

X3 Frequency Multiplier

RMK-3-93+

50Ω Output 5400 to 9000 MHz

The Big Deal

- Broadband tripler for 5.4-9 GHz signal production
- High rejection of F2 and F4 (-55 dBc typ)
- Low conversion loss, 15 dB typ
- Outstanding performance at a low price



CASE STYLE: TT1224

Product Overview

The RMK-3-93+ is a broadband frequency tripler offering excellent performance for C- to X-band signals. The aqueous washable and RoHS-compliant package features rugged, wire-welded construction, in a small 0.25" x 0.31" x 0.16" plastic case.

Key Features

Feature	Advantages
Broad bandwidth	Ideal for satellite up- and down-converters and line-of-sight communication links, as well as items operating in the 8.5-9.0 GHz radiolocation band
High rejection of F2 and F4	Proprietary internal circuitry achieves high harmonic suppression, keeping filtering requirements to a minimum
Low conversion loss	High output reduces external gain requirements after frequency tripling.
Low price	Practical, low cost solution for providing high frequency sources from lower frequency VCOs and synthesizers.

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



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RMK-3-93+

50Ω Output 5400 to 9000 MHz

Maximum Ratings

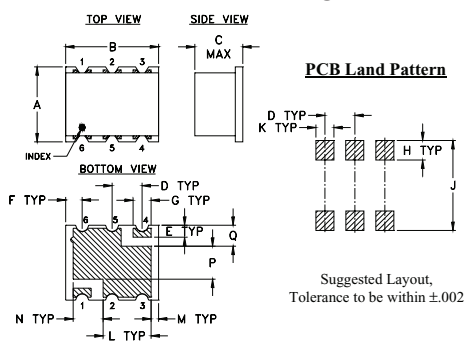
Operating Temperature	-40°C to 85°C
Storage Temperature	-55°C to 100°C
RF Input Power	17 dBm

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

Pin Connections

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

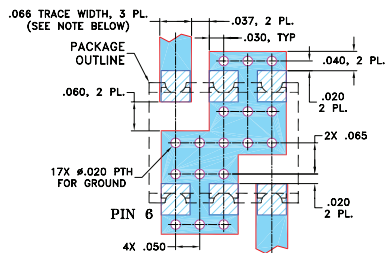
Outline Drawing



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 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

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Features

- broadband
- high rejection F2 & F4, -55 dBc typ.
- low cost
- aqueous washable

Applications

- synthesizers
- local oscillators
- satellite up and down converters

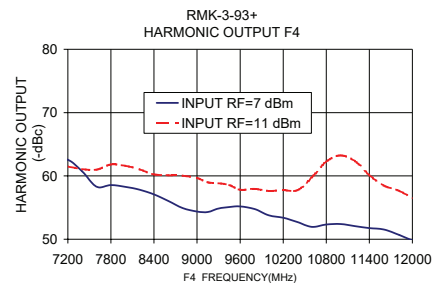
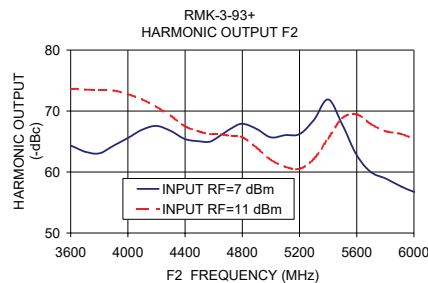
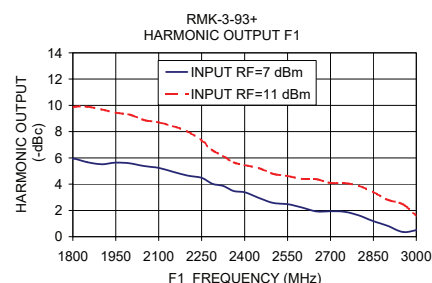
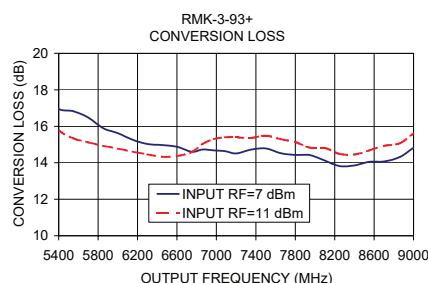
Electrical Specifications

MULTIPLICATION FACTOR	FREQUENCY (MHz)		INPUT POWER (dBm)		CONVERSION LOSS (dB)		*HARMONIC OUTPUT (dBC)		
	F1 Input	F3 Output	Min.	Max.	Typ.	Max.	F1 Typ.	F2 Typ.	F4 Typ.
3	1800-3000	5400-9000	7	11	15	19.5	6	-6	55 35 55 35

* Harmonics of input frequency below the power level of F3

Typical Performance Data

Input Frequency (MHz)	INPUT RF= 7 dBm			INPUT RF= 11 dBm				
	Conversion Loss (dB)	Harmonic Output Below F3 (-dBc)		Conversion Loss (dB)	Harmonic Output Below F3 (-dBc)			
		F1	F2	F4	F1	F2	F4	
1800.00	16.94	5.94	64.33	62.56	15.79	9.86	73.68	61.49
1900.00	16.48	5.52	63.05	58.30	15.12	9.69	73.46	60.98
2000.00	15.62	5.58	65.59	58.27	14.78	9.29	72.77	61.61
2100.00	15.03	5.24	67.56	57.08	14.46	8.70	70.70	60.24
2200.00	14.88	4.66	65.40	54.92	14.37	8.01	67.50	60.03
2287.50	14.73	4.02	64.99	54.30	15.04	6.58	66.22	58.98
2325.00	14.68	3.86	66.04	54.86	15.30	6.15	66.18	58.85
2400.00	14.51	3.38	67.92	55.19	15.39	5.45	65.72	57.81
2450.00	14.72	2.95	67.05	54.79	15.36	5.22	64.01	57.96
2500.00	14.79	2.57	65.67	53.79	15.49	4.78	62.00	57.62
2550.00	14.53	2.48	66.05	53.40	15.30	4.62	60.87	57.76
2600.00	14.43	2.23	66.21	52.72	15.14	4.40	60.52	57.74
2650.00	14.42	1.93	68.53	51.96	14.83	4.38	62.14	59.76
2700.00	14.12	1.94	71.91	52.32	14.81	4.09	65.72	62.24
2750.00	13.82	1.89	67.73	52.40	14.49	4.08	68.87	63.23
2800.00	13.85	1.62	62.77	52.06	14.45	3.86	69.45	62.33
2850.00	14.05	1.18	59.98	51.75	14.68	3.39	67.86	60.15
2900.00	14.07	0.82	58.96	51.55	14.93	2.81	66.70	58.49
2955.00	14.33	0.35	57.62	50.67	15.08	2.45	66.24	57.64
3010.00	14.90	0.57	56.61	49.65	15.68	1.47	65.11	56.28



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

Typical Performance Data

FREQUENCY (MHz)				CONVERSION LOSS (dB)	RF IN = 7 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
1800.0	3600.0	5400.0	7200.0	16.94	5.94	64.33	62.56
1850.0	3700.0	5550.0	7400.0	16.82	5.67	63.33	60.72
1900.0	3800.0	5700.0	7600.0	16.48	5.52	63.05	58.30
1950.0	3900.0	5850.0	7800.0	15.90	5.64	64.32	58.55
2000.0	4000.0	6000.0	8000.0	15.62	5.58	65.59	58.27
2050.0	4100.0	6150.0	8200.0	15.26	5.38	66.93	57.83
2100.0	4200.0	6300.0	8400.0	15.03	5.24	67.56	57.08
2150.0	4300.0	6450.0	8600.0	14.97	4.94	66.75	56.03
2200.0	4400.0	6600.0	8800.0	14.88	4.66	65.40	54.92
2250.0	4500.0	6750.0	9000.0	14.60	4.48	65.03	54.37
2287.5	4575.0	6862.5	9150.0	14.73	4.02	64.99	54.30
2325.0	4650.0	6975.0	9300.0	14.68	3.86	66.04	54.86
2362.5	4725.0	7087.5	9450.0	14.64	3.47	67.19	55.08
2400.0	4800.0	7200.0	9600.0	14.51	3.38	67.92	55.19
2450.0	4900.0	7350.0	9800.0	14.72	2.95	67.05	54.79
2500.0	5000.0	7500.0	10000.0	14.79	2.57	65.67	53.79
2550.0	5100.0	7650.0	10200.0	14.53	2.48	66.05	53.40
2600.0	5200.0	7800.0	10400.0	14.43	2.23	66.21	52.72
2650.0	5300.0	7950.0	10600.0	14.42	1.93	68.53	51.96
2700.0	5400.0	8100.0	10800.0	14.12	1.94	71.91	52.32
2750.0	5500.0	8250.0	11000.0	13.82	1.89	67.73	52.40
2800.0	5600.0	8400.0	11200.0	13.85	1.62	62.77	52.06
2850.0	5700.0	8550.0	11400.0	14.05	1.18	59.98	51.75
2900.0	5800.0	8700.0	11600.0	14.07	0.82	58.96	51.55
2955.0	5910.0	8865.0	11820.0	14.33	0.35	57.62	50.67
3010.0	6020.0	9030.0	12040.0	14.90	0.57	56.61	49.65

* Harmonic Output below power level of X3 Output.

FREQUENCY (MHz)				CONVERSION LOSS (dB)	RF IN = 11 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
1800.0	3600.0	5400.0	7200.0	15.79	9.86	73.68	61.49
1850.0	3700.0	5550.0	7400.0	15.34	9.90	73.51	61.07
1900.0	3800.0	5700.0	7600.0	15.12	9.69	73.46	60.98
1950.0	3900.0	5850.0	7800.0	14.93	9.44	73.36	61.81
2000.0	4000.0	6000.0	8000.0	14.78	9.29	72.77	61.61
2050.0	4100.0	6150.0	8200.0	14.61	8.88	71.89	61.03
2100.0	4200.0	6300.0	8400.0	14.46	8.70	70.70	60.24
2150.0	4300.0	6450.0	8600.0	14.33	8.42	69.22	60.11
2200.0	4400.0	6600.0	8800.0	14.37	8.01	67.50	60.03
2250.0	4500.0	6750.0	9000.0	14.59	7.34	66.63	59.68
2287.5	4575.0	6862.5	9150.0	15.04	6.58	66.22	58.98
2325.0	4650.0	6975.0	9300.0	15.30	6.15	66.18	58.85
2362.5	4725.0	7087.5	9450.0	15.40	5.65	65.93	58.56
2400.0	4800.0	7200.0	9600.0	15.39	5.45	65.72	57.81
2450.0	4900.0	7350.0	9800.0	15.36	5.22	64.01	57.96
2500.0	5000.0	7500.0	10000.0	15.49	4.78	62.00	57.62
2550.0	5100.0	7650.0	10200.0	15.30	4.62	60.87	57.76
2600.0	5200.0	7800.0	10400.0	15.14	4.40	60.52	57.74
2650.0	5300.0	7950.0	10600.0	14.83	4.38	62.14	59.76
2700.0	5400.0	8100.0	10800.0	14.81	4.09	65.47	62.24
2750.0	5500.0	8250.0	11000.0	14.49	4.08	68.87	63.23
2800.0	5600.0	8400.0	11200.0	14.45	3.86	69.45	62.33
2850.0	5700.0	8550.0	11400.0	14.68	3.39	67.86	60.15
2900.0	5800.0	8700.0	11600.0	14.93	2.81	66.70	58.49
2955.0	5910.0	8865.0	11820.0	15.08	2.45	66.24	57.64
3010.0	6020.0	9030.0	12040.0	15.68	1.47	65.11	56.28

* Harmonic Output below power level of X3 Output.

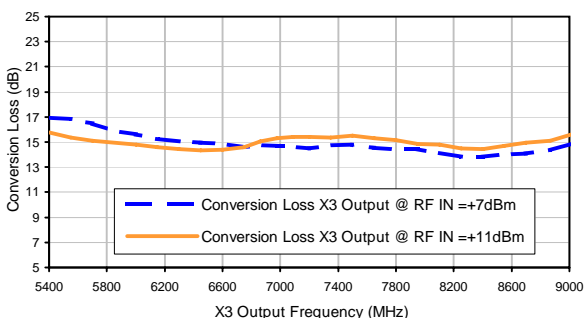


ISO 9001 ISO 14001 AS 9100 CERTIFIED

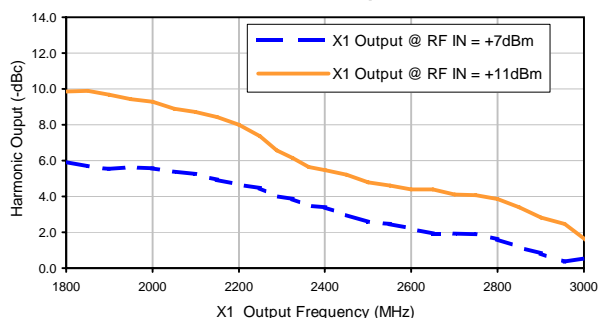


Typical Performance Curves

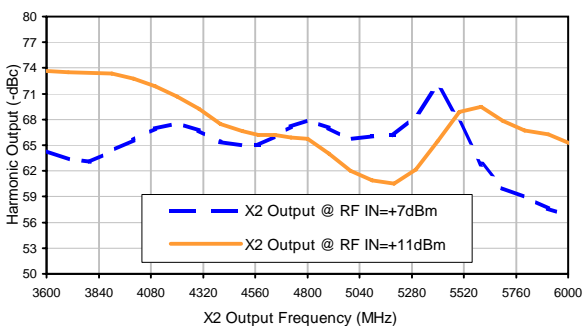
Conversion Loss X3 Output



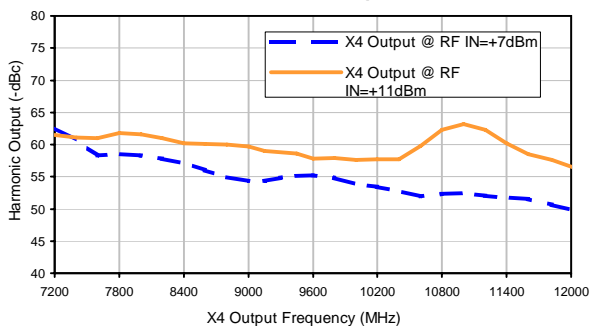
Harmonic X1 Output



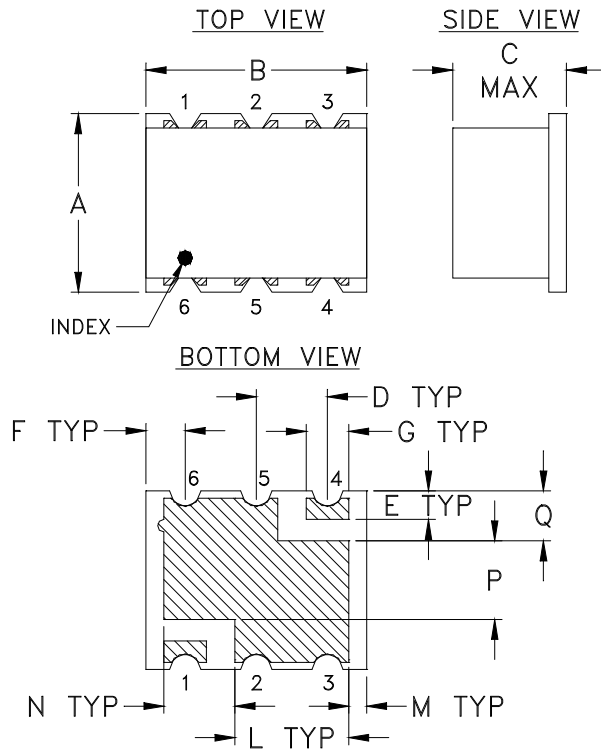
Harmonic X2 Output



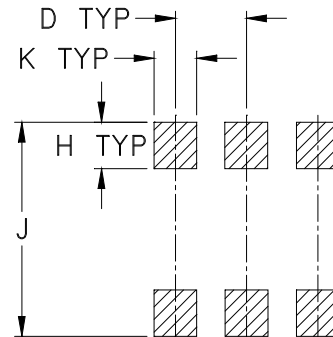
Harmonic X4 Output



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 μ inch (.05-.25 microns) Gold over 100-300 μ inch (2.54-7.62 microns) Nickel plate



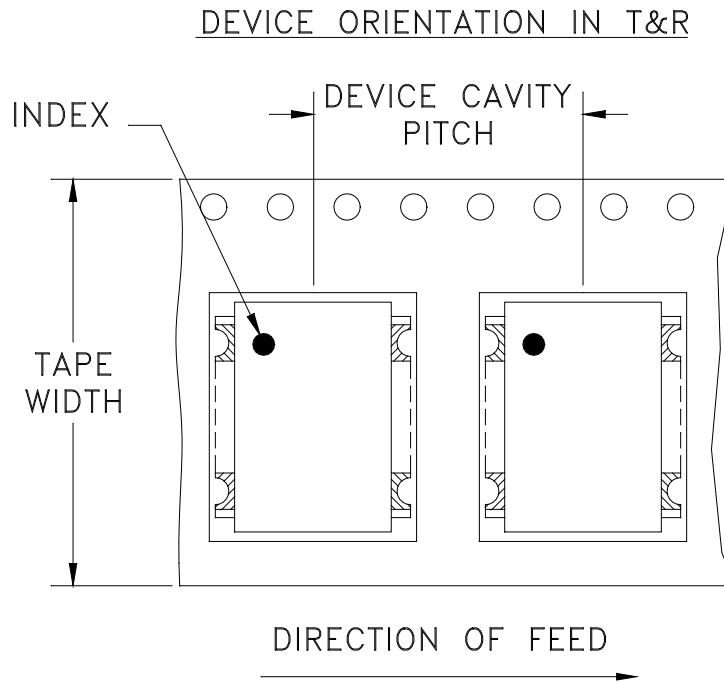
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The Design Engineers Search Engine Provides ACTUAL Data Instantly From MINI-CIRCUITS At: www.minicircuits.com

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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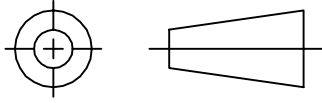
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THIRD ANGLE PROJECTION

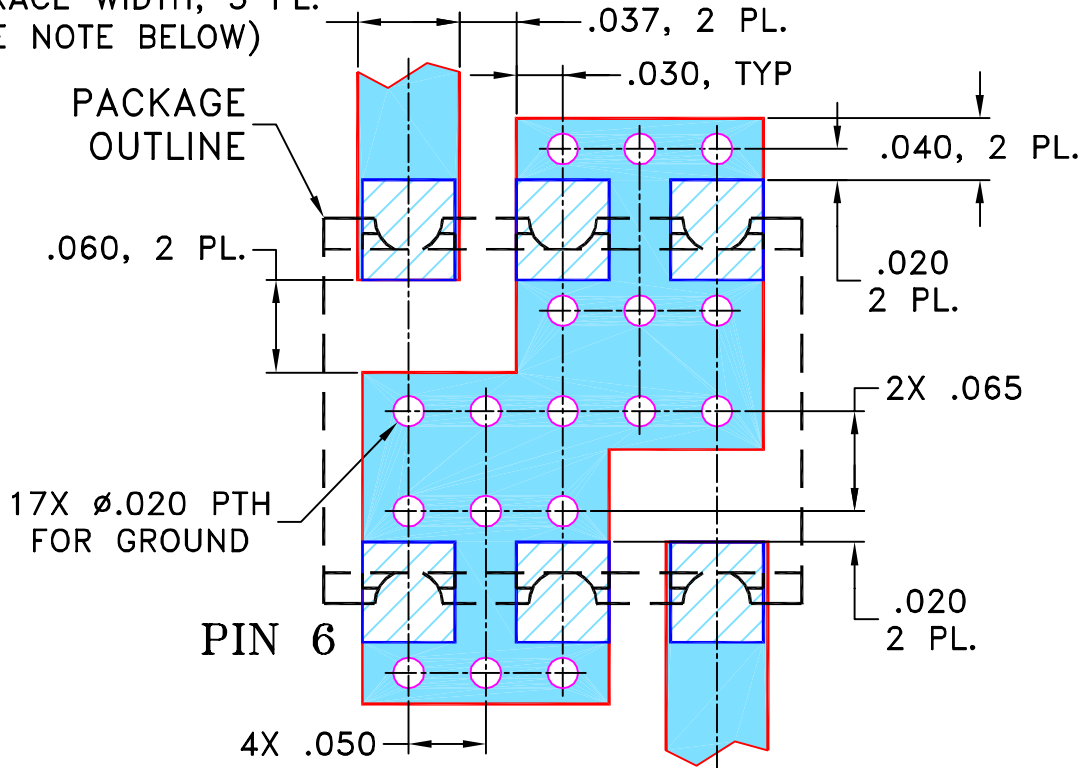


REVISIONS

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" ± .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 ±

APPROVED

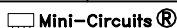
DJ

01/04/07

3 PL DECIMALS ± .005

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

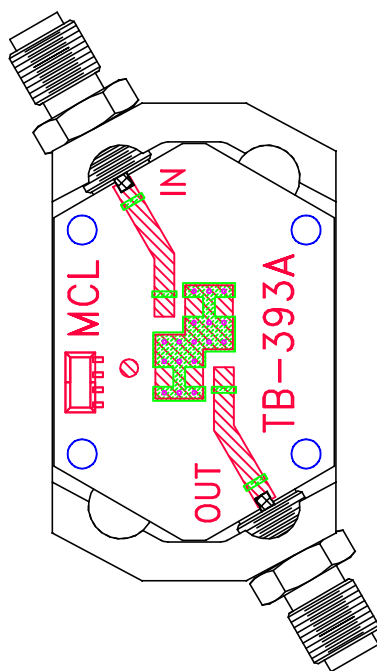
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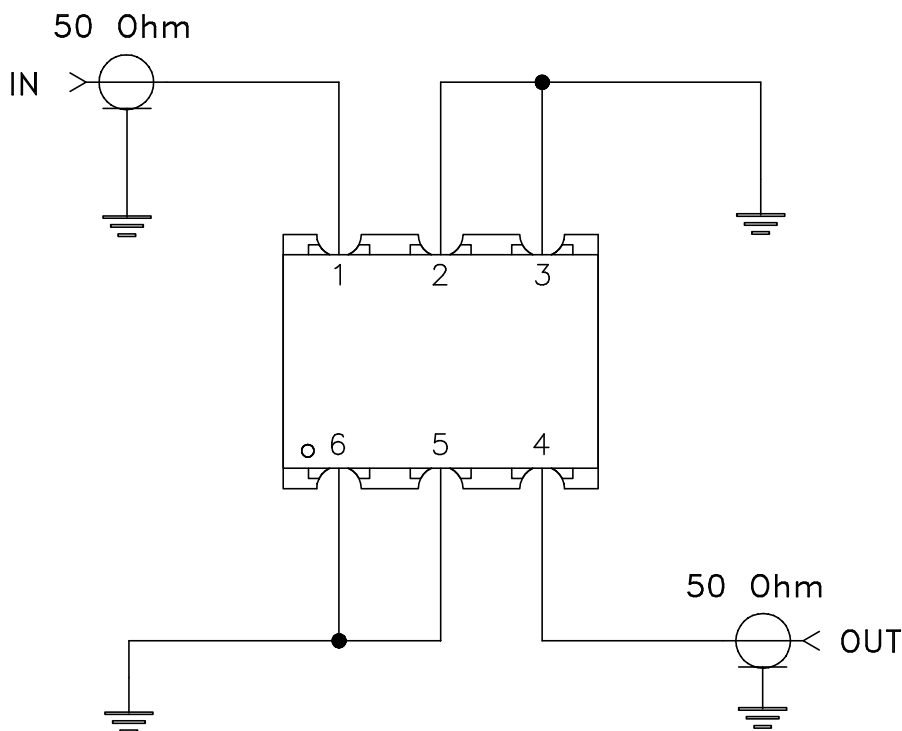
SCALE: 8:1

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