MMIC

Power Splitter/Combiner Die

EP4KA-D+

4 Way-0° 50Ω 10.7 to 31 GHz

The Big Deal

- Ultra-Wide Bandwidth, 10.7 to 31 GHz
- High Isolation, 19.3 dB typ.
- High Power Handling, 0.6W as a splitter/combiner

Product Overview

Mini-Circuits' EP4KA-D+ is a MMIC 4-way 0˚ splitter/combiner Die designed for wideband operation from 10.7 to 31 GHz supporting many applications requiring high performance across a wide frequency range including LTE bands through phased array radars, 5G, as well as instrumentation and more. This model provides excellent power handling up to 0.6W (as a splitter/combiner) with insertion loss, good isolation, and low phase and amplitude unbalance. Manufactured using GaAs IPD technology, the EP4KA-D+ provides a high level of ESD protection and excellent repeatability.

Key Features

Feature	Advantages
Wideband, 10.7 to 31 GHz	Ideal for wideband applications such as 5G, phased array radars, military and instrumentation.
Good amplitude and phase unbalance 0.2 dB typ 4.7° typ.	Excellent value in applications such as phased array radar.
DC Passing	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 hybrid chip and wire assemblies.

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Product Features

- Wide bandwidth, 10.7 to 31 GHz
- Excellent isolation, 19.3 dB typ.
- Excellent amplitude unbalance, 0.2 dB typ.
- DC Passing
- High ESD level

+RoHS Compliant

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

Ordering Information: Refer to Last Page

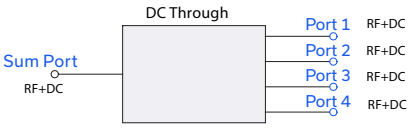
Typical Applications

- Instrumentation
- Radar
- Satellite communications
- 5G
- Phased array

General Description

Mini-Circuits' EP4KA-D+ is a MMIC 4-way 0˚ splitter/combiner Die designed for wideband operation from 10.7 to 31 GHz supporting many applications requiring high performance across a wide frequency range including LTE bands through phased array radars, 5G, as well as instrumentation and more. This model provides excellent power handling up to 0.6W (as a splitter/combiner) with low insertion loss, good isolation, and low phase and amplitude unbalance. Manufactured using GaAs IPD technology, the EP4KA-D+ provides a high level of ESD protection and excellent repeatability.

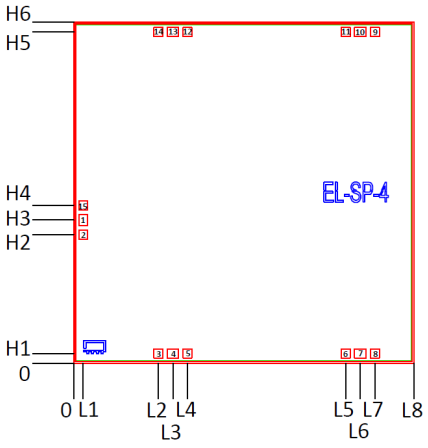
Simplified Schematic and Pad Description



Pad#	Function
1	Sum Port (RF IN)
4	Port 4 (RF OUT 4)
7	Port 3 (RF OUT 3)
10	Port 2 (RF OUT 2)
13	Port 1 (RF OUT 1)
2,3,5,6,8,9,11,12,14,15	Ground

Note: 1. Bond Pad material - Gold
2. Bottom of Die is ground - Gold plated

Bonding Pad Position



L1	L2	L3	L4	L5	L6	L7	L8	H1	H2	H3	H4	H5	H6	Thickness	Die Size	Pad Size 1	Pad Size 2,3,5,6,8 11,12,14 & 15	Pad Size 1-15
98	871	1021	1171	2799	2949	3099	3500	99	1320	1470	1620	3401	3500	100	3500X3500	92x117	92x92	117x92

Dimensions: µm

Electrical Specifications at 25°C[1]

Parameter		Frequency (GHz)	Min.	Typ.	Max.	Unit
Frequency Range			10.7		31	GHz
Insertion Loss, above 6.0 dB		10.7 - 13	—	0.4	—	dB
		13 - 22	—	0.6	—	
		22 - 31	—	1.1	—	
Isolation		10.7 - 13	—	13.1	—	dB
		13 - 22	—	19.3	—	
		22 - 31	—	21.5	—	
Phase Unbalance		10.7 - 13	—	2.7	—	Degree
		13 - 22	—	4.7	—	
		22 - 31	—	7.8	—	
Amplitude Unbalance		10.7 - 13	—	0.3	—	dB
		13 - 22	—	0.2	—	
		22 - 31	—	0.2	—	
VSWR (Port S)		10.7 - 13	—	1.2	—	:1
		13 - 22	—	1.3	—	
		22 - 31	—	1.2		
VSWR (Port 1-4)		10.7 - 13	—	1.4	—	:1
		13 - 22	—	1.3	—	
		22 - 31	—	1.2	—	
Power Handling	As a splitter	10.7 - 31	—	—	0.6	W
	As a combiner	10.7 - 31	—	—	0.6	

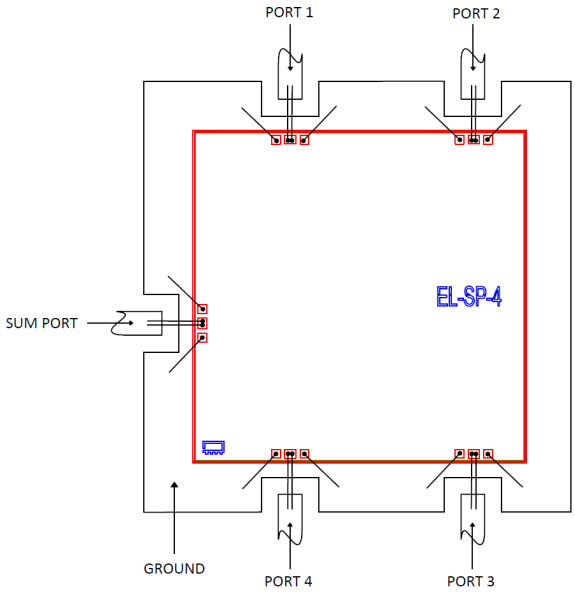
1. Measured on Mini-Circuits characterization test board TB-EP4KAC+ with die packaged in 5x5 mm, 32-lead MCLP package.

Maximum Ratings

Parameter	Ratings
Operating Temperature	-55°C to 105°C
DC Current	100mA

Permanent damage may occur if any of these limits are exceeded.

Assembly Diagram



Assembly and Handling Procedure

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

Additional Detailed Technical Information additional information is available on our dash board.		
Performance Data	Data Table	
	Swept Graphs	
	S-Parameter (S5P Files) Data Set with and without port extension(.zip file)	
Case Style	Die	
Die Ordering and packaging information (Note 5)	Quantity, Package	Model No.
	Small, Gel - Pak: 5,10	EP4KA-DG+
	Medium†, Partial wafer: 225 Max.	EP4KA-DP+
	†Available upon request contact sales representative	
	Refer to AN-60-067	
Environmental Ratings	ENV-80	

5. Known Good Dice ("KGD") means that the dice are taken from PCM good wafer and vissually inspected in question have been subjected to Mini-Circuits. 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 (Pass 2000V) in accordance with ANSI/ESD STM 5.1 - 2001

** Tested in industry standard, 5x5mm, 32-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.

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Typical Performance Data [2]

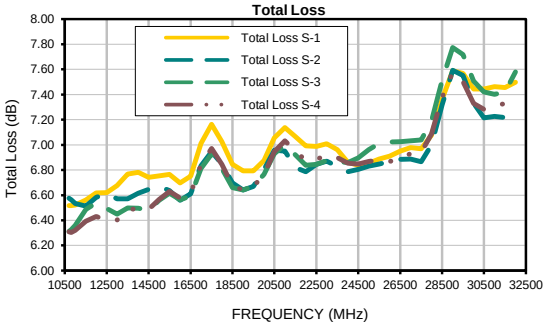
TEST CONDITIONS: Input Power = -10dBm @Temperature = +25°C

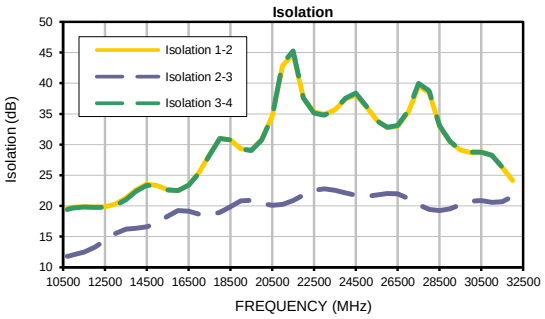
FREQ. (MHz)	TOTAL LOSS[1] (dB)				AMP. UNBAL. (dB)	PHASE UNBAL. (deg.)	ISOLATION (dB)			VSWR (:1)				
	S-1	S-2	S-3	S-4			1-2	2-3	3-4	S	1	2	3	4
10700	6.52	6.57	6.31	6.31	0.27	4.83	19.58	11.80	19.40	1.24	1.48	1.47	1.43	1.57
10800	6.52	6.56	6.32	6.30	0.26	4.84	19.69	11.88	19.52	1.25	1.47	1.44	1.42	1.54
11000	6.52	6.53	6.36	6.32	0.21	4.91	19.81	12.03	19.67	1.24	1.42	1.41	1.40	1.51
11500	6.56	6.51	6.49	6.39	0.17	5.35	19.87	12.50	19.84	1.32	1.32	1.29	1.32	1.40
12000	6.62	6.58	6.54	6.43	0.19	5.91	19.82	13.24	19.79	1.38	1.24	1.24	1.27	1.29
12500	6.62	6.61	6.49	6.40	0.22	6.13	19.86	14.35	19.77	1.33	1.22	1.28	1.29	1.22
13000	6.68	6.57	6.45	6.40	0.27	6.17	20.29	15.52	20.08	1.30	1.32	1.39	1.39	1.27
13500	6.77	6.57	6.50	6.48	0.28	6.05	21.30	16.21	21.04	1.39	1.45	1.53	1.51	1.42
14000	6.78	6.61	6.50	6.49	0.29	5.91	22.67	16.38	22.40	1.37	1.53	1.58	1.55	1.51
14500	6.74	6.65	6.48	6.49	0.26	5.75	23.57	16.61	23.36	1.26	1.51	1.55	1.48	1.48
15000	6.75	6.67	6.56	6.57	0.19	5.89	23.33	17.29	23.22	1.28	1.41	1.46	1.40	1.43
15500	6.77	6.64	6.61	6.63	0.15	6.21	22.67	18.34	22.62	1.39	1.26	1.34	1.29	1.33
16000	6.70	6.56	6.56	6.58	0.14	6.63	22.51	19.23	22.50	1.39	1.10	1.17	1.16	1.16
16500	6.75	6.61	6.59	6.62	0.16	7.01	23.43	19.15	23.37	1.47	1.12	1.13	1.19	1.09
17000	7.01	6.83	6.81	6.84	0.20	7.27	25.45	18.65	25.34	1.66	1.33	1.34	1.35	1.27
17500	7.16	6.94	6.93	6.97	0.24	7.26	28.37	18.52	28.24	1.66	1.47	1.49	1.46	1.42
18000	7.02	6.85	6.81	6.85	0.21	7.32	31.00	18.97	31.00	1.44	1.48	1.54	1.46	1.46
18500	6.84	6.70	6.66	6.67	0.19	7.49	30.76	19.89	30.74	1.25	1.41	1.51	1.41	1.42
19000	6.79	6.64	6.64	6.64	0.15	7.63	29.33	20.80	29.26	1.28	1.33	1.41	1.32	1.33
19500	6.79	6.67	6.67	6.67	0.12	7.86	29.14	20.94	29.03	1.28	1.19	1.26	1.17	1.18
20000	6.88	6.80	6.76	6.76	0.11	8.11	30.87	20.42	30.69	1.34	1.01	1.07	1.01	1.02
20500	7.06	6.96	6.93	6.95	0.13	8.35	34.62	20.10	34.57	1.53	1.17	1.16	1.16	1.18
21000	7.14	6.95	7.00	7.03	0.19	8.56	42.83	20.26	43.16	1.58	1.34	1.33	1.28	1.34
21500	7.07	6.82	6.92	6.95	0.25	8.80	44.81	20.90	45.27	1.41	1.45	1.43	1.35	1.44
22000	6.99	6.79	6.84	6.88	0.20	9.34	37.59	21.78	37.55	1.20	1.49	1.48	1.38	1.48
22500	6.99	6.84	6.84	6.88	0.14	9.49	35.32	22.54	35.10	1.20	1.50	1.49	1.40	1.51
23000	7.01	6.87	6.87	6.92	0.14	9.49	34.92	22.79	34.81	1.27	1.49	1.42	1.39	1.50
23500	6.96	6.83	6.87	6.90	0.13	9.85	35.66	22.56	35.66	1.21	1.39	1.34	1.30	1.42
24000	6.86	6.79	6.86	6.85	0.08	10.25	37.41	22.11	37.58	1.07	1.24	1.21	1.20	1.31
24500	6.84	6.81	6.90	6.85	0.09	10.56	38.06	21.73	38.40	1.10	1.15	1.14	1.12	1.21
25000	6.85	6.83	6.96	6.87	0.13	10.75	36.20	21.56	36.23	1.20	1.09	1.11	1.11	1.13
25500	6.89	6.85	7.01	6.88	0.16	11.05	33.97	21.77	33.87	1.20	1.08	1.12	1.13	1.06
26000	6.91	6.87	7.02	6.87	0.16	11.26	32.73	22.01	32.81	1.10	1.12	1.15	1.16	1.04
26500	6.95	6.89	7.02	6.89	0.14	11.31	33.03	21.96	33.11	1.06	1.17	1.20	1.18	1.11
27000	6.98	6.89	7.03	6.93	0.15	11.42	35.24	21.21	35.50	1.16	1.18	1.20	1.18	1.18
27500	6.97	6.87	7.04	6.94	0.17	11.59	39.47	20.22	39.99	1.21	1.14	1.12	1.11	1.17
28000	7.08	7.00	7.19	7.09	0.19	11.91	38.49	19.42	38.75	1.38	1.19	1.11	1.09	1.14
28500	7.36	7.32	7.51	7.38	0.20	12.55	33.08	19.22	33.13	1.64	1.31	1.26	1.20	1.20
29000	7.59	7.59	7.77	7.57	0.20	12.92	30.40	19.55	30.52	1.73	1.43	1.43	1.35	1.32
29500	7.57	7.55	7.72	7.50	0.22	13.33	29.12	20.21	29.13	1.55	1.55	1.60	1.48	1.42
30000	7.44	7.33	7.51	7.33	0.18	13.48	28.71	20.79	28.79	1.28	1.61	1.71	1.58	1.49
30500	7.44	7.22	7.42	7.28	0.23	13.30	28.85	20.90	28.76	1.26	1.71	1.79	1.66	1.57
31000	7.46	7.23	7.40	7.32	0.24	13.27	28.28	20.59	28.28	1.32	1.65	1.73	1.62	1.57
31500	7.46	7.22	7.42	7.33	0.24	13.14	26.31	20.67	26.35	1.21	1.52	1.59	1.52	1.49
32000	7.50	7.22	7.58	7.40	0.36	13.32	24.14	21.52	24.27	1.18	1.38	1.41	1.38	1.37

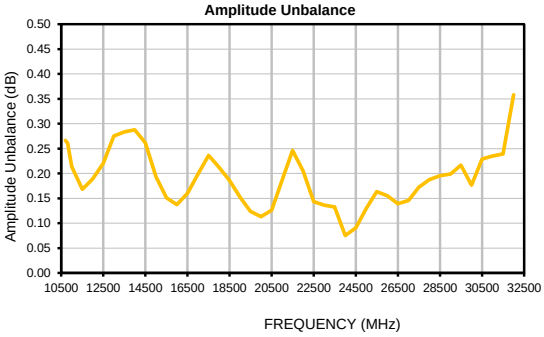
[1] Total Loss = Insertion Loss + 6dB Splitter Loss

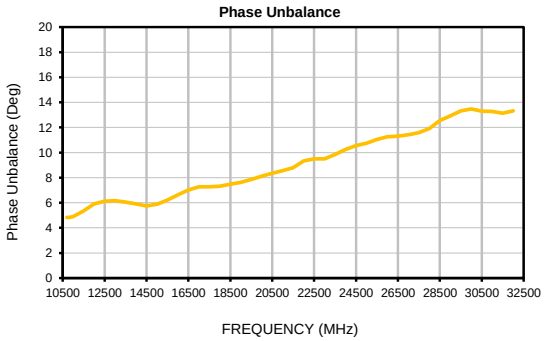
[2] Testdata of Die packaged in 5x5 mm, 32-lead MCLP package.

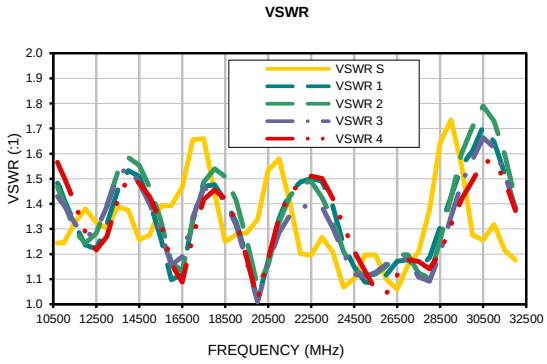
Typical Performance Data [2]











[2] Testdata of Die packaged in 5x5 mm, 32-lead MCLP package.

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)	

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