

1.5 Gb/s Signal/Data Serial Interface



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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 ST 292-1 was prepared by Technology Committee 32NF.

Intellectual Property

At the time of publication no notice had been received by SMPTE claiming patent rights essential to the implementation of this Standard. 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 Engineering Document.

This standard has been developed to carry HDTV digital video signals and formatted data within the defined payload areas including ancillary data. The standard can carry 1280×720, 1920×1080 or 2048×1080 active pixel formats through the 1.5 Gb/s Serial Digital Interface and enables the carriage of any ancillary data conforming to SMPTE ST 291.

1 Scope

This standard defines a bit-serial data structure and the coaxial cable interface specifications for 1.5 Gb/s [nominal] Signal/Data Serial Interface to carry either 1280×720, 1920×1080 or 2048×1080 active pixel formats mapped into the 1.5 Gb/s payload. This standard defines the method of serializing the parallel source format data to a serial bit stream. This interface may also carry packetized data mapped into the 1.5 Gb/s transport payload providing the constraints imposed by the reference source image formats are observed.

This standard specifies a coaxial cable interface suitable for application where the signal loss does not exceed an amount specified by the receiver manufacturer, typical loss amounts would be in the range of up to 20 dB at one-half the clock frequency.

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.

3 Normative References

Note: All references in this document to other SMPTE documents use the current numbering style (e.g. SMPTE ST 274:2008) although, during a transitional phase, the document as published (printed or PDF) may bear an older designation (such as SMPTE 274M-2008). Documents with the same root number (e.g. 274) and publication year (e.g. 2008) are functionally identical.

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

SMPTE ST 274:2008, Television — 1920 x 1080 Image Sample Structure, Digital Representation and Digital Timing Reference Sequences for Multiple Picture Rates

SMPTE ST 296:2011, 1280 x 720 Progressive Image Sample Structure — Analog and Digital Representation and Analog Interface

SMPTE ST 352:2011, Payload Identification Codes for Serial Digital Interfaces

SMPTE ST 2048-2:2011, 2048 x 1080 Digital Cinematography Production Image FS/709 Formatting for Serial Digital Interface

SMPTE RP 184:2004, Specification of Jitter in Bit-Serial Digital Systems

IEC 61169-8 (2007-2), Part 8: Sectional Specification — R.F. Coaxial Connectors with Inner Diameter of Outer Conductor 6,5 mm (0,256 in) with Bayonet Lock — Characteristic Impedance 50Ω (Type BNC), Annex A (Normative) Information for Interface Dimensions of 75Ω Characteristic Impedance Connector with Unspecified Reflection Factor¹

4 Source Format Data

4.1 For this interface, the source data shall be 10-bit words. The source data may be an uncompressed video source or packetized data constrained by the pixel array of the referenced source image formats.

4.2 For uncompressed 4:2:2 HDTV or 2048×1080 pixel signals, the interface shall be two parallel bit streams. One stream shall be defined as the Luma (Y') data channel, and the second stream shall be the Color-Difference (C'_B, C'_R) data channel. These data channels shall be multiplexed to form the serial data stream. The multiplexing shall be as defined in Figure 3. Other mappings shall be defined by application documents.

4.3 Data for each line of the interface shall be divided into four areas: SAV (start of active video) timing reference, digital active line, EAV (end of active video) timing reference, LN (Line number), CRC (Cyclic Redundancy Check Code), and digital line blanking as shown in Figure 1. The number of words and defined data in each area shall be specified by the source format or mapping documents.

4.4 Parameters for uncompressed HDTV and 2048×1080 pixel sources and associated ancillary space shall be defined by:

SMPTE ST 274
SMPTE ST 296
SMPTE ST 2048-2
(See informative Annex E.)

The total data rate shall be either 1.485 Gb/s or 1.485/1.001 Gb/s. The source format or mapping documents determine the precise interface clock frequency².

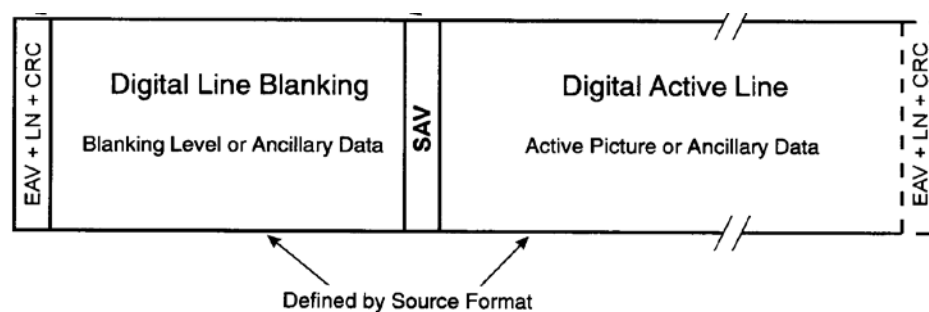


Figure 1 – Interface horizontal line data

¹ Please note that the title of this normative reference could be misleading. This standard requires the use of the 75-ohm connector defined in this reference.

² Designers are encouraged to refer to multi-link 1.5 Gb/s-SDI or higher data rate SDI documents for the image formats which require higher than 1.485 Gb/s or 1.485/1.001 Gb/s.

5 Interface Data Format

5.1 Digital active line and digital line blanking shall consist of 10-bit words as defined by the source format document. Data values 000h to 003h and 3FCh to 3FFh shall be used exclusively for synchronization purposes.³

5.2 Timing references SAV, EAV, line number, and CRCs for each of the two parallel data streams shall be formatted as shown in Figure 2.

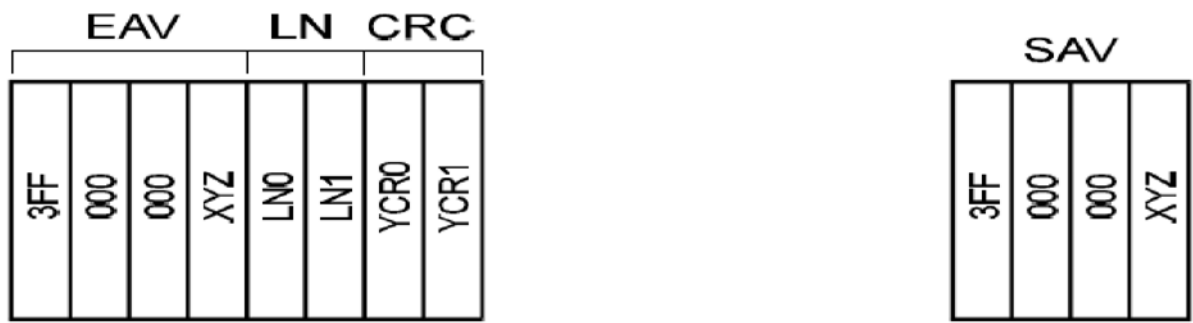


Figure 2 – Timing reference format (Luma channel shown)

5.3 Interface line number data shall be composed of two words and shall be as shown in Table 1.

5.4 CRC (cyclic redundancy check codes) shall be used to detect errors in the active digital line, including EAV and LN. The error detection code shall consist of two words determined by the polynomial generator equation:

$$\text{CRC}(X) = X^{18} + X^5 + X^4 + 1$$

The initial value of the CRC shall be set to zero. The calculation shall start at the first active line word and shall end at the final word of the line number data, LN1. Two CRCs shall be calculated, one for the luma data channel and one for the color-difference data channel of the interface, as shown in Table 2.

Luma channel and color-difference channel of the interface may carry packetized data as defined by other application documents providing the constraints defined in this standard and that of the source image formats are observed.

5.5 Available ancillary data space shall be defined by the source format. Attention is drawn to the reduced sample number of H-Blank by 2048 – 1920 = 128 when transporting 2048×1080 active image formats. (See informative Annex F.)

³ SMPTE ST 291 Ancillary data packets use these values for identification.

Table 1 – Line number data

Word	9 (MSB)	8	7	6	5	4	3	2	1	0 (LSB)
LN0	$\overline{\text{B8}}$	L6	L5	L4	L3	L2	L1	L0	R	R
LN1	$\overline{\text{B8}}$	R	R	R	L10	L9	L8	L7	R	R
NOTES 1 L0 – L10 = line number in binary code. 2 R = reserved, set to "0".										

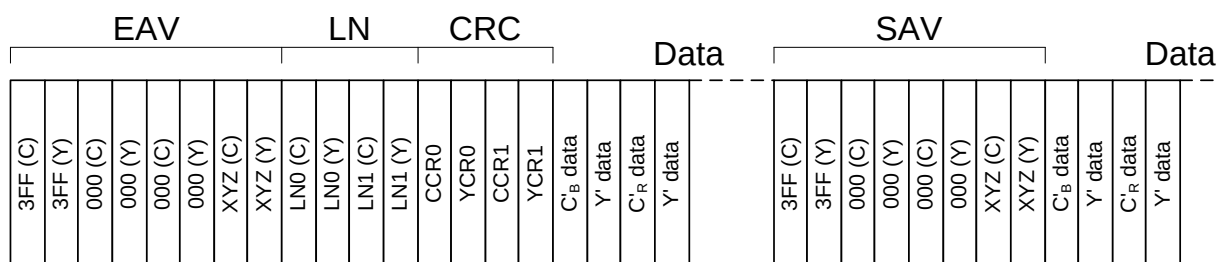
Table 2 – CRC data

Word	9 (MSB)	8	7	6	5	4	3	2	1	0 (LSB)
YCR0	$\overline{\text{B8}}$	CRC8	CRC7	CRC6	CRC5	CRC4	CRC3	CRC2	CRC1	CRC0
YCR1	$\overline{\text{B8}}$	CRC17	CRC16	CRC15	CRC14	CRC13	CRC12	CRC11	CRC10	CRC9
CCR0	$\overline{\text{B8}}$	CRC8	CRC7	CRC6	CRC5	CRC4	CRC3	CRC2	CRC1	CRC0
CCR1	$\overline{\text{B8}}$	CRC17	CRC16	CRC15	CRC14	CRC13	CRC12	CRC11	CRC10	CRC9

6 Serial Data Format

6.1 The two source format parallel data streams with EAV and SAV shall be as shown in Figure 2 and shall be interleaved as shown in Figure 3.

6.2 Interleaved data shall be serialized with the LSB (least significant bit) of each data word transmitted first.

**Figure 3 – Interleaved data stream**