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FIBRE CHANNEL

LOW COST 10km OPTICAL
1063 MBAUD INTERFACE
100-SM-LC-L
REV 2

working draft proposed
American National Standard
for Information Systems

February 11, 1998

Secretariat:
Information Technology Industry Council

ABSTRACT: This standard describes an enhancement to the ANSI X3.230, Fibre Channel Physical and Signalling Interface (FC-PH) and to the ANSI X3.297, Fibre Channel Physical and Signalling Interface - 2 (FC-PH-2) and to the ANSI X3.303, Fibre Channel Physical and Signalling interface - 3 (FC-PH-3) and is an addendum to these documents.

NOTE:

This is a draft proposed American National Standard of Accredited Standards Committee X3. As such, this is not a completed standard. The T11.2 Technical Committee may modify this document as a result of comments received during public review and its approval as a standard.

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American National Standard
for Information Technology — Fibre Channel— Low Cost 10km Optical 1063MBaud Interface (100-SM-LC-L)

Secretariat

Information Technology Industry Council

Approved ,199

American National Standards Institute, Inc.

Abstract

This standard describes the enhancement to the ANSI X3.230, Fibre Channel Physical and Signalling Interface (FC-PH), to the ANSI X3.297, Fibre Channel Physical and Signalling Interface - 2 (FC-PH-2) and to the ANSI X3.xxx, Fibre Channel Physical and Signaling Interface - 3 (FC-PH-3), and is an addendum to these documents.

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Foreword (This Foreword is not part of dpANS X3.xxx-199x.)

This Fibre Channel, Low Cost 10km Optical 1063 Mbaud Interface standard (100-SM-LC-L) describes an enhancement to the ANSI X3.230-1994 (FC-PH), X3.297-1997 (FC-PH-2), and X3.303-199X (FC-PH-3) and is an extension to these documents.

This standard was developed by Task Group T11.2 of Accredited Standards Committee NCITS during 1997-8. The standards approval process started in 1997.

Requests for interpretation, suggestions for improvement or addenda, or defect reports are welcome. They should be sent to the National Committee for Information Technology (NCITS), 1250 Eye Street, NW, Suite 200, Washington, DC 20005.

NOTE: The developers of this standard have requested that holders of patents that may be required for the implementation of the standard, disclose such patents to the publisher. However neither the developers nor the publisher have undertaken a patent search in order to identify which if any patents may apply to this standard. No position is taken with respect to the validity of any claim or any patent rights that may have been disclosed. Details may be obtained from the publisher concerning any statement of patents and willingness to grant a license on a nondiscriminatory basis and with reasonable terms and conditions to applicants desiring to obtain such a license.

This standard was processed and approved for submittal to ANSI by NCITS. Committee approval of the standard does not necessarily imply that all committee members voted for approval. At the time it approved this standard, NCITS had the following members:

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TBD, Vice-Chair
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TBD

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James Myers, 100-SM-LC-L Technical Editor

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draft proposed American National Standard
for Information Technology—

Fibre Channel —
Low Cost 10km Optical 1063MBaud Interface —
(100-SM-LC-L)

1 Scope

100-SM-LC-L describes an enhancement to ANSI X3.230, FC-PH, to ANSI X3.297, FC-PH-2 and to ANSI X3.303, FC-PH-3, and is an addendum to the FC-PH, FC-PH-2, and FC-PH-3 documents.

This document is an extension to the FC-PH, FC-PH-2, and FC-PH-3 standards and describes a low cost 10km optical interface.

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 editions of the standards listed below.

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2.1 Approved references

ANSI X3.230-1994, *Fibre Channel Physical and Signalling Interface (FC-PH)*

ANSI X3.297-1996, *Fibre Channel Physical and Signalling Interface - 2(FC-PH-2)*

ANSI X3.303-199X, *Fibre Channel Physical and Signalling Interface - 3(FC-PH-3)*

3 Definitions and conventions

For 100-SM-LC-L, the following definitions and the definitions, conventions, abbreviations, acronyms, and symbols defined in X3.230-1994 (FC-PH), X3.297-1996 (FC-PH-2), and X3.303-199X (FC-PH-3) apply.

3.1 Definitions

3.1.1 $\mathbf{T_{RISE\backslash FALL}}$**:** The adjusted 20% to 80% rise and/or fall times of the optical signal.

3.1.2 $\mathbf{T_{RISE\backslash FALL\_MEASURED}}$**:** The measured 20% to 80% rise and/or fall times of the optical signal.

3.1.3 $\mathbf{T_{RISE\backslash FALL\_FILTER}}$**:** The measured 20% to 80% rise and/or fall times of a fourth order Bessel Thompson filter

4 Structure and concepts

No change.

5 FC-0 functional characteristics

The enhancement of an additional physical variant to FC-PH, FC-PH-2, and FC-PH-3, is specified.

5.1 General characteristics

The FC-2 protocol is defined to operate across connections having a BER detected at the receiving node of 10^{-12}. It shall be the combined responsibility of the component vendors and the system integrator to ensure that this level of service is provided in a given Fibre Channel installation.

The general characteristics specified in FC-PH 5.1 are enhanced as follows:

— A low cost 10km interface operating at a data rate of 1 063 MBaud using a long wavelength (1310nm) laser on single mode fiber is defined in this standard.

5.2 FC-0 nomenclature

The nomenclature for the technology options are illustrated in Figure 1.

5.3 FC-0 technology options

Optical media signal interface enhancements are included in table 1 based on FC-PH table 2.

Optical cable plant enhancements are included in table 2 based on FC-PH table 4.

Table 1 – Optical Media Signal Interface Overview

100 MB/sec 1,062 Gbaud
100-SM-LC-L Subclause 6.1 SM 1310nm 2m-10km

Table 2 – Optical Cable Plant Overview

Single Mode
100-SM-LC-L Subclause 6.1 SM 1310nm 2m-10km

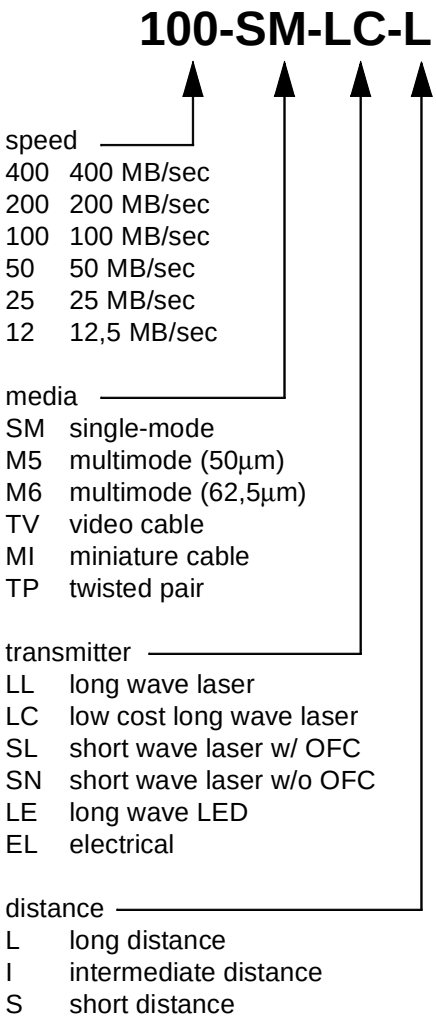

Figure 1 – FC-0 nomenclature

6 Optical fibre interface specification

Enhancement to FC-PH, FC-PH-2, and FC-PH-3 is specified.

6.1 SM data links

Table 3 includes a low cost 10km link operating at 1063 MBaud using a long wave wavelength (1310nm) laser on single mode fiber. The optical power coupled into the fibre shall be limited to a maximum value consistent with Class 1 laser safety operations in accordance with IEC 825-1.

Table 3 – FC-0 physical links for single-mode classes

FC-0	Units	100-SM-LC-L
Subclause		FC-PH-2 6.1
Data rate	MB/sec	100
Nominal bit rate	MBaud	1062.5
Tolerance	ppm	±100
Operating range	m	2-10k
Fibre core diameter	µm	9
Transmitter (S)		
Type		Laser
λ (Spectral centre wavelength)	nm (min.)	**(*C*)**
	nm (max.)	**(*C*)**
RMS spectral width	nm (max.)	**(*C*)**
Launched power, max.	dBm (ave.)	-3
Launched power, min.	dBm (ave.)	**(*C*)**
Extinction ratio	dB (min.)	9
RIN (max.)	dB/Hz	-116
Rise and fall time***(A)***	ps (max) (20%-80%)	320
Eye opening **(*B*)**	% (min.)	57
Deterministic jitter	% (p-p)	20
Receiver (R)		
Received power, min.***(D)***	dBm (ave.)	-20
Received power, max.	dBm (ave.)	-3
Optical path penalty	dB (max.)	4.2
Return loss of receiver	dB (min.)	12

(*A*) See subclause 6.1.3

(*B*) @BER≤10^{-12}

(*C*) Trade-offs are available between spectral centre wavelength, RMS spectral width, and minimum launched power. See subclause 6.1.4 and Figure 2.

(D) Receiver sensitivity is measured by sampling at the center of the eye while using a minimum specified extinction ratio source.

6.1.3 SM optical response specifications

Optical response time specifications are based on the unfiltered waveforms. For the purposes of standardizing the measurement method, measured waveforms shall conform to the mask defined in FC-PH Figure 22: **Transmitter eye diagram mask**. If a filter is needed to conform to the mask, the filter response effect should be removed from the measured rise and fall times using the equation:

$$T_{RISE\backslash\mathrm{FALL}} = \sqrt{(T^2_{RISE\backslash\mathrm{FALL\_MEASURED}}) - (T^2_{RISE\backslash\mathrm{FALL\_FILTER}})}$$

The optical signal may have different rise and fall times. Any filter should have an impulse response equivalent to a fourth order Bessel Thompson filter.

6.1.4 100-SM-LC-L transmitter specifications

Figure 2 shows the relative trade-offs in transmitter specifications. Choosing a minimum launched power defines a compliance curve. Transmitter specifications for maximum spectral width and minimum and maximum spectral center wavelength are then defined acceptably as any point on or below the corresponding minimum launched power curve.

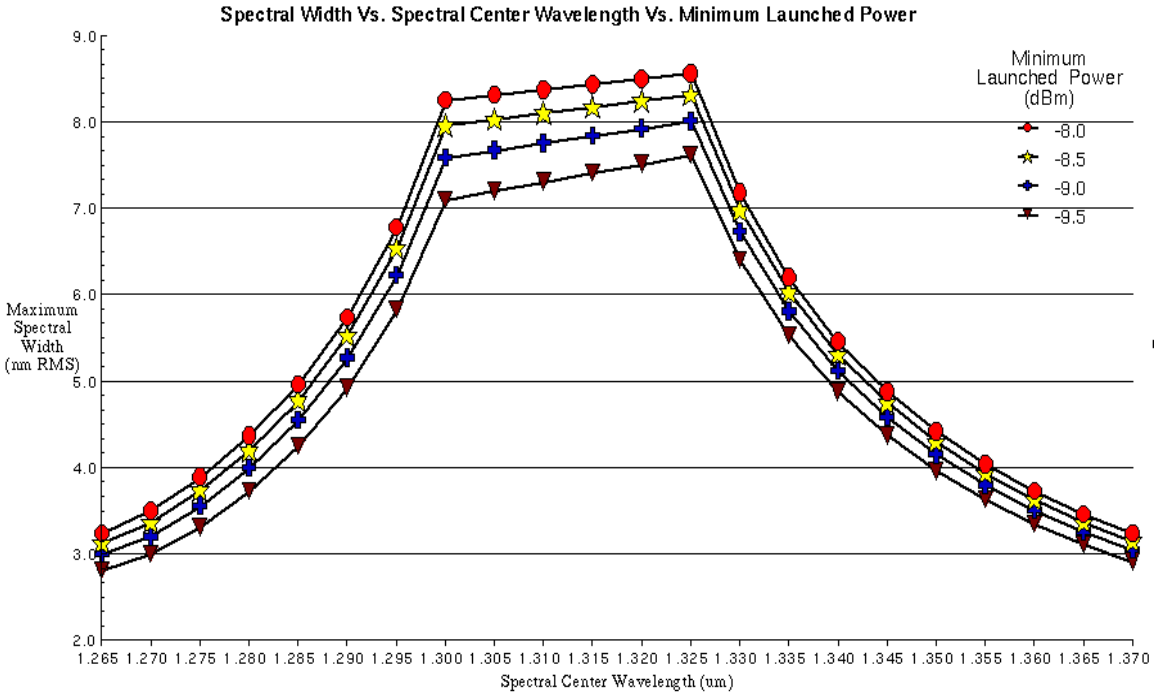

Figure 2 – 100-SM-LC-L transmitter specifications

6.1.5 100-SM-LC-L jitter specifications

6.1.5.1 100-SM-LC-L jitter budget table

The numbers in Table 4 represent high frequency jitter (above 637 kHz) and do not include low frequency jitter or wander.

Table 4 – 100-SM-LC-L jitter budget

Compliance point	Total jitter		Deterministic jitter		Reference
	UI	ps	UI	ps	
b (Serial Output) α_T	0.210	198	0.100	94	Compliance points are defined in FC-PH Figure 9: **FC-0 transmitter interfaces**, and in FC-PH Figure 10: **FC-0 receiver interfaces;** and in **Fibre Channel Methodologies for Jitter Specification** Technical Report
S (Media Output) γ_T	0.430	405	0.200	188	
R (Media Input) γ_R	0.430	405	0.200	188	
c (Receiver Output) α_R	0.600	565	0.380	358	

6.1.5.2 Receiver output jitter measurement

Receiver TJ and DJ must comply to the listed values in Table 4 over all allowable optical power input ranges and extinction ratios as listed in Table 3. The minimum optical power input test condition may need to be adjusted to account for penalties inherent in the test setup. (Eg. a 0.6 dB reflection degradation in the test setup would require a minimum optical power input of -19.4 dBm)

7 Electrical cable interface specification

No changes.

8 Optical fibre cable plant specification

Enhancement to FC-PH, FC-PH-2, and FC-PH-3 is specified.

8.1 SM cable plant specification

This subclause specifies a single-mode cable plant (see FC-PH 3.1.17 for definition) for the Low Cost 10km Optical 1063 MBaud Interface (100-SM-LC-L).

Table 5 – Single-mode cable plant

FC-0	Unit	100-SM-LC-L
Subclause		6.1
Operating range	m	2-10k
Cable plant dispersion	ps/nm	35
Dispersion related penalty (-9.5 dBm minimum launched power)	dB	1.7
Dispersion related penalty (-9.0 dBm minimum launched power)	dB	2.2
Dispersion related penalty (-8.5 dBm minimum launched power)	dB	2.7
Dispersion related penalty (-8.0 dBm minimum launched power)	dB	3.2
Reflection related penalty	dB	1.0
Loss budget	dB	7.8

8.2 Cable plant loss budget

The passive loss budget for the 100-SM-LC-L shall be no greater than specified in table 5. This limit was arrived at by taking the difference between the minimum transmitter output power (from clause 6.1, figure 2), and the receiver sensitivity (from clause 6.1, table 3) and subtracting a 1dB reflection link penalty and a dispersion penalty corresponding to the minimum transmitter output power.

The dispersion related penalties shown in table 5 are the maximum calculated dispersion related penalties based on the corresponding transmitter specification curve as shown in clause 6.1.4, figure 2.

No changes to all remaining clauses of FC-PH.