EG 32-1996

SMPTE ENGINEERING GUIDELINE

Emphasis of AES/EBU Audio in Television Systems and Preferred Audio Sampling Rate

1 Scope

This guideline defines the use of emphasis and sample rate in digital audio systems within television facilities. The AES/EBU digital audio standard has four conditions of emphasis and three basic sample rates. Although any or all of the possible emphasis and sample rate combinations can be used, it is good engineering practice to use a common emphasis and a single sample rate within a television facility.

2 Definitions

2.1 AES audio: Audio data and auxiliary data that are derived from ANSI S4.40 are hereafter referred to as AES audio. This may be in a normal serial digital audio format or embedded within a serial digital video stream.

2.2 emphasis indication: AES audio uses bits 2 through 4 of the channel status byte 0 to indicate the type of emphasis, if any, used with the digital audio signal. Two types of emphasis are defined, along with no emphasis and an emphasis not indicated.

3 Background

3.1 Although many pieces of digital audio storage and distribution equipment used within television facilities do not care about sample rates and emphasis, mixing and other processing devices may be significantly affected by these characteristics. Digital audio signals must have matching emphasis and sample rates when they are mixed together. Standardizing the sample rate and emphasis within television studios can greatly simplify system structures and prevent problems in processing of audio signals.

3.2 Emphasis is used to boost the high-frequency components of an analog audio signal prior to certain storage and transmission systems. This can be useful in FM transmission or analog disc recordings where the noise level increases with frequency. The emphasis is removed at the receiving end or during playback, reducing the high-frequency noise at the same time. Emphasis reduces the high-frequency audio head room, which can lead to earlier clipping on loud transient sounds or high amplitude signals of high audio frequencies. Emphasis is useful in some kinds of companded coding, such as NICAM and J41 (12-bit A-Law), but is generally not useful in linearly represented audio, although some compact discs have been released with emphasis. CD players automatically remove the emphasis in either the digital or analog domain. With modern audio digital-to-analog conversion systems using oversampling and other techniques, emphasis is seldom used on modern digital recordings.

3.3 Digital audio signals must have identical sample rates in order to be properly mixed together. In a facility where the audio sources are locked to a common reference, this should not be a problem. Signals that are at a different sample rate, or signals that have an almost identical sample rate, but are not locked to the local reference, will require resampling to synchronize them with the other sources and permit proper mixing to take place. This is similar to the need to synchronize video signals before mixing them.

3.4 Modern technology is making it easier and less expensive to change audio emphasis curves, and to change audio sample rates. Unfortunately, these conversions are not transparent. The audio is distorted each time the digital samples are converted. Some manipulations are necessary,

Approved October 1, 1996

such as gain changes in mixing or sample rate conversions to mix a compact disc into a signal sampled at 48 kHz, but unnecessary conversions should be avoided.

4 Specification

4.1 It is recommended that no emphasis be used for the normal interchange of AES/EBU audio within television facilities.

4.1.1 A signal marked as "emphasis not indicated" in the channel status byte should be assumed to have no emphasis and the channel status byte should not be changed. Any signals that are marked in the channel status byte 0 as having emphasis should have the emphasis removed and the signal marked as no emphasis in the channel status byte. It is recommended that emphasis be removed at the point where the signal having emphasis enters the television system.

4.2 The preferred audio sampling rate is 48 kHz for audio interchange within television facilities, because it gives the widest audio bandwidth of the AES/EBU family of sampling rates. It also has the simplest ratio of sample rate to frame rate for 29.97-Hz and 59.94-Hz systems.

4.2.1 Sample rates must match when digital audio signals are mixed together. Any signals with different sample rates must be converted before they are mixed together. It is recommended that a sample rate conversion take place at the point where a signal with a different sample rate enters the television system. It should be synchronized to the plant reference signal at that time.

4.3 The emphasis and sample rate recommendations listed above are the best options at this time for most television facilities. Future technologies, system designs, or user preferences may suggest, or even require, that a different sample rate or emphasis be used. It will still be necessary for sample rates and emphasis to match when signals are mixed. The user must decide whether to convert all of the facility to a different standard, or to convert between that standard and other standards in the television facility.

Annex A (informative)
Bibliography

ANSI S4.40-1992, Digital Audio Engineering — Serial Transmission Format for Two-Channel Linearly Represented Digital Audio Data (AES-3)

ANSI/SMPTE 272M-1994, Television — Formatting AES/EBU Audio and Auxiliary Data into Digital Video Ancillary Data Space