

HSMW-C360

Low Profile 0.6mm InGaN White Surface Mount
Right Angle LED Indicator



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 JESD (Jedec Standard). 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 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:

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

Where

T_A = ambient temperature in ($^{\circ}\text{C}$)

θ_{JA} = thermal resistance of junction-to ambient in $^{\circ}\text{C}/\text{watt}$

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 0.43eV (reference MIL-HDBK-217)

Table 1. Life Tests

Demonstrated Performance

Colors	Stress Test Conditions	Total Device Hrs	Units Tested	Units Failed	Point Typical Performance	
					MTBF	Failure Rate(%/1K Hrs)
InGaN White	Ta=55 C, If=18mA	112,000	112	0	112,000	0.89
	Ta=55 C, If=18mA	112,000	112	0	112,000	0.89
	Ta=55 C, If=18mA	112,000	112	0	112,000	0.89
	Ta=55 C, If=18mA	112,000	112	0	112,000	0.89

Table 2. Reliability Prediction

Ambient Temperature (°C)	Junction Temperature (°C)	Performance in Time (60% Confidence)		Performance in Time (90% Confidence)	
		MTBF	Failure Rate (%/1K Hours)	MTBF	Failure Rate (%/1K Hours)
85	92	76,000	1.32	30,200	3.31
80	90	82,400	1.21	32,800	3.05
75	88	89,500	1.12	35,600	2.81
70	85	97,200	1.03	38,700	2.58
65	83	105,800	0.95	42,100	2.38
60	81	115,200	0.87	45,900	2.18
55	79	125,600	0.80	50,000	2.00
50	77	137,100	0.73	54,600	1.83
45	75	149,800	0.67	59,600	1.68
40	72	163,800	0.61	65,200	1.53
35	70	179,400	0.56	71,400	1.40
30	68	196,600	0.51	78,300	1.28
25	66	215,800	0.46	85,900	1.16
20	61	269,000	0.37	107,100	0.93
15	56	337,600	0.30	134,400	0.74
10	51	426,700	0.23	169,900	0.59

Notes:

1. The point typical MTBF(which represents 60% confidence level) is the total device hours divided by the number of failures. In the case of zero failure, one failure is assumed for this calculation.
2. The 90% 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 is exponential. This particular distribution is commonly used in describing useful life failures. Refer to MIL-STD-690B for details on this methodology.
3. A failures is any LED which is open, shorted, or failed to emit light.

Example of Failure Rate Calculation

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

$$(8\text{hours/day}) \times (5 \text{ days/week}) / (168 \text{ hours/week}) = 0.25$$

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

$$(0.80\% / 1\text{K hours}) \times 0.25 \times (8760 \text{ hours/year}) = 1.752\% \text{ per year}$$

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

$$(2.00\% / 1\text{K hours}) \times 0.25 \times (8760 \text{ hours/year}) = 4.38\% \text{ per year.}$$

Table 3. Environmental Tests

Test	Reference	Test Conditions	Units Tested	Unit Failed
Temperature Cycle	JESD22-A103	-40/85°C 15 min dwell 5min transfer, 1000 cycles	112	0
Temperature Shock	Avago Requirement	-40/110°C 20min dwell, <0sec transfer, 200cycles	112	0
Resistance to Soldering Heat	JESD22-B106	260°C for 10seconds	44	0
High Temperature Storage	JESD22-A103	85°C for 1000hours	112	0
High Humidity High Temperature Storage	JESD22-A101	60 °C /90%RH , 1000hours	112	0
Mechanical Shock	JESD22-B104	5 shocks pulses of 1500g for 0.5ms in each of the orientation (X1, X2, Y1, Y2, Z1 and Z2)	60	0
ESD Characterization Human Body Model	JESD22-A114	Class 1A	10	0

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