



Mini-Circuits

MICROWAVE PRECISION

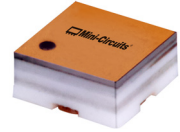
# Fixed Attenuator

RCAT-02+

50Ω 2 W 2 dB DC to 20 GHz

## THE BIG DEAL

- Wide Bandwidth, DC to 20 GHz
- Excellent Power Handling, 2 W
- Excellent Attenuation Accuracy & Flatness
- Miniature Size, 2.25 x 2.25 x 1.1 mm
- Ceramic, Hermetic, Nitrogen Filled
- Aqueous Washable



Generic photo used for illustration purposes only

CASE STYLE: LZ1737

### +RoHS Compliant

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

## APPLICATIONS

- Cellular
- PCS
- Communications
- Radar
- Wideband Military
- Test and Measurement Equipment

## PRODUCT OVERVIEW

RCAT-02+ (RoHS compliant) is a wideband fixed attenuator with excellent attenuation accuracy and flatness. It can handle up to 2 W. The integrated circuits comprising of thin film resistors is bonded in an optimized multi layer integrated LTCC substrate, and then hermetically sealed under a controlled nitrogen atmosphere with gold-plated covers and eutectic AuSn solder. These attenuators are capable of meeting MIL requirements for gross leak, fine leak, thermal shock, vibration, acceleration, mechanical shock, and HTOL. The testing can be done if requested.

## KEY FEATURES

| Feature                      | Advantages                                                                                                                                             |
|------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|
| Max Power Input 2 W          | Thermally optimized design can operate reliably at much higher input power as compared to similar devices                                              |
| Wide Bandwidth, DC to 20 GHz | Supports a broad band of applications with predictable and repeatable performance, excellent choice to buffer cascaded reflective components.          |
| Ceramic Hermetic Package     | Highly reliable hermetic package provides predictable and repeatable performance in military applications including ground, air, and ship requirements |
| Very Small Size              | Miniature 2.25 mm x 2.25 mm and very low profile of 1.1 mm.                                                                                            |

REV. C  
ECO-024243  
RCAT-02+  
MCL NY  
250116





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## ELECTRICAL SPECIFICATIONS<sup>1</sup> AT +25°C, 50Ω

| Parameter       | Condition (GHz) | Min. | Typ. | Max. | Unit |
|-----------------|-----------------|------|------|------|------|
| Frequency Range |                 | DC   |      | 20   | GHz  |
| Attenuation     | 1               | 1.5  | 2.04 | 2.5  | dB   |
|                 | 10              | 1.9  | 2.37 | 2.9  |      |
|                 | 20              | 1.9  | 2.73 | 3.5  |      |
| Return Loss     | 1               |      | 30   |      | dB   |
|                 | 10              |      | 18   |      |      |
|                 | 20              |      | 16   |      |      |

1. Tested using characterization test circuit as defined in Figure 1. See data and graphs for performance at all other frequencies.

## ABSOLUTE MAXIMUM RATINGS<sup>2</sup>

| Parameter                               | Ratings         |
|-----------------------------------------|-----------------|
| Operating Case Temperature <sup>3</sup> | -55°C to +125°C |
| Storage Temperature                     | -65°C to +150°C |
| RF Input Power <sup>4</sup>             | 2 W at +25°C    |

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

3. Case is defined as ground lead.

4. RF Power at +25°C case temperature: 2 W. Derate linearly to 0.33 W at +125°C.





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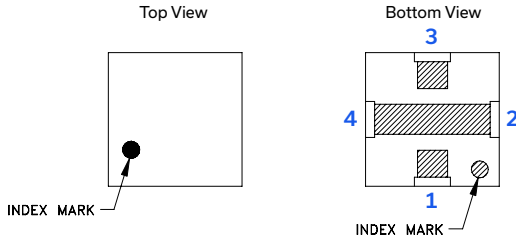
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## PAD DESCRIPTION

| Function       | Pad Number | Description                 |
|----------------|------------|-----------------------------|
| RF-IN / RF-OUT | 1          | RF input / output pad       |
| RF-OUT / RF-IN | 3          | RF input / output pad       |
| GND            | 2,4        | Connected to circuit ground |



## CHARACTERIZATION TEST CIRCUIT

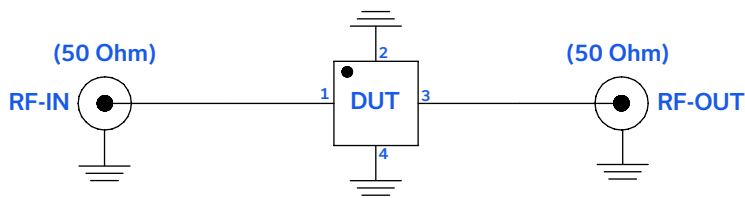
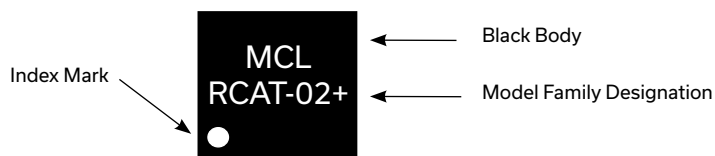


Fig 1. Block diagram of Test Circuit used for characterization. Characterization was performed by Modelithics, conditions test board details are available at: [www.modelithics.com/mvp/minicircuits](http://www.modelithics.com/mvp/minicircuits)

## PRODUCT MARKING



Marking may contain other features or characters for internal lot control.





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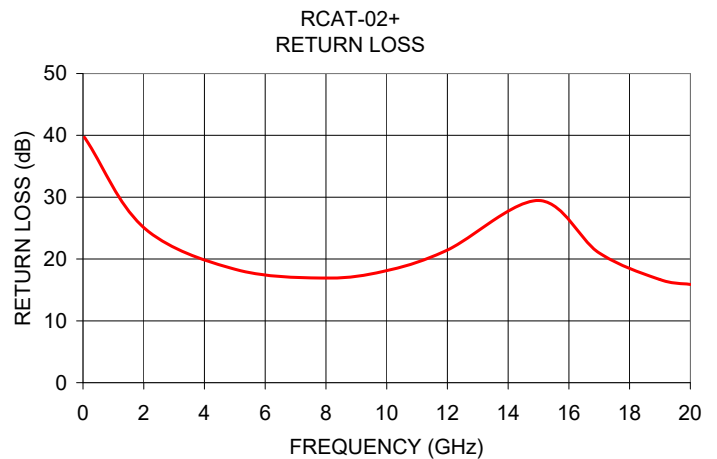
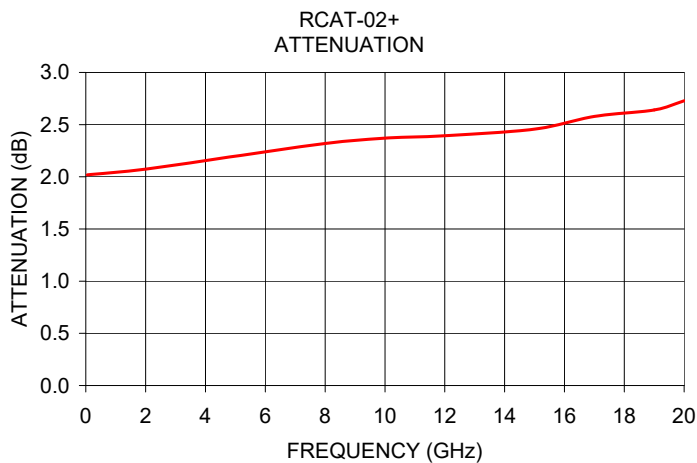
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TYPICAL PERFORMANCE DATA AT +25°C

| Frequency (GHz) | Attenuation (dB) | VSWR (:1) |
|-----------------|------------------|-----------|
| 0.05            | 2.02             | 39.68     |
| 2.00            | 2.07             | 25.08     |
| 5.00            | 2.20             | 18.35     |
| 8.00            | 2.32             | 16.92     |
| 10.00           | 2.37             | 18.13     |
| 12.00           | 2.39             | 21.46     |
| 15.00           | 2.46             | 29.46     |
| 17.00           | 2.58             | 20.99     |
| 19.00           | 2.64             | 16.67     |
| 20.00           | 2.73             | 15.89     |





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ADDITIONAL DETAILED TECHNICAL INFORMATION IS AVAILABLE ON OUR DASHBOARD. [CLICK HERE](#)

|                                 |                                                   |
|---------------------------------|---------------------------------------------------|
| Performance Data and Graphs     | Data Table                                        |
|                                 | Swept Graphs                                      |
| Case Style                      | LZ1737 Ceramic package, Terminal finish: Ni-Pd-Au |
| Tape & Reel                     | F66                                               |
| Suggested Layout for PCB Design | PL-386                                            |
| Evaluation Board                | TB-668-02+                                        |
| Environmental Ratings           | ENV71                                             |

## ESD RATING

Human Body Model (HBM): Class 1A (Pass 250 V) (JESD22-A114)

Machine Model (MM): Class B (Pass 200 V) (JESD22-A115)

## MSL RATING

Moisture Sensitivity: MSL1 in accordance with IPC/JEDEC J-STD-020D

## 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.
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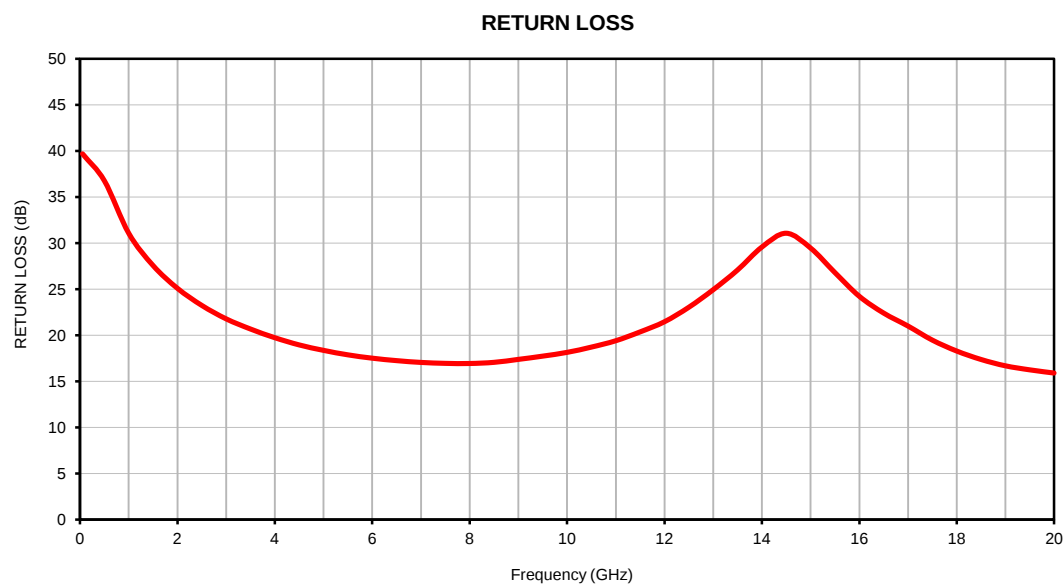
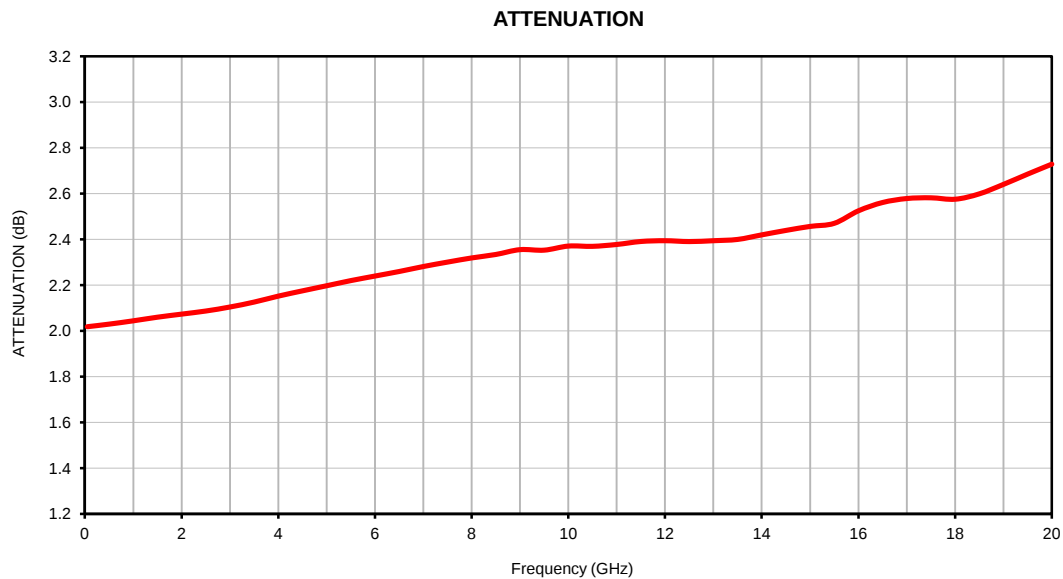
# Fixed Attenuator

# RCAT-02+

## Typical Performance Data

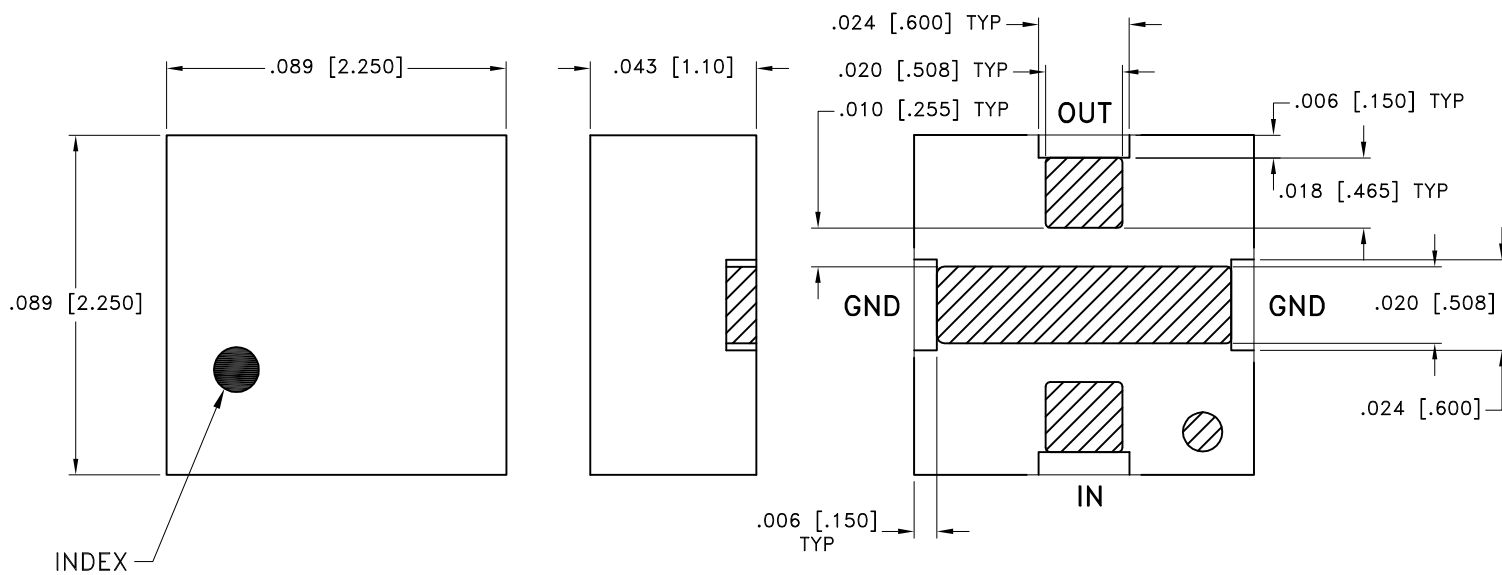
| FREQUENCY<br>(GHz) | ATTENUATION<br>(dB) | RETURN LOSS<br>(dB) |
|--------------------|---------------------|---------------------|
| 0.05               | 2.02                | 39.68               |
| 0.5                | 2.03                | 36.74               |
| 1.0                | 2.04                | 31.05               |
| 1.5                | 2.06                | 27.55               |
| 2.0                | 2.07                | 25.08               |
| 2.5                | 2.09                | 23.23               |
| 3.0                | 2.10                | 21.77               |
| 3.5                | 2.13                | 20.66               |
| 4.0                | 2.15                | 19.72               |
| 4.5                | 2.17                | 18.94               |
| 5.0                | 2.20                | 18.35               |
| 5.5                | 2.22                | 17.86               |
| 6.0                | 2.24                | 17.50               |
| 6.5                | 2.26                | 17.23               |
| 7.0                | 2.28                | 17.04               |
| 7.5                | 2.30                | 16.94               |
| 8.0                | 2.32                | 16.92               |
| 8.5                | 2.33                | 17.05               |
| 9.0                | 2.36                | 17.37               |
| 9.5                | 2.35                | 17.72               |
| 10.0               | 2.37                | 18.13               |
| 10.5               | 2.37                | 18.70               |
| 11.0               | 2.38                | 19.39               |
| 11.5               | 2.39                | 20.35               |
| 12.0               | 2.39                | 21.46               |
| 12.5               | 2.39                | 23.03               |
| 13.0               | 2.39                | 24.93               |
| 13.5               | 2.40                | 27.07               |
| 14.0               | 2.42                | 29.56               |
| 14.5               | 2.44                | 31.06               |
| 15.0               | 2.46                | 29.46               |
| 15.5               | 2.47                | 26.79               |
| 16.0               | 2.52                | 24.22               |
| 16.5               | 2.56                | 22.40               |
| 17.0               | 2.58                | 20.99               |
| 17.5               | 2.58                | 19.46               |
| 18.0               | 2.58                | 18.28               |
| 18.5               | 2.60                | 17.36               |
| 19.0               | 2.64                | 16.67               |
| 19.5               | 2.69                | 16.23               |
| 20.0               | 2.73                | 15.89               |

## Typical Performance Curves

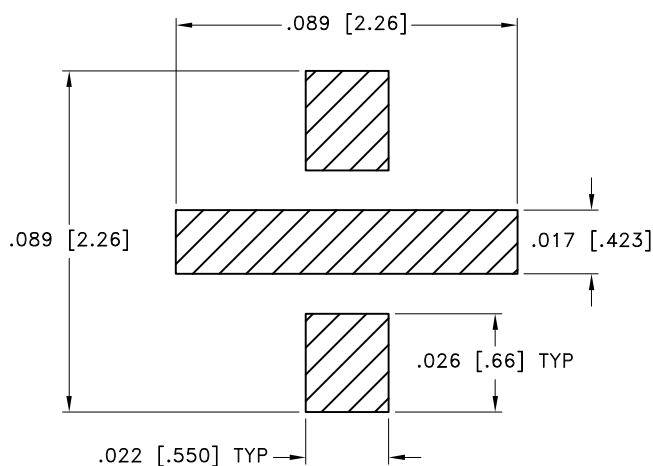


## Outline Dimensions

## LZ1737



### PCB LAND PATTERN



### SUGGESTED LAYOUT TOLERANCE TO BE WITHIN $\pm .002$

#### NOTES:

1.  DENOTES METALLIZATION

Weight: .015 grams

Dimensions are in inches [mm]. Tolerances: 2 Pl.  $\pm .01$ ; 3 Pl.  $\pm .005$  Inch

#### Notes:

1. Case material: Ceramic.
2. Base material: 36 mil thk laminate.
3. Termination finish: Electroless Nickel-Palladium-Gold Plate.



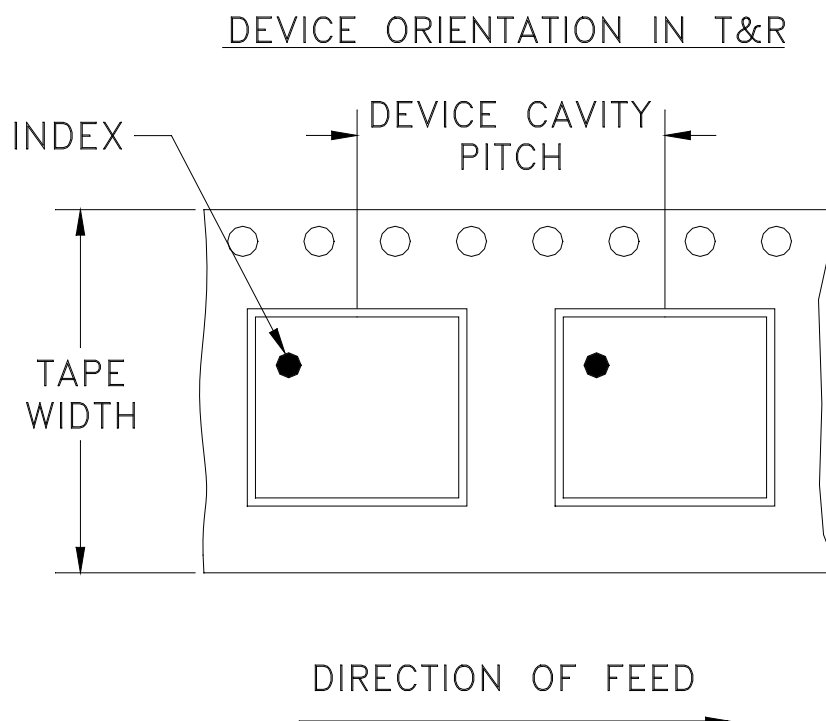
P.O. Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718) 332-4661 For detailed performance specs & shopping online see Mini-Circuits web site



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-F66



| Tape Width,<br>mm | Device Cavity<br>Pitch, mm | Reel Size,<br>inches | Devices per Reel<br>see note  |                  |
|-------------------|----------------------------|----------------------|-------------------------------|------------------|
| 8                 | 4                          | 7                    | Small<br>quantity<br>standard | 20               |
|                   |                            |                      |                               | 50               |
|                   |                            |                      |                               | 100              |
|                   |                            |                      |                               | 200              |
|                   |                            |                      |                               | 500              |
|                   |                            | 7                    | Standard                      | 1000, 2000, 3000 |

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)

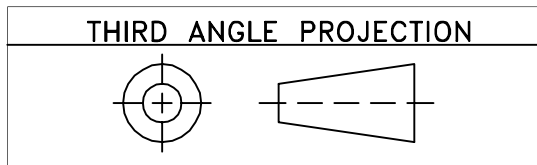


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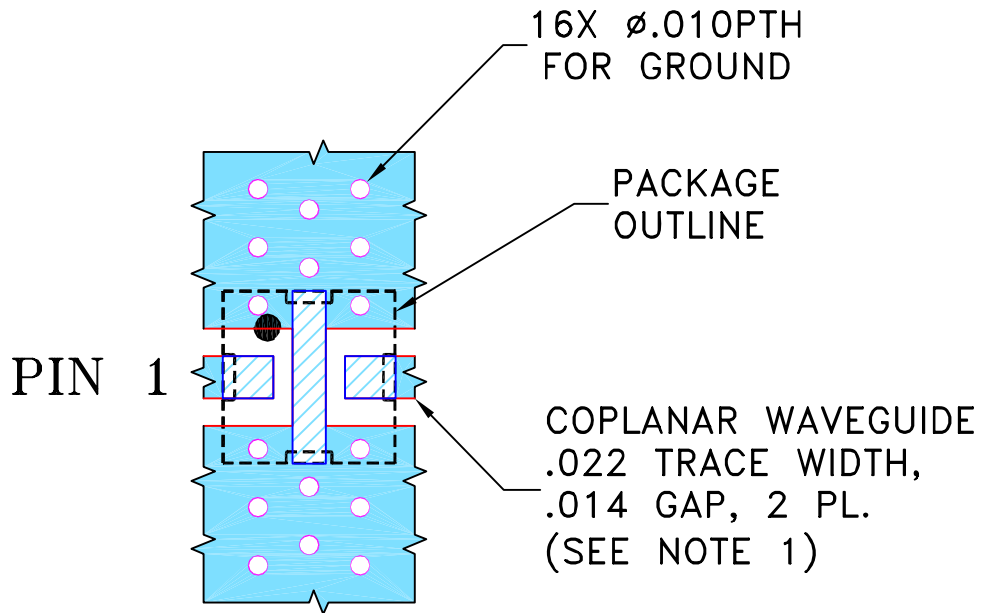
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| REVISIONS |         |                       |          |    |      |
|-----------|---------|-----------------------|----------|----|------|
| REV       | ECN No. | DESCRIPTION           | DATE     | DR | AUTH |
| OR        | M138802 | NEW RELEASE           | 12/07/12 | AV | BT   |
| A         | M142XXX | REDESIGNED PL-DRAWING | 07/17/13 | IL | RD   |
|           |         |                       |          |    |      |
|           |         |                       |          |    |      |

SUGGESTED MOUNTING CONFIGURATION FOR  
LZ1737 CASE STYLE, "04AF03" PIN CODE



NOTES:

1. COPLANAR WAVEGUIDE PARAMETERS ARE SHOWN FOR ROGERS RO4350B WITH DIELECTRIC THICKNESS .010"  $\pm$  .001"; COPPER: 1/2 OZ. EACH SIDE. FOR OTHER MATERIALS TRACE WIDTH AND GAP MAY NEED TO BE MODIFIED.
2. BOTTOM SIDE OF THE PCB IS CONTINUOUS GROUND PLANE.
3. IN ORDER TO ACHIEVE PERFORMANCE AT HIGHER FREQUENCIES, THICKNESS OF SOLDER MASK SHALL BE MINIMAL.



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 $\pm$<br>3 PL DECIMALS $\pm$ .005<br>ANGLES $\pm$<br>FRACTIONS $\pm$ | DRAWN    | AV | 09/19/12 |
|                                                                                                                                  | CHECKED  | IL | 10/11/12 |
|                                                                                                                                  | APPROVED | BT | 12/07/12 |
|                                                                                                                                  |          |    |          |



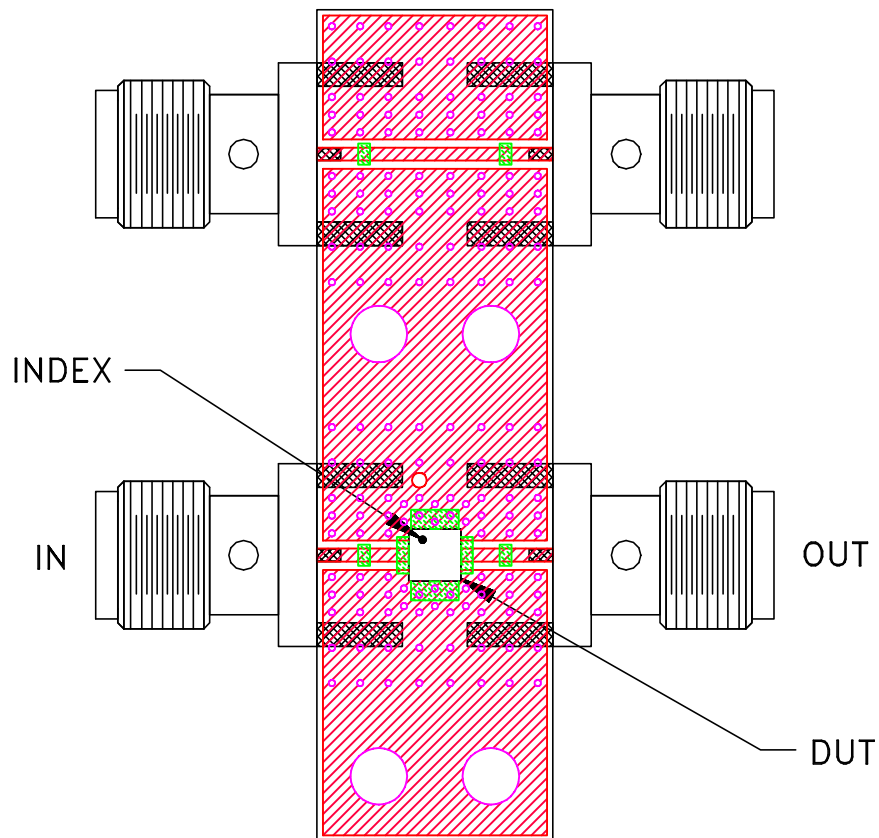
Mini-Circuits® 13 Neptune Avenue  
Brooklyn NY 11235

PL, 04AF03, LZ1737, TB-668-XX+

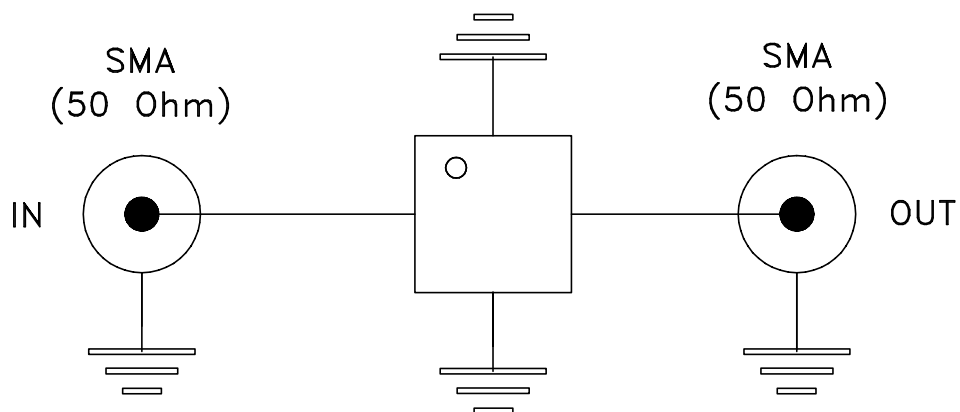
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| ASHEETA1.DWG REV:A                                                                                                                                                                                                                                   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

| SIZE  | CODE IDENT | DRAWING NO: | REV:          |
|-------|------------|-------------|---------------|
| A     | 15542      | 98-PL-386   | A             |
| FILE: | 98PL386    | SCALE: 10:1 | SHEET: 1 OF 1 |

# Evaluation Board and Circuit



TB-668-02+



Schematic Diagram

## Notes:

1. 50 Ohm SMA Female connectors.
2. PCB Material: R04350 or equivalent,  
Dielectric Constant=3.5, Thickness=.010 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        | -55° to 125° C<br>Ambient Environment                             | Individual Model Data Sheet          |
| Storage Temperature          | -65° to 150° C<br>Ambient Environment                             | Individual Model Data Sheet          |
| Thermal Shock (device level) | -55° to 125°C, 100 cycles                                         | MIL-STD-202, Method 107              |
| Thermal Shock (board level)  | -55° to 150°C, 1000 cycles                                        | MIL-STD-202, Method 107              |
| HTOL                         | 1000 hours, 25°C, @ rated power                                   | MIL-STD-202, Method 108, cond D.     |
| Constant Acceleration        | Y1 plane only, 30 Kg                                              | MIL-STD-883, Method 2001, Cond. E    |
| Vibration                    | 10-2000MHz sine, 20g, 3 axis                                      | MIL-STD-202, Method 204, Cond. 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 |
| PIND                         | 20G's @130 Hz                                                     | MIL-STD-750, Method 2052.2           |
| Resistance to Soldering Heat | 3X Reflow, Peak Temperature 260°C                                 | JESD22-B102                          |
| Moisture Sensitivity Level   | Hermetic device, MSL-1 by construction                            | JESD22-A113, MSL1/260                |
| Hermeticity                  | Fine Leak, Gross Leak                                             | MIL-STD-202, Method 112, Cond. C&D   |



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| Specification | Test/Inspection Condition         | Reference/Spec       |
|---------------|-----------------------------------|----------------------|
| Autoclave     | 15 psig, 100% RH, 121°C, 96 hours | JESD22 - Method A102 |