

# Suspended Substrate Stripline Filters and Multiplexers

50Ω

DC to 26 GHz

## The Big Deal

- Low insertion loss
- Ultra-wide passband width
- Fast roll-off with wide stopband
- Good power handling and temperature stability
- Passband up to 26 GHz
- Stopband up to 26.5 GHz can extend to 40 GHz



## Product Overview

Mini-Circuits' Suspended Substrate Stripline filters offer low insertion loss by implementing printed circuit board suspended between two parallel ground planes, providing high Q. Low insertion loss combined with wide stop-band makes them an excellent choice for wideband instruments and systems like ECM, ECCM, ELINT and ultra-broadband receivers.

Low pass, high pass, band pass, band stop, diplexer and multiplexer designs can be realized with this technology. Advanced filter design and construction can achieve stopband width greater than 6x the center frequency, and temperature stability will be better than other printed circuit realizations because the fields are mainly in the air rather than in a dielectric. The inside walls of the housing hold the circuit and prevent movement that could be caused by vibration or mechanical shock, making these designs excellent candidates for harsh operating environments.

Suspended substrate stripline filters can be realized in small form factors with high-quality, precise machining for applications where size is critical. 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 receiver front end and better power delivery to antenna in transmitters |
| Fast roll-off                   | Higher selectivity results in better adjacent channel rejection and dynamic range                                |
| Wide stopband                   | Wide, spur-free stop band results in better receiver sensitivity                                                 |
| High power handling             | Well suited for transmitter applications                                                                         |
| Excellent temperature stability | Ensures minimal variation in electrical performance across temperature                                           |

### 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.  
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[www.minicircuits.com](http://www.minicircuits.com) P.O. Box 350166, Brooklyn, NY 11235-0003 (718) 934-4500 [sales@minicircuits.com](mailto:sales@minicircuits.com)

# Band Pass Filter

50Ω 2000 to 18000 MHz

## ZBSS-A10G-S+



Generic photo used for illustration purposes only

CASE STYLE:WG3316

Connectors Model

SMA - F ZBSS-A10G-S+

### Features

- Wide fractional bandwidth design of 160%
- 1dB typ. Insertion Loss at Center frequency
- Sharp roll-off
- High rejection floor of 90dB typ.
- Stop band up to 26.5 GHz
- Connectorized package

### Applications

- Satellite communications
- Wideband receivers (S, C, X, Ku - bands)
- Military and defense
- Electronic warfare receiver

### Electrical Specifications at 25°C

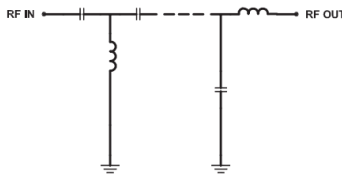
| Parameter        | F#               | Frequency (MHz) | Min.          | Typ. | Max. | Unit   |
|------------------|------------------|-----------------|---------------|------|------|--------|
| Pass Band        | Center Frequency | Fc              | 10000         | -    | 1    | dB     |
|                  | Insertion Loss   | F1-F2           | 2000 - 18000  | -    | 2.2  | 3.5 dB |
|                  | VSWR             | F1-F2           | 2000 - 18000  | -    | 1.9  | - :1   |
| Stop Band, Lower | Insertion Loss   | DC-F3           | DC - 1100     | 60   | 90   | dB     |
|                  |                  | F3-F4           | 1100 - 1300   | 40   | 60   | dB     |
|                  |                  | F4-F5           | 1300 - 1400   | 20   | 40   | dB     |
| Stop Band, Upper | Insertion Loss   | F6-F7           | 20500 - 21500 | 20   | 40   | dB     |
|                  |                  | F7-F8           | 21500 - 26500 | -    | 40   | dB     |

### Maximum Ratings

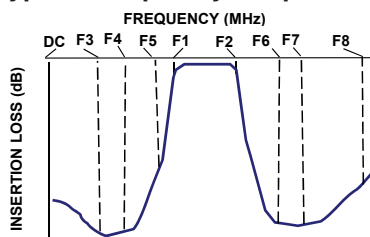
|                       |                |
|-----------------------|----------------|
| Operating Temperature | -40°C to 85°C  |
| Storage Temperature   | -55°C to 100°C |
| RF Power Input        | 5W max. @ 25°C |

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

### Functional Schematic



### Typical Frequency Response

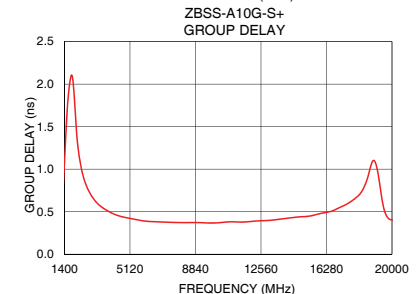
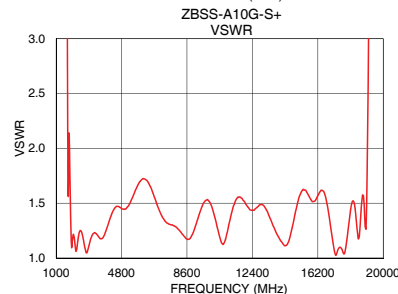
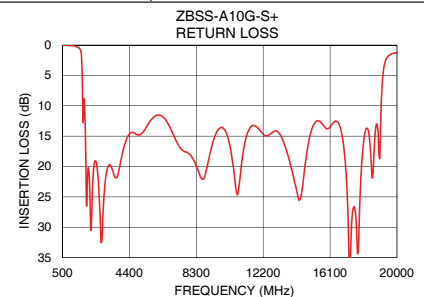
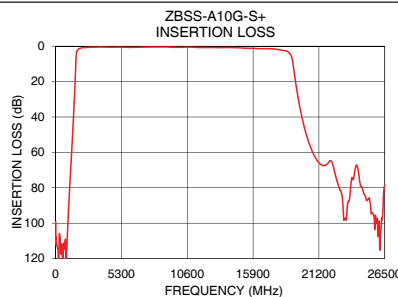


### Typical Performance Data at 25°C

| Frequency (MHz) | Insertion Loss (dB) | VSWR (:1) | Frequency (MHz) | Group Delay (nsec) |
|-----------------|---------------------|-----------|-----------------|--------------------|
| 10              | 99.15               | 9119.04   | 2000            | 1.71               |
| 500             | 111.76              | 465.07    | 3000            | 0.67               |
| 1100            | 85.01               | 147.92    | 4000            | 0.49               |
| 1300            | 59.15               | 66.34     | 5000            | 0.43               |
| 1400            | 46.16               | 45.17     | 6000            | 0.39               |
| 1500            | 32.21               | 28.98     | 7000            | 0.38               |
| 1550            | 24.43               | 20.82     | 8000            | 0.37               |
| 1700            | 2.95                | 1.60      | 9000            | 0.37               |
| 2000            | 1.14                | 1.22      | 10000           | 0.37               |
| 6000            | 0.69                | 1.72      | 11000           | 0.38               |
| 10000           | 0.65                | 1.49      | 12000           | 0.38               |
| 14000           | 0.77                | 1.17      | 13000           | 0.40               |
| 18000           | 1.97                | 1.31      | 14000           | 0.42               |
| 18650           | 2.98                | 1.28      | 15000           | 0.44               |
| 19350           | 21.63               | 7.21      | 15200           | 0.44               |
| 19550           | 30.27               | 10.43     | 15500           | 0.46               |
| 20500           | 56.56               | 9.13      | 16000           | 0.48               |
| 21500           | 67.35               | 9.88      | 16500           | 0.50               |
| 23000           | 82.87               | 6.27      | 17000           | 0.55               |
| 26500           | 78.41               | 1.56      | 18000           | 0.67               |

### +RoHS Compliant

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



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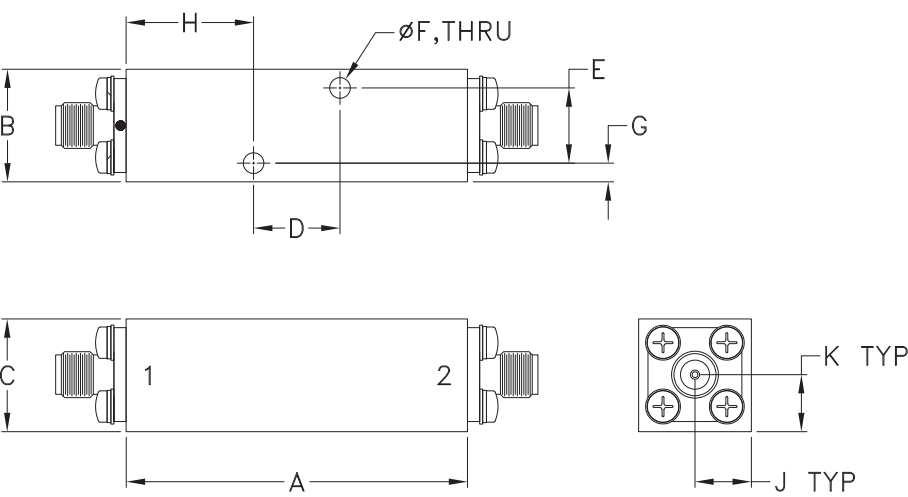
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ZBSS-A10G-S+  
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211208  
Page 2 of 3

Coaxial Connections

|          |            |
|----------|------------|
| PORT - 1 | SMA FEMALE |
| PORT - 2 | SMA FEMALE |

Outline Drawing



Outline Dimensions ( inch mm )

|      |      |      |       |       |       |
|------|------|------|-------|-------|-------|
| A    | B    | C    | D     | E     | F     |
| 1.82 | .60  | .60  | .460  | .400  | .110  |
| 46.2 | 15.2 | 15.2 | 11.68 | 10.16 | 2.80  |
| G    | H    | J    | K     |       | Wt.   |
| .10  | .68  | .30  | .30   |       | grams |
| 2.5  | 17.2 | 7.6  | 7.7   |       | 84    |

Note: Please refer to case style drawing for details

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# Suspended substrate stripline Band Pass Filter

## ZBSS-A10G-S+

### Typical Performance Data

| FREQ. | INSERTION LOSS |        |        | INPUT RETURN LOSS |        |        | OUTPUT RETURN LOSS |        |        |
|-------|----------------|--------|--------|-------------------|--------|--------|--------------------|--------|--------|
| (MHz) | (dB)           |        |        | (dB)              |        |        | (dB)               |        |        |
|       | @-40°C         | @+25°C | @+85°C | @-40°C            | @+25°C | @+85°C | @-40°C             | @+25°C | @+85°C |
| 10    | 102.33         | 99.15  | 98.35  | 0.00              | 0.00   | 0.00   | 0.00               | 0.00   | 0.00   |
| 50    | 115.69         | 109.20 | 102.10 | 0.00              | 0.00   | 0.00   | 0.02               | 0.01   | 0.02   |
| 100   | 111.96         | 111.88 | 110.70 | 0.01              | 0.01   | 0.01   | 0.02               | 0.01   | 0.01   |
| 150   | 104.02         | 113.87 | 110.69 | 0.03              | 0.02   | 0.02   | 0.03               | 0.02   | 0.02   |
| 200   | 113.11         | 114.92 | 107.20 | 0.06              | 0.03   | 0.04   | 0.06               | 0.03   | 0.04   |
| 250   | 117.63         | 126.52 | 113.51 | 0.08              | 0.05   | 0.05   | 0.05               | 0.02   | 0.03   |
| 300   | 108.13         | 105.99 | 115.13 | 0.10              | 0.06   | 0.07   | 0.09               | 0.04   | 0.06   |
| 350   | 103.23         | 106.92 | 114.34 | 0.11              | 0.07   | 0.08   | 0.07               | 0.02   | 0.04   |
| 400   | 108.22         | 112.10 | 131.23 | 0.11              | 0.06   | 0.08   | 0.07               | 0.02   | 0.03   |
| 450   | 111.02         | 117.63 | 115.54 | 0.11              | 0.05   | 0.07   | 0.06               | 0.00   | 0.02   |
| 500   | 109.56         | 111.76 | 122.49 | 0.09              | 0.04   | 0.06   | 0.02               | 0.03   | 0.02   |
| 550   | 117.05         | 118.64 | 108.52 | 0.07              | 0.01   | 0.04   | 0.02               | 0.04   | 0.03   |
| 600   | 128.32         | 120.13 | 118.39 | 0.05              | 0.01   | 0.01   | 0.03               | 0.08   | 0.08   |
| 650   | 122.65         | 111.32 | 105.94 | 0.03              | 0.03   | 0.02   | 0.05               | 0.09   | 0.10   |
| 700   | 117.63         | 111.52 | 114.50 | 0.01              | 0.05   | 0.04   | 0.07               | 0.12   | 0.13   |
| 800   | 119.11         | 109.49 | 108.46 | 0.02              | 0.07   | 0.07   | 0.11               | 0.16   | 0.17   |
| 1000  | 101.01         | 99.22  | 98.40  | 0.04              | 0.09   | 0.10   | 0.15               | 0.22   | 0.23   |
| 1100  | 85.40          | 85.01  | 85.25  | 0.06              | 0.12   | 0.13   | 0.18               | 0.26   | 0.26   |
| 1300  | 59.55          | 59.15  | 58.91  | 0.18              | 0.26   | 0.28   | 0.31               | 0.40   | 0.41   |
| 1400  | 46.60          | 46.16  | 45.92  | 0.29              | 0.38   | 0.41   | 0.38               | 0.47   | 0.50   |
| 1500  | 32.73          | 32.21  | 31.94  | 0.48              | 0.60   | 0.64   | 0.52               | 0.63   | 0.68   |
| 1550  | 25.03          | 24.43  | 24.15  | 0.68              | 0.84   | 0.89   | 0.69               | 0.83   | 0.90   |
| 1600  | 16.40          | 15.73  | 15.44  | 1.23              | 1.50   | 1.63   | 1.22               | 1.48   | 1.62   |
| 1700  | 2.73           | 2.95   | 3.08   | 13.82             | 12.72  | 12.26  | 14.00              | 12.77  | 12.22  |
| 2000  | 0.99           | 1.14   | 1.20   | 20.12             | 20.23  | 20.31  | 19.24              | 19.38  | 19.49  |
| 3000  | 0.45           | 0.57   | 0.60   | 22.13             | 22.15  | 22.24  | 21.12              | 21.22  | 21.16  |
| 4000  | 0.40           | 0.52   | 0.55   | 17.64             | 17.78  | 17.66  | 17.09              | 17.31  | 17.21  |
| 5000  | 0.43           | 0.55   | 0.58   | 14.55             | 14.76  | 14.60  | 14.67              | 14.91  | 14.76  |
| 6000  | 0.56           | 0.69   | 0.72   | 11.34             | 11.55  | 11.46  | 11.40              | 11.61  | 11.53  |
| 8000  | 0.31           | 0.47   | 0.50   | 17.95             | 18.22  | 17.96  | 19.14              | 19.14  | 18.97  |
| 10000 | 0.47           | 0.65   | 0.68   | 14.18             | 14.19  | 14.56  | 14.36              | 14.48  | 14.73  |
| 12000 | 0.56           | 0.75   | 0.81   | 13.67             | 14.04  | 14.07  | 13.81              | 14.30  | 14.31  |
| 13000 | 0.59           | 0.82   | 0.88   | 14.51             | 14.20  | 14.31  | 15.59              | 15.39  | 15.60  |
| 14000 | 0.55           | 0.77   | 0.85   | 21.97             | 22.14  | 22.35  | 22.03              | 22.18  | 22.19  |
| 16000 | 0.95           | 1.25   | 1.36   | 14.03             | 13.74  | 13.74  | 16.38              | 16.47  | 16.63  |
| 18000 | 1.52           | 1.97   | 2.16   | 18.24             | 17.46  | 16.96  | 18.32              | 17.83  | 17.19  |
| 18650 | 2.30           | 2.98   | 3.26   | 22.16             | 18.31  | 17.35  | 23.28              | 19.89  | 18.58  |
| 19100 | 6.99           | 9.44   | 10.28  | 10.79             | 8.40   | 7.96   | 4.73               | 3.99   | 3.85   |
| 19350 | 18.77          | 21.63  | 22.44  | 2.38              | 2.43   | 2.50   | 1.40               | 1.52   | 1.58   |
| 19550 | 27.84          | 30.27  | 30.94  | 1.43              | 1.67   | 1.79   | 0.88               | 1.06   | 1.13   |
| 19800 | 37.17          | 39.16  | 39.70  | 1.04              | 1.36   | 1.49   | 0.65               | 0.83   | 0.91   |
| 20000 | 43.47          | 45.15  | 45.61  | 0.92              | 1.27   | 1.42   | 0.50               | 0.69   | 0.76   |
| 20200 | 48.91          | 50.28  | 50.70  | 0.99              | 1.41   | 1.57   | 0.37               | 0.58   | 0.64   |
| 20500 | 55.54          | 56.56  | 57.01  | 1.38              | 1.91   | 2.11   | 0.28               | 0.47   | 0.54   |
| 20800 | 60.64          | 61.44  | 61.97  | 1.96              | 2.43   | 2.60   | 0.22               | 0.43   | 0.49   |
| 21000 | 63.43          | 64.01  | 64.54  | 2.08              | 2.45   | 2.58   | 0.18               | 0.40   | 0.46   |
| 21200 | 65.61          | 65.80  | 66.39  | 1.86              | 2.18   | 2.29   | 0.09               | 0.32   | 0.37   |
| 21500 | 67.81          | 67.35  | 67.81  | 1.41              | 1.76   | 1.89   | 0.02               | 0.25   | 0.30   |
| 21800 | 67.93          | 66.93  | 67.31  | 1.37              | 1.93   | 2.16   | 0.04               | 0.27   | 0.31   |
| 22000 | 66.65          | 65.47  | 65.81  | 2.19              | 3.43   | 4.07   | 0.03               | 0.25   | 0.30   |
| 22200 | 65.00          | 64.85  | 65.67  | 7.85              | 11.87  | 13.64  | 0.02               | 0.23   | 0.28   |
| 22400 | 68.30          | 69.19  | 70.30  | 5.67              | 4.93   | 4.74   | 0.01               | 0.20   | 0.25   |
| 22600 | 74.12          | 74.68  | 75.66  | 2.18              | 2.41   | 2.49   | 0.03               | 0.19   | 0.24   |
| 22800 | 78.74          | 79.38  | 79.94  | 1.45              | 1.86   | 2.02   | 0.01               | 0.20   | 0.25   |
| 23000 | 82.44          | 82.87  | 83.34  | 1.70              | 2.80   | 3.26   | 0.01               | 0.20   | 0.25   |
| 23500 | 94.09          | 89.57  | 89.75  | 2.10              | 2.95   | 3.28   | 0.04               | 0.16   | 0.21   |
| 24000 | 75.98          | 74.67  | 74.70  | 7.23              | 5.16   | 5.41   | 0.06               | 0.14   | 0.19   |
| 24500 | 74.40          | 77.27  | 78.93  | 6.49              | 5.34   | 5.12   | 0.10               | 0.11   | 0.16   |
| 25000 | 84.70          | 86.32  | 87.55  | 6.27              | 5.24   | 4.91   | 0.14               | 0.09   | 0.14   |
| 26500 | 81.50          | 78.41  | 79.33  | 10.79             | 13.20  | 12.62  | 0.20               | 0.04   | 0.10   |

# Suspended substrate stripline Band Pass Filter

## ZBSS-A10G-S+

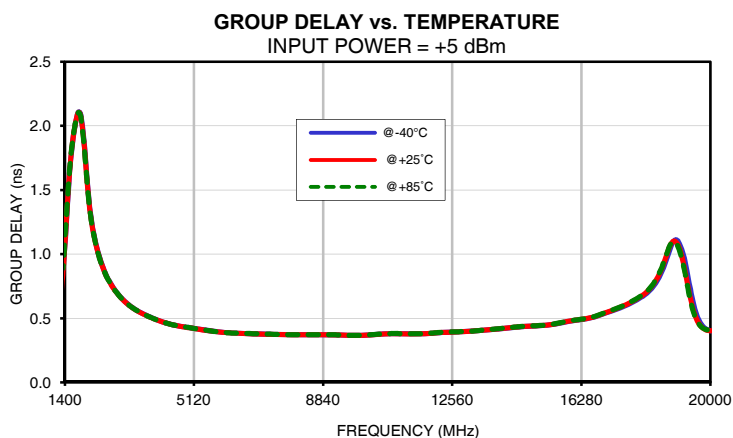
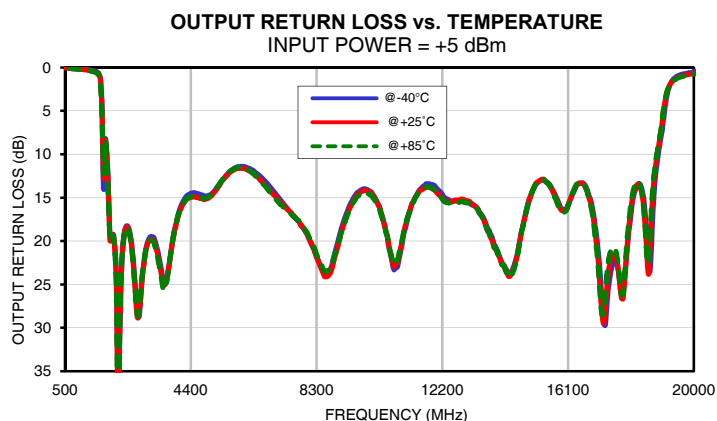
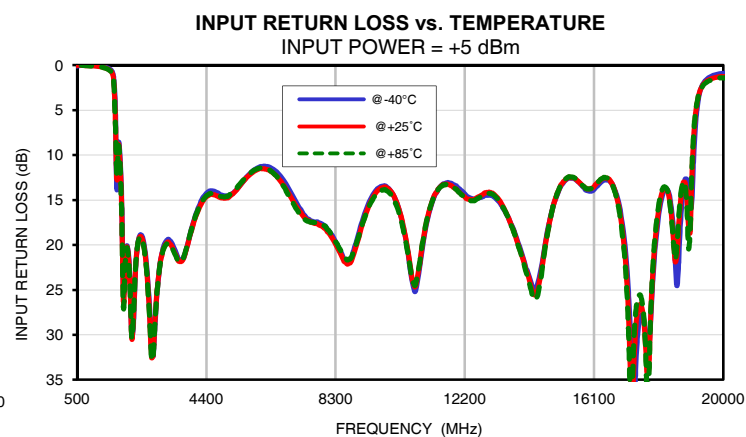
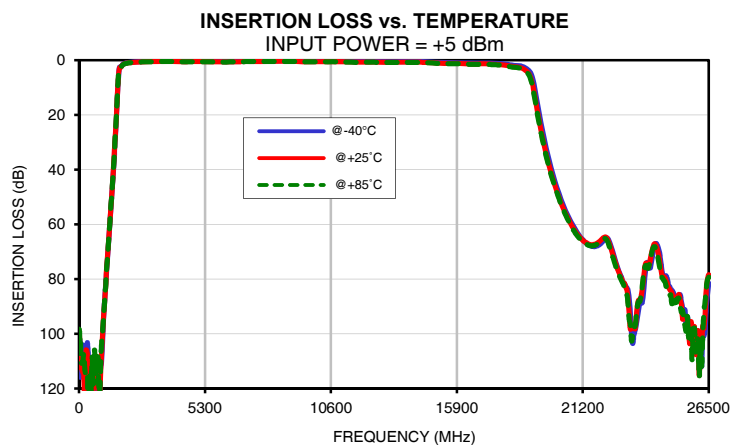
### Typical Performance Data

| FREQ. | GROUP DELAY |        |        |
|-------|-------------|--------|--------|
| (MHz) | (nsec)      |        |        |
|       | @-40°C      | @+25°C | @+85°C |
| 2000  | 1.73        | 1.71   | 1.70   |
| 2200  | 1.21        | 1.20   | 1.20   |
| 2300  | 1.07        | 1.07   | 1.07   |
| 2400  | 0.97        | 0.97   | 0.97   |
| 2700  | 0.78        | 0.78   | 0.78   |
| 3000  | 0.67        | 0.67   | 0.67   |
| 3300  | 0.59        | 0.59   | 0.59   |
| 3600  | 0.54        | 0.54   | 0.54   |
| 3900  | 0.51        | 0.50   | 0.50   |
| 4200  | 0.47        | 0.47   | 0.47   |
| 4500  | 0.45        | 0.45   | 0.45   |
| 4800  | 0.43        | 0.43   | 0.43   |
| 5100  | 0.42        | 0.42   | 0.42   |
| 5400  | 0.41        | 0.41   | 0.41   |
| 5700  | 0.40        | 0.40   | 0.40   |
| 6000  | 0.39        | 0.39   | 0.39   |
| 6300  | 0.38        | 0.38   | 0.38   |
| 6600  | 0.38        | 0.38   | 0.38   |
| 6900  | 0.38        | 0.38   | 0.38   |
| 7200  | 0.38        | 0.38   | 0.38   |
| 7500  | 0.37        | 0.37   | 0.37   |
| 7800  | 0.37        | 0.37   | 0.37   |
| 8100  | 0.37        | 0.37   | 0.37   |
| 8400  | 0.37        | 0.37   | 0.37   |
| 8700  | 0.37        | 0.37   | 0.37   |
| 9000  | 0.37        | 0.37   | 0.37   |
| 9300  | 0.37        | 0.37   | 0.37   |
| 9600  | 0.37        | 0.37   | 0.37   |
| 9900  | 0.37        | 0.37   | 0.37   |
| 10200 | 0.37        | 0.37   | 0.37   |
| 10500 | 0.38        | 0.38   | 0.38   |
| 10800 | 0.38        | 0.38   | 0.38   |
| 11100 | 0.38        | 0.38   | 0.38   |
| 11500 | 0.38        | 0.38   | 0.38   |
| 12000 | 0.38        | 0.38   | 0.39   |
| 13000 | 0.40        | 0.40   | 0.40   |
| 14000 | 0.42        | 0.42   | 0.42   |
| 15000 | 0.44        | 0.44   | 0.44   |
| 16000 | 0.48        | 0.48   | 0.48   |
| 17000 | 0.54        | 0.55   | 0.55   |
| 18000 | 0.66        | 0.67   | 0.67   |

# Suspended substrate stripline Band Pass Filter

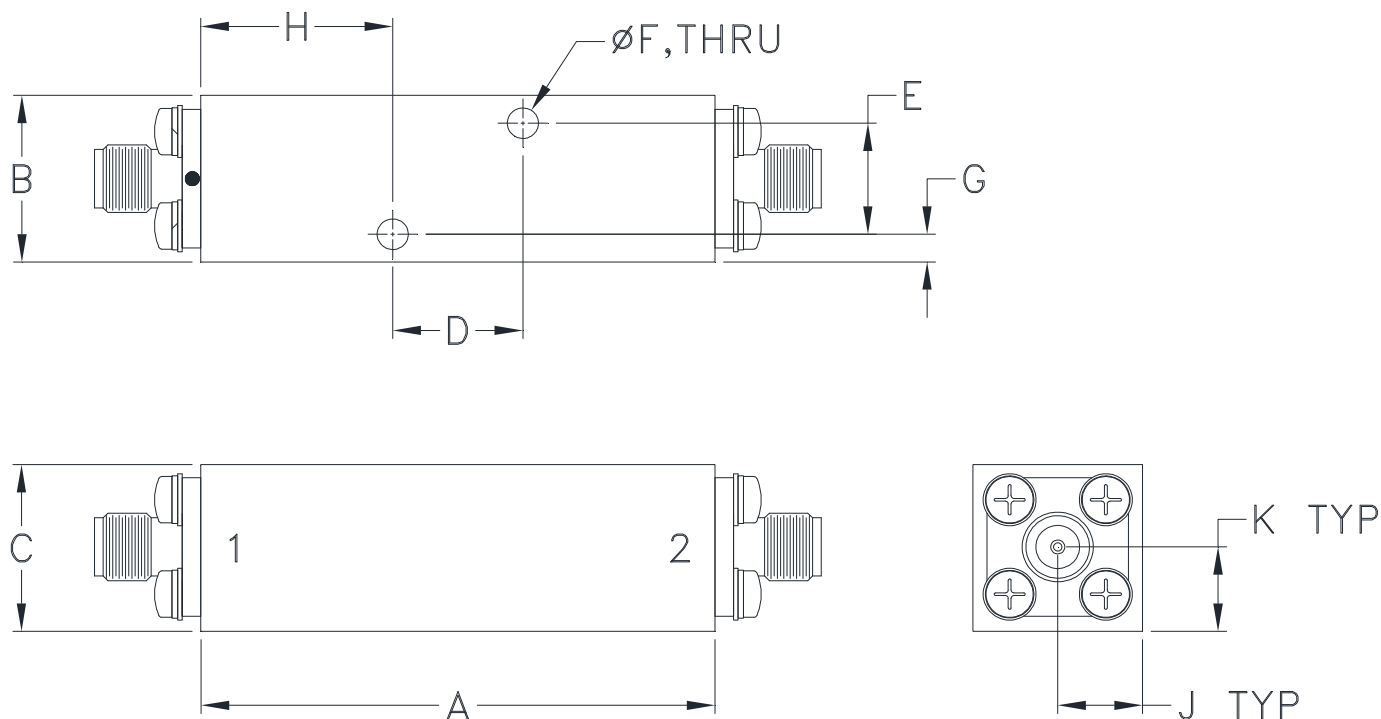
ZBSS-A10G-S+

## Typical Performance Curves



## Outline Dimensions

WG3316



| CASE#  | A              | B             | C             | D               | E               | F              |
|--------|----------------|---------------|---------------|-----------------|-----------------|----------------|
| WG3316 | 1.82<br>(46.2) | .60<br>(15.2) | .60<br>(15.2) | .460<br>(11.68) | .400<br>(10.16) | .110<br>(2.80) |

| CASE#  | G            | H             | J            | K            | WT.GRAMS |
|--------|--------------|---------------|--------------|--------------|----------|
| WG3316 | .10<br>(2.5) | .68<br>(17.2) | .30<br>(7.6) | .30<br>(7.7) | 84       |

Dimensions are in inches (mm). Tolerances: 2 Pl.  $\pm .100$ ; 3 Pl.  $\pm .015$

### Notes:

1. Case material: Brass.
2. Case Finish: Powder coated over silver plating.
3. Refer to the individual model data sheet for the type of connectors available.



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RF/IF MICROWAVE COMPONENTS



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 100°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, 40°C, 96 hours;<br>Units may require bake-out after humidity to restore full performance. | MIL-STD-202, Method 103, Condintion B                 |
| Thermal Shock              | -55° to 100°C, 100 cycles                                                                               | MIL-STD-202, Method 107, Condition A-3, except +100°C |
| 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, 11ms half-sine, 3 shocks each direction 3 axes (total 18)                                          | MIL-STD-202, Method 213, Condition A                  |