

# X5 Frequency Multiplier

RMK-5-2251+

50Ω      Output 2100 to 3000 MHz

## The Big Deal

- Wide bandwidth, 1500 to 2250 output
- High harmonic suppression, F4, 52 dBc; F6, 56 dBc
- Small size, 0.25 x 0.31 x 0.16"



CASE STYLE: TT1224

## Product Overview

Mini-Circuits' RMK-5-2251+ frequency multiplier provides a multiplication factor of 5 converting input frequencies from 300 to 450 MHz into output frequencies from 1500 to 2250 MHz, supporting applications including synthesizers, local oscillators, satellite up and down converters and more. The unit supports input power of +17 dBm with conversion loss of 21 dB and excellent 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.

| Feature                                                                                                          | Advantages                                                                                                              |
|------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|
| Wide bandwidth                                                                                                   | With an output frequency range spanning 1500-2250 MHz, this multiplier covers a wide range of applications.             |
| Excellent harmonic suppression <ul style="list-style-type: none"><li>• F4, 52 dBc</li><li>• F6, 56 dBc</li></ul> | Reduces spurious signals and the need for additional filtering.                                                         |
| Low conversion loss, 21 dB                                                                                       | With a low conversion loss, the unit produces higher output power signal level and less amplification may be used.      |
| Wide input power range, +12 to +17 dBm                                                                           | Wide input power signal range accommodates different input signal levels while still maintaining a low conversion loss. |
| 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-5-2251+ saves space in crowded PCB 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](http://www.minicircuits.com/MCLStore/terms.jsp)



# RMK-5-2251+

[illegible]

CASE STYLE: TT1224

|                       |                |
|-----------------------|----------------|
| 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 |

| 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  |

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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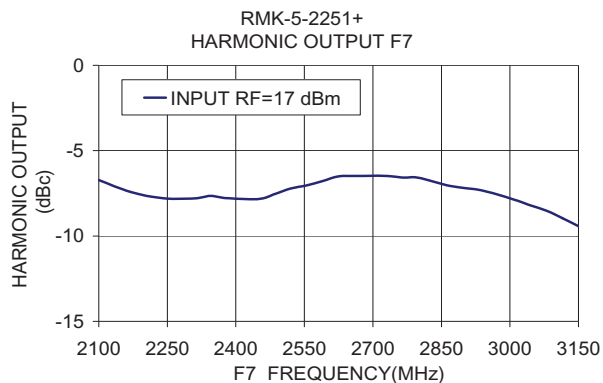
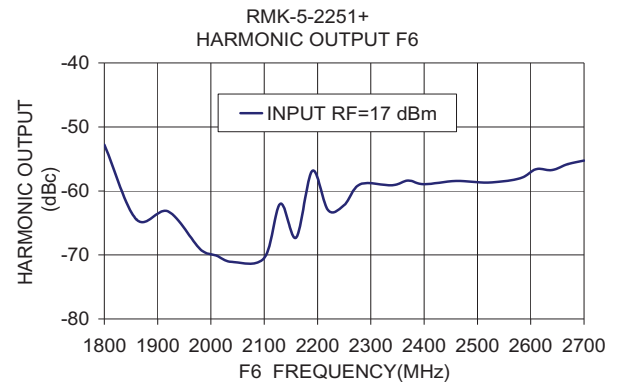
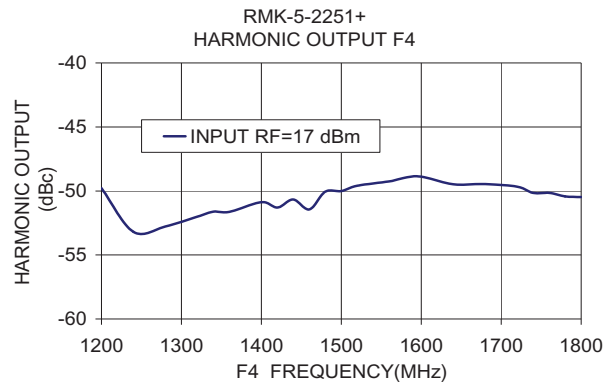
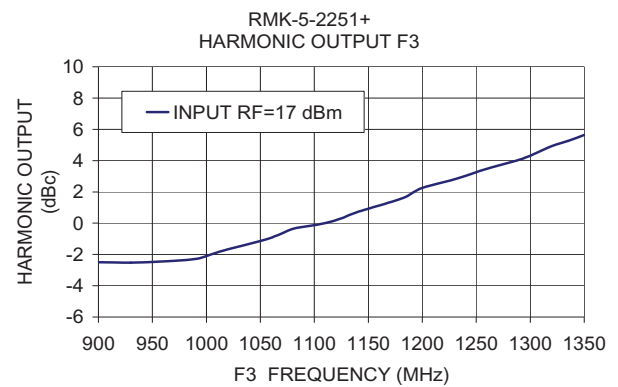
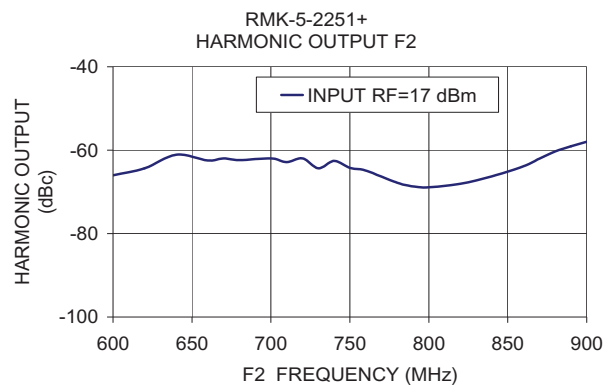
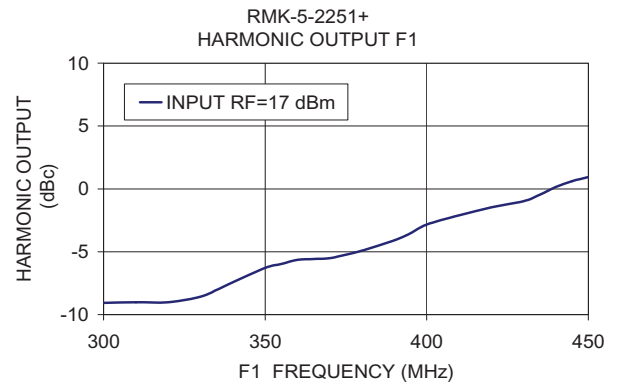
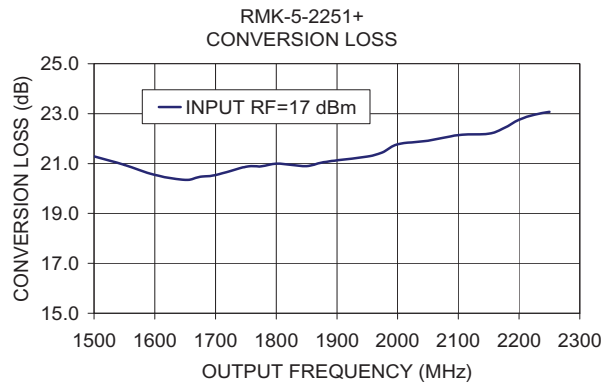
- low conversion loss, 21 dB typ.
- high rejection of adjacent harmonics, 56 dBc typ.
- aqueous washable

- synthesizers
- local oscillators
- satellite up and down converters

| Parameter                    |    | Min. | Typ.  | Max. | Unit |
|------------------------------|----|------|-------|------|------|
| Multiplier Factor            |    | 5    |       |      |      |
| Frequency Range, Input (F1)  |    | 300  | —     | 450  | MHz  |
| Frequency Range, Output (F5) |    | 1500 | —     | 2250 | MHz  |
| Input Power                  |    | —    | 17    | —    | dBm  |
| Conversion Loss              |    | —    | 21    | 24.8 | dB   |
| Harmonic Ouput*              | F1 | -3.5 | 5.3   | —    | -dBc |
|                              | F2 | 38   | 64    | —    |      |
|                              | F3 | -7.6 | -0.34 | —    |      |
|                              | F4 | 35   | 52    | —    |      |
|                              | F6 | 35   | 56    | —    |      |
|                              | F7 | 2.5  | 6.5   | —    |      |

\* Harmonics of input frequency below the power level of F5

| Frequency   |              | Conv. Loss (dB) | Harmonic Rejection Below F5, (dBc)<br>at RF Input Power 17 dBm |        |       |        |        |       |
|-------------|--------------|-----------------|----------------------------------------------------------------|--------|-------|--------|--------|-------|
| Input (MHz) | Output (MHz) |                 | F5                                                             | F1     | F2    | F3     | F4     | F6    |
| 300.00      | 1500.00      | 21.29           | -9.07                                                          | -66.02 | -2.50 | -49.79 | -52.79 | -6.72 |
| 310.00      | 1550.00      | 20.95           | -9.02                                                          | -64.33 | -2.53 | -53.20 | -64.41 | -7.42 |
| 320.00      | 1600.00      | 20.55           | -9.01                                                          | -61.09 | -2.44 | -52.78 | -63.19 | -7.78 |
| 330.00      | 1650.00      | 20.35           | -8.58                                                          | -62.47 | -2.29 | -52.01 | -69.13 | -7.79 |
| 335.00      | 1675.00      | 20.47           | -8.03                                                          | -61.99 | -1.98 | -51.61 | -70.09 | -7.65 |
| 340.00      | 1700.00      | 20.54           | -7.43                                                          | -62.35 | -1.67 | -51.64 | -71.09 | -7.78 |
| 350.00      | 1750.00      | 20.87           | -6.28                                                          | -61.96 | -1.14 | -50.88 | -70.48 | -7.83 |
| 355.00      | 1775.00      | 20.89           | -5.97                                                          | -62.85 | -0.80 | -51.30 | -62.01 | -7.54 |
| 360.00      | 1800.00      | 21.00           | -5.65                                                          | -61.96 | -0.36 | -50.66 | -67.29 | -7.22 |
| 365.00      | 1825.00      | 20.95           | -5.57                                                          | -64.33 | -0.18 | -51.44 | -56.87 | -7.03 |
| 370.00      | 1850.00      | 20.90           | -5.51                                                          | -62.59 | 0.00  | -50.06 | -63.01 | -6.78 |
| 375.00      | 1875.00      | 21.04           | -5.24                                                          | -64.25 | 0.31  | -50.00 | -62.20 | -6.51 |
| 380.00      | 1900.00      | 21.13           | -4.90                                                          | -64.89 | 0.71  | -49.59 | -58.94 | -6.48 |
| 390.00      | 1950.00      | 21.28           | -4.09                                                          | -67.78 | 1.34  | -49.25 | -59.11 | -6.48 |
| 395.00      | 1975.00      | 21.45           | -3.53                                                          | -68.70 | 1.69  | -48.97 | -58.36 | -6.58 |
| 400.00      | 2000.00      | 21.77           | -2.84                                                          | -68.89 | 2.26  | -48.88 | -58.96 | -6.59 |
| 410.00      | 2050.00      | 21.91           | -2.11                                                          | -68.06 | 2.81  | -49.48 | -58.45 | -7.07 |
| 420.00      | 2100.00      | 22.14           | -1.47                                                          | -66.25 | 3.48  | -49.46 | -58.71 | -7.34 |
| 430.00      | 2150.00      | 22.20           | -0.98                                                          | -63.87 | 4.06  | -49.67 | -58.03 | -7.88 |
| 435.00      | 2175.00      | 22.42           | -0.46                                                          | -62.03 | 4.47  | -50.16 | -56.62 | -8.21 |
| 440.00      | 2200.00      | 22.76           | 0.15                                                           | -60.29 | 4.93  | -50.15 | -56.72 | -8.52 |
| 445.00      | 2225.00      | 22.96           | 0.61                                                           | -59.06 | 5.26  | -50.43 | -55.81 | -8.96 |
| 450.00      | 2250.00      | 23.07           | 0.94                                                           | -57.99 | 5.64  | -50.47 | -55.24 | -9.43 |



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## Typical Performance Data

| FREQUENCY (MHz) |              |              |              |              |              |              | CONVERSION<br>LOSS<br>(dB) | RF IN = +17 dBm            |              |              |              |              |              |
|-----------------|--------------|--------------|--------------|--------------|--------------|--------------|----------------------------|----------------------------|--------------|--------------|--------------|--------------|--------------|
|                 |              |              |              |              |              |              |                            | HARMONIC OUTPUT*<br>(-dBc) |              |              |              |              |              |
| X1<br>OUTPUT    | X2<br>OUTPUT | X3<br>OUTPUT | X4<br>OUTPUT | X5<br>OUTPUT | X6<br>OUTPUT | X7<br>OUTPUT | X5 OUTPUT                  | X1<br>OUTPUT               | X2<br>OUTPUT | X3<br>OUTPUT | X4<br>OUTPUT | X6<br>OUTPUT | X7<br>OUTPUT |
| 270             | 540          | 810          | 1080         | 1350         | 1620         | 1890         | 22.95                      | 9.87                       | 41.78        | 1.78         | 36.66        | 30.68        | 3.21         |
| 275             | 550          | 825          | 1100         | 1375         | 1650         | 1925         | 22.67                      | 9.61                       | 41.07        | 1.84         | 35.87        | 30.20        | 3.87         |
| 280             | 560          | 840          | 1120         | 1400         | 1680         | 1960         | 22.49                      | 9.34                       | 39.80        | 2.07         | 34.83        | 29.54        | 4.64         |
| 285             | 570          | 855          | 1140         | 1425         | 1710         | 1995         | 22.17                      | 9.17                       | 44.34        | 2.25         | 42.18        | 35.38        | 5.35         |
| 290             | 580          | 870          | 1160         | 1450         | 1740         | 2030         | 21.80                      | 9.17                       | 49.01        | 2.30         | 40.84        | 38.23        | 5.68         |
| 295             | 590          | 885          | 1180         | 1475         | 1770         | 2065         | 21.54                      | 9.05                       | 55.02        | 2.32         | 44.74        | 43.69        | 6.14         |
| 300             | 600          | 900          | 1200         | 1500         | 1800         | 2100         | 21.29                      | 9.07                       | 66.02        | 2.50         | 49.79        | 52.79        | 6.72         |
| 305             | 610          | 915          | 1220         | 1525         | 1830         | 2135         | 21.10                      | 9.03                       | 68.38        | 2.51         | 52.32        | 61.09        | 7.10         |
| 310             | 620          | 930          | 1240         | 1550         | 1860         | 2170         | 20.95                      | 9.02                       | 64.33        | 2.53         | 53.20        | 64.41        | 7.42         |
| 315             | 630          | 945          | 1260         | 1575         | 1890         | 2205         | 20.91                      | 8.89                       | 61.83        | 2.42         | 53.05        | 63.93        | 7.82         |
| 320             | 640          | 960          | 1280         | 1600         | 1920         | 2240         | 20.55                      | 9.01                       | 61.09        | 2.44         | 52.78        | 63.19        | 7.78         |
| 330             | 660          | 990          | 1320         | 1650         | 1980         | 2310         | 20.35                      | 8.58                       | 62.47        | 2.29         | 52.01        | 69.13        | 7.79         |
| 335             | 670          | 1005         | 1340         | 1675         | 2010         | 2345         | 20.47                      | 8.03                       | 61.99        | 1.98         | 51.61        | 70.09        | 7.65         |
| 340             | 680          | 1020         | 1360         | 1700         | 2040         | 2380         | 20.54                      | 7.43                       | 62.35        | 1.67         | 51.64        | 71.09        | 7.78         |
| 345             | 690          | 1035         | 1380         | 1725         | 2070         | 2415         | 20.73                      | 6.80                       | 62.28        | 1.37         | 51.41        | 73.43        | 7.86         |
| 350             | 700          | 1050         | 1400         | 1750         | 2100         | 2450         | 20.87                      | 6.28                       | 61.96        | 1.14         | 50.88        | 70.48        | 7.83         |
| 355             | 710          | 1065         | 1420         | 1775         | 2130         | 2485         | 20.89                      | 5.97                       | 62.85        | 0.80         | 51.30        | 62.01        | 7.54         |
| 360             | 720          | 1080         | 1440         | 1800         | 2160         | 2520         | 21.00                      | 5.65                       | 61.96        | 0.36         | 50.66        | 67.29        | 7.22         |
| 365             | 730          | 1095         | 1460         | 1825         | 2190         | 2555         | 20.95                      | 5.57                       | 64.33        | 0.18         | 51.44        | 56.87        | 7.03         |
| 370             | 740          | 1110         | 1480         | 1850         | 2220         | 2590         | 20.90                      | 5.51                       | 62.59        | 0.00         | 50.06        | 63.01        | 6.78         |
| 375             | 750          | 1125         | 1500         | 1875         | 2250         | 2625         | 21.04                      | 5.24                       | 64.25        | -0.31        | 50.00        | 62.20        | 6.51         |
| 380             | 760          | 1140         | 1520         | 1900         | 2280         | 2660         | 21.13                      | 4.90                       | 64.89        | -0.71        | 49.59        | 58.94        | 6.48         |
| 385             | 770          | 1155         | 1540         | 1925         | 2310         | 2695         | 21.21                      | 4.56                       | 65.18        | -1.08        | 49.10        | 59.44        | 6.31         |
| 390             | 780          | 1170         | 1560         | 1950         | 2340         | 2730         | 21.28                      | 4.09                       | 67.78        | -1.34        | 49.25        | 59.11        | 6.48         |
| 395             | 790          | 1185         | 1580         | 1975         | 2370         | 2765         | 21.45                      | 3.53                       | 68.70        | -1.69        | 48.97        | 58.36        | 6.58         |
| 400             | 800          | 1200         | 1600         | 2000         | 2400         | 2800         | 21.77                      | 2.84                       | 68.89        | -2.26        | 48.88        | 58.96        | 6.59         |
| 405             | 810          | 1215         | 1620         | 2025         | 2430         | 2835         | 21.85                      | 2.44                       | 69.17        | -2.54        | 49.34        | 58.71        | 6.87         |
| 410             | 820          | 1230         | 1640         | 2050         | 2460         | 2870         | 21.91                      | 2.11                       | 68.06        | -2.81        | 49.48        | 58.45        | 7.07         |
| 415             | 830          | 1245         | 1660         | 2075         | 2490         | 2905         | 22.04                      | 1.81                       | 67.12        | -3.07        | 49.30        | 60.83        | 7.16         |
| 420             | 840          | 1260         | 1680         | 2100         | 2520         | 2940         | 22.14                      | 1.47                       | 66.25        | -3.48        | 49.46        | 58.71        | 7.34         |
| 425             | 850          | 1275         | 1700         | 2125         | 2550         | 2975         | 22.20                      | 1.22                       | 64.83        | -3.85        | 48.93        | 62.36        | 7.44         |
| 430             | 860          | 1290         | 1720         | 2150         | 2580         | 3010         | 22.20                      | 0.98                       | 63.87        | -4.06        | 49.67        | 58.03        | 7.88         |
| 435             | 870          | 1305         | 1740         | 2175         | 2610         | 3045         | 22.42                      | 0.46                       | 62.03        | -4.47        | 50.16        | 56.62        | 8.21         |
| 440             | 880          | 1320         | 1760         | 2200         | 2640         | 3080         | 22.76                      | -0.15                      | 60.29        | -4.93        | 50.15        | 56.72        | 8.52         |
| 445             | 890          | 1335         | 1780         | 2225         | 2670         | 3115         | 22.96                      | -0.61                      | 59.06        | -5.26        | 50.43        | 55.81        | 8.96         |
| 450             | 900          | 1350         | 1800         | 2250         | 2700         | 3150         | 23.07                      | -0.94                      | 57.99        | -5.64        | 50.47        | 55.24        | 9.43         |
| 455             | 910          | 1365         | 1820         | 2275         | 2730         | 3185         | 23.04                      | -1.08                      | 57.26        | -5.82        | 49.88        | 55.44        | 9.58         |
| 460             | 920          | 1380         | 1840         | 2300         | 2760         | 3220         | 23.00                      | -1.17                      | 56.68        | -6.02        | 49.43        | 55.55        | 9.75         |
| 465             | 930          | 1395         | 1860         | 2325         | 2790         | 3255         | 22.98                      | -1.26                      | 56.00        | -6.37        | 49.01        | 55.36        | 9.75         |
| 470             | 940          | 1410         | 1880         | 2350         | 2820         | 3290         | 22.83                      | -1.22                      | 55.61        | -6.48        | 49.00        | 54.62        | 9.98         |

\* Harmonic Output below power level of X5 Output.

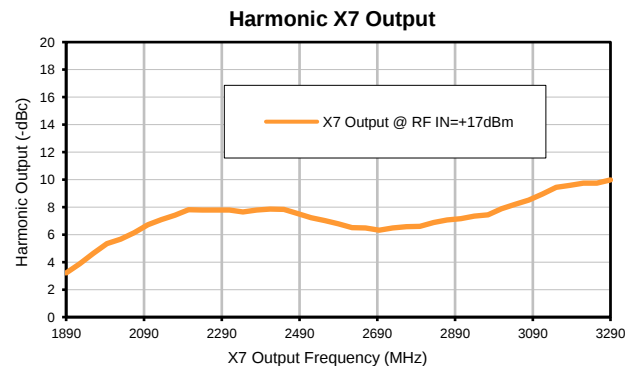
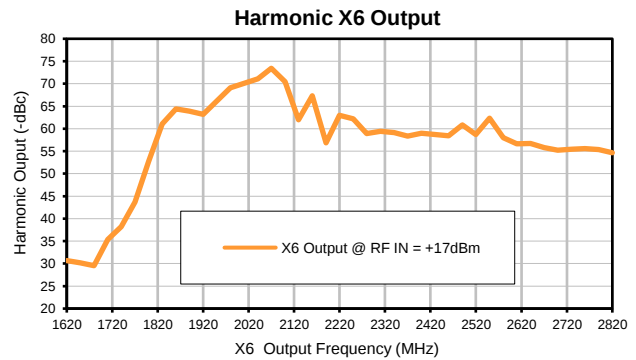
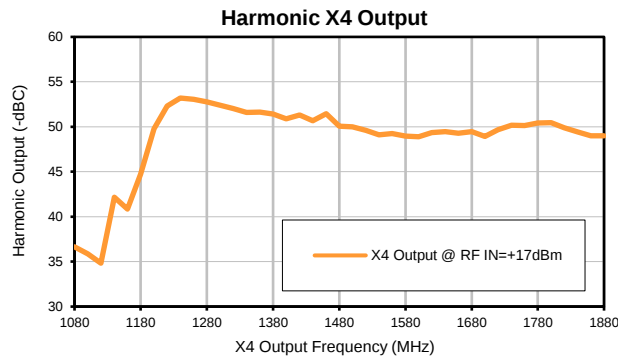
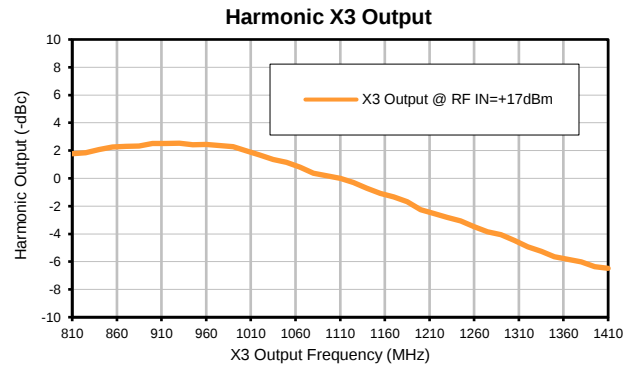
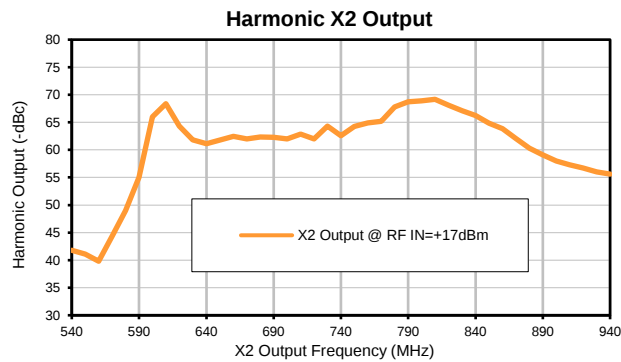
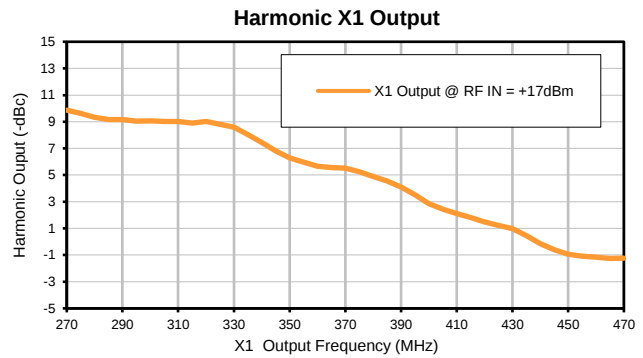
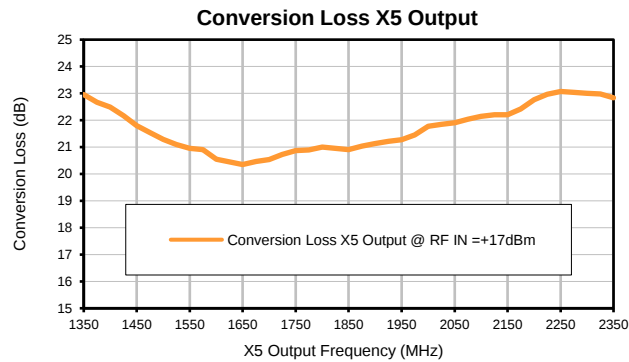


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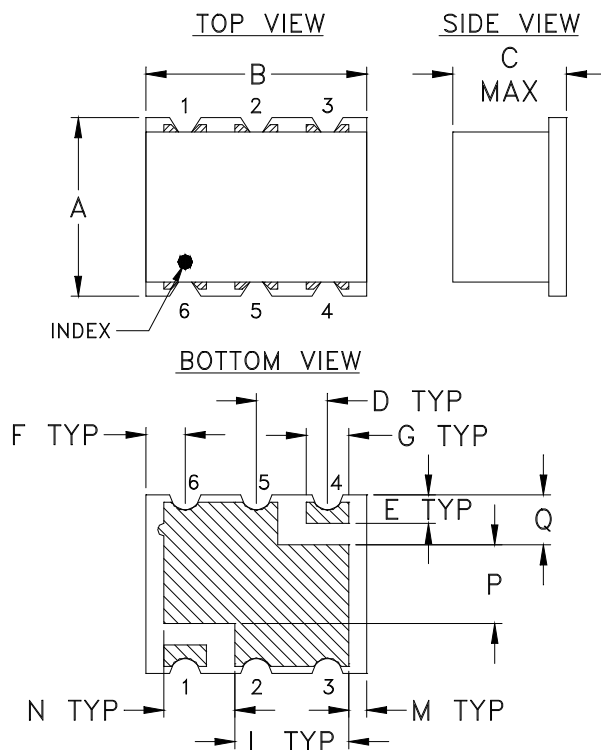
The Design Engineers Search Engine Provides ACTUAL Data Instantly From MINI-CIRCUITS At: [www.minicircuits.com](http://www.minicircuits.com)

IF/RF MICROWAVE COMPONENTS

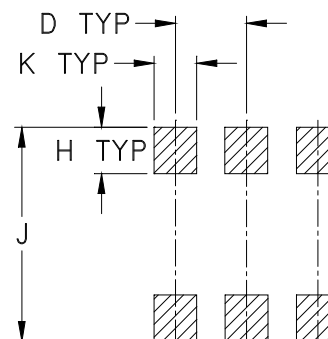
## Typical Performance Curves



## 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<br>(6.35) | .31<br>(7.87) | .16<br>(4.06) | .100<br>(2.54) | .040<br>(1.02) | .055<br>(1.40) | .060<br>(1.52) | .065<br>(1.65) | .300<br>(7.62) | .060<br>(1.52) | .160<br>(4.06) |

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

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

### Notes:

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



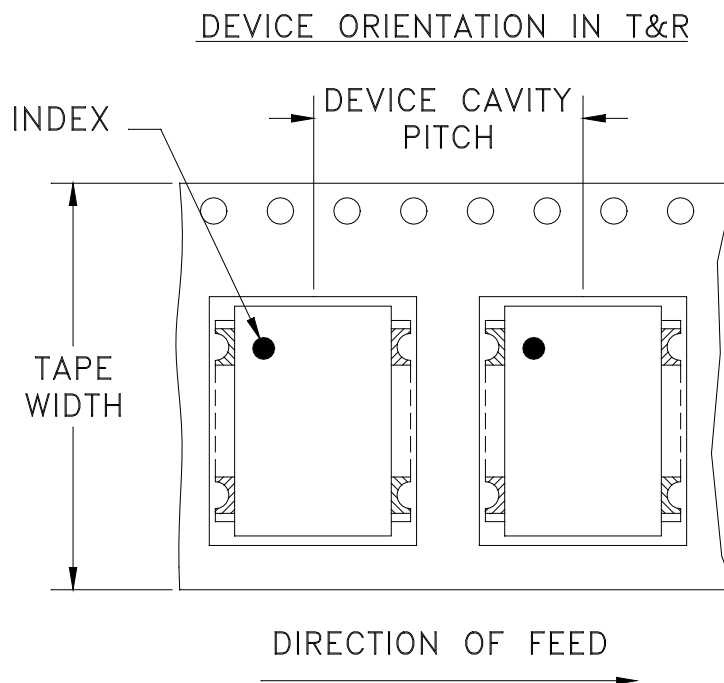
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RF/IF MICROWAVE COMPONENTS

# Tape & Reel Packaging TR-F2



| Tape Width, mm | Device Cavity Pitch, mm | Reel Size, inches | Devices per Reel<br>See note |
|----------------|-------------------------|-------------------|------------------------------|
| 16             | 12                      | 7                 | 10                           |
|                |                         |                   | 20                           |
|                |                         |                   | 50                           |
|                |                         |                   | 100                          |
|                |                         |                   | 200                          |
|                |                         | 13                | 500                          |
|                |                         |                   | 1000                         |

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)



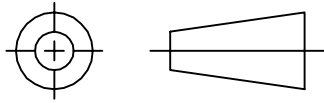
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## THIRD ANGLE PROJECTION

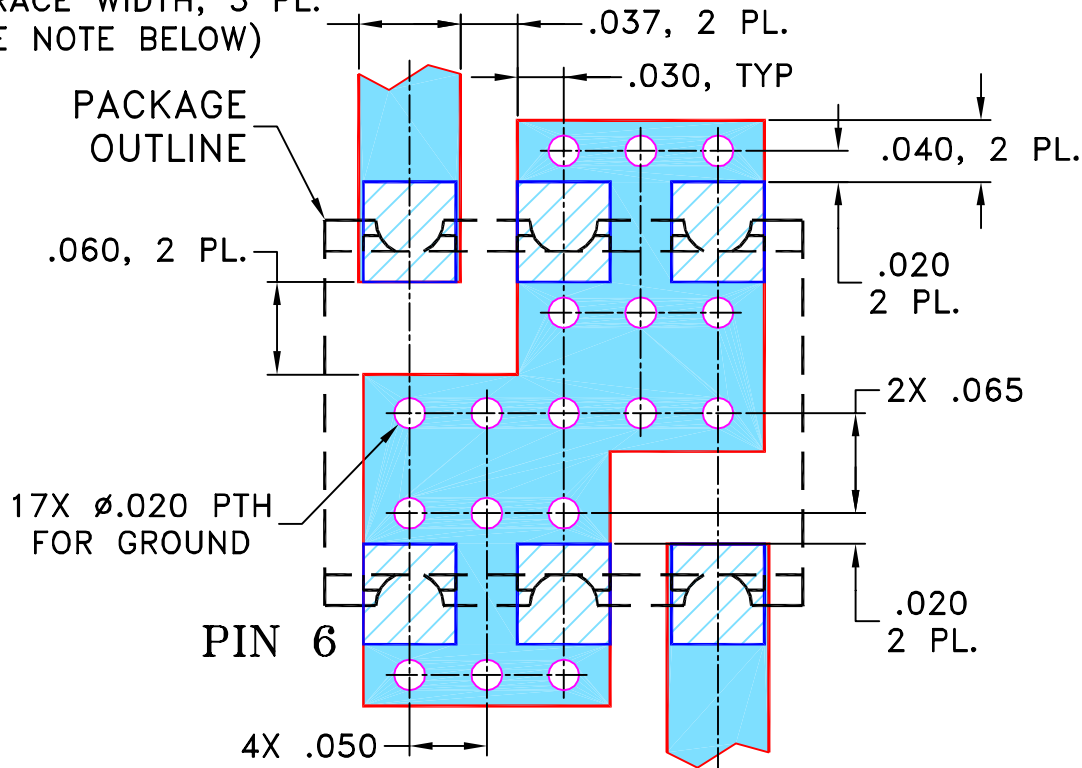


## REVISIONS

| 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"  $\pm$  .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

IL

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

DRAWING NO:  
98-PL-258

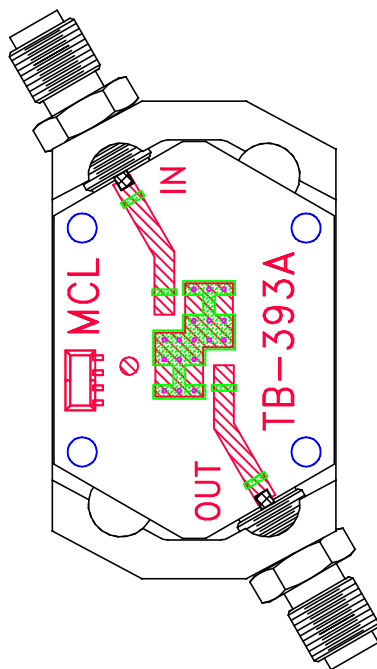
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OR

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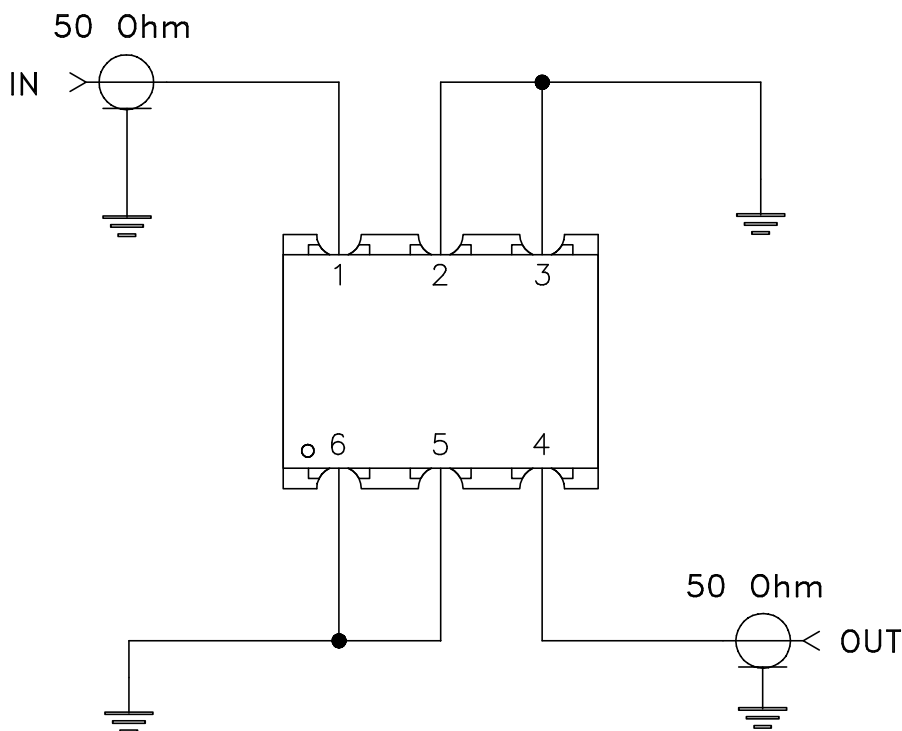
SCALE: 8:1

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<br>Ambient Environment                                                                                                                             | Individual Model Data Sheet                                                                          |
| Storage Temperature            | -55° to 100° C<br>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<br>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;<br>distilled water + proylene glycol monomethyl ether + monoethanolamine at 63°C to 70°C | MIL-STD-202, Method 215                                                                              |