Agilent Technologies
Innovating the HP Way

Seven Segment Displays—
Ultra mini, 0.3 mini, 0.3 inch

Reliability Data

HDSP-Uxxx,
HDSP-Axxx, HDSP-3xxx,
HDSP-4xxx, HDSP-7xxx

Description

The following cumulative test results have been obtained from testing performed at Agilent Optoelectronics Division in accordance with the latest revision of MIL- STD-883.

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

Table 1. Life Tests
Demonstrated Performance

Colors	Stress Test Conditions	Total Device Hours	Units Tested	Total Failed	Point Typical Performance	
					MTBF	Failure Rate (%/1 K Hours)
Yellow	T_A = 55°C, I_F = 20 mA	10,500	21	0	10,500	≤ 0.95 %
STD Red	T_A = 55°C, I_F = 25 mA	147,000	21	0	147,000	≤ 0.68 %
Green	T_A = 55°C, I_F = 30 mA	399,000	63	0	399,000	≤ 0.25 %
HER	T_A = 55°C, I_F = 30 mA	399,000	63	0	399,000	≤ 0.25 %

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:

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

where T_A = ambient temperature in °C

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

P_{AVG} = average power dissipated in 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 below using an activation energy of 0.43 eV (reference MIL-HDBK-217).

Table 2.

I_F	Ambient Temp. (°C)	Junction Temp. (°C)	Point Typical Performance[1] in Time		Performance in Time[2] (90%Confidence)	
			MTBF [1]	Failure Rate (%/1K Hours)	MTBF [2]	Failure Rate (%/1K Hours)
30	85	115	357,000	0.280%	92,000	1.089%
	75	105	502,000	0.199%	129,000	0.775%
	65	95	718,000	0.139%	185,000	0.542%
	55	85	1,049,000	0.095%	270,000	0.371%
	45	75	1,566,000	0.064%	403,000	0.248%
	35	65	2,393,000	0.042%	615,000	0.163%
	25	55	3,753,000	0.027%	965,000	0.104%

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 failures, 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. The assumed 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 failure is any LED which does not emit light.

Example of Failure Rate Calculation:

Assume a device operating 8 hours/day, 5 days a 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 25°C ambient temperature is:

(0.027%/1K hours) x 0.25 x (8760 hours/year) = 0.059% per year

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

(0.104%/1K hours) x 0.25 x (8760 hours/year) = 0.228% per year

Table 3. Environmental Tests

Test Name	Reference	Test Conditions	Units Tested	Units Failed
Solder Heat Resistance	MIL-STD-883 Method 2003	260°C, 3 seconds	10	0
Temperature Cycle	MIL-STD-883 Method 1010	-55°C to 100°C, 15 min. dwell, 5 min. transfer, 20 cycles	1000	1
Humidity Storage	JIS C 7021 Method B-11	85°C, 85% RH, 168 Hours	103	0
Solderability	MIL-STD-883 Method 2003	16 Hours steam aging followed by solder dip at 260°C for 5 seconds	10	0
Salt Atmosphere	MIL-STD-883 Method 1009	35°C, 24 Hours	10	0

Table 4. Mechanical Tests

Test Name	Reference	Test Conditions	Units Tested	Units Failed
Terminal Strength	MIL-STD-883 Method 2004 Cond. A	1 lb. for 30 sec.	11	0
Lead Strength	MIL-STD-883 Method 2004 Cond. B	3 X 90 degree bend, 8 oz.	11	0
Vibration Variable Frequency	MIL-STD-883 Method 2007	2 Hours for each X, Y, Z axis at 20 Gs, 10 to 2k Hz; 20 min. sweep	22	0

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