HFBR-5701/5710/5730L / LP

Small Form Factor Pluggable (SFP) Optical Transceivers for Gigabit Ethernet (1.25 GBd) and Fibre Channel (1.063 GBd) Services

Reliability Data Sheet

Description

The VCSEL based Small Form Factor Pluggable (SFP) Optical Transceivers from Avago Technologies are designed for use in multimode fiber optic (1000BASE-SX) links between Gigabit Ethernet networking equipment and Fibre Channel applications.

It is interoperable with all equipment meeting GBE, FC, and SFP MSA specifications. It uses an 850 nm VCSEL source.

Demonstrated Performance

The following demonstrated data represents information based upon the High Temperature Operating Life tests to date on Avago Technologies SFP transceivers.

Predicted Reliability Performance

The reliability prediction model used is based upon the exponential failure distribution coupled with the Arrhenius temperature derating equation (assuming constant failure rate in time and no failure mechanism change between stress and use conditions). The high temperature results allow acceleration factors to be used to predict performance at other use conditions but the amount of temperature acceleration is constrained by the product device ratings.

For confidence intervals, the chi-squared prediction method is used.

The acceleration factors used in this data sheet are derived from the Arrhenius equation with an activation energy of 0.43 electron volts which is used in MIL-HDBK- 217 for this type of product (hybrid packaging). Activation energies of 0.6 - 1.2 eV are typically observed in the main components, making the predictions quite conservative.

Table 1. Demonstrated Performance

Test Name	Stress Test Conditions	Total Units Tested	Total Device Hours	No. of Failed Units (Note 2)
High Temperature Operating Life	V_{CC} = 3.47 Vdc T_A = +85 °C (Note 1)	139	204,000	0

Notes:
1. Both the Transmitter and Receiver of each transceiver were connected by a loopback cable in this test and operated in a self-oscillation mode.
2. Product failure has occurred when the unit fails to respond properly to a dc/ac functional test condition. The functional test condition shall not exceed the absolute maximum data sheet limits for the product.

Point MTTF is the total device hours divided by the number of failures. If no failures have occurred, one failure is assumed and would represent a conservative estimate. The confidence intervals (60% or 90%) are based on the statistics of the assumed distribution of failures. It takes into account the fact that the "point" data have a predictable uncertainty that can be bounded with a quantified confidence interval.

For the exponential failure distribution model assumed here, the lower bound is given by device hours divided by [chi-square/2], evaluated with parameter "alpha" given by [1- (confidence level % /100)] and parameter "degree of freedom" given by [2 (number of failures +1)]. Note that this expression, unlike the point estimate, is not indeterminate for 0 failures. Instead, the 60% and 90% confidence level lower bound equals device hours divided by 0.92 and 2.3, respectively. Failure-in-Time rate, or FIT, is defined as the number of failures per billion device hours and is calculated by 1/ MTTF.

Table 2.

Case Temp (°C)	Point Typical Performance MTBF (yrs)	Point Typical Performance FITS	60% Confidence MTBF (yrs)	90% Confidence MTBF (yrs)	60% Confidence FITS	90% Confidence FITS
85	34.0	3,357.55	37.1	14.8	3,077.19	7,730.76
80	41.4	2,756.49	45.2	18.0	2,526.33	6,346.83
75	50.7	2,250.24	55.4	22.0	2,062.35	5,181.19
70	62.5	1,826.14	68.2	27.1	1,673.65	4,204.68
65	77.5	1,472.83	84.6	33.7	1,349.85	3,391.20
60	96.7	1,180.24	105.5	42.0	1,081.69	2,717.50
55	121.5	939.41	132.6	52.8	860.97	2,162.98
50	153.8	742.45	167.8	66.8	680.46	1,709.49
45	196.0	582.46	213.8	85.1	533.83	1,341.13
40	251.8	453.42	274.7	109.3	415.56	1,044.01
35	326.1	350.11	355.8	141.6	320.88	806.13
30	425.9	268.04	464.7	185.0	245.66	617.17
25	561.3	203.38	612.4	243.8	186.40	468.28

Table 3. Mechanical and Environmental Tests

Test	Conditions	Duration	Sample Size	Failure
Temperature Cycle	-40 °C to +100 °C, 15 min dwell, 5 min transfer	2000 cycles	66	0
85/85 Biased	T_A = +85 °C, 85% RH, V_{CC} = +3.47 V (See Note 1)	1000 hours 2000 hours	33 50	0 0
Power/Humidity/ Temperature Cycle (Moisture Resistance)	MIL-STD-883, Method 1004.7 -10 °C/+65 °C, 95% RH, Power on/off 30/30 min, V_{CC} = +3.47 V (See Note 1)	20 cycles/500 hours 40 cycles/1000 hours	17 10	0 0
High Temperature Storage	T_A = +100 °C	1000 hours 2000 hours	5 11 (Note 3)	0 0
Low Temperature Operating Life	TA = -40 °C VCC = +3.47 V (See Note 1)	1000 hours 2000 hours	5 11 (Note 3)	0 0
Thermal Shock	-40 °C/+100 °C 20 min/10 sec air/air	1000 cycles	44	0
Mechanical Shock	MIL-STD-883, Method 2002B 1500 g	5 shocks/axis	5 15 (Note 3)	0 0
Mechnical Vibration	MIL-STD-883, Method 2007A 20-2000 Hz, 20 g	4 minutes per cycle, 4 cycles per axis	5 15 (Note 3)	0 0
Mate/Demate I	TA = +25 °C 50/100/150 mate/demate performed on each cage	Electrical and optical measurements on all transceivers after 50, 100 and 150 connections	8 (unextended delatch) 5 (bail wire delatch)	0 0
Mate/Demate II	Mate/demate performed on each cage after each environmental condition, total of 50 times minimum	Electrical and optical measurements on all transceivers.		
	Temp Cycling, 1000 cycles, -40 °C to +100 °C 15 min dwell 5 min transfer		5	0
	Bias 85/85, 1000 hours T_A = +85 °C, 85% RH, V_{CC} = +3.47 V (See Note 1)		5	0
	High Temp Storage, 1000 hours T_A = +100 °C		5	0
	Low Temp Storage, 1000 hours T_A = -40 °C V_{CC} = +3.47 V (See Note 1)		5 (Note 3)	0
HALT	Stepwise temperature stress (-60 °C to +100 °C) and voltage margin (3.3 V ± 10%)		12	0
	Random Vibration (25 Grms) 150 hours, V_{CC} = +3.47 V (See Note 1)		6 (Note 3)	0

Table 3. Mechanical and Environmental Tests (continued)

Test	Conditions	Duration	Sample Size	Failure
Insertion Test	T_A = +25 °C 500 connections performed on each transceiver paired with one each connectored cable	Electrical and optical measurements on all transceivers at 250 and 500 connections	10 transceivers paired with 10 connectored cables (Note 3)	0

Notes:

1. Both the Transmitter and Receiver of each transceiver were connected by a loopback cable in this test and operated in a self oscillation mode.
3. The HFBR-5720xxx is a similar product that shares a common circuit design concept, mechanical assembly and manufacturing site with the SFP products that are covered in this data sheet.

Table 4. Electrostatic Discharge Information

Test	Conditions	Duration	Sample Size	Failure
ESD1	JEDEC / EIA JESD22-A114-A C=100 pF, R = 1,500 Ω (Human Body Model)	2,000 V (Class 2) 3,000 V (Class 2)	18 9 (Note 3) 18 9 (Note 3)	0 0 0 0
ESD2 (in-field)	Variation of IEC 61000-4-2, Air-to-Air Discharge Test (Simulation of discharges from human body to D.U.T.)	15 kV 10 single discharges applied repeatedly about the top, bottom, sides and front of nose. Repeated test with discharges applied to the top of entire module.	9 3 (Note 3)	0 0
ESD3	Variation of IEC 61000-4-2, Contact Discharge Test (Simulation of discharges from human body to D.U.T.)	8 kV 10 single contact discharges applied repeatedly about the top and front of nose.	6 3 (Note 3)	0 0
ESD4 (live traffic test-1)	Variation of GR-1089-CORE (Simulation of discharges from human body to D.U.T.) 3.3V Biased	2/4/8/15 kV 10 single air-to-air discharges applied repeatedly about the top and front of nose.	6 each 3 each (Note 3)	0 0
ESD5 (live traffic test-2)	Variation of GR-1089-CORE (Simulation of discharges from human body to D.U.T.) 3.3V Biased	2/4/6/8 kV 10 single contact discharges applied repeatedly about the top and front of nose.	8 each 4 each (Note 3)	0 0
ESD6	JEDEC / EIA JESD22-C101 (CDM)	1,000 V 1,500 V	6 6 (Note 3) 6 6 (Note 3)	0 0 0 0

For product information and a complete list of distributors, please go to our web site: **www.avagotech.com**

Avago, Avago Technologies, and the A logo are trademarks of Avago Technologies, Limited in the United States and other countries.
Data subject to change. Copyright © 2007 Avago Technologies Limited. All rights reserved.
5988-9559EN - February 22, 2007

AVAGO
TECHNOLOGIES