

# Reflectionless Band Pass Filter Die

## XBF-D- Series

50Ω      15.5 to 20.5 GHz

### The Big Deal

- High Stopband rejection, up to 77 dB
- Patented design terminates stopband signals
- Stop band up to 40 GHz
- Excellent repeatability through IPD\* process



### Product Overview

Mini-Circuits' XBF-D-Series are GaAs MMIC reflectionless filters which includes 4-sections, giving you ultra-high rejection in the stopband – up to 77 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
Choice of BW 15.5 - 16.5 GHz 17.5 - 18.5 GHz 19.5 - 20.5 GHz	Three different models to cover the band XBF-163-D+ XBF-183-D+ XBF-24-D+
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 77 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 stop band; 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 pass band signals.
Excellent power handling in a tiny surface mount device up to 0.5W in passband	High power handling extends the usability of these filters to the transmit path for inter-stage filtering.
Unpackaged die	Enables the user to integrate the filter directly into hybrids
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



# Reflectionless Band Pass Filter Die

**XBF-163-D+**

**50Ω      15.5 to 16.5 GHz**

## Features

- Match to 50Ω in the stop band, eliminates undesired reflections
- Cascadable
- Excellent stopband rejection, 53 dB typ.
- Temperature stable, up to 105°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

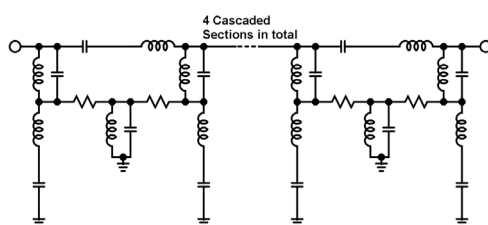
## Applications

- Transmitters & Receivers
- Harmonic Rejection
- Spurious Rejection

## General Description

Mini-Circuits' XBF-163-D+ four-section reflectionless filter Die 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.

## 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	L4	L5	H1	H2	H3	H4	H5	Thickness	Bond pad size
80	2370	2470	2570	2650	80	550	650	750	1300	100	78 X 78



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REV. OR  
M167791  
XBF-163-D+  
WP/RS/CP  
180802  
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Electrical Specifications<sup>1</sup> at 25°C

Parameter	F#	Frequency (MHz)	Min.	Typ.	Max.	Unit
Pass Band	Insertion Loss	F2-F3	15500 - 16500	4.2		dB
	VSWR	F2-F3	15500 - 16500	1.5		:1
Stop Band, Lower	Rejection	DC-F1	DC - 8000	77		dB
	VSWR	DC-F1	DC - 8000	1.2		:1
Stop Band, Upper	Rejection	F4-F5	24000 - 30000	53		dB
		F5-F6	30000 - 40000	49		dB
	VSWR	F4-F5	24000 - 30000	1.3		:1
		F5-F6	30000 - 40000	1.4		:1

<sup>1</sup> Measured on die using MPI titan series 100µm pitch GSG probe.

Absolute Maximum Ratings<sup>4</sup>

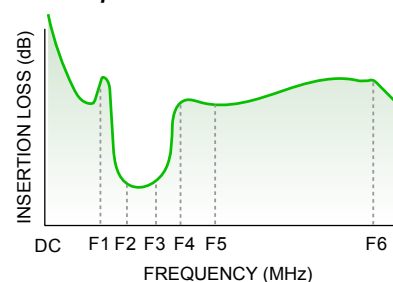
Parameter	Ratings
Operating Temperature	-55°C to +105°C
RF Power Input, Passband (F2-F3) <sup>2</sup>	0.5W at 25°C
RF Power Input, Stopband (DC-F2, F3-F6) <sup>3</sup>	0.16W at 25°C

<sup>2</sup> Passband rating derates linearly to 0.25W at 105°C ambient

<sup>3</sup> Stopband rating derates linearly to 0.08W at 105°C ambient

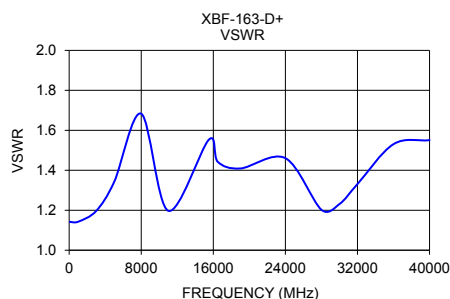
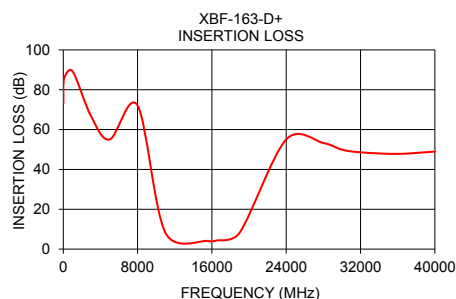
<sup>4</sup> Permanent damage may occur if any of these limits are exceeded.

Specification Definition

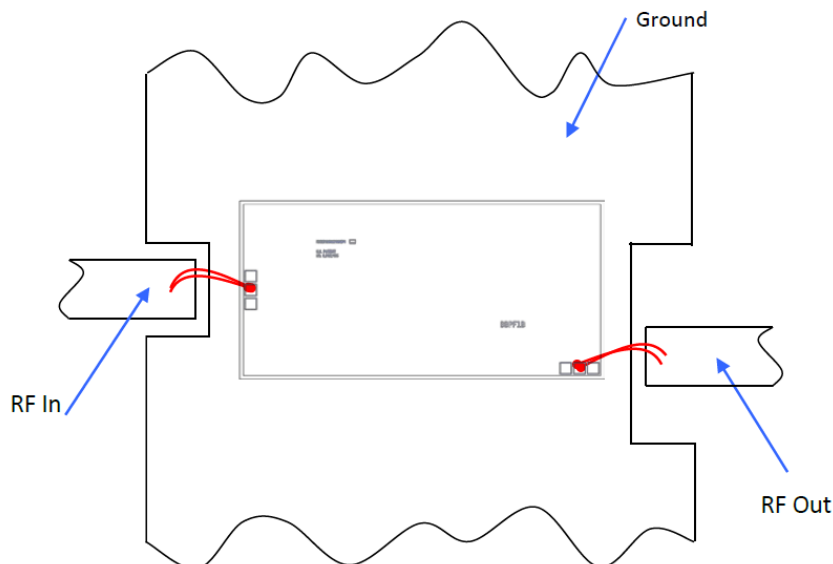


## Typical Performance Data at 25°C

Frequency (GHz)	Insertion Loss (dB)	VSWR (:1)
10	73.04	1.14
100	85.74	1.14
1000	89.27	1.14
3000	66.63	1.20
5000	55.03	1.34
8000	72.07	1.68
11000	8.17	1.20
15500	4.10	1.55
16500	4.34	1.44
19000	8.34	1.41
24000	55.06	1.46
28000	53.23	1.20
30000	49.92	1.23
32000	48.58	1.33
36000	47.80	1.53
40000	48.96	1.55



## 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 workstation. 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 manufacturer'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 <i>additional information is available on our dash board.</i>	
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	<p>Quantity, Package                      Model No.</p> <p>Small, Gel - Pak: 5,10,50,100 KGD*    XBF-163-DG+</p> <p>Medium†, Partial wafer: KGD*&lt;605    XBF-163-DP+</p> <p>†Available upon request contact sales representative</p> <p>Refer to <a href="#">AN-60-067</a></p>
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 1C (Pass 1000V) in accordance with ANSI/ESD STM 5.1 - 2001

\*\* Tested in industry standard MCLP 4x4mm, 24-lead package.

## Additional Notes

- 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.
- 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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# MMIC Reflectionless Band Pass Filter Die

# XBF-163-D+

## Typical Performance Data

Test Condition @ Temperature = +25°C

FREQ.	INSERTION LOSS	INPUT RETURN LOSS	OUTPUT RETURN LOSS
(MHz)	(dB)	(dB)	(dB)
10	73.04	23.57	25.44
50	86.78	23.56	25.40
100	85.74	23.57	25.42
200	86.90	23.58	25.44
300	85.99	23.60	25.45
400	88.82	23.61	25.46
500	92.74	23.61	25.46
600	88.80	23.60	25.44
700	90.09	23.59	25.42
800	89.84	23.58	25.38
900	96.34	23.55	25.32
1000	89.27	23.53	25.25
2000	78.59	22.69	23.77
3000	66.63	20.96	21.42
4000	59.30	18.81	19.02
5000	55.03	16.71	16.84
6000	54.97	14.63	14.89
7000	62.84	12.90	13.37
8000	72.07	11.88	12.76
9000	54.01	13.56	15.05
10000	20.67	30.72	25.20
11000	8.17	22.16	20.94
12000	5.23	19.45	21.16
13000	4.29	24.82	28.27
14000	3.97	22.68	19.54
15000	4.01	15.70	14.33
15500	4.10	14.34	13.29
15600	4.13	14.20	13.21
15700	4.15	14.15	13.17
15800	4.17	14.15	13.20
15900	4.19	14.25	13.26
16000	4.21	14.36	13.40
16100	4.23	14.57	13.57
16200	4.25	14.84	13.81
16300	4.28	15.20	14.09
16400	4.31	15.60	14.44
16500	4.34	16.17	14.85
17000	4.57	20.44	17.70
18000	5.75	17.78	16.23
19000	8.34	16.77	15.40
20000	14.28	18.67	16.89
21000	26.54	17.49	15.88
22000	45.76	14.81	13.92
23000	54.03	14.05	13.91
24000	55.06	14.55	15.06
25000	55.00	15.70	16.85
26000	52.77	17.25	18.93
27000	51.19	19.03	20.93
28000	53.23	20.73	21.71
29000	52.15	22.08	21.09
30000	49.92	22.25	19.70
31000	51.18	21.12	18.24
32000	48.58	19.69	16.95
33000	49.66	17.84	15.66
34000	49.20	15.37	13.96
35000	46.40	12.85	12.85
36000	47.80	13.57	14.37
37000	50.12	13.66	14.95
38000	50.57	13.48	15.31
39000	50.36	13.41	15.76
40000	48.96	13.32	16.29

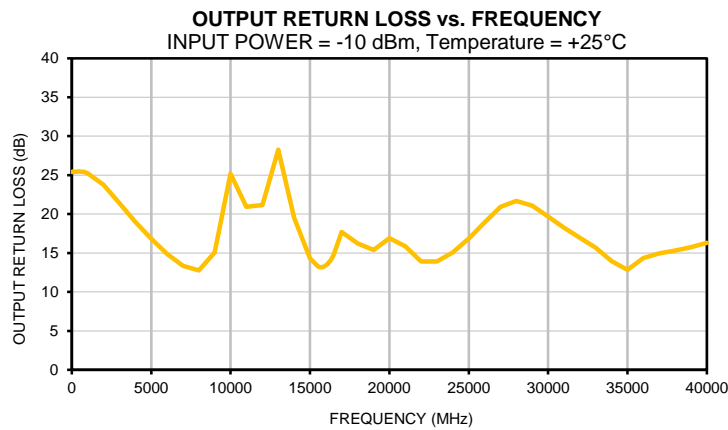
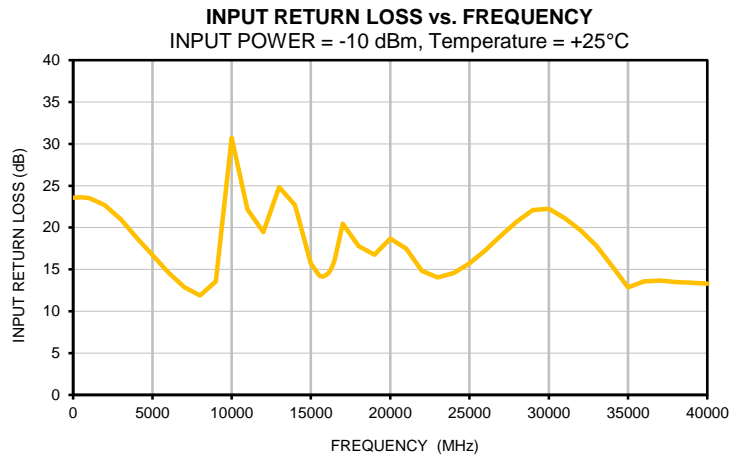
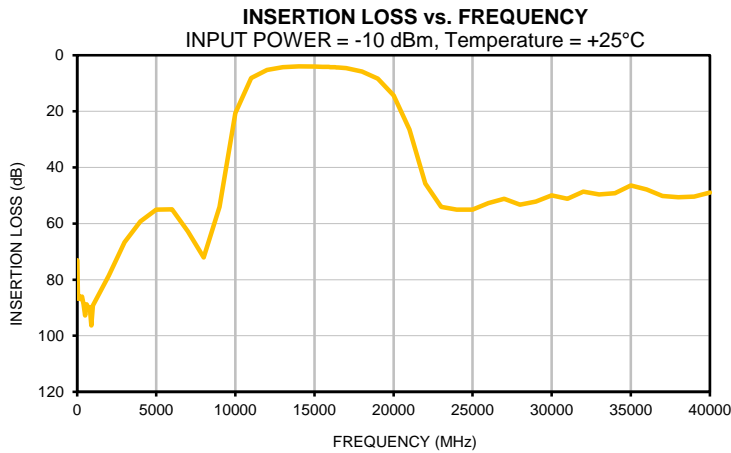


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The Design Engineers Search Engine Provides ACTUAL Data Instantly From MINI-CIRCUITS At: [www.minicircuits.com](http://www.minicircuits.com)

IF/RF MICROWAVE COMPONENTS

REV. OR  
XBF-163-D+  
8/21/2018  
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## Typical Performance Curves





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 Ambient Environment	Refer to Individual Model Data Sheet
Storage Environment	20° to 35° C and 40 to 60% humidity (In Factory Shipped Package)	Individual Model Data Sheet