

# X3 Frequency Multiplier

## RMK-3-722+

50Ω      Output 4575 to 7200 MHz



CASE STYLE: TT1224

### The Big Deal

- Broadband, output frequency 4575 to 7200 MHz
- High rejection of adjacent harmonics, 55dB below the carrier, F3
- Small package size, 0.25" x 0.3"
- Low cost \$6.45, quantity of 1000

### Product Overview

The RMK-3-722+ is a self contained frequency tripler that does not require external components. It is constructed using a specially designed diode quad ring configuration to enable high rejection of adjacent harmonics. The tripler is packaged in a miniature 0.3" x 0.25" case, with wrap-around terminations to enable convenient high density assembly.

### Key Features

| Feature                                                                          | Advantages                                                                                                                        |
|----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|
| Broadband frequency tripler<br>Input 1525 to 2400 MHz<br>Output 4575 to 7200 MHz | Enables the use of low frequency VCO's and Synthesizers to provide high frequency sources at low cost.                            |
| Low conversion loss, 14 dB                                                       | Enables output power to be sufficiently high so that amplifier gain requirements following the tripler is reduced.                |
| High rejection of adjacent harmonics, F2 and F4, 55 dB                           | Extremely high rejection of F2 and F4 harmonics enables a significant reduction of unwanted signals without the need for filters. |
| Low cost                                                                         | Enables a practical solution to achieve high frequency sources from low cost, lower frequency VCO's 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](http://www.minicircuits.com/MCLStore/terms.jsp)



# X3 Frequency Multiplier

50Ω Output 4575 to 7200 MHz

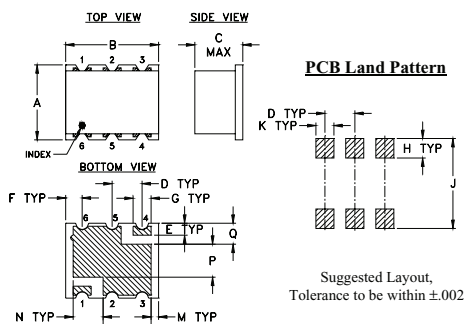
## Maximum Ratings

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

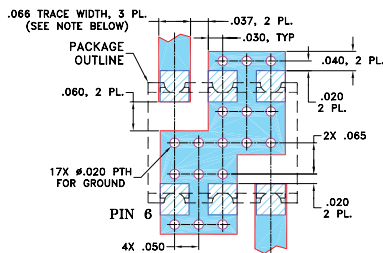
## Outline Drawing



## Outline Dimensions (inch)

| 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.  
3. DENOTES PCB COPPER LAYOUT WITH SMOBC (SOLDER MASK OVER BARE COPPER)  
4. DENOTES COPPER LAND PATTERN FREE OF SOLDER MASK

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## Features

- broadband
- low conversion loss, 14 dB typ.
- high rejection F2, 55 dBc typ.; F4, 55 dBc typ.
- low cost
- aqueous washable

## Applications

- synthesizers
- local oscillators
- satellite up and down converters

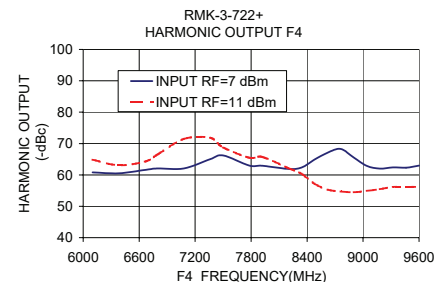
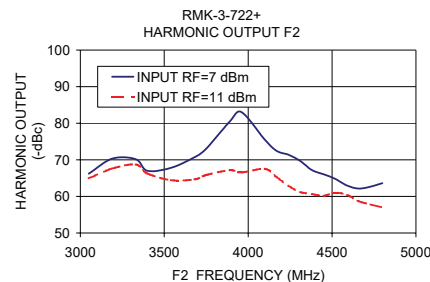
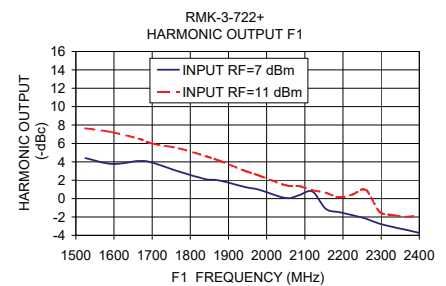
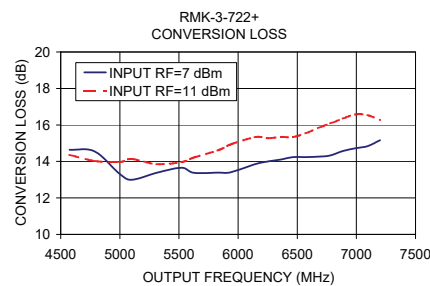
## Electrical Specifications

| MULTIPLICATION FACTOR | FREQUENCY (MHz) |           | INPUT POWER (dBm) |      | CONVERSION LOSS (dB) | *HARMONIC OUTPUT (dBc) |         |         |         |         |         |
|-----------------------|-----------------|-----------|-------------------|------|----------------------|------------------------|---------|---------|---------|---------|---------|
|                       | F1 Input        | F3 Output | Min.              | Max. |                      | F1 Typ.                | F2 Typ. | F3 Min. | F4 Typ. | F5 Min. | F6 Typ. |
| 3                     | 1525-2400       | 4575-7200 | 7                 | 11   | 14 19                | 3                      | -7      | 55 35   | 55 35   |         |         |

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

## Typical Performance Data

| INPUT RF= 7 dBm       |                      |                                 |       |       | INPUT RF= 11 dBm     |                                 |       |       |    |
|-----------------------|----------------------|---------------------------------|-------|-------|----------------------|---------------------------------|-------|-------|----|
| Input Frequency (MHz) | Conversion Loss (dB) | Harmonic Output Below F3 (-dBc) |       |       | Conversion Loss (dB) | Harmonic Output Below F3 (-dBc) |       |       |    |
|                       |                      | F3                              | F1    | F2    |                      | F4                              | F3    | F1    | F2 |
| 1525                  | 14.64                | 4.41                            | 66.20 | 60.80 | 14.36                | 7.65                            | 64.92 | 64.88 |    |
| 1595                  | 14.55                | 3.77                            | 70.33 | 60.53 | 14.03                | 7.22                            | 67.62 | 63.06 |    |
| 1665                  | 13.34                | 4.09                            | 70.15 | 61.60 | 13.96                | 6.51                            | 68.73 | 64.22 |    |
| 1700                  | 12.99                | 3.91                            | 67.00 | 62.08 | 14.14                | 6.00                            | 66.24 | 66.54 |    |
| 1770                  | 13.38                | 2.95                            | 67.80 | 62.08 | 13.85                | 5.46                            | 64.45 | 71.46 |    |
| 1840                  | 13.65                | 2.11                            | 70.68 | 65.00 | 13.96                | 4.62                            | 64.63 | 71.87 |    |
| 1875                  | 13.38                | 1.98                            | 73.03 | 66.20 | 14.21                | 4.14                            | 65.84 | 68.75 |    |
| 1945                  | 13.39                | 1.24                            | 80.44 | 62.98 | 14.62                | 3.00                            | 67.16 | 65.50 |    |
| 1980                  | 13.41                | 0.97                            | 83.05 | 62.93 | 14.94                | 2.50                            | 66.55 | 65.71 |    |
| 2050                  | 13.86                | 0.07                            | 75.46 | 61.91 | 15.34                | 1.45                            | 67.55 | 62.15 |    |
| 2085                  | 14.00                | 0.37                            | 72.44 | 62.33 | 15.27                | 1.35                            | 65.32 | 60.38 |    |
| 2120                  | 14.10                | 0.76                            | 71.38 | 64.92 | 15.34                | 0.92                            | 62.92 | 57.20 |    |
| 2155                  | 14.24                | -1.11                           | 69.70 | 67.06 | 15.34                | 0.63                            | 61.18 | 55.31 |    |
| 2190                  | 14.24                | -1.47                           | 67.22 | 68.30 | 15.54                | 0.12                            | 60.65 | 54.71 |    |
| 2225                  | 14.26                | -1.81                           | 66.05 | 65.52 | 15.82                | 0.44                            | 60.15 | 54.46 |    |
| 2260                  | 14.33                | -2.18                           | 64.76 | 62.89 | 16.08                | 0.93                            | 61.00 | 54.93 |    |
| 2295                  | 14.57                | -2.72                           | 62.98 | 62.03 | 16.35                | -1.40                           | 60.43 | 55.45 |    |
| 2330                  | 14.72                | -3.08                           | 62.15 | 62.39 | 16.57                | -1.77                           | 58.69 | 56.19 |    |
| 2365                  | 14.84                | -3.40                           | 62.66 | 62.31 | 16.54                | -1.98                           | 57.82 | 56.21 |    |
| 2400                  | 15.16                | -3.74                           | 63.61 | 62.98 | 16.26                | -1.80                           | 56.96 | 56.16 |    |



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

| Reel Size | Devices/Reel         |
|-----------|----------------------|
| 7"        | 10, 20, 50, 100, 200 |
| 13"       | 500                  |



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REV. B  
M151107  
RMK-3-722+  
ED-13615  
DJ/CP/AM  
200813  
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# Frequency Multiplier (Tripler)

**RMK-3-722+**

## Typical Performance Data

Test Conditions: RF Input Power = 7 dBm @ +25°C

| FREQUENCY<br>(MHz) |           |           |           | CONVERSION<br>LOSS<br>(dB) | HARMONIC OUTPUT*<br>(-dBc) |           |           |
|--------------------|-----------|-----------|-----------|----------------------------|----------------------------|-----------|-----------|
| X1 OUTPUT          | X2 OUTPUT | X3 OUTPUT | X4 OUTPUT | X3 OUTPUT                  | X1 OUTPUT                  | X2 OUTPUT | X4 OUTPUT |
| 1525.0             | 3050.0    | 4575.0    | 6100.0    | 15.32                      | 3.96                       | 68.30     | 63.37     |
| 1560.0             | 3120.0    | 4680.0    | 6240.0    | 14.38                      | 4.40                       | 65.39     | 62.47     |
| 1595.0             | 3190.0    | 4785.0    | 6380.0    | 14.37                      | 3.94                       | 68.41     | 61.03     |
| 1630.0             | 3260.0    | 4890.0    | 6520.0    | 14.02                      | 3.88                       | 70.82     | 61.59     |
| 1665.0             | 3330.0    | 4995.0    | 6660.0    | 13.61                      | 3.85                       | 67.27     | 61.31     |
| 1700.0             | 3400.0    | 5100.0    | 6800.0    | 14.84                      | 2.41                       | 71.58     | 59.57     |
| 1735.0             | 3470.0    | 5205.0    | 6940.0    | 13.78                      | 3.06                       | 75.01     | 60.26     |
| 1770.0             | 3540.0    | 5310.0    | 7080.0    | 13.76                      | 2.72                       | 68.51     | 61.21     |
| 1805.0             | 3610.0    | 5415.0    | 7220.0    | 13.45                      | 2.66                       | 70.46     | 63.33     |
| 1840.0             | 3680.0    | 5520.0    | 7360.0    | 13.48                      | 2.22                       | 75.25     | 63.84     |
| 1875.0             | 3750.0    | 5625.0    | 7500.0    | 13.60                      | 1.94                       | 72.81     | 65.97     |
| 1910.0             | 3820.0    | 5730.0    | 7640.0    | 13.40                      | 1.67                       | 76.97     | 64.36     |
| 1945.0             | 3890.0    | 5835.0    | 7780.0    | 13.42                      | 1.29                       | 84.90     | 64.12     |
| 1980.0             | 3960.0    | 5940.0    | 7920.0    | 13.60                      | 0.86                       | 80.71     | 62.69     |
| 2015.0             | 4030.0    | 6045.0    | 8060.0    | 13.93                      | 0.16                       | 77.64     | 63.15     |
| 2050.0             | 4100.0    | 6150.0    | 8200.0    | 14.00                      | -0.09                      | 78.76     | 62.71     |
| 2085.0             | 4170.0    | 6255.0    | 8340.0    | 14.16                      | -0.62                      | 74.89     | 64.34     |
| 2120.0             | 4240.0    | 6360.0    | 8480.0    | 14.09                      | -0.82                      | 70.94     | 65.68     |
| 2155.0             | 4310.0    | 6465.0    | 8620.0    | 14.04                      | -1.04                      | 70.63     | 68.13     |
| 2190.0             | 4380.0    | 6570.0    | 8760.0    | 14.78                      | -1.96                      | 69.56     | 65.72     |
| 2225.0             | 4450.0    | 6675.0    | 8900.0    | 14.80                      | -2.14                      | 66.58     | 68.50     |
| 2260.0             | 4520.0    | 6780.0    | 9040.0    | 14.49                      | -2.16                      | 65.44     | 64.24     |
| 2295.0             | 4590.0    | 6885.0    | 9180.0    | 14.92                      | -2.89                      | 63.67     | 61.89     |
| 2330.0             | 4660.0    | 6990.0    | 9320.0    | 15.16                      | -3.28                      | 64.28     | 67.91     |
| 2365.0             | 4730.0    | 7095.0    | 9460.0    | 16.00                      | -4.22                      | 62.72     | 66.57     |
| 2400.0             | 4800.0    | 7200.0    | 9600.0    | 14.93                      | -3.64                      | 63.07     | 62.34     |

\* Harmonic Output below power level of X3 Output.



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RF/MW MICROWAVE COMPONENTS



REV. X1  
RMK-3-722+  
9/15/2009  
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# Frequency Multiplier (Tripler)

**RMK-3-722+**

## Typical Performance Data

Test Conditions: RF Input Power = 7 dBm @ -40°C

| FREQUENCY<br>(MHz) |           |           |           | CONVERSION<br>LOSS<br>(dB) | HARMONIC OUTPUT*<br>(-dBc) |           |           |
|--------------------|-----------|-----------|-----------|----------------------------|----------------------------|-----------|-----------|
| X1 OUTPUT          | X2 OUTPUT | X3 OUTPUT | X4 OUTPUT | X3 OUTPUT                  | X1 OUTPUT                  | X2 OUTPUT | X4 OUTPUT |
| 1525.0             | 3050.0    | 4575.0    | 6100.0    | 15.33                      | 3.50                       | 64.03     | 63.10     |
| 1560.0             | 3120.0    | 4680.0    | 6240.0    | 14.12                      | 4.17                       | 61.57     | 60.94     |
| 1595.0             | 3190.0    | 4785.0    | 6380.0    | 14.20                      | 3.63                       | 63.75     | 58.93     |
| 1630.0             | 3260.0    | 4890.0    | 6520.0    | 13.74                      | 3.65                       | 66.77     | 60.16     |
| 1665.0             | 3330.0    | 4995.0    | 6660.0    | 13.29                      | 3.73                       | 63.11     | 58.29     |
| 1700.0             | 3400.0    | 5100.0    | 6800.0    | 15.13                      | 1.73                       | 65.94     | 57.43     |
| 1735.0             | 3470.0    | 5205.0    | 6940.0    | 13.53                      | 2.89                       | 70.88     | 56.55     |
| 1770.0             | 3540.0    | 5310.0    | 7080.0    | 13.56                      | 2.45                       | 64.09     | 54.74     |
| 1805.0             | 3610.0    | 5415.0    | 7220.0    | 12.92                      | 2.69                       | 65.86     | 56.02     |
| 1840.0             | 3680.0    | 5520.0    | 7360.0    | 12.90                      | 2.29                       | 71.44     | 58.56     |
| 1875.0             | 3750.0    | 5625.0    | 7500.0    | 13.09                      | 1.93                       | 68.07     | 62.17     |
| 1910.0             | 3820.0    | 5730.0    | 7640.0    | 12.72                      | 1.78                       | 70.19     | 62.33     |
| 1945.0             | 3890.0    | 5835.0    | 7780.0    | 12.71                      | 1.44                       | 70.29     | 62.24     |
| 1980.0             | 3960.0    | 5940.0    | 7920.0    | 12.84                      | 1.07                       | 66.92     | 58.87     |
| 2015.0             | 4030.0    | 6045.0    | 8060.0    | 13.21                      | 0.36                       | 65.58     | 58.16     |
| 2050.0             | 4100.0    | 6150.0    | 8200.0    | 13.34                      | 0.01                       | 64.79     | 57.59     |
| 2085.0             | 4170.0    | 6255.0    | 8340.0    | 13.54                      | -0.58                      | 65.18     | 57.73     |
| 2120.0             | 4240.0    | 6360.0    | 8480.0    | 13.46                      | -0.77                      | 68.31     | 57.83     |
| 2155.0             | 4310.0    | 6465.0    | 8620.0    | 13.38                      | -0.95                      | 77.24     | 61.57     |
| 2190.0             | 4380.0    | 6570.0    | 8760.0    | 14.15                      | -1.90                      | 76.26     | 62.46     |
| 2225.0             | 4450.0    | 6675.0    | 8900.0    | 14.15                      | -2.07                      | 66.44     | 70.75     |
| 2260.0             | 4520.0    | 6780.0    | 9040.0    | 13.76                      | -2.02                      | 65.99     | 63.48     |
| 2295.0             | 4590.0    | 6885.0    | 9180.0    | 14.21                      | -2.79                      | 63.40     | 61.10     |
| 2330.0             | 4660.0    | 6990.0    | 9320.0    | 14.53                      | -3.27                      | 60.10     | 70.44     |
| 2365.0             | 4730.0    | 7095.0    | 9460.0    | 15.94                      | -4.74                      | 55.29     | 61.19     |
| 2400.0             | 4800.0    | 7200.0    | 9600.0    | 14.52                      | -3.78                      | 61.15     | 61.13     |

\* Harmonic Output below power level of X3 Output.



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# Frequency Multiplier (Tripler)

**RMK-3-722+**

## Typical Performance Data

Test Conditions: RF Input Power = 7 dBm @ +85°C

| FREQUENCY<br>(MHz) |           |           |           | CONVERSION<br>LOSS<br>(dB) | HARMONIC OUTPUT*<br>(-dBc) |           |           |
|--------------------|-----------|-----------|-----------|----------------------------|----------------------------|-----------|-----------|
| X1 OUTPUT          | X2 OUTPUT | X3 OUTPUT | X4 OUTPUT | X3 OUTPUT                  | X1 OUTPUT                  | X2 OUTPUT | X4 OUTPUT |
| 1525.0             | 3050.0    | 4575.0    | 6100.0    | 15.31                      | 4.36                       | 73.85     | 63.35     |
| 1560.0             | 3120.0    | 4680.0    | 6240.0    | 14.65                      | 4.51                       | 72.35     | 63.58     |
| 1595.0             | 3190.0    | 4785.0    | 6380.0    | 14.59                      | 4.13                       | 75.21     | 62.93     |
| 1630.0             | 3260.0    | 4890.0    | 6520.0    | 14.32                      | 4.02                       | 75.95     | 63.26     |
| 1665.0             | 3330.0    | 4995.0    | 6660.0    | 14.00                      | 3.90                       | 73.76     | 63.74     |
| 1700.0             | 3400.0    | 5100.0    | 6800.0    | 14.83                      | 2.83                       | 78.77     | 62.60     |
| 1735.0             | 3470.0    | 5205.0    | 6940.0    | 14.15                      | 3.16                       | 77.13     | 63.79     |
| 1770.0             | 3540.0    | 5310.0    | 7080.0    | 14.15                      | 2.77                       | 72.97     | 64.80     |
| 1805.0             | 3610.0    | 5415.0    | 7220.0    | 14.00                      | 2.58                       | 75.73     | 66.04     |
| 1840.0             | 3680.0    | 5520.0    | 7360.0    | 14.00                      | 2.18                       | 78.46     | 65.61     |
| 1875.0             | 3750.0    | 5625.0    | 7500.0    | 14.14                      | 1.91                       | 76.98     | 66.47     |
| 1910.0             | 3820.0    | 5730.0    | 7640.0    | 14.03                      | 1.50                       | 82.26     | 66.01     |
| 1945.0             | 3890.0    | 5835.0    | 7780.0    | 14.06                      | 1.17                       | 81.47     | 66.50     |
| 1980.0             | 3960.0    | 5940.0    | 7920.0    | 14.26                      | 0.75                       | 82.79     | 65.78     |
| 2015.0             | 4030.0    | 6045.0    | 8060.0    | 14.51                      | 0.11                       | 75.91     | 66.47     |
| 2050.0             | 4100.0    | 6150.0    | 8200.0    | 14.59                      | -0.18                      | 74.00     | 66.74     |
| 2085.0             | 4170.0    | 6255.0    | 8340.0    | 14.76                      | -0.73                      | 74.10     | 68.08     |
| 2120.0             | 4240.0    | 6360.0    | 8480.0    | 14.73                      | -0.98                      | 70.05     | 67.32     |
| 2155.0             | 4310.0    | 6465.0    | 8620.0    | 14.71                      | -1.19                      | 69.60     | 68.22     |
| 2190.0             | 4380.0    | 6570.0    | 8760.0    | 15.41                      | -2.05                      | 69.01     | 66.18     |
| 2225.0             | 4450.0    | 6675.0    | 8900.0    | 15.42                      | -2.21                      | 66.55     | 67.19     |
| 2260.0             | 4520.0    | 6780.0    | 9040.0    | 15.08                      | -2.20                      | 66.21     | 65.26     |
| 2295.0             | 4590.0    | 6885.0    | 9180.0    | 15.50                      | -2.91                      | 64.93     | 63.29     |
| 2330.0             | 4660.0    | 6990.0    | 9320.0    | 15.61                      | -3.18                      | 65.66     | 67.47     |
| 2365.0             | 4730.0    | 7095.0    | 9460.0    | 16.19                      | -3.93                      | 63.64     | 68.35     |
| 2400.0             | 4800.0    | 7200.0    | 9600.0    | 15.39                      | -3.57                      | 64.25     | 63.26     |

\* Harmonic Output below power level of X3 Output.



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# Frequency Multiplier (Tripler)

**RMK-3-722+**

## Typical Performance Data

Test Conditions: RF Input Power = 11 dBm @ +25°C

| FREQUENCY<br>(MHz) |           |           |           | CONVERSION<br>LOSS<br>(dB) | HARMONIC OUTPUT*<br>(-dBc) |           |           |
|--------------------|-----------|-----------|-----------|----------------------------|----------------------------|-----------|-----------|
| X1 OUTPUT          | X2 OUTPUT | X3 OUTPUT | X4 OUTPUT | X3 OUTPUT                  | X1 OUTPUT                  | X2 OUTPUT | X4 OUTPUT |
| 1525.0             | 3050.0    | 4575.0    | 6100.0    | 14.25                      | 7.77                       | 67.72     | 63.94     |
| 1560.0             | 3120.0    | 4680.0    | 6240.0    | 14.17                      | 7.52                       | 64.47     | 67.80     |
| 1595.0             | 3190.0    | 4785.0    | 6380.0    | 14.02                      | 7.23                       | 65.56     | 65.51     |
| 1630.0             | 3260.0    | 4890.0    | 6520.0    | 13.92                      | 6.89                       | 68.27     | 64.35     |
| 1665.0             | 3330.0    | 4995.0    | 6660.0    | 13.97                      | 6.56                       | 65.24     | 67.64     |
| 1700.0             | 3400.0    | 5100.0    | 6800.0    | 14.02                      | 6.03                       | 65.47     | 66.83     |
| 1735.0             | 3470.0    | 5205.0    | 6940.0    | 13.88                      | 5.83                       | 68.46     | 65.85     |
| 1770.0             | 3540.0    | 5310.0    | 7080.0    | 13.83                      | 5.54                       | 65.12     | 68.98     |
| 1805.0             | 3610.0    | 5415.0    | 7220.0    | 14.14                      | 4.96                       | 65.14     | 70.77     |
| 1840.0             | 3680.0    | 5520.0    | 7360.0    | 14.10                      | 4.53                       | 66.52     | 69.08     |
| 1875.0             | 3750.0    | 5625.0    | 7500.0    | 14.18                      | 4.30                       | 65.72     | 69.53     |
| 1910.0             | 3820.0    | 5730.0    | 7640.0    | 14.51                      | 3.54                       | 66.23     | 66.78     |
| 1945.0             | 3890.0    | 5835.0    | 7780.0    | 14.60                      | 3.08                       | 67.45     | 66.06     |
| 1980.0             | 3960.0    | 5940.0    | 7920.0    | 15.05                      | 2.44                       | 68.34     | 64.63     |
| 2015.0             | 4030.0    | 6045.0    | 8060.0    | 15.38                      | 1.69                       | 66.83     | 64.79     |
| 2050.0             | 4100.0    | 6150.0    | 8200.0    | 15.33                      | 1.52                       | 65.01     | 62.15     |
| 2085.0             | 4170.0    | 6255.0    | 8340.0    | 15.73                      | 0.79                       | 66.38     | 60.47     |
| 2120.0             | 4240.0    | 6360.0    | 8480.0    | 15.57                      | 0.69                       | 63.13     | 57.30     |
| 2155.0             | 4310.0    | 6465.0    | 8620.0    | 15.63                      | 0.42                       | 64.47     | 56.92     |
| 2190.0             | 4380.0    | 6570.0    | 8760.0    | 16.37                      | -0.54                      | 61.86     | 54.70     |
| 2225.0             | 4450.0    | 6675.0    | 8900.0    | 15.94                      | -0.42                      | 63.10     | 55.46     |
| 2260.0             | 4520.0    | 6780.0    | 9040.0    | 16.12                      | -0.81                      | 60.40     | 55.09     |
| 2295.0             | 4590.0    | 6885.0    | 9180.0    | 16.75                      | -1.59                      | 60.52     | 55.57     |
| 2330.0             | 4660.0    | 6990.0    | 9320.0    | 16.27                      | -1.35                      | 61.35     | 56.84     |
| 2365.0             | 4730.0    | 7095.0    | 9460.0    | 16.21                      | -1.73                      | 58.10     | 56.26     |
| 2400.0             | 4800.0    | 7200.0    | 9600.0    | 15.49                      | -1.54                      | 54.38     | 55.81     |

\* Harmonic Output below power level of X3 Output.



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# Frequency Multiplier (Tripler)

**RMK-3-722+**

## Typical Performance Data

Test Conditions: RF Input Power = 11 dBm @ -40°C

| FREQUENCY<br>(MHz) |           |           |           | CONVERSION<br>LOSS<br>(dB) | HARMONIC OUTPUT*<br>(-dBc) |           |           |
|--------------------|-----------|-----------|-----------|----------------------------|----------------------------|-----------|-----------|
| X1 OUTPUT          | X2 OUTPUT | X3 OUTPUT | X4 OUTPUT | X3 OUTPUT                  | X1 OUTPUT                  | X2 OUTPUT | X4 OUTPUT |
| 1525.0             | 3050.0    | 4575.0    | 6100.0    | 13.42                      | 8.24                       | 65.31     | 63.55     |
| 1560.0             | 3120.0    | 4680.0    | 6240.0    | 13.36                      | 7.92                       | 62.26     | 65.29     |
| 1595.0             | 3190.0    | 4785.0    | 6380.0    | 13.21                      | 7.64                       | 63.84     | 62.63     |
| 1630.0             | 3260.0    | 4890.0    | 6520.0    | 13.09                      | 7.28                       | 66.56     | 62.71     |
| 1665.0             | 3330.0    | 4995.0    | 6660.0    | 13.13                      | 7.07                       | 62.70     | 66.02     |
| 1700.0             | 3400.0    | 5100.0    | 6800.0    | 13.23                      | 6.51                       | 63.92     | 64.56     |
| 1735.0             | 3470.0    | 5205.0    | 6940.0    | 13.08                      | 6.31                       | 68.62     | 63.19     |
| 1770.0             | 3540.0    | 5310.0    | 7080.0    | 13.08                      | 5.91                       | 64.03     | 66.34     |
| 1805.0             | 3610.0    | 5415.0    | 7220.0    | 13.35                      | 5.37                       | 63.55     | 70.65     |
| 1840.0             | 3680.0    | 5520.0    | 7360.0    | 13.31                      | 4.95                       | 64.88     | 71.95     |
| 1875.0             | 3750.0    | 5625.0    | 7500.0    | 13.35                      | 4.72                       | 64.82     | 71.42     |
| 1910.0             | 3820.0    | 5730.0    | 7640.0    | 13.67                      | 3.93                       | 66.44     | 66.72     |
| 1945.0             | 3890.0    | 5835.0    | 7780.0    | 13.72                      | 3.54                       | 68.87     | 64.31     |
| 1980.0             | 3960.0    | 5940.0    | 7920.0    | 14.18                      | 2.90                       | 71.38     | 63.39     |
| 2015.0             | 4030.0    | 6045.0    | 8060.0    | 14.59                      | 2.10                       | 67.37     | 65.40     |
| 2050.0             | 4100.0    | 6150.0    | 8200.0    | 14.62                      | 1.82                       | 65.03     | 62.64     |
| 2085.0             | 4170.0    | 6255.0    | 8340.0    | 15.04                      | 1.05                       | 67.82     | 62.17     |
| 2120.0             | 4240.0    | 6360.0    | 8480.0    | 14.82                      | 1.00                       | 63.61     | 60.17     |
| 2155.0             | 4310.0    | 6465.0    | 8620.0    | 14.84                      | 0.75                       | 63.58     | 57.92     |
| 2190.0             | 4380.0    | 6570.0    | 8760.0    | 15.56                      | -0.19                      | 61.54     | 53.75     |
| 2225.0             | 4450.0    | 6675.0    | 8900.0    | 14.99                      | 0.08                       | 65.19     | 54.00     |
| 2260.0             | 4520.0    | 6780.0    | 9040.0    | 15.36                      | -0.50                      | 59.69     | 52.54     |
| 2295.0             | 4590.0    | 6885.0    | 9180.0    | 16.11                      | -1.42                      | 59.54     | 54.67     |
| 2330.0             | 4660.0    | 6990.0    | 9320.0    | 15.59                      | -1.14                      | 59.74     | 56.72     |
| 2365.0             | 4730.0    | 7095.0    | 9460.0    | 15.77                      | -1.77                      | 57.05     | 55.90     |
| 2400.0             | 4800.0    | 7200.0    | 9600.0    | 14.79                      | -1.22                      | 54.00     | 53.77     |

\* Harmonic Output below power level of X3 Output.



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RF/MW MICROWAVE COMPONENTS



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# Frequency Multiplier (Tripler)

**RMK-3-722+**

## Typical Performance Data

Test Conditions: RF Input Power = 11 dBm @ +85°C

| FREQUENCY<br>(MHz) |           |           |           | CONVERSION<br>LOSS<br>(dB) | HARMONIC OUTPUT*<br>(-dBc) |           |           |
|--------------------|-----------|-----------|-----------|----------------------------|----------------------------|-----------|-----------|
| X1 OUTPUT          | X2 OUTPUT | X3 OUTPUT | X4 OUTPUT | X3 OUTPUT                  | X1 OUTPUT                  | X2 OUTPUT | X4 OUTPUT |
| 1525.0             | 3050.0    | 4575.0    | 6100.0    | 15.01                      | 7.31                       | 69.53     | 63.72     |
| 1560.0             | 3120.0    | 4680.0    | 6240.0    | 14.94                      | 7.00                       | 66.43     | 67.08     |
| 1595.0             | 3190.0    | 4785.0    | 6380.0    | 14.79                      | 6.75                       | 67.28     | 65.69     |
| 1630.0             | 3260.0    | 4890.0    | 6520.0    | 14.69                      | 6.42                       | 69.67     | 64.49     |
| 1665.0             | 3330.0    | 4995.0    | 6660.0    | 14.76                      | 6.11                       | 66.77     | 67.12     |
| 1700.0             | 3400.0    | 5100.0    | 6800.0    | 14.81                      | 5.58                       | 66.92     | 67.02     |
| 1735.0             | 3470.0    | 5205.0    | 6940.0    | 14.59                      | 5.47                       | 68.69     | 66.75     |
| 1770.0             | 3540.0    | 5310.0    | 7080.0    | 14.57                      | 5.10                       | 65.71     | 68.71     |
| 1805.0             | 3610.0    | 5415.0    | 7220.0    | 14.85                      | 4.59                       | 66.06     | 69.36     |
| 1840.0             | 3680.0    | 5520.0    | 7360.0    | 14.82                      | 4.15                       | 66.14     | 67.55     |
| 1875.0             | 3750.0    | 5625.0    | 7500.0    | 14.94                      | 3.90                       | 65.48     | 68.45     |
| 1910.0             | 3820.0    | 5730.0    | 7640.0    | 15.24                      | 3.13                       | 64.90     | 67.03     |
| 1945.0             | 3890.0    | 5835.0    | 7780.0    | 15.37                      | 2.68                       | 65.99     | 66.00     |
| 1980.0             | 3960.0    | 5940.0    | 7920.0    | 15.78                      | 2.13                       | 66.31     | 64.96     |
| 2015.0             | 4030.0    | 6045.0    | 8060.0    | 16.04                      | 1.42                       | 64.24     | 64.07     |
| 2050.0             | 4100.0    | 6150.0    | 8200.0    | 16.06                      | 1.15                       | 63.23     | 61.19     |
| 2085.0             | 4170.0    | 6255.0    | 8340.0    | 16.41                      | 0.43                       | 64.26     | 59.75     |
| 2120.0             | 4240.0    | 6360.0    | 8480.0    | 16.35                      | 0.24                       | 62.21     | 57.80     |
| 2155.0             | 4310.0    | 6465.0    | 8620.0    | 16.43                      | 0.01                       | 63.76     | 57.81     |
| 2190.0             | 4380.0    | 6570.0    | 8760.0    | 17.16                      | -0.93                      | 61.82     | 56.61     |
| 2225.0             | 4450.0    | 6675.0    | 8900.0    | 16.80                      | -0.87                      | 62.37     | 56.79     |
| 2260.0             | 4520.0    | 6780.0    | 9040.0    | 16.76                      | -1.07                      | 59.93     | 56.49     |
| 2295.0             | 4590.0    | 6885.0    | 9180.0    | 17.38                      | -1.81                      | 60.47     | 56.75     |
| 2330.0             | 4660.0    | 6990.0    | 9320.0    | 16.87                      | -1.51                      | 61.50     | 57.69     |
| 2365.0             | 4730.0    | 7095.0    | 9460.0    | 16.68                      | -1.85                      | 58.52     | 57.67     |
| 2400.0             | 4800.0    | 7200.0    | 9600.0    | 16.36                      | -2.03                      | 55.32     | 57.89     |

\* Harmonic Output below power level of X3 Output.



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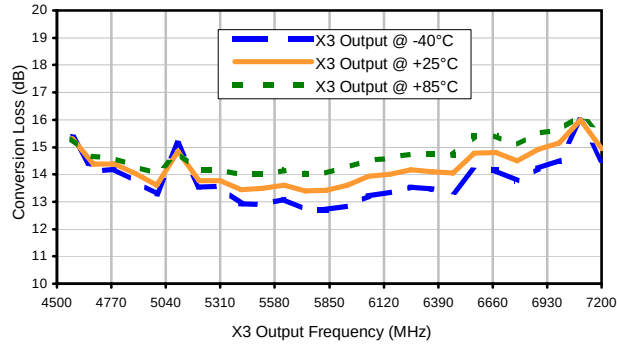


# Frequency Multiplier (Tripler)

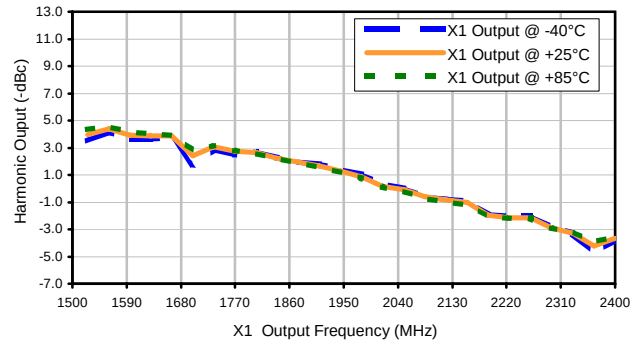
RMK-3-722+

## Typical Performance Curves

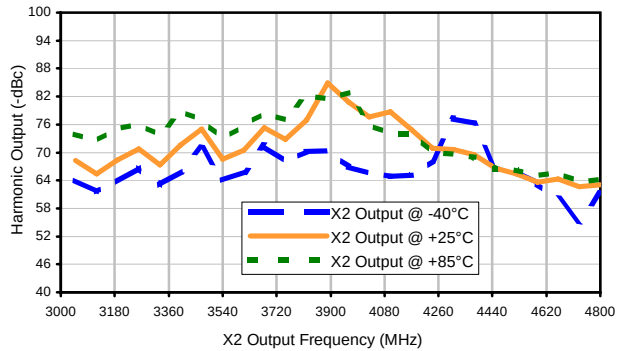
Conversion Loss X3 Output @ RF IN =7dBm



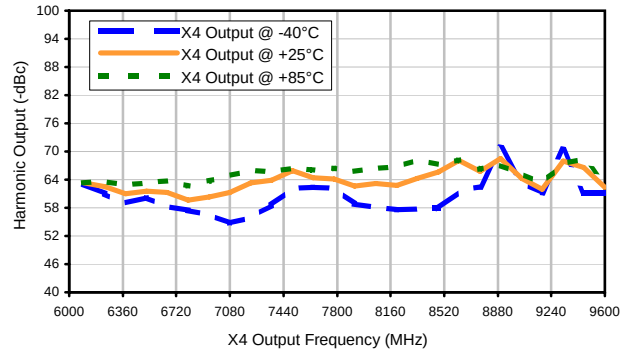
Harmonic X1 Output @ RF IN =7dBm



Harmonic X2 Output @ RF IN =7dBm



Harmonic X4 Output @ RF IN =7dBm



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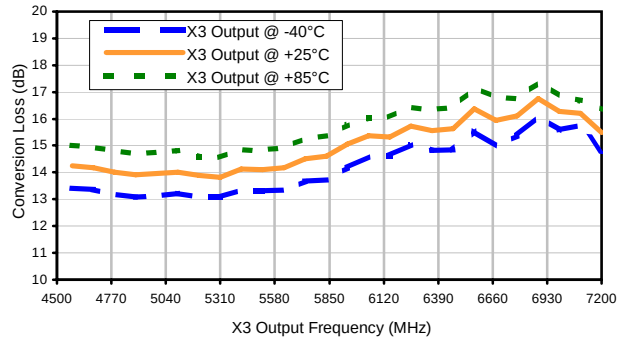
REV. X1  
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9/15/2009  
Page 1 of 2

# Frequency Multiplier (Tripler)

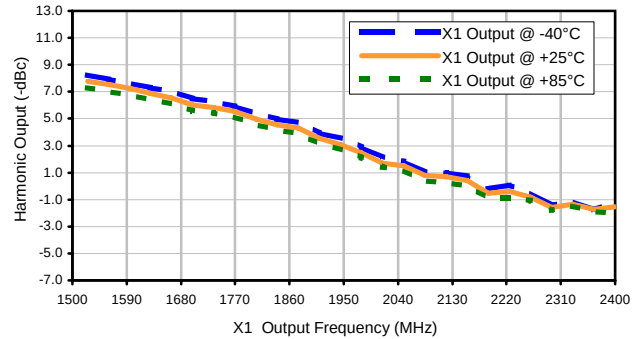
RMK-3-722+

## Typical Performance Curves

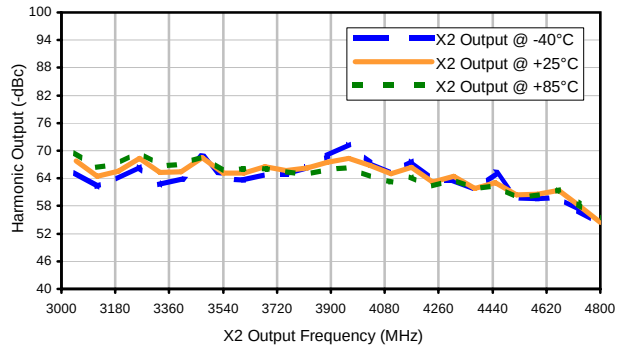
Conversion Loss X3 Output @ RF IN=11dBm



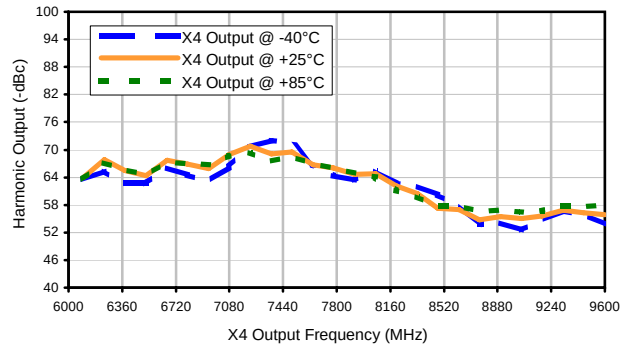
Harmonic X1 Output @ RF IN=11dBm



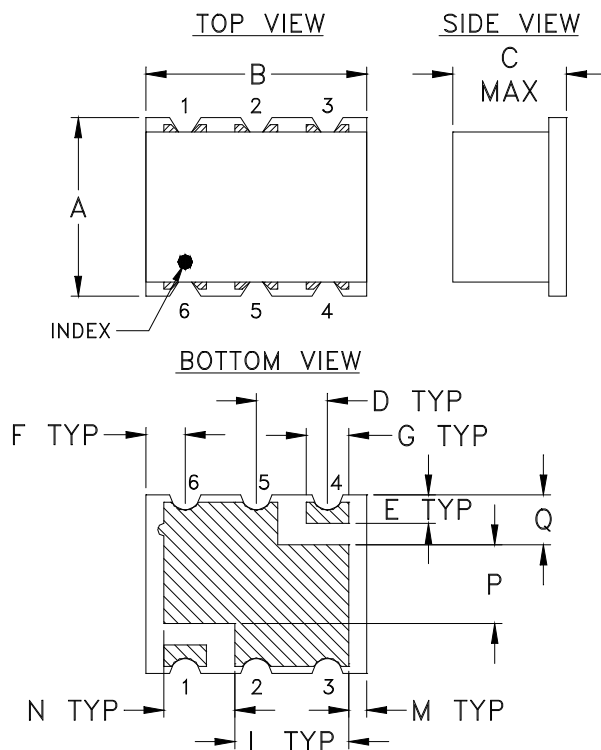
Harmonic X2 Output @ RF IN=11dBm



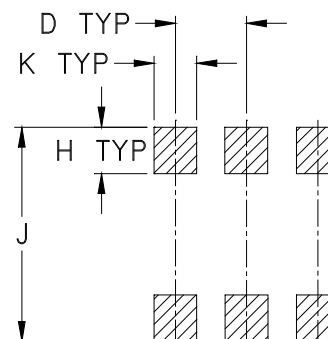
Harmonic X4 Output @ RF IN=11dBm



## 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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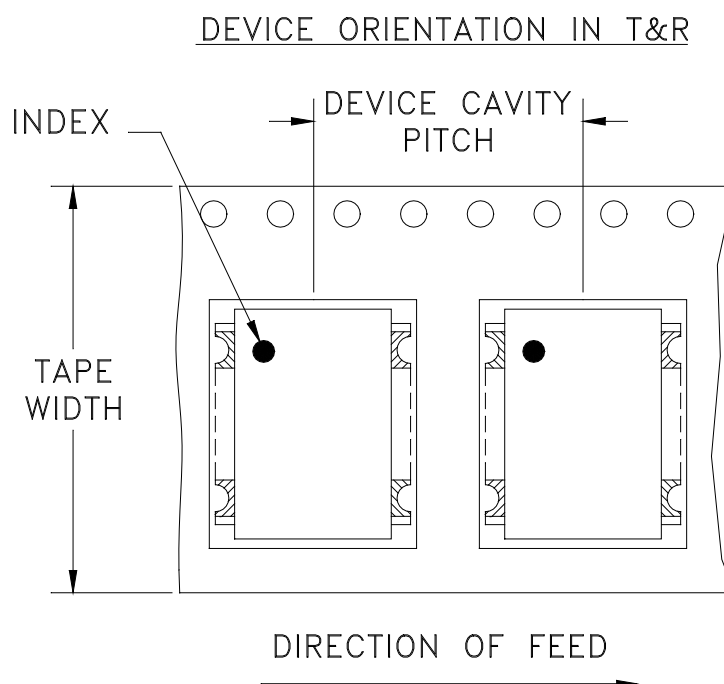


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# *Tape & Reel Packaging TR-F2*



| 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                         |

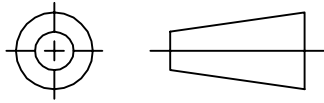
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## THIRD ANGLE PROJECTION

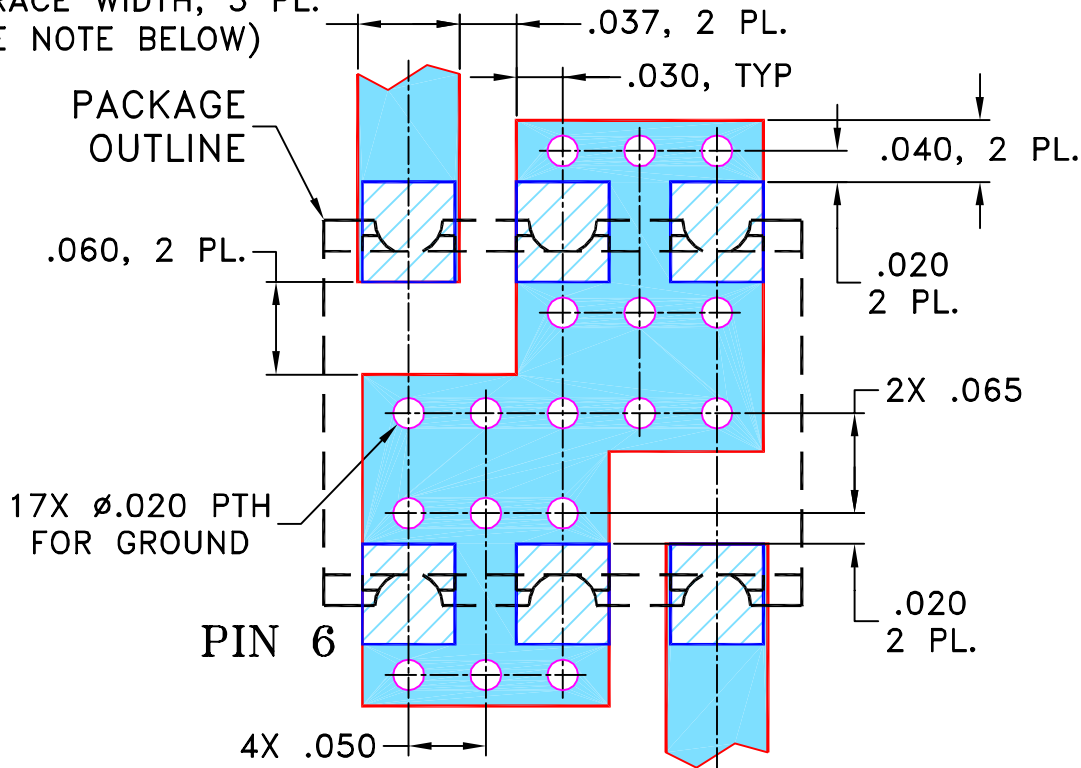


## REVISIONS

| 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

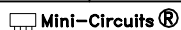
01/04/07

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



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

SIZE  
A

CODE IDENT  
15542

DRAWING NO:  
98-PL-258

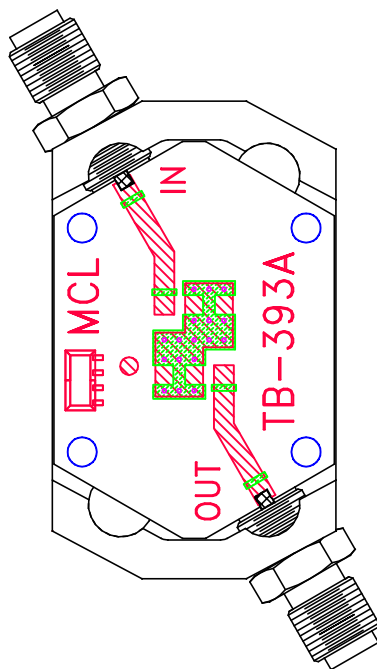
REV:  
OR

FILE: 98PL258

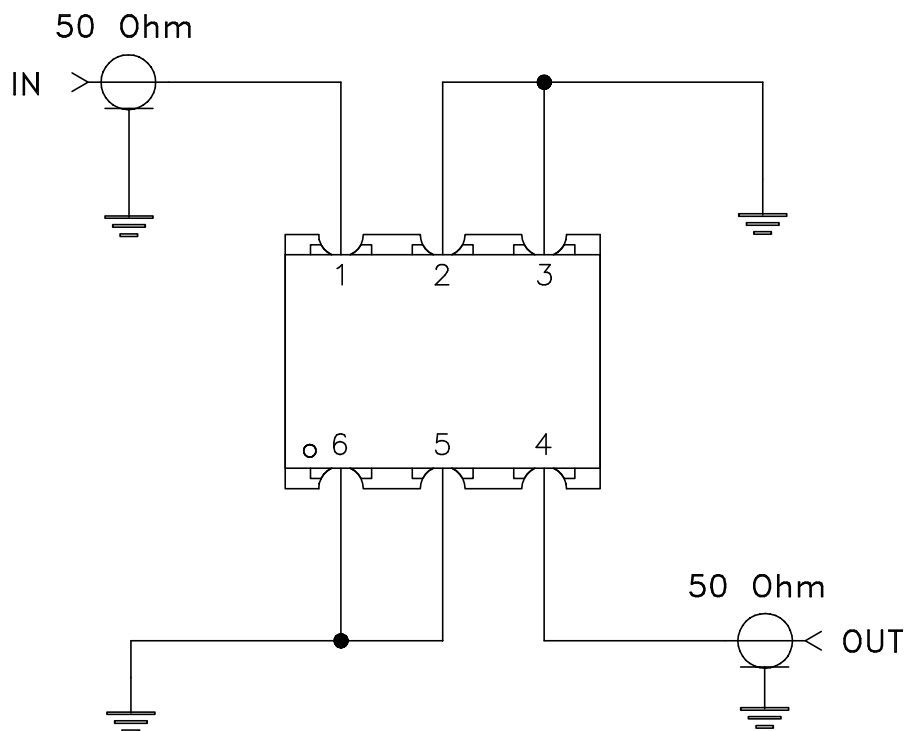
SCALE: 8:1

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.

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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                                                                              |