

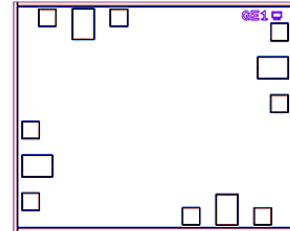
MMIC

# Bi-Directional Coupler Die EBDC19-KA-D+

50Ω 5 to 43.5 GHz

## The Big Deal

- Ultra-Wide Bandwidth, 5-43.5 GHz
- Excellent Coupling Flatness  $\pm 0.6$  dB typ over 20-40 GHz



## Product Overview

Mini-Circuits' EBDC19-KA-D+ is a Bi-Directional Coupler die designed for wideband operation from 5 to 43.5 GHz with a nominal coupling of 18.7 dB over 20-40 GHz. Manufactured using GaAs IPD technology, it has excellent repeatability and excellent reliability.

## Key Features

Feature	Advantages
Wideband, 5 to 43.5 GHz	A single Directional Coupler can be used in many applications, saving component count. Also ideal for applications such as 5G, military and instrumentation.
DC Passing up to 1.3A	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.



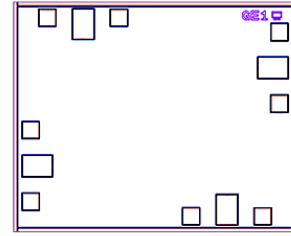
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# Bi-Directional Coupler Die EBDC19-KA-D+

50Ω 5 to 43.5 GHz

## Product Features

- Wide bandwidth, 5 to 43.5 GHz
- Excellent Coupling Flatness,  $\pm 0.6$  dB over 20 to 40 GHz
- Nominal Coupling 18.6 dB over 20 to 40 GHz
- DC passing



**+RoHS Compliant**

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

## Typical Applications

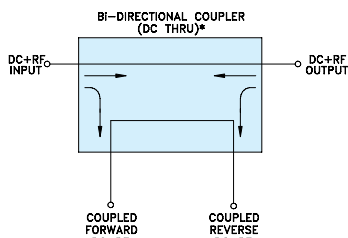
- 5G
- Instrumentation
- Military

Ordering Information: Refer to Last Page

## General Description

Mini-Circuits' EBDC19-KA-D+ is a Bi-Directional Coupler die designed for wideband operation from 5 to 43.5 GHz with a nominal coupling of 18.7 dB over 20-40 GHz. Manufactured using GaAs IPD technology, it has excellent repeatability and excellent reliability.

## Simplified Schematic and Pad description



Pad#	Function
1	Input
2	Output
4	Couple Forward
3	Couple Reverse
Die Bottom	Ground

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

## Bonding Pad Position



Dimensions in  $\mu\text{m}$ , Typical

L1	L2	L3	L4	L5	H1	H2	H3	H4	H5	Die Thickness	Bond Pad #1, #3 Size	Bond Pad #2, #4 Size
134	392	1199	1456	1590	124	370	921	1166	1290	100	117 x 167	167 x 117



**Electrical Specifications<sup>1</sup> at 25°C**

Parameter	Frequency (GHz)	Min.	Typ.	Max.	Units
Frequency Range		5		43.5	GHz
Main Line Loss	5 - 10		0.3		dB
	10 - 20		0.6		
	20 - 40		0.6		
	40 - 43.5		0.6		
Nominal Coupling	5 - 10		25.6		dB
	10 - 20		21.0		
	20 - 40		18.7		
	40 - 43.5		19.5		
Coupling Flatness ( $\pm$ )	5 - 10		2.8		dB
	10 - 20		1.9		
	20 - 40		0.6		
	40 - 43.5		0.6		
Directivity	5 - 10		8.8		dB
	10 - 25		9.1		
	25 - 30		10		
	30 - 43.5		6.0		
Return Loss - Input / Output	5 - 10		15.6		dB
	10 - 20		13.7		
	20 - 40		14.7		
	40 - 43.5		16.0		
Return loss - CPL-FWD/CPL-REV	5 - 10		15.8		dB
	10 - 20		14.1		
	20 - 40		14.8		
	40 - 43.5		15.8		

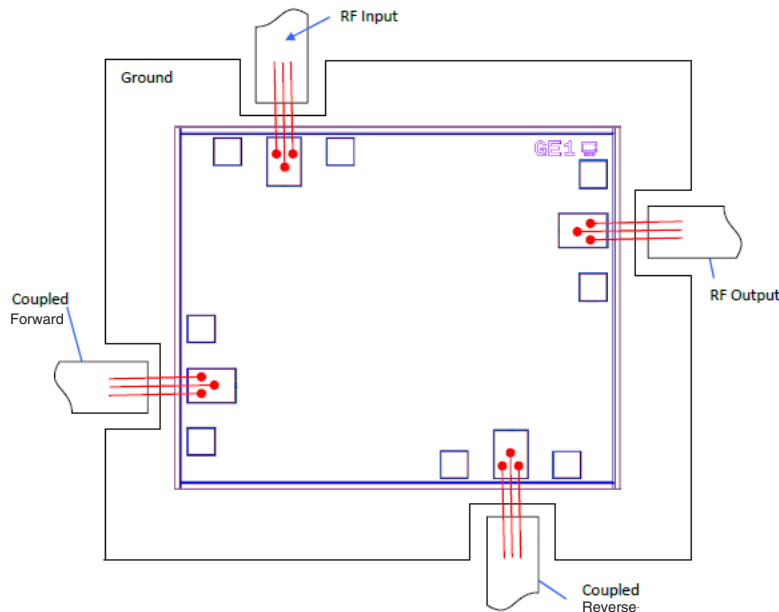
1. Measured on Die using MPI TITAN 200 $\mu$ m GSG probe

**Absolute Maximum Ratings<sup>2</sup>**

Parameter	Ratings
Operating Temperature	-40°C to 85°C
Power Input	1W Max.
Power into Coupled Port	1W Max.
DC Current	1.3A at 25°C. Derate linearly to 0.65A at 85°C

2. Permanent damage may occur if any of these limits are exceeded.  
Electrical maximum ratings are not intended for continuous normal operation.

## Assembly Diagram



Note: Ground bond wires are optional

## Assembly and Handling Procedure

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

<b>Additional Detailed Technical Information</b> <i>additional information is available on our dash board.</i>	
<b>Performance Data</b>	Data Table
	Swept Graphs
	S-Parameter (S4P Files)
<b>Case Style</b>	Die
<b>Die Ordering and packaging information</b>	Quantity, Package <span style="float: right;">Model No.</span>
	Small, Gel - Pak: 5, KGD* <span style="float: right;">EBDC19-KA-DG+</span> Medium†, Partial wafer: 350 KGD* <span style="float: right;">EBDC19-KA-DP+</span>
	†Available upon request contact sales representative
	Refer to <a href="#">AN-60-067</a>
<b>Environmental Ratings</b>	ENV80

\*Known Good Dice ("KGD") means that the dice are taken from PCM good wafer and visually inspected according to Mini-Circuits inspection criteria. While this is not definitive, 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 1C (Pass 1000V) in accordance with ANSI/ESD STM 5.1 - 2001

### 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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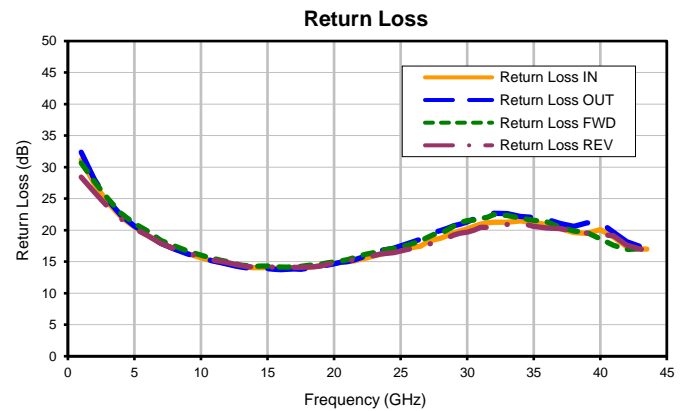
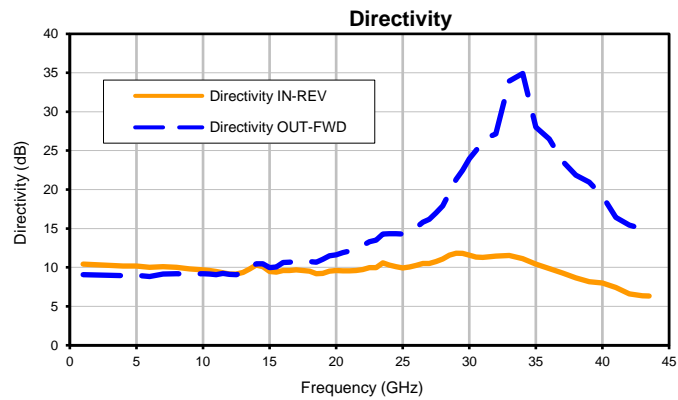
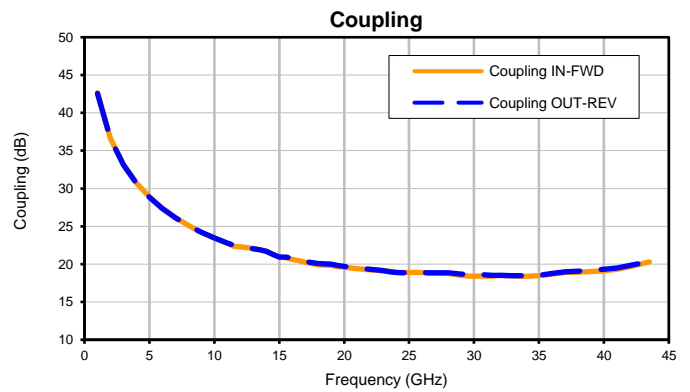
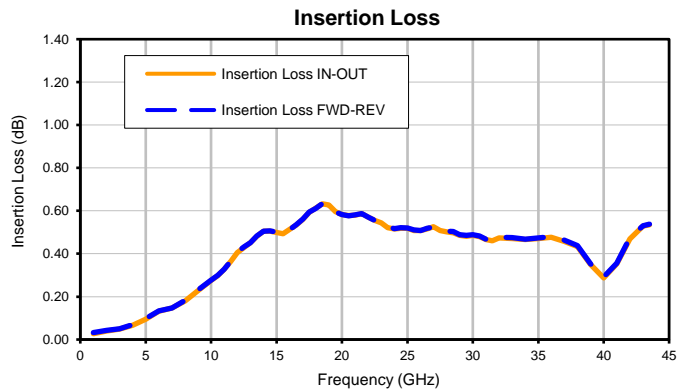


## Typical Performance Data

TEST CONDITIONS: INPUT POWER = -10 dBm @Temperature = +25°C

FREQ. (GHz)	INSERTION LOSS		COUPLING		DIRECTIVITY		RETURN LOSS			
	(dB)		(dB)		(dB)		(dB)			
	IN-OUT	FWD-REV	IN-FWD	OUT-REV	IN-REV	OUT-FWD	IN	OUT	FWD	REV
1.0	0.03	0.03	42.63	42.58	10.41	9.05	31.14	32.37	30.67	28.42
2.0	0.04	0.04	36.65	36.60	10.33	9.01	27.36	28.07	27.73	26.05
3.0	0.05	0.05	33.18	33.13	10.27	9.00	24.35	24.78	25.02	23.68
4.0	0.07	0.07	30.75	30.70	10.18	8.96	22.10	22.36	22.68	21.80
5.0	0.10	0.10	28.89	28.85	10.17	9.00	20.48	20.64	21.03	20.26
6.0	0.13	0.13	27.40	27.37	10.03	8.83	19.12	19.28	19.84	19.10
7.0	0.15	0.15	26.18	26.13	10.10	9.16	17.93	17.92	18.38	17.89
8.0	0.18	0.18	25.10	25.08	10.02	9.20	17.03	17.02	17.50	17.06
9.0	0.23	0.23	24.20	24.22	9.81	9.15	16.28	16.25	16.71	16.36
10.0	0.28	0.28	23.40	23.47	9.70	9.20	15.63	15.60	16.01	15.75
10.5	0.30	0.30	23.12	23.11	9.60	9.15	15.32	15.30	15.71	15.43
11.0	0.33	0.33	22.76	22.80	9.46	9.07	15.08	15.06	15.48	15.24
11.5	0.36	0.37	22.36	22.48	9.30	9.22	14.87	14.85	15.21	15.06
12.0	0.41	0.41	22.26	22.34	9.14	9.13	14.66	14.62	15.00	14.86
12.5	0.43	0.43	22.21	22.19	9.13	9.08	14.48	14.37	14.70	14.63
13.0	0.45	0.45	22.08	22.03	9.37	9.36	14.29	14.15	14.48	14.39
13.5	0.48	0.48	21.92	21.92	9.80	9.79	14.11	13.98	14.35	14.22
14.0	0.51	0.51	21.73	21.69	10.32	10.48	14.04	13.87	14.28	14.18
14.5	0.51	0.51	21.25	21.30	10.11	10.48	14.07	13.88	14.30	14.20
15.0	0.50	0.50	20.91	20.93	9.48	9.97	14.07	13.90	14.29	14.23
15.5	0.49	0.49	20.85	20.91	9.38	10.06	13.94	13.80	14.22	14.10
16.0	0.51	0.51	20.65	20.79	9.62	10.63	13.91	13.74	14.17	14.06
16.5	0.53	0.53	20.45	20.56	9.62	10.68	13.93	13.78	14.13	14.10
17.0	0.56	0.56	20.23	20.36	9.69	10.76	13.96	13.84	14.21	14.11
17.5	0.59	0.59	20.09	20.22	9.59	10.77	13.95	13.82	14.25	14.10
18.0	0.61	0.61	19.91	20.10	9.51	10.75	14.08	13.96	14.42	14.15
18.5	0.63	0.63	19.88	20.03	9.20	10.69	14.18	14.06	14.51	14.20
19.0	0.63	0.63	19.81	19.98	9.25	11.06	14.38	14.27	14.63	14.32
19.5	0.60	0.59	19.66	19.81	9.52	11.50	14.53	14.45	14.81	14.60
20.0	0.58	0.58	19.61	19.71	9.59	11.63	14.71	14.68	14.98	14.78
20.5	0.58	0.58	19.48	19.58	9.57	11.90	14.91	14.90	15.10	14.98
21.0	0.58	0.58	19.39	19.47	9.54	12.10	15.00	15.03	15.31	15.12
21.5	0.59	0.59	19.32	19.42	9.60	12.43	15.12	15.26	15.63	15.32
22.0	0.57	0.57	19.25	19.33	9.71	12.81	15.36	15.63	15.98	15.53
22.5	0.56	0.56	19.21	19.24	9.99	13.31	15.63	16.02	16.24	15.75
23.0	0.54	0.55	19.11	19.15	9.98	13.50	15.94	16.36	16.42	15.96
23.5	0.52	0.53	19.06	19.00	10.60	14.30	16.16	16.79	16.81	16.25
24.0	0.52	0.52	18.91	18.90	10.30	14.34	16.37	16.96	16.95	16.36
24.5	0.52	0.52	18.88	18.87	10.09	14.33	16.59	17.17	17.09	16.44
25.0	0.52	0.52	18.89	18.90	9.94	14.31	16.81	17.51	17.42	16.71
25.5	0.51	0.51	18.89	18.88	10.07	14.66	17.11	17.88	17.61	16.92
26.0	0.51	0.51	18.88	18.90	10.25	15.10	17.30	18.19	17.94	17.14
26.5	0.52	0.52	18.82	18.86	10.51	15.79	17.47	18.59	18.32	17.41
27.0	0.53	0.52	18.79	18.87	10.52	16.16	18.09	19.16	18.83	17.71
27.5	0.51	0.51	18.76	18.88	10.77	16.98	18.46	19.64	19.34	18.02
28.0	0.50	0.51	18.77	18.88	11.10	17.92	18.74	19.91	19.50	18.37
28.5	0.50	0.50	18.66	18.78	11.57	19.60	19.12	20.32	20.04	18.75
29.0	0.49	0.49	18.51	18.67	11.80	21.31	19.57	20.71	20.67	19.21
29.5	0.48	0.49	18.44	18.63	11.81	22.45	19.91	20.96	21.19	19.52
30.0	0.49	0.49	18.39	18.63	11.58	23.95	20.20	21.32	21.53	19.70
30.5	0.48	0.48	18.44	18.63	11.34	25.01	20.58	21.78	21.61	20.00
31.0	0.47	0.47	18.41	18.55	11.28	26.21	20.95	22.15	21.86	20.43
31.5	0.46	0.46	18.44	18.52	11.36	26.77	21.16	22.39	22.01	20.46
32.0	0.47	0.48	18.51	18.53	11.46	27.14	21.25	22.70	22.49	20.36
33.0	0.47	0.47	18.44	18.48	11.52	33.92	21.26	22.65	22.33	20.89
34.0	0.47	0.47	18.40	18.47	11.13	34.91	21.46	22.19	21.94	21.14
35.0	0.47	0.47	18.49	18.50	10.42	28.02	21.25	22.00	21.54	20.58
36.0	0.48	0.48	18.70	18.77	9.86	26.51	20.85	21.73	21.32	20.34
37.0	0.46	0.46	18.90	18.97	9.29	23.61	20.24	21.05	20.43	20.26
38.0	0.43	0.44	18.96	19.05	8.66	21.86	19.62	20.62	19.91	19.82
39.0	0.35	0.35	19.04	19.21	8.17	20.96	19.49	21.16	19.65	19.55
40.0	0.29	0.29	19.11	19.31	8.02	19.18	20.09	21.21	18.60	19.26
41.0	0.35	0.36	19.33	19.50	7.43	16.41	18.91	19.69	17.63	19.11
42.0	0.47	0.48	19.67	19.82	6.59	15.44	17.34	18.17	16.95	17.60
43.0	0.53	0.53	20.10	20.17	6.37	14.96	17.06	17.38	17.07	16.99
43.5	0.54	0.54	20.30	20.33	6.33	14.58	17.00	17.41	16.26	16.85

## Typical Performance Curves





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.

<b>Specification</b>	<b>Test/Inspection Condition</b>	<b>Reference/Spec</b>
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)	