Reliability Prediction Report
On
PMI Model No.
PIA-BTFL-GPO-2CH Revision B

Date Issued: 12 April 2012

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Revision Status

Revision	Date	Summary of Changes
-	12 April 2012	Draft copy released for review
A	13 April 2012	Initial Release

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Appendix A   **Filter Module Reliability Prediction Details**

1.0   SUMMARY

Planar Monolithics Industries, Inc. (PMI) has prepared this Reliability Prediction Report for the Filter Module P/N 27314740-B.

1.1   Scope

This report describes the Reliability Prediction and related tasks completed for the design of the Filter Module.

2.0   INTRODUCTION

The purpose of this report is to document the basic reliability prediction performed on the Filter Module, to establish analytically the quantitative reliability of the unit's designs.

2.1   Referenced Documents

The following of the exact issue shown form a part of this report to the extent specified herein. In the event of a conflict between the contents of this report and the referenced Military Standards and Specifications, the contents of this report will take precedence.

2.1.1   Military Standards

MIL-HDBK-217F	Reliability Prediction of Electronic Equipment (Notice 2)	10 NOV 2010 Revision F

3.0   EQUIPMENT DESCRIPTION AND OPERATING ENVIRONMENT

3.1   Equipment Description

The Filter Module consists of one (1) substrate (P/N 26614751). The design is a simple bias-tee, passive substrate filter and non-active limiter.

3.2   Operating Environment

The anticipated operating environment for the Filter Module is an Airborne – Uninhabited Fighter (Auf) environment with a base-plate temperature of up to +65°C.

4.0   RELIABILITY PREDICTION PROCESS

4.1   Reliability Methodology

The Reliability Prediction of the Filter Module was performed, in the Auf environment using part stress method and part failure rate models of MIL-HDBK-217F Notice 2. Each part type failure rate was calculated using the calculated stresses provided by engineering and a computerized Reliability Prediction Program (Relex version 7.7) then was added to arrive at the unit's serial failure rate. The result of the reliability prediction Process is to obtain the equipment failure rate (λ) in failures per million hours (FPMH) and then calculate the equipment Mean Time Between Failures (MTBF) by reciprocating and converting to hours from million hours.

4.2   Ground Rules/Assumptions

The reliability prediction was performed under the following ground rules/assumptions:

Reliability Model:	Serial
Environment:	Auf (Airborne Uninhabited Fighter)
Part Temperature:	65°C
Thermal/part stresses:	Capacitors: Actual stress (C1, C2) or 30% Voltage Stress Resistors: 10% Power Stress Semiconductors: 10% Power Stress
Quality Levels:	Capacitors: Established Reliability Failure Rate Level M (Pi Q = 1.0) Resistors: Established Reliability Failure Rate Level M (Pi Q = 1.0) Semiconductors: JAN (Pi Q = 5.0)

5.0   RELIABILITY GOAL

The Reliability Goal for the Mean Time Between Failure (MTBF) of the Filter Module is in excess 75,000 operating hours at Auf 65°C base-plate.

6.0   RELIABILITY PREDICTION RESULTS

6.1   MTBF Calculation

Using the parts lists, calculated stress data and part temperatures for the Environmental Conditions, the MTBF was calculated and is reflected in Table 1.

Table 1 – Filter Module Reliability Prediction Summary

Assembly Model	Environment	Base-Plate Temperature	Predicted Failure Rate (FPMH)	Predicted MTBF (Hours)
Filter Module	Auf	65°C	6.5913	151,715

6.2   Reliability Prediction Worksheets

The Reliability Prediction Worksheets are contained in Appendix A. The worksheets provide the details of the part stress method reliability prediction. The report includes all piece-part model parameter data or Pi-factors so that prediction can be reproduced using different temperatures or environments.

7.0   CONCLUSIONS

Based on the results of the parts count reliability prediction, the reliability of the Filter Module is predicted to have a MTBF of 151,715 hours when calculated per MIL-HDBK-21F Notice 2 in an airborne uninhabited fighter environment in a 65 degree Celsius base-plate temperature which meets the reliability goal of 75,000 hours.

8.0   LIST OF ABBREVIATIONS AND ACRONYMS

Auf   Airborne Uninhabited Fighter

FPMH   Failures Per Million Hours

MTBF   Mean Time Between Failure
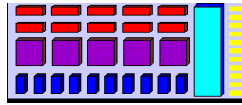
PMI   Planar Monolithic Industries

Appendix A

Filter Module Reliability Prediction Details

Auf 65°C Base-Plate

Standard Reliability Prediction Report

Part Number	System		**Description**	Top-level assembly
Reference Des			**File Name**	27314740-B 4-12-12.RPJ
Date	April 12, 2012		**Time**	10:21 PM
Environment	AUF - Airborne Uninhab Fighter		**Failure Rate**	6.591286
Temperature	65.00		**MTBF**	151,715

Assembly Name	Part Number	Ref Des	Qty	Failure Rate	MTBF
27314740-8	System		1.00	6.591286	151,715

Standard Reliability Prediction Report

Part Number	System	
Reference Des		
Date	April 12, 2012	
Environment	AUF - Airborne Uninhab Fighter	
Temperature	65.00	
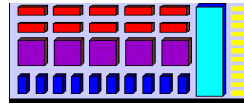
Description	Top-level assembly
File Name	27314740-B 4-12-12.RPJ
Time	10:21 PM
Failure Rate	6.591286
MTBF	151,715

Part Number	Category	Ref Des	Failure Rate, Unit	Quantity	Failure Rate
26614751	Connection	Substrate	0.618800	1.00	0.618800
PL75-490	Resistor	FT1	0.074271	1.00	0.074271
PL75-490	Resistor	FT2	0.074271	1.00	0.074271
PL75-490	Resistor	FT3	0.074271	1.00	0.074271
PL75-490	Resistor	FT4	0.074271	1.00	0.074271
PL25-105	Capacitor	C1	0.065575	1.00	0.065575
PL25-105	Capacitor	C2	0.065575	1.00	0.065575
PL25-105	Capacitor	C3	0.073187	1.00	0.073187
PL25-105	Capacitor	C4	0.073187	1.00	0.073187
PL25-008	Capacitor	C5	0.065051	1.00	0.065051
PL25-008	Capacitor	C6	0.065051	1.00	0.065051
PL-30-012	Inductor	L1	0.000448	1.00	0.000448
PL-30-012	Inductor	L2	0.000448	1.00	0.000448
PL45-203	Semiconductor	D1	1.316719	1.00	1.316719
PL45-203	Semiconductor	D2	1.316719	1.00	1.316719
PL45-203	Semiconductor	D3	1.316719	1.00	1.316719
PL45-203	Semiconductor	D4	1.316719	1.00	1.316719

Pi Factors Report

Part Number	System	
Reference Des		
Date	April 12, 2012	
Environment	AUF - Airborne Uninhab Fighter	
Temperature	65.00	
Hybrid Pi Factors		
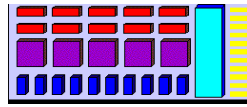
Description	Top-level assembly
File Name	27314740-B 4-12-12.RPJ
Time	10:21 PM
Failure Rate	6.591286
MTBF	151,715

Part Number	Ref Des	Pi Factors	Failure Rate
26614751	Substrate	Lambda B: 0.000017, N1: 0.000000, N2: 0.000000, Pi C: 1.300000, Pi E: 28.000000, Pi FY: 4.000000, Pi Q: 1.000000, Model Failure Rate: 0.618800	0.618800
PL75-490	FT1	Lambda B: 0.003700, Pi E: 43.000000, Pi FY: 3.618006, Pi P: 0.407380, Pi Q: 1.000000, Pi S: 0.792557, Pi T: 1.445839, Model Failure Rate: 0.074271	0.074271
PL75-490	FT2	Lambda B: 0.003700, Pi E: 43.000000, Pi FY: 3.618006, Pi P: 0.407380, Pi Q: 1.000000, Pi S: 0.792557, Pi T: 1.445839, Model Failure Rate: 0.074271	0.074271
PL75-490	FT3	Lambda B: 0.003700, Pi E: 43.000000, Pi FY: 3.618006, Pi P: 0.407380, Pi Q: 1.000000, Pi S: 0.792557, Pi T: 1.445839, Model Failure Rate: 0.074271	0.074271
PL75-490	FT4	Lambda B: 0.003700, Pi E: 43.000000, Pi FY: 3.618006, Pi P: 0.407380, Pi Q: 1.000000, Pi S: 0.792557, Pi T: 1.445839, Model Failure Rate: 0.074271	0.074271
PL25-105	C1	Lambda B: 0.000990, Pi C: 0.436516, Pi E: 30.000000, Pi FY: 1.597856, Pi Q: 1.000000, Pi SR: 1.000000, Pi T: 5.017928, Pi V: 1.008000, Model Failure Rate: 0.065575	0.065575
PL25-105	C2	Lambda B: 0.000990, Pi C: 0.436516, Pi E: 30.000000, Pi FY: 1.597856, Pi Q: 1.000000, Pi SR: 1.000000, Pi T: 5.017928, Pi V: 1.008000, Model Failure Rate: 0.065575	0.065575
PL25-105	C3	Lambda B: 0.000990, Pi C: 0.436516, Pi E: 30.000000, Pi FY: 1.597856, Pi Q: 1.000000, Pi SR: 1.000000, Pi T: 5.017928, Pi V: 1.125000, Model Failure Rate: 0.073187	0.073187
PL25-105	C4	Lambda B: 0.000990, Pi C: 0.436516, Pi E: 30.000000, Pi FY: 1.597856, Pi Q: 1.000000, Pi SR: 1.000000, Pi T: 5.017928, Pi V: 1.125000, Model Failure Rate: 0.073187	0.073187
PL25-008	C5	Lambda B: 0.000990, Pi C: 0.387992, Pi E: 30.000000, Pi FY: 1.597856, Pi Q: 1.000000, Pi SR: 1.000000, Pi T: 5.017928, Pi V: 1.125000, Model Failure Rate: 0.065051	0.065051
PL25-008	C6	Lambda B: 0.000990, Pi C: 0.387992, Pi E: 30.000000, Pi FY: 1.597856, Pi Q: 1.000000, Pi SR: 1.000000, Pi T: 5.017928, Pi V: 1.125000, Model Failure Rate: 0.065051	0.065051
PL-30-012	L1	Lambda B: 0.000030, Pi E: 9.000000, Pi FY: 2.806993, Pi Q: 1.000000, Pi T: 1.660217, Model Failure Rate: 4.48259E-4	0.000448
PL-30-012	L2	Lambda B: 0.000030, Pi E: 9.000000, Pi FY: 2.806993, Pi Q: 1.000000, Pi T: 1.660217, Model Failure Rate: 4.48259E-4	0.000448
PL45-203	D1	Lambda B: 0.008100, Pi A: 1.000000, Pi E: 12.000000, Pi FY: 1.553649, Pi Q: 5.000000, Pi R: 0.500000, Pi T: 5.418597, Model Failure Rate: 1.316719	1.316719
PL45-203	D2	Lambda B: 0.008100, Pi A: 1.000000, Pi E: 12.000000, Pi FY: 1.553649, Pi Q: 5.000000, Pi R: 0.500000, Pi T: 5.418597, Model Failure Rate: 1.316719	1.316719
PL45-203	D3	Lambda B: 0.008100, Pi A: 1.000000, Pi E: 12.000000, Pi FY: 1.553649, Pi Q: 5.000000, Pi R: 0.500000, Pi T: 5.418597, Model Failure Rate: 1.316719	1.316719
PL45-203	D4	Lambda B: 0.008100, Pi A: 1.000000, Pi E: 12.000000, Pi FY: 1.553649, Pi Q: 5.000000, Pi R: 0.500000, Pi T: 5.418597, Model Failure Rate: 1.316719	1.316719

Specific Part Information Report

Part Number	System	**Description**	Top-level assembly
Reference Des		**File Name**	27314740-B 4-12-12.RPJ
Date	April 12, 2012	**Time**	10:22 PM
Environment	AUF - Airborne Uninhab Fighter	**Failure Rate**	6.591286
Temperature	65.00	**MTBF**	151,715
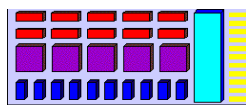
Part Number	Ref Des	Specific Part Information	Failure Rate
26614751	Substrate	Qual:Mil-Spec, Type:Printed Wiring, Burn Time:0.00e+000, Burn Temp:0.0e+000	0.618800
PL75-490	FT1	Qual:M, OpPwr:0.100, RtPwr:1.000, P S/R:10.0, Type:Chip (RM), Burn Time:0.00e+000, Burn Temp:0.0e+000	0.074271
PL75-490	FT2	Qual:M, OpPwr:0.100, RtPwr:1.000, P S/R:10.0, Type:Chip (RM), Burn Time:0.00e+000, Burn Temp:0.0e+000	0.074271
PL75-490	FT3	Qual:M, OpPwr:0.100, RtPwr:1.000, P S/R:10.0, Type:Chip (RM), Burn Time:0.00e+000, Burn Temp:0.0e+000	0.074271
PL75-490	FT4	Qual:M, OpPwr:0.100, RtPwr:1.000, P S/R:10.0, Type:Chip (RM), Burn Time:0.00e+000, Burn Temp:0.0e+000	0.074271
PL25-105	C1	Qual:M, Op DC:12.00, RtVt:100.00, V S/R:12.0, Cap:100.000, Units:pF, Burn Time:0.00e+000, Burn Temp:0.0e+000	0.065575
PL25-105	C2	Qual:M, Op DC:12.00, RtVt:100.00, V S/R:12.0, Cap:100.000, Units:pF, Burn Time:0.00e+000, Burn Temp:0.0e+000	0.065575
PL25-105	C3	Qual:M, Op DC:30.00, RtVt:100.00, V S/R:30.0, Cap:100.000, Units:pF, Burn Time:0.00e+000, Burn Temp:0.0e+000	0.073187
PL25-105	C4	Qual:M, Op DC:30.00, RtVt:100.00, V S/R:30.0, Cap:100.000, Units:pF, Burn Time:0.00e+000, Burn Temp:0.0e+000	0.073187
PL25-008	C5	Qual:M, Op DC:30.00, RtVt:100.00, V S/R:30.0, Cap:27.000, Units:pF, Burn Time:0.00e+000, Burn Temp:0.0e+000	0.065051
PL25-008	C6	Qual:M, Op DC:30.00, RtVt:100.00, V S/R:30.0, Cap:27.000, Units:pF, Burn Time:0.00e+000, Burn Temp:0.0e+000	0.065051
PL-30-012	L1	Qual:Mil-Spec, Type:RF, Fixed or Molded, Burn Time:0.00e+000, Burn Temp:0.0e+000	0.000448
PL-30-012	L2	Qual:Mil-Spec, Type:RF, Fixed or Molded, Burn Time:0.00e+000, Burn Temp:0.0e+000	0.000448
PL45-203	D1	Qual:JAN, Diode:PIN, RtPwr:3.000, OpPwr:0.300, ThRes:180.000, TRise:54.0, Burn Time:0.00e+000, Burn Temp:0.0e+000	1.316719
PL45-203	D2	Qual:JAN, Diode:PIN, RtPwr:3.000, OpPwr:0.300, ThRes:180.000, TRise:54.0, Burn Time:0.00e+000, Burn Temp:0.0e+000	1.316719
PL45-203	D3	Qual:JAN, Diode:PIN, RtPwr:3.000, OpPwr:0.300, ThRes:180.000, TRise:54.0, Burn Time:0.00e+000, Burn Temp:0.0e+000	1.316719
PL45-203	D4	Qual:JAN, Diode:PIN, RtPwr:3.000, OpPwr:0.300, ThRes:180.000, TRise:54.0, Burn Time:0.00e+000, Burn Temp:0.0e+000	1.316719