



## Product Description

GRF4001 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 0.1 to 6.0 GHz with a single match.

Configured as a first stage LNA, linear driver or cascaded gain block, GRF4001 offers high levels of reuse both within a design and across platforms. The device is typically operated from a supply voltage of 3.3 V with a selectable  $I_{DDQ}$  range of 10 to 50 mA for optimal efficiency and linearity.  $V_{dd} > 3.6$  volts is not recommended for application frequencies below 700 MHz.

GRF4001 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 and device s-parameters.

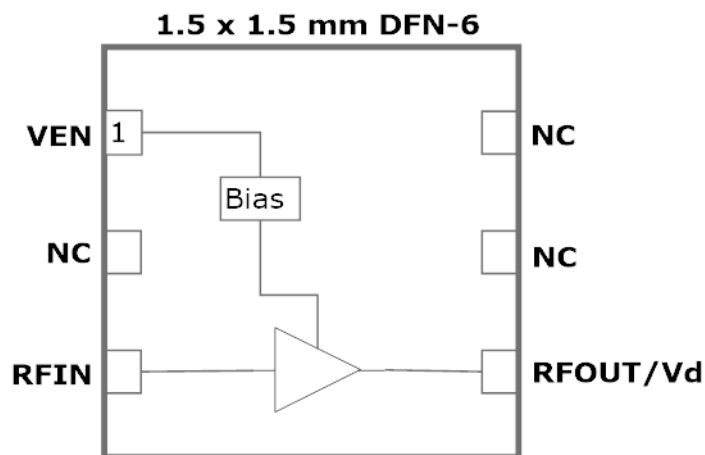
## Features

Reference: 3.3V/45mA/2.5 GHz

- EVB NF: 0.9 dB
- Gain: 15.5 dB
- OIP3: 30.5 dBm
- OP1dB: 16.5 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
- First Stage LNA
- Microwave Backhaul
- C-Band Amplifiers
- Low Voltage Radios



## 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>		17	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>		300	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 GRF4001 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 <sub>In</sub>	LNA RF input	Internally matched 50Ω. An external DC blocking cap must be used.
4	RF <sub>Out</sub>	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 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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# GRF4001

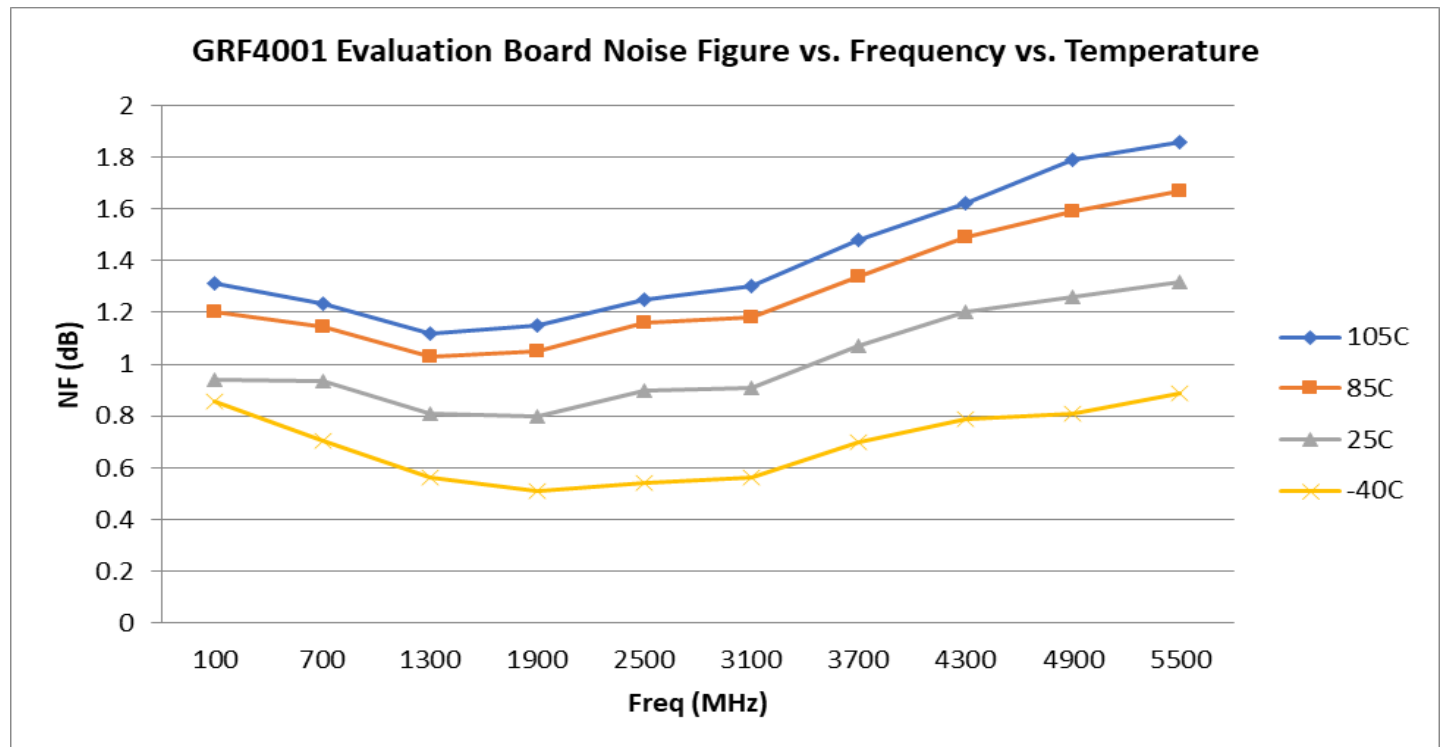
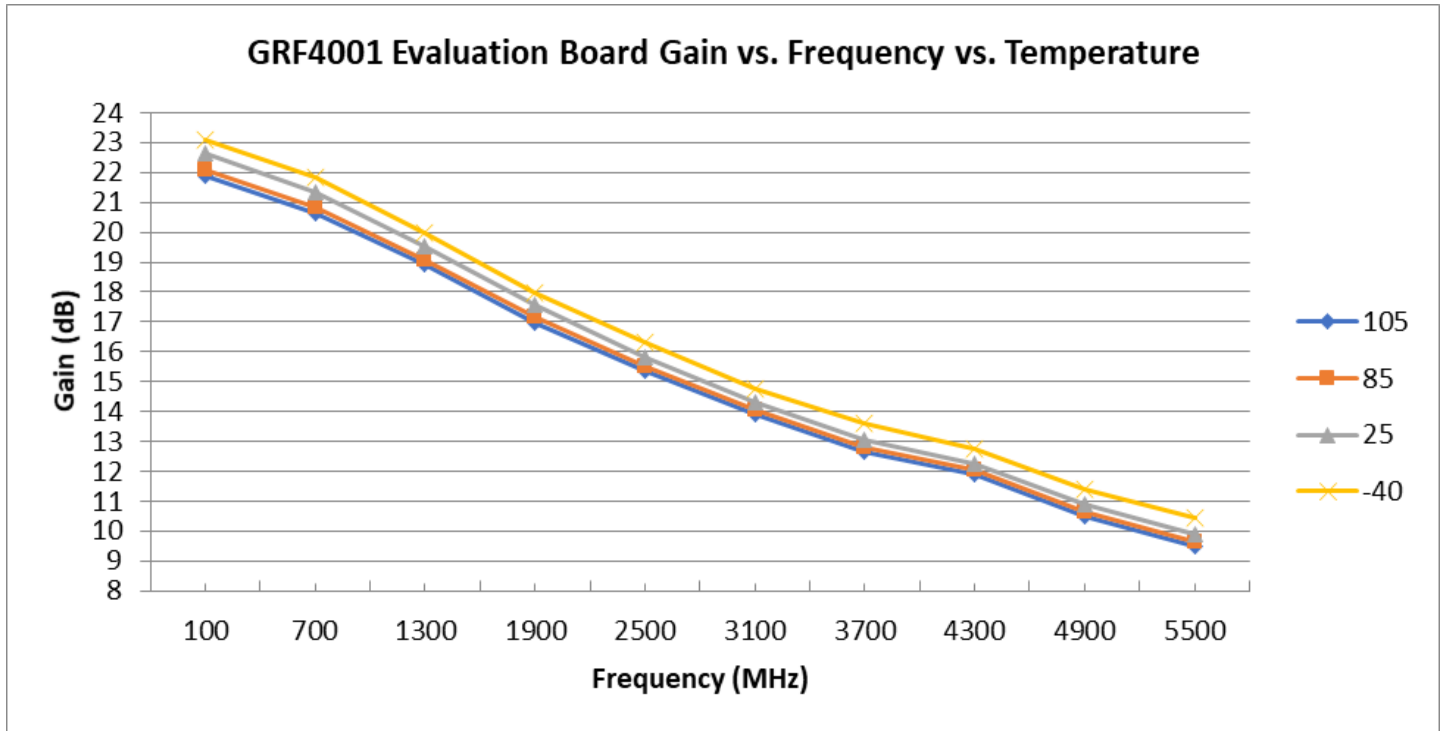
Broadband LNA/Linear Driver  
0.1–6.0 GHz

## Nominal Operating Parameters:

Parameter	Symbol	Specification			Unit	Condition
		Min.	Typ.	Max.		
Test Frequency	F <sub>TEST</sub>		2500		MHz	V <sub>DD</sub> = 3.3 V, T <sub>A</sub> = 25 °C
Gain	S <sub>21</sub>	14.5	15.5		dB	
Evaluation Board Noise Figure	NF		0.9		dB	
Output 3rd Order Intercept	OIP <sub>3</sub>		30.5		dBm	0.0 dBm P <sub>OUT</sub> per tone at 2 MHz Spacing (2499 and 2501 MHz)
Output 1dB Compression Power	OP <sub>1dB</sub>	14.5	16.5		dBm	
Switching Rise Time	T <sub>RISE</sub>		700		ns	
Switching Fall Time	T <sub>FALL</sub>		500		ns	
Supply Current	I <sub>DD</sub>		45		mA	Target I <sub>DDQ</sub> : 45 mA
<b>Disabled Mode</b>						
Leakage Current	I <sub>LEAKAGE</sub>		2	20	uA	V <sub>DD</sub> : 3.3V; V <sub>ENABLE</sub> : 0.0V
<b>Thermal Data</b>						
Thermal Resistance: (Infra-Red Scan)	Θ <sub>JC</sub>		225		°C/W	On standard Evaluation Board
Channel Temperature @ +85 C Reference (Package heat sink)	T <sub>CHANNEL</sub>		119		°C	V <sub>DD</sub> : 3.3 V; I <sub>DDQ</sub> : 45 mA; No RF; P <sub>BISS</sub> : 150 mW

**Note:** GRF4001 not recommended for applications below 700 MHz with V<sub>dd</sub> > 3.6 volts.

GRF4001 Evaluation Board Measured Data:



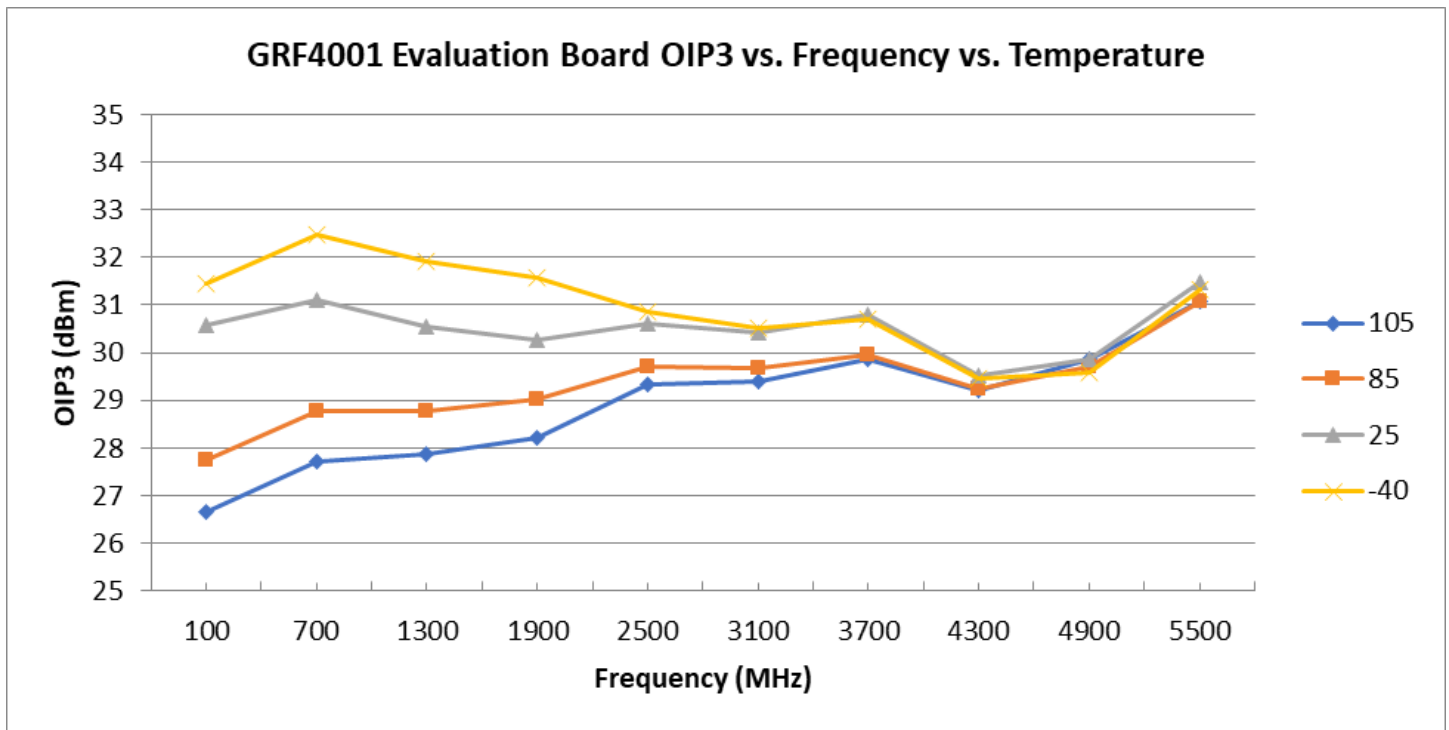
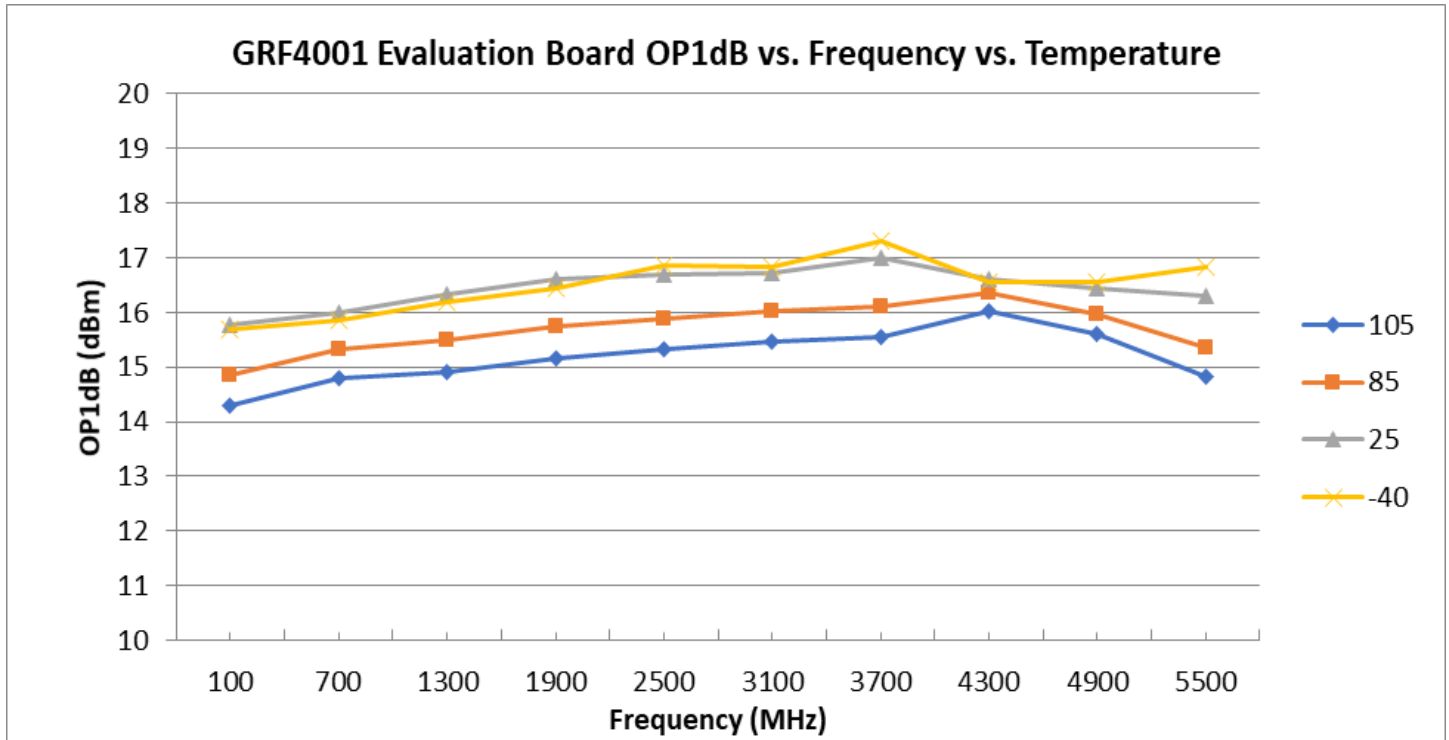


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0.1–6.0 GHz

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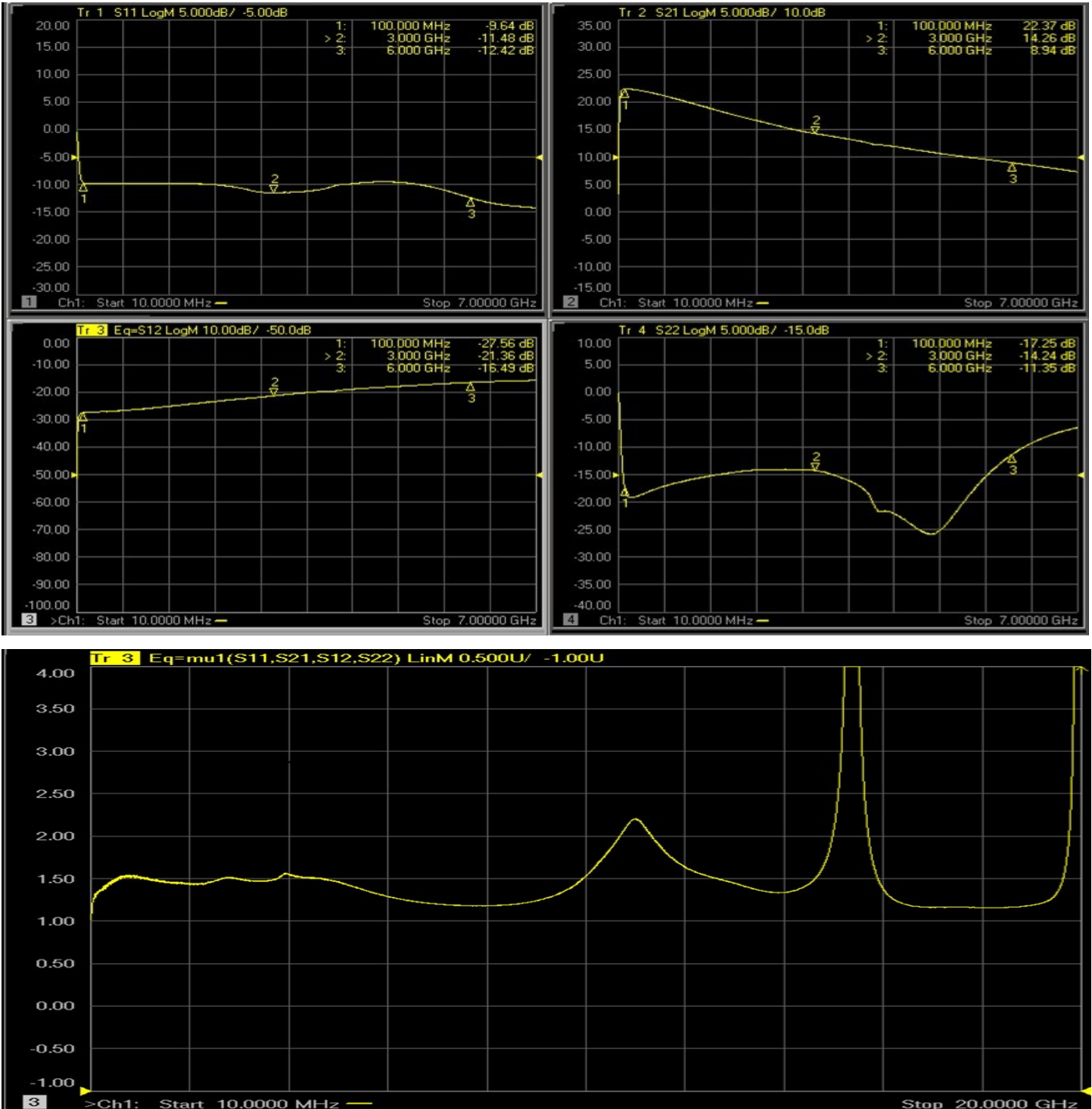


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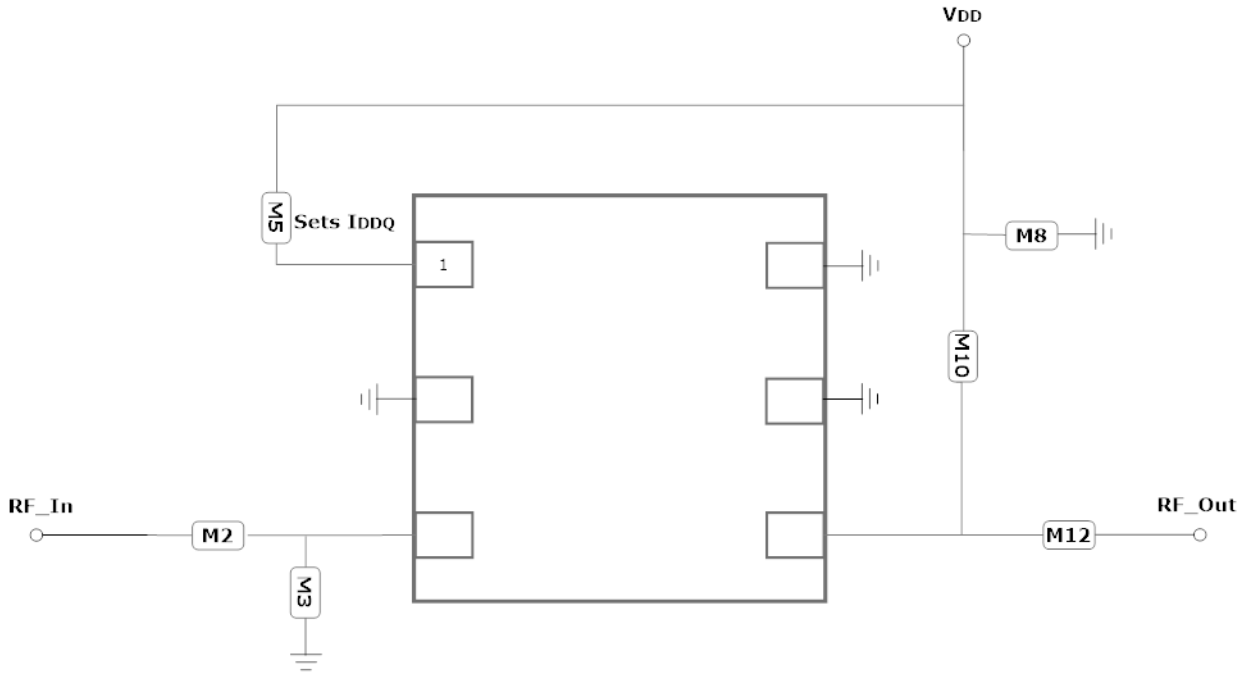
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Broadband LNA/Linear Driver  
0.1–6.0 GHz

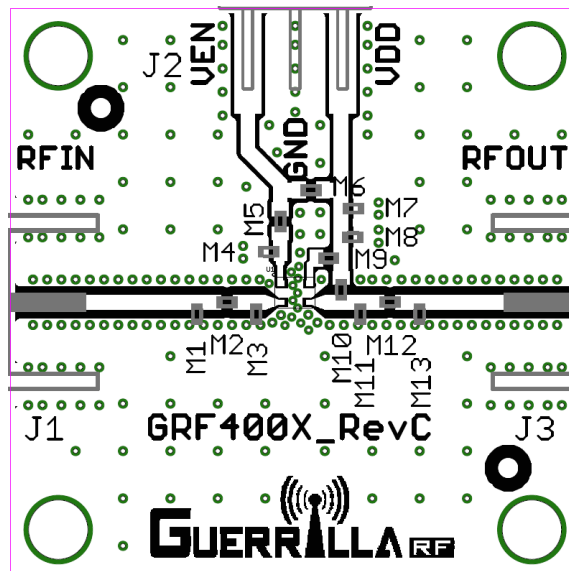
## GRF4001 Evaluation Board S-Pars and Stability Mu Factor: (0.1 – 6.0 GHz Match)



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



GRF4001 Application Schematic



GRF400X Evaluation Board Assembly Diagram





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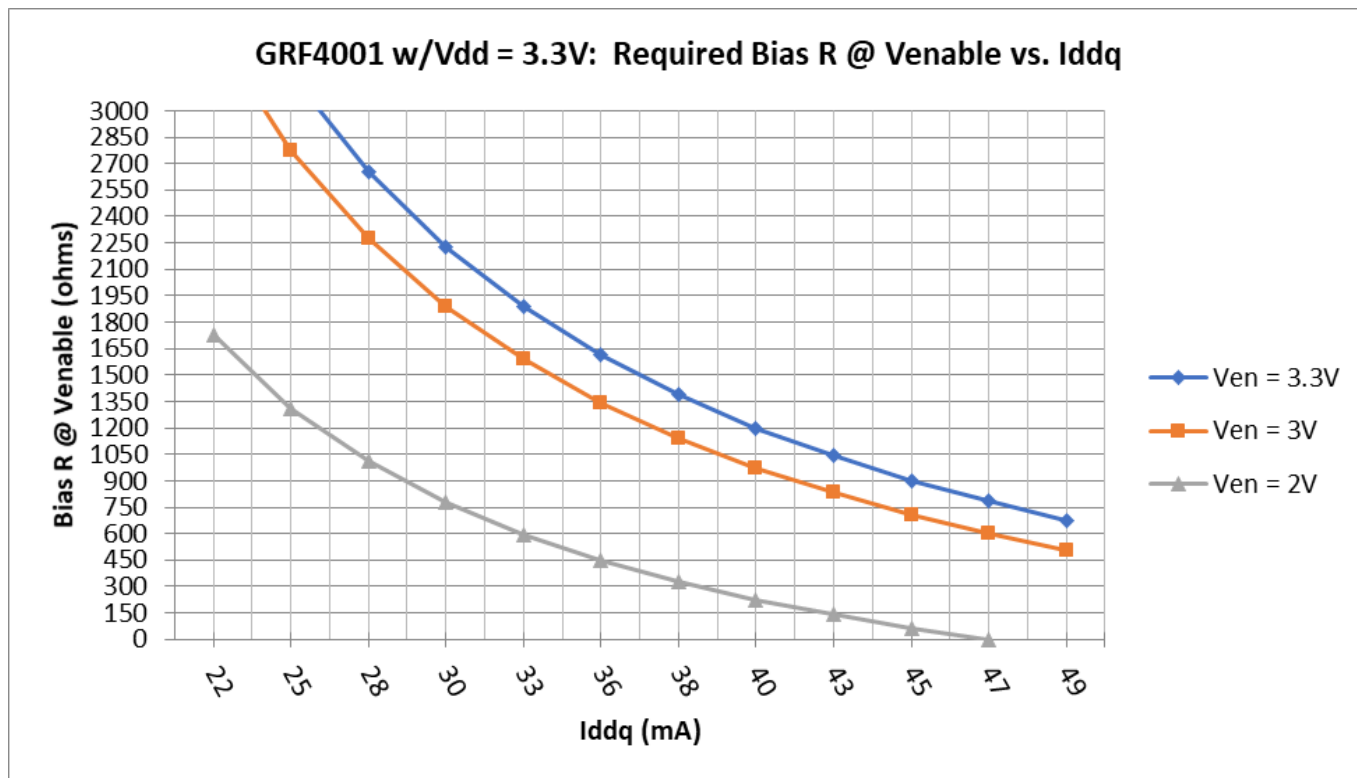
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Broadband LNA/Linear Driver  
0.1–6.0 GHz

## GRF4001 Standard Evaluation Board BOM: (0.1 to 6.0 GHz Tune)

Component	Type	Manufacturer	Family	Value	Package Size	Substitution
M2	Capacitor	Murata	GRM	100 pF	0402	ok
M3	Capacitor	Murata	GJM	0.2 pF	0402	ok
M5 (See curves)	Resistor: 5%	Various	—	—	0402	ok
M8	Capacitor	Murata	GRM	0.1 uF	0402	ok
M10	Inductor	Coilcraft	HPA	220 nH	0402	ok
M12	Capacitor	Murata	GRM	100 pF	0402	ok
Evaluation Board:	GRF400X_RevC					

## GRF4001 Bias Resistor Selection Plot





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0.1–6.0 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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