

# X3 Frequency Multiplier

RMK-3-93+

50Ω Output 5400 to 9000 MHz

## The Big Deal

- Broadband tripler for 5.4-9 GHz signal production
- High rejection of F2 and F4 (-55 dBc typ)
- Low conversion loss, 15 dB typ
- Outstanding performance at a low price



CASE STYLE: TT1224

## Product Overview

The RMK-3-93+ is a broadband frequency tripler offering excellent performance for C- to X-band signals. The aqueous washable and RoHS-compliant package features rugged, wire-welded construction, in a small 0.25" x 0.31" x 0.16" plastic case.

## Key Features

Feature	Advantages
Broad bandwidth	Ideal for satellite up- and down-converters and line-of-sight communication links, as well as items operating in the 8.5-9.0 GHz radiolocation band
High rejection of F2 and F4	Proprietary internal circuitry achieves high harmonic suppression, keeping filtering requirements to a minimum
Low conversion loss	High output reduces external gain requirements after frequency tripling.
Low price	Practical, low cost solution for providing high frequency sources from lower frequency VCOs and synthesizers.

### Notes

- A. Performance and quality attributes and conditions not expressly stated in this specification document are intended to be excluded and do not form a part of this specification document.  
B. Electrical specifications and performance data contained in this specification document are based on Mini-Circuit's applicable established test performance criteria and measurement instructions.  
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# X3 Frequency Multiplier

## RMK-3-93+

50Ω Output 5400 to 9000 MHz

### Maximum Ratings

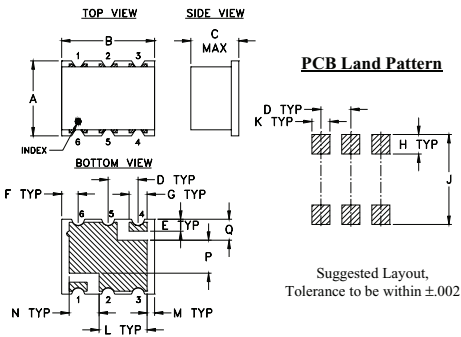
Operating Temperature	-40°C to 85°C
Storage Temperature	-55°C to 100°C
RF Input Power	17 dBm

Permanent damage may occur if any of these limits are exceeded.

### Pin Connections

INPUT	1
OUTPUT	4
GROUND	2,3,5,6

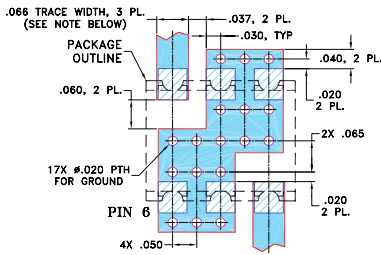
### Outline Drawing



### Outline Dimensions (inch/mm)

A	B	C	D	E	F	G	H
.25	.31	.16	.100	.040	.055	.060	.065
6.35	7.87	4.06	2.54	1.02	1.40	1.52	1.65
J	K	L	M	N	P	Q	wt.
.300	.060	.160	.025	.100	.110	.070	grams
7.62	1.52	4.06	0.64	2.54	2.79	1.78	0.16

### Demo Board MCL P/N: TB-393 Suggested PCB Layout (PL-258)



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### Features

- broadband
- high rejection F2 & F4, -55 dBc typ.
- low cost
- aqueous washable

### Applications

- synthesizers
- local oscillators
- satellite up and down converters

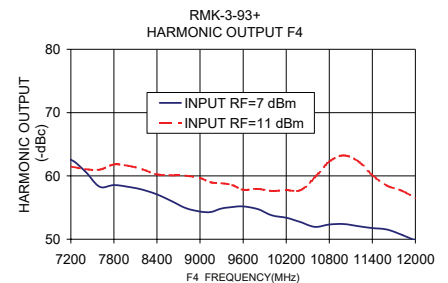
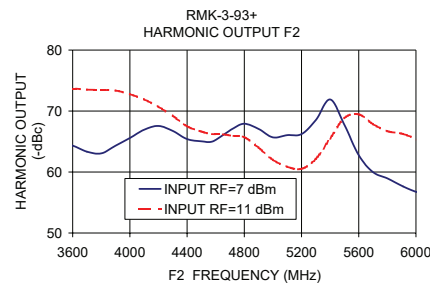
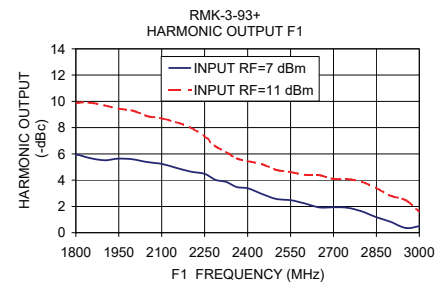
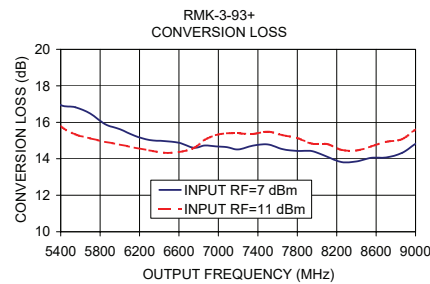
### Electrical Specifications

MULTIPLICATION FACTOR	FREQUENCY (MHz)		INPUT POWER (dBm)		CONVERSION LOSS (dB)		*HARMONIC OUTPUT (dBC)					
	F1 Input	F3 Output	Min.	Max.	Typ.	Max.	F1 Typ.	F2 Typ.	F4 Typ.			
3	1800-3000	5400-9000	7	11	15	19.5	6	-6	55	35	55	35

\* Harmonics of input frequency below the power level of F3

### Typical Performance Data

Input Frequency (MHz)	INPUT RF= 7 dBm			INPUT RF= 11 dBm				
	Conversion Loss (dB)	Harmonic Output Below F3 (-dBc)		Conversion Loss (dB)	Harmonic Output Below F3 (-dBc)			
		F1	F2	F4		F1	F2	F4
1800.00	16.94	5.94	64.33	62.56	15.79	9.86	73.68	61.49
1900.00	16.48	5.52	63.05	58.30	15.12	9.69	73.46	60.98
2000.00	15.62	5.58	65.59	58.27	14.78	9.29	72.77	61.61
2100.00	15.03	5.24	67.56	57.08	14.46	8.70	70.70	60.24
2200.00	14.88	4.66	65.40	54.92	14.37	8.01	67.50	60.03
2287.50	14.73	4.02	64.99	54.30	15.04	6.58	66.22	58.98
2325.00	14.68	3.86	66.04	54.86	15.30	6.15	66.18	58.85
2400.00	14.51	3.38	67.92	55.19	15.39	5.45	65.72	57.81
2450.00	14.72	2.95	67.05	54.79	15.36	5.22	64.01	57.96
2500.00	14.79	2.57	65.67	53.79	15.49	4.78	62.00	57.62
2550.00	14.53	2.48	66.05	53.40	15.30	4.62	60.87	57.76
2600.00	14.43	2.23	66.21	52.72	15.14	4.40	60.52	57.74
2650.00	14.42	1.93	68.53	51.96	14.83	4.38	62.14	59.76
2700.00	14.12	1.94	71.91	52.32	14.81	4.09	65.72	62.24
2750.00	13.82	1.89	67.73	52.40	14.49	4.08	68.87	63.23
2800.00	13.85	1.62	62.77	52.06	14.45	3.86	69.45	62.33
2850.00	14.05	1.18	59.98	51.75	14.68	3.39	67.86	60.15
2900.00	14.07	0.82	58.96	51.55	14.93	2.81	66.70	58.49
2955.00	14.33	0.35	57.62	50.67	15.08	2.45	66.24	57.64
3010.00	14.90	0.57	56.61	49.65	15.68	1.47	65.11	56.28



## Typical Performance Data

FREQUENCY (MHz)				CONVERSION LOSS (dB)	RF IN = 7 dBm		
X1 OUTPUT	X2 OUTPUT	X3 OUTPUT	X4 OUTPUT		HARMONIC OUTPUT* (-dBc)		
X1 OUTPUT	X2 OUTPUT	X3 OUTPUT	X4 OUTPUT	X3 OUTPUT	X1 OUTPUT	X2 OUTPUT	X4 OUTPUT
1800.0	3600.0	5400.0	7200.0	16.94	5.94	64.33	62.56
1850.0	3700.0	5550.0	7400.0	16.82	5.67	63.33	60.72
1900.0	3800.0	5700.0	7600.0	16.48	5.52	63.05	58.30
1950.0	3900.0	5850.0	7800.0	15.90	5.64	64.32	58.55
2000.0	4000.0	6000.0	8000.0	15.62	5.58	65.59	58.27
2050.0	4100.0	6150.0	8200.0	15.26	5.38	66.93	57.83
2100.0	4200.0	6300.0	8400.0	15.03	5.24	67.56	57.08
2150.0	4300.0	6450.0	8600.0	14.97	4.94	66.75	56.03
2200.0	4400.0	6600.0	8800.0	14.88	4.66	65.40	54.92
2250.0	4500.0	6750.0	9000.0	14.60	4.48	65.03	54.37
2287.5	4575.0	6862.5	9150.0	14.73	4.02	64.99	54.30
2325.0	4650.0	6975.0	9300.0	14.68	3.86	66.04	54.86
2362.5	4725.0	7087.5	9450.0	14.64	3.47	67.19	55.08
2400.0	4800.0	7200.0	9600.0	14.51	3.38	67.92	55.19
2450.0	4900.0	7350.0	9800.0	14.72	2.95	67.05	54.79
2500.0	5000.0	7500.0	10000.0	14.79	2.57	65.67	53.79
2550.0	5100.0	7650.0	10200.0	14.53	2.48	66.05	53.40
2600.0	5200.0	7800.0	10400.0	14.43	2.23	66.21	52.72
2650.0	5300.0	7950.0	10600.0	14.42	1.93	68.53	51.96
2700.0	5400.0	8100.0	10800.0	14.12	1.94	71.91	52.32
2750.0	5500.0	8250.0	11000.0	13.82	1.89	67.73	52.40
2800.0	5600.0	8400.0	11200.0	13.85	1.62	62.77	52.06
2850.0	5700.0	8550.0	11400.0	14.05	1.18	59.98	51.75
2900.0	5800.0	8700.0	11600.0	14.07	0.82	58.96	51.55
2955.0	5910.0	8865.0	11820.0	14.33	0.35	57.62	50.67
3010.0	6020.0	9030.0	12040.0	14.90	0.57	56.61	49.65

\* Harmonic Output below power level of X3 Output.

FREQUENCY (MHz)				CONVERSION LOSS (dB)	RF IN = 11 dBm		
X1 OUTPUT	X2 OUTPUT	X3 OUTPUT	X4 OUTPUT		HARMONIC OUTPUT* (-dBc)		
X1 OUTPUT	X2 OUTPUT	X3 OUTPUT	X4 OUTPUT	X3 OUTPUT	X1 OUTPUT	X2 OUTPUT	X4 OUTPUT
1800.0	3600.0	5400.0	7200.0	15.79	9.86	73.68	61.49
1850.0	3700.0	5550.0	7400.0	15.34	9.90	73.51	61.07
1900.0	3800.0	5700.0	7600.0	15.12	9.69	73.46	60.98
1950.0	3900.0	5850.0	7800.0	14.93	9.44	73.36	61.81
2000.0	4000.0	6000.0	8000.0	14.78	9.29	72.77	61.61
2050.0	4100.0	6150.0	8200.0	14.61	8.88	71.89	61.03
2100.0	4200.0	6300.0	8400.0	14.46	8.70	70.70	60.24
2150.0	4300.0	6450.0	8600.0	14.33	8.42	69.22	60.11
2200.0	4400.0	6600.0	8800.0	14.37	8.01	67.50	60.03
2250.0	4500.0	6750.0	9000.0	14.59	7.34	66.63	59.68
2287.5	4575.0	6862.5	9150.0	15.04	6.58	66.22	58.98
2325.0	4650.0	6975.0	9300.0	15.30	6.15	66.18	58.85
2362.5	4725.0	7087.5	9450.0	15.40	5.65	65.93	58.56
2400.0	4800.0	7200.0	9600.0	15.39	5.45	65.72	57.81
2450.0	4900.0	7350.0	9800.0	15.36	5.22	64.01	57.96
2500.0	5000.0	7500.0	10000.0	15.49	4.78	62.00	57.62
2550.0	5100.0	7650.0	10200.0	15.30	4.62	60.87	57.76
2600.0	5200.0	7800.0	10400.0	15.14	4.40	60.52	57.74
2650.0	5300.0	7950.0	10600.0	14.83	4.38	62.14	59.76
2700.0	5400.0	8100.0	10800.0	14.81	4.09	65.47	62.24
2750.0	5500.0	8250.0	11000.0	14.49	4.08	68.87	63.23
2800.0	5600.0	8400.0	11200.0	14.45	3.86	69.45	62.33
2850.0	5700.0	8550.0	11400.0	14.68	3.39	67.86	60.15
2900.0	5800.0	8700.0	11600.0	14.93	2.81	66.70	58.49
2955.0	5910.0	8865.0	11820.0	15.08	2.45	66.24	57.64
3010.0	6020.0	9030.0	12040.0	15.68	1.47	65.11	56.28

\* Harmonic Output below power level of X3 Output.

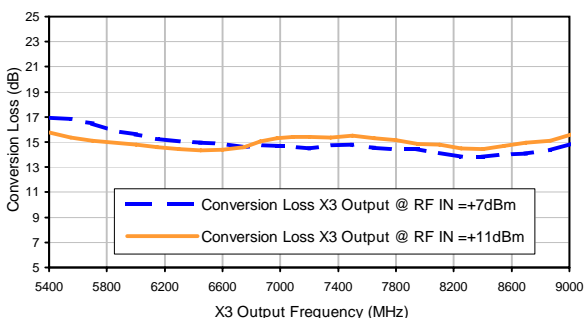


ISO 9001 ISO 14001 AS 9100 CERTIFIED

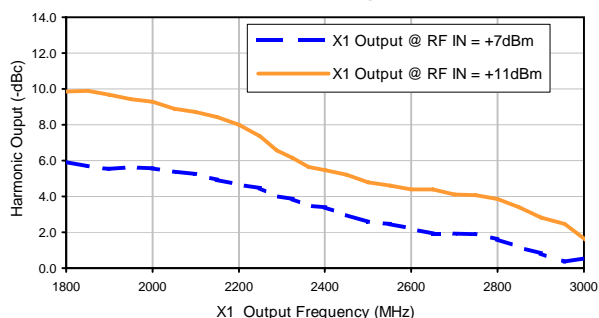


## Typical Performance Curves

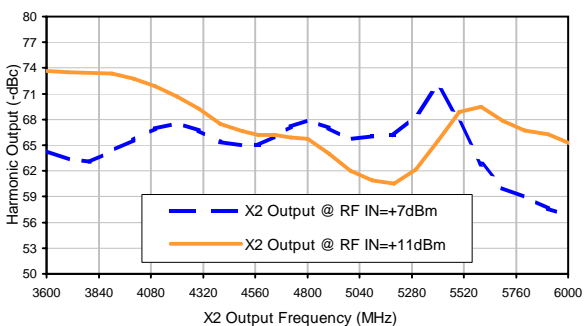
**Conversion Loss X3 Output**



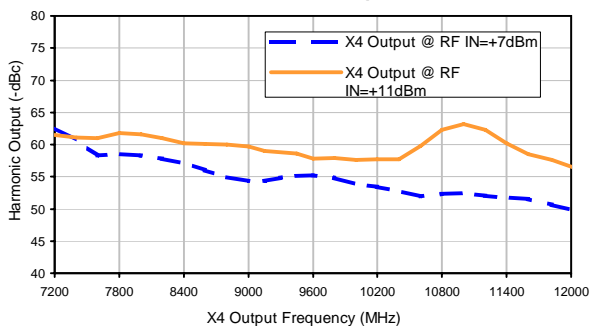
**Harmonic X1 Output**



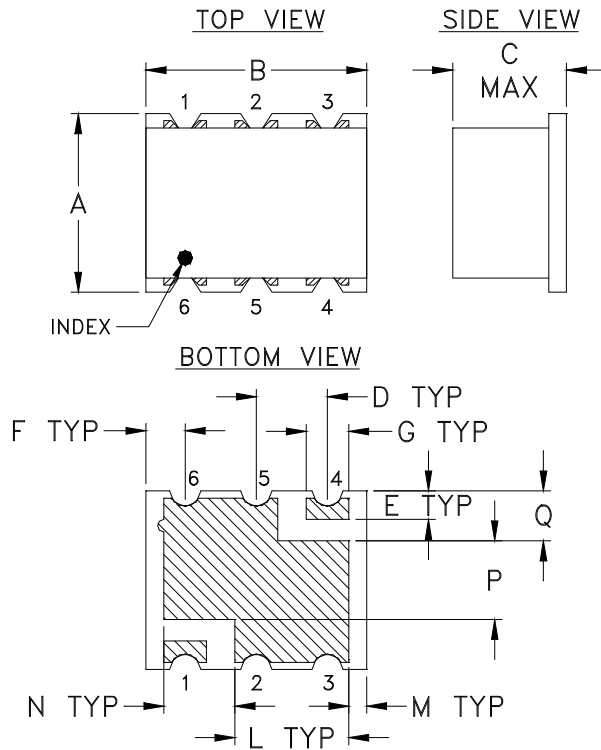
**Harmonic X2 Output**



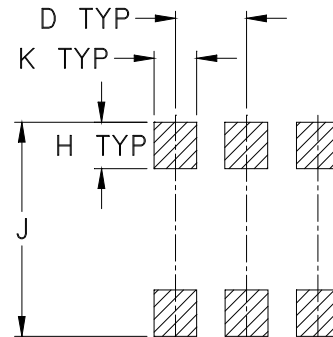
**Harmonic X4 Output**



### Outline Dimensions



### PCB Land Pattern



Suggested Layout,  
Tolerance to be within  $\pm .002$

CASE #	A	B	C	D	E	F	G	H	J	K	L
TT1224	.25 (6.35)	.31 (7.87)	.16 (4.06)	.100 (2.54)	.040 (1.02)	.055 (1.40)	.060 (1.52)	.065 (1.65)	.300 (7.62)	.060 (1.52)	.160 (4.06)

CASE #	M	N	P	Q	WT. GRAM
TT1224	.025 (.64)	.100 (2.54)	.110 (2.79)	.070 (1.78)	.16

Dimensions are in inches (mm). Tolerances: 2Pl.  $\pm .01$ ; 3 Pl.  $\pm .005$

#### Notes:

1. Case material: Plastic.
2. Termination: 2-10  $\mu$  inch (.05-.25 microns) Gold over 100-300  $\mu$  inch (2.54-7.62 microns) Nickel plate



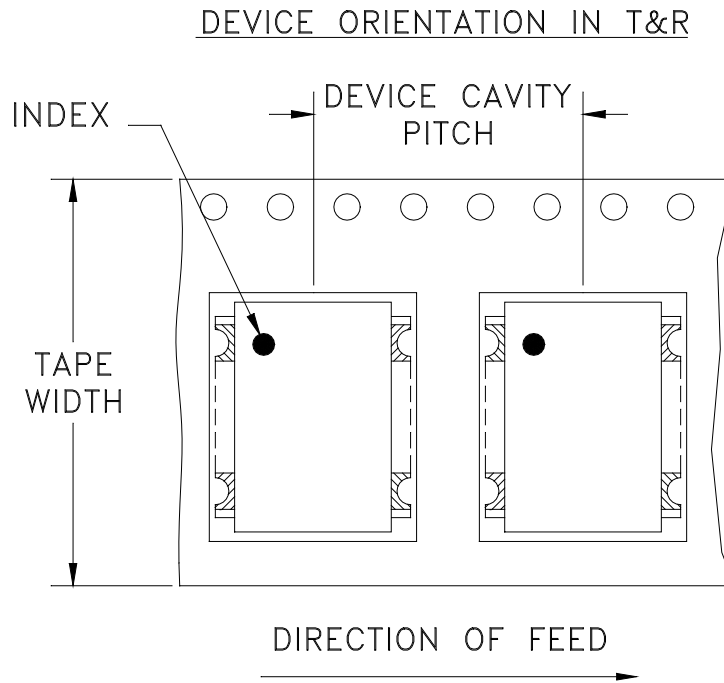
P.O. Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718) 332-4661 For detailed performance specs & shopping online see Mini-Circuits web site



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RF/IF MICROWAVE COMPONENTS

# Tape & Reel Packaging TR-F2



Tape Width, mm	Device Cavity Pitch, mm	Reel Size, inches	Devices per Reel See note
16	12	7	10
			20
			50
			100
			200
		13	500
			1000

Mini-Circuits carrier tape materials provide protection from ESD (Electro-Static Discharge) during handling and transportation. Tapes are static dissipative and comply with industry standards EIA-481/EIA-541.

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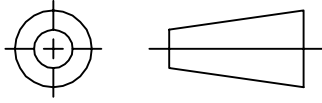
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THIRD ANGLE PROJECTION

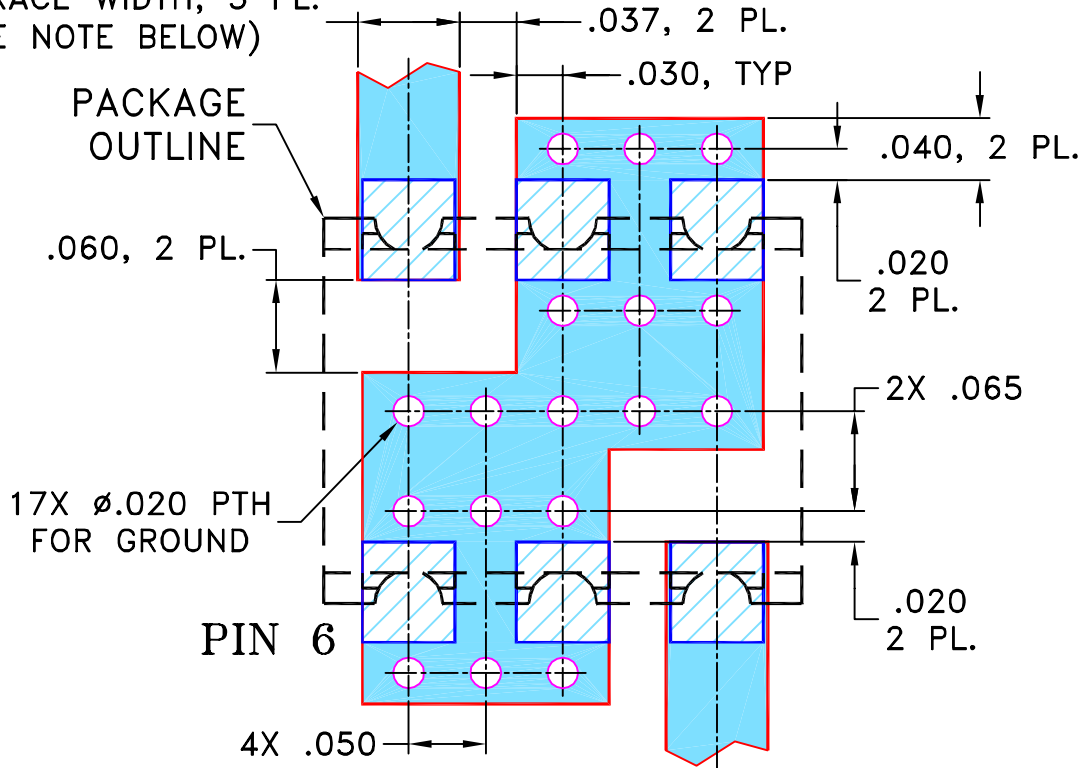


REVISIONS

REV	ECN No.	DESCRIPTION	DATE	DR	AUTH
OR	M108897	NEW RELEASE	01/04/07	AV	DJ

**SUGGESTED MOUNTING CONFIGURATION  
FOR TT1224 CASE STYLE "rv" PIN CONNECTION**

.066 TRACE WIDTH, 3 PL.  
(SEE NOTE BELOW)



- NOTES: 1. TRACE WIDTH IS SHOWN FOR ROGERS R04350B WITH DIELECTRIC THICKNESS .030" ± .002"; COPPER: 1/2 OZ. EACH SIDE. FOR OTHER MATERIALS TRACE WIDTH MAY NEED TO BE MODIFIED.  
2. BOTTOM SIDE OF THE PCB IS CONTINUOUS GROUND PLANE.

- DENOTES PCB COPPER LAYOUT WITH SMOBC (SOLDER MASK OVER BARE COPPER)
- DENOTES COPPER LAND PATTERN FREE OF SOLDER MASK

UNLESS OTHERWISE SPECIFIED	INITIALS	DATE
DRAWN	AV	12/14/06
CHECKED	IL	01/04/07
APPROVED	DJ	01/04/07

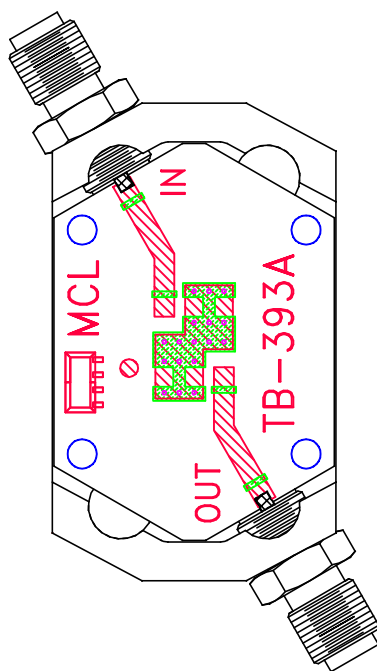
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PL, rv, TT1224, RMK-3-662+, TB-393

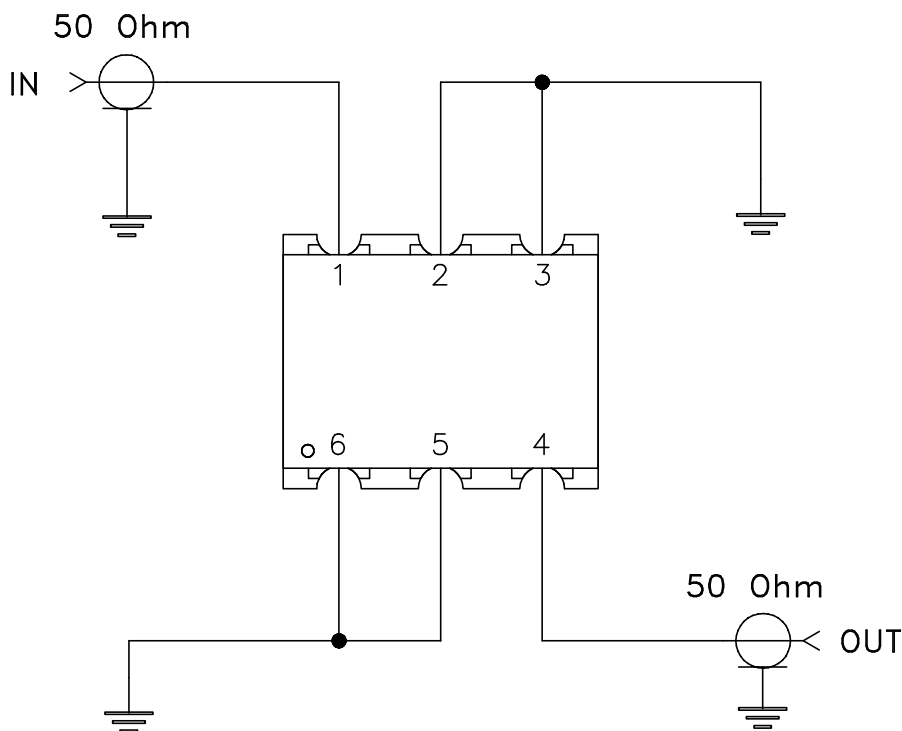
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SIZE	CODE IDENT	DRAWING NO:	REV:
A	15542	98-PL-258	OR
FILE:	98PL258	SCALE:	8:1
SHEET:	1	OF	1

# Evaluation Board and Circuit




TB-393



Schematic Diagram

## Notes:

1. SMA Female connectors.
2. PCB Material: Rogers R04350 or equivalent, Dielectric Constant=3.5, Thickness=.030 inch.

 Mini-Circuits®





All Mini-Circuits products are manufactured under exacting quality assurance and control standards, and are capable of meeting published specifications after being subjected to any or all of the following physical and environmental test.

Specification	Test/Inspection Condition	Reference/Spec
Operating Temperature	-40° to 85°C Ambient Environment	Individual Model Data Sheet
Storage Temperature	-55° to 100° C Ambient Environment	Individual Model Data Sheet
Humidity	90 to 95% RH, 240 hours, 50°C	MIL-STD-202, Method 103, Condition A, Except 50°C and end-point electrical test done within 12 hours
Thermal Shock	-55° to 100°C, 100 cycles	MIL-STD-202, Method 107, Condition A-3, except +100°C
Solder Reflow Heat	Sn-Pb Eutetic Process: 225°C peak Pb-Free Process 245° - 250°C peak	J-STD-020, Table 4-1, 4-2 and 5-2, Figure 5-1
Solderability	10X Magnification	J-STD-002, 95% Coverage
Vibration (High Frequency)	20g peak, 10-2000 Hz, 12 times in each of three perpendicular directions (total 36)	MIL-STD-202, Method 204, Condition D
Mechanical Shock	50g, 11 ms, 1/2-sine, 18 shocks: 3 each direction, each of 3 axes	MIL-STD-202, Method 213, Condition A
Marking Resistance to Solvents	Isopropyl alcohol + mineral spirits at 25°C; terpene defluxer at 25°C; distilled water + proylene glycol monomethyl ether + monoethanolamine at 63°C to 70°C	MIL-STD-202, Method 215