LTCC SURFACE MOUNT

# Low Pass Filter

# LFCG-360+

50Ω DC to 360 MHz

## THE BIG DEAL

- Insertion Loss, Typ. 0.9 dB
- Stopband Rejection, Typ. 46 dB
- Passband Return Loss, Typ. 19 dB
- 0805 Surface Mount Footprint
- Power Handling: 3 Watts

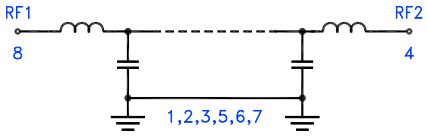


*Generic photo used for illustration purposes only*

## APPLICATIONS

- Harmonic Rejection
- VHF/UHF Transmitters / Receivers
- Test and Measurement Equipment
- Telecommunications & Broadband Wireless Applications
- Satcom Modems

## FUNCTIONAL DIAGRAM




## PRODUCT OVERVIEW

Mini-Circuits' LFCG-360+ is a miniature low temperature co-fired ceramic (LTCC) low pass filter with a DC to 360 MHz passband supporting a variety of applications. This model provides 0.9 dB typical insertion loss over a wide band due to its rugged monolithic construction. Housed in an 0805 ceramic form factor which is ideal for dense signal chain PCB layouts where it complements MMIC size and performance. The LTCC fabrication process assures minimal RF performance variation while delivering a product that is well suited for environmental extremes of high humidity and temperature.

## KEY FEATURES

| Features | Advantages |
|---|---|
| Ultra-wide Stopband | The LTCC lowpass filter provides a very good stopband rejection until 8500 MHz suitable for wide band applications. |
| LTCC Construction | Provides repeatable performance in a rugged, ceramic package well suited for tough environments such as high humidity and temperature extremes. |
| Small Size, 0805 | Saves space in dense circuit board layouts and minimizes the effects of parasitics. |
| Rugged Power Handling, 3 Watts | Handles up to 3 Watts in a small 0805 package. |

# Low Pass Filter

# LFCG-360+

50Ω DC to 360 MHz

## ELECTRICAL SPECIFICATIONS[1,2,3] AT +25°C

| Parameter | | F# | Frequency (MHz) | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|---|
| Passband | Insertion Loss | DC-F1 | DC - 360 | — | 0.9 | 1.6 | dB |
| | Freq. Cut-Off[4] | Fc | 500 | — | 3.0 | — | dB |
| | Return Loss | DC-F1 | DC - 360 | — | 19 | — | dB |
| Stopband | Rejection | F2-F3 | 630 - 830 | 20 | 37 | — | dB |
| | | F3-F4 | 830 - 1500 | 37 | 46 | — | |
| | | F4-F5 | 1500 - 3000 | 35 | 43 | — | |
| | | F5-F6 | 3000 - 8500 | — | 20 | — | |

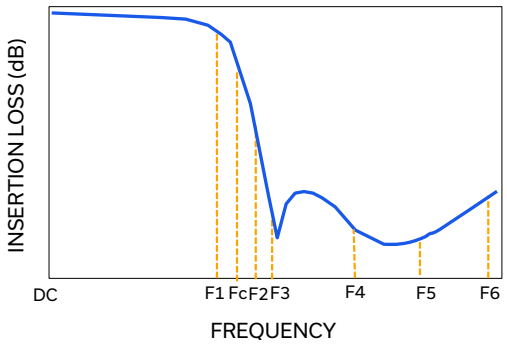
1. Tested in Evaluation Board P/N TB-LFCG-360+.
2. This filter is bi-directional, RF1 and RF2 ports may be interchanged. See S-Parameters for actual performance.
3. In applications where DC voltage and/or current is present at either the input or output ports, external DC blocking capacitors are required.
4. Typical variation ± 5%.

## ABSOLUTE MAXIMUM RATINGS[5]

| Parameter | Ratings |
|---|---|
| Operating Temperature | -55°C to +125°C |
| Storage Temperature | -55°C to +125°C |
| Input Power[6] | 3 W @ +25°C |

5. Permanent damage may occur if any of these limits are exceeded.
6. Power rating applies only to signals within the passband. Power rating above +25°C operating temperature decreases linearly to 0.7 W at +125°C.

## TYPICAL FREQUENCY RESPONSE AT +25°C



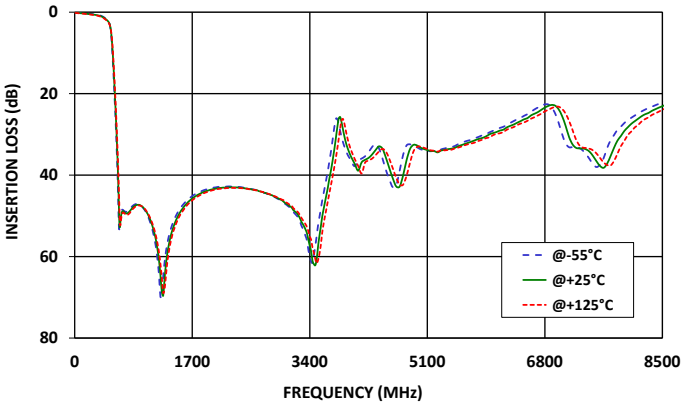
# Low Pass Filter

# LFCG-360+

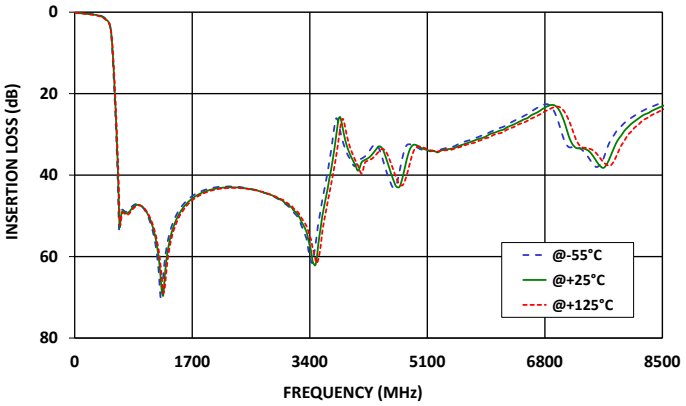
50Ω DC to 360 MHz

## TYPICAL PERFORMANCE GRAPHS

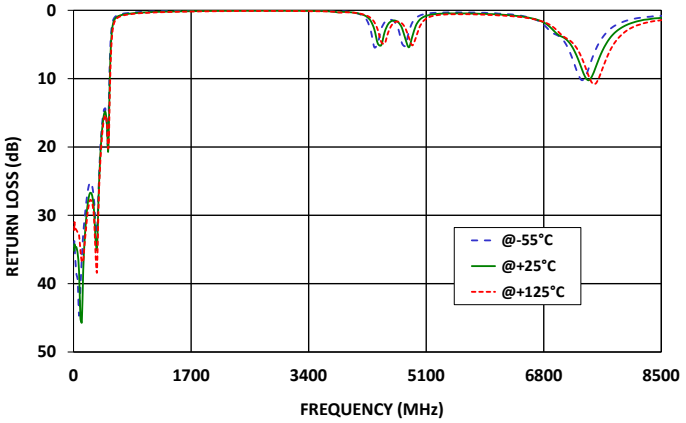
LFCG-360+
INSERTION LOSS



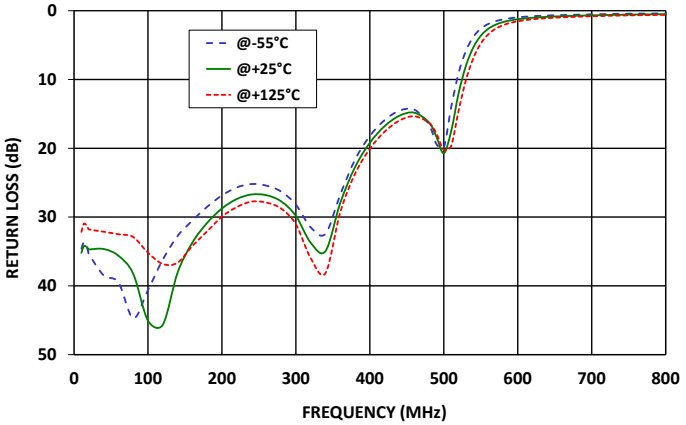

LFCG-360+
INSERTION LOSS



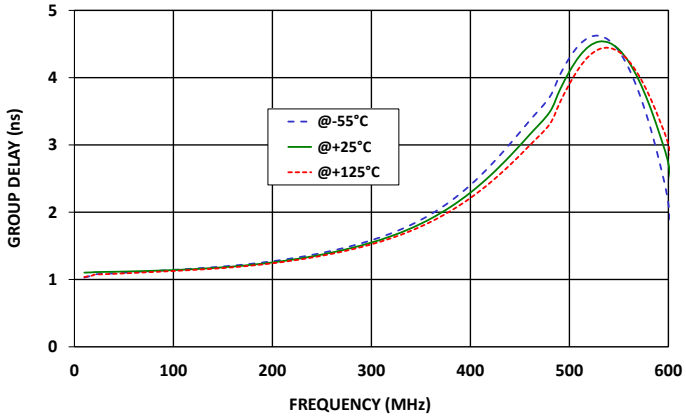

LFCG-360+
RETURN LOSS




LFCG-360+
RETURN LOSS (Zoomed)




LFCG-360+
GROUP DELAY



# Low Pass Filter

# LFCG-360+

50Ω DC to 360 MHz

## FUNCTIONAL DIAGRAM

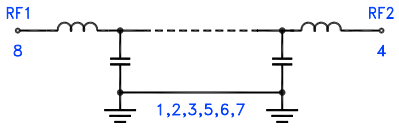
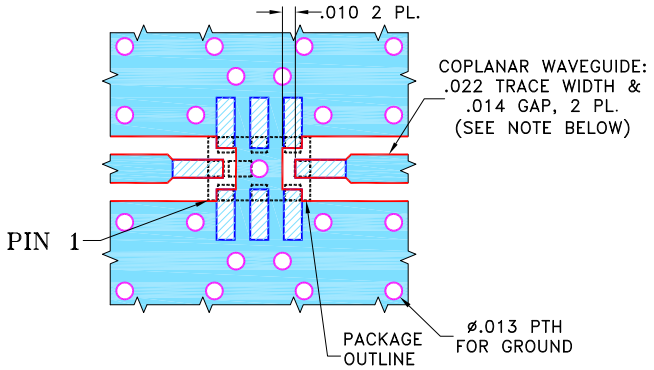



Figure 1. LFCG-360+ Functional Diagram

## PAD DESCRIPTION

| Function | Pad Number | Description |
|---|---|---|
| RF1[2] | 8 | Connects to RF Input Port |
| RF2[2] | 4 | Connects to RF Output Port |
| GROUND | 1,2,3,5,6,7 | Connects to Ground on PCB, (See drawing PL-429) |

## SUGGESTED PCB LAYOUT (PL-429)




NOTES:

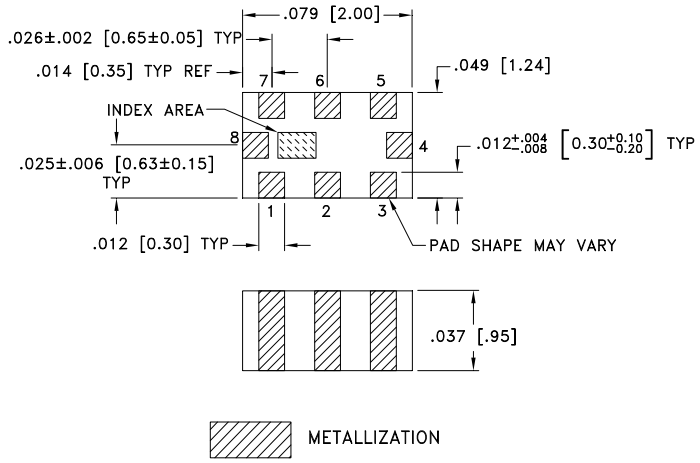
1. COPLANAR WAVEGUIDE IS SHOWN FOR ROGERS RO4350B WITH DIELECTRIC THICKNESS .010" ± .001". COPPER: 1/2 OZ. EACH SIDE. FOR OTHER MATERIALS TRACE WIDTH AND GAP MAY NEED TO BE MODIFIED.
2. BOTTOM SIDE OF THE PCB IS CONTINUOUS GROUND PLANE.

DENOTES PCB COPPER LAYOUT WITH SMOBC (SOLDER MASK OVER BARE COPPER).

DENOTES COPPER LAND PATTERN FREE OF SOLDER MASK.

Figure 2. Suggested PCB Layout PL-429

## CASE STYLE DRAWING




Weight: .008 grams
Dimensions are in inches (mm). Tolerances: 2Pl. ± .01; 3 Pl. ± .005

## PRODUCT MARKING*: WF

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

# Low Pass Filter

## LFCG-360+

50Ω DC to 360 MHz

**ADDITIONAL DETAILED INFORMATION IS AVAILABLE ON OUR DASHBOARD.** CLICK HERE

| | |
|---|---|
| **Performance Data and Graphs** | Data<br>Graphs<br>S-Parameter (S2P Files) Data Set (.zip file) De-embedded to device pads |
| **Case Style** | GE0805C-2 Lead Finish: Tin over Nickel plating |
| **RoHS Status** | Compliant |
| **Tape and Reel** | F114 |
| **Suggested Layout for PCB Design** | PL-429 |
| **Evaluation Board** | TB-LFCG-360+ |
| | Gerber File |
| **Environmental Rating** | ENV06T11 |

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.
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

# Ceramic Low Pass Filter LFCG-360+

*Typical Performance Data*

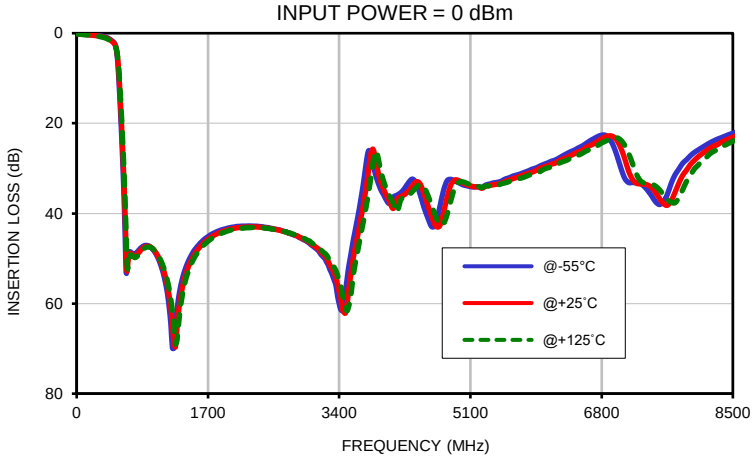
| FREQ. | INSERTION LOSS | | | INPUT RETURN LOSS | | | OUTPUT RETURN LOSS | | |
|---|---|---|---|---|---|---|---|---|---|
| (MHz) | (dB) | | | (dB) | | | (dB) | | |
| | @-55°C | @+25˚C | @+125˚C | @-55°C | @+25˚C | @+125˚C | @-55°C | @+25˚C | @+125˚C |
| 10 | 0.12 | 0.15 | 0.19 | 34.58 | 35.20 | 32.15 | 35.25 | 35.66 | 32.50 |
| 20 | 0.13 | 0.17 | 0.21 | 35.37 | 34.70 | 31.80 | 34.63 | 33.99 | 31.45 |
| 16 | 0.13 | 0.16 | 0.20 | 34.11 | 34.26 | 31.08 | 34.33 | 34.29 | 31.26 |
| 40 | 0.15 | 0.20 | 0.24 | 38.48 | 34.64 | 32.13 | 34.47 | 32.09 | 30.54 |
| 60 | 0.18 | 0.22 | 0.27 | 39.49 | 35.62 | 32.50 | 30.74 | 29.67 | 28.29 |
| 80 | 0.20 | 0.25 | 0.30 | 44.70 | 38.24 | 32.90 | 28.86 | 28.02 | 26.87 |
| 100 | 0.23 | 0.28 | 0.33 | 40.60 | 45.07 | 35.17 | 26.60 | 26.33 | 25.32 |
| 120 | 0.25 | 0.31 | 0.37 | 36.20 | 45.66 | 36.82 | 25.20 | 24.90 | 24.24 |
| 140 | 0.28 | 0.34 | 0.40 | 32.75 | 38.08 | 36.63 | 23.66 | 23.51 | 23.00 |
| 160 | 0.31 | 0.37 | 0.44 | 30.51 | 33.72 | 34.19 | 22.48 | 22.42 | 22.05 |
| 180 | 0.34 | 0.41 | 0.47 | 28.51 | 30.84 | 32.08 | 21.55 | 21.57 | 21.25 |
| 200 | 0.37 | 0.45 | 0.52 | 26.86 | 28.75 | 29.93 | 21.01 | 21.04 | 20.80 |
| 220 | 0.41 | 0.49 | 0.56 | 25.69 | 27.38 | 28.55 | 20.83 | 20.82 | 20.61 |
| 240 | 0.45 | 0.53 | 0.60 | 25.20 | 26.72 | 27.75 | 20.87 | 20.85 | 20.65 |
| 260 | 0.48 | 0.57 | 0.65 | 25.43 | 26.82 | 27.89 | 21.38 | 21.34 | 21.12 |
| 280 | 0.52 | 0.62 | 0.71 | 26.29 | 27.71 | 28.76 | 22.44 | 22.42 | 22.09 |
| 300 | 0.57 | 0.67 | 0.76 | 28.20 | 29.83 | 31.05 | 24.83 | 24.59 | 24.07 |
| 320 | 0.62 | 0.73 | 0.83 | 31.49 | 33.73 | 35.98 | 29.68 | 28.68 | 27.44 |
| 340 | 0.68 | 0.80 | 0.91 | 32.43 | 34.94 | 38.13 | 43.04 | 35.82 | 32.40 |
| 360 | 0.77 | 0.89 | 1.01 | 26.72 | 27.94 | 29.29 | 27.91 | 28.60 | 28.61 |
| 380 | 0.88 | 1.01 | 1.13 | 21.66 | 22.74 | 23.71 | 21.55 | 22.34 | 22.85 |
| 400 | 1.03 | 1.16 | 1.29 | 18.22 | 19.20 | 20.08 | 17.74 | 18.47 | 19.00 |
| 420 | 1.22 | 1.35 | 1.49 | 15.90 | 16.78 | 17.58 | 15.27 | 15.93 | 16.41 |
| 440 | 1.45 | 1.59 | 1.73 | 14.54 | 15.27 | 15.97 | 13.89 | 14.41 | 14.80 |
| 460 | 1.70 | 1.86 | 2.02 | 14.37 | 14.82 | 15.34 | 13.80 | 14.00 | 14.22 |
| 480 | 2.01 | 2.19 | 2.37 | 16.56 | 16.25 | 16.29 | 15.80 | 15.19 | 14.96 |
| 490 | 2.24 | 2.41 | 2.60 | 19.39 | 18.34 | 17.86 | 17.90 | 16.63 | 15.99 |
| 500 | 2.61 | 2.72 | 2.90 | 19.88 | 20.73 | 20.23 | 18.20 | 17.86 | 17.13 |
| 630 | 46.67 | 41.87 | 38.63 | 0.74 | 0.95 | 1.15 | 2.44 | 2.95 | 3.48 |
| 730 | 49.00 | 49.28 | 49.58 | 0.46 | 0.60 | 0.72 | 1.24 | 1.53 | 1.83 |
| 770 | 48.78 | 49.29 | 49.71 | 0.41 | 0.54 | 0.64 | 0.92 | 1.15 | 1.38 |
| 810 | 48.05 | 48.57 | 49.01 | 0.37 | 0.49 | 0.59 | 0.69 | 0.87 | 1.06 |
| 830 | 47.68 | 48.15 | 48.57 | 0.35 | 0.47 | 0.56 | 0.60 | 0.76 | 0.93 |
| 900 | 47.09 | 47.31 | 47.53 | 0.29 | 0.39 | 0.48 | 0.38 | 0.50 | 0.62 |
| 830 | 47.68 | 48.15 | 48.57 | 0.35 | 0.47 | 0.56 | 0.60 | 0.76 | 0.93 |
| 1100 | 52.04 | 51.28 | 50.86 | 0.18 | 0.28 | 0.34 | 0.13 | 0.20 | 0.28 |
| 1200 | 61.14 | 58.51 | 56.97 | 0.15 | 0.23 | 0.30 | 0.07 | 0.14 | 0.21 |
| 1300 | 61.42 | 65.37 | 68.11 | 0.12 | 0.20 | 0.27 | 0.04 | 0.10 | 0.16 |
| 1400 | 52.69 | 54.21 | 55.55 | 0.10 | 0.18 | 0.24 | 0.01 | 0.08 | 0.13 |
| 1500 | 48.85 | 49.86 | 50.61 | 0.08 | 0.16 | 0.22 | 0.01 | 0.07 | 0.12 |
| 1600 | 46.61 | 47.35 | 47.92 | 0.06 | 0.14 | 0.20 | 0.01 | 0.06 | 0.12 |
| 1700 | 45.16 | 45.74 | 46.19 | 0.04 | 0.13 | 0.18 | 0.01 | 0.05 | 0.10 |
| 1800 | 44.18 | 44.67 | 45.03 | 0.03 | 0.11 | 0.17 | 0.01 | 0.05 | 0.10 |
| 1900 | 43.53 | 43.93 | 44.24 | 0.02 | 0.11 | 0.15 | 0.01 | 0.05 | 0.10 |
| 2000 | 43.10 | 43.44 | 43.69 | 0.01 | 0.09 | 0.14 | 0.01 | 0.05 | 0.10 |
| 2200 | 42.81 | 43.04 | 43.18 | 0.01 | 0.08 | 0.12 | 0.01 | 0.06 | 0.11 |
| 2400 | 42.95 | 43.11 | 43.20 | 0.01 | 0.07 | 0.11 | 0.00 | 0.07 | 0.12 |
| 2600 | 43.58 | 43.63 | 43.65 | 0.03 | 0.06 | 0.09 | 0.01 | 0.08 | 0.14 |
| 2800 | 44.69 | 44.65 | 44.59 | 0.01 | 0.07 | 0.10 | 0.01 | 0.09 | 0.16 |
| 3000 | 46.42 | 46.21 | 46.04 | 0.04 | 0.05 | 0.08 | 0.03 | 0.11 | 0.18 |
| 3200 | 49.75 | 49.14 | 48.70 | 0.00 | 0.08 | 0.11 | 0.03 | 0.12 | 0.20 |
| 3400 | 59.99 | 57.37 | 55.14 | 0.00 | 0.09 | 0.12 | 0.06 | 0.15 | 0.24 |
| 3600 | 44.47 | 48.36 | 51.94 | 0.05 | 0.12 | 0.15 | 0.11 | 0.19 | 0.28 |
| 3800 | 26.31 | 28.04 | 33.29 | 0.19 | 0.26 | 0.24 | 1.50 | 1.36 | 0.72 |
| 4000 | 36.67 | 35.58 | 34.00 | 0.23 | 0.28 | 0.31 | 0.12 | 0.25 | 0.42 |
| 4500 | 38.70 | 35.67 | 34.18 | 1.74 | 3.16 | 4.85 | 0.08 | 0.21 | 0.35 |
| 5000 | 33.64 | 33.24 | 32.98 | 0.81 | 1.45 | 2.54 | 0.12 | 0.27 | 0.42 |
| 5500 | 32.84 | 33.28 | 33.43 | 0.31 | 0.46 | 0.57 | 0.19 | 0.35 | 0.50 |
| 6000 | 29.50 | 29.97 | 30.72 | 0.41 | 0.55 | 0.67 | 0.27 | 0.43 | 0.58 |
| 8500 | 22.19 | 23.08 | 23.96 | 0.81 | 1.10 | 1.44 | 1.14 | 1.15 | 1.19 |

*Typical Performance Data*

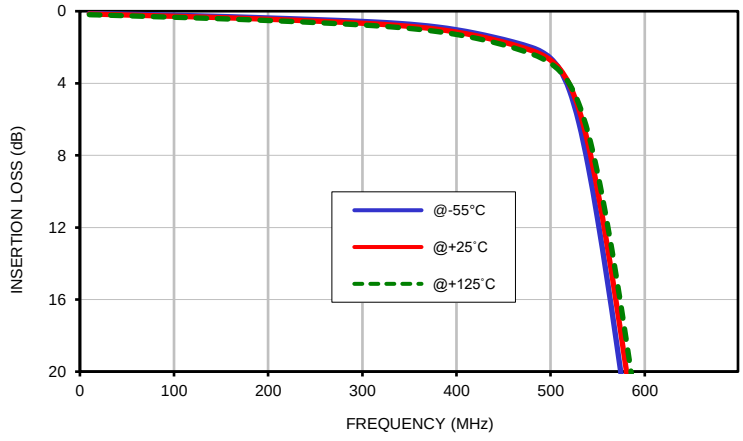
| FREQ. (MHz) | GROUP DELAY (nsec) | | |
|---|---|---|---|
| | @-55°C | @+25˚C | @+125˚C |
| 10.00 | 1.03 | 1.10 | 1.04 |
| 13.00 | 1.04 | 1.10 | 1.05 |
| 16.00 | 1.05 | 1.11 | 1.05 |
| 19.00 | 1.06 | 1.11 | 1.06 |
| 20.00 | 1.08 | 1.11 | 1.07 |
| 40.00 | 1.09 | 1.12 | 1.08 |
| 60.00 | 1.11 | 1.12 | 1.10 |
| 80.00 | 1.13 | 1.13 | 1.11 |
| 100.00 | 1.14 | 1.14 | 1.13 |
| 120.00 | 1.16 | 1.15 | 1.14 |
| 140.00 | 1.18 | 1.17 | 1.16 |
| 160.00 | 1.21 | 1.19 | 1.18 |
| 180.00 | 1.24 | 1.22 | 1.21 |
| 200.00 | 1.27 | 1.25 | 1.24 |
| 220.00 | 1.32 | 1.30 | 1.28 |
| 240.00 | 1.37 | 1.34 | 1.33 |
| 260.00 | 1.43 | 1.40 | 1.38 |
| 280.00 | 1.50 | 1.47 | 1.45 |
| 300.00 | 1.58 | 1.55 | 1.52 |
| 320.00 | 1.69 | 1.64 | 1.61 |
| 340.00 | 1.81 | 1.76 | 1.72 |
| 360.00 | 1.97 | 1.91 | 1.86 |

*Typical Performance Curves*

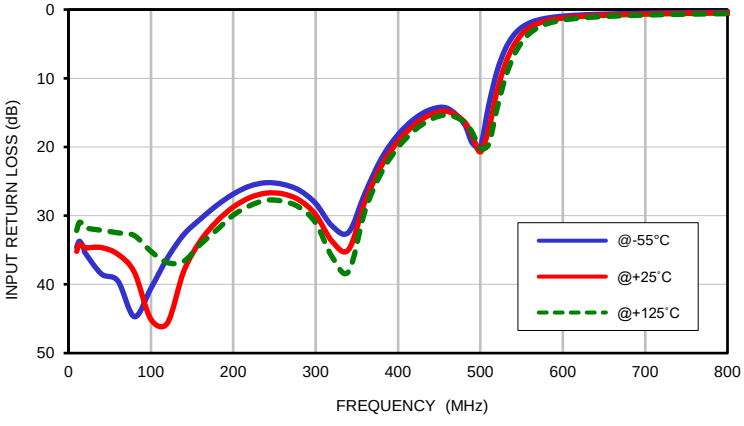
**INSERTION LOSS vs. TEMPERATURE**
INPUT POWER = 0 dBm



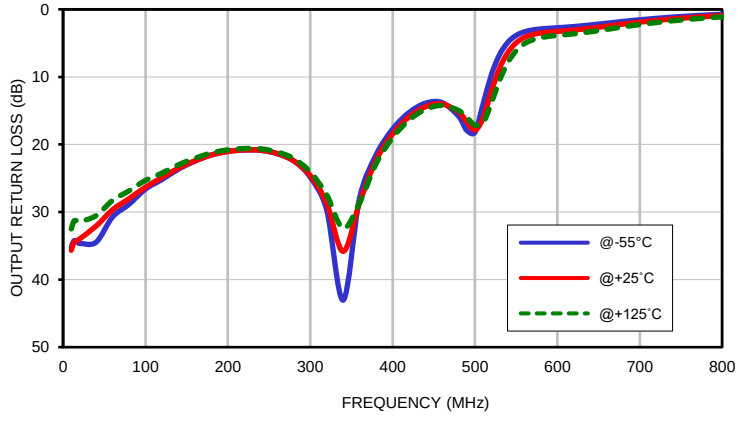

**INSERTION LOSS vs. TEMPERATURE (Zoomed)**
INPUT POWER = 0 dBm



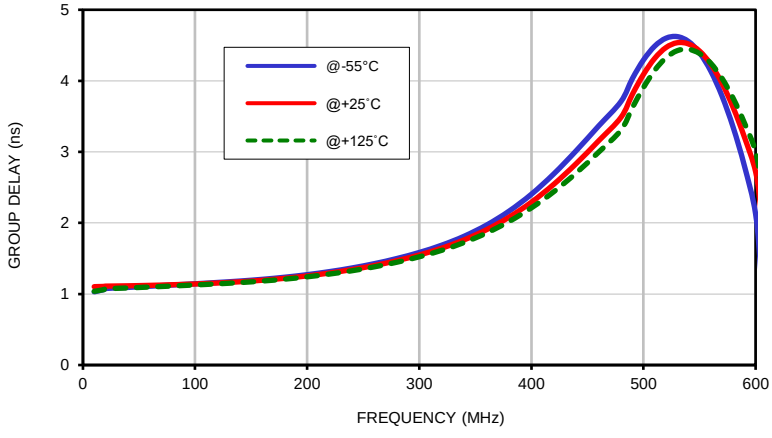

**INPUT RETURN LOSS vs. TEMPERATURE**
INPUT POWER = 0 dBm




**OUTPUT RETURN LOSS vs. TEMPERATURE**
INPUT POWER = 0 dBm



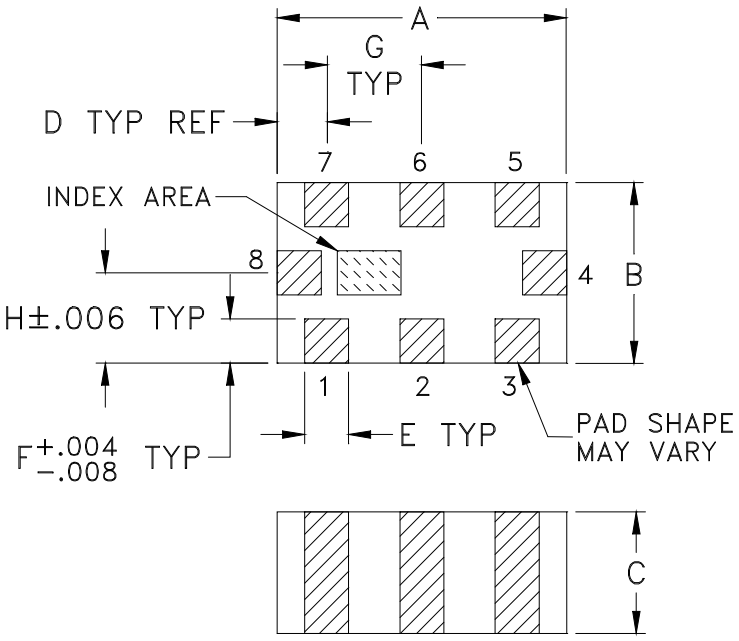

**GROUP DELAY vs. TEMPERATURE**
**INPUT POWER = 0 dBm**



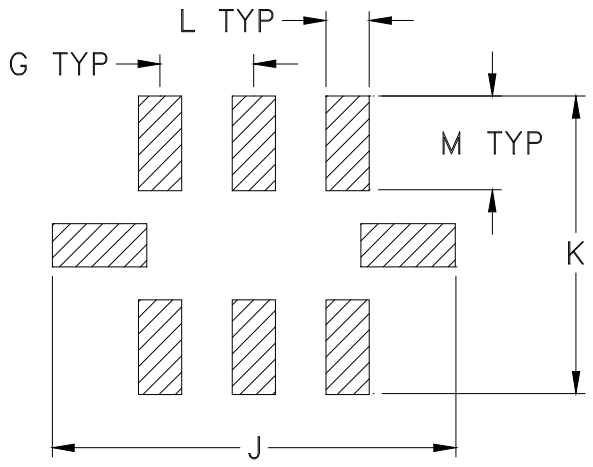
# Case Style GE

**GE0805C-2**

## Outline Dimensions




### PCB Land Pattern




Suggested Layout,
Tolerance to be within ±.002

| CASE # | A | B | C | D | E | F | G | H | J | K | L |
|---|---|---|---|---|---|---|---|---|---|---|---|
| GE0805C-2 | .079 (2.00) | .049 (1.25) | .037 (0.95) | .014 (0.35) | .012 (0.30) | .012 (0.30) | .026 (0.65) | .025 (0.63) | .134 (3.40) | .110 (2.80) | .014 (0.35) |

| CASE # | M | WT. GRAM |
|---|---|---|
| GE0805C-2 | .039 (1.00) | .008 |

**Dimensions are in inches (mm). Tolerances: 2Pl. ± .01; 3 Pl. ± .005**

### Notes:

1. Open style, ceramic base.
2. Termination finish: For RoHS Case Styles: Tin plate over Nickel plate. All models, (+) suffix.
   For RoHS-5 Case Styles: Tin-Lead plate over Nickel plate. All models, no (+) suffix.
3. Pad tolerance to be non-cumulative. Minimum spacing between each pad is .004 (0.1).


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# Tape & Reel Packaging TR-F114

DEVICE ORIENTATION IN T&R

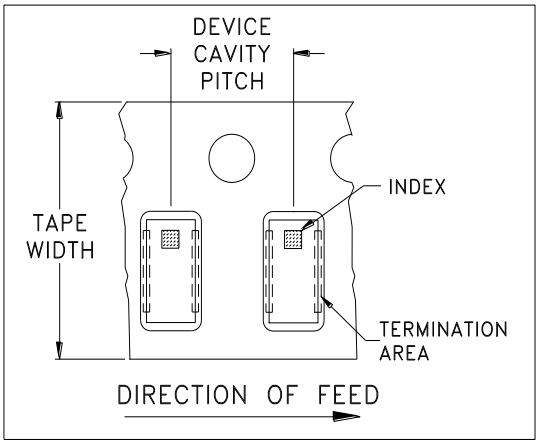



ILLUSTRATION 1

| Applicable Case Styles | |
|---|---|
| GE0805C | JC0603C |
| GE0805C-1 | JC0603C-4 |
| GE0805C-1AP | JC0603C-6 |
| GE0805C-7 | |
| GE0805C-9 | |
| GE0805C-10 | |
| GE0805C-11 | |
| GE0805C-12 | |

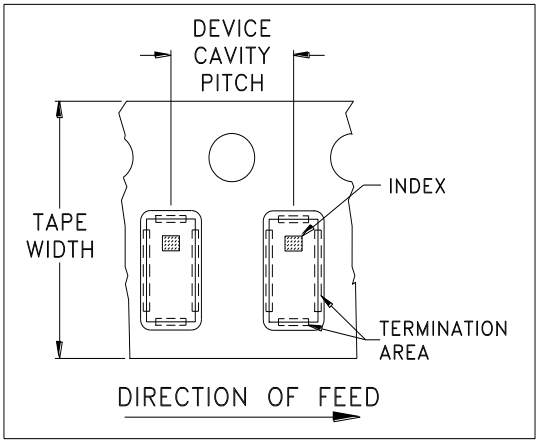



ILLUSTRATION 2

| Applicable Case Styles | |
|---|---|
| GE0805C-2 | JC0603C-1 |
| GE0805C-3 | JC0603C-2 |
| GE0805C-4 | JC0603C-3 |
| GE0805C-5 | JC0603C-5 |
| GE0805C-6 | JC0603C-7 |
| GE0805C-8 | |
| GE0805C-15 | |

| Tape Width, mm | Device Cavity Pitch, mm | Reel Size, inches | Devices per Reel | |
|---|---|---|---|---|
| 8 | 4 | 7 | Small quantity standards (see note) | 20 |
| | | | | 50 |
| | | | | 100 |
| | | | | 200 |
| | | | | 500 |
| | | | | 1000 |
| | | | Standard | 4000 |

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

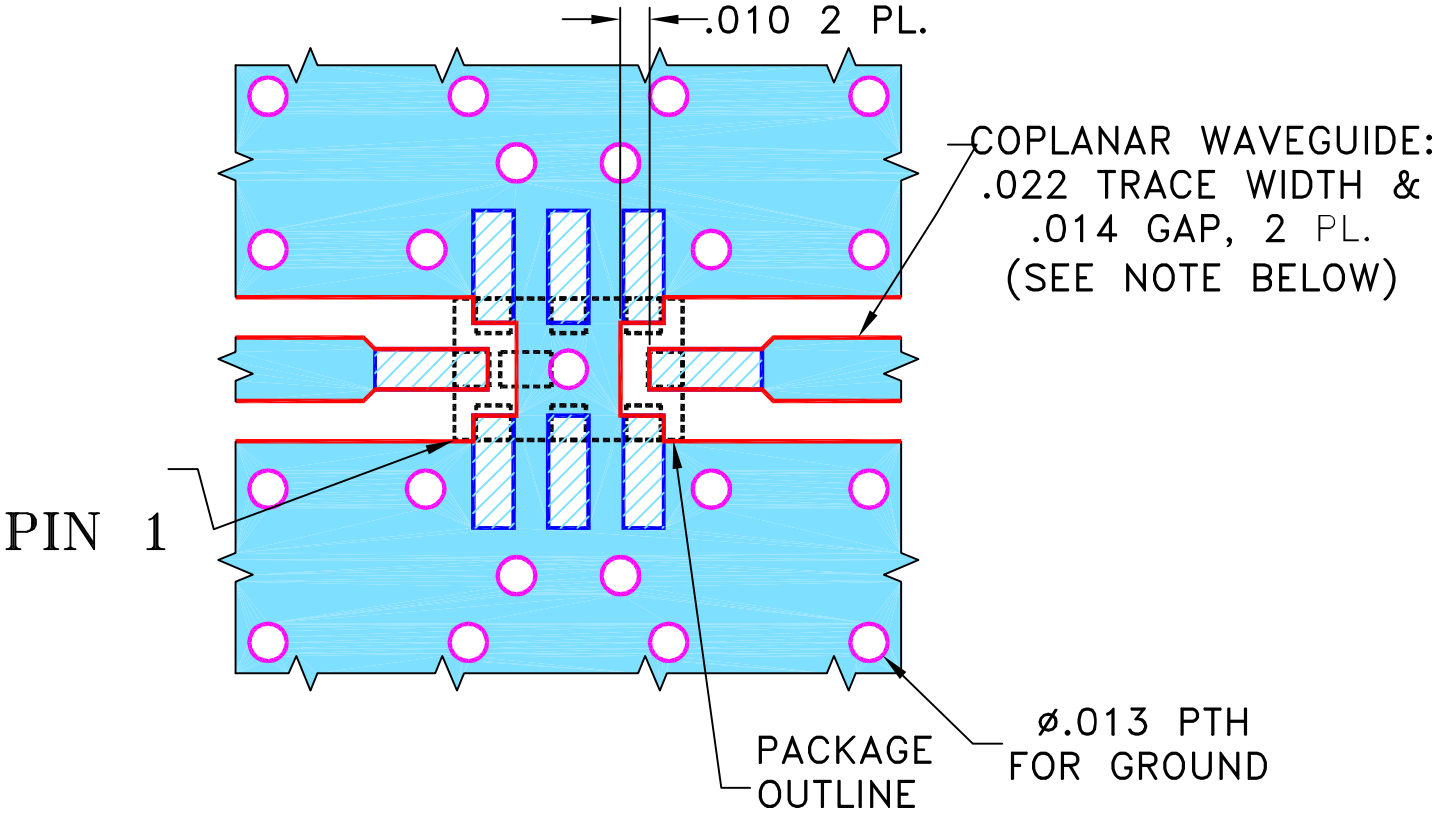
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THIRD ANGLE PROJECTION

| REVISIONS | | | | | |
|---|---|---|---|---|---|
| REV | ECN No. | DESCRIPTION | DATE | DR | AUTH |
| OR | M148457 | NEW RELEASE | 10/14/14 | GF | MY |
| | | | | | |
| | | | | | |
| | | | | | |

# SUGGESTED MOUNTING CONFIGURATION FOR GE0805C-4 CASE STYLE, "08FL07" PIN CODE




## NOTES:

1. COPLANAR WAVEGUIDE IS SHOWN FOR ROGERS RO4350B WITH DIELECTRIC THICKNESS .010" ± .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.

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 | DRAWN | GF | 10/01/14 |
| TOLERANCES ON: | CHECKED | IL | 10/14/14 |
| 2 PL DECIMALS ± | APPROVED | MY | 10/14/14 |
| 3 PL DECIMALS ± .005 | | | |
| ANGLES ± | | | |
| FRACTIONS ± | | | |

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

Mini-Circuits® 13 Neptune Avenue Brooklyn NY 11235

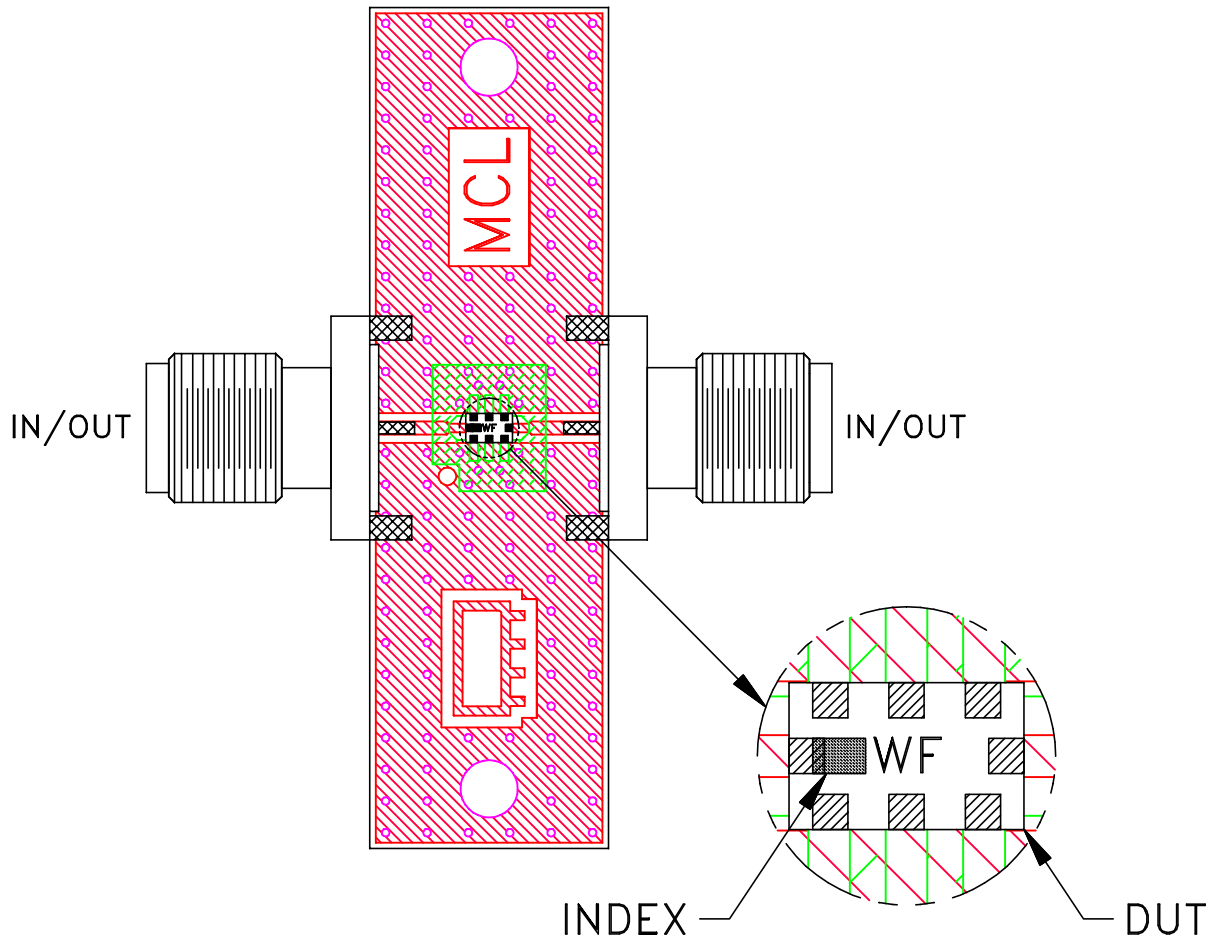
PL, 08FL07, GE0805C-4, TB-799+

| SIZE | CODE IDENT | DRAWING NO: | REV: |
|---|---|---|---|
| A | 15542 | 98-PL-429 | OR |

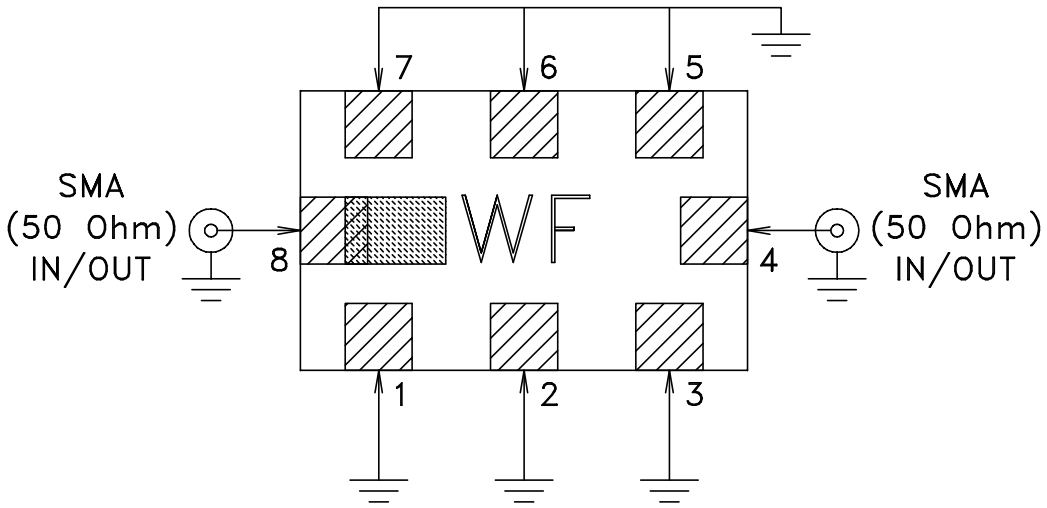
| FILE: | SCALE: | SHEET: |
|---|---|---|
| 98PL429 | 15:1 | 1 OF 1 |

# Evaluation Board and Circuit

TB-LFCG-360+




## Schematic diagram




Notes:

1. PCB Material: ROGERS (RO4350) OR Equivalent, Dielectric Constant=3.5
Dielectric Thickness: .010 inch
2. 50 Ohm SMA Female Connectors.

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**Environmental Specifications** **ENV06T11**

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 | -55° to 125° 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 |
| 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, Test B,B1, 95% Coverage |
| Thermal Shock | -40° to +125°C, 15 min dwell, 100 cycles | MIL-STD-202, Method 107 |
| Bend Test | 1mm, deflection for 5 seconds<br>Span of bending: 2.75" | -- |
| High Temp Storage | 125°C to 1000 Hrs | --- |


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