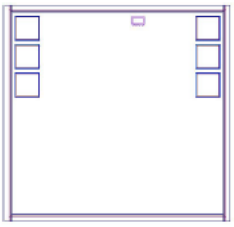
MMIC

REFLECTIONLESS FILTER DICE

50Ω DC to 21 GHz



X-Series

Available in Low Pass, High Pass and Band Pass designs

The Big Deal

- *Patented design eliminates in band spurs*
- *Pass band cut-off up to 21 GHz*
- *Stop band up to 35 GHz*
- *Excellent repeatability through IPD* process*
- *Unpackaged Die Form*

Product Overview

Mini-Circuits' X-Series reflectionless filters employ 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 which interact with neighboring components and often result in intermodulation 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 isolators, 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.
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	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
Unpackaged Die form	Enables direct integration into customer hybrids

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

Reflectionless

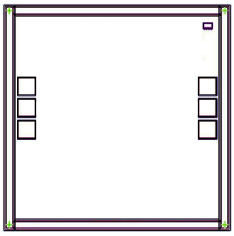
Low Pass Filter Die

XLF-151-D+

50Ω DC to 150 MHz

Features

- Match to 50Ω in the stop band, eliminates undesired reflections
- Cascadable
- Excellent Power handling
- Protected by US Patent No. 8,392,495



+RoHS Compliant

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

Ordering Information: Refer to Last Page

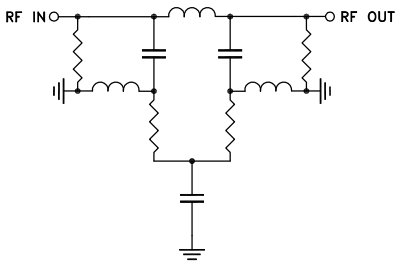
Applications

- Harmonics Rejection
- Wideband Matching
- Transmitters / Receivers

General Description

Mini-Circuits' XLF-151-D+ 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



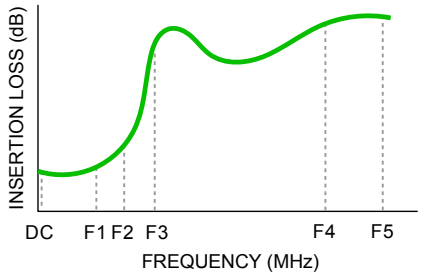
Pad	Description
RF-IN	RF Input Pad
RF-OUT	RF Output Pad
Ground	Ground Bonding Pad

Electrical Specifications[1] at 25°C

Parameter		F#	Frequency (MHz)	Min.	Typ.	Max.	Unit
Pass Band	Insertion Loss	DC - F1	DC - 150		1.4		dB
	Frequency Cut-off	F2	280		3.0		dB
	VSWR	DC - F1	DC - 150		1.2		:1
Stop Band	Rejection	F3 - F4	460 - 2800		15		dB
		F4 - F5	2800 - 16000		24		dB
	VSWR	F3 - F4	460 - 2800		1.2		:1
		F4 - F5	2800 -16000		1.8		:1

[1] Measured on Mini-Circuits Characterization test board. Die packaged in 3mm x 3mm, 12-lead MCLP package and soldered on TB-844-151+

Specification Definition



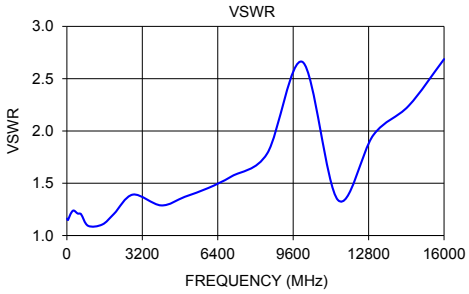
Absolute Maximum Ratings[1,4]

Parameter	Ratings
Operating Temperature	-55°C to +105°C
RF Power Input, Passband (DC-F1)[2]	2W at 25°C
RF Power Input, Stopband (F2-F5)[3]	0.5W at 25°C

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

Typical Performance Data at 25°C[1]

Frequency (MHz)	Insertion Loss (dB)	VSWR (:1)
10	1.15	1.16
50	1.12	1.15
150	1.35	1.20
280	2.87	1.24
460	15.82	1.21
600	19.41	1.20
900	14.77	1.09
1500	16.30	1.11
2000	17.70	1.21
2800	16.26	1.39
4000	31.30	1.29
5000	34.54	1.37
6000	31.72	1.45
7000	29.01	1.57
8500	25.30	1.79
10000	30.46	2.66
11500	17.55	1.34
13000	18.73	1.96
14500	18.43	2.24
16000	18.20	2.69



Die Layout

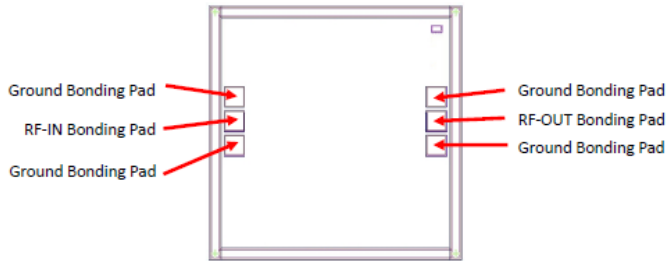


Fig 1. Die Layout

Bonding Pad Position

(Dimensions in µm, Typical)

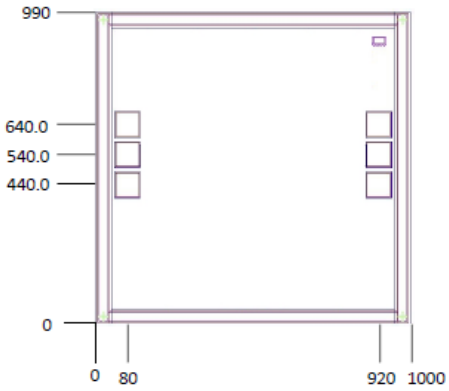


Fig 2. Bonding Pad Positions

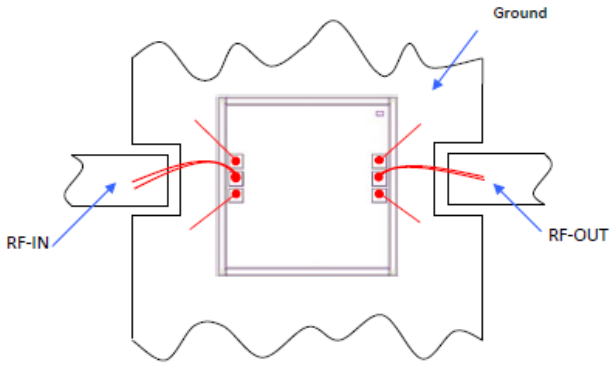
Critical Dimensions

Parameter	Values
Die Thickness, µm	100
Die Width, µm	1000
Die Length, µm	990
Bond Pad Size (Ground pad), µm	75 x 75

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.

Assembly Diagram



Recommended Wire Length, Typical

Wire	Wire Length (mm)	Wire Loop Height (mm)
All wires	1.0	0.15

Note: Use double bond wire at RF IN & RF OUT

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: 10,50,100 KGD* — XLF-151-DG+ Medium†, Partial wafer: KGD*<5K — XLF-151-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 according to Mini-Circuits inspection criteria. 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 (250V) 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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Typical Performance Data

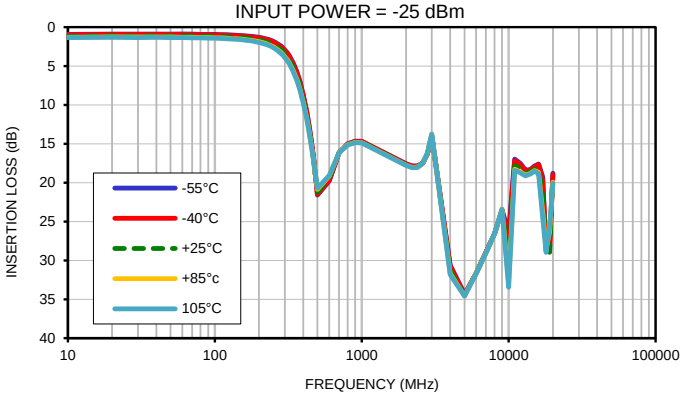
FREQ.	INSERTION LOSS					GROUP DELAY				
(MHz)	(dB)					(nsec)				
	@-55°C	@-40˚C	@+25˚C	@+85˚C	@+105°C	@-55°C	@-40˚C	@+25˚C	@+85˚C	@+105°C
10	0.95	0.98	1.18	1.31	1.34	0.65	0.69	0.68	0.69	0.70
20	0.88	0.95	1.12	1.25	1.31	0.65	0.68	0.68	0.69	0.70
30	0.90	0.95	1.14	1.28	1.33	0.65	0.68	0.68	0.68	0.69
40	0.90	0.93	1.13	1.27	1.31	0.65	0.68	0.68	0.68	0.69
50	0.90	0.95	1.14	1.27	1.33	0.66	0.67	0.67	0.68	0.69
60	0.88	0.94	1.11	1.29	1.33	0.66	0.67	0.67	0.68	0.69
70	0.91	0.95	1.14	1.31	1.37	0.67	0.67	0.67	0.68	0.68
80	0.92	0.97	1.16	1.33	1.37	0.68	0.67	0.67	0.68	0.68
90	0.93	0.98	1.18	1.34	1.40	0.68	0.68	0.68	0.69	0.69
100	0.94	1.00	1.20	1.37	1.42	0.69	0.69	0.69	0.70	0.70
110	0.97	1.02	1.23	1.40	1.46	0.69	0.69	0.69	0.70	0.71
120	0.98	1.04	1.25	1.43	1.50	0.71	0.71	0.71	0.71	0.72
130	1.02	1.07	1.29	1.47	1.53	0.72	0.72	0.72	0.73	0.73
140	1.04	1.09	1.31	1.50	1.56	0.73	0.73	0.73	0.74	0.74
150	1.07	1.12	1.35	1.54	1.61	0.75	0.75	0.74	0.75	0.75
160	1.11	1.17	1.40	1.60	1.68	0.76	0.76	0.76	0.76	0.77
180	1.19	1.25	1.51	1.72	1.80	0.80	0.80	0.80	0.80	0.80
200	1.30	1.37	1.64	1.88	1.96	0.85	0.84	0.84	0.84	0.84
210	1.37	1.44	1.74	1.97	2.07	0.87	0.87	0.86	0.86	0.85
220	1.47	1.54	1.84	2.09	2.19	0.90	0.89	0.88	0.88	0.88
230	1.57	1.65	1.96	2.23	2.32	0.92	0.92	0.90	0.90	0.89
240	1.69	1.77	2.09	2.37	2.47	0.94	0.94	0.92	0.92	0.91
250	1.82	1.89	2.25	2.54	2.64	0.98	0.97	0.95	0.94	0.94
260	1.99	2.06	2.42	2.73	2.84	1.00	0.99	0.97	0.96	0.95
270	2.18	2.26	2.64	2.96	3.07	1.03	1.02	1.00	0.98	0.97
280	2.39	2.49	2.88	3.21	3.33	1.05	1.04	1.01	0.99	0.98
290	2.64	2.73	3.14	3.48	3.60	1.07	1.06	1.03	1.00	0.99
300	2.94	3.03	3.46	3.82	3.93	1.09	1.08	1.04	1.01	1.00
310	3.26	3.36	3.79	4.17	4.29	1.10	1.09	1.05	1.01	1.00
320	3.64	3.74	4.18	4.56	4.69	1.11	1.10	1.05	1.01	1.00
330	4.04	4.16	4.61	5.01	5.13	1.11	1.10	1.04	1.00	0.98
340	4.53	4.64	5.10	5.50	5.63	1.10	1.09	1.03	0.98	0.96
350	5.06	5.17	5.65	6.04	6.18	1.08	1.07	1.01	0.96	0.94
360	5.67	5.77	6.24	6.65	6.79	1.06	1.04	0.97	0.92	0.90
370	6.33	6.44	6.90	7.32	7.45	1.02	1.00	0.93	0.87	0.85
380	7.04	7.16	7.63	8.03	8.16	0.97	0.95	0.88	0.81	0.79
390	7.85	7.96	8.42	8.81	8.94	0.90	0.89	0.80	0.73	0.71
400	8.70	8.82	9.28	9.65	9.76	0.83	0.81	0.72	0.64	0.62
410	9.63	9.73	10.18	10.54	10.66	0.73	0.71	0.61	0.53	0.50
420	10.63	10.74	11.16	11.51	11.61	0.60	0.58	0.47	0.39	0.36
430	11.71	11.82	12.22	12.53	12.63	0.45	0.42	0.31	0.22	0.20
440	12.87	12.98	13.34	13.61	13.71	0.26	0.23	0.11	0.02	-0.01
450	14.11	14.22	14.55	14.78	14.84	0.01	-0.02	-0.14	-0.23	-0.24
460	15.44	15.52	15.81	15.97	16.04	-0.31	-0.34	-0.45	-0.51	-0.52
470	16.90	16.94	17.13	17.24	17.25	-0.69	-0.71	-0.78	-0.80	-0.80
480	18.37	18.46	18.52	18.48	18.47	-1.10	-1.10	-1.11	-1.09	-1.08
490	19.97	19.98	19.91	19.72	19.62	-1.49	-1.48	-1.42	-1.35	-1.33
500	21.58	21.53	21.21	20.86	20.72	-1.79	-1.77	-1.66	-1.56	-1.52
600	19.79	19.72	19.42	19.17	19.10	-0.85	-0.83	-0.76	-0.70	-0.69
700	16.17	16.19	16.17	16.16	16.17	0.13	0.12	0.11	0.10	0.09
800	15.01	15.03	15.09	15.13	15.14	0.18	0.18	0.17	0.17	0.17
900	14.66	14.69	14.77	14.82	14.85	0.17	0.17	0.17	0.16	0.17
1000	14.67	14.70	14.78	14.86	14.89	0.15	0.15	0.15	0.15	0.15
2000	17.58	17.59	17.71	17.77	17.80	0.09	0.09	0.09	0.09	0.10
2200	17.86	17.87	17.99	18.03	18.07	0.09	0.09	0.09	0.09	0.10
2400	17.88	17.90	17.97	18.00	18.03	0.10	0.10	0.10	0.11	0.11
2600	17.46	17.46	17.51	17.50	17.49	0.12	0.13	0.13	0.14	0.14
2800	16.31	16.31	16.28	16.19	16.17	0.18	0.19	0.20	0.23	0.24
3000	13.93	13.92	13.85	13.76	13.77	0.40	0.41	0.47	0.53	0.54
4000	30.61	30.75	31.32	31.69	31.82	0.04	0.04	0.06	0.05	0.07
5000	34.34	34.41	34.45	34.59	34.60	0.04	0.06	0.04	0.05	0.05
6000	31.72	31.65	31.60	31.66	31.69	0.05	0.06	0.04	0.04	0.05
7000	28.98	28.96	29.00	29.08	29.09	0.03	0.04	0.04	0.03	0.04
8000	26.58	26.55	26.63	26.62	26.57	0.03	0.05	0.04	0.05	0.05
9000	23.54	23.50	23.49	23.42	23.43	0.09	0.10	0.11	0.13	0.14
10000	26.39	27.18	30.40	32.81	33.44	0.32	0.28	0.11	0.01	0.04
11000	16.99	17.16	17.81	18.26	18.40	0.58	0.55	0.44	0.37	0.35
12000	17.53	17.66	18.20	18.62	18.74	0.11	0.11	0.10	0.09	0.10
13000	18.37	18.45	18.76	19.03	19.13	0.06	0.06	0.05	0.05	0.06
14000	18.35	18.39	18.61	18.82	18.90	0.05	0.06	0.05	0.06	0.06
15000	17.88	17.94	18.25	18.44	18.52	0.07	0.07	0.06	0.07	0.08
16000	17.58	17.69	18.17	18.66	18.87	0.09	0.10	0.10	0.11	0.11
17000	19.22	19.60	21.64	23.69	24.38	0.19	0.19	0.15	0.09	0.06
18000	28.70	28.36	28.00	28.49	28.99	0.00	0.03	0.12	0.19	0.22
19000	28.23	28.95	28.93	26.42	25.83	0.80	0.75	0.45	0.27	0.25
20000	18.79	18.96	19.52	19.93	20.09	0.20	0.19	0.16	0.13	0.13

Typical Performance Data

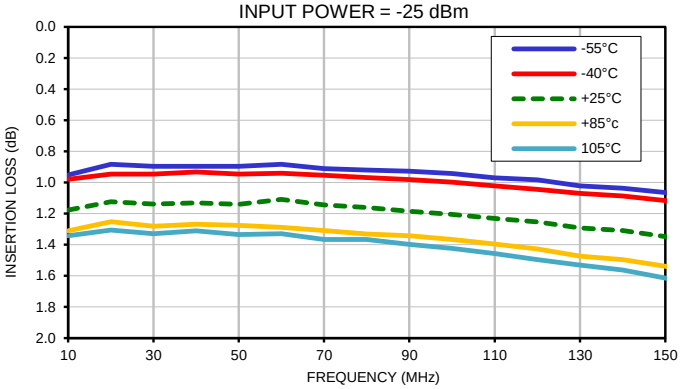
FREQ.	INPUT RETURN LOSS					OUTPUT RETURN LOSS				
(MHz)	(dB)					(dB)				
	@-55°C	@-40°C	@+25°C	@+85°C	@+105°C	@-55°C	@-40°C	@+25°C	@+85°C	@+105°C
10	25.60	24.90	22.74	21.18	20.60	26.85	26.38	23.77	21.83	21.28
20	26.90	26.42	23.65	21.88	21.42	27.41	26.34	23.71	22.00	21.36
30	27.28	26.48	23.91	21.95	21.41	26.96	26.24	23.63	21.84	21.25
40	26.70	26.13	23.62	21.76	21.18	26.07	25.46	23.24	21.46	20.96
50	26.11	25.45	23.21	21.46	20.96	26.19	25.59	23.29	21.56	21.04
60	25.73	25.17	23.15	21.47	20.95	25.66	25.05	22.85	21.28	20.74
70	25.26	24.64	22.87	21.23	20.76	25.17	24.74	22.83	21.22	20.69
80	24.88	24.38	22.60	21.15	20.69	24.78	24.46	22.66	21.17	20.70
90	24.29	23.84	22.30	20.90	20.50	24.40	23.93	22.37	20.99	20.52
100	23.86	23.54	22.06	20.69	20.30	23.91	23.54	22.01	20.69	20.26
110	23.35	23.04	21.73	20.45	20.06	23.57	23.21	21.72	20.46	20.09
120	23.16	22.85	21.51	20.38	19.99	23.32	23.00	21.56	20.37	20.03
130	22.79	22.50	21.21	20.15	19.73	22.69	22.31	21.06	20.04	19.61
140	22.56	22.22	21.01	19.96	19.59	22.48	22.16	20.90	19.87	19.54
150	22.21	21.85	20.78	19.73	19.47	22.01	21.76	20.58	19.60	19.29
160	21.75	21.46	20.32	19.46	19.18	21.73	21.45	20.24	19.43	19.17
180	21.29	21.04	19.94	19.12	18.89	21.17	20.86	19.82	19.09	18.87
200	20.73	20.53	19.51	18.81	18.60	20.65	20.43	19.41	18.80	18.58
210	20.61	20.37	19.38	18.73	18.56	20.45	20.22	19.28	18.69	18.47
220	20.30	20.12	19.22	18.57	18.43	20.28	20.08	19.16	18.59	18.46
230	20.24	20.08	19.16	18.65	18.43	20.21	20.00	19.11	18.61	18.45
240	20.01	19.90	19.09	18.60	18.39	19.93	19.81	19.00	18.50	18.34
250	19.97	19.78	19.02	18.54	18.42	19.95	19.80	19.01	18.62	18.46
260	20.00	19.91	19.13	18.67	18.55	19.90	19.77	19.05	18.66	18.55
270	19.95	19.86	19.19	18.76	18.61	19.95	19.83	19.22	18.75	18.64
280	20.10	20.02	19.42	18.98	18.86	20.09	19.98	19.31	18.97	18.81
290	20.42	20.28	19.69	19.28	19.15	20.22	20.17	19.51	19.16	19.08
300	20.49	20.38	19.80	19.44	19.31	20.51	20.40	19.78	19.44	19.36
310	20.79	20.71	20.11	19.74	19.64	20.91	20.76	20.09	19.75	19.71
320	21.21	21.09	20.53	20.13	20.01	21.31	21.14	20.50	20.11	19.97
330	21.63	21.54	20.93	20.47	20.35	21.73	21.54	20.88	20.45	20.38
340	22.14	21.97	21.37	20.90	20.80	22.23	22.00	21.30	20.86	20.74
350	22.56	22.39	21.76	21.23	21.07	22.53	22.39	21.59	21.10	21.02
360	22.86	22.63	21.99	21.46	21.31	22.78	22.63	21.85	21.37	21.25
370	23.01	22.80	22.13	21.61	21.45	22.86	22.71	21.97	21.47	21.35
380	22.95	22.77	22.10	21.66	21.48	22.84	22.66	21.94	21.50	21.36
390	22.81	22.68	22.00	21.59	21.47	22.63	22.52	21.84	21.46	21.32
400	22.55	22.46	21.85	21.44	21.33	22.42	22.28	21.67	21.36	21.22
410	22.22	22.13	21.61	21.29	21.17	22.07	21.95	21.42	21.18	21.08
420	21.81	21.71	21.30	21.03	20.92	21.71	21.67	21.19	20.92	20.83
430	21.50	21.45	21.06	20.83	20.75	21.36	21.27	20.90	20.68	20.67
440	21.18	21.19	20.82	20.62	20.54	21.11	21.02	20.70	20.53	20.49
450	21.00	20.94	20.64	20.47	20.39	20.85	20.81	20.46	20.35	20.31
460	20.73	20.71	20.41	20.29	20.22	20.65	20.60	20.33	20.22	20.19
470	20.57	20.52	20.26	20.19	20.08	20.45	20.44	20.18	20.04	20.00
480	20.44	20.44	20.15	20.06	20.03	20.38	20.33	20.08	19.99	19.96
490	20.38	20.35	20.07	20.00	19.97	20.25	20.26	19.98	19.89	19.86
500	20.29	20.27	20.02	19.96	19.93	20.21	20.17	19.93	19.87	19.84
600	20.71	20.73	20.62	20.53	20.49	20.90	20.89	20.64	20.54	20.49
700	22.34	22.34	22.26	22.00	21.97	22.42	22.44	22.30	22.06	22.03
800	24.57	24.65	24.46	24.07	23.97	24.36	24.42	24.45	24.05	23.92
900	27.26	27.29	27.14	26.43	26.25	26.86	26.97	26.90	26.27	26.04
1000	30.55	30.52	29.94	28.72	28.48	30.35	30.33	29.81	28.69	28.32
2000	20.79	20.80	20.54	20.44	20.41	20.70	20.65	20.43	20.24	20.21
2200	19.11	19.11	19.08	19.00	19.00	19.41	19.37	19.20	19.11	19.09
2400	17.76	17.77	17.92	17.87	17.86	18.14	18.12	18.03	18.11	18.10
2600	16.64	16.66	16.75	16.73	16.73	17.10	17.09	17.03	17.11	17.09
2800	15.70	15.71	15.71	15.76	15.78	16.05	16.01	15.91	15.96	15.95
3000	14.87	14.91	15.00	15.25	15.32	14.79	14.78	14.77	14.97	15.04
4000	17.75	17.82	18.01	18.39	18.49	18.14	18.14	18.02	18.44	18.51
5000	16.30	16.30	16.14	15.92	15.91	15.78	15.78	15.83	15.63	15.59
6000	14.70	14.70	14.66	14.54	14.51	13.96	13.98	14.24	14.07	14.05
7000	13.09	13.10	13.13	13.10	13.14	13.05	13.08	13.24	13.39	13.45
8000	12.16	12.17	12.30	12.32	12.28	12.33	12.33	12.31	12.28	12.26
9000	9.12	9.15	9.30	9.15	9.12	9.49	9.49	9.37	9.15	9.06
10000	6.74	6.78	6.85	7.08	7.21	7.12	7.11	6.95	7.15	7.26
11000	10.61	10.94	12.36	13.28	13.49	11.17	11.48	12.81	13.89	14.20
12000	14.37	14.15	13.37	12.55	12.24	15.01	14.73	13.47	12.71	12.48
13000	9.82	9.83	9.82	9.39	9.24	10.14	10.12	10.32	9.90	9.74
14000	8.44	8.48	8.65	8.66	8.67	8.15	8.20	8.57	8.61	8.67
15000	7.79	7.86	8.07	8.33	8.45	7.03	7.10	7.43	7.77	7.92
16000	6.28	6.37	6.84	7.04	7.10	6.08	6.17	6.65	6.87	6.91
17000	4.46	4.61	5.18	5.63	5.79	5.47	5.62	6.13	6.60	6.75
18000	4.29	4.52	5.41	6.25	6.52	6.09	6.33	6.98	8.12	8.51
19000	6.12	6.41	7.92	8.07	8.18	8.71	8.78	8.94	9.38	9.55
20000	9.89	9.86	9.51	9.09	8.89	9.63	9.67	9.63	9.18	8.98

Typical Performance Curves

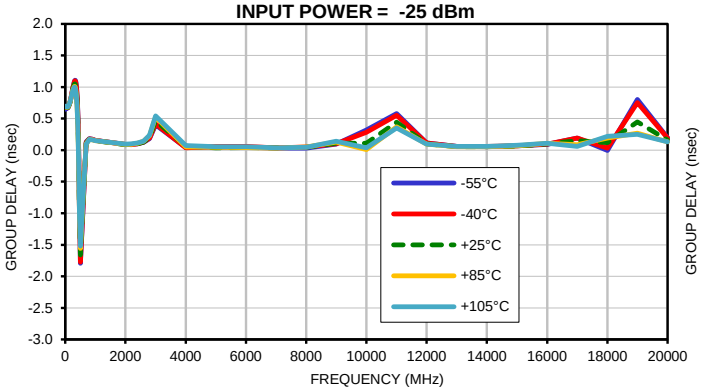
INSERTION LOSS vs. TEMPERATURE (Full band)
INPUT POWER = -25 dBm



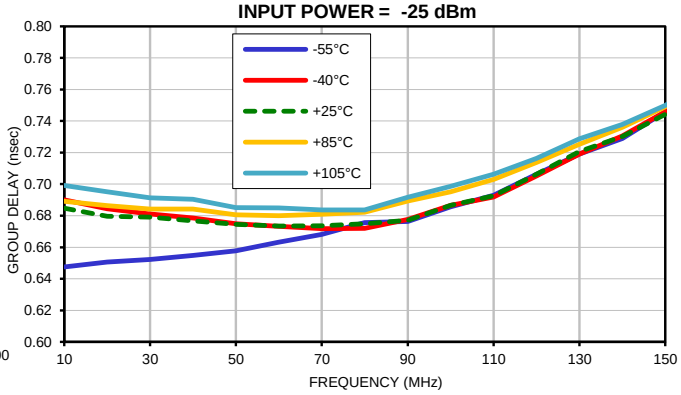
INSERTION LOSS vs. TEMPERATURE (Pass band)
INPUT POWER = -25 dBm



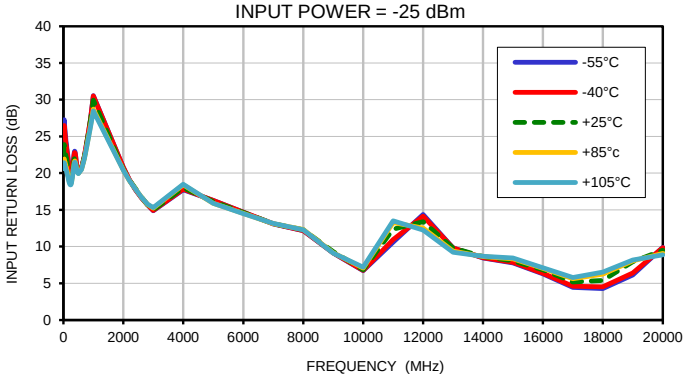
GROUP DELAY vs. TEMPERATURE (Full band)
INPUT POWER = -25 dBm



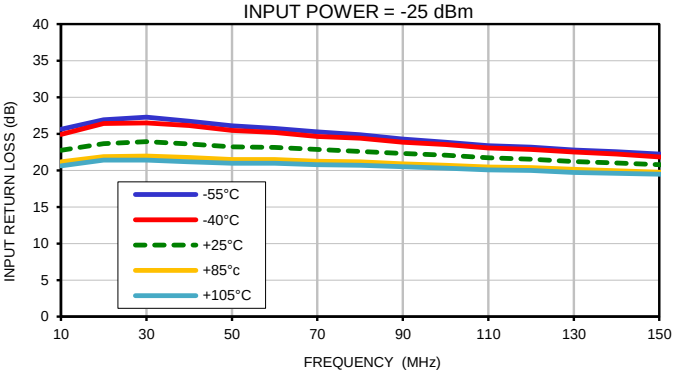
GROUP DELAY vs. TEMPERATURE (Pass band)
INPUT POWER = -25 dBm



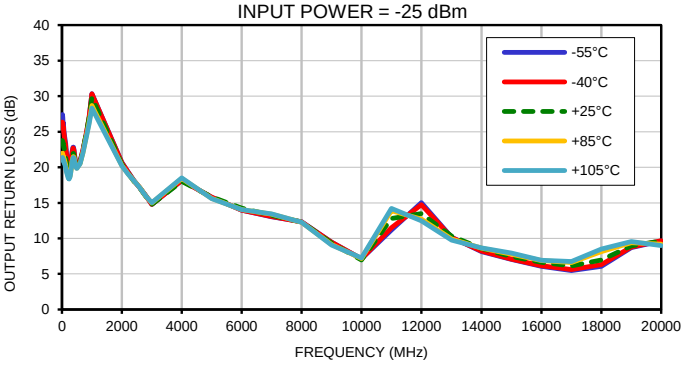
INPUT RETURN LOSS vs. TEMPERATURE (Full band)
INPUT POWER = -25 dBm



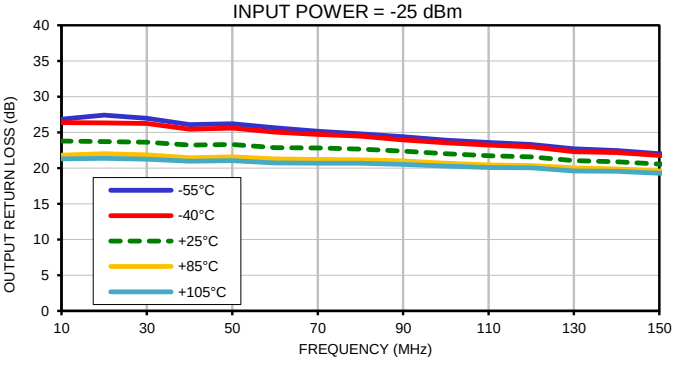
INPUT RETURN LOSS vs. TEMPERATURE (Pass band)
INPUT POWER = -25 dBm



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



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



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)	