

GRF2201

HIGH GAIN, ULTRA-LNA

1.2 to 6.1 GHz

FEATURES

- Flexible Bias Voltage and Current
- Internally Match to 50 Ω
- Process: GaAs pHEMT
- Compact 1.5 x 1.5 mm DFN-6 Package

Reference: 3.3 V / 15 mA / 2.45 GHz

- Gain: 20 dB
- OIP3: 23 dBm
- OP1dB: 12 dBm
- Evaluation Board Noise Figure: 0.75 dB

APPLICATIONS

- ISM LNA
- Zigbee
- Bluetooth
- 2.4 GHz Drones
- 2.4 GHz 802.11 b.g.n
- Small Cells and Cellular Repeaters

DESCRIPTION

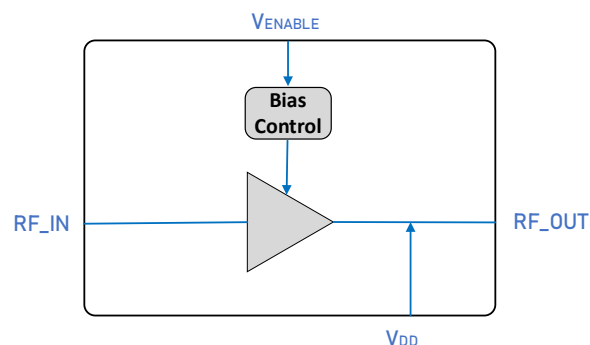
The GRF2201 is a high-gain, low current LNA tunable over sub-bands from 1.2 to 6.1 GHz. It exhibits outstanding gain and noise figure (NF) with I_{DDQ} levels as low as 8 mA.

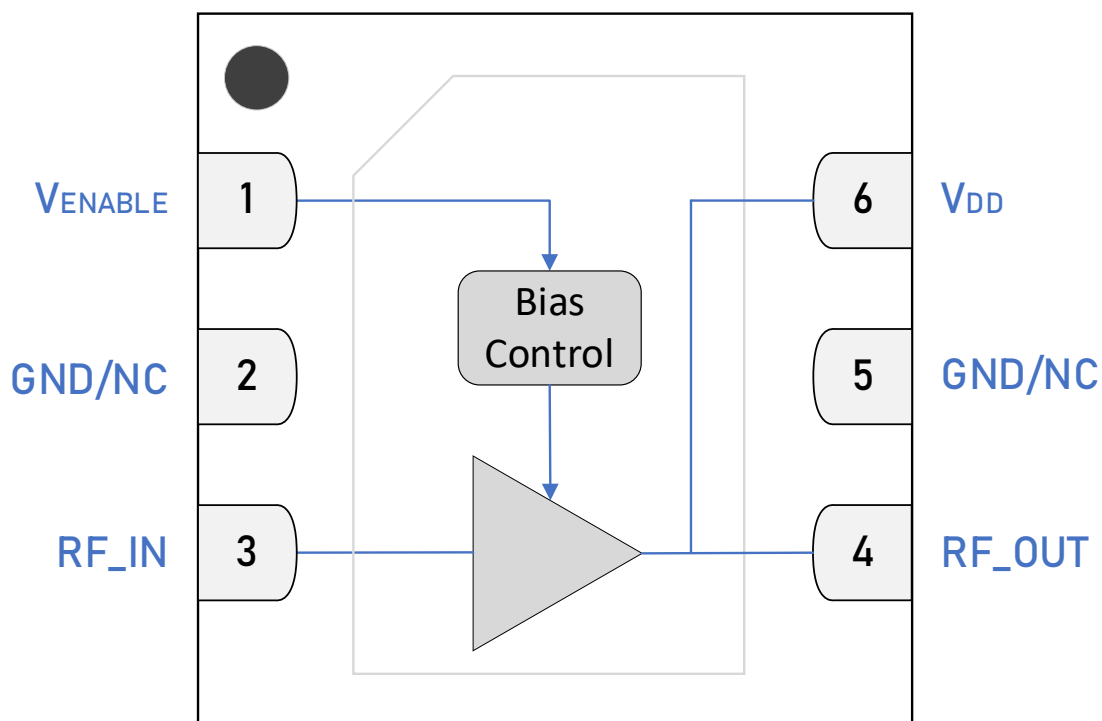
The device is operated from a supply voltage of 2.7 to 5 volts with a selectable I_{DDQ} range from 8 to 30 mA for optimal efficiency and linearity.

Please consult with the GRF applications engineering team for custom tuning/evaluation board data and device S-parameters.

Additional tunes can be found on the GRF2201 "Custom Tunes" product page: [GRF2201 Custom Tunes](#)

BLOCK DIAGRAM





1.5 x 1.5mm DFN-6 Pin Out (Top View)

Pin Assignments

Pin	Name	Description	Note
1	V _{ENABLE}	LNA Enable Input	V _{ENABLE} and series resistor sets I _{DDQ} . V _{ENABLE} ≤ 0.2 volts disables device.
2, 5	GND/NC	Ground or No Connect	No internal connection to die. We recommend connecting these pins to ground.
3	RF_IN	RF Input	An external DC blocking capacitor must be used.
4	RF_OUT	RF Output	An external DC blocking capacitor must be used.
6	V _{DD}	Supply Voltage	V _{DD} applied via external matching inductor.
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.

Absolute Ratings

Parameter	Symbol	Min.	Max.	Unit
Supply Voltage	V_{DD}	0	5.5	V
RF Input Power: Load VSWR < 2:1, $V_{DD} \leq 5$ V, $V_{ENABLE} = 5$ V.	$P_{IN\ MAX\ ON}$		17	dBm
RF Input Power: Load VSWR < 2:1, $V_{DD} \leq 5$ V, $V_{ENABLE} = 0$ V.	$P_{IN\ MAX\ OFF}$		17	dBm
Operating Temperature (package base)	$T_{PKG\ BASE}$	-40	105	°C
Maximum Channel Temperature (MTTF > 10 ⁶ hours)	T_{MAX}		170	°C
Maximum Dissipated Power	$P_{DISS\ MAX}$		200	mW

Electrostatic Discharge

Human Body Model	HBM	250		V
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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 additional information, please refer to [Manufacturing Note MN-001 — Package and Manufacturing Information](#).



All Guerrilla RF products are provided in RoHS compliant lead (Pb)-free packaging requiring no exemptions. Additional information for this topic can be found at this link - [Environmental and Restricted Substance Statement Library](#).

Recommended Operating Conditions

Parameter	Symbol	Specification			Unit	Condition
		Min.	Typ.	Max.		
Supply Voltage	V_{DD}	2.7	3.3	5.5	V	
Operating Temperature (package base)	$T_{PKG\ BASE}$	-40		105	°C	
RF Frequency Range	F_{RF}	1.2	2.45	6.1	GHz	Typical application schematic with external matching components (notes 1 & 2).
RF_IN Port Impedance	Z_{RFIN}		50		Ω	Single-ended.
RF_OUT Port Impedance	Z_{RFOUT}		50		Ω	Single-ended.

Note 1: Operation outside of this range is supported by using different custom tunes. Examples of other optimized tunes can be found here: [GRF2201 Custom Tunes](#)

Note 2: Contact the Guerrilla RF Applications team for guidance on optimizing the tuning of the device for alternative bands.

Nominal Operating Parameters – General

The following conditions apply unless noted otherwise: typical application schematic using the 2.4 to 2.5 GHz tuning set. $V_{DD} = 3.3\text{ V}$, $V_{ENABLE} = 3.3\text{ V}$, $I_{DD} = 15\text{ mA}$, $F_{TEST} = 2.45\text{ GHz}$, $M5 = 4.6\text{ k}\Omega$, $50\text{ }\Omega$ system impedance, $T_{PKG\text{ BASE}} = 25\text{ }^{\circ}\text{C}$. Evaluation board losses are included within the specifications.

Parameter	Symbol	Specification			Unit	Condition
		Min.	Typ.	Max.		
Supply Current	I_{DD}	10	15	20	mA	
Enable Current	I_{ENABLE}		0.5		mA	
Switching Rise Time	T_{RISE}		130		ns	Disabled mode to Gain mode (note 3).
Switching Fall Time	T_{FALL}		20		ns	Gain mode to Disabled mode (note 4).

Disabled Mode

Leakage Current	$I_{LEAKAGE}$		230		μA	$V_{DD} = 3.3\text{ V}$, $V_{ENABLE} = 0\text{ V}$.
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Thermal Data

Thermal Resistance (Infrared Scan)	Θ_{JC}		132		$^{\circ}\text{C}/\text{W}$	On standard evaluation board (note 5).
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Note 3: Switching Time: 50% of V_{ENABLE} to 90% of P_{OUT} .

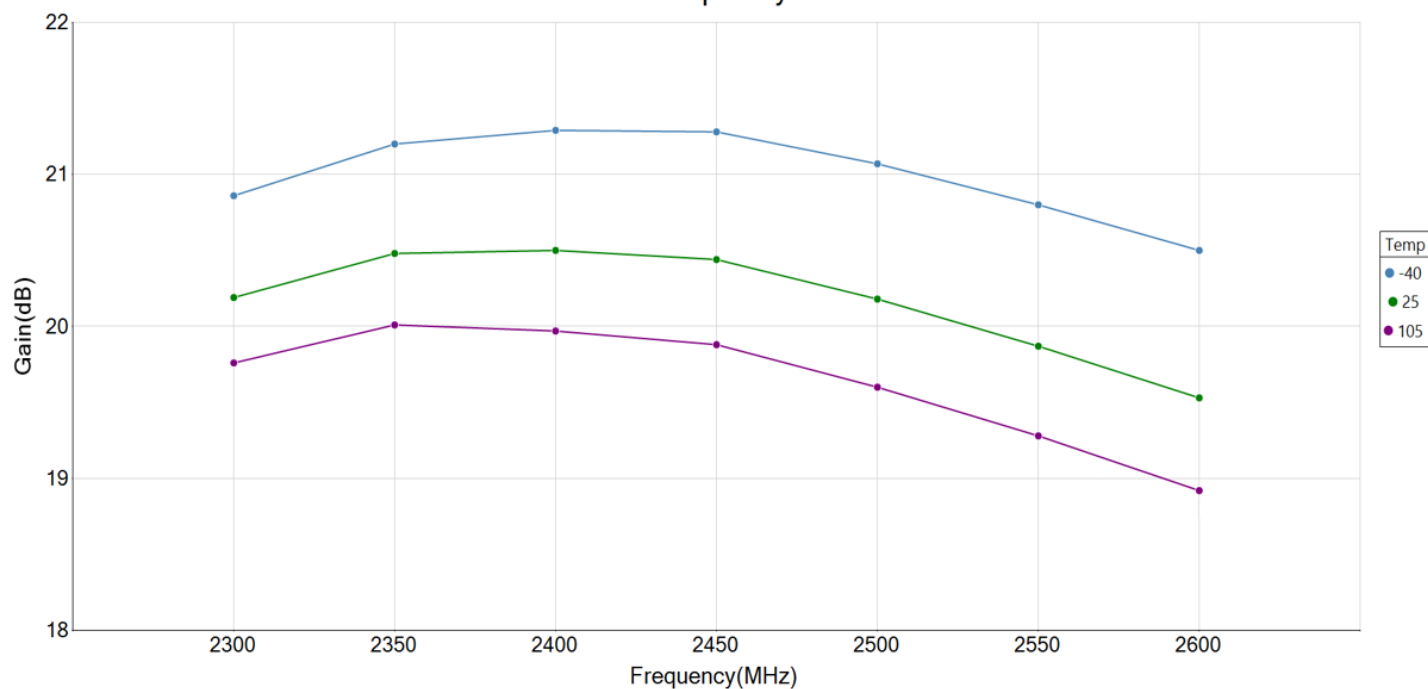
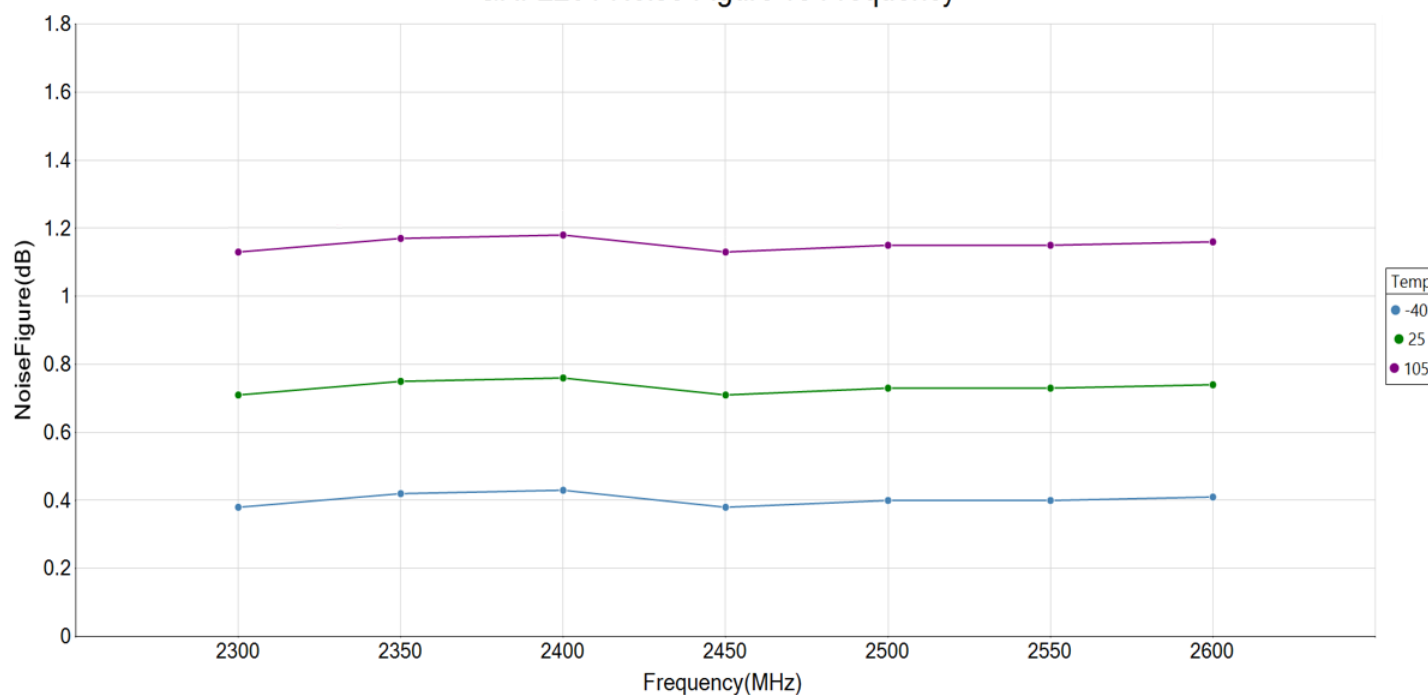
Note 4: Switching Time: 50% of V_{ENABLE} to 10% of P_{OUT} .

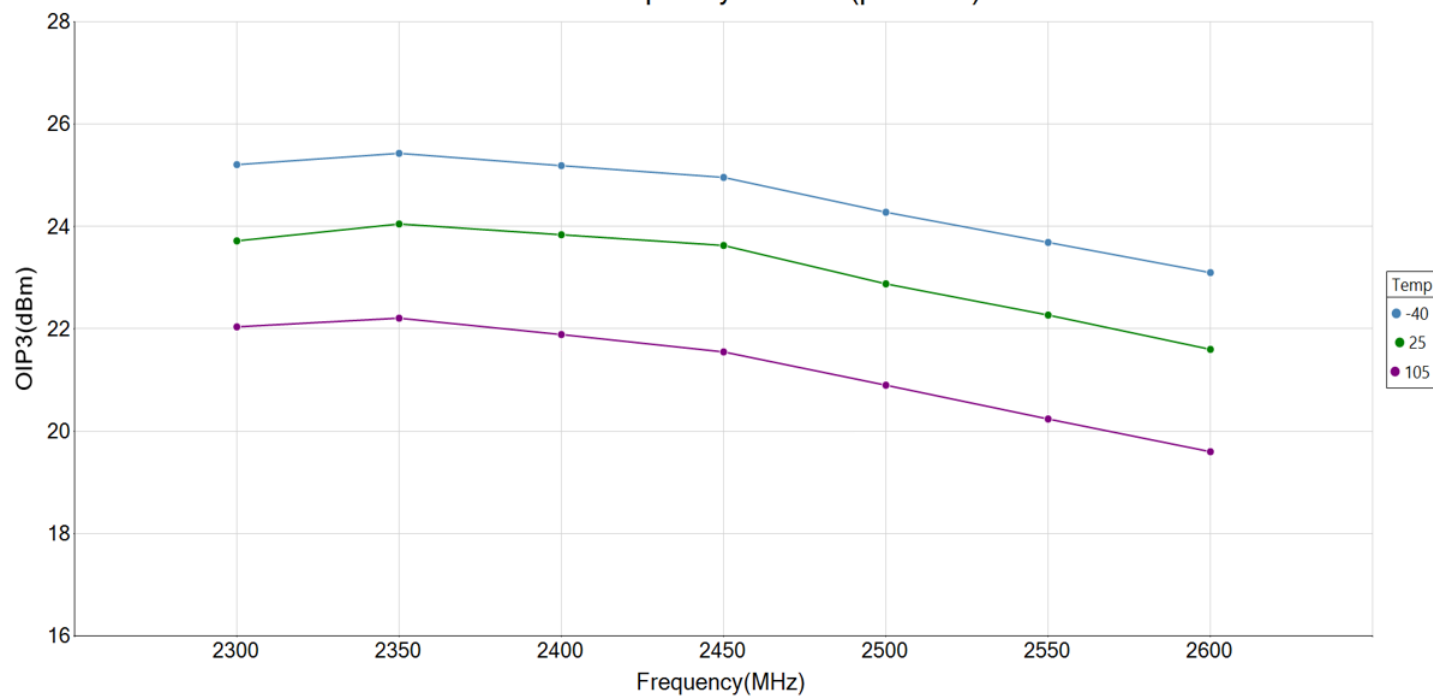
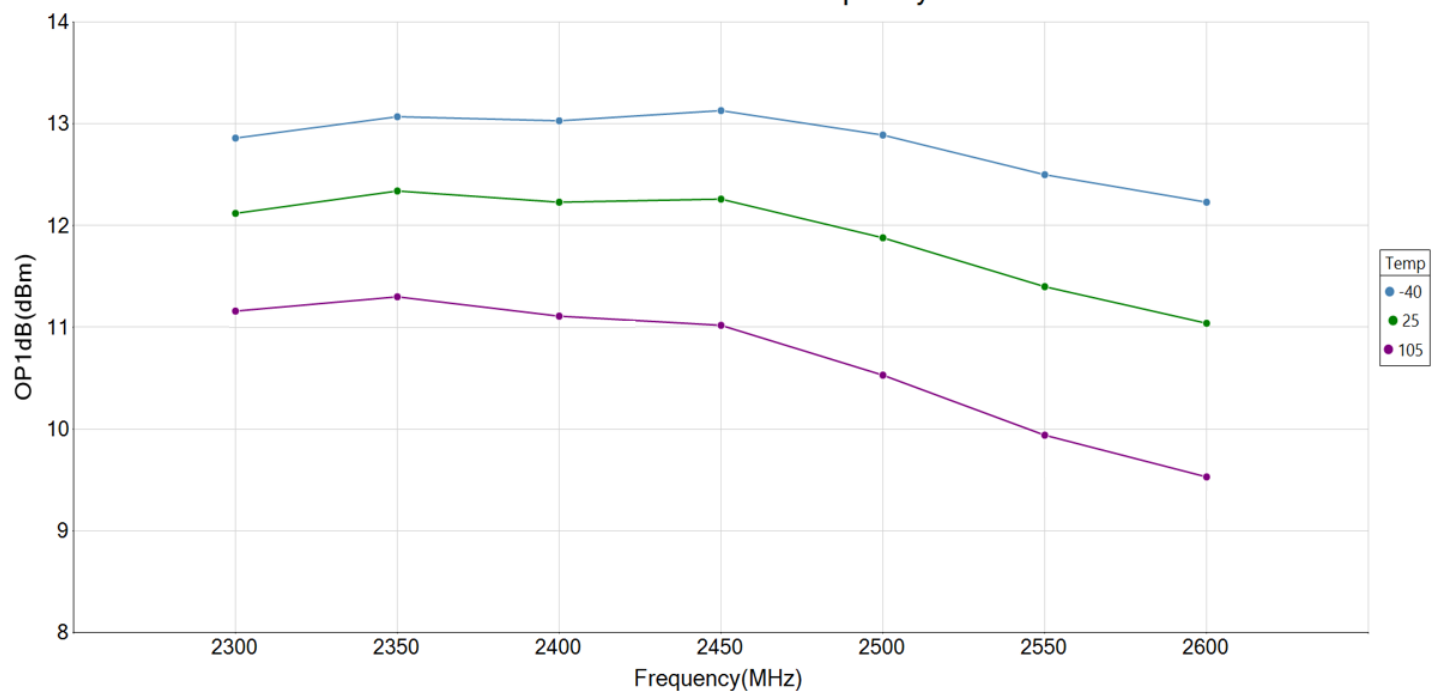
Note 5: MTTF > 10^6 hours for $T_{CHANNEL} < 170\text{ }^{\circ}\text{C}$.

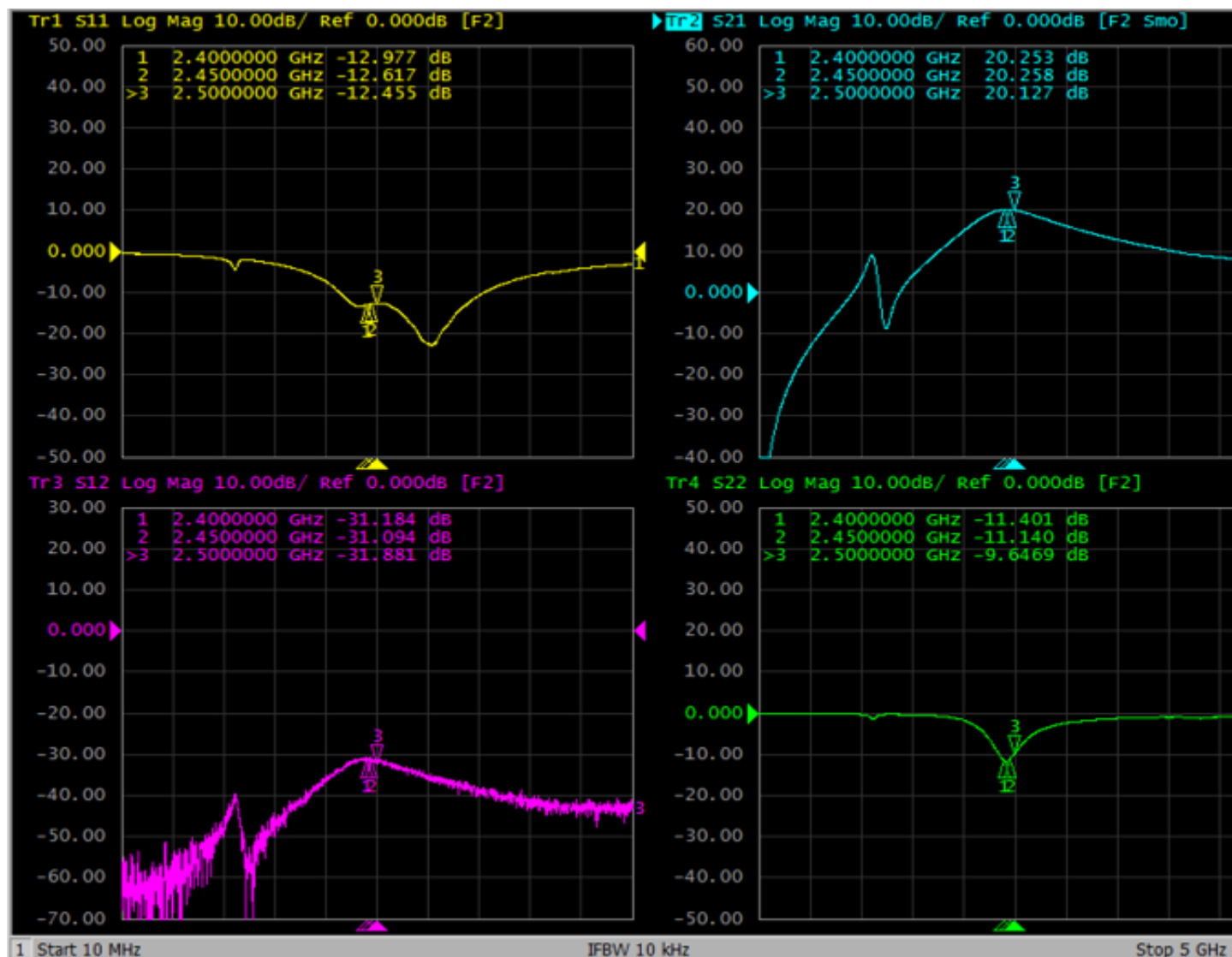
Nominal Operating Parameters – RF

The following conditions apply unless noted otherwise: typical application schematic using the 2.4 to 2.5 GHz tuning set. $V_{DD} = 3.3\text{ V}$, $V_{ENABLE} = 3.3\text{ V}$, $I_{DD} = 15\text{ mA}$, $F_{TEST} = 2.45\text{ GHz}$, $M5 = 4.6\text{ k}\Omega$, $50\text{ }\Omega$ system impedance, $T_{PKG\text{ BASE}} = 25\text{ }^{\circ}\text{C}$. Evaluation board losses are included within the specifications.

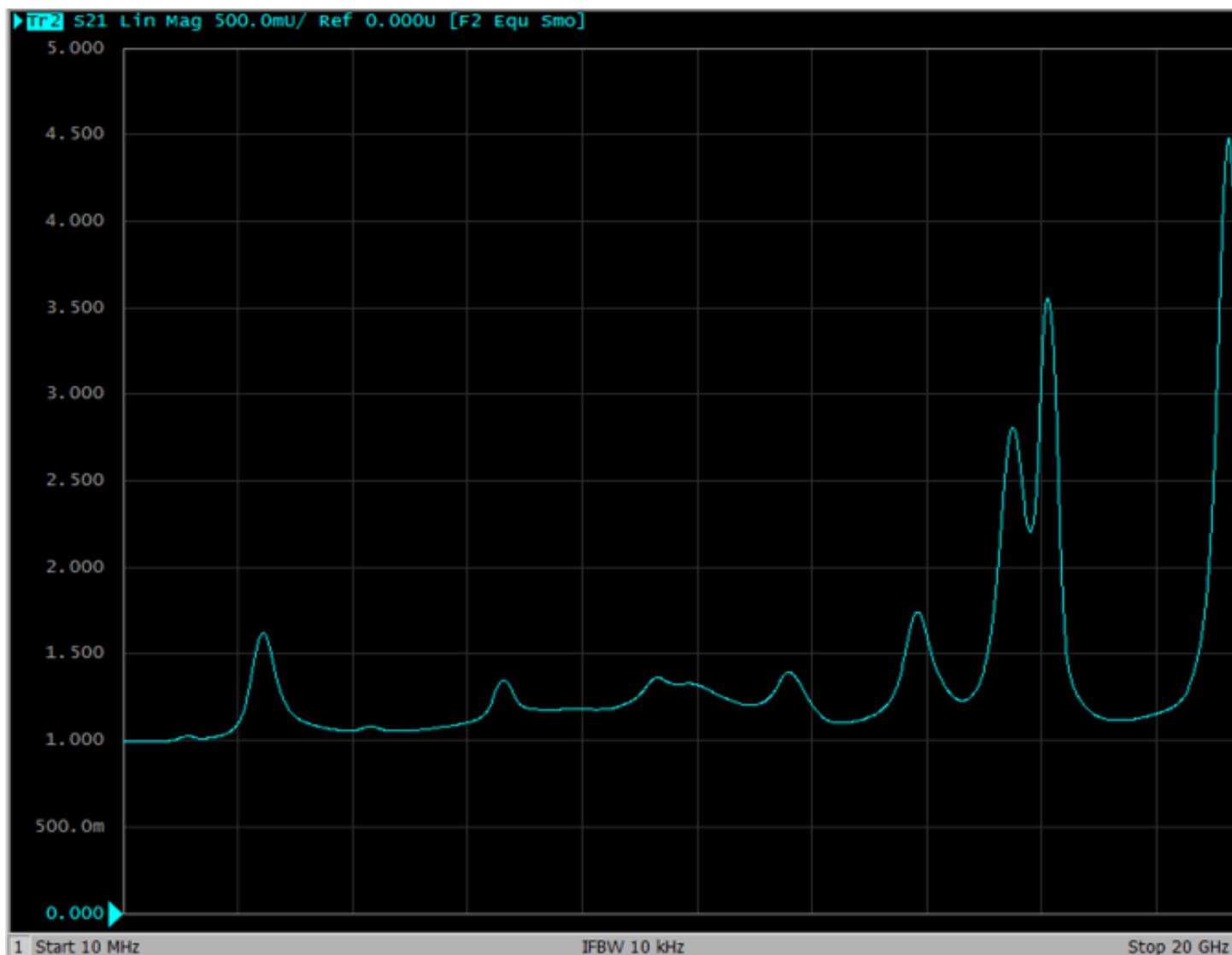
Parameter	Symbol	Specification			Unit	Condition
		Min.	Typ.	Max.		
Gain	S21	18	20		dB	
Reverse Isolation	S12		< -30		dB	$F_{RF} = 2.4\text{ to }2.5\text{ GHz}$.
Input Return Loss	S11		< -12		dB	$F_{RF} = 2.4\text{ to }2.5\text{ GHz}$.
Output Return Loss	S22		< -9		dB	$F_{RF} = 2.4\text{ to }2.5\text{ GHz}$.
Noise Figure	NF		0.75		dB	On standard evaluation board.
Output 3rd Order Intercept Point	OIP3		23		dBm	-5 dBm P_{OUT} per tone at 2 MHz spacing (2499 and 2451 MHz).
Output 1 dB Compression Power	OP1dB	9.5	12		dBm	

GRF2201 Typical Operating Curves: 3.3 V, 15 mA, 2.4 to 2.5 GHz
GRF2201 Gain vs Frequency at Pin = -25 dBm

GRF2201 Noise Figure vs Frequency


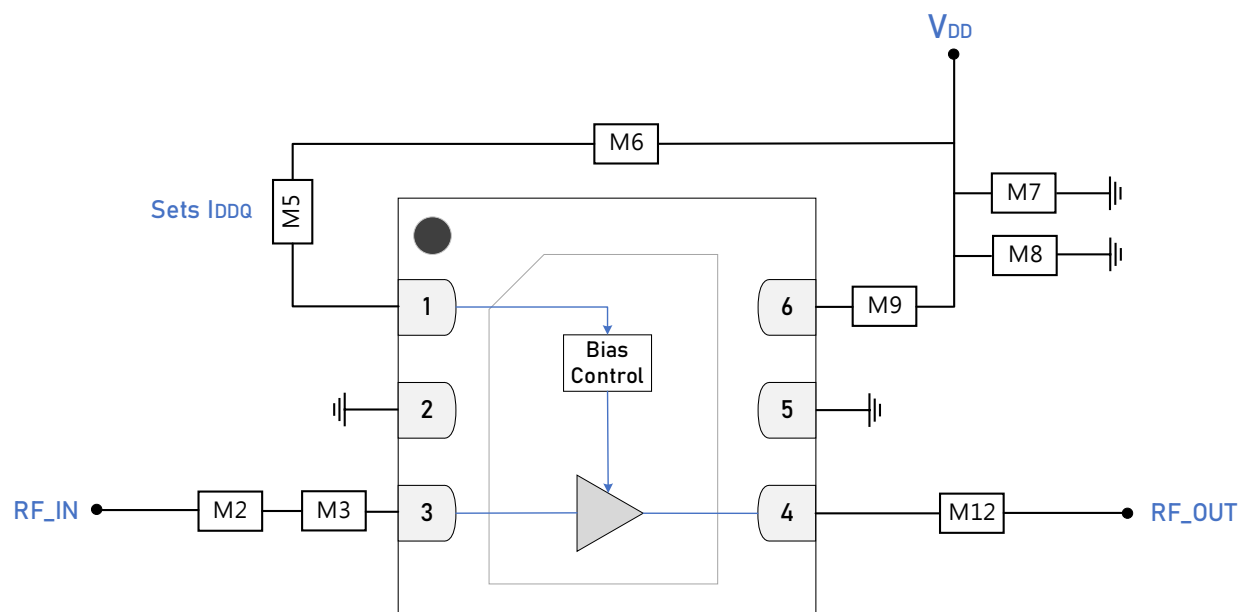
GRF2201 Typical Operating Curves: 3.3 V, 15 mA, 2.4 to 2.5 GHz
GRF2201 OIP3 vs Frequency at Pout (per tone) = 2 dBm

GRF2201 OP1dB vs Frequency


GRF2201 Typical Operating Curves: S-Parameters (2.4 to 2.5 GHz Tune)


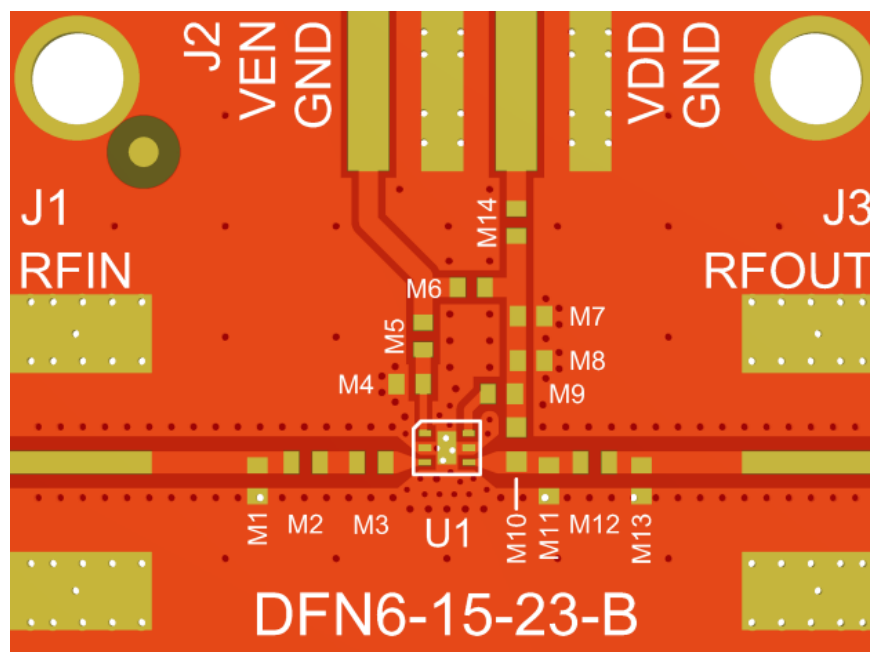
GRF2201 Typical Operating Curves: Stability Mu Factor (10 MHz to 20 GHz)



Note: Mu factor ≥ 1 implies unconditional stability.



GRF2201 Standard Evaluation Board Schematic



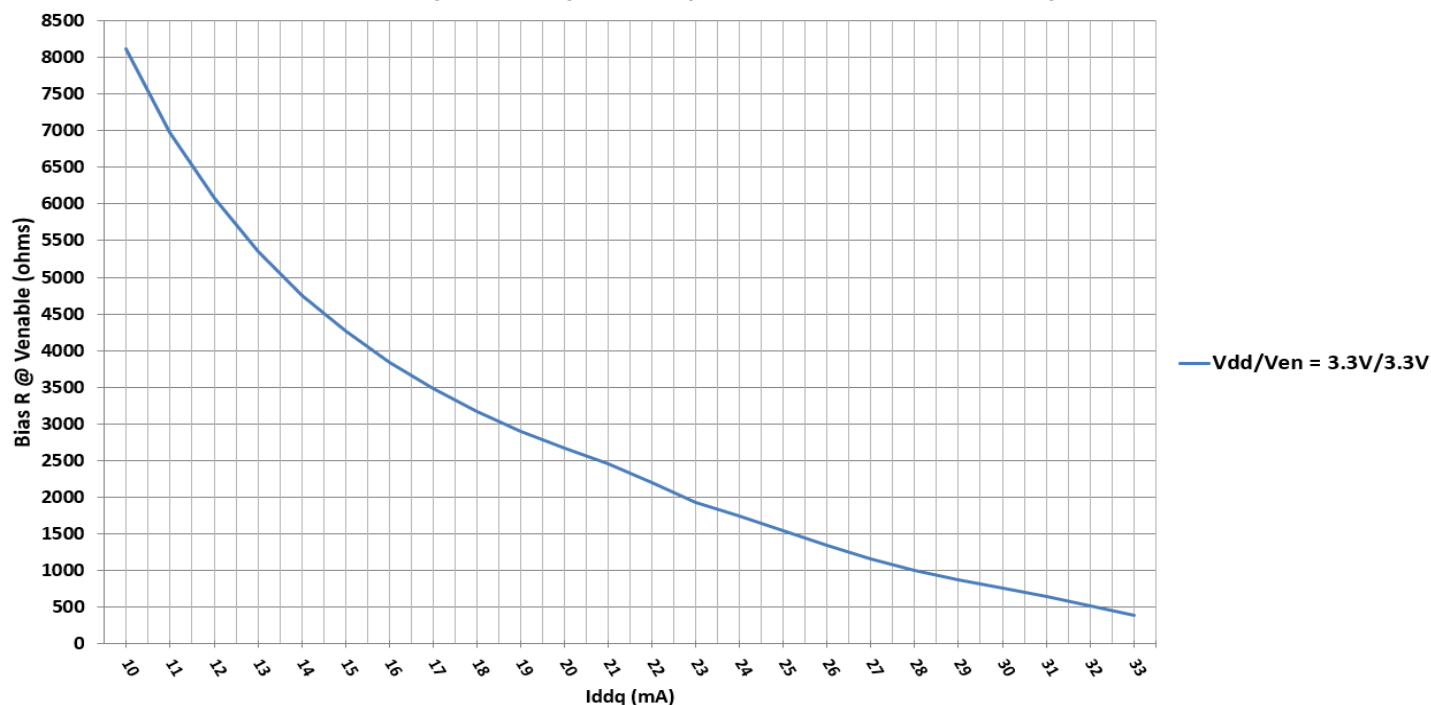
GRF2201 Evaluation Board Assembly Diagram

GRF2201 Evaluation Board Assembly Diagram Reference: 2.4 to 2.5 GHz Tune

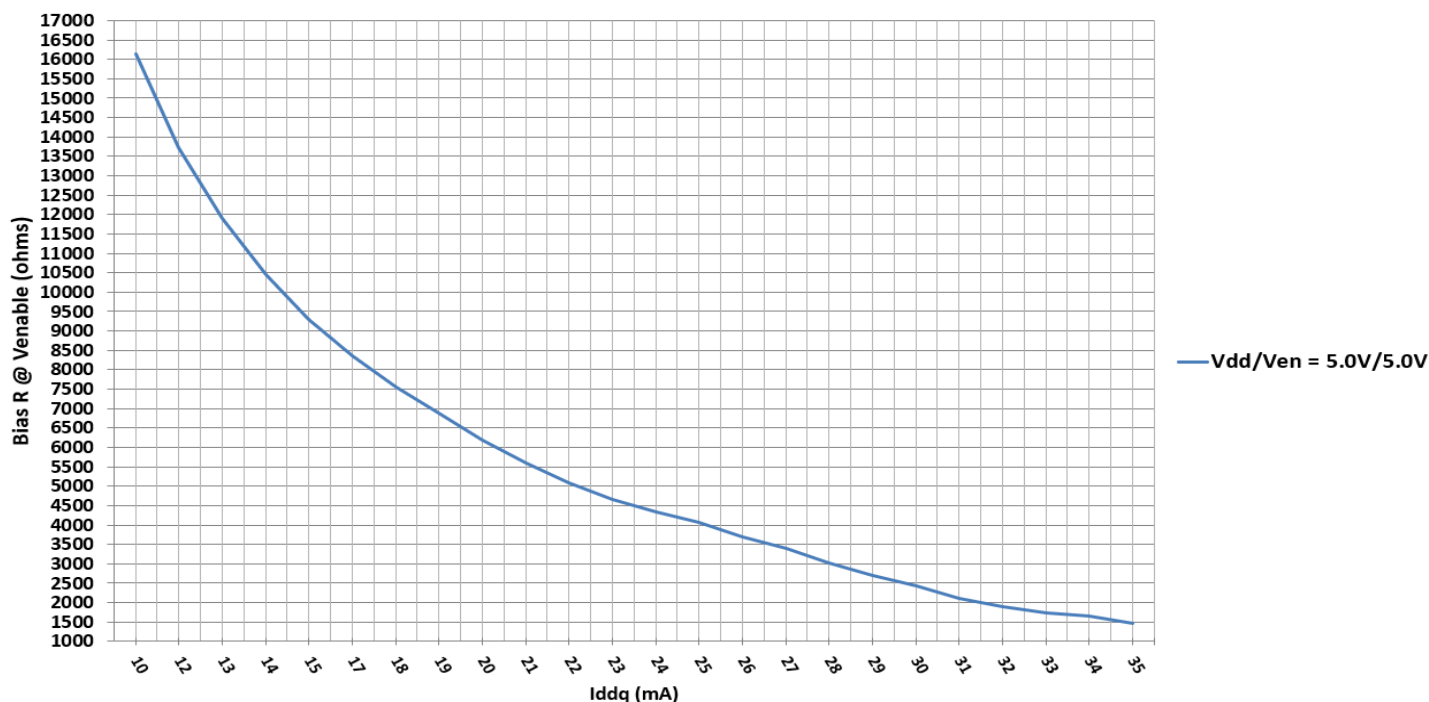
Component	Type	Manufacturer	Family	Value	Package Size	Substitution
M2	Capacitor	Murata	GJM	22 pF	0402	ok
M3	Inductor	Coilcraft	0402 HP	2.7 nH	0402	ok
M5 (sets I _{DDQ})	Resistor	Various	5%	4.6 kΩ	0402	ok
M6	Resistor (jumper)	Various	5%	0 Ω	0402	ok
M7	Capacitor	Murata	GRM	0.1 μF	0402	ok
M8	Capacitor	Murata	GJM	22 pF	0402	ok
M9	Inductor	Murata	LQGWH	1.3 nH	0402	ok
M12	Capacitor	Murata	GJM	0.6 pF	0402	ok
M14	Resistor (jumper)	Various	5%	0 Ω	0402	ok
Evaluation Board	DFN6-15-23-B					

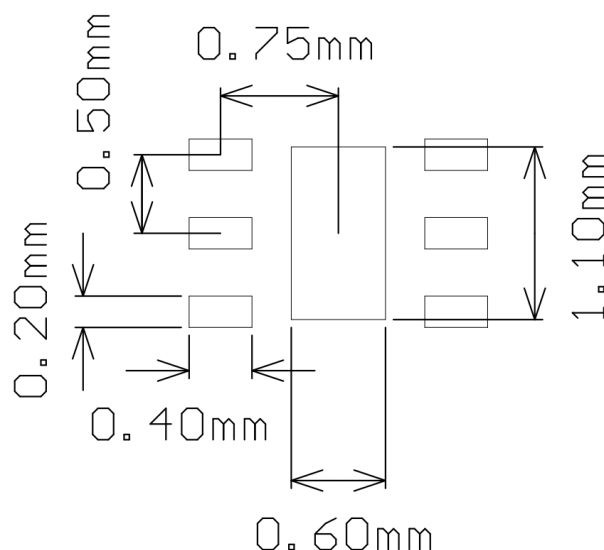
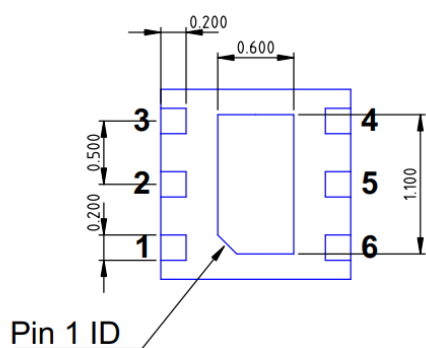
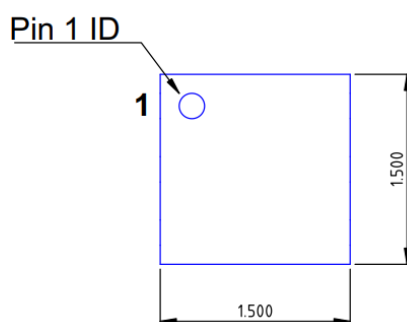
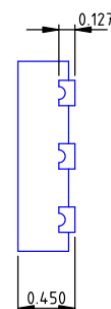
GRF2201 Bias Resistor Selection Curves:

GRF2201 Vdd/Ven = 3.3V/3.3V: Required Bias R @ Venable vs. Iddq



GRF2201 Vdd/Ven = 5.0V/5.0V: Required Bias R @ Venable vs. Iddq




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

Bottom View

Top View

Side View

DFN6 1.5x1.5mm

Dimensions in millimeters
Dimensional Tolerance: ± 0.05

1.5 x 1.5 mm DFN-6 Package Dimensions

Package Marking Diagram



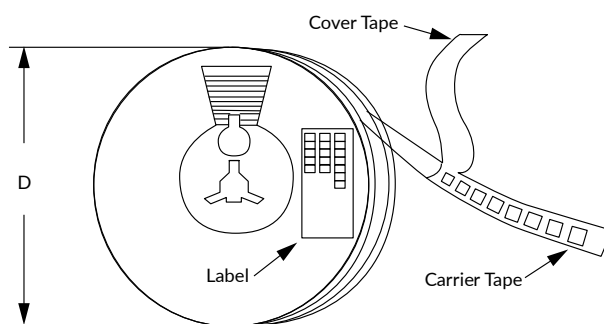
- Line 1: "YWW" = YEAR (single digit). "WW" = WORK WEEK the Device was assembled.
- Line 2: "XXXX" = Device PART NUMBER.

Tape and Reel Information

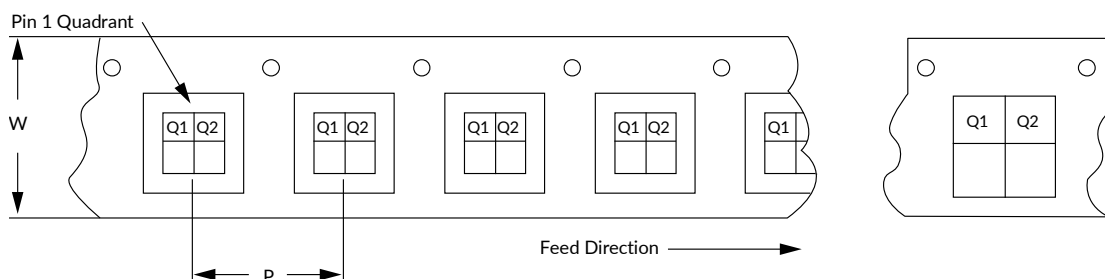
Guerrilla RF's tape and reel specification complies with Electronic Industries Alliance (EIA) standards for "Embossed Carrier Tape of Surface Mount Components for Automatic Handling" (reference EIA-481). See the following page for the Tape and Reel Specification and Device Package Information table, which includes units per reel.

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

For the Tape and Reel Reference Table, please refer to: <https://www.guerrilla-rf.com/prodFiles/Manufacturing/MN001.pdf>



Tape and Reel Packaging with Reel Diameter Noted (D)



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

Revision History

Revision Date	Description of Change
February 26, 2018	Preliminary Data Sheet.
January 9, 2025	Release Ø Data Sheet.
June 2, 2025	Extended upper frequency range from 6.0 GHz to 6.1 GHz.



Data Sheet Classifications

Data Sheet 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 limited evaluation board measurements taken within the Guerrilla RF Applications Lab. All parametric values are subject to change pending the collection of additional data.
Release Ø	All data based on measurements taken with <i>production-released</i> material. TYP values are based on a combination of ATE and bench-level measurements, with MIN/MAX limits defined using <i>modelled estimates</i> that account for part-to-part variations and expected process spreads. Although unlikely, future refinements to the TYP/MIN/MAX values may be in order as multiple lots are processed through the factory.
Release A-Z	All data based on measurements taken with production-released material <i>derived from multiple lots which have been fabricated over an extended period of time</i> . MIN/MAX limits may be refined over previous releases as more statistically significant data is collected to account for process spreads.

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