

X5 Frequency Multiplier

RMK-5-352+

50Ω Output 2750 to 3500 MHz

The Big Deal

- Low conversion loss, 22 dB
- Excellent harmonic suppression, -40 dBc @ F4 and F6.



CASE STYLE: TT1224

Product Overview

Mini-Circuits' RMK-5-352+ is a surface mount frequency multiplier with a multiplication factor of 5, converting input frequencies from 550 to 700 MHz into output frequencies from 2750 to 3500 MHz. This model is rated for +17 dBm input power and provides low conversion loss and excellent harmonic suppression. The multiplier comes housed in a shielded surface-mount package (0.25 x 0.31 x 0.16") with wraparound terminations for excellent solderability.

Key Features

Feature	Advantages
Low conversion loss, 22 dB typ.	Low conversion loss results in higher output signal power, reducing the need for amplification at later stages.
Excellent harmonic suppression: • F4, 40 dBc • F6, 40 dBc	Reduces spurious signals and the need for additional filtering. Reduces spectral regrowth in multiple-channel systems.
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



50Ω Output 2750 to 3500 MHz

[illegible]

+RoHS Compliant

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

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.

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

TOP VIEW

SIDE VIEW

PCB Land Pattern

BOTTOM VIEW

Suggested Layout,
Tolerance to be within ± 0.02

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

Figure 1: Package Outline for the 16-pin DIP package. The diagram shows a rectangular package with dimensions: .068 TRACE WIDTH, 3 PL. (SEE NOTE BELOW); .037, 2 PL.; .030, TYP.; .040, 2 PL.; .020, 2 PL.; 2X .065; .020, 2 PL.; 4X .050; 17X .020 PTH FOR GROUND; .060, 2 PL.; and PIN 6. The package outline is shown in blue, and the lead profile is shown in red.

NOTES: 1. TRACE WIDTH IS SHOWN FOR ROGERS RO4350B WITH DIELECTRIC THICKNESS .030" $\pm$.002"; COPPER: 1/2 OZ. EACH SIDE.
2. FOR OTHER MATERIALS TRACE WIDTH MAY NEED TO BE MODIFIED.
3. 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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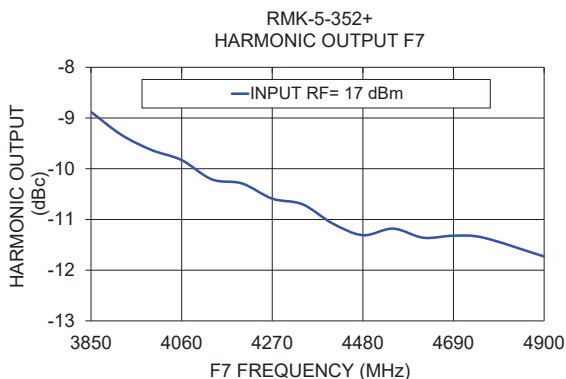
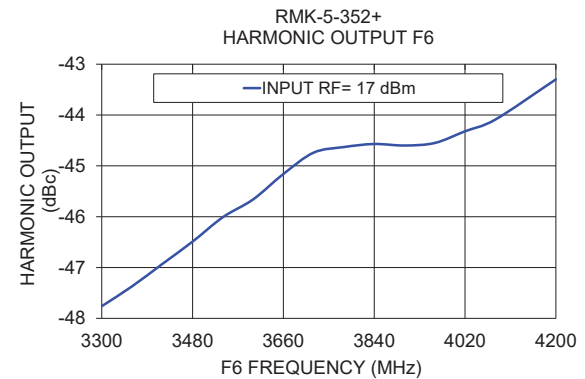
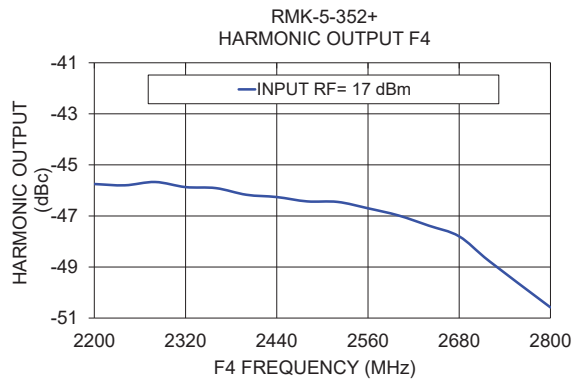
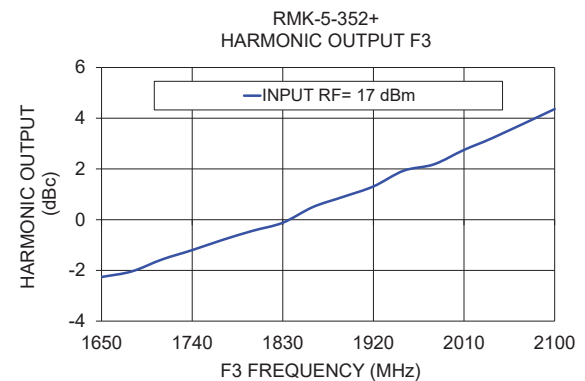
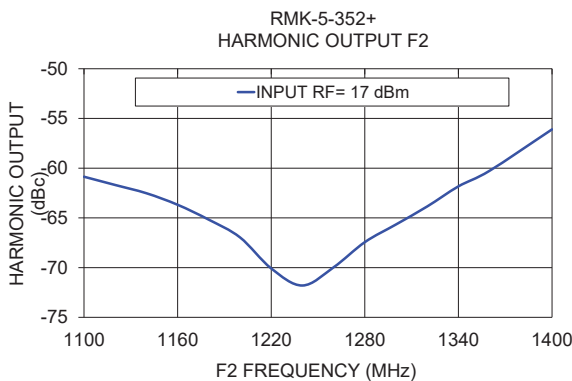
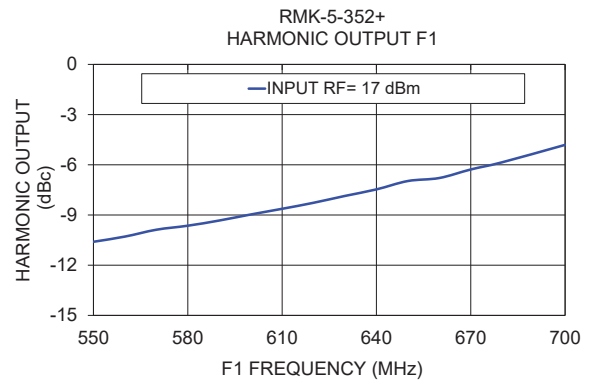
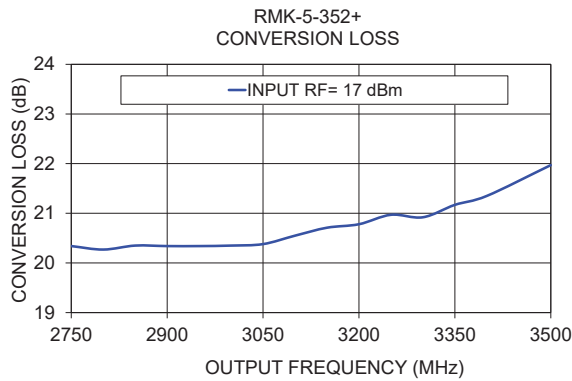
- low conversion loss, 22 dB typ.
- high rejection of adjacent harmonics, -40 dBc typ.
- aqueous washable

- synthesizers
- local oscillators
- satellite up and down converters

Parameter		Min.	Typ.	Max.	Unit
Multiplier Factor		5			
Frequency Range, Input (F1)		550	—	700	MHz
Frequency Range, Output (F5)		2750	—	3500	MHz
Input Power		—	17	—	dBm
Conversion Loss		—	22	24.5	dB
Harmonic Ouput*	F1	—	-6.5	-1	dBc
	F2	—	-56	-40	
	F3	—	0	+9.5	
	F4	—	-40	-30	
	F6	—	-40	-30	
	F7	—	-10.5	-4	

* Harmonics of input frequency relative to the power level of F5

Frequency		Conv. Loss (dB) F5	Harmonic Rejection Relative to F5, (dBc) <i>at RF Input Power 17 dBm</i>					
Input (MHz)	Output (MHz)		F1	F2	F3	F4	F6	F7
550	2750	20.34	-10.60	-60.86	-2.26	-45.75	-47.76	-8.88
560	2800	20.27	-10.29	-61.69	-2.04	-45.80	-47.37	-9.33
570	2850	20.35	-9.88	-62.52	-1.57	-45.67	-46.93	-9.63
580	2900	20.34	-9.64	-63.68	-1.20	-45.87	-46.49	-9.83
590	2950	20.34	-9.33	-65.18	-0.80	-45.91	-46.01	-10.21
600	3000	20.35	-8.97	-66.96	-0.44	-46.17	-45.66	-10.29
610	3050	20.38	-8.63	-70.08	-0.12	-46.26	-45.16	-10.59
620	3100	20.55	-8.27	-71.80	0.50	-46.43	-44.74	-10.70
630	3150	20.71	-7.86	-69.97	0.90	-46.45	-44.63	-11.08
640	3200	20.78	-7.47	-67.44	1.31	-46.70	-44.57	-11.31
650	3250	20.97	-6.97	-65.66	1.93	-46.98	-44.60	-11.18
660	3300	20.92	-6.79	-63.85	2.18	-47.38	-44.55	-11.36
670	3350	21.17	-6.28	-61.83	2.75	-47.80	-44.32	-11.32
680	3400	21.35	-5.85	-60.26	3.25	-48.78	-44.09	-11.36
700	3500	21.97	-4.81	-56.10	4.36	-50.58	-43.30	-11.73



Notes

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Frequency Multiplier (X5)

RMK-5-352+

Typical Performance Data

FREQUENCY (MHz)							CONVERSION LOSS (dB)	RF IN = +17 dBm					
								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
500	1000	1500	2000	2500	3000	3500	21.16	11.37	61.94	3.60	46.01	54.30	6.72
510	1020	1530	2040	2550	3060	3570	20.98	11.25	62.60	3.29	45.59	53.98	7.36
520	1040	1560	2080	2600	3120	3640	20.81	11.10	61.08	3.14	45.88	50.78	7.68
530	1060	1590	2120	2650	3180	3710	20.60	10.95	60.74	2.94	45.95	48.73	7.99
540	1080	1620	2160	2700	3240	3780	20.41	10.83	60.66	2.64	45.88	48.31	8.43
550	1100	1650	2200	2750	3300	3850	20.34	10.60	60.86	2.26	45.75	47.76	8.88
560	1120	1680	2240	2800	3360	3920	20.27	10.29	61.69	2.04	45.80	47.37	9.33
570	1140	1710	2280	2850	3420	3990	20.35	9.88	62.52	1.57	45.67	46.93	9.63
580	1160	1740	2320	2900	3480	4060	20.34	9.64	63.68	1.20	45.87	46.49	9.83
590	1180	1770	2360	2950	3540	4130	20.34	9.33	65.18	0.80	45.91	46.01	10.21
600	1200	1800	2400	3000	3600	4200	20.35	8.97	66.96	0.44	46.17	45.66	10.29
610	1220	1830	2440	3050	3660	4270	20.38	8.63	70.08	0.12	46.26	45.16	10.59
620	1240	1860	2480	3100	3720	4340	20.55	8.27	71.80	-0.50	46.43	44.74	10.70
630	1260	1890	2520	3150	3780	4410	20.71	7.86	69.97	-0.90	46.45	44.63	11.08
640	1280	1920	2560	3200	3840	4480	20.78	7.47	67.44	-1.31	46.70	44.57	11.31
650	1300	1950	2600	3250	3900	4550	20.97	6.97	65.66	-1.93	46.98	44.60	11.18
660	1320	1980	2640	3300	3960	4620	20.92	6.79	63.85	-2.18	47.38	44.55	11.36
670	1340	2010	2680	3350	4020	4690	21.17	6.28	61.83	-2.75	47.80	44.32	11.32
680	1360	2040	2720	3400	4080	4760	21.35	5.85	60.26	-3.25	48.78	44.09	11.36
690	1380	2070	2760	3450	4140	4830	21.70	5.23	57.95	-3.78	49.94	43.53	11.57
700	1400	2100	2800	3500	4200	4900	21.97	4.81	56.10	-4.36	50.58	43.30	11.73
710	1420	2130	2840	3550	4260	4970	22.18	4.30	54.46	-4.85	50.71	43.03	11.63
720	1440	2160	2880	3600	4320	5040	22.38	3.78	52.85	-5.36	50.27	42.50	11.64
730	1460	2190	2920	3650	4380	5110	22.64	3.23	51.17	-5.84	51.67	41.92	11.68
740	1480	2220	2960	3700	4440	5180	23.07	2.69	49.79	-6.38	55.11	41.66	11.72

* Harmonic Output below power level of X5 Output.



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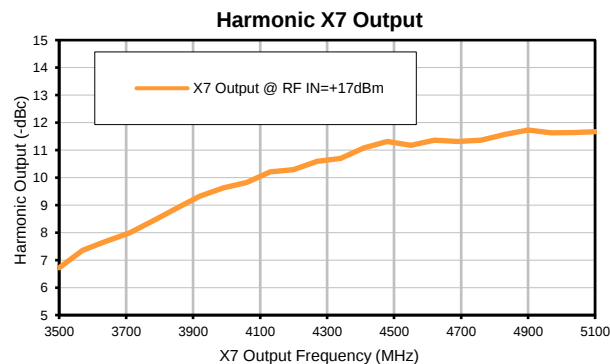
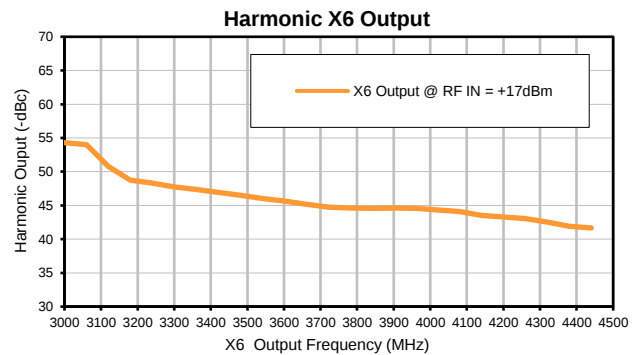
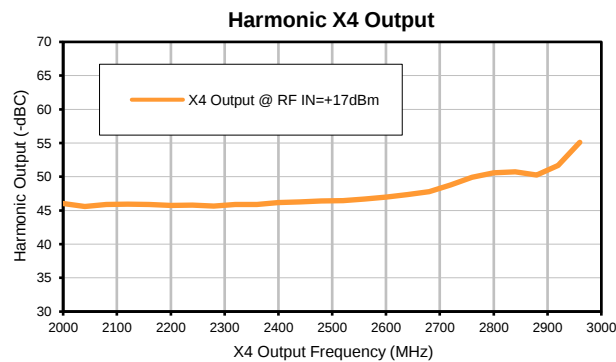
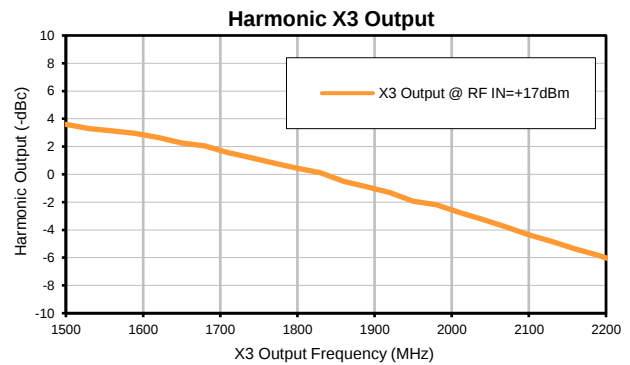
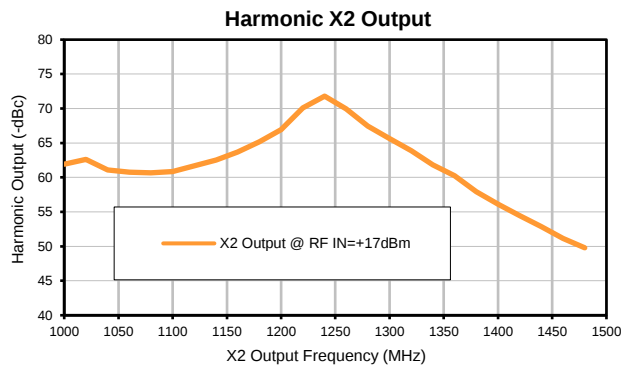
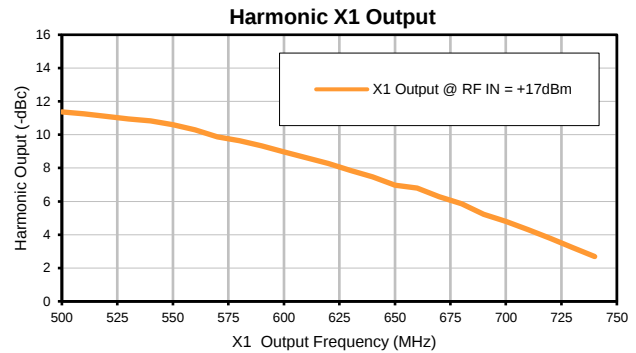
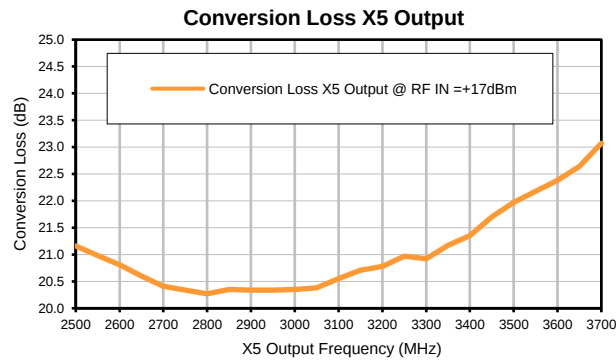


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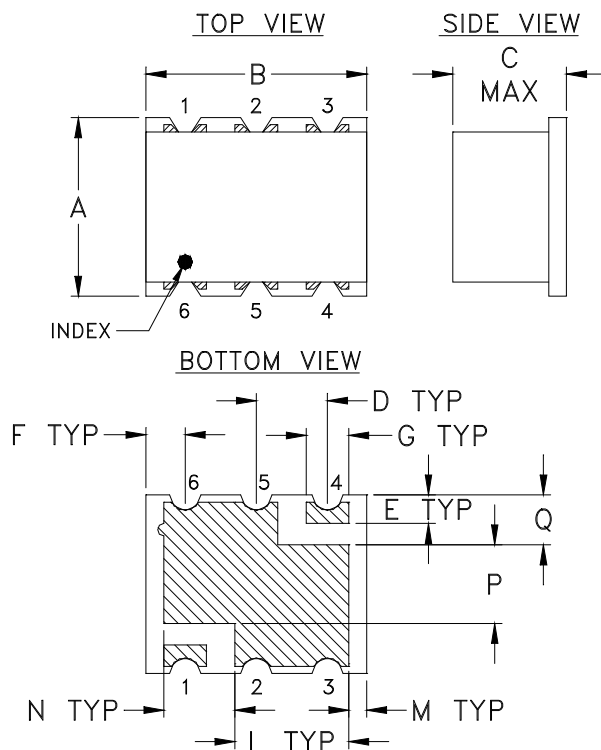
IF/RF MICROWAVE COMPONENTS

REV. OR
RMK-5-352+
2/19/2016
Page 1 of 1

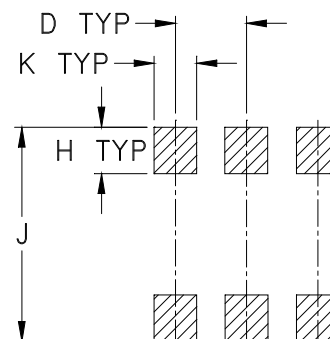
Typical Performance Curves



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:

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



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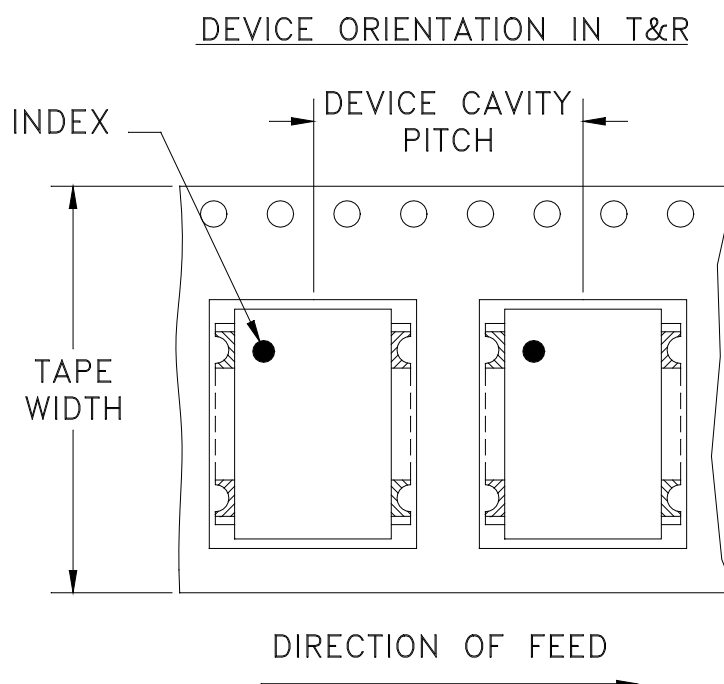


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RF/IF MICROWAVE COMPONENTS



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

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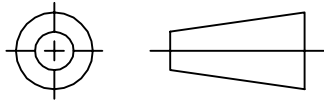
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THIRD ANGLE PROJECTION

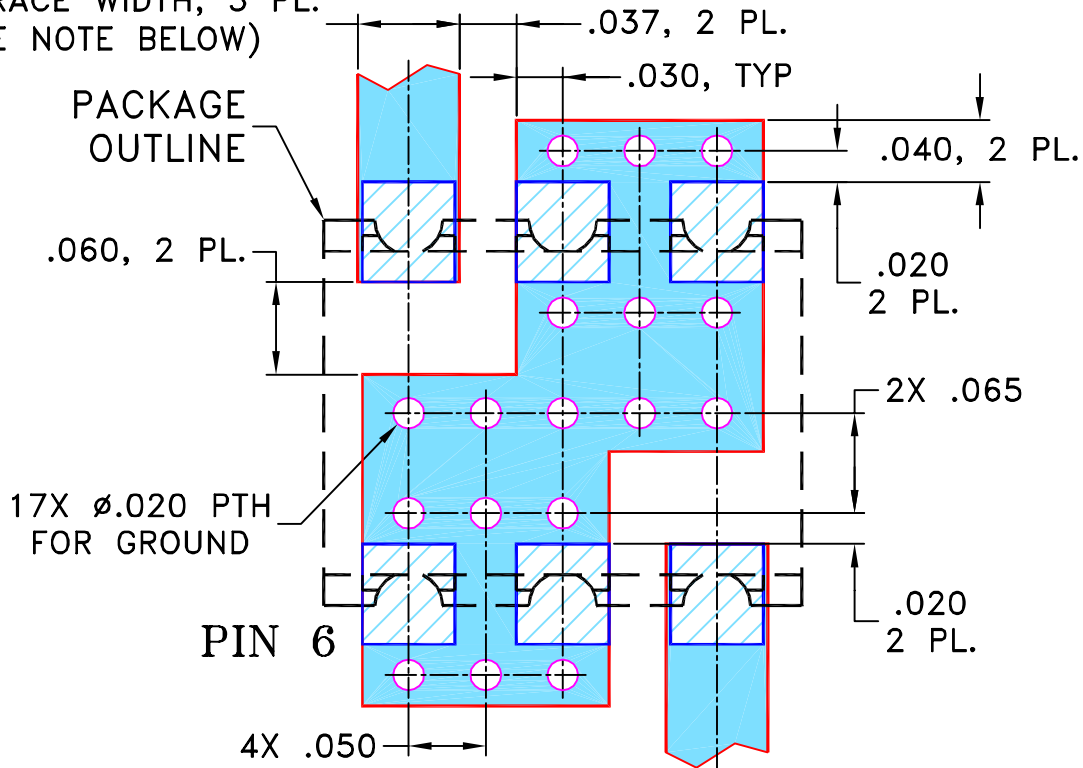


REVISIONS

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" $\pm$.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

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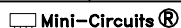
01/04/07

2 PL DECIMALS $\pm$

APPROVED

DJ

01/04/07

3 PL DECIMALS $\pm$.005ANGLES $\pm$ FRACTIONS $\pm$ 

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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

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98-PL-258

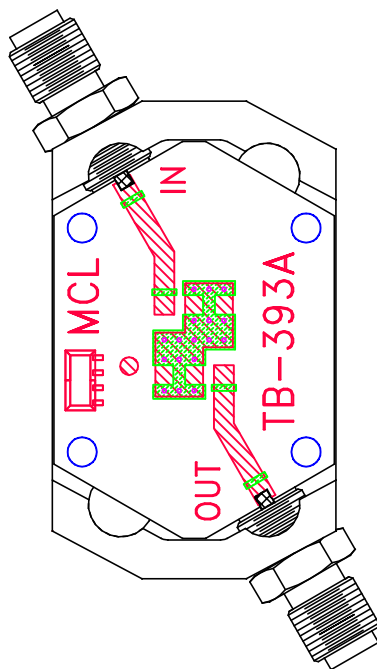
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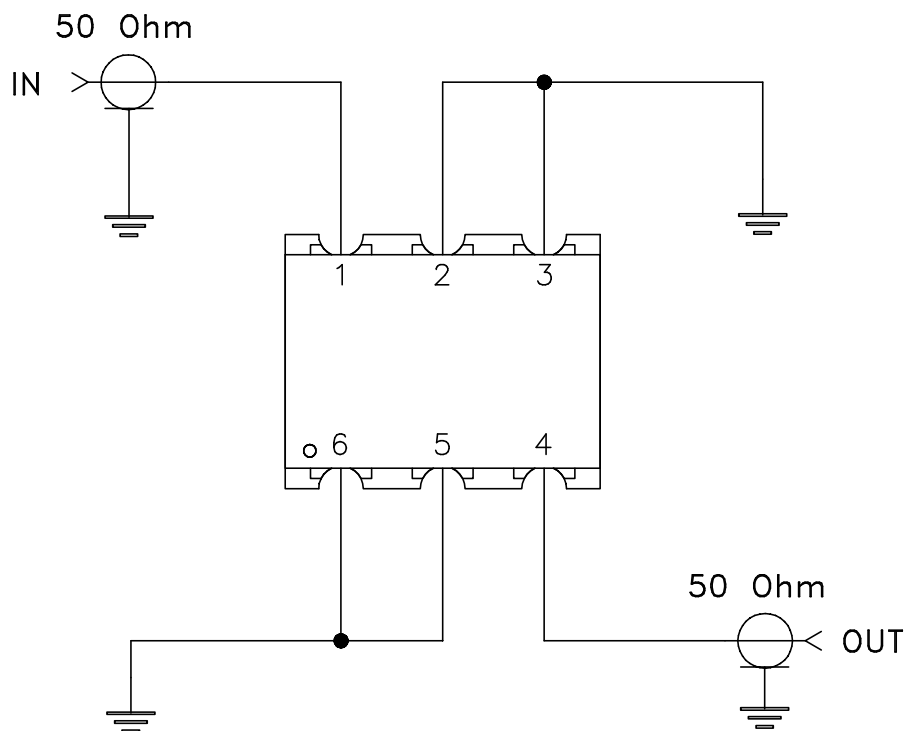
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SHEET: 1 OF 1

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