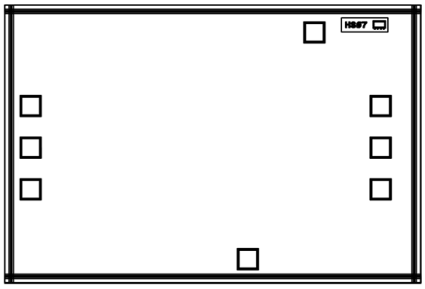
SUPER WIDEBAND, HIGH GAIN

# Monolithic Amplifier Die PMA3-453-D+

50Ω 10 to 45 GHz

## THE BIG DEAL

- Wideband, 10 to 45 GHz
- Usable down to 9 GHz
- High Gain, 25.5 dB typ. at 20 GHz
- Low NF, 1.6 dB typ. at 20 GHz
- P1dB, 10 dBm typ. at 20 GHz
- OIP3, 22 dBm typ. at 20 GHz
- Built-in Bias Tee and DC Blocks
- Patent Pending



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

SEE ORDERING INFORMATION ON THE LAST PAGE

## APPLICATIONS

- 5G
- Lab Instrument
- Satellite

## PRODUCT OVERVIEW

The PMA3-453-D+ is a PHEMT based wideband, low noise MMIC amplifier die with a unique combination of high gain and low noise figure over a very board bandwidth making it ideal for using as the first stage driver amplifier of receiver applications. This design operates on a single 4V supply, and is matched to 50 Ohm.

## KEY FEATURES

| Feature | Advantages |
|---|---|
| Low NF (<3.0dB typ.) up to 30GHz | Enables lower system noise figure performance. |
| High Gain 20dB typ. up to 30GHz | Enables signal amplification without the need for multiple gain stage, minimizing the effect of subsequent stages on noise figure. |
| Built-in Bias Tee & DC Blocks | Minimizes the external component count & PC board space, making it less expensive and user friendly for system designers. |
| Unpackaged Die | Enables users to integrates it directly into hybrids. |

REV. A
ECO-011060
PMA3 -453-D+
MCLNY
211213

# Monolithic Amplifier Die PMA3-453-D+

## ELECTRICAL SPECIFICATIONS[1] AT 25°C, 50Ω, UNLESS NOTED

| Parameter | Condition (GHz) | Vs=4.0V | | | Units |
|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | |
| Frequency Range | — | 10 | | 45 | GHz |
| Noise Figure | 10<br>20<br>30<br>40<br>45 | | 1.9<br>1.6<br>2.4<br>3.8<br>5.2 | | dB |
| Gain | 10<br>20<br>30<br>40<br>45 | | 25.3<br>25.5<br>18.2<br>14.1<br>9.1 | | dB |
| Input Return Loss | 10<br>20<br>30<br>40<br>45 | | 13<br>21<br>8<br>5<br>5 | | dB |
| Output Return Loss | 10<br>20<br>30<br>40<br>45 | | 12<br>10<br>9<br>15<br>7 | | dB |
| Output Power @ 1 dB compression | 10<br>20<br>30<br>40<br>45 | | 8.5<br>10.0<br>11.0<br>11.7<br>10.1 | | dBm |
| Output IP3 | 10<br>20<br>30<br>40<br>45 | | 18.6<br>22.0<br>23.4<br>21.9<br>21.4 | | dBm |
| Supply Voltage (Vs) | | 3.75 | 4.0 | 4.25 | V |
| Device Operating Current ($I_{DD}$) | | | 68 | 112 | mA |
| Device Current Variation vs. Temperature[2] | | | -50 | | µA/°C |
| Device Current Variation vs. Voltage | | | 0.02 | | mA/mV |
| Thermal Resistance, junction-to-ground lead | | | 106 | | °C/W |

1. Die is packaged in 3x3mm 12L MCLP and soldered on Mini-Circuits Characterization test board TB-PMA3-453+ with thru-line loss being deducted. See Characterization Test Circuit (Fig. 1)
2. Device Current Variation vs. Temperature = (Current at 85°C - Current at -45°C)/130°C

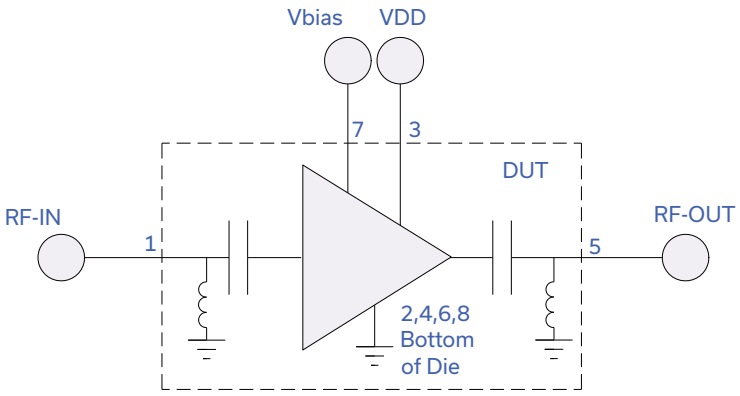
## MAXIMUM RATINGS[3]

| Parameter | Ratings |
|---|---|
| Operating temperature (ground lead) | -40°C to 85°C |
| Junction Temperature | 146°C |
| Total Power Dissipation | 0.65W |
| Input Power (CW), Vs=4V | +23 dBm (5 minutes max.)<br>+13 dBm (continuous) |
| DC Voltage (RF-IN & RF-OUT) | 2V |
| DC voltage (Vs) | 6V |

3.Permanent damage may occur if any of these limits are exceeded.
Electrical maximum ratings are not intended for continuous normal operation.

# Monolithic Amplifier Die PMA3-453-D+

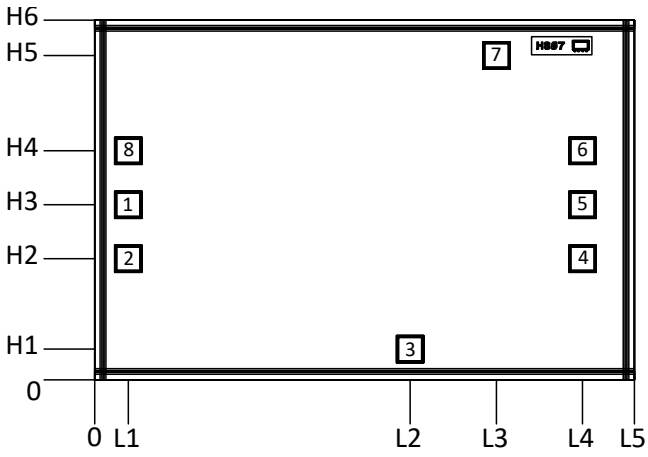
## SIMPLIFIED SCHEMATIC



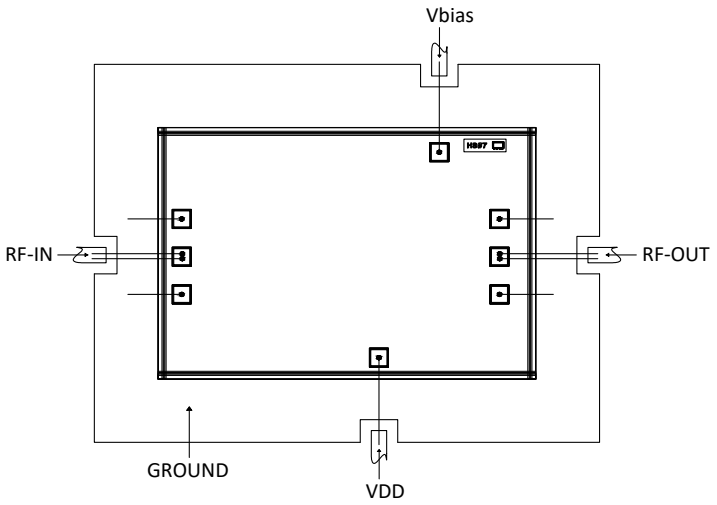

## PAD DESCRIPTION

| Function | Pad Number | Description |
|---|---|---|
| RF-IN | 1 | RF Input Pad. Connects to RF input |
| RF-OUT | 5 | RF Output Pad. Connects to RF output |
| VDD | 3 | DC Power Supply Pad. Connects to Voltage Source Vs via R1 |
| VBias | 7 | Connects to VDD |
| Ground | 2,4,6,8 & Bottom of Die | Connects to ground |

## BONDING PAD POSITION



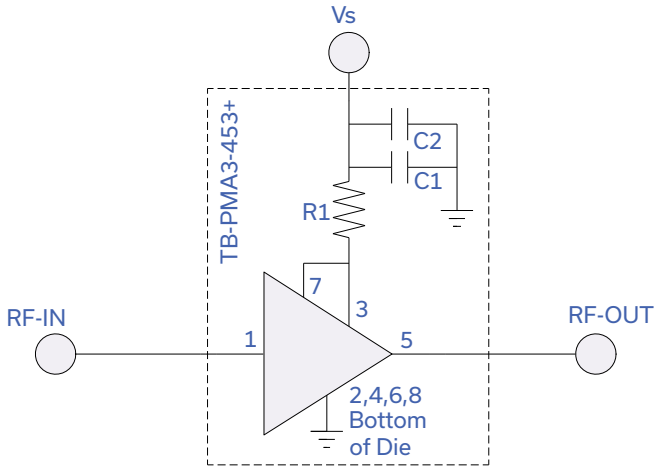

## ASSEMBLY DIAGRAM




## DIMENSION IN µM, TYPICAL

| L1 | L2 | L3 | L4 | L5 | H1 | H2 | H3 | H4 | H5 | H6 | Thick-ness | Die Size | Pad Size 1,2,3,4,5 6,7 & 8 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 93.0 | 877.0 | 1117.0 | 1356.0 | 1500.0 | 85.0 | 337.0 | 487.0 | 637.0 | 902.0 | 1000.0 | 100 | 1500 x 1000 | 64 x 64 |

## RECOMMENDED APPLICATION AND CHARACTERIZATION TEST CIRCUIT




| Component | Size | Value | Part Number | Manufacturer |
|---|---|---|---|---|
| R1 | 0603 | 18 Ohm | SG73G1JTTD18R0C | Koa |
| C1 | 0402 | 5pF | GJM1555C1H5R0CB01D | Murata |
| C2 | 0402 | 0.1uF | GRM155R71C104KA88D | Murata |

Fig 1. Application and Characterization Circuit

Note: This block diagram is used for characterization. (Die is packaged in 3x3mm 12L MCLP and soldered on Mini-Circuits Characterization Test Board TB-PMA3-453+) Gain, Return Loss, Output Power at 1dB Compression (P1dB), Ouptut IP3(OIP3), and Noise Figure are measured using Agilent's N4245A microwave network analyzer.

Conditions:
1. Gain and Return loss: Pin= -25dBm
2. Output IP3 (OIP3): Two tones, spaced 1 MHz apart, -5dBm/tone at output.

## ASSEMBLY PROCEDURE

1. Storage
   Dice should be stored in a dry nitrogen purged desiccators or equivalent.
2. ESD
   MMIC PHEMT amplifier dice are susceptible to electrostatic and mechanical damage. Die are supplied in antistatic protected material, which should be open in clean room conditions at an appropriately grounded anti-static workstation.
3. Die Handling and Attachment
   Devices need careful handling using correctly designed collets, it is recommended to handle the chip along the edges with a custom design collet. The die mounting surface must be clean and flat. Using conductive silver filled epoxy, recommended epoxies are Ablestik 84-1 LMISR4 or equivalents. Apply sufficient epoxy to meet required epoxy bond line thickness, epoxy fillet height and epoxy coverage around total periphery. Parts shall be cured in a nitrogen filled atmosphere per manufacturer's cure condition. The surface of the chip has exposed air bridges and should not be touched with vacuum collet, tweezers or fingers.
5. 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. Thermo-sonic bonding is used with minimized ultrasonic content. Bond force, time, ultrasonic power and temperature are all critical parameters. Suggested wire is pure gold, 1mil diameter. Bonds must be made from the bond pads on the die to the packaged 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 IS AVAILABLE ON OUR DASH BOARD.

| | |
|---|---|
| **Performance Data** | Data Table<br><br>Swept Graphs<br><br>S-Parameter (S2P Files) Data Set with and without port extension(.zip file) |
| **Case Style** | Die |
| **Die Ordering and packaging information** | Quantity, Package — Model No.<br><br>Small, Gel - Pak: 5,10,50,100 KGD* — PMA3-453-DG+<br>Medium†, Partial wafer: KGD*<1102 — PMA3-453-DP+<br>Full Wafer — PMA3-453-DF+<br><br>†Available upon request contact sales representative<br>Refer to AN-60-067 |
| **Environmental Ratings** | ENV80 |

*Known Good Die ("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 provide a higher degree of confidence that die 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 3x3 12L MCLP package

NOTES

A. Performance and quality attributes and conditions not expressly stated in this specification document are intended to be excluded and do not form a part of this specification document.

B. 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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## *Typical Performance Data*

**Definitions:**

Input Return Loss = -S11 (dB)
Gain(Power Gain) = S21 (dB)
Reverse Isolation = -S12 (dB)
Output Return Loss = -S22 (dB)

TEST CONDITIONS: Vd = 3.75V, Id = 63mA @ Temperature = +25°C

| FREQ | Gain | Isolation | Input Return Loss | Output Return Loss | Stability | | IP-3 Output | 1dB Comp. Output | Noise Figure |
|---|---|---|---|---|---|---|---|---|---|
| (MHz) | (dB) | (dB) | (dB) | (dB) | K | Measure | (dBm) | (dBm) | (dB) |
| 7000 | 6.72 | 66.69 | 4.00 | 5.41 | 229.36 | 1.00 | 1.77 | -5.07 | 7.38 |
| 8000 | 18.93 | 64.83 | 9.50 | 9.82 | 84.65 | 1.00 | 12.47 | 2.55 | 3.48 |
| 9000 | 22.62 | 69.03 | 10.61 | 12.09 | 97.34 | 1.02 | 16.77 | 5.68 | 2.29 |
| 10000 | 25.07 | 58.79 | 12.08 | 12.24 | 23.53 | 1.00 | 17.26 | 7.51 | 1.79 |
| 11000 | 26.69 | 60.80 | 10.21 | 12.69 | 23.91 | 1.04 | 18.50 | 7.58 | 1.81 |
| 12000 | 27.87 | 61.71 | 8.21 | 15.65 | 22.40 | 1.12 | 18.09 | 8.12 | 1.84 |
| 13000 | 28.47 | 57.87 | 8.16 | 18.25 | 13.64 | 1.14 | 18.55 | 8.06 | 1.93 |
| 14000 | 28.43 | 54.72 | 10.16 | 12.70 | 9.85 | 1.04 | 19.01 | 8.14 | 1.85 |
| 15000 | 27.95 | 52.49 | 13.35 | 10.63 | 8.31 | 0.95 | 19.76 | 8.69 | 1.75 |
| 16000 | 27.42 | 51.84 | 16.15 | 10.85 | 8.46 | 0.93 | 20.52 | 8.81 | 1.63 |
| 17000 | 26.86 | 49.85 | 15.83 | 11.89 | 7.31 | 0.95 | 20.86 | 8.73 | 1.61 |
| 18000 | 26.32 | 48.56 | 14.38 | 12.32 | 6.72 | 0.97 | 20.19 | 8.45 | 1.59 |
| 19000 | 25.83 | 48.32 | 14.04 | 11.64 | 6.88 | 0.96 | 19.62 | 8.19 | 1.58 |
| 20000 | 25.46 | 46.87 | 15.08 | 10.96 | 6.12 | 0.94 | 19.09 | 8.83 | 1.55 |
| 21000 | 24.91 | 46.06 | 16.61 | 10.48 | 5.95 | 0.92 | 19.04 | 9.31 | 1.54 |
| 22000 | 23.79 | 46.98 | 14.85 | 9.31 | 7.23 | 0.90 | 20.51 | 10.07 | 1.49 |
| 23000 | 23.02 | 47.30 | 12.32 | 8.90 | 7.89 | 0.91 | 21.02 | 9.90 | 1.56 |
| 24000 | 22.22 | 47.73 | 10.87 | 8.78 | 8.86 | 0.93 | 21.33 | 10.47 | 1.65 |
| 25000 | 21.45 | 48.31 | 10.29 | 8.43 | 10.11 | 0.93 | 22.13 | 10.61 | 1.69 |
| 26000 | 20.65 | 47.95 | 9.39 | 7.79 | 10.13 | 0.92 | 20.99 | 10.49 | 1.80 |
| 27000 | 19.77 | 46.74 | 8.51 | 7.24 | 9.25 | 0.92 | 21.02 | 10.58 | 1.95 |
| 28000 | 19.04 | 47.45 | 7.94 | 7.35 | 10.68 | 0.95 | 20.85 | 10.59 | 2.18 |
| 29000 | 18.55 | 45.02 | 7.78 | 8.20 | 8.79 | 1.00 | 21.39 | 10.33 | 2.14 |
| 30000 | 18.13 | 45.16 | 8.08 | 9.29 | 9.91 | 1.03 | 20.69 | 10.58 | 2.25 |
| 31000 | 17.62 | 46.59 | 8.21 | 9.90 | 12.74 | 1.04 | 21.48 | 10.41 | 2.43 |
| 32000 | 16.98 | 47.12 | 7.69 | 9.49 | 14.10 | 1.04 | 20.92 | 9.99 | 2.65 |
| 33000 | 16.14 | 47.52 | 6.33 | 8.81 | 14.75 | 1.08 | 20.86 | 9.89 | 2.96 |
| 34000 | 15.28 | 46.77 | 4.98 | 8.29 | 13.16 | 1.13 | 21.47 | 9.75 | 3.36 |
| 35000 | 14.61 | 46.42 | 4.19 | 8.06 | 12.52 | 1.16 | 21.60 | 9.48 | 3.82 |
| 36000 | 13.69 | 46.42 | 3.74 | 7.89 | 13.15 | 1.18 | 21.00 | 9.42 | 3.95 |
| 37000 | 13.31 | 46.45 | 3.72 | 8.43 | 14.11 | 1.21 | 22.28 | 9.33 | 4.16 |
| 38000 | 12.93 | 45.12 | 4.12 | 9.04 | 13.67 | 1.21 | 20.68 | 9.85 | 4.04 |
| 39000 | 12.97 | 47.36 | 4.66 | 10.44 | 19.57 | 1.22 | 21.20 | 10.33 | 3.94 |
| 40000 | 13.36 | 44.39 | 4.90 | 11.97 | 14.27 | 1.24 | 21.32 | 11.15 | 3.84 |
| 41000 | 12.94 | 45.29 | 4.78 | 10.92 | 16.33 | 1.22 | 21.38 | 10.27 | 3.87 |
| 42000 | 11.81 | 43.80 | 4.46 | 9.13 | 14.42 | 1.19 | 20.57 | 9.89 | 4.25 |
| 43000 | 10.17 | 46.40 | 4.26 | 8.11 | 21.70 | 1.17 | 22.22 | 9.26 | 4.53 |
| 44000 | 8.30 | 54.38 | 4.39 | 7.74 | 67.56 | 1.14 | 20.93 | 8.76 | 4.58 |
| 45000 | 7.68 | 53.78 | 4.06 | 7.86 | 65.49 | 1.17 | 20.43 | 9.97 | 5.07 |
| 46000 | 7.50 | 49.77 | 3.73 | 8.38 | 41.40 | 1.22 | 20.84 | 10.15 | 4.74 |
| 47000 | 7.88 | 49.30 | 3.80 | 8.83 | 39.42 | 1.23 | 20.26 | 9.67 | 5.08 |
| 48000 | 9.54 | 45.75 | 4.56 | 8.06 | 23.72 | 1.14 | 19.04 | 10.11 | 4.79 |
| 49000 | 10.80 | 43.42 | 6.78 | 7.06 | 18.59 | 0.97 | 21.39 | 11.19 | 4.78 |
| 50000 | 10.51 | 42.55 | 12.09 | 6.98 | 20.83 | 0.84 | 18.84 | 12.01 | 5.69 |

Note: Test data of Die packaged in industry standard 3x3mm 12L MCLP package

## *Typical Performance Data*

**Definitions:**

Input Return Loss = -S11 (dB)
Gain(Power Gain) = S21 (dB)
Reverse Isolation = -S12 (dB)
Output Return Loss = -S22 (dB)

TEST CONDITIONS: Vd = 4.00V, Id = 68mA @ Temperature = +25°C

| FREQ | Gain | Isolation | Input Return Loss | Output Return Loss | Stability | | IP-3 Output | 1dB Comp. Output | Noise Figure |
|---|---|---|---|---|---|---|---|---|---|
| (MHz) | (dB) | (dB) | (dB) | (dB) | K | Measure | (dBm) | (dBm) | (dB) |
| 7000 | 7.38 | 66.16 | 4.18 | 5.42 | 205.54 | 0.99 | 2.49 | -4.39 | 7.36 |
| 8000 | 19.18 | 62.70 | 9.27 | 9.75 | 63.74 | 1.00 | 13.28 | 3.34 | 3.62 |
| 9000 | 22.92 | 67.81 | 10.44 | 11.99 | 81.23 | 1.02 | 17.62 | 6.34 | 2.23 |
| 10000 | 25.39 | 60.57 | 12.03 | 12.15 | 27.79 | 1.00 | 18.22 | 8.15 | 1.81 |
| 11000 | 27.02 | 60.08 | 10.36 | 12.65 | 21.27 | 1.03 | 19.26 | 8.11 | 1.70 |
| 12000 | 28.20 | 61.13 | 8.44 | 15.64 | 20.35 | 1.11 | 18.58 | 8.65 | 1.77 |
| 13000 | 28.77 | 59.85 | 8.41 | 17.94 | 16.68 | 1.13 | 19.02 | 8.68 | 1.83 |
| 14000 | 28.70 | 56.31 | 10.46 | 12.54 | 11.52 | 1.03 | 19.73 | 8.62 | 1.79 |
| 15000 | 28.20 | 54.41 | 13.69 | 10.53 | 10.07 | 0.95 | 20.49 | 9.15 | 1.69 |
| 16000 | 27.68 | 51.56 | 16.58 | 10.77 | 7.96 | 0.93 | 21.06 | 9.41 | 1.61 |
| 17000 | 27.13 | 50.77 | 16.15 | 11.78 | 7.88 | 0.95 | 21.38 | 9.21 | 1.56 |
| 18000 | 26.59 | 49.29 | 14.63 | 12.22 | 7.08 | 0.96 | 20.90 | 8.94 | 1.57 |
| 19000 | 26.11 | 48.93 | 14.29 | 11.55 | 7.14 | 0.96 | 19.54 | 8.68 | 1.55 |
| 20000 | 25.73 | 47.20 | 15.35 | 10.87 | 6.16 | 0.93 | 20.34 | 9.44 | 1.59 |
| 21000 | 25.16 | 46.32 | 16.74 | 10.38 | 5.95 | 0.92 | 19.21 | 9.91 | 1.51 |
| 22000 | 24.01 | 46.70 | 14.76 | 9.21 | 6.80 | 0.90 | 20.96 | 10.65 | 1.54 |
| 23000 | 23.23 | 47.32 | 12.27 | 8.81 | 7.69 | 0.91 | 22.11 | 10.48 | 1.59 |
| 24000 | 22.43 | 47.48 | 10.86 | 8.69 | 8.39 | 0.92 | 21.63 | 11.05 | 1.65 |
| 25000 | 21.65 | 48.14 | 10.30 | 8.35 | 9.66 | 0.92 | 22.93 | 11.19 | 1.59 |
| 26000 | 20.86 | 48.38 | 9.42 | 7.72 | 10.38 | 0.92 | 21.22 | 11.06 | 1.81 |
| 27000 | 19.97 | 48.01 | 8.52 | 7.20 | 10.41 | 0.92 | 21.83 | 11.15 | 1.99 |
| 28000 | 19.25 | 46.14 | 7.97 | 7.34 | 8.98 | 0.95 | 22.33 | 11.16 | 2.16 |
| 29000 | 18.76 | 45.49 | 7.85 | 8.18 | 9.10 | 0.99 | 21.06 | 10.91 | 2.18 |
| 30000 | 18.34 | 45.90 | 8.17 | 9.27 | 10.56 | 1.02 | 20.56 | 11.16 | 2.27 |
| 31000 | 17.84 | 46.16 | 8.32 | 9.90 | 11.87 | 1.04 | 21.01 | 10.99 | 2.40 |
| 32000 | 17.21 | 46.83 | 7.76 | 9.49 | 13.33 | 1.04 | 21.75 | 10.56 | 2.70 |
| 33000 | 16.37 | 46.96 | 6.41 | 8.85 | 13.55 | 1.08 | 21.03 | 10.36 | 3.01 |
| 34000 | 15.53 | 46.49 | 5.04 | 8.37 | 12.50 | 1.13 | 21.29 | 10.24 | 3.39 |
| 35000 | 14.88 | 46.66 | 4.24 | 8.19 | 12.63 | 1.17 | 20.15 | 10.01 | 3.80 |
| 36000 | 13.96 | 47.31 | 3.78 | 8.01 | 14.28 | 1.19 | 21.30 | 9.83 | 3.98 |
| 37000 | 13.58 | 45.79 | 3.75 | 8.57 | 12.83 | 1.21 | 21.70 | 9.71 | 4.19 |
| 38000 | 13.19 | 44.82 | 4.16 | 9.15 | 12.93 | 1.21 | 22.13 | 10.31 | 4.10 |
| 39000 | 13.20 | 46.60 | 4.69 | 10.53 | 17.57 | 1.22 | 21.22 | 10.79 | 3.97 |
| 40000 | 13.59 | 44.74 | 4.93 | 12.17 | 14.53 | 1.24 | 22.37 | 11.68 | 3.86 |
| 41000 | 13.18 | 44.17 | 4.83 | 11.04 | 14.06 | 1.22 | 22.59 | 10.80 | 3.81 |
| 42000 | 12.05 | 44.69 | 4.50 | 9.22 | 15.66 | 1.19 | 22.72 | 10.40 | 4.16 |
| 43000 | 10.40 | 45.36 | 4.28 | 8.12 | 18.82 | 1.17 | 21.10 | 9.74 | 4.58 |
| 44000 | 8.52 | 52.61 | 4.40 | 7.75 | 53.79 | 1.14 | 21.79 | 9.25 | 5.12 |
| 45000 | 7.88 | 52.63 | 4.07 | 7.87 | 56.17 | 1.17 | 20.48 | 10.27 | 5.12 |
| 46000 | 7.69 | 49.10 | 3.74 | 8.36 | 37.46 | 1.22 | 19.38 | 10.38 | 4.97 |
| 47000 | 8.06 | 47.43 | 3.80 | 8.83 | 31.12 | 1.23 | 20.71 | 9.90 | 5.04 |
| 48000 | 9.73 | 45.19 | 4.53 | 8.03 | 21.64 | 1.14 | 19.56 | 10.44 | 4.73 |
| 49000 | 10.99 | 42.74 | 6.74 | 6.97 | 16.68 | 0.97 | 20.51 | 11.59 | 4.81 |
| 50000 | 10.73 | 42.82 | 12.03 | 6.87 | 20.79 | 0.84 | 20.31 | 12.44 | 5.56 |

Note: Test data of Die packaged in industry standard 3x3mm 12L MCLP package

## *Typical Performance Data*

**Definitions:**

Input Return Loss = -S11 (dB)
Gain(Power Gain) = S21 (dB)
Reverse Isolation = -S12 (dB)
Output Return Loss = -S22 (dB)

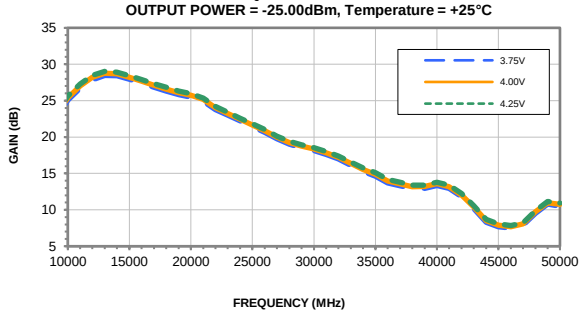
TEST CONDITIONS: Vd = 4.25V, Id = 73mA @ Temperature = +25°C

| FREQ | Gain | Isolation | Input Return Loss | Output Return Loss | Stability | | IP-3 Output | 1dB Comp. Output | Noise Figure |
|---|---|---|---|---|---|---|---|---|---|
| (MHz) | (dB) | (dB) | (dB) | (dB) | K | Measure | (dBm) | (dBm) | (dB) |
| 7000 | 7.94 | 72.53 | 4.35 | 5.43 | 411.03 | 0.98 | 2.76 | -3.80 | 7.29 |
| 8000 | 19.39 | 61.47 | 9.09 | 9.68 | 53.60 | 1.00 | 14.08 | 4.07 | 3.47 |
| 9000 | 23.16 | 63.93 | 10.31 | 11.90 | 50.30 | 1.02 | 18.43 | 6.94 | 2.24 |
| 10000 | 25.64 | 64.95 | 11.98 | 12.07 | 44.52 | 1.00 | 18.54 | 8.62 | 1.80 |
| 11000 | 27.30 | 59.77 | 10.49 | 12.61 | 19.91 | 1.03 | 19.54 | 8.58 | 1.75 |
| 12000 | 28.48 | 63.04 | 8.63 | 15.65 | 24.72 | 1.11 | 19.37 | 9.24 | 1.80 |
| 13000 | 29.02 | 60.77 | 8.65 | 17.67 | 18.17 | 1.12 | 19.69 | 9.13 | 1.88 |
| 14000 | 28.92 | 56.45 | 10.72 | 12.39 | 11.46 | 1.02 | 20.17 | 9.04 | 1.79 |
| 15000 | 28.41 | 54.31 | 13.99 | 10.46 | 9.74 | 0.94 | 21.39 | 9.69 | 1.73 |
| 16000 | 27.89 | 51.75 | 16.96 | 10.71 | 7.95 | 0.93 | 21.65 | 9.83 | 1.65 |
| 17000 | 27.35 | 50.42 | 16.43 | 11.71 | 7.38 | 0.95 | 22.03 | 9.77 | 1.54 |
| 18000 | 26.82 | 49.92 | 14.84 | 12.16 | 7.41 | 0.96 | 21.20 | 9.51 | 1.57 |
| 19000 | 26.33 | 48.70 | 14.49 | 11.48 | 6.79 | 0.95 | 21.13 | 9.12 | 1.58 |
| 20000 | 25.95 | 47.19 | 15.60 | 10.79 | 6.00 | 0.93 | 20.60 | 9.86 | 1.59 |
| 21000 | 25.37 | 47.13 | 16.84 | 10.28 | 6.36 | 0.91 | 20.01 | 10.32 | 1.57 |
| 22000 | 24.19 | 46.84 | 14.70 | 9.12 | 6.75 | 0.90 | 21.01 | 11.05 | 1.50 |
| 23000 | 23.41 | 47.58 | 12.22 | 8.73 | 7.74 | 0.91 | 23.43 | 10.87 | 1.53 |
| 24000 | 22.60 | 47.81 | 10.85 | 8.61 | 8.51 | 0.92 | 21.75 | 11.57 | 1.62 |
| 25000 | 21.81 | 47.98 | 10.32 | 8.28 | 9.30 | 0.92 | 22.88 | 11.71 | 1.70 |
| 26000 | 21.02 | 48.09 | 9.44 | 7.65 | 9.84 | 0.91 | 21.31 | 11.59 | 1.82 |
| 27000 | 20.13 | 47.29 | 8.55 | 7.14 | 9.44 | 0.91 | 22.38 | 11.68 | 1.92 |
| 28000 | 19.42 | 46.74 | 8.00 | 7.28 | 9.42 | 0.94 | 22.08 | 11.68 | 2.15 |
| 29000 | 18.93 | 45.56 | 7.90 | 8.17 | 9.00 | 0.99 | 21.89 | 11.45 | 2.21 |
| 30000 | 18.52 | 45.42 | 8.24 | 9.26 | 9.82 | 1.02 | 21.58 | 11.60 | 2.31 |
| 31000 | 18.03 | 45.92 | 8.38 | 9.90 | 11.33 | 1.03 | 21.78 | 11.51 | 2.44 |
| 32000 | 17.40 | 47.07 | 7.84 | 9.53 | 13.47 | 1.04 | 21.35 | 11.10 | 2.68 |
| 33000 | 16.57 | 47.93 | 6.48 | 8.87 | 14.90 | 1.07 | 21.50 | 10.93 | 3.08 |
| 34000 | 15.75 | 46.88 | 5.09 | 8.46 | 12.84 | 1.13 | 21.91 | 10.82 | 3.43 |
| 35000 | 15.12 | 46.16 | 4.27 | 8.34 | 11.72 | 1.17 | 21.20 | 10.54 | 3.78 |
| 36000 | 14.19 | 47.36 | 3.81 | 8.14 | 14.14 | 1.19 | 20.63 | 10.39 | 4.01 |
| 37000 | 13.81 | 45.68 | 3.78 | 8.70 | 12.48 | 1.22 | 23.23 | 10.27 | 4.21 |
| 38000 | 13.40 | 45.63 | 4.18 | 9.23 | 13.93 | 1.21 | 21.24 | 10.85 | 4.10 |
| 39000 | 13.40 | 46.93 | 4.71 | 10.62 | 17.86 | 1.22 | 23.14 | 11.22 | 3.92 |
| 40000 | 13.80 | 45.55 | 4.95 | 12.26 | 15.65 | 1.24 | 22.59 | 12.14 | 3.86 |
| 41000 | 13.39 | 43.19 | 4.84 | 11.17 | 12.30 | 1.22 | 22.62 | 11.26 | 3.90 |
| 42000 | 12.26 | 45.33 | 4.51 | 9.26 | 16.46 | 1.19 | 22.28 | 10.86 | 4.11 |
| 43000 | 10.59 | 46.69 | 4.29 | 8.14 | 21.51 | 1.16 | 24.06 | 10.18 | 4.52 |
| 44000 | 8.71 | 50.95 | 4.42 | 7.75 | 43.54 | 1.14 | 21.75 | 9.68 | 5.08 |
| 45000 | 8.06 | 52.86 | 4.10 | 7.85 | 56.69 | 1.16 | 21.41 | 10.61 | 5.23 |
| 46000 | 7.84 | 48.39 | 3.75 | 8.34 | 33.98 | 1.22 | 20.31 | 10.68 | 4.90 |
| 47000 | 8.22 | 47.10 | 3.80 | 8.81 | 29.34 | 1.23 | 19.94 | 10.11 | 5.06 |
| 48000 | 9.89 | 44.72 | 4.52 | 7.95 | 20.00 | 1.14 | 19.16 | 10.72 | 4.70 |
| 49000 | 11.16 | 43.73 | 6.70 | 6.85 | 18.16 | 0.96 | 22.14 | 11.89 | 4.85 |
| 50000 | 10.92 | 43.53 | 11.89 | 6.75 | 21.88 | 0.84 | 19.89 | 12.92 | 5.48 |

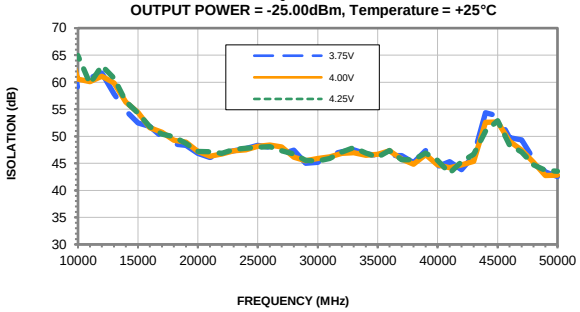
Note: Test data of Die packaged in industry standard 3x3mm 12L MCLP package

## Typical Performance Curves

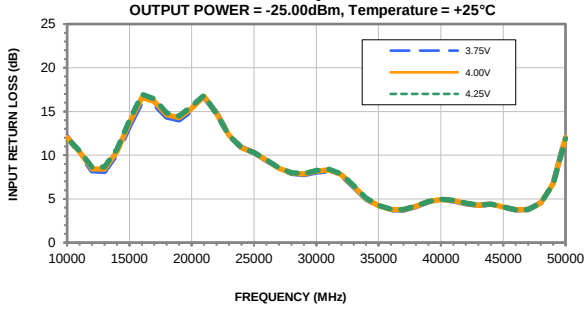
GAIN vs. FREQUENCY & DEVICE VOLTAGE
OUTPUT POWER = -25.00dBm, Temperature = +25°C



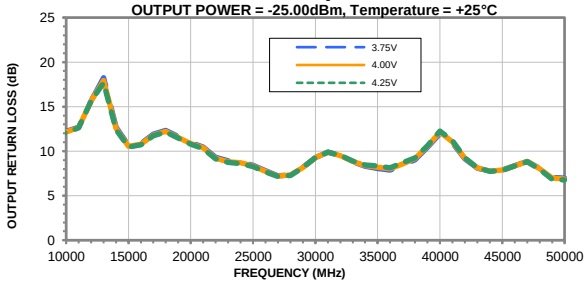

ISOLATION vs. FREQUENCY & DEVICE VOLTAGE
OUTPUT POWER = -25.00dBm, Temperature = +25°C



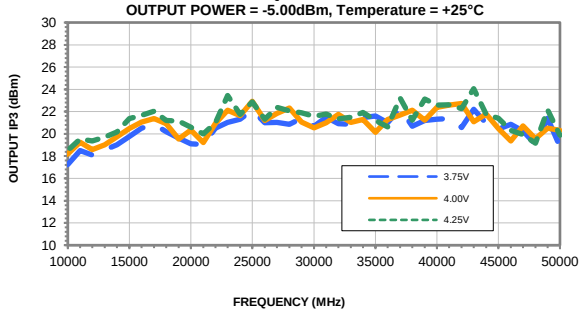

INPUT RETURN LOSS vs. FREQUENCY & DEVICE VOLTAGE
OUTPUT POWER = -25.00dBm, Temperature = +25°C



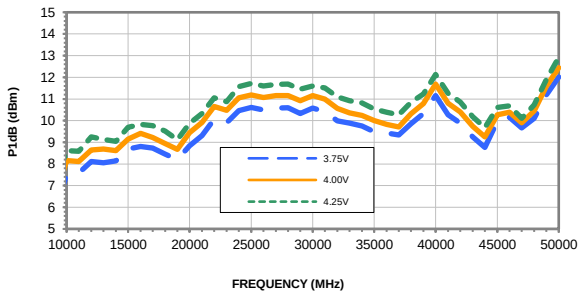

OUTPUT RETURN LOSS vs. FREQUENCY & DEVICE VOLTAGE
OUTPUT POWER = -25.00dBm, Temperature = +25°C



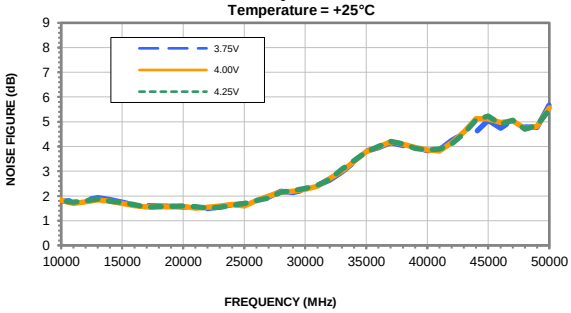

OUTPUT IP3 vs. FREQUENCY & DEVICE VOLTAGE
OUTPUT POWER = -5.00dBm, Temperature = +25°C




P1dB vs. FREQUENCY & DEVICE VOLTAGE
Temperature = +25°C




NOISE FIGURE vs. FREQUENCY & DEVICE VOLTAGE
Temperature = +25°C




Note: Test data of Die packaged in industry standard 3x3mm 12L MCLP package

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) | |