



Mini-Circuits

SURFACE MOUNT



## RF Transformer

TC1-1-13MX+

50Ω 4.5 to 3000 MHz

## FEATURES

- Wideband, 4.5 to 3000 MHz
- Balanced transmission line
- Good return loss
- Excellent amplitude unbalance, 0.5 dB typ. and phase unbalance, 2 deg typ. in 1 dB bandwidth
- Plastic base with leads
- Aqueous washable



Generic photo used for illustration purposes only

CASE STYLE: AT1521

**+RoHS Compliant**

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

## APPLICATIONS

- Balanced to unbalanced transformation
- Push-pull amplifiers
- PCS/DCS
- MMDS

## ELECTRICAL SPECIFICATIONS AT +25°C

| Parameter           | Condition | Min. | Typ. | Max. | Unit   |
|---------------------|-----------|------|------|------|--------|
| Impedance Ratio     |           |      | 1    |      | Ohm    |
| Frequency Range     |           | 4.5  |      | 3000 | MHz    |
| Insertion Loss*     | 2000-3000 |      | 3.0  |      | dB     |
|                     | 1000-2000 |      | 2.0  |      |        |
|                     | 4.5-1000  |      | 1.0  |      |        |
| Amplitude Unbalance | 4.5-1000  |      | 0.5  |      | dB     |
|                     | 1000-2000 |      | 0.5  |      |        |
| Phase Unbalance     | 4.5-1000  |      | 2    |      | Degree |
|                     | 1000-2000 |      | 3    |      |        |

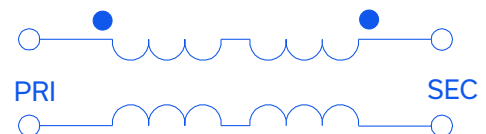
\*Insertion Loss is referenced to mid-band loss, 0.5 dB typ.

## 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.

## CONFIG. G



REV. B  
ECO-021646  
TC1-1-13MX+  
MCL NY  
240424





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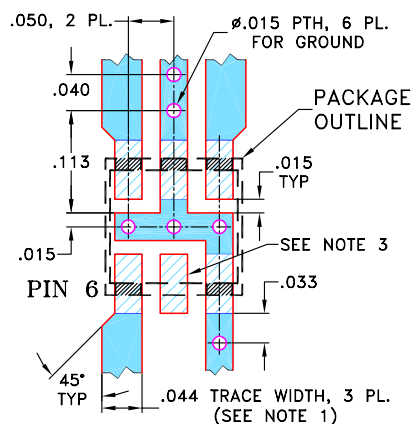
TC1-1-13MX+

## PIN CONNECTIONS

| Function      | Pin Number |
|---------------|------------|
| PRIMARY DOT   | 6          |
| PRIMARY       | 4          |
| SECONDARY DOT | 1          |
| SECONDARY     | 3          |
| NOT USED      | 2          |

## PRODUCT MARKING: AK

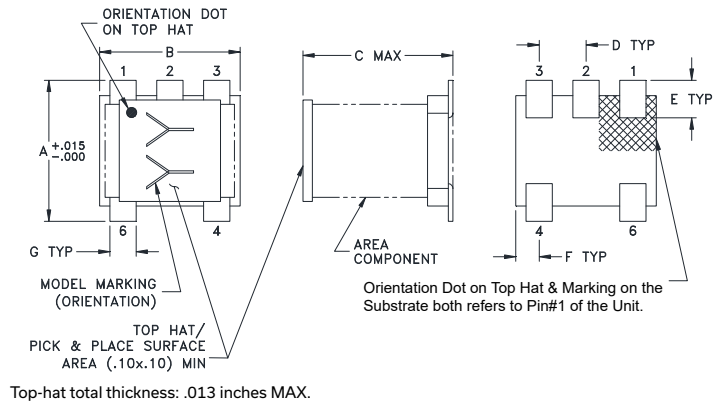
**DEMO BOARD MCL P/N:** TB-145  
**SUGGESTED PCB LAYOUT:** (PL-244)



1. 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.
2. BOTTOM SIDE OF THE PCB IS CONTINUOUS GROUND PLANE.
3. THIS PAD IS NOT REQUIRED FOR AT224 CASE STYLE.

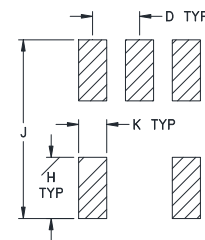
 DENOTES PCB COPPER LAYOUT WITH SMOBC (SOLDER MASK OVER BARE COPPER)  
 DENOTES COPPER LAND PATTERN FREE OF SOLDER MASK

## 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

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SURFACE MOUNT



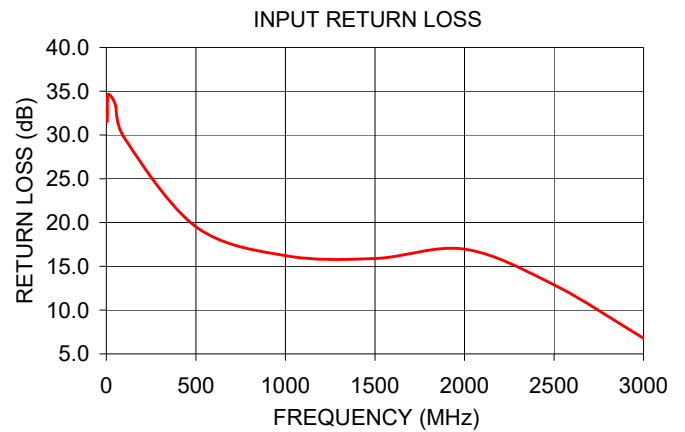
# RF Transformer

TC1-1-13MX+

50Ω 4.5 to 3000 MHz

## TYPICAL PERFORMANCE DATA

| FREQUENCY (MHz) | INSERTION LOSS (dB) | INPUT R. LOSS (dB) | AMPLITUDE UNBALANCE (dB) | PHASE UNBALANCE (Deg.) |
|-----------------|---------------------|--------------------|--------------------------|------------------------|
| 4.50            | 0.18                | 31.52              | 0.69                     | 3.81                   |
| 10.00           | 0.18                | 34.60              | 0.56                     | 1.78                   |
| 50.00           | 0.19                | 33.50              | 0.56                     | 0.11                   |
| 100.00          | 0.24                | 29.68              | 0.55                     | 0.19                   |
| 500.00          | 0.46                | 19.52              | 0.45                     | 0.81                   |
| 1000.00         | 0.68                | 16.22              | 0.14                     | 1.59                   |
| 1500.00         | 0.90                | 15.89              | 0.29                     | 0.89                   |
| 2000.00         | 1.11                | 16.97              | 0.71                     | 1.28                   |
| 2500.00         | 1.62                | 12.88              | 0.78                     | 5.79                   |
| 3000.00         | 3.02                | 6.79               | 0.49                     | 12.32                  |



### NOTES

- 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.
- Electrical specifications and performance data contained in this specification document are based on Mini-Circuit's applicable established test performance criteria and measurement instructions.
- 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

## TC1-1-13MX+

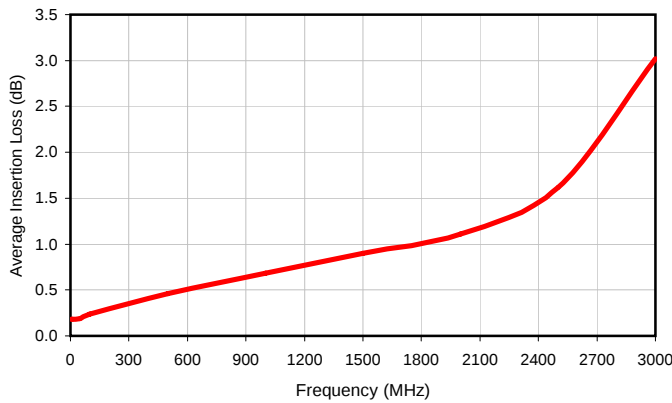
### Typical Performance Data

| FREQUENCY<br>MHz | AVERAGE<br>INSERTION<br>LOSS<br>(dB) | INPUT<br>RETURN<br>LOSS<br>(dB) | AMPLITUDE<br>UNBALANCE<br>(dB) | PHASE<br>UNBALANCE<br>(deg.) |
|------------------|--------------------------------------|---------------------------------|--------------------------------|------------------------------|
| 4.50             | 0.18                                 | 31.52                           | 0.69                           | 3.81                         |
| 10.00            | 0.18                                 | 34.60                           | 0.56                           | 1.78                         |
| 50.00            | 0.19                                 | 33.50                           | 0.56                           | 0.11                         |
| 100.00           | 0.24                                 | 29.68                           | 0.55                           | 0.19                         |
| 500.00           | 0.46                                 | 19.52                           | 0.45                           | 0.81                         |
| 1000.00          | 0.68                                 | 16.22                           | 0.14                           | 1.59                         |
| 1500.00          | 0.90                                 | 15.89                           | 0.29                           | 0.89                         |
| 2000.00          | 1.11                                 | 16.97                           | 0.71                           | 1.28                         |
| 2500.00          | 1.62                                 | 12.88                           | 0.78                           | 5.79                         |
| 3000.00          | 3.02                                 | 6.79                            | 0.49                           | 12.32                        |

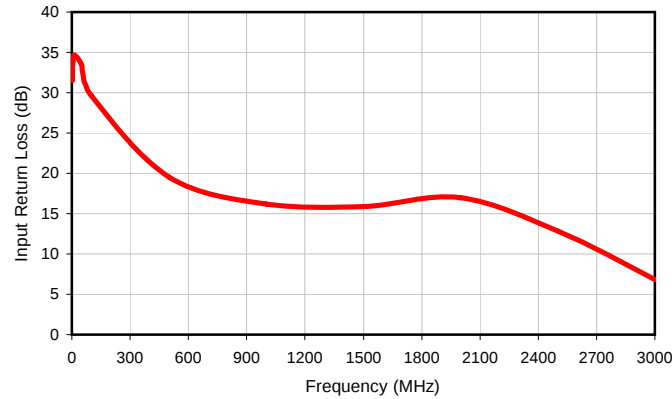


## Typical Performance Data

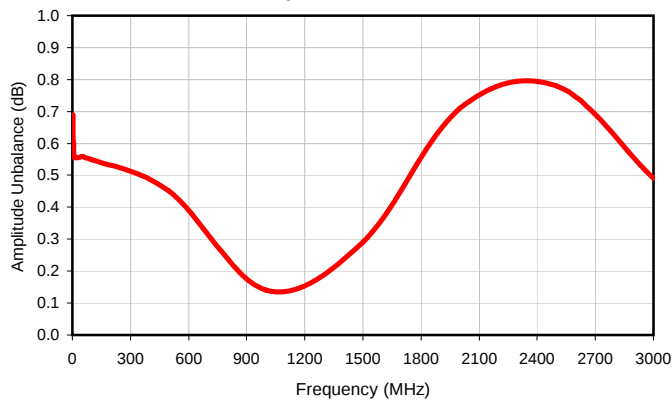
Average Insertion Loss



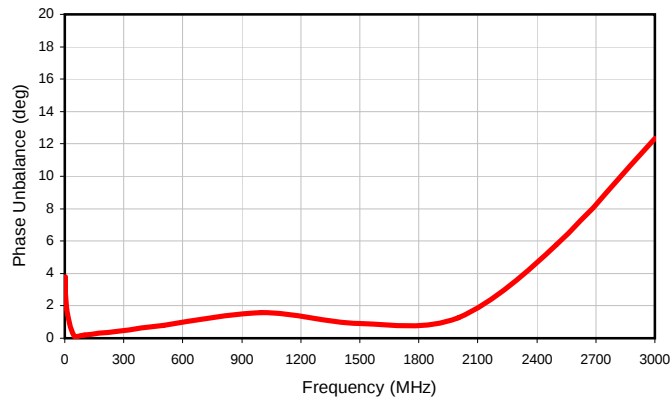
Input Return Loss



Amplitude Unbalance



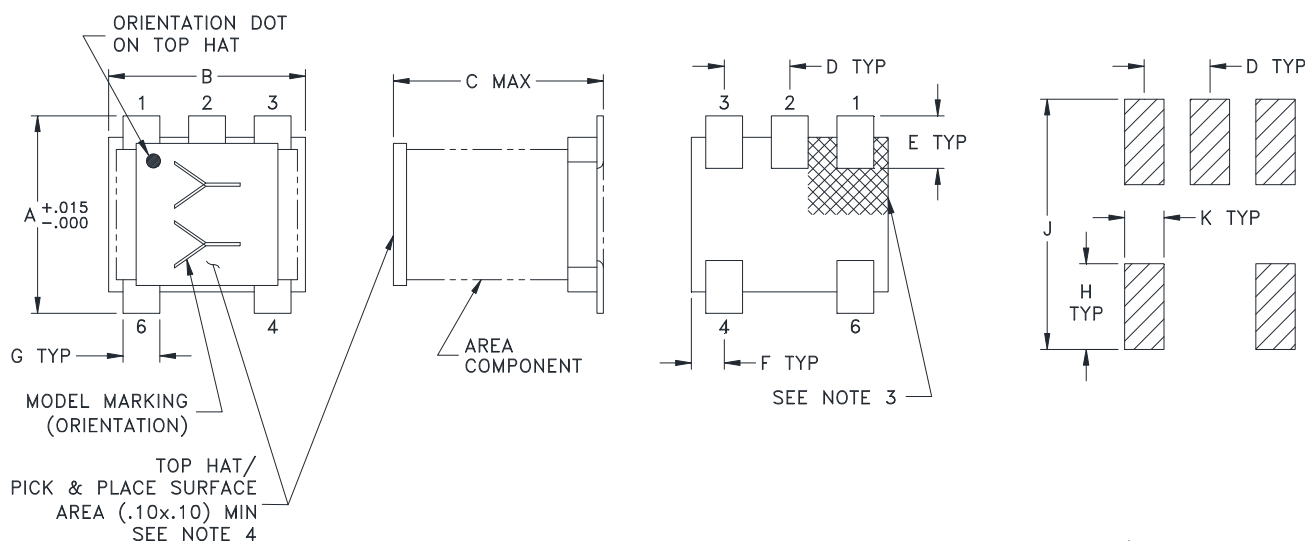
Phase Unbalance



## 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:

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



P.O. Box 350186, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718) 332-4661 For detailed performance specs & shopping online see Mini-Circuits web site

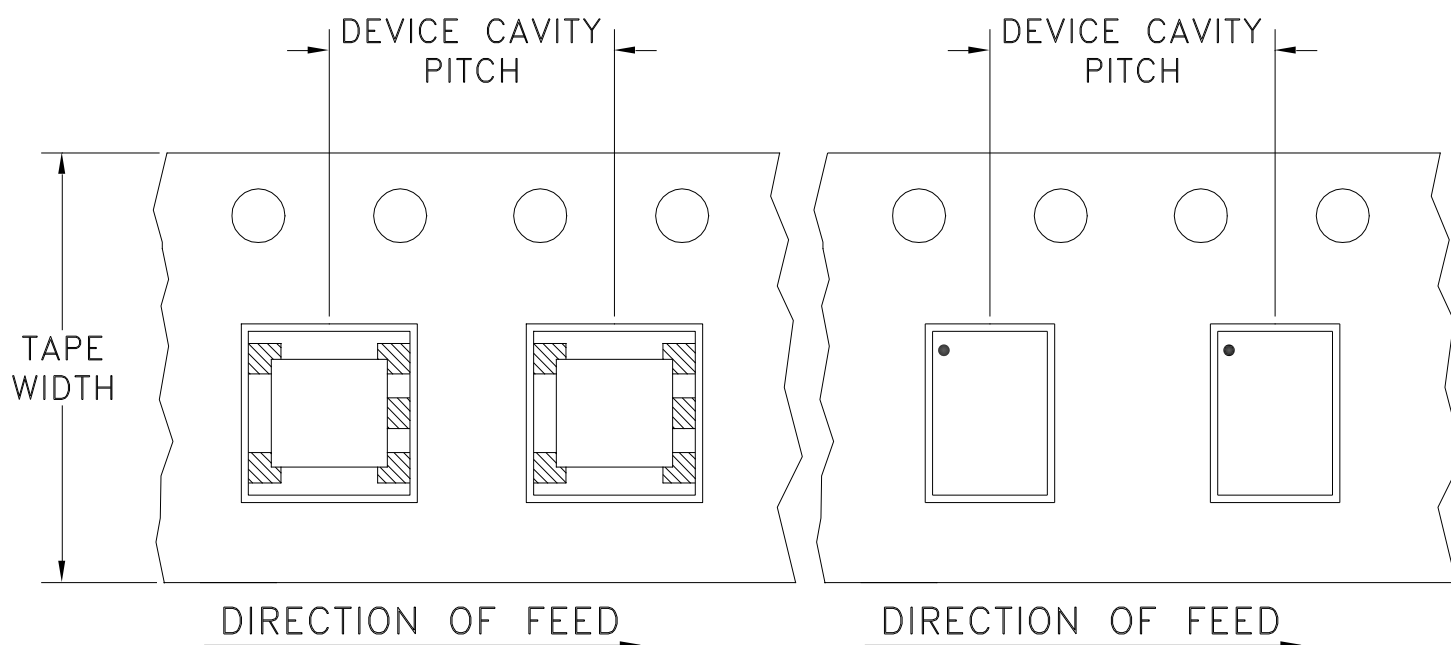


The Design Engineers Search Engine Provides ACTUAL Data Instantly From MINI-CIRCUITS At: [www.minicircuits.com](http://www.minicircuits.com)

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)



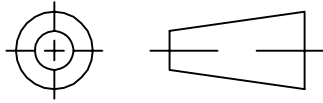
P.O. Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718) 332-4661 For detailed performance specs & shopping online see Mini-Circuits web site



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RF/IF MICROWAVE COMPONENTS

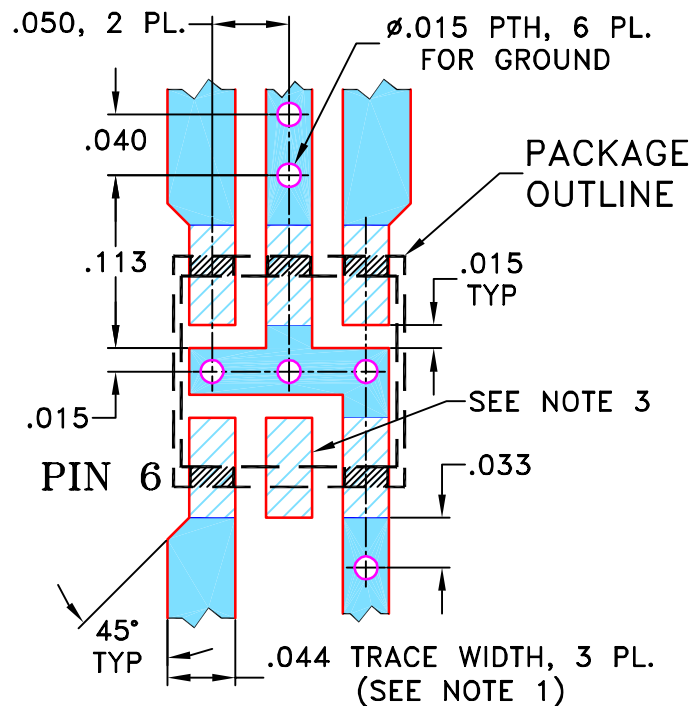
## THIRD ANGLE PROJECTION



## REVISIONS

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

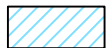
**SUGGESTED MOUNTING CONFIGURATION**  
**FOR AT224/DB714 CASE STYLE, "gs/ha/hd" PIN CONNECTIONS**  
**(FOR SINGLE ENDED TO BALANCED APPLICATION)**



- NOTES:** 1. TRACE WIDTH IS SHOWN FOR ROGERS RO4350B WITH DIELECTRIC THICKNESS .020"  $\pm$  .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

UNLESS OTHERWISE SPECIFIED

INITIALS

DATE

DIMENSIONS ARE IN INCHES

TOLERANCES ON:

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

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

SIZE  
A

CODE IDENT  
15542

DRAWING NO:  
98-PL-244

REV:  
OR

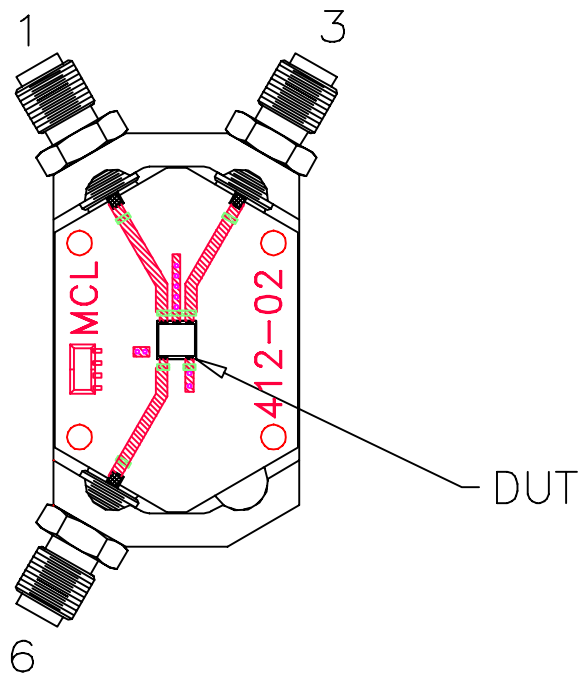
FILE: 98PL244

SCALE: 8:1

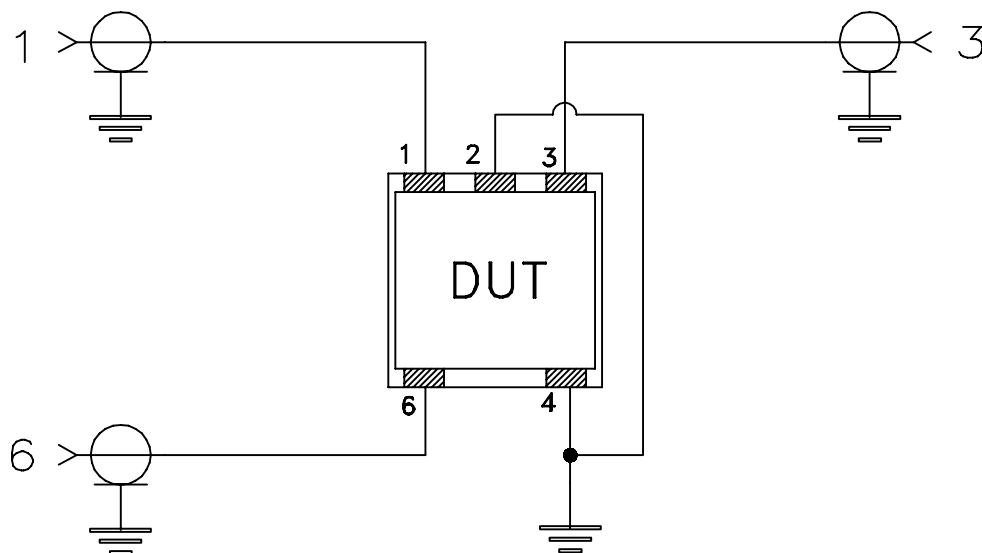
SHEET: 1 OF 1

# 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 R04350B 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                                                                              |