

**ASMT-QWBE-Nxxxxx, ASMT-QYBE-Nxxxxx,  
ASMT-QBBE-Nxxxxx, ASMT-QGBE-Nxxxxx**  
Super 0.5W White/Blue/Green Power PLCC-4



## 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:

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

where

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

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

$P_{AVG}$  = 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 (%/1 K Hours) |
| Cool White (InGaN, QWBE)       | $T_A = 55^{\circ}\text{C}$ , $I_F = 150\text{ mA}$ | 112000             | 28           | 0            | 122200                    | 0.82                       |
| WarmWhite (InGaN, QYBE)        | $T_A = 55^{\circ}\text{C}$ , $I_F = 150\text{ mA}$ | 112000             | 28           | 0            | 122200                    | 0.82                       |
| Blue/Green (InGaN, QBGE, QGBE) | $T_A = 55^{\circ}\text{C}$ , $I_F = 150\text{ mA}$ | 28000              | 28           | 0            | 30600                     | 3.27                       |

**Table 2. (Cool White-QWBE)**

| Ambient Temperature (°C) | Junction Temperature (°C) | Point Typical Performance <sup>[1]</sup> in Time (60% Confidence) |                           | Point Typical Performance <sup>[2]</sup> in Time (90% Confidence) |                           |
|--------------------------|---------------------------|-------------------------------------------------------------------|---------------------------|-------------------------------------------------------------------|---------------------------|
|                          |                           | MTTF <sup>[1]</sup>                                               | Failure Rate (%/1K Hours) | MTTF <sup>[2]</sup>                                               | Failure Rate (%/1K Hours) |
| 110                      | 122                       | 95700                                                             | 1.04                      | 38100                                                             | 2.62                      |
| 105                      | 121                       | 97900                                                             | 1.02                      | 39000                                                             | 2.56                      |
| 100                      | 121                       | 100000                                                            | 1.00                      | 39800                                                             | 2.51                      |
| 95                       | 120                       | 102200                                                            | 0.98                      | 40700                                                             | 2.46                      |
| 90                       | 119                       | 104500                                                            | 0.96                      | 41600                                                             | 2.40                      |
| 85                       | 118                       | 106900                                                            | 0.94                      | 42500                                                             | 2.35                      |
| 80                       | 118                       | 109200                                                            | 0.92                      | 43500                                                             | 2.30                      |
| 75                       | 117                       | 111700                                                            | 0.90                      | 44500                                                             | 2.25                      |
| 70                       | 116                       | 114200                                                            | 0.88                      | 45500                                                             | 2.20                      |
| 65                       | 116                       | 116800                                                            | 0.86                      | 46500                                                             | 2.15                      |
| 60                       | 115                       | 119500                                                            | 0.84                      | 47600                                                             | 2.10                      |
| 55                       | 114                       | 122200                                                            | 0.82                      | 48600                                                             | 2.06                      |
| 50                       | 109                       | 144600                                                            | 0.69                      | 57600                                                             | 1.74                      |
| 45                       | 104                       | 171900                                                            | 0.58                      | 68400                                                             | 1.46                      |
| 40                       | 99                        | 205300                                                            | 0.49                      | 81700                                                             | 1.22                      |
| 35                       | 94                        | 246400                                                            | 0.41                      | 98100                                                             | 1.02                      |

**Table 3. (Warm White-QYBE)**

| Ambient Temperature (°C) | Junction Temperature (°C) | Point Typical Performance <sup>[1]</sup> in Time (60% Confidence) |                           | Point Typical Performance <sup>[2]</sup> in Time (90% Confidence) |                           |
|--------------------------|---------------------------|-------------------------------------------------------------------|---------------------------|-------------------------------------------------------------------|---------------------------|
|                          |                           | MTTF <sup>[1]</sup>                                               | Failure Rate (%/1K Hours) | MTTF <sup>[2]</sup>                                               | Failure Rate (%/1K Hours) |
| 110                      | 122                       | 95700                                                             | 1.04                      | 38100                                                             | 2.62                      |
| 105                      | 121                       | 97900                                                             | 1.02                      | 39000                                                             | 2.56                      |
| 100                      | 121                       | 100000                                                            | 1.00                      | 39800                                                             | 2.51                      |
| 95                       | 120                       | 102200                                                            | 0.98                      | 40700                                                             | 2.46                      |
| 90                       | 119                       | 104500                                                            | 0.96                      | 41600                                                             | 2.40                      |
| 85                       | 118                       | 106900                                                            | 0.94                      | 42500                                                             | 2.35                      |
| 80                       | 118                       | 109200                                                            | 0.92                      | 43500                                                             | 2.30                      |
| 75                       | 117                       | 111700                                                            | 0.90                      | 44500                                                             | 2.25                      |
| 70                       | 116                       | 114200                                                            | 0.88                      | 45500                                                             | 2.20                      |
| 65                       | 116                       | 116800                                                            | 0.86                      | 46500                                                             | 2.15                      |
| 60                       | 115                       | 119500                                                            | 0.84                      | 47600                                                             | 2.10                      |
| 55                       | 114                       | 122200                                                            | 0.82                      | 48600                                                             | 2.06                      |
| 50                       | 109                       | 144600                                                            | 0.69                      | 57600                                                             | 1.74                      |
| 45                       | 104                       | 171900                                                            | 0.58                      | 68400                                                             | 1.46                      |
| 40                       | 99                        | 205300                                                            | 0.49                      | 81700                                                             | 1.22                      |
| 35                       | 94                        | 246400                                                            | 0.41                      | 98100                                                             | 1.02                      |

**Table 4. (Blue/Green- QBGE/QGBE)**

| Ambient Temperature (°C) | Junction Temperature (°C) | Point Typical Performance <sup>[1]</sup> in Time (60% Confidence) |                           | Point Typical Performance <sup>[2]</sup> in Time (90% Confidence) |                           |
|--------------------------|---------------------------|-------------------------------------------------------------------|---------------------------|-------------------------------------------------------------------|---------------------------|
|                          |                           | MTTF <sup>[1]</sup>                                               | Failure Rate (%/1K Hours) | MTTF <sup>[2]</sup>                                               | Failure Rate (%/1K Hours) |
| 110                      | 122                       | 23900                                                             | 4.18                      | 9500                                                              | 10.53                     |
| 105                      | 121                       | 24500                                                             | 4.08                      | 9700                                                              | 10.31                     |
| 100                      | 121                       | 25000                                                             | 4.00                      | 10000                                                             | 10.00                     |
| 95                       | 120                       | 25600                                                             | 3.91                      | 10200                                                             | 9.80                      |
| 90                       | 119                       | 26100                                                             | 3.83                      | 10400                                                             | 9.62                      |
| 85                       | 118                       | 26700                                                             | 3.75                      | 10600                                                             | 9.43                      |
| 80                       | 118                       | 27300                                                             | 3.66                      | 10900                                                             | 9.17                      |
| 75                       | 117                       | 27900                                                             | 3.58                      | 11100                                                             | 9.01                      |
| 70                       | 116                       | 28600                                                             | 3.50                      | 11400                                                             | 8.77                      |
| 65                       | 116                       | 29200                                                             | 3.42                      | 11600                                                             | 8.62                      |
| 60                       | 115                       | 29900                                                             | 3.34                      | 11900                                                             | 8.40                      |
| 55                       | 114                       | 30600                                                             | 3.27                      | 12200                                                             | 8.20                      |
| 50                       | 109                       | 36200                                                             | 2.76                      | 14400                                                             | 6.94                      |
| 45                       | 104                       | 43000                                                             | 2.33                      | 17100                                                             | 5.85                      |
| 40                       | 99                        | 51300                                                             | 1.95                      | 20400                                                             | 4.90                      |
| 35                       | 94                        | 61600                                                             | 1.62                      | 24500                                                             | 4.08                      |

Notes:

1. The 60% or 90% confidence MTBF 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  $1/\text{MTBF} \times 10^5$ , 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 150mA with  $R_{\theta JA}=110^{\circ}\text{C/W}$

### 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 35°C ambient temperature is(60% confidence level) :

$$(0.82\% / 1\text{K hours}) \times 0.24 \times (8760 \text{ hours/year}) = 1.72\% \text{ per year}$$

Similarly, 90% confidence level failure rate per year at 35°C:

$$(2.06\% / 1\text{K hours}) \times 0.24 \times (8760 \text{ hours/year}) = 4.33\% \text{ per year}$$

**Table 5. Environmental Tests**

| Test Name                           | MIL-STD/JEDEC Reference | Test Conditions                                                                     | Units Tested | Units Failed |
|-------------------------------------|-------------------------|-------------------------------------------------------------------------------------|--------------|--------------|
| Temperature Cycle                   | JESDA104                | -40°C/110°C, 15 min dwell, 5 min transfer, 1000 cycles                              | 852          | 0            |
| Low Temperature Operating Life      | JESDA108                | Ta=-40°C, If= 150mA, 1000hrs                                                        | 56           | 0            |
| High Temperature Operating Life     | JESDA108                | Ta=110°C, If= 30mA, 1000hrs                                                         | 84           | 0            |
| Temperature Humidity Operating Life | JESDA101                | Ta= 85°C, RH = 85%RH, If= 90mA, 1000hrs                                             | 112          | 0            |
| Temperature Humidity Storage Life   | JESDA101                | Ta= 85°C, RH = 85%RH, 1000hrs                                                       | 168          | 0            |
| High Temperature Storage Life       | JESDA103                | Ta = 110°C, 1000hrs                                                                 | 56           | 0            |
| Low Temperature Storage Life        | JESDA108                | Ta = -40°C, 1000hrs                                                                 | 56           | 0            |
| Pulse Test                          | Avago Req               | Ta= 25°C, Ip= 300mA, Duty Cycle = 10%, 1000hrs                                      | 84           | 0            |
| Power Temperature Cycle             | Auto Req                | -40°C/85°C, 18 min dwell, 42 min transfer, 5 mins on/off, If= 90mA, 200 cycles      | 84           | 0            |
| Power Temperature Humidity Cycle    | Auto Req                | 25°C/65°C, 3hrs dwell, 6hrs transfer, RH = 95%, 5 mins on/off, If= 130mA, 30 cycles | 84           | 0            |

**Table 6. Mechanical Tests**

| Test Name        | MIL-STD/JEDEC Reference | Test Conditions                                                               | Units Tested | Units Failed |
|------------------|-------------------------|-------------------------------------------------------------------------------|--------------|--------------|
| Mechanical shock | JESDB104                | 5 shocks each X1, X2, Y1, Y2, Z1, Z2, 1500G, 0.5msec pulse                    | 30           | 0            |
| Vibration        | JESDB103                | 4 cycles, 4 mins each X, Y and Z at 0.06inch @ 20Hz-100Hz, 50g @ 100Hz-2000Hz | 30           | 0            |

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