

# X3 Frequency Multiplier

## RMK-3-332+

50Ω Output 2100 to 3300 MHz

### The Big Deal

- Wideband, 2100 to 3300 MHz output
- Wide input power range, +10 to +15 dBm
- Low conversion loss, 15 dB typ.
- Excellent harmonic suppression, 40 dBc typ.



CASE STYLE: TT1224

### Product Overview

Mini-Circuits' RMK-3-332+ is a surface mount frequency multiplier with a multiplication factor of 3, converting input frequencies of 700 to 1100 MHz into output frequencies of 2100 to 3300 MHz. It provides a wide input power range, low conversion loss and excellent suppression of adjacent harmonics. 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
Wideband, 2100 – 3300 MHz output	With an output frequency range spanning 2100 to 3300 MHz, this multiplier covers a wide range of applications.
Low conversion loss, 15 dB typ.	Low conversion loss results in higher output signal power, reducing the need for amplification at later stages.
Excellent harmonic suppression: <ul style="list-style-type: none"><li>• F2, 40 dBc typ.</li><li>• F3, 37 dBc typ.</li></ul>	Reduces spurious signals and the need for additional filtering. Helps avoid spectral regrowth in multiple-channel systems.
Wide input power range, +10 to +15 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, 0.25 x 0.31 x 0.16"	Saves space in dense circuit board 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.  
C. The parts covered by this specification document are subject to Mini-Circuits standard limited warranty and terms and conditions (collectively, "Standard Terms"); Purchasers of this part are entitled to the rights and benefits contained therein. For a full statement of the Standard Terms and the exclusive rights and remedies thereunder, please visit Mini-Circuits' website at [www.minicircuits.com/MCLStore/terms.jsp](http://www.minicircuits.com/MCLStore/terms.jsp)



# X3 Frequency Multiplier

## RMK-3-332+

50Ω Output 2100 to 3300 MHz

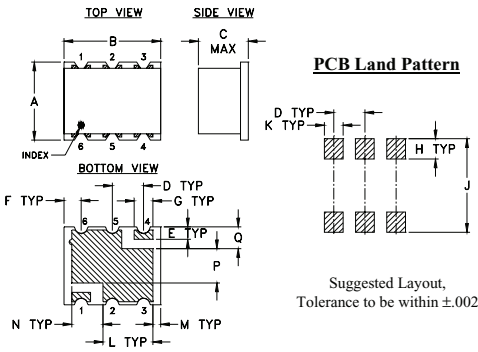
### Maximum Ratings

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

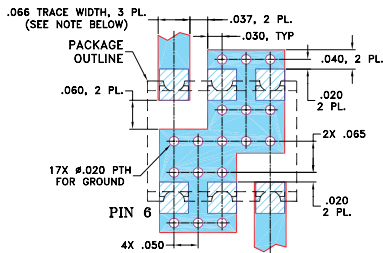
### Outline Drawing



### Outline Dimensions (inch/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

- low input power, +10 dBm
- low conversion loss, 15 dB typ.
- high rejection of adjacent harmonics, 40 dBc typ.
- aqueous washable

### Applications

- synthesizers
- local oscillators
- satellite up and down converters

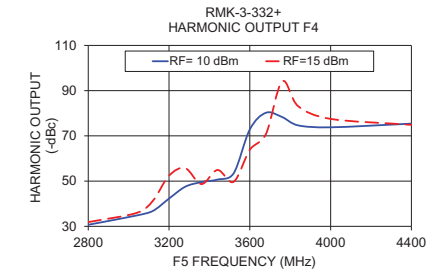
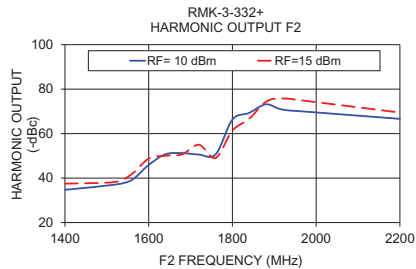
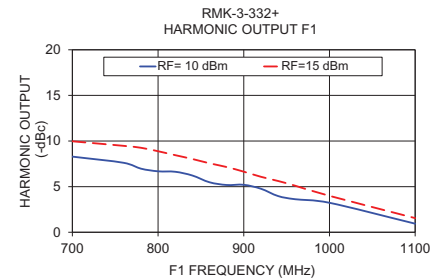
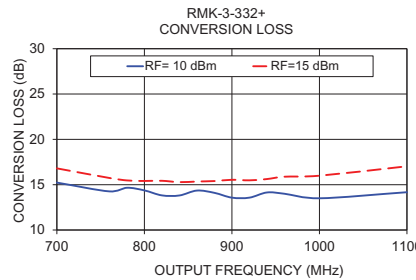
### Electrical Specifications at 25°C

Parameter	Min.	Typ.	Max.	Unit
Multiplier Factor		3		
Frequency Range, Input (F1)	700		1100	MHz
Frequency Range, Output (F3)	2100		3300	MHz
Input Power	10		15	dBm
Conversion Loss		15.6	20	dB
Harmonic Output*	F1	-3	3	dBc
	F2	25	40	
	F4	24	37	

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

### Typical Performance Data

Input Frequency (MHz)	INPUT RF= 10 dBm				INPUT RF= 15dBm			
	Conversion Loss (dB)	Harmonic Output Below F3 (dBc)			Conversion Loss (dB)	Harmonic Output Below F3 (dBc)		
	F3	F1	F2	F4	F3	F1	F2	F4
700	15.23	8.29	34.75	30.69	16.80	9.97	37.49	31.86
760	14.26	7.61	37.07	34.81	15.74	9.47	38.29	35.95
780	14.66	6.97	39.19	36.81	15.47	9.26	41.87	41.30
800	14.37	6.68	45.91	42.27	15.41	8.88	48.74	52.41
820	13.82	6.63	50.71	47.51	15.43	8.45	50.06	55.73
840	13.81	6.22	51.23	49.55	15.28	8.03	50.69	48.69
860	14.35	5.48	50.58	50.68	15.35	7.56	54.99	54.91
880	14.10	5.18	50.70	53.46	15.40	7.15	49.07	49.70
900	13.57	5.20	66.29	72.85	15.54	6.64	61.36	63.84
920	13.57	4.77	69.31	80.23	15.48	6.08	66.64	70.85
940	14.14	3.97	73.17	78.32	15.62	5.62	74.28	84.06
960	14.00	3.62	70.78	74.62	15.88	5.10	75.81	83.07
1000	13.50	3.23	69.53	73.79	15.99	3.99	74.14	77.51
1100	14.17	0.94	66.64	75.41	17.03	1.55	69.48	74.88



# Frequency Multiplier (Tripler)

# RMK-3-332+

## Typical Performance Data

FREQUENCY (MHz)				CONVERSION LOSS (dB)	RF IN = +10 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
700	1400	2100	2800	15.23	8.29	34.75	30.69
720	1440	2160	2880	14.80	8.07	36.14	32.60
740	1480	2220	2960	14.15	8.17	40.15	37.07
760	1520	2280	3040	14.26	7.61	37.07	34.81
780	1560	2340	3120	14.66	6.97	39.19	36.81
800	1600	2400	3200	14.37	6.68	45.91	42.27
820	1640	2460	3280	13.82	6.63	50.71	47.51
840	1680	2520	3360	13.81	6.22	51.23	49.55
860	1720	2580	3440	14.35	5.48	50.58	50.68
880	1760	2640	3520	14.10	5.18	50.70	53.46
900	1800	2700	3600	13.57	5.20	66.29	72.85
920	1840	2760	3680	13.57	4.77	69.31	80.23
940	1880	2820	3760	14.14	3.97	73.17	78.32
960	1920	2880	3840	14.00	3.62	70.78	74.62
980	1960	2940	3920	13.42	3.77	70.99	74.44
1000	2000	3000	4000	13.50	3.23	69.53	73.79
1020	2040	3060	4080	14.03	2.48	67.70	74.12
1040	2080	3120	4160	13.88	2.16	67.49	74.23
1060	2120	3180	4240	13.54	2.03	68.29	73.94
1080	2160	3240	4320	13.61	1.63	67.78	74.58
1100	2200	3300	4400	14.17	0.94	66.64	75.41
1120	2240	3360	4480	14.08	0.58	66.76	75.40
1140	2280	3420	4560	13.93	0.28	66.75	75.15
1160	2320	3480	4640	14.13	-0.26	65.88	75.37
1180	2360	3540	4720	14.57	-0.81	64.56	76.20
1200	2400	3600	4800	14.66	-1.32	63.82	75.60

\* Harmonic Output below power level of X3 Output.

FREQUENCY (MHz)				CONVERSION LOSS (dB)	RF IN = +15dBm		
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
700	1400	2100	2800	16.80	9.97	37.49	31.86
720	1440	2160	2880	16.39	9.77	37.13	31.90
740	1480	2220	2960	16.01	9.78	39.06	35.11
760	1520	2280	3040	15.74	9.47	38.29	35.95
780	1560	2340	3120	15.47	9.26	41.87	41.30
800	1600	2400	3200	15.41	8.88	48.74	52.41
820	1640	2460	3280	15.43	8.45	50.06	55.73
840	1680	2520	3360	15.28	8.03	50.69	48.69
860	1720	2580	3440	15.35	7.56	54.99	54.91
880	1760	2640	3520	15.40	7.15	49.07	49.70
900	1800	2700	3600	15.54	6.64	61.36	63.84
920	1840	2760	3680	15.48	6.08	66.64	70.85
940	1880	2820	3760	15.62	5.62	74.28	94.06
960	1920	2880	3840	15.88	5.10	75.81	83.07
980	1960	2940	3920	15.97	4.66	76.92	80.55
1000	2000	3000	4000	15.99	3.99	74.14	77.51
1020	2040	3060	4080	16.18	3.62	71.55	75.54
1040	2080	3120	4160	16.44	3.12	70.85	74.88
1060	2120	3180	4240	16.58	2.51	70.84	75.01
1080	2160	3240	4320	16.63	1.92	70.42	75.38
1100	2200	3300	4400	17.03	1.55	69.48	74.88
1120	2240	3360	4480	17.25	1.07	68.51	74.30
1140	2280	3420	4560	17.30	0.46	68.30	73.77
1160	2320	3480	4640	17.39	-0.11	67.49	73.03
1180	2360	3540	4720	17.78	-0.38	66.05	73.18
1200	2400	3600	4800	18.00	-0.90	65.06	72.39

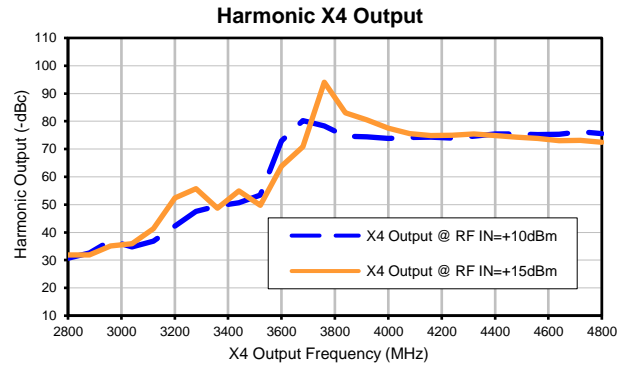
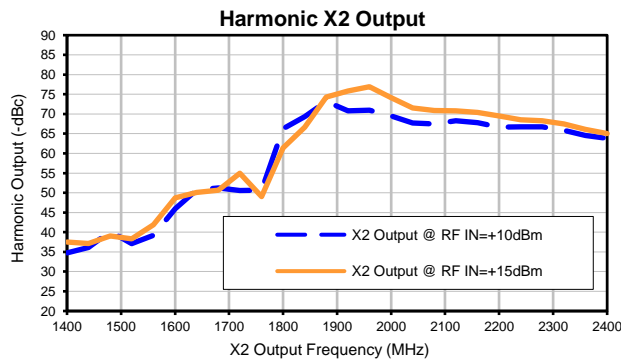
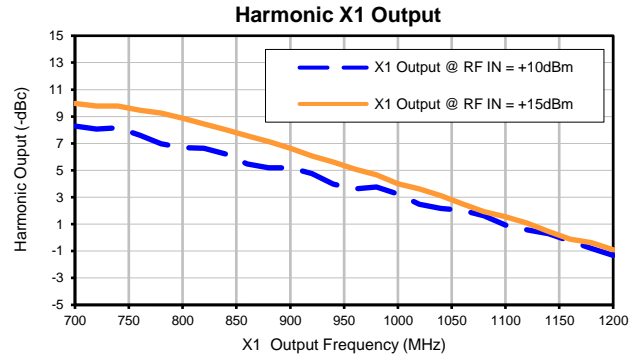
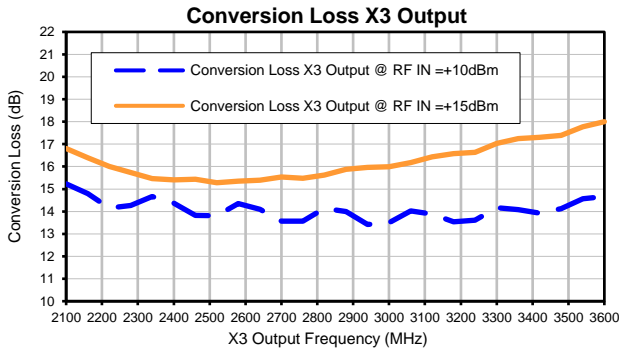
\* Harmonic Output below power level of X3 Output.



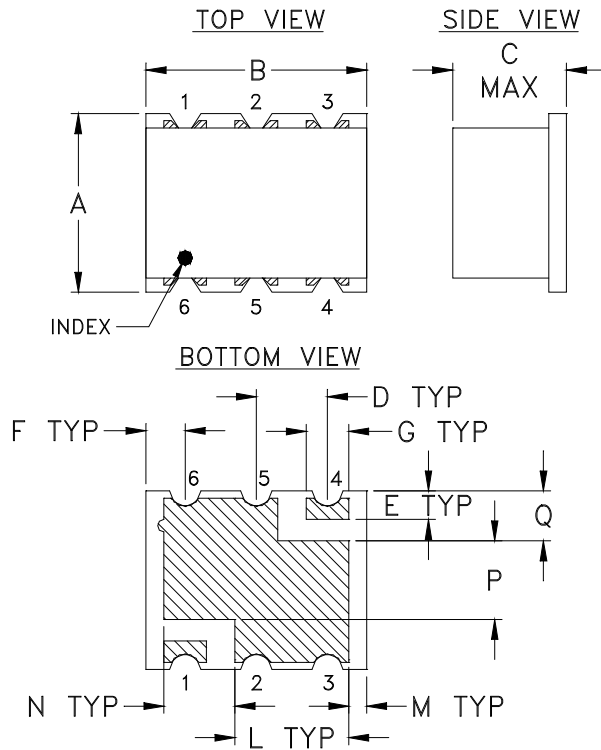
# Frequency Multiplier (Tripler)

# RMK-3-332+

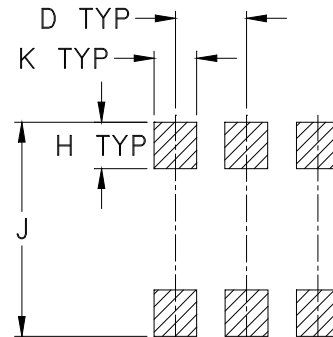
## Typical Performance Curves



### 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



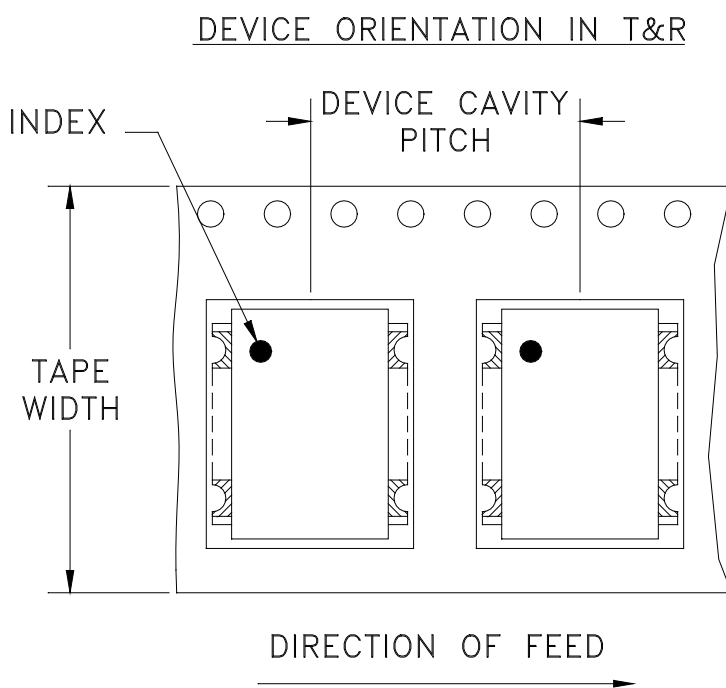
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The Design Engineers Search Engine Provides ACTUAL Data Instantly From MINI-CIRCUITS At: [www.minicircuits.com](http://www.minicircuits.com)

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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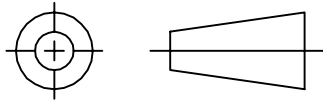
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THIRD ANGLE PROJECTION

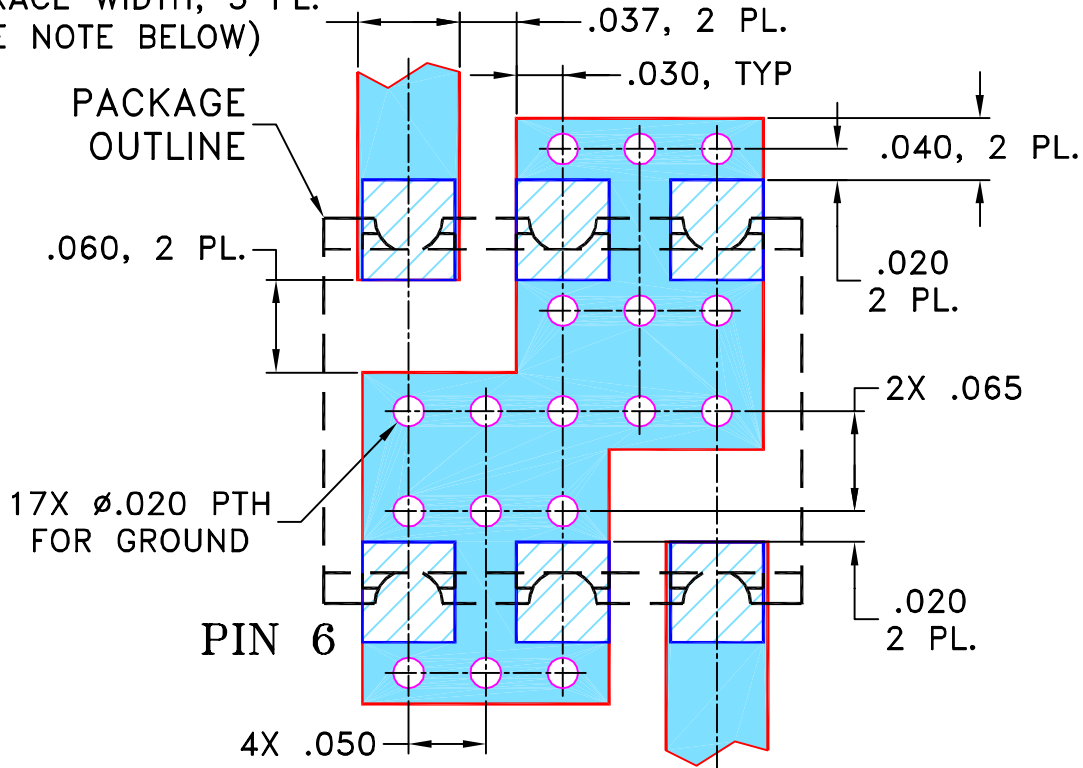


REVISIONS

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

DIMENSIONS ARE IN INCHES

DRAWN

AV

12/14/06

TOLERANCES ON:

CHECKED

IL

01/04/07

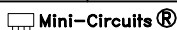
2 PL DECIMALS ± .005

APPROVED

DJ

01/04/07

ANGLES ±  
FRACTIONS ±



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ASHEETA1.DWG REV:A DATE:01/12/95



Mini-Circuits®

13 Neptune Avenue  
Brooklyn NY 11235

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

SIZE  
A

CODE IDENT  
15542

DRAWING NO:  
98-PL-258

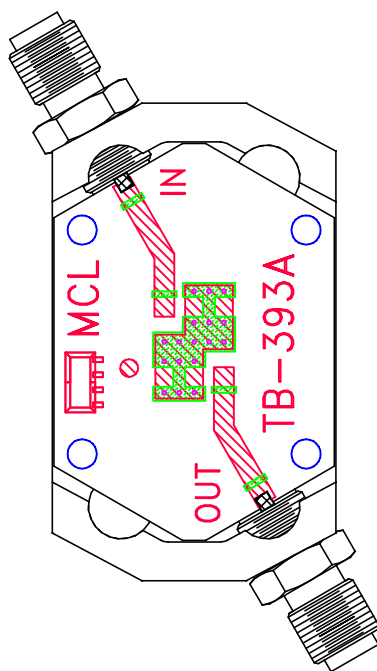
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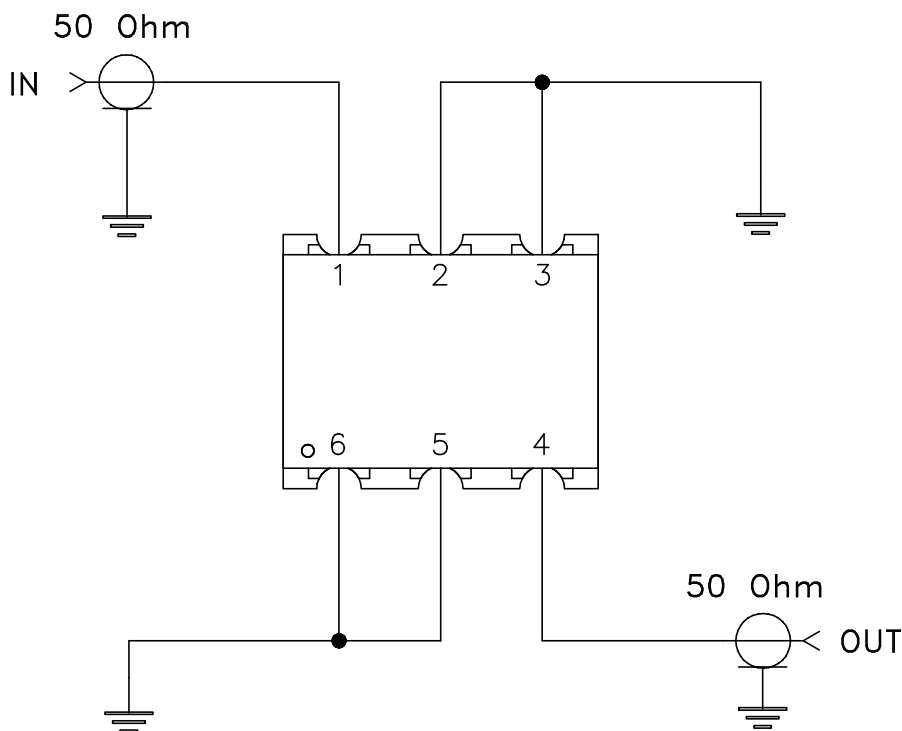
SCALE: 8:1

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