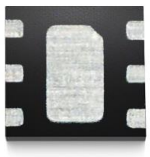
DATA SHEET

RELEASE Ø DATA SHEET



GRF2243

Low Noise Amplifier with Bypass 0.4 to 5 GHz

FEATURES

- Flexible Bias Voltage and Current
- Process: GaAs pHEMT
- Single Control Logic Input
- Compact 1.5 x 1.5 mm DFN-6 Package

Reference: 3.3 V / 15 mA / 2.5 GHz

- Gain: 19.7 dB
- OP1dB: 12 dBm
- OIP3: 23 dBm
- Evaluation Board Noise Figure: 0.75 dB
- Bypass Mode Gain: -1.6 dB
- Bypass Mode OP1dB: 22.5 dBm
- Bypass Mode OIP3: 16 dBm

APPLICATIONS

- Cellular Repeaters and Signal Boosters
- Cellular Infrastructure
- VHF/UHF and ISM Radios

DESCRIPTION

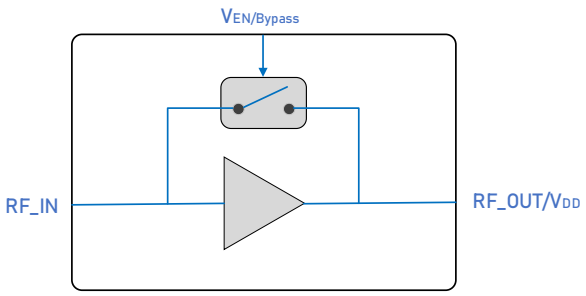
The GRF2243 is a low noise amplifier (LNA) with low loss bypass which requires only a single control input. It is designed for high performance applications up to 5 GHz.

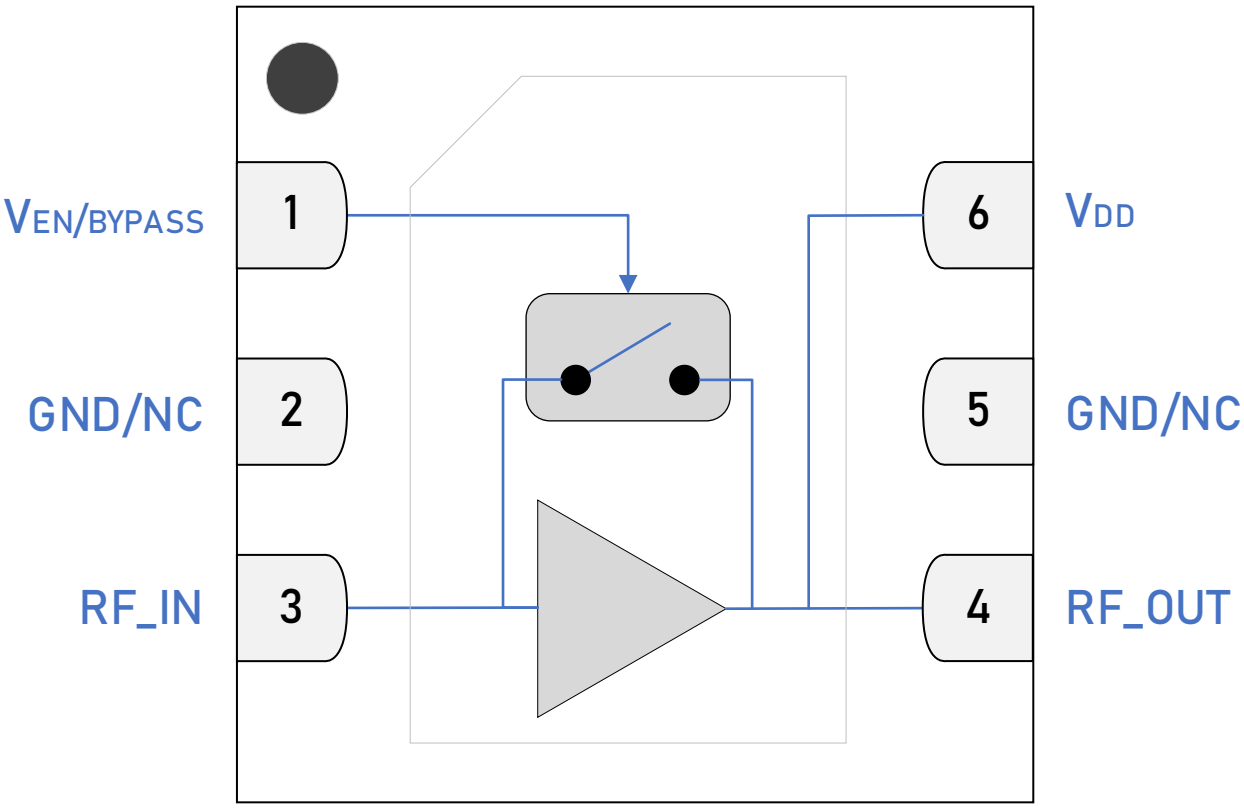
With minimal external matching, the device achieves outstanding noise figure (NF), high gain, and efficient linearity. The device is operated from a single positive supply of 2.7 to 5 volts with a selectable I_{DDQ} range of 8 to 25 mA.

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 GRF2243 "Custom Tunes" product page: GRF2243 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	$V_{ENABLE/BYPASS}$	$V_{EN/BYPASS}$ Voltage Input	$V_{EN/BYPASS} \leq 0.2$ volts sets Bypass Mode. $V_{EN/BYPASS}$ and external series resistor control the device I_{DDQ} when $V_{EN/BYPASS}$ is high.
2, 5	GND/NC	Ground or No Connect	No internal connection 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	An external DC blocking capacitor must be used.
6	V_{DD}	V_{DD}/I_{DD} Input	V_{DD} must be applied through a bias Inductor to this pin.
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.

Mode	Description	V_{DD}	$V_{EN/BYPASS}$
High Gain	High LNA Gain	1	1
Bypass	Linear Bypass Mode	1	0
Logic Level "0"	Logic Low	0 V to 0.2 V	0 V to 0.2 V
Logic Level "1"	Logic High	1.8 V to 5 V	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} = 3.3 V (High Gain Mode)	$P_{IN\ MAX}$		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	$P_{DISS\ MAX}$		500	mW

Electrostatic Discharge

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.

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}	0.4		5	GHz	Typical application schematic with external matching components **(notes 1 & 2)**.
RF_IN Port Impedance	Z_{RFIN}		50		Ω	Single-ended with 2-element match.
RF_OUT Port Impedance	Z_{RFOUT}		50		Ω	Single-ended with 3-element match.

Note 1: Operation outside of this range is supported by using different custom tunes. Examples of other optimized tunes can be found here: GRF2243 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 0.4 to 5 GHz tuning set: V_{DD} = 3.3 V, $V_{EN/BYPASS}$ = High, I_{DD} = 15 mA. M5 = 1.5 kΩ. F_{TEST} = 2.5 GHz. $T_{PKG\ BASE}$ = 25 °C. Evaluation board losses are included within the specifications.

Parameter	Symbol	Specification			Unit	Condition
		Min.	Typ.	Max.		
Supply Current	I_{DD}		15		mA	V_{DD} = 3.3 V, $V_{EN/BYPASS}$ = High
Enable Current	I_{ENABLE}		2		mA	V_{DD} = 3.3 V, $V_{EN/BYPASS}$ = High
Switching Rise Time	T_{RISE}		100		ns	Bypass mode to Gain mode **(note 3)**.
Switching Fall Time	T_{FALL}		30		ns	Gain mode to Bypass mode **(note 4)**.

Disabled Mode

Leakage Current	$I_{LEAKAGE}$		450		µA	V_{DD} = 3.3 V, $V_{EN/BYPASS}$ = 0 V

Thermal Data

Thermal Resistance: (Infrared Scan)	Θ_{JC}		132		°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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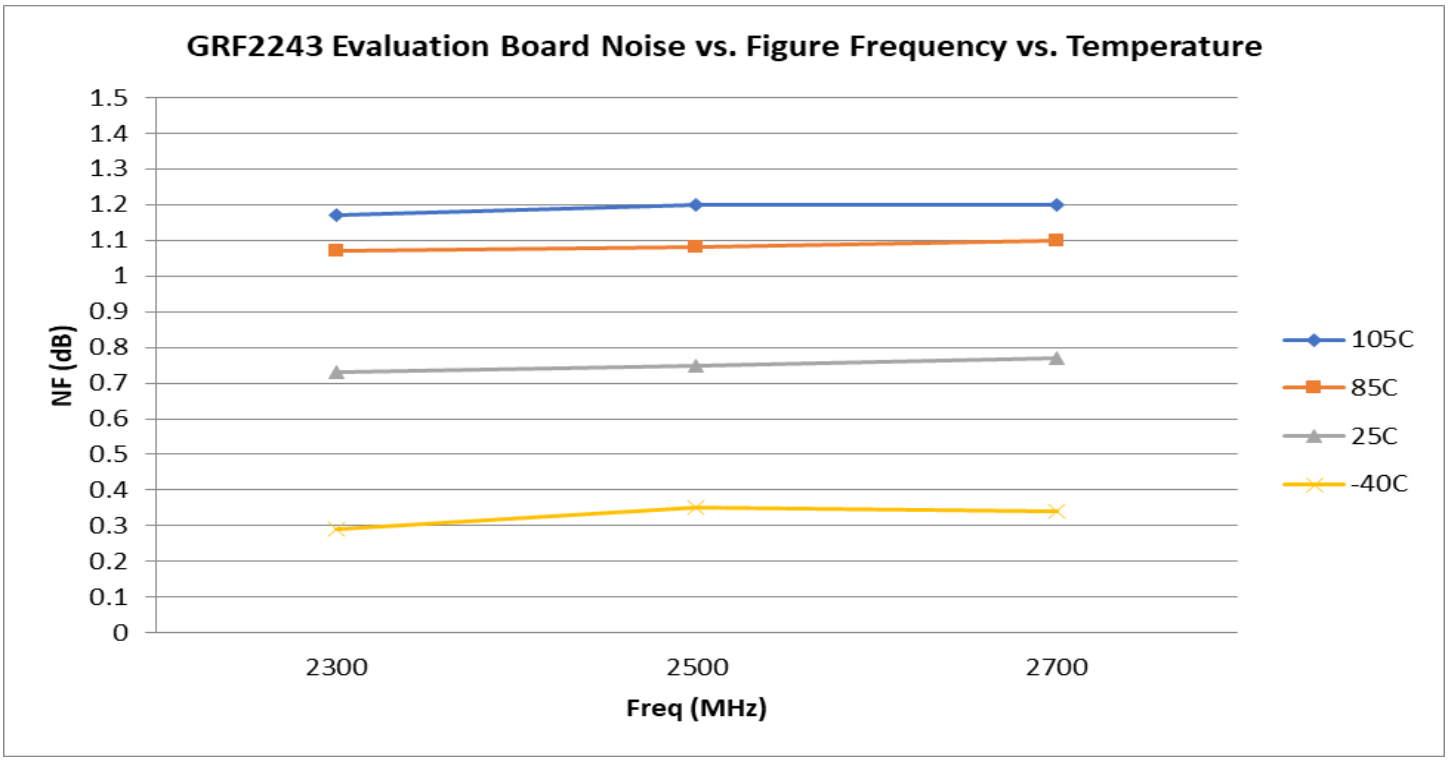
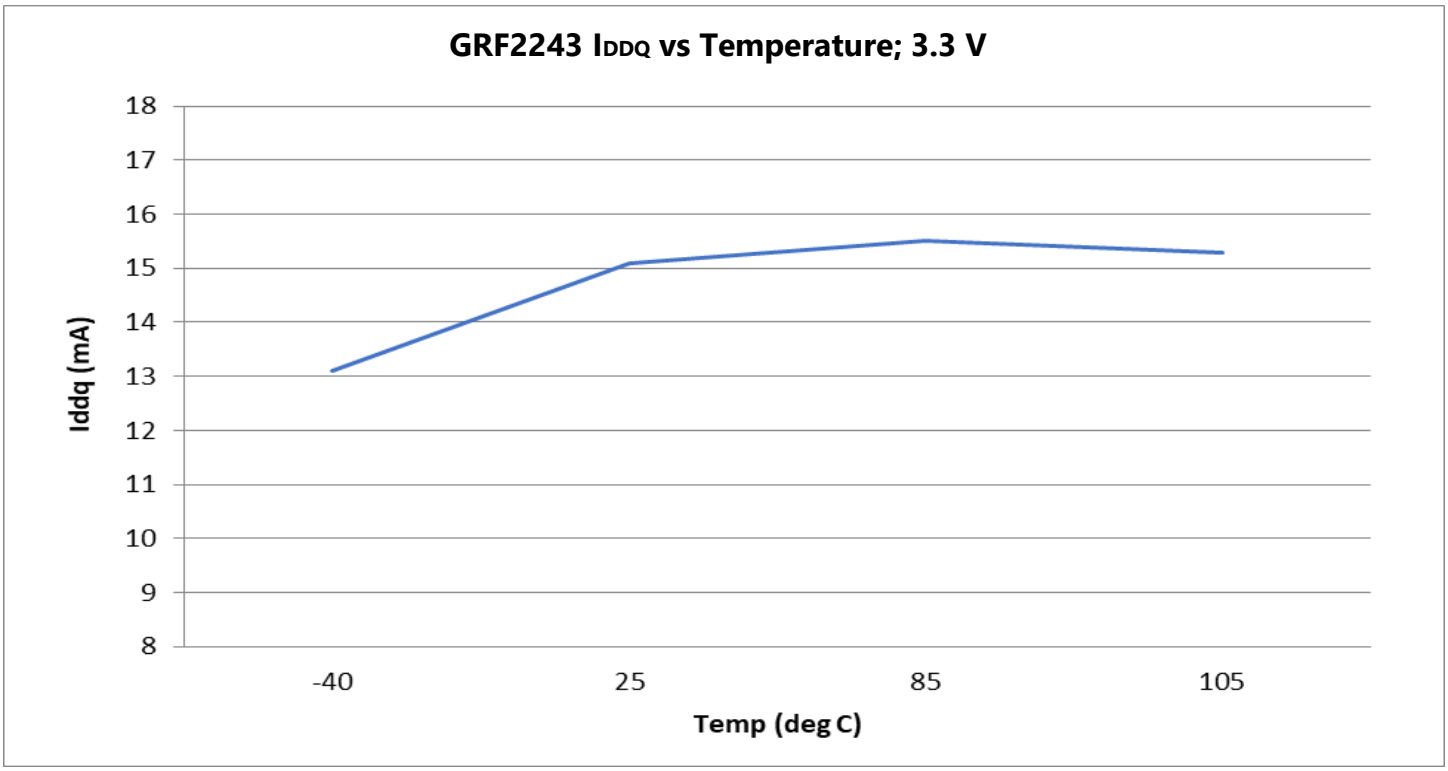
Nominal Operating Parameters – RF

The following conditions apply unless noted otherwise: Typical application schematic using the 0.4 to 5 GHz tuning set: V_{DD} = 3.3 V, $V_{EN/BYPASS}$ = High, I_{DD} = 15 mA. M5 = 1.5 kΩ. F_{TEST} = 2.5 GHz. $T_{PKG\ BASE}$ = 25 °C. Evaluation board losses are included within the specifications.

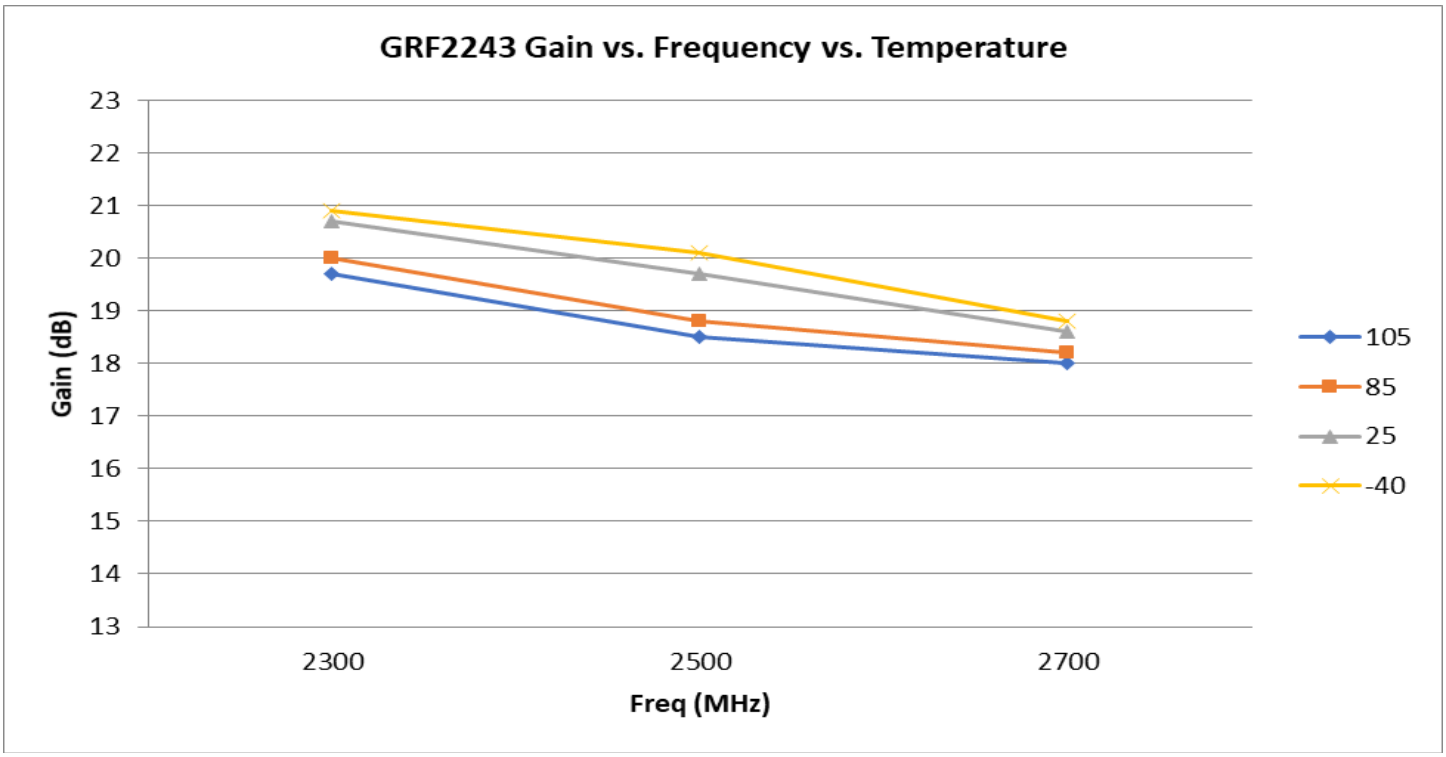
Parameter	Symbol	Specification			Unit	Condition
		Min.	Typ.	Max.		
High Gain Mode						V_{DD} = 3.3 V, $V_{EN/BYPASS}$ = High
Gain	S21		19.7		dB	
Output 3rd Order Intercept Point	OIP3		23		dBm	-5 dBm P_{OUT} per tone at 2 MHz spacing (2499 and 2501).
Output 1 dB Compression Power	OP1dB		12		dBm	
Noise Figure	NF		0.75		dB	On standard evaluation board.
Bypass Mode						V_{DD} = 3.3 V, $V_{EN/BYPASS}$ = 0 V
Gain	S21		-1.6		dB	
Output 3rd Order Intercept Point	OIP3		16		dBm	
Output 1 dB Compression Power	OP1dB		22.5		dBm	

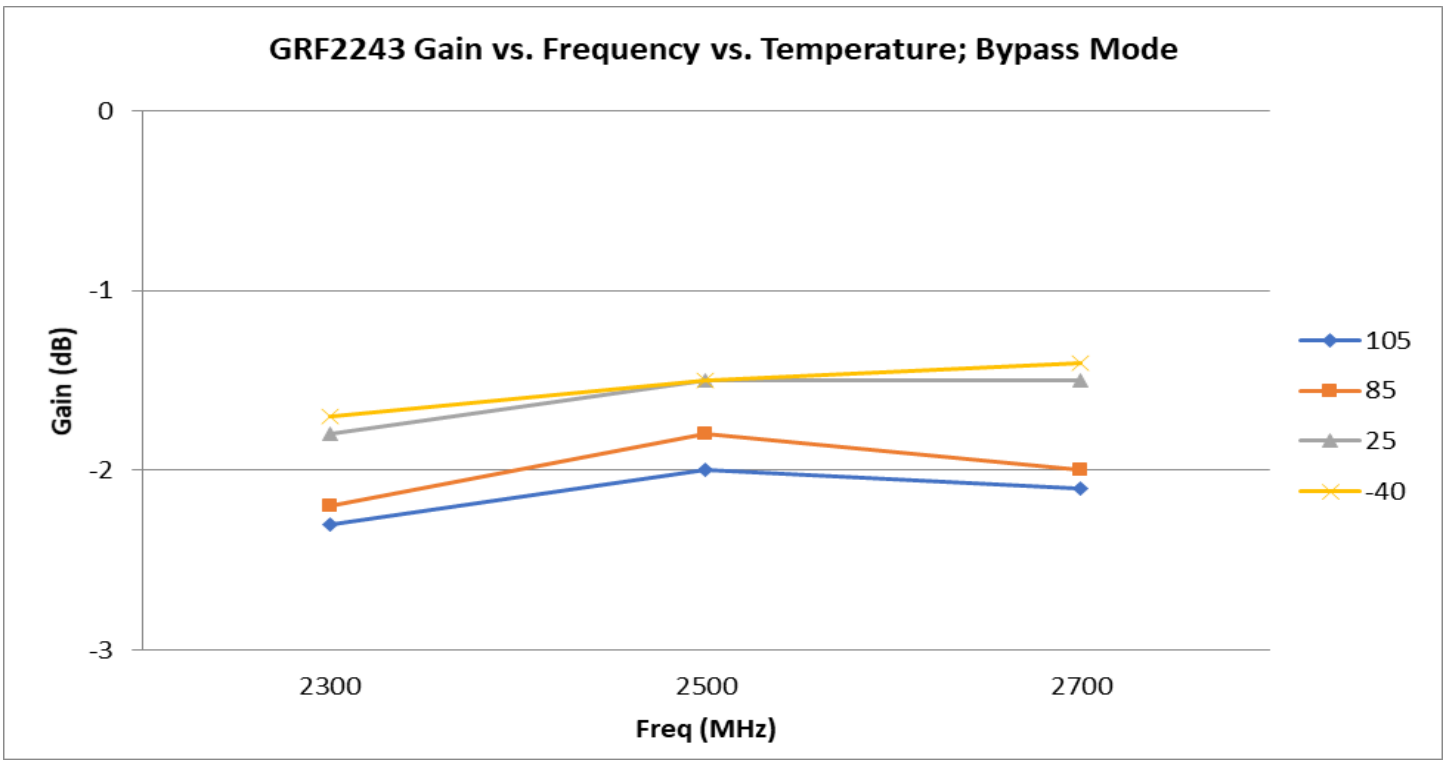
GRF2243 Evaluation Board Data: 3.3 V (2.3 to 2.7 GHz Tune)



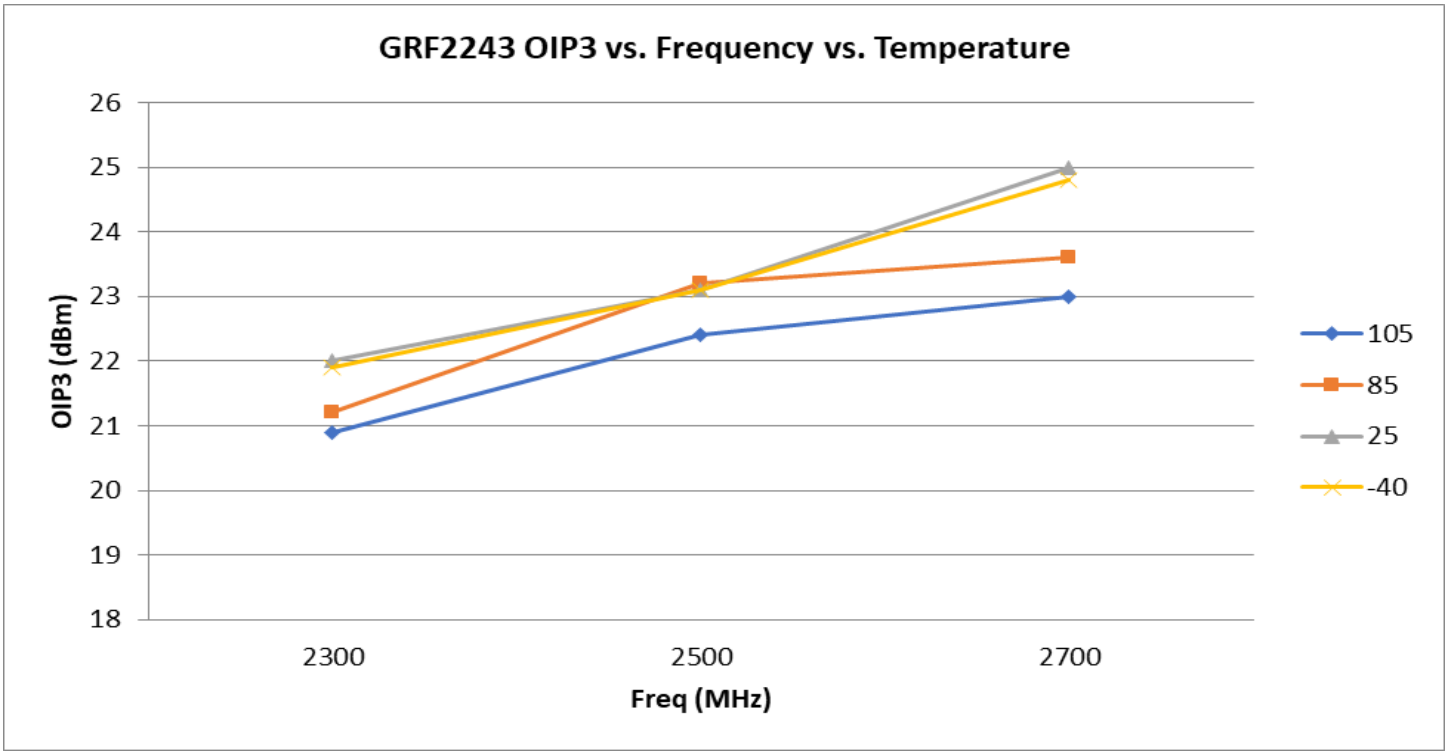


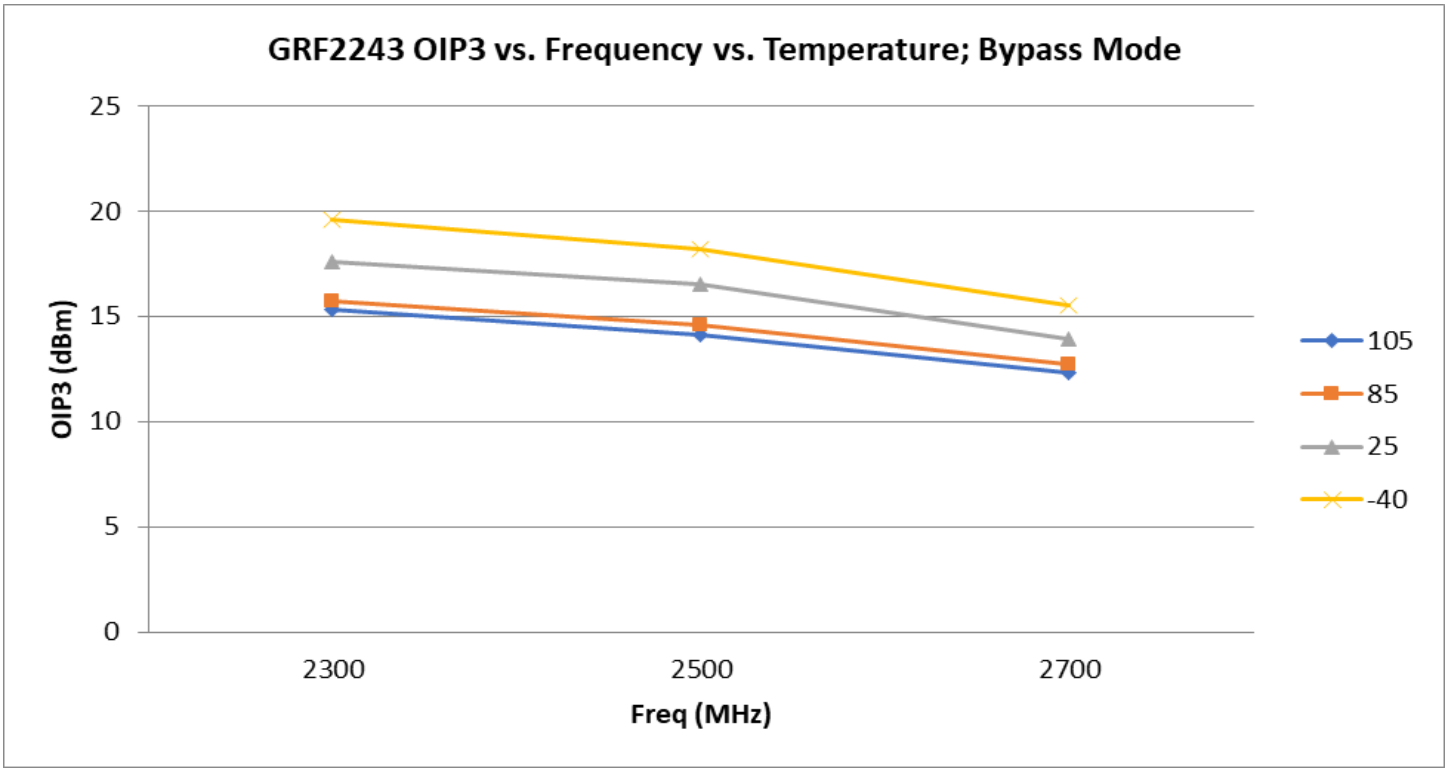
GRF2243 Evaluation Board Data: 3.3 V (2.3 to 2.7 GHz Tune)





GRF2243 Evaluation Board Data: 3.3 V (2.3 to 2.7 GHz Tune)





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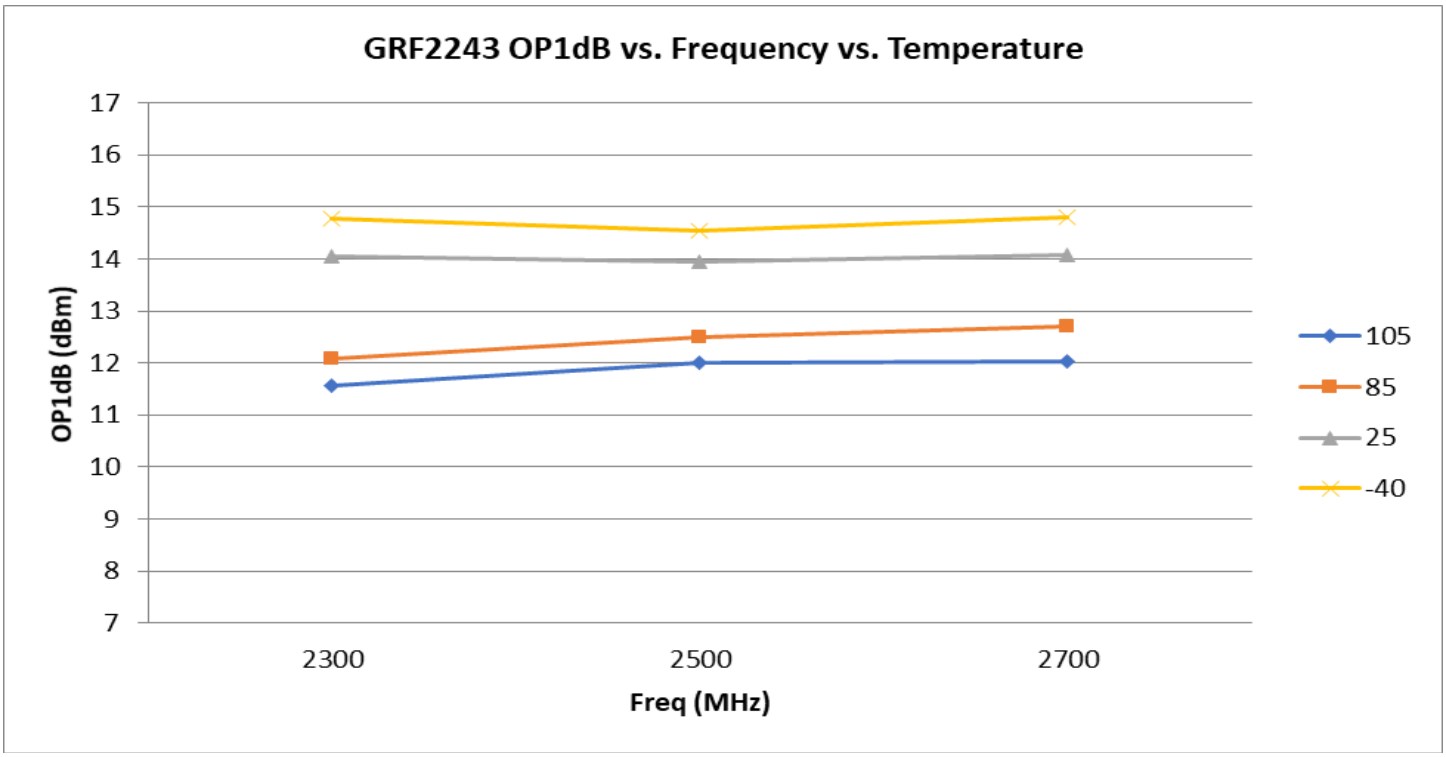
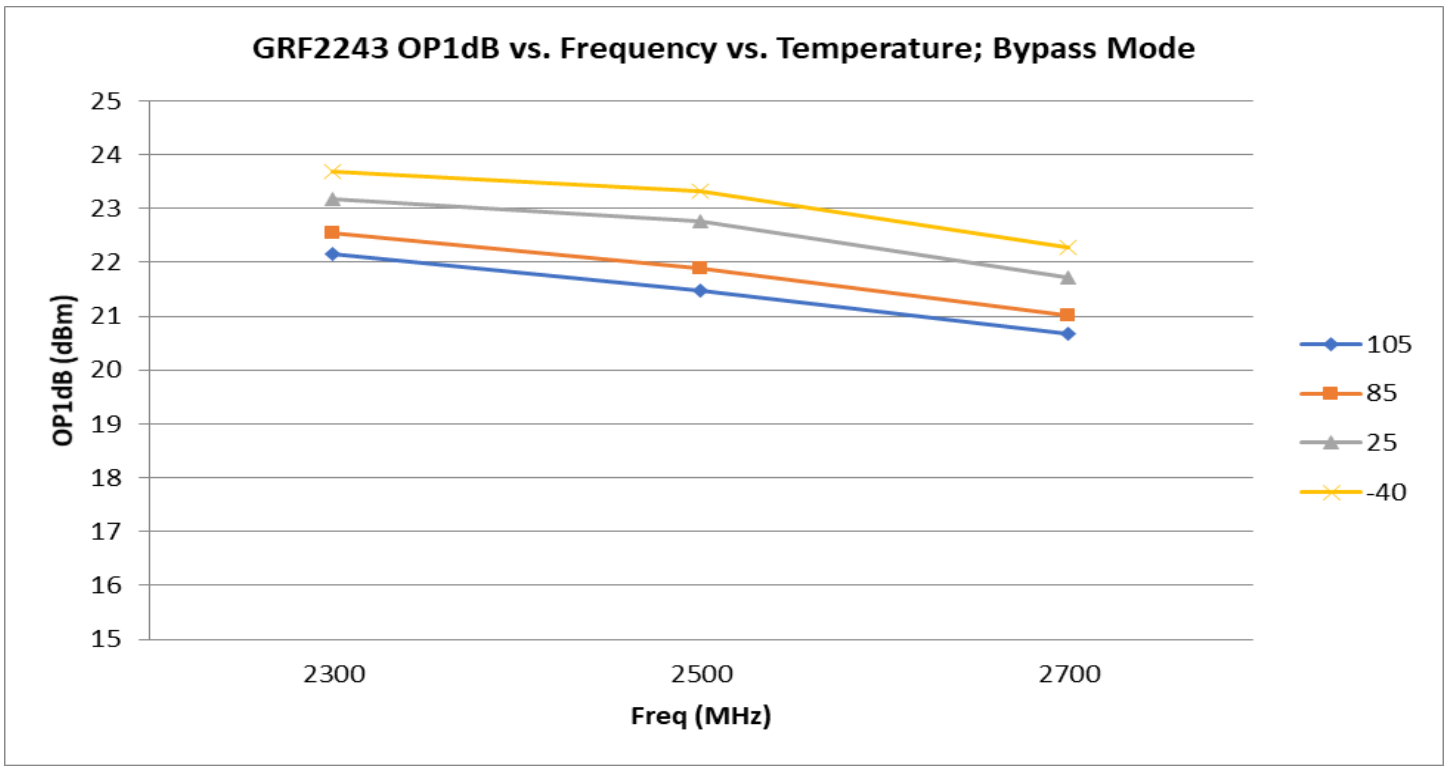
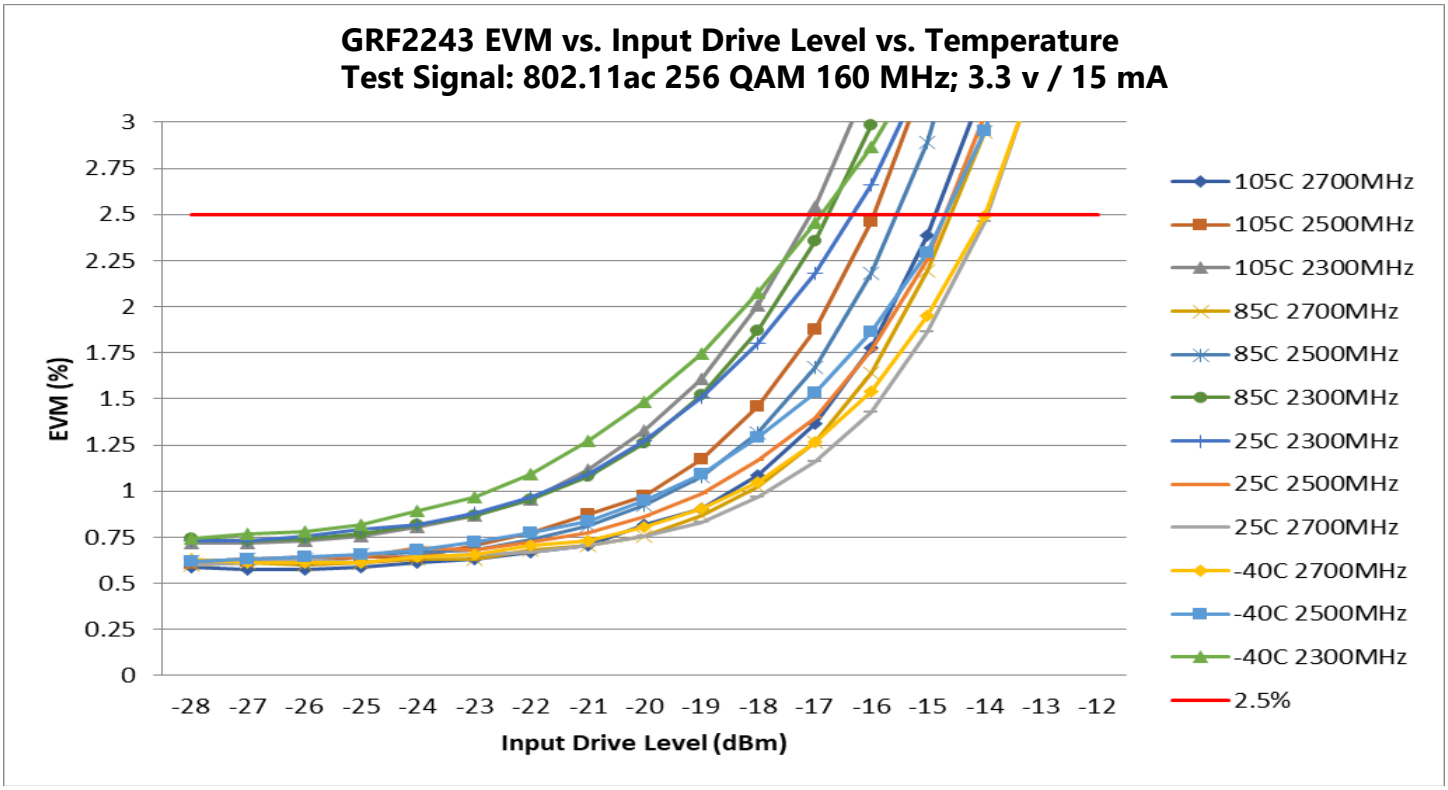
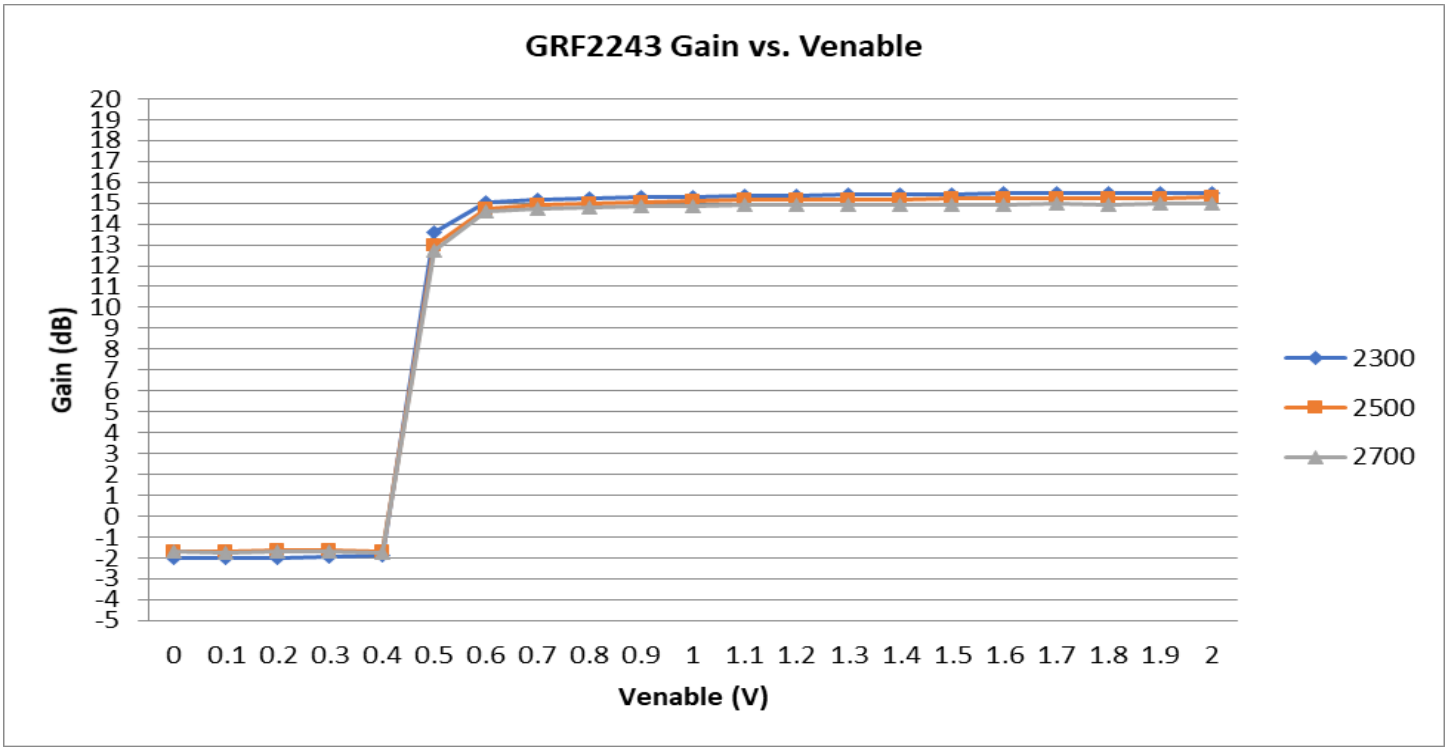
GRF2243 Evaluation Board Data: 3.3 V (2.3 to 2.7 GHz Tune)



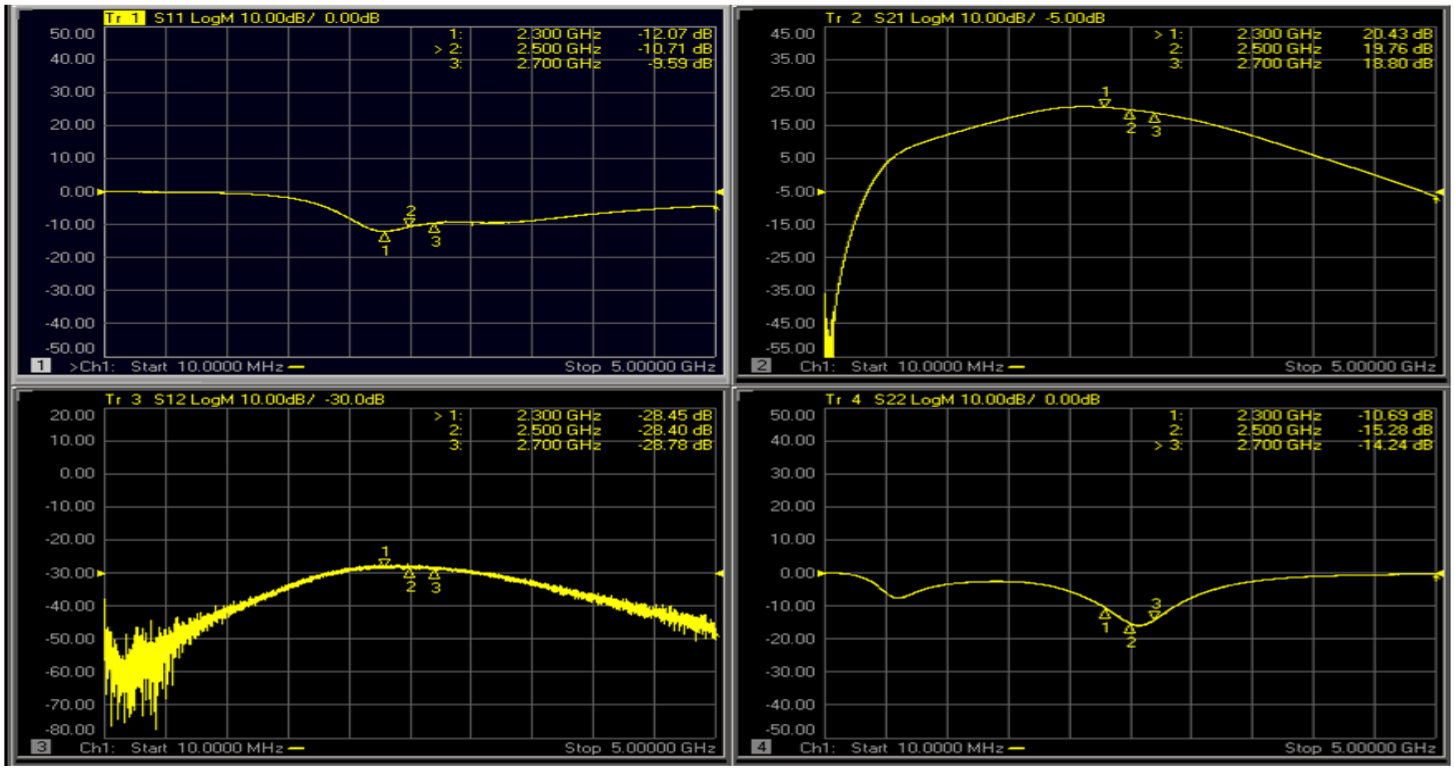


GRF2243 Evaluation Board Data: 3.3 V

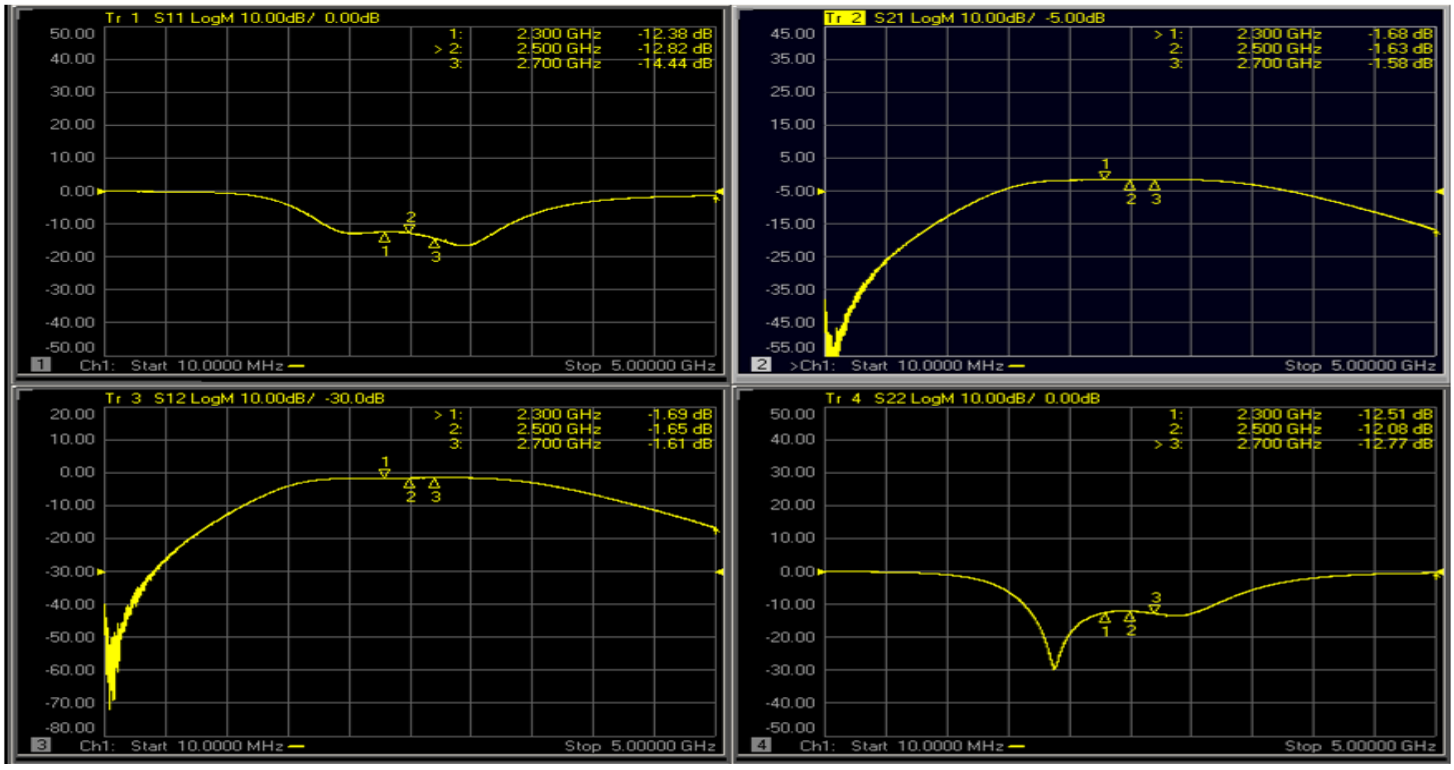




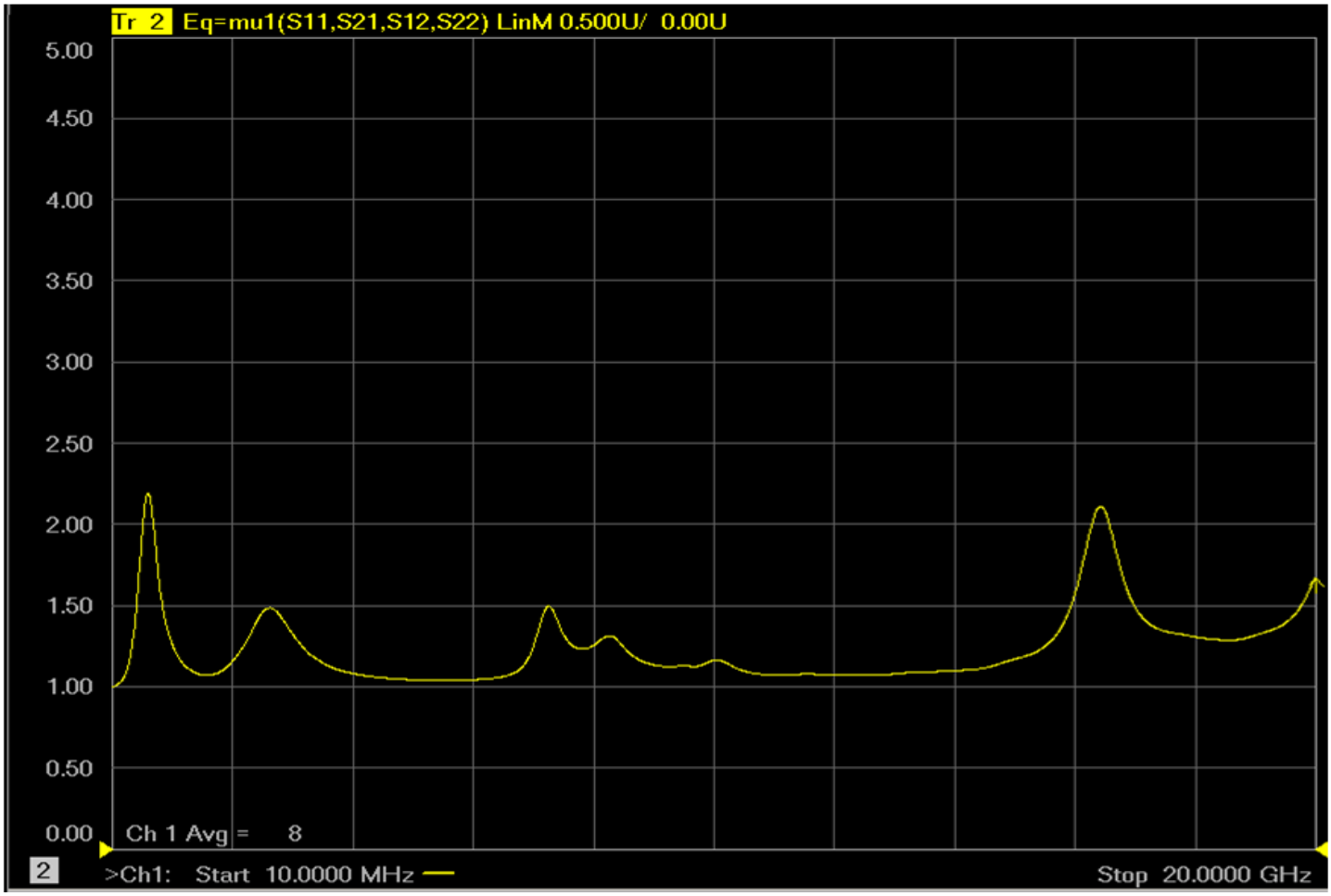
GRF2243 Evaluation Board S-Pars: Gain Mode (2.3 to 2.7 GHz Tune)



GRF2243 Evaluation Board S-Pars: Bypass Mode (2.3 to 2.7 GHz Tune)



GRF2243 Evaluation Board Stability Mu Factor (10 MHz to 20 GHz)



Note: Mu factor ≥ 1.0 implies unconditional stability.

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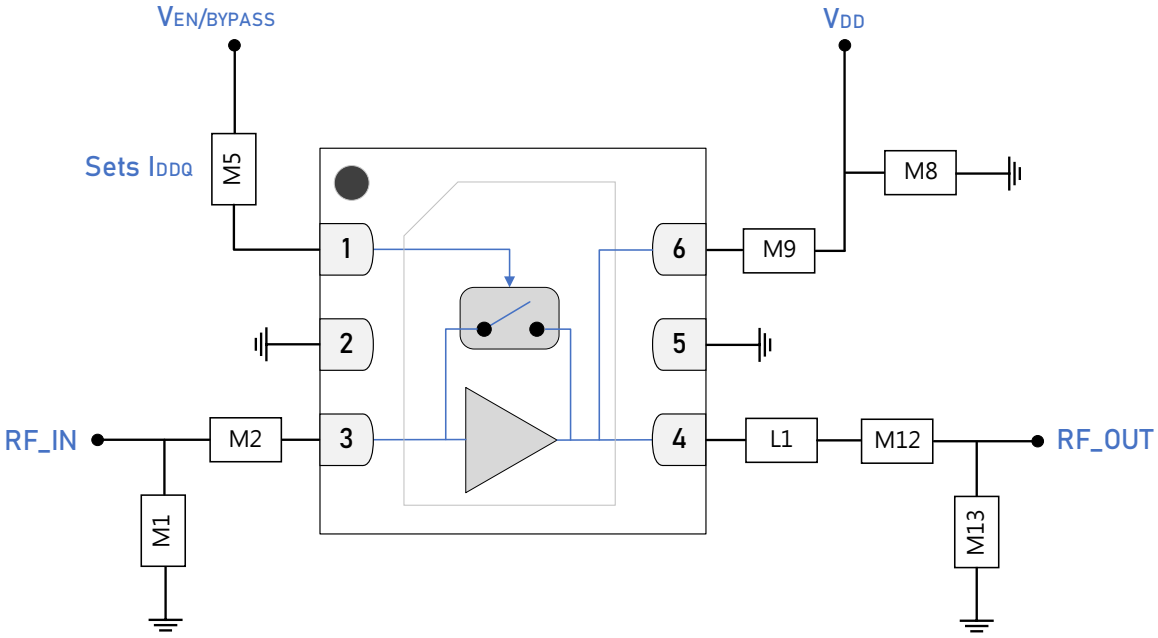
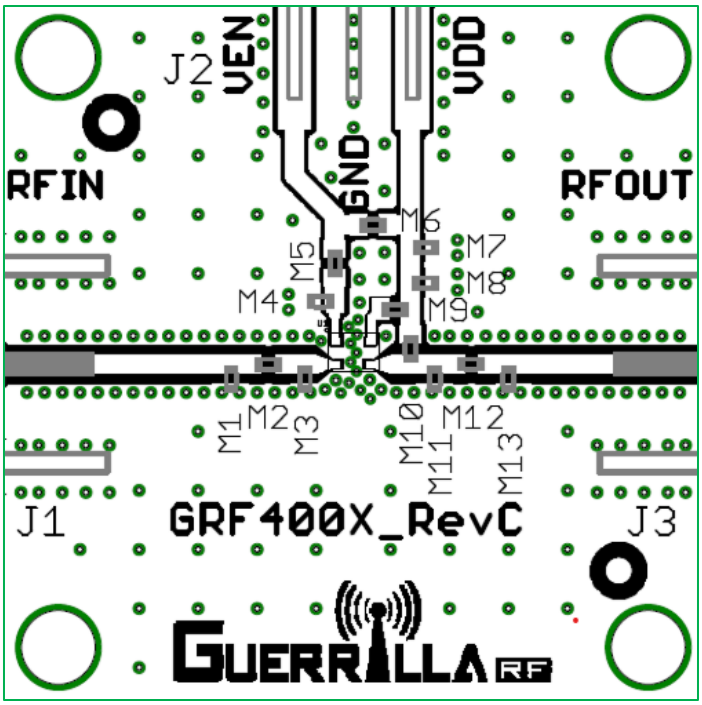


GRF2243 Standard Evaluation Board Schematic



GRF2243 Evaluation Board Assembly Diagram

GRF2243 Evaluation Board Assembly Diagram Reference (2.3 to 2.7 GHz Tune)

Component	Type	Manufacturer	Family	Value	Package Size	Substitution
M1	Inductor	Murata	LQG	2.4 nH	0402	ok
M2	Capacitor	Murata	GJM	4.7 pF	0402	ok
M5 (sets I_{DDQ})	Resistor	Various	5%	See Curves	0402	ok
M8	Capacitor	Murata	GRM	0.1 uF	0402	ok
M9	Inductor	Murata	LQG	10 nH	0402	ok
L1 (next to M12)	Inductor	Murata	LQG	2.2 nH	0402	ok
M12	Capacitor	Murata	GRM	5.6 pF	0402	ok
M13	Capacitor	Murata	GRM	0.5 pF	0402	ok
Evaluation Board	GRF400X_RevC					

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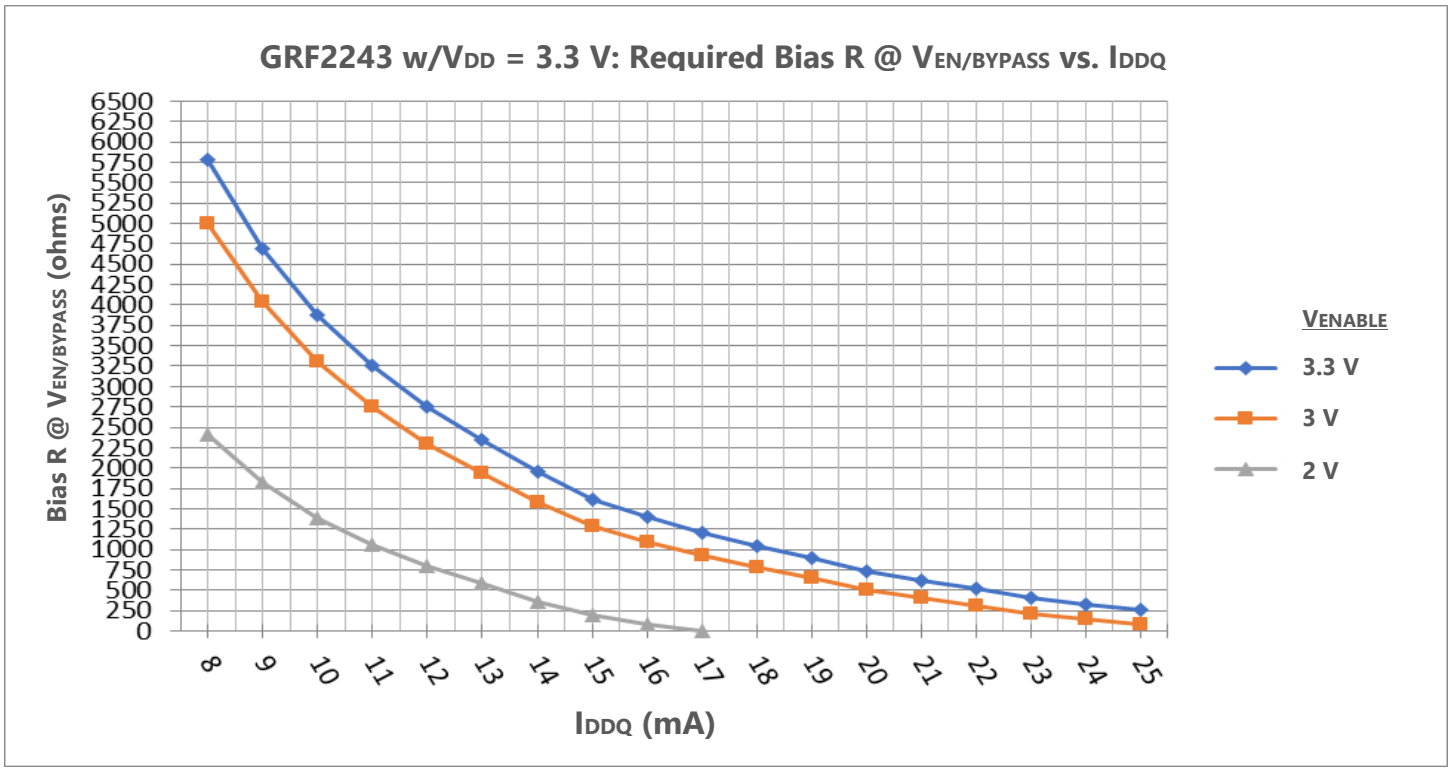
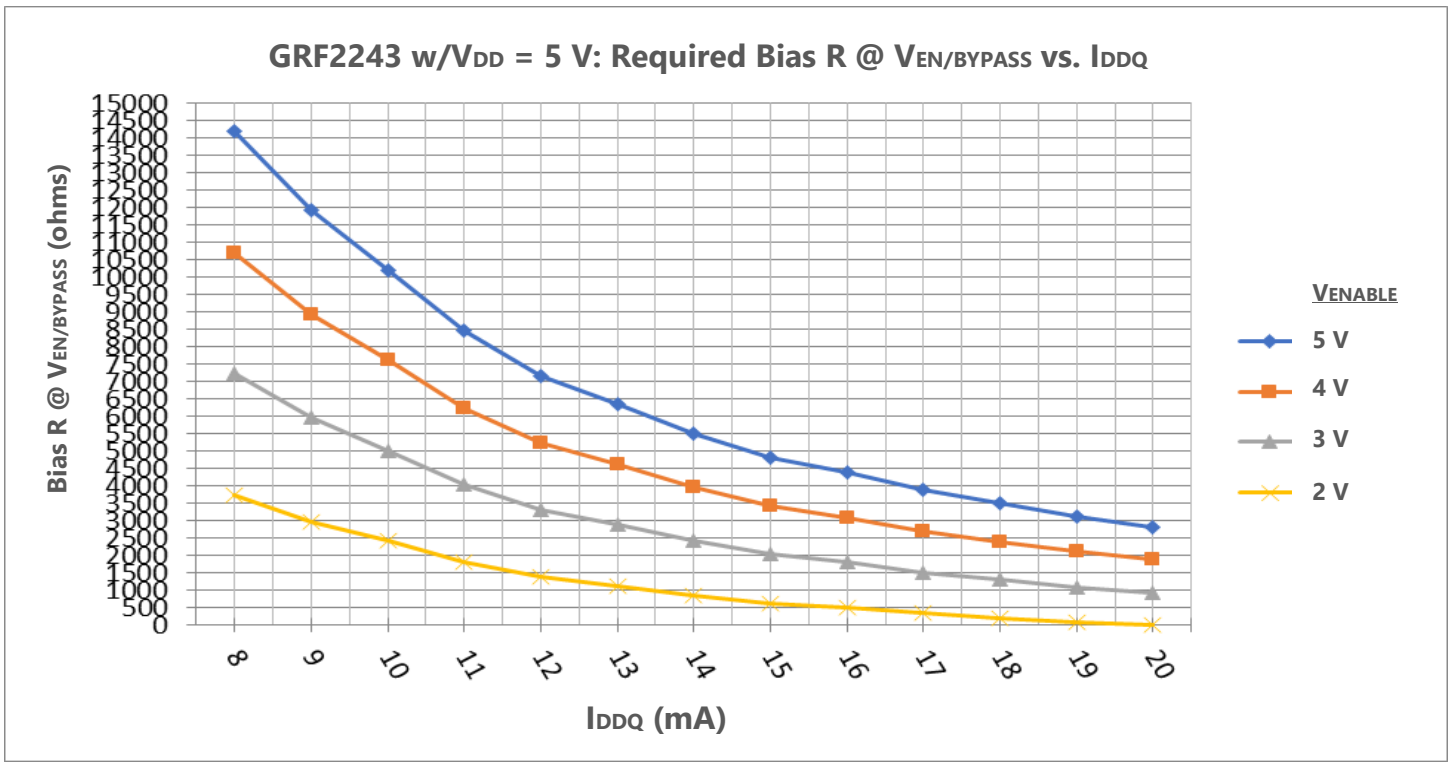
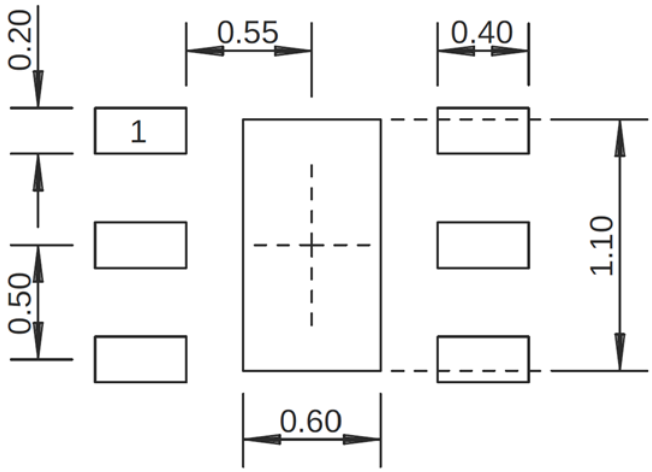
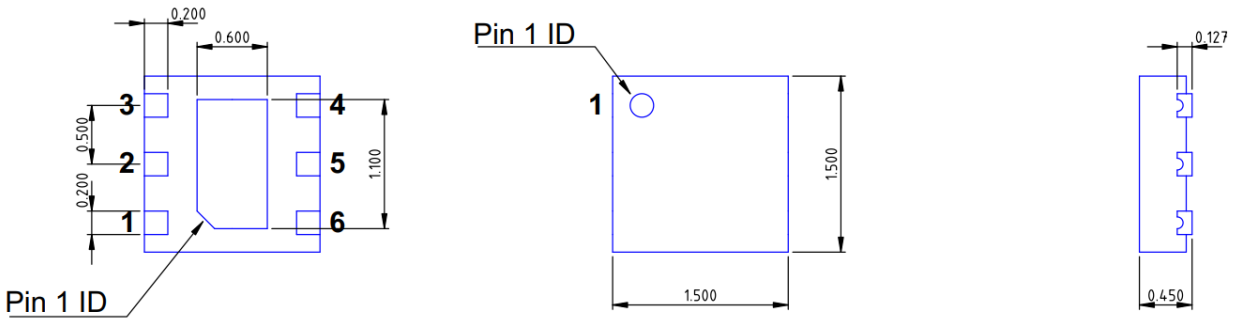
GRF2243 Bias Resistor Selection Curves







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

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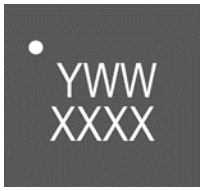
Package Marking Diagram



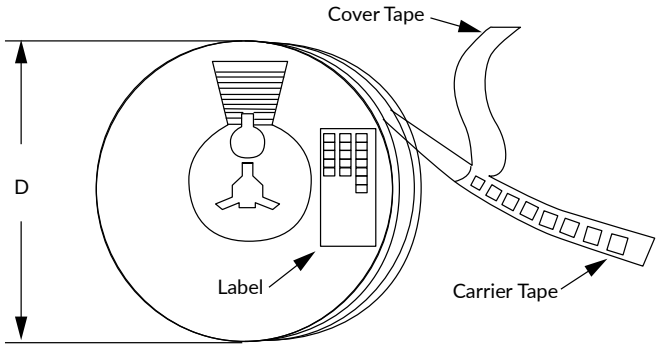
- Line 1: "Y" = YEAR (single digit). "WW" = WORK WEEK the Device was assembled.
- Line 2: "XXXX" = Device PART NUMBER.

Tape and Reel Information

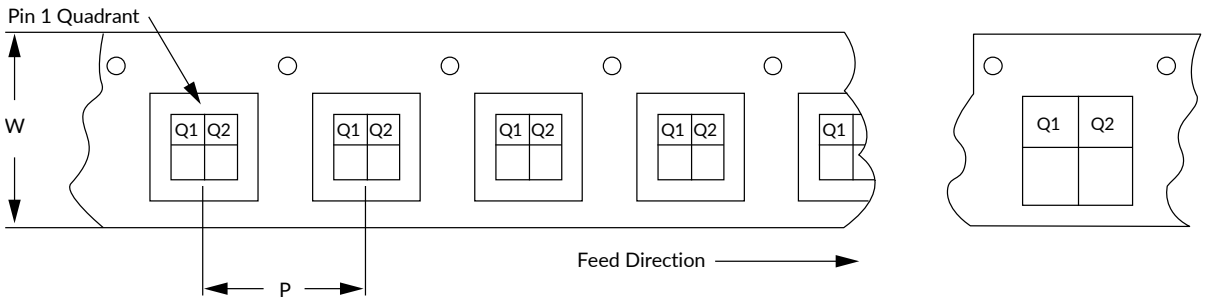
Guerrilla RF's tape and reel specification complies with Electronic Industries Association (EIA) standards for "Embossed Carrier Tape of Surface Mount Components for Automatic Handling" (reference EIA-481). See the following page for the Tape and Reel Specification and Device Package Information table,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

Revision History

Revision Date	Description of Change
December 18, 2019	Preliminary Data Sheet.
August 18, 2022	Upgraded Data Sheet to new format. Changed Switching Times to reflect latest test data.
August 2, 2023	Changed Pin Max specification to "TBD".
July 16, 2024	Added Pin Max specification to Absolute Ratings.
October 21, 2024	Release Ø Data Sheet. Updated thermal resistance and switching times.

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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.