

GRF5010

28.5 dBm Power-LNA™
10 to 6000 MHz

FEATURES

- Excellent OP1dB, OIP3, and NF Performance
- Flexible Bias Voltage and Current
- 95 mA Native Mode Quiescent Current Consumption
- -40 to 105 °C Operating Temperature Range
- Process: GaAs pHEMT
- Compact 3 x 3 mm QFN-16 Package

Reference: 8 V / 95 mA / 2.5 GHz

- Gain: 17 dB
- OIP3: 45 dBm
- OP1dB: 28.5 dBm
- Noise Figure: 0.85 dB

Reference: 5 V / 60 mA / 2.5 GHz

- Gain: 17 dB
- OIP3: 38.5 dBm
- OP1dB: 24.5 dBm
- Noise Figure: 0.82 dB

APPLICATIONS

- Multi-Stage LNA
- Linear Driver Amplifier for High PAR Waveforms
- Distributed Antenna Systems
- Microwave Backhaul

DESCRIPTION

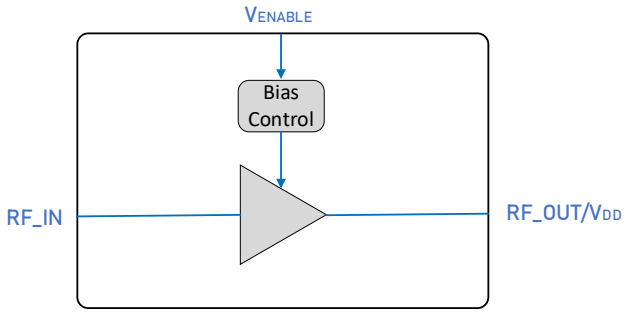
The GRF5010 is a high linearity Power-LNA with ultra-low noise figure (NF). The primary tune for this device covers 1.7 to 3.8 GHz. It achieves outstanding P1dB, IP3 and NF over the band. The device can be tuned to deliver outstanding performance from 10 MHz to 6000 MHz with fractional bandwidths > 30%. With an 8 volt supply, the device can deliver broadband OP1dB values > 28 dBm.

In addition to use as a PA or linear driver, GRF5010 is well suited to demanding first, second or third stage LNA applications requiring high linearity, ruggedness, and low NF.

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

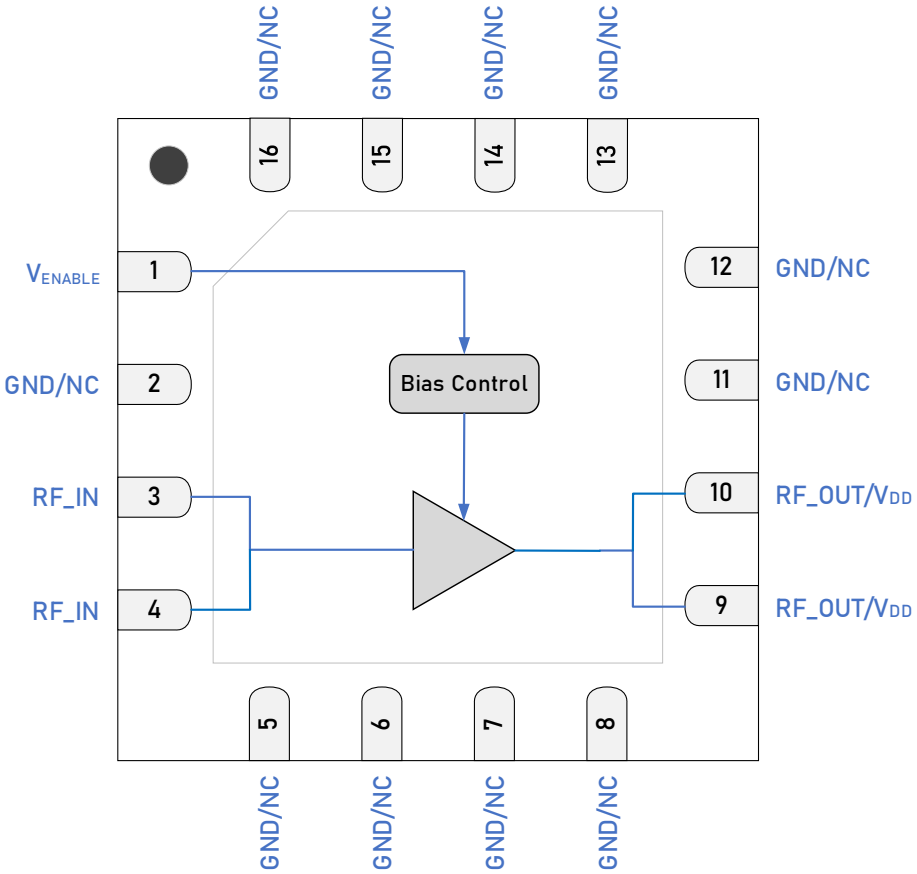
Additional tunes can be found on the GRF5010 "Custom Tunes" product page: GRF5010 Custom Tunes

BLOCK DIAGRAM



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3 x 3mm QFN-16 Pin Out (Top View)

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Pin Assignments

Pin	Name	Description	Note
1	V_{ENABLE}	Enable Voltage Input	V_{ENABLE} and series resistor set I_{DDQ}. $V_{ENABLE} \leq 0.2$ V disables device. On-die pull-down resistor turns the device off if this node is allowed to float.
2, 5, 6, 7, 8, 11, 12, 13, 14, 15, 16	GND/NC	Ground or No Connect	No internal connection to die. These pins can be left unconnected, or be connected to ground (recommended). Use a via as close to the pin as possible if grounded.
3, 4	RF_IN	RF Input	Pins 3 & 4 tied together on system board.
9, 10	RF_OUT/V_{DD}	PA Output/Bias	Pins 9 & 10 tied together on system board. V_{DD} must be applied to this pin via an RF choke.
PKG BASE	GND	Ground	Provides DC and RF ground for the 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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Absolute Ratings

Parameter	Symbol	Min.	Max.	Unit
Supply Voltage	V_{DD}	0	10	V
Transient Average RF Input Power CW: Load VSWR < 2:1; Duration: < 1 hour	$P_{IN\ MAX}$		22	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	$P_{DISS\ MAX}$		1.5	W

Electrostatic Discharge

Charged Device Model	CDM	1000		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 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. For additional information, please refer to the ROHS Compliance | Guerrilla RF (guerrilla-rf.com)

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Recommended Operating Conditions

Parameter	Symbol	Specification			Unit	Condition
		Min.	Typ.	Max.		
Supply Voltage	V_{DD}	2.7	8	10	V	
Operating Temperature (package base)	$T_{PKG\ BASE}$	-40		105	°C	
RF Frequency Range	F_{RF}	10	2500	6000	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: GRF5010 Custom Tunes.

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

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Nominal Operating Parameters – General

The following conditions apply unless noted otherwise: typical application schematic using the 1.7 to 3.8 GHz tuning set, V_{DD}= 8 V, I_{DDQ} = 95 mA, M1 = 5 kΩ, F_{TEST} = 2.5 GHz, 50 Ω system impedance, $T_{PKG\ BASE}$ = 25 °C. Evaluation board losses are included within the specifications.

Parameter	Symbol	Specification			Unit	Condition
		Min.	Typ.	Max.		
Supply Quiescent Current	I_{DDQ}		95		mA	
Enable Current	I_{ENABLE}		2.0		mA	
Operating Temperature Range	$T_{PKG\ BASE}$	-40		105	°C	
Switching Rise Time	T_{RISE}		100		ns	Disabled mode to Gain mode **(note 3)**.
Switching Fall Time	T_{FALL}		100		ns	Gain mode to Disabled mode **(note 4)**.
Disabled Mode						
Leakage Current	I_{DD}		300	600	µA	
Thermal Data						
Thermal Resistance (Infrared Scan)	Θ_{JC}		43		°C/W	On standard evaluation board **(note 5)**.

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

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

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

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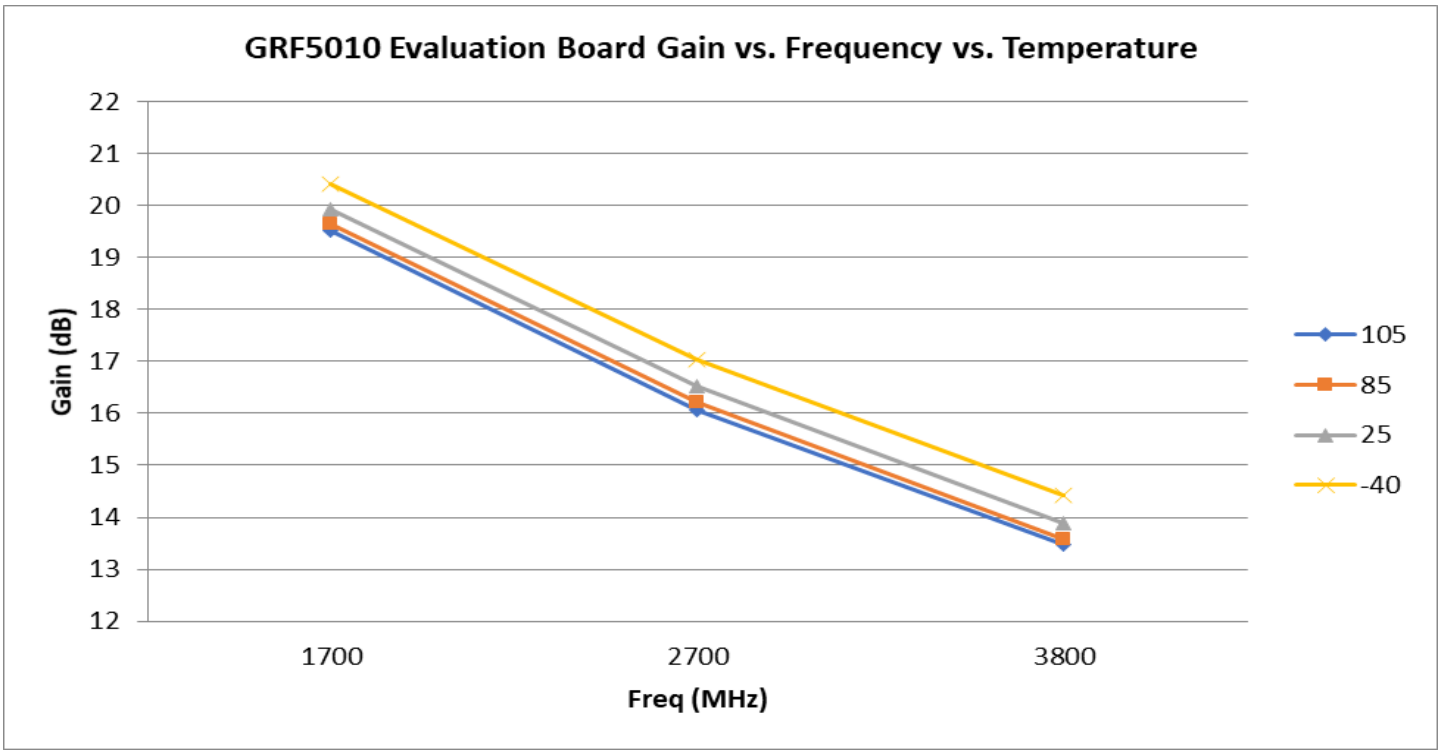
Nominal Operating Parameters – RF

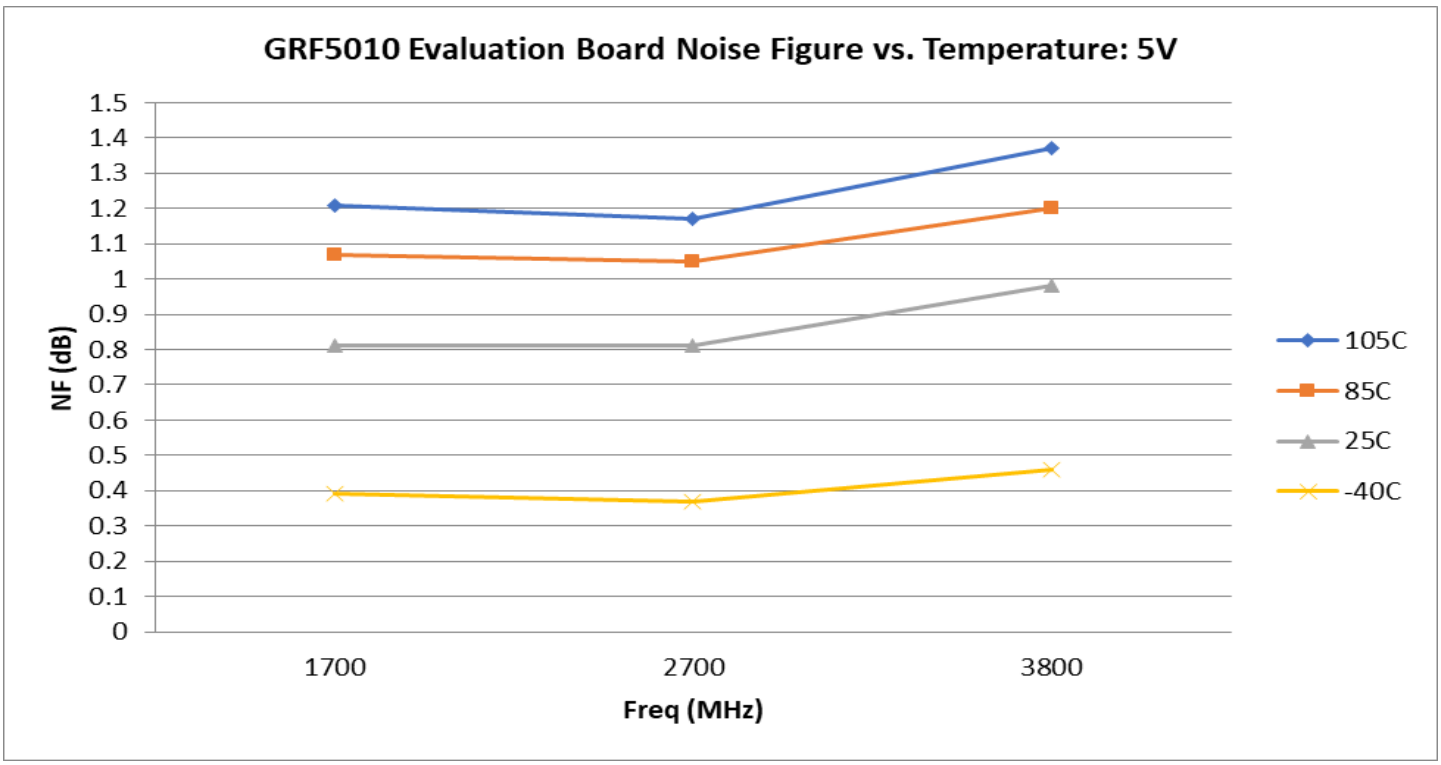
The following conditions apply unless noted otherwise: typical application schematic using the 1.7 to 3.8 GHz tuning set. V_{DD} = 8 V, I_{DDQ} = 95 mA, M1 = 5 kΩ, F_{TEST} = 2.5 GHz, 50 Ω system impedance, $T_{PKG\ BASE}$ = 25 °C. Evaluation board losses are included within the specifications

Parameter	Symbol	Specification			Unit	Condition
		Min.	Typ.	Max.		
Small Signal Gain	S21	16	17		dB	
Reverse Isolation	S12		< -25		dB	F_{RF} = 1.7 to 3.8 GHz.
Noise Figure	NF		0.85	1.05	dB	On standard evaluation board.
Output 3rd Order Intercept Point	OIP3		45		dBm	8 dBm P_{OUT} per tone at 2 MHz spacing (2499 and 2501 MHz).
Output 1 dB Compression Power	OP1dB	26.5	28.5		dBm	

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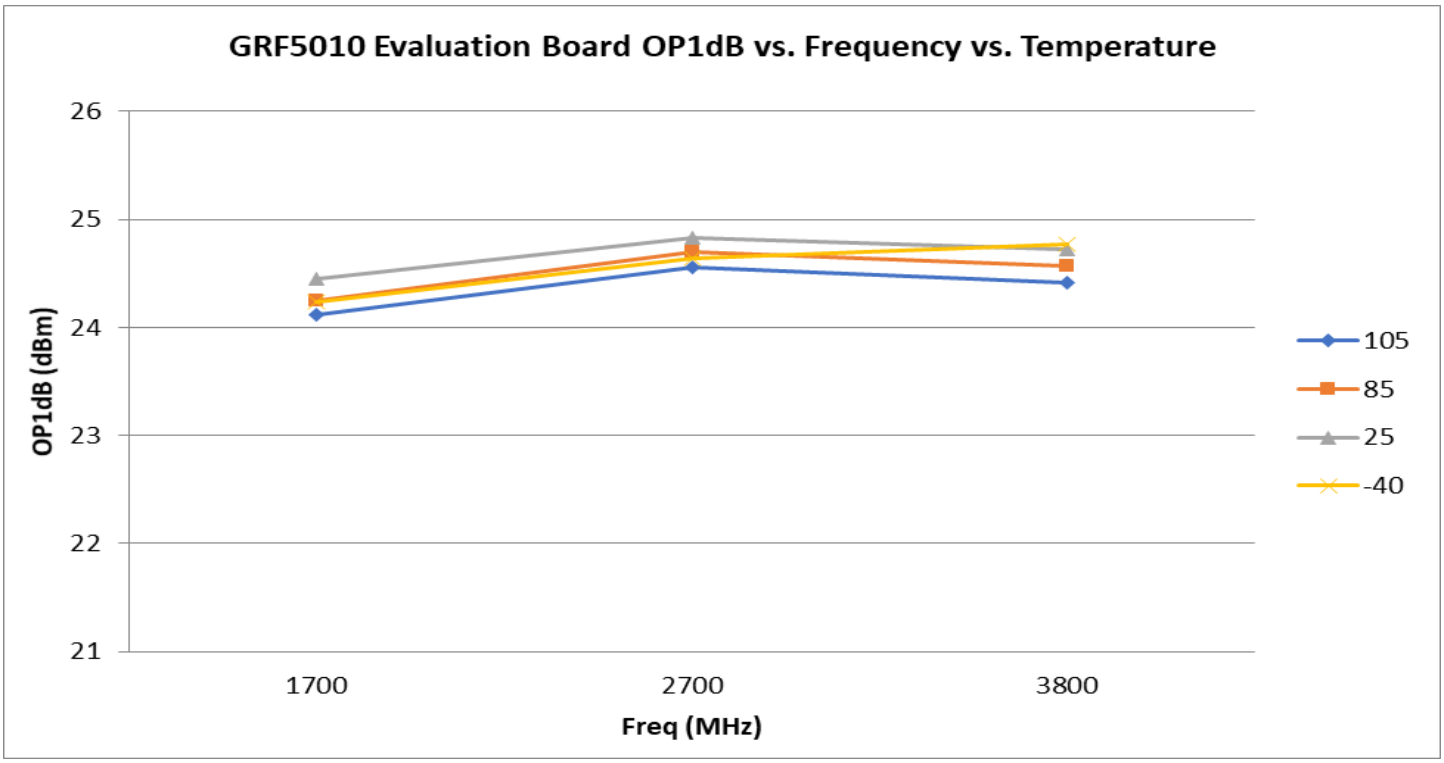
GRF5010 Typical Operating Curves: 5 V, 60 mA (1.7 to 3.8 GHz Tune)

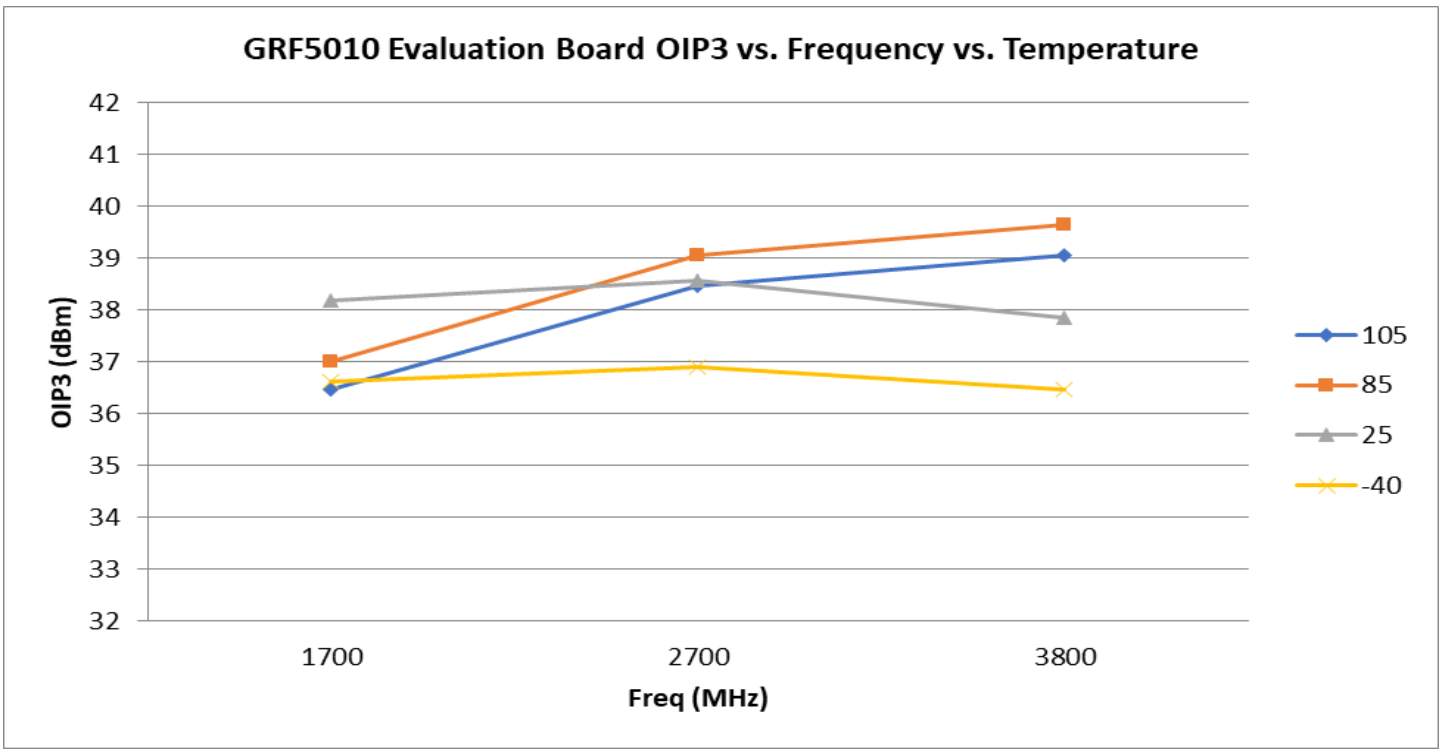




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GRF5010 Typical Operating Curves: 5 V, 60 mA (1.7 to 3.8 GHz Tune)

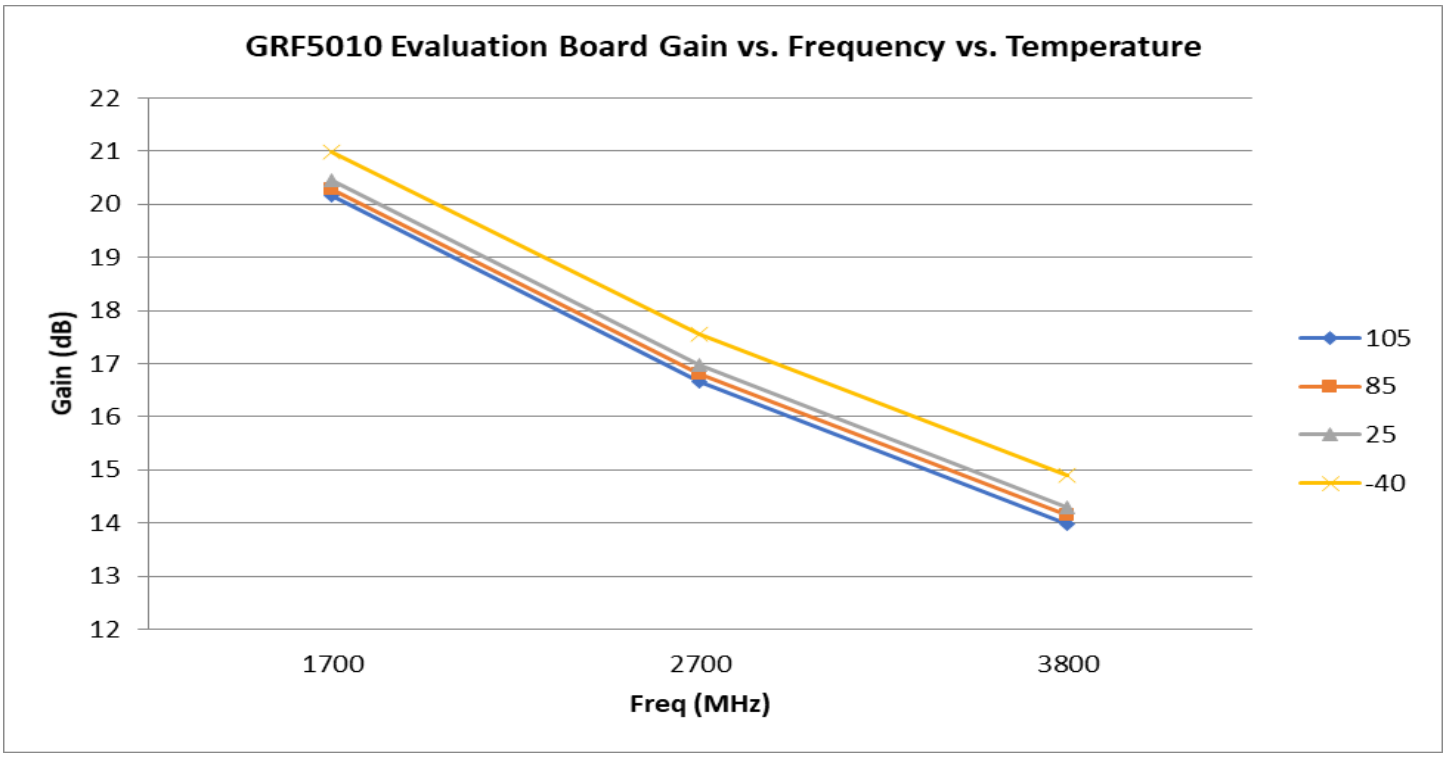


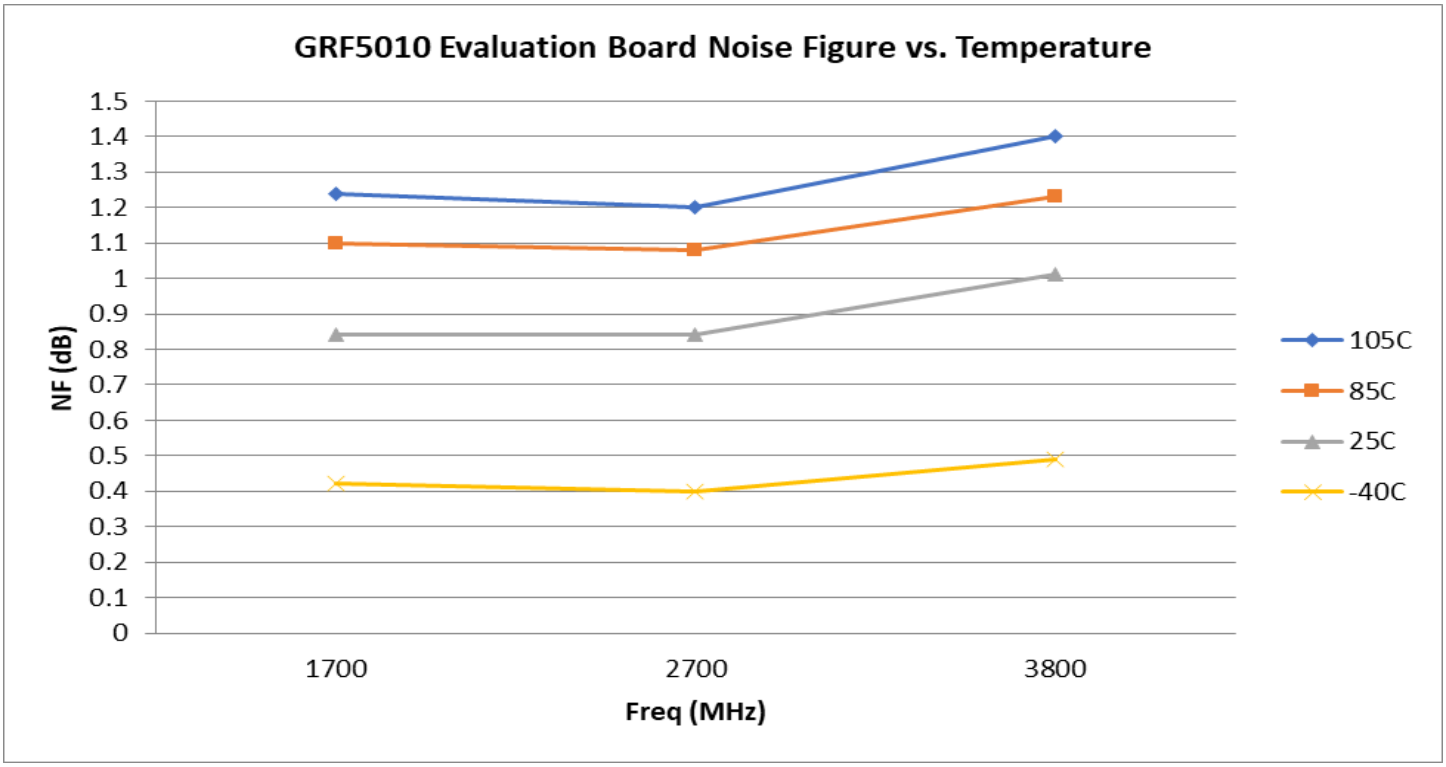


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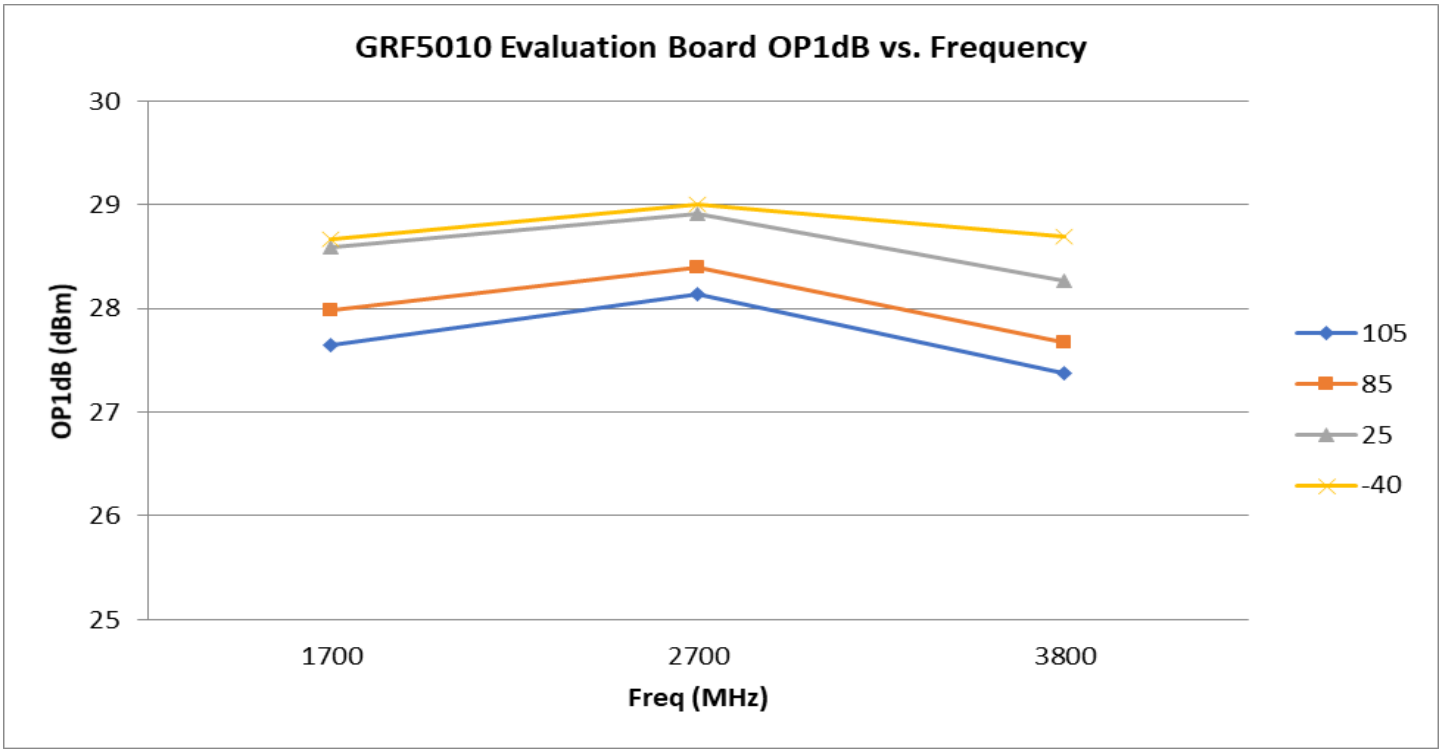
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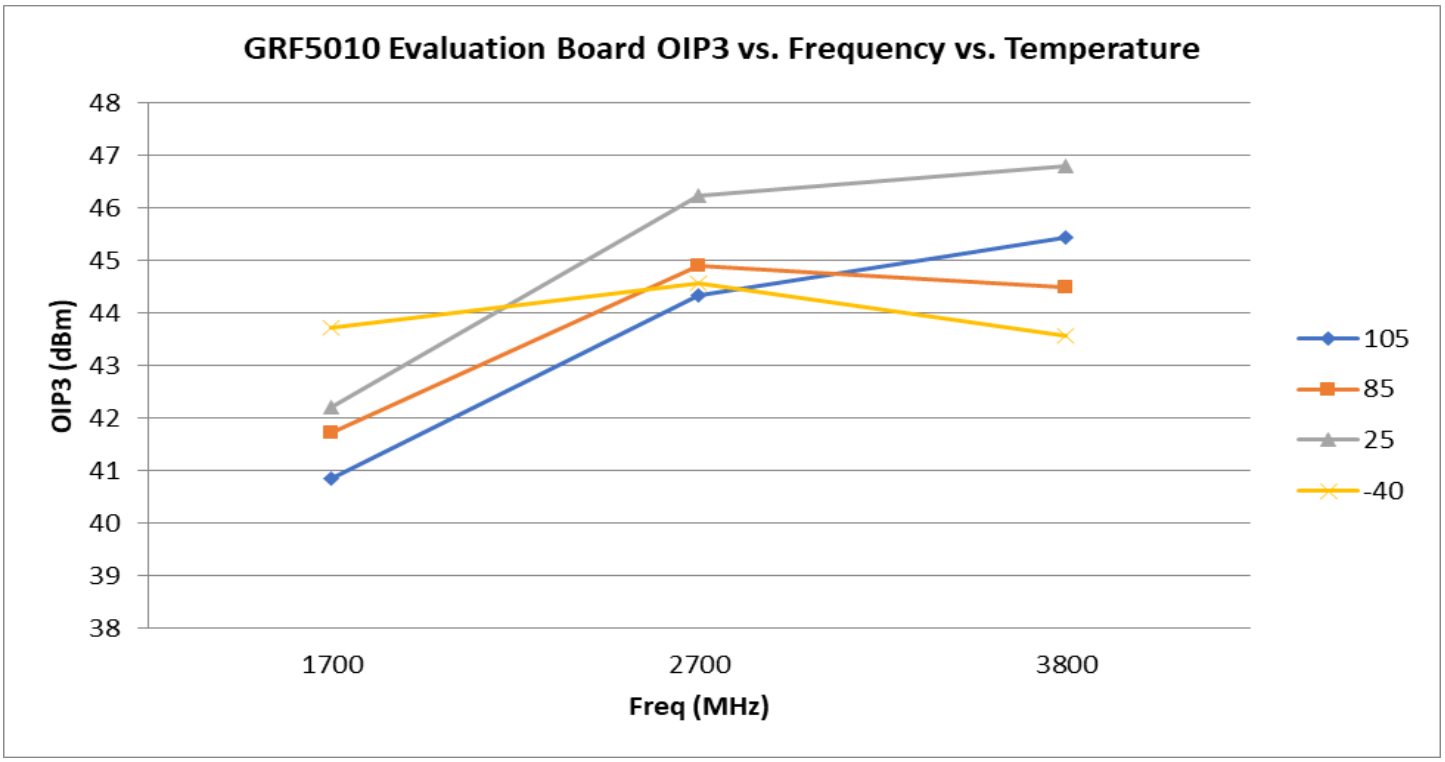




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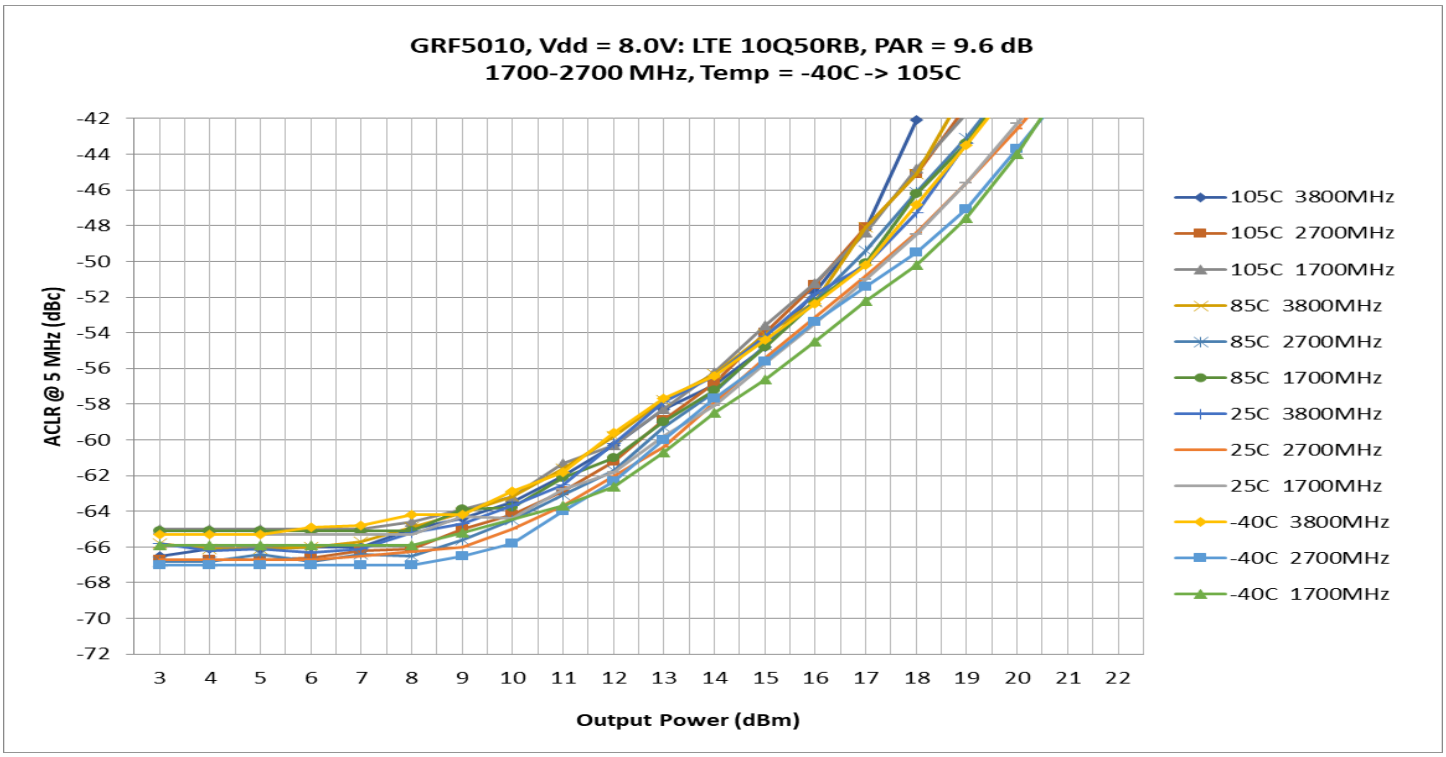


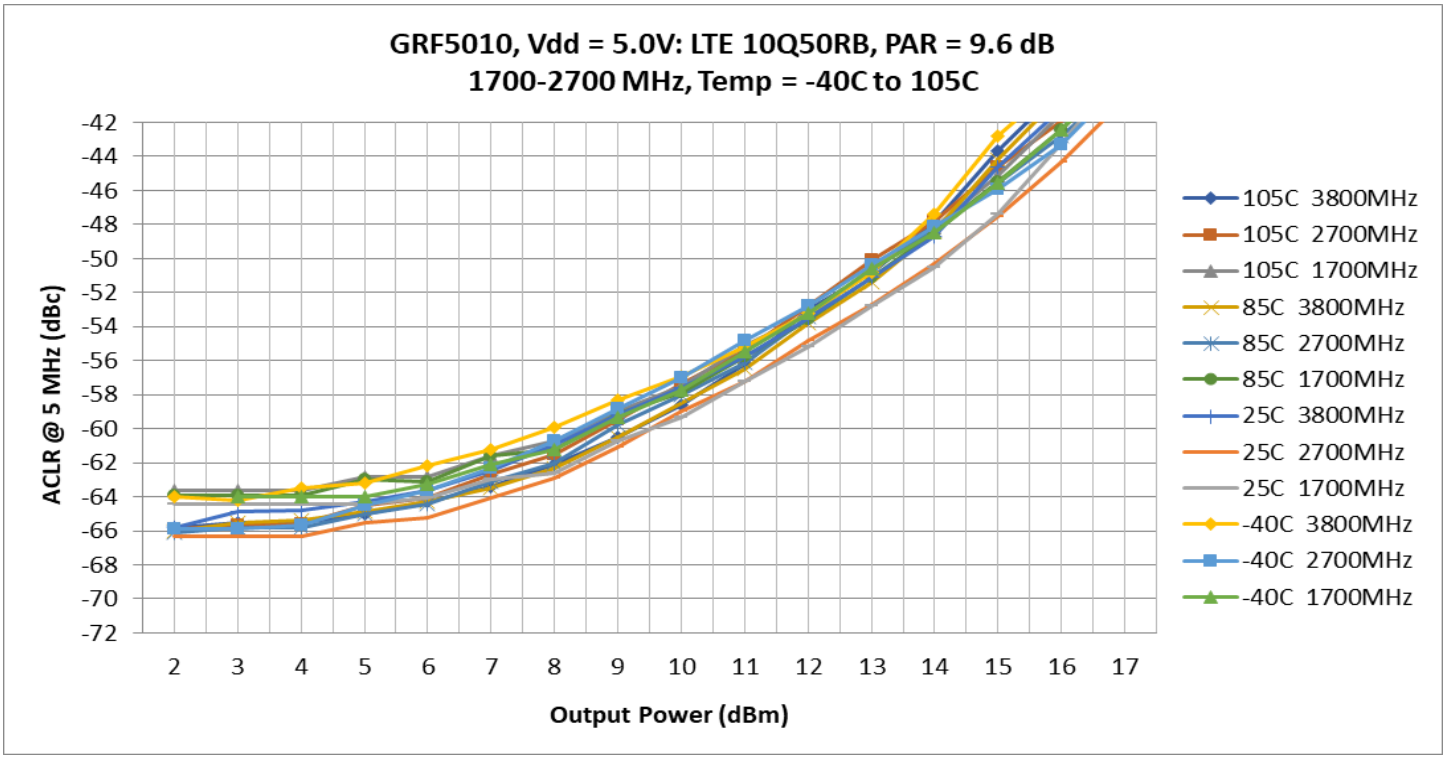


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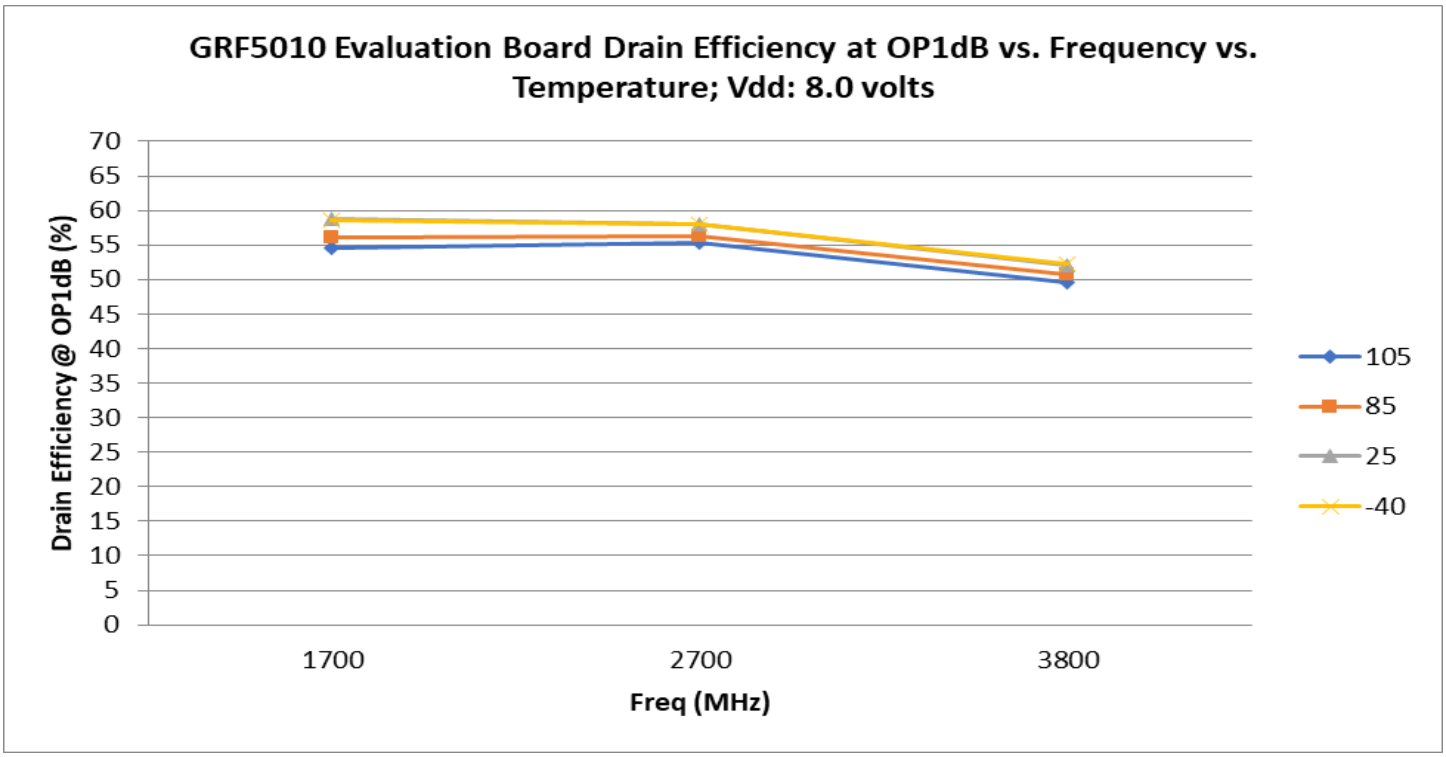
GRF5010 Typical Operating Curves: 1.7 to 3.8 GHz Tune

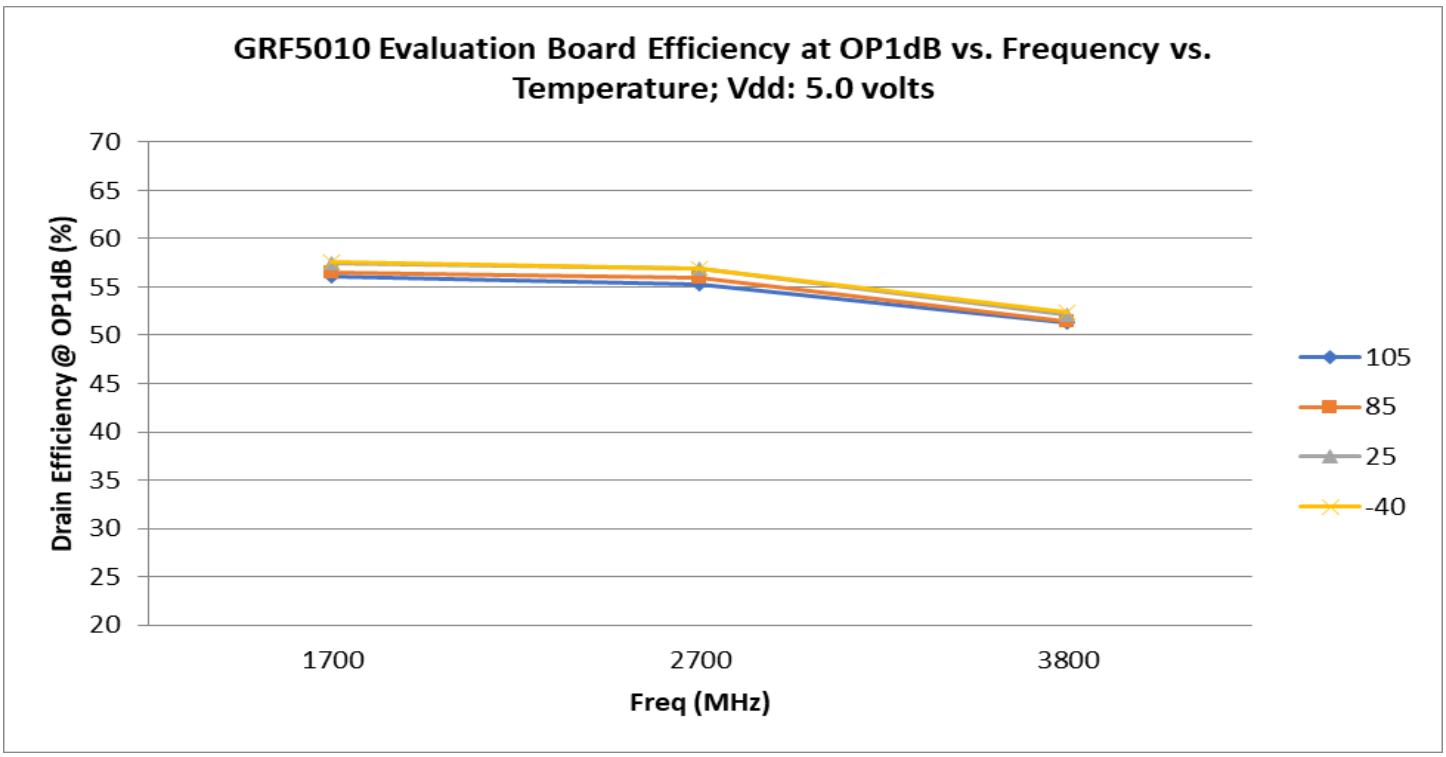




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GRF5010 Typical Operating Curves: 1.7 to 3.8 GHz Tune

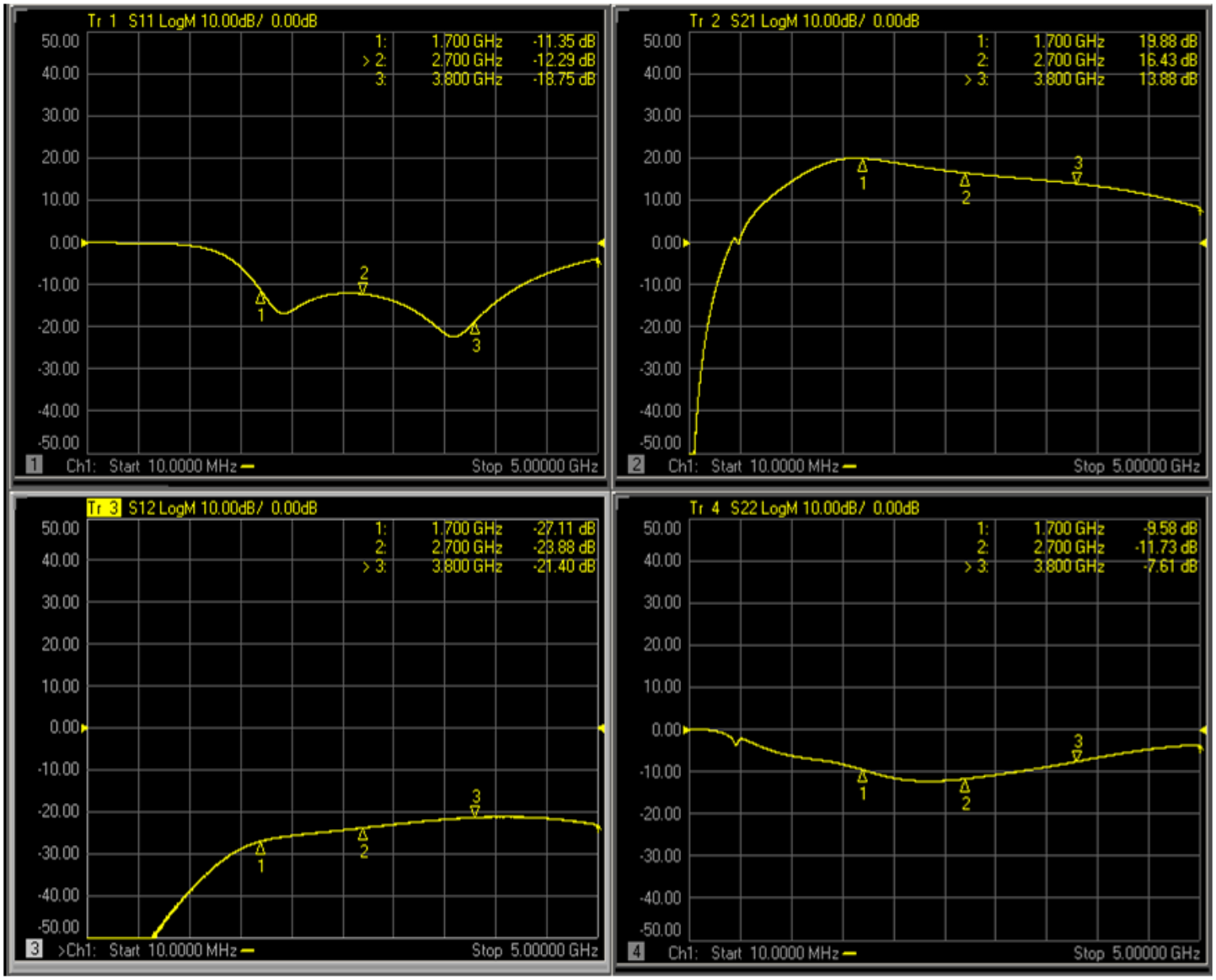




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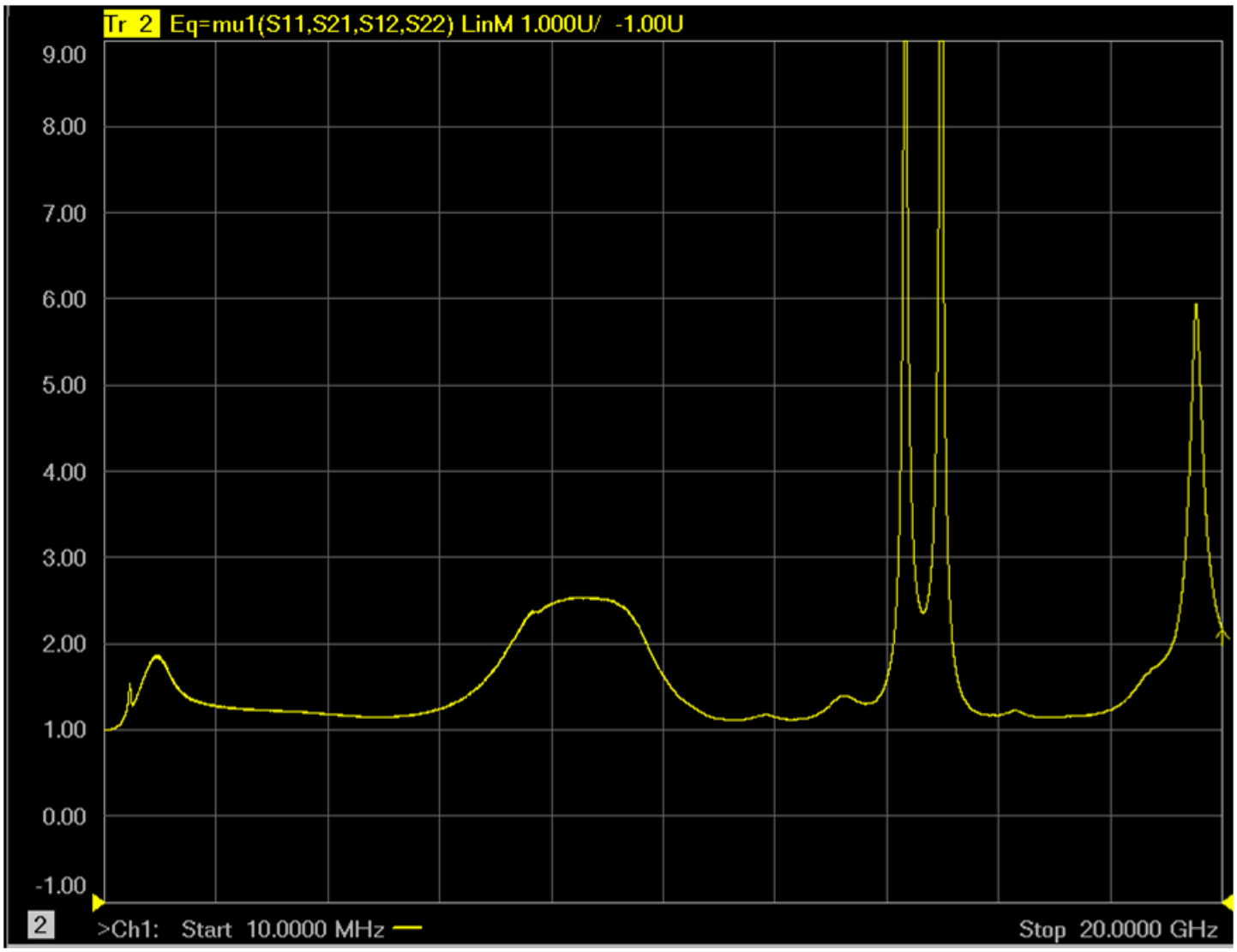
GRF5010 Typical Operating Curves: S-Parameters (1.7 to 3.8 GHz Tune)



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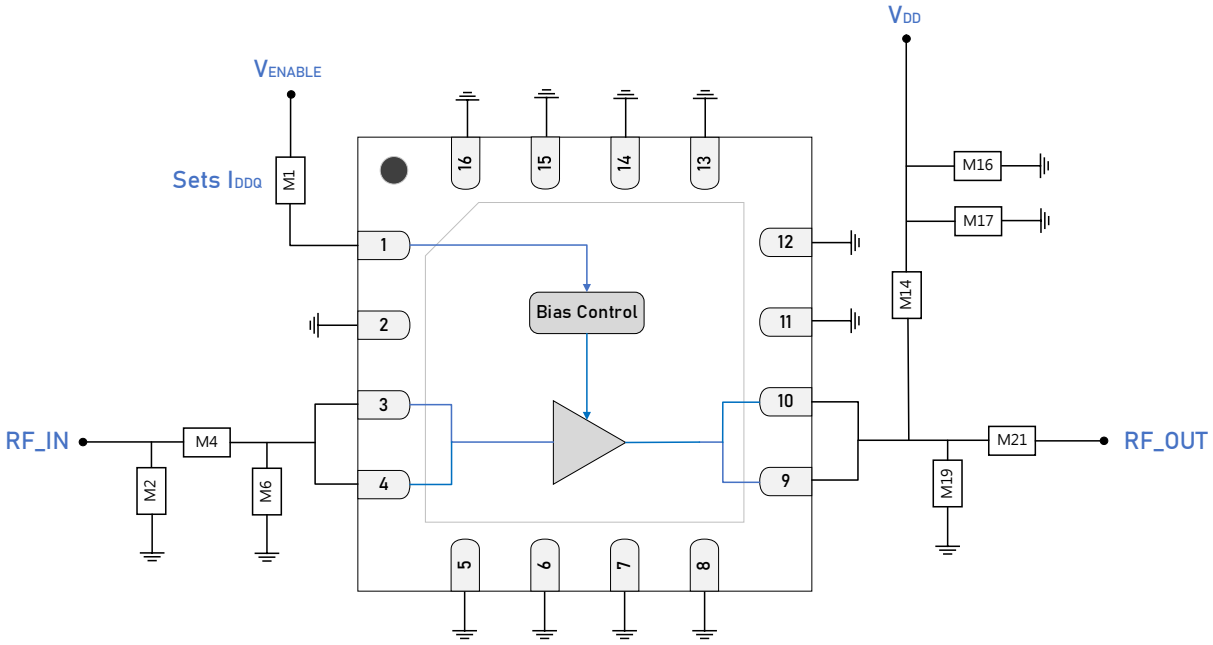
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GRF5010 Typical Operating Curves: Mu Factor (10 MHz to 20 GHz)

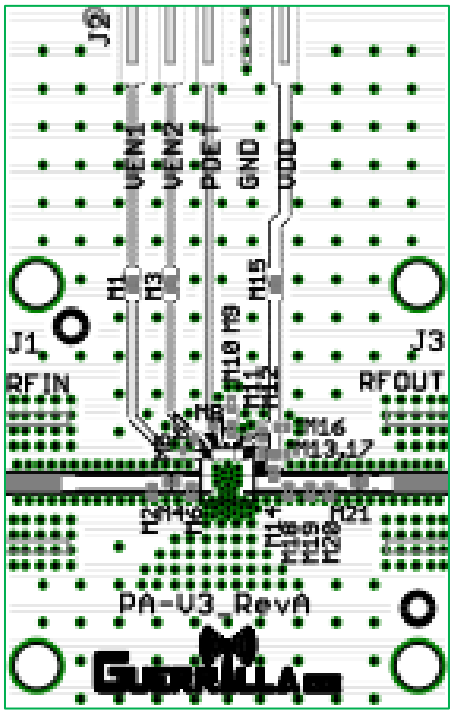


Note: Mu factor ≥ 1.0 implies unconditional stability

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GRF5010 Standard Evaluation Board Schematic



GRF5010 Evaluation Board Assembly Diagram

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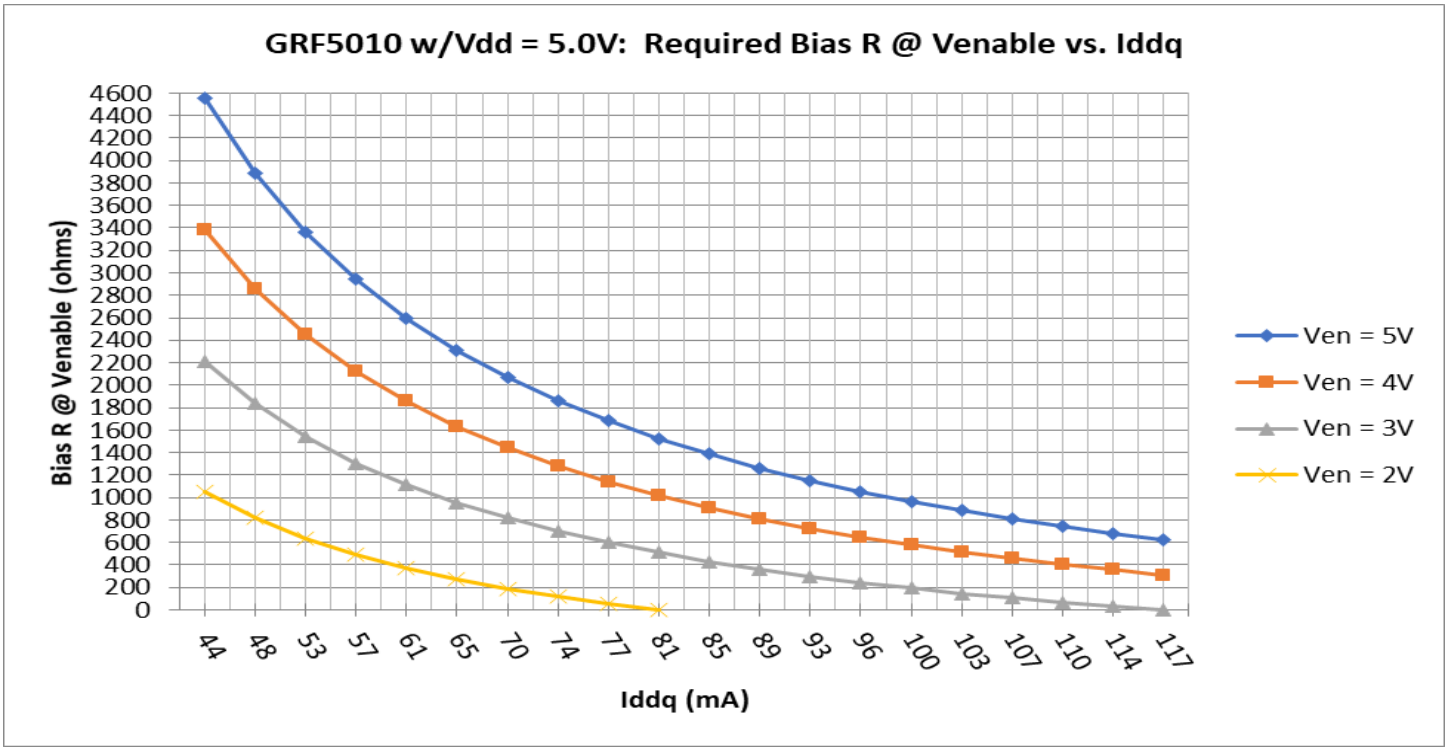
GRF5010 Evaluation Board Assembly Diagram Reference: 1.7 to 3.8 GHz Tune

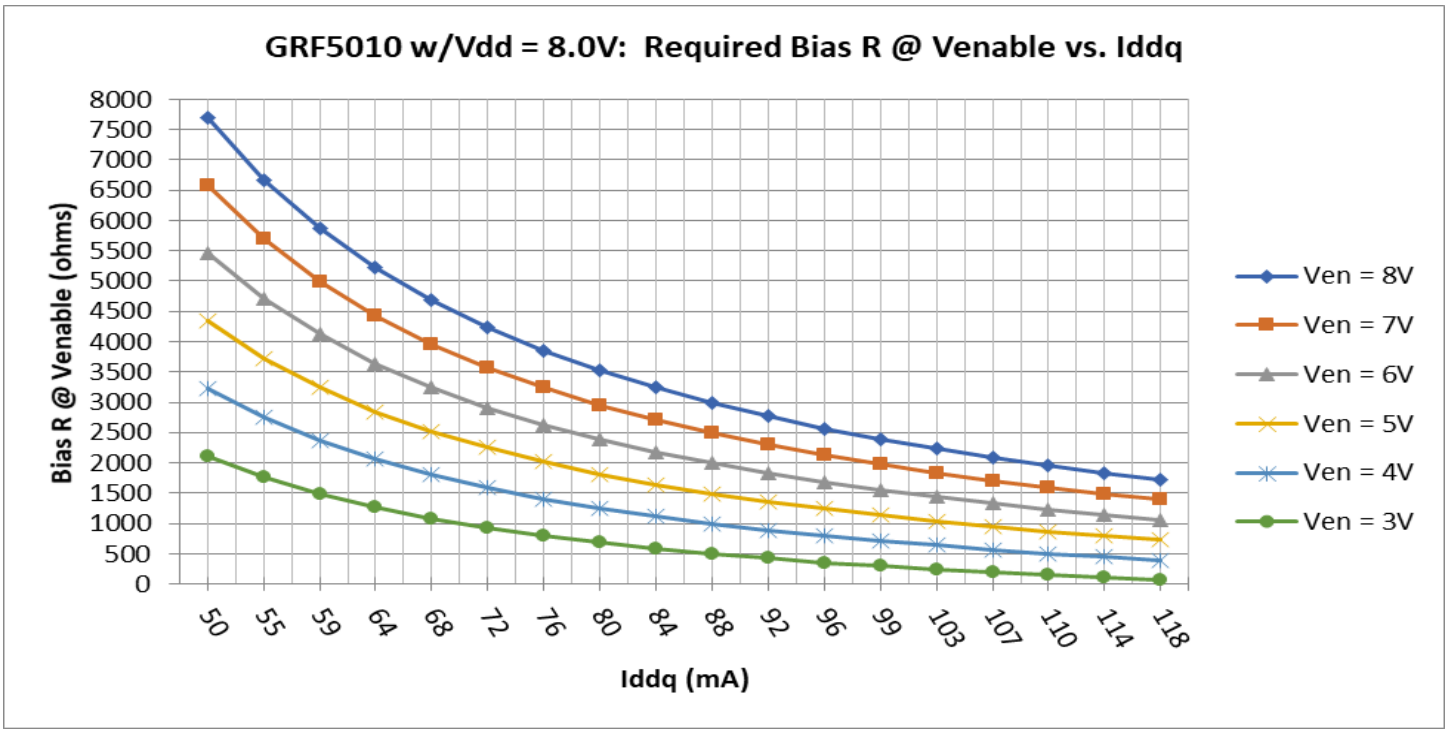
Component	Type	Manufacturer	Family	Value	Package Size	Substitution
M1 (sets I_{DDQ})	Resistor	Various	5%	see curves	0402	ok
M2	Inductor: High Q	Coilcraft	HP	3.6 nH	0402	ok
M4	Capacitor: High Q	Murata	GJM	2.0 pF	0402	ok
M6	Capacitor: High Q	Murata	GJM	0.7 pF	0402	ok
M14	Inductor	Coilcraft	HP	10 nH	0402	ok
M16	Capacitor	Murata	GRM	0.1 µF	0402	ok
M17	Capacitor	Murata	GRM	100 pF	0402	ok
M19	DNP	--	--	--	--	--
M21	Capacitor	Murata	GJM	10 pF	0402	ok
Evaluation Board	PA-V3_RevA					

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GRF5010 Bias Resistor Curves

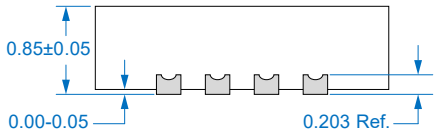




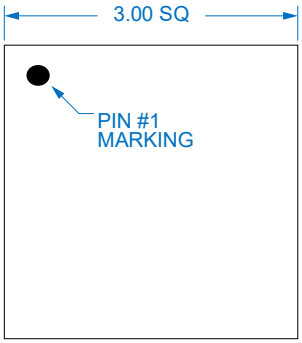
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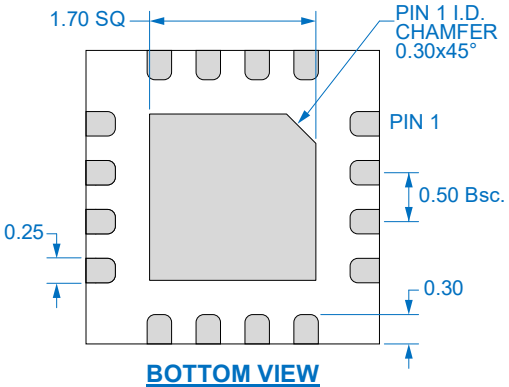
Package Outline Drawing



SIDE VIEW

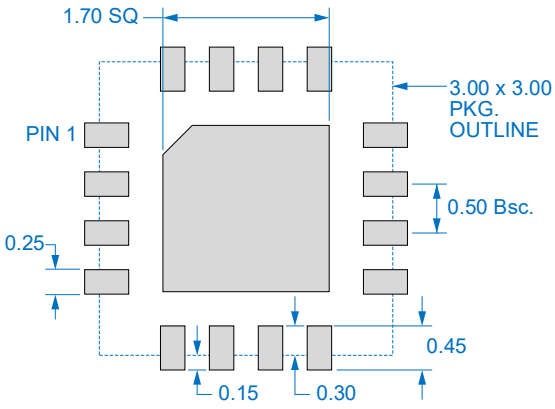


TOP VIEW



BOTTOM VIEW

Recommended PCB Footprint



TOP VIEW

QFN-16 3 x 3 mm Package Dimensions and Suggested PCB Footprint (Top View)

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Package Marking Diagram



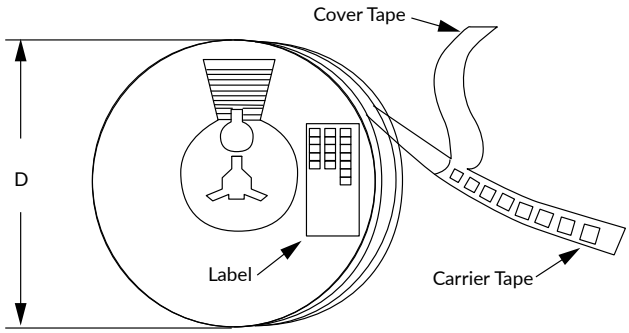
- Line 1: "YY" = YEAR. "WW" = WORK WEEK the device was assembled.
- Line 2: "GRF" = Guerrilla RF.
- Line 3: "XXXX" = Device PART NUMBER.

Tape and Reel Information

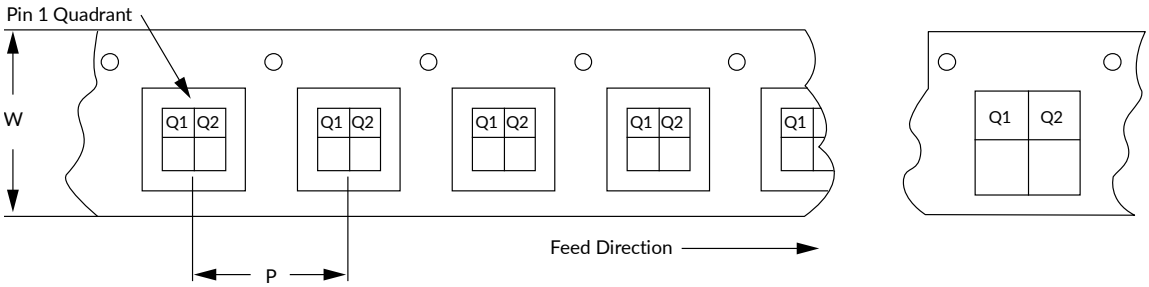
Guerrilla RF's tape and reel specification complies with Electronic Industries Alliance (EIA) standards for "Embossed Carrier Tape of Surface Mount Components for Automatic Handling" (reference EIA-481). See the following page for the Tape and Reel Specification and Device Package Information table, 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
January 13, 2017	Release Ø Data Sheet.
November 6, 2024	Upgraded Data Sheet to new format.
June 9, 2025	Extended lower frequency range from 500 MHz to 10 MHz.
January 9, 2026	Updated Package Outlne drawing and PCB Footprint.

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Datasheet 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.

Information in this datasheet is specific to the Guerrilla RF, Inc. ("Guerrilla RF") product identified.

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