GRF2093

Released

Ultra-Low Noise Amplifier
Tuning Range: 1.0 to 6.0 GHz

Features

Reference: 5V/55mA/2332.5 MHz

- EVB NF: 0.37dB
- Gain: 21.0 dB
- OP1dB: 19.0 dBm
- OIP3: 35.5 dBm
- Flexible Bias Voltage and Current
- Process: GaAs pHEMT

Applications

- Satellite Radio
- CBRS
- Small Cells and Cellular Repeaters
- Distributed Antenna Systems
- GPS

Product Description

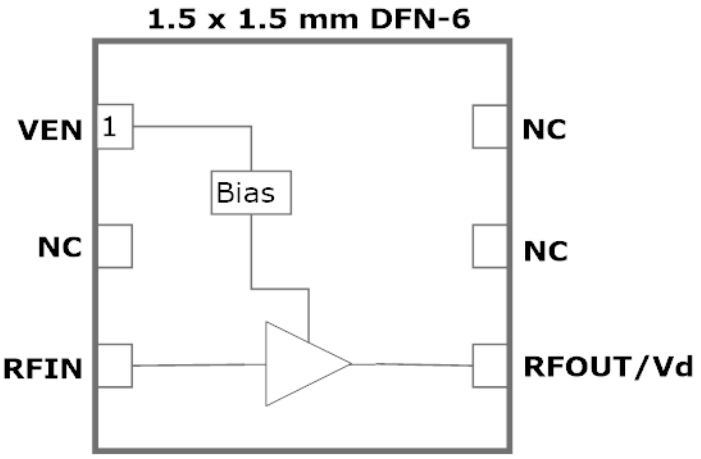
GRF2093 offers industry leading NF and gain performance and can be tuned over a wide range of frequencies from roughly 1.0 to 6.0 GHz.

With application-specific biasing, GRF2093 is part of Guerrilla RF's highest performance satellite radio solution where it functions as the first-stage LNA over 2320 to 2345 MHz.

It can be biased over a range of Vdd from 2.7 to 5.0 volts and Iddq values from 30 mA to 100 mA.

The device uses the standard Guerrilla RF 1.5 mm DFN-6 package and pin out and it joins more than 20 other LNAs and linear drivers which can use the same evaluation board.

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



Absolute Ratings:

Parameter	Symbol	Min.	Max.	Unit
Supply Voltage	V_{DD}	0	6.0	V
RF Input Power CW : (Load VSWR < 2:1; V_D: 5.0 volts)	$P_{IN\ MAX}$		23	dBm
Operating Temperature (Package Heat Sink)	T_{AMB}	-40	105	°C
Maximum Channel Temperature (MTTF > 10^6 Hours)	T_{MAX}		170	°C
Maximum Dissipated Power	$P_{DISS\ MAX}$		1000	mW
Electrostatic Discharge:				
Charged Device Model:	CDM	1500		V
Human Body Model:	HBM	500		V
Storage:				
Storage Temperature	T_{STG}	-65	150	°C
Moisture Sensitivity Level	MSL		1	--

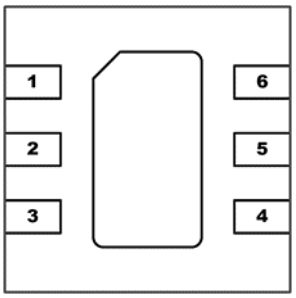
Caution! ESD Sensitive Device

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

Note: For manufacturing information, see the Guerrilla-RF.com website for the following document located on the GRF2093 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:

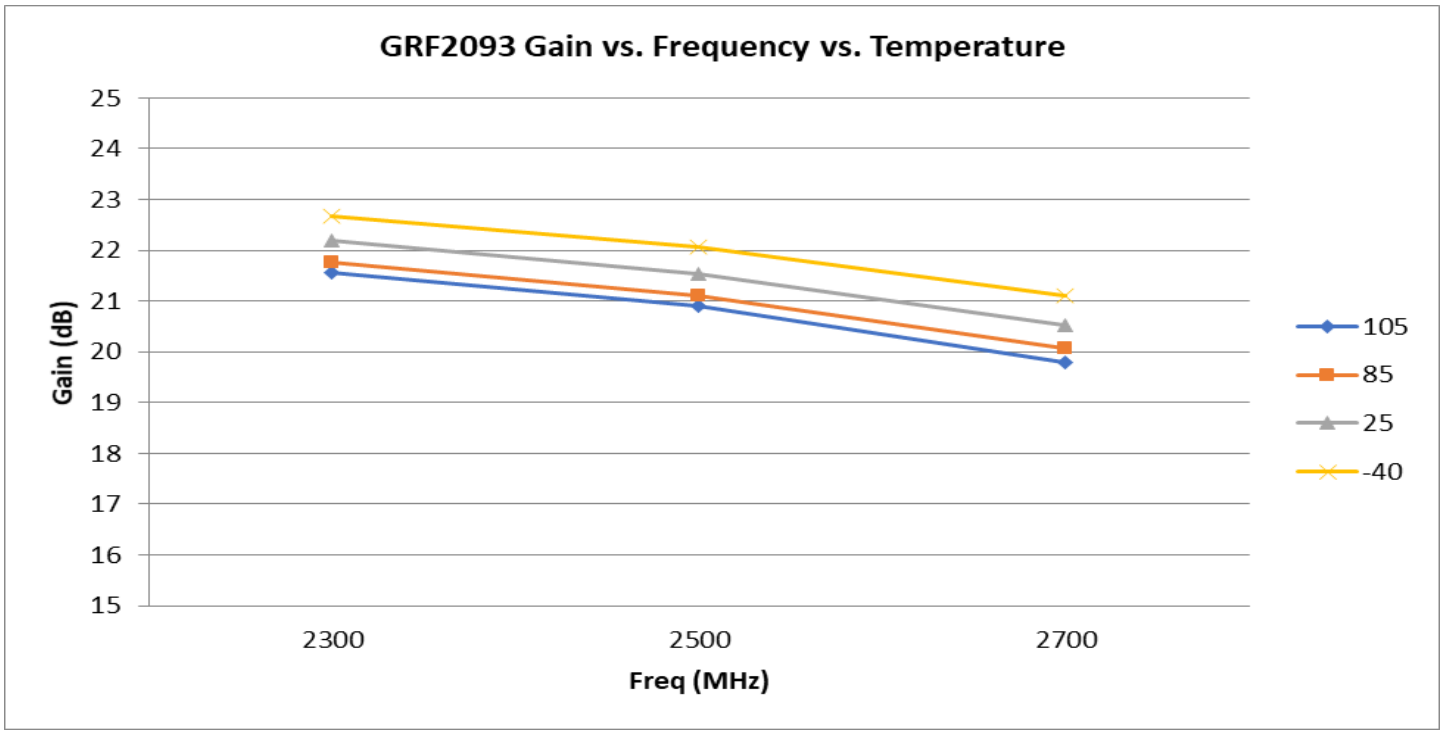
Pin	Name	Description	Note
1	V_{ENABLE}	Enable Voltage Input	V_{ENABLE} and series resistor set I_{DDQ}. V_{ENABLE} < =0.2 volts disables device. On -die pull-down resistor will turn the part off if this node is allowed to float.
2	NC	No Connect or Ground	No internal connection to die
3	RF_In	LNA RF input	An external DC blocking cap must be used.
4	RF_Out	LNA RF output	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. Recommend multiple 8 mil vias beneath the package for optimal RF and thermal performance. Refer to evaluation board top layer graphic on schematic page.

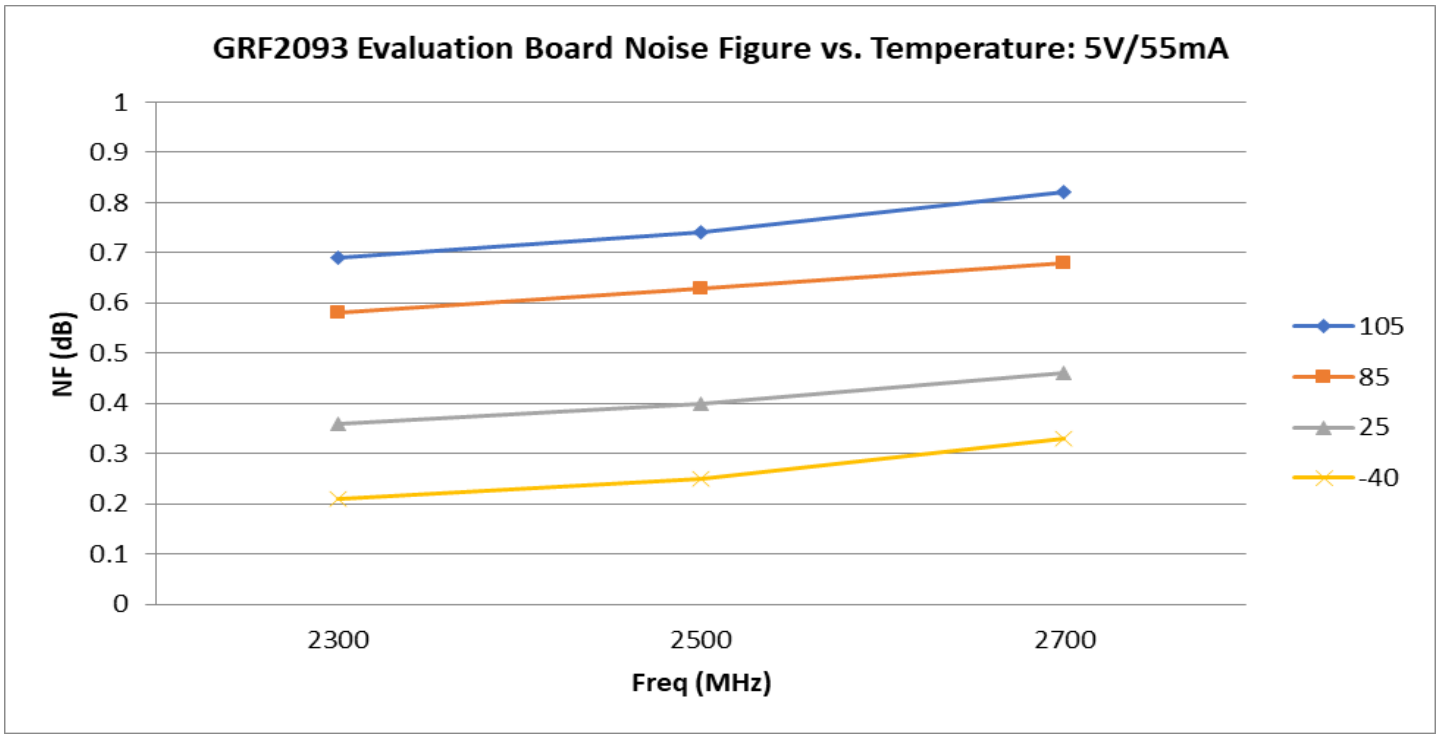
Nominal Operating Parameters:

Parameter	Symbol	Specification			Unit	Condition
		Min.	Typ.	Max.		
Test Frequency	F_{TEST}		2332.5		MHz	V_{DD} = 5.0 V, T_A = 25°C
Gain	S21	20.8	22.0	23.2	dB	
Evaluation Board Noise Figure	NF		0.37	0.57	dB	Incudes Board Losses
Output 1dB Compression Power	OP1dB	17.2	19.0		dBm	
Output 3rd Order Intercept	OIP3		35.5		dBm	4.0 dBm P_{OUT} per tone at 2 MHz Spacing (2331.5 and 2333.5 MHz)
Switching Rise Time	T_{RISE}		400		ns	
Switching Fall Time	T_{FALL}		100		ns	
Supply Current	I_{DD}	40	55	70	mA	$V_{DD=}$=V_{ENABLE}=5.0V; R_{BIAS}=3.0k Ohm
Enable Current	I_{ENABLE}		1.3	2.0	mA	
Leakage Current	$I_{LEAKAGE}$		180	500	uA	V_{DD}: 5.0V; V_{ENABLE}: 0.0V
Thermal Data						
Thermal Resistance: (Infra-Red Scan)	Θjc		43		°C/W	On standard Evaluation Board
Channel Temperature @ +85 C Reference (Package heat sink)	$T_{CHANNEL}$		100 (See note)		°C	V_{DD}: 5.0 V; I_{DDQ}: 70 mA; No RF; P_{DISS}: 350 mW

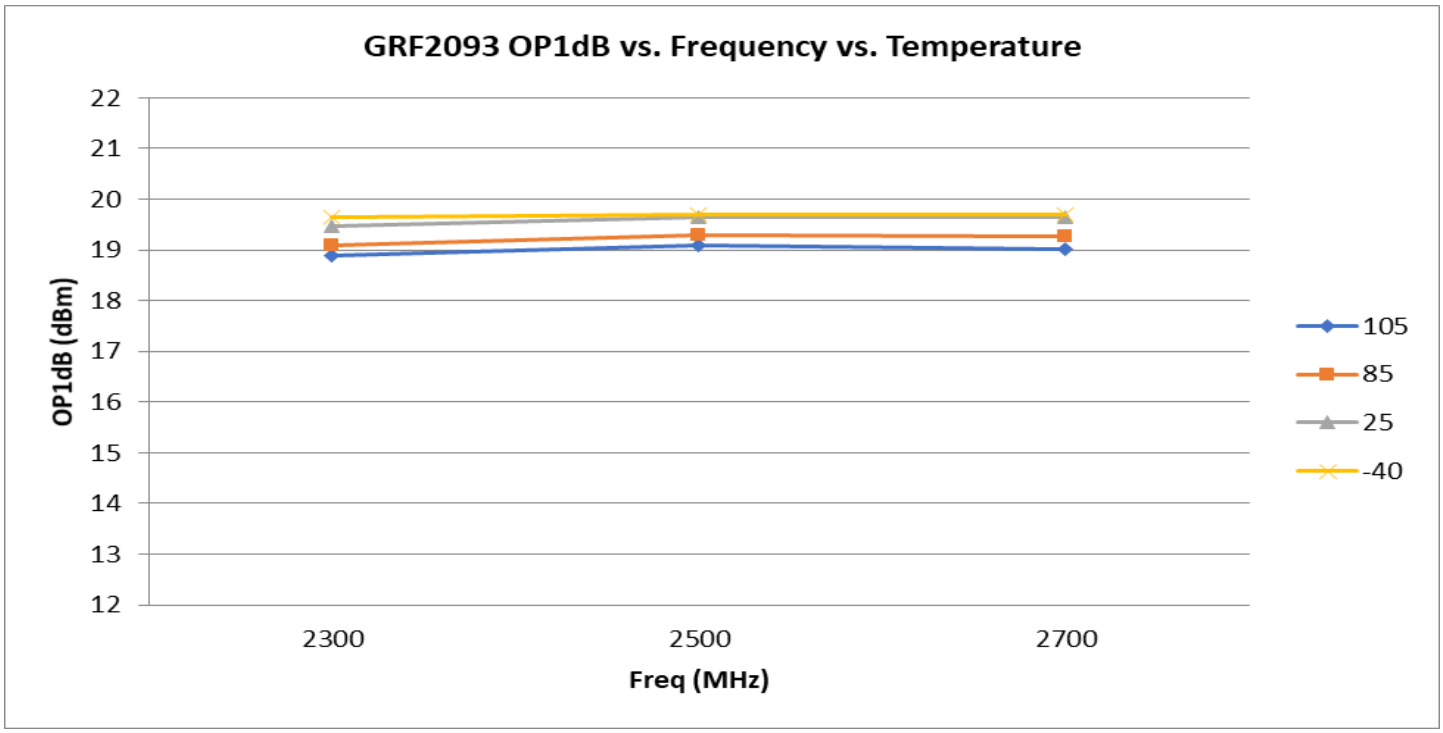
Note: MTTF >10^6 hours for $T_{CHANNEL}$ <=170 degrees C.

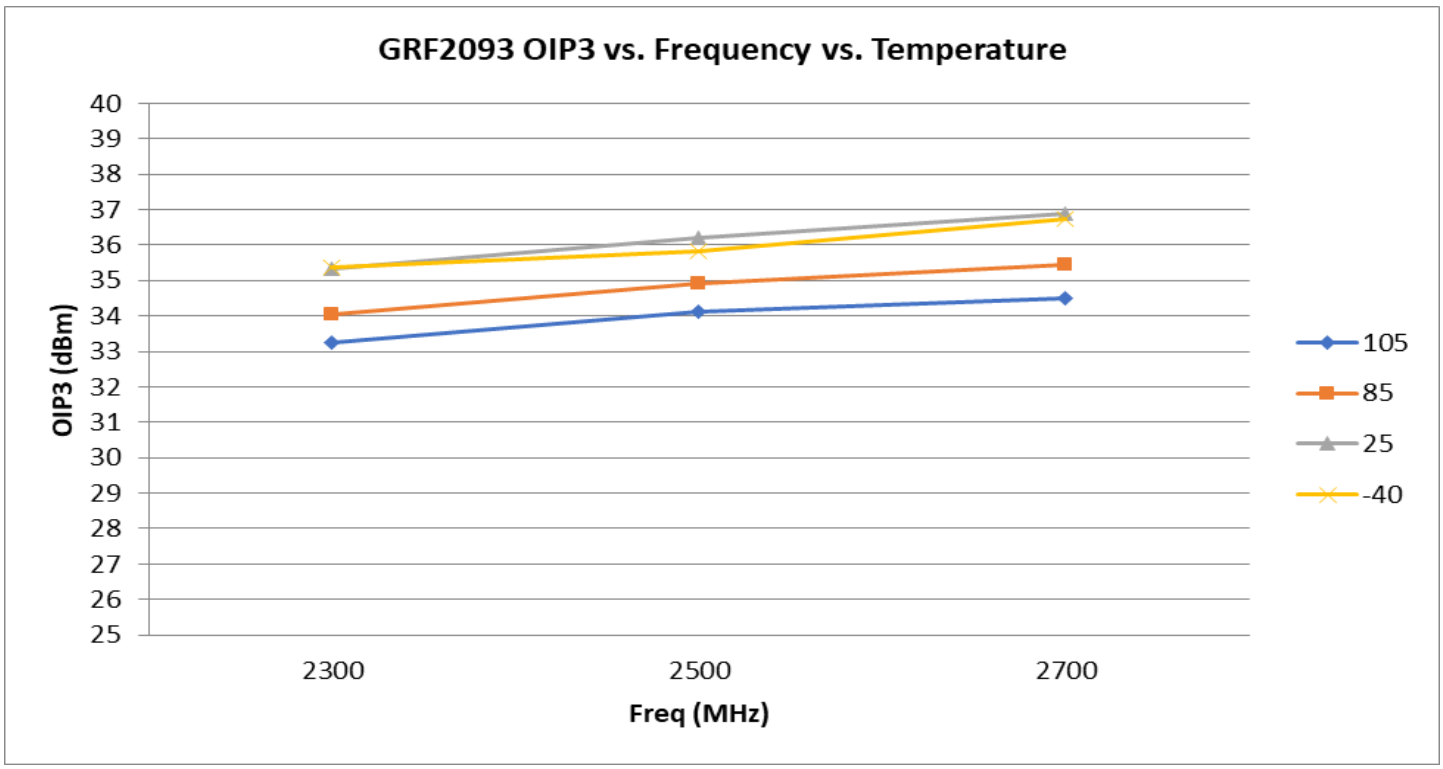
GRF2093 Evaluation Board Data:



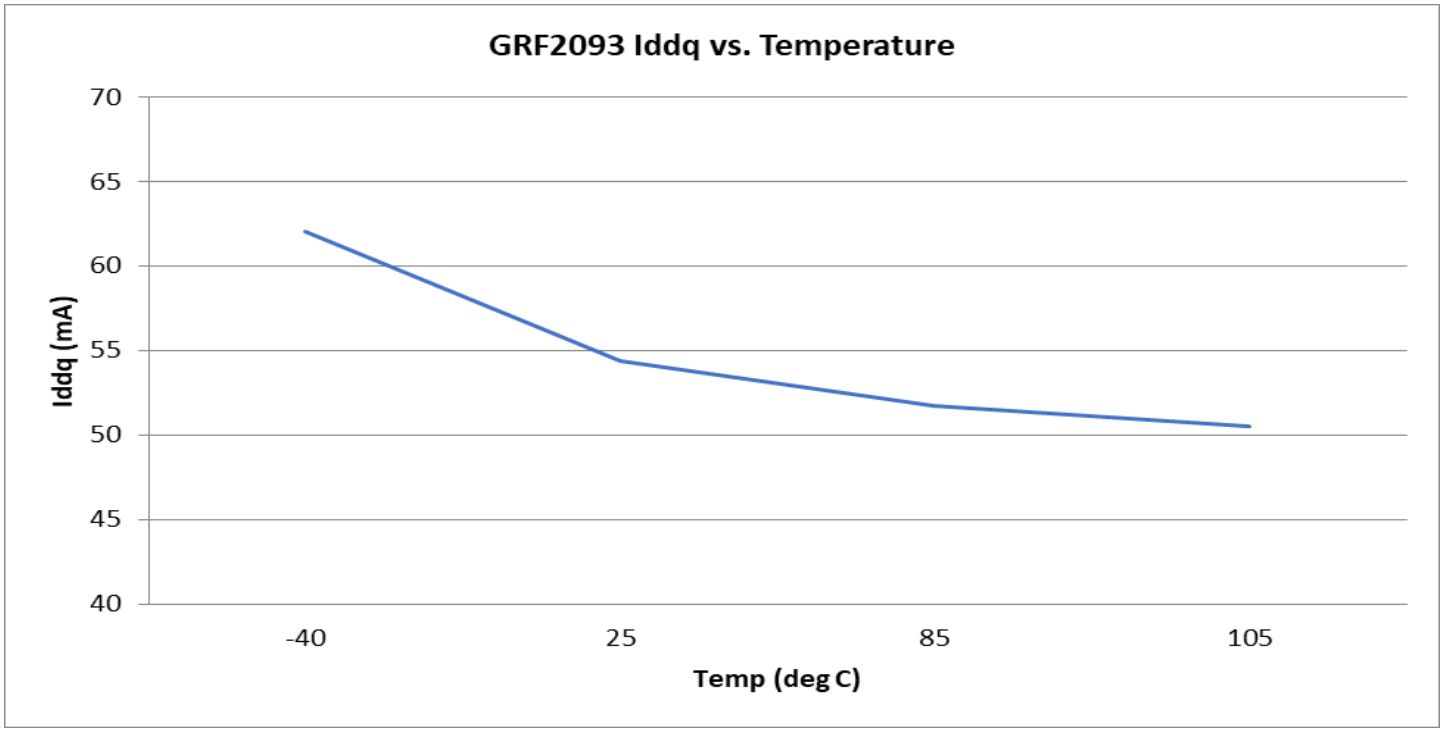


GRF2093 Evaluation Board Data:

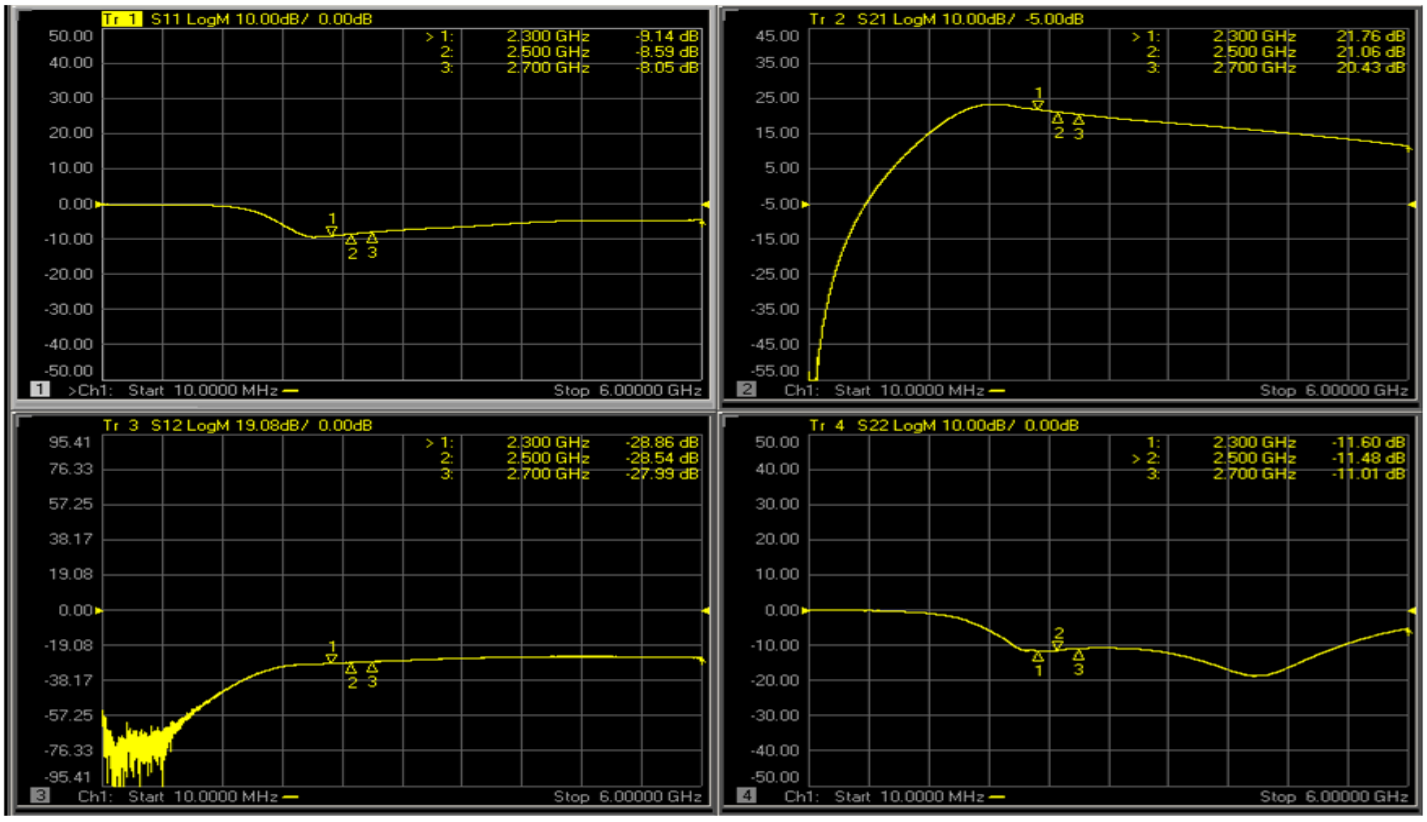


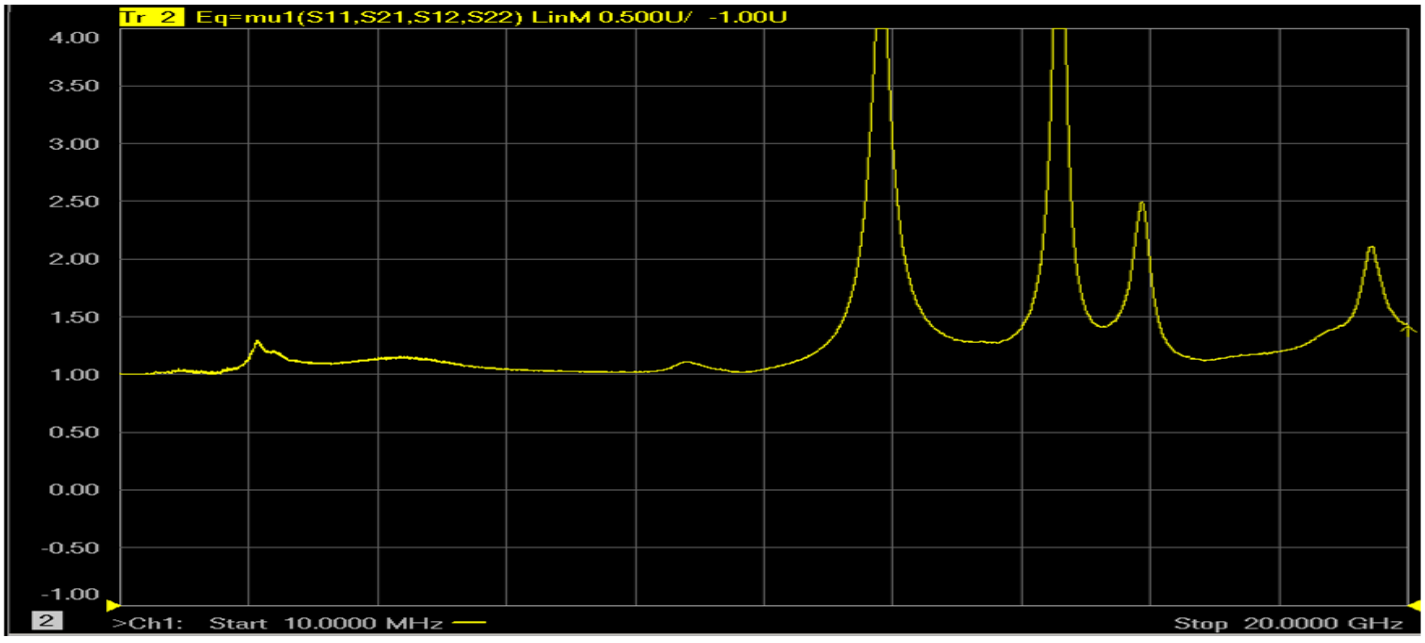


GRF2093 Evaluation Board Data:

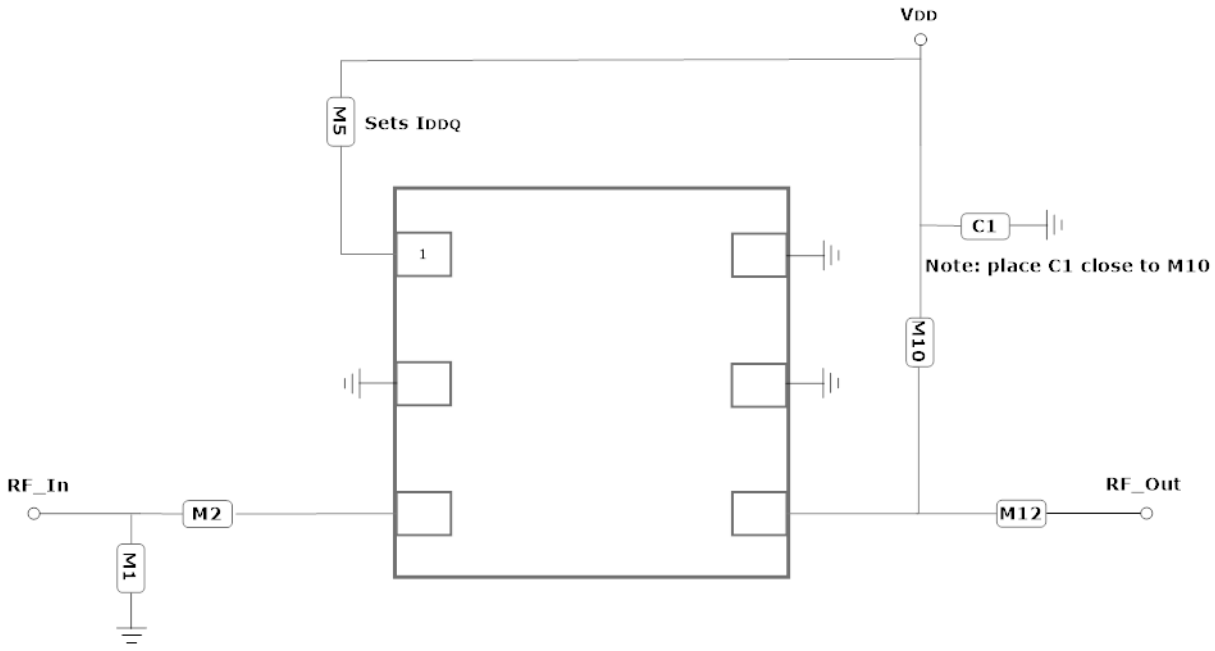


GRF2093 Evaluation Board S-Pars and Stability Mu Factor: (2.3 to 2.7 GHz Match)

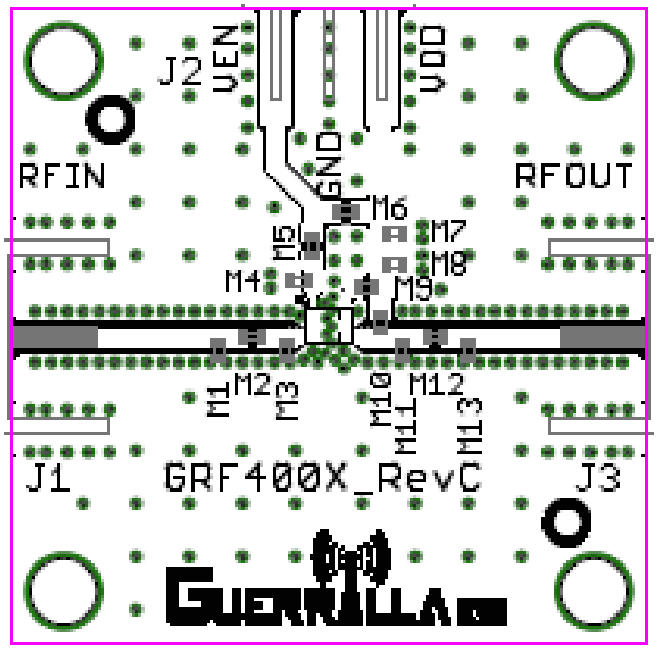




Note: Mu >= 1.0 implies unconditional stability.



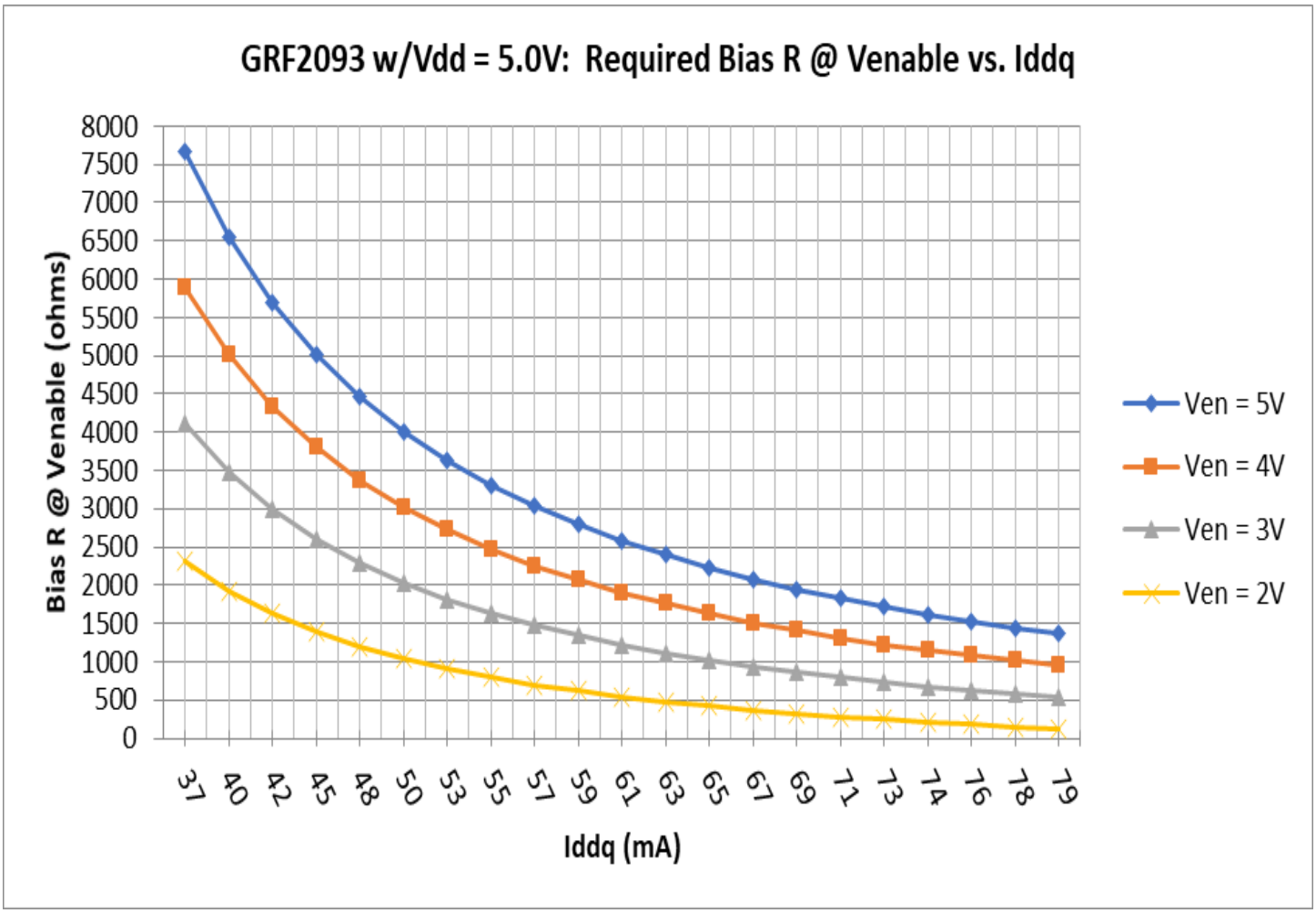
GRF2093 Application Schematic

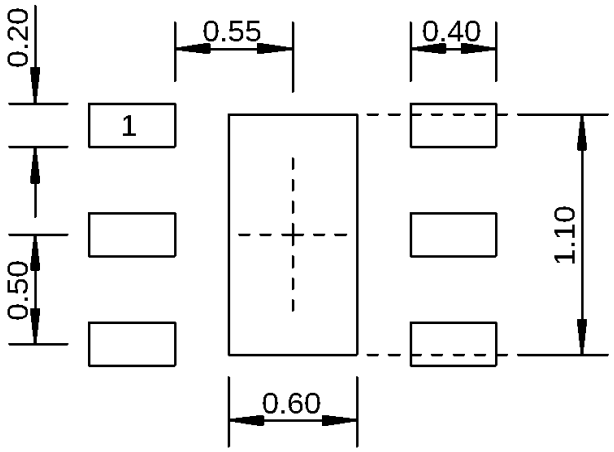


GRF2093 Evaluation Board Assembly Diagram

GRF2093 Standard Evaluation Board BOM: (2.3 to 2.7 GHz Tune)

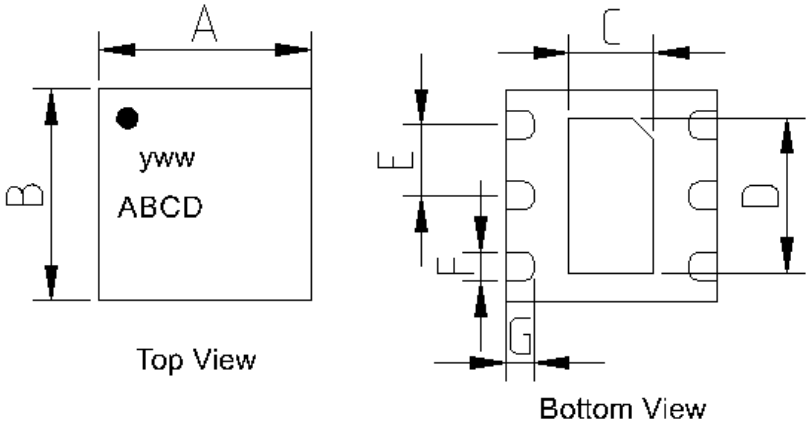
Component	Type	Manufacturer	Family	Value	Package Size	Substitution
M1	Inductor	Coilcraft	HP	3.3 nH	0402	ok
M2	Capacitor	Murata	GJM	2.7 pF	0402	ok
M5 (See curves)	Resistor: 5%	Various	—	—	0402	ok
C1	Capacitor	Murata	GRM	0.1 uF	0402	ok
M10	Inductor	Murata	LQG	1.8 nH	0402	ok
M12	Capacitor	Murata	GJM	2.7 pF	0402	ok
Evaluation Board	GRF400X_RevC					





Dimensions in millimeters

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



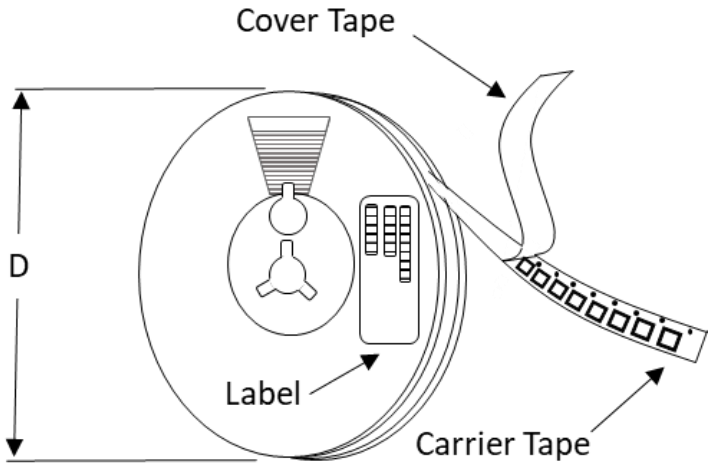
Dimensions (MM)	
A	1.5 +/- 0.050
B	1.5 +/- 0.050
C	.6 +/- 0.050
D	1.1 +/- 0.050
E	.5 Bsc
F	.2 +/- 0.050
G	.2 +/- 0.050
H	.45 +/- 0.050
J	.12 Ref.

1.5 mm DFN-6 Package Dimensions

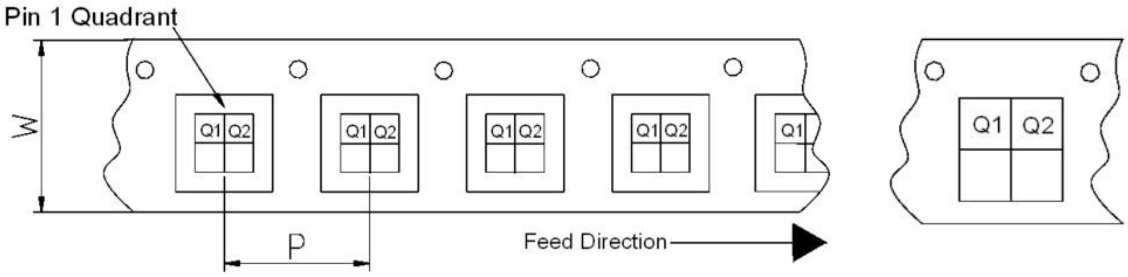
Tape and Reel Information:

Guerrilla RF's Tape and Reel specification complies with the Electronics Industries Association (EIA) standards for 'Embossed Carrier Tape of Surface Mount Components for Automatic Handling". Reference EIA-481. See the table on the following page for Tape and Reel specifications along with units per reel.

Devices are loaded with pins down into the carrier pocket with protective cover tape, wound into a plastic reel. Each reel will be packaged in a cardboard box. There will be product labels on the reel, the protective ESD bag and the outside surface of the box.



Tape and Reel Packaging with Reel Diameter Noted (D)



Carrier Tape Width (W), Pitch (P), Feed Direction and Pin 1 Quadrant Information

Tape and Reel Specification and Device Package Information Table

Package				Carrier Tape			Reel	
Type	Dimensions (mm)	Leads	Weight (mg)	Width (W) (mm)	Pocket Pitch (P) (mm)	Pin 1 Quad-rant	Diameter (D) (inches)	Units per Reel
QFN	2.0 x 2.0 x 0.50	12	7	8	4	Q1	7	2500
QFN	3.0 x 3.0 x 0.85	16	24	12	8	Q1	7	1500
DFN	1.5 x 1.5 x 0.45	6	4	8	4	Q1	7	2500
DFN	2.0 x 2.0 x 0.75	8	12	8	4	Q1	7	2500
LFM	3.5 x 3.5 x 0.75	See	TBD	12	8	Q2	7	1500
LFM	4.0 x 4.0 x 0.75	See note	TBD	12	8	Q2	7	1500

Note: Lead count may vary. Reference applicable product data sheet

Released

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.