NEW!
Two & Three
Section Models

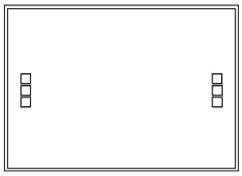
MMIC

# REFLECTIONLESS FILTERS DICE

50Ω DC to 21 GHz

## The Big Deal

- High Stopband rejection, up to 50 dB
- Patented design terminates stopband signals
- Pass band cut-off up to 11 GHz
- Stop band up to 26 GHz
- Excellent repeatability through IPD* process



**X-Series**

*Available in Low Pass and High Pass designs*

## Product Overview

Mini-Circuits' ***X-Series*** of reflectionless filters now includes 2- and 3-section models, giving you ultra-high rejection in the stopband – up to 50 dB! Reflectionless filters employ a patented filter topology which absorbs and terminates stopband 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 stopband, sending signals back to the source at 100% power. These reflections interact with neighboring components and often result in intermodulation and other interferences. By eliminating stopband reflections, reflectionless filters can readily be paired with sensitive devices and used in applications that otherwise require circuits such as isolation amplifiers or attenuators.

| Key Features | Advantages |
|---|---|
| Easy integration with sensitive reflective components, e.g. mixers, multipliers | Reflectionless filters absorb unwanted signals, 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. |
| Excellent repeatability of RF performance | Through semiconductor IPD process, X-series filters are inherently repeatable for large volume production. |
| Excellent stability over temperature | With ±0.3 dB variation over temperature ideal for use in wide temperature range applications without the need for additional temperature compensation. |
| Operating temperature up to 105˚C | Suitable for operation close to high power components. |

*IPD – Integrated Passive Device, is a GaAs semiconductor process

*Reflectionless*

# Low Pass Filter Die

## XLF-662M-D+

50Ω DC to 6600 MHz

### Features

- Match to 50Ω in the stop band, eliminates undesired reflections
- Cascadable
- Excellent stopband rejection, 36 dB typ.
- Temperature stable, up to 85°C
- Protected by US Patents 8,392,495; 9,705,467, additional patent pending
- Protected by China Patent 201080014266.1
- Protected by Taiwan Patent I581494



***+RoHS Compliant***

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

*Ordering Information: Refer to Last Page*

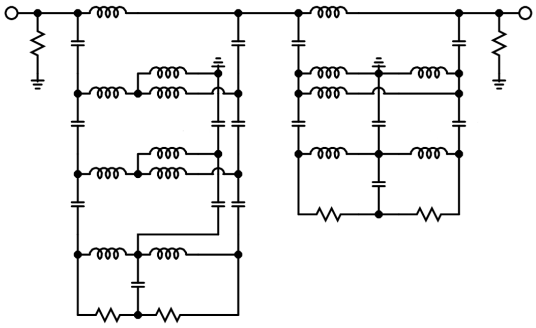
### Applications

- Mobile
- ISM Applications
- TV broadcasting
- UHF radar

### General Description

Mini-Circuits' XLF-662M-D+ two-section reflectionless filter die employs a patented 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.

### Simplified Schematic and Pad description



| Pad# | Description |
|---|---|
| 2 | RF-IN |
| 5 | RF-OUT |
| 1,3,4,6 | Ground |
| Die bottom | Ground |

Note: 1. Bond Pad material - Gold
2. Bottom of Die - Gold plated

### Bonding Pad Position




Dimensions in µm, Typical

| L1 | L2 | L3 | H1 | H2 | H3 | H4 | Thickness | Bond pad size |
|---|---|---|---|---|---|---|---|---|
| 80 | 1320 | 1400 | 400 | 500 | 600 | 730 | 100 | 75 x 75 |

## Electrical Specifications[1] at 25°C

| Parameter | | F# | Frequency (MHz) | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|---|
| Pass Band | Insertion Loss | DC-F1 | DC-6600 | — | 1.1 | — | dB |
| | Frequency Cut-off | F2 | 7100 | — | 3.0 | — | dB |
| | VSWR | DC-F1 | DC-6600 | — | 1.2 | — | :1 |
| Stop Band | Rejection | F3-F4 | 9200-18000 | — | 31 | — | dB |
| | | F4-F5 | 18000-43500 | — | 38 | — | |
| | VSWR | F3-F4 | 9200-18000 | — | 1.5 | — | :1 |
| | | F4-F5 | 18000-43500 | — | 1.6 | — | |

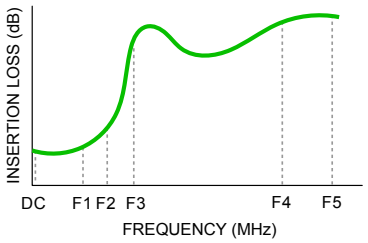
1. Measured on die using MPI Titan series 100 µm pitch as a probe

## Absolute Maximum Ratings[1,4]

| Parameter | Ratings |
|---|---|
| Operating Temperature | -55°C to +105°C |
| RF Power Input, Passband (DC-F1)[2] | 5W at 25°C |
| RF Power Input, Stopband (F1-F5)[3] | 1.3 at 25°C |

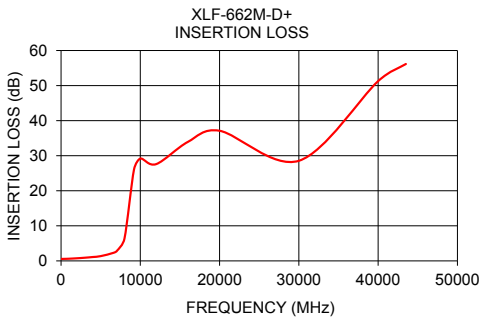
[2] Passband rating derates linearly to 2.5W at 105°C ambient
[3] Stopband rating derates linearly to 0.6W at 105°C ambient
[4] Permanent damage may occur if any of these limits are exceeded.

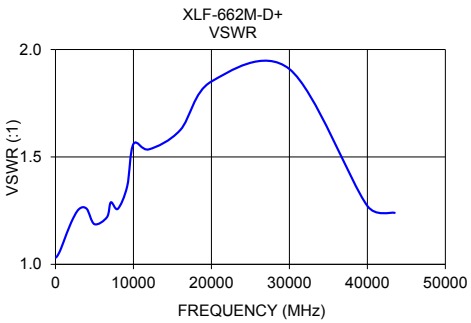
***Specification Definition***



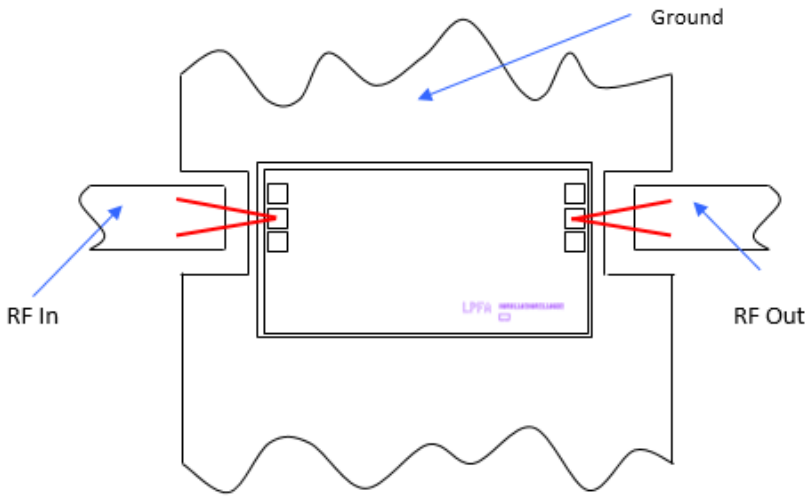

## Typical Performance Data at 25°C[1]

| Frequency (MHz) | Insertion Loss (dB) | VSWR (:1) |
|---|---|---|
| 10 | 0.6 | 1.03 |
| 100 | 0.6 | 1.03 |
| 500 | 0.6 | 1.06 |
| 1000 | 0.6 | 1.10 |
| 2000 | 0.7 | 1.19 |
| 3000 | 0.9 | 1.26 |
| 4000 | 1.1 | 1.26 |
| 5000 | 1.4 | 1.19 |
| 6600 | 2.3 | 1.22 |
| 7100 | 3.0 | 1.29 |
| 8000 | 6.4 | 1.26 |
| 9200 | 26.0 | 1.36 |
| 10000 | 29.2 | 1.56 |
| 12000 | 27.6 | 1.54 |
| 16000 | 33.9 | 1.62 |
| 20000 | 37.1 | 1.85 |
| 30000 | 28.6 | 1.91 |
| 40000 | 51.3 | 1.27 |
| 43500 | 56.2 | 1.24 |



## Assembly Diagram




Note: Ground bond wires are optional.

## Assembly and Handling Procedure

1. Storage
   Dice should be stored in a dry nitrogen purged desiccators or equivalent.
2. ESD
   MMIC Gallium Arsenide (GaAs) filter dice are susceptible to electrostatic and mechanical damage. Die are supplied in antistatic protected material, which should be opened in clean room conditions at an appropriately grounded anti-static worksta tion. Devices need careful handling using correctly designed collets, vacuum pickup tips or sharp antistatic tweezers to deter ESD damage to dice.
3. Die Attach
   The die mounting surface must be clean and flat. Using conductive silver filled epoxy, recommended epoxies are DieMat DM6030Hk-PT/H579/H579 or Ablestik 84-1LMISR4. Apply sufficient epoxy to meet required epoxy bond line thickness, epoxy fillet height and epoxy coverage around total die periphery. Parts shall be cured in a nitrogen filled atmosphere per manufac turer's cure condition. It is recommended to use antistatic die pick up tools only.
4. Wire Bonding
   Bond pad openings in the surface passivation above the bond pads are provided to allow wire bonding to the dice gold bond pads. Thermosonic bonding is used with minimized ultrasonic content. Bond force, time, ultrasonic power and temperature are all critical parameters. Suggested wire is pure gold, 1 mil diameter. Bonds must be made from the bond pads on the die to the package or substrate. All bond wires should be kept as short as low as reasonable to minimize performance degradation due to undesirable series inductance.

| Additional Detailed Technical Information<br>*additional information is available on our dash board.* | |
|---|---|
| **Performance Data** | Data Table |
| | Swept Graphs |
| | S-Parameter (S2P Files) Data Set with and without port extension(.zip file) |
| **Case Style** | Die |
| **Die Ordering and packaging information** | Quantity, Package — Model No.<br>Small, Gel - Pak: 5,10,50,100 KGD* — XLF-662M-DG+<br>Medium†, Partial wafer: KGD*<1420 — XLF-662M-DP+<br><br>†*Available upon request contact sales representative*<br><br>Refer to AN-60-067 |
| **Environmental Ratings** | ENV-80 |

*Known Good Dice ("KGD") means that the dice are taken from PCM good wafer and visually inspected in question have been subjected to Mini-Circuits while this is not definitive, it does help to provide a higher degree of confidence that dice are capable of meeting typical RF electrical parameters specified by Mini-Circuits.

## ESD Rating**

Human Body Model (HBM): Class 1A(250 to <500V) in accordance with ANSI/ESD STM 5.1 - 2001

** Tested in industry standard MCLP 3x3mm 12 lead package.

### Additional 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.

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# MMIC Reflectionless Low Pass Filter Die XLF-662M-D+

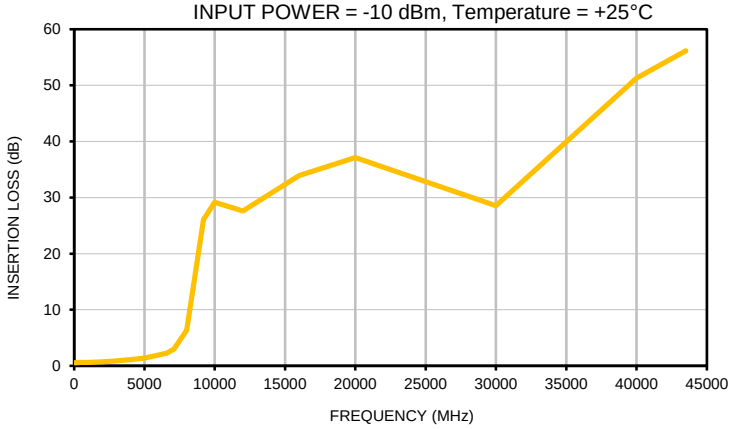
*Typical Performance Data*

**Test Condition @ Temperature = +25°C**

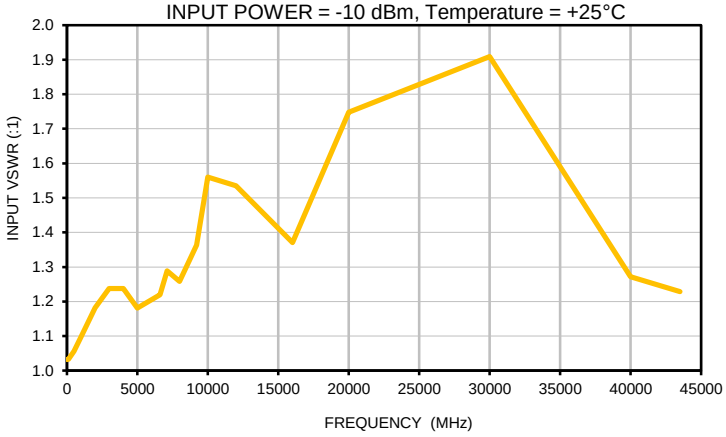
| FREQ. (MHz) | INSERTION LOSS (dB) | INPUT VSWR (:1) | OUTPUT VSWR (:1) |
|---|---|---|---|
| 10 | 0.56 | 1.03 | 1.03 |
| 100 | 0.57 | 1.03 | 1.03 |
| 500 | 0.58 | 1.06 | 1.06 |
| 1000 | 0.62 | 1.10 | 1.10 |
| 2000 | 0.74 | 1.18 | 1.19 |
| 3000 | 0.90 | 1.24 | 1.26 |
| 4000 | 1.11 | 1.24 | 1.26 |
| 5000 | 1.36 | 1.18 | 1.19 |
| 6600 | 2.29 | 1.22 | 1.15 |
| 7100 | 3.00 | 1.29 | 1.22 |
| 8000 | 6.38 | 1.26 | 1.25 |
| 9200 | 26.04 | 1.36 | 1.20 |
| 10000 | 29.19 | 1.56 | 1.20 |
| 12000 | 27.60 | 1.54 | 1.19 |
| 16000 | 33.94 | 1.37 | 1.62 |
| 20000 | 37.11 | 1.75 | 1.85 |
| 30000 | 28.55 | 1.91 | 1.77 |
| 40000 | 51.28 | 1.27 | 1.02 |
| 43500 | 56.16 | 1.23 | 1.24 |

*Typical Performance Curves*

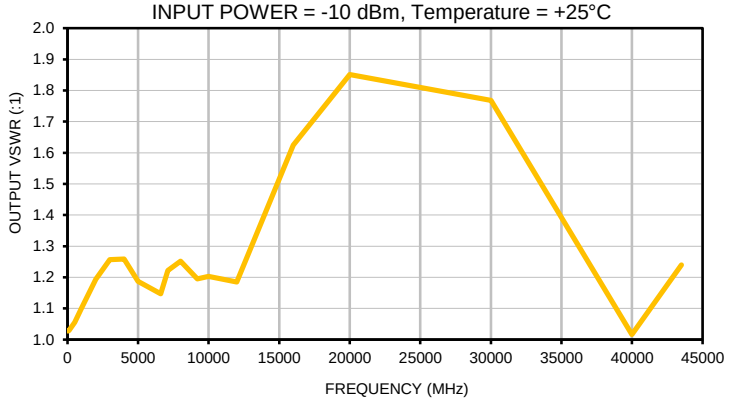
**INSERTION LOSS vs. FREQUENCY**
INPUT POWER = -10 dBm, Temperature = +25°C




**INPUT VSWR vs. FREQUENCY**
INPUT POWER = -10 dBm, Temperature = +25°C




**OUTPUT VSWR vs. FREQUENCY**
INPUT POWER = -10 dBm, Temperature = +25°C



Mini-Circuits

# Environmental Specifications ENV80

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 or -40° to 105° C or -55° to 105° C or -45° to 105° C<br>Ambient Environment | Refer to Individual Model Data Sheet |
| Storage Environment (Die) | -65° to 150°C | Individual Model Data Sheet |
| Storage Environment(Packaging) | -40° to 70°C and 40 to 60% humidity (In Factory Shipped Package) | |


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