REVISIONS				
ZONE	REV.	DESCRIPTION	DATE	APPROVED
	--	Original Release	8/27/07	

REV STATUS	REV	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SHEETS	SHEET	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

REV STATUS	REV																
SHEETS	SHEET	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32

CONTRACT No.:			Planar Monolithics Industries, Inc. 7311-G Grove Road, Frederick, MD 21704		
		DATE			
DRAWN	E. Elder	8/27/07			
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MEAN TIME BETWEEN FAILURE ANALYSIS (MTBF)

FOR

PMI MODEL NUMBER: SLVAC-0102-70M OPTION LA

LOGARITHMIC AMPLIFIER
SUCCESSIVE DETECTION
CONSTANT PHASE

TABLE OF CONTENTS

1.0 INTRODUCTION AND SUMMARY

This document presents the American Microwave Corporation Reliability Prediction Report performed on the Successive Detection Logarithmic Amplifier. It was analyzed for Mean Time Between Failure (MTBF) in accordance with Task 203 of MIL-STD-785B; paragraph 2.4 of Task 100 of MIL-STD-756B; and the Parts Count Analysis method of MIL-HDBK-217F(N1/2), Appendix A.

The Successive Detection Logarithmic Amplifier was found to have a Mean Time Between Failure (MTBF) of 111,694.40 hours of operation. This statement is fully supported by the reliability mathematical model presented in Section 3.0, the Table 1 Failure Rate Data Summary and the detailed reliability parts count failure rate data tables presented in the Appendix A of this report.

1.1 Scope

This report reflects the Successive Detection Logarithmic Amplifier reliability design analysis performed from project inception through the issue date of this document. This report is limited to electronic parts.

1.2 Objectives

Through this report, Planar Monolithics seeks to provide a prediction of the Successive Detection Logarithmic Amplifier MTBF, to evaluate it's current and potential reliability, to provide information in order to assist in directing and planning for reliability and related program efforts and to identify design features which are critical to reliability.

2.0 APPLICABLE DOCUMENTS

2.1 Military Specification Documents

MIL-STD-756B, N1, 31 August 1982	Reliability Modeling and Prediction
MIL-STD-785B, 15 September 1980	Reliability Program for Systems and Equipment Development and Production
MIL-HDBK-217F(N1/2),	Reliability Prediction of Electronic Equipment

10 July 1992/28 February 1995

2.2 Commercial/Bellcore Documents

TR-332, Issue 6, December 1997	Technical Reference, Bellcore Method 1, "Reliability Prediction Procedure for Electronic Equipment" (A Module of RQGR, FR-796).

2.3 Planar Monolithics Documents

Successive Detection Logarithmic Amplifier Parts Lists and Engineering Drawings

3.0 RELIABILITY ANALYSIS

3.1 Reliability Analysis Methodology

The parts count method of reliability prediction used in this analysis is MIL-HDBK-217F(N1/2), "Reliability Prediction Procedure for Electronic Equipment", Appendix A.

3.2 Reliability Mathematical Model

The Reliability model MTBF reflects the reliability of all electrical parts in the equipment. Their failure rates are summarized in Table 1, by assembly, and presented in appendices tables by part type.

The Mathematical Model used in determining the Successive Detection Logarithmic Amplifier reliability is known as the series model. This model is based on the equation:

$$R(t) = e^{-\lambda t}$$

Where:

$R(t) =$ Reliability of the Successive Detection Logarithmic Amplifier

$t =$ Elapsed operation time, in hours

$\lambda =$ Successive Detection Logarithmic Amplifier failure rate, in parts per million hours (ppmh)

The assumption is that if any part fails during operation, the Successive Detection Logarithmic Amplifier is considered to have failed as a whole, and maintenance is required. The reliability of the Successive Detection Logarithmic Amplifier, $R(t)$, is the combined probability of the individual parts reliability, where the unit contains quantity n parts:

$$R(t) = \underset{i=1}{\overset{n}{\pi}} R(t)_i$$

Where: $R(t)_i =$ reliability of part, i, over time, $t, e^{-\lambda_i t}$

The summation of all Successive Detection Logarithmic Amplifier part failure rates provides the system failure rate, see Table 1. Thus, the system MTBF is determined by taking the reciprocal of the summation of the failure rates of all the Successive Detection Logarithmic Amplifier parts:

$$MTBF = \int_{\circ}^{\infty} R(t)dt = 1/\sum_{i=1}^{n} \lambda_i$$

The analysis presented in this report contains no redundancy. Thus, the total Successive Detection Logarithmic Amplifier MTBF is 111,694.40 hours of operation.

The parts count reliability prediction method reflects the generic part types, quantities and qualities used, and considers the operational environment impact. These factors are combined in the following mathematical model:

$$\lambda_A = \sum_{i=1}^{n} N_i (\lambda_G \pi_Q)_i$$

where:

$\lambda_A =$ total failure rate (parts per million hours) of the Successive Detection Logarithmic Amplifier.

$\lambda_G =$ generic failure rate for a given environment for the ith generic part of an assembly.

$\pi_Q =$ quality factor for the ith generic part of an assembly.

$N_i =$ quantity of the ith generic part of an assembly.

$n =$ number of different generic part categories.

The failure rate model modifiers, quantity, quality factor and generic failure rate are listed under their respective columns in the appendix tables.

The modifiers are numerical multipliers for the individual generic parts failure rate. The quality factor, π_Q, designation is listed in the data tabulation Specification/Quality Level column for each part.

3.3 Quality Factors

American Microwave Corporation's use of commercial or mil-spec parts throughout the Successive Detection Logarithmic Amplifier is reflected in the quality factors, presented in the tables of Appendix A. The exact quality is presented for each part under the specification and quality factor columns of the failure rate data sheets.

The learning factor, π_L, is equal to 1.0 for American Microwave Corporation's production conditions and field experience.

3.4 Environmental Conditions

All part generic failure rates include the effects of environment factors. The appropriate environment factor for the Successive Detection Logarithmic Amplifier is Airborne Inhabited Fighter (A_{IF}). For A_{IF} the semiconductor junction temperature, T_J, is 75 degrees Celsius, and the other parts ambient temperature, T_A, is 55 degrees Celsius.

3.5 Parts Count Failure Rate Calculations

The parts count reliability prediction procedure conducted on the Successive

Detection Logarithmic Amplifier provides the data upon which part failure rates are assigned for reliability prediction. The failure rate model of each component was determined and the associated failure rates were calculated and listed in the data tabulation sheets of the appendices using the generic reliability failure rates determined per MIL-HDBK-217F, Notice 1/2, Appendix A, “Parts Count Reliability Prediction”.

The various failure rate model modifiers are listed in the appendices on detailed Failure Rate Data tables under "π" columns for each factor. The "π" factors are numerical multipliers for parts quality levels. The Quality "π" factor, π_Q, is determined from the part procurement specification or information available at the time of analysis.

RELIABILITY PARTS COUNT FAILURE RATE DATA SUMMARY

Table 1, Successive Detection Logarithmic Amplifier

Assembly/ Parts List	Quantity	Failure Rate in Parts Per Million Hours	
		Total	Quantity x Total
991106-2/ 100-5295-1	1	8.95300	8.95300

Total System Failure Rate = 8.95300 Parts Per Million Hours.

Total System Mean Time Between Failure (MTBF) = 111,694.40 Hours.

APPENDIX A

1.1.1 Reliability Parts Count Failure Rate Data Tabulation

for the

Successive Detection Logarithmic Amplifier

RELIABILITY PARTS COUNT FAILURE RATE DATA

System: Successive Detection Logarithmic Amplifier **Page 1**

Assembly: 991106-2

Parts List: 100-5295-1

Environment: Airborne, Inhabited Fighter (AIF)

Description/ Generic Part Type	Specification/ Quality Level	Quantity	Quality Factor (Pi Q)	Failure Rate in Parts Per Million Hours	
				Generic	Total
Integrated Circuit/ MOS, Digital 1001-3000 Gates	Mil-M-38510/ B	1	1.00	0.10000	0.10000
Integrated Circuit/ Linear 1-100 Transistors	Mil-M-38510/ B	4	1.00	0.06200	0.24800
Integrated Circuit/ Linear 301-1K Transistors	Mil-M-38510/ B	1	1.00	0.19000	0.19000
Resistor/ RM Fixed Film Chip	Mil-R-55342/ Mil-Spec	20	3.00	0.11000	6.60000
Capacitor/ CDR Ceramic Chip	Mil-C-55681/ Mil-Spec	28	3.00	0.01500	1.26000
Coil/ Radio Frequency, Fixed	Mil-C-15305/ Mil-Spec	1	1.00	0.01500	0.01500
Connector/ Printed Circuit Board	Mil-Spec	1	1.00	0.11000	0.11000
Interconnect Assy./ Printed Circuit Board (PCB)	Mil-Spec	1	1.00	0.43000	0.43000

Total Assembly Quantity of Parts = 57

Total Assembly Failure Rate = 8.95300 Parts Per Million Hours.