



Mini-Circuits

HIGH DIRECTIVITY

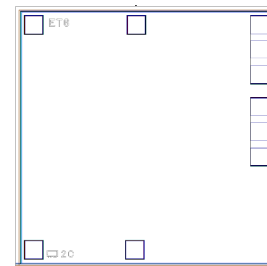
# Monolithic Amplifier Die

**MNA-5A-D+**

50Ω 0.5 to 4.5 GHz

## THE BIG DEAL

- Choice of supply voltage, +2.8V to +5V
- Internal DC blocking at RF input and output
- High directivity, 17-23 dB typ.
- Output power, up to +14 dBm typ.



### +RoHS Compliant

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

## APPLICATIONS

- Buffer amplifier
- Cellular infrastructure
- Communications satellite
- Defense

SEE ORDERING INFORMATION ON THE LAST PAGE

## PRODUCT OVERVIEW

MNA-5A-D+ is a wideband PHEMT based MMIC amplifier die with high active Directivity. MNA integrates the entire matching network and majority of the bias circuit inside the die, reducing the need for complicated external circuits. This approach makes the MNA amplifier die extremely straightforward to use. This design operates on a single 2.8 to 5V supply, is well matched for 50Ω. [MNA series models are available in Die and packaged form.](#)

## KEY FEATURES

| Features                                                      | Advantages                                                                                                          |
|---------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|
| Excellent Active Directivity<br>(Isolation- Gain)<br>17-23 dB | Ideal for use as a buffer amplifier minimizing interaction of adjacent circuits                                     |
| Integrates DC blocks and RF choke                             | Minimizes external components, component count and circuit area.                                                    |
| Single +2.8 to +5V operation                                  | Amplifier can be used at low voltage such as +3V or standard +5V.<br>+5V operation results in higher P1dB and OIP3. |
| Unpackaged die                                                | Enables the user to integrate the amplifier directly into hybrids.                                                  |

REV. B  
ECO-015286  
MNA-5A-D+  
MCL NY  
221007



**HIGH DIRECTIVITY**

# Monolithic Amplifier Die

**MNA-5A-D+****50Ω 0.5 to 4.5 GHz****ELECTRICAL SPECIFICATIONS<sup>1</sup> AT 25°C**

| Parameter                                             | Condition (GHz) | Min. | Vs=5V<br>Typ.       | Max. | Vs=2.8V<br>Typ.     | Units |
|-------------------------------------------------------|-----------------|------|---------------------|------|---------------------|-------|
| Frequency Range                                       |                 | 0.5  |                     | 4.5  | 0.5-4.5             | GHz   |
| Gain                                                  | 0.5             |      | 21.6                |      | 20.5                | dB    |
|                                                       | 1.0             |      | 23.5                |      | 21.9                |       |
|                                                       | 2.0             |      | 21.3                |      | 19.4                |       |
|                                                       | 2.5             |      | 19.2                |      | 17.4                |       |
|                                                       | 3.5             |      | 14.5                |      | 13.1                |       |
|                                                       | 4.5             |      | 10.3                |      | 9.1                 |       |
| Input Return Loss                                     | 0.5             |      | 5.4                 |      | 5.6                 | dB    |
|                                                       | 1.0             |      | 14.9                |      | 15.3                |       |
|                                                       | 2.0             |      | 21.6                |      | 21.1                |       |
|                                                       | 2.5             |      | 17.1                |      | 17.2                |       |
|                                                       | 3.5             |      | 10.3                |      | 10.4                |       |
|                                                       | 4.5             |      | 6.5                 |      | 6.6                 |       |
| Output Return Loss                                    | 0.5             |      | 14.5                |      | 14.4                | dB    |
|                                                       | 1.0             |      | 12.8                |      | 17.4                |       |
|                                                       | 2.0             |      | 12.2                |      | 15.3                |       |
|                                                       | 2.5             |      | 12.8                |      | 15.7                |       |
|                                                       | 3.5             |      | 13.9                |      | 17.1                |       |
|                                                       | 4.5             |      | 13.7                |      | 16.8                |       |
| Output Power at P1dB                                  | 0.5             |      | 12.6                |      | 11.0                | dBm   |
|                                                       | 1.0             |      | 11.1                |      | 10.1                |       |
|                                                       | 2.0             |      | 9.6                 |      | 8.4                 |       |
|                                                       | 2.5             |      | 8.7                 |      | 7.5                 |       |
|                                                       | 3.5             |      | 7.2                 |      | 5.8                 |       |
|                                                       | 4.5             |      | 5.5                 |      | 4.1                 |       |
| Output IP3                                            | 0.5             |      | 23.8                |      | 21.8                | dBm   |
|                                                       | 1.0             |      | 22.3                |      | 20.6                |       |
|                                                       | 2.0             |      | 20.1                |      | 18.5                |       |
|                                                       | 2.5             |      | 19.1                |      | 17.5                |       |
|                                                       | 3.5             |      | 17.8                |      | 15.9                |       |
|                                                       | 4.5             |      | 16.0                |      | 14.1                |       |
| Noise Figure                                          | 0.5             |      | 3.2                 |      | 3.3                 | dB    |
|                                                       | 1.0             |      | 3.0                 |      | 3.0                 |       |
|                                                       | 2.0             |      | 3.1                 |      | 3.2                 |       |
|                                                       | 2.5             |      | 3.2                 |      | 3.2                 |       |
|                                                       | 3.5             |      | 3.4                 |      | 3.6                 |       |
|                                                       | 4.5             |      | 4.3                 |      | 4.6                 |       |
| Directivity<br>(Isolation-Gain)                       | 0.5             |      | 20.3                |      | 22.5                | dB    |
|                                                       | 1.0             |      | 19.7                |      | 19.3                |       |
|                                                       | 2.0             |      | 16.6                |      | 16.2                |       |
|                                                       | 2.5             |      | 17.3                |      | 16.6                |       |
|                                                       | 3.5             |      | 20.0                |      | 18.9                |       |
|                                                       | 4.5             |      | 22.9                |      | 21.7                |       |
| DC Current                                            |                 | —    | 34                  | 43   | 32                  | mA    |
| Device Current Variation vs. Temperature <sup>2</sup> |                 |      | 15                  |      | 5                   | μA/°C |
| Device Current Variation vs Voltage                   |                 |      | 0.0004 <sup>3</sup> |      | 0.0014 <sup>4</sup> | mA/mV |
| Thermal resistance at 85°C (Junction to Lead)         |                 |      | 64                  |      | 64                  | °C/W  |

1. Measured on Mini-Circuits characterization test board. Die packaged in 3x3 mm MCLP package and soldered on test board TB-186+

2. (Current at 85°C -Current at -45°C)/130

3. (Current at 5.25V-Current at 3.9V)/1.35

4. (Current at 3.9V-Current at 2.66V)/1.24

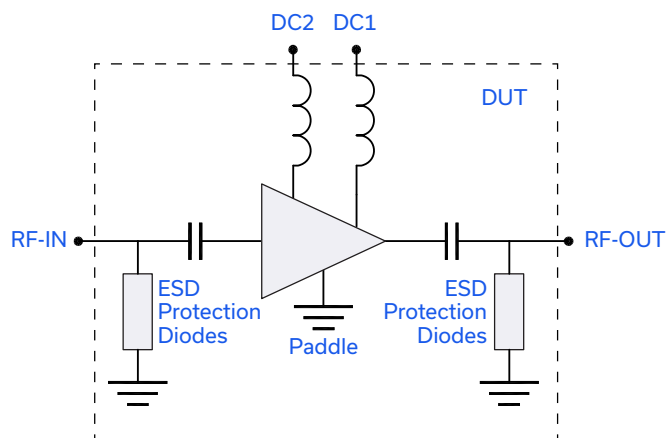


MAXIMUM RATINGS<sup>1,5</sup>

| Parameter             | Ratings                                                                     |
|-----------------------|-----------------------------------------------------------------------------|
| Operating Temperature | -40°C to 85°C                                                               |
| DC Voltage            | 7V at DC1 (DC2 connected to DC1 via 33.2 $\Omega$ )<br>1V at RF IN & RF OUT |
| Power Dissipation     | 700 mW                                                                      |
| Input Power           | +5 dBm at +5V (continuous operation)<br>+28 dBm (5 minutes max)             |

5. Permanent damage may occur if any of these limits are exceeded.  
These ratings are not intended for continuous normal operation.

## SIMPLIFIED SCHEMATIC AND PAD DESCRIPTION



| Function  | Description                                                  |
|-----------|--------------------------------------------------------------|
| RF IN     | RF input pad.                                                |
| RF-OUT    | RF output pad                                                |
| DC1 & DC2 | DC Supply pad. Connect DC2 to DC1 via 33.2 $\Omega$ resistor |

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



## CHARACTERIZATION CIRCUIT

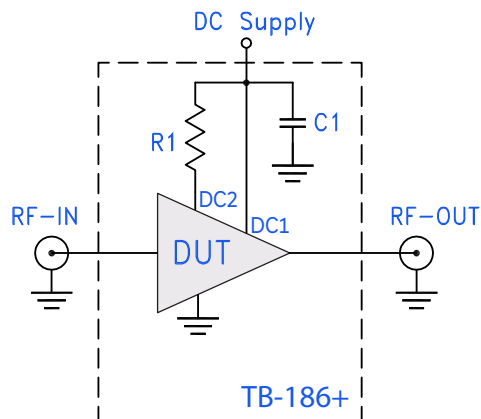


Fig 1. Block Diagram of Test Circuit used for characterization. (Die packaged in 3x3 mm MCLP package and soldered on Mini-Circuits Characterization test board TB-186+) Gain, Return loss, Output power at 1dB compression (P1 dB), output IP3 (OIP3) and noise figure measured using Agilent's N5242A PNA-X microwave network analyzer.

## Conditions:

1. Gain and Return loss: Pin= -25dBm
2. Output IP3 (OIP3): Two tones, spaced 1 MHz apart, 0 dBm/tone at output.

| Component | Size | Value | Units    |
|-----------|------|-------|----------|
| R1        | 0805 | 33.2  | $\Omega$ |
| C1        | 0402 | 1000  | $\mu F$  |

## RECOMMENDED APPLICATION CIRCUIT

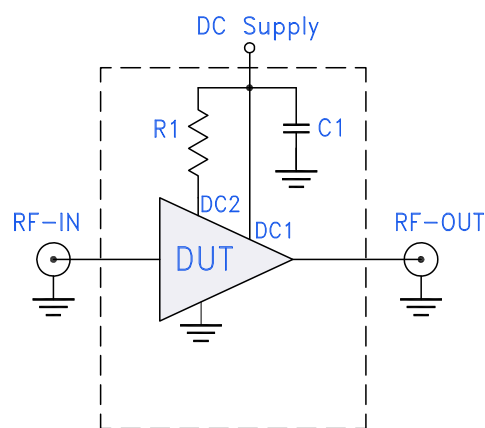


Fig 2. Test Board includes case, connectors, and components soldered to PCB

| Component | Value | Units    |
|-----------|-------|----------|
| R1        | 33.2  | $\Omega$ |
| C1        | 1000  | $\mu F$  |



### DIE LAYOUT

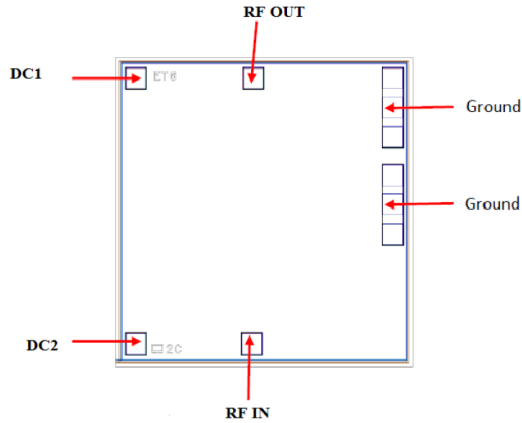


Fig 3. Die Layout

### BONDING PAD POSITION (Dimensions in $\mu\text{m}$ , Typical)

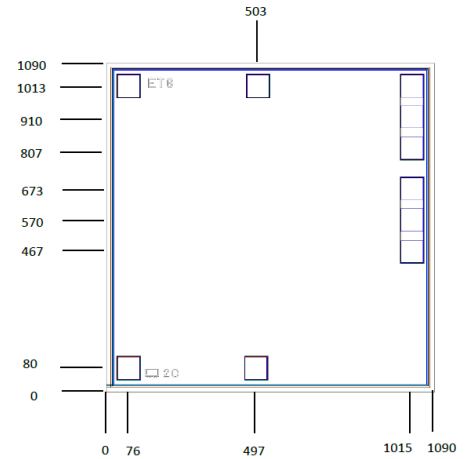


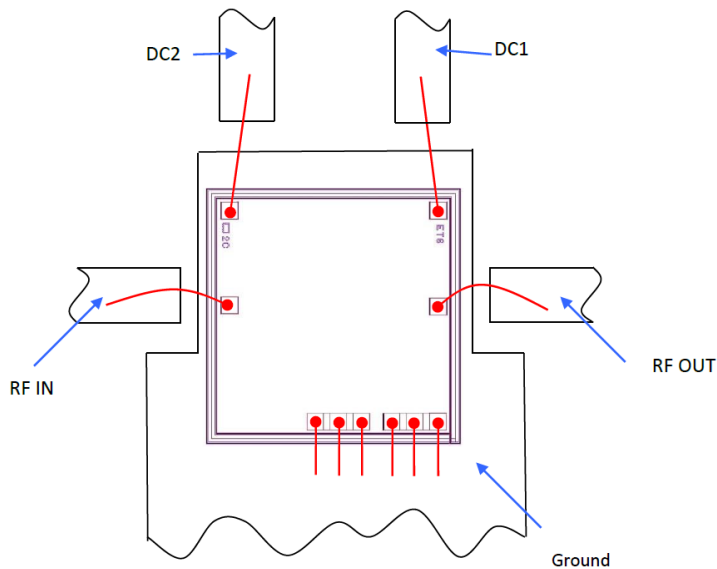
Fig 4. Bonding Pad Positions

### CRITICAL DIMENSIONS

| Parameter                                        | Values   |
|--------------------------------------------------|----------|
| Die Thickness, $\mu\text{m}$                     | 100      |
| Die Width, $\mu\text{m}$                         | 1090     |
| Die Length, $\mu\text{m}$                        | 1090     |
| Bond Pad Size (RF In, RF Out, DC), $\mu\text{m}$ | 80 x 80  |
| Bond Pad Size (Ground pad), $\mu\text{m}$        | 80 x 286 |



## ASSEMBLY DIAGRAM



Note: Ground bond wires are optional.

## RECOMMENDED WIRE LENGTH, TYPICAL

| Wire          | Wire Length (mm) | Wire Loop Height (mm) |
|---------------|------------------|-----------------------|
| Ground        | 0.35             | 0.15                  |
| DC            | 1.00             | 0.15                  |
| RF In, RF Out | 1.20             | 0.15                  |

## ASSEMBLY PROCEDURE

- Storage**  
Die should be stored in a dry nitrogen purged desiccators or equivalent.
- ESD**  
 MMIC PHEMT amplifier Die 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.
- 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.
- Wire Bonding**  
Bond pad openings in the surface passivation above the bond pads are provided to allow wire bonding to the Die 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 wire length and bond wire height should be kept as short as possible unless specified by the Assembly Drawing to minimize performance degradation due to undesirable series inductance.



# Monolithic Amplifier Die

**MNA-5A-D+**

50Ω 0.5 to 4.5 GHz

**ADDITIONAL DETAILED TECHNICAL INFORMATION IS AVAILABLE ON OUR DASH BOARD.**

|                                                                                            |                                                                                               |                                        |
|--------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|----------------------------------------|
| Performance Data                                                                           | Data Table                                                                                    |                                        |
|                                                                                            | Swept Graphs                                                                                  |                                        |
|                                                                                            | 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.                              |
|                                                                                            | Small, Gel - Pak: 5,10,50,100 KGD*<br>Medium†, Partial wafer: KGD*<1295<br>Large†, Full Wafer | MNA-5A-DG+<br>MNA-5A-DP+<br>MNA-5A-DF+ |
| †Available upon request contact sales representative<br>Refer to <a href="#">AN-60-067</a> |                                                                                               |                                        |
| Environmental Ratings                                                                      | ENV-80                                                                                        |                                        |

\*Known Good Die ('KGD') means that the die in question have been subjected to Mini-Circuits DC test performance criteria and measurement instructions and that the parametric data of such die 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 performance specified by Mini-Circuits.

**ESD RATING\*\***

Human Body Model (HBM): Class 1A (250 to &lt; 500V) in accordance with ANSI/ESD STM 5.1 - 2001

\*\*Tested in \_x\_ xxL MCLP Package

**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.
- The parts covered by this specification document are subject to Mini-Circuits standard limited warranty and terms and conditions (collectively, "Standard Terms"); Purchasers of this part are entitled to the rights and benefits contained there in. For a full statement of the standard. Terms and the exclusive rights and remedies thereunder, please visit Mini-Circuits' website at [www.minicircuits.com/terms/viewterm.html](http://www.minicircuits.com/terms/viewterm.html)
- Mini-Circuits does not warrant the accuracy or completeness of the information, text, graphics and other items contained within this document and same are provided as an accommodation and on an As is basis, with all faults.
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## Typical Performance Data

NOTE: Use PDF Bookmarks to view DATA at required conditions

## Definitions:

Input Return Loss = -S11 (dB)

Gain(Power Gain) = S21 (dB)

Reverse Isolation = -S12 (dB)

Output Return Loss = -S22 (dB)

TEST CONDITIONS: Vd = 3.9V, Id = 33.77 mA @ Temperature = +25degC

| FREQ  | Gain  | Isolation | Input<br>Return<br>Loss | Output<br>Return<br>Loss | Stability |         | IP-3<br>Output | 1dB<br>Comp.<br>Output | Noise<br>Figure |
|-------|-------|-----------|-------------------------|--------------------------|-----------|---------|----------------|------------------------|-----------------|
| (MHz) | (dB)  | (dB)      | (dB)                    | (dB)                     | K         | Measure | (dBm)          | (dBm)                  | (dB)            |
| 200   | 4.46  | 45.30     | 1.75                    | 2.32                     | 7.36      | 0.69    | 9.45           | 1.65                   | 5.54            |
| 300   | 14.54 | 41.54     | 2.22                    | 5.87                     | 2.97      | 1.22    | 19.87          | 9.06                   | 4.13            |
| 400   | 19.14 | 41.31     | 3.56                    | 9.76                     | 3.04      | 1.32    | 23.26          | 12.24                  | 3.51            |
| 500   | 21.26 | 42.74     | 5.44                    | 14.49                    | 4.03      | 1.25    | 24.20          | 13.17                  | 3.58            |
| 600   | 22.27 | 43.43     | 7.49                    | 20.63                    | 4.66      | 1.17    | 24.79          | 13.35                  | 3.08            |
| 700   | 22.75 | 43.95     | 9.49                    | 23.64                    | 5.11      | 1.10    | 24.60          | 13.19                  | 3.06            |
| 800   | 23.06 | 44.49     | 11.44                   | 19.41                    | 5.48      | 1.05    | 24.16          | 12.88                  | 3.08            |
| 900   | 23.06 | 43.34     | 13.40                   | 18.26                    | 4.92      | 1.02    | 23.46          | 12.40                  | 2.98            |
| 1000  | 23.09 | 42.78     | 15.08                   | 16.61                    | 4.65      | 0.99    | 23.30          | 12.20                  | 2.99            |
| 1100  | 23.05 | 41.91     | 16.76                   | 15.81                    | 4.26      | 0.98    | 23.15          | 12.08                  | 2.99            |
| 1200  | 22.97 | 41.28     | 18.32                   | 15.29                    | 4.02      | 0.96    | 23.19          | 11.96                  | 2.97            |
| 1300  | 22.84 | 40.52     | 19.70                   | 14.86                    | 3.75      | 0.96    | 22.56          | 11.70                  | 2.91            |
| 1400  | 22.69 | 40.10     | 20.91                   | 14.48                    | 3.63      | 0.95    | 22.26          | 11.43                  | 2.91            |
| 1500  | 22.49 | 39.77     | 22.12                   | 14.18                    | 3.58      | 0.94    | 22.27          | 11.40                  | 2.93            |
| 1600  | 22.32 | 39.10     | 22.07                   | 14.32                    | 3.39      | 0.94    | 22.02          | 11.30                  | 2.99            |
| 1700  | 22.06 | 38.60     | 22.75                   | 14.17                    | 3.30      | 0.94    | 21.56          | 10.93                  | 2.96            |
| 1800  | 21.81 | 38.51     | 22.60                   | 13.99                    | 3.35      | 0.94    | 21.42          | 10.73                  | 3.03            |
| 1900  | 21.53 | 37.80     | 22.12                   | 13.96                    | 3.20      | 0.94    | 20.93          | 10.41                  | 3.01            |
| 2000  | 21.23 | 37.56     | 22.15                   | 13.68                    | 3.21      | 0.93    | 20.94          | 10.42                  | 3.04            |
| 2100  | 20.91 | 37.26     | 21.05                   | 13.84                    | 3.22      | 0.94    | 20.94          | 10.37                  | 2.97            |
| 2200  | 20.55 | 37.17     | 20.09                   | 14.17                    | 3.32      | 0.94    | 20.69          | 10.18                  | 3.01            |
| 2300  | 20.19 | 36.45     | 19.57                   | 14.06                    | 3.19      | 0.94    | 20.43          | 9.94                   | 3.02            |
| 2400  | 19.81 | 36.40     | 18.67                   | 14.18                    | 3.30      | 0.95    | 20.37          | 9.81                   | 2.93            |
| 2500  | 19.43 | 36.46     | 17.30                   | 14.41                    | 3.46      | 0.95    | 19.85          | 9.43                   | 3.05            |
| 2600  | 19.07 | 35.88     | 16.78                   | 14.27                    | 3.36      | 0.95    | 19.99          | 9.46                   | 3.10            |
| 2700  | 18.59 | 35.68     | 15.77                   | 14.63                    | 3.46      | 0.96    | 19.95          | 9.35                   | 3.15            |
| 2800  | 18.17 | 35.62     | 14.89                   | 14.56                    | 3.58      | 0.97    | 19.68          | 9.06                   | 3.14            |
| 2900  | 17.72 | 35.96     | 14.01                   | 15.17                    | 3.90      | 0.98    | 19.45          | 9.03                   | 3.23            |
| 3000  | 17.30 | 35.26     | 13.30                   | 14.83                    | 3.75      | 0.99    | 19.32          | 8.71                   | 3.21            |
| 3100  | 16.92 | 34.63     | 12.76                   | 14.69                    | 3.62      | 0.99    | 19.37          | 8.83                   | 3.24            |
| 3200  | 16.45 | 34.78     | 11.96                   | 15.19                    | 3.85      | 1.01    | 18.61          | 8.60                   | 3.35            |
| 3300  | 16.05 | 34.47     | 11.45                   | 15.07                    | 3.86      | 1.01    | 18.68          | 8.50                   | 3.24            |
| 3400  | 15.50 | 34.61     | 10.70                   | 15.94                    | 4.13      | 1.04    | 18.59          | 8.33                   | 3.43            |
| 3500  | 15.12 | 34.21     | 10.33                   | 15.66                    | 4.08      | 1.04    | 18.25          | 8.13                   | 3.45            |
| 3600  | 14.79 | 33.87     | 9.98                    | 15.38                    | 4.03      | 1.04    | 18.29          | 7.87                   | 3.52            |
| 3700  | 14.31 | 33.67     | 9.52                    | 15.92                    | 4.12      | 1.06    | 17.99          | 7.86                   | 3.55            |
| 3800  | 13.86 | 33.94     | 8.96                    | 16.08                    | 4.40      | 1.08    | 18.01          | 7.58                   | 3.67            |
| 3900  | 13.37 | 33.66     | 8.65                    | 16.15                    | 4.45      | 1.09    | 17.52          | 7.41                   | 3.70            |
| 4000  | 12.92 | 34.20     | 8.02                    | 16.10                    | 4.85      | 1.11    | 17.50          | 7.25                   | 3.83            |

*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 = 2.8V, Id = 32.63 mA @ Temperature = +25degC

| FREQ  | Gain  | Isolation | Input<br>Return<br>Loss | Output<br>Return<br>Loss | Stability |         | IP-3<br>Output | 1dB<br>Comp.<br>Output | Noise<br>Figure |
|-------|-------|-----------|-------------------------|--------------------------|-----------|---------|----------------|------------------------|-----------------|
| (MHz) | (dB)  | (dB)      | (dB)                    | (dB)                     | K         | Measure | (dBm)          | (dBm)                  | (dB)            |
| 200   | 4.21  | 45.11     | 1.79                    | 2.39                     | 7.68      | 0.71    | 9.05           | 1.18                   | 5.63            |
| 300   | 14.09 | 42.07     | 2.28                    | 5.93                     | 3.45      | 1.21    | 18.47          | 8.14                   | 4.18            |
| 400   | 18.54 | 41.78     | 3.66                    | 9.71                     | 3.52      | 1.30    | 21.58          | 10.79                  | 3.56            |
| 500   | 20.54 | 42.91     | 5.61                    | 14.33                    | 4.53      | 1.24    | 22.53          | 11.71                  | 3.65            |
| 600   | 21.47 | 44.30     | 7.72                    | 20.87                    | 5.71      | 1.16    | 22.89          | 11.89                  | 3.15            |
| 700   | 21.88 | 44.13     | 9.78                    | 34.56                    | 5.83      | 1.10    | 22.77          | 11.79                  | 3.15            |
| 800   | 22.12 | 43.78     | 11.75                   | 26.61                    | 5.69      | 1.06    | 22.43          | 11.60                  | 3.12            |
| 900   | 22.09 | 42.28     | 13.70                   | 23.33                    | 4.94      | 1.03    | 22.05          | 11.38                  | 3.04            |
| 1000  | 22.07 | 41.84     | 15.38                   | 20.64                    | 4.75      | 1.01    | 21.78          | 11.17                  | 3.02            |
| 1100  | 21.98 | 40.67     | 17.04                   | 19.31                    | 4.24      | 0.99    | 21.74          | 11.08                  | 3.03            |
| 1200  | 21.85 | 40.13     | 18.57                   | 18.30                    | 4.06      | 0.98    | 21.76          | 10.95                  | 3.04            |
| 1300  | 21.69 | 39.41     | 19.87                   | 17.72                    | 3.82      | 0.97    | 21.22          | 10.76                  | 2.97            |
| 1400  | 21.51 | 38.61     | 20.96                   | 17.17                    | 3.57      | 0.97    | 20.96          | 10.45                  | 2.98            |
| 1500  | 21.28 | 38.45     | 22.05                   | 16.81                    | 3.59      | 0.96    | 20.98          | 10.43                  | 3.00            |
| 1600  | 21.07 | 37.70     | 22.04                   | 16.80                    | 3.38      | 0.96    | 20.69          | 10.33                  | 3.03            |
| 1700  | 20.79 | 37.35     | 22.56                   | 16.56                    | 3.35      | 0.96    | 20.28          | 10.01                  | 3.01            |
| 1800  | 20.52 | 36.83     | 22.42                   | 16.27                    | 3.26      | 0.96    | 20.15          | 9.80                   | 3.12            |
| 1900  | 20.23 | 36.49     | 21.99                   | 16.19                    | 3.24      | 0.95    | 19.77          | 9.54                   | 3.11            |
| 2000  | 19.92 | 36.02     | 21.95                   | 15.93                    | 3.18      | 0.95    | 19.78          | 9.48                   | 3.09            |
| 2100  | 19.60 | 35.72     | 20.92                   | 15.90                    | 3.18      | 0.95    | 19.68          | 9.51                   | 3.04            |
| 2200  | 19.25 | 35.67     | 20.02                   | 16.23                    | 3.29      | 0.96    | 19.45          | 9.22                   | 3.08            |
| 2300  | 18.89 | 35.13     | 19.47                   | 16.08                    | 3.22      | 0.96    | 19.25          | 8.95                   | 3.11            |
| 2400  | 18.53 | 35.03     | 18.63                   | 16.26                    | 3.31      | 0.96    | 19.12          | 8.85                   | 3.05            |
| 2500  | 18.15 | 35.01     | 17.38                   | 16.45                    | 3.43      | 0.97    | 18.74          | 8.57                   | 3.16            |
| 2600  | 17.81 | 34.18     | 16.83                   | 16.31                    | 3.24      | 0.97    | 18.79          | 8.46                   | 3.19            |
| 2700  | 17.35 | 34.27     | 15.84                   | 16.88                    | 3.44      | 0.98    | 18.72          | 8.37                   | 3.25            |
| 2800  | 16.95 | 34.05     | 14.97                   | 16.75                    | 3.49      | 0.98    | 18.48          | 8.10                   | 3.26            |
| 2900  | 16.52 | 34.32     | 14.11                   | 17.24                    | 3.75      | 1.00    | 18.23          | 8.00                   | 3.36            |
| 3000  | 16.12 | 33.81     | 13.40                   | 17.26                    | 3.68      | 1.00    | 18.09          | 7.78                   | 3.31            |
| 3100  | 15.77 | 33.07     | 12.83                   | 17.16                    | 3.51      | 1.00    | 18.11          | 7.76                   | 3.35            |
| 3200  | 15.32 | 33.21     | 12.06                   | 17.73                    | 3.71      | 1.02    | 17.38          | 7.61                   | 3.47            |
| 3300  | 14.93 | 32.91     | 11.54                   | 17.63                    | 3.72      | 1.03    | 17.34          | 7.55                   | 3.42            |
| 3400  | 14.41 | 33.11     | 10.79                   | 18.46                    | 3.98      | 1.05    | 17.27          | 7.35                   | 3.54            |
| 3500  | 14.05 | 32.66     | 10.42                   | 18.49                    | 3.91      | 1.05    | 17.00          | 7.19                   | 3.55            |
| 3600  | 13.73 | 32.33     | 10.06                   | 18.34                    | 3.88      | 1.06    | 16.94          | 6.82                   | 3.67            |
| 3700  | 13.26 | 32.25     | 9.59                    | 19.00                    | 4.01      | 1.07    | 16.68          | 6.91                   | 3.74            |
| 3800  | 12.82 | 32.47     | 9.03                    | 19.26                    | 4.24      | 1.09    | 16.65          | 6.74                   | 3.82            |
| 3900  | 12.35 | 32.38     | 8.68                    | 19.21                    | 4.38      | 1.10    | 16.20          | 6.42                   | 3.89            |
| 4000  | 11.92 | 32.88     | 8.06                    | 19.04                    | 4.74      | 1.13    | 16.16          | 6.28                   | 4.02            |

*Typical Performance Data***Definitions:**

Input Return Loss = -S11 (dB)

Gain(Power Gain) = S21 (dB)

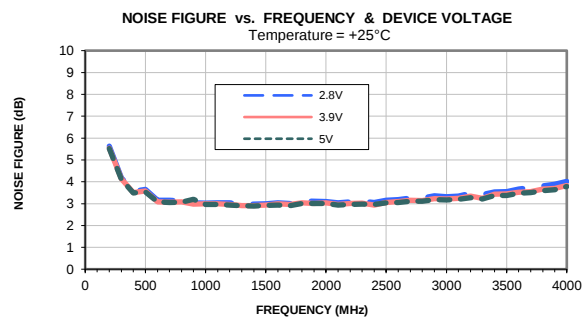
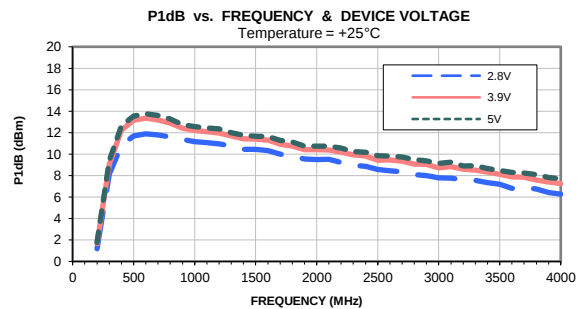
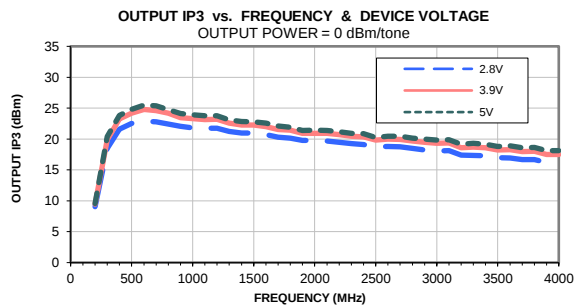
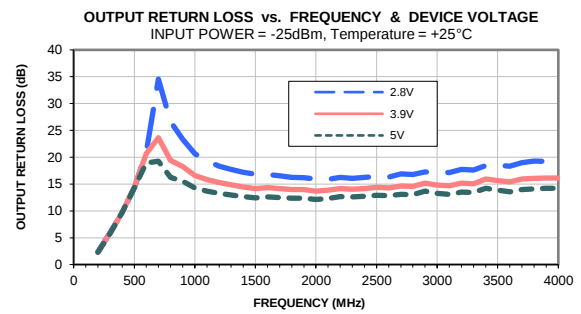
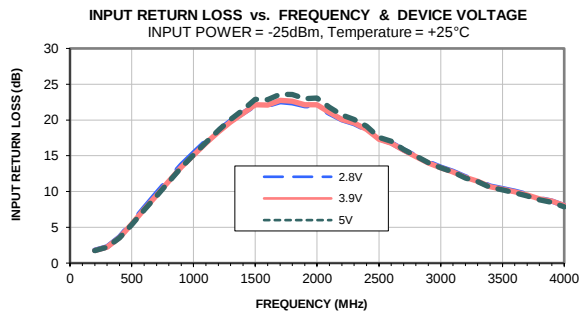
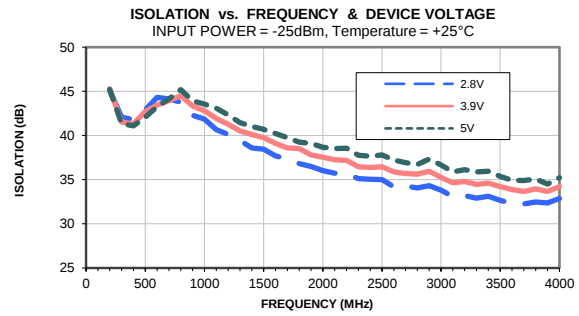
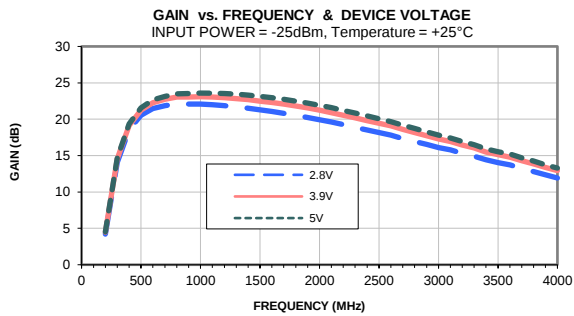
Reverse Isolation = -S12 (dB)

Output Return Loss = -S22 (dB)

TEST CONDITIONS: Vd = 5V, Id = 34.20 mA @ Temperature = +25degC

| FREQ  | Gain  | Isolation | Input<br>Return<br>Loss | Output<br>Return<br>Loss | Stability |         | IP-3<br>Output | 1dB<br>Comp.<br>Output | Noise<br>Figure |
|-------|-------|-----------|-------------------------|--------------------------|-----------|---------|----------------|------------------------|-----------------|
| (MHz) | (dB)  | (dB)      | (dB)                    | (dB)                     | K         | Measure | (dBm)          | (dBm)                  | (dB)            |
| 200   | 4.51  | 45.20     | 1.74                    | 2.27                     | 7.12      | 0.68    | 9.55           | 1.77                   | 5.52            |
| 300   | 14.69 | 41.33     | 2.21                    | 5.83                     | 2.82      | 1.21    | 20.40          | 9.39                   | 4.11            |
| 400   | 19.37 | 41.08     | 3.53                    | 9.77                     | 2.85      | 1.32    | 23.83          | 12.65                  | 3.49            |
| 500   | 21.56 | 42.07     | 5.38                    | 14.33                    | 3.57      | 1.25    | 24.82          | 13.55                  | 3.53            |
| 600   | 22.63 | 43.27     | 7.41                    | 18.91                    | 4.36      | 1.17    | 25.49          | 13.76                  | 3.08            |
| 700   | 23.15 | 44.12     | 9.40                    | 19.26                    | 4.93      | 1.09    | 25.35          | 13.59                  | 3.05            |
| 800   | 23.50 | 45.18     | 11.35                   | 16.27                    | 5.56      | 1.04    | 24.77          | 13.29                  | 3.06            |
| 900   | 23.54 | 43.91     | 13.38                   | 15.52                    | 4.92      | 1.00    | 24.12          | 12.73                  | 3.20            |
| 1000  | 23.59 | 43.54     | 15.09                   | 14.28                    | 4.71      | 0.98    | 23.91          | 12.55                  | 2.96            |
| 1100  | 23.58 | 43.07     | 16.86                   | 13.68                    | 4.50      | 0.96    | 23.78          | 12.44                  | 2.96            |
| 1200  | 23.53 | 42.34     | 18.57                   | 13.29                    | 4.18      | 0.95    | 23.79          | 12.35                  | 2.94            |
| 1300  | 23.43 | 41.44     | 20.08                   | 12.96                    | 3.82      | 0.94    | 23.11          | 12.00                  | 2.90            |
| 1400  | 23.31 | 41.01     | 21.43                   | 12.65                    | 3.69      | 0.93    | 22.84          | 11.76                  | 2.89            |
| 1500  | 23.13 | 40.70     | 22.88                   | 12.43                    | 3.63      | 0.93    | 22.79          | 11.68                  | 2.92            |
| 1600  | 22.98 | 40.21     | 22.86                   | 12.58                    | 3.50      | 0.93    | 22.59          | 11.65                  | 2.94            |
| 1700  | 22.73 | 39.76     | 23.60                   | 12.50                    | 3.42      | 0.92    | 22.09          | 11.29                  | 2.90            |
| 1800  | 22.48 | 39.25     | 23.56                   | 12.39                    | 3.32      | 0.92    | 21.92          | 11.13                  | 3.01            |
| 1900  | 22.21 | 39.10     | 23.00                   | 12.39                    | 3.37      | 0.92    | 21.38          | 10.75                  | 3.01            |
| 2000  | 21.91 | 38.67     | 23.06                   | 12.14                    | 3.31      | 0.92    | 21.45          | 10.74                  | 3.01            |
| 2100  | 21.59 | 38.52     | 21.77                   | 12.33                    | 3.37      | 0.92    | 21.37          | 10.74                  | 2.94            |
| 2200  | 21.22 | 38.54     | 20.68                   | 12.67                    | 3.53      | 0.93    | 21.19          | 10.55                  | 2.96            |
| 2300  | 20.85 | 37.76     | 20.08                   | 12.59                    | 3.37      | 0.93    | 20.90          | 10.24                  | 2.98            |
| 2400  | 20.46 | 37.64     | 19.14                   | 12.71                    | 3.47      | 0.93    | 20.85          | 10.17                  | 2.96            |
| 2500  | 20.05 | 37.81     | 17.58                   | 12.93                    | 3.70      | 0.94    | 20.27          | 9.85                   | 3.04            |
| 2600  | 19.68 | 37.23     | 17.01                   | 12.85                    | 3.60      | 0.94    | 20.45          | 9.81                   | 3.05            |
| 2700  | 19.18 | 36.93     | 15.89                   | 13.08                    | 3.68      | 0.95    | 20.44          | 9.73                   | 3.11            |
| 2800  | 18.74 | 36.71     | 14.98                   | 13.05                    | 3.74      | 0.95    | 20.16          | 9.50                   | 3.11            |
| 2900  | 18.27 | 37.34     | 14.02                   | 13.69                    | 4.23      | 0.97    | 19.97          | 9.38                   | 3.19            |
| 3000  | 17.82 | 36.67     | 13.31                   | 13.26                    | 4.08      | 0.97    | 19.81          | 9.14                   | 3.17            |
| 3100  | 17.43 | 35.86     | 12.75                   | 13.09                    | 3.87      | 0.97    | 19.89          | 9.24                   | 3.20            |
| 3200  | 16.93 | 36.12     | 11.90                   | 13.52                    | 4.18      | 0.99    | 19.16          | 8.90                   | 3.27            |
| 3300  | 16.51 | 35.86     | 11.38                   | 13.43                    | 4.21      | 1.00    | 19.29          | 8.93                   | 3.21            |
| 3400  | 15.93 | 35.94     | 10.59                   | 14.22                    | 4.49      | 1.03    | 19.16          | 8.66                   | 3.38            |
| 3500  | 15.54 | 35.37     | 10.22                   | 13.83                    | 4.36      | 1.03    | 18.80          | 8.47                   | 3.37            |
| 3600  | 15.21 | 34.94     | 9.85                    | 13.54                    | 4.27      | 1.03    | 18.89          | 8.29                   | 3.47            |
| 3700  | 14.70 | 34.90     | 9.38                    | 14.00                    | 4.45      | 1.05    | 18.59          | 8.24                   | 3.51            |
| 3800  | 14.24 | 35.08     | 8.83                    | 14.10                    | 4.70      | 1.07    | 18.63          | 8.09                   | 3.60            |
| 3900  | 13.74 | 34.50     | 8.51                    | 14.20                    | 4.61      | 1.08    | 18.12          | 7.82                   | 3.64            |
| 4000  | 13.27 | 35.23     | 7.88                    | 14.21                    | 5.13      | 1.10    | 18.11          | 7.70                   | 3.78            |

## 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<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          |