



## Product Description

GRF4002 is a broadband low noise gain block designed for small cell, wireless infrastructure and other high performance applications. It exhibits outstanding broadband NF, linearity and return losses over 700 to 3800 MHz with a single match.

Configured as a first stage LNA, linear driver or cascaded gain block, GRF4002 offers high levels of reuse both within a design and across platforms. The device is operated from a supply voltage ( $V_{DD}$ ) of 1.8 to 5.0 V with a selectable  $I_{DDQ}$  range of 20 to 80 mA for optimal efficiency and linearity.

GRF4002 is internally matched to  $50\Omega$  at the input and output ports, needing only external DC blocks and a bias choke on the output.

Consult with the GRF applications engineering team for custom tuning/evaluation board data. Packaged device s-parameters are available on the website landing page.

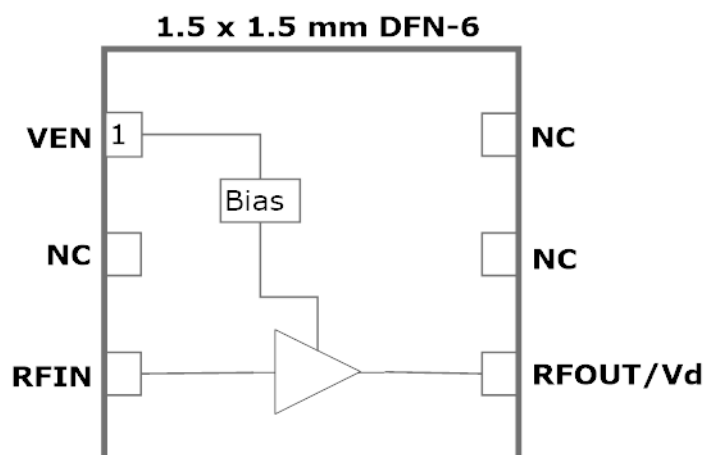
## Features

Reference: 5V/70mA/2.5 GHz

- EVB NF: 0.85 dB
- Gain: 15.0 dB
- OP1dB: 23.5 dBm
- OIP3: 36.5 dBm
- Flexible Bias Voltage and Current
- Internally Matched to  $50\Omega$
- Process: GaAs pHEMT

## Applications

- Linear Driver Amplifier
- Small Cells and Cellular Repeaters
- Distributed Antenna Systems
- Microwave Backhaul



## Absolute Ratings:

| Parameter   | Symbol                | Min. | Max. | Unit |
|---|-----------------------|------|------|------|
| Supply Voltage  | V <sub>DD</sub>       | 0    | 6.0  | V    |
| RF Input Power: (Load VSWR < 2:1; V <sub>D</sub> : 5.0 volts) | P <sub>IN MAX</sub>   |      | 22   | dBm  |
| Operating Temperature (Package Heat Sink)                     | T <sub>AMB</sub>      | -40  | 105  | °C   |
| Maximum Channel Temperature (MTTF > 10 <sup>6</sup> Hours)    | T <sub>MAX</sub>      |      | 170  | °C   |
| Maximum Dissipated Power                                      | P <sub>DISS MAX</sub> |      | 500  | mW   |
| <b>Electrostatic Discharge:</b>                               |                       |      |      |      |
| Charged Device Model:   | CDM                   | 1500 |      | V    |
| Human Body Model:   | HBM                   | 250  |      | V    |
| <b>Storage:</b>   |                       |      |      |      |
| Storage Temperature   | T <sub>STG</sub>      | -65  | 150  | °C   |
| Moisture Sensitivity Level                                    | MSL                   |      | 1    | --   |



**Caution!** ESD Sensitive Device



Exceeding Absolute Maximum Rating conditions may cause permanent damage to the device.

**Note:** For package dimensions and manufacturing information, see the [Guerrilla-RF.com](http://Guerrilla-RF.com) website for the following document located on the GRF4002 landing page: **Manufacturing Note—MN-001 Product Tape and Reel, Solderability and Package Outline Specification.**

[Link to manufacturing note](#)

### Pin Out (Top View)



### Pin Assignments:

| Pin         | Name                | Description          | Note  |
|-------------|---------------------|----------------------|---|
| 1           | V <sub>ENABLE</sub> | Enable Voltage Input | V <sub>ENABLE</sub> and series resistor set I <sub>DDQ</sub> . V <sub>ENABLE</sub> < =0.2 volts disables device. On -die pull-down resistor will turn the part off if this node is allowed to float.                      |
| 2           | NC                  | No Connect or Ground | No internal connection to die   |
| 3           | RF_In               | LNA RF input         | Internally matched 50Ω. An external DC blocking cap must be used.   |
| 4           | RF_Out              | LNA RF output        | Internally matched 50Ω. V <sub>DD</sub> must be applied through a choke to this pin   |
| 5           | NC                  | No Connect or Ground | No internal connection to die   |
| 6           | NC                  | No Connect or Ground | No internal connection to die   |
| PKG<br>BASE | GND                 | Ground               | Provides DC and RF ground for LNA, as well as thermal heat sink. Recommend multiple 8 mil vias beneath the package for optimal RF and thermal performance. Refer to evaluation board top layer graphic on schematic page. |



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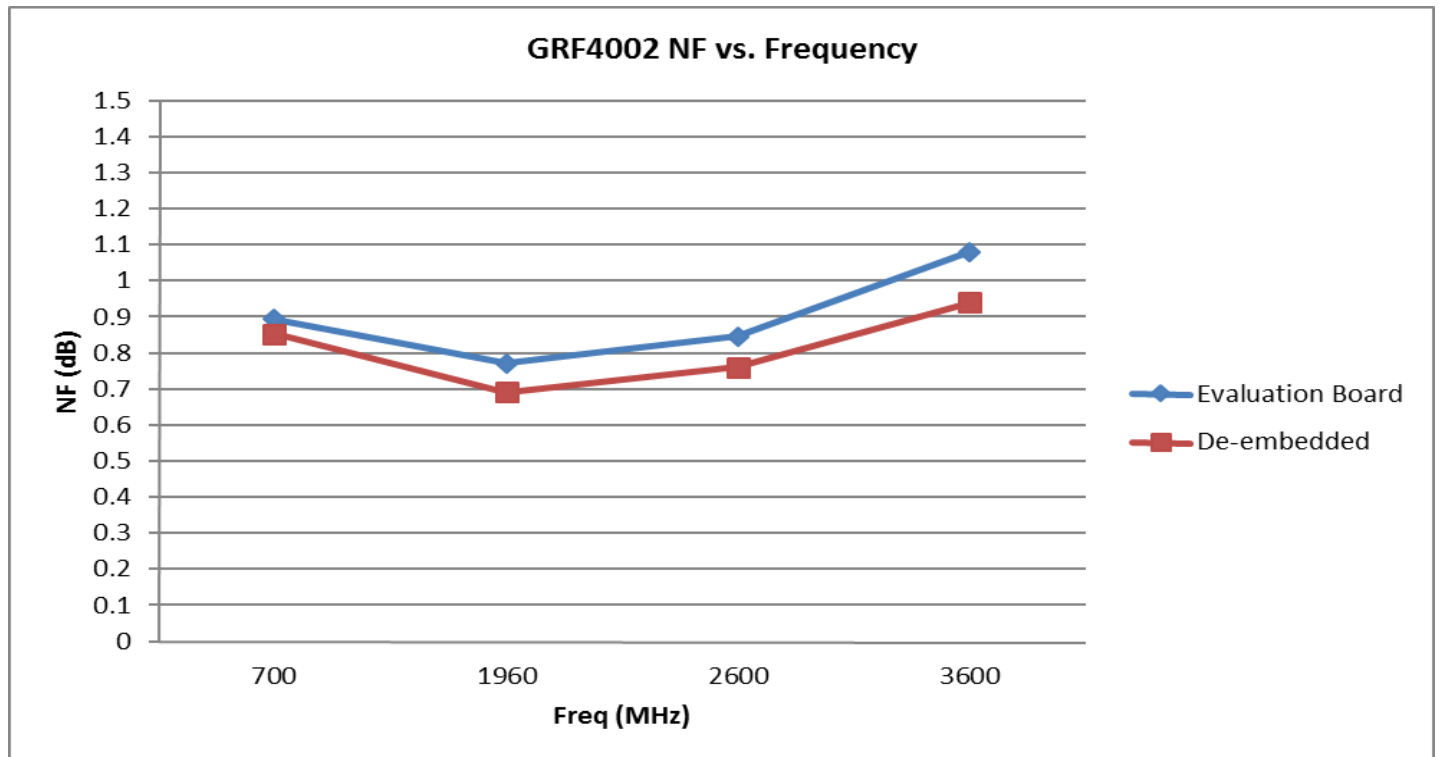
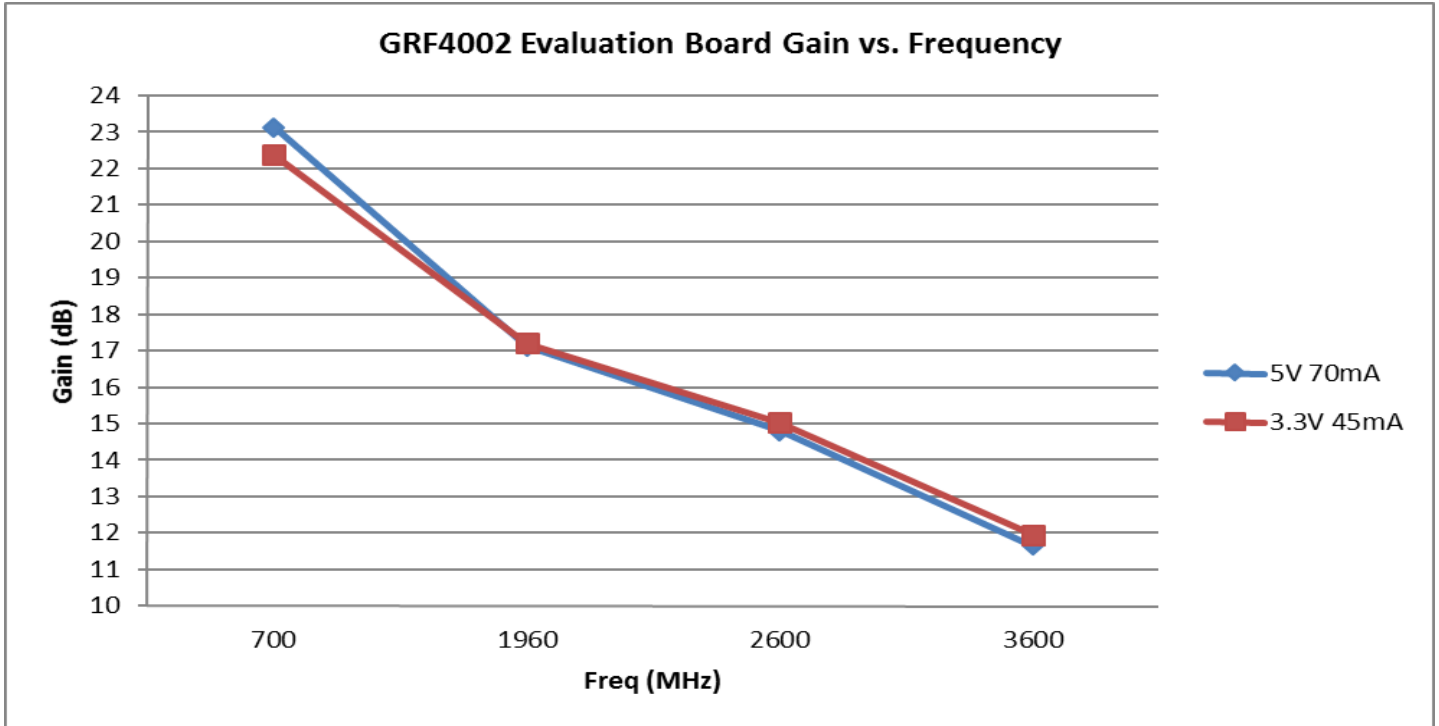
# GRF4002

Broadband LNA/Linear Driver  
0.1–3.8 GHz

## Nominal Operating Parameters:

| Parameter   | Symbol               | Specification |      |      | Unit | Condition  |
|---|----------------------|---------------|------|------|------|--|
|   |                      | Min.          | Typ. | Max. |      |  |
| Test Frequency  | F <sub>TEST</sub>    |               | 2500 |      | MHz  | V <sub>DD</sub> = 5.0 V, T <sub>A</sub> = 25 °C                                      |
| Gain  | S <sub>21</sub>      | 14.0          | 15.0 |      | dB   |  |
| Evaluation Board Noise Figure                             | NF                   |               | 0.85 | 1.0  | dB   |  |
| Output 3rd Order Intercept                                | OIP <sub>3</sub>     |               | 36.5 |      | dBm  | 2.0 dBm P <sub>OUT</sub> per tone at 2 MHz Spacing (2499 and 2501 MHz)               |
| Output 1dB Compression Point                              | OP <sub>1dB</sub>    | 22.0          | 23.5 |      | dBm  |  |
| Switching Rise Time                                       | T <sub>RISE</sub>    |               | 500  |      | ns   |  |
| Switching Fall Time                                       | T <sub>FALL</sub>    |               | 500  |      | ns   |  |
| Supply Current  | I <sub>DD</sub>      |               | 70.0 |      | mA   | V <sub>DD</sub> =V <sub>ENABLE</sub> = 5.0V; M5: 1500 ohms                           |
| Enable Current  | I <sub>ENABLE</sub>  |               | 3.0  | 6.0  | mA   |  |
| <b>Disabled Mode</b>                                      |                      |               |      |      |      |  |
| Leakage Current   | I <sub>LEAKAGE</sub> |               | 40   | 100  | uA   | V <sub>DD</sub> : 5.0V; V <sub>ENABLE</sub> : 0.0V                                   |
| <b>Thermal Data</b>                                       |                      |               |      |      |      |  |
| Thermal Resistance: (Infra-Red Scan)                      | Θ <sub>jc</sub>      |               | 131  |      | °C/W | On standard Evaluation Board   |
| Channel Temperature @ +85 C Reference (Package heat sink) | T <sub>CHANNEL</sub> |               | 131  |      | °C   | V <sub>DD</sub> : 5.0 V; I <sub>DDQ</sub> : 70 mA; No RF; P <sub>DISS</sub> : 350 mW |

GRF4002 Evaluation Board Measured Data:



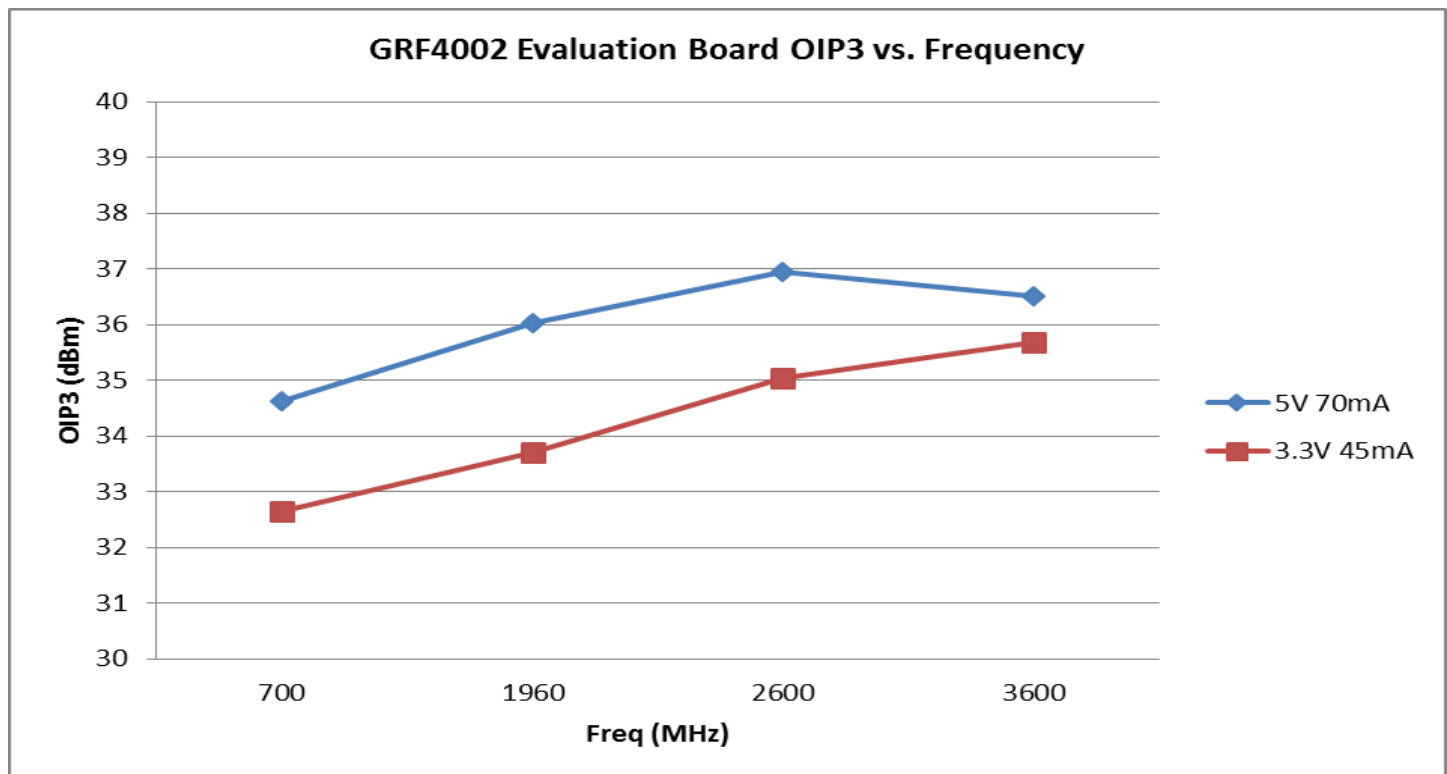
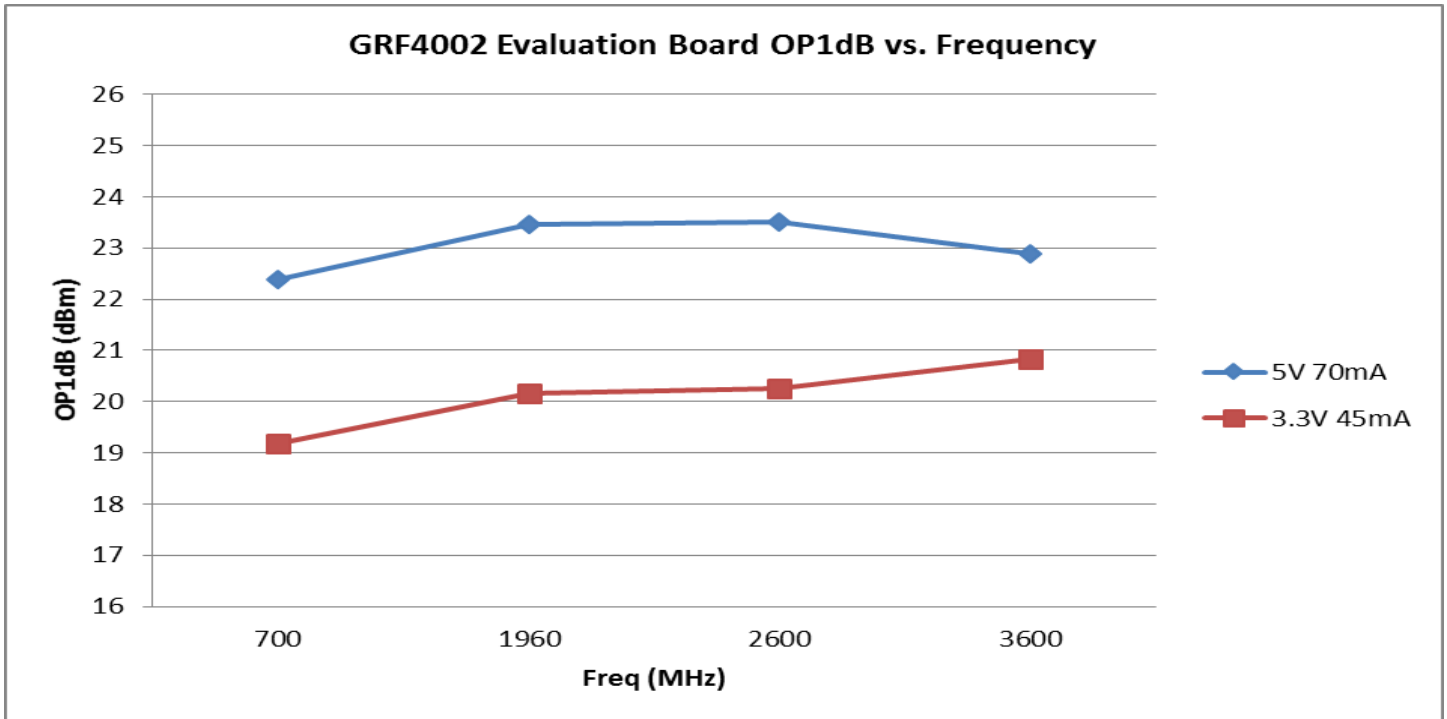


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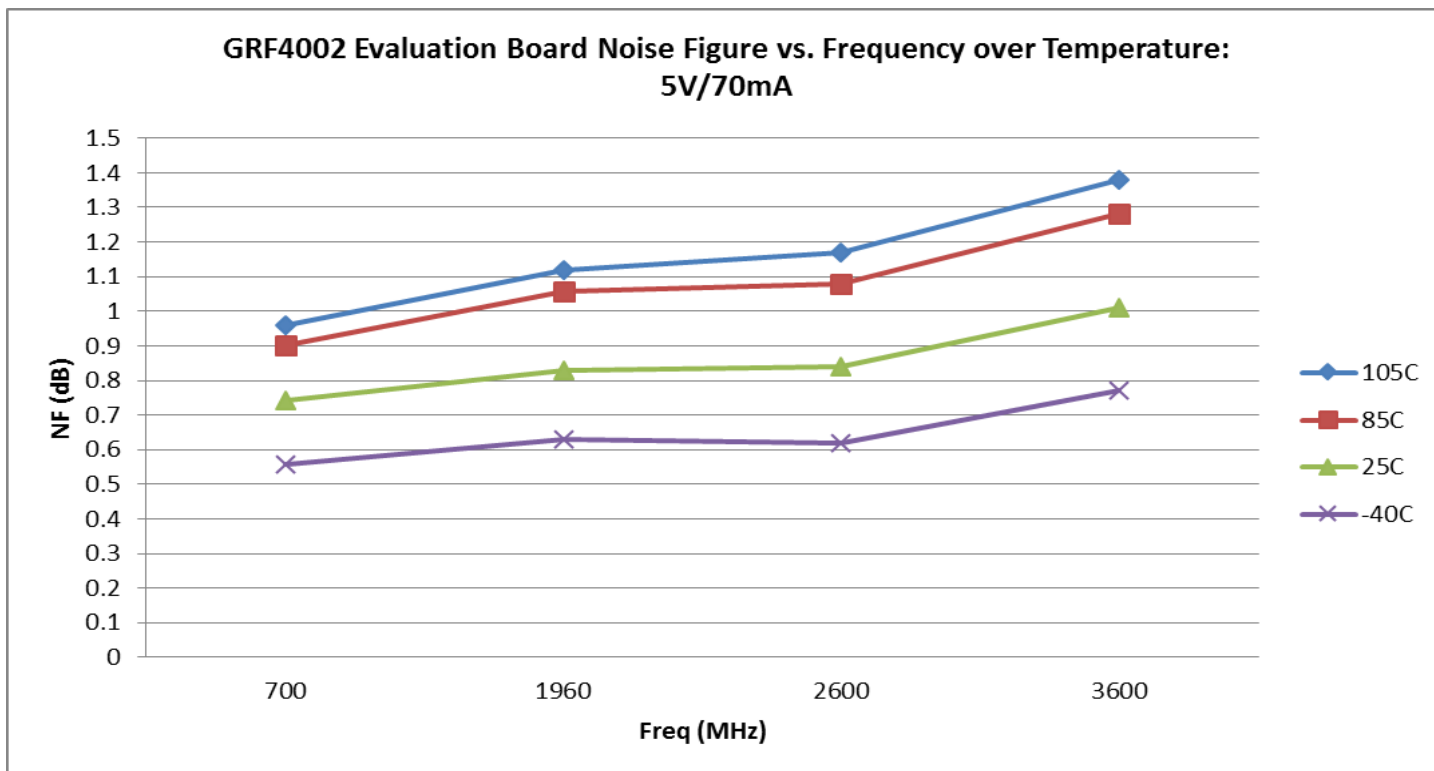
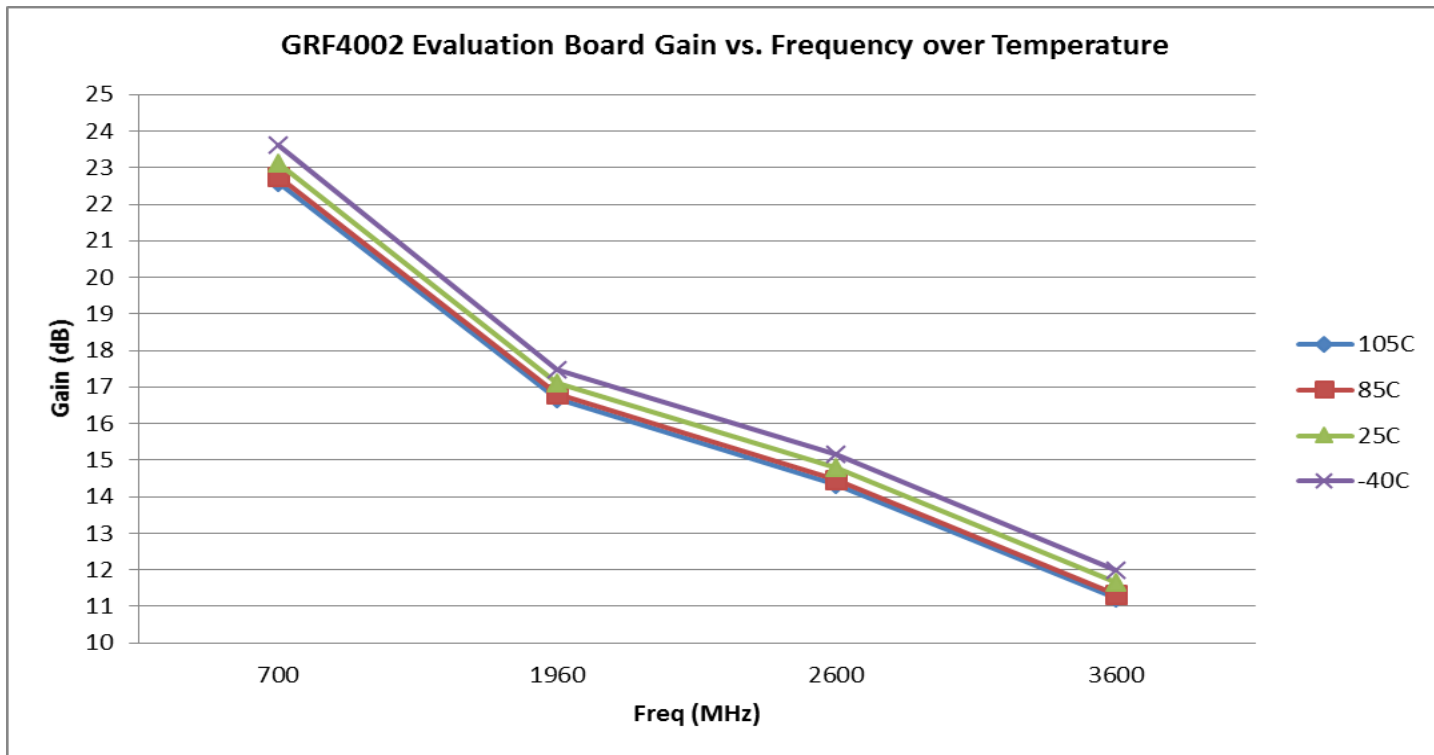
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Broadband LNA/Linear Driver  
0.1–3.8 GHz

## GRF4002 Evaluation Board Measured Data:



## GRF4002 Evaluation Board Performance over Temperature: (5V/70mA)



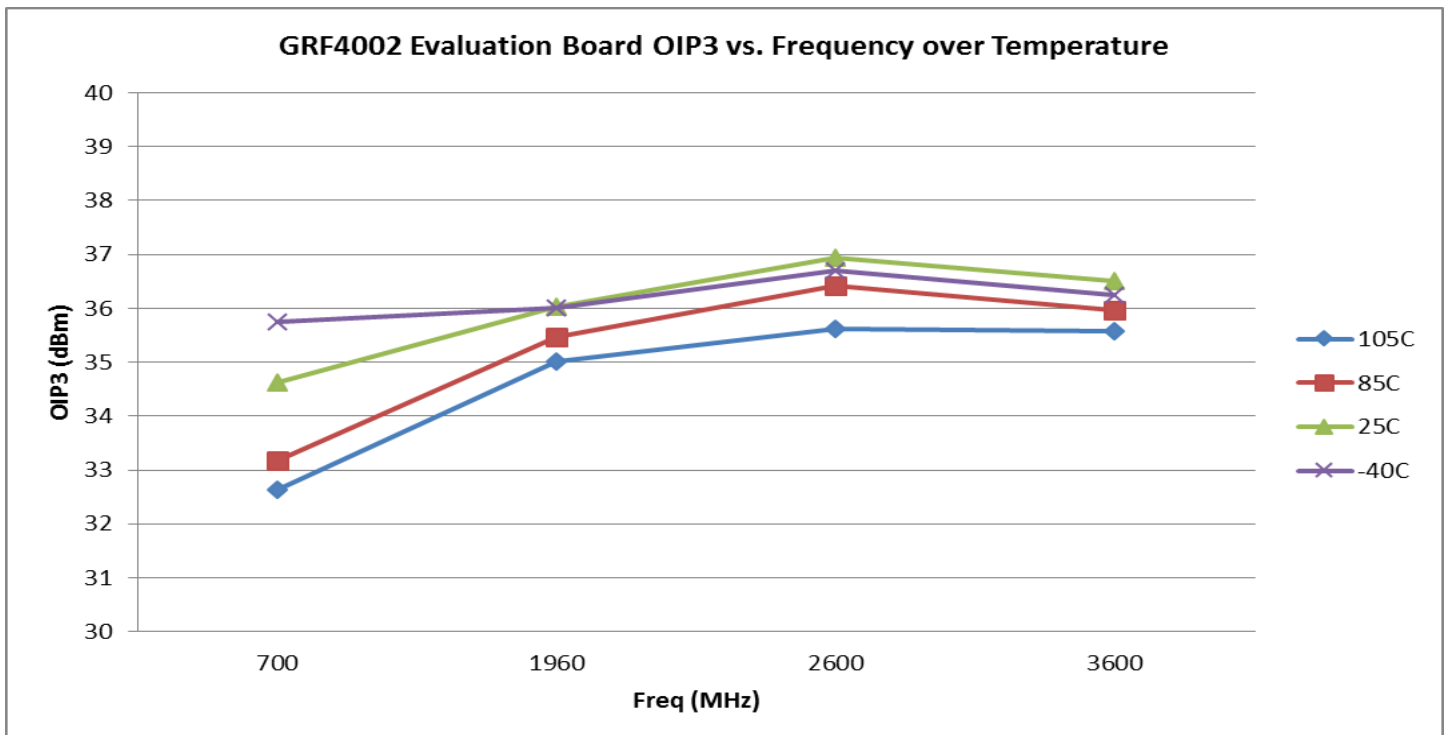
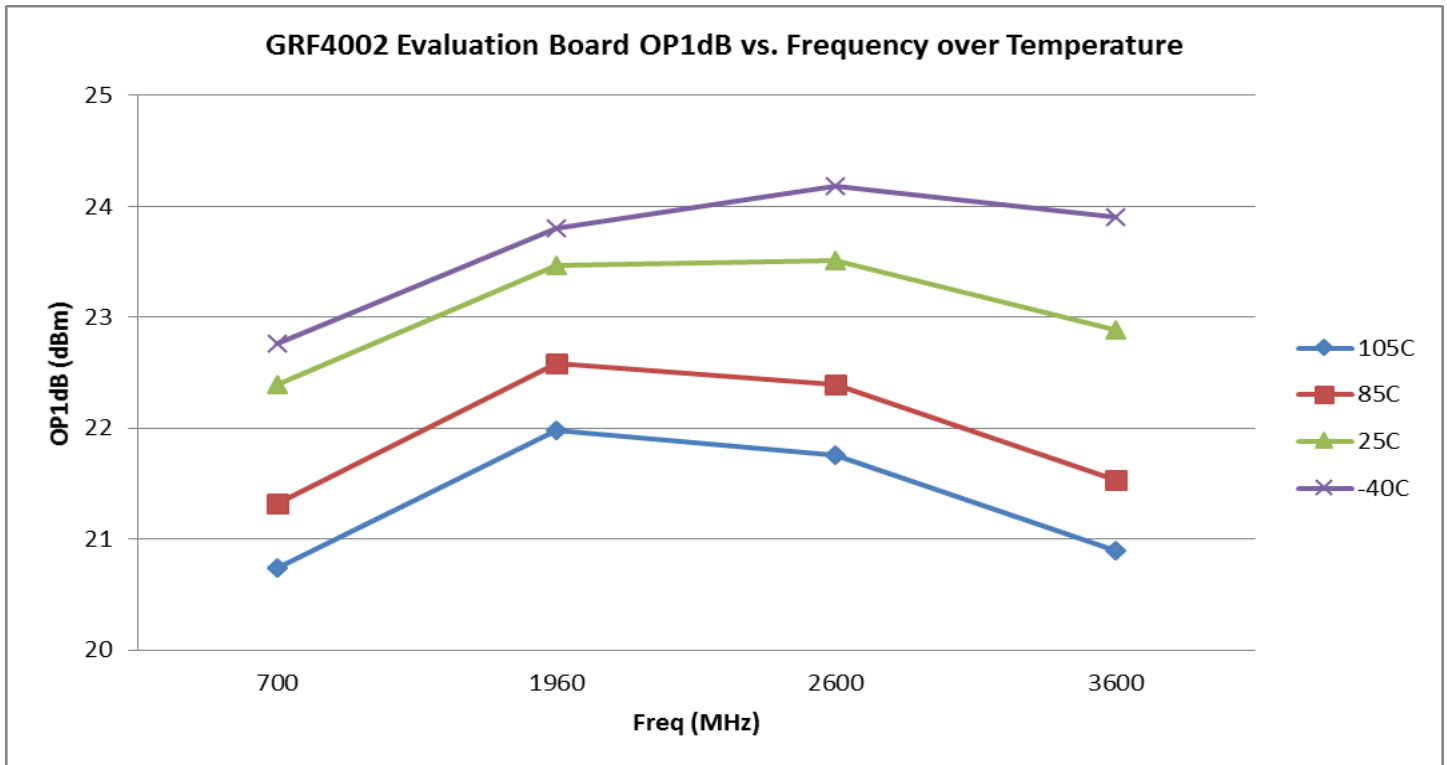


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## GRF4002 Evaluation Board Performance over Temperature: (5V/70mA)





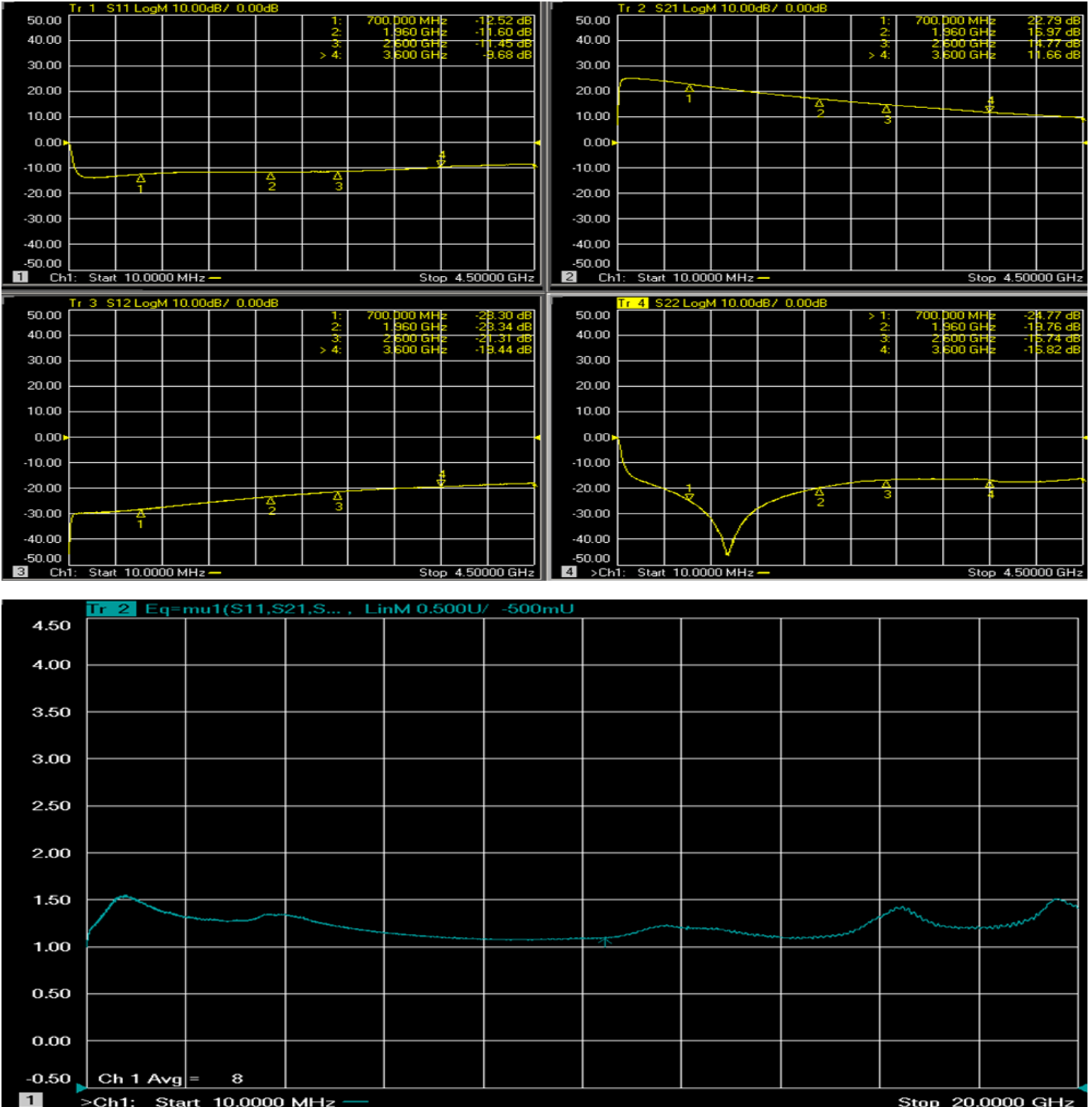


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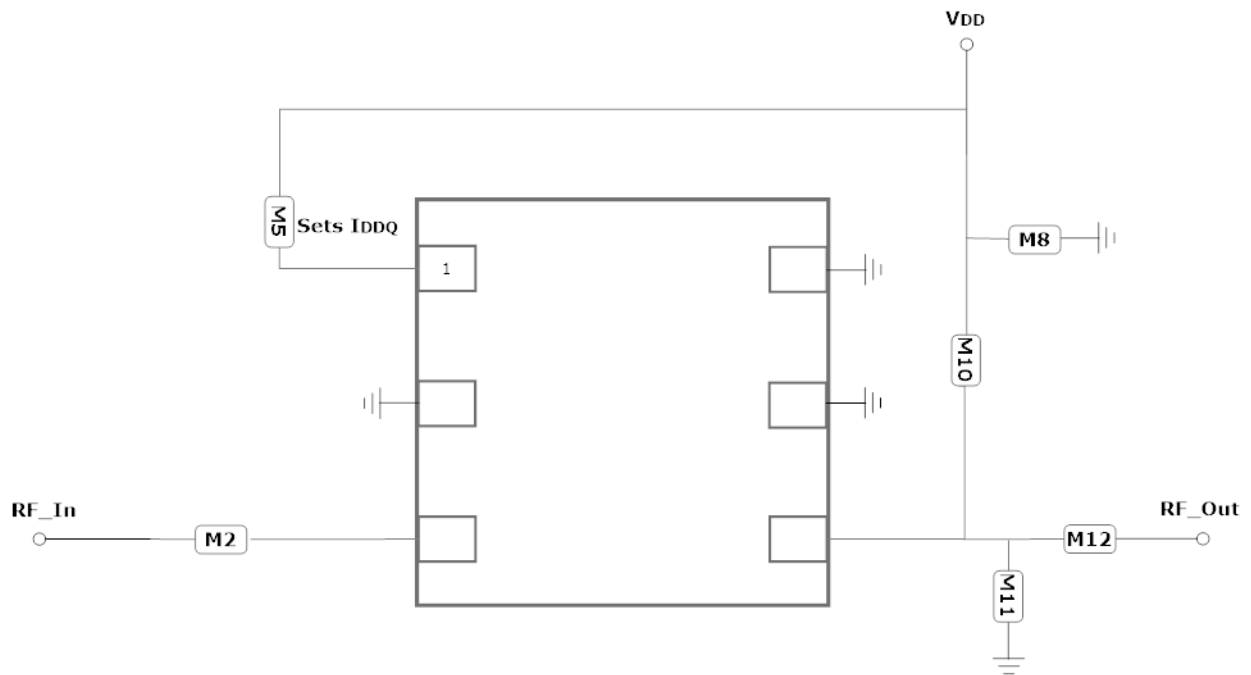
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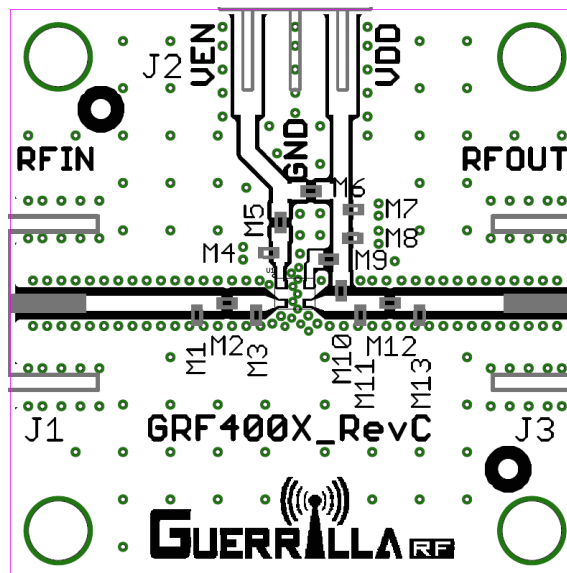
## GRF4002 Evaluation Board S-Pars and Stability Mu Factor: (0.7 – 3.8 GHz Match)



Note: Mu factor  $\geq 1.0$  implies unconditional stability.



GRF4002 Application Schematic



GRF400X Evaluation Board Assembly Diagram



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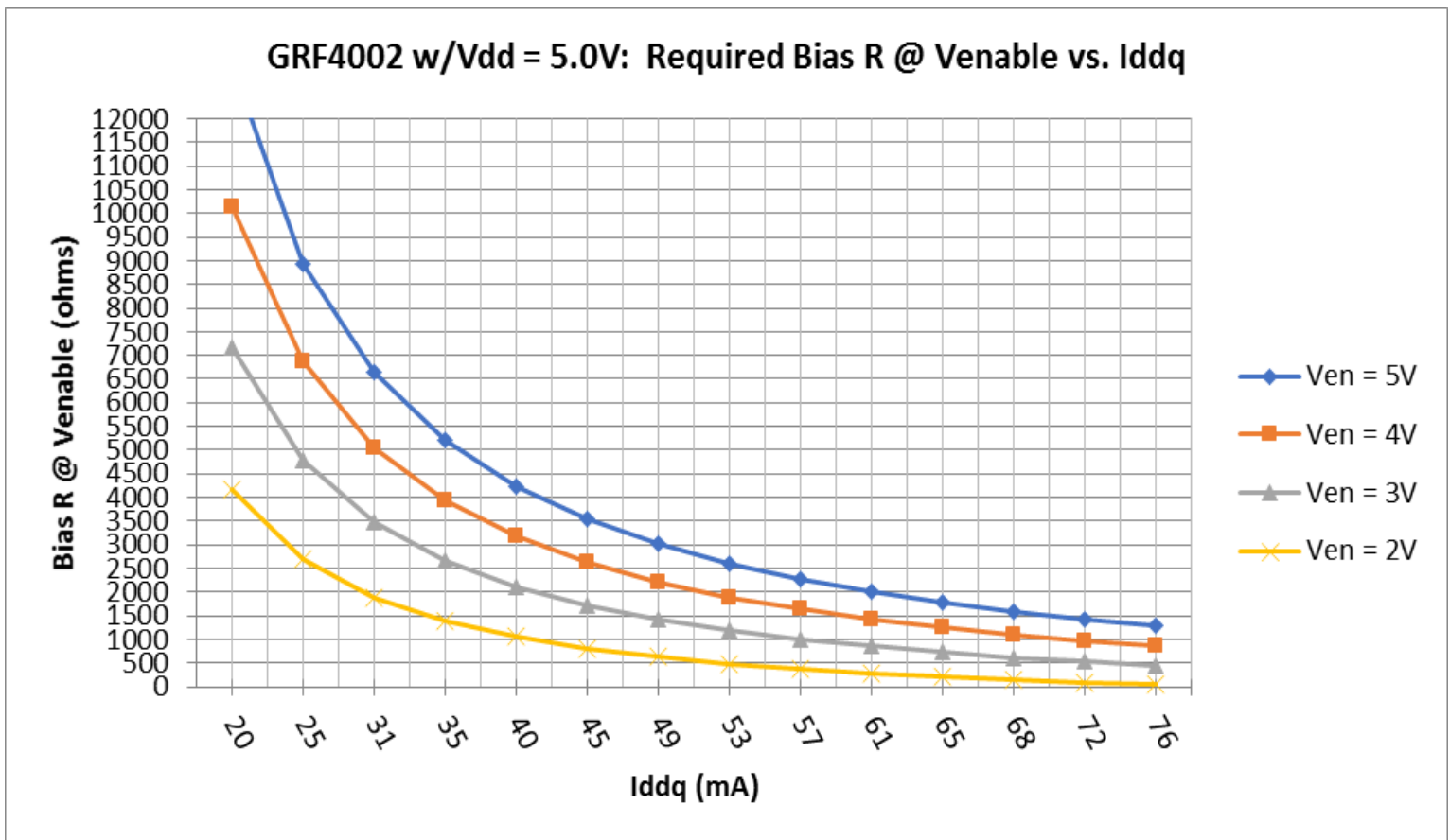
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Broadband LNA/Linear Driver  
0.1–3.8 GHz

## GRF4002 Standard Evaluation Board BOM: (0.1 to 3.8 GHz Tune)

| Component       | Type      | Manufacturer | Family  | Value     | Package Size | Substitution |
|-----------------|-----------|--------------|---------|-----------|--------------|--------------|
| M2              | Capacitor | Murata       | GRM     | 100 pF    | 0402         | ok           |
| M5 (See curves) | Resistor  | Various      | 5%      | Sets Iddq | 0402         | ok           |
| M8              | Capacitor | Murata       | GRM     | 0.1 uF    | 0402         | ok           |
| M10             | Inductor  | Coilcraft    | HP      | 100 nH    | 0402         | ok           |
| M11             | Capacitor | Murata       | GRM/GJM | 0.5 pF    | 0402         | ok           |
| M12             | Capacitor | Murata       | GRM     | 100 pF    | 0402         | ok           |

## GRF4002 Bias Resistor Selection Chart





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# GRF4002

## Broadband LNA/Linear Driver

### 0.1–3.8 GHz

| Data Sheet Release Status: | Notes   |
|----------------------------|---|
| Advance                    | S-parameter and NF data based on EM simulations for the fully packaged device using foundry supplied transistor s-parameters. Linearity estimates based on device size, bias condition and experience with related devices. |
| Preliminary                | All data based on evaluation board measurements in the Guerrilla RF Applications Lab.   |
| Released                   | All data based on device qualification data. Typically, this data is nearly identical to the data found in the preliminary version. Max and min values for key RF parameters are included.                                  |

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