REVISIONS				
ZONE	REV.	DESCRIPTION	DATE	APPROVED
	--	Original Release	25 Jan 2008	PRELIMINARY

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

SCD No.: MIKES 730049			Planar Monolithics Industries, Inc. 7311-G Grove Road, Frederick, MD 21704		
		DATE			
DRAWN	S Kuhn	25 Jan 2008			
CHECK			RELIABILITY PREDICTION MODEL: RFFD-618-730049 PART No. T0737SOCN730049-001 FILTER DETECTOR		
APPD.					
ENGR.					
QC.					
			SIZE: A	FSCM: 0ZXZ8	DRAWING No: 150-R000-000
			REV: A	SCALE: N/A	SHEET 1 OF 35

PLANAR MONOLITHICS INDUSTRIES, INC.
7311-G GROVE RD., FREDERICK MD.21704
TEL: 301-631-1579 FAX: 301-662-2029
URL: WWW.PLANARMONOLITHICS.COM
SALES@PLANARMONOLITHICS.COM
ISO 9001:2000 CERTIFIED

RELIABILITY PREDICTION

FOR

PMI MODEL NUMBER: RFDD-618-730049

FILTER DETECTOR

PLANAR MONOLITHICS INDUSTRIES, INC.
7311-G GROVE RD., FREDERICK MD.21704
TEL: 301-631-1579 FAX: 301-662-2029
URL: WWW.PLANARMONOLITHICS.COM
SALES@PLANARMONOLITHICS.COM
ISO 9001:2000 CERTIFIED

TABLE OF CONTENTS

PLANAR MONOLITHICS INDUSTRIES, INC.
7311-G GROVE RD., FREDERICK MD.21704
TEL: 301-631-1579 FAX: 301-662-2029
URL: WWW.PLANARMONOLITHICS.COM
SALES@PLANARMONOLITHICS.COM
ISO 9001:2000 CERTIFIED

1. SCOPE

1.1. This document contains the Reliability Prediction and Derating for the PMI Model RFFD-618-730049 FILTER DETECTOR. This reliability prediction has been done according to RF, FILTER DETECTOR ASSY drawing number 730049. As specified the reliability prediction is done in accordance with MIL-HDBK-217F and CHANGE NOTICE 1 and 2. In addition to the reliability prediction, all parts have been derated according to RADC-TR-72-177 level II. The specifications and stresses of each component are detailed in this document.

2. RELIABILITY PREDICTION

2.1. The failure rate of each individual component used in the Filter Detector was evaluated by using the specifications contained in RF, FILTER DETECTOR ASSY drawing number 730049 together with the individual component manufacturers specifications and the values given in MIL-HDBK-217F together with change notices 1 and 2.

2.2. Each components predicted failures per million hours at 95 deg C were then multiplied by the number of components used The failure rates of all components were then summed to form the total predicted failure rate.

2.3. The overall predicted failure rate of about 5 failures per million hours (FPMH) is within the maximum of 9 FPMH as specified in 730049 point 3.7.1.

2.4. The equations and details of the individual components failure rate calculations are included in Appendix A.

PART NAME	Part References	No parts	Individual Failure Rate	Combined Failure Rate
			Failures per million hours	Failures per million hours
DETECTOR DIODE	D1, D2	2	1.2312	2.4624
PROTECTION DIODE	D3, D4	2	0.0002	0.0004
RESISTORS SMD 0603	R1, R2, R3	3	0.0487	0.1462
RESISTORS ETCHED	R4, R5, R6, R7, R8, R9, R10	7	0.0256	0.1795
CAPACITORS	C1a, C1b, C1c, C1d	4	0.1197	0.4788
CONNECTORS SMA RF	J1, J2	2	0.1197	0.2394
CONNECTORS GLASS FEEDTHROUGH PINS	J1, J2, PIN1, PIN2, PIN3	5	0.0048	0.0240
LOW PASS FILTER	LPF1	1	1.5600	1.5600
COMBINED TOTAL FAILURE RATE				5.0906

PLANAR MONOLITHICS INDUSTRIES, INC.
7311-G GROVE RD., FREDERICK MD.21704
TEL: 301-631-1579 FAX: 301-662-2029
URL: WWW.PLANARMONOLITHICS.COM
SALES@PLANARMONOLITHICS.COM
ISO 9001:2000 CERTIFIED

3. COMPONENT PART DERATING

3.1. The electrical and thermal stresses of each component have been evaluated using the specifications contained in RF, FILTER DETECTOR ASSY drawing number 730049 together with the individual component manufacturers specifications. The derating as specified in RADC-TR-72-177 level II.

PART NAME	Part References	Rated	Level II	Design	Units	
DETECTOR DIODE	D1, D2	175	125	110	deg C	Junction Temperature
		4	2.8	0	V	Breakdown Voltage DC
						Current Not Specified
		150	97.5	5	mW	Power Dissipation Normal Maximum
		150	97.5	50	mW	Power Dissipation No Damage Specification 3.2.3
PROTECTION DIODE	D3, D4	150	110	110	deg C	Junction Temperature
		85	59.5	1	V	Breakdown Voltage DC
		215	140	30	mA	Current Protection Specification 3.2.9
		150	97.5	0	mW	Power Dissipation Normal Maximum
		150	97.5	30	mW	Power Dissipation At Protection Specification 3.2.9
RESISTORS SMD 0603	R1, R2, R3	155	115	110	deg C	Temperature
		50		1	V	Maximum working voltage
		100	15	0.1	mW	Power Dissipation Normal Maximum
		100	15	15	mW	Power Dissipation At Protection Specification 3.2.9
RESISTORS ETCHED	R4, R5, R6, R7, R8, R9, R10	155	115	110	deg C	Temperature Omegaply has been tested at 160 deg C
		50		1	V	Maximum working voltage
		100	20	1	mW	Power Dissipation Normal Maximum
		100	20	17	mW	Power Dissipation No Damage Specification 3.2.3

PLANAR MONOLITHICS INDUSTRIES, INC.
7311-G GROVE RD., FREDERICK MD.21704
TEL: 301-631-1579 FAX: 301-662-2029
URL: WWW.PLANARMONOLITHICS.COM
SALES@PLANARMONOLITHICS.COM
ISO 9001:2000 CERTIFIED

CAPACITORS	C1a, C1b, C1c, C1d	150	125	110	deg C	Temperature
		50	30	1	V	Maximum working voltage
CONNECTORS SMA RF	J1, J2	165	140	110	deg C	Temperature
		500	350	1	V	Breakdown Voltage DC
		2000	1400	30	mA	Current Protection Specification 3.2.9
CONNECTORS GLASS FEEDTHROUGH PINS	J1, J2, PIN1, PIN2, PIN3	250		110	deg C	Temperature MIL-HDBK-217F pp15-2
		2000	1400	30	mA	Current Protection Specification 3.2.9
LOW PASS FILTER	LPF1	150		110	deg C	Temperature Dielectric tested -100 to +250 deg C

4. CONCLUSIONS

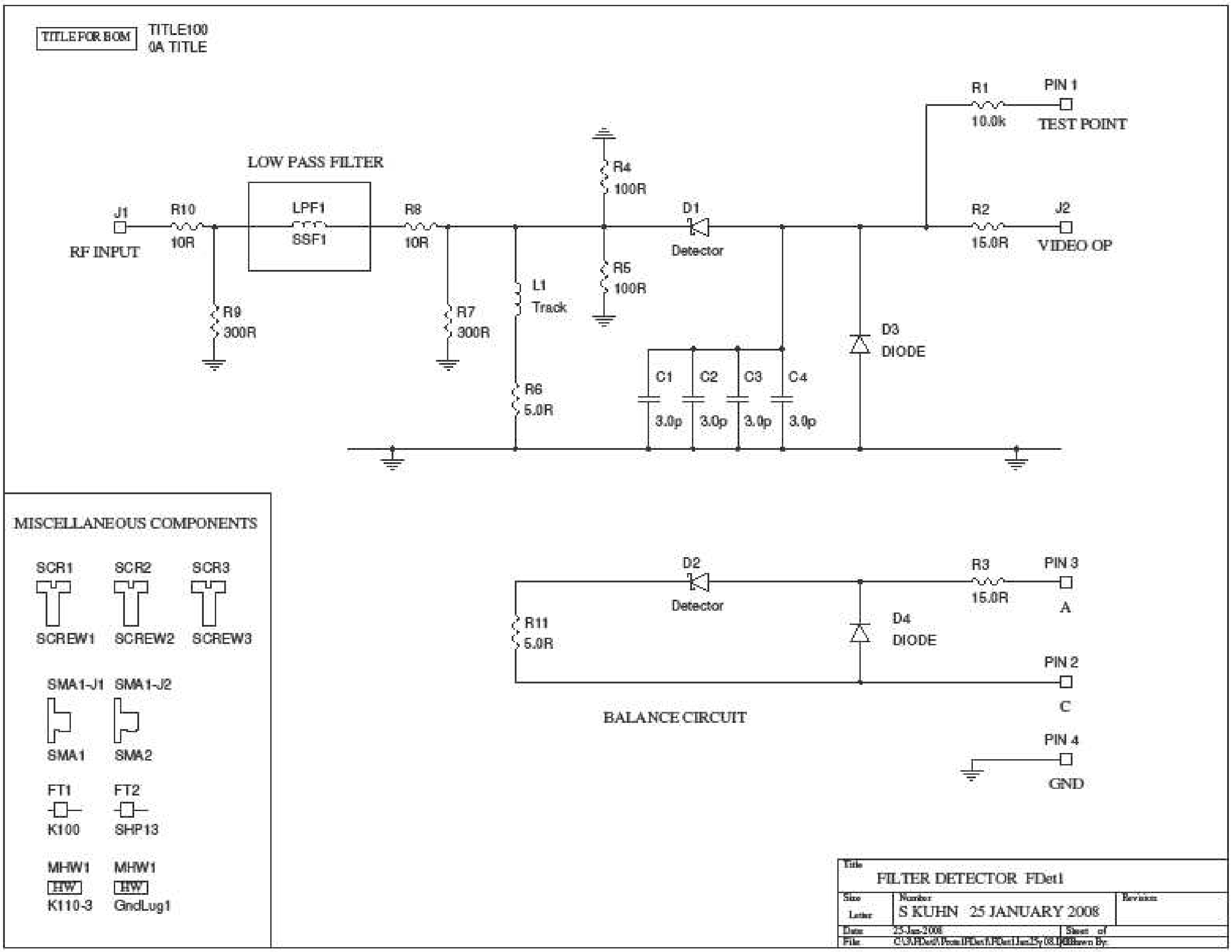
4.1. The Reliability Prediction for the Filter Detector was calculated according to the specifications contained in RF, FILTER DETECTOR ASSY drawing number 730049 together with the individual component manufacturers specifications and the values given in MIL-HDBK-217F and shown to be withing the specified value. That is 5 FPMH versus a specified maximum of 9 FPMH. (FPMH is failures all per million hours).

4.2. The stresses on all components has been shown to be within the derating limits as specified in RADC-TR-72-177 level II.

4.3. The conclusion is that this design meets the reliability and derating levels for the RF, FILTER DETECTOR ASSY drawing number 730049 .

PLANAR MONOLITHICS INDUSTRIES, INC.
7311-G GROVE RD., FREDERICK MD.21704
TEL: 301-631-1579 FAX: 301-662-2029
URL: WWW.PLANARMONOLITHICS.COM
SALES@PLANARMONOLITHICS.COM
ISO 9001:2000 CERTIFIED

APPENDIX A: ELECTRICAL SCHEMATIC DRAWING



PLANAR MONOLITHICS INDUSTRIES, INC.
7311-G GROVE RD., FREDERICK MD.21704
TEL: 301-631-1579 FAX: 301-662-2029

URL: WWW.PLANARMONOLITHICS.COM
SALES@PLANARMONOLITHICS.COM
ISO 9001:2000 CERTIFIED

APPENDIX B: FAILURE RATE CALCULATIONS AND STRESS

DETECTOR DIODE		
PARTS:	D1,D2	
DIODES, HIGH FREQUENCY (MICROWAVE, RF)		
MIL-HDBK-217F		pp 6-4 -- 6-5
λp = λb πT πA πR πQ πE failures per million hours		
λb	0.027	Base Failure Rate
πT	3.8	Temperature Factor for 95 deg C Mikes730049 3.7.1 sheet19
πA	1	Application Factor
πR	1	Power Rating Factor
πQ	1	Quality Factor Manufacturer states good for high reliability in space and military
πE	12	Environement Factor Auf Airborne Uninhabited Fighter Mil217 pp3-5 Mikes730049 3.7.1 sheet19
	1.2312	Failures per million hours.

DERATING		DETECTOR DIODE		
RADC-TR-82-177 LEVEL II ref pp 99-108				
Rated	Level II	Design	Units	
175	125	110	deg C	Junction Temperature
4	2.8	0	V	Breakdown Voltage DC
				Current Not Specified
150	97.5	5	mW	Power Dissipation Normal Maximum
150	97.5	50	mW	Power Dissipation No Damage Specification 3.2.3

PLANAR MONOLITHICS INDUSTRIES, INC.
7311-G GROVE RD., FREDERICK MD.21704
TEL: 301-631-1579 FAX: 301-662-2029
URL: WWW.PLANARMONOLITHICS.COM
SALES@PLANARMONOLITHICS.COM
ISO 9001:2000 CERTIFIED

PROTECTION DIODE		
PARTS:	D3,D4	
DIODES, LOW FREQUENCY		
MIL-HDBK-217F		pp 6-2 -- 6-3 Notice 2
λp = λb πT πS πC πQ πE failures per million hours		
λb	0.0038	Base Failure Rate
πT	7.2	Temperature Factor for 95 deg C Mikes730049 3.7.1 sheet19
πS	0.00002	Stress Factor Applied V= 1 volt Rated V = 85 Vs = 1/85 πS= Vs^2.43
πC	1	Contact Construction Factor
πQ	8	Quality Factor (Qualified to AEC-Q101 standards for High Reliability) Plastic -> 8
πE	43	Environement Factor Auf Airborne Uninhabited Fighter Mil217 pp3-5 Mikes730049 3.7.1 sheet19
	0.0002	Failures per million hours.

DERATING		PROTECTION DIODE		
RADC-TR-82-177 LEVEL II ref pp 99-108				
Rated	Level II	Design	Units	
150	110	110	deg C	Junction Temperature
85	59.5	1	V	Breakdown Voltage DC
215	140	30	mA	Current Protection Specification 3.2.9
150	97.5	0	mW	Power Dissipation Normal Maximum
150	97.5	30	mW	Power Dissipation At Protection Specification 3.2.9

PLANAR MONOLITHICS INDUSTRIES, INC.
7311-G GROVE RD., FREDERICK MD.21704
TEL: 301-631-1579 FAX: 301-662-2029
URL: WWW.PLANARMONOLITHICS.COM
SALES@PLANARMONOLITHICS.COM
ISO 9001:2000 CERTIFIED

RESISTORS SMD 0603		
PARTS:	R1,R2,R3	
RESISTORS RM Chip		
MIL-HDBK-217F		pp 9-1 -- 9-3 Notice 2
λp = λb πT πP πS πQ πE failures per million hours		
λb	0.0037	Base Failure Rate RM Chip
πT	1.9	Temperature Factor for 95 deg C Mikes730049 3.7.1 sheet19
πP	0.068	Power Factor Normally less than 0.001 Watts
πS	0.79	Power Stress Factor
πQ	3	Quality Factor Using Non Established Reliability value of 3
πE	43	Environement Factor Auf Airborne Uninhabited Fighter Mil217 pp3-5 Mikes730049 3.7.1 sheet19
	0.0487	Failures per million hours.

DERATING		RESISTORS SMD 0603		
RADC-TR-82-177 LEVEL II ref pp 120-123 MIL-R-22684 and MIL-R39017				
Rated	Level II	Design	Units	
155	115	110	deg C	Temperature
50		1	V	Maximum working voltage
100	15	0.1	mW	Power Dissipation Normal Maximum
100	15	15	mW	Power Dissipation At Protection Specification 3.2.9

PLANAR MONOLITHICS INDUSTRIES, INC.
7311-G GROVE RD., FREDERICK MD.21704
TEL: 301-631-1579 FAX: 301-662-2029
URL: WWW.PLANARMONOLITHICS.COM
SALES@PLANARMONOLITHICS.COM
ISO 9001:2000 CERTIFIED

RESISTORS ETCHED		
PARTS:	R4,R5,R6,R7,R8,R9,R10	
RESISTORS RD		
MIL-HDBK-217F		pp 23-1 Microwave Attenuators states use Resistor type RD
		pp 9-1 -- 9-3 Notice 2
$\lambda p = \lambda b\ \pi T\ \pi P\ \pi S\ \pi Q\ \pi E$ failures per million hours		
λb	0.0037	Base Failure Rate
πT	1	Temperature Factor for 95 deg C Mikes730049 3.7.1 sheet19
πP	0.068	Power Factor Normally less than 0.001 Watts
πS	0.79	Power Stress Factor
πQ	3	Quality Factor Using Non Established Reliability value of 3
πE	43	Environement Factor Auf Airborne Uninhabited Fighter Mil217 pp3-5 Mikes730049 3.7.1 sheet19
	0.0256	Failures per million hours.

DERATING		RESISTORS ETCHED		
RADC-TR-82-177 LEVEL II ref pp 120-123 MIL-R-22684 and MIL-R39017				
Rated	Level II	Design	Units	
155	115	110	deg C	Temperature Omegaply has been tested at 160 deg C
50		1	V	Maximum working voltage
100	20	1	mW	Power Dissipation Normal Maximum
100	20	17	mW	Power Dissipation No Damage Specification 3.2.3

PLANAR MONOLITHICS INDUSTRIES, INC.
7311-G GROVE RD., FREDERICK MD.21704
TEL: 301-631-1579 FAX: 301-662-2029
URL: WWW.PLANARMONOLITHICS.COM
SALES@PLANARMONOLITHICS.COM
ISO 9001:2000 CERTIFIED

CAPACITORS MIS Beam Lead Capacitors		
PARTS:	C1a, C1b, C1c,C1d 4 in parallel	
CAPACITORS CM, CMR, CY, CYR all equivalent.		
MIL-HDBK-217F		pp10-1 -- 10-6 Notice 2
λp = λb πT πC πV πSR πQ πE failures per million hours		
λb	0.00076	Base Failure Rate Mica or Glass Cap Style CM or CY
πT	15	Temperature Factor for 95 deg C Mikes730049 3.7.1 sheet19
πC	0.35	Capacitance Factor 10pF
πV	1	Voltage Stress Factor 50 Volt diodes
πSR	1	Series Resistance Factor for tantalum capacitors only.
πQ	1	Quality Factor These capacitors are available as high reliability screened version.
πE	30	Environement Factor Auf Airborne Uninhabited Fighter Mil217 pp3-5 Mikes730049 3.7.1 sheet19
	0.1197	Failures per million hours.

DERATING		CAPACITORS MIS Beam Lead Capacitors		
RADC-TR-82-177 LEVEL II ref pp ,177 MIL-C-39014				
Rated	Level II	Design	Units	
150	125	110	deg C	Temperature
50	30	1	V	Maximum working voltage

PLANAR MONOLITHICS INDUSTRIES, INC.
7311-G GROVE RD., FREDERICK MD.21704
TEL: 301-631-1579 FAX: 301-662-2029
URL: WWW.PLANARMONOLITHICS.COM
SALES@PLANARMONOLITHICS.COM
ISO 9001:2000 CERTIFIED

CONNECTORS SMA RF		
PARTS:	J1,J2	
CONNECTORS COAXIAL, RF		
MIL-HDBK-217F		pp 15-1 -- 15-3
λp = λb πK πP πE failures per million hours		
λb	0.016	Base Failure Rate Teflon insert at 100 deg C
πK	1	Mating Factor. Mating / Unmating cycles per 1000 hours < 0.05
πP	1	Active Pins Factor Only 1 pin
πE	12	Environement Factor Auf Airborne Uninhabited Fighter Mil217 pp3-5 Mikes730049 3.7.1 sheet19
	0.1920	Failures per million hours.

DERATING		CONNECTORS SMA RF		
RADC-TR-82-177 LEVEL II ref pp 206-210				
Rated	Level II	Design	Units	
165	140	110	deg C	Temperature
500	350	1	V	Breakdown Voltage DC
2000	1400	30	mA	Current Protection Specification 3.2.9 (IttCannonSpec)

PLANAR MONOLITHICS INDUSTRIES, INC.
7311-G GROVE RD., FREDERICK MD.21704
TEL: 301-631-1579 FAX: 301-662-2029
URL: WWW.PLANARMONOLITHICS.COM
SALES@PLANARMONOLITHICS.COM
ISO 9001:2000 CERTIFIED

CONNECTORS GLASS FEEDTHROUGH PINS		
PARTS:	J1,J2,PIN1,2,3	
CONNECTORS COAXIAL, RF		
MIL-HDBK-217F		pp 15-1 -- 15-3
λp = λb πK πP πE failures per million hours		
λb	0.0004	Base Failure Rate
πK	1	Mating Factor. Mating / Unmating cycles per 1000 hours < 0.05
πP	1	Active Pins Factor Only 1 pin
πE	12	Environement Factor Auf Airborne Uninhabited Fighter Mil217 pp3-5 Mikes730049 3.7.1 sheet19
	0.0048	Failures per million hours.

DERATING		CONNECTORS GLASS FEEDTHROUGH PINS		
RADC-TR-82-177 LEVEL II ref pp 206-210				
Rated	Level II	Design	Units	
250		110	deg C	Temperature MIL-HDBK-217F pp15-2
2000	1400	30	mA	Current Protection Specification 3.2.9

PLANAR MONOLITHICS INDUSTRIES, INC.
7311-G GROVE RD., FREDERICK MD.21704
TEL: 301-631-1579 FAX: 301-662-2029
URL: WWW.PLANARMONOLITHICS.COM
SALES@PLANARMONOLITHICS.COM
ISO 9001:2000 CERTIFIED

LOW PASS FILTER		
PARTS:	LPF1	
ELECTRONIC FILTERS, NON TUNABLE		
MIL-HDBK-217F		pp 21-1
$\lambda p = \lambda b \; \pi Q \; \pi E$ failures per million hours		
λb	0.12	Base Failure Rate
πQ	1	Quality Factor MIL-SPEC
πE	13	Environement Factor Auf Airborne Uninhabited Fighter Mil217 pp3-5 Mikes730049 3.7.1 sheet19
	1.5600	Failures per million hours.

DERATING		LOW PASS FILTER		
RADC-TR-82-177 LEVEL II No Specific section covering filters or Duroid substrate				
Rated	Level II	Design	Units	
150		110	deg C	Temperature Dielectric tested -100 to +250 deg C

PLANAR MONOLITHICS INDUSTRIES, INC.
7311-G GROVE RD., FREDERICK MD.21704
TEL: 301-631-1579 FAX: 301-662-2029
URL: WWW.PLANARMONOLITHICS.COM
SALES@PLANARMONOLITHICS.COM
ISO 9001:2000 CERTIFIED

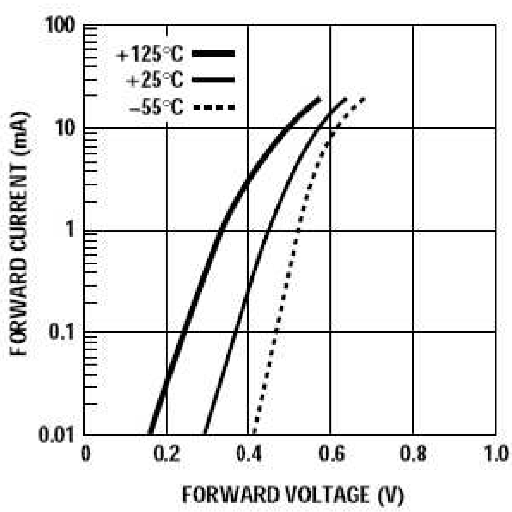
APPENDIX C: COMPONENT SPECIFICATIONS AND DATA

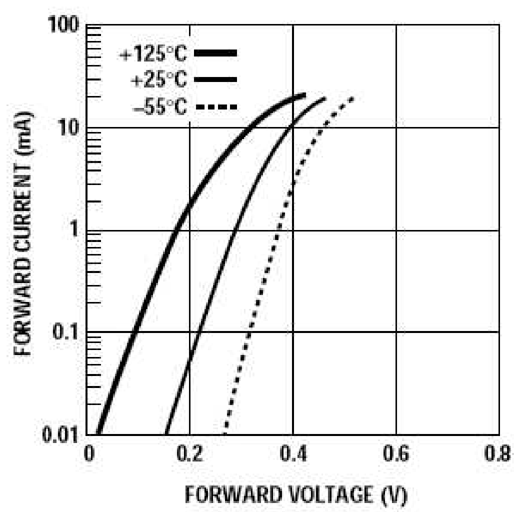
Detector Diode

The schottky diodes are rated for operation to 26 GHz..
High reliability specified and tested.
Specified to operate from –65 to 175 deg C.

There are a few optional models of these diodes, we will construct detectors with at least the two versions shown here. We will then select the best choice to meet specifications.

Typical Parameters





Maximum Ratings

Pulse Power Incident at T_A = 25° C .... 1 W
Pulse Width = 1 ms, Du = 0.001
CW Power Dissipation at T_A = 25° C .... 150 mW
Measured in an infinite heat sink derated linearly to zero at maximum rated temperature
T_{OPR} – Operating Temperature Range .... -65° C to +175 °C
T_{STG} – Storage Temperature Range .... -65° C to +200° C

Protection Diode

Maximum Ratings @ $T_A = 25°C$ unless otherwise specified

Characteristic	Symbol	Value	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	85	V
RMS Reverse Voltage	$V_{R(RMS)}$	60	V
Forward Continuous Current (Note 1) Single Diode Double Diode	I_{FM}	215 125	mA
Repetitive Peak Forward Current	I_{FRM}	500	mA
Non-Repetitive Peak Forward Surge Current @ t = 1.0μs @ t = 1.0ms @ t = 1.0s	I_{FSM}	4.0 1.0 0.5	A
Power Dissipation (Note 1)	P_d	150	mW
Thermal Resistance Junction to Ambient Air (Note 1)	$R_{\theta JA}$	833	°C/W
Operating and Storage Temperature Range	T_j, T_{STG}	-65 to +150	°C

Electrical Characteristics @ $T_A = 25°C$ unless otherwise specified

Characteristic	Symbol	Min	Typ	Max	Unit	Test Condition
Reverse Breakdown Voltage (Note 3)	$V_{(BR)R}$	85	—	—	V	$I_R = 100\mu A$
Forward Voltage	V_F	—	—	0.90 1.0 1.1 1.25	V	$I_F = 1.0mA$ $I_F = 10mA$ $I_F = 50mA$ $I_F = 150mA$
Leakage Current (Note 3)	I_R	—	—	5.0 80	nA nA	$V_R = 75V$ $V_R = 75V$, $T_j = 150°C$
Total Capacitance	C_T	—	2	—	pF	$V_R = 0$, f = 1.0MHz
Reverse Recovery Time	t_{rr}	—	—	3.0	μs	$I_F = I_R = 10mA$, $I_{rr} = 0.1 \times I_R$, $R_L = 100\Omega$

Notes: 3. Short duration test pulse used to minimize self-heating effect.

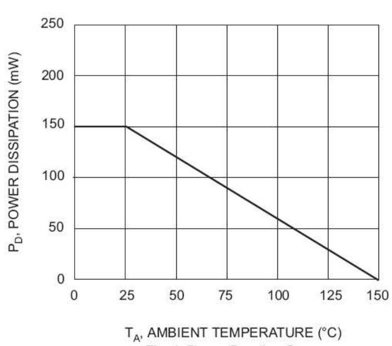


Fig. 1 Power Derating Curve

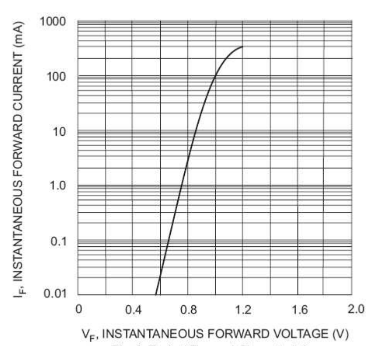


Fig. 2 Typical Forward Characteristics

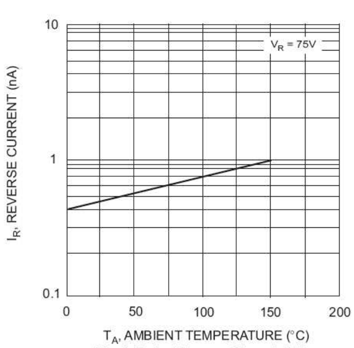


Fig. 3 Typical Reverse Characteristics

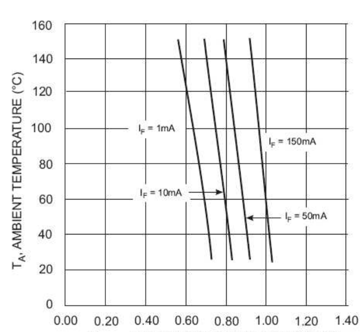


Fig. 4 Typical Forward Voltage vs Ambient Temperature

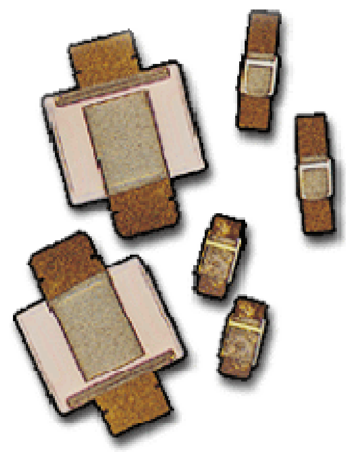
PLANAR MONOLITHICS INDUSTRIES, INC.
7311-G GROVE RD., FREDERICK MD.21704
TEL: 301-631-1579 FAX: 301-662-2029

URL: WWW.PLANARMONOLITHICS.COM
SALES@PLANARMONOLITHICS.COM
ISO 9001:2000 CERTIFIED

BEAM LEAD CAPACITORS MIS

Applications:

- DC Blocks
- Bypass
- Filters
- Matching



Maximum Ratings:

Storage Temperature -65 to 150°C
Operating Temperature -65 to 150 °C

Notes:

1. Consult factory for special versions or high reliability screening
2. Dielectric Withstanding Voltage is 50V
3. Typical Temperature Coeff. = 55ppm/°C
4. Typical Insertion Loss = 0.04dB
5. All data at 25°C

PLANAR MONOLITHICS INDUSTRIES, INC.
7311-G GROVE RD., FREDERICK MD.21704
TEL: 301-631-1579 FAX: 301-662-2029

URL: WWW.PLANARMONOLITHICS.COM
SALES@PLANARMONOLITHICS.COM
ISO 9001:2000 CERTIFIED

DISCRETE RESISTORS

ELECTRICAL CHARACTERISTICS

Table 2

CHARACTERISTICS		RC0603 1/10 W
Operating Temperature Range		–55 °C to +155 °C
Maximum Working Voltage		50 V
Maximum Overload Voltage		100 V
Dielectric Withstanding Voltage		100 V
Resistance Range	5% (E24)	1 Ω to 22 MΩ
	1% (E96)	1 Ω to 10 MΩ
	Zero Ohm Jumper < 0.05 Ω	
Temperature Coefficient	10 Ω < R ≤ 10 MΩ	±100 ppm/°C
	R ≤ 10 Ω; R > 10 MΩ	±200 ppm/°C
Jumper Criteria	Rated Current	1.0 A
	Maximum Current	2.0 A

FOOTPRINT AND SOLDERING PROFILES

For recommended footprint and soldering profiles, please see the special data sheet “Chip resistors mounting”.

ENVIRONMENTAL DATA

For material declaration information (IMDS-data) of the products, please see the separated info “Environmental data”.

PLANAR MONOLITHICS INDUSTRIES, INC.
7311-G GROVE RD., FREDERICK MD.21704
TEL: 301-631-1579 FAX: 301-662-2029
URL: WWW.PLANARMONOLITHICS.COM
SALES@PLANARMONOLITHICS.COM
ISO 9001:2000 CERTIFIED

ETCHED RESISTORS

SPECIFICATIONS AND PROPERTIES
OHMEGA-PLY® RESISTOR-CONDUCTOR MATERIAL

SHEET RESISTIVITIES	
Standard	10, 25, 50, 100, 250 ohms per square

TYPICAL PROPERTIES (EPOXY-GLASS DIELECTRIC)

ETCHED RESISTOR VARIATION (0.5" x 0.5" RESISTOR SIZE)	
10 ohms per square	Plus or minus 3%
25, 50, 100 ohms per square	Plus or minus 5%
250 ohms per square	Plus or minus 10%

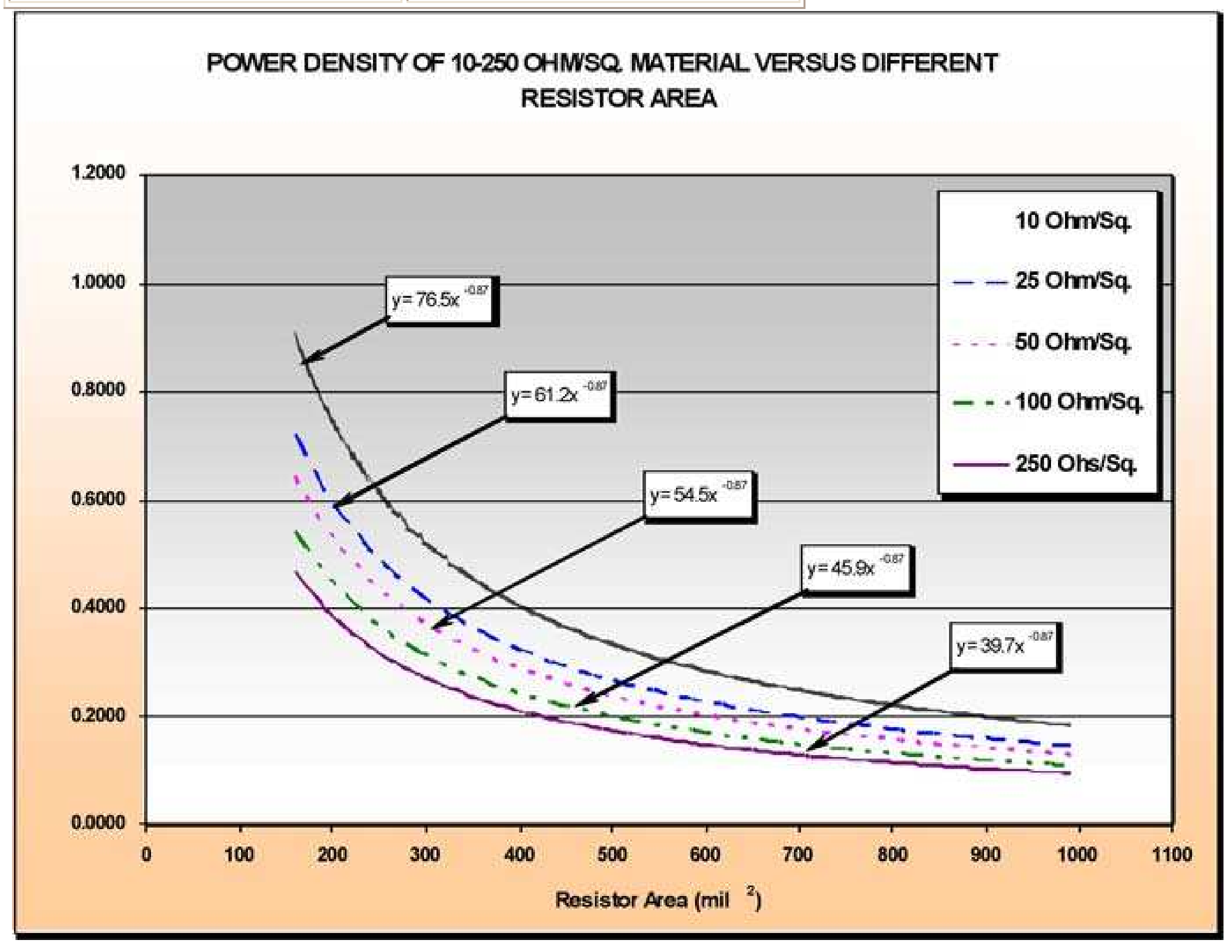
RESISTANCE CHANGE AFTER 240 HOURS EXPOSURE TO 95% HUMIDITY AT 40 ºC	2% maximum
CURRENT NOISE (PER MIL-STD-202, METHOD 308)	Less than -15 db

MAXIMUM TEMPERATURE COEFFICIENT OF RESISTANCE (-65 ºC TO 125 ºC)	
10 ohms per square	-20 ppm per degree C
25 ohms per square	-50 ppm per degree C
50 ohms per square	-80 ppm per degree C
100 ohms per square	+100 ppm per degree C
250 ohms per square	+100 ppm per degree C

RESISTANCE CHANGE AFTER 1000 HOURS 70 ºC AMBIENT TEMPERATURE	
10 ohms per square	0.4% max (10 Watts/square load)
25 ohms per square	0.5% max (5 Watts/square load)
50 ohms per square	1.0% max (2.5 Watts/square load)

100 ohms per square	1.0% max (2.5 Watts/square load)
250 ohms per square	1.0% max (2.5 Watts/square load)

TCR TRACKING	
25 ohms per square	Plus or minus 7 ppm per degree C max; Less than 2 ppm per degree C average
100 ohms per square	Plus or minus 15 ppm per degree C max; Less than 8 ppm per degree C average



PLANAR MONOLITHICS INDUSTRIES, INC.
7311-G GROVE RD., FREDERICK MD.21704
TEL: 301-631-1579 FAX: 301-662-2029
URL: WWW.PLANARMONOLITHICS.COM
SALES@PLANARMONOLITHICS.COM
ISO 9001:2000 CERTIFIED

FOR RESISTOR AREA LARGER THAN 1100 MIL^2, THE RECOMMENDED POWER DISSIPATION AT 25°C AMBIENT IS AS FOLLOWS:	
10 ohms per square	0.190+ MilliWatts/mil^2
25 ohms per square	0.150+Milliwatts/mil^2
50 ohms per square	0.138+Milliwatts/mil^2
100 ohms per square	0.100+Milliwatts/mil^2
250 ohms per square	0.090+Milliwatts/mil^2

Maximum power dissipation depends on the ambient temperature, resistor element size and laminate/circuit board thermal properties. Dissipation improves with the use of natural heatsinks such as ground and power planes. Typical power dissipation for most Ohmega-Ply resistor designs operating at an ambient of less than 70 °C is approximately 1/10 to 1/8 Watt.

Note: Because of continuing product improvement, the above specifications and properties are subject to change. The information and data contained herein are based on tests to date, but no warranty thereof is given.

VII) RELIABILITY TEST DATA AND SPECIFICATIONS

- Ohmega-Ply® has been used in numerous applications for over 25 years; exhibiting excellent performance and dependability. Due to its absolute long-term reliability under a variety of severe environmental conditions, Ohmega-Ply® is used in numerous critical products (space-base, aerospace, avionics, etc.) where the utmost in reliability is required.

- The estimated failure rate for Ohmega-Ply® resistors is less than 0.001 resistor elements per 1 million operating hours (this is based on test results where over 1 trillion component hour have been accumulated without a field failure. Field failure is defined as resistor failure that is caused by the resistive material itself, and not other sources of printed circuit board failure (opens, shorts, defective base material, excessive power surges, improper operating conditions, etc.).

- Ohmega-Ply® Specifications and Properties

PLANAR MONOLITHICS INDUSTRIES, INC.
7311-G GROVE RD., FREDERICK MD.21704
TEL: 301-631-1579 FAX: 301-662-2029

URL: WWW.PLANARMONOLITHICS.COM
SALES@PLANARMONOLITHICS.COM
ISO 9001:2000 CERTIFIED

OHMEGA-PLY® RCM PROPERTIES AND SPECIFICATIONS						Remark & Condition
Sheet Resistivities (ohm/square)	10	25	50	100	250	
Material Tolerance	+/-3	+/-5	+/-5	+/-5	+/-10	
Load Life Cycling Test (Δ R%)	<0.4 (after 1000 hrs)	<5	<5	<5	0.5 (after 1000 hrs)	MIL-STD-202-108I Ambient Temp: 70C On Cycle: 1.5 hrs Off Cycle: 1.5 hrs Length of Test: 10000 hrs
Current Noise Index in dB	<-16	<-15	<-15	<-15	<-15	MIL-STD-202-308 Voltage Applied 10 ohm/sq.: 53.2V 25 ohm/sq.: 5.6V 100 ohm/sq.: 7.9V
Short Time Overload (Δ R%)	0	0	0	0	0	MIL-R-10509 Method 4.6.6 Power: 2.5 X Rated Time: 5 Sec
Resistance Temperature Characteristic (RTC) PPM/ºC	13	50	60	100	100	MIL-STD-202-304 Hot Cycle: 25º , 50º, 75º & 125ºC Cold Cycle: 25º, 0º, -25º & -55ºC
Humidity Test (Δ R%)	0.3	0.5	0.75	1.0	2.0	MIL-STD-202-103A Temp: 40ºC Relative Humidity: 95 %

						Time: 240 hrs
Thermal Shock (Δ R%)	0.1	-0.5	1.0	1.0	1.0	MIL-STD-202-107B No. of Cycles: 25 Hot Cycle Temp: 125°C Cold Cycle Temp: -65ºC
Hot Oil (Δ R%)	--	0.1	0.25	0.5	0.75	IPC-TM-650 METHOD 2.4.6 Temp: 260ºC Immersion: 20ºC
Solder Float (Δ R%)	0.2	0.5	0.75	1.0	0.5	MIL-STD-202-210D Temp: 260ºC Immersion: 20 Seconds
Resistance To Solvent (Δ R%) Tolerance 1-1-1: Trichloroethan: Acetone: Freon:	N/A	0.2 0.0 0.2 0.0	N/A	N/A	N/A	MIL-STD-202-215A Immersion: 15 Min
Capacitance(pF) (at 5 Hz)	~0	~1	~1	~1	~1	
Inductance(nH) (at 5 Hz)	<~0.6	<~0.6	<~0.6	<~0.6	<~0.6	

PLANAR MONOLITHICS INDUSTRIES, INC.
7311-G GROVE RD., FREDERICK MD.21704
TEL: 301-631-1579 FAX: 301-662-2029

URL: WWW.PLANARMONOLITHICS.COM
SALES@PLANARMONOLITHICS.COM
ISO 9001:2000 CERTIFIED

- In addition to in-house reliability testing at Ohmega Technologies, Inc., there have been numerous tests performed on Ohmega-Ply® by OEM customers and prospective customers. A few of them are:

Cray Research[1]

In a study of the stability of buried Ohmega-Ply® resistors used for ECL termination, Cray concluded that the Ohmega-Ply® resistors "would operate well beyond all normal voltages and temperatures, and there have been no reports of a resistor failure due to resistive material." Cray Research also found that incorporating the Ohmega-Ply resistors into the internal plane of a multilayer board substantially improved the signal quality for high-speed devices. Cray Research has used Ohmega-Ply® in millions of multilayer circuit boards since 1982 with absolute field reliability of the resistive elements.

Alcatel Bell[2]

Researchers at Alcatel Bell tested Ohmega-Ply resistors for broadband (45 MHz-5GHz) telecom applications to characterize its impedance response and to compare the reliability of Ohmega-Ply to 0805 discrete thick film chip resistors, rated power 125 mW. A summary of their results is as follows.

Type of Test	Measured max./min. R (Alcatel Tested)	Ohmega Specifications	Thick film chip R (0805)
Humidity Test **Temp: 40ºC** **Relative Humidity: 93%**	**After 21 days:** 0.22% for 25 Ohm/sq. 0.07% for 100 Ohm/sq. 0.10% for 250 Ohm/sq. **After 56 days:** 0.74% for 25 Ohm/sq. 0.14% for 100 Ohm/sq. 0.22% for 250 Ohm/sq.	**After 10 days:** 0.5% for 25 Ohm/sq. 1.0% for 100 Ohm/sq.	After 56 days: ≤ ± 1.50%
Thermal Cycling **Hot Cycle Temp: 125ºC** **Cold Cycle: -25 ºC**	**After 100 Cycles** -0.03% for 25 Ohm/sq. 0.03% for 100 Ohm/sq. -0.08 for 250 Ohm/sq.	**After 25 Cycles** -0.5% for 25 Ohm/sq. 1% for 100 Ohm/sq.	≤± 0.25%
Aging Without Load **Temp: 125ºC**	**After 100 Hours** 0.10% for 25 Ohm/sq 0.08% for 100 Ohm/sq -0.13% for 250 Ohm/sq	Not specified	Not specified
Solder Heat/Float **Temp: 260ºC** **Immersion: 20ºC**	-0.02% for 25 Ohm/sq 0.01% for 100 Ohm/sq -0.01% for 250 Ohm/sq	0.5% for 25 Ohm/sq 1% for 100 Ohm/sq	≤± 0.25%

Sheet Resistivity Ohm/sq.	Lmin (nH)	Lmax (nH)	Cmin (pF)	Cmax (pF)
25	0.599	0.657	0.935	1.139
100	0.622	0.682	1.053	1.154
250	0.571	0.653	1.117	1.202
Short	0.6		1	

Minimum and maximum parasitic effects extracted from measured characteristic of integrated resistor

IBM[3]

IBM built and tested a numbers of evaluation boards that incorporated Ohmega-Ply® into number of internal layers of a multiplayer design. This effort was to see what effect, if any, there was on the assembly (and rework) process due to the embedded resistors. In addition, standard environmental stress tests were performed (including thermal cycling, thermal shock, vibration testing and torque testing). The findings of their published report showed “no significant resistance change on the resistors from the assembly process and stress test”.

Unisys[4]

In evaluating the long term drift characteristics of Ohmega-Ply® on high Tg, low DC substrate, Unisys concluded that powered (22 mA), Ni-P buried resistors, fabricated using ammoniacal etch process and fully aqueous resist, when placed in a 55 °C cabinet environment, will drift < 2 % in 100,000 hours (11.4 years).

Dassault[5]

Dassault Electronique did a 2 year study of Ohmega-Ply® for an active phased array antenna (X-band). The resistors were used in a stripline configuration a PTFE substrate (Rogers RT Duroid® 60002 and fusion bonded inside a multilayer package). The Ohmega-Ply® was compared to chip resistors and screen printed polymer inks. Ohmega-Ply® was selected for use due to superior tolerance and stability (compared to printed polymer inks) and space saving, parasitic reduction, and solder joint removal (compared to chip resistors). The results of testing are as follows:

PLANAR MONOLITHICS INDUSTRIES, INC.
7311-G GROVE RD., FREDERICK MD.21704
TEL: 301-631-1579 FAX: 301-662-2029
URL: WWW.PLANARMONOLITHICS.COM
SALES@PLANARMONOLITHICS.COM
ISO 9001:2000 CERTIFIED

Etching Tolerance	Minimum Resistor Width	Tolerance After Fusion Bonding	Influence of Ohmega-Ply Foil Layer on Microwave Properties	Shift of Resistor Values After 500 Thermal Cycles (-55°C, +125°C)	Thermal Coefficient of Resistance Within the Range (-55°C, +125°C)	Power Handling	No shift in microwave performance of two ports power divider, when Ohmega Foil Technology is tested under the following conditions:
5%	200 µ m	7%	NO	Microstrip: +2% Stripline: +3%	Microstrip: ±6% Stripline: ±7%	300 mW	• 500 thermal cycles (-55ºC, +125ºC) • 500 hours at 125ºC • 40 days 40ºC, 95% HR • 48 hours salt spray

Rogers Corporation[6]
In an internal study, Rogers evaluated Ohmega-Ply® resistors on Kapton® /Pyralux®. They found the following change in a resistor that was 0.25" x 4.0" in size with a flex radius of 0.25" (the flex rate was 10 cycles/minute):

Number of Flex Cycles	% Change in Resistance
150	0.5
1,500	6.1
10,000	25.5

When a cover film or conformal coating was placed over the resistors (or, the resistors were multilayered on an internal plane of circuitry), and flexed up to 250,000 cycles, there was no significant change in resistance.

References

1. Mahler, Bruce and Schroeder, Paul, "Planar Resistors in PCB Design", *Electronic Manufacturing, January 1989.*

2. Peeters, Joris et all., "Characterization of Integrated Resistors for Broadband Telecom Printed Circuit Boards", IPC *World Expo, June 1996.*

3. Martin, Cynthia, "Passive Devices Buried Resistors", *report from IBM, Austin, TX, 1998.*

4. Murphy, Tim, "Long Term Drift of Ni-P Buried Resistors on Cyanate Ester laminate", *IPC Printed Circuit Expo, 1994.*

5. Ledain, Bernard and Herblot, Jean, "Innovative Multilayer Technologies for Active Phased Array Antennas", *report from Dassault Electronique Saint-Cloud, France.*

6. Nguyen, Phong, "Shelf-Life and Flex-Life of Ohmega-Ply Materials", *Roger Microwave Conference, June 1989.*

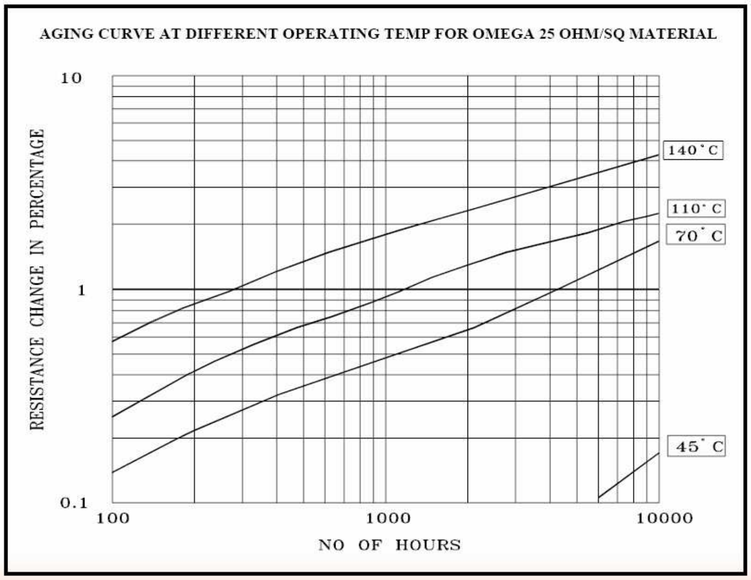
PLANAR MONOLITHICS INDUSTRIES, INC.
7311-G GROVE RD., FREDERICK MD.21704
TEL: 301-631-1579 FAX: 301-662-2029
URL: WWW.PLANARMONOLITHICS.COM
SALES@PLANARMONOLITHICS.COM
ISO 9001:2000 CERTIFIED

Ohmega Technologies, Inc.

Design Parameters for Optimum Long Term Stability

As a Function for Resistor Operating Temperature

Long-term reliability is a function of operating temperature. Like most electronic components, operating temperature (ambient temperature + temperature rise) is one of the most important factors that determine power rating of the component. As more power is dissipated through the resistors, the temperature of the resistor film increases which makes it more susceptible to thermal oxidation. Stability is measured by the change of resistance with aging. The figure below illustrates the relationship between different operating temperatures and change of resistance with respect to time.



Because the resistor film is a part of laminate, the physical and thermal characteristics of the substrate become major considerations. The heat dissipation of resistor films depends on:

1. The size (area) of the resistor
2. The circuit thickness and material type
3. The circuit configuration (clad/unclad)
4. ambient temperature
5. The thermal conductivity of the substrate
6. Additional system cooling (e.g. air-cooling, other heat sinking, etc.)

32

PLANAR MONOLITHICS INDUSTRIES, INC.
7311-G GROVE RD., FREDERICK MD.21704
TEL: 301-631-1579 FAX: 301-662-2029

URL: WWW.PLANARMONOLITHICS.COM
SALES@PLANARMONOLITHICS.COM
ISO 9001:2000 CERTIFIED

BURIED RESISTOR BURN-IN TRAYS

GENERAL OVERVIEW

Stressing the semi- conductor junctions can accelerate failure modes in integrated circuits. This stress usually takes the form of applying the rated, or just slightly above rated, voltages to the part while it is elevated to a higher than rated temperature. The parts are subsequently tested and the failures weeded out. This eliminates the phenomena of higher than normal failure rates early in the life cycle of a part, known as "infant mortality".

In order to ensure that all the parts see the required voltage, in the event of a single part failing with a short circuit, resistors are used to isolate each pin on each part from the common excitation signal. Since the excitation signal, whether DC or AC voltage, will drive the equivalent pins on each part, a short circuit on one part would jeopardize the integrity of the full burn-in on all the other parts.

IC's may have 16 isolated pins, thus requiring 16 eighth or quarter watt resistors per pin. These resistors take up valuable real estate on the burn-in trays. So much so that a tray with no isolation may hold 240 parts while a tray with full isolation may only hold 130 parts.

Utilizing Ohmega-Ply® and other modern printed circuit board design and fabrication techniques, a burn-in tray may be manufactured with the same density as a non-isolated tray, but with each pin fully isolated with the equivalent of an eighth watt resistor. A significant number of tray hours have already been experienced with no detrimental effects.

Trays were designed with multilayer polyimide construction for 125-150 degrees C continuous operation. Power dissipation per tray was limited to 75 watts based on system constraints. Testing has been accomplished on samples of the initial production run primarily to determine the effects of thermal shock and thermal soaking on the multilayer structure and resistor values.

Thermal Shock - MIL-STD-202, Method 107, Condition F, was followed for 50 cycles. This consisted of cycling from -65 to +150 degrees C holding at each temperature for 15 minutes and transferring in less than 2 minutes. There was absolutely no evidence of measling, blistering, or delamination. Further none of the 60 measured resistors changed in value.

PLANAR MONOLITHICS INDUSTRIES, INC.
7311-G GROVE RD., FREDERICK MD.21704
TEL: 301-631-1579 FAX: 301-662-2029
URL: WWW.PLANARMONOLITHICS.COM
SALES@PLANARMONOLITHICS.COM
ISO 9001:2000 CERTIFIED

Thermal Soak - Two sets of samples, one powered to 10 watts per square inch, the other powered to 1 watt per square inch were immersed in a 160 degree C environment in excess of 4,400 hours. Inasmuch as these are isolation and not precision resistors, design tolerances of +/- 20 percent are reasonable and achievable with this technique.

HIGH TEMPERATURE DRIFT
100 OHMS/SQ. @ 160 C

HOURS	1 WATT/SQ. IN.	10 WATTS/SQ. IN.
1400	+ 2.0%	+ 5%
2500	+ 2.5%	+ 5%
3500	+ 2.5%	+ 6%
4500	+ 2.5%	+ 7%

PLANAR MONOLITHICS INDUSTRIES, INC.
7311-G GROVE RD., FREDERICK MD.21704
TEL: 301-631-1579 FAX: 301-662-2029
URL: WWW.PLANARMONOLITHICS.COM
SALES@PLANARMONOLITHICS.COM
ISO 9001:2000 CERTIFIED

ROGERS CORPORATION

Advanced Circuit Materials

Advanced Circuit Materials Division
100 S. Roosevelt Avenue
Chandler, AZ 85226
Tel: 480-961-1382, Fax: 480-961-4533
www.rogerscorporation.com

Data Sheet
1.5000

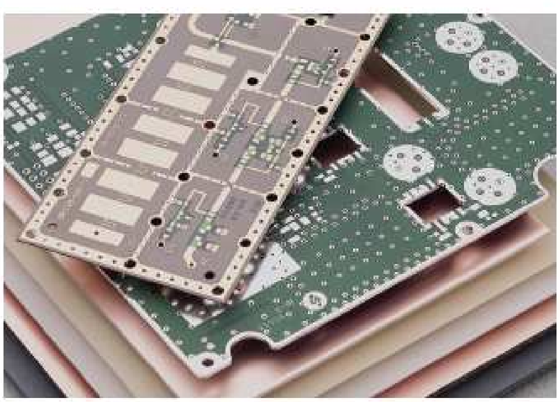
RT/duroid®5870 /5880 High Frequency Laminates

Features:

- Lowest electrical loss for reinforced PTFE material.
- Low moisture absorption.
- Isotropic
- Uniform electrical properties over frequency.
- Excellent chemical resistance.

Some Typical Applications:

- Commercial Airline Telephones
- Microstrip and Stripline Circuits
- Millimeter Wave Applications
- Military Radar Systems
- Missile Guidance Systems
- Point to Point Digital Radio Antennas



RT/duroid® 5870 and 5880 glass microfiber reinforced PTFE composites are designed for exacting stripline and microstrip circuit applications.

Glass reinforcing microfibers are randomly oriented to maximize benefits of fiber reinforcement in the directions most valuable to circuit producers and in the final circuit application.

The dielectric constant of RT/duroid 5870 and 5880 laminates is uniform from panel to panel and is constant over a wide frequency range. Its low dissipation factor extends the usefulness of RT/duroid 5870 and 5880 to Ku-band and above.

RT/duroid 5870 and 5880 laminates are easily cut, sheared and machined to shape. They are resistant to all solvents and reagents, hot or cold, normally used in etching printed circuits or in plating edges and holes.

Normally supplied as a laminate with electrodeposited copper of ¼ to 2 ounces/ft.^{2} (8 to 70μm) on both sides, RT/duroid 5870 and 5880 composites can also be clad with rolled copper foil for more critical electrical applications. Cladding with aluminum, copper or brass plate may also be specified.

When ordering RT/duroid 5870 and 5880 laminates, it is important to specify dielectric thickness, tolerance, rolled or electrodeposited copper foil, and weight of copper foil required.

PLANAR MONOLITHICS INDUSTRIES, INC.
7311-G GROVE RD., FREDERICK MD.21704
TEL: 301-631-1579 FAX: 301-662-2029

URL: WWW.PLANARMONOLITHICS.COM
SALES@PLANARMONOLITHICS.COM
ISO 9001:2000 CERTIFIED

PROPERTY	TYPICAL VALUE RT/duroid® 5870			TYPICAL VALUE RT/duroid 5880			DIRECTION	UNITS	CONDITION	TEST METHOD
Dielectric Constant, ε_r	2.33 2.33 ± 0.02 spec.			2.20 2.20 ± 0.02 spec.			Z Z		C24/23/50 C24/23/50	1 MHz IPC-TM-650, 2.5.5.3 10 GHz IPC-TM-2.5.5.5
Dissipation Factor, tan δ	0.0005 0.0012			0.0004 0.0009			Z Z		C24/23/50 C24/23/50	1 MHz IPC-TM-650, 2.5.5.3 10 GHz IPC-TM-2.5.5.5
Thermal Coefficient of ε_r	-115			-125				ppm/°C	-50 - 150°C	IPC-TM-650, 2.5.5.5
Volume Resistivity	2 X 10^7			2 X 10^7			Z	Mohm cm	C96/35/90	ASTM D257
Surface Resistivity	2 X 10^8			3 X 10^7			Z	Mohm	C/96/35/90	ASTM D257
Tensile Modulus	Test at 23°C	Test at 100°C		Test at 23°C	Test at 100°C			MPa (kpsi)	A	ASTM D638
	1300 (189)	490 (71)		1070 (156)	450 (65)		X			
	1280 (185	430 (63)		860 (125)	380 (55)		Y			
ultimate stress	50 (7.3)	34 (4.8)		29 (4.2)	20 (2.9)		X			
	42 (6.1)	34 (4.8)		27 (3.9)	18 (2.6)		Y			
ultimate strain	9.8	8.7		6.0	7.2		X	%		
	9.8	8.6		4.9	5.8		Y			
Compressive Modulus	1210 (176)	680 (99)		710 (103)	500 (73)		X	MPa (kpsi)	A	ASTM D695
	1360 (198)	860 (125)		710 (103)	500 (73)		Y			
	803 (120)	520 (76)		940 (136)	670 (97)		Z			
ultimate stress	30 (4.4)	23 (3.4)		27 (3.9)	22 (3.2)		X			
	37 (5.3)	25 (3.7)		29 (5.3)	21 (3.1)		Y			
	54 (7.8)	37 (5.3)		52 (7.5)	43 (6.3)		Z			
ultimate strain	4.0	4.3		8.5	8.4		X	%		
	3.3	3.3		7.7	7.8		Y			
	8.7	8.5		12.5	17.6		Z			
Deformation Under Load, Test at 150°C				1.0			Z	%	24hr/14 MPa (2 Kpsi)	ASTM D621
Heat Distortion Temperature	>260 (>500)			>260 (>500)			X,Y	°C (°F)	1.82 MPa (264 psi)	ASTM D648
Specific Heat	0.96 (0.23)			0.96 (0.23				J/g/K		Calculated
Moisture Absorption, Thickness 0.31" (0.8mm)	0.9 (0.02)			0.9 (0.02)				mg (%)	D24/23	ASTM D570
Moisture Absorption, 0.62" (1.6mm)	13 (0.015)			13 (0.015						
Thermal Conductivity	0.22			0.20			Z	W/m/K		ASTM C518
Thermal Expansion	X	Y	Z	X	Y	Z		mm/m		ASTM D3386 (10K/min) (Values given are total change from a base temperature of 35°C)
	-5.0	-5.5	-11.6	-6.1	-8.7	-18.7			-100°C	
	-0.6	-0.9	-4.0	-0.9	-1.8	-6.9			15	
	-0.3	-0.4	-2.6	-0.5	-0.9	-4.5			25	
	0.7	0.9	7.5	1.1	1.5	8.7			75	
	1.8	2.2	22.0	2.3	3.2	28.3			150	
	3.4	4.0	58.9	3.8	5.5	69.5			250	
Td	500			500				°C TGA		ASTM D3850
Density	2.2			2.2						ASTM D792
Copper Peel	20.8 (3.7)			22.8 (4.0)				pli (N/mm)	after solder float	IPC-TM-650 2.4.8
Flammability	94V-0			94V-0						UL
Lead-Free Process Compatible	Yes			Yes						

[1] SI unit given first with other frequently used units in parentheses.
[2] References: Internal TR's 1430, 2224, 2854. Test were at 23°C unless otherwise noted.
Typical values should not be used for specification limits.

STANDARD THICKNESS:		STANDARD PANEL SIZE:	STANDARD COPPER CLADDING:
0.005" (0.127mm),	0.031" (0.787mm)	18" X 12" (457 X 305mm)	¼ oz. (8 µm) electrodeposited copper foil.
0.010" (0.254mm),	0.062" (1.575mm)	18" X 24" (457 X 610mm)	½ oz. (17µm), 1 oz. (35µm), 2 oz. (70µm) electrodeposited and rolled copper foil.
0.015" (0.381mm),	0.125" (3.175mm)	18" X 36" (457 X 915mm)	
0.020" (0.508mm),		18" X 48" (457 X 1.224m)	

The information in this data sheet is intended to assist you in designing with Rogers' circuit material laminates. It is not intended to and does not create any warranties express or implied, including any warranty of merchantability or fitness for a particular purpose or that the results shown on this data sheet will be achieved by a user for a particular purpose. The user should determine the suitability of Rogers' circuit material laminates for each application.

These commodities, technology and software are exported from the United States in accordance with the Export Administration regulations. Diversion contrary to U.S. law prohibited. RT/duroid and DUROID are licensed trademarks of Rogers Corporation.

Revised 11/06 0696-1106-0.5CC **Publication #92-101**

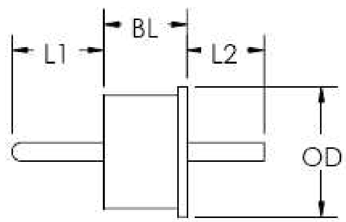
PLANAR MONOLITHICS INDUSTRIES, INC.
7311-G GROVE RD., FREDERICK MD.21704
TEL: 301-631-1579 FAX: 301-662-2029

URL: WWW.PLANARMONOLITHICS.COM
SALES@PLANARMONOLITHICS.COM
ISO 9001:2000 CERTIFIED

SPECIAL HERMETIC PRODUCTS, INC.
Hi-Rel By Design
39 Souhegan Street - P.O. Box 269, Wilton, New Hampshire 03086
TEL (603) 654-2002 FAX (603) 654-2533
email: sales@shp-seals.com - website: www.shp-seals.com

HERMETIC FEEDTHRUS

PATENTED
US Patent No. 4,841,101
Canada Patent No. 1,318,371



ALUMINUM COMPATIBLE

Designed specifically for use in aluminum housings, our feedthrus will provide highly reliable hermetic sealing in cyclic military and processing temperature environments, when installed in accordance with recommended application data. Our feedthrus will also minimize assembly time and enhance solder joint quality.

STANDARD SEALS (1) (7)									
PART NO.				OTHER DIMENSIONS			f_c	MATERIAL	
SERIES	L1 (4) ±.005	L2 (4) (8) ±.005	PLATING CODE (2) (3)	OD +.001 -.002	BL ±.002	PIN DIA. RF ±.0005 DC ±.0015	GHz	GLASS Corning or Equiv.	FERRULE & PIN
50 Ω (6)									
SHP8612	xxxR	xxx	01	.086	.062	.012	45	7070	
SHP9815	xxxR	xxx	01	.098	.062	.015	40	7070	
SHP98B12	xxxR	xxx	01	.098	.062	.012	49	7070	
SHP1115	xxxR	xxx	01	.110	.060	.015	40	7070	ASTM-F15
SHP1218	xxxR	xxx	01	.120	.060	.018	30	7070	
SHP1520	xxxR	xxx	01	.158	.060	.020	23	7052	
SHP1536/20	085C	xxx	01	.158	.060	.036/.020	23	7052	
DC (5)									
SHP60xx	xxx	xxx	01	.060	.050	.015, .018, .020, .021		7052	ASTM-F15
SHP74Bxx	xxx	xxx	02	.074	.073	.020, .025		9013	STEEL
SHP74Cxx	xxx	xxx	02	.074	.062	.020, .025	N/A	9013	STEEL
SHP74Dxx	xxx	xxx	02	.074	.040	.020, .025		9013	STEEL
SHP98Axx	xxx	xxx	02	.098	.062	.025, .030		9013	STEEL
SHP13xx	xxx	xxx	02	.138	.110	.030, .040, .050		9013	STEEL

Example Part No: SHP9815-075R-125-01

NOTES:
(1) Seals of any desired geometry can be provided. Contact us for your special requirements.
(2) Standard plating for ASTM-F15 is 50 microinches minimum GOLD per MIL-G-45204, Type III, Grade A over 100-200 microinches NICKEL per MIL-C-26074. Plating thickness is measured on pin.
(3) Standard plating for STEEL is 50 microinches minimum GOLD per MIL-G-45204, Type III, Grade A over 200-400 microinches NICKEL per MIL-C-26074. Plating thickness is measured on pin.
(4) Standard pin termination is straight-cut (radius on L1 end on 50 Ω). Special pin terminations are also available (see page 3).
(5) Insert desired pin diameter in thousandths, in series.
(6) RF feedthrus are stocked with various standard L1 lead lengths for quicker delivery. Contact us for details.
(7) See Bulletin 200 for solder preforms.
(8) ±.003 on 50 Ω

All dimensions are inches.