

High Gain

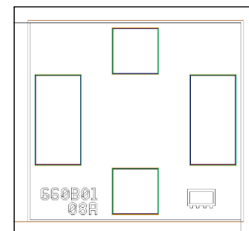
# Monolithic Amplifier Die

MAR-8A-D+

50Ω DC to 1 GHz

## The Big Deal

- High gain, 31.5 dB at 0.1 GHz
- High IP3, up to +25 dBm
- Low noise figure, 3.1 dB typ up to 1 GHz



## Product Overview

MAR-8A-D+ is a wideband amplifier Die offering high gain and low noise figure. It has repeatable performance from lot to lot. MAR-8A-D+ uses Darlington configuration and is fabricated using InGaP HBT technology.

## Key Features

| Feature                                                                             | Advantages                                                                                                                                                                                                                            |
|-------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| High Gain, 31 dB typ. at 0.1GHz                                                     | The MAR-8A-D+ provides high gain eliminating need for multiple stages reducing cost and real estate. Minimizes the effect of noise figure follow up stages on overall noise figure.                                                   |
| High Dynamic Range<br>Low Noise Figure, 3.1dB typ. up to 1 GHz<br>High IP3, +25 dBm | Combination of low noise and high IP3 makes this MMIC amplifier die ideal for use in low noise receiver front end (RFE) as it gives the user advantages of sensitivity and two-tone IM performance at both ends of the dynamic range. |
| Unpackaged die                                                                      | Enables the user to integrate the amplifier directly into hybrids.                                                                                                                                                                    |



High Gain

# Monolithic Amplifier Die

MAR-8A-D+

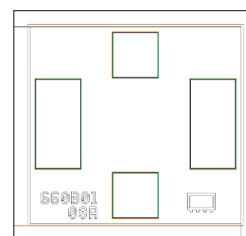
50Ω DC to 1 GHz

## Product Features

- High gain, 31.5 dB at 0.1 GHz, reduces component count
- Internally Matched to 50 Ohms
- High power output, +12.5 dBm typ.
- Low noise
- Improved stability
- Protection against power supply transients
- Protected by US Patent 6,943,629

## Typical Applications

- Cellular Infrastructure
- UHF/VHF transmitters/receivers



### +RoHS Compliant

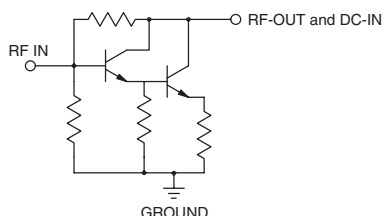
The +Suffix identifies RoHS Compliance. See our web site for RoHS Compliance methodologies and qualifications

Ordering Information: Refer to Last Page

## General Description

MAR-8A-D+ (RoHS compliant) is a wideband amplifier Die offering high gain and low noise figure. It has repeatable performance from lot to lot. MAR-8A-D+ uses Darlington configuration and is fabricated using InGaP HBT technology.

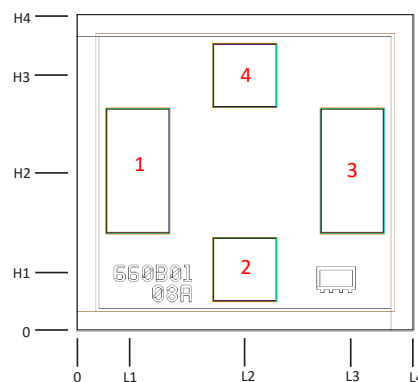
## Simplified Schematic and Pad description



| Pad # | Function         | Description                                                                                                                                                                                                                      |
|-------|------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 4     | RF IN            | RF input pad. This pad requires the use of an external DC blocking capacitor chosen for the frequency of operation.                                                                                                              |
| 2     | RF-OUT and DC-IN | RF output pad and bias pad. DC voltage is present on this pad, therefore, a DC blocking capacitor is necessary for proper operation. An RF choke is needed to feed DC bias without loss of RF signal due to the bias connection. |
| 1,3   | GROUND           | Connections to ground.                                                                                                                                                                                                           |

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

## Bonding Pad Position



Dimensions in μm, Typical

| L1 | L2  | L3  | L4  | H1 | H2  | H3  | H4  | Thickness | Bond Pad Size (RF In, RF Out and DC In) | Ground Pad Size |
|----|-----|-----|-----|----|-----|-----|-----|-----------|-----------------------------------------|-----------------|
| 95 | 260 | 425 | 520 | 95 | 248 | 395 | 490 | 100       | 100 x 100                               | 100 x 195       |



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REV. OR  
M167940  
MAR-8A-D+  
WP/RS/CP  
180910  
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**Electrical Specifications<sup>1</sup> at 25°C and 35mA, unless noted**

| Parameter                                         |                      | Min. | Typ.       | Max.   | Units |
|---------------------------------------------------|----------------------|------|------------|--------|-------|
| Frequency Range <sup>2</sup>                      |                      | DC   |            | 1      | GHz   |
| Gain                                              | f=0.1 GHz<br>f=1 GHz |      | 31.5<br>25 | —<br>— | dB    |
| Input Return Loss                                 | f=DC to 1 GHz        |      | 15.5       |        | dB    |
| Output Return Loss                                | f=DC to 1 GHz        |      | 11         |        | dB    |
| Output Power @ 1 dB compression                   | f=1 GHz              |      | +12.5      |        | dBm   |
| Output IP3                                        | f=1 GHz              |      | +25        |        | dBm   |
| Noise Figure                                      | f=1 GHz              |      | 3.1        |        | dB    |
| Recommended Device Operating Current              |                      |      | 36         |        | mA    |
| Device Operating Voltage                          |                      | 3.2  | 3.7        | 4.2    | V     |
| Device Voltage Variation vs. Temperature at 36 mA |                      |      | +1.2       |        | mV/°C |
| Device Voltage Variation vs. Current at 25°C      |                      |      | 11.3       |        | mV/mA |
| Thermal Resistance, junction-to-case <sup>3</sup> |                      |      | 119        |        | °C/W  |

1. Measured on Mini-Circuits characterization test board. Die packaged in a plastic micro-x package and soldered on test board TB-432-8A+. See characterization test circuit (Fig. 1)

2. Guaranteed specification DC-1 GHz. Low frequency cut off determined by external coupling capacitors.

3. Case is defined as ground leads.

**Absolute Maximum Ratings<sup>4</sup>**

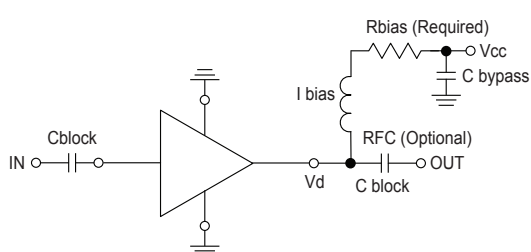
| Parameter             | Ratings       |
|-----------------------|---------------|
| Operating Temperature | -40°C to 85°C |
| Operating Current     | 65mA          |
| Power Dissipation     | 250mW         |
| Input Power           | 13dBm         |

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

These ratings are not intended for continuous normal operation.

<sup>4</sup> Full temperature range.

## Recommended Application and Characterization Test Circuit



Test Board includes case, connectors, and components (in bold) soldered to PCB

| R BIAS |                                  |
|--------|----------------------------------|
| Vcc    | Bias Resistor Value <sup>1</sup> |
| 7      | 88.7                             |
| 8      | 118                              |
| 9      | 143                              |
| 10     | 174                              |
| 11     | 200                              |
| 12     | 226                              |
| 13     | 255                              |
| 14     | 280                              |
| 15     | 309                              |

1. 1% resistor values (ohms) for optimum bias.

Fig 1. Block Diagram of Test Circuit used for characterization. (DUT, Die packaged in plastic micro-x package, soldered on Mini-Circuits Characterization test board TB-432-8A+)

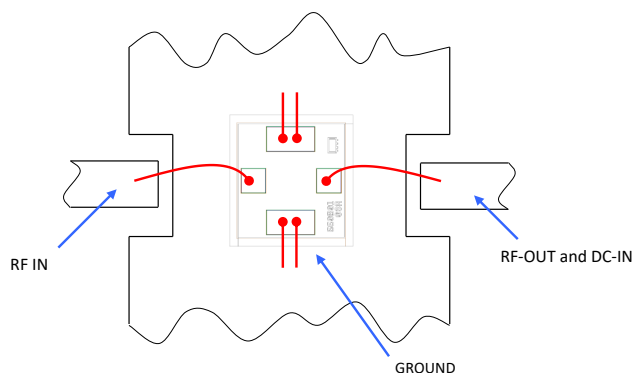
Gain, Return loss, Output power at 1dB compression (P1 dB), output IP3 (OIP3) and noise figure measured using Agilent's N5242A PNA-X microwave network analyzer.

Conditions:

1. Gain and Return loss: Pin= -25dBm.

Output IP3 (OIP3): Two tones, spaced 1 MHz apart, -5 dBm/tone at output.

## Assembly Diagram



## Assembly and Handling Procedure

- Storage**  
Dice should be stored in a dry nitrogen purged desiccators or equivalent.
- ESD**  
MMIC HBT amplifier 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.
- Die Attach**  
The die mounting surface must be clean and flat. Using conductive silver filled epoxy, recommended epoxies are DieMat DM6030HK-PT/H579 or Ablestik 84-1LMISR4. Apply sufficient epoxy to meet required epoxy bond line thickness, epoxy fillet height and epoxy coverage around total die periphery. Parts shall be cured in a nitrogen filled atmosphere per manufacturer's cure condition. It is recommended to use antistatic die pick up tools only.
- Wire Bonding**  
Bond pad openings in the surface passivation above the bond pads are provided to allow wire bonding to the dice gold bond pads. Thermosonic bonding is used with minimized ultrasonic content. Bond force, time, ultrasonic power and temperature are all critical parameters. Suggested wire is pure gold, 1 mil diameter. Bonds must be made from the bond pads on the die to the package or substrate. All bond wires should be kept as short as low as reasonable to minimize performance degradation due to undesirable series inductance.

| Additional Detailed Technical Information                     |                                                                             |
|---------------------------------------------------------------|-----------------------------------------------------------------------------|
| <i>additional information is available on our dash board.</i> |                                                                             |
| Performance Data                                              | Data Table                                                                  |
|                                                               | Swept Graphs                                                                |
|                                                               | 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*      MAR-8A-DG+                          |
|                                                               | Medium <sup>†</sup> , Partial wafer: KGD* <3020      MAR-8A-DP+             |
|                                                               | Large <sup>†</sup> , Full Wafer                      MAR-8A-DF+             |
|                                                               | <sup>†</sup> Available upon request contact sales representative            |
|                                                               | Refer to <a href="#">AN-60-067</a>                                          |
| Environmental Ratings                                         | ENV80                                                                       |

\*Known Good Dice ("KGD") means that the dice in question have been subjected to Mini-Circuits DC test performance criteria and measurement instructions and that the parametric data of such dice fall within a predefined range. While DC testing is not definitive, it does help to provide a higher degree of confidence that dice are capable of meeting typical RF electrical parameters specified by Mini-Circuits.

## ESD Rating\*\*

Human Body Model (HBM): Class 2 (2000V to <4000V) in accordance with ANSI/ESD STM 5.1 - 2001

\*\* Measured on Mini-Circuits characterization test board. Die packaged in a plastic micro-x package and soldered on test board TB-432-8A+.

## Additional Notes

- Performance and quality attributes and conditions not expressly stated in this specification document are intended to be excluded and do not form a part of this specification document.
- Electrical specifications and performance data contained in this specification document are based on Mini-Circuit's applicable established test performance criteria and measurement instructions.
- 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 therein. For a full statement of the Standard Terms and the exclusive rights and remedies thereunder, please visit Mini-Circuits' website at [www.minicircuits.com/MCLStore/terms.jsp](http://www.minicircuits.com/MCLStore/terms.jsp)
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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: Id=36mA; Vd=3.97V @ Temperature = +25degC

| 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)         |
| 50    | 31.43 | 34.52     | 15.52             | 12.46              | 1.04      | 0.74    | 26.36       | 12.85            | 2.13         |
| 60    | 31.50 | 34.53     | 15.95             | 12.54              | 1.04      | 0.74    | 26.45       | 12.91            | 2.17         |
| 80    | 31.37 | 34.43     | 15.47             | 12.61              | 1.04      | 0.74    | 26.70       | 12.84            | 2.20         |
| 100   | 31.34 | 34.46     | 15.08             | 12.65              | 1.04      | 0.74    | 26.46       | 12.80            | 2.26         |
| 120   | 31.23 | 34.26     | 16.14             | 12.68              | 1.04      | 0.74    | 26.22       | 12.72            | 2.27         |
| 140   | 31.12 | 34.40     | 15.51             | 12.71              | 1.05      | 0.72    | 25.93       | 12.64            | 2.25         |
| 160   | 30.87 | 34.30     | 16.55             | 12.75              | 1.05      | 0.71    | 25.69       | 12.63            | 2.31         |
| 180   | 30.83 | 34.21     | 15.57             | 12.83              | 1.05      | 0.71    | 25.74       | 12.55            | 2.28         |
| 200   | 30.66 | 34.15     | 16.03             | 12.87              | 1.06      | 0.70    | 25.98       | 12.65            | 2.28         |
| 220   | 30.51 | 34.09     | 16.32             | 12.98              | 1.06      | 0.69    | 26.13       | 12.74            | 2.36         |
| 240   | 30.37 | 33.95     | 16.36             | 13.01              | 1.06      | 0.69    | 25.95       | 12.72            | 2.36         |
| 260   | 30.17 | 33.96     | 16.06             | 13.10              | 1.07      | 0.67    | 26.00       | 12.64            | 2.41         |
| 280   | 29.96 | 33.80     | 15.82             | 13.16              | 1.07      | 0.67    | 26.02       | 12.56            | 2.46         |
| 300   | 29.82 | 33.75     | 16.13             | 13.19              | 1.07      | 0.66    | 25.79       | 12.38            | 2.55         |
| 320   | 29.63 | 33.62     | 15.92             | 13.26              | 1.08      | 0.66    | 25.69       | 12.49            | 2.51         |
| 340   | 29.44 | 33.52     | 16.23             | 13.33              | 1.08      | 0.65    | 25.67       | 12.60            | 2.54         |
| 360   | 29.25 | 33.39     | 16.19             | 13.40              | 1.08      | 0.64    | 25.60       | 12.59            | 2.61         |
| 380   | 29.07 | 33.24     | 16.23             | 13.45              | 1.08      | 0.64    | 25.60       | 12.60            | 2.62         |
| 400   | 28.89 | 33.16     | 16.64             | 13.55              | 1.09      | 0.63    | 25.53       | 12.55            | 2.63         |
| 420   | 28.71 | 32.95     | 16.47             | 13.60              | 1.08      | 0.63    | 25.43       | 12.54            | 2.64         |
| 440   | 28.47 | 32.82     | 16.47             | 13.67              | 1.09      | 0.62    | 25.39       | 12.63            | 2.63         |
| 460   | 28.32 | 32.70     | 16.56             | 13.76              | 1.09      | 0.62    | 25.59       | 12.62            | 2.71         |
| 480   | 28.15 | 32.54     | 16.43             | 13.82              | 1.09      | 0.62    | 25.55       | 12.58            | 2.71         |
| 500   | 27.96 | 32.40     | 16.78             | 13.91              | 1.09      | 0.61    | 25.68       | 12.63            | 2.76         |
| 520   | 27.78 | 32.24     | 16.20             | 13.90              | 1.09      | 0.61    | 25.79       | 12.67            | 2.73         |
| 540   | 27.58 | 32.01     | 16.37             | 13.96              | 1.09      | 0.61    | 25.85       | 12.69            | 2.76         |
| 560   | 27.43 | 31.89     | 16.42             | 14.04              | 1.09      | 0.60    | 25.81       | 12.68            | 2.82         |
| 580   | 27.24 | 31.74     | 16.74             | 14.04              | 1.09      | 0.60    | 25.82       | 12.68            | 2.79         |
| 600   | 27.10 | 31.56     | 16.50             | 14.11              | 1.09      | 0.60    | 25.94       | 12.72            | 2.81         |
| 620   | 26.88 | 31.40     | 16.32             | 14.12              | 1.09      | 0.59    | 25.97       | 12.74            | 2.81         |
| 640   | 26.72 | 31.25     | 16.61             | 14.19              | 1.09      | 0.59    | 25.91       | 12.71            | 2.78         |
| 660   | 26.58 | 31.07     | 16.70             | 14.16              | 1.09      | 0.59    | 26.06       | 12.68            | 2.85         |
| 680   | 26.39 | 30.85     | 16.78             | 14.22              | 1.08      | 0.60    | 26.13       | 12.75            | 2.84         |
| 700   | 26.20 | 30.73     | 16.42             | 14.22              | 1.08      | 0.59    | 26.19       | 12.77            | 2.83         |
| 750   | 25.82 | 30.29     | 16.63             | 14.37              | 1.08      | 0.59    | 26.04       | 12.82            | 2.81         |
| 800   | 25.42 | 29.88     | 16.83             | 14.31              | 1.08      | 0.59    | 25.90       | 12.76            | 2.88         |
| 850   | 25.04 | 29.50     | 16.78             | 14.30              | 1.07      | 0.59    | 25.76       | 12.82            | 2.86         |
| 900   | 24.65 | 29.08     | 16.80             | 14.32              | 1.07      | 0.58    | 25.35       | 12.73            | 2.84         |
| 940   | 24.29 | 28.71     | 17.07             | 14.27              | 1.07      | 0.58    | 25.52       | 12.81            | 2.92         |
| 1000  | 23.95 | 28.33     | 16.83             | 14.17              | 1.06      | 0.58    | 25.65       | 12.78            | 2.87         |

Note: Test data measured on Mini-Circuits plastic Micro-X package characterization test board TB-432-8A+

*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: Id=29mA; Vd=3.87V @ 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)            |
| 50    | 30.34 | 33.78     | 12.12                   | 9.83                     | 1.04      | 0.75    | 24.75          | 11.10                  | 2.14            |
| 60    | 30.47 | 33.87     | 12.82                   | 9.88                     | 1.04      | 0.75    | 24.92          | 11.17                  | 2.15            |
| 80    | 30.33 | 33.96     | 12.37                   | 9.95                     | 1.05      | 0.73    | 25.19          | 11.10                  | 2.17            |
| 100   | 30.33 | 33.84     | 12.33                   | 10.01                    | 1.04      | 0.74    | 24.87          | 11.03                  | 2.24            |
| 120   | 30.24 | 33.71     | 12.87                   | 10.07                    | 1.04      | 0.74    | 24.64          | 10.77                  | 2.23            |
| 140   | 30.14 | 33.72     | 12.89                   | 10.12                    | 1.04      | 0.73    | 24.35          | 10.63                  | 2.22            |
| 160   | 29.95 | 33.68     | 13.71                   | 10.14                    | 1.05      | 0.71    | 24.09          | 10.57                  | 2.28            |
| 180   | 29.90 | 33.60     | 12.95                   | 10.19                    | 1.04      | 0.72    | 24.05          | 10.48                  | 2.24            |
| 200   | 29.74 | 33.52     | 13.13                   | 10.29                    | 1.05      | 0.71    | 24.27          | 10.66                  | 2.27            |
| 220   | 29.62 | 33.53     | 13.50                   | 10.35                    | 1.05      | 0.69    | 24.43          | 10.82                  | 2.31            |
| 240   | 29.48 | 33.44     | 13.51                   | 10.38                    | 1.05      | 0.69    | 24.21          | 10.85                  | 2.33            |
| 260   | 29.32 | 33.29     | 13.35                   | 10.49                    | 1.05      | 0.68    | 24.27          | 10.62                  | 2.38            |
| 280   | 29.15 | 33.24     | 13.37                   | 10.56                    | 1.05      | 0.67    | 24.22          | 10.41                  | 2.47            |
| 300   | 29.05 | 33.13     | 13.71                   | 10.59                    | 1.05      | 0.67    | 23.87          | 10.22                  | 2.51            |
| 320   | 28.87 | 33.03     | 13.75                   | 10.69                    | 1.06      | 0.66    | 23.82          | 10.49                  | 2.50            |
| 340   | 28.71 | 32.96     | 13.97                   | 10.78                    | 1.06      | 0.65    | 23.70          | 10.55                  | 2.53            |
| 360   | 28.55 | 32.82     | 13.89                   | 10.88                    | 1.06      | 0.65    | 23.63          | 10.58                  | 2.57            |
| 380   | 28.38 | 32.69     | 13.94                   | 10.95                    | 1.06      | 0.64    | 23.63          | 10.65                  | 2.58            |
| 400   | 28.21 | 32.58     | 14.26                   | 11.06                    | 1.06      | 0.63    | 23.59          | 10.57                  | 2.59            |
| 420   | 28.06 | 32.41     | 14.27                   | 11.13                    | 1.06      | 0.63    | 23.45          | 10.44                  | 2.62            |
| 440   | 27.86 | 32.27     | 14.35                   | 11.21                    | 1.06      | 0.63    | 23.41          | 10.52                  | 2.60            |
| 460   | 27.73 | 32.17     | 14.47                   | 11.33                    | 1.06      | 0.62    | 23.62          | 10.52                  | 2.69            |
| 480   | 27.58 | 32.02     | 14.47                   | 11.39                    | 1.06      | 0.62    | 23.62          | 10.47                  | 2.69            |
| 500   | 27.41 | 31.90     | 14.75                   | 11.49                    | 1.07      | 0.61    | 23.75          | 10.58                  | 2.72            |
| 520   | 27.25 | 31.75     | 14.34                   | 11.54                    | 1.06      | 0.61    | 23.90          | 10.62                  | 2.73            |
| 540   | 27.06 | 31.56     | 14.55                   | 11.65                    | 1.06      | 0.61    | 24.01          | 10.77                  | 2.71            |
| 560   | 26.94 | 31.41     | 14.72                   | 11.78                    | 1.06      | 0.61    | 23.96          | 10.57                  | 2.73            |
| 580   | 26.77 | 31.25     | 14.95                   | 11.82                    | 1.06      | 0.60    | 23.99          | 10.65                  | 2.77            |
| 600   | 26.65 | 31.11     | 14.78                   | 11.89                    | 1.06      | 0.60    | 24.18          | 10.81                  | 2.79            |
| 620   | 26.44 | 30.93     | 14.73                   | 11.96                    | 1.06      | 0.60    | 24.24          | 10.73                  | 2.79            |
| 640   | 26.31 | 30.81     | 14.93                   | 12.08                    | 1.06      | 0.60    | 24.15          | 10.70                  | 2.77            |
| 660   | 26.16 | 30.63     | 15.12                   | 12.10                    | 1.06      | 0.60    | 24.26          | 10.70                  | 2.78            |
| 680   | 26.00 | 30.43     | 15.17                   | 12.21                    | 1.06      | 0.60    | 24.41          | 10.67                  | 2.81            |
| 700   | 25.85 | 30.31     | 15.00                   | 12.26                    | 1.06      | 0.60    | 24.63          | 10.79                  | 2.80            |
| 750   | 25.48 | 29.92     | 15.21                   | 12.41                    | 1.05      | 0.59    | 24.71          | 11.05                  | 2.80            |
| 800   | 25.12 | 29.50     | 15.39                   | 12.50                    | 1.05      | 0.59    | 24.50          | 10.77                  | 2.81            |
| 850   | 24.75 | 29.14     | 15.48                   | 12.65                    | 1.05      | 0.59    | 24.62          | 11.05                  | 2.86            |
| 900   | 24.38 | 28.74     | 15.55                   | 12.74                    | 1.04      | 0.59    | 24.41          | 11.24                  | 2.84            |
| 940   | 24.07 | 28.37     | 15.78                   | 12.77                    | 1.04      | 0.59    | 24.41          | 11.07                  | 2.89            |
| 1000  | 23.73 | 28.03     | 15.70                   | 12.88                    | 1.04      | 0.59    | 24.81          | 11.17                  | 2.84            |

Note: Test data measured on Mini-Circuits plastic Micro-X package characterization test board TB-432-8A+

*Typical Performance Data***Definitions:**

Input Return Loss = -S11 (dB)

Gain(Power Gain) = S21 (dB)

Reverse Isolation = -S12 (dB)

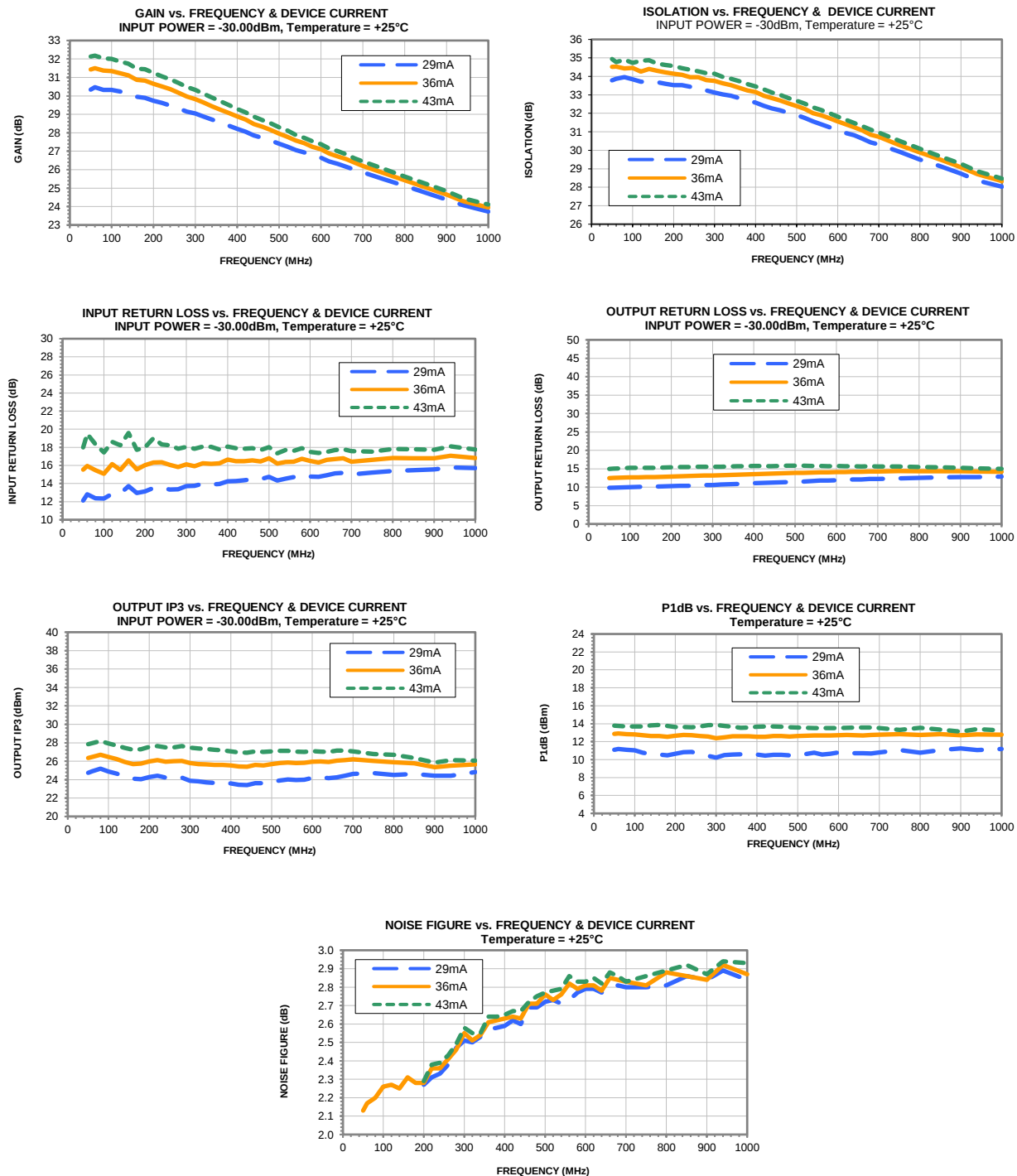
Output Return Loss = -S22 (dB)

TEST CONDITIONS: Id=43mA; Vd=4.05V @ 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)            |
| 50    | 32.14 | 34.94     | 18.00                   | 14.96                    | 1.04      | 0.75    | 27.84          | 13.78                  | 2.16            |
| 60    | 32.18 | 34.77     | 19.49                   | 15.04                    | 1.03      | 0.76    | 27.96          | 13.75                  | 2.17            |
| 80    | 32.03 | 34.91     | 18.34                   | 15.08                    | 1.04      | 0.74    | 28.19          | 13.69                  | 2.22            |
| 100   | 32.01 | 34.73     | 17.44                   | 15.24                    | 1.04      | 0.75    | 27.92          | 13.68                  | 2.29            |
| 120   | 31.86 | 34.85     | 18.61                   | 15.27                    | 1.05      | 0.73    | 27.70          | 13.70                  | 2.32            |
| 140   | 31.74 | 34.87     | 18.22                   | 15.27                    | 1.05      | 0.72    | 27.44          | 13.82                  | 2.29            |
| 160   | 31.47 | 34.69     | 19.59                   | 15.25                    | 1.06      | 0.71    | 27.24          | 13.86                  | 2.31            |
| 180   | 31.44 | 34.62     | 17.74                   | 15.35                    | 1.06      | 0.71    | 27.31          | 13.74                  | 2.29            |
| 200   | 31.25 | 34.56     | 17.98                   | 15.39                    | 1.06      | 0.70    | 27.55          | 13.62                  | 2.29            |
| 220   | 31.06 | 34.44     | 19.01                   | 15.51                    | 1.06      | 0.69    | 27.65          | 13.62                  | 2.38            |
| 240   | 30.90 | 34.36     | 18.33                   | 15.49                    | 1.07      | 0.69    | 27.49          | 13.59                  | 2.39            |
| 260   | 30.70 | 34.27     | 18.22                   | 15.57                    | 1.07      | 0.68    | 27.51          | 13.69                  | 2.43            |
| 280   | 30.48 | 34.17     | 17.86                   | 15.58                    | 1.07      | 0.67    | 27.64          | 13.84                  | 2.49            |
| 300   | 30.32 | 34.14     | 18.05                   | 15.53                    | 1.08      | 0.66    | 27.48          | 13.86                  | 2.58            |
| 320   | 30.11 | 33.97     | 17.86                   | 15.57                    | 1.08      | 0.66    | 27.39          | 13.76                  | 2.55            |
| 340   | 29.91 | 33.87     | 18.09                   | 15.65                    | 1.09      | 0.65    | 27.33          | 13.66                  | 2.55            |
| 360   | 29.71 | 33.74     | 18.06                   | 15.69                    | 1.09      | 0.64    | 27.23          | 13.54                  | 2.64            |
| 380   | 29.51 | 33.59     | 17.76                   | 15.67                    | 1.09      | 0.64    | 27.18          | 13.56                  | 2.64            |
| 400   | 29.29 | 33.46     | 18.08                   | 15.75                    | 1.09      | 0.63    | 27.07          | 13.66                  | 2.65            |
| 420   | 29.10 | 33.30     | 17.92                   | 15.73                    | 1.09      | 0.63    | 26.96          | 13.70                  | 2.67            |
| 440   | 28.87 | 33.13     | 17.86                   | 15.72                    | 1.10      | 0.62    | 26.93          | 13.68                  | 2.67            |
| 460   | 28.69 | 32.99     | 17.90                   | 15.77                    | 1.10      | 0.62    | 27.08          | 13.65                  | 2.72            |
| 480   | 28.51 | 32.82     | 17.70                   | 15.82                    | 1.10      | 0.62    | 27.01          | 13.60                  | 2.75            |
| 500   | 28.30 | 32.68     | 18.03                   | 15.84                    | 1.10      | 0.61    | 27.08          | 13.58                  | 2.77            |
| 520   | 28.12 | 32.52     | 17.34                   | 15.81                    | 1.10      | 0.61    | 27.11          | 13.55                  | 2.78            |
| 540   | 27.88 | 32.32     | 17.70                   | 15.74                    | 1.10      | 0.60    | 27.11          | 13.51                  | 2.79            |
| 560   | 27.72 | 32.18     | 17.61                   | 15.79                    | 1.10      | 0.60    | 27.04          | 13.52                  | 2.86            |
| 580   | 27.54 | 32.00     | 17.90                   | 15.70                    | 1.10      | 0.60    | 27.02          | 13.51                  | 2.83            |
| 600   | 27.38 | 31.82     | 17.51                   | 15.74                    | 1.10      | 0.60    | 27.10          | 13.52                  | 2.83            |
| 620   | 27.15 | 31.65     | 17.39                   | 15.70                    | 1.10      | 0.60    | 27.05          | 13.55                  | 2.85            |
| 640   | 27.00 | 31.48     | 17.50                   | 15.72                    | 1.10      | 0.60    | 27.01          | 13.57                  | 2.82            |
| 660   | 26.84 | 31.30     | 17.69                   | 15.64                    | 1.10      | 0.60    | 27.16          | 13.57                  | 2.88            |
| 680   | 26.62 | 31.12     | 17.78                   | 15.67                    | 1.10      | 0.59    | 27.15          | 13.56                  | 2.86            |
| 700   | 26.45 | 30.96     | 17.57                   | 15.59                    | 1.10      | 0.59    | 27.06          | 13.51                  | 2.83            |
| 750   | 26.04 | 30.51     | 17.52                   | 15.63                    | 1.09      | 0.59    | 26.79          | 13.32                  | 2.86            |
| 800   | 25.62 | 30.08     | 17.81                   | 15.47                    | 1.09      | 0.59    | 26.68          | 13.54                  | 2.89            |
| 850   | 25.24 | 29.67     | 17.80                   | 15.39                    | 1.08      | 0.59    | 26.34          | 13.35                  | 2.92            |
| 900   | 24.83 | 29.27     | 17.72                   | 15.25                    | 1.08      | 0.59    | 25.85          | 13.12                  | 2.87            |
| 940   | 24.45 | 28.87     | 18.10                   | 15.10                    | 1.08      | 0.59    | 26.13          | 13.41                  | 2.94            |
| 1000  | 24.11 | 28.47     | 17.76                   | 14.98                    | 1.07      | 0.59    | 26.05          | 13.26                  | 2.93            |

Note: Test data measured on Mini-Circuits plastic Micro-X package characterization test board TB-432-8A+

## Typical Performance Curves



Note: Test data measured on Mini-Circuits plastic Micro-X package characterization test board TB-432-8A+



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          |