

**NEW!**  
Two & Three  
Section Models

# MMIC REFLECTIONLESS FILTERS

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  
& 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 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/ 4x4 mm/ 5x5mm QFN	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.
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 High Pass Filter

## XHF-721M+

50Ω 700 to 5000 MHz

### Features

- Match to 50Ω in the stop band, eliminates undesired reflections
- Cascadable
- Good stopband rejection, 35 dB typ.
- Temperature stable, up to 105°C
- Small size, 5 x 5 mm
- Protected by US Patents 8,392,495; 9,705,467, additional patent pending
- Protected by China Patent 201080014266.1
- Protected by Taiwan Patent I581494



Generic photo used for illustration purposes only  
CASE STYLE: DG1847

### +RoHS Compliant

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

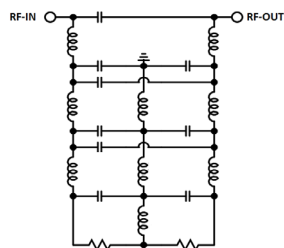
### Applications

- Cellular
- WiFi, WiMAX
- PCS, AWS, LTE B42/B43
- GPS

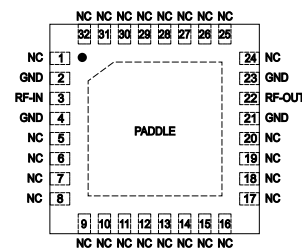
### General Description

Mini-Circuits' XHF-721M+ two-section 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.

### simplified schematic and pad description



(each section)



Function	Pad Number	Description
RF-IN	3	RF Input Pad
RF-OUT	22	RF Output Pad
GND	2,4,21,23	Connected to ground
NC (GND Externally)	1,5-20,24-32 & paddle	No internal connection



Electrical Specifications<sup>1</sup> at 25°C

Parameter	F#	Frequency (MHz)	Min.	Typ.	Max.	Unit
Stop Band	Rejection	DC - F'	DC - 300	28	35	—
		F' - F1	300 - 450	17	30	—
	Frequency Cut-off	F2	600	—	3.0	—
	VSWR	DC - F1	DC - 450	—	1.4	—
Pass Band	Insertion Loss	F3 - F5	700 - 5000	—	0.7	2.3
	VSWR	F3 - F4	700 - 2000	—	1.1	—
		F4 - F5	2000 - 5000	—	1.7	—

<sup>1</sup> Measured on Mini-Circuits Characterization Test Board TB-944-721M+

Absolute Maximum Ratings<sup>4</sup>

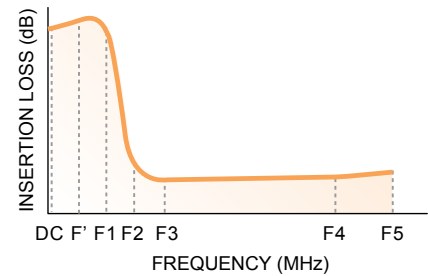
Parameter	Ratings
Operating Temperature	-55°C to +105°C
Storage Temperature	-65°C to +150°C
RF Power Input, Passband (F3-F5) <sup>2</sup>	32 dBm at 25°C
RF Power Input, Stopband (DC-F3) <sup>3</sup>	35 dBm at 25°C

<sup>2</sup> Passband rating derates linearly to 29 dBm at 105°C ambient

<sup>3</sup> Stopband rating derates linearly to 32 dBm at 105°C ambient

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

SPECIFICATION DEFINITION

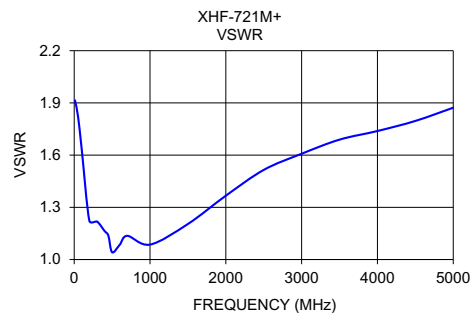
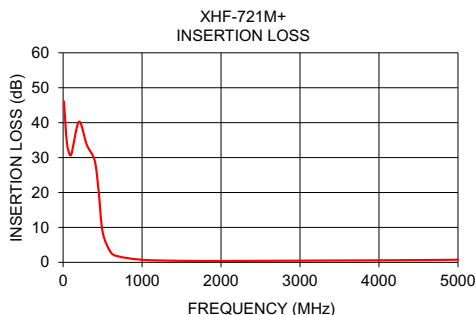


ESD rating

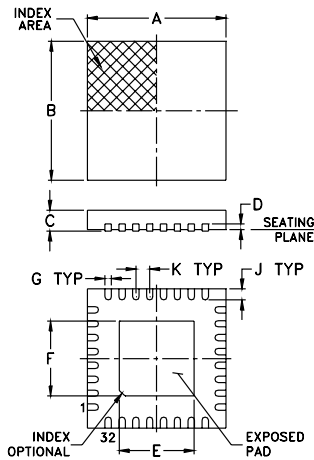
Human body model (HBM): Class 2(Pass 2000V) in accordance with ANSI/ESD 5.1-2001

Typical Performance Data at 25°C

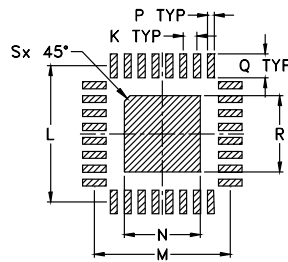
Frequency (MHz)	Insertion Loss (dB)	VSWR (:1)
10	46.11	1.91
50	33.91	1.82
100	30.74	1.63
200	40.26	1.22
300	33.64	1.22
400	29.11	1.16
450	20.33	1.14
500	8.78	1.04
600	3.01	1.08
700	1.71	1.14
1000	0.74	1.09
1500	0.44	1.20
2000	0.40	1.37
2500	0.44	1.51
3000	0.49	1.61
3500	0.54	1.69
4000	0.58	1.74
4500	0.65	1.80
5000	0.75	1.87



Outline Drawing

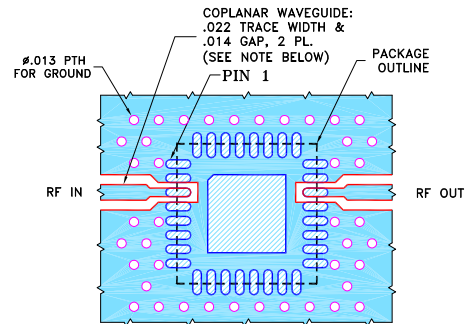


PCB Land Pattern



Suggested Layout, Tolerance to be within ±.002

Demo Board MCL P/N: TB-944-721M+  
Suggested PCB Layout: PL-518



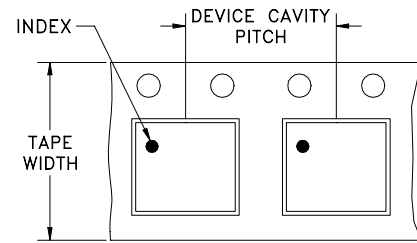
- NOTES:
- TRACE WIDTH & GAP ARE SHOWN FOR ROGERS R04350B WITH DIELECTRIC THICKNESS .010" ± .001"; COPPER: 1/2 OZ. EACH SIDE. FOR OTHER MATERIALS TRACE WIDTH MAY NEED TO BE MODIFIED.
  - BOTTOM SIDE OF THE PCB IS CONTINUOUS GROUND PLANE.
- DENOTES PCB COPPER LAYOUT WITH SMOBC (SOLDER MASK OVER BARE COPPER)
  - DENOTES COPPER LAND PATTERN FREE OF SOLDER MASK

Outline Dimensions ( inch / mm )

A	B	C MAX	C MIN	D	E	F	G	H	J
.197	.197	.039	.031	.008	.142	.142	.009	-	.016
5.00	5.00	0.99	0.79	0.20	3.61	3.61	0.23	-	0.41
K	L	M	N	P	Q	R	S		wt
.020	.193	.193	.110	.012	.035	.110	0.008		grams
0.51	4.90	4.90	2.79	0.30	0.89	2.79	0.20		0.05

Tape & Reel Packaging, F68

DEVICE ORIENTATION IN T&R



Product Marking



← black body  
← model family designation

Tape Width, mm	Device Cavity Pitch, mm	Reel Size, inches	Devices per Reel see note	
12	8	7	Small quantity standard	20
				50
				100
		13	Standard	500
				1000
				2000
			Standard	4000

Lead Finish: Matte-Tin