


| REVISIONS |                            |         |          |
|-----------|----------------------------|---------|----------|
| REV.      | DESCRIPTION                | DATE    | APPROVED |
| -         | As Drawn                   | 6/10/99 | STR      |
| A         | Update using Metelics data | 6/10/04 | HK       |
|           |                            |         |          |
|           |                            |         |          |

Stress Analysis and Reliability Prediction  
 for the  
 Marki Microwave RF Mixer  
 Single-Quad Housing Assembly  
 Airborne Uninhabited Environment, 85°C

|      |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |
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| Rev. | - | A | A | A |   |   |   |   |    |    |    |    |    |    |    |    |    |

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|-----------|--------------|--|---|------------------------------|------------------|
| APPROVALS | DATE         |  | 215 Vineyard Court<br>Morgan Hill, CA 95037   |                              |                  |
| Drawn     | STR          | 6/10/99  | <b>Stress Analysis and Reliability Prediction</b><br><b>Single-Quad Housing, Airborne Uninhabited Environment</b> |                              |                  |
| Checked   | Steve Rempel | 6/10/99  |   |                              |                  |
| Q.A.      | Herb knight  | 6/10/99  |   |                              |                  |
|           |              | SIZE<br><b>A</b>   | CAGE CODE<br><b>0UC32</b>   | DWG. NO.<br><b>051-03083</b> | REV.<br><b>A</b> |
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## 1.0 Purpose and Scope

This report presents the results of stress analysis and reliability prediction performed on the Marki Microwave single-quad mixer assembly in a housing. It was performed to the requirements of MIL-HDBK-217F, Notice #2, with an environment of Airborne, Uninhabited Fighter (A<sub>UF</sub>), and an ambient temperature of 85°C.

## 2.0 Reference Documents

### 2.1 Military

MIL-HDBK-217, Rev. F  
Notice #2

Reliability Prediction of Electronic  
Equipment

### 2.2 Marki Microwave

Top Assembly, P2108

### 2.3 Metelics

Diode Test Data

## 3.0 Assumptions

The standard assumptions of MIL-HDBK-217 were used in addition to those specifically listed herein. The mounting surface to ambient thermal path resistance used for temperature rise calculations was 10°C/W for the components mounted on the hybrid assembly substrate.

## 4.0 Models

Discreet component failure rate calculations were used for all the components in the mixer. The factors used are referenced in the remarks column or shown at the bottom of the sheet. The failure rates shown are for single components unless otherwise specified.

The stress factor used for arriving at the operating failure rate used the methods of -217. The stress factor shown on the prediction worksheets is the fully derated stress factor. The attached worksheets summarize all calculations.

The assembly consists of a packaged quad schottky diode mounted on a microwave circuit board, which is mounted in a housing with SMA connectors. The quad diode is modeled using data from Metelics.

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#### 4.0 Models (continued)

A detailed calculation for a diode quad (A1) is show below as a typical calculation example:

|                                      |                 |
|--------------------------------------|-----------------|
| Total input power (RF)               | +10 dBm         |
| Split between 2 diodes               | -6 dB           |
| Coupling loss, per diode (est.)      | -1 dB           |
| Dissipation (+6 dBm)                 | 2 mW            |
| Thermal Resistance for A1            | 300°C/W         |
| Thermal Resistance, mount to housing | 10°C/W          |
| A1 temperature rise                  | 0.6°C+0.1°C=1°C |

Since the diode quad rating is 0.250W at 75°C ambient, it is necessary to determine the mounting surface temperature for the stress calculation required for MIL-HDBK-217. From the calculation above, the mounting surface temperature is 85°C (ambient) plus 0.1°C rise for a total of 85C. Because the operating temperature is below the full rated temperature, the stress is:

$$\text{Stress} = \frac{P_{APP}}{(T_{JMAX} - T_{JOP})} * P_{MAX}$$

$$\frac{(T_{JMAX} - T_{JO})}{(T_{JMAX} - T_{JO})}$$

$$\text{Stress} = \frac{4 * .002w}{(150^\circ - 85^\circ) * .250W}$$

$$(150^\circ - 75^\circ)$$

$$\text{Stress} = \frac{.008W}{.217}$$

Stress = .04 *The minimum stress used for -217 calculations is 0.10*

#### 5.0 Summary

The results of the MTBF stress analysis included with this report shows no component with a stress over 4% of the temperature rated maximum values. The MTBF is 615,700 hours in an Airborne, Uninhabited Fighter (A<sub>UF</sub>) environment at 85°C.

#### 6.0 Worksheet

See page 5

|                             |                  |                           |                              |                  |
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