



KTM – The First Neumann Transistor Condenser Microphone

By the mid-'60s the tube age seemed to have passed and semiconductors taking over the market began to introduce a new chapter in electronics.

With it, the era of the 6-transistor pocket radio and numerous other devices also began. But with the popularity of these cheap, home entertainment products, the transistor gained a reputation for inferiority in recording studios.

However, Neumann had already begun developing studio products with transistors in the early '60s. Back then, germanium transistors were the only ones available. Neumann preferred to use the AC 151 r type for studio equipment, which led to the production of a complete series of devices for mixing boards. That technology became an important field for Neumann in the following years.

Because Germanium transistors feature an input impedance of approximately 1.2 kOhms, it makes them unsuitable for condenser microphones working with a low-frequency circuit, which requires an input impedance of several hundred MOhms. Of course, it is possible to build condenser microphones with such transistors.

One solution would be to use a high-frequency circuit, in which the condenser capsule represents a lower impedance

in a radio-frequency circuit. This topology is used in Sennheiser condenser microphones. But all of Neumann's previous models had used low-frequency circuits, and Neumann intended to continue that practice.

With the development of the field-effect transistor, a solid state component had been created that featured a very high input impedance. In 1965, Neumann released its first condenser-transistor microphone, the KTM.

Its advantages were explained in the following product description:

The microphone's built in amplifier has replaced the tube with semiconductor elements. This offers the advantages of easier implementation, low power input, fast operation, no tube noise and a high degree of operational safety.



The microphone contained the cardioid capsule KM 64, known for its outstanding acoustical qualities. Power was provided by a 12 volt wire feed, which was introduced by Sennheiser according to the DIN 45 595 standard. Today, it's DIN IEC 268 15.

The KTM was the first in a long line of Neumann solid-state-condenser microphones. It was soon succeeded by the KM 74, which was electro-acoustically identical to the KTM, but had the 21 mm diameter typical of Neumann miniature microphones at the time.



KM 66 - The Figure-8 for an Even Sound Field

Occasionally, by combining elements of existing products, previously unknown possibilities are discovered. One example of this in Neumann's product history is the KM 66, a switchable-pattern miniature microphone first produced in 1966.

In developing this microphone, Neumann combined two cardioid capsules from the KM 64 in a special way: the diaphragms face away from each other with a spacing of 10 mm; the backplates are separated by an elliptical divider. The result is a capsule combination producing excellent polar pattern characteristics, even in the extreme low-frequency range. Even at 40 Hz, the rear-to-front differential for each single capsule is 20 dB!



In an even (diffuse) sound field, no appreciable change in on-axis (0 degrees) response occurs when switching from omni to cardioid pattern. Also, when the backside capsule is added (for omni), there is less than a 10% increase in output voltage from the microphone.

In contrast, polar diagrams of typical dual-diaphragm microphones indicate that the reverse attenuation of the cardioid pickup pattern decreases remarkably towards the low frequencies. When the two capsule halves are activated at the same time, the backside part adds a much higher share of the whole signal. This generates a narrower figure-8 pattern in the low frequencies and an uneven response due to changes in distance.



In the KM 66, the cardioid and figure-8 patterns



feature an accurate representation of low frequencies, even in such a case where the microphone is used at a greater distance from the sound source. This near-ideal cardioid capsule with its unique attributes is a great asset to other microphones utilizing it: the KM 64, U 64, KTM, KM 74 and the legendary KM 84.



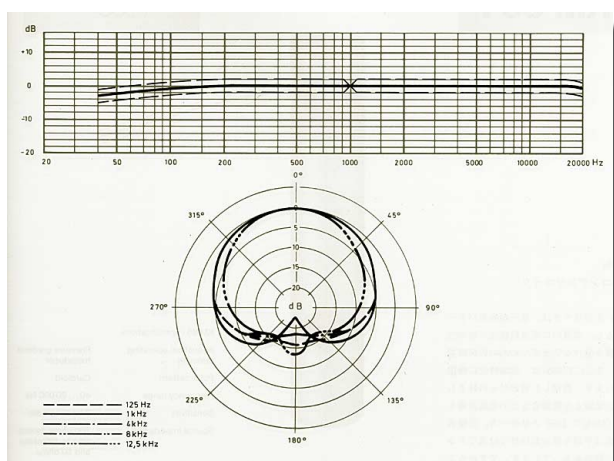
KM 84 - 48 Volt Phantom Powered

From the very start, Neumann has maintained close relations with the people using its products. The suggestions, wishes and demands of these important customers often lead to the development of new standards and the introduction of novel techniques. One particularly important development began with a visit by Neumann staff to Oslo, Norway in 1966.

Norwegian State Television planned to outfit a new station which would use transistor-based microphones. Instead of using the German 12 Volt wire circuit system, the engineers wished to use the station's existing central 48 Volt DC system. Neumann suggested a circuit in which the microphone could be operated with this 48 Volt supply by dividing the voltage across the two modulation pins and developing the necessary current in reference to the cable shield.



In this system the supply voltage is fed to both modulation leads across two matching 6.8 kOhms resistors. The voltage is recovered in the microphone in a similar way. Due to the high degree of balance (because of the carefully matched resistors), no potential difference voltage exists between the modulation wires. Thus the term "Phantom Power" has come to be understood as a powering system



tem where no voltage is developed between the modulation pins of the microphone and thus "does not appear" unless used with a corresponding microphone.

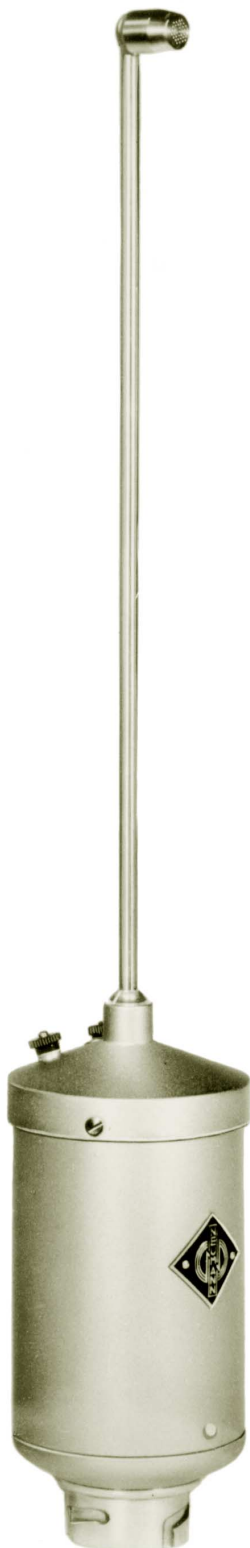
This type of powering system has several advantages, one being particularly important in standard applications. Phantom powering allows for the connection of dynamic and ribbon mics without damage. All microphones with a symmetrical, ungrounded output can also be used with this powering scheme. Even tube microphones, with their separate power supplies, can be connected to a phantom supply without problems.

The first microphone made with this technology was the Neumann KM 84, a miniature microphone with a near-perfect cardioid characteristic (due to the excellent KM 64 capsule it contains). The circuit was made quite small so that the mic could be made with a diameter of only 21 mm and a length of 110 mm. With phantom powering, a truly "miniature microphone" was now possible!



The KM 84 was designed with a 10 dB attenuation switch, therefore allowing the microphone to be used up close with loud instruments. By placing the pad at the gate of the field-effect transistor (FET), this "pre-attenuation" prevents the hot capsule signal from overloading the front end of the amplifier. With the switch on, a sound pressure level of 130 dB can pass through without distortion.

What began as a modest interest in this new type of powering (and using a new connector for microphones) in 1966 resulted with the KM 84 as being one of the great success stories in Neumann's history. Following its introduction, all microphone manufacturers began to produce or modify models for 48 volt phantom powering and this system has since become the world standard for condenser microphone powering.



**Calibration Microphones
MM 2, MM 3, MM 5**

As an audio pioneer, Neumann is constantly charting new territory. In the early years, when microphone production was still in its infancy, new problems were encountered at nearly every turn. For example, how can a thin diaphragm be produced from plastic? Neumann solved this particular problem by heating the plastic and pouring a controlled amount onto the surface of water.

For the very first microphone amplifiers, resistors were fashioned from thin bars of graphite. Acoustic measuring devices hardly existed. So Neumann developed the first practical logarithmic level recorder. For the absolute calibration of pressure microphones, Neumann designed a pistonphone. In the best pioneering tradition, Neumann used these devices as indispensable tools and aids for exploring the frontiers of acoustic research and the realization of innovative ideas.

The industry also lacked a calibration standard for the acoustic testing of microphones. In 1949 Neumann developed a miniature microphone capsule that functioned as a pressure transducer. The aluminum membrane measures 10 mm in diameter. To prevent disturbing the sound field in the calibration room by the relatively large microphone amplifier, the capsule assembly is separated from the amplifier housing with electrical connection running through a thin tube of 25 cm length. The amplifier is modified from the U 47, with the same tube model VF 14 M.

The calibration microphone features a linear frequency range of 20-16,000 Hz, with a maximum deviation of +/- 1 dB. Neumann used the calibration microphone in conjunction with two Neumann P2 level recorders for quality control of its own microphone production. The combination of the calibration microphone with one level recorder served to maintain a constant sound pressure level in the calibration room, independent of the frequency. The second level recorder monitored the output voltage of the microphone under investigation.

The MM 2 was succeeded in 1954 by the MM 3, which had the same specifications, but was equipped with the AC 701(k) tube in place of the VF 14 M.

For detecting higher frequencies up to 50 kHz – for example, when testing acoustic models in reduced scale – Neumann developed an even smaller capsule with a Nickel diaphragm, known as the MM 5. Introduced in 1955, the MM 5's frequency response up to 20 kHz is as consistent as that of the MM 2 and MM 3. In the 20 kHz to 50 kHz range, the tolerance is less than 3 dB. These close tolerances were regularly checked in cooperation with the Natural Metrology Institute in Braunschweig, (now Physikalisch Technische Bundesanstalt, the German equivalent of National Bureau of Standards).

Just as Neumann level recorders were standard equipment in most acoustic calibration laboratories of the time, Neumann calibration microphones served for decades as the standard for nearly all manufacturers of microphones and loudspeakers. Calibration microphones continued to be produced until the early 1970s. Today, almost thirty years later, many of them are still in service.

