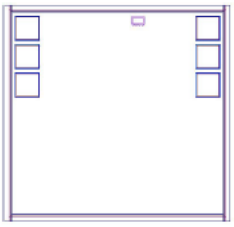
MMIC

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

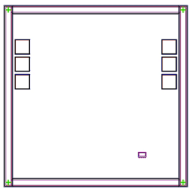
Bandpass Filter Die

XBF-282-D+

50Ω 2350 to 3150 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

- Wi-Fi
- WiMax
- Bluetooth
- Satellite

+RoHS Compliant

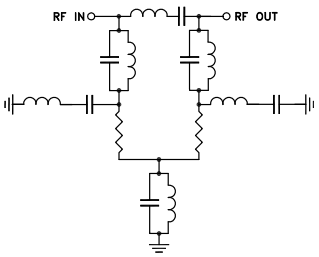
The +Suffix identifies RoHS Compliance. See our web site for RoHS Compliance methodologies and qualifications

Ordering Information: Refer to Last Page

General Description

Mini-Circuits' XBF-282-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	F2-F3	2350 - 3150		3.2		dB
	VSWR	F2-F3	2350 - 3150		1.2		:1
Stop Band, Lower	Rejection	DC-F1	DC - 1810		15		dB
	VSWR	DC-F1	DC - 1810		1.2		:1
Stop Band, Upper	Rejection	F4-F5	3800 - 9500		15		dB
		F5-F6	9500 - 20000		20		
	VSWR	F4-F5	3800 - 9500		1.2		:1
		F5-F6	9500 - 20000		1.5		

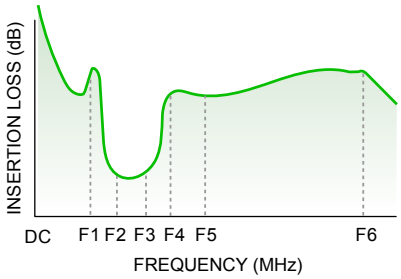
[1] Measured on Mini-Circuits Characterization test board. Die packaged in 3mm x 3mm, 12-lead MCLP package and soldered on TB-844-282B+

Absolute Maximum Ratings[1,4]

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

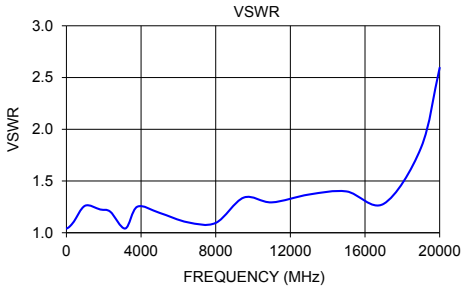
[2] Passband rating derates linearly to 1W at 105°C ambient
[3] Stopband rating derates linearly to 0.25W at 105°C ambient
[4] Permanent damage may occur if any of these limits are exceeded.

Specification Definition



Typical Performance Data at 25°C[1]

Frequency (MHz)	Insertion Loss (dB)	VSWR (:1)
10	44.12	1.04
50	39.26	1.04
100	35.00	1.05
200	29.51	1.07
400	23.66	1.11
1000	16.34	1.26
1810	16.16	1.23
2350	2.50	1.20
3150	3.10	1.04
3800	15.35	1.25
5000	15.22	1.19
6500	17.66	1.10
8000	19.49	1.10
9500	17.03	1.34
11000	20.26	1.29
13000	22.61	1.37
15000	20.73	1.40
17000	18.99	1.28
19000	18.32	1.82
20000	18.66	2.59



Die Layout

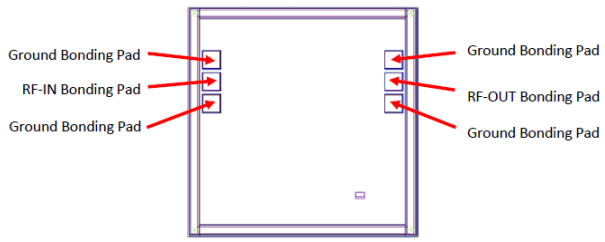


Fig 1. Die Layout

Bonding Pad Position

(Dimensions in µm, Typical)

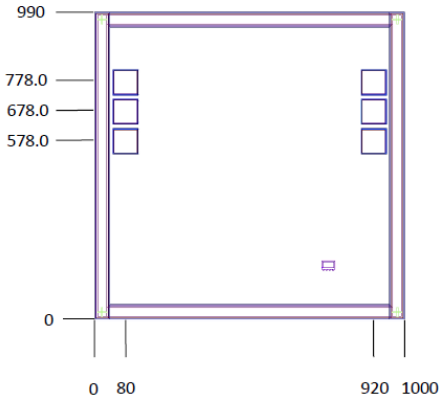


Fig 2. Bonding Pad Positions

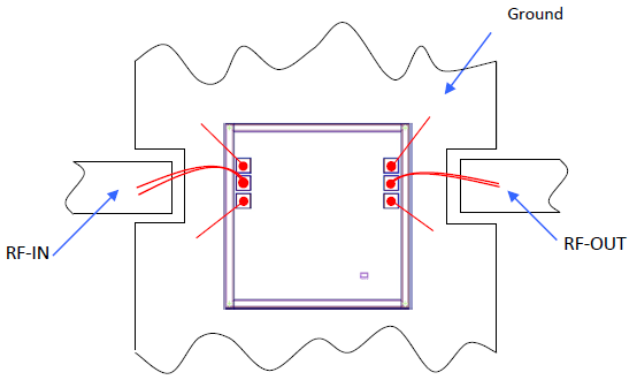
Critical Dimensions

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* — XBF-282-DG+ Medium†, Partial wafer: KGD*<5K — XBF-282-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 2 (2000 to <4000V) 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

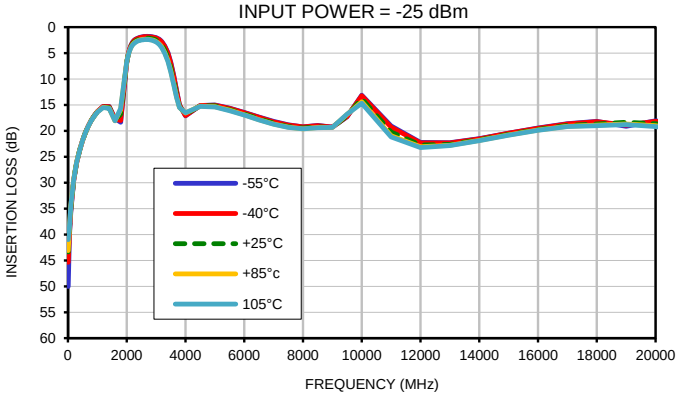
FREQ.	INSERTION LOSS					GROUP DELAY				
(MHz)	(dB)					(nsec)				
	@-55°C	@-40°C	@+25°C	@+85°C	@+105°C	@-55°C	@-40°C	@+25°C	@+85°C	@+105°C
10	50.03	45.37	43.37	43.11	40.99	-3.44	-5.06	-0.85	-3.19	-2.63
50	40.28	39.67	38.91	38.70	38.50	-2.00	-2.69	-1.06	-1.96	-1.80
100	35.45	35.07	34.82	34.39	34.31	-0.50	-0.46	-0.62	-0.69	-0.63
200	29.50	29.49	29.37	29.26	29.35	-0.04	0.01	-0.06	-0.08	-0.10
300	26.12	26.16	26.09	26.00	26.05	0.06	0.06	0.03	0.02	0.03
400	23.65	23.70	23.62	23.63	23.68	0.08	0.07	0.07	0.06	0.07
500	21.77	21.79	21.79	21.80	21.80	0.10	0.10	0.09	0.09	0.08
600	20.26	20.28	20.28	20.31	20.30	0.11	0.11	0.10	0.10	0.09
700	19.00	19.00	19.05	19.05	19.07	0.11	0.11	0.11	0.10	0.10
800	17.93	17.96	17.98	17.98	18.01	0.11	0.11	0.11	0.11	0.12
900	17.03	17.04	17.09	17.12	17.11	0.12	0.12	0.12	0.12	0.12
1000	16.28	16.30	16.33	16.37	16.38	0.13	0.13	0.13	0.13	0.13
1200	15.30	15.31	15.41	15.46	15.49	0.14	0.14	0.13	0.14	0.14
1400	15.29	15.33	15.48	15.60	15.65	0.13	0.13	0.11	0.11	0.10
1600	17.64	17.68	17.92	18.05	18.06	-0.13	-0.14	-0.22	-0.28	-0.30
1800	18.33	18.01	16.81	15.92	15.67	-0.91	-0.85	-0.64	-0.48	-0.44
1810	17.66	17.35	16.20	15.36	15.12	-0.80	-0.74	-0.53	-0.39	-0.35
2000	6.83	6.80	6.72	6.66	6.66	0.52	0.51	0.50	0.48	0.48
2050	5.28	5.29	5.35	5.41	5.44	0.57	0.56	0.53	0.51	0.51
2100	4.18	4.22	4.38	4.51	4.55	0.57	0.56	0.53	0.50	0.50
2150	3.43	3.49	3.70	3.87	3.92	0.54	0.53	0.50	0.48	0.47
2200	2.93	2.99	3.23	3.42	3.48	0.49	0.49	0.46	0.45	0.44
2250	2.57	2.64	2.90	3.09	3.16	0.45	0.45	0.43	0.41	0.41
2300	2.34	2.41	2.66	2.87	2.93	0.41	0.41	0.39	0.39	0.38
2350	2.16	2.23	2.49	2.69	2.76	0.38	0.38	0.37	0.36	0.36
2400	2.04	2.11	2.37	2.57	2.64	0.36	0.36	0.35	0.34	0.34
2450	1.95	2.01	2.27	2.47	2.54	0.34	0.34	0.33	0.33	0.33
2500	1.88	1.94	2.21	2.40	2.47	0.32	0.32	0.32	0.32	0.32
2550	1.83	1.90	2.16	2.36	2.43	0.31	0.31	0.31	0.31	0.31
2600	1.79	1.86	2.13	2.33	2.40	0.30	0.30	0.30	0.30	0.30
2650	1.78	1.84	2.11	2.32	2.39	0.30	0.30	0.29	0.30	0.30
2700	1.77	1.84	2.12	2.33	2.39	0.29	0.29	0.29	0.29	0.29
2750	1.78	1.85	2.13	2.35	2.42	0.29	0.29	0.29	0.29	0.29
2800	1.80	1.87	2.17	2.39	2.47	0.29	0.29	0.29	0.29	0.29
2850	1.83	1.91	2.21	2.45	2.52	0.29	0.29	0.29	0.30	0.30
2900	1.87	1.96	2.27	2.52	2.61	0.30	0.30	0.30	0.30	0.30
2950	1.94	2.03	2.36	2.63	2.72	0.30	0.30	0.30	0.31	0.31
3000	2.04	2.13	2.49	2.77	2.87	0.31	0.31	0.31	0.31	0.31
3050	2.15	2.25	2.63	2.95	3.05	0.32	0.32	0.32	0.32	0.32
3100	2.31	2.41	2.83	3.17	3.29	0.33	0.33	0.33	0.33	0.33
3150	2.52	2.63	3.09	3.47	3.60	0.34	0.34	0.34	0.34	0.34
3200	2.79	2.92	3.43	3.84	3.99	0.35	0.35	0.35	0.34	0.34
3300	3.61	3.76	4.38	4.89	5.06	0.37	0.36	0.35	0.34	0.33
3400	4.90	5.08	5.82	6.42	6.61	0.36	0.35	0.32	0.30	0.29
3500	6.78	6.99	7.82	8.46	8.66	0.29	0.28	0.24	0.21	0.20
3600	9.27	9.48	10.31	10.90	11.09	0.17	0.16	0.10	0.06	0.05
3700	12.15	12.34	13.01	13.44	13.56	-0.03	-0.04	-0.09	-0.12	-0.13
3800	14.95	15.03	15.33	15.46	15.50	-0.26	-0.26	-0.27	-0.26	-0.26
4000	17.13	17.06	16.79	16.57	16.50	-0.30	-0.29	-0.24	-0.20	-0.18
4500	15.11	15.13	15.18	15.23	15.26	0.04	0.04	0.04	0.04	0.04
5000	14.99	15.05	15.21	15.33	15.39	0.06	0.06	0.05	0.06	0.05
5500	15.63	15.68	15.89	16.04	16.11	0.05	0.05	0.05	0.05	0.05
6000	16.47	16.49	16.75	16.90	16.98	0.04	0.05	0.04	0.05	0.04
6500	17.34	17.42	17.66	17.85	17.88	0.05	0.04	0.04	0.04	0.05
7000	18.21	18.26	18.50	18.66	18.73	0.04	0.04	0.04	0.04	0.04
7500	18.87	18.92	19.17	19.31	19.36	0.04	0.04	0.04	0.04	0.04
8000	19.22	19.26	19.48	19.61	19.64	0.05	0.04	0.05	0.05	0.05
8500	18.96	19.00	19.22	19.36	19.41	0.08	0.07	0.08	0.08	0.09
9000	19.27	19.31	19.40	19.35	19.37	0.03	0.03	0.03	0.05	0.06
9500	17.28	17.25	17.04	16.84	16.80	0.12	0.12	0.15	0.18	0.20
10000	13.15	13.24	13.80	14.42	14.66	0.37	0.38	0.39	0.39	0.39
11000	19.06	19.31	20.24	20.97	21.19	0.14	0.15	0.13	0.13	0.14
12000	22.21	22.34	22.75	23.08	23.21	0.08	0.08	0.08	0.07	0.08
13000	22.29	22.37	22.61	22.81	22.86	0.06	0.05	0.05	0.05	0.05
14000	21.49	21.55	21.75	21.86	21.92	0.05	0.04	0.04	0.04	0.05
15000	20.44	20.48	20.70	20.81	20.86	0.05	0.05	0.04	0.04	0.05
16000	19.43	19.50	19.73	19.86	19.88	0.05	0.05	0.05	0.05	0.05
17000	18.62	18.68	18.94	19.13	19.18	0.05	0.05	0.04	0.05	0.05
18000	18.19	18.24	18.71	18.89	18.99	0.05	0.05	0.05	0.04	0.05
19000	19.10	18.91	18.36	18.69	18.82	-0.06	-0.03	0.07	0.06	0.07
20000	18.04	18.15	18.62	19.04	19.19	0.05	0.05	0.05	0.04	0.04
21000	18.88	18.98	19.43	19.81	19.94	0.04	0.04	0.03	0.04	0.04
22000	19.53	19.63	20.09	20.38	20.45	0.04	0.04	0.04	0.03	0.04
23000	20.15	20.25	20.71	20.91	21.00	0.04	0.04	0.04	0.04	0.04
24000	21.03	21.16	21.57	21.78	21.78	0.03	0.04	0.04	0.03	0.04
25000	21.69	21.82	22.32	22.56	22.65	0.03	0.03	0.03	0.03	0.03

Typical Performance Data

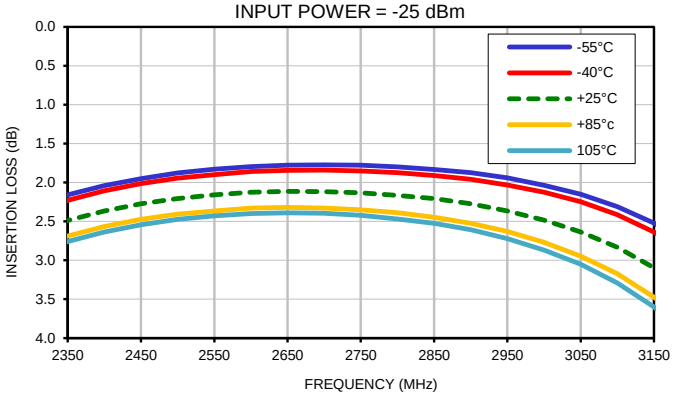
FREQ.	INPUT RETURN LOSS					OUTPUT RETURN LOSS				
(MHz)	(dB)					(dB)				
	@-55°C	@-40°C	@+25°C	@+85°C	@+105°C	@-55°C	@-40°C	@+25°C	@+85°C	@+105°C
10	34.90	34.72	33.61	33.05	32.92	34.62	34.36	33.20	33.12	32.80
50	33.63	33.51	33.35	32.74	32.68	33.49	33.51	33.45	32.80	32.61
100	31.85	31.93	32.31	32.06	32.07	31.97	31.95	32.20	31.93	31.77
200	29.83	29.75	30.01	29.87	29.97	29.74	29.78	30.07	30.09	29.96
300	27.86	27.83	27.64	27.55	27.49	28.09	28.08	27.86	27.84	27.82
400	25.82	25.86	25.85	25.77	25.75	25.66	25.77	25.64	25.64	25.60
500	24.25	24.17	24.13	24.17	24.11	23.67	23.62	23.63	23.69	23.71
600	22.73	22.77	22.62	22.71	22.71	22.35	22.36	22.21	22.31	22.30
700	21.47	21.42	21.42	21.46	21.48	21.29	21.30	21.12	21.20	21.21
800	20.54	20.54	20.51	20.56	20.59	20.24	20.24	20.13	20.20	20.20
900	19.62	19.65	19.65	19.72	19.77	19.27	19.28	19.23	19.29	19.31
1000	18.70	18.70	18.77	18.87	18.89	18.41	18.44	18.44	18.50	18.53
1200	17.24	17.26	17.47	17.52	17.54	17.17	17.22	17.24	17.29	17.32
1400	16.44	16.51	16.64	16.74	16.78	16.09	16.17	16.38	16.51	16.55
1600	15.96	16.11	16.71	17.04	17.12	15.91	16.02	16.50	16.82	16.92
1800	18.00	18.28	19.54	20.77	21.10	17.87	18.20	19.70	20.88	21.22
1810	18.24	18.55	19.86	21.18	21.55	18.16	18.51	20.10	21.40	21.76
2000	26.49	27.22	29.52	29.77	29.67	27.97	28.48	29.09	28.17	27.88
2050	26.69	26.88	26.38	25.65	25.43	25.80	25.76	25.11	24.26	24.09
2100	25.32	25.16	24.20	23.44	23.29	23.91	23.78	23.08	22.43	22.31
2150	24.01	23.78	22.92	22.19	22.03	22.88	22.73	22.02	21.42	21.34
2200	22.92	22.69	21.95	21.35	21.19	22.21	22.03	21.37	20.85	20.74
2250	22.24	22.03	21.40	20.87	20.74	21.77	21.59	21.00	20.51	20.42
2300	21.52	21.39	20.93	20.49	20.38	21.17	21.04	20.55	20.13	20.05
2350	21.08	20.99	20.74	20.35	20.28	20.90	20.78	20.42	20.09	20.02
2400	20.87	20.81	20.72	20.40	20.30	20.69	20.60	20.34	20.08	20.04
2450	20.82	20.78	20.74	20.51	20.44	20.73	20.63	20.45	20.26	20.20
2500	20.91	20.88	20.86	20.67	20.60	20.89	20.81	20.65	20.52	20.46
2550	20.88	20.87	20.84	20.73	20.66	21.03	21.01	20.84	20.73	20.67
2600	21.04	21.00	20.92	20.89	20.81	21.26	21.26	21.09	21.04	20.99
2650	21.21	21.20	21.10	21.13	21.09	21.45	21.42	21.25	21.28	21.26
2700	21.79	21.79	21.67	21.76	21.69	21.89	21.83	21.67	21.78	21.75
2750	22.12	22.09	21.99	22.22	22.17	22.15	22.11	21.96	22.16	22.09
2800	22.77	22.75	22.70	22.99	22.93	22.72	22.67	22.51	22.78	22.75
2850	23.54	23.54	23.48	23.87	23.80	23.61	23.55	23.36	23.68	23.62
2900	24.33	24.34	24.30	24.72	24.68	24.35	24.37	24.08	24.49	24.38
2950	25.34	25.33	25.28	25.81	25.76	25.45	25.34	25.12	25.48	25.45
3000	26.43	26.41	26.40	26.91	26.83	26.37	26.37	26.10	26.50	26.40
3050	28.14	28.19	28.00	28.53	28.50	27.75	27.73	27.43	27.70	27.60
3100	30.37	30.39	30.16	30.70	30.69	29.39	29.39	28.91	29.18	29.11
3150	33.92	34.12	33.70	34.43	34.31	31.96	31.92	31.18	31.13	30.96
3200	38.54	39.51	40.40	40.76	39.89	35.05	34.93	33.51	32.91	32.39
3300	37.00	37.52	37.50	35.77	35.07	35.37	34.50	31.90	30.63	30.13
3400	29.00	28.82	27.82	27.43	27.17	27.62	27.33	26.15	25.63	25.45
3500	23.76	23.69	23.17	23.12	23.00	22.92	22.82	22.29	22.16	22.09
3600	20.98	20.95	20.73	20.80	20.76	20.36	20.34	20.15	20.18	20.15
3700	19.67	19.67	19.50	19.68	19.68	19.19	19.20	19.11	19.20	19.20
3800	19.00	19.01	19.04	19.18	19.16	18.89	18.92	18.80	18.91	18.92
4000	18.98	19.06	19.09	19.01	19.02	19.02	18.99	18.86	18.81	18.77
4500	20.38	20.37	20.20	19.82	19.75	19.51	19.51	19.63	19.08	18.98
5000	21.28	21.29	21.17	20.68	20.61	20.80	20.77	20.71	20.04	19.93
5500	23.30	23.29	23.03	22.52	22.43	22.68	22.62	22.27	21.67	21.56
6000	25.76	25.69	24.92	24.33	24.33	24.28	24.16	23.46	22.85	22.81
6500	27.47	27.14	26.26	26.04	26.04	24.48	24.33	23.46	23.17	23.29
7000	27.97	27.60	26.56	26.16	26.23	25.36	25.20	24.19	24.42	24.71
7500	26.98	26.79	25.94	26.01	26.23	25.68	25.65	25.23	25.82	26.30
8000	27.85	27.66	27.08	27.15	27.33	27.82	27.63	27.02	27.29	27.40
8500	29.13	28.86	28.38	27.12	26.62	27.73	27.53	27.25	25.86	25.27
9000	23.21	23.24	23.20	22.03	21.57	21.23	21.23	21.43	20.34	19.81
9500	17.24	17.18	16.76	16.09	15.83	16.48	16.42	16.18	15.70	15.47
10000	11.16	11.18	11.27	11.62	11.79	11.83	11.89	11.97	12.66	12.95
11000	17.42	17.45	17.83	17.85	17.80	20.58	20.68	21.22	21.29	21.25
12000	18.36	18.19	17.72	16.98	16.67	19.94	19.81	19.99	18.50	17.99
13000	16.25	16.22	16.17	15.55	15.37	15.60	15.56	15.98	15.00	14.67
14000	15.05	15.12	15.25	15.13	15.23	14.33	14.35	14.48	14.14	14.16
15000	15.36	15.44	15.58	16.13	16.50	16.30	16.35	15.97	16.69	17.31
16000	17.08	17.19	17.96	18.46	18.64	20.39	20.50	21.08	22.22	22.48
17000	17.38	17.48	18.20	18.17	17.96	19.53	19.66	21.06	20.49	19.97
18000	12.97	12.90	12.60	12.31	12.21	16.28	16.28	15.38	15.39	15.49
19000	8.72	9.27	10.66	10.04	9.90	10.90	10.87	10.49	10.20	10.12
20000	7.07	7.07	7.07	6.85	6.83	6.88	6.91	7.07	6.80	6.68
21000	4.86	4.92	5.14	5.21	5.24	4.95	5.00	5.24	5.22	5.20
22000	3.78	3.85	4.14	4.36	4.44	4.20	4.27	4.42	4.68	4.80
23000	3.06	3.15	3.48	3.77	3.89	3.55	3.62	3.89	4.18	4.30
24000	2.54	2.63	3.03	3.39	3.56	2.64	2.73	3.12	3.35	3.45
25000	2.15	2.25	2.72	3.10	3.26	2.32	2.42	2.81	3.15	3.32

Typical Performance Curves

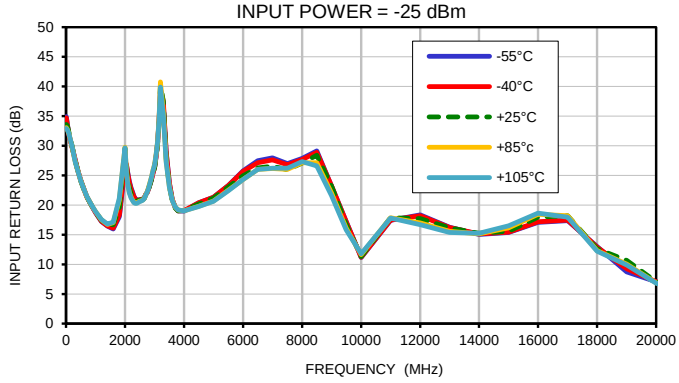
INSERTION LOSS vs. TEMPERATURE (Full Band)
INPUT POWER = -25 dBm



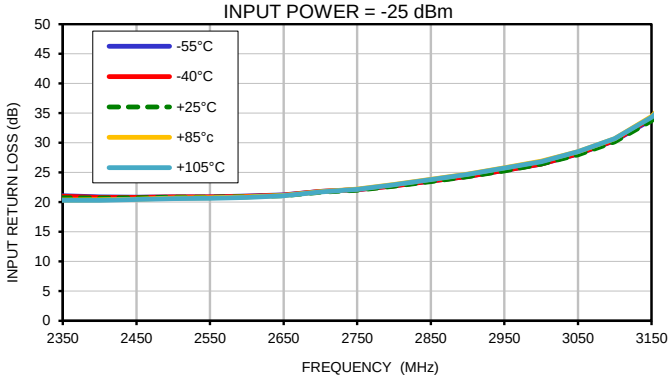
INSERTION LOSS vs. TEMPERATURE (Pass band)
INPUT POWER = -25 dBm



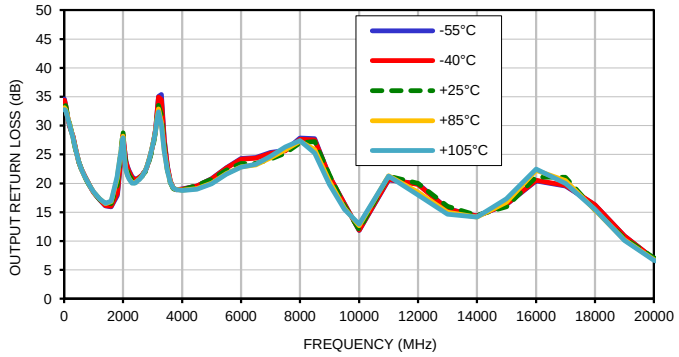
INPUT RETURN LOSS vs. TEMPERATURE (Full band)
INPUT POWER = -25 dBm



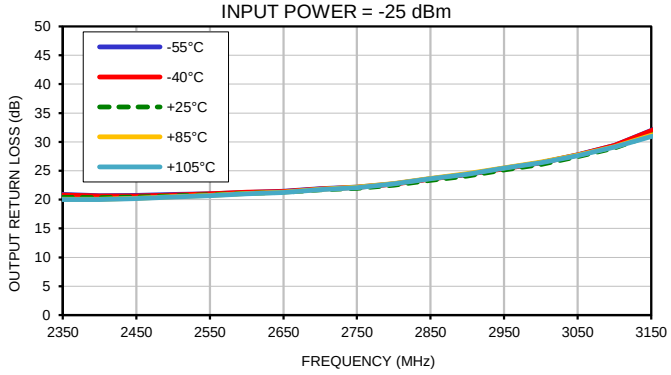
INPUT RETURN LOSS vs. TEMPERATURE (Pass band)
INPUT POWER = -25 dBm



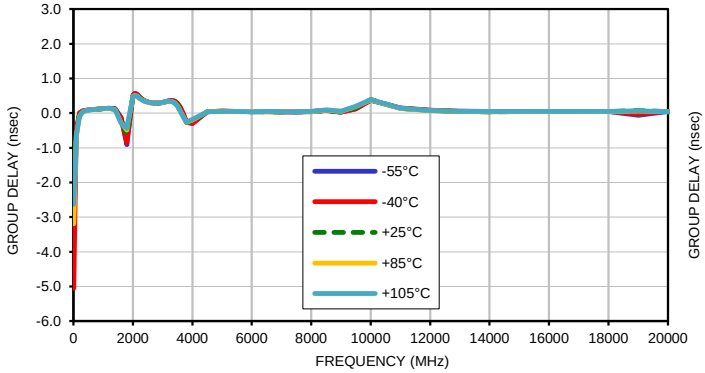
OUTPUT RETURN LOSS vs. TEMPERATURE (Full band)
INPUT POWER = -25 dBm



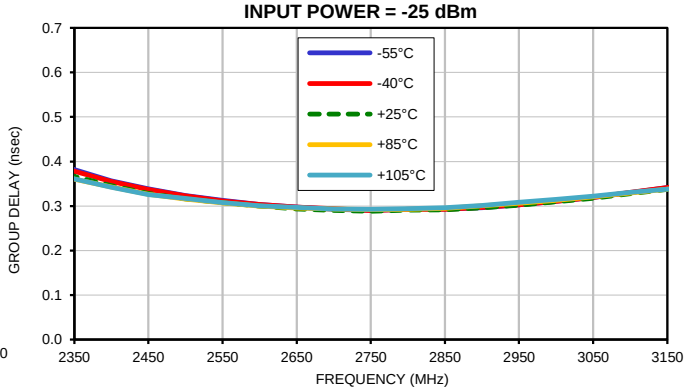
OUTPUT RETURN LOSS vs. TEMPERATURE (Pass band)
INPUT POWER = -25 dBm



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



GROUP DELAY vs. TEMPERATURE (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)	