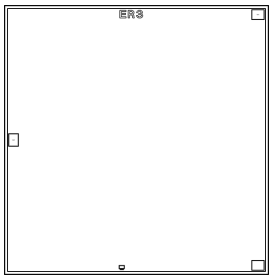
MMIC

Power Splitter/Combiner Die

EP2C-D+

2 Way-0° 50Ω 1800 to 12500 MHz



The Big Deal

- Ultra-Wide Bandwidth, 1800-12500 MHz
- High Power Handling, 1.85W as a Splitter

Product Overview

Mini-Circuits EP2C-D+ is a MMIC splitter/combiner die designed for wideband operation from 1800 to 12500 MHz. This model provides excellent power ratings with up to 1.85W power handling (as a splitter) and up to 0.4A DC current handling. Manufactured using GaAs IPD technology, it provides a high level of ESD protection and excellent reliability.

Key Features

Feature	Advantages
Wideband, 1800 to 12500 MHz	One power splitter can be used in many applications, saving component count. Also ideal for wideband applications such as military and instrumentation.
Excellent power handling: 1.85W as a splitter 0.85W internal dissipation as a combiner	In power combiner applications, half the power is dissipated internally. EP2C-D+ is designed to handle 0.85W internal dissipation as a combiner allowing reliable operation without excessive temperature rise. Similar splitters implemented as Wilkinson splitters on PCB require big resistors and additional heat sinking. As a splitter, EP2C-D+ can handle up to 1.85W in a very small package.
DC Passing up to 0.4A	DC current passing is helpful in applications where both RF & DC need to pass through the DUT, such as antenna mounted hardware.
Unpackaged die	Enables user to integrate it directly into hybrids.

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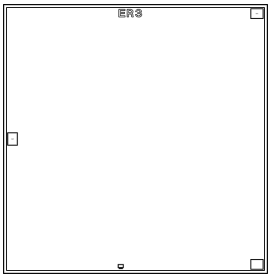


Features

- Wide bandwidth, 1800 to 12500 MHz
- Excellent amplitude unbalance, 0.2 dB typ.
- Good phase unbalance, 6 deg. typ.
- High ESD level*
- DC passing

Applications

- WIMAX
- ISM
- Instrumentation
- Radar
- WLAN
- Satellite communications
- LTE

+RoHS Compliant

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

Ordering Information: Refer to Last Page

Electrical Specifications[1] at 25°C

Parameter	Frequency (MHz)	Min.	Typ.	Max.	Unit
Frequency Range		1800		12500	MHz
Insertion Loss, above 3.0 dB	1800-3800 3800-8500 8500-12500		0.8 0.9 1.4		dB
Isolation	1800-3800 3800-8500 8500-12500		12.0 19.7 17.9		dB
Phase Unbalance	1800-3800 3800-8500 8500-12500		1.5 3.2 4.9		Degree
Amplitude Unbalance	1800-3800 3800-8500 8500-12500		0.05 0.09 0.23		dB
VSWR (Port S)	1800-3800 3800-8500 8500-12500		1.4 1.3 1.3		:1
VSWR (Port 1-2)	1800-3800 3800-8500 8500-12500		1.2 1.2 1.3		:1

1. Measured on Mini-Circuits Die Characterization Test Board.

Maximum Ratings[2,3]

Parameter	Ratings
Operating Temperature	-40°C to 85°C
Power Input (as a splitter)	1.85 W max.
Internal Dissipation	0.85 W max.
DC Current	0.4 A max

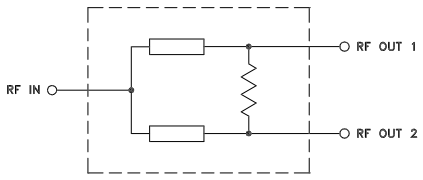
ESD rating[3]
Human body model (HBM): Class 2(1800 to <4000 V) in accordance with ANSI/ESD 5.1-2007
Machine model (MM): Class M3 (200 to <400 V) in accordance with ANSI/ESD 5.2-2009

2. Permanent damage may occur if any of these limits are exceeded.
3. Tested in industry standard 4x4x1mm MCLP package 24-lead

Pad Connections

Function	Pad Number
SUM PORT	RF IN
RF OUT1	RF OUT1
RF OUT2	RF OUT2
GROUND	Bottom of die

Simplified Electrical Schematic



Die Layout

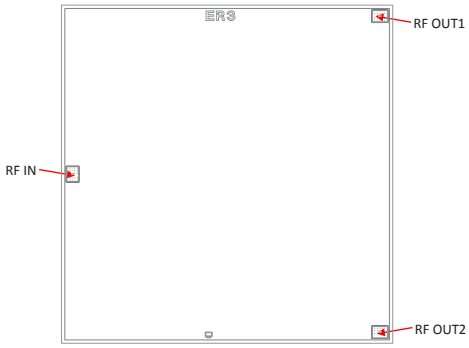


Fig 2. Die Layout

Bonding Pad Position

(Dimensions in µm, Typical)

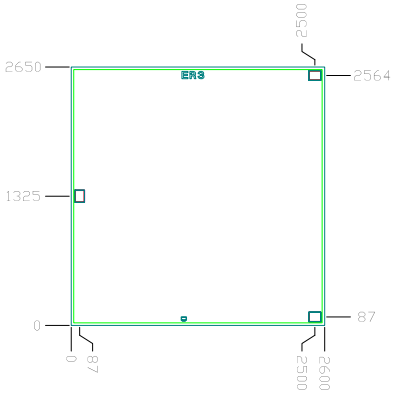


Fig 3. Bonding Pad Positions

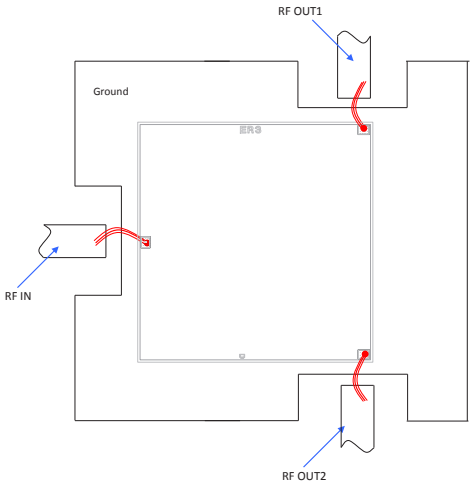
Critical Dimensions

Parameter	Values
Die Thickness, µm	200
Die Width, µm	2650
Die Length, µm	2600
Bond Pad Size, µm	100 X 125

Assembly and Handling Procedure

1. Storage
   Dice should be stored in a dry nitrogen purged desiccators or equivalent.
2. ESD
   MMIC amplifier 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 workstation. 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 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 manufacturer'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



Three 1 mil bond wires should be used for RF input and RF output.

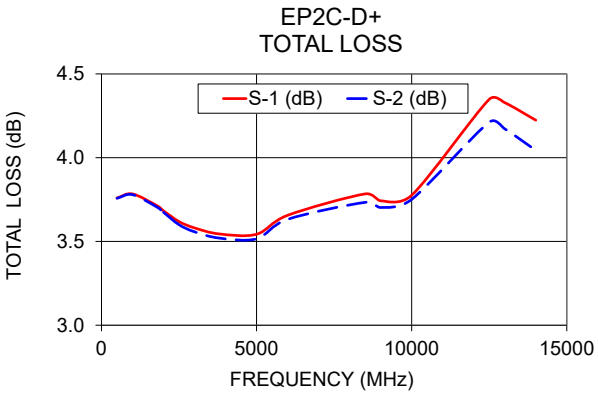
Recommended Wire Length, Typical

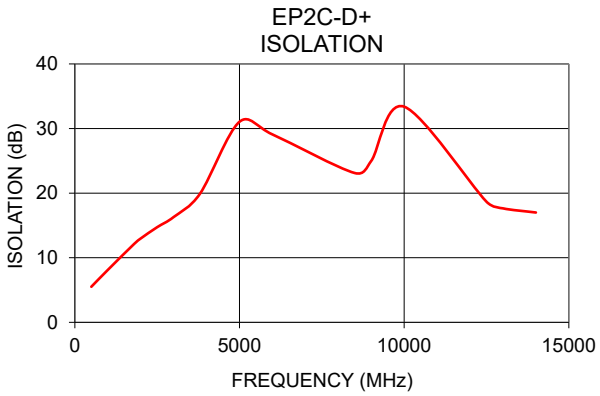
Wire	Wire Length (mm)	Wire Loop Height (mm)
RF-IN, RF-OUT1, RF OUT2	0.50	0.15

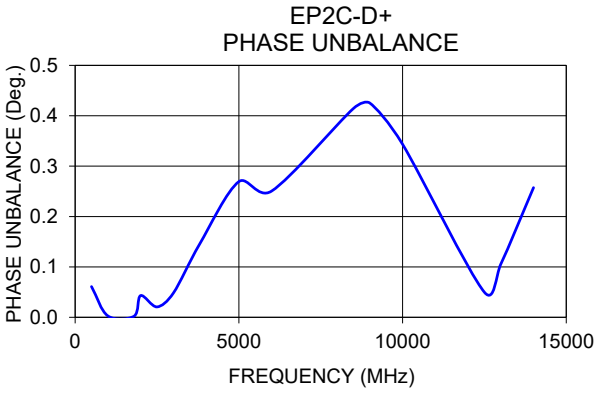
Typical Performance Data

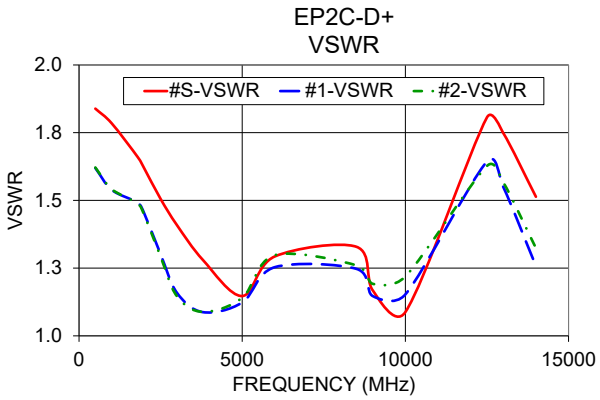
Frequency (MHz)	Total Loss[1] (dB)		Amplitude Unbalance (dB)	Isolation (dB)	Phase Unbalance (deg.)	VSWR S	VSWR 1	VSWR 2
	S-1	S-2						
500	3.76	3.76	0.01	5.51	0.06	1.84	1.62	1.62
1000	3.78	3.78	0.00	8.11	0.00	1.78	1.54	1.54
1800	3.71	3.70	0.00	12.14	0.00	1.66	1.49	1.49
2000	3.68	3.67	0.01	12.98	0.04	1.62	1.45	1.45
2500	3.62	3.60	0.02	14.73	0.02	1.51	1.30	1.29
3000	3.58	3.56	0.02	16.30	0.05	1.41	1.16	1.15
3800	3.54	3.52	0.03	19.91	0.15	1.28	1.09	1.09
5000	3.54	3.52	0.03	31.05	0.27	1.15	1.12	1.14
6000	3.66	3.63	0.02	29.09	0.25	1.29	1.25	1.30
8500	3.78	3.73	0.04	23.11	0.41	1.33	1.25	1.26
9000	3.74	3.70	0.04	24.99	0.43	1.17	1.15	1.19
10000	3.78	3.75	0.03	33.38	0.34	1.09	1.15	1.22
12500	4.35	4.21	0.13	18.67	0.05	1.81	1.64	1.63
13000	4.33	4.17	0.16	17.64	0.11	1.75	1.55	1.57
14000	4.22	4.04	0.16	17.00	0.26	1.51	1.26	1.32

1. Total Loss = Insertion Loss + 3dB splitter loss.









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 (Note 3)	Quantity, Package	Model No.
	Small, Gel - Pak: 5,10,50	EP2C-DG+
	Medium†, Partial wafer: 350	EP2C-DP+
	†*Available upon request contact sales representative*	
	Refer to AN-60-067	
Environmental Ratings	ENV-80	

3. Dice taken from PCM good wafer. No RF or DC test performed.

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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2 Way-0° Power Splitter/Combiner Die EP2C-D+

Typical Performance Data

Full 2-Port Extension

TEST CONDITIONS: Input Power = -10dBm @Temperature = +25°C

FREQ. (MHz)	TOTAL LOSS[1] (dB) S-1	TOTAL LOSS[1] (dB) S-2	AMP. UNBAL. (dB)	PHASE UNBAL. (deg.)	ISOLATION (dB) 2-1	VSWR (:1) S	VSWR (:1) 1	VSWR (:1) 2
500	3.76	3.76	0.01	0.06	5.51	1.84	1.62	1.62
1000	3.78	3.78	0.00	0.00	8.11	1.78	1.54	1.54
1500	3.75	3.74	0.00	0.03	10.73	1.71	1.53	1.53
1800	3.71	3.70	0.00	0.00	12.14	1.66	1.49	1.49
2000	3.68	3.67	0.01	0.04	12.98	1.62	1.45	1.45
2500	3.62	3.60	0.02	0.02	14.73	1.51	1.30	1.29
3000	3.58	3.56	0.02	0.05	16.30	1.41	1.16	1.15
3500	3.56	3.53	0.02	0.15	18.26	1.34	1.10	1.10
3800	3.54	3.52	0.03	0.15	19.91	1.28	1.09	1.09
4000	3.52	3.50	0.03	0.17	21.21	1.23	1.07	1.07
4200	3.52	3.49	0.03	0.20	22.76	1.18	1.04	1.04
4400	3.51	3.48	0.03	0.20	24.55	1.13	1.01	1.00
4600	3.51	3.49	0.02	0.21	26.77	1.11	1.04	1.05
4800	3.53	3.50	0.02	0.18	29.04	1.12	1.08	1.09
5000	3.54	3.52	0.03	0.27	31.05	1.15	1.12	1.14
5200	3.56	3.54	0.02	0.28	32.33	1.18	1.16	1.18
5400	3.59	3.57	0.02	0.26	32.18	1.22	1.19	1.22
5600	3.61	3.59	0.02	0.30	31.24	1.24	1.22	1.26
5800	3.63	3.61	0.01	0.26	30.24	1.27	1.24	1.28
6000	3.66	3.63	0.02	0.25	29.09	1.29	1.25	1.30
6200	3.68	3.65	0.02	0.29	27.93	1.32	1.27	1.31
6400	3.70	3.67	0.02	0.24	26.89	1.34	1.27	1.31
6600	3.72	3.70	0.02	0.22	25.83	1.37	1.28	1.31
6800	3.74	3.72	0.03	0.20	24.92	1.39	1.29	1.31
7000	3.77	3.74	0.04	0.19	24.07	1.42	1.31	1.31
7200	3.79	3.75	0.03	0.21	23.41	1.45	1.32	1.31
7400	3.82	3.76	0.04	0.22	22.93	1.47	1.33	1.31
7600	3.83	3.77	0.05	0.27	22.56	1.48	1.34	1.31
7800	3.83	3.78	0.05	0.27	22.39	1.47	1.34	1.31
8000	3.83	3.77	0.05	0.33	22.42	1.45	1.33	1.31
8500	3.78	3.73	0.04	0.41	23.11	1.33	1.25	1.26
9000	3.74	3.70	0.04	0.43	24.99	1.17	1.15	1.19
9500	3.75	3.71	0.03	0.37	28.00	1.03	1.12	1.17
10000	3.78	3.75	0.03	0.34	33.38	1.09	1.15	1.22
10500	3.85	3.83	0.02	0.19	41.62	1.22	1.21	1.30
11000	3.97	3.94	0.03	0.02	29.23	1.41	1.33	1.41
11500	4.15	4.08	0.06	0.16	23.55	1.62	1.51	1.53
12000	4.30	4.19	0.10	0.18	20.44	1.79	1.64	1.62
12500	4.35	4.21	0.13	0.05	18.67	1.81	1.64	1.63
13000	4.33	4.17	0.16	0.11	17.64	1.75	1.55	1.57
13500	4.28	4.11	0.16	0.22	17.29	1.64	1.41	1.46
14000	4.22	4.04	0.16	0.26	17.00	1.51	1.26	1.32

[1]Total Loss = Insertion Loss + 3dB Splitter Loss

2 Way-0° Power Splitter/Combiner Die EP2C-D+

Typical Performance Data

Without Full 2-Port Extension

TEST CONDITIONS: Input Power = -10dBm @Temperature = +25°C

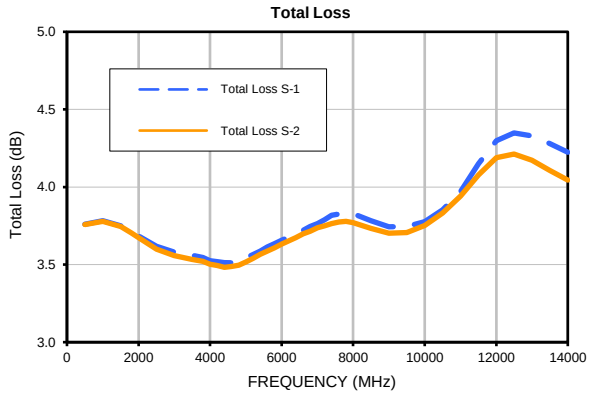
FREQ. (MHz)	TOTAL LOSS[1] (dB) S-1	TOTAL LOSS[1] (dB) S-2	AMP. UNBAL. (dB)	PHASE UNBAL. (deg.)	ISOLATION (dB) 2-1	VSWR (:1) S	VSWR (:1) 1	VSWR (:1) 2
500	3.79	3.78	0.01	0.06	5.53	1.85	1.62	1.62
1000	3.85	3.84	0.00	0.08	8.19	1.78	1.53	1.53
1500	3.86	3.85	0.01	0.16	10.87	1.70	1.52	1.51
1800	3.85	3.84	0.01	0.20	12.29	1.65	1.48	1.48
2000	3.83	3.82	0.01	0.21	13.19	1.61	1.44	1.43
2500	3.81	3.80	0.02	0.25	14.97	1.50	1.29	1.28
3000	3.81	3.79	0.03	0.25	16.61	1.39	1.15	1.14
3500	3.84	3.81	0.03	0.25	18.60	1.33	1.09	1.09
3800	3.84	3.82	0.03	0.26	20.25	1.27	1.08	1.08
4000	3.84	3.82	0.03	0.27	21.57	1.22	1.06	1.07
4200	3.85	3.83	0.03	0.29	23.20	1.17	1.03	1.04
4400	3.86	3.84	0.02	0.29	25.03	1.13	1.01	1.00
4600	3.88	3.86	0.03	0.31	27.04	1.11	1.04	1.04
4800	3.90	3.88	0.03	0.32	29.25	1.12	1.08	1.09
5000	3.94	3.91	0.02	0.34	31.45	1.15	1.12	1.13
5200	3.97	3.95	0.02	0.36	32.84	1.18	1.15	1.17
5400	4.01	3.99	0.03	0.36	32.85	1.21	1.18	1.21
5600	4.05	4.03	0.02	0.38	31.99	1.23	1.21	1.24
5800	4.08	4.06	0.02	0.42	30.84	1.26	1.23	1.26
6000	4.12	4.10	0.02	0.44	29.75	1.28	1.24	1.27
6200	4.15	4.14	0.02	0.46	28.67	1.30	1.25	1.28
6400	4.19	4.17	0.02	0.52	27.59	1.33	1.26	1.29
6600	4.22	4.20	0.03	0.55	26.61	1.35	1.26	1.28
6800	4.26	4.24	0.03	0.60	25.64	1.38	1.27	1.28
7000	4.30	4.27	0.03	0.61	24.91	1.40	1.28	1.28
7200	4.35	4.31	0.04	0.64	24.13	1.43	1.29	1.28
7400	4.38	4.34	0.05	0.62	23.62	1.44	1.30	1.28
7600	4.41	4.36	0.05	0.63	23.27	1.45	1.31	1.28
7800	4.43	4.38	0.05	0.59	23.00	1.45	1.31	1.29
8000	4.44	4.39	0.06	0.59	23.07	1.43	1.30	1.28
8500	4.43	4.39	0.05	0.56	23.83	1.31	1.23	1.24
9000	4.42	4.39	0.04	0.60	25.74	1.16	1.14	1.17
9500	4.45	4.43	0.03	0.68	28.84	1.03	1.11	1.15
10000	4.52	4.51	0.02	0.78	34.56	1.09	1.14	1.20
10500	4.62	4.62	0.01	1.00	42.18	1.22	1.20	1.27
11000	4.77	4.76	0.02	1.30	29.90	1.38	1.30	1.37
11500	4.98	4.93	0.06	1.50	24.41	1.57	1.45	1.47
12000	5.17	5.08	0.09	1.53	21.35	1.71	1.55	1.53
12500	5.24	5.12	0.13	1.52	19.70	1.71	1.56	1.52
13000	5.25	5.11	0.15	1.38	18.84	1.64	1.47	1.46
13500	5.24	5.10	0.15	1.32	18.52	1.56	1.36	1.37
14000	5.23	5.09	0.15	1.36	18.28	1.46	1.23	1.27

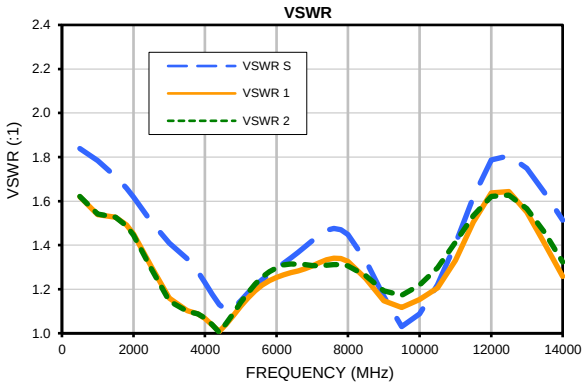
[1]Total Loss = Insertion Loss + 3dB Splitter Loss

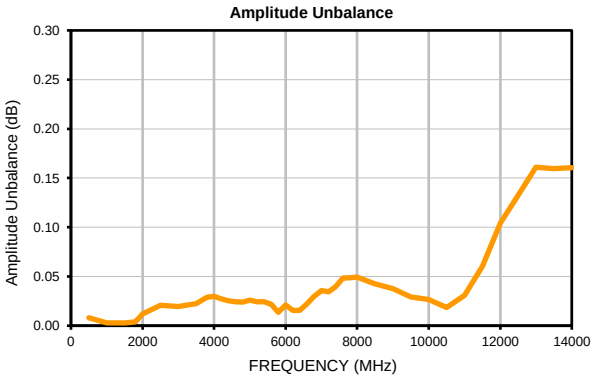
2 Way-0° Power Splitter/Combiner Die EP2C-D+

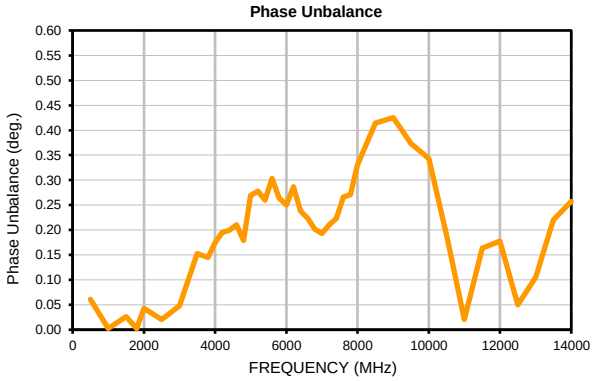
Typical Performance Curves

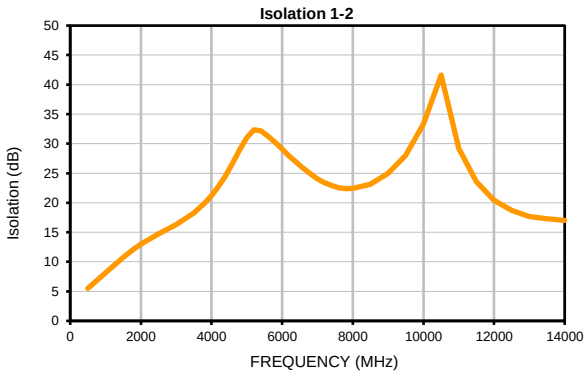
Full 2-Port Extension





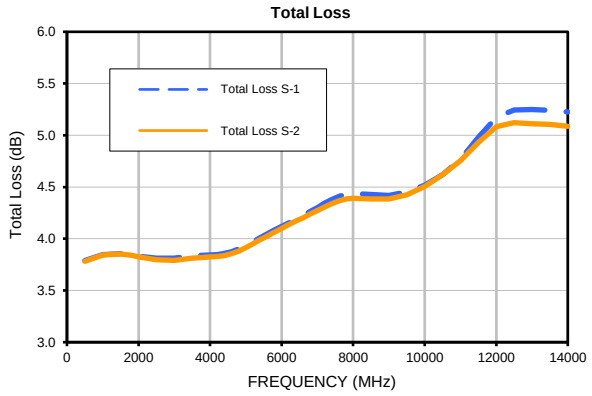


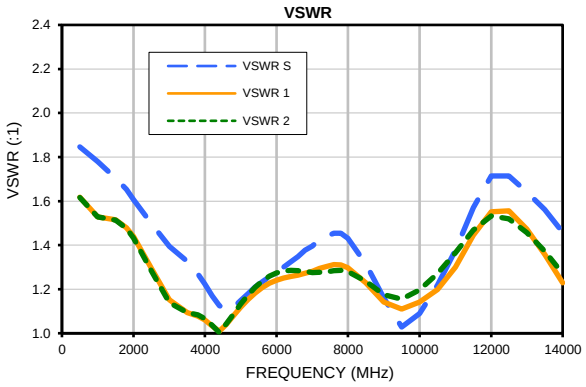


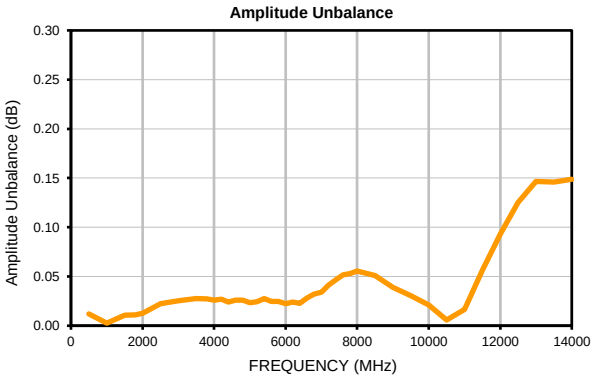


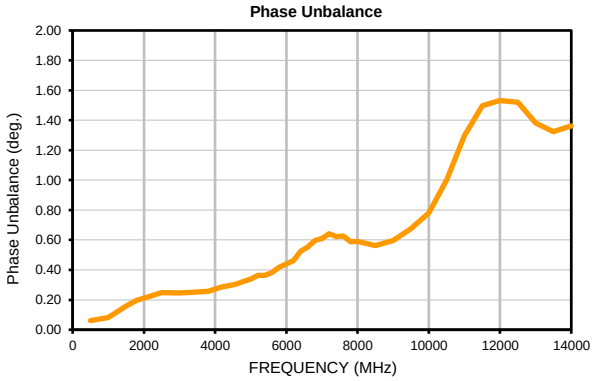
Typical Performance Curves

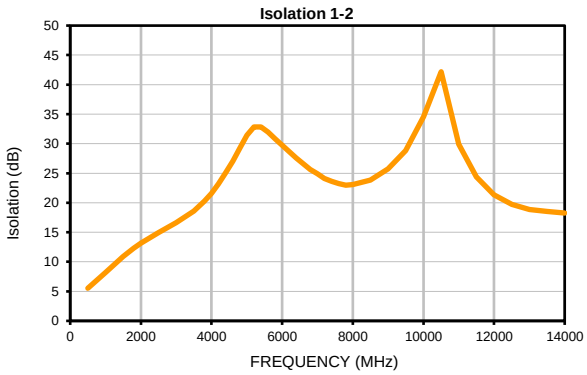
Without Full 2-Port Extension











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)	