SMPTE 214M-2007
Revision of
SMPTE 214M-1999

SMPTE STANDARD

for Motion-Picture Film (35-mm) — Analog Photographic Audio Reproduction Characteristics

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Foreword

SMPTE (the Society of Motion Picture and Television Engineers) is an internationally-recognized standards developing organization. Headquartered and incorporated in the United States of America, SMPTE has members in over 80 countries on six continents. SMPTE's Engineering Documents, including Standards, Recommended Practices and Engineering Guidelines, are prepared by SMPTE's Technology Committees. Participation in these Committees is open to all with a bona fide interest in their work. SMPTE cooperates closely with other standards-developing organizations, including ISO, IEC and ITU.

SMPTE Engineering Documents are drafted in accordance with the rules given in Part XIII of its Administrative Practices.

SMPTE Standard 214M was prepared by Technology Committee A12.

Approved
December 14, 2007

Introduction

Previous versions of this standard were written at a time when pre-emphasized audio tracks were still being created. That is no longer the case, but as there is still a requirement to play back old films with pre-emphasized audio tracks, this standard still includes the required de-emphasis characteristic.

1 Scope

This standard specifies the electrical frequency response characteristics for analog photographic audio reproduction in motion-picture control rooms and indoor theatres. It is intended to assist in standardization of recording monitor and reproduction characteristics of 35-mm motion-picture audio in studio dubbing theatres, review rooms, and indoor theatres. The standard covers that part of the motion-picture audio-system from the transducer to the input terminals of the main fader.

2 Conformance Notation

Normative text is text that describes elements of the design that are indispensable or contains the conformance language keywords: "shall", "should", or "may". Informative text is text that is potentially helpful to the user, but not indispensable, and can be removed, changed, or added editorially without affecting interoperability. Informative text does not contain any conformance keywords.

All text in this document is, by default, normative, except: the Introduction, any section explicitly labeled as "Informative" or individual paragraphs that start with "Note:"

The keywords "shall" and "shall not" indicate requirements strictly to be followed in order to conform to the document and from which no deviation is permitted.

The keywords, "should" and "should not" indicate that, among several possibilities, one is recommended as particularly suitable, without mentioning or excluding others; or that a certain course of action is preferred but not necessarily required; or that (in the negative form) a certain possibility or course of action is deprecated but not prohibited.

The keywords "may" and "need not" indicate courses of action permissible within the limits of the document.

The keyword “reserved” indicates a provision that is not defined at this time, shall not be used, and may be defined in the future. The keyword “forbidden” indicates “reserved” and in addition indicates that the provision will never be defined in the future.

A conformant implementation according to this document is one that includes all mandatory provisions ("shall") and, if implemented, all recommended provisions ("should") as described. A conformant implementation need not implement optional provisions ("may") and need not implement them as described.

3 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.

SMPTE 202M-1998, Motion-Pictures — Dubbing Theaters, Review Rooms and Indoor Theaters — B-Chain Electroacoustic Response

4 Definitions

4.1 complete audio reproduction system: Represented diagrammatically in figure A.2 and used in studio dubbing theatres, review rooms, and indoor theatres; by convention consist of an A-chain and a B-chain.

4.2 pre-emphasized audio track: An analog monaural photographic audio track, also known as an Academy sound track, which is pre-emphasized and requires de-emphasis during playback. Now very rarely used, but found on all films prior to the mid-1970's.

4.3 wide-range audio track: An analog photographic audio track (typically stereophonic) which has not been pre-emphasized and is intended for playback over a theatre system whose B-chain has been aligned to curve X of SMPTE 202M. Invariably uses noise reduction/companding technology.

4.4 A-chain (transducer system): The A part of a motion picture audio system, shown in figure A.2, which for analog photographic sound playback extends from the transducer cell to a point beyond any de-emphasis or noise reduction decoding, and prior to any B-chain equalization. The A-chain will also typically include aperture loss correction circuitry.

4.5 B-chain (final chain): The B part of a motion picture reproduction system, as shown in figure A.2, which extends from the output of the A-chain to the listening area of the room or auditorium. Two B-chain characteristics are described in SMPTE 202M; curve N, typical of practice prior to the 1980's, and a wide-range curve, referred to as curve X, typical of contemporary practice.

4.6 type O theatre: A theatre in which only pre-emphasized motion pictures are played – now very rare.

4.7 type N theatre: A theatre in which both wide-range pictures and (rarely) pre-emphasized motion pictures are played.

5 Method of Measurement

5.1 The electrical response of the A-chain shall be measured after any required de-emphasis or noise reduction/companding decoding has been applied, and before any B-chain equalization has been applied.

5.2 The response shall be measured using either a high-impedance voltmeter accurate from 20 Hz to 20 kHz $\pm$ 0.25 dB in combination with a multi-frequency photographic test film, or a one-third octave real-time analyzer in combination with a pink noise test film.

6 Characteristics

6.1 When the test film is played on the reproducer, the measured frequency response shall match the curves given in Figure 1 and Table 1 within the tolerances given in Table 1.

6.1.1 Column 2 of Table 1 represents practice for playback of pre-emphasized audio tracks over a B-chain described as curve N in SMPTE 202M.

6.1.2 Column 3 of Table 1 represents practice for playback of pre-emphasized audio tracks over a B-chain described as curve X in SMPTE 202M.

6.1.3 Wide-range audio tracks should be played back with a flat A-chain, as shown in column 4 of Table 1.

NOTE – In some theatres, it may not be possible to separate the A-chain and B-chain responses. For reference purposes, therefore, Figure A.1 and Table A.1 in the annex show the total A + B responses.

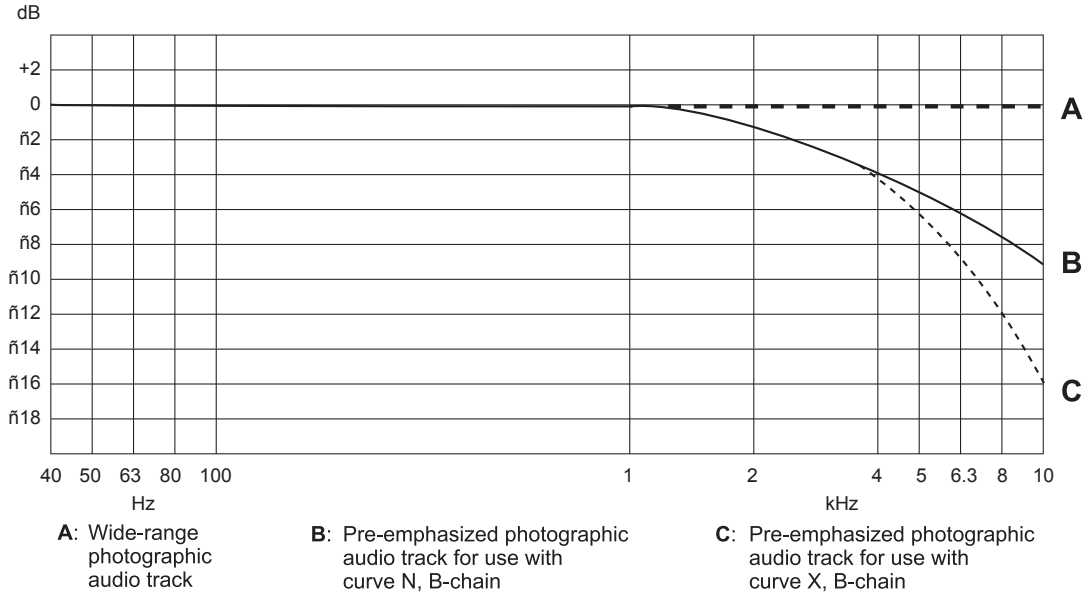

Figure 1 – A-chain characteristics

Table 1 – A-chain frequency response characteristics (dB)

Frequencies (Hz)	Pre-emphasized audio track curve N, B-chain	Pre-emphasized audio track curve X, B-chain	Wide-range audio track curve X, B-chain	Tolerances (dB)
40	0	0	0	± 2
63	0	0	0	± 2
125	0	0	0	± 1
250	0	0	0	± 1
500	0	0	0	± 1
1,000	0	0	0	± 1
2,000	– 1.0	– 1.0	0	± 1
2,500	– 2.0	– 2.0	0	± 1
3,150	– 3.0	– 3.0	0	± 1
4,000	– 4.0	– 4.5	0	± 1
5,000	– 5.0	– 6.5	0	± 1
6,300	– 6.0	– 9.0	0	± 1
7,100	– 7.0	– 10.5	0	± 1
8,000	– 7.5	– 12.0	0	± 1
9,000	– 8.0	– 14.0	0	± 1
10,000	– 9.0	– 16.0	0	± 1

Annex (informative)
Additional data

A.1 For reference purposes only, Figure A.1 and Table A.1 show the overall A-chain + B-chain figures for the playback of pre-emphasized (column 2) and wide-range (column 3) analog photographic audio tracks. The wide-range characteristic uses a B-chain described as curve X in SMPTE 202M.

A.2 The figures in Figure A.1 (solid curve) and Table A.1 (column 2) represent the best average A-chain + B-chain electroacoustic characteristic for the playback of pre-emphasized audio tracks. The characteristic is based on the average of 150 theatre replay curves measured in six countries between 1971 and 1975, adjusted slightly to take account of international practice during the 1980's. There is some spread in the international figures, but the characteristic shown in this standard is a best average for the playback of this archive material.

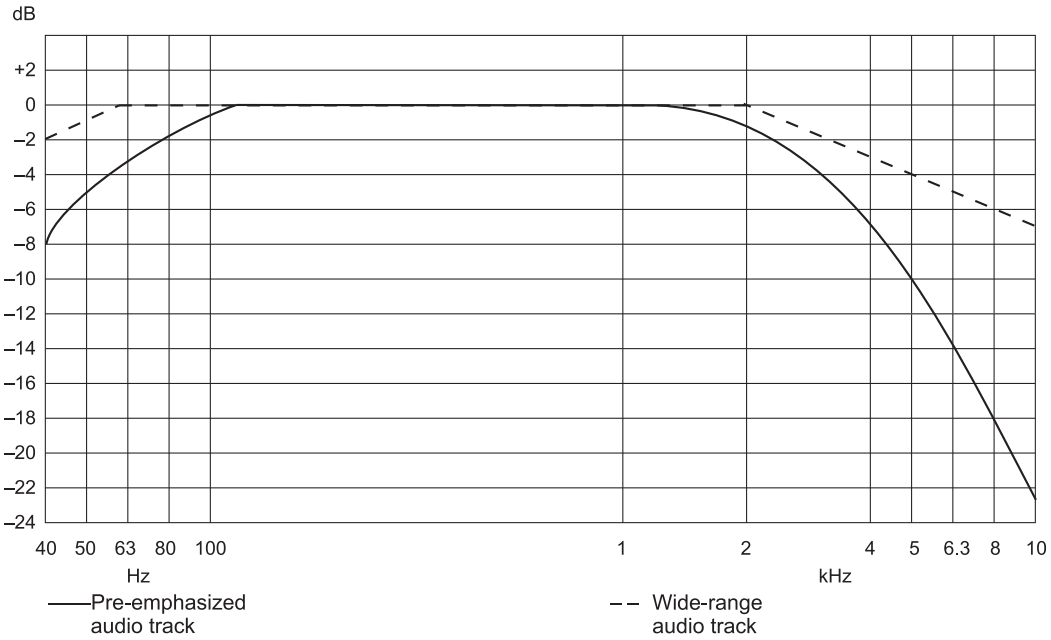

Figure A.1 – A-chain + B-chain total electro-acoustic response

Table A.1 – A-chain + B-chain total electro-acoustic response

Frequencies (Hz)	Pre-emphasized audio track	Wide-range audio track
40	– 8.0	– 2.0
63	– 3.0	0
125	0	0
250	0	0
500	0	0
1,000	0	0
2,000	– 1.0	0
2,500	– 3.0	– 1.0
3,150	– 5.0	– 2.0
4,000	– 7.5	– 3.0
5,000	– 10.5	– 4.0
6,300	– 14.0	– 5.0
7,100	– 16.0	– 5.5
8,000	– 18.0	– 6.0
9,000	– 20.5	– 6.5
10,000	– 23.0	– 7.0

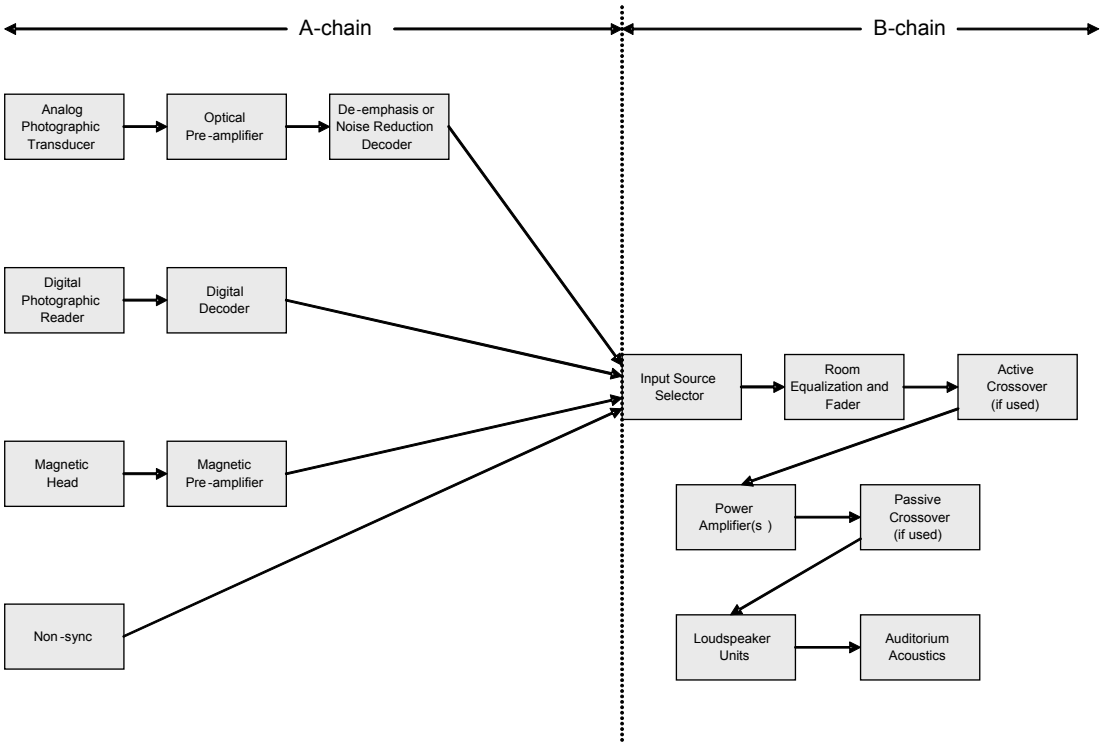

Figure A.2 – Complete theatrical audio reproducing chain