



# SURFACE MOUNT <sup>top hat</sup> RF Transformer

## TC1-1T-75X+

75Ω 5 to 120 MHz

### THE BIG DEAL

- Supports DOCSIS® 3.1 upstream bandwidth
- Low insertion loss, 0.2 dB
- Good return loss, 28 dB
- Low amplitude / phase unbalance, 0.2 dB / 2°
- Small size, 0.15 x 0.15 x 0.16"



Generic photo used for illustration purposes only

CASE STYLE: AT1521

### APPLICATIONS

- Impedance matching
- Unbalance to balance transformation
- Cable/CATV and broadband fiber networks

#### +RoHS Compliant

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

### PRODUCT OVERVIEW

TC1-1T-75X+ is a 75Ω surface-mount, DC-isolated transformer with a secondary center tap, covering the 5 to 120 MHz band, supporting upstream bandwidth requirements for DOCSIS® 3.1 systems and equipment. This model provides a 1:1 secondary/primary impedance ratio and is capable of handling up to 0.25W RF input power. It provides 0.2 dB insertion loss, 28 dB return loss, 0.2 dB amplitude unbalance and 2° phase unbalance. Featuring core and wire construction mounted on a 5-lead plastic base with tin over nickel termination finish, the unit measures 0.15 x 0.15 x 0.16" to accommodate dense circuit board layouts. It also incorporates Mini-Circuits' Top Hat® feature for faster, more accurate pick-and-place assembly.

### KEY FEATURES

| Feature  | Advantages   |
|--|--|
| Supports DOCSIS® 3.1 upstream bandwidth requirements   | This model is optimized for use over the upstream bandwidth for CATV and broadband fiber networks including DOCSIS® 3.1 systems. |
| Low insertion loss, 0.2 dB   | Provides excellent transmission of signal power from input to output.  |
| Good return loss, 28 dB  | Provides excellent matching for 75Ω systems.   |
| Low unbalance: <ul style="list-style-type: none"> <li>• 0.2dB amplitude unbalance</li> <li>• 2° phase unbalance</li> </ul> | Low unbalance improves a system's electromagnetic compatibility by rejecting unwanted common-mode noise.                         |
| DC isolation   | Provides DC isolation between circuits and efficient AC transmission, eliminating the need for external DC biasing components.   |
| Secondary center tap   | Allows DC feed up to 30 mA and DC bias without adding bias tees into the signal chain.   |
| Small footprint (0.15 x 0.15 x 0.16")  | Accommodates tight space requirements for dense PCB layouts.   |
| Top Hat® feature   | Improves speed and accuracy of pick and place assembly and provides clear device marking for visual inspection.                  |



# SURFACE MOUNT <sup>top hat</sup> RF Transformer

## TC1-1T-75X+

75Ω 5 to 120 MHz

### ELECTRICAL SPECIFICATIONS AT +25°C

| Parameter           | Frequency (MHz) | Min. | Typ. | Max. | Unit   |
|---------------------|-----------------|------|------|------|--------|
| Impedance Ratio     |                 |      | 1    |      | Ohm    |
| Frequency Range     |                 | 5    | —    | 120  | MHz    |
| Insertion Loss*     | 5 - 75          | —    | 0.1  | 0.4  | dB     |
|                     | 75 - 120        | —    | 0.3  | 0.6  |        |
| Amplitude Unbalance | 5 - 75          | —    | 0.1  | 0.2  | dB     |
|                     | 75 - 120        | —    | 0.2  | 0.3  |        |
| Phase Unbalance     | 5 - 75          | —    | 1    | 4    | Degree |
|                     | 75 - 120        | —    | 3    | 6    |        |
| Return Loss         | 5 - 20          | 25   | 30   | —    | dB     |
|                     | 20-75           | 23   | 28   | —    |        |
|                     | 75-120          | 20   | 25   | —    |        |

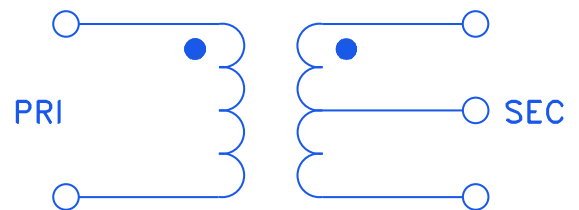
\*Insertion Loss is referenced to mid-band loss, 0.25 dB typ.

### MAXIMUM RATINGS

| Parameter             | Ratings        |
|-----------------------|----------------|
| Operating Temperature | -40°C to 85°C  |
| Storage Temperature   | -55°C to 100°C |
| RF Power              | 0.25W          |
| DC Current            | 30mA           |

Permanent damage may occur if any of these limits are exceeded.

### CONFIGURATION A



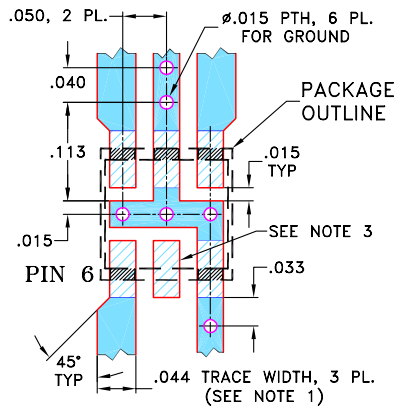


### PIN CONNECTIONS

|               |   |
|---------------|---|
| PRIMARY DOT   | 6 |
| PRIMARY       | 4 |
| SECONDARY DOT | 1 |
| SECONDARY     | 3 |
| SECONDARY CT  | 2 |

### PRODUCT MARKING: JD

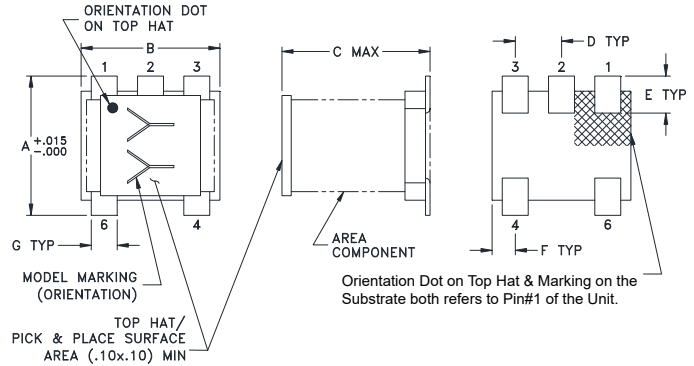
DEMO BOARD MCL P/N: TB-145  
SUGGESTED PCB LAYOUT: PL-244



1. TRACE WIDTH IS SHOWN FOR ROGERS R04350B WITH DIELECTRIC THICKNESS .020" ± .0015"; COPPER: 1/2 OZ. ON EACH SIDE. FOR OTHER MATERIALS TRACE WIDTH MAY NEED TO BE MODIFIED.
2. BOTTOM SIDE OF THE PCB IS CONTINUOUS GROUND PLANE.
3. THIS PAD IS NOT REQUIRED FOR AT224 CASE STYLE.

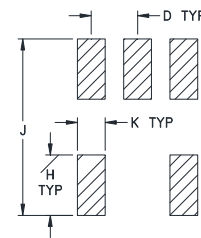
DENOTES PCB COPPER LAYOUT WITH SMOBC (SOLDER MASK OVER BARE COPPER)  
 DENOTES COPPER LAND PATTERN FREE OF SOLDER MASK

### OUTLINE DRAWING



Top-hat total thickness: .013 inches MAX.

### PCB Land Pattern



Suggested Layout,  
Tolerance to be within ±.002

### OUTLINE DIMENSIONS (Inch/mm)

| A    | B    | C    | D    | E    | F    | G    | H    | J    | K    |
|------|------|------|------|------|------|------|------|------|------|
| .150 | .150 | .160 | .050 | .040 | .025 | .028 | .065 | .190 | .030 |
| 3.81 | 3.81 | 4.06 | 1.27 | 1.02 | 0.64 | 0.71 | 1.65 | 4.83 | 0.76 |

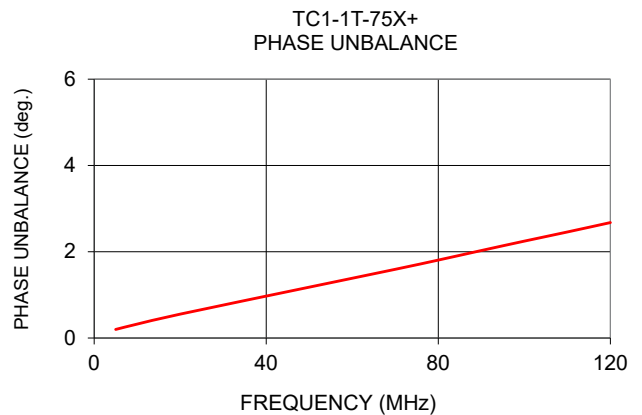
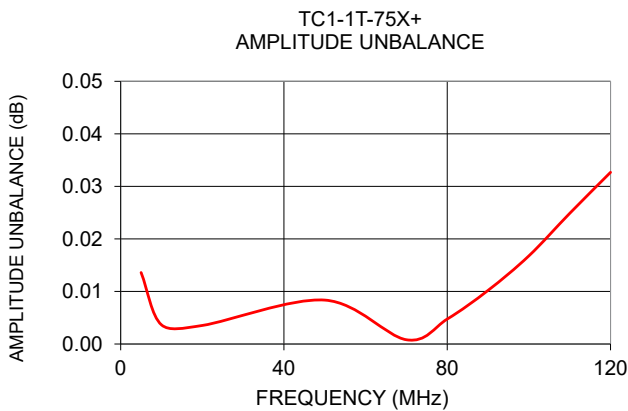
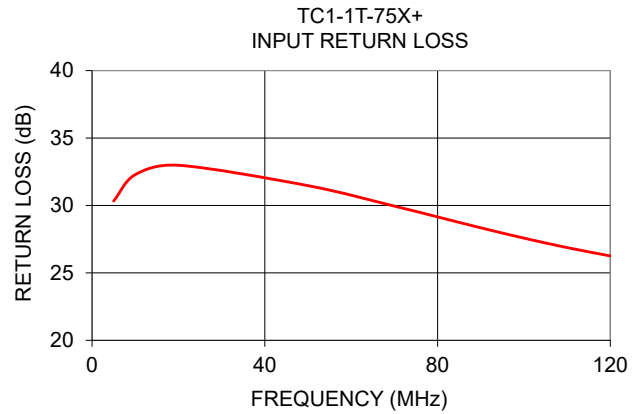
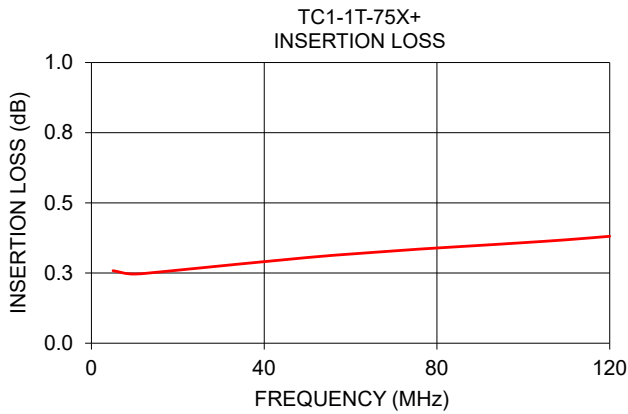
Weight: 0.15 grams

### TAPE & REEL INFORMATION: F17



### TYPICAL PERFORMANCE DATA AT +25°C

| FREQUENCY (MHz) | INSERTION LOSS (dB) | INPUT R. LOSS (dB) | AMPLITUDE UNBALANCE (dB) | PHASE UNBALANCE (Deg.) |
|-----------------|---------------------|--------------------|--------------------------|------------------------|
| 5.00            | 0.26                | 30.33              | 0.01                     | 0.20                   |
| 10.00           | 0.25                | 32.29              | 0.00                     | 0.32                   |
| 20.00           | 0.26                | 32.98              | 0.00                     | 0.55                   |
| 50.00           | 0.31                | 31.47              | 0.01                     | 1.18                   |
| 70.00           | 0.33                | 29.95              | 0.00                     | 1.59                   |
| 80.00           | 0.34                | 29.15              | 0.00                     | 1.81                   |
| 90.00           | 0.35                | 28.34              | 0.01                     | 2.03                   |
| 100.00          | 0.36                | 27.58              | 0.02                     | 2.25                   |
| 110.00          | 0.37                | 26.88              | 0.02                     | 2.46                   |
| 120.00          | 0.38                | 26.26              | 0.03                     | 2.68                   |



- 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/terms/viewterm.html](http://www.minicircuits.com/terms/viewterm.html)

# RF Transformer

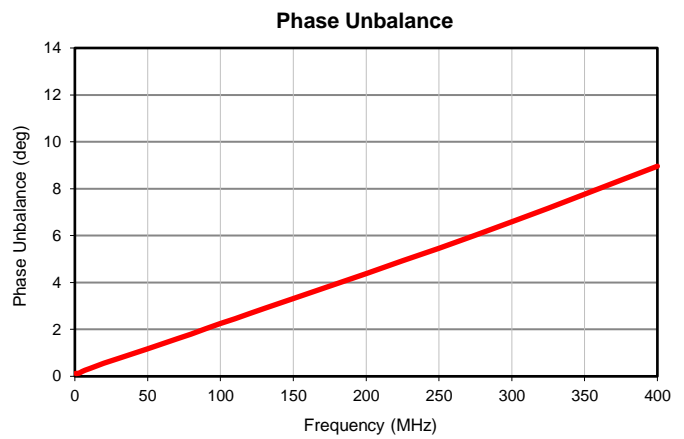
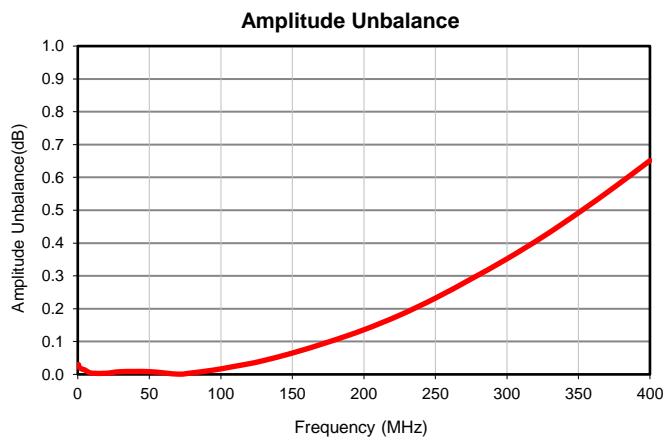
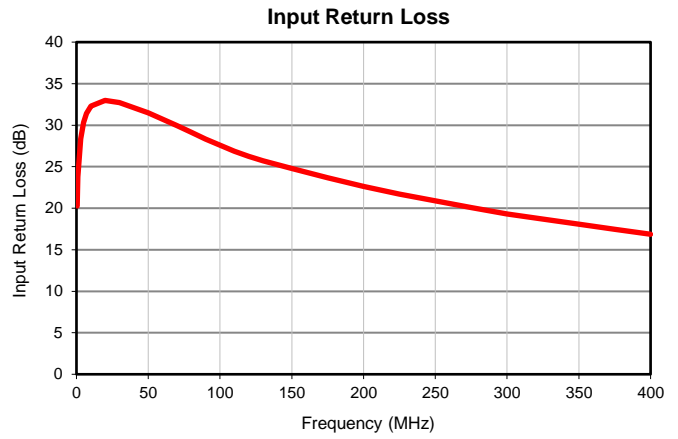
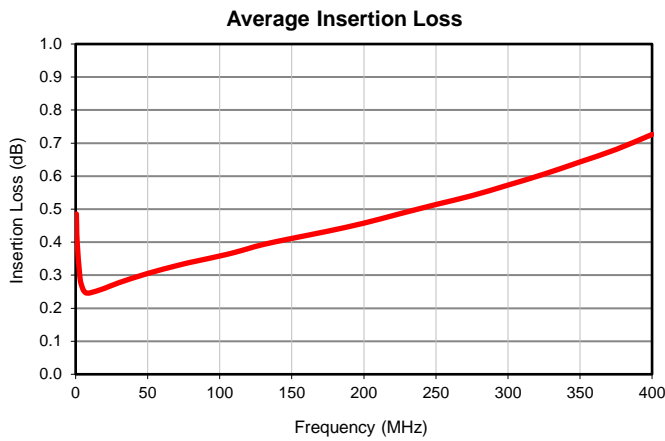
# TC1-1T-75X+

## Typical Performance Data

| FREQUENCY<br>(MHz) | AVERAGE<br>INSERTION LOSS<br>(dB) | INPUT<br>RETURN LOSS<br>(dB) | AMPLITUDE<br>UNBALANCE<br>(dB) | PHASE<br>UNBALANCE<br>(deg.) |
|--------------------|-----------------------------------|------------------------------|--------------------------------|------------------------------|
| 0.5                | 0.49                              | 20.27                        | 0.03                           | 0.13                         |
| 0.7                | 0.44                              | 22.09                        | 0.03                           | 0.13                         |
| 1.0                | 0.40                              | 23.78                        | 0.02                           | 0.12                         |
| 3.0                | 0.29                              | 28.36                        | 0.02                           | 0.14                         |
| 5.0                | 0.26                              | 30.33                        | 0.01                           | 0.20                         |
| 7.0                | 0.25                              | 31.41                        | 0.01                           | 0.26                         |
| 10                 | 0.25                              | 32.29                        | 0.00                           | 0.32                         |
| 20                 | 0.26                              | 32.98                        | 0.00                           | 0.55                         |
| 30                 | 0.28                              | 32.70                        | 0.01                           | 0.77                         |
| 50                 | 0.31                              | 31.47                        | 0.01                           | 1.18                         |
| 70                 | 0.33                              | 29.95                        | 0.00                           | 1.59                         |
| 80                 | 0.34                              | 29.15                        | 0.00                           | 1.81                         |
| 90                 | 0.35                              | 28.34                        | 0.01                           | 2.03                         |
| 100                | 0.36                              | 27.58                        | 0.02                           | 2.25                         |
| 110                | 0.37                              | 26.88                        | 0.02                           | 2.46                         |
| 120                | 0.38                              | 26.26                        | 0.03                           | 2.68                         |
| 130                | 0.39                              | 25.71                        | 0.04                           | 2.89                         |
| 150                | 0.41                              | 24.77                        | 0.06                           | 3.31                         |
| 175                | 0.43                              | 23.67                        | 0.10                           | 3.85                         |
| 200                | 0.46                              | 22.60                        | 0.14                           | 4.38                         |
| 225                | 0.49                              | 21.70                        | 0.18                           | 4.92                         |
| 250                | 0.51                              | 20.90                        | 0.23                           | 5.46                         |
| 275                | 0.54                              | 20.09                        | 0.29                           | 6.02                         |
| 300                | 0.57                              | 19.32                        | 0.35                           | 6.60                         |
| 325                | 0.61                              | 18.68                        | 0.42                           | 7.17                         |
| 350                | 0.64                              | 18.09                        | 0.49                           | 7.76                         |
| 375                | 0.68                              | 17.45                        | 0.57                           | 8.36                         |
| 400                | 0.73                              | 16.86                        | 0.65                           | 8.96                         |

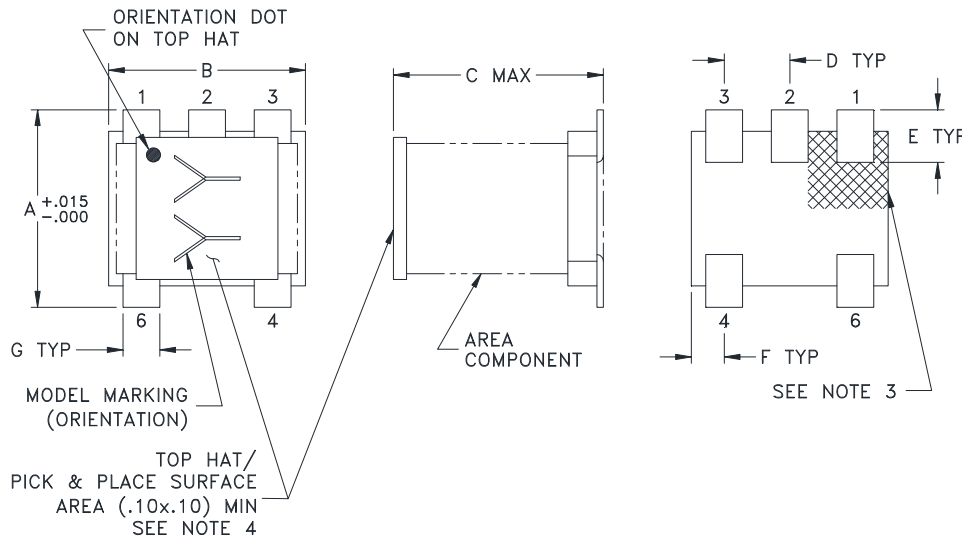


## Typical Performance Data

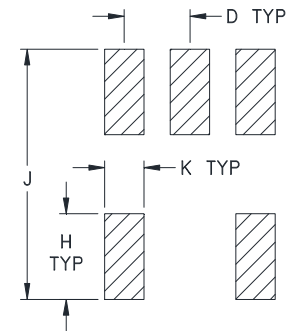


## Outline Dimensions

AT1521



## PCB Land Pattern



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

| CASE # | A              | B              | C              | D              | E              | F             | G             | H              | J              | K             | WT. GRAMS |
|--------|----------------|----------------|----------------|----------------|----------------|---------------|---------------|----------------|----------------|---------------|-----------|
| AT1521 | .150<br>(3.81) | .150<br>(3.81) | .160<br>(4.06) | .050<br>(1.27) | .040<br>(1.02) | .025<br>(.64) | .028<br>(.71) | .065<br>(1.65) | .190<br>(4.83) | .030<br>(.76) | .15       |

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

### Notes:

1. Case material: Plastic.
2. Termination finish:  
For RoHS Case Styles: Tin plate over Nickel plate. All models, (+) suffix.
3. Orientation Dot on Top Hat & Marking on the Substrate both refers to Pin #1 of the Unit.
4. Top-Hat total thickness: .013 inches MAX.



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

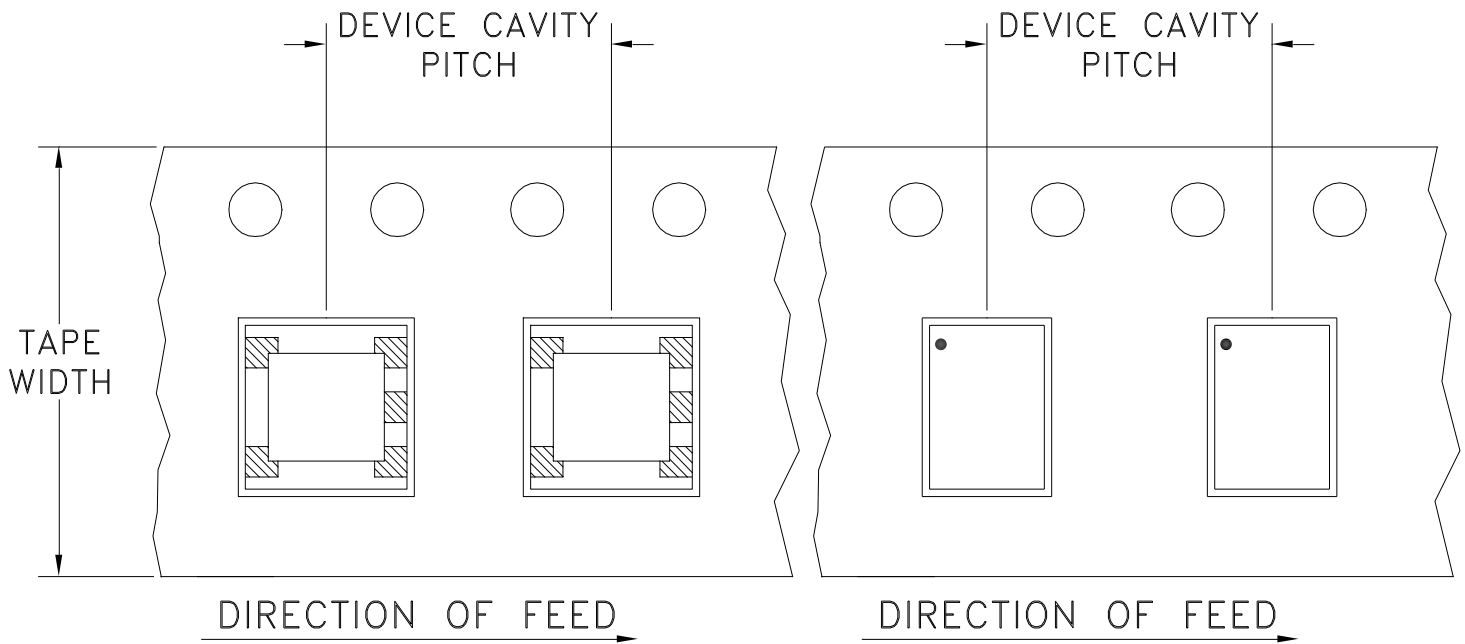


The Design Engineers Search Engine Provides ACTUAL Data Instantly From MINI-CIRCUITS At: [www.minicircuits.com](http://www.minicircuits.com)

RF/IF MICROWAVE COMPONENTS

# Tape & Reel Packaging TR-F17

## DEVICE ORIENTATION IN T&R



| Tape Width, mm | Device Cavity Pitch, mm | Reel Size, inches | Devices per Reel                    |      |
|----------------|-------------------------|-------------------|-------------------------------------|------|
| 12             | 8                       | 7                 | Small quantity standards (see note) | 20   |
|                |                         |                   |                                     | 50   |
|                |                         |                   |                                     | 100  |
|                |                         |                   |                                     | 200  |
|                |                         |                   |                                     | 500  |
|                |                         | 13                | Standard                            | 1000 |
|                |                         |                   | 2000                                |      |

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)



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

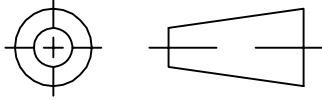


The Design Engineers Search Engine Provides ACTUAL Data Instantly From MINI-CIRCUITS At: [www.minicircuits.com](http://www.minicircuits.com)

RF/IF MICROWAVE COMPONENTS



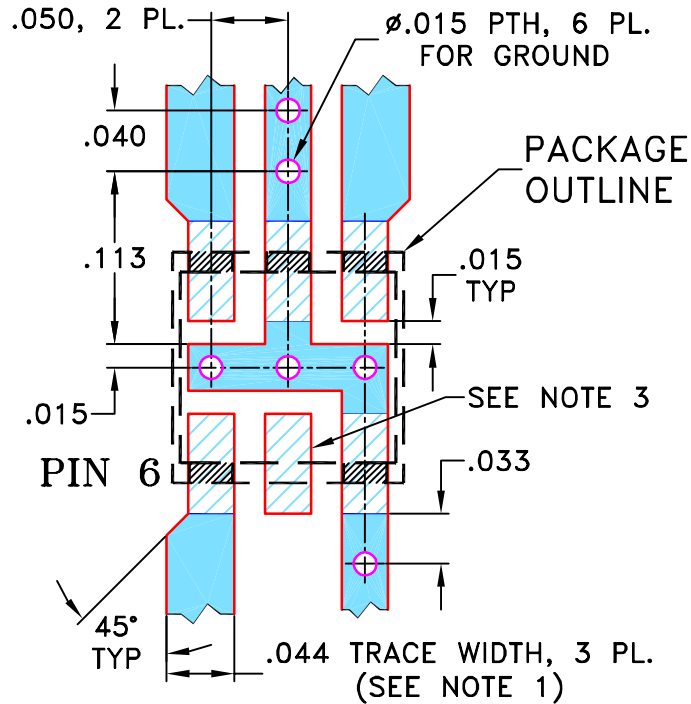
THIRD ANGLE PROJECTION



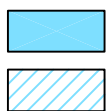
REVISIONS

| REV | ECN No. | DESCRIPTION | DATE     | DR | AUTH |
|-----|---------|-------------|----------|----|------|
| OR  | M106563 | NEW RELEASE | 08/23/06 | AV | IG   |
|     |         |             |          |    |      |
|     |         |             |          |    |      |

SUGGESTED MOUNTING CONFIGURATION  
FOR AT224/DB714 CASE STYLE, "gs/ha/hd" PIN CONNECTIONS  
(FOR SINGLE ENDED TO BALANCED APPLICATION)



- NOTES:**
- TRACE WIDTH IS SHOWN FOR ROGERS RO4350B WITH DIELECTRIC THICKNESS .020" ± .0015"; COPPER: 1/2 OZ. ON EACH SIDE. FOR OTHER MATERIALS TRACE WIDTH MAY NEED TO BE MODIFIED.
  - BOTTOM SIDE OF THE PCB IS CONTINUOUS GROUND PLANE.
  - THIS PAD IS NOT REQUIRED FOR AT224 CASE STYLE.



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 ±  
 3 PL DECIMALS ± .005  
 ANGLES ±  
 FRACTIONS ±

|          |    |          |
|----------|----|----------|
| DRAWN    | AV | 07/28/06 |
| CHECKED  | IL | 08/23/06 |
| APPROVED | IG | 08/23/06 |



**Mini-Circuits®**

13 Neptune Avenue  
 Brooklyn NY 11235

PL, gs/ha/hd, AT224/DB714, TC/TCM, TB-145

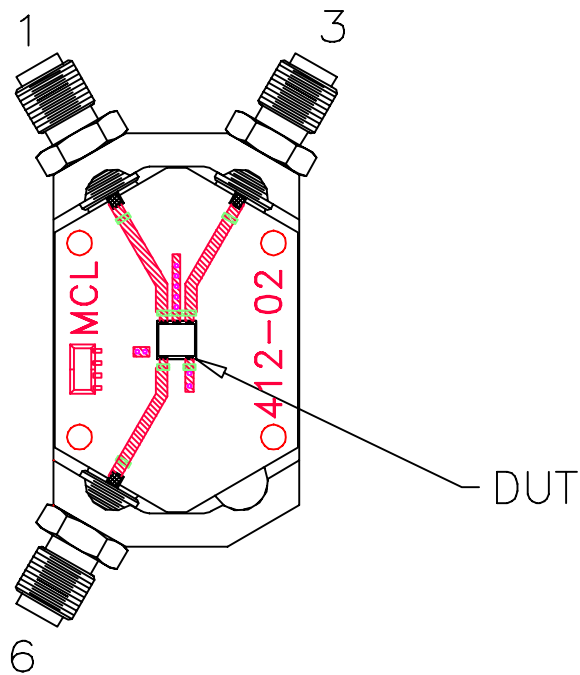
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|           |                     |                          |            |
|-----------|---------------------|--------------------------|------------|
| SIZE<br>A | CODE IDENT<br>15542 | DRAWING NO:<br>98-PL-244 | REV:<br>OR |
|-----------|---------------------|--------------------------|------------|

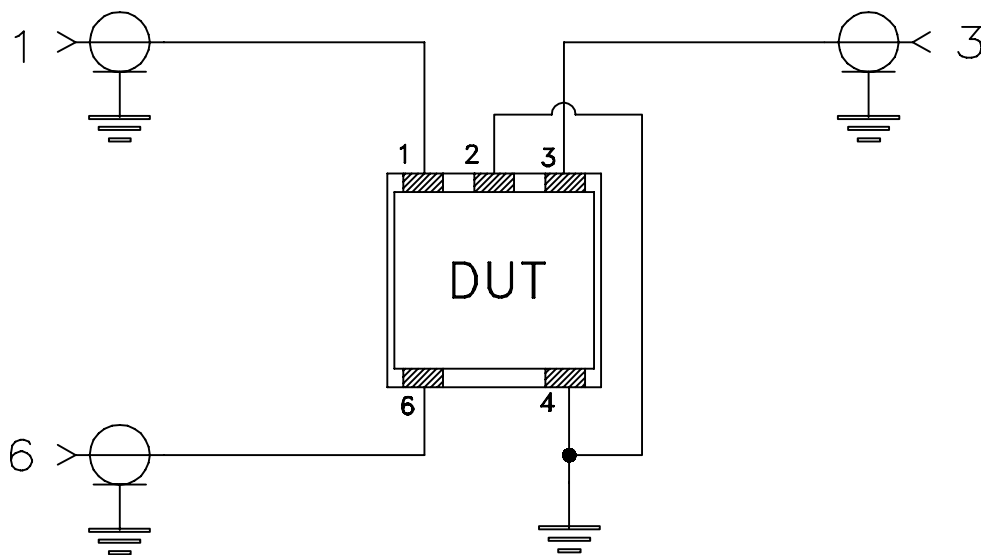
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|------------------|---------------|------------------|
| FILE:<br>98PL244 | SCALE:<br>8:1 | SHEET:<br>1 OF 1 |
|------------------|---------------|------------------|

# Evaluation Board and Circuit

For Pin Connections refer to Data Sheet of the DUT




TB-145



Schematic Diagram

## Notes:

1. 50 Ohm SMA Female connectors.
2. PCB Material: Rogers RO4350B or its equivalent, Dielectric Constant=3.5, Thickness=.020"

 **Mini-Circuits®**



All Mini-Circuits products are manufactured under exacting quality assurance and control standards, and are capable of meeting published specifications after being subjected to any or all of the following physical and environmental test.

| Specification                  | Test/Inspection Condition   | Reference/Spec   |
|--------------------------------|---|--|
| Operating Temperature          | -40° to 85°C<br>Ambient Environment   | Individual Model Data Sheet  |
| Storage Temperature            | -55° to 100° C<br>Ambient Environment   | Individual Model Data Sheet  |
| Humidity                       | 90 to 95% RH, 240 hours, 50°C   | MIL-STD-202, Method 103, Condition A, Except 50°C and end-point electrical test done within 12 hours |
| Thermal Shock                  | -55° to 100°C, 100 cycles   | MIL-STD-202, Method 107, Condition A-3, except +100°C  |
| Solder Reflow Heat             | Sn-Pb Eutetic Process: 225°C peak<br>Pb-Free Process 245° - 250°C peak  | J-STD-020, Table 4-1, 4-2 and 5-2, Figure 5-1  |
| Solderability                  | 10X Magnification   | J-STD-002, 95% Coverage  |
| Vibration (High Frequency)     | 20g peak, 10-2000 Hz, 12 times in each of three perpendicular directions (total 36)   | MIL-STD-202, Method 204, Condition D   |
| Mechanical Shock               | 50g, 11 ms, 1/2-sine, 18 shocks: 3 each direction, each of 3 axes   | MIL-STD-202, Method 213, Condition A   |
| Marking Resistance to Solvents | Isopropyl alcohol + mineral spirits at 25°C; terpene defluxer at 25°C;<br>distilled water + proylene glycol monomethyl ether + monoethanolamine at 63°C to 70°C | MIL-STD-202, Method 215  |