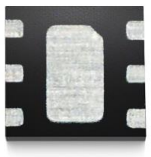
DATA SHEET

RELEASE Ø DATA SHEET



GRF2543

High Gain, Ultra-LNA with Bypass 802.11ac: 3750 to 8500 MHz

FEATURES

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

Reference: 3.3 V / 5.5 GHz / 15 mA

- Gain: 14.5 dB
- OP1dB: 11.5 dBm
- Evaluation Board Noise Figure: 1.0 dB
- Bypass Mode Gain: -1.0 dB
- Bypass Mode IP1dB: 24 dBm

APPLICATIONS

- WiFi Access Points
- Mobile WiFi Devices
- 802.11p Vehicle Communications
- Microwave Backhaul

DESCRIPTION

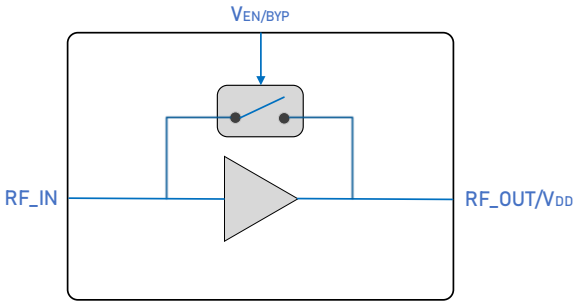
The GRF2543 is an ultra-low noise amplifier (LNA) with bypass designed for IEEE 802.11a/n/ac/p applications from 5.1 to 5.925 GHz. The device exhibits outstanding noise figure (NF), linearity, and gain up to 8.5 GHz. Note that the reported NF is for the entire evaluation board from SMA to SMA connector.

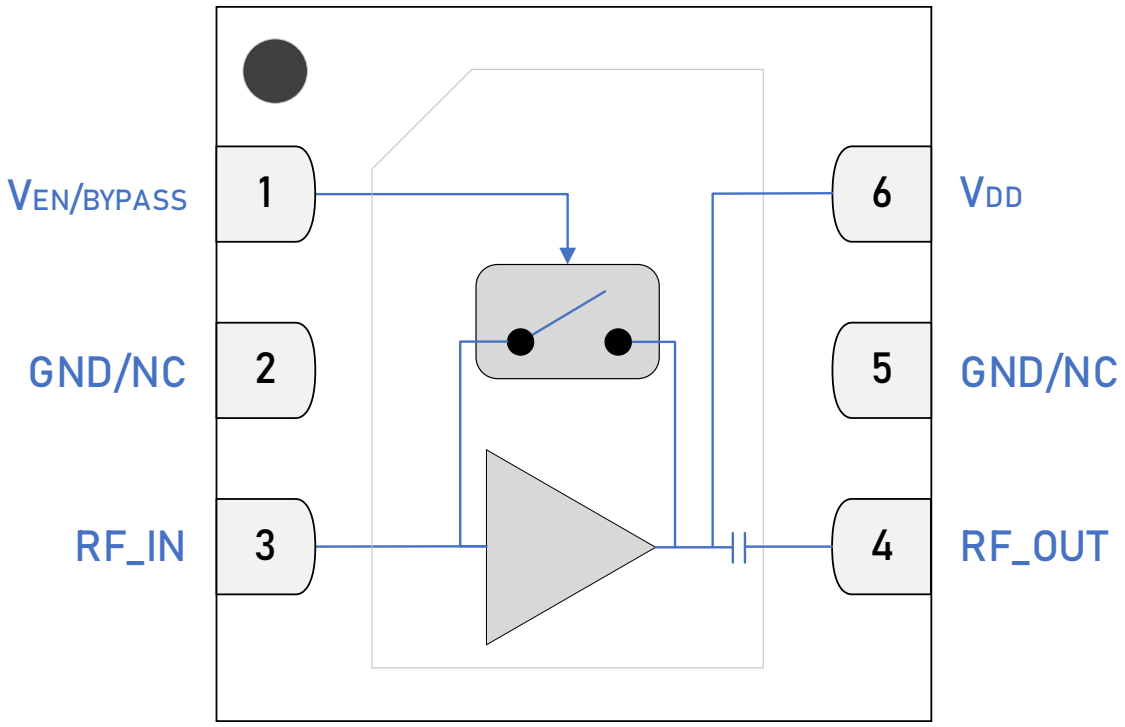
The LNA is operated from a single positive supply of 2.7 to 5 volts with typical bias conditions of 3.3 volts and 15 mA.

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

Additional tunes can be found on the GRF2543 "Custom Tunes" product page: GRF2543 Custom Tunes

BLOCK DIAGRAM





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

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Pin Assignments

Pin	Name	Description	Note
1	$V_{EN/BYPASS}$	$V_{ENABLE/BYPASS}$ Voltage Input	$V_{EN/BYPASS}$ and series resistor set I_{DDQ}. $V_{EN/BYPASS}$ < 0.2 volts disables device. On-die pull-down resistor will turn the device off if this node is allowed to float.
2, 5	GND/NC	Ground or No Connect	No internal connections to die. We recommend connecting these pins to ground.
3	RF_IN	LNA RF Input	An external DC blocking capacitor must be used.
4	RF_OUT	LNA RF Output	Internally DC blocked but do not apply external DC > 0.2 volts to this pin. External capacitor to ground strongly affects the impedance matching of the device.
6	V_{DD}	V_{DD} Input	Requires bypass capacitance as close as possible to pin on PCB.
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.

$V_{EN/BYPASS}$ Truth Table

Mode	Description	$V_{EN/BYPASS}$
High Gain	High LNA Gain	1
Bypass	Linear Bypass Mode	0
Logic Level "0"	Logic Low	0 V to 0.2 V
Logic Level "1"	Logic High	1.5 V to V_{DD}

Absolute Ratings

Parameter	Symbol	Min.	Max.	Unit
Supply Voltage	V_{DD}	0	6	V
RF Input Power: Load VSWR < 2:1, V_{DD} = 5 V	$P_{IN\ MAX}$		15	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	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.

Note: For additional information, please refer to *Package Manufacturing Information | Guerrilla RF (guerrilla-rf.com)*

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*

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Recommended Operating Conditions

Parameter	Symbol	Specification			Unit	Condition
		Min.	Typ.	Max.		
Supply Voltage	V_{DD}	0		6	V	
Operating Temperature (Package Base)	$T_{PKG\ BASE}$	-40		105	°C	
RF Frequency Range	F_{RF}	3750		8500	MHz	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: GRF2543 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 4.9 to 6 GHz tuning set. V_{DD} = 3.3 V, $V_{EN/BYPASS}$ = high, I_{DD} = 15 mA. M5 = 1.5 kΩ, F_{TEST} = 5.5 GHz. $T_{PKGBASE}$ = 25 °C. Evaluation board losses are included within the specifications.

Parameter	Symbol	Specification			Unit	Condition
		Min.	Typ.	Max.		
Supply Current	I_{DD}	10	15	21	mA	V_{DD} = 3.3 V, $V_{EN/BYPASS}$ = high
Enable Current	I_{ENABLE}		1	1.5	mA	V_{DD} = 3.3 V, $V_{EN/BYPASS}$ = high
Switching Rise Time	T_{RISE}		150		ns	Bypass mode to Gain mode **(note 3)**.
Switching Fall Time	T_{FALL}		50		ns	Gain mode to Bypass mode **(note 4)**.
Disabled Mode						
Leakage Current	$I_{LEAKAGE}$		500	700	µA	V_{DD} = 3.3 V, $V_{EN/BYPASS}$ = 0 V
Thermal Data						
Thermal Resistance: (Infrared Scan)	Θ_{JC}		75		°C/W	On standard evaluation board **(note 5)**.

Note 3: Switching Time: 50% of $V_{EN/BYPASS}$ to 90% of Pout.

Note 4: Switching Time: 50% of $V_{EN/BYPASS}$ to 10% of Pout.

Note 5: MTTF > 10^6 hours for $T_{CHANNEL}$ ≤170 °C.

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Nominal Operating Parameters – RF

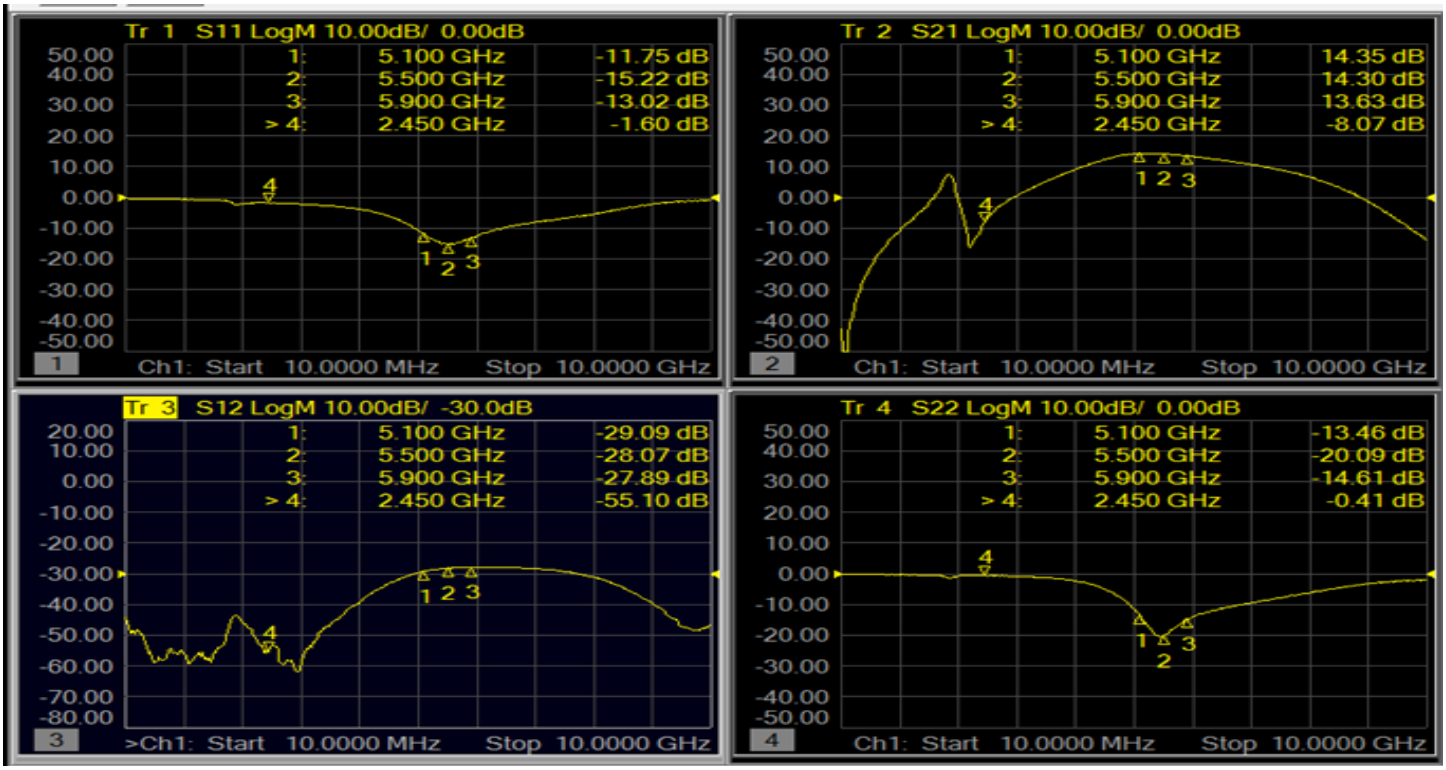
The following conditions apply unless noted otherwise: typical application schematic using the 4.9 to 6 GHz tuning set. V_{DD} = 3.3 V, $V_{EN/BYPASS}$ = high, I_{DD} = 15 mA. M5 = 1.5 kΩ, F_{TEST} = 5.5 GHz. $T_{PKGBASE}$ = 25 °C. Evaluation board losses are included within the specifications.

Parameter	Symbol	Specification			Unit	Condition
		Min.	Typ.	Max.		
High Gain Mode						**VDD = 3.3 V, VEN/BYPASS = 3.3 V**
Gain	S21	12.9	14.5	15.9	dB	
Output 1 dB Compression Point	OP1dB	10.1	11.5		dBm	
Evaluation Board Noise Figure	NF		1.0		dB	
Input Power for 1% EVM	IP1%		TBD		dBm	Waveform: 802.11a/g: PAR 11.6 dB
Bypass Mode						**VDD = 3.3 V, VEN/BYPASS = 0 V**
Gain	S21	-3.0	-1.0		dB	
Input 1 dB Compression Power	IP1dB		24		dBm	
Input Power for 1% EVM	IP1%		TBD		dBm	Waveform: 802.11a/g: PAR 11.6 dB

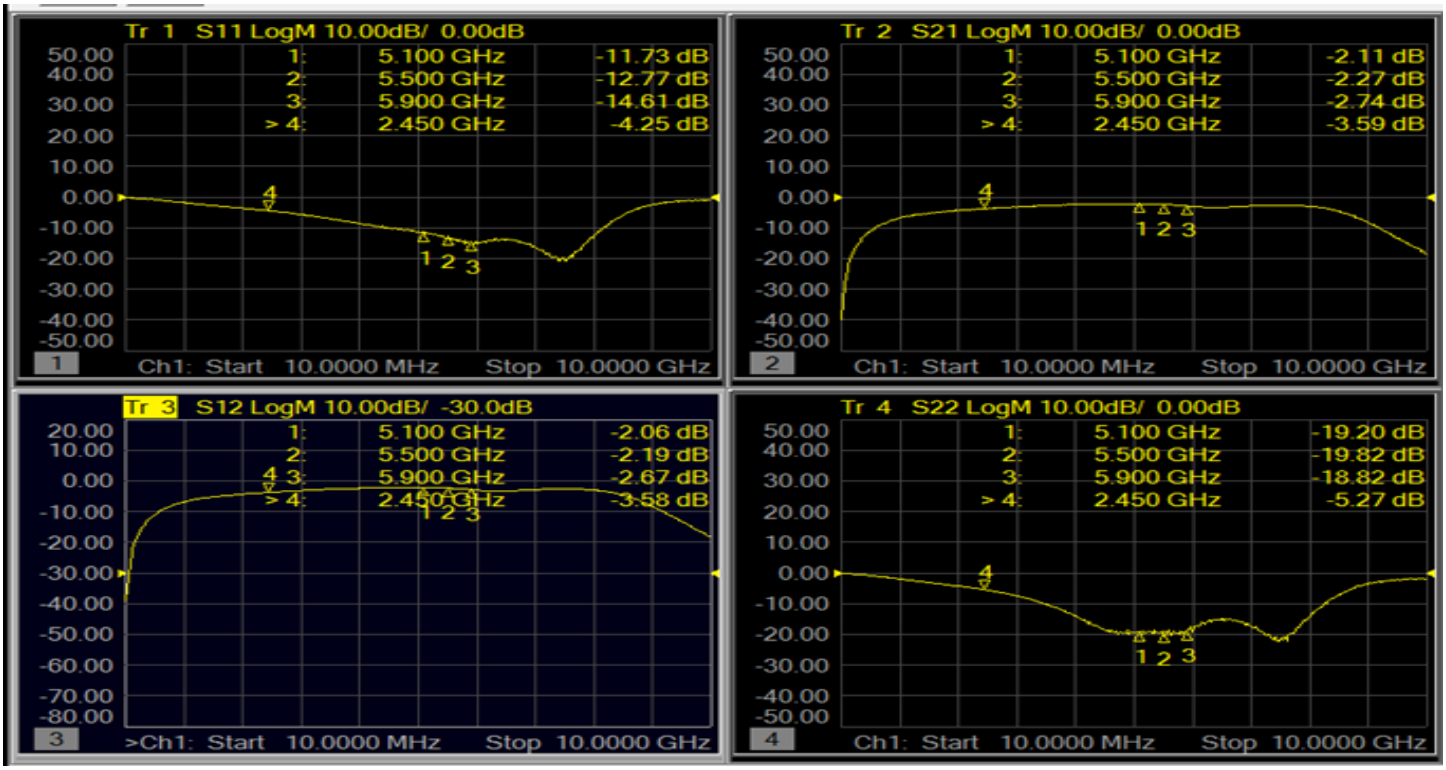
GRF2543 Evaluation Board Measured Data

Mode	Freq (MHz)	VDD (V)	IDDQ (mA)	Gain (dB)	IIP3 (dBm)	OIP3 (dBm)	IP1dB (dBm)	OP1dB (dBm)	EVB NF (dB)
Gain Mode	5100	3.3	14.8	14.37	10.26	24.63	-1.2	12.05	1.00
Gain Mode	5500	3.3	14.5	14.43	11.3	25.73	-0.7	12.7	0.97
Gain Mode	5900	3.3	14.5	14.03	11.6	25.63	0.5	13.48	1.05
Mode	**Freq (MHz)**	**VDD (V)**	**IDDQ (mA)**	**Gain (dB)**	**IIP3 (dBm)**	**OIP3 (dBm)**	**IP1dB (dBm)**	**OP1dB (dBm)**	**EVB NF (dB)**
Bypass Mode	5100	3.3	0.5	-1.98	23.77	21.79	24.9	21.95	--
Bypass Mode	5500	3.3	0.5	-2.05	21.64	19.59	23.9	21.07	--
Bypass Mode	5900	3.3	0.5	-2.82	21.37	18.55	21.9	18.33	--

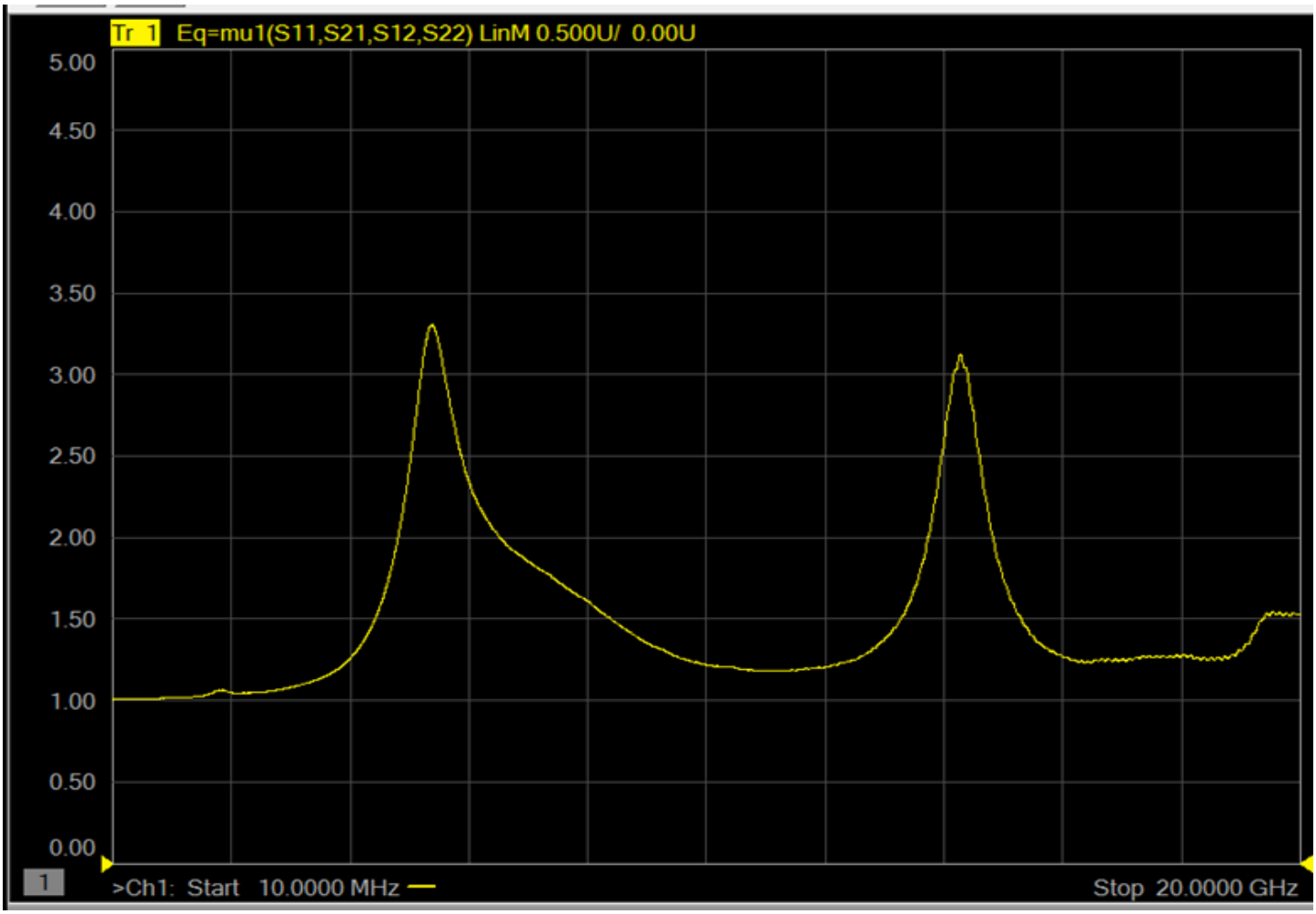
GRF2543 Evaluation Board S-Parameters: Gain Mode (5.1 to 5.9 GHz Tune)



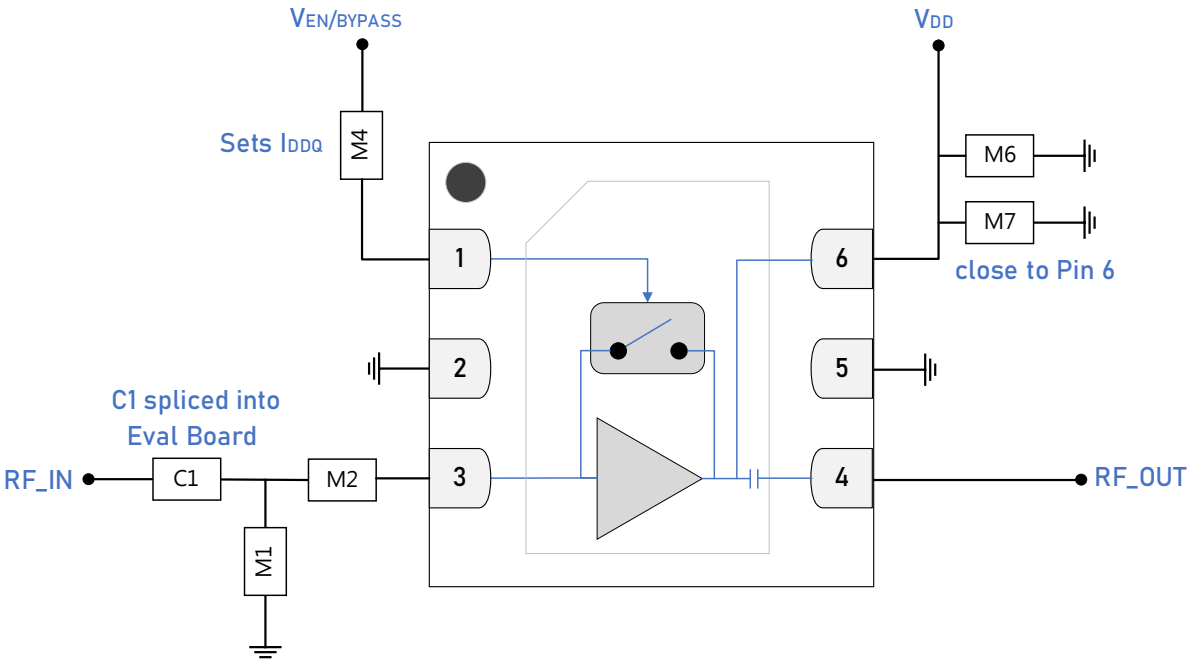
GRF2543 Evaluation Board S-Parameters: Bypass Mode (5.1 to 5.9 GHz Tune)



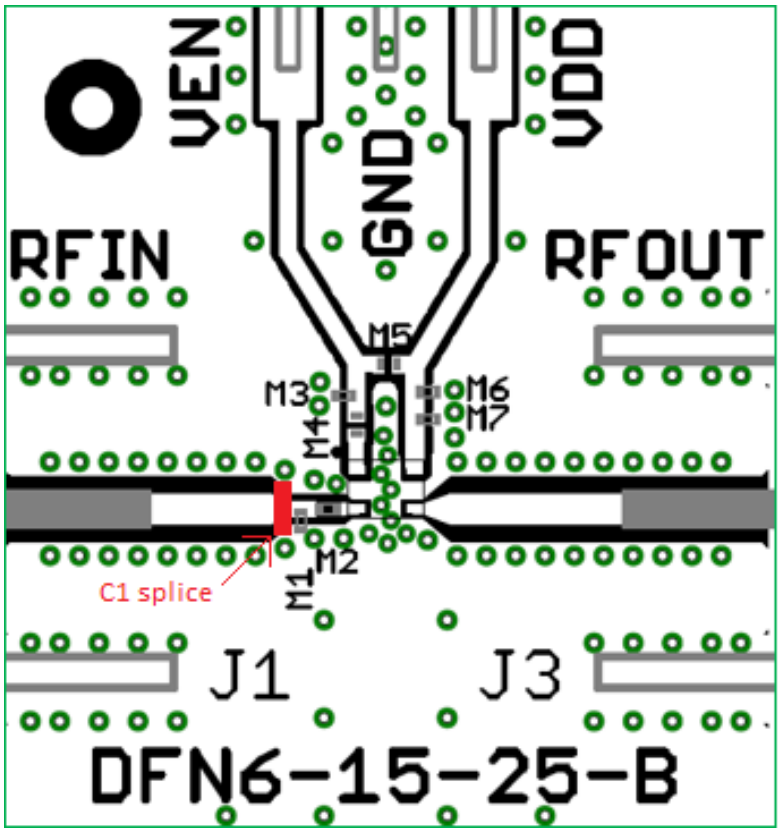
GRF2543 Evaluation Board Stability Mu Factor: 10 MHz to 20 GHz



Note: Mu factor >= 1.0 implies unconditional stability.



GRF2543 Standard Evaluation Board Schematic



GRF2543 Evaluation Board Assembly Diagram

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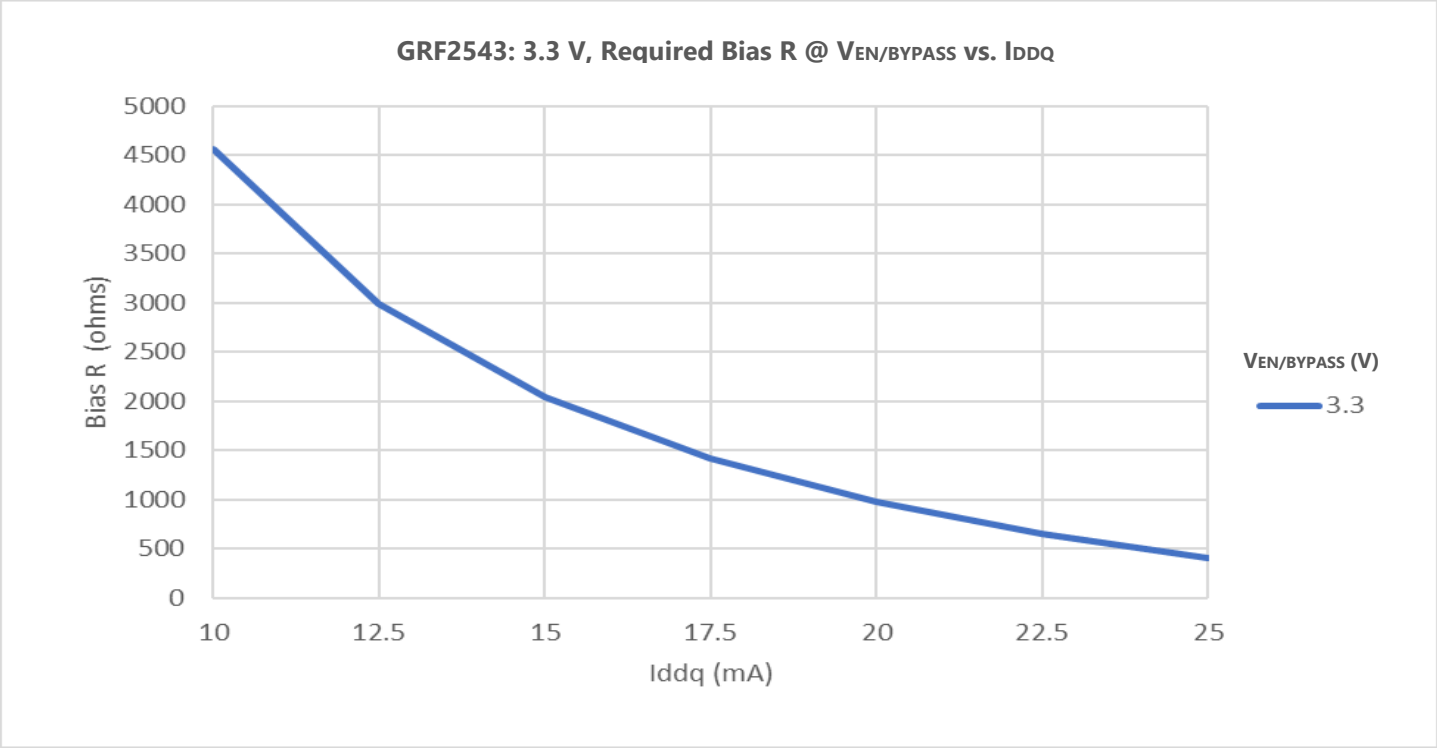
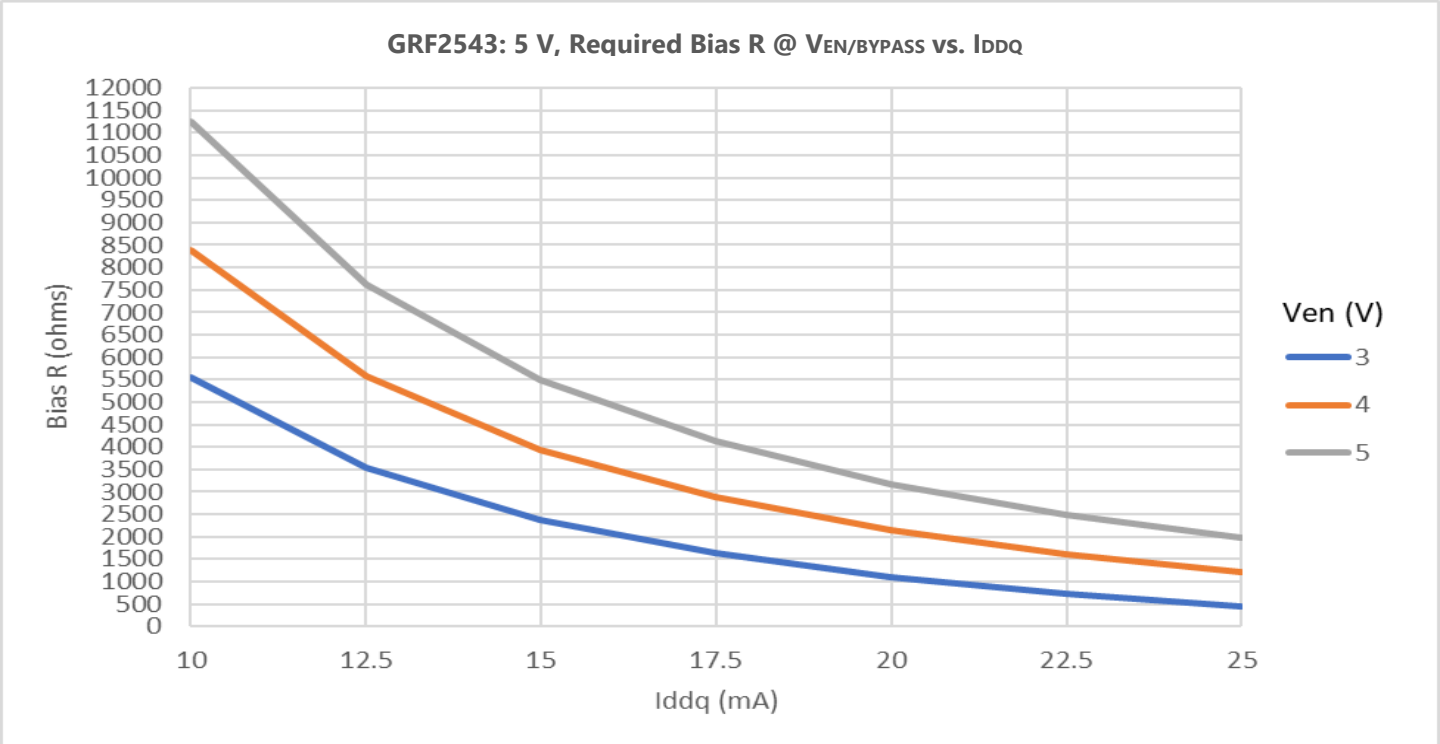
GRF2543 Evaluation Board Assembly Diagram Reference: 5.1 to 5.9 GHz Tune

Component	Type	Manufacturer	Family	Value	Package Size	Substitution
C1	Capacitor	Murata	GJM	5.1 pF	0201	ok
M1	Capacitor	Murata	GJM	0.6 pF	0201	ok
M2	Resistor	Various	5%	0 Ω	0201	ok
M4 (sets I_{DDQ})	Resistor	Various	5%	see curves	0201	ok
M6	Capacitor	Murata	GRM	0.1 uF	0201	ok
M7	Capacitor	Murata	GJM	8.2 pF	0201	ok
Evaluation Board	DFN6-15-25-B					

GRF2543 Bias Resistor Selection Curves





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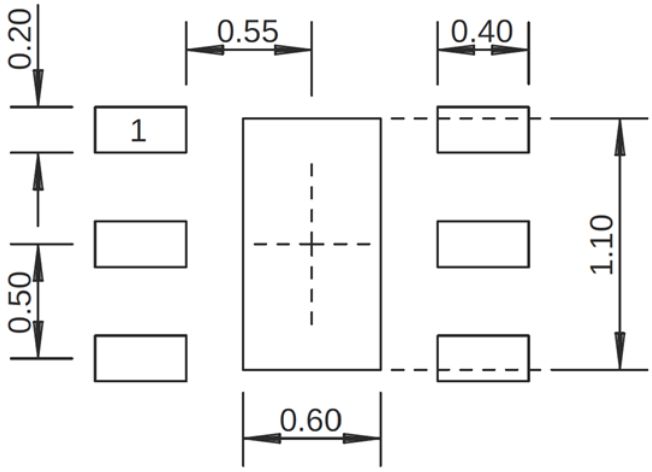
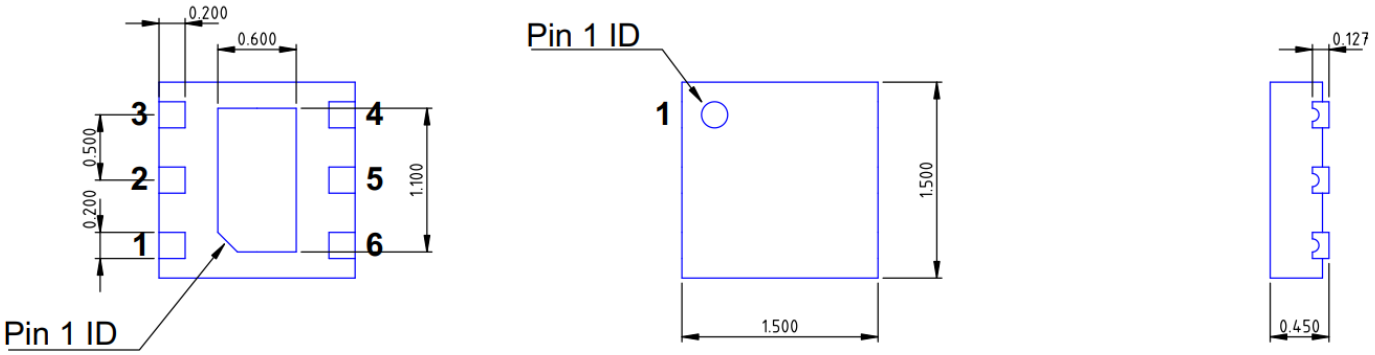


1.5 x 1.5 mm DFN-6 Suggested PCB Footprint (Top View)

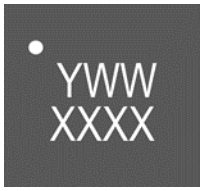


Bottom View **Top View** **Side View**

DFN6 1.5x1.5mm
Dimensions in millimeters
Dimensional Tolerance: ±0.05

1.5 x 1.5 mm DFN-6 Package Dimensions

Package Marking Diagram



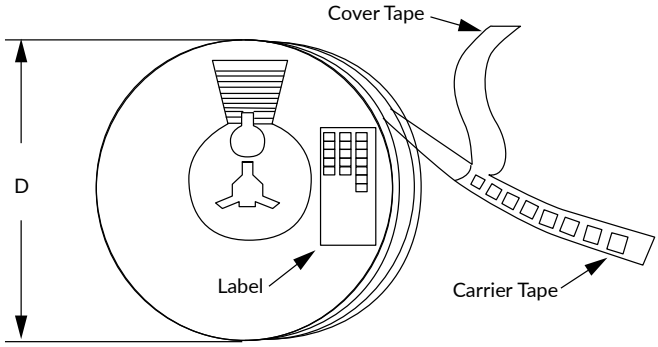
- Line 1: "Y" = YEAR (single digit). "WW" = WORK WEEK the Device was assembled.
- Line 2: "XXXX" = Device PART NUMBER.

Tape and Reel Information

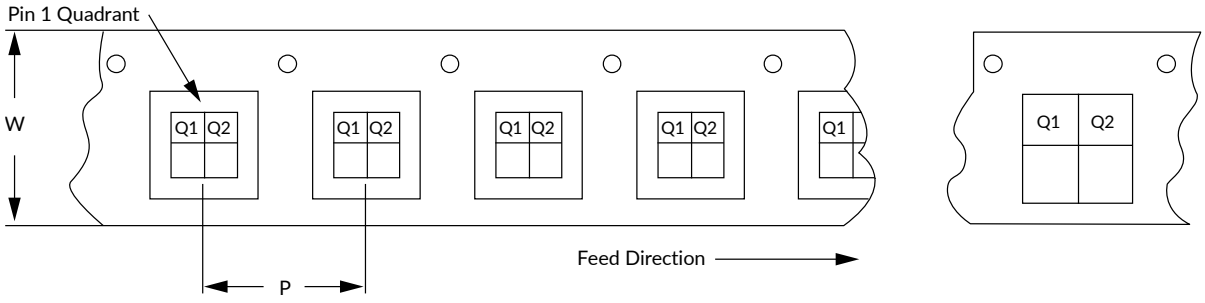
Guerrilla RF's tape and reel specification complies with Electronic Industries Alliance (EIA) standards for "Embossed Carrier Tape of Surface Mount Components for Automatic Handling" (reference EIA-481). See the following page for the Tape and Reel Specification and Device Package Information table, 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: *Package Manufacturing Information | Guerrilla RF (guerrilla-rf.com)*



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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Revision History

Revision Date	Description of Change
June 1, 2020	Preliminary Data Sheet.
September 29, 2021	Release Ø Data Sheet.
August 8, 2022	Upgraded Data Sheet to new format. Changed Switching Times to reflect latest test data.
June 2, 2025	Extended frequency range from 4900 - 6000 MHz to 3750 - 8500 MHz.

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 *production-released* material. TYP values are based on a combination of ATE and bench-level measurements, with MIN/MAX limits defined using *modelled estimates* 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 *derived from multiple lots which have been fabricated over an extended period of time*. 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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