TriQuint SEMICONDUCTOR

# Advance Product Information

**July 15, 2005**

# 4 - 14 GHz balanced LNA

# TGA2512-SM


**Self Bias**


**Gate Bias**

## Key Features

- Typical Frequency Range: 4 - 14 GHz
- 2.3 dB Nominal Noise Figure
- 25 dB Nominal Gain
- 15 dB AGC Range
- 13 dBm Nominal P1dB
- 24dBm Nominal OIP3
- Bias: 5 V, 160 mA Gate Bias
  5 V, 90 mA Self Bias
- Package Dimensions:
  4.0 x 4.0 x 0.9 mm

## Primary Applications

- X-Band Radar
- EW, ECM
- Point-to-Point Radio

## Product Description

The TriQuint TGA2512-SM is a packaged X-band balanced LNA with AGC amplifier for EW, ECM, and RADAR receiver or driver amplifier applications. The TGA2512-SM provides excellent noise performance with typical midband NF of 2.3dB, and high gain, 25dB from 4-14GHz

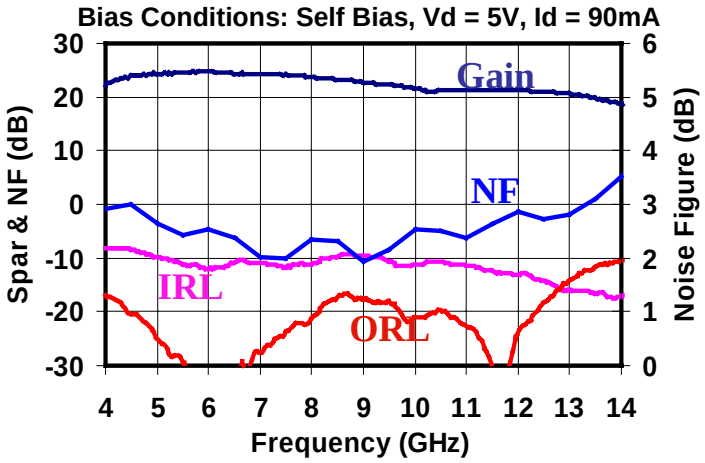
The TGA2512-SM is designed for maximum ease of use. TGA2512-SM can handle up to 21dBm input power reliably, while the build-in gain control provides 15dB of typical gain control range. The part can be used in self-biased mode, with a single +5V supply connection, or in gate biased mode, allowing the user to control the current for a particular application.

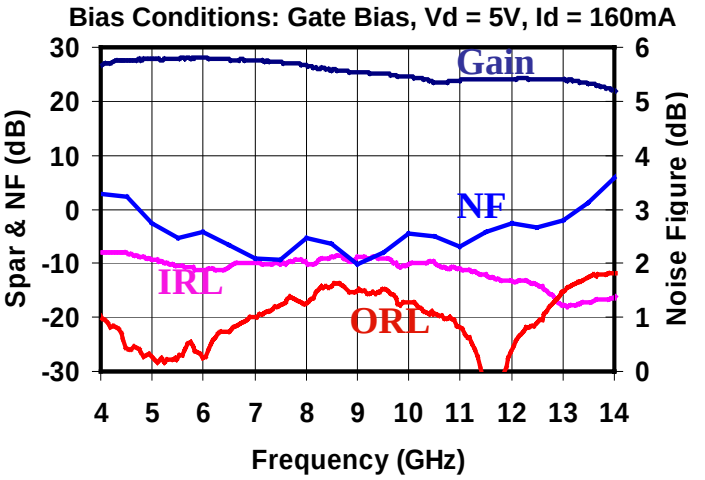
In self-biased mode the TGA2512-SM achieves 6dBm typical P1dB, while in gate-biased mode the typical P1dB is over 13dBm.

Lead-Free & RoHS compliant.

Evaluation boards are available.

## Measured Data




*Note: Device is early in the characterization process prior to finalizing all electrical specifications. Specifications are subject to change without notice*



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**TABLE I**
**MAXIMUM RATINGS 1/**

| SYMBOL | PARAMETER | VALUE | NOTES |
|---|---|---|---|
| Vd | Drain Voltage | [3.5 + (0.0125)(Id)] V | 2/ 3/ |
| Vg | Gate Voltage Range | -1 TO +0.5 V | |
| Id | Drain Current (gate biased) | 240 mA | 2/ |
| $\lvert Ig \rvert$ | Gate Current | 7.04 mA | |
| $P_{IN}$ | Input Continuous Wave Power | 21 dBm | |
| $P_D$ | Power Dissipation | See note 4/ | 2/ |
| $T_{CH}$ | Operating Channel Temperature | 117 $^0$C | 5/ |
| $T_M$ | Mounting Temperature (30 Seconds) | 260 $^0$C | |
| $T_{STG}$ | Storage Temperature | -65 to 150 $^0$C | |
| $T_{CASE}$ | Package Operating Temperature | -40 to 110 $^0$C | |

1/ These ratings represent the maximum operable values for this device.

2/ Combinations of supply voltage, supply current, input power, and output power shall not exceed $P_D$.

3/ Unit for Id is A

4/ For a median life time of 1E+6 hrs, Power dissipation is limited to:

$$P_D(max) = (117\ ^0C - T_{BASE}\ ^0C) / \theta_{JC}\ (^0C/W)$$

Where $T_{BASE}$ is the base plate temperature.

$\theta_{JC}$ for self bias is 28.2 $^0$C/W

$\theta_{JC}$ for gate bias is 37.6 $^0$C/W

5/ Junction operating temperature will directly affect the device median time to failure (MTTF). For maximum life, it is recommended that junction temperatures be maintained at the lowest possible levels.



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**TABLE II**
**ELECTRICAL CHARACTERISTICS**
(Ta = 25 $^0$C, Nominal)

| PARAMETER | Gate Bias | Self Bias | UNITS |
|---|---|---|---|
| Frequency Range | 4 - 14 | 4 - 14 | GHz |
| Drain Voltage, Vd | 5.0 | 5.0 | V |
| Drain Current, Id | 160 | 90 | mA |
| Gate Voltage, Vg | -0.1 | - | V |
| Small Signal Gain, S21 | 25 | 22 | dB |
| Input Return Loss, S11 | 10 | 10 | dB |
| Output Return Loss, S22 | 20 | 20 | dB |
| Noise Figure, NF | 2.3 | 2.3 | dB |
| Output Power @ 1dB Gain Compression, P1dB | 13 | 6 | dBm |
| OIP3 | 24 | 16 | dBm |
| Temperature Gain Coefficent | -0.02 | -0.02 | dB/$^0$C |

Note: Table II Lists the RF Characteristics of typical devices as determined by fixtured measurements.

**TABLE III**
**THERMAL INFORMATION**

| PARAMETER | TEST CONDITIONS | $T_{CH}$ ($^O$C) | $\theta_{JC}$ (°C/W) | $T_M$ (HRS) |
|---|---|---|---|---|
| $\theta_{JC}$ Thermal Resistance (channel to Case) | Vd = 5 V<br>Id = 160 mA Gate Bias<br>Pdiss = 0.80 W | 100 | 37.6 | 5.8E+6 |
| $\theta_{JC}$ Thermal Resistance (channel to Case) | Vd = 5 V<br>Id = 90 mA Self Bias<br>Pdiss = 0.45 W | 82.7 | 28.2 | 4.1E+7 |

Note: Worst case condition with no RF applied, 100% of DC power is dissipated, Case Temperature @ 70 $^O$C


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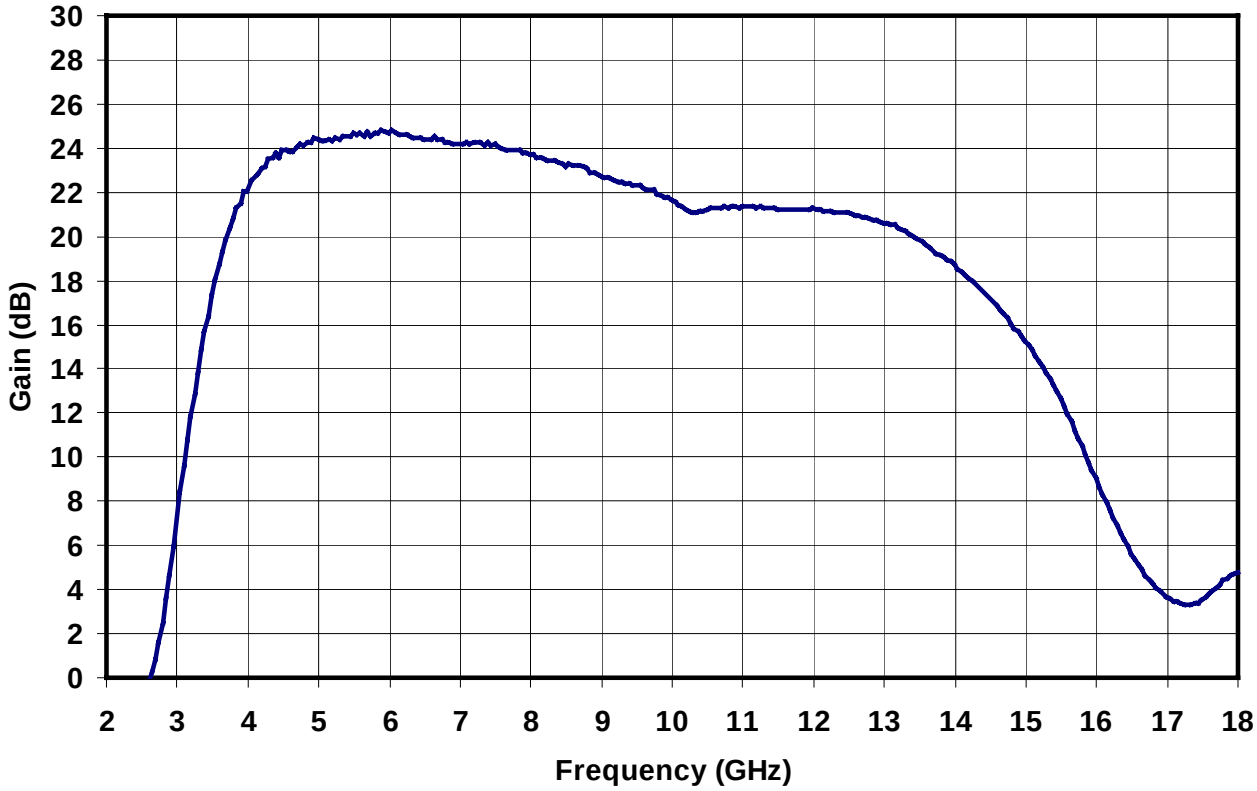
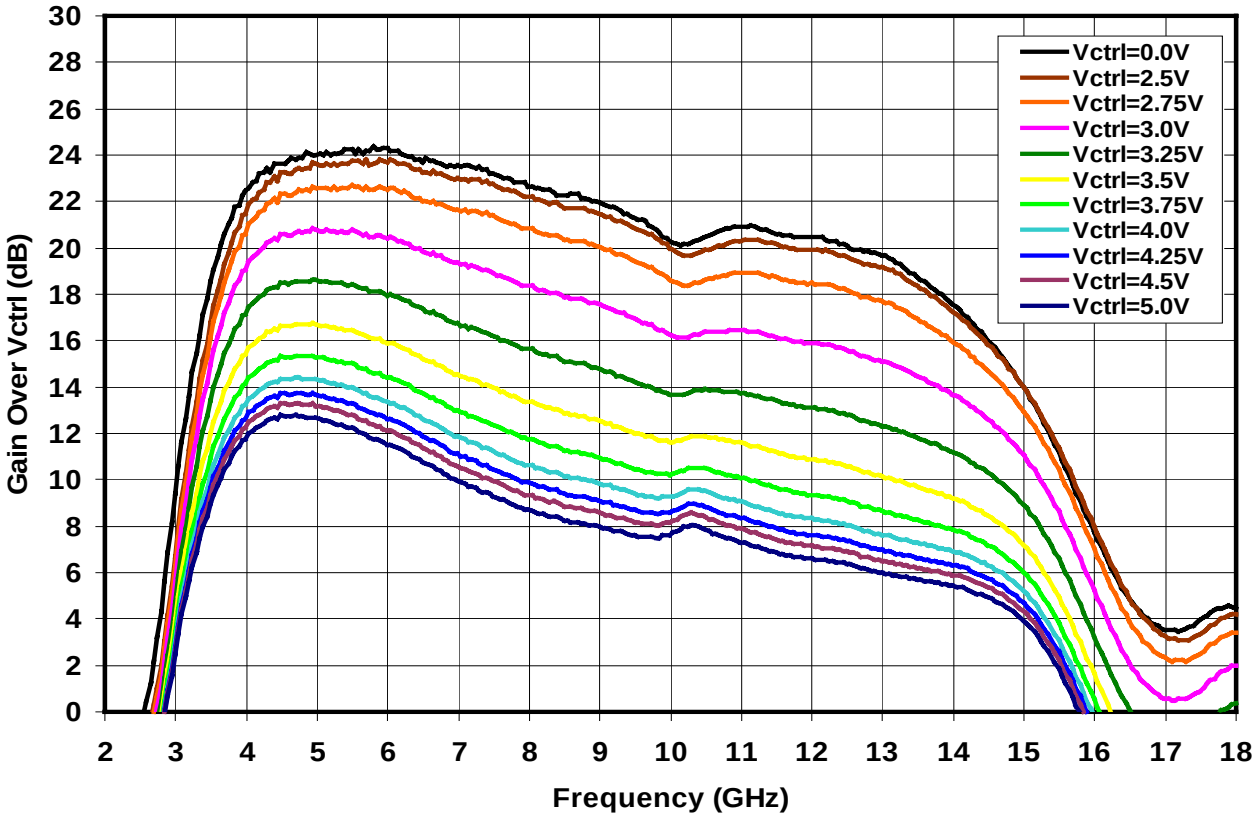
# Measured Data

**Bias Conditions: Self Bias, Vd = 5 V, Id = 90 mA**



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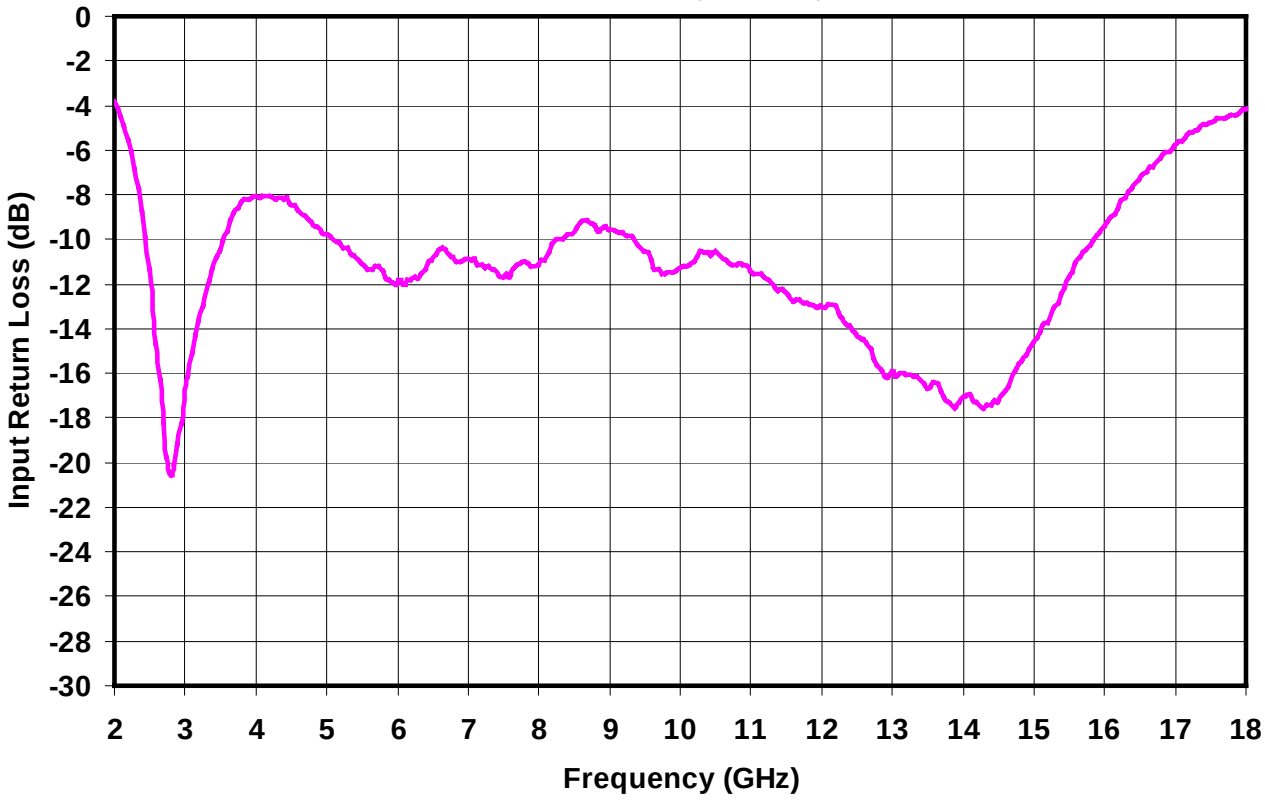


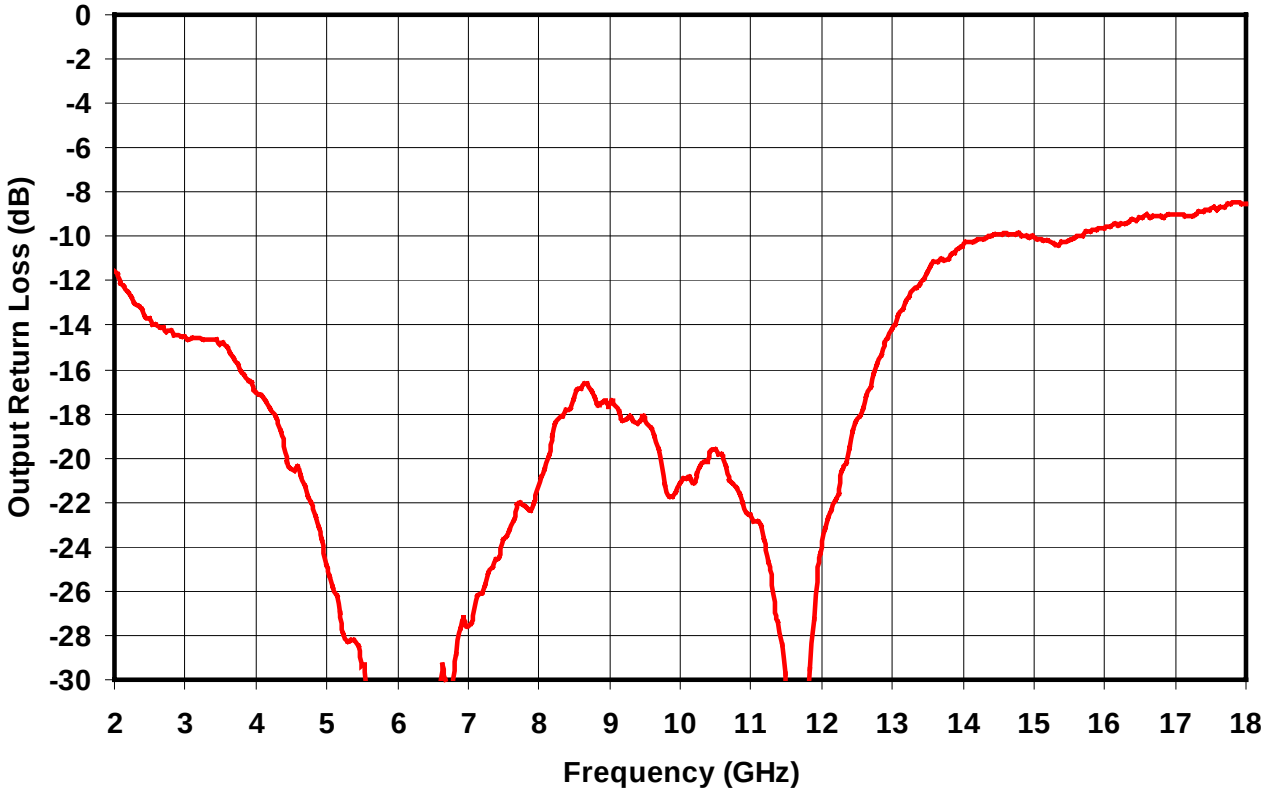




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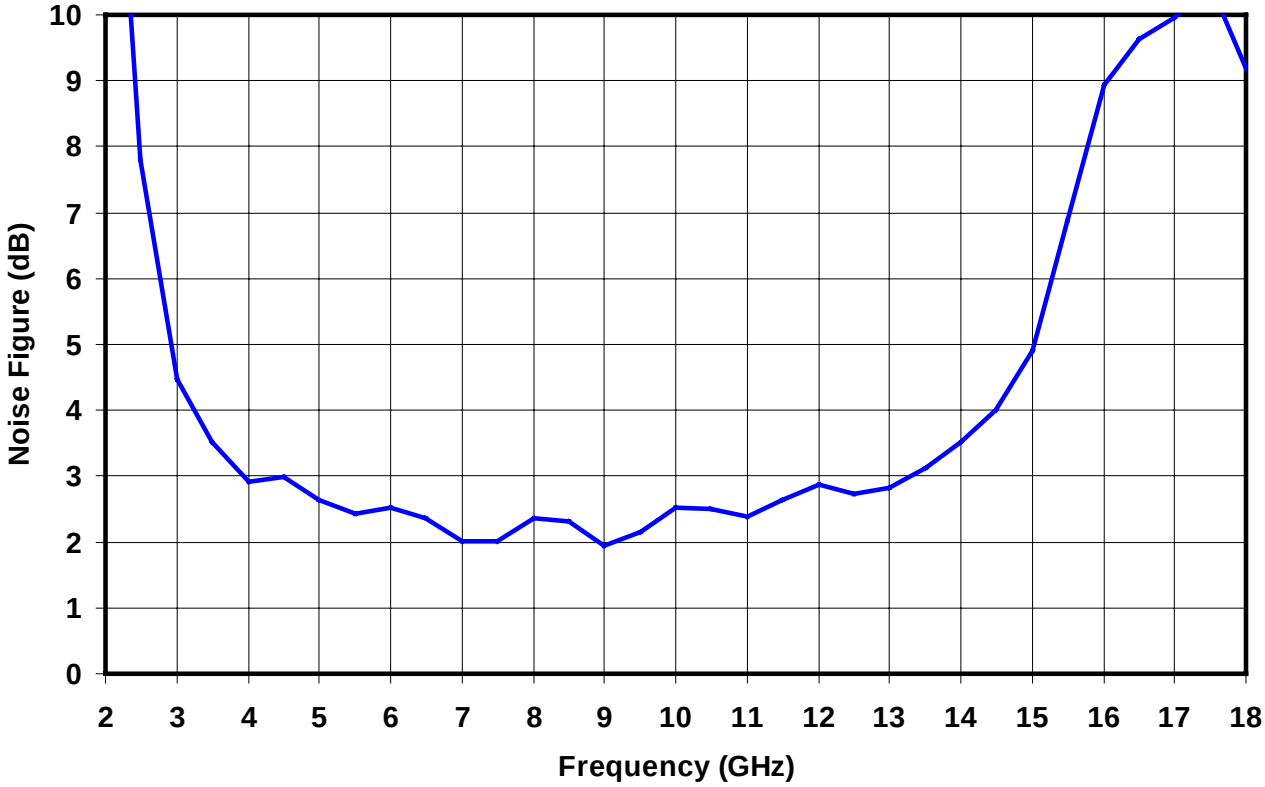


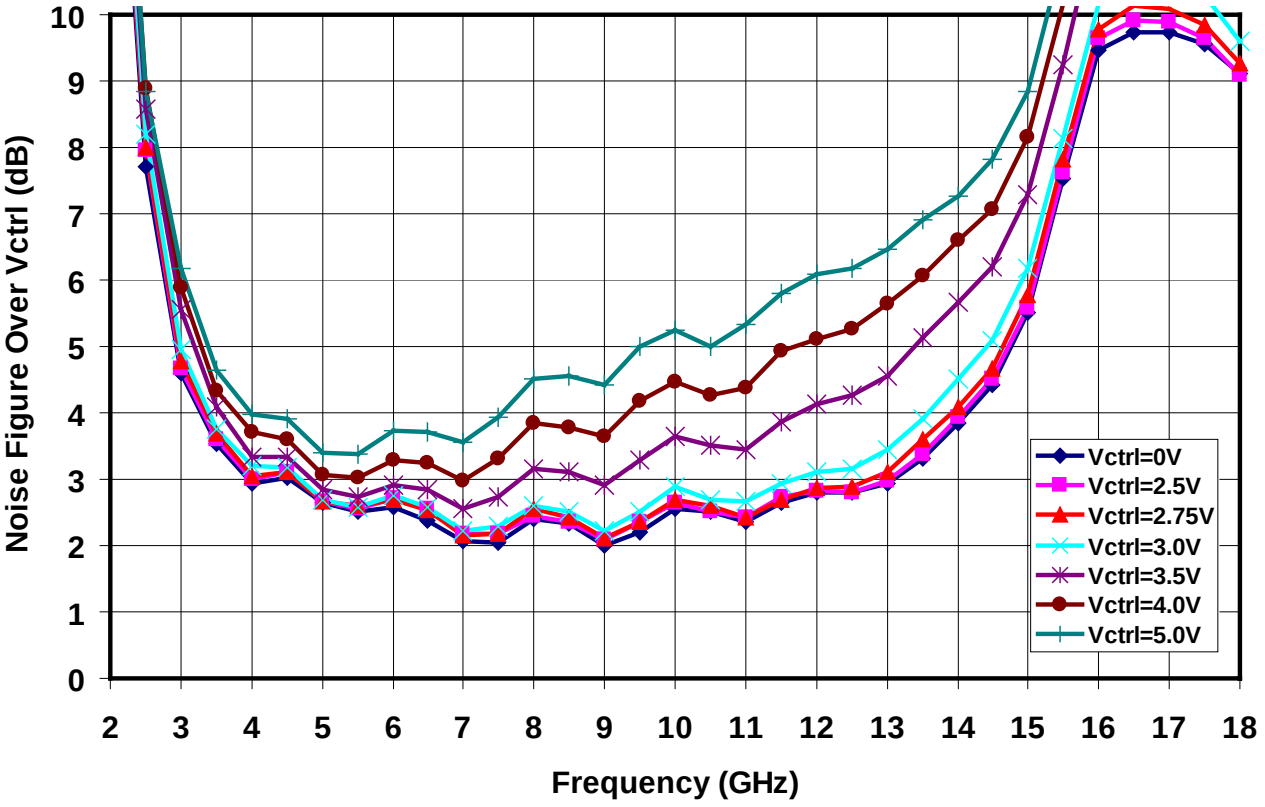




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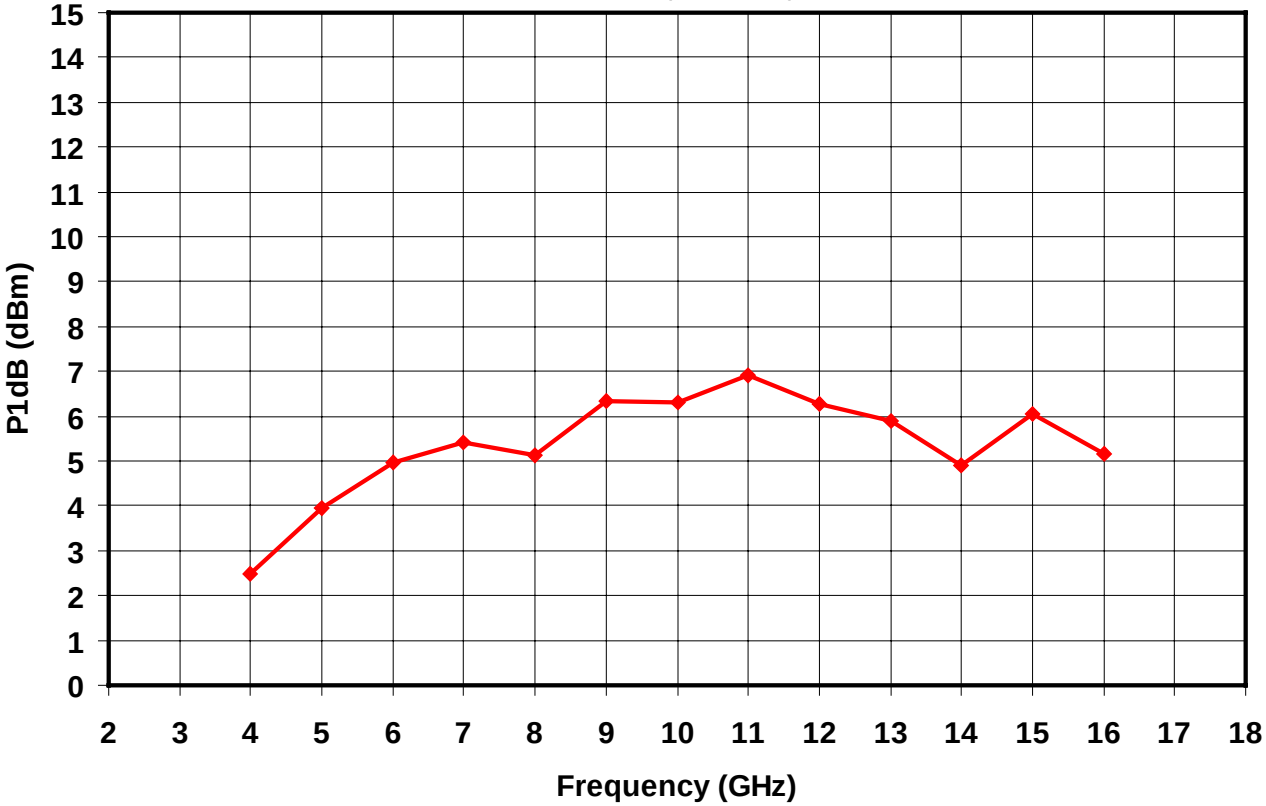


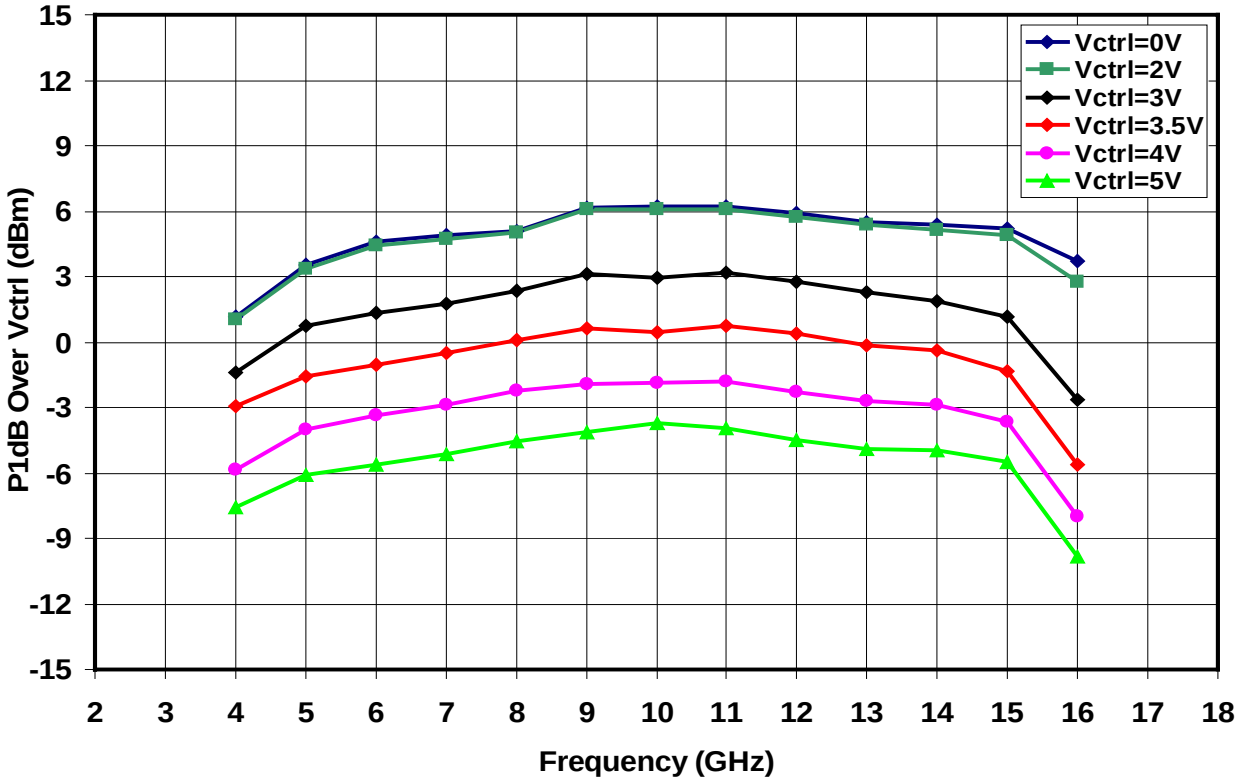




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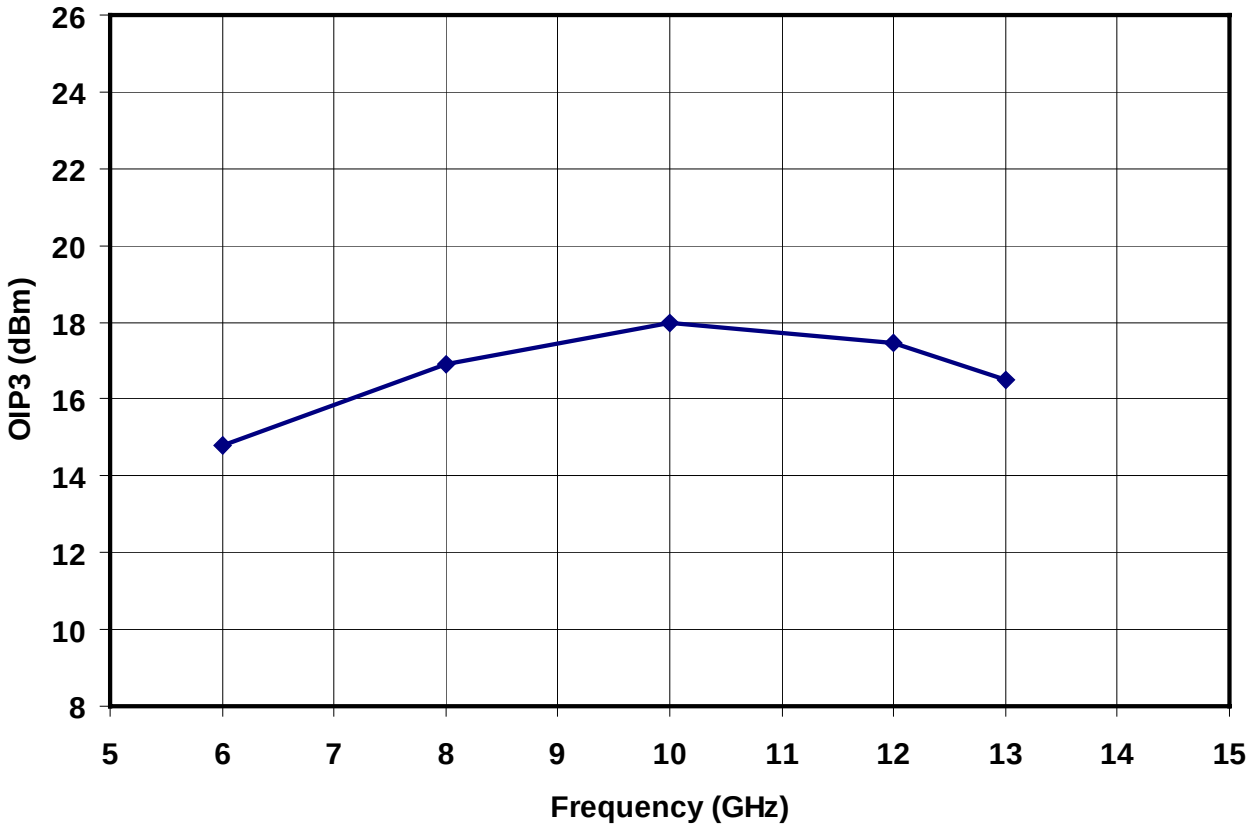




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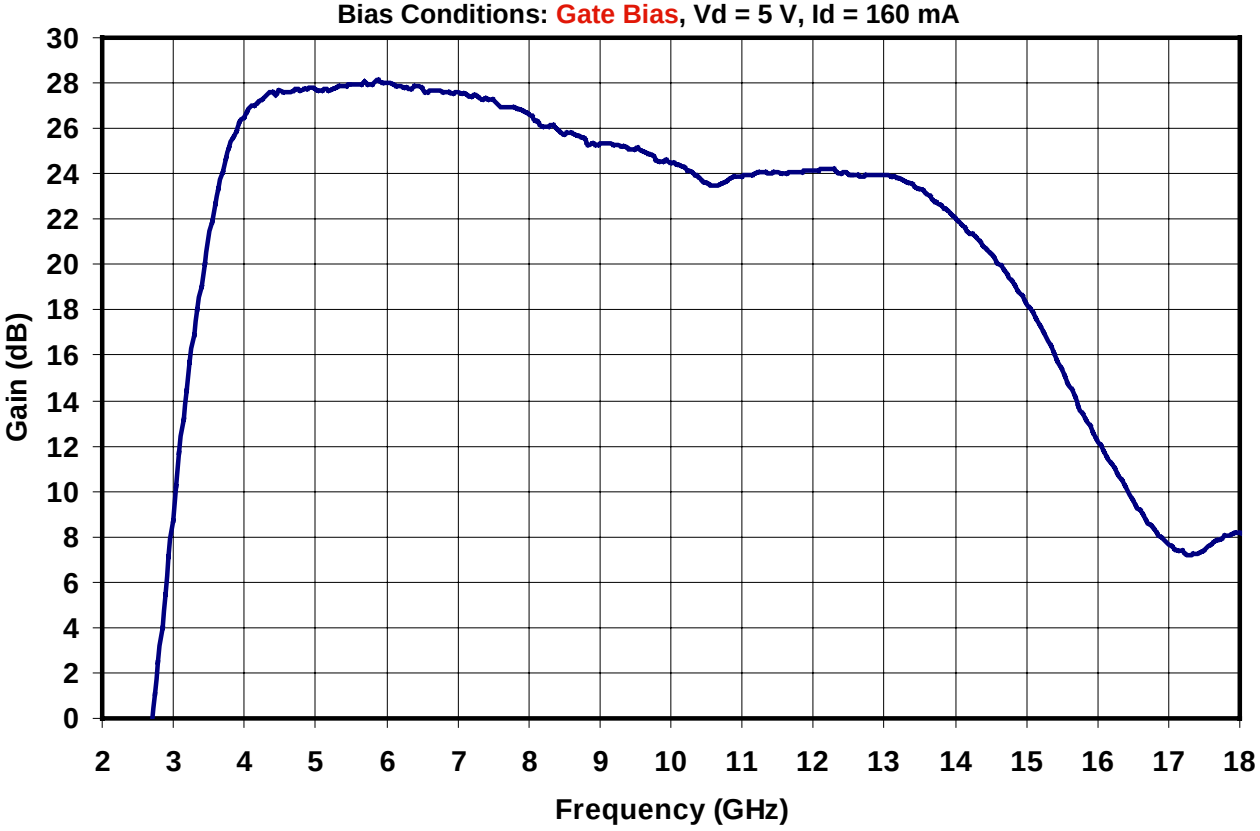
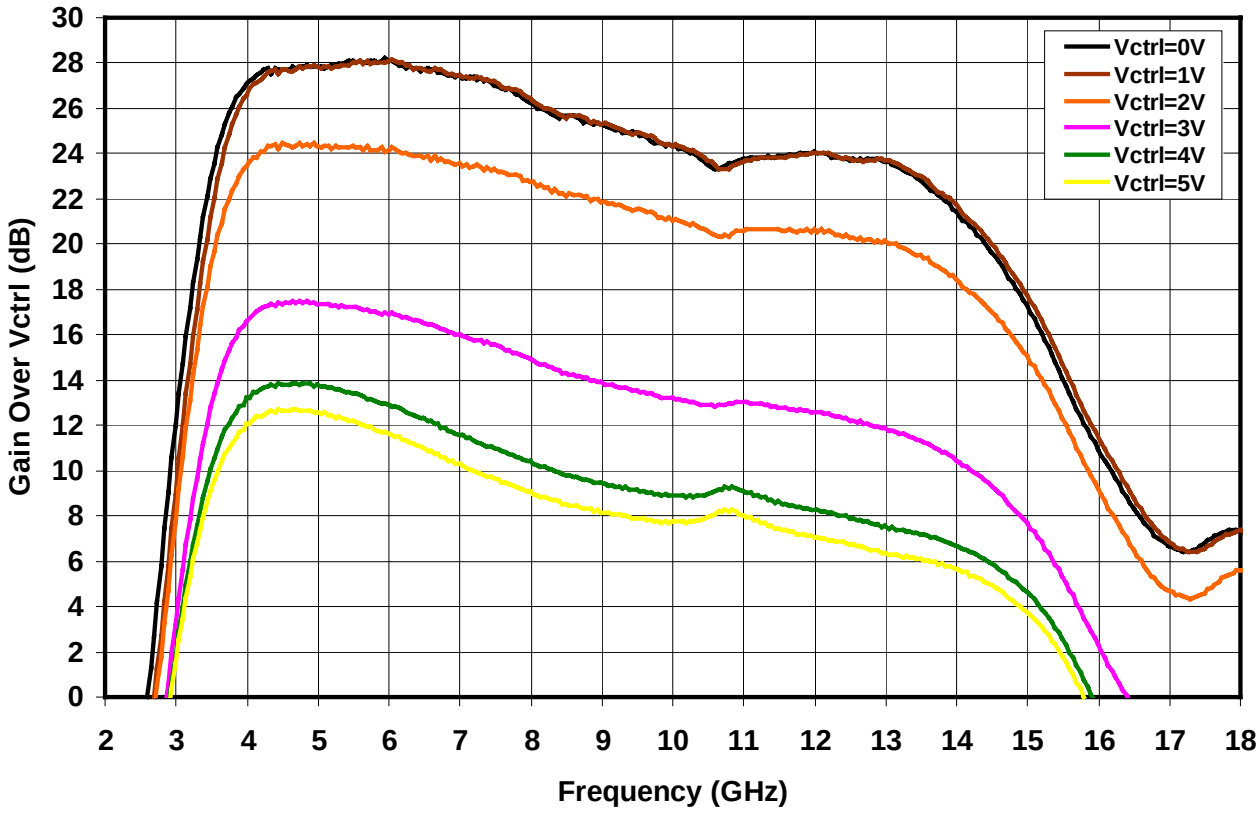
## Measured Data

**Bias Conditions: Gate Bias, Vd = 5 V, Id = 160 mA**



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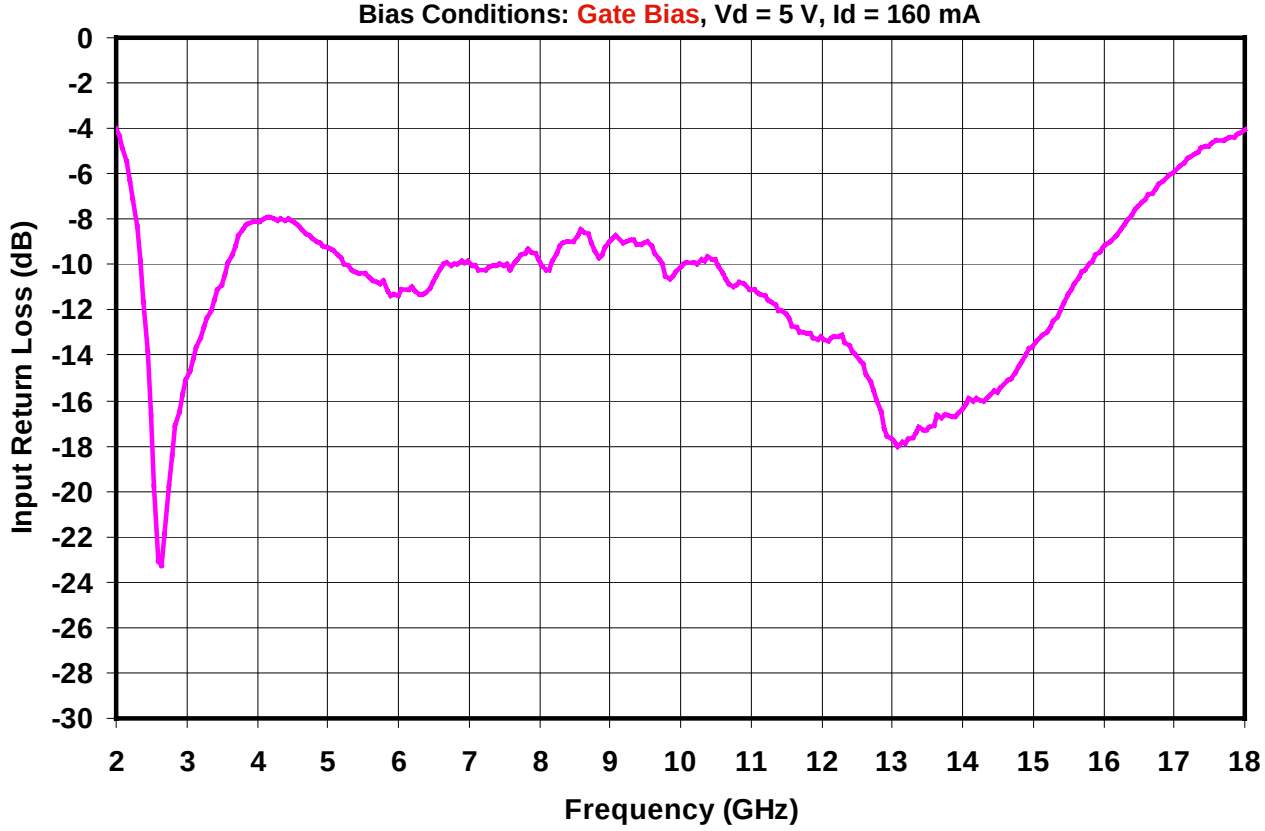


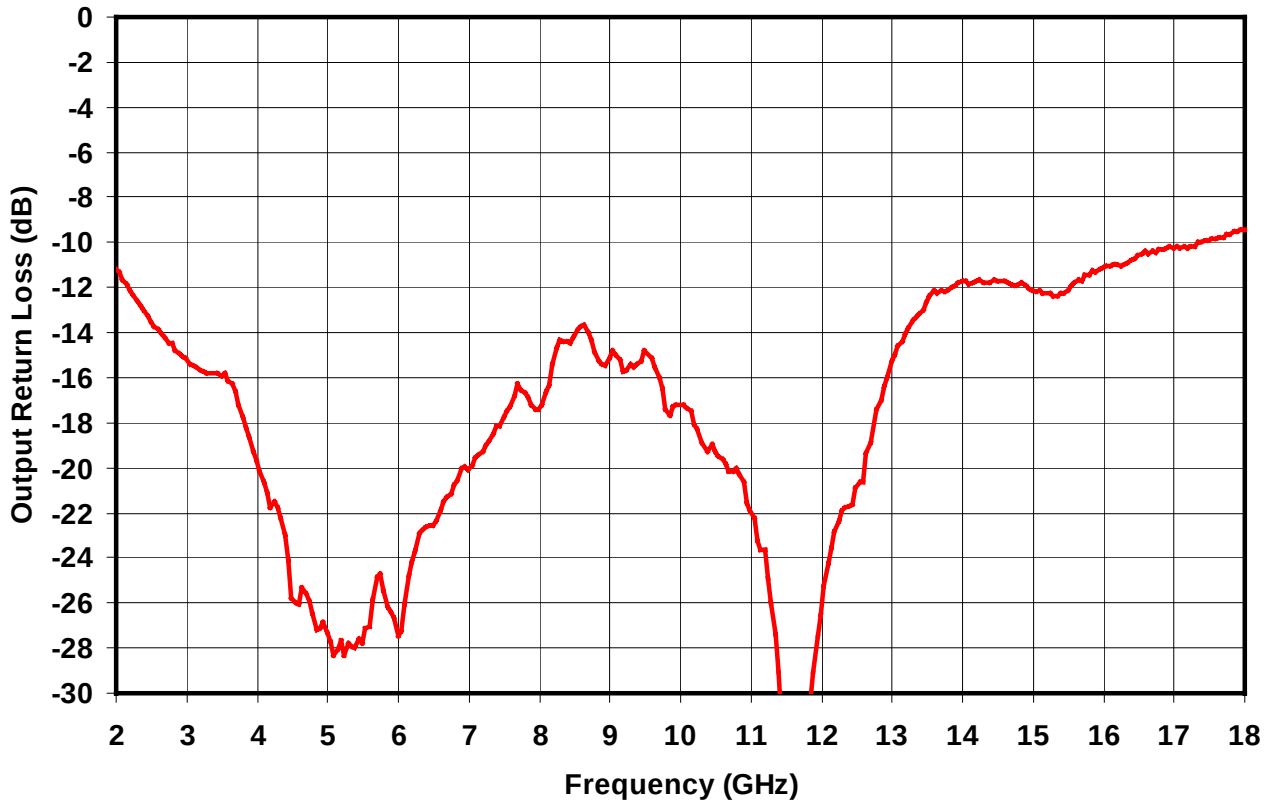




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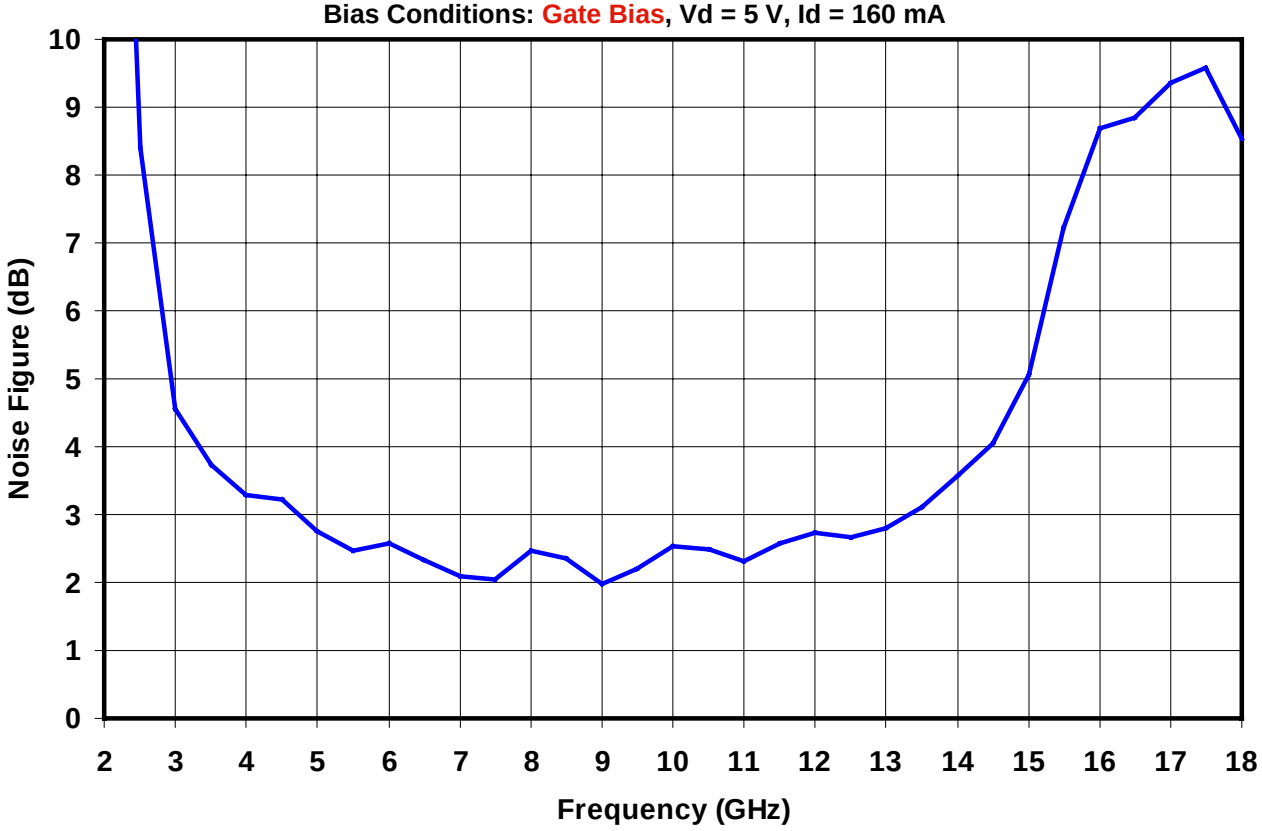


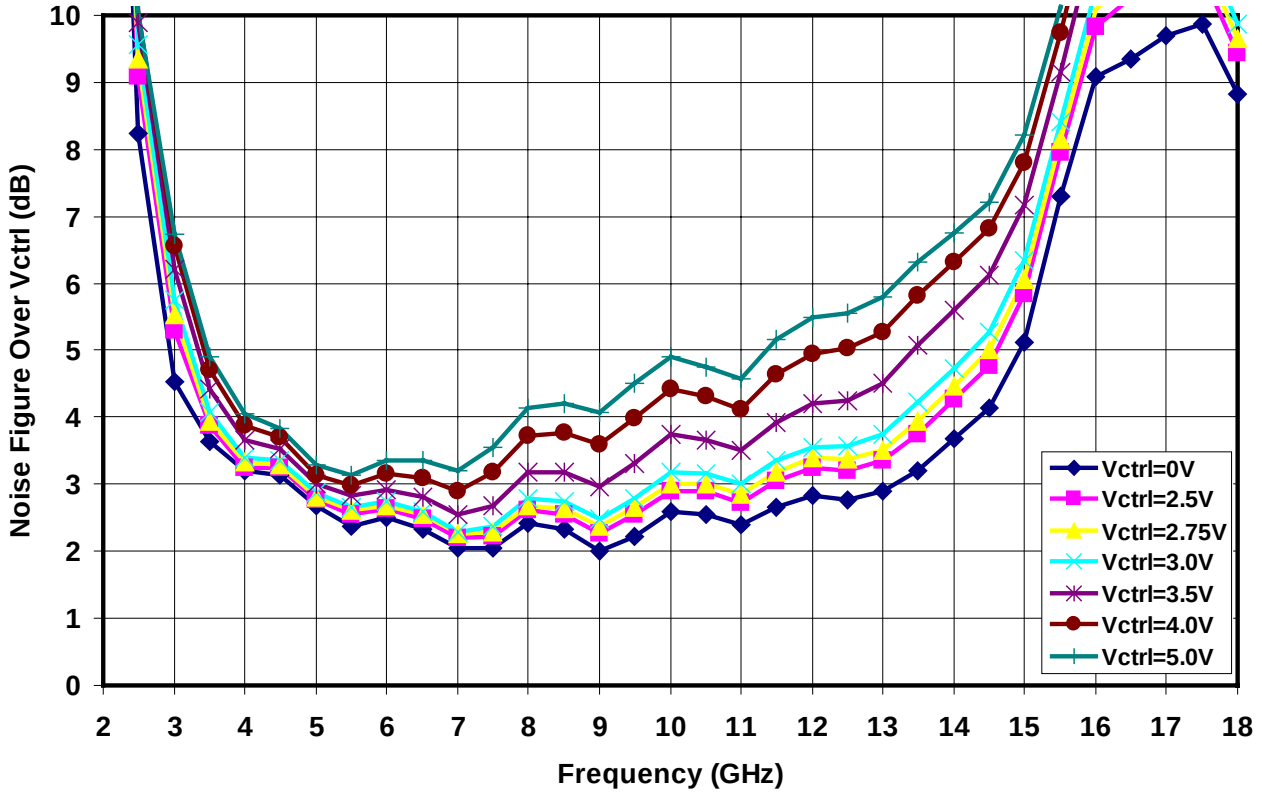




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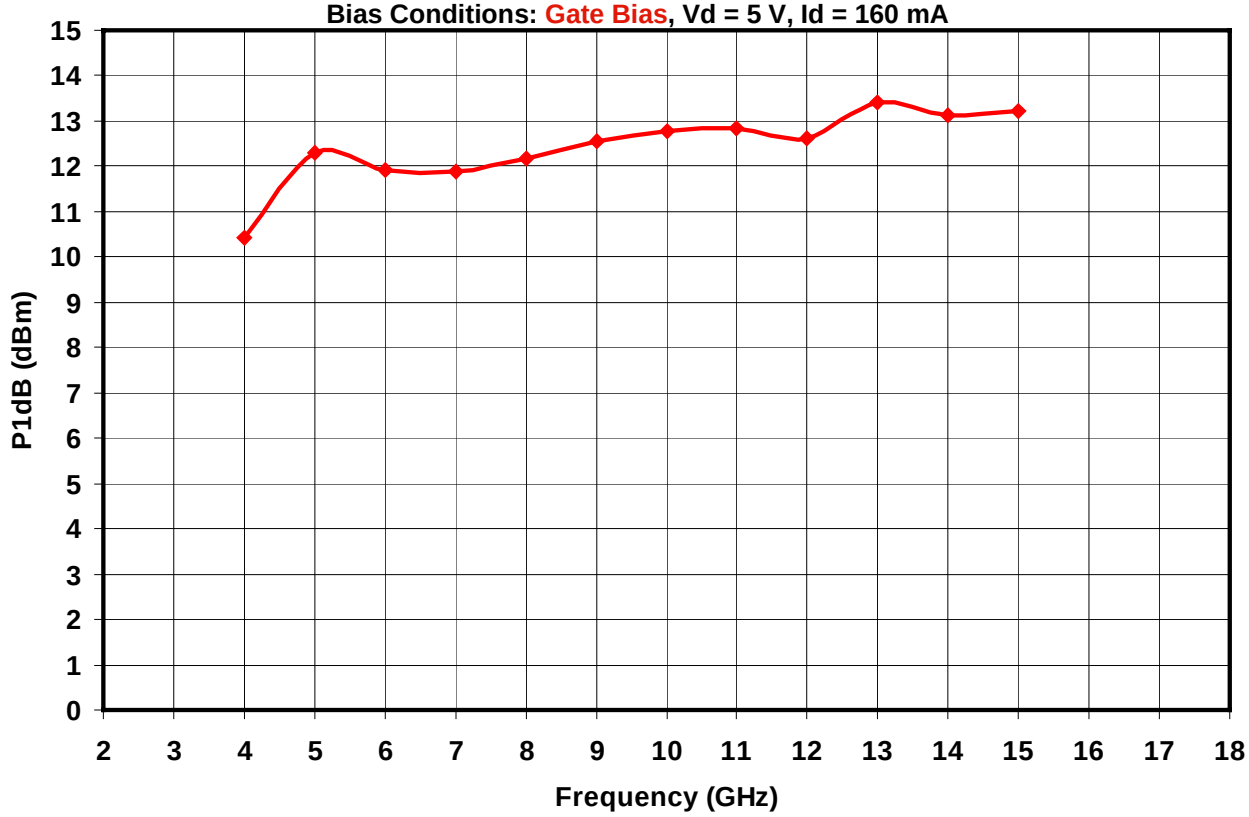


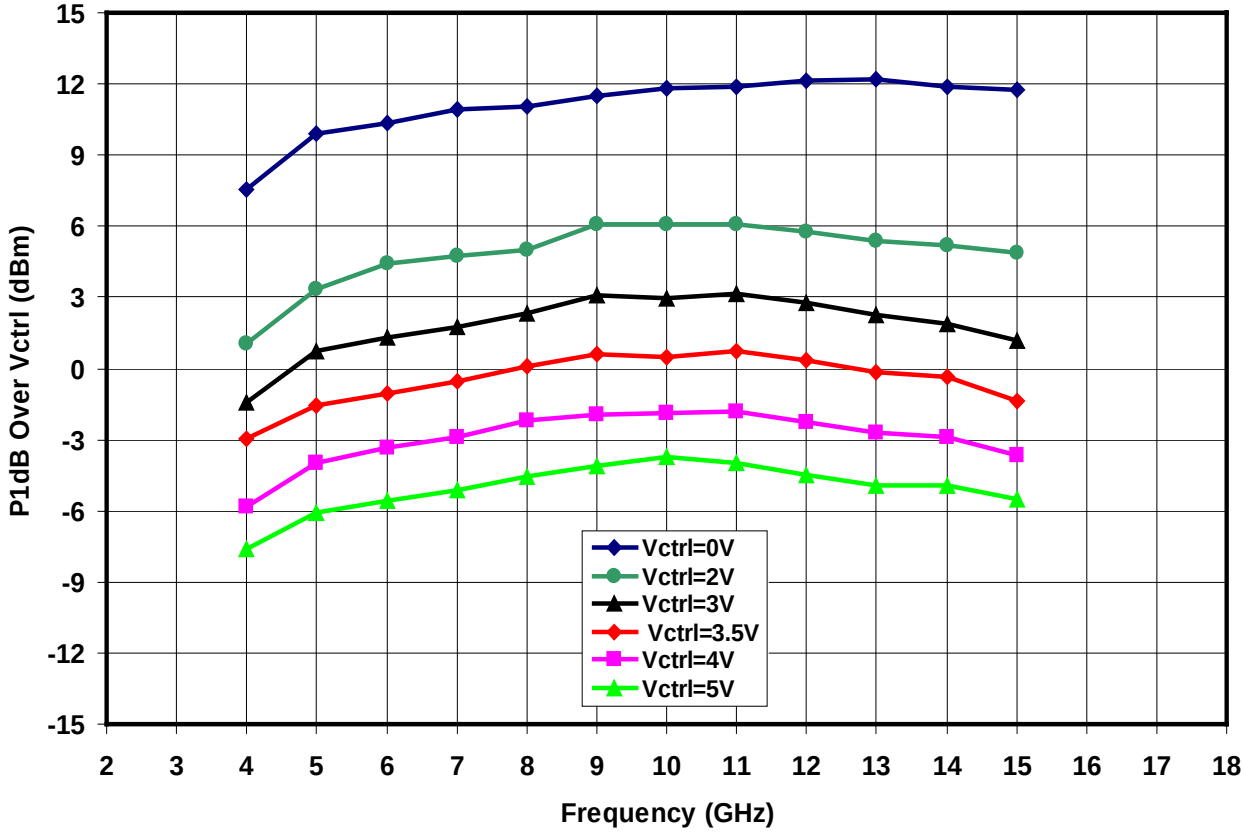




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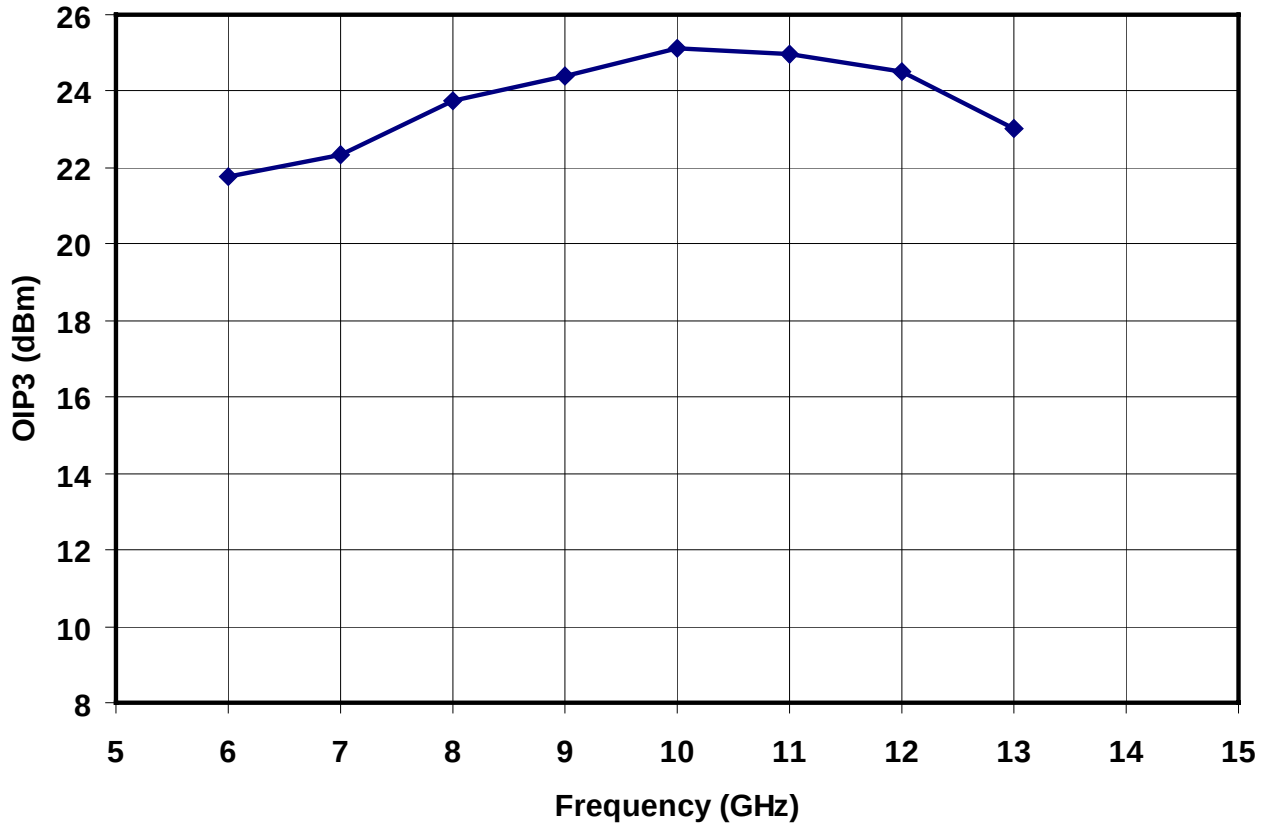




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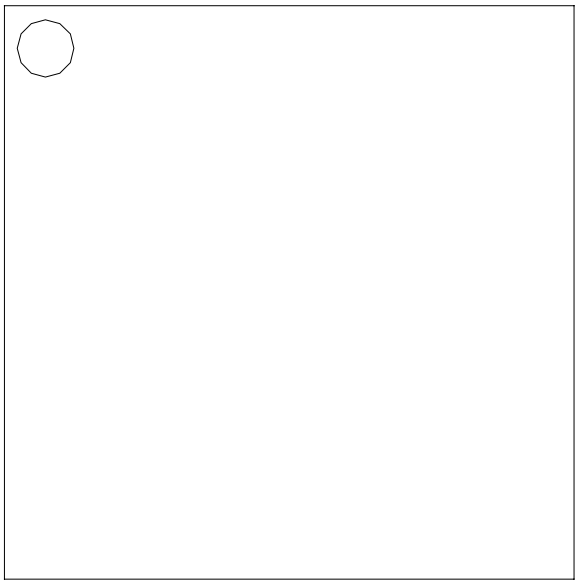
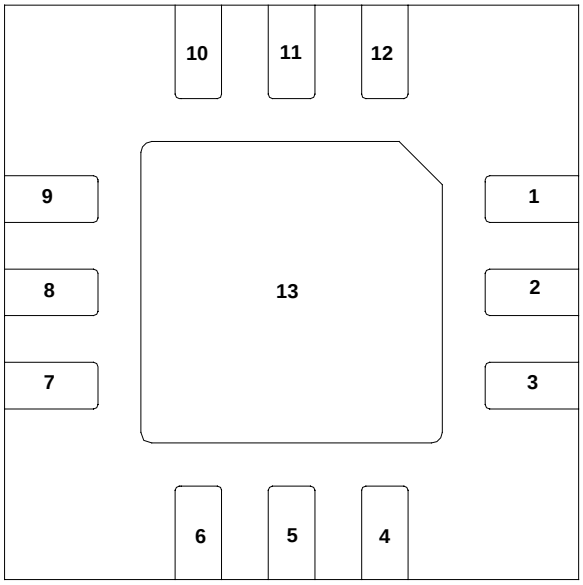
# Package Pinout Diagram



Top View

Dot indicates Pin 1




Bottom View

Self Bias

| Pin | Description |
|---|---|
| 1,3, 4, 5, 6, 7, 9, 12 | NC |
| 2 | RF Input |
| 8 | RF Output |
| 10 | Vd |
| 11 | Vctrl |
| 13 | Gnd |

Self Bias: Vd = 5V (Id = ~90mA), Vctrl = 0 to +5V for Gain adjustment

Gate Bias

| Pin | Description |
|---|---|
| 1,3, 4, 5, 6, 7, 9 | NC |
| 2 | RF Input |
| 8 | RF Output |
| 10 | Vd |
| 11 | Vctrl |
| 12 | Vg |
| 13 | Gnd |

Gate Bias: Vd = 5V , Vctrl = 0 to +5V for Gain adjustment
Vg = Range, -0.5 to 0, typically ~ -0.1 will provide ~160mA of Id.



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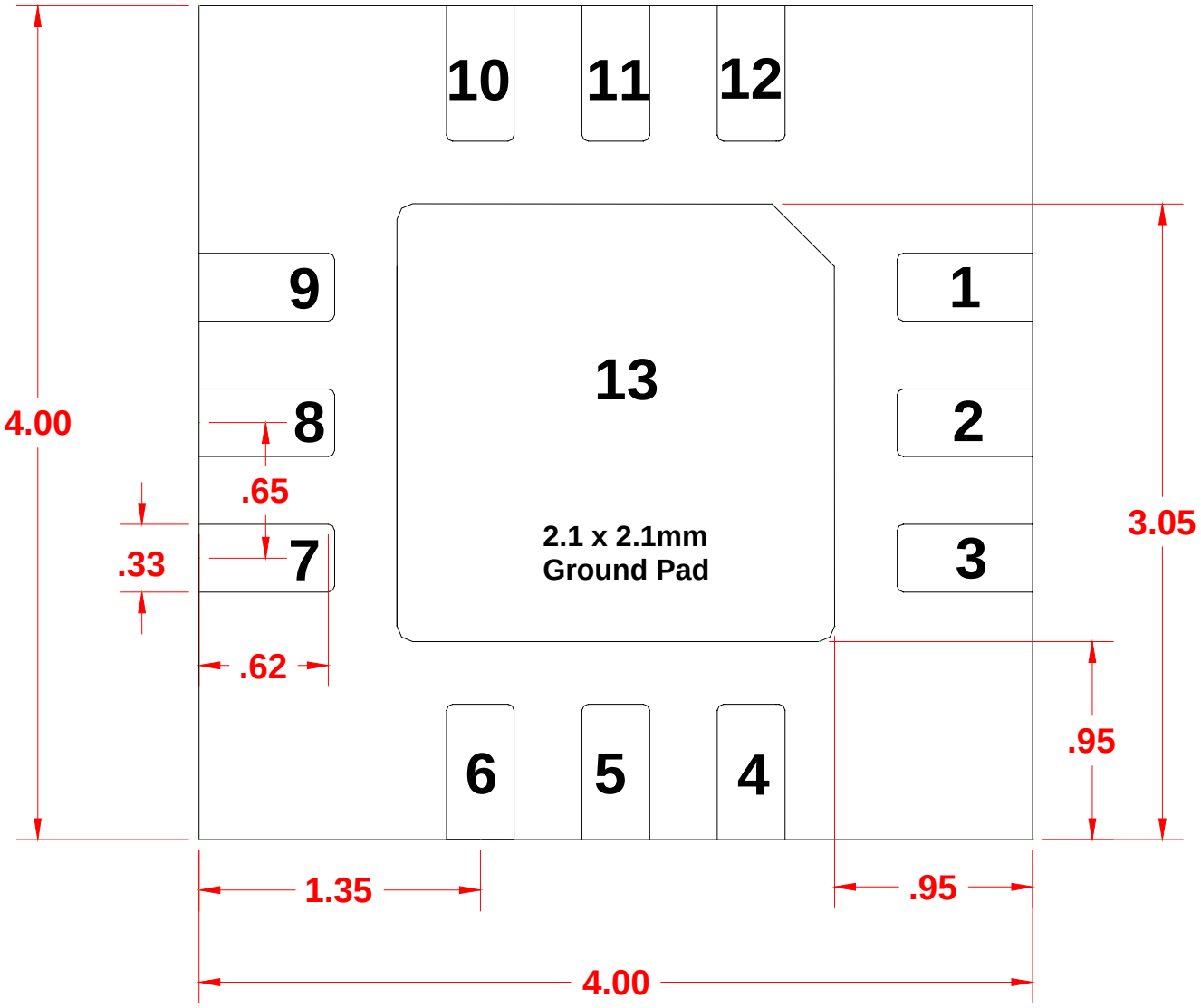
## Mechanical Drawing




Bottom View

**Units: Millimeters. Package tolerance: +/- 0.10**

***GaAs MMIC devices are susceptible to damage from Electrostatic Discharge. Proper precautions should be observed during handling, assembly and test.***



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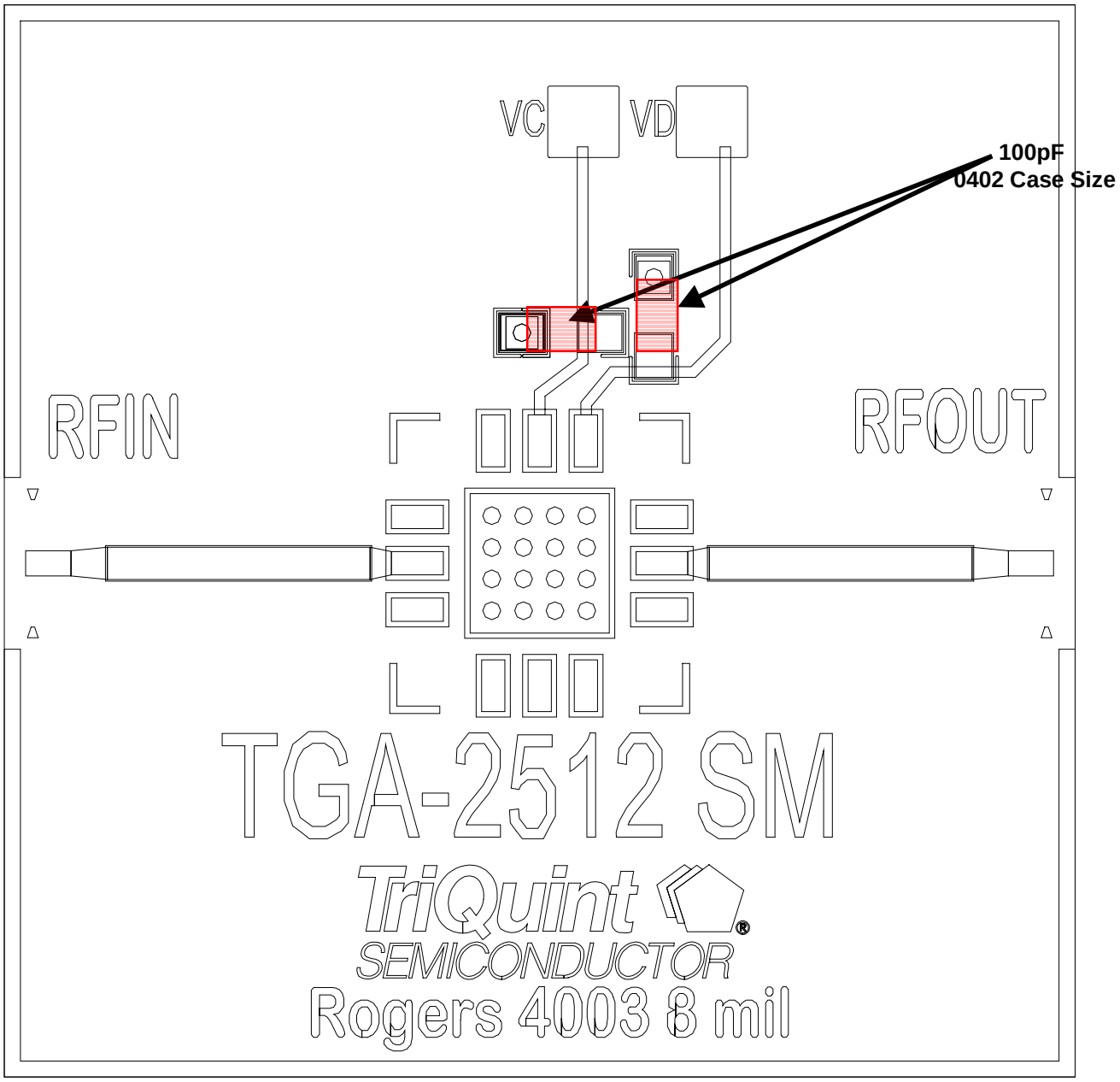
# Recommended Board Layout Assembly

## Self Bias



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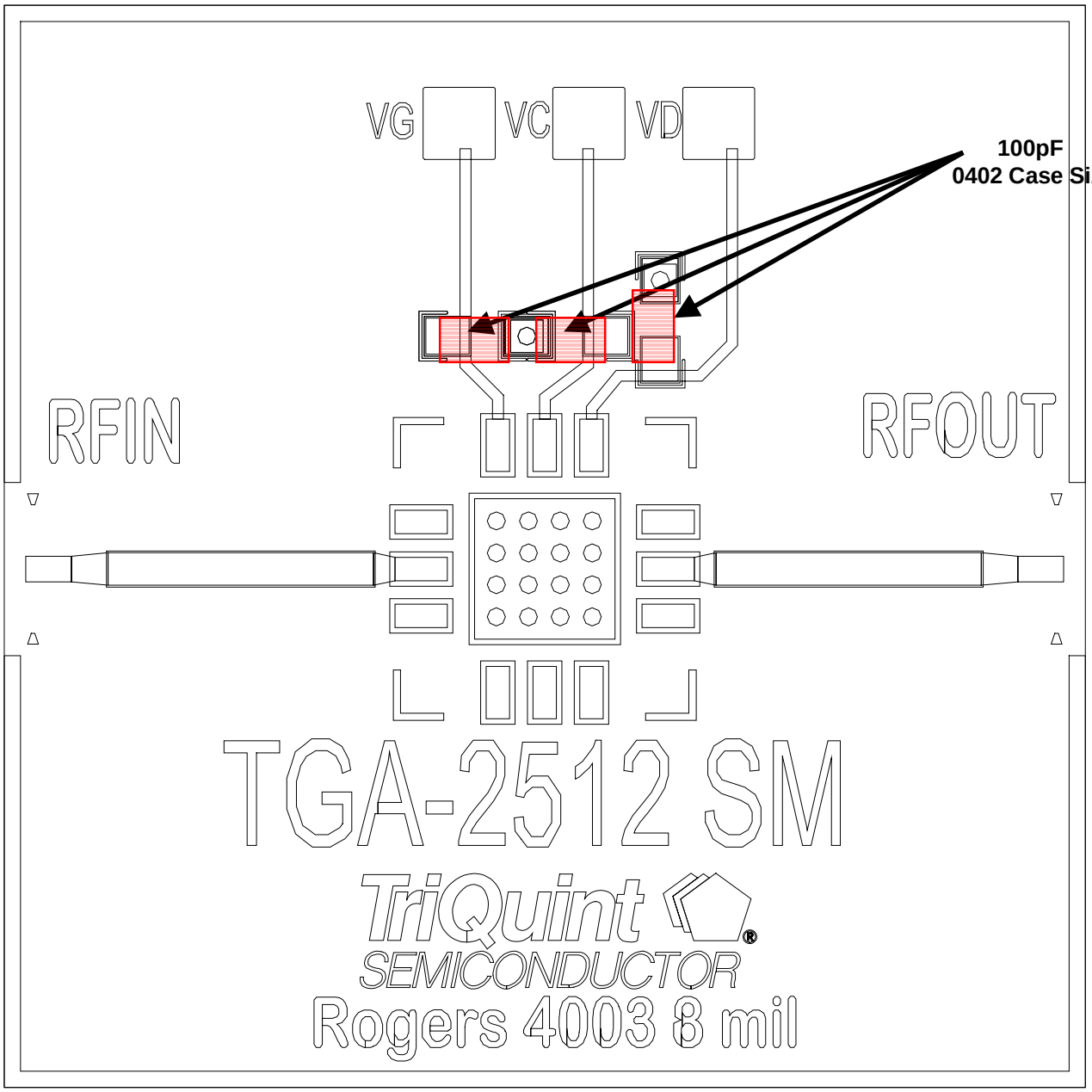
## Gate Bias



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## Ordering Information

| Part | Package Style |
|---|---|
| TGA2512-SM-1 | QFN 4x4 Surface Mount – Self Bias |
| TGA2512-SM-2 | QFN 4x4 Surface Mount – Gate Bias |