Preliminary

GRF2001

Broadband Gain Block; 0.05 – 11.0 GHz

Package: 1.5 x 1.5 mm DFN-6

Features

- Bandwidth: 0.05 to 11.0 GHz
- Gain: 14.6 dB @ 2.0 GHz
- Gain: 10.0 dB @ 11.0 GHz
- OP1dB: +12.6 dBm @ 2.0 GHz
- OP1dB: +13.0 dBm @ 11.0 GHz
- OIP3: +28.0 dBm @ 2.0 GHz
- NF: 3.3 dB 2.0 GHz
- Flexible Bias Voltage and Current

Applications

- Microwave Backhaul
- Multi-stage Cascaded Amplifiers
- C and X-Band Amplifiers
- Fast Switching TDD Systems
- General Purpose Amplifier

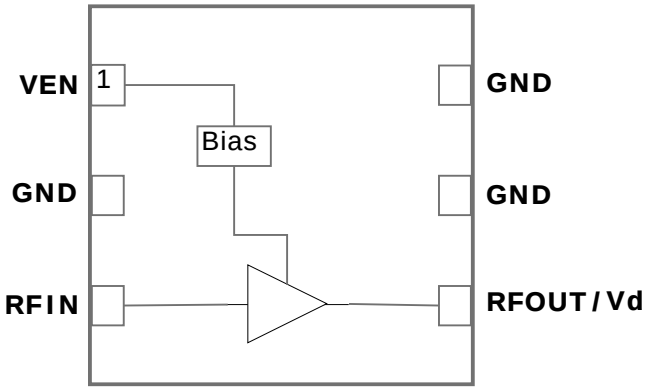
Product Description

The GRF2001 is a broadband, low noise, linear gain block designed for small cell, wireless infrastructure and other high performance RF applications. Internally matched to 50 ohms, it exhibits low NF, with good linearity and gain flatness over 0.05 to 11.0 GHz.

Due to its flexible biasing capability, GRF2001 offers high levels of reuse both within a design and across platforms. The device can be operated over a range of supply voltages (Vdd) from 2.7 to 5.5 V with a typical Iddq range of 30 to 65 mA for optimal efficiency and linearity.

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	Vd	0	5.5	V
RF Input Power: (Load VSWR < 2:1; V_D: 5.0 volts)	$P_{IN\ MAX}$		+15	dBm
Operating Temperature (Package Heat Sink)	T_{AMB}	-40	+105	°C
Storage Temperature	T_{STG}	-40	+150	°C
Maximum Channel Temperature (MTTF > 10^6 Hours)	Tmax		+160	°C
Maximum Quiescent Current	$I_{DDQ\ MAX}$		100	mA
Maximum Dissipated Power (Note: De-rate 8 mW/°C for T_{AMB} > +85C.	$P_{DISS\ MAX}$		325	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

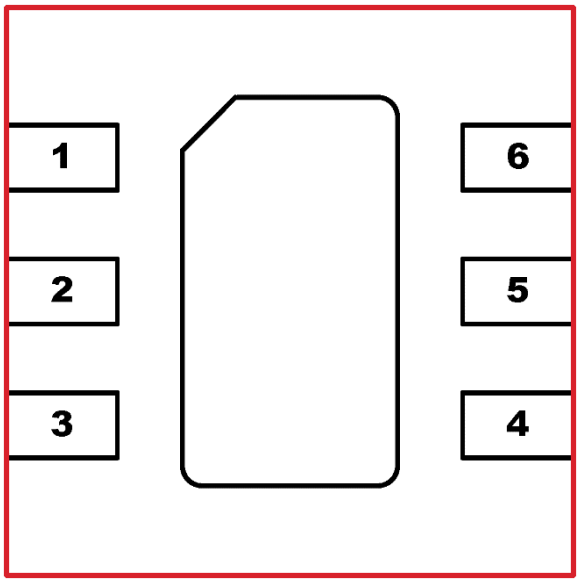
Caution! ESD Sensitive Device

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

Nominal Operating Parameters

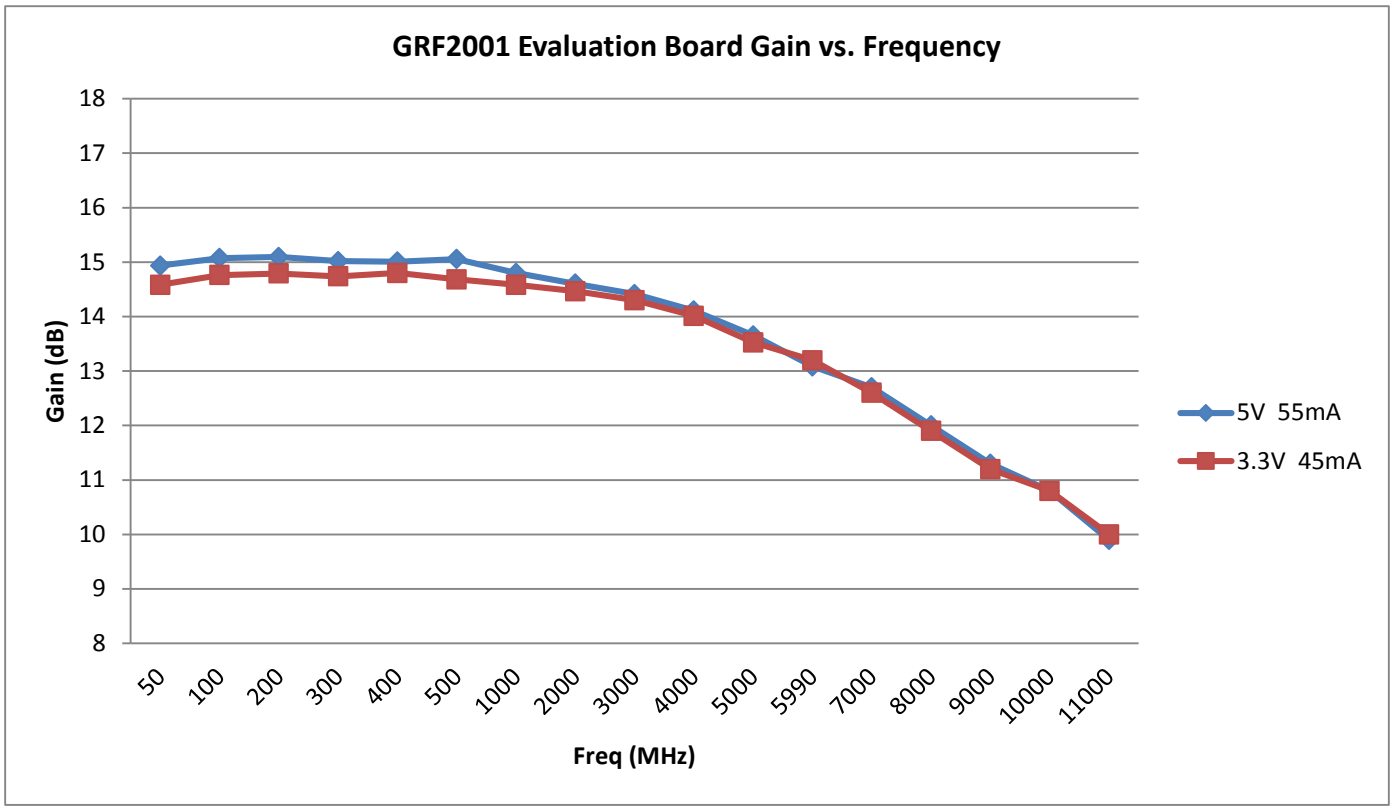
Parameter	Symbol	Specification			Unit	Condition
		Min.	Typ.	Max.		
Gain Mode (Venable high)						Vdd = 5.0 V, T_A = 25°C
Test Frequency	F_{test}		2.0		GHz	
Gain	S21		14.6		dB	
Input Return Loss	S11		-10		dB	
Output Return Loss	S22		-20		dB	
Noise Figure (De-embedded)	NF		3.3		dB	Input trace losses included
Output 3rd Order Intercept	OIP3		+28.0		dBm	+2 dBm P_{OUT} per tone at 2 MHz Spacing (2599 and 2601 MHz)
Ouput 1dB Compression Power	OP1dB		+12.5		dBm	
Switching Rise Time	T_{RISE}		300		ns	
Switching Fall Time	T_{FALL}		300		ns	
Supply Current	Idd		55		mA	Adjustable for optimal IP3
Enable Current	Ienable		3		mA	
Thermal Data						
Thermal Resistance (measured via IR scan)	Θjc		198		°C/W	On standard evaluation board
Channel Temperature @ +85 C Reference (Package Heat Sink)	Tchannel		140		°C	Vdd: 5.0 V; Iddq: 55 mA; No RF; Pdiss: 275 mW

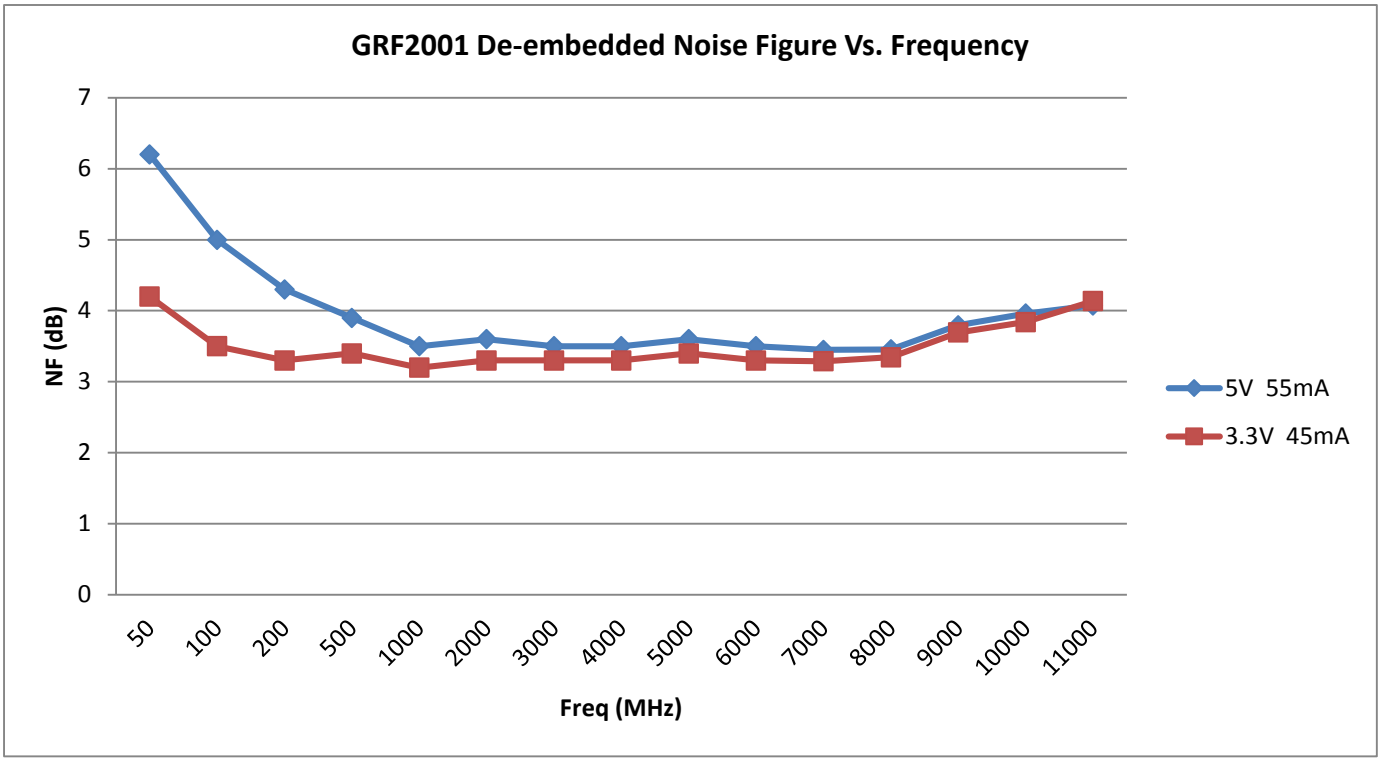
Pin Out

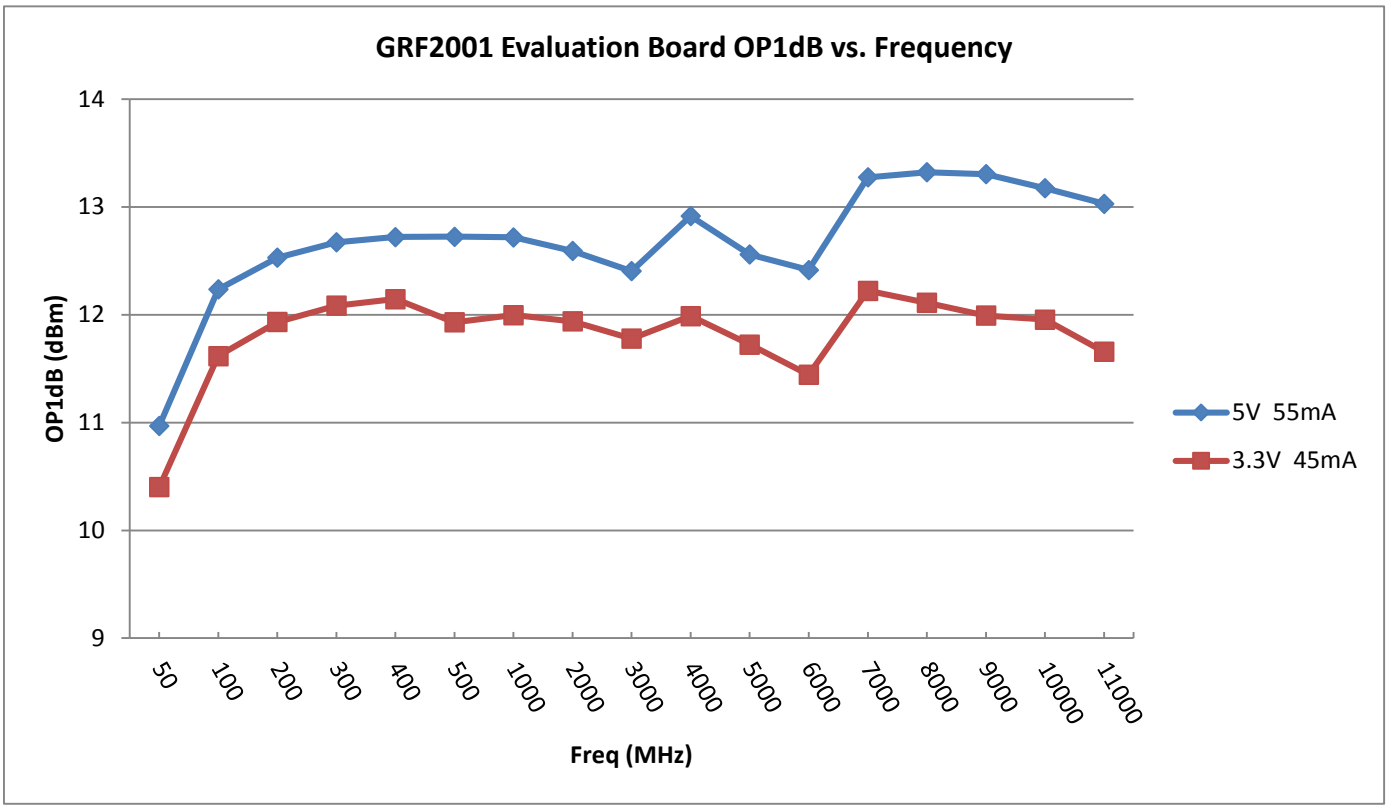


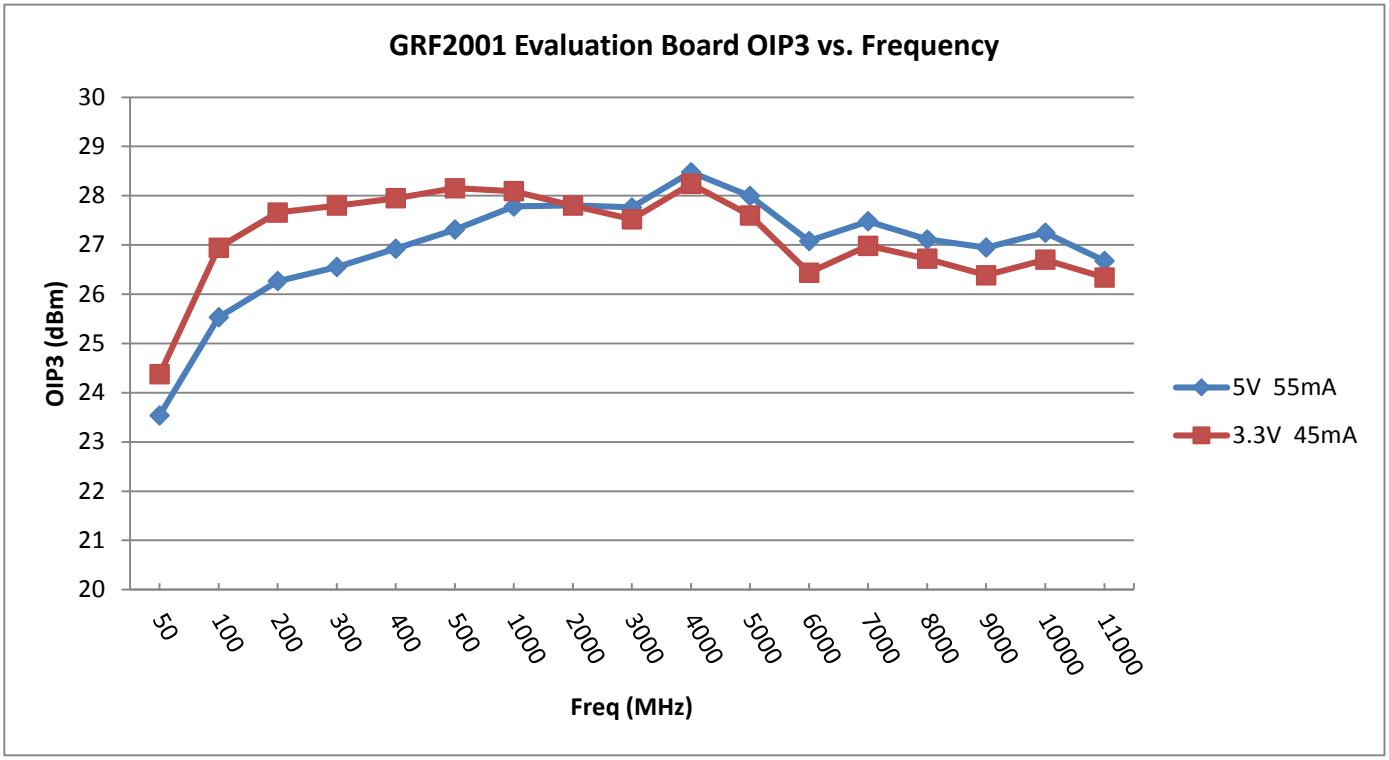
Pin Assignments

Pin	Name	Description	Note
1	V_{ENABLE}	Enable Voltage Input	Venable < 0.2 volts turns the device off. Venable and series resistor control the device Iddq.
2	GND	Ground	Connect to ground for maximum RF performance.
3	RF_{IN}	LNA RF input	Internally matched 50 Ω. This pin must be DC blocked.
4	RF_{OUT}	LNA RF output	Internally matched 50 Ω. 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.

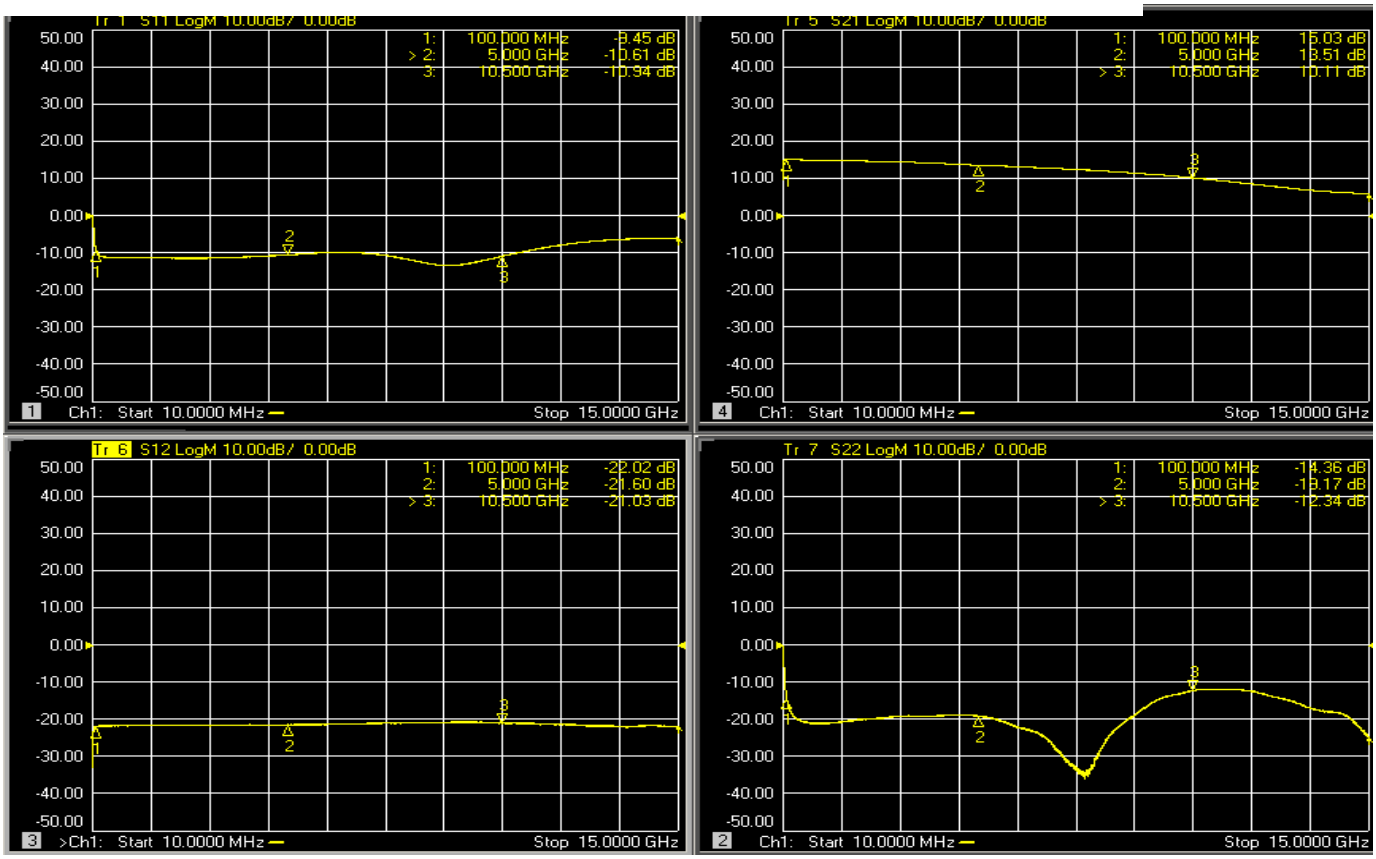

GRF2001 Evaluation Board Gain vs. Frequency
Gain (dB)
18
17
16
15
14
13
12
11
10
9
8
50
100
200
300
400
500
1000
2000
3000
4000
5000
5990
7000
8000
9000
10000
11000
Freq (MHz)
5V 55mA
3.3V 45mA

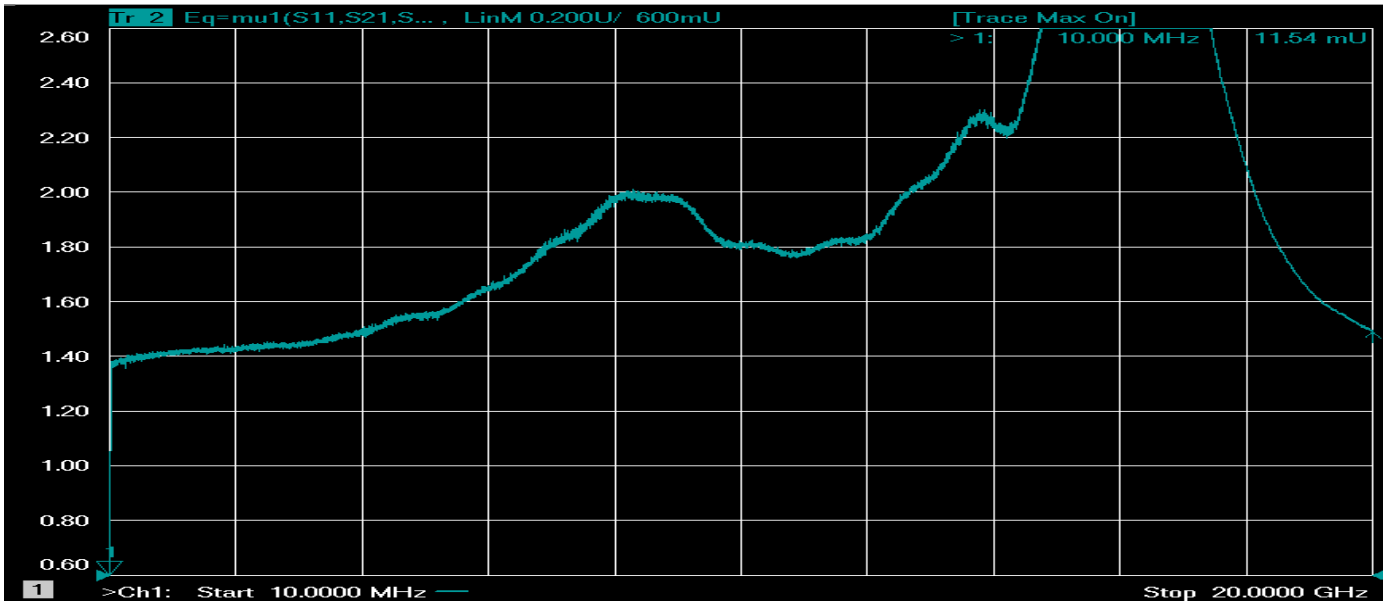

GRF2001 De-embedded Noise Figure Vs. Frequency
NF (dB)
7
6
5
4
3
2
1
0
50
100
200
500
1000
2000
3000
4000
5000
6000
7000
8000
9000
10000
11000
Freq (MHz)
5V 55mA
3.3V 45mA


GRF2001 Evaluation Board OP1dB vs. Frequency
OP1dB (dBm)
14
13
12
11
10
9
50
100
200
300
400
500
1000
2000
3000
4000
5000
6000
7000
8000
9000
10000
11000
Freq (MHz)
5V 55mA
3.3V 45mA

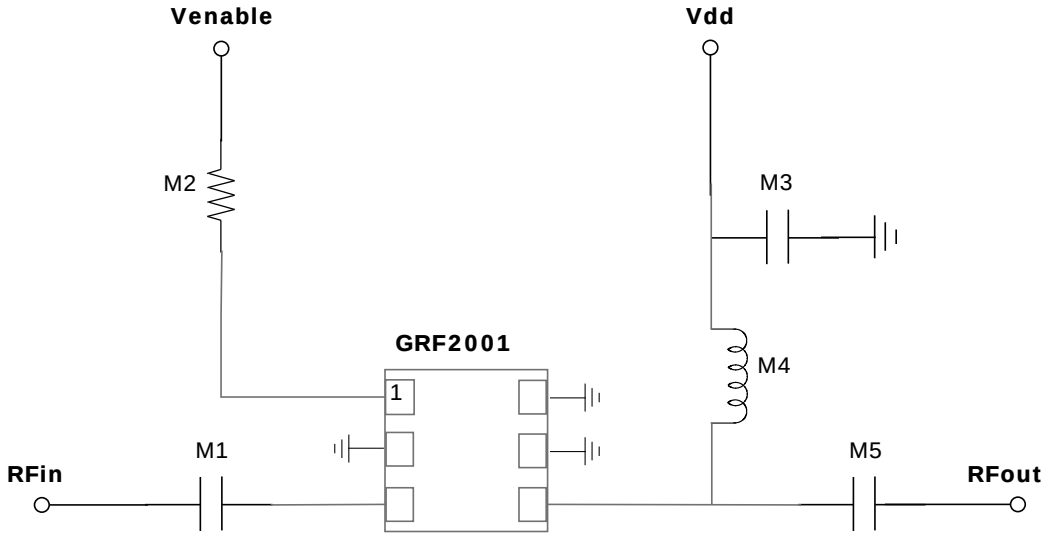

GRF2001 Evaluation Board OIP3 vs. Frequency
OIP3 (dBm)
30
29
28
27
26
25
24
23
22
21
20
50
100
200
300
400
500
1000
2000
3000
4000
5000
6000
7000
8000
9000
10000
11000
Freq (MHz)
5V 55mA
3.3V 45mA

GRF2001 Evaluation Board S-Parameters and Stability Mu Factor





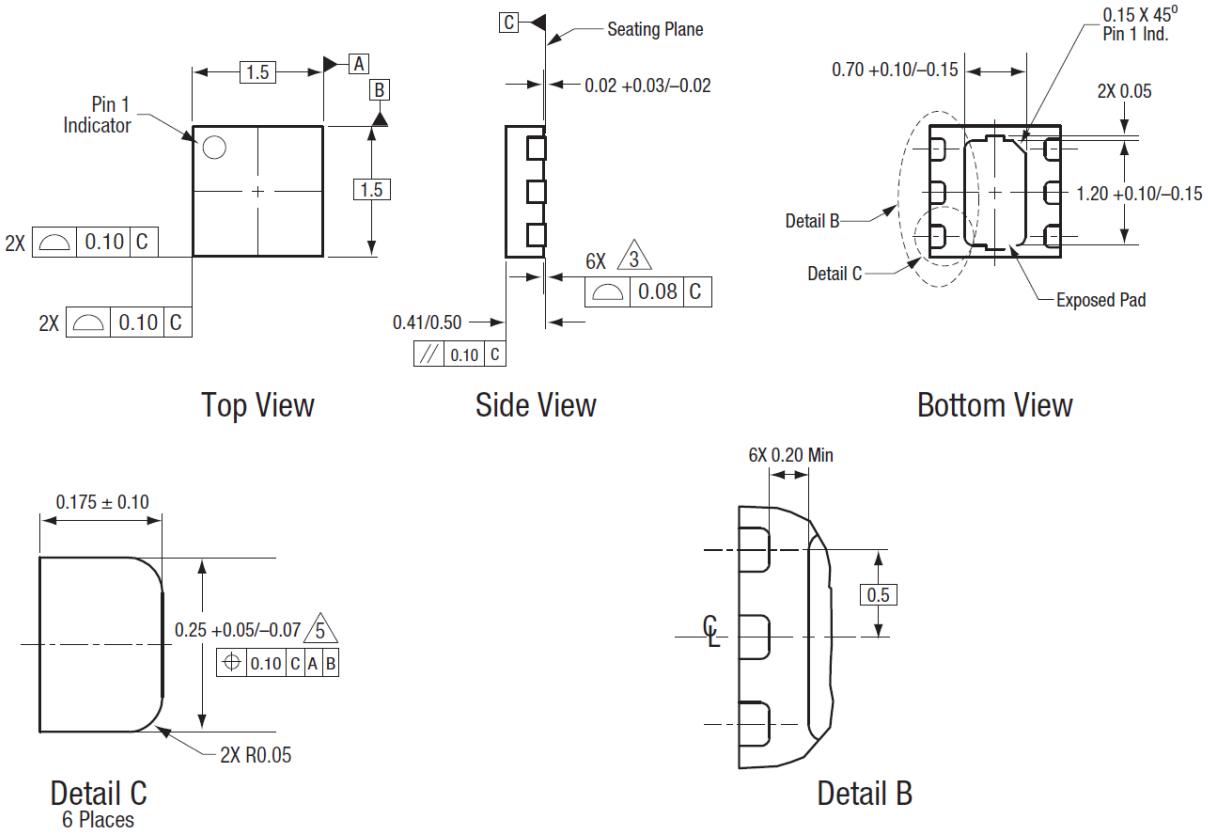
Note: Mu >= 1.0 implies unconditional stability



GRF2001 Application Schematic

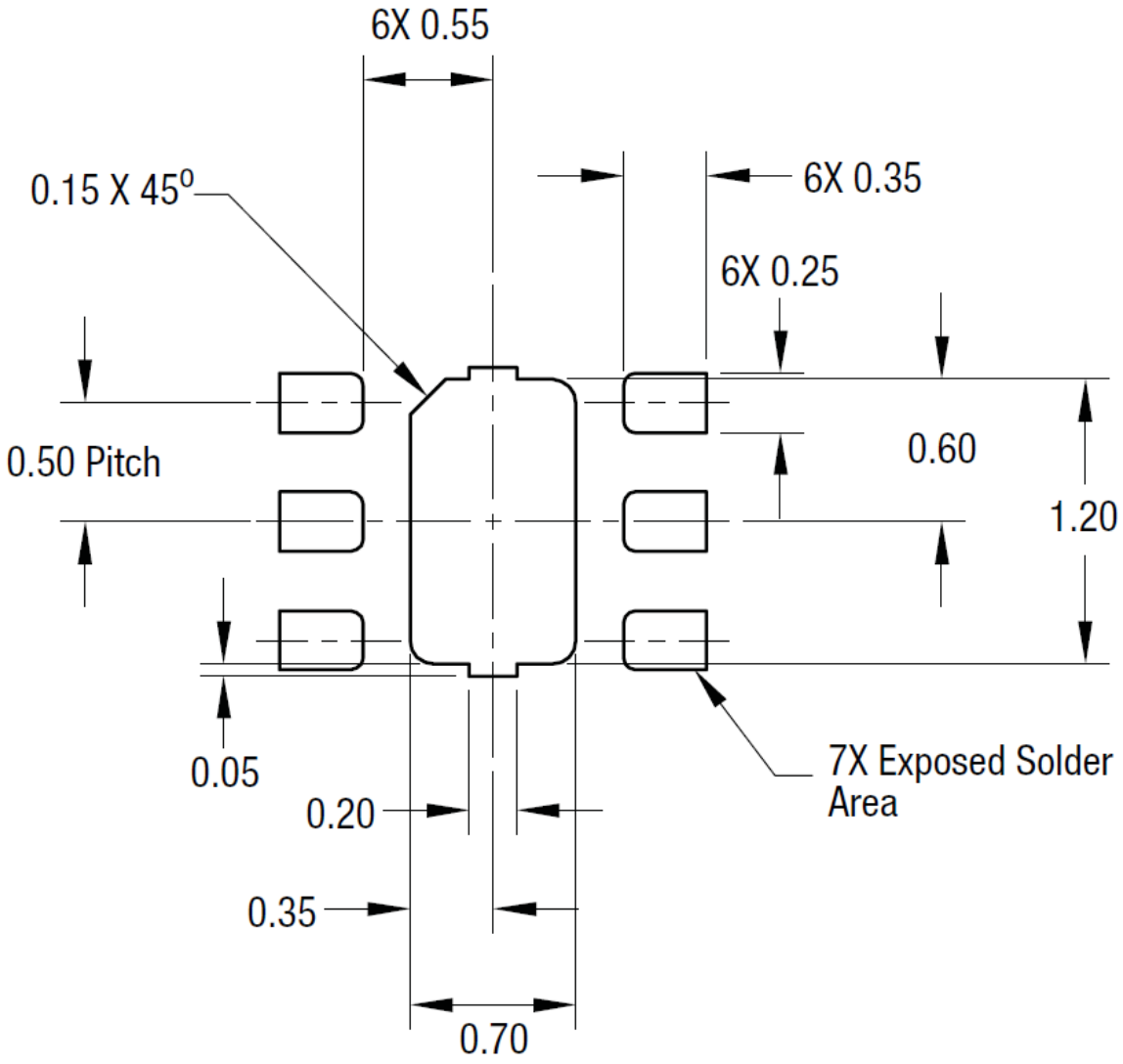
Device	Vdd	Venable	M2 (ohms)	Iddq (mA)		Device	Vdd	Venable	M2 (ohms)	Iddq (mA)		Device	Vdd	Venable	M2 (ohms)	Iddq (mA)
GRF2001	5.0	5.0	3000	55		GRF2001	4.5	4.5	700	55		GRF2001	4.0	4.0	0	55
GRF2001	5.0	5.0	4300	50		GRF2001	4.5	4.5	1600	50		GRF2001	4.0	4.0	500	50
GRF2001	5.0	5.0	6000	45		GRF2001	4.5	4.5	2500	45		GRF2001	4.0	4.0	1300	45
GRF2001	5.0	5.0	7000	40		GRF2001	4.5	4.5	4000	40		GRF2001	4.0	4.0	2000	40
GRF2001	5.0	5.0	10000	35		GRF2001	4.5	4.5	6000	35		GRF2001	4.0	4.0	3300	35
GRF2001	5.0	5.0	13000	30		GRF2001	4.5	4.5	10000	30		GRF2001	4.0	4.0	6000	30
GRF2001	5.0	5.0	23000	25		GRF2001	4.5	4.5	15000	25		GRF2001	4.0	4.0	10000	25
Device	Vdd	Venable	M2 (ohms)	Iddq (mA)		Device	Vdd	Venable	M2 (ohms)	Iddq (mA)		Device	Vdd	Venable	M2 (ohms)	Iddq (mA)
GRF2001	3.6	3.6	0	50		GRF2001	3.3	3.3	0	45		GRF2001	3.0	3.0	0	40
GRF2001	3.6	3.6	500	45		GRF2001	3.3	3.3	500	40		GRF2001	3.0	3.0	500	35
GRF2001	3.6	3.6	1200	40		GRF2001	3.3	3.3	1300	35		GRF2001	3.0	3.0	1500	30
GRF2001	3.6	3.6	2200	35		GRF2001	3.3	3.3	2600	30		GRF2001	3.0	3.0	3500	25
GRF2001	3.6	3.6	4000	30		GRF2001	3.3	3.3	5000	25						
GRF2001	3.6	3.6	7000	25												

Note: For a given Venable voltage and desired Iddq, use the above table to determine the required M2 resistor value. Vdd higher than Venable will result in a slight increase in Iddq compared to Vdd = Venable.



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.

GRF2001 6-Pin DFN Package Dimensions



GRF2001 1.5 x 1.5mm 6-Pin DFN PCB Layout Footprint

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.