

# X4 Frequency Multiplier

RKK-4-112+

50Ω     Output 800 to 1100 MHz

## The Big Deal

- Broadband, output from 800 to 1100 MHz
- Wide input power range, +17 to +23 dBm
- Low conversion loss, 22.5 dB
- Good harmonic suppression:  
F3, 30 dBc; F5, 23 dBc



CASE STYLE: CK1246

## Product Overview

Mini-Circuits' RKK-4-112+ frequency multiplier provides a multiplication factor of 4, converting input frequencies from 200 to 275 MHz into output frequencies from 800 to 1100 MHz, supporting applications including synthesizers, local oscillators, satellite up and down converters and more. This model provides an input power range from +17 to +23 dBm, low conversion loss and good harmonic suppression. The multiplier comes housed in a miniature, shielded surface-mount package (0.50 x 0.50 x 0.18") with wrap-around terminations for excellent solderability.

## Key Features

| Feature                                                                                                          | Advantages                                                                                                              |
|------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|
| Low conversion loss, 22.5 dB typ                                                                                 | With a low conversion loss, RKK-4-112+ produces higher output power, reducing the need for amplification.               |
| Very good harmonic suppression <ul style="list-style-type: none"><li>• F3, 30 dBc</li><li>• F5, 23 dBc</li></ul> | Reduces spurious signals and the need for additional filtering.                                                         |
| Broadband, 800 to 1100 MHz output                                                                                | With an output frequency range spanning 800 to 1100 MHz, this multiplier covers a wide range of applications.           |
| Wide input power range, +17 to +23 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, 0.50 x 0.50 x 0.18"                                                                                  | 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)



# X4 Frequency Multiplier

50Ω Output 800 to 1100 MHz

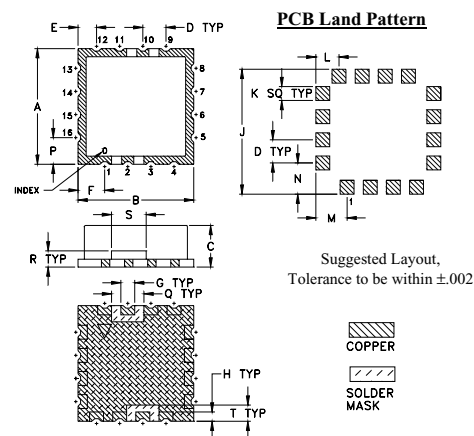
## Maximum Ratings

|                                                                 |                |
|-----------------------------------------------------------------|----------------|
| Operating Temperature                                           | -40°C to 85°C  |
| Storage Temperature                                             | -55°C to 100°C |
| RF Input Power                                                  | 25dBm          |
| Permanent damage may occur if any of these limits are exceeded. |                |

## Pin Connections

|        |                                   |
|--------|-----------------------------------|
| INPUT  | 2                                 |
| OUTPUT | 10                                |
| GROUND | 1,3,4,5,6,7,8,9,11,12,13,14,15,16 |

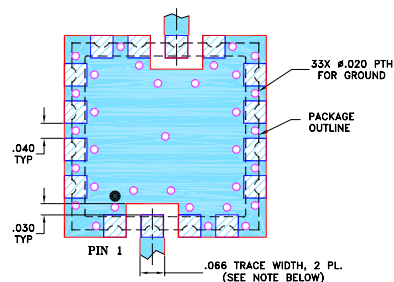
## Outline Drawing



## Outline Dimensions (inch/mm)

| A     | B     | C    | D    | E    | F    | G    | H    | J     | K    |
|-------|-------|------|------|------|------|------|------|-------|------|
| .500  | .500  | .180 | .100 | .080 | .115 | .060 | .040 | .540  | .060 |
| 12.70 | 12.70 | 4.57 | 2.54 | 2.03 | 2.92 | 1.52 | 1.02 | 13.72 | 1.52 |
| L     | M     | N    | P    | Q    | R    | S    | T    | wt.   |      |
| .100  | .135  | .135 | .115 | .140 | .070 | .150 | .070 | grams |      |
| 2.54  | 3.43  | 3.43 | 2.92 | 3.56 | 1.78 | 3.81 | 1.78 | 1.0   |      |

## Demo Board MCL P/N: TB-435+ Suggested PCB Layout (PL-267)



- NOTES: 1. TRACE WIDTH IS SHOWN FOR ROGERS RO4350B WITH DIELECTRIC THICKNESS .030" ± .002"; COPPER: 1/2 OZ. EACH SIDE. FOR OTHER MATERIALS TRACE WIDTH MAY NEED TO BE MODIFIED.
2. BOTTOM SIDE OF THE PCB IS CONTINUOUS GROUND PLANE.
- DENOTES PCB COPPER LAYOUT WITH SMOBC (SOLDER MASK OVER BARE COPPER)
- DENOTES COPPER LAND PATTERN FREE OF SOLDER MASK

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## Features

- broadband
- high rejection F1, 36 dBc typ; F2, 30 dBc typ; F3, 30 dBc typ; F5, 23 dBc typ.
- aqueous washable

## Applications

- synthesizers
- local oscillators
- satellite up and down converters



Generic photo used for illustration purposes only

CASE STYLE: CK1246

## +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 |
| 13"       | 200, 500        |

## Electrical Specifications at 25°C

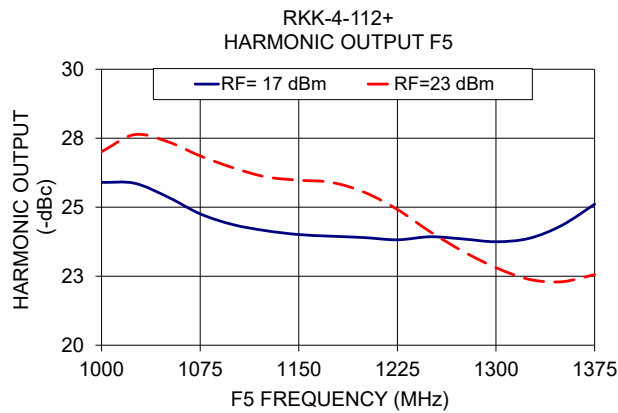
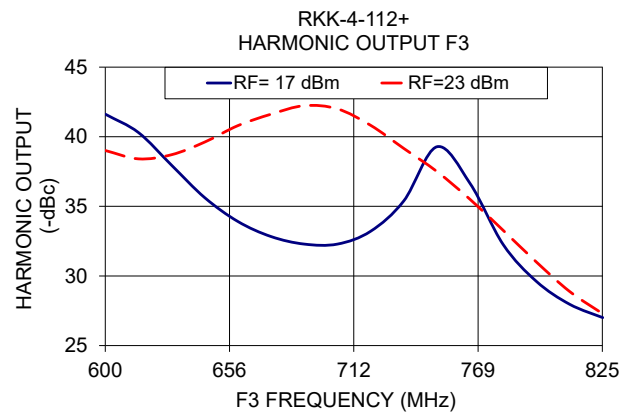
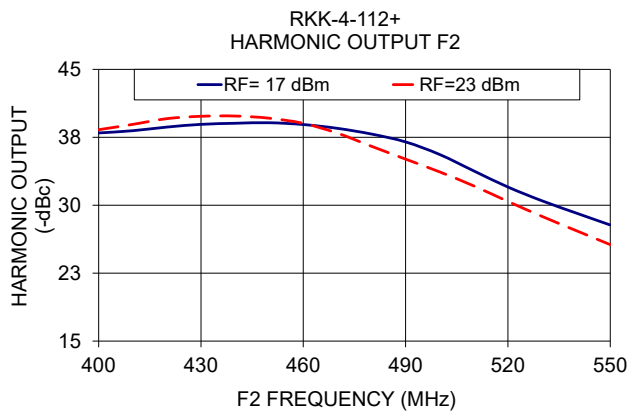
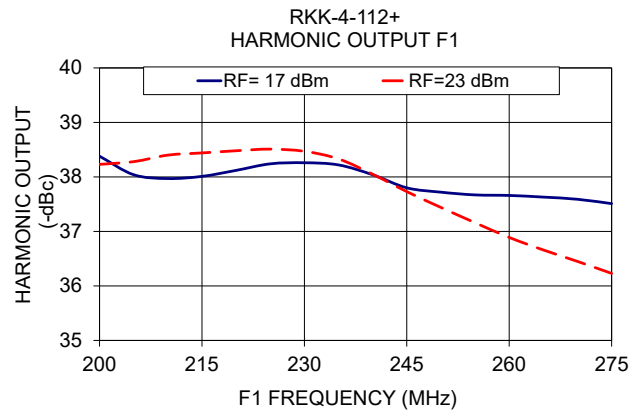
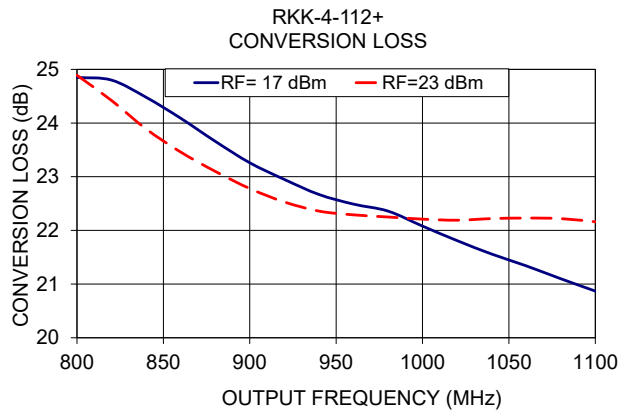
| Parameter                    | Min. | Typ. | Max. | Unit |
|------------------------------|------|------|------|------|
| Multiplier Factor            |      | 4    |      |      |
| Frequency Range, Input (F1)  | 200  | —    | 275  | MHz  |
| Frequency Range, Output (F4) | 800  | —    | 1100 | MHz  |
| Input Power                  | 17   | —    | 23   | dBm  |
| Conversion Loss              | —    | 22.5 | 29   | dB   |
| Harmonic Output*             | F1   | 25   | 36   | dBc  |
|                              | F2   | 20   | 30   |      |
|                              | F3   | 20   | 30   |      |
|                              | F5   | 18   | 23   |      |

\* Harmonics of input frequency below the power level of F4.

## Typical Performance Data

| Input Frequency (MHz) | INPUT RF= 17dBm      |                                |       |       |       | INPUT RF= 23dBm      |                                |       |       |       |
|-----------------------|----------------------|--------------------------------|-------|-------|-------|----------------------|--------------------------------|-------|-------|-------|
|                       | Conversion Loss (dB) | Harmonic Output Below F4 (dBc) |       |       |       | Conversion Loss (dB) | Harmonic Output Below F4 (dBc) |       |       |       |
|                       | F4                   | F1                             | F2    | F3    | F5    | F4                   | F1                             | F2    | F3    | F5    |
| 200                   | 24.85                | 38.38                          | 37.98 | 41.62 | 25.90 | 24.89                | 38.23                          | 38.34 | 39.01 | 27.01 |
| 205                   | 24.80                | 38.04                          | 38.23 | 40.30 | 25.87 | 24.42                | 38.28                          | 38.93 | 38.41 | 27.63 |
| 210                   | 24.48                | 37.97                          | 38.63 | 37.95 | 25.38 | 23.89                | 38.40                          | 39.56 | 38.71 | 27.38 |
| 215                   | 24.09                | 38.01                          | 38.93 | 35.62 | 24.76 | 23.46                | 38.44                          | 39.82 | 39.62 | 26.86 |
| 220                   | 23.66                | 38.12                          | 39.05 | 33.91 | 24.37 | 23.10                | 38.48                          | 39.85 | 40.80 | 26.43 |
| 225                   | 23.26                | 38.24                          | 39.11 | 32.83 | 24.15 | 22.78                | 38.51                          | 39.61 | 41.62 | 26.10 |
| 230                   | 22.95                | 38.26                          | 38.91 | 32.29 | 24.01 | 22.53                | 38.47                          | 39.04 | 42.23 | 25.98 |
| 235                   | 22.67                | 38.22                          | 38.49 | 32.29 | 23.95 | 22.36                | 38.33                          | 37.96 | 42.00 | 25.90 |
| 240                   | 22.49                | 38.04                          | 37.86 | 33.21 | 23.90 | 22.29                | 38.05                          | 36.51 | 40.82 | 25.54 |
| 245                   | 22.36                | 37.80                          | 36.99 | 35.39 | 23.82 | 22.25                | 37.73                          | 35.09 | 39.16 | 24.92 |
| 250                   | 22.08                | 37.72                          | 36.99 | 39.28 | 23.93 | 22.21                | 37.44                          | 33.68 | 37.50 | 24.11 |
| 255                   | 21.81                | 37.67                          | 33.79 | 36.64 | 23.85 | 22.19                | 37.16                          | 32.13 | 35.50 | 23.40 |
| 260                   | 21.56                | 37.66                          | 32.01 | 32.25 | 23.75 | 22.22                | 36.89                          | 30.42 | 33.27 | 22.81 |
| 265                   | 21.34                | 37.63                          | 30.49 | 29.61 | 23.87 | 22.23                | 36.66                          | 28.77 | 31.00 | 22.39 |
| 270                   | 21.10                | 37.59                          | 29.14 | 27.97 | 24.34 | 22.22                | 36.45                          | 27.20 | 28.89 | 22.30 |
| 275                   | 20.87                | 37.51                          | 27.82 | 27.01 | 25.11 | 22.16                | 36.23                          | 25.65 | 27.29 | 22.56 |





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## Typical Performance Data

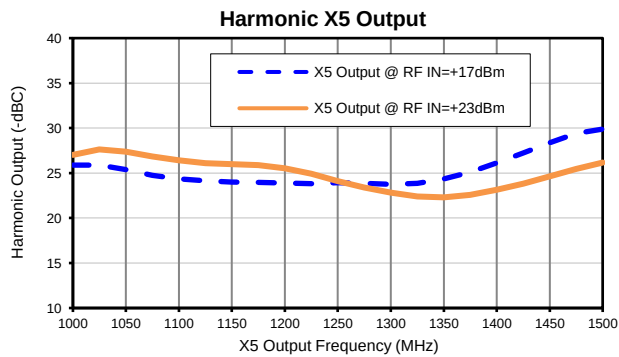
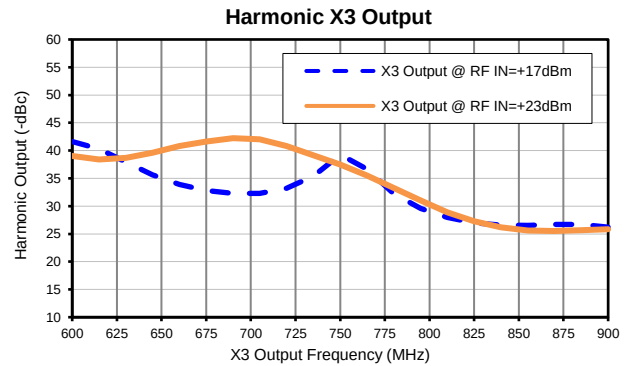
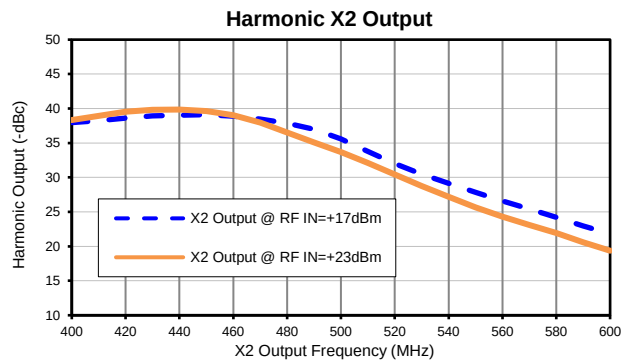
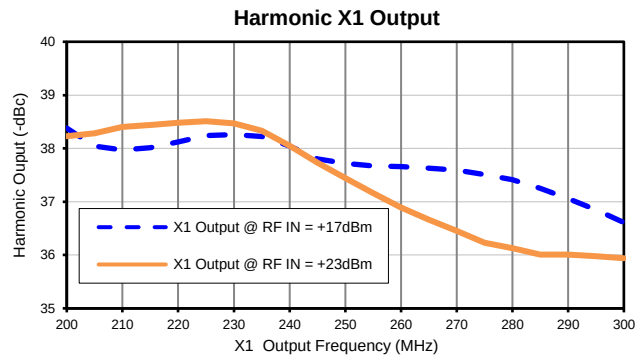
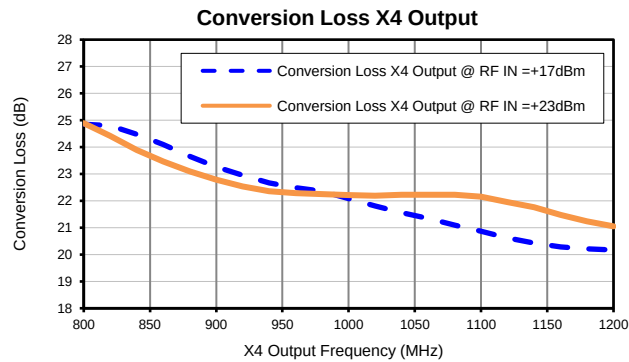
| FREQUENCY (MHz) |              |              |              |              | CONVERSION<br>LOSS<br>(dB) | RF IN = +17 dBm            |              |              |              |
|-----------------|--------------|--------------|--------------|--------------|----------------------------|----------------------------|--------------|--------------|--------------|
|                 |              |              |              |              |                            | HARMONIC OUTPUT*<br>(-dBc) |              |              |              |
| X1<br>OUTPUT    | X2<br>OUTPUT | X3<br>OUTPUT | X4<br>OUTPUT | X5<br>OUTPUT | X4 OUTPUT                  | X1<br>OUTPUT               | X2<br>OUTPUT | X3<br>OUTPUT | X5<br>OUTPUT |
| 200             | 400          | 600          | 800          | 1000         | 24.85                      | 38.38                      | 37.98        | 41.62        | 25.90        |
| 205             | 410          | 615          | 820          | 1025         | 24.80                      | 38.04                      | 38.23        | 40.30        | 25.87        |
| 210             | 420          | 630          | 840          | 1050         | 24.48                      | 37.97                      | 38.63        | 37.95        | 25.38        |
| 215             | 430          | 645          | 860          | 1075         | 24.09                      | 38.01                      | 38.93        | 35.62        | 24.76        |
| 220             | 440          | 660          | 880          | 1100         | 23.66                      | 38.12                      | 39.05        | 33.91        | 24.37        |
| 225             | 450          | 675          | 900          | 1125         | 23.26                      | 38.24                      | 39.11        | 32.83        | 24.15        |
| 230             | 460          | 690          | 920          | 1150         | 22.95                      | 38.26                      | 38.91        | 32.29        | 24.01        |
| 235             | 470          | 705          | 940          | 1175         | 22.67                      | 38.22                      | 38.49        | 32.29        | 23.95        |
| 240             | 480          | 720          | 960          | 1200         | 22.49                      | 38.04                      | 37.86        | 33.21        | 23.90        |
| 245             | 490          | 735          | 980          | 1225         | 22.36                      | 37.80                      | 36.99        | 35.39        | 23.82        |
| 250             | 500          | 750          | 1000         | 1250         | 22.08                      | 37.72                      | 35.60        | 39.28        | 23.93        |
| 255             | 510          | 765          | 1020         | 1275         | 21.81                      | 37.67                      | 33.79        | 36.64        | 23.85        |
| 260             | 520          | 780          | 1040         | 1300         | 21.56                      | 37.66                      | 32.01        | 32.25        | 23.75        |
| 265             | 530          | 795          | 1060         | 1325         | 21.34                      | 37.63                      | 30.49        | 29.61        | 23.87        |
| 270             | 540          | 810          | 1080         | 1350         | 21.10                      | 37.59                      | 29.14        | 27.97        | 24.34        |
| 275             | 550          | 825          | 1100         | 1375         | 20.87                      | 37.51                      | 27.82        | 27.01        | 25.11        |
| 280             | 560          | 840          | 1120         | 1400         | 20.62                      | 37.41                      | 26.57        | 26.60        | 26.14        |
| 285             | 570          | 855          | 1140         | 1425         | 20.43                      | 37.25                      | 25.42        | 26.55        | 27.25        |
| 290             | 580          | 870          | 1160         | 1450         | 20.29                      | 37.06                      | 24.21        | 26.72        | 28.37        |
| 295             | 590          | 885          | 1180         | 1475         | 20.21                      | 36.85                      | 22.96        | 26.68        | 29.42        |
| 300             | 600          | 900          | 1200         | 1500         | 20.17                      | 36.61                      | 21.83        | 26.21        | 29.89        |

\* Harmonic Output below power level of X4 Output.

| FREQUENCY (MHz)  |              |              |              |              | CONVERSION<br>LOSS | RF IN = +23 dBm |              |              |              |
|------------------|--------------|--------------|--------------|--------------|--------------------|-----------------|--------------|--------------|--------------|
| HARMONIC OUTPUT* |              |              |              |              |                    |                 |              |              |              |
| X1<br>OUTPUT     | X2<br>OUTPUT | X3<br>OUTPUT | X4<br>OUTPUT | X5<br>OUTPUT | X4 OUTPUT          | X1<br>OUTPUT    | X2<br>OUTPUT | X3<br>OUTPUT | X5<br>OUTPUT |
| 200              | 400          | 600          | 800          | 1000         | 24.89              | 38.23           | 38.34        | 39.01        | 27.01        |
| 205              | 410          | 615          | 820          | 1025         | 24.42              | 38.28           | 38.93        | 38.41        | 27.63        |
| 210              | 420          | 630          | 840          | 1050         | 23.89              | 38.40           | 39.56        | 38.71        | 27.38        |
| 215              | 430          | 645          | 860          | 1075         | 23.46              | 38.44           | 39.82        | 39.62        | 26.86        |
| 220              | 440          | 660          | 880          | 1100         | 23.10              | 38.48           | 39.85        | 40.80        | 26.43        |
| 225              | 450          | 675          | 900          | 1125         | 22.78              | 38.51           | 39.61        | 41.62        | 26.10        |
| 230              | 460          | 690          | 920          | 1150         | 22.53              | 38.47           | 39.04        | 42.23        | 25.98        |
| 235              | 470          | 705          | 940          | 1175         | 22.36              | 38.33           | 37.96        | 42.00        | 25.90        |
| 240              | 480          | 720          | 960          | 1200         | 22.29              | 38.05           | 36.51        | 40.82        | 25.54        |
| 245              | 490          | 735          | 980          | 1225         | 22.25              | 37.73           | 35.09        | 39.16        | 24.92        |
| 250              | 500          | 750          | 1000         | 1250         | 22.21              | 37.44           | 33.68        | 37.50        | 24.11        |
| 255              | 510          | 765          | 1020         | 1275         | 22.19              | 37.16           | 32.13        | 35.50        | 23.40        |
| 260              | 520          | 780          | 1040         | 1300         | 22.22              | 36.89           | 30.42        | 33.27        | 22.81        |
| 265              | 530          | 795          | 1060         | 1325         | 22.23              | 36.66           | 28.77        | 31.00        | 22.39        |
| 270              | 540          | 810          | 1080         | 1350         | 22.22              | 36.45           | 27.20        | 28.89        | 22.30        |
| 275              | 550          | 825          | 1100         | 1375         | 22.16              | 36.23           | 25.65        | 27.29        | 22.56        |
| 280              | 560          | 840          | 1120         | 1400         | 21.95              | 36.13           | 24.32        | 26.19        | 23.14        |
| 285              | 570          | 855          | 1140         | 1425         | 21.76              | 36.01           | 23.10        | 25.62        | 23.82        |
| 290              | 580          | 870          | 1160         | 1450         | 21.47              | 36.01           | 21.92        | 25.52        | 24.63        |
| 295              | 590          | 885          | 1180         | 1475         | 21.24              | 35.98           | 20.60        | 25.67        | 25.46        |
| 300              | 600          | 900          | 1200         | 1500         | 21.05              | 35.94           | 19.37        | 25.86        | 26.17        |

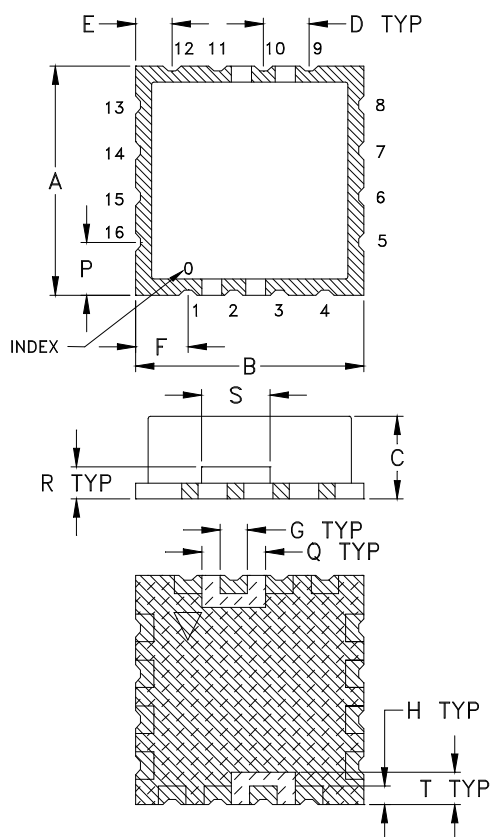
\* Harmonic Output below power level of X4 Output.

## Typical Performance Curves

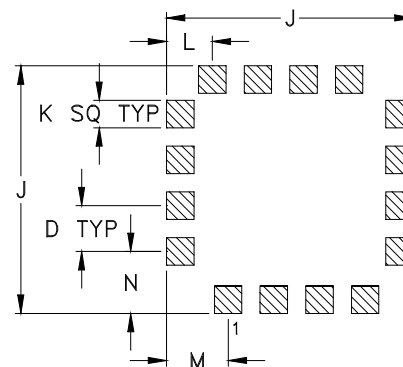


CK1246

## Outline Dimensions



## PCB Land Pattern



Suggested Layout,  
Tolerance to be within  $\pm .002$

| CASE # | A               | B               | C              | D              | E              | F              | G              | H              | J               | K              |
|--------|-----------------|-----------------|----------------|----------------|----------------|----------------|----------------|----------------|-----------------|----------------|
| CK1246 | .500<br>(12.70) | .500<br>(12.70) | .180<br>(4.57) | .100<br>(2.54) | .080<br>(2.03) | .115<br>(2.92) | .060<br>(1.52) | .040<br>(1.02) | .540<br>(13.72) | .060<br>(1.52) |

| CASE # | L              | M              | N              | P              | Q              | R              | S              | T              | WT. GRAM |
|--------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------|
| CK1246 | .100<br>(2.54) | .135<br>(3.43) | .135<br>(3.43) | .115<br>(2.92) | .140<br>(3.56) | .070<br>(1.78) | .150<br>(3.81) | .070<br>(1.78) | 1.0      |

Dimensions are in inches (mm). Tolerances: 2 Pl.  $\pm .03$ ; 3Pl.  $\pm .015$

### Notes:

- Case material: Nickel-Silver alloy.
- Base: Printed wiring laminate.
- Termination finish:  
For RoHS Case Styles: 3-5  $\mu$  inch (.08-.13 microns) Gold over 120-240  $\mu$  inch (3.05-6.10 microns) Nickel plate.  
All models, (+) suffix.

**Mini-Circuits®**  
ISO 9001 ISO 14001 CERTIFIED

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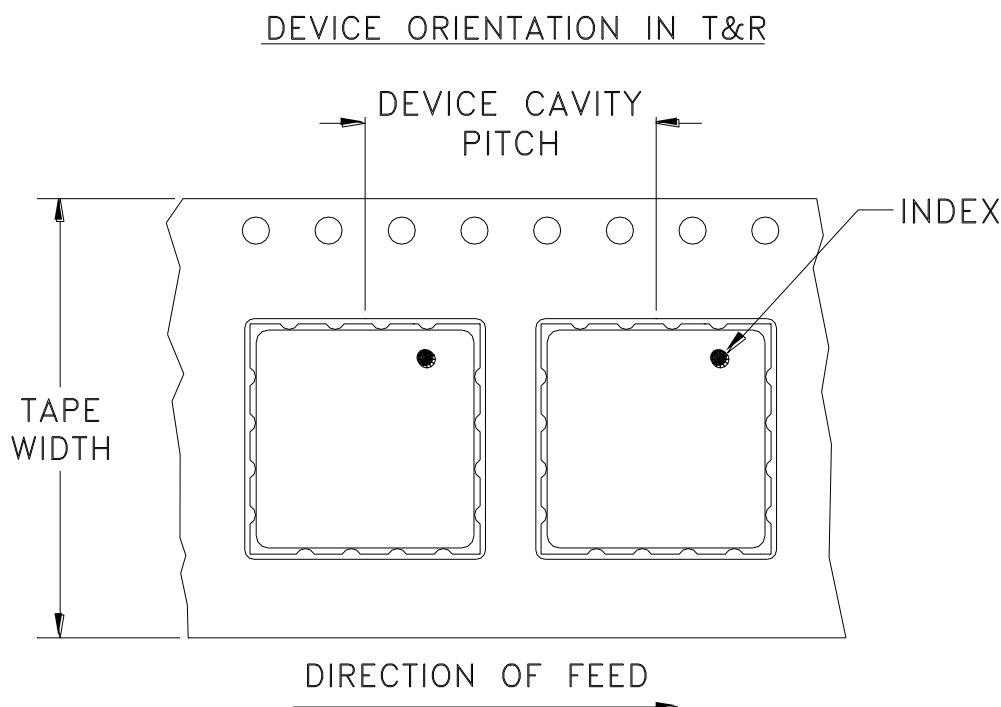
P.O. Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718) 332-4661 For detailed performance specs & shopping online see Mini-Circuits web site



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

RF/IF MICROWAVE COMPONENTS

# Tape & Reel Packaging TR-F37



| Tape Width,<br>mm | Device Cavity<br>Pitch, mm | Reel Size,<br>inches | Devices per Reel                             |     |
|-------------------|----------------------------|----------------------|----------------------------------------------|-----|
| 24                | 16                         | 7                    | Small<br>quantity<br>standards<br>(see note) | 10  |
|                   |                            |                      |                                              | 20  |
|                   |                            |                      |                                              | 50  |
|                   |                            |                      |                                              | 100 |
|                   |                            | 13                   | Standard                                     | 200 |
|                   |                            |                      |                                              | 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)



INTERNET <http://www.minicircuits.com>

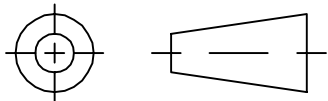
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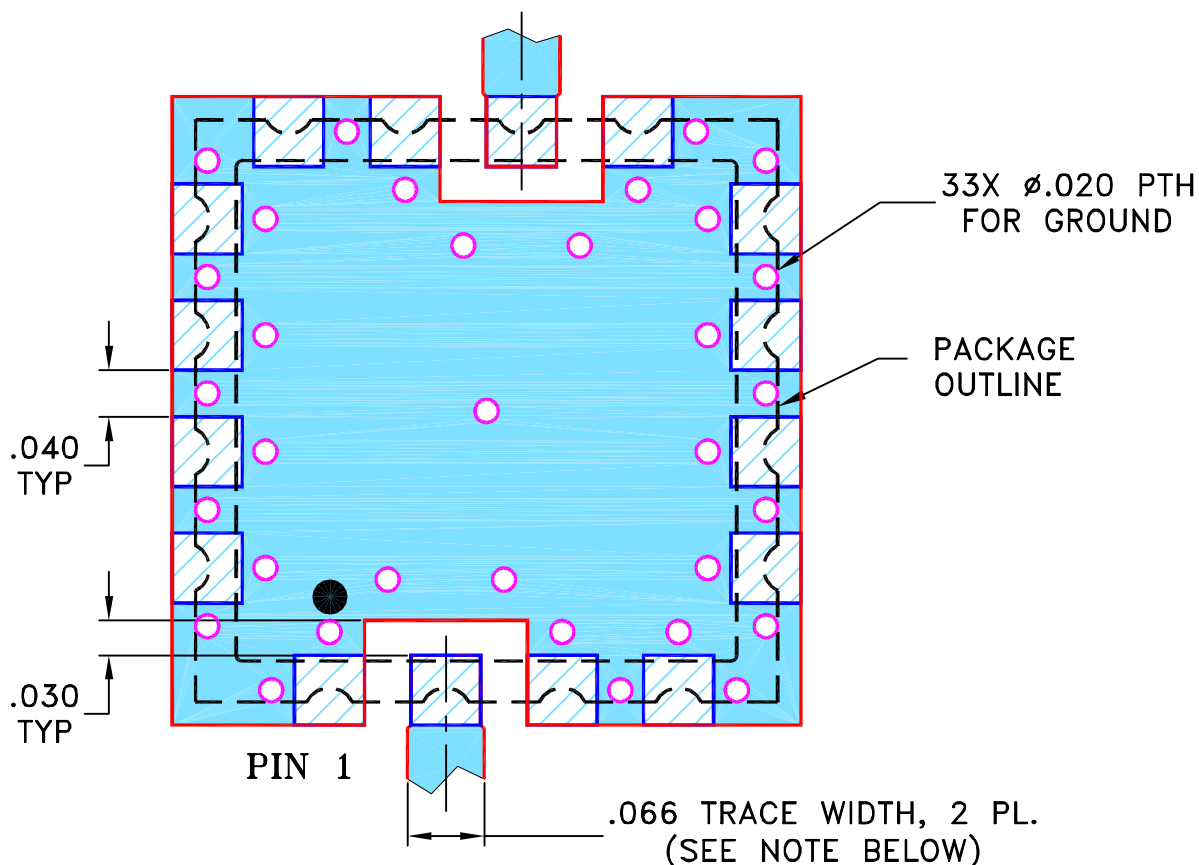
## THIRD ANGLE PROJECTION



## REVISIONS

| REV OR | ECN No. | DESCRIPTION | DATE     | DR | AUTH |
|--------|---------|-------------|----------|----|------|
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|        |         |             |          |    |      |
|        |         |             |          |    |      |

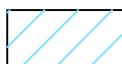
### SUGGESTED MOUNTING CONFIGURATION FOR CK1246 CASE STYLE, "rz" PIN CONNECTION



- 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

TOLERANCES ON:

2 PL DECIMALS  $\pm$ 3 PL DECIMALS  $\pm$  .005ANGLES  $\pm$ FRACTIONS  $\pm$ 

DRAWN

PW

01/19/07

CHECKED

IL

01/24/07

APPROVED

DJ

01/24/07

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



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13 Neptune Avenue  
Brooklyn NY 11235

PL, rz, CK1246, RKK, TB-435+

SIZE  
ACODE IDENT  
15542DRAWING NO:  
98-PL-267REV:  
OR

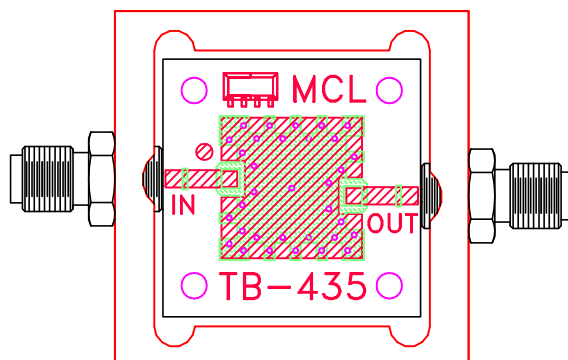
FILE: 98PL267

SCALE: 6:1

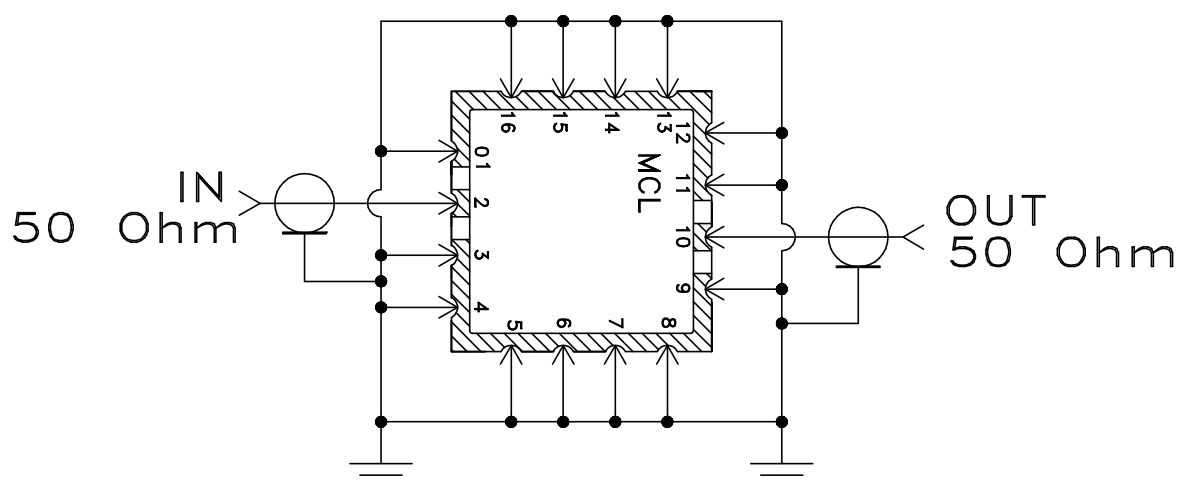
SHEET: 1 OF 1



# Evaluation Board and Circuit



TB-435+



Schematic Diagram

## Notes:

1. 50 Ohm 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                                                                          |
| HAST                           | 130°C, 85% RH, 96 hours                                                                                                                                         | JESD22-A110                                                                                          |
| 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 Eutectic Process: 225°C peak<br>Pb-Free Process, 245°C peak                                                                                               | J-STD-020, Table 4-1, 4-2 and 5-2, Figure 5-1                                                        |
| Solderability                  | 10X Magnification                                                                                                                                               | J-STD-002, Para 4.2.5, Test S, 95% Coverage                                                          |
| Vibration (High Frequency)     | 20g peak, 20-2000 Hz, 4 times in each of three axes (total 12)                                                                                                  | MIL-STD-883, Method 2007.3, Condition A                                                              |
| 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                                                                              |