selectable frequency range is calculated

Measurement Displays

OVERVIEW MAP
Map of Source and Receiver positions with reverberation time readout for a selectable frequency band on each measurement position together with quality indicator.
Organisation of Source and Receiver positions: measure at all receiver positions for each source or measure in a number of positions (1 to 10) for each source
Source and Receiver positions can be added, moved or deleted.

OVERVIEW TABLE
Table of measurement positions with reverberation time readout for selectable frequency band on each position together with quality indicator. Positions can be included/excluded from Room average

SOUND LEVEL SPECTRUM
LZF spectrum plus A and C broadband bars
Y-axis: Range: 5, 10, 20, 40, 60, 80, 100, 120, 140 or 160 dB. Auto zoom or auto scale available
Cursor: Readout of selected band
Quality indicator for each frequency band

REVERBERATION TIME SPECTRUM
One or two spectra can be displayed
Y-axis: Range: 0.5, 1, 2, 5, 10 or 20 s. Auto zoom available
Cursor: Readout of selected band
Quality Indicator for each frequency band

REVERBERATION TIME SPECTRUM TABLE
One or two spectra can be displayed in tabular form

DECAY
Decay curve for a position or the room average available for each frequency band
Readout of Correlation Coefficient
Y-axis: Range: 5, 10, 20, 40, 60, 80, 100, 120, 140 or 160 dB. Auto zoom or auto scale available

Measurement Control

Measurement Sequence: Supports measuring:
- at all receiver positions before using another source
- at a receiver position for all sources before measuring at a new position
- at subsequent receiver positions without source information, or
- at manually selected source and receiver positions

During measurement, the instantaneous sound level spectrum is displayed. After measurement, the reverberation time is displayed
Interrupted Noise Excitation: Measurements are started manually and can be automatically stored on completion of measurement. The noise generator is turned on and off automatically
Escape Time: 0 to 60 s
Build-up Time: 1 to 10 s
Number of Decays per Measurement: 1 to 100, ensemble averaged into one decay
The generator can be turned on and off manually for checking equipment and sound levels
Impulse Excitation: Manual start of first measurement. When level (say from starter pistol) exceeds the user-selected trigger level, the decay is recorded and backwards integration performed (Schroeder method). The trigger can then be armed automatically for measuring at the next position
Sound Recording: Recording of the measured signal can be done at each position
Sound Recording requires a CF- or SD-Card for data storage
Sound Recording requires license for Sound Recording Option BZ-7226

Measurement Status

On Screen: Information such as *overload*, *awaiting trigger* and *running/paused* are displayed on screen as icons
Traffic Light: Red, yellow and green LEDs show measurement status and instantaneous overload as follows:
- Yellow LED flashing every 5 s = stopped, ready to measure
- Green LED flashing slowly = awaiting trigger or calibration signal
- Green LED on constantly = measuring
- Yellow LED flashing slowly = paused, measurement not stored
- Red LED flashing quickly = intermittent overload, calibration failed

Calibration

Initial calibration is stored for comparison with later calibrations
Acoustic: Using Sound Calibrator Type 4231 or custom calibrator. The calibration process automatically detects the calibration level when Sound Calibrator Type 4231 is used
Electrical: Uses internally generated electrical signal combined with a typed-in value of microphone sensitivity
Calibration History: Up to 20 of the last calibrations made are listed and can be viewed on the instrument

Signal Monitoring

Input signal can be monitored using an earphone/headphones connected to the headphone socket, or it can be fed to output socket
Output Signal: Input conditioned; A-, C- or Z-weighted
Gain Adjustment: –60 dB to 60 dB
L_{AF} output (every ms) as a DC voltage between 0 V and 4 V
DC output for calibration purposes: 0 dB ~ 0 V and 200 dB ~ 4 V
Headphone Signal: Input signal can be monitored using this socket with headphones/earphones
Gain Adjustment: –60 dB to 60 dB

Voice Annotations

Voice annotations can be attached to the Reverberation Time Project, to Sources, to Receivers and to measurements at each Position
Playback: Playback of voice annotations or sound recordings can be listened to using earphone/headphones connected to the headphone socket
Gain Adjustment: –60 dB to 0 dB

Text Annotations

Text annotations can be attached to the Reverberation Time Project, to Sources, to Receivers and to measurements at each Position

Data Management

Project Template: Defines the display and measurement setups
Project: Measurement data for all positions defined in a room are stored with the Project Template
Job: Projects are organised in Jobs
Explorer facilities for easy management of data (copy, cut, paste, delete, rename, view data, open project, create job, set default project name)

Users

Multi-user concept with login. Users can have their own settings with jobs and projects totally independent of other users

Preferences

Date, Time and Number formats can be specified per user

Note: For specifications and details on Type 7831 and Type 7830, please refer to Product Data BP 1691

Ordering Information

The ordering information lists the items especially relevant for the Reverberation Time Software. For items related to the Type 2250 platform or other Type 2250 application software, please refer to the Type 2250 Product Data (BP 2025).

PACKAGES

Type 2250-F	Hand-held Analyzer with Sound Level Meter and Reverberation Time Software
Type 2250-F-001	Hand-held Analyzer with Sound Level Meter and Reverberation Time Software, Sound Calibrator Type 4231, Qualifier Light Type 7831, 10 m Microphone Extension Cable and Small Tripod
Type 2250-F-002	Hand-held Analyzer with Sound Level Meter, Frequency Analysis, Reverberation Time and Sound Recording Software, Sound Calibrator Type 4231, Qualifier Light Type 7831, 10 m Microphone Extension Cable and Small Tripod

SOFTWARE MODULE AVAILABLE SEPARATELY

BZ-7227	2250 Reverberation Time Software

ACCESSORIES AND COMPONENTS AVAILABLE SEPARATELY

Type 2716	Power Amplifier
Type 4292	OmniPower Sound Source
KE-0449	Flight Case for Type 4292
KE-0364	Carrying Case for Type 4292's Tripod
Type 4224	Sound Source
Type 4295	Omnidirectional Sound Source
KE-0392	Carrying Case for Type 4295
KE-0538	Flight Case
AO-0523	10 m Cable from Type 2250 to Type 2716
AO-0524	10 m Cable from Type 2250 to Type 4224
AQ-0667	Bridging Cable for Type 2716/4292
AQ-0673	10 m Cable from Type 2716 to sound source
UA-1476	Wireless Transmission Kit
Type 7831	Qualifier Light
Type 7830	Qualifier

Note: For sound sources, please see separate Product Data BP 1689

BP 2152 – 11 2006-09 Rosendahls Bogtrykkeri

HEADQUARTERS: DK-2850 Nærum · Denmark · Telephone: +45 4580 0500 · Fax: +45 4580 1405
www.bksv.com · info@bksv.com

Australia (+61) 2 9889-8888 · Austria (+43) 1 865 74 00 · Brazil (+55) 11 5188-8161 · Canada (+1) 514 695-8225
China (+86) 10 680 29906 · Czech Republic (+420) 2 6702 1100 · Finland (+358) 9-521 300 · France (+33) 1 69 90 71 00
Germany (+49) 421 17 87 0 · Hong Kong (+852) 2548 7486 · Hungary (+36) 1 215 83 05 · Ireland (+353) 1 807 4083
Italy (+39) 0257 68061 · Japan (+81) 3 5715 1612 · Korea (+82) 2 3473 0605 · Netherlands (+31) 318 55 9290
Norway (+47) 66 77 11 55 · Poland (+48) 22 816 75 56 · Portugal (+351) 21 41 69 040 · Singapore (+65) 6377 4512
Slovak Republic (+421) 2 5443 0701 · Spain (+34) 91 659 0820 · Sweden (+46) 33 225 622
Switzerland (+41) 44 880 7035 · Taiwan (+886) 2 2502 7255 · United Kingdom (+44) 14 38 739 000
USA (+1) 800 332 2040 · Local representatives and service organisations worldwide

Brüel & Kjær