HEDR-54xx Series
Mid-sized Housed Encoder

Reliability Data Sheet

Description
The following cumulative test results have been obtained from testing performed at Avago Technologies in accordance with the latest revisions of MIL-STD-883 and JIS-C 7021.

Avago Technologies tests parts at the absolute maximum rated conditions recommended for the device. The actual performance you obtain from Avago Technologies' parts depends on the electrical and environmental characteristics of your application but will probably be better than the performance outlined in Table 1.

Failure Rate Prediction
The failure rate of semiconductor devices is determined by the junction temperature of the device. The relationship between ambient temperature and actual junction temperature is given by the following:

T_J (°C) = T_A (°C) + θ_{JA} P_{AVG}

where
T_A = ambient temperature in °C

θ_{JA} = thermal resistance of junction-to-ambient in °C/watt

P_{AVG} = average power dissipated in watts

The estimated MTBF and failure rate at temperatures lower than the actual stress temperature can be determined by using an Arrhenius model for temperature acceleration. Results of such calculations are shown in the table on the following page using an activation energy of 0.43 eV (reference MIL-HDBK-217).

Table 1. Life Tests
Demonstrated Performance

					Point Typical Performance	
Test Name	**Stress Test Conditions**	**Total Device Hrs.**	**Units Tested**	**Units Failed**	**MTBF**	**Failure Rate (% /1K Hours)**
High Temperature Operating Life	T_A = +85°C V_{CC} = 5.0 V I_{LED} = 15 mA	450,000	450	0	> 450,000	< 0.22
High Temperature Storage Life [1]	T_A = 100°C Static State	23,000	23	0	> 23,000	< 4.35
Low Temperature Storage Life [2]	T_A = - 40°C Static State	21,000	21	0	> 21,000	< 4.76

MTBF = Mean Time Between Failures
T_A = Ambient Temperature
V_{CC} = Voltage Supply
I_{LED} = LED Current

Table 2. Reliability Predictions

Ambient Temperature (°C)	Junction Temperature (°C)	Point Typical Performance in Time [3] (60% Confidence) MTBF	Point Typical Performance in Time [3] (60% Confidence) Failure Rate (%/1K Hours)	Performance in Time [4] (90% Confidence) MTBF	Performance in Time [4] (90% Confidence) Failure Rate (%/1K Hours)
85	94	450,000	0.222	195,000	0.512
75	84	659,000	0.152	286,000	0.350
65	74	985,000	0.101	428,000	0.234
55	64	1,510,000	0.066	656,000	0.153
45	54	2,374,000	0.042	1,031,000	0.097
35	44	3,842,000	0.026	1,669,000	0.060
25	34	6,415,000	0.016	2,786,000	0.036
15	24	11,089,000	0.009	4,816,000	0.012
5	14	19,912,000	0.005	8,648,000	0.012

Notes:
1. Performed in accordance with JIS-C 7021-B-10.
2. Performed in accordance with JIS-C 7021-B-12.
3. The point typical MTBF (which represents a 60% confidence level) is simply the total device hours divided by the number of failures. In the case of zero failures, one failure is assumed for this calculation.
4. The confidence MTBF represents the minimum level of reliability performance which 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 on this methodology.

Example of Failure Rate Calculation

Assume a device operating 8 hours/day, 5 days/week. The utilization factor, given 168 hours/week is:

(8 hours/day) x (5 days/week) / (168 hours/week) = 0.25

The point failure rate per year (8760 hours) at 55°C ambient temperature is:

(0.066% / 1K hours) x (0.25) x (8760 hours/year) = 0.145 % per year

Similarly, 90% confidence level failure rate per year at 55°C:

(0.153% / 1K hours) x (0.25) x (8760 hours/year) = 0.335 % per year

Table 3. Environmental Tests

Test Name	MIL-STD-883C Reference	JIS-C 7021 Reference	Test Conditions	Units Tested	Units Failed
Temperature Cycle	1010	A-4	- 40°C to +85°C, 30 min. dwell, 5 min. transfer, 1000 cycles.	77	0
Wet High Temperature Storage Life			B-11 T_A = 85°C RH = 85% 1,000 hours, non-operating		77
			24 hrs		0
			168 hrs		0
			336 hrs		0
			500 hrs		0
			1000 hrs		0

Table 4. Electrical Tests

Test Name	MIL-STD-883C Reference	JIS-C 7021 Reference	Test Conditions	Units Tested	Units Failed
ESD Air Discharge Mode	CE-IEC-61000-4-2		330 Ω, 150 pF, Single discharge (positive and negative voltage) up to 15 KV applied to all pins versus ground.		
			2 KV	5	0
			6 KV	5	5
			10 KV	5	5
			13 KV	5	5
			15 KV	5	5
ESD Contact Discharge Mode	CE-IEC-61000-4-2		330 Ω, 150 pF, Single discharge (positive and negative voltage) up to 8 KV applied to all pins versus ground.		
			1 KV	5	0
			3 KV	5	5
			5 KV	5	5
			7 KV	5	5
			8 KV	5	5

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