

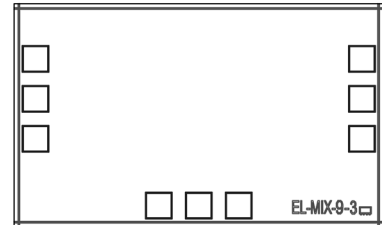
Super Wideband Double Balanced Mixer Die

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. |

Super Wideband Double Balanced Mixer Die

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Product Features

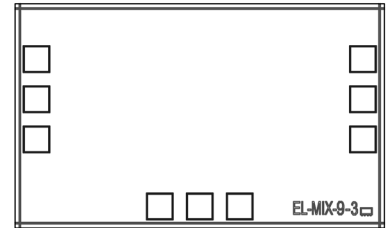
- Super Wideband RF & LO, 20-65GHz
- Super wideband IF, DC-20GHz
- High L-R Isolation, 45 dB typ.
- Excellent input IP3, 20 dBm typ.
- Usable as Up & Down Converter

Typical Applications

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

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.

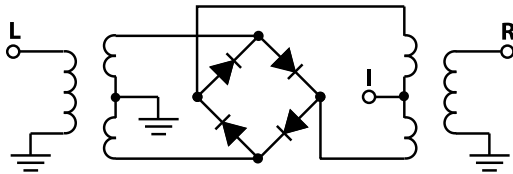


+RoHS Compliant

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

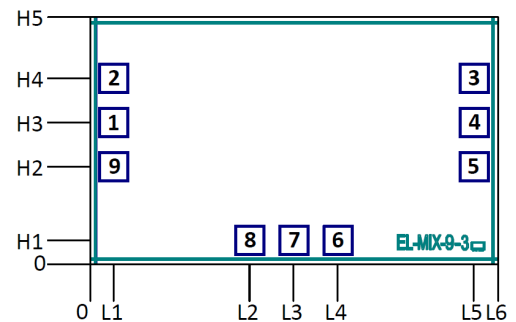
Ordering Information: Refer to Last Page

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 |
|-----------|------------|----------|
| 100 | 1386 x 838 | 92 x 92 |

Electrical Specifications¹ 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 Ratings²

| 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

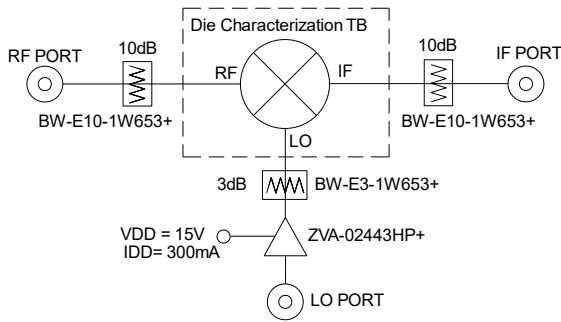


Figure 1A. Block Diagram of Test Circuit used for characterization of Conversion Loss, Isolation (L-R, L-I, R-I) & VSWR from 20 to 35 GHz.

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

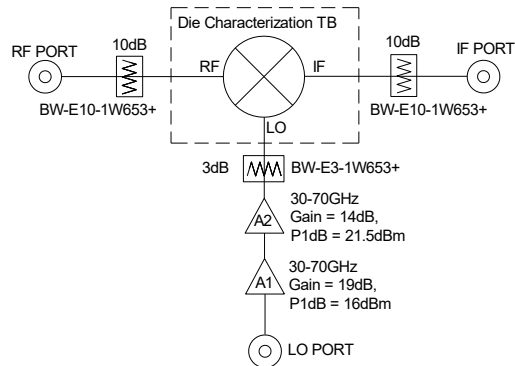


Figure 1B. Block Diagram of Test Circuit used for characterization of Conversion Loss, Isolation (L-R, L-I, R-I) & VSWR from 35 to 65 GHz.

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

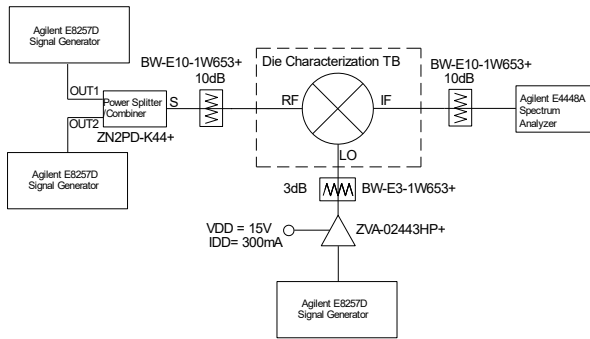


Figure 1C. Block Diagram of Test Circuit used for characterization of Input IP3 from 20 to 35GHz

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

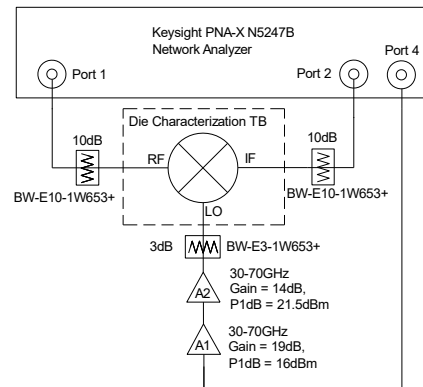


Figure 1D. Block Diagram of Test Circuit used for characterization of Input IP3 from 35 to 65 GHz

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

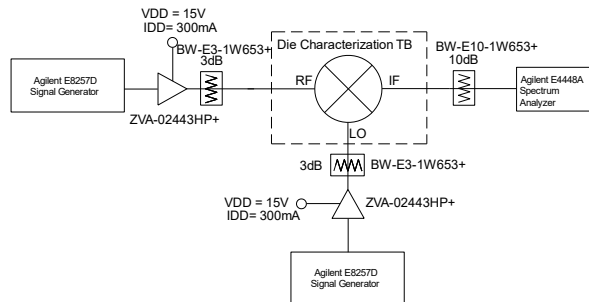


Figure 1E. Block Diagram of Test Circuit used for characterization of Compression from 20 to 35 GHz

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

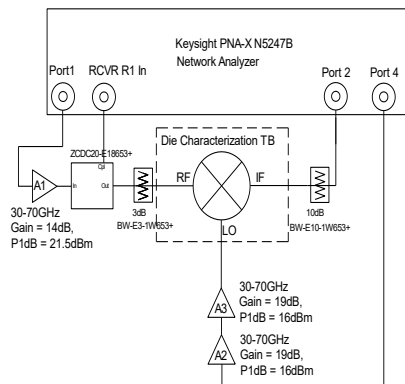
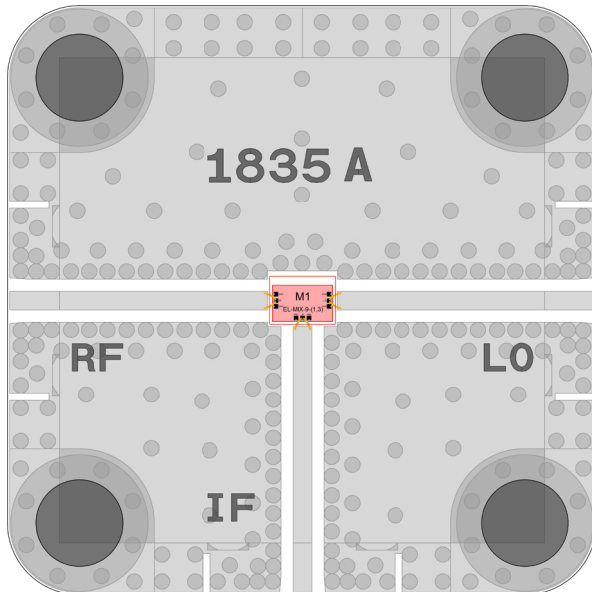


Figure 1F. Block Diagram of Test Circuit used for characterization of Compression from 35 to 65GHz

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 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 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 | | | | | | | |
|---|---|-------------------|-----------|----------------------------------|--------------|-------------------------------------|--------------|
| <i>additional information is available on our dash board.</i> | | | | | | | |
| Performance Data | Data Table | | | | | | |
| | Swept Graphs | | | | | | |
| Case Style | Die | | | | | | |
| Die Ordering and packaging information | <table> <tr> <td>Quantity, Package</td> <td>Model No.</td> </tr> <tr> <td>Small, Gel - Pak: 10,50,100 KGD*</td> <td>MDB-653H-DG+</td> </tr> <tr> <td>Medium†, Partial wafer: KGD* < 1333</td> <td>MDB-653H-DP+</td> </tr> </table> | Quantity, Package | Model No. | Small, Gel - Pak: 10,50,100 KGD* | MDB-653H-DG+ | Medium†, Partial wafer: KGD* < 1333 | MDB-653H-DP+ |
| | 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

- 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.
- Electrical specifications and performance data contained in this specification document are based on Mini-Circuit's applicable established test performance criteria and measurement instructions.
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Wideband Double Balanced Mixer Die

MDB-653H-D+

Typical Performance Data

| RF (IN) (MHz) | LO (MHz) | CONVERSION LOSS IF FIXED @ IF(OUT)=30MHz (dB) | | | RF (IN) (MHz) | LO (MHz) | CONVERSION LOSS IF FIXED @ IF(OUT)=2GHz (dB) | | | RF (IN) (MHz) | LO (MHz) | CONVERSION LOSS IF FIXED @ IF(OUT)=3GHz (dB) | | |
|---------------|----------|---|------|------|---------------|----------|--|------|------|---------------|----------|--|------|------|
| | | @LO (dBm) | | | | | @LO (dBm) | | | | | @LO (dBm) | | |
| | | +14 | +15 | +16 | | | +14 | +15 | +16 | | | +14 | +15 | +16 |
| 18000 | 18030 | 10.6 | 10.6 | 10.7 | 18000 | 20000 | 11.7 | 11.7 | 11.7 | 18000 | 21000 | 11.8 | 11.8 | 11.8 |
| 19000 | 19030 | 10.0 | 9.9 | 9.9 | 19000 | 21000 | 10.1 | 10.1 | 10.1 | 19000 | 22000 | 9.9 | 10.0 | 10.2 |
| 20000 | 20030 | 9.7 | 9.6 | 9.5 | 20000 | 22000 | 9.4 | 9.4 | 9.5 | 20000 | 23000 | 9.6 | 9.7 | 9.9 |
| 21000 | 21030 | 9.8 | 9.7 | 9.6 | 21000 | 23000 | 9.5 | 9.6 | 9.7 | 21000 | 24000 | 9.5 | 9.6 | 9.7 |
| 22000 | 22030 | 9.6 | 9.5 | 9.6 | 22000 | 24000 | 9.4 | 9.4 | 9.5 | 22000 | 25000 | 9.5 | 9.6 | 9.9 |
| 23000 | 23030 | 9.9 | 9.9 | 10.1 | 23000 | 25000 | 9.7 | 9.8 | 10.0 | 23000 | 26000 | 10.1 | 10.2 | 10.4 |
| 24000 | 24030 | 11.0 | 11.0 | 11.0 | 24000 | 26000 | 11.2 | 11.3 | 11.5 | 24000 | 27000 | 11.3 | 11.6 | 12.0 |
| 25000 | 25030 | 11.7 | 11.8 | 12.0 | 25000 | 27000 | 12.1 | 12.3 | 12.6 | 25000 | 28000 | 12.0 | 12.2 | 12.5 |
| 26000 | 26030 | 11.7 | 11.8 | 12.2 | 26000 | 28000 | 11.7 | 11.9 | 12.2 | 26000 | 29000 | 11.6 | 12.1 | 12.8 |
| 27000 | 27030 | 11.3 | 11.5 | 12.0 | 27000 | 29000 | 11.1 | 11.5 | 12.3 | 27000 | 30000 | 11.1 | 11.2 | 11.5 |
| 28000 | 28030 | 10.5 | 10.7 | 11.2 | 28000 | 30000 | 10.5 | 10.6 | 10.9 | 28000 | 31000 | 10.4 | 10.6 | 11.1 |
| 29000 | 29030 | 10.5 | 11.0 | 11.9 | 29000 | 31000 | 10.2 | 10.4 | 10.9 | 29000 | 32000 | 10.2 | 10.4 | 10.9 |
| 30000 | 30030 | 9.7 | 9.9 | 10.3 | 30000 | 32000 | 9.6 | 9.8 | 10.3 | 30000 | 33000 | 9.6 | 9.8 | 10.2 |
| 31000 | 31030 | 9.5 | 9.8 | 10.5 | 31000 | 33000 | 9.6 | 9.8 | 10.2 | 31000 | 34000 | 9.7 | 10.1 | 11.0 |
| 32000 | 32030 | 8.9 | 9.2 | 9.8 | 32000 | 34000 | 9.1 | 9.6 | 10.5 | 32000 | 35000 | 9.1 | 9.0 | 9.2 |
| 33000 | 33030 | 8.9 | 9.1 | 9.5 | 33000 | 35000 | 9.0 | 8.9 | 9.0 | 33000 | 36000 | 9.6 | 9.4 | 9.3 |
| 34000 | 34030 | 8.8 | 9.3 | 10.3 | 34000 | 36000 | 9.7 | 9.5 | 9.4 | 34000 | 37000 | 9.3 | 9.5 | 10.1 |
| 35000 | 35030 | 9.3 | 9.2 | 9.3 | 35000 | 37000 | 9.3 | 9.5 | 10.1 | 35000 | 38000 | 12.1 | 11.4 | 10.0 |
| 36000 | 36030 | 8.8 | 8.6 | 8.7 | 36000 | 38000 | 11.2 | 10.7 | 9.3 | 36000 | 39000 | 8.7 | 8.7 | 8.9 |
| 37000 | 37030 | 8.6 | 8.6 | 8.8 | 37000 | 39000 | 8.5 | 8.5 | 8.7 | 37000 | 40000 | 8.3 | 8.2 | 8.3 |
| 38000 | 38030 | 9.8 | 9.7 | 9.8 | 38000 | 40000 | 9.7 | 9.6 | 9.6 | 38000 | 41000 | 9.2 | 9.4 | 10.0 |
| 39000 | 39030 | 10.2 | 10.2 | 10.4 | 39000 | 41000 | 10.0 | 10.2 | 10.7 | 39000 | 42000 | 9.5 | 9.5 | 9.8 |
| 40000 | 40030 | 10.4 | 10.3 | 10.3 | 40000 | 42000 | 9.9 | 9.9 | 10.1 | 40000 | 43000 | 9.7 | 9.7 | 10.1 |
| 42000 | 42030 | 10.7 | 10.7 | 10.9 | 42000 | 44000 | 10.7 | 10.7 | 11.0 | 42000 | 45000 | 10.5 | 10.5 | 10.7 |
| 44000 | 44030 | 10.8 | 10.9 | 11.2 | 44000 | 46000 | 10.8 | 10.9 | 11.2 | 44000 | 47000 | 10.5 | 10.6 | 11.0 |
| 46000 | 46030 | 10.5 | 10.5 | 10.9 | 46000 | 48000 | 10.4 | 10.5 | 10.7 | 46000 | 49000 | 10.2 | 10.3 | 10.6 |
| 48000 | 48030 | 10.2 | 10.3 | 10.5 | 48000 | 50000 | 10.3 | 10.3 | 10.4 | 48000 | 51000 | 9.9 | 10.0 | 10.5 |
| 50000 | 50030 | 9.9 | 9.9 | 10.1 | 50000 | 52000 | 10.0 | 10.1 | 10.4 | 50000 | 53000 | 9.7 | 9.7 | 10.1 |
| 52000 | 52030 | 8.7 | 8.9 | 9.3 | 52000 | 54000 | 9.0 | 9.1 | 9.5 | 52000 | 55000 | 8.6 | 8.7 | 9.1 |
| 54000 | 54030 | 9.4 | 9.5 | 9.9 | 54000 | 56000 | 9.0 | 9.2 | 9.6 | 54000 | 57000 | 8.8 | 9.0 | 9.4 |
| 56000 | 56030 | 9.9 | 10.0 | 10.3 | 56000 | 58000 | 10.1 | 10.3 | 10.7 | 56000 | 59000 | 9.8 | 9.8 | 9.9 |
| 58000 | 58030 | 11.7 | 11.9 | 12.4 | 58000 | 60000 | 11.9 | 11.9 | 12.1 | 58000 | 61000 | 11.7 | 11.4 | 11.2 |
| 60000 | 60030 | 11.4 | 11.5 | 11.7 | 60000 | 62000 | 11.4 | 11.4 | 11.6 | 60000 | 63000 | 10.8 | 10.8 | 11.1 |
| 62000 | 62030 | 11.0 | 11.0 | 11.2 | 63000 | 65000 | 12.5 | 12.4 | 12.6 | 62000 | 65000 | 10.6 | 10.6 | 10.8 |
| 65000 | 65030 | 13.0 | 13.0 | 13.2 | 64000 | 66000 | --- | --- | --- | 63900 | 66900 | --- | --- | --- |



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
 The Design Engineers Search Engine Provides ACTUAL Data Instantly From MINI-CIRCUITS At: www.minicircuits.com

IF/RF MICROWAVE COMPONENTS

REV. OR
 MDB-653H-D+
 2/16/2021
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Wideband Double Balanced Mixer Die

MDB-653H-D+

Typical Performance Data

| RF (IN) (MHz) | LO (MHz) | IP-3 INPUT (dBm) | | | RF (IN) (MHz) | LO (MHz) | COMPRESSION @ RF IN=+10dBm (dB) | | |
|---------------|----------|------------------|-------|-------|---------------|----------|---------------------------------|------|------|
| | | @LO (dBm) | | | | | @LO (dBm) | | |
| | | +14 | +15 | +16 | | | +14 | +15 | +16 |
| 20000 | 22000 | 19.22 | 19.56 | 20.34 | 20000 | 22000 | 0.89 | 0.88 | 0.77 |
| 21000 | 23000 | 20.02 | 20.07 | 20.29 | 21000 | 23000 | 0.70 | 0.64 | 0.56 |
| 22000 | 24000 | 19.74 | 19.75 | 19.93 | 22000 | 24000 | 0.69 | 0.64 | 0.64 |
| 23000 | 25000 | 23.63 | 23.21 | 23.64 | 23000 | 25000 | 0.49 | 0.41 | 0.35 |
| 24000 | 26000 | 24.62 | 24.84 | 25.35 | 24000 | 26000 | 0.78 | 0.81 | 0.58 |
| 25000 | 27000 | 27.49 | 27.76 | 28.78 | 25000 | 27000 | 0.29 | 0.28 | 0.32 |
| 26000 | 28000 | 24.63 | 25.54 | 26.93 | 26000 | 28000 | 0.28 | 0.22 | 0.20 |
| 27000 | 29000 | 25.75 | 25.41 | 26.24 | 27000 | 29000 | 0.24 | 0.18 | 0.14 |
| 28000 | 30000 | 22.91 | 22.84 | 23.31 | 28000 | 30000 | 0.42 | 0.36 | 0.30 |
| 29000 | 31000 | 23.23 | 23.15 | 24.24 | 29000 | 31000 | 0.42 | 0.37 | 0.26 |
| 30000 | 32000 | 23.02 | 22.84 | 22.72 | 30000 | 32000 | 0.41 | 0.40 | 0.32 |
| 31000 | 33000 | 21.54 | 21.55 | 21.83 | 31000 | 33000 | 0.46 | 0.40 | 0.35 |
| 32000 | 34000 | 21.64 | 21.57 | 21.35 | 32000 | 34000 | 0.37 | 0.31 | 0.21 |
| 33000 | 35000 | 23.21 | 23.46 | 23.75 | 33000 | 35000 | 0.43 | 0.37 | 0.30 |
| 34000 | 36000 | 25.07 | 23.99 | 24.19 | 34000 | 36000 | 0.18 | 0.17 | 0.13 |
| 35000 | 37000 | 21.77 | 21.29 | 21.56 | 35000 | 37000 | 0.33 | 0.33 | 0.27 |
| 36000 | 38000 | 21.56 | 21.09 | 21.43 | 36000 | 38000 | 0.42 | 0.37 | 0.49 |
| 37000 | 39000 | 21.60 | 21.47 | 21.39 | 37000 | 39000 | 1.03 | 0.89 | 0.80 |
| 38000 | 40000 | 22.86 | 21.34 | 22.65 | 38000 | 40000 | 0.95 | 0.81 | 0.84 |
| 39000 | 41000 | 23.88 | 23.23 | 23.82 | 39000 | 41000 | 0.62 | 0.59 | 0.41 |
| 40000 | 42000 | 19.55 | 19.11 | 20.52 | 40000 | 42000 | 0.89 | 0.83 | 0.87 |
| 41000 | 43000 | 27.73 | 23.97 | 22.57 | 41000 | 43000 | 0.48 | 0.48 | 0.78 |
| 42000 | 44000 | 19.53 | 19.34 | 23.12 | 42000 | 44000 | 0.80 | 0.72 | 0.58 |
| 43000 | 45000 | 23.73 | 21.02 | 20.58 | 43000 | 45000 | 0.77 | 0.73 | 0.75 |
| 44000 | 46000 | 19.20 | 18.97 | 28.28 | 44000 | 46000 | 0.36 | 0.32 | 0.39 |
| 45000 | 47000 | 21.49 | 19.57 | 19.01 | 45000 | 47000 | 0.94 | 0.90 | 0.88 |
| 46000 | 48000 | 18.96 | 18.90 | 25.52 | 46000 | 48000 | 0.72 | 0.72 | 0.71 |
| 47000 | 49000 | 20.29 | 17.97 | 17.92 | 47000 | 49000 | 1.13 | 0.86 | 0.95 |
| 48000 | 50000 | 20.68 | 16.64 | 16.93 | 48000 | 50000 | 1.25 | 1.19 | 1.22 |
| 49000 | 51000 | 19.01 | 18.89 | 19.79 | 49000 | 51000 | 0.57 | 0.51 | 0.78 |
| 50000 | 52000 | 23.33 | 14.86 | 14.62 | 50000 | 52000 | 1.44 | 1.55 | 1.56 |
| 51000 | 53000 | 18.92 | 18.97 | 21.80 | 51000 | 53000 | 1.09 | 1.11 | 1.03 |
| 52000 | 54000 | 29.43 | 17.65 | 17.33 | 52000 | 54000 | 1.00 | 1.46 | 1.44 |
| 53000 | 55000 | 18.10 | 17.95 | 20.64 | 53000 | 55000 | 1.16 | 1.27 | 1.19 |
| 54000 | 56000 | 27.09 | 19.12 | 19.15 | 54000 | 56000 | 1.27 | 1.24 | 1.13 |
| 56000 | 58000 | 23.50 | 22.67 | 21.83 | 56000 | 58000 | 0.58 | 0.93 | 0.92 |
| 58000 | 60000 | 22.21 | 22.76 | 23.52 | 58000 | 60000 | 2.30 | 2.17 | 2.08 |
| 60000 | 62000 | 20.34 | 16.07 | 15.87 | 60000 | 62000 | 2.67 | 2.37 | 2.13 |



Typical Performance Data

| IF (MHz) | LO (MHz) | CONVERSION LOSS VS. IF FREQUENCY @ RF=40GHz (dB) | | | IF (MHz) | RF (MHz) | CONVERSION LOSS VS. IF FREQUENCY @ LO=40GHz (dB) | | |
|----------|----------|--|------|------|----------|----------|--|------|------|
| | | @LO (dBm) | | | | | @LO (dBm) | | |
| | | +14 | +15 | +16 | | | +14 | +15 | +16 |
| 10 | 40010 | 10.5 | 10.4 | 10.4 | 10 | 40010 | 10.5 | 10.3 | 10.3 |
| 1000 | 41000 | 10.4 | 10.5 | 10.9 | 1000 | 41000 | 10.6 | 10.4 | 10.3 |
| 2000 | 42000 | 10.2 | 10.2 | 10.4 | 2000 | 42000 | 11.0 | 10.7 | 10.6 |
| 3000 | 43000 | 10.3 | 10.4 | 10.7 | 3000 | 43000 | 11.4 | 11.1 | 10.9 |
| 4000 | 44000 | 10.6 | 10.5 | 10.7 | 4000 | 44000 | 11.5 | 11.1 | 11.0 |
| 5000 | 45000 | 10.7 | 10.6 | 10.9 | 5000 | 45000 | 11.2 | 10.8 | 10.6 |
| 6000 | 46000 | 11.0 | 11.0 | 11.1 | 6000 | 46000 | 11.2 | 10.8 | 10.6 |
| 7000 | 47000 | 11.1 | 11.1 | 11.4 | 7000 | 47000 | 11.5 | 11.0 | 10.8 |
| 8000 | 48000 | 11.4 | 11.3 | 11.4 | 8000 | 48000 | 11.9 | 11.5 | 11.2 |
| 9000 | 49000 | 11.2 | 11.1 | 11.4 | 9000 | 49000 | 12.1 | 11.6 | 11.4 |
| 10000 | 50000 | 11.6 | 11.4 | 11.5 | 10000 | 50000 | 12.2 | 11.6 | 11.3 |
| 11000 | 51000 | 11.8 | 11.9 | 12.4 | 11000 | 51000 | 12.0 | 11.4 | 11.1 |
| 12000 | 52000 | 11.8 | 11.9 | 12.3 | 12000 | 52000 | 11.7 | 11.1 | 10.9 |
| 13000 | 53000 | 11.9 | 12.0 | 12.4 | 13000 | 53000 | 11.8 | 11.3 | 11.1 |
| 14000 | 54000 | 12.0 | 12.1 | 12.6 | 14000 | 54000 | 12.1 | 11.6 | 11.3 |
| 15000 | 55000 | 12.7 | 12.7 | 13.3 | 15000 | 55000 | 13.0 | 12.6 | 12.3 |
| 16000 | 56000 | 13.2 | 13.2 | 13.7 | 16000 | 56000 | 14.8 | 14.2 | 13.9 |
| 17000 | 57000 | 13.2 | 13.2 | 13.8 | 17000 | 57000 | 16.2 | 15.6 | 15.2 |
| 18000 | 58000 | 13.3 | 13.5 | 14.1 | 18000 | 58000 | 17.2 | 16.4 | 15.9 |
| 19000 | 59000 | 14.0 | 13.8 | 13.8 | 19000 | 59000 | 18.0 | 17.0 | 16.4 |
| 20000 | 60000 | 14.4 | 14.2 | 14.5 | 20000 | 60000 | 18.8 | 17.7 | 16.9 |
| 21000 | 61000 | 15.9 | 15.2 | 14.9 | 21000 | 61000 | 18.3 | 17.3 | 16.6 |
| 22000 | 62000 | 15.4 | 15.2 | 15.3 | 22000 | 62000 | 16.6 | 16.0 | 15.6 |
| 23000 | 63000 | 14.6 | 14.6 | 14.8 | 23000 | 63000 | 16.0 | 15.5 | 15.3 |
| 24000 | 64000 | 15.3 | 15.4 | 15.7 | 24000 | 64000 | 16.8 | 16.4 | 16.3 |
| 25000 | 65000 | 17.0 | 17.1 | 17.3 | 25000 | 65000 | 18.6 | 18.4 | 18.4 |

Wideband Double Balanced Mixer Die

MDB-653H-D+

Typical Performance Data

| LO (MHz) | LO-RF ISOLATION (dB) | | | LO-IF ISOLATION (dB) | | | RF (MHz) | LO (MHz) | RF-IF ISOLATION (dB) | | |
|-------------|-------------------------|------|------|-------------------------|------|------|-------------|-------------|-------------------------|------|------|
| | @LO (dBm) | | | @LO (dBm) | | | | | @LO (dBm) | | |
| | +14 | +15 | +16 | +14 | +15 | +16 | | | +14 | +15 | +16 |
| 18000 | 32.9 | 33.4 | 33.8 | 30.1 | 30.5 | 31.0 | 18000 | 20000 | 27.0 | 27.8 | 28.5 |
| 19000 | 31.9 | 34.3 | 36.5 | 33.5 | 34.0 | 34.8 | 19000 | 21000 | 27.2 | 28.0 | 28.4 |
| 20000 | 37.4 | 37.8 | 37.8 | 33.2 | 34.3 | 36.2 | 20000 | 22000 | 31.6 | 32.5 | 32.9 |
| 21000 | 41.2 | 42.6 | 43.0 | 36.2 | 37.8 | 39.8 | 21000 | 23000 | 32.3 | 30.7 | 30.9 |
| 22000 | 42.3 | 42.8 | 42.6 | 35.1 | 36.6 | 38.7 | 22000 | 24000 | 36.6 | 33.7 | 31.1 |
| 23000 | 41.3 | 41.6 | 41.3 | 36.1 | 37.6 | 39.6 | 23000 | 25000 | 29.0 | 29.0 | 30.1 |
| 24000 | 43.0 | 43.7 | 43.9 | 36.1 | 37.3 | 38.6 | 24000 | 26000 | 29.7 | 29.0 | 29.7 |
| 25000 | 43.6 | 43.5 | 43.4 | 37.5 | 38.9 | 40.4 | 25000 | 27000 | 34.7 | 33.9 | 35.2 |
| 26000 | 44.6 | 44.4 | 44.1 | 38.2 | 39.6 | 41.0 | 26000 | 28000 | 38.0 | 38.0 | 39.0 |
| 27000 | 43.8 | 44.6 | 45.4 | 37.8 | 39.2 | 40.7 | 27000 | 29000 | 36.1 | 35.9 | 37.5 |
| 28000 | 42.6 | 43.7 | 44.8 | 38.6 | 40.0 | 41.3 | 28000 | 30000 | 36.8 | 36.8 | 36.6 |
| 29000 | 40.1 | 40.8 | 42.2 | 41.7 | 43.8 | 45.6 | 29000 | 31000 | 33.8 | 33.0 | 31.7 |
| 30000 | 39.9 | 40.7 | 41.6 | 47.1 | 48.3 | 49.2 | 30000 | 32000 | 32.9 | 32.8 | 32.5 |
| 31000 | 40.1 | 40.6 | 40.8 | 52.3 | 51.6 | 51.2 | 31000 | 33000 | 29.5 | 29.1 | 28.6 |
| 32000 | 40.2 | 40.4 | 39.9 | 56.1 | 52.0 | 50.2 | 32000 | 34000 | 29.6 | 29.5 | 29.2 |
| 33000 | 36.6 | 36.7 | 36.6 | 53.4 | 51.4 | 50.2 | 33000 | 35000 | 28.0 | 27.9 | 27.8 |
| 34000 | 36.5 | 37.0 | 36.6 | 50.5 | 48.0 | 47.0 | 34000 | 36000 | 27.3 | 27.4 | 27.5 |
| 35000 | 35.9 | 36.2 | 36.1 | 53.6 | 52.9 | 52.3 | 35000 | 37000 | 27.7 | 27.7 | 27.8 |
| 36000 | 34.6 | 34.7 | 34.8 | 53.1 | 52.7 | 52.5 | 36000 | 38000 | 25.9 | 26.3 | 26.7 |
| 37000 | 35.1 | 35.2 | 35.0 | 49.9 | 50.7 | 51.4 | 37000 | 39000 | 26.2 | 26.3 | 26.5 |
| 38000 | 36.2 | 36.2 | 35.9 | 45.2 | 46.3 | 47.4 | 38000 | 40000 | 25.1 | 25.4 | 25.5 |
| 39000 | 36.6 | 36.5 | 36.3 | 41.0 | 41.8 | 42.5 | 39000 | 41000 | 24.8 | 24.8 | 24.9 |
| 40000 | 38.0 | 38.1 | 38.0 | 38.3 | 39.1 | 39.8 | 40000 | 42000 | 24.1 | 24.2 | 24.1 |
| 42000 | 38.1 | 38.1 | 37.9 | 32.4 | 33.0 | 33.5 | 42000 | 44000 | 21.7 | 21.7 | 21.7 |
| 44000 | 38.3 | 38.2 | 38.1 | 28.0 | 28.4 | 28.7 | 44000 | 46000 | 20.1 | 20.1 | 20.1 |
| 46000 | 39.7 | 39.6 | 39.4 | 23.9 | 24.3 | 24.6 | 46000 | 48000 | 17.7 | 17.7 | 17.7 |
| 48000 | 42.1 | 41.9 | 41.8 | 21.7 | 22.0 | 22.4 | 48000 | 50000 | 16.5 | 16.6 | 16.7 |
| 50000 | 54.5 | 56.4 | 58.6 | 23.7 | 24.0 | 24.2 | 50000 | 52000 | 19.5 | 19.5 | 19.5 |
| 52000 | 51.3 | 49.9 | 48.7 | 25.7 | 25.7 | 25.8 | 52000 | 54000 | 22.4 | 22.4 | 22.3 |
| 54000 | 48.4 | 47.3 | 46.3 | 29.4 | 29.2 | 29.1 | 54000 | 56000 | 27.0 | 26.8 | 26.8 |
| 56000 | 44.7 | 44.2 | 43.8 | 28.7 | 28.5 | 28.4 | 56000 | 58000 | 26.1 | 26.1 | 26.1 |
| 58000 | 43.6 | 43.1 | 42.8 | 29.5 | 29.3 | 29.3 | 58000 | 60000 | 28.1 | 27.8 | 27.9 |
| 60000 | 44.0 | 43.4 | 43.0 | 31.9 | 31.6 | 31.5 | 60000 | 62000 | 29.5 | 29.8 | 29.7 |
| 62000 | 41.5 | 41.4 | 41.4 | 32.1 | 31.8 | 31.8 | 62000 | 64000 | 30.1 | 31.0 | 30.4 |
| 64900 | 38.4 | 38.6 | 38.7 | 30.2 | 30.2 | 30.0 | 64900 | 66900 | 38.7 | 39.3 | 39.8 |



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IF/RF MICROWAVE COMPONENTS

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Wideband Double Balanced Mixer Die MDB-653H-D+

Typical Performance Data

| RF (IN) (MHz) | LO (MHz) | RF VSWR (:1) | | | LO (MHz) | LO VSWR (:1) | | | IF (OUT) (MHz) | IF VSWR @ LO=2GHz (:1) | | |
|---------------|----------|--------------|------|------|----------|--------------|------|------|----------------|------------------------|------|------|
| | | @LO (dBm) | | | | @LO (dBm) | | | | @LO (dBm) | | |
| | | +14 | +15 | +16 | | +14 | +15 | +16 | | +14 | +15 | +16 |
| 18000 | 20000 | 4.92 | 5.00 | 5.06 | 18000 | 5.69 | 5.20 | 4.89 | 10 | 1.07 | 1.04 | 1.01 |
| 19000 | 21000 | 3.31 | 3.52 | 3.63 | 19000 | 4.06 | 3.81 | 3.62 | 500 | 1.11 | 1.08 | 1.06 |
| 20000 | 22000 | 2.88 | 3.04 | 3.09 | 20000 | 3.07 | 2.97 | 2.90 | 1000 | 1.18 | 1.15 | 1.13 |
| 21000 | 23000 | 3.10 | 3.13 | 3.14 | 21000 | 2.57 | 2.54 | 2.52 | 2000 | 1.37 | 1.34 | 1.32 |
| 22000 | 24000 | 3.50 | 3.50 | 3.48 | 22000 | 2.41 | 2.38 | 2.37 | 3000 | 1.56 | 1.53 | 1.51 |
| 23000 | 25000 | 4.06 | 3.98 | 3.95 | 23000 | 2.32 | 2.32 | 2.35 | 4000 | 1.64 | 1.61 | 1.59 |
| 24000 | 26000 | 4.76 | 4.61 | 4.53 | 24000 | 2.03 | 2.09 | 2.14 | 5000 | 1.60 | 1.56 | 1.54 |
| 25000 | 27000 | 5.17 | 5.04 | 4.97 | 25000 | 1.80 | 1.89 | 1.96 | 6000 | 1.61 | 1.57 | 1.54 |
| 26000 | 28000 | 5.00 | 4.91 | 4.88 | 26000 | 1.58 | 1.68 | 1.74 | 7000 | 1.68 | 1.64 | 1.60 |
| 27000 | 29000 | 4.79 | 4.57 | 4.49 | 27000 | 1.55 | 1.61 | 1.64 | 8000 | 1.83 | 1.78 | 1.74 |
| 28000 | 30000 | 4.11 | 3.98 | 3.94 | 28000 | 1.63 | 1.64 | 1.65 | 9000 | 2.02 | 1.96 | 1.91 |
| 29000 | 31000 | 3.42 | 3.26 | 3.24 | 29000 | 1.78 | 1.75 | 1.72 | 10000 | 2.29 | 2.21 | 2.14 |
| 30000 | 32000 | 2.75 | 2.66 | 2.64 | 30000 | 1.89 | 1.82 | 1.78 | 11000 | 2.55 | 2.46 | 2.37 |
| 31000 | 33000 | 2.45 | 2.37 | 2.35 | 31000 | 1.91 | 1.82 | 1.77 | 12000 | 2.87 | 2.77 | 2.67 |
| 32000 | 34000 | 2.42 | 2.25 | 2.23 | 32000 | 2.00 | 1.87 | 1.79 | 13000 | 3.12 | 3.01 | 2.91 |
| 33000 | 35000 | 2.47 | 2.33 | 2.27 | 33000 | 2.03 | 1.90 | 1.81 | 14000 | 3.66 | 3.54 | 3.43 |
| 34000 | 36000 | 2.81 | 2.48 | 2.39 | 34000 | 2.26 | 2.12 | 2.02 | 15000 | 4.65 | 4.52 | 4.39 |
| 35000 | 37000 | 2.04 | 1.94 | 1.92 | 35000 | 2.88 | 2.61 | 2.44 | 16000 | 5.52 | 5.39 | 5.26 |
| 36000 | 38000 | 3.01 | 2.53 | 2.22 | 36000 | 3.27 | 3.01 | 2.83 | 17000 | 5.85 | 5.72 | 5.57 |
| 37000 | 39000 | 1.94 | 1.76 | 1.72 | 37000 | 5.08 | 4.08 | 3.83 | 18000 | 5.82 | 5.68 | 5.53 |
| 38000 | 40000 | 2.87 | 2.52 | 2.46 | 38000 | 7.98 | 5.59 | 5.01 | 19000 | 5.92 | 5.75 | 5.58 |
| 39000 | 41000 | 3.29 | 3.12 | 3.08 | 39000 | 7.12 | 5.12 | 4.62 | 20000 | 6.04 | 5.85 | 5.67 |
| 40000 | 42000 | 3.96 | 3.54 | 3.45 | 40000 | 5.64 | 4.25 | 3.89 | 21000 | 6.08 | 5.91 | 5.74 |
| 42000 | 44000 | 3.88 | 3.59 | 3.51 | 42000 | 3.68 | 3.00 | 2.83 | 22000 | 5.60 | 5.49 | 5.38 |
| 44000 | 46000 | 3.27 | 3.03 | 2.96 | 44000 | 3.70 | 2.91 | 2.67 | 23000 | 4.61 | 4.52 | 4.46 |
| 46000 | 48000 | 2.67 | 2.42 | 2.35 | 46000 | 2.96 | 2.51 | 2.36 | 24000 | 4.42 | 4.35 | 4.30 |
| 48000 | 50000 | 2.96 | 2.66 | 2.59 | 48000 | 3.62 | 2.94 | 2.76 | 25000 | 5.62 | 5.63 | 5.66 |
| 50000 | 52000 | 2.63 | 2.48 | 2.43 | 50000 | 3.76 | 3.06 | 2.86 | 26000 | 7.20 | 7.31 | 7.40 |
| 52000 | 54000 | 1.73 | 1.67 | 1.65 | 52000 | 2.24 | 2.00 | 1.94 | 27000 | 8.53 | 8.69 | 8.84 |
| 54000 | 56000 | 1.22 | 1.15 | 1.13 | 54000 | 2.19 | 1.86 | 1.77 | --- | --- | --- | --- |
| 56000 | 58000 | 1.72 | 1.68 | 1.66 | 56000 | 1.56 | 1.42 | 1.38 | --- | --- | --- | --- |
| 58000 | 60000 | 3.59 | 3.40 | 3.32 | 58000 | 1.90 | 1.70 | 1.63 | --- | --- | --- | --- |
| 60000 | 62000 | 3.19 | 2.96 | 2.85 | 60000 | 3.92 | 3.33 | 3.34 | --- | --- | --- | --- |
| 62000 | 64000 | 1.67 | 1.60 | 1.57 | 62000 | 3.20 | 2.77 | 2.62 | --- | --- | --- | --- |
| 64900 | 66900 | 6.17 | 5.30 | 5.04 | 65000 | 2.23 | 2.03 | 1.97 | --- | --- | --- | --- |



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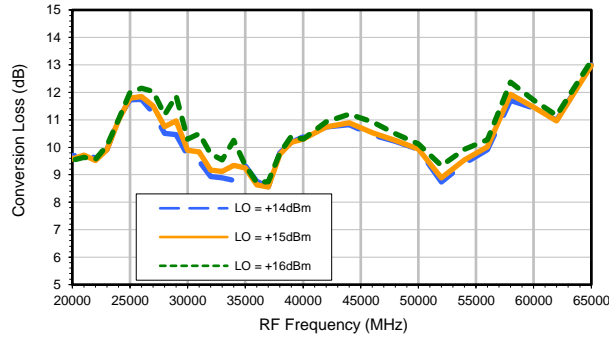
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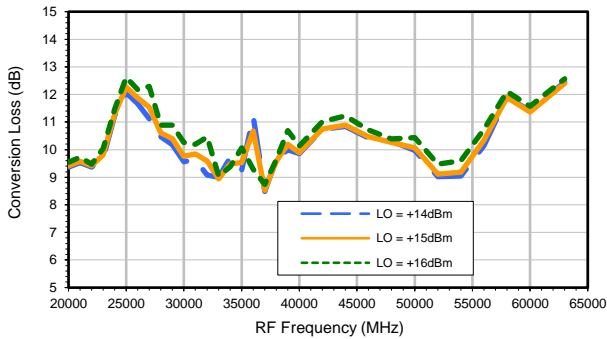
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Typical Performance Curves

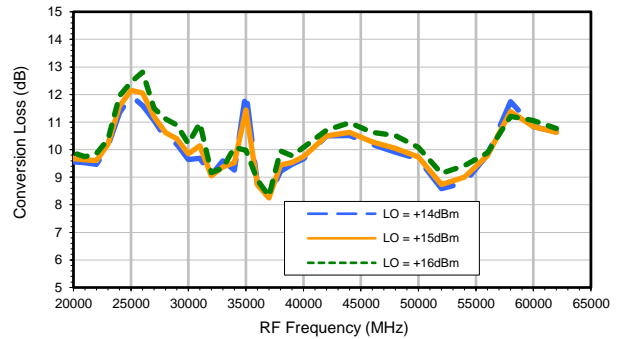
Conversion Loss @ IF=30 MHz



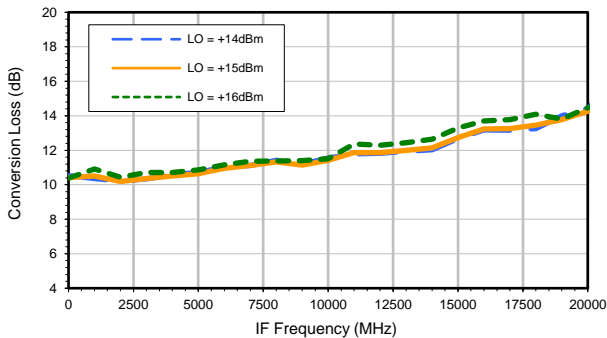
Conversion Loss @ IF=2GHz



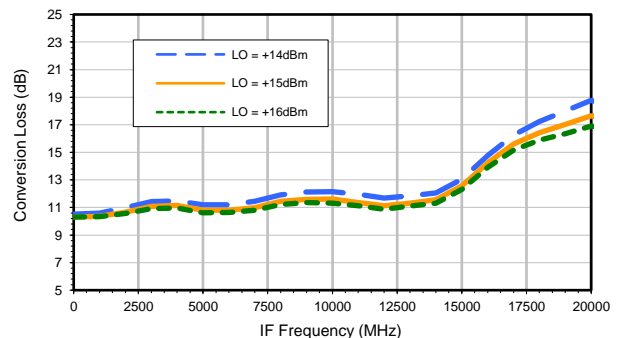
Conversion Loss @ IF=3GHz



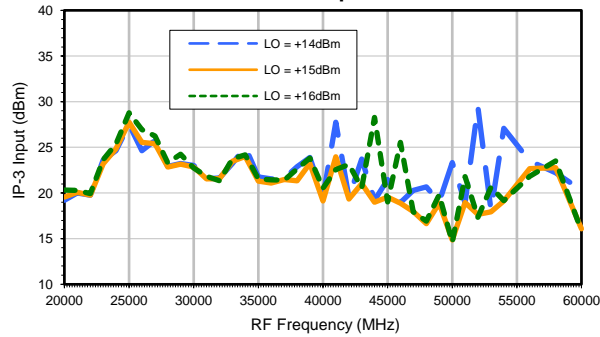
Conversion Loss vs. IF @ RF=40GHz



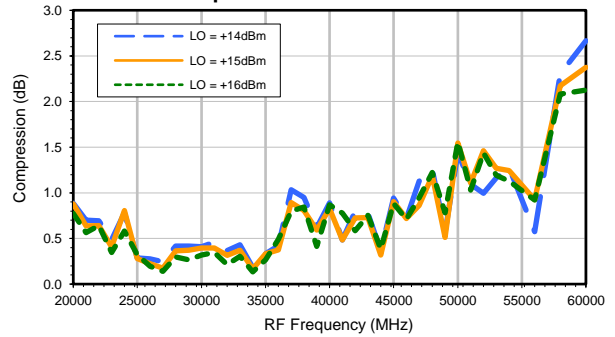
Conversion Loss vs. IF @ LO=40GHz



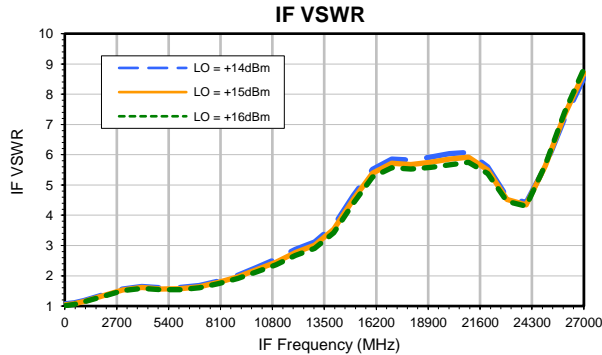
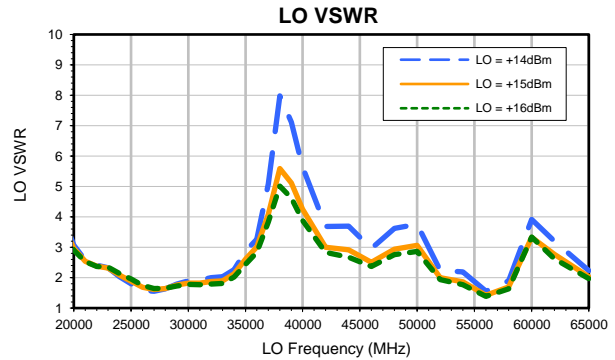
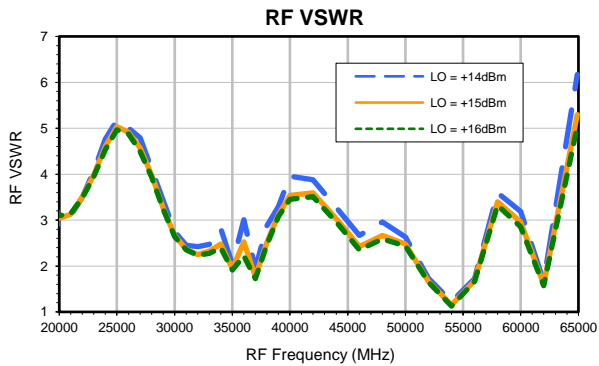
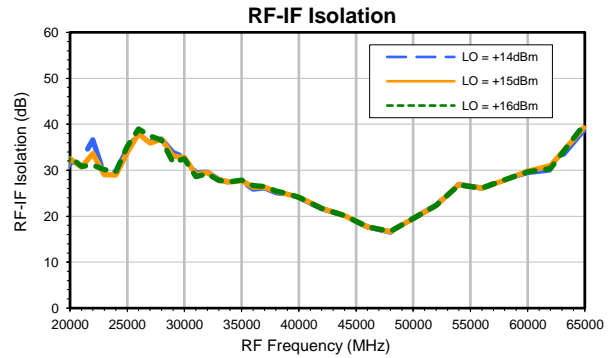
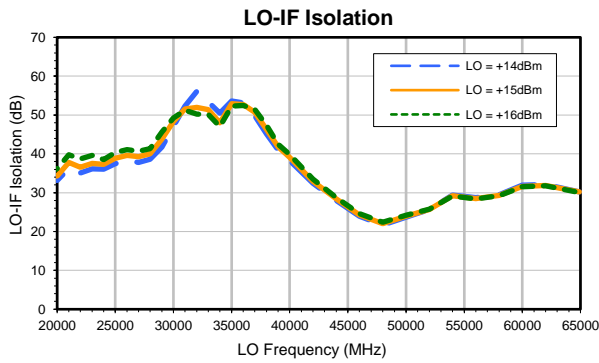
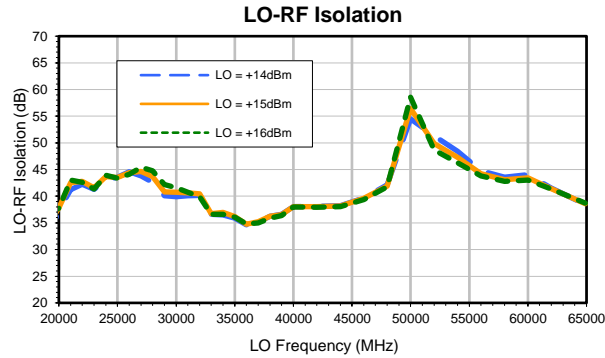
IP-3 Input



Compression @ RF IN=+10 dBm



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.

| Specification | Test/Inspection Condition | Reference/Spec |
|-----------------------|--|--------------------------------------|
| Operating Temperature | -40° to 85° C or -40° to 105° C or -55° to 105° C Ambient Environment | Refer to Individual Model Data Sheet |
| Storage Environment | 20° to 35° C and 40 to 60% humidity (In Factory Shipped Package) | Individual Model Data Sheet |