LTCC SURFACE MOUNT

# Bandpass Filter & Balun BBFCG2-472+

50Ω 4200 to 5200 MHz 1:2 Ratio

## THE BIG DEAL

- Compact Design includes Balun and Filter in One Package
- Low Passband Insertion Loss, Typ. 2 dB avg.
- Excellent CMRR, Typ. 21.5 dB
- Small 0805 Surface Mount Footprint

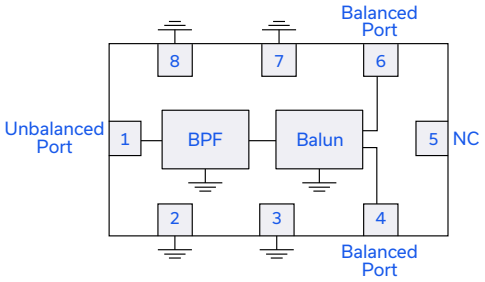


*Generic photo used for illustration purposes only*

## APPLICATIONS

- 5G Sub-6 GHz, MIMO Wireless Infrastructure Systems
- Satellite Communications
- Telecommunications
- RF Front-End Modules

## FUNCTIONAL DIAGRAM




## PRODUCT OVERVIEW

Mini-Circuits' BBFCG2-472+ is a tiny ceramic RF balun filter with an impedance ratio of 1:2, covering a variety of wireless communications applications from 4200 to 5200 MHz. This model provides low insertion loss, low phase unbalance (relative to 180°), and low amplitude unbalance. Fabricated using LTCC technology, the unit comes housed in a tiny, rugged ceramic package (0.079" x 0.049" x 0.037") suitable for harsh operating environments.

## KEY FEATURES

| Features | Advantages |
|---|---|
| Compact Design | Integrates filter and balun in one small package. |
| Tiny Size, 0805 | Accommodates tight space requirements for dense PCB layouts. |
| LTCC Construction | LTCC process enables tiny size and low cost, suitable for high-volume production. Rugged ceramic package provides excellent reliability in harsh operating environments. |

# Bandpass Filter & Balun BBFCG2-472+

50Ω 4200 to 5200 MHz 1:2 Ratio

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

| Parameter | | F# | Frequency (MHz) | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|---|
| Impedance Ratio | | - | - | - | 1:2 | | - |
| Passband | Center Frequency[3] | - | - | - | 4700 | - | MHz |
| | Average Insertion Loss[4] | F3-F4 | 4200 - 5200 | - | 2 | 2.5 | dB |
| | Return Loss - Unbalanced Port | F3-F4 | 4200 - 5200 | 10 | 13.5 | - | dB |
| | Return Loss - Balanced Port[4] | F3-F4 | 4200 - 5200 | 10 | 13.5 | - | dB |
| Stopband, Lower | Rejection[4] | DC-F1 | 10 - 3100 | 27 | 32 | - | dB |
| | | F1-F2 | 3100 - 3580 | - | 25 | - | |
| Stopband, Upper | Rejection[4] | F5-F6 | 6740 - 7650 | 28 | 32 | - | dB |
| | | F6-F7 | 7650 - 11000 | 30 | 39 | - | |
| Amplitude Unbalance (±) | | F3-F4 | 4200 - 5200 | -1.4 | ±1.2 | +1.4 | dB |
| Phase Unbalance (Relative to 180°) | | F3-F4 | 4200 - 5200 | -11 | - | +11 | Deg. |
| CMRR | | F3-F4 | 4200 - 5200 | 18 | 21.5 | - | dB |

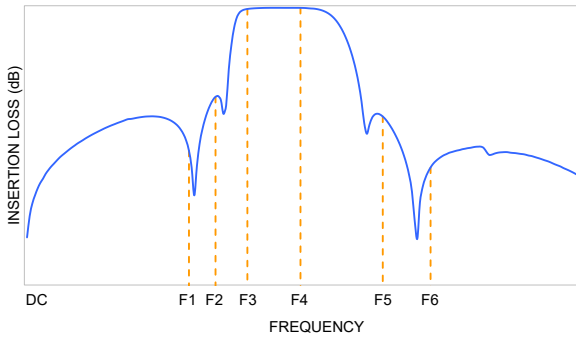
1. Tested on Evaluation Board P/N TB-BBFCG2-472C+ with connectors and feedline loss compensated.
2. This component should not be used as a DC Block. In applications where DC voltage and/or current is present at either the input or output ports, external DC blocking capacitors are required.
3. Typical variation ±3%.
4. Measured in mixed mode.

## ABSOLUTE MAXIMUM RATINGS[5]

| Parameter | Ratings |
|---|---|
| Operating Temperature | -55°C to +125°C |
| Storage Temperature | -55°C to +125°C |
| Input Power[6] | 2 W |

5. Permanent damage may occur if any of these limits are exceeded.
6. Power rating applies only to signals within the passband at +25°C. Power rating above +25°C operating temperature decreases linearly to 0.5 W at +125°C.

## TYPICAL FREQUENCY RESPONSE AT +25°C



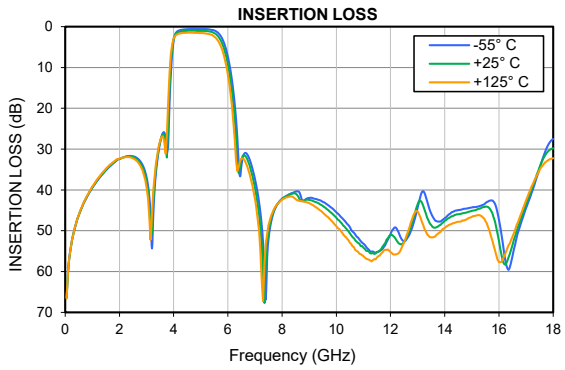

## DC RESISTANCE PORT-PORT

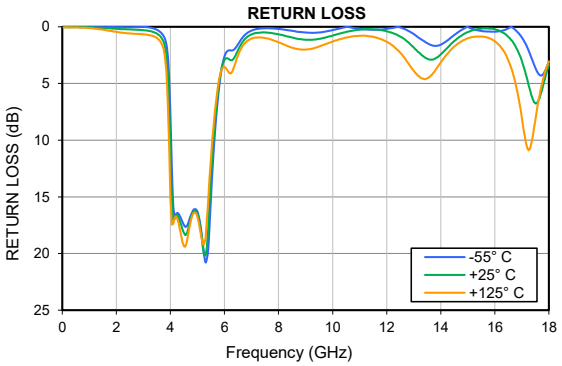
| Function | Pad Number |
|---|---|
| Unbalanced Port to Ground | DC Short |
| Unbalanced Port to Balanced Port | DC Open |
| Balanced Port to Ground | DC Open |
| Balanced Port to Balanced Port | DC Short |

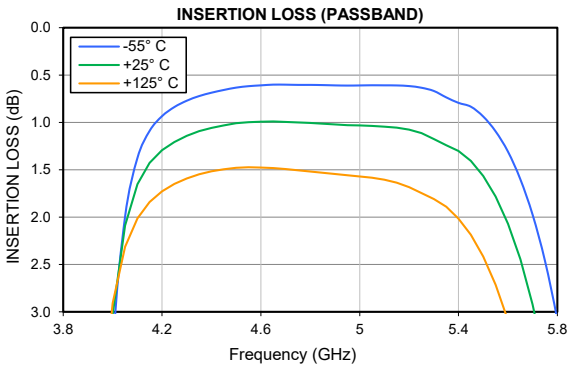
# Bandpass Filter & Balun BBFCG2-472+

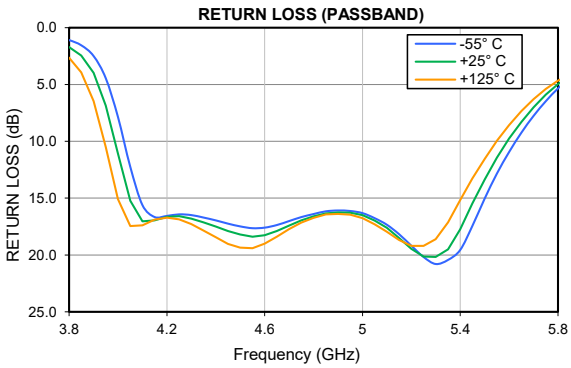
50Ω 4200 to 5200 MHz 1:2 Ratio

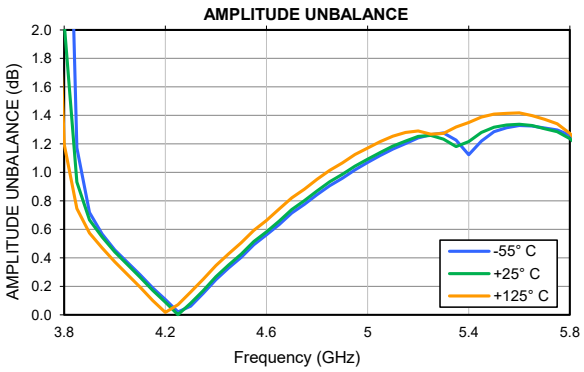
## TYPICAL PERFORMANCE GRAPHS

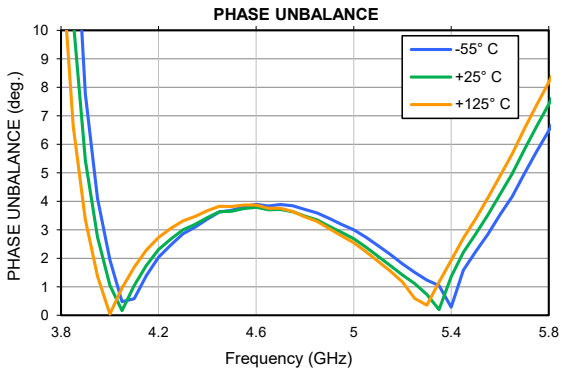


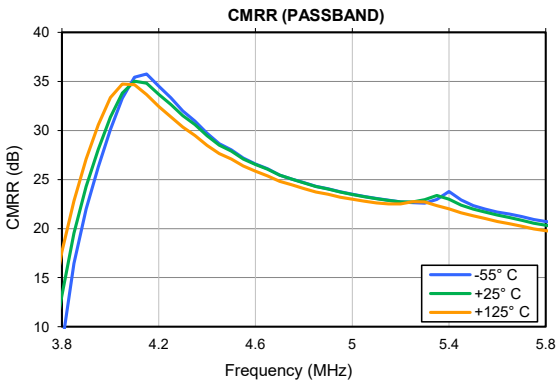



# Bandpass Filter & Balun BBFCG2-472+

50Ω 4200 to 5200 MHz 1:2 Ratio

## FUNCTIONAL DIAGRAM

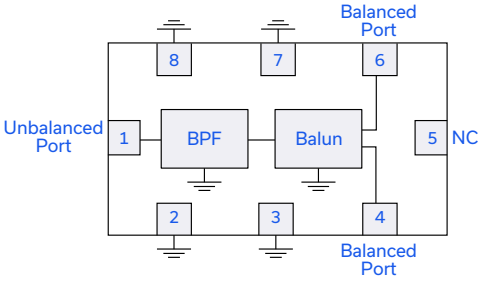
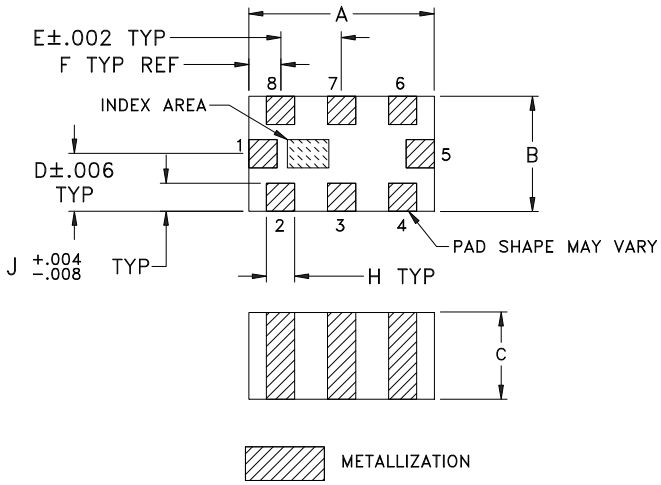



**Figure 1. BBFCG2-472+ Functional Diagram**

## PAD DESCRIPTION

| Function | Pad Number | Description |
|---|---|---|
| Unbalanced Port | 1 | Unbalanced Input Port |
| Balanced Ports | 4, 6 | Balanced Output Ports |
| Ground | 2, 3, 7, 8 | Connects to Ground on PCB. (See drawing PL-724) |
| NC | 5 | No connection, not used internally. See drawing PL-724 for connection to PCB. |

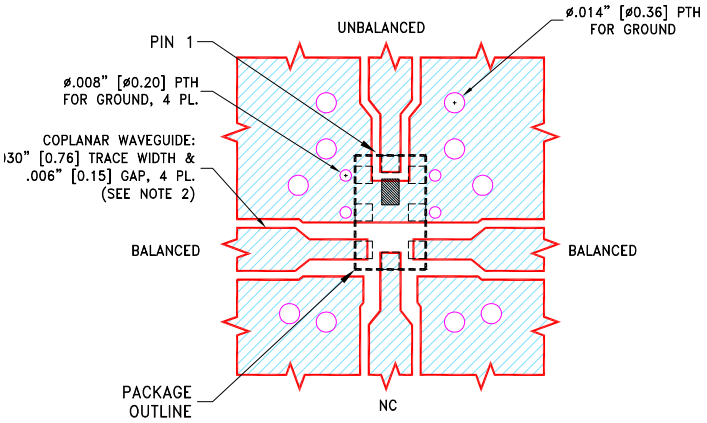
## CASE STYLE DRAWING

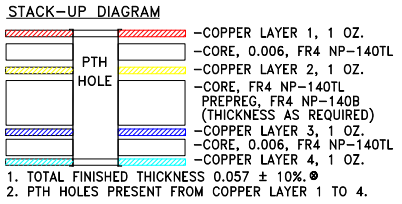


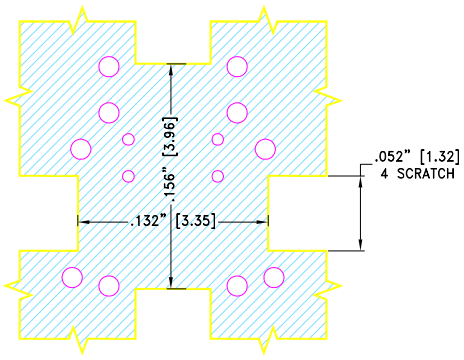

## OUTLINE DIMENSIONS (inch / mm)

| A | B | C | D | E | F | G | H | J | wt |
|---|---|---|---|---|---|---|---|---|---|
| .079 | .049 | .037 | .025 | .026 | .014 | .110 | .012 | .010 | grams |
| 2.00 | 1.25 | 0.95 | 0.63 | 0.65 | 0.35 | 2.80 | 0.30 | 0.25 | .008 |

## SUGGESTED PCB LAYOUT (PL-724)




TOP VIEW TO LAYER 2

NOTES:
1. PCB IS MULTILAYER PCB, SEE STACK-UP DIAGRAM.
2. TRACE WIDTH & GAP PARAMETERS ARE SHOWN FOR FR4 NP-140TL WITH DIELECTRIC THICKNESS .006"±.0005"; COPPER: 1 OZ. FOR OTHER MATERIALS TRACE WIDTH AND GAP MAY NEED TO BE MODIFIED.
3. COPPER LAYERS 3,4 OF THE PCB IS CONTINUOUS GROUND PLANES.

DENOTES COPPER LAND PATTERN FREE OF SOLDER MASK.

**Figure 2. Suggested PCB Layout PL-724**

## PRODUCT MARKING*: NO MARKING

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

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50Ω 4200 to 5200 MHz 1:2 Ratio

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

| | |
|---|---|
| **Performance Data & Graphs** | Data<br>Graphs<br>S-Parameter (S3P Files) Data Set (.zip file) with connectors and feedline loss compensated. |
| **Case Style** | GE0805C-15 Lead Finish: Tin over Nickel Plating |
| **RoHS Status** | Compliant |
| **Tape and Reel** | F114 |
| **Suggested Layout for PCB Design** | PL-724 |
| **Evaluation Board** | TB-BBFCG2-472C+<br>Gerber File |
| **Environmental Rating** | ENV06T10 |

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.

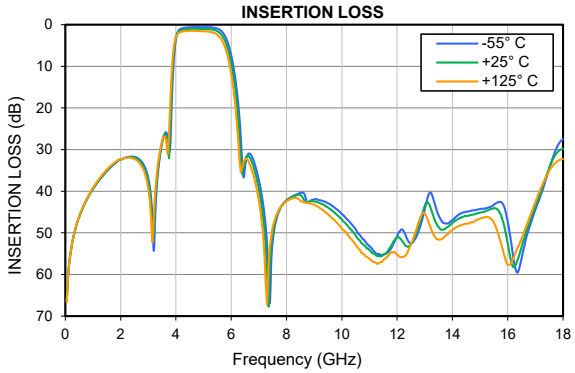
B. Electrical specifications and performance data contained in this specification document are based on Mini-Circuits' applicable established test performance criteria and measurement instructions.

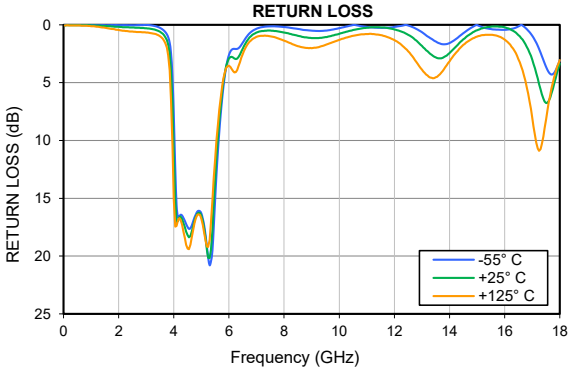
C. The parts covered by this specification document are subject to Mini-Circuits' standard limited warranty and terms and conditions (collectively, "Standard Terms"; Purchasers of this part are entitled to the rights and benefits contained therein. For a full statement of the standard terms and the exclusive rights and remedies thereunder, please visit Mini-Circuits' website at https://www.minicircuits.com/terms/viewterm.html

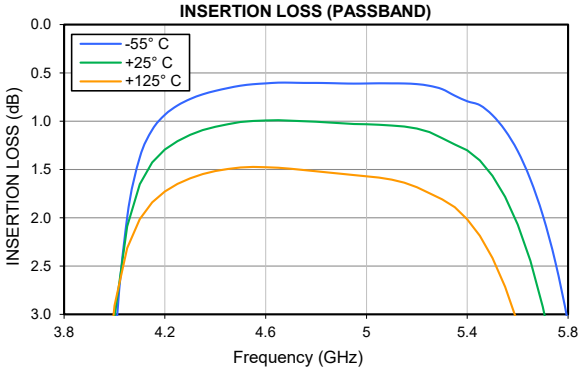
*Typical Performance Data*

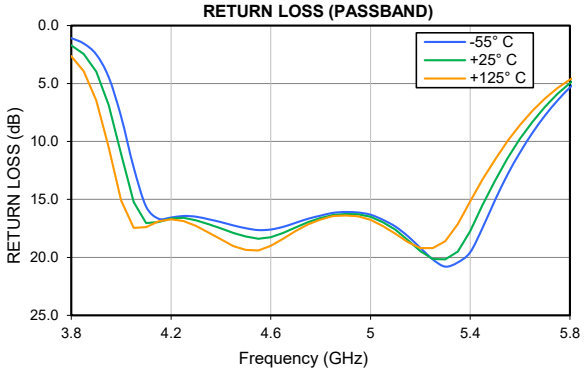
| FREQUENCY (GHz) | AVERAGE INSERTION LOSS (dB) | RETURN LOSS (UNBALANCED PORT) (dB) | AMPLITUDE UNBALANCE (dB) | PHASE UNBALANCE (deg.) | CMRR (dB) |
|---|---|---|---|---|---|
| 3.500 | 28.14 | 0.60 | 0.77 | 0.92 | 26.93 |
| 3.550 | 26.95 | 0.68 | 1.01 | 4.58 | 23.03 |
| 3.600 | 26.32 | 0.78 | 1.26 | 8.40 | 19.74 |
| 3.650 | 26.61 | 0.91 | 1.68 | 13.53 | 16.32 |
| 3.700 | 28.70 | 1.07 | 3.09 | 22.25 | 11.58 |
| 3.750 | 32.06 | 1.32 | 9.63 | 6.01 | 5.91 |
| 3.800 | 22.74 | 1.72 | 2.05 | 21.15 | 13.13 |
| 3.850 | 14.58 | 2.46 | 0.93 | 10.38 | 19.54 |
| 3.900 | 8.82 | 3.98 | 0.67 | 5.44 | 24.28 |
| 3.950 | 5.06 | 6.85 | 0.55 | 2.75 | 28.07 |
| 4.000 | 3.03 | 11.07 | 0.44 | 1.05 | 31.35 |
| 4.050 | 2.09 | 15.24 | 0.35 | 0.16 | 33.81 |
| 4.100 | 1.65 | 17.04 | 0.26 | 1.04 | 35.03 |
| 4.150 | 1.43 | 16.96 | 0.17 | 1.75 | 34.81 |
| 4.200 | 1.29 | 16.65 | 0.09 | 2.30 | 33.68 |
| 4.250 | 1.21 | 16.59 | 0.00 | 2.67 | 32.63 |
| 4.300 | 1.14 | 16.79 | 0.08 | 3.00 | 31.50 |
| 4.350 | 1.09 | 17.13 | 0.17 | 3.19 | 30.59 |
| 4.400 | 1.06 | 17.50 | 0.27 | 3.42 | 29.47 |
| 4.450 | 1.03 | 17.89 | 0.35 | 3.63 | 28.51 |
| 4.500 | 1.01 | 18.21 | 0.43 | 3.66 | 27.91 |
| 4.550 | 1.00 | 18.38 | 0.52 | 3.75 | 27.10 |
| 4.600 | 0.99 | 18.26 | 0.58 | 3.79 | 26.53 |
| 4.650 | 0.99 | 17.90 | 0.66 | 3.70 | 26.06 |
| 4.700 | 1.00 | 17.41 | 0.74 | 3.71 | 25.44 |
| 4.750 | 1.00 | 16.96 | 0.80 | 3.64 | 25.04 |
| 4.800 | 1.01 | 16.61 | 0.87 | 3.48 | 24.65 |
| 4.850 | 1.01 | 16.34 | 0.93 | 3.34 | 24.28 |
| 4.900 | 1.02 | 16.25 | 0.99 | 3.12 | 24.02 |
| 4.950 | 1.03 | 16.28 | 1.04 | 2.91 | 23.72 |
| 5.000 | 1.03 | 16.50 | 1.09 | 2.69 | 23.48 |
| 5.050 | 1.04 | 16.97 | 1.14 | 2.39 | 23.25 |
| 5.100 | 1.04 | 17.61 | 1.18 | 2.07 | 23.04 |
| 5.150 | 1.06 | 18.49 | 1.22 | 1.75 | 22.88 |
| 5.200 | 1.08 | 19.46 | 1.25 | 1.41 | 22.73 |
| 5.250 | 1.11 | 20.15 | 1.26 | 1.11 | 22.72 |
| 5.300 | 1.18 | 20.17 | 1.23 | 0.72 | 22.95 |
| 5.350 | 1.24 | 19.50 | 1.18 | 0.19 | 23.36 |
| 5.400 | 1.30 | 17.73 | 1.22 | 1.35 | 22.99 |
| 5.450 | 1.41 | 15.48 | 1.28 | 2.21 | 22.38 |
| 5.500 | 1.57 | 13.35 | 1.32 | 2.84 | 21.98 |
| 5.550 | 1.78 | 11.43 | 1.33 | 3.52 | 21.67 |
| 5.600 | 2.07 | 9.77 | 1.34 | 4.25 | 21.37 |
| 5.650 | 2.45 | 8.29 | 1.33 | 4.96 | 21.13 |
| 5.700 | 2.92 | 7.00 | 1.31 | 5.81 | 20.85 |
| 5.750 | 3.53 | 5.89 | 1.29 | 6.62 | 20.55 |
| 5.800 | 4.28 | 4.95 | 1.24 | 7.41 | 20.34 |
| 5.850 | 5.21 | 4.19 | 1.16 | 8.26 | 20.14 |
| 5.900 | 6.34 | 3.60 | 1.07 | 9.05 | 19.97 |
| 5.950 | 7.68 | 3.18 | 0.94 | 9.83 | 19.87 |
| 6.000 | 9.26 | 2.92 | 0.74 | 10.57 | 19.84 |
| 6.050 | 11.12 | 2.79 | 0.47 | 11.30 | 19.78 |
| 6.100 | 13.28 | 2.77 | 0.06 | 11.98 | 19.58 |
| 6.150 | 15.82 | 2.83 | 0.57 | 12.76 | 18.67 |
| 6.200 | 18.85 | 2.91 | 1.59 | 14.090 | 16.27 |
| 6.250 | 22.52 | 2.95 | 3.34 | 17.569 | 12.23 |
| 6.300 | 27.07 | 2.91 | 6.49 | 31.441 | 6.89 |
| 6.350 | 32.54 | 2.78 | 7.52 | 82.680 | 0.79 |
| 6.400 | 35.90 | 2.57 | 0.59 | 109.023 | 2.93 |
| 6.450 | 34.26 | 2.32 | 4.38 | 100.299 | 1.39 |
| 6.500 | 32.51 | 2.06 | 6.59 | 85.82 | 0.49 |

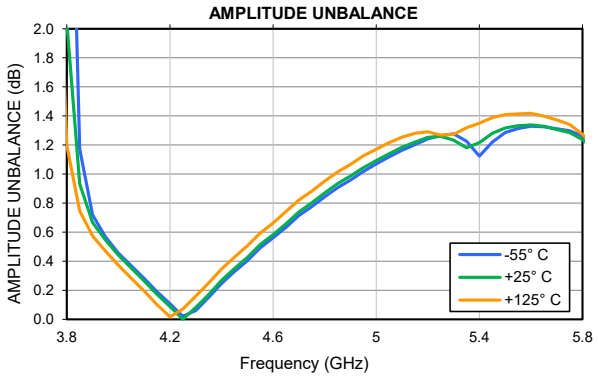
*Typical Performance Curves*

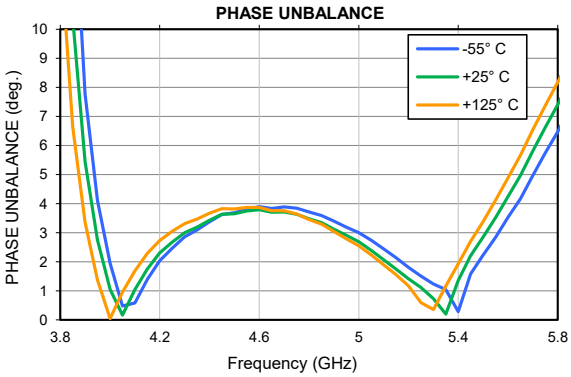


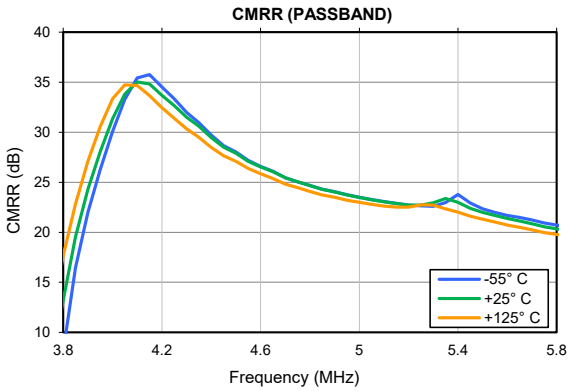



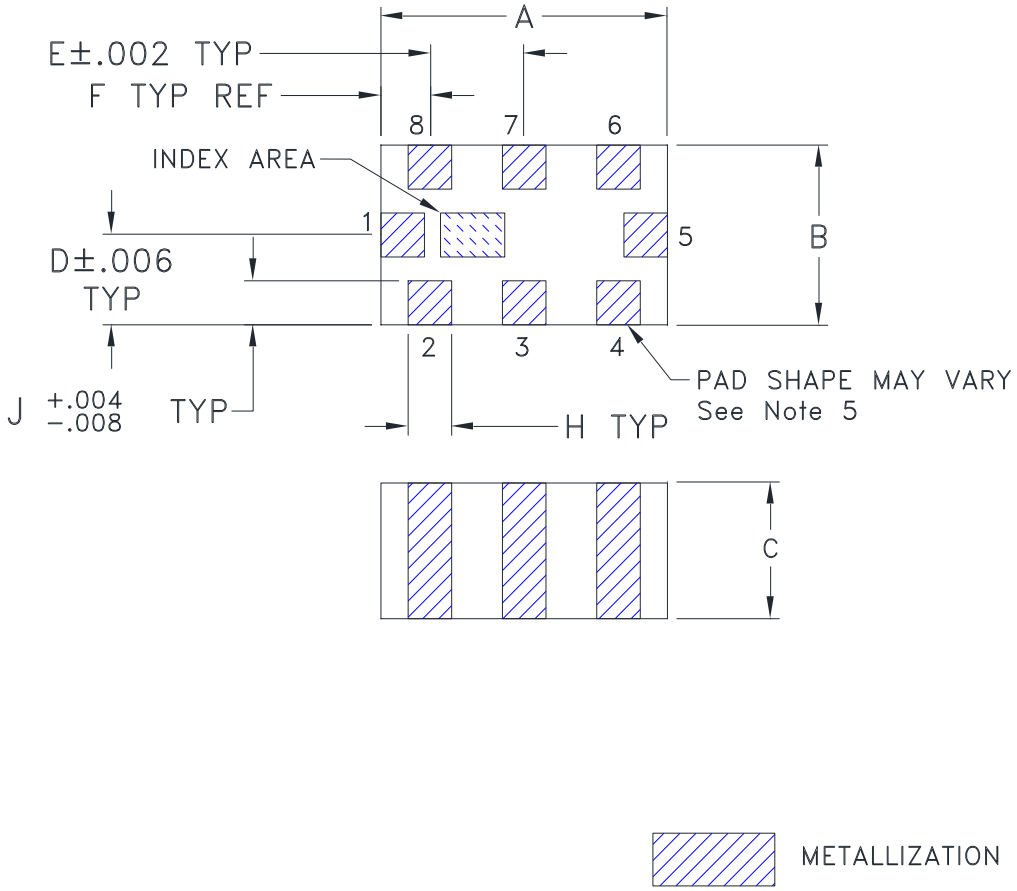



# Case Style GE

**GE0805C-15**

## Outline Dimensions

### Top View




| CASE# | A | B | C | D | E | F | G | H | J | WT, GRAM |
|---|---|---|---|---|---|---|---|---|---|---|
| GE0805C-15 | .079 (2.00) | .049 (1.25) | .037 (0.95) | .025 (0.63) | .026 (0.65) | .014 (0.35) | .110 (2.80) | .012 (0.30) | .010 (0.25) | .008 |

**Dimensions are in inches (mm). Tolerances: 2 Pl. ± .01(.25); 3 Pl. ± .005(.100)**

### Notes:

1. Open style, ceramic base
2. Termination finish: For RoHS Case Styles: Tin plate over Nickel plate. All model , (+) suffix.
   For RoHS-5 Case Styles: Tin-lead plate over Nickel plate. All model ,no (+) suffix.
3. Pad tolerance to be non-cumulative. Minimum spacing between each pad is .004(0.1).
4. Pin numbers do not appear on unit. For reference only.
5. During the manufacturing process, the pad shape may not be rectangular and may take on a more semi-circle shape. However, the pad dimensions reflect this, with the pad shape being within the specified lengths. The metallization compensates accordingly and so performance will not be affected. In addition, solderability will not be influenced by the pad shape


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INTERNET http://www.minicircuits.com
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# Tape & Reel Packaging TR-F114

DEVICE ORIENTATION IN T&R

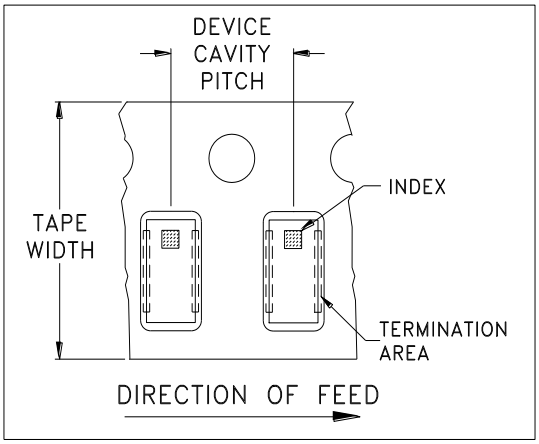



ILLUSTRATION 1

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

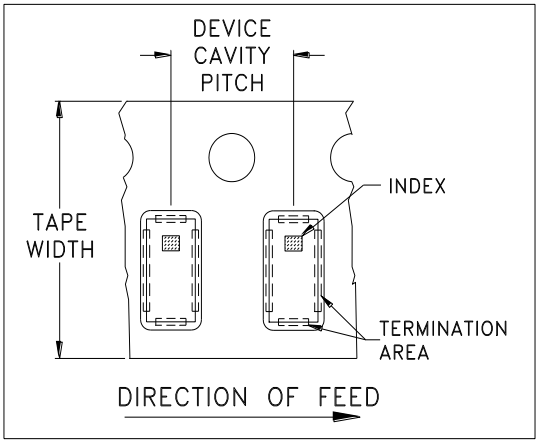



ILLUSTRATION 2

| 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.

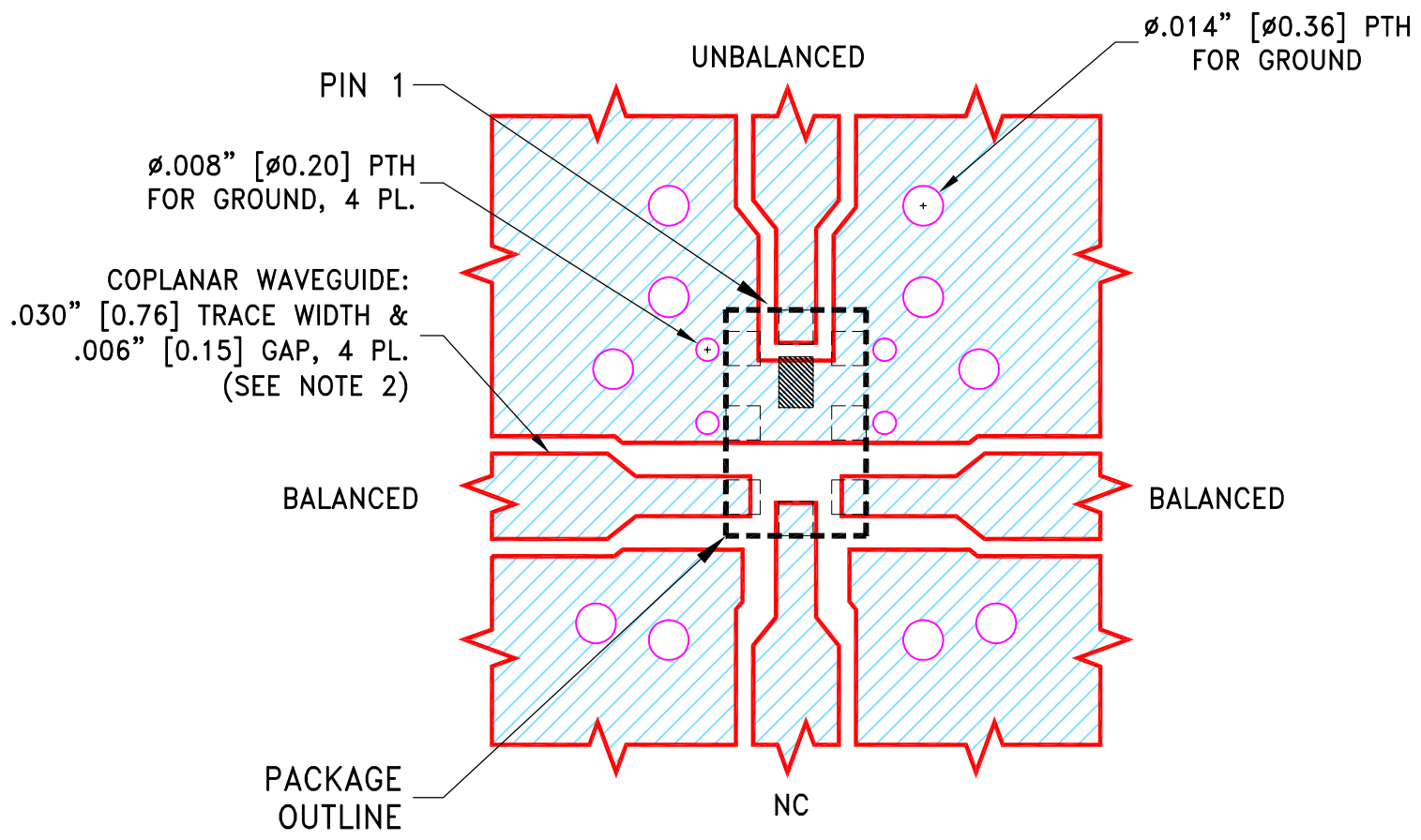
Mini-Circuits carrier tape materials provide protection from ESD (Electro-Static Discharge) during handling and transportation. Tapes are static dissipative and comply with industry standards EIA-481/EIA-541.

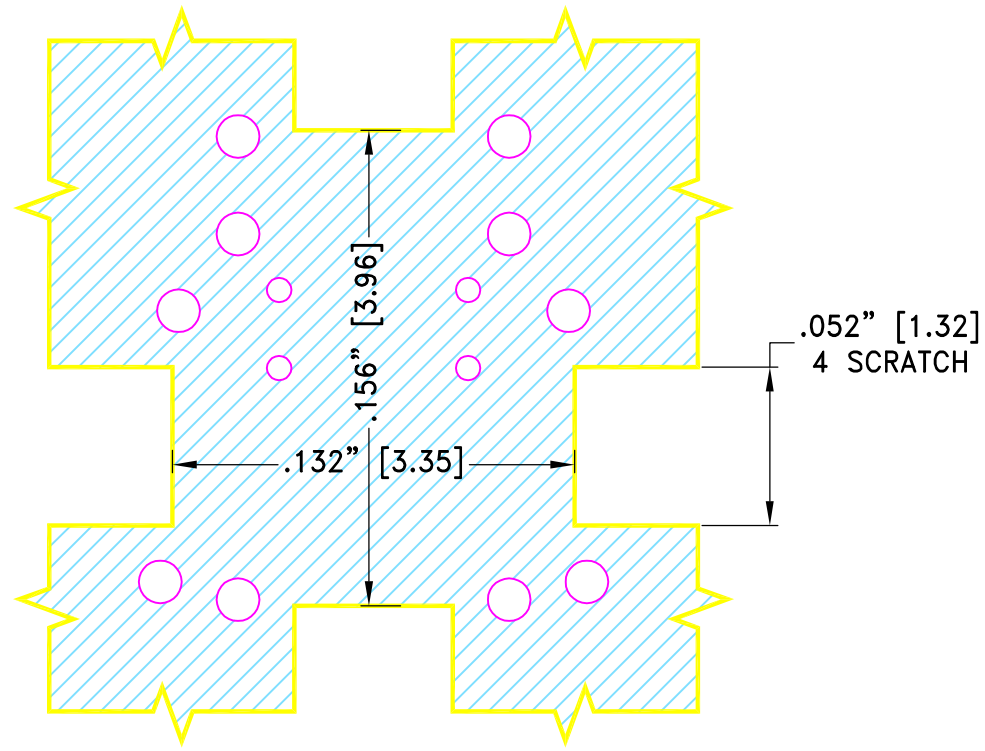
Go to: www.minicircuits.com/pages/pdfs/tape.pdf

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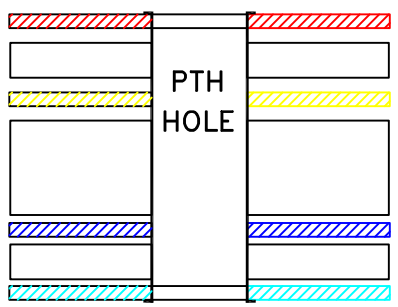
# SUGGESTED MOUNTING CONFIGURATION
# FOR GE0805C-15 CASE STYLE




TOP VIEW TO LAYER 2

## STACK-UP DIAGRAM




- –COPPER LAYER 1, 1 OZ.
- –CORE, 0.006, FR4 NP-140TL
- –COPPER LAYER 2, 1 OZ.
- –CORE, FR4 NP-140TL PREPREG, FR4 NP-140B (THICKNESS AS REQUIRED)
- –COPPER LAYER 3, 1 OZ.
- –CORE, 0.006, FR4 NP-140TL
- –COPPER LAYER 4, 1 OZ.

1. TOTAL FINISHED THICKNESS 0.057 ± 10%.⊗
2. PTH HOLES PRESENT FROM COPPER LAYER 1 TO 4.

## NOTES:

1. PCB IS MULTILAYER PCB, SEE STACK-UP DIAGRAM.
2. TRACE WIDTH & GAP PARAMETERS ARE SHOWN FOR FR4 NP-140TL WITH DIELECTRIC THICKNESS .006"±.0005"; COPPER: 1 OZ. FOR OTHER MATERIALS TRACE WIDTH AND GAP MAY NEED TO BE MODIFIED.
3. COPPER LAYERS 3,4 OF THE PCB IS CONTINUOUS GROUND PLANES.

DENOTES COPPER LAND PATTERN FREE OF SOLDER MASK.

| REV | ECN No. | DESCRIPTION | DATE | DR | AUTH |
|---|---|---|---|---|---|
| 0R | ECO-010908 | NEW RELEASE | 12/02/21 | ITG | IL |

REVISIONS

| UNLESS OTHERWISE SPECIFIED | | INITIALS | DATE |
|---|---|---|---|
| DIMENSIONS ARE IN INCHES<br>TOLERANCES ON:<br>2 PL DECIMALS ±<br>3 PL DECIMALS ± .005<br>ANGLES ± 1°<br>FRACTIONS ± | DRAWN | ITG | 12/02/21 |
| | CHECKED | GF | 12/02/21 |
| | APPROVED | IL | 12/02/21 |


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BSHEETA1.DWG REV:A DATE:01/12/94

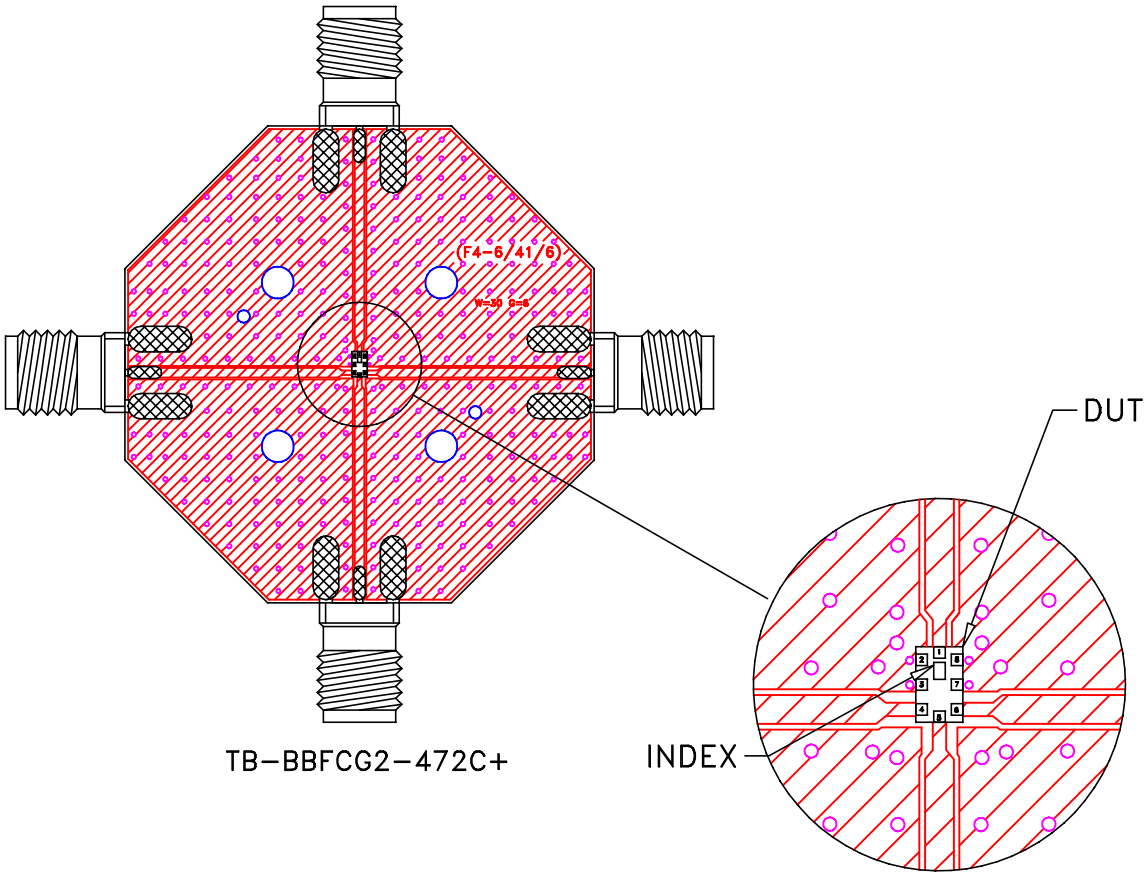

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PL, GE0805C-15, TB-1233+

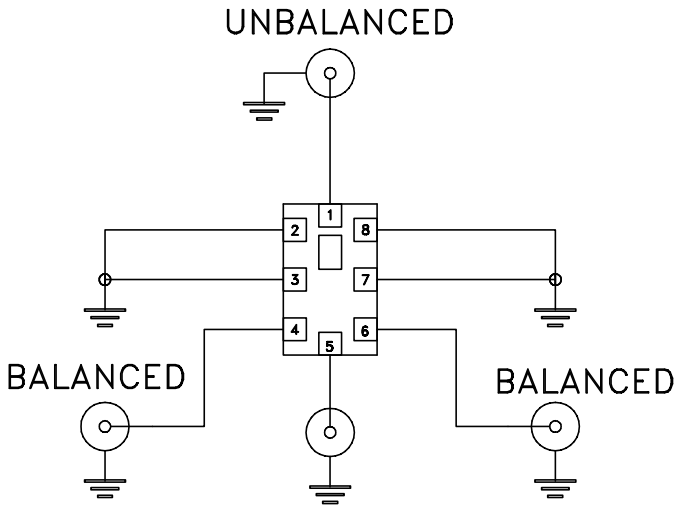
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| FILE: 98PL724 | | SCALE: 15:1 | SHEET: 1 OF 1 |

THIRD ANGLE PROJECTION

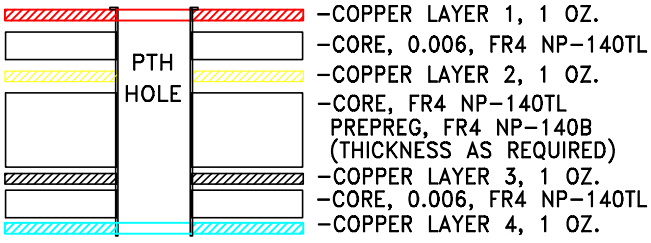
# Evaluation Board and Circuit




TB-BBFCG2-472C+




Schematic Diagram




Stack-up Diagram

Notes:

1. 50 Ohm SMA Female connectors.
2. PCB Material: FR4 or equivalent,
   Dielectric Constant=4.5,
   Total finished Thickness = .057 inch.

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# Environmental Specifications ENV06T10

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 Eutectic Process 225°C peak<br>Pb-Free Process 245° - 250°C peak | J-STD-020C, Table 4-1, 4-2 and 5-2, Figure 5-1 |
| Solderability | 10X Magnification | J-STD-002, Test B,B1, 95% Coverage |
| Thermal Shock | -55° to +125°C, 15 min dwell,250 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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