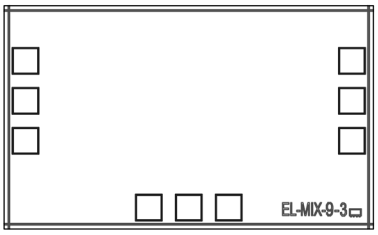
*Super Wideband*

# 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

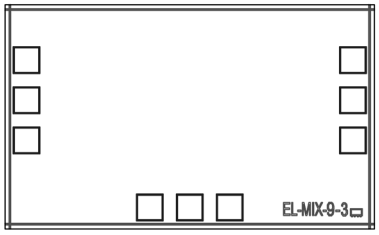
| Feature | Advantages |
|---|---|
| Double Balanced | Results in excellent LO-RF (35-55 dB typical) & LO-IF (23-52 dB typical) Isolations, minimizing need for external filtering. |
| Super Wideband, 20 to 65 GHz | Useful in wideband systems or in in several narrowband systems, reducing inventory. |
| 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

# MDB-653H-D+

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




### 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

***+RoHS Compliant***

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

*Ordering Information: Refer to Last Page*

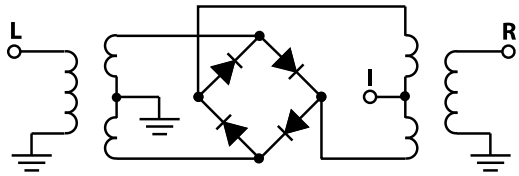
### Typical Applications

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

### Product Overview

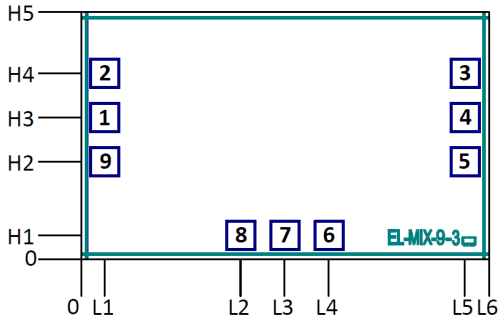
MDB-653H-D+ is super-wideband double balanced mixer die fabricated using InGaP HBT technology. The MDB-653H-D+ mixer functions as an up converter or down converter for LO and RF frequencies from 20 to 65GHz and covers IF bandwidths from DC-20GHz. The Mixer operates with 15dBm LO power level while providing 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.

### Simplified Schematic and Pad description




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

### Bonding Pad Position




Dimensions in µm, Typical

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

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

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

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

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

## Absolute Maximum Ratings[2]

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

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

## Characterization Test and Applications Circuits

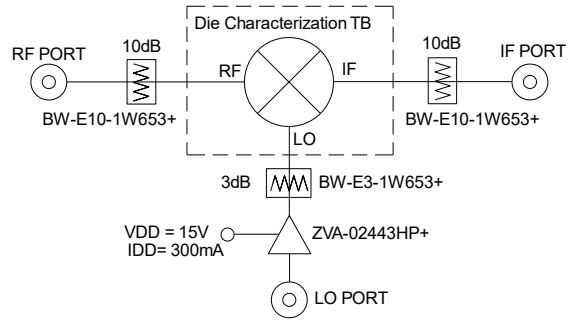



*Figure 1A. Block Diagram of Test Circuit used for characterization of Conversion Loss, Isolation (L-R,L-I, R-I) & VSWR from 20 to 35 GHz.*

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

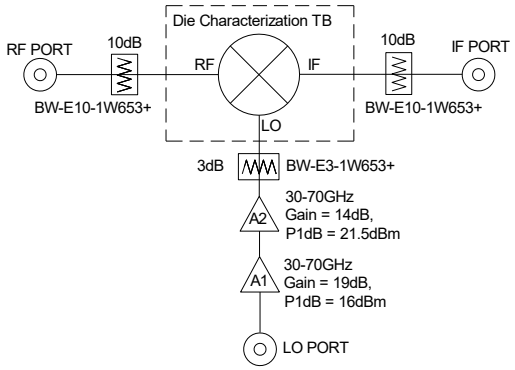



*Figure 1B. Block Diagram of Test Circuit used for characterization of Conversion Loss, Isolation(L-R,L-I, R-I) & VSWR from 35 to 65 GHz.*

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

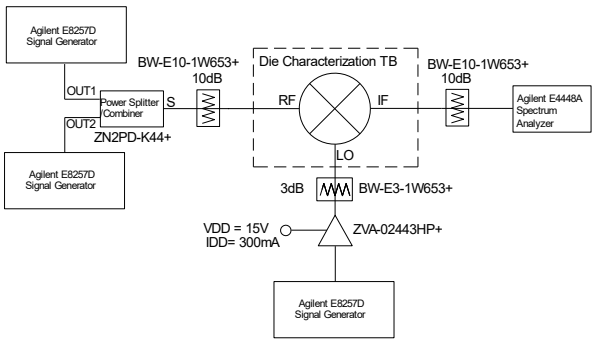



*Figure 1C. Block Diagram of Test Circuit used for characterization of Input IP3 from 20 to 35GHz*

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

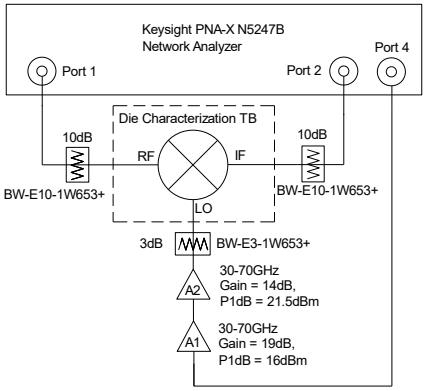



*Figure 1D. Block Diagram of Test Circuit used for characterization of Input IP3 from 35 to 65 GHz*
*Test Condition:*
*RF=-10dBm/Tone, LO = 15dBm, IF= 2GHz*
*Input IP3 (IIP3): Two tones, spaced 1MHz apart*

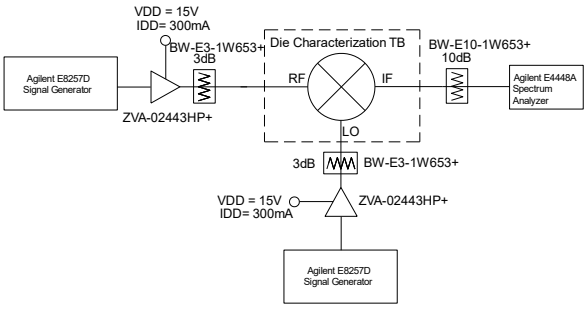



*Figure 1E. Block Diagram of Test Circuit used for characterization of Compression from 20 to 35 GHz*

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

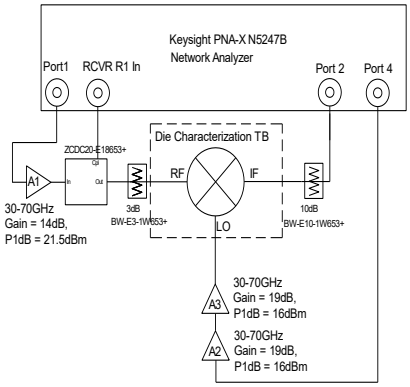
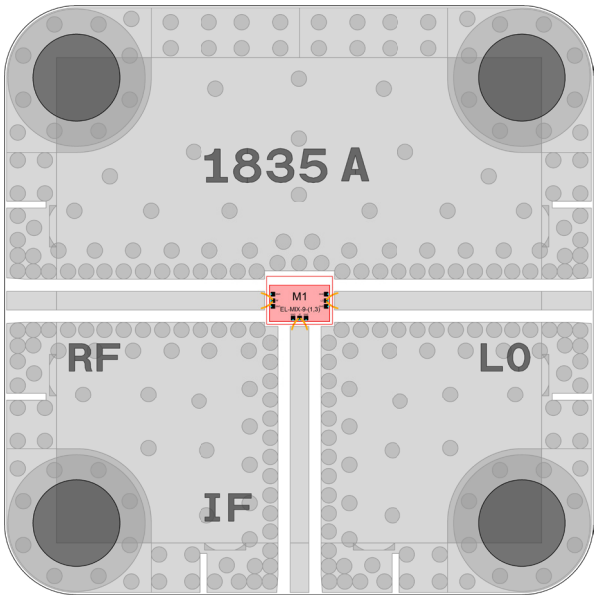



*Figure 1F. Block Diagram of Test Circuit used for characterization of Compression from 35 to 65GHz*

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

## Assembly Diagram




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

## Assembly and Handling Procedure

1. Storage
   Dice should be stored in a dry nitrogen purged desiccators or equivalent.
2. ESD
   MMIC InGap HBT mixer dice are susceptible to electrostatic and mechanical damage. Die are supplied in antistatic protected material, which should be opened in clean room conditions at an appropriately grounded anti-static 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

*additional information is available on our dash board.*

| | | |
|---|---|---|
| **Performance Data** | Data Table | |
| | Swept Graphs | |
| **Case Style** | Die | |
| **Die Ordering and packaging information** | Quantity, Package | Model No. |
| | Small, Gel - Pak: 10,50,100 KGD* | MDB-653H-DG+ |
| | Medium†, Partial wafer: KGD*<1333 | MDB-653H-DP+ |
| | †*Available upon request contact sales representative* | |
| | Refer to AN-60-067 | |
| **Die TB Reference** | XM-C9L2-0404D (Please check X-Microwave's Website) | |
| **Environmental Ratings** | ENV-80 | |

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

## ESD Rating**

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

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

### Additional Notes

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## *Typical Performance Data*

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

| RF (IN) (MHz) | LO (MHz) | CONVERSION LOSS IF FIXED @ IF(OUT)=2GHz (dB) | | |
|---|---|---|---|---|
| | | @LO (dBm) | | |
| | | +14 | +15 | +16 |
| 18000 | 20000 | 11.7 | 11.7 | 11.7 |
| 19000 | 21000 | 10.1 | 10.1 | 10.1 |
| 20000 | 22000 | 9.4 | 9.4 | 9.5 |
| 21000 | 23000 | 9.5 | 9.6 | 9.7 |
| 22000 | 24000 | 9.4 | 9.4 | 9.5 |
| 23000 | 25000 | 9.7 | 9.8 | 10.0 |
| 24000 | 26000 | 11.2 | 11.3 | 11.5 |
| 25000 | 27000 | 12.1 | 12.3 | 12.6 |
| 26000 | 28000 | 11.7 | 11.9 | 12.2 |
| 27000 | 29000 | 11.1 | 11.5 | 12.3 |
| 28000 | 30000 | 10.5 | 10.6 | 10.9 |
| 29000 | 31000 | 10.2 | 10.4 | 10.9 |
| 30000 | 32000 | 9.6 | 9.8 | 10.3 |
| 31000 | 33000 | 9.6 | 9.8 | 10.2 |
| 32000 | 34000 | 9.1 | 9.6 | 10.5 |
| 33000 | 35000 | 9.0 | 8.9 | 9.0 |
| 34000 | 36000 | 9.7 | 9.5 | 9.4 |
| 35000 | 37000 | 9.3 | 9.5 | 10.1 |
| 36000 | 38000 | 11.2 | 10.7 | 9.3 |
| 37000 | 39000 | 8.5 | 8.5 | 8.7 |
| 38000 | 40000 | 9.7 | 9.6 | 9.6 |
| 39000 | 41000 | 10.0 | 10.2 | 10.7 |
| 40000 | 42000 | 9.9 | 9.9 | 10.1 |
| 42000 | 44000 | 10.7 | 10.7 | 11.0 |
| 44000 | 46000 | 10.8 | 10.9 | 11.2 |
| 46000 | 48000 | 10.4 | 10.5 | 10.7 |
| 48000 | 50000 | 10.3 | 10.3 | 10.4 |
| 50000 | 52000 | 10.0 | 10.1 | 10.4 |
| 52000 | 54000 | 9.0 | 9.1 | 9.5 |
| 54000 | 56000 | 9.0 | 9.2 | 9.6 |
| 56000 | 58000 | 10.1 | 10.3 | 10.7 |
| 58000 | 60000 | 11.9 | 11.9 | 12.1 |
| 60000 | 62000 | 11.4 | 11.4 | 11.6 |
| 63000 | 65000 | 12.5 | 12.4 | 12.6 |
| 64000 | 66000 | --- | --- | --- |

| RF (IN) (MHz) | LO (MHz) | CONVERSION LOSS IF FIXED @ IF(OUT)=3GHz (dB) | | |
|---|---|---|---|---|
| | | @LO (dBm) | | |
| | | +14 | +15 | +16 |
| 18000 | 21000 | 11.8 | 11.8 | 11.8 |
| 19000 | 22000 | 9.9 | 10.0 | 10.2 |
| 20000 | 23000 | 9.6 | 9.7 | 9.9 |
| 21000 | 24000 | 9.5 | 9.6 | 9.7 |
| 22000 | 25000 | 9.5 | 9.6 | 9.9 |
| 23000 | 26000 | 10.1 | 10.2 | 10.4 |
| 24000 | 27000 | 11.3 | 11.6 | 12.0 |
| 25000 | 28000 | 12.0 | 12.2 | 12.5 |
| 26000 | 29000 | 11.6 | 12.1 | 12.8 |
| 27000 | 30000 | 11.1 | 11.2 | 11.5 |
| 28000 | 31000 | 10.4 | 10.6 | 11.1 |
| 29000 | 32000 | 10.2 | 10.4 | 10.9 |
| 30000 | 33000 | 9.6 | 9.8 | 10.2 |
| 31000 | 34000 | 9.7 | 10.1 | 11.0 |
| 32000 | 35000 | 9.1 | 9.0 | 9.2 |
| 33000 | 36000 | 9.6 | 9.4 | 9.3 |
| 34000 | 37000 | 9.3 | 9.5 | 10.1 |
| 35000 | 38000 | 12.1 | 11.4 | 10.0 |
| 36000 | 39000 | 8.7 | 8.7 | 8.9 |
| 37000 | 40000 | 8.3 | 8.2 | 8.3 |
| 38000 | 41000 | 9.2 | 9.4 | 10.0 |
| 39000 | 42000 | 9.5 | 9.5 | 9.8 |
| 40000 | 43000 | 9.7 | 9.7 | 10.1 |
| 42000 | 45000 | 10.5 | 10.5 | 10.7 |
| 44000 | 47000 | 10.5 | 10.6 | 11.0 |
| 46000 | 49000 | 10.2 | 10.3 | 10.6 |
| 48000 | 51000 | 9.9 | 10.0 | 10.5 |
| 50000 | 53000 | 9.7 | 9.7 | 10.1 |
| 52000 | 55000 | 8.6 | 8.7 | 9.1 |
| 54000 | 57000 | 8.8 | 9.0 | 9.4 |
| 56000 | 59000 | 9.8 | 9.8 | 9.9 |
| 58000 | 61000 | 11.7 | 11.4 | 11.2 |
| 60000 | 63000 | 10.8 | 10.8 | 11.1 |
| 62000 | 65000 | 10.6 | 10.6 | 10.8 |
| 63900 | 66900 | --- | --- | --- |

## *Typical Performance Data*

| RF (IN) (MHz) | LO (MHz) | IP-3 INPUT (dBm) @LO (dBm) | | |
|---|---|---|---|---|
| | | +14 | +15 | +16 |
| 20000 | 22000 | 19.22 | 19.56 | 20.34 |
| 21000 | 23000 | 20.02 | 20.07 | 20.29 |
| 22000 | 24000 | 19.74 | 19.75 | 19.93 |
| 23000 | 25000 | 23.63 | 23.21 | 23.64 |
| 24000 | 26000 | 24.62 | 24.84 | 25.35 |
| 25000 | 27000 | 27.49 | 27.76 | 28.78 |
| 26000 | 28000 | 24.63 | 25.54 | 26.93 |
| 27000 | 29000 | 25.75 | 25.41 | 26.24 |
| 28000 | 30000 | 22.91 | 22.84 | 23.31 |
| 29000 | 31000 | 23.23 | 23.15 | 24.24 |
| 30000 | 32000 | 23.02 | 22.84 | 22.72 |
| 31000 | 33000 | 21.54 | 21.55 | 21.83 |
| 32000 | 34000 | 21.64 | 21.57 | 21.35 |
| 33000 | 35000 | 23.21 | 23.46 | 23.75 |
| 34000 | 36000 | 25.07 | 23.99 | 24.19 |
| 35000 | 37000 | 21.77 | 21.29 | 21.56 |
| 36000 | 38000 | 21.56 | 21.09 | 21.43 |
| 37000 | 39000 | 21.60 | 21.47 | 21.39 |
| 38000 | 40000 | 22.86 | 21.34 | 22.65 |
| 39000 | 41000 | 23.88 | 23.23 | 23.82 |
| 40000 | 42000 | 19.55 | 19.11 | 20.52 |
| 41000 | 43000 | 27.73 | 23.97 | 22.57 |
| 42000 | 44000 | 19.53 | 19.34 | 23.12 |
| 43000 | 45000 | 23.73 | 21.02 | 20.58 |
| 44000 | 46000 | 19.20 | 18.97 | 28.28 |
| 45000 | 47000 | 21.49 | 19.57 | 19.01 |
| 46000 | 48000 | 18.96 | 18.90 | 25.52 |
| 47000 | 49000 | 20.29 | 17.97 | 17.92 |
| 48000 | 50000 | 20.68 | 16.64 | 16.93 |
| 49000 | 51000 | 19.01 | 18.89 | 19.79 |
| 50000 | 52000 | 23.33 | 14.86 | 14.62 |
| 51000 | 53000 | 18.92 | 18.97 | 21.80 |
| 52000 | 54000 | 29.43 | 17.65 | 17.33 |
| 53000 | 55000 | 18.10 | 17.95 | 20.64 |
| 54000 | 56000 | 27.09 | 19.12 | 19.15 |
| 56000 | 58000 | 23.50 | 22.67 | 21.83 |
| 58000 | 60000 | 22.21 | 22.76 | 23.52 |
| 60000 | 62000 | 20.34 | 16.07 | 15.87 |

| RF (IN) (MHz) | LO (MHz) | COMPRESSION @ RF IN=+10dBm (dB) @LO (dBm) | | |
|---|---|---|---|---|
| | | +14 | +15 | +16 |
| 20000 | 22000 | 0.89 | 0.88 | 0.77 |
| 21000 | 23000 | 0.70 | 0.64 | 0.56 |
| 22000 | 24000 | 0.69 | 0.64 | 0.64 |
| 23000 | 25000 | 0.49 | 0.41 | 0.35 |
| 24000 | 26000 | 0.78 | 0.81 | 0.58 |
| 25000 | 27000 | 0.29 | 0.28 | 0.32 |
| 26000 | 28000 | 0.28 | 0.22 | 0.20 |
| 27000 | 29000 | 0.24 | 0.18 | 0.14 |
| 28000 | 30000 | 0.42 | 0.36 | 0.30 |
| 29000 | 31000 | 0.42 | 0.37 | 0.26 |
| 30000 | 32000 | 0.41 | 0.40 | 0.32 |
| 31000 | 33000 | 0.46 | 0.40 | 0.35 |
| 32000 | 34000 | 0.37 | 0.31 | 0.21 |
| 33000 | 35000 | 0.43 | 0.37 | 0.30 |
| 34000 | 36000 | 0.18 | 0.17 | 0.13 |
| 35000 | 37000 | 0.33 | 0.33 | 0.27 |
| 36000 | 38000 | 0.42 | 0.37 | 0.49 |
| 37000 | 39000 | 1.03 | 0.89 | 0.80 |
| 38000 | 40000 | 0.95 | 0.81 | 0.84 |
| 39000 | 41000 | 0.62 | 0.59 | 0.41 |
| 40000 | 42000 | 0.89 | 0.83 | 0.87 |
| 41000 | 43000 | 0.48 | 0.48 | 0.78 |
| 42000 | 44000 | 0.80 | 0.72 | 0.58 |
| 43000 | 45000 | 0.77 | 0.73 | 0.75 |
| 44000 | 46000 | 0.36 | 0.32 | 0.39 |
| 45000 | 47000 | 0.94 | 0.90 | 0.88 |
| 46000 | 48000 | 0.72 | 0.72 | 0.71 |
| 47000 | 49000 | 1.13 | 0.86 | 0.95 |
| 48000 | 50000 | 1.25 | 1.19 | 1.22 |
| 49000 | 51000 | 0.57 | 0.51 | 0.78 |
| 50000 | 52000 | 1.44 | 1.55 | 1.56 |
| 51000 | 53000 | 1.09 | 1.11 | 1.03 |
| 52000 | 54000 | 1.00 | 1.46 | 1.44 |
| 53000 | 55000 | 1.16 | 1.27 | 1.19 |
| 54000 | 56000 | 1.27 | 1.24 | 1.13 |
| 56000 | 58000 | 0.58 | 0.93 | 0.92 |
| 58000 | 60000 | 2.30 | 2.17 | 2.08 |
| 60000 | 62000 | 2.67 | 2.37 | 2.13 |

## *Typical Performance Data*

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

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

*Typical Performance Data*

| LO (MHz) | LO-RF ISOLATION (dB) @LO (dBm) | | | LO-IF ISOLATION (dB) @LO (dBm) | | |
|---|---|---|---|---|---|---|
| | +14 | +15 | +16 | +14 | +15 | +16 |
| 18000 | 32.9 | 33.4 | 33.8 | 30.1 | 30.5 | 31.0 |
| 19000 | 31.9 | 34.3 | 36.5 | 33.5 | 34.0 | 34.8 |
| 20000 | 37.4 | 37.8 | 37.8 | 33.2 | 34.3 | 36.2 |
| 21000 | 41.2 | 42.6 | 43.0 | 36.2 | 37.8 | 39.8 |
| 22000 | 42.3 | 42.8 | 42.6 | 35.1 | 36.6 | 38.7 |
| 23000 | 41.3 | 41.6 | 41.3 | 36.1 | 37.6 | 39.6 |
| 24000 | 43.0 | 43.7 | 43.9 | 36.1 | 37.3 | 38.6 |
| 25000 | 43.6 | 43.5 | 43.4 | 37.5 | 38.9 | 40.4 |
| 26000 | 44.6 | 44.4 | 44.1 | 38.2 | 39.6 | 41.0 |
| 27000 | 43.8 | 44.6 | 45.4 | 37.8 | 39.2 | 40.7 |
| 28000 | 42.6 | 43.7 | 44.8 | 38.6 | 40.0 | 41.3 |
| 29000 | 40.1 | 40.8 | 42.2 | 41.7 | 43.8 | 45.6 |
| 30000 | 39.9 | 40.7 | 41.6 | 47.1 | 48.3 | 49.2 |
| 31000 | 40.1 | 40.6 | 40.8 | 52.3 | 51.6 | 51.2 |
| 32000 | 40.2 | 40.4 | 39.9 | 56.1 | 52.0 | 50.2 |
| 33000 | 36.6 | 36.7 | 36.6 | 53.4 | 51.4 | 50.2 |
| 34000 | 36.5 | 37.0 | 36.6 | 50.5 | 48.0 | 47.0 |
| 35000 | 35.9 | 36.2 | 36.1 | 53.6 | 52.9 | 52.3 |
| 36000 | 34.6 | 34.7 | 34.8 | 53.1 | 52.7 | 52.5 |
| 37000 | 35.1 | 35.2 | 35.0 | 49.9 | 50.7 | 51.4 |
| 38000 | 36.2 | 36.2 | 35.9 | 45.2 | 46.3 | 47.4 |
| 39000 | 36.6 | 36.5 | 36.3 | 41.0 | 41.8 | 42.5 |
| 40000 | 38.0 | 38.1 | 38.0 | 38.3 | 39.1 | 39.8 |
| 42000 | 38.1 | 38.1 | 37.9 | 32.4 | 33.0 | 33.5 |
| 44000 | 38.3 | 38.2 | 38.1 | 28.0 | 28.4 | 28.7 |
| 46000 | 39.7 | 39.6 | 39.4 | 23.9 | 24.3 | 24.6 |
| 48000 | 42.1 | 41.9 | 41.8 | 21.7 | 22.0 | 22.4 |
| 50000 | 54.5 | 56.4 | 58.6 | 23.7 | 24.0 | 24.2 |
| 52000 | 51.3 | 49.9 | 48.7 | 25.7 | 25.7 | 25.8 |
| 54000 | 48.4 | 47.3 | 46.3 | 29.4 | 29.2 | 29.1 |
| 56000 | 44.7 | 44.2 | 43.8 | 28.7 | 28.5 | 28.4 |
| 58000 | 43.6 | 43.1 | 42.8 | 29.5 | 29.3 | 29.3 |
| 60000 | 44.0 | 43.4 | 43.0 | 31.9 | 31.6 | 31.5 |
| 62000 | 41.5 | 41.4 | 41.4 | 32.1 | 31.8 | 31.8 |
| 64900 | 38.4 | 38.6 | 38.7 | 30.2 | 30.2 | 30.0 |

| RF (MHz) | LO (MHz) | RF-IF ISOLATION (dB) @LO (dBm) | | |
|---|---|---|---|---|
| | | +14 | +15 | +16 |
| 18000 | 20000 | 27.0 | 27.8 | 28.5 |
| 19000 | 21000 | 27.2 | 28.0 | 28.4 |
| 20000 | 22000 | 31.6 | 32.5 | 32.9 |
| 21000 | 23000 | 32.3 | 30.7 | 30.9 |
| 22000 | 24000 | 36.6 | 33.7 | 31.1 |
| 23000 | 25000 | 29.0 | 29.0 | 30.1 |
| 24000 | 26000 | 29.7 | 29.0 | 29.7 |
| 25000 | 27000 | 34.7 | 33.9 | 35.2 |
| 26000 | 28000 | 38.0 | 38.0 | 39.0 |
| 27000 | 29000 | 36.1 | 35.9 | 37.5 |
| 28000 | 30000 | 36.8 | 36.8 | 36.6 |
| 29000 | 31000 | 33.8 | 33.0 | 31.7 |
| 30000 | 32000 | 32.9 | 32.8 | 32.5 |
| 31000 | 33000 | 29.5 | 29.1 | 28.6 |
| 32000 | 34000 | 29.6 | 29.5 | 29.2 |
| 33000 | 35000 | 28.0 | 27.9 | 27.8 |
| 34000 | 36000 | 27.3 | 27.4 | 27.5 |
| 35000 | 37000 | 27.7 | 27.7 | 27.8 |
| 36000 | 38000 | 25.9 | 26.3 | 26.7 |
| 37000 | 39000 | 26.2 | 26.3 | 26.5 |
| 38000 | 40000 | 25.1 | 25.4 | 25.5 |
| 39000 | 41000 | 24.8 | 24.8 | 24.9 |
| 40000 | 42000 | 24.1 | 24.2 | 24.1 |
| 42000 | 44000 | 21.7 | 21.7 | 21.7 |
| 44000 | 46000 | 20.1 | 20.1 | 20.1 |
| 46000 | 48000 | 17.7 | 17.7 | 17.7 |
| 48000 | 50000 | 16.5 | 16.6 | 16.7 |
| 50000 | 52000 | 19.5 | 19.5 | 19.5 |
| 52000 | 54000 | 22.4 | 22.4 | 22.3 |
| 54000 | 56000 | 27.0 | 26.8 | 26.8 |
| 56000 | 58000 | 26.1 | 26.1 | 26.1 |
| 58000 | 60000 | 28.1 | 27.8 | 27.9 |
| 60000 | 62000 | 29.5 | 29.8 | 29.7 |
| 62000 | 64000 | 30.1 | 31.0 | 30.4 |
| 64900 | 66900 | 38.7 | 39.3 | 39.8 |

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

*Typical Performance Data*

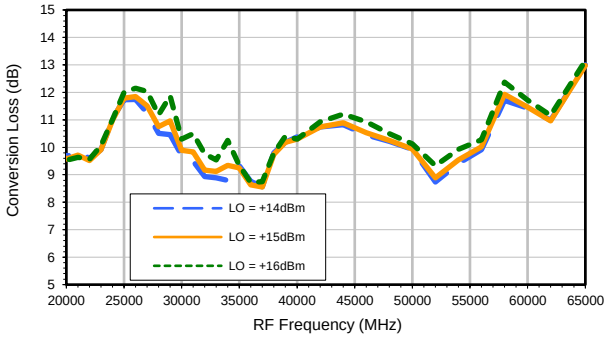
| RF (IN) (MHz) | LO (MHz) | RF VSWR (:1) @LO (dBm) | | |
|---|---|---|---|---|
| | | +14 | +15 | +16 |
| 18000 | 20000 | 4.92 | 5.00 | 5.06 |
| 19000 | 21000 | 3.31 | 3.52 | 3.63 |
| 20000 | 22000 | 2.88 | 3.04 | 3.09 |
| 21000 | 23000 | 3.10 | 3.13 | 3.14 |
| 22000 | 24000 | 3.50 | 3.50 | 3.48 |
| 23000 | 25000 | 4.06 | 3.98 | 3.95 |
| 24000 | 26000 | 4.76 | 4.61 | 4.53 |
| 25000 | 27000 | 5.17 | 5.04 | 4.97 |
| 26000 | 28000 | 5.00 | 4.91 | 4.88 |
| 27000 | 29000 | 4.79 | 4.57 | 4.49 |
| 28000 | 30000 | 4.11 | 3.98 | 3.94 |
| 29000 | 31000 | 3.42 | 3.26 | 3.24 |
| 30000 | 32000 | 2.75 | 2.66 | 2.64 |
| 31000 | 33000 | 2.45 | 2.37 | 2.35 |
| 32000 | 34000 | 2.42 | 2.25 | 2.23 |
| 33000 | 35000 | 2.47 | 2.33 | 2.27 |
| 34000 | 36000 | 2.81 | 2.48 | 2.39 |
| 35000 | 37000 | 2.04 | 1.94 | 1.92 |
| 36000 | 38000 | 3.01 | 2.53 | 2.22 |
| 37000 | 39000 | 1.94 | 1.76 | 1.72 |
| 38000 | 40000 | 2.87 | 2.52 | 2.46 |
| 39000 | 41000 | 3.29 | 3.12 | 3.08 |
| 40000 | 42000 | 3.96 | 3.54 | 3.45 |
| 42000 | 44000 | 3.88 | 3.59 | 3.51 |
| 44000 | 46000 | 3.27 | 3.03 | 2.96 |
| 46000 | 48000 | 2.67 | 2.42 | 2.35 |
| 48000 | 50000 | 2.96 | 2.66 | 2.59 |
| 50000 | 52000 | 2.63 | 2.48 | 2.43 |
| 52000 | 54000 | 1.73 | 1.67 | 1.65 |
| 54000 | 56000 | 1.22 | 1.15 | 1.13 |
| 56000 | 58000 | 1.72 | 1.68 | 1.66 |
| 58000 | 60000 | 3.59 | 3.40 | 3.32 |
| 60000 | 62000 | 3.19 | 2.96 | 2.85 |
| 62000 | 64000 | 1.67 | 1.60 | 1.57 |
| 64900 | 66900 | 6.17 | 5.30 | 5.04 |

| LO (MHz) | LO VSWR (:1) @LO (dBm) | | |
|---|---|---|---|
| | +14 | +15 | +16 |
| 18000 | 5.69 | 5.20 | 4.89 |
| 19000 | 4.06 | 3.81 | 3.62 |
| 20000 | 3.07 | 2.97 | 2.90 |
| 21000 | 2.57 | 2.54 | 2.52 |
| 22000 | 2.41 | 2.38 | 2.37 |
| 23000 | 2.32 | 2.32 | 2.35 |
| 24000 | 2.03 | 2.09 | 2.14 |
| 25000 | 1.80 | 1.89 | 1.96 |
| 26000 | 1.58 | 1.68 | 1.74 |
| 27000 | 1.55 | 1.61 | 1.64 |
| 28000 | 1.63 | 1.64 | 1.65 |
| 29000 | 1.78 | 1.75 | 1.72 |
| 30000 | 1.89 | 1.82 | 1.78 |
| 31000 | 1.91 | 1.82 | 1.77 |
| 32000 | 2.00 | 1.87 | 1.79 |
| 33000 | 2.03 | 1.90 | 1.81 |
| 34000 | 2.26 | 2.12 | 2.02 |
| 35000 | 2.88 | 2.61 | 2.44 |
| 36000 | 3.27 | 3.01 | 2.83 |
| 37000 | 5.08 | 4.08 | 3.83 |
| 38000 | 7.98 | 5.59 | 5.01 |
| 39000 | 7.12 | 5.12 | 4.62 |
| 40000 | 5.64 | 4.25 | 3.89 |
| 42000 | 3.68 | 3.00 | 2.83 |
| 44000 | 3.70 | 2.91 | 2.67 |
| 46000 | 2.96 | 2.51 | 2.36 |
| 48000 | 3.62 | 2.94 | 2.76 |
| 50000 | 3.76 | 3.06 | 2.86 |
| 52000 | 2.24 | 2.00 | 1.94 |
| 54000 | 2.19 | 1.86 | 1.77 |
| 56000 | 1.56 | 1.42 | 1.38 |
| 58000 | 1.90 | 1.70 | 1.63 |
| 60000 | 3.92 | 3.33 | 3.34 |
| 62000 | 3.20 | 2.77 | 2.62 |
| 65000 | 2.23 | 2.03 | 1.97 |

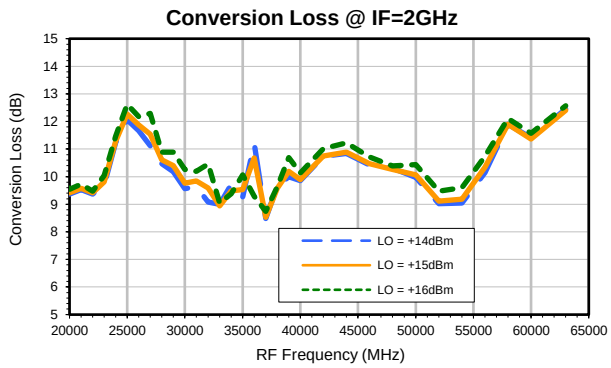
| IF (OUT) (MHz) | IF VSWR @ LO=2GHz (:1) @LO (dBm) | | |
|---|---|---|---|
| | +14 | +15 | +16 |
| 10 | 1.07 | 1.04 | 1.01 |
| 500 | 1.11 | 1.08 | 1.06 |
| 1000 | 1.18 | 1.15 | 1.13 |
| 2000 | 1.37 | 1.34 | 1.32 |
| 3000 | 1.56 | 1.53 | 1.51 |
| 4000 | 1.64 | 1.61 | 1.59 |
| 5000 | 1.60 | 1.56 | 1.54 |
| 6000 | 1.61 | 1.57 | 1.54 |
| 7000 | 1.68 | 1.64 | 1.60 |
| 8000 | 1.83 | 1.78 | 1.74 |
| 9000 | 2.02 | 1.96 | 1.91 |
| 10000 | 2.29 | 2.21 | 2.14 |
| 11000 | 2.55 | 2.46 | 2.37 |
| 12000 | 2.87 | 2.77 | 2.67 |
| 13000 | 3.12 | 3.01 | 2.91 |
| 14000 | 3.66 | 3.54 | 3.43 |
| 15000 | 4.65 | 4.52 | 4.39 |
| 16000 | 5.52 | 5.39 | 5.26 |
| 17000 | 5.85 | 5.72 | 5.57 |
| 18000 | 5.82 | 5.68 | 5.53 |
| 19000 | 5.92 | 5.75 | 5.58 |
| 20000 | 6.04 | 5.85 | 5.67 |
| 21000 | 6.08 | 5.91 | 5.74 |
| 22000 | 5.60 | 5.49 | 5.38 |
| 23000 | 4.61 | 4.52 | 4.46 |
| 24000 | 4.42 | 4.35 | 4.30 |
| 25000 | 5.62 | 5.63 | 5.66 |
| 26000 | 7.20 | 7.31 | 7.40 |
| 27000 | 8.53 | 8.69 | 8.84 |
| --- | --- | --- | --- |
| --- | --- | --- | --- |
| --- | --- | --- | --- |
| --- | --- | --- | --- |
| --- | --- | --- | --- |
| --- | --- | --- | --- |

## *Typical Performance Curves*

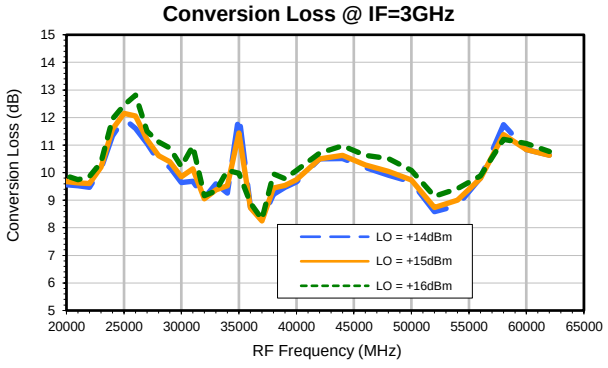
**Conversion Loss @ IF=30 MHz**



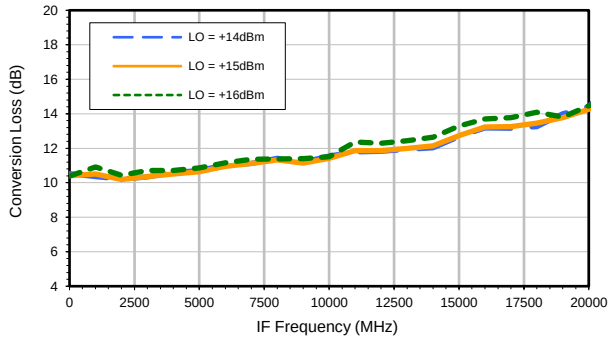

**Conversion Loss @ IF=2GHz**



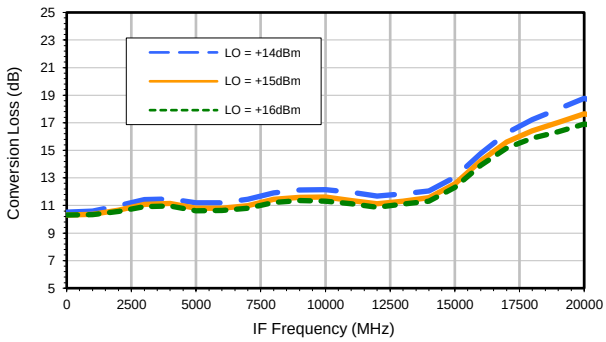

**Conversion Loss @ IF=3GHz**



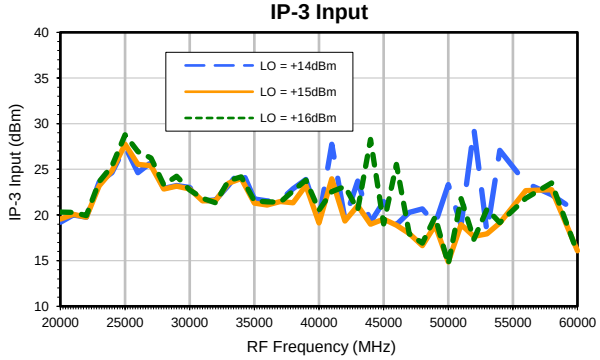

**Conversion Loss vs. IF @ RF=40GHz**



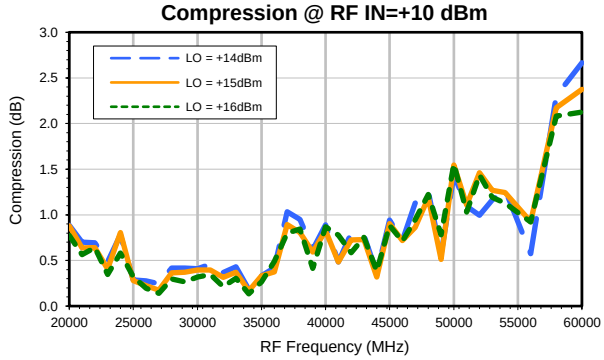

**Conversion Loss vs. IF @ LO=40GHz**



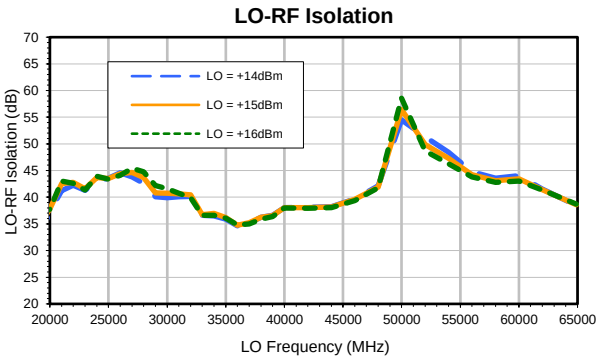

**IP-3 Input**

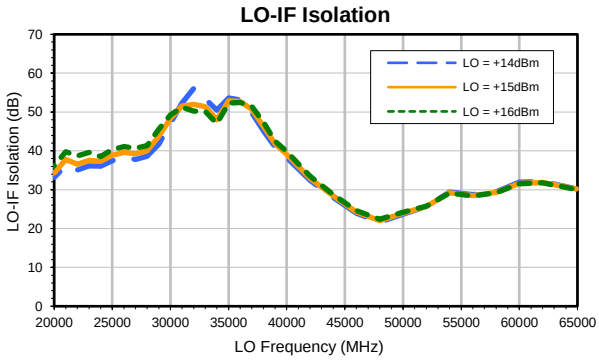


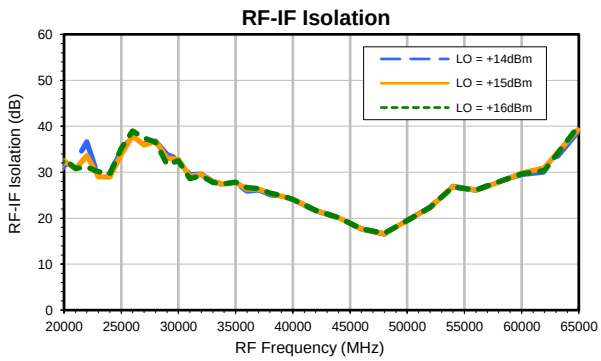

**Compression @ RF IN=+10 dBm**

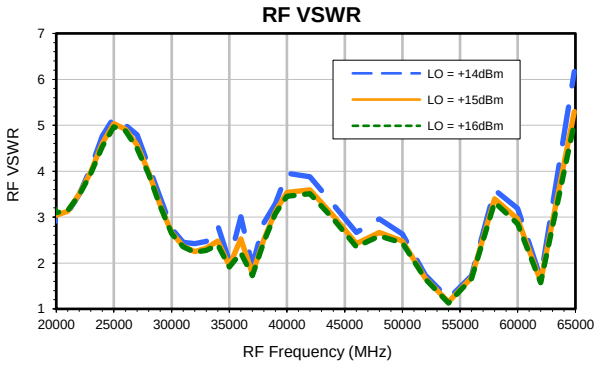


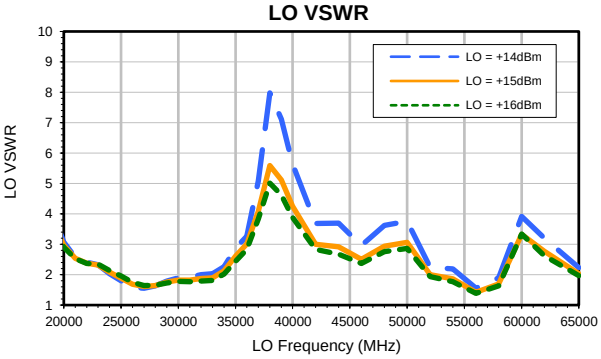
## *Typical Performance Curves*

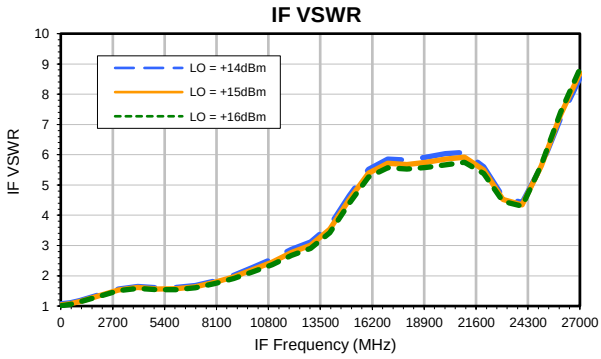


Mini-Circuits

# Environmental Specifications ENV80

All Mini-Circuits products are manufactured under exacting quality assurance and control standards, and are capable of meeting published specifications after being subjected to any or all of the following physical and environmental test.

| Specification | Test/Inspection Condition | Reference/Spec |
|---|---|---|
| Operating Temperature | -40° to 85° C or -40° to 105° C or -55° to 105° C or -45° to 105° C<br>Ambient Environment | Refer to Individual Model Data Sheet |
| Storage Environment (Die) | -65° to 150°C | Individual Model Data Sheet |
| Storage Environment(Packaging) | -40° to 70°C and 40 to 60% humidity (In Factory Shipped Package) | |