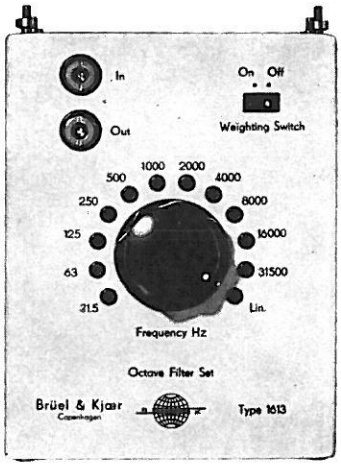
1613

Instructions and Applications



Octave Filter Set
Type 1613

A portable octave filter set which satisfies IEC Recommendation 225 and ANSI S 1.11 – 1966 class II. It is designed for operation with and attachment to the B & K Sound Level Meters Types 2203 and 2209.

Brüel & Kjær

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1. INTRODUCTION

The Octave Filter Set Type 1613 is a compact, portable unit which contains eleven passive band-pass filters for octave analysis. It is primarily designed for use in conjunction with the Precision Sound Level Meter Type 2203 or the Impulse Precision Sound Level Meter Type 2209. Four screws are used to join the 1613 and the Sound Level Meter together, making a portable noise and vibration analyzer.

Filter centre frequencies are 31.5 Hz to 31.5 kHz arranged according to the preferred frequencies of ISO Recommendation R 266 (i.e. related to multiples and sub-multiples of 1000 Hz). Each filter satisfies the requirements of ANSI S 1.11 — 1966 for octave band filters of class II and IEC Recommendation 225.

The filter should be fed from a signal source of impedance less than 25 Ω and the load impedance should be 146 kΩ in parallel with 40 — 60 pF. This means that the 1613 is not recommended for use with the Vibration Meter Type 2510 (filter output impedance 100 Ω) or for driving the Power Amplifier Type 2706 (input impedance 15 kΩ) without suitable buffer stages.

2. CONTROLS

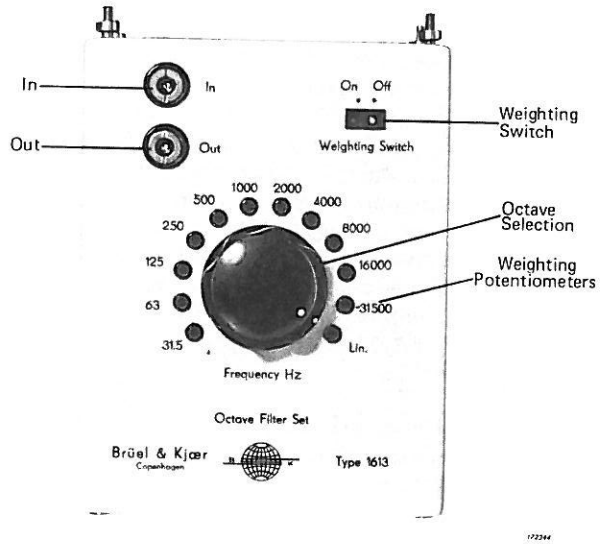

Fig. 2.1. The Octave Filter Set Type 1613

N and OUT

These sockets are for connection to the Sound Level Meter external filter sockets via the Connection Bar JP 0400 or to other equipment via cables AO 0034 or AO 0035. These sockets accept the B & K coaxial plugs JP 0006. The signal source should have an impedance of less than 25 Ω, and the signal level should not be greater than 1 V_{RMS}. The output should be loaded by 146 kΩ in parallel with 40— 60 pF.

OCTAVE SELECTION

This knob is used for selecting the required octave filter. The numbers indicate pass-band centre frequency. A "Lin" position is also provided.

WEIGHTING POTENTIOMETERS

These potentiometers are screwdriver operated and are used to give different attenuation (from 0 to 50 dB) in each pass-band when the WEIGHTING SWITCH is in position "On". A weighting potentiometer is also provided for the "Lin." mode.

WEIGHTING SWITCH

When this is set to "Off" the weighting potentiometers are out of action.

3. OPERATION

3.1. GENERAL

The Octave Filter Set is primarily designed for use in conjunction with the Precision Sound Level Meter Type 2203 or the Impulse Precision Sound Level Meter Type 2209. The signal source should have an output impedance of less than 25 Ω and should deliver a level of less than 1 V. Also, the Filter Set should be loaded by 146 kΩ.

Both Sound Level Meters conform to these requirements. Type 2203 has an output impedance of 25 Ω at the EXT. FILTER "In" socket and the output level is 0.3 V for full scale deflection. Type 2209 has as output impedance of less than 5 Ω at the EXT. FILTER "In" socket and the output level is 0.2 V for full scale deflection.

Both instruments have an input impedance of 146 kΩ at the EXT. FILTER "Out" socket.

The general procedure for an octave analysis is:

1. Measure the level in the "Lin." mode of the Sound Level Meter according to the standard procedure. This will ensure that the level at the filter input is correctly set.

2. Measure the level in the desired octave band without changing the input level of the filter (i.e. without moving the black OUTPUT ATTENUATOR knob of the Sound Level Meter).

Complete procedures for measuring noise and vibration using Type 1613 in conjunction with Type 2203 or 2209 are detailed in the following.

3.2. MOUNTING ON THE SOUND LEVEL METER

3.2.1. Precision Sound Level Meter Type 2203

1. Remove the cover plate for the battery compartment at the bottom of the 2203.

2. Ensure the four transit bushes are on the four long fixing bolts of the 1613.

3. Using the four long fixing bolts of the Octave Filter Set, screw the 1613 to the Sound Level Meter. The foam rubber pad in the battery compartment of the 2203 should be returned in order to avoid undesirable movement of the batteries.

4. Plug in the Connecting Bar JP 0400 supplied with the 1613 to connect the Sound Level Meter and the Filter Set. The portable analyzer thus obtained is shown in Fig.3.1.

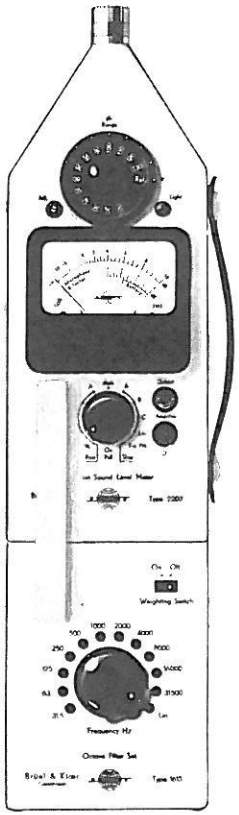

Fig.3.1. The 1613 mounted on the Precision Sound Level Meter Type 2203

5. If desired, move the leather carrying handle of the 2203 to give a correct balance of the combined instruments. Note that bushes for the handle's screws are on both sides of the instruments.

Note: when the 1613 is fitted to the 2203, the Sound Level Meter batteries can only be changed by removing the Filter Set.

3.2.2. Impulse Precision Sound Level Meter Type 2209

1. Remove the transit bushes from the four long fixing bolts of the 1613.

2. Using the four long fixing bolts of the Octave Filter Set, screw the 1613 to the 2209.

3. Plug in the Connecting Bar JP 0400 supplied with the 1613 to connect the Sound Level Meter and the Filter Set. The portable analyzer thus obtained is shown in Fig.3.2.

4. If desired, move the leather carrying handle of the 2209 to give a correct balance of the combined instruments. Note that bushes for the handle's screws are on both sides of the instruments.

3.3. USE WITH THE PRECISION SOUND LEVEL METER TYPE 2203

3.3.1. Sound measurements

1. Calibrate the Sound Level Meter as described in its instruction manual.

2. Set the METER SWITCH of the 2203 to one of the "Lin." positions ("Fast" or "Slow" as required).

3. Hold the instrument steadily as far away from the body as possible (preferably use a tripod or other firm, non interfering support. The microphone should be at least 1 metre away from the observer's body) with the microphone directed towards the measuring object.

4. With the transparent OUTPUT ATTENUATOR knob in its fully clockwise position, turn the black INPUT ATTENUATOR knob until a meter deflection in the top 2/3 of the scale is obtained.

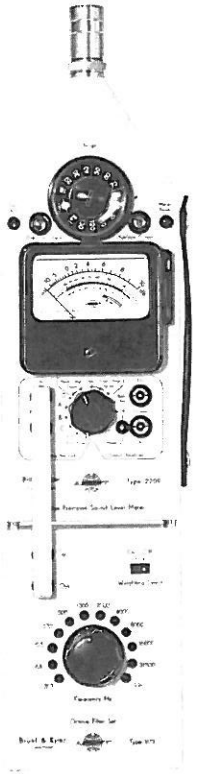

Fig.3.2. The 1613 mounted on the Impulse Precision Sound Level Meter Type 2209

If this is not possible, the transparent knob may also be used. However, the transparent knob should be kept as far clockwise as possible in order to maintain the optimum signal to noise ratio.

5. Set the METER SWITCH of the 2203 to one of the "Ext. Filt." positions ("Fast or "Slow" as required).

6. On the Octave Filter Set select the desired filter and set the WEIGHTING SWITCH to the required position. See § 3.5 for presetting the weighting potentiometers.

7. If the meter indicates less than 0 dB, increase sensitivity using the transparent OUTPUT ATTENUATOR knob on 2203.

8. The measured sound level is the sum of the meter reading and the number in the red circle on the transparent knob.

3.3.2. Vibration measurements

1. Adjust the 2203 for a K-factor of 0 as outlined in its instruction manual.

2. Mount the accelerometer using one of the methods described in its instruction manual, taking care to avoid cable whip. For measurements of velocity or displacement use can be made of the Integrator ZR 0020.

3. Set the METER SWITCH of 2203 to one of the "Lin." positions ("Fast" or "Slow" as required).

4. Hold the instrument as far as possible from the vibration environment and other undesirable influences.

5. With the transparent OUTPUT ATTENUATOR knob in its fully clockwise position, turn the black INPUT ATTENUATOR knob until a meter deflection in the top 2/3 of the scale is obtained. If this is not possible the transparent knob may also be used. However, the transparent knob should be kept as far clockwise as possible in order to maintain the optimum signal to noise ratio.

6. Set the METER SWITCH of 2203 to one of the "Ext. Filt." positions ("Fast" or "Slow" as required).

7. Select the desired filter on the Octave Filter Set and set the WEIGHTING SWITCH to the required position. See § 3.5 for presetting the weighting potentiometers.

8. If the meter indicates less than 0 dB, increase sensitivity using the transparent OUTPUT ATTENUATOR knob on 2203.

9. Read the vibration level in dB indicated by the meter.

10. Set the Slide Rule QH 0001 to the correct accelerometer sensitivity (mV/g).

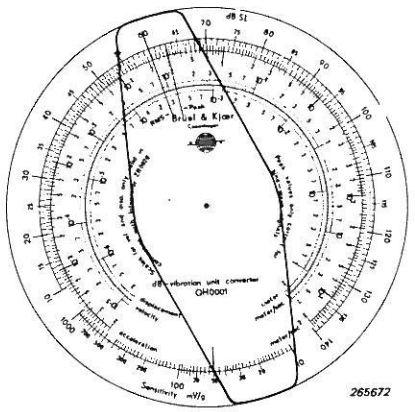

Fig. 3.3. The Slide Rule set to an accelerometer sensitivity of 50 mV/g and an instrument reading of 60 dB

11. Set the cursor to the number of dB read on the 2203 and read off the corresponding RMS acceleration, velocity or displacement.

Note: the slide rule can not be used for conversion of for example, acceleration to velocity. Each scale must only be used in connection with the appropriate setting of "Acc.", "Vel." or "Disp." on the Integrator ZR 0020.

For more details on sound and vibration measurements reference should be made to the 2203 instruction manual.

3.4. USE WITH THE IMPULSE PRECISION SOUND LEVEL METER TYPE 2209

3.4.1. Sound measurements

1. Calibrate the 2209 as described in its instruction manual.

2. Set the controls of 2209 to:

WEIGHTING NETWORK	"Lin."
METER SWITCH	as required

3. Hold the instrument steadily, as far away from the body as possible (preferably use a tripod or other firm non-interfering support. The microphone should be at least 1 metre from the observer's body) with the microphone directed towards the measuring object.

4. With the transparent OUTPUT ATTENUATOR knob in its fully clockwise position, turn the black INPUT ATTENUATOR knob until a meter deflection in the top 2/3 of the scale is obtained. If this is not possible, the transparent knob may also be used. In all cases, the transparent knob should be as far clockwise as possible in order to maintain the optimum signal to noise ratio.

   If the OVERLOAD INPUT lamp flashes, the black RANGE knob should be switched anti-clockwise until the overload is removed. The meter deflection should then be restored by turning the transparent knob anti-clockwise.

5. Set the WEIGHTING NETWORK switch of Type 2209 to "Ext. Filt."

6. Select the desired filter on the Octave Filter Set and set the WEIGHTING SWITCH to the required position. See § 3.5 for presetting the weighting potentiometers.

7. If the meter indicates less than 0 dB, increase sensitivity using the transparent knob.

   If the OVERLOAD OUTPUT lamp flashes, turn the transparent OUTPUT ATTENUATOR knob clockwise until the overload is removed. If the overload cannot be removed while retaining a meter deflection, any reading taken will be lower than the true signal level and the overload indication should be noted with the results.

8. The measured sound level is the sum of the meter reading and the number which appears between the two red lines on the transparent knob.

3.4.2. Vibration measurements

1. Calibrate the instrument as described in its instruction manual.

2. Mount the accelerometer using one of the methods described in its instruction manual, taking care to avoid cable whip. For measurements of velocity or displacement, use can be made of the Integrator ZR 0020.

3. Set the controls of the 2209 to:

WEIGHTING NETWORK	"Lin."
METER SWITCH	as required

4. Hold the instrument as far as possible from the vibration environment and other undesirable influences.

5. With the transparent OUTPUT ATTENUATOR knob in its fully cloclwise position, turn the black INPUT ATTENUATOR knob until a meter deflection in the top 2/3 of the scale is obtained. If this is not possible, the transparent knob may also be used. In all cases the transparent knob should be kept as far clockwise as possible in order to obtain the optimum signal to noise ratio.

   If the OVERLOAD INPUT lamp flashes, the black INPUT ATTENUATOR knob should be switched anti-clockwise until the overload is removed. The meter deflection should then be restored by turning the transparent knob anti-clockwise.

6. Set the WEIGHTING NETWORK switch of Type 2209 to "Ext. Filter".

7. Select the desired filter on the Octave Filter Set and set the WEIGHTING SWITCH to the required position. See § 3.5 for presetting the weighting potentiometers.

8. If the meter deflection is less than 1/3 of full scale, increase sensitivity using the transparent knob.

   If the OVERLOAD OUTPUT lamp flashes, turn the transparent OUTPUT ATTENUATOR knob clockwise until the overload is removed. If the overload can not be removed while retaining a meter deflection, any reading taken will be lower than the true signal level and the overload indication should be noted with the results.

9. The RMS vibration level is read on the meter. The level corresponding to full scale deflection is indicated by the number which appears between the two red lines on the transparent knob.

3.5. USE OF THE WEIGHTING POTENTIOMETERS

The octave filters of Type 1613 may be used with or without the weighting potentiometers. The attenuation in each filter may be set between 0 and

50 dB when the WEIGHTING SWITCH of the 1613 is set to "On".

To adjust the attenuation in each filter, the procedure is as follows:

1. Connect the Octave Filter Set to the Sound Level Meter as described in § 3.2.1 or 3.2.2.

2. Replace the microphone of the Sound Level Meter by the input Adaptor (JJ 2612 for 2203 and JJ 2614 for 2209).

3. Connect a signal source, such as a B & K Beat Frequency Oscillator Type 1022, to the Adaptor as shown in Fig.3.4.

4. Select a measuring range, say 100 dB, on the Sound Level Meter, keeping the transparent OUTPUT ATTENUATOR knob as far clockwise as possible. Select the "Ext. Filter" mode.

5. On the Octave Filter Set, select the desired position of the OCTAVE SELECTION switch and set the WEIGHTING SWITCH to "Off".

6. Set the frequency of the signal generator to the centre frequency of

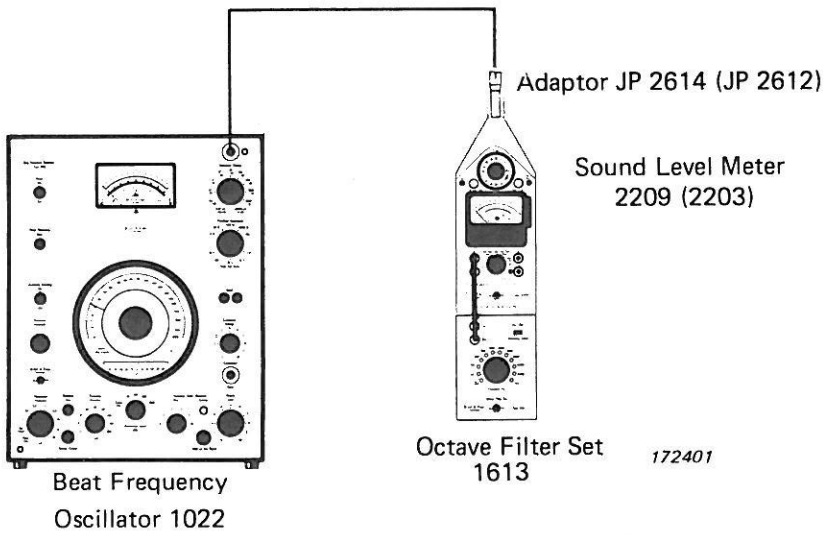

Fig.3.4. Arrangement for presetting the weighting potentiometers attenuation

the selected filter and adjust the output voltage in order to obtain a suitable indication (for example full scale deflection) on the meter of the Sound Level Meter.

7. Set the WEIGHTING SWITCH of Type 1613 to "On".

8. Using a small screwdriver, adjust the weighting potentiometer corresponding to the selected filter until the desired attenuation is obtained. In order to obtain convenient reading of the new level, it may be necessary to increase the sensitivity for this purpose. Only transparent OUTPUT ATTENUATOR knob of the Sound Level Meter must be used since changing the setting of the black INPUT ATTENUATOR knob would change the filter input level.

Note: the weighting potentiometers have 0 dB attenuation when turned fully clockwise.

4. DESCRIPTION

A block diagram of the Octave Filter Set Type 1613 is shown in Fig.4.1.

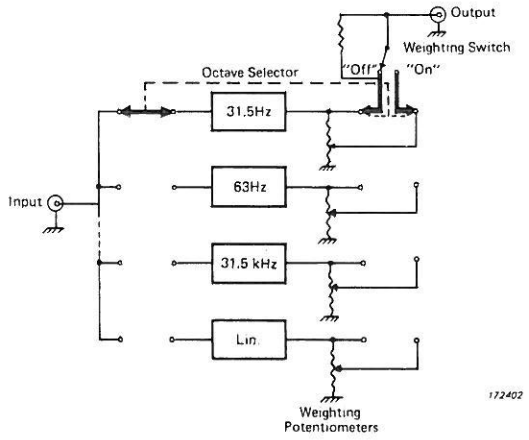

Fig.4.1. Block diagram of 1613

4.1. INPUT

The coaxial INPUT socket takes the B&K plug JP 0006. The source impedance should be equal to or less than 25 Ω. The input signal should not exceed approximately 1 V in order to keep low distortion. These conditions are automatically fulfilled when using the 1613 with the Precision Sound Level Meter Type 2203 or the Impulse Precision Sound Level Meter Type 2209.

4.2. OCTAVE FILTERS

From the input, the signal is led to the selected filter. There are eleven octave filters in Type 1613. Their centre frequencies range from 31.5 Hz to 31.5 kHz according to the perferred frequencies specified in ISO R 266 (i.e. related to multiples and sub-multiples of 1000 Hz) as shown in Fig.4.2.

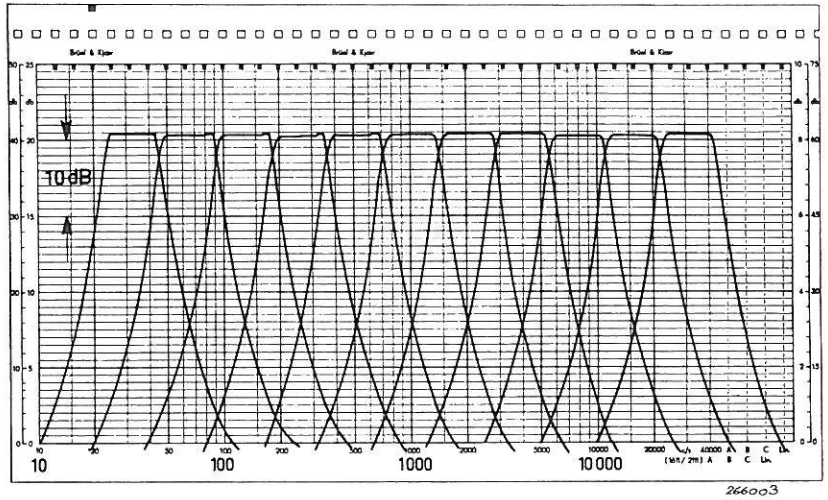

Fig.4.2. Frequency characteristics of the octave filters

Each filter conforms to the requirements of ANSI S 1.11 — 1966 for octave band filters class II and IEC Recommendation 225. Fig.4.3 shows the typical response of an octave filter of the 1613 compared with the limits set by ANSI and IEC. Uniformity in the pass band is within ± 0.5 dB. Attenuation at one, two and three octaves from centre frequency is approximately 25, 50 and 68 dB respectively.

Distortion in the filters is negligible as long as the 1 V input voltage limit is not exceeded.

4.3. OUTPUT

The output from the filter is fed to the output socket either directly or via the weighting potentiometer corresponding to the selected filter. The socket takes B & K coaxial plug JP 0006. The load impedance should be 146 kΩ in parallel with 40 — 60 pF. The weighting potentiometers are used to adjust the attenuation within each pass-band between 0 and 50 dB when the WEIGHTING SWITCH is set to "On". This allows the 1613 to meet any particular requirements on frequency weighting. An example of the frequency characteristics of the 1613 using the weighting potentiometers is shown in Fig.4.4 while the procedure to adjust the attenuation in each filter is described in § 3.5.

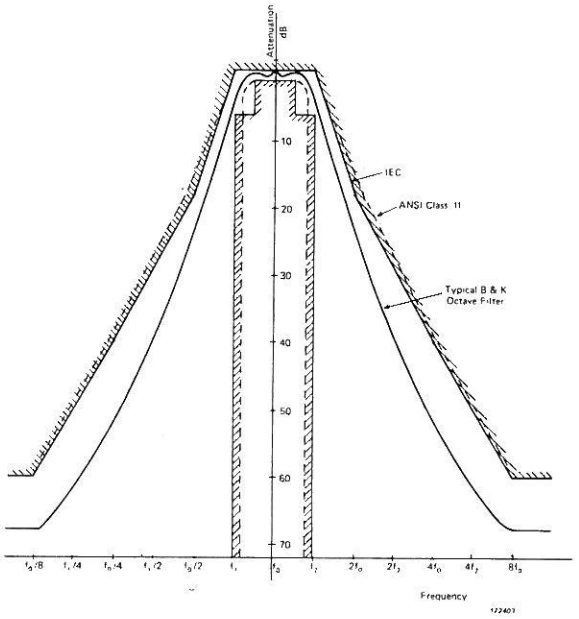

Fig. 4.3. Typical frequency response of an octave filter of 1613 compared with ANSI and IEC specifications. f_o is the centre frequency and f_1 and f_2 are the band limits

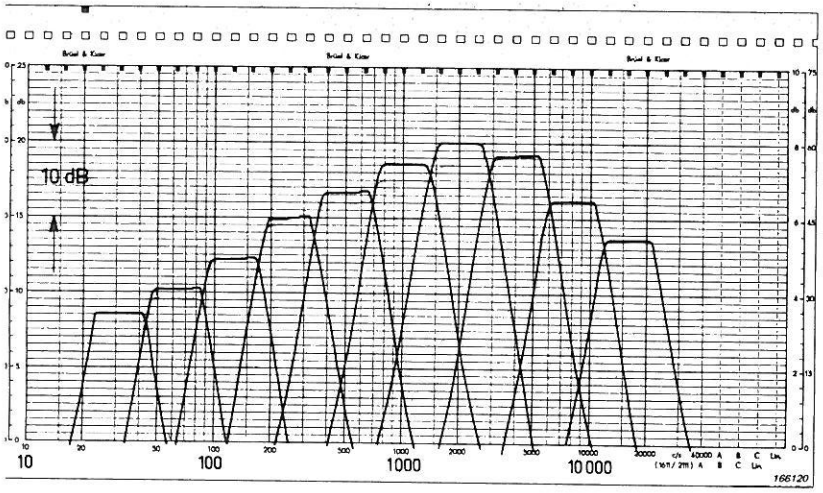

Fig. 4.4. Example of use of the weighting potentiometers

5. ASSOCIATED INSTRUMENTATION AND ACCESSORIES

5.1. PRECISION SOUND LEVEL METER TYPE 2203

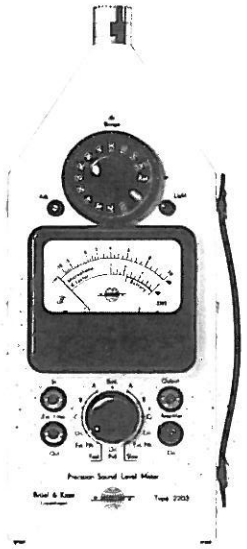

Fig. 5.1. The Precision Sound Level Meter Type 2203

The Precision Sound Level Meter Type 2203 is a compact, portable, battery operated instrument which fulfills the requirements of IEC Recommendation 179 and DIN 45 633 part 1 for precision sound level meters.

Type 2203 has a frequency range (± 2 dB) of 10 Hz to 18 kHz with a one-inch Condenser Microphone Type 4145 and of 10 Hz to 25 kHz with a half-inch Condenser Microphone Type 4133. A, B and C weighting networks are incorporated as well as the normalised "Fast" and "Slow" meter dampings. The quasi-RMS detector of the 2203 has a crest factor capability of 3.

The Octave Filter Set Type 1613 screws directly on the 2203, making a portable sound and vibration analyzer. The measuring range of the combined instruments is 14* to 134 dB with a one-inch microphone and 36* to 148 dB with a half-inch microphone.

For further details on the Precision Sound Level Meter, reference should be made to the 2203 instruction manual.

5.2. IMPULSE PRECISION SOUND LEVEL METER TYPE 2209

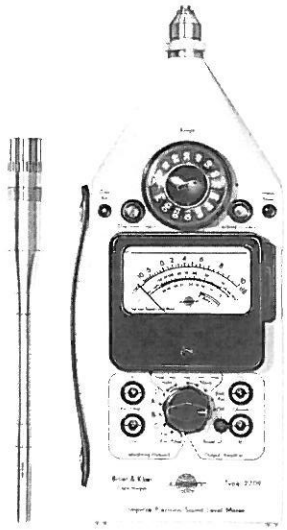

Fig. 5.2. The Impulse Precision Sound Level Meter Type 2209

The Impulse Precision Sound Level Meter Type 2209 has the same external dimensions as Type 2203. It is a compact, portable, battery operated instrument which conforms to IEC 179 for precision sound level meters, the proposed IEC Recommendation for impulse sound level meters and to DIN 45 633 parts 1 and 2. Type 2209 has a frequency range of 3 Hz to 18 kHz (+1, −1.5 dB) with a one-inch Condenser Microphone Type 4145 and of 4 Hz to 40 kHz (± 2 dB) with a half-inch Condenser Microphone Type 4133. A, B, C and D weighting networks are incorporated. The 2209 has the "Fast" and "Slow" meter dampings as well as an "Impulse" response with an integration time constant of 35 ms. It also includes a hold circuit which will retain the maximum RMS level of the input signal in the "Imp. Hold" mode or the maximum peak level of the input signal in the "Peak Hold" mode. Crest factor capability is up to 40. 20 interchangeable attenuator scales supplied with the instrument allow direct reading of sound level or vibration units with different transducers.

* Valid for octave centre frequencies above 500 Hz. Close to the lower limiting frequency, these values may be up to 12 dB higher.

The Octave Filter Set Type 1613 screws directly on Type 2209, making a portable sound and vibration analyzer. The measuring range of the combined instrument is, with a one-inch microphone:

500 — 16000 Hz	12 — 140 dB
125 — 16000 Hz	18 — 140 dB
31.5 — 16000 Hz	23 — 140 dB

and with a half-inch microphone:

125 — 31500 Hz	40 — 150 dB
31.5 — 31500 Hz	45 — 150 dB

Further details on the Impulse Precision Sound Level Meter will be found in the instruction manual for Type 2209.

5.3. ACCESSORIES

5.3.1. Connection Bar JP 0400

Fig. 5.3. Connection Bar JP 0400

The Connection Bar JP 0400 is used to electrically connect the Octave Filter Set and the Sound Level Meter. It is supplied with the 1613.

5.3.2. Plug JP 0006

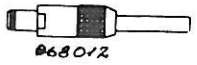

Fig. 5.4. JP 0006

This coaxial plug fits the INPUT and OUTPUT sockets of the Octave Filter Set and the EXT. FILTER sockets of the Sound Level Meters. Two of them are supplied with the 1613.

5.3.3. Connection Cables AO 0034 and AO 0035

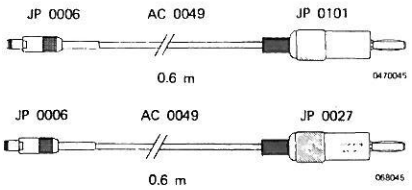

Fig.5.5. Connection cables AO 0034 (upper) and AO 0035 (lower)

These coaxial cables are used to connect the 1613 to other B & K equipment. Cable AO 0034 has a plug JP 0006 at one end and a standard B & K coaxial plug JP 0101. Cable AO 0035 has a plug JP 0006 at one end and a plug JP 0027 (162 kΩ shunt resistance in the plug) at the other. Both cables are 0.6 m long. Cable AO 0035 should be used for connection of the OUTPUT of Type 1613 to the EXT. FILTER "Output" of the Microphone Amplifier Type 2603 as the input impedance at this socket is 1.46 MΩ, which, in parallel with 162 kΩ gives the required load impedance at the 1613 output.

6. SPECIFICATIONS

Frequency Range: 22 Hz to 45 kHz covered by 11 octave filters.

Centre Frequencies: 31.5, 63, 125, 250, 500, 1000, 2000, 4000, 8000, 16000, 31500 Hz in accordance with ISO R 266.

Pass-band Uniformity: Within ± 0.5 dB.

Attenuation outside pass-band: At the band edge frequencies (1/2 octave from the centre frequency): 3± 1 dB.

One octave from centre frequency: Approx. 25 dB.

Two octaves from centre frequency: Approx. 50 dB.

Three octaves from centre frequency: Approx. 68 dB.
(See also Fig.4.3)

Each filter satisfies the requirements of IEC Recommendation 225 and ANSI S. 1.11 — 1966, Octave Band Filter class II.

Max. Input Voltage: Approx. 1 V RMS

Max. Source Impedance: 25 Ω

Load Impedance: 146 kΩ//40 — 60 pF.

Range of Attenuation: 0 — 50 dB with WEIGHTING SWITCH in position "On".

Operating Temperature Range: —20°C to 50°C (—4°F to 122°F).

Dimensions:	Height 15.5 cm (6.25 in) Width 12.0 cm (5.0 in) Depth 9.0 cm (4.0 in)
Weight:	2.5 kg (5.5 lbs)
Accessories supplied:	1 Connection Bar JP 0400 2 Screened Plugs JP 0006 1 Screwdriver QA 0001