

# X5 Frequency Multiplier

## RMK-5-2251+

50Ω    Output 2100 to 3000 MHz

### The Big Deal

- Wide bandwidth, 1500 to 2250 output
- High harmonic suppression, F4, 52 dBc; F6, 56 dBc
- Small size, 0.25 x 0.31 x 0.16"



CASE STYLE: TT1224

### Product Overview

Mini-Circuits' RMK-5-2251+ frequency multiplier provides a multiplication factor of 5 converting input frequencies from 300 to 450 MHz into output frequencies from 1500 to 2250 MHz, supporting applications including synthesizers, local oscillators, satellite up and down converters and more. The unit supports input power of +17 dBm with conversion loss of 21 dB and excellent 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
Wide bandwidth	With an output frequency range spanning 1500-2250 MHz, this multiplier covers a wide range of applications.
Excellent harmonic suppression <ul style="list-style-type: none"><li>• F4, 52 dBc</li><li>• F6, 56 dBc</li></ul>	Reduces spurious signals and the need for additional filtering.
Low conversion loss, 21 dB	With a low conversion loss, the unit produces higher output power signal level and less amplification may be used.
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-5-2251+ saves space in crowded PCB layouts.

#### Notes

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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)



# X5 Frequency Multiplier

## RMK-5-2251+

50Ω Output 1500 to 2250 MHz

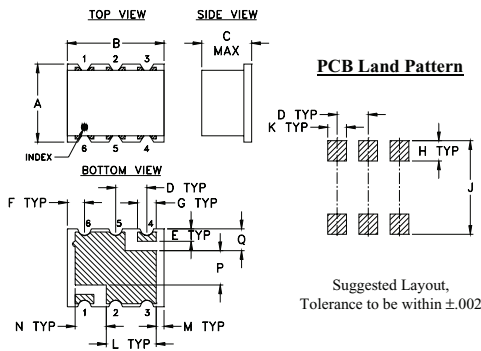
### Maximum Ratings

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

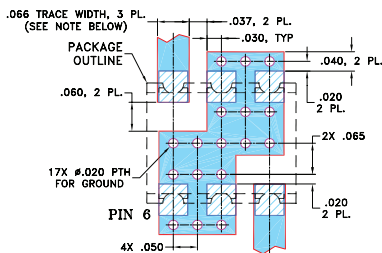
### Outline Drawing



### 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)



- NOTES: 1. TRACE WIDTH IS SHOWN FOR ROGERS RO4350B 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

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### Features

- low conversion loss, 21 dB typ.
- high rejection of adjacent harmonics, 56 dBc typ.
- aqueous washable

### Applications

- synthesizers
- local oscillators
- satellite up and down converters



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

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

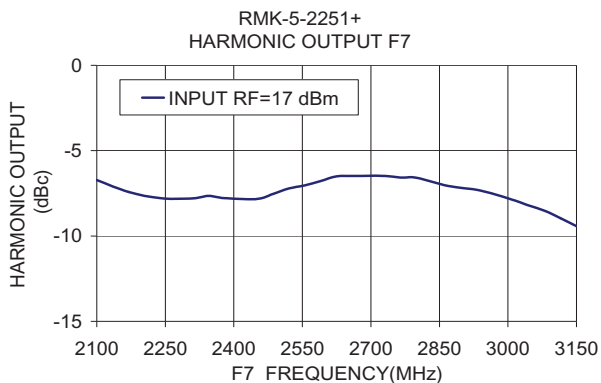
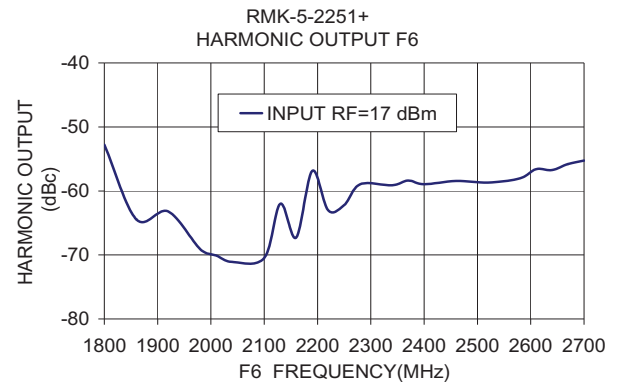
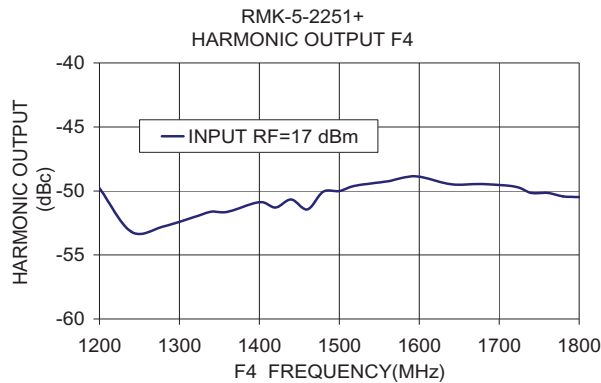
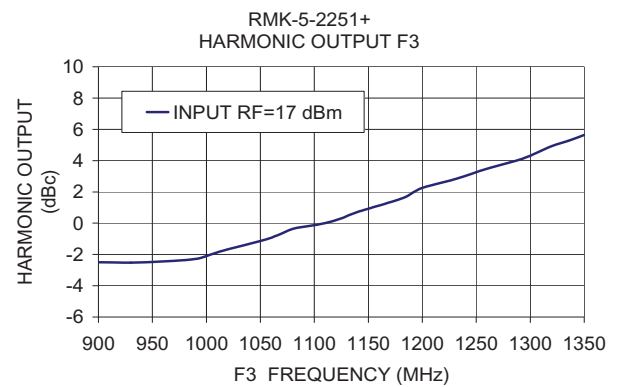
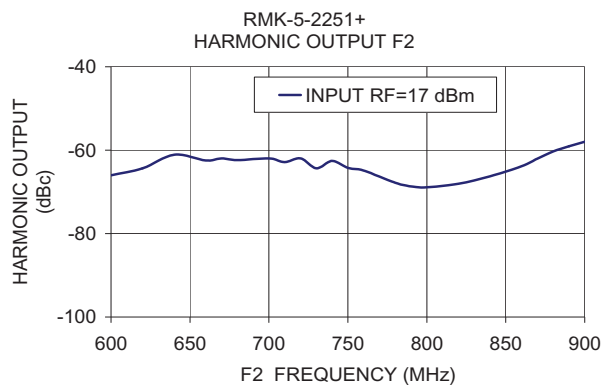
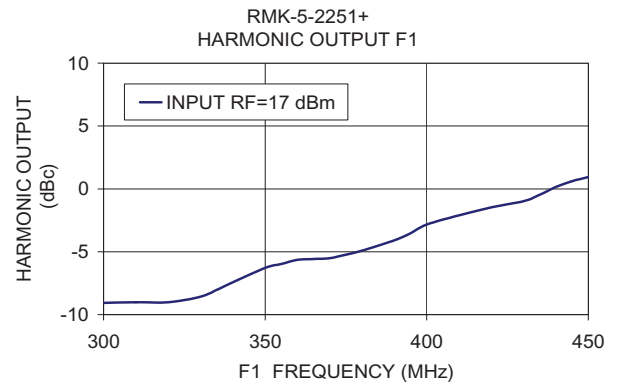
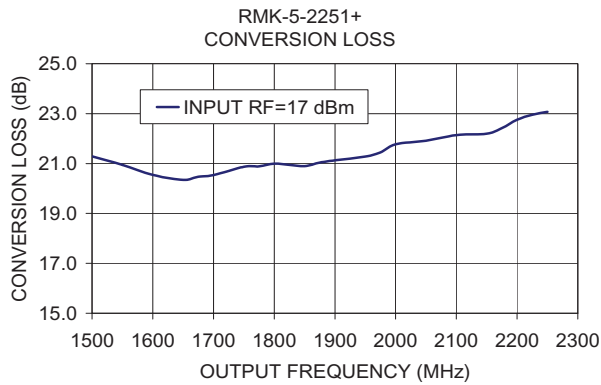
### Electrical Specifications at 25°C

Parameter	Min.	Typ.	Max.	Unit	
Multiplier Factor		5			
Frequency Range, Input (F1)	300	—	450	MHz	
Frequency Range, Output (F5)	1500	—	2250	MHz	
Input Power	—	17	—	dBm	
Conversion Loss	—	21	24.8	dB	
Harmonic Output*	F1	-3.5	5.3	—	-dBc
	F2	38	64	—	
	F3	-7.6	-0.34	—	
	F4	35	52	—	
	F6	35	56	—	
	F7	2.5	6.5	—	

\* Harmonics of input frequency below the power level of F5

### Typical Performance

Frequency	Harmonic Rejection Below F5, (dBc) at RF Input Power 17 dBm								
	Input (MHz)	Output (MHz)	Conv. Loss (dB) F5	F1	F2	F3	F4	F6	F7
300.00	1500.00	21.29	-9.07	-66.02	-2.50	-49.79	-52.79	-6.72	
310.00	1550.00	20.95	-9.02	-64.33	-2.53	-53.20	-64.41	-7.42	
320.00	1600.00	20.55	-9.01	-61.09	-2.44	-52.78	-63.19	-7.78	
330.00	1650.00	20.35	-8.58	-62.47	-2.29	-52.01	-69.13	-7.79	
335.00	1675.00	20.47	-8.03	-61.99	-1.98	-51.61	-70.09	-7.65	
340.00	1700.00	20.54	-7.43	-62.35	-1.67	-51.64	-71.09	-7.78	
350.00	1750.00	20.87	-6.28	-61.96	-1.14	-50.88	-70.48	-7.83	
355.00	1775.00	20.89	-5.97	-62.85	-0.80	-51.30	-62.01	-7.54	
360.00	1800.00	21.00	-5.65	-61.96	-0.36	-50.66	-67.29	-7.22	
365.00	1825.00	20.95	-5.57	-64.33	-0.18	-51.44	-56.87	-7.03	
370.00	1850.00	20.90	-5.51	-62.59	0.00	-50.06	-63.01	-6.78	
375.00	1875.00	21.04	-5.24	-64.25	0.31	-50.00	-62.20	-6.51	
380.00	1900.00	21.13	-4.90	-64.89	0.71	-49.59	-58.94	-6.48	
390.00	1950.00	21.28	-4.09	-67.78	1.34	-49.25	-59.11	-6.48	
395.00	1975.00	21.45	-3.53	-68.70	1.69	-48.97	-58.36	-6.58	
400.00	2000.00	21.77	-2.84	-68.89	2.26	-48.88	-58.96	-6.59	
410.00	2050.00	21.91	-2.11	-68.06	2.81	-49.48	-58.45	-7.07	
420.00	2100.00	22.14	-1.47	-66.25	3.48	-49.46	-58.71	-7.34	
430.00	2150.00	22.20	-0.98	-63.87	4.06	-49.67	-58.03	-7.88	
435.00	2175.00	22.42	-0.46	-62.03	4.47	-50.16	-56.62	-8.21	
440.00	2200.00	22.76	0.15	-60.29	4.93	-50.15	-56.72	-8.52	
445.00	2225.00	22.96	0.61	-59.06	5.26	-50.43	-55.81	-8.96	
450.00	2250.00	23.07	0.94	-57.99	5.64	-50.47	-55.24	-9.43	



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*Typical Performance Data*

FREQUENCY (MHz)							CONVERSION LOSS (dB)	RF IN = +17 dBm					
X1 OUTPUT	X2 OUTPUT	X3 OUTPUT	X4 OUTPUT	X5 OUTPUT	X6 OUTPUT	X7 OUTPUT		HARMONIC OUTPUT* (-dBc)					
X1 OUTPUT	X2 OUTPUT	X3 OUTPUT	X4 OUTPUT	X5 OUTPUT	X6 OUTPUT	X7 OUTPUT	X5 OUTPUT	X1 OUTPUT	X2 OUTPUT	X3 OUTPUT	X4 OUTPUT	X6 OUTPUT	X7 OUTPUT
270	540	810	1080	1350	1620	1890	22.95	9.87	41.78	1.78	36.66	30.68	3.21
275	550	825	1100	1375	1650	1925	22.67	9.61	41.07	1.84	35.87	30.20	3.87
280	560	840	1120	1400	1680	1960	22.49	9.34	39.80	2.07	34.83	29.54	4.64
285	570	855	1140	1425	1710	1995	22.17	9.17	44.34	2.25	42.18	35.38	5.35
290	580	870	1160	1450	1740	2030	21.80	9.17	49.01	2.30	40.84	38.23	5.68
295	590	885	1180	1475	1770	2065	21.54	9.05	55.02	2.32	44.74	43.69	6.14
300	600	900	1200	1500	1800	2100	21.29	9.07	66.02	2.50	49.79	52.79	6.72
305	610	915	1220	1525	1830	2135	21.10	9.03	68.38	2.51	52.32	61.09	7.10
310	620	930	1240	1550	1860	2170	20.95	9.02	64.33	2.53	53.20	64.41	7.42
315	630	945	1260	1575	1890	2205	20.91	8.89	61.83	2.42	53.05	63.93	7.82
320	640	960	1280	1600	1920	2240	20.55	9.01	61.09	2.44	52.78	63.19	7.78
330	660	990	1320	1650	1980	2310	20.35	8.58	62.47	2.29	52.01	69.13	7.79
335	670	1005	1340	1675	2010	2345	20.47	8.03	61.99	1.98	51.61	70.09	7.65
340	680	1020	1360	1700	2040	2380	20.54	7.43	62.35	1.67	51.64	71.09	7.78
345	690	1035	1380	1725	2070	2415	20.73	6.80	62.28	1.37	51.41	73.43	7.86
350	700	1050	1400	1750	2100	2450	20.87	6.28	61.96	1.14	50.88	70.48	7.83
355	710	1065	1420	1775	2130	2485	20.89	5.97	62.85	0.80	51.30	62.01	7.54
360	720	1080	1440	1800	2160	2520	21.00	5.65	61.96	0.36	50.66	67.29	7.22
365	730	1095	1460	1825	2190	2555	20.95	5.57	64.33	0.18	51.44	56.87	7.03
370	740	1110	1480	1850	2220	2590	20.90	5.51	62.59	0.00	50.06	63.01	6.78
375	750	1125	1500	1875	2250	2625	21.04	5.24	64.25	-0.31	50.00	62.20	6.51
380	760	1140	1520	1900	2280	2660	21.13	4.90	64.89	-0.71	49.59	58.94	6.48
385	770	1155	1540	1925	2310	2695	21.21	4.56	65.18	-1.08	49.10	59.44	6.31
390	780	1170	1560	1950	2340	2730	21.28	4.09	67.78	-1.34	49.25	59.11	6.48
395	790	1185	1580	1975	2370	2765	21.45	3.53	68.70	-1.69	48.97	58.36	6.58
400	800	1200	1600	2000	2400	2800	21.77	2.84	68.89	-2.26	48.88	58.96	6.59
405	810	1215	1620	2025	2430	2835	21.85	2.44	69.17	-2.54	49.34	58.71	6.87
410	820	1230	1640	2050	2460	2870	21.91	2.11	68.06	-2.81	49.48	58.45	7.07
415	830	1245	1660	2075	2490	2905	22.04	1.81	67.12	-3.07	49.30	60.83	7.16
420	840	1260	1680	2100	2520	2940	22.14	1.47	66.25	-3.48	49.46	58.71	7.34
425	850	1275	1700	2125	2550	2975	22.20	1.22	64.83	-3.85	48.93	62.36	7.44
430	860	1290	1720	2150	2580	3010	22.20	0.98	63.87	-4.06	49.67	58.03	7.88
435	870	1305	1740	2175	2610	3045	22.42	0.46	62.03	-4.47	50.16	56.62	8.21
440	880	1320	1760	2200	2640	3080	22.76	-0.15	60.29	-4.93	50.15	56.72	8.52
445	890	1335	1780	2225	2670	3115	22.96	-0.61	59.06	-5.26	50.43	55.81	8.96
450	900	1350	1800	2250	2700	3150	23.07	-0.94	57.99	-5.64	50.47	55.24	9.43
455	910	1365	1820	2275	2730	3185	23.04	-1.08	57.26	-5.82	49.88	55.44	9.58
460	920	1380	1840	2300	2760	3220	23.00	-1.17	56.68	-6.02	49.43	55.55	9.75
465	930	1395	1860	2325	2790	3255	22.98	-1.26	56.00	-6.37	49.01	55.36	9.75
470	940	1410	1880	2350	2820	3290	22.83	-1.22	55.61	-6.48	49.00	54.62	9.98

\* Harmonic Output below power level of X5 Output.

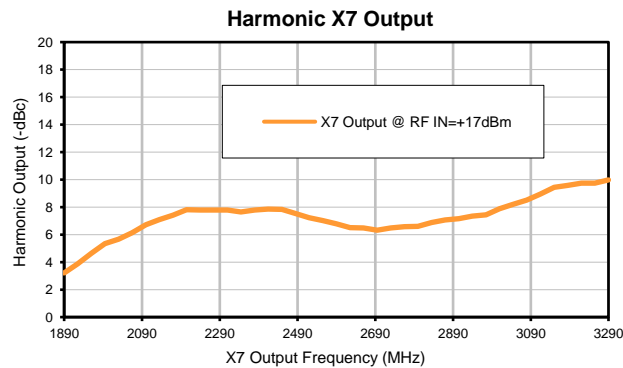
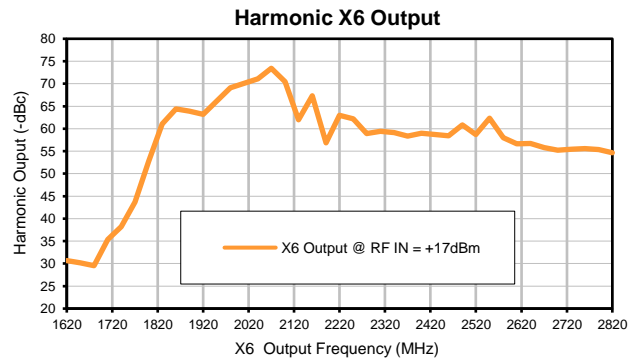
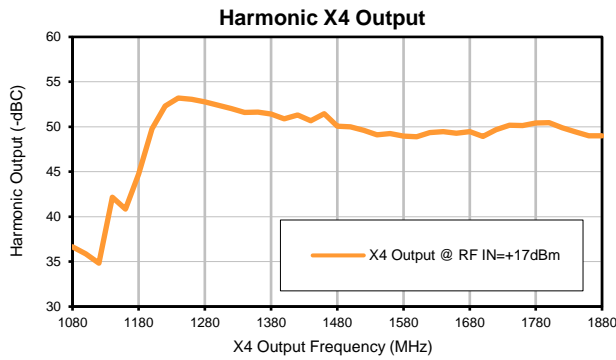
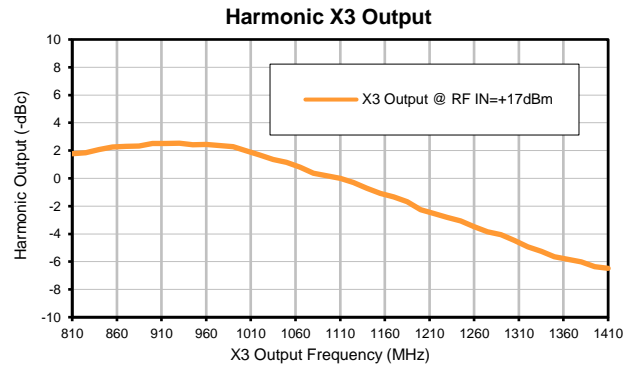
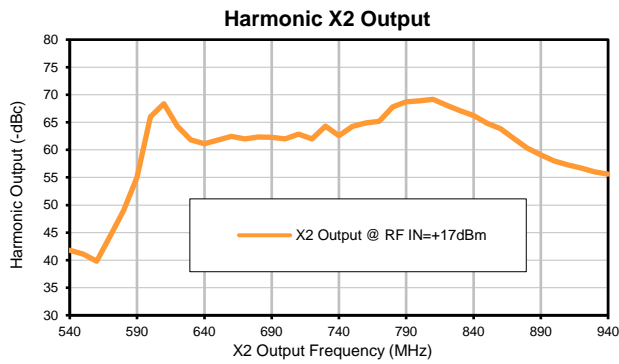
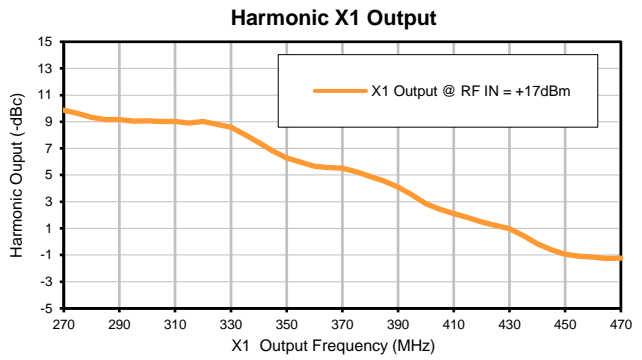
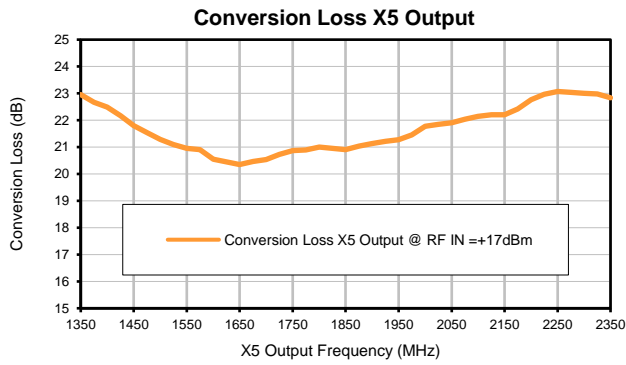


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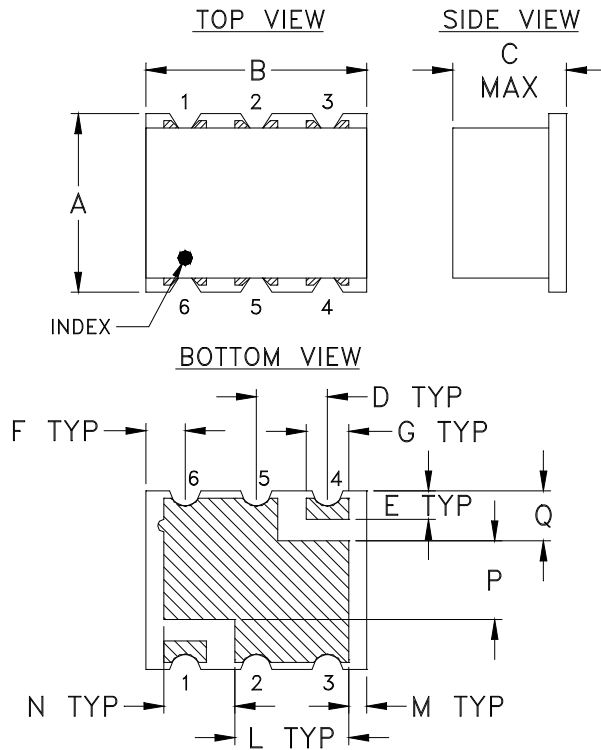
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**IF/RF MICROWAVE COMPONENTS**

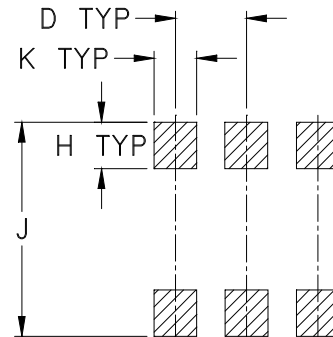
## Typical Performance Curves



### 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



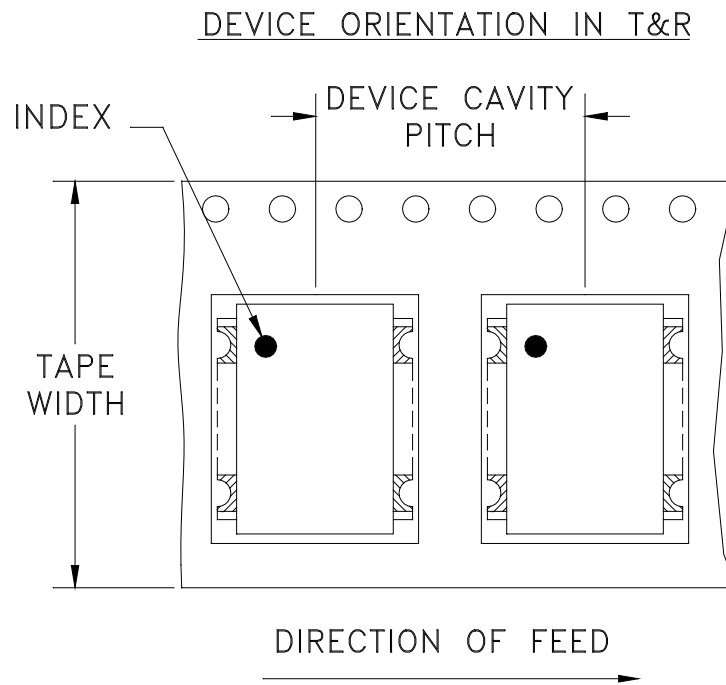
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The Design Engineers Search Engine Provides ACTUAL Data Instantly From MINI-CIRCUITS At: [www.minicircuits.com](http://www.minicircuits.com)

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.

Go to: [www.minicircuits.com/pages/pdfs/tape.pdf](http://www.minicircuits.com/pages/pdfs/tape.pdf)



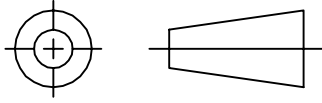
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P.O. Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718) 332-4661

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THIRD ANGLE PROJECTION

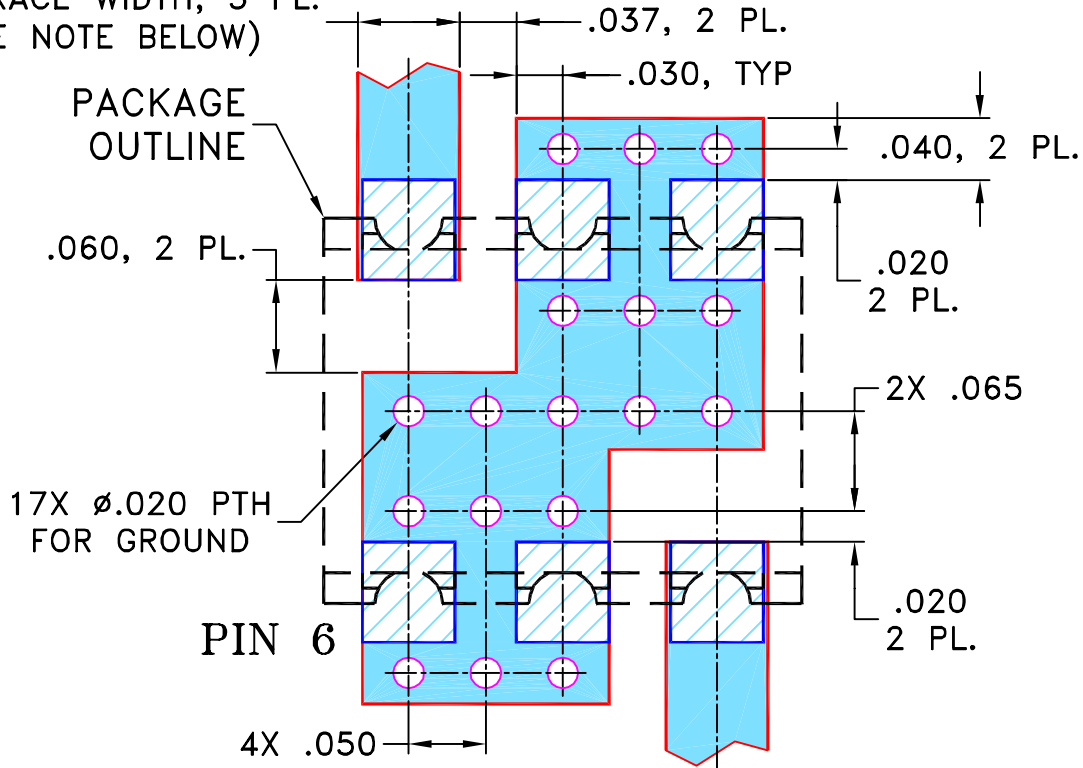


REVISIONS

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

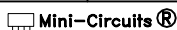
2 PL DECIMALS ± .005

APPROVED

DJ

01/04/07

ANGLES ±  
FRACTIONS ±



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



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13 Neptune Avenue  
Brooklyn NY 11235

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

SIZE  
A

CODE IDENT  
15542

DRAWING NO:  
98-PL-258

REV:  
OR

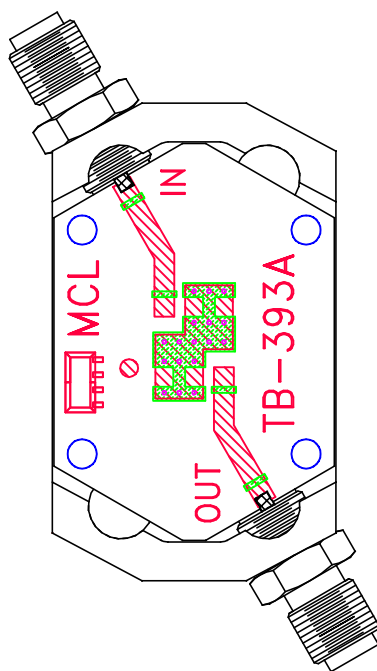
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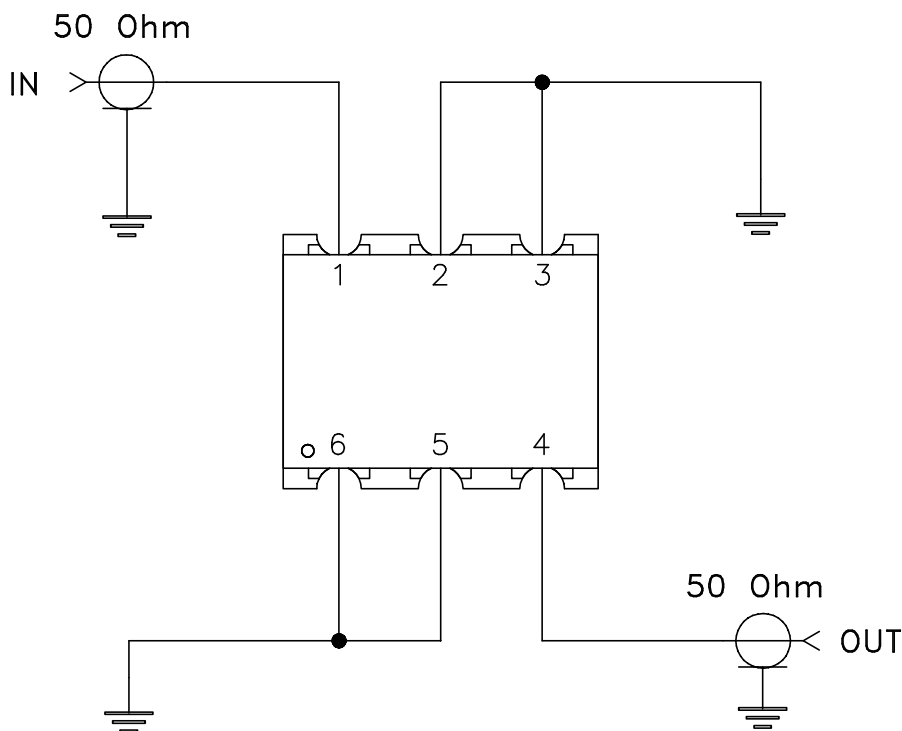
SHEET: 1 OF 1



# 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