Preliminary

GRF2005

Broadband Gain Block with Low NF; 0.05 – 9.0 GHz

Package: 1.5 x 1.5 mm DFN-6

Features

- Bandwidth: 0.05 to 9.0 GHz
- Gain: 18.0 dB @ 2.0 GHz
- Gain: 10.0 dB @ 9.0 GHz
- OP1dB: +19.9 dBm @ 2.0 GHz
- OP1dB: + 13.7 dBm @ 9.0 GHz
- OIP3: +34.9 dBm @ 2.0 GHz
- NF: 1.3 dB @ 2.0 GHz
- Flexible Bias Voltage and Current
- Process: GaAs pHEMT

Applications

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

Product Description

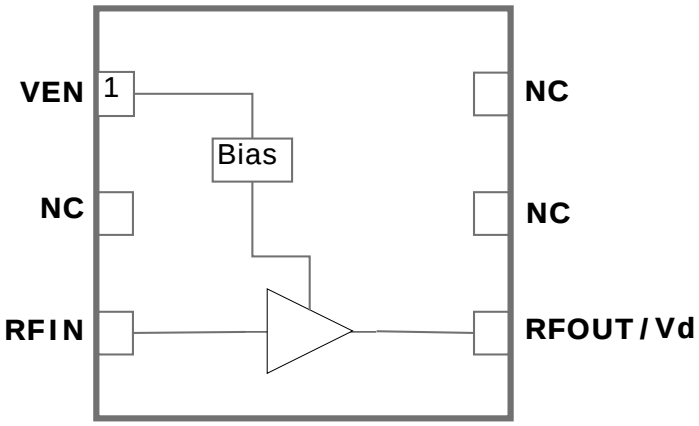
The GRF2005 is a broadband, low noise linear gain block designed for small cell, wireless infrastructure and other high performance RF applications. Internally matched to 50 ohms, it exhibits low NF, with good linearity and gain flatness over 0.05 to 9.0 GHz.

Due to its flexible biasing capability, GRF2005 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 50 to 120 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

1.5 x 1.5 mm DFN-6



Absolute Ratings:

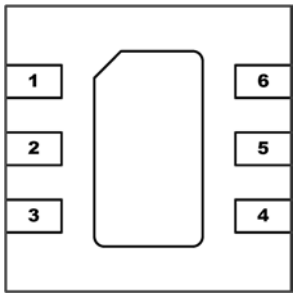
Parameter	Symbol	Min.	Max.	Unit
Drain Voltage	Vd	0	5.5	V
RF Input Power: (Load VSWR < 2:1; V_D: 5.0 volts)	$P_{IN\ MAX}$		+15	dBm
Operating Temperature (Package Heat Sink)	T_{AMB}	-40	+105	°C
Maximum Channel Temperature (MTTF > 10^6 Hours)	Tmax		+170	°C
Maximum Dissipated Power	$P_{DISS\ MAX}$		750	mW
Electrostatic Discharge:				
Charged Device Model: (TBD)	CDM	500		V
Human Body Model: (TBD)	HBM	250		V
Storage:				
Storage Temperature	T_{STG}	-40	+150	°C
Moisture Sensitivity Level	MSL		2	--

RoHS Compliant

Caution! ESD Sensitive Device

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

Pin Out (Top View)

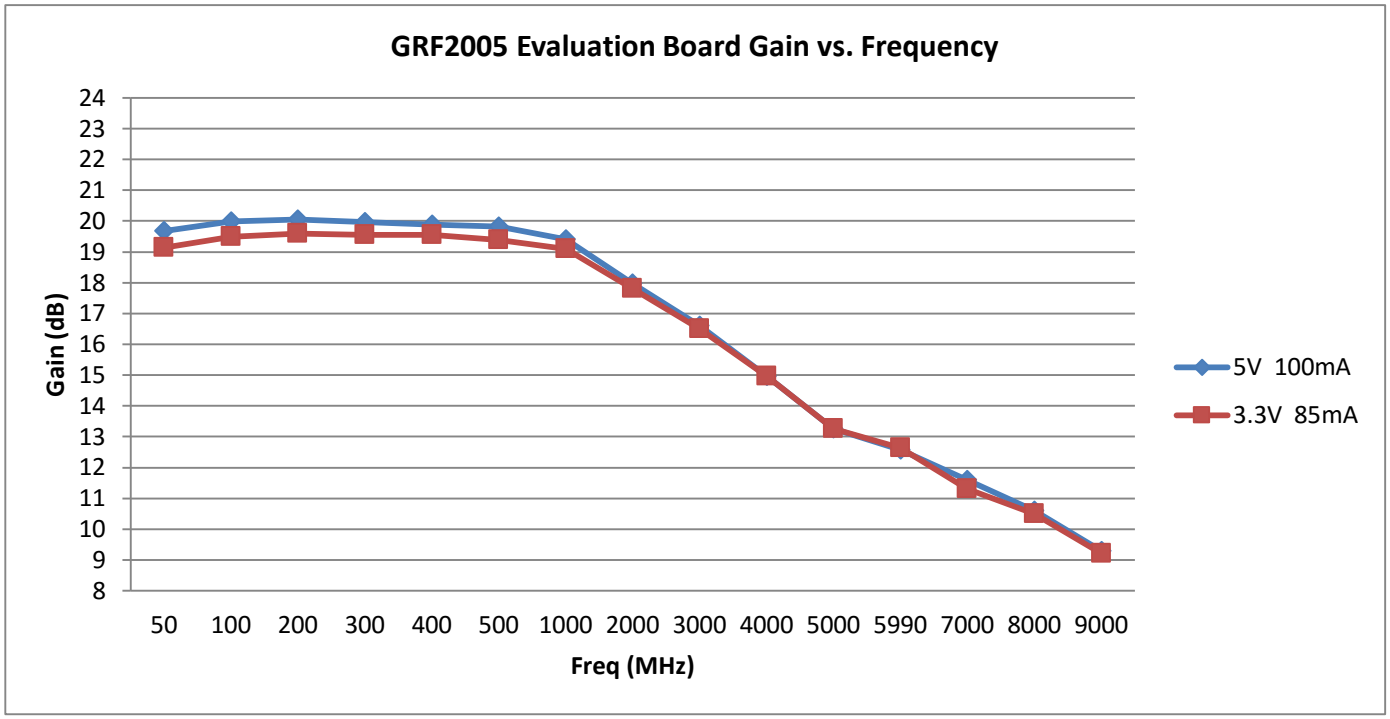


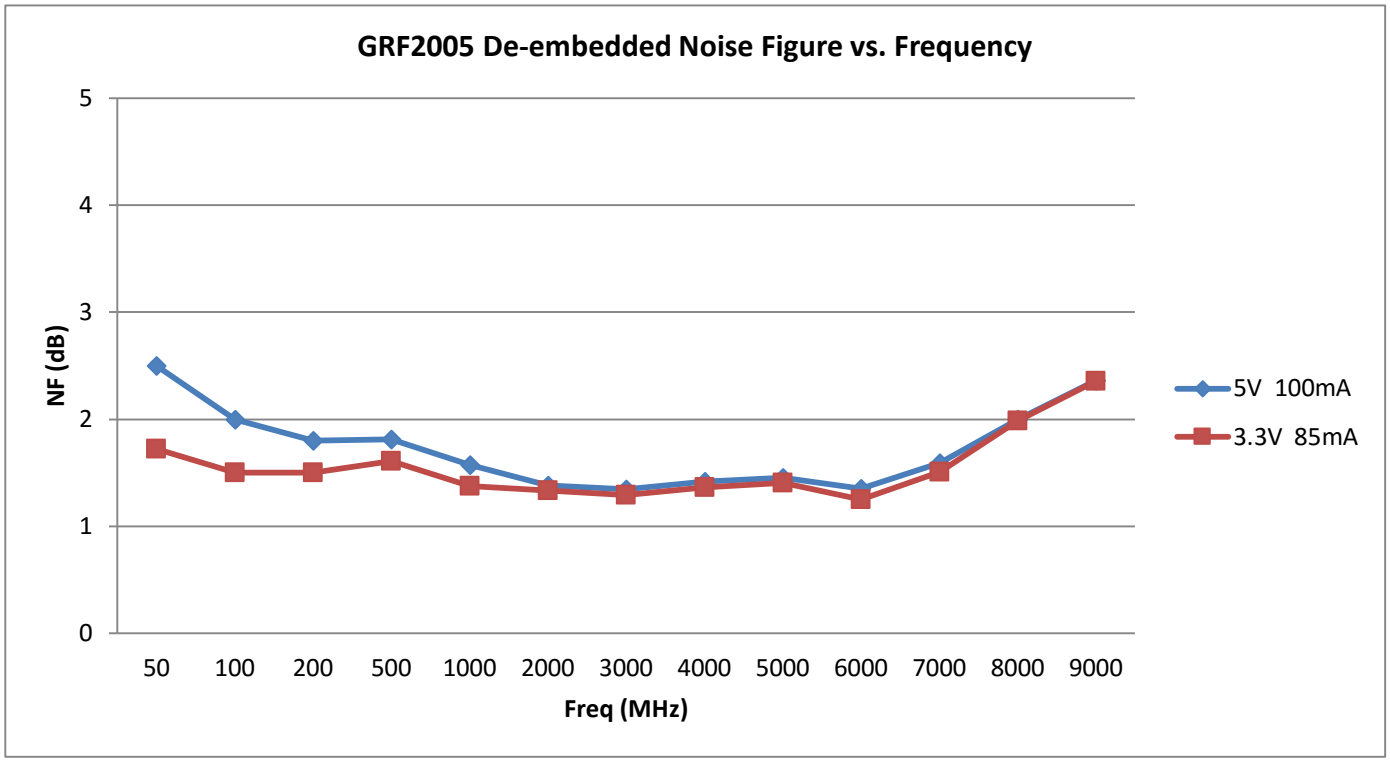
Pin Assignments:

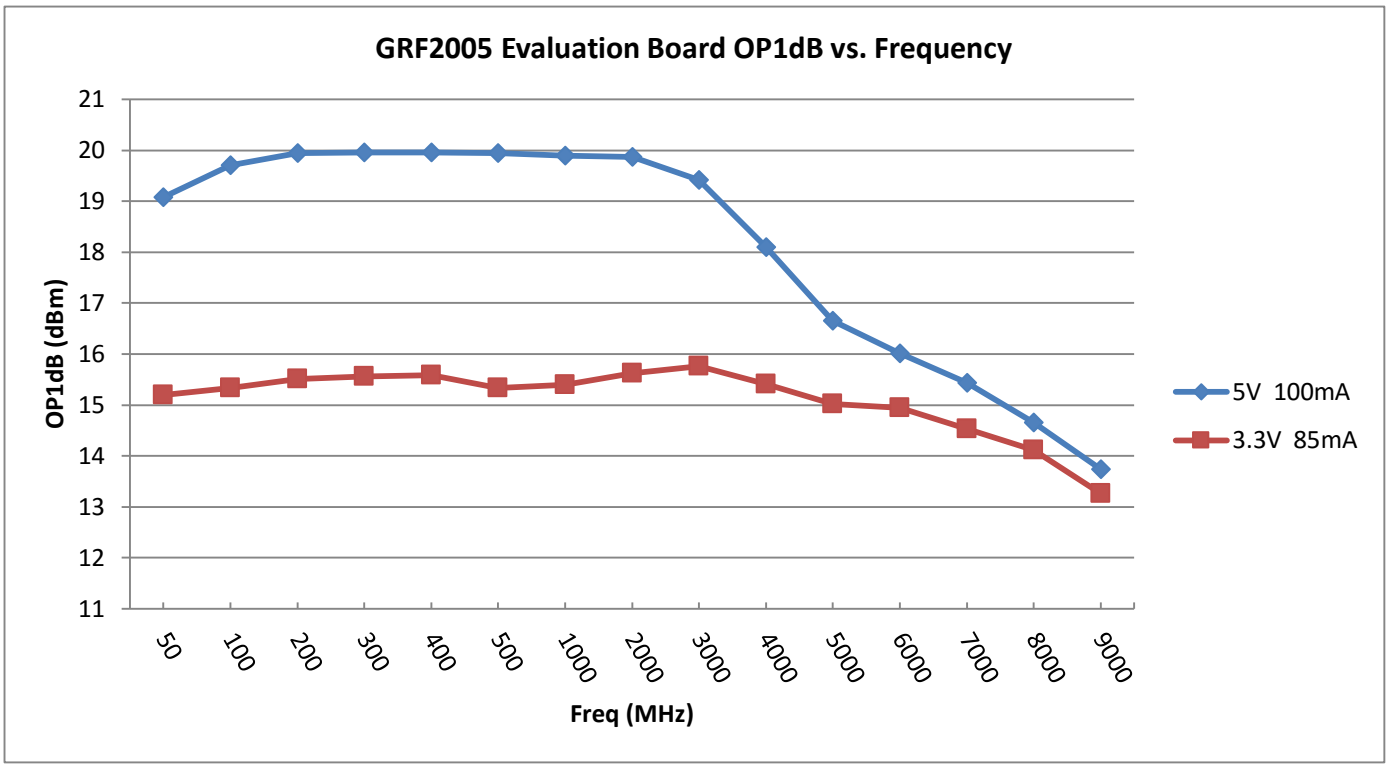
Pin	Name	Description	Note
1	**V_{ENABLE}**	Enable Voltage Input	Venable < 0.2 volts turns the device off. Venable and series resistor M2 control the device Iddq.
2	**NC**	No Connect or Ground	No internal connection to die
3	**RF_In**	LNA RF input	Internally matched 50Ω. An external DC blocking cap must be used.
4	**RF_Out**	LNA RF output	Internally matched 50Ω. V_{DD} 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. Use multiple ground vias beneath the package for optimal RF and thermal performance

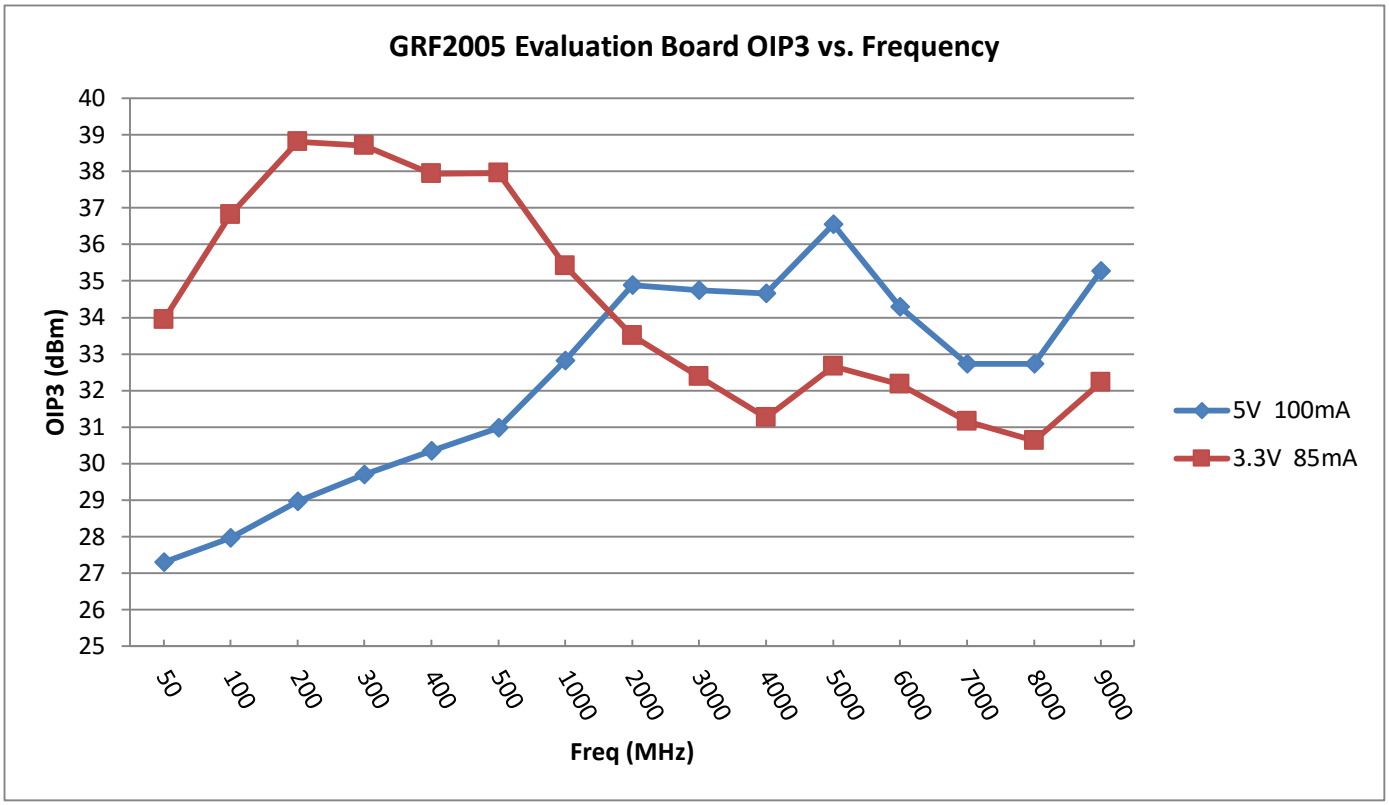
Nominal Operating Parameters:

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		18.0		dB	
Input Return Loss	S11		-15		dB	
Output Return Loss	S22		-15		dB	
Noise Figure (De-embedded)	NF		1.3		dB	
Output 3rd Order Intercept	OIP3		+34.9		dBm	+2 dBm P_{OUT} per tone at 2 MHz Spacing (2599 and 2601 MHz)
Ouput 1dB Compression Power	OP1dB		+19.7		dBm	
Switching Rise Time	T_{RISE}		500		ns	
Switching Fall Time	T_{FALL}		500		ns	
Supply Current	I_{DD}		100		mA	Adjustable for optimal IP3
Enable Current	I_{ENABLE}		3		mA	
Thermal Data						
Thermal Resistance (measured via IR scan)	Θjc		75		°C/W	On standard evaluation board
Channel Temperature @ +85 C Reference (Package Heat Sink)	$T_{CHANNEL}$		123		°C	Vdd: 5.0 V; Iddq: 100 mA; No RF; Pdiss: 500 mW

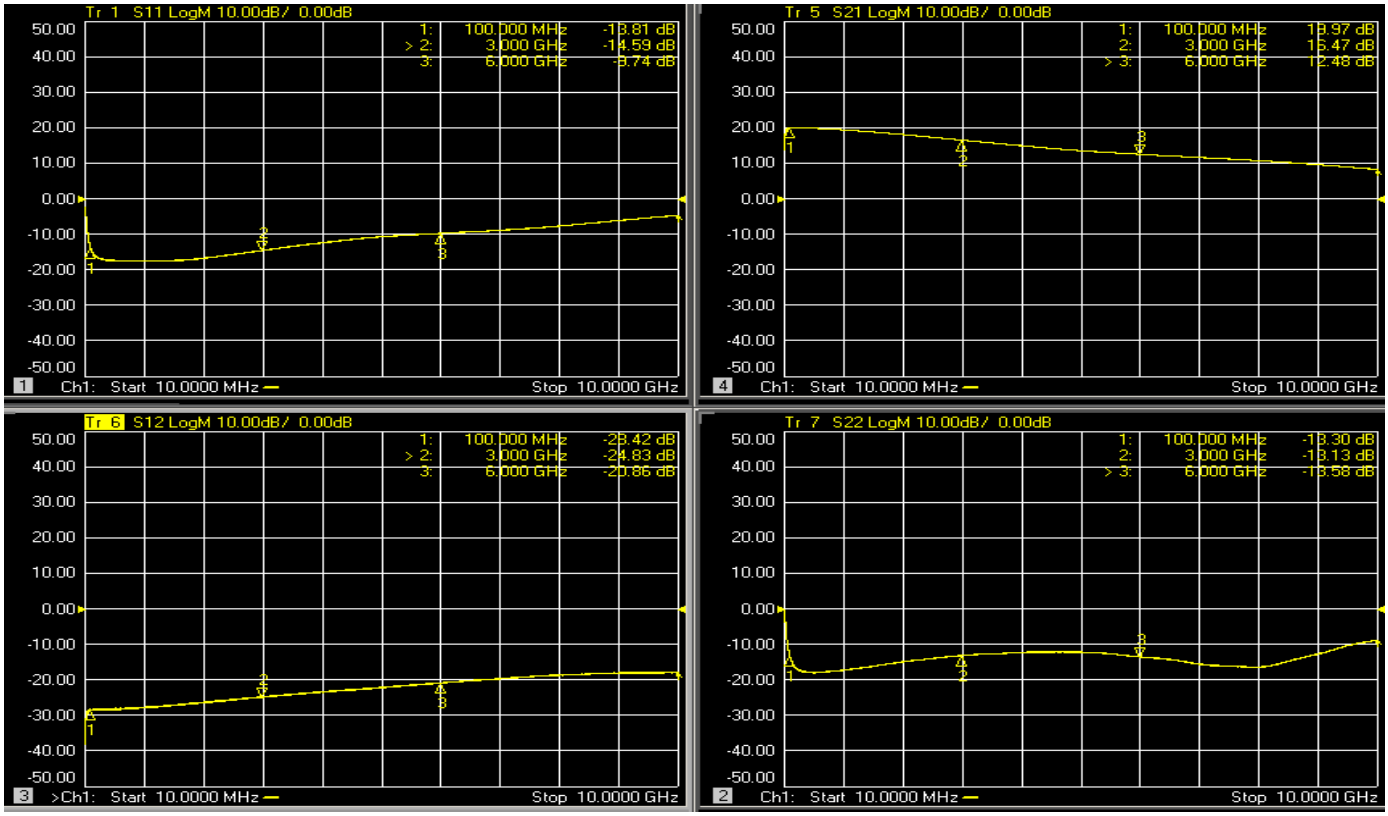

GRF2005 Evaluation Board Gain vs. Frequency
Gain (dB)
24
23
22
21
20
19
18
17
16
15
14
13
12
11
10
9
8
50
100
200
300
400
500
1000
2000
3000
4000
5000
5990
7000
8000
9000
Freq (MHz)
5V 100mA
3.3V 85mA

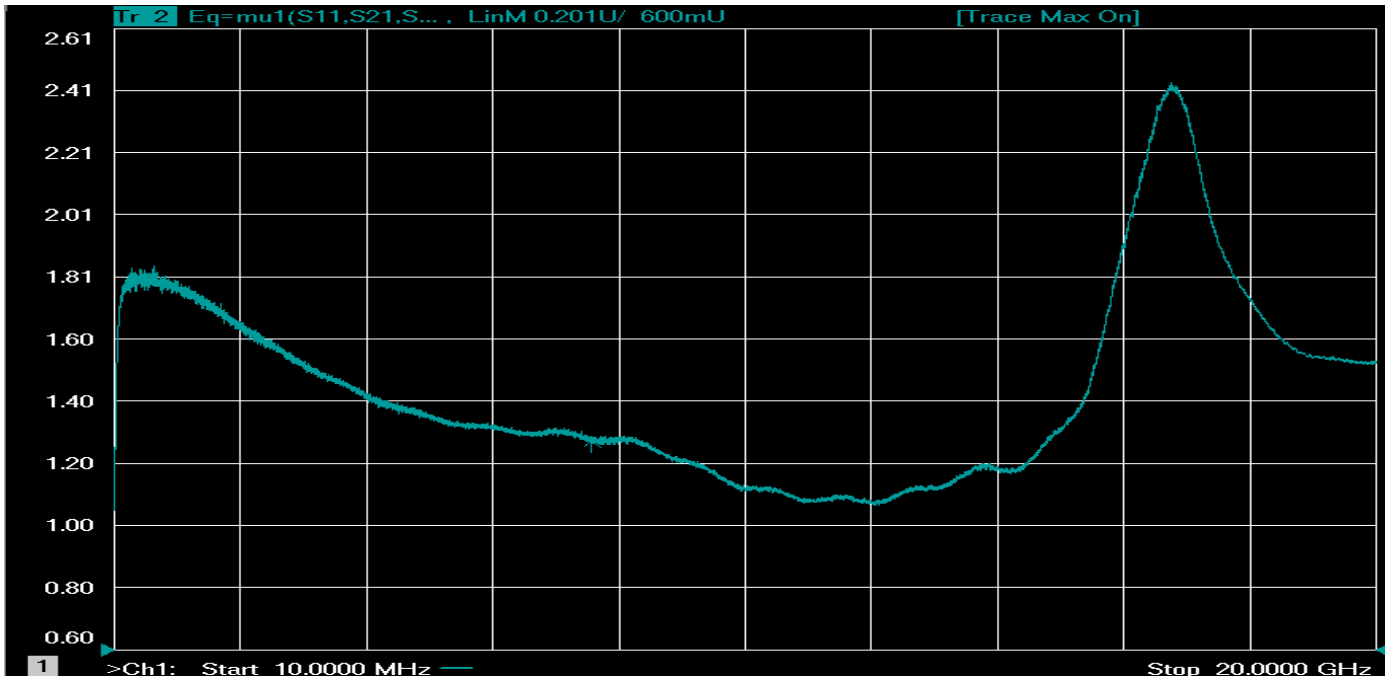

GRF2005 De-embedded Noise Figure vs. Frequency
NF (dB)
5
4
3
2
1
0
50
100
200
500
1000
2000
3000
4000
5000
6000
7000
8000
9000
Freq (MHz)
5V 100mA
3.3V 85mA


GRF2005 Evaluation Board OP1dB vs. Frequency
OP1dB (dBm)
21
20
19
18
17
16
15
14
13
12
11
50
100
200
300
400
500
1000
2000
3000
4000
5000
6000
7000
8000
9000
Freq (MHz)
5V 100mA
3.3V 85mA

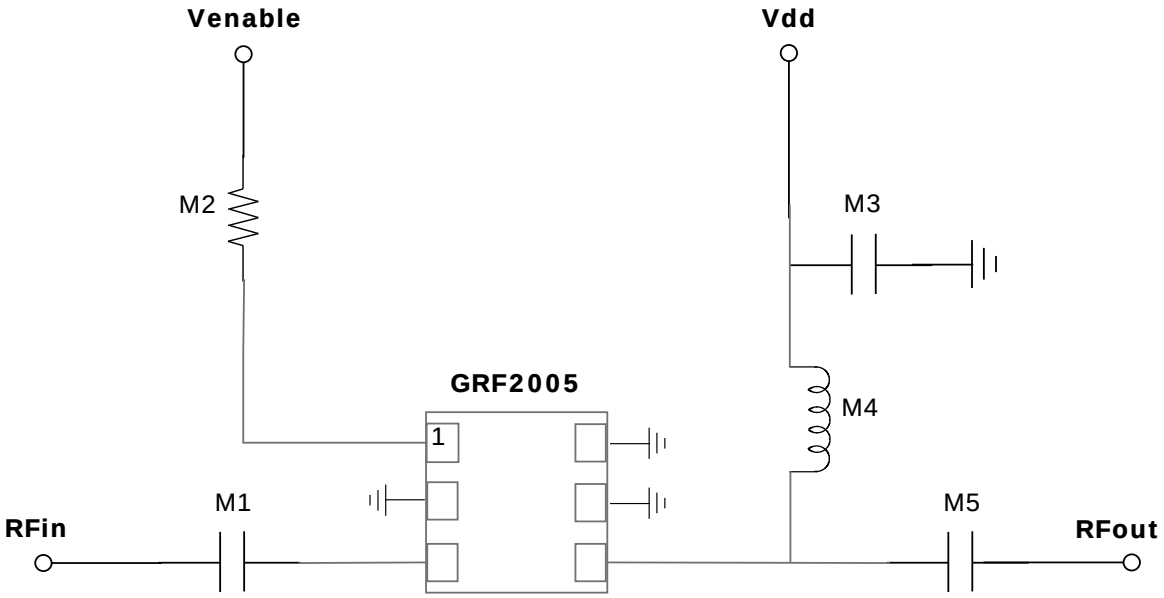

GRF2005 Evaluation Board OIP3 vs. Frequency
OIP3 (dBm)
40
39
38
37
36
35
34
33
32
31
30
29
28
27
26
25
50
100
200
300
400
500
1000
2000
3000
4000
5000
6000
7000
8000
9000
Freq (MHz)
5V 100mA
3.3V 85mA

GRF2005 Evaluation Board S-Parameters and Stability Mu





Note: Mu >= 1.0 implies unconditional stability

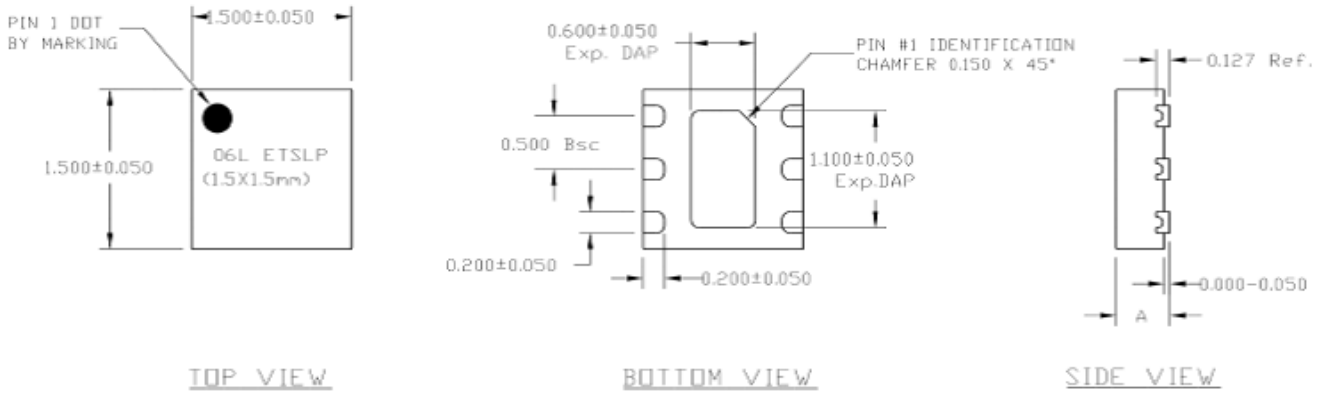


GRF2005 Application Schematic

GRF2005 Bias Resistor (M2) Table:

Device	Vdd	Venable	M3 (ohms)	Iddq (mA)		Device	Vdd	Venable	M3 (ohms)	Iddq (mA)		Device	Vdd	Venable	M3 (ohms)	Iddq (mA)
GRF2005	5.0	5.0	2000	142		GRF2005	4.5	4.5	1200	143		GRF2005	4.0	4.0	1000	126
GRF2005	5.0	5.0	2500	132		GRF2005	4.5	4.5	2500	116		GRF2005	4.0	4.0	2500	98
GRF2005	5.0	5.0	3000	123		GRF2005	4.5	4.5	3000	108		GRF2005	4.0	4.0	3000	92
GRF2005	5.0	5.0	3500	116		GRF2005	4.5	4.5	3500	102		GRF2005	4.0	4.0	3500	86
GRF2005	5.0	5.0	4000	110		GRF2005	4.5	4.5	4000	96		GRF2005	4.0	4.0	4000	82
GRF2005	5.0	5.0	7000	85		GRF2005	4.5	4.5	7000	74		GRF2005	4.0	4.0	7000	63
GRF2005	5.0	5.0	10000	71		GRF2005	4.5	4.5	10000	62		GRF2005	4.0	4.0	10000	52
GRF2005	5.0	5.0	15000	57		GRF2005	4.5	4.5	15000	49		GRF2005	4.0	4.0	15000	42
GRF2005	5.0	5.0	20000	48		GRF2005	4.5	4.5	20000	42		GRF2005	4.0	4.0	20000	36
GRF2005	5.0	5.0	30000	38		GRF2005	4.5	4.5	30000	34		GRF2005	4.0	4.0	30000	30
GRF2005	5.0	5.0	40000	33		GRF2005	4.5	4.5	40000	29		GRF2005	4.0	4.0	40000	26
GRF2005	5.0	5.0	50000	29		GRF2005	4.5	4.5	50000	26		GRF2005	4.0	4.0	50000	24
Device	Vdd	Venable	M3 (ohms)	Iddq (mA)		Device	Vdd	Venable	M3 (ohms)	Iddq (mA)		Device	Vdd	Venable	M3 (ohms)	Iddq (mA)
GRF2005	3.6	3.6	1000	110		GRF2005	3.3	3.3	0	126		GRF2005	3.0	3.0	0	106
GRF2005	3.6	3.6	2000	92		GRF2005	3.3	3.3	1000	100		GRF2005	3.0	3.0	1000	84
GRF2005	3.6	3.6	3000	80		GRF2005	3.3	3.3	2000	84		GRF2005	3.0	3.0	2000	71
GRF2005	3.6	3.6	4000	71		GRF2005	3.3	3.3	3000	73		GRF2005	3.0	3.0	3000	62
GRF2005	3.6	3.6	6000	59		GRF2005	3.3	3.3	4000	65		GRF2005	3.0	3.0	4000	55
GRF2005	3.6	3.6	7000	55		GRF2005	3.3	3.3	6000	54		GRF2005	3.0	3.0	6000	46
GRF2005	3.6	3.6	10000	46		GRF2005	3.3	3.3	7000	50		GRF2005	3.0	3.0	7000	43
GRF2005	3.6	3.6	15000	37		GRF2005	3.3	3.3	10000	42		GRF2005	3.0	3.0	10000	37
GRF2005	3.6	3.6	20000	32		GRF2005	3.3	3.3	15000	35		GRF2005	3.0	3.0	15000	30
GRF2005	3.6	3.6	30000	27		GRF2005	3.3	3.3	20000	30		GRF2005	3.0	3.0	20000	27

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.



		ETSLP
A	MAX.	0.500
	NOM.	0.450
	MIN.	0.400

DESCRIPTION	DATE	BY	APPD

TOLERANCES
REFER TO SPECIFICATION ABOVE

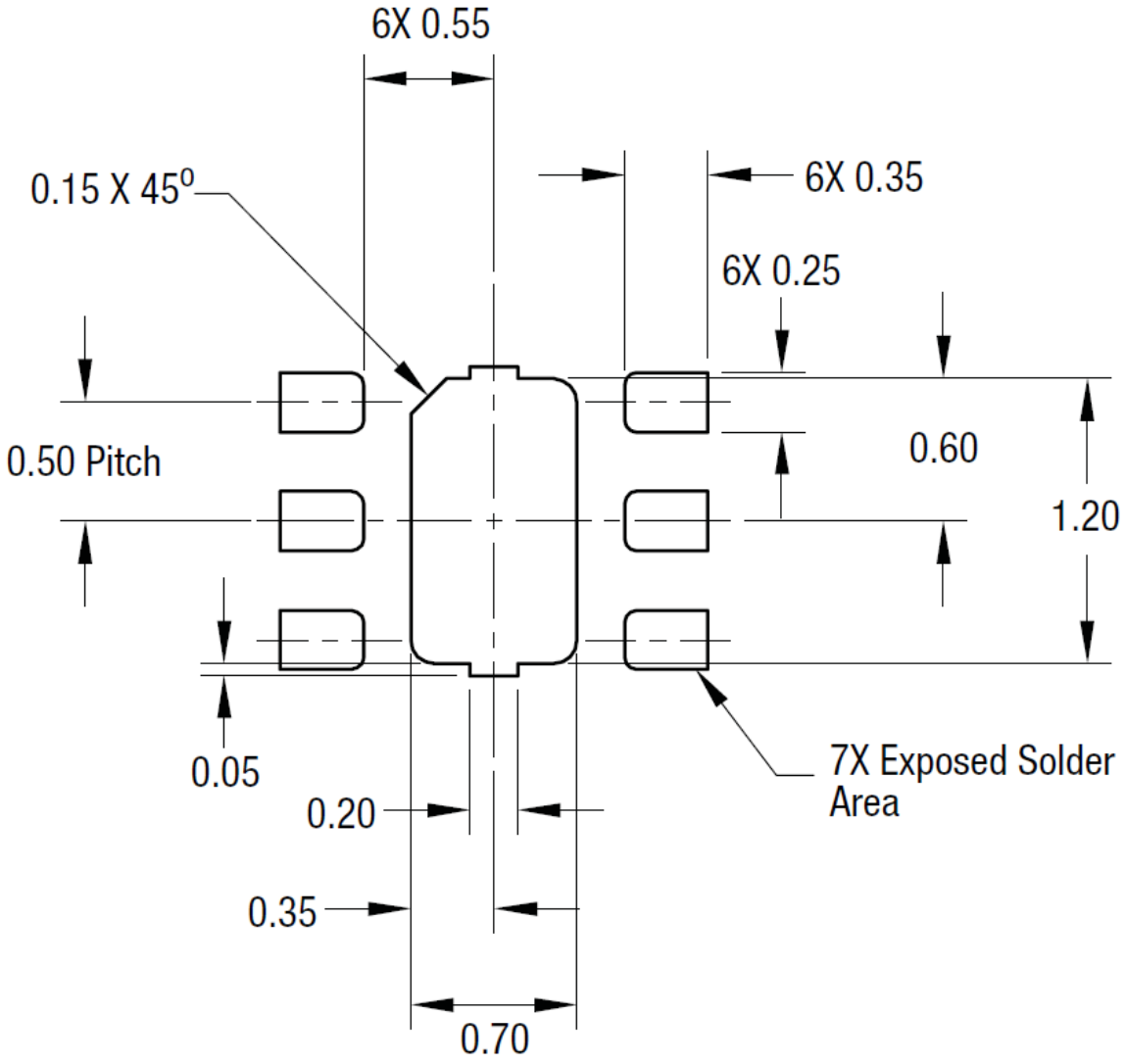
UNIT: MM | SCALE: NTS

SYMBOL

DATE:
DATE:
DATE:
DATE:
DATE:
REV.: 00

06L (ETSLP) 1.5X1.5 mm
(PACKAGE OUTLINE)
SHEET NO : 1 OF 1.

GRF2005 DFN-6 Package Dimensions



GRF2005 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.