

Studio Microphones

• Types 4003, 4004, 4006, and 4007
Two-Channel Power Supply Type 2812



Brüel & Kjær



Brüel & Kjær Instruments, Inc.

Specialists in Sound & Vibration Data Analysis Instrumentation

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The Brüel & Kjær Studio Microphone

Within the fields of acoustics and vibration Brüel & Kjær has long held a reputation for high product quality. Condenser microphones for precision measurement purposes have been produced at B&K for more than twenty-five years. This wealth of experience and manufacturing expertise has now been turned towards the professional recording and broadcasting industries with the introduction of B&K Studio Microphones Types 4003, 4004, 4006 and 4007 and Two Channel Microphone Power Supply Type 2812. Two basic microphone designs are offered: Types 4003 and 4006 are acoustically identical microphones with an on-axis frequency response from 20 Hz to 20 kHz and very low equivalent noise levels (typically 15 dB(A)). Types 4004 and 4007 have on-axis responses from 20 Hz to 40 kHz and can handle peak levels up to 168 dB before clipping. Each basic design is available as a *Line Level* model (Types 4003, 4004) for use with Power Supply Type 2812, or as a standard *P48 Phantom* model (Types 4006, 4007). Using the 2812 gives the added advantages of increased headroom and a balanced, transformerless output.

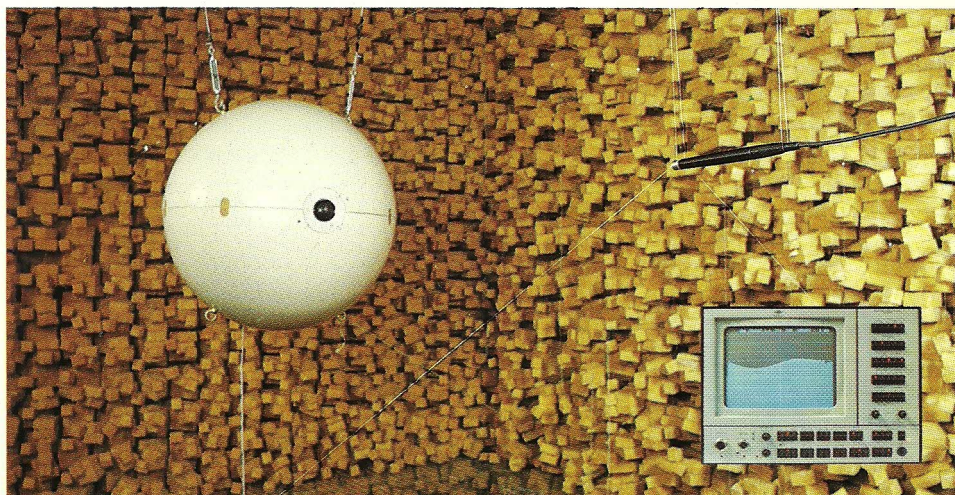
An extensive and detailed examination of the sound recording industry has led to the development of these technically innovative transducers which are as aesthetically pleasing as they are robust. The careful attention paid to optimising *both* the on- and off-axis responses of the Microphones results in a sound which is clean, transparent and well balanced. The audio engineer is assured that B&K Microphones will not colour the sound and he has full control over his programme material — *clean sound without compromise.*

Each B&K Studio Microphone undergoes a stringent quality control procedure before leaving the factory and is supplied with an individual calibration chart giving essential data for the professional user.



Cover photo courtesy of Brødr. Jørgensen Musikinstrumenter, Copenhagen

With the considerable improvement in recording technology in recent years — the advent of digital recording, improved analogue techniques and the re-introduction of Direct-to-Disc recording — it is essential that microphone technology follows suit to permit the faithful capture of sounds ranging from the softest whisper to the loudest percussive sound. Both on- and off-axis the Studio Microphone must be equally responsive to all frequencies with no appreciable time distortion or phase shifts. The Microphone should have negligible self-noise and the ability to reproduce very high levels without distortion.



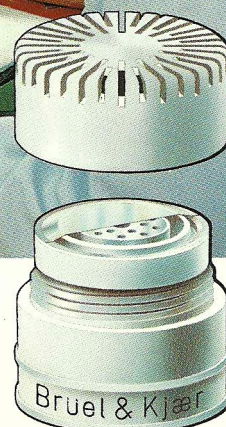
Measurement of the frequency response of B&K Microphones in an anechoic chamber

To achieve such a balanced and clean sound, classical yet sophisticated design principles have been employed. B & K Studio Microphones are condenser microphones utilizing a thin metallic diaphragm which is suspended in tension some $20\mu\text{m}$ above a rigid backplate. The diaphragm and backplate constitute the electrodes of an air-dielectric capacitor to which a fixed charge is applied by deposition of a pre-polarized polymer film on the backplate. Capacitive variations caused by the diaphragm displacement are transformed into variations in voltage — the audio signal. The primary resonance of the system lies at a high frequency, resulting in a very linear phase response and thus an accurate reproduction of high frequency transients.

Throughout the development of the Microphones special care has been taken to ensure that the high standards set by current state-of-the-art technology have been maintained. The often overlooked occurrence of problematic resonances, standing waves and reflections in and around the cartridge, grid and body housing has been thoroughly investigated. Careful geometric design has enabled these adverse effects to be minimized and excluded from the audio frequency range. For long-term stability and to ensure no degradation of performance with time and use, the microphones are constructed from specially selected, hard-wearing materials. The nickel diaphragm is coated with an extremely thin polymer layer for protection against corrosion. Each B & K Studio Microphone is checked for compliance with specifications and is supplied



with a calibration chart containing the individually measured sensitivity, A-weighted equivalent noise level and on-axis frequency response.

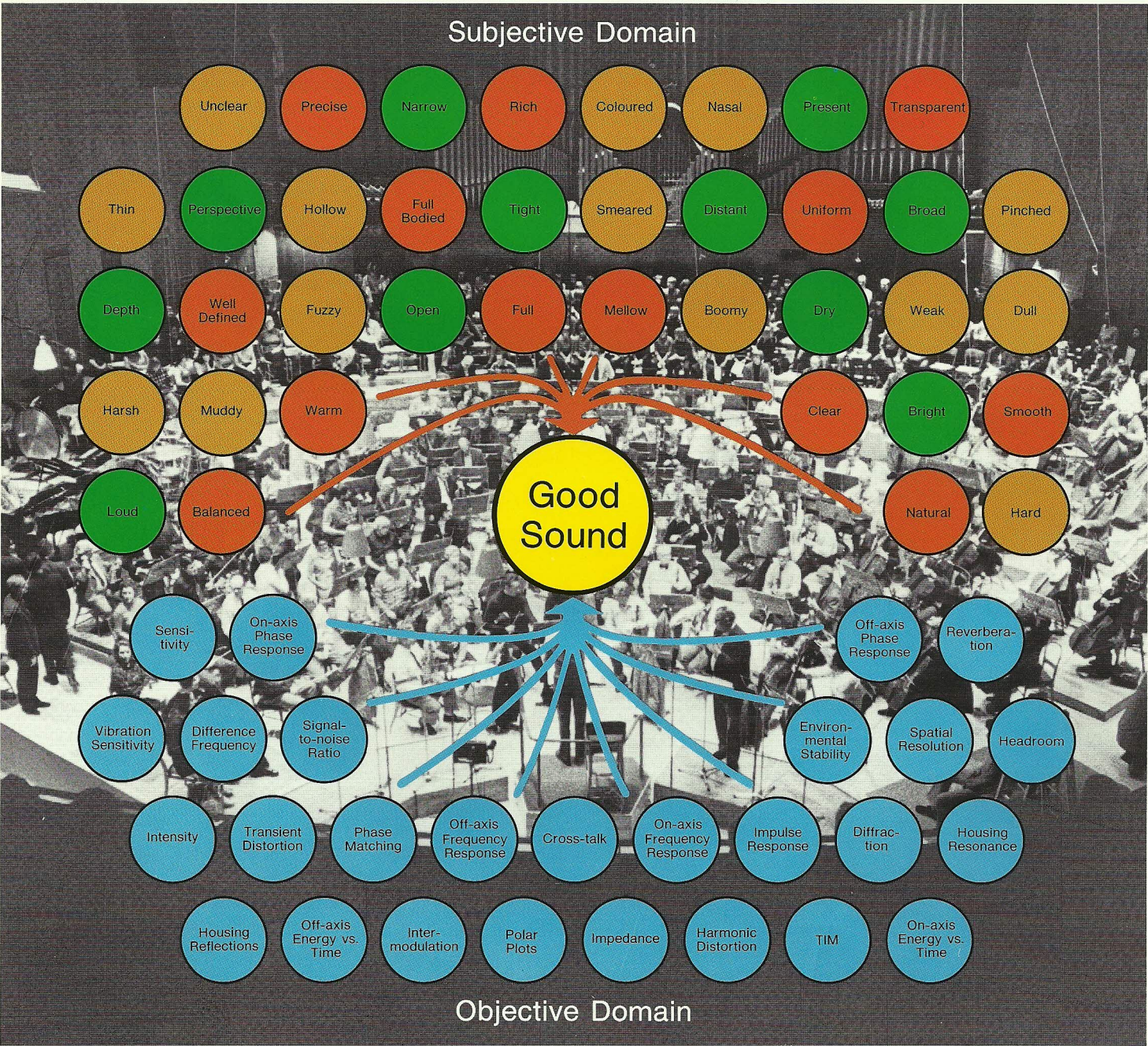


The B & K Concept

When listening to music, we normally attribute certain subjective qualities to the sound; body, warmth, brightness, and transparency are a few of the terms often invoked to describe a sound which is pleasing. In the objective domain we can make many measurements of tangible characteristics such as amplitude, phase

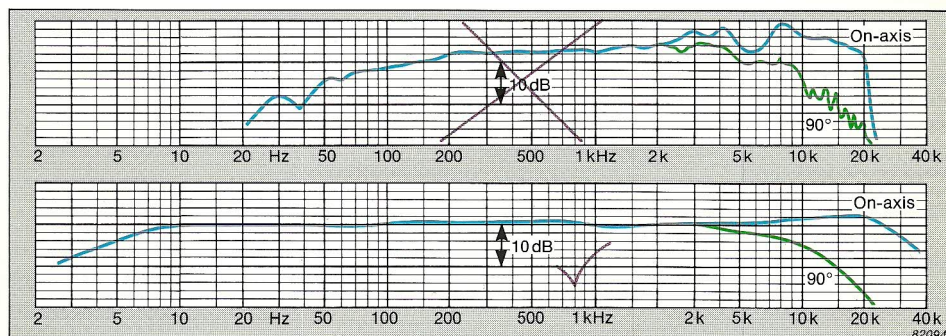
and time responses. Although correlation between the two domains is not always easy and often the subject of much discussion, adherents to only one philosophy can never give a global description of "good sound". Throughout the development of these Studio Microphones this tenet has been kept in mind. At B & K we

have combined many years microphone expertise with a "good ear" to produce a clean-sounding microphone which will not colour the original sound quality of the source. Thus, the recording engineer is provided with the best possible raw material and can implement any post-processing desired.



Clean Characteristics, Clean Sound

While it is difficult to explain fully why a particular microphone sound is pleasing, examining objective data does show that many undesirable characteristics are due to effects that produce "wrinkles" in some of the relevant response curves. At B&K, both traditional and recently developed methods of analysis have been used to identify such response anomalies. During the development stages these anomalies have either been smoothed out or moved to frequencies well outside the audio range.

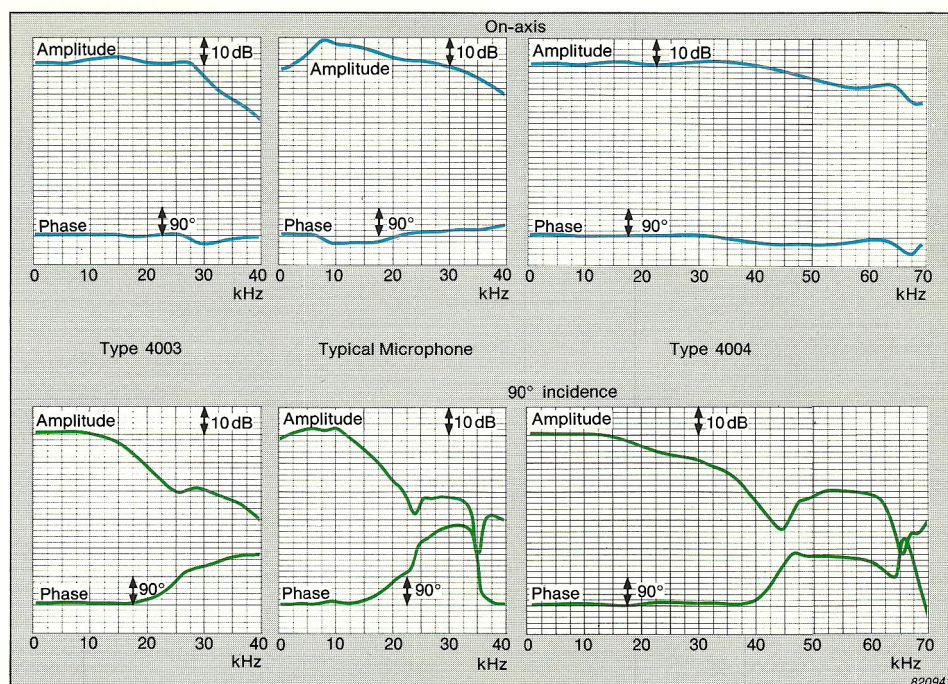


Both on- and off-axis frequency responses of a Studio Microphone should be smooth throughout the entire audio range

Frequency and Phase Response

The frequency response should be sufficiently broad to accommodate the entire audio range comfortably. On-axis, the response of B&K Microphones extends two octaves below 20 Hz and continues well beyond 20 kHz before *rolling off smoothly* to ensure excellent phase response. This clean on-axis "sound" is achieved without compromising the off-axis response, which in many microphones is limited in range and irregular at high frequencies.

When two microphones are used for "spaced apart" stereo recording, phase considerations are of paramount importance since the stereo image is dependent on arrival-time differences at the microphone pair. If the microphones are not phase matched, the image will be blurred or distorted. B&K Types 4004 and 4007 will track within $\pm 5^\circ$ over the range 50 Hz to 20 kHz. Larger diameter Types 4003 and 4006 are phase matched within $\pm 10^\circ$ over the same frequency range.

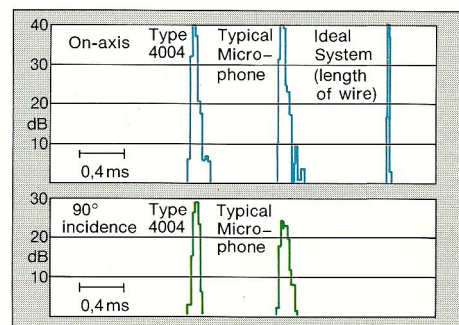


On- and off-axis frequency and phase responses for B&K Types 4003, 4004 and a typical studio microphone. The curves are plotted using a linear frequency axis for evaluation of the phase responses

Time Response

The time response of a microphone can be conveniently represented as a plot of amplitude versus time called the Energy-Time Curve (ETC)*. The narrower (sharper) the ETC, the better is the transient response of the microphone. Time responses of B&K Type 4004, a typical microphone and an ideal system are shown in the figure. The response of the microphones is better on-axis than at 90° , as would be expected since the frequency response of both microphones is broader on-axis than at 90° . However, for both angles of incidence B&K Type 4004 exhibits

its the better response, thus giving a more accurate rendering of off-axis sound and better resolution of the acoustic environment and its boundaries. This agrees favourably with subjective listening tests. Even in studios with little reflection, the off-axis behaviour of two apparently similar microphones can account for a substantial difference in sound quality.



Energy-Time Curves illustrate the transient response of the microphones. The narrower the ETC, the better is the response

* For a thorough description of Energy-Time Curves and Time Delay Spectrometry techniques in general, see B&K Product Data Type 5842