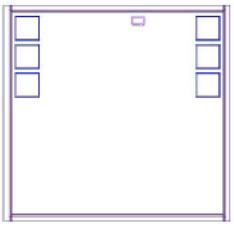
MMIC

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

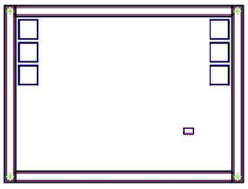
Low Pass Filter Die

XLF-63-D+

50Ω DC to 6000 MHz

Features

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



Applications

- Harmonics Rejection
- Satellite
- Radar
- Military & Space

+RoHS Compliant

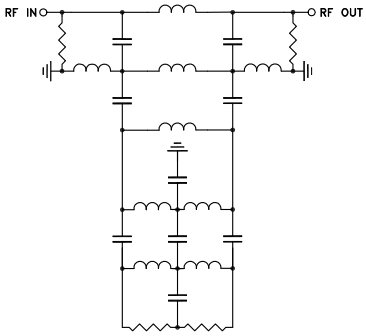
The +Suffix identifies RoHS Compliance. See our web site for RoHS Compliance methodologies and qualifications

Ordering Information: Refer to Last Page

General Description

Mini-Circuits' XLF-63-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



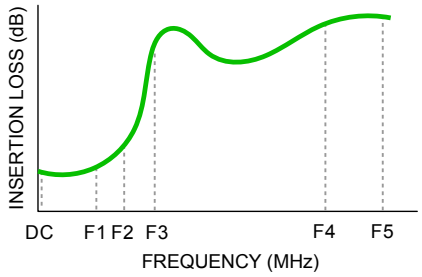
Pad	Description
RF-IN	RF Input Pad
RF-OUT	RF Output Pad
Ground	Ground Bonding Pad

Electrical Specifications[1] at 25°C

Parameter		F#	Frequency (MHz)	Min.	Typ.	Max.	Unit
Pass Band	Insertion Loss	DC - F1	DC-6000		1.3		dB
	Frequency Cut-off	F2	8100		3.0		dB
	VSWR	DC - F1	DC-6000		1.3		:1
Stop Band	Rejection	F3 - F5	9600 - 17800		15		dB
	VSWR	F3 - F5	9600 - 17800		1.5		:1

[1] Measured on Mini-Circuits Characterization test board. Die packaged in 3mm x 3mm, 12-lead MCLP package and soldered on TB-844-63+

Specification Definition



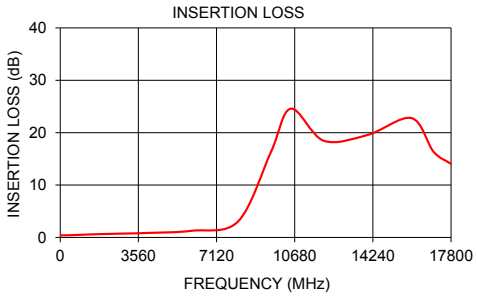
Absolute Maximum Ratings[1,4]

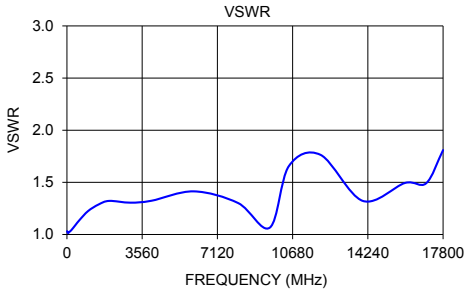
Parameter	Ratings
Operating Temperature	-55°C to +105°C
RF Power Input, Passband (DC-F1)[2]	2W at 25°C
RF Power Input, Stopband (F2-F5)[3]	150mW at 25°C

[2] Passband rating derates linearly to 1W at 105°C ambient
[3] Stopband rating derates linearly to 75mW 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	0.44	1.03
50	0.41	1.01
100	0.41	1.02
200	0.41	1.04
400	0.43	1.09
600	0.46	1.14
1000	0.52	1.22
1500	0.60	1.29
2000	0.66	1.32
3000	0.76	1.31
4000	0.87	1.32
6000	1.28	1.41
8100	3.06	1.30
9600	16.34	1.07
10500	24.58	1.66
12000	18.46	1.76
14000	19.57	1.32
16000	22.78	1.49
17000	16.37	1.49
17800	14.04	1.81





Die Layout

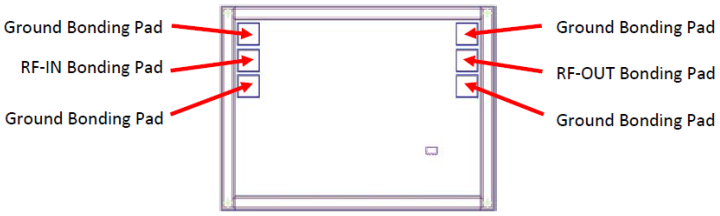


Fig 1. Die Layout

Bonding Pad Position

(Dimensions in µm, Typical)

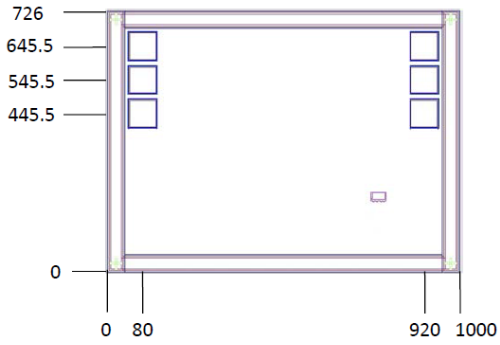


Fig 2. Bonding Pad Positions

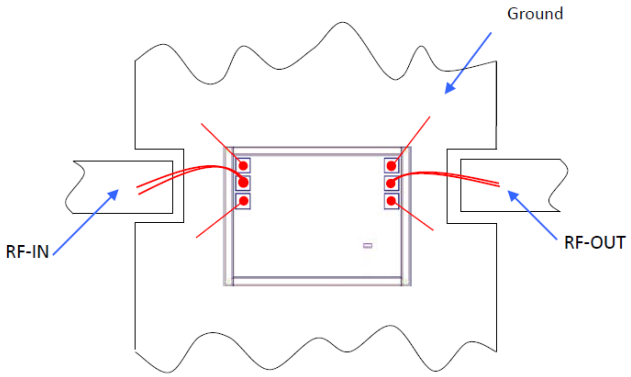
Critical Dimensions

Parameter	Values
Die Thickness, µm	100
Die Width, µm	1000
Die Length, µm	726
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-63-DG+ Medium†, Partial wafer: KGD*<1745 — XLF-63-DP+ †*Available upon request contact sales representative* Refer to AN-60-067
Environmental Ratings	ENV-80

*Known Good Dice ("KGD") means that the dice in question have been subjected to Mini-Circuits DC test performance criteria and measurement instructions and that the parametric data of such dice fall within a predefined range. While DC testing 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.

B. 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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Typical Performance Data

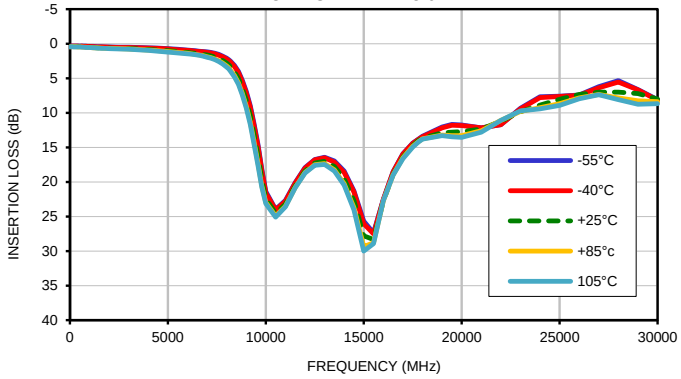
FREQ.	INSERTION LOSS					GROUP DELAY				
(MHz)	(dB)					(nsec)				
	@-55°C	@-40˚C	@+25˚C	@+85˚C	@+105°C	@-55°C	@-40˚C	@+25˚C	@+85˚C	@+105°C
10	0.39	0.41	0.42	0.45	0.46	0.10	0.16	0.12	0.14	0.12
50	0.35	0.35	0.40	0.42	0.43	0.08	0.10	0.08	0.09	0.08
100	0.35	0.35	0.41	0.43	0.44	0.06	0.06	0.06	0.06	0.06
200	0.34	0.35	0.41	0.44	0.45	0.06	0.06	0.05	0.06	0.06
300	0.34	0.36	0.43	0.44	0.46	0.06	0.06	0.06	0.05	0.06
400	0.33	0.35	0.41	0.46	0.46	0.06	0.06	0.05	0.05	0.05
500	0.34	0.36	0.44	0.47	0.48	0.06	0.06	0.05	0.05	0.05
600	0.34	0.36	0.45	0.48	0.50	0.06	0.06	0.05	0.05	0.05
700	0.36	0.38	0.47	0.51	0.52	0.06	0.06	0.05	0.05	0.05
800	0.36	0.38	0.48	0.51	0.54	0.06	0.06	0.05	0.05	0.05
900	0.37	0.39	0.50	0.53	0.55	0.06	0.05	0.05	0.05	0.05
1000	0.37	0.39	0.51	0.54	0.56	0.06	0.06	0.05	0.05	0.05
1200	0.40	0.42	0.54	0.58	0.60	0.05	0.05	0.05	0.05	0.05
1400	0.42	0.45	0.57	0.61	0.63	0.05	0.05	0.05	0.05	0.05
1600	0.44	0.47	0.60	0.64	0.66	0.05	0.05	0.05	0.05	0.05
1800	0.45	0.48	0.62	0.67	0.68	0.06	0.06	0.05	0.05	0.05
2000	0.47	0.50	0.64	0.68	0.70	0.05	0.05	0.05	0.05	0.05
2500	0.51	0.54	0.70	0.73	0.76	0.06	0.06	0.05	0.05	0.05
3000	0.52	0.56	0.73	0.77	0.80	0.06	0.06	0.05	0.05	0.05
3500	0.55	0.58	0.78	0.83	0.87	0.06	0.06	0.05	0.05	0.05
4000	0.58	0.63	0.84	0.92	0.96	0.06	0.06	0.06	0.06	0.06
4500	0.64	0.68	0.94	1.02	1.07	0.06	0.06	0.06	0.06	0.06
5000	0.72	0.77	1.03	1.14	1.20	0.07	0.07	0.06	0.06	0.06
5500	0.81	0.86	1.14	1.26	1.32	0.07	0.07	0.07	0.07	0.07
6000	0.91	0.97	1.26	1.40	1.45	0.08	0.08	0.08	0.08	0.07
6200	0.96	1.03	1.32	1.46	1.52	0.08	0.08	0.08	0.08	0.08
6400	1.01	1.08	1.39	1.54	1.60	0.09	0.09	0.08	0.08	0.08
6600	1.08	1.15	1.47	1.63	1.69	0.09	0.09	0.09	0.09	0.09
6800	1.11	1.19	1.54	1.73	1.80	0.10	0.10	0.09	0.09	0.09
7000	1.18	1.26	1.65	1.86	1.95	0.10	0.10	0.10	0.10	0.10
7200	1.27	1.36	1.77	2.01	2.11	0.11	0.11	0.11	0.11	0.11
7400	1.39	1.49	1.94	2.21	2.32	0.12	0.12	0.12	0.12	0.12
7600	1.55	1.66	2.16	2.46	2.58	0.13	0.13	0.13	0.13	0.13
7800	1.78	1.89	2.43	2.78	2.92	0.14	0.14	0.14	0.14	0.14
8000	2.08	2.20	2.80	3.21	3.37	0.16	0.16	0.15	0.15	0.15
8100	2.28	2.41	3.05	3.47	3.64	0.16	0.16	0.16	0.16	0.16
8200	2.51	2.65	3.32	3.79	3.96	0.17	0.17	0.17	0.17	0.17
8400	3.13	3.29	4.04	4.58	4.78	0.19	0.19	0.18	0.18	0.18
8600	4.00	4.19	5.04	5.68	5.90	0.20	0.20	0.20	0.19	0.19
8800	5.24	5.45	6.41	7.14	7.40	0.21	0.21	0.20	0.20	0.19
9000	6.88	7.12	8.19	9.02	9.32	0.21	0.21	0.20	0.19	0.19
9200	8.95	9.23	10.42	11.36	11.69	0.21	0.20	0.19	0.18	0.17
9400	11.53	11.83	13.14	14.16	14.52	0.19	0.19	0.17	0.15	0.14
9600	14.63	14.94	16.32	17.36	17.69	0.15	0.14	0.11	0.09	0.09
9800	18.13	18.40	19.63	20.55	20.77	0.06	0.06	0.04	0.02	0.02
10000	21.38	21.58	22.43	22.95	23.15	-0.01	-0.02	0.00	0.02	0.03
10500	23.96	24.06	24.55	24.94	25.10	0.16	0.16	0.20	0.21	0.22
11000	22.69	22.78	23.23	23.49	23.58	0.25	0.26	0.25	0.25	0.24
11500	20.11	20.16	20.59	20.78	20.84	0.20	0.20	0.18	0.18	0.17
12000	17.93	17.99	18.42	18.65	18.71	0.17	0.16	0.14	0.14	0.14
12500	16.74	16.79	17.25	17.50	17.58	0.14	0.14	0.13	0.12	0.12
13000	16.43	16.52	17.01	17.34	17.48	0.12	0.13	0.12	0.12	0.12
13500	16.97	17.12	17.78	18.26	18.42	0.14	0.13	0.12	0.11	0.12
14000	18.43	18.63	19.54	20.25	20.48	0.14	0.14	0.13	0.13	0.12
14500	21.29	21.49	22.72	23.74	24.06	0.18	0.17	0.17	0.16	0.17
15000	25.67	26.06	27.81	29.35	30.01	0.31	0.31	0.35	0.42	0.42
15500	27.37	27.52	28.33	28.80	28.91	0.43	0.43	0.41	0.37	0.39
16000	22.50	22.56	22.76	22.73	22.74	0.20	0.20	0.17	0.15	0.15
16500	18.50	18.54	18.89	18.98	19.01	0.13	0.13	0.12	0.11	0.11
17000	15.93	15.95	16.37	16.51	16.64	0.12	0.11	0.09	0.09	0.09
17500	14.39	14.44	14.71	14.85	14.97	0.09	0.09	0.08	0.08	0.08
17800	13.79	13.86	14.01	14.17	14.21	0.08	0.08	0.08	0.08	0.08
18000	13.38	13.45	13.66	13.78	13.82	0.07	0.07	0.08	0.08	0.08
19000	12.03	12.16	12.90	13.22	13.32	0.07	0.06	0.05	0.05	0.05
19500	11.68	11.81	12.82	13.29	13.49	0.06	0.06	0.04	0.03	0.03
20000	11.75	11.83	12.71	13.28	13.55	0.05	0.05	0.04	0.02	0.02
21000	12.19	12.16	12.36	12.58	12.80	0.03	0.03	0.01	0.02	0.01
22000	11.73	11.72	11.22	11.11	11.10	0.02	0.01	0.02	0.04	0.05
23000	9.33	9.45	9.83	9.78	9.72	0.06	0.05	0.04	0.05	0.06
24000	7.69	7.82	8.87	9.28	9.44	0.05	0.05	0.04	0.04	0.03
25000	7.60	7.63	8.04	8.68	8.94	0.05	0.05	0.04	0.04	0.04
26000	7.41	7.45	7.34	7.84	7.96	0.03	0.03	0.05	0.05	0.05
27000	6.23	6.39	6.99	7.33	7.39	0.06	0.06	0.05	0.06	0.07
28000	5.34	5.54	6.99	7.85	8.09	0.09	0.09	0.05	0.05	0.05
29000	6.61	6.69	7.24	8.24	8.74	0.05	0.05	0.05	0.04	0.03
30000	8.08	8.19	8.01	8.40	8.69	0.03	0.03	0.05	0.05	0.05

Typical Performance Data

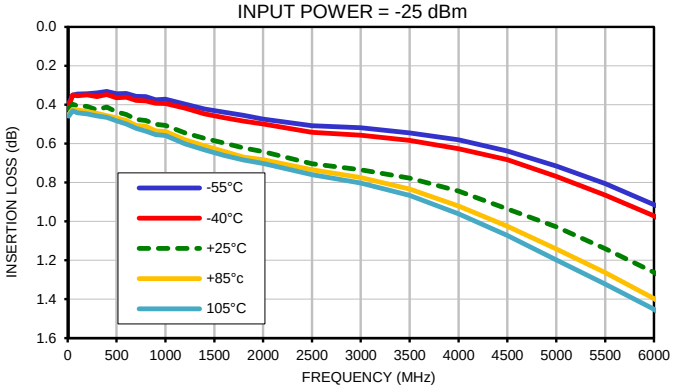
FREQ.	INPUT RETURN LOSS					OUTPUT RETURN LOSS				
(MHz)	(dB)					(dB)				
	@-55°C	@-40°C	@+25°C	@+85°C	@+105°C	@-55°C	@-40°C	@+25°C	@+85°C	@+105°C
10	33.75	33.74	35.42	37.12	37.00	38.59	39.01	42.70	48.03	47.18
50	37.05	37.85	42.75	47.46	52.69	36.13	36.87	40.06	42.05	41.74
100	35.37	35.70	38.89	41.10	42.07	36.44	36.70	38.74	38.84	38.78
200	35.25	34.96	34.15	33.62	33.46	34.06	34.03	33.49	32.36	31.82
300	30.54	30.38	30.06	30.18	30.12	30.88	30.66	30.55	30.15	29.99
400	27.92	27.87	27.13	27.29	27.16	28.02	27.72	27.34	26.93	26.85
500	26.00	25.87	25.25	25.15	25.01	26.27	26.09	25.66	25.21	25.03
600	24.60	24.54	23.72	23.81	23.78	24.81	24.72	24.02	23.77	23.71
700	23.37	23.21	22.43	22.44	22.35	23.42	23.29	22.60	22.31	22.27
800	22.11	22.04	21.38	21.27	21.18	22.16	22.05	21.44	21.18	21.05
900	21.23	21.17	20.64	20.57	20.57	21.21	21.16	20.62	20.47	20.45
1000	20.52	20.44	19.95	19.83	19.82	20.38	20.30	19.74	19.64	19.61
1200	19.29	19.22	18.94	18.75	18.74	19.12	19.08	18.62	18.58	18.60
1400	18.19	18.18	18.14	17.89	17.87	18.10	18.10	17.87	17.83	17.79
1600	17.67	17.71	17.80	17.61	17.59	17.50	17.53	17.50	17.48	17.48
1800	17.11	17.14	17.41	17.27	17.28	16.98	17.05	17.26	17.21	17.22
2000	16.75	16.81	17.13	17.16	17.18	16.71	16.77	17.22	17.19	17.20
2500	16.76	16.84	17.06	17.44	17.51	16.65	16.73	17.33	17.41	17.49
3000	17.19	17.26	17.57	17.80	17.86	17.02	17.10	17.51	17.79	17.91
3500	17.44	17.50	17.84	17.68	17.66	17.26	17.34	17.59	17.72	17.72
4000	17.24	17.29	17.11	16.79	16.66	17.06	17.11	17.16	16.76	16.63
4500	16.42	16.42	16.06	15.70	15.56	16.17	16.22	16.24	15.65	15.50
5000	15.46	15.48	15.37	15.10	14.97	15.12	15.20	15.39	15.06	14.90
5500	14.70	14.77	15.09	15.16	15.16	14.28	14.41	14.99	15.12	15.05
6000	14.48	14.57	15.33	15.86	16.05	14.02	14.19	15.39	15.95	16.13
6200	14.59	14.71	15.55	16.20	16.46	14.11	14.25	15.62	16.32	16.63
6400	14.86	14.98	15.87	16.56	16.83	14.44	14.60	15.99	16.80	17.13
6600	15.31	15.41	16.32	16.91	17.14	14.94	15.10	16.51	17.25	17.59
6800	16.15	16.19	16.75	17.14	17.30	15.48	15.56	16.71	17.29	17.49
7000	16.78	16.84	17.08	17.26	17.30	16.32	16.35	17.00	17.40	17.52
7200	17.33	17.33	17.30	17.35	17.31	16.85	16.82	17.00	17.21	17.17
7400	17.79	17.78	17.47	17.44	17.35	17.34	17.26	16.90	16.89	16.76
7600	17.65	17.67	17.54	17.47	17.36	17.71	17.62	16.93	16.74	16.58
7800	17.36	17.47	17.59	17.61	17.53	17.46	17.35	16.60	16.35	16.16
8000	16.96	17.13	17.61	17.78	17.76	17.42	17.34	16.56	16.26	16.02
8100	16.69	16.88	17.59	17.90	17.98	17.17	17.20	16.62	16.38	16.23
8200	16.56	16.76	17.66	18.08	18.22	16.75	16.80	16.49	16.32	16.20
8400	16.46	16.65	17.71	18.35	18.57	16.04	16.15	16.30	16.33	16.33
8600	16.35	16.55	17.56	18.29	18.56	15.66	15.83	16.44	16.59	16.59
8800	16.22	16.43	17.35	18.15	18.45	14.71	14.96	16.40	17.14	17.43
9000	16.42	16.63	17.42	18.40	18.79	14.48	14.79	17.01	18.37	19.02
9200	17.27	17.54	18.54	19.93	20.44	15.26	15.76	19.04	21.59	22.87
9400	19.54	19.97	21.72	23.70	24.51	17.72	18.41	23.38	28.76	32.10
9600	24.66	25.44	29.77	35.40	38.31	25.62	27.20	40.12	32.27	29.45
9800	27.22	27.31	26.82	25.45	24.93	28.54	27.43	23.90	21.81	21.13
10000	19.55	19.48	19.16	18.75	18.57	17.85	17.73	17.81	17.32	17.28
10500	12.08	12.10	12.16	12.20	12.22	10.59	10.71	11.87	12.48	12.81
11000	9.65	9.72	10.00	10.14	10.19	9.31	9.41	10.21	10.71	10.95
11500	9.29	9.40	9.89	10.15	10.24	10.03	10.16	10.32	10.48	10.51
12000	10.17	10.35	11.15	11.67	11.84	10.77	11.09	11.73	11.92	11.88
12500	12.13	12.41	13.65	14.81	15.25	11.17	11.67	13.93	14.95	15.11
13000	15.29	15.64	17.40	19.71	20.63	12.03	12.56	16.41	19.56	21.14
13500	17.96	18.24	19.50	20.48	20.69	14.92	15.23	17.42	18.76	19.18
14000	17.15	17.19	17.16	16.92	16.87	20.86	20.19	16.64	15.55	15.04
14500	15.02	15.05	14.99	14.72	14.63	16.73	16.92	15.89	14.75	14.16
15000	13.67	13.75	13.96	13.89	13.88	12.96	13.42	16.26	16.65	16.49
15500	13.06	13.18	13.59	13.74	13.82	12.18	12.62	16.56	19.54	21.22
16000	13.27	13.42	14.05	14.52	14.70	14.25	14.57	15.95	16.87	17.18
16500	13.57	13.73	14.49	15.33	15.62	17.25	17.22	14.41	13.21	12.66
17000	13.08	13.20	14.10	14.70	14.88	11.89	12.11	12.48	11.67	11.16
17500	11.58	11.65	12.21	12.50	12.54	8.16	8.37	10.48	10.93	10.90
17800	10.49	10.54	10.80	10.92	10.96	6.74	6.91	9.20	10.42	10.87
18000	9.70	9.72	9.87	9.86	9.88	6.59	6.72	8.68	9.94	10.58
19000	6.41	6.45	6.51	6.40	6.41	6.36	6.23	5.72	5.89	6.03
19500	5.36	5.44	5.60	5.64	5.69	5.92	5.84	4.82	4.62	4.56
20000	4.63	4.73	5.11	5.18	5.23	4.44	4.56	4.28	4.06	3.92
21000	4.12	4.21	5.18	4.90	4.99	2.55	2.82	4.39	4.61	4.47
22000	4.51	4.56	5.00	5.14	5.24	2.68	2.89	5.12	6.88	7.59
23000	5.10	5.19	5.64	6.06	6.25	5.35	5.40	6.15	7.55	8.55
24000	5.50	5.60	6.30	7.30	7.56	8.25	8.45	6.45	5.78	5.62
25000	6.57	6.64	6.74	7.33	7.20	4.54	4.99	7.01	6.40	5.88
26000	6.43	6.57	7.23	7.24	6.81	3.47	3.79	7.78	9.44	9.28
27000	6.77	6.87	7.63	7.81	7.95	6.12	6.15	7.78	9.94	11.44
28000	8.82	8.65	7.50	7.59	7.81	12.06	11.60	6.56	5.39	5.13
29000	6.37	6.41	6.38	6.05	5.80	3.78	4.01	5.42	4.49	4.00
30000	3.88	3.96	4.71	4.78	4.72	1.94	2.02	4.37	5.56	5.42

Typical Performance Curves

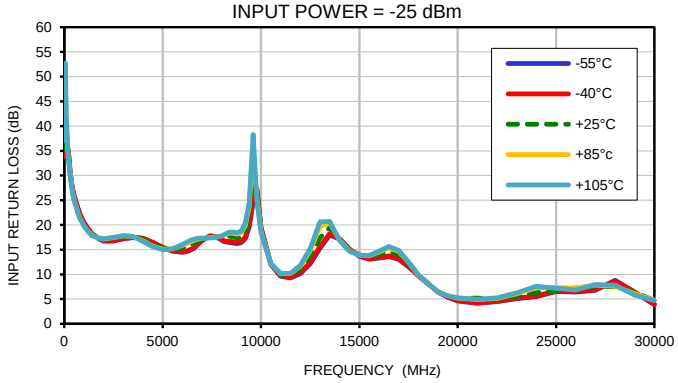
INSERTION LOSS vs. TEMPERATURE (Full band)
INPUT POWER = -25 dBm



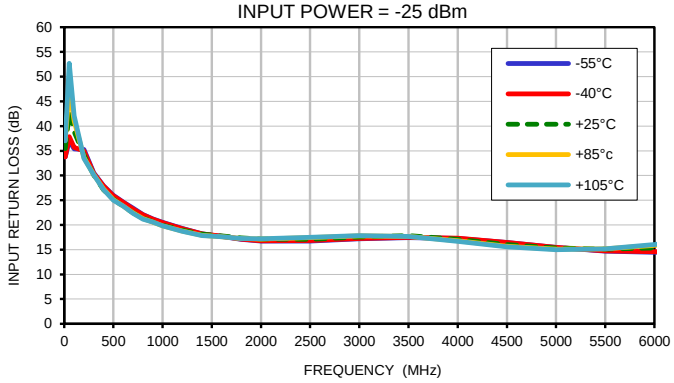
INSERTION LOSS vs. TEMPERATURE (Pass band)
INPUT POWER = -25 dBm



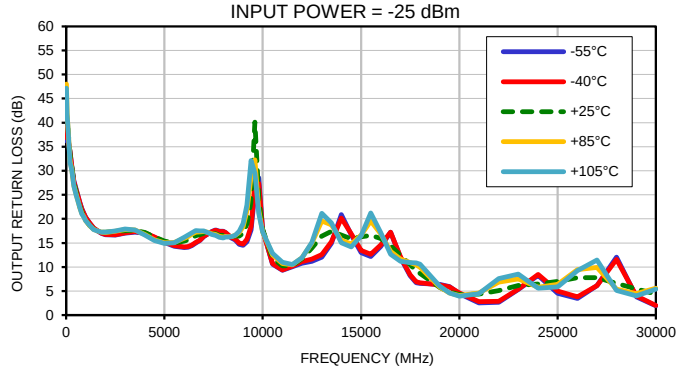
INPUT RETURN LOSS vs. TEMPERATURE (Full band)
INPUT POWER = -25 dBm



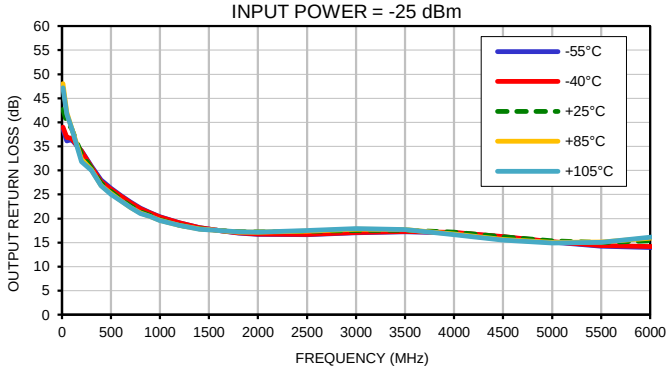
INPUT RETURN LOSS vs. TEMPERATURE (Pass band)
INPUT POWER = -25 dBm



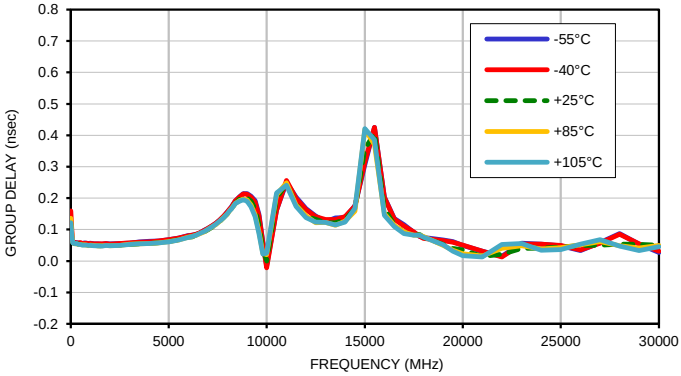
OUTPUT RETURN LOSS vs. TEMPERATURE (Full band)
INPUT POWER = -25 dBm



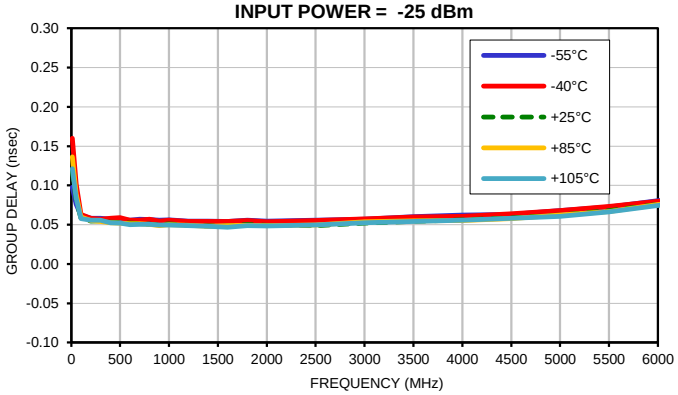
OUTPUT RETURN LOSS vs. TEMPERATURE (Pass band)
INPUT POWER = -25 dBm



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



GROUP DELAY vs. TEMPERATURE (Passband)
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)	