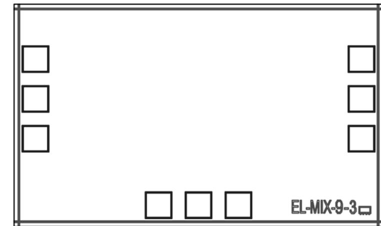
Super Wideband

Double Balanced Mixer Die

MDB-653H-D+

Level 15 (LO Power 15dBm) 20 to 65 GHz



The Big Deal

- Super Wideband RF & LO, 20-65 GHz
- Super wideband IF, DC-20 GHz
- High L-R Isolation, 45 dB typ.
- Excellent Input IP3, 20dBm Typ.
- Usable as Up & Down Converter

Product Overview

MDB-653H-D+ is super-wideband double balanced mixer die fabricated using InGaP HBT technology. The MDB-653H-D+ mixer functions as an up converter or down converter for LO and RF frequencies from 20 to 65GHz and covers IF bandwidths from DC-20GHz. The Mixer operates with 15dBm LO power level while providing 11dB conversion loss, 45dB LO/RF isolation and 20 dBm input IP3. The mixer is ideal for use in wideband millimeter wave systems for communications, defense and test and measurement applications.

Key Features

Feature	Advantages
Double Balanced	Results in excellent LO-RF (35-55 dB typical) & LO-IF (23-52 dB typical) Isolations, minimizing need for external filtering.
Super Wideband, 20 to 65 GHz	Useful in wideband systems or in in several narrowband systems, reducing inventory.
Wide IF Bandwidth DC-20 GHz	Usable in first and second down converter applications. IF as low as DC enables use in phase detector applications.
Unpackaged die	Enables users to integrate it directly into hybrid.

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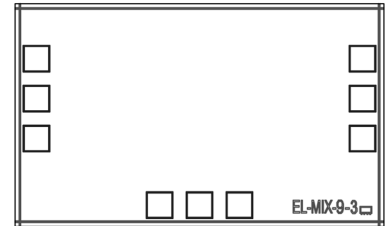

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+RoHS Compliant
The +Suffix identifies RoHS Compliance. See our web site for RoHS Compliance methodologies and qualifications

Ordering Information: Refer to Last Page

Typical Applications
- Satellite up and down converters
- Defense radar & communication
- WiGig
- 5G
- ISM

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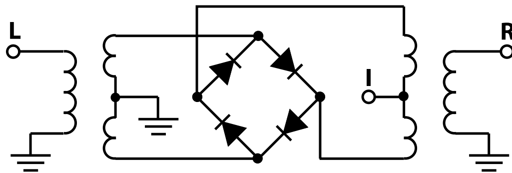
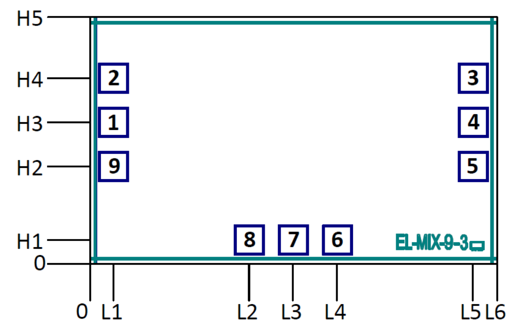
Simplified Schematic and Pad description



Pad#	Function
1	RF
2,3,5,6,8,9 & Bottom of Die	GROUND
4	LO
7	IF

Bonding Pad Position



Dimensions in µm, Typical

L1	L2	L3	L4	L5	L6	H1	H2	H3	H4	H5
81	543	693	843	1306	1386	81	331	481	631	838

Thickness	Die size	Pad size 1-9
100	1386 x 838	92 x 92

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

Parameter	Condition (GHz)	Min.	Typ.	Max.	Units
RF Frequency Range		20		65	GHz
LO Frequency Range		20		65	GHz
IF Frequency Range		DC		20	GHz
LO Power		14	15	16	dBm
Conversion Loss (at IF=2 GHz)	20		9.5		dB
	30		9.7		
	40		11.0		
	50		9.9		
	60		11.4		
	65		13.4		
LO-RF Isolation	20		38		dB
	30		41		
	40		38		
	50		54		
	60		44		
	65		38		
LO-IF Isolation	20		34		dB
	30		48		
	40		39		
	50		24		
	60		32		
	65		30		
RF-IF Isolation	20		32		dB
	30		30		
	40		24		
	50		20		
	60		29		
	65		34		
Pin at 1dB Compression	20 - 60		10		dBm
Input IP3	20 - 60		20		dBm

1. Die performance is measured in Die Characterization Test Board. See Assembly Diagram.

Absolute Maximum Ratings[2]

Parameter	Ratings
Operating Temperature	-40°C to 85°C
RF Power	21 dBm
LO Power	21 dBm
IF Current	30 mA

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

Characterization Test and Applications Circuits

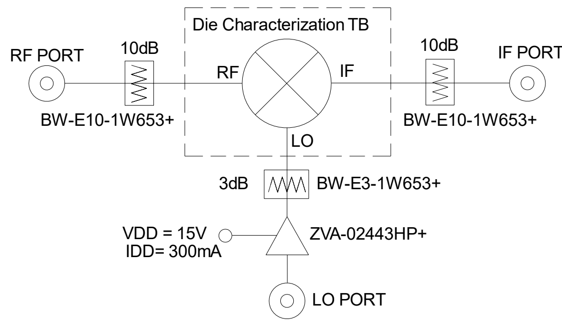


Figure 1A. Block Diagram of Test Circuit used for characterization of Conversion Loss, Isolation (L-R,L-I, R-I) & VSWR from 20 to 35 GHz.

Test Condition:
RF =-10dBm,LO=15dBm, IF =30MHz,2GHz & 3GHz

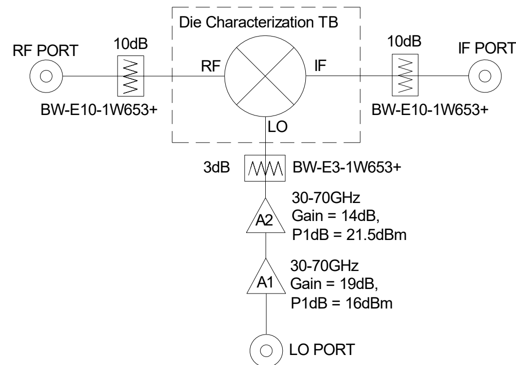


Figure 1B. Block Diagram of Test Circuit used for characterization of Conversion Loss, Isolation(L-R,L-I, R-I) & VSWR from 35 to 65 GHz.

Test Condition:
RF =-10dBm,LO=15dBm, IF =30MHz,2GHz & 3GHz

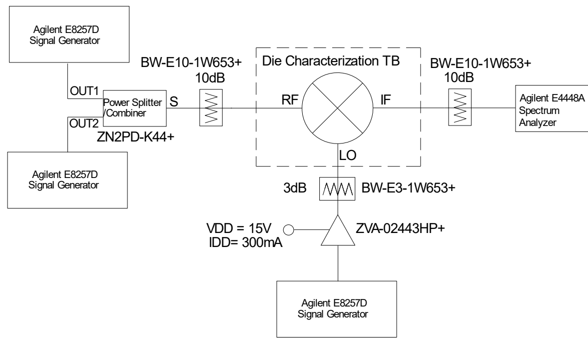


Figure 1C. Block Diagram of Test Circuit used for characterization of Input IP3 from 20 to 35GHz

Test Condition: RF= -10dBm/Tone, LO=15dBm, IF = 2GHzInput IP3(IIP3):Two tones, spaced 1MHz apart

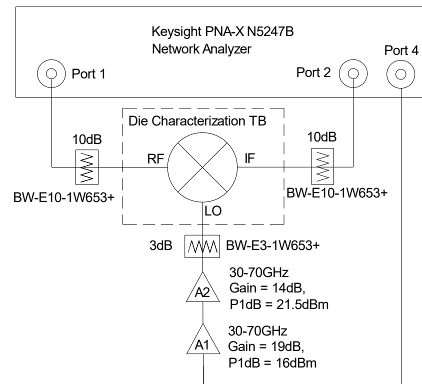


Figure 1D. Block Diagram of Test Circuit used for characterization of Input IP3 from 35 to 65 GHz
Test Condition:
RF=-10dBm/Tone, LO = 15dBm, IF= 2GHz
Input IP3 (IIP3): Two tones, spaced 1MHz apart

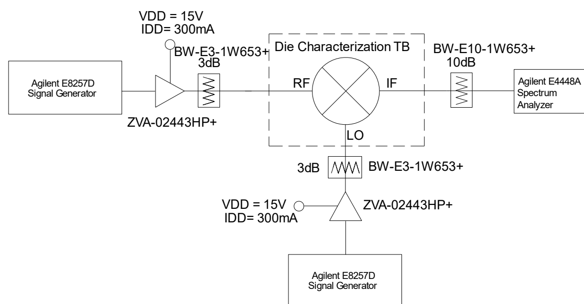


Figure 1E. Block Diagram of Test Circuit used for characterization of Compression from 20 to 35 GHz

Test Condition:
RF = 10dBm & -10dBm, LO = 15dBm, IF = 2GHz
Compression = CL(RF=10dBm) - CL(RF=-10dBm)

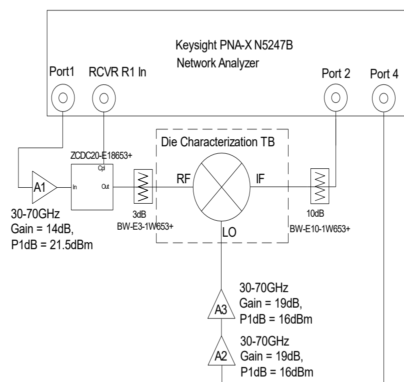
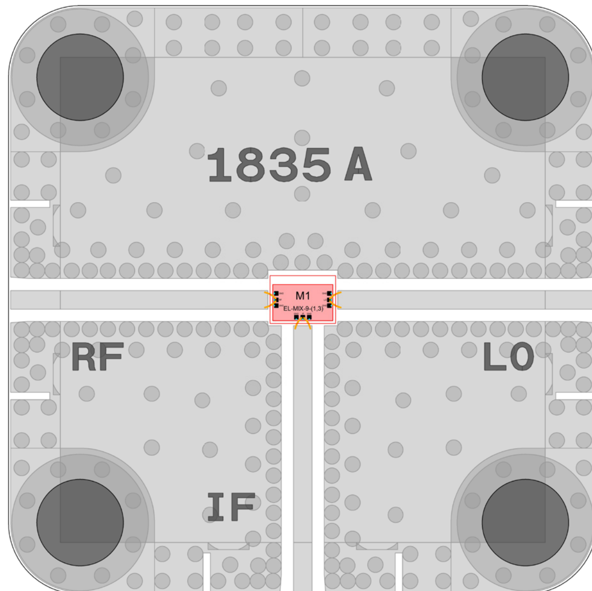


Figure 1F. Block Diagram of Test Circuit used for characterization of Compression from 35 to 65GHz

Test Condition:
RF = 10dBm & -10dBm, LO = 15dBm, IF = 2GHz
Compression = CL(RF=10dBm) - CL(RF=-10dBm)

Assembly Diagram



Note: Die is attached and wire-bonded on X-Microwave's Drop-In Evaluation Board.
Please see the last page for P/N and website link to X-Microwave's Website to order.

Assembly and Handling Procedure

1. Storage
   Dice should be stored in a dry nitrogen purged desiccators or equivalent.
2. ESD
   MMIC InGap HBT mixer 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 worksta tion. 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 Ablestik 84-1LMISR4 or equivalent. 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
Case Style	Die
Die Ordering and packaging information	Quantity, Package / Model No. Small, Gel - Pak: 10,50,100 KGD* / MDB-653H-DG+ Medium†, Partial wafer: KGD*<1333 / MDB-653H-DP+ †*Available upon request contact sales representative* Refer to AN-60-067
Die TB Reference	XM-C9L2-0404D (Please check X-Microwave's Website)
Environmental Ratings	ENV-80

*Known Good Dice ("KGD") means that the dice are taken from PCM good wafer and then visually inspected per Mini-Circuits' criteria. Though this is not definitive, it does provide a higher degree of confidence that the dice are capable of meeting typical RF electrical parameters specified by Mini-Circuits

ESD Rating**

Human Body Model (HBM): Class 1A (250V) in accordance with ANSI/ESD STM 5.1 - 2001

** Tested in industry standard 12-lead, 3x3 mm 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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