



## Product Description

GRF2004 is a broadband, low noise linear gain block designed for small cell, wireless infrastructure and other high performance RF applications. Due to the extreme broadband nature of the device, data is presented for wideband RF measurements using network analyzer bias tees. Under these conditions, the device exhibits good performance over 100 MHz to 10 GHz with minimal external components.

The device can be operated over a range of supply voltages from 1.8 to 5.0 V selectable  $I_{DDQ}$  for optimal efficiency and linearity.

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

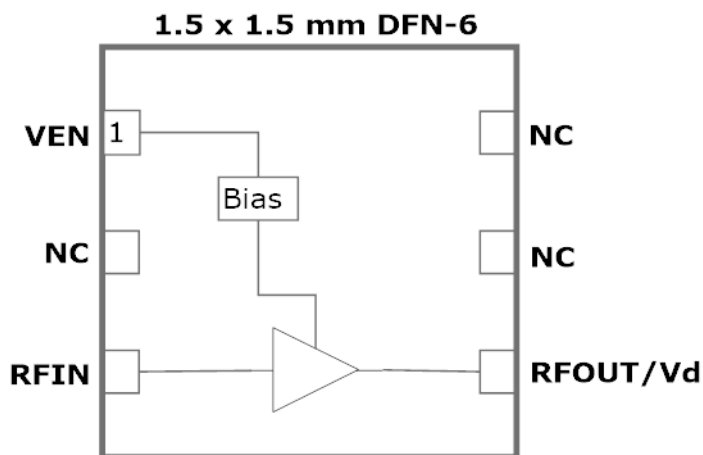
## Features

Reference: 5V/100mA/4.0 GHz

- Gain: 16.5 dB
- OP1dB: 18.0 dBm
- OIP3: 31.0 dBm
- Eval Board NF: 1.9 dB
  
- Flexible Bias Voltage and Current
- Internally Matched to  $50 \Omega$
- Process: GaAs pHEMT

## Applications

- Microwave Backhaul
- C/X-Band Amplifiers
- General Purpose Amplifiers
- Instrumentation



## 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>		15	dBm
RF Input Power: (Load VSWR < 2:1; V <sub>D</sub> : <4.0 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>		600	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 GRF2004 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> /V <sub>DD</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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# GRF2004

Broadband Gain Block  
0.1 to 10.0 GHz

## Nominal Operating Parameters:

Parameter	Symbol	Specification			Unit	Condition
		Min.	Typ.	Max.		
Test Frequency	F <sub>TEST</sub>		4.0		GHz	V <sub>DD</sub> = 5.0 V, T <sub>A</sub> = 25 °C
Gain	S <sub>21</sub>	15.0	16.5		dB	
Evaluation Board Noise Figure	NF		1.9		dB	
Output 3rd Order Intercept	OIP <sub>3</sub>		31.0		dBm	0.0 dBm P <sub>OUT</sub> per tone at 2 MHz Spacing (3999 and 4001 MHz)
Output 1dB Compression Point	OP <sub>1dB</sub>	16.0	18.0		dBm	
Switching Rise Time	T <sub>RISE</sub>		800		ns	
Switching Fall Time	T <sub>FALL</sub>		600		ns	
Supply Current	I <sub>DD</sub>		100		mA	
Enable Current	I <sub>ENABLE</sub>		1.8		mA	
Leakage Current	I <sub>LEAKAGE</sub>		1		uA	V <sub>DD</sub> : 5.0V; V <sub>ENABLE</sub> : 0.0V
Thermal Data						
Thermal Resistance: (Infra-Red Scan)	Θ <sub>jc</sub>		104		°C/W	On standard Evaluation Board
Channel Temperature @ +85 C Reference (Package heat sink)	T <sub>CHANNEL</sub>		137 (See note)		°C	V <sub>DD</sub> : 5.0 V; I <sub>DDQ</sub> : 100 mA; No RF; P <sub>DISS</sub> : 500 mW

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

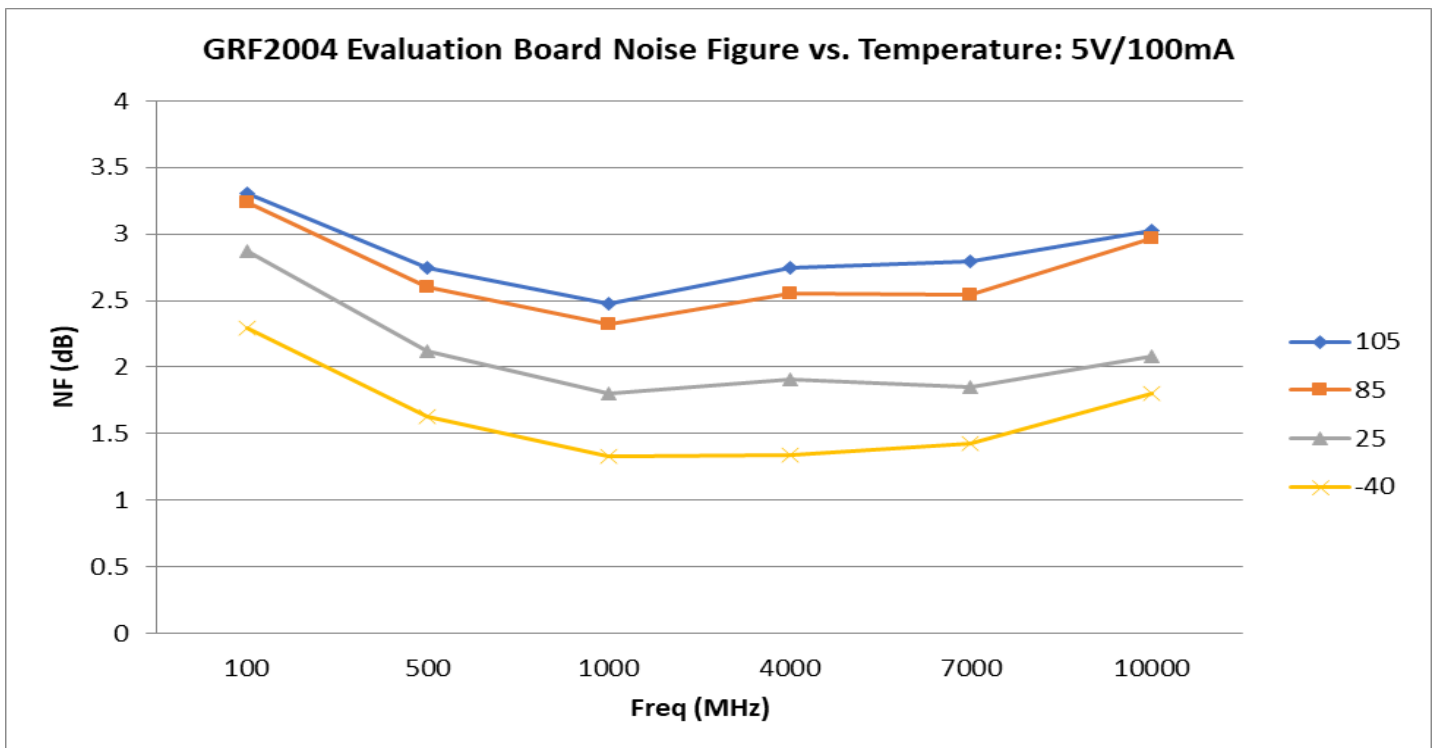
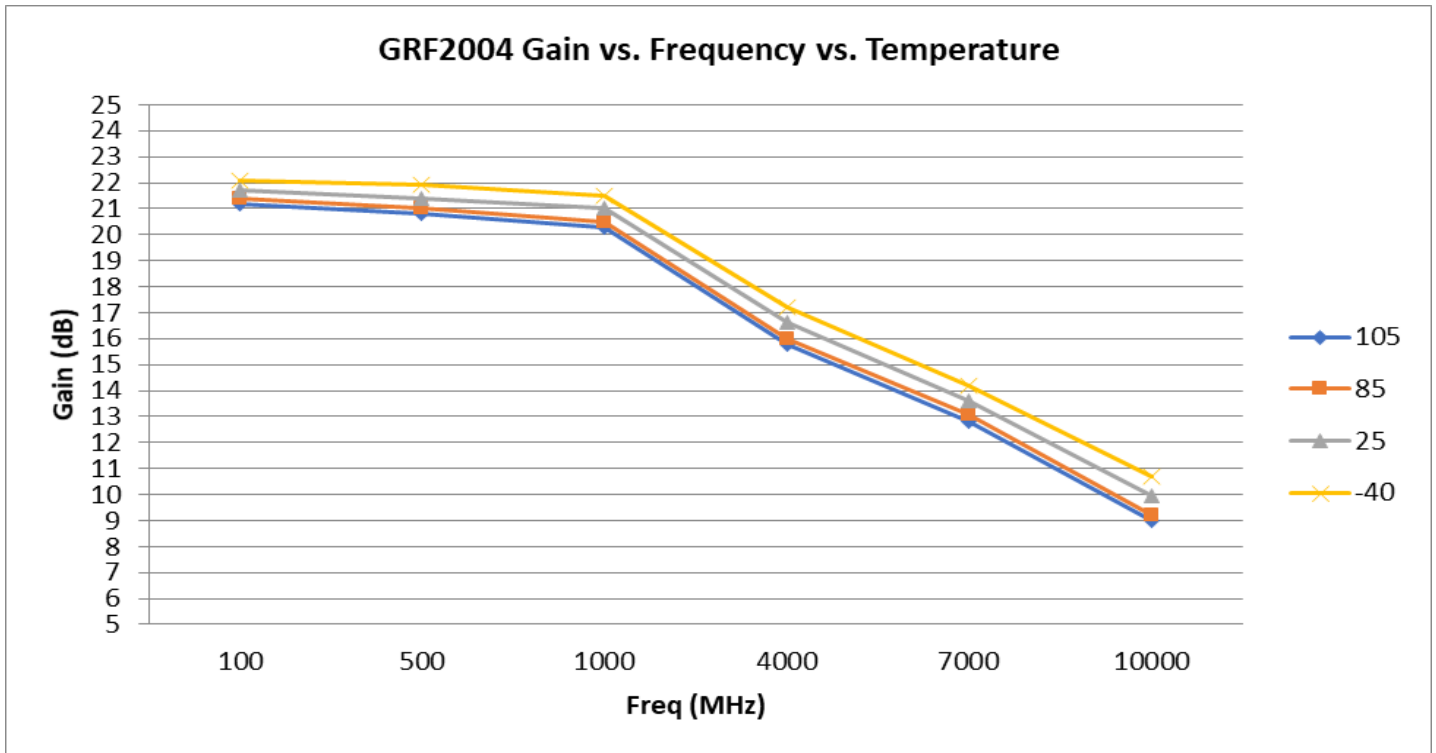


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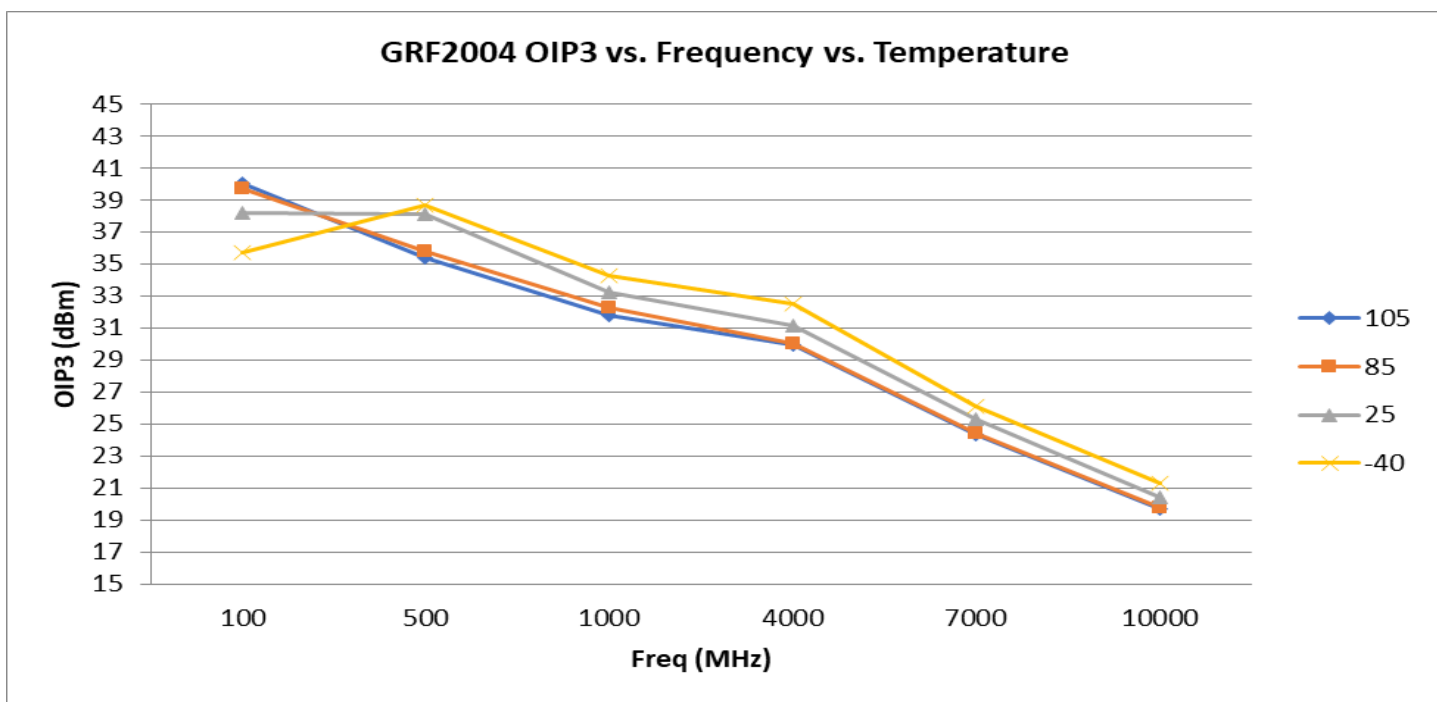
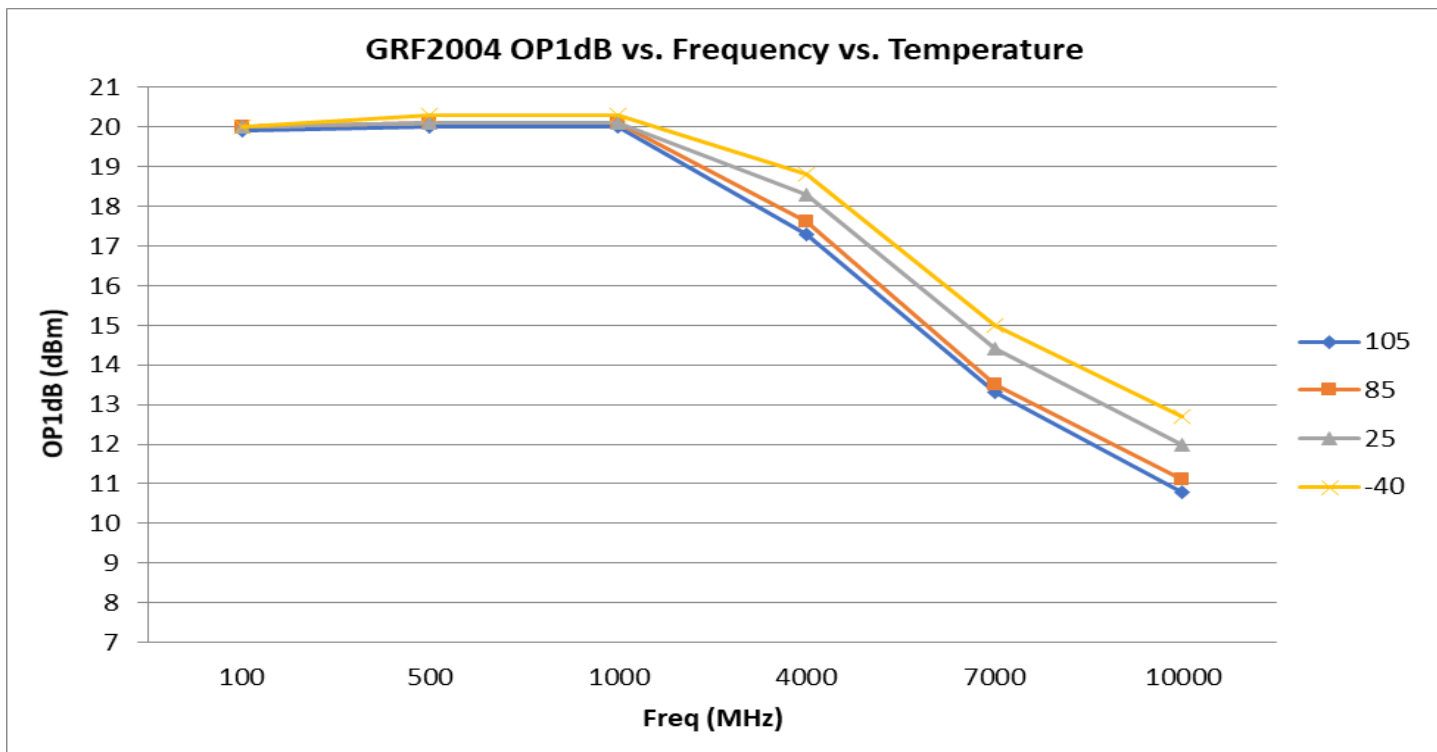
# GRF2004

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## GRF2004 Evaluation Board Measured Data: (0.1 to 10.0 GHz Bias T Measurements)



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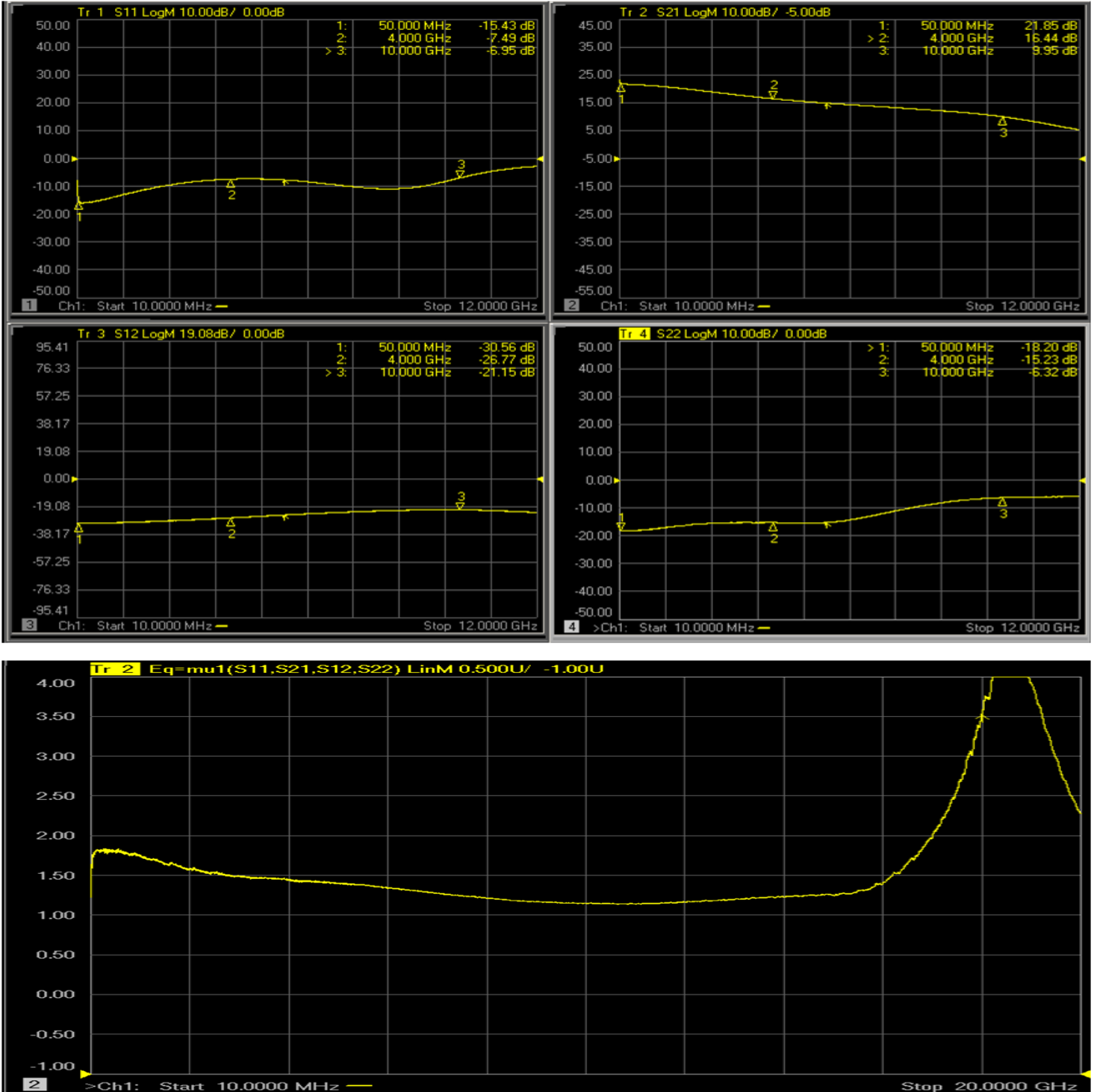


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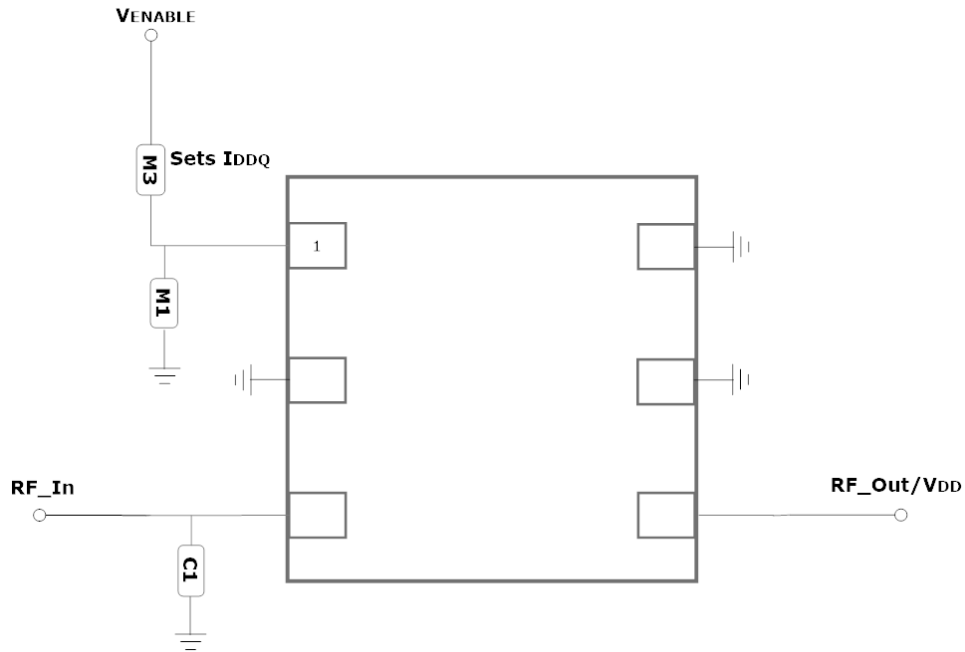
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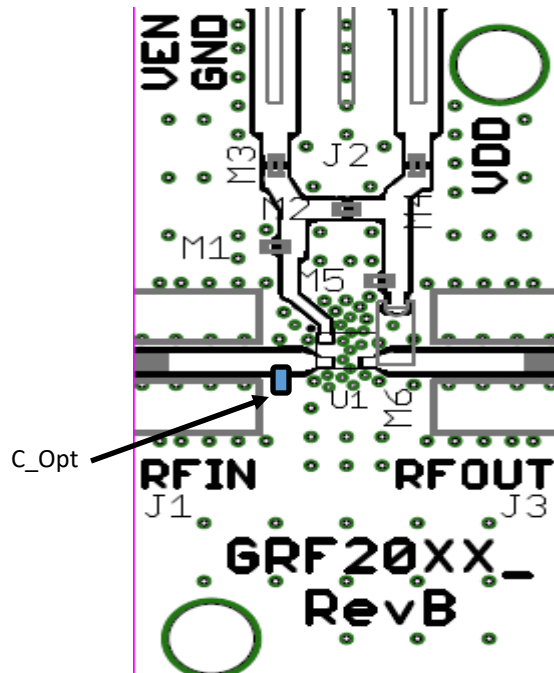
## GRF2004 Evaluation Board S-Pars and Stability Mu Factor: (0.1 to 10.0 GHz VNA Bias Ts)



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



GRF2004 Application Schematic (0.1 to 10.0 GHz Eval Board)



GRF2004 Evaluation Board Assembly Drawing

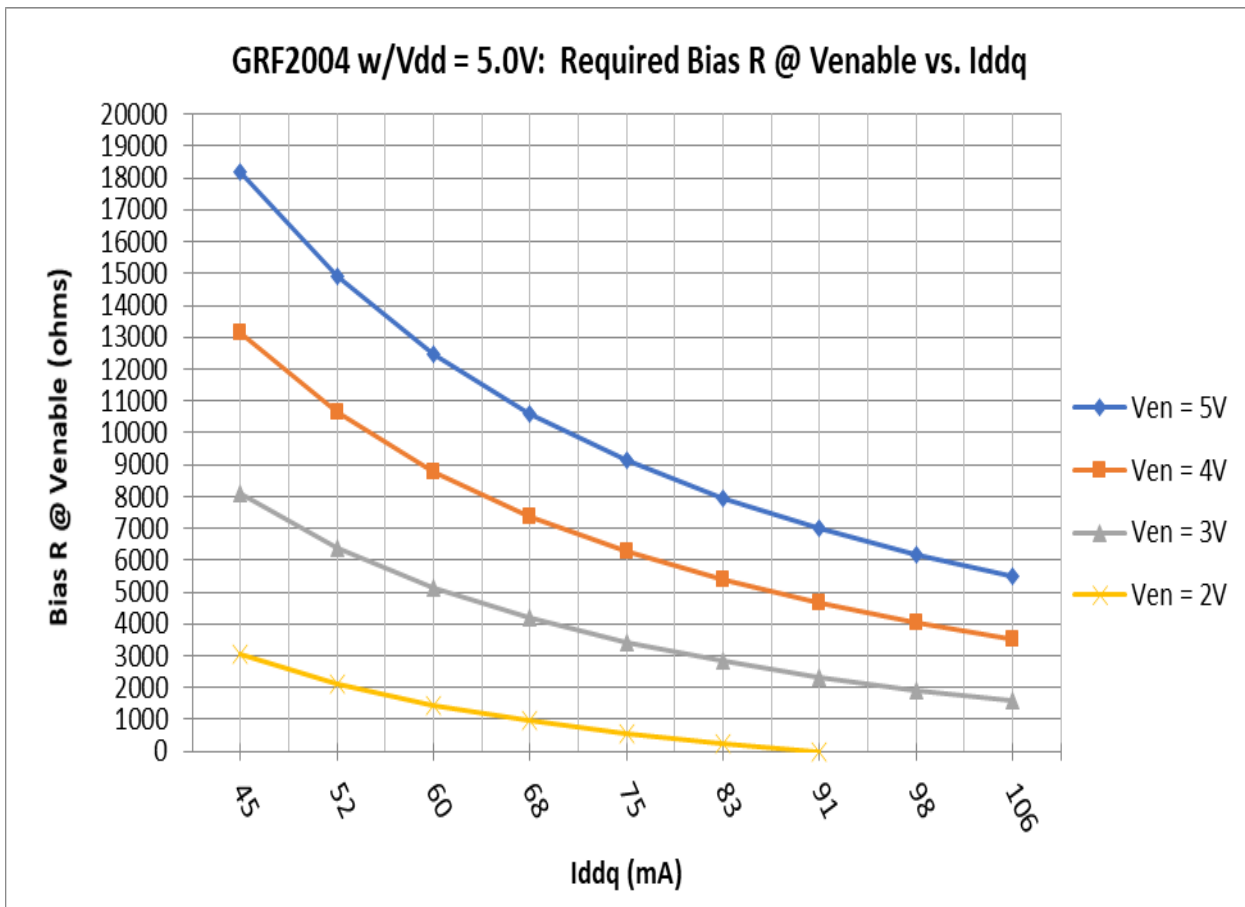


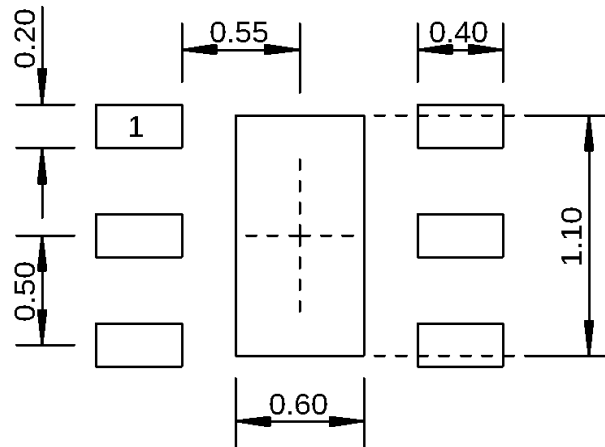
### GRF2004 Evaluation Board BOM for VNA S-parameter measurement

Component	Type	Manufacturer	Family	Value	Package Size	Substitution
M1	Capacitor	Murata	GRM	1000 pF	0402	ok
M3 (See curves)	Resistor	Various	5%	Sets Iddq	0402	ok
C1	Capacitor	Murata	GJM	0.2 pF	0402	ok
Evaluation Board	GRF20XX_RevB	—	—	—	—	—

Note: C1 is added to test board input to enhance high frequency gain of the device.

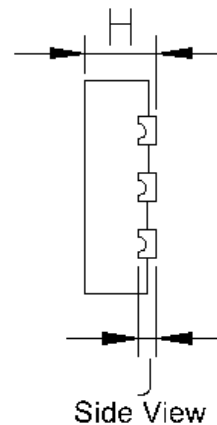
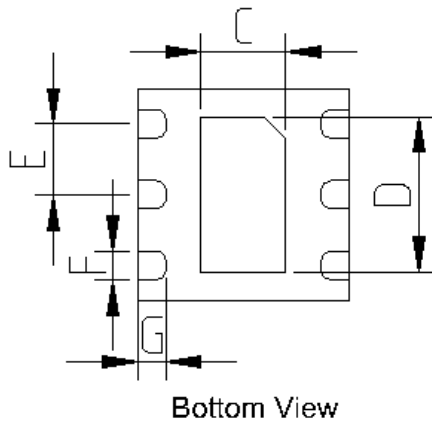
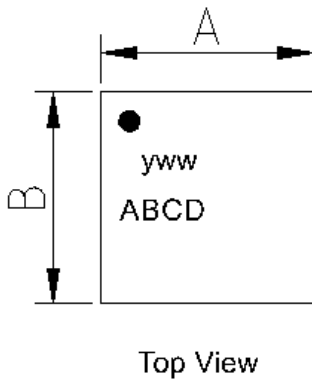
### Bias Resistor Selection Curves





Dimensions in millimeters

### 1.5 mm DFN-6 Suggested PCB Footprint (Top View)



Dimensions (MM)	
A	1.5 +/- 0.050
B	1.5 +/- 0.050
C	.6 +/- 0.050
D	1.1 +/- 0.050
E	.5 Bsc
F	.2 +/- 0.050
G	.2 +/- 0.050
H	.45 +/- 0.050
J	.12 Ref.

### 1.5 mm DFN-6 Package Dimensions



Released

# GRF2004

## Broadband Gain Block 0.1 to 10.0 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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