



Mini-Circuits®

SURFACE MOUNT 

# Directional Coupler

**TCD-9-1WX+**

50Ω

5 to 2000 MHz

## FEATURES

- Wideband, 5 to 2000 MHz
- Low mainline loss, 1.2 dB typ. (5-1000 MHz)
- Aqueous washable
- Leads for excellent solderability
- Protected by US Patent 6,140,887



Generic photo used for illustration purposes only

CASE STYLE: DB1627

## APPLICATIONS

- GPS
- Cellular
- Satellite distribution
- CABLE TV

### +RoHS Compliant

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

## ELECTRICAL SPECIFICATIONS AT 25°C

| Parameter                                             | Frequency (MHz) | Min. | Typ.    | Max. | Unit |
|-------------------------------------------------------|-----------------|------|---------|------|------|
| Frequency Range                                       | —               | 5    | —       | 2000 | MHz  |
| Mainline Loss <sup>1</sup> (above theoretical 0.1 dB) | 5-50            | —    | 1.2     | 2.1  | dB   |
|                                                       | 50-500          | —    | 1.2     | 1.8  |      |
|                                                       | 500-1000        | —    | 1.5     | 2.1  |      |
|                                                       | 1000-2000       | —    | 2.5     | —    |      |
| Coupling                                              | 5-1000          | —    | 8.9±0.5 | —    | dB   |
|                                                       | 1000-2000       | —    | 8.9±0.5 | —    |      |
| Coupling Flatness (±)                                 | 5-2000          | —    | ±0.6    | —    |      |
| Directivity                                           | 5-50            | 17   | 21      | —    | dB   |
|                                                       | 50-500          | 13   | 17      | —    |      |
|                                                       | 500-1000        | 10   | 13      | —    |      |
|                                                       | 1000-2000       | —    | 10      | —    |      |
| VSWR                                                  | 5-1000          | —    | 1.30    | —    | :1   |
|                                                       | 1000-2000       | —    | 1.60    | —    |      |
| Input Power                                           | 5-1000          | —    | —       | 0.5  | W    |
|                                                       | 1000-2000       | —    | —       | 1.0  |      |

1. Mainline loss includes theoretical power loss at coupled port.

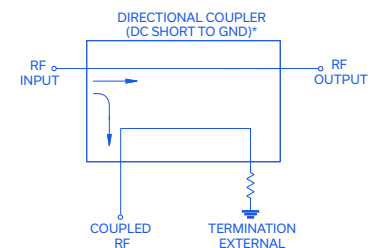
## MAXIMUM RATINGS

| Parameter             | Ratings        |
|-----------------------|----------------|
| Operating Temperature | -40°C to 85°C* |
| Storage Temperature   | -55°C to 100°C |

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

\* Case temperature is defined as temperature on ground leads.

## ELECTRICAL SCHEMATIC



\*Electrical schematic is for Directional coupler with internal transformer(s) and external termination

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ECO-014186  
TCD-9-1WX+  
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220627  
PAGE 1 OF 3



# Directional Coupler

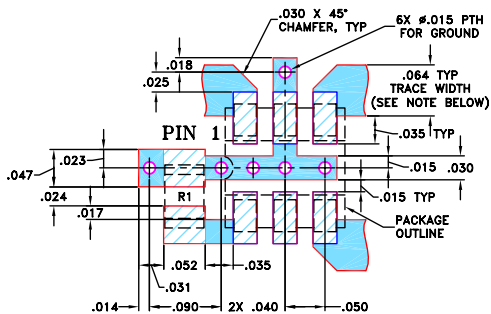
# TCD-9-1WX+

50Ω

5 to 2000 MHz

|                   |   |
|-------------------|---|
| INPUT             | 3 |
| OUTPUT            | 4 |
| COUPLED           | 1 |
| GROUND            | 2 |
| 50Ω TERM EXTERNAL | 6 |
| NOT USED          | 5 |

**DEMO BOARD MCL P/N:** TB-71  
**SUGGESTED PCB LAYOUT** (PL-009)

 DENOTES COPPER LAND PATTERN FREE OF SOLDER MASK

ORIENTATION DOT ON TOP HAT

MODEL MARKING (ORIENTATION)

COMPONENT AREA

A

B

C MAX

D TYP

E TYP

F TYP

G TYP

H TYP

TOP-HAT / PICK & PLACE SURFACE AREA (.10X.10) MIN

TOP-HAT TOTAL THICKNESS: .013 inches MAX.

Orientation dot on Top-Hat & orientation feature on substrate corresponds to pin #1.

PCB Land Pattern

### OUTLINE DIMENSIONS (Inches)

|      |      |      |      |      |       |
|------|------|------|------|------|-------|
| A    | B    | C    | D    | E    | F     |
| .160 | .150 | .160 | .050 | .040 | .025  |
| 4.06 | 3.81 | 4.06 | 1.27 | 1.02 | 0.64  |
| G    | H    | J    | K    |      | wt    |
| .028 | .065 | .190 | .030 |      | grams |
| 0.71 | 1.65 | 4.83 | 0.76 |      | 0.15  |

### TAPE & REEL INFORMATION: F47



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# Directional Coupler

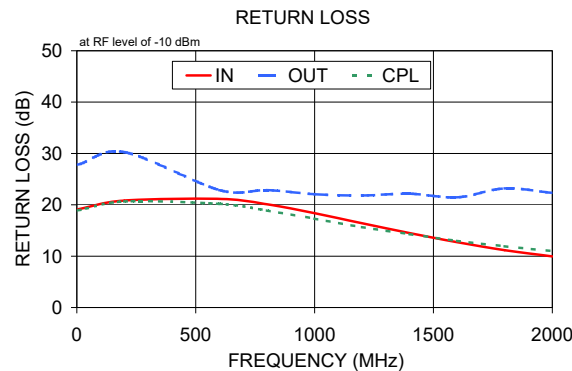
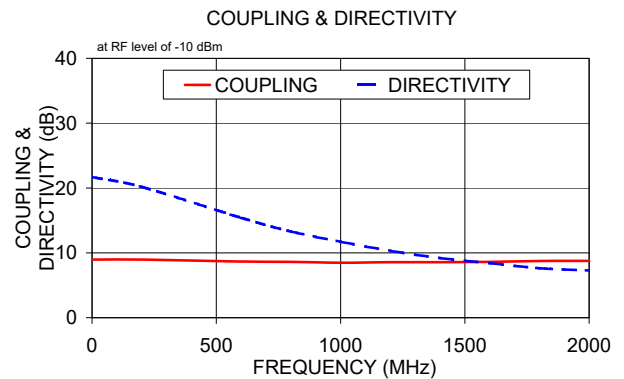
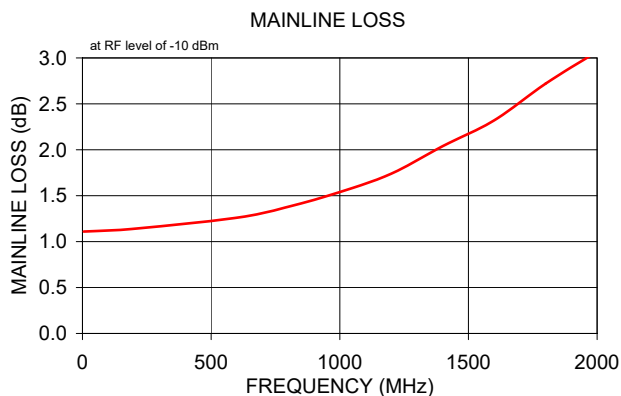
**TCD-9-1WX+**

50Ω

5 to 2000 MHz

**TYPICAL PERFORMANCE DATA**

| Frequency<br>(MHz) | Mainline Loss<br>(dB) | Coupling<br>(dB) | Directivity<br>(dB) | Return Loss<br>(dB) |       |       |
|--------------------|-----------------------|------------------|---------------------|---------------------|-------|-------|
|                    | In-Out                | In-Cpl           |                     | In                  | Out   | Cpl   |
| 5.00               | 1.11                  | 8.96             | 21.65               | 19.14               | 27.81 | 18.92 |
| 200.00             | 1.14                  | 8.97             | 20.18               | 20.84               | 30.26 | 20.66 |
| 600.00             | 1.26                  | 8.67             | 15.41               | 21.16               | 22.87 | 20.18 |
| 800.00             | 1.38                  | 8.61             | 13.30               | 20.11               | 22.87 | 18.90 |
| 1000.00            | 1.54                  | 8.48             | 11.72               | 18.37               | 22.07 | 17.30 |
| 1200.00            | 1.74                  | 8.57             | 10.31               | 16.42               | 21.82 | 15.67 |
| 1400.00            | 2.04                  | 8.57             | 9.19                | 14.49               | 22.16 | 14.29 |
| 1600.00            | 2.32                  | 8.61             | 8.42                | 12.72               | 21.46 | 12.97 |
| 1800.00            | 2.72                  | 8.75             | 7.63                | 11.17               | 23.19 | 11.93 |
| 2000.00            | 3.07                  | 8.76             | 7.28                | 9.96                | 22.33 | 10.99 |

**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)



# Directional Coupler

# TCD-9-1WX+

## Typical Performance Data

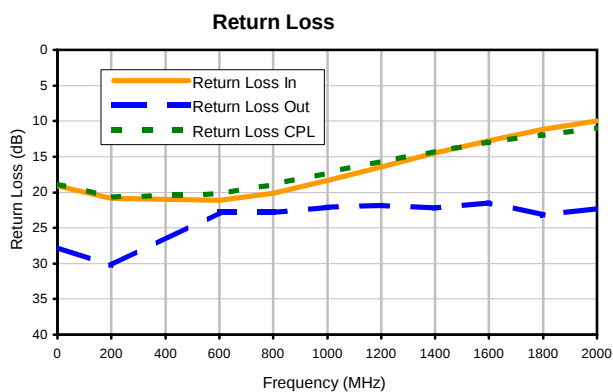
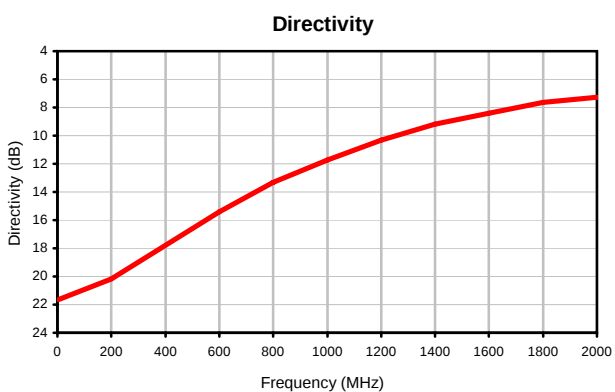
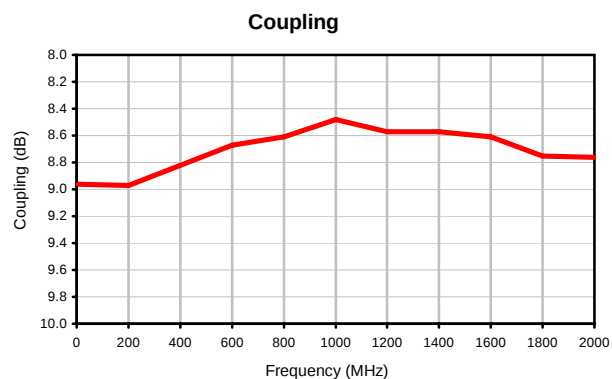
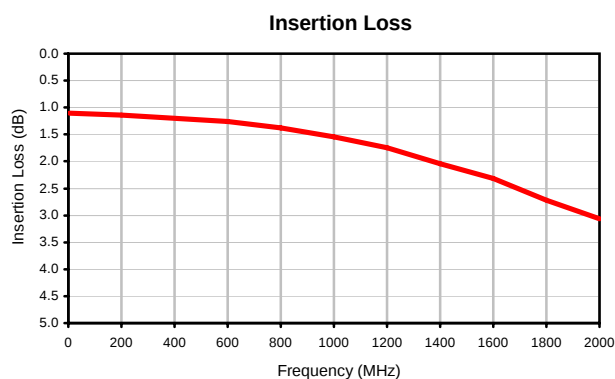
| FREQUENCY<br>(MHz) | INSERTION LOSS<br>(dB) | COUPLING<br>(dB) | DIRECTIVITY<br>(dB) | RETURN LOSS |             |       |
|--------------------|------------------------|------------------|---------------------|-------------|-------------|-------|
|                    |                        |                  |                     | IN          | (dB)<br>OUT | CPL   |
| 5.0                | 1.11                   | 8.96             | 21.65               | 19.14       | 27.81       | 18.92 |
| 200.0              | 1.14                   | 8.97             | 20.18               | 20.84       | 30.26       | 20.66 |
| 600.0              | 1.26                   | 8.67             | 15.41               | 21.16       | 22.87       | 20.18 |
| 800.0              | 1.38                   | 8.61             | 13.30               | 20.11       | 22.87       | 18.90 |
| 1000.0             | 1.54                   | 8.48             | 11.72               | 18.37       | 22.07       | 17.30 |
| 1200.0             | 1.74                   | 8.57             | 10.31               | 16.42       | 21.82       | 15.67 |
| 1400.0             | 2.04                   | 8.57             | 9.19                | 14.49       | 22.16       | 14.29 |
| 1600.0             | 2.32                   | 8.61             | 8.42                | 12.72       | 21.46       | 12.97 |
| 1800.0             | 2.72                   | 8.75             | 7.63                | 11.17       | 23.19       | 11.93 |
| 2000.0             | 3.07                   | 8.76             | 7.28                | 9.96        | 22.33       | 10.99 |



# Directional Coupler

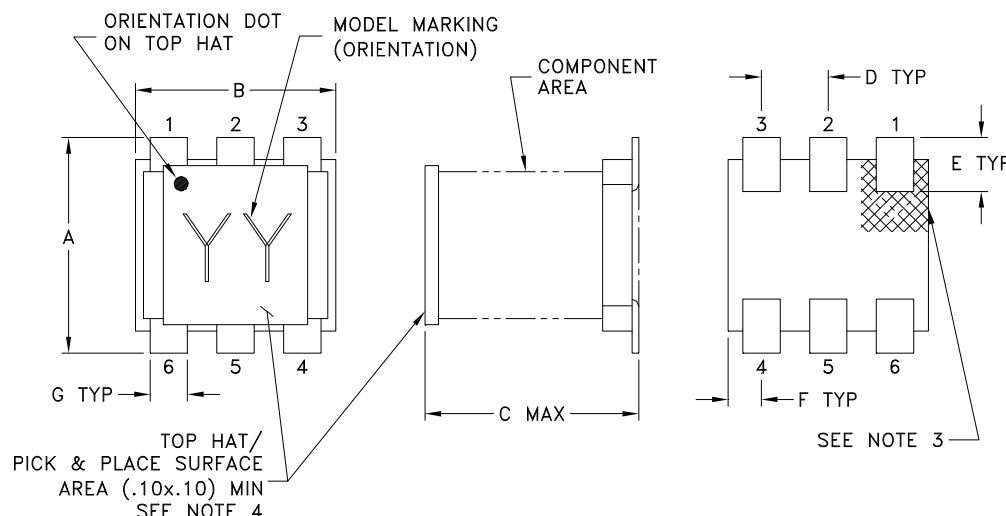
## TCD-9-1WX+

### Typical Performance Curves

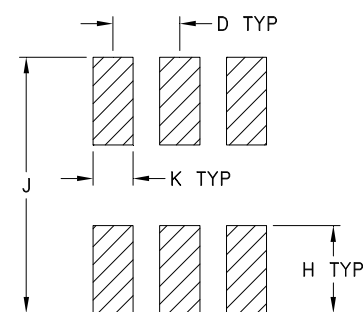


## Outline Dimensions

DB1627



## PCB Land Pattern



| CASE # | A              | B              | C              | D              | E              | F              | G              | H              | J              | K              | WT. GRAM |
|--------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------|
| DB1627 | .160<br>(4.06) | .150<br>(3.81) | .160<br>(4.06) | .050<br>(1.27) | .040<br>(1.02) | .025<br>(0.64) | .028<br>(0.71) | .065<br>(1.65) | .190<br>(4.83) | .030<br>(0.76) | .15      |

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

### Notes:

- Case material: Plastic.
- Termination finish:  
For RoHS Case Styles: Tin plate over Nickel plate. All models, (+) suffix.  
For RoHS-5 Case Styles: Tin-Lead plate. All models, no (+) suffix.
- Orientation dot on top hat & orientation feature on substrate correspondence to pin #1.
- Top-Hat total thickness: .013 inches MAX.



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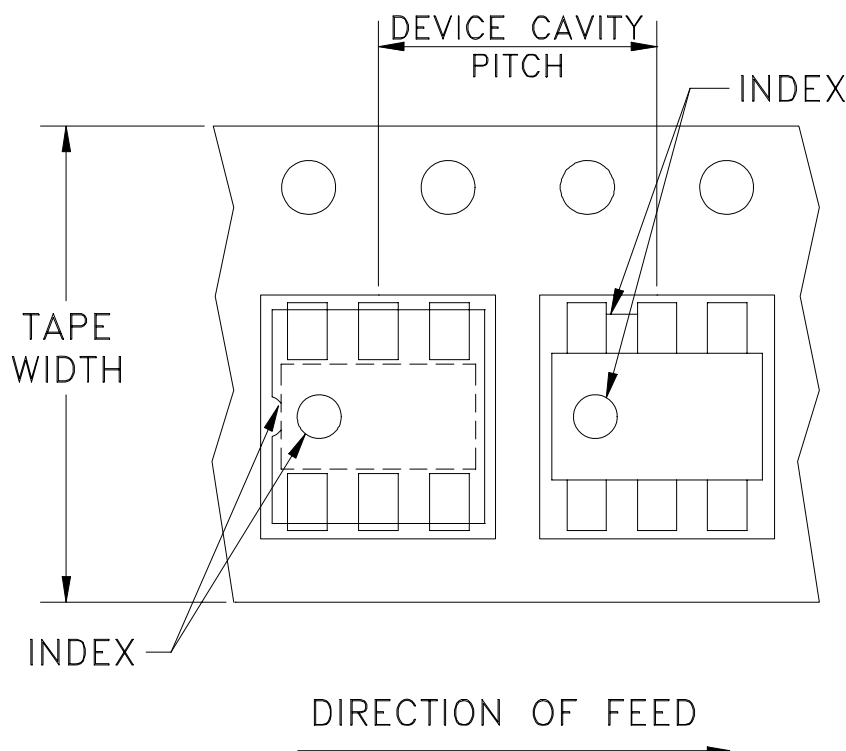
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RF/IF MICROWAVE COMPONENTS



# Tape & Reel Packaging TR-F47

## DEVICE ORIENTATION IN T&R



| Tape Width,<br>mm | Device Cavity<br>Pitch, mm | Reel Size,<br>inches | Devices per Reel<br>see note |
|-------------------|----------------------------|----------------------|------------------------------|
| 12                | 8                          | 13                   | 1000, 2000                   |
|                   |                            | 7                    | 20, 50, 100, 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)



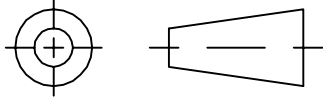
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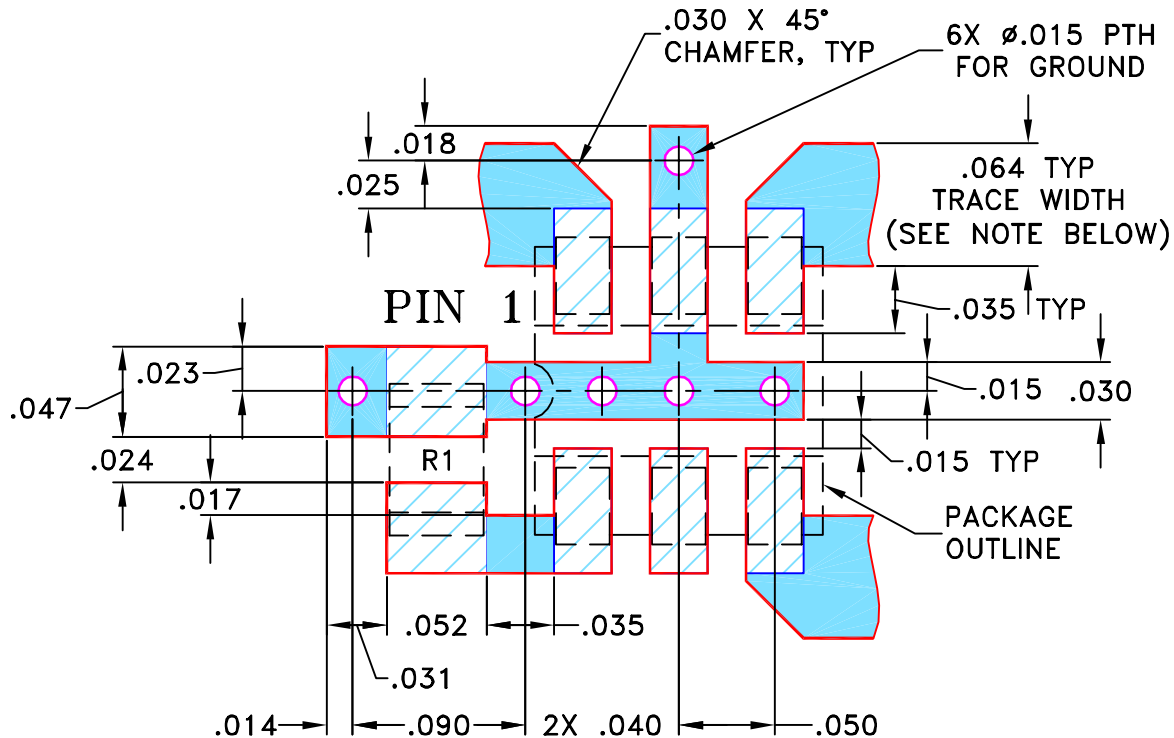
## THIRD ANGLE PROJECTION



## REVISIONS

| REV | ECN No. | DESCRIPTION     | DATE     | DR | AUTH |
|-----|---------|-----------------|----------|----|------|
| OR  | M73159  | NEW RELEASE     | 08/00    | IL | DB   |
| A   | M82377  | UPDATED DRAWING | 07/21/02 | AV | LC   |
| B   | M102713 | UPDATED NOTES   | 01/12/08 | GF | IL   |

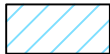
### SUGGESTED MOUNTING CONFIGURATION FOR DB714 CASE STYLE, "mm" PIN CONNECTION



RESISTOR R1:  $49.9 \pm 1\%$  Ohm, 0805 SIZE

**NOTES:** 1. TRACE WIDTH IS SHOWN FOR ROGERS RO4350B WITH DIELECTRIC THICKNESS  $0.030'' \pm 0.002''$ ; 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  $\pm .005$   
3 PL DECIMALS  $\pm$   
ANGLES  $\pm$   
FRACTIONS  $\pm$

DRAWN

IL

08/03/00

CHECKED

WP

08/08/00

APPROVED

DB

08/08/00

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



Mini-Circuits® 13 Neptune Avenue  
Brooklyn NY 11235

PL, mm, DB714, TCD, TB-71

SIZE  
A

CODE IDENT  
15542

DRAWING NO:  
98-PL-009

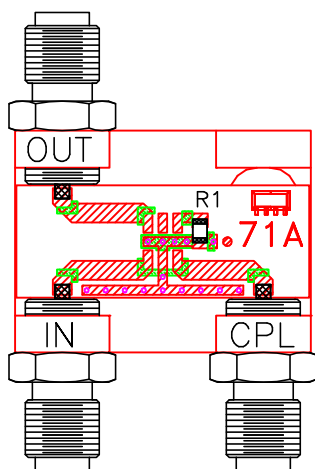
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FILE: 98PL009

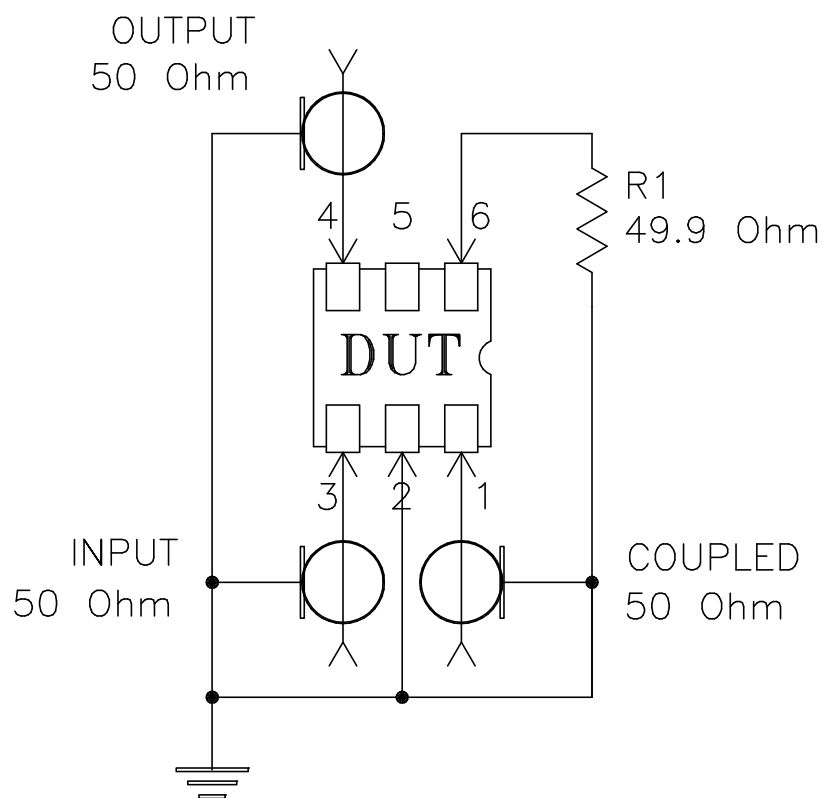
SCALE: 10:1

SHEET: 1 OF 1

# Evaluation Board and Circuit



TB-71



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                                                                              |