

**THE BIG DEAL**

- Wideband, 100 to 1000 MHz
- DC isolated up to 1000 MHz
- Good return loss
- Excellent amplitude unbalance, 0.5 dB typ. in 1 dB bandwidth
- Plastic base with leads
- Aqueous washable

*Generic photo used for illustration purposes only*

CASE STYLE: AT1521

+RoHS CompliantThe +Suffix identifies RoHS Compliance.
See our website for methodologies and qualifications**APPLICATIONS**

- Impedance matching
- Balanced to unbalanced transformation
- Push-pull amplifiers

PRODUCT OVERVIEW

TC4-13TX+ is a surface-mount, DC-isolated transformer with a center-tap on its secondary winding, covering the 100 to 1000 MHz band. This model provides a 4:1 secondary/primary impedance ratio, 0.6 dB insertion loss, 0.5 dB amplitude unbalance (in 1 dB bandwidth) and 9° phase unbalance. It features core and wire construction mounted on a 5-lead plastic base with tin over nickel termination finish. It measures 0.15 x 0.15 x 0.16", easily accommodating dense circuit board layouts, and features Mini-Circuits' Top Hat® feature for faster, more accurate pick-and-place assembly.

KEY FEATURES

| Features | Advantages |
|---------------------------------------|---|
| Wide bandwidth, 40 to 1250 MHz | Wide frequency range covers bandwidth requirements for DOCSIS® 3.1 systems and equipment. |
| Low insertion loss, 1.4 dB | Provides excellent signal power transmission from input to output. |
| Secondary center tap | Allows DC feed up to 30mA 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. |



ELECTRICAL SPECIFICATIONS AT 25°C

| Parameter | Frequency (MHz) | Min. | Typ. | Max. | Unit |
|-------------------------------------|-----------------|------|------|------|--------|
| Impedance Ratio (secondary/primary) | | | 4 | | |
| Frequency Range | | 100 | — | 1000 | MHz |
| Insertion Loss* | 200-800 | — | 0.2 | 0.8 | dB |
| | 100-1000 | — | 0.6 | 1.4 | |
| Amplitude Unbalance | 200-800 | — | 0.5 | 1.4 | dB |
| | 100-1000 | — | 1 | — | |
| Phase Unbalance | 200-800 | — | 5 | 11 | Degree |
| | 100-1000 | — | 9 | — | |

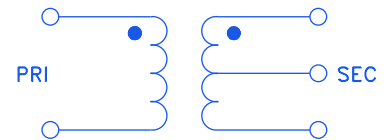
* Insertion Loss is referenced to mid-band loss, 0.8 dB typ.

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. A





top hat
SURFACE MOUNT
RF Transformer

TC4-13TX+

Mini-Circuits

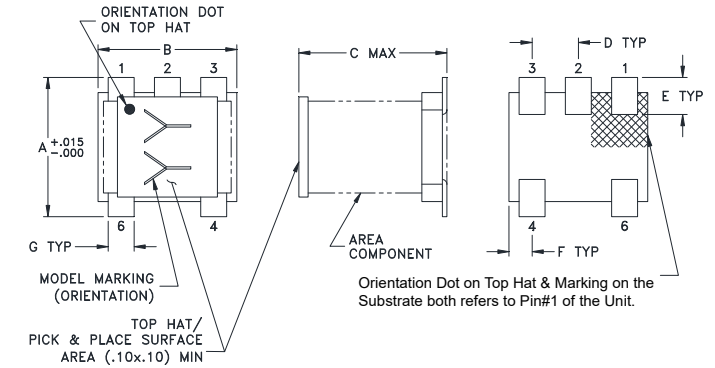
50Ω 100 to 1000 MHz

PIN CONNECTIONS

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

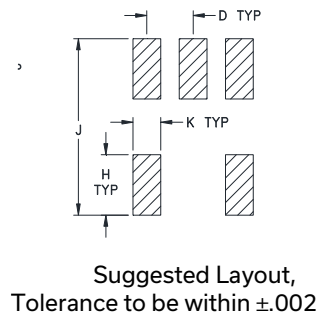
PRODUCT MARKING: FD

OUTLINE DRAWING



Top-hat total thickness: .013 inches MAX.

PCB Land Pattern



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

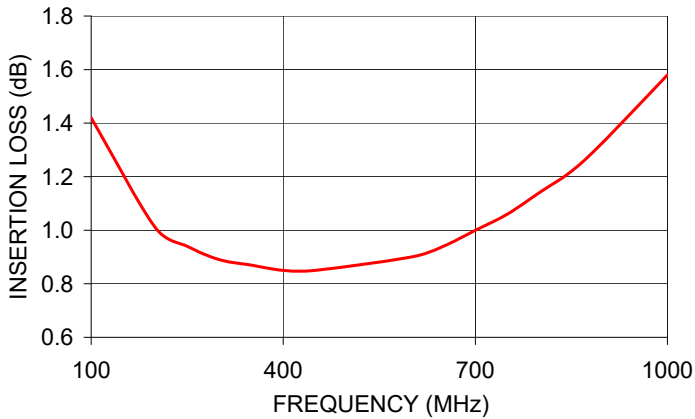
TAPE & REEL INFORMATION: F17



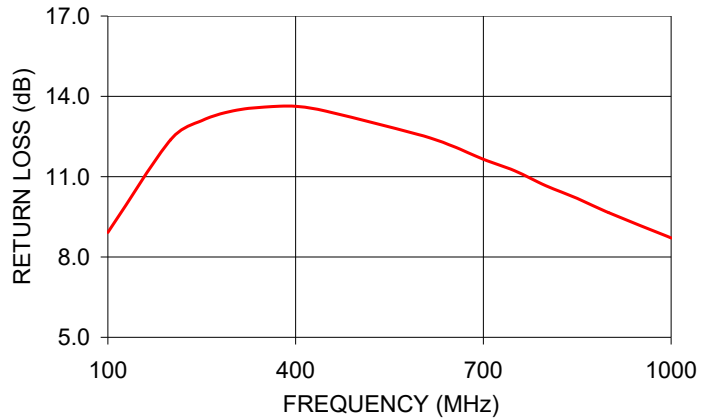
TYPICAL PERFORMANCE DATA

| FREQUENCY (MHz) | INSERTION LOSS (dB) | INPUT R. LOSS (dB) | AMPLITUDE UNBALANCE (dB) | PHASE UNBALANCE (deg.) |
|-----------------|---------------------|--------------------|--------------------------|------------------------|
| 100.00 | 1.42 | 8.92 | 0.04 | 0.09 |
| 200.00 | 1.01 | 12.37 | 0.10 | 0.22 |
| 300.00 | 0.89 | 13.46 | 0.18 | 0.35 |
| 400.00 | 0.85 | 13.63 | 0.28 | 0.73 |
| 600.00 | 0.90 | 12.55 | 0.59 | 2.26 |
| 700.00 | 1.00 | 11.65 | 0.76 | 3.68 |
| 800.00 | 1.14 | 10.66 | 0.93 | 5.77 |
| 900.00 | 1.33 | 9.66 | 1.11 | 8.78 |
| 1000.00 | 1.58 | 8.71 | 1.29 | 13.02 |

TC4-13TX+
INSERTION LOSS



TC4-13TX+
INPUT RETURN LOSS



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

RF Transformer

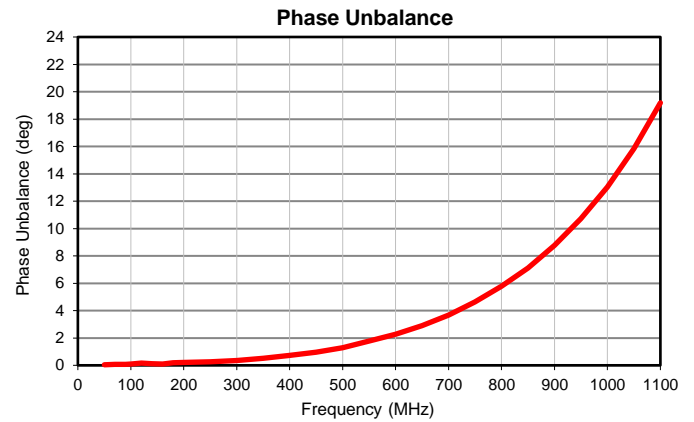
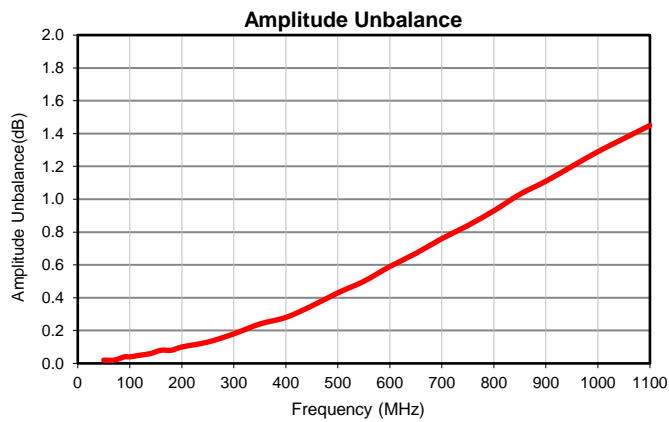
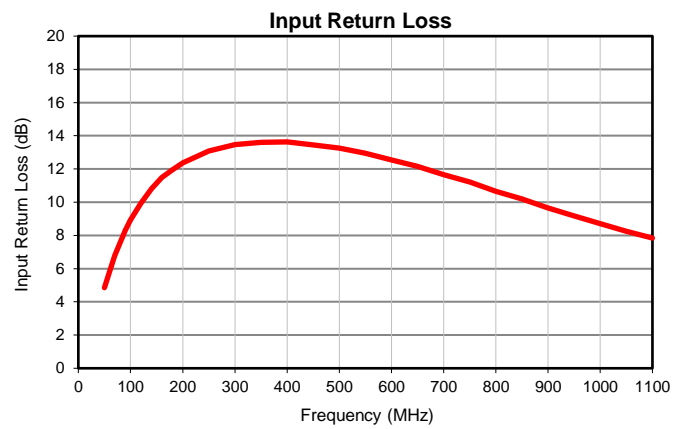
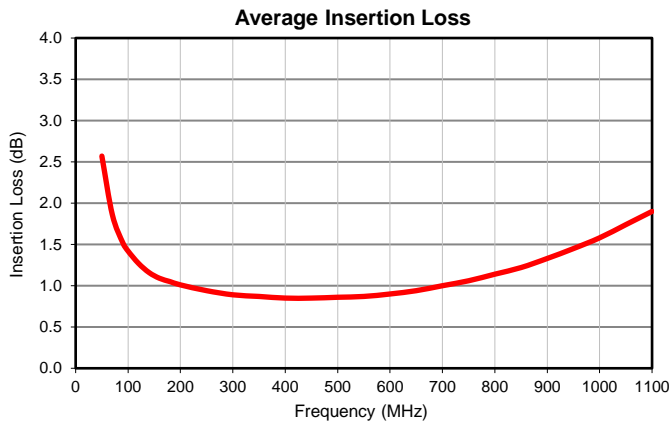
TC4-13TX+

Typical Performance Data

| FREQUENCY (MHz) | AVERAGE INSERTION LOSS (dB) | INPUT RETURN LOSS (dB) | AMPLITUDE UNBALANCE (dB) | PHASE UNBALANCE (deg.) |
|-----------------|-----------------------------|------------------------|--------------------------|------------------------|
| 50 | 2.57 | 4.85 | 0.02 | 0.04 |
| 70 | 1.86 | 6.79 | 0.02 | 0.08 |
| 90 | 1.52 | 8.30 | 0.04 | 0.08 |
| 100 | 1.42 | 8.92 | 0.04 | 0.09 |
| 120 | 1.27 | 9.94 | 0.05 | 0.16 |
| 140 | 1.16 | 10.80 | 0.06 | 0.11 |
| 160 | 1.09 | 11.48 | 0.08 | 0.10 |
| 180 | 1.05 | 11.95 | 0.08 | 0.18 |
| 200 | 1.01 | 12.37 | 0.10 | 0.22 |
| 250 | 0.94 | 13.09 | 0.13 | 0.26 |
| 300 | 0.89 | 13.46 | 0.18 | 0.35 |
| 350 | 0.87 | 13.60 | 0.24 | 0.51 |
| 400 | 0.85 | 13.63 | 0.28 | 0.73 |
| 450 | 0.85 | 13.44 | 0.35 | 0.96 |
| 500 | 0.86 | 13.26 | 0.43 | 1.28 |
| 550 | 0.87 | 12.95 | 0.50 | 1.78 |
| 600 | 0.90 | 12.55 | 0.59 | 2.26 |
| 650 | 0.94 | 12.15 | 0.67 | 2.89 |
| 700 | 1.00 | 11.65 | 0.76 | 3.68 |
| 750 | 1.06 | 11.22 | 0.84 | 4.64 |
| 800 | 1.14 | 10.66 | 0.93 | 5.77 |
| 850 | 1.22 | 10.19 | 1.03 | 7.11 |
| 900 | 1.33 | 9.66 | 1.11 | 8.78 |
| 950 | 1.45 | 9.18 | 1.20 | 10.72 |
| 1000 | 1.58 | 8.71 | 1.29 | 13.02 |
| 1050 | 1.74 | 8.24 | 1.37 | 15.84 |
| 1100 | 1.90 | 7.84 | 1.45 | 19.19 |

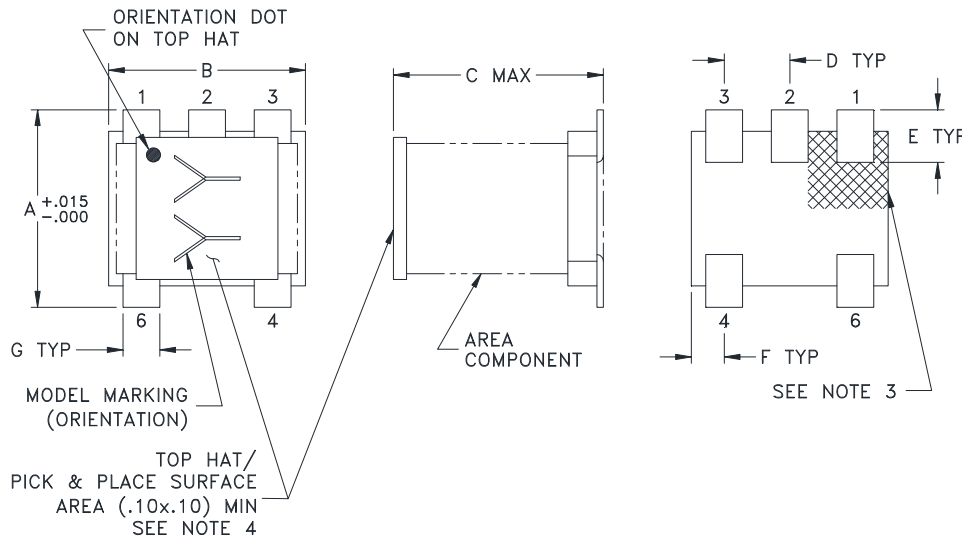


Typical Performance Data



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 (3.81) | .150 (3.81) | .160 (4.06) | .050 (1.27) | .040 (1.02) | .025 (.64) | .028 (.71) | .065 (1.65) | .190 (4.83) | .030 (.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 350186, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718) 332-4661 For detailed performance specs & shopping online see Mini-Circuits web site

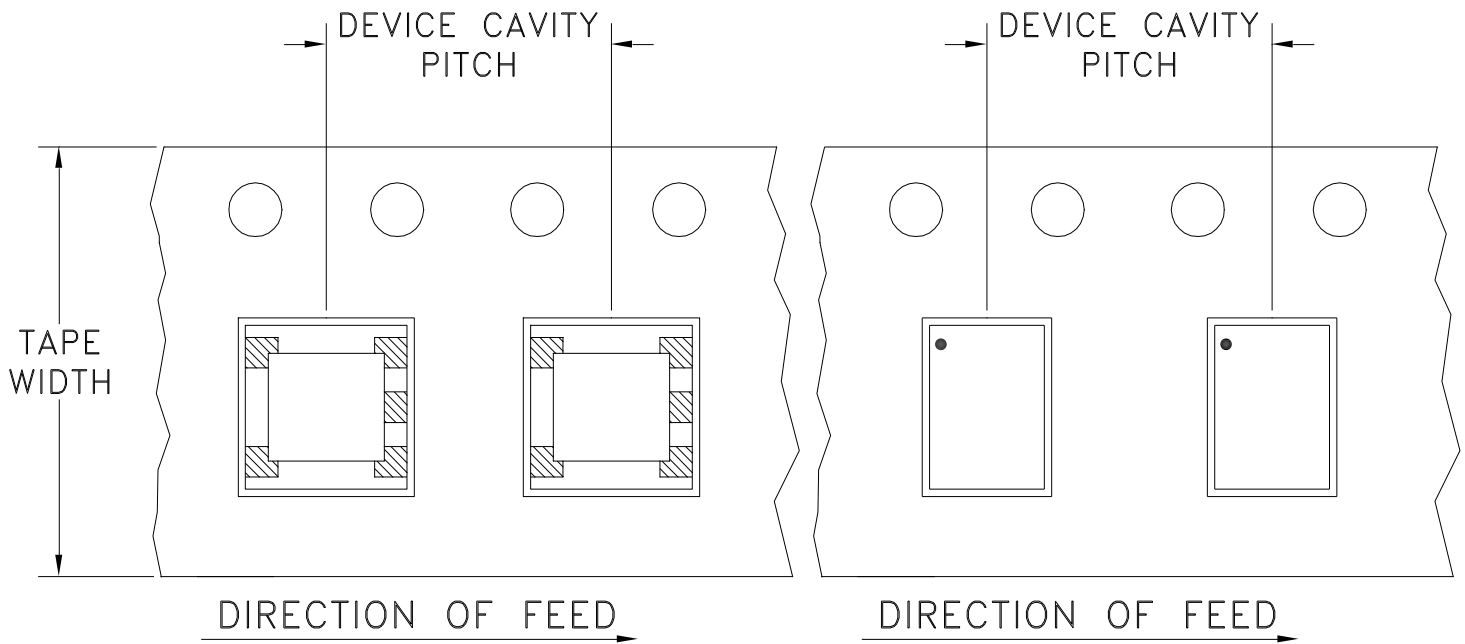


The Design Engineers Search Engine Provides ACTUAL Data Instantly From MINI-CIRCUITS At: www.minicircuits.com

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



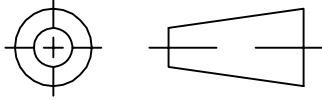
P.O. Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718) 332-4661 For detailed performance specs & shopping online see Mini-Circuits web site



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RF/IF MICROWAVE COMPONENTS

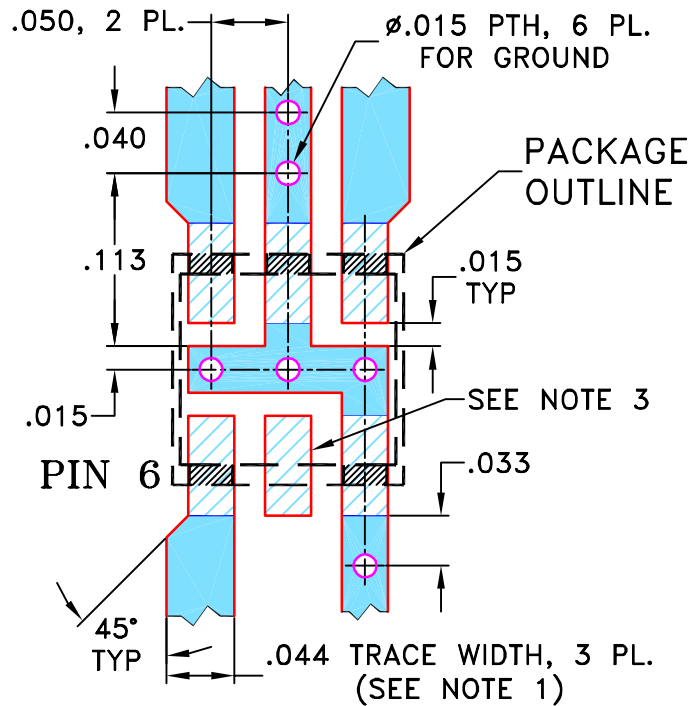
THIRD ANGLE PROJECTION



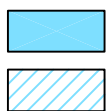
REVISIONS

| 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:**
- 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

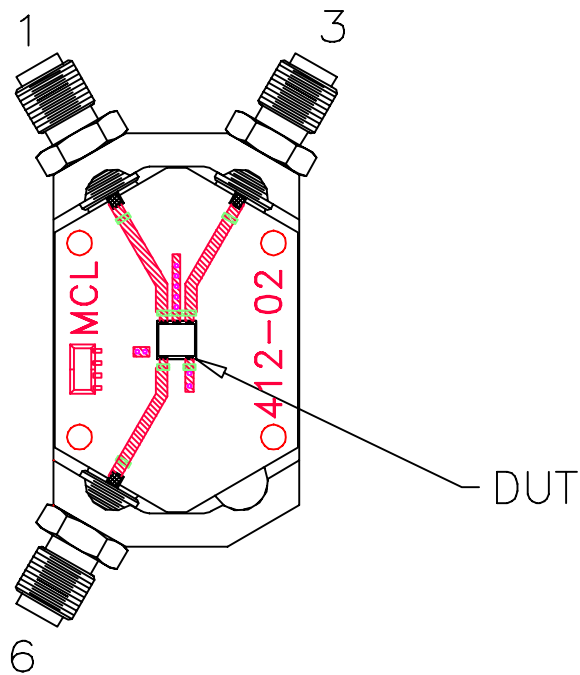
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| SIZE | CODE IDENT | DRAWING NO: | REV: |
|------|------------|-------------|------|
| A | 15542 | 98-PL-244 | OR |

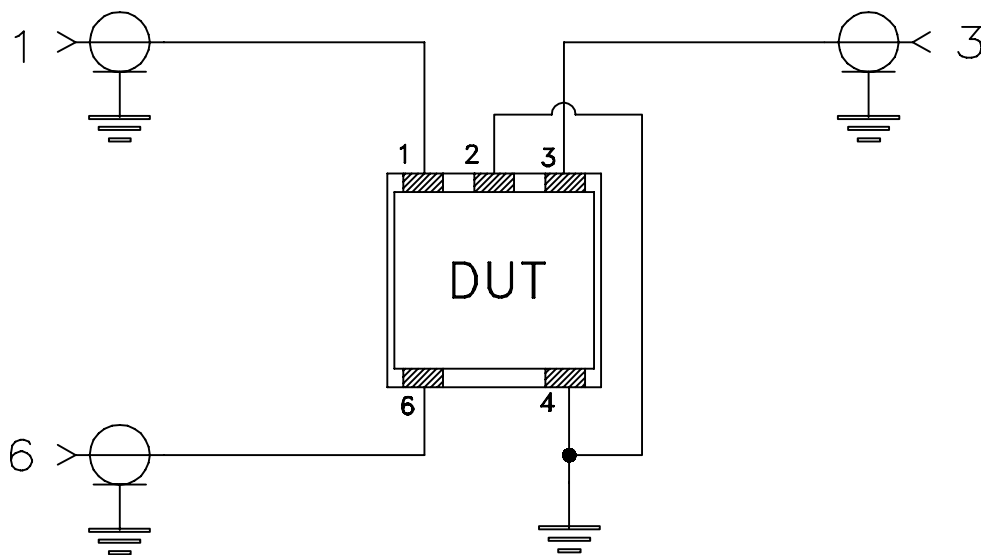
| FILE: | SCALE: | SHEET: |
|---------|--------|--------|
| 98PL244 | 8:1 | 1 OF 1 |

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 Ambient Environment | Individual Model Data Sheet |
| Storage Temperature | -55° to 100° C 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 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; distilled water + proylene glycol monomethyl ether + monoethanolamine at 63°C to 70°C | MIL-STD-202, Method 215 |