RECOMMENDATION ITU-R BT.1619

Vertical ancillary data mapping for serial digital interface

(Questions ITU-R 42/6 and ITU-R 20/6)

(2003)

The ITU Radiocommunication Assembly,

considering

a) that many countries are installing digital television production facilities based on the use of digital video components conforming to Recommendations ITU-R BT.601, ITU-R BT.656, ITU-R BT.709, ITU-R BT.799 and ITU-R BT.1120;

b) that there exists the capacity within a signal conforming to Recommendation ITU-R BT.656, ITU-R BT.799 or ITU-R BT.1120 for additional data signals to be multiplexed with the video data signal itself;

c) that there are operational and economic benefits to be achieved by the multiplexing of ancillary data signals with the video data signal;

d) that the operational benefits are increased if a minimum of different formats are used for ancillary data signals;

e) that formatting of ancillary data packets is specified in Recommendation ITU-R BT.1364;

f) that carriage of data broadcast services intended for the public as well as broadcaster internal control and communications within the serial digital interface (SDI) benefit broadcast transmission operations,

recommends

1 that the ancillary data formatting described in SMPTE Standard 334M-2000 – Vertical Ancillary Data Mapping for Bit-Serial Interface, be used as a method for carrying communications and control information in the SDI.

NOTE 1 – SMPTE 334M includes a normative reference to SMPTE 292M – Bit-Serial Digital Interface for High-Definition Television Systems. The 1250-line, 50 Hz format listed in Table 1, column C of SMPTE 292M shall not be considered part of this Recommendation.

Summary of SMPTE Standard 334M-2000

This Recommendation defines a method of coding which allows data services to be carried in the vertical ancillary data space of a bit-serial component television signal conforming with Recommendation ITU-R BT.656 or ITU-R BT.1120 and formatted as specified in Recommendation ITU-R BT.1364.

This includes data broadcast services intended for the public as well as broadcaster internal control and communications. Despite the reference to the bit-serial interface, nothing in this specification precludes its use in a parallel digital interface for component digital video signals. The data described in this Standard may also be transported in key length value format according to Recommendation ITU-R BT.1563 (SMPTE 336M-2001), or via other means.

NOTE 1 – SMPTE Standards 334M-2000 and 292M-1998 are given in Annexes 1 and 2. SMPTE Standards 334M-2000 and 292M-1998 refer to Versions 2000 and 1998 respectively only, which are the versions approved by Administrations of Member States of the ITU in application of Resolution ITU-R 1-3 on 3-05-03. By agreement between ITU and SMPTE, these Versions were provided and authorized for use by SMPTE and accepted by ITU-R for inclusion in this Recommendation. Any subsequent versions of SMPTE Standards 334M and 292M, which have not been accepted and approved by Radiocommunication Study Group 6 are not part of this Recommendation. For subsequent versions of SMPTE documents, the reader should consult the SMPTE website: http://www.smpte.org/.

SMPTE 334M-2000

SMPTE STANDARD

for Television — Vertical Ancillary Data Mapping for Bit-Serial Interface

1 Scope

This standard defines a method of coding which allows data services to be carried in the vertical ancillary data space of a bit-serial component television signal conforming with SMPTE 292M or ANSI/SMPTE 259M.

This includes data broadcast services intended for the public as well as broadcaster internal control and communications.

Despite the reference to the bit-serial interface, nothing in this specification precludes its use in a parallel digital interface for component digital video signals.

The data described in this standard may also be transported in KLV format according to SMPTE 336M, or via other means.

2 Normative references

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.

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

ANSI/SMPTE 259M-1997, Television — 10-Bit 4:2:2 Component and $4f_{SC}$ Composite Digital Signals — Serial Digital Interface

SMPTE 291M-1998, Television — Ancillary Data Packet and Space Formatting

SMPTE 292M-1998, Television — Bit-Serial Digital Interface for High-Definition Television Systems

ANSI/EIA-608-1994, Recommended Practice for Line 21 Data Service

EIA-708-B, Digital Television Closed-Captioning (DTVCC)

EIA-766-1998, U.S. Region Rating Table (RRT) and Content Advisory Descriptor for Transport of Content Advisory Information Using ATSC A/65 Program and System Information Protocol (PSIP)

3 Location of vertical ancillary data

The data packets are located in the active line portion of one or more lines in the vertical ancillary space. Data may be located in any lines in the area from the second line after the line specified for switching to the last line before active video, inclusively.

Individual data services are not assigned to any specific data lines; receiving equipment should identify and select services on the basis of their ANC DID and SDID fields.

Because ANC data may be located in the lines immediately preceding active video, manufacturers of video compression equipment should ensure that these data bits are not included in video compression calculations.

The chrominance (C_b/C_r) and luminance (Y) data are carried in two separate streams within the SMPTE 292M signal with their own ANC data flags and CRCs.

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Defined data services shall be carried in the Y stream. Other data services may be inserted into either one of these streams without restrictions.

In the 259M/125M signal, the chrominance and luminance data are carried in a single stream. In this case, all data services shall be carried in this stream with a single ANC data flag and CRC.

4 Format of VANC data packets

Each data packet follows 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 UDW consists of the data payload plus forward error correction overhead.

4.1 ANC packet header format

The ADF has the value 000_h $3FF_h$ $3FF_h$.

The following value of DID is used for the closed-captioning services defined in this standard: 161_h (61_h plus parity bits per 291M). A second value of DID (162_h = 62_h plus parity) is used for other services which are identified by this standard, and whose format is specified by recommended practices.

Other data services which are internal to a broadcast network may use DID values in the ranges specified for user application data (40_h-$5F_h$ and $C0_h$-DF_h). These DID values are not registered.

The specified values of DID (61_h and 62_h) identify type 2 ANC packets. In each packet, the SDID code identifies the type of data. Table 1 shows the values of DID and SDID for services defined within this standard. Table 2 shows the values of DID and SDID for other services.

DC is a count of the number of words in the UDW; bits b7-b0 of DC represent the number of words of user data; bits b8 and b9 are parity per 291M.

For defined services such as captioning, the format of the data in the UDW is defined in this specification or in a normative reference. For other data services, the data content is not specified here, and the value of DC is variable.

4.2 UDW format

All data services consist of 8-bit data bytes, which are transmitted in bits b7-b0 of the 10-bit data word. Bit b8 is even parity for b7 through b0, and b9 = not b8. In addition to providing a simple error detection capability, this avoids transmitting data which match one of the code words 0-3 and 1020-1023 which are prohibited by SMPTE 292M and ANSI/SMPTE125M.

Table 1 – Defined data services

Service	DID	SDID	DC
Closed captioning (EIA-708-B)	61_h (161_h)	1 (101_h)	Variable
EIA-608 data	61_h (161_h)	2 (102_h)	3 (203_h)

Table 2 – Variable-format data services

Service	DID	SDID	DC
Program description (DTV)	62_h (162_h)	1 (101_h)	Variable
Data broadcast (DTV)	62_h (162_h)	2 (102_h)	Variable
VBI data	62_h (162_h)	3 (203_h)	Variable

The data payload for each service is inserted into the UDW of the ANC packet as a sequence of 10-bit words. The number of words is indicated in the DC field of the ANC packet header.

4.3 Defined services

The services shown in table 1 have their format defined in this clause. The values in parentheses for DID, SDID, and DC include parity bits b8 and b9.

4.3.1 Format of the closed captioning (EIA-708-B) packet

The payload of the closed captioning (EIA-708-B) packet is the caption distribution packet (CDP) defined in EIA-708-B. This packet has a variable length.

4.3.2 Format of the ANC EIA-608 (VBI) packet

In NTSC video, the closed captioning, content advisory, and other services are carried in a format defined by the EIA-608 standard. Closed captioning may be carried in line 21 of either field. Content advisory and other data may be in line 21 of field 2 only.

These can be carried in an ANC packet in a 292M stream to allow the EIA-608 data waveform to be recreated and reinserted into an NTSC signal produced by converting the DTV signal into an analog signal at a station. The format of this ANC packet is defined in annex A.

4.4 Other data services

Table 2 lists other data services whose format is not specified by this standard. Their DID and SDID values are specified here to ensure that they can be correctly and consistently recognized and routed.

The DTV program description service carries data which pertain to the video and audio programs. Its contents are defined in the forthcoming SMPTE RP 207.

The DTV data broadcast service carries data intended for broadcast to the public along with the video and audio programs. Its contents are the subject of a future recommended practice.

The VBI data service is intended for use in reconstituting data in the VBI of a standard-definition analog video signal produced from the digital video program. Its contents are defined in the forthcoming SMPTE RP 208.

5 Timing of data and video

There is no specific provision in this standard for ensuring that the relative timing between the video and its embedded VANC data is correct. The only timing relationship that exists is created when the data are embedded in the video. Once that relationship is established, the deterministic nature of 292M or 259M transport ensures that the relationship is preserved.

Annex A (normative)
Format of the ANC EIA-608 packet

The data payload for EIA-608 data is 2 bytes per line. The ANC packet encapsulates these two bytes without modification, and adds a byte which identifies the VBI line and field to be used for insertion. The data count (DC) is therefore 3 (203_h).

The format of the packet is as follows:

Header:
- ADF (3 words)
- DID = 161_h
- SDID = 102_h
- DC = 203_h

UDW:
- LINE (1 word)
- EIA-608 data (2 words)

Suffix:
- CS (1 word)

The LINE value at the start of the UDW represents the field number and VBI line where the data are intended to be carried. Bit b7 of the LINE value is the field number (0 for field 2; 1 for field 1). Bits b6 and b5 are 0. Bits b4-b0 form a 5-bit unsigned integer which represents the offset (in lines) of the data insertion line, relative to the base VBI frameline (line 9 of 525-line field 1, line 272 of 525-line field 2, line 5 of 625-line field 1, line 318 of 625-line field 2).

Annex B (informative)
Bibliography

ANSI/SMPTE 296M-1997, Television — 1280 × 720 Scanning, Analog and Digital Representation and Analog Interface

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

ATSC A/53, ATSC Digital Television Standard

ATSC A/65, Program and System Information Protocol for Terrestrial Broadcast and Cable

SMPTE 274M-1998, Television — 1920 × 1080 Scanning and Analog and Parallel Digital Interfaces for Multiple Picture Rates

Forthcoming SMPTE 336M, Television — Data Encoding Protocol Using Key-Length-Value

Forthcoming SMPTE RP 207, Transport of Program Description Data in Ancillary Data Packets

Forthcoming SMPTE RP 208, Transport of VBI Packet Data in Ancillary Data Packets

SMPTE STANDARD

SMPTE 292M-1998
Revision of
ANSI/SMPTE 292M-1996

for Television — Bit-Serial Digital Interface for High-Definition Television Systems

1 Scope

This standard defines a bit-serial digital coaxial and fiber-optic interface for HDTV component signals operating at data rates of 1.485 Gb/s and 1.485/1.001 Gb/s. Bit-parallel data derived from specified source formats are multiplexed and serialized to form the serial data stream. A common data format and channel coding are used based on the source format parallel data for a given high-definition television system. Coaxial cable interfaces are 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. Fiber optic interfaces are suitable for application at up to 2 km of distance using single-mode fiber.

Several source formats are referenced and others operating within the covered data rate range may be serialized based on the techniques defined by this standard. Revisions to this standard may add other source formats when approved documents are available. Mechanisms for transporting lower data-rate formats over this interface are under development and will be specified in other documents.

2 Normative references

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.

ANSI/SMPTE 295M-1997, Television — 1920 × 1080 50 Hz — Scanning and Interface

ANSI/SMPTE 296M-1997, Television — 1280 × 720 Scanning, Analog and Digital Representation and Analog Interface

SMPTE 260M-1999, Television — 1125/60 High-Definition Production System — Digital Representation and Bit-Parallel Interface

SMPTE 274M-1998, Television — 1920 × 1080 Scanning and Analog and Parallel Digital Interfaces for Multiple Picture Rates

SMPTE 291M-1998, Television — Ancillary Data Packet and Space Formatting

SMPTE RP 184-1996, Specification of Jitter in Bit-Serial Digital Systems

IEC 60169-8 (1978-01), Radio Frequency Connectors, Part 8: R.F. Coaxial Connectors with Inner Diameter of Outer Conductor 6.5 mm (0.256 in) with Bayonet Lock — Characteristic Impedance 50 Ohms (Type BNC), and Appendix A (1990), and Amendment No. 1 (1996-03)

IEC 60793-2 (1992-06), Optical Fibres — Part 2: Product Specifications

IEC 60874-7 (1993-04), Connectors for Optical Fibres and Cables — Part 7: Sectional Specifications for Fibre Optic Connector — Type FC

3 Definition of terms

3.1 source format: Data structure and documentation which defines the bit-parallel input to the serialization process for a given high-definition

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television system. Source formats are referenced in SMPTE 260M and ANSI/SMPTE 274M.

3.2 interim specifications: Values given in brackets are interim and subject to revision following further investigation by the SMPTE Committee on Television Signal Technology (see 8.1.2, 8.1.9, 8.2.1, and 9.1).

4 Source format data

4.1 Source data shall be 10-bit words representing an E_Y', E_{C_B}', E_{C_R}' signal, where E_Y' is one formatted parallel data stream and E_{C_B}', E_{C_R}' is a second formatted parallel data stream. This limits the serial data rate to 1.5 Gb/s although the source format parallel data may allow higher data rates for RGB or Y, C_B, C_R keytype operation.

4.2 Data for each television line are divided into four areas: SAV (start of active video) timing reference, digital active line, EAV (end of active video) timing reference, and digital line blanking as shown in figure 1. The number of words and defined data in each area are specified by the source format document.

4.3 Since not all bit-parallel digital television data formats have the same timing reference data, a modification may be required prior to multiplexing and serialization in order to meet the requirements of clause 5. Where additional words are required for EAV/SAV, data words from the adjacent digital blanking area shall be used. Modifications are typically made using a coprocessor in the parallel domain.

4.4 Parameters for referenced source formats are shown in table 1.

4.5 The total data rate is either 1.485 Gb/s or 1.485/1.001 Gb/s. In table 1, the former is indicated by a data rate division of 1 and the latter by a divsor of M, which equals 1.001.

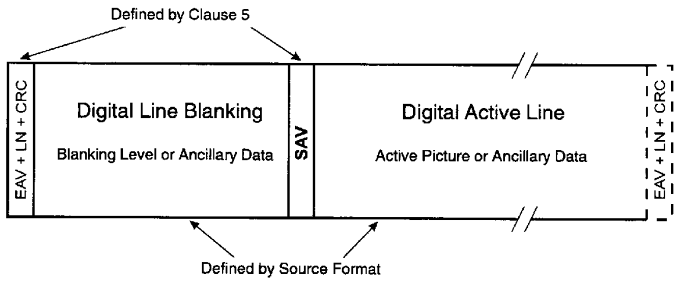

Figure 1 – Television horizontal line data

Table 1 – Source format parameters

Reference SMPTE standard	260M		295M	274M								296M	
Format	A	B	C	D	E	F	G	H	I	J	K	L	M
Lines per frame	1125	1125	1250	1125	1125	1125	1125	1125	1125	1125	1125	750	750
Words per active line (each channel Y C_B/C_R)	1920	1920	1920	1920	1920	1920	1920	1920	1920	1920	1920	1280	1280
Total active lines	1035	1035	1080	1080	1080	1080	1080	1080	1080	1080	1080	720	720
Words per total line (each channel Y C_B/C_R)	2200	2200	2376	2200	2200	2640	2200	2200	2640	2750	2750	1650	1650
Frame rate (Hz)	30	30/M	25	30	30/M	25	30	30/M	25	24	24/M	60	60/M
Fields per frame	2	2	2	2	2	2	1	1	1	1	1	1	1
Data rate divisor (see 4.5)	1	M	1	1	M	1	1	M	1	1	M	1	M

5 Data format

5.1 Digital active line and digital line blanking consist of 10-bit words as defined by the source format document. Data values 000_h to 003_h and $3FC_h$ to $3FF_h$ are excluded.

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 (see 4.3 regarding possible modification of source data).

5.3 Timing reference codes shall be as shown in table 2.

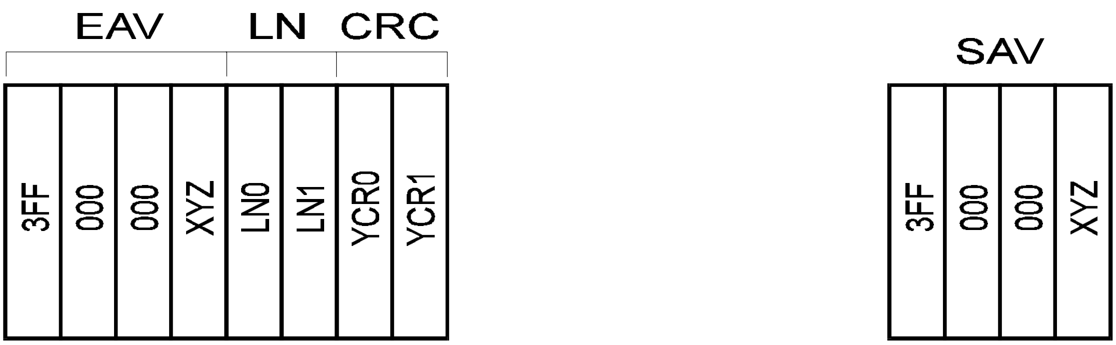

Figure 2 – Timing reference format (luminance channel shown)

Table 2 – Timing reference codes

Word	9 (MSB)	8	7	6	5	4	3	2	1	0 (LSB)
3FF	1	1	1	1	1	1	1	1	1	1
000	0	0	0	0	0	0	0	0	0	0
000	0	0	0	0	0	0	0	0	0	0
XYZ	1	F	V	H	P3	P2	P1	P0	0	0

NOTES
1 F = 0 during field 1; F = 1 during field 2.
2 V = 0 elsewhere; V = 1 during field blanking.
3 H = 0 in SAV; H = 1 in EAV.
4 MSB = most significant bit; LSB = least significant bit.
5 P0, P1, P2, P3 are protection bits defined below.

Bit	9 (MSB)	8	7	6	5	4	3	2	1	0 (LSB)
	1 Fixed	F	V	H	P3	P2	P1	P0	0 Fixed	0 Fixed
200_h	1	0	0	0	0	0	0	0	0	0
274_h	1	0	0	1	1	1	0	1	0	0
$2AC_h$	1	0	1	0	1	0	1	1	0	0
$2D8_h$	1	0	1	1	0	1	1	0	0	0
$31C_h$	1	1	0	0	0	1	1	1	0	0
368_h	1	1	0	1	1	0	1	0	0	0
$3B0_h$	1	1	1	0	1	1	0	0	0	0
$3C4_h$	1	1	1	1	0	0	0	1	0	0

5.4 Line number data are composed of two words and shall be as shown in table 3.

5.5 CRC (cyclic redundancy codes) are used to detect errors in the active digital line and the EAV which follows it. The error detection code consists of two words determined by the polynomial generator equation:

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

The initial value of the CRC is set to zero. The calculation starts at the first active line word and ends at the final word of the line number, LN1. Two CRCs are calculated, one for luminance data, YCR, and one for color difference data, CCR. CRC data shall be as shown in table 4.

5.6 Available ancillary data space is defined by the source format. The ancillary data header shall consist of the three words 000_h, $3FF_h$, $3FF_h$ with formatting of the ancillary data packet defined by SMPTE 291M. Data values 000_h to 003_h and $3FC_h$ to $3FF_h$ are excluded from user ancillary data.

6 Serial data format

6.1 The two source format parallel data streams, with EAV and SAV constructed as defined in 5.3 through 5.5, 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.

7 Channel coding

7.1 The channel coding scheme shall be scrambled NRZI (non-return to zero inverted). (See annex A.)

7.2 The generator polynomial for the scrambled NRZ shall be $G_1(X) = X^9 + X^4 + 1$. Polarity-free scrambled NRZI sequence data shall be produced by $G_2(X) = X + 1$. The input signal to the scrambler shall be positive logic. (The highest voltage represents data 1 and the lowest voltage represents data 0.)

7.3 Data word length shall be 10 bits.

Table 3 – Line number data

Word	9 (MSB)	8	7	6	5	4	3	2	1	0 (LSB)
LN0	not b8	L6	L5	L4	L3	L2	L1	L0	R	R
LN1	not 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 4 – CRC data

Word	9 (MSB)	8	7	6	5	4	3	2	1	0 (LSB)
YCR0	not b8	CRC8	CRC7	CRC6	CRC5	CRC4	CRC3	CRC2	CRC1	CRC0
YCR1	not b8	CRC17	CRC16	CRC15	CRC14	CRC13	CRC12	CRC11	CRC10	CRC9
CCR0	not b8	CRC8	CRC7	CRC6	CRC5	CRC4	CRC3	CRC2	CRC1	CRC0
CCR1	not b8	CRC17	CRC16	CRC15	CRC14	CRC13	CRC12	CRC11	CRC10	CRC9

8 Coaxial cable interface

8.1 Signal levels and specifications

These specifications are defined for measurement of the serial output of a source derived from a parallel domain signal whose timing and other characteristics meet good studio practices. Specifications at the output of equipment located at other places in an all-serial digital chain are not addressed by this standard.

8.1.1 The output of the generator shall be measured across a 75-ohm resistive load connected through a 1-m coaxial cable. Figure 4 depicts the measurement dimensions for amplitude, risetime, and overshoot.

8.1.2 The generator shall have an unbalanced output circuit with a source impedance of 75 ohms and a return loss of at least [15 dB] over a frequency range of 5 MHz to the clock frequency of the signal being transmitted.

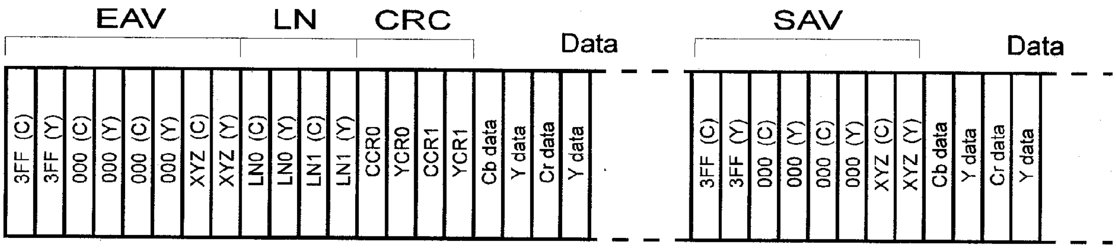

Figure 3 – Interleaved data stream

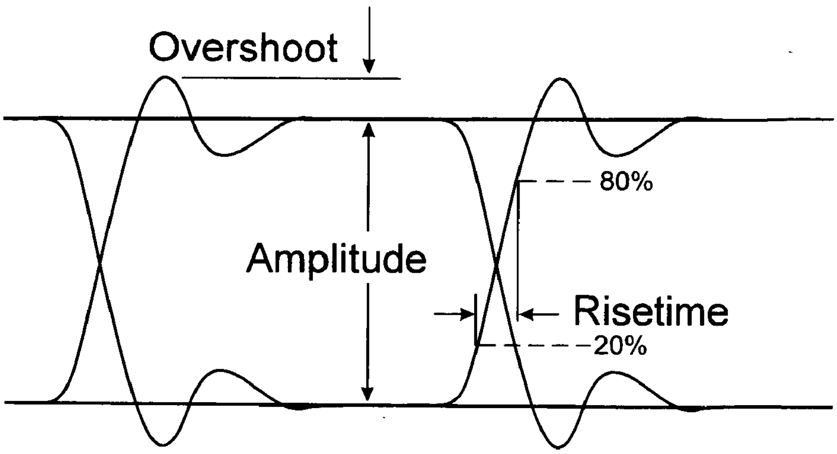

Figure 4 – Waveform measurement dimensions

8.1.3 The peak-to-peak signal amplitude shall be 800 mV ± 10% measured as specified in 8.1.1.

8.1.4 The dc offset, as defined by the mid-amplitude point of the signal, shall be nominally 0.0 V ± 0.5 V.

8.1.5 The rise and fall times, determined between the 20% and 80% amplitude points shall be no greater than 270 ps and shall not differ by more than 100 ps.

8.1.6 Overshoot of the rising and falling edges of the waveform shall not exceed 10% of the amplitude.

8.1.7 Output amplitude excursions due to signals with a significant dc component occurring for a horizontal line (pathological signals) shall not exceed 50 mv above or below the average peak-to-peak signal envelope. (In effect, this specification defines a minimum output coupling time constant.)

8.1.8 The jitter in the timing of the transitions of the data signal shall be measured in accordance with SMPTE RP 184. Measurement parameters are defined in SMPTE RP 184 and shall have the values shown in table 5 for compliance with this standard.

NOTE – This clause will be updated editorially to bring it into compliance with current SMPTE practices.

8.1.9 The receiver of the serial interface signal shall present an impedance of 75 ohms with a return loss of at least [15 dB] over a frequency range of 5 MHz to the clock frequency of the signal being transmitted.

8.1.10 Receivers operating with input cable losses in the range of up to 20 dB at one-half the clock frequency are nominal; however, receivers designed to work with greater or lesser signal attenuation are acceptable.

8.1.11 When connected to a line driver operating at the lower limit of voltage permitted by 8.1.3, the receiver must sense correctly the binary data in the presence of the superimposed interfering signal at the following levels:

dc	± 2.5 V
Below 5 kHz	< 2.5 V p-p
5 kHz to 27 MHz	< 100 mV p-p
Above 27 MHz	< 40 mV p-p

Table 5 – Jitter specifications

B1	10 Hz	Timing jitter lower band edge	
B2	100 kHz	Alignment jitter lower band edge	
B3	> 1/10 the clock rate	Upper band edge	
A1	1 UI	Timing jitter	(Note 1)
A2	.2 UI	Alignment jitter (UI = unit interval)	
Test signal	Color bar test signal		(Note 2)
n	≠ 10 (preferred)	Serial clock divided	(Note 3)

NOTES

1 Designers are cautioned that parallel signals conforming to interconnection standards, such as SMPTE 260M, may contain jitter up to 2 ns p-p. Direct conversion of such signals from parallel to serial could result in excessive serial signal jitter.

2 Color bars are chosen as a nonstressing test signal for jitter measurements. Use of a stressing signal with long runs of zeros may give misleading results.

3 Use of a serial clock divider value of 10 may mask word correlated jitter components.

4 See SMPTE RP 184 for definition of terms.

NOTE – Receivers intended for use in environments with minimum interfering signal levels do not need to meet the low-frequency interference specifications of 8.1.11 (see annex B).

8.2 Connector and cable types

8.2.1 The connector shall have the mechanical characteristics conforming to the 50-ohm BNC type. Mechanical dimensions of the connector may produce either a nominal 50-ohm or nominal 75-ohm impedance and shall be usable at frequencies up to 2.4 GHz based on a return loss at 1.5 GHz that is greater than [15 dB]. However, the electrical characteristics of the connector and its associated interface circuitry shall provide a resistive impedance of 75 ohms. Where a 75-ohm connector is used, its mechanical characteristics must reliably interface with the nominal 50-ohm BNC type defined by IEC 60169-8.

8.2.2 Application of this standard does not require a particular type of coax. It is necessary for the frequency response of the coax loss, in decibels, to be approximately proportional to $1/\sqrt{f}$ from 1 MHz to the clock frequency of the signal being transmitted to ensure correct operation of automatic cable equalizers over moderate to maximum lengths.

8.2.3 Return loss of the correctly terminated transmission line shall be greater than 15 dB over a frequency range of 5 MHz to the clock frequency of the signal being transmitted.

9 Optical fiber interface

The interface consists of one transmitter and one receiver in a point-to-point connection.

9.1 Source characteristics shall be as shown in table 6.

9.2 Optical fiber characteristics shall be as shown in table 7.

9.3 Receiver characteristics shall be as shown in table 8.

Table 6 – Optical source characteristics

Optical wavelength	1310 nm ± 40 nm
Maximum spectral line width between half-power points	10 nm
Output power maximum	– 7.5 dBm
Output power minimum	– 12 dBm
Rise and fall times	< 270 ps (20% to 80%)
Extinction ratio	5:1 min, 30:1 max
Jitter	[0.2 UI]
Maximum reflected power	4%

NOTES
1 Power is average power measured with an average-reading power meter.
2 Rise and fall times in the electrical domain must meet the requirements of 8.1.5.

Table 7 – Optical fiber link characteristics

Fiber type	Single mode (IEC 60793-2)
Connector (see figure 5)	Type SC/PC (IEC 60874-7)

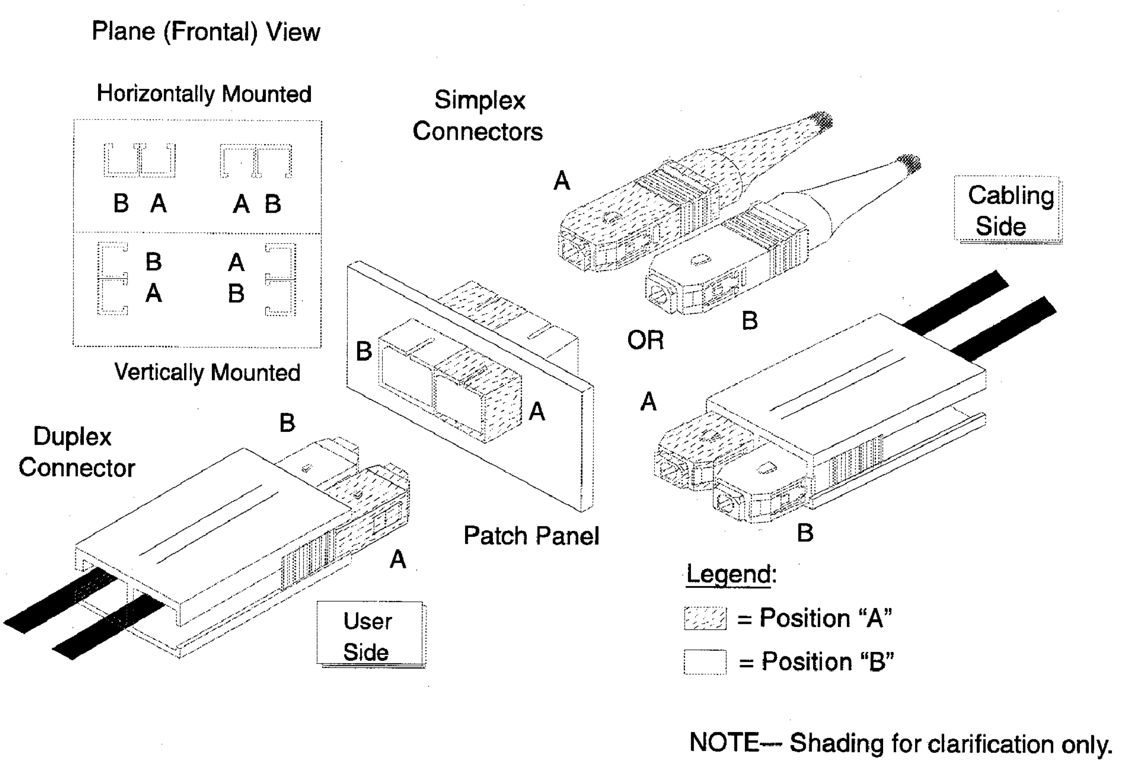

Figure 5 – SC connector (patch panel shown for information only)

Table 8 – Optical receiver characteristics

Maximum input power	–7.5 dBm
Minimum input power	–20 dBm
Detector damage threshold	+ 1 dBm
Output rise and fall times	see 8.1.5
Output jitter	see 8.1.8

Annex A (informative)
Channel code

When scrambled NRZI channel coding is applied to certain video signals (informally called pathological signals), repeated long strings of 19 or 20 zeros may occur during the period of one horizontal television line. A stressing test signal (SDI checkfield, SMPTE RP 178) that produces this effect has been defined for 525- and 625-line component digital systems conforming to ANSI/SMPTE 259M. An equivalent test signal is being developed by SMPTE for the serial HDTV system defined in this standard. Additional SMPTE work is in process to recommend methods that may be used to avoid the occurrence of pathological signals in normal television operations.

Annex B (informative)
Receiver type

Receivers conforming to the specifications of 8.1.11 should be labeled "Type A." Receivers that may not conform to the specifications of 8.1.11 should be labeled "Type B."

Annex C (informative)
Bibliography

ANSI/SMPTE 259M-1997, Television — 10-Bit 4:2:2 Component and $4f_{SC}$ Composite Digital Signals — Serial Digital Interface

SMPTE RP 178-1996, Serial Digital Interface Checkfield for 10-Bit 4:2:2 Component and $4f_{SC}$ Composite Digital Signals