

SMPTE STANDARD

Serial Digital Fiber Transmission System for SMPTE ST 259, SMPTE ST 344, SMPTE ST 292-1/2, SMPTE ST 424, SMPTE ST 2081-1 and SMPTE ST 2082-1 Signals



Page 1 of 26 pages

Table of Contents	Page
Foreword	2
Intellectual Property	2
1 Scope	3
2 Conformance Notation	3
3 Normative References	3
4 Optical Transmission System Specification (see Annex A for Definitions of Fiber Terms)	4
4.1 Physical Packaging and Connectors of Transmitter and Receiver Units	4
4.2 Transmitter Unit.....	5
4.3 Transmitter Unit Labeling.....	7
4.4 Receiver Unit.....	7
4.5 Receiver Unit Labeling.....	8
4.6 Optical Fiber Circuit and Connector Specification	9
Annex A Definitions of Optical Domain Transmission Media and Connector Terms (Informative)	10
Annex B Optical Transmission Circuit Design and Performance Options (Informative).....	11
Annex C Laser Safety Information (Informative).....	13
Annex D Maximum Transmission Distance Range (Informative)	14
Annex E Minimum Transmission Distance (Informative).....	15
Annex F Damage Thresholds (Informative).....	17
Annex G Glossary of Fiber Optic Terms (Informative)	18
Annex H Bibliography (Informative)	26

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 its Standards Operations Manual.

SMPTE ST 297 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. Attention is drawn, however, 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.

1 Scope

This standard defines an optical fiber system for transmitting bit-serial digital signals. It is intended for transmitting SMPTE ST 259 signals (143 through 360 Mb/s), SMPTE ST 344 signals (540Mb/s), SMPTE ST 292-1/2 signals (1.485 Gb/s and 1.485/1.001 Gb/s), SMPTE ST 424 signals (2.970 Gb/s and 2.970/1.001 Gb/s), SMPTE ST 2081-1 signals (5.940 Gb/s and 5.940/1.001 Gb/s) and SMPTE ST 2082-1 signals (11.88 Gb/s and 11.88/1.001 Gb/s).

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.

Unless otherwise specified, the order of precedence of the types of normative information in this document shall be as follows: Normative prose shall be the authoritative definition; Tables shall be next; followed by formal languages; then figures; and then any other language forms.

3 Normative References

Note: All references in this document to other SMPTE documents use the current numbering style (e.g. SMPTE ST 259:2008) although, during a transitional phase, the document as published (printed or PDF) may bear an older designation (such as SMPTE 259M-2008). Documents with the same root number (e.g. 259) and publication year (e.g. 2008) are functionally identical.

The following standards contain provisions that, 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 259:2008, Television — SDTV Digital Signal/Data — Serial Digital Interface

SMPTE ST 292-1:2012, 1.5 Gb/s Signal/Data Serial Interface

SMPTE ST 344:2000, Television — 540 Mb/s Serial Digital Interface

SMPTE ST 424:2012, 3 Gb/s Signal/Data Serial Interface

SMPTE ST 2081-1:2015, 6 Gb/s Signal/Data Serial Interface — Electrical

SMPTE ST 2082-1:2015, 12 Gb/s Signal/Data Serial Interface — Electrical

SMPTE EG 34:2004, Pathological Conditions in Serial Digital Video Systems

ANSI/EIA/TIA-492AAAA-A (2002), Detail Specification for 62.5 μm Core Diameter/125 μm Cladding Diameter Class Ia, Graded-Index Multimode Optical Fibers

Recommendation ITU-T G.651.1 (2007), Characteristics of a 50/125 μm Multimode Graded Index Optical Fibre Cable for the Optical Access Network

Recommendation ITU-T Rec. G.652 (2009), Characteristics of a Single-Mode Optical Fibre Cable

IEC 60793-2 (2011), Optical Fibres — Part 2: Product Specifications — General

IEC 60825-1(2014) Ed 3, Safety of Laser Products — Part 1: Equipment Classification and Requirements

IEC 61754-20 (2012), Fibre Optic Interconnecting Devices and Passive Components — Fibre Optic Connector Interfaces — Part 20: Type LC Connector Family

IEC 60793-1-1 (2008), Measurement Methods and Test Procedures — General and Guidance

IEC 60793-1-40 (2001-07), Optical Fibres — Part 1-40: Measurement Methods and Test Procedures — Attenuation

4 Optical Transmission System Specification (see Annex A for Definitions of Fiber Terms)

4.1 Physical Packaging and Connectors of Transmitter and Receiver Units

4.1.1 The preferred Tx and Rx unit optical domain connectors and their mating input and output cable sections shall be LC/PC as per IEC 61754-20-1.

Other application-specific connector types such as SC, ST, FC, MU, etc. may optionally be specified. The Tx / Rx unit or its product documentation should indicate the connector type. Furthermore, the product documentation should include detailed mechanical and optical specifications for the specified connector.

4.1.2 The preferred Tx and Rx unit optical domain connector polish shall be PC.

Other application-specific connector polishes such as SPC, UPC and APC may optionally be specified, provided the polish is clearly labeled as described in Sections 4.3 and 4.5 below. The Tx / Rx unit product documentation shall include detailed specifications for the required optical connector polish.

Note: While angle-polish connectors (i.e. APC) and flat-polish connectors (i.e. PC, SPC, and UPC) of the same type (e.g. LC) can be mechanically mated, they are not optically compatible. System designers and system installers are therefore advised to ensure compatibility of cable, connector type and polish throughout the installation.

4.1.3 A short pigtail of single-mode fiber as specified in Recommendation ITU-T G.652 shall be used to connect the Tx unit light source to its output optical connector if the light source is not physically installed and connected in a receptacle (see Annex A.1).

A short pigtail of multimode 50/125 micron fiber as specified in Recommendation ITU-T G.651 is acceptable if the Tx unit is intended exclusively for multimode link applications.

The Tx unit or its product documentation shall indicate which type of pigtail, if any, is installed.

4.1.4 A short pigtail of 62.5/125 micron multimode fiber specified in ANSI/EIA/TIA-492AAAA-A (2002) shall be used to connect the Rx unit optical receiver to its input optical connector if the receiver is not physically installed and connected in a receptacle (see Annex A.1).

The Rx unit or its product documentation shall indicate which type of pigtail, if any, is installed.

4.2 Transmitter Unit

4.2.1 The transmitter unit shall produce an intensity-varying optical output signal in accordance with the relevant low-power (short-haul), medium-power (medium-haul) or high-power (long-haul) link parameters in Table 1, when modulated by an electrical signal with specifications per SMPTE ST 259, modulated by an electrical signal with specifications per SMPTE ST 344, modulated by an electrical signal with specifications per SMPTE ST 292-1 or modulated by an electrical signal with specifications per SMPTE ST 424, modulated by an electrical signal with specifications per SMPTE ST 2081-1 or modulated by an electrical signal with specifications per SMPTE ST 2082-1.

Note: Devices compliant with this standard may be designed to accept one, all, or any combination of SMPTE ST 259, SMPTE ST 344, SMPTE ST 292-1, SMPTE ST 424, SMPTE ST 2081-1 (5.940 Gb/s and 5.940/1.001 Gb/s), and SMPTE ST 2082-1 (11.88 Gb/s and 11.88/1.001 Gb/s) input signals.

Table 1 – Transmitter unit output signal specifications

	High-power (Long-haul) link	Medium-power (medium-haul) link	Low-power (short-haul) link	
Transmission circuit fiber ¹⁰⁾	SM (9.0/125 μm)	SM (9.0/125 μm)	SM (9.0/125 μm)	MM ¹⁾ (50.0/125 μm , 62.5/125 μm)
Light source type ⁸⁾⁹⁾	Laser	Laser	Laser	Laser or LED ²⁾³⁾
Optical wavelength	1310 nm 40 nm	1310 nm 40 nm	1310 nm 40 nm	1310 nm 40 nm
	1550 nm 40 nm	1550 nm 40 nm	1550 nm 40 nm	850 nm 30 nm
Maximum spectral line width between half-power points	≤ 1 nm	≤ 4 nm	≤ 10 nm	≤ 30 nm
Maximum Optical Power ⁴⁾	+10 dBm	0 dBm	-3 dBm	
Minimum Optical Power ⁴⁾	0 dBm	-3 dBm	-12dBm	

Minimum Extinction ratio ⁵⁾	5:1 (10:1 preferred)
Rise and fall times for SMPTE ST 259 ⁶⁾	As specified in SMPTE ST 259 for the electrical signal < 1.5 ns (20% to 80%)
Rise and fall times for SMPTE ST 344 ⁶⁾	As specified in SMPTE ST 344 for the electrical signal < 0.80 ns (20% to 80%)
Rise and fall times for SMPTE ST 292-1 ⁶⁾	As specified in SMPTE ST 292-1 for the electrical signal < 270 ps (20% to 80%)
Rise and fall times for SMPTE ST 424 ⁶⁾	As specified in SMPTE ST 424 for the electrical signal < 135 ps (20% to 80%)
Rise and fall times for SMPTE ST 2081-1 ⁶⁾	As specified in SMPTE ST 2081-1 for the electrical signal < 80 ps (20% to 80%)
Rise and fall times for SMPTE ST 2082-1 ⁶⁾	As specified in SMPTE ST 2082-1 for the electrical signal < 45 ps (20% to 80%)
Maximum Reflected power	-14 dB
Electrical / optical transfer function	Logic "1" maximum intensity / Logic "0" minimum intensity
NOTES: ¹⁾ See Recommendation ITU-T G.651 and ANSI/EIA/TIA-492AAAA-A for optional MM fiber type. ²⁾ LEDs may not function reliably at higher bit rates specified in SMPTE ST 259, SMPTE ST 344 SMPTE ST 292-1, SMPTE ST 424, SMPTE ST 2081-1, or SMPTE ST 2082-1, ³⁾ Tx units intended solely for multimode transmission link applications shall be so marked. ⁴⁾ Power is average power measured with an average-reading power meter. ⁵⁾ Is the ratio between the maximum and minimum output power of the transmitter. ⁶⁾ Rise/fall times are measured following a fourth-order Bessel-Thompson filter with a 3 dB point at 0.75 x data rate in MHz; i.e., 0.75 x 270 Mb/s = 203 MHz. ⁷⁾ Lasers are all class 1 as defined in IEC 60825-1 (2001-08). ⁸⁾ A laser warning label that is clearly visible during maintenance, operations, and servicing shall be present on equipment. Text borders and symbols must be black on a yellow background. The laser warning label shall be as illustrated: Refer to Annex C for further information. ⁹⁾ Optical fiber specification defined by IEC 60793-2 (2003-10) and IEC 60793-1 Measurement methods and test procedures - General and guidance.	

4.3 Transmitter Unit Labeling

4.3.1 Transmitter units shall be labeled to indicate the application (low-power, medium-power or high-power), the polish of the connector, the payload types they support and the wavelength they use. The labeling shall have the format <application>-<polish>-<signal type>-<wavelength>.

- The element <application> shall have the value:
 - H for high-power (long-haul) link applications
 - M for medium-power (medium-haul) link applications
 - L for low-power (short-haul) link applications
- The element <polish> shall have the value:
 - PC for Physical Contact (flat polished) Connectors – preferred
 - SPC for Super Physical Contact (flat polished) Connectors – optional
 - UPC for Ultra Physical Contact (flat polished) Connectors – optional
 - APC for Angle Physical Contact (angle polished) Connectors – optional
- For each supported signal type, the element <signal type> shall have the value:
 - A to indicate support of SMPTE ST 259 signals
 - B to indicate support of SMPTE ST 344 signals
 - C to indicate support of SMPTE ST 292-1 signals
 - D to indicate support for SMPTE ST 424 signals
 - E to indicate support for SMPTE ST 2081-1 signals
 - F to indicate support for SMPTE ST 2082-1 signals
- The element <wavelength> shall have the value:
 - 850 for 850 nm transmitters
 - 1310 for 1310 nm transmitters
 - 1550 for 1550 nm transmitters

EXAMPLE: An angle polished low-power (short-haul) transmitter that supports SMPTE ST 259 and SMPTE ST 292-1 signals at an optical wavelength of 1310 nm is labeled L-APC-AC-1310.

Note: Equipment designed in compliance with previous revisions of this standard may not conform to this label requirement.

4.4 Receiver Unit

A receiver unit shall output an electrical signal per SMPTE ST 259, SMPTE ST 344, SMPTE ST 292-1, SMPTE ST 424, SMPTE ST 2081-1, or SMPTE ST 2081-2 when receiving an optical signal per Table 2.

Note: Devices compliant with this standard may be designed to produce one, all, or any combination of SMPTE ST 259, SMPTE ST 344, SMPTE ST 292-1, SMPTE ST 424, SMPTE ST 2081-1, and SMPTE 2081-2 electrical signals.

Table 2 – Optical receiver input signal specifications

Transmission circuit fiber	Single-mode	Multimode ²⁾
Minimum input overload power ^{1) 3)}	-7.5 dBm, 0 dBm preferred	
Minimum input overload power for SMPTE ST 2081-1, SMPTE St 2082-1	+0.5dBm	
Minimum input power for SMPTE ST 259, SMPTE ST 344 and SMPTE ST 292-1	-20 dBm	
Minimum input power for SMPTE ST 424 ¹⁾	-17 dBm	
Minimum input power for SMPTE ST 2081-1,SMPTE ST 2082-1	-14dBm	
Detector damage threshold ³⁾	+1 dBm (minimum)	
NOTES: ¹⁾ Within the receiver input range, a BER < 10-12 shall be achieved with the SDI Matrix Checkfield signal. A BER < 10-14 is recommended. ²⁾ Multimode fiber is not recommended for high-power (long-haul), or medium-power (medium-haul), link applications at SMPTE ST 344 SMPTE ST 292-1, SMPTE ST 424, SMPTE ST 2081-1, or SMPTE ST 2082-1 signal rates. ³⁾ Depending on product implementation, optical attenuators may need to be used to meet specified overload and detector damage performance. See informative Annex E and Annex F for further information.		

4.5 Receiver Unit Labeling

Receivers shall be labeled to indicate the polish of the connector and the payload types they support. The labeling shall have the format <polish>-<signal type>-<wavelength range>.

– The element <polish> shall have the value:

- PC for Physical Contact (flat polished) Connectors – preferred
- SPC for Super Physical Contact (flat polished) Connectors – optional
- UPC for Ultra Physical Contact (flat polished) Connectors – optional
- APC for Angle Physical Contact (angle polished) Connectors – optional

– For each support signal type, the element <signal type> shall have the value:

- A to indicate support of SMPTE ST 259 signals
- B to indicate support of SMPTE ST 344 signals
- C to indicate support of SMPTE ST 292-1 signals
- D to indicate support for SMPTE ST 424 signals
- E to indicate support for SMPTE ST 2081-1 signals
- F to indicate support for SMPTE ST 2082-1 signals