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SMPTE ENGINEERING GUIDELINE

Nomenclature for Television Digital Recording of 19-mm Type D-1 Component and Type D-2 Composite Formats

1 Scope

This guideline explains terms as used in the documents defining the D-1 and D-2 digital television recording formats.

2 General definitions

2.1 D-1 format recorder: A 19-mm cassette-based digital recorder for component video and other television signals in accordance with ANSI/SMPTE 227M.

2.2 D-2 format recorder: A 19-mm cassette-based digital recorder for composite video and other television signals in accordance with ANSI/SMPTE 247M.

2.3 program areas: That part of the tape on which is digitally recorded the program video and audio signals.

2.4 program area track pattern: The arrangement of video and audio sectors on helical-scan tracks within the program area.

3 Track pattern allocation — Video and audio segments

3.1 video segment: A video segment contains the digital video data originating from one contiguous portion of a television field. It is recorded within several video sectors, which are located in adjacent video tracks.

3.2 audio segment: An audio segment contains the digital audio data associated with one or more video segments. These data are written into several audio sectors. Audio sectors from different audio channels are interleaved and written on adjacent helical tracks at the ends of video sectors.

4 Electrical signal allocation

4.1 video and audio sectors: A sector is a structured sequence of data which incorporates the video or audio data and appropriate synchronizing and identification patterns, so that the video or audio data can be recovered from tape and identified for subsequent processing.

4.1.1 preamble: A preamble consists of a runup sequence, a sync pattern, an identification pattern, and some fill data.

4.1.1.1 runup sequence: A runup sequence consists of a sequential bit pattern chosen to facilitate the locking of data-extraction circuits.

4.1.1.2 sync pattern: A sync pattern consists of two consecutive bytes whose bit pattern is chosen to be a robust indication of the start of a sync block.

4.1.1.3 identification pattern: An identification pattern consists of two to four consecutive bytes providing a unique address of the position of a sync block within two to four frames of recorded data. It may be coded to remove direct current and provide error protection.

4.1.1.4 fill data: Fill data consists of a few bytes of a fixed pattern which is designed to provide a minimum separation on tape between the runup, sync pattern, and the first sync block. Fill data may also be recorded in the edit gap between sectors in a track.

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4.1.2 sync block: A sync block consists of a sync pattern followed by an identification pattern followed by two inner code blocks.

4.1.2.1 inner code block: An inner code block consists of a number of bytes of video data, audio data, or outer code check data, followed by a number of inner code check data. A D-2 inner code block may include an identification pattern.

4.1.3 postamble: A postamble consists of a sync pattern followed by an identification pattern and, possibly, some fill data.

5 Subsets of binary data

Usually, for convenience in parallel digital processing, binary information is processed in groups of bits referred to in the literature as words or bytes. These terms have generally understood meanings but are not unambiguously defined. For the purpose of this terminology, the following definitions are assumed:

5.1 bit: A contraction of binary and digit to define a unit of information.

5.2 bit-parallel: Refers to a set of concurrent data bits present on a like number of data lines used to carry information. Bit-parallel data bits may be acted upon concurrently as a group (word) or independently as individual data bits.

5.3 byte: A byte consists of eight bits of binary information. It may have an identity other than being a convenient processing unit (for example, see video data word), but generally this is not implicit.

5.4 video data word: A video data word is a byte in which the eight bits represent the possible 256 quantum levels of a video sample.

5.5 audio data word: An audio data word consists of 16 to 20 bits. In the most basic operating mode 16 bits represent the possible 2^{16} quantum levels of an audio sample and four bits are used for auxiliary signals. Other modes are defined in which either one, two, three, or four of the auxiliary signal bits are allocated to extend the dynamic range of the audio sample quantization. For convenience, the 20-bit word may be processed in five words of four bits each.

5.6 bit rate: The rate at which encoded information is transmitted from one part of a system to another, expressed in bits per second.

5.6.1 In component digital video with a luminance sampling frequency of 13.5 MHz and a color difference sampling frequency of 6.75 MHz for each of the two color-difference channels and 8-bit PCM encoding of each sample, the bit rate is 216 million bits per second.

5.6.2 In composite digital video with a sampling frequency of 14.32 MHz ($4f_{SC}$) and 8-bit PCM encoding of each sample, the bit rate is approximately 114 million bits per second.

5.7 bus: A signal line or a set of signal lines used by an interface to which multiple devices are connected and over which messages are carried.

5.8 unidirectional bus: A bus used by any individual device for one-way transmission only; that is, either input only or output only.

5.9 positive binary: The condition where the most positive of the two possible signal levels is a logical 1.

5.10 clock: A source of accurately timed pulses used for synchronization in a digital computer or as a time base in a transmission system.

A synchronous clock in this application means that the clock pulses are synchronous in frequency and phase to the video horizontal rate for a component signal or the chrominance subcarrier frequency for a composite signal.

5.11 data lines: Refers to the interconnecting signal lines of the interface system. A single data line is defined as a pair of signal lines due to the balanced electrical specification of the system. The signal wires that make up a data line are usually twisted together for crosstalk considerations in conventional cable technology.

5.12 data rate: The rate at which data is transferred from one part of the system to another expressed in bits, bytes, or words per second.

5.13 ECL: Refers to emitter coupled logic. This logic is a nonsaturating form of digital logic

which eliminates transistor storage time, permitting very high speed operation. Standard ECL in this application means an integrated circuit device of the ECL 10,000 series or equivalent.

5.14 interface system: The device-independent mechanical, electrical, and functional elements of an interface necessary to effect communication among a set of devices. Cables, connector, driver and receiver circuits, signal line descriptions, timing and control conventions, and functional logic circuits are typical interface system elements.

5.15 LSB: Least significant bit of a data word.

5.16 MSB: Most significant bit of a data word.

5.17 parallel interface: Pertains to a transmission system wherein all bits of a particular character are sent simultaneously.

5.18 serial interface: Pertains to a transmission system wherein all bits are sent in serial (series) order.

5.19 system: A set of interconnected elements constituted to achieve a given objective by performing a specified function.

6 Error protection strategy

6.1 Various methods are used to reduce the effect of data errors on the objective and subjective quality of the replayed video or audio. The appropriate combination of methods to achieve an optimum result is generally known as the error protection strategy.

6.1.1 error correction: The use of mathematically related check data, recorded with the video and audio data, to determine the precise value and location and, hence, enable correction of data errors.

6.1.2 error concealment: To replace the error sample with the interpolation of adjacent audio or video samples as an estimate of the value of data words previously detected to be in error, but which cannot be corrected.

6.1.3 source precoding: The mapping of video data words so that, for the most probable distribution of data errors, there is a reduction in the peak error produced in a video sample. Source precoding is used in the type D-1 format. Source precoding is not used in the type D-2 format.

7 Error protection — Data organization

7.1 Error correction for both video data and audio data is of the product block type in which each data word is included in the computation of two sets of check data known as outer code check data and inner code check data, respectively.

Additionally, the video and audio data are redistributed from their naturally occurring sequences in order to reduce the effect of burst errors.

Outer code check data are the first to be computed. Inner code check data are the second to be computed, and are applied to the outer code check data as well as to the video and audio data.

7.2 data sector array: For the application of product block error correction, the video data words to be recorded in a video sector are considered as a rectangular array with rows and columns.

7.2.1 outer code check data — outer code block: Outer code check data consists of a number of bytes computed from a column of the video data array and regarded as being appended.

7.2.2 inner code check data — inner code block: Inner code check data consists of a number of bytes computed from a row of the array (or a row of the outer code check data) and appended to that subset. The resulting bytes are known as an inner code block.

7.2.3 product block: The array defined by a number of inner code blocks or the corresponding outer code blocks is known as a product block. There are a number of such product blocks in each sector.

7.3 Video and audio data redistribution

7.3.1 interleaving: The systematic reordering of data so that originally adjacent bytes of data in an error correcting code are separated on tape,

thus reducing the effect of bursts of data errors on the error correcting capability. The separation is known as the interleave distance.

7.3.2 shuffling: The systematic reordering of video or audio data words to increase the probability that uncorrectable samples are surrounded by error-free data words, for the application of error concealment.

8 Coding and modulation

8.1 channel coding: The process by which binary information obtained from the digital logic circuits, used in the processing of video and audio data, is converted to a waveform suitable for recording onto a magnetic medium.

8.2 randomization: The reduction of correlation in a serial bit sequence so that it statistically approximates a random sequence.

8.3 scrambling: Alternate term for randomization.

8.4 mapping: The recoding of data by computation or look-up table, so that there is a defined one-to-one relationship between each original code word and the derived code word.

8.5 composite video signal (analog): The color-picture signal, encoded in the NTSC standard, including blanking and all synchronizing signals.

8.6 composite encoded signal (digital): A digital representation of a composite video signal.

8.7 digitize: To sample, quantize, and code an analog signal.

8.8 PCM (pulse-code modulation): A format for representing information as a set of digital words. As used herein, the process involves the conversion of a signal from analog to digital form by means of sampling, quantizing, and coding. The peak-to-peak amplitude range of the analog signal is divided into a finite number of discrete values each having its own value code.

8.9 linear PCM: Pertaining to quantizing intervals that are equal throughout the range of the system.

8.10 quantization: The division of a continuous range of values into a finite number of distinct values.

8.11 sampling: The process of obtaining a series of discrete, instantaneous values of a signal at regular or intermittent intervals.

8.12 SCH: An abbreviation for the timing relationship between the color subcarrier burst and horizontal sync pulses of a composite color video signal. Zero SCH occurs when the positive going zero-crossings of a subcarrier with the same phase as the color burst are nominally coincident with the 50% point on the leading edges of the even horizontal sync pulses in color field 1, as shown in ITU-R BT.470.

9 Mechanical terms

9.1 basic dimension: A basic dimension is a fundamental dimension to which no tolerance is applicable.

9.2 derived dimension: A derived dimension is obtained from other fundamental dimensions by computation and is given for information purposes only.

9.3 reference dimension: A dimension usually without tolerance, used for informational purposes. It may be a dimension resulting from other values.

9.4 scanner: A mechanical assembly containing a drum, rotating pole tips, and tape-guiding elements used to record and reproduce data.

9.5 drum: A cylindrical column around which the tape is at least partially wrapped in order to form a head-to-tape interface of a recording system.

9.6 effective diameter: The effective diameter is the diameter at the surface of tape wrapped around the drum which includes the drum diameter and the air film between drum and tape.

9.7 helix angle: An angle formed between the path of the rotating pole tips and the tape reference edge-guiding system on the scanner of the helical-scan recording system.

9.8 track angle: An angle of the helical track record with respect to the reference edge of the tape.

9.9 effective wrap angle: An angle at the center of the drum subtended by the start and endpoint of the track.

9.10 total wrap angle: An angle at the center of the drum subtended by the lines of contact between the drum and the reference edge of the tape.

9.11 center span tension: A calculated value of the tape tension at a point midway between the tape entrance and exit guides of the scanner in the recording system.

10 Editing definitions

10.1 edit gap: The space between adjacent sectors, to which edit transitions must be confined, between the end of the sector postamble and the start of the sector preamble.

10.2 cue track: The longitudinal track reserved for the recording of audio frequency signals which are to be used for editing reference purposes.

Annex A (informative)
Bibliography

ANSI/IEEE 100-1992, Dictionary of Electrical and Electronics Terms

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