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ANSI/SMPTE 222M-1994
Revision of
ANSI/SMPTE 222M-1987

SMPTE STANDARD

for Television — Control and Review Rooms — Monitor System Electroacoustic Response

1 Scope

1.1 This standard specifies the method of measurement and characteristics for the monitor chain electroacoustic response of television control and review rooms with volumes of 150 m^3 (5300 ft^3) and smaller. It is intended to assist in standardization of reproduction of program sound in television control and review rooms.

1.2 It does not apply where the recorded sound is intended for reproduction under theater listening conditions; i.e., to motion-picture or public address systems. This standard does not cover equalization standards for other parts of the system, such as fixed or variable equalization applied for noise reduction around tape recorders, or the like.

2 Normative reference

The following standard contains provisions which, through reference in this text, constitute provisions of this standard. At the time of publication, the edition indicated was valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent edition of the standard indicated below.

ANSI S1.13-1971 (R1986), Methods for the Measurement of Sound Pressure Levels

3 Definitions

3.1 complete sound reproduction system: Represented diagrammatically in figure 1 and used in television control and review rooms, consisting of a main chain and a monitor chain.

3.2 main chain: That part of the television audio system which includes input transducers, audio, and the audio portion of video tape and/or disk recorders, pretransmitter audio signal processing, and the aural transmitter.

3.3 monitor chain: That part of the television audio system which includes the monitor fader, monitor equalization, monitor loudspeaker, and room acoustics of the monitor environment.

3.4 electroacoustic response: The electroacoustic response of the monitor chain at a point is the sound pressure level expressed in decibels with respect to a reference level of 20 μPa at 1 kHz measured over the bandwidth of the measuring system in use (see annex A) over a given frequency range measured at a given position in the listening area when pink noise is applied to the input of the monitor system. The overall electroacoustic response is made by averaging points in the room by the method specified in 4.2.

3.5 pink noise: A continuous spectrum of random noise exceeding the bandwidth of the object under test having constant energy per constant percentage of bandwidth (equal energy per octave).

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MOTION PICTURE AND TELEVISION ENGINEERS
595 W. Hartsdale Ave., White Plains, NY 10607
(914) 761-1100

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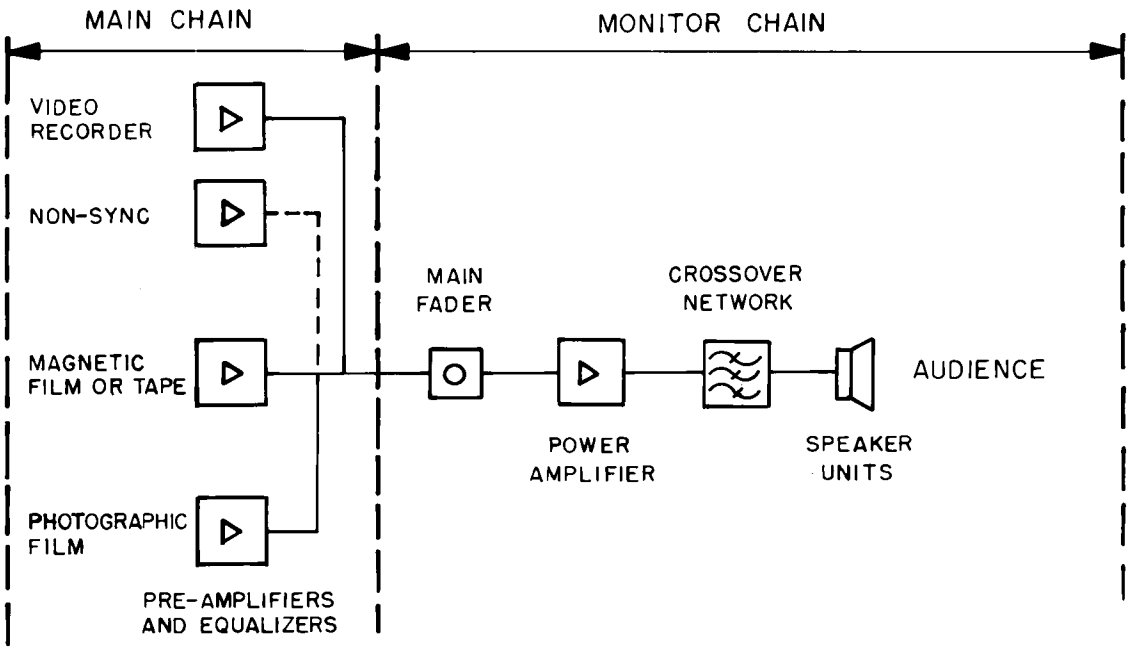


Figure 1 – Complete television sound reproducing system

4 Method of measurement

4.1 The electroacoustic response shall be measured with the equipment and instruments arranged in accordance with figure 2.

4.2 Sound pressure level vs frequency measurements shall be made as follows:

a) in dubbing control rooms, at each of the principal listening areas;

b) in review rooms, at a sufficient number of positions to cover the listening area.

To obtain a valid representation of the acoustic response throughout the listening area, it is suggested that at least three positions be averaged when employing whole-octave bands, and at least five positions when employing third-octave bands.

Averaging shall be done by the sum of the squares of the sound pressure levels as follows:

$$L = 10 \log_{10} \left[\frac{1}{N} \sum_{k=1}^{N} \text{antilog}_{10} \left(\frac{L_k}{10} \right) \right]$$

where N is the number of positions and L_k is the sound pressure level at each position. If the range of sound pressure levels lies within 4 dB, simple arithmetic averaging is sufficiently accurate to be used.

4.3 It is recommended that measurements be made at a normal seated head height between 1 m and 1.5 m (3.3 ft and 4.9 ft) and not closer than:

a) 1.5 m (4.9 ft) to any wall;

b) 2 m (6.6 ft) to the loudspeakers.

4.4 A suitable single loudspeaker sound pressure level with pink noise is 85 dB (flat or linear), but the spectral level in any third-octave band shall exceed the background noise in the band by at least 10 dB, or by 4 dB if adjusted according to ANSI S1.13.

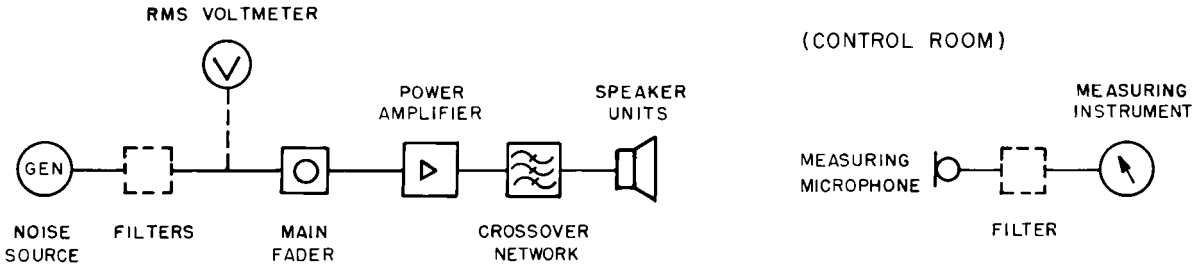


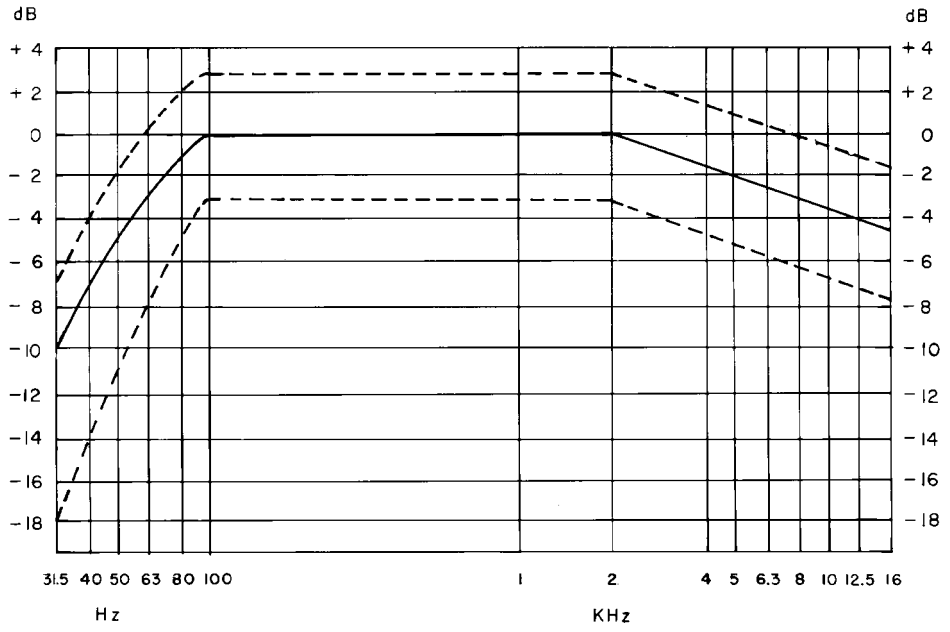
Figure 2 – Method of measurement of monitor chain (Optional equipment shown with dotted lines)

4.5 It is recommended that measurements be made with a microphone small enough so that high-frequency response errors due to diffraction effects about the microphone are minimized. A microphone having a difference between the direct 0° incidence and random incidence responses less than the tolerance specified in table 1 is preferred (see annex A.5).

4.6 Measurements of low-frequency response in small rooms are strongly influenced by individual room modes. The effect of room modes can be minimized by averaging the response at a large number of locations in the room (see annex A.4).

5 Characteristics

The electroacoustic response of the monitor chain shall be within the tolerance of the curve in figure 3 and table 1. This response is satisfactory for monitoring of all types of tracks at the monitor point in figure 1, including monitoring of film tracks after appropriate deemphasis, such as an Academy filter for monaural tracks, has been applied.



NOTE – Tolerances are based upon ⅓ octave measurements. If 1/1 octave measurements are used, reduce tolerance by 1 dB.

Figure 3 – Curve of monitor chain characteristic

Table 1 – Monitor chain characteristic

Central frequencies of one-third octave bands Hz	Characteristic dB	Tolerances + dB	–
31.5	–10	3	8
40	– 7	3	7
50	– 5	3	6
63	– 3	3	5
80	– 1	3	4
100	0	3	3
125	0	3	3
160	0	3	3
200	0	3	3
250	0	3	3
315	0	3	3
400	0	3	3
500	0	3	3
630	0	3	3
800	0	3	3
1000	0	3	3
1250	0	3	3
1600	0	3	3
2000	0	3	3
2500	– 0.5	3	3
3150	– 1.0	3	3
4000	– 1.5	3	3
5000	– 2.0	3	3
6300	– 2.5	3	3
8000	– 3.0	3	3
10 000	– 3.5	3	3
12 500	– 4.0	3	3
16 000	– 4.5	3	3

Annex A (informative)
Additional data

A.1 This standard refers to the monitor chain which includes the reproduction equipment as shown in figure 1 and the listening area in the control or review room.

It is emphasized that, in practice, satisfactory reproduction of sound in a control room or a review room is also dependent upon the alignment and performance of the principal chain equipment in the installation. It is therefore essential that the elements of the principal chain be correctly aligned within the tolerances of existing or proposed standards and practices by the use of appropriate photographic or magnetic test tape or film, and, in the case of reproducing photographic film or magnetic masters that were mixed for monaural photographic film and intended for playback through an Academy filter, that the relevant deemphasis network be applied.

A.2 The monitor chain response in this standard represents industry practice, but may result in inadequate monitoring at the lower bass end. A bass response which is flat to a lower frequency is more desirable for future television audio monitoring as loudspeakers are improved in the consumer market.

A.3 At least five methods of measurement are recognized as providing appropriate data for the evaluation of the electroacoustic response of the monitor chain. The methods depend on the generation of pink noise with flat frequency response from 31.5 Hz to 16 kHz or beyond, and are as follows:

a) Generate wide-band pink noise and measure the acoustic output with a calibrated microphone intended for use in the diffuse field and an audio-frequency, constant-percentage-bandwidth spectrum analyzer, such as a ⅓-octave band analyzer.

b) Generate pink noise in 1/3-octave bands conforming to the requirements for class II third-octave band filters, specified in ANSI S1.11. Measure the output sound pressure levels with a microphone and true-rms meter conforming to the requirements for a type 1 sound level meter specified in ANSI S1.4.

c) Generate wide-band pink noise and measure the acoustic output with an rms voltmeter and sound level meter as in b) above, reading the acoustic output through a series of 1/3-octave bandpass filters.

d) Generate pink noise in octave bands, the center frequencies of which shall be altered in either 1/1- or ⅓-octave steps. Measure the acoustic output with a sound level meter as described in b). This procedure, using full-octave bands, requires that tolerances on the monitor chain electroacoustic response curve be reduced as noted in figure 3.

e) Generate pink noise and, with a calibrated microphone intended for use in the diffuse field and a precision tape recorder, record the microphone signal as a function of both frequency and position in the control room. Reproduce and analyze the results by one of the methods described above at a subsequent time in an appropriate laboratory.

The pink noise test signal should be at such a level in the room as to be clearly louder than any ambient noise (air conditioning, traffic rumble, video tape recorders, etc.). The level should not be so loud as to risk loudspeaker damage or power amplifier clipping.

A.4 Care should be taken that none of the microphone placements chosen is extraordinary. Positions should be avoided which are exactly on lateral or transverse room centerlines.

A.5 A microphone satisfying the requirements of 4.5 will generally have a diameter of approximately ¼ in.

Annex B (informative)
Bibliography

ANSI S1.4-1983, Specification for Sound Level Meters

ANSI S1.11-1986, Specifications for Octave-Band and Fractional Octave-Band Analog and Digital Filters