RP 215-2009
Revision of RP 215-2001

SMPTE RECOMMENDED PRACTICE

Vertical Ancillary Data Mapping of Film Transfer and Video Production Information

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Foreword

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

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

SMPTE Recommended Practice RP 215 was prepared by Technology Committee 22TV.

Intellectual Property

At the time of publication no notice had been received by SMPTE claiming patent rights essential to the implementation of this Recommended Practice. However, attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. SMPTE shall not be held responsible for identifying any or all such patent rights.

Introduction

This section is entirely informative and does not form an integral part of this document.

During the telecine transfer of film originated material to high definition video, the video and production time code and film edge number information, as well as other production metadata is collected for later use during the high definition post production work flow. This document provides the mapping of this data into the high definition video bit stream using SMPTE 291M ancillary data packets. The mapping in this document has been designed to have a maximum data rate requirement of 255 bytes per field (per frame for progressive and segmented frame video formats) and this has been found to be appropriate for all existing equipment.

During the post-production process when high-definition video is down converted to standard definition video, it is often necessary to map the video and production time code and film edge number information carried in the HD ancillary data into vertical interval time code according to SMPTE RP 201. Informative Annex E shows how the RP 201 data maps into the mapping method specified in this document.

The data described in this recommended practice can also be transported using the SMPTE K-L-V data mapping protocol. Informative Annex F shows how the mapping method specified in this document maps into K-L-V format.

1 Scope

This recommended practice specifies a method of mapping video time code, film edge numbers, production audio time code and other production data into the Vertical Ancillary (VANC) Data Space of a bit-serial high-definition component television signal in accordance with SMPTE 291M. This recommended practice is intended for use in postproduction as a means of conveying the essential elements that define the film to tape transfer. It also specifies an alternate mapping for video originated production information. Normally this information is not intended for inclusion in the released program.

2 Conformance Notation

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

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

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

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

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

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

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

3 Normative References

The following standards contain provisions which, through reference in this text, constitute provisions of this recommended practice. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this recommended practice are encouraged to investigate the possibility of applying the most recent edition of the standards indicated below.

SMPTE 12M-1-2008, Television — Time and Control Code

SMPTE 254-2008, Motion-Picture Film (35-mm) — Manufacturer-Printed Latent Image Identification Information

SMPTE 270-2008, Motion-Picture Film (65-mm) — Manufacturer-Printed Latent Image Identification Information — 80 Perforation Repeat

SMPTE 271-2008, Motion-Picture Film (16-mm) — Manufacturer-Printed Latent Image Identification Information

SMPTE 291M-2006, Television — Ancillary Data Packet and Space Formatting

SMPTE 309M-1999, Television — Transmission of Date and Time Zone Information in Binary Groups of Time and Control Code

SMPTE 313-2008, Motion-Picture Film (65-mm) — Manufacturer-Printed Latent Image Identification Information — 120 Perforation Repeat

SMPTE RP 135-2004, Use of Binary User Groups in Motion Picture Time and Control Codes

SMPTE RP 168-2002, Definition of Vertical Interval Switching Point for Synchronous Video Switching

SMPTE RP 195-2004, Use of the Reference Mark in Manufacturer-Printed Latent Image Key Numbers for Unambiguous Film Frame Identification

SMPTE RP 201-2008, Encoding Film Transfer Information Using Vertical Interval Time Code

ISO/IEC 646:1991, Information Technology — ISO 7-Bit Coded Character Set For Information Exchange

ISO/IEC 2022:1999, Information Technology —- Character Code Structure and Extension Techniques

IEEE 754-2008, Standard for Binary Floating-Point Arithmetic

4 Format of VANC Data Packets

Each data packet shall comply with the format defined in SMPTE 291M for a type 2 ANC packet. It consists of the ancillary data flag (ADF), the data ID (DID), the secondary data ID (SDID), the data count (DC), the user data words (UDW), and the checksum (CS). The DID shall be set to the value 51h. The SDID shall be set to the value 01h. The ADF and CS are defined in SMPTE 291M.

4.1 UDW format

The ancillary space packet UDW shall be a sequence of 10-bit words. The film transfer or video production information is transmitted in bits b7 through b0 of the 10-bit data word. Bit b8 is even parity for bits b7 through b0 of the 10-bit data word, and bit b9 equals not bit b8.

4.2 Overview of the Film Transfer Descriptor Packet

The payload of the Film Transfer Descriptor packet consists of several groups of individual data items that are defined below. Each group consists of a one byte Key that identifies the group, a one byte Length, and one or more data items of a similar type which are placed in a specific sequence within the group. The last two bytes of the payload are a 16-bit CRC that serves to identify when bit errors have occurred in the transmission of the packet. The Film Transfer Descriptor packet shall contain at least the Temporal_F group and CRC. Carriage of each of the remaining groups is optional. Decoders should parse the individual group Keys to determine if the data is of interest and skip the number of bytes identified by the group Length byte +1 to find the start of the next group. Table 1 shows the possible groups in the Film Transfer Descriptor packet with their respective Keys and Length values.

Table 1 – Groups in the Film Transfer Descriptor

Group Key	Group Length	Total Size	Name	Description
10_h	44	46	Temporal_F	Data required to identify individual frames. This data is the minimum required to generate 3 Line Vertical Interval time code conforming to RP 201 when the video is down converted to legacy formats. E.g. time code, Key Number, Ink Numbers, etc.
20_h	67	69	Material_F	Data that identifies individual shots. This data will generally remain constant throughout a complete shot or take. E.g. scene, take, Cam Roll, sound roll, etc.
30_h	96	98	Label_F	Data that identifies the video tape or other storage media. This data will generally remain constant throughout a complete videotape. E.g. VT Roll, Production name, episode, etc.
60_h	20	22	Color Decision	Data that described the Color Decision information for individual shots. This data will remain constant throughout a complete shot or take. E.g. slope, power, offset, saturation, etc.
	2	2	CRC	CRC-CCITT Error detection code
Payload Byte Count		237		

Note: The terms Video Tape, VT Roll, and Video Tape Roll are used in this document for legacy reasons, as these are the common terms used in post production. There is nothing that precludes the recording on other storage media such as disc recorders and servers.

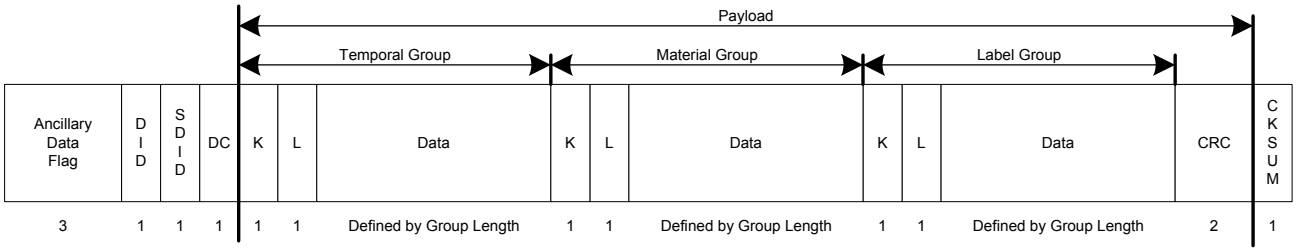


Figure 1 – Structure of the Film Descriptor ANC Packet

Table 2 – Temporal_F Group Data Items

Data Item Number	Length	Name	Ref §	Description
1	4	Video TC	5.1.1	Video Time Address (BCD)
2	4	Video BG	5.1.2	Video Binary Groups (Hex)
3	4	Audio TC	5.1.1	Audio Time Address (BCD)
4	4	Audio BG	5.1.2	Audio Binary Groups (Hex)
5	1	Audio Phase	5.1.5	Audio to Video Bit Phase
6	1	KK MFG	5.1.3	Key Number Mfg Letter (ISO)
7	1	KK Emulsion	5.1.3	Key Number Emulsion Letter (ISO)
8	8	KK	5.1.3	Key Number + Frames (BCD)
9	4	Ink Prefix	5.1.4	Ink Number prefix (ISO)
10	3	Ink	5.1.4	Ink Feet + Frames (BCD)
11	1	Pulldown	5.1.6	Film Pulldown
12	1	Sequence	5.1.7	Film Sequence
13	4	ABS Frames	5.1.8	Absolute Film Frames
14	1	Video Format	5.1.9	Video Format Id
15	1	Audio Modulus	5.1.10	Audio Frame Modulus
16	1	Film Format	5.1.11	Film Format ID
17	1	Film Rate	5.1.12	Film Transfer Rate
Temporal_F Group Length	44			

Table 3 – Material_F Group Data Items

Data Item Number	Length	Name	Ref §	Description
18	4	Tag	5.2.1	Database Index Tag
19	3	Flags		RP 135 Film TC Flags (Bitmapped)
20	4	Equip ID		RP 135 Film TC Equipment ID (ISO)
21	4	Prod Date	5.2.4	Date of Production
22	8	Daily Roll	5.2.2	Daily Roll (ISO)
23	8	Cam Roll	5.2.2	Camera Roll (ISO)
24	8	Sound Roll	5.2.2	Sound Roll (ISO)
25	8	Lab Roll	5.2.2	Lab Roll (ISO)
26	8	Scene	5.2.3	Scene number (ISO)
27	4	Take	5.2.3	Take Number (ISO)
28	8	Slate	5.2.3	Slate Number (ISO)
Material_F Group Length	67			

Table 4 – Label_F Group Data Items

Data Item Number	Length	Name	Ref §	Description
28	8	VT Roll	5.3.1	Video Tape Roll (ISO)
29	20	Title	5.3.2	Show Title (ISO)
30	8	Episode	5.3.2	Episode Number (ISO)
31	20	Facility	5.3.2	Facility Name (ISO)
32	40	Misc	5.3.2	Miscellaneous Data
Label_F Group Length	96			

Note: The term Video Tape Roll (and its abbreviation VT Roll) is used in this document for legacy reasons, as they are the common terms used in post production. There is nothing that precludes the recording on other storage media such as disc recorders and servers. In these cases the Video Tape Roll refers to an identifier used on these storage media.

Table 5 – Color Decision Group Data Items

Data Item Number	Length	Name	Ref §	Description
18	2	Slope_R	5.4.1	ASC Slope Red Value (Half Float)
19	2	Slope_G	5.4.1	ASC Slope Green Value (Half Float)
20	2	Slope_B	5.4.1	ASC Slope Blue Value (Half Float)
21	2	Offset_R	5.4.1	ASC Offset Red Value (Half Float)
22	2	Offset_G	5.4.1	ASC Offset Green Value (Half Float)
23	2	Offset_B	5.4.1	ASC Offset Blue Value (Half Float)
24	2	Power_R	5.4.1	ASC Power Red Value (Half Float)
25	2	Power_G	5.4.1	ASC Power Green Value (Half Float)
26	2	Power_B	5.4.1	ASC Power Blue Value (Half Float)
27	2	Saturation	5.4.1	ASC Saturation Value (Half Float)
Material Group Length	20			

4.3 Overview of the Video Production Descriptor Packet

An alternate mapping may be used for video (non-film) originated material. The payload of the Video Production Descriptor packet is formatted in a similar way to the Film transfer packet; however some of the data groups contain some different items than the corresponding groups in the Film Transfer Descriptor packet. Each group consists of a one byte Key that identifies the group, a one byte Length, and one or more data items of a similar type which are placed in a specific sequence within the group. The last two bytes of the payload are a 16-bit CRC that serves to identify when bit errors have occurred in the transmission of the packet. The Video Production Descriptor packet shall contain the Temporal_V group and CRC. Carriage of each of the remaining groups is optional. Decoders should parse the individual group Key to determine if the data is of interest and skip the number of bytes identified by the group Length byte +1 to find the start of the next group. Table 6 shows the possible groups in the Video Production Descriptor packet with their respective Keys and Length values.

Table 6 – Groups in the Video Production Data Descriptor

Group Key	Group Length	Total Size	Name	Description
11_h	18	20	Temporal_V	Data required to identify individual frames. This data is the minimum required to generate 3 Line Vertical Interval time code conforming to RP 201 when the video is down converted to legacy formats. E.g. video and audio time code, etc.
21_h	46	48	Material_V	Data that identifies individual shots. This data will generally remain constant throughout a complete shot or take. E.g. scene, take, camera roll, sound roll, etc.
31_h	44	46	Label_V	Data that identifies the video tape. This data will generally remain constant throughout a complete video tape. E.g. VT Roll, Production name, episode, etc.
50_h	20	22	Dolly	Data that identifies dolly position and Camera lens data
60_h	20	22	Color Decision	Data that described the Color Decision information for individual shots. This data will remain constant throughout a complete shot or take. E.g. slope, power, offset, saturation, etc.
$F0_h$	66	68	User	User specified data
	2	2	CRC	CRC-CCITT Error detection code
Payload Byte Count		228		

Note: The terms Video Tape, VT Roll, and Video Tape Roll are used in this document for legacy reasons, as these are the common terms used in post production. There is nothing that precludes the recording on other storage media such as disc recorders and servers.

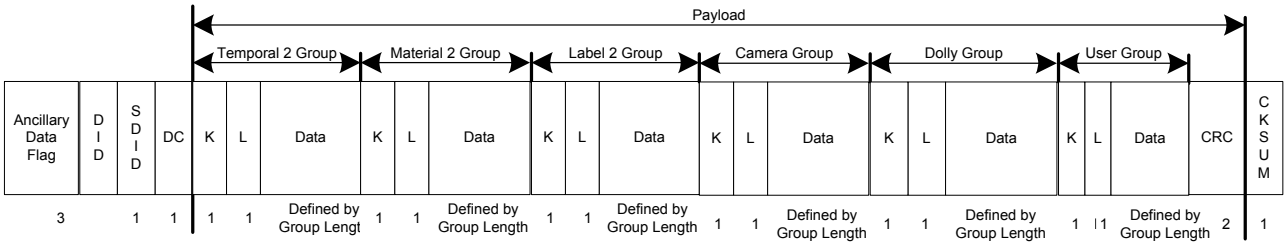


Figure 2 – Structure of the Video Production Data ANC Packet

Table 7 – Temporal_V Group Data Items

Data Item Number	Length	Name	Ref §	Description
1	4	Video TC	5.1.1	Video Time Address (BCD)
2	4	Video BG	5.1.2	Video Binary Groups (Hex)
3	4	Audio TC	5.1.1	Audio Time Address (BCD)
4	4	Audio BG	5.1.2	Audio Binary Groups (Hex)
5	1	Audio Phase	5.1.5	Audio to Video Bit Phase
6	1	Audio Modulus	5.1.10	Audio Frame Modulus
Temporal_V Group Length	18			

Table 8 – Material_V Group Data Items

Data Item Number	Length	Name	Ref	Description
1	4	Tag		Database Index Tag
2	2	Sync Mark		
3	4	Prod Date	5.2.2	Date of Production
4	8	Cam Roll	5.2.2	Camera Roll (ISO)
5	8	Sound Roll	5.2.2	Sound Roll (ISO)
6	8	Scene	5.2.3	Scene number (ISO)
7	4	Take	5.2.3	Take Number (ISO)
8	8	Slate	5.2.3	Slate Number (ISO)
Material_V Group Length	46			

Table 9 – Label_V Group Data Items (PVE)

Data Item Number	Length	Name	Ref	Description
1	20	Title	5.3.2	Show Title (ISO)
2	8	Episode	5.3.2	Episode Number (ISO)
3	4	Unit	5.3.20	Crew Num (ISO)
4	4	Operator	5.3.2	Operator ID (ISO)
5	4	Director	5.3.2	Director ID (ISO)
6	4	Producer	5.3.2	Producer ID (ISO)
Label_V Group Length	44			

Table 10 – Dolly Group Data Items

Data Item Number	Length	Name	Ref	Description
1	4	LENS ID		8 BCD digit serial number
2	2	Focal Length (zoom)		
3	2	Focus Position		
4	2	Iris		F-stop
5	4	Cam Height		
6	2	Cam tilt		
7	2	Cam roll		
8	2	Cam Pan		
Camera Group Length	20			

4.4 CRC Error Check Code

The last two bytes of the payload contain a 16-bit cyclical redundancy checkword. This checkword will catch all single and double errors, all errors with an odd number of bits, all burst errors of length 16 or less and over 99.9% of 17 bit and longer burst errors. The generating polynomial of the CRC is the industry standard CRC-CCITT polynomial. This polynomial is defined as $G(x) = X^{16} + x^{12} + x^5 + 1$ with an initial condition of all zeros.

The generating polynomial shall be applied to all bits in the temporal, material and label groups. The remainder is then encoded into the CRC group as shown in Table 1 most significant bits first. Applying the

generating polynomial to the temporal, material and label groups of the received payload data shall result in a value that matches the CRC group of the received payload when no error exists.

4.4 Data Order

Data items that represent numeric data (BCD or Hex) are ordered with the most significant byte first. Data items that represent ISO character strings are ordered with the leftmost character first.

5 Data Item Descriptors

5.1 Temporal Group Items

5.1.1 Time Code Data items

The Video Time Code and Audio Time Code data items each consist of 4 bytes of packed BCD data in the following format.

10 Hr	1 Hr	10 Min	1 Min	10 Sec	1 Sec	10 Fr	1 Fr

Since the frame rate of 50 and 60 frames per second progressive systems exceeds the frame count of the time address, the frame count shall be constrained to increment only every other frame. The VANC packet for both frames of the pair shall contain the same video time code data item. See SMPTE 12M-1for a full description of time address counting for these progressive systems.

Time code flag bits shall be encoded in the bit positions shown in Table 11.

In the case where Audio time code is not present the Audio Time Code data item should be set to all zeros.

Table 11 – Time Code Flag Positions

SMPTE 12M-1 Flag Bit Name	Location
Drop Frame Flag	Bit 6 of Frames Byte
Color Frame Flag	Bit 7 of Frames Byte
Field Flag	Bit 7 of Seconds Byte
BGF0	Bit 7 of Minutes Byte
BGF1	Bit 6 of Hours Byte
BGF2	Bit 7 of Hours Byte

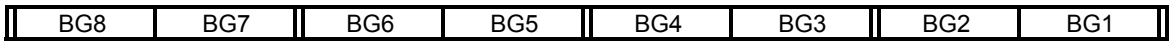
The field flag shall be set as shown in Table 12.

Table 12 – Field Flag Mapping

Video Format	Field Flag Mapping
Interlaced	Each time code word refers to two fields. The field flag shall be set to 0 for the first field and set to 1 for the second field.
Segmented Progressive	Each time code word refers to one frame. The field flag shall be set to 0.
Progressive (24, 25, 30 fps)	Each time code word refers to one frame. The field flag shall be set to 0.
Progressive (50, 60 fps)	Each time code word refers to two distinct frames. The field flag shall be set to 0 for the first of these frames and set to 1 for the second of these frames.

5.1.2 Binary Group Data Item

The Video Binary Group and Audio Binary Group data items each consist of 4 bytes of packed hexadecimal data in the format.

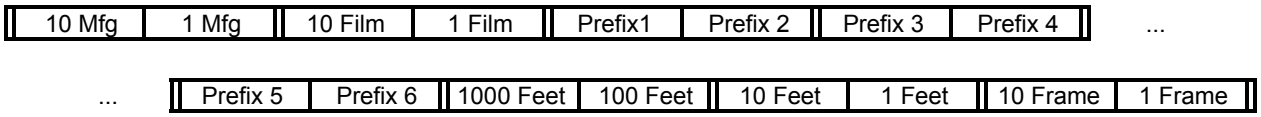


5.1.3 Film Manufacturer, Film Emulsion and Key Number Data items

The Film Manufacturer data item carries the ISO character code for the Manufacturer Character of the human readable Key Number.

The Film Emulsion data item carries the ISO character code for the Film Type Character of the human readable part of the Key Number.

The Key Number data item consists of 8 bytes of packed BCD data in the following format.



The Manufacturer byte is a packed BCD digit pair containing the Manufacturer Code .

The Film byte is a packed BCD digit pair containing the Film Type Code.

The Prefix consists of six BCD digits containing the Film Prefix.

The Feet consists of four BCD digits containing the Film Feet

The Frame consists of two BCD digits containing the Film Frame Offset.

5.1.4 Ink Prefix and Ink Number Data items

The Ink Prefix data item contains four ISO character bytes of the Ink Number Prefix. If there is no letter part to the Ink Number Prefix, the ISO character value for a space (20h) is encoded into the fourth byte.

The Ink Number data item consists of 3 bytes of packed BCD data in the following format.

1000 Feet	100 Feet	10 Feet	1 Feet	10 Frame	1 Frame

The Feet consists of four BCD digits containing the Ink Feet.

The Frame consists of two BCD digits containing the Ink Frame Offset

5.1.5 Audio Time Code Phase Data item

The Audio Time Code Phase data item contains a 1 byte signed binary encoded number. This byte contains the bit number of the Audio LTC at the beginning of the video frame. In progressive television systems with a frame-per-second count greater than 30 fps, this byte contains the bit number of the Audio LTC at the beginning of the first video frame in the pair of video frames that have the same video time code data value. (See § 5.1.1) If the audio frame identified in the Audio TC data item begins before the beginning of the video frame (or pair of video frames for frame rates greater than 30 frames per second) then the phase number encoded shall be the actual bit number of the audio LTC that is coincident with the beginning of the video frame (a positive number). If the audio frame identified in the Audio TC data item begins after the beginning of the video frame then the phase number encoded shall be encoded as a negative number and shall be the number of bits from the beginning of the video frame to the beginning of the audio LTC bit 0. Valid values for the audio phase data item are –79 to +79. Annex D shows examples of how to encode the audio phase information. In cases where there is no Audio time code present the Audio Time Code Phase data item should be set to zero.

5.1.6 Film Pulldown Data item

The Film Pulldown data item contains a 1-byte binary encoded pulldown number. The lower 7 bits indicate where the film frame is in a multi-frame pulldown sequence. The upper bit is a mixed image Flag. For interlaced video formats, the most significant bit indicates that the video frame has the same film image in both fields when it is set to zero, and that the video frame has different film images in each field when it is set to one. For progressive video formats, most significant bit of the pulldown shall always be set to zero. Annex C shows examples of how to encode the pulldown information for different video formats and film transfer rates.

5.1.7 Film Sequence Data item

The Film Sequence data item contains a 1-byte binary encoded film sequence number. For interlaced video formats, the Film Sequence number indicates how many video fields have contained this film image. The Film Sequence will return to 1 on the first field of each new film image. For progressive video formats, the Film Sequence number indicates how many video frames have contained this film image. The Film Sequence will return to 1 on the first frame of each new film image. Annex C shows examples of how to encode the pulldown information for different video formats and film transfer rates.

5.1.8 Film Frames Data item

The Film Frames data item contains a signed 4 byte binary film frame number. This number is a count of the film frames before or after a specific reference frame (e.g., a punch frame).

ABS Frames (MS byte)	ABS Frames	ABS Frames	ABS Frames (LS byte)

5.1.9 Video Format Data item

The Video Format data item contains 1 byte consisting of a bitmapped video format identifier indicating the original transfer video format. Bit 0 is set to 0 when the video frame rate is an integer, and is set to 1 when the frame rate is reduced by a factor of 1/1.001. Bits 1 to 3 encode the video frame rate. Bits 4 and 5 are reserved at this time and shall be set to 0. Bits 6 and 7 are used to encode whether the video format is interlaced, segmented progressive or true progressive. The frame rate of the video implies the frame modulus of the video time code to the nearest integer, but not necessarily whether it is drop frame or not. The drop frame information is carried in the flag bits of the Time Code data item. Table 13 shows the mapping of bits 0 to 3. Table 14 shows the mapping of bits 6 and 7.

Table 13 – Video Frame Rate Mapping (Bits 0 to 3)

Video Frame Rate				1 / 1.001	Time code Frame Modulus
	Bit 3	Bit 2	Bit 1	Bit 0	
24	0	0	1	0	24
23.98	0	0	1	1	24
25	0	1	0	0	25
30	0	1	1	0	30
29.97	0	1	1	1	30
60	1	0	0	0	30
59.94	1	0	0	1	30
50	1	0	1	1	25

Table 14 – Progressive / Interlace Mapping (Bits 6 and 7)

	Bit 7	Bit 6
Reserved	0	0
Interlaced	0	1
Progressive	1	0
Segmented Progressive	1	1

5.1.10 Audio Frame Modulus Data item

The Audio Frame Modulus data item contains a 1-byte binary encoded audio time code frame counting modulus. Table 15 shows the common audio frame rates with their associated identifiers. The audio frame modulus identifier values are shown in hexadecimal notation.

Table 15 – Audio Frame Modulus Identifiers

Frame Modulus	Frame Modulus ID
30	1_h
25	3_h
24	4_h

5.1.11 Film Format Data Item

The Film Format data item contains 1 byte consisting of a counting direction flag in the most significant bit and a 7-bit binary encoded film format identifier in the remaining bits. When the count direction bit is set to one, it indicates that the feet and frames numbers are decrementing when the film is traveling in a forward direction. The Film Format Identifier implies a particular Film Type with its corresponding Key Number and Ink Number repetition rate, and a particular Frame Repetition Rate. Table 16 shows the common film formats, their associated Feet Frame counts and the Film Format ID Codes. The Film Format identifier values are shown in hexadecimal notation.

Table 16 – Film Format Identifiers (Frames per Foot for Different Film Formats)

Film Format	Key Number Repetition Rate (perf / key)	Frame Repetition Rate (perf / frame)	Feet Frame Count (frame / Key)	Ink Number Frame modulus (frame / Ink #)	Film Format Code (7 LS Bits)
16-mm	20	1	20	40	1_h
	40	1	40	40	2_h
35-mm 3 perf	64	3	21 (Perf 1)	21 (Perf 1)	11_h
			21 (Perf 2)	21 (Perf 2)	12_h
			22 (Perf 3)	22 (Perf 3)	13_h
35-mm 4-perf	64	4	16	16	14_h
35-mm 8-perf	64	8	8	8	15_h
35-mm 2-perf	64	2	32	32	16_h
65-mm	80	5	16	16	21_h
		8	10	10	22_h
		10	8	8	23_h
65-mm	120	5	24	24	31_h
		8	15	15	32_h
		10	12	12	33_h
		15	8	8	34_h

5.1.12 Film Rate Data Item

The Film Rate data item contains a 1-byte binary encoded film transfer rate identifier. The upper bit shall be set to 1 when the frame rate is other than one of the standard transfer rates. When the upper bit is set to 0 the lower 7 bits determine one of the standard film transfer rates as shown in Table 17. When the upper bit is set to one, the lower 7 bits are used to binary encode the film transfer rate to the closest integer value. When the film transfer rate is unknown, the value 80h shall be encoded into the Film Rate data item.

Table 17 – Film Transfer Rate Identifiers

Frame Rate	Bit 7	Film Rate ID Bits 0 to 6
30	0	1_h
29.97	0	2_h
25	0	3_h
24	0	4_h
23.98	0	5_h
60	0	6_h
59.94	0	7_h
Unknown	1	0
Varispeed	1	Closest integer frame rate (binary encoded)

5.2 Material Group Items

5.2.1 Database Tag Data item

The Database Tag data item consists of 4 bytes of packed hexadecimal data in the format.

TAG8	TAG7	TAG6	TAG5	TAG4	TAG3	TAG2	TAG1

This data item will serve as an index into computer databases that may contain additional data about the transfer. Tag8 is the most significant digit of the tag number.

5.2.2 Production Roll Number Data items

The Daily Roll, Camera Roll, Sound Roll, and Lab Roll data items each contain eight bytes containing the ISO character values for the respective alphanumeric roll numbers. Roll numbers are encoded left justified within the data item. For roll numbers shorter than the data item length, the remaining bytes shall be encoded with the ISO character value for a Null (00h).

5.2.3 Scene, Take and Slate Data items

The Scene data item contains eight bytes containing the ISO character values for the alphanumeric Scene number. The Take data item contains four bytes containing the ISO character values for the alphanumeric Take number. The Slate data item contains eight bytes containing the ISO character values for the alphanumeric Slate number. Scene, Take and Slate numbers are encoded left justified within the data item. For numbers shorter than the maximum data item length, the remaining bytes shall be encoded with the ISO character value for a Null (00h).

5.2.4 Production Date Data Item

The Production Date data item consists of 4 bytes and shall be encoded in accordance with SMPTE 309M. The format shall be either 4 bytes of packed BCD data or modified Julian dates as specified in SMPTE 309M. The Date 4 byte corresponds to the byte defined in SMPTE 309M consisting of BG8 and BG7.The most significant bit of the Date 4 byte indicates the formatting of the remainder of the bytes.

The Production date usually consists of the date that the original material was exposed onto the film. This value may be read directly from film time code binary groups that have been encoded according to RP135, or may be entered into by the user.

5.2.5 Sync Mark

The Sync Mark shall be a 16-bit field as defined below. The bits serve to identify the start or end of a recording. Multiple bits may be used simultaneously.

Table 18 – Sync Mark Bits

Bit #	Function
0	Slate Triggered
1	Alternate 1 Triggered
2	Alternate 2 Triggered
3-5	Reserved, set to zero
6	End Take
7	Start Take
15-8	Reserved, set to zero

5.3 Label Group Items

5.3.1 Video Tape Roll Number Data Item

The Video Tape Roll data item contains eight bytes containing the ISO character values for the alphanumeric video tape roll number. The roll number is encoded left justified within the data item. For roll numbers shorter than the data item length, the remaining bytes shall be encoded with the ISO character value for a Null (00h).

Note: The term Video Tape Roll are used in this document for legacy reasons, as it is the common term used in post production. There is nothing that precludes the recording on other storage media such as disc recorders and servers. In these cases the Video Tape Roll refers to an identifier used on these storage media.

5.3.2 Other Label Data Items

The Title, Episode, Facility and Misc. data items each contain the number of bytes shown in Table 4 and contain ISO character values. These data items are encoded left justified within each data item. For items shorter than the data item length, the remaining bytes shall be encoded with the ISO character value for a Null (00_h).

5.4 Color Decision Group Items

5.4.1 Slope, Offset, Power and Data Items

The slope, offset, power and saturation data items each contain IEEE 754 half precision (2 byte) floating point value, representing slope, offset, power and saturation color decision values as defined by the American Society of Cinematographers. Separate data items exist for Red, Green and Blue colors. See Annex G for a description of the Color Decision group data items.

5.5 Dolly Group Items

5.5.1 Lens Zoom, Focus

A Lens Zoom and Focus data items are distances (in metres) represented as 16 bit exponential values

b15 ~ b12 = e, b11 ~ b0 = a, value = a × 10POW(e) [m].

The 16 bits are divided into two parts: one is the exponent part ‘E’ made up of the upper 4 bits, and the other is the mantissa part ‘A’ made up of the lower 12 bits. 'A' represents 0 to 4095 unsigned, and 'E' represents -8 to 7 with sign. The exponent part and the mantissa part combined shall represent the value as shown above. In this method there are multiple expressions to indicate one distance. The one with which the mantissa part becomes maximum value is used.

5.5.2 Iris

A 16-bit number. FN№ = 2 POW (8×(1 - Data/10000H)); i.e., 10000H is regarded as F1.0 with 1000H per iris.

5.5.3 Camera Pan, Tilt, Roll

The Camera Pan, Tilt and Roll data items store angles represented as 16 bit signed integer over +/- 90 or 180 degrees. Angle = value*180.0/32767

5.5.4 Camera Height

The camera Height data item is an IEEE 754 single precision (4-byte) floating point value representing camera height in meters above a user defined reference point.

5.6 USER Group Items

The user data group consists of a variable number of user data bytes. These bytes can be used to user defined data. The maximum length of the user group shall be such that the overall length of the UDW (including all data groups and the checksum) does not exceed 255 bytes

6 Location of the Vertical Ancillary Data

The ANC data packet containing film transfer metadata shall be located in the active line portion of one line in the vertical ancillary space. Data shall be located in any line in the area from the second line after the line specified for switching, as defined in RP 168, to the last line before active video, inclusive. The ANC packets shall be carried in the Y stream of a SMPTE 292 1.5G SDI interface, and data stream 1 of a SMPTE 425 3G SDI interface.

For interlaced systems, the data packets shall be placed in the VANC area of both fields. For progressive segmented frame systems, the data packets shall be placed in the VANC area of the first segment of the frame only. For progressive formats, the ANC packet shall be placed in the VANC area of the frame.

Receiving equipment shall identify the ANC packets on the basis of their ANC DID and SDID fields.

Annex A (Informative)
Bibliography

SMPTE 292-2008, 1.5 Gb/s Signal/Data Serial Interface

SMPTE 336M-2007, Data Encoding Protocol Using Key-Length-Value

SMPTE 372-2009, Dual Link 1.5 Gb/s Digital Interface for 1920 × 1080 and 2048 × 1080 Picture Formats

SMPTE 425-2008, 3 Gb/s Signal/Data Serial Interface — Source Image Format Mapping

SMPTE RP 291-2009, Assigned Ancillary Identification Codes

Annex B (Informative)
Definitions and Glossary

B.1 Terms Defined by SMPTE 254, SMPTE 270, SMPTE 271 and SMPTE 313

Key Number: A number, sometimes referred to as an edge number or footage number, which is printed with ink or exposed onto the film at the time of manufacture. The numbers are placed at regular intervals typically one foot. Film that conforms to SMPTE 254, SMPTE 271, SMPTE 270 or SMPTE 313 use a 12-character alphanumeric key number. For the purposes of this document references to Key Number will refer to the machine-readable key number unless otherwise stated.

Key Number Repetition Rate: The interval at which Key Numbers repeat on the film stock, measured in perforations.

Manufacturer Character: The first character of the human readable Key Number which identifies the manufacturer of the film stock.

Manufacturer Code: The two BCD digits of the machine readable Key Number which identify the manufacturer of the film stock.

Film Type Character: The second character of the human readable Key Number which identifies the type of film stock.

Film Type Code: The two BCD digits of the machine readable Key Number which identify the type of the film stock.

B.2 Terms Defined by RP 195

Frame Repetition Rate: The interval, at which exposed film images occur along the film, measured in perforations.

B.3 Terms Defined by RP 201

Film Feet: The least significant 4 digits of the Key Number. This number increments every *n* frames where *n* is calculated by dividing the Key Number Repetition Rate by the Frame Repetition Rate.

Film Prefix: The part of the Key Number that is not contained in the Film Feet. This number is used to identify the stock or batch of film. Normally this number does not increment during a single roll of film.

Film Frame Offset: This is the frame offset away from the Key Number. It is not included as part of the Key Number. RP 195 specifies the procedure for unambiguously identifying the film frame numbers from exposed latent-image key numbers.

Feet Frame Count: This is the number of film frames in the current Film Foot. For film formats where Key Number Repetition Rate is not evenly divisible by the Frame Repetition Rate, the Feet Frame Count identifies which foot has an extra frame.

B.4 Terms Defined by this Practice

Ink Number: A number, which is printed with ink onto the film at the time of post production. The numbers are placed at regular intervals typically one foot. The Ink number typically consists of a roll identifier prefix that remains constant throughout the roll of film and a counting part that increments at each instance of the ink number on the film.

Ink Number Repetition Rate: The interval at which Ink Numbers repeat on the film stock, measured in perforations.

Ink Feet: The least significant 4 digits of the Ink Number. This number increments every *n* frames where *n* is calculated by dividing the Ink Number Repetition Rate by the Frame Repetition Rate.

Ink Prefix: The part of the Ink Number that is not contained in the Ink Feet. This number is typically used to identify an assembled roll of film during post production and consists of 3 BCD digits and an alphabetic character. Normally this number does not change during a roll of film.

Ink Frame Offset: This is the frame offset away from the Ink Number. It is not included as part of the Ink Number.

Annex C (Informative)
Pulldown Sequence Mapping Examples

Table C.1 – 23.98 FPS Pulldown Flags – 1080i/59.94 Systems

Film Frame	Pulldown Data item		Sequence	Video Frame Example
	Bit 7	Bits 6-0		
A	0	1_h	1_h	0:00
	0	1_h	2_h	
B	0	2_h	1_h	0:01
	0	2_h	2_h	
	1	2_h	3_h	0:02
C	1	3_h	1_h	
	1	3_h	2_h	0:03
D	1	4_h	1_h	
	0	4_h	2_h	0:04
	0	4_h	3_h	
A	0	1_h	1_h	0:05
	0	1_h	2_h	

Table C.2 – 23.98 FPS – 1080p/23.98 Systems

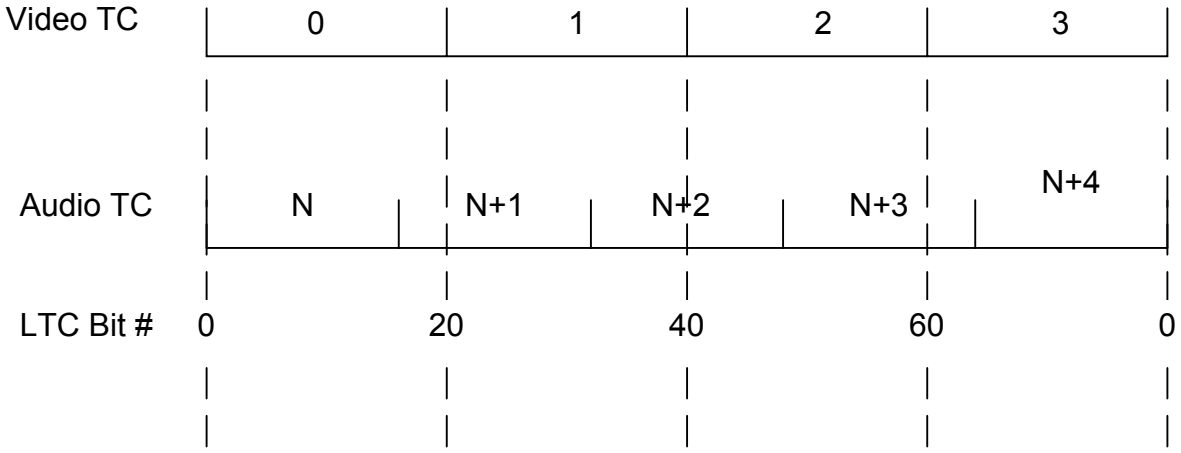
Film Frame	Pulldown Data item		Sequence	Video Frame Example
	Bit 7	Bits 6-0		
A	0	1_h	1_h	0:00
	0	1_h	1_h	
A	0	1_h	1_h	0:01
	0	1_h	1_h	

Table C.3 – 29.97 FPS – 1080i/59.94 Systems

Film Frame	Pulldown Data item		Sequence	Video Frame Example
	Bit 7	Bits 6-0		
A	0	1_h	1_h	0:00
	0	1_h	2_h	
A	0	1_h	1_h	0:01
	0	1_h	2_h	

Annex D (Informative)
Examples of Audio Time Code Mapping when the Frame Rate of the Video Time Code is Slower

When the video frame rate is slower than the audio frame rate, each video frame corresponds to parts of two different audio frames. The ANC packet in each video frame contains only one of these audio time code numbers. When the audio time code referenced in the ANC packet starts before the beginning of the video frame, the bit number of this audio time code that coincides with the beginning of the frame is encoded into the audio phase data item. When the audio time code starts after the beginning of the video frame, the number of (audio LTC) bits from the beginning of the video frame to the start of the audio LTC word is encoded as a negative number. The diagram below shows an example of video and audio time codes and the bit numbers of the audio time code at the start of each video frame. The following tables show two different ways that the audio time code numbers and audio phase can be encoded in the ANC packets in each of the video frames. Both methods of mapping are equivalent and will produce the same results at the decoding end.



Method 1:

Video TC	00	01	02	03
Audio TC	N	N+1	N+2	N+3
Audio Phase	0	20	40	60

Method 2:

Video TC	00	01	02	03
Audio TC	N	N+1	N+3	N+4
Audio Phase	0	20	-40	-20

Annex E (Informative)
Mapping into RP 201 Data Constructs

During the post production process when high definition video is down converted to standard definition video, it may be necessary to map the data encoded in the HD VANC data into RP 201 format data.

Table E.1 – Mapping of VANC Packet Data into the RP 201 Data Structure

Description	VANC Data Item	RP 201 Data Item
Video Time Address	1	Video Tape Data Block Time Bits
Video Binary Groups	2	Video Tape Data Block User Bits
Audio Time Address	3	Production Data Block Time Bits
Audio Binary Groups	4	Production Data Block User Bits
KK	8	Film Data Block with MFG ID non zero (MFG ID, Emulsion, Prefix, Feet and Offset bytes)
Ink Numbers	9 and 10	Film Data Block with MFG ID equal zero (MFG ID, Emulsion, Prefix, Feet and Offset bytes)
Pulldown	11	Film Data Block Pulldown bits
Film Format	16	Film Data Block MFG ID (not all formats are supported)
Film Rate	17	Implied from sequence of Pulldown Bits over multiple fields

Annex F (Informative)
Mapping the Film Transfer Metadata from the HD VANC Packet to the K-L-V Data Mapping Protocol for Data Sets

Although the Film Transfer and Video Production ancillary data described in this document is encoded in type 2 ancillary data packets as defined by SMPTE 291M, it can also be mapped into a Key-Length-Value construct as defined by SMPTE 336M. The packet starts with a start code, the ADF word sequence that is unique in the digital video interface. This is followed by DID and SDID words which define the data type, a 'Data Count' and the data itself (the HD film transfer metadata has 3 variable length data packs – using the term 'packs' as defined in the K-L-V Data Mapping Protocol document). The packet is completed with a check sum to detect possible errors. If the ADF and CS words are removed, then the data structure is a Key-Length-Value. Thus the Value of the VANC packet can be mapped into the K-L-V protocol of a metadata set follows:

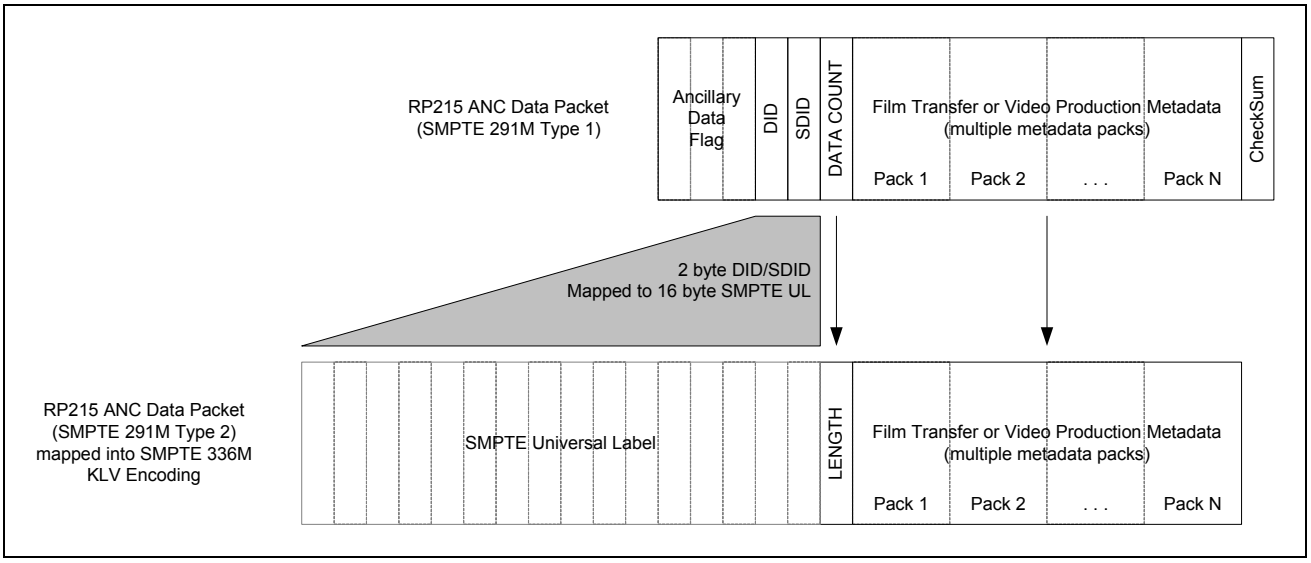


Figure F.1 –Mapping the VANC Packet into the K-L-V Metadata Set

Table F.1 – Mapping of VANC Packet Data into the K-L-V Data Set Construct

Data Structure:	VANC Packet	K-L-V Protocol
Key:	DID + SDID	16-byte Universal Label
Length:	DC	Variable Length
Value:	Film transfer metadata	Film transfer metadata

The following value is recommended for the SMPTE Universal Label (UL):

Table F.2 – Recommended Value for the SMPTE Metadata Set Universal Label

Byte No.	Description	Value (hex)
1	Object Identifier	06_h
2	Label size	$0E_h$
3	Designation: ISO	$2B_h$
4	Designation: SMPTE	34_h
5	Registry: Sets & Packs	02_h
6	Registry: Local Sets	03_h
7	Standard: default tag and length usage	01_h
8	Version Number	01_h
9	Metadata sets	01_h
10	Film Industry Class 1	01_h
11	Telecine Transfer Packed Metadata	01_h
12	Standard: I23.18	01_h
13	Version Number	01_h
14	Zero fill	00_h
15	Zero fill	00_h
16	Zero fill	00_h

Note: The above 16-byte UL value is shown for guidance only. Users should consult the most recent version of the SMPTE Sets Registry for the definitive value.

Annex G (Informative)
ASC Color Decision List

The American Society of Cinematographers Color Decision List (ASC CDL) is intended to help share and maintain the cinematographer's look through the production process - the communication part of a very basic form of look management. The ASC CDL allows basic, primary color corrections to be interchanged between equipment and software from different manufacturers at different facilities – no secondaries, power-windows, geometry, tracking, etc. This is increasingly necessary as projects are built from elements acquired or created by different sources that are processed, assembled, and mastered at different facilities.

The ASC has specified an interchange format for the Color Decision List (CDL) that consists of the Red, Green and Blue values of three parameters: Slope, Offset and Power, and a single value for Saturation. These 10 numbers are to be exported from, and imported to, a variety of Color Correctors such that any Color Corrector, given a common base image to which the CDL parameters are applied, will produce a color corrected image that matches the color corrected image on all the other Color Correctors.

Because the terms Lift, Gain, and Gamma have long established definitions, and because those definitions may vary in detail from system to system and manufacturer to manufacturer, to avoid controversy, competition, and confusion, the ASC proposes a set of three transfer functions with unique names and orthogonal (non-overlapping) definitions.

The three basic transfer functions – Offset, Slope, and Power – are applied in the order Slope, Offset, then Power. The transfer functions are in RGB color space and are applied to each color component of the image data with the same mathematical definition no matter what the image data representation (e.g. linear or log) or color space (e.g., RGB or Rec. 709). The three transfer functions for the three color components (assuming the current trichromatic systems) can collectively be described by ten parameters. The traditional Lift, Gain, and Gamma operations, individually or in combination, can be readily translated into Slope, Offset, and Power. The Saturation transfer function operates on all three components simultaneously.

SLOPE

Slope changes the slope of the transfer function without shifting the black level established by *Offset* (see the next section). The input value, *slope*, ranges from 0.0 (constant output at *Offset*) to less than infinity (although, in practice, systems probably limit at a substantially lower value). The nominal *slope* value is 1.0.

$$out = in * slope, \text{ where } 0 \leq slope < \infty$$

Slope adjustment is a component of both traditional *Lift* and *Gain*, but *Lift* combines slope adjustment with the appropriate offset added to force the maximum value to be held constant.

OFFSET

Offset raises or lowers overall brightness of a component. It shifts the transfer function up or down while holding the *slope* constant. The input value, *offset*, can in theory range from $-\infty$ to $+\infty$ although the range –1.0 to 1.0 will fit most traditional use. The nominal *offset* value is 0.0.

$$out = in + offset, \text{ where } -\infty < offset < \infty$$

If the underlying data is log, then *Offset* is an interpretation of printer points – the most common method of color correction in film lab work.

POWER

Power is the only non-linear function. It changes the intermediate shape of the transfer function. The input value, *power*, ranges from greater than 0.0 to less than infinity. The nominal *power* value is 1.0.

$$out = in \text{ ^ } power, \text{ where ^ is "raised to the power", and } 0 < power < \infty$$

SATURATION

Saturation is a parameter that varies the overall saturation of the image from fully desaturated to fully saturated. The saturation operation is basically a weighted average between the original color image and a black/white version of the same image. When this weighting goes > 1.0, then, hyper-saturation occurs. Specifically, the black/white image used by the ASC CDL saturation algorithm is derived using the Rec. 709 "luminance" coefficients.

The input value, *Saturation*, ranges from 0.0 to less than infinity. A value of 0.0 represents the fully desaturated (grey) condition. The nominal *Saturation* value is 1.0 and represents the case where the output has the same saturation as the input. Values of *Saturation* greater than 1.0 represent the hyper-saturated condition where an output that is more saturated than the input.