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GRF5109

28.3 dBm Power-LNA™
Tuning Range: 0.1 – 1.5 GHz



Product Description

GRF5109 is a high linearity PA /Linear Driver with low noise figure (NF). It delivers excellent P1dB, IP3 and NF over a wide range of frequencies with fractional bandwidths of roughly 5 to 10%.

The device can be tuned over a wide range of frequencies from around 0.1 GHz to 1.5 GHz.

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

Features

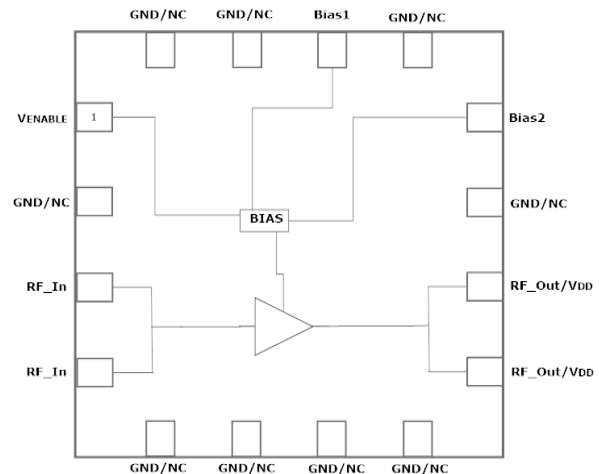
Reference: 5V/160mA/830MHz

- Gain: 19.0 dB
- OP1dB: 28.5 dBm
- OIP3: 43.5 dBm
- Eval Board NF: 1.3 dB

- Flexible Bias Voltage and Current
- Process: GaAs pHEMT

Applications

- Power Amplifier
- Linear Driver Amplifier for High PAR Waveforms
- Multi-stage LNA



3.0 x 3.0 mm QFN-16



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Absolute Ratings:

Parameter	Symbol	Min.	Max.	Unit
Drain Voltage	V _{DD}		6.0	V
Transient Average RF Input Power CW: (Load VSWR < 2:1; Duration: <1 hour)	P _{IN MAX}		24.0	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}		1.0	W
Electrostatic Discharge:				
Charged Device Model: (TBD)	CDM	1500		V
Human Body Model:	HBM	250		V
Storage:				
Storage Temperature	T _{STG}	-65	150	°C
Moisture Sensitivity Level	MSL		1	–



Caution! ESD Sensitive Device

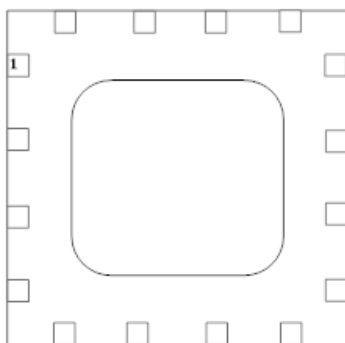


Exceeding Absolute Maximum Rating conditions may cause permanent damage to the device.

Note: For manufacturing information, see the Guerrilla-RF.com website for the following document located on the GRF5109 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	RF Input	Pins 3-4 tied together on system board
4	RF_In	RF Input	Pins 3-4 tied together on system board
5	NC	No Connect or Ground	No internal connection to die
6	NC	No Connect or Ground	No internal connection to die
7	NC	No Connect or Ground	No internal connection to die
8	NC	No Connect or Ground	No internal connection to die
9	RF_Out/V _{DD}	PA Output/Bias	Pins 9-10 tied together on system board. Supply V _{DD} here.
10	RF_Out/V _{DD}	PA Output/Bias	Pins 9-10 tied together on system board. Supply V _{DD} here.
11	NC	No Connect or Ground	No internal connection to die
12	Bias2	Bias Circuit Supply	Connect to V _{DD} through external resistor
13	NC	No Connect or Ground	No internal connection to die
14	Bias1	Bias Circuit Ground	Consult application schematic
15	NC	No Connect or Ground	No internal connection to die
16	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.



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Nominal Operating Parameters:

Parameter	Symbol	Specification			Unit	Condition
		Min.	Typ.	Max.		
Target Performance (0.7 to 0.96 GHz Tune)						Bias: 5.0 V and 160 mA unless otherwise noted. (+25C)
Test Frequency	F _{TEST}		0.83		GHz	
Gain	S(2,1)	18.0	19.0		dB	
Noise Figure (Evaluation Board)	NF		1.3		dB	
Output 1dB Compression Point	OP1dB	26.8	28.5		dBm	
Output Third Order Intercept Point	OIP3		43.5		dBm	
Switching Rise Time	T _{RISE}		100		ns	
Switching Fall Time	T _{FALL}		800		ns	
Quiescent Supply Current	I _{DDQ}		160	190	mA	V _{DD} =V _{enable} =5.0volts R _{bias} : 5.5k ohms
Enable Current	I _{ENABLE}		2.0		mA	
Disabled Mode						
Supply Current (Leakage)	I _{DD}		30	150	uA	
Thermal Data						
Thermal Resistance: (IR Scan Method)	Θ _{jc}		80		°C/W	
Channel Temperature @ +85C Reference (package heat sink)	T _{CHANNEL}		149 (See note)		°C	V _{DD} : 5.0 volts; I _{DDQ} : 160 mA P _{DISS} : 800 mW; No RF

Note: MTTF >10⁶ hours for T_{CHANNEL} < =170 degrees C.

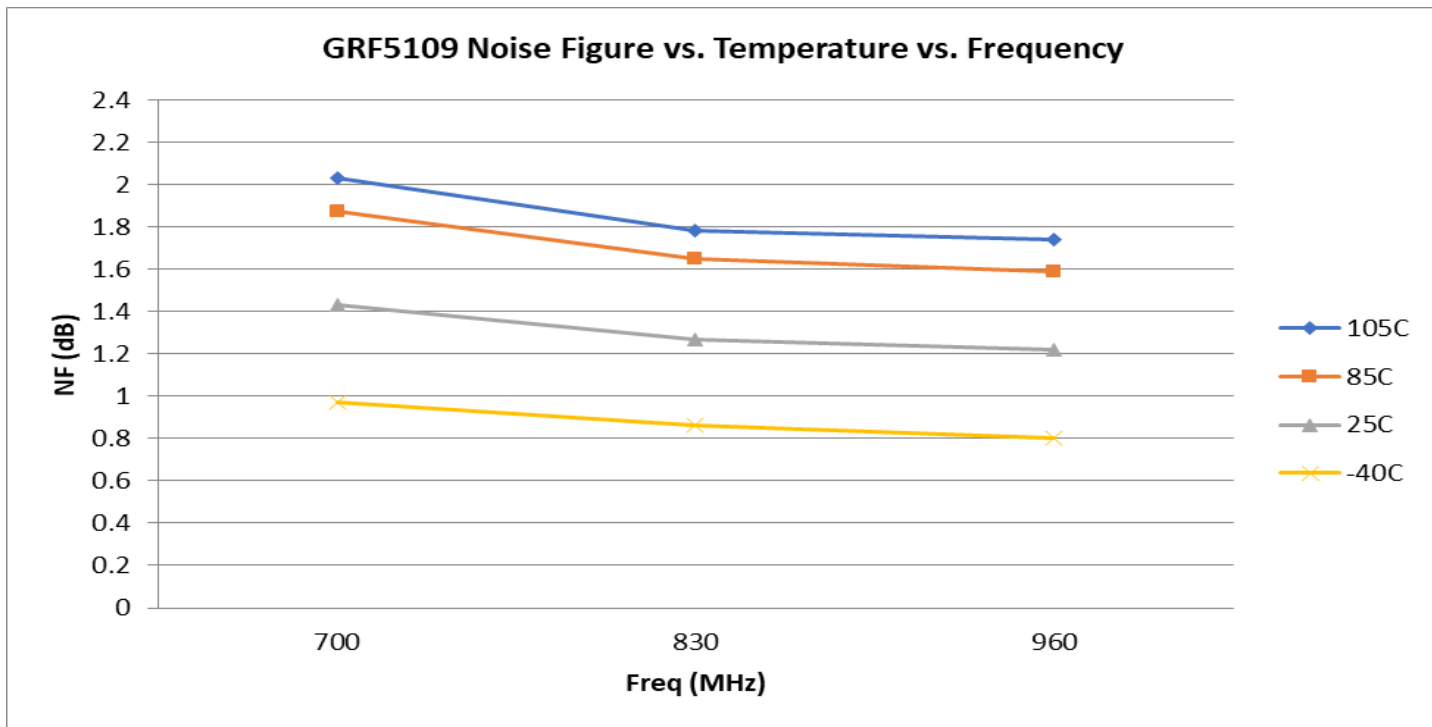
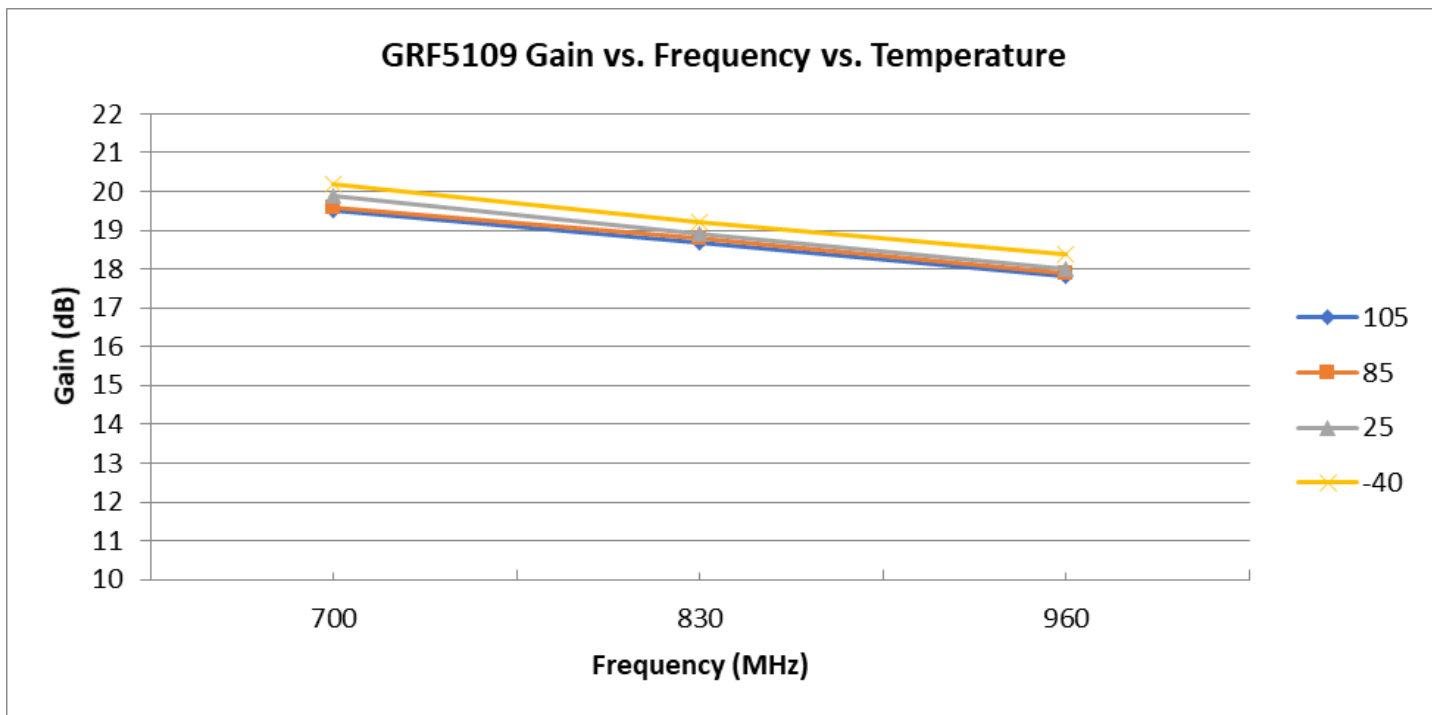


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GRF5109 Evaluation Board Measured Data: (0.7 to 0.96 GHz Tune)



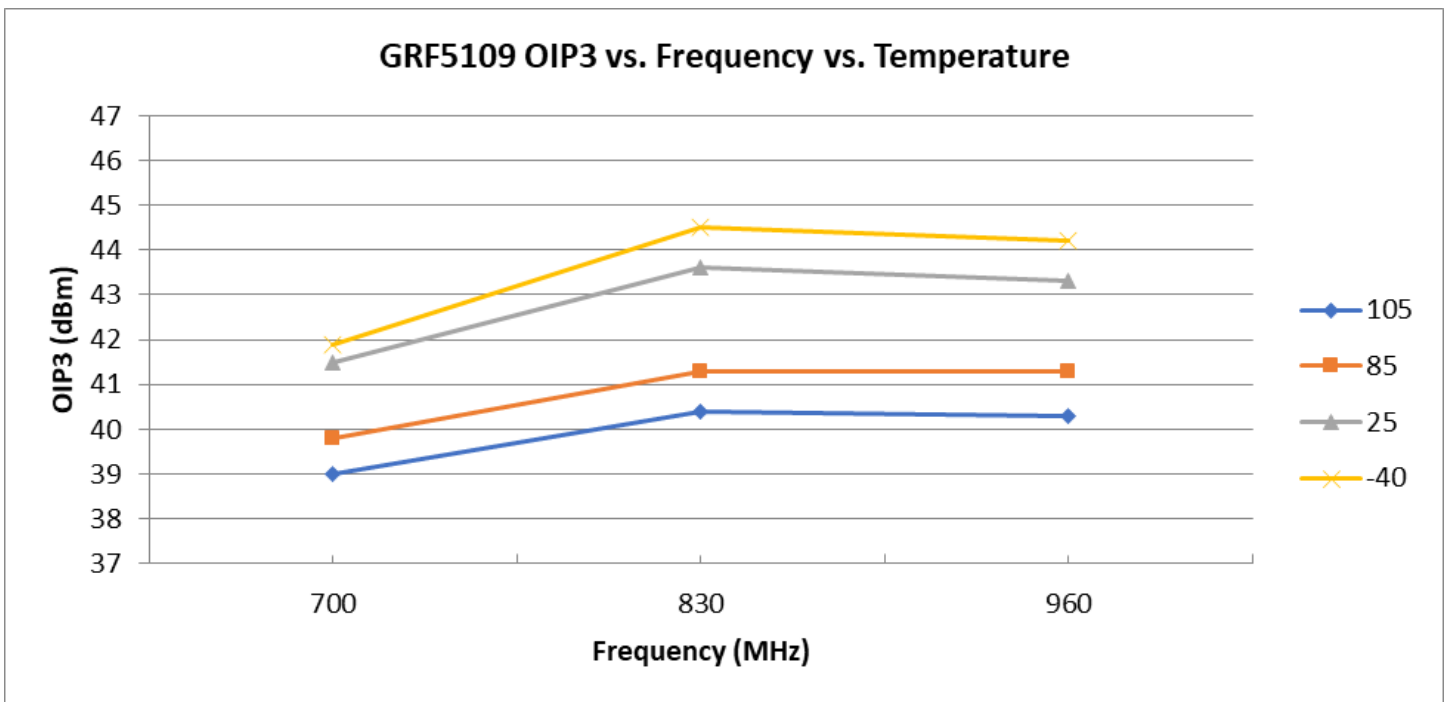
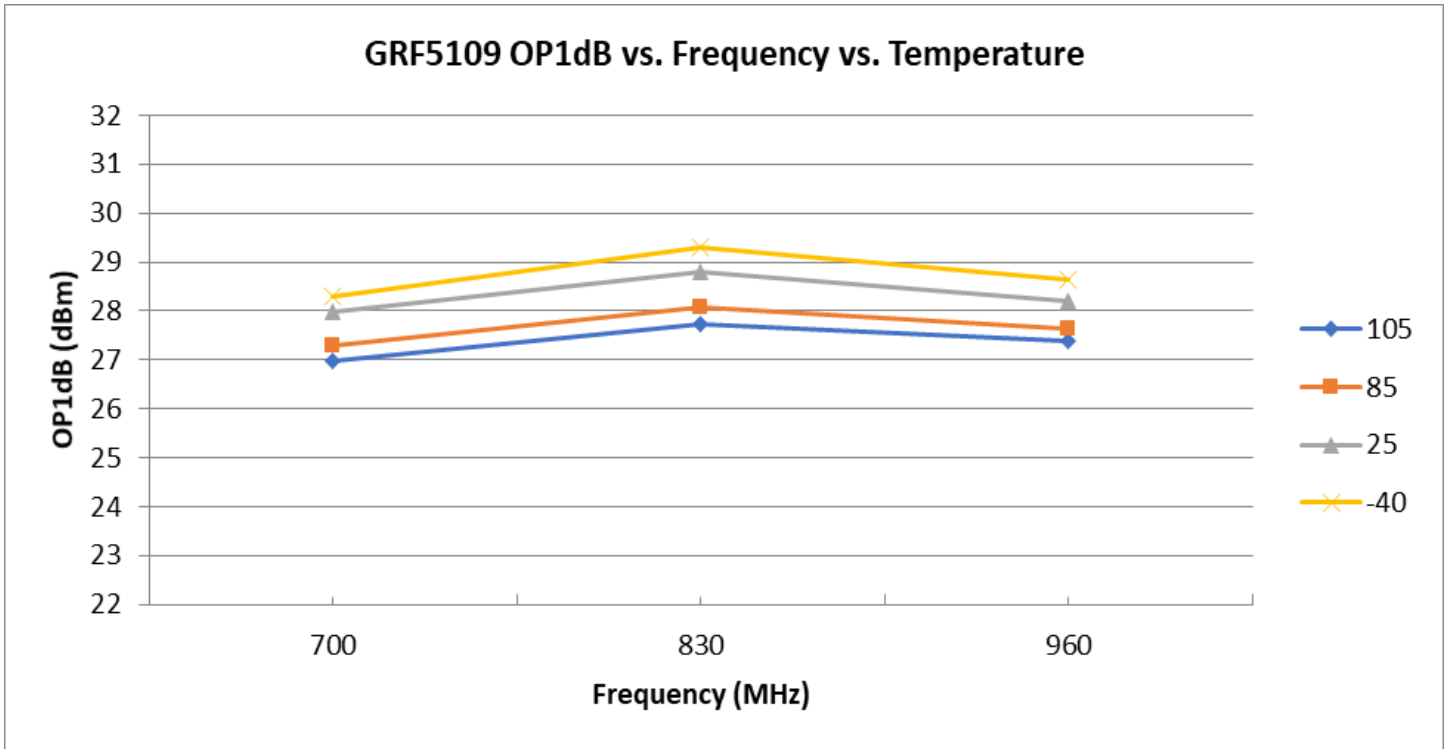


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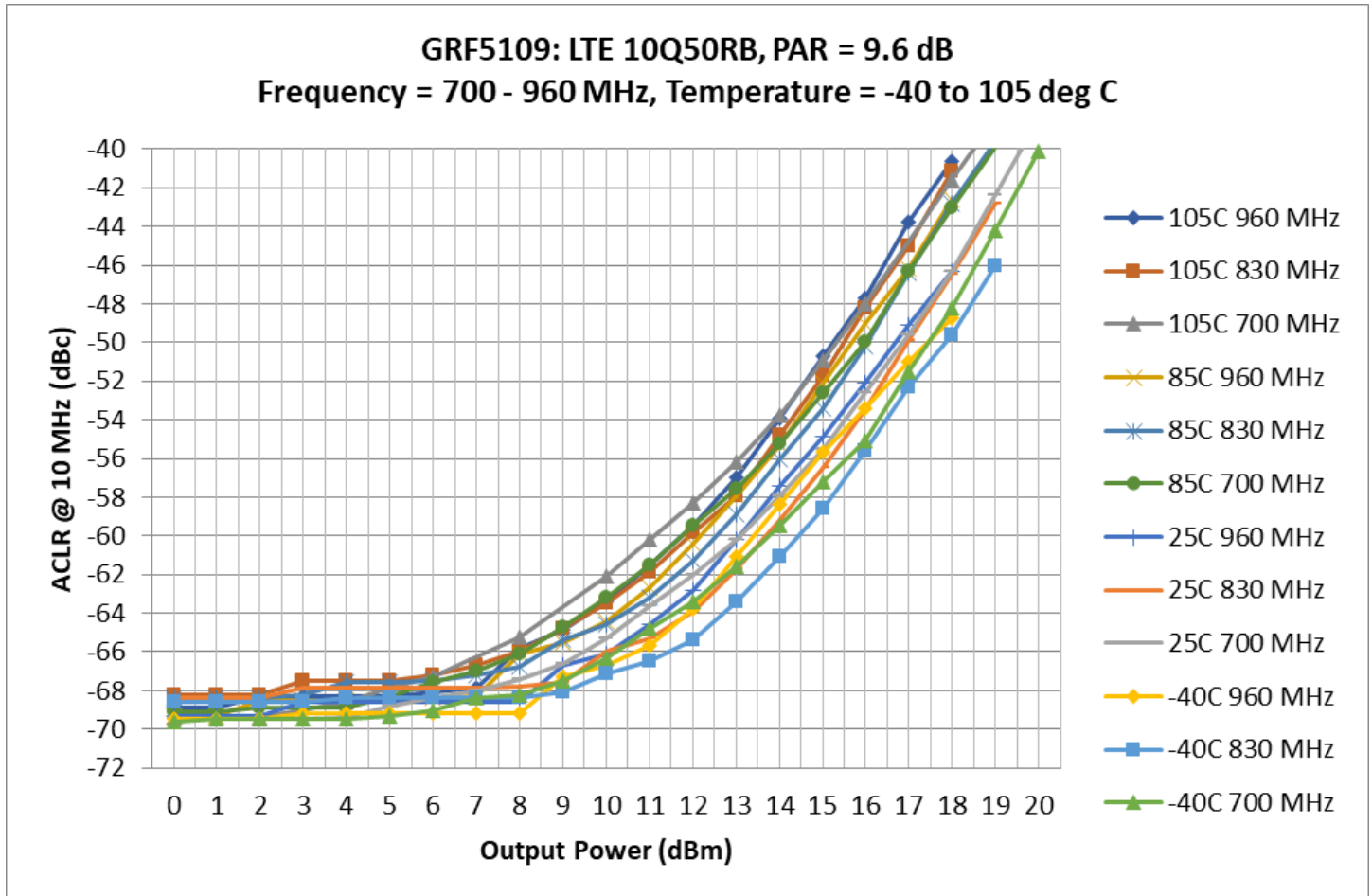


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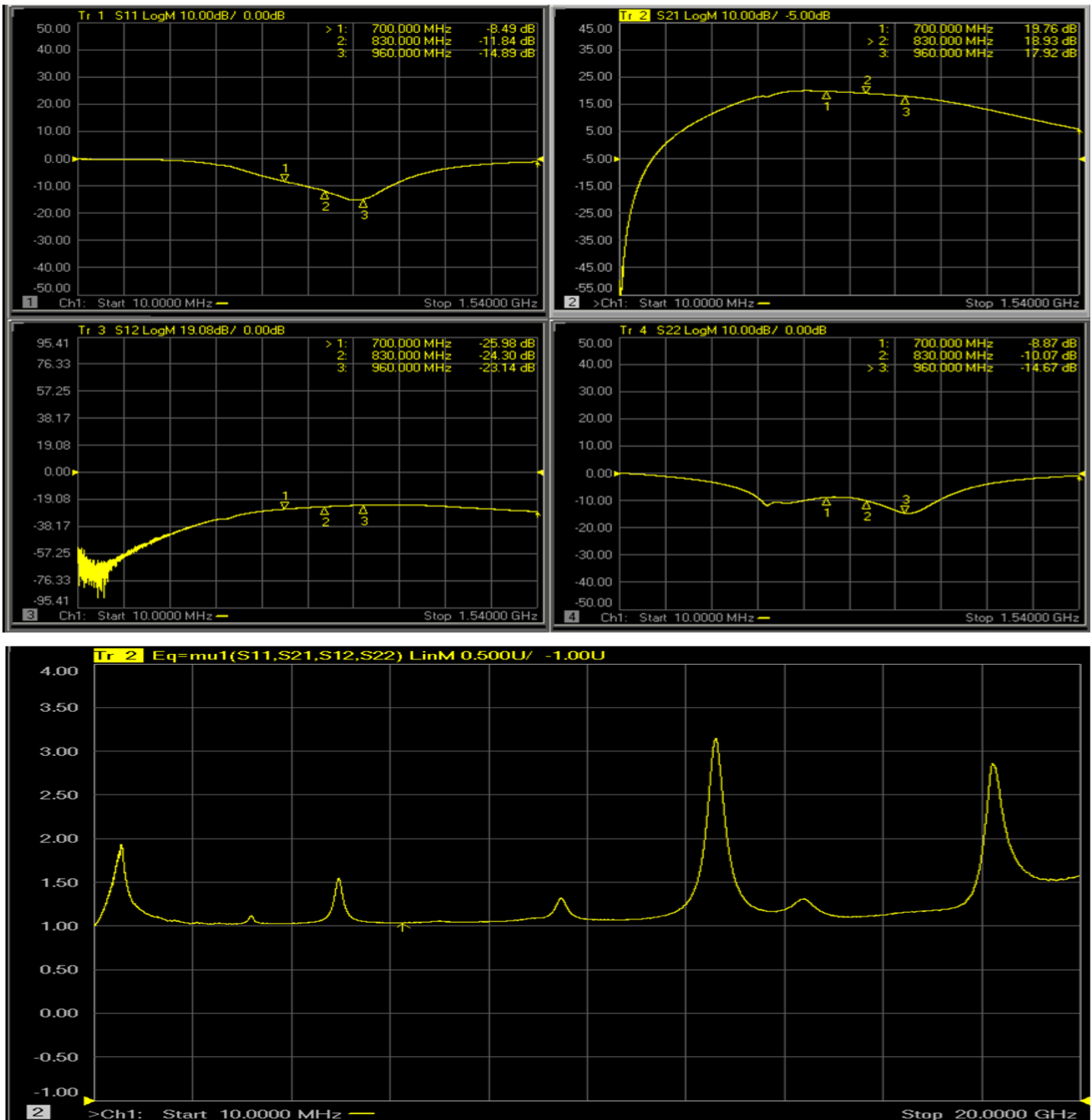


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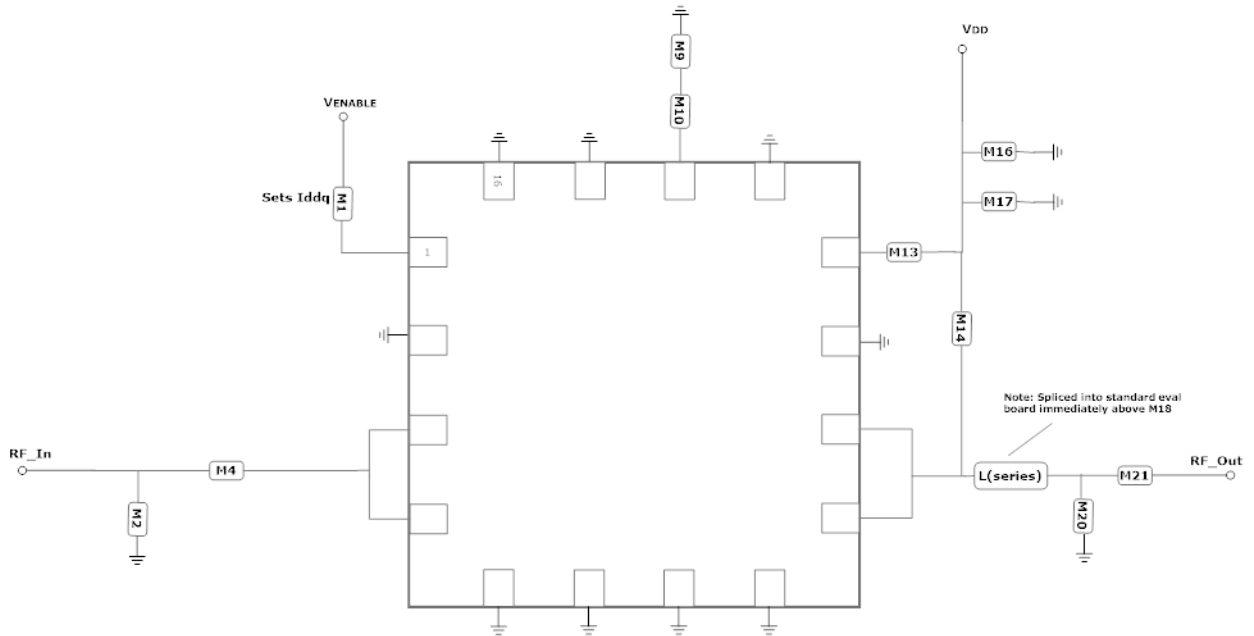
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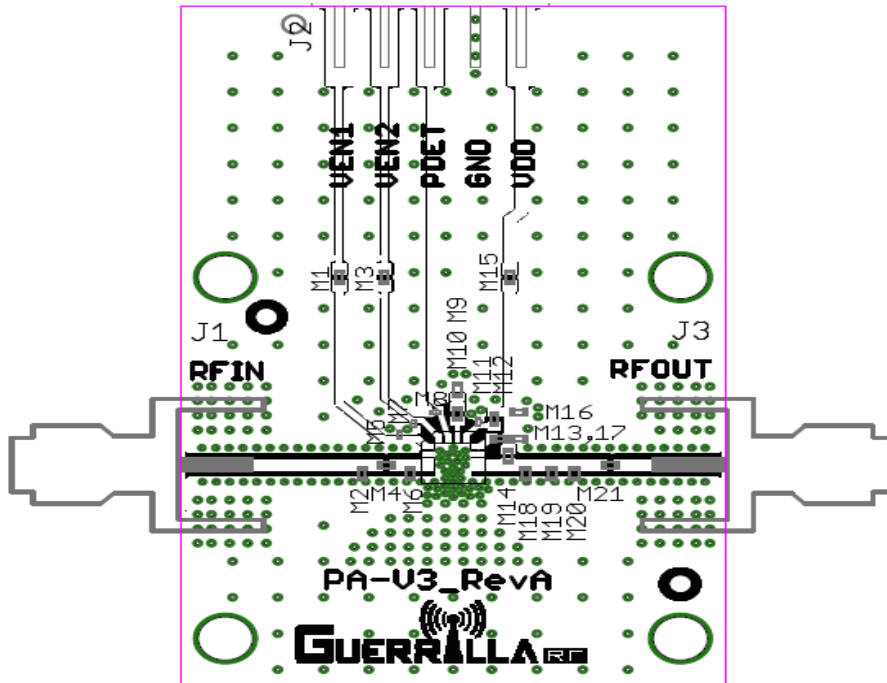
GRF5109 Evaluation Board S-Parms: (0.7 to 0.96 GHz Tune)



Note: Mu factor ≥ 1.0 implies unconditional stability.



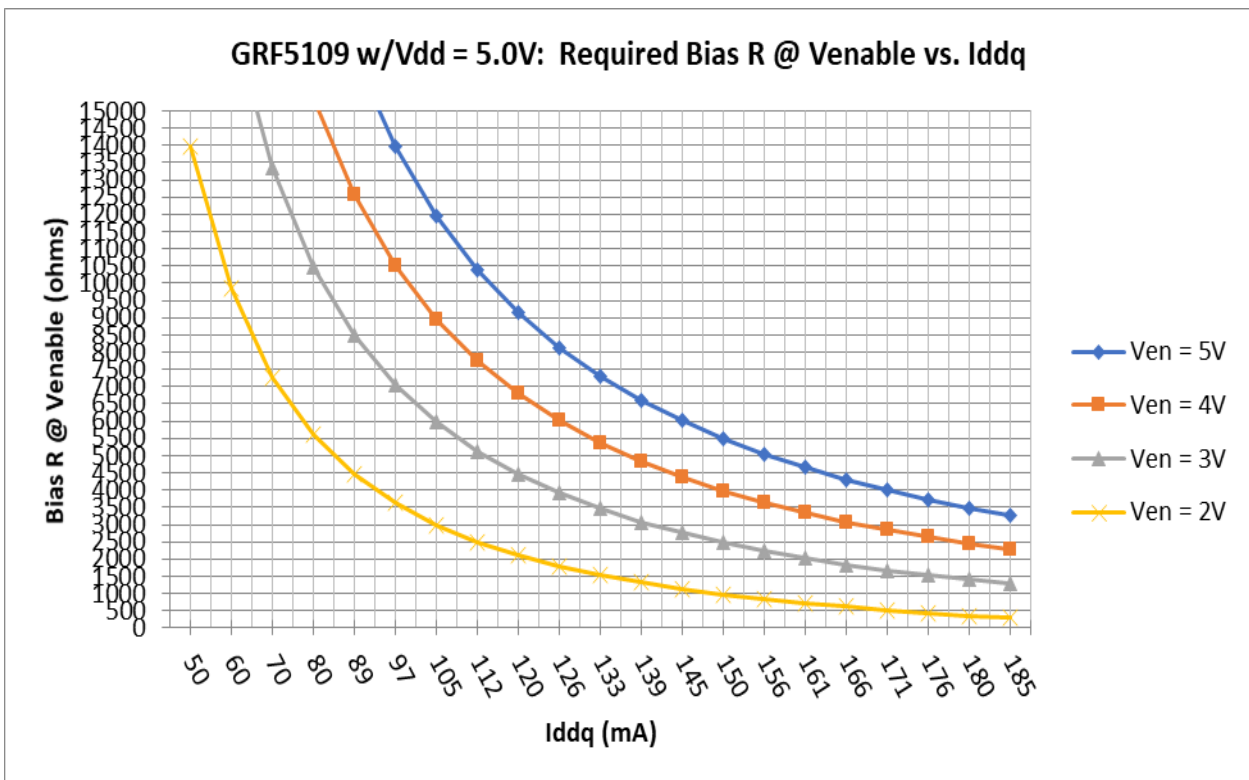
GRF5109 Application Schematic: (0.7 to 0.96 GHz)



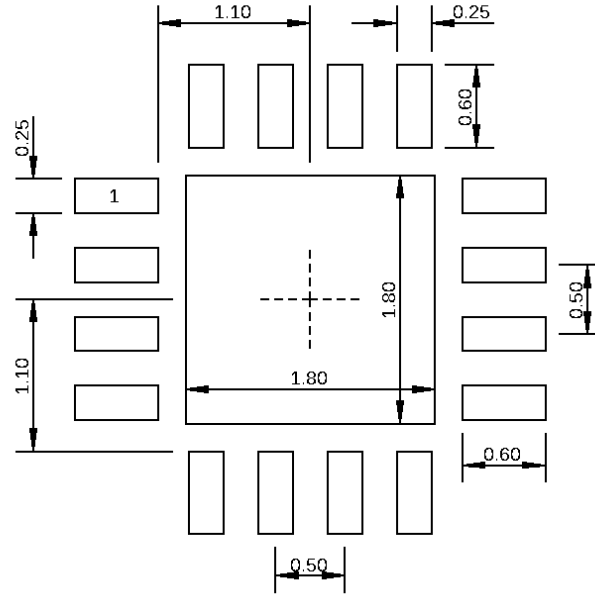
GRF5109 Evaluation Board Assembly Drawing

GRF5109 Evaluation Board BOM: (0.7–0.96 GHz)

Component	Type	Manufacturer	Family	Value	Package Size	Substitution
M1 (See curves)	Resistor	Various	5%	Sets Iddq	0402	ok
M2	Inductor: High Q	Coilcraft	HP	5.1 nH	0402	ok
M4	Capacitor: High Q	Murata	GJM	12.0 pF	0402	ok
M9	Inductor	Murata	LQP/LQG	39 nH	0402	ok
M10	Resistor	Various	5%	230 Ohm	0402	ok
M13	Resistor	Various	5%	475 Ohm	0402	ok
M14	Inductor: High Q	Coilcraft	HP	18 nH	0402	ok
M16	Capacitor	Murata	GRM	0.1 uF	0402	ok
M17	Capacitor	Murata	GRM	100 pF	0402	ok
M20	Capacitor	Murata	GJM	5.1 pF	0402	ok
M21	Capacitor	Murata	GJM	39 pF	0402	ok
L(series)	Inductor: High Q	Coilcraft	HP	3.3 nH	0402	ok

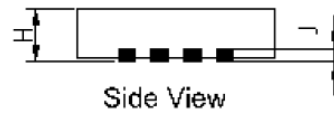
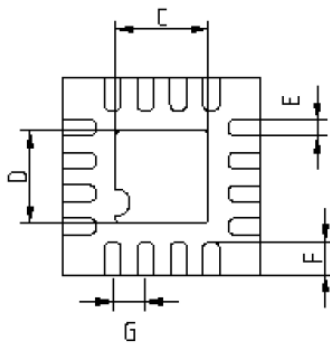
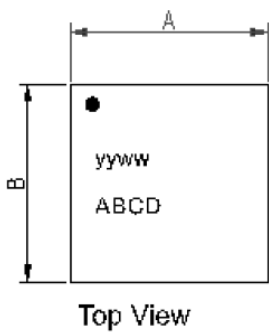


GRF5109 Bias Resistor (M1) Selection Curves



Dimensions in millimeters

3.0 mm QFN-16 Suggested PCB Footprint (Top View)



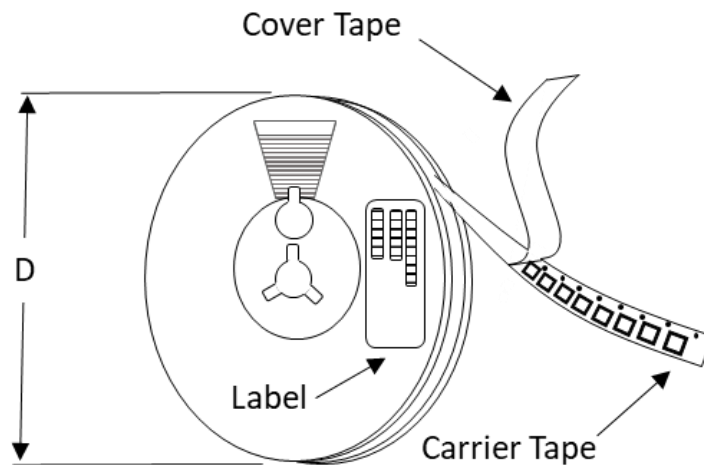
Dimensions (MM)	
A	3.0 Bsc
B	3.0 Bsc
C	1.40 +/- 0.10
D	1.40 +/- 0.10
E	.25 + 0.05 / - 0.07
F	.50 +/- 0.05
G	.50 Bsc.
H	.85 +/- 0.05
J	.20 Ref.

3.0 mm QFN-16 Package Dimensions

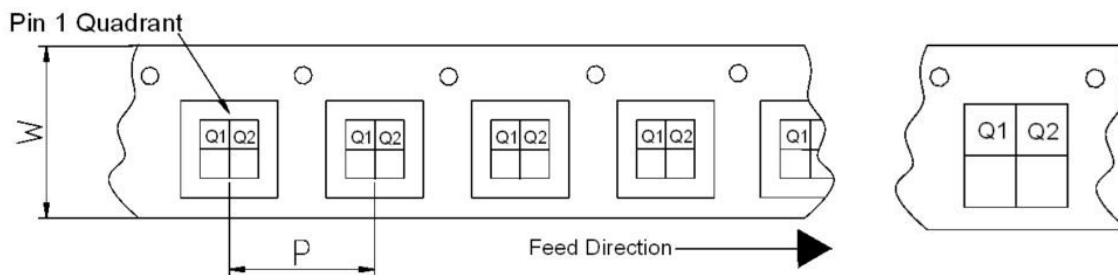
Tape and Reel Information:

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



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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 Quadrant	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



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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.

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