The Sound Level Meter for every application.....

**Industrial**
- Enables noise level surveys of industrial environments
- Performs sound power level measurements on industrial equipment
- Measures vibration levels to which operator is exposed
- Measures (with Attenuator ZF 0020) overall RMS noise levels up to 130dBA (with 20dB crest factor) and Peak levels up to 150dBA

**Community**
- Measures $L_{eq}$ and SEL
- With Application Module BZ 7101 performs statistical noise measurements ($L_1$, $L_{10}$, $L_{50}$, $L_{90}$)
- With Application Module BZ 7101 provides, for a given measurement period, $L_u$, Cumulative Distribution, and Probability Distribution
- With Application Module BZ 7102, performs Taktraxt maximal noise measurements according to TA Läarm

**Architectural**
- Measures ambient background noise levels in 1/1 octave bands with Filter Set Types 1624 or 1625, and 1/3 octave bands with Filter Set Type 1625
- Acoustical modelling facilitated by the exceptional high frequency response

**Commercial**
- Performs sound reduction tests in octave bands (with Filter Set Types 1624 or 1625) or 1/3 octave bands (with Filter Set Type 1625) according to international standards
- Rates the noisiness of business machines according to standards
- Determines noise impact due to commercial production processes
- Enables the assessment of loudness and potential annoyance of work environments

**Research and Development**
- Use as a calibration standard Sound Level Meter
- Measures low sound levels, below 10dB in certain 1/3 octave bands with Filter Set Type 1625
- Allows accurate measurements over a very wide frequency range
- Gives type 0 accuracy, as defined in IEC 651, with appropriate microphone and extension cable
- Makes measurements in the infrasound and ultrasound regions with Filter Set Type 1627
made possible by its unmatched versatility,

A system of interchangeable modules allows the 2231 Sound Level Meter to perform a wide variety of measurement tasks not previously possible with a single hand-held instrument. Each module effects a conversion of the Sound Level Meter, creating a new instrument capable of measuring a different set of acoustical parameters. Indeed the 2231 is more than just a sound level meter: it is a sophisticated acoustical analyzer with capabilities normally associated with multi-instrument set-ups.

There are many practical advantages in using a system of application modules rather than having a single self-contained instrument. For one, the modular system allows the same internal memory space to be used for a number of different applications, keeping the size of the instrument to a minimum. In addition, the functions enabled by each pushkey on the faceplate can be limited to 1 or 2, avoiding the use of numerous "shift" keys. (A convoluted hierarchy of functions assigned to one pushkey may save space, but can lead to considerable confusion and operational difficulties.) Furthermore, the future capabilities of the instrument are greatly expanded by the potential for development of more application modules. The instrument literally grows along with your needs, and is not limited by the confines of its own hardware.

1) Attach the faceplate.

The function of the pushkeys on the front of the Sound Level Meter is determined by the contents of the module to be used. Each module has a dedicated faceplate which identifies the pushkey functions. The inscriptions on the faceplate are very comprehensive, making use of the instrument almost self explanatory.

2) Insert the module

Each Application Module for Sound Level Meter Type 2231 is a firmware package (the software is implemented in a ROM) which enables the sound level meter to perform specific measurement functions. The module of choice is inserted into the connector slot on the rear of the instrument.

3) Load the program

The software contained in the module is transferred into the central memory of the Sound Level Meter by pressing the pushkey marked Module No., while the Run/Load switch is set to the Load position. The loading process takes less than one second, and when proper loading is completed the module number is shown on the display.

4) Remove the module.

Once the application software has been loaded into the internal memory, the module may be removed. The Sound Level Meter has sufficient memory capacity to store the program and perform the necessary processing. A back-up battery retains memory contents when the Sound Level Meter is turned off, eliminating the need to reload every time it is used.

and its outstanding features.

- Selectable polarization voltage allows use of almost any microphone in the Brüel and Kjær range
- RMS and Peak detection in parallel
- Fulfills proposed IEC standard for Integrating Sound Level Meters Type 1, and relevant sections of IEC 651 Type 1 and ANSI S1.4 (1983) Type 1
- Extra wide all pass frequency range allows infra- and ultrasound measurements
- 24 to 130 dB measuring range with standard microphone (30 to 150 dB with attenuator) in 7 overlapping sub-ranges
- Digital and quasi-analogue liquid crystal display. Each digital character is constructed from 14 elements, allowing unambiguous alphanumeric characters to be displayed
- Choice of impulse, Fast and Slow time weightings, depending on the application module being used
- 73 dB Pulse range; 70 dB Linearity range
- A, C, Lin. and All-pass weightings
- 16 kbyte RAM for programs and data storage: back-up battery power maintains software storage while the instrument is turned off
- Can accept a Brüel & Kjær Serial Interface communications port for external control and digital interface
- Displays status of any parameter without interruption of measurements
- When used with Microphone Type 4133 and Extension Cable Type AO 0027, fulfills proposed IEC standard for Integrating Sound Level Meters Type 0 and relevant sections of IEC 651 Type 01.
The 2231 provides the framework: a family of Application

Standard module supplied with the 2231 for which basic specifications are appropriate. Fast data sampling rate ensures optimum accuracy. Displays any of the following 8 parameters:

- MAXP (max. peak hold)
- PEAK (max. peak in 1 s period)
- INST (samp. RMS in 1 s period)
- SPL (max. RMS in 1 s period)
- MAXL (max. SPL hold)
- MINL (min. SPL hold)
- LEQ (or LIm with L time weighting)
- SEL (or iEL with L time weighting)

The DC output may be used to obtain plots of any of these parameters.

SPECIAL FUNCTIONS include: automatic digital readout after predetermined interval, data inhibit facility (including deletion of set amount of data prior to activation), display PEAK on quasi-analogue scale.

In addition to the 8 parameters mentioned above, it can display:

- \( L(99.0) - L(90.0) - L(50.0) \)
- \( L(10.0) - L(1.0) \)

It also calculates and displays:

- \( L(N) \)
- Cumulative Distribution
- Level Distribution with 0.5 dB resolution, for any measurement period.

Data sampling is performed four times slower than in the standard module. Impulse weighting is not available.

SPECIAL FUNCTIONS include: display \( L(N) \) for any value of \( N \) (in 0.1% steps), calculate Cum. Dist. and Level Dist., with variable resolution, data inhibit including deletion of set amount of data prior to activation.
enables an entire range of measurement possibilities.

Displays any of the following 10 parameters:
- MAXP (max. peak hold)
- PEAK (max. peak in 1 s period)
- INST (smp; RMS in 1 s period)
- SPL (max. RMS in 1 s period)
- LT (3 s and 5 s Tak)
- MAXL (max. SPL hold)
- MINL (min. SPL hold)
- LEQ (or LIm with l time weighting)
- LTm3, LTm5
- SEL (or IEL with l time weighting)

The DC Output may be used to obtain plots of any of these parameters.

Data sampling is performed at half the rate of that in the standard module.

SPECIAL FUNCTIONS include: digital readout after predetermined interval, data inhibit facility (including deletion of set amount of data prior to activation), display PEAK on quasi-analogue scale, change quasi-analogue scale from 2 dB to 1 dB resolution.
Advanced construction: enhanced capabilities

FREQUENCY WEIGHTING: Available are A, C, Lin. (20 Hz to 20 kHz), and All Pass (2 Hz to 70 kHz). The truncated linear range can be used when accurate measurement of sound within the normal range of human hearing is required. The excellent high and low frequency response characteristics of the instrument are necessary for measurements in the infrasound and ultrasound ranges.

MICROPHONE: A selectable polarization voltage of 0 V, 28 V, and 200 V allows the use of any microphone in the Brüel & Kjær range. Although the standard supplied microphone (Pre-polarized Microphone Type 4155) is suitable for the vast majority of measurement applications, it may be necessary from time to time to use an alternate. For example, the 2231 becomes a Type 0 Sound Level Meter if the 1/2 inch Microphone Type 4133 (or, to meet ANSI standards, Type 4134) is used in conjunction with Extension Cable Type A00027. For high frequency sound measurements, 1/4 inch Microphones Types 4135 and 4136, or 1/8 inch Microphone Type 4138 are ideal.

FILTER CONNECTION

CONTROL BUS

DISPLAY: The Liquid Crystal Display comprises four digits, a quasi-analog display, overload indicator, and battery low indicator. The four digits give 0.1 dB resolution of the displayed parameter and since each digit is comprised of 14 display segments, alphanumericics are displayed clearly and concisely. The range and resolution of the quasi-analog scale are determined by the application module in use, as is the rate of update of the display.

A/D CONVERTER: accepts data from the detector at a rate determined by the application module in use.

D/A CONVERTER: The Digital Interface Module ZJ9100 allows the Sound Level Meter to be connected to a printer with a Brüel and Kjær Serial Interface. Additionally, RS 232 compatible printers or computers may be connected for printout or control. When hooked up to a computer, communication by the 2231 is enabled through the Monitor program which can operate at 110, 150, 300, 600, and 1200 baud, with or without echo. All Monitor commands are straightforward and simple to use.

μ-PROCESSOR: This is the heart of the Sound Level Meter, controlling and monitoring the functions of all the other sections. All the signal analysis and data processing is performed here according to the loaded software. Since the software can be changed, the Sound Level Meter demonstrates its remarkable versatility. A single compact microprocessor can perform all the analysis functions that would normally require a processor coupled to a large amount of memory space.
Accessories - expand the measurement possibilities.

INTERFACE MODULE ZI9100.

Since the 2231 can be left to operate automatically, printed results may be very useful. Interface Module ZI9100 is required for the transmission of data to a printer. A compatible printer must be able to receive data over an RS232C interface, and respond to the signal voltage levels which are generated by the 2231.

Printout can be obtained manually, automatically, or under the control of a computer. Automatic printout is normally initiated at the end of a preset time period, allowing for a hard copy of the measured data to be obtained at preset intervals during a long measurement.

The format of the printout is selectable, ranging from detailed, fully annotated readouts to concise, single line information. Even in the shortest format, measured data and primary instrument settings are given so that all the necessary information is at hand.

EXTERNAL FILTERS:

Three filter sets may be used with the 2231: Octave Filter Set Type 1624, 1/2 - 1/3 Octave Filter Set Type 1625, and Infrasound and Ultrasound Filter Set Type 1627. Each filter set snaps directly to the bottom of the Sound Level Meter. Filter Sets Types 1624 and 1625 may be used in conjunction with a level recorder such as Type 2317 to obtain plots of octave or 1/3 octave levels. Filter Set Type 1627 contains several infra- and ultra-sound filters in accordance with IEC recommendations.

LEVEL RECORDERS:

The 2231 has two signal outputs (AC and DC) for level recording. For laboratory and field work, Type 2317 Level Recorder is ideal. Weighing only 3.5kg, it nevertheless satisfies IEC 651 precision Type 1 for documenting measurements by the 2231. Typical uses of the 2317 plus 2231 (depending on the Application Module used) include direct recording of the signal, octave and 1/3 octave analysis recording, and plotting of sound level decays for the direct measurement of reverberation time.

FIELD MEASURING SET:

A combination of Sound Level Meter Type 2231 with a Filter Set (e.g. Type 1624 or Type 1625) and some of the more commonly used accessories in a practical Carrying Case KE 0226, results in a compact field measuring set. The addition of extra application modules will significantly expand the measurement capabilities of the set without increasing the amount of equipment to be transported. For the first time, a complete acoustical analysis system is available in a lightweight, truly portable package.
MEASURING RANGE:
With standard microphone (Type 4155):

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<tr>
<th>FSD</th>
<th>Measuring Range</th>
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<td>60</td>
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<td>120</td>
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1 FSD on quasi-analog display
2 Only with attenuator ZF 0020 employed
3 Max values may diverge slightly from nominal value depending on microphone Kp factor

FREQUENCY WEIGHTING:
A weighting in acc. with IEC 651 Type 1 (and Type 0)
Linear: (10 Hz to 20 kHz)
All-pass: (2 Hz to 70 kHz)

DETECTOR:
Characteristics: RMS, peak
Linearity range: 70 dB
Pulse range: 75 dB
Crest factor capability: 13 dB at FSD

TIME WEIGHTING CHARACTERISTICS:

AC OUTPUT:
1 V RMS for full scale, output impedance < 120 Ohm, short circuit protected, mini-jack socket.

DC OUTPUT:
3 V for full scale, 0 V bottom scale, 50 V/mV, output impedance < 100 Ohm, short circuit protected, mini-jack socket.

RESET FUNCTION:
Reset all: Max./min. detectors, L_eq, SEL and overload detector are reset
Reset max./min.: Only max./min detectors are reset

MICROPHONE:
Type: 1/2 inch B & K Pre-polarized Condenser Microphone Type 4155
Sensitivity: 50 mV/Pa
Capacitance: 15 pF
Windscreen effect: < 0.9 dB up to 10 kHz
Polarization Voltage:Selectable: 0V, 28V, 200V.

CALIBRATION:
Acoustical: With Sound Level Calibrator Type 4230 or Pistonphone Type 4220 by potentiometer adjustment.

REFERENCE CONDITIONS FOR ACOUSTICAL CALIBRATION

SPECIFICATIONS TYPE 2231 / BZ 7100

Interface: Via optional Bruel & Kjaer Serial Interface Module ZI 9100. Open circuit signal level ± 5 V (min. Send level ± 2 V, min. Receive level ± 1 V).

DISPLAY:
Digital: 4 digits 14 segments, liquid crystal, 8 mm high, resolution 0.1 dB
Quasi-analog: 60 dB scale with 2 dB resolution for monitoring current SPL (RMS or Peak)

Additional functions:
Overload occurring:
Battery near low level: BAT flashing
Battery low level: BAT flashing plus + (non-resettable)
Overrange:
Underrange:
Selected value outside allowable range:
Error code:

AC OUTPUT:
1 V RMS for full scale, output impedance < 120 Ohm, short circuit protected, mini-jack socket.

DC OUTPUT:
3 V for full scale, 0 V bottom scale, 50 mV/dB, output impedance < 100 Ohm, short circuit protected, mini-jack socket.

RESET FUNCTION:
Reset all: Max./min. detectors, L_eq, SEL and overload detector are reset
Reset max./min.: Only max./min detectors are reset

MICROPHONE:
Type: 1/2 inch B & K Pre-polarized Condenser Microphone
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CALIBRATION:
Acoustical: With Sound Level Calibrator Type 4230 or Pistonphone Type 4220 by potentiometer adjustment.

REFERENCE CONDITIONS FOR ACOUSTICAL CALIBRATION

ACCESSORIES INCLUDED:
Hail-inch Pre-polarized Condenser Microphone:
2,5 mm mini-jack plug (x2):
Windscreen:
Input Adaptor:
Screwdriver:
Cells (x4):
Integrating SLM Module:

ACCESSORIES AVAILABLE:
Sound Level Calibrator:
3 m Microphone Extension cable:
Carrying case:
Statistical Analysis Module:
Interface Module: