Preliminary

GRF2104

Broadband, Linear LNA for Small Cells/Infrastructure

Package: 6-Pin DFN

Features

- Internally Matched: 700 - 2700 MHz
- Reference Bias Condition: 3.3V/65 mA
- Gain: 19.9 to 18.4 dB; 700 - 2700 MHz
- Noise Figure: 0.45 dB @ 2500 MHz
- IIP3: +13.5 dBm @ 2500 MHz
- IP1dB: +2.0 dBm @ 2500 MHz

Applications

- Small Cells and Cellular Repeaters
- First Stage LNA
- Fast Switching TDD Systems
- Low Voltage Radio
- General Purpose Amplifier

Product Description

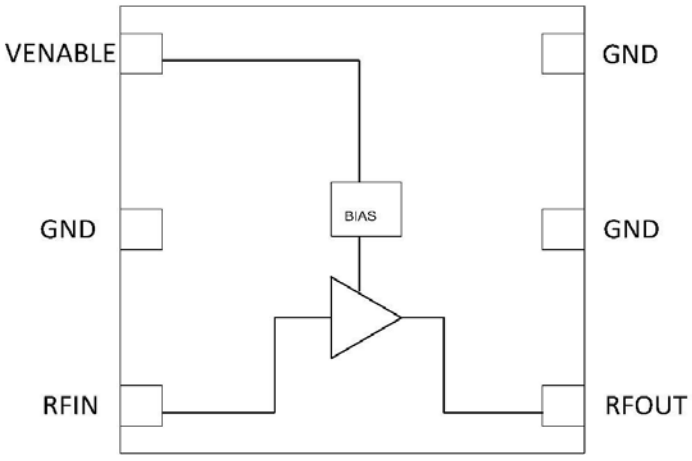
The GRF2104 is a broadband, ultra-low noise linear amplifier designed for small cell, wireless infrastructure and other high performance RF applications. With fully integrated matching, it exhibits outstanding NF, linearity, return losses and flat gain over 700 to 2700 MHz. External matching can be added to achieve good performance to 3800 MHz.

Configured as a first stage LNA, linear driver or cascaded gain block, GRF2104 offers high levels of reuse both within a design and across platforms. The device is operated from a supply voltage (Vdd) range of 3.3 to 5.0 V with a typical Iddq of 65 mA for optimal efficiency and linearity.

Housed in a 1.5 x 1.5 x 0.5 mm 6-pin plastic DFN, GRF2104 is internally pre-matched to 50 Ω at the input and output ports, requiring minimal external matching.

Functional Block Diagram

1.5mm X 1.5mm 6-Pin DFN Package



Absolute Ratings

Parameter	Symbol	Min.	Max.	Unit
Drain Voltage	Vd	0	6.0	V
RF Input Power: (Load VSWR < 2:1; V_D: 5.0 volts)	$P_{IN\ MAX}$		+18	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 Disspated Power (Note: De-rate 8 mW/°C for T_{AMB} > +85C.	$P_{DISS\ MAX}$		500	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

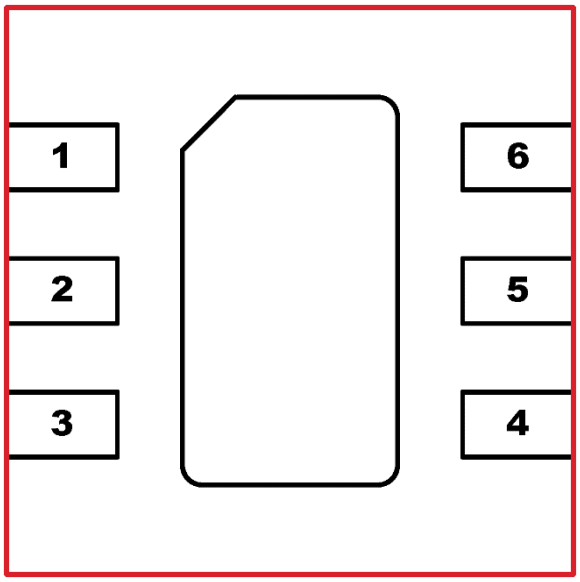
Caution! ESD Sensitive Device

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 = 3.3 V, T_A = 25°C
Test Frequency	F_{test}		2500		MHz	
Gain	S21		18.5		dB	
Input Return Loss	S11		-11		dB	
Output Return Loss	S22		-20		dB	
Noise Figure	NF		0.45		dB	Input trace losses de-embedded
Input 3rd Order Intercept	IIP3		+14.0		dBm	+2 dBm P_{OUT} per tone at 2 MHz Spacing (2599 and 2601 MHz)
Input 1dB Compression Power	IP1dB		+0.5		dBm	
Switching Rise Time	T_{RISE}		300		ns	
Switching Fall Time	T_{FALL}		300		ns	
Supply Current	Idd		65		mA	Adjustable for optimal IP3
Enable Current	Ienable		3		mA	
Thermal Data						
Thermal Resistance (measured via IR scan)	Θjc		132		°C/W	On standard evaluation board
Channel Temperature @ +85 C Reference (Package Heat Sink)	Tchannel		+113		°C	Vdd: 3.3 V; Iddq: 65 mA; No RF; Pdiss: 215 mW

Pin Out

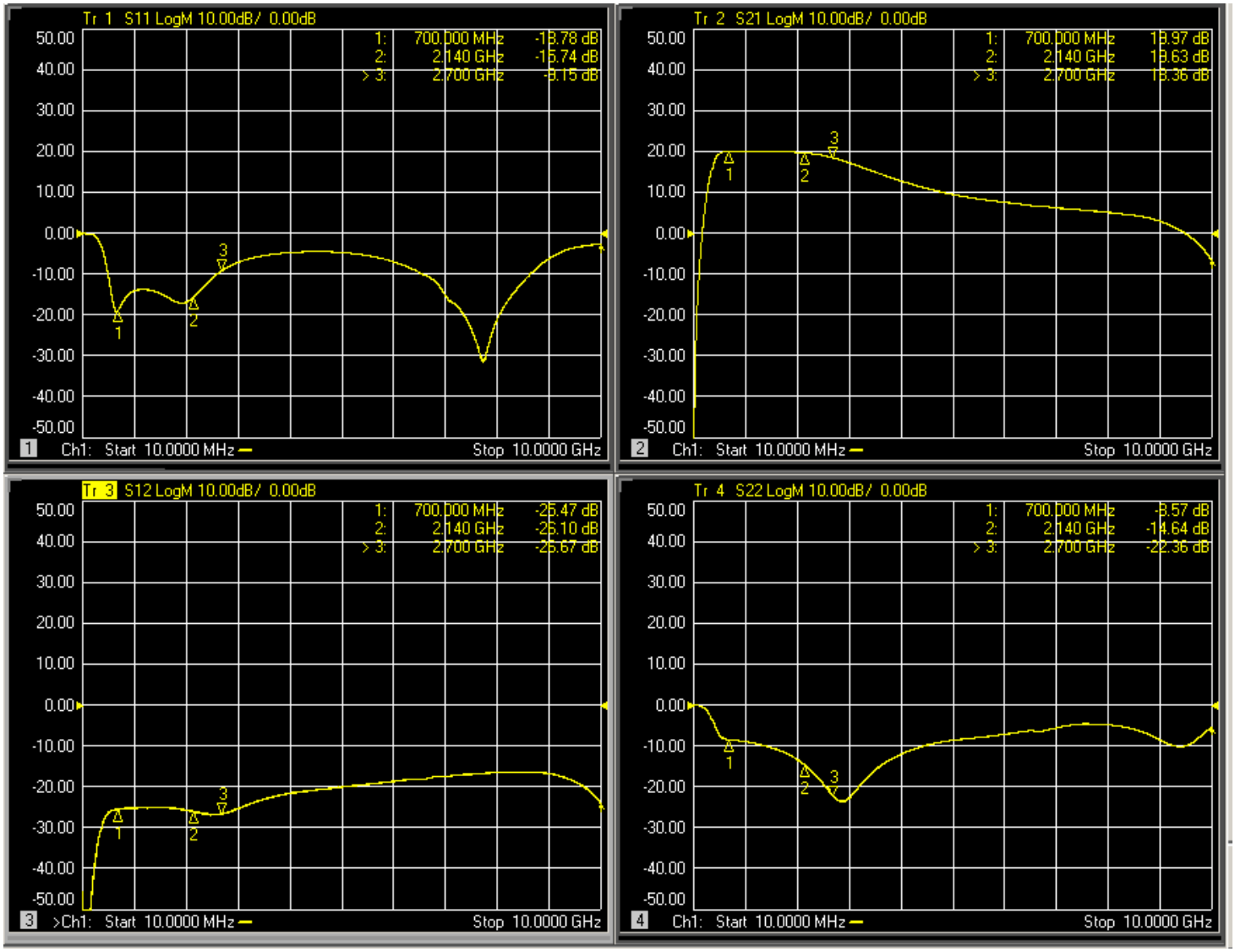


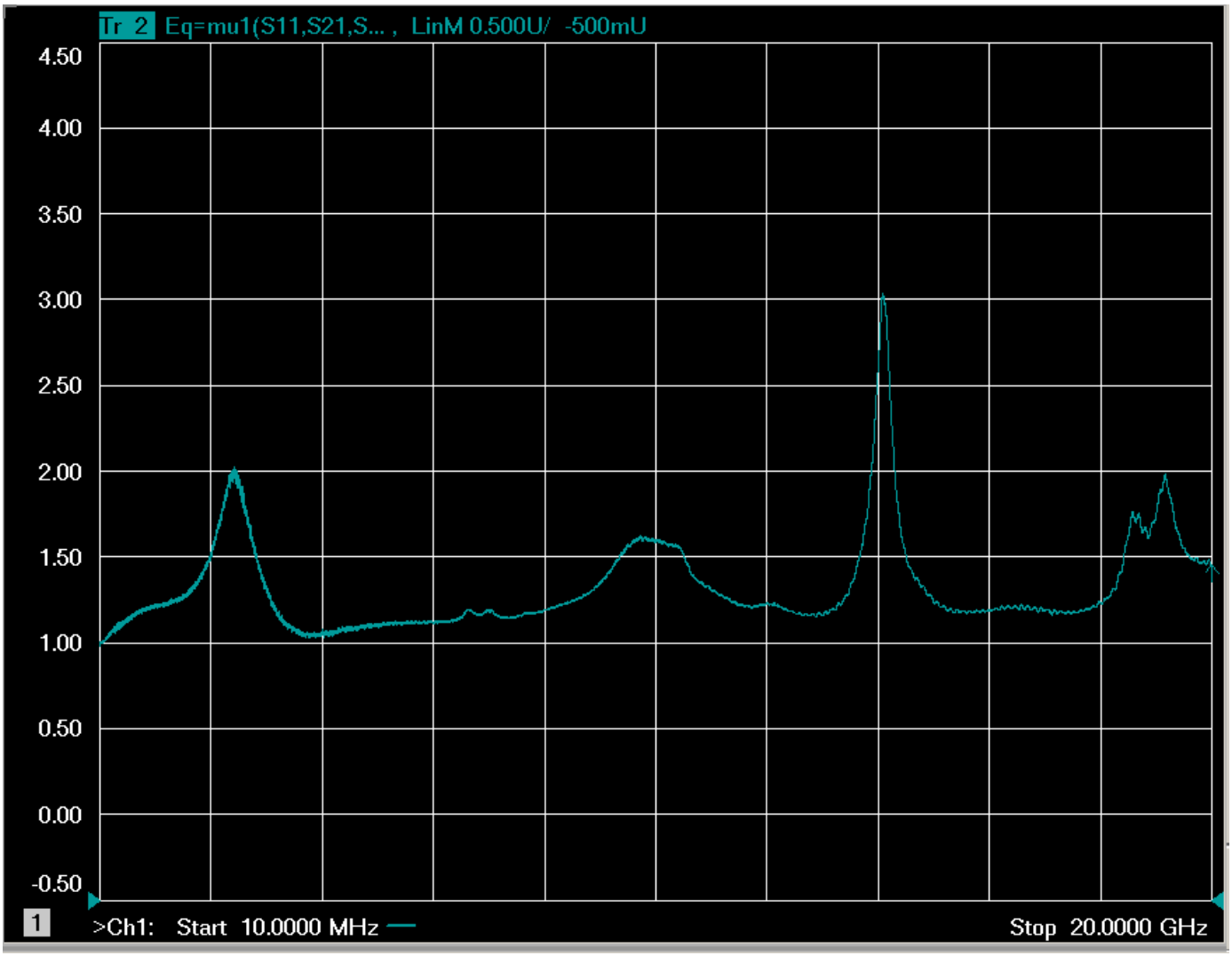
Pin Assignments

Pin	Name	Description	Note
1	V_{ENABLE}	LNA RF 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. An optional inductor to ground is added to slightly improve S(1,1)
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.

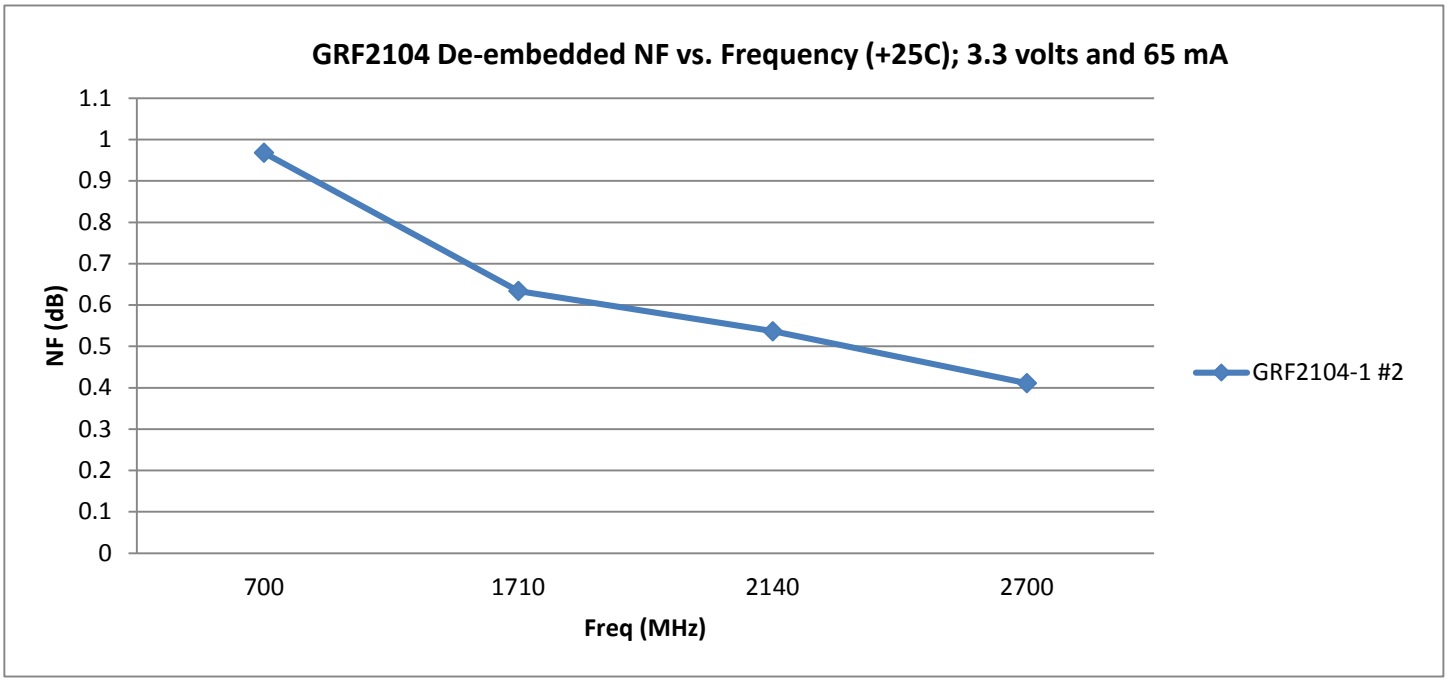
GRF2104 Measured Evaluation Board S-Parameters; (3.3 volts and 65 mA):

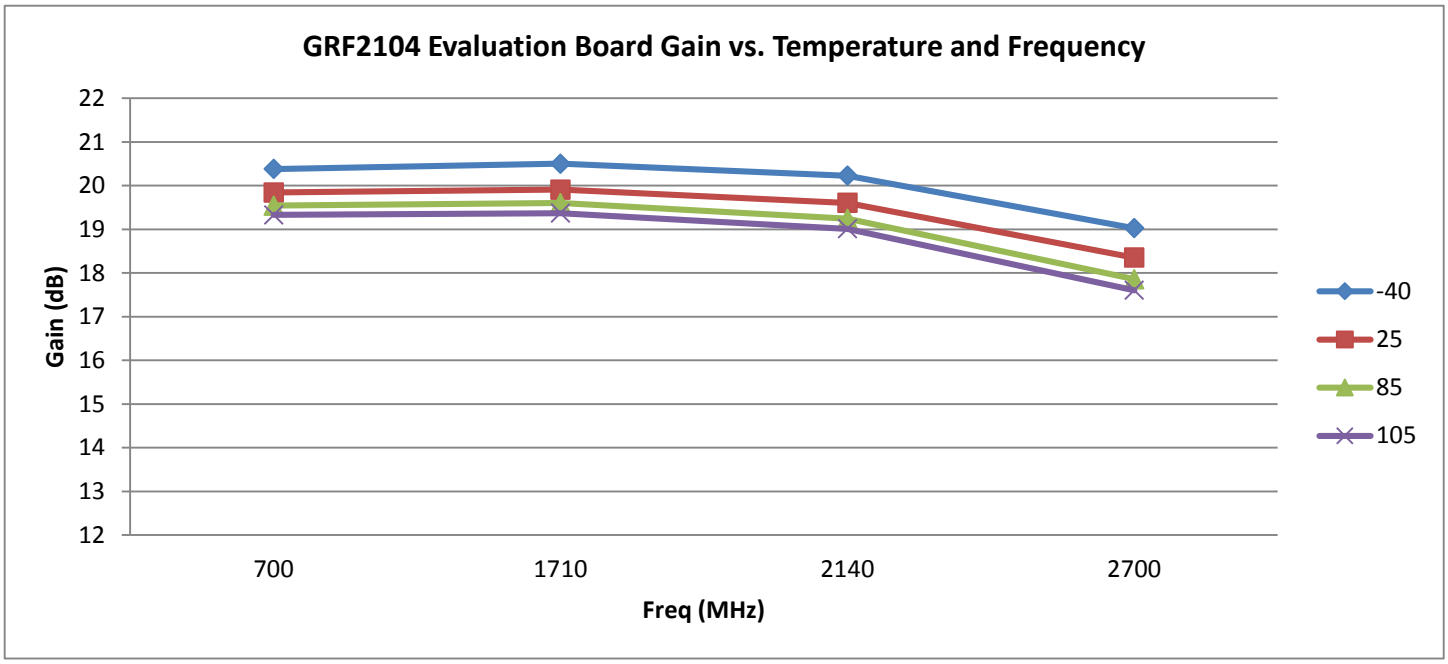
Note: This device is internally broadband pre-matched to 50 ohms.

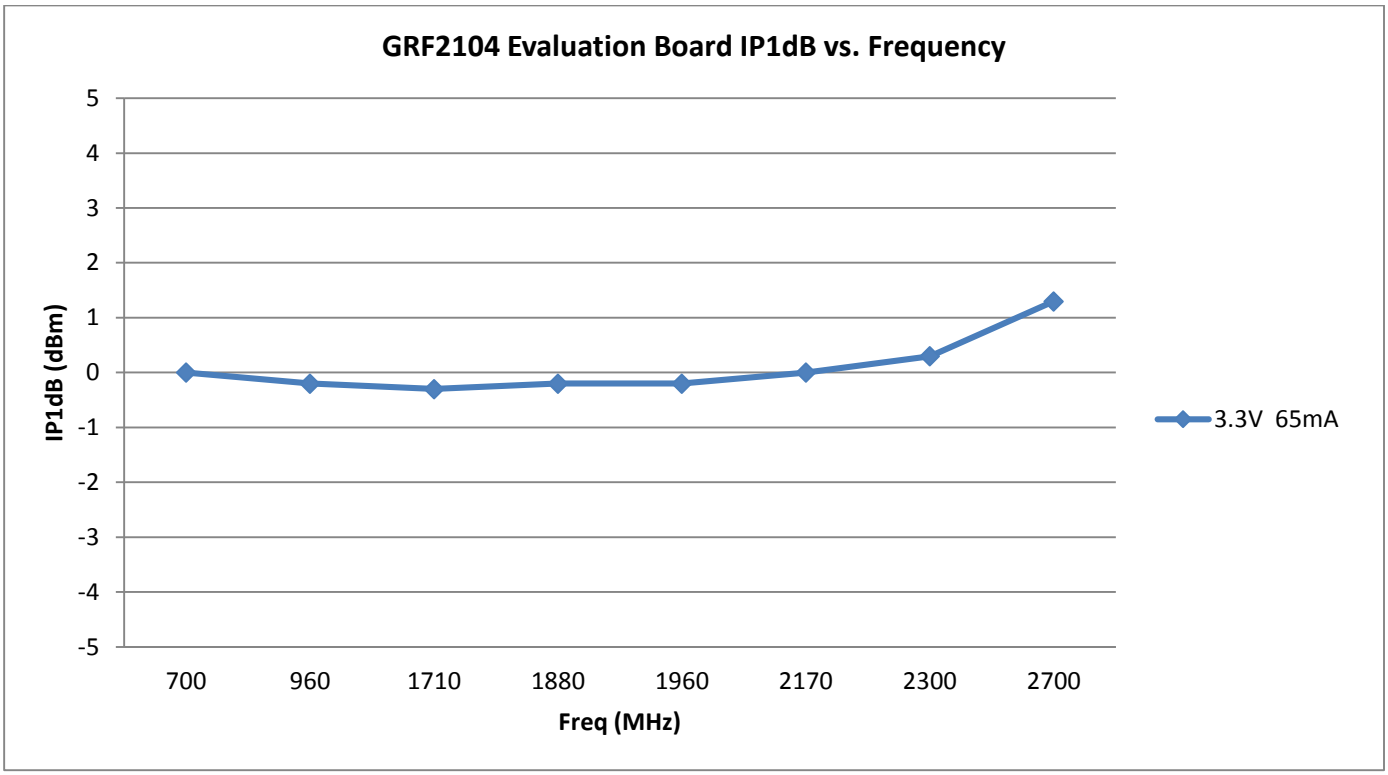


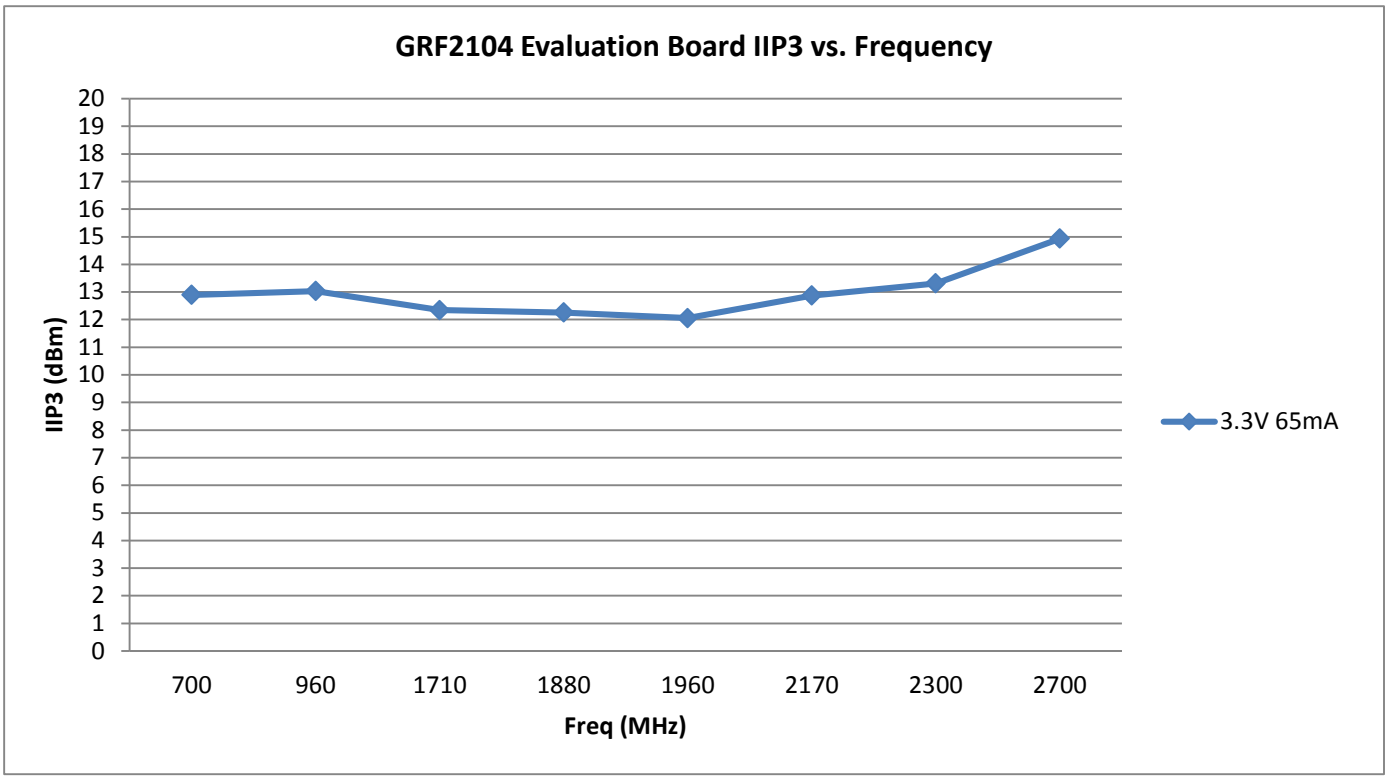


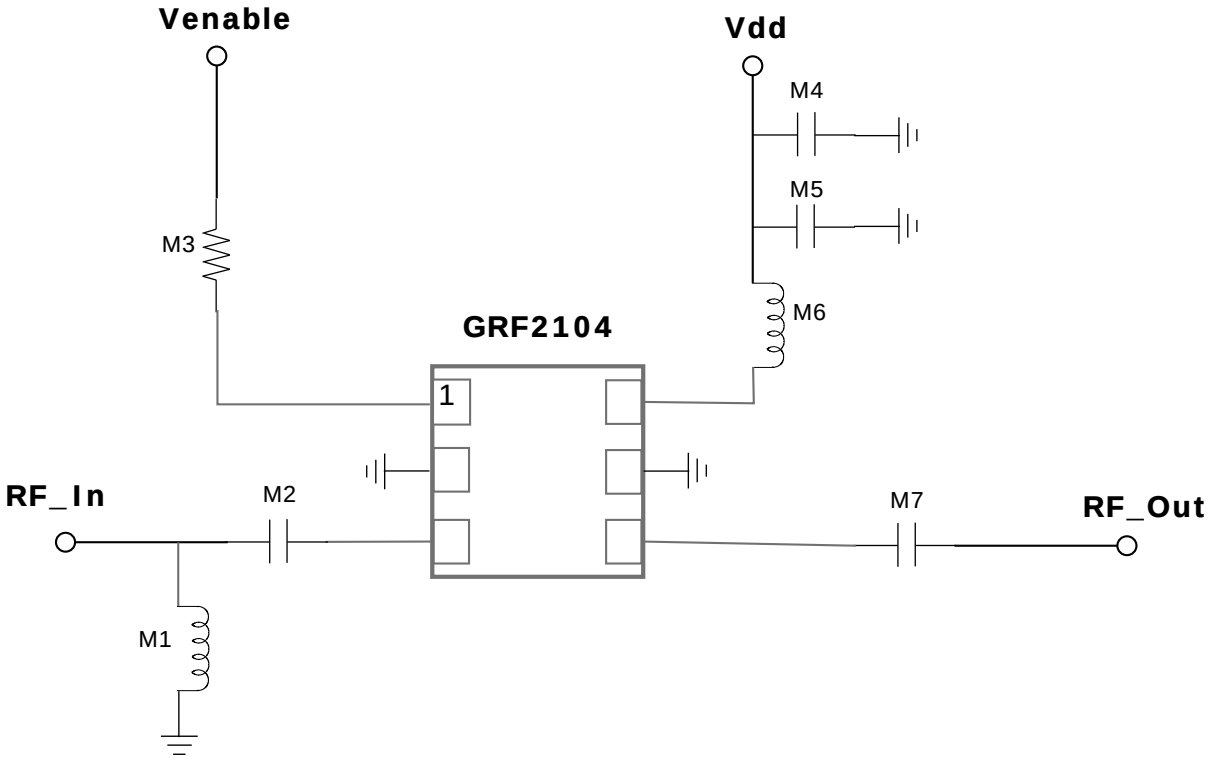
GRF2104 Measured Evaluation Board Stability Mu Factor; (3.3 volts and 65 mA):


GRF2104 De-embedded NF vs. Frequency (+25C); 3.3 volts and 65 mA
NF (dB)
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
700
1710
2140
2700
Freq (MHz)
GRF2104-1 #2


GRF2104 Evaluation Board Gain vs. Temperature and Frequency
Gain (dB)
22
21
20
19
18
17
16
15
14
13
12
700
1710
2140
2700
Freq (MHz)
-40
25
85
105


GRF2104 Evaluation Board IP1dB vs. Frequency
IP1dB (dBm)
5
4
3
2
1
0
-1
-2
-3
-4
-5
700
960
1710
1880
1960
2170
2300
2700
Freq (MHz)
3.3V 65mA

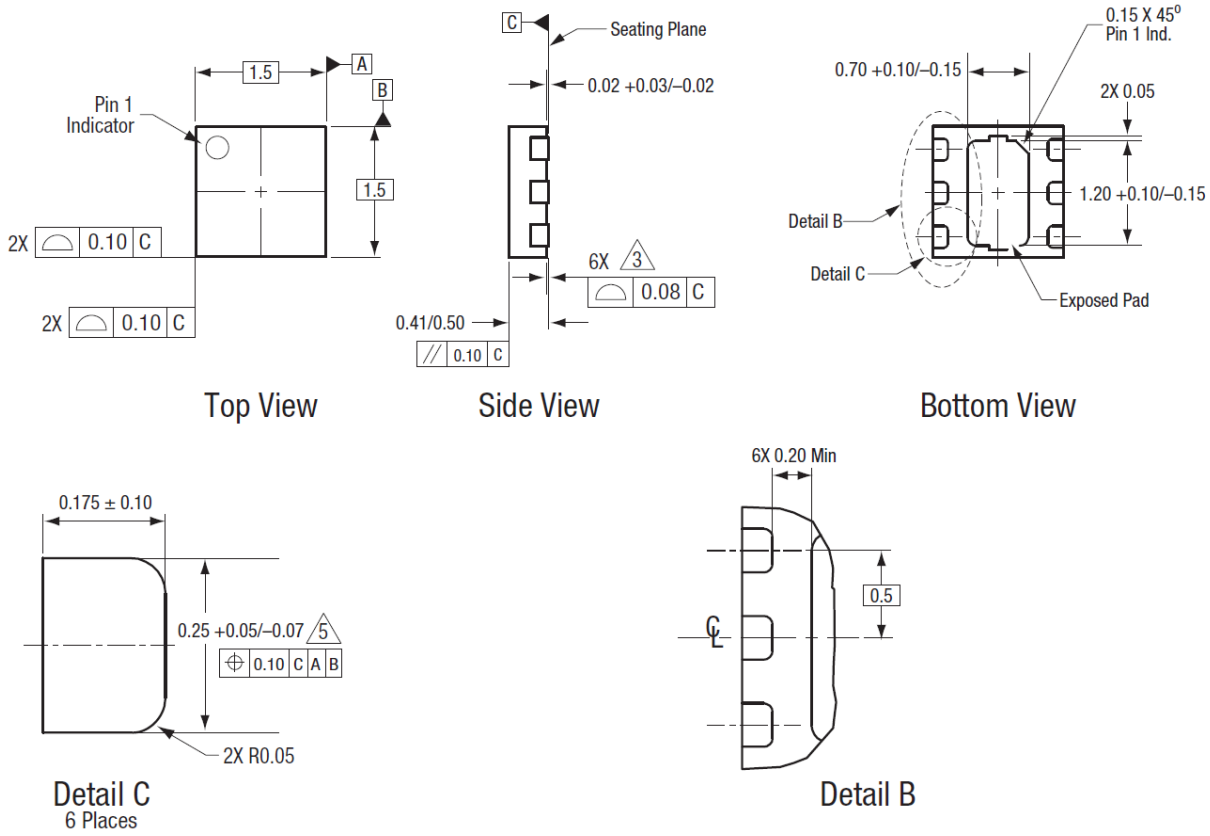

GRF2104 Evaluation Board IIP3 vs. Frequency
IIP3 (dBm)
20
19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
700
960
1710
1880
1960
2170
2300
2700
Freq (MHz)
3.3V 65mA



GRF2104 Application Schematic

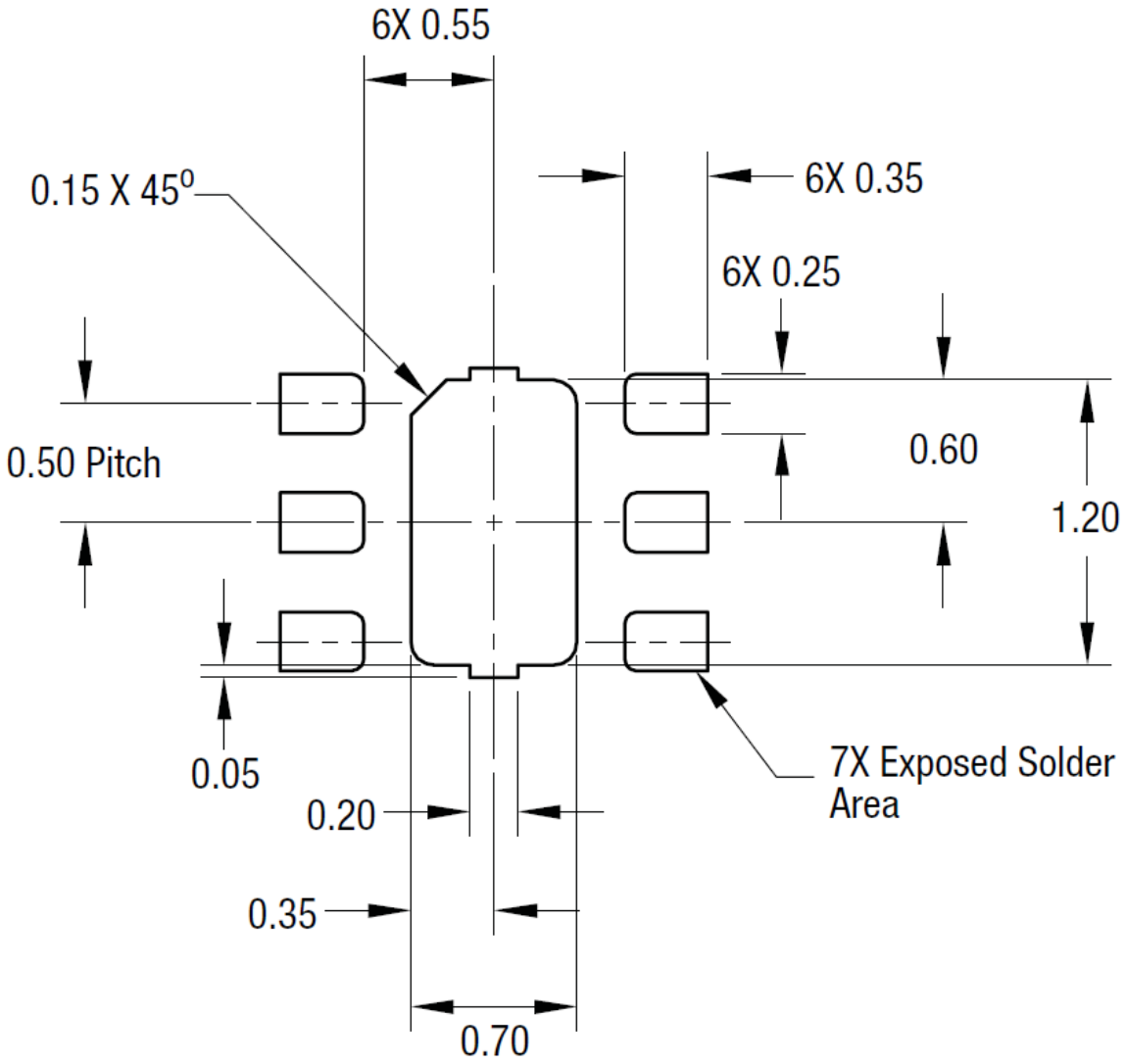
GRF2104 Theory of Operation:

The GRF2104 is a single-stage, high-performance, ultra-low noise linear amplifier that is suitable for a wide range of high performance applications. The device is internally matched to 50 ohms and covers 700-2700 MHz with excellent gain flatness and RF performance using a single set of external components. Iddq can be set independently from Vdd via the Venable input and an external series resistor. The device can deliver good performance to 3800 MHz via the addition of external matching.



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.

GRF2104 6-Pin DFN Package Dimensions



GRF2104 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.