SMPTE ENGINEERING GUIDELINE

EG 23-2005
Revision of EG 23-1996

Transfer of Two-Channel Stereo Audio from Audio Magnetic Film or Tape to Video Tape

1 Scope

1.1 This guideline specifies the handling of volume range issues when transferring two-channel stereo audio from 35-mm or 16-mm magnetic film, or other audio tape formats utilizing time-code based methods of synchronization, to any video recording media.

1.2 Among the volume range issues are both objective and subjective ones, including:

– most end users will usually adjust loudness so that dialog is reproduced at a normalized level (despite how loud or soft other parts of the program may be) for best intelligibility;

– dubbing stages and monitor theaters are often operated at higher reference sound pressure levels than the end video consumer will use;

– commercials may well be intercut with program material, creating the potential for abrupt level changes among video sources;

– many of the video formats have reduced audio dynamic range capability when compared to magnetic audio-only masters;

– video transmission involves at least a 75-ms preemphasis network in the transmitter, and often much more nonstandardized audio signal processing, which has an impact on the volume range relationships within the program material.

1.3 The guideline also specifies certain labeling requirements for audio masters.

2 Definitions

2.1 dynamic range: The range along an intensity scale of which a medium is capable; measured from a maximum point of stated distortion to a background noise level. Dynamic range varies frequency-by-frequency, but is often expressed as a single number from the mid-band defined distortion level to the psycho-acoustically weighted noise level, e.g., "the dynamic range was 72 dB (3% THD to CCIR-ARM noise)."

2.2 volume range: The range along an intensity scale occupied by program material; volume range is taken to be from the highest peaks of the program to the lowest signal intended to be audible.

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3 Identification

3.1 The audio film or tape shall be clearly marked with the title and reel number of the program and identified as a two-channel stereo recording. If the medium is capable of more than two audio records, then the channels containing the left and right audio master information shall be indicated.

3.2 If proprietary noise-reduction companding is employed on the master, the type of noise reduction, and, if required, the reference fluxivity for setting the operating point of the noise reduction system shall be indicated.

4 Use of noise reduction

4.1 If the program material has been encoded for a proprietary companding noise-reduction system, then corresponding noise reduction decoders must be engaged. If external to the video recorder, such decoders shall be included in the signal path immediately after the audio film or tape playback preamplifier, and before any other audio signal processing.

4.2 If the video master is to employ external noise-reduction encoding, then the noise-reduction encoder shall be included in the signal path after all other audio processing, immediately before the video recorder.

5 Reference levels and their usage

5.1 Reference fluxivity for film masters is given in SMPTE EG 9 as 185 nWb/m. Reference fluxivity for 1-in C-format video tape is given in SMPTE 20M as 100 nWb/m. Reference fluxivity on tape masters may range from 185 to 320 nWb/m, depending on the practice of the studio making the master and so must be indicated on the label. Even though reference fluxivity on tape masters may range from 185 to 320 nWb/m, the peak level used for program material is usually within a smaller range, since metering practice (vu vs. peak) dictates that vu meters are used with lower reference levels, and peak meters with higher ones.

5.2 Normal practice is to set the audio reproduction and recording chain gain structure such that the reference fluxivity used in the source medium is copied to the reference fluxivity of the recording medium. For media wherein reference fluxivity does not apply as a level-determining mechanism, such as 1/2-in "hi-fi" recording by way of audio on FM carriers on the video tracks, a combination of setting the level using meter readings on the recorder while playing the source material, and sample recordings, are the best way of determining the correct recording level.

5.3 If the video recorder has a compressor or limiter as a part of its circuitry, the compressor or limiter should be switched off, if possible.

6 Need for volume-range reduction

6.1 The combination of the subjective and objective factors given in the scope often leads to the need for reducing the volume range of source material, when copying from audio masters to video tape.

6.2 Measurements of contemporary magnetic film and 1-in video tape on recorders set to all the relevant standards show video tape to have 8 dB less headroom for equal distortion to magnetic film at 200 Hz, but equal headroom at 10 kHz. In addition, video tape is some 10 dB noisier in the psycho-acoustically important 2-3 kHz region.

6.3 Differing conditions outlined in the scope lead to a range of solutions, so that no one set of rules can be developed. On the other hand, examples can be given for various transfer conditions, and are shown in the next clause.

General principles are:

– it is important to monitor the program under conditions as like those as encountered by the final user as possible, so that volume range judgments are not obscured by other factors. These conditions include reference sound pressure level and frequency response of monitoring, background noise level of the listening room, choice of stereo vs. monaural monitoring, and the like;

– it is important to monitor the output from the recording media, rather than simply its input, to check the generation loss due to the transfer process. If the recorder does not provide playback off the tape simultaneously while recording, then a sample recording should be synchronized to the audio master, and A/B compared;

– limiting may be preferred to compression as producing the better artistic representation of the program material on the recording medium (i.e., limiting can have fewer audible side effects than compression). The amount of limiting is usually kept to the range of about 6 dB on the peaks of program.

7 Examples

7.1 *Problem:* A 35-mm magnetic master intended for transfer to a stereo optical track of a theatrical motion picture is to be transferred to 1-in C-format video tape for playback on commercial television. The picture is action-oriented, containing loud sound effects and music.

Discussion: There are a number of factors stated in the problem that influence the amount of volume range modification necessary:

The fact that the master has been prepared for transfer to optical film means that the volume range has probably already been limited, since conventional optical tracks have less dynamic range than do magnetic ones.

The statement that the picture contains loud sound effects and music implies that the dialog level is relatively low, compared to the maximum levels, for this example.

The reference sound pressure level in motion-picture theaters has been observed to be about 6 dB greater than that used by the majority of listeners in the home
environment.

The statement that the program will be played over commercial television means that low dialog level will be much more noticeable than if there were no commercials, since listeners will adjust the volume for a normalized level of dialog during the program, and if the program dialog level is low, will find the commercials too loud.

The first factor implies little volume-range modification is necessary, but, on the other hand, the other three factors, especially taken together, call for a reduction of the volume range.

Solution: Use a limiter set so that the program peaks cause 6 dB of limiting.

7.2 *Problem:* The same master as in 7.1 is to be transferred to a wide dynamic range digital recording for use as a running master in duplicating 1/2-in "hi-fi" format video tapes.

Discussion: The emphasis in maintaining the full dynamics of the master are more important for the "hi-fi" part of the market than they are for commercial television, due to the rising popularity of home use of VCRs with attached stereo audio systems. The use of a wide dynamic range running master is essential since the dynamic range performance of the "hi-fi" recording is greater than that of 1-in C-format video tape, even if noise reducing companding is employed on the video tape.

Solution: Use no limiting or compression to make the running master. (Note: It may be necessary for the duplicator to employ compression or limiting of the signal sent to the conventional longitudinal track, if both the "hi-fi" and conventional tracks are to be optimized simultaneously.

7.3 *Problem:* A monaural DME (having dialog, music and effects on separate channels of a 3-track magnetic film) is to be transferred to 3/4-in video tape. The program material is a documentary in which narration is the loudest part of the program.

Discussion: Despite the probable low volume range of the original, some limiting may be necessary due to the low audio dynamic range of the 3/4-in video medium compared to the audio film source.

Solution: Use a limiter with a maximum gain reduction of about 6 dB.

Annex A (informative**)**
Bibliography

SMPTE 20M-2003, Television Analog Recording — 1-in Type C Recorders and Reproducers — Longitudinal Audio Characteristics

SMPTE RP 150-2000 (Archived 2005), Channel Assignments and Test Leader for Magnetic Film Masters Intended for Transfer to Video Media Having Stereo Audio

SMPTE EG 9-2005, Audio Recording Reference Level for Post-Production of Motion-Picture Related Materials