

# Surface Mount Coaxial-Ceramic Resonator Filters and Multiplexers

50Ω      DC to 6 GHz

## The Big Deal

- Low insertion loss with excellent power handling
- Passbands up to 6 GHz
- Fractional bandwidth from <1 to 25%
- Low profile designs with min. height of 0.120"
- Excellent temperature stability
- Rugged construction to handle demanding environmental conditions



## Product Overview

Mini-Circuits' *Coaxial-Ceramic Resonator filters* offer low insertion loss in very small form factors, using ceramic material with high dielectric constant and superior Q factor. Bandpass and bandstop filters, diplexer and multiplexer designs can be constructed using this technology. Low insertion loss combined with excellent power handling makes these filters well suited for transmitter and receiver signal chains. Advanced filter design and construction can achieve stopband width greater than 3x the center frequency as high as 20 GHz.

All our coaxial-ceramic resonator filters are built with rugged construction, qualified to withstand multiple demanding reflow cycles. Excellent repeatability across units is achieved through precise tuning and process control.

## Key Features

| Feature                  | Advantages                                                                                                                                                                            |
|--------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Low insertion loss       | Low signal loss results in better SNR in signal chain                                                                                                                                 |
| Fast roll-off            | Higher selectivity results in better adjacent channel rejection and dynamic range                                                                                                     |
| Wide stop band           | Wide spur-free stopband results in better receiver sensitivity                                                                                                                        |
| Excellent power handling | Well suited for transmitter applications                                                                                                                                              |
| Rugged Construction      | These filter assemblies have been qualified over a wide range of thermal, mechanical and environmental conditions including withstanding the stress of extensive solder reflow cycles |
| Small Size               | Very well suited for high performance applications where size is a constraint.                                                                                                        |
| Temperature stability    | Very minimal change in electrical performance across temperature makes these filters suitable for a wide range of operating conditions.                                               |

### Notes

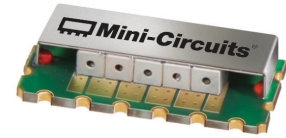
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# Bandpass Filter

50Ω 1765 to 1920 MHz

CSBP-A1843+



Generic photo used for illustration purposes only  
CASE STYLE: KU1513

## Features

- Low Insertion Loss, 1.3 dB typ.
- Minimal Insertion loss variation over operating temperature  $\pm 0.3$  dB
- High power handling, 12.6 W
- Wide pass band (8.4%), high selectivity

## Applications

- Sub harmonic filtering
- Image Rejection
- PCS/DCS

## Electrical Specifications at 25°C

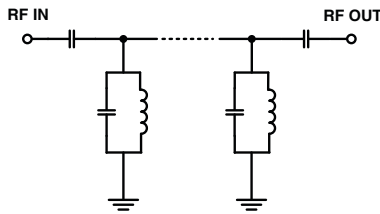
| Parameter               | F#               | Frequency (MHz) | Min. | Typ.   | Max. | Unit |
|-------------------------|------------------|-----------------|------|--------|------|------|
| <b>Pass Band</b>        | Center Frequency | -               | -    | 1842.5 | -    | MHz  |
|                         | Insertion Loss   | F1-F2           | -    | 1.3    | 2.5  | dB   |
|                         | VSWR             | F1-F2           | -    | 1.4    | 1.6  | :1   |
| <b>Stop Band, Lower</b> | Insertion Loss   | DC-F3           | 20   | 31     | -    | dB   |
| <b>Stop Band, Upper</b> | Insertion Loss   | F4-F5           | 20   | 28     | -    | dB   |

## Maximum Ratings

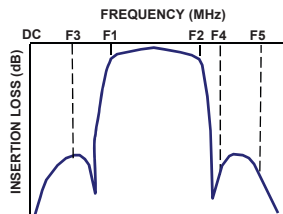
|                       |                    |
|-----------------------|--------------------|
| Operating Temperature | -40°C to 85°C      |
| Storage Temperature   | -55°C to 100°C     |
| RF Power Input*       | 12.6W max. at 25°C |

\*Derate linearly to 6.5W at 85°C  
Permanent damage may occur if any of these limits are exceeded.

## Functional Schematic



## Typical Frequency Response

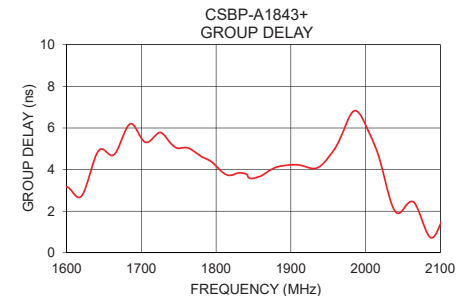
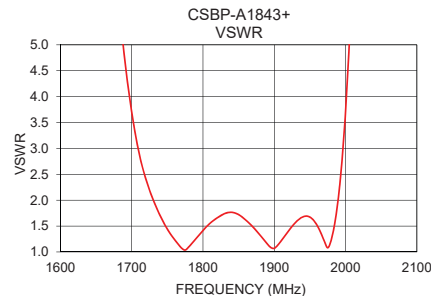
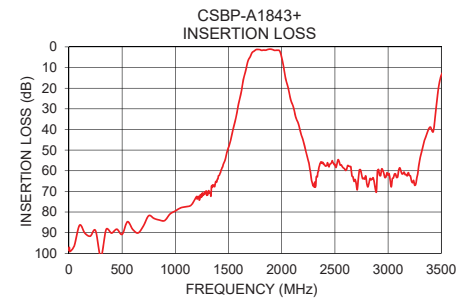
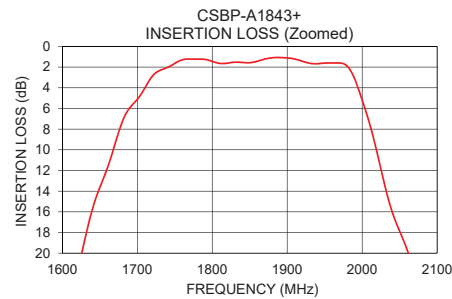


### +RoHS Compliant

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

## Typical Performance Data at 25°C

| Frequency (MHz) | Insertion Loss (dB) | VSWR (:1) | Frequency (MHz) | Group Delay (ns) |
|-----------------|---------------------|-----------|-----------------|------------------|
| 1               | 97.15               | 6520.72   | 1765            | 5.01             |
| 500             | 90.79               | 346.00    | 1775            | 4.76             |
| 1000            | 79.50               | 100.24    | 1785            | 4.55             |
| 1460            | 55.83               | 45.43     | 1795            | 4.35             |
| 1580            | 31.63               | 27.77     | 1805            | 3.99             |
| 1635            | 17.16               | 16.29     | 1815            | 3.74             |
| 1670            | 9.51                | 8.01      | 1825            | 3.78             |
| 1695            | 5.52                | 4.18      | 1835            | 3.83             |
| 1765            | 1.24                | 1.15      | 1843            | 3.64             |
| 1810            | 1.64                | 1.56      | 1855            | 3.63             |
| 1843            | 1.57                | 1.76      | 1865            | 3.80             |
| 1920            | 1.43                | 1.41      | 1875            | 4.03             |
| 1995            | 4.12                | 2.76      | 1880            | 4.11             |
| 2095            | 27.14               | 35.63     | 1885            | 4.16             |
| 2120            | 31.31               | 39.68     | 1890            | 4.18             |
| 2240            | 53.16               | 48.06     | 1895            | 4.21             |
| 2500            | 56.96               | 48.89     | 1900            | 4.23             |
| 3000            | 62.08               | 52.46     | 1905            | 4.23             |
| 3200            | 62.25               | 46.63     | 1915            | 4.19             |
| 3300            | 54.13               | 34.94     | 1920            | 4.13             |



## Notes

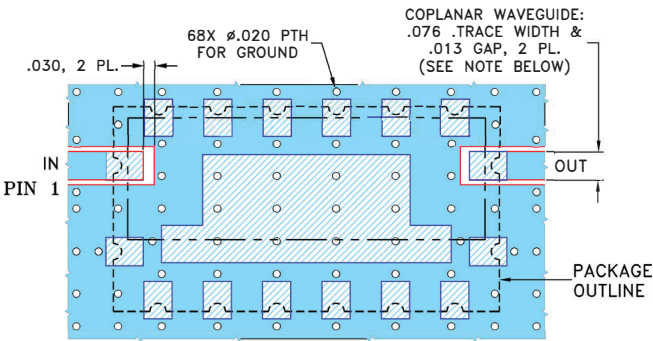
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Pad Connections

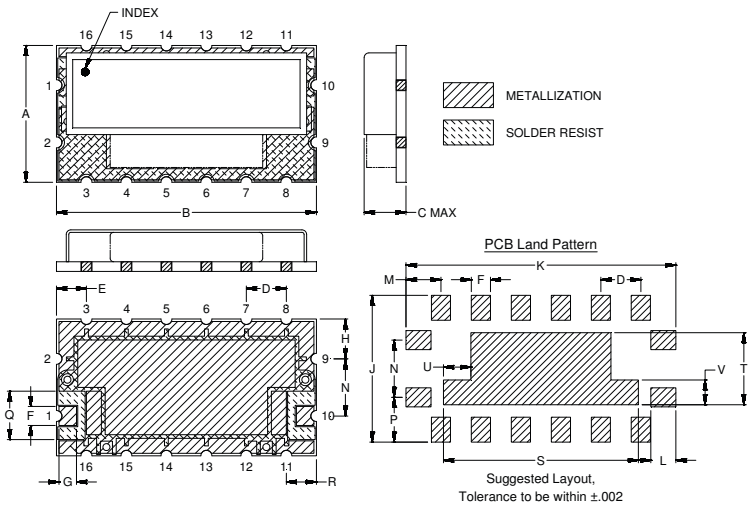
|        |                 |
|--------|-----------------|
| INPUT  | 1               |
| OUTPUT | 10              |
| GROUND | 2 to 9,11 to 16 |

Demo Board MCL P/N: TB-578+  
Suggested PCB Layout (PL-331)



- NOTE: 1. COPLANAR WAVEGUIDE PARAMETERS ARE SHOWN FOR ROGERS RO4350B WITH DIELECTRIC THICKNESS .060" ± .004"; 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



Outline Dimensions ( inch mm )

| A     | B     | C    | D    | E    | F     | G    | H    | J     | K     | L    |
|-------|-------|------|------|------|-------|------|------|-------|-------|------|
| .550  | 1.040 | .185 | .160 | .120 | .077  | .070 | .160 | .590  | 1.080 | .100 |
| 13.97 | 26.24 | 4.70 | 4.06 | 3.05 | 1.96  | 1.78 | 4.06 | 14.99 | 27.43 | 2.54 |
| M     | N     | P    | Q    | R    | S     | T    | U    | V     | Wt.   |      |
| .140  | .230  | .180 | .195 | .115 | .780  | .290 | .110 | .100  | grams |      |
| 3.56  | 5.84  | 4.57 | 4.95 | 2.92 | 19.81 | 7.36 | 2.79 | 2.54  | 2.6   |      |

Note: Please refer to case style drawing for details

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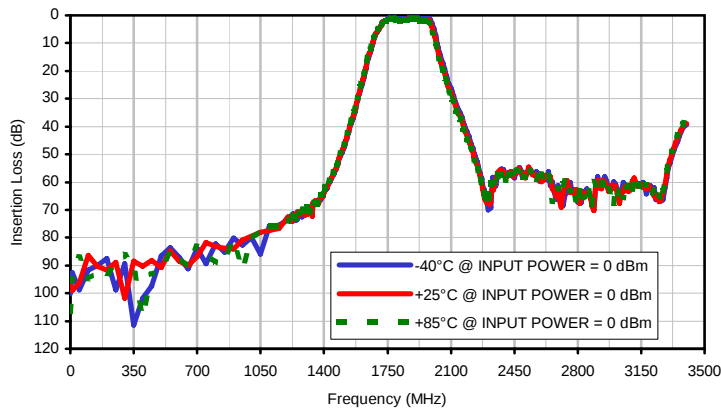
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## Typical Performance Data

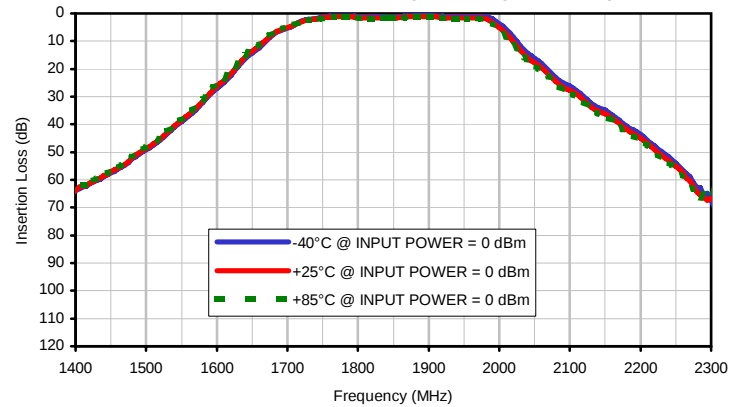
| FREQ.<br><br>(MHz) | INSERTION LOSS |          |          | INPUT VSWR |          |          | OUTPUT VSWR |          |          |
|--------------------|----------------|----------|----------|------------|----------|----------|-------------|----------|----------|
|                    | (dB)           |          |          | (:1)       |          |          | (:1)        |          |          |
|                    | @ -40° C       | @ +25° C | @ +85° C | @ -40° C   | @ +25° C | @ +85° C | @ -40° C    | @ +25° C | @ +85° C |
| 1.0                | 100.23         | 97.15    | 106.72   | 7415.28    | 2251.14  | 6002.84  | 378199.63   | 6520.72  | 9454.68  |
| 50.0               | 98.90          | 96.38    | 87.17    | 2954.56    | 5729.99  | 3567.84  | 2198.89     | 8404.47  | 3049.92  |
| 100.0              | 91.66          | 86.39    | 94.83    | 10805.66   | 1826.95  | 1341.11  | 801.29      | 1881.49  | 936.10   |
| 500.0              | 86.58          | 90.79    | 91.83    | 1792.35    | 323.51   | 213.67   | 596.53      | 346.00   | 208.83   |
| 1000.0             | 79.85          | 79.50    | 80.24    | 178.98     | 103.42   | 87.04    | 354.78      | 100.24   | 84.74    |
| 1100.0             | 75.87          | 77.42    | 75.85    | 134.49     | 85.45    | 74.07    | 230.88      | 86.29    | 75.51    |
| 1200.0             | 73.48          | 72.53    | 73.74    | 112.19     | 73.88    | 64.92    | 170.66      | 75.58    | 66.25    |
| 1300.0             | 71.58          | 71.38    | 71.32    | 90.70      | 64.33    | 55.00    | 123.15      | 64.41    | 55.93    |
| 1400.0             | 63.72          | 63.97    | 62.62    | 76.19      | 51.86    | 45.27    | 92.00       | 52.61    | 44.96    |
| 1460.0             | 56.17          | 55.83    | 55.66    | 63.66      | 44.57    | 37.99    | 79.29       | 45.43    | 38.06    |
| 1480.0             | 52.48          | 52.12    | 51.92    | 56.66      | 40.88    | 34.49    | 77.12       | 43.13    | 35.87    |
| 1500.0             | 49.22          | 48.69    | 48.15    | 56.18      | 39.41    | 32.97    | 69.63       | 40.86    | 33.34    |
| 1540.0             | 40.99          | 40.56    | 39.96    | 45.61      | 32.30    | 26.55    | 59.87       | 34.88    | 27.49    |
| 1560.0             | 36.99          | 36.40    | 35.73    | 43.84      | 30.19    | 24.53    | 52.32       | 30.96    | 24.21    |
| 1580.0             | 32.11          | 31.63    | 31.09    | 38.72      | 26.77    | 21.55    | 48.02       | 27.77    | 21.44    |
| 1600.0             | 26.99          | 26.28    | 25.63    | 32.56      | 22.48    | 18.19    | 40.43       | 24.00    | 18.60    |
| 1620.0             | 22.40          | 21.76    | 21.19    | 27.13      | 18.89    | 15.10    | 32.10       | 19.51    | 15.11    |
| 1640.0             | 16.45          | 15.79    | 15.25    | 20.75      | 14.51    | 11.82    | 24.11       | 15.09    | 11.92    |
| 1660.0             | 12.38          | 11.79    | 11.28    | 14.14      | 10.15    | 8.40     | 15.10       | 10.16    | 8.27     |
| 1680.0             | 7.61           | 7.29     | 7.02     | 8.23       | 6.33     | 5.38     | 8.40        | 6.19     | 5.22     |
| 1700.0             | 5.30           | 5.13     | 4.90     | 4.70       | 3.86     | 3.37     | 4.63        | 3.71     | 3.22     |
| 1715.0             | 3.34           | 3.42     | 3.42     | 3.19       | 2.74     | 2.43     | 3.14        | 2.64     | 2.31     |
| 1735.0             | 2.01           | 2.18     | 2.25     | 2.15       | 1.92     | 1.73     | 2.11        | 1.85     | 1.64     |
| 1745.0             | 1.63           | 1.87     | 1.99     | 1.79       | 1.63     | 1.49     | 1.75        | 1.56     | 1.40     |
| 1755.0             | 1.12           | 1.45     | 1.66     | 1.52       | 1.41     | 1.32     | 1.47        | 1.33     | 1.21     |
| 1765.0             | 0.87           | 1.24     | 1.50     | 1.30       | 1.25     | 1.24     | 1.25        | 1.15     | 1.07     |
| 1775.0             | 0.85           | 1.23     | 1.49     | 1.16       | 1.19     | 1.24     | 1.06        | 1.04     | 1.10     |
| 1800.0             | 1.09           | 1.45     | 1.64     | 1.42       | 1.46     | 1.48     | 1.40        | 1.41     | 1.43     |
| 1810.0             | 1.29           | 1.64     | 1.84     | 1.59       | 1.59     | 1.58     | 1.57        | 1.56     | 1.53     |
| 1820.0             | 1.26           | 1.63     | 1.84     | 1.71       | 1.69     | 1.63     | 1.71        | 1.66     | 1.60     |
| 1830.0             | 1.19           | 1.53     | 1.72     | 1.83       | 1.76     | 1.66     | 1.83        | 1.74     | 1.64     |
| 1840.0             | 1.27           | 1.56     | 1.70     | 1.88       | 1.78     | 1.65     | 1.89        | 1.77     | 1.64     |
| 1842.0             | 1.28           | 1.57     | 1.71     | 1.88       | 1.77     | 1.64     | 1.89        | 1.76     | 1.63     |
| 1842.5             | 1.29           | 1.57     | 1.70     | 1.88       | 1.77     | 1.64     | 1.89        | 1.76     | 1.62     |
| 1845.0             | 1.30           | 1.58     | 1.71     | 1.88       | 1.76     | 1.63     | 1.88        | 1.75     | 1.61     |
| 1850.0             | 1.31           | 1.58     | 1.71     | 1.86       | 1.73     | 1.59     | 1.86        | 1.72     | 1.57     |
| 1860.0             | 1.14           | 1.44     | 1.60     | 1.76       | 1.62     | 1.48     | 1.77        | 1.62     | 1.46     |
| 1870.0             | 0.92           | 1.23     | 1.44     | 1.63       | 1.49     | 1.35     | 1.64        | 1.48     | 1.33     |
| 1880.0             | 0.77           | 1.11     | 1.34     | 1.46       | 1.33     | 1.21     | 1.47        | 1.33     | 1.20     |
| 1890.0             | 0.72           | 1.08     | 1.33     | 1.26       | 1.16     | 1.11     | 1.28        | 1.16     | 1.06     |
| 1900.0             | 0.73           | 1.11     | 1.38     | 1.07       | 1.07     | 1.16     | 1.11        | 1.07     | 1.12     |
| 1920.0             | 0.99           | 1.43     | 1.69     | 1.33       | 1.41     | 1.46     | 1.35        | 1.41     | 1.44     |
| 2000.0             | 3.58           | 5.19     | 6.36     | 3.12       | 3.96     | 4.59     | 2.97        | 3.72     | 4.27     |
| 2010.0             | 5.72           | 7.49     | 8.71     | 5.90       | 6.89     | 7.43     | 5.72        | 6.51     | 6.95     |
| 2020.0             | 8.57           | 10.31    | 11.37    | 10.49      | 11.05    | 11.10    | 10.39       | 10.42    | 10.35    |
| 2030.0             | 11.67          | 13.39    | 14.37    | 17.02      | 15.89    | 15.13    | 16.86       | 14.98    | 14.09    |
| 2040.0             | 14.23          | 16.00    | 17.07    | 23.93      | 20.56    | 18.79    | 24.40       | 19.39    | 17.30    |
| 2050.0             | 16.08          | 17.87    | 19.04    | 30.87      | 24.77    | 21.92    | 32.39       | 23.40    | 20.38    |
| 2060.0             | 18.07          | 19.67    | 20.73    | 37.33      | 28.61    | 24.81    | 40.83       | 27.51    | 23.21    |
| 2070.0             | 20.65          | 22.07    | 22.88    | 43.35      | 31.13    | 27.15    | 48.90       | 30.62    | 25.80    |
| 2080.0             | 23.14          | 24.57    | 25.38    | 47.96      | 34.10    | 29.04    | 55.26       | 33.24    | 27.79    |
| 2085.0             | 24.13          | 25.63    | 26.51    | 48.39      | 35.02    | 29.43    | 56.60       | 33.86    | 28.27    |
| 2090.0             | 24.92          | 26.48    | 27.46    | 50.40      | 35.47    | 30.00    | 58.92       | 35.42    | 28.69    |
| 2095.0             | 25.55          | 27.14    | 28.18    | 52.34      | 36.68    | 30.71    | 60.82       | 35.63    | 29.14    |
| 2100.0             | 26.18          | 27.74    | 28.78    | 54.56      | 37.14    | 31.28    | 64.75       | 36.74    | 29.79    |
| 2200.0             | 43.56          | 45.03    | 45.91    | 62.85      | 44.01    | 36.25    | 88.08       | 44.52    | 35.47    |
| 2220.0             | 47.73          | 49.09    | 49.64    | 66.18      | 44.55    | 36.18    | 102.16      | 46.96    | 36.10    |
| 2260.0             | 56.56          | 57.54    | 58.50    | 66.25      | 45.03    | 36.62    | 102.02      | 46.62    | 36.24    |
| 2300.0             | 67.43          | 66.73    | 66.00    | 65.71      | 44.20    | 35.52    | 112.72      | 46.43    | 36.12    |
| 2500.0             | 57.35          | 56.96    | 57.70    | 72.93      | 45.29    | 35.30    | 224.04      | 48.89    | 36.13    |
| 2600.0             | 59.49          | 59.82    | 56.71    | 80.21      | 45.60    | 35.12    | 256.23      | 49.39    | 34.41    |
| 2800.0             | 67.28          | 66.21    | 68.98    | 98.83      | 47.06    | 33.79    | 1919.86     | 54.75    | 34.21    |
| 3000.0             | 59.78          | 62.08    | 67.61    | 143.80     | 49.72    | 32.67    | 498.29      | 52.46    | 29.41    |
| 3200.0             | 61.19          | 62.25    | 64.20    | 117.09     | 45.36    | 29.39    | 851.76      | 46.63    | 25.15    |
| 3300.0             | 55.14          | 54.13    | 53.41    | 78.88      | 36.41    | 24.49    | 134.35      | 34.94    | 20.15    |
| 3400.0             | 39.44          | 38.94    | 38.09    | 25.78      | 16.70    | 12.33    | 19.57       | 12.27    | 8.86     |

## Typical Performance Curves

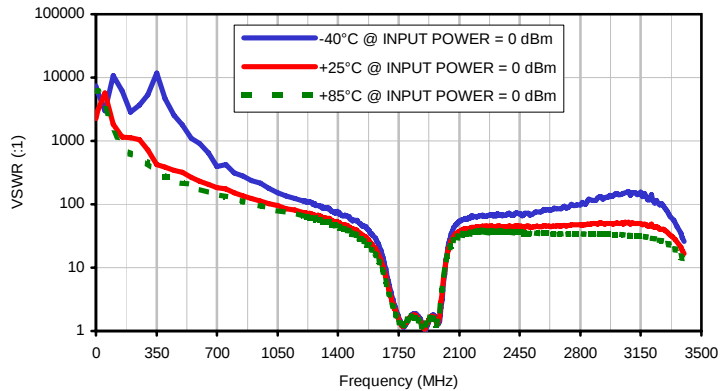
Insertion Loss vs. Temperature (Full band)



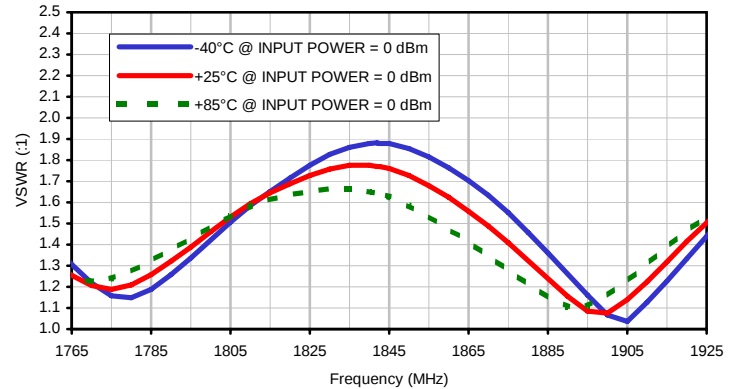
Insertion Loss vs. Temperature (Pass band)



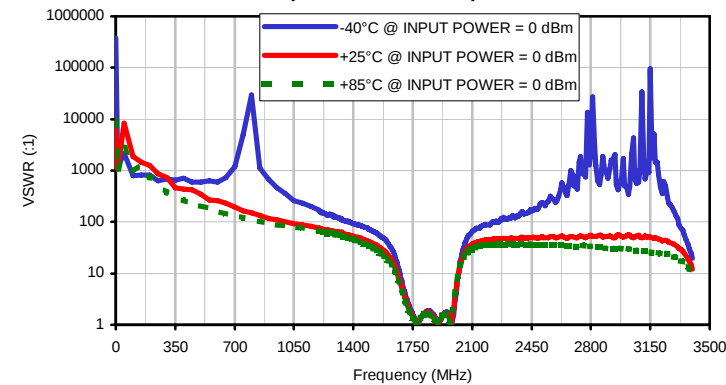
Input VSWR vs. Temperature



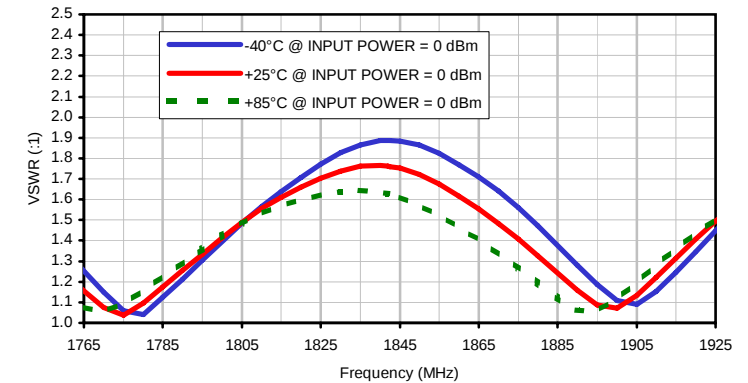
Input VSWR vs. Temperature



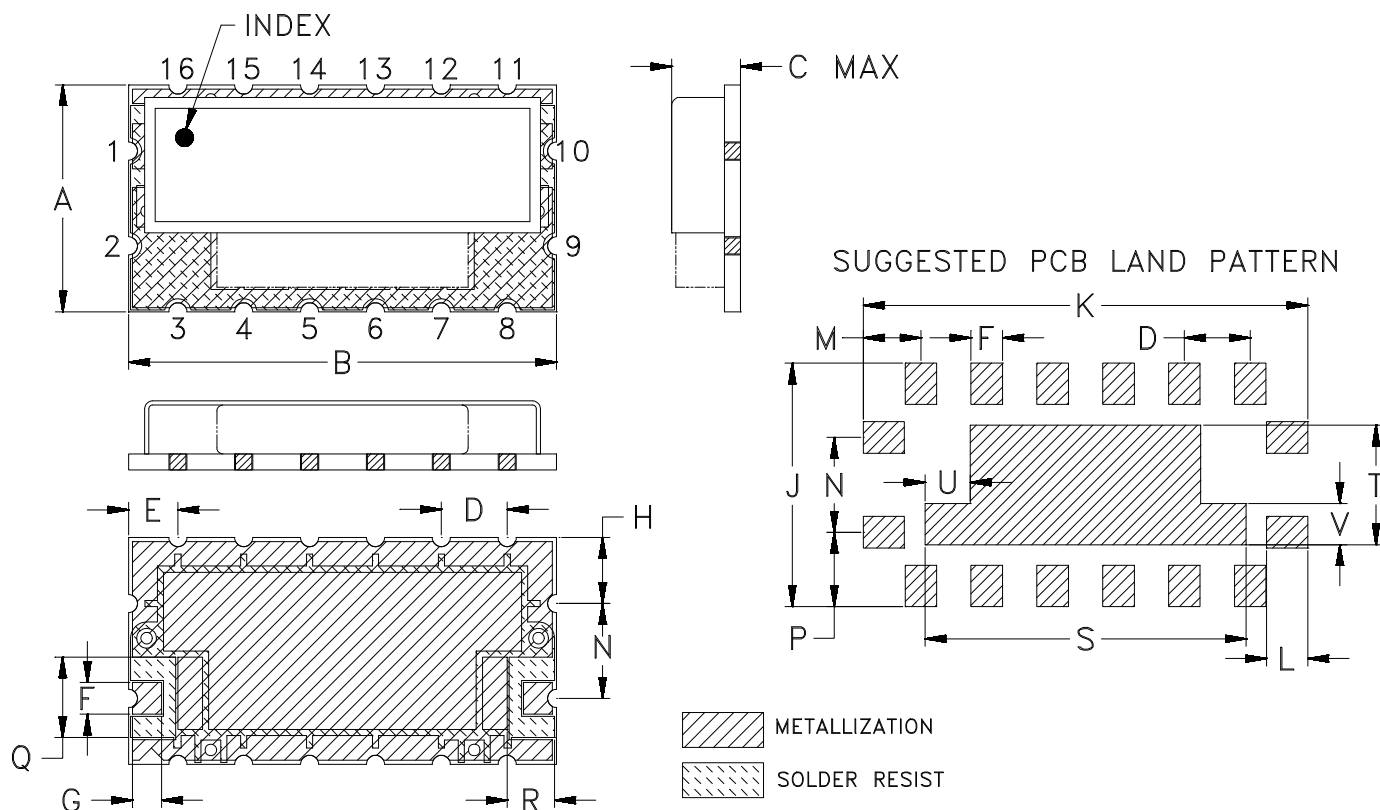
Output VSWR vs. Temperature



Output VSWR vs. Temperature



### Outline Dimensions



| CASE#  | A               | B                | C              | D              | E              | F              | G              | H              | J               | K                | L              | M              |
|--------|-----------------|------------------|----------------|----------------|----------------|----------------|----------------|----------------|-----------------|------------------|----------------|----------------|
| KU1513 | .550<br>(13.97) | 1.040<br>(26.24) | .185<br>(4.70) | .160<br>(4.06) | .120<br>(3.05) | .077<br>(1.96) | .070<br>(1.78) | .160<br>(4.06) | .590<br>(14.99) | 1.080<br>(27.43) | .100<br>(2.54) | .140<br>(3.56) |

| CASE#  | N              | P              | Q              | R              | S               | T              | U              | V              | WT, GRAMS |
|--------|----------------|----------------|----------------|----------------|-----------------|----------------|----------------|----------------|-----------|
| KU1513 | .230<br>(5.84) | .180<br>(4.57) | .195<br>(4.95) | .115<br>(2.92) | .780<br>(19.81) | .290<br>(7.36) | .110<br>(2.79) | .100<br>(2.54) | 2.6       |

Dimensions are in inches (mm). Tolerances: 2PL.  $\pm .03$ ; 3PL.  $\pm .015$

#### Notes:

- Case material: Nickel-Silver alloy.
- Base: Printed wiring laminate.
- Termination finish:  
For RoHS Case Styles: 2-5  $\mu$  inch (.05-.13 microns) Gold over 120-240  $\mu$  inch (3.05-6.10 microns) Nickel plate.  
All models, (+) suffix.



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

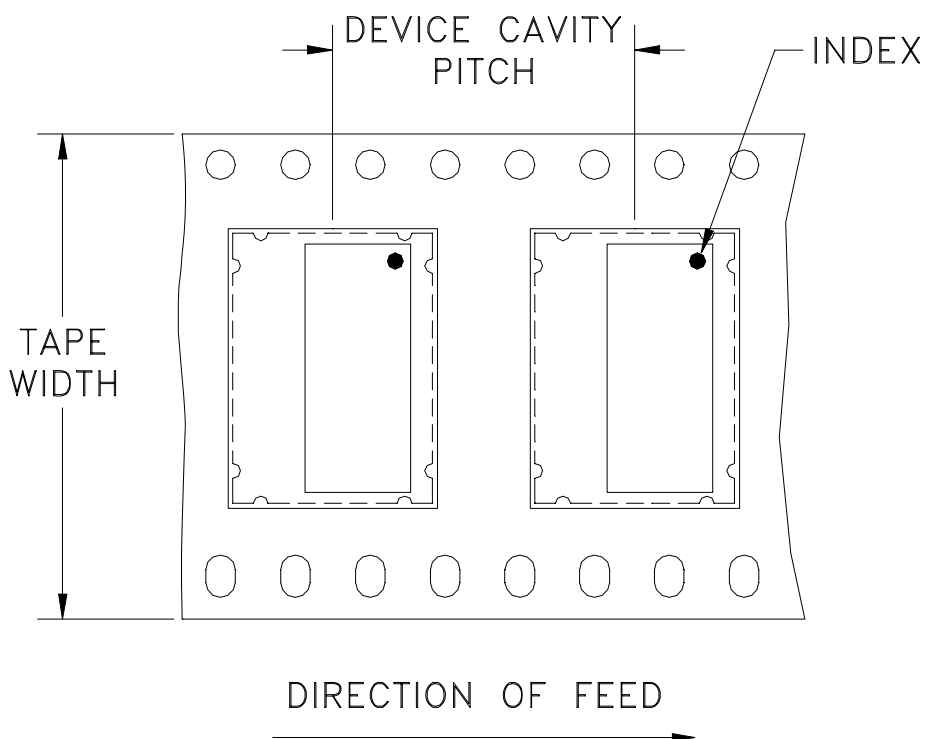
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# Tape & Reel Packaging TR-F106

## DEVICE ORIENTATION IN T&R



| Tape Width,<br>mm | Device Cavity<br>Pitch, mm | Reel Size,<br>inches | Devices per Reel |
|-------------------|----------------------------|----------------------|------------------|
| 44                | 24                         | 13                   | 250              |

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)

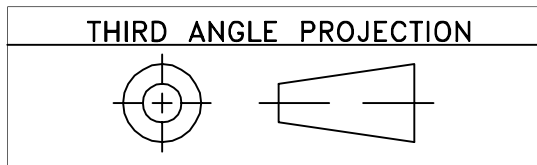


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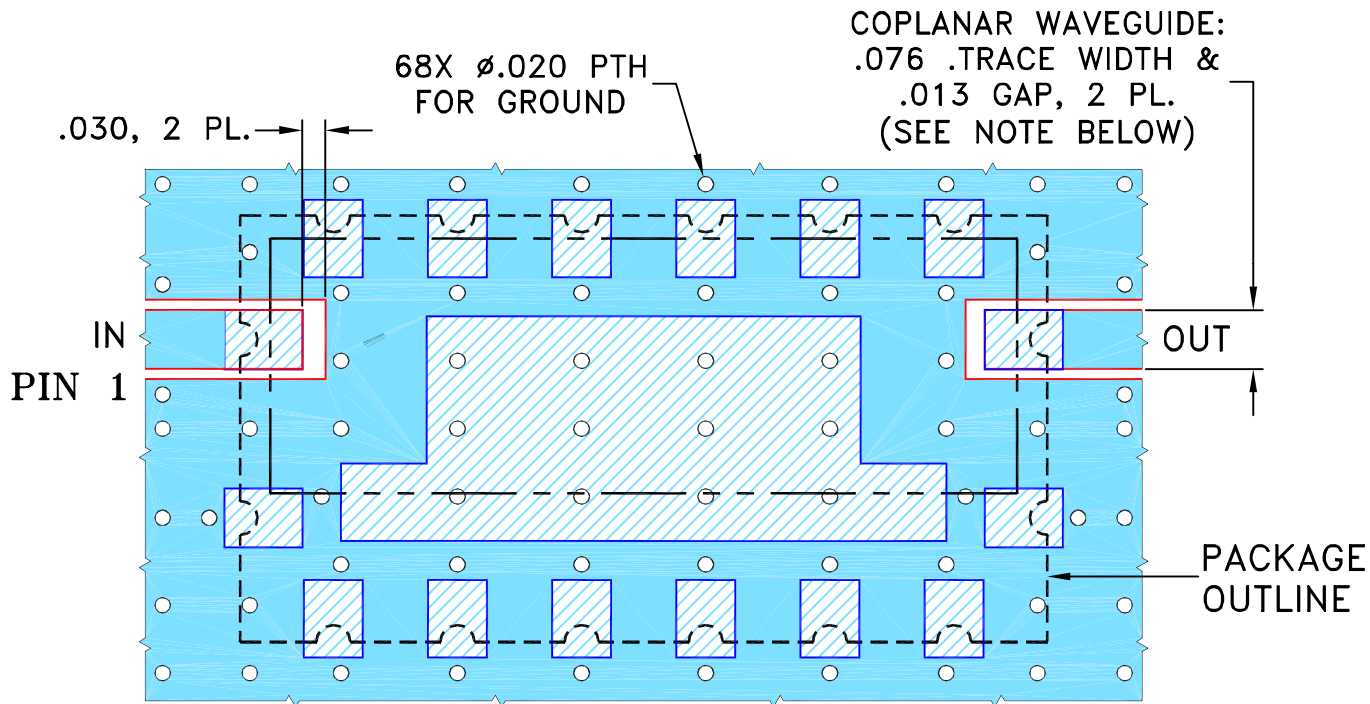
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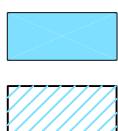


| REVISIONS |         |             |          |     |      |
|-----------|---------|-------------|----------|-----|------|
| REV OR    | ECN No. | DESCRIPTION | DATE     | DR  | AUTH |
|           | M126876 | NEW RELEASE | 04/21/10 | MMG | RD   |
|           |         |             |          |     |      |
|           |         |             |          |     |      |
|           |         |             |          |     |      |

**SUGGESTED MOUNTING CONFIGURATION FOR  
KU1513/KV1514 CASE STYLE, "16FL02" PIN CODE**



- NOTE: 1. COPLANAR WAVEGUIDE PARAMETERS ARE SHOWN FOR ROGERS RO4350B WITH DIELECTRIC THICKNESS .060"  $\pm$  .004"; 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.



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

HATCHED BLUE DENOTES COPPER LAND PATTERN FREE OF SOLDER MASK

| UNLESS OTHERWISE SPECIFIED | INITIALS | DATE         |
|----------------------------|----------|--------------|
| DIMENSIONS ARE IN INCHES   | DRAWN    | MMG 04/08/10 |
| TOLERANCES ON:             | CHECKED  | IL 04/21/10  |
| 2 PL DECIMALS $\pm$        | APPROVED | RD 04/21/10  |
| 3 PL DECIMALS $\pm$ .005   |          |              |
| ANGLES $\pm$               |          |              |
| FRACTIONS $\pm$            |          |              |



**Mini-Circuits®** 13 Neptune Avenue  
Brooklyn NY 11235

**PL, 16FL02, KU1513/KV1514, TB-578+**

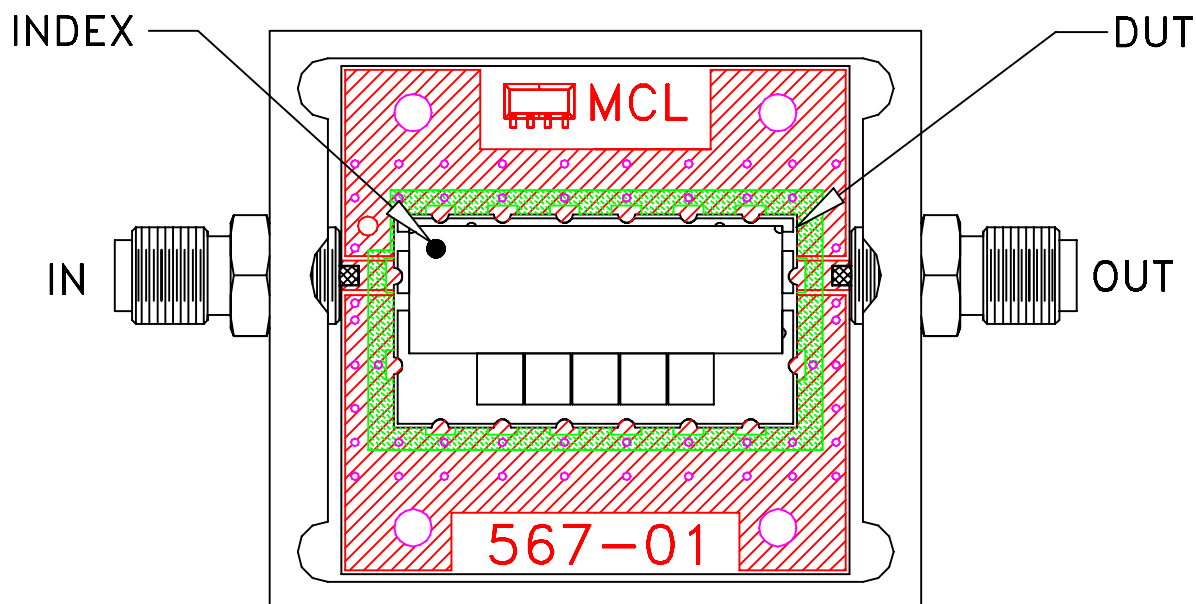
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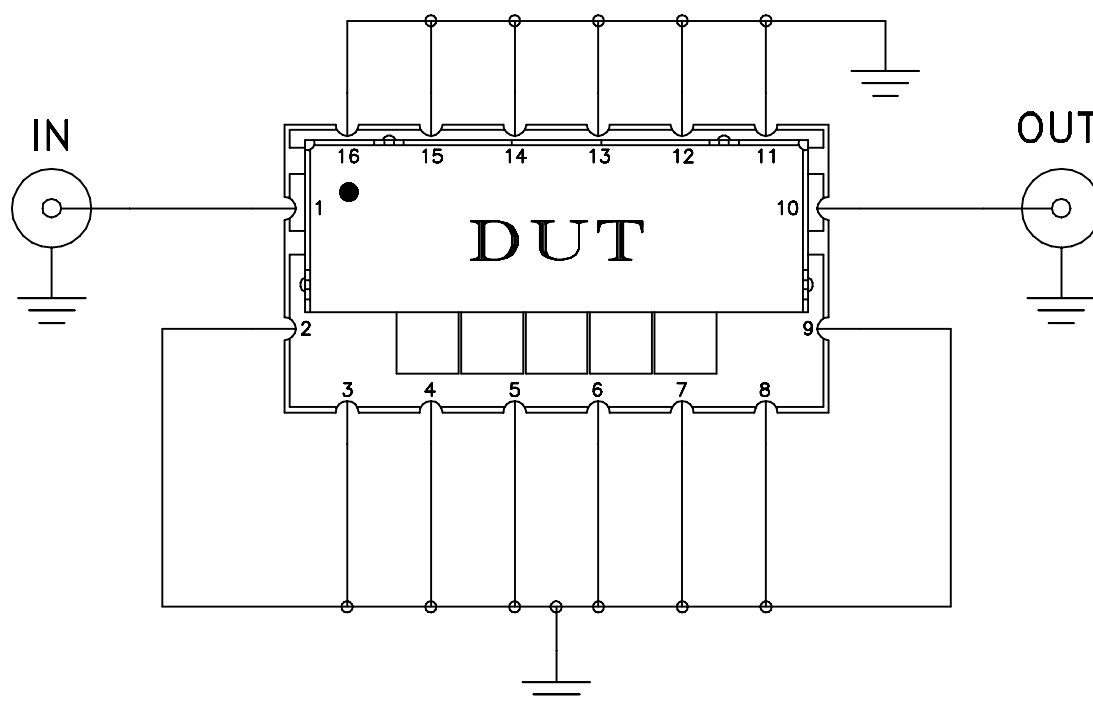
ASHEET1.DWG REV:A DATE:01/12/95

| SIZE  | CODE IDENT | DRAWING NO: | REV:          |
|-------|------------|-------------|---------------|
| A     | 15542      | 98-PL-331   | OR            |
| FILE: | 98PL331    | SCALE: 4:1  | SHEET: 1 OF 1 |

# Evaluation Board and Circuit



TB-578+



Schematic Diagram

## Notes:

1. 50 Ohm SMA Female connectors.
2. PCB Material: R04350 or equivalent,  
Dielectric Constant=3.5, Thickness=.060 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, 96 hours, 40°C                                      | MIL-STD-202, Method 103B, Condition B, Except 50°C    |
| Thermal Shock              | -55° to 100°C, 100 cycles                                         | MIL-STD-202, Method 107, Condition A-3, except +100°C |
| Solder Reflow Heat         | Sn-Pb Eutectic Process: 225°C peak<br>Pb-Free Process, 245°C peak | J-STD-020, Table 4-1, 4-2 and 5-2, Figure 5-1         |
| Solderability              | 10X Magnification                                                 | J-STD-002, Para 4.2.5, Test S, 95% Coverage           |
| Vibration (High Frequency) | 20g peak, 10-2000 Hz, 4 times in each of three axes (total 12)    | 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                  |