GRF2060

Preliminary

Broadband, Low Noise Gain Block; 0.7 - 4.0 GHz

Package: 1.5 x 1.5 mm DFN-6

Features

- 700 – 4000 MHz Operation
- Guerrilla Armor™ for High Off-state Isolation
- NF: 2.1 dB @ 2.0 GHz
- Gain 15.4 dB @ 2.0 GHz
- 2.7 V to 5.0 V Single Supply
- Internally Matched to 50 Ω

Applications

- General Purpose Amplifier
- Microwave Backhaul
- WiFi Access Points
- Small Cells and Repeaters

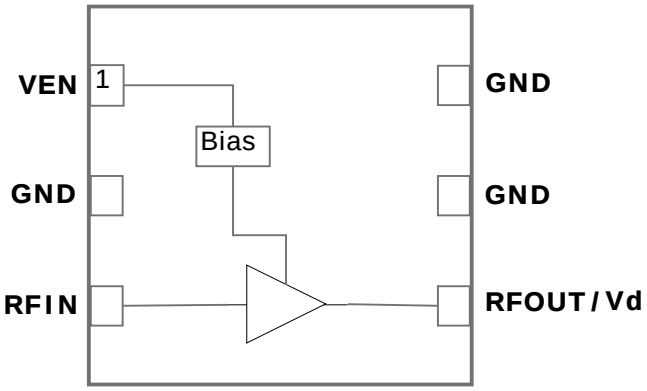
Product Description

The GRF2060 is a broadband low noise amplifier (LNA) featuring proprietary Guerrilla Armor™ high isolation technology, which provides excellent off-state isolation under high RF input power conditions. It is designed for high performance applications in the 700 - 4000 MHz spectrum, exhibiting a typical low noise figure (NF) of 1.8 dB along with flat gain.

The LNA is operated from a single positive supply of 2.7 to 5.0 V with a typical bias condition of 5.0 V and 55 mA. GRF2060 is internally matched to 50 Ω at the input and output ports.

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

Functional Block Diagram



Absolute Ratings

Parameter	Symbol	Min.	Max.	Unit
Drain Voltage	V_D	0	6.0	V
RF Input Power: (Load VSWR < 2:1; Vd: 5.0 volts; Venable High)	$P_{IN\ MAX}$		+15	dBm
RF Input Power: (Load VSWR < 2:1; Vd: 5.0 volts; Venable Low)	$P_{IN\ MAX}$		+23	dBm
Operating Temperature	T_{AMB}	-40	+105	°C
Storage Temperature	T_{STG}	-40	+150	°C
Maximum Channel Temperature	T_{MAX}		+160	°C
Maximum Dissipated Power (Note: De-rate 5 mW/°C for T_{AMB} > +85C.	$P_{DISS\ MAX}$		300	mW
Electrostatic Discharge:				
Charged Device Model: (TBD)	CDM	Class 4: 1000		V
Human Body Model: (TBD)	HBM	Class 1B: 500		V
Machine Model: (TBD)	MM	Class A: 50		V

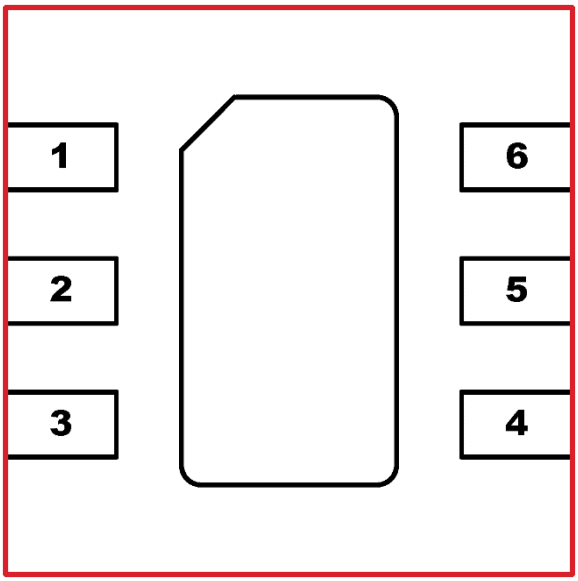
Caution! ESD Sensitive Device

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

Nominal Operating Parameters

Parameter	Symbol	Specification			Unit	Condition
		Min.	Typ.	Max.		
Gain Mode (Venable high)						V_{DD} = 5.0 V, T_A = 25°C
Test Frequency	F_{TEST}		2000		MHz	
Gain	S21		15.4		dB	
Gain Flatness	ΔS21		+/- 0.5		dB	Across any 500 MHz Band
Input Return Loss	S11		-9.0		dB	
Output Return Loss	S22		-20		dB	
Noise Figure	NF		2.1		dB	Input trace losses de-embedded
Ouput 3rd Order Intercept	OIP3		+27.8		dBm	
Output 1dB Compression Power	OP1dB		+12.5		dBm	
Switching Rise Time	T_{RISE}		300		ns	
Switching Fall Time	T_{FALL}		300		ns	
Supply Current	I_{DD}		55		mA	Adjustable for optimal IP3
Thermal Data						
Thermal Resistance: (Infra-Red Scan)	Θjc		200		°C/W	On standard Evaluation Board
Channel Temperature @ +85 C Reference (Package heat sink)	Tchannel		+130		°C	Vdd: 5.0 V; Iddq: 55 mA; No RF; Pdiss: 225 mW

Pin Out (Top View)

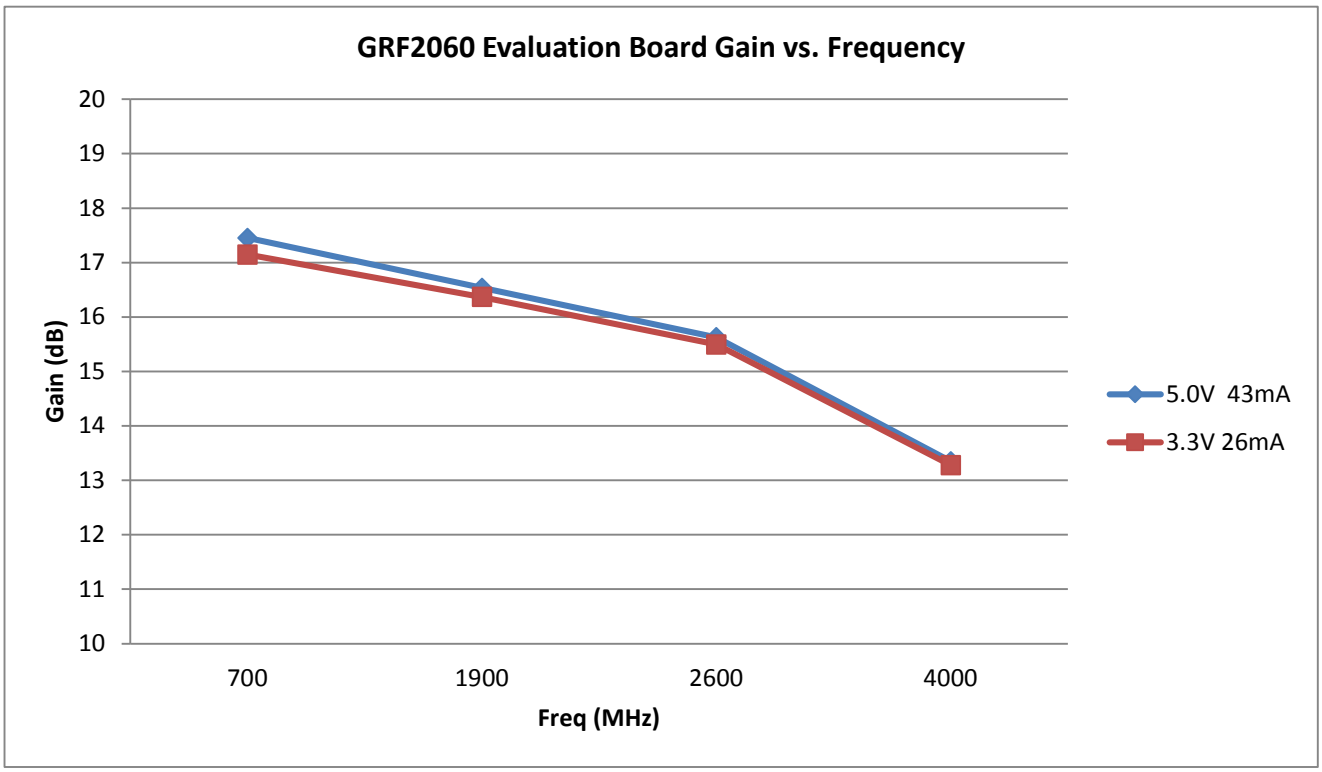


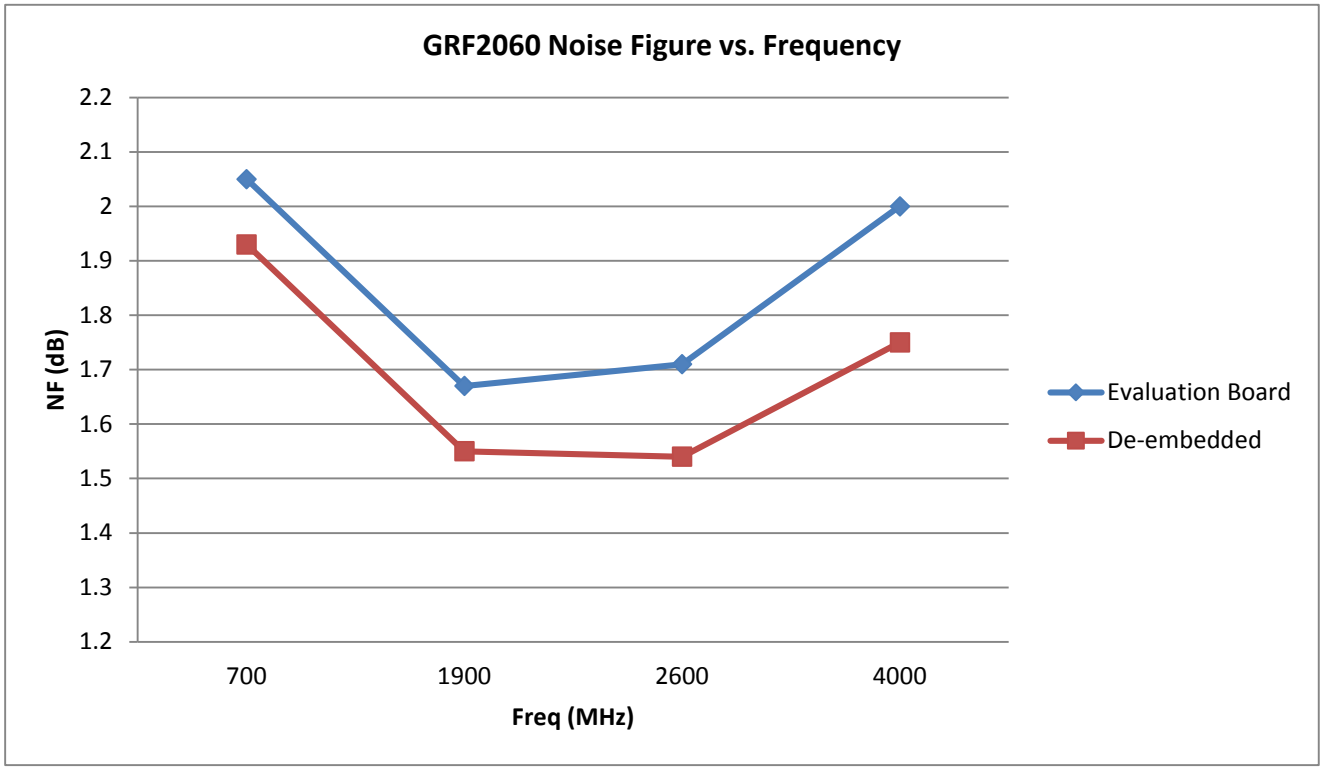
Pin Assignments

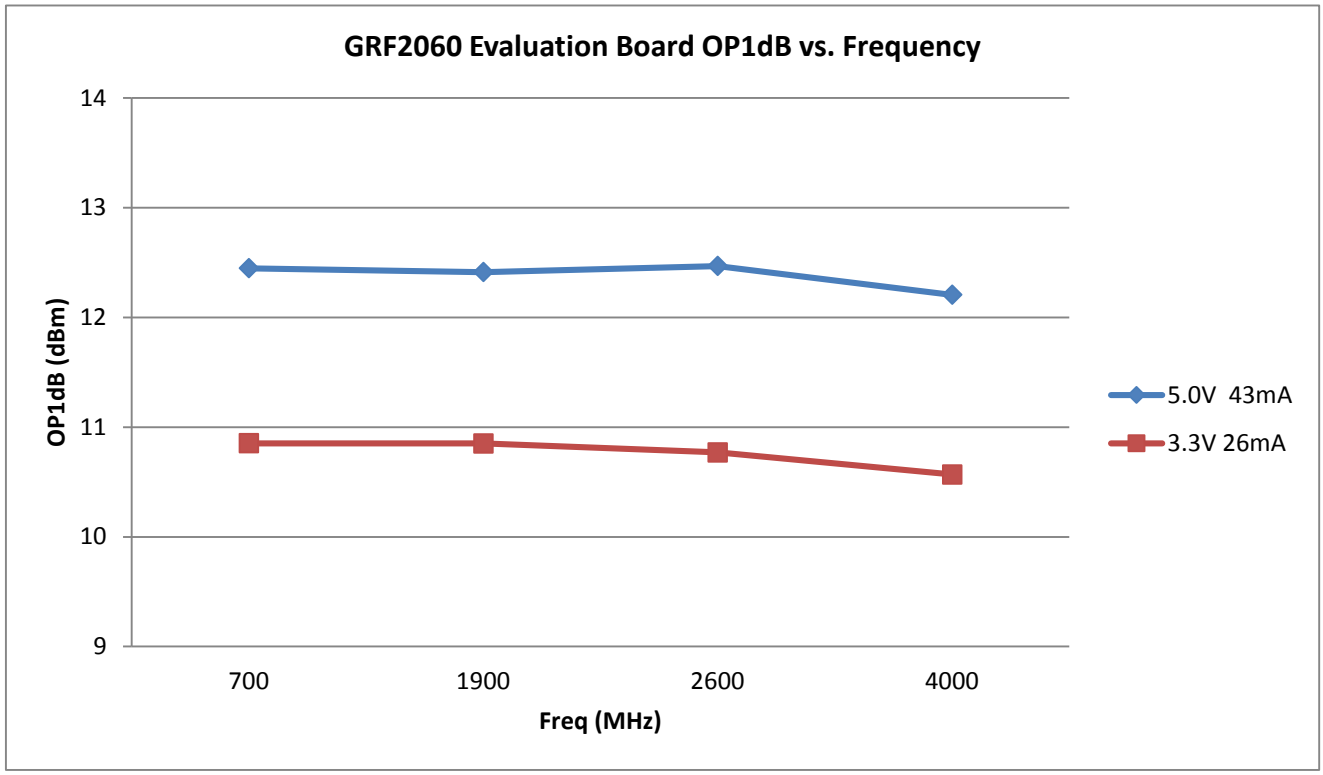
Pin	Name	Description	Note
1	Venable	LNA Enable Input	Venable < 0.2 volts turns the device off. Venable and series resistor M3 control the device Iddq.
2	GND	Ground	Connect to ground for maximum RF performance .
3	RF_In	LNA RF input	Internally matched 50Ω. Requires external DC block.
4	RF_Out	LNA RF output	Internally matched 50Ω. V_{DD} must be applied through a choke to this pin
5	GND	Ground	Connect to ground for maximum RF performance
6	GND	Ground	Connect to ground for maximum RF performance
PKG BASE	GND	Ground	Provides DC and RF ground for LNA, as well as thermal heat sink. Use multiple ground vias beneath the package for optimal RF and thermal performance

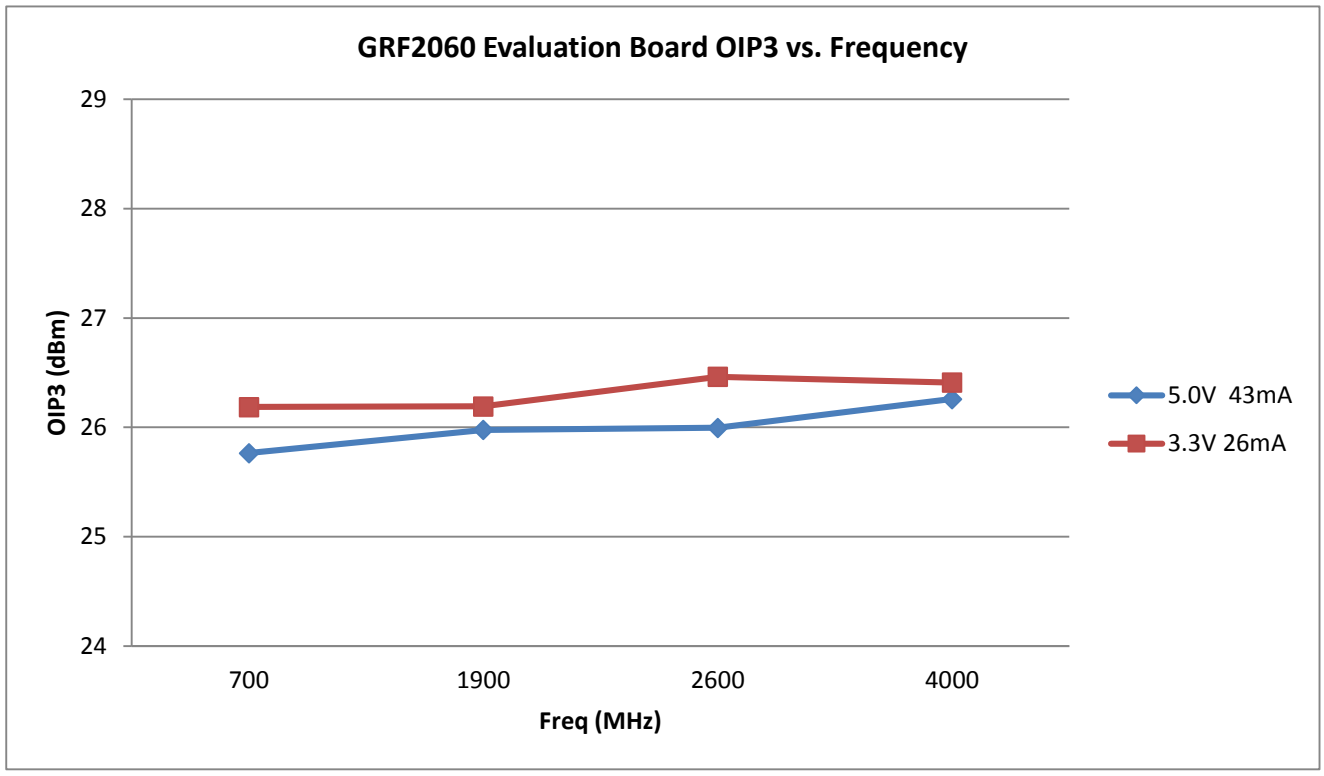
Venable Truth Table

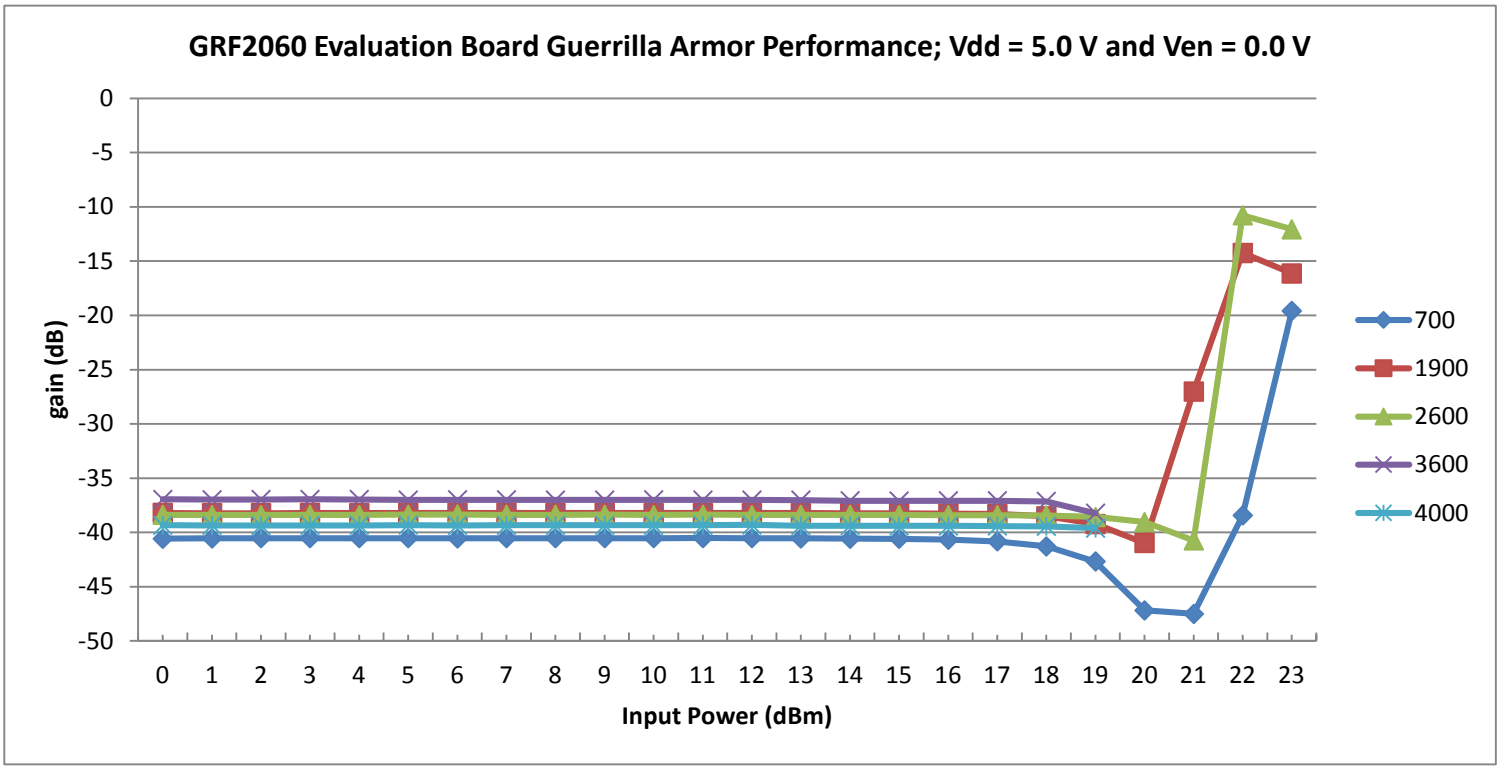
V_{ENABLE}	Mode
>=1.8V	LNA On
<0.5V	LNA Off


GRF2060 Evaluation Board Gain vs. Frequency
Gain (dB)
20
19
18
17
16
15
14
13
12
11
10
700
1900
2600
4000
Freq (MHz)
5.0V 43mA
3.3V 26mA

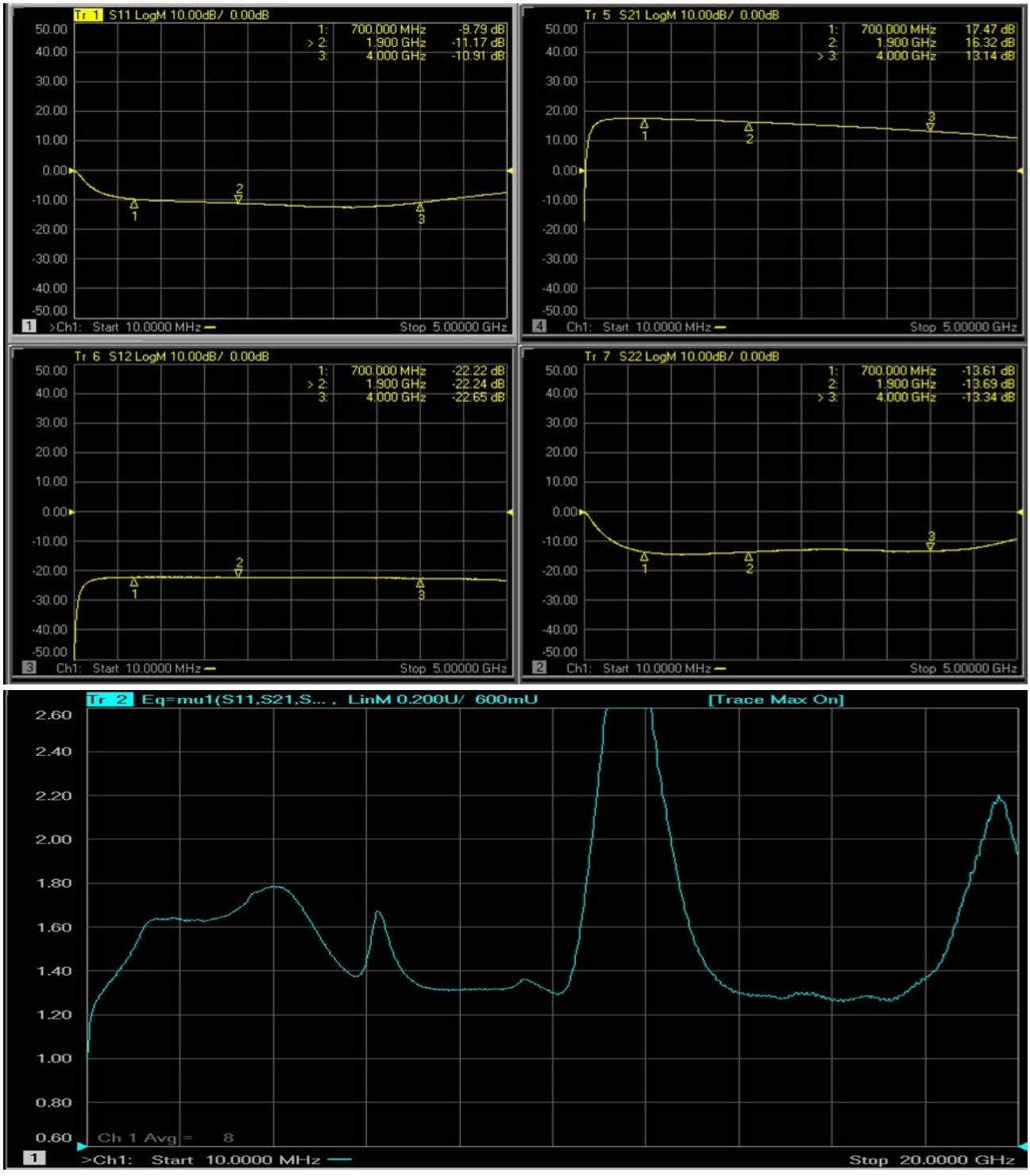

GRF2060 Noise Figure vs. Frequency
NF (dB)
2.2
2.1
2
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
700
1900
2600
4000
Freq (MHz)
Evaluation Board
De-embedded


GRF2060 Evaluation Board OP1dB vs. Frequency
OP1dB (dBm)
14
13
12
11
10
9
700
1900
2600
4000
Freq (MHz)
5.0V 43mA
3.3V 26mA

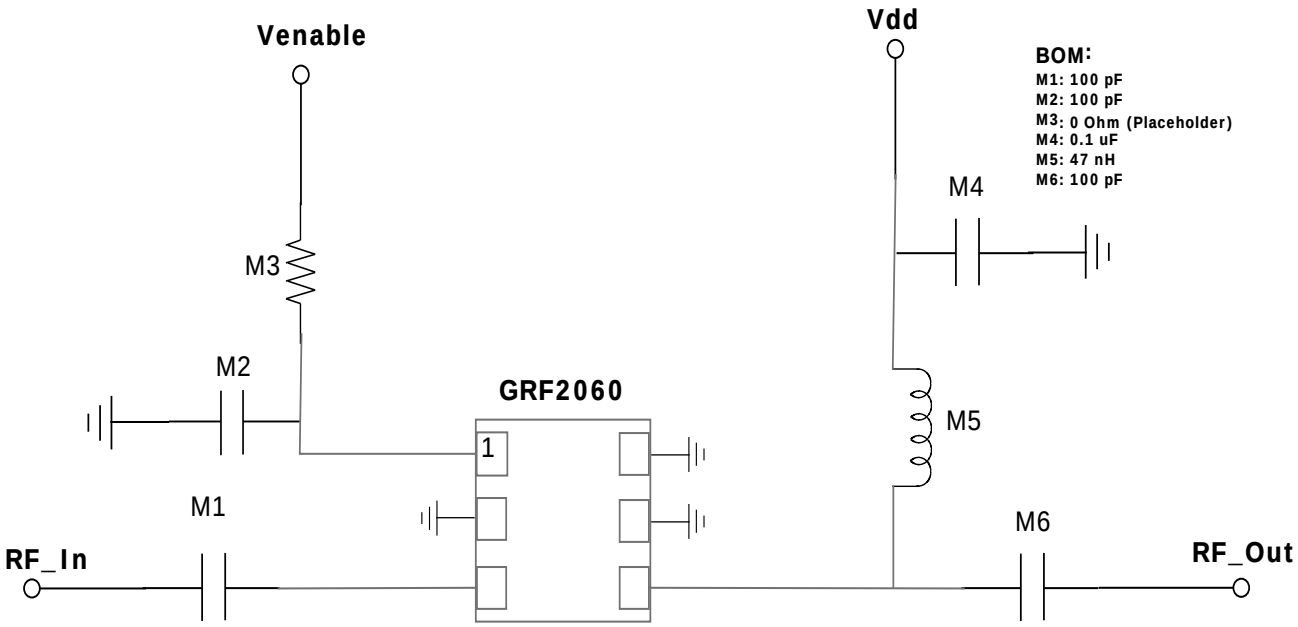

GRF2060 Evaluation Board OIP3 vs. Frequency
OIP3 (dBm)
29
28
27
26
25
24
700
1900
2600
4000
Freq (MHz)
5.0V 43mA
3.3V 26mA


GRF2060 Evaluation Board Guerrilla Armor Performance; Vdd = 5.0 V and Ven = 0.0 V
gain (dB)
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
-50
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23
Input Power (dBm)
700
1900
2600
3600
4000

GRF2060 Evaluation Board S-Pars and Stability Mu Factor:



Note: Mu >= 1.0 implies unconditional stability



GRF2060 Evaluation Board Application Schematic

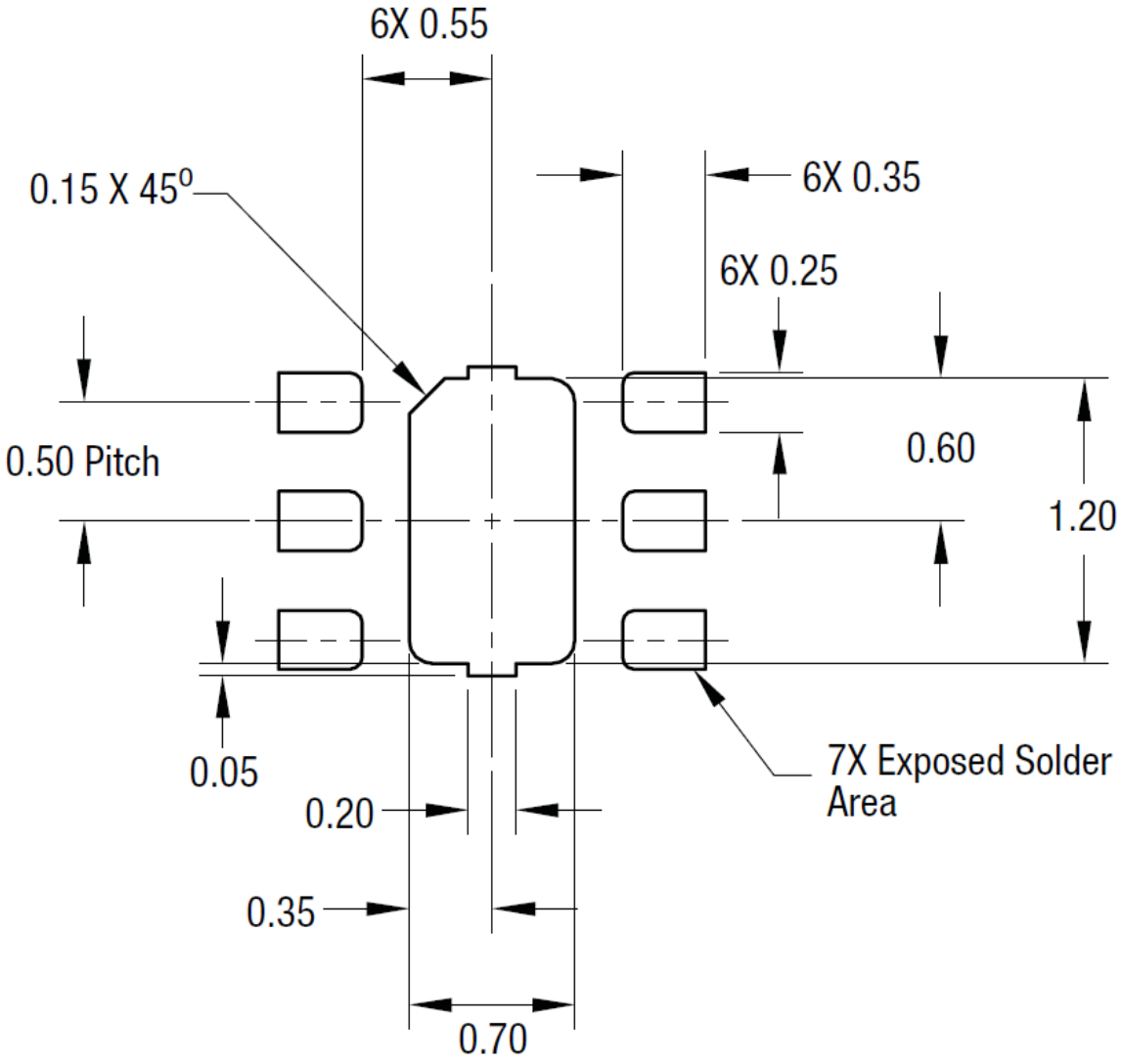
GRF2060 Theory of Operation:

The GRF2060 is a flat gain, linear gain block amplifier that is suitable for a wide range of applications. The device is internally matched to 50 ohms and covers 700 - 4000 MHz with a minimal number of external components.

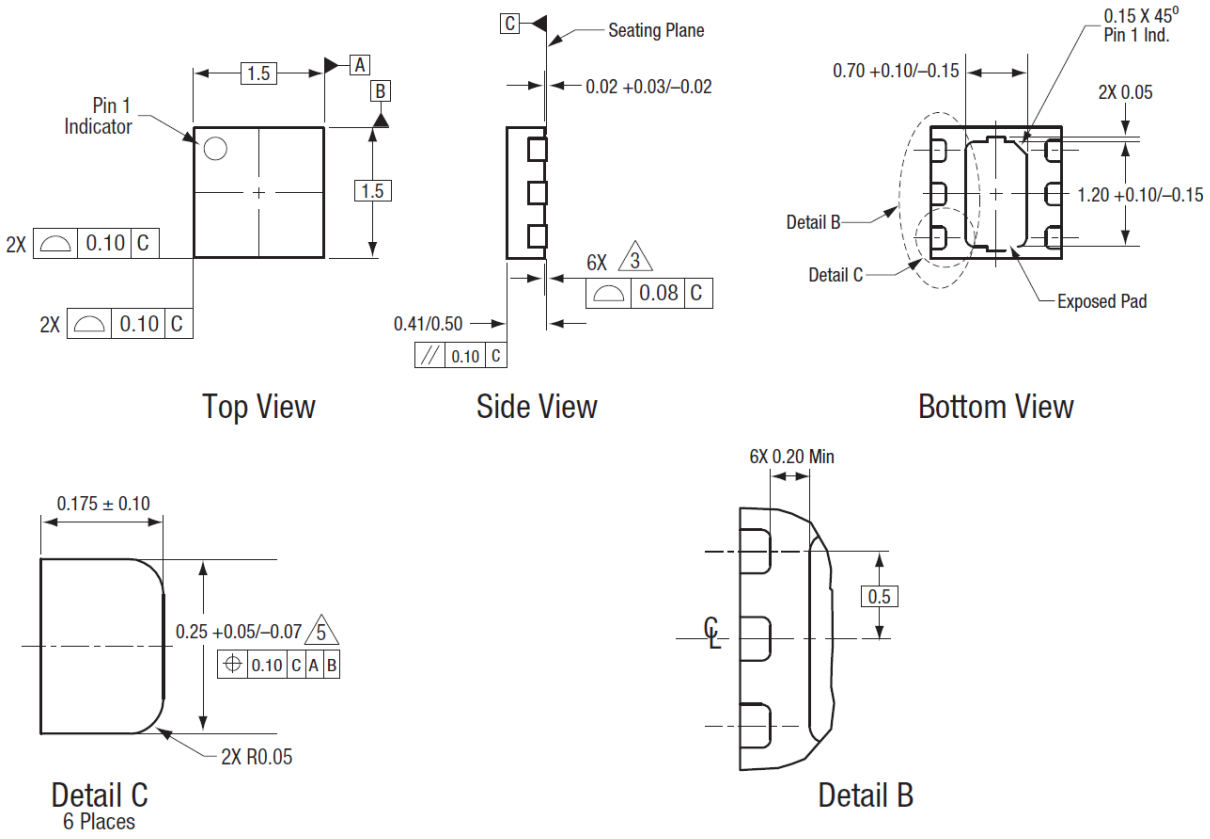
The device Iddq can be set independently from the drain voltage Vdd via the resistor M2 in series with Venable. This allows the device Iddq to be optimized to meet a given linearity requirement with the highest possible efficiency.

For a given Venable, increasing M3 will result in lower Iddq. The standard evaluation board is populated with a 0 Ohm resistor at M3 for evaluation purposes. With this resistor in place, the Venable voltage can be varied to achieve the desired Iddq to meet the target linearity requirements. The GRF applications team sees little performance benefit from GRF2060 Iddq values greater than 50 mA.

GRF2060 Bias Resistor vs. Iddq Table: (TBD)



GRF2060 1.5 x 1.5 mm 6-Pin DFN PCB Layout Footprint



All measurements are in millimeters.
Dimensioning and tolerancing according to ASME Y14.5M-1994.
Coplanarity applies to the exposed heat sink slug as well as the terminals..
Plating requirement per source control drawing (SCD) 2504.
Dimension applies to metalized terminal and is measured between 0.15 mm and 0.30 mm from terminal tip.

GRF2060 6-Pin DFN Package Dimensions

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.