

# X3 Frequency Multiplier

50Ω Output 300 to 450 MHz

## RMK-3-451+



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

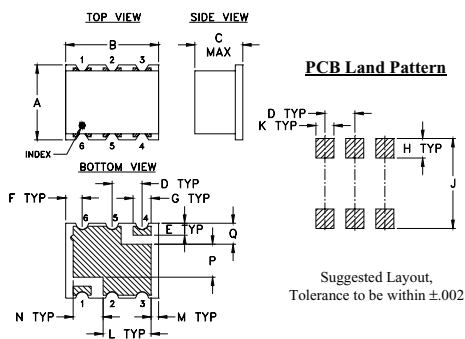
### Maximum Ratings

Operating Temperature	-40°C to 85°C
Storage Temperature	-55°C to 100°C
RF Input Power	20 dBm

### Pin Connections

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

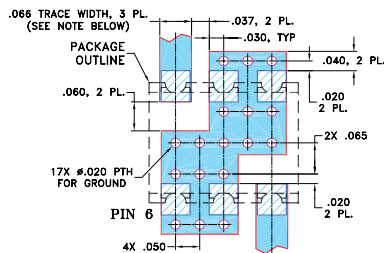
### Outline Drawing



### Outline Dimensions (inch)

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

- 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.
- Electrical specifications and performance data contained in this specification document are based on Mini-Circuits' applicable established test performance criteria and measurement instructions.
- 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)

### Features

- broadband
- low conversion loss, 13.2 dB typ.
- high rejection F2, -52 dBc typ.; F4, -50 dBc typ.
- low cost
- aqueous washable

### Applications

- synthesizers
- local oscillators
- satellite up and down converters

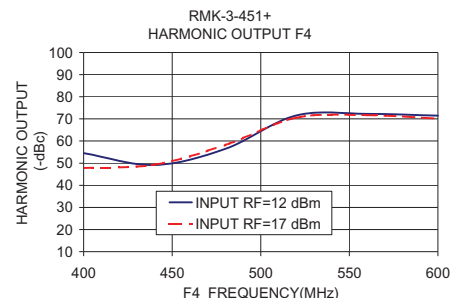
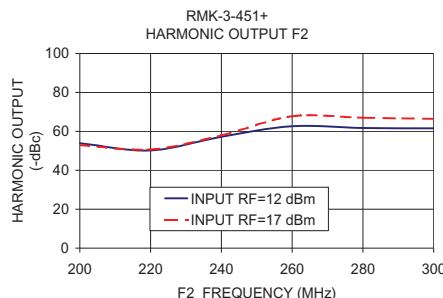
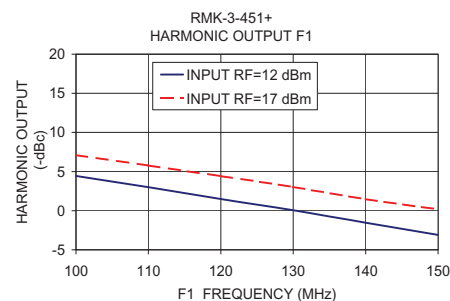
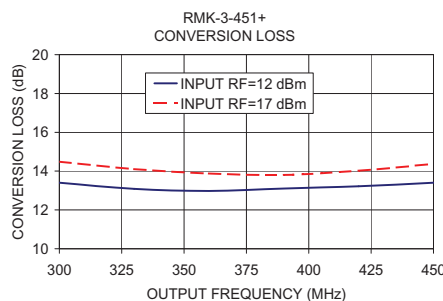
### Electrical Specifications

MULTIPLICATION FACTOR	FREQUENCY (MHz)		INPUT POWER (dBm)		CONVERSION LOSS (dB)		*HARMONIC OUTPUT (dBC)					
	F1 Input	F3 Output	Min.	Max.	Typ.	Max.	F1 Typ. Min.	F2 Typ. Min.	F4 Typ. Min.			
3	100-150	300-450	12	17	13.2	16	4	-7	52	40	50	37

\* Harmonics of input frequency below the power level of F3

### Typical Performance Data

Input Frequency (MHz)	INPUT RF= 12 dBm				INPUT RF= 17 dBm			
	Conversion Loss (dB)	Harmonic Output Below F3 (-dBc)			Conversion Loss (dB)	Harmonic Output Below F3 (-dBc)		
	F3	F1	F2	F4	F3	F1	F2	F4
100.00	13.40	4.43	53.95	54.52	14.49	7.11	52.92	47.80
110.00	13.09	3.00	50.23	49.20	14.10	5.78	50.69	49.32
120.00	12.98	1.49	57.22	56.49	13.88	4.41	57.92	58.21
130.00	13.10	-0.05	62.62	71.51	13.80	3.03	67.71	70.53
140.00	13.22	-1.53	61.72	72.27	14.02	1.47	66.97	71.68
150.00	13.40	-3.09	61.54	71.44	14.37	-0.19	66.43	70.17



# Frequency Multiplier (Tripler)

# RMK-3-451+

## Typical Performance Data

Test Conditions: RF Input Power = 12 dBm @ +25°C

FREQUENCY (MHz)				CONVERSION LOSS (dB)	HARMONIC OUTPUT* (-dBc)		
X1 OUTPUT	X2 OUTPUT	X3 OUTPUT	X4 OUTPUT	X3 OUTPUT	X1 OUTPUT	X2 OUTPUT	X4 OUTPUT
100.0	200.0	300.0	400.0	13.84	3.43	78.59	75.89
102.0	204.0	306.0	408.0	13.86	3.14	80.93	77.50
104.0	208.0	312.0	416.0	14.01	2.67	83.31	78.73
106.0	212.0	318.0	424.0	14.24	2.13	85.52	79.58
108.0	216.0	324.0	432.0	14.48	1.60	86.74	80.05
110.0	220.0	330.0	440.0	14.68	1.07	84.81	80.55
112.0	224.0	336.0	448.0	14.73	0.68	82.88	80.70
114.0	228.0	342.0	456.0	14.58	0.48	79.96	80.01
116.0	232.0	348.0	464.0	14.35	0.34	77.86	79.32
118.0	236.0	354.0	472.0	14.10	0.19	76.11	78.94
120.0	240.0	360.0	480.0	13.80	0.16	74.89	78.64
122.0	244.0	366.0	488.0	13.60	-0.07	73.99	77.97
124.0	248.0	372.0	496.0	13.42	-0.24	73.34	77.51
126.0	252.0	378.0	504.0	13.27	-0.42	72.97	77.45
128.0	256.0	384.0	512.0	13.15	-0.64	72.64	77.24
130.0	260.0	390.0	520.0	13.12	-0.89	72.19	77.14
132.0	264.0	396.0	528.0	13.17	-1.21	72.05	77.33
134.0	268.0	402.0	536.0	13.28	-1.58	71.69	77.81
136.0	272.0	408.0	544.0	13.43	-1.97	71.37	78.07
138.0	276.0	414.0	552.0	13.57	-2.42	71.15	78.51
140.0	280.0	420.0	560.0	13.59	-2.68	71.29	79.02
142.0	284.0	426.0	568.0	13.60	-3.00	71.27	78.53
144.0	288.0	432.0	576.0	13.57	-3.27	71.37	78.14
146.0	292.0	438.0	584.0	13.50	-3.45	71.60	77.56
148.0	296.0	444.0	592.0	13.41	-3.61	72.05	77.02
150.0	300.0	450.0	600.0	13.32	-3.80	72.43	76.46

\* Harmonic Output below power level of X3 Output.

# Frequency Multiplier (Tripler)

# RMK-3-451+

## Typical Performance Data

Test Conditions: RF Input Power = 12 dBm @ -40°C

FREQUENCY (MHz)				CONVERSION LOSS (dB)	HARMONIC OUTPUT* (-dBc)		
X1 OUTPUT	X2 OUTPUT	X3 OUTPUT	X4 OUTPUT	X3 OUTPUT	X1 OUTPUT	X2 OUTPUT	X4 OUTPUT
100.0	200.0	300.0	400.0	14.11	2.69	77.94	74.69
102.0	204.0	306.0	408.0	14.18	2.34	80.22	75.78
104.0	208.0	312.0	416.0	14.46	1.76	82.55	77.23
106.0	212.0	318.0	424.0	14.84	1.08	84.56	78.33
108.0	216.0	324.0	432.0	15.22	0.42	85.00	79.23
110.0	220.0	330.0	440.0	15.54	-0.21	82.35	79.68
112.0	224.0	336.0	448.0	15.59	-0.61	80.33	79.80
114.0	228.0	342.0	456.0	15.33	-0.72	78.19	79.38
116.0	232.0	348.0	464.0	14.90	-0.68	76.76	78.78
118.0	236.0	354.0	472.0	14.45	-0.66	75.22	78.37
120.0	240.0	360.0	480.0	13.94	-0.49	74.56	77.71
122.0	244.0	366.0	488.0	13.61	-0.60	73.65	77.54
124.0	248.0	372.0	496.0	13.31	-0.67	73.08	77.12
126.0	252.0	378.0	504.0	13.07	-0.78	72.80	76.77
128.0	256.0	384.0	512.0	12.93	-0.97	72.40	76.60
130.0	260.0	390.0	520.0	12.91	-1.24	72.17	76.66
132.0	264.0	396.0	528.0	13.01	-1.60	71.86	76.81
134.0	268.0	402.0	536.0	13.23	-2.06	71.35	76.93
136.0	272.0	408.0	544.0	13.46	-2.53	71.03	77.57
138.0	276.0	414.0	552.0	13.65	-3.02	70.85	77.87
140.0	280.0	420.0	560.0	13.61	-3.23	70.93	78.08
142.0	284.0	426.0	568.0	13.54	-3.49	71.07	77.76
144.0	288.0	432.0	576.0	13.44	-3.69	71.26	77.14
146.0	292.0	438.0	584.0	13.35	-3.86	71.65	76.66
148.0	296.0	444.0	592.0	13.35	-4.09	71.89	76.21
150.0	300.0	450.0	600.0	13.40	-4.39	72.27	75.62

\* Harmonic Output below power level of X3 Output.



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# Frequency Multiplier (Tripler)

# RMK-3-451+

## Typical Performance Data

Test Conditions: RF Input Power = 12 dBm @ +85°C

FREQUENCY (MHz)				CONVERSION LOSS (dB)	HARMONIC OUTPUT* (-dBc)		
X1 OUTPUT	X2 OUTPUT	X3 OUTPUT	X4 OUTPUT	X3 OUTPUT	X1 OUTPUT	X2 OUTPUT	X4 OUTPUT
100.0	200.0	300.0	400.0	13.80	4.07	80.64	77.76
102.0	204.0	306.0	408.0	13.76	3.81	82.64	79.34
104.0	208.0	312.0	416.0	13.81	3.43	85.13	80.69
106.0	212.0	318.0	424.0	13.92	3.01	87.74	81.16
108.0	216.0	324.0	432.0	14.03	2.58	88.44	81.25
110.0	220.0	330.0	440.0	14.16	2.13	85.70	81.31
112.0	224.0	336.0	448.0	14.20	1.76	83.40	81.04
114.0	228.0	342.0	456.0	14.15	1.46	80.53	80.20
116.0	232.0	348.0	464.0	14.07	1.19	78.04	79.23
118.0	236.0	354.0	472.0	13.98	0.91	75.95	78.71
120.0	240.0	360.0	480.0	13.86	0.73	74.76	78.15
122.0	244.0	366.0	488.0	13.78	0.41	73.76	77.57
124.0	248.0	372.0	496.0	13.71	0.14	73.10	77.48
126.0	252.0	378.0	504.0	13.62	-0.10	72.72	77.30
128.0	256.0	384.0	512.0	13.54	-0.35	72.30	77.13
130.0	260.0	390.0	520.0	13.49	-0.59	71.97	77.07
132.0	264.0	396.0	528.0	13.48	-0.86	71.85	77.36
134.0	268.0	402.0	536.0	13.49	-1.15	71.63	77.45
136.0	272.0	408.0	544.0	13.56	-1.47	71.36	78.16
138.0	276.0	414.0	552.0	13.66	-1.89	71.15	78.37
140.0	280.0	420.0	560.0	13.73	-2.19	71.22	78.84
142.0	284.0	426.0	568.0	13.82	-2.57	71.15	78.58
144.0	288.0	432.0	576.0	13.85	-2.89	71.25	78.27
146.0	292.0	438.0	584.0	13.79	-3.08	71.39	77.67
148.0	296.0	444.0	592.0	13.64	-3.20	71.83	77.07
150.0	300.0	450.0	600.0	13.43	-3.30	72.23	76.53

\* Harmonic Output below power level of X3 Output.



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# Frequency Multiplier (Tripler)

# RMK-3-451+

## Typical Performance Data

Test Conditions: RF Input Power = 17 dBm @ +25°C

FREQUENCY (MHz)				CONVERSION LOSS (dB)	HARMONIC OUTPUT* (-dBc)		
X1 OUTPUT	X2 OUTPUT	X3 OUTPUT	X4 OUTPUT	X3 OUTPUT	X1 OUTPUT	X2 OUTPUT	X4 OUTPUT
100.0	200.0	300.0	400.0	14.03	7.03	78.15	73.97
102.0	204.0	306.0	408.0	13.82	6.85	77.23	73.64
104.0	208.0	312.0	416.0	13.61	6.65	76.35	73.72
106.0	212.0	318.0	424.0	13.39	6.45	75.85	74.12
108.0	216.0	324.0	432.0	13.17	6.26	75.39	74.87
110.0	220.0	330.0	440.0	13.03	6.01	74.88	75.33
112.0	224.0	336.0	448.0	13.04	5.70	74.67	76.78
114.0	228.0	342.0	456.0	13.20	5.27	74.39	77.85
116.0	232.0	348.0	464.0	13.45	4.78	74.32	78.82
118.0	236.0	354.0	472.0	13.72	4.26	74.18	79.55
120.0	240.0	360.0	480.0	14.01	3.79	73.33	80.53
122.0	244.0	366.0	488.0	14.22	3.25	72.59	79.56
124.0	248.0	372.0	496.0	14.42	2.78	72.33	78.70
126.0	252.0	378.0	504.0	14.53	2.38	72.20	78.64
128.0	256.0	384.0	512.0	14.57	2.05	71.90	78.88
130.0	260.0	390.0	520.0	14.50	1.80	71.45	79.01
132.0	264.0	396.0	528.0	14.33	1.65	71.00	79.42
134.0	268.0	402.0	536.0	14.05	1.57	70.37	79.26
136.0	272.0	408.0	544.0	13.80	1.45	69.79	79.45
138.0	276.0	414.0	552.0	13.69	1.19	69.41	79.52
140.0	280.0	420.0	560.0	13.88	0.81	69.18	78.99
142.0	284.0	426.0	568.0	14.22	0.26	69.18	77.83
144.0	288.0	432.0	576.0	14.59	-0.31	69.04	76.56
146.0	292.0	438.0	584.0	14.87	-0.82	69.91	76.97
148.0	296.0	444.0	592.0	14.31	-0.63	69.17	77.47
150.0	300.0	450.0	600.0	13.56	-0.39	68.14	77.78

\* Harmonic Output below power level of X3 Output.



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# Frequency Multiplier (Tripler)

# RMK-3-451+

## Typical Performance Data

Test Conditions: RF Input Power = 17 dBm @ -40°C

FREQUENCY (MHz)				CONVERSION LOSS (dB)	HARMONIC OUTPUT* (-dBc)		
X1 OUTPUT	X2 OUTPUT	X3 OUTPUT	X4 OUTPUT	X3 OUTPUT	X1 OUTPUT	X2 OUTPUT	X4 OUTPUT
100.0	200.0	300.0	400.0	13.44	7.14	77.16	72.47
102.0	204.0	306.0	408.0	13.24	6.96	76.15	72.33
104.0	208.0	312.0	416.0	13.04	6.76	75.59	72.42
106.0	212.0	318.0	424.0	12.84	6.57	75.05	72.78
108.0	216.0	324.0	432.0	12.62	6.39	74.74	73.47
110.0	220.0	330.0	440.0	12.50	6.14	74.27	73.75
112.0	224.0	336.0	448.0	12.50	5.82	74.27	74.94
114.0	228.0	342.0	456.0	12.68	5.37	73.95	75.73
116.0	232.0	348.0	464.0	12.93	4.84	73.97	76.34
118.0	236.0	354.0	472.0	13.20	4.29	73.80	76.82
120.0	240.0	360.0	480.0	13.47	3.82	73.37	77.26
122.0	244.0	366.0	488.0	13.68	3.26	72.90	77.16
124.0	248.0	372.0	496.0	13.86	2.80	72.55	76.91
126.0	252.0	378.0	504.0	13.96	2.40	72.33	76.82
128.0	256.0	384.0	512.0	13.98	2.08	71.95	76.93
130.0	260.0	390.0	520.0	13.91	1.84	71.54	77.20
132.0	264.0	396.0	528.0	13.74	1.69	70.97	77.43
134.0	268.0	402.0	536.0	13.47	1.62	70.34	77.33
136.0	272.0	408.0	544.0	13.22	1.52	69.80	77.62
138.0	276.0	414.0	552.0	13.11	1.26	69.35	77.56
140.0	280.0	420.0	560.0	13.30	0.87	69.15	77.13
142.0	284.0	426.0	568.0	13.66	0.28	69.11	76.01
144.0	288.0	432.0	576.0	14.05	-0.31	69.11	74.94
146.0	292.0	438.0	584.0	14.27	-0.77	69.83	75.30
148.0	296.0	444.0	592.0	13.73	-0.58	69.11	75.73
150.0	300.0	450.0	600.0	12.93	-0.25	68.11	75.94

\* Harmonic Output below power level of X3 Output.



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# Frequency Multiplier (Tripler)

# RMK-3-451+

## Typical Performance Data

Test Conditions: RF Input Power = 17 dBm @ +85°C

FREQUENCY (MHz)				CONVERSION LOSS (dB)	HARMONIC OUTPUT* (-dBc)		
X1 OUTPUT	X2 OUTPUT	X3 OUTPUT	X4 OUTPUT	X3 OUTPUT	X1 OUTPUT	X2 OUTPUT	X4 OUTPUT
100.0	200.0	300.0	400.0	14.71	6.83	79.18	74.82
102.0	204.0	306.0	408.0	14.50	6.63	77.90	74.53
104.0	208.0	312.0	416.0	14.28	6.42	76.92	74.53
106.0	212.0	318.0	424.0	14.06	6.20	76.10	74.93
108.0	216.0	324.0	432.0	13.83	5.99	75.54	75.67
110.0	220.0	330.0	440.0	13.69	5.73	74.95	76.18
112.0	224.0	336.0	448.0	13.69	5.45	74.60	77.79
114.0	228.0	342.0	456.0	13.86	5.06	74.29	78.99
116.0	232.0	348.0	464.0	14.10	4.62	74.14	80.00
118.0	236.0	354.0	472.0	14.37	4.14	73.99	80.62
120.0	240.0	360.0	480.0	14.66	3.70	73.20	81.28
122.0	244.0	366.0	488.0	14.87	3.19	72.67	79.94
124.0	248.0	372.0	496.0	15.08	2.72	72.57	79.75
126.0	252.0	378.0	504.0	15.20	2.32	72.43	79.80
128.0	256.0	384.0	512.0	15.25	1.97	72.09	80.19
130.0	260.0	390.0	520.0	15.19	1.71	71.78	80.31
132.0	264.0	396.0	528.0	15.02	1.53	71.15	80.89
134.0	268.0	402.0	536.0	14.74	1.43	70.55	81.02
136.0	272.0	408.0	544.0	14.50	1.27	69.90	81.14
138.0	276.0	414.0	552.0	14.38	1.00	69.44	81.34
140.0	280.0	420.0	560.0	14.57	0.63	69.34	80.63
142.0	284.0	426.0	568.0	14.91	0.12	69.31	79.54
144.0	288.0	432.0	576.0	15.25	-0.38	69.19	78.20
146.0	292.0	438.0	584.0	15.59	-0.95	69.98	78.54
148.0	296.0	444.0	592.0	15.01	-0.76	69.27	79.45
150.0	300.0	450.0	600.0	14.30	-0.63	68.17	79.45

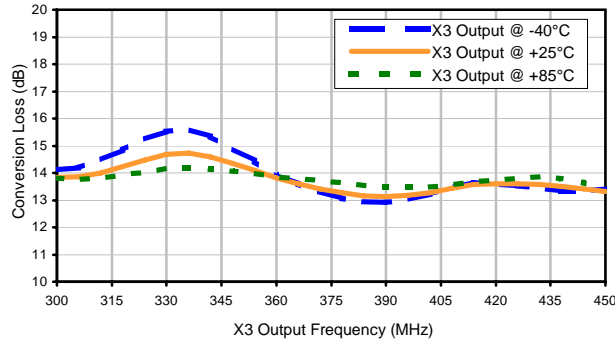
\* Harmonic Output below power level of X3 Output.

# Frequency Multiplier (Tripler)

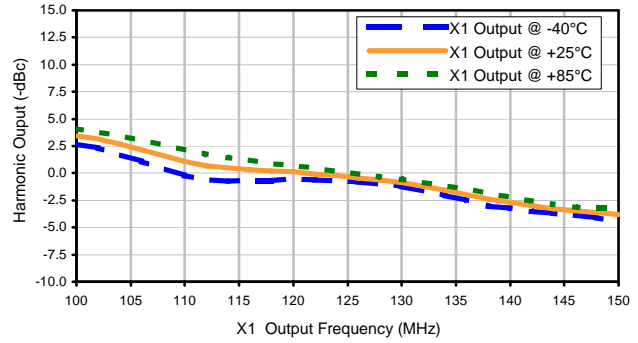
RMK-3-451+

## Typical Performance Curves

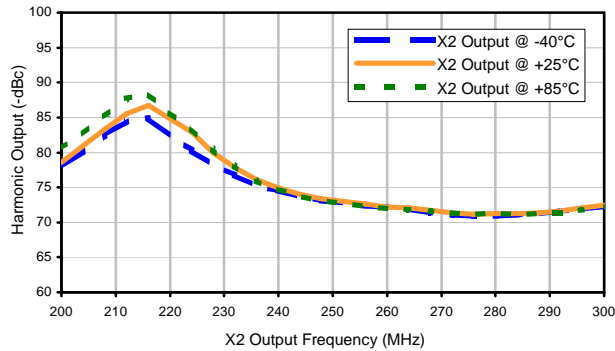
Conversion Loss X3 Output @ RF IN=12dBm



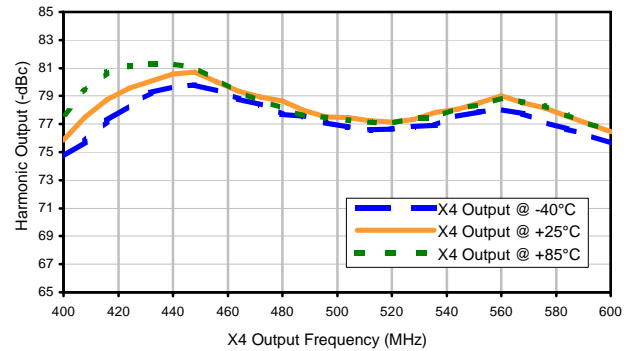
Harmonic X1 Output @ RF IN=12dBm



Harmonic X2 Output @ RF IN=12dBm



Harmonic X4 Output @ RF IN=12dBm



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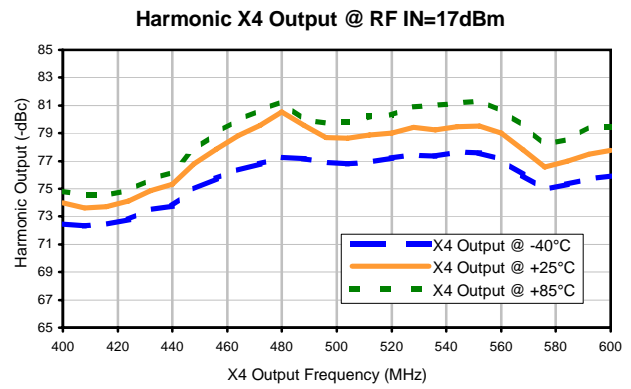
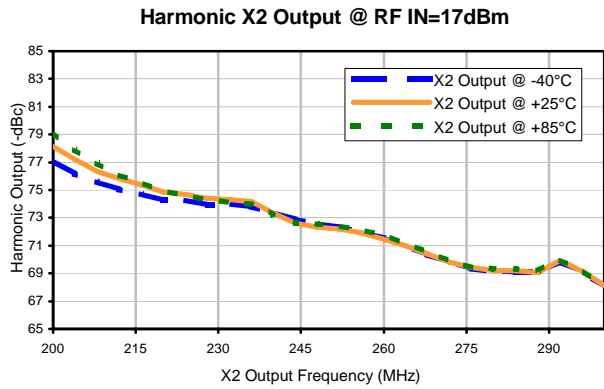
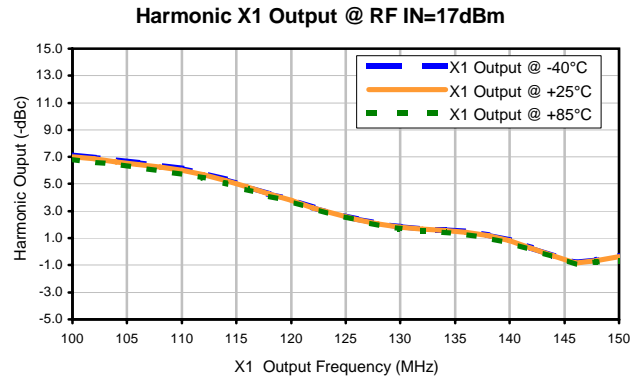
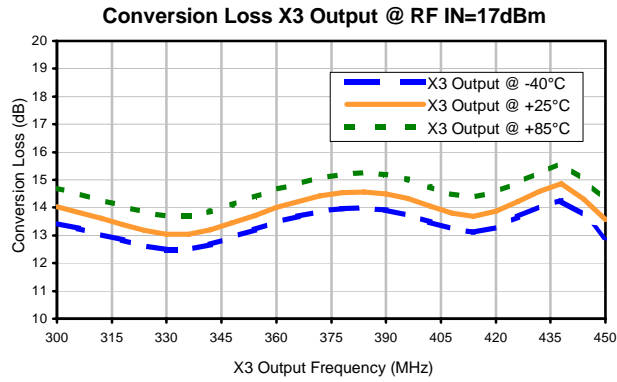
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IF/RF MICROWAVE COMPONENTS

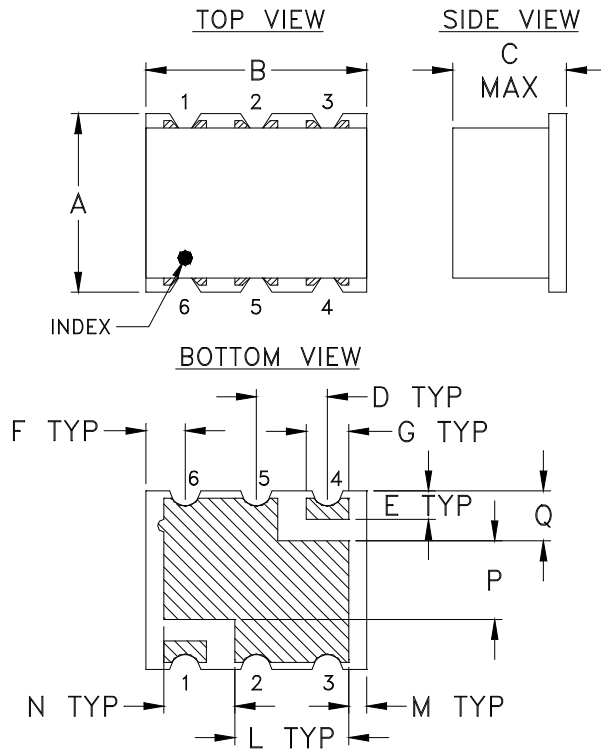




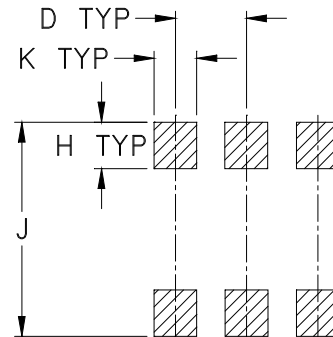
## Typical Performance Curves



### 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



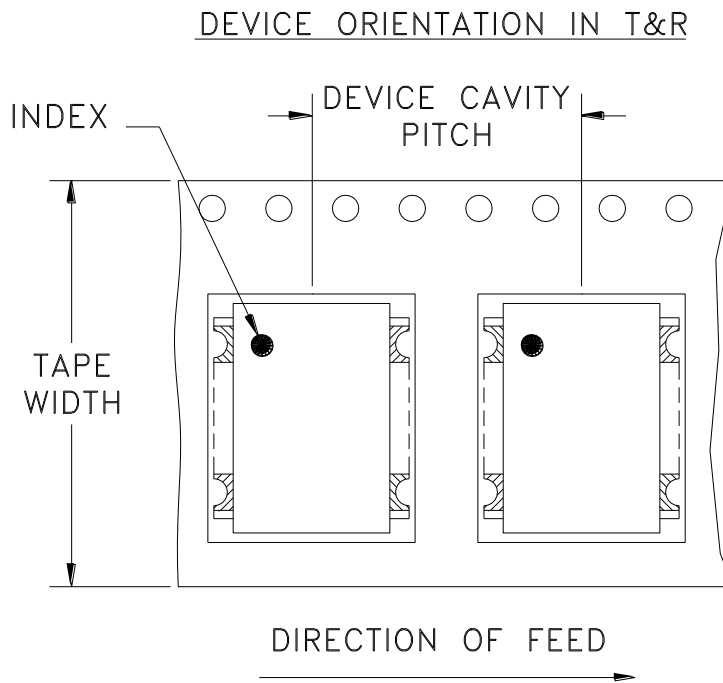
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RF/IF MICROWAVE COMPONENTS

# 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

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



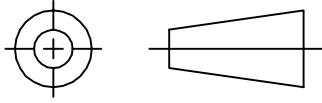
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THIRD ANGLE PROJECTION

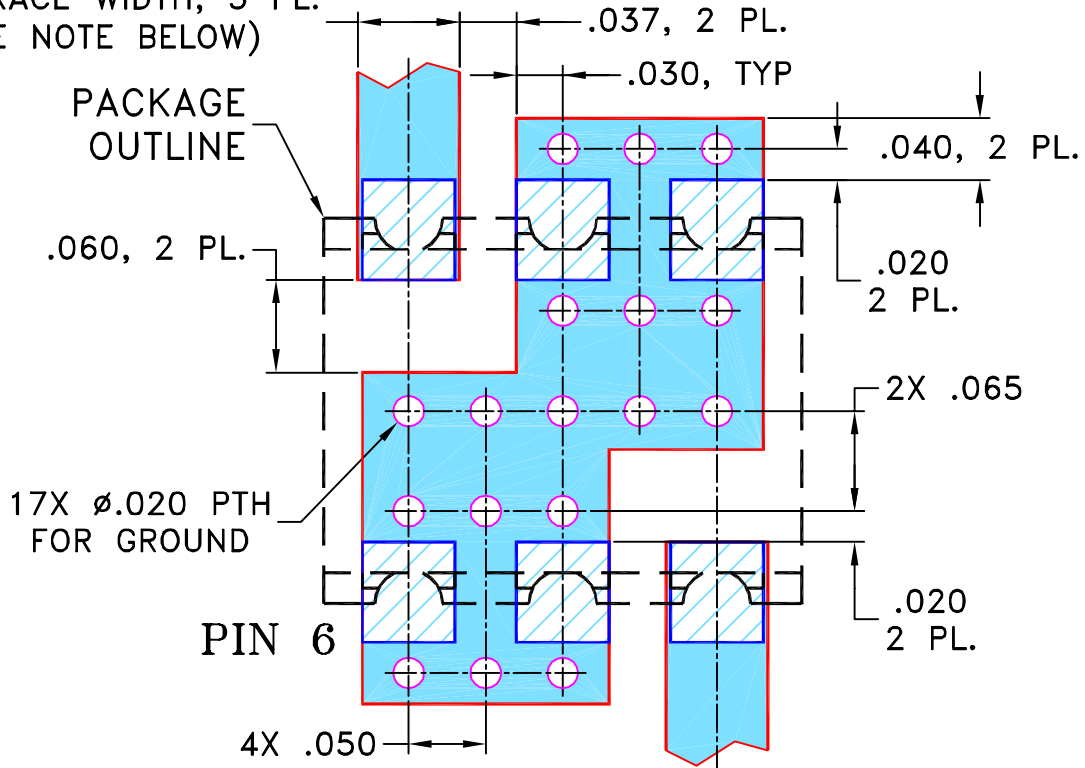


REVISIONS

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
DRAWN	AV	12/14/06
CHECKED	IL	01/04/07
APPROVED	DJ	01/04/07

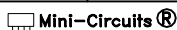


**Mini-Circuits®**

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Brooklyn NY 11235

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

DIMENSIONS ARE IN INCHES  
TOLERANCES ON:  
2 PL DECIMALS ±  
3 PL DECIMALS ± .005  
ANGLES ±  
FRACTIONS ±

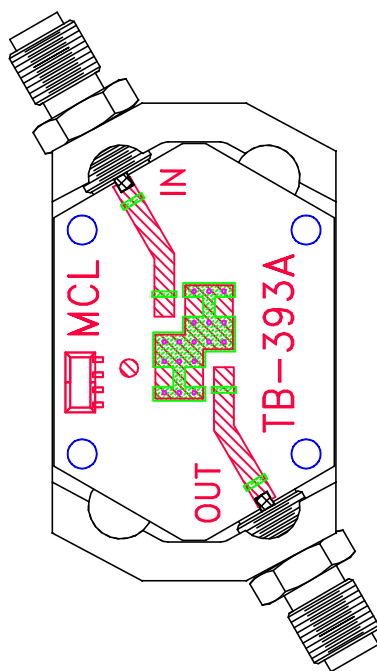


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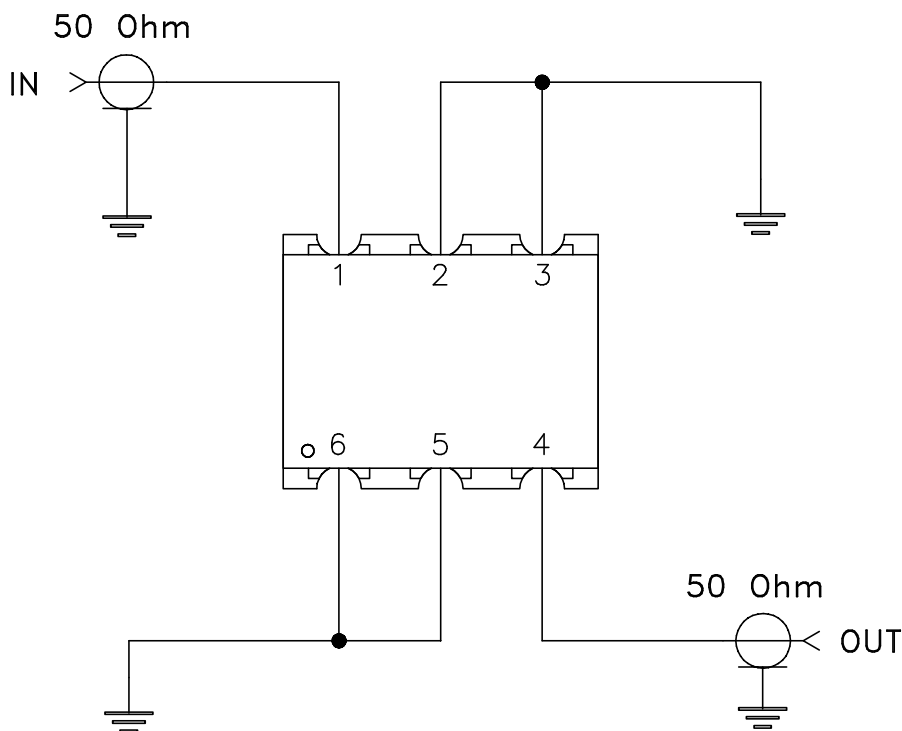
ASHEETA1.DWG REV:A DATE:01/12/95

SIZE	CODE IDENT	DRAWING NO:	REV:
A	15542	98-PL-258	OR
FILE:	98PL258	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