Agilent HFBR-0501 Series Versatile Link Plastic Fiber Optic Transmitter and Receiver

Reliability Data Sheet

Transmitters:
HFBR-1521, 1522, 1524, 1531, 1532

Receivers:
HFBR-2521, 2522, 2524, 2531, 2532

Introduction

Agilent Technologies' quality system includes an ongoing reliability monitor program to generate a data base from which this reliability data sheet is published.

Transmitter Reliability

The HFBR- 15xx transmitters incorporate a GaAsP LED emitter and an optical lens system. The molded plastic lens of the package increases the power transmitted to the fiber.

High Temperature Operating Life (HTOL) is used to characterize transmitter reliability in severe applications over time. The stress conditions in Agilent's reliability testing are accelerated using a 150 mA peak forward current at 1 kHz square wave with 50% duty factor at 85°C.

Reliability performance observed on HFBR-1521 applies to the other HFBR-15xx part numbers listed above by physical similarity.

Temperature cycling is also performed in reliability monitor testing. Table 5 shows available results on other reliability tests. The data in Table 5 not included in Agilent's ongoing reliability monitor testing plan was taken from device or process qualification.

Reliability Prediction Model

The reliability prediction model used to project failure rate and mean time to failure (MTTF) at various temperatures shown in the second table assumes an exponential cumulative failure function (constant failure rate).

The Arrhenius temperature de-rating equation is used. Agilent assumes no failure mechanism change between stress and use conditions. A conservative activation energy of 0.43 eV was used and is derived from MIL-HDBK-217 for hybrid devices. Confidence intervals are based upon the chi-squared prediction method associated with exponential distributions.

Versatile Link Transmitter

HFBR-1521, 1522, 1524, 1531, 1532
High Temperature Operating Life Test

A. Demonstrated Performance

Test	Equivalent Test Condition	Samples	Device Hours	Failures
High Temperature Operating Life	T_A = 85°C, I_f = 150 mA, 50% Duty Cycle, 1 kHz	HFBR-1521 480 units	480,000	0

B. Failure Criteria

Failure has occurred when the unit fails catastrophically, or when the light output power decreases 3 dB.

C. Failure Rate Prediction for Random Failures (I_F @ 150 mA, 50% duty cycle)

		Point Typical [1]		90% Confident [2]	
Ambient Temperature (°C)	Junction Temperature (°C)	MTTF [1] (hours)	FITs [3] (/ 10^9 hours)	MTTF [2] (hours)	FITs [3] (/ 10^9 hours)
85	100	480,000	2,100	208,000	4,800
75	90	716,000	1,400	311,000	3,200
65	80	1,090,000	910	473,000	2,100
55	70	1,710,000	580	742,000	1,300
45	60	2,760,000	360	1,200,000	840
35	50	4,600,000	220	2,000,000	500
25	40	7,910,000	130	3,430,000	290

Notes:

1. The *point* MTTF (representing an estimate of the mean point MTTF) is the total device hours divided by either the number of failures or unity if there are no failures.
2. *90% confident* MTTF and failure rate represent the minimum level of reliability performance that is expected from 90% of all samples. This confidence interval is based on the statistics of the distribution of failures. The assumed distribution of failures is exponential. This particular distribution is commonly used in describing failure rates prior to the onset of wear out. Refer to MIL-STD-690 for details of this methodology.
3. 1 FIT = 1 failure per 10^9 device hours.

High Speed Versatile Link Receiver

HFBR-2521, 2522, 2524, 2531, 2532
High Temperature Operating Life Test

A. Demonstrated Performance

Test	Equivalent Test Condition	Samples	Device Hours	Failures
High Temperature Operating Life	T_A = 85°C, V_{CC} = 5.5 V	HFBR-2521 520 units	520,000	0

B. Failure Criteria

Failure has occurred when the unit fails catastrophically.

C. Failure Rate Prediction, Receiver (V_{CC} = 5.5 V)

		Point Typical [1]		90% Confident [2]	
Ambient Temperature (°C)	Junction Temperature (°C)	MTTF [1] (hours)	FITs [3] (/ 10^9 hours)	MTTF [2] (hours)	FITs [3] (/ 10^9 hours)
85	95	520,000	1,900	226,000	4,400
75	85	776,000	1,300	337,000	3,000
65	75	1,180,000	840	512,000	2,000
55	65	1,860,000	540	807,000	1,200
45	55	2,990,000	330	1,300,000	770
35	45	4,980,000	200	2,160,000	460
25	35	8,570,000	120	3,720,000	270

Notes:

1. The *point* MTTF (representing an estimate of the mean point MTTF) is the total device hours divided by either the number of failures or unity if there are no failures.
2. *90% confident* MTTF and failure rate represent the minimum level of reliability performance that is expected from 90% of all samples. This confidence interval is based on the statistics of the distribution of failures. The assumed distribution of failures is exponential. This particular distribution is commonly used in describing useful life failures. Refer to MIL-STD-690 for details of this methodology.
3. 1 FIT = 1 failure per 10^9 device hours.

HFBR-0501 Environmental Test Data

Test	MIL-STD-883 Reference	Test Conditions	Units Tested	Units Failed
Temperature Cycle	1010	200 cycles from -40 to +100°C, 15 minutes at extremes, 5 min. transfer. [1]	1080 HFBR-1521	0
		200 cycles from -40 to +85°C, 15 minutes at extremes, 5 min. transfer. [1]	1120 HFBR-2521	0
85/85		T_A = 85°C, 85% relative humidity, No bias, duration = 1,000 hours. [1]	200 HFBR-1521	0
		T_A = 85°C, 85% relative humidity, V_{CC} = 5 volts, duration = 1,000 hours [1]	200 HFBR-2521	0
Wave Soldering		3 cycles and washes.[2]	80 HFBR-1521	0
		3 cycles and washes.[2]	80 HFBR-2521	0
Manual Soldering		260°C, 10 seconds	30 HFBR-1521	0
			30 HFBR-2521	0
Gross Leak	1014, Cond. D	3 hours soak in UV fluorescent dye at 90 psi.	20	0
Resistance to Solvents	2015	Brush after solvent immersion.	30	0
Vibration Variable Frequency	2007, Condition B	20 G min., 20 to 2000 Hz. 4, 4 minute cycles each X, Y, Z.	20	0
Terminal Strength	2004	1 lb. tension, 8 oz. bending stress.	24	0
Mechanical Shock	2002, Condition B	5 blows each X1, X2, Y1, Y2, Z1, Z1 1500 G, 0.5 msec. pulse.	20	0
ESD	Method 3015	Human body model @ 8000 V	3 HFBR-1521	0
		Human body model @ 2000V	3 HFBR-2521	0

Notes:
1. Devices were preconditioned with 10 second, 260°C solder dip and 20 cycles, -40°C to 85°C, temperature cycle.
2. Agilent procedure: 3 second flux cycle, 2 minute preheat at 95°C, 5 second wave solder at 255-265°C, 7 minute cleaning at 60-70°C.

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