

# Surface Mount Directional Coupler

75Ω, 16dB coupling, 5 to 1500 MHz

## DBTC-16-5-75X+

### Features

- very flat coupling
- very broadband, multi octave
- temperature stable, LTCC base
- all welded construction
- leads attached for better solderability
- micro miniature coupler
- aqueous washable
- protected by US Patents 6,140,887 & 6,784,521

### Applications

- VHF/UHF receivers/transmitters
- cellular



Generic photo used for illustration purposes only

CASE STYLE: AT1667-1

#### +RoHS Compliant

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



Available Tape and Reel at no extra cost

| Reel Size | Devices/Reel     |
|-----------|------------------|
| 7"        | 20, 50, 100, 200 |
| 13"       | 500, 1000, 2000  |

### Electrical Specifications at 25°C

| Parameter                  | Condition (MHz) | Min. | Typ.     | Max. | Unit |
|----------------------------|-----------------|------|----------|------|------|
| Frequency Range            |                 | 5    |          | 1500 | MHz  |
| Mainline Loss <sup>1</sup> | 5-50            |      | 1.2      | 2.0  | dB   |
|                            | 50-500          |      | 1.0      | 1.5  |      |
|                            | 500-1000        |      | 1.1      | 1.6  |      |
|                            | 1000-1500       |      | 1.3      | 1.9  |      |
| Nominal Coupling           | 5-1000          |      | 16.3±0.5 |      | dB   |
|                            | 1000-1500       |      | 16.8±0.7 |      |      |
| Coupling Flatness(±)       | 5-1000          |      |          | ±0.7 | dB   |
|                            | 1000-1500       |      |          | ±0.7 |      |
| Directivity                | 5-50            | 16   | 22       |      | dB   |
|                            | 50-500          | 13   | 21       |      |      |
|                            | 500-1000        | —    | 20       |      |      |
|                            | 1000-1500       | —    | 19       |      |      |
| VSWR <sup>2</sup>          | 5-1000          |      | 1.3      |      | dB   |
|                            | 1000-1500       |      | 1.3      |      |      |
| Input Power                | 5-50            |      |          | 0.5  | W    |
|                            | 50-500          |      |          | 1.0  |      |
|                            | 500-1000        |      |          | 1.0  |      |
|                            | 1000-1500       |      |          | 1.0  |      |

1. Includes theoretical coupled power loss of 0.10 dB at 16 dB coupling.

2. For coupled port VSWR above 500 MHz, 1.6:1 typ.

### 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.

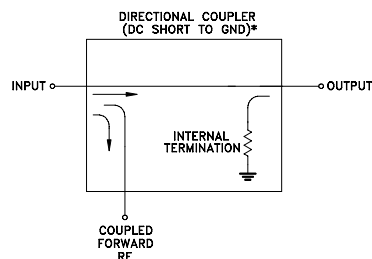
### Pin Connections

| Function             | Pin Number |
|----------------------|------------|
| INPUT                | 3          |
| OUTPUT               | 4          |
| COUPLED              | 1          |
| GROUND               | 2          |
| ISOLATE (DO NOT USE) | 6          |

### Product Marking



### Electrical Schematic

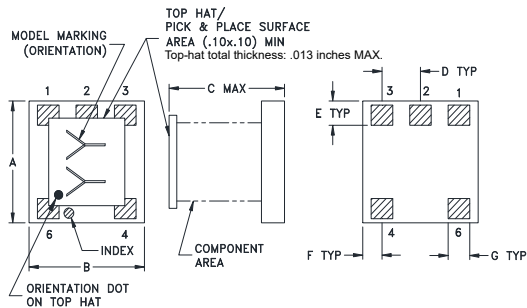


\* ELECTRICAL SCHEMATIC IS FOR DIRECTIONAL COUPLER WITH INTERNAL TRANSFORMER(S) THAT ROUTES DC FROM RF PORTS TO GROUND.

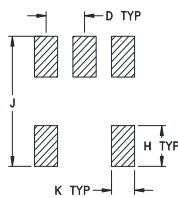


# DBTC-16-5-75X+

## Outline Drawing



## PCB Land Pattern

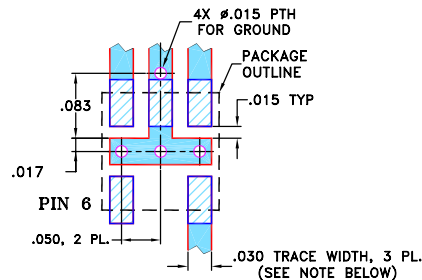


Suggested Layout,  
Tolerance to be within ±.002

## Outline Dimensions (inch)

| A    | B    | C    | D    | E     | F    |
|------|------|------|------|-------|------|
| .150 | .150 | .150 | .050 | .030  | .025 |
| 3.81 | 3.81 | 3.81 | 1.27 | 0.76  | 0.64 |
| G    | H    | J    | K    | wt    |      |
| .028 | .050 | .160 | .030 | grams |      |
| 0.71 | 1.27 | 4.06 | 0.76 | 0.10  |      |

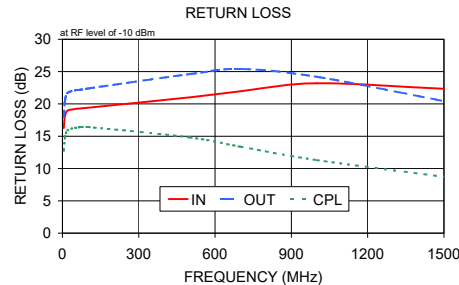
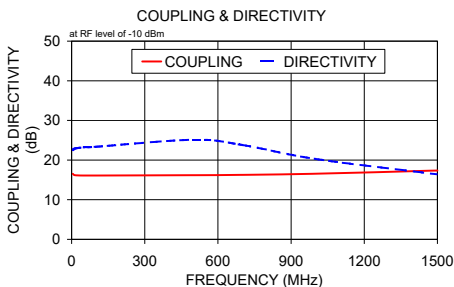
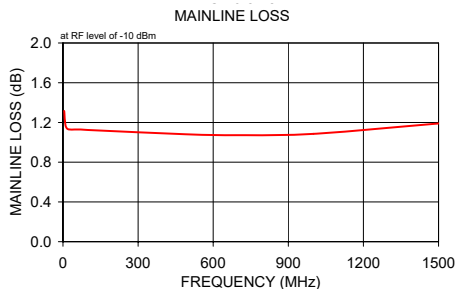
## Demo Board MCL P/N: TB-279 Suggested PCB Layout (PL-151)



- NOTES: 1. TRACE WIDTH IS SHOWN FOR ROGERS RO4350B WITH DIELECTRIC THICKNESS 0.030" ± 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

## Typical Performance Data

| Frequency (MHz) | Mainline Loss (dB) In-Out | Coupling (dB) In-Cpl | Directivity (dB) | Return Loss (dB) In | Return Loss (dB) Out | Cpl   |
|-----------------|---------------------------|----------------------|------------------|---------------------|----------------------|-------|
| 5.0             | 1.32                      | 16.54                | 22.53            | 16.26               | 17.94                | 12.74 |
| 10.0            | 1.18                      | 16.25                | 22.81            | 18.13               | 20.48                | 14.84 |
| 20.0            | 1.13                      | 16.14                | 23.00            | 18.94               | 21.68                | 15.90 |
| 50.0            | 1.13                      | 16.11                | 23.19            | 19.20               | 22.11                | 16.31 |
| 70.0            | 1.13                      | 16.10                | 23.23            | 19.30               | 22.19                | 16.37 |
| 100.0           | 1.12                      | 16.10                | 23.35            | 19.41               | 22.38                | 16.43 |
| 500.0           | 1.08                      | 16.18                | 25.13            | 21.01               | 24.62                | 14.81 |
| 700.0           | 1.07                      | 16.27                | 23.81            | 21.95               | 25.41                | 13.38 |
| 1000.0          | 1.09                      | 16.56                | 20.29            | 23.20               | 24.19                | 11.31 |
| 1500.0          | 1.19                      | 17.35                | 16.40            | 22.34               | 20.43                | 8.71  |



## Additional 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-Circuits' applicable established test performance criteria and measurement instructions.
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# Directional Coupler

## DBTC-16-5-75X+

### Typical Performance Data

| FREQUENCY<br>(MHz) | INSERTION<br>LOSS<br>(dB) | COUPLING<br>(dB) | DIRECTIVITY<br>(dB) | RETURN LOSS<br>(dB) |       |       |
|--------------------|---------------------------|------------------|---------------------|---------------------|-------|-------|
|                    |                           |                  |                     | IN                  | OUT   | CPL   |
| 5.0                | 1.32                      | 16.54            | 22.53               | 16.26               | 17.94 | 12.74 |
| 10.0               | 1.18                      | 16.25            | 22.81               | 18.13               | 20.48 | 14.84 |
| 20.0               | 1.13                      | 16.14            | 23.00               | 18.94               | 21.68 | 15.90 |
| 30.0               | 1.13                      | 16.12            | 23.04               | 19.10               | 21.90 | 16.15 |
| 40.0               | 1.13                      | 16.11            | 23.12               | 19.16               | 22.03 | 16.25 |
| 50.0               | 1.13                      | 16.11            | 23.19               | 19.20               | 22.11 | 16.31 |
| 60.0               | 1.13                      | 16.10            | 23.20               | 19.25               | 22.15 | 16.35 |
| 70.0               | 1.13                      | 16.10            | 23.23               | 19.30               | 22.19 | 16.37 |
| 80.0               | 1.13                      | 16.11            | 23.25               | 19.35               | 22.24 | 16.40 |
| 85.0               | 1.13                      | 16.10            | 23.29               | 19.37               | 22.28 | 16.41 |
| 90.0               | 1.13                      | 16.10            | 23.31               | 19.39               | 22.31 | 16.42 |
| 95.0               | 1.13                      | 16.10            | 23.33               | 19.40               | 22.34 | 16.42 |
| 100.0              | 1.12                      | 16.10            | 23.35               | 19.41               | 22.38 | 16.43 |
| 150.0              | 1.12                      | 16.11            | 23.84               | 19.55               | 22.85 | 16.41 |
| 200.0              | 1.12                      | 16.13            | 23.69               | 19.66               | 22.75 | 16.24 |
| 250.0              | 1.11                      | 16.14            | 24.02               | 19.90               | 23.04 | 16.08 |
| 300.0              | 1.11                      | 16.15            | 24.32               | 20.13               | 23.31 | 15.90 |
| 350.0              | 1.10                      | 16.16            | 24.64               | 20.30               | 23.63 | 15.65 |
| 400.0              | 1.09                      | 16.16            | 24.94               | 20.55               | 23.98 | 15.40 |
| 450.0              | 1.09                      | 16.17            | 25.14               | 20.71               | 24.28 | 15.13 |
| 500.0              | 1.08                      | 16.18            | 25.13               | 21.01               | 24.62 | 14.81 |
| 550.0              | 1.08                      | 16.19            | 25.00               | 21.24               | 24.80 | 14.43 |
| 600.0              | 1.07                      | 16.21            | 24.81               | 21.43               | 25.12 | 14.09 |
| 650.0              | 1.07                      | 16.24            | 24.40               | 21.78               | 25.19 | 13.74 |
| 700.0              | 1.07                      | 16.27            | 23.81               | 21.95               | 25.41 | 13.38 |
| 750.0              | 1.07                      | 16.30            | 23.24               | 22.26               | 25.37 | 12.98 |
| 800.0              | 1.07                      | 16.35            | 22.66               | 22.43               | 25.28 | 12.66 |
| 850.0              | 1.08                      | 16.39            | 22.01               | 22.73               | 25.15 | 12.31 |
| 900.0              | 1.08                      | 16.44            | 21.41               | 22.86               | 24.85 | 11.95 |
| 950.0              | 1.08                      | 16.50            | 20.85               | 23.08               | 24.63 | 11.63 |
| 1000.0             | 1.09                      | 16.56            | 20.29               | 23.20               | 24.19 | 11.31 |
| 1050.0             | 1.09                      | 16.62            | 19.80               | 23.24               | 23.86 | 11.00 |
| 1100.0             | 1.10                      | 16.69            | 19.30               | 23.29               | 23.39 | 10.68 |
| 1150.0             | 1.11                      | 16.77            | 18.86               | 23.23               | 22.96 | 10.40 |
| 1200.0             | 1.12                      | 16.85            | 18.44               | 23.19               | 22.54 | 10.11 |
| 1250.0             | 1.13                      | 16.92            | 18.06               | 23.08               | 22.11 | 9.85  |
| 1300.0             | 1.14                      | 17.01            | 17.68               | 23.02               | 21.79 | 9.58  |
| 1350.0             | 1.15                      | 17.09            | 17.34               | 22.85               | 21.35 | 9.37  |
| 1400.0             | 1.16                      | 17.17            | 17.03               | 22.67               | 21.05 | 9.11  |
| 1450.0             | 1.18                      | 17.26            | 16.69               | 22.55               | 20.66 | 8.89  |
| 1500.0             | 1.19                      | 17.35            | 16.40               | 22.34               | 20.43 | 8.71  |



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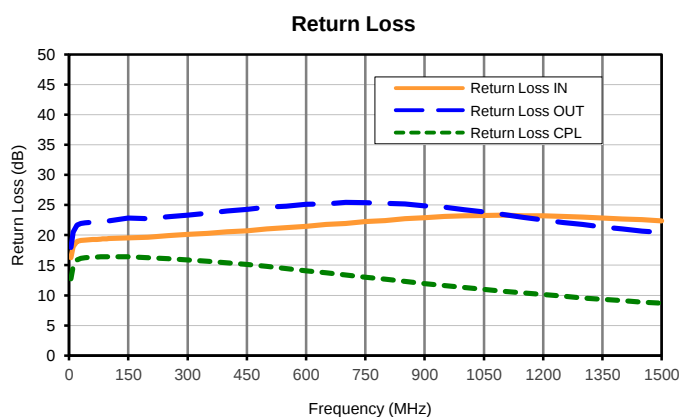
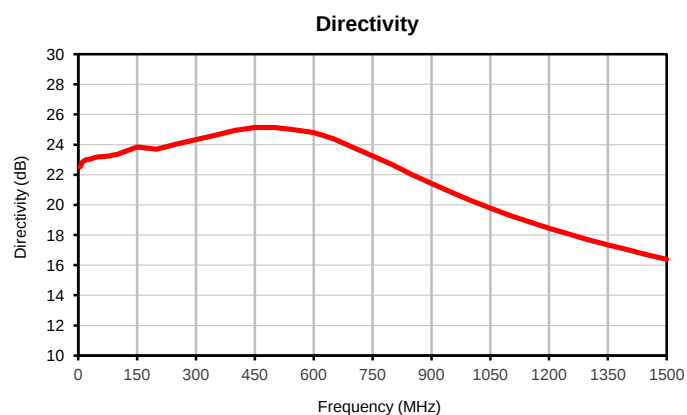
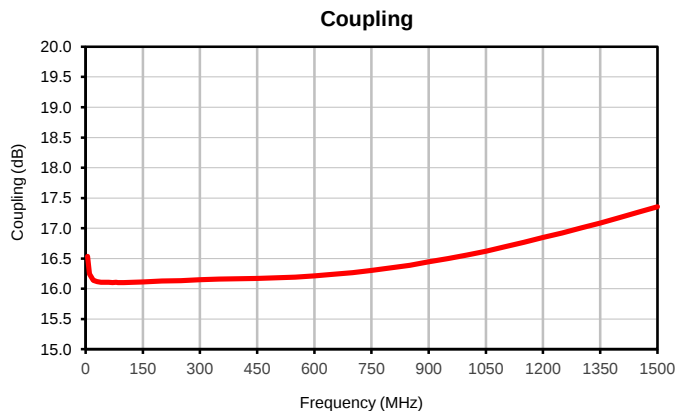
IF/RF MICROWAVE COMPONENTS

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DBTC-16-5-75X+  
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Page 1 of 1

# Directional Coupler

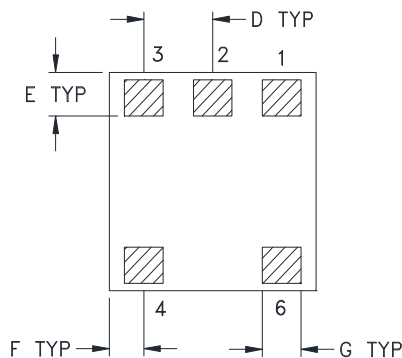
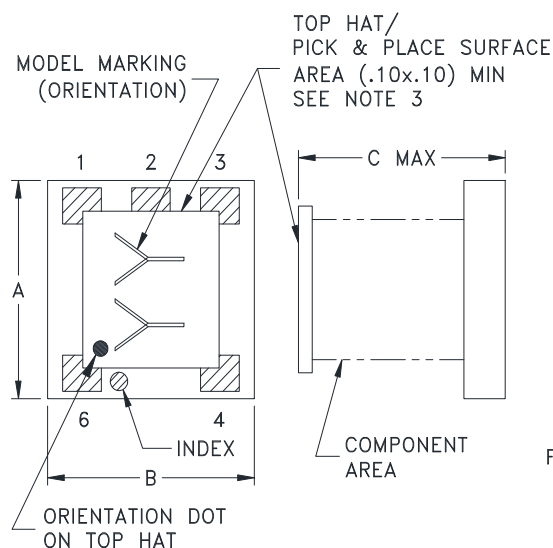
## DBTC-16-5-75X+

### Typical Performance Curves

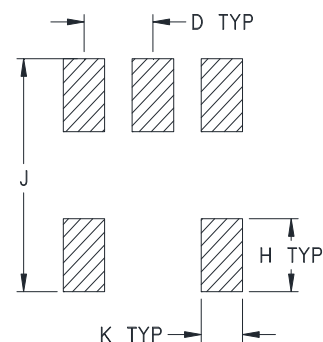


## Outline Dimensions

AT1667-1



## PCB Land Pattern



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

| CASE #   | A              | B              | C              | D              | E              | F              | G              | H              | J              | K              | L        | WT. GRAMS |
|----------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------|-----------|
| AT1667-1 | .150<br>(3.81) | .150<br>(3.81) | .150<br>(3.81) | .050<br>(1.27) | .030<br>(0.76) | .025<br>(0.64) | .028<br>(0.71) | .050<br>(1.27) | .160<br>(4.06) | .030<br>(0.76) | --<br>-- | .10       |

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

### Notes:

1. Open style, Ceramic base.
2. Termination finish: Palladium Silver.
3. Top-hat total thickness: .013 inches MAX.
4. Orientation Dot on Top Hat & Marking on the Substrate both refers to Pin #6 of the Unit.



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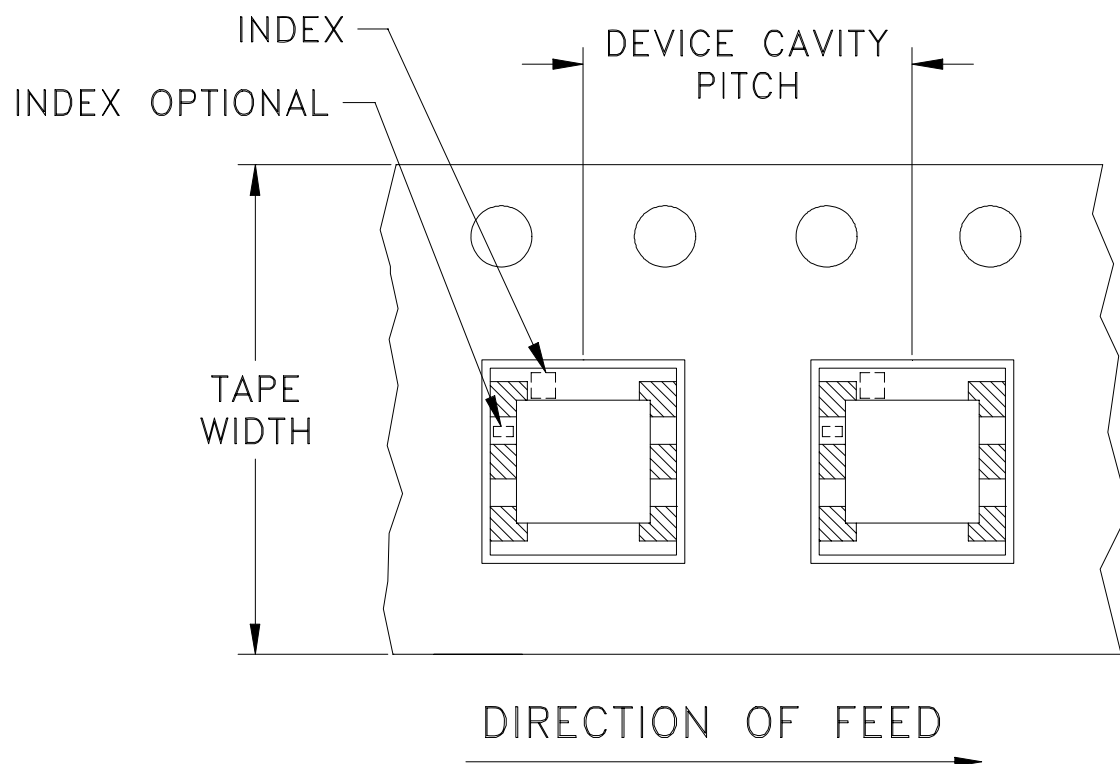


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RF/IF MICROWAVE COMPONENTS

# Tape & Reel Packaging TR-F15

## DEVICE ORIENTATION IN T&R



| Tape Width,<br>mm | Device Cavity<br>Pitch, mm | Reel Size,<br>inches | Devices per Reel |
|-------------------|----------------------------|----------------------|------------------|
| 12                | 8                          | 7                    | 20               |
|                   |                            |                      | 50               |
|                   |                            |                      | 100              |
|                   |                            |                      | 200              |
|                   |                            | 13                   | 500              |
|                   |                            |                      | 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.

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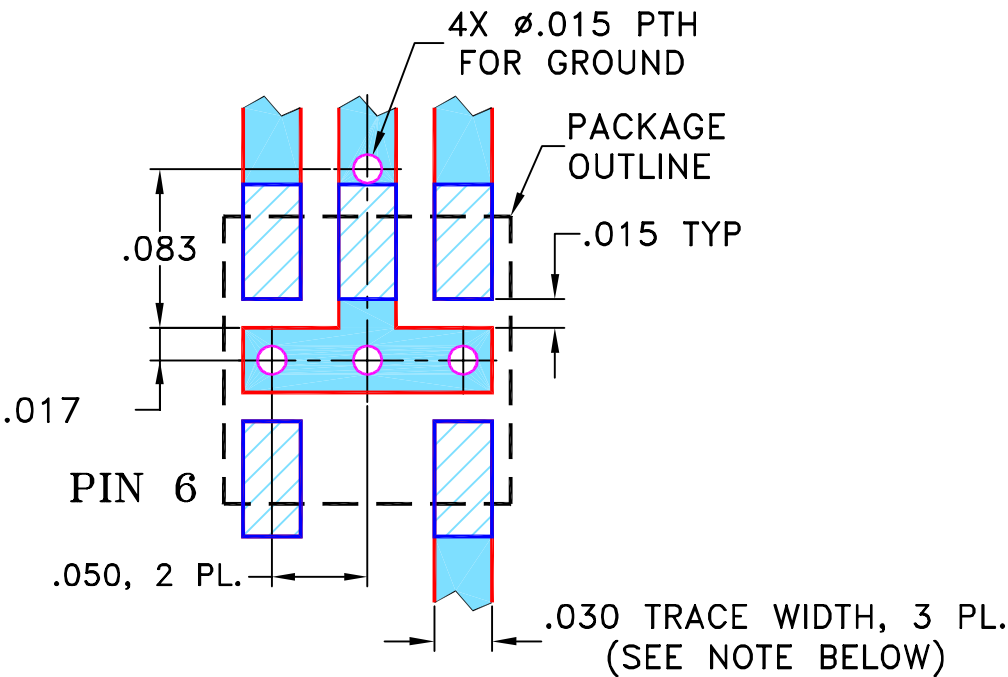
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THIRD ANGLE PROJECTION

| REVISIONS |         |                       |          |     |      |
|-----------|---------|-----------------------|----------|-----|------|
| REV/      | ECN No. | DESCRIPTION           | DATE     | DR  | AUTH |
| OR        | M90455  | NEW RELEASE           | 01/16/04 | AV  | WP   |
| A         | M102713 | ADDED "...WITH SMOBC" | 01/17/06 | MMG | IL   |
|           |         |                       |          |     |      |
|           |         |                       |          |     |      |

SUGGESTED MOUNTING CONFIGURATION FOR

AT1029 CASE STYLE, "na" PIN CONNECTION

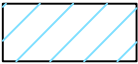


- NOTES: 1. TRACE WIDTH IS SHOWN FOR ROGERS RO4350B WITH DIELECTRIC THICKNESS 0.030" ± 0.002"; COPPER: 1/2 OZ. EACH SIDE. FOR OTHER MATERIALS TRACE WIDTH MAY NEED TO BE MODIFIED.

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<br>TOLERANCES ON:<br>2 PL DECIMALS ±<br>3 PL DECIMALS ± .005<br>ANGLES ±<br>FRACTIONS ±                                                                                                                                                                                                                                                                                                                                | DRAWN    | AV                               | 01/07/04 |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                 | CHECKED  | IL                               | 01/16/04 |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                 | APPROVED | WP                               | 01/16/04 |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                 |          |                                  |          |
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Brooklyn NY 11235

PL, na, 75, AT1029, DBTC, TB-279

SIZE

A

CODE IDENT

15542

DRAWING NO:

98-PL-151

REV:

A

FILE:

98PL151

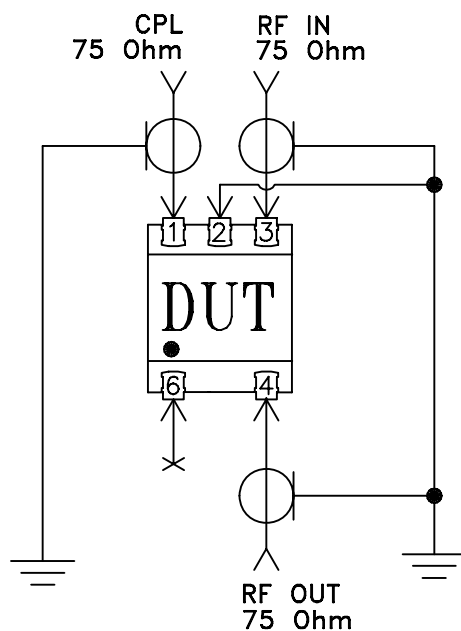
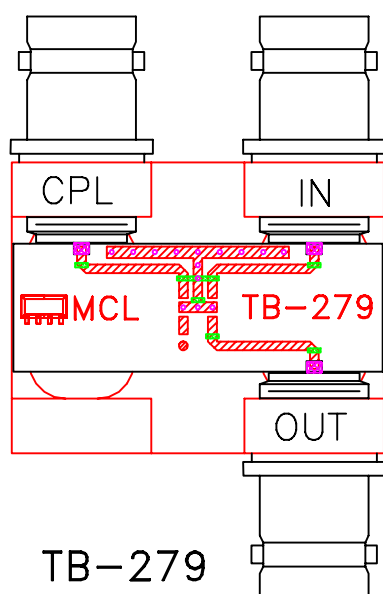
SCALE:

10:1

SHEET:

1 OF 1

# Evaluation Board and Circuit



Schematic Diagram

## Notes:

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

 **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                                                                              |