



## Product Description

GRF2052 is an ultra-low noise amplifier designed for wireless infrastructure and other high performance RF applications requiring the absolute lowest possible NF, high gain and outstanding linearity. Broadband external matches deliver outstanding RF performance over 1.5 to 4.5 GHz.

Configured as a first stage LNA, linear driver or cascaded gain block, the GRF2052 flexible biasing capability offers high levels of reuse both within a design and across platforms. For lower gain applications from 0.7 GHz up to 3.8 GHz, the pin compatible GRF2051 should be used.

Consult with the GRF applications engineering team for application notes, custom tuning/evaluation board data and device s-parameters.

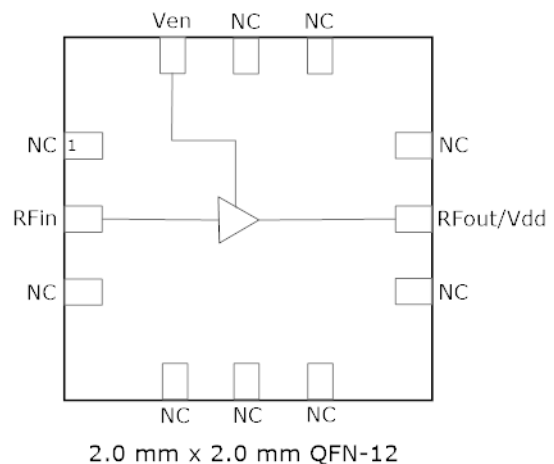
## Features

Reference: 5V/70mA /2.5 GHz

- Gain: 19.2 dB
- Eval Board NF: 0.50 dB
- OP1dB: 21.0 dBm
- OIP3: 38.0 dBm
  
- Flexible Bias Voltage and Current
- Process: GaAs pHEMT

## Applications

- Cellular Infrastructure
- Small Cells and Cellular Repeaters
- Distributed Antenna Systems





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# GRF2052

Ultra-Low Noise Amplifier  
Tuning Range: 1.7 – 4.5 GHz

## 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>   |      | 20   | 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

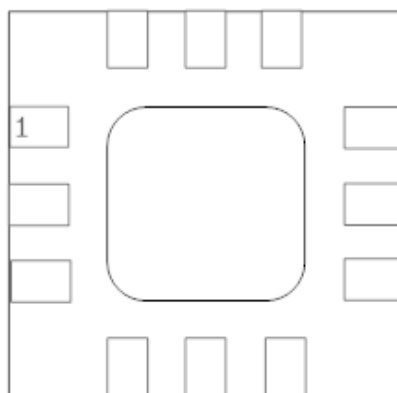


Exceeding Absolute Maximum Rating conditions may cause permanent damage to the device.

**Note:** For manufacturing information, see the [Guerrilla-RF.com](http://Guerrilla-RF.com) website for the following document located on the GRF2052 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               | NC                     | No Connect or Ground | No internal connection to die   |
| 2               | RF_In                  | RF Input             | External match must provide DC block  |
| 3               | NC                     | No Connect or Ground | No internal connection to die   |
| 4               | NC                     | No Connect or Ground | No internal connection to die   |
| 5               | NC                     | No Connect or Ground | No internal connection to die   |
| 6               | NC                     | No Connect or Ground | No internal connection to die   |
| 7               | NC                     | No Connect or Ground | No internal connection to die   |
| 8               | RF_Out/V <sub>DD</sub> | RF Output            | Provide device V <sub>DD</sub> via external bias inductor   |
| 9               | NC                     | No Connect or Ground | No internal connection to die   |
| 10              | NC                     | No Connect or Ground | No internal connection to die   |
| 11              | NC                     | No Connect or Ground | No internal connection to die   |
| 12              | 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.                      |
| <b>PKG BASE</b> | <b>GND</b>             | 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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## Nominal Operating Parameters:

| Parameter   | Symbol               | Specification |                   |      | Unit | Condition  |
|---|----------------------|---------------|-------------------|------|------|--|
|   |                      | Min.          | Typ.              | Max. |      |  |
| <b>Gain Mode (Venable high)</b>                           |                      |               |                   |      |      | V <sub>DD</sub> = 5.0 V, T <sub>A</sub> = 25 °C                                      |
| Test Frequency  | F <sub>TEST</sub>    |               | 2500              |      | MHz  |  |
| Evaluation Board Gain                                     | S <sub>21</sub>      | 18.0          | 19.0              |      | dB   |  |
| Evaluation Board Noise Figure                             | NF                   |               | 0.50              | 0.70 | dB   | Evaluation Board SMA to SMA  |
| Output 3rd Order Intercept Point                          | OIP <sub>3</sub>     |               | 38.2              |      | dBm  | 3 dBm P <sub>OUT</sub> per tone at 2 MHz Spacing (2499 and 2501 MHz)                 |
| Output 1dB Compression Point                              | OP <sub>1dB</sub>    | 19.5          | 21.0              |      | dBm  |  |
| Switching Rise Time                                       | T <sub>RISE</sub>    |               | 400               |      | ns   |  |
| Switching Fall Time                                       | T <sub>FALL</sub>    |               | 400               |      | ns   |  |
| Supply Current  | I <sub>DD</sub>      |               | 70                |      | mA   |  |
| Enable Current  | I <sub>ENABLE</sub>  |               | 4                 | 8    | mA   |  |
| <b>Disabled Mode</b>                                      |                      |               |                   |      |      |  |
|   | I <sub>LEAKAGE</sub> |               | 10                | 150  | uA   |  |
| <b>Thermal Data</b>                                       |                      |               |                   |      |      |  |
| Thermal Resistance (measured via IR scan)                 | Θ <sub>jc</sub>      |               | 60                |      | °C/W | On standard evaluation board   |
| Channel Temperature @ +85 C Reference (Package Heat Sink) | T <sub>CHANNEL</sub> |               | 106<br>(See note) |      | °C   | V <sub>DD</sub> : 5.0 V; I <sub>DDQ</sub> : 70 mA; No RF; P <sub>DISS</sub> : 350 mW |

Note: MTTF >10<sup>6</sup> hours for T<sub>CHANNEL</sub> < =170 degrees C.

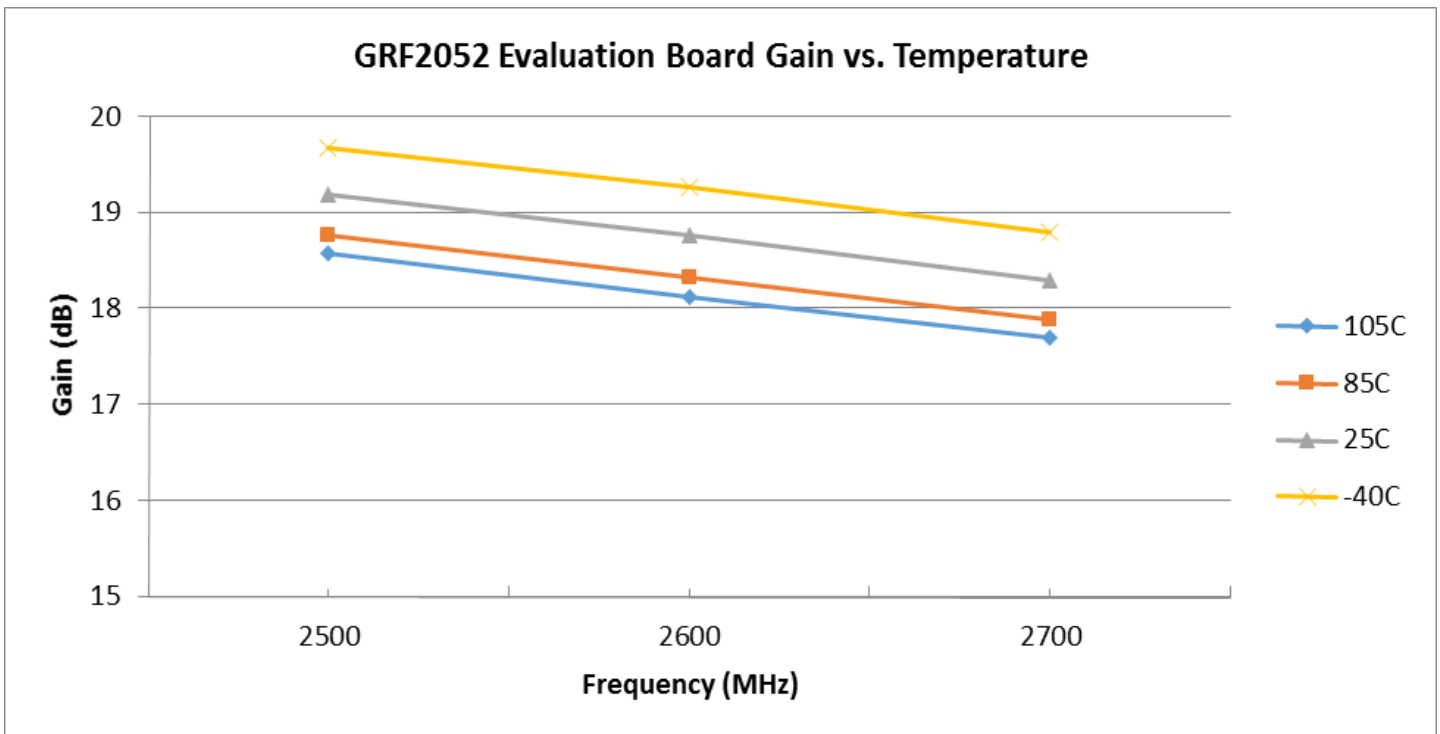
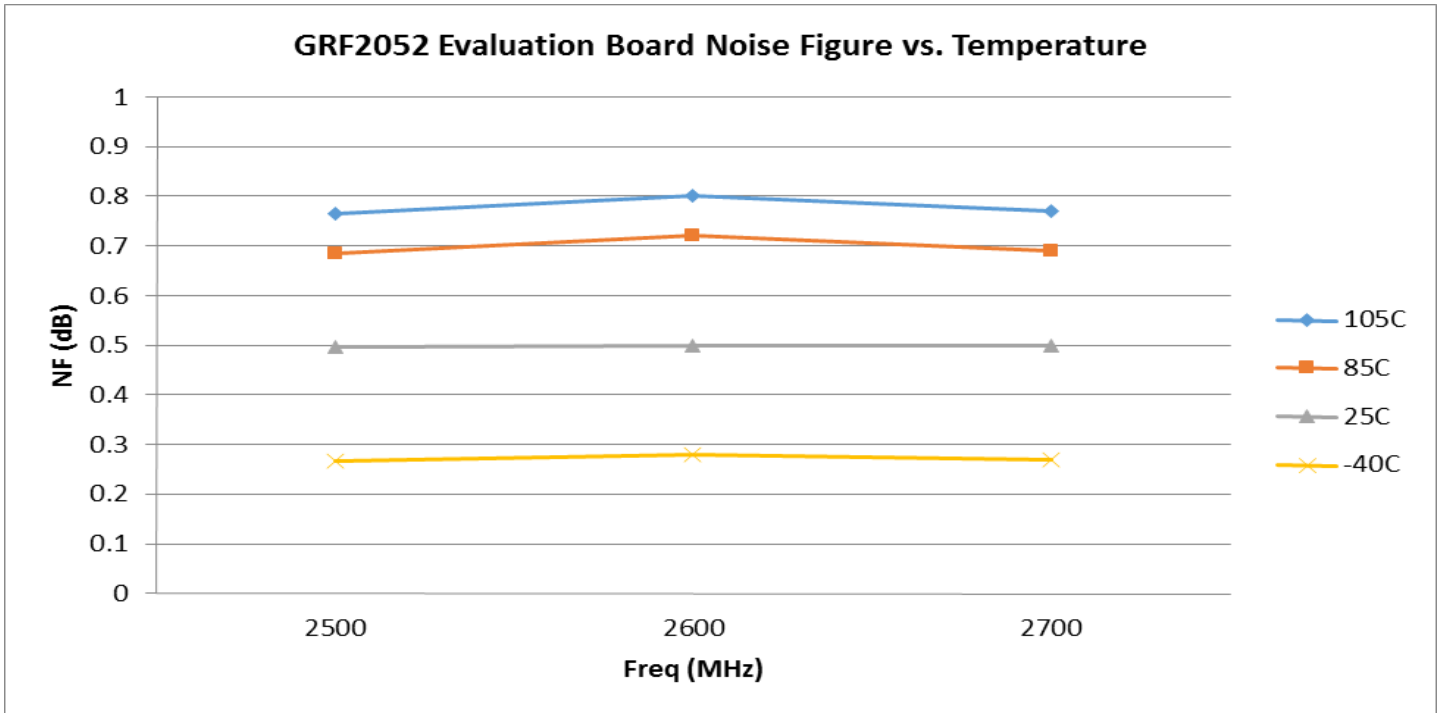


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# GRF2052

Ultra-Low Noise Amplifier  
Tuning Range: 1.7 – 4.5 GHz

## GRF2052 Evaluation Board Measured Data over Temperature: (2.5 to 2.7 GHz Tune)



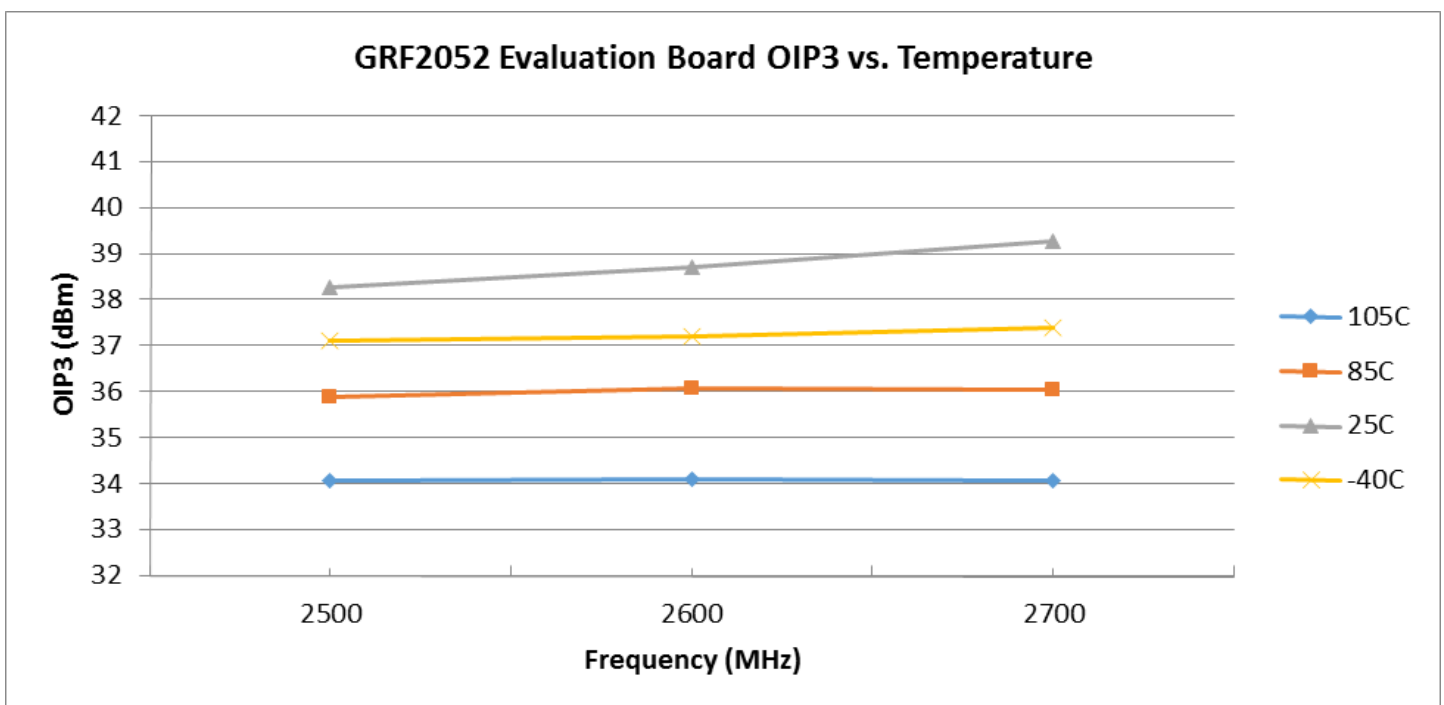
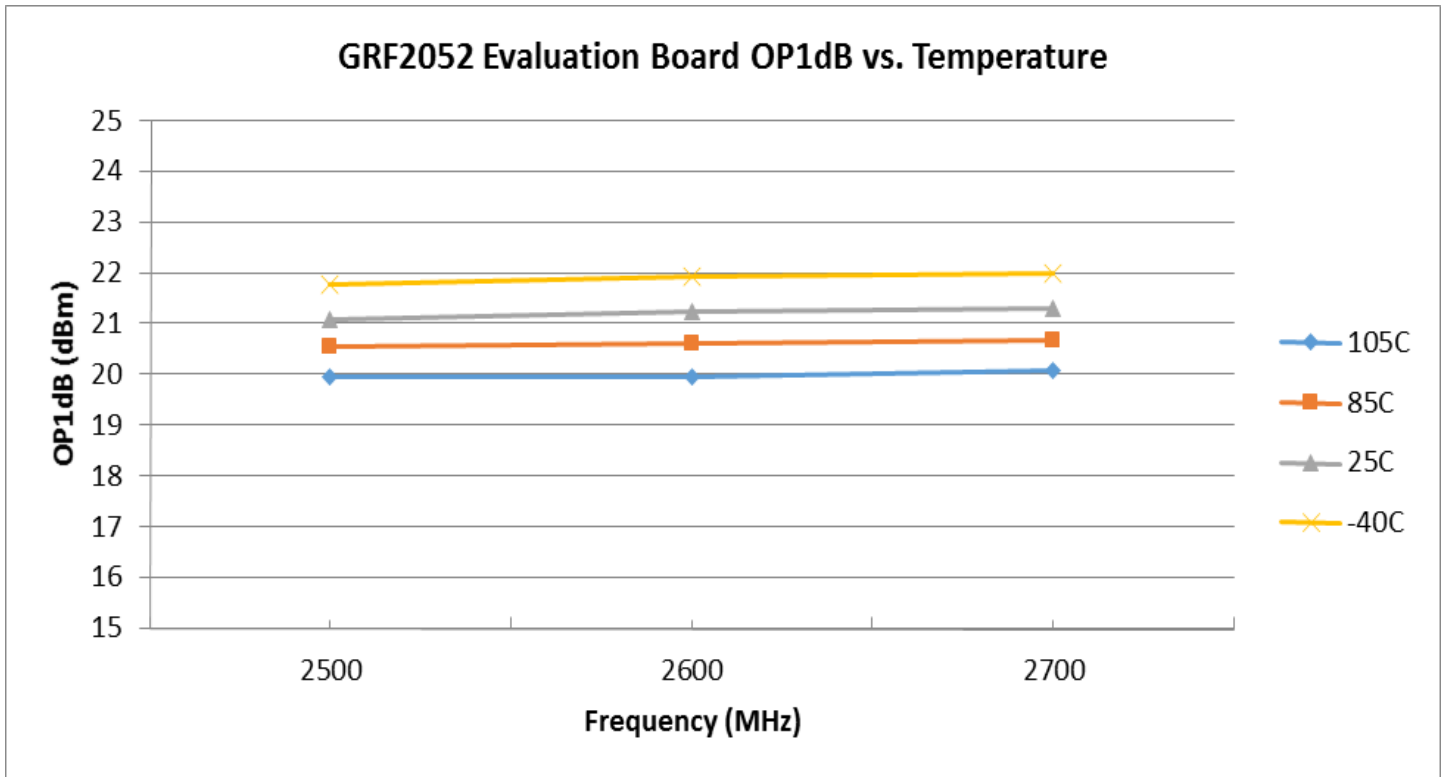


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Ultra-Low Noise Amplifier  
Tuning Range: 1.7 – 4.5 GHz

## GRF2052 Evaluation Board Measured Data over Temperature: (2.5 to 2.7 GHz Tune)



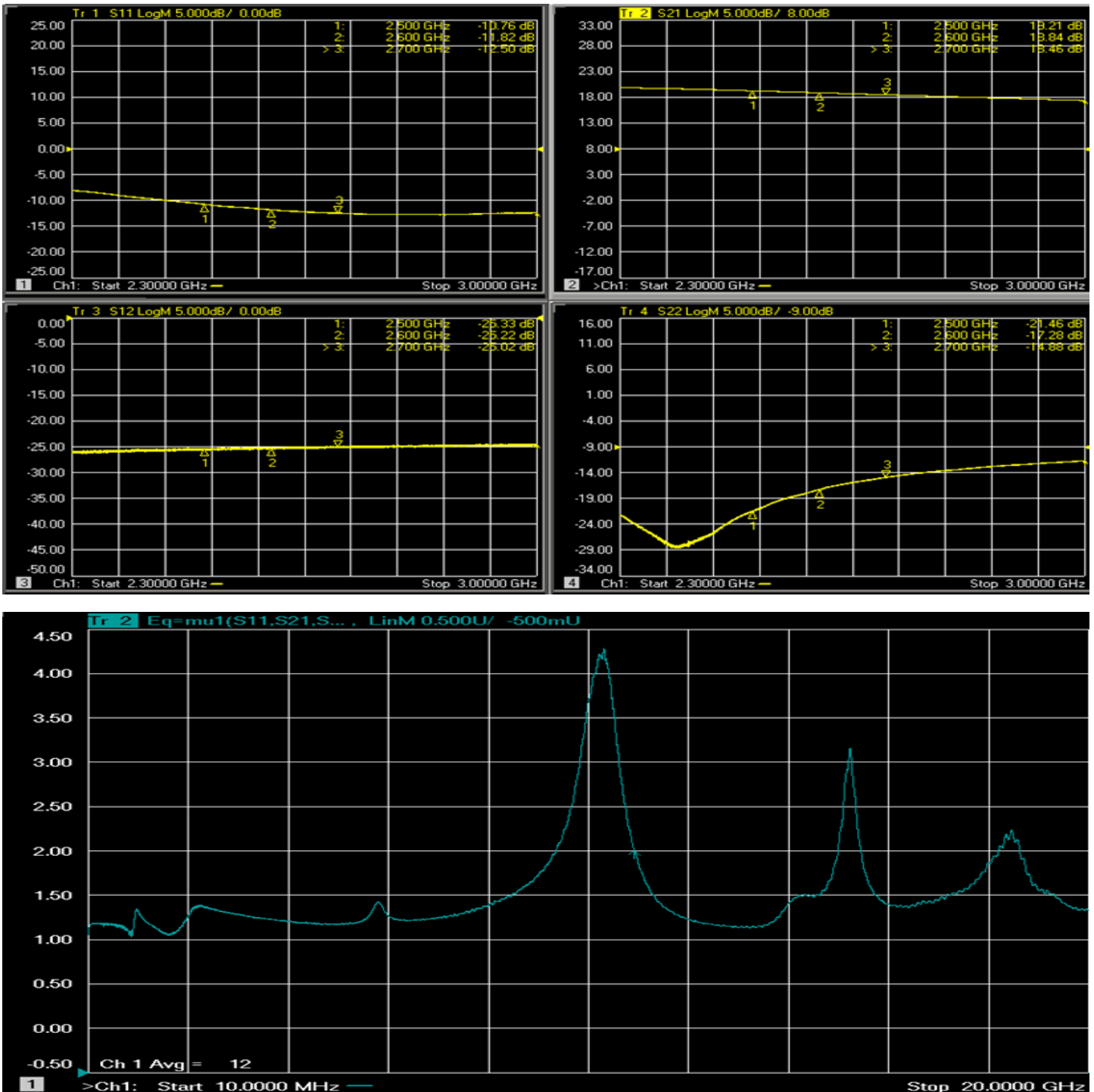


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# GRF2052

Ultra-Low Noise Amplifier  
Tuning Range: 1.7 – 4.5 GHz

## GRF2052 Evaluation Board S-Pars and Stability Mu Factor: (2.5 to 2.7 GHz Tune)



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

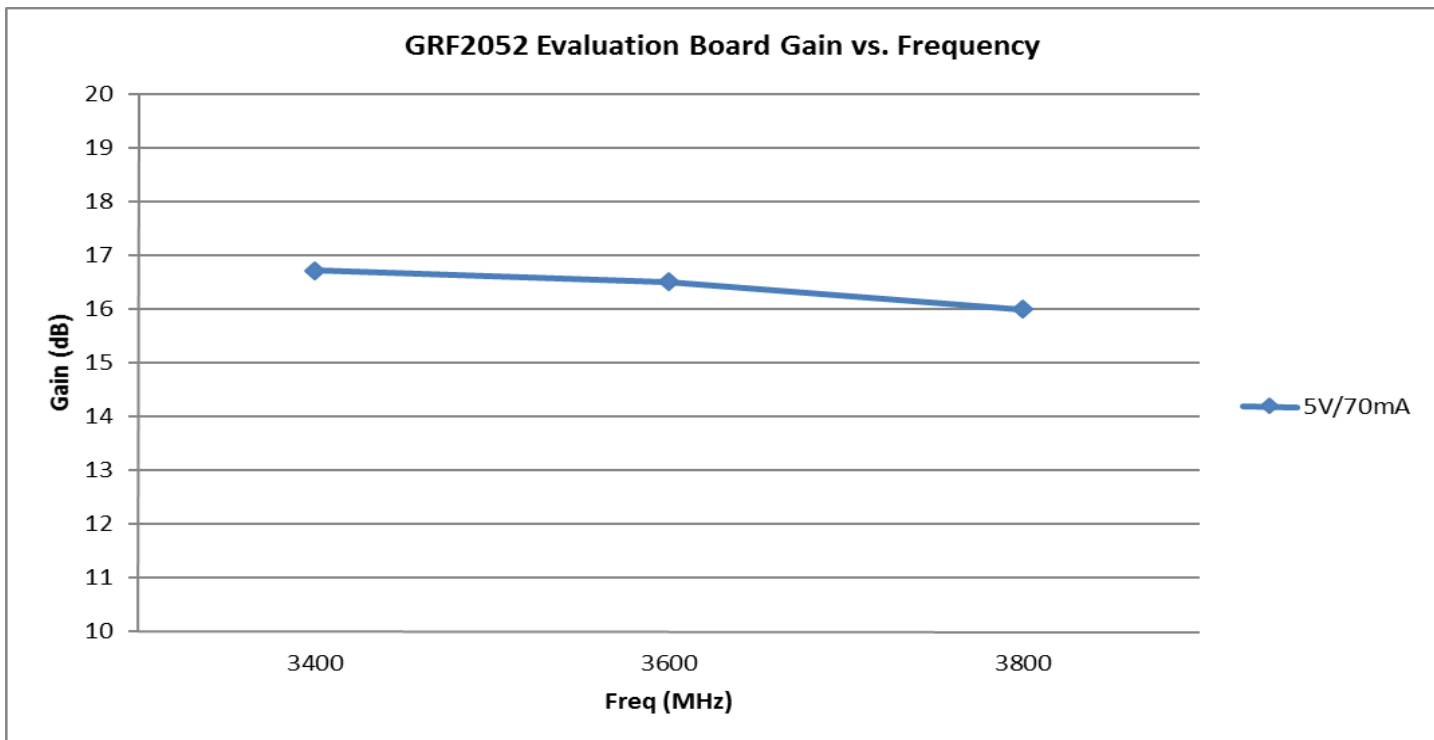
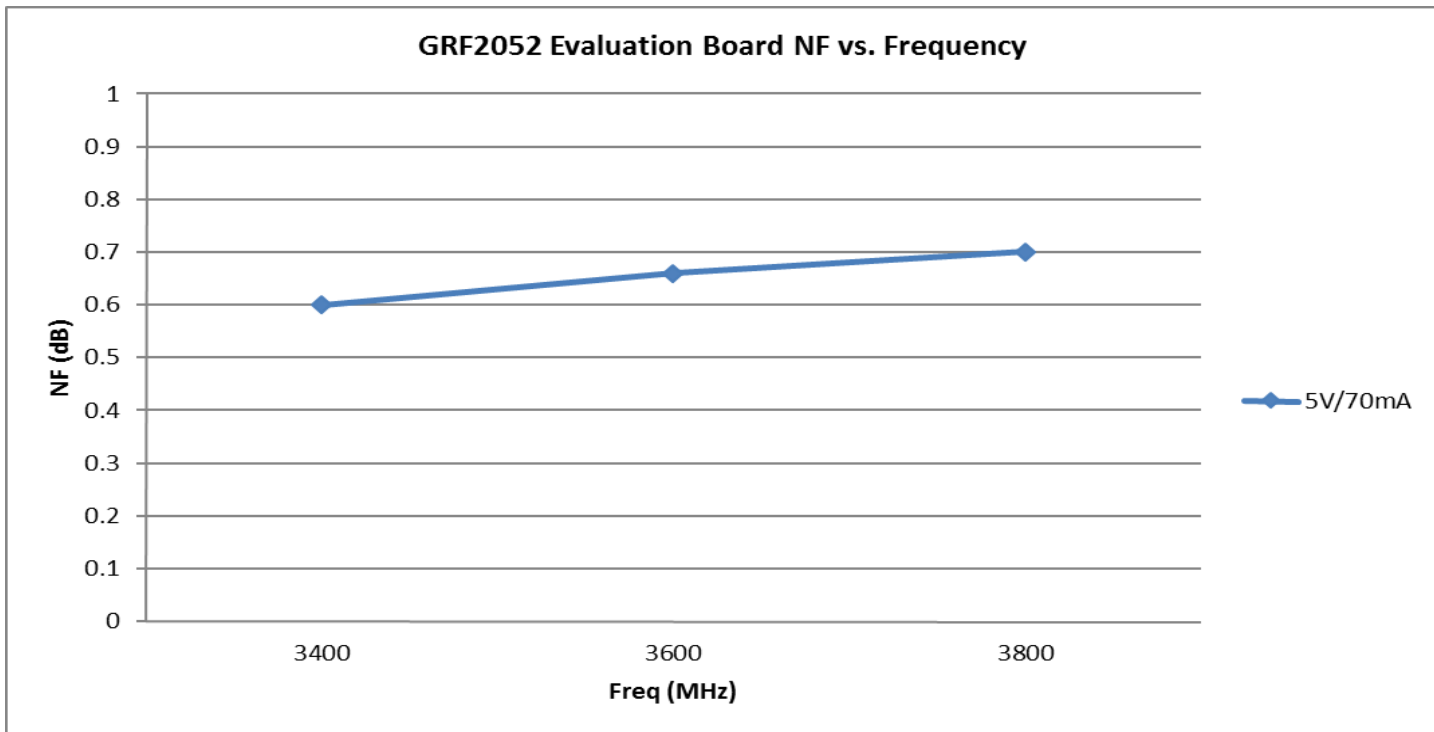


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# GRF2052

Ultra-Low Noise Amplifier  
Tuning Range: 1.7 – 4.5 GHz

## GRF2052 Evaluation Board Measured Data: (3.4 to 3.8 GHz Tune)





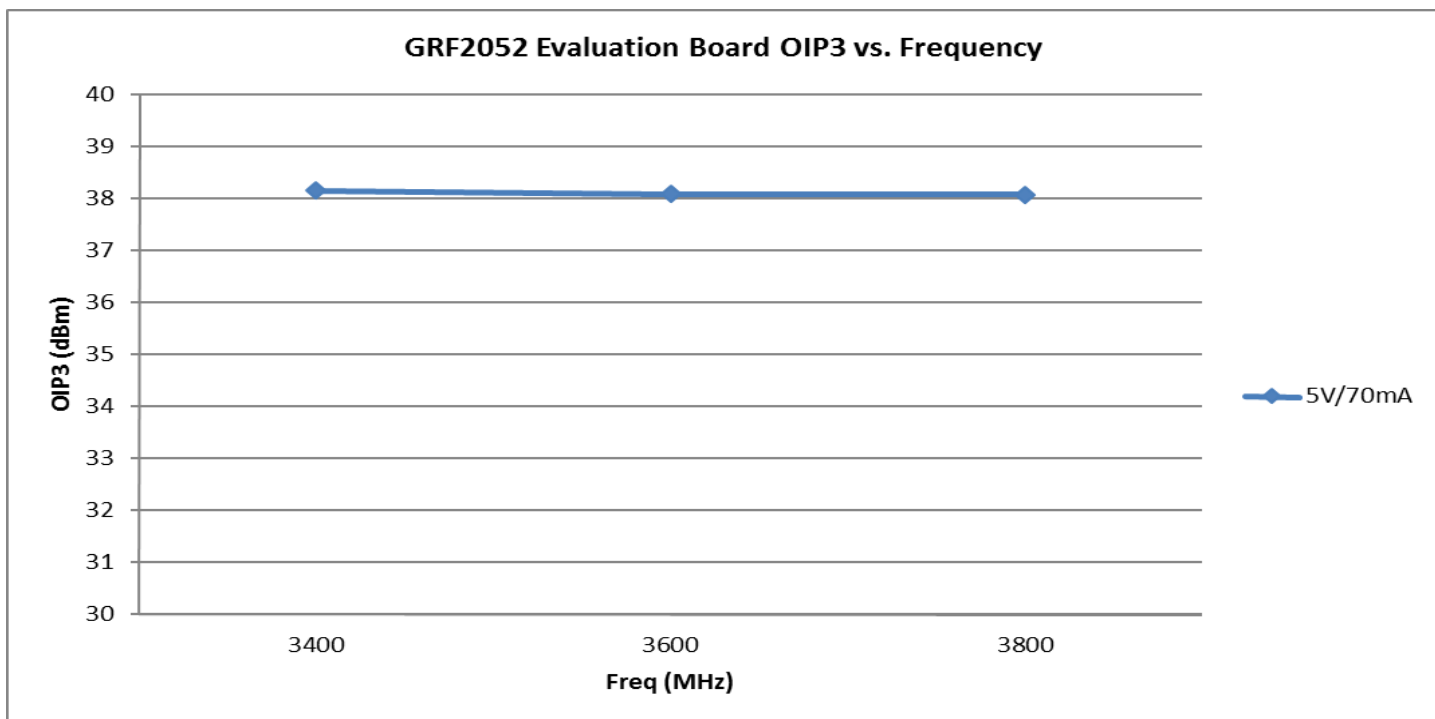
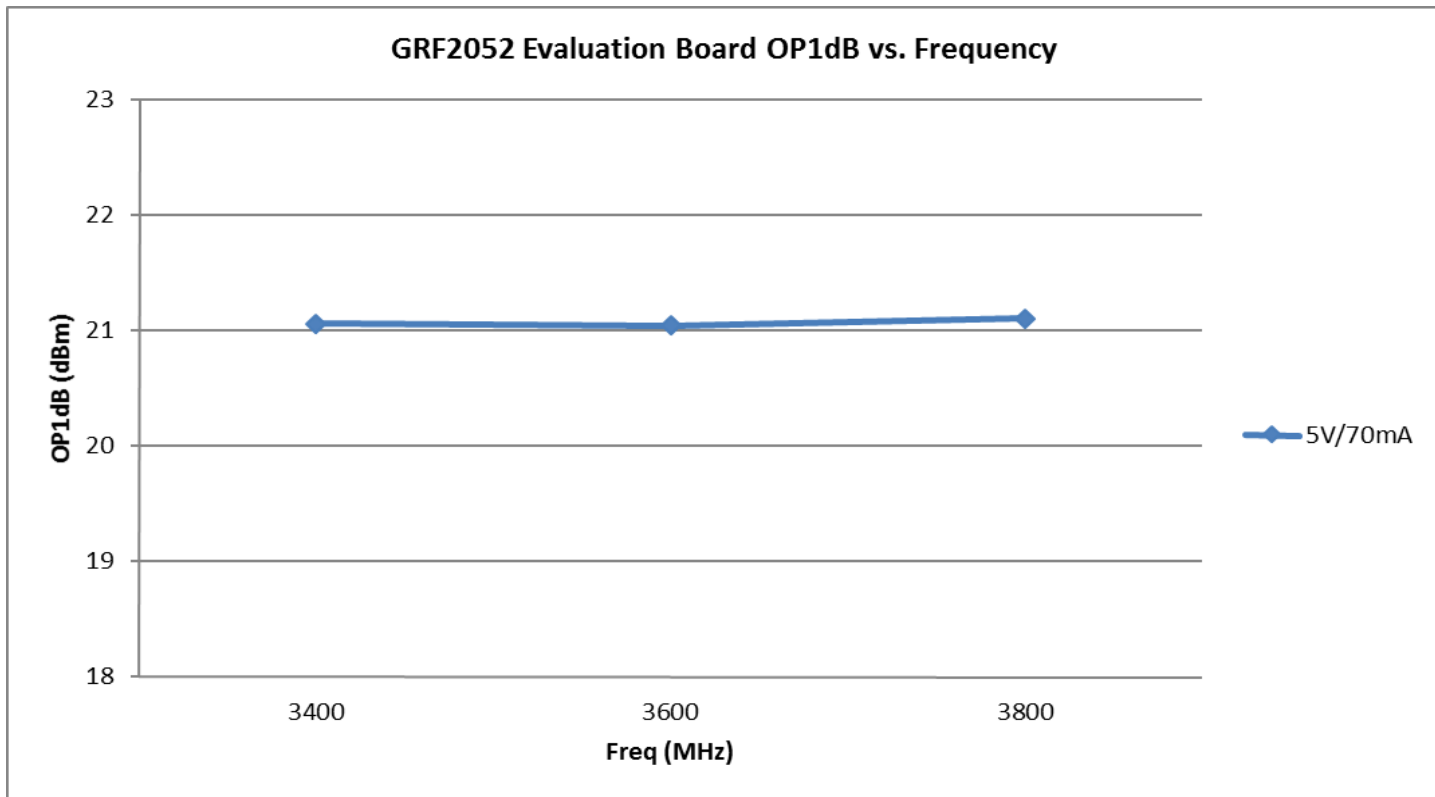


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# GRF2052

Ultra-Low Noise Amplifier  
Tuning Range: 1.7 – 4.5 GHz

## GRF2052 Evaluation Board Measured Data: (3.4 to 3.8 GHz Tune)



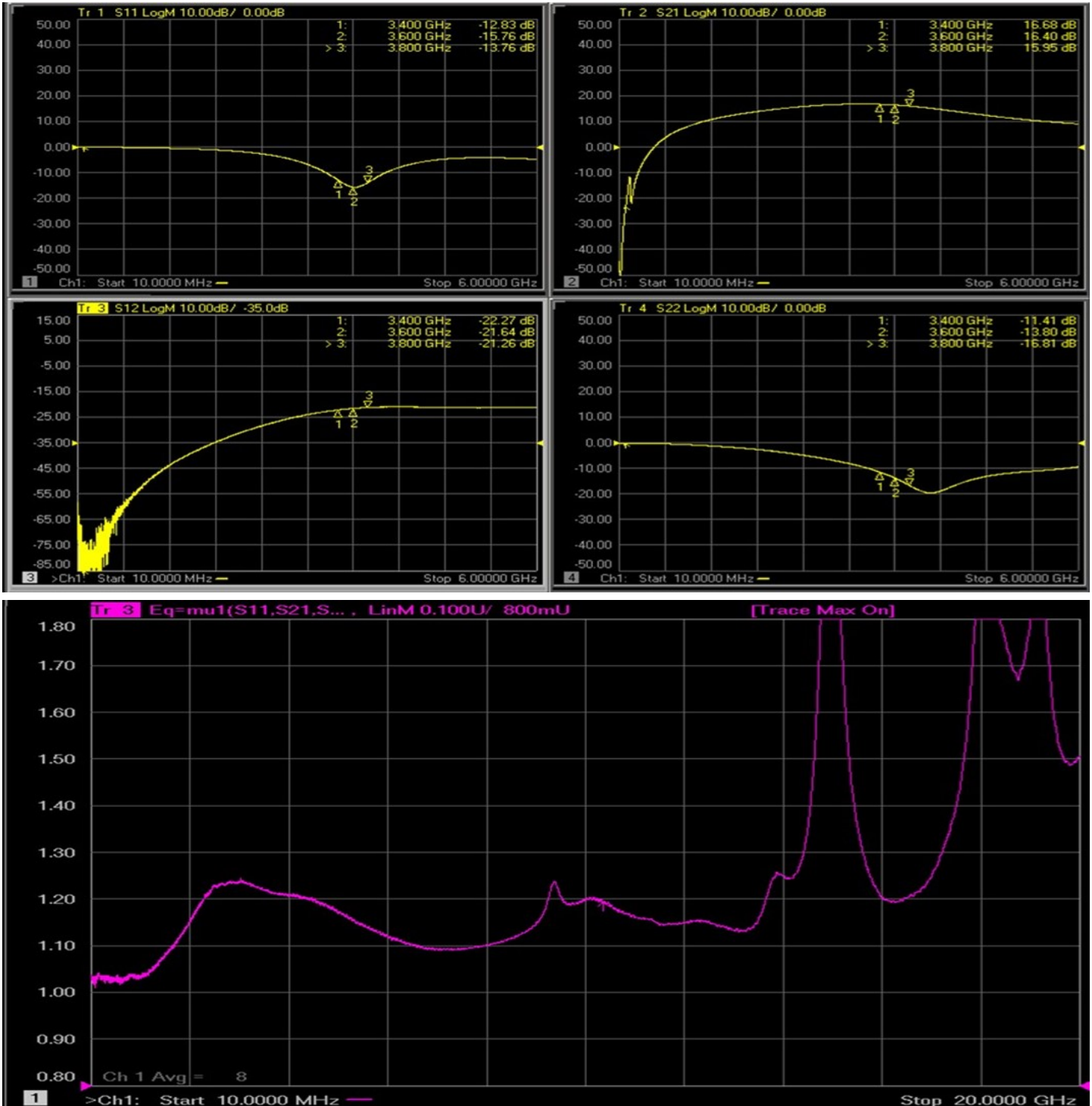


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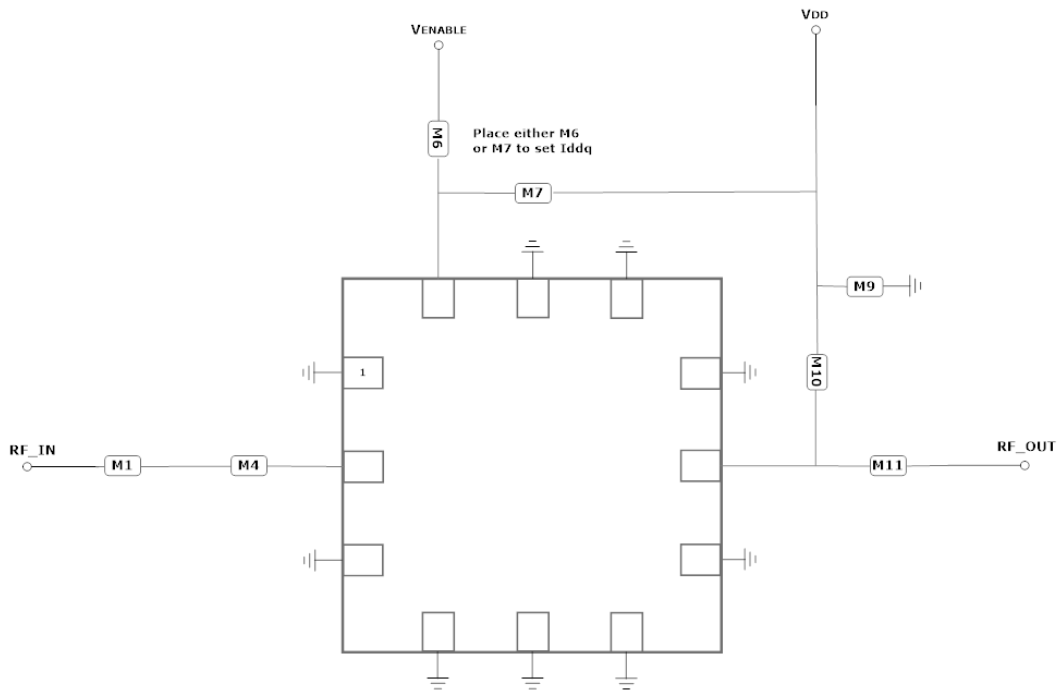
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Ultra-Low Noise Amplifier  
Tuning Range: 1.7 – 4.5 GHz

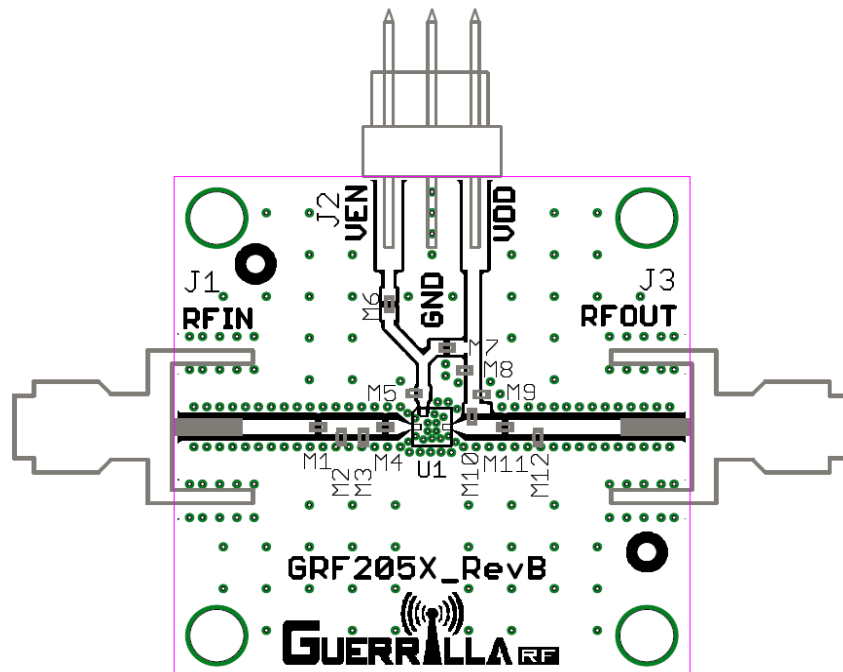
## GRF2052 Evaluation Board S-Pars and Stability Mu Factor: (3.4 to 3.8 GHz Tune)



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



GRF2052 Application Schematic



GRF2052 Eval Board Assembly Drawing



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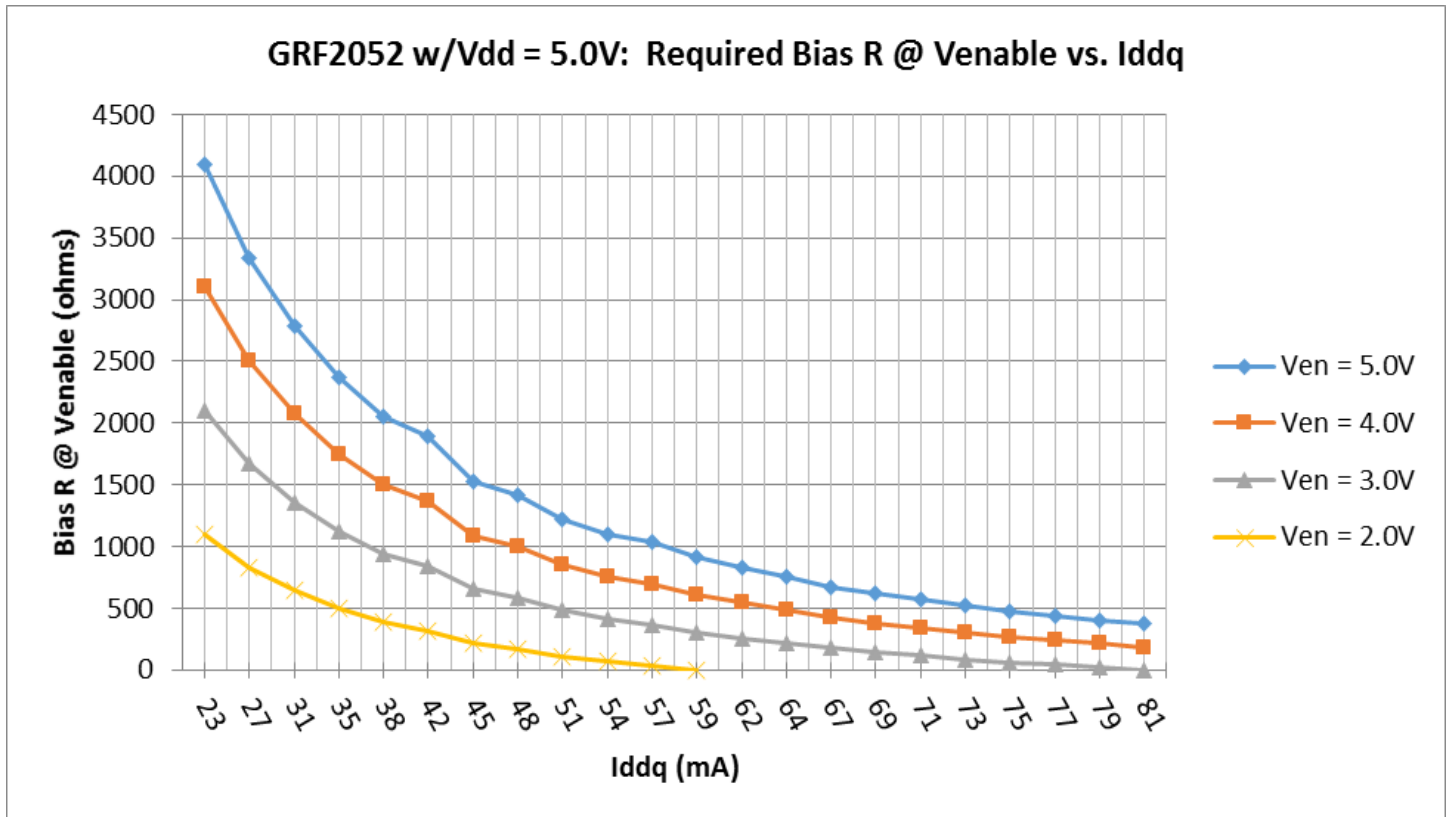
# GRF2052

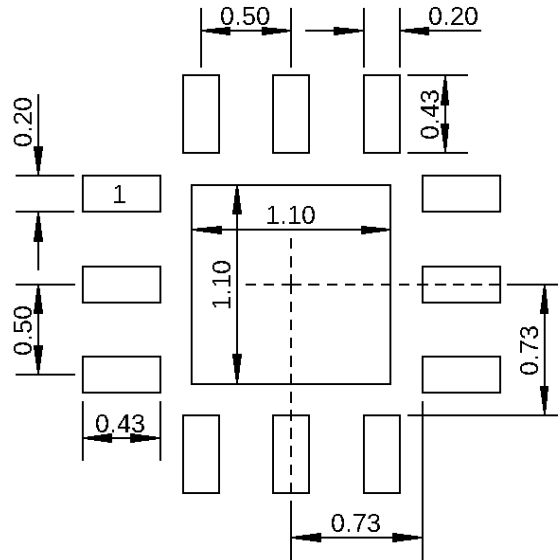
Ultra-Low Noise Amplifier  
Tuning Range: 1.7 – 4.5 GHz

## GRF2052 Evaluation Board BOM (2.5 to 2.7 GHz Tune)

| Component        | Type              | Manufacturer | Family | Value  | Package | Substitu- | Comment        |
|------------------|-------------------|--------------|--------|--------|---------|-----------|----------------|
| M1               | Capacitor: High Q | Murata       | GJM    | 2.4 pF | 0402    | ok        |                |
| M4               | Inductor          | Murata       | LQG    | 1.0 nH | 0402    | ok        |                |
| M6/7             | Resistor: 5%      | Various      | —      | —      | 0402    | ok        | Place M6 or M7 |
| M9               | Capacitor         | Murata       | GRM    | 0.1 uF | 0402    | ok        |                |
| M10              | Inductor          | Various      | MLC    | 2.7 nH | 0402    | ok        |                |
| M11              | Capacitor         | Murata       | GJM    | 2.4 pF | 0402    | ok        |                |
| Evaluation Board | GRF205X_RevB      |              |        |        |         |           |                |

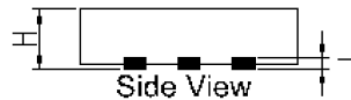
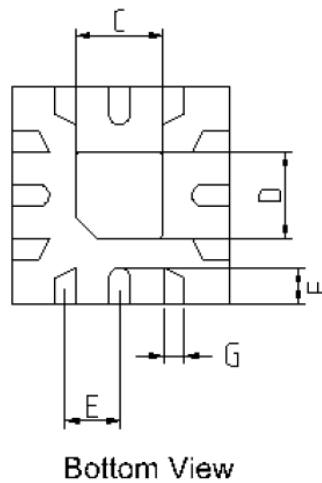
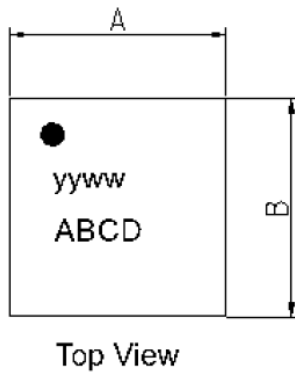
Note: Standard evaluation board bias: Vdd: 5.0V; Venable: 5.0V; M6/M7:





Dimensions in millimeters

### 2.0 mm QFN-12 Suggested PCB Footprint (Top View)



| Dimensions (MM) |             |
|-----------------|-------------|
| A               | 2.00 Bsc    |
| B               | 2.00 Bsc    |
| C               | .80 +/- .10 |
| D               | .80 +/- .10 |
| E               | .50 Bsc     |
| F               | .30 +/- .05 |
| G               | .20 +/- .05 |
| H               | .50 +/- .05 |
| J               | .12 Ref     |

### 2.0 mm QFN-12 Package Dimensions



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| 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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