

Figure 29 - Polar responses of the RCA 77 D microphone in its three configurations

SM58



Figure 30 - SM58[®] Microphone (Copyright Shure Incorporated. Used with permission.) - Probably the most famous and widely used of all dynamic, vocal microphones

Surprisingly for a generation, brought up to regard this type of microphone as the *de facto* standard for music applications, the moving-coil, dynamic microphone is a relative newcomer and had to await the development of rare-earth magnetic materials for compact, high-quality designs to become a reality. The Shure SM58 (Fig. 30) is probably the most famous and widely used of all dynamic, vocal microphones. Introduced in 1966, it is a workhorse of live and studio vocal sound.

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The SM58 is a cardioid microphone and has a sensitivity of 1.9mV/Pa. Its character derives from a flattering frequency response. At HF, the response displays a “hump” and the fall towards high-frequencies; as shown in Fig. 31. This characteristic tends to flatter a singer but prevent sibilance. At LF, the response falls away at about 6dB/octave and this compensates from the proximity effect of a unidirectional microphone. The circuit, which has a 300 ohm output impedance, is also given in Fig. 31 and illustrates an "on/off" switch which is available on the "S" model. Note that the switch shorts the generator, thereby maintaining a low impedance output to the following amplifier.

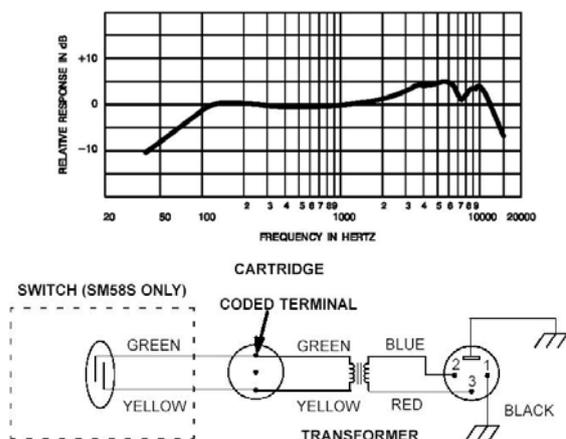


Figure 31 – Frequency response and circuit of the SM58[®] microphone (Copyright Shure Incorporated. Used with permission.)

SM57



Figure 32 - Shure SM57[®] Microphone (Copyright Shure Incorporated. Used with permission.)

The SM57 (Fig. 32) was introduced by Shure in 1967. This self-effacing product is arguably the most useful, general-purpose microphone available and has wide applications, both live and in the studio. A favourite microphone for the recording of snare and guitar amplifiers, it may also be used for vocals. It, like the '58, is a unidirectional microphone and has a sensitivity of 1.9mV/Pa and an output impedance of 300 ohms. It has a similar frequency response to the SM58 but with an even stronger presence peak around 5kHz. It also has a slight "suck-out" (frequency dip) around 400Hz which removes the “honk” from guitars and snares.

Neumann U47 and U48 microphones

Figure 33 - The Neumann U47 microphone (external and internal view)

The U47 microphone was developed by the small, German company Neumann and was launched on the market in 1947. It is common to see Neumann, Telefunken and Siemens “versions” of the U47 because Neumann manufactured and OEM’ed the microphone to Telefunken and Siemens who stuck on their own badges, but all U47s were manufactured by Neumann. The U47 is deservedly a legendary microphone, it has been used on so many famous records that they are too numerous to list. Ella Fitzgerald and Billie Holiday both recorded using the U47. Sinatra refused to record without his “Tele” (Telefunken U47), and the microphone was the first choice for the early Beatles records; both for vocals and guitar. George Martin referred to the U47 as his, “favourite microphone.”



Figure 34 - Sinatra refused to record without his “Tele” (Telefunken U47)

This microphone set a new standard for microphones which had remained set by the RCA 44 for 15 years. There are two body shapes; a long-body version (Fig. 33) and a shorter body type like the U48, the two types being due to a change in later U47s to the orientation of the output transformer. The U47 is a switchable omni/cardioid microphone

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with a high sensitivity of 25mV/Pa. The microphone's internals are illustrated in Fig. 33 and the circuit diagram is given in Figure 35. Note that the polar pattern is switchable by means of selecting the signal from one or both the diaphragms either side of the common back plate - the latter forming the other, common, energised electrode⁷.

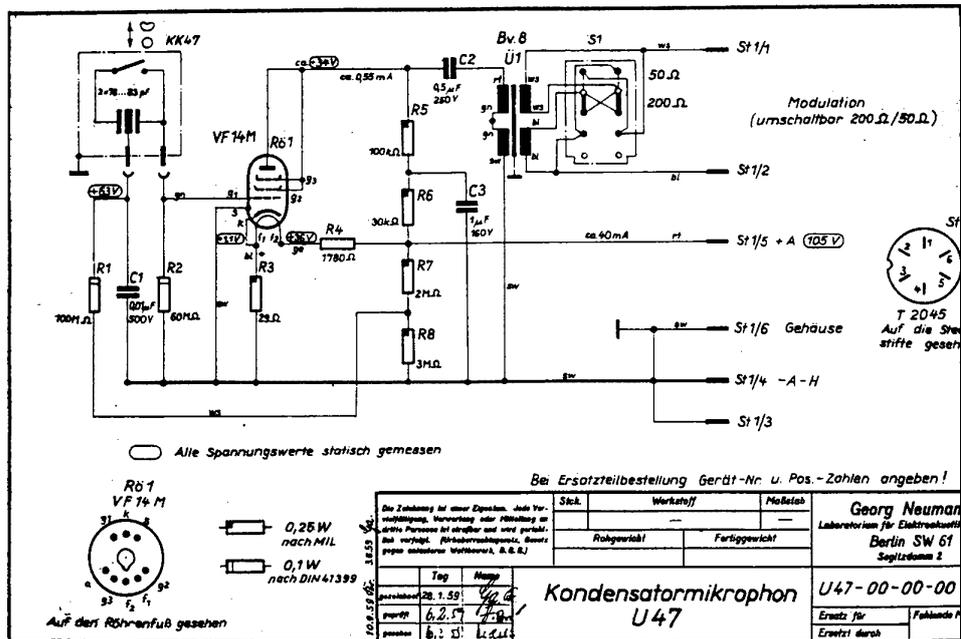


Figure 35 - Circuit of the U47

The back plate is held at a constant tension of about 55V and the charge is held steady by feeding this through a very large resistance. The impedance-converter uses a VF14 (M) valve; a special and selected version of the wartime, metal-envelope pentode valve, the EF14 (Fig. 36). This valve type was selected by Neumann for low-noise and microphony, and presumably for small size. The valve acts as a voltage amplifier circuit (much more about this in later chapters) and it drives the output transformer which loses most of the voltage gain of the valve, but translates the output impedance to 50 or 200 ohms to drive the long microphone cable. Note that there is only one supply (105V at 40mA) which is used for the HT and for the heater supply for the valve (specified to be the unusually high 55V, but under-run in this application at about 35V). The heater supply is simply dropped by R4 which dissipates about 2.6 watts in the process!



Figure 36 - The VF14 valve used in the impedance converter of the U47

Ten years passed before Neumann introduced the U48 microphone, which is identical to the U47 in every way, except for the selection of directional characteristics; the U48

⁷ Note also that the U47 capsule has a physical and electrical termination in the centre and acts as an annular diaphragm.

offering the choice of cardioid and figure-of-eight instead of the U47's choice of cardioid and omnidirectional. Although this seems quite a radical change, in fact the modification to bring this about is relatively simple. In the U48, the left hand diaphragm in Fig. 35 is not simply paralleled when the switch is closed, as in the case when selecting the omnidirectional response in the U47. Instead this diaphragm is fed from a smoothed version of the full HT voltage (about 105V) derived from the junction of R6 and R7. In this manner, the diaphragm is held positively charged, with respect to the centre plate, which is held at a constant 55V. The right hand diaphragm, on the other hand, is held "earthy" (by R2), and is negatively charged with respect to the centre plate. The signal outputs of the two diaphragms are thereby in opposite phase - exactly as required in an eight response. Obviously, given a potential difference of >100V between them, the two diaphragms cannot now be simply paralleled via the switch, as in the U47, so a 1nF capacitor is added in series with the switch in the U48. This extra component is mounted on the platform which supports the diaphragm housing. Both the U47 and the U48 employ either a PVC/gold membrane in capsule M7, or the later polyester/gold diaphragm in the K47/49 capsule.

The elusive VF14

In retrospect, Neumann's selection of the VF14 valve was a bad choice for the active device in the impedance converter because only about thirty thousand of these valves were ever made before production was halted 1954. Two-thirds of the valves off the production-line were rejected for inadequate performance in the U47 and U48 microphones. The rest were returned to Telefunken who sold them for use in cheap, FM receivers. The maths speaks for itself. Authorities differ on the exact numbers, but we know that Neumann produced about 6000 U47s and about 800 U48 microphones. So their consumption was about 21,000 of the 30,000 or so available valves. Taking into account the known rejection rate, this left about 3000 suitable valves for the rest of all time. Not even enough units to allow for re-valving the microphones once in their lifetime! In fact, even by the late nineteen-fifties, Neumann could not get hold of reliable quantities of the VF14 for production, maintenance and repair.

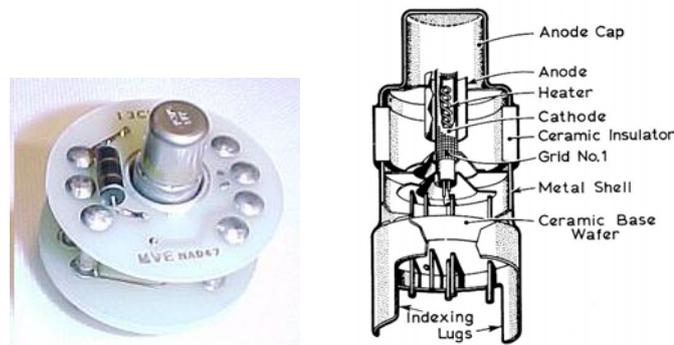


Figure 37 - 13CW4 Nuvistor and the assembly which replaced the VF14(M) valve

The situation was so serious that, by 1960, a major German broadcaster refused further to invest in Neumann equipment unless the company demonstrated that it had a solution to keeping their substantial investment in U47s in service. Neumann's solution utilised a 13CW4 *Nuvistor*: a miniature, metal-encapsulated valve which was thermionic technology's last-gasp attempt to compete with the transistor. Little bigger than the germanium transistors of the time, the Nuvistor could be soldered into a PCB and the internal structure is detailed in Fig. 37. Fitted in a small board which could be plugged into the VF14 socket, this substitution required a modification to the associated microphone power-supply. (A modification which rendered the PSU incompatible for microphones using the original VF14: the broadcaster must have been delighted by that!) By the mid sixties, Neumann had decided that the only real alternative, if another more common valve was to be substituted for the VF14, was to re-design the associated circuitry, and particularly the output transformer, and this is exactly what they chose to do with the release of the wonderful U67 microphone in 1960.