

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 MHz. 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+

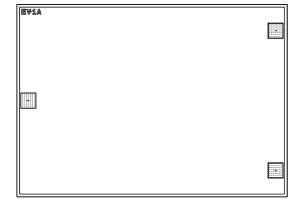
2 Way-0° 50Ω 2 to 26.5 GHz

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°C¹

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

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.

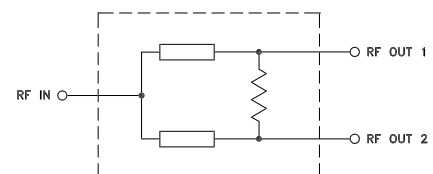
* ESD rating

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

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-OUT1 as splitter / RF-IN1 as combiner

Simplified Electrical Schematic



Die Layout

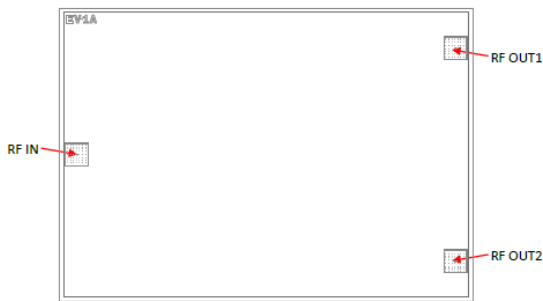


Fig 2. Die Layout

Bonding Pad Position
(Dimensions in μm , Typical)

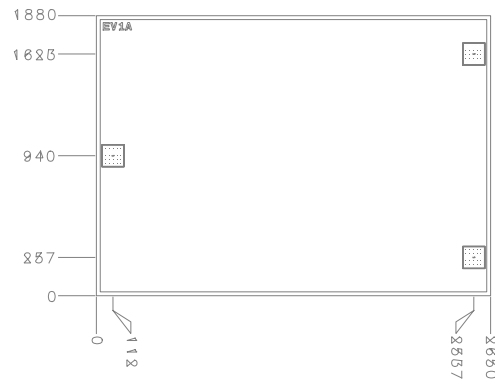


Fig 3. Bonding Pad Positions

Critical Dimensions

Parameter	Values
Die Thickness, μm	200
Die Width, μm	2650
Die Length, μm	1880
Bond Pad Size, μm	150 X 150

Assembly and Handling Procedure

- Storage**
Dice should be stored in a dry nitrogen purged desiccators or equivalent.
- 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.
- 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.
- 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



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

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⁾		AMP. UNBAL.	ISOLATION	PHASE UNBAL.	VSWR		
	(dB)	(dB)	(dB)	(dB)	(deg.)	S	(:1)	
	S-1	S-2		2-1			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

¹Total Loss = Insertion Loss + 3dB Splitter Loss



2 Way-0° Power Splitter/Combiner Die

EP2K-D+

Typical Performance Data

Without Full 2-Port Extension

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

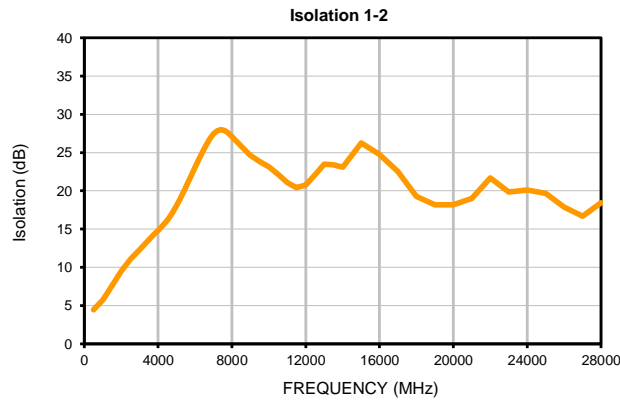
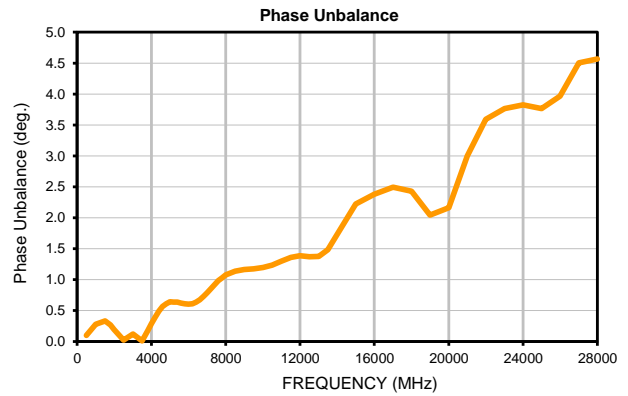
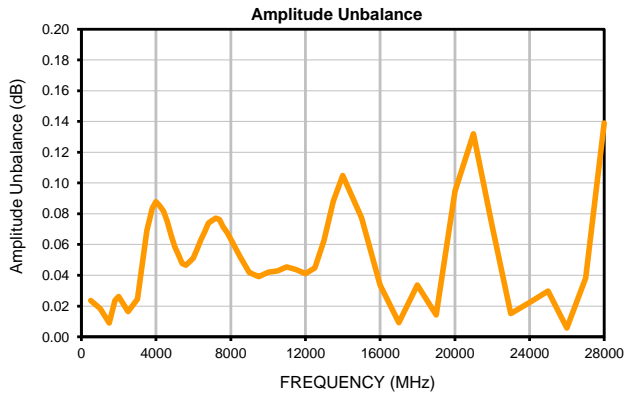
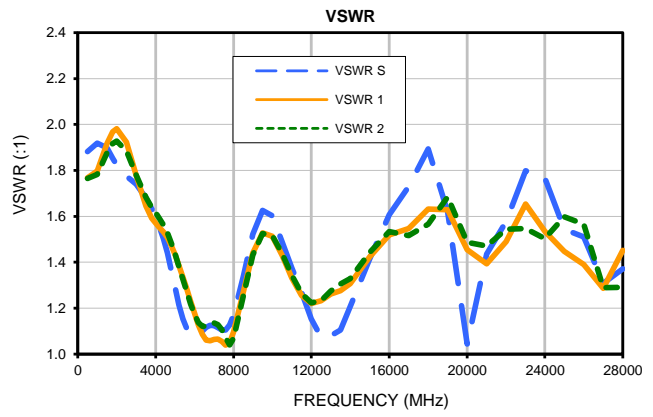
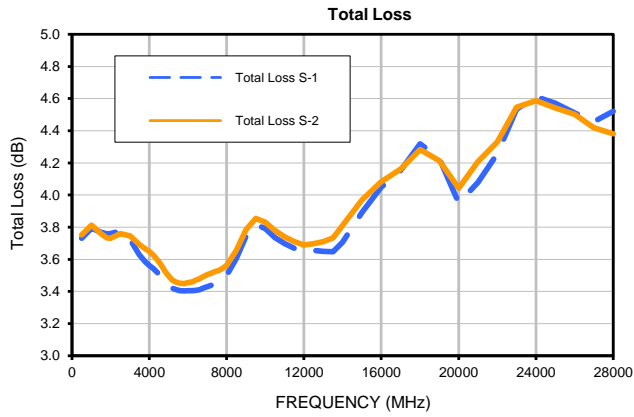
FREQ. (MHz)	TOTAL LOSS ⁽¹⁾		AMP. UNBAL.	ISOLATION	PHASE UNBAL.	VSWR		
	(dB)	(dB)	(dB)	(dB)	(deg.)	S	(:1)	
	S-1	S-2		2-1			1	2
500	3.78	3.78	0.00	4.53	0.08	1.88	1.76	1.76
1000	3.90	3.90	0.00	5.88	0.24	1.91	1.78	1.77
1500	3.93	3.90	0.03	7.82	0.32	1.88	1.89	1.86
1800	3.95	3.90	0.05	9.04	0.25	1.83	1.93	1.90
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

¹Total Loss = Insertion Loss + 3dB Splitter Loss



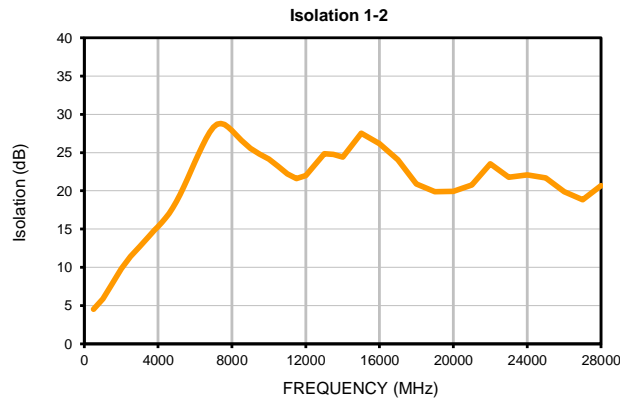
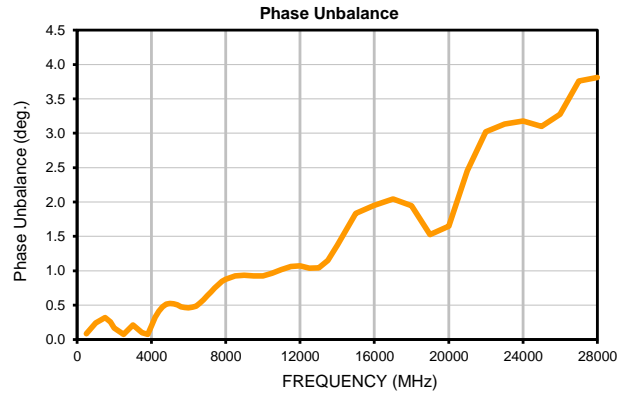
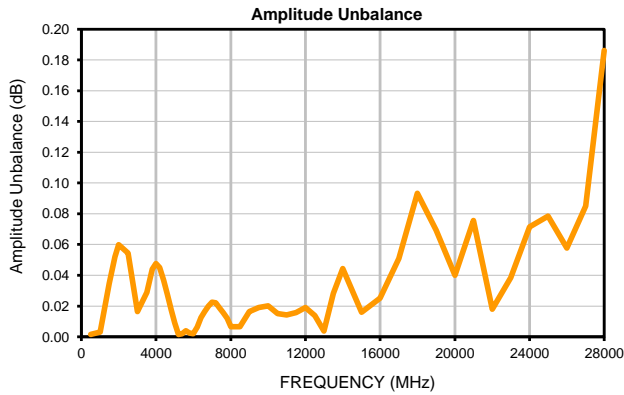
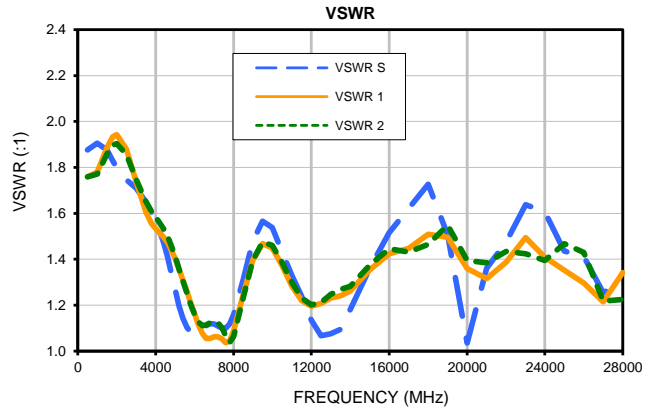
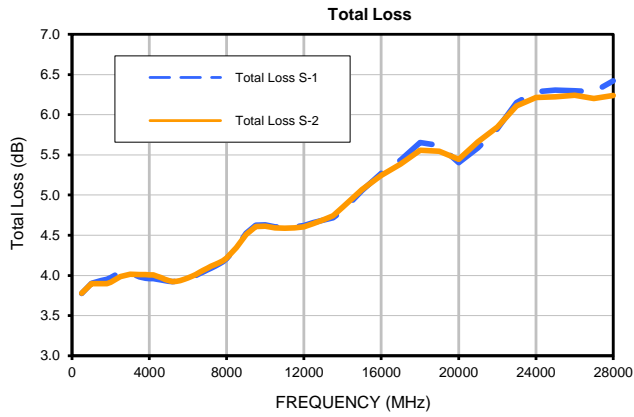
Typical Performance Curves

Full 2-Port Extension



Typical Performance Curves

Without Full 2-Port Extension





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 Ambient Environment	Refer to Individual Model Data Sheet
Storage Environment	20° to 35° C and 40 to 60% humidity (In Factory Shipped Package)	Individual Model Data Sheet