MMIC

Power Splitter/Combiner Die EPQ-133-D+

2 Way-90° 50Ω 6 to 14 GHz

The Big Deal

- Wideband, 6 to 14 GHz
- Good Isolation and Return Loss
- Highly repeatable performance (GaAs based design)
- No external termination required
- High Power handling (>30 dBm)

Product Overview

Mini-Circuits' EPQ-133-D+ is a wideband 6-14 GHz , 90° hybrid die . It splits an input signal into two output signals with quadrature phase shift between them. It provides low loss, wideband in a small layout size and handles high power with good VSWR.

Key Features

Feature	Advantages
Low Phase and Amplitude Unbalance	3.4 deg. and 0.5 dB unbalance make this 90° hybrid applicable for use in higher level integrated components such as image reject mixers, single sideband modulators, phase shifters, variable attenuators, and balance amplifiers.
High Power Handling	Capable of operating up to 32 dBm, MMIC structure of EPQ-133-D+ makes this 90° hybrid a robust, rugged product that can be used effectively in either the transmit or receive paths.
Unpackaged Die	Enables user to integrate it directly into hybrids.

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Features

- Low insertion loss, 0.6 dB typ. at 8-10 GHz
- Good isolation, 20 dB typ. at 8-10 GHz
- High Power

Applications

- Balanced amplifiers
- Modulators
- Electronic variable attenuator
- Phase shifter

+RoHS Compliant

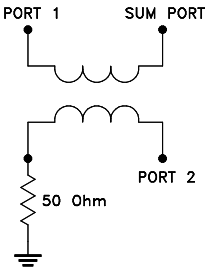
The +Suffix identifies RoHS Compliance. See our web site for RoHS Compliance methodologies and qualifications

Ordering Information: Refer to Last Page

General Description

Mini-Circuits' EPQ-133-D+ is a wideband 6-14 GHz , 90° hybrid die . It splits an input signal into two output signals with quadrature phase shift between them. It provides low loss, wideband in a small layout size and handles high power with good VSWR.

Simplified Schematic and Pad Description



Pad#	Function
1	Sum Port
2	Port 1 (0°)
3	Port 2 (+90°)

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

Bonding Pad Position

Dimensions in µm, Typical

L1	L2	L3	H1	H2	H3	H4	Thickness	Bond Pad Size
84	2566	2650	42	948	1078	1120	100	80 x 175

Electrical Specifications[1] at 25°C, 50Ω

Parameter	Frequency (MHz)	Min.	Typ.	Max.	Unit
Frequency Range		6000		14000	MHz
Insertion Loss, (Avg. of Mainline & Coupled) above 3dB	6000 - 8000 8000 - 10000 10000 - 12000 12000 - 14000		0.6 0.6 0.8 1.0		dB
Isolation	6000 - 8000 8000 - 10000 10000 - 12000 12000 - 14000		20 20 18 16		dB
Amplitude Unbalance	6000 - 8000 8000 - 10000 10000 - 12000 12000 - 14000		0.5 0.5 0.6 0.4		dB
Phase Unbalance (Deviation from 90°)	6000 - 8000 8000 - 10000 10000 - 12000 12000 - 14000		2.9 3.4 4.1 4.4		Degree
Input VSWR	6000 - 8000 8000 - 10000 10000 - 12000 12000 - 14000		1.2 1.2 1.4 1.6		:1
Output VSWR (0°&90°)	6000 - 8000 8000 - 10000 10000 - 12000 12000 - 14000		1.2 1.1 1.3 1.5		:1

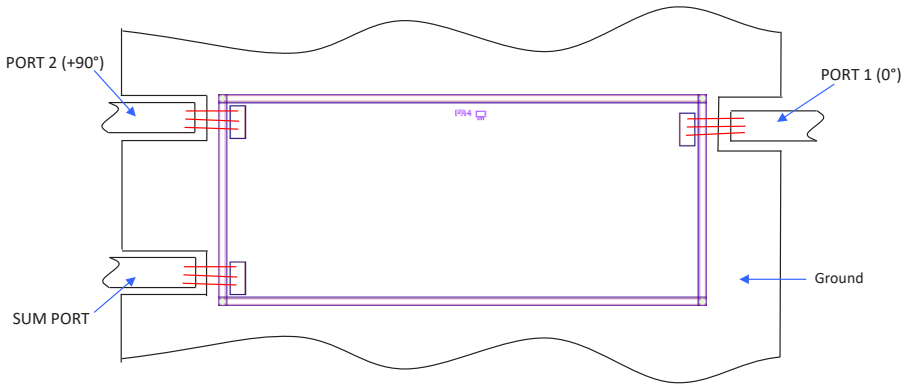
1. Measured on Mini-Circuits Die Characterization Test Board. Die packaged in 4x4 mm, 24-lead MCLP package and soldered in TB-961-133+.

Maximum Ratings

Parameter	Ratings
Operating Temperature	-45°C to 85°C
Power Input (as a splitter)[1]	32 dBm
Internal Dissipation[1]	30 dBm

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 (S3P 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, 50, KGD*	EPQ-133-DG+
	Medium†, Partial wafer: 350 Max.	EPQ-133-DP+
	Large†, Full wafer	EPQ-133-DF+
	†**Available upon request contact sales representative**	
	Refer to AN-60-067	
Environmental Ratings	ENV-80	

*Known Good Dice ("KGD") means that the dice are taken from PCM good wafer and are visually inspected. 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 1A (250 to <500V) in accordance with ANSI/ESD STM 5.1 - 2001

** 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.

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Typical Performance Data

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

FREQ. (GHz)	TOTAL LOSS[1] (dB)		AMP. UNBAL. (dB)	PHASE UNBAL. (deg.)	ISOLATION (dB)	VSWR (:1)		
	S-1	S-2			1-2	S	1	2
3.0	1.25	7.30	6.05	90.51	25.98	1.09	1.08	1.02
3.5	1.54	6.37	4.83	90.61	24.21	1.10	1.06	1.04
4.0	1.84	5.65	3.80	90.69	22.53	1.13	1.02	1.09
4.5	2.14	5.08	2.93	90.73	21.57	1.16	1.05	1.13
5.0	2.43	4.64	2.21	90.72	20.92	1.20	1.09	1.16
5.5	2.71	4.29	1.59	90.80	20.18	1.24	1.10	1.19
6.0	2.96	4.01	1.05	90.86	19.89	1.26	1.16	1.20
6.5	3.18	3.81	0.63	90.91	19.90	1.27	1.18	1.21
7.0	3.38	3.63	0.25	90.99	19.62	1.27	1.17	1.23
7.5	3.53	3.50	0.04	91.08	19.75	1.24	1.19	1.24
8.0	3.64	3.38	0.26	91.35	20.31	1.17	1.17	1.22
8.5	3.73	3.29	0.44	91.67	20.32	1.13	1.16	1.20
9.0	3.81	3.23	0.58	91.98	20.02	1.13	1.16	1.16
9.5	3.86	3.17	0.70	92.43	19.91	1.12	1.12	1.10
10.0	3.92	3.15	0.77	92.54	19.17	1.18	1.12	1.02
10.5	4.00	3.17	0.83	92.57	17.85	1.31	1.11	1.09
11.0	4.10	3.33	0.78	92.80	16.48	1.46	1.19	1.19
11.5	4.17	3.49	0.68	92.61	15.80	1.58	1.29	1.23
12.0	4.24	3.72	0.52	92.45	15.04	1.72	1.40	1.24
12.5	4.26	4.00	0.26	92.30	14.45	1.86	1.58	1.18
13.0	4.08	4.15	0.06	92.48	14.41	1.81	1.56	1.08
13.5	3.75	4.19	0.44	92.68	15.86	1.52	1.53	1.17
14.0	3.54	4.45	0.91	93.75	16.08	1.49	1.46	1.31
14.5	3.32	4.66	1.34	94.49	17.23	1.35	1.39	1.47
15.0	3.12	5.01	1.88	95.38	17.68	1.30	1.29	1.55
15.5	2.95	5.38	2.43	96.32	18.54	1.22	1.26	1.57
16.0	2.76	5.80	3.04	96.73	18.98	1.17	1.19	1.50

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

Note: Data tested in industry standard, 4x4mm, 24-lead MCLP package

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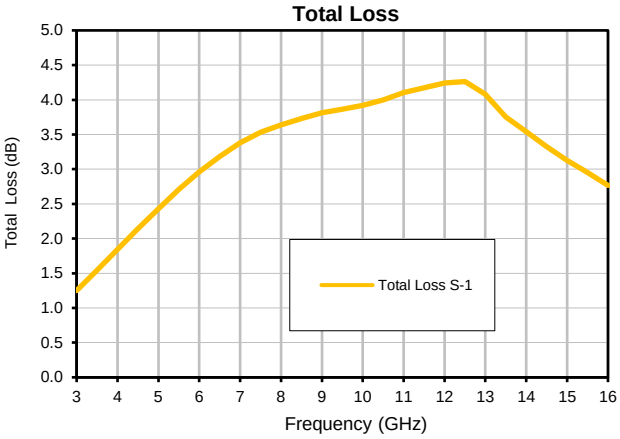
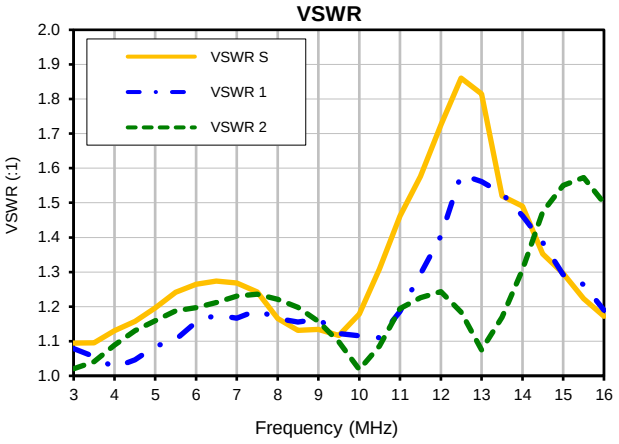
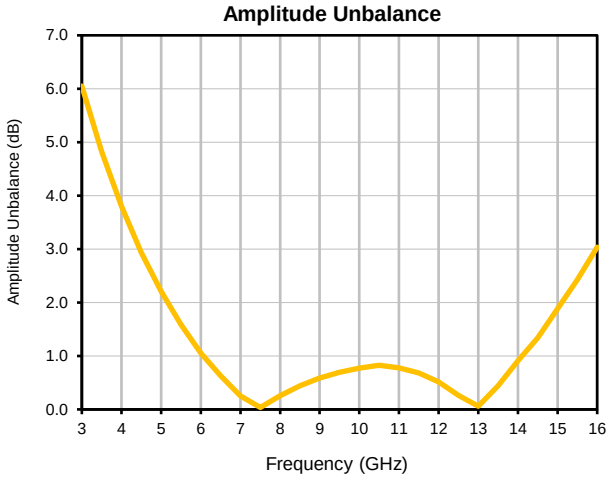
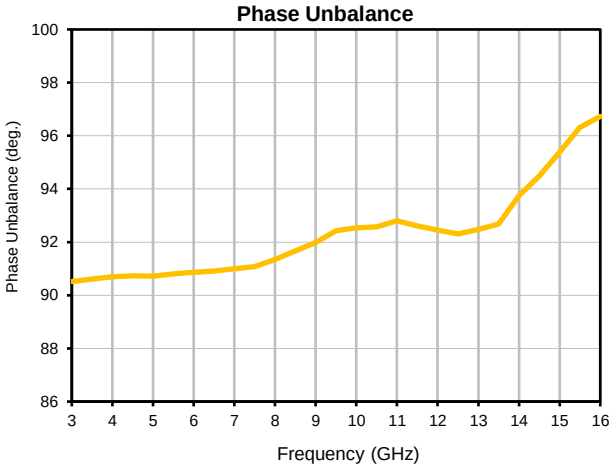
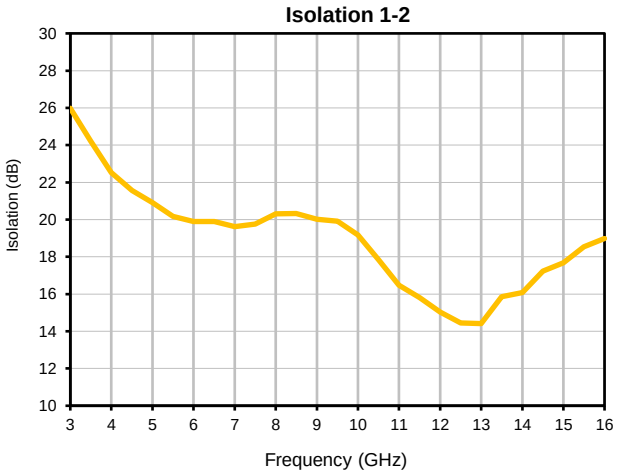
Typical Performance Curves











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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)	