



REFLECTIONLESS

# High Pass Filter

## XHF-252+

Mini-Circuits

50Ω 2460 to 10400 MHz

### THE BIG DEAL

- Match to 50Ω in the stop band, eliminates undesired reflections
- Cascadable
- Excellent Power handling
- Temperature stable, up to 105°C
- Small size, 3 x 3 mm
- Protected by US Patent No. 8,392,495



Generic photo used for illustration purposes only

CASE STYLE: DQ1225

### +RoHS Compliant

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

### APPLICATIONS

- Wi-Fi
- WiMax
- Microwave Radio
- Military & Space

### GENERAL DESCRIPTION

Mini-Circuits' XHF-252+ reflectionless filter employs a novel filter topology which absorbs and terminates stop band signals internally rather than reflecting them back to the source. This new capability enables unique applications for filter circuits beyond those suited to traditional approaches. Traditional filters are reflective in the stop band, sending signals back to the source at 100% of the power level. These reflections interact with neighboring components and often result in inter-modulation and other interferences. Reflectionless filters eliminate stop band reflections, allowing them to be paired with sensitive devices and used in applications that otherwise require circuits such as isolation amplifiers or attenuators.

### KEY FEATURES

| Feature   | Advantages  |
|---|---|
| Easy integration with sensitive reflective components, e.g. mixers, multipliers | Reflectionless filters absorb unwanted signals falling in filter stopband, preventing reflections back to the source. This reduces generation of additional unwanted signals without the need for extra components like attenuators, improving system dynamic range and saving board space. |
| High stopband rejection, up to 50 dB  | Ideal for applications where suppression of strong spurious signals and intermodulation products is needed.   |
| Enables stable integration of wideband amplifiers                               | Because reflectionless filters maintain good impedance in the stopband; they can be integrated with high gain, wideband amplifiers without the risk of creating instabilities in these out of band regions.   |
| Cascadable  | Reflectionless filters can be cascaded in multiple sections to provide sharper and higher attenuation, while also preventing any standing waves that could affect passband signals. Low & highpass filters can be cascaded to realize bandpass filters.                                     |
| Excellent power handling in a tiny surface mount device up to 7W in passband    | High power handling extends the usability of these filters to the transmit path for inter-stage filtering.  |
| Small size, 3x3mm QFN-Style   | Allows replacement of filter/attenuator pairs with a single reflectionless filter, saving board space.  |
| Excellent repeatability of RF performance                                       | Through semiconductor IPD process, X-series filters are inherently repeatable for large volume production.  |
| Operating temperature up to 105 °C  | Suitable for operation close to high power components.  |

IPD – Integrated Passive Device, is a GaAs semiconductor process





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### ELECTRICAL SPECIFICATIONS<sup>1</sup> AT +25°C

| Parameter | F#                | Frequency (MHz) | Min.         | Typ. | Max. | Unit |    |
|-----------|-------------------|-----------------|--------------|------|------|------|----|
| Stop Band | Rejection         | DC-F1           | DC-1520      | 12   | 14   | —    | dB |
|           | Frequency Cut-off | F2              | 2030         | —    | 3.0  | —    | dB |
|           | VSWR              | DC - F1         | DC-1520      | —    | 1.2  | —    | :1 |
| Pass Band | Insertion Loss    | F3-F5           | 2460 -10400  | —    | 1.0  | 1.8  | dB |
|           | VSWR              | F3-F4           | 2460 - 3700  | —    | 1.5  | —    | :1 |
|           |                   | F4-F5           | 3700 - 10400 | —    | 1.7  | —    | :1 |

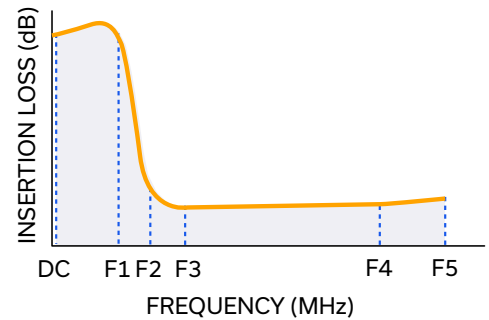
1. Measured on Mini-Circuits Characterization Test Board TB-844-252H+

### ABSOLUTE MAXIMUM RATINGS<sup>2</sup>

| Parameter                                     | Ratings         |
|---|-----------------|
| Operating Temperature                         | -55°C to +105°C |
| Storage Temperature                           | -65°C to +150°C |
| RF Power Input, Passband (F3-F5) <sup>3</sup> | 2 W at +25°C    |
| RF Power Input, Stopband (DC-F3) <sup>4</sup> | 0.5 W at +25°C  |

- 2. Permanent damage may occur if any of these limits are exceeded.
- 3. Passband rating derates linearly to 1 W at 105°C ambient
- 4. Stopband rating derates linearly to 0.25 W at 105°C ambient

### SPECIFICATION DEFINITION





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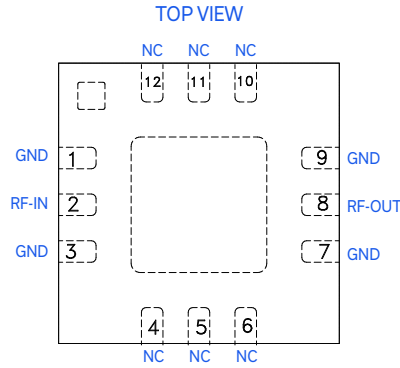
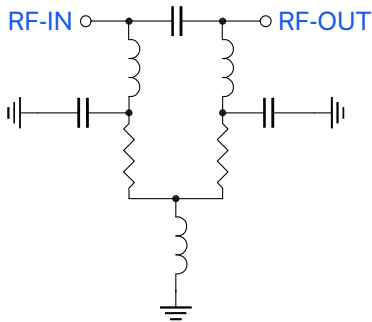
# High Pass Filter

## XHF-252+

Mini-Circuits

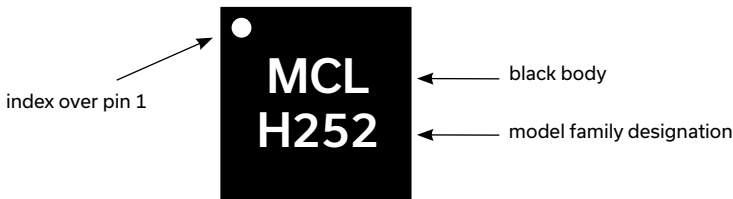
50Ω 2460 to 10400 MHz

### SIMPLIFIED SCHEMATIC AND PAD DESCRIPTION



| Function            | Pad Number      | Description            |
|---------------------|-----------------|------------------------|
| RF-IN               | 2               | RF Input Pad           |
| RF-OUT              | 8               | RF Output Pad          |
| GND                 | 1,3,7,9, Paddle | Connected to ground    |
| NC (GND Externally) | 4,5,6,10,11,12  | No internal connection |

### PRODUCT MARKING



Marking may contain other features or characters for internal lot control



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# High Pass Filter

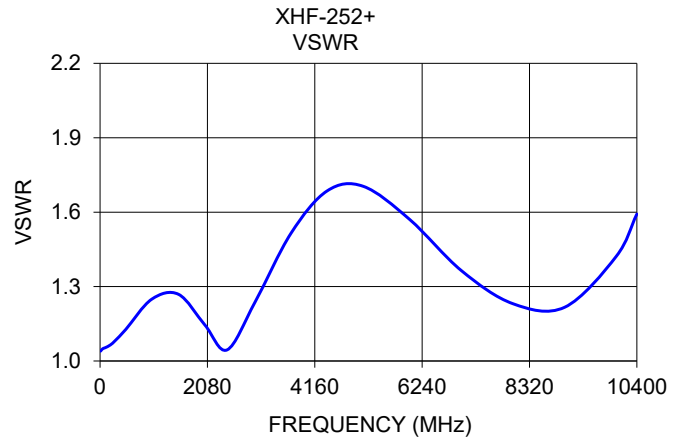
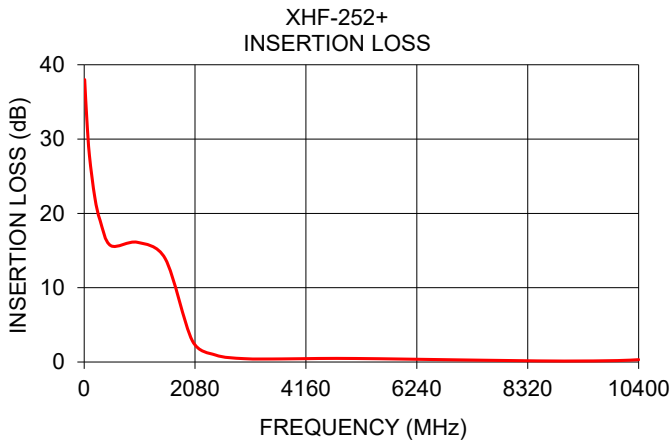
## XHF-252+

Mini-Circuits

50Ω 2460 to 10400 MHz

### TYPICAL PERFORMANCE DATA AT +25°C

| Frequency (MHz) | Insertion Loss (dB) | VSWR (:1) |
|-----------------|---------------------|-----------|
| 10              | 38.00               | 1.04      |
| 50              | 32.70               | 1.05      |
| 100             | 27.74               | 1.05      |
| 200             | 22.16               | 1.06      |
| 300             | 19.04               | 1.08      |
| 500             | 15.66               | 1.13      |
| 1000            | 16.11               | 1.25      |
| 1520            | 13.92               | 1.27      |
| 2030            | 2.86                | 1.15      |
| 2460            | 0.95                | 1.04      |
| 3000            | 0.46                | 1.24      |
| 3700            | 0.42                | 1.52      |
| 4400            | 0.48                | 1.69      |
| 5100            | 0.48                | 1.70      |
| 6000            | 0.40                | 1.57      |
| 7000            | 0.30                | 1.36      |
| 8000            | 0.20                | 1.23      |
| 9000            | 0.14                | 1.22      |
| 10000           | 0.20                | 1.42      |
| 10400           | 0.32                | 1.59      |





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ADDITIONAL DETAILED TECHNICAL INFORMATION IS AVAILABLE ON OUR DASH BOARD. TO ACCESS [CLICK HERE](#)

|  |  |
|--|--|
| Performance Data & Graphs                            | Table  |
|  | Graphs   |
|  | S-Parameter (S2P Files) Data Set (.zip file)   |
| Case Style   | DQ1225<br>Plastic package, exposed paddle lead finish: matte-tin   |
| Tape & Reel<br>Standard quantities available on reel | F66<br>7" reels with 20, 50, 100, 200, 500 ,1000 ,2000 or 3000 devices   |
| Suggested Layout for PCB Design                      | PL-451+  |
| Evaluation Board                                     | TB-844-252H+ (without connectors)<br>TB-844-252HC+ (with connectors)<br>B20-118-F1+ Connector sold separately. |
| Environmental Ratings                                | ENV82  |

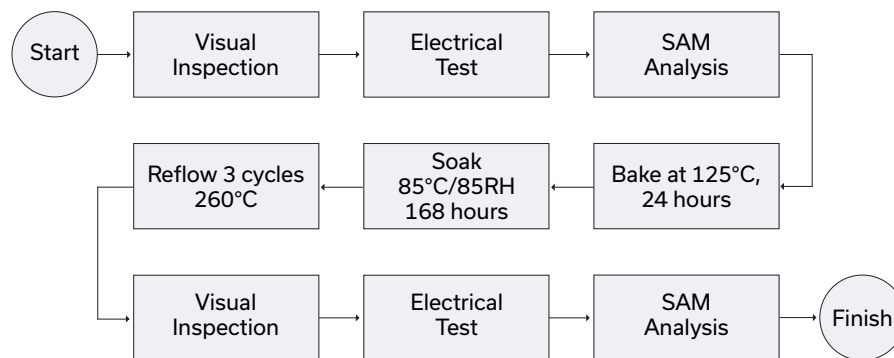
### ESD RATING

Human body model (HBM): Class 2 (2000 to < 4000 V) in accordance with ANSI/ESD 5.1-2001

### MSL RATING

Moisture Sensitivity: MSL1 in accordance with IPC/JEDEC J-STD-020D

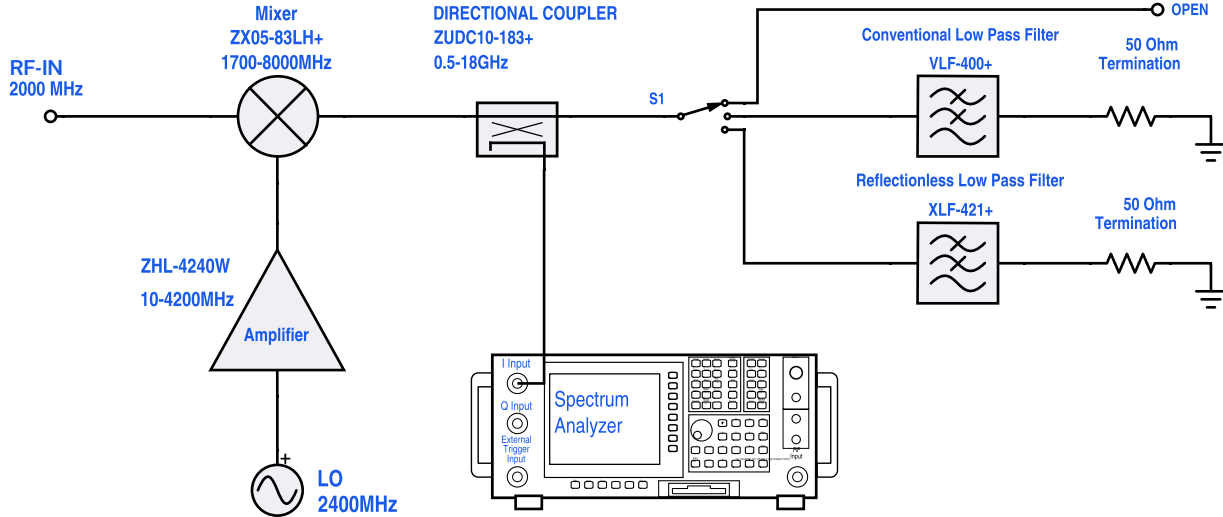
### MSL TEST FLOW CHART





### REFLECTIONLESS FILTER APPLICATION NOTE

Application Circuit Example: Pairing mixers with reflectionless filters to improve system dynamic range



Test block diagram: IF output reflection spectrum with single input frequency

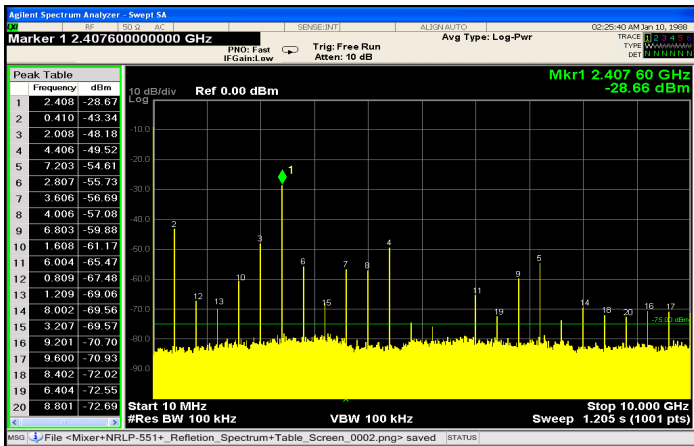


Figure 1. IF output reflection spectrum without filter

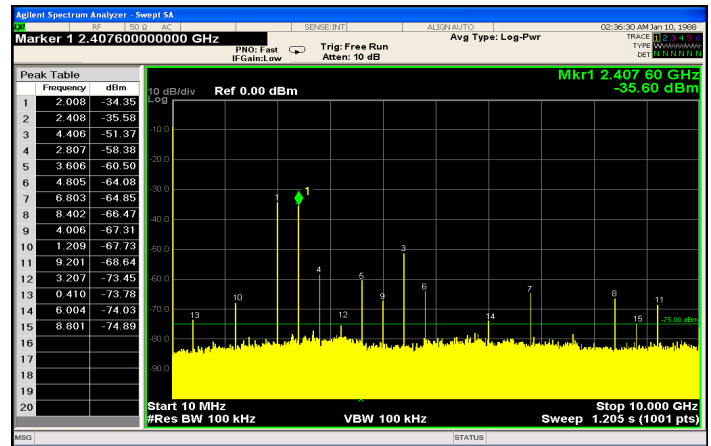


Figure 2. IF output reflection spectrum with conventional filter

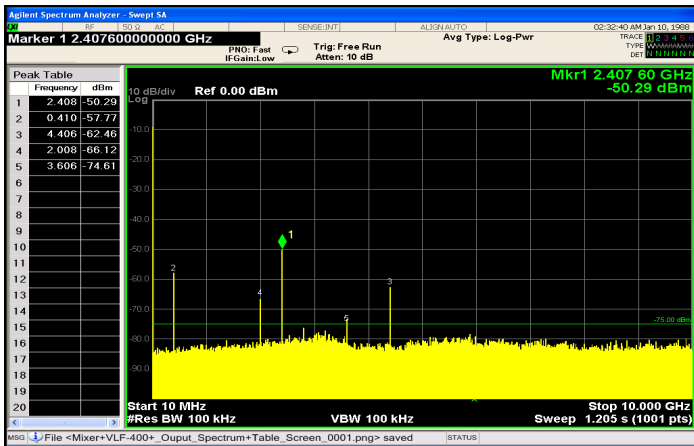


Figure 3. IF output reflection spectrum with reflectionless filter

An application circuit was assembled to measure the IF reflection spectrum at the output of a mixer when the mixer was paired with a conventional filter versus a reflectionless filter.

While the conventional filter reduces the reflections present when the mixer is used alone (no filter), the reflectionless filter virtually eliminates those reflections altogether.

The reflected signal at marker 1 in the figures above exhibits a reduction of more than 20 dB from -28.7 dBm to -50.3 dBm when the reflectionless filter is used as compared to the conventional filter, thus eliminating unwanted spurious mixing products and improving system dynamic range.

For more information, refer to application note [AN-75-007](#)

#### 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)

Typical Performance Data

| FREQ.<br><br>(MHz) | INSERTION LOSS |        |        |        |         | GROUP DELAY |        |        |        |         |
|--------------------|----------------|--------|--------|--------|---------|-------------|--------|--------|--------|---------|
|                    | (dB)           |        |        |        |         | (nsec)      |        |        |        |         |
|                    | @-55°C         | @-40°C | @+25°C | @+85°C | @+105°C | @-55°C      | @-40°C | @+25°C | @+85°C | @+105°C |
| 10                 | 40.40          | 40.01  | 39.14  | 37.45  | 37.45   | -3.06       | -3.52  | -2.26  | -3.60  | -1.77   |
| 50                 | 33.24          | 33.36  | 32.67  | 32.28  | 32.28   | -1.63       | -1.91  | -1.44  | -1.98  | -1.19   |
| 100                | 27.81          | 27.77  | 27.72  | 27.68  | 27.52   | -0.13       | -0.11  | -0.22  | -0.27  | -0.28   |
| 200                | 22.19          | 22.21  | 22.23  | 22.19  | 22.22   | 0.29        | 0.27   | 0.23   | 0.23   | 0.21    |
| 400                | 17.05          | 17.08  | 17.13  | 17.13  | 17.17   | 0.35        | 0.34   | 0.34   | 0.32   | 0.33    |
| 600                | 14.88          | 14.90  | 14.98  | 15.02  | 15.04   | 0.36        | 0.35   | 0.34   | 0.34   | 0.34    |
| 800                | 14.44          | 14.48  | 14.58  | 14.68  | 14.71   | 0.36        | 0.36   | 0.35   | 0.34   | 0.34    |
| 1000               | 16.01          | 16.07  | 16.26  | 16.40  | 16.44   | 0.35        | 0.35   | 0.33   | 0.32   | 0.32    |
| 1100               | 18.15          | 18.21  | 18.52  | 18.69  | 18.76   | 0.33        | 0.32   | 0.29   | 0.26   | 0.24    |
| 1200               | 22.45          | 22.55  | 23.01  | 23.31  | 23.39   | 0.15        | 0.12   | -0.02  | -0.15  | -0.20   |
| 1300               | 35.59          | 35.37  | 33.88  | 32.22  | 31.78   | -3.08       | -3.04  | -2.78  | -2.55  | -2.46   |
| 1400               | 22.70          | 22.54  | 21.90  | 21.35  | 21.17   | -0.25       | -0.24  | -0.25  | -0.23  | -0.24   |
| 1500               | 15.43          | 15.37  | 15.15  | 14.93  | 14.89   | 0.36        | 0.36   | 0.33   | 0.31   | 0.30    |
| 1520               | 14.41          | 14.38  | 14.19  | 14.00  | 13.95   | 0.39        | 0.38   | 0.35   | 0.34   | 0.33    |
| 1600               | 11.12          | 11.10  | 11.02  | 10.93  | 10.90   | 0.44        | 0.43   | 0.42   | 0.40   | 0.40    |
| 1700               | 8.12           | 8.13   | 8.14   | 8.11   | 8.11    | 0.46        | 0.46   | 0.44   | 0.44   | 0.43    |
| 1800               | 5.95           | 5.96   | 6.02   | 6.05   | 6.06    | 0.47        | 0.46   | 0.45   | 0.44   | 0.44    |
| 1900               | 4.38           | 4.40   | 4.50   | 4.56   | 4.58    | 0.45        | 0.45   | 0.44   | 0.43   | 0.43    |
| 2000               | 3.25           | 3.28   | 3.40   | 3.48   | 3.51    | 0.43        | 0.43   | 0.42   | 0.42   | 0.41    |
| 2030               | 2.98           | 3.01   | 3.14   | 3.22   | 3.25    | 0.43        | 0.42   | 0.41   | 0.41   | 0.41    |
| 2100               | 2.45           | 2.49   | 2.63   | 2.71   | 2.74    | 0.41        | 0.41   | 0.40   | 0.39   | 0.39    |
| 2200               | 1.89           | 1.93   | 2.08   | 2.17   | 2.20    | 0.38        | 0.38   | 0.37   | 0.37   | 0.37    |
| 2300               | 1.49           | 1.53   | 1.69   | 1.78   | 1.81    | 0.36        | 0.36   | 0.35   | 0.35   | 0.34    |
| 2400               | 1.21           | 1.26   | 1.42   | 1.51   | 1.54    | 0.34        | 0.34   | 0.33   | 0.33   | 0.33    |
| 2460               | 1.08           | 1.13   | 1.29   | 1.38   | 1.42    | 0.33        | 0.33   | 0.32   | 0.32   | 0.31    |
| 2500               | 1.02           | 1.06   | 1.22   | 1.32   | 1.35    | 0.32        | 0.32   | 0.31   | 0.31   | 0.31    |
| 2600               | 0.88           | 0.92   | 1.08   | 1.18   | 1.21    | 0.31        | 0.31   | 0.30   | 0.30   | 0.29    |
| 2700               | 0.77           | 0.81   | 0.98   | 1.07   | 1.11    | 0.29        | 0.29   | 0.28   | 0.28   | 0.28    |
| 2800               | 0.71           | 0.75   | 0.92   | 1.01   | 1.05    | 0.28        | 0.28   | 0.27   | 0.27   | 0.27    |
| 2900               | 0.67           | 0.71   | 0.88   | 0.97   | 1.00    | 0.27        | 0.27   | 0.26   | 0.26   | 0.26    |
| 3000               | 0.64           | 0.68   | 0.84   | 0.94   | 0.97    | 0.26        | 0.26   | 0.25   | 0.25   | 0.25    |
| 3100               | 0.62           | 0.66   | 0.83   | 0.92   | 0.96    | 0.25        | 0.25   | 0.25   | 0.25   | 0.25    |
| 3200               | 0.61           | 0.66   | 0.83   | 0.91   | 0.94    | 0.25        | 0.25   | 0.24   | 0.24   | 0.24    |
| 3300               | 0.62           | 0.66   | 0.83   | 0.91   | 0.94    | 0.24        | 0.24   | 0.24   | 0.24   | 0.23    |
| 3400               | 0.63           | 0.67   | 0.84   | 0.92   | 0.95    | 0.24        | 0.24   | 0.23   | 0.23   | 0.23    |
| 3500               | 0.64           | 0.68   | 0.85   | 0.93   | 0.96    | 0.23        | 0.23   | 0.23   | 0.23   | 0.23    |
| 3600               | 0.65           | 0.70   | 0.86   | 0.94   | 0.97    | 0.23        | 0.23   | 0.22   | 0.22   | 0.22    |
| 3700               | 0.67           | 0.71   | 0.87   | 0.95   | 0.98    | 0.22        | 0.23   | 0.22   | 0.22   | 0.22    |
| 3800               | 0.69           | 0.74   | 0.89   | 0.98   | 1.00    | 0.22        | 0.22   | 0.22   | 0.22   | 0.22    |
| 3900               | 0.71           | 0.75   | 0.91   | 0.98   | 1.01    | 0.22        | 0.22   | 0.21   | 0.21   | 0.21    |
| 4000               | 0.73           | 0.77   | 0.93   | 1.01   | 1.05    | 0.22        | 0.22   | 0.21   | 0.21   | 0.21    |
| 4200               | 0.75           | 0.80   | 0.95   | 1.04   | 1.08    | 0.21        | 0.21   | 0.21   | 0.21   | 0.21    |
| 4400               | 0.75           | 0.80   | 0.97   | 1.06   | 1.10    | 0.21        | 0.21   | 0.20   | 0.20   | 0.20    |
| 4600               | 0.77           | 0.82   | 1.00   | 1.10   | 1.14    | 0.21        | 0.21   | 0.20   | 0.20   | 0.20    |
| 4800               | 0.78           | 0.82   | 1.01   | 1.12   | 1.16    | 0.20        | 0.20   | 0.20   | 0.20   | 0.20    |
| 5000               | 0.77           | 0.82   | 1.01   | 1.14   | 1.18    | 0.20        | 0.20   | 0.20   | 0.20   | 0.20    |
| 5200               | 0.76           | 0.81   | 1.01   | 1.14   | 1.20    | 0.20        | 0.20   | 0.20   | 0.19   | 0.19    |
| 5400               | 0.74           | 0.79   | 1.00   | 1.14   | 1.20    | 0.20        | 0.20   | 0.19   | 0.20   | 0.19    |
| 5600               | 0.70           | 0.76   | 0.98   | 1.14   | 1.19    | 0.20        | 0.20   | 0.19   | 0.19   | 0.19    |
| 5800               | 0.69           | 0.74   | 0.97   | 1.13   | 1.19    | 0.20        | 0.20   | 0.20   | 0.19   | 0.19    |
| 6000               | 0.67           | 0.73   | 0.97   | 1.13   | 1.19    | 0.20        | 0.20   | 0.19   | 0.19   | 0.19    |
| 6200               | 0.65           | 0.70   | 0.94   | 1.10   | 1.16    | 0.20        | 0.20   | 0.19   | 0.19   | 0.19    |
| 6400               | 0.64           | 0.69   | 0.93   | 1.09   | 1.15    | 0.20        | 0.20   | 0.20   | 0.19   | 0.19    |
| 6600               | 0.63           | 0.68   | 0.93   | 1.08   | 1.14    | 0.20        | 0.20   | 0.19   | 0.19   | 0.19    |
| 6800               | 0.62           | 0.68   | 0.92   | 1.07   | 1.12    | 0.20        | 0.20   | 0.19   | 0.19   | 0.19    |
| 7000               | 0.62           | 0.68   | 0.91   | 1.06   | 1.11    | 0.20        | 0.20   | 0.19   | 0.19   | 0.19    |
| 7200               | 0.63           | 0.69   | 0.92   | 1.06   | 1.09    | 0.20        | 0.20   | 0.19   | 0.19   | 0.19    |
| 7400               | 0.61           | 0.67   | 0.92   | 1.05   | 1.09    | 0.20        | 0.20   | 0.19   | 0.19   | 0.19    |
| 7600               | 0.59           | 0.65   | 0.90   | 1.04   | 1.09    | 0.20        | 0.20   | 0.19   | 0.19   | 0.19    |
| 7800               | 0.58           | 0.65   | 0.90   | 1.05   | 1.10    | 0.20        | 0.20   | 0.19   | 0.19   | 0.19    |
| 8000               | 0.59           | 0.65   | 0.90   | 1.06   | 1.11    | 0.20        | 0.20   | 0.19   | 0.19   | 0.19    |
| 8200               | 0.59           | 0.65   | 0.91   | 1.07   | 1.13    | 0.20        | 0.20   | 0.19   | 0.19   | 0.19    |
| 8400               | 0.59           | 0.65   | 0.92   | 1.09   | 1.15    | 0.20        | 0.20   | 0.19   | 0.19   | 0.19    |
| 8600               | 0.59           | 0.66   | 0.94   | 1.11   | 1.17    | 0.20        | 0.20   | 0.19   | 0.19   | 0.19    |
| 8800               | 0.60           | 0.67   | 0.96   | 1.13   | 1.20    | 0.20        | 0.20   | 0.19   | 0.19   | 0.19    |
| 9000               | 0.60           | 0.67   | 0.97   | 1.15   | 1.23    | 0.20        | 0.20   | 0.19   | 0.19   | 0.19    |
| 9200               | 0.61           | 0.69   | 1.00   | 1.19   | 1.27    | 0.20        | 0.20   | 0.19   | 0.19   | 0.19    |
| 9400               | 0.63           | 0.70   | 1.03   | 1.23   | 1.31    | 0.20        | 0.20   | 0.19   | 0.19   | 0.19    |
| 9600               | 0.64           | 0.72   | 1.07   | 1.27   | 1.35    | 0.20        | 0.20   | 0.19   | 0.19   | 0.19    |
| 9800               | 0.68           | 0.75   | 1.11   | 1.32   | 1.42    | 0.20        | 0.20   | 0.19   | 0.19   | 0.19    |
| 10000              | 0.72           | 0.80   | 1.16   | 1.38   | 1.47    | 0.20        | 0.20   | 0.20   | 0.19   | 0.19    |
| 10400              | 0.89           | 0.95   | 1.31   | 1.55   | 1.64    | 0.20        | 0.20   | 0.19   | 0.19   | 0.19    |
| 10500              | 0.93           | 1.00   | 1.35   | 1.59   | 1.68    | 0.20        | 0.20   | 0.19   | 0.19   | 0.19    |
| 11000              | 1.29           | 1.35   | 1.65   | 1.89   | 1.96    | 0.20        | 0.20   | 0.19   | 0.19   | 0.19    |
| 11500              | 1.76           | 1.82   | 2.06   | 2.28   | 2.34    | 0.19        | 0.19   | 0.19   | 0.19   | 0.19    |
| 12000              | 2.23           | 2.29   | 2.56   | 2.78   | 2.84    | 0.19        | 0.19   | 0.19   | 0.19   | 0.19    |



Typical Performance Data

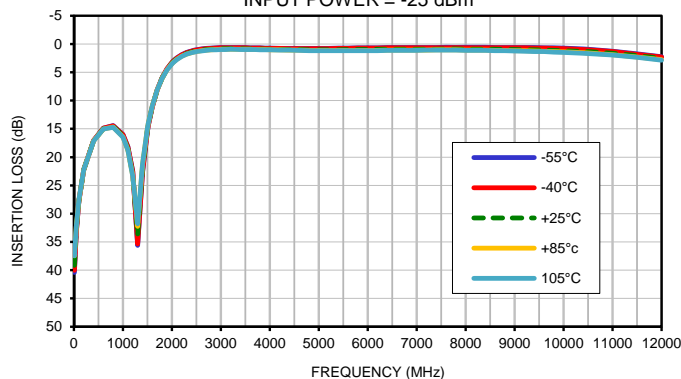
| FREQ.<br><br>(MHz) | INPUT RETURN LOSS |        |        |        |         | OUTPUT RETURN LOSS |        |        |        |         |
|--------------------|-------------------|--------|--------|--------|---------|--------------------|--------|--------|--------|---------|
|                    | (dB)              |        |        |        |         | (dB)               |        |        |        |         |
|                    | @-55°C            | @-40°C | @+25°C | @+85°C | @+105°C | @-55°C             | @-40°C | @+25°C | @+85°C | @+105°C |
| 10                 | 34.79             | 34.91  | 32.47  | 30.60  | 30.48   | 35.21              | 34.71  | 33.08  | 30.67  | 31.05   |
| 50                 | 35.25             | 34.63  | 33.20  | 31.41  | 30.98   | 33.97              | 33.48  | 32.42  | 31.42  | 31.23   |
| 100                | 32.92             | 32.83  | 32.09  | 31.01  | 30.53   | 32.28              | 32.09  | 32.20  | 31.93  | 31.71   |
| 200                | 31.05             | 30.89  | 30.09  | 29.31  | 28.99   | 31.33              | 31.14  | 30.30  | 29.49  | 29.13   |
| 400                | 26.49             | 26.42  | 26.12  | 25.72  | 25.62   | 27.13              | 26.93  | 26.34  | 26.09  | 25.85   |
| 600                | 23.56             | 23.53  | 23.20  | 23.03  | 22.96   | 24.03              | 23.92  | 23.49  | 23.19  | 23.07   |
| 800                | 21.24             | 21.23  | 20.99  | 20.90  | 20.87   | 21.57              | 21.53  | 21.18  | 20.80  | 20.63   |
| 1000               | 19.35             | 19.38  | 19.20  | 19.08  | 19.06   | 19.56              | 19.54  | 19.31  | 19.18  | 19.10   |
| 1100               | 18.65             | 18.65  | 18.57  | 18.48  | 18.44   | 18.76              | 18.78  | 18.60  | 18.42  | 18.35   |
| 1200               | 18.13             | 18.12  | 18.08  | 18.00  | 17.95   | 18.08              | 18.12  | 18.08  | 18.01  | 17.98   |
| 1300               | 17.81             | 17.82  | 17.84  | 17.76  | 17.73   | 17.72              | 17.77  | 17.83  | 17.79  | 17.74   |
| 1400               | 17.82             | 17.85  | 17.95  | 17.86  | 17.82   | 17.61              | 17.67  | 17.84  | 17.83  | 17.79   |
| 1500               | 18.24             | 18.29  | 18.45  | 18.36  | 18.32   | 17.97              | 18.03  | 18.25  | 18.29  | 18.32   |
| 1520               | 18.35             | 18.42  | 18.57  | 18.47  | 18.44   | 18.04              | 18.15  | 18.36  | 18.42  | 18.46   |
| 1600               | 19.02             | 19.08  | 19.26  | 19.15  | 19.10   | 18.54              | 18.63  | 18.98  | 19.01  | 19.02   |
| 1700               | 20.12             | 20.16  | 20.31  | 20.19  | 20.13   | 19.42              | 19.52  | 20.00  | 20.02  | 20.01   |
| 1800               | 21.10             | 21.14  | 21.40  | 21.24  | 21.22   | 20.38              | 20.50  | 21.01  | 21.08  | 21.11   |
| 1900               | 21.70             | 21.76  | 22.22  | 22.14  | 22.12   | 21.11              | 21.20  | 21.91  | 22.03  | 22.02   |
| 2000               | 22.23             | 22.33  | 22.98  | 23.08  | 23.07   | 21.66              | 21.84  | 22.73  | 22.94  | 22.96   |
| 2030               | 22.41             | 22.55  | 23.29  | 23.41  | 23.39   | 21.97              | 22.13  | 23.12  | 23.39  | 23.41   |
| 2100               | 23.19             | 23.37  | 24.28  | 24.46  | 24.46   | 22.64              | 22.87  | 23.98  | 24.34  | 24.41   |
| 2200               | 24.60             | 24.84  | 26.05  | 26.28  | 26.31   | 24.11              | 24.30  | 25.67  | 26.22  | 26.13   |
| 2300               | 27.14             | 27.43  | 28.89  | 28.77  | 28.62   | 26.26              | 26.55  | 28.05  | 28.51  | 28.43   |
| 2400               | 31.51             | 31.81  | 32.62  | 31.15  | 30.27   | 29.22              | 29.56  | 30.37  | 29.96  | 29.72   |
| 2460               | 35.58             | 35.66  | 33.90  | 31.09  | 30.33   | 30.76              | 31.00  | 31.04  | 29.96  | 29.49   |
| 2500               | 38.27             | 37.61  | 33.12  | 30.40  | 29.70   | 31.22              | 31.17  | 30.54  | 29.23  | 28.65   |
| 2600               | 33.74             | 32.84  | 29.47  | 27.74  | 27.23   | 29.93              | 29.58  | 28.34  | 27.12  | 26.74   |
| 2700               | 28.15             | 27.77  | 26.10  | 25.17  | 24.93   | 26.65              | 26.38  | 25.49  | 24.68  | 24.41   |
| 2800               | 24.50             | 24.28  | 23.25  | 22.76  | 22.60   | 23.77              | 23.63  | 22.96  | 22.47  | 22.27   |
| 2900               | 22.14             | 21.99  | 21.27  | 20.99  | 20.90   | 21.66              | 21.50  | 21.09  | 20.79  | 20.67   |
| 3000               | 20.20             | 20.14  | 19.70  | 19.56  | 19.57   | 19.91              | 19.83  | 19.61  | 19.44  | 19.42   |
| 3100               | 18.69             | 18.63  | 18.37  | 18.35  | 18.35   | 18.46              | 18.42  | 18.36  | 18.28  | 18.27   |
| 3200               | 17.57             | 17.53  | 17.31  | 17.37  | 17.42   | 17.33              | 17.32  | 17.25  | 17.29  | 17.34   |
| 3300               | 16.61             | 16.57  | 16.45  | 16.56  | 16.65   | 16.38              | 16.39  | 16.43  | 16.52  | 16.59   |
| 3400               | 15.65             | 15.62  | 15.62  | 15.75  | 15.84   | 15.51              | 15.52  | 15.63  | 15.75  | 15.84   |
| 3500               | 14.95             | 14.95  | 14.99  | 15.15  | 15.23   | 14.82              | 14.84  | 15.01  | 15.17  | 15.25   |
| 3600               | 14.35             | 14.36  | 14.41  | 14.58  | 14.68   | 14.19              | 14.23  | 14.42  | 14.60  | 14.70   |
| 3700               | 13.79             | 13.80  | 13.93  | 14.10  | 14.19   | 13.63              | 13.65  | 13.92  | 14.14  | 14.22   |
| 3800               | 13.28             | 13.29  | 13.46  | 13.68  | 13.79   | 13.11              | 13.15  | 13.47  | 13.72  | 13.84   |
| 3900               | 12.88             | 12.89  | 13.12  | 13.33  | 13.44   | 12.70              | 12.76  | 13.10  | 13.33  | 13.46   |
| 4000               | 12.56             | 12.57  | 12.79  | 12.95  | 13.05   | 12.38              | 12.42  | 12.78  | 12.99  | 13.09   |
| 4200               | 12.04             | 12.06  | 12.28  | 12.42  | 12.50   | 11.87              | 11.94  | 12.28  | 12.45  | 12.53   |
| 4400               | 11.82             | 11.83  | 11.99  | 12.04  | 12.12   | 11.65              | 11.70  | 11.97  | 12.06  | 12.13   |
| 4600               | 11.62             | 11.64  | 11.76  | 11.76  | 11.81   | 11.46              | 11.49  | 11.74  | 11.77  | 11.82   |
| 4800               | 11.55             | 11.56  | 11.68  | 11.62  | 11.65   | 11.38              | 11.42  | 11.64  | 11.61  | 11.63   |
| 5000               | 11.65             | 11.67  | 11.69  | 11.54  | 11.53   | 11.53              | 11.56  | 11.67  | 11.54  | 11.54   |
| 5200               | 11.80             | 11.82  | 11.80  | 11.58  | 11.55   | 11.68              | 11.73  | 11.79  | 11.60  | 11.55   |
| 5400               | 12.10             | 12.13  | 12.03  | 11.75  | 11.67   | 11.95              | 12.01  | 11.97  | 11.69  | 11.61   |
| 5600               | 12.50             | 12.52  | 12.33  | 11.98  | 11.86   | 12.42              | 12.45  | 12.29  | 11.94  | 11.83   |
| 5800               | 12.93             | 12.97  | 12.71  | 12.30  | 12.16   | 12.72              | 12.77  | 12.60  | 12.17  | 12.02   |
| 6000               | 13.34             | 13.39  | 13.12  | 12.70  | 12.55   | 13.10              | 13.17  | 12.98  | 12.58  | 12.40   |
| 6200               | 13.91             | 13.95  | 13.69  | 13.21  | 13.03   | 13.60              | 13.70  | 13.53  | 13.07  | 12.87   |
| 6400               | 14.43             | 14.48  | 14.24  | 13.82  | 13.64   | 14.05              | 14.14  | 14.08  | 13.68  | 13.49   |
| 6600               | 14.95             | 15.01  | 14.92  | 14.53  | 14.40   | 14.42              | 14.56  | 14.69  | 14.34  | 14.19   |
| 6800               | 15.41             | 15.51  | 15.59  | 15.34  | 15.24   | 14.82              | 15.02  | 15.35  | 15.16  | 15.07   |
| 7000               | 15.89             | 16.00  | 16.29  | 16.18  | 16.18   | 15.24              | 15.46  | 16.05  | 16.02  | 16.03   |
| 7200               | 16.26             | 16.39  | 16.98  | 17.11  | 17.18   | 15.61              | 15.83  | 16.73  | 16.93  | 17.07   |
| 7400               | 16.76             | 16.83  | 17.51  | 17.97  | 18.12   | 16.04              | 16.22  | 17.26  | 17.75  | 18.08   |
| 7600               | 17.53             | 17.56  | 18.21  | 18.83  | 19.10   | 16.67              | 16.80  | 17.88  | 18.72  | 19.11   |
| 7800               | 18.20             | 18.20  | 18.89  | 19.67  | 20.00   | 17.43              | 17.51  | 18.63  | 19.61  | 20.09   |
| 8000               | 18.59             | 18.56  | 19.37  | 20.27  | 20.60   | 17.90              | 17.98  | 19.21  | 20.41  | 21.04   |
| 8200               | 19.06             | 19.00  | 19.79  | 20.54  | 20.79   | 18.43              | 18.52  | 19.67  | 20.85  | 21.33   |
| 8400               | 19.56             | 19.47  | 20.02  | 20.50  | 20.68   | 19.22              | 19.23  | 20.07  | 20.84  | 21.29   |
| 8600               | 20.01             | 19.86  | 20.16  | 20.48  | 20.54   | 19.71              | 19.67  | 20.25  | 21.00  | 21.25   |
| 8800               | 20.33             | 20.11  | 20.02  | 19.96  | 19.88   | 20.23              | 20.11  | 20.18  | 20.37  | 20.42   |
| 9000               | 20.94             | 20.57  | 19.69  | 19.26  | 19.01   | 21.10              | 20.82  | 19.96  | 19.64  | 19.45   |
| 9200               | 20.98             | 20.53  | 19.09  | 18.39  | 18.04   | 21.36              | 20.95  | 19.52  | 18.87  | 18.56   |
| 9400               | 20.70             | 20.16  | 18.29  | 17.47  | 17.08   | 21.34              | 20.76  | 18.72  | 17.92  | 17.56   |
| 9600               | 19.84             | 19.33  | 17.32  | 16.43  | 16.02   | 20.65              | 20.09  | 17.89  | 16.91  | 16.51   |
| 9800               | 18.36             | 17.99  | 16.27  | 15.46  | 15.06   | 18.92              | 18.56  | 16.75  | 15.91  | 15.59   |
| 10000              | 16.62             | 16.40  | 15.12  | 14.43  | 14.12   | 17.22              | 16.93  | 15.70  | 14.95  | 14.67   |
| 10400              | 13.40             | 13.38  | 12.95  | 12.46  | 12.32   | 13.69              | 13.72  | 13.46  | 12.97  | 12.77   |
| 10500              | 12.67             | 12.70  | 12.45  | 12.03  | 11.94   | 12.95              | 12.99  | 12.97  | 12.59  | 12.40   |
| 11000              | 9.47              | 9.60   | 10.01  | 9.97   | 10.03   | 9.71               | 9.83   | 10.58  | 10.65  | 10.66   |
| 11500              | 7.43              | 7.55   | 8.13   | 8.30   | 8.44    | 7.61               | 7.72   | 8.64   | 8.96   | 9.12    |
| 12000              | 6.20              | 6.29   | 6.71   | 6.94   | 7.07    | 6.47               | 6.49   | 7.19   | 7.50   | 7.63    |



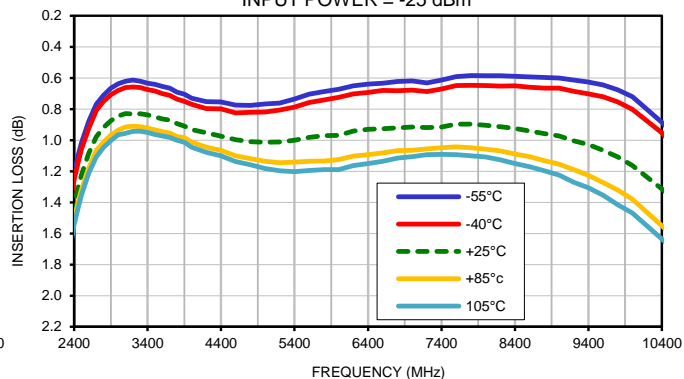


## Typical Performance Curves

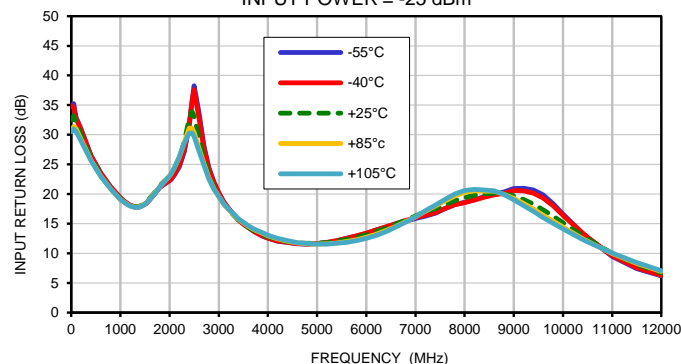
**INSERTION LOSS vs. TEMPERATURE (Full band)**  
INPUT POWER = -25 dBm



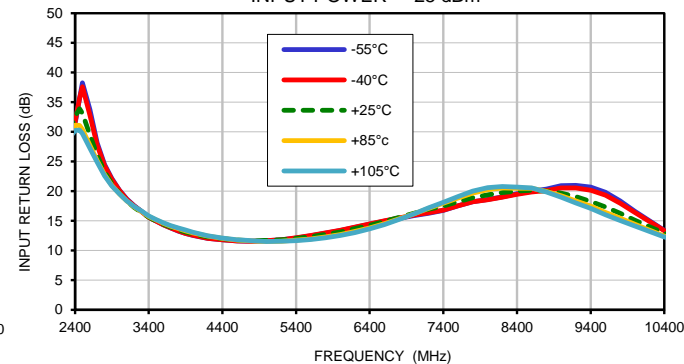
**INSERTION LOSS vs. TEMPERATURE (Pass band)**  
INPUT POWER = -25 dBm



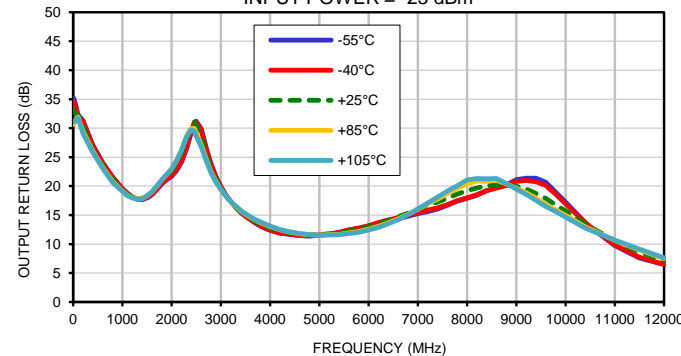
**INPUT RETURN LOSS vs. TEMPERATURE (Full band)**  
INPUT POWER = -25 dBm



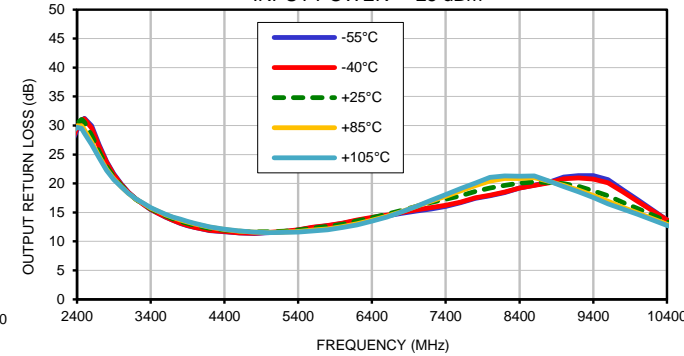
**INPUT RETURN LOSS vs. TEMPERATURE (Pass band)**  
INPUT POWER = -25 dBm



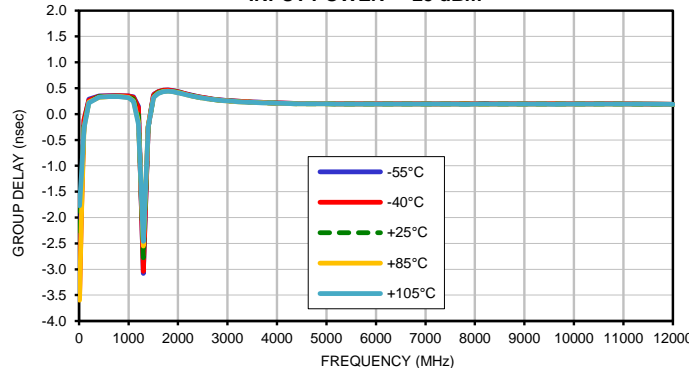
**OUTPUT RETURN LOSS vs. TEMPERATURE (Full band)**  
INPUT POWER = -25 dBm



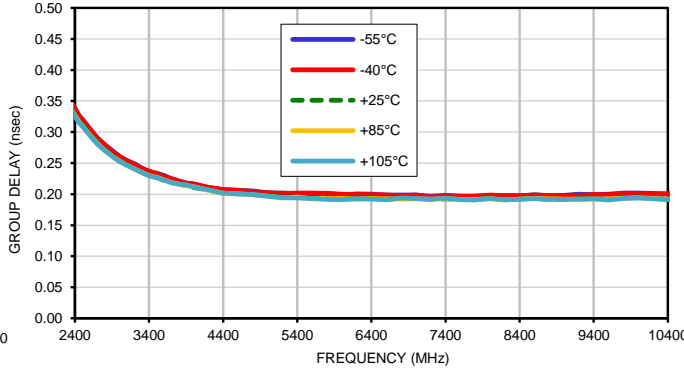
**OUTPUT RETURN LOSS vs. TEMPERATURE (Pass band)**  
INPUT POWER = -25 dBm



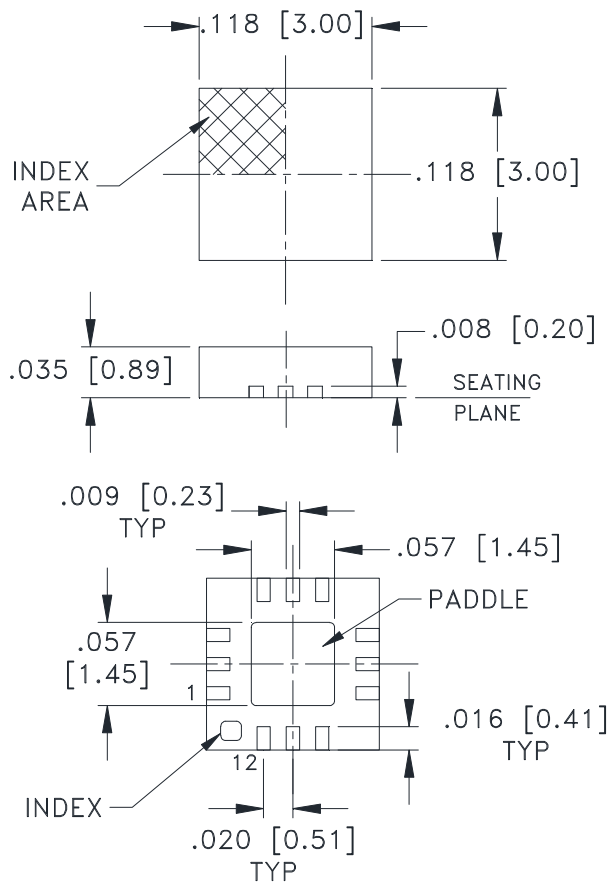
**GROUP DELAY vs. TEMPERATURE (Full band)**  
INPUT POWER = -25 dBm



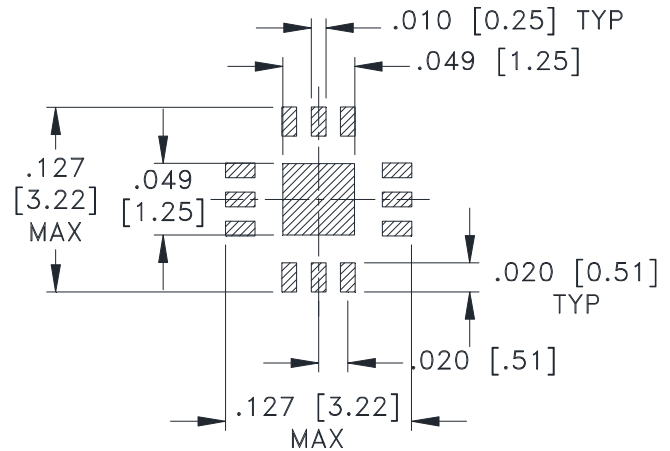
**GROUP DELAY vs. TEMPERATURE (Pass band)**  
INPUT POWER = -25 dBm



### Outline Dimensions



### PCB Land Pattern



SUGGESTED LAYOUT,  
TOLERANCE TO BE WITHIN  $\pm .002$

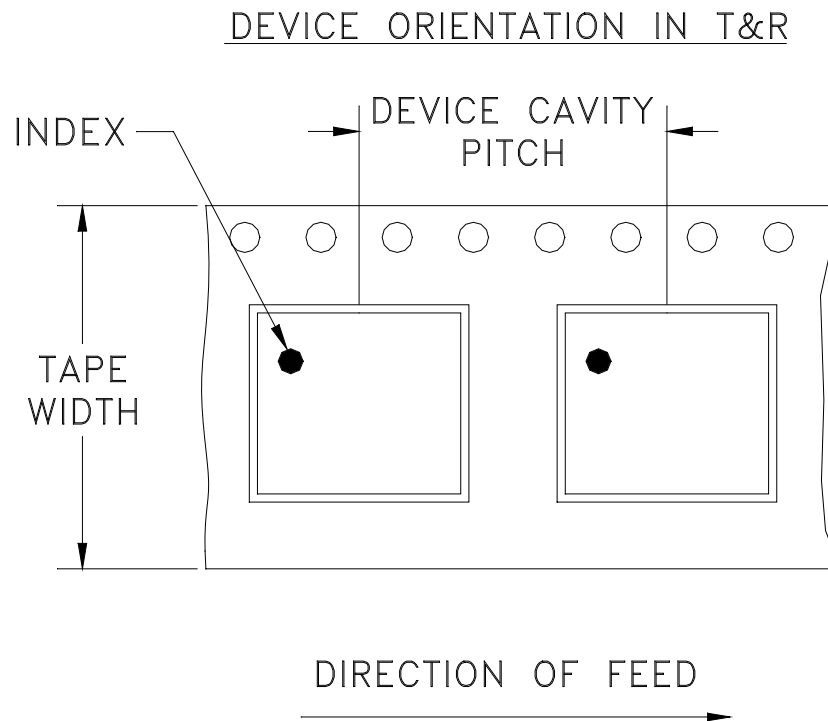
**Weight: .02 Grams**

**Dimensions are in inches (mm). Tolerances: 2Pl.  $\pm .01$ ; 3 Pl.  $\pm .004$**

### Notes:

1. Case material: Plastic.
2. Termination finish:
  - For RoHS Case Styles: Tin-Silver alloy plate over Nickel barrier or Matte-Tin. All models, (+) suffix. See Data sheet.
  - For RoHS-5 Case Styles: Tin-Lead plate. All models, no (+) suffix.

# Tape & Reel Packaging TR-F66



| Tape Width, mm | Device Cavity Pitch, mm | Reel Size, inches | Devices per Reel<br>see note |                  |
|----------------|-------------------------|-------------------|------------------------------|------------------|
| 8              | 4                       | 7                 | Small quantity standard      | 20               |
|                |                         |                   |                              | 50               |
|                |                         |                   |                              | 100              |
|                |                         |                   |                              | 200              |
|                |                         |                   |                              | 500              |
|                |                         | 7                 | Standard                     | 1000, 2000, 3000 |

Note: Please consult individual model data sheet to determine device per reel availability.

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

Go to: [www.minicircuits.com/pages/pdfs/tape.pdf](http://www.minicircuits.com/pages/pdfs/tape.pdf)

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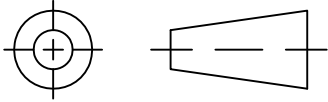
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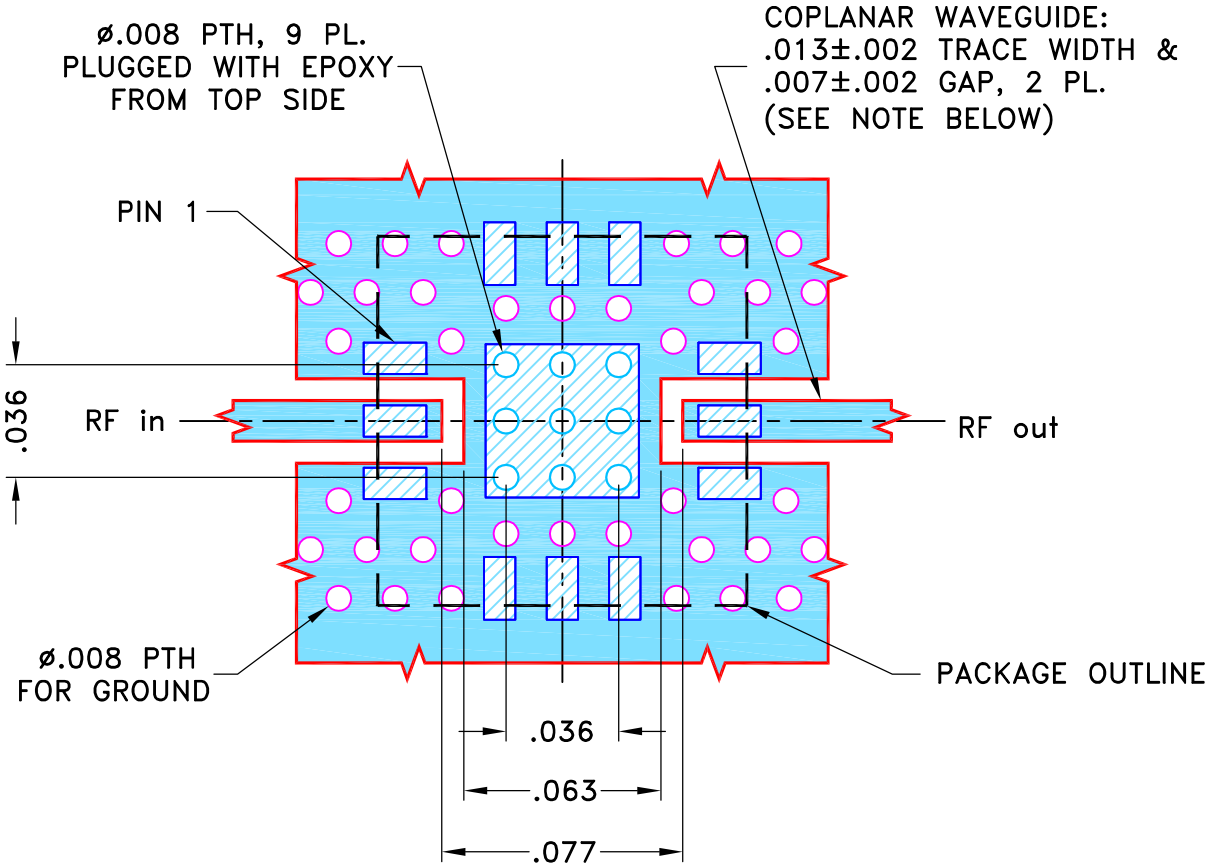
THIRD ANGLE PROJECTION



REVISIONS

| REV | ECN No. | DESCRIPTION | DATE     | DR  | AUTH |
|-----|---------|-------------|----------|-----|------|
| OR  | M152656 | NEW RELEASE | 09/11/15 | ITG | MY   |
|     |         |             |          |     |      |
|     |         |             |          |     |      |

SUGGESTED MOUNTING CONFIGURATION  
FOR DQ1225 CASE STYLE, "12FL02" PIN CODE

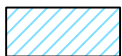


**NOTES:**

- TRACE WIDTH PARAMETERS ARE SHOWN FOR ROGERS R04350B WITH DIELECTRIC THICKNESS  $.0066 \pm .0007$ ". COPPER: 1/2 OZ. EACH SIDE. FOR OTHER MATERIALS TRACE WIDTH AND GAP MAY NEED TO BE MODIFIED.
- 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   | INITIALS |     | DATE     |
|--|----------|-----|----------|
| DIMENSIONS ARE IN INCHES<br>TOLERANCES ON:<br>2 PL DECIMALS ±<br>3 PL DECIMALS ± .005<br>ANGLES ±<br>FRACTIONS ± | DRAWN    | ITG | 09/10/15 |
|  | CHECKED  | GF  | 09/11/15 |
|  | APPROVED | MY  | 09/11/15 |



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Brooklyn NY 11235

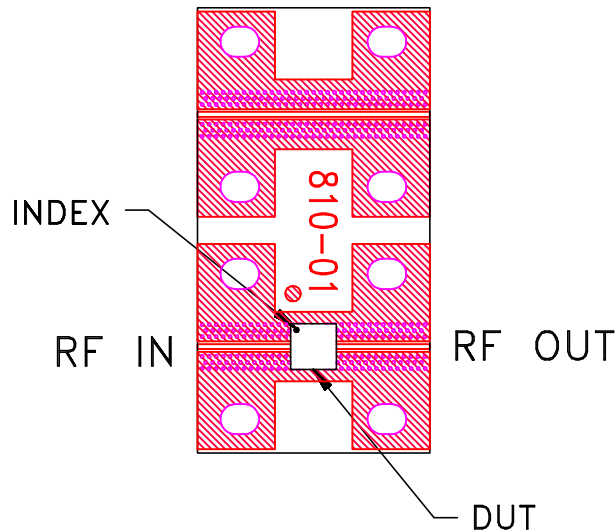
PL, 12FL02, DQ1225, TB-844+

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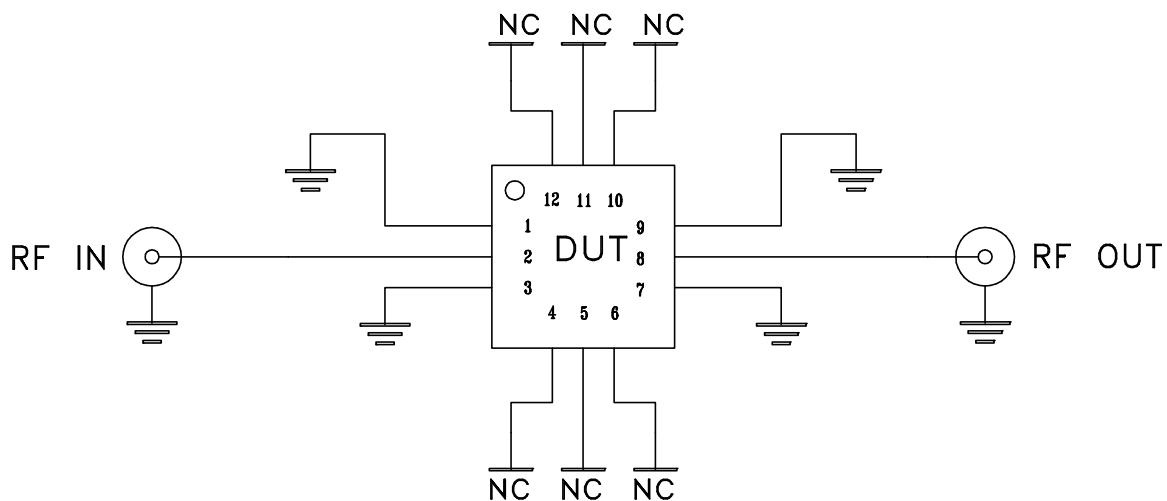
|                  |                     |                          |            |
|------------------|---------------------|--------------------------|------------|
| SIZE<br>A        | CODE IDENT<br>15542 | DRAWING NO:<br>98-PL-451 | REV:<br>OR |
| FILE:<br>98PL451 | SCALE:<br>16:1      | SHEET:<br>1 OF 1         |            |

# Evaluation Board and Circuit

To be used with Mini-Circuits 50 Ohm 2.92 connectors B20-118-F1+.  
Connectors are sold separately.




TB-844-252H+



Schematic Diagram

## Note:

PCB Material: R04350 or equivalent,  
Dielectric Constant=3.5, Thickness=.0066 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 105°C<br>Ambient Environment  | Individual Model Data Sheet                   |
| Storage Temperature            | -65° to 150° C<br>Ambient Environment   | Individual Model Data Sheet                   |
| Autoclave                      | 15 psig, 100% RH, 121°C, 96 hours   | JESD22-A102-C, Condition C                    |
| Temperature Cycling            | -65° to 150°C, 100 cycles   | JESD22-A104                                   |
| Temperature Humidity           | 85°C/ 85% RH, 168 hours   | JESD22-113                                    |
| Solder Reflow Heat             | Sn-Pb Eutetic Process: 240°C peak<br>Pb-Free Process: 260°C peak  | J-STD-020, Table 4-1, 4-2 and 5-2; Figure 5-1 |
| Moisture Sensitivity: Level 1  | Bake at 125°C for 24 hours<br>Soak at 85°C/85% RH for 168 hours, Reflow 3 cycles at 240°C peak (Non-RoHS) or 260°C (RoHS)                                       | J-STD-020C                                    |
| Solderability                  | 10X magnification, 95% coverage   | JESD22-B102, Method 1: Dip and Look Test      |
| 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                       |