

Ceramic

# Bandpass Filter

**BFTC-618+**

50Ω

460 to 776 MHz

## The Big Deal

- LTCC construction
- Temperature stable from -40°C to +85°C
- Small size (0.150 x 0.150 x 0.059")



*Generic photo used for illustration purposes only*  
CASE STYLE: FR933-1

## Product Overview

The BFTC-618+ LTCC bandpass filter covers the 460 to 776 MHz passband with 25 dB upper/lower stopband rejection. This model handles up to 3W RF input power and provides a wide operating temperature range from -40 to +85°C. Utilizing LTCC multi-layer construction, the filter achieves excellent repeatability of performance and comes in a tiny ceramic package saving space in dense PCB layouts.

## Key Features

| Feature                                        | Advantages                                                                                                   |
|------------------------------------------------|--------------------------------------------------------------------------------------------------------------|
| LTCC Construction                              | Provides a rugged package well suited for tough environments such as high humidity and temperature extremes. |
| Tiny size (0.150 x 0.150 x 0.059")             | Saves space in dense circuit boards and minimizes the effects of parasitics.                                 |
| Wide operating temperature range, -40 to +85°C | Enables reliable performance in extreme environments                                                         |

### 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-Circuit's 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/MCLStore/terms.jsp](http://www.minicircuits.com/MCLStore/terms.jsp)



# Bandpass Filter

50Ω 460 to 776 MHz

## BFTC-618+



Generic photo used for illustration purposes only  
CASE STYLE: FR933-1

### Features

- Good VSWR 1.5 typ. @ passband
- Small size
- Hermetically sealed
- Temperature stable
- LTCC construction

### Applications

- Test and measurement
- Harmonic rejection
- Transmitters / Receivers

### Electrical Specifications<sup>1,2</sup> at 25°C

| Parameter        | F#               | Frequency (MHz) | Min.     | Typ. | Max. | Unit |
|------------------|------------------|-----------------|----------|------|------|------|
| Pass Band        | Center Frequency | —               | —        | 618  | —    | MHz  |
|                  | Insertion Loss   | F1-F2           | —        | 4.8  | 6.0  | dB   |
|                  | VSWR             | F1-F2           | —        | 1.3  | —    | :1   |
| Stop Band, Lower | Insertion Loss   | F3-F4           | 1-330    | 25   | 35   | dB   |
|                  | VSWR             | F3-F4           | 1-330    | —    | 16   | :1   |
| Stop Band, Upper | Insertion Loss   | F5-F6           | 980-2400 | 25   | 30   | dB   |
|                  | VSWR             | F5-F6           | 980-2400 | —    | 10   | :1   |

1. Measured on Mini-Circuits Characterization Test Board TB-233

2. This filter is not intended for use as a DC Blocking circuit element. In Application where DC voltage is present at either input or output ports, blocking capacitors are required at the corresponding RF port.

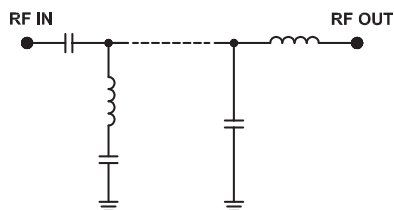
### Maximum Ratings

|                       |                 |
|-----------------------|-----------------|
| Operating Temperature | -40°C to 85°C   |
| Storage Temperature   | -55°C to 100°C  |
| RF Power Input*       | 3 W max @ +25°C |

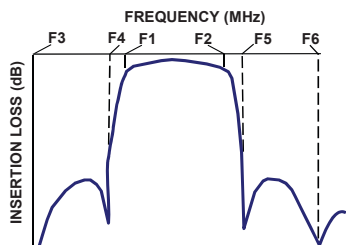
\*Passband rating, derate linearly to 1.5 W at 85°C ambient

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

### Functional Schematic



### Typical Frequency Response

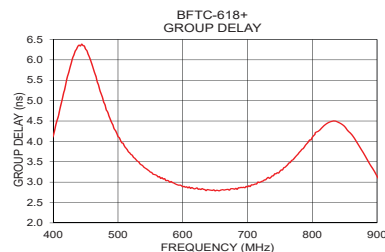
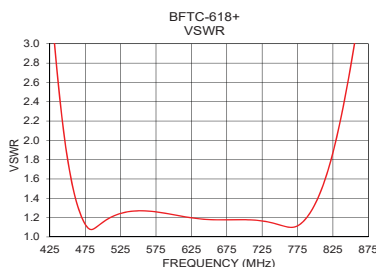
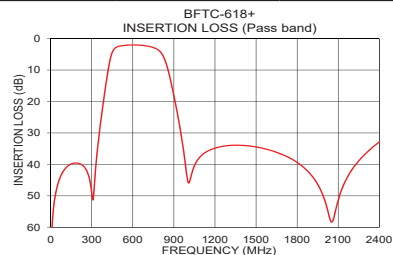
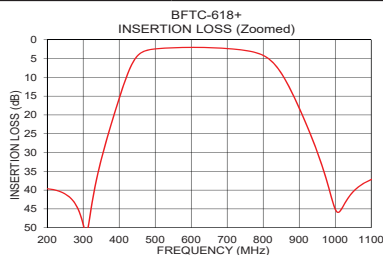


### Typical Performance Data at 25°C

| Frequency (MHz) | Insertion Loss (dB) | VSWR (:1) | Frequency (MHz) | Group Delay (nsec) |
|-----------------|---------------------|-----------|-----------------|--------------------|
| 1               | 80.59               | 8168.80   | 460             | 5.88               |
| 10              | 60.35               | 4270.56   | 468             | 5.46               |
| 100             | 41.68               | 101.99    | 470             | 5.38               |
| 290             | 46.00               | 13.65     | 480             | 4.90               |
| 330             | 40.52               | 10.57     | 490             | 4.47               |
| 340             | 35.92               | 9.90      | 500             | 4.12               |
| 350             | 31.96               | 9.26      | 510             | 3.88               |
| 380             | 21.77               | 7.32      | 550             | 3.25               |
| 450             | 4.36                | 1.81      | 570             | 3.08               |
| 460             | 3.52                | 1.43      | 580             | 3.00               |
| 618             | 2.03                | 1.21      | 600             | 2.89               |
| 776             | 3.33                | 1.12      | 618             | 2.83               |
| 800             | 4.16                | 1.34      | 620             | 2.85               |
| 875             | 13.10               | 3.87      | 650             | 2.79               |
| 910             | 20.31               | 5.33      | 680             | 2.83               |
| 950             | 29.80               | 6.86      | 700             | 2.88               |
| 980             | 38.66               | 8.06      | 720             | 3.00               |
| 1500            | 34.46               | 35.78     | 740             | 3.16               |
| 2000            | 51.21               | 47.51     | 760             | 3.40               |
| 2400            | 32.85               | 51.96     | 776             | 3.66               |

### +RoHS Compliant

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



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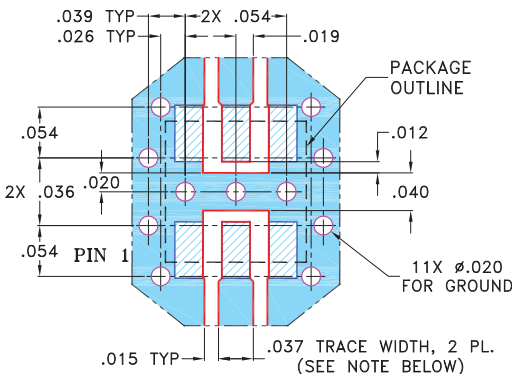


Pad Connections

|        |         |
|--------|---------|
| RF IN  | 2       |
| RF OUT | 5       |
| GROUND | 1,3,4,6 |

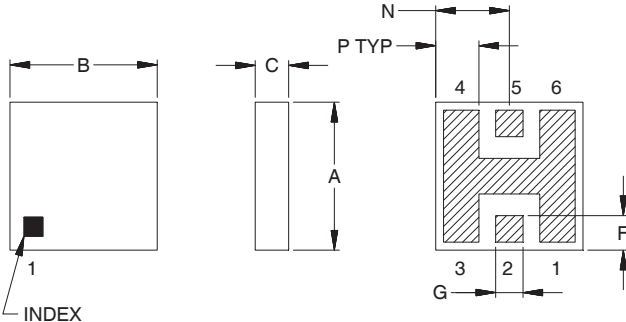
Product Marking: 351

Demo Board MCL P/N: TB-233  
Suggested PCB Layout (PL-112)

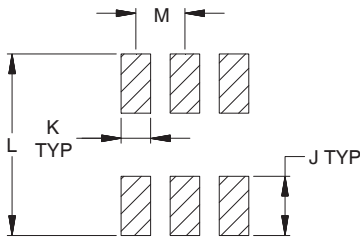


- NOTES: 1. TRACE WIDTH IS SHOWN FOR ROGERS RO4350B WITH DIELECTRIC THICKNESS 0.020" ± 0.0015"; COPPER: 1/2 OZ. EACH SIDE. FOR OTHER MATERIALS TRACE WIDTH MAY NEED TO BE MODIFIED.
2. BOTTOM SIDE OF THE PCB IS CONTINUOUS GROUND PLANE.
-  DENOTES PCB COPPER LAYOUT WITH SMOBC (SOLDER MASK OVER BARE COPPER)
-  DENOTES COPPER LAND PATTERN FREE OF SOLDER MASK

Outline Drawing



PCB Land Pattern



Suggested Layout,  
Tolerance to be within ±.002

Outline Dimensions ( inch mm )

| A    | B    | C    | D    | E    | F    | G     | H  |
|------|------|------|------|------|------|-------|----|
| .150 | .150 | .059 | --   | --   | .035 | .028  | -- |
| 3.81 | 3.81 | 1.50 | --   | --   | .89  | .71   | -- |
| J    | K    | L    | M    | N    | P    | Wt.   |    |
| .060 | .030 | .184 | .050 | .075 | .044 | grams |    |
| 1.52 | .76  | 4.67 | 1.27 | 1.91 | 1.12 | 0.15  |    |

Note: Please refer to case style drawing for details

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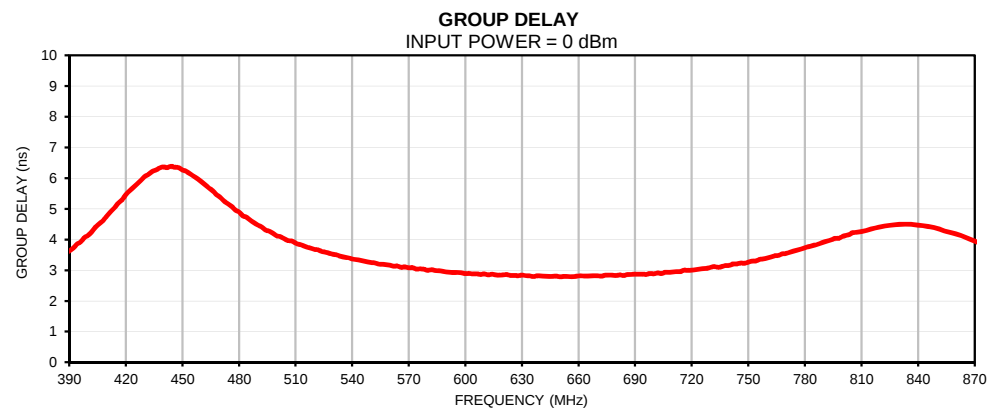
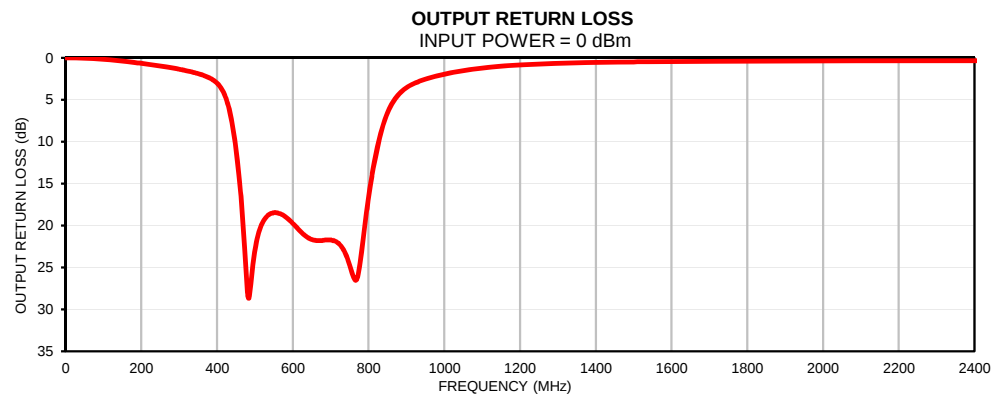
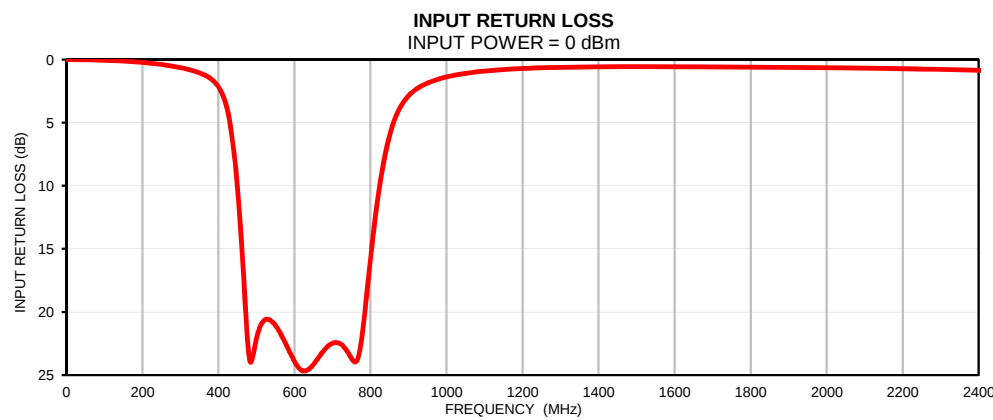
# Ceramic Band Pass Filter

**BFTC-618+**

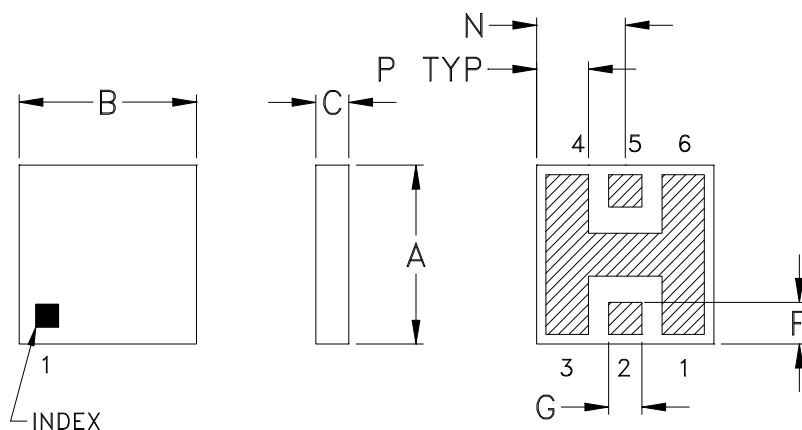
## Typical Performance Data

| FREQ. | Insertion Loss | Input Return Loss | Output Return Loss | FREQ. | Group Delay |
|-------|----------------|-------------------|--------------------|-------|-------------|
| (MHz) | (dB)           | (dB)              | (dB)               | (MHz) | (ns)        |
| 1     | 80.59          | 0.00              | 0.00               | 460   | 5.88        |
| 50    | 46.67          | 0.01              | 0.04               | 462   | 5.78        |
| 75    | 43.58          | 0.03              | 0.09               | 464   | 5.68        |
| 100   | 41.68          | 0.05              | 0.17               | 468   | 5.46        |
| 125   | 40.54          | 0.08              | 0.27               | 474   | 5.17        |
| 150   | 39.86          | 0.11              | 0.39               | 480   | 4.90        |
| 175   | 39.57          | 0.16              | 0.51               | 486   | 4.63        |
| 200   | 39.62          | 0.22              | 0.66               | 492   | 4.41        |
| 225   | 40.06          | 0.30              | 0.81               | 498   | 4.20        |
| 250   | 41.05          | 0.39              | 0.98               | 504   | 4.02        |
| 300   | 49.10          | 0.63              | 1.36               | 510   | 3.88        |
| 320   | 46.22          | 0.77              | 1.54               | 516   | 3.75        |
| 330   | 40.52          | 0.85              | 1.65               | 522   | 3.66        |
| 340   | 35.92          | 0.94              | 1.76               | 528   | 3.55        |
| 360   | 28.36          | 1.17              | 2.02               | 534   | 3.45        |
| 380   | 21.77          | 1.51              | 2.39               | 540   | 3.37        |
| 400   | 15.60          | 2.14              | 3.02               | 546   | 3.30        |
| 420   | 9.97           | 3.57              | 4.41               | 552   | 3.24        |
| 440   | 5.70           | 7.07              | 7.83               | 558   | 3.18        |
| 460   | 3.52           | 14.14             | 14.99              | 564   | 3.14        |
| 480   | 2.73           | 23.38             | 27.76              | 570   | 3.08        |
| 500   | 2.43           | 22.13             | 22.98              | 576   | 3.04        |
| 520   | 2.27           | 20.68             | 19.67              | 582   | 3.02        |
| 540   | 2.16           | 20.75             | 18.62              | 588   | 2.96        |
| 560   | 2.09           | 21.53             | 18.51              | 594   | 2.92        |
| 580   | 2.04           | 22.69             | 18.96              | 600   | 2.89        |
| 600   | 2.02           | 23.91             | 19.76              | 606   | 2.89        |
| 618   | 2.03           | 24.62             | 20.60              | 612   | 2.85        |
| 640   | 2.06           | 24.48             | 21.46              | 618   | 2.83        |
| 660   | 2.12           | 23.76             | 21.78              | 624   | 2.83        |
| 680   | 2.21           | 22.97             | 21.77              | 630   | 2.84        |
| 700   | 2.34           | 22.49             | 21.74              | 636   | 2.79        |
| 720   | 2.50           | 22.52             | 22.11              | 642   | 2.81        |
| 740   | 2.71           | 23.17             | 23.45              | 648   | 2.81        |
| 760   | 2.99           | 23.97             | 26.12              | 654   | 2.80        |
| 776   | 3.33           | 22.31             | 25.05              | 660   | 2.81        |
| 800   | 4.16           | 15.80             | 16.68              | 666   | 2.81        |
| 825   | 5.85           | 9.86              | 10.36              | 672   | 2.80        |
| 850   | 8.85           | 6.05              | 6.59               | 678   | 2.84        |
| 875   | 13.10          | 3.96              | 4.60               | 684   | 2.82        |
| 880   | 14.06          | 3.69              | 4.34               | 690   | 2.87        |
| 900   | 18.15          | 2.87              | 3.57               | 696   | 2.86        |
| 910   | 20.31          | 2.58              | 3.30               | 702   | 2.91        |
| 950   | 29.80          | 1.85              | 2.55               | 708   | 2.93        |
| 980   | 38.66          | 1.53              | 2.17               | 714   | 2.95        |
| 1000  | 45.05          | 1.37              | 1.95               | 720   | 3.00        |
| 1100  | 37.21          | 0.90              | 1.22               | 726   | 3.05        |
| 1200  | 34.83          | 0.70              | 0.85               | 732   | 3.12        |
| 1300  | 34.00          | 0.61              | 0.65               | 738   | 3.15        |
| 1400  | 33.95          | 0.57              | 0.55               | 744   | 3.21        |
| 1500  | 34.46          | 0.57              | 0.49               | 750   | 3.27        |
| 1600  | 35.46          | 0.56              | 0.44               | 752   | 3.30        |
| 1700  | 37.01          | 0.58              | 0.41               | 754   | 3.30        |
| 1800  | 39.34          | 0.60              | 0.40               | 756   | 3.35        |
| 1900  | 43.25          | 0.61              | 0.38               | 758   | 3.37        |
| 2000  | 51.21          | 0.64              | 0.37               | 760   | 3.40        |
| 2100  | 51.36          | 0.68              | 0.35               | 762   | 3.43        |
| 2200  | 41.68          | 0.72              | 0.35               | 764   | 3.47        |
| 2300  | 36.58          | 0.77              | 0.34               | 770   | 3.55        |
| 2400  | 32.85          | 0.85              | 0.33               | 776   | 3.66        |

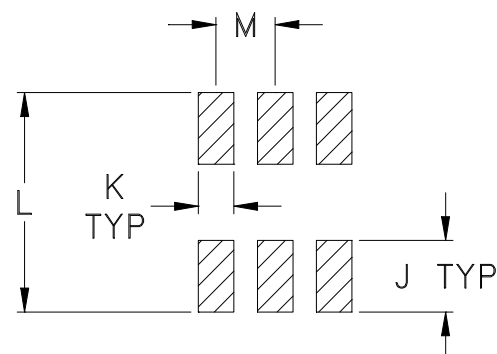
Typical Performance Curves



### Outline Dimensions



### PCB Land Pattern



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

| CASE #  | A              | B              | C              | D  | E  | F              | G              | H  | J              | K              | L              | M              |
|---------|----------------|----------------|----------------|----|----|----------------|----------------|----|----------------|----------------|----------------|----------------|
| FR933-1 | .150<br>(3.81) | .150<br>(3.81) | .059<br>(1.50) | -- | -- | .035<br>(0.89) | .028<br>(0.71) | -- | .060<br>(1.52) | .030<br>(0.76) | .184<br>(4.67) | .050<br>(1.27) |

| CASE #  | N              | P              | WT. GRAM |
|---------|----------------|----------------|----------|
| FR933-1 | .075<br>(1.91) | .044<br>(1.12) | 0.15     |

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

#### Notes:

1. Open style, Ceramic Base.
2. Termination finish: Palladium Silver.



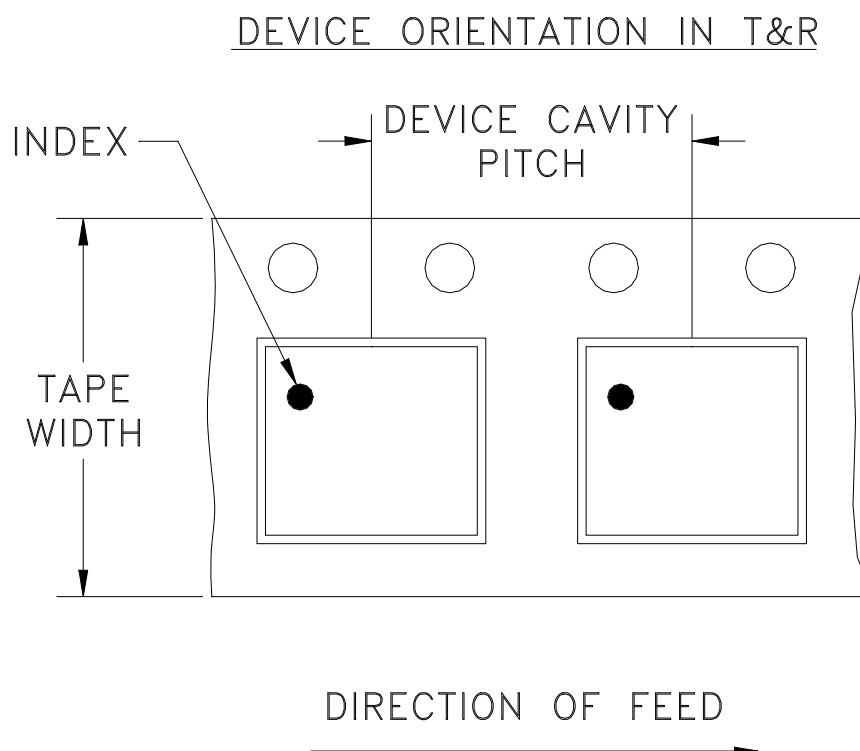
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Mini-Circuits ISO 9001 & ISO 14001 Certified

# Tape & Reel Packaging TR-F68



| Tape Width, mm | Device Cavity Pitch, mm | Reel Size, inches | Devices per Reel see note |      |
|----------------|-------------------------|-------------------|---------------------------|------|
| 12             | 8                       | 7                 | Small quantity standard   | 20   |
|                |                         |                   |                           | 50   |
|                |                         |                   |                           | 100  |
|                |                         |                   |                           | 200  |
|                |                         |                   |                           | 500  |
|                |                         | 7                 | Standard                  | 1000 |
|                |                         | 13                | Standard                  | 2000 |
|                |                         |                   |                           | 3000 |
|                |                         |                   |                           | 4000 |

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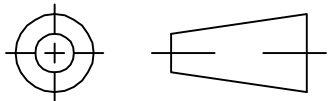
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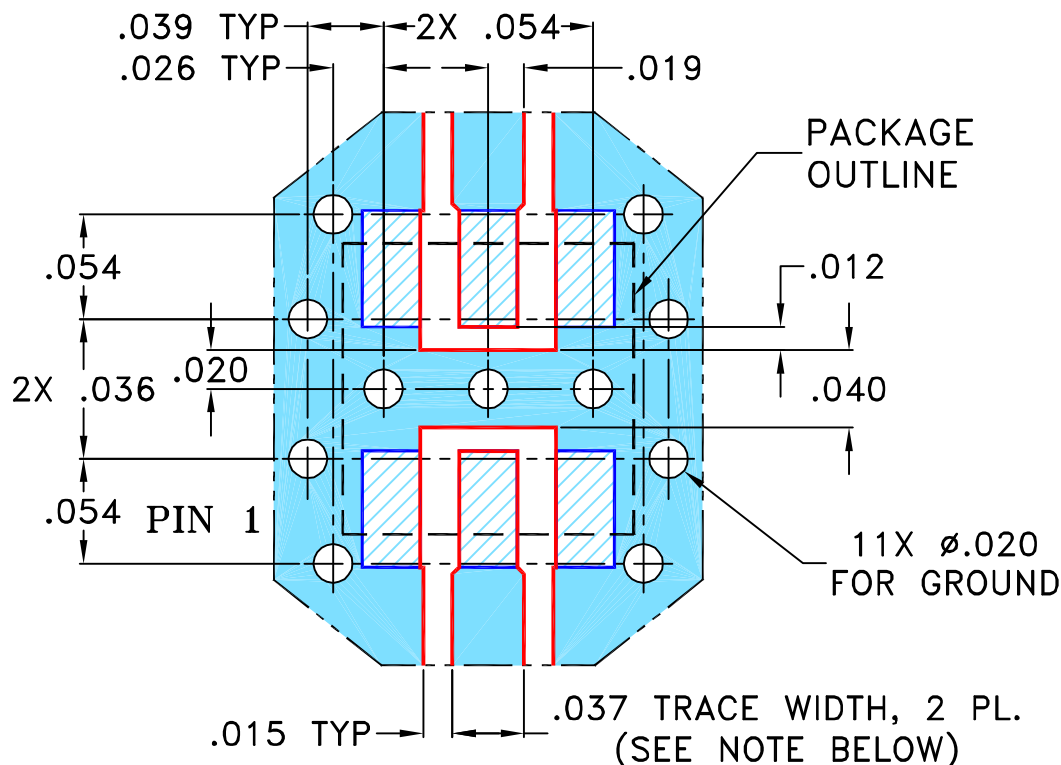
## THIRD ANGLE PROJECTION



## REVISIONS

| REV | ECN No. | DESCRIPTION                  | DATE     | DR  | AUTH |
|-----|---------|------------------------------|----------|-----|------|
| OR  | M83007  | NEW RELEASE                  | 09/04/02 | MMG | LER  |
| A   | M83501  | CNG LAYOUT AS PER B14-TB-233 | 10/01/02 | MMG | ABD  |
| B   | M102713 | ADDED "...WITH SMOBC"        | 01/14/06 | GF  | IL   |
| C   | M164713 | ADDED "933-1 & 06FL03"       | 11/15/17 | CA  | IL   |

**SUGGESTED MOUNTING CONFIGURATION**  
**FOR FR932/933/933-1 CASE STYLE, "06FL03" PIN CONNECTION**



NOTES: 1. TRACE WIDTH IS SHOWN FOR ROGERS R04350B WITH DIELECTRIC THICKNESS 0.020"  $\pm$  0.0015"; 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

DIMENSIONS ARE IN INCHES

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



INITIALS

DATE

DRAWN

MMG

09/04/02

CHECKED

APPROVED

LER(BC)

09/04/02

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



Mini-Circuits®

13 Neptune Avenue  
 Brooklyn NY 11235

PL, 06FL03, FR932/933/933-1, TB-233

SIZE  
 A

CODE IDENT  
 15542

DRAWING NO:  
 98-PL-112

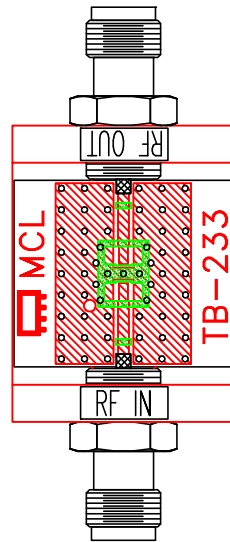
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FILE: 98PL112

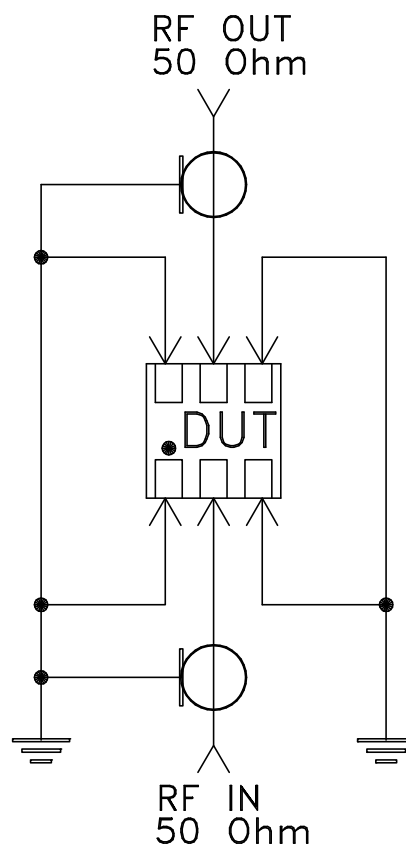
SCALE: 10:1

SHEET: 1 OF 1

# Evaluation Board and Circuit



TB-233



Schematic Diagram

## Notes:

1. SMA Female connectors.
2. PCB Material: Rogers R04350 or equivalent,  
Dielectric Constant=3.5, Thickness=.020 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                                                                              |