SECTION 14

AURAL SENSITIVITY NETWORKS ASN/3, ASN/4, ASN/4P

Introduction

Aural sensitivity networks ASN/3 and ASN/4 are designed for making frequency-weighted measurements of noise, and conform with the C.C.I.F.* requirements for measurements on broadcasting circuits, as based on appreciation tests carried out to determine the disturbing effect of noise in the presence of music.

Both networks employ the same circuit, and are used in conjunction with a T.P.M. or P.P.M., but whereas the ASN/3 is in portable form the ASN/4 is intended for rack-mounting. The ASN/4P replaces the ASN/3.

Noise Measurements

General Considerations

The normal BBC practice hitherto regarding noise measurements has been to measure the peak-noise to peak-programme separation and, providing this was better than 46 db, to rely on a listening test for the final assessment. The inadequacy of this method has long been clear, since on the one hand induced 50-c/s hum or h.f. carrier break-through at 40-db separation may occur without marring programme under normal listening conditions, whereas on the other hand such induced noises as l.f. carrier, crosstalk, ringing, teleprinter signals and supervisory tones can be very objectionable at a separation of 46 db. Unfortunately, also, a subjective listening test is not a reliable means of estimating the disturbing effect of noises on programme, as the assessment depends on the observer, the loudspeaker and the general listening conditions; opinions are thus likely to differ both between BBC stations and between the BBC and the Post Office.

The subjective influence could be reduced by determining and tabulating the acceptable separation for each particular type of noise, but before such a table could be applied it would be necessary to identifiy the noise, and even then the method could only be used successfully provided that not more than one kind of noise was present at a time.

The discrepancies between peak-noise measurements and the degree to which various noises mar programme are due in part to the varying sensitivity of the ear to the frequency content of the noise, and ideally, this particular discrepancy can thus be eliminated by introducing into the measuring circuit a frequency-weighting network which modifies all peak-noise voltages in such a way that for a given disturbing effect their peak separations from programme are all the same.

The ear is also sensitive to the repetition rate of the interfering noise, and again, ideally, this can be taken into account by a suitable choice of time constant for the measuring instrument.

* Comité Consultatif International Téléphonique: Paris, July 1949: tome 4, page 193, table 2.

C.C.I.F. Weighting Characteristic

The weighting characteristic specified by the C.C.I.F. is given below in tabular form and its general shape is indicated (necessarily to a lower degree of accuracy) by Fig. 14.1.

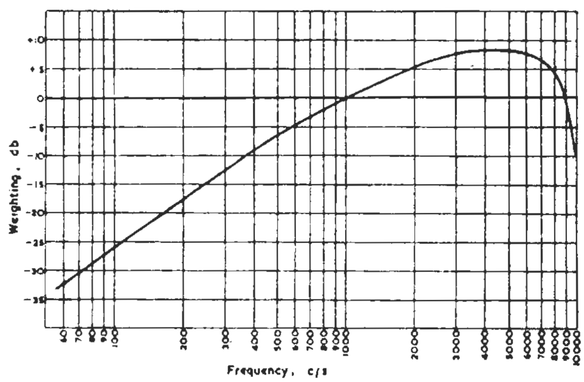

Fig. 14.1. C.C.I.F. Weighting Characteristic

Frequency kc/s	*Weighting* db	*Freqency* kc/s	*Weighting* db
0.06	−32·2	4	+ 8·2
0·1	−26·1	5	+ 8·4
0·2	−17·3	6	+ 8·2
0·4	−8·8	7	+ 7·3
0·8	−1·9	8	+ 5·1
1	0	9	− 0·3
2	+ 5·3	10	− 9·7

The C.C.I.F. recommended that a network with the given characteristic should be used with a specified measuring instrument; this had a time constant which resulted in indications approximating to an r.m.s. law. Obviously, however, it was undesirable for the BBC to introduce this additional type of measuring instrument unless essential, and Designs Department therefore made a large number of subjective tests to determine whether the standard T.P.M. when used with the C.C.I.F. network gave consistent results for all the usual types of noise experienced on lines. The consistency obtained in these tests was of the same order as that resulting from the use of an instrument built to the C.C.I.F. specification, although with neither instrument could exact correlation be obtained. However, in measurements which attempt to simulate subjective opinions the acceptance of some degree of compromise is normally required.

Circuit Description (Fig. 14.2)

General

The circuit takes the form of a constant-resistance network designed for operation between 600-ohm terminating impedances. The weighting network itself is unbalanced, but the input and output connections are made via unity-ratio unbalance/balance transformers. The ASN/3 is provided with duplicate input and output jacks; the ASN/4 is terminated on a tag-strip for permanent wiring. The 1-kc/s input and output impedances of the network itself are both 600 ohms, but this is increased to about 680 ohms in each instance by copper losses in the transformers.

Provision is made for replacing the weighting network by a 600/600-ohm loss-pad, which can be introduced by a key, and is the 1-kc/s equivalent of the network between the apparatus sides of the transformers. The overall insertion loss between the line sides of the transformers at 1 kc/s is about 10 db in either position of the key.

The required frequency characteristic is achieved by using two separate bridged-T networks followed by a low-pass filter. The shape of the curve is governed at low and middle frequencies by the bridged-T networks and at high frequencies by the filter.

Bridged-T Networks

Advantages of the bridged-T conformation are a constant input and output impedance (here 600 ohms) at all frequencies and a minimum basic insertion loss using relatively few components. The first bridged-T, incorporating C1 and L1, is responsible for most of the fall-off in the bass. The second bridged-T has two resonant branches,

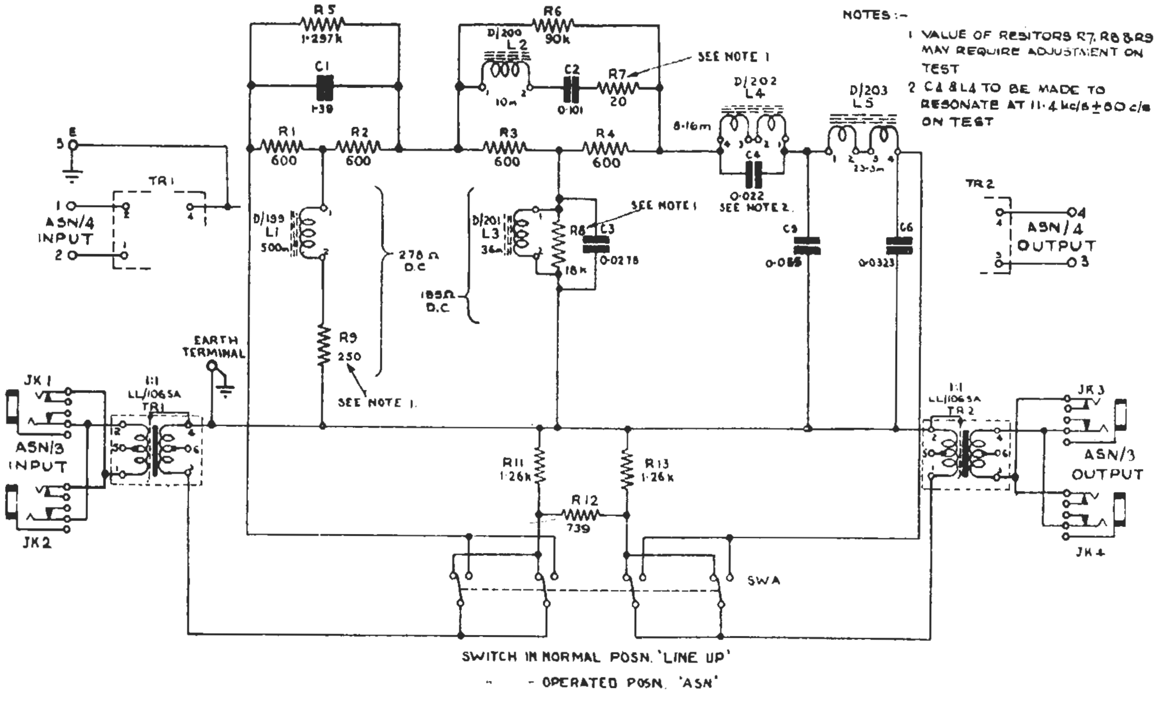

Fig. 14.2 Networks ASN/3, ASN/4, ASN/4P
Drawings No. EB 7885 and 7944, EA 11114

the series acceptor circuit C2 and L2, and the shunt rejector circuit C3 and L3; both branches are tuned to 5 kc/s, at which frequency the insertion loss of the complete network has its minimum value, the overall loss including transformers being then some 2 to 3 db. The required shape of response curve in the region of 5 kc/s is obtained by adjusting R7 and R8, it being necessary, however, to maintain their product at 600^2 to avoid altering the image impedances; increasing R7 and reducing R8 increases the 5-kc/s insertion loss, and vice versa.

Low-pass Filter

The low-pass filter consists of a 600-ohm prototype section with a cut-off frequency of 8·2 kc/s, preceded by a shunt-derived terminating half-section with an m value of 0·7 and a frequency of infinite attenuation of 11·4 kc/s.

The terminating half-section, comprising L4, C4 and 0·0227 μF of C5, improves the impedance presented to the bridged-T networks, and introduces considerable loss over a comparatively narrow band of frequencies immediately beyond the pass-band of the prototype section, thus providing the steeply falling response above 8 kc/s shown in Fig. 14.1. (The value for C4 of 0·022 μF, marked on the circuit diagram, is somewhat below the calculated figure, but is built out on test to tune with L4 at 11·4 kc/s $\pm$ 50 c/s.)

The prototype section, which is a π-type structure comprising L5, C6 and ·0323 μF of C5, has an attenuation characteristic which rises gradually beyond the cut-off frequency; this section ensures that the insertion loss of the weighting network remains high up to the maximum frequencies at which a T.P.M. is sensitive, and thus prevents incorrect weighting.

Mechanical Construction

The ASN/3 is constructed on a bent-up U-shaped chassis to which is attached a panel carrying input and output jacks and an earth terminal, together with a switch marked *Line-up* in the normal position and *A.S.N.* in the operated position. The unit fits inside a wooden case provided with a hinged lid and a leather carrying strap. Overall dimensions are 10 in. by 9 in. by 5 in. approximately. The total weight is 13¼ lb.

The ASN/4 is constructed on a base-plate to which are attached four pillars supporting a top-plate carrying the *Line-up/A.S.N.* switch. The base-plate forms a sub-panel occupying one quarter of a standard 4½-in. mounting-plate on a 22-in. bay, and one such mounting-plate can thus be equipped with up to four separate sub-panels carrying small units of various types. The unequipped 4½-in. by 22-in. plate ready drilled to take four sub-panels and with end-slots for bay fixing is designated a *General Purpose Mounting GPM/2.*

Operating Procedure

See Communications Department Operational Instruction No. 205.

General Data

Impedances

Normal source	Z = 600 Ω
Input	Z = 680 Ω (balanced) at 1 kc/s with 600-Ω load.
Output	Z = 680 Ω (balanced) at 1 kc/s with 600-Ω source.
Load	Z = 600 Ω

Insertion Loss

Frequency kc/s	*Insertion Loss db*	*Frequency kc/s*	*Insertion Loss db*
0·06	43	5	2·4
0·1	36·9	6	2·6
0·2	28·1	7	3·5
0·4	19·6	8	5·7
0·8	12·7	9	11·1
1	10·8	10	20·5
2	5·5	12-100	>30
4	2·6		

Component Types

Capacitors ($\pm$1 per cent tolerance):
C1 C2, Muirhead Type 33AT.
C3, Muirhead Type M.81.
(C1-C3 in 33AT case, inverted mounting).
C4-C6, L.E.M. Type 3220.

Inductors: see Fig. 14.2.

Jacks: P.O. No. 4112B.

Resistors ($\pm$2 per cent tolerance): Welwyn Type SA3622.

Switch: N.S.F. Type TG.3 standard 1-section 4-p. 2-w.

Transformers: see Fig. 14.2.

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