MMIC

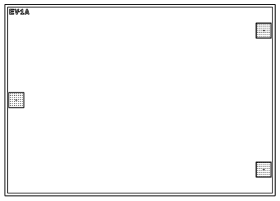
Power Splitter/Combiner Die

EP2K-D+

2 Way-0° 50Ω 2 to 26.5 GHz

The Big Deal

- Ultra-Wide Bandwidth, usable over 1.8 to 28 GHz
- High Power Handling, 2.5W as a Splitter



Product Overview

Mini-Circuits EP2K-D+ is a MMIC splitter/combiner die designed for wideband operation from 2 to 26.5 GHz. This model provides excellent power ratings up to 2.5W power handling (as a splitter) and up to 1.2A DC current handling. Manufactured using GaAs IPD technology, it provides a high level of ESD protection and excellent reliability.

Key Features

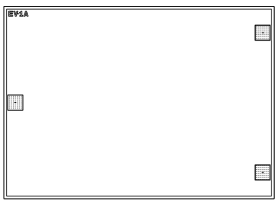
Feature	Advantages
Wideband, 1.8 to 28 GHz	One power splitter can be used in many applications, saving component count. Also ideal for wideband applications such as military and instrumentation.
Excellent power handling 2.5W as a splitter 1.7W internal dissipation as a combiner	In power combiner applications, half the power is dissipated internally. EP2K-D+ is designed to handle 1.7W 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, EP2K-D+ can handle up to 2.5W in a very small package.
DC Passing up to 1.2A	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.

MMIC

Power Splitter/Combiner Die

EP2K-D+

2 Way-0° 50Ω 2 to 26.5 GHz



Features

- Wide bandwidth, 2 to 26.5 GHz, usable over 1.8 to 28 GHz
- Excellent amplitude unbalance, 0.1 dB typ.
- Good phase unbalance, 1.5 to 8.5 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 at 25°C[1]

Parameter	Frequency (GHz)	Min.	Typ.	Max.	Unit
Frequency Range		2		26.5	GHz
Insertion Loss, above 3.0 dB	2 - 5 5 - 10 10 - 18 18 - 26.5		0.8 0.9 1.6 2.1		dB
Isolation	2 - 5 5 - 10 10 - 18 18 - 26.5		9.5 18.0 18.9 15.9		dB
Phase Unbalance	2 - 5 5 - 10 10 - 18 18 - 26.5		1.5 2.9 6.0 8.5		Degree
Amplitude Unbalance	2 - 5 5 - 10 10 - 18 18 - 26.5		0.1 0.1 0.2 0.3		dB
VSWR (Port S)	2 - 5 5 - 10 10 - 18 18 - 26.5		1.6 1.2 1.3 1.5		:1
VSWR (Port 1-2)	2 - 5 5 - 10 10 - 18 18 - 26.5		1.7 1.2 1.4 1.6		:1

1. Tested on Mini-Circuits die characterization test board.

Maximum Ratings[2,3]

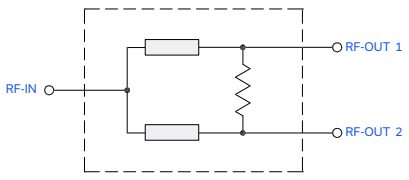
Parameter	Ratings
Operating Temperature	-40°C to 85°C
Power Input (as a splitter)	2.5W max. at 25°C. Derate linearly to 1.25W at 85°C
Internal Dissipation	1.7W max. at 25°C. Derate linearly to 1.1W at 85°C
DC Current	1.2A max. at 25°C. Derate linearly to 0.6A at 85°C

2. Permanent damage may occur if any of these limits are exceeded.
3. Die performance is measured in industry standard 4x4mm 24-lead MCLP package.

Pad Connections

Pad	Description
RF IN	RF-IN as splitter / RF-OUT as combiner
RF OUT1	RF-OUT1 as splitter / RF-IN1 as combiner
RF OUT2	RF-OUT2 as splitter / RF-IN2 as combiner

Simplified Electrical Schematic



* ESD rating
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

Die Layout

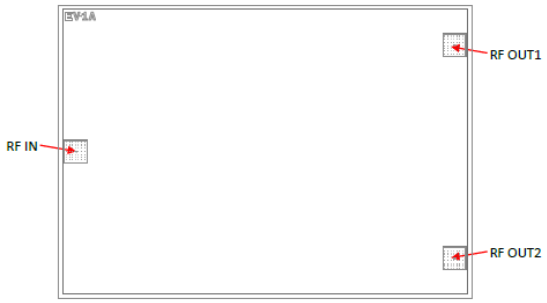


Fig 2. Die Layout

Bonding Pad Position

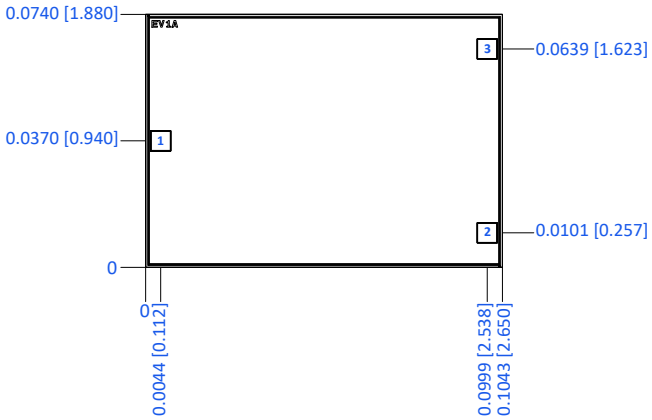


Fig 3. Bonding Pad Positions

DIMENSION: inches [mm], Typical

Die Size	0.1043 x 0.0740 [2.650 x 1.880]
Die Thickness	0.0079 [0.200]
Bond Pad Size Pad 1,2,3	0.0056 x 0.0056 [0.142 x 0.142]
Plating (Pads & bottom of Die)	Gold

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 and as low as reasonable to minimize performance degradation due to undesirable series inductance.

Assembly Diagram



Four 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	0.40	0.15

Additional Detailed Technical Information additional information is available on our dash board.	
Performance Data	Data Table
	Swept Graphs
	S-Parameter (S3P 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 — EP2K-DG+ Medium†, Partial Wafer: 350 — EP2K-DP+ Large†, Full Wafer — EP2K-DF+ †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.

ESD Rating**

Human Body Model (HBM): Class 2 (1800 to <4000V) in accordance with ANSI/ESD STM 5.1 - 2007

Machine Model (MM): Class M3 (200 to <400V) in accordance with ANSI/ESD STM5.2-1999

** Tested in industry standard 4X4mm, 24-Lead MCLP 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.

C. The parts covered by this specification document are subject to Mini-Circuits standard limited warranty and terms and conditions (collectively, "Standard Terms"); Purchasers of this part are entitled to the rights and benefits contained therein. For a full statement of the Standard Terms and the exclusive rights and remedies thereunder, please visit Mini-Circuits' website at www.minicircuits.com/MCLStore/terms.jsp

D. Mini-Circuits does not warrant the accuracy or completeness of the information, text, graphics and other items contained within this document and same are provided as an accommodation and on an "As is" basis, with all faults.

E. Purchasers of this part are solely responsible for proper storing, handling, assembly and processing of Known Good Dice (including, without limitation, proper ESD preventative measures, die preparation, die attach, wire bond ing and related assembly and test activities), and Mini-Circuits assumes no responsibility therefor or for environmental effects on Known Good Dice.

F. Mini-Circuits and the Mini-Circuits logo are registered trademarks of Scientific Components Corporation d/b/a Mini-Circuits. All other third-party trademarks are the property of their respective owners. A reference to any third-party trademark does not constitute or imply any endorsement, affiliation, sponsorship, or recommendation by any such third-party of Mini-Circuits or its products.

2 Way-0° Power Splitter/Combiner Die EP2K-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)	ISOLATION (dB) 2-1	PHASE UNBAL. (deg.)	VSWR (:1) S	VSWR (:1) 1	VSWR (:1) 2
500	3.73	3.75	0.02	4.46	0.10	1.88	1.77	1.76
1000	3.79	3.81	0.02	5.73	0.28	1.92	1.80	1.78
1500	3.77	3.76	0.01	7.60	0.33	1.90	1.92	1.88
1800	3.76	3.73	0.02	8.79	0.27	1.85	1.97	1.92
2000	3.76	3.73	0.03	9.54	0.19	1.82	1.98	1.93
2500	3.78	3.76	0.02	11.07	0.03	1.78	1.92	1.88
3000	3.72	3.75	0.02	12.31	0.12	1.74	1.78	1.78
3500	3.63	3.69	0.07	13.61	0.01	1.68	1.64	1.68
3800	3.58	3.66	0.08	14.34	0.17	1.63	1.59	1.64
4000	3.56	3.65	0.09	14.82	0.29	1.60	1.57	1.62
4200	3.54	3.63	0.09	15.30	0.39	1.55	1.55	1.59
4400	3.52	3.60	0.08	15.84	0.49	1.50	1.53	1.56
4600	3.49	3.57	0.07	16.47	0.57	1.44	1.51	1.53
4800	3.46	3.53	0.07	17.20	0.61	1.37	1.47	1.49
5000	3.44	3.49	0.06	18.03	0.64	1.29	1.43	1.44
5200	3.42	3.47	0.05	18.95	0.64	1.22	1.39	1.38
5400	3.41	3.46	0.05	19.94	0.64	1.15	1.34	1.33
5600	3.41	3.45	0.05	20.97	0.62	1.11	1.28	1.27
5800	3.40	3.45	0.05	22.00	0.61	1.09	1.23	1.22
6000	3.40	3.45	0.05	23.05	0.60	1.08	1.18	1.17
6200	3.40	3.46	0.06	24.05	0.61	1.09	1.13	1.14
6400	3.41	3.47	0.06	25.03	0.64	1.10	1.09	1.12
6600	3.41	3.48	0.07	25.95	0.68	1.12	1.06	1.12
6800	3.42	3.49	0.07	26.77	0.73	1.13	1.06	1.13
7000	3.43	3.50	0.08	27.43	0.79	1.12	1.06	1.14
7200	3.44	3.51	0.08	27.86	0.86	1.11	1.07	1.13
7400	3.45	3.52	0.08	28.00	0.92	1.10	1.06	1.11
7600	3.46	3.53	0.07	27.89	0.99	1.11	1.04	1.07
7800	3.48	3.54	0.07	27.57	1.03	1.13	1.05	1.04
8000	3.50	3.56	0.06	27.11	1.08	1.17	1.10	1.07
8500	3.61	3.66	0.05	25.80	1.14	1.34	1.27	1.25
9000	3.74	3.79	0.04	24.65	1.16	1.52	1.44	1.43
9500	3.82	3.85	0.04	23.83	1.17	1.63	1.53	1.53
10000	3.79	3.83	0.04	23.13	1.19	1.60	1.51	1.52
10500	3.73	3.78	0.04	22.16	1.24	1.49	1.43	1.44
11000	3.70	3.74	0.05	21.09	1.30	1.38	1.33	1.34
11500	3.67	3.71	0.04	20.42	1.36	1.27	1.26	1.27
12000	3.65	3.69	0.04	20.75	1.39	1.15	1.22	1.22
12500	3.65	3.70	0.04	22.10	1.37	1.07	1.23	1.23
13000	3.65	3.71	0.06	23.48	1.38	1.08	1.26	1.27
13500	3.65	3.73	0.09	23.41	1.49	1.11	1.28	1.31
14000	3.71	3.81	0.10	23.08	1.73	1.21	1.31	1.33
15000	3.89	3.97	0.08	26.23	2.22	1.42	1.42	1.44
16000	4.05	4.08	0.03	24.75	2.38	1.61	1.52	1.53
17000	4.15	4.16	0.01	22.54	2.49	1.73	1.55	1.52
18000	4.32	4.28	0.03	19.26	2.43	1.89	1.63	1.57
19000	4.23	4.21	0.01	18.17	2.04	1.62	1.63	1.68
20000	3.95	4.04	0.09	18.16	2.17	1.04	1.46	1.49
21000	4.08	4.21	0.13	18.99	3.00	1.44	1.39	1.47
22000	4.26	4.33	0.07	21.69	3.59	1.58	1.49	1.54
23000	4.53	4.55	0.02	19.85	3.77	1.80	1.65	1.55
24000	4.61	4.59	0.02	20.11	3.83	1.77	1.54	1.50
25000	4.57	4.54	0.03	19.66	3.77	1.54	1.45	1.60
26000	4.51	4.50	0.01	17.88	3.97	1.51	1.39	1.57
27000	4.46	4.42	0.04	16.71	4.50	1.31	1.29	1.29
28000	4.52	4.38	0.14	18.43	4.57	1.37	1.45	1.29

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

Typical Performance Data

Without Full 2-Port Extension

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

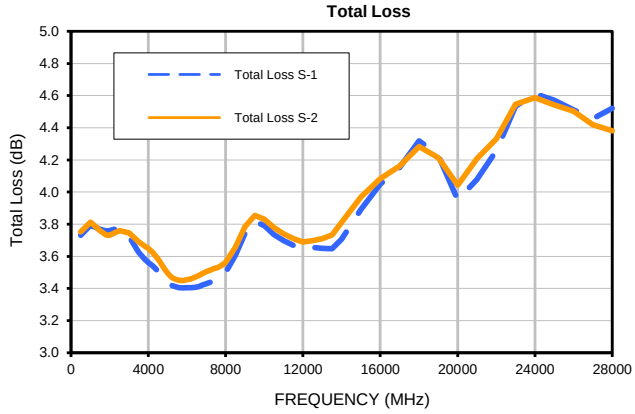
FREQ. (MHz)	TOTAL LOSS[1] (dB) S-1	TOTAL LOSS[1] (dB) S-2	AMP. UNBAL. (dB)	ISOLATION (dB) 2-1	PHASE UNBAL. (deg.)	VSWR (:1) S	VSWR (:1) 1	VSWR (:1) 2
500	3.78	3.78	0.00	4.53	0.08	1.88	1.76	1.76
1000	3.90	3.90	0.00	5.88	0.24	1.91	1.78	1.77
1500	3.93	3.90	0.03	7.82	0.32	1.88	1.89	1.86
1800	3.95	3.90	0.05	9.04	0.25	1.83	1.93	1.90
2000	3.97	3.91	0.06	9.82	0.17	1.80	1.94	1.90
2500	4.04	3.98	0.05	11.40	0.08	1.75	1.88	1.86
3000	4.03	4.02	0.02	12.69	0.21	1.71	1.74	1.75
3500	3.98	4.01	0.03	14.05	0.10	1.65	1.61	1.65
3800	3.96	4.01	0.04	14.82	0.08	1.60	1.55	1.61
4000	3.96	4.01	0.05	15.32	0.20	1.57	1.53	1.58
4200	3.96	4.00	0.05	15.84	0.32	1.53	1.52	1.56
4400	3.95	3.99	0.04	16.40	0.41	1.47	1.50	1.53
4600	3.94	3.97	0.03	17.05	0.48	1.41	1.47	1.50
4800	3.93	3.95	0.02	17.79	0.52	1.34	1.44	1.46
5000	3.92	3.93	0.01	18.63	0.53	1.27	1.40	1.41
5200	3.92	3.92	0.00	19.55	0.52	1.20	1.36	1.36
5400	3.93	3.93	0.00	20.56	0.50	1.14	1.31	1.31
5600	3.94	3.94	0.00	21.61	0.48	1.10	1.26	1.25
5800	3.95	3.95	0.00	22.69	0.47	1.08	1.21	1.20
6000	3.97	3.97	0.00	23.79	0.46	1.08	1.16	1.16
6200	3.98	3.99	0.01	24.84	0.47	1.08	1.12	1.13
6400	4.00	4.01	0.01	25.86	0.49	1.10	1.08	1.11
6600	4.02	4.04	0.02	26.84	0.53	1.11	1.06	1.11
6800	4.04	4.06	0.02	27.66	0.58	1.12	1.05	1.12
7000	4.07	4.09	0.02	28.32	0.64	1.12	1.06	1.13
7200	4.09	4.11	0.02	28.71	0.69	1.11	1.06	1.12
7400	4.12	4.14	0.02	28.80	0.75	1.10	1.05	1.10
7600	4.14	4.16	0.02	28.66	0.80	1.10	1.04	1.07
7800	4.17	4.18	0.01	28.31	0.85	1.12	1.04	1.04
8000	4.21	4.21	0.01	27.86	0.88	1.16	1.09	1.06
8500	4.35	4.34	0.01	26.60	0.93	1.31	1.25	1.24
9000	4.52	4.51	0.02	25.55	0.94	1.48	1.40	1.40
9500	4.63	4.61	0.02	24.79	0.93	1.57	1.47	1.47
10000	4.63	4.61	0.02	24.15	0.93	1.54	1.45	1.46
10500	4.60	4.59	0.02	23.22	0.97	1.43	1.37	1.39
11000	4.60	4.59	0.01	22.20	1.02	1.33	1.28	1.30
11500	4.61	4.59	0.02	21.61	1.06	1.24	1.22	1.23
12000	4.62	4.60	0.02	21.99	1.07	1.14	1.20	1.20
12500	4.66	4.65	0.01	23.40	1.04	1.07	1.21	1.21
13000	4.69	4.69	0.00	24.85	1.04	1.08	1.23	1.25
13500	4.72	4.74	0.03	24.76	1.15	1.09	1.24	1.27
14000	4.80	4.85	0.04	24.40	1.37	1.18	1.26	1.28
15000	5.05	5.07	0.02	27.52	1.84	1.36	1.35	1.37
16000	5.27	5.24	0.03	26.16	1.95	1.52	1.42	1.45
17000	5.44	5.39	0.05	24.06	2.05	1.62	1.45	1.43
18000	5.65	5.56	0.09	20.89	1.95	1.73	1.51	1.47
19000	5.61	5.54	0.07	19.87	1.53	1.51	1.50	1.55
20000	5.40	5.44	0.04	19.92	1.65	1.04	1.36	1.39
21000	5.58	5.66	0.08	20.78	2.45	1.36	1.32	1.38
22000	5.83	5.85	0.02	23.52	3.02	1.48	1.39	1.43
23000	6.15	6.11	0.04	21.77	3.13	1.64	1.49	1.42
24000	6.28	6.21	0.07	22.10	3.18	1.61	1.41	1.40
25000	6.30	6.22	0.08	21.70	3.10	1.44	1.35	1.47
26000	6.30	6.24	0.06	19.89	3.28	1.41	1.30	1.43
27000	6.29	6.20	0.09	18.81	3.76	1.25	1.22	1.22
28000	6.42	6.24	0.19	20.70	3.81	1.30	1.34	1.23

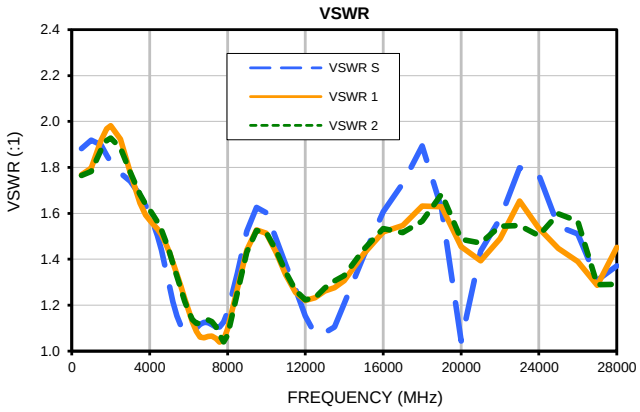
[1]Total Loss = Insertion Loss + 3dB Splitter Loss

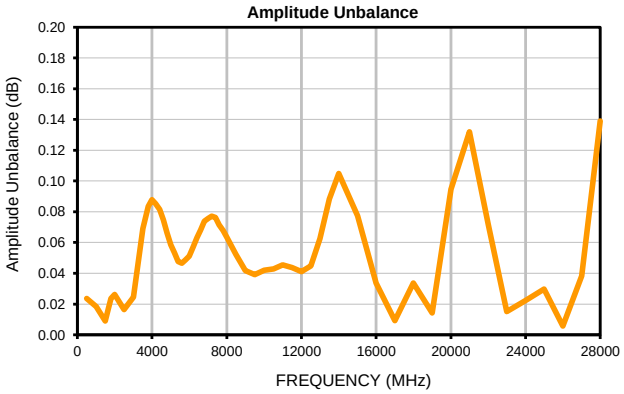
2 Way-0° Power Splitter/Combiner Die EP2K-D+

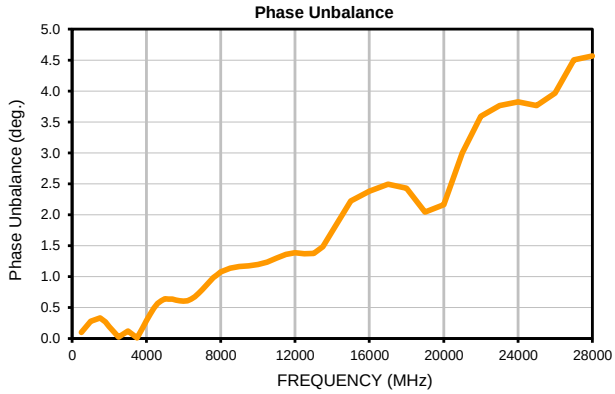
Typical Performance Curves

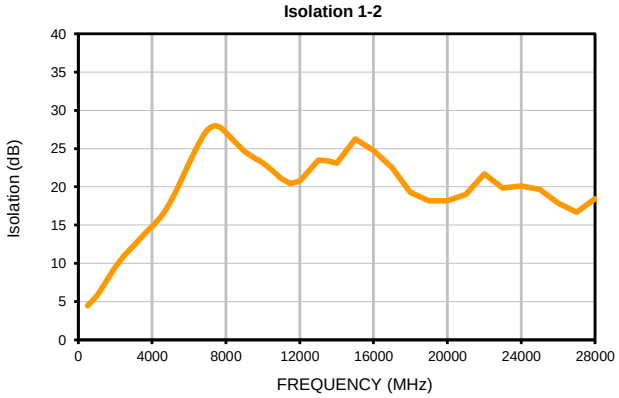
Full 2-Port Extension





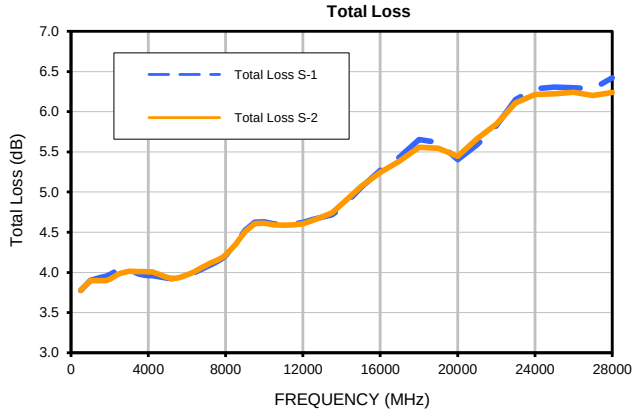


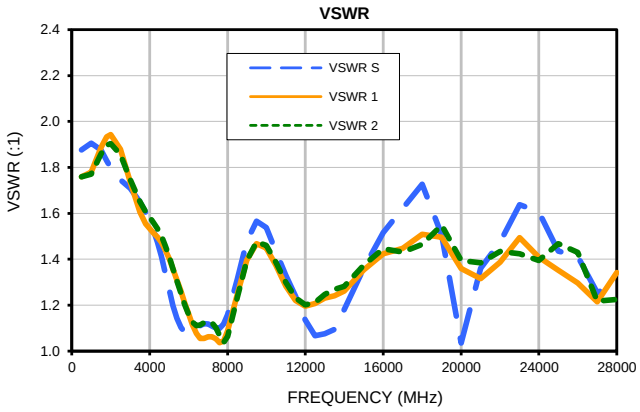


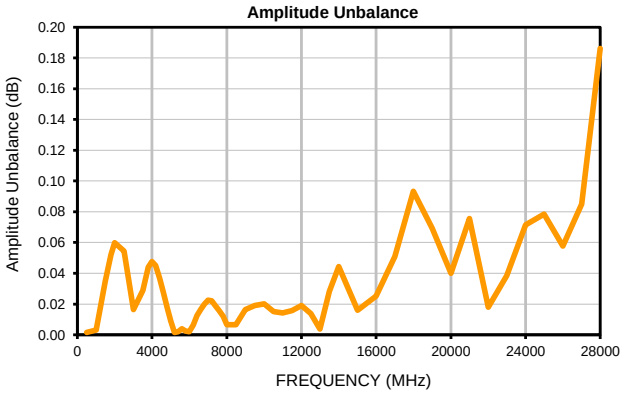


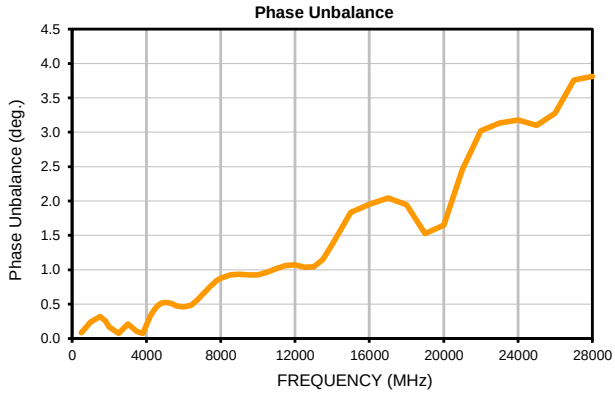
Typical Performance Curves

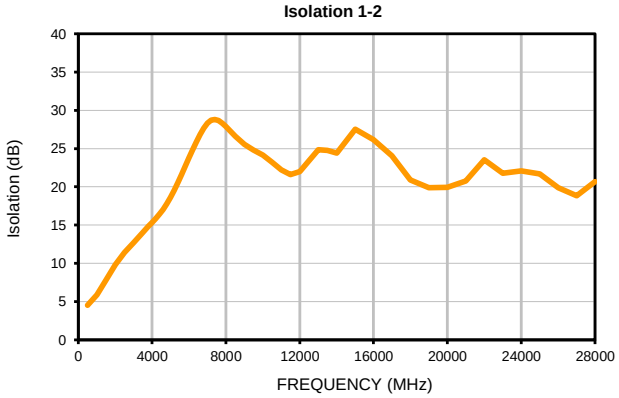
Without Full 2-Port Extension











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)	

This document and its contents are the property of Mini-Circuits.