

# X3 Frequency Multiplier

## RMK-3-33+

50Ω    Output 2100 to 3000 MHz

### The Big Deal

- Broadband, for 2.1 to 3.0 GHz signal production
- Wide input power range, +12 to +17 dBm
- Low conversion loss, 14.1 dB typ.
- Good harmonic suppression: F2, 47.5 dBc; F4, 43.5 dBc



CASE STYLE: TT1224

### Product Overview

Mini-Circuits' RMK-3-33+ frequency multiplier provides a multiplication factor of 3 converting input frequencies from 700 to 1000 MHz into output frequencies from 2100 to 3000 MHz, supporting applications including synthesizers, local oscillators, transceiver chains, satellite up and down converters and more. It provides an input power range from +12 to +17 dBm, low conversion loss, and good harmonic suppression. The multiplier comes housed in a miniature surface mount package (0.25 x 0.31 x 0.16") ideal for dense circuit board layouts.

Feature	Advantages
Low conversion loss, 14.1 dB typ.	With a low conversion loss, RMK-3-33+ produces higher output power, reducing the need for amplification.
Very good harmonic suppression <ul style="list-style-type: none"><li>• F2, 47.5 dBc</li><li>• F4, 43.5 dBc</li></ul>	Reduces spurious signals and the need for additional filtering.
Broadband	With an output frequency range spanning 2100 to 3000 MHz, this multiplier covers a wide range of applications.
Wide input power range, +12 to +17 dBm	Wide input power signal range accommodates different input signal levels while still maintaining a low conversion loss.
Low cost	Provides an easy, cost-effective solution for generating high-frequency signals from a lower frequency signal source.
Small size	Measuring only 0.25 x 0.31 x 0.16", the RMK-3-33+ saves space in crowded PCB layouts.

#### 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-3-33+

50Ω Output 2100 to 3000 MHz



Generic photo used for illustration purposes only  
CASE STYLE: TT1224

**+RoHS Compliant**  
The +Suffix identifies RoHS Compliance. See our web site for RoHS Compliance methodologies and qualifications

**Available Tape and Reel at no extra cost**

Reel Size	Devices/Reel
7"	10, 20, 50, 100, 200
13"	500

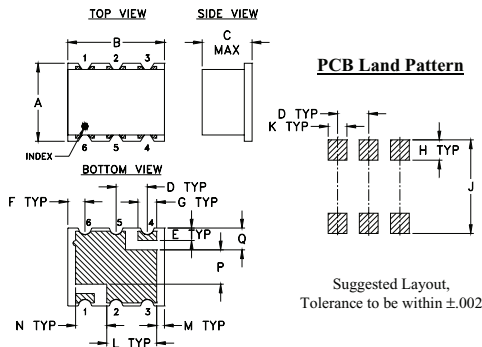
### Maximum Ratings

Operating Temperature	-40°C to 85°C
Storage Temperature	-55°C to 100°C
RF Input Power	20 dBm
Permanent damage may occur if any of these limits are exceeded.	

### Pin Connections

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

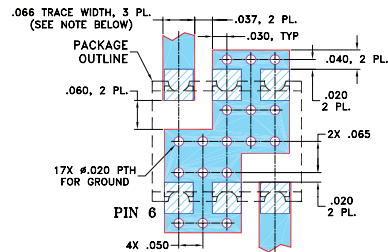
### Outline Drawing



### Outline Dimensions (inch)

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
- low conversion loss, 14.1 dB typ.
- high rejection F2, 47.5 dBc typ; F4, 43.5 dBc typ
- low cost
- aqueous washable

### Applications

- synthesizers
- local oscillators
- satellite up and down converters

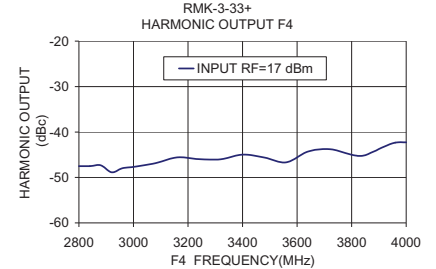
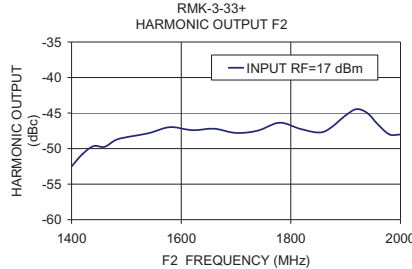
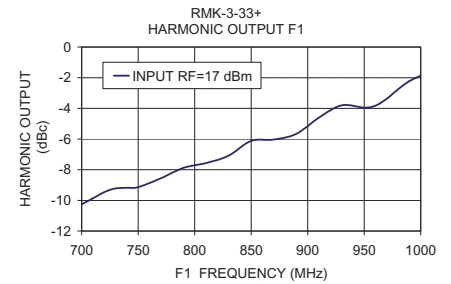
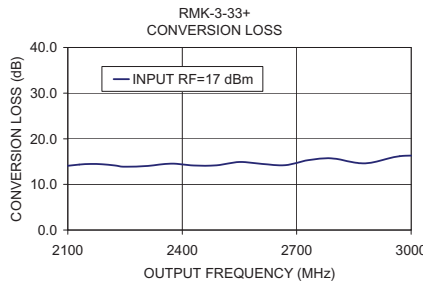
### Electrical Specifications at 25°C

Parameter	Min.	Typ.	Max.	Unit
Multiplier Factor		3		
Frequency Range, Input (F1)	700	—	1000	MHz
Frequency Range, Output (F3)	2100	—	3000	MHz
Input Power	12	—	17	dBm
Conversion Loss		14.1	18.5	dB
Harmonic Output*	F1	-5	4.5	—
	F2	32	47.5	—
	F4	30	43.5	—

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

### Typical Performance Data

Frequency	Input (MHz)	Output (MHz)	Conv. Loss (dB) F3	Harmonic Rejection Below F3, (dBc) at RF Input Power 17 dBm		
				F1	F2	F4
700.00	2100.00	14.08	-10.26	-52.50	-47.53	
750.00	2250.00	13.88	-9.14	-48.39	-47.66	
770.00	2310.00	14.05	-8.56	-47.83	-46.87	
810.00	2430.00	14.14	-7.57	-47.40	-45.98	
850.00	2550.00	14.91	-6.12	-47.79	-44.96	
910.00	2730.00	15.31	-4.60	-47.29	-44.31	
950.00	2850.00	14.81	-3.95	-45.32	-45.02	
960.00	2880.00	14.62	-3.82	-44.44	-45.22	
980.00	2940.00	15.69	-2.75	-46.68	-43.21	
1000.00	3000.00	16.31	-1.87	-48.02	-42.27	



Typical Performance Data

FREQUENCY (MHz)				CONVERSION LOSS	RF IN = +12 dBm		
X1 OUTPUT	X2 OUTPUT	X3 OUTPUT	X4 OUTPUT		X3 OUTPUT	X1 OUTPUT	X2 OUTPUT
650.0	1300.0	1950.0	2600.0	15.36	6.60	49.22	46.53
660.0	1320.0	1980.0	2640.0	14.50	7.13	49.23	45.23
670.0	1340.0	2010.0	2680.0	14.15	7.18	49.17	44.38
680.0	1360.0	2040.0	2720.0	14.14	6.92	50.73	47.38
690.0	1380.0	2070.0	2760.0	14.49	6.42	48.21	44.76
700.0	1400.0	2100.0	2800.0	15.03	5.81	48.02	43.84
710.0	1420.0	2130.0	2840.0	15.13	5.46	47.90	43.56
720.0	1440.0	2160.0	2880.0	14.51	5.65	48.37	43.56
730.0	1460.0	2190.0	2920.0	13.93	5.85	48.30	44.92
740.0	1480.0	2220.0	2960.0	13.57	5.94	47.71	43.88
750.0	1500.0	2250.0	3000.0	13.55	5.72	47.79	43.57
770.0	1540.0	2310.0	3080.0	14.32	4.58	48.56	43.41
790.0	1580.0	2370.0	3160.0	14.02	4.50	48.42	43.57
810.0	1620.0	2430.0	3240.0	13.28	4.56	49.23	44.21
830.0	1660.0	2490.0	3320.0	13.67	3.81	50.10	44.00
850.0	1700.0	2550.0	3400.0	13.93	3.10	51.20	43.86
870.0	1740.0	2610.0	3480.0	13.00	3.55	50.38	43.76
890.0	1780.0	2670.0	3560.0	12.97	3.07	49.71	43.60
910.0	1820.0	2730.0	3640.0	14.05	1.81	51.15	43.37
930.0	1860.0	2790.0	3720.0	13.92	1.43	50.09	43.51
950.0	1900.0	2850.0	3800.0	12.93	1.85	49.22	42.93
960.0	1920.0	2880.0	3840.0	12.80	1.71	50.10	42.35
970.0	1940.0	2910.0	3880.0	13.25	1.15	50.16	42.12
980.0	1960.0	2940.0	3920.0	13.88	0.44	49.07	42.26
990.0	1980.0	2970.0	3960.0	14.29	-0.07	48.48	42.26
1000.0	2000.0	3000.0	4000.0	14.36	-0.34	47.74	42.22
1010.0	2020.0	3030.0	4040.0	14.11	-0.32	47.39	41.56
1020.0	2040.0	3060.0	4080.0	13.69	-0.15	47.10	41.02
1030.0	2060.0	3090.0	4120.0	13.69	-0.35	46.06	40.91
1040.0	2080.0	3120.0	4160.0	14.13	-0.93	45.27	40.72
1050.0	2100.0	3150.0	4200.0	14.66	-1.59	42.51	40.61
1070.0	2140.0	3210.0	4280.0	14.47	-1.82	41.11	39.70
1090.0	2180.0	3270.0	4360.0	14.68	-2.32	41.28	40.33
1110.0	2220.0	3330.0	4440.0	15.96	-3.69	40.30	41.07
1130.0	2260.0	3390.0	4520.0	15.56	-3.82	39.79	40.32
1150.0	2300.0	3450.0	4600.0	17.30	-5.55	40.19	42.00

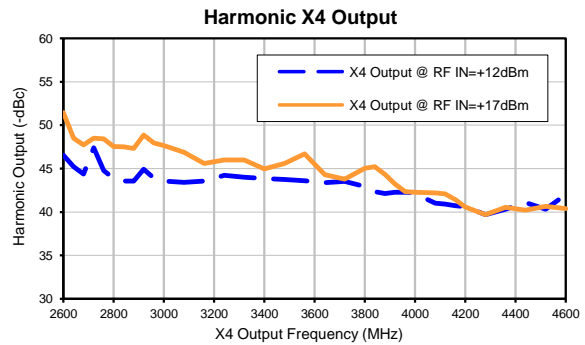
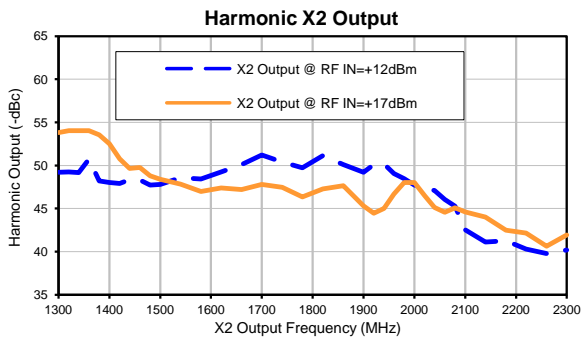
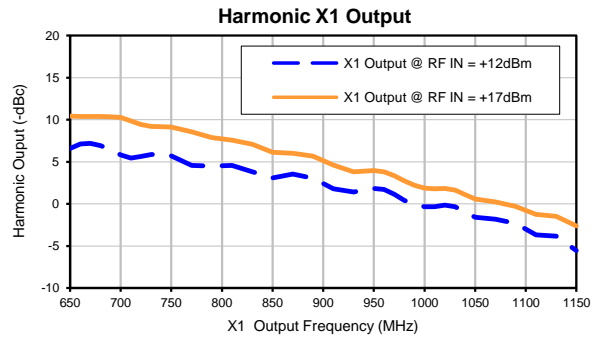
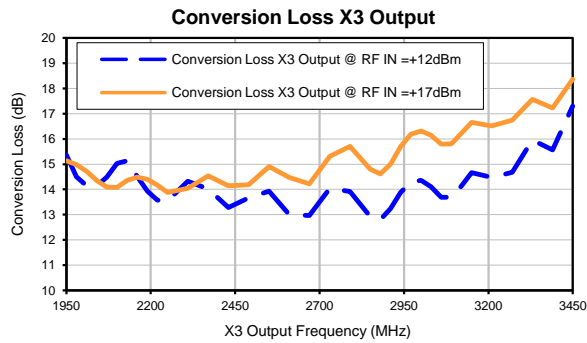
\* Harmonic Output below power level of X3 Output.

FREQUENCY (MHz)				CONVERSION LOSS	RF IN = +17dBm		
X1 OUTPUT	X2 OUTPUT	X3 OUTPUT	X4 OUTPUT		X3 OUTPUT	X1 OUTPUT	X2 OUTPUT
650.0	1300.0	1950.0	2600.0	15.14	10.43	53.82	51.46
660.0	1320.0	1980.0	2640.0	14.98	10.38	54.04	48.48
670.0	1340.0	2010.0	2680.0	14.71	10.38	54.02	47.71
680.0	1360.0	2040.0	2720.0	14.35	10.38	54.05	48.50
690.0	1380.0	2070.0	2760.0	14.09	10.37	53.54	48.44
700.0	1400.0	2100.0	2800.0	14.08	10.26	52.50	47.53
710.0	1420.0	2130.0	2840.0	14.36	9.87	50.76	47.50
720.0	1440.0	2160.0	2880.0	14.49	9.46	49.64	47.32
730.0	1460.0	2190.0	2920.0	14.40	9.22	49.76	48.86
740.0	1480.0	2220.0	2960.0	14.17	9.18	48.81	47.96
750.0	1500.0	2250.0	3000.0	13.88	9.14	48.39	47.66
770.0	1540.0	2310.0	3080.0	14.05	8.56	47.83	46.87
790.0	1580.0	2370.0	3160.0	14.54	7.88	46.98	45.59
810.0	1620.0	2430.0	3240.0	14.14	7.57	47.40	45.98
830.0	1660.0	2490.0	3320.0	14.19	7.09	47.21	46.00
850.0	1700.0	2550.0	3400.0	14.91	6.12	47.79	44.96
870.0	1740.0	2610.0	3480.0	14.48	6.03	47.47	45.60
890.0	1780.0	2670.0	3560.0	14.22	5.66	46.36	46.68
910.0	1820.0	2730.0	3640.0	15.31	4.60	47.29	44.31
930.0	1860.0	2790.0	3720.0	15.71	3.80	47.63	43.77
950.0	1900.0	2850.0	3800.0	14.81	3.95	45.32	45.02
960.0	1920.0	2880.0	3840.0	14.62	3.82	44.44	45.22
970.0	1940.0	2910.0	3880.0	15.01	3.37	45.02	44.33
980.0	1960.0	2940.0	3920.0	15.69	2.75	46.68	43.21
990.0	1980.0	2970.0	3960.0	16.18	2.22	48.01	42.34
1000.0	2000.0	3000.0	4000.0	16.31	1.87	48.02	42.27
1010.0	2020.0	3030.0	4040.0	16.15	1.79	46.50	42.22
1020.0	2040.0	3060.0	4080.0	15.79	1.82	45.14	42.20
1030.0	2060.0	3090.0	4120.0	15.81	1.64	44.58	42.08
1040.0	2080.0	3120.0	4160.0	16.23	1.10	45.09	41.43
1050.0	2100.0	3150.0	4200.0	16.66	0.56	44.60	40.56
1070.0	2140.0	3210.0	4280.0	16.52	0.23	44.00	39.67
1090.0	2180.0	3270.0	4360.0	16.75	-0.30	42.49	40.54
1110.0	2220.0	3330.0	4440.0	17.57	-1.23	42.16	40.21
1130.0	2260.0	3390.0	4520.0	17.23	-1.49	40.65	40.63
1150.0	2300.0	3450.0	4600.0	18.36	-2.63	41.94	40.38

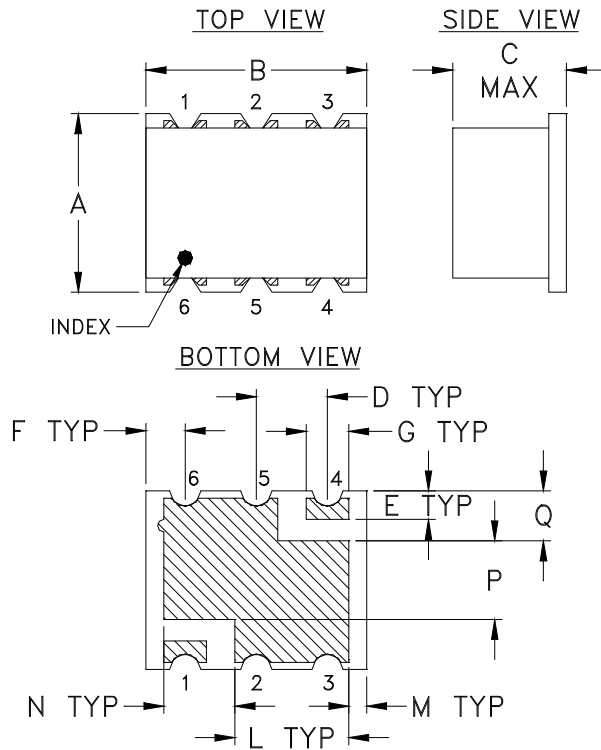
\* Harmonic Output below power level of X3 Output.



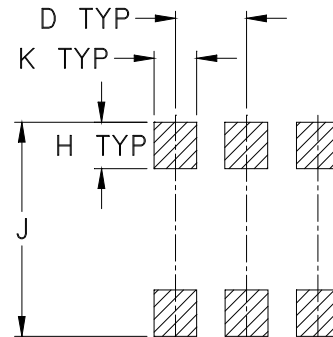
## Typical Performance Curves



### 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



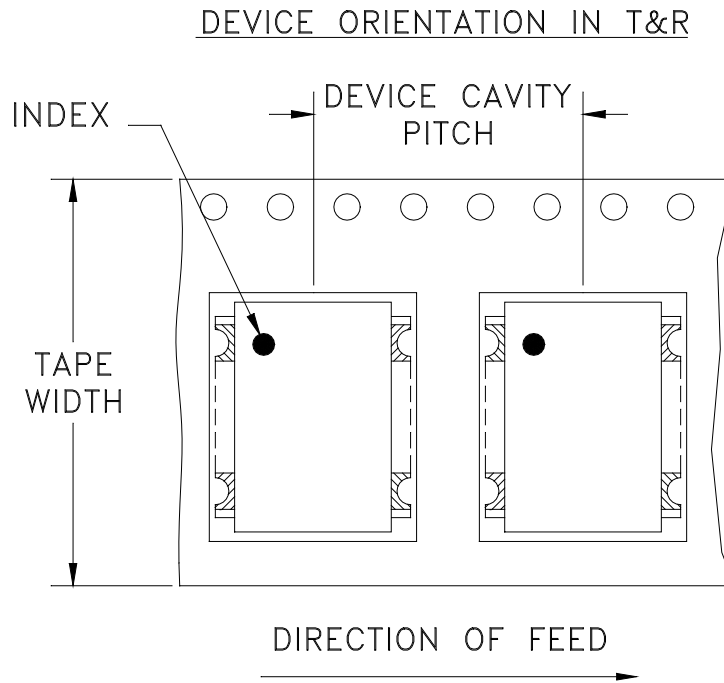
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RF/IF MICROWAVE COMPONENTS

# 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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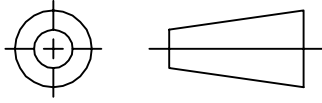
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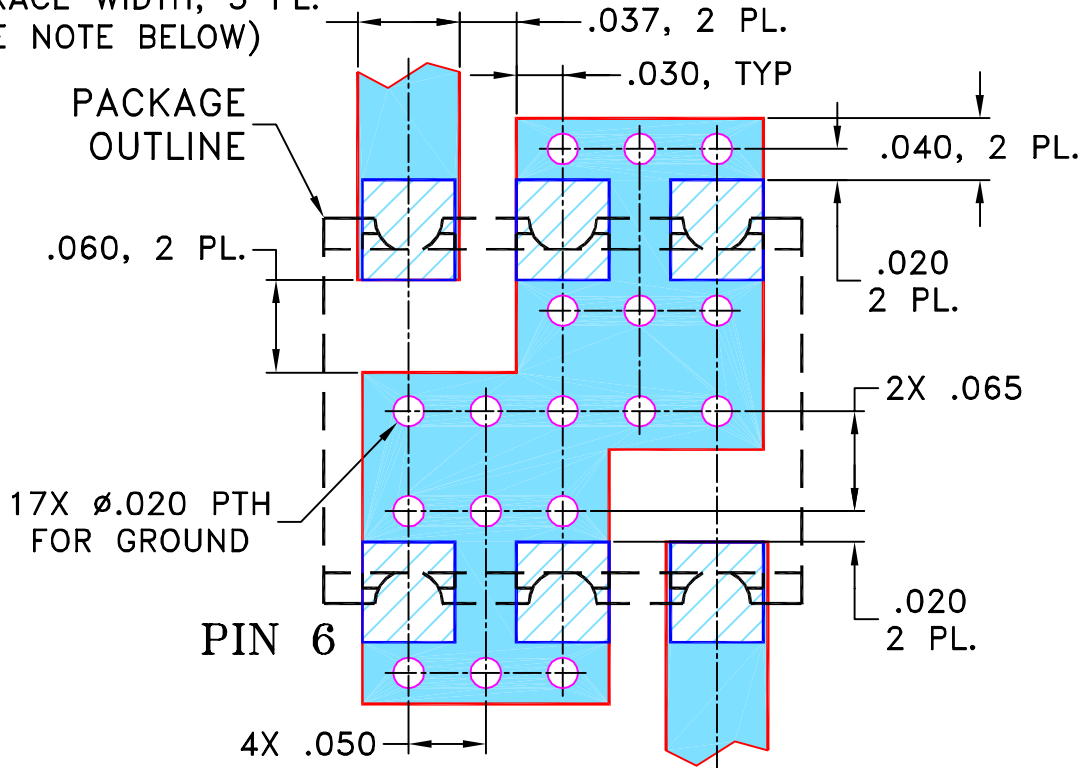


REVISIONS

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

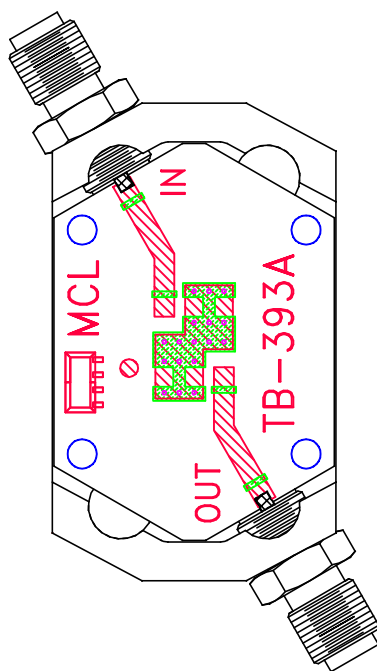
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Brooklyn NY 11235

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

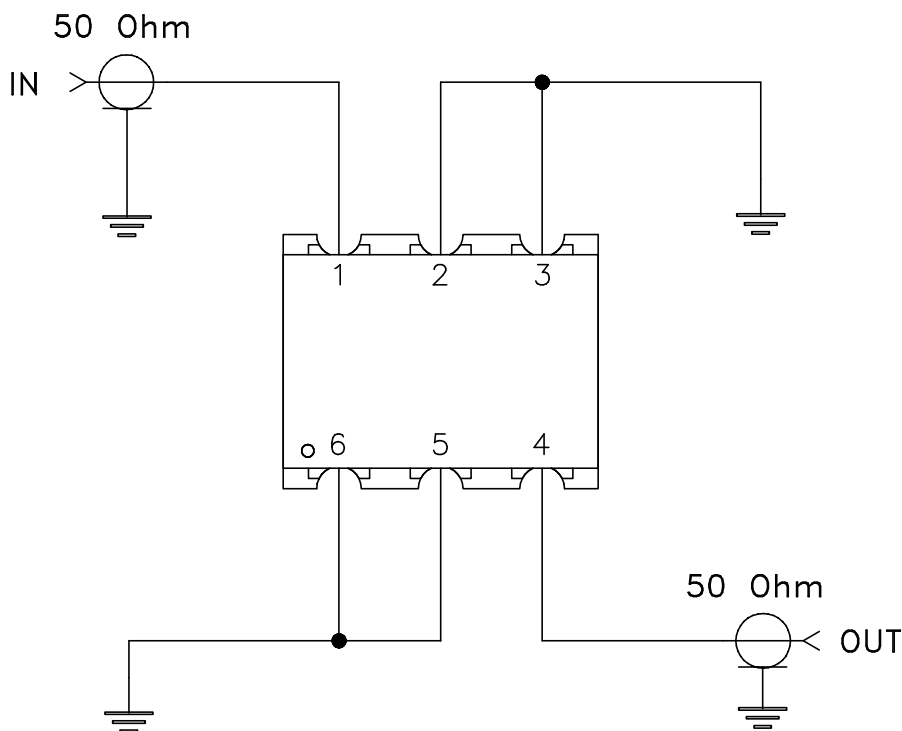
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SIZE	CODE IDENT	DRAWING NO:	REV:
A	15542	98-PL-258	OR
FILE:	98PL258	SCALE:	8:1
SHEET:	1	OF	1

# 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