

+12 to +33 dBm

# Limiter

50Ω Broadband 0.2 to 3000 MHz

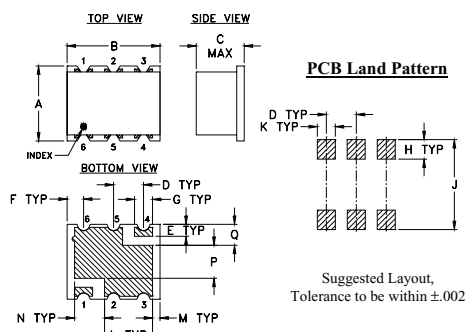
## Maximum Ratings

|                                                                 |                |
|-----------------------------------------------------------------|----------------|
| Operating Temperature                                           | -40°C to 85°C  |
| Storage Temperature                                             | -55°C to 100°C |
| RF Input Power                                                  | 2.5W           |
| Permanent damage may occur if any of these limits are exceeded. |                |

## Pin Connections

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

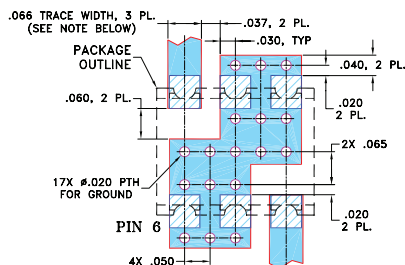
## Outline Drawing



## Outline Dimensions (inch/mm)

|      |      |      |      |      |      |      |       |
|------|------|------|------|------|------|------|-------|
| A    | B    | C    | D    | E    | F    | G    | H     |
| .25  | .31  | .16  | .100 | .040 | .055 | .060 | .065  |
| 6.35 | 7.87 | 4.06 | 2.54 | 1.02 | 1.40 | 1.52 | 1.65  |
| J    | K    | L    | M    | N    | P    | Q    | wt.   |
| .300 | .060 | .160 | .025 | .100 | .110 | .070 | grams |
| 7.62 | 1.52 | 4.06 | 0.64 | 2.54 | 2.79 | 1.78 | 0.16  |

## Demo Board MCL P/N: TB-393 Suggested PCB Layout (PL-258)



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

### Notes

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## Features

- wideband, 0.2 to 3000 MHz
- low insertion loss 0.25 dB typ.
- good recovery time, 22.5nsec typ.
- excellent VSWR 1.33:1 typ.
- low output power, 13 dBm typ.

## Applications

- military, hi-rel applications
- stabilizing generator outputs
- reducing amplitude variations
- protects low noise amplifiers and other devices from ESD or input power damage

RLM-33-2W+



Generic photo used for illustration purposes only

CASE STYLE: TT1224

+RoHS Compliant

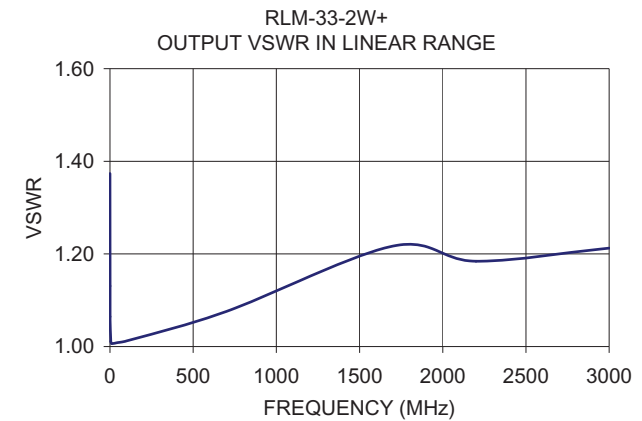
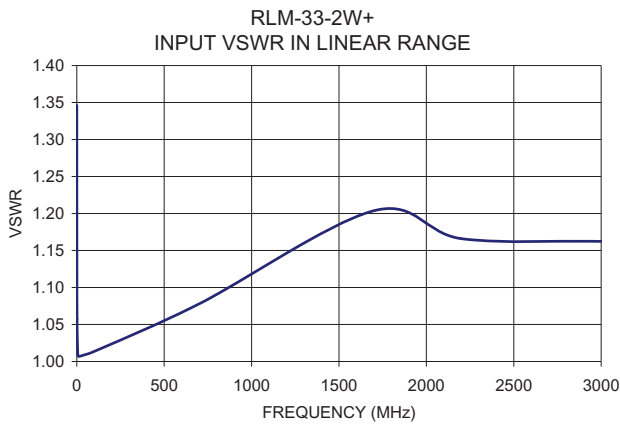
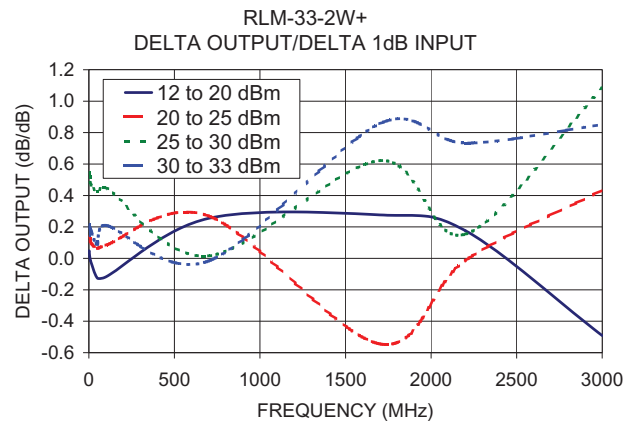
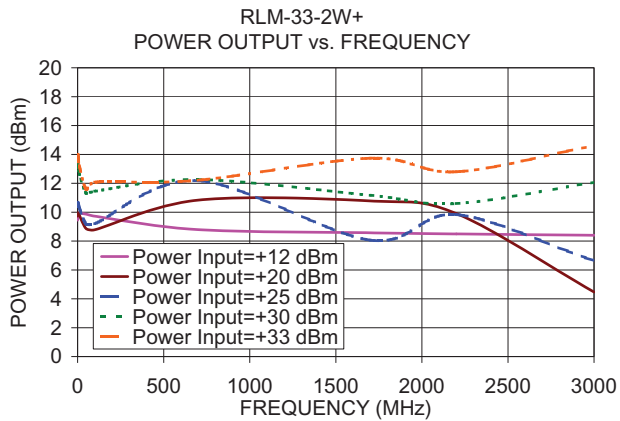
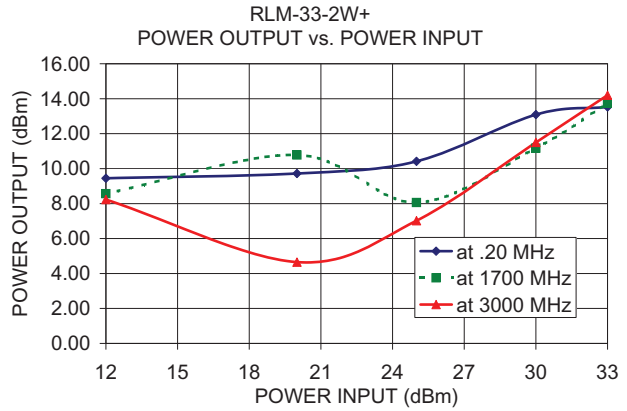
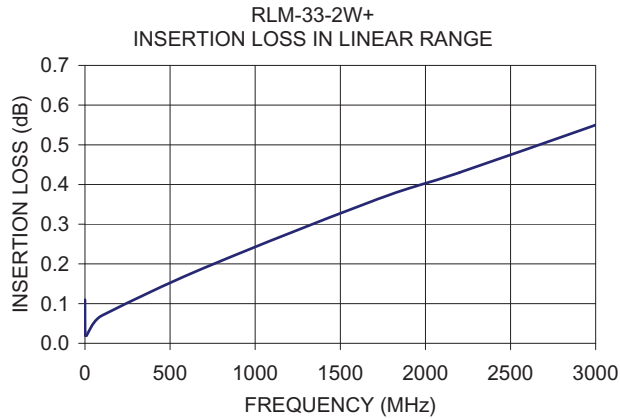
The +Suffix identifies RoHS Compliance. See our web site for RoHS Compliance methodologies and qualifications

## Electrical Specifications

| Parameter                           | Condition                                                                                   | Min. | Typ. | Max. | Units |
|-------------------------------------|---------------------------------------------------------------------------------------------|------|------|------|-------|
| Frequency Range                     |                                                                                             | 0.2  |      | 3000 | MHz   |
| <b>Linear Range</b>                 |                                                                                             |      |      |      |       |
| Max Input Power                     | less than 1 dB compression                                                                  | —    | —    | 5    | dBm   |
| Insertion Loss                      | less than -10 dBm input power                                                               | —    | 0.25 | 0.9  | dB    |
| VSWR                                | less than -10 dBm input power                                                               | —    | 1.33 | 1.5  | :1    |
| <b>Limiting Range</b>               |                                                                                             |      |      |      |       |
| Input Power                         | >1dB compression filtered signal frequency                                                  | +12  | —    | +33  | dBm   |
| Output Power                        |                                                                                             | —    | +13  | —    | dBm   |
| $\Delta$ Output/ $\Delta$ 1dB Input | Input Power Range (dBm)                                                                     |      |      |      |       |
|                                     | 12 to 20                                                                                    | —    | 0.3  | —    |       |
|                                     | 20 to 25                                                                                    | —    | 0.1  | —    | dB/dB |
|                                     | 25 to 30                                                                                    | —    | 0.1  | —    |       |
|                                     | 30 to 33                                                                                    | —    | 0.2  | —    |       |
| Recovery Time                       | 1 watt pulse 50 $\mu$ sec pw 1kHz duty cycle recovery to within 90% of final value @ 33 dBm | —    | 22.5 | —    | nsec  |
| Response Time                       | 33 dBm input 50 $\mu$ sec PW 1 kHz duty cycle                                               | —    | 5.6  | —    | nsec  |

## Typical Performance Data

| Freq.<br>(MHz) | I. Loss (dB)<br>in Linear<br>Range<br>at -10 dBm | VSWR (:1)<br>in Linear<br>Range<br>at -10 dBm | Power Output<br>(dBm) |                  |                  |                  |                 | Δ Output / Δ 1dB Input     |                            |                            |                            |
|----------------|--------------------------------------------------|-----------------------------------------------|-----------------------|------------------|------------------|------------------|-----------------|----------------------------|----------------------------|----------------------------|----------------------------|
|                |                                                  |                                               | +12 dBm<br>Input      | +20 dBm<br>Input | +25 dBm<br>Input | +30 dBm<br>Input | +33dBm<br>Input | +12 to<br>+20 dBm<br>Input | +20 to<br>+25 dBm<br>Input | +25 to<br>+30 dBm<br>Input | +30 to<br>+33 dBm<br>Input |
| 0.20           | 0.11                                             | 1.35                                          | 9.45                  | 9.72             | 10.42            | 13.09            | 13.53           | 0.03                       | 0.14                       | 0.53                       | 0.15                       |
| 0.50           | 0.03                                             | 1.12                                          | 9.55                  | 9.91             | 10.60            | 13.33            | 13.94           | 0.04                       | 0.14                       | 0.55                       | 0.20                       |
| 1.00           | 0.02                                             | 1.06                                          | 9.57                  | 9.95             | 10.64            | 13.36            | 14.00           | 0.05                       | 0.14                       | 0.54                       | 0.21                       |
| 5.00           | 0.02                                             | 1.01                                          | 9.86                  | 9.93             | 10.56            | 13.15            | 13.74           | 0.01                       | 0.13                       | 0.52                       | 0.20                       |
| 10.00          | 0.02                                             | 1.01                                          | 9.93                  | 9.80             | 10.30            | 12.66            | 13.21           | -0.02                      | 0.10                       | 0.47                       | 0.18                       |
| 50.00          | 0.05                                             | 1.01                                          | 9.86                  | 8.85             | 9.17             | 11.30            | 11.57           | -0.13                      | 0.06                       | 0.43                       | 0.09                       |
| 100.00         | 0.07                                             | 1.01                                          | 9.72                  | 8.78             | 9.20             | 11.45            | 12.08           | -0.12                      | 0.08                       | 0.45                       | 0.21                       |
| 700.00         | 0.19                                             | 1.08                                          | 8.79                  | 10.83            | 12.18            | 12.26            | 12.21           | 0.26                       | 0.27                       | 0.02                       | -0.02                      |
| 1700.00        | 0.36                                             | 1.20                                          | 8.57                  | 10.78            | 8.06             | 11.17            | 13.74           | 0.28                       | -0.54                      | 0.62                       | 0.86                       |
| 2200.00        | 0.43                                             | 1.17                                          | 8.49                  | 9.90             | 9.83             | 10.60            | 12.80           | 0.18                       | -0.01                      | 0.15                       | 0.73                       |
| 3000.00        | 0.55                                             | 1.16                                          | 8.40                  | 4.47             | 6.64             | 12.06            | 14.61           | -0.49                      | 0.43                       | 1.08                       | 0.85                       |



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# Surface Mount Limiter

RLM-33-2W+

## Typical Performance Data

| FREQUENCY | LOW INPUT POWER |       |        | POWER OUTPUT (dBm) |                  |                  |                  |                  | DELTA OUTPUT/1dB DELTA INPUT (dB/dB) |                         |                         |                         |
|-----------|-----------------|-------|--------|--------------------|------------------|------------------|------------------|------------------|--------------------------------------|-------------------------|-------------------------|-------------------------|
|           | INSERTION LOSS  | VSWR  |        |                    |                  |                  |                  |                  |                                      |                         |                         |                         |
| (MHz)     | (dB)            | Input | Output | +12 dBm<br>INPUT   | +20 dBm<br>INPUT | +25 dBm<br>INPUT | +30 dBm<br>INPUT | +33 dBm<br>INPUT | +12 to +20 dBm<br>INPUT              | +20 to +25 dBm<br>INPUT | +25 to +30 dBm<br>INPUT | +30 to +33 dBm<br>INPUT |
|           |                 | (:1)  |        |                    |                  |                  |                  |                  |                                      |                         |                         |                         |
| 0.2       | 0.11            | 1.35  | 1.37   | 9.45               | 9.72             | 10.42            | 13.09            | 13.53            | 0.03                                 | 0.14                    | 0.53                    | 0.15                    |
| 0.5       | 0.03            | 1.12  | 1.13   | 9.55               | 9.91             | 10.60            | 13.33            | 13.94            | 0.04                                 | 0.14                    | 0.55                    | 0.20                    |
| 1.0       | 0.02            | 1.06  | 1.06   | 9.57               | 9.95             | 10.64            | 13.36            | 14.00            | 0.05                                 | 0.14                    | 0.54                    | 0.21                    |
| 5.0       | 0.02            | 1.01  | 1.01   | 9.86               | 9.93             | 10.56            | 13.15            | 13.74            | 0.01                                 | 0.13                    | 0.52                    | 0.20                    |
| 10.0      | 0.02            | 1.01  | 1.01   | 9.93               | 9.80             | 10.30            | 12.66            | 13.21            | -0.02                                | 0.10                    | 0.47                    | 0.18                    |
| 50.0      | 0.05            | 1.01  | 1.01   | 9.86               | 8.85             | 9.17             | 11.30            | 11.57            | -0.13                                | 0.06                    | 0.43                    | 0.09                    |
| 100.0     | 0.07            | 1.01  | 1.01   | 9.72               | 8.78             | 9.20             | 11.45            | 12.08            | -0.12                                | 0.08                    | 0.45                    | 0.21                    |
| 700.0     | 0.19            | 1.08  | 1.08   | 8.79               | 10.83            | 12.18            | 12.26            | 12.21            | 0.26                                 | 0.27                    | 0.02                    | -0.02                   |
| 1700.0    | 0.36            | 1.20  | 1.22   | 8.57               | 10.78            | 8.06             | 11.17            | 13.74            | 0.28                                 | -0.54                   | 0.62                    | 0.86                    |
| 2200.0    | 0.43            | 1.17  | 1.18   | 8.49               | 9.90             | 9.83             | 10.60            | 12.80            | 0.18                                 | -0.01                   | 0.15                    | 0.73                    |
| 3000.0    | 0.55            | 1.16  | 1.21   | 8.40               | 4.47             | 6.64             | 12.06            | 14.61            | -0.49                                | 0.43                    | 1.08                    | 0.85                    |



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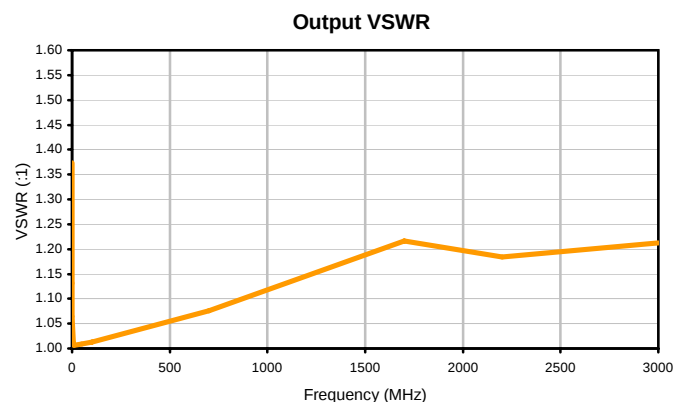
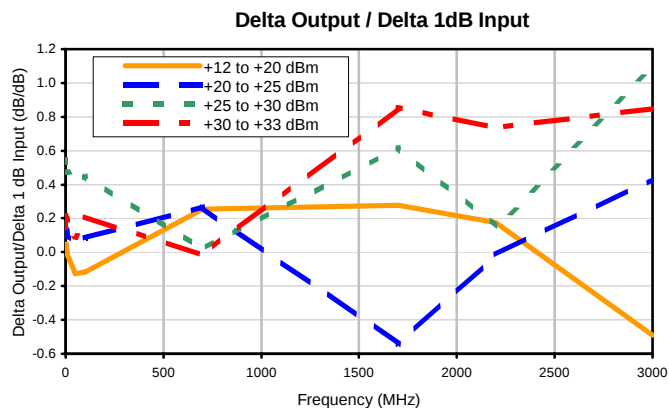
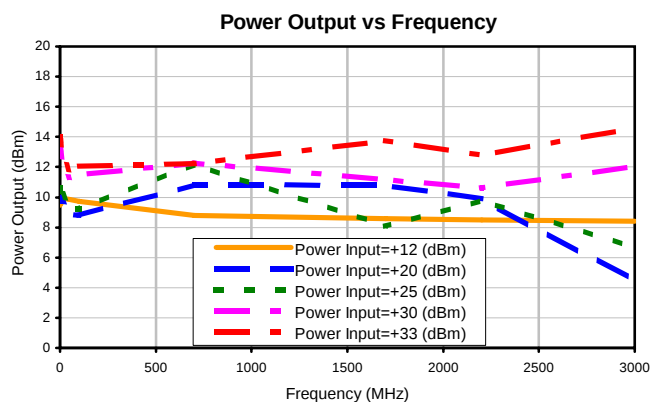
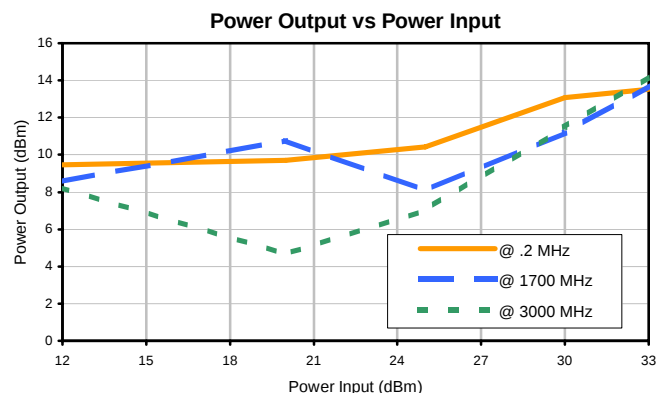
IF/RF MICROWAVE COMPONENTS

REV. OR  
RLM-33-2W+  
8/28/2012  
Page 1 of 2

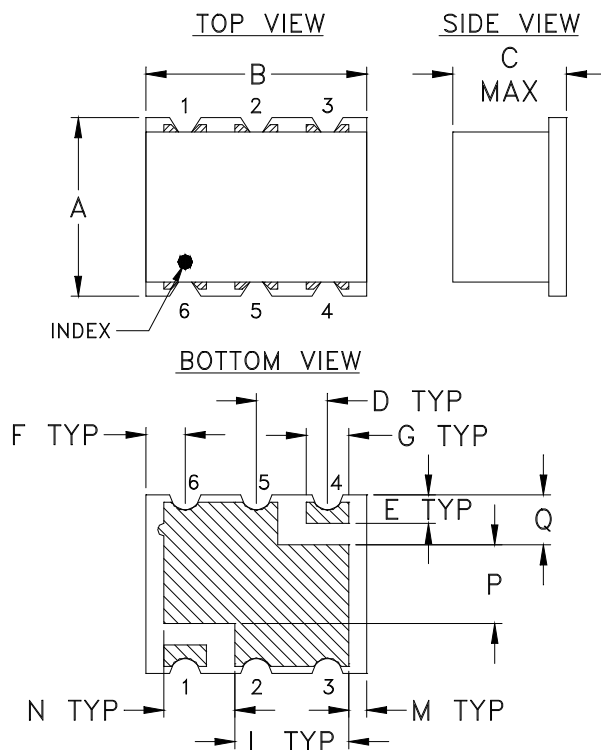
## Typical Performance Data

| POWER INPUT | POWER OUTPUT | POWER INPUT | POWER OUTPUT | POWER INPUT | POWER OUTPUT |
|-------------|--------------|-------------|--------------|-------------|--------------|
| @ .2 MHz    |              | @ 1700 MHz  |              | @ 3000 MHz  |              |
| (dBm)       |              | (dBm)       |              | (dBm)       |              |
| 12          | 9.45         | 12          | 8.57         | 12          | 8.23         |
| 20          | 9.72         | 20          | 10.78        | 20          | 4.65         |
| 25          | 10.42        | 25          | 8.06         | 25          | 7.02         |
| 30          | 13.09        | 30          | 11.17        | 30          | 11.50        |
| 33          | 13.53        | 33          | 13.74        | 33          | 14.20        |

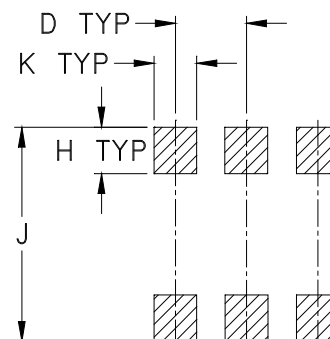
## Typical Performance Curves



## 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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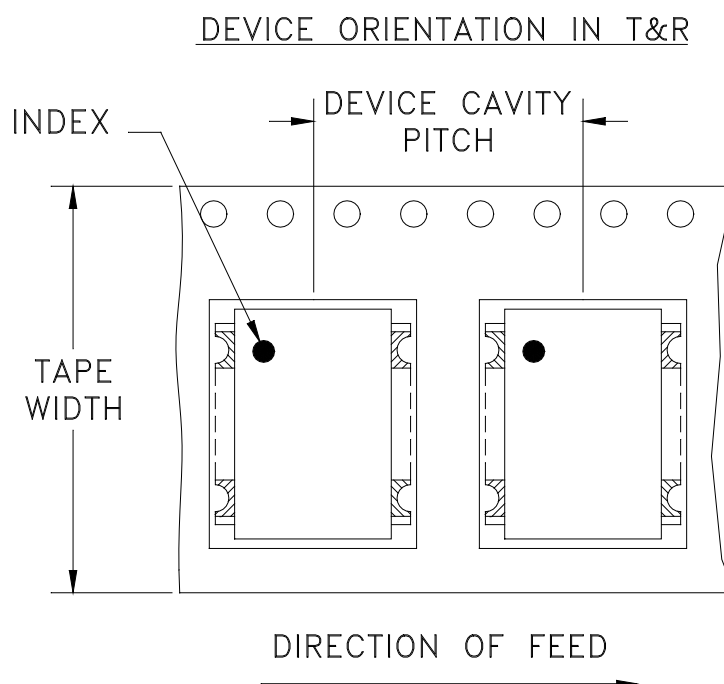


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RF/IF MICROWAVE COMPONENTS



# 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                         |

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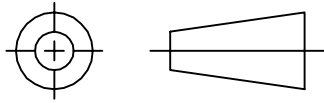
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## THIRD ANGLE PROJECTION

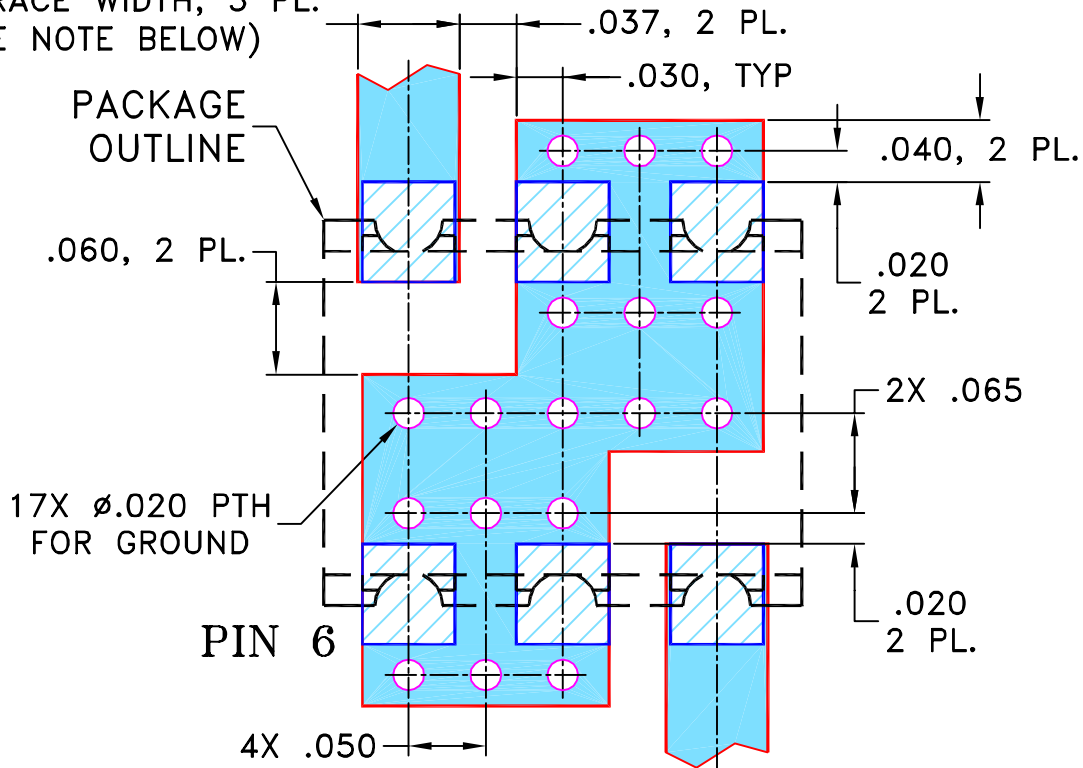


## REVISIONS

| 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

12/14/08

TOLERANCES ON:

CHECKED

IL

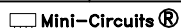
01/04/07

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®

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

SIZE  
A

CODE IDENT  
15542

DRAWING NO:  
98-PL-258

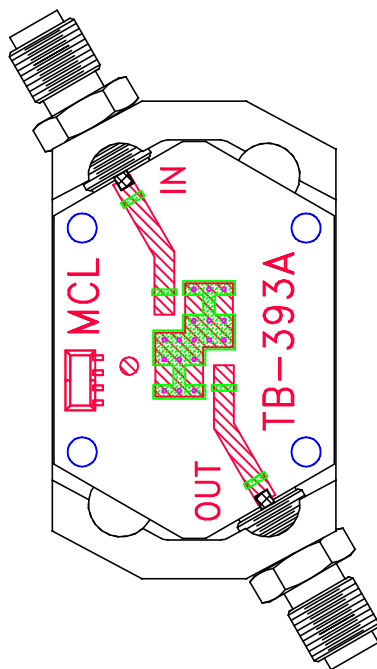
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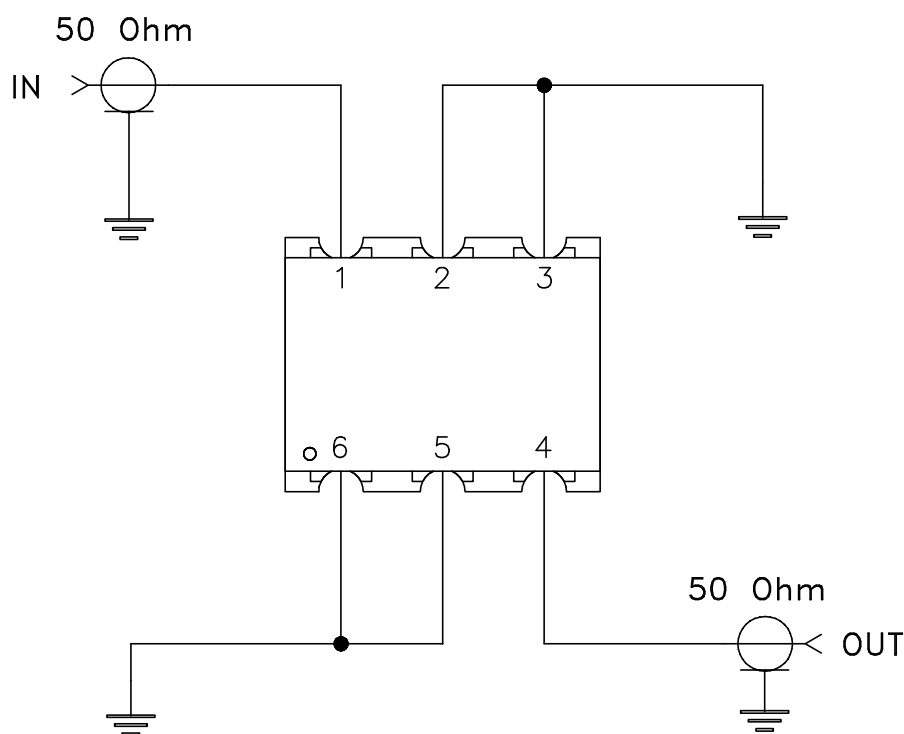
SCALE: 8:1

SHEET: 1 OF 1

# Evaluation Board and Circuit



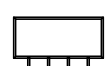
TB-393



Schematic Diagram

## Notes:

1. SMA Female connectors.
2. PCB Material: Rogers R04350 or equivalent,  
Dielectric Constant=3.5, Thickness=.030 inch.

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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                                                                              |