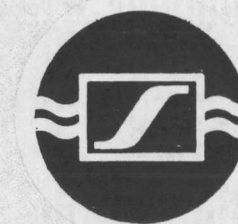
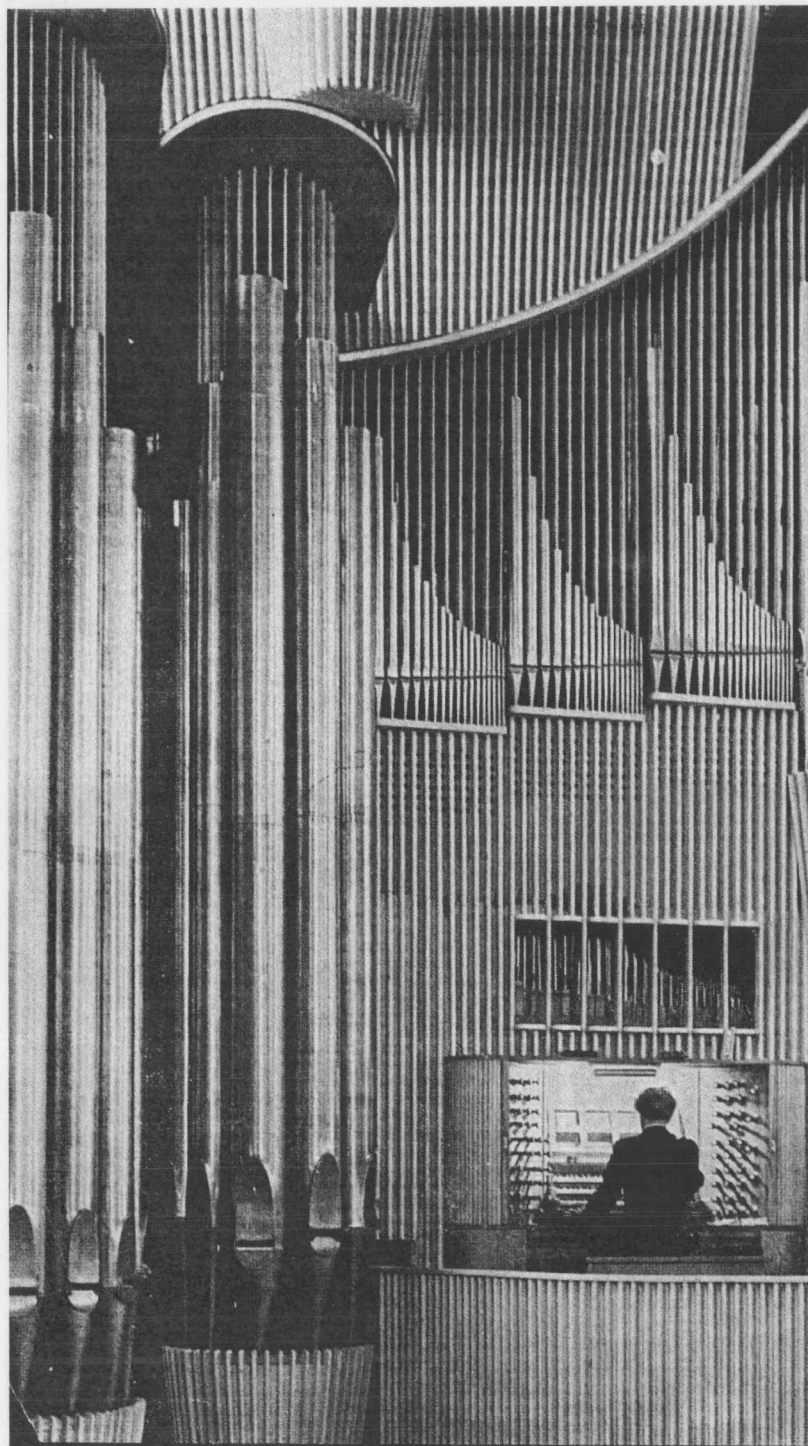


CONDENSER MICROPHONES WITH INTEGRAL TRANSISTORIZED RF CIRCUITRY



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2009-03-04



CONDENSER MICROPHONES WITH INTEGRAL TRANSISTORIZED RF CIRCUITRY

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1. INTRODUCTION

SENNHEISER RF condenser microphones are widely used throughout the broadcast and recording industries, and have found many outstanding commercial and research applications as well. Advanced audio amateurs with most exacting requirements in as far as overall performance is concerned, have also added these microphones to their installations. What are the facts behind this wide acceptance? To fully understand, let us first consider

CONVENTIONAL (AUDIO-FREQUENCY) CONDENSER MICROPHONES

The small dimensions and excellent electro-acoustic design of the transducing element, which consists of an extremely light diaphragm, yield an improved directional characteristic, which is independent of frequency. This factor, in conjunction with their excellent frequency response, results in a definite superiority over other microphone types.

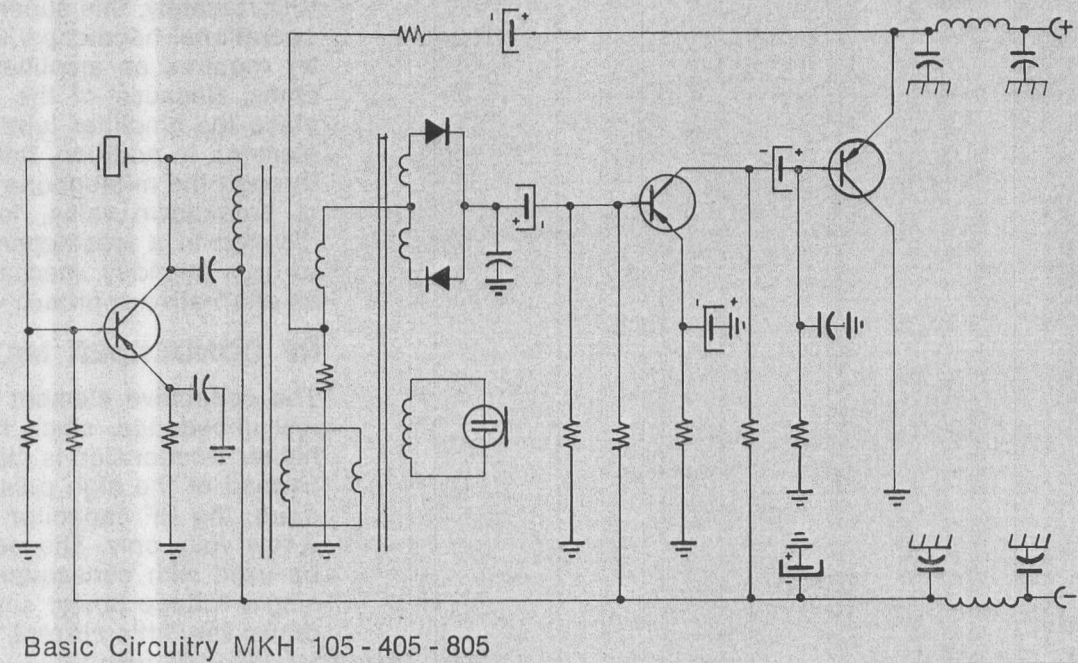
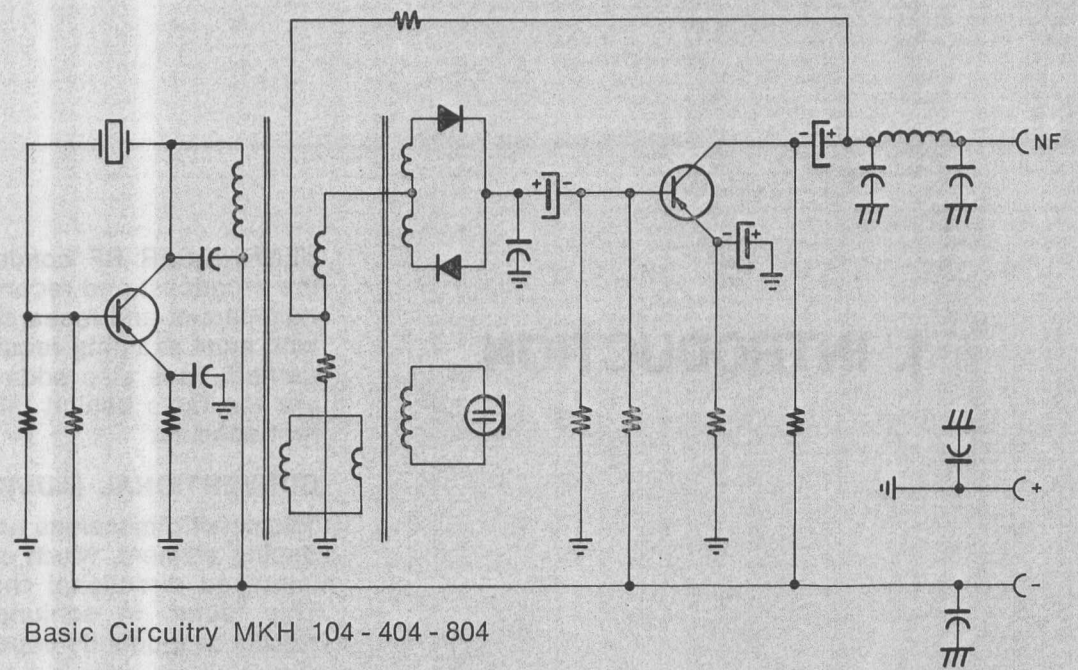
Unfortunately, this superior performance was previously offset by certain operational handicaps. Conventional AF condenser microphones' circuitry required an amplifier with an input impedance exceeding 100 megohms. Because of the high impedance involved, it was necessary to place the amplifier tube in extremely close proximity to the transducing element. In addition, both filament and B+ voltages had to be supplied through the microphone cable, as well as a polarizing voltage, just short of breakdown value, for the condenser element itself. These factors resulted in a less-dependable microphone with increased susceptibility to high humidity, mechanical shock, etc. It was therefore apparent that an alternative approach was required, such as the

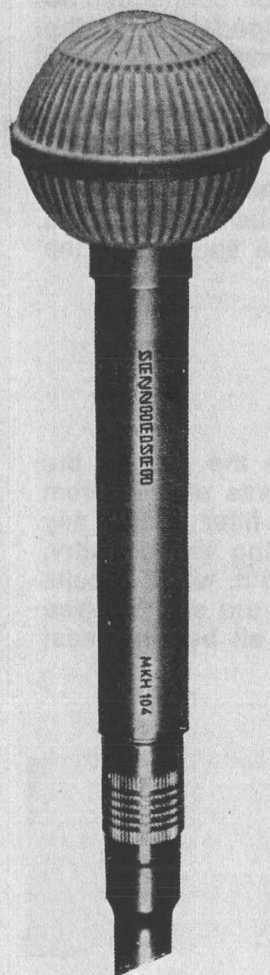
RF CONDENSER MICROPHONE

The capacitive element used with RF circuitry, unlike the above, has a low impedance, since the effect of a small change in capacitance at higher frequencies is markedly greater than at audio frequencies or DC. Instead of the high polarizing voltage which AF condenser elements require, the RF capacitor is subjected to an RF voltage in the vicinity of a few volts only. The need for a tube is eliminated and transistors can be used with consequent savings in space and power required. Only a single-voltage power supply is needed with this type of circuitry, which draws very little current.

In addition, RF condenser microphones are impervious to air-pressure shock waves, as well as humidity, mechanical vibration and electrical or magnetic fields, since the transducer is not operating in a critical balance between maximum capacity and arc-over.

Let us examine some essential points of RF condenser microphones.





Microphone MKH 104
with windscreen Model
MZW 104

2. CIRCUIT THEORY

In order to obtain a good signal-to-noise ratio, most RF transistor condenser microphones employ special types of bridge circuitry, which achieve a measure of compensation for the noise produced by the RF oscillator. However, the effectiveness of such compensation is somewhat limited, since it is dependent upon numerous factors, such as temperature, operating voltage, component aging, etc. This combination of many factors makes reliable, long-term compensation difficult to obtain, despite the most meticulous care in design and production. This problem is the reason for

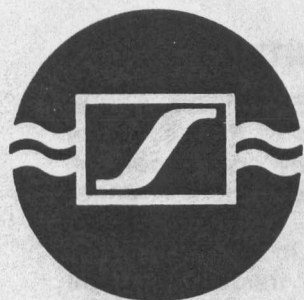
SENNHEISER'S CRYSTAL-CONTROLLED CIRCUITRY

In order to eliminate RF oscillator noise, SENNHEISER utilizes crystal control. Noise in an oscillator is inversely proportional to the 'Q' of the circuitry. Because of the higher stability ('Q') offered by crystal control, additional compensation of the type described above becomes unnecessary, thus accounting for the consistently lower noise of SENNHEISER microphones under all operating conditions. In fact, the noise output of the microphone circuitry is so low that the theoretical noise limit is approached. This fact can be substantiated by observing the microphone's noise output in free air, and then placing it in a vacuum. The low initial noise level will be reduced even more due to the fact that microphone noise is mainly caused by random motion of air molecules, rather than by the circuit or transducing element.

Now let us turn to the microphones'

SELF-CONTAINED AUDIO AMPLIFIER

As the two schematics show, SENNHEISER condenser microphones also contain single- or double-stage audio amplifiers. The amplification — only about 12 db — is kept extremely constant through the use of large amounts of inverse feedback, which yields additional advantages. These



audio amplifiers are carefully matched to the RF oscillator to reduce noise. They also provide enough gain to ensure that the internal noise of any mixing amplifier to which the unit is connected will not enter significantly into the over-all noise figure of the system.

Because the two-stage amplifier is also an impedance transformer, models MKH 105, 405 and 805, which are designed for connection to balanced circuitry, have an extremely low output impedance, in the neighborhood of 10 ohms. When used with properly matched circuitry (i. e. with amplifiers having a 150 ohm minimum input impedance) this low output impedance permits the use of extremely long cables without degraded performance or significant noise. *

In many cases the amplifier also produces an improvement in frequency response, and the suppression of low-frequency noise, such as the sound of steps, blasting from wind, or extreme proximity of a speaker to the microphone.

Another factor in the elimination of noise is the

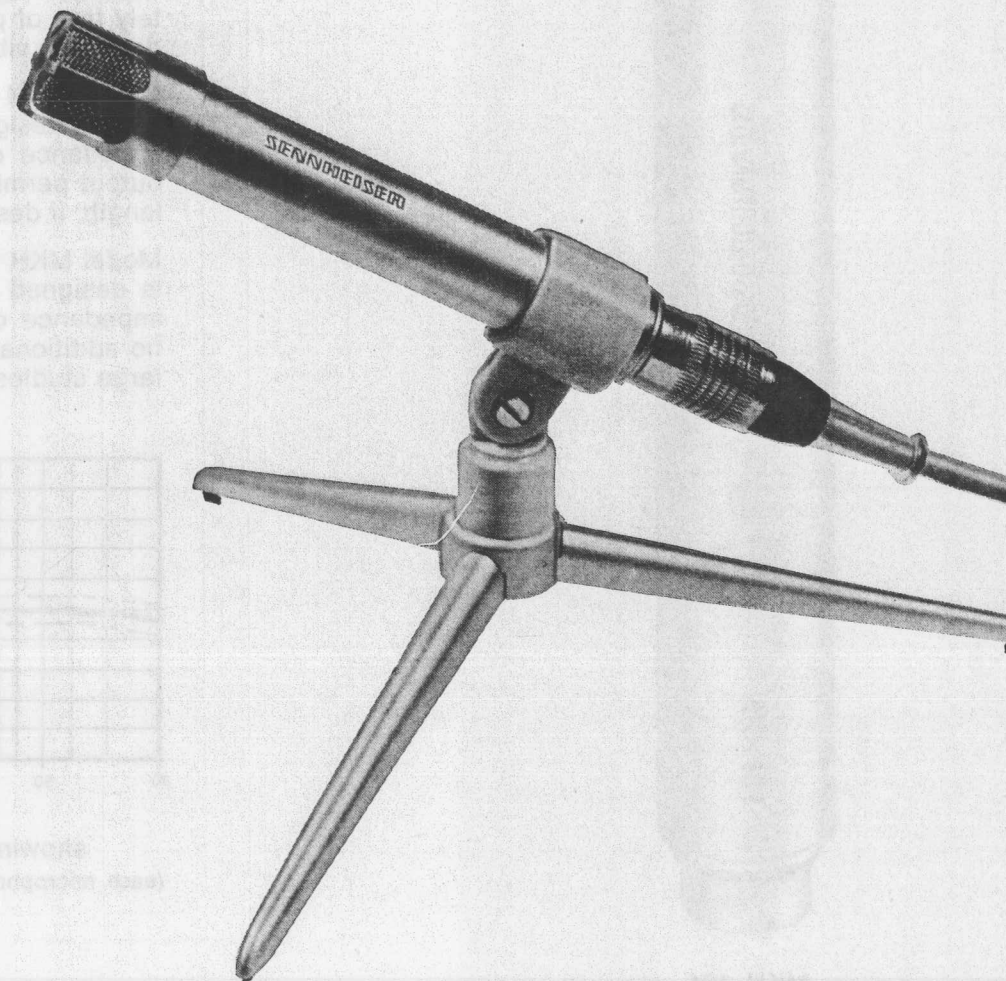
RF FILTER

Before the audio output of the amplifier is applied to the pins of the connector, it passes through an RF filter, which prevents any RF from leaving the microphone. Even more importantly, this filter shorts any incoming RF to ground, preventing noise from entering the circuitry. Because of this (as well as the microphones' high output, which results in an excellent signal-to-noise ratio), the microphones are so noise-free that double-shielded cable can be dispensed with in all but the most unusual of situations.

* see section entitled Connection and Power Supply.

A MICROPHONE FOR EVERY REQUIREMENT

Individual SENNHEISER RF condenser microphones are described in detail on the following pages, accompanied by full specifications. You will note that there are two types in each category. These differ mainly in their method of power supply, which is discussed in this brochure.





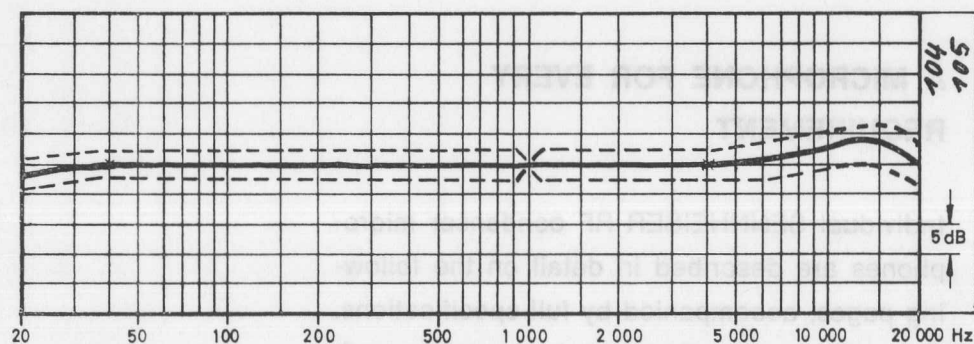
MKH 104

3. MODELS MKH 104 AND MKH 105 OMNIDIRECTIONAL CONDENSER MICROPHONES WITH TRANSISTORIZED RF CIRCUITRY

Models MKH 104 and 105 are high-quality condenser pressure-transducers, with spherical directional characteristics. The microphones' frequency range is extremely wide, while their response curve is completely free of peaks and dips. Especially notable is the microphones' freedom from vibrational pickup.

Model MKH 104 has an output impedance of approximately 100 ohms, and is designed to be connected to circuitry having a minimum input impedance of 2000 ohms. The microphone's low impedance and high output permit connection to unbalanced circuitry with cables of extreme length, if desired.

Model MKH 105 has an output impedance of approximately 10 ohms, and is designed for connection to balanced circuitry with a minimum input impedance of 200 ohms. Power is duplexed into the audio cable, and no additional conductor is required. This model is designed primarily for large studios and other installations with master power supplies.



Nominal Response Curve of MKH 104 and 105 (cps)
showing maximum permissible deviation from nominal values.
(each microphone is supplied with its individually plotted frequency response curve)

TECHNICAL DATA

	MKH 104	MKH 105
Acoustic mode of operation	pressure receiver	pressure receiver
Directional characteristic	omnidirectional	omnidirectional
Frequency range	20 to 20,000 cps	20 to 20,000 cps
Output level ref. 1 mW/10 dynes/cm ²	- 37 dbm	- 27 dbm
EIA Rating	- 131.5 db	- 121.5 db
Impedance	approx. 100 ohms unbalanced, ungrounded	approx. 10 ohms balanced, ungrounded
Minimum matching load	2000 ohms	200 ohms
Unweighted noise voltage	approx. 4 μ volts	approx. 4 μ volts
Weighted noise voltage (DIN 45405)	approx. 7 μ volts	approx. 7 μ volts
Equivalent noise level DIN 5045-A-Filter DIN 45405	approx. 19 db approx. 25 db	approx. 19 db approx. 25 db
Total harmonic distortion at 100 μ bar	< .5 %	< .5 %
Power supply voltage	8 volts \pm 1 volt	10 volts \pm 1 volt
Operating current	approx. 5 ma	approx. 5 ma
Temperature range	- 10 to + 70° C (14° to 158° F)	- 10 to + 70° C (14° to 158° F)
Dimensions	3/4 in. diameter 5 in. long	3/4 in. diameter 5 in. long
Weight	3.2 oz.	3.2 oz.
Connector	Tuchel T 3262	Tuchel T 3262
Contact 1	audio output	audio, + 10 volts
Contact 2	common audio and + voltage supply	
Contact 3	- 8 volts	audio, - 10 volts
Plug shell	shield	shield

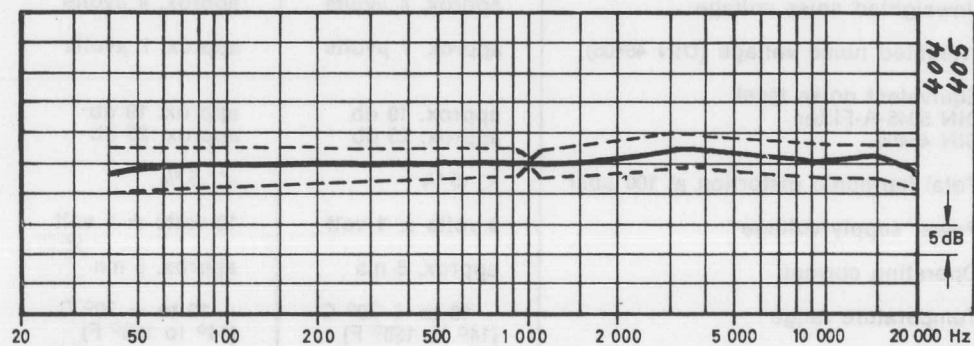


4. MODELS MKH 404 AND MKH 405 DIRECTIONAL CONDENSER MICROPHONES WITH TRANSISTORIZED RF CIRCUITRY

Models MKH 404 and 405 are high-quality transducers which respond to pressure gradients, and possess cardioid directional characteristics. Their response curve is remarkably free of peaks and dips, and their directional characteristics are very precise and independent of frequency.

Like the model MKH 104, Model MKH 404 has an output impedance of approximately 100 ohms, and is designed to be connected to circuitry having a minimum input impedance of 2000 ohms. The microphone's low impedance and high output permit connection to unbalanced circuitry with cables of extreme length, if desired.

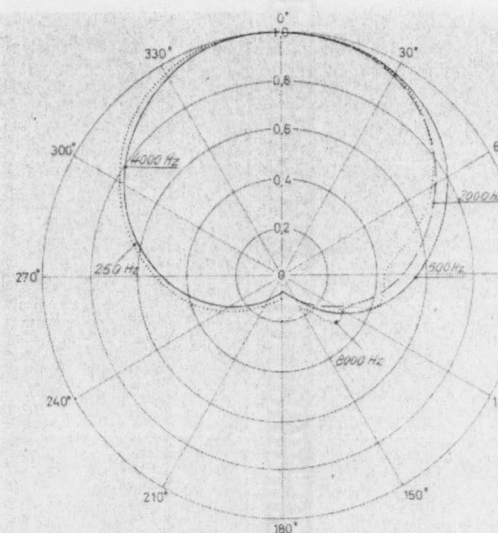
Similarly, Model MKH 405 has an output impedance of approximately 10 ohms, and is designed for connection to balanced circuitry with a minimum input impedance of 200 ohms. Power is duplexed into the audio cable, and no additional conductor is required. This model is designed primarily for large studios and other installations with master power supplies.



Nominal Response Curve of MKH 404 and 405 (cps)
showing maximum permissible deviation from nominal values.
(each microphone is supplied with its individually plotted frequency response curve)

TECHNICAL DATA

	MKH 404	MKH 405
Acoustic mode of operation	pressure gradient receiver	pressure gradient receiver
Directional characteristic	cardioid	cardioid
Frequency range	40 to 20,000 cps	40 to 20,000 cps
Output level ref. 1 mW/10 dynes/cm ²	- 37 dbm	- 27 dbm
EIA Rating	- 131.5 db	- 121.5 db
Impedance	approx. 100 ohms	approx. 10 ohms
Minimum matching load	2000 ohms	200 ohms
Unweighted noise voltage	approx. 10 μ volts	approx. 10 μ volts
Weighted noise voltage (DIN 45405)	approx. 7 μ volts	approx. 7 μ volts
Equivalent noise level DIN 5045-A-Filter DIN 45405	approx. 19 db approx. 25 db	approx. 19 db approx. 25 db
Total harmonic distortion at 100 μ bar	< .5 %	< .5 %
Power supply voltage	8 volts \pm 1 volt	10 volts \pm 1 volt
Operating current	approx. 5 ma	approx. 5 ma
Temperature range	- 10° to + 70° C (14° to 158° F)	- 10° to + 70° C (14° to 158° F)
Dimensions	$\frac{3}{4}$ inch diameter $5\frac{3}{16}$ inch long	$\frac{3}{4}$ inch diameter $5\frac{3}{16}$ inch long
Weight	3.5 oz.	3.5 oz.
Connector	Tuchel T 3262	Tuchel T 3262
Contact 1	audio output	audio, + 10 volts
Contact 2	common audio and + voltage supply	
Contact 3	- 8 volts	audio, - 10 volts
Plug shell	shield	shield



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5. MODELS MKH 804 AND MKH 805

ULTRADIRECTIONAL NARROW BEAM CONDENSER MICROPHONES WITH TRANSISTORIZED RF CIRCUITRY

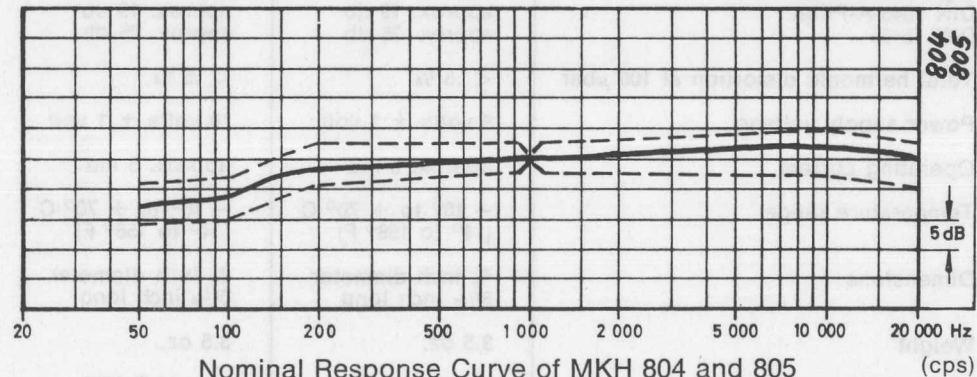
Models MKH 804 and 805 are extremely directional microphones of a new type, featuring an exceptionally narrow front lobe and high front-to-back (and side) ratio. A novel combination of the principle of interference with that of pressure gradients has resulted in the development of an unidirectional narrow-beam pattern which can 'pick out' a speaker at great distances. The unit is especially useful in television and film work where aesthetic considerations make it imperative that the microphone be placed far from the performer. Of especial note are the microphones' low internal noise level and imperviousness to wind and mechanical noises.

Model MKH 804 has an internal impedance of approximately 180 ohms, and is designed to be connected to circuitry having a minimum input impedance of 2000 ohms. The microphone's low impedance and high output permit connection to unbalanced circuitry with cables of extreme length, if desired.

Model MKH 805 has an output impedance of approximately 10 ohms, and is designed for connection to balanced circuitry with a minimum input impedance of 200 ohms. Power is duplexed into the audio cable, and no additional conductor is required. This model is designed primarily for large studios and other installations with master power supplies. Models MZN 5/1 and MZN 6 were especially designed for these applications.



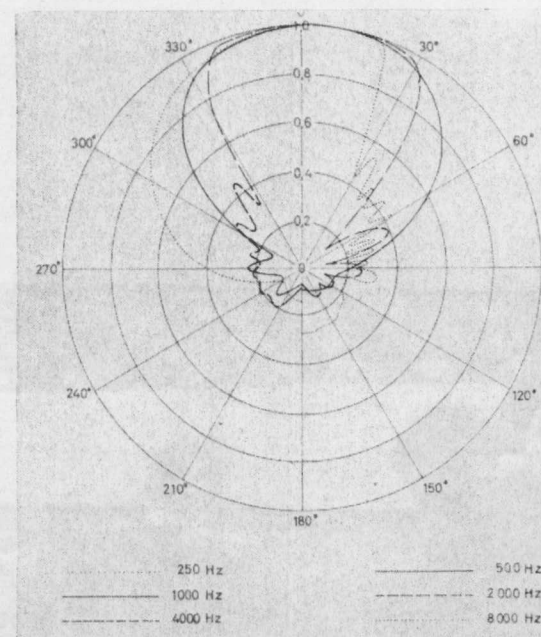
MKH 804



Nominal Response Curve of MKH 804 and 805 (cps)
showing maximum permissible deviation from nominal values.
(each microphone is supplied with its individually plotted frequency response curve)

TECHNICAL DATA

	MKH 804	MKH 805
Acoustic mode of operation	interference receiver	interference receiver
Directional characteristic	narrow beam	narrow beam
Frequency range	50 to 20,000 cps	50 to 20,000 cps
Output level ref. 1 mW/10 dynes/cm ²	- 31 dbm	- 21 dbm
EIA Rating	- 125.7 db	- 115.4 db
Impedance	approx. 180 ohms unbalanced ungrounded	approx. 10 ohms balanced ungrounded
Minimum matching load	2000 ohms	200 ohms
Unweighted noise voltage	approx. 10 μ volts	approx. 10 μ volts
Weighted noise voltage (DIN 45405)	approx. 10 μ volts	approx. 10 μ volts
Equivalent noise level DIN 5045-A-Filter DIN 45405	approx. 19 db approx. 24 db	approx. 19 db approx. 24 db
Total harmonic distortion at 50 μ bar	< .5 %	< .5 %
Power supply voltage	8 volts \pm 1 volt	10 volts \pm 1 volt
Operating current	approx. 5 ma	approx. 5 ma
Temperature range	- 10° to + 70° C (14° to 158° F)	- 10° to + 70° C (14° to 158° F)
Dimensions	3/4 inch diameter 22 inch long	3/4 inch diameter 22 inch long
Weight	14 oz.	14 oz.
Connector	Tuchel T 3262	Tuchel T 3262
Contact 1	audio output	audio, + 10 volts
Contact 2	common audio and + voltage supply	
Contact 3	- 8 volts	audio, - 10 volts
Plug shell	shield	shield



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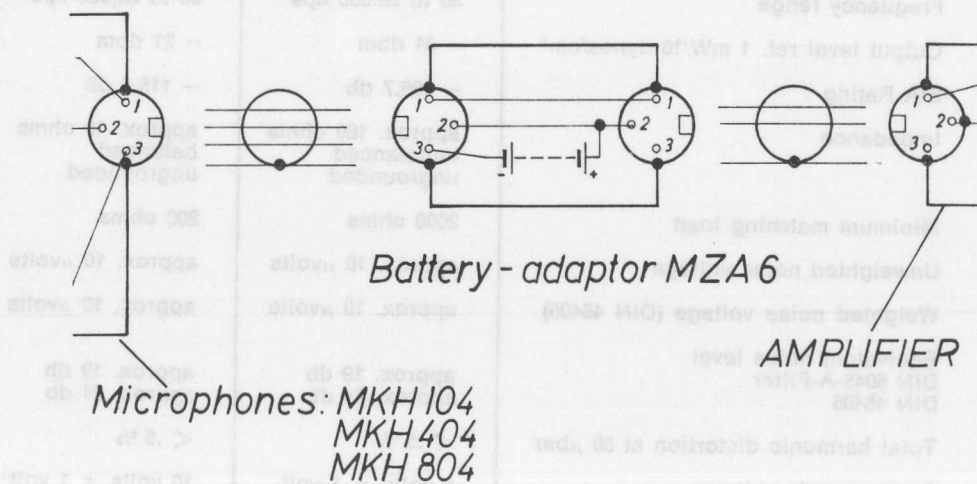


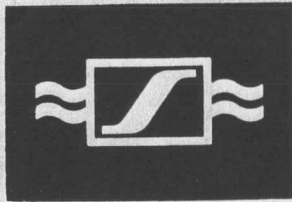
Figure 1: Power Supply with battery adaptor MZA 6

6. CONNECTION AND POWER SUPPLY

SENNHEISER condenser microphones are designed for connection via voltage matching. Since the microphones' output impedance is quite small in comparison to the amplifier input impedance, the microphones operate virtually unloaded. This has the important result of making the microphones' frequency response virtually independent of the amplifier input impedance characteristics.

Models MKH 104, 404 and 804 are designed for use with unbalanced circuits, requiring a third cable lead for power supply. The TM 515 wide-range cable transformer is available from us for connecting these microphones to low-impedance balanced circuits.

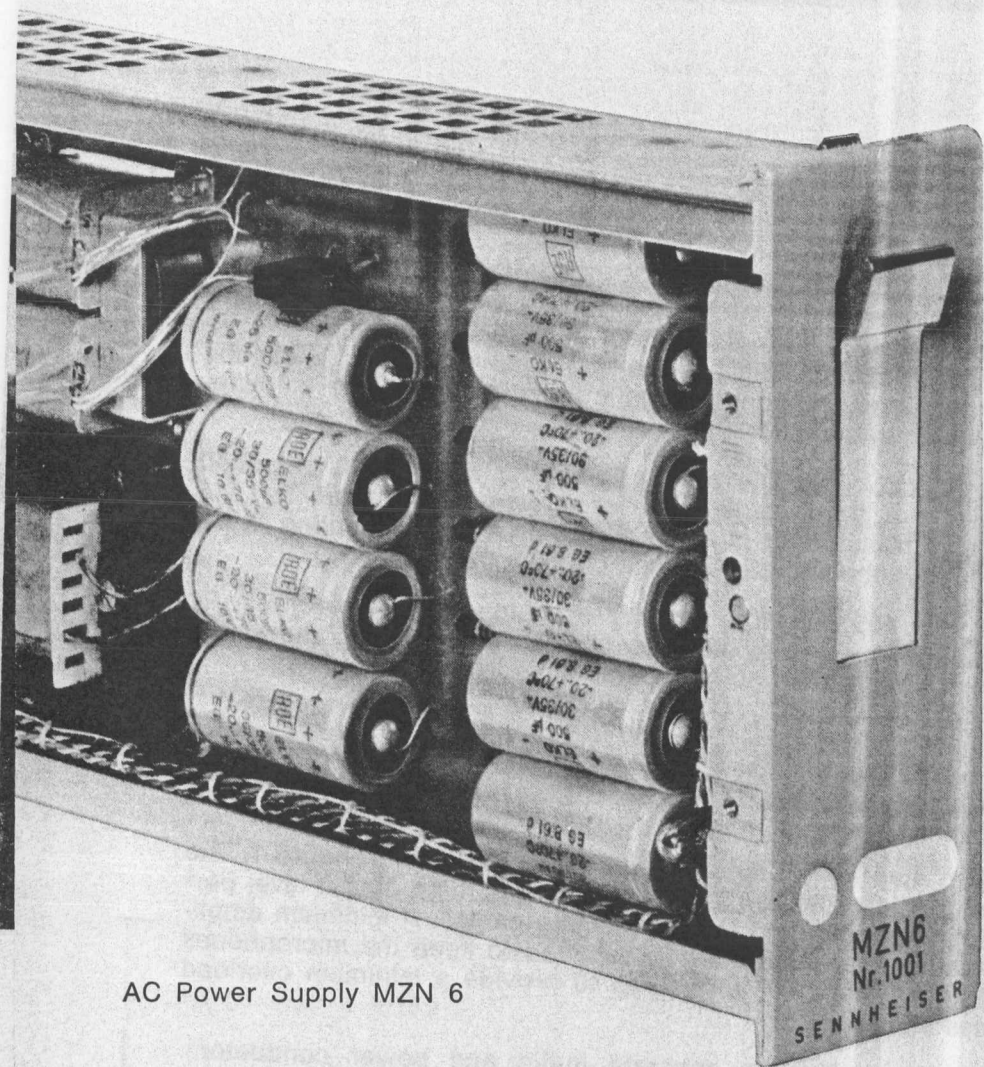
Models MKH 105, 405 and 805, which are designed for connection to balanced circuitry, operate by utilizing power duplexed into the audio conductors, and thus require no additional cable leads.



Models MKH 104, 404, 804

The connection diagram for these microphones is shown in figure 1. The microphones' low impedance (100–200 ohms) and high output level permit the use of extremely long interconnecting cables. A minimum amplifier input impedance of 2000 ohms is required to keep the microphones operating virtually unloaded, as well as to provide a minimum overload level in excess of 300 μ bar.

Figure 1 also illustrates the separate audio and power conductors. Approximately 8 v dc is applied across pins 2 and 3 of the connector, while audio appears between pins 1 and 2. All three pins are isolated from the microphone case, to prevent RF from entering the circuitry. A flating internal ground also effectively protects the circuitry from noise induced in the cable shield, which can enter through the power supply.



AC Power Supply MZN 6

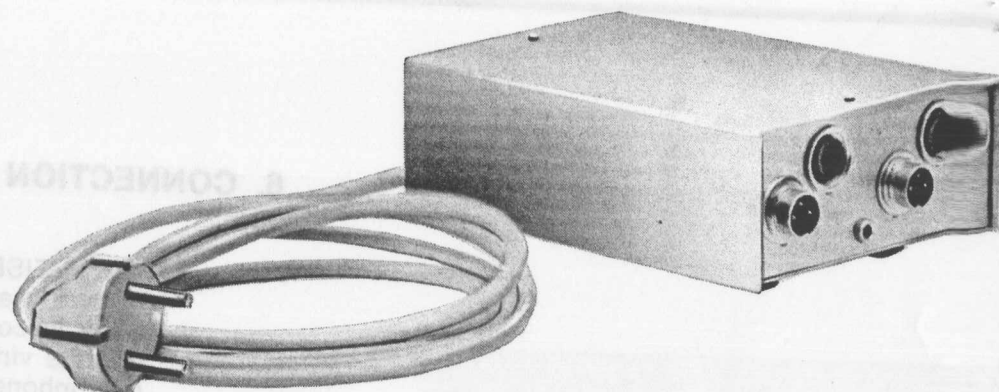


Figure 2: AC Power Supply MZN 4/1

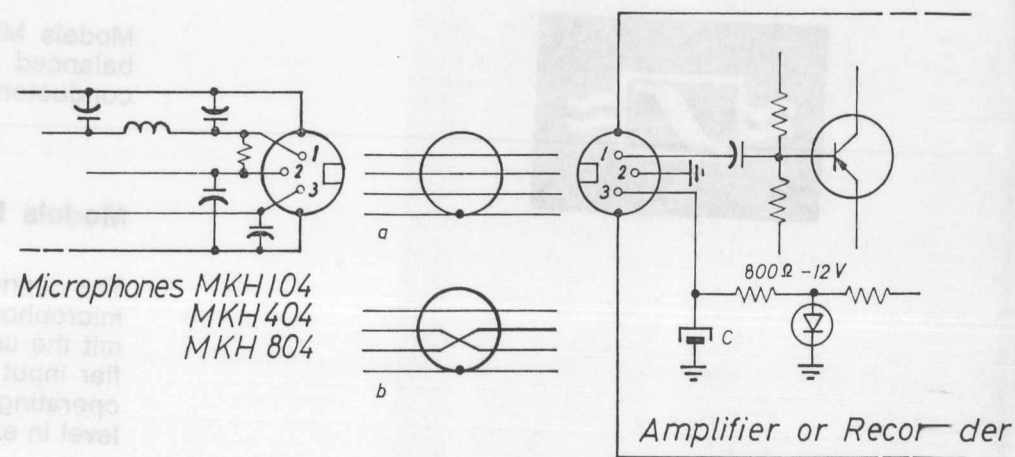


Figure 3: Connecting diagram MKH 104 - 404 - 804

BATTERY POWER SUPPLY

The simplest method of supplying power to the '-04' microphones is with our model MZA 6 battery supply (see figures 1 and 4), which can be attached directly to the microphone itself, or placed anywhere along the microphone cable. The MZA 6 accepts 6 mercury 'button' cells (Mallory RM 625, or equivalent), which will provide power for 50 to 60 hours of continuous operation. These batteries are widely available at stores which sell hearing aids, at jewelers and at electronic outlets.

LINE-OPERATED (AC) POWER SUPPLY

Model MZN 4/1 (Figure 2) can be used to power one or two microphones. DC is stabilized by means of a zener diode, and high audio isolation is maintained between the two lines. Like the MZA 6, the MZN 4/1 can be placed anywhere along the microphone cable.

POWERING MICROPHONES FROM ASSOCIATED EQUIPMENT

Because of their low power requirements, SENNHEISER transistor condenser microphones can be powered by the amplifier or other unit to which they are connected. For example, if the unit has a well-filtered power supply with more than 12 volt, a stabilized DC source for the microphone may be made from a 12 volt zener diode, a capacitor of about 500 μ F and a 800 ohm resistor as shown in figure 3.

In other cases, a resistor of different value or an additional dropping resistor may be required. In addition, because the internal circuitry of the microphone is ungrounded, it is also possible to use a DC supply voltage which is positive with respect to ground (applied to pin 2). In this situation one must interchange cable connections as shown in figure 3b.

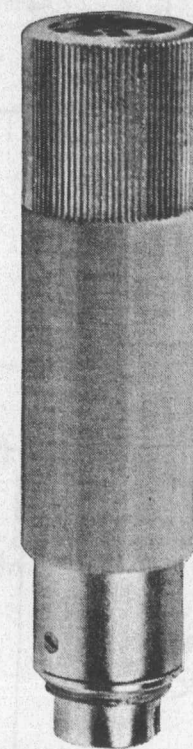


Figure 4: Battery adaptor MZA 6

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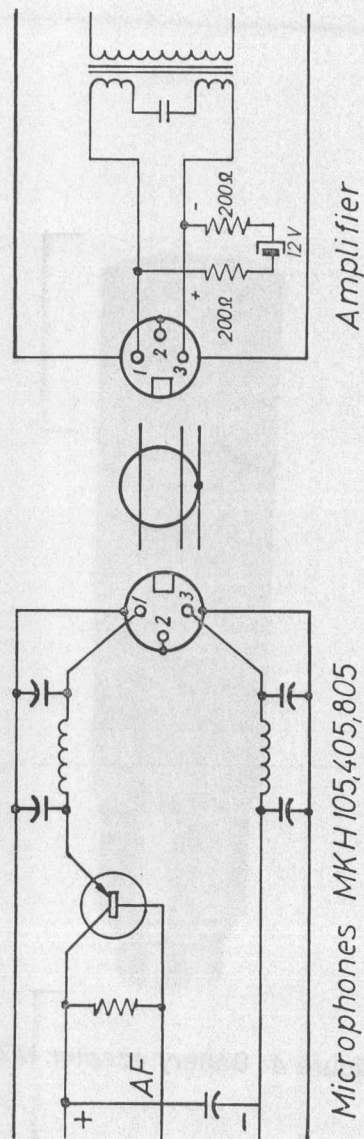


Figure 5: Connecting diagram
MKH 105 - 405 - 805

Models MKH 105, 405, 805

Figure 5 depicts the connection diagram for these microphones. A transistor which acts as an impedance transformer is placed in series with the remaining microphone circuitry, and conducts the full 5 ma which flow through the two 80 ohm voltage-dropping resistors shown in figure 5. The amplifier input then sees the microphone as a modulated resistor in series with the voltage which it provides. The microphones' impedance at audio frequencies is only about 10 ohms, and voltage-matching, as mentioned above, requires that the amplifier or recorder input impedance exceeds 150 ohms.

If it is desired to use the microphones in constant-impedance systems, the microphone output should be connected to a transformer having an input impedance of 200 ohms, since a mismatch could exaggerate the effects of stray capacity in the amplifier input transformer, producing resonance peaks in the response curve. The proper circuit for this application is shown in figure 6. The series resistor, added to the internal impedance of the microphone causes the amplifier to see the required 200 ohm impedance. The capacitor serves to prevent DC current flow through the transformer.

Needless to say, the configuration shown in figure 5 is the preferred method of power supply.

AC POWER SUPPLY FOR MKH 105, 405, 805

If it is not possible to connect the microphone as shown in figure 5, or if the power supply must be separated from the amplifier or recorder, an AC power supply may be used. The MZN 5/1, which is identical to the MZN 4/1 (above) except for power duplexing facilities, is ideal for this purpose (see figure 7).

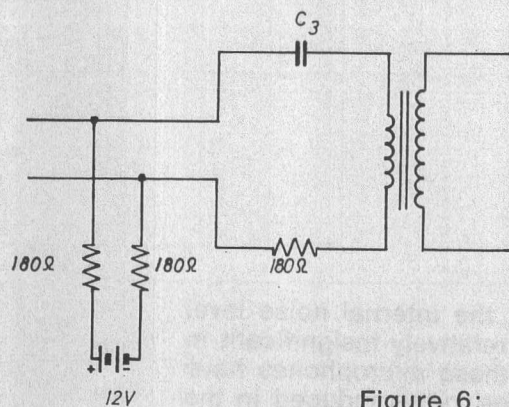


Figure 6:

Connection method of Models MKH 105-405-805 to an input transformer with a 200 Ω source impedance

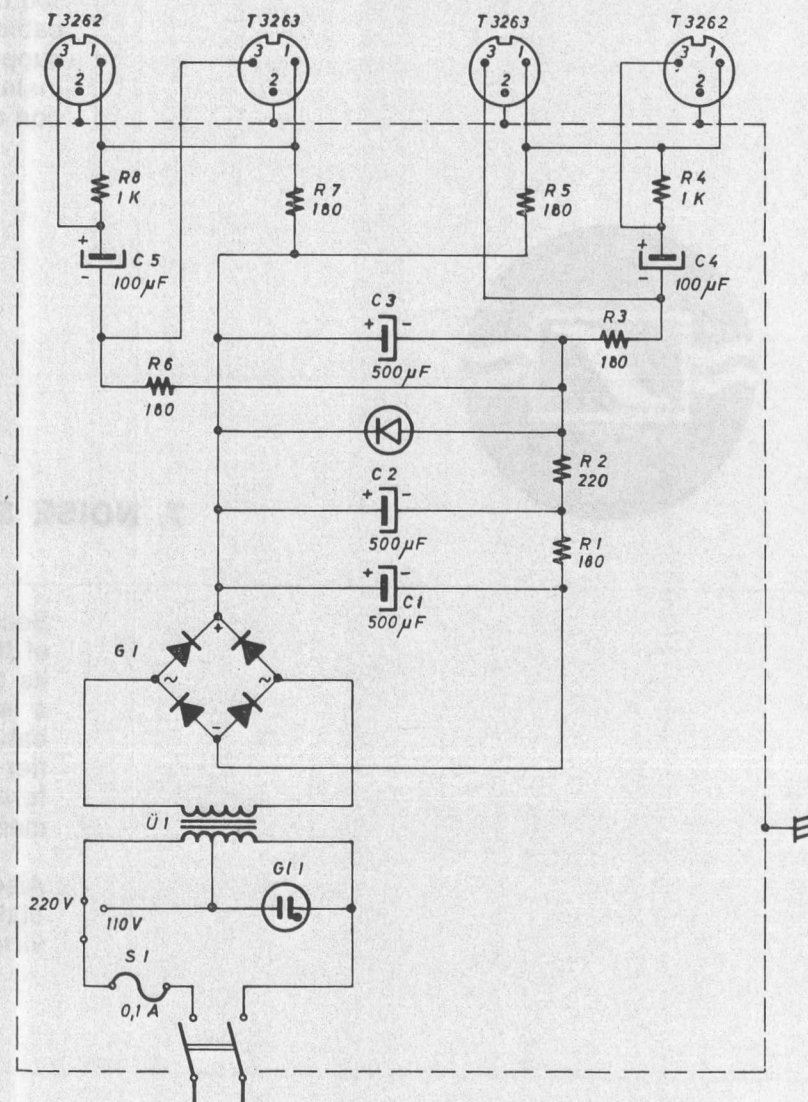
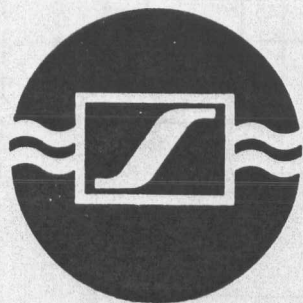


Figure 7: Circuit diagram of AC Power Supply MZN 5/1

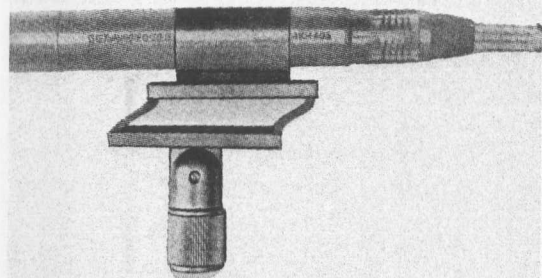



If it is necessary to power more than a pair of microphones, the MZN 6, which has connections for six microphones, is also available. Because of the excellent inter-channel isolation of this power supply (better than 100 db, with each channel zener-stabilized) it is possible to run extended cables from the supply outputs to the location of the mixer inputs if the supply cannot be located close to the console. Isolation resistors can be installed wherever power is fed into the audio lines (preferable to location at console input sockets).


7. NOISE SUPPRESSION

Because of the microphones' high output level, the internal noise level of the amplifier to which they are connected is relatively insignificant in its effect on the over-all noise figure. Because these microphones have a level which is 20 db higher than dynamic types, noise induced in the cables is effectively reduced by the same amount because less amplifier gain is required. The need for critical balancing of cables is therefore eliminated, since it results in little or no improvement in performance.

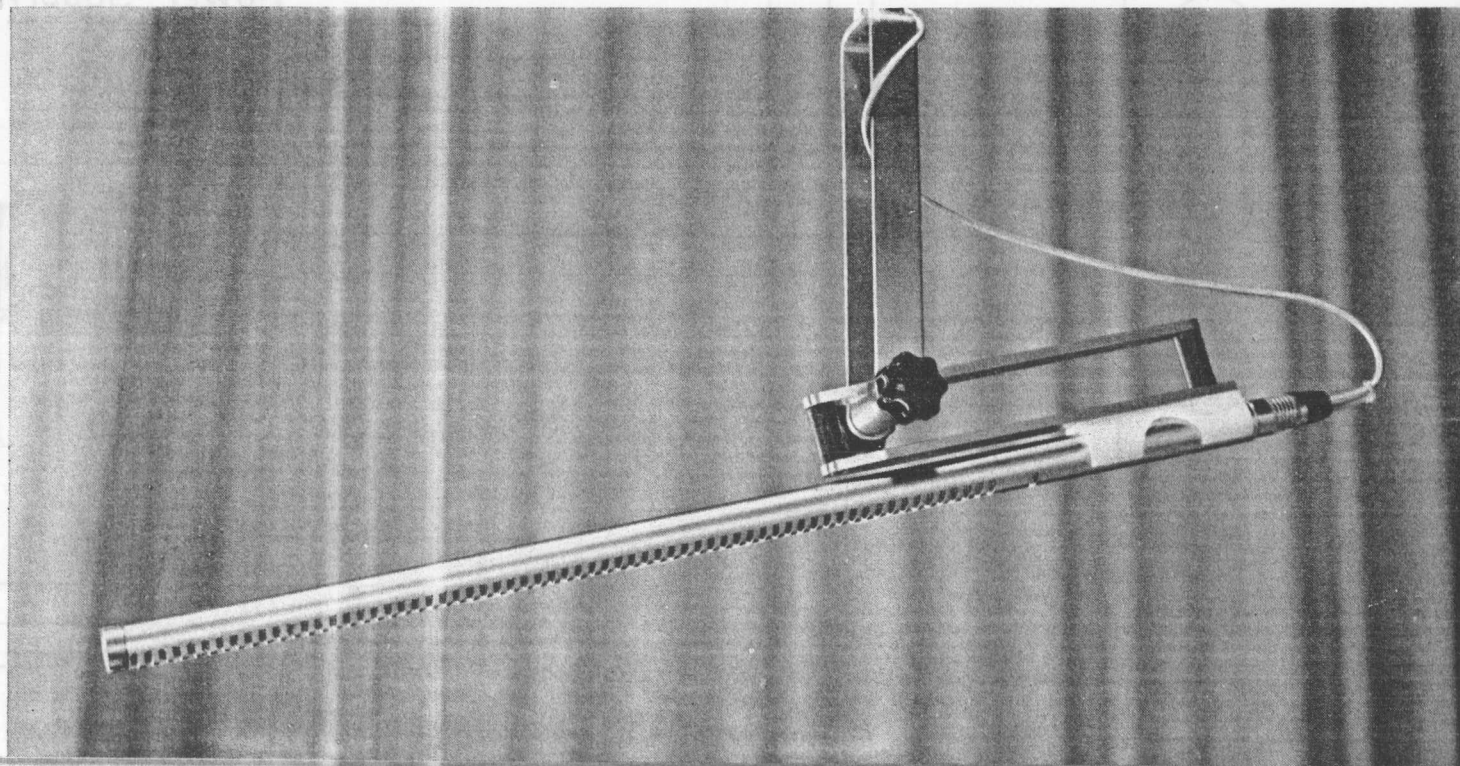
Also notable is the microphones' imperviousness to induced noise (especially hum). Since their circuitry contains no audio transformers, they are virtually immune to this type of interference.




 MZS 105, Shock-mount for
 MKH 104 - 105 - 404 - 405

MZS 805, Boom-mount
 for MKH 804 - 805
 

High-frequency field also presents no interference problems. Besides the high-frequency filter at the microphone output, which provides high rejection of RF interference, it must be remembered that there is only one frequency which could yield potential problems: that of the oscillator; about 8 mc. Should a high-level 8 mc RF field be placed in close proximity to the microphone, an RF choke or filter can be added to the circuit, or double-shielded cable could be used.

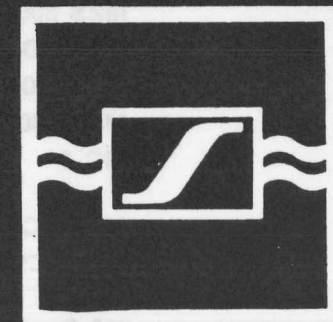


8. ACCESSORIES

MZA 6	Battery Adaptor for MKH 104/404/804
MZA 6/2	Battery Adaptor for MKH 105/405/805
MZN 4/1	AC Power Supply for 2 microphones
MZN 5/1	AC Power Supply for 2 microphones
MZN 6	AC Power Supply for 6 microphones
CL 404	Clamp for stand and boom mounting
MZA 216	Thread Adaptor $\frac{3}{8}$ — $\frac{5}{8}$ " 27 gauge for CL 404
MZT 102	Desk Stand
MZS 105	Shock-mount
MZS 805	Boom Shock-mount
MZW 104	Anti-Popping Windscreen 2" dia.
MZW 1048	Windscreen 3" dia.
MZW 804	Windscreen for MKH 804/5
MC 1	Extension Cable with T 3261/1 mounted on one end and pigtail on other end, 16.5 ft. long
MC 1/C	Connection Cable with T 3261/1 and XLR 3-12C mounted
MC 1/CP	Connection Cable with T 3261/1 and XLR 3-12C mounted, 16.5 ft. long with built-in 20 dB loss-pad
KA 7	Three conductor shielded Connection Cable with T 3260/1 and T 3261/1 mounted, 22 ft. long
DA 7	Two conductor shielded Connection Cable with T 3260/1 and T 3261/1 mounted, 22 ft. long
TM 515/1	Cable Transformer, in-line
KAT 2	Special Transistorized Cable for use with NAGRA tape recorder
KAM 1	Special Cable for use with MIKROPORT Wireless Microphone
MC 4	Connection Cable with T 3261/1 and phone plug, 16.5 ft. long
MCU	Connection Cable with T 3261/1 and Preh three-pin lock connector for UHER 4000 tape recorder, 6 ft. long

Cross- reference for associated accessories

MKH					
104	105	404	405	804	805
X		X		X	
	X		X		X
X		X		X	
	X		X		X
	X		X		X
X	X	X	X		
X	X	X	X		
X	X	X	X		
				X	X
X	X	X	X		
X	X	X	X		
				X	X
X	X	X	X	X	X
X	X	X	X	X	X
X	X	X	X	X	X
	X		X		X
X		X		X	
X		X		X	
X		X		X	
X	X	X	X	X	X
X		X		X	



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