

## Qualification and Reliability Report

 Series: EMK13

| Qualification Tests                                     |                                                                           |      |      |      |
|---------------------------------------------------------|---------------------------------------------------------------------------|------|------|------|
| Test                                                    | Method/Condition                                                          | Test | Pass | Fail |
| Aging                                                   | Biased, Nominal V <sub>DD</sub> , Temperature = 85°C, Duration = 30 days  | 120  | 120  | 0    |
| Autoclave                                               | JESD22-A102, 121°C, 100% RH, 15 PSIG, 96 hours                            | 240  | 240  | 0    |
| ESD Susceptibility                                      | MIL-STD-883 Method 3015, Class 2, HBM = 2,000V<br>JESD22-C101, CDM = 500V | 36   | 36   | 0    |
| Flammability                                            | UL94-V0                                                                   | 24   | 24   | 0    |
| High Temperature Operating Life                         | MIL-STD-883 Method 1005, Condition B, Biased, 125°C, 1,000 hours          | 240  | 240  | 0    |
| High Temperature Storage                                | MIL-STD-883 Method 1008, 150°C, 1,000 hours                               | 240  | 240  | 0    |
| Highly Accelerated Temperature and Humidity Stress Test | JESD22-A110, Biased, 130°C, 85% RH, 96 hours                              | 240  | 240  | 0    |
| Latchup                                                 | JESD17, 200mA @ 25°C                                                      | 24   | 24   | 0    |
| Mechanical Dimensions                                   | Per Datasheet                                                             | 48   | 48   | 0    |
| Mechanical Shock                                        | MIL-STD-883 Method 2002 Condition G, 30,000G's, 0.12msec, ½ sine          | 120  | 120  | 0    |
| Moisture Sensitivity Level                              | JESD22-A113, MSL = 1, 260°C                                               | 180  | 180  | 0    |
| Resistance to Soldering Heat                            | MIL-STD-202, Method 210, Condition K, 250°C, 30 seconds                   | 120  | 120  | 0    |
| Resistance to Solvents                                  | MIL-STD-202, Method 215                                                   | 120  | 120  | 0    |
| Solderability                                           | MIL-STD-883, Method 2003 (Pads on bottom of package only)                 | 120  | 120  | 0    |
| Temperature Cycle                                       | JESD22-A104, -65°C to +150°C, 1,000 cycles                                | 240  | 240  | 0    |
| Thermal Shock                                           | MIL-STD-883 Method 1011 Condition B, -55°C to 125°C, 200 Cycles           | 180  | 180  | 0    |
| Vibration                                               | MIL-STD-883 Method 2007 Condition A, 20G's                                | 120  | 120  | 0    |

| Reliability Tests |                                                                            |      |      |      |
|-------------------|----------------------------------------------------------------------------|------|------|------|
| Test              | Method/Condition                                                           | Test | Pass | Fail |
| Vibration         | MIL-STD-883, Method 2007, 20 G's                                           | 160  | 160  | 0    |
| Mechanical Shock  | MIL-STD-883, Method 2002, 1,500G's, 0.5msec, ½ sine                        | 160  | 160  | 0    |
| Temperature Cycle | MIL-STD-883, Method 1010, -55°C to +125°C, 10 cycles                       | 160  | 160  | 0    |
| Aging             | Biased, Nominal V <sub>DD</sub> , Temperature = 85°C, Duration = 720 hours | 160  | 160  | 0    |

| Reliability Data    |                                              |                         |
|---------------------|----------------------------------------------|-------------------------|
| Characteristic      | Constant                                     | Value                   |
| Number of Units     | <i>N</i>                                     | 160                     |
| Hours Tested        | <i>t</i>                                     | 1,000                   |
| Activation Voltage  | <i>Ea</i>                                    | 0.7eV                   |
| Boltzman's Constant | <i>k</i>                                     | 8.62 x 10 <sup>-5</sup> |
| Aging Temperature   | <i>T1</i>                                    | 85°C                    |
| Ambient Temperature | <i>T2</i>                                    | 25°C                    |
| Confidence Level    | <i>X</i> <sup>2</sup> <sub>(CL, 2 dof)</sub> | 90%                     |

| Reliability Calculations    |                                      |
|-----------------------------|--------------------------------------|
| Parameter                   | Value                                |
| Failures in Time (FIT)      | 15 units / 1 x 10 <sup>9</sup> Hours |
| Mean Time To Failure (MTTF) | 67,175,000 hours / Failure           |

$$FIT = \frac{(\chi^2 / 2) \cdot 1,000,000,000}{\sum \left[ f_i \cdot t_i \cdot e^{\frac{Ea}{k} \left( \frac{1}{T1+273} - \frac{1}{T2+273} \right)} \right] + \left[ N \cdot t \cdot e^{\frac{Ea}{k} \left( \frac{1}{T1+273} - \frac{1}{T2+273} \right)} \right]}$$

$$MTTF = 1,000,000,000 / FIT$$