

**HLMP-CE13, HLMP-CE14, HLMP-CE22,
HLMP-CE25, HLMP-CE34, HLMP-CE35**
T-1 3/4 (5mm) Extra Bright Cyan LEDs



Reliability Data Sheet

Description

The following cumulative test results have been obtained from testing performed at Avago Technologies in accordance with the latest revision of MIL-STD-883 and JEDEC.

Avago tests parts at the absolute maximum rated conditions recommended for the device. The actual performance you obtain from Avago 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 junction temperature of the device determines the failure rate of semiconductor devices. The relationship between ambient temperature and actual junction temperature is given by the following:

$$T_J (\text{°C}) = T_A (\text{°C}) + \theta_{JA} P_{AVG}$$

where

T_A = ambient temperature in °C

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

P_{AVG} = average power dissipated in Watt

The estimated MTTF 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 below using activation energy of 0.43eV (reference MIL-HDBK-217).

**Table 1. Life Tests
Demonstrated Performance**

Colors	Stress Test Conditions	Total Device Hours	Units Tested	Total Failed	Point Typical Performance	
					MTTF (60% Confidence)	Failure Rate (% /1K Hours)
Cyan	$T_A = 55^{\circ}\text{C}$, $I_F = 23 \text{ mA}$	168,000	168	0	215,100	0.46

Table 2. Reliability Prediction

Ambient Temperature (°C)	Junction Temperature (°C)	Point Typical Performance in Time ^[1 - 5] (60% Confidence)		Performance in Time ^[1 - 5] (90% Confidence)	
		MTTF	Failure Rate (%/1K Hours)	MTTF	Failure Rate (%/1K Hours)
85	99	198700	0.50	79100	1.26
80	99	201400	0.50	80100	1.25
75	98	204000	0.49	81200	1.23
70	98	206700	0.48	82300	1.22
65	98	209500	0.48	83400	1.20
60	97	212200	0.47	84500	1.18
55	97	215100	0.46	85600	1.17
50	97	217900	0.46	86800	1.15
45	96	220900	0.45	87900	1.14
40	96	223800	0.45	89100	1.12
35	95	226800	0.44	90300	1.11
30	90	273300	0.37	108800	0.92
25	85	330900	0.30	131700	0.76
20	80	403000	0.25	160400	0.62
15	75	493400	0.20	196400	0.51
10	70	607800	0.16	241900	0.41

Notes:

1. The 60% or 90% confidence MTTF represents the minimum level of reliability performance which is expected from 60% or 90% of all samples. The confidence level is established based on the chi-square distribution.
2. Failure rate (FIT) is $1/\text{MTTF} \times 10^5$, assuming the failures are exponentially distributed
3. A failure is any LED that is open, shorted or fails to emit light.
4. Calculated from data generated at 55°C biased at 23mA.
5. Junction temperature is calculated based on $\theta_{JA} = 630^\circ\text{C/W}$

Example of Failure Rate Calculation

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

$$(8 \text{ hours/day}) \times (5 \text{ days/week}) / (168 \text{ hours/week}) = 0.24$$

The point failure rate per year (8760 hours) at 25°C ambient temperature is (60% confidence level) :

$$(0.30\% / 1\text{K hours}) \times 0.24 \times (8760 \text{ hours/year}) = 0.63 \% \text{ per year}$$

Similarly, 90% confidence level failure rate per year at 25°C:

$$(0.76\% / 1\text{K hours}) \times 0.24 \times (8760 \text{ hours/year}) = 1.59 \% \text{ per year}$$

Table 3. Environmental Tests

Test Name	Reference	Test Conditions	Units Tested	Units Failed
Temperature Cycle	Avago Req.	-40/85°C 15 min dwell, 5 min transfer, 100 cycles	3744	0
Resistance to Soldering Heat	JESD 22-B106	260°C for 5 seconds	30	0
Temperature Humidity Operating Life	Avago Req.	T _A = 85°C, 85%RH, for 1000 hours	168	0
High Temperature Operating Life	JESD22-A108	T _A = 55°C, I _F = 23 mA for 1000 hours	168	0
Low Temperature Operating Life	JESD22-A108	T _A = -40°C, I _F = 30 mA for 1000 hours	84	0
Pulse Test	Avago Req.	T _A = 55°C, Duty factor = 10%, 100 mA, Frequency = 1kHz, 1000 hours	168	0

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