Technical Requirements for Third-Party Product Compatibility with Dolby E Bitstreams

Version 1.2 S01/13571

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Chapter 1
Introduction

Dolby E is a professional digital audio coding system intended for the distribution of audio and metadata in professional audio/video applications. Dolby Laboratories manufactures Dolby E encoding and decoding equipment and other devices that support Dolby E; a key feature of Dolby E, however, is compatibility with products from third-party manufacturers. In practice, Dolby E bitstreams will encounter a wide variety of devices within broadcast facilities and other professional audio/video environments. To ensure maximum interoperability of Dolby E bitstreams between devices (and to aid users in identifying the compatibility of devices), it is valuable to define a set of compatibility standards.

This document defines compatibility standards for third-party products that transport, record, monitor, process, or otherwise convey Dolby E bitstreams and/or associated audio metadata. This document may be used by equipment designers as a specification and a guide for designing Dolby E compatibility into devices. It may also be used by manufacturers as a specification for assessing compatibility of existing devices. In addition this document may be useful to systems integrators and end users who wish to fully understand Dolby E product compatibility requirements in order to make informed system specifications and equipment purchasing decisions.

This document provides both specifications for Dolby E compatibility as well as information about Dolby E that is necessary for a complete description of the compatibility standards. Information and fundamental specifications for Dolby E are provided in Chapters 0, 4, 5 and 11. Chapter 0 provides basic information about Dolby E including a detailed description of Dolby E features. Chapter 4 gives specifications for transport of Dolby E including video synchronization specifications and various I/O specifications. Chapter 5 describes detailed system integration issues that affect product compatibility standards. Chapter 11 includes references to other information about Dolby E, standards, and related subjects.

Chapters 6, 7, 8, 9, and 10 describe the product compatibility standards. Product compatibility includes specific requirements and recommendations that are dependent on product function. Chapter 6 defines the product categories that are used to specify Dolby E compatibility. Chapter 7 defines compatibility options that may be supported within each product category. This is followed by the specific Dolby E compatibility standards. Chapter 0 provides baseline standards that apply to all product categories, and Chapter 9 provides specific standards for each product category. Chapter 10 includes testing procedures used to evaluate product and system compatibility.

As a reference tool, this document is designed to be read from “back to front” with product standards summarized towards the back and more detailed information on a particular topic available in the front. The structure of this document is illustrated in Figure 1-1.

Dolby E Information and Specifications	.	Dolby E Fundamentals	Basic Dolby E information
	Chapter 4	Transport Specifications	Specifications for transport (and storage) of Dolby E bitstreams
	Chapter 5	System Integration Issues	Additional issues regarding transport (and storage) of Dolby E bitstreams
	Chapter 11	References	References to standards and other Dolby E information

Compatibility Standards	Chapter 6	Product Categories	Definition of product categories
	Chapter 7	Compatibility Options	Definition of levels of product compatibility
	Chapter 0	Baseline Standards	Standards applying to all product categories
	Chapter 9	Standards for Specific Product Categories	Standards applying to specific product categories
	Chapter 10	Test Procedures	Information about testing and evaluation of product compliance

Figure 1-1 Document Structure

Chapter 2
Compliance Notation

This document specifies a set of compatibility standards for assessing product compatibility with Dolby E bitstreams. Various compatibility levels and classes are specified. Within compatibility levels, various product compliance standards are defined. Product compliance standards fall into three main categories: requirements, recommendations, and options.

- *Requirements* are functions and specifications that are mandatory for compatibility. Requirements are generally inflexible and have been set to allow the greatest range of products to comply with the requirements while still providing a meaningful benefit to product users.
- *Recommendations* are suggestions that are intended to increase interoperability between devices and to maintain Dolby E features within a distribution chain.
- *Options* are alternatives that are presented for certain features or modes of operation. In general, options provide additional support for specific Dolby E features that may be desired by end users.

As used in this document, "*must*", "*shall*", or "*will*" denote mandatory requirements. "*Should*" denotes a provision that is recommended but not mandatory. "*May*" denotes a feature whose presence does not preclude compatibility, and that may or may not be present at the option of the equipment designer or manufacturer.

Chapter 3
Dolby E Fundamentals

3.1 Dolby E Features

The Dolby E format that has been developed for the distribution of audio in digital TV broadcast systems. The Dolby E system supports features found in digital broadcast audio emission formats that current broadcast distribution infrastructures are not currently equipped to support. These include multichannel sound (5.1), support for multiple languages and audio programs, and the inclusion of metadata describing the audio program. Dolby E utilizes a “mezzanine” level bit-rate reduction algorithm that allows for multiple tandem encode/decode cycles within a distribution chain without loss of quality even with processing between coding stages.

3.1.1 Channel Configurations

The Dolby E algorithm is optimized for handling discrete multichannel audio programs and/or multiple audio programs. Encoded audio channels are grouped as programs which are typically either mono (one channel), stereo or matrix surround (Lt/Rt) encoded (two channels), or discrete five-channel audio with an LFE track (5.1 channels). The eight available channels can be flexibly assigned in many different program configurations. For instance, the “5.1+2” configuration can be used to carry a 5.1-channel main audio program plus a second language stereo program. The “4×2” mode can be used to carry four separate stereo programs, each possibly a different language or service type (commentary tracks, etc.). The “8×1” mode can convey eight individual mono programs, making it highly useful for a wide variety of broadcast applications even when 5.1 channel audio is not required. If less than eight audio channels are needed Dolby E will make use of the available data space for the number of channels that present. The channel configuration is determined at the time of encoding, allowing users to choose the best mode for the specific application.

3.1.2 Bit Depth

The Dolby E frames are embedded into the AES3 interface by mapping the Dolby E data into the audio sample word bits of the AES3 frames utilizing both channels within the signal. The data can be packed to utilize 16, 20, or 24 bits in each AES3 subframe. The advantage of utilizing more bits per subframe is that more data rate is available for carrying the coded information. With a 48 kHz AES3 signal, the 16-bit mode allows a data rate of up to 1.536 Mbps for the Dolby E signal, while the 20-bit mode allows 1.92 Mbps. The higher data rate allows more generations and/or more channels of audio to be supported; however, some AES3 data paths may be restricted in data rate (for example, some storage devices will only record 16 or 20 bits). Dolby E allows the user to choose the optimal data rate for a given application.

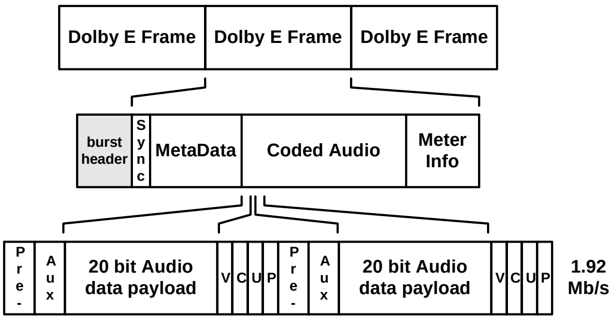

Figure 3-1 AES3/Dolby E Packet Structure

3.1.3 Compression Ratio

To meet the requirements of operation with existing equipment and facilities and the cascadability of multiple encode/decode generations, the Dolby E algorithm uses a moderate level of approximately 4:1 data rate compression. This allows up to eight channels of audio (six channels for 16-bit depth) to be carried over a single AES3 interface intended to be stored on a single AES pair of a DVTR or other storage device capable of recording digital audio conforming to AES3. It is this rate reduction that allows Dolby E to work with many existing devices in a two-channel digital audio infrastructure. However, the rate reduction is moderate enough to allow multiple encode/decode cycles.

3.1.4 Video Frame Rates

The Dolby E algorithm is designed to work with all common video rates and standards: 29.97 Hz (NTSC), 25 Hz (PAL), 24 Hz, 30 Hz, and so on.

Currently supported video frame rates:

- 29.97 fps* (NTSC)
- 25 fps* (PAL)

  *As of software version 1.05

3.1.5 Video Synchronization

Fundamental to the operation of Dolby E is the principal of synchronization with video. In order to provide an exact match between encoded Dolby E audio frames and video frames, Dolby E requires synchronization to a video signal. All Dolby E encoders must have either a direct reference video signal, or the information derived from a video reference signal. Dolby E decoders also require video reference information to maintain Dolby E features, and in general, Dolby E transport methods always rely on synchronization to video for proper operation. This section specifies Dolby E video synchronization requirements for transport methods.

Dolby E transport methods have two requirements for synchronization to video: *frame rate* synchronization and *phase* synchronization. Essential to synchronization are *video reference signals*.

3.1.6 Seamless/Glitchless Switching and Editing

When Dolby E signals are transported synchronously with video, switching and editing between coded Dolby E signals can be performed seamlessly with no glitches or other artifacts. This is illustrated in Figure 3-2 and Figure 3-3. Figure 3-2 shows the problem that can occur when two nonsynchronous coded audio signals (Dolby Digital/AC-3 streams in this example) are switched or edited, a common occurrence with emission coding formats. Since there is no common reference between the encoded frames a gap will likely occur between the frames resulting in an audio mute or other artifact. Figure 2 shows editing with Dolby E frames. Since the Dolby E frames are linked to a common video reference, there is no gap in the audio during a switch or edit, and no mute or loss of data will occur as long as the edit or switch preserves the data in each coded Dolby E frame. Dolby E decoders will automatically detect the change in audio streams and perform a crossfade between the two signals. The crossfade will be identical to what occurs when PCM audio signals are crossfaded during an edit or switch.

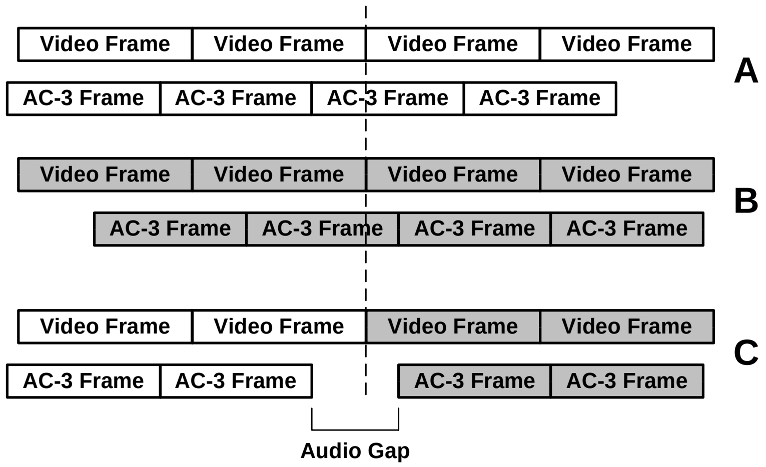

Figure 3-2 AC-3 Switching

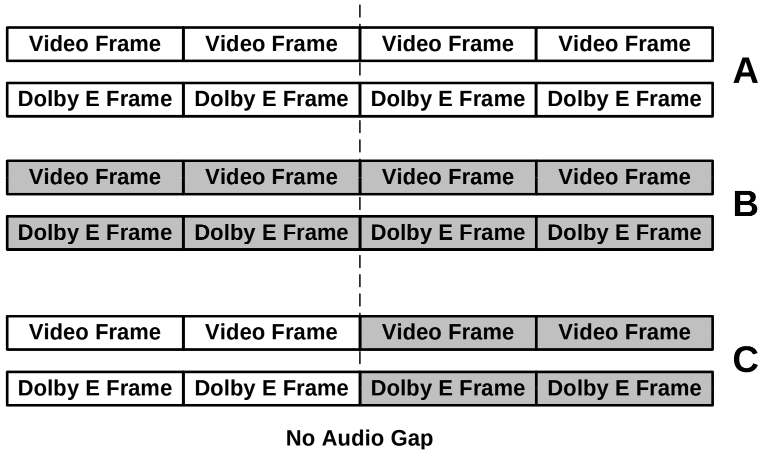

Figure 3-3 Dolby E Switching

3.1.7 Multiple Coding Generations

Dolby E supports at least ten tandem coding generations without audible degradation of the audio signals, even when processing on the audio signals is performed between generations. This allows typical audio signal processing that is performed in a distribution chain, such as postproduction editing and voice-over processing, to be done in the PCM domain without suffering audible degradation if the audio is re-encoded into the Dolby E format. However, several features built into Dolby E allow simple processing functions to be performed in the coded domain to further reduce the number of generations required.

3.2 Dolby E Frames

Dolby E signals are carried in the AES3 interface using a packetized structure. The packets (data bursts) are based on the coded Dolby E frame which is illustrated in the Figure below. Each Dolby E frame consists of a synchronization field, metadata field, coded audio field, and a meter field. The metadata field contains a complete set of parameters so that each Dolby E frame can be decoded independently. The Dolby E frames are embedded into the AES3 interface by mapping the Dolby E data into the audio sample word bits of the AES3 frames utilizing both channels within the signal.

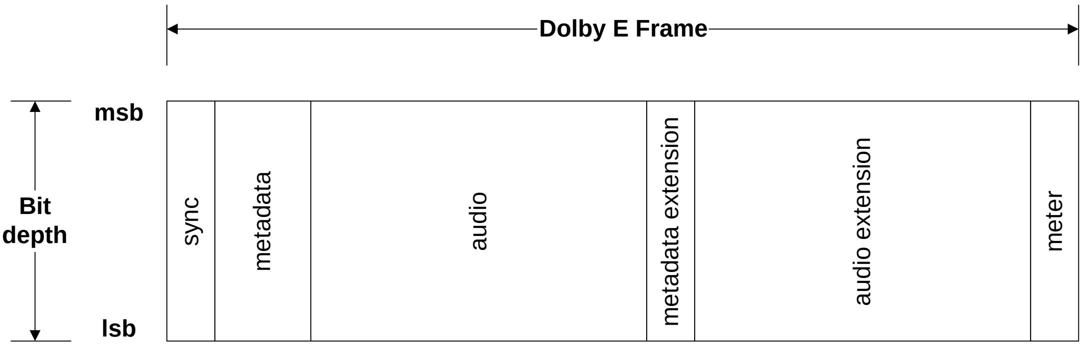

Figure 3-4 Dolby E frame structure, low frame rate

Chapter 4
Transport Specifications

This chapter provides specifications for transport and storage of Dolby E bitstreams and Dolby E metadata.

4.1 Video Synchronization

Fundamental to the operation of Dolby E is the principal of synchronization with video. In order to provide an exact match between encoded Dolby E audio frames and video frames, Dolby E requires synchronization to a video signal. All Dolby E encoders must have either a direct reference video signal or the information derived from a video reference signal. Dolby E decoders also require video reference information to maintain Dolby E features, and in general, Dolby E transport methods always rely on synchronization to video for proper operation. This section specifies Dolby E video synchronization requirements for transport methods.

Dolby E transport methods have two requirements for synchronization to video: *frame rate* synchronization and *phase* synchronization. Essential to synchronization are *video reference signals*.

4.1.1 Frame Rate Synchronization

Dolby E frame rate synchronization is analogous to sample-rate synchronization of linear PCM audio. Dolby E encoders produce exactly one Dolby E frame for every frame of video, and transport interfaces must ensure that Dolby E bitstreams are conveyed to decoders such that exactly one Dolby E frame is presented to the decoder for each video frame. This synchronization must be maintained within equipment as well.

In cases where Dolby E is transported over existing digital audio interfaces, Dolby E frame rate synchronization is directly related to the audio sample rate of the transport interface. The basic requirement for frame rate synchronization with existing transport methods is the following:

When Dolby E is transported over digital audio interfaces intended for linear PCM digital audio, the interface shall be operated at 48 kHz sample-rate locked to a video reference signal corresponding to the Dolby E frame rate.

In current usage there are two exceptions to this rule:

DP571 “48 kHz Pull-Down” mode: This mode of the DP571 Encoder outputs Dolby E on an AES3 interface with a frame rate of ~47.952 kHz (48 kHz × 1000/1001) for compatibility with some VTRs.

DP572 “Program Play” mode: This mode of the DP572 Decoder accepts Dolby E bitstreams on an AES3 interface with a frame rate at an offset from 48 kHz (normally between ±15%) for compatibility with offspeed play modes supported by some storage devices (such as VTRs).

Other exceptions to this rule for transport of Dolby E are possible, but in general the above cases and any future cases are nominally to be restricted to special operating conditions in local environments.

For cases where transport (or storage) methods are designed to specifically handle Dolby E, the analogy to transport interface sample rate may not exist (for example, within disk storage devices). In such cases the frame rate synchronization requirement falls back to the basic requirement that the exact match between video frame rate and encoded Dolby E frame rate be maintained.

Equipment manufacturers shall ensure that audio/video sample-rate synchronization is maintained within equipment, and sample-rate synchronization requirements are an important part of the product standards described in this document. It is the burden of systems designers and end users to ensure that equipment input signals are properly synchronized and that sample-rate synchronization of transport signals is maintained within facilities and systems. Section 5.1.1 provides illustrations and further discussion of Dolby E frame synchronization concepts.

Note: Frame rate synchronization of Dolby E signals is a fundamental requirement of all systems and transport methods.

4.1.2 Phase Synchronization

Many of the properties of Dolby E rely on phase synchronization of Dolby E frames to video frames. In particular, phase synchronization is a key requirement maintaining the seamless switching/editing property of Dolby E. Dolby E encoders will produce Dolby E frames with a specific alignment of phase (with respect to video reference), and Dolby E decoders will accept a certain tolerance of phase alignment. Equipment and systems are expected to maintain phase alignment to within a certain tolerance.

The principal of phase synchronization is to keep each Dolby E frame as closely aligned in phase to a video reference location as possible. The ideal is to align each Dolby E frame to the exact video frame to which it is associated, however in the context of phase synchronization, the alignment is specified in terms of a generic video frame.

With existing transport methods, phase synchronization is expressed in terms of an alignment of the Dolby E frame with respect to a video reference signal. Specific phase alignment specifications vary based on frame rate, transport method, and video reference signal and can be found in the other sections in this chapter. In most cases the specifications will indicate the location of the start of the Dolby E frame with respect to a certain point in the video reference signal. A term that is used in the context of phase synchronization is *guard band*. In terms of existing transport methods the guard band refers to a number of audio sample locations that do not contain Dolby E data. The guard band is intended to be aligned with the editing/switching areas so that edits and switches will not corrupt Dolby E data.

In the context of compatibility standards, phase synchronization requirements are, in general, specified in terms of *delay* tolerances. The delay specifications are meant to ensure that, when input to a given device, Dolby E signals with the specified phase alignment will maintain that alignment within the device, and will appear at the output with the same phase alignment, within a certain tolerance. The delay tolerances are in most cases directly related to the size of the Dolby E guard band for a particular transport method.

In some cases (e.g., within disk storage devices) a specific reference video signal may not exist. In such cases the phase synchronization requirement will be specified either in terms of I/O interfaces or other requirements that accomplish the same function (to maintain Dolby E features).

Phase synchronization requirements are an important part of the product standards described in this document. Understanding of phase synchronization and the allowed tolerances are important for systems designers and end users to ensure that Dolby E signals are properly handled within facilities. Section 5.1.2 provides illustrations and further discussion of Dolby E phase synchronization concepts.

Note: Phase synchronization of Dolby E signals is required to fully maintain features of Dolby E, but decoding of Dolby E signals without video phase synchronization is possible.

4.1.3 Video Reference Signals

Some Dolby E transport specifications and compatibility standards specify requirements in terms of video reference signals. The following are video signals currently identified as reference signals for Dolby E:

Analog Composite Reference (Color Black)

Analog color black is the primary reference signal for 25 and 29.97 Hz Dolby E operation. The following defines the analog composite reference signals:

29.97 Hz: Analog composite signal per NTSC standard (SMPTE 170)

525 lines, 59.94 fields per second

25 Hz: Analog composite signal per PAL standard

625 lines, 50 fields per second

Figure 4-1 illustrates the vertical blanking interval and line numbering for NTSC composite reference. Figure 4-2 illustrates the vertical blanking interval and line numbering for PAL composite reference.

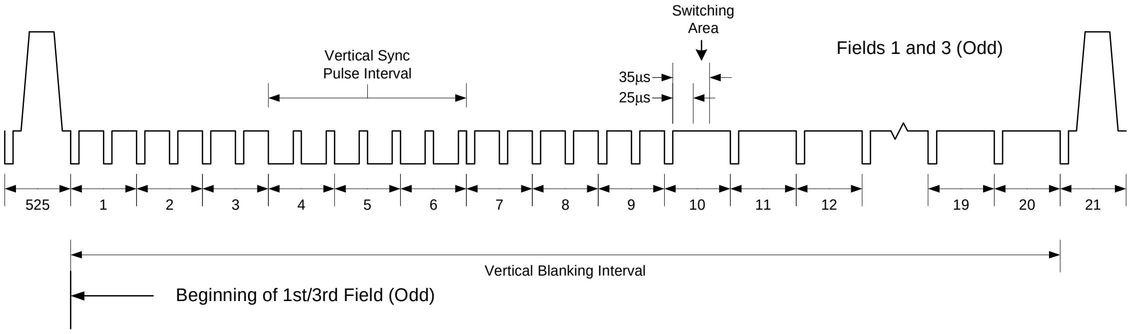

Figure 4-1 NTSC Composite Vertical Blanking Interval

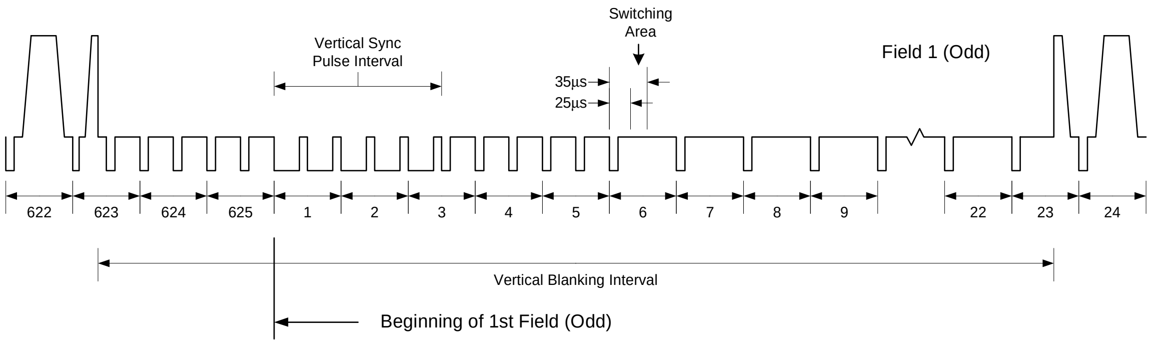

Figure 4-2 PAL Composite Vertical Blanking Interval

Analog Composite Reference Switching Location

The reference vertical interval switching point for the analog composite signals is defined in SMPTE RP168. Switching on both even and odd fields is specified by SMPTE RP168. For 29.97 and 25 Hz Dolby E operation the switching points shall be restricted to odd fields. Therefore the reference switching location is:

29.97 Hz frame rate: line 10

25 Hz frame rate: line 6

The switching location is shown in Figure 4-1 and Figure 4-2 and illustrated in greater detail in Figure 4-3 (for NTSC).

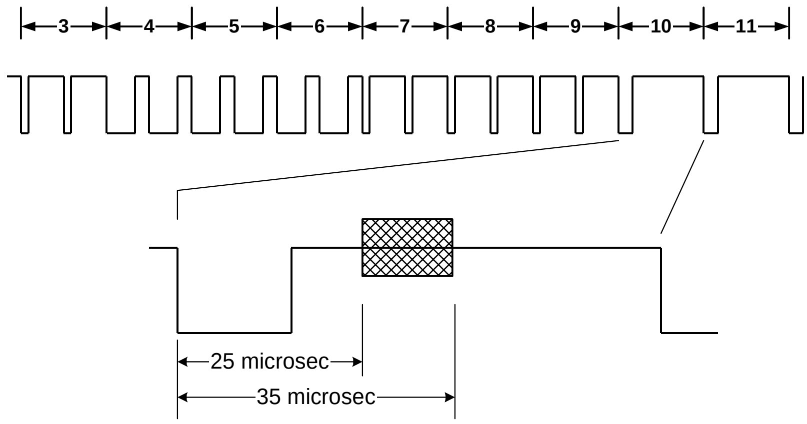

Figure 4-3 NTSC Composite Vertical Interval Switching Area

Note: Current Dolby E encoders only support analog composite reference signals. Most current Dolby E compatibility standards are specified in terms of an analog composite reference.

SDI (Serial Digital Interface)

The SDI signal reference signal is defined by SMPTE 259M. SDI supports several levels of operation. Level C, 270 Mbps, 525/625 line component, is supported by Dolby E. The correspondence between SDI lines and data space to an analog composite signal is defined in SMPTE 125M.

SDI Switching Location

The reference vertical interval switching point for the SDI reference is defined in SMPTE RP168. Switching on both even and odd fields is specified by SMPTE RP168. For 29.97 and 25 Hz Dolby E operation the switching points shall be restricted to odd fields. Therefore the reference switching location is line 10 for 29.97 Hz operation and line 6 for 25 Hz operation.

Note: The SDI signal is current referenced by the SDI transport specification and standards for products with SDI interfaces.

HDSDI (High Definition Serial Digital Interface)

The HDSDI reference signal is defined by SMPTE 292M. The correspondence between HDSDI lines and data space to a 1,125-line analog composite signal is defined in SMPTE 260M.

HDSDI Switching Location

For 29.97 Hz Dolby E operation the reference switching location for the HDSDI signal is line 7.

Note: The HDSDI signal is current referenced by the HDSDI transport specification and standards for products with HDSDI interfaces.

4.2 AES3 Transport

Dolby E is carried in the AES3 (AES/EBU) interface according to the format described in SMPTE 337M. This section provides an overview of SMPTE 337M and defines specific Dolby E formatting requirements not defined in SMPTE 337M.

Note: Much of the AES3 transport specification, including the data burst format and the usage of the audio sample word, applies to other digital audio paths when the source Dolby E signal is originally derived from an AES3 transport. In general all current Dolby E applications will follow this format specification.

Portions of the AES3 transport specification are contained in a proposed SMPTE standard for the Dolby E data type in SMPTE 337M. When this standard is finalized by SMPTE, it should be viewed as a normative part of the Dolby E AES3 transport specification.

4.2.1 Overview of SMPTE 337M

SMPTE 337M specifies an interface format for the transport of “non-PCM” data in the AES3 serial digital audio interface. Non-PCM data refers to any type of data other than linear PCM audio data that is normally carried in the AES3 interface. SMPTE 337M supports multiple coded audio data types including Dolby E, Dolby Digital, and MPEG audio. Non-audio data types are supported also including time code information, captioning data, and generic data. Other data types may be included in the future.

The format specified in SMPTE 337M is an extension of the format documented in Annex B of the ATSC A/52 standard. (The Annex is informational only and is not considered a standard.) IEC61937 defines a version of the Annex B format that has been standardized by the IEC for use in consumer devices, generally for carrying consumer encoded audio data such as Dolby Digital. The IEC61937 format is similar to the SMPTE 337M format and can be considered a subset of SMPTE 337M for some data types (see SMPTE 337M Section 7), however there are significant differences in the two standards. In particular IEC61937 does not support the Dolby E data type. All Dolby E applications should follow SMPTE 337M and the formatting requirements specified in this document.

SMPTE 337M uses the physical and logical interface of AES3 and therefore is compatible with existing AES3 interfaces and transmitter/receiver devices at the physical and logical level. However, SMPTE 337M uses the “non-audio” mode of the

AES3 interface. This usage was considered in the original AES3 specification (in channel status bit 1), but was never formally specified, so SMPTE 337M can be considered the standard for the AES3 non-audio mode. It describes usage of the channel status words and the format for placement of non-PCM data in the audio sample word space normally used for the linear PCM samples. Many Dolby E equipment compatibility issues are largely concerned with how the data in the audio sample space is treated, and how channel status fields are used.

SMPTE 337M is the primary method by which Dolby E is able to work in existing facilities and with existing devices. The standard is written such that the same AES3 interface can be shared with the normal PCM audio usage either by treating the AES3 channels independently or by alternating between data and linear PCM usage. Devices that are specifically designed for SMPTE 337M/Dolby E compatibility should be able to transition easily between both usages.

SMPTE 337M formatted data is placed in the available AES3 data space in bursts (data packets) that consist of a burst preamble containing descriptive information about the data and a burst payload that contains the actual audio data. SMPTE 337M describes basic header and packet formatting that applies to all data types. Other standards describe additional formatting requirements for specific data types. (Specific Dolby E requirements for the burst preamble are defined in this document.) Bursts for a data stream are placed sequentially onto the AES3 interface. Multiple data streams, which can include multiple data types, may be placed in the AES3 signal. Unused data space between bursts is zero filled. Dolby E uses the majority of the AES3 data space, but some space (in the Dolby E guard band) is still available for other data streams.

The AES3 interface normally carries two channels of audio. Each AES3 frame contains two subframes each with a single PCM sample for one of the two channels. SMPTE 337M data can be placed into frames in one of two modes referred to as the frame and subframe mode. In the frame mode data is placed sequentially into both AES3 subframes so that the entire data space within a frame is used. In the subframe mode the data is placed into only one of the subframes allowing the channels to be used independently. In this way a single AES3 interface can carry a) one set of SMPTE 337M data streams, b) two sets of SMPTE 337M data streams, or c) one set of SMPTE 337M data streams and one mono PCM audio channel. Dolby E always uses the frame mode (both AES3 channels carry data).

Burst data can be packed in each subframe utilizing either 16, 20, or 24 bits. The 24-bit mode allows more of the AES3 data space to be used, but the 16- or 20-bit modes may be desired when dealing with existing equipment that cannot handle 24 bit data words. When operating at a 48 kHz sample rate, the data capacity of the AES3 signal is 3.072 Mbps. In 24-bit mode, a total data rate of 2.304 Mbps is available for audio elementary stream data. In 16- and 20-bit modes, 1.536 Mbps and 1.920 Mbps, respectively, are available. For carrying Dolby E, the data mode should match the Dolby E encoded bit depth. The 20- bit mode is preferred, but 16-bit is also supported.

Each data burst is identified with a stream number. Numbers 0–6 are available for data bursts, allowing up to seven individual data streams in the frame mode. In the subframe mode, the stream numbers can be used independently in each channel so that potentially up to 14 separate audio programs can be conveyed in a single AES3 interface. Stream type 7 is reserved for time-stamp information. Dolby E data streams will always be labeled as stream number 0 since they are the primary information carried on the AES3 interface.

SMPTE 337M does not define specific synchronization methods but provides features that support synchronization. Synchronization requirements for specific data types are defined by standards for those data types. Synchronization requirements for Dolby E are defined in this document and rely on a video reference signal.

Note: Current Dolby E encoder and decoder products (DP571 and DP572) transmit and receive Dolby E information on the AES3 interface and follow the SMPTE 337M specification. All product interfaces should be compliant with SMPTE 337M and specifications in this document for compatibility with Dolby products.

4.2.2 Physical Interface

As specified in SMPTE 337M Section 5.1, Dolby E can be carried on physical interfaces specified by AES3 (balanced) or AES3-id/SMPTE 276M (unbalanced) and therefore is electrically and mechanically compatible with existing AES3 interfaces and transmitter/receiver devices.

While it is possible for the Dolby E logical format to be carried on the consumer S/PDIF interface (IEC60958), Dolby E is not compatible with the consumer non-PCM data standard (IEC61937) and it is recommended that its use be restricted to the AES3 and 276M physical specifications.

4.2.3 Logical Interface

As specified in SMPTE 337M Section 5.1, Dolby E is carried in the AES3 interface using the AES3 logical interface with exceptions described in SMPTE 337M. The exceptions are in the usage of the channel status word (see Section 4.2.4 in this document) and the audio sample word (see Section 4.2.5). Some deviation from the channel status word usage is allowed for Dolby E pass-through compatibility, but support for the audio sample word usage is required in all cases.

Note that the logical interface format requirements apply to other transport interfaces that convey the entire AES3 signal (e.g., SDI embedded audio and MPEG embedded audio via SMPTE 302M). SMPTE 337M data burst formatting requirements will apply to other transport interfaces where the audio sample words are derived from the AES3 interface.

4.2.4 AES3 Channel Status Word

The defined AES3 channel status word usage when carrying Dolby E is as specified in SMPTE 337M Section 5.2. SMPTE 337M allows the frame frequency (sampling frequency) field and the word length fields in byte 2 to be set to default settings, however it is highly recommended that all Dolby E applications set these fields to indicate 48 kHz frame rate and the appropriate Dolby E word size. Dolby E use is restricted to the SMPTE 337M frame mode therefore the channel status bits for both AES3 channels should be set identically.

Note: While SMPTE 337M specifies AES3 channel status settings, existing equipment may not be compatible with such usage. Many paths may not pass or set the channel status bits as desired for Dolby E bitstreams. Also some existing devices may have incompatible behavior when channel status bit 1 is set to indicate non-audio. Therefore, Dolby E receiving devices should not rely on settings of channel status fields to indicate the presence Dolby E in the AES3 stream.

4.2.5 Dolby E Data Burst Format

When conveying Dolby E data on the AES3 interface, the Dolby E frame is mapped into a SMPTE 337M data burst (transport packet) following the basic burst format described in SMPTE 337M Section 6. The data burst consists of a four-word burst_preamble followed by a variable length burst_payload. For Dolby E, the burst_payload will consist of a single Dolby E frame; each Dolby E frame maps uniquely to a single SMPTE 337M data burst. The Dolby E data burst is illustrated in Figure 4-4.

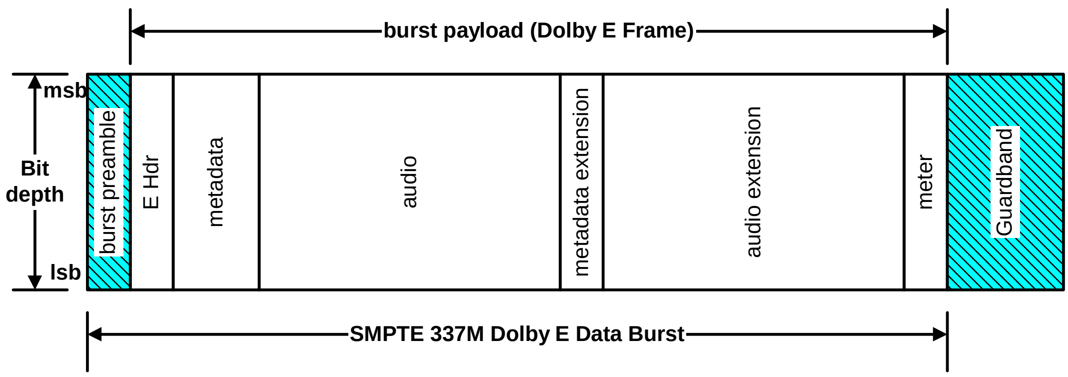

Figure 4-4 Dolby E Frame with SMPTE 337M Transport Header

The burst_header contains four preamble words, Pa–Pd, which are defined as follows for Dolby E:

<u>Pa:</u> Sync word 1 as defined in SMPTE 337M Table 6
For data bursts containing 16-bit Dolby E data Pa = “0xF872”

For data bursts containing 20-bit Dolby E data Pa = "0x6F872"
For data bursts containing 24-bit Dolby E data Pa = "0x96F872"

Pb: Sync word 2 as defined in SMPTE 337M Table 6
For data bursts containing 16-bit Dolby E data Pb = "0x4E1F"
For data bursts containing 20-bit Dolby E data Pb = "0x54E1F"
For data bursts containing 24-bit Dolby E data Pb = "0xA54E1F"

Pc: burst_info as defined in SMPTE 337M Section 6.1.3; for Dolby E, the burst_info fields are defined as follows:

data_type = 28	(per SMPTE 338M data type table)	
data_mode	= 0	for data bursts containing 16-bit Dolby E data
	= 1	for data bursts containing 20-bit Dolby E data
	= 2	for data bursts containing 24-bit Dolby E data
error_flag	set per 337M Section 6.1.3.3	
data_type_dependent = 0		
data_stream_number = 0		

Pd: length_code as defined in SMPTE 337M Section 6.1.4
For data bursts containing 16-bit Dolby E data Pd = number of Dolby E data words x 16.
For data bursts containing 20-bit Dolby E data Pd = number of Dolby E data words x 20.
For data bursts containing 24-bit Dolby E data Pd = number of Dolby E data words x 24.

The data bursts containing the Dolby E frames are subsegmented and mapped into AES3 subframes. AES3 subframes consist of 32 bits (time slots) of which 16, 20, or 24 bits may be used to carry data, depending on the data mode that is selected. This mapping is illustrated in Figure 4-5. As shown, the most significant bit (MSB) of each 16, 20, or 24 bit subsegment will map to time slot 27 of the AES3 subframe. The least significant bit (LSB) will map to time slot 12, 8, or 4, depending on the data mode.

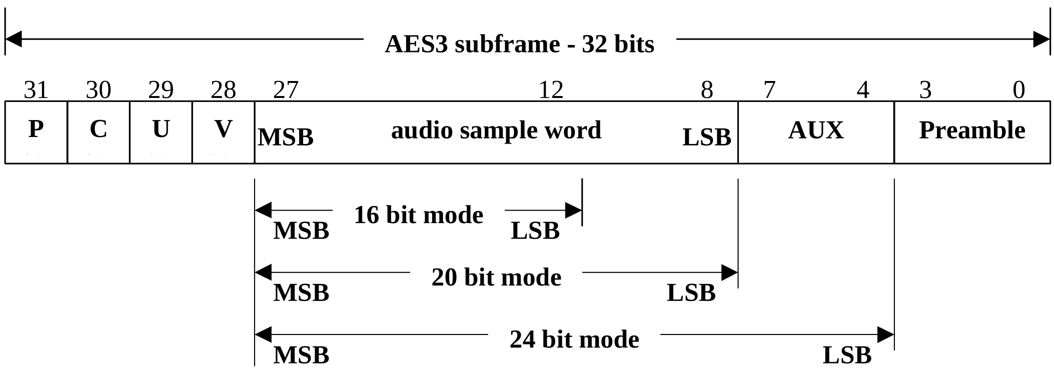

Figure 4-5 Mapping Data Burst Segments to AES3 Subframes

Figure 4-6 and Figure 4-7 illustrate a detailed mapping of the burst_preamble and burst_payload segments to AES3 time slots. Since the burst_preamble is defined to always occupy four AES3 subframes independent of the data_mode, the start of the burst_payload, and therefore the start of the Dolby E data, will always begin in time slot 27 of an AES3 subframe. Figure 4-6 shows the mapping for the 16-bit mode. Figure 4-7 shows the mapping for the 20-bit mode. The 24-bit mode is an extension of the same concept.

Note: Currently, only 16-bit (six-channel) and 20-bit (eight-channel) modes are supported for Dolby E.

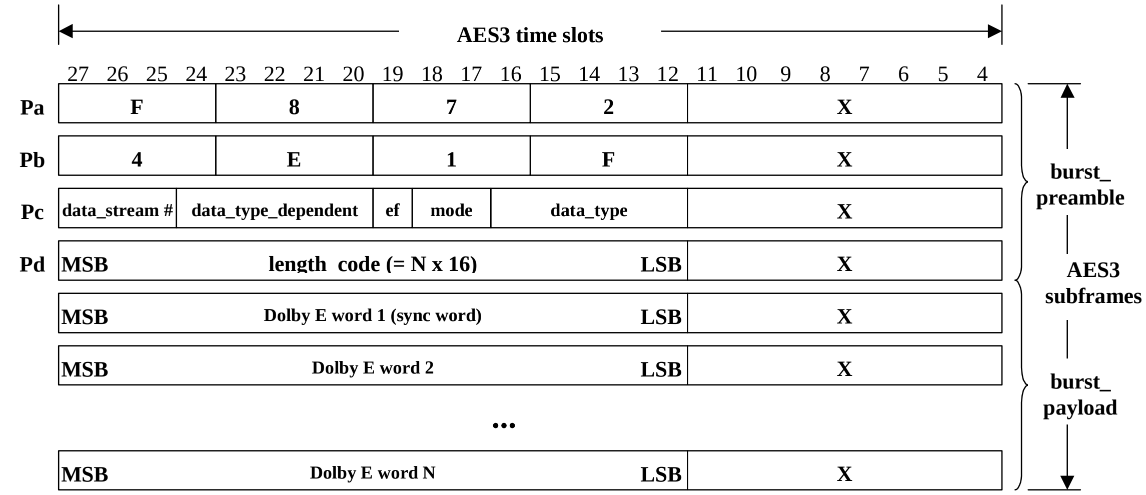

Figure 4-6 Mapping Dolby E to AES3 time slots (16-bit mode)

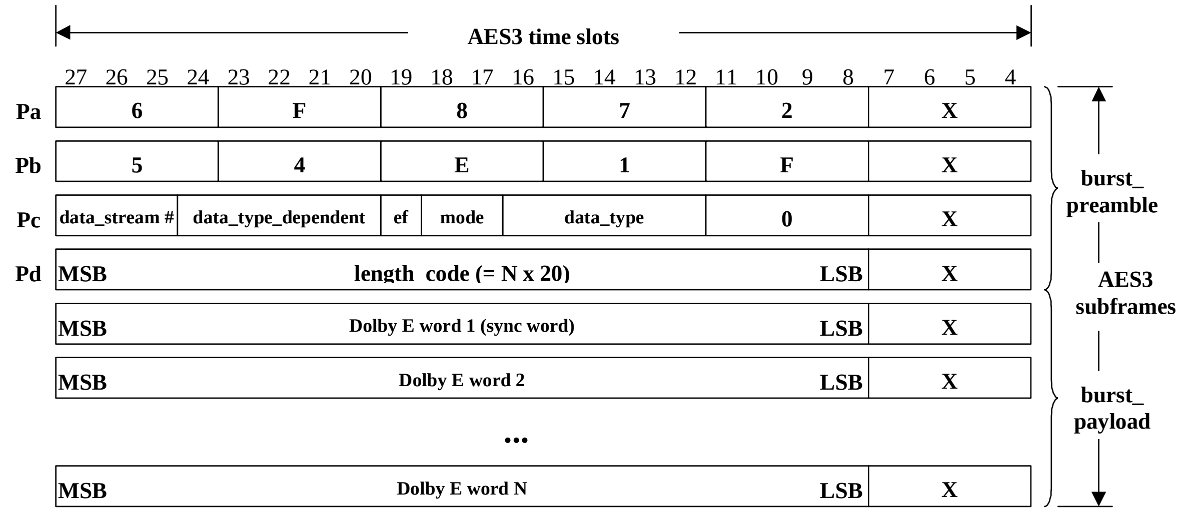

Figure 4-7 Mapping Dolby E to AES3 time slots (20-bit mode)

Dolby E data bursts are placed in the AES3 frame sequentially according to the synchronization requirements described in Section 4.2.6. Note that data bursts of other data types may be present in the AES3 frames between Dolby E data bursts.

4.2.6 Dolby E Data Burst Synchronization Requirements

Dolby E data bursts are placed in the AES3 interface according to the following requirements:

Video Reference Signal

The AES3 interface frame rate (sample rate) and Dolby E data burst spacing must be locked to a video reference signal corresponding to the Dolby E encoded frame rate. The currently defined frame rates and reference signals for AES3 transport of Dolby E are the following:

29.97 Hz frame rate	NTSC Analog Composite Reference (SMPTE 170M)
25 Hz frame rate	PAL Analog Composite Reference

AES3 Frame Rate

When carrying Dolby E data bursts the AES3 interface must be operated at a frame rate (sample rate) of 48 kHz locked to a video reference signal corresponding to the Dolby E encoded frame rate.

Dolby E Reference Point

The *reference point* of a Dolby E data burst is defined as bit 0 of the burst_preamble; that is, the start of the data burst (Pa=sync word 1).

Dolby E Standard Repetition Rate

Dolby E data bursts are nominally placed in the AES3 interface such that the reference points of consecutive data bursts occur at a *standard repetition rate*. The standard repetition rate is defined as the number of AES3 frames that correspond to the one video frame of an associated video reference signal corresponding to the Dolby E encoded frame rate. This corresponds to:

29.97 Hz frame rate:	1,601.6 AES3 frames
25 Hz frame rate:	1,920 AES3 frames

Note that for the 29.97 Hz frame rate the defined repetition rate is not an integer number of AES3 frames due to the relationship of AES3 frames to video frames (8,008 AES3 frames over 5 video frames). In practice, the spacing between data bursts will vary between 1,601 and 1,602 samples. Dolby E decoders are designed to tolerate this variance under normal operating conditions.

Note: The AES3 frame rate and standard repetition rate requirements are essential for all AES3 transport applications to meet the basic Dolby E frame synchronization requirement.

Dolby E Reference Position

Dolby E data bursts are nominally placed in the AES3 interface in a *reference position.* The reference position is defined in relation to the video signal corresponding to the Dolby E encoded data. A Dolby E burst is defined as occupying the reference position if the reference point of the Dolby E burst is located in the AES3 interface such that it meets the following requirements:

1. The reference point occurs in the AES3 interface at the first AES3 frame occurring *after* the start of the defined video line of an analog composite reference signal corresponding to the Dolby E frame rate:

   29.97 Hz frame rate: line 14
   25 Hz frame rate: line 10

2. The Dolby E data burst is coincident in time with the video frame that corresponds to the audio samples coded within the Dolby E frame.

Note that requirement 1 references a defined video reference signal. Requirement 2 references a content video signal which may or may not be the reference video signal. If not, it is assumed to be locked to the video reference signal. Requirement 1 meets the basic Dolby E phase synchronization requirement for AES3 transport applications. Requirement 2 defines the reference location for lip sync.

Note: Phase synchronization is *not* a requirement for basic Dolby E pass-through compatibility, and the Dolby E data bursts in many AES3 signals encountered in practice may not be present in the defined reference position.

Dolby E Standard Decode Latency

The *standard decode latency* of Dolby E is defined as the time equivalent to one video frame of an associated video reference signal corresponding to the Dolby E encoded frame rate. This corresponds to:

29.97 Hz frame rate: 33.33 ms
25 Hz frame rate: 40 ms

Note that the Dolby E encode latency is equal to the standard decode latency.

Dolby E AES3 Guard Band

The above synchronization requirements along with the size of encoded Dolby E frames will determines the size and location of the AES3 Dolby E guard band. In current practice Dolby E frames are sized such that the guard band takes up approximately 5% of the available AES3 data space. This guard band location is chosen so that Dolby E data is not present on the AES3 interface during video lines in which switches or edits will occur and so that some delay (a few lines) can be tolerated in the audio path. The guard band is illustrated in Figure 4-8 for both 29.97 and 25 Hz reference signals. The guard band location shown is an approximate ideal location. In addition to the variances in the precise alignment of the data burst starting location, the data burst end location may vary based on the actual Dolby E frame size. The ending location shown is the approximate location for current Dolby E product implementations.

Note that the Dolby E guard band applies to Dolby E data bursts only. Other SMPTE 337M data bursts may appear during the Dolby E guard band interval. For instance, captioning data, time code, or other types of low bit-rate data may be carried in the space not used by Dolby E. In general, this data has a higher chance of being corrupted during a switch or edit.

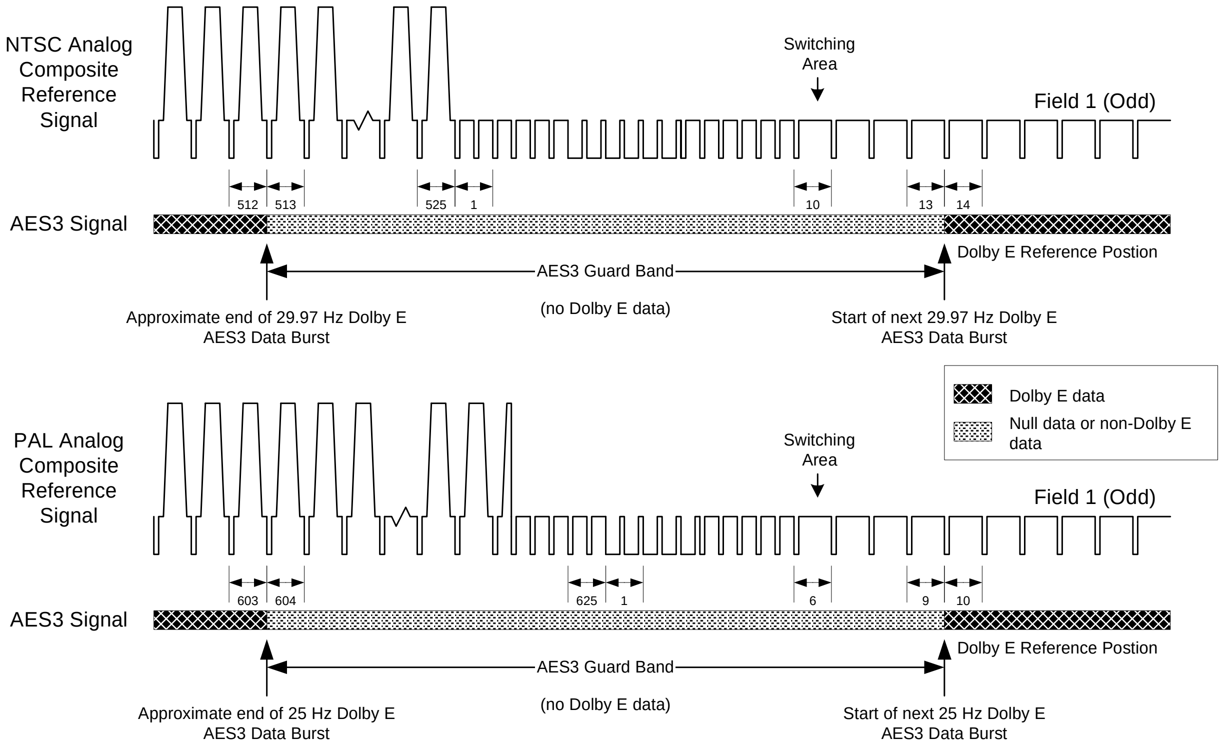

Figure 4-8 AES3 Dolby E Data Burst Location with 5% Guard Band

Note: Equipment designers should also note that while this is the desired reference position for Dolby E signals, there is no guarantee that received Dolby E bitstreams will be in the desired location. Equipment designers should make every effort to maintain the desired alignment, but in general it is the burden of users to maintain Dolby E signal alignment within facilities.

4.2.7 Formatting Dolby E in AES3 via SMPTE 337M (Example)

As example of mapping Dolby E into the AES3 interface, consider a Dolby E frame that begins with the following 20-bit words:

0x0788E
0x1F804
0xC7260
...

The size of the Dolby E frame is 3,040 20-bit words (Dolby E data will appear in 1,520 AES3 frames). Note that the four-word preamble header is added to the Dolby E frame so that the entire data burst will be 3,044 20-bit words (1,522 AES3 frames).

In this example, the Dolby E packet is to be carried in the AES3 interface in 20-bit mode, in an AES3 data burst identified as stream #0. Therefore, the values of the fields in the burst_info header of the AES3 burst_preamble are:

data_stream_number = 0
data_type_dependent = 0
error_flag = 0
data_mode = 1
data_type = 0x1C (28)

These values give a preamble Pc value of 0x003C0.

The length_code is equal to the size of the Dolby E frame in bits, which in this example is 3,040 × 20 = 60,800. This corresponds to a preamble Pd value of 0x0ED80.

Therefore the mapping of the Dolby E frame to the AES3 data burst is as shown in Figure 4-9:

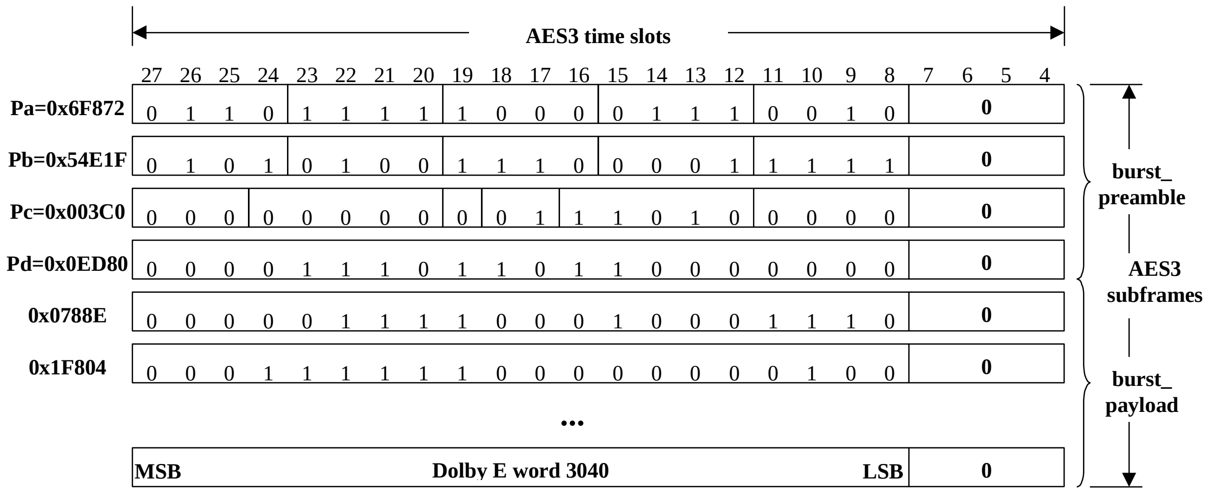

Figure 4-9 Example Mapping of KLV Data Burst to AES3 Time Slots

4.3 SDI Transport

Dolby E is carried in the SDI interface according to the SMPTE 337M/Dolby E transport specification and SMPTE 272M. With this method, Dolby E is first formatted in the AES3 transport format and then the entire AES3 data stream is mapped into the SDI intake according the specification in SMPTE 272M.

SMPTE 337M allows a 16-bit sample resolution mode, however it is recommended that the SMPTE 337M implementation convey at least 20 bits of the AES3 audio sample word. AES3 channel status bits are carried with the audio sample data according to SMPTE 337M.

4.4 MPEG-2 Stream Transport

Dolby E is carried in MPEG-2 transport streams according to the SMPTE 337M/Dolby E transport specification and SMPTE 302M. With this method, Dolby E is first formatted in the AES3 transport format and then the entire AES3 data stream is mapped into the MPEG-2 transport stream using the specification in SMPTE 302M. SMPTE 302M allows a 16-bit sample resolution mode, however it is recommended that the SMPTE 302M implementation convey at least 20 bits of the AES3 audio sample word. AES3 channel status bits are carried with the audio sample data according to SMPTE 302M.

As specified in SMPTE 302M Section 4.4, the SMPTE 302M data must be coded in the MPEG-2 stream such that the AES3 sample rate is 48 kHz, locked to the 27 MHz MPEG-2 transport clock. For compatibility with Dolby E, the SMPTE 302M interface should be designed in such as way that a 48 kHz AES3 signal synchronous with the MPEG system clock rate can be multiplexed into the MPEG-2 transport stream (and demultiplexed out of the transport stream) without modification (i.e., no sample-rate conversion, data loss due to buffering, or other PCM-type processing).

No alignment of the AES3 Dolby E data burst with SMPTE 302M PES packet headers is specified, nor is any phase alignment of the Dolby E data burst to a video signal within the MPEG-2 stream. Therefore, seamless/glitchless splicing or editing of Dolby E streams embedded in MPEG-2 transport streams is currently not defined. However the AES3 stream should be multiplexed such that the phase alignment with respect to an associated video signal on the multiplexer input is preserved on the outputs from a MPEG-2 demultiplexer.

Note that this transport method does not uniquely identify Dolby E as an audio element in the MPEG-2 transport stream. Systems may identify the presence of Dolby E via private methods if desired, however no standard is currently defined. This method will also support carriage of any kind of SMPTE 337M formatted audio or non-audio data in the MPEG-2 stream and thus may have potential application beyond Dolby E.

Note: Specifications for Dolby E the MPEG transport stream are subject to change. Alternative methods for carrying Dolby E in MPEG streams are under development, but the SMPTE 302M method is currently the accepted standard.

Chapter 5
System Integration Issues

5.1 Dolby E Synchronization

This section describes issues related to synchronization of Dolby E signals to video.

5.1.1 Frame Rate Synchronization

As described in Section 4.1.1, a basic requirement of Dolby E is that Dolby E frames be encoded and transported synchronously with video frames. Figure 5-1 illustrates proper synchronization between Dolby E frames and video frames. In this case, there is and exact match between Dolby E frames and video frames. Figure 5-2 illustrates unsynchronized Dolby E frames. In this case Dolby E frames do not match video frames. This condition may be due to Dolby E encoding with improper video reference signal, transport over an unsynchronized transmission link, unsynchronized playback from a recording device, or resampling of the video rate without a corresponding resampling of the Dolby E signal. Unsynchronized Dolby E frames may result in audible glitches in decoders due to buffer over- or underruns, audio/video lip sync problems, and/or loss of Dolby E properties such as seamless editing and switching.

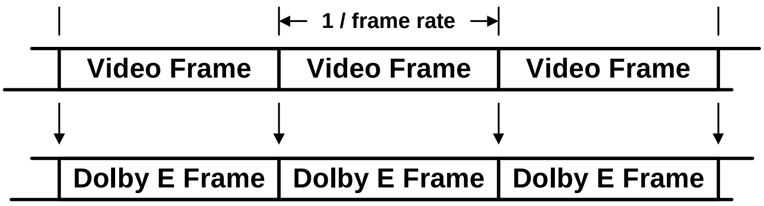

Figure 5-1 Synchronized Dolby E Frames

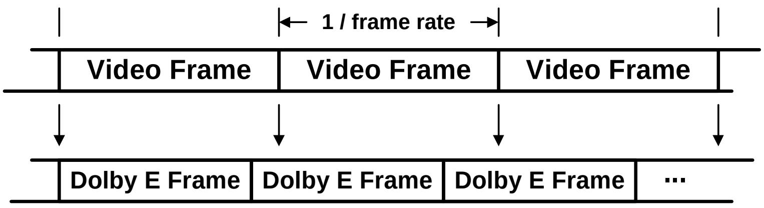

Figure 5-2 Unsynchronized Dolby E Frames

5.1.2 Phase Synchronization

As described in Section 4.1.2 phase synchronization is important for maintaining the features of Dolby E. Figure 5-3 illustrates properly phase aligned Dolby E frames. For a transport method such as AES3, proper phase alignment positions guard band around the defined switching/editing location so that when the Dolby E bitstream is switched or edited, no Dolby E data will be lost. Figure 5-4 illustrates improperly phase-aligned Dolby E frames. In this case, the guard band has been delayed in time so that Dolby E data is now present at the switching and editing location. This will result in lost data during any switch or edit of the bitstream.

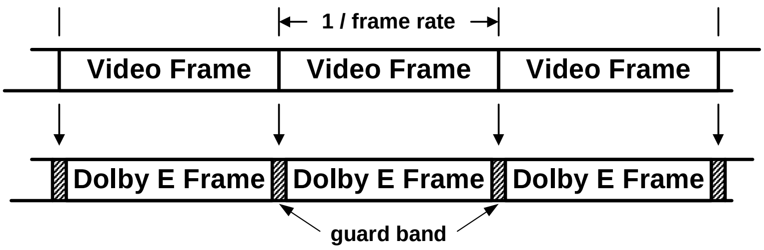

Figure 5-3 Phase-Aligned Dolby E Frames

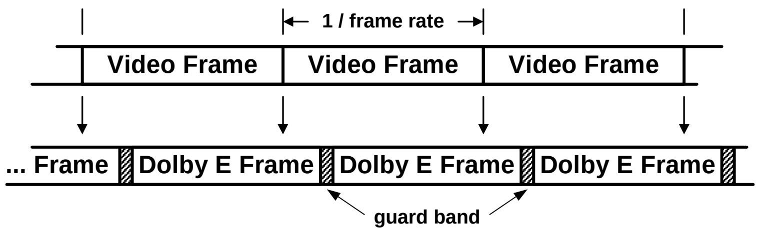

Figure 5-4 Non-Phase-Aligned Dolby E Frames

Figure 5-5 shows an example of a switch or edit of two Dolby E bitstreams (A and B) that are properly phase aligned. Since the switch or edit occurs during the guard band interval, the Dolby E decoder receiving the resulting switched/edited stream (C) will see no loss of data and will perform the desired crossfade resulting in an audibly clean switch/edit.

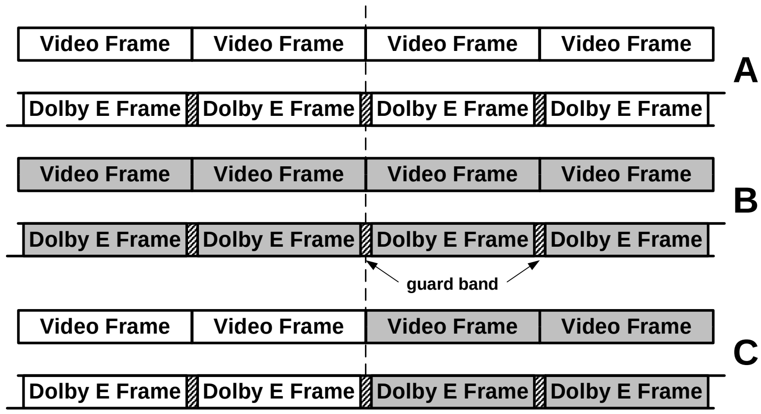

Figure 5-5 Glitchless Switch/Edit of Phase-Aligned Dolby E Bitstreams

Figure 5-6 shows an example of a switch or edit of two Dolby E bitstreams that are not properly phase aligned. In this example, both bitstreams have been equally delayed but with the guard band location shifted beyond the switch/edit location. In this case the Dolby E decoder receiving the resulting switched/edited stream will detect corruption of data from the last frame of stream A before the switch and will be forced to conceal the error (repeat or mute) for one frame. Figure 5-7 shows a second example. In this case the Dolby E streams are both misaligned but not by the same amount so that the data from the first frame of stream B is also corrupted. This will result in the Dolby E decoder having to perform error concealment for a longer period (up to two video frames). In both cases the resulting error concealment is potentially audible depending on the program content at the time of the switch/edit.

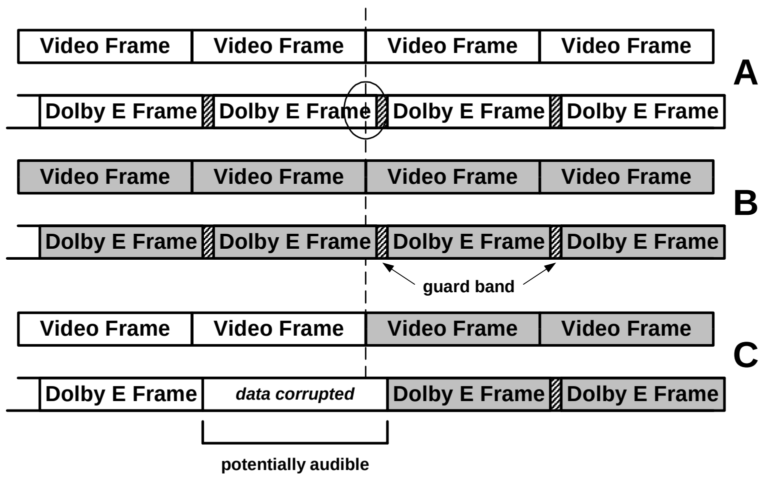

Figure 5-6 Switch/Edit of Non-Phase-Aligned Dolby E Bitstreams (Example 1)

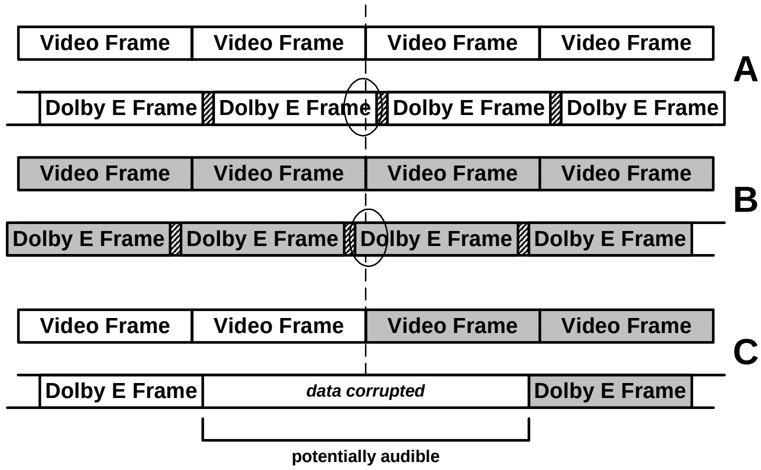

Figure 5-7 Switch/Edit of Non-Phase-Aligned Dolby E Bitstreams (Example 2)

5.2 Program Play Feature

In many situations a Dolby E user may wish to shorten or lengthen a program's duration. For example, a broadcaster may possess a program with a length of 30 minutes and require that the program be completed within 28 minutes to allow for advertisements at the beginning and end. In order to transmit the program in its entirety – a broadcaster may accelerate the program playback speed by approximately 7%. This is what the Dolby E decoder "Program Play" feature is used for.

Program Play is a Dolby E decoder mode that allows the decoding of an off rate Dolby E stream. For example, when the DP572 unit is interfaced to VTR equipment operating in Program Play mode, the Dolby E Main Input data rate is allowed to vary from the nominal 48 kHz, corresponding to an increase or decrease of the VTR AES3 playback rate.

The Decoder's Video Reference input frame rate will remain at the normal rate in this mode.

As a result of the off-speed playback, the decoded PCM audio (corresponding to 1,792 PCM samples / video frame) will span a time interval that is shorter or longer than the input Video Reference frame period.

While in program play mode the audio will be pitch-shifted proportionally to the playback speed. Before output, the decoded signal is sample-rate converted to a video synchronous 48 kHz and then sent to the decoders outputs.

Note: The decoder's *standard decode latency* (refer to Section 4.2.6) is no longer applicable when the Program Play feature is enabled. Instead, a minimum decoding latency bounded by the constraints of the adjusted Dolby E frame length is produced.

Caution must be used when performing input switches to a Dolby E decoder operating in Program Play mode. Due to the fact that Dolby E frames may not be phase aligned with video during program play, switches made on video boundaries may result in audible “glitches.”

A product is compatible with the Dolby E Program Play feature if the following guidelines are met:

1. The product allows off-rate AES3 playback. Playback rates of ±15% 48kHz are supported by current Dolby E decoders.

2. No sample-rate conversion, pitch correction, or any other processing is done to the encoded audio stream during off-rate playback.

3. All other Baseline requirements are followed. Refer to Section 8.1.

5.3 Bitstream Keys

In general, digital audio storage and transmission equipment is designed to convey linearly coded PCM audio samples. For 16-bit audio samples, the range of these values is from 32,767 (0x7fff) through –32,768 (0x8000). The magnitudes of the most positive and negative values differ due to the crossing of the origin, therefore, some equipment intentionally avoids the most negative value (0x8000) in order to simplify the design. Since the value of 0x8000 is not used for PCM, it is sometimes used for another purpose, such as control. If a PCM value of 0x8000 is presented to such equipment, it is replaced with, or limited to, a value of 0x8001 to prevent confusion with the control signal. This solution works very well for PCM, as insignificant distortion is added. However, a problem occurs when a Dolby E bitstream is applied to the storage or transmission device. If a Dolby E bitstream value of 0x8000 is altered to become 0x8001, the effect could be to render the entire frame of non-PCM data useless. The only way to prevent this from happening is to guarantee that the forbidden value does not occur in the Dolby E bitstream.

To solve the problem, a separate key word is chosen and applied to each Dolby E frame segment in a reversible manner. A key word is chosen so as to not be equivalent to any of the values in the particular segment or the forbidden value. The key word is then applied to the frame segment using a bitwise EXCLUSIVE-OR-Or operation. This operation is reversible in the decoder since the operation, when applied twice, results in the original value. The only way that the key word could cause the forbidden value to occur would be if the key word appeared in the original segment. However, by choosing a key word that doesn’t exist in the segment, the scrambled segment is guaranteed not to contain the forbidden word. Furthermore, a key word of zero also is not appropriate since the EXCLUSIVE-OR operation with zero returns the original value unchanged. By limiting the segment length to substantially less than the number of possible unused words, the value of zero is avoided for the key word.

The use of bitstream keys is provided as an option in the Dolby E encoder to the user. The Dolby E decoder has the ability to detect the presence of bitstream keys on a frame basis. The frame synchronization words for the Dolby E bitstream signal the existence of bitstream keys for a particular frame.

No bitstream keys present:

```
0x078E      /* 16 bit Dolby E sync word */
0x0788E     /* 20 bit Dolby E sync word */
```

Bitstream keys present:

```
0x078F      /* 16 bit Dolby E sync word */
0x0788F     /* 20 bit Dolby E sync word */
```

5.4 Dolby E/Linear PCM Switching

As described in Section 3.1.6 (Seamless glitchless switch and editing), it is possible to switch between two Dolby E bitstreams without any audio artifacts. Following similar guidelines, it is possible to perform Dolby E to PCM and PCM to Dolby E switches with no undesirable audio artifacts or glitches. Similar to the switch between two Dolby E bitstreams, Dolby E to PCM switches work best when performed during the Dolby E guard band period as described in Section 4.1.2

In the case of a Dolby E to PCM switch, the Dolby E decoder detects the transition after not finding the Dolby E sync word in the incoming data. At this point the decoder fades out and mutes the decoded signal in the main output. The decoder continues to mute the main output for a fraction of a video frame, at which point it fades in the PCM signal to the main output. Figure 5-9 shows the signal in the main output during a Dolby E to PCM transition.

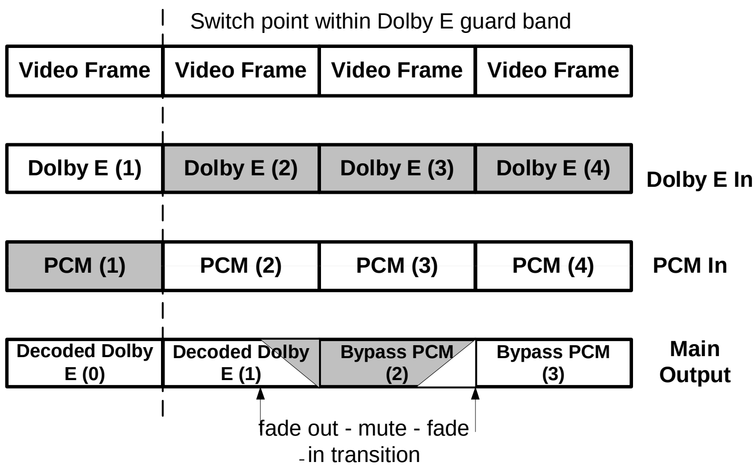

Figure 5-8 PCM to Dolby E Switch

A PCM to Dolby E transition occurs when the Dolby E decoder is in PCM bypass and it detects a Dolby E sync word. Immediately upon detecting the Dolby E sync word, the decoder fades out and mutes the signal in the main output. The decoder waits until two valid frames of Dolby E have been received prior to fading in the decoded audio into the main output. **Error! Reference source not found.** shows the signal in the main output during a PCM to Dolby E transition.

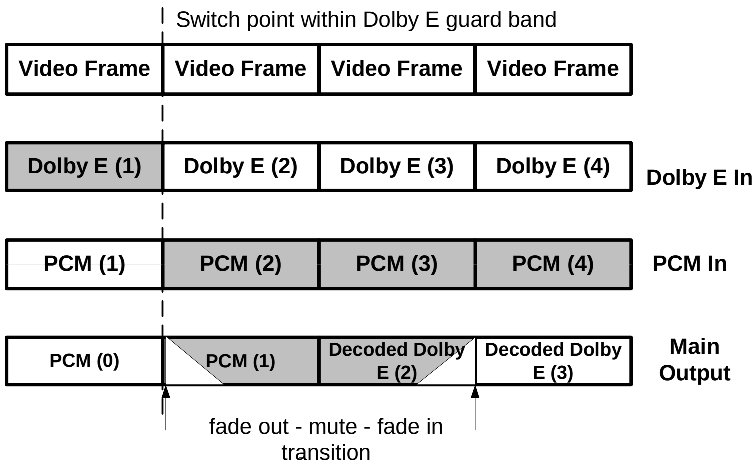

Figure 5-9 Dolby E to PCM Transition

The Dolby E to PCM transitions described in the previous paragraphs assume that the switch point occurs during the Dolby E guard band as recommended. It is still possible to perform a clean switch outside the Dolby E guard band when going from Dolby E to PCM because of the error-detection capabilities build into Dolby E. However, it is not possible to perform a clean switch outside the Dolby E guard band when going from PCM to Dolby E. This is because while in PCM bypass mode, the decoder assumes that incoming data is PCM unless a Dolby E sync word is detected. If a switch takes place outside video frame boundaries it is very likely that the Dolby E sync word will be cut, preventing the decoder from recognizing the first Dolby E frame after the transition. The decoder may output part of the raw Dolby E data as PCM, causing undesirable audio artifacts in the main output. The duration of the audio artifacts will depend on the PCM delay mode.

Chapter 6
Product Categories

To define product standards, products are grouped into categories according to the basic product function. Products within a category will have similar standards. This section defines the product categories and describes the characteristics of products within each category. All products must adhere to a set of baseline standards defined in Chapter 0. Standards for specific product types are given in Chapter 9.

6.1 Product Category Overview

The basic product categories are:

- Storage Products
- Router/Switcher Products
- Transport Products
- Audio Processing Products

Standards within each product category are further broken down based on processing level, compatibility level, video reference signal, Dolby E frame rates, and interfaces. In some cases, products will be difficult to categorize due to complex functionality and may require standards from multiple product classes. Contact Dolby Laboratories for a specific determination of product class if the product category is not clear.

6.2 Storage Products

Storage products are devices that can record and playback digital audio signals from tape, disk, or other media. In most cases, storage devices include the ability to edit audio signals. Audio and/or video editing products with storage (i.e., editing workstations) are included in this product class. Categories within this product class are described below.

6.2.1 Video Tape Recorders (VTRs)

VTR products include any tape-based video format with digital audio recording capability, generally with dedicated digital audio sectors included in the tape format. Most devices in this category will include editing capabilities. Both standard- and high-definition video formats are included in this category.

6.2.2 Video Disk Recorders (VDRs)

VDR products include any disk-based video format with digital audio recording capability. Two VDR subcategories are defined based on editing capabilities:

Editing VDR

Products in this category perform as "VTR replacements" and include editing features similar to VTR products.

Program VDR

Products in this category generally function as program storage devices and do not have VTR-like editing capabilities (for example, time-delay disk recorders, commercial-insert disk recorders).

Both standard- and high-definition video disk recorders are included in this category.

6.2.3 Nonlinear Video Editing Workstations (Video NLE)

Products in this category are computer workstation based nonlinear video editing platforms with digital audio recording/editing capability. Generally products in this category use disk-based storage and support similar functions as editing VDRs. This category is meant to focus on dedicated NLE products versus editing VDRs, which are targeted as VTR replacements.

6.2.4 MPEG-Transport Based Video Recorders

Products in this category include tape- or disk-based products that store digital audio as an element in an MPEG-transport stream. These devices may or may not include editing capability. Note that this category only refers to devices that store MPEG-transport streams as the basic format. Many video recording devices use MPEG video compression but do not store data as a transport stream. These devices are covered by the above categories.

6.2.5 Audio Only Recorders

This category covers dedicated audio recording devices. Products in this category include tape- or disk-based products that store digital audio signals only and do not include video storage capability. Most devices in this category will include editing capabilities.

6.2.6 Nonlinear Digital Audio Editing Workstations (Audio NLE)

This category is similar to the video NLE category but includes products dedicated to nonlinear audio editing without video capability. Some audio-only recorders can be considered audio NLEs, however this category is meant to focus on workstation-based NLE products versus standalone audio recording devices, which do not require traditional workstation interfaces.

6.2.7 Other Storage Devices

This category includes storage products not covered by the above storage product categories.

6.3 Router/Switching Products

Devices in this class route/switch digital audio signals either as AES3 signals or as part of other physical/logical formats.

6.3.1 AES3 Routing Switchers

Products in this category route/switch dedicated AES3 signals. Included are standalone AES3 routers (with or without a video reference input) and combination video/AES3 routers which may switch analog, SDI, or other video signals in addition to AES3 signals.

6.3.2 SDI Routing Switchers (with Embedded Audio)

Products in this category route/switch SDI signals (Serial Digital Interface, SMPTE 259M) with embedded AES3 bitstreams (as specified by SMPTE 272M).

Note: In general all SDI switchers support this function.

6.3.3 HDSDI Routing Switchers (with Embedded Audio)

Products in this category route/switch HDSDI signals (High-Definition Serial Digital Interface, SMPTE 292M) with embedded AES3 bitstreams (as specified by SMPTE 299M).

Note: In general, all HDSDI switchers support this function.

6.3.4 MPEG Transport Stream Routing Switchers

Products in this category route/switch MPEG transport streams, which may include digital audio elementary streams.

6.3.5 Production Consoles

Products in this category provide production routing/switching functions. These generally include production console style audio editing and switching functions, whereas simple routing switchers do not provide audio editing functions.

6.3.6 Master Control Consoles

Products in this category provide master control routing/switching functions. These generally include master-control style audio editing and switching functions, whereas simple routing switchers do not provide audio editing functions.

6.3.7 Other Routers/Switchers

This category includes router/switcher products not covered by the above routing/switching categories.

6.4 Transport Products

Devices in this class are intended to transport digital audio signals within facilities or between facilities, generally by physical/logical formats other than AES3. The devices of primary importance in this class are the I/O products or functions that translate digital audio signals to/from the desired transport format.

6.4.1 SDI Transport Devices

Products in this category transport digital audio signals embedded in SDI signals (SMPTE 259M). This category includes two subcategories based on I/O functions:

SDI Embedders (Multiplexers)

SDI embedding devices insert digital audio signals into SDI signals according to SMPTE 272M.

SDI Disembedders (Demultiplexers)

SDI disembedding devices extract digital audio signals embedded in SDI signals according to SMPTE 272M.

6.4.2 HDSDI Transport Devices

Products in this category transport digital audio signals embedded in HDSDI signals (SMPTE 292M). This category includes two subcategories based on I/O functions:

HDSDI Embedders (Multiplexers)

HDSDI embedding devices insert digital audio signals into HDSDI signals according to SMPTE 299M.

HDSDI Disembedders (Demultiplexers)

HDSDI disembedding devices extract digital audio signals that are embedded in HDSDI signals according to SMPTE 299M.

6.4.3 MPEG Transport Devices

Products in this category transport digital audio signals embedded in MPEG transport streams. This category includes two subcategories based on I/O functions:

MPEG Multiplexers

MPEG multiplexer devices insert digital audio signals into MPEG transport streams.

MPEG Demultiplexers

MPEG demultiplexer devices extract digital audio signals from MPEG transport streams.

6.4.4 Other Transport Devices

This category includes transport products not covered by the above transport categories. Examples in this category include devices that interface digital audio signals to satellite, telecom, and fiber links that use non-MPEG transmission protocols.

6.5 Audio Processing Products

This class of products primarily includes devices that provide digital audio signal processing functions. This class also includes other products that convey digital audio signals but do not fit in one of the above-defined classes.

6.6 Other Devices

This category includes any devices not covered by the above product categories.

Chapter 7
Compatibility Options

Within each product category multiple compatibility options exist. These options are broken down into categories based on the product functionality with respect to Dolby E, compatibility with Dolby E standards, and the types of Dolby E bitstreams that are supported.

7.1 Processing Levels

The basic level of product compatibility is determined by product functionality with respect to Dolby E. This functionality is categorized by the level of capability to read and/or write Dolby E metadata. The categories of metadata processing are defined by the following *processing levels*:

- *Level 1: Dolby E Pass-Through* devices operate at the simplest level of compatibility. These devices pass or record/playback Dolby E bistreams without modification. In general, devices in this class do not have any ability to monitor the Dolby E bitstream, although some devices in this class may include simple detection of the presence of Dolby E within an AES3 signal. Some devices in this class may also have the ability to adjust the phase alignment of the Dolby E signal, but without modification of the Dolby E data itself.
- *Level 2: Dolby E Pass-Through with Metadata Read* devices can detect Dolby E bitstreams and read (monitor) the Dolby E metadata segments. As with Level 1 devices, these devices also pass or record/playback Dolby E bitstreams without modification. Some devices in this class may also have the ability to adjust the phase alignment of the Dolby E signal, but without modification of the Dolby E data itself.
- *Level 3: Dolby E with Metadata Read/Write* devices can read and write Dolby E metadata segments. In general, devices in this class have more stringent operational standards, and can be expected in most cases to output fully compatible Dolby E bitstreams, including properly phased output.
- *Level 4: Metadata Generation and/or Processing* devices operate with standalone metadata signals (which include Dolby E metadata) rather then Dolby E bitstreams themselves. In general, these devices operate in conjunction with linear PCM audio signals associated with the metadata.

In general a specific device will be compatible with Dolby E at only one processing level; it is, however, possible that a device may support Level 4 functionality in addition to Level 2 or 3 functionality.

Within individual product categories, multiple processing levels may be supported, but not all categories support all levels. Multiple standards categories may exist under each product category/processing level, based on other options described below.

Note: As of the date of publication of this document, only Level 1 standards are specified. Level 2–4 standards are currently under development.

7.2 Compatibility Levels

Ideally, new equipment that is designed to be fully compatible with Dolby E will meet all defined requirements, and may include optional or recommended features. However, existing devices and new devices that are not specifically designed for Dolby E compatibility may not meet all requirements necessary for full compatibility but may still be able to convey Dolby E bitstreams. To better characterize equipment behavior and to aid users in identifying device compatibility, a set of *compatibility levels* have been defined:

- *Level A: Fully Compatible* devices meet all specified Dolby E requirements.
- *Level B: Conditionally Compatible* devices meet all specified Dolby E requirements only under certain conditions. Generally these devices require specific product settings or have restrictions on usage in order to meet Dolby E requirements. In some cases, conditional compatibility may imply that hardware and/or software upgrades are required to meet full compatibility.
- *Level C: Partially Compatible* devices do not meet all specified Dolby E requirements for a particular product class but still meet the minimum baseline requirements for Dolby E compatibility (i.e., they have the basic ability to transport or convey Dolby E signals). In some cases, conditional product settings and/or usage may also be required in order to meet the baseline set of requirements.

Within individual product categories multiple compatibility levels may be supported, but not all categories support all levels. Furthermore, multiple processing levels may be defined for each product category, and multiple compatibility levels may exist within each processing level.

7.3 Data Mode

Dolby E supports multiple data modes. The data mode refers to the number of bits placed in each AES3 subframe as defined in SMPTE 337M. In general, this translates to the audio sample word width supported by a product. The defined Dolby E data modes are:

- *16-bit mode* devices support 16-bit Dolby E bitstreams only.
- *20-bit mode* devices support 16- and 20-bit Dolby E bitstreams.
- *24-bit mode* devices support 16-, 20-, and 24-bit Dolby E bitstreams.

Some product compatibility standards are global for all data modes. Other standards may vary based on the data mode. Standards specific to a given data mode are noted.

Note: As of the date of publication of this document, only the 16- and 20-bit data modes are currently supported by Dolby E products.

7.4 Frame Rate

Dolby E supports operation at multiple video frame rates. The defined Dolby E frame rates are:

"Low" frame rates

- *23.98 fps*
- *24 fps*
- *25 fps (PAL rate)*
- *29.97 fps (NTSC rate)*
- *30 fps*

"High" frame rates

- *50 fps*
- *59.94 fps*
- *60 fps*

Some product compatibility standards are global for all frame rates. Other standards may vary based on the frame rate. Standards specific to a given frame rate are noted.

Note that the Dolby E frame rate does not necessarily correspond to the frame rate of an associated video signal, particularly with high-definition video signals. For instance, a 29.97 fps Dolby E signal is likely to be used in conjunction with a 59.94 Hz progressive high-definition video signal.

Note: As of the date of publication of this document only the 25 fps (PAL) and 29.97 fps (NTSC) frame rates are currently supported by Dolby E products. Some standards for other frame rates may be noted, but in general only standards for the 25 and 29.97 fps frame rates are specified in this document.

Chapter 8
Baseline Standards

Any level of compatibility with Dolby E signals implies a certain minimal set of requirements and recommendations for all product categories and processing levels. Therefore a set of *baseline standards* have been defined that may apply to all product categories. Not all baseline standards defined below apply to all products products that contain features addressed by these standards, however, shall follow the defined requirements and recommendations. Also included are optional features that may apply to all product categories.

Note: Many of the following requirements and recommendations are part of a SMPTE recommended practice regarding equipment compatibility with the SMPTE 337M standard. The proposed RP applies to all data that may be carried according to the SMPTE 337M standard, including Dolby E. When this recommended practice is finalized by SMPTE, it should be viewed as an element of the baseline Dolby E standards.

8.1 Baseline Product Requirements

8.1.1 Digital Audio Data Path

For compatibility with existing audio interfaces and transmission/storage paths, a digital audio data path capable of conveying linear PCM data without modification is required. Analog signal or interfaces will not convey Dolby E data. An exception is made for certain digital bit patterns that can be prevented from occuring by use of the Dolby E bitstream key feature, but it is highly recommended that restriction of data patterns be avoided.

8.1.2 Bit Depth

A minimum bit depth (audio sample size) of at least 16 bits shall be supported in all cases. For devices supporting Dolby E 20-bit mode, a bit depth of at least 20 bits is required.

Word Length Truncation

Many devices receive audio data with sample sizes of 24 bits but have audio paths restricted to less than 24-bit word lengths. Equipment that cannot pass the entire word length of received audio sample words shall truncate the least significant audio data bits such that data contained in the remaining most significant audio bits is unaltered.

For instance, devices that can receive Dolby E data via the AES3 interface, but are restricted to 16-bit word lengths, should remove the least significant 8 bits of the 24-bit data word (4 bits from the aux data field and 4 least significant bits from the audio data field) without altering the remaining 16 bits.

Truncation of linear PCM sample words is often done by adding dither at the point of truncation. This dither will affect the bit patterns of the linear PCM words, and will change the data patterns of Dolby E data, therefore dither should not be applied when truncating audio words containing Dolby E data. It should also be noted that internal conversions, such as fixed- to floating-point conversions, may take place in some equipment. If such conversions are performed on words containing Dolby E data, care should be taken that these conversions do not perform rounding or any other numeric processes that may alter the Dolby E data.

8.1.3 AES3 Channel Status Information

Devices transporting AES3 signals (either directly or indirectly as embedded information), storing information from AES3 signals, or having AES3 interfaces, shall either correctly respond to or ignore channel status bits specified in SMPTE 337M. In particular, devices shall not mute or otherwise reject input signals when channel status bit 1 (non-audio bit) is set to “1” to indicate the presence of non-audio data.

8.1.4 PCM Processing

Modification of the signal level (i.e., PCM gain adjustment) or any kind of signal processing that will alter the Dolby E data contained in the audio sample words shall not be performed. Any user-adjustable gain controls on the equipment shall be bypassed or locked to a value of exactly 1.0, and any signal processing nominally performed on linear PCM signals shall be defeated, either automatically or via manual user control. Transient PCM processing, such as crossfades at switch/edit locations, is allowed, but should also be defeatable.

Examples of signal processing functions to be defeated are dithering, rounding, sample-rate conversion, pitch correction, and any kind of fixed to floating point conversion processes that have the possibility of altering the Dolby E data.

Sample-Rate Conversion

Sample-rate conversion circuits shall be bypassed, or shall not change the bit pattern of the audio sample data. Typically sample-rate converters change the bit patterns of the samples even when operating at identical input and output sample rates.

8.1.5 Video Synchronization

Proper frame synchronization of Dolby E data to a reference video signal shall be maintained, either directly or by preserving the frame rate (sample rate) of the Dolby E transport signal (which in most cases will be 48 kHz locked to a video reference). In particular, devices shall support operational modes where Dolby E data is not corrupted due to I/O buffer management (e.g., sample drops or repeats) under specified Dolby E operating conditions. Corruption due to improper I/O synchronization by the user or to transient input conditions (e.g., prior switching, editing, and so on), is allowed when necessary but should be avoided whenever possible.

This requirement may impose limitations on the usage of Dolby E in certain applications where equipment that operates at different sample rates must be interconnected. It is the responsibility of users to ensure that transport signals containing Dolby E data are properly synchronized to avoid loss of data.

8.2 Baseline Product Recommendations

8.2.1 Bit Depth

A bit depth (audio sample size) of at least 20 bits is recommended in all cases (Dolby E 20-bit mode is the preferred operating mode).

Devices receiving SMPTE 337M formatted Dolby E data should follow audio sample word length recommendations contained in SMPTE 337M Annex B.1.

8.2.2 Switching/Editing

Video tape recorders (VTR), video disk recorders (VDR), routers, switchers, or other devices, which edit or switch between two Dolby E signals, should perform an abrupt switch or edit at the defined Dolby E switch point for the given video rate and reference signal. Any PCM fade operation (as is typically done with linear PCM signals to minimize artifacts) should be defeated. The type of audio edit performed by a VTR or other recordable device should be set to a cut edit, equivalent to a crossfade time of 0.

8.2.3 AES3 Channel Status Information

For devices transporting AES3 signals (either directly or indirectly as embedded information), storing information from AES3 signals, or having AES3 interfaces, it is desirable for such devices to respond to and preserve channel status information fields defined in SMPTE 337M. In particular, AES3 channel status bit 1 should be preserved and/or set correctly (per SMPTE 337M) at the equipment output when Dolby E is carried on the AES3 interface.

Devices receiving SMPTE 337M formatted Dolby E data should follow channel status usage recommendations contained in SMPTE 337M Annex B.1 and B.2. Specifically correct channel status usage should not be relied upon for input signals containing Dolby E. Whenever possible output signals containing Dolby E should set channel status fields as specified in SMPTE 337M.

8.2.4 Dolby E Autodetection or Manual Select

For devices that do not meet audio channel requirements or recommendations by default, or that continue to apply standard PCM processing when PCM signals are present, a Dolby E autodetection option is recommended. The autodetect feature should implement all desired Dolby E operational characteristics when Dolby E is detected. An example of a Dolby E autodetection algorithm for the AES3 transport interface is described in SMPTE 337M Annex A.

Note that for the AES3 transport interface, AES3 channel status bit 1 should be used as the primary indicator of the presence of data on the AES3 channel. As described in SMPTE 337M Annex B.2, channel status bit 1 may not a reliable indicator of the presence of SMPTE 337M formatted data, and will not uniquely identify the presence of Dolby E (other types of SMPTE 337M data may be present). Therefore, an explicit detection of Dolby E data as described in SMPTE 337M Annex A is recommended.

When full autodetection of Dolby E is not possible, when only detection of AES3 channel status bit 1 is available, or when no autodetection is possible, it is recommended that equipment allow a manual, user-selectable option to indicate the presence of Dolby E. Such an option should implement all desired Dolby E operational characteristics without requiring the user to set individual operating options.

8.2.5 Data Corruption

Corruption of Dolby E data within a device or transmission link should be avoided whenever possible. In some cases corruption may be necessary. In such cases, modifications to audio sample words or disruption of the audio data stream should be minimized. In transmission paths and storage devices, error correction is highly recommended and should be used to *correct* errors whenever possible. When error correction is not present, or when error correction exceeds allowable limits, error *concealment* should be minimized or disabled. In particular, error concealment techniques that rely on PCM processing to reduce the audibility of errors in PCM data should be avoided when Dolby E data is present.

Other data corruption may be required for synchronization purposes. Some devices may require transient I/O buffer management techniques, typically sample drops or repeats to maintain buffer limits. When such corruption is required, it is recommended that the corruption occur during the defined Dolby E guard band area whenever possible. In particular, limiting sample drops or repeats to the vertical sync interval will minimize the impact on Dolby E signals.

Also refer to SMPTE 337M Annex B.3, for further information regarding corruption of data contained in AES3 signals.

8.2.6 D/A Conversion

Direct digital-to-analog (D/A) conversion of Dolby E data contained in audio sample words should be avoided whenever possible. It is recommended that all D/A outputs be muted whenever Dolby E data is detected or manually indicated.

Users should be aware that many existing devices may not follow this recommendation, therefore all signal paths that may contain Dolby E data should be monitored with devices capable of detecting and decoding Dolby E data. Direct D/A conversion of Dolby E data will produce a high-level noise-like signal that should not be reproduced at high amplification levels.

8.2.7 Metering

It is recommended for devices that include level meters for monitoring of signal levels of linear PCM audio to include a specific indication of the presence of Dolby E data, and not attempt to indicate level information, unless such devices are capable of reading and displaying metering information included in the Dolby E frame (requires Level 2/3 support).

Users should be aware that many existing level meters may not provide this capability and will therefore display inaccurate level information, typically showing high-level or clipped signals when Dolby E data is present; this behavior does, however, give the knowledgeable user an indication that the signal being metered is a Dolby E signal and not a PCM audio signal.

8.2.8 Delay

Audio path delays should be within one audio sample period (~20 microseconds), or to even multiples of video frames to maintain phase synchronization of Dolby E signals. Otherwise audio path delays should be minimized as much as possible.

8.2.9 Product Documentation

It is recommended to include Dolby E compatibility information with all product documentation. In addition to basic Dolby E compatibility statements, the following specific information is recommended:

- Product settings required for compatibility
- Bit depth(s) supported
- Dolby E frame rate(s) supported
- Support for AES3 channel status bits (when applicable)
- Delay through I/O paths and any variability in delay greater than ±20 microseconds.

8.3 Baseline Product Options

8.3.1 Dolby E Encoding/Decoding Compensation Delay

In most applications, compensation in the video path is required for the one frame processing delay incurred by Dolby E encoders and decoders. Many products that contain both audio and video paths may allow flexible buffering on input and output paths. A desirable feature for such products is a compensation delay that either advances or delays the audio data path by one video frame with respect to the video path. Specific recommendations are provided for some product categories.

8.3.2 Dolby E Frame Alignment

In distribution paths digital audio signals are typically delayed with respect to video signals due to equipment processing delays or other synchronization equipment. In many cases the phase synchronization of Dolby E signals may be offset from the desired location. In products that are capable of detecting Dolby E data and adjusting audio path delays, it is desirable to rephase the Dolby E frame to the correct alignment with respect to video.

Chapter 9 Standards for Specific Product Categories

This chapter describes standards that are specific to individual product categories.

Note: As of the date of publication of this document, standards for all product categories have not been defined. In addition, only Level 1 standards are currently specified. Please contact Dolby Laboratories for information regarding product categories and processing levels that have not yet been defined.

9.1 Storage Products

9.1.1 Video Tape Recorders (VTRs)

Standards for Level 1 Processing: Dolby E Pass-Through

Requirements:

1. All baseline requirements specified in Section 8.1 shall be met.
2. Video Reference
3. Record, playback, and editing in synchronization with a defined Dolby E reference video signal shall be supported.
4. Offspeed Playback

For devices that support offspeed playback (program play), the Dolby E data shall be played back without modification at a rate corresponding to the offspeed play (nominally ±15%). This feature is currently defined for the AES3 transport signal only, and requires the AES3 signal to be output with a sample rate of 48 kHz ±15% corresponding to the offspeed play rate. Other transport interfaces (e.g., SDI) shall mute the audio tracks with Dolby E when in program play mode.

a. Editing

Tape edits of audio tracks containing Dolby E data shall be performed at the defined edit point for the given video rate/reference signal according to the following tolerances:

frame rate	video reference	video line for edit
29.97 Hz	Analog Composite or SDI	line 4–10
	HDSDI	line 4–7
25 Hz	Analog Composite or SDI	line 1–6

The editing interval is for analog composite reference signals is illustrated in Figure 9-1. Tape edits of audio tracks containing Dolby E data shall be performed with a “cut” edit as described in Section 8.2.2.

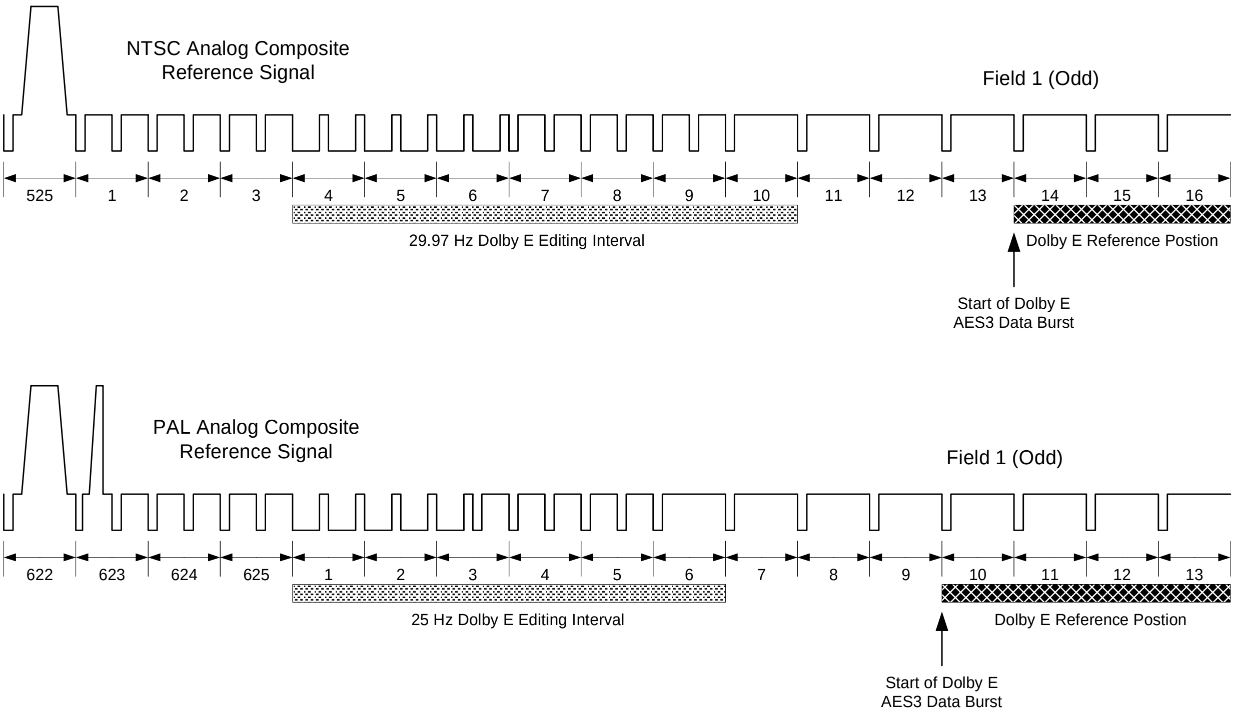

Figure 9-1 VTR Dolby E Editing Interval

b. Delay

The audio path delay (from record input to playback output) shall be –0/+1 video line.

c. AES3 Channel Status Bits

For devices with AES3 or embedded AES3 I/O, all channel status fields defined in SMPTE 337M shall either be maintained (recorded and played back) or set as required by SMPTE 337M on the output when Dolby E signals are present.

d. D/A Conversion

D/A conversion of audio tracks containing Dolby E data shall not be performed. Analog outputs, including headphone outputs, shall be muted when playing back Dolby E data.

Recommendations:

Mute during shuttle/jog

It is recommended that all digital audio tracks containing Dolby E data be muted when in shuttle, jog, or other "trick play" modes.

Options:

When possible it is desirable to implement a video delay adjust feature to compensate for Dolby E encoding and decoding delays. This feature should allow audio inputs containing Dolby E which is one video frame delayed with respect to the video input to be recorded on tape in sync with the video signal. On playback this feature should allow audio tracks containing Dolby E data to be played out one video frame in advance with respect to the video output. It is recommended that the input and output delay features be individually controlled via manual user selection options.

Standards for Level B: Partial Compatibility

Devices not supporting all Level A requirements, but still meeting baseline requirements specified in Section 8.1 *in all operating modes,* shall be considered partially compliant.

Recommendations:

It is recommended that product documentation clearly state product behavior and deviations from Level A requirements.

Standards for Level C: Conditional Compatibility

Devices supporting Level A or Level B requirements, *but not in all operating modes*, shall be considered conditionally compliant.

Recommendations:

It is recommended that product documentation clearly state product settings and operating modes required to support full or partial compliance.

9.1.2 Video Disk Recorders (VDRs)

Product specific standards for this category have not been defined.

9.1.3 Nonlinear Video Editing Workstations (Video NLE)

Product specific standards for this category have not been defined.

9.1.4 MPEG-Transport Based Video Recorders

Product specific standards for this category have not been defined.

9.1.5 Audio Only Recorders

Product specific standards for this category have not been defined.

9.1.6 Nonlinear Digital Audio Editing Workstations (Audio NLE)

Product specific standards for this category have not been defined.

9.1.7 Other Storage Devices

Product specific standards for this category have not been defined.

9.2 Router/Switching Products

9.2.1 AES3 Routing Switchers

Standards for Level 1 Processing: Dolby E Pass-Through

Requirements:

1. All baseline requirements specified in Section 8.1 shall be met.

2. Video Reference

Switching synchronization with a defined Dolby E reference video signal shall be supported.

3. Switch Point

Switches of AES3 signals containing Dolby E shall be performed at the defined switch point for the given video rate/reference signal according to the following tolerances:

frame rate	video reference	video line	tolerance
29.97 Hz	Analog Composite or SDI	line 10	±1 line
	HDSDI	line 7	±1 line
25 Hz	Analog Composite or SDI	line 6	±1 line

The switch interval for analog composite reference signals is illustrated in Figure 9-2.

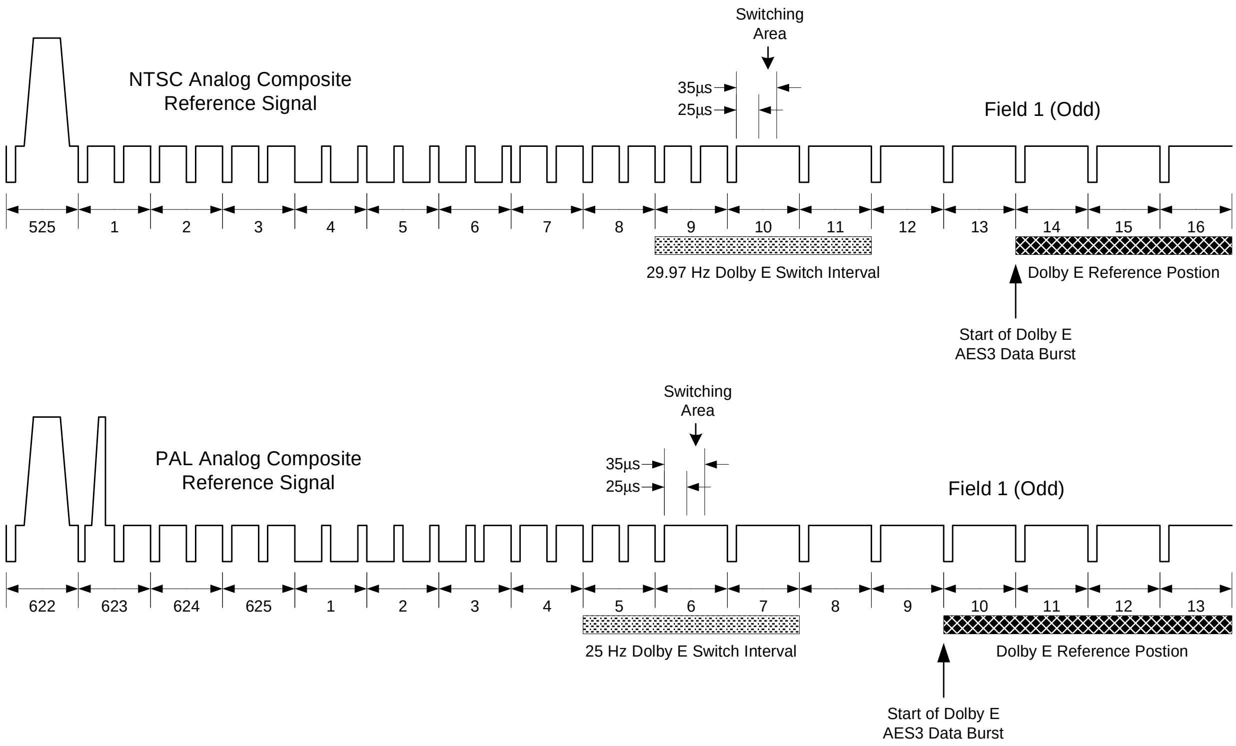

Figure 9-2 AES3 Routing Switcher Dolby E Switch Interval

4. Delay

The audio path delay shall be –0/+1 video line.

5. Channel Status Bits

All AES3 channel status fields specified in SMPTE 337M shall be maintained.

Recommendations:

1. It is recommended to switch the AES3 signal at the start of the first AES3 frame following the defined switch location.

2. For devices supporting field or asynchronous (not follow video) switching, a Dolby E autodetect feature can be added to restrict switching to the defined switching location when Dolby E data is present.

Devices not supporting all Level A requirements, but still meeting baseline requirements specified in Section 8.1 *in all operating modes,* shall be considered partially compliant.

Recommendations:

It is recommended that product documentation clearly state product behavior and deviations from Level A requirements.

Standards for Level C: Conditional Compatibility

Devices supporting Level A requirements, *but not in all operating modes,* shall be considered conditionally compliant.

Recommendations:

It is recommended that product documentation clearly state product settings and operating modes required to support full compliance.

9.2.2 SDI Routing Switchers (with embedded audio)

Product specific standards for this category have not been defined.

9.2.3 HDSDI Routing Switchers (with embedded audio)

Product specific standards for this category have not been defined.

9.2.4 MPEG Transport Stream Routing Switchers

Product specific standards for this category have not been defined.

9.2.5 Production Consoles

Product specific standards for this category have not been defined.

9.2.6 Master Control Consoles

Product specific standards for this category have not been defined.

9.2.7 Other Routers/Switchers

Product specific standards for this category have not been defined.

9.3 Transport Products

9.3.1 SDI Transport Devices

Product specific standards for this category have not been defined.

9.3.2 HDSDI Transport Devices

Product specific standards for this category have not been defined.

9.3.3 MPEG Transport Devices

Standards for Level 1 Processing: Dolby E Pass-Through

Requirements:

All baseline requirements specified in Section 8.1 shall be met.

1. SMPTE 302M Implementation

Dolby E shall be multiplexed in the MPEG-2 transport stream according the MPEG-2 transport specification defined in Section 4.4.

2. Delay

The AES3 signal shall be encoded in the MPEG-2 bitstream such that timing of the SMPTE 302M PES packets preserves the alignment of the AES3 audio samples to an associated video signal (also carried in the MPEG-2 bitstream) to within ±1 video line. Demultiplexers shall output AES3 signals such that the timing of the AES3 signal, as indicated by the SMPTE 302M PES packets, maintains the alignment with an associated video signal (when decoded) to within ±1 video line.

3. Channel Status Bits

All AES3 channel status fields from the source AES3 signal shall be multiplexed in the SMPTE 302M data fields. Demultiplexers shall set the channel status bits of the output AES3 according to these fields.

Standards for Level B: Partial Compatibility

Devices not supporting all Level A requirements, but still meeting baseline requirements specified in Section 8.1 *in all operating modes,* shall be considered partially compliant.

Recommendations:

It is recommended that product documentation clearly state product behavior and deviations from Level A requirements.

Standards for Level C: Conditional Compatibility

Devices supporting Level A requirements, *but not in all operating modes,* shall be considered conditionally compliant.

Recommendations:

It is recommended that product documentation clearly state product settings and operating modes required to support full compliance.

Note: Specifications for Dolby E in MPEG transport streams are subject to change. Alternative methods for carrying Dolby E in MPEG streams are under development, but the SMPTE 302M method is currently the accepted standard.

9.3.4 Other Transport Devices

Product specific standards for this category have not been defined.

9.4 Audio Processing Products

9.4.1 Video Frame Synchronizers

Product specific standards for this category have not been defined.

9.4.2 Audio Mixers and Mixing Consoles

Product specific standards for this category have not been defined.

9.4.3 Other Audio Processing Devices

Product specific standards for this category have not been defined.

9.4.4 Audio Monitoring and Metering Devices

Product specific standards for this category have not been defined.

9.4.5 Other Devices

Product specific standards for this category have not been defined.

Chapter 10
Test Procedures

Please contact Dolby Laboratories for further information regarding testing of product and system compatibility with Dolby E.

Chapter 11
References

11.1 Dolby Specifications

The following documents are available under NDA to third parties requiring information for Level 2, 3, or 4 compatibility:

Dolby E High Level Frame Description

Dolby E Metadata Protocol

11.2 Standards

AES3-1992 (ANSI S4.40-1992), *Digital Audio Engineering—Serial Transmission Format for Two-Channel Linearly Represented Digital Audio Data (AES3)*

IEC 60958, *Digital Audio Interface*

IEC 61937, I*nterface for Nonlinear PCM Encoded Audio Bitstreams Applying IEC 60958*

ANSI/SMPTE 12M-1995, *Television, Audio and Film—Time and Control Code*

ANSI/SMPTE 125M-1995, *Television—Component Video Signal 4:2:2—Bit-Parallel Digital Interface*

SMPTE 170M-1999, *Television—Composite Analog Video Signal—NTSC for Studio Applications*

ANSI/SMPTE 244M-1995, *Television—System M/NTSC Composite Video Signals—Bit-Parallel Digital Interfac*e

ANSI/SMPTE 259M-1997, *Television—10-Bit 4:2:2 Component and* $4f_{sc}$ *NTSC Composite Digital Signals—Serial Digital Interfac*e

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

SMPTE 276M-1995, *Television—Transmission of AES-EBU Digital Audio Signals Over Coaxial Cable*

SMPTE 292M-1996, *Television—Bit-Serial Digital Interface for High-Definition Television Systems*

ANSI/SMPTE 299M-1997, *Television—24-Bit Digital Audio Format for HDTV Bit-Serial Interface*

SMPTE 302M-1998, *Television—Mapping of AES3 Data into MPEG-2 Transport Stream*

SMPTE 337M-2000 *Television—Format for Non-PCM Audio and Data in an AES3 Serial Digital Audio Interface*

SMPTE 338M-2000 *Television—Format for Non-PCM Audio and Data in AES3—Data Types*

SMPTE 339M-2000 *Television—Format for Non-PCM Audio and Data in AES3—Generic Data Types*

SMPTE 340M-2000 *Television—Format for Non-PCM Audio and Data in AES3—ATSC A/52 (AC-3) Data Type*

SMPTE 341M - 2000 *Television—Format for Non-PCM Audio and Data in AES3—Captioning Data Type*

SMPTE RP 168-1993, *Definition of Vertical Interval Switching Point for Synchronous Video Switching*

ITU-T Rec. H.2220.0 | ISO/IEC 13818-1 I

ITU-R BT.601-5, *Studio Encoding Parameters of Digital Television for Standard 4:3 and Widescreen 16:9 Aspect Ratios*

11.3 Background Information

Dolby Digital Broadcast Implementations Guidelines—available on Dolby’s website under www.dolby.com/tvaudio

Also refer to *www.dolby.com* for additional information, including newsletters and product documentation.