


REVISIONS			
REV.	DESCRIPTION	DATE	APPROVED
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Stress Analysis and Reliability Prediction  
 for the  
 Marki Microwave RF Mixer  
 Dual-Quad (Triple-Balanced) Carrier Assembly  
 Airborne Uninhabited Environment

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Rev.	-	-	-	-													

APPROVALS	DATE		215 Vineyard Court Morgan Hill, CA 95037		
Drawn	STR	6/10/04	<b>Stress Analysis and Reliability Prediction</b> <b>Dual-Quad (Triple-Balanced) Carrier, Airborne Uninhabited Environment</b>		
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		SIZE <b>A</b>	CAGE CODE <b>0UC32</b>	DWG. NO. <b>051-03658</b>	REV. <b>-</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 Dual-Quad (Triple-Balanced) mixer assembly on a carrier. It was performed to the requirements of MIL-HDBK-217F, Notice #2, with an environment of Airborne, Uninhabited ( $A_{UF}$ ), 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

P1085 Top Assembly

### 2.3 Metelics

Life 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 components in the mixer. The factors used are 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 two packaged quad schottky diodes mounted on a microwave circuit board in a carrier. 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)	+15 dBm
Split between 2 quads, 2 diodes	-12 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 85°C. Because the operating temperature is below the full rated temperature, the stress is:

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

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

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

$$(150° - 75°)$$

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

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

#### 5.0 Summary

The results of the MTBF stress analysis shows no component with a stress over 4% of the temperature derated maximum values. The MTBF is 1,380,800 hours in an Airborne, Uninhabited (A<sub>UF</sub>) environment at 85°C.

#### 6.0 Worksheet

See page 5

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# DESIGN ANALYSIS PARTS LIST

UNIT DESIG. TOP ASSEMBLY  
 ASSY NAME RF MIXER  
 ASSY NO.  
 SCHEMATIC

PREPARED BY RICHARD L. MAYEUR

REFERENCE DESIGNAT.	PART NUMBER	NAME OR MANUFACTURER'S PART NAME & NUMBER	APPLICATION DATA						FAILURE DATA			
			WATTS	RATED VOLTS/ AMPS	AMBIENT TEMP. °C	OPERATING VOLTS/ AMPS	TEMP. RISE	STRESS FACTOR	FAILURE RATE	AUF	REMARKS	
A1,2		DIODE, QUAD MIXER	250	6.0/.025	75°	.008	1.0/.005	1°	.04	0.7200	FOR 2	85° C
E1,3		FEEDTHRU, RF		100/5.0	125°		1.0/.005	1°	.01	0.0042	FOR 3	

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