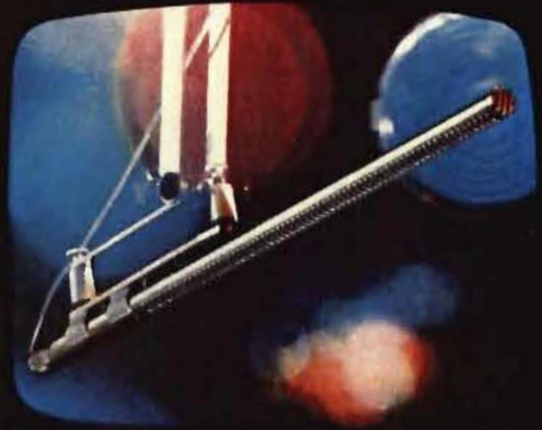


micro-revue
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SENNHEISER
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1945 At the end of the Second World War, the then Dr. F. Sennheiser started together with about twelve co-workers his "Laboratory Wennebostel" in this old farmhouse located in a village called Wennebostel, just south of the Luneburger Heide in West Germany.



1946 Because of its good acoustical qualities, radio stations began to purchase the first dynamic microphone MD 2 which had been completely developed by "Labor W".



1949 Thanks to the early research in dictating microphones, close contacts were made with the major dictating machine manufacturers all over the world and today Sennheiser is still considered the leader in this field.



1950 The very first power amplifier of the Company complied, almost without exception, with the terms of the Hi-Fi Norm DIN 45 500 which were established only many years later.



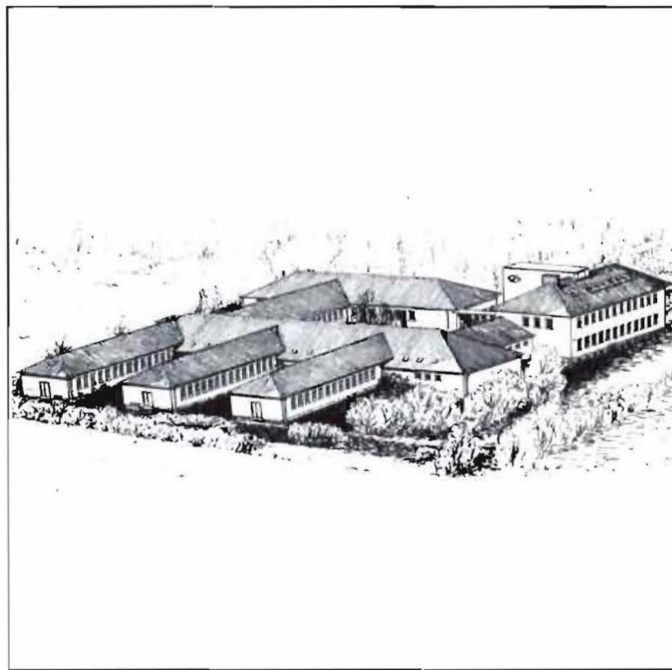
1951 The Company went into the production of highly specialized audio transformers of complicated design, thus consolidating its contact with the electronic industry.



1952 Magnetic transducers for dictating machines as well as for hearing-aids opened up new markets; the magnetic subminiature microphone MM 301 formed the basis for the manufacture of miniature hearing aids.



1954 The dynamic professional microphone MD 21 has become one of the most widely used microphones by reporters at radio and TV stations and is considered even today the cornerstone in the entire program of the Company.



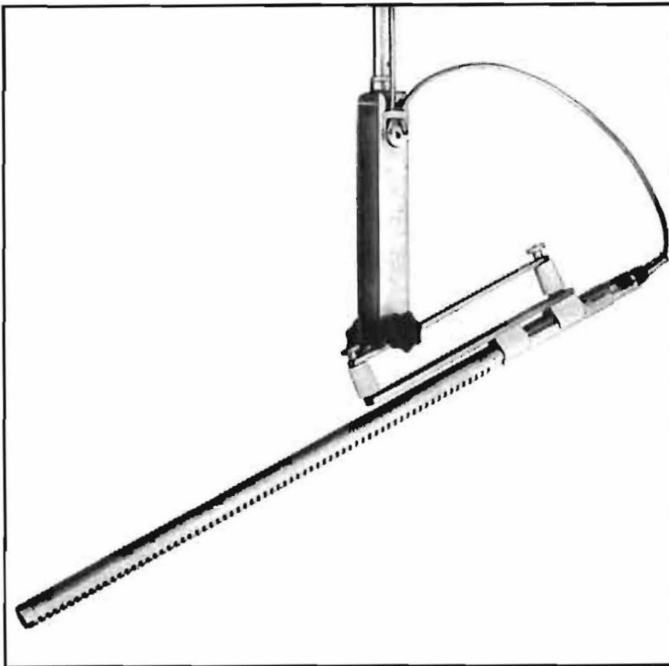
1955 The Company employed at that time more than 250 people. The foundation for an ambitious new building was laid which would fit harmoniously into the rural landscape.



1958 With a staff that had increased in the meantime to 450 people the name of the Company was changed from "Laboratory Wennebostel" to "Sennheiser electronic". The first wireless microphone system "Mikroport" left the factory.



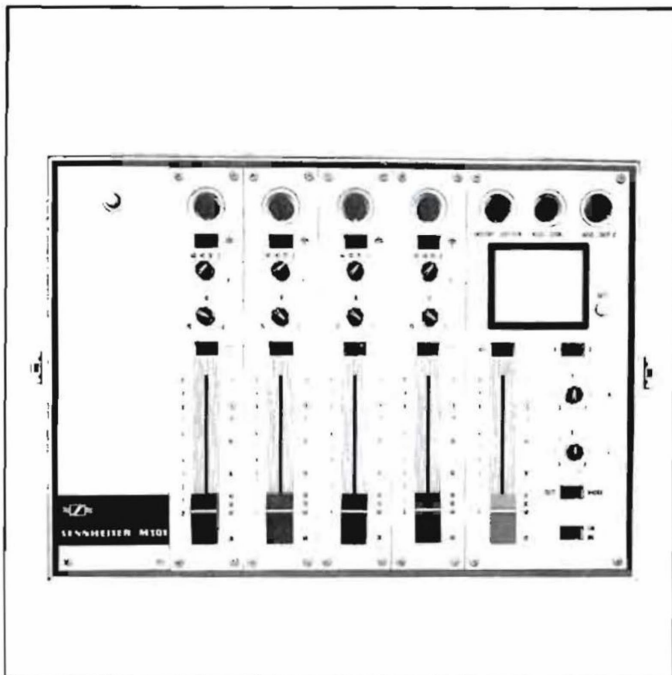
1960 The promising professional dynamic directional microphone MD 421 was introduced at the Hannover Fair. So far well over 100,000 units have been sold all over the world.



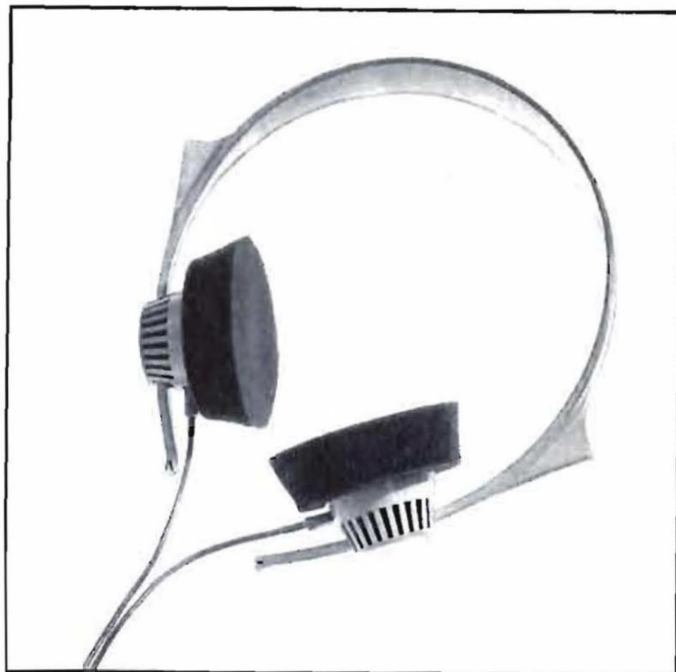
1961 Also with regard to condenser microphones Sennheiser electronic started to offer something special. "Shotgun" microphones make it possible to keep the microphone for television and film use always out of the camera range.



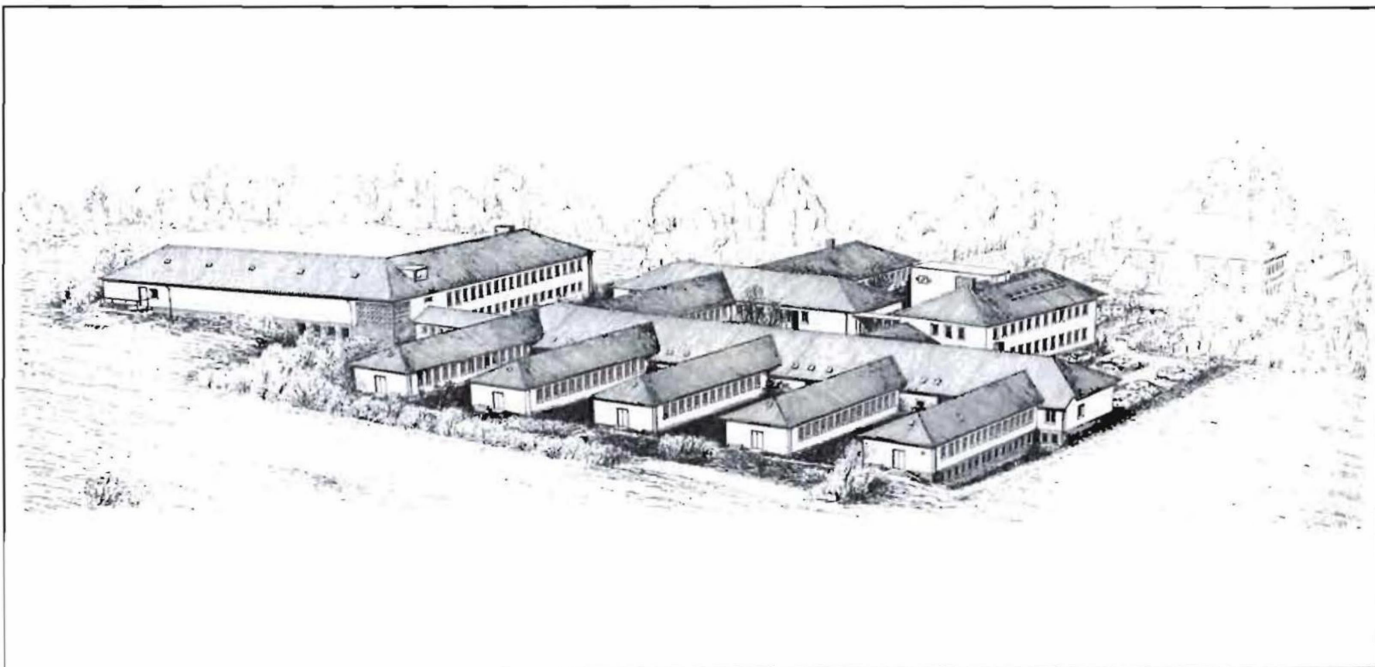
1965 With the new stereo set "Philharmonic", speakerbox and amplifier were incorporated for the first time into so-called amplifier/speakerboxes and are now in use at radio and TV stations.



1967 With the portable audio mixer M 101 Sennheiser electronic consolidated its position in the studio-equipment field since this new item closed a gap in the market especially as far as small sound units were concerned.



1968 The biggest success in the new product group "dynamic headphones" was — and still is — the "Open-Air" stereo headphone HD 414. Over 150,000 units are in use so far.



1970 The Company with more than 750 employees is still headed by Professor Dr. F. Sennheiser, who has been lecturing for years at the Institute of Technology in Hannover, Germany. Research, design and planning are being carried out in an ambitious new building complex. At the same time the manu-

facturing program is being consolidated and the volume of public relations activity has been increased, as planned.

Also in the current year, when the Company will celebrate its 25th anniversary, it will keep on tackling all new tasks with great energy and initiative.

Interesting facts about microphones

Niere = Cardioid
Kugel = Omnidirectional
Acht = Figure Eight
Keule = "Club shaped" super directional characteristic
Super Kardioid = Super Cardioid

In the following specifications technical terms arise which we would like to explain.

1. Sound and Sound-Waves

Sound in physical terms means vibration of air particles, small fluctuations of air pressure which spread like waves from a source of sound. A space in which this is occurring is referred to as a sound-field. It is the purpose of a microphone to convert sound-waves into electrical energy. The quality of a microphone is its ability to effect this conversion accurately.

2. Sound Pressure

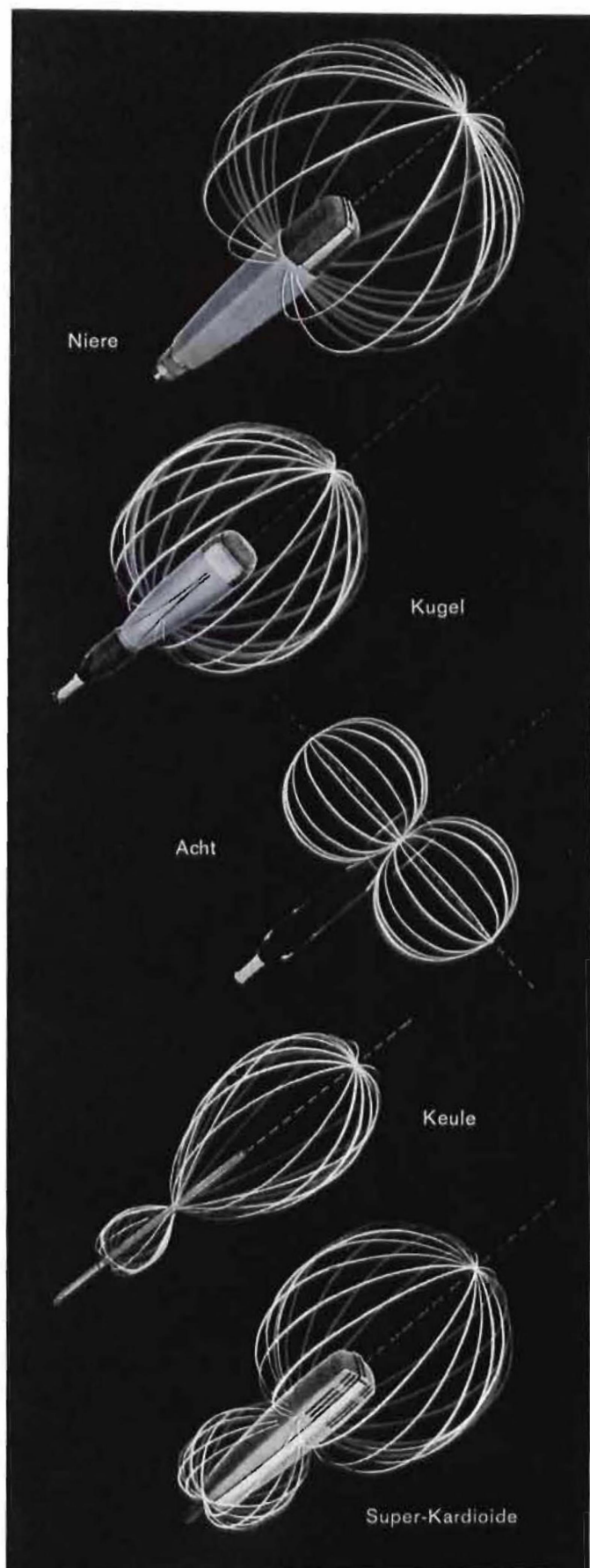
The human ear responds to the change in pressure in a sound-wave. The amplitude of the pressure variations is measured in μbar (equivalent to dynes per square centimeter). A steady pressure of one μbar represents one millionth of the pressure of the atmosphere which surrounds us. If you listen to someone speaking in a normal voice at a distance of about two feet the alternating pressure which your ears are detecting is about one μbar .

The world is slowly changing from this old system of units and the μbar is gradually being replaced by the new unit of sound pressure, the Newton per square meter (N/m^2). This is a unit from the new international MKSA* system. Engineers and Scientists have been using this system for some time since it has a number of advantages over the old CGS** system from which the Microbar derives. There is a simple relationship between the Newton per square metre and the Microbar: $1 \text{ N}/\text{m}^2 = 10 \mu\text{bar}$.

3. Microphone Characteristics, Directivity

Like the human ear many commonly used microphones respond to the alternating pressure in the sound-wave and convert these fluctuations of pressure into electrical energy. With such microphones the sound pressure acts on the outside of the diaphragm only. This means in practice that they respond to sounds from all directions equally well. They have, as it is called, an approximately omnidirectional characteristic.

There is also an important group of microphones which are useful because they respond to sound pressure gradient. This means in practice the pressure difference between adjacent points in a sound-field. In this type of microphone the back of the diaphragm is also exposed to the sound-field but through an acoustic labyrinth. The result of this type of construction is that the microphone does not respond equally to sound



* The MKSA system uses basic units of the meter, kilogram, second and ampere, and all other units are derived from these.

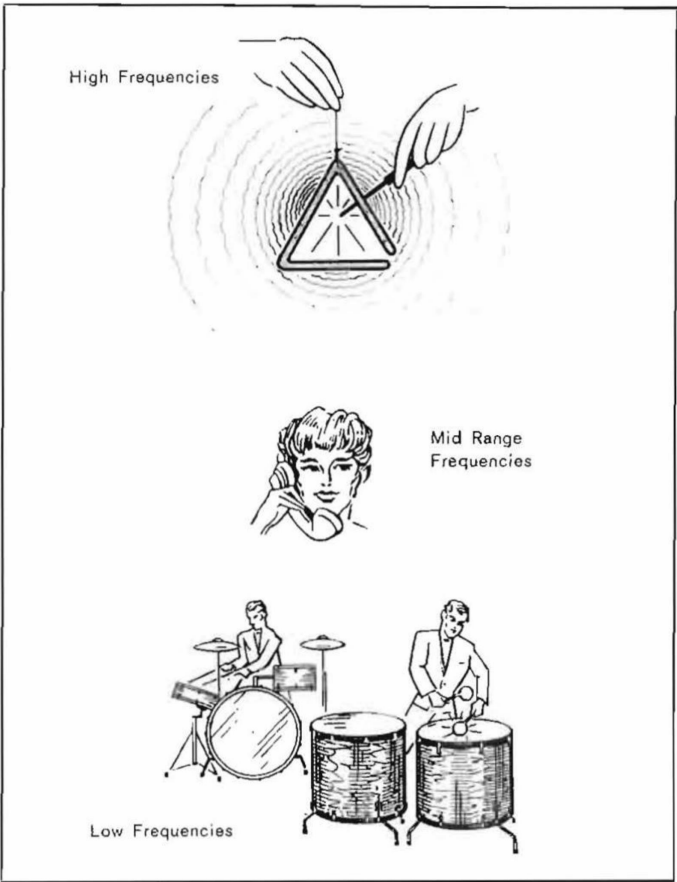
** The CGS system works on the basis of the centimeter, gram and second, and the electrical units are related to these.

from all directions. There are various types of directional microphones, those with a cardioid characteristic, those with a super-cardioid characteristic, and also the figure 8 characteristic. The cardioid characteristic is particularly interesting since it represents a maximum sensitivity in the forward direction with a minimum pick-up of random sounds reflected from the walls of a room. Since this type of microphone has the properties which are expected from a cardioid microphone particularly accentuated, the characteristic is frequently referred to as a super-cardioid.

In another design a cancellation (or interference tube) is fitted in front of the microphone diaphragm. This results in a particularly directional type of microphone having an almost cone-shaped directional pattern.

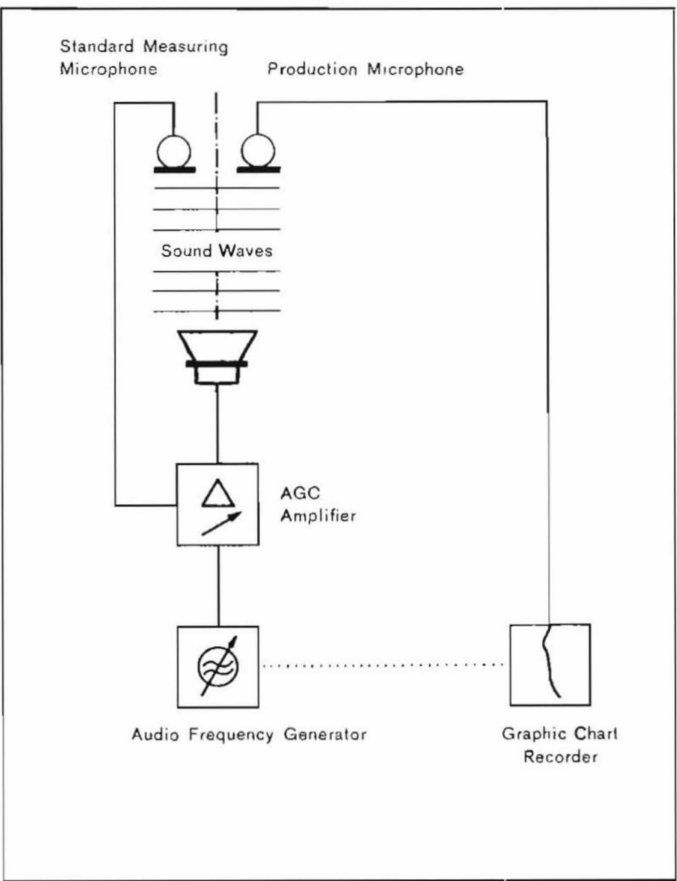
Directional microphones show to particular advantage in difficult acoustical conditions e. g. in reverberant (live) rooms, for sound reinforcement use where the microphone may be close to the loudspeaker, and for "spotting" soloists in stereo recordings.

The illustrations on the opposite page show the directional characteristics of various types of microphones. The white cages around the microphones represent their directional patterns.



4. Frequency, Frequency Response

The quality of a microphone is determined by its capacity to convert all sounds into electrical vibrations equally well, over the whole audio spectrum. The pitch of a sound, its frequency, is measured in hertz (Hz) = cycles per second. The higher the pitch, the higher is the frequency. The human ear can perceive sound vibrations from approximately 16 Hz up to 15,000 Hz (15 kHz). For the recording of music a microphone should have an equal response to sounds from 50 Hz up to 15,000 Hz. For intelligibility of speech it is sufficient for the microphone to have a response from about 200 Hz up to 5 kHz.



5. Frequency Response, Sensitivity and the Decibel

In order to record objectively a microphone's capacity to translate acoustical sounds into electrical impulses, a frequency response curve is drawn. It illustrates the variation of sensitivity with frequency of a microphone. The usual way of making this measurement is shown on page 5. Sounds of varying frequency emitted by the loudspeaker in a dead room are picked up by the test microphone, amplified and recorded on the frequency response chart.

The sensitivity is the alternating voltage measured in mV (Millivolt) at the output of the microphone which results when a sound-wave with a sound pressure of 1 μ bar falls on the microphone. The sensitivity figures quoted in our data sheets refer to measurements made in a "free field" condition with the microphone unterminated and are normally quoted in millivolts per μ bar. In the MKSA system sensitivity would be quoted in

$\frac{V \cdot m^2}{N}$ (Volts per Newton/m²). There is a simple

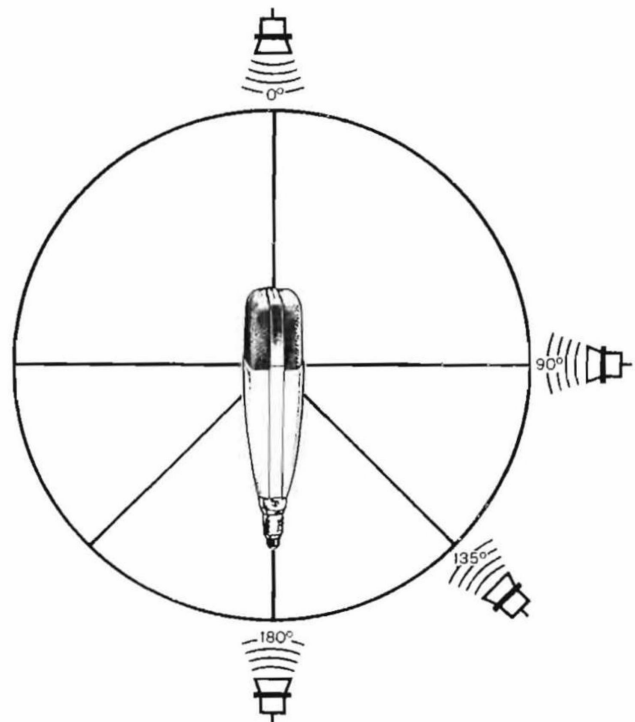
relation between the two systems as shown.

$$1 \text{ mV}/\mu\text{bar} = 10 \frac{\text{mV} \cdot \text{m}^2}{\text{N}}$$

So for example the free field sensitivity of the Sennheiser moving coil microphone MD 21 is approximately 0.2 mV/ μ bar (0.2 millivolts per microbar). In the MKSA system this would be shown as

$$2 \frac{\text{mV} \cdot \text{m}^2}{\text{N}}$$

For magnetic microphones it is customary to quote the sensitivity with the microphone terminated. The value of the terminating resistance is quoted. The measurement of the sensitivity of a microphone is performed with the sound-wave falling perpendicularly on the membrane of the microphone and unless otherwise stated all frequency response curves are recorded in the same way (on the axis). To judge the variation of frequency response with angle of incidence of sound particularly with directional microphones, other frequency response curves are often shown typically for sound incidence of 90°, 135° and 180° to the axis of the microphone. The difference between the response at 0° and at 180°, i. e. the front and the back of the microphone is frequently referred to as the front to back ratio of a microphone with a



cardioid characteristic. To interpret a frequency response curve it is necessary to be able to assess quickly the various ratios of measured values of sensitivity at different frequencies. In electroacoustics a logarithmic scale is used for the portrayal of the various values whose unit is the Decibel (dB). The dB scale expresses the measured values in a logarithmic relationship. Thus two (values of electrical power) which have a ratio of 10 to 1 are said to be different by 10 dB, and two electrical voltages having a ratio of 10 to 1 have a difference of 20 dB. Thus we have:

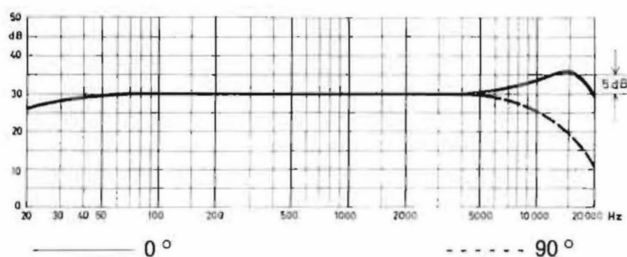
0 dB voltage ratio	1 : 1
3 dB voltage ratio (approx.)	1 : 1,4
6 dB voltage ratio (approx.)	1 : 2
10 dB voltage ratio (approx.)	1 : 3,16
20 dB voltage ratio	1 : 10
40 dB voltage ratio	1 : 100

Datas are quoted in dB to enable one to assess quickly the relationship between two measured values eg. different parts of one frequency response curve or in comparison of two response curves or sensitivities.

Let us examine two examples of frequency response curves. The first example is the frequency response curve of an omnidirectional studio microphone.

The frequency response curve is flat over a wide frequency range. The decrease in sensitivity at 20 Hz compared with the sensitivity at 1 kHz is of the order of 4 dB. You will notice a gentle rise in the on-axis response (0°) at the higher frequencies (above 5,000 Hz) — in practice this is frequently a desirable feature. This high frequency rise can be traced to a "pressure doubling" effect which occurs at the diaphragm of every microphone at high frequencies. For sound-waves incident from the side of the diaphragm this pressure doubling effect is absent. This is shown in the dotted response curve (90°).

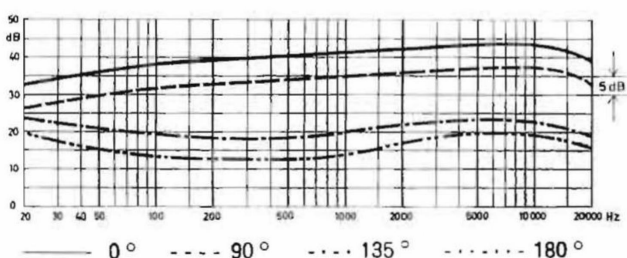
Example 1:
Omnidirectional Microphone MKH 105



Example two, the response curve of a studio microphone with a cardioid characteristic.

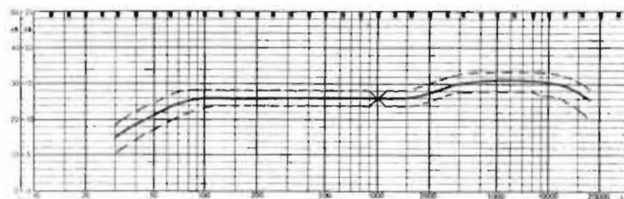
The response curves are smooth over the range 40 Hz to 20 kHz. The on-axis response shows a gentle rise towards the high frequency end of the scale. The drop at 40 Hz compared to 1 kHz is about 6 dB. The curve for sound approaching the back of the microphone (180°) is 26 dB below the curve for on-axis sound-waves (at 1000 Hz). The front to back ratio is therefore 26 dB at this frequency. The front to back ratio is maintained over a wide frequency range (the distance between the two curves varies only a little with frequency), likewise the curve for incidence at 90° has a very constant spacing from the on-axis response. From this we conclude

Example 2:
Cardioid Microphone MKH 405



that this microphone has a very accurate cardioid characteristic over a wide frequency range. For precise stereo recordings it is important that the microphone should have a smooth frequency response for the 90° incident sound. Any central sound source is picked up equally by the two directional microphones from their sides.

In our data sheets every microphone has a stated frequency response. In production small variations occur. The dotted curves on the frequency response chart show the maximum tolerances allowable. In production every Sennheiser microphone is tested acoustically in an anechoic chamber and the frequency response is recorded.



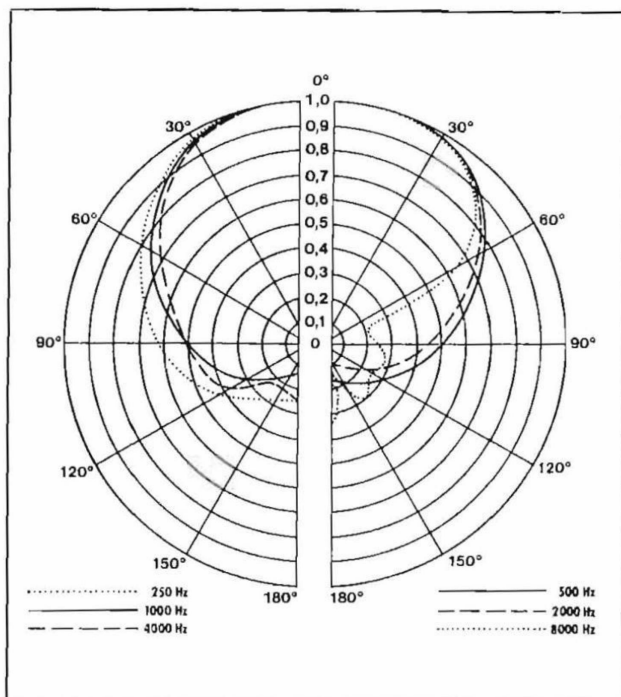
Nominal Frequency Response Curve (with Tolerance Limits)

6. Polar Diagram, Directivity

The directional properties of microphones can be demonstrated by means of a polar diagram. The polar diagram shows the shape of the directional characteristic of a microphone (omni, cardioid, etc.).

A microphone is placed in a sound-field in an anechoic chamber at a fixed frequency and is rotated slowly. The relative sensitivity of the microphone for sound approaching it at varying angles is recorded. The sensitivity to sound on the axis of the microphone (0°) is taken as a reference of 1.0. The sensitivity of the microphone at any given angle is shown on the polar diagram by the distance of the response curve from the centre of the diagram.

For example let us show you the polar diagram of the studio cardioid microphone MD 421. For the sake of clarity the diagram is shown in two halves. Instead of plotting the six response curves all together, the response for 250 Hz, 1 kHz and 4 kHz are shown on the left half of the diagram and the response for 500 Hz, 2 kHz and 8 kHz are shown on the right-hand half of the diagram. Of course each response curve would continue as a mirror image of the opposite half of the circle.



MD 421 Polar Diagram

The purpose of a directional microphone is to suppress unwanted sounds. The measure of the power of a microphone in this regard is the so-called directivity factor of the microphone which can be calculated from the directional characteristics. The directivity factor indicates how much greater the total power input of the room sound would be if a microphone with the same axial sensitivity had an omnidirectional characteristic. For an ideal cardioid microphone the directivity index would have a value of 3. This means in practice because the directivity index is related to acoustic power, and the acoustic power decreases as the square of the speaking distance, you can increase the speaking distance by a factor $\sqrt{3}$ ($= 1,73$ times) compared with an omni directional microphone of the same sensitivity. If an omnidirectional microphone and a cardioid microphone are placed in the same room and arranged so that the omnidirectional microphone is 1 m and the cardioid microphone is 1,73 m from the speaker, the percentage of room "acoustic sound" will be the same for the two microphones. Obviously if the two microphones were at the same speaking distance the cardioid microphone would give a more "intimate sound" than the omnidirectional microphone.

In certain situations it is better to have a microphone with a super-cardioid characteristic having a directivity index of 4 and even more so with microphones having a cone type characteristic such as the Sennheiser gun microphone MKH 805. The MKH 805 has a directivity index in the middle frequencies of approximately 6 and the index increases from 3 at low frequencies to 11 at high frequencies.

7. Source Resistance, Electrical Impedance

Every microphone has, as a source of electrical currents, an internal resistance and electrical impedance known as its source impedance. It is quoted in ohms usually at a frequency of 1,000 Hz. It is important to know the value of this source impedance so that the microphone can be optimally matched to the impedance of the following amplifier. With dynamic microphones (moving coil microphones) this source impedance is frequently 200 Ω . To connect such a low impedance microphone to a high impedance amplifier one should use a step-up transformer.

The effective internal resistance of the microphone is increased by the square of the turns ratio of the transformer. For example if the transformer turns ratio is 1 to 20, the internal resistance of the microphone of 200 Ω would be increased to a value of $200 \Omega \times 400 = 80,000 \Omega$. In this case it would be advisable for the input impedance of the amplifier to be above this value (80,000 Ω) otherwise a transformer with a smaller turns ratio would be required. Suitable transformers are available from Sennheiser in various values. Some of the dynamic microphones have built-in transformers for direct connection to high impedance amplifiers. These microphones also have an alternative low impedance output direct from the moving coil (see paragraph 10).

8. Minimum Load Resistance

Sometimes microphones have a quoted nominal impedance. This nominal impedance (nominal terminating impedance) of a microphone is the value of the electrical resistance into which the microphone is designed to work, i. e. "a 200 Ω " microphone is intended to work into an impedance of 200 Ω . For microphones with a built-in amplifier e. g. the Sennheiser condenser microphones, it is most important that the minimum load resistance values quoted in the data sheets are observed otherwise distortion will result, since the source impedance of these microphones is considerably lower than their nominal impedance.

9. Overload Levels

Dynamic microphones can withstand such high sound pressure levels that it is hardly necessary to quote an overload level. It is different with condenser microphones since excessively high sound levels can cause distortion in the amplifying circuits.

10. Balanced and Unbalanced Microphones

Microphones can be connected to amplifiers and tape recorders with either balanced or unbalanced connections. In the balanced connection both signal leads are isolated from ground. The two wires from the microphone could therefore be interchanged without affecting the signal. This would, however, reverse the "phase" of the microphone and where microphones are being used in pairs for stereo recording or a "multi-mike" situation, the phase of the microphone is important. DIN 45 594 is the European standard for the phasing of microphones.

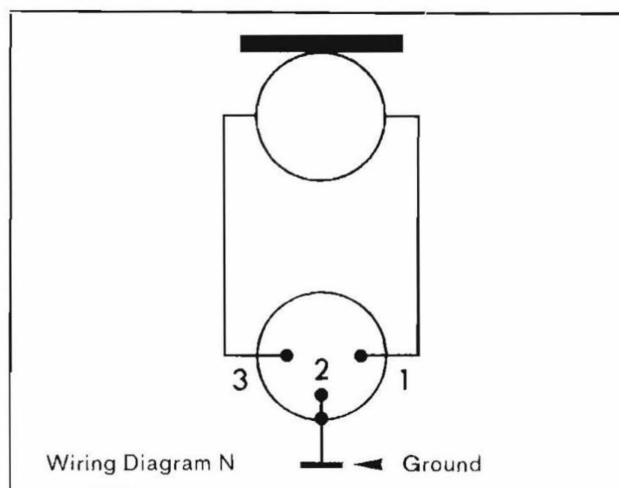
For unbalanced connections only single core shielded cable would be required since the cable shield acts as the second conductor for microphone signals. However, even for unbalanced connections it is better to use a two core shielded cable with the second inner core of the cable acting as the ground return for the microphone so that hum currents are not induced in this lead. The advantage of balanced connections is, amongst other things, that when long cable runs are used and with only moderate shielding of the cable, interference signals induced in the cable such as hum and switching clicks will cancel in the input transformer of the following amplifier. The balanced connection is almost always used in studio installations where long cable runs are typical.

The danger of interference in unbalanced circuits using relatively short cables with effective shielding, is not too serious and is often used by amateurs because of its simplicity and because most low priced amplifiers and tape recorders have unbalanced input circuits.

High impedance outputs from microphones are always unbalanced, and the high impedance input of amplifiers are also always unbalanced. However, very good shielding is required and only short cables can be used.

In the following data sheets on our microphones you will see the following codes used: N, HL, HLM, LM or -2.

The suffix N indicates that the microphone is fitted with a cable connector to the DIN standard 41 524 and is connected according to the DIN standard 45 594 for low impedance balanced connection to pins 1 and 3. Such microphones can be connected with up to 200 m of two core shielded cable without the addition of a step-up transformer, to tape recorders or amplifiers with low impedance inputs. For high impedance inputs it is essential to use a step-up transformer at the amplifier end of the cable. On pages 74 and 75 you can see further details of cable transformers.



The suffix HL added to the type number of a Sennheiser microphone indicates that this microphone has a built-in transformer and that both high and low impedance outputs are available at the cable connector wired according to DIN 45 594. It is because of the built-in transformer that the HL type microphone costs a little extra. HL type microphones can be connected directly to all vacuum tube operated tape recorders and amplifiers having a high impedance input but with a maximum cable length of 2 m. An HL type microphone will also connect directly to a low impedance amplifier input and with relatively long cables. Where a long cable is required to an amplifier or tape recorder having a high impedance input, a step-up transformer must be used such as type TM 514 HL which has only a short connection between the transformer and the amplifier input and will not affect the sound quality.

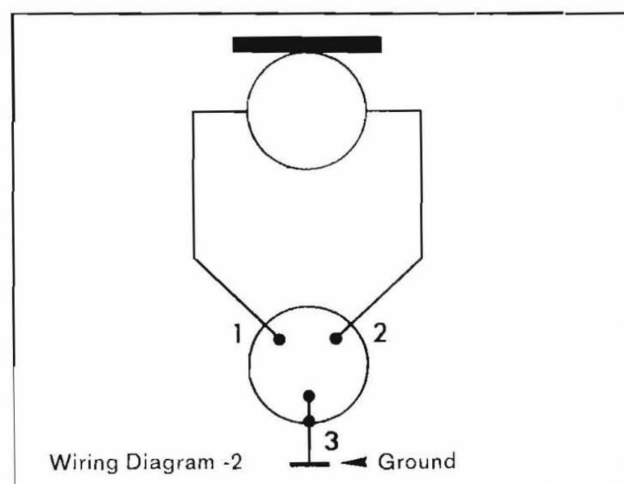
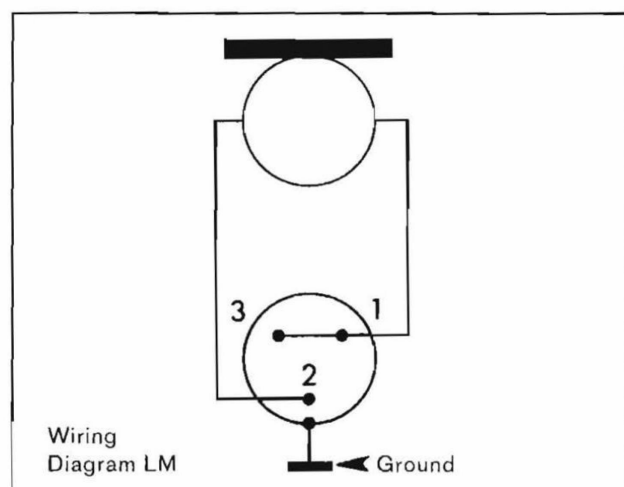
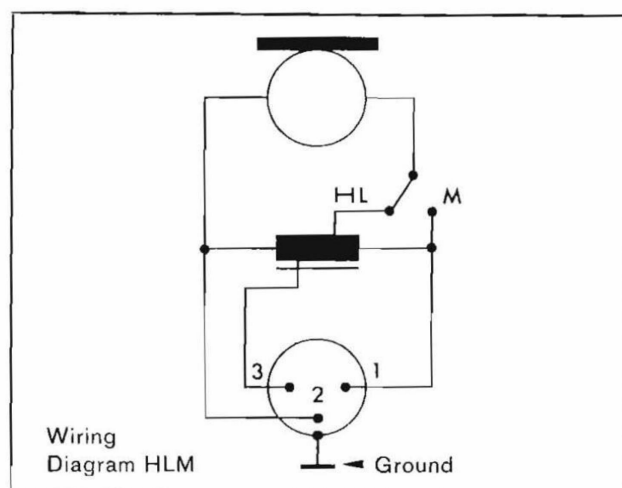
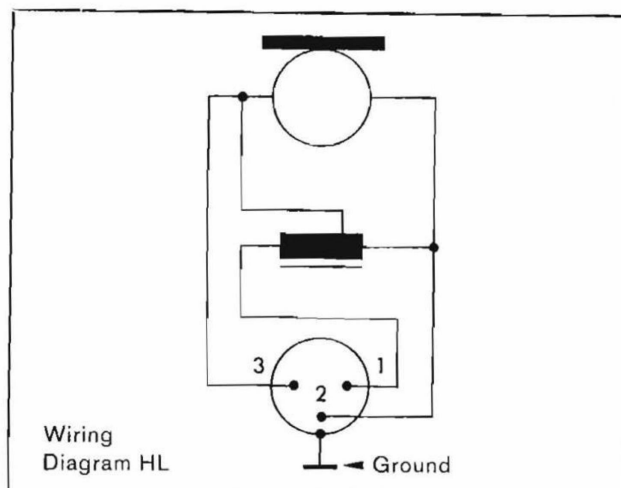
The suffix HLM which is applied to our microphone MD 411 HLM indicates a triple impedance facility. Such a microphone has the high and low impedance facilities of an HL microphone and also a medium impedance output. The microphone connector is wired according to DIN 45 594 as shown in the diagram opposite. The medium impedance output is particularly suitable for transistorized tape recorders and amplifiers. The circuit diagram HLM shows that the switching from HL to M is effected by an internal switch. The HLM facility is universal. It enables connection of the microphone to any type of amplifier or tape recorder.

Microphones wired as per diagram LM do not have this connective capacity. Basically, they are microphones with an M switch which means that they are designed for medium impedance transistorized recorders. However, the bridge between contacts 1 and 3 makes it possible to use them for low impedance unbalanced inputs (as per diagram L, connections 3 and 2).

The suffix -2 indicates a microphone with a balanced output and fitted with a large tuchel connector T 3079/2 wired according to DIN standard 41 624. There is no acoustical difference between this and other parallel types mentioned below.

The suffix-U indicates a low impedance microphone with a balanced output and fitted with a XLR-type three prong male connector.

The following mode of connection is advised: For equipment with high impedance inputs, use, if possible, low impedance microphones with step-up transformers. One is then free to use any desired length of microphone cable. If you need only 2 m of microphone cable, an HL or HLM microphone will be more economical since it can be connected directly without a cable transformer. For transistorized equipment the medium impedance M connection is the simplest possibility. In general the high sensitivity of Sennheiser microphones enables the low impedance version to be connected directly to transistorized amplifiers and tape recorders. Long cables may be used in this connection.



11. Noise Voltage, Equivalent Noise, Signal to Noise Ratio

If you bring a microphone into a completely noise free room and connect it to a very good amplifier, you will notice a hiss or rustling sound which originates from the microphone. In dynamic microphones this noise is caused by the thermal agitation of electrons in the resistance of the moving coil of the microphone. In condenser microphones this noise derives from several sources.

The noise output of a microphone can be measured with a voltmeter and a weighting network to the DIN standard 45 405. The weighting network is an equalizer which has a frequency response which simulates the response of the human ear to attenuate sounds and enables the measuring instrument to give an indication of the subjective effect of the noise. The DIN standard requires the use of a peak reading measuring instrument to follow the weighting network.

From the noise voltage and the sensitivity of the microphone the equivalent noise output can be derived in which 2×10^{-4} μbar is used as a reference level. 2×10^{-4} μbar represents in practice the threshold of hearing of the human ear at 1,000 Hz. With the help of the equivalent noise figure it is possible to compare the noise properties of various microphones with one another and as a matter of fact, independently of the sensitivity of these microphones.

If the equivalent noise of a microphone is 24 dB and that of another microphone 28 dB, one could say that the first microphone can successfully record sounds which are 4 dB quieter than the second and furthermore, that the noise output of the microphone corresponds to an acoustic noise with a level of 24 or 28 dB above the threshold of hearing.

Unfortunately, the measurement of noise voltages and consequently of equivalent noise, is not uniformly handled. Other weighting networks as opposed to the German standard are used by other manufacturers and instead of peak reading measurements, the RMS value is used. The DIN standard 45 591 stipulates that the noise voltage with a noise measurement system according to DIN 45 405 should be used. Sennheiser microphones are calibrated according to this standard and this should be borne in mind when making comparisons with other types of microphones.

Now according to new international standards the idea of loudness should only be used for subjective comparisons with a 1,000 Hz tone. There is such a discrepancy between existing measuring instruments and the subjective values that this concept can no longer be used. For this reason the concept of equivalent noise volume will eventually be deleted. Thus there will be no recognition for the concept of equivalent noise voltage. In order to overcome these difficulties in this volume of *Micro-Revue* for the first time, in addition to the equivalent noise figure, a signal to noise ratio is quoted. This signal to noise ratio relates to a standard sound pressure level of $1 \text{ N/m}^2 = 10 \mu\text{bar}$. This sound pressure represents the peak sound level of normal speech at a speaking distance of 30 cm and also represents a typical sound level in a musical performance. One can therefore say that the signal to noise ratio is comparable with a practical situation and can be compared with the signal to noise ratio of tape recorders, amplifiers, etc. A conversion to the old equivalent noise concept is quite simple when it is known that 1 N/m^2 is equivalent to a sound level of 94 dB. From this 94 dB the signal to noise ratio figure is subtracted to arrive at the equivalent noise figure. If for example the signal to noise ratio is 60 dB the equivalent noise figure would be 34 dB.

Our Cover

The majority of broadcast stations in Germany and throughout the world are using studio equipment made by Sennheiser Electronic. During the past 25 years Sennheiser microphones in particular proved to be a reliable aid to the radio, television

and motion picture industries. Sennheiser products have made many friends — not only in the studio but also in the home. Our cover shows a few photographs of TV shows in which Sennheiser products are being used i. e.:

- 1 A pop group using the MD 421.
- 2 The MK 12 condenser microphone worn on the lapel is, due to its minute size, hardly noticeable. The SK 1007 transmitter is carried inside the coat pocket.
- 3 The MD 214 N Lavalier microphone shock-mounted to eliminate contact noises, is widely used because of its superior frequency response.
- 4 The outstanding quality of the MD 421 makes it the most popular microphone among professional entertainers.
- 5 The HD 414, already famous for its superb frequency response, became even more widely known after it received a price winning award for its industrial design from the German Government. It is shown here during a television newscast.
- 6 The omnidirectional microphone MD 21 is often used in studios for interviewing purposes. But also soloists can be seen on TV using this "work-horse" most frequently.
- 7 Throughout Europe the MD 421 has become the standard microphone in the television and broadcast industries.
- 8 This picture you will hardly ever see on TV. Because of the extremely directional pattern of the MKH 805 and 815 condenser "shot gun" microphones, they are used on a boom. These microphones pick up the sound at a large distance, thus enabling the cameraman to take his picture without showing the microphone.
- 9 In the center of the Sennheiser products is the HD 414 stereo headset of which more than 150,000 units have been sold during the past two years.

micro-revue
70/71

SENNHEISER
25 JAHRE

SENNHEISER ELECTRONIC 3002 BISSENDORF/HANN. TELEFON (05130) 8011 TELEX 092423

Product Group 1

Dynamic Microphones



Studio Microphone MD 21

The dynamic studio microphone MD 21 is one of the most successful produced by Sennheiser. In the last 15 years over 270,000 of these models have been manufactured, with a significant proportion of these being used in radio and television studios throughout the world.

This microphone has become an international standard for quality and reliability in dynamic microphones. How has this come about? The German Broadcasting networks were in need of a reliable high quality microphone for general purpose use. The MD 21 was developed to meet this need. The rugged die-cast casing will withstand heavy treatment but the smooth frequency response meets the stringent requirements of broadcasting authorities. In particular, the 5 dB lift in response between 2,000 and 15,000 cycles, gives the added presence required by the networks. Being an omnidirectional pressure-operated microphone the MD 21 is relatively insensitive to wind noise and is most suitable for exterior use. For outdoor environments a windshield is available as an accessory, Type MZW 22.

MD 21 Types

MD 21 N The standard low impedance type, wired as diagram N (pages 12 and 13). Balanced output.

MD 21 HL Dual impedance type, wired as diagram HL (pages 12 and 13).

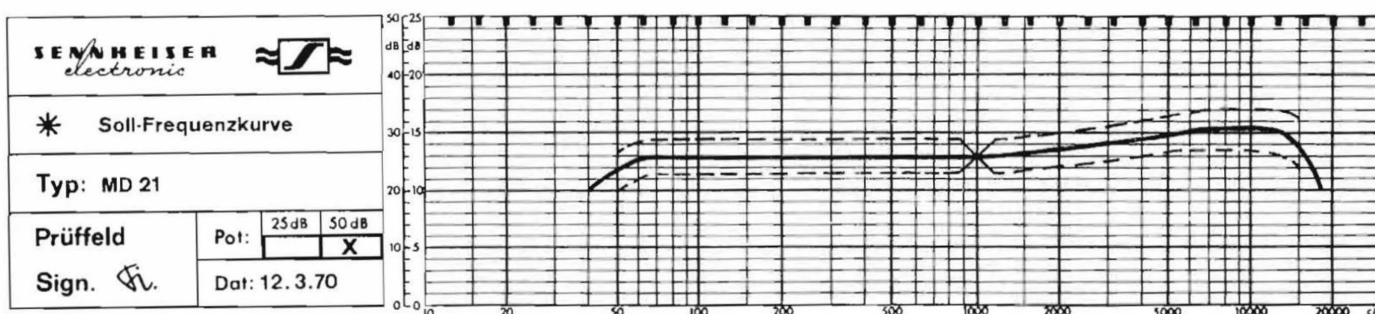
MD 21-2 Low impedance, balanced output, fitted with large Tuchel connector, type T 3079/2.



Technical Data



Rudi Carrell during one of his TV shows.



Nominal frequency response curve (with tolerance limits) MD 21

	MD 21 N	MD 21-2	MD 21 HL
Acoustical mode of operation	Pressure sensitive transducer	Pressure sensitive transducer	Pressure sensitive transducer
Frequency range	40 – 18,000 Hz	40 – 18,000 Hz	40 – 18,000 Hz
Tolerance limits	± 3 dB	± 3 dB	± 3 dB
	of reference curve from	of reference curve from	of reference curve from
	50 Hz to 15,000 Hz	50 Hz to 15,000 Hz	50 Hz to 15,000 Hz
Sensitivity at 1,000 Hz	0.2 mV/μbar	0.2 mV/μbar	2.5 mV/μbar, 2.0 mV/μbar
	± 3 dB	± 3 dB	± 3 dB
Output level ref. 1 mW/10 dynes/cm ²	– 53 dbm	– 53 dbm	– 53 dbm and – 54 dbm
EIA rating	– 145.8 db	– 145.8 db	– 145.8 db and – 150 db
Impedance	200 ohm	200 ohm	30,000 ohm
			200 ohm
Directional characteristics	omnidirectional	omnidirectional	omnidirectional
Connector	T 3260	T 3079/2	T 3260
Pin connections	1 + 3: signal	1 + 2: signal	H: 1 + 2: case: ground
	2 & case: ground	3 & case: ground	L: 2 + 3: case: ground
Cable connectors	T 3261	T 3080/2	T 3261
Stray magnetic field interference	≤ 100 μV/50 mG	≤ 100 μV/50 mG	≤ 100 μV/50 mG
Dimensions	120 x 46 x 46 mm	120 x 46 x 46 mm	120 x 46 x 46 mm
Weight	10 oz.	10 oz.	10 oz.

We reserve the right to alter the specifications especially with regards to technical improvements.

Studio Cardioid Microphone

MD 421



Probably the most famous of all Sennheiser microphones. So popular with Radio and Television users that Sennheiser were able to go into mass production and bring this superb studio microphone within the price range of the serious amateur.

To date more than 100,000 of these microphones have been supplied throughout the world. The outstanding quality and cardioid characteristic have made this microphone very popular in many radio and television studios. Almost every European radio and television station uses this microphone.

The individual frequency response chart that comes with every microphone will look like the solid curve on the opposite page. The dotted lines show the narrow tolerance limits allowed on a production microphone.

From 2,000 Hz to 17,000 Hz there is a smooth 5 dB increase in the response curve to add presence to the recording.

The cardioid directional characteristic is the other feature that allows natural sound recordings to be made in difficult situations such as small rooms with bad acoustics. Average front to back ratio of 18 dB. Suited for sound reinforcement installations — pop groups and all situations where a microphone has to be used near a loudspeaker. In such situations the variable bass attenuator will allow maximum clarity and presence particularly when the MD 421 is used close to the mouth.

MD 421 types

MD 421 N is the low impedance version, wired according to diagram N (pages 12 and 13). It is fitted with a standard Tuchel connector T 3260.

MD 421 HL is the dual impedance version, wired according to diagram HL (pages 12 and 13). Connector as for MD 421 N.

MD 421-2 is low impedance as the MD 421 N but is fitted with the large Tuchel connector T 3079/2.

MD 421-U is low impedance as the MD 421 N but is fitted with XLR-type three prong male connector.

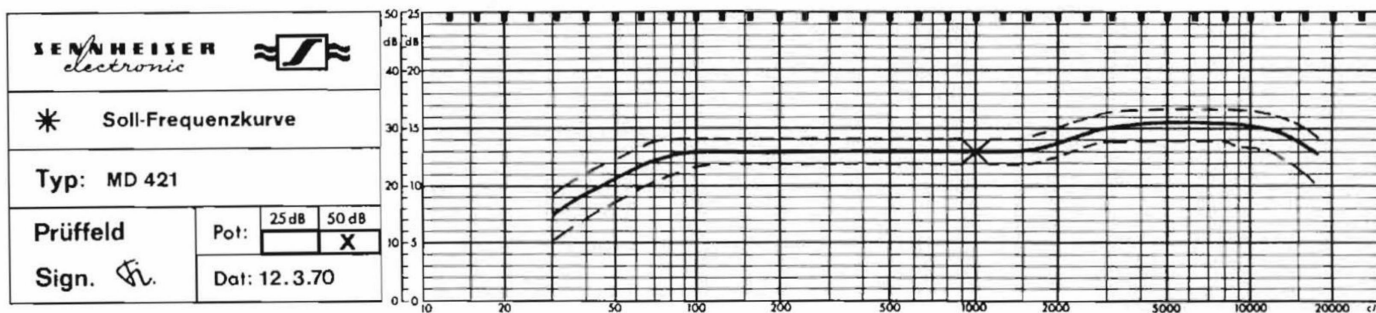
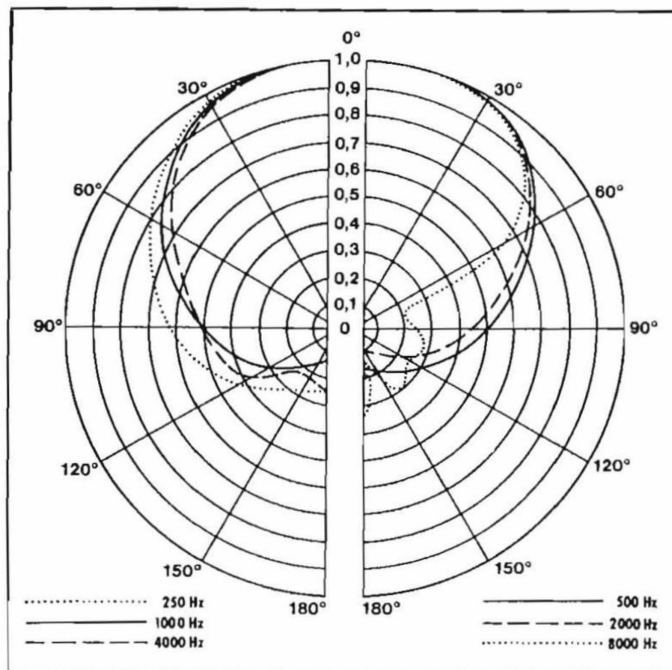
Models MD 421 N and MD 421 HL only are fitted with a variable bass attenuator. The attenuator is marked: M (music) = flat response, S (speech) = max. bass cut.

Added to the MD 421 range are the MD 421 HL de luxe and MD 421 N de luxe. These microphones are finished in black and gold consequently are naturally preferred by musicians for stage work and festive occasions.



Well known Teldec-Star Paola during a recording session with a MD 421

Technical Data



Nominal frequency response curve (with tolerance limits) MD 421

Every MD 421 is supplied with its own factory frequency response curve.

	MD 421 N	MD 421-2	MD 421 HL
Acoustical mode of operation	Pressure gradient	Pressure gradient	Pressure gradient
Frequency range	30 – 17,000 Hz	30 – 17,000 Hz	30 – 17,000 Hz
Tolerance limits	See frequency response curve above	See frequency response curve above	See frequency response curve above
Sensitivity (1 kHz)	0.2 mV/μbar ± 3 dB	0.2 mV/μbar ± 3 dB	0.2 mV/μbar & 2.0 mV/μbar ± 3 dB
Output level ref. 1 mW/10 dynes/cm ²	– 53 dbm	– 53 dbm	– 53 dbm and – 54 dbm
EIA rating	– 145.8 db	– 145.8 db	– 145.8 db and – 150 db
Impedance (1 kHz)	200 Ω	200 Ω	200 Ω & 24 kΩ
Directional characteristics	Cardioid	Cardioid	Cardioid
Front to back ratio	18 dB – 2 dB	18 dB – 2 dB	18 dB – 2 dB
Bass attenuator	Yes	No	Yes
Output plug	T 3260	T 3079/2	T 3260
Cable connectors	T 3261/1	T 3080/2	T 3261/1
Connections	1 + 3: signal 2 & case: ground	1 + 2: signal 3 & case: ground	1 + 2 high Ω 2 + 3 Low Ω case: ground
Sensitivity to magnetic fields	approx. 5 μV/50 mG	approx. 5 μV/50 mG	approx. 5 μV/50 mG
Dimensions	177 x 48 x 46 mm	177 x 48 x 46 mm	177 x 48 x 46 mm
Weight	14 oz.	14 oz.	14 oz.

We reserve the right to alter the specifications especially with regards to technical improvements.

Super Cardioid Dynamic Microphone MD 411 HLM



Although the MD 411 HLM microphone is very similar in appearance to that of the MD 421, it was specifically designed for the amateur recordist and costs less than half the price of the MD 421. Naturally some of the features in the MD 421 had to be omitted. The cable is connected permanently to the microphone, and the compensating coil for magnetic leakage fields has been omitted. There is also no bass attenuator.

However, from the home recordist's point of view, the MD 411 has some advantages over its big brother. The amateur does not normally have the advantage of an acoustically treated studio for his recordings and therefore requires a microphone with superior directional properties to remove the unpleasant effects of room echoes. The MD 411 has been designed with this situation in mind.

The response at the sides of a true cardioid microphone such as the MD 421 is reduced only slightly compared with the response on the axis. The MD 411 however, is a super-cardioid whose response is greatly attenuated at the sides of the microphone. A glance at the polar diagram on page 21 shows clearly the superb directional properties of the MD 411 HLM at all frequencies.

Stereo recordings are outstanding made with a pair of MD 411s because of the accuracy of the directional characteristics over the whole audio spectrum. The frequency response is consistent from one microphone to the next, and even in this economical design, the response is controlled to meet the HiFi standard DIN 45500.

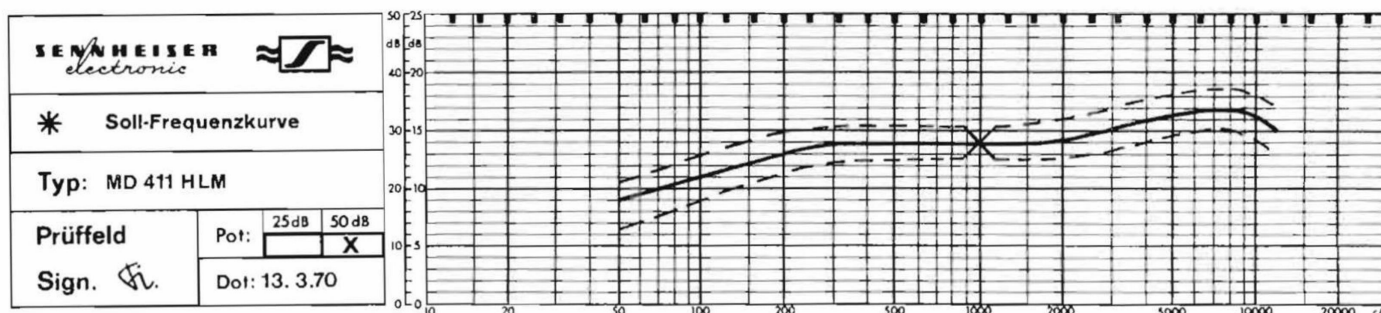
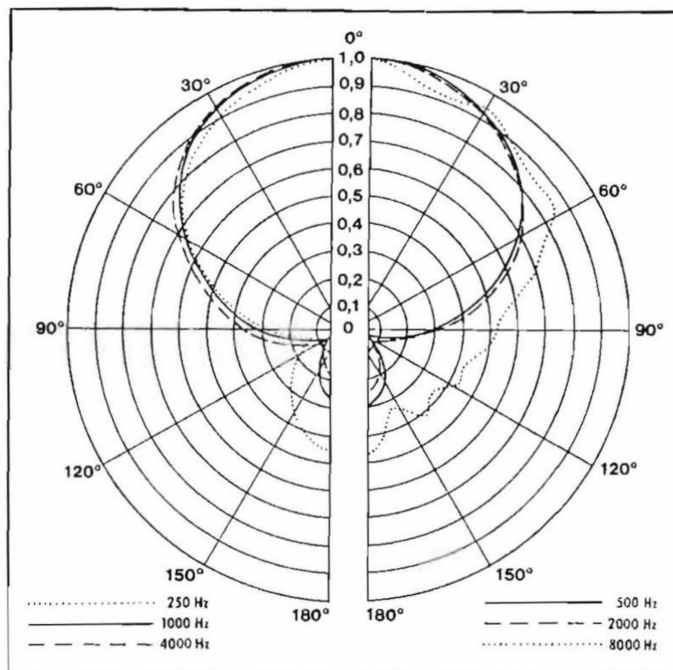
The built-in triple impedance transformer enables the MD 411 HLM to be connected directly to any tape recorder. High impedance (H) = 25,000 ohms for tube recorders; Medium impedance (M) = 800 ohms for transistorized recorders; Low impedance (L) = 200 ohms for recorders of either type, fitted with low impedance input circuitry.

A selector switch on the underside of the microphone gives a choice of high and low impedance or medium impedance connection, as shown on the diagram on page 13.

The MD 411 HLM comes complete with its table stand-floor stand-adaptor and zip-up cushioned case.



The super-cardioid microphone MD 411 HLM
being used for commentary recording



MD 411 HLM

Acoustic mode of operation	Pressure gradient	M	H	L
Directional characteristic	Super-cardioid			
Side attenuation at 120°	20 dB ~ 2 dB			
Directivity index	3.5 – 0.2			
Frequency range	50 Hz to 12,000 Hz			
Tolerance limits	to HiFi standard DIN 45 500			
		M	H	L
Sensitivity at 1 kHz	0.25 mV/μbar	1.25 mV/μbar	0.12 mV/μbar	
Output level ref. 1 mW/10 dynes/cm²	– 57.1 dbm	– 58.1 dbm	– 57.5 dbm	
EIA rating	– 150 db	– 154 db	– 150 db	
Impedance	800 Ω ± 15 %	25 kΩ ± 20 %	200 Ω ± 20 %	
Pin connections: case to screen				
Switch to "M"	1 & 2	–	–	
Switch to "HL"	–	1 & 2	2 & 3	
Output plug	Mas 30 (Continental 3 pin)			
Cable socket required	Mak 30 S (Continental 3 pin)			
Dimensions	140 x 38 x 38 mm			
Weight	8 ozs.			
Weight of stand	2 ozs.			

21

Super Cardioid Dynamic Microphone MD 402 LM

A high quality but medium priced microphone to meet the needs of the recording novice was long overdue. The MD 402 from Sennheiser electronic fills this gap without sacrificing the well known Sennheiser quality. Special care has been taken to design a microphone for the widest possible range of users.

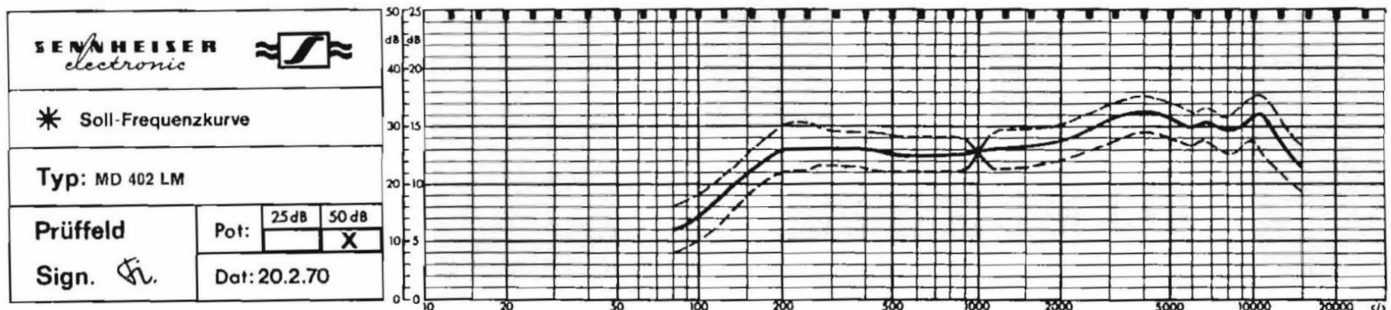
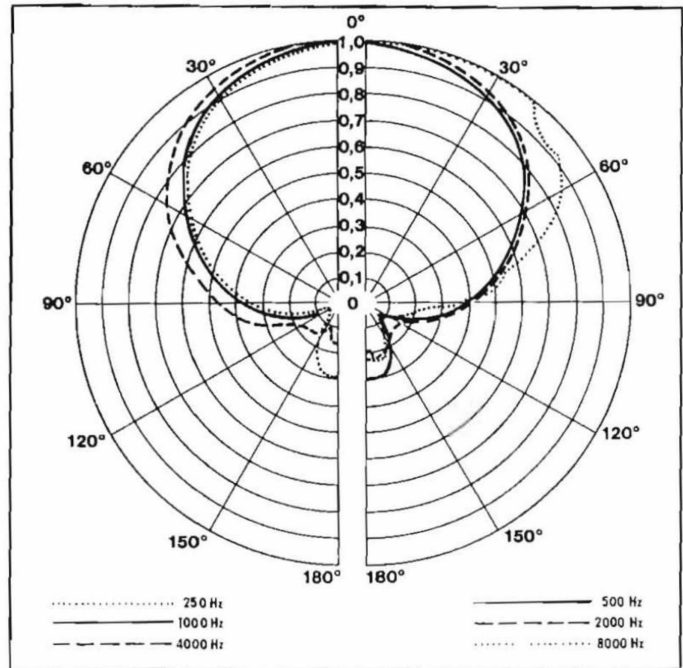
The steel body of the MD 402 is insensitive against shocks and drops. It contains a high quality and acoustically sensitive dynamic system capable of fulfilling all the wishes of the demanding amateur. The wide frequency range together with the super cardioid characteristics ensure best results even in noisy or reverberant surroundings. The "built-in-windscreen" not only protects the sensitive capsule but also suppresses the annoying pop and windnoises when used closely. This special feature ensures good quality recordings even for the inexperienced.

The MD 402 LM is connected in the medium impedance configuration (see pages 12 and 13) so that it can be used directly with about 90 % of all tape-recorders at present on the market. If only a high impedance microphone input is available the TS 514 M transformer-adapter must be used which is fitted a 5 meter long extension cable. A detailed description of this adapter can be found in the accessory program on page 53. The standard 1.5 meter connecting cable provided uses a three prong male connector as per DIN 41 524.



Baby's talk is going to be recorded for the family's archives
with the MD 402 LM.

Technical Data



Nominal frequency response curve (with tolerance limits) MD 402 LM

MD 402 LM

Acoustic mode of operation	pressure gradient
Frequency range	80 ... 12,500 Hz
Tolerance limits	see graph
Directional characteristics	super cardioid
Attenuation at 120°	20 dB - 2 dB
Directivity index	3.5 - 0.2
Sensitivity at 1 kHz	0.23 mV/μbar ± 3 dB
Impedance	750 Ω
Load	4 kΩ
Pin connections	1 = 3 → coil 2 → ground
Connectors	DIN 41 524, Mas 30
Cable socket required	DIN 41 524, Mak 30 S
Dimensions	21 mm φ x 145 mm
Weight	appror. 185 grams with cable
Length of cable	1.5 meter

We reserve the right to alter the specifications especially with regards to technical improvements.

Studio Microphone MD 211 N



Perhaps one of the finest moving coil microphone in the world. The frequency response shown below can be seen to be so smooth and so wide in range that the MD 211 N might almost be considered to be a condenser microphone. Its small size and elegant design have made it equally as popular with orchestral recording engineers as with pop groups. The test certificate and frequency response curve issued with every MD 211 N bears testimony to the fact, that no microphone leaves the factory having a deviation of more than 2.5 dB from the nominal response from 40 to 20,000 cycles per second. The extended low frequency response enables the recording of organ pedal notes with thrilling realism, while the smooth response over the treble range gives a natural quality seldom heard with a moving coil microphone. Not only does this microphone have an outstanding frequency response, it is rugged and suitable for exterior use.

A windshield, Type MZW 201, is available.

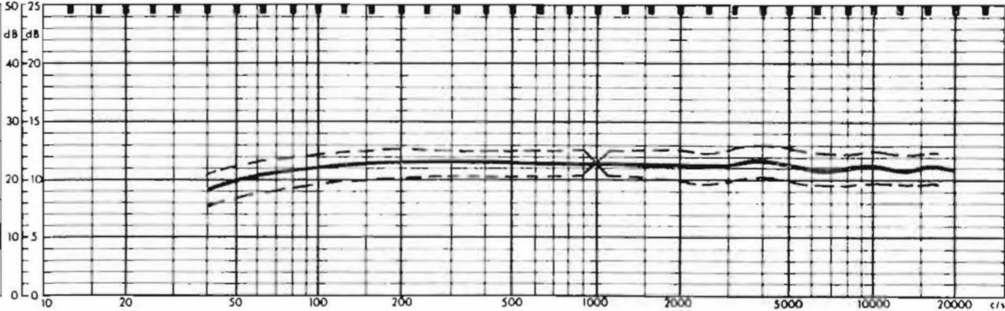
The MD 211 N has a low impedance balanced output, wired according to diagram N page 12.

For use with tape recorders with high impedance inputs use step-up cable transformer TM 513 N.

This microphone is also available with Cannon XLR connector, the model number is MD 211 U.



SENNHEISER <i>electronic</i>			
* Soll-Frequenzkurve			
Typ: MD 211 N			
Prüffeld Sign. 	Pot:	25 dB	50 dB
			X
Dat: 17.3.70			



Nominal frequency response curve (with tolerance limits) MD 211 N

Every MD 211 is supplied with an individually plotted frequency response curve.

Technical Data

MD 211 N

Acoustical mode of operation	Pressure sensitive transducer
Frequency range	40 – 20,000 Hz
Tolerance limits	± 2.5 dB from reference curve (above) from 40 to 20,000 Hz
Sensitivity at 1,000 Hz	0.13 mV/μbar ± 2.5 dB
Output level ref. 1 mW/10 dynes/cm ²	– 56.8 dbm
EIA rating	– 149.3 db
Impedance at 1,000 Hz	> 200 ohms
Directional characteristic	Omnidirectional
Connector	T 3260 or XLR
Pin connections	T 3260 = 1 + 3: signal, 2 & case: ground XLR = 2 + 3: signal, 1: ground
Cable connector	T 3261/1
Leakage magnetic field sensitivity	40 μV/50 mG
Dimensions	Diameter 22 mm, length 120 mm
Weight	5 oz.

We reserve the right to alter the specifications especially with regards to technical improvements

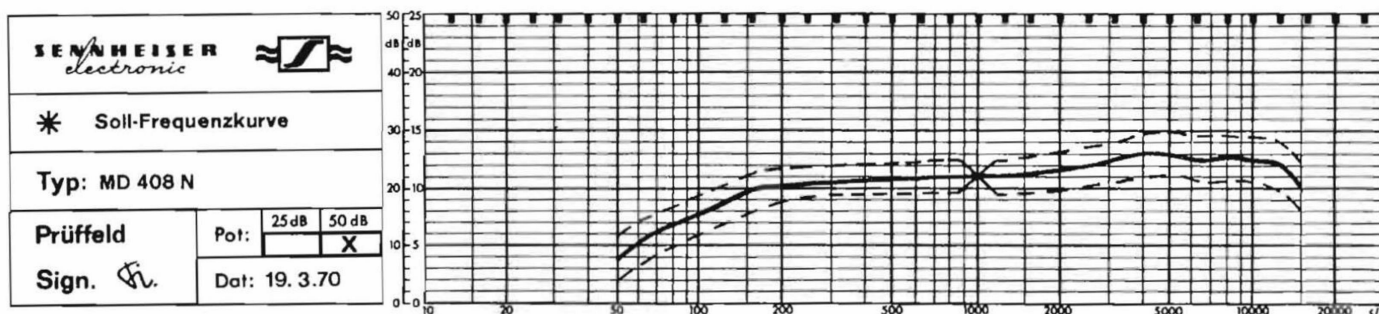
Goose Neck Directional Microphone MD 408 N

Frequently there is a requirement for a microphone to be mounted on a flexible goose neck. This usually means paying for a microphone and a goose neck in addition. Not in this case.

The MD 408 N is a super cardioid microphone built-on-to a goose neck stand, complete with a silent operating on-off switch. The result is an elegant but unobtrusive design which looks well in architectural installations for sound reinforcement applications and, mounted on a floor stand, provides a high class microphone for use on stage. In both situations the directional pattern of this inexpensive microphone provides a superior result, which will be of great advantage for the recording Amateur as well.

The advantages of the directional pattern of the MD 408 N are increased by the extremely smooth frequency response — extending to 14,000 Hz — which greatly reduces the usual tendency to acoustical feedback or "howl round".

The MD 408 N is wired according to diagram N on page 12.



Nominal frequency response curve (with tolerance limits) MD 408 N

Technical Data

MD 408 N

Acoustical mode of operation	Pressure gradient transducer
Frequency range	60 – 14,000 Hz
Tolerance limits	± 3 dB from the reference curve above
Sensitivity at 1,000 Hz	0.13 mV/μbar ± 3 dB
Output level ref. 1 mW/10 dynes/cm ²	– 56.8 db
EIA rating	– 149.3 db
Impedance at 1,000 Hz	200 ohms nominal
Directional characteristic	Super-cardioid
Sound reduction at 150 ° to axis above 1,000 Hz	≥ 15 dB – 3 dB
Connector	T 3260
Pin connections	1 + 3: signal (balanced) 2 & case: ground
Cable connector	T 3261/1
Dimensions	Head 40 mm diameter Length of stem 300 mm
Weight	10 ozs. approx

We reserve the right to alter the specifications especially with regards to technical improvements.

Lavalier Microphone

MD 214 N

This is a very special microphone with a number of unique features. A considerable research program was undertaken to determine the best way to achieve the natural response of the human voice when a microphone is worn against the chest. If a microphone with a flat frequency response is used in this position, the resonance of the chest and the interference of clothing combined produce a tubby and unnatural sound. It was found that the most natural voice quality was achieved when a microphone with a flat response was equalized to have a response with a dip at 700 cycles in order to reduce the effect of the chest resonance, and a 5 dB peak between 3,000 and 10,000 cycles, to overcome the masking effect of clothing. To achieve this, Sennheiser uses the capsule of the MD 211 N microphone in conjunction with an electrical equalizer.

A further problem with Lavalier microphones is the interference of rustle — caused by rubbing of the housing and cable against clothes. To reduce this effect the capsule of the MD 214 N is springmounted inside the case. The rectangular section of this case has the additional advantage that the microphone is less inclined to roll from one side to the other on the wearer's chest. The MD 214 N is a pressure operated moving-coil microphone and has therefore an omnidirectional characteristic. A feature which will be appreciated by service departments is that in case the microphone cable is damaged it can be changed quickly and easily by removing the screw link at the base of the microphone.

MD 214 Types

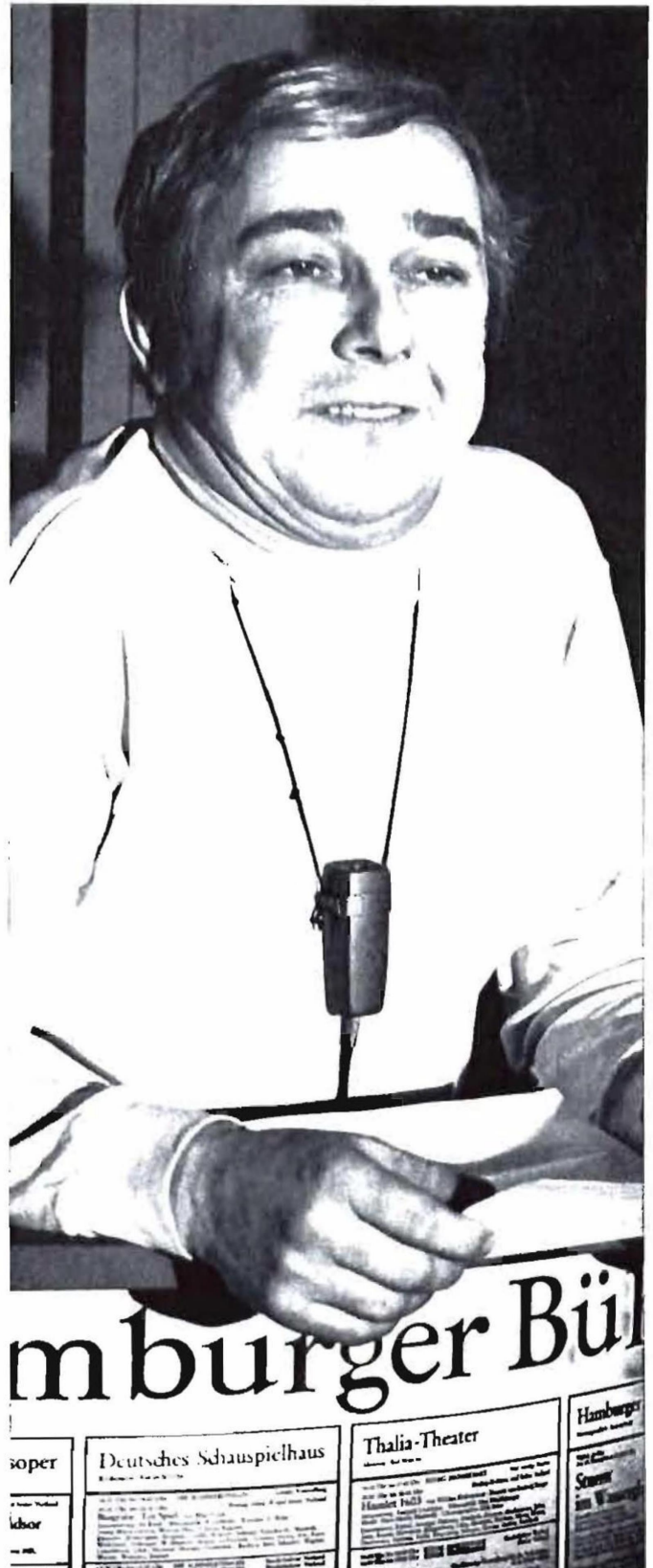
MD 214 N has a balanced low impedance output, wiring as diagram N (page 12 and 13).

MD 214-1 * has the same impedance as MD 214 N but is fitted with a 6 pin Tuchel connector for use with the Sennheiser Mikroport radio microphone.

MD 214 CM has the same impedance and is fitted with Cannon XLR male connector.

MD 214 CM same as above, but with Cannon XLR female connector.

* Technical Data page 72



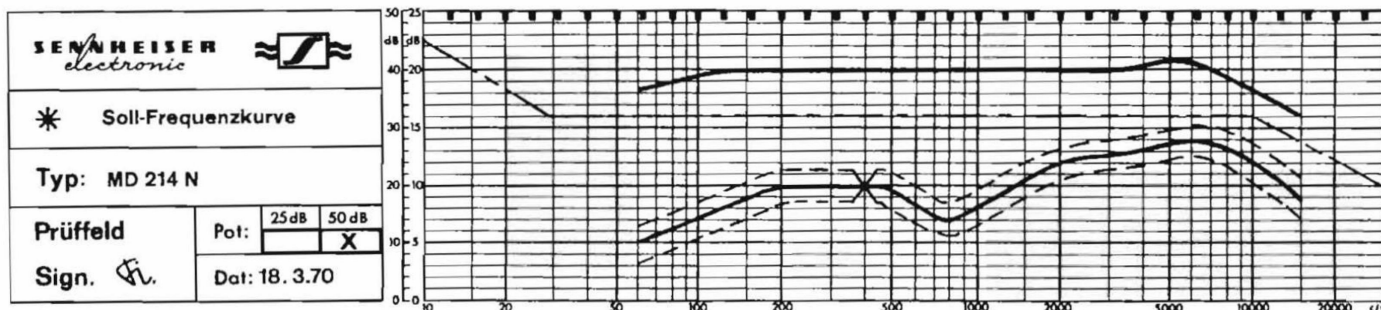
The MD 214 during a broadcast for the Norddeutsche Rundfunk
Photo: H. E. Müller

Technical Data



Teldec-Star Manuela with the
Lavalier microphone MD 214 N

Photo: Teldec



Upper curve: Frequency response used as a lavalier microphone

Lower curve: Frequency response in a free soundfield on axis

Every MD 214 is supplied with an individually plotted frequency response curve.

MD 214 N

Acoustical mode of operation	Pressure sensitive transducer
Frequency range	60 to 15,000 Hz
Tolerance limits	± 2.5 dB from the special response curve (shown above)
Sensitivity at 1,000 Hz	0.10 mV/ μ bar ± 2.5 dB
Output level ref. 1 mW/10 dynes/cm ²	- 59 dbm
EIA rating	- 151.8 db
Impedance at 1,000 Hz	≥ 200 ohms
Directional characteristic	Omnidirectional
Connector	T 3260 or XLR
Pin connections	T 3260 = 1 + 3: signal, 2 & case: ground XLR = 2 + 3: signal, 1: ground
Cable connector	T 3261/1
Magnetic field sensitivity	8 μ V/50 mG
Dimensions	75 x 28 x 28 mm
Weight	5 oz. without cable 11 oz. approx. with cable

We reserve the right to alter the specifications especially with regards to technical improvements.

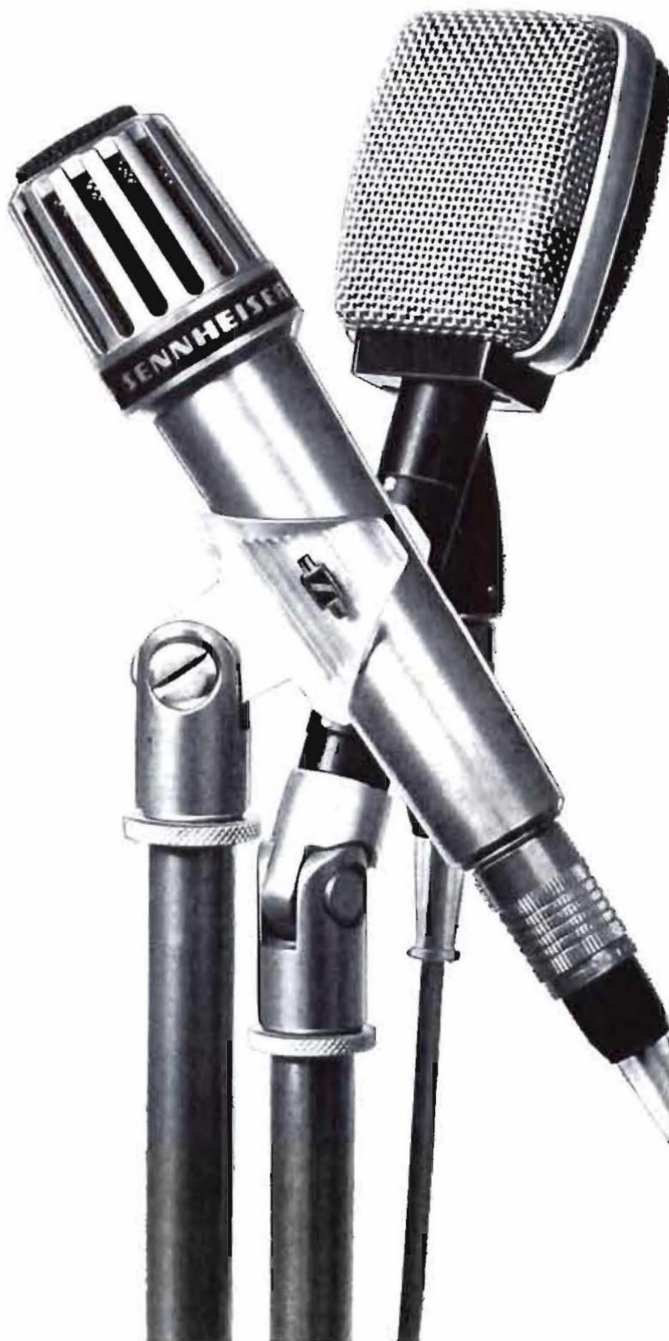
Microphones for Musicians

The studio dynamic cardioid microphone type MD 421 as described on pages 14 and 15 has been used successfully by professional musicians for many years, both for live stage work and recording purposes.

The popularity of this microphone increased in stage application with the advent of the black and gold version MD 421 de luxe. As an all purpose music microphone the MD 421 series is excellent, however, it became obvious, particularly with the increasing demand on the beat scene for a good vocalist microphone, that Sennheiser electronic should produce such a unit. This in mind design laboratory developed the MD 409 N and the MD 415 N.

The MD 409 N dynamic microphone was designed for stand mounting to be used by instrumentalists who are unable to hold microphones, yet the properties of the microphone will allow the user to come within close proximity without distortion or exaggerating the bass response. The anti feedback properties built into the capsule allow the microphone to be used within a few feet of the loudspeaker without experiencing any "howl round". The MD 409 is fitted with a silent operating ON/OFF switch. The bass response in the MD 409 and MD 415 has been specially calibrated to avoid any bass overload when a vocalist is operating within a few inches of the diaphragm.

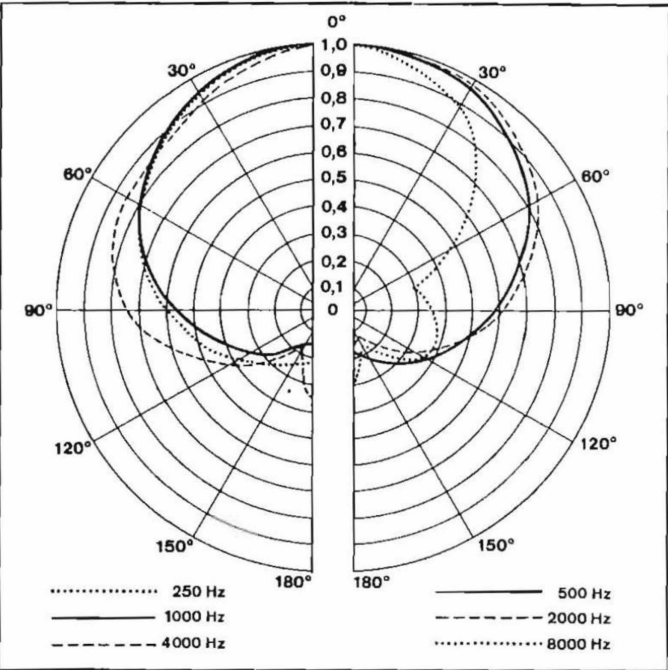
The MD 415 N has been especially designed for the vocalist. With all the acoustical features of the MD 409 N the MD 415 can be quickly released from a floor stand providing the MZA 415 microphone adaptor is used. An anti popping shield is built over the diaphragm for close work and the microphone case is turned in brass for ruggedness. Both the MD 415 and the MD 409 are finished in black and gold. The output of both microphones is balanced and wired to the N standard (page 12) and can be used with long cables.



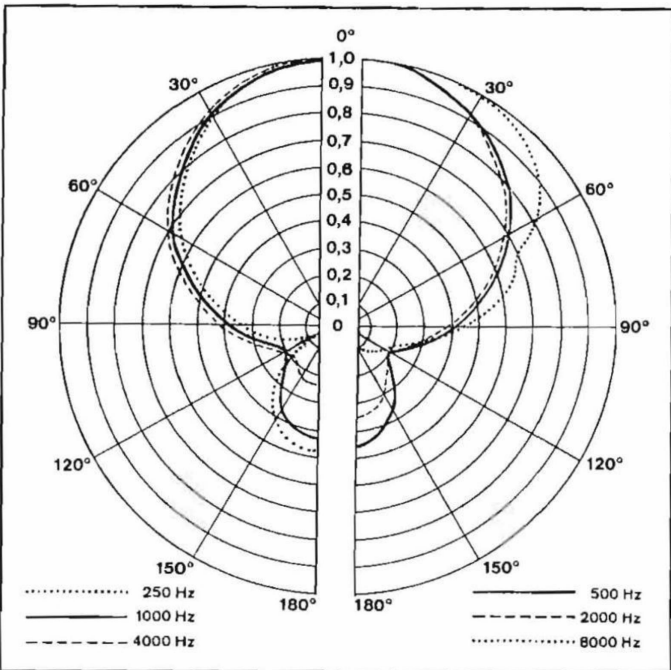
MD 415 N

MD 409 N

Technical Data



Polar diagram MD 409 N



Polar diagram MD 415 N

MD 409 N

Acoustical mode of operation	Pressure gradient transducer
Frequency range	50 – 15,000 Hz
Directional characteristic	Super-cardioid
Attenuation at 145 ° at 1,000 Hz	≥ 14 dB
Sensitivity at 1,000 Hz	0.18 mV/μbar
Impedance at 1,000 Hz	200 ohms
Output socket	T 3260
Cable connector	T 3261/1
Pin connections	1 + 3: signal 2 + case: ground
Dimensions	55 mm x 35 mm x 195 mm
Weight	12 oz.

MD 415 N

Acoustical mode of operation	Pressure gradient transducer
Frequency range	60 – 15,000 Hz
Directional characteristic	Super-cardioid
Attenuation at 1,000 Hz	≥ 18 dB
Sensitivity at 1,000 Hz	0.12 mV/μbar ± 3 dB
Impedance at 1,000 Hz	300 ohms
Output socket	T 3260
Cable connector	T 3261/1
Pin connections	1 + 3: signal 2 + case: ground
Dimensions	35 mm Ø, 140 mm length
Weight	11 oz.

We reserve the right to alter the specifications especially with regards to technical improvements.

Noise Cancelling Microphone MD 4-2 and Anti-Feedback Microphone MD 420-2

Close talking microphones are necessary in many situations today — railway stations, noisy factories, sport stadiums, airport concourses, touring coaches, etc. A close talking microphone operates by having both sides of its diaphragm exposed to the sound waves. It is therefore insensitive to distant sounds, since their sound waves reach both sides of the diaphragm simultaneously and largely cancel out. In use the microphone is held close to the speaker's mouth, so that more sound energy reaches the front of the diaphragm than the rear. Cancellation of the wanted sound is therefore avoided.

The MD 4 is a close talking microphone, designed to be held to one side of the mouth. The fidelity of response at high frequencies — vital for clarity in public address systems — is ensured by the acoustic duct in front of the diaphragm. Since this microphone has a figure eight response to distant sounds, it can be rotated to reduce further interference with a particularly disturbing noise. The MD 4-2T is an alternative version with a built-in on-off switch. The MD 420 is also a close talking microphone designed to be used in front of the mouth, but does not require to be quite as close to the mouth as the MD 4. The principle of operation is similar, but the MD 420 is designed to have a super-cardioid characteristic. Since it is used further from the mouth, a more natural voice reproduction is achieved.

The natural sound quality and the outstanding anti feedback features of the MD 420 are ideal advantages to use this microphone with beat groups and on stage for public address.

Both microphones are available without switch as model numbers MD 4-2 and MD 420-2. If the microphones are equipped with switch a T is added to the type number. A shorter version MD 420-9 is also available for mounting on a gooseneck.

All models are wired according to diagram -2 (see page 13).



Noise Cancelling Microphone MD 4-2



Anti-Feedback Microphone MD 420-2

Technical Data

	MD 4-2 MD 4-2T	MD 420-2 MD 420-2T
Acoustical mode of operation	Pressure gradient transducer	Pressure gradient transducer
Frequency range	50 – 10,000 Hz	200 – 10,000 Hz
Frequency response	Special for close speaking	Special for close speaking
Sensitivity at 1,000 Hz	0.16 mV/ μ bar approx.	0.18 mV/ μ bar approx.
Output level ref. 1 mW/10 dynes/cm ²	– 55 dbm	– 54 dbm
EIA rating	– 147.5 db	– 146.5 db
Impedance at 1,000 Hz	200 Ω	200 Ω
Directional characteristic	Figure of 8 cardioid at high frequencies	Super cardioid
Attenuation at 1,000 Hz	at 90° ~ 20 dB	at 120° ~ 18 dB – 3 dB
Switch	on type MD 4-2T	on type MD 420-2T
Output socket	T 3079/2	T 3079/2
Pin connections	1 + 2: signal 3 + case: ground	1 + 2: signal 3 + case: ground
Cable connector	T 3080/2	T 3080/2
Dimensions	Head 60 mm ϕ Length 180 mm	35 mm ϕ 130 mm
Weight	13 oz.	4 oz.

We reserve the right to alter the specifications especially with regards to technical improvements



MD 420-9

Probe Measuring Microphone MD 321 N



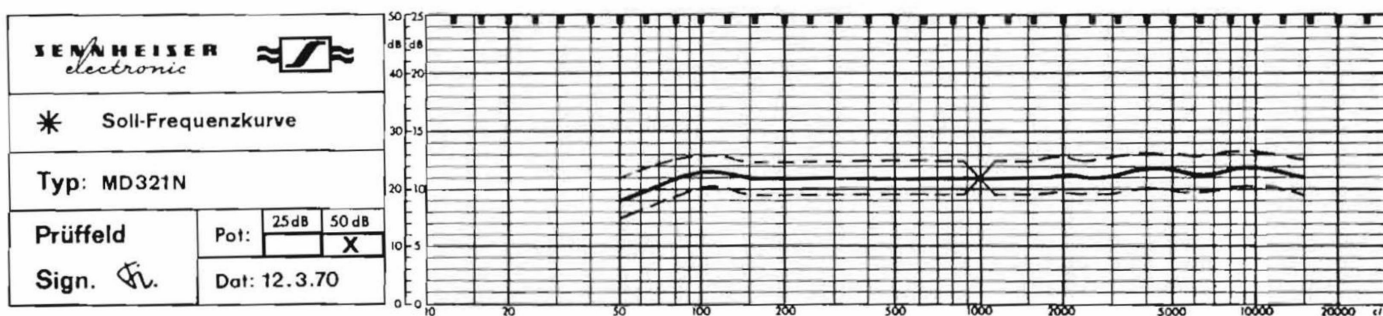
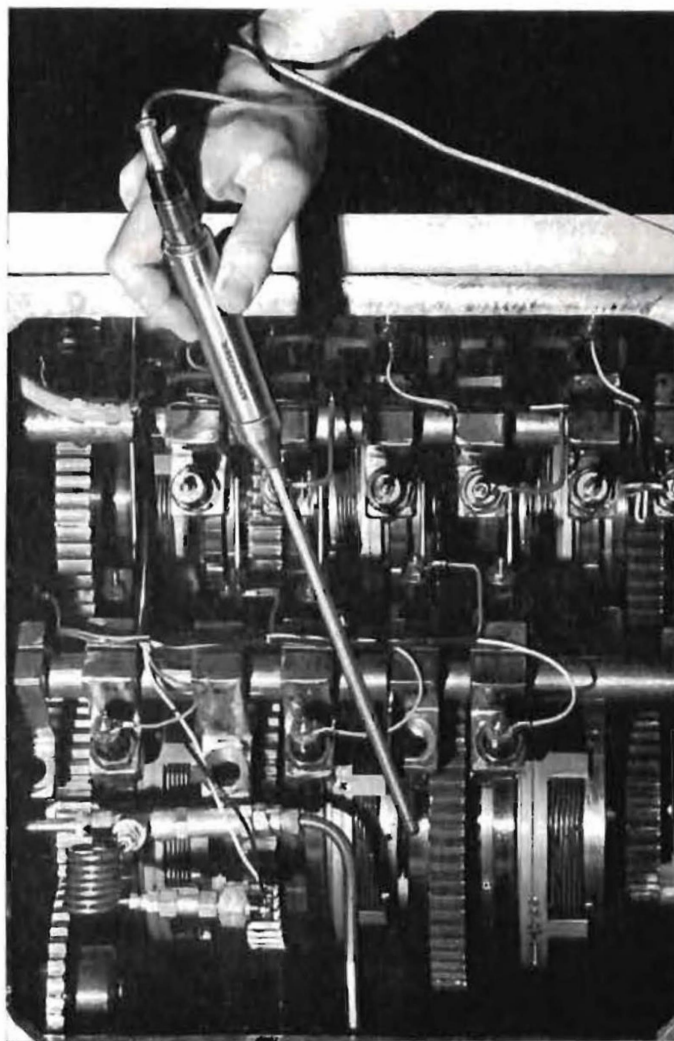
This new probe microphone is designed primarily for industrial acoustic measurements. As the curves testify it has an unusually smooth frequency response. The dotted lines on the frequency response curve show the limits of production tolerance of plus or minus 2.5 dB.

The MD 321 N is intended for use in trouble shooting and noise suppression of machinery since the probe can be inserted into inaccessible corners to pick up, e. g., the sound of a defective bearing or a noisy gear wheel.

For acoustic measurements the small size of the probe permits measurements to be made without disturbance of the sound field.

The probe tube is detachable and can be replaced easily and quickly in case of accident or damage. An important feature is that this probe has especially been designed to be used in high temperature environments e. g. for measurements of sound levels in hot exhaust gases.

The MD 321 N is wired according to diagram N on page 12. Balanced output.



Nominal frequency response curve (with tolerance limits) MD 321 N

Every MD 321 N is supplied with an individually plotted frequency response curve.

Technical Data

MD 321 N

Acoustical mode of operation	Pressure sensitive transducer
Frequency range	50 – 15,000 Hz
Tolerance limits	See above graph
Sensitivity at 1,000 Hz	0.045 mV/μbar ± 3 dB
Output level ref. 1 mW/10 dynes/cm ²	– 66 dbm
EIA rating	– 158.7 db
Max. sound level for 3 % distortion at 400 Hz	3 mbar
Impedance	200 Ω
Directional characteristic	Omnidirectional
Output connector	T 3260
Pin connections	1 + 3: signal
	2 + case: ground
Cable connector	T 3261/1
Magnetic field sensitivity	23 μV/50 mG
Dimensions	25 mm Ø, 440 mm length. Tube 8 mm Ø
Weight	10 oz.

We reserve the right to alter the specifications especially with regards to technical improvements

Product Group 2

Transistorized

Condenser Microphones

It is a well-known fact that condenser microphones can cope with the most difficult problems in recording mainly because the moving part of a condenser microphone consists of only a feather-light membrane.

In conjunction with the small dimensions of the elements, exceptionally good electro-acoustical characteristics can be achieved.

So far condenser microphones were known to be not as rugged as dynamic microphones. Therefore they were often only used in studios or similar localities. Today there are no objections to using condenser microphones outdoors. Especially the condenser microphones made by Sennheiser are famous for their durability when used under various climatic conditions.

The Radio Frequency System

Throughout the range of Sennheiser condenser microphones the capacitive transducing element is part of a radio frequency circuit. This means that unlike conventional condenser microphones, the capsule operates at a low impedance. There is no high polarizing voltage on the diaphragm and, in consequence, the microphone is less sensitive to physical shock, humidity and changes of temperature.

The capsule is not required to operate with the diaphragm in a critical balance between maximum capacity and high voltage arc-over. The extremely low noise level of the Sennheiser microphones is obtained by the use of a crystal controlled radio frequency oscillator. The high "Q" of the crystal oscillator reduces the random radio frequency noise. The noise output of the microphone approaches the theoretical noise limit. This fact can be substantiated by measuring the noise output in free air and then placing the microphone in a vacuum; the low noise level in free air will be reduced even further in a vacuum, due to the fact that the microphone noise is mainly caused by the random motion of the air molecules rather than by the microphone circuit itself. The high signal output of the Sennheiser condenser microphones means that the signal to noise ratio of the microphone amplifier is of little importance and for this reason even a poor quality microphone amplifier will appear to have a good signal to noise ratio when used with a Sennheiser microphone.

Connection

The requirements for the voltage matching system employed demand a low impedance of the source compared to the load represented by the amplifier input. The impedance characteristic versus the frequency of the amplifier input as well as of the microphone thus do not influence the frequency response. The source impedance of the Sennheiser condenser microphones is only approximately 20 ohms and the amplifier input impedance can have any value as long as it is at least 200 ohms.

Sennheiser condenser microphones generate high audio voltages, approximately 25 dB above that of dynamic microphones. Accordingly, even very long connection cables may be used without the danger of noise pickup. Before entering the amplifier, the level may have to be attenuated in order to avoid overmodulation of the first stage.

Power Supplies

Sennheiser electronic introduced the audio wire powering system, sometimes called A-B powering. This has become a German engineering standard DIN 45 595 and is being used by the German Federal Radio and TV Networks. The dc current for the condenser microphone goes through the audio conductors, and regular microphone cables as for dynamic microphones (2 conductors plus shield) can be used. Compared to another recent powering system, the phantom circuit, our A-B powering is isolated from ground and cable shield. Interference voltages on the cable shield will not be introduced into the microphone circuit.

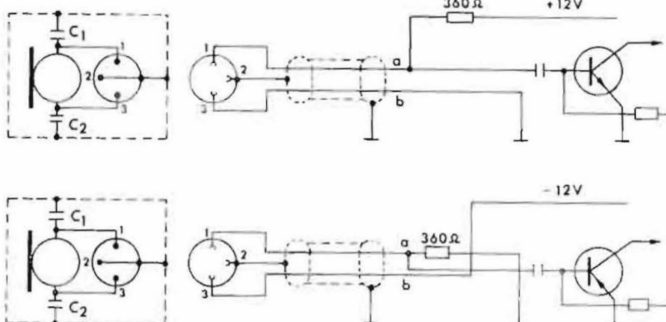
The simplest power supply is the battery adapter MZA 6-2 which can be inserted into the cable. Nine mercury cells HG 625 allow a continuous operation up to 60 hours.

For fixed installations, a dual ac line connected power supply Model MZN 5-1 is available.

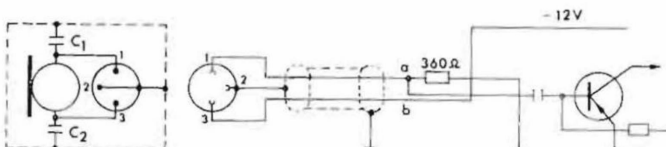
The microphones may also be powered directly from the amplifier, as it is done for instance in the Sennheiser mixer M 101, the Nagra IV tape recorder by Kudelski (with QPM-3-5) or the SP 7 tape recorder by Stellavox.

Unbalanced microphone inputs can also be accommodated as shown in the sketch. The diagram below shows the output and overload level versus the supply dc voltage.

In larger studio installations, a central dc-power supply may be advantageous. For each microphone channel, a switch is provided to disconnect the dc if dynamic microphones shall be used. There is no danger of damaging a dynamic microphone should



A-B powering system
for unbalanced inputs

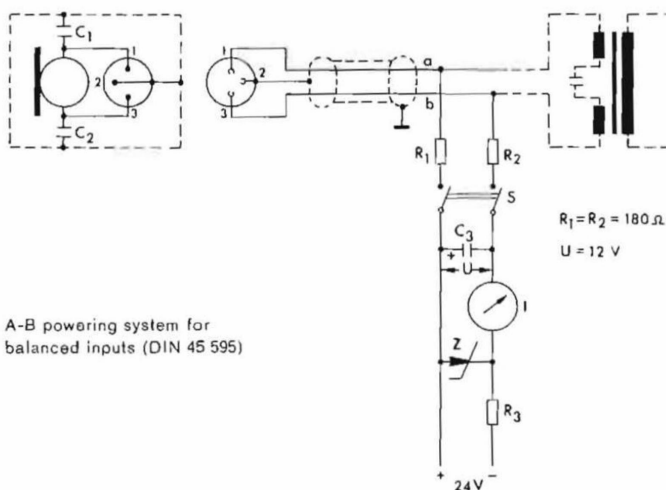
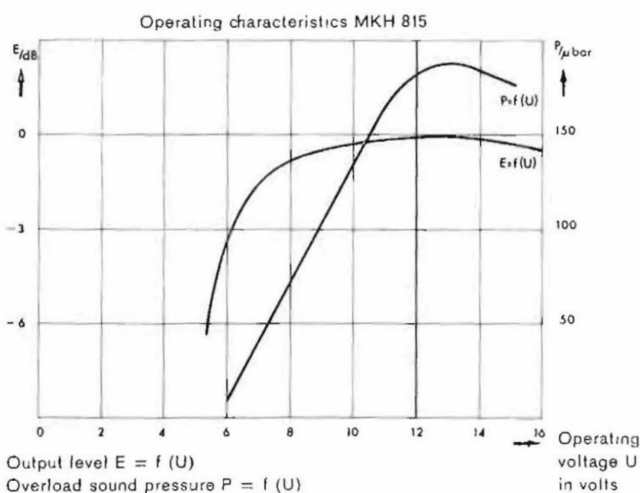


it be forgotten to switch off the dc. Small meters can be inserted into the circuit to indicate as to whether the circuit is closed and the correct microphone has been connected.

Another possibility is to install separate lines for dynamic and condenser microphones with transfer switches at the console.

Insensitivity to Interference

Since the condenser microphones have a high output level, typically 20 dB higher than a dynamic microphone, the cable is less susceptible to pick-up and interference. The microphone itself has a highly efficient radio frequency filter which has the secondary advantage that it provides a short circuit to radio frequency signals that might be picked up in a long microphone cable. The full range of RF condenser microphones are now fitted with silicon transistors for maximum long term reliability.



A-B powering system for
balanced inputs (DIN 45 595)

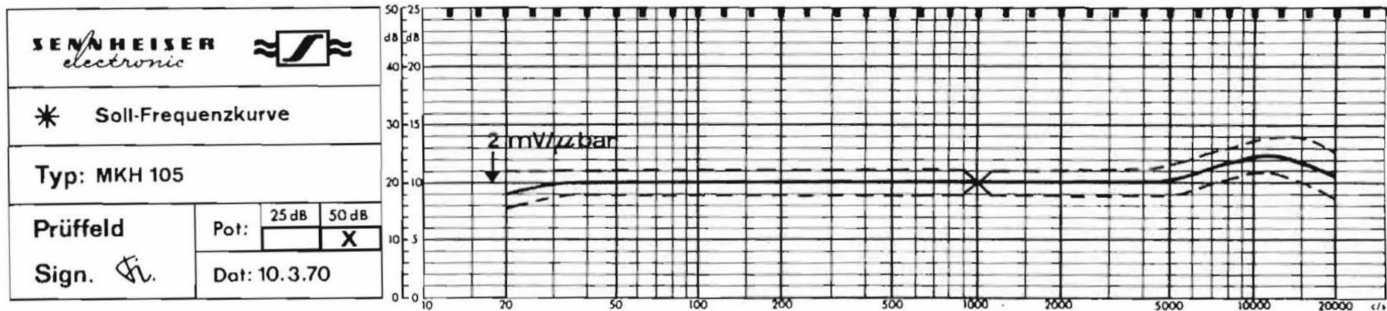
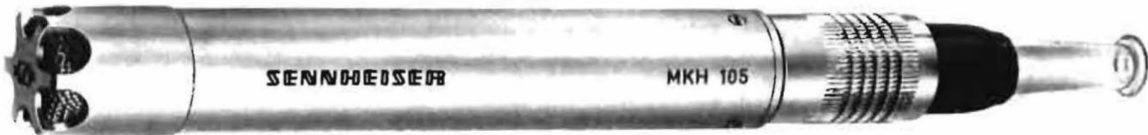
Transistorized Condenser Microphone MKH 105

The model MKH 105 is a pressure operated condenser microphone with omnidirectional characteristics. The microphone diaphragm is a gold plated hostaphan membrane. As shown below, the frequency response extends from 20 to 20,000 Hz and is free from peaks and dips.

The MKH 105 is remarkably insensitive to handling noise and is therefore suitable both for studio use and for location work where the highest possible quality is required. By virtue of the omnidirectional characteristic the MKH 105 has the lowest sensitivity to wind noise of all types of microphone.



Shmuel Rodensky is being interviewed with a MKH 105



Nominal frequency response curve (with tolerance limits) MKH 105
 Every MKH 105 is supplied with an individually plotted frequency response curve.

Technical Data

MKH 105



Acoustic mode of operation	Pressure receiver
Directional characteristic	Omnidirectional
Frequency range	20 to 20,000 Hz
Output level ref. 1 mW/10 dynes/cm ²	- 27 dbm
EIA Rating	- 121.5 db
Impedance	Approx. 10 ohms balanced, ungrounded
Minimum matching load	200 ohms
Weighted noise voltage (DIN 45 405)	Approx. 7 μvolts
Equivalent noise level	
DIN 5045-A-Filter	Approx. 19 dB
DIN 45 405	Approx. 25 dB
Total harmonic distortion at 100 μbar	≤ 5 %
Power supply voltage	10 volts ± 1 volt
Operating current	Approx. 5 ma
Temperature range	- 10 to + 70 ° C (14 ° to 158 ° F)
Dimensions	1/4 in. diameter, 5 in. long
Weight	3.2 oz.
Connector	Tuchel T 3262
Contact 1	audio, + 10 volts
Contact 2	audio, + 10 volts
Contact 3	audio, - 10 volts
Plug shell	shield

We reserve the right to alter the specifications especially with regards to technical improvements.

Transistorized Condenser Microphones

MKH 110 and MKH 110-1



Both microphones are specially designed for instrumentation purposes. Since the principle of operation of the Sennheiser condenser microphones allows the frequency response to extend down to zero Hz, the low frequency limit of response is set by the capsule design. In the MKH 110 the response extends down to one Hz and in the MKH 110-1 the response extends to 0.1 Hz. The other difference between the two microphone types relates to their sensitivity. The MKH 110 has a higher sensitivity, nominally 2 mV/μbar, whereas the MKH 110-1 has a relatively low sensitivity of 0.2 mV/μbar. The difference in sensitivity implies a similar difference in overload level. The MKH 110 will respond to a maximum level of 200 μbar, while the MKH 110-1 will give an undistorted response to sound levels as far as 5000 μbar.

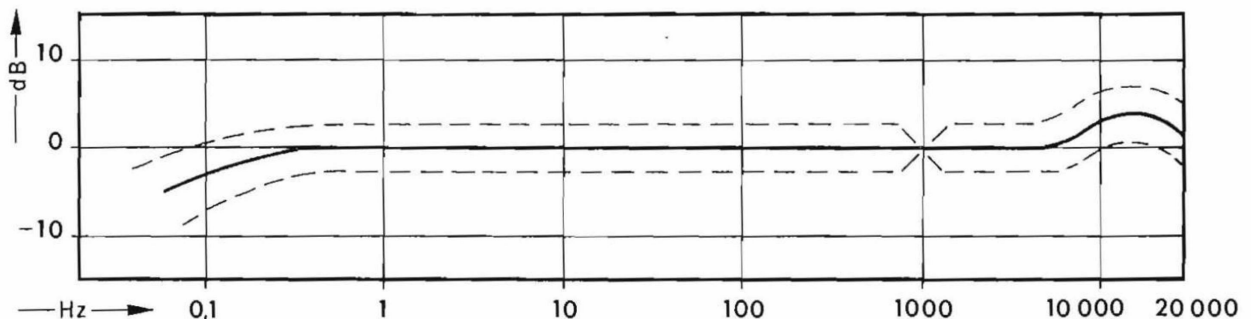
Both microphones are intended for military and research purposes and have been designed to

operate over an extremely wide temperature range. Silicon transistors are used throughout, and the capsule itself has been especially designed for operation under extreme temperatures.

In order that the frequency response not be limited by the small value of the coupling capacitor in the output circuit, the audio output on pin 1 of the microphone is connected directly to the output amplifier without a blocking capacitor. There is, therefore, a DC voltage of approximately 3 volts on this pin and a blocking capacitor must be fitted in the microphone amplifier.

Unlike the studio microphones the MKH 110 and 110-1 operate with a positive battery supply with respect to ground. See the diagram below.

$$C = \frac{2}{\omega (r + 90 \Omega)}$$



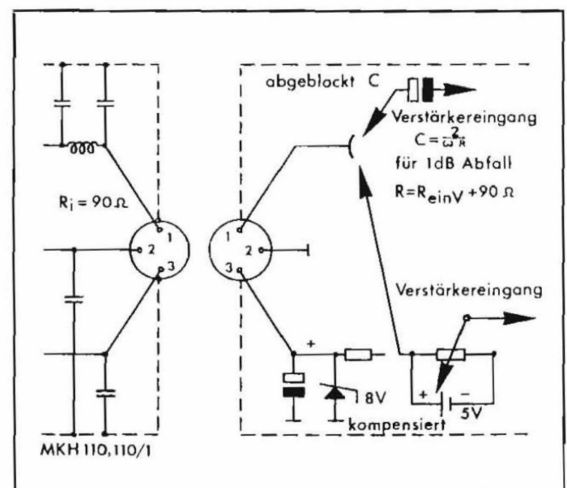
Nominal frequency response curve (with tolerance limits) MKH 110-1

Every MKH 110 is supplied with an individually plotted frequency response curve.

Technical Data

	MKH 110	MKH 110-1
Acoustical mode of operation	Pressure transducer	Pressure transducer
Directional characteristic	Omnidirectional	Omnidirectional
Frequency range	1.0 to 20,000 Hz	0.1 to 20,000 Hz
Sensitivity	2 mV/μbar ± 2 dB	0.2 mV/μbar ± 3 dB
Output impedance	Approx. 90 Ω	Approx. 90 Ω
Minimum load impedance required	Approx. 2000 Ω	Approx. 2000 Ω
Equivalent noise voltage (DIN 45405)	31 ± 3 dB	47 ± 3 dB
Signal to noise ratio ref. 1 N/m ²	63 dB	47 dB
Maximum sound level	200 μbar	5000 μbar
Supply voltage	8 V ± 1 V	8 V ± 1 V
Current consumption	Approx. 8 mA	Approx. 8 mA
Temperature range	-35 °C to +70 °C	-35 °C to +70 °C
Dimensions	20 mm φ x 126 mm	20 mm φ x 126 mm
Weight	Approx. 90 g	Approx. 90 g
Output plug	Tuchel T 3262	Tuchel T 3262
Connections	1... AF (+3 V) 2... 0 3... +8 V	1... AF (+3 V) 2... 0 3... +8 V

We reserve the right to alter the specifications especially with regards to technical improvements.



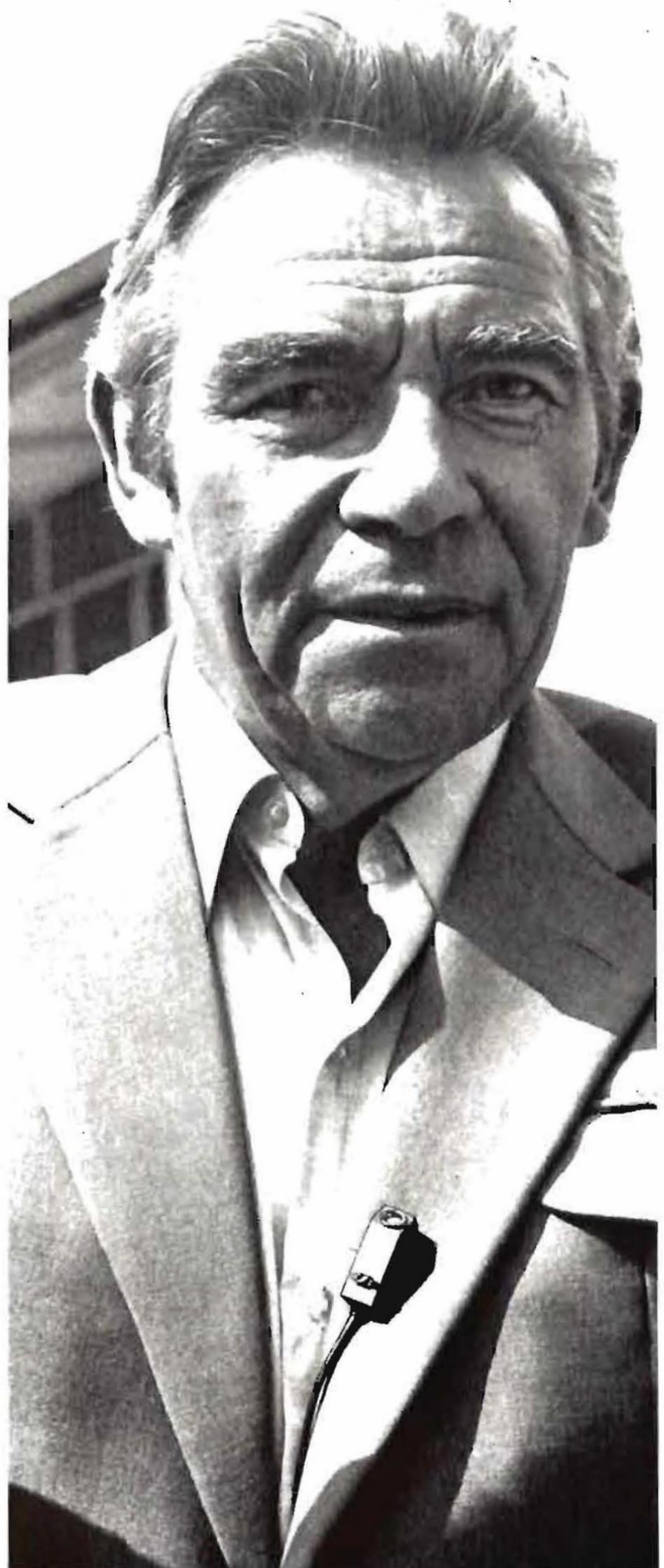
Condenser Lavalier Microphones MKH 124 and MKH 125



The continuing demand for a small high quality Lavalier microphone prompted Sennheiser electronic to design the MKH 124 and MKH 125. These microphones are an extension of the Sennheiser studio condenser microphone line. The electronic circuitry is basically similar, but in order to achieve the extremely small size of the complete microphone the membrane diameter is only 6 millimeters.

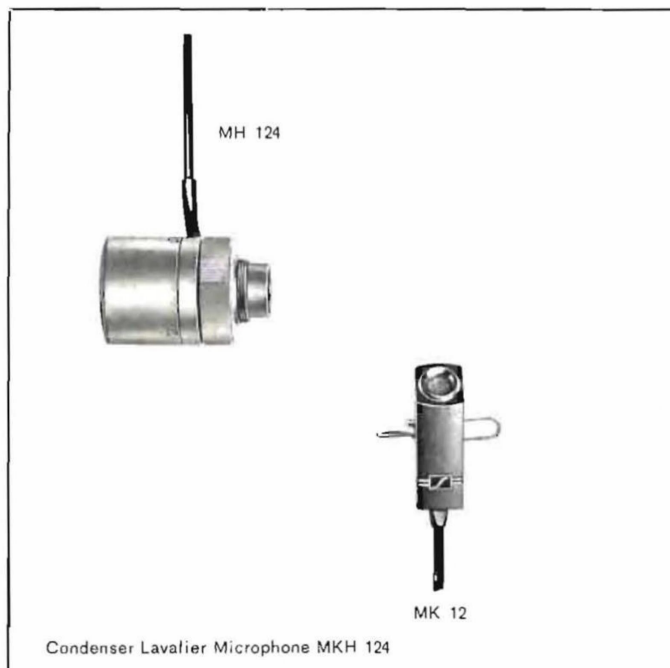
The smooth, resonance-free response of a condenser microphone provides a clear and natural sound which cannot be obtained with other microphones. The omnidirectional characteristics of the microphone make it largely insensitive to handling and rubbing noises. The frequency response rises smoothly and slowly above 1,000 Hz to compensate for the loss of the higher frequencies caused by the position of the microphone; for the same reason the low frequencies are attenuated. The complete microphone consists of two parts, the miniature microphone which can be fastened to clothes by a clip and the electronic unit which contains the radio frequency transistor system which can be connected directly to a wireless microphone transmitter and kept in the coat pocket.

The microphone part MK 12 is identical for the MKH 124 and MKH 125 microphone and can be purchased separately to be connected directly to the wireless transmitter SK 1007 which contains the radio frequency system for the condenser microphone. The MKH 124 is a complete microphone system with an unbalanced output which may be connected directly to other wireless microphone transmitters, e. g. the SK 1005 and the SK 1008. The MKH 125 which comprises the microphone part MK 12 and the electronic unit MH 125 has a balanced output with power supply requirements similar to the other Sennheiser series of "05" condenser microphones. The microphone is supplied with 5 meters of cable between the microphone and the electronic unit. The cable may be extended to a maximum of 20 meters without impairing the performance.

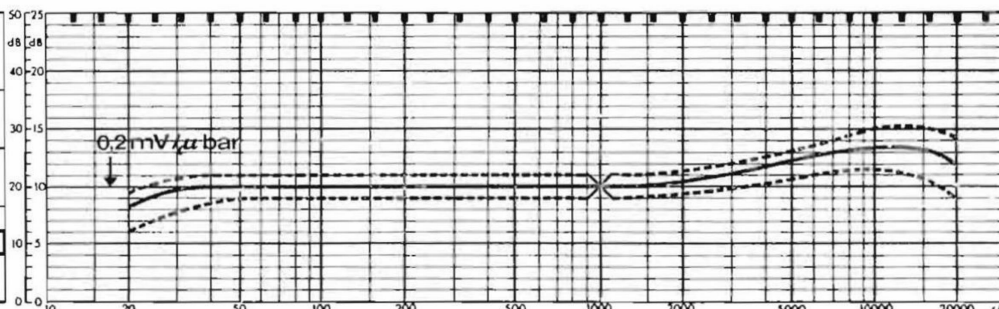


An MC uses the MK 12 as a wireless microphone

Technical Data



SENNHEISER <i>electronic</i>	
* Soll-Frequenzkurve	
Typ: MKH 124 und MKH 125	
Prüffeld	Pot: 25 dB 50 dB
Sign.	Dat: 10.3.70



Nominal frequency response curve (with tolerance limits) MKH 124 and MKH 125

Every MKH 124 and MKH 125 is supplied with an individually plotted frequency response curve

	MKH 124	MKH 125
Frequency range	20 to 20,000 Hz	20 to 20,000 Hz
Sensitivity	Approx. 0.32 mV/μbar	Approx. 2 mV/μbar
EIA rating	- 131.5 dB	- 121.5 dB
Impedance	Approx. 150 Ω	Approx. 10 Ω
Minimum matching load	Approx. 200 Ω	Approx. 200 Ω
Equivalent noise voltage (DIN 45 405)	Approx. 32 dB	Approx. 32 dB
Signal to noise ratio ref. 1 N/m ²	59 dB	59 dB
Supply voltage	8 V ± 1 V	10 V ± 1 V
Current consumption	Approx. 5 mA	Approx. 6 mA
Temperature range	- 10 to + 70 °C	- 10 to + 70 °C
Dimensions		
Microphone section	11.5 x 36 x 12 mm	11.5 x 36 x 12 mm
Electronic section	27 mm Φ, 41 mm long	19 mm Φ, 128 mm long
Weight of microphone	Approx. 3.2 oz.	Approx. 3.2 oz.
Output plugs		
Microphone to electronic section	Lemo F 00250/AG/3 and Lemo RC 00250/AG/3	Lemo F 00250/AG/3 and Lemo RA 00250
Electronic section to amplifier	Tuchel T 3400/1	Tuchel T 3262
Connections		
Microphone section	1 pole Lemo RF plug	1 pole Lemo RF plug
Electronic section	4 ... AF 1, 2, 5, ... 0 3 ... - 8 V	1 ... AF, + 10 V 2 case 3 ... AF, - 10 V

We reserve the right to alter the specifications especially with regards to technical improvements.

Transistor Condenser Microphone MKH 405



The condenser microphone MKH 405 is a pressure gradient transducer with a cardioid characteristic. The directionality is accurately maintained over the full frequency range which makes this microphone

particularly suitable for stereo recording, film and television use. The frequency response is extremely smooth and free from resonances between 40 and 20,000 Hz as shown on the response curve opposite.

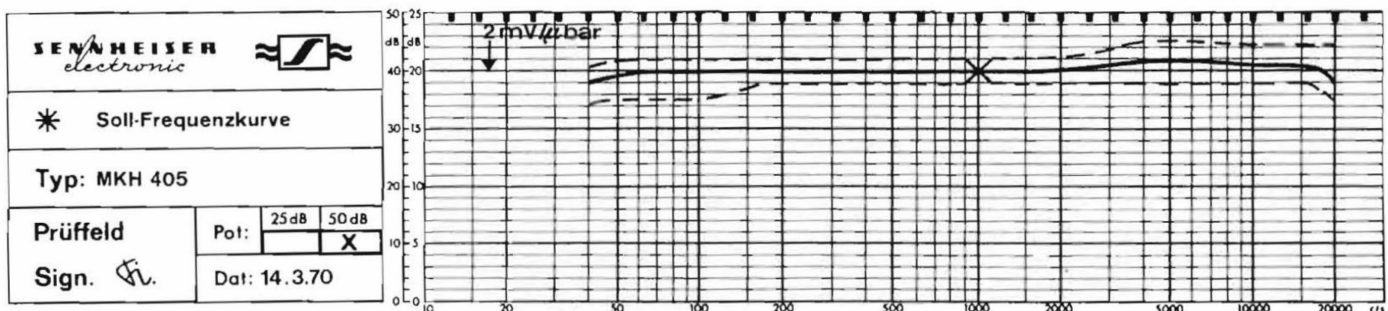
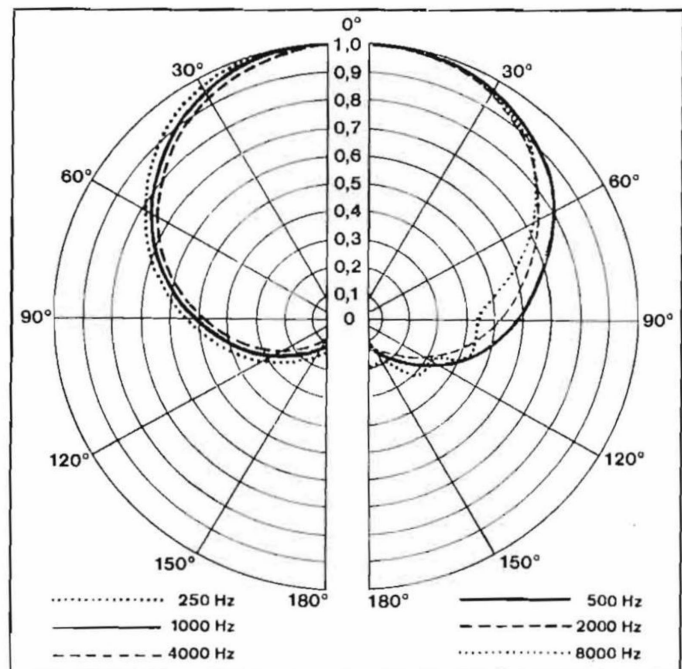


Christian Müller during a broadcast for the NDR.

Photo: H. E. Müller



Technical Data



Frequency response (with tolerance limits) MKH 405

Every MKH 405 is supplied with its individually plotted frequency response curve.

MKH 405

Acoustic mode of operation	pressure gradient receiver
Directional characteristic	cardioid
Frequency range	40 to 20,000 Hz
Output level ref. 1 mW/10 dynes/cm ²	- 27 dbm
EIA Rating	- 121.5 dB
Impedance	approx. 10 ohms
Minimum matching load	200 ohms
Weighted noise voltage (DIN 45 405)	approx. 7 μvolts
Equivalent noise level	
DIN 5045-A-Filter	approx. 19 dB
DIN 45 405	approx. 25 dB
Total harmonic distortion at 100 μbar	≤ 5 %
Power supply voltage	10 volts ± 1 volt
Operating current	approx. 5 ma
Temperature range	- 10 ° to + 70 ° C (14 ° to 158 ° F)
Dimensions	1/4 inch diameter, 5 3/16 inch long
Weight	3.5 oz.
Connector	Tuchel T 3262
Contact 1	audio, + 10 volts
Contact 2	shield
Contact 3	audio, - 10 volts
Plug shell	shield

We reserve the right to alter the specifications especially with regards to technical improvements.



Microphone Boom Arm MZS 211

The MZS 211 will fit on all Sennheiser and other stands fitted with a $\frac{3}{8}$ " thread. The boom arm is fully adjustable for length and angle, and is itself fitted with a $\frac{3}{8}$ " thread. Maximum extension 30".



Floor Stand Suspension SZS 1008

With this accessory the wireless microphone transmitter SK 1008 can be mounted on a floor- or desk stand. To be used together with thread adapter MZH 216.



Power Supply MZN 5-1

Power supply for microphones MKH 105, MKH 405, and MKH 805. Stabilized and filtered power for two microphones. Dimensions 100 x 170 x 55 mm.



MZV 125

60 Ω coaxial cable 15 ft long for the extension of MK 12 microphone to MH 124 or MH 125.



Transistor Pre-Amplifier KAT 15

The pre-amplifier KAT 15 enables Sennheiser condenser microphones MKH 105, MKH 405 and MKH 805 to be powered from the accessory socket of the Nagra III. Fitted with switchable bass cut and 10 dB attenuator.



Dual Input Microphone Pre-Amplifier KAT 25

A combined pre-amplifier and voltage stabilizer for use with Nagra III tape recorders. Two Sennheiser condenser microphones can be used simultaneously and powered from the Nagra III batteries. Channel 1 has a 20 dB attenuator and connects to the microphone input of the Nagra. Channel 2 has a 15 dB amplification and connects to the Nagra accessory socket. The bass cut switch operates on both channels simultaneously. For use with MKH 105, 405 and 805. Dimensions 170 x 60 x 28 mm.



Roll off Filter MZF 5

A roll off filter MZF 5 for use with microphones MKH 105, 405 and 805 may be fitted between the battery supply unit and the microphone input. Fitted with a Tuchel connector at either end. Attenuation at 100 Hz – 6 dB. Attenuation at 50 Hz $\geq$ 15 dB.



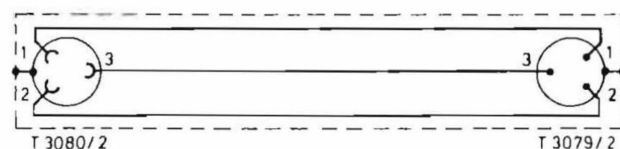
Battery Adapter MZA 6-2

A lightweight power supply for condenser microphones MKH 105, 125, 405 and 805. The battery adapter is fitted with a Tuchel connector at either end and may be fitted at any convenient place in the microphone cable. The battery pack will accept 9 mercury cells (Mallory RM 625). One set of 9 cells has a nominal life of 60 – 70 hours.



Power Supply Unit MZN 4-4

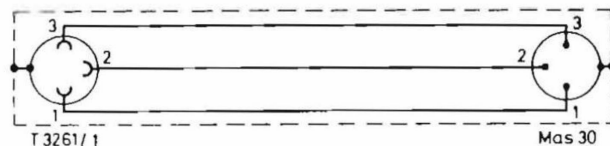
Power supply for microphones MKH 110 and 110-1. Stabilized and filtered for two microphones. The power supply can be connected at any convenient point along the microphone cable. Dimensions 100 x 170 x 55 mm.



Length: 5 m

Connecting Cable DAV 5

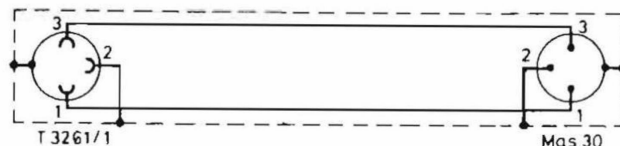
Fitted with a female Tuchel coupling T 3080/2 to connect to all dynamic microphones fitted with the male Tuchel connector T 3079/2. The other end of the 3 lead shielded cable is fitted with the male Tuchel T 3079/2 connector.



Length: 1.5 m

Connecting Cable DA 1 HL

Connects all dynamic microphones fitted with 3 prong plugs as per DIN 41524. The 3 lead shielded cable is fitted with the 3 prong coupling as per DIN 41524 (e. g. T 3261/1). The other end is fitted with a male connector (e. g. Mas 30).



Length: 7.5 m

Connecting Cable DA 7 N

Connects all low impedance dynamic microphones fitted with 3 prong connector as per DIN 41524. The 7.5 metre 2 lead shielded cable is fitted with a coupling (e.g. T 3261/1) and a male connector (e. g. Mas 30).

Dynamic Stereo Headphone HD 414

The HD 414 represents a complete revolution in design of headphones. The new electro-acoustic system does not require that the headphones should be sealed to the ear. In conventional headphones this ear-seal has always been necessary for obtaining an extended bass response. For long listening periods the air-tight seal can be uncomfortable and tiresome to the wearer.

The HD 414 uses a totally new principle. The light-weight porous foam ear cushions fit comfortably against the ears and allow the ear to "breathe". In this way a sound impression is received which resembles normal hearing. This combined with the wide, smooth frequency response makes reproduction even more realistic. A new measurement system has been developed for the measurement of sensitivity and frequency response which is related to normal hearing. To add to the outstanding frequency response the HD 414 headphones have the further features; extreme light weight, rugged removable sponge ear-pads, detachable ear-pieces, detachable cables.

The headset is supplied at a remarkably low price, complete with a set of multi adaptors to enable them to be connected to almost every amplifier and

tape recorder on the market without further conversion (US version supplied with standard stereo phone plug). Unlike other moving coil headphones, the HD 414 capsules have a usefully high impedance of 2 k Ω per capsule.

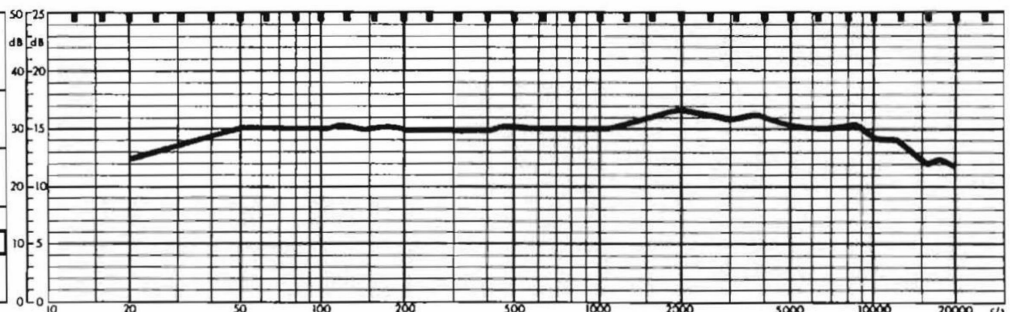
The HD 414 De Luxe is supplied with four pairs of individually coloured ear-pads so that each member of the family can readily identify his own pair of ear-pads.

Technical Data

Frequency range	20 to 20,000 Hz linear, in comparison with free field response
Impedance	2 k Ω approx. (each capsule)
Power consumption	1 mW per capsule (1.41 V into 2 k Ω) for an acoustic output of 102 dB (25 μ bar) at 1,000 Hz
Maximum audio output	122 dB (250 μ bar) for 1 % distortion (corresponding to an input of 240 mW: 22 V per capsule)
Sensitivity	$790 \frac{\mu\text{bar}}{\sqrt{V \cdot A}}$ at 1,000 Hz i. e. 17.7 $\frac{\mu\text{bar}}{V}$ at 2 k Ω
Weight	approx. 5 oz.

We reserve the right to alter the specifications especially with regards to technical improvements.

SENNHEISER <i>electronic</i>			
* Freifeldübertragungsmass			
Typ: HD 414			
Prüffeld Sign. 	Pot:	25dB	50dB
			X
Dat: 19.3.70			



To what extent this method has been successful can be seen from the frequency response curve and the oscillograms below. For the tone burst tests the loudspeaker was sunk into the ground in the open air with its diaphragm flush with the earth, radiating in an upwards direction. The measuring microphone was placed approximately two meters above the loudspeaker. The upper oscillograms show the bursts of tone applied to the input of the amplifier, the lower oscillograms show the amplified output of the microphone. The frequency response diagram shows also the harmonic distortion of the loudspeaker. The measurements were made using $\frac{1}{3}$ octave band filters. The sound pressure was $12 \mu\text{bar}$ at a distance of 1 meter from the loudspeaker.

The acoustical properties of the listening room and the sitting of the loudspeaker within the room affect

the reproduction of the low frequencies to a large degree. The output amplifier has, therefore, variable equalization which can be switched to suit the situation.

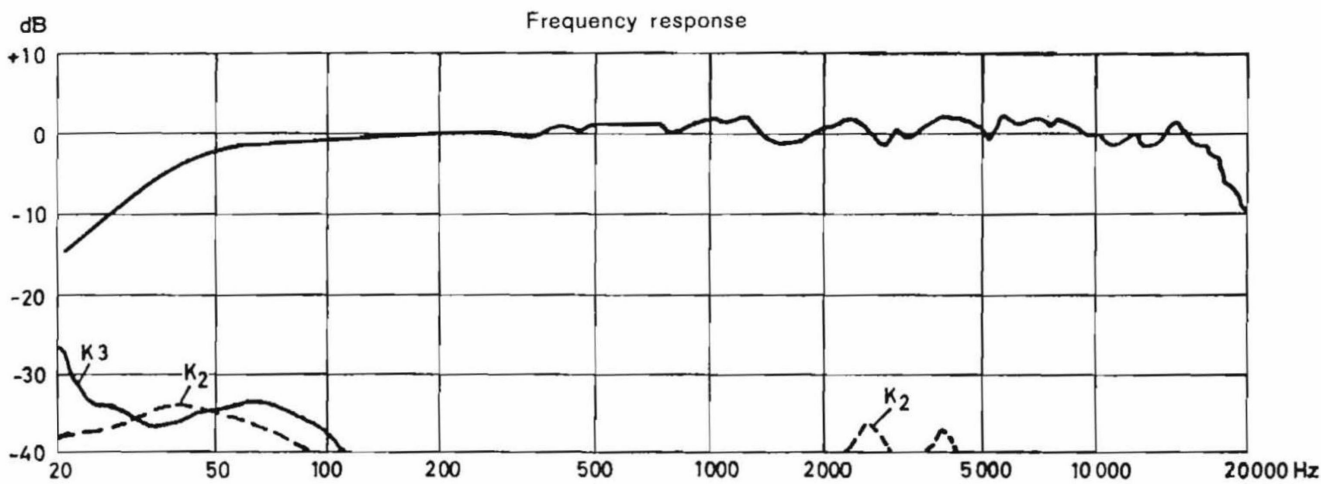
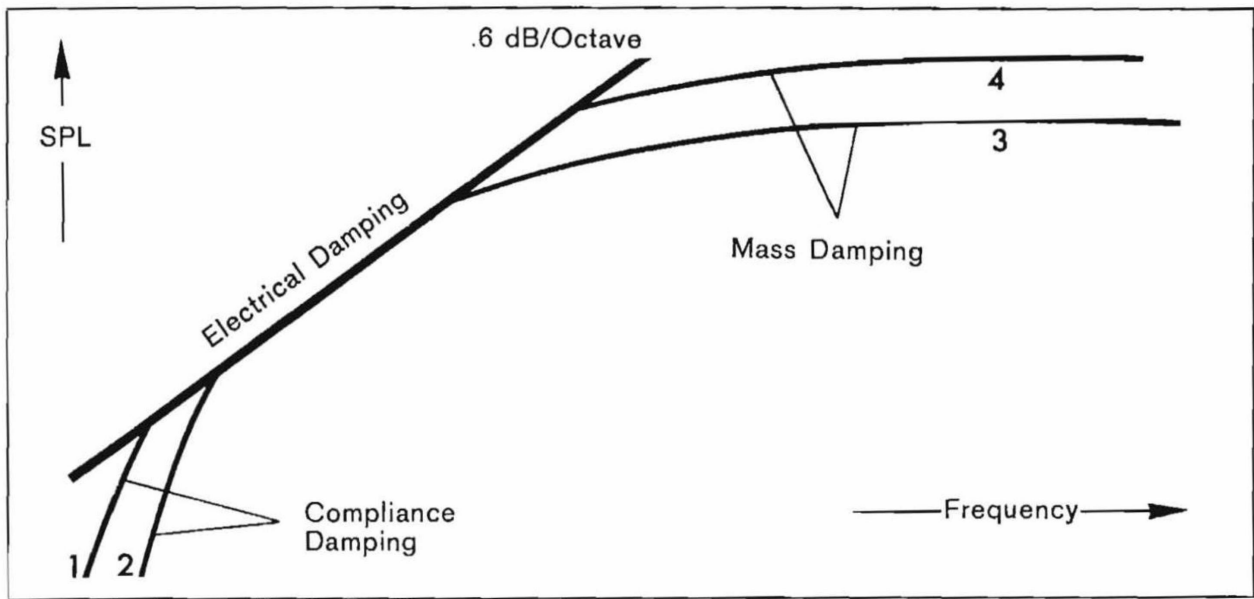
The built-in 30 W amplifier has a transformerless output stage with heavy negative feedback so that the distortion, even at 25 W, amounts to less than 0.2 %. All parts requiring to be cooled are mounted on a heavy, cast aluminium plate with cooling fins. By this means cooling slots are rendered totally unnecessary and the amplifier remains completely free of dust.

The power reproducer is offered in two different finishes. The VKL 303-1 has a walnut housing. The exterior of VKL 303-4 is covered in light grey Hornitex and is additionally provided with carrying handles and easy-run casters.

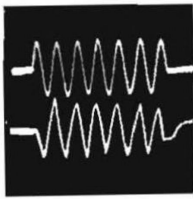
Dimensions	x x x x x x x x x x	10 x 16 x 26 inches
		without casters
Weight	x x x x x x x x x x	approx. 48 lbs.



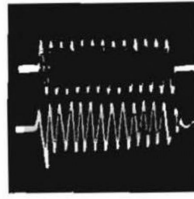
Technical Data



60 Hz



125 Hz



250 Hz



500 Hz

Transient response

VKL 303-1 and VKL 303-4

Input impedance	≥ 20 kΩ
Input sensitivity	+ 6 dB for full output variable
Output power continuous sine wave of the amplifier	approx. 30 W
Maximum pressure at 1,000 Hz at a distance of 1 m	approx. 100 μbar
Power consumption quiescent	7 W
Power consumption full output	70 W
Dimensions	24 x 40 x 65 cm without wheels
Weight	approx. 48 lbs.

We reserve the right to alter the specifications especially with regards to technical improvements.

Product Group 10

Audio Test Equipment

Sennheiser Audio Test Equipment is widely used throughout all the major acoustic laboratories in Europe. In some gramophone and tape recorder companies the Sennheiser range of test equipment has become a standard. Many service departments in radio and television stations also use this equipment for testing and alignment purposes.

The first reason for the standardisation on this test equipment is mainly economical. It is essential that the design engineer, service technician and inspection departments all operate with the same make and type of equipment in order to guarantee a constant quality throughout the whole production.

Sennheiser test equipment is manufactured to very fine tolerances, which is essential when two or three units of the same type are used in one laboratory. A piece of equipment manufactured and tested at

the factory on one set of test apparatus must meet the same stringent tolerances when tested by the user on his own audio test equipment.

The test equipment is neat in appearance and all controls and push buttons are fitted on the front panel. Each unit is so designed to enable vertical stacking of a few units. This gives the operator the total range of test equipment within easy reach, as illustrated below.

In this illustration the RV 55 Voltmeter, FO 55 Weighting Network and Filter unit, and KB 55 Harmonic Distortion Bridge are being used to check the quality of a tape recorder.

The following pages give detailed descriptions and technical data of all the Sennheiser Audio Test Equipment.



Vacuum Tube Voltmeter RV 56

The RV 56 has emerged out of the successful predecessor the model RV 54. The band width of amplifier and meter is now 10 Hz to 1 MHz with a maximum sensitivity of 1 mV for full scale deflection. The twelve overlapping ranges selected by push-buttons combined with a large meter ensure ease of operation and error-free readings.

The meter has two voltage scales 0 to 10 and 0 to 30 so that whichever sensitivity setting is in use, the meter reading need only be multiplied by a power of ten. Similarly the range selection switches are in steps of 10 dB so that measurement on the decibel scales is equally simple. For extra simplicity of observation, two dB scales are fitted. The dbm scale is related to a zero at 0.775 V (voltage equivalent of 1 mW in 600 Ω). The dbv scale relates to zero at 1 Volt.

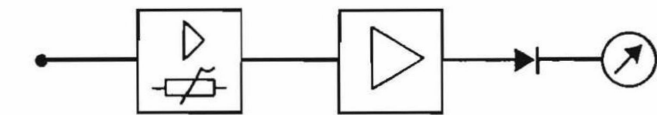
The input signal passes first through a high impedance voltage divider, a cathode follower amplifier and second voltage divider. In the succeeding 4 stage high stability amplifier the signal is amplified

to approximately 5 V. for full scale deflection of the meter. The rectifying system responds to the average value of the input signal. The meter is calibrated in RMS values for a sine-wave input.

The instrument is exceptionally stable due to the use of heavy negative feedback and an electronically stabilized power supply.

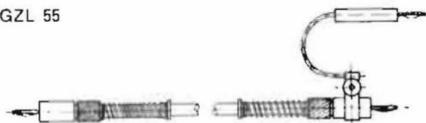
For recalibration purposes a zener-stabilized alternating voltage is applied to the amplifier input by a push-button.

The RV 56 meter may be used simultaneously as a measuring instrument and wide band amplifier. The output socket has a source impedance of 600 Ω, for connection to an oscilloscope or headphones.



Block Diagram

GZL 55



An interconnecting cable for all Sennheiser measuring equipment. The shielded cable is fitted with two 13 mm coaxial connectors.



Technical Data

Measuring range	0 ... 1/3/10/30/100/300 mV 1/3/10/30/100/300 V - 90 ... + 50 dBv - 90 ... + 52,5 dBm
Frequency range	10 Hz ... 1 MHz
Measurement error	20 Hz ... 200 kHz ≤ 3 % f. s. d. 10 Hz ... 1 MHz ≤ 5 % f. s. d.
Input impedance	1 MΩ 30 pF
Max. superimposed DC at the input	400 V
Output impedance	600 Ω nominal
Output EMF	0.3 V nominal
Power supply	50 ... 60 Hz 115, 220 V ± 10 % 40 VA nominal
Valves	4 x EF 80, 2 x EF 184, EL 86, 85 A 2
Dimensions	296 x 197 x 165 mm
Weight	approx. 14 lbs.

We reserve the right to alter the specifications especially with regards to technical improvements.

RV 56

Vacuum Tube Voltmeter RV 55

By virtue of its wide frequency range (10 Hz – 1 MHz), high sensitivity, choice of rectifying system and filter insertion facilities, the RV 55 is a uniquely versatile laboratory instrument.

By push-button selection the instrument will measure true RMS values, (for accurate indication of noise voltage, distortion factor or impulsive signals) or alternately the peak value of the applied signal to DIN standard 45 505.

The two coaxial jack sockets enable any required filters to be inserted in the measuring chain at a constant high voltage level and between fixed impedances.

The integration time of the meter circuit may be altered by push-button selection in both RMS and peak indicating mode.

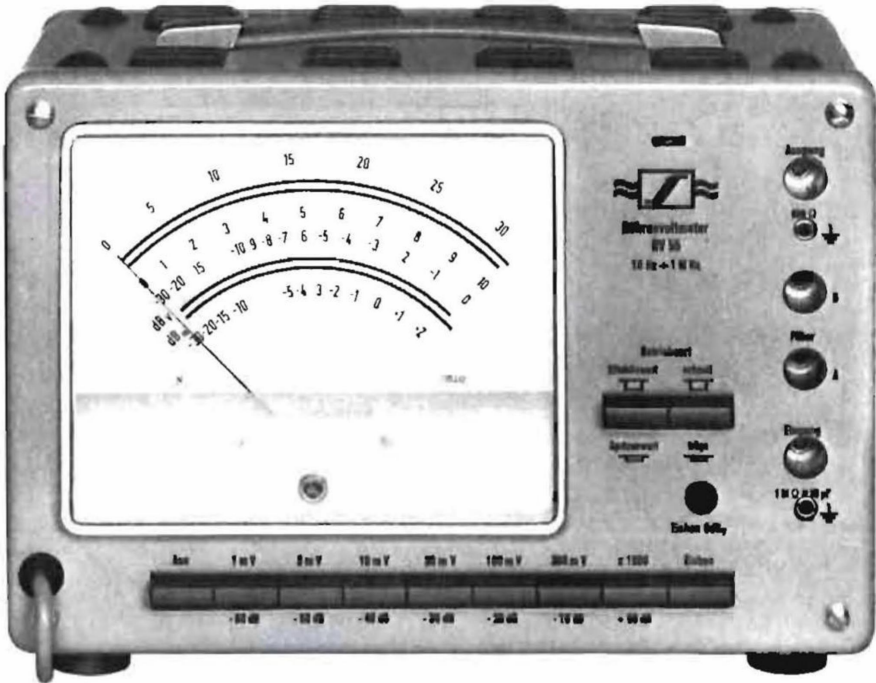
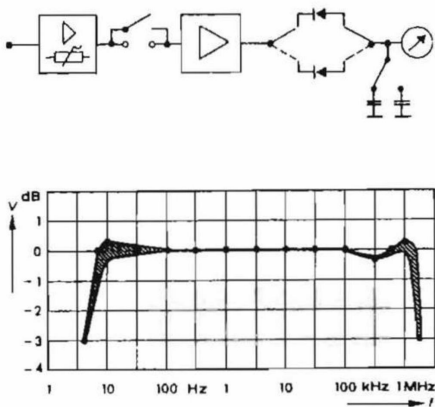
As with the RV 56 the selection of the twelve sensitivity ranges by push-button together with the large easily read meter scales allow comfortable operation and error free readings.

There are two voltage scales 0 to 30 and 0 to 10 and two dB scales. The dBm scale is related to a zero at 0.775 V (voltage equivalent of 1 mW in 600 Ω). The dBv scale relates to zero at 1 V.

The test signal is available at the output socket at 600 Ω impedance for connecting to an oscilloscope or our headphone HD 414.

For recalibration purposes a zener stabilised alternating voltage is applied to the amplifier input by a push-button (Eichen).

Block Diagram



Technical Data

RV 55

Measuring range	0 ... 1/3/10/30/100/300 mV, 1/3/10/30/100/300 V
Frequency range	- 90 ... + 50 dBv, - 90 ... + 52,5 dBm
Measurement error for sine waves peak or RMS measurement	10 Hz ... 1 MHz
	20 Hz ... 200 kHz $\leq 3\%$ f. s. d.
	10 Hz ... 1 MHz $\leq 5\%$ f. s. d.
	20 Hz ... 100 kHz $\leq 5\%$ f. s. d.
Measurement error for impulsive signals with peak to mean ratio up to 10 : 1, for both measuring methods	fast "Schnell": 500 msec approx.
Integration time for RMS measurement	slow "Träge": 1.5 sec approx.
	fast "Schnell": DIN 45 405
Integration time for peak measurements	slow "Träge": Electrical time constant increased by a factor of 5
Input impedance	1 M Ω 30 pF
Maximum superimposed DC at the input	400 V
Output impedance	600 Ω approx.
Output EMF	0.3 V approx.
Output impedance at the filter socket	600 Ω approx.
Output EMF at the filter socket	80 mV approx. for f. s. d.
Input impedance of the filter socket	1 M Ω approx.
Power supply	50 ... 60 Hz, 115, 220 V $\pm 10\%$
	40 VA approx.
Valves	2 x PCC 88, 2 x EF 80, 2 x EF 184, EL 86, 85 A 2
Dimensions	296 x 197 x 165 mm
Weight	approx. 14 lbs.

We reserve the right to alter the specifications especially with regards to technical improvements.

Harmonic Distortion Bridge

KB 55

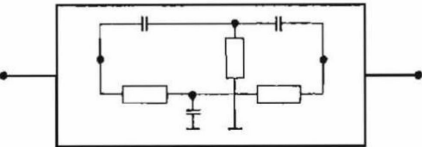
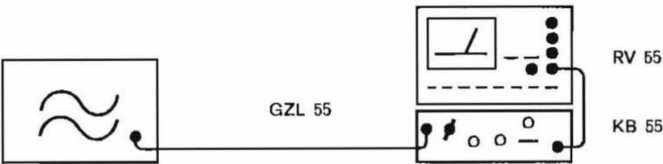
The Harmonic Distortion Bridge is a passive unit designed as an accessory for the sensitive vacuum tube voltmeter RV 55. The KB 55 can also be used with other true RMS reading vacuum tube millivolts meters having an input impedance greater than 1 MΩ and a sufficiently wide bandwidth.

The KB 55 is designed for fundamental frequencies of 40, 100, 1,000, 6,300 and 12,500 Hz to DIN standard.

The combination of RV 55 and KB 55 permits the measurement of distortion factors from 0.05 % to 30 %. The bridge may be tuned over a range of $\pm 10\%$ for frequencies which differ from the nominal values. Measurement error using a true RMS reading meter is better than 0.5 %.

The KB 55 Bridge uses a double T filter for the suppression of the fundamental frequency, followed by an equalizer. By this means the transfer coefficient is maintained correctly from the second to the tenth harmonic. For fundamental frequencies of 400 Hz and above a high-pass filter is incorporated to attenuate hum voltages.

Measurement of the Distortion of a Generator



Block Diagram



Technical Data

KB 55	
Measurement principle	Double T filter with harmonic equalization
Distortion factor measurement range	0.05 to 30 %
Ranges (using RV 55)	0 to 1, 0 to 3, 0 to 10, 0 to 30 %
Measurement accuracy	± 0.5 dB
Measuring frequencies (fundamental)	40/100/400/1000/6300/12500 Hz
Tolerance for each fundamental frequency	$\pm 10\%$
Suppression of the fundamental frequency	≥ 80 dB
Attenuation in the measuring range (second to tenth harmonic, 75 kHz max.)	20 dB ± 0.5 dB
Input	unbalanced
Impedance	≥ 10 kΩ
Minimum input voltage	1 V
Maximum input voltage	100 V
Output (to voltmeter)	voltage (mV) equals distortion (%)
Suitable voltmeter	RV 55
Case dimensions	296 x 94 x 165 mm
Weight	approx. 7 lbs.

We reserve the right to alter the specifications especially with regards to technical improvements.

Weighting Filter FO 55

There is a frequent requirement for the standardized measurement of noise voltages and loudness levels in the broadcast, television and recording industries, and by manufacturers of tape recorders, record players, amplifiers and microphones. Special filters are necessary for these measurements in order to weight each frequency component according to its nuisance value or effective loudness.

Standardized weighting curves have been produced by international agreement for the measurement of the nuisance value of noise voltages and the subjective loudness of sounds.

The weighting filter FO 55 is designed as an accessory for the vacuum tube voltmeter RV 55. It can however be used in conjunction with other vacuum tube voltmeters of the true RMS or peak reading type as appropriate, providing that their input impedance is sufficiently high.

The FO 55 contains a band pass filter (31.5 Hz to 20 kHz), a weighting filter for noise voltage measurements in broadband transmission systems (as specified by the CCITT) as well as a weighting filter for sound level measurements according to IEC 123 curve A. The band pass filter consists of a high-pass basic section with a cut off frequency of 31.5 Hz together with a steep cut high pass filter with a cut off frequency of 20 kHz.

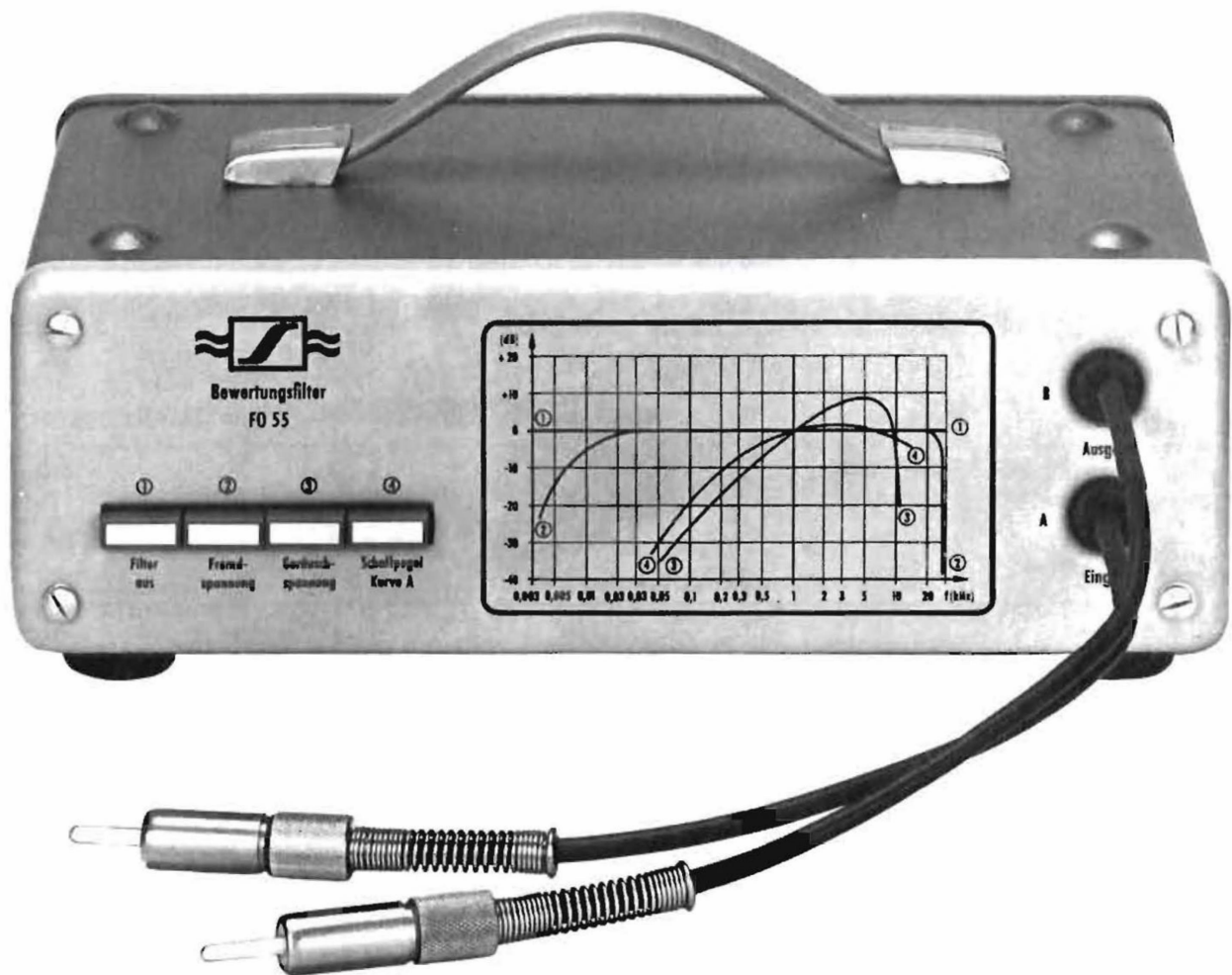
The weighting filter is most conveniently used with the voltmeter RV 55 which is fitted with sockets for the purpose. The filter is then connected between circuits of the correct impedance and at a suitable voltage level. To avoid high frequency measurement errors, it is not permissible to extend the leads of the FO 55. The cases of the instruments are designed for the stacking of one instrument on top of the other with complete stability, and with such an arrangement a neat and convenient set-up results. By inserting the plugs of the FO 55 into the appropriate sockets on the RV 55, the filter is automatically connected into the amplifier circuit of the voltmeter. By depressing key 1 of the FO 55, all filters are disconnected and the RV 55 has full bandwidth.

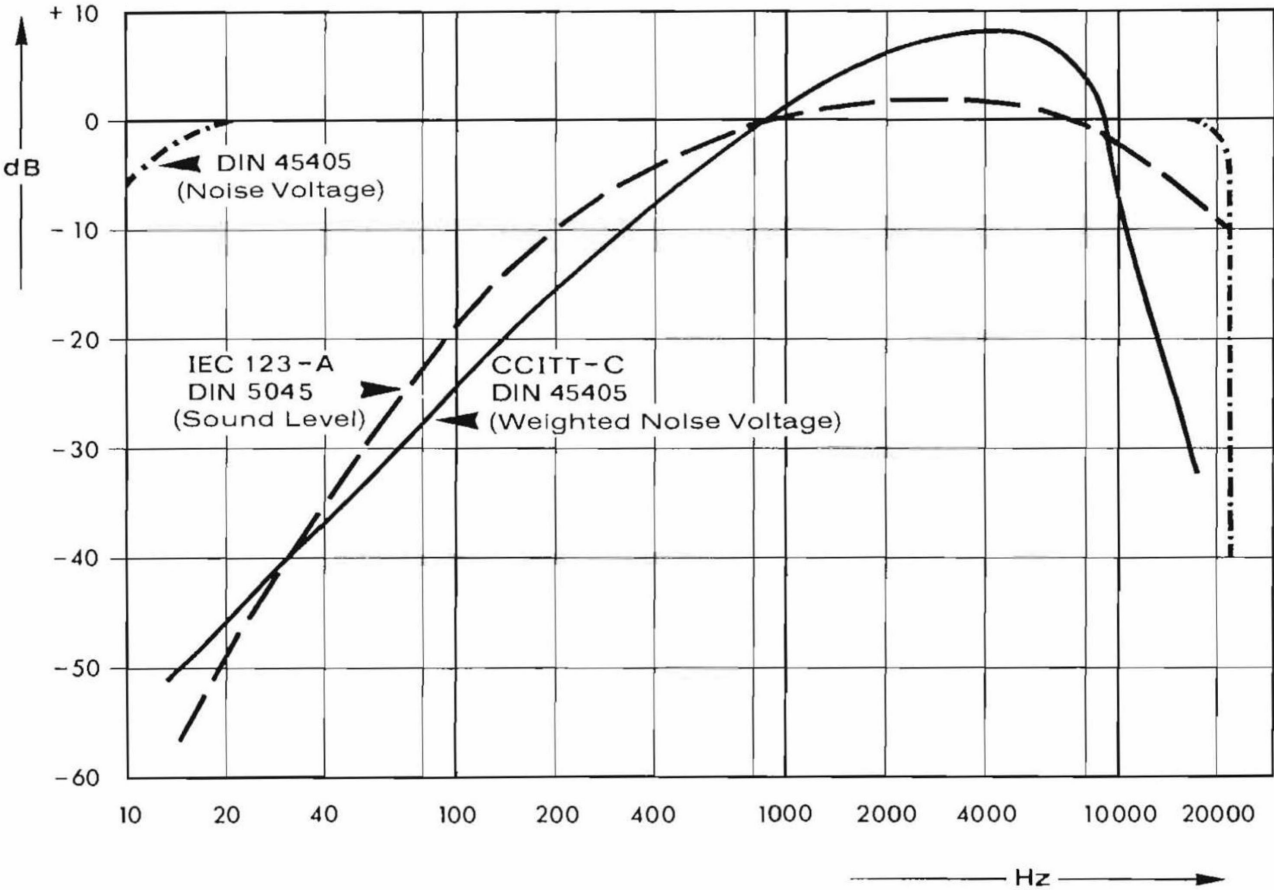
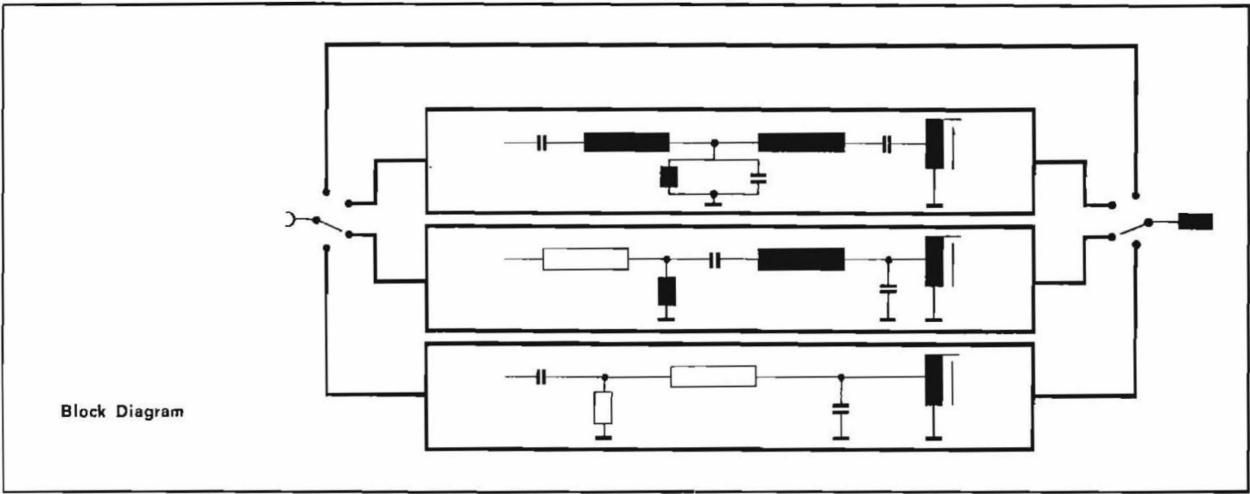
Key 2 inserts the band pass filter.

Key 3 of the FO 55 is required for measurements of noise voltage to CCITT - C standard and also for measurements to DIN 45405. For CCITT standard measurements the voltmeter should be set for RMS measurement, whereas DIN 45405 requires peak readings.

Key 4 is required for sound level measurements to IEC 123-A standard, the voltmeter being set to RMS reading.

In all filter positions the measurements can be read directly without conversion.





FO 55

Frequency response	see curve
Input	unbalanced
Input impedance	600 Ω
Maximum input voltage	1 V RMS
Voltage loss at 1 kHz	0 dB
Dimensions	296 x 94 x 165 mm
Weight	approx. 7 lbs.

We reserve the right to alter the specifications especially with regards to technical improvements.

Weighting Filter FO 2

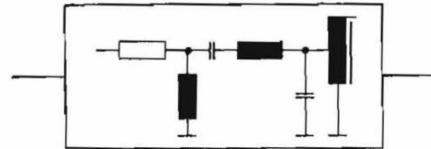
An aural sensitivity network or weighting filter is a necessary accessory in the measurement of noise voltages in tape recorders, amplifiers, microphones and other electroacoustic equipment.

The weighting filter FO 2 is designed for use with the vacuum tube voltmeter RV 55. Its transmission curve corresponds to DIN standard 45 405 and the CCITT curve for noise voltages in wideband transmission equipment.

The use of the filter is extremely simple since it merely requires to be plugged into the sockets on

the front panel of the RV 55. The filter is then automatically connected into the voltmeter circuit. The voltage loss in the filter network is arranged to be zero at 1 kHz so that noise levels can be read directly from the voltmeter without any conversion factor.

Block Diagram



Technical Data

FO 2

Input impedance	600 Ω
Insertion loss at 1 kHz	0 dB
Maximum input voltage	1.5 V RMS
Dimensions	190 x 130 x 90 mm
Weight	0.9 kg approx.

Balance to Unbalance Transformer RVZ 11

This transformer is designed to enable audio measurements to be made on circuits that are balanced to ground. It is designed in particular for use with the Sennheiser vacuum tube voltmeters into which it will connect directly.

The transformer input is via two 4 mm signal sockets and a 4 mm ground socket to accept "banana" plugs to DIN 41 628.



Technical Data

RVZ 11

Frequency range	30 Hz ... 15,000 Hz
Measurement error	50 Hz ... 10 kHz ± 0.1 dB 30 Hz ... 15 kHz ± 0.5 dB
Input voltage	up to 10 V RMS
Input impedance	$\geq 15,000 \Omega$
Rejection of unbalanced signal components	≥ 60 dB

We reserve the right to alter the specifications especially with regards to technical improvements.

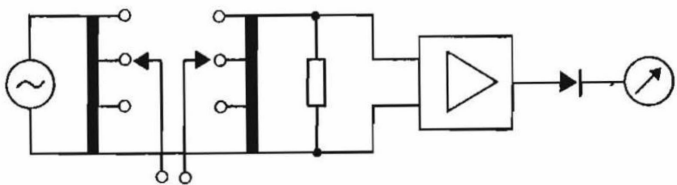
Impedance Tester ZP 2

The ZP 2 is designed for the quick and easy measurement of impedance. It has proven to be an invaluable aid in the design and construction of audio circuits.

Because of the minuteness of the signal that it applies to the object under test, the ZP 2 may be used for impedance measurements on microphones, magnetic recording heads, microphone transformers and any other object that would be damaged by the application of a large test signal. It can of course be used for the rapid measurement of all other components of resistance, capacitance and inductance. The ZP 2 operates with one of three audio test frequencies, selected by push-button and gives a direct reading of impedance in ohms on the clear-view meter. A change of frequency will show instantly whether the impedance is inductive or capacitive, and reference to the nomogram supplied with the instrument will give the actual value of the component under test.

The test frequencies of the ZP 2 are 250 Hz, 1 kHz and 4 kHz. The range of measurement is 1 Ω to 1 MΩ, divided into twelve push-button selected ranges. The large number of ranges available means that each range has a clear, open and easy-to-read scale.

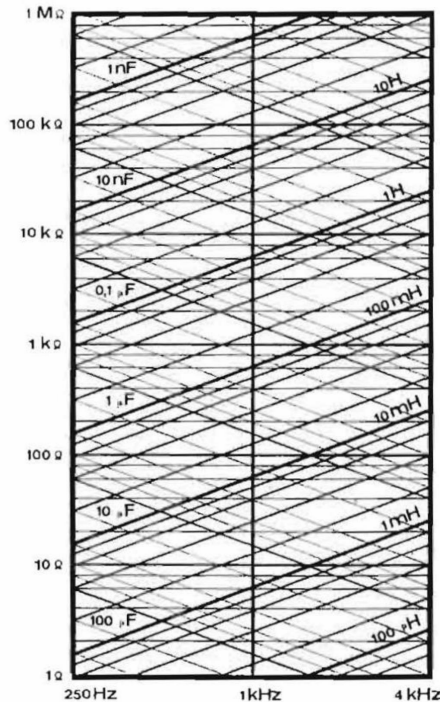
The internal transistorized oscillator applies to a small signal to the test object. The alternating current passing through the test object is amplified by the internal transistorized amplifier and applied to the meter. Range selection is achieved by the alteration of the turns ratio of two transformers and is therefore stable and not prone to ageing errors. Changes of sensitivity of the instrument with time can be checked by reference to one standard component and the sensitivity corrected if necessary by a front panel control. The single recalibration will hold good for all twelve ranges. Power is supplied from an internal 9 V dry battery, Eveready No. 276 or equivalent.



Block Diagram



The Nomogram shown below is printed in 3 colors and is included with each unit. Further copys are available on request.



Technical Data

Test frequencies	250 Hz ($\omega = 1,570$) 1 kHz ($\omega = 6,280$) 4 kHz ($\omega = 25,000$)
Range of measurement:	
Resistance and impedance	1 Ω to 1 MΩ
Capacitance	40 pF to 650 μF
Inductance	40 μH to 650 H
Measurement accuracy	± 5 % at 1 kHz ± 10 % at 250 Hz and 4 kHz
Power dissipated in test object	maximum 90 μVA
Power supply required	7 – 9 V
Transistors used	5 x AC 161, 1 x AC 117
Dimensions	220 x 155 x 115 mm
Weight	approx. 5.5 lbs.

We reserve the right to alter the specifications especially with regards to technical improvements.

Resistance Decades
RD 1 and RD 2

Decade resistance boxes are one of the most frequently used auxiliary instruments in any laboratory. The Sennheiser resistance decades are in use all over the world, under their own and other brand names, in laboratories, technical colleges and development departments.

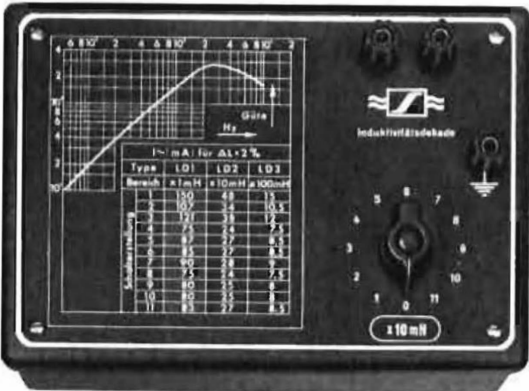
Capacitance Decade CD 1

The Sennheiser capacitance decade is as well known in the test laboratories of the world as their resistance decades. A capacitance decade is useful not only for bridge measurements and other laboratory measurements, but also as an accurate component substitution box for the development engineer. The effects of variation of component tolerances can be quickly determined by the substitution of a calibrated variable capacitance. The usefulness of this decade capacitance is increased by the clear labelling and compact size of the box.

Inductance Decades
LD 1, LD 2 and LD 3

The three Sennheiser inductance decades cover a range of values from 1 mH to 1 H and offer obvious uses to the development laboratory for the empirical design and testing of filters, equalizers, etc. The inductors are wound on large ferrite pot-cores with the resultant advantage of high Q values.

The Q value varies with frequency and is illustrated on the front panel of each decade. Also illustrated in table form is the value of alternating current in mA that will cause a 2% increase of inductance value for each step of the decade. For a further increase of current the inductance value rises a little further then falls. The cases of the three different decades are finished in different colours for quick identification.



Technical Data

Technical Data																	RD 1		RD 2	
Range																	0 to 11.1 kΩ	0 to 11.1 MΩ		
Steps																	10 Ω	10 kΩ		
Accuracy																	± 1 %	± 1 %		
Temperature coefficient																	- 2 %/100 ° C	≤ - 5 %/100 ° C		
Maximum dissipation																	1 Watt	1 Watt		
Dimensions																	190 x 130 x 60 mm	190 x 130 x 60 mm		
Weight																	1.8 lbs.	1.8 lbs.		
CD 1																				
Range																	0 ... 1.11μF			
Steps																	1 nF			
Accuracy																	2 %			
Loss factor:	1 nF to 100 nF																≤ 10 ⁻³			
	100 nF to 1 μF																≤ 10 ⁻²			
Applied voltage																	400 V DC max.			
Dimensions																	190 x 130 x 90 mm			
Weight																	1.9 lbs.			
																	LD 1	LD 2	LD 3	
Range																	0 - 11 mH	0 - 110 mH	0 - 1.1 H	
Steps																	1 mH	10 mH	100 mH	
Accuracy (at temperatures between 15 ° and 40 ° C)																	± 2 %	± 2 %	± 2 %	
Capacities C ₁ , C ₂ , C ₃																	200 pF max.	200 pF max.	200 pF max.	
Weight																	1.25 kg approx.	1.25 kg approx.	1.25 kg approx.	
Dimensions																	190x130x90 mm	190x130x90 mm	190x130x90 mm	
Case colour																	grey	red	green	

We reserve the right to alter the specifications especially with regards to technical improvements.

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Norsk Musikk Instrument Co.
A/S,
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439 - 8379

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Sennheiser electronic Corp.,
(N. Y.),
500, Fifth Avenue - Suite 5422,
New York, N. Y. - 10036,
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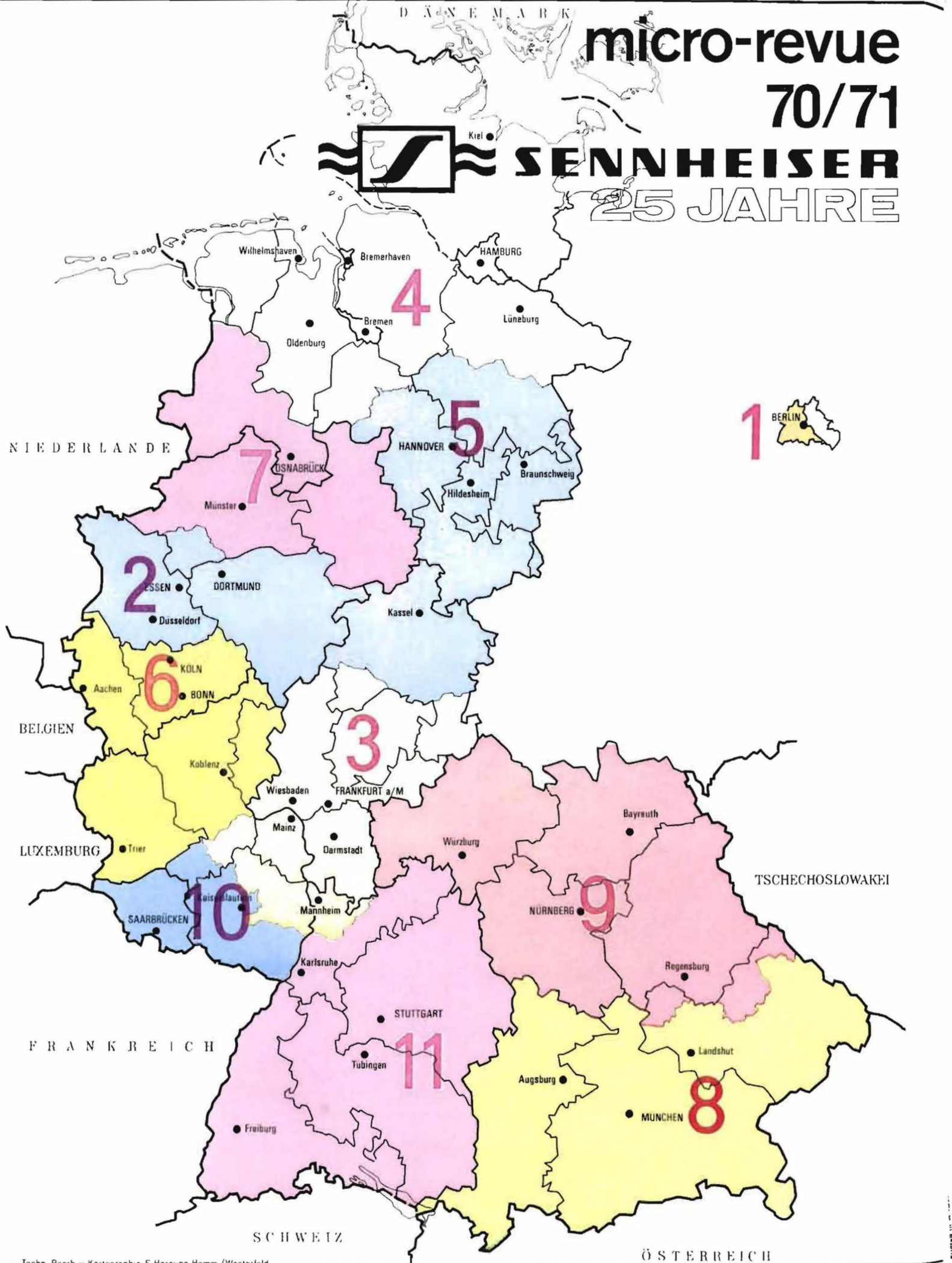


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