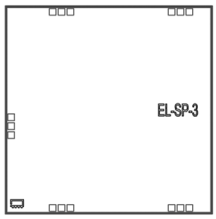
MMIC

Power Splitter/Combiner Die EP4RKU-D+

4 Way-0° 50Ω DC to 18 GHz



The Big Deal

- Ultra-Wide Bandwidth, DC to 18 GHz
- High Isolation, 20 dB typ. at 9 GHz

Product Overview

Mini-Circuits' EP4RKU-D+ is a MMIC 4-way 0˚ splitter/combiner Die designed for wideband operation from DC to 18 GHz supporting many applications requiring high performance across a wide frequency range including all the LTE bands through WiMax an WiFi, as well as instrumentation and more. This model provides low insertion loss, good isolation, and low phase and amplitude unbalance. Manufactured using GaAs IPD technology, the EP4RKU-D+ provides a high level of ESD protection and excellent repeatability.

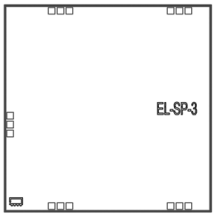
Key Features

Feature	Advantages
Wideband, DC to 18 GHz	One power splitter can be used in all the LTE bands through WiMAX and WiFi, saving component count. Also ideal for wideband applications such as military and instrumentation.
Excellent amplitude and phase unbalance 0.2 dB typ at 18 GHz 5° typ. at 18 GHz	Excellent value in applications such as phased array radar
Unpackaged Die	Enables user to integrate it directly into hybrids.

MMIC

Power Splitter/Combiner Die EP4RKU-D+

2 Way-0° 50Ω DC to 18 GHz



Product Features

- Wide bandwidth, DC to 18 GHz
- Excellent isolation, 20 dB typ. at 9 GHz
- Excellent amplitude unbalance, 0.3 dB typ. up to 9 GHz
- Good phase unbalance, 2 deg. typ. at 9 GHz
- High ESD level
- Patent pending

+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

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

General Description

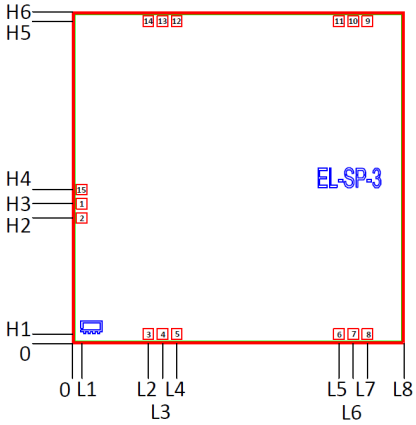
Mini-Circuits' EP4RKU-D+ is a MMIC 4-way 0˚ splitter/combiner Die designed for wideband operation from DC to 18 GHz supporting many applications requiring high performance across a wide frequency range including all the LTE bands through WiMax an WiFi, as well as instrumentation and more. This model provides low insertion loss, good isolation, and low phase and amplitude unbalance. Manufactured using GaAs IPD technology, the EP4RKU-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 1-15
98	799	949	1099	2811	2961	3111	3500	92	1327	1477	1627	3400	3500	100	3500X3500	112X112

Electrical Specifications at 25°C[1]

Parameter		Frequency (GHz)	Min.	Typ.	Max.	Unit
Frequency Range			DC		18	GHz
Insertion Loss, above 6.0 dB		DC - 4	—	4.2	—	dB
		4 - 18	—	3.4	—	
Isolation		DC - 4	—	12.1	—	dB
		4 - 18	—	18.8	—	
Phase Unbalance		DC - 4	—	0.3	—	Degree
		4 - 18	—	1.9	—	
Amplitude Unbalance		DC - 4	—	0.1	—	dB
		4 - 18	—	0.2	—	
VSWR (Port S)		DC - 4	—	1.8	—	:1
		4 - 18	—	1.4	—	
VSWR (Port 1-4)		DC - 4	—	1.6	—	:1
		4 - 18	—	1.5	—	
Power Handling	As a splitter	DC - 18	—	—	0.6	W
	As a combiner	DC - 18	—	—	0.6	

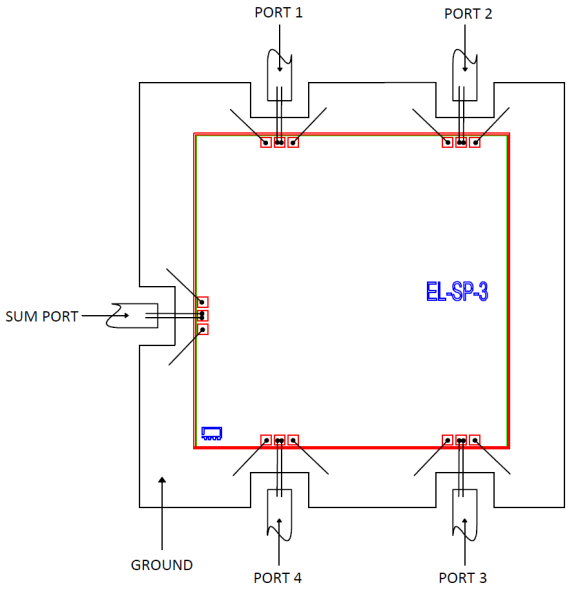
1. Measured on Mini-Circuits characterization test board TB-EP4KUC+. Die packaged in 5x5 mm, 32-lead MCLP package.

Maximum Ratings

Parameter	Ratings
Operating Temperature	-55°C to 105°C

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	EP4RKU-DG+
	Medium†, Partial wafer: 225 Max.	EP4RKU-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.

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.

4 Way-0° Power Splitter/Combiner Die

EP4RKU-D+

Typical Performance Data

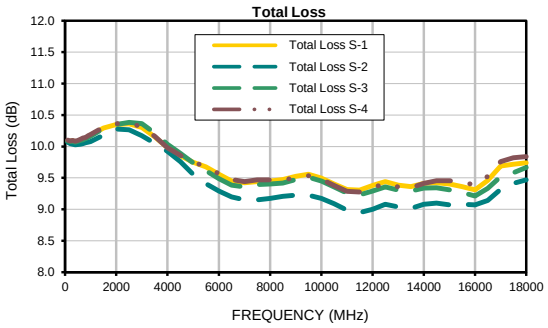
TEST CONDITIONS: Input Power = -10dBm @Temperature = +25°C

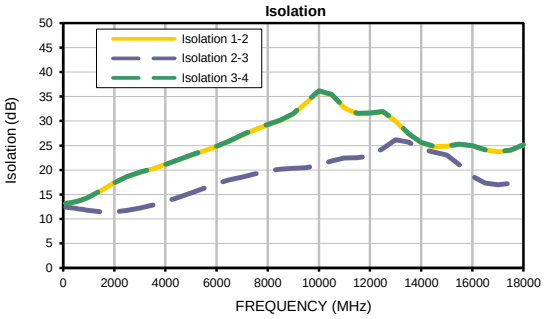
FREQ. (MHz)	TOTAL LOSS[1] (dB)				AMP. UNBAL. (dB)	PHASE UNBAL. (deg.)	ISOLATION (dB)			VSWR (:1)				
	S-1	S-2	S-3	S-4			1-2	2-3	3-4	S	1	2	3	4
100	10.09	10.07	10.09	10.10	0.03	0.13	13.17	12.39	13.18	1.84	1.10	1.10	1.10	1.10
200	10.08	10.05	10.08	10.09	0.04	0.13	13.22	12.36	13.22	1.83	1.11	1.11	1.11	1.11
300	10.09	10.04	10.08	10.10	0.06	0.20	13.28	12.29	13.29	1.82	1.13	1.13	1.13	1.13
400	10.07	10.03	10.07	10.08	0.06	0.26	13.40	12.23	13.42	1.79	1.16	1.17	1.16	1.16
500	10.08	10.03	10.08	10.10	0.07	0.28	13.51	12.15	13.52	1.79	1.19	1.19	1.19	1.19
600	10.10	10.04	10.10	10.12	0.08	0.29	13.65	12.07	13.66	1.79	1.22	1.22	1.22	1.22
700	10.12	10.05	10.11	10.13	0.09	0.39	13.82	11.99	13.83	1.79	1.25	1.26	1.25	1.25
800	10.13	10.06	10.12	10.15	0.09	0.45	14.01	11.91	14.02	1.78	1.29	1.29	1.28	1.28
900	10.16	10.07	10.14	10.17	0.10	0.45	14.22	11.82	14.23	1.77	1.32	1.32	1.31	1.32
1000	10.18	10.08	10.16	10.19	0.11	0.47	14.46	11.75	14.47	1.77	1.36	1.37	1.35	1.36
1500	10.29	10.18	10.29	10.31	0.13	0.65	15.86	11.44	15.89	1.78	1.56	1.55	1.56	1.56
2000	10.35	10.28	10.35	10.36	0.08	0.85	17.39	11.44	17.43	1.80	1.70	1.71	1.70	1.71
2500	10.36	10.27	10.38	10.37	0.12	1.02	18.60	11.73	18.65	1.81	1.77	1.81	1.77	1.77
3000	10.30	10.17	10.36	10.31	0.19	1.41	19.48	12.21	19.54	1.80	1.76	1.82	1.78	1.76
3500	10.15	10.05	10.21	10.16	0.17	1.94	20.25	12.81	20.29	1.78	1.70	1.77	1.72	1.69
4000	9.98	9.92	10.04	9.98	0.11	2.40	21.11	13.55	21.15	1.76	1.64	1.71	1.66	1.62
4500	9.85	9.76	9.89	9.86	0.13	2.92	22.07	14.40	22.10	1.75	1.57	1.62	1.60	1.57
5000	9.75	9.56	9.74	9.76	0.20	3.29	23.00	15.29	23.06	1.70	1.53	1.56	1.54	1.53
5500	9.67	9.41	9.61	9.67	0.27	3.41	23.92	16.25	23.98	1.65	1.51	1.53	1.50	1.52
6000	9.56	9.29	9.49	9.57	0.28	3.40	24.82	17.19	24.87	1.58	1.50	1.48	1.47	1.51
6500	9.45	9.20	9.39	9.47	0.27	3.53	25.85	17.98	25.94	1.49	1.48	1.46	1.45	1.51
7000	9.42	9.15	9.36	9.44	0.29	3.69	27.08	18.57	27.19	1.44	1.47	1.47	1.45	1.51
7500	9.44	9.15	9.39	9.47	0.32	3.91	28.24	19.19	28.34	1.38	1.48	1.48	1.47	1.52
8000	9.45	9.18	9.40	9.47	0.29	4.19	29.23	19.79	29.29	1.27	1.49	1.48	1.46	1.50
8500	9.47	9.21	9.42	9.47	0.27	4.38	30.08	20.19	30.18	1.12	1.51	1.48	1.43	1.47
9000	9.53	9.23	9.47	9.51	0.30	4.50	31.44	20.33	31.52	1.09	1.50	1.48	1.45	1.46
9500	9.56	9.23	9.51	9.53	0.33	4.75	33.70	20.46	33.84	1.17	1.46	1.43	1.42	1.43
10000	9.50	9.17	9.45	9.48	0.33	5.06	36.12	20.99	36.19	1.18	1.37	1.35	1.33	1.33
10500	9.40	9.09	9.36	9.38	0.31	5.32	35.30	21.86	35.43	1.12	1.25	1.24	1.25	1.24
11000	9.32	8.99	9.26	9.29	0.33	5.62	32.68	22.42	32.80	1.12	1.16	1.12	1.18	1.17
11500	9.31	8.95	9.23	9.28	0.36	5.85	31.45	22.48	31.57	1.27	1.15	1.09	1.11	1.13
12000	9.38	9.00	9.29	9.35	0.38	6.04	31.55	22.87	31.62	1.45	1.23	1.18	1.15	1.19
12500	9.44	9.08	9.36	9.41	0.36	6.23	31.86	24.37	31.92	1.54	1.30	1.28	1.23	1.26
13000	9.39	9.04	9.31	9.36	0.35	6.45	29.98	26.17	30.09	1.34	1.32	1.30	1.23	1.27
13500	9.36	9.02	9.29	9.34	0.34	6.71	27.35	25.72	27.46	1.09	1.31	1.26	1.21	1.26
14000	9.41	9.08	9.34	9.41	0.33	7.05	25.57	24.32	25.63	1.15	1.31	1.24	1.18	1.25
14500	9.42	9.10	9.34	9.46	0.36	7.35	24.76	23.67	24.84	1.19	1.26	1.22	1.15	1.22
15000	9.40	9.07	9.31	9.46	0.38	7.53	24.82	23.06	24.90	1.22	1.24	1.24	1.17	1.23
15500	9.36	9.08	9.27	9.44	0.36	7.75	25.21	21.08	25.29	1.28	1.26	1.26	1.20	1.24
16000	9.31	9.07	9.21	9.39	0.32	7.99	24.91	18.73	24.98	1.24	1.16	1.19	1.12	1.14
16500	9.46	9.14	9.33	9.53	0.38	8.20	24.11	17.32	24.16	1.29	1.08	1.15	1.08	1.10
17000	9.69	9.32	9.52	9.76	0.44	8.15	23.69	16.96	23.75	1.41	1.25	1.28	1.21	1.23
17500	9.72	9.41	9.58	9.82	0.41	8.44	23.99	17.29	24.07	1.28	1.37	1.39	1.31	1.33
18000	9.74	9.47	9.67	9.84	0.37	8.81	25.09	17.45	25.16	1.13	1.43	1.41	1.36	1.38

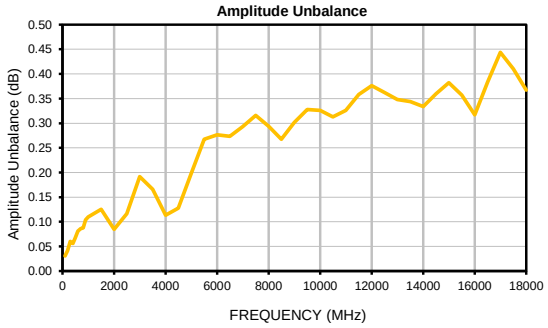
[1] Total Loss = Insertion Loss + 6dB Splitter Loss

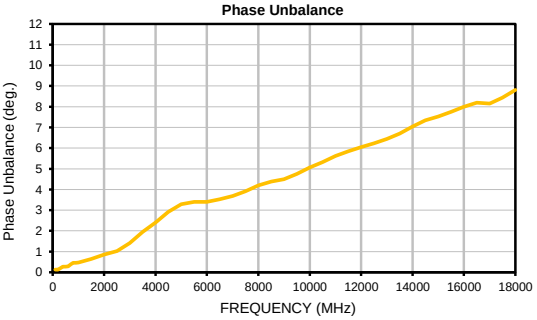
4 Way-0° Power Splitter/Combiner Die EP4RKU-D+

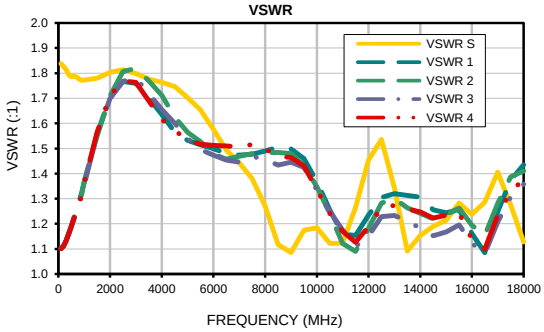
Typical Performance Curves











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)	