

Qualification and Reliability Report

 Series: EMRE13

| Qualification Tests | | | | |
|---------------------------------------------------------|---------------------------------------------------------------------------|------|------|------|
| Test | Method/Condition | Test | Pass | Fail |
| Aging | Biased, Nominal V _{DD} , 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 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 _{DD} , 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 ⁻⁵ |
| Aging Temperature | <i>T1</i> | 85°C |
| Ambient Temperature | <i>T2</i> | 25°C |
| Confidence Level | <i>X</i> ² _(CL, 2 dof) | 90% |

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

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

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