

Table 4 – 850 nm optical parameters

Parameter	Value	Units
Data link		
Channel count	12	
Nominal Baud rate (per channel)	1000	MBaud
User data rate (per channel)	800	Mbit/s
Bit error ratio (per channel)	$\leq 10^{-12}$	
Optical passive loss	3.3	dB
Optical system penalty	2.7	dB
Total link power budget (min.)	6	dB
Operating distance ¹	220	meters
Transmitter		
Wavelength (min.)	830	nm
Wavelength (max.)	860	nm
Spectral width (max.)	0.85	nm RMS
Average launched power (max. per channel)	note 2	dBm
Optical modulation amplitude (min. per channel)	120	μ W
Relative intensity noise (max.)	-116	dB/Hz
Optical rise/fall time (max.) ³	260	ps
Channel-to-channel skew ⁴	500	ps
Receiver		
Received optical modulation amplitude (min.)	0.030	mW
Stressed receiver optical modulation amplitude (min.) ³	0.075	mW
ISI penalty for stressed receiver test	1.2	dB
Average received power (max.)	-4	dBm
Receiver return loss (min.)	12	dB
Electrical rise/fall time (max.) ⁴	400	ps
Channel-to-channel skew ⁵	500	ps
Optical path		
Fiber core diameter	62.5	μ m
Modal bandwidth (min; overfilled launch)	160	MHz*km
Interchannel skew (max.) ⁶	5	ns
Connector	MPO	
NOTES –		
1 – Operating distance calculated with 2.5 dB connection loss. For systems with fewer in-line connections, and/or higher bandwidth fiber, see Annex A.1 to determine operating distance.		
2 – Maximum average coupled power must conform to IEC requirements for Class 3a laser product and CDRH CFR 21 Ch. 1 (J) Part 1040.1 requirements for Class 1 laser product and shall not exceed -4 dBm for any fiber.		
3 – The nominal amplitude without ISI (see B.5).		
4 – Specified at 20% and 80% points		
5 – Transmitter or receiver contribution to channel-to-channel skew. Does not include contribution due to jitter and duty cycle distortion.		
6 – See B.3 for measurement techniques.		

Table 5 – 1300 nm optical parameters

Parameter	MM value ¹	SM value ¹	Units
Data link			
Channel count	12	12	
Nominal Baud rate (per channel)	1000	1000	MBaud
User data rate (per channel)	800	800	Mbit/s
Bit error ratio (per channel)	$\leq 10^{-12}$	$\leq 10^{-12}$	
Optical passive loss	2.5	2.5	dB
Optical system penalty	3.5	3.5	dB
Total link power budget (min.)	6	6	dB
Operating distance ²	300	1000	meters
Transmitter			
Wavelength (min.)	1260	1260	nm
Wavelength (max.)	1360	1360	nm
Spectral width (max.)	4	4	nm RMS
Launch power (min.) ³	-12	-12	dBm
Launch power (max.) ³	-8	-8	dBm
Optical modulation amplitude (min. per channel)	120	120	μ W
Relative intensity noise (max.)	-122	-122	dB/Hz
Optical rise/fall time (max.) ⁴	260	260	ps
Channel-to-channel skew (max.) ⁵	500	500	ps
Receiver			
Received optical modulation amplitude (min.)	0.030	0.030	mW
Stressed receiver optical modulation amplitude (min.) ⁶	0.05	n/a	mW
ISI penalty for stressed receiver test	0.5	n/a	dB
Average received power (max.)	-6	-6	dBm
Receiver return loss (min.)	12	12	dB
Electrical rise/fall time (max.) ⁴	400	400	ps
Channel-to-channel skew ⁵	500	500	ps
Optical path			
Fiber core diameter / mode field diameter	62.5	9.5	μ m
Modal bandwidth (min; overfilled launch)	500	10,000	MHz*km
Interchannel skew (max.) ⁷	5	5	ns
Connector	MPO	MPO	
<p>NOTES –</p> <p>1 – SM and MM modules are not interchangeable. See clause 8 for SM definition.</p> <p>2 – Operating distance calculated with 2 dB connection loss.</p> <p>3 – Max. average coupled power must conform to IEC requirements for Class 3a laser product and CDRH CFR 21 Ch. 1 (J) Part 1040.1 requirements for Class 1 laser product.</p> <p>4 – Specified at 20% and 80% points</p> <p>5 – Transmitter or receiver contribution to channel-to-channel skew. Does not include contribution due to jitter and duty cycle distortion.</p> <p>6 – The nominal amplitude without ISI (see B.5).</p> <p>7 – See B.3 for measurement techniques.</p>			

8 Optical fiber cable plant

The optical fiber for a link shall consist of 12 fibers in each direction. The fiber optic cable requirements are satisfied by the fibers specified in IEC 60793-2:1998-12, Category A1b (62.5/125 μm multimode) and Class B1 (single-mode). Note that connector fiber number 1 at one end connects to connector fiber number 12 at the other end.

8.1 Modal bandwidth

The modal bandwidth specified in tables 4 and 5 is the bandwidth of the fiber measured with an overfilled launch conditions. At 850 nm, with the restricted launch conditions typical of laser transmitters used in this application, the bandwidth of the fiber is typically significantly larger allowing greater distances. However the bandwidth for the overfilled launch condition is

used in this standard as a conservative assumption. At 1300 nm overfilled launch conditions are assumed for the laser launch into the fiber.

8.2 Cable plant loss budget

The loss budget shall be no more than specified in tables 4 and 5. The loss of the fiber plant shall be verified by the methods of OFSTP-14.

8.3 Optical return loss

The fiber plant optical return loss, with the receiver connected, shall be ≥ 12 dB. The receiver shall have a return loss \geq one glass-air interface. Connectors and splices shall each have a return loss ≥ 20 dB as measured by the methods of FOTP-107.

Table 7 – Optical media connector layout

Transmit side		Channel number	Receive side	
HIPPI-6400 signal name	Fiber number		Fiber number	HIPPI-6400 signal name
CLOCK_Out	1	1	12	CLOCK_In
D00_Out	2	2	11	D00_In
D01_Out	3	3	10	D01_In
D02_Out	4	4	9	D02_In
D03_Out	5	5	8	D03_In
D04_Out	6	6	7	D04_In
D05_Out	7	7	6	D05_In
D06_Out	8	8	5	D06_In
D07_Out	9	9	4	D07_In
C0_Out	10	10	3	C0_In
C1_Out	11	11	2	C1_In
FRAME_Out	12	12	1	FRAME_In

For a perfectly aligned system without setup and hold times:

$$DJ_{\text{CLOCK_total}} + DJ_{\text{data_total}} + \sqrt{RJ_{\text{CLOCK_total}}^2 + RJ_{\text{data_total}}^2} \leq 1 \text{ UI or } 1 \text{ ns}$$

where the CLOCK and data deterministic jitter (DJ) and random jitter (RJ) are:

$$DJ_{\text{CLOCK_total}} = \text{MAC CLOCK source jitter } DJ_{\text{clk}} + \text{CLOCK optics jitter } DJ_{\text{opc}}$$

$$DJ_{\text{data_total}} = \text{MAC data source jitter } DJ_{\text{dat}} + \text{data optics jitter } DJ_{\text{opd}}$$

$$RJ_{\text{CLOCK_total}} = \sqrt{(\text{MAC CLOCK source jitter } RJ_{\text{clk}})^2 + (\text{CLOCK optics jitter } RJ_{\text{opc}})^2}$$

$$RJ_{\text{data_total}} = \sqrt{(\text{MAC data source jitter } RJ_{\text{dat}})^2 + (\text{data optics jitter } RJ_{\text{opd}})^2}$$

Here, the HIPPI-6400 MAC CLOCK and source channel jitter is measured at the β_T reference point. The CLOCK line and data line optics jitter, DJ_{opc} , RJ_{opc} , DJ_{opd} and RJ_{opd} , is the total jitter contributed by the optics link (β_T to β_R points).

In addition, to properly align the skewed signals, a delay line tap placement accuracy (τ_{tap} for CLOCK placement accuracy plus τ_{tap} for data placement accuracy) must be added to the setup and hold time $\tau_{\text{s\&h}}$ and to the ping edge shift τ_{pes} . Our equation is thus:

$$DJ_{\text{clk}} + DJ_{\text{opc}} + DJ_{\text{dat}} + DJ_{\text{opd}} + 2\tau_{\text{tap}} + \tau_{\text{s\&h}} + DJ_{\text{pes}} + \sqrt{RJ_{\text{clk}}^2 + RJ_{\text{opc}}^2 + RJ_{\text{dat}}^2 + RJ_{\text{opd}}^2 + RJ_{\text{pes}}^2} \leq 1 \text{ ns}$$

Table B.1 is an example for a specific 850 nm link.

B.5 Stressed receiver test

The stressed receiver test procedure is described in clause 38.6.11 of ISO/IEC 8802-3:1998, Part 3: Carrier sense multiple access with collision detection (CSMA/CD) access method and physical layer specifications. The stressed receiver specifications in tables 4 and 5 (on pages 10 and 11) are without intersymbol interference (ISI) and correspond to the nominal amplitude without ISI (A_N) in figure 38-4 of ISO/IEC 8802-3:1998.