RESEARCH DEPARTMENT

THE NORDWESTDEUTSCHER RUNDFUNK-HILLER ELECTROSTATIC MICROPHONE TYPE M 59

Report No. M.025

Serial No. 1954/39

J.R. Chew, B.Sc. (Eng.).
D.E.L. Shorter, B.Sc. (Eng.), A.M.I.E.E.

W. Proctor Wilson

(W. Proctor Wilson)

Report No. M.925

THE NORDWESTDEUTSCHER RUNDFUNK-HILLER
ELECTROSTATIC MICROPHONE
TYPE M 59

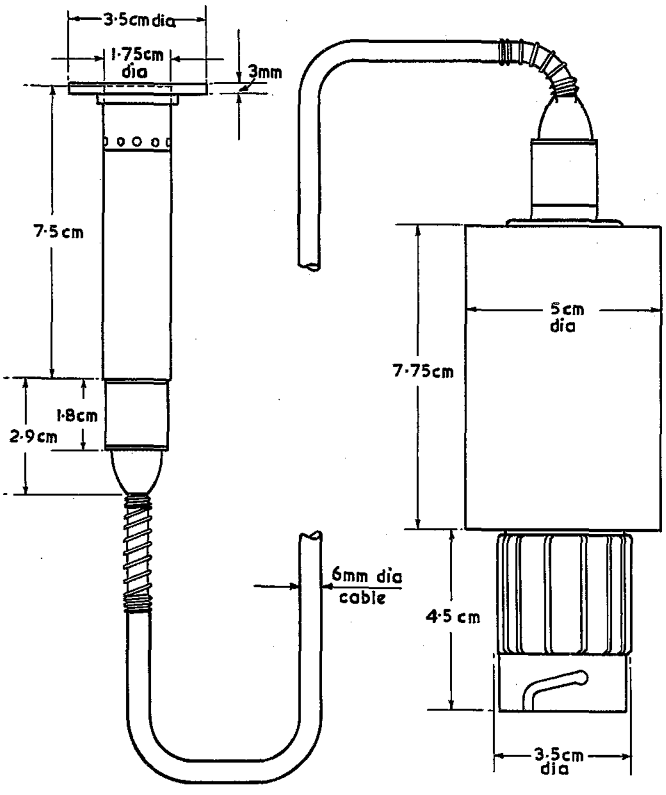

Fig. 1 - External View

CONFIDENTIAL

Report No. M.025

November 1954

Serial No. 1954/39

THE NORDWESTDEUTSCHER RUNDFUNK-HILLER ELECTROSTATIC MICROPHONE TYPE M 59

SUMMARY.

The M 59 is an electrostatic microphone of exceptionally small size and of nominally cardioid polar characteristics. Tests on a single specimen are described in this report. Frequency characteristics and figures for sensitivity, noise level and interference from magnetic fields are given, together with the results of a listening test.

1. INTRODUCTION.

The M 59 microphone was designed by Nordwestdeutscher Rundfunk and produced by the Hiller Company in Hamburg. It is a single diaphragm electrostatic microphone having nominal cardioid directional characteristics and is remarkable for its small size. Unlike most other directional electrostatic microphones it employs a metal diaphragm and is claimed to withstand high temperatures——an important consideration in television. The specimen to which this report refers has been in occasional use in the Television Theatre since October 1953 and others have since been employed in the sound service.

Fig. 1 shows the appearance and dimensions of the microphone head. As in all single element cardioid microphones an acoustic phase shifting network is provided at the back of the diaphragm and is so proportioned that sound incident from the rear produces equal pressures on both faces of the diaphragm. In the M 59 sound enters this network through a ring of holes in the microphone case. The minimum path length between these holes and the front of the diaphragm is artificially increased by means of a perspex baffle; by removing the baffle, polar characteristics intermediate between a cardioid and a circle can be obtained.

The pre-amplifier valve with its grid leak is housed in the microphone head, which is connected by a thin multicore screened cable 33 ft (10 m) long to a cylindrical housing containing the output transformer and other pre-amplifier components.

From this point connection is made by a heavier multicore cable to the mains unit, which, with its associated cables, is identical with those used for the N.W.D.R. electrostatic microphones M 49 and M 50[1].

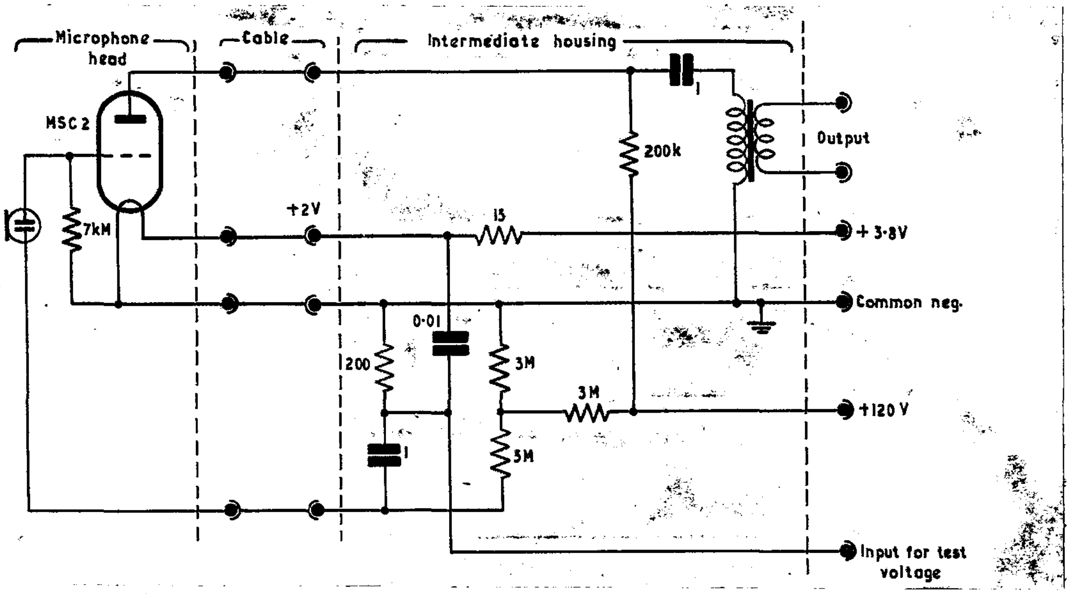

Fig. 2 - Circuit diagram

Fig. 2 shows the head amplifier circuit. It will be noted that a 7000 meg-ohm grid leak is used; this high value of resistance imposes very severe requirements on the capsule insulation and on the permissible grid current. The valve is of special design[1,2]. Its electrodes are brought out to wire ends, with which contact is made by very small screw connectors; valve replacement therefore requires some skill.

1.1. Weight.

Microphone head without baffle	56 g (0·12 lb)
Baffle	2½ g (0·005 lb)
Transformer housing and plug	460 g (1·0 lb)
Mains unit	7 Kg (15·4 lb)

2. FREQUENCY CHARACTERISTICS.

Figs. 3 and 4 show the open-circuit frequency characteristics with and without the baffle, for sound incident at various angles to the microphone axis. In both cases the axial response falls off rapidly below about 80 c/s and rises to a maximum in the 9 to 10 kc/s region. Without the baffle, the difference between the front and back response is from 8 to 10 dB over the whole frequency range, while the frequency characteristic is nearly independent of angle up to 90°. With the baffle, the difference between front and back response is greater than 14 dB up to 4 kc/s while the frequency characteristics for angles up to 90° show variations of a few decibels.

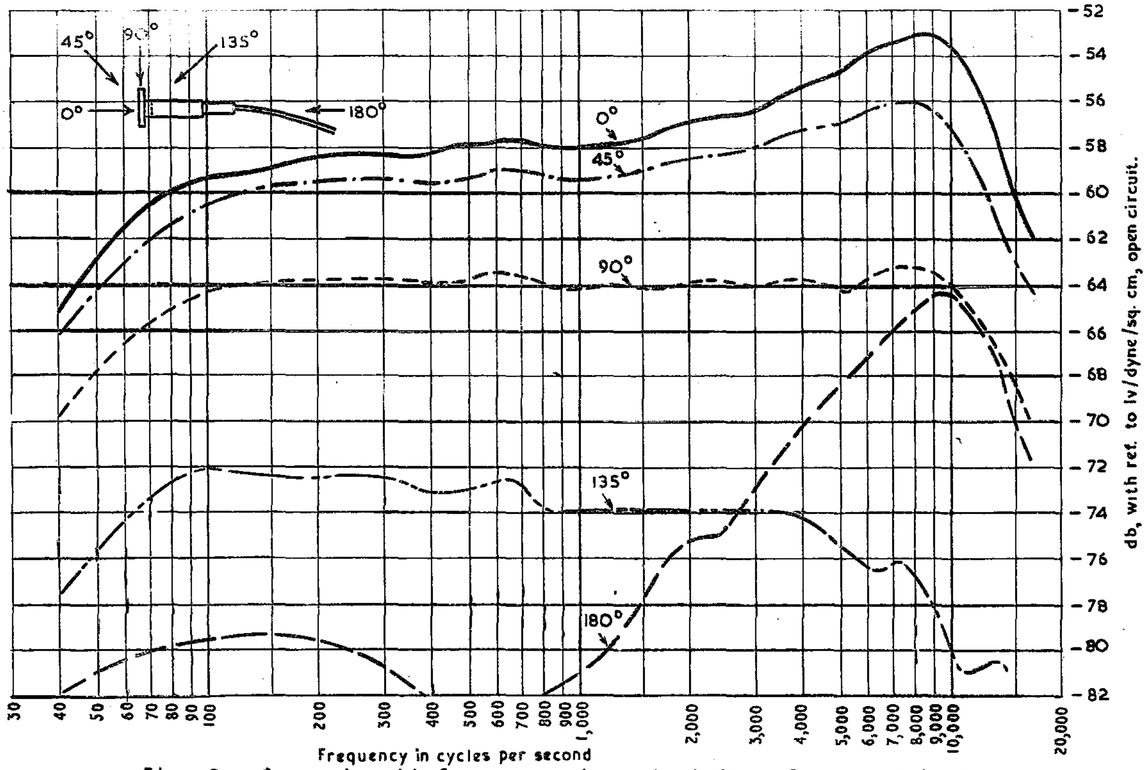

Fig. 3 - Open circuit frequency characteristics for sound incident at various angles. With baffle

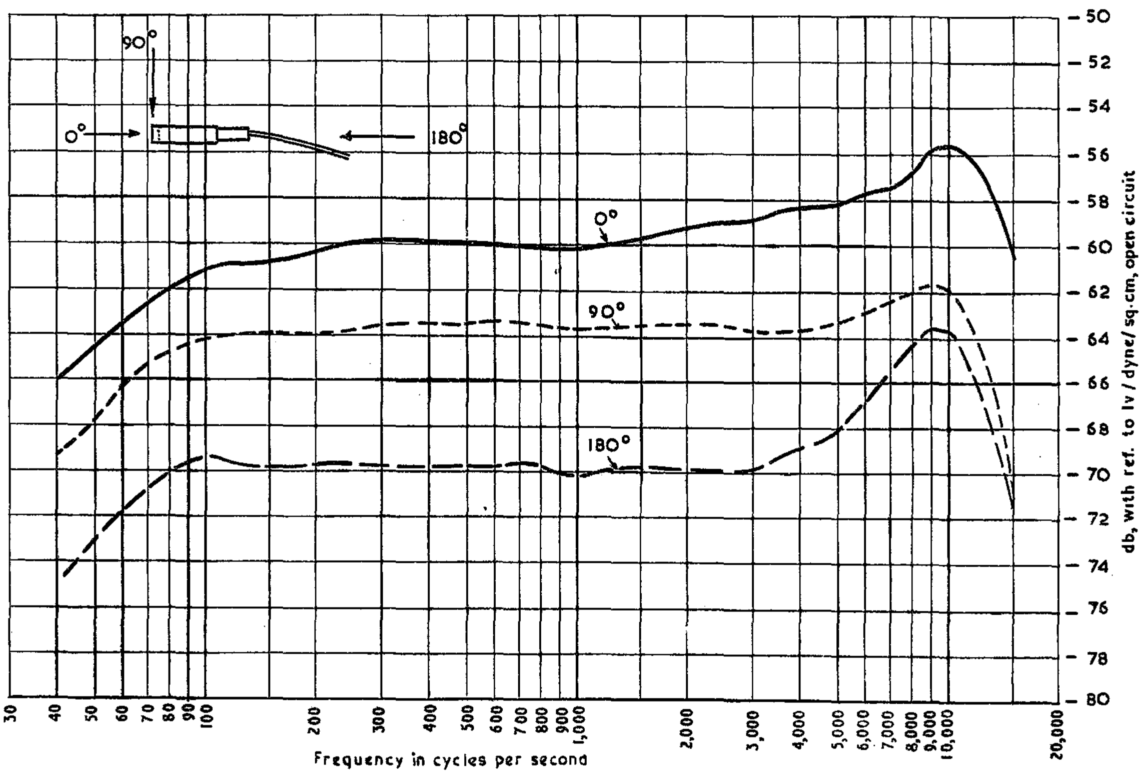

Fig. 4 - Open circuit frequency characteristics for sound incident at various angles. Without baffle

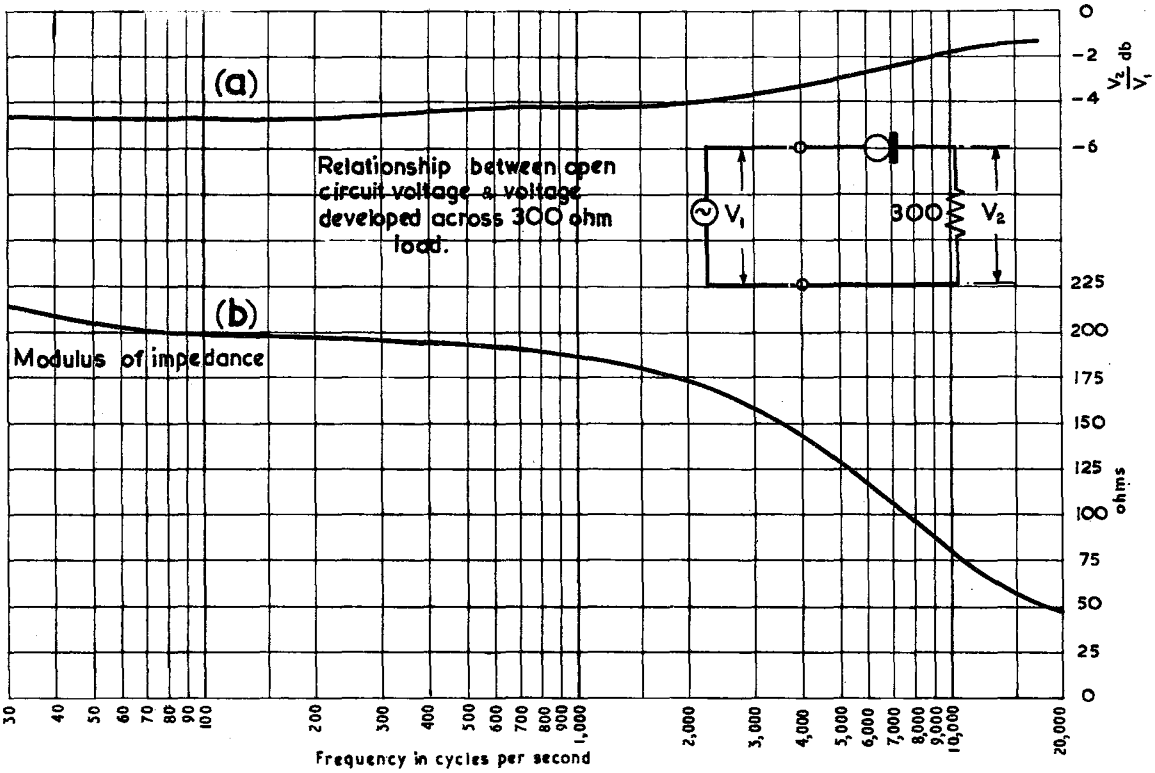

Fig. 5

Fig. 5(a) shows the relationship between the open-circuit voltage and the voltage developed across a 300 ohm load. It should be noted that in the on-load condition the rise in microphone response at high frequencies is accentuated.

3. IMPEDANCE.

Fig. 5(b) shows the modulus of the output impedance which is nominally 200 ohms. The large variation with frequency is due to the capacitance of the cable which links the microphone head and the transformer housing.

4. SENSITIVITY.

The open-circuit mid-band sensitivity with reference to 1 volt/dyne/cm^2 is −58 dB with the baffle and −60 dB without. At the output of an ideal 200 ohm/300 ohm transformer the sensitivities would be −56 dB and −58 dB respectively. The corresponding figure for the type AXBT microphone is −71 dB.

The makers' sensitivity figure is −63 dB.

5. NOISE.

The weighted[3] open-circuit noise level of the microphone is −110 dB with reference to 1 volt. The sound levels in the mid-band region which at axial incidence would produce equal output voltages with and without the baffle are +22 dB and +24 dB respectively with reference to 0·0002 dyne/cm^2. For comparison, the corresponding figure for the AXBT microphone is +18 dB.

5.1. Interference from Magnetic Fields.

As is usual with electrostatic microphones, the interference from magnetic fields is extremely low. Such induction as is present occurs mainly in the cylindrical housing which contains the output transformer. The levels of interference caused by a uniform magnetic field of 1 milligauss, at frequencies of 50 c/s, 1000 c/s and 10 000 c/s and expressed in terms of the mid-band sound levels which would generate equal output voltages are respectively 0 dB, +17 dB and +26 dB with reference to 2×10^{-4} dyne/cm^2. These values apply to the microphone with its baffle. The corresponding figures for an average AXBT microphone are, for comparison, +12 dB at 50 c/s, +24 dB at 1000 c/s, and +38 dB at 10 000 c/s. It should be noted that these figures are unweighted.

6. LISTENING TEST.

For this purpose male speech from a non-reverberant room was used. The rise in axial response at high frequencies was apparent, and the change in frequency characteristic as the sound source moved from the axis to 90° was noticeable. With the baffle attached the response to sound arriving from the rear of the microphone was very small.

7. CONCLUSIONS.

The frequency characteristics of the M 59 microphone are remarkably smooth and reasonably independent of angle of sound incidence over the front hemisphere. The noise level is adequately low and the interference from magnetic fields for most purposes negligible. In low-level mixing circuits the large variation of output impedance with frequency is a disadvantage since the frequency characteristics, not only of the M 59, but of the other microphones in parallel then depend on the mixer settings.

The small size of the microphone head is an advantage in certain circumstances but may cause some difficulty in maintenance.

8. REFERENCES.

1. F.W.O. Bauch. "New High-Grade Condenser Microphones". Wireless World, Vol. 59, February and March 1953.
2. H. Grosskopf. "Neue Kondensatormikrophone für Rundfunk-Studios". Fernmeldetech. Z., Vol. 4, September 1951.
3. C.C.I.F. weighting characteristics for noise in music circuits (1949).