NEW!
Two & Three
Section Models

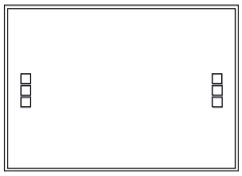
MMIC

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.

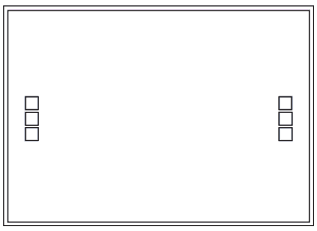
*IPD – Integrated Passive Device, is a GaAs semiconductor process

Reflectionless

Low Pass Filter Die

XLF-13H-D+

50Ω DC to 1000 MHz



Features

- Match to 50Ω in the stop band, eliminates undesired reflections
- Cascadable
- Excellent stopband rejection, 47 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

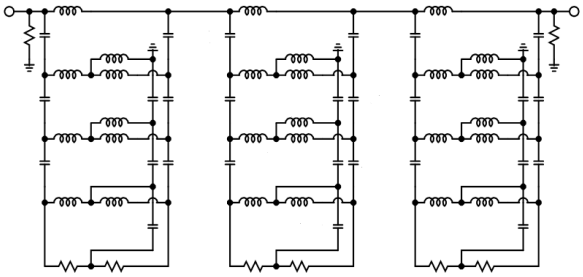
Applications

- Mobile
- ISM Applications
- TV broadcasting
- UHF radar

General Description

Mini-Circuits' XLF-13H-D+ three-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.

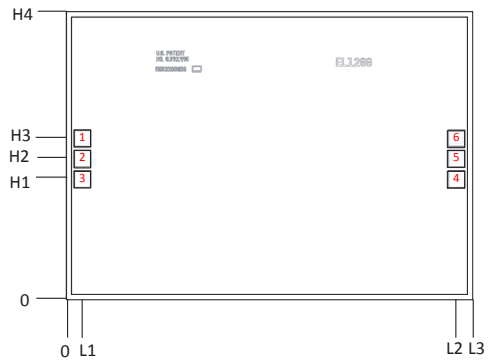
Simplified Schematic and Pad description



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	H1	H2	H3	H4	Thickness	Bond pad size
80	1920	2000	594	694	794	1420	100	78 x 78

Electrical Specifications[1] at 25°C

Parameter		F#	Frequency (MHz)	Min.	Typ.	Max.	Unit
Pass Band	Insertion Loss	DC - F1	DC - 1000	—	1.9	—	dB
	Frequency Cut-off	F2	1150	—	3.0	—	
	VSWR	DC - F1	DC - 1000	—	1.3	—	:1
Stop Band	Rejection	F3 - F3'	1850 - 2500	—	34	—	dB
		F3' - F4	2500 - 10000	—	47	—	
		F4 - F5	10000 - 19000	—	50	—	
	VSWR	F3 - F3'	1850 - 2500	—	1.4	—	:1
		F3' - F4	2500 - 10000	—	1.3	—	
		F4 - F5	10000 - 19000	—	2.1	—	

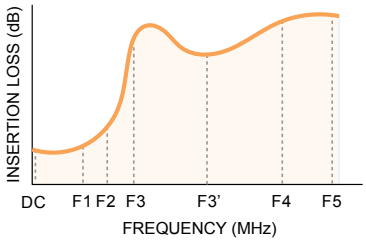
[1] Measured on Mini-Circuits Characterization Test Board. Die packaged in 4x4mm, 24-lead MCLP package and soldered on TB-952-13H+.

Absolute Maximum Ratings[1,4]

Parameter	Ratings
Operating Temperature	-55°C to +105°C
RF Power Input, Passband (DC-F1)[2]	7.9W at 25°C
RF Power Input, Stopband (F2-F5)[3]	1.58W at 25°C

[2] Passband rating derates linearly to 3.9W at 105°C ambient
[3] Stopband rating derates linearly to 0.75W at 105°C ambient
[4] Permanent damage may occur if any of these limits are exceeded.

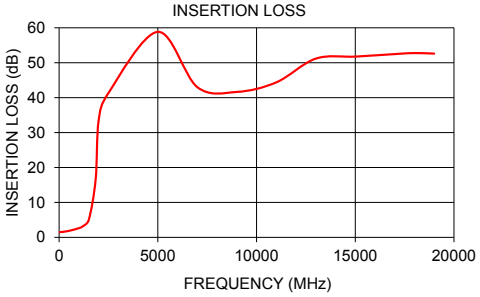
SPECIFICATION DEFINITION



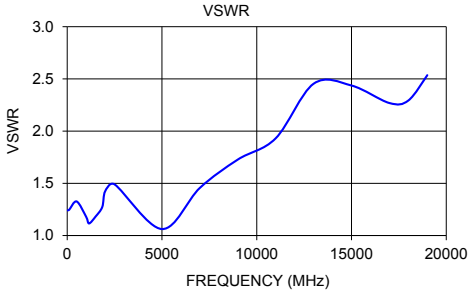
Typical Performance Data at 25°C[1]

Frequency (MHz)	Insertion Loss (dB)	VSWR (:1)
10	1.5	1.24
100	1.5	1.25
500	1.9	1.33
1000	2.6	1.18
1150	3.0	1.12
1500	5.0	1.18
1850	16.5	1.27
2000	33.4	1.42
2500	41.3	1.49
5000	58.8	1.06
7000	43.0	1.46
9000	41.6	1.73
11000	44.4	1.93
13000	51.2	2.45
15000	51.8	2.44
17000	52.5	2.27
18000	52.8	2.29
19000	52.6	2.54

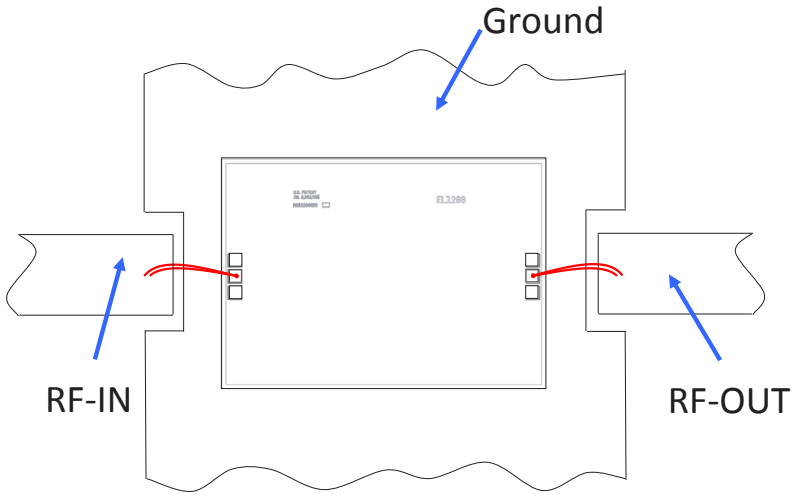
INSERTION LOSS



VSWR



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 *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. Small, Gel - Pak: 5,10,50,100 KGD* — XLF-13H-DG+ Medium†, Partial wafer: KGD*<400 — XLF-13H-DP+ †*Available upon request contact sales representative* 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 1B (500V) in accordance with ANSI/ESD STM 5.1 - 2001

** Tested in industry standard MCLP 4x4mm 24 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-13H-D+

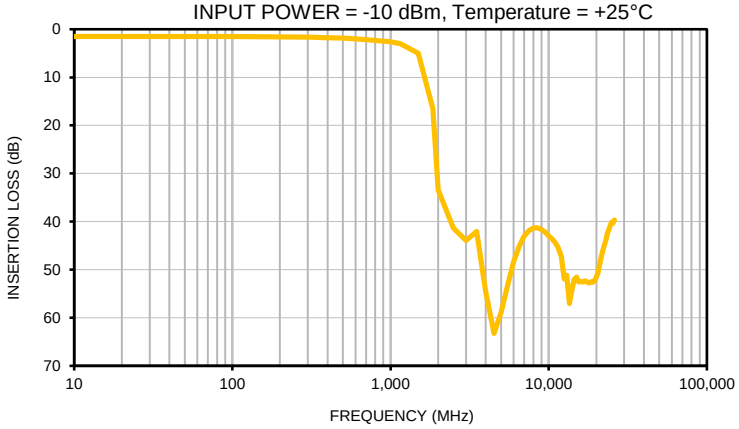
Typical Performance Data

FREQ. (MHz)	INSERTION LOSS (dB)	INPUT RETURN LOSS (dB)	OUTPUT RETURN LOSS (dB)
10	1.50	19.33	19.41
50	1.51	19.30	19.50
100	1.52	19.23	19.22
300	1.65	18.14	17.93
400	1.74	17.59	17.39
500	1.86	17.31	17.06
700	2.13	17.72	17.38
1000	2.63	21.91	21.70
1150	3.00	25.25	25.77
1500	4.98	21.77	21.56
1850	16.55	18.48	18.40
2000	33.39	15.16	15.37
2500	41.33	14.13	14.78
3000	43.95	16.25	17.23
3500	42.02	19.03	19.74
4000	54.52	22.91	22.99
4500	63.26	34.95	30.38
5000	58.85	30.44	34.57
5500	53.19	22.27	23.98
6000	48.40	18.55	19.29
6500	45.12	16.29	16.40
7000	42.99	14.79	14.62
7500	41.88	13.78	13.48
8000	41.37	13.07	12.63
8500	41.30	12.58	12.00
9000	41.64	12.08	11.48
9500	42.16	11.66	11.10
10000	42.93	11.17	10.81
10500	43.61	10.64	10.46
11000	44.38	9.96	10.05
11500	45.48	9.18	9.49
12000	47.26	8.28	8.87
12500	51.94	7.49	8.31
13000	51.18	7.52	8.80
13500	57.01	10.22	12.30
14000	54.19	8.75	10.56
14500	52.05	7.88	9.50
15000	51.52	7.58	9.12
15500	52.59	7.60	8.97
16000	52.42	7.80	9.00
16500	52.58	8.09	8.96
17000	52.29	8.22	8.85
17500	52.58	8.33	8.56
18000	52.77	8.29	8.12
18500	52.53	8.29	7.66
19000	52.61	8.14	7.24
19500	52.31	8.17	6.85
20000	51.49	8.05	6.51
20500	50.65	8.07	6.23
21000	48.99	7.69	6.05
21500	47.14	7.38	5.96
22000	45.94	6.68	5.97
22500	44.78	6.24	6.02
23000	43.71	5.55	6.11
23500	42.47	5.08	6.12
24000	41.65	4.71	6.14
24500	40.70	4.40	5.99
25000	40.14	4.16	5.81
25500	40.39	4.06	5.63
26000	39.68	4.01	5.54

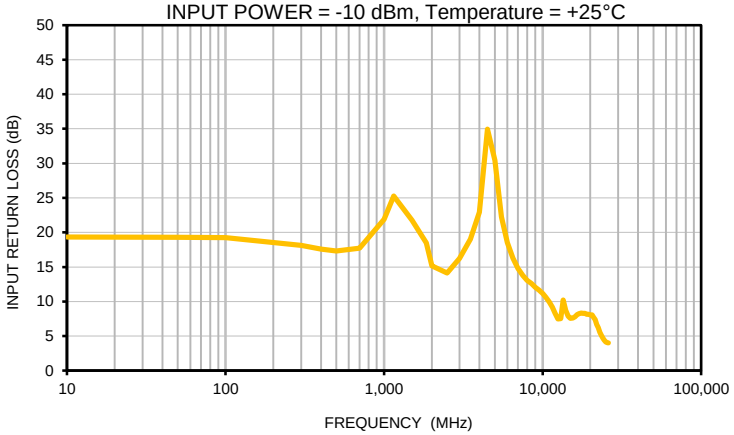
Note: ”Test data of Die packaged in industry standard 4x4mm, 24-lead MCLP package”

Typical Performance Curves

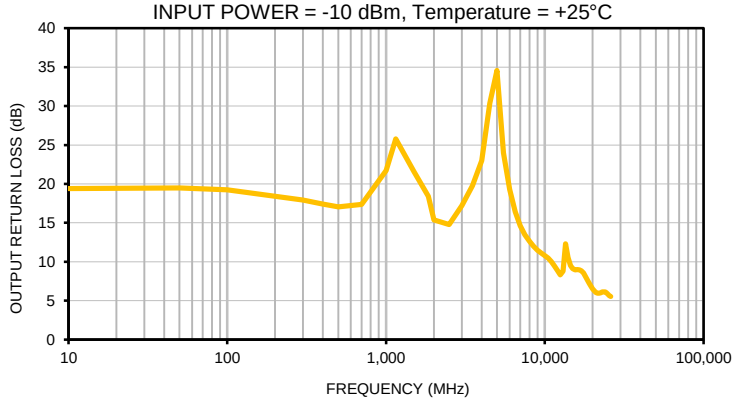
INSERTION LOSS vs. FREQUENCY
INPUT POWER = -10 dBm, Temperature = +25°C



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



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



Note: ”Test data of Die packaged in industry standard 4x4mm, 24-lead MCLP package”

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 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)	