

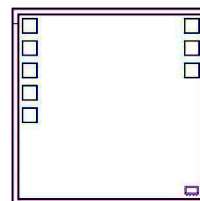
MMIC

## Wideband Double Balanced Mixer Die      MDB-24H-D+

Level 15 (LO Power 15dBm) 5-21.5 GHz

### The Big Deal

- Wide bandwidth, 5-21.5 GHz
- High L-I Isolation, 44 dB typ
- Useable as Up & Down Converter



### Product Overview

MDB-24H-D+ is an advanced wideband frequency mixer die fabricated using InGaP HBT technology with integrated LO and RF Baluns. It has repeatable performance making it suitable for volume production.

### Key Features

| Feature                       | Advantages                                                                                                                 |
|-------------------------------|----------------------------------------------------------------------------------------------------------------------------|
| Double Balanced               | Results in excellent LO-RF (21-35 dB typical) & LO-IF (28-44 dB typical) Isolations minimizing need for external filtering |
| Wide Bandwidth, 5 to 21.5 GHz | Useful in wideband systems or in in several narrowband systems. Reducing inventory                                         |
| Wide IF Bandwidth DC-5 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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# Wideband Double Balanced Mixer Die MDB-24H-D+

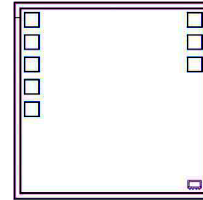
Level 15 (LO Power 15dBm) 5-21.5 GHz

## Product Features

- Wide bandwidth 5 to 21.5 GHz
- High L-I Isolation, 44 dB typ. at 15 GHz
- Useable as Up & Down Converter

## Typical Applications

- Satellite up and down converters
- Defense radar & communication
- VSAT
- Line of sight links
- Federal fixed service
- WiFi
- ISM



**+RoHS Compliant**

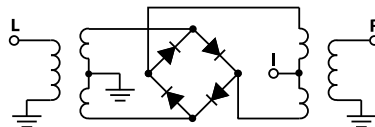
The +Suffix identifies RoHS Compliance. See our web site for RoHS Compliance methodologies and qualifications

*Ordering Information: Refer to Last Page*

## General Description

MDB-24H-D+ is an advanced wideband frequency mixer die fabricated using InGaP HBT technology with integrated LO and RF Baluns. It has repeatable performance making it suitable for volume production.

## Simplified Schematic and Pad description



| Pad    | Description       |
|--------|-------------------|
| RF-IN  | RF input pad      |
| LO-IN  | LO input pad      |
| IF-OUT | IF output pad     |
| GND    | Connect to Ground |

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



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

| Parameter                                       | Condition (GHz) | Min. | Typ. | Max. | Units |
|-------------------------------------------------|-----------------|------|------|------|-------|
| RF Frequency Range                              |                 | 5    |      | 21.5 | GHz   |
| LO Frequency Range                              |                 | 5    |      | 21.5 | GHz   |
| IF Frequency Range                              |                 | DC   |      | 5    | GHz   |
| LO Power                                        |                 |      | +15  |      | dBm   |
| Conversion Loss (at IF=30 MHz)                  | 5               |      | 6.9  |      | dB    |
|                                                 | 10              |      | 9.0  |      |       |
|                                                 | 15              |      | 7.9  |      |       |
|                                                 | 20              |      | 9.4  |      |       |
|                                                 | 21.5            |      | 10.3 |      |       |
| LO-RF Isolation                                 | 5               |      | 28   |      |       |
|                                                 | 10              |      | 33   |      |       |
|                                                 | 15              |      | 35   |      |       |
|                                                 | 20              |      | 21   |      |       |
|                                                 | 21.5            |      | 25   |      |       |
| LO-IF Isolation                                 | 5               |      | 28   |      | dB    |
|                                                 | 10              |      | 36   |      |       |
|                                                 | 15              |      | 44   |      |       |
|                                                 | 20              |      | 36   |      |       |
|                                                 | 21.5            |      | 39   |      |       |
| RF-IF Isolation                                 | 5               |      | 10   |      | dB    |
|                                                 | 10              |      | 15   |      |       |
|                                                 | 15              |      | 22   |      |       |
|                                                 | 20              |      | 22   |      |       |
|                                                 | 21.5            |      | 21   |      |       |
| Input at 1dB Compression                        | 5-21.5          |      | 10   |      | dBm   |
| Input IP3                                       | 5               |      | 14   |      | dBm   |
|                                                 | 10              |      | 21   |      |       |
|                                                 | 15              |      | 23   |      |       |
|                                                 | 20              |      | 24   |      |       |
|                                                 | 21.5            |      | 23   |      |       |
| Noise Figure                                    | 5               |      | 6.9  |      | dB    |
| Thermal Resistance<br>(junction-to-ground lead) |                 |      | 105  |      | °C/W  |

1. Die performance measured in industry standard 4x4mm, 24-lead package. See Characterization Test Circuit, Figure 1.

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

| 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.  
Electrical maximum ratings are not intended for continuous normal operation.

## Characterization Test Circuit

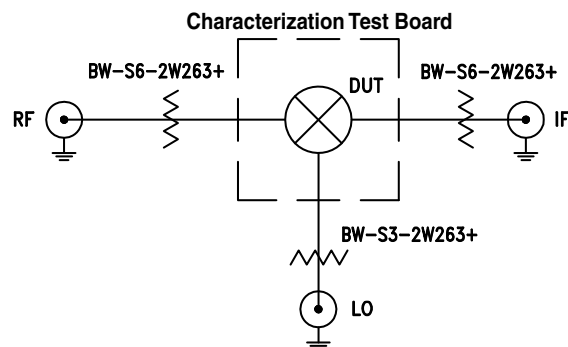


Figure 1A.

Block Diagram of Test Circuit used for die characterization of Conversion Loss, Isolations (LO-RF, LO-IF, RF-IF) and Return Loss (LO, RF, IF).

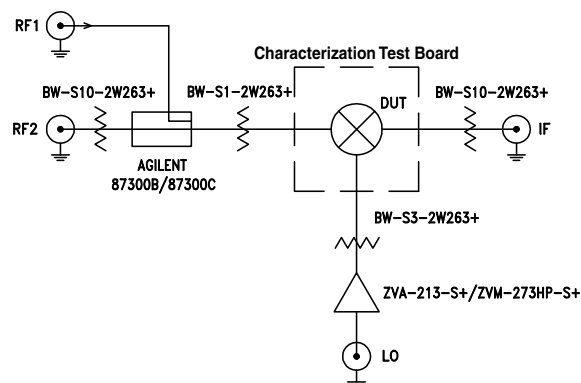


Figure 1B.

Block Diagram of Test Circuit used for die characterization of Input IP3.

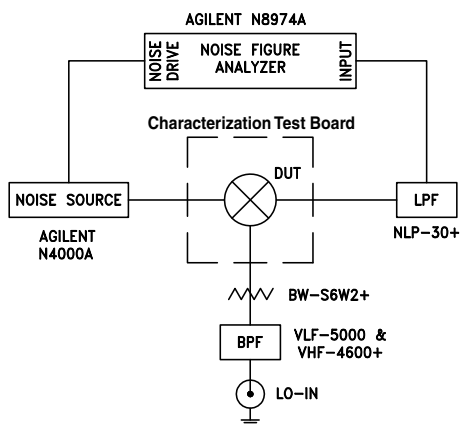


Figure 1C.

Block Diagram of Test Circuit used for die characterization of Noise Figure.

Figure 1. Block Diagram of Test Circuit used for die characterization. (DUT in MCLP package soldered on Mini-Circuits Characterization test board). Conversion Loss, Isolations; L-R, L-I & R-I are measured using R&S ZVA 24 microwave network analyzer. Input IP3 is measured Agilent MXA N9020A spectrum Analyzer and PSG E8257D Signal Generators. NF is measured using Agilent's N8974A NF Analyzer

Conditions (Down Converter):

1. Conversion Loss, Isolations (L-R, L-I & R-I): RF= 0 dBm, LO=+15 dBm, IF=30 MHz
2. Output IP3 (OIP3): Two tones, spaced 1 MHz apart, 0 dBm/tone at output.
3. Noise Figure: LO=+15 dBm

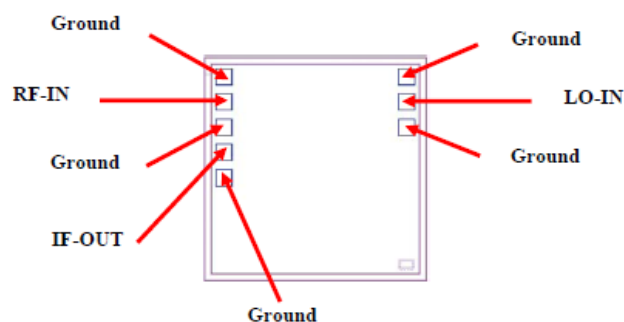
**Die Layout**

Fig 2. Die Layout

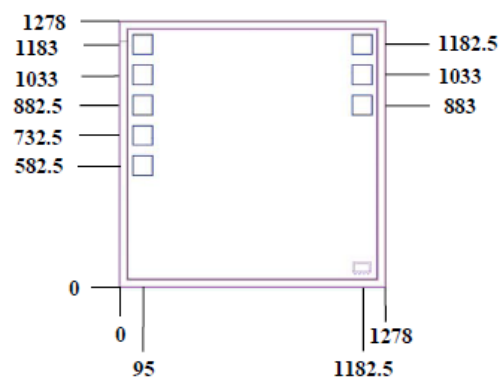
**Bonding Pad Position**  
(Dimensions in  $\mu\text{m}$ , Typical)

Fig 3. Bonding Pad Positions

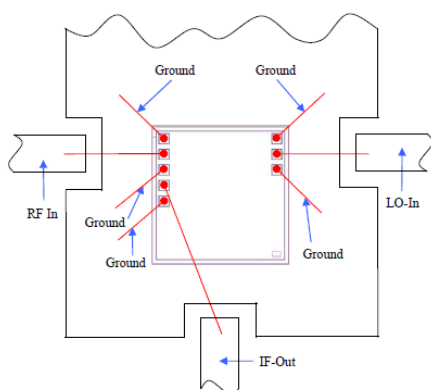
**Critical Dimensions**

| Parameter                                 | Values  |
|-------------------------------------------|---------|
| Die Thickness, $\mu\text{m}$              | 100     |
| Die Width, $\mu\text{m}$                  | 1278    |
| Die Length, $\mu\text{m}$                 | 1278    |
| Bond Pad Size (RF In), $\mu\text{m}$      | 100x100 |
| Bond Pad Size (IF_Out ), $\mu\text{m}$    | 100x100 |
| Bond Pad Size (LO_In ), $\mu\text{m}$     | 100x100 |
| Bond Pad Size (Ground pad), $\mu\text{m}$ | 100x100 |

## Assembly and Handling Procedure

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

## Assembly Diagram



Note: Ground bond wires are optional.

### Recommended Wire Length, Typical

| Wire   | Wire Length (mm) | Wire Loop Height (mm) |
|--------|------------------|-----------------------|
| GROUND | 1.20             | 0.15                  |
| RF In  | 1.20             | 0.15                  |
| IF-Out | 1.60             | 0.15                  |
| LO-In  | 1.20             | 0.15                  |

| Additional Detailed Technical Information                     |                                                                  |
|---------------------------------------------------------------|------------------------------------------------------------------|
| <i>additional information is available on our dash board.</i> |                                                                  |
| 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-24H-DG+                  |
|                                                               | Medium <sup>†</sup> , Partial wafer: KGD* <1085    MDB-24H-DP+   |
|                                                               | Large <sup>†</sup> , Full Wafer                      MDB-24H-DF+ |
|                                                               | <sup>†</sup> Available upon request contact sales representative |
|                                                               | Refer to <a href="#">AN-60-067</a>                               |
| Environmental Ratings                                         | ENV-80                                                           |

\*Known Good Dice ("KGD") means that the dice in question have been subjected to Mini-Circuits DC test performance criteria and measurement instructions and that the parametric data of such dice fall within a predefined range. While DC testing 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 24-lead, 4x4mm MCLP package.

## Additional Notes

- 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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# Wideband Double Balanced Mixer Die

# MDB-24H-D+

## Typical Performance Data

| RF<br>(IN)<br>(MHz) | LO<br>(MHz) | CONVERSION LOSS<br>IF FIXED<br>@IF(OUT)=30MHz<br>(dB) |       |       | RF<br>(IN)<br>(MHz) | LO<br>(MHz) | IP-3 INPUT<br>(dBm) |       |       | RF<br>(IN)<br>(MHz) | LO<br>(MHz) | COMPRESSION<br>@RF IN=+10dBm<br>(dB) |       |       |
|---------------------|-------------|-------------------------------------------------------|-------|-------|---------------------|-------------|---------------------|-------|-------|---------------------|-------------|--------------------------------------|-------|-------|
|                     |             | @LO (dBm)                                             |       |       |                     |             | @LO (dBm)           |       |       |                     |             | @LO (dBm)                            |       |       |
|                     |             | +12                                                   | +15   | +18   |                     |             | +12                 | +15   | +18   |                     |             | +12                                  | +15   | +18   |
| 3500.1              | 3530.1      | 16.81                                                 | 15.59 | 15.05 | 3500.1              | 3470.1      | 11.04               | 13.69 | 17.26 | 3500.1              | 3470.1      | -1.22                                | -1.02 | -0.73 |
| 4000.1              | 4030.1      | 12.04                                                 | 11.30 | 10.89 | 4000.1              | 3970.1      | 13.26               | 13.94 | 14.17 | 4000.1              | 3970.1      | 0.23                                 | 0.22  | 0.21  |
| 4500.1              | 4530.1      | 9.05                                                  | 8.48  | 8.29  | 4500.1              | 4470.1      | 13.89               | 14.39 | 15.13 | 4500.1              | 4470.1      | 1.87                                 | 1.69  | 1.37  |
| 5000.1              | 5030.1      | 7.54                                                  | 7.15  | 6.95  | 5000.1              | 4970.1      | 12.97               | 13.74 | 14.48 | 5000.1              | 4970.1      | 2.68                                 | 2.38  | 2.11  |
| 5500.1              | 5530.1      | 7.29                                                  | 6.92  | 6.74  | 5500.1              | 5470.1      | 14.64               | 15.32 | 15.66 | 5500.1              | 5470.1      | 3.17                                 | 2.83  | 2.50  |
| 6000.1              | 6030.1      | 6.91                                                  | 6.53  | 6.38  | 6000.1              | 5970.1      | 17.11               | 17.91 | 18.25 | 6000.1              | 5970.1      | 2.69                                 | 2.35  | 1.99  |
| 6500.1              | 6530.1      | 7.06                                                  | 6.65  | 6.47  | 6500.1              | 6470.1      | 18.26               | 19.43 | 19.80 | 6500.1              | 6470.1      | 2.56                                 | 2.19  | 1.81  |
| 7000.1              | 7030.1      | 6.85                                                  | 6.51  | 6.42  | 7000.1              | 6970.1      | 18.59               | 20.04 | 20.48 | 7000.1              | 6970.1      | 1.80                                 | 1.43  | 1.11  |
| 7500.1              | 7530.1      | 7.41                                                  | 6.91  | 6.85  | 7500.1              | 7470.1      | 18.91               | 22.03 | 23.17 | 7500.1              | 7470.1      | 1.31                                 | 0.92  | 0.68  |
| 8000.1              | 8030.1      | 7.83                                                  | 7.31  | 7.20  | 8000.1              | 7970.1      | 18.05               | 20.05 | 22.09 | 8000.1              | 7970.1      | 0.76                                 | 0.50  | 0.40  |
| 8500.1              | 8530.1      | 8.19                                                  | 7.59  | 7.43  | 8500.1              | 8470.1      | 20.86               | 20.76 | 20.20 | 8500.1              | 8470.1      | 0.60                                 | 0.32  | 0.22  |
| 9000.1              | 9030.1      | 8.39                                                  | 7.84  | 7.81  | 9000.1              | 8970.1      | 23.28               | 23.41 | 22.25 | 9000.1              | 8970.1      | 0.31                                 | 0.23  | 0.24  |
| 9500.1              | 9530.1      | 9.13                                                  | 8.01  | 7.89  | 9500.1              | 9470.1      | 21.11               | 21.02 | 23.56 | 9500.1              | 9470.1      | 0.22                                 | 0.15  | 0.04  |
| 10000.1             | 10030.1     | 9.37                                                  | 8.35  | 8.07  | 10000.1             | 9970.1      | 20.39               | 21.09 | 21.85 | 10000.1             | 9970.1      | 0.54                                 | 0.18  | 0.10  |
| 10500.1             | 10530.1     | 10.06                                                 | 8.65  | 8.40  | 10500.1             | 10470.1     | 21.22               | 21.33 | 22.87 | 10500.1             | 10470.1     | -0.12                                | 0.09  | 0.16  |
| 11000.1             | 11030.1     | 10.27                                                 | 8.66  | 8.60  | 11000.1             | 10970.1     | 21.68               | 20.20 | 20.04 | 11000.1             | 10970.1     | -0.08                                | 0.21  | 0.22  |
| 11500.1             | 11530.1     | 8.69                                                  | 7.96  | 8.18  | 11500.1             | 11470.1     | 21.13               | 19.69 | 19.39 | 11500.1             | 11470.1     | 1.00                                 | 0.39  | 0.16  |
| 12000.1             | 12030.1     | 10.06                                                 | 8.42  | 8.42  | 12000.1             | 11970.1     | 20.36               | 20.15 | 20.14 | 12000.1             | 11970.1     | -0.58                                | 0.24  | 0.45  |
| 12500.1             | 12530.1     | 8.78                                                  | 8.07  | 8.22  | 12500.1             | 12470.1     | 19.18               | 19.01 | 19.36 | 12500.1             | 12470.1     | 0.96                                 | 0.49  | 0.30  |
| 13000.1             | 13030.1     | 8.18                                                  | 7.68  | 7.80  | 13000.1             | 12970.1     | 18.20               | 19.16 | 20.05 | 13000.1             | 12970.1     | 0.81                                 | 0.43  | 0.27  |
| 13500.1             | 13530.1     | 8.33                                                  | 7.82  | 7.83  | 13500.1             | 13470.1     | 18.04               | 20.83 | 23.47 | 13500.1             | 13470.1     | 0.96                                 | 0.42  | 0.25  |
| 14000.1             | 14030.1     | 8.17                                                  | 7.66  | 7.64  | 14000.1             | 13970.1     | 19.92               | 22.86 | 23.55 | 14000.1             | 13970.1     | 0.36                                 | 0.28  | 0.34  |
| 14500.1             | 14530.1     | 7.62                                                  | 7.28  | 7.25  | 14500.1             | 14470.1     | 19.15               | 21.19 | 22.41 | 14500.1             | 14470.1     | 0.85                                 | 0.37  | 0.19  |
| 15000.1             | 15030.1     | 7.92                                                  | 7.69  | 7.70  | 15000.1             | 14970.1     | 21.07               | 23.51 | 25.29 | 15000.1             | 14970.1     | 0.76                                 | 0.37  | 0.20  |
| 15500.1             | 15530.1     | 8.29                                                  | 7.87  | 7.70  | 15500.1             | 15470.1     | 22.56               | 25.80 | 27.20 | 15500.1             | 15470.1     | 0.46                                 | 0.27  | 0.24  |
| 16000.1             | 16030.1     | 8.36                                                  | 7.95  | 7.80  | 16000.1             | 15970.1     | 21.87               | 22.79 | 23.87 | 16000.1             | 15970.1     | 0.87                                 | 0.50  | 0.31  |
| 16500.1             | 16530.1     | 8.95                                                  | 8.50  | 8.33  | 16500.1             | 16470.1     | 19.59               | 20.94 | 22.83 | 16500.1             | 16470.1     | 0.36                                 | 0.24  | 0.18  |
| 17000.1             | 17030.1     | 9.16                                                  | 8.52  | 8.32  | 17000.1             | 16970.1     | 21.75               | 21.03 | 22.43 | 17000.1             | 16970.1     | 0.29                                 | 0.14  | 0.10  |
| 17500.1             | 17530.1     | 9.84                                                  | 9.12  | 8.83  | 17500.1             | 17470.1     | 24.62               | 24.57 | 23.38 | 17500.1             | 17470.1     | 0.24                                 | 0.09  | 0.05  |
| 18000.1             | 18030.1     | 9.82                                                  | 8.84  | 8.50  | 18000.1             | 17970.1     | 23.04               | 26.05 | 23.59 | 18000.1             | 17970.1     | 0.61                                 | 0.28  | 0.15  |
| 18500.1             | 18530.1     | 10.32                                                 | 9.19  | 8.84  | 18500.1             | 18470.1     | 23.03               | 25.72 | 25.49 | 18500.1             | 18470.1     | 0.82                                 | 0.36  | 0.17  |
| 19000.1             | 19030.1     | 10.33                                                 | 9.05  | 8.72  | 19000.1             | 18970.1     | 24.01               | 26.46 | 27.04 | 19000.1             | 18970.1     | 0.27                                 | 0.19  | 0.12  |
| 19500.1             | 19530.1     | 10.84                                                 | 9.19  | 8.88  | 19500.1             | 19470.1     | 24.13               | 25.73 | 27.76 | 19500.1             | 19470.1     | -0.22                                | 0.08  | 0.06  |
| 20000.1             | 20030.1     | 10.05                                                 | 9.01  | 8.83  | 20000.1             | 19970.1     | 25.53               | 25.33 | 28.01 | 20000.1             | 19970.1     | 0.63                                 | 0.25  | 0.13  |
| 20500.1             | 20530.1     | 9.92                                                  | 8.88  | 8.73  | 20500.1             | 20470.1     | 22.26               | 24.02 | 27.26 | 20500.1             | 20470.1     | 0.47                                 | 0.23  | 0.12  |
| 21000.1             | 21030.1     | 10.41                                                 | 9.02  | 8.83  | 21000.1             | 20970.1     | 20.79               | 23.00 | 25.02 | 21000.1             | 20970.1     | 0.61                                 | 0.47  | 0.35  |
| 21500.1             | 21530.1     | 11.97                                                 | 9.80  | 9.29  | 21500.1             | 21470.1     | 23.80               | 22.12 | 23.46 | 21500.1             | 21470.1     | 0.37                                 | 0.50  | 0.30  |
| 22000.1             | 22030.1     | 17.31                                                 | 12.52 | 11.02 | 22000.1             | 21970.1     | 15.32               | 26.07 | 25.40 | 22000.1             | 21970.1     | -2.77                                | -0.55 | -0.11 |
| 22500.1             | 22530.1     | 23.27                                                 | 16.15 | 13.22 | 22500.1             | 22470.1     | 12.18               | 16.83 | 30.13 | 22500.1             | 22470.1     | -1.11                                | 0.84  | 0.39  |
| 23000.1             | 23030.1     | 32.51                                                 | 25.11 | 17.66 | 23000.1             | 22970.1     | 11.66               | 13.18 | 28.31 | 23000.1             | 22970.1     | -2.38                                | -1.86 | -0.58 |

Note: Test data measured in industry standard 4x4mm, 24-lead package



P.O. Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 • Fax (718) 332-4661 For detailed performance specs & shopping online see Mini-Circuits web site [www.minicircuits.com](http://www.minicircuits.com)



The Design Engineers Search Engine Provides ACTUAL Data Instantly From MINI-CIRCUITS At: [www.minicircuits.com](http://www.minicircuits.com)

IF/RF MICROWAVE COMPONENTS



REV. OR  
MDB-24H-D+  
12/27/2016  
Page 1 of 4

# Wideband Double Balanced Mixer Die

# MDB-24H-D+

## Typical Performance Data

| IF<br>(OUT)<br>(MHz) | LO<br>(MHz) | CONVERSION LOSS<br>VS. IF FREQUENCY<br>@RF(IN)=12500.1MHz<br>(dB) | IF<br>(OUT)<br>(MHz) | LO<br>(MHz) | CONVERSION LOSS<br>VS. IF FREQUENCY<br>@RF(IN)=4100.1MHz<br>(dB) | IF<br>(OUT)<br>(MHz) | LO<br>(MHz) | CONVERSION LOSS<br>VS. IF FREQUENCY<br>@RF(IN)=21500.1MHz<br>(dB) |
|----------------------|-------------|-------------------------------------------------------------------|----------------------|-------------|------------------------------------------------------------------|----------------------|-------------|-------------------------------------------------------------------|
|                      |             | @LO (dBm)                                                         |                      |             | @LO (dBm)                                                        |                      |             | @LO (dBm)                                                         |
|                      |             | +15                                                               |                      |             | +15                                                              |                      |             | +15                                                               |
| 6500.0               | 6000.1      | 17.13                                                             | 10.0                 | 4110.1      | 10.56                                                            | 5500.0               | 16000.1     | 14.85                                                             |
| 5700.0               | 6800.1      | 13.40                                                             | 20.0                 | 4120.1      | 10.38                                                            | 5300.0               | 16200.1     | 14.21                                                             |
| 5300.0               | 7200.1      | 12.28                                                             | 30.0                 | 4130.1      | 10.22                                                            | 5100.0               | 16400.1     | 13.91                                                             |
| 4900.0               | 7600.1      | 11.38                                                             | 40.0                 | 4140.1      | 10.19                                                            | 4900.0               | 16600.1     | 13.50                                                             |
| 4500.0               | 8000.1      | 10.20                                                             | 50.0                 | 4150.1      | 10.28                                                            | 4700.0               | 16800.1     | 13.12                                                             |
| 4100.0               | 8400.1      | 10.12                                                             | 60.0                 | 4160.1      | 10.30                                                            | 4500.0               | 17000.1     | 12.64                                                             |
| 3700.0               | 8800.1      | 11.22                                                             | 70.0                 | 4170.1      | 10.35                                                            | 4300.0               | 17200.1     | 12.63                                                             |
| 3300.0               | 9200.1      | 10.77                                                             | 80.0                 | 4180.1      | 10.18                                                            | 4100.0               | 17400.1     | 12.42                                                             |
| 2900.0               | 9600.1      | 10.42                                                             | 90.0                 | 4190.1      | 10.21                                                            | 3900.0               | 17600.1     | 12.47                                                             |
| 2500.0               | 10000.1     | 10.32                                                             | 100.0                | 4200.1      | 10.27                                                            | 3700.0               | 17800.1     | 12.62                                                             |
| 2100.0               | 10400.1     | 9.46                                                              | 150.0                | 4250.1      | 10.06                                                            | 3500.0               | 18000.1     | 12.66                                                             |
| 1700.0               | 10800.1     | 8.99                                                              | 400.0                | 4500.1      | 10.00                                                            | 3300.0               | 18200.1     | 12.91                                                             |
| 1300.0               | 11200.1     | 8.43                                                              | 650.0                | 4750.1      | 9.96                                                             | 3100.0               | 18400.1     | 13.26                                                             |
| 900.0                | 11600.1     | 8.04                                                              | 900.0                | 5000.1      | 10.33                                                            | 2900.0               | 18600.1     | 12.98                                                             |
| 500.0                | 12000.1     | 8.13                                                              | 1150.0               | 5250.1      | 10.87                                                            | 2700.0               | 18800.1     | 13.31                                                             |
| 100.0                | 12400.1     | 7.95                                                              | 1400.0               | 5500.1      | 10.87                                                            | 2500.0               | 19000.1     | 12.90                                                             |
| 80.0                 | 12420.1     | 7.95                                                              | 1650.0               | 5750.1      | 10.97                                                            | 2300.0               | 19200.1     | 12.55                                                             |
| 60.0                 | 12440.1     | 7.97                                                              | 1900.0               | 6000.1      | 10.67                                                            | 2100.0               | 19400.1     | 12.20                                                             |
| 40.0                 | 12460.1     | 8.06                                                              | 2150.0               | 6250.1      | 10.38                                                            | 1900.0               | 19600.1     | 11.92                                                             |
| 20.0                 | 12480.1     | 8.16                                                              | 2400.0               | 6500.1      | 10.49                                                            | 1700.0               | 19800.1     | 11.59                                                             |
| 10.0                 | 12510.1     | 8.23                                                              | 2650.0               | 6750.1      | 10.39                                                            | 1500.0               | 20000.1     | 10.97                                                             |
| 30.0                 | 12530.1     | 8.03                                                              | 2900.0               | 7000.1      | 10.08                                                            | 1300.0               | 20200.1     | 10.61                                                             |
| 50.0                 | 12550.1     | 7.95                                                              | 3150.0               | 7250.1      | 10.51                                                            | 1100.0               | 20400.1     | 10.34                                                             |
| 70.0                 | 12570.1     | 7.98                                                              | 3400.0               | 7500.1      | 10.66                                                            | 900.0                | 20600.1     | 9.90                                                              |
| 90.0                 | 12590.1     | 7.97                                                              | 3650.0               | 7750.1      | 10.26                                                            | 700.0                | 20800.1     | 9.77                                                              |
| 300.0                | 12800.1     | 8.08                                                              | 3900.0               | 8000.1      | 10.31                                                            | 500.0                | 21000.1     | 9.83                                                              |
| 700.0                | 13200.1     | 8.15                                                              | 4150.0               | 8250.1      | 10.61                                                            | 300.0                | 21200.1     | 9.71                                                              |
| 1100.0               | 13600.1     | 8.30                                                              | 4400.0               | 8500.1      | 10.36                                                            | 100.0                | 21400.1     | 9.74                                                              |
| 1500.0               | 14000.1     | 8.65                                                              | 4650.0               | 8750.1      | 10.30                                                            | 90.0                 | 21410.1     | 9.70                                                              |
| 1900.0               | 14400.1     | 9.22                                                              | 4900.0               | 9000.1      | 10.60                                                            | 80.0                 | 21420.1     | 9.74                                                              |
| 2300.0               | 14800.1     | 9.09                                                              | 5150.0               | 9250.1      | 10.81                                                            | 70.0                 | 21430.1     | 9.79                                                              |
| 2700.0               | 15200.1     | 9.19                                                              | 5400.0               | 9500.1      | 11.21                                                            | 60.0                 | 21440.1     | 9.78                                                              |
| 3100.0               | 15600.1     | 9.40                                                              | 5650.0               | 9750.1      | 11.21                                                            | 50.0                 | 21450.1     | 9.78                                                              |
| 3500.0               | 16000.1     | 9.24                                                              | 5900.0               | 10000.1     | 11.20                                                            | 40.0                 | 21460.1     | 9.80                                                              |
| 3900.0               | 16400.1     | 9.13                                                              | 6150.0               | 10250.1     | 11.51                                                            | 30.0                 | 21470.1     | 9.81                                                              |
| 4250.0               | 16750.1     | 9.92                                                              | 6400.0               | 10500.1     | 12.53                                                            | 20.0                 | 21480.1     | 9.88                                                              |
| 4750.0               | 17250.1     | 10.15                                                             | 6650.0               | 10750.1     | 13.18                                                            | 10.0                 | 21490.1     | 10.05                                                             |
| 5250.0               | 17750.1     | 10.56                                                             | 6900.0               | 11000.1     | 14.54                                                            |                      |             |                                                                   |
| 5750.0               | 18250.1     | 11.79                                                             | 7400.0               | 11500.1     | 16.05                                                            |                      |             |                                                                   |
| 6250.0               | 18750.1     | 14.13                                                             | 7900.0               | 12000.1     | 17.42                                                            |                      |             |                                                                   |

Note: Test data measured in industry standard 4x4mm, 24-lead package



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# Wideband Double Balanced Mixer Die MDB-24H-D+

## Typical Performance Data

| LO<br>(MHz) | LO-RF ISOLATION<br>(dB) |       |       | LO-IF ISOLATION<br>(dB) |       |       |
|-------------|-------------------------|-------|-------|-------------------------|-------|-------|
|             | @LO (dBm)               |       |       | @LO (dBm)               |       |       |
|             | +12                     | +15   | +18   | +12                     | +15   | +18   |
| 3530.1      | 29.52                   | 28.00 | 28.18 | 32.50                   | 29.02 | 28.63 |
| 4030.1      | 24.41                   | 25.24 | 26.08 | 29.31                   | 29.00 | 28.93 |
| 4530.1      | 23.80                   | 24.98 | 26.05 | 28.87                   | 28.50 | 28.39 |
| 5030.1      | 27.79                   | 29.14 | 29.87 | 29.14                   | 28.30 | 27.86 |
| 5530.1      | 33.59                   | 33.97 | 33.97 | 31.11                   | 29.70 | 28.89 |
| 6030.1      | 39.19                   | 37.75 | 36.84 | 35.26                   | 32.94 | 31.64 |
| 6530.1      | 35.28                   | 35.80 | 36.88 | 38.28                   | 35.72 | 33.96 |
| 7030.1      | 33.00                   | 33.60 | 34.40 | 40.96                   | 40.34 | 38.44 |
| 7530.1      | 31.28                   | 31.25 | 31.61 | 37.06                   | 41.02 | 41.47 |
| 8030.1      | 30.54                   | 31.43 | 31.89 | 32.59                   | 36.45 | 39.05 |
| 8530.1      | 29.91                   | 31.96 | 32.73 | 32.19                   | 35.09 | 37.32 |
| 9030.1      | 30.58                   | 32.09 | 32.77 | 33.26                   | 35.67 | 37.60 |
| 9530.1      | 32.43                   | 34.55 | 36.06 | 33.32                   | 35.28 | 36.89 |
| 10030.1     | 32.01                   | 32.66 | 32.70 | 33.81                   | 35.57 | 37.12 |
| 10530.1     | 33.14                   | 33.85 | 33.30 | 34.53                   | 36.01 | 37.28 |
| 11030.1     | 33.62                   | 33.81 | 33.09 | 34.50                   | 35.64 | 36.50 |
| 11530.1     | 30.21                   | 30.02 | 29.49 | 32.12                   | 33.05 | 33.57 |
| 12030.1     | 28.89                   | 28.84 | 27.86 | 28.12                   | 28.57 | 28.67 |
| 12530.1     | 43.00                   | 37.08 | 33.28 | 34.21                   | 34.84 | 35.22 |
| 13030.1     | 33.64                   | 29.83 | 28.29 | 46.33                   | 47.82 | 49.06 |
| 13530.1     | 29.94                   | 27.80 | 27.15 | 51.24                   | 49.70 | 49.30 |
| 14030.1     | 31.60                   | 29.82 | 28.57 | 49.07                   | 47.57 | 46.55 |
| 14530.1     | 33.93                   | 33.00 | 31.37 | 46.00                   | 45.10 | 44.14 |
| 15030.1     | 33.97                   | 33.82 | 31.85 | 41.91                   | 41.12 | 40.16 |
| 15530.1     | 30.82                   | 31.92 | 31.52 | 40.39                   | 40.05 | 39.43 |
| 16030.1     | 27.14                   | 27.81 | 27.69 | 37.22                   | 36.98 | 36.59 |
| 16530.1     | 25.71                   | 27.59 | 28.42 | 36.32                   | 36.89 | 37.01 |
| 17030.1     | 25.23                   | 26.45 | 27.42 | 37.30                   | 38.24 | 38.94 |
| 17530.1     | 23.57                   | 23.99 | 24.49 | 38.97                   | 39.65 | 40.32 |
| 18030.1     | 24.88                   | 24.66 | 24.70 | 41.01                   | 40.85 | 40.87 |
| 18530.1     | 24.90                   | 24.14 | 23.84 | 40.28                   | 39.19 | 38.62 |
| 19030.1     | 24.22                   | 23.35 | 22.95 | 40.24                   | 39.18 | 38.53 |
| 19530.1     | 24.42                   | 23.37 | 22.83 | 38.71                   | 37.89 | 37.29 |
| 20030.1     | 21.77                   | 21.29 | 20.95 | 35.91                   | 35.65 | 35.36 |
| 20530.1     | 21.50                   | 21.35 | 21.16 | 35.86                   | 35.94 | 35.89 |
| 21030.1     | 21.92                   | 22.09 | 22.05 | 36.86                   | 37.18 | 37.34 |
| 21530.1     | 24.91                   | 25.45 | 25.56 | 38.71                   | 39.04 | 39.28 |
| 22030.1     | 29.75                   | 29.62 | 29.79 | 39.40                   | 39.44 | 39.57 |
| 22530.1     | 30.57                   | 30.56 | 29.37 | 37.32                   | 37.41 | 37.30 |
| 23030.1     | 28.52                   | 28.71 | 28.69 | 37.20                   | 37.23 | 37.29 |

| RF<br>(IN)<br>(MHz) | LO<br>(MHz) | RF-IF ISOLATION<br>(dB) |       |       |
|---------------------|-------------|-------------------------|-------|-------|
|                     |             | @LO (dBm)               |       |       |
|                     |             | +12                     | +15   | +18   |
| 3500.1              | 3530.1      | 6.04                    | 6.27  | 6.20  |
| 4000.1              | 4030.1      | 6.63                    | 6.47  | 6.29  |
| 4500.1              | 4530.1      | 6.77                    | 6.51  | 6.35  |
| 5000.1              | 5030.1      | 8.95                    | 8.73  | 8.63  |
| 5500.1              | 5530.1      | 9.15                    | 8.85  | 8.74  |
| 6000.1              | 6030.1      | 9.26                    | 9.03  | 8.91  |
| 6500.1              | 6530.1      | 9.77                    | 9.62  | 9.59  |
| 7000.1              | 7030.1      | 9.98                    | 9.85  | 9.84  |
| 7500.1              | 7530.1      | 10.76                   | 10.77 | 10.81 |
| 8000.1              | 8030.1      | 10.69                   | 10.76 | 10.82 |
| 8500.1              | 8530.1      | 11.02                   | 11.24 | 11.42 |
| 9000.1              | 9030.1      | 12.16                   | 12.40 | 12.57 |
| 9500.1              | 9530.1      | 13.09                   | 13.50 | 13.80 |
| 10000.1             | 10030.1     | 14.31                   | 14.59 | 14.83 |
| 10500.1             | 10530.1     | 16.13                   | 16.47 | 16.65 |
| 11000.1             | 11030.1     | 18.14                   | 18.52 | 18.73 |
| 11500.1             | 11530.1     | 20.91                   | 21.20 | 21.36 |
| 12000.1             | 12030.1     | 21.98                   | 22.18 | 22.32 |
| 12500.1             | 12530.1     | 14.93                   | 15.27 | 15.48 |
| 13000.1             | 13030.1     | 17.22                   | 17.55 | 17.74 |
| 13500.1             | 13530.1     | 19.05                   | 19.38 | 19.58 |
| 14000.1             | 14030.1     | 20.41                   | 20.73 | 20.92 |
| 14500.1             | 14530.1     | 20.59                   | 20.75 | 20.87 |
| 15000.1             | 15030.1     | 20.89                   | 20.99 | 21.07 |
| 15500.1             | 15530.1     | 20.68                   | 20.73 | 20.77 |
| 16000.1             | 16030.1     | 21.64                   | 21.62 | 21.58 |
| 16500.1             | 16530.1     | 23.19                   | 23.09 | 22.99 |
| 17000.1             | 17030.1     | 24.02                   | 23.71 | 23.48 |
| 17500.1             | 17530.1     | 24.43                   | 23.93 | 23.53 |
| 18000.1             | 18030.1     | 23.26                   | 22.73 | 22.34 |
| 18500.1             | 18530.1     | 22.61                   | 22.12 | 21.78 |
| 19000.1             | 19030.1     | 22.20                   | 21.67 | 21.32 |
| 19500.1             | 19530.1     | 21.96                   | 21.52 | 21.21 |
| 20000.1             | 20030.1     | 21.12                   | 20.80 | 20.53 |
| 20500.1             | 20530.1     | 20.07                   | 19.88 | 19.70 |
| 21000.1             | 21030.1     | 19.95                   | 19.94 | 19.85 |
| 21500.1             | 21530.1     | 19.51                   | 19.73 | 19.79 |
| 22000.1             | 22030.1     | 18.71                   | 18.98 | 19.16 |
| 22500.1             | 22530.1     | 19.37                   | 19.55 | 19.73 |
| 23000.1             | 23030.1     | 19.86                   | 19.91 | 20.04 |

Note: Test data measured in industry standard 4x4mm, 24-lead package



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# Wideband Double Balanced Mixer Die    MDB-24H-D+

## Typical Performance Data

| RF<br>(IN)<br>(MHz) | LO<br>(MHz) | RF VSWR<br>(:1) |      |      | LO<br>(MHz) | LO VSWR<br>(:1) |      |      | IF<br>(OUT)<br>(MHz) | IF VSWR<br>@LO=21500.1MHz<br>(:1) |       |       |
|---------------------|-------------|-----------------|------|------|-------------|-----------------|------|------|----------------------|-----------------------------------|-------|-------|
|                     |             | @LO (dBm)       |      |      |             | @LO (dBm)       |      |      |                      | @LO (dBm)                         |       |       |
|                     |             | +12             | +15  | +18  |             | +12             | +15  | +18  |                      | +12                               | +15   | +18   |
| 3500.1              | 3530.1      | 2.70            | 2.69 | 2.68 | 3530.1      | 9.40            | 6.79 | 6.15 | 10.1                 | 2.10                              | 1.47  | 1.17  |
| 4000.1              | 4030.1      | 2.17            | 2.14 | 2.08 | 4030.1      | 4.44            | 4.20 | 4.41 | 20.1                 | 2.24                              | 1.46  | 1.20  |
| 4500.1              | 4530.1      | 1.97            | 1.93 | 1.88 | 4530.1      | 2.77            | 2.99 | 3.44 | 30.1                 | 2.27                              | 1.47  | 1.24  |
| 5000.1              | 5030.1      | 1.87            | 1.83 | 1.77 | 5030.1      | 1.92            | 2.38 | 2.90 | 40.1                 | 2.24                              | 1.47  | 1.23  |
| 5500.1              | 5530.1      | 1.78            | 1.74 | 1.69 | 5530.1      | 1.63            | 2.17 | 2.72 | 50.1                 | 2.24                              | 1.49  | 1.22  |
| 6000.1              | 6030.1      | 1.78            | 1.74 | 1.68 | 6030.1      | 1.65            | 2.17 | 2.70 | 60.1                 | 2.25                              | 1.49  | 1.23  |
| 6500.1              | 6530.1      | 2.13            | 2.08 | 2.00 | 6530.1      | 1.86            | 2.29 | 2.77 | 70.1                 | 2.27                              | 1.50  | 1.23  |
| 7000.1              | 7030.1      | 2.22            | 2.19 | 2.12 | 7030.1      | 2.08            | 2.31 | 2.70 | 80.1                 | 2.25                              | 1.48  | 1.23  |
| 7500.1              | 7530.1      | 2.10            | 2.09 | 2.02 | 7530.1      | 2.48            | 2.44 | 2.68 | 90.1                 | 2.26                              | 1.50  | 1.23  |
| 8000.1              | 8030.1      | 2.08            | 2.09 | 2.06 | 8030.1      | 2.96            | 2.61 | 2.61 | 100.1                | 2.25                              | 1.49  | 1.23  |
| 8500.1              | 8530.1      | 2.36            | 2.37 | 2.35 | 8530.1      | 3.34            | 2.78 | 2.66 | 200.1                | 2.26                              | 1.49  | 1.24  |
| 9000.1              | 9030.1      | 2.55            | 2.65 | 2.72 | 9030.1      | 3.72            | 2.85 | 2.60 | 300.1                | 2.32                              | 1.54  | 1.29  |
| 9500.1              | 9530.1      | 2.76            | 2.85 | 2.94 | 9530.1      | 4.95            | 3.41 | 2.75 | 400.1                | 2.34                              | 1.57  | 1.32  |
| 10000.1             | 10030.1     | 2.55            | 2.62 | 2.74 | 10030.1     | 5.65            | 3.70 | 2.86 | 500.1                | 2.43                              | 1.64  | 1.38  |
| 10500.1             | 10530.1     | 2.49            | 2.55 | 2.69 | 10530.1     | 6.59            | 3.90 | 2.78 | 600.1                | 2.52                              | 1.71  | 1.45  |
| 11000.1             | 11030.1     | 2.56            | 2.62 | 2.78 | 11030.1     | 6.89            | 3.85 | 2.62 | 700.1                | 2.56                              | 1.74  | 1.47  |
| 11500.1             | 11530.1     | 2.60            | 2.66 | 2.86 | 11530.1     | 5.17            | 3.16 | 2.32 | 800.1                | 2.67                              | 1.82  | 1.55  |
| 12000.1             | 12030.1     | 2.42            | 2.41 | 2.51 | 12030.1     | 5.80            | 3.33 | 2.36 | 900.1                | 2.80                              | 1.94  | 1.66  |
| 12500.1             | 12530.1     | 2.29            | 2.26 | 2.31 | 12530.1     | 4.34            | 2.90 | 2.37 | 1000.1               | 2.79                              | 1.95  | 1.68  |
| 13000.1             | 13030.1     | 2.25            | 2.18 | 2.19 | 13030.1     | 3.64            | 2.81 | 2.54 | 1500.1               | 3.17                              | 2.22  | 1.91  |
| 13500.1             | 13530.1     | 2.49            | 2.42 | 2.40 | 13530.1     | 3.32            | 2.81 | 2.71 | 2000.1               | 3.16                              | 2.36  | 2.07  |
| 14000.1             | 14030.1     | 2.98            | 2.96 | 2.94 | 14030.1     | 2.68            | 2.60 | 2.85 | 2500.1               | 3.24                              | 2.49  | 2.20  |
| 14500.1             | 14530.1     | 3.52            | 3.55 | 3.54 | 14530.1     | 2.27            | 2.64 | 3.13 | 3000.1               | 3.34                              | 2.63  | 2.31  |
| 15000.1             | 15030.1     | 3.32            | 3.42 | 3.46 | 15030.1     | 2.28            | 2.90 | 3.53 | 3500.1               | 3.06                              | 2.50  | 2.21  |
| 15500.1             | 15530.1     | 2.83            | 2.89 | 2.91 | 15530.1     | 2.16            | 2.76 | 3.38 | 4000.1               | 3.71                              | 3.07  | 2.70  |
| 16000.1             | 16030.1     | 2.57            | 2.56 | 2.53 | 16030.1     | 2.42            | 3.01 | 3.62 | 4500.1               | 4.45                              | 3.60  | 3.11  |
| 16500.1             | 16530.1     | 3.10            | 3.11 | 3.09 | 16530.1     | 2.75            | 3.11 | 3.56 | 5000.1               | 5.19                              | 4.20  | 3.68  |
| 17000.1             | 17030.1     | 3.96            | 3.98 | 3.96 | 17030.1     | 3.13            | 3.28 | 3.54 | 5500.1               | 5.98                              | 4.93  | 4.46  |
| 17500.1             | 17530.1     | 3.90            | 3.89 | 3.87 | 17530.1     | 3.63            | 3.62 | 3.80 | 6000.1               | 5.01                              | 4.42  | 4.27  |
| 18000.1             | 18030.1     | 3.65            | 3.66 | 3.65 | 18030.1     | 4.20            | 3.93 | 3.97 | 6500.1               | 4.79                              | 4.84  | 5.10  |
| 18500.1             | 18530.1     | 3.36            | 3.37 | 3.35 | 18530.1     | 4.74            | 4.13 | 4.03 | 7000.1               | 5.91                              | 6.80  | 7.45  |
| 19000.1             | 19030.1     | 3.68            | 3.68 | 3.65 | 19030.1     | 4.64            | 3.85 | 3.59 | 7500.1               | 8.10                              | 9.73  | 10.73 |
| 19500.1             | 19530.1     | 3.46            | 3.42 | 3.36 | 19530.1     | 4.30            | 3.42 | 3.07 | 8000.1               | 8.37                              | 9.61  | 10.35 |
| 20000.1             | 20030.1     | 2.61            | 2.53 | 2.47 | 20030.1     | 2.97            | 2.41 | 2.15 | 8500.1               | 10.74                             | 11.85 | 12.51 |
| 20500.1             | 20530.1     | 2.18            | 2.09 | 2.04 | 20530.1     | 2.01            | 1.67 | 1.52 | 9000.1               | 14.55                             | 15.48 | 16.01 |
| 21000.1             | 21030.1     | 1.68            | 1.60 | 1.56 | 21030.1     | 1.49            | 1.34 | 1.38 | 9500.1               | 13.49                             | 13.87 | 14.11 |
| 21500.1             | 21530.1     | 1.66            | 1.58 | 1.54 | 21530.1     | 1.79            | 1.78 | 1.90 | 10000.1              | 15.13                             | 15.32 | 15.47 |
| 22000.1             | 22030.1     | 1.72            | 1.66 | 1.62 | 22030.1     | 2.63            | 2.57 | 2.60 |                      |                                   |       |       |
| 22500.1             | 22530.1     | 2.26            | 2.23 | 2.21 | 22530.1     | 3.87            | 3.80 | 3.76 |                      |                                   |       |       |
| 23000.1             | 23030.1     | 3.51            | 3.48 | 3.42 | 23030.1     | 4.96            | 4.91 | 4.79 |                      |                                   |       |       |

Note: Test data measured in industry standard 4x4mm, 24-lead package



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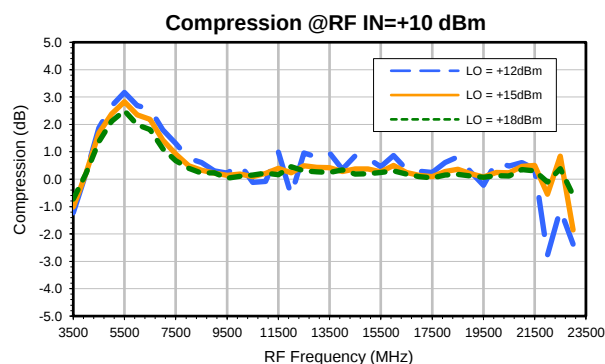
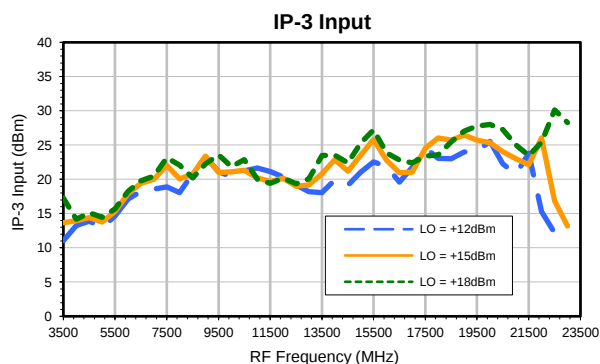
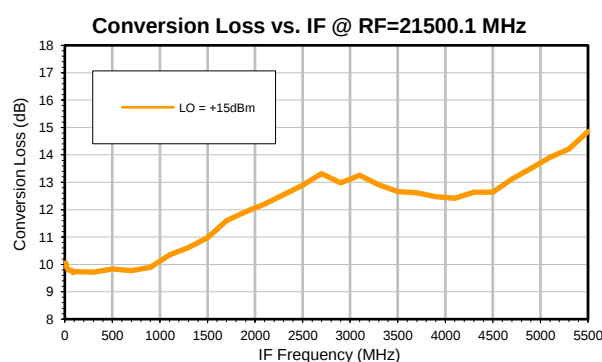
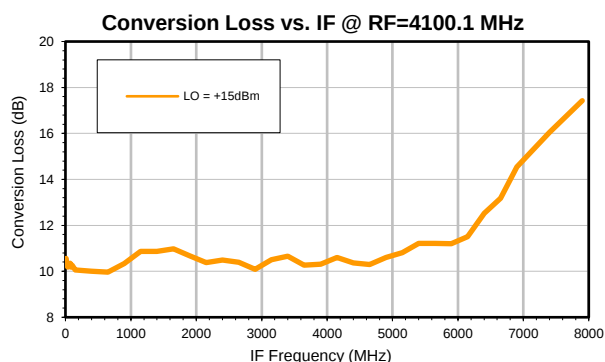
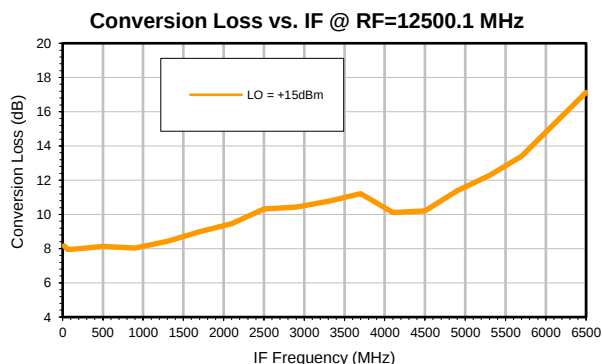
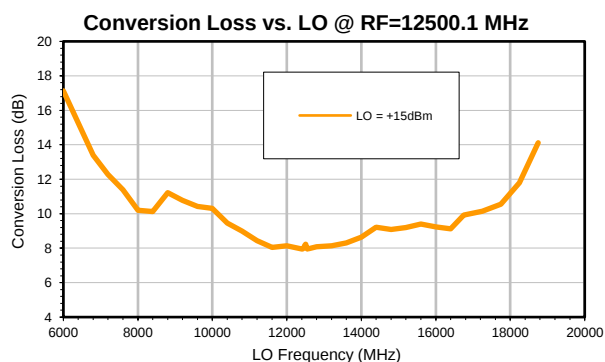
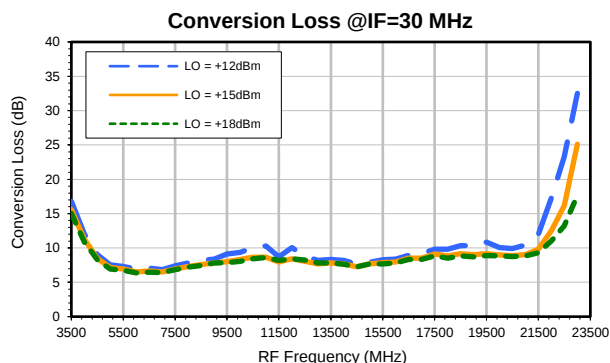


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# Wideband Double Balanced Mixer Die

## Typical Performance Curves

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Note: Test data measured in industry standard 4x4mm, 24-lead package



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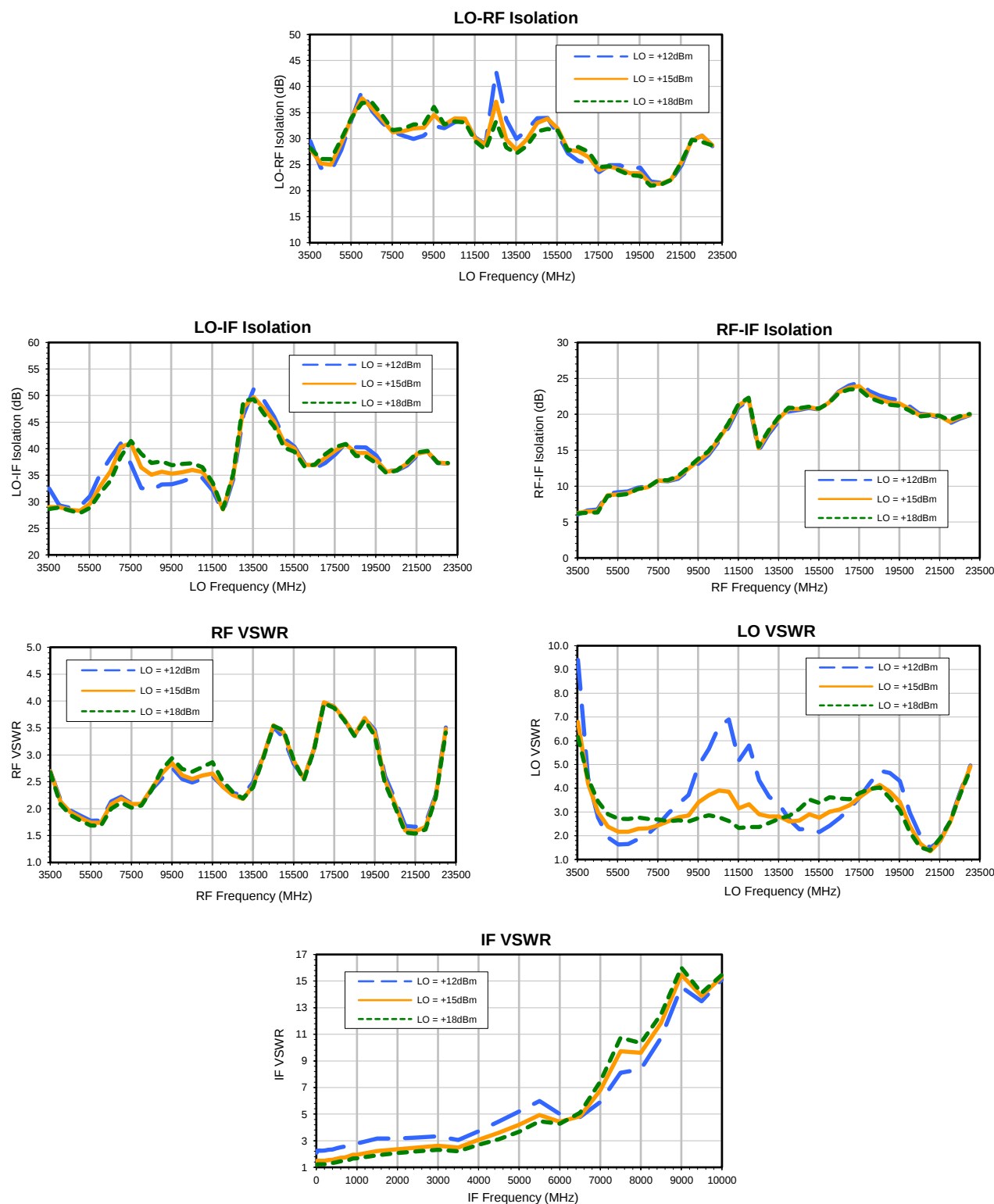


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# Wideband Double Balanced Mixer Die

## Typical Performance Curves

**MDB-24H-D+**



Note: Test data measured in industry standard 4x4mm, 24-lead package



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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<br>Ambient Environment | Refer to Individual Model Data Sheet |
| Storage Environment   | 20° to 35° C and 40 to 60% humidity<br>(In Factory Shipped Package)      | Individual Model Data Sheet          |