X5 Frequency Multiplier

RMK-5-13+

50Ω Output 750 to 1000 MHz

The Big Deal

- Broadband, 750 to 1000 MHz output
- Good harmonic suppression:
  F4, 63 dBc; F6, 68 dBc
- Small size, 0.25 x 0.31 x 0.16”

CASE STYLE: TT1224

Product Overview

i-Circuits’ RMK-5-13+ frequency multiplier provides a multiplication factor of 5, converting input frequencies from 150 to 200 MHz into output frequencies from 750 to 1000 MHz, supporting applications including synthesizers, local oscillators, satellite up and down converters and more. The unit supports signal input power of +17 dBm with 21.2 dB conversion loss and very 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.

Key Features

Feature	Advantages
Low conversion loss, 21.2 dB	With a low conversion loss, the unit produces higher output power, reducing the need for amplification.
Very good harmonic suppression • F4, 63 dBc • F6, 68 dBc	Reduces spurious signals and the need for additional filtering.
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-5-13+ saves space in crowded PCB layouts.

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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	21 dBm

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

Pin Connections

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

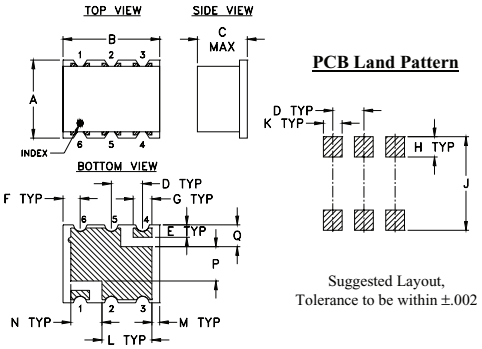
Features

- low conversion loss, 21.2 dB typ.
- excellent adjacent harmonic rejection, F4, 63 dBc typ., F6, 68 dBc typ
- aqueous washable

Applications

- synthesizers
- local oscillators
- satellite up and down converters

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

Electrical Specifications at 25°C

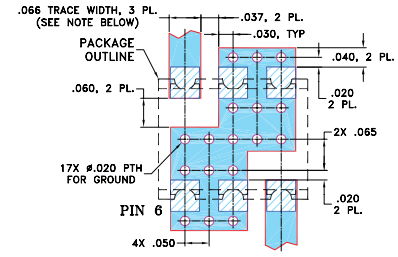
Parameter		Min.	Typ.	Max.	Unit
Multiplier Factor			5		
Frequency Range, Input (F1)		150	—	200	MHz
Frequency Range, Output (F3)		750	—	1000	MHz
Input Power		—	17.0	—	dBm
Conversion Loss		—	21.2	24.5	dB
Harmonic Ouput*	F1	-3	2.0	—	-dBc
	F2	40	65	—	
	F3	-10	5	—	
	F4	40	63	—	
	F6	40	68	—	
	F7	-1	4.0	—	

* Harmonics of input frequency below the power level of F5

Typical Performance Data

Frequency Input (MHz)	Frequency Output (MHz)	Conv. Loss (dB) F5	Harmonic Rejection Below F5, (dBc) at RF Input Power 17 dBm F1	F2	F3	F4	F6	F7
150.00	750.00	21.06	-4.59	-74.17	1.60	-65.07	-77.10	-5.27
160.00	800.00	21.21	-3.35	-74.39	2.49	-64.97	-85.69	-5.71
170.00	850.00	21.64	-1.94	-75.77	3.32	-63.82	-74.36	-6.64
180.00	900.00	21.27	-1.26	-74.11	3.89	-64.03	-76.02	-6.50
190.00	950.00	21.35	-0.22	-71.91	4.45	-64.16	-72.50	-6.69
200.00	1000.00	21.98	1.20	-69.72	5.23	-65.48	-67.62	-7.51

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.

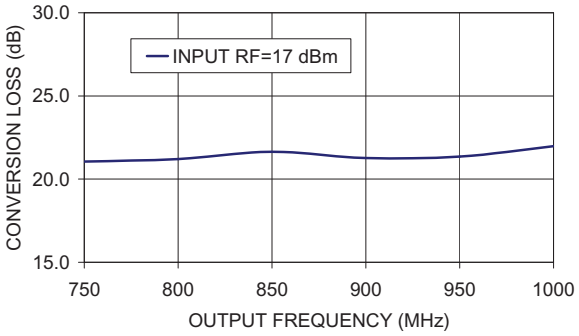
DENOTES PCB COPPER LAYOUT WITH SMOBC (SOLDER MASK OVER BARE COPPER)

DENOTES COPPER LAND PATTERN FREE OF SOLDER MASK

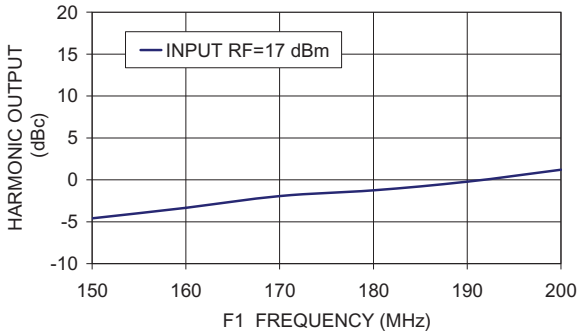
Notes

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

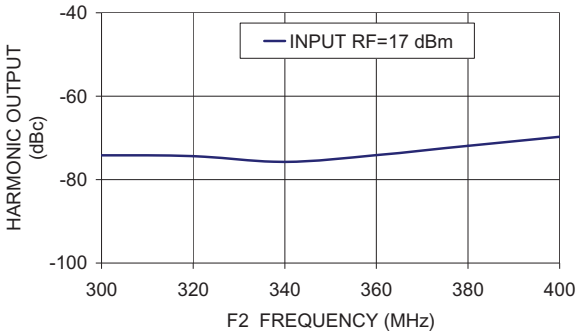
RMK-5-13+
CONVERSION LOSS



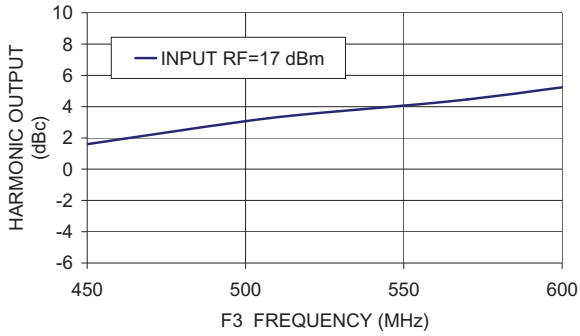
RMK-5-13+
HARMONIC OUTPUT F1



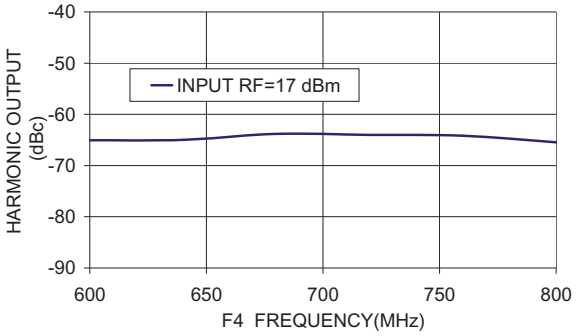
RMK-5-13+
HARMONIC OUTPUT F2



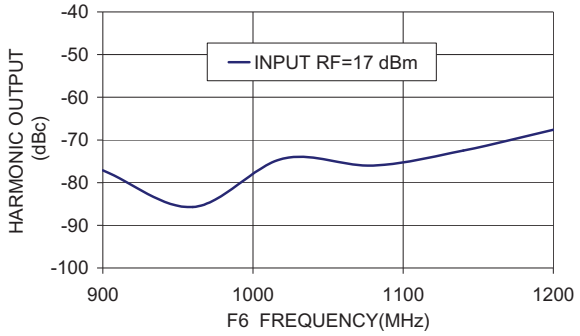
RMK-5-13+
HARMONIC OUTPUT F3



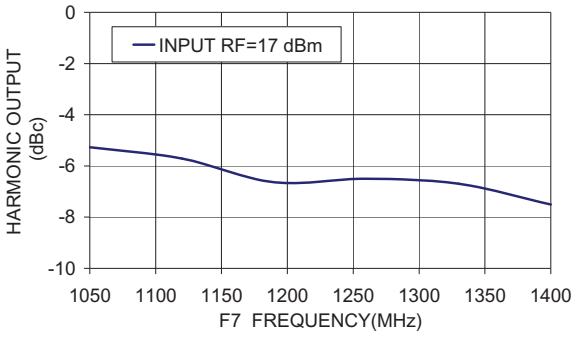
RMK-5-13+
HARMONIC OUTPUT F4



RMK-5-13+
HARMONIC OUTPUT F6



RMK-5-13+
HARMONIC OUTPUT F7



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Frequency Multiplier (X5) RMK-5-13+

Typical Performance Data

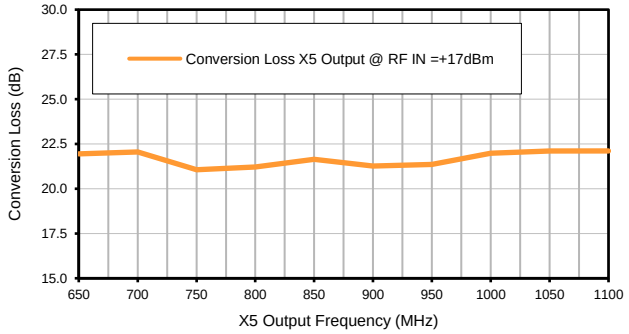
FREQUENCY (MHz)							CONVERSION LOSS (dB)	RF IN = +17 dBm HARMONIC OUTPUT* (-dBc)					
X1 OUTPUT	X2 OUTPUT	X3 OUTPUT	X4 OUTPUT	X5 OUTPUT	X6 OUTPUT	X7 OUTPUT	X5 OUTPUT	X1 OUTPUT	X2 OUTPUT	X3 OUTPUT	X4 OUTPUT	X6 OUTPUT	X7 OUTPUT
130	260	390	520	650	780	910	21.95	6.26	79.83	-0.24	64.11	67.24	4.59
140	280	420	560	700	840	980	22.06	4.91	73.97	-1.09	64.09	74.11	5.39
150	300	450	600	750	900	1050	21.06	4.59	74.17	-1.60	65.07	77.10	5.27
160	320	480	640	800	960	1120	21.21	3.35	74.39	-2.49	64.97	85.69	5.71
170	340	510	680	850	1020	1190	21.64	1.94	75.77	-3.32	63.82	74.36	6.64
180	360	540	720	900	1080	1260	21.27	1.26	74.11	-3.89	64.03	76.02	6.50
190	380	570	760	950	1140	1330	21.35	0.22	71.91	-4.45	64.16	72.50	6.69
200	400	600	800	1000	1200	1400	21.98	-1.20	69.72	-5.23	65.48	67.62	7.51
210	420	630	840	1050	1260	1470	22.10	-2.13	68.35	-5.81	64.91	65.38	7.67
220	440	660	880	1100	1320	1540	22.11	-2.95	66.35	-6.17	65.04	64.84	7.56

* Harmonic Output below power level of X5 Output.

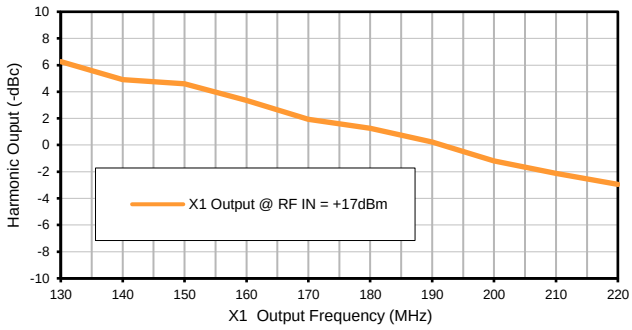
Frequency Multiplier (X5) RMK-5-13+

Typical Performance Curves

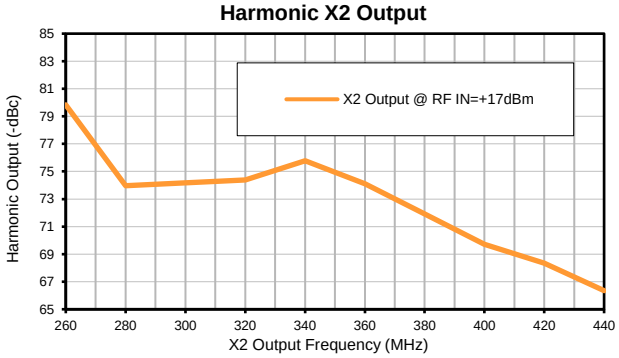
Conversion Loss X5 Output



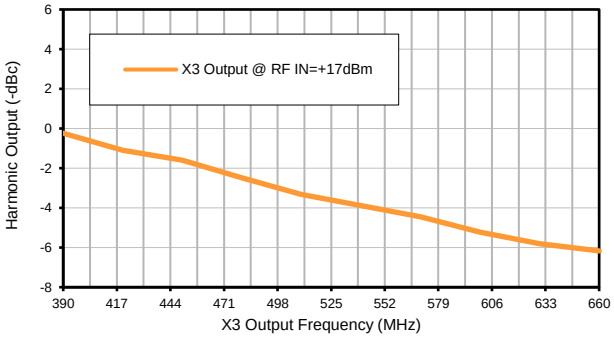
Harmonic X1 Output



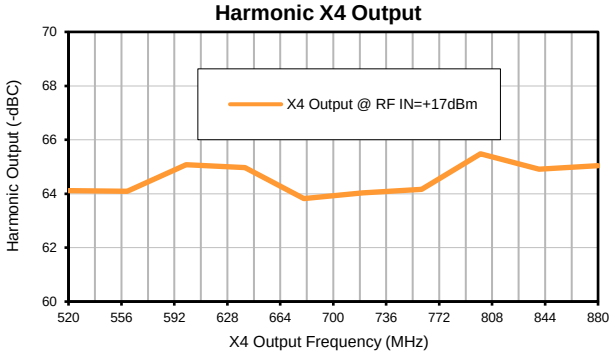
Harmonic X2 Output



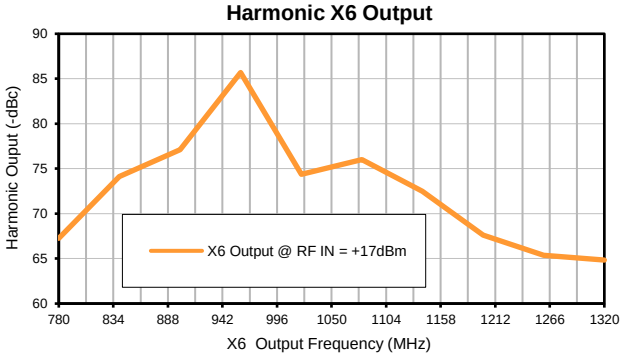
Harmonic X3 Output



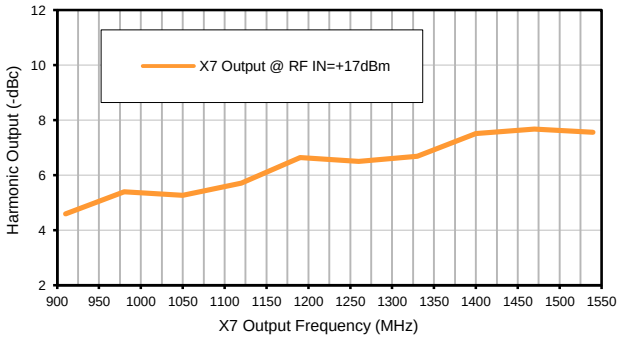
Harmonic X4 Output



Harmonic X6 Output



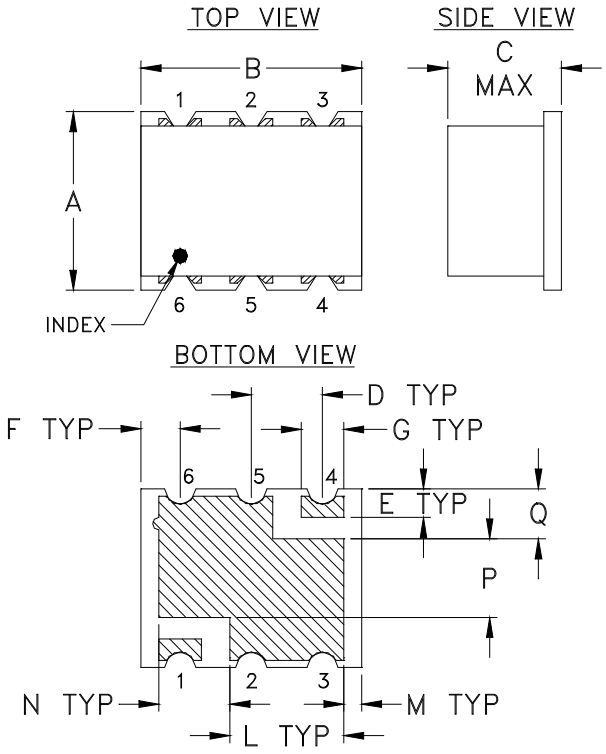
Harmonic X7 Output



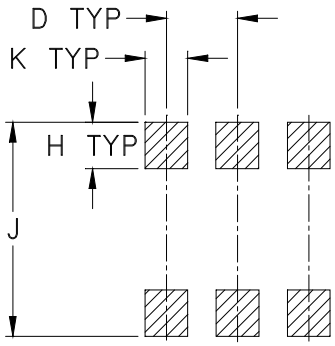
Case Style TT

TT1224

Outline Dimensions



PCB Land Pattern



Suggested Layout,
Tolerance to be within ±.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)

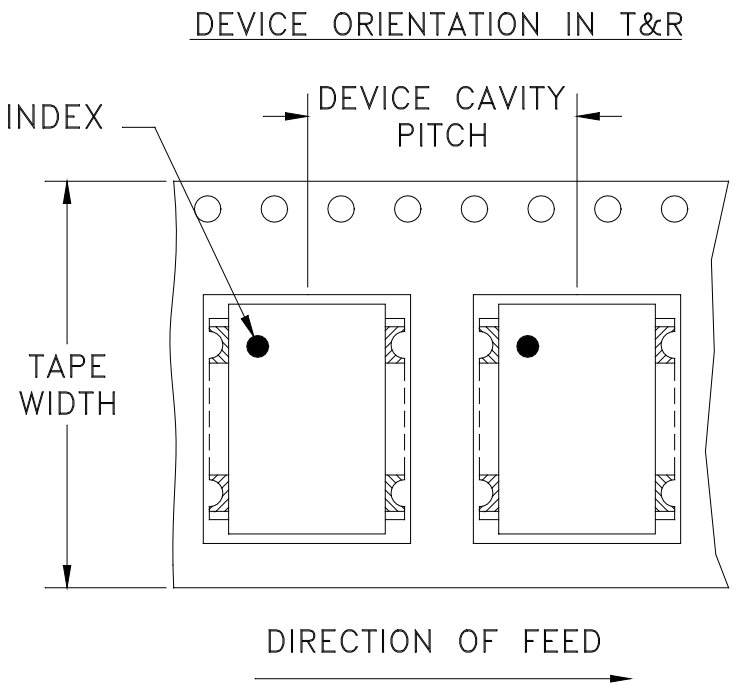
CASE #	M	N	P	Q	WT. GRAM
TT1224	.025 (.64)	.100 (2.54)	.110 (2.79)	.070 (1.78)	.16

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

Notes:

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

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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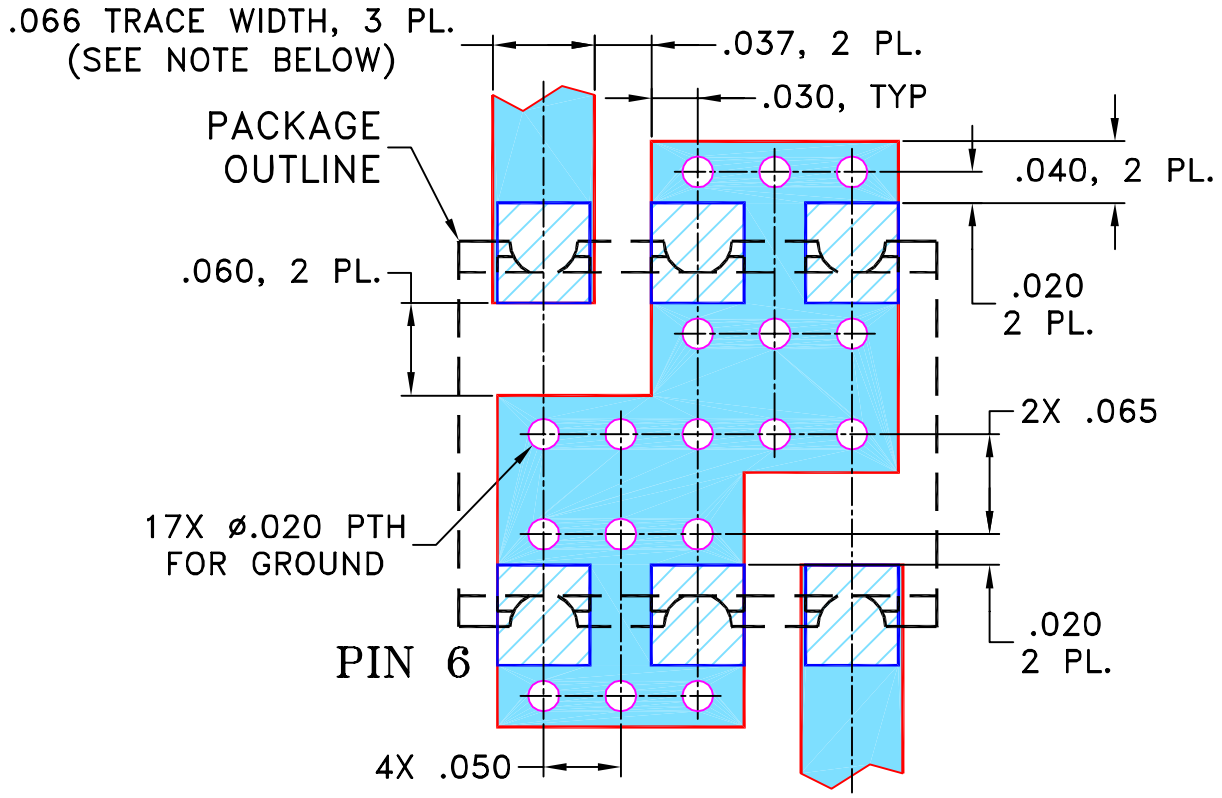
THIRD ANGLE PROJECTION

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



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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 ±	APPROVED	DJ	01/04/07
3 PL DECIMALS ± .005			
ANGLES ±			
FRACTIONS ±			

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

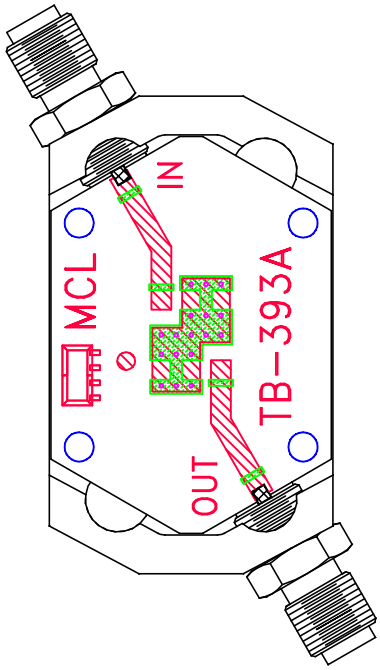
Mini-Circuits® 13 Neptune Avenue Brooklyn NY 11235

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

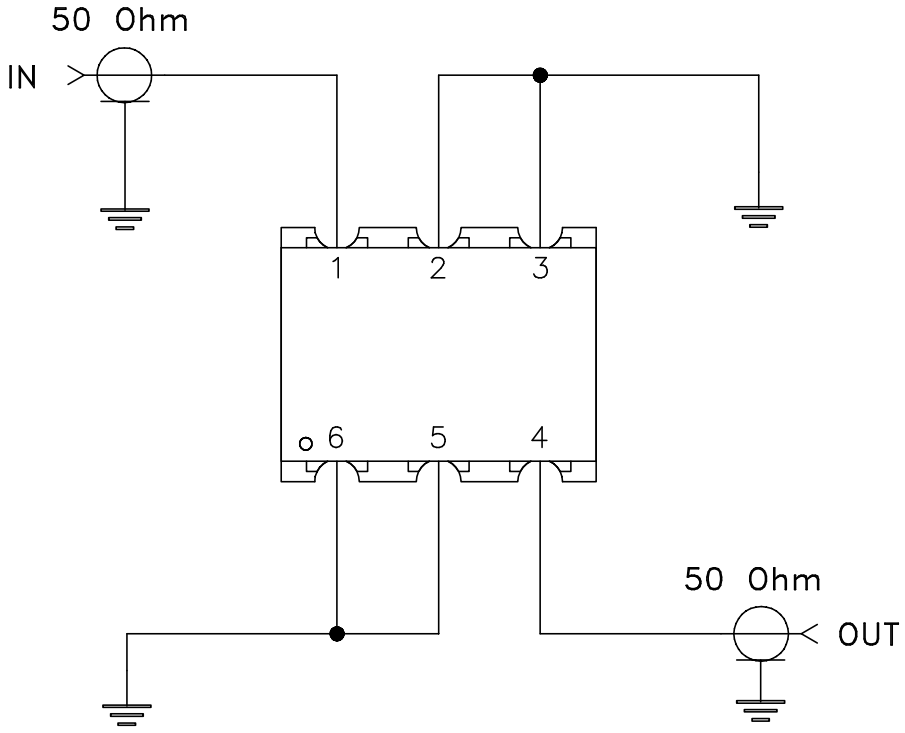
SIZE	CODE IDENT	DRAWING NO:	REV:
A	15542	98-PL-258	OR

FILE:	SCALE:	SHEET:
98PL258	8:1	1 OF 1

Evaluation Board and Circuit



TB-393



Schematic Diagram

Notes:

1. SMA Female connectors.
2. PCB Material: Rogers RO4350 or equivalent, Dielectric Constant=3.5, Thickness=.030 inch.

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Environmental Specifications ENV02T1

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