X5 Frequency Multiplier

RMK-5-472+

50Ω Output 3375 to 4750 MHz

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	20 dBm

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

Pin Connections

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

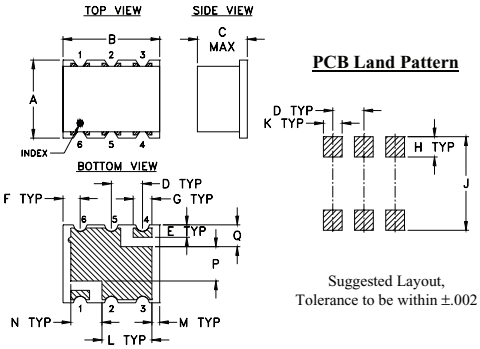
Features

- low conversion loss, 22 dB typ.
- high adjacent harmonic rejection, F4, -55 dBc typ., F6, 60 dBc typ.
- aqueous washable

Applications

- synthesizers
- local oscillators
- satellite up and down converters

Outline Drawing

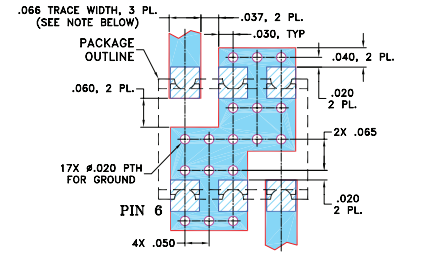


Outline Dimensions (inch / mm)

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

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

Electrical Specifications at 25°C

Parameter		Min.	Typ.	Max.	Unit
Multiplier Factor			5		
Frequency Range, Input (F1)		675		950	MHz
Frequency Range, Output (F5)		3375		4750	MHz
Input Power		10	—	15	dBm
Conversion Loss		—	22	26.5	dB
Harmonic Ouput*	F1	-3	4	—	dBc
	F2	40	60	—	
	F3	-8	0	—	
	F4	40	55	—	
	F6	40	60	—	
	F7	0	5	—	

* 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 10 dBm F1	F2	F3	F4	F6	F7
675	3375	22.65	8.67	65.80	2.14	56.28	59.68	8.06
700	3500	22.56	8.18	64.45	1.57	54.80	58.58	10.02
725	3625	22.39	7.67	67.46	1.04	58.07	64.28	11.24
750	3750	22.22	7.28	66.36	0.64	57.14	64.54	12.62
775	3875	22.02	6.90	65.86	0.19	56.94	66.06	13.65
800	4000	22.03	6.43	65.28	-0.66	56.72	67.50	14.70
825	4125	22.16	5.72	64.71	-1.36	56.48	69.52	14.86
850	4250	22.17	5.26	64.07	-2.07	56.09	71.27	14.80
875	4375	22.51	4.42	62.51	-2.96	55.70	75.31	15.00
900	4500	22.84	3.60	61.27	-3.93	55.20	79.85	13.74
925	4625	23.07	2.89	59.77	-4.66	54.44	83.09	9.54
950	4750	23.83	1.69	57.92	-5.80	53.56	82.63	11.69

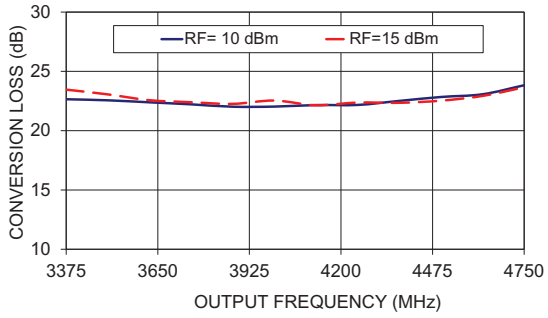
at RF Input Power 15 dBm

675	3375	23.46	11.30	64.84	5.10	56.19	54.87	4.85
700	3500	23.06	11.09	63.82	4.84	54.76	54.22	5.99
725	3625	22.57	10.90	67.78	4.47	59.20	63.77	7.21
750	3750	22.40	10.44	66.20	4.32	57.68	63.12	8.31
775	3875	22.26	10.02	65.58	3.86	57.36	66.03	8.44
800	4000	22.54	9.30	64.75	2.98	56.85	66.67	9.12
825	4125	22.14	9.06	64.85	2.46	56.91	69.93	8.92
850	4250	22.37	8.40	64.49	1.63	56.57	73.03	8.18
875	4375	22.35	7.85	63.64	0.84	56.65	72.66	8.62
900	4500	22.53	7.22	62.87	-0.18	56.48	71.92	7.25
925	4625	22.93	6.37	61.61	-1.03	55.74	71.85	7.71
950	4750	23.66	5.19	60.02	-1.89	54.90	69.13	7.64

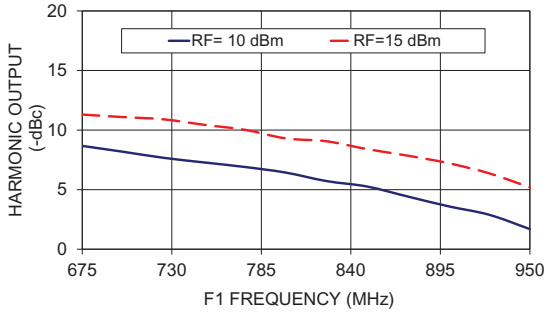
Notes

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

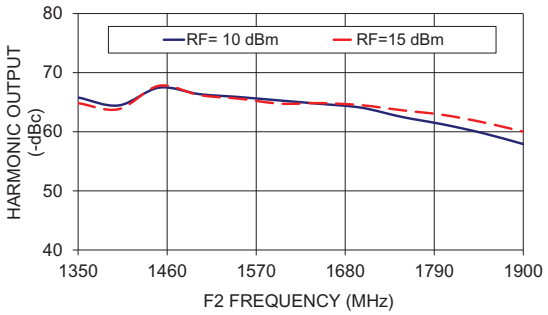
RMK-5-472+
CONVERSION LOSS



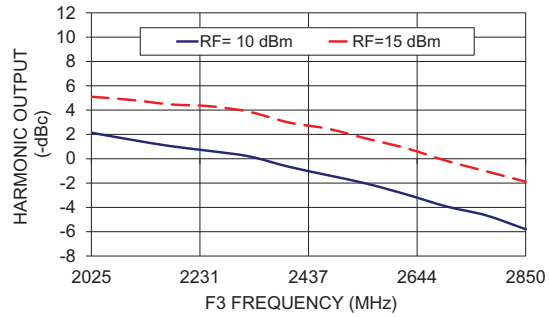
RMK-5-472+
HARMONIC OUTPUT F1



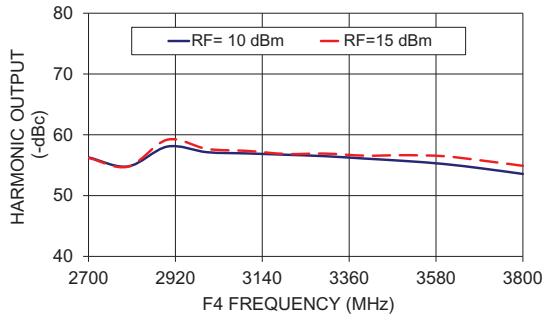
RMK-5-472+
HARMONIC OUTPUT F2



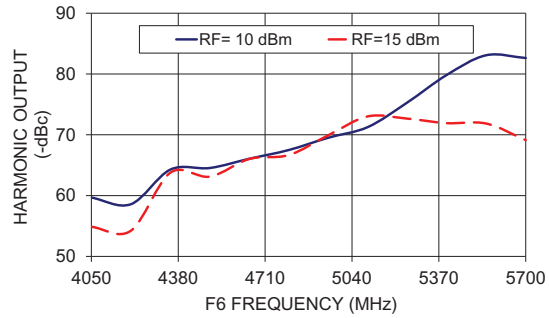
RMK-5-472+
HARMONIC OUTPUT F3



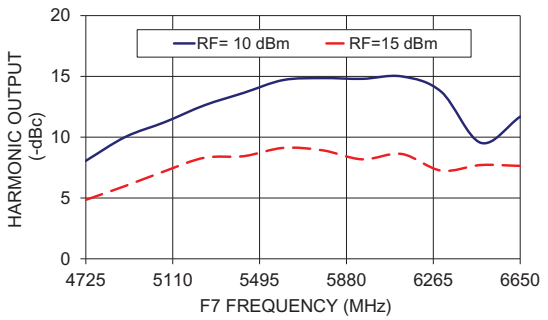
RMK-5-472+
HARMONIC OUTPUT F4



RMK-5-472+
HARMONIC OUTPUT F6



RMK-5-472+
HARMONIC OUTPUT F7



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

Frequency Multiplier (X5) RMK-5-472+

Typical Performance Data

FREQUENCY (MHz)							CONVERSION LOSS (dB)	RF IN = +10 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	26.93	9.62	51.08	3.23	45.23	36.49	1.06
525	1050	1575	2100	2625	3150	3675	26.06	9.58	50.78	3.21	42.72	37.45	1.09
550	1100	1650	2200	2750	3300	3850	25.34	9.55	44.29	3.05	35.49	31.31	2.18
575	1150	1725	2300	2875	3450	4025	24.54	9.58	52.78	3.06	44.23	40.02	4.40
600	1200	1800	2400	3000	3600	4200	23.88	9.43	62.44	2.94	54.08	50.55	4.08
625	1250	1875	2500	3125	3750	4375	23.39	9.22	63.48	2.78	54.83	52.66	5.85
650	1300	1950	2600	3250	3900	4550	23.00	8.96	67.93	2.38	58.55	60.04	7.40
675	1350	2025	2700	3375	4050	4725	22.65	8.67	65.80	2.14	56.28	59.68	8.06
700	1400	2100	2800	3500	4200	4900	22.56	8.18	64.45	1.57	54.80	58.58	10.02
725	1450	2175	2900	3625	4350	5075	22.39	7.67	67.46	1.04	58.07	64.28	11.24
750	1500	2250	3000	3750	4500	5250	22.22	7.28	66.36	0.64	57.14	64.54	12.62
775	1550	2325	3100	3875	4650	5425	22.02	6.90	65.86	0.19	56.94	66.06	13.65
800	1600	2400	3200	4000	4800	5600	22.03	6.43	65.28	-0.66	56.72	67.50	14.70
825	1650	2475	3300	4125	4950	5775	22.16	5.72	64.71	-1.36	56.48	69.52	14.86
850	1700	2550	3400	4250	5100	5950	22.17	5.26	64.07	-2.07	56.09	71.27	14.80
875	1750	2625	3500	4375	5250	6125	22.51	4.42	62.51	-2.96	55.70	75.31	15.00
900	1800	2700	3600	4500	5400	6300	22.84	3.60	61.27	-3.93	55.20	79.85	13.74
925	1850	2775	3700	4625	5550	6475	23.07	2.89	59.77	-4.66	54.44	83.09	9.54
950	1900	2850	3800	4750	5700	6650	23.83	1.69	57.92	-5.80	53.56	82.63	11.69
1000	2000	3000	4000	5000	6000	7000	25.00	-0.32	54.70	-7.65	52.16	74.56	8.08
1050	2100	3150	4200	5250	6300	7350	26.81	-2.93	51.25	-9.77	50.56	65.80	5.00
1100	2200	3300	4400	5500	6600	7700	28.90	-5.64	48.10	-12.02	48.92	61.27	3.13

* Harmonic Output below power level of X5 Output.

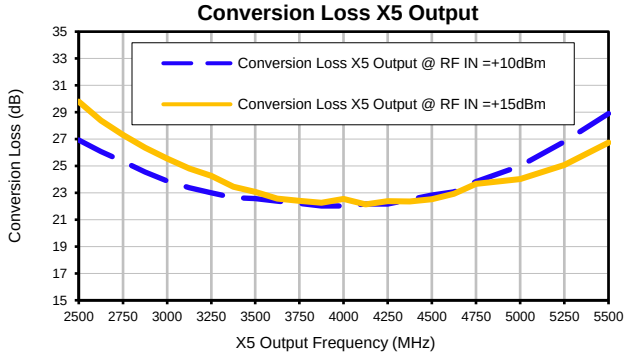
FREQUENCY (MHz)							CONVERSION LOSS (dB)	RF IN = +15 dBm HARMONIC OUTPUT* (-dBc)					
X1 OUTPUT	X2 OUTPUT	X3 OUTPUT	X4 OUTPUT	X5 OUTPUT	X6 OUTPUT	X7 OUTPUT	X5 OUTPUT	X1 OUTPUT	X2 OUTPUT	X3 OUTPUT	X4 OUTPUT	X6 OUTPUT	X7 OUTPUT
500	1000	1500	2000	2500	3000	3500	29.79	10.33	44.94	5.09	48.55	37.77	-2.77
525	1050	1575	2100	2625	3150	3675	28.39	10.88	44.03	5.08	37.30	30.30	-2.34
550	1100	1650	2200	2750	3300	3850	27.30	11.20	39.47	5.15	30.87	23.72	-1.54
575	1150	1725	2300	2875	3450	4025	26.36	11.37	49.10	5.23	41.10	34.06	-0.68
600	1200	1800	2400	3000	3600	4200	25.54	11.41	59.02	5.19	52.07	45.64	0.66
625	1250	1875	2500	3125	3750	4375	24.81	11.34	61.33	5.28	53.93	48.22	2.00
650	1300	1950	2600	3250	3900	4550	24.26	11.21	66.83	5.01	58.55	55.97	3.04
675	1350	2025	2700	3375	4050	4725	23.46	11.30	64.84	5.10	56.19	54.87	4.85
700	1400	2100	2800	3500	4200	4900	23.06	11.09	63.82	4.84	54.76	54.22	5.99
725	1450	2175	2900	3625	4350	5075	22.57	10.90	67.78	4.47	59.20	63.77	7.21
750	1500	2250	3000	3750	4500	5250	22.40	10.44	66.20	4.32	57.68	63.12	8.31
775	1550	2325	3100	3875	4650	5425	22.26	10.02	65.58	3.86	57.36	66.03	8.44
800	1600	2400	3200	4000	4800	5600	22.54	9.30	64.75	2.98	56.85	66.67	9.12
825	1650	2475	3300	4125	4950	5775	22.14	9.06	64.85	2.46	56.91	69.93	8.92
850	1700	2550	3400	4250	5100	5950	22.37	8.40	64.49	1.63	56.57	73.03	8.18
875	1750	2625	3500	4375	5250	6125	22.35	7.85	63.64	0.84	56.65	72.66	8.62
900	1800	2700	3600	4500	5400	6300	22.53	7.22	62.87	-0.18	56.48	71.92	7.25
925	1850	2775	3700	4625	5550	6475	22.93	6.37	61.61	-1.03	55.74	71.85	7.71
950	1900	2850	3800	4750	5700	6650	23.66	5.19	60.02	-1.89	54.90	69.13	7.64
1000	2000	3000	4000	5000	6000	7000	24.03	3.96	58.04	-3.58	54.35	65.18	7.87
1050	2100	3150	4200	5250	6300	7350	25.08	2.13	55.71	-5.40	53.67	64.80	7.14
1100	2200	3300	4400	5500	6600	7700	26.74	-0.08	52.45	-7.64	51.38	62.71	7.48

* Harmonic Output below power level of X5 Output.

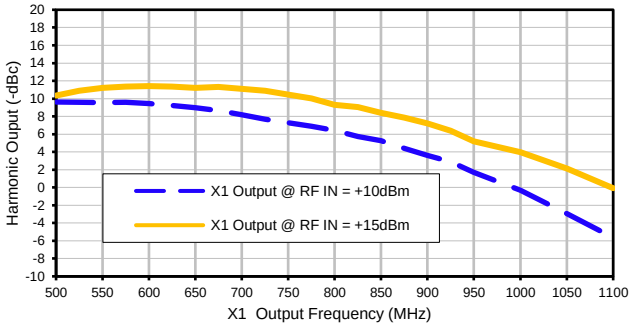
Frequency Multiplier (X5) RMK-5-472+

Typical Performance Curves

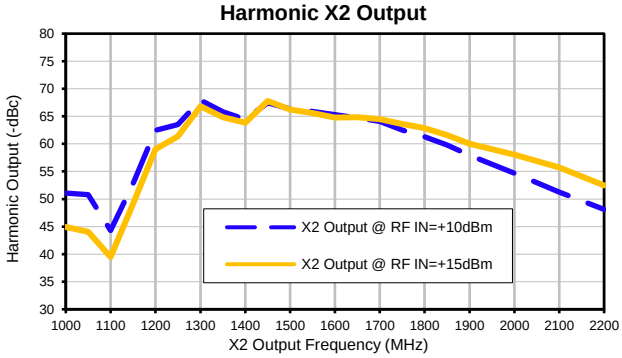
Conversion Loss X5 Output



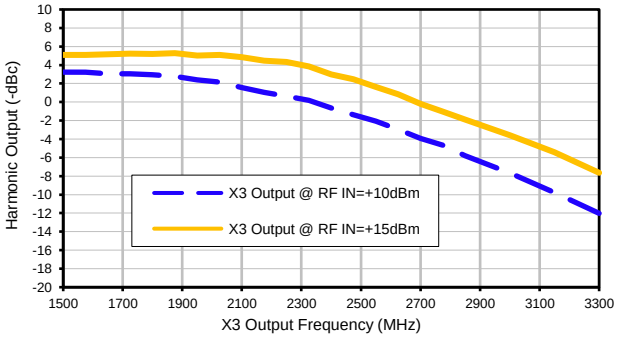
Harmonic X1 Output



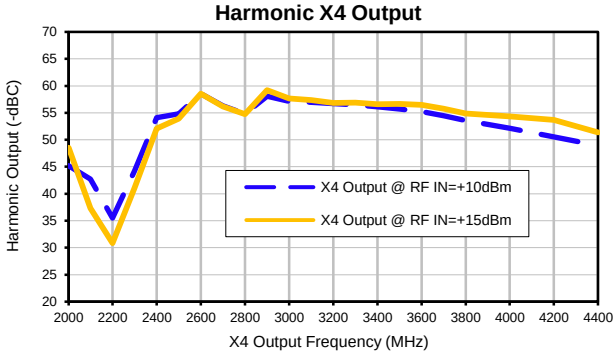
Harmonic X2 Output



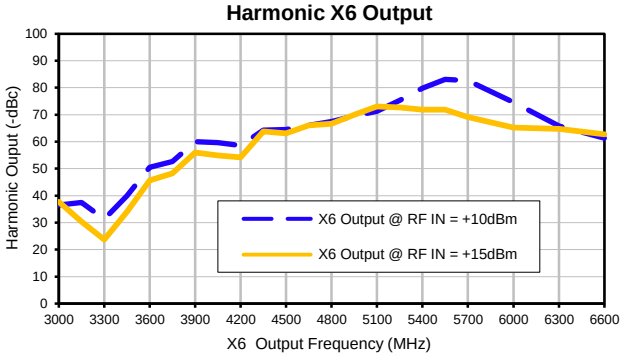
Harmonic X3 Output



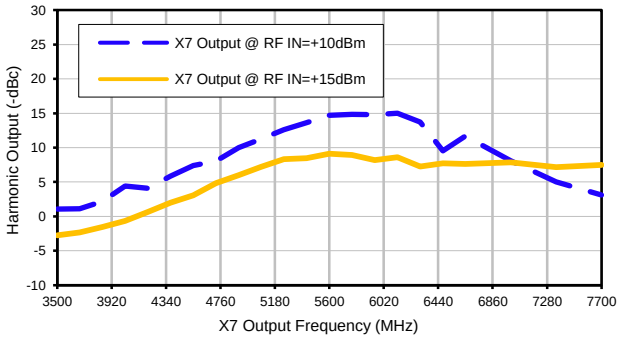
Harmonic X4 Output



Harmonic X6 Output



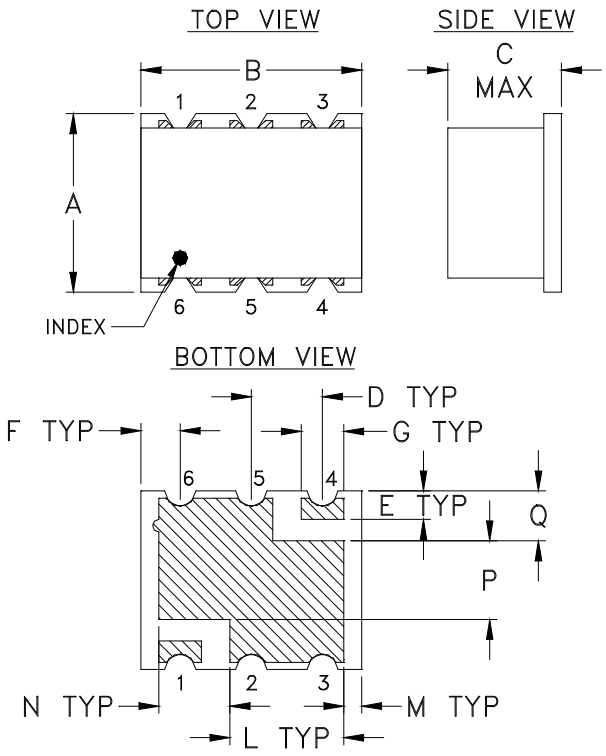
Harmonic X7 Output



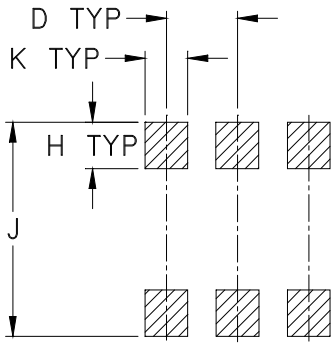
Case Style TT

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)

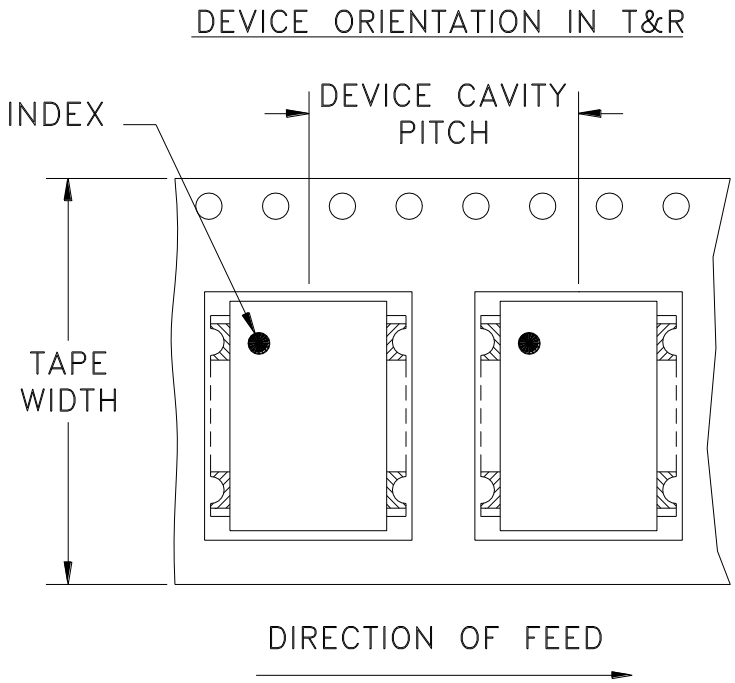
CASE #	M	N	P	Q	WT. GRAM
TT1224	.025 (.64)	.100 (2.54)	.110 (2.79)	.070 (1.78)	.16

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

Note: Please consult individual model data sheet to determine device per reel availability

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.

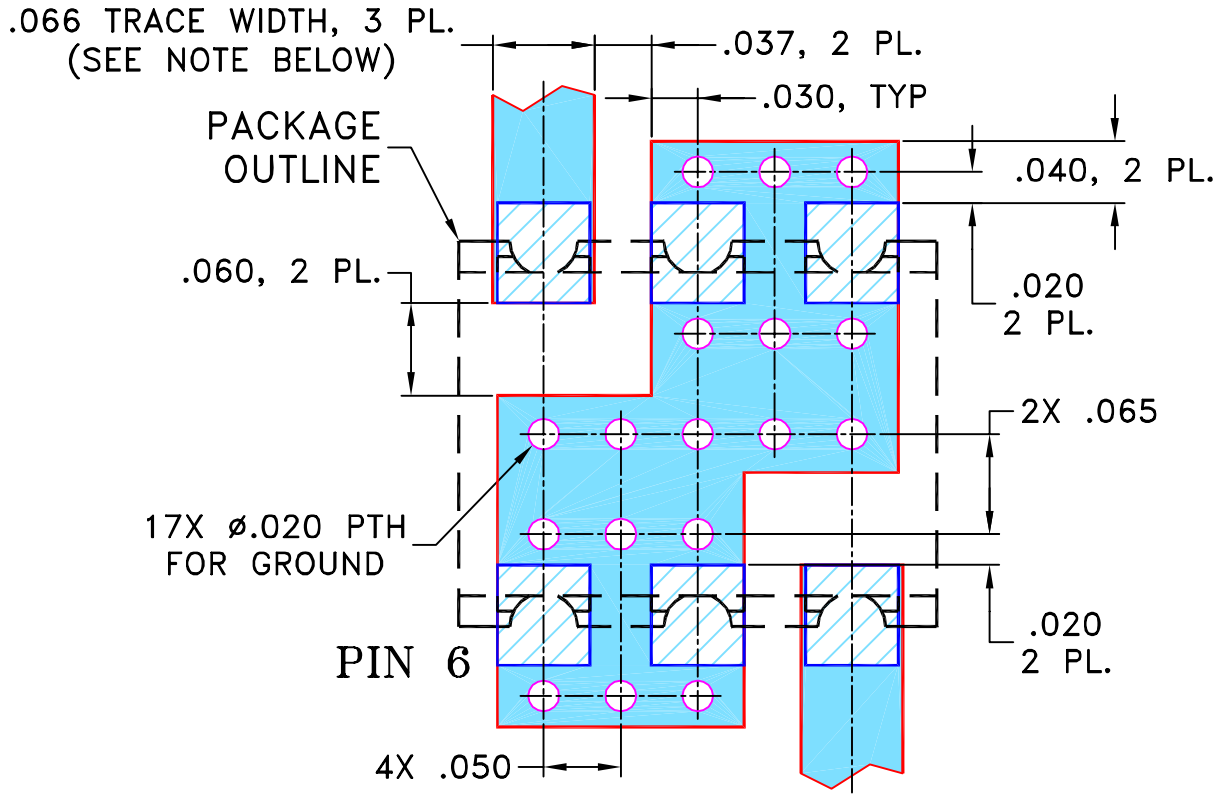
Go to: www.minicircuits.com/pages/pdfs/tape.pdf

Mini-Circuits®
INTERNET http://www.minicircuits.com
P.O. Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718) 332-4661
Distribution Centers NORTH AMERICA 800-654-7949 • 417-335-5935 • Fax 417-335-5945 • EUROPE 44-1252-832600 • Fax 44-1252-837010
Mini-Circuits ISO 9001 & ISO 14001 Certified

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



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

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

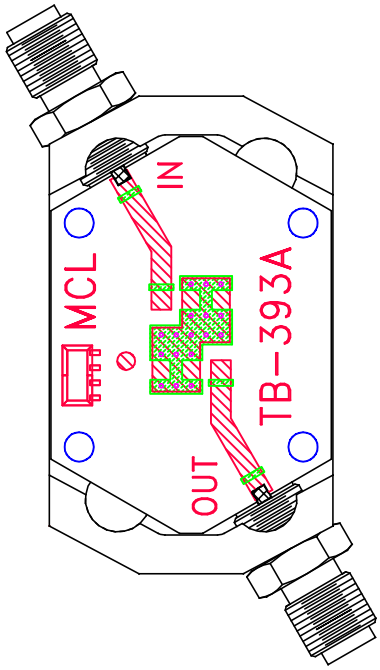
Mini-Circuits®
13 Neptune Avenue
Brooklyn NY 11235

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

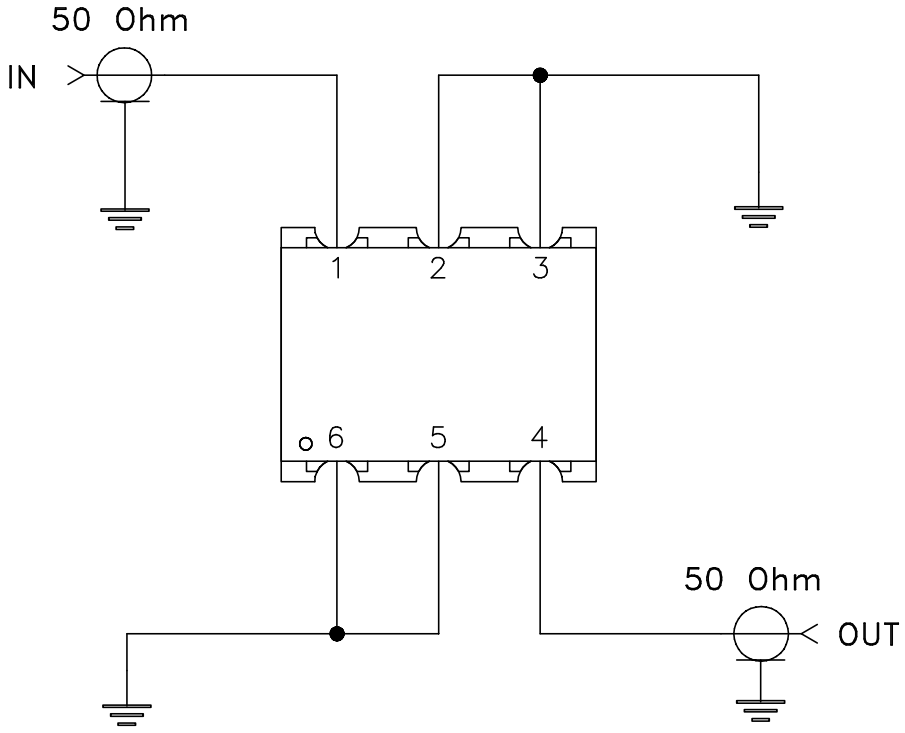
SIZE	CODE IDENT	DRAWING NO:	REV:
A	15542	98-PL-258	OR

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.

Mini-Circuits®

Mini-Circuits

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