

# 8 mm (0.31 inch) Ultra Mini Seven Segment Displays

## **Reliability Data**

HDSP-U0xx Series HDSP-U1xx Series HDSP-U2xx Series HDSP-U3xx Series HDSP-U4xx Series HDSP-U5xx Series

## Description

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

					Point Typical Performance	
Test Name	Stress Test Conditions	Total Device Hrs.	Units Tested	Total Failed	MTBF	Failure Rate (% /1K Hours)
Operating Life	$ \begin{array}{l} T_A = 55^\circ C \\ I_F = rated \\ current \end{array} $	45,000	45	0	>45,000	<2.2

#### **Failure Rate Prediction**

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

 $T_{J}(^{\circ}C) = T_{A}(^{\circ}C) + \theta_{JA} P_{AVG}$ 

#### where

 $T_A$  = ambient temperature in °C

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

P<sub>AVG</sub> = 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 Table 2 using an activation energy of 0.43 eV (reference MIL-HDBK-217).

#### **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  $55^{\circ}$ C ambient temperature is: (<2.22% / 1K hours) x 0.25 x

(8760 hours/year) = 4.86% per year

Similarly, 90% confidence level failure rate per year at 55°C ambient temperature is: (<5.11% / 1K hours) x 0.25 x (8760 hours/year) = 11.1% per year



		Point Typical Performance <sup>[1]</sup> in Time		Performance in Time [2] (90% Confidence)	
Ambient	Junction		Failure Rate		Failure Rate
Temperature (°C)	Temperature (°C)	<b>MTBF</b> [1]	(%/1K Hours)	MTBF [2]	(%/1K Hours)
55	75	>45,000	<2.22	>20,000	<5.11
45	65	>69,000	<1.45	>30,000	<3.34
35	55	>108,000	< 0.92	>47,000	<2.13
25	45	>174,000	<0.57	>76,000	<1.32

### **Table 2. Failure Rate Prediction** ( $I_F = 30 \text{ mA DC}$ )

Notes:

1. The point typical MTBF (which represents a 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.

## **Table 3. Environmental Tests**

Test Name	MIL-STD-883C Ref	Test Conditions	Units Tested	Units Failed
Temperature	1010	-30°C to 90°C, 15 min. dwell, 5 min.	132	0
Cycle		transfer, 100 cycles		
Solder Heat	2003	260°C, 3 seconds	500	0
Resistance				
Solderability	2003	230°C, 10 seconds	23	0
Resistance to	MIL-STD-750	TCA, 3 min. US bath, cotton	11	0
Solvents <sup>[4]</sup>	Method 1022	swab, rub 3x		

## **Table 4. Mechanical Tests**

Test Name	MIL-STD-883C Ref	Test Conditions	Units Tested	Units Failed
Vibration Variable	2007	2 hrs for each X, Y, Z axis at 20 Gs,	22	0
Frequency		10 - 2000 Hz; 20 min. sweep		
Terminal Strength	2004 Condition A	0.5 lb. for 30 sec.	11	0
Lead Fatigue	2004 Condition B	Bend 90°, 2x	11	0
Physical	2016	Check physical dimensions	23	0
Dimensions				

## **Table 5. Electrical Tests**

Test Name	MIL-STD-883C Ref	Test Conditions	Units Tested	Units Failed
ESD	3015.2	100 pF, 1.5 kΩ, ± 2000 volts	11	0
		200 pF, 0 $\Omega$ , ± 200 volts	11	0

Note:

4. This test is for marking only, not for device functionality.

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