RECOMMENDATION ITU-R BS.468-4*,**

Measurement of audio-frequency noise voltage level in sound broadcasting

(1970-1974-1978-1982-1986)

The ITU Radiocommunication Assembly,

considering

a)   that it is desirable to standardize the methods of measurement of audio-frequency noise in broadcasting, in sound-recording systems and on sound-programme circuits;

b)   that such measurements of noise should provide satisfactory agreement with subjective assessments,

recommends

that the noise voltage level be measured in a quasi-peak and weighted manner, using the measurement system defined below:

1   Weighting network

The nominal response curve of the weighting network is given in Fig. 1b which is the theoretical response of the passive network shown in Fig. 1a. Table 1 gives the values of this response at various frequencies.

The permissible differences between this nominal curve and the response curve of the measuring equipment, comprising the amplifier and the network, are shown in the last column of Table 1 and in Fig. 2.
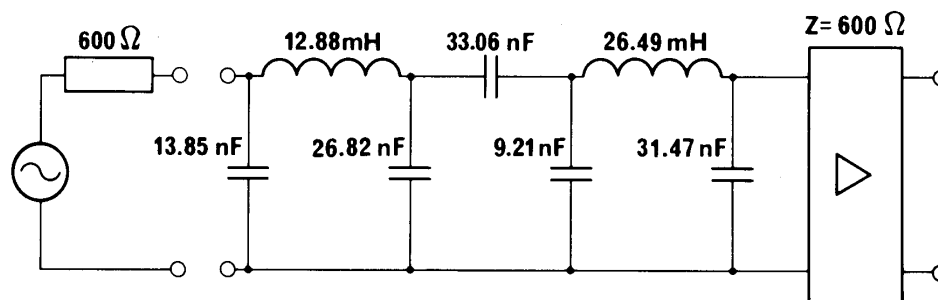

FIGURE 1a − *Weighting network, simple form*

(A constant-resistance realization is described in Annex 1)

A tolerance of at most 1 % on the component values and a *Q*-factor of at least 200 at 10 000 Hz are sufficient to meet the tolerances given in Table 1.

(The difference between the responses at 1 000 Hz and 6 300 Hz may be adjusted more precisely by a small adjustment of the 33.06 nF capacitor or by a different approach using an active filter.)

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*   This Recommendation should be brought to the attention of Telecommunication Standardization Study Group 9.

**   Radiocommunication Study Group 6 made editorial amendments to this Recommendation in 2002 in accordance with Resolution ITU-R 44.
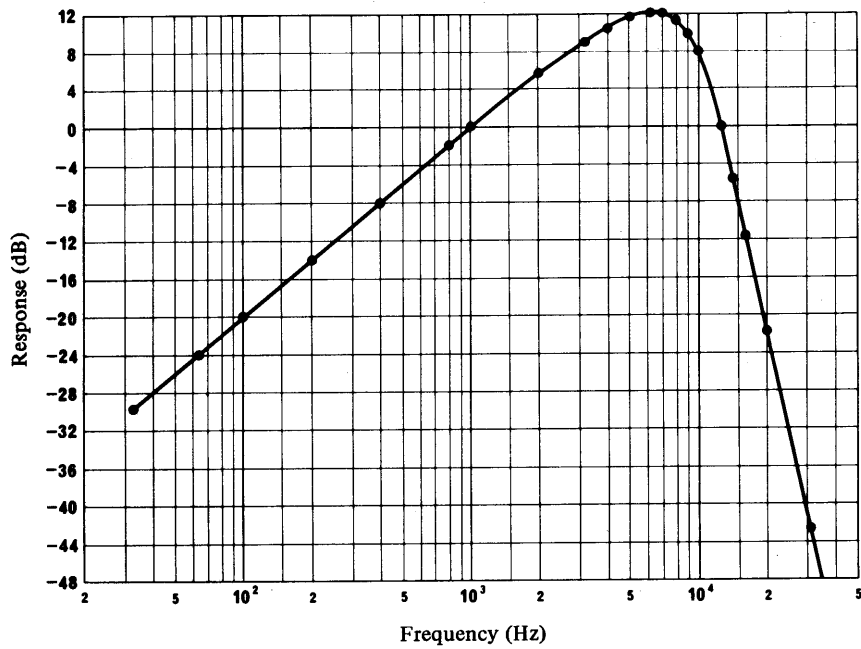
FIGURE 1b – *Frequency response of the weighting network shown in Fig. 1a*

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TABLE 1

Frequency (Hz)	Response (dB)	Proposed tolerance (dB)
31.5	−29.9	± 2.0
63	−23.9	± 1.4 [1]
100	−19.8	± 1.0
200	−13.8	± 0.85 [1]
400	− 7.8	± 0.7 [1]
800	− 1.9	± 0.55 [1]
1 000	0	± 0.5
2 000	+ 5.6	± 0.5
3 150	+ 9.0	± 0.5 [1]
4 000	+ 10.5	± 0.5 [1]
5 000	+ 11.7	± 0.5
6 300	+ 12.2	0
7 100	+ 12.0	± 0.2 [1]
8 000	+ 11.4	± 0.4 [1]
9 000	+ 10.1	± 0.6 [1]
10 000	+ 8.1	± 0.8 [1]
12 500	0	± 1.2 [1]
14 000	− 5.3	± 1.4 [1]
16 000	−11.7	± 1.6 [1]
20 000	−22.2	± 2.0
31 500	−42.7	$\begin{cases} + 2.8 \text{ [1]} \\ - \infty \end{cases}$

[1] This tolerance is obtained by a linear interpolation on a logarithmic graph on the basis of values specified for the frequencies used to define the mask, i.e., 31.5, 100, 1 000, 5 000, 6 300 and 20 000 Hz.
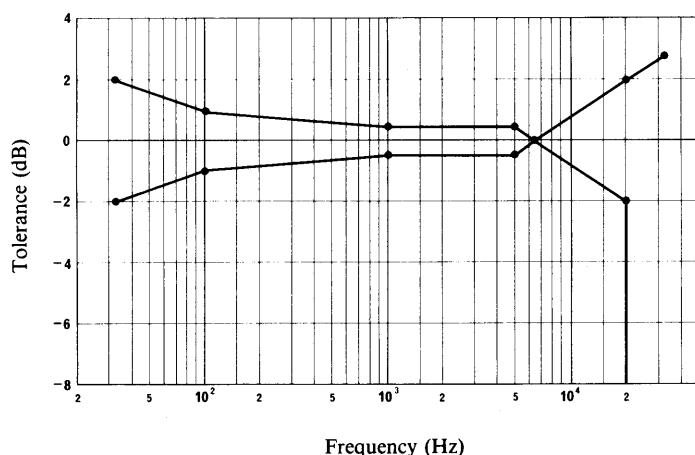
FIGURE 2 – *Maximum tolerances for the frequency response of the weighting network and the amplifier*

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NOTE 1 – When a weighting filter conforming to § 1 is used to measure audio-frequency noise, the measuring device should be a quasi-peak meter conforming to § 2. Indeed, the use of any other meter (e.g. an r.m.s. meter) for such a measurement would lead to figures for the signal-to-noise ratio that are not directly comparable with those obtained by using the characteristics that are described in the present Recommendation.

NOTE 2 – The whole instrument is calibrated at 1 kHz (see § 2.6).

2 Characteristics of the measuring device

A quasi-peak value method of measurement shall be used. The required dynamic performance of the measuring set may be realized in a variety of ways (see Note). It is defined in the following sections. Tests of the measuring equipment, except those for § 2.4, should be made through the weighting network.

NOTE – After full wave rectification of the input signal, a possible arrangement would consist of two peak rectifier circuits of different time constants connected in tandem.

2.1 Dynamic characteristic in response to single tone-bursts

Method of measurement

Single bursts of 5 kHz tone are applied to the input at an amplitude such that the steady signal would give a reading of 80% of full scale. The burst should start at the zero-crossing of the 5 kHz tone and should consist of an integral number of full periods. The limits of reading corresponding to each duration of tone burst are given in Table 2.

The tests should be performed both without adjustment of the attenuators, the readings being observed directly from the instrument scale, and also with the attenuators adjusted for each burst duration to maintain the reading as nearly constant at 80% of full scale as the attenuator steps will permit.

2.2   Dynamic characteristic in response to repetitive tone-bursts

Method of measurement

A series of 5 ms bursts of 5 kHz tone starting at zero-crossing is applied to the input at an amplitude such that the steady signal would give a reading of 80% of full scale. The limits of the reading corresponding to each repetition frequency are given in Table 3.

The tests should be performed without adjustment of the attenuators but the characteristic should be within tolerance on all ranges.

TABLE 2

Burst duration (ms)	1 ([1])	2	5	10	20	50	100	200
Amplitude reference steady signal reading (%) (dB)	17.0 −15.4	26.6 −11.5	40 −8.0	48 −6.4	52 −5.7	59 −4.6	68 −3.3	80 −1.9
Limiting values								
– lower limit (%) (dB)	13.5 −17.4	22.4 −13.0	34 −9.3	41 −7.7	44 −7.1	50 −6.0	58 −4.7	68 −3.3
– upper limit (%) (dB)	21.4 −13.4	31.6 −10.0	46 −6.6	55 −5.2	60 −4.4	68 −3.3	78 −2.2	92 −0.7

([1]) The Administration of the USSR intends to use burst duration ≥ 5 ms.

TABLE 3

Number of bursts per second	2	10	100
Amplitude reference steady signal reading (%) (dB)	48 −6.4	77 −2.3	97 −0.25
Limiting values			
– lower limit (%) (dB)	43 −7.3	72 −2.9	94 −0.5
– upper limit (%) (dB)	53 −5.5	82 −1.7	100 −0.0

2.3   Overload characteristics

The overload capacity of the measuring set should be more than 20 dB with respect to the maximum indication of the scale at all settings of the attenuators. The term "overload capacity" refers both to absence of clipping in linear stages and to retention of the law of any logarithmic or similar stage which may be incorporated.

Method of measurement

Isolated 5 kHz tone-bursts of 0.6 ms duration starting at zero-crossing are applied to the input at an amplitude giving full scale reading using the most sensitive range of the instrument. The amplitude of the tone-bursts is decreased in steps by a total of 20 dB while the readings are observed to check that they decrease by corresponding steps within an overall tolerance of ±1 dB. The test is repeated for each range.

2.4   Reversibility error

The difference in reading when the polarity of an asymmetrical signal is reversed shall not be greater than 0.5 dB.

Method of measurement

1 ms rectangular d.c. pulses with a pulse repetition rate of 100 pulses per second or less are applied to the input in the unweighted mode, at an amplitude giving an indication of 80% of full scale. The polarity of the input signal is reversed and the difference in indication is noted.

2.5   Overswing

The reading device shall be free from excessive overswing.

Method of measurement

1 kHz tone is applied to the input at an amplitude giving a steady reading of 0.775 V or 0 dB (see § 2.6). When this signal is suddenly applied there shall be less than 0.3 dB momentary excess reading.

2.6   Calibration

The instrument shall be calibrated such that a steady input signal of 1 kHz sine-wave at 0.775 V r.m.s., having less than 1% total harmonic distortion, shall give a reading of 0.775 V, 0 dB. The scale should have a calibrated range of at least 20 dB with the indication corresponding to 0.775 V (or 0 dB) between 2 and 10 dB below full scale.

2.7   Input impedance

The instrument should have an input impedance ≥ 20 kΩ and if an input termination is provided then this should be 600 Ω ±1%.

3   Presentation of results

Noise voltage levels measured according to this Recommendation are expressed in units of dBqps.

NOTE 1 – If, for technical reasons, it is desirable to measure unweighted noise, the method described in Annex 2 should be used.

ANNEX 1
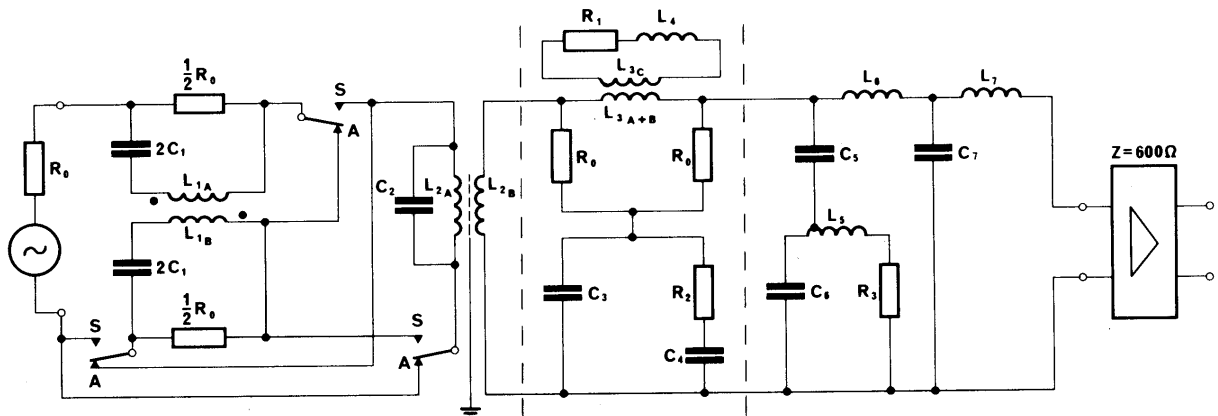
Constant resistance realization of weighting network

FIGURE 3 – *Constant resistance realization of weighting network*

R (Ω)	C (nF)	L (mH)		
R_0: 600	$2C_1$: 83.7	L_1:	12.70	(for both windings in series)
½ R_0: 300	C_2: 35.28	L_2:	15.06	(for each of two windings separated by electrostatic shield)
R_1: 912	C_3: 38.4			
R_2: 3340	C_4: 7.99			
R_3: 941	C_5: 23.8	L_{3A+B}:	16.73	(two equal windings in series)
	C_6: 13.94	L_{3C}:	4.18	(one winding, turns half L_{3A+B}, can have large d.c. resistance, absorbed in R_3)
	C_7: 35.4			
		L_4:	20.1	(can have large d.c. resistance, absorbed in R_3)
		L_5:	31.5	(with tap 20.1 at 0.798 of total turns)
A: unbalanced		L_6:	13.29	
S: balanced		L_7:	8.00	

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ANNEX 2

Unweighted measurement

It is recognized that unweighted measurements outside the scope of this Recommendation may be required for specific purposes. A standard response for unweighted measurements is included here for guidance.

Frequency response

The frequency response shall be within the limits given in Fig. 4.

This response serves to standardize the measurement and ensure consistent readings of noise distributed across the useful spectrum. When out-of-band signals, e.g. carrier leaks, are present at a sufficient amplitude, they may produce readings that are inconsistent between measuring equipments whose responses are different but still fall within the tolerance template of Fig. 4.
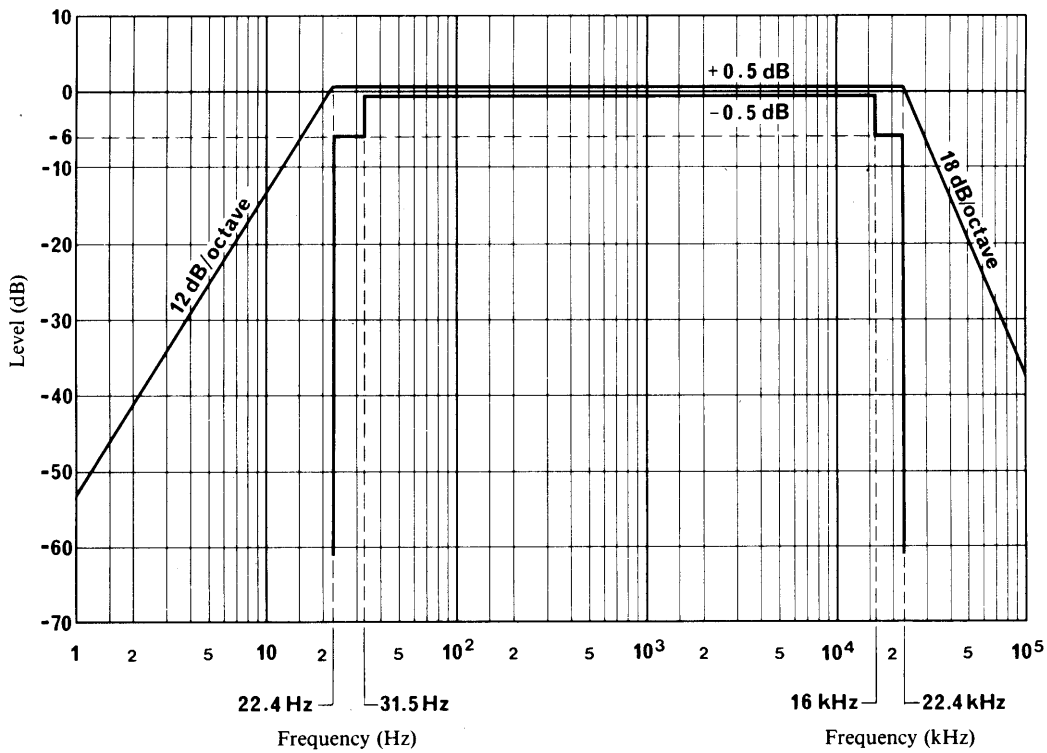
FIGURE 4