



Mini-Circuits

LTCC SURFACE MOUNT

# Bandpass Filter

**BFHKL-7551+**

50Ω 6.8 to 8.4 GHz

## THE BIG DEAL

- LTCC Band Pass Filter with Integrated Interposer Board
- Wide Stopband Rejection, Typ. 50 dB up to 19 GHz
- Small Size, 4.95 mm x 3.65 mm
- Shielded Construction
- Protected by US Patents 11,638,370 and 11,744,057

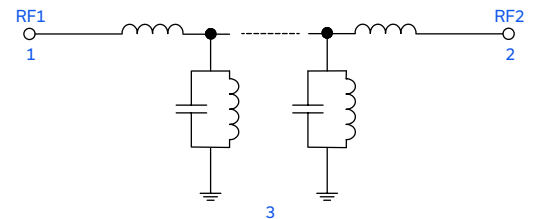


Generic photo used for illustration purposes only

## APPLICATIONS

- Quantum Computing
- Backhaul Radio Systems
- Test & Measurement Equipment
- Aerospace and Defense Signal Conditioning

## FUNCTIONAL DIAGRAM



## PRODUCT OVERVIEW

BFHKL-7551+ is a miniature low temperature co-fired ceramic (LTCC) ultra-high stopband rejection band pass filter with a 6.8 to 8.4 GHz passband that supports a variety of applications. This model achieves 50 dB typical stopband rejection up to 19 GHz, when mounted on coplanar waveguide layouts. Housed in a small 4.95 mm by 3.65 mm ceramic form factor, the filter is ideal for dense signal chain PCB layouts where it complements MMIC size and performance. The BFHKL family with integrated interposer board enables installation onto PCB layouts with automated manufacturing equipment. This model provides 3.8 dB typical insertion loss over a wide band due to its rugged monolithic construction. 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                                                                                                                                      |
|------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|
| Surface Mountable due to Integrated Interposer Board | Enables installation with automated manufacturing equipment, making this suitable for high-volume processes.                                    |
| Wide Rejection                                       | Provides high stopband rejection of 50 dB typical up to 19 GHz.                                                                                 |
| Small Size (4.95 x 3.65 mm)                          | Saves space in dense circuit board layouts and minimizes the effects of parasitics.                                                             |
| LTCC Construction                                    | Provides repeatable performance in a rugged, ceramic package well suited for tough environments such as high humidity and temperature extremes. |
| Cost Effective                                       | LTCC is a scalable technology that is cost effective due to its ease of production in high-volume.                                              |

REV. OR  
ECO-023769  
BFHKL-7551+  
MCL NY  
241127





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## Bandpass Filter

BFHKI-7551+

50Ω 6.8 to 8.4 GHz

ELECTRICAL SPECIFICATIONS<sup>1,2,3</sup> AT +25°C

| Parameter                     | F#    | Frequency (GHz) | Min. | Typ. | Max. | Units |
|-------------------------------|-------|-----------------|------|------|------|-------|
| Center Frequency <sup>4</sup> | —     | —               | —    | 7.5  | —    | GHz   |
| Passband                      |       |                 |      |      |      |       |
| Insertion Loss                | F1-F2 | 6.8 – 8.4       | —    | 3.8  | 4.6  | dB    |
| Return Loss                   | F1-F2 | 6.8 – 8.4       | 13   | 15   | —    | dB    |
| Stopband, Lower               |       |                 |      |      |      |       |
| Rejection                     | DC-F3 | 0.1 – 4         | 65   | 75   | —    | dB    |
| Stopband, Upper               |       |                 |      |      |      |       |
| Rejection                     | F4-F5 | 10.6 – 19       | 40   | 50   | —    | dB    |

1. Tested on Evaluation Board P/N TB-BFHKI-7551C+. Measured with the connector and feedline effects de-embedded using the 2XThru IEEE P370 method.

2. Bi-directional, RF1 and RF2 ports can be interchanged.

3. 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.

4. Typical variation  $\pm 3\%$ .

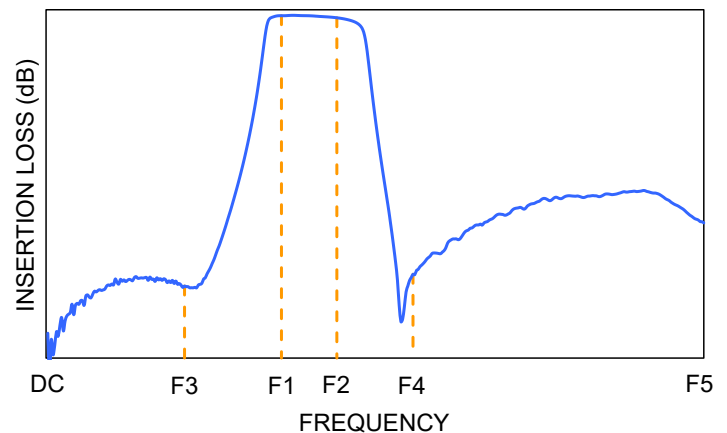
ABSOLUTE MAXIMUM RATINGS<sup>5</sup>

| Parameter                | Ratings         |
|--------------------------|-----------------|
| Operating Temperature    | -55°C to +125°C |
| Storage Temperature      | -55°C to +125°C |
| Input Power <sup>6</sup> | 1 W             |

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 0.5 W at +125°C.

## TYPICAL FREQUENCY RESPONSE AT +25°C





LTCC SURFACE MOUNT

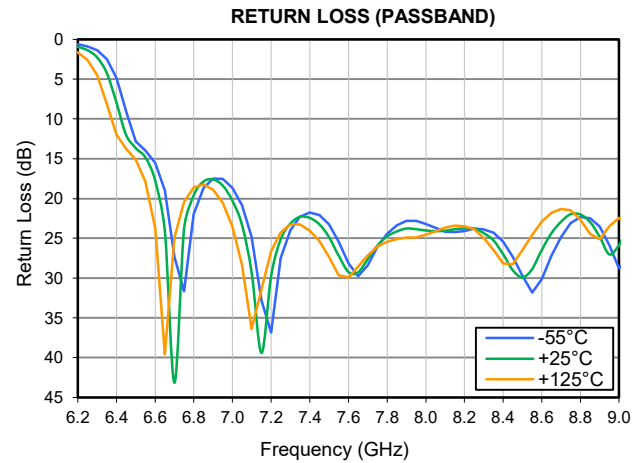
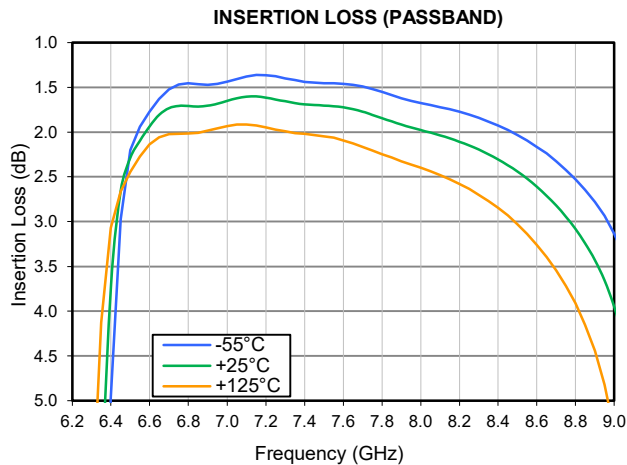
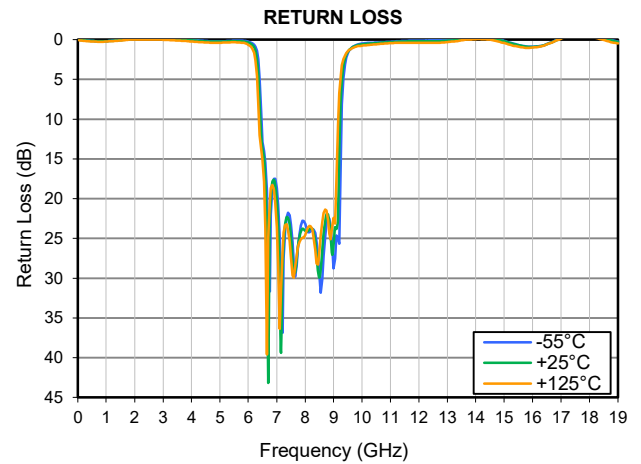
# Bandpass Filter

**BFHKI-7551+**

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50Ω 6.8 to 8.4 GHz

## TYPICAL PERFORMANCE GRAPHS





LTCC SURFACE MOUNT

# Bandpass Filter

**BFHKI-7551+**

50Ω 6.8 to 8.4 GHz

## FUNCTIONAL DIAGRAM

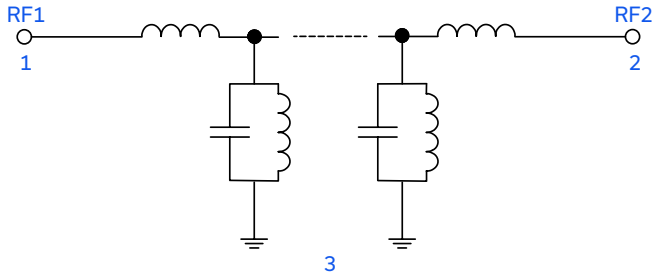
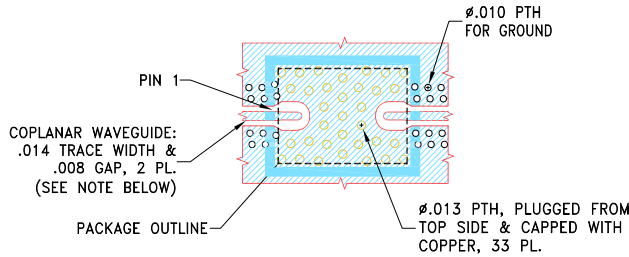


Figure 1. BFHKI-7551+ Functional Diagram

## PAD DESCRIPTION

| Function         | Pad Number | Description                                        |
|------------------|------------|----------------------------------------------------|
| RF1 <sup>2</sup> | 1          | Connects to RF Input Port                          |
| RF2 <sup>2</sup> | 2          | Connects to RF Output Port                         |
| GROUND           | 3          | Connects to Ground on PCB,<br>(See drawing PL-767) |

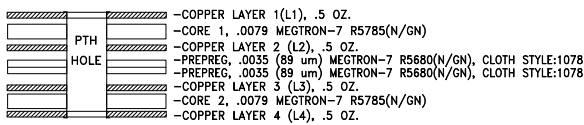
## SUGGESTED PCB LAYOUT (PL-767)



- NOTES:
1. PCB IS MULTILAYER PCB, SEE STACK-UP DIAGRAM.
  2. TRACE WIDTH & GAP ARE SHOWN FOR .0079 MEGTRON-7 R5785(N/GN), COPPER: 1/2 OZ. EACH LAYER. FOR OTHER MATERIALS TRACE WIDTH & GAP MAY NEED TO BE MODIFIED.
  3. LAYERS L2, L3 & L4 OF PCB ARE CONTINUOUS GROUND PLANES.

- DENOTES PCB COPPER LAYOUT WITH SMOBC (SOLDER MASK OVER BARE COPPER).  
 DENOTES COPPER LAND PATTERN FREE OF SOLDER MASK.

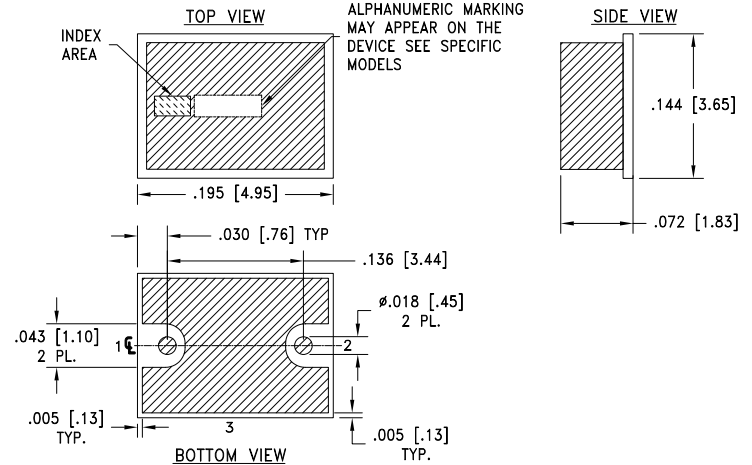
## STACK-UP DIAGRAM



1. TOTAL FINISHED THICKNESS 0.026 ± 10%.  
 2. PTH PRESENT FROM COPPER LAYER 1 TO COPPER LAYER 4.

Figure 2. Suggested PCB Layout for BFHKI-7551+

## CASE STYLE DRAWING (NM3237)



METALLIZATION

Weight: .135 grams.

Dimensions are in inches [mm]. Tolerances: 2 PL. ±.01; 3 PL. ±.005

## PRODUCT MARKING\*: F562

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



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

|                                 |                                                                                           |
|---------------------------------|-------------------------------------------------------------------------------------------|
| Performance Data & Graphs       | Data<br>Graphs<br>S-Parameter (S2P Files) Data Set (.zip file) De-embedded to device pads |
| Case Style                      | NM3237 Finish: Gold over Nickel Plating                                                   |
| RoHS Status                     | Compliant                                                                                 |
| Tape and Reel                   | TR-F77                                                                                    |
| Suggested Layout for PCB Design | PL-767                                                                                    |
| Evaluation Board                | TB-BFHKI-7551C+<br>Gerber File                                                            |
| Environmental Rating            | ENV06T12                                                                                  |

## 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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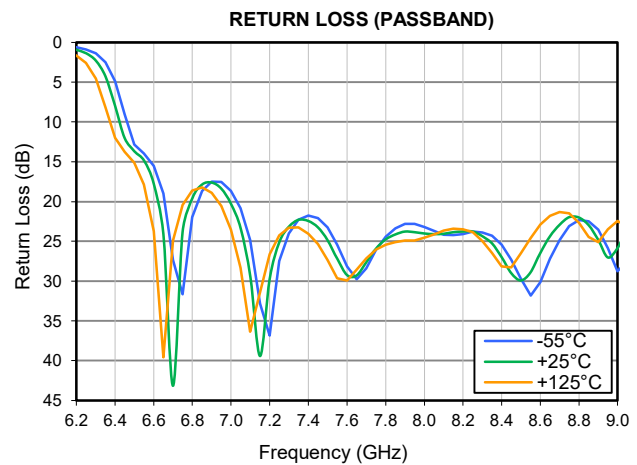
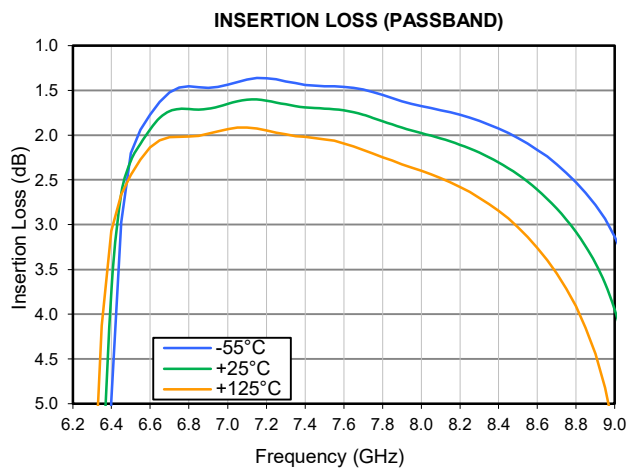
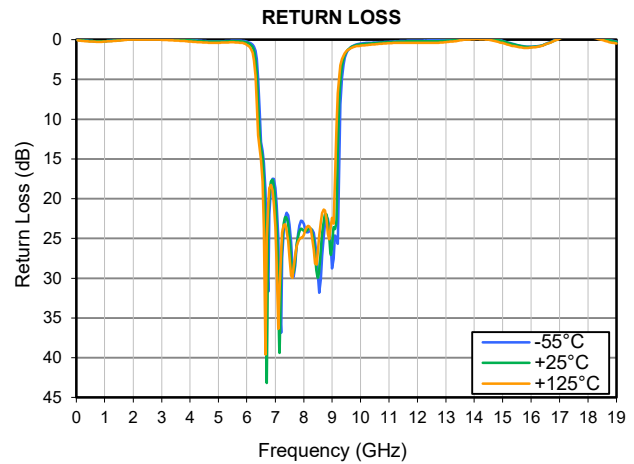
LTCC Bandpass Filter

BFHKI-7551+

Typical Performance Data

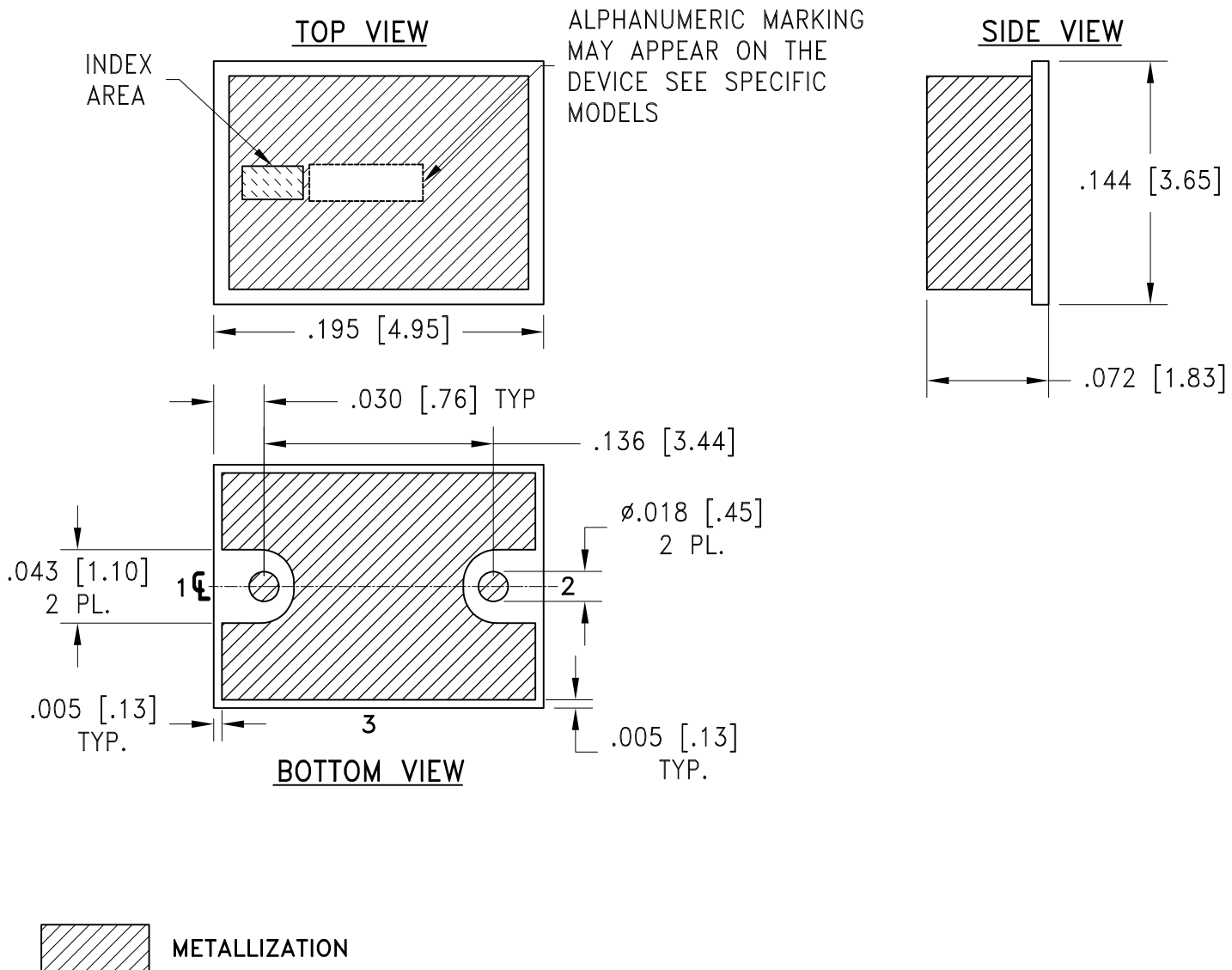
| FREQUENCY<br>(GHz) | INSERTION LOSS<br>(dB) |        |         | RETURN LOSS<br>(dB) |        |         |
|--------------------|------------------------|--------|---------|---------------------|--------|---------|
|                    | @-55°C                 | @+25°C | @+125°C | @-55°C              | @+25°C | @+125°C |
| 0.1                | 100.83                 | 105.77 | 103.28  | 0.03                | 0.04   | 0.11    |
| 0.2                | 97.88                  | 99.07  | 105.27  | 0.07                | 0.08   | 0.14    |
| 0.4                | 90.32                  | 90.65  | 100.15  | 0.13                | 0.13   | 0.19    |
| 0.6                | 86.80                  | 87.91  | 88.02   | 0.17                | 0.17   | 0.23    |
| 0.8                | 86.16                  | 87.56  | 85.79   | 0.20                | 0.19   | 0.25    |
| 1.0                | 83.76                  | 83.52  | 84.03   | 0.19                | 0.19   | 0.24    |
| 1.2                | 82.73                  | 81.87  | 82.59   | 0.13                | 0.14   | 0.18    |
| 1.4                | 81.84                  | 80.79  | 81.22   | 0.08                | 0.09   | 0.14    |
| 1.6                | 80.69                  | 80.59  | 79.38   | 0.01                | 0.02   | 0.08    |
| 1.8                | 79.01                  | 79.01  | 78.98   | -0.06               | -0.05  | 0.02    |
| 2.0                | 78.12                  | 77.30  | 78.63   | -0.12               | -0.10  | -0.02   |
| 2.2                | 78.14                  | 77.94  | 77.74   | -0.15               | -0.13  | -0.03   |
| 2.4                | 77.70                  | 77.40  | 77.09   | -0.19               | -0.16  | -0.05   |
| 2.6                | 77.17                  | 76.62  | 77.37   | -0.19               | -0.16  | -0.02   |
| 2.8                | 77.10                  | 77.04  | 77.31   | -0.18               | -0.15  | 0.00    |
| 3.0                | 76.63                  | 76.75  | 77.16   | -0.16               | -0.12  | 0.03    |
| 3.2                | 77.06                  | 76.95  | 77.55   | -0.15               | -0.10  | 0.06    |
| 3.4                | 77.54                  | 77.24  | 77.40   | -0.12               | -0.07  | 0.09    |
| 3.6                | 78.13                  | 78.33  | 78.03   | -0.09               | -0.03  | 0.13    |
| 3.8                | 78.39                  | 78.83  | 79.12   | -0.04               | 0.01   | 0.16    |
| 4.0                | 78.90                  | 79.32  | 79.71   | 0.02                | 0.07   | 0.22    |
| 4.2                | 79.59                  | 79.79  | 79.24   | 0.08                | 0.13   | 0.27    |
| 4.4                | 79.42                  | 79.01  | 78.86   | 0.13                | 0.18   | 0.31    |
| 4.6                | 77.73                  | 76.95  | 76.20   | 0.18                | 0.23   | 0.35    |
| 4.8                | 73.56                  | 72.83  | 71.88   | 0.20                | 0.24   | 0.36    |
| 5.0                | 68.31                  | 67.77  | 66.56   | 0.19                | 0.24   | 0.35    |
| 5.2                | 62.78                  | 61.77  | 60.62   | 0.18                | 0.22   | 0.34    |
| 5.4                | 56.47                  | 55.16  | 53.89   | 0.13                | 0.18   | 0.31    |
| 5.6                | 49.25                  | 47.91  | 46.21   | 0.11                | 0.17   | 0.32    |
| 5.8                | 41.01                  | 39.56  | 37.40   | 0.13                | 0.21   | 0.39    |
| 6.0                | 31.43                  | 29.60  | 26.89   | 0.23                | 0.36   | 0.62    |
| 6.2                | 19.39                  | 16.96  | 13.46   | 0.63                | 0.94   | 1.65    |
| 6.4                | 4.97                   | 3.70   | 3.07    | 4.86                | 7.99   | 12.00   |
| 6.6                | 1.77                   | 1.93   | 2.14    | 15.51               | 17.79  | 23.76   |
| 6.8                | 1.45                   | 1.71   | 2.02    | 21.95               | 19.56  | 18.64   |
| 7.0                | 1.44                   | 1.65   | 1.93    | 18.66               | 20.29  | 23.55   |
| 7.2                | 1.36                   | 1.61   | 1.95    | 36.85               | 29.76  | 26.64   |
| 7.4                | 1.44                   | 1.69   | 2.02    | 21.77               | 22.44  | 24.04   |
| 7.6                | 1.46                   | 1.72   | 2.09    | 28.17               | 29.26  | 29.94   |
| 7.8                | 1.55                   | 1.84   | 2.25    | 24.40               | 24.78  | 25.42   |
| 8.0                | 1.67                   | 1.98   | 2.40    | 23.19               | 24.03  | 24.56   |
| 8.2                | 1.77                   | 2.11   | 2.58    | 24.11               | 23.78  | 23.48   |
| 8.4                | 1.93                   | 2.30   | 2.84    | 25.42               | 26.99  | 28.17   |
| 8.6                | 2.16                   | 2.61   | 3.26    | 30.12               | 26.47  | 22.92   |
| 8.8                | 2.53                   | 3.08   | 3.91    | 22.33               | 22.01  | 22.68   |
| 9.0                | 3.13                   | 3.95   | 5.34    | 28.78               | 25.87  | 22.42   |
| 9.2                | 4.89                   | 7.38   | 12.88   | 25.69               | 13.76  | 6.70    |
| 9.4                | 16.81                  | 22.36  | 29.28   | 3.11                | 2.42   | 1.98    |
| 9.6                | 33.20                  | 37.86  | 43.81   | 1.12                | 1.12   | 1.16    |
| 9.8                | 47.08                  | 51.20  | 56.66   | 0.67                | 0.74   | 0.87    |
| 10.0               | 59.49                  | 64.85  | 69.59   | 0.49                | 0.58   | 0.74    |
| 10.2               | 76.35                  | 84.73  | 85.17   | 0.42                | 0.50   | 0.66    |
| 10.4               | 80.47                  | 81.03  | 76.06   | 0.37                | 0.45   | 0.61    |
| 10.6               | 79.29                  | 75.94  | 75.43   | 0.32                | 0.40   | 0.55    |
| 10.8               | 75.50                  | 73.78  | 73.44   | 0.28                | 0.35   | 0.50    |
| 11.0               | 72.37                  | 71.56  | 70.77   | 0.24                | 0.31   | 0.45    |
| 11.5               | 67.86                  | 69.12  | 66.12   | 0.15                | 0.22   | 0.38    |
| 12.0               | 66.16                  | 65.22  | 65.19   | 0.10                | 0.18   | 0.37    |
| 12.5               | 61.14                  | 61.78  | 60.75   | 0.09                | 0.18   | 0.37    |
| 13.0               | 61.31                  | 59.04  | 61.00   | 0.04                | 0.12   | 0.28    |
| 13.5               | 57.20                  | 57.26  | 56.99   | -0.09               | -0.02  | 0.09    |
| 14.0               | 55.06                  | 55.80  | 54.62   | -0.26               | -0.19  | -0.07   |
| 14.5               | 53.85                  | 54.59  | 53.95   | -0.24               | -0.18  | 0.01    |
| 15.0               | 54.29                  | 53.59  | 53.95   | 0.14                | 0.18   | 0.42    |
| 15.5               | 54.42                  | 53.89  | 54.44   | 0.67                | 0.69   | 0.88    |
| 16.0               | 52.68                  | 53.65  | 53.13   | 0.89                | 0.90   | 0.99    |
| 16.5               | 52.13                  | 52.83  | 52.27   | 0.56                | 0.58   | 0.61    |
| 17.0               | 52.18                  | 52.08  | 52.54   | -0.24               | -0.18  | -0.13   |
| 17.5               | 51.70                  | 52.55  | 51.97   | -0.89               | -0.79  | -0.62   |
| 18.0               | 53.82                  | 54.79  | 55.11   | -0.84               | -0.74  | -0.49   |
| 18.5               | 58.07                  | 58.13  | 59.70   | -0.27               | -0.21  | 0.03    |
| 19.0               | 60.61                  | 61.21  | 62.85   | 0.23                | 0.27   | 0.48    |

## Typical Performance Data



## Outline Dimensions

NM3237



Weight: .135 grams.

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

### Notes:

1. Case material: LTCC on printed circuit board base.
2. Termination Finish: **as shown below or indicated on Data Sheet.**  
For RoHS Case Styles: Gold Plate over Nickel plate. All models, (+) suffix.



INTERNET <http://www.minicircuits.com>

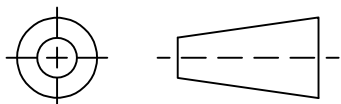
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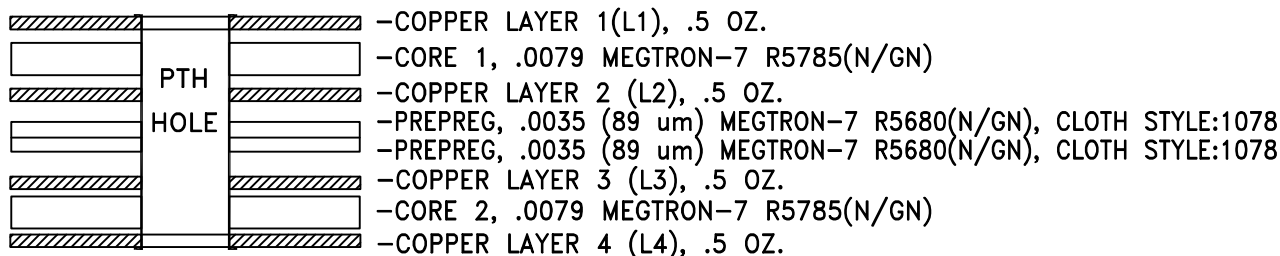
## THIRD ANGLE PROJECTION



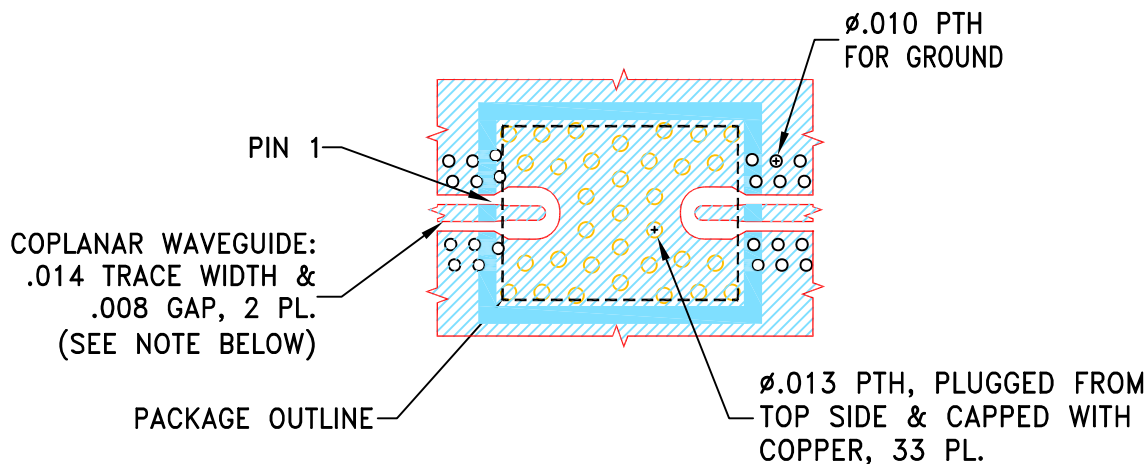
## REVISIONS

| REV | ECN No.    | DESCRIPTION | DATE     | DR  | AUTH |
|-----|------------|-------------|----------|-----|------|
| OR  | ECO-019771 | NEW RELEASE | 11/06/23 | ITG | IL   |
|     |            |             |          |     |      |
|     |            |             |          |     |      |
|     |            |             |          |     |      |

SUGGESTED MOUNTING CONFIGURATION  
FOR NM3237 CASE STYLE

STACK-UP DIAGRAM

1. TOTAL FINISHED THICKNESS  $0.026 \pm 10\%$ .
2. PTH PRESENT FROM COPPER LAYER 1 TO COPPER LAYER 4.

NOTES:

1. PCB IS MULTILAYER PCB, SEE STACK-UP DIAGRAM.
2. TRACE WIDTH & GAP ARE SHOWN FOR .0079 MEGTRON-7 R5785(N/GN), COPPER: 1/2 OZ. EACH LAYER.  
FOR OTHER MATERIALS TRACE WIDTH & GAP MAY NEED TO BE MODIFIED.
3. LAYERS L2, L3 & L4 OF PCB ARE CONTINUOUS GROUND PLANES.



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



DENOTES COPPER LAND PATTERN FREE OF SOLDER MASK.

## UNLESS OTHERWISE SPECIFIED

DIMENSIONS ARE IN INCHES

TOLERANCES ON:  
2 PL DECIMALS  $\pm$   
3 PL DECIMALS  $\pm$  .005  
ANGLES  $\pm$   
FRACTIONS  $\pm$

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



Mini-Circuits®

13 Neptune Avenue  
Brooklyn NY 11235

PL,NM3237, TB-BFHKI-XXXXC+

SIZE  
A

CODE IDENT  
15542

DRAWING NO:

98-PL-767

REV:

OR

FILE:

98PL767

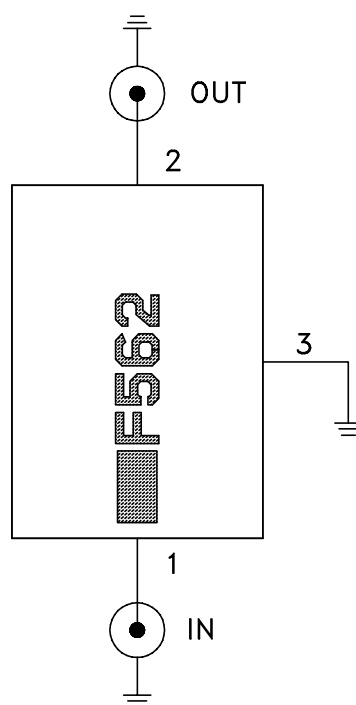
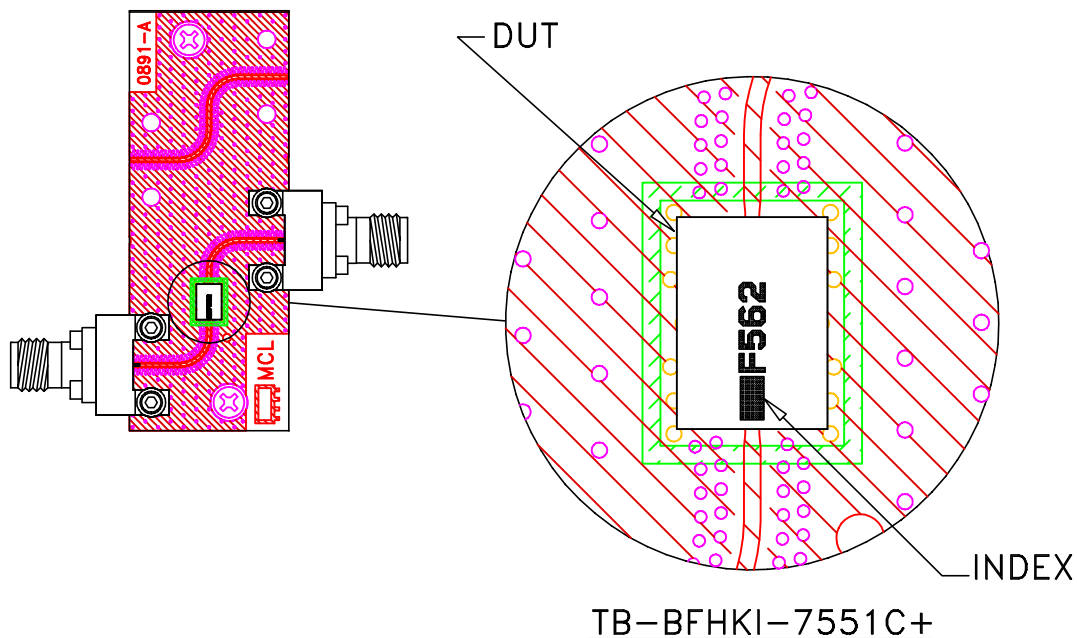
SCALE:

6:1

SHEET:

1 OF 1

# Evaluation Board and Circuit



Schematic Diagram

1. 50 Ohm 2.92 mm Female end Launch connectors.
2. PCB Material: MEGTRON-7 R5785(N or GN) or equivalent,  
Dielectric Constant=3.37 Thickness=.0079 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   | -55° to 125° C<br>Ambient Environment                   | Individual Model Data Sheet            |
| Thermal Cycling       | -55 to 125°C, 100 cycles, Dwell Time 15 minutes.        | MIL-STD-202, Method 107, Condition A-3 |
| Humidity              | 85°C, 90-95% Relative Humidity, 250hours                |                                        |
| Solderability         | 10X / 30X Magnification                                 | J-STD-002C Test S, J-STD-002C Test S1  |
| High Temp Storage     | 125°C, 250 hours                                        |                                        |
| Bend Test             | 1mm, deflection for 5 seconds<br>Span of bending: 2.75" | --                                     |