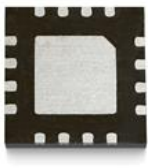
DATA SHEET

RELEASE A DATA SHEET



GRF5110

28.5 dBm POWER-LNA™ 470 to 3900 MHz

FEATURES

- Excellent OP1dB, OIP3, and NF Performance
- Flexible Bias Voltage and Current
- 5 V Supply Voltage
- Process: GaAs pHEMT
- -40 to 105 °C Operating Temperature Range
- Compact 3 x 3 mm QFN-16 Package

Reference: 5 V / 150 mA / 1.9 GHz

- Gain: 15 dB
- OIP3: 46 dBm
- OP1dB: 28.5 dBm
- Noise Figure: 0.9 dB

APPLICATIONS

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

DESCRIPTION

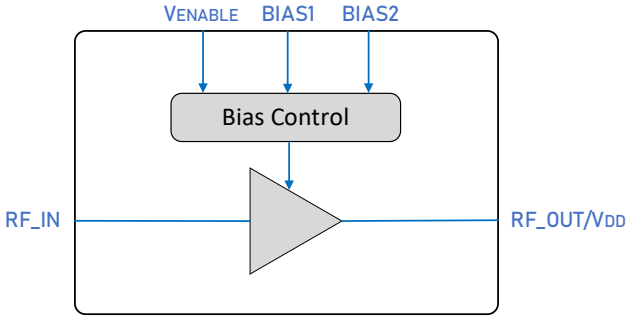
GRF5110 is a high linearity PA /Linear Driver with low noise figure (NF). It delivers excellent P1dB, IP3 and NF over a wide range of frequencies with fractional bandwidths of roughly 5 to 10%.

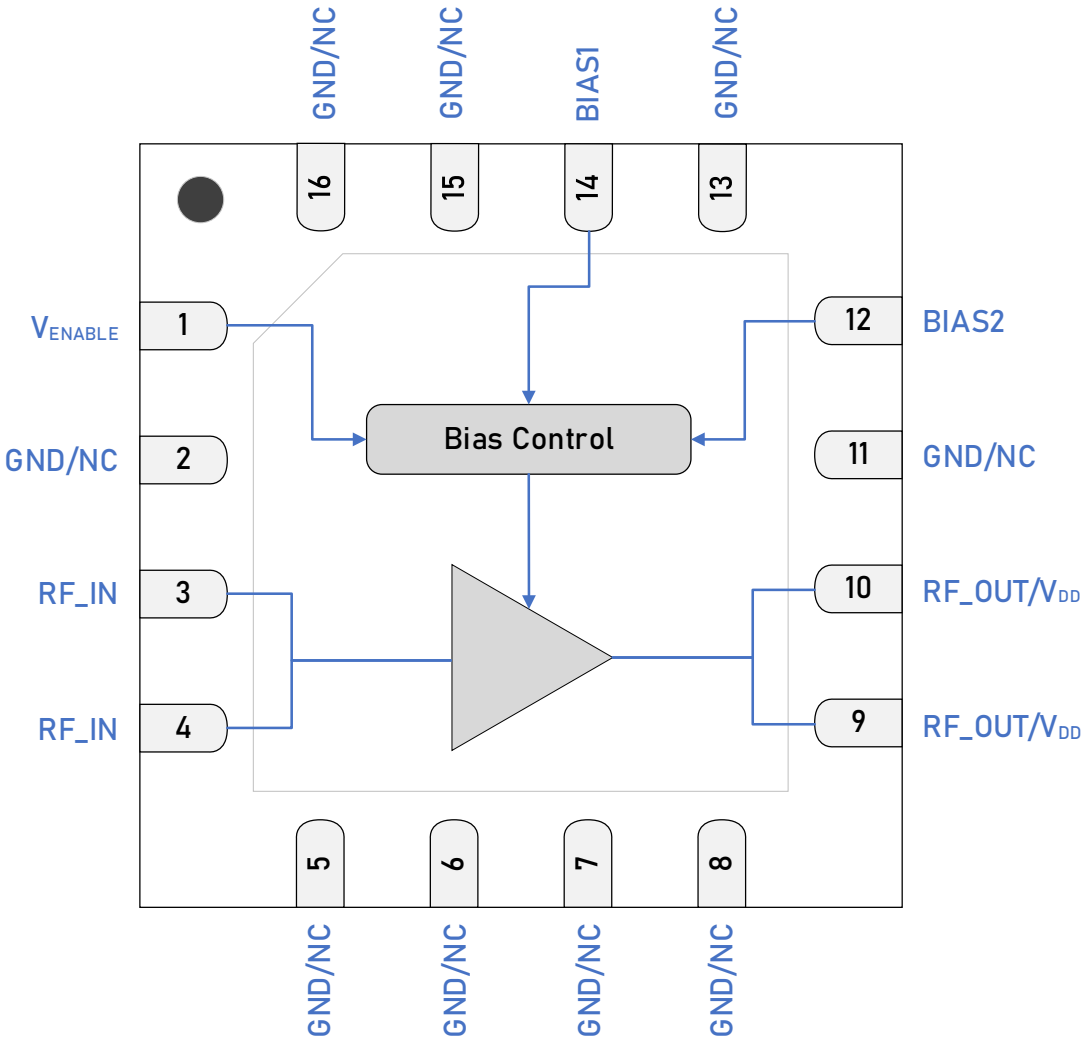
The device can be tuned over a wide range of frequencies from around 470 MHz to 3900 MHz.

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 GRF5110 "Custom Tunes" product page: GRF5110 Custom Tunes

BLOCK DIAGRAM





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.
2, 5, 6, 7, 8, 11, 13, 15, 16	GND/NC	Ground or No Connect	No internal connection to die. We recommend connecting these pins to ground.
3, 4	RF_IN	RF Input	Pins 3 & 4 tied together on system board.
9, 10	RF_OUT/V_{DD}	PA Output	Pins 9 & 10 tied together on system board.
12	Bias2	Bias Circuit Supply	Connect to V_{DD} through external resistor.
14	Bias1	Bias Circuit Ground	Consult application schematic.
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
Drain Voltage	V_{DD}		6	V
Transient Average RF Input Power: Load VSWR < 2:1, Duration: <1 hour, $T_{PKG\ BASE}$ = -40 to 85 °C.	$P_{IN\ MAX}$		24	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	W

Electrostatic Discharge

Charged Device Model	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 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. For additional information, please refer to the *Certificate of RoHS Compliance.*

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Recommended Operating Conditions

Parameter	Symbol	Specification			Unit	Condition
		Min.	Typ.	Max.		
Supply Voltage	V_{DD}		5		V	
Operating Temperature (package base)	$T_{PKG\ BASE}$	-40		105	°C	
RF Frequency Range	F_{RF}	470	1900	3900	MHz	Typical application schematic using the 1.85 to 2.0 GHz tuning set **(note 1)**.
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: GRF5110 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 1.85 to 2.0 GHz tuning set. V_{DD} = 5 V, I_{DDQ} = 150 mA, F_{TEST} = 1.9 GHz, M1= 5.5 kΩ, $T_{PKG\ BASE}$ = -40 to 105 °C. Evaluation board losses are included within the specifications.

Parameter	Symbol	Specification			Unit	Condition
		Min.	Typ.	Max.		
Supply Quiescent Current	I_{DDQ}	100	150	190	mA	V_{DD} = 5 V, V_{ENABLE} = 5 V, R_{BIAS} = 5.5 kΩ.
Enable Current	I_{ENABLE}		2		mA	
Operating Temperature Range	$T_{PKG\ BASE}$	-40		105	°C	Measured on package base.
Switching Rise Time	T_{RISE}		100		ns	Bypass mode to Gain mode **(note 3)**.
Switching Fall Time	T_{FALL}		800		ns	Gain mode to Bypass mode **(note 4)**.

Disabled Mode

Leakage Current	I_{DD}		30		µA	V_{DD} = 5 V, V_{ENABLE} = 0 V.

Thermal Data

Thermal Resistance (Infrared Scan)	Θ_{JC}		80		°C/W	On standard evaluation board **(note 5)**.

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 °C.

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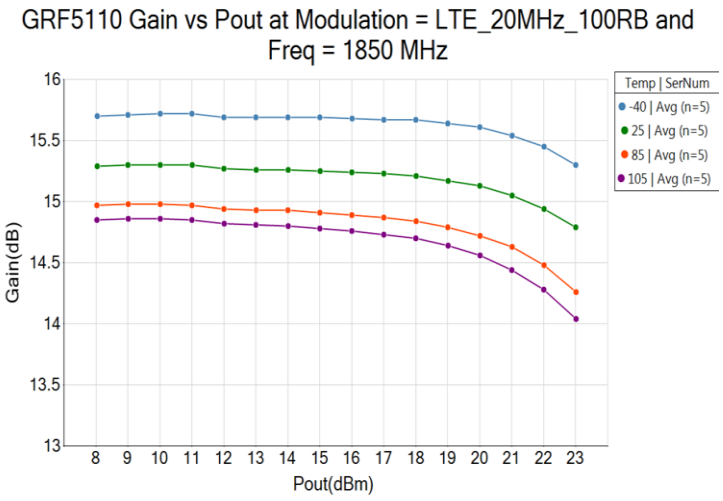
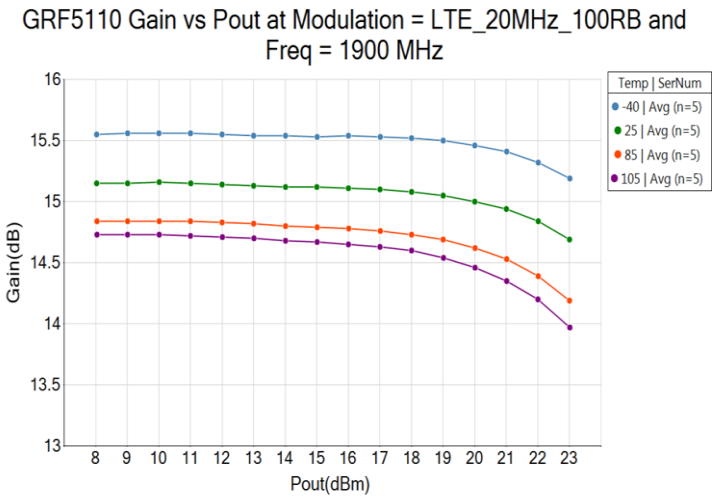
Nominal Operating Parameters – RF

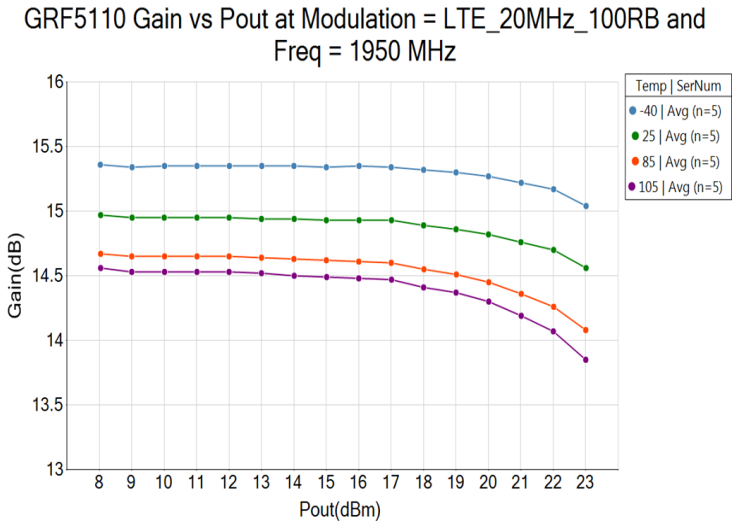
The following conditions apply unless noted otherwise: typical application schematic using the 1.85 to 2.0 GHz tuning set. V_{DD} = 5 V, I_{DDQ} = 150 mA, F_{TEST} = 1.9 GHz, M1= 5.5 kΩ, $T_{PKG\ BASE}$ = -40 to 105 °C. Evaluation board losses are included within the specifications.

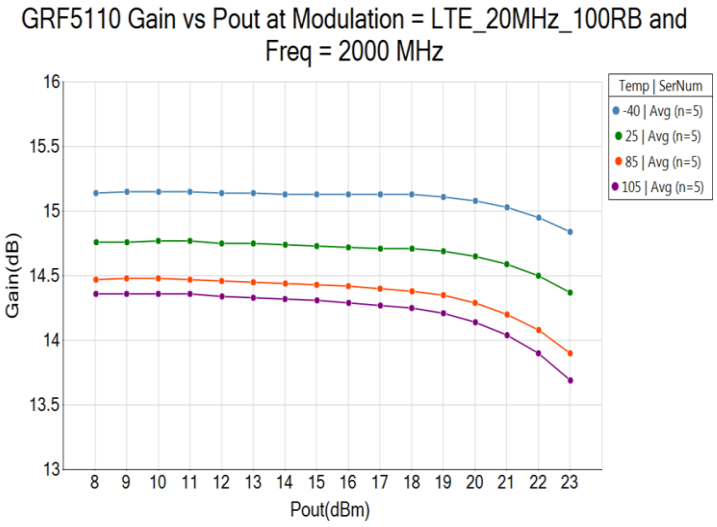
Parameter	Symbol	Specification			Unit	Condition
		Min.	Typ.	Max.		
Small Signal Gain	S21	14	15		dB	V_{DD} = 5 V, F_{TEST} = 1.9 GHz.
Reverse Isolation	S12		< -19		dB	F_{RF} = 1.85 to 2.0 GHz.
Noise Figure	NF		0.9		dB	On standard evaluation board.
Output 3rd Order Intercept Point	OIP3		46		dBm	8 dBm P_{OUT} per tone at 2 MHz spacing (1899 and 1901 MHz).
Output 1 dB Compression Power	OP1dB	27.3	28.5		dBm	

GRF5110 Typical Operating Curves: Gain vs. P_{OUT} (9.8 dB PAR)

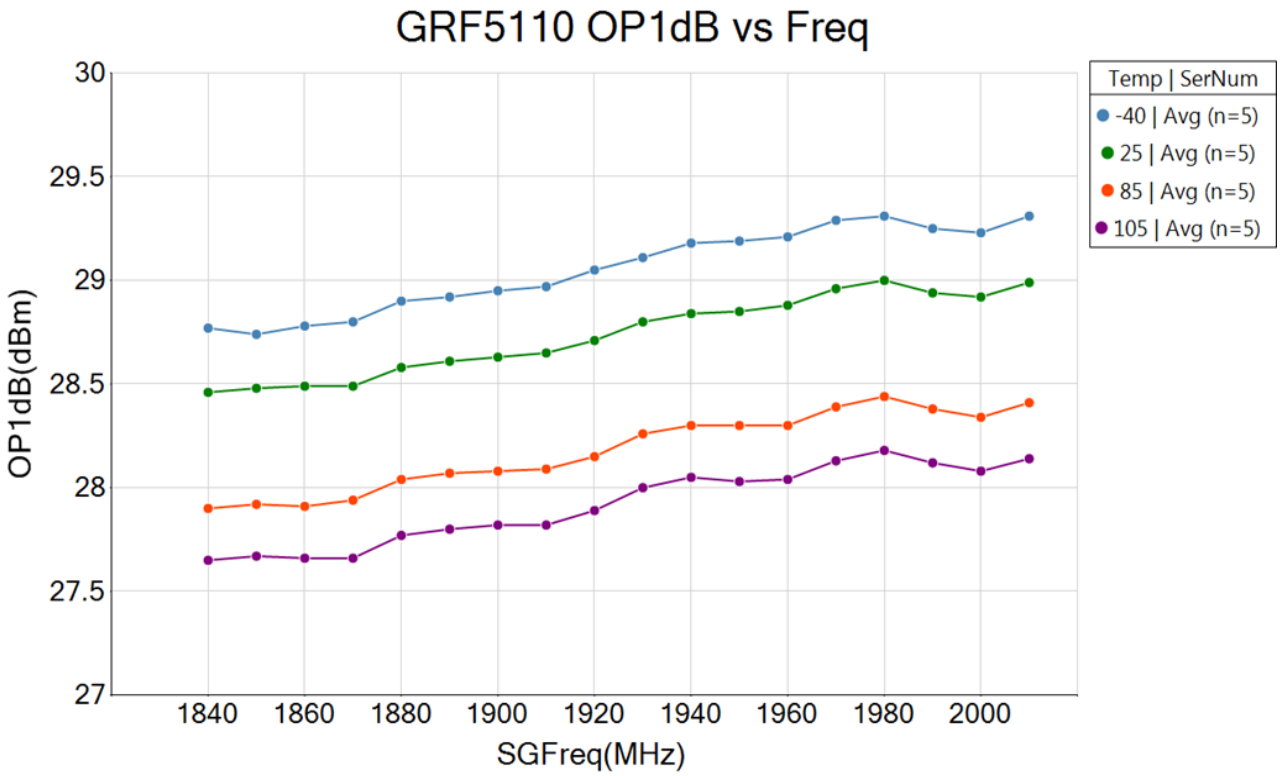




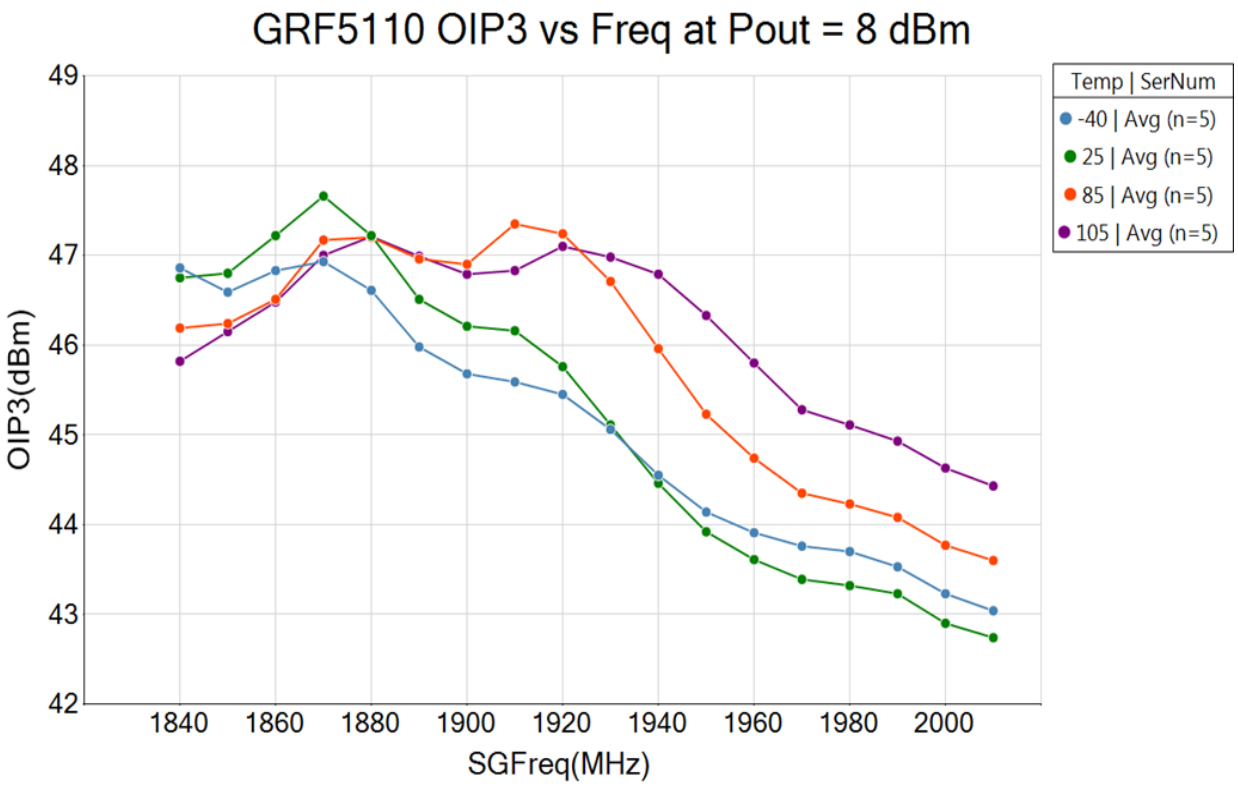




GRF5110 Typical Operating Curves: OP1dB vs. Frequency



GRF5110 Typical Operating Curves: OIP3 vs. P_{OUT}



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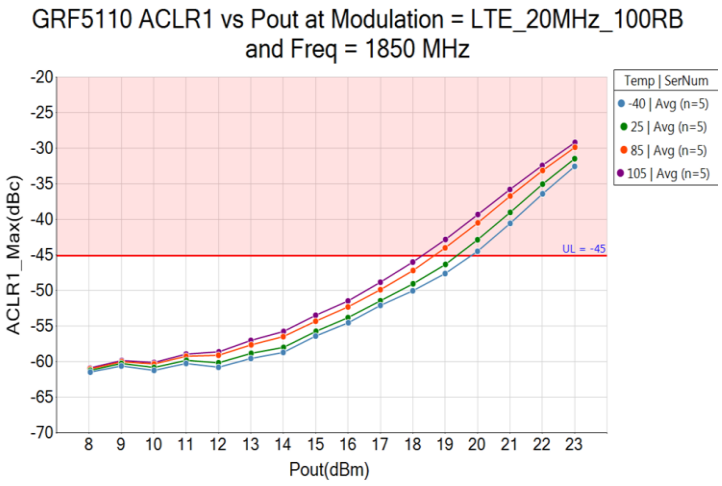
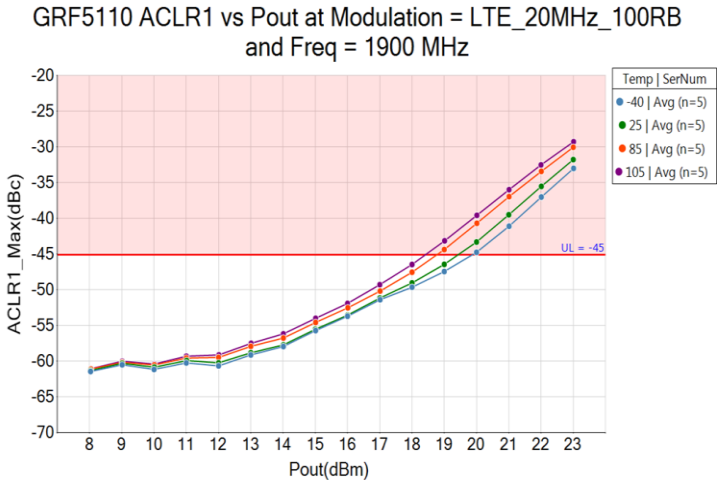
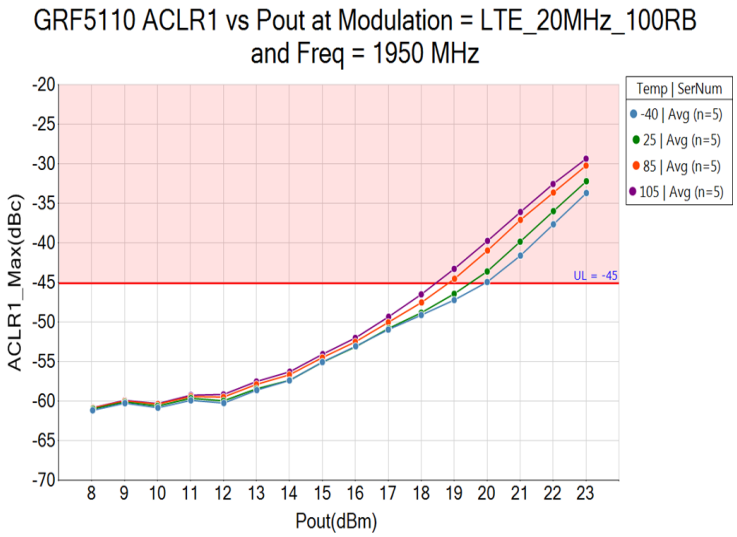
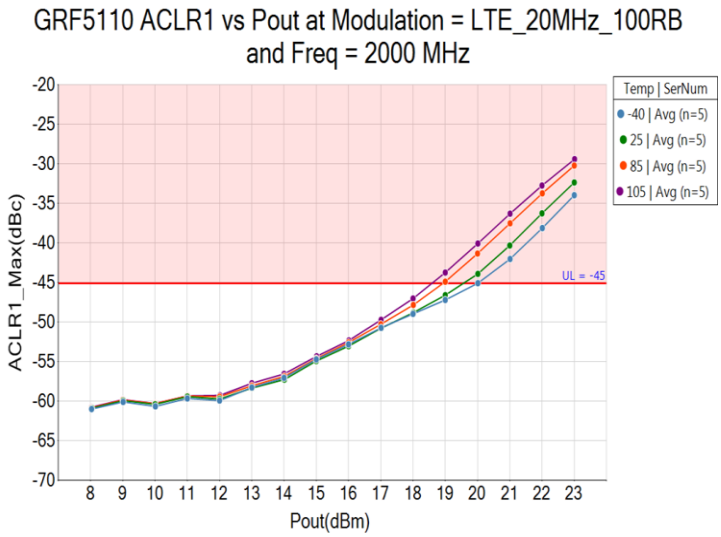
GRF5110 Typical Operating Curves: ACLR vs. P_{OUT} (9.8 dB PAR)

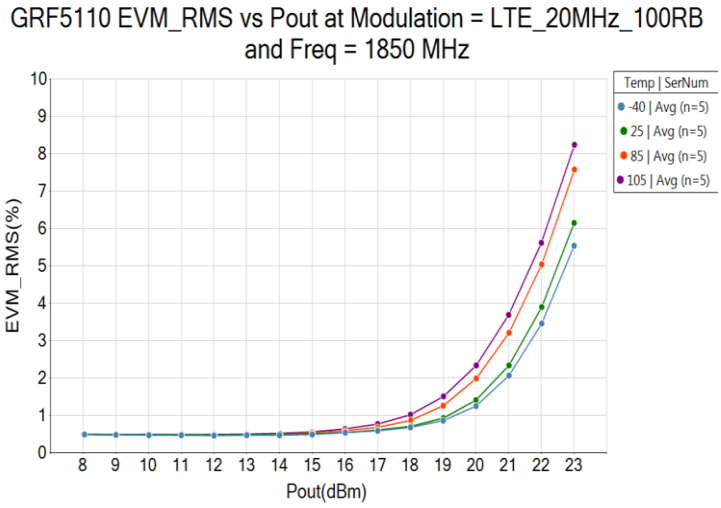


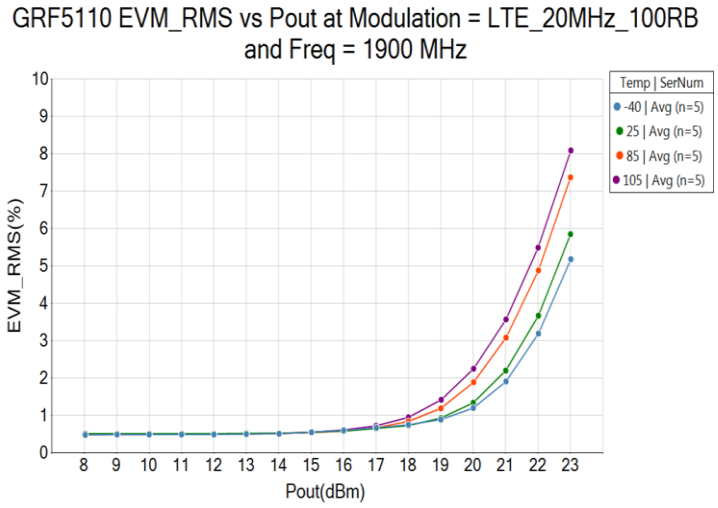


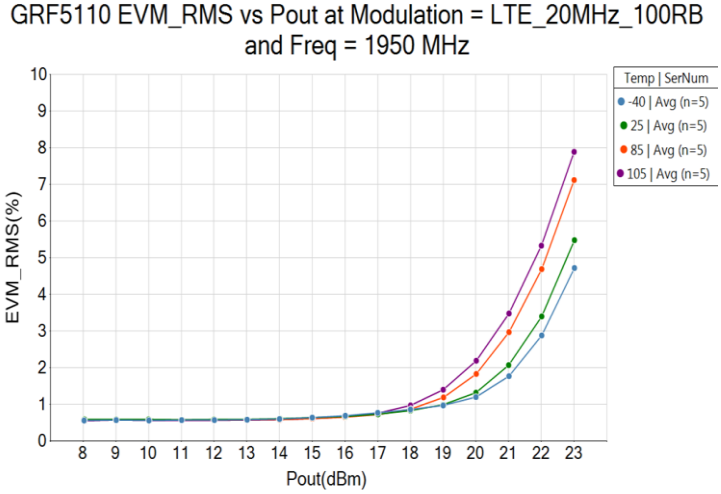


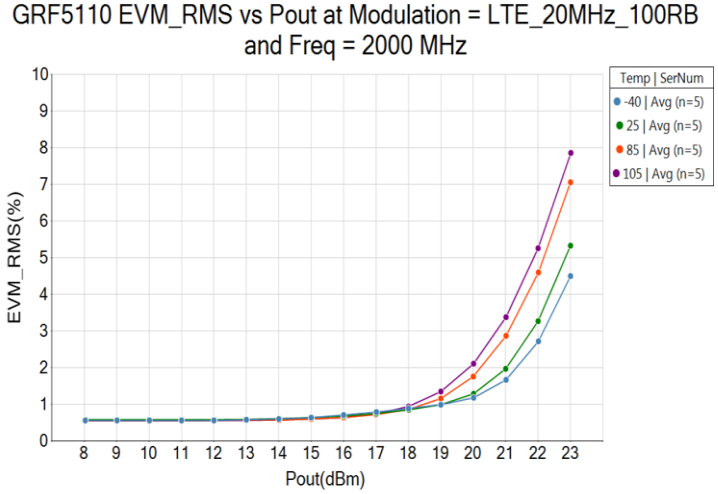


GRF5110 Typical Operating Curves: EVM vs. P_{OUT} (9.8 dB PAR)

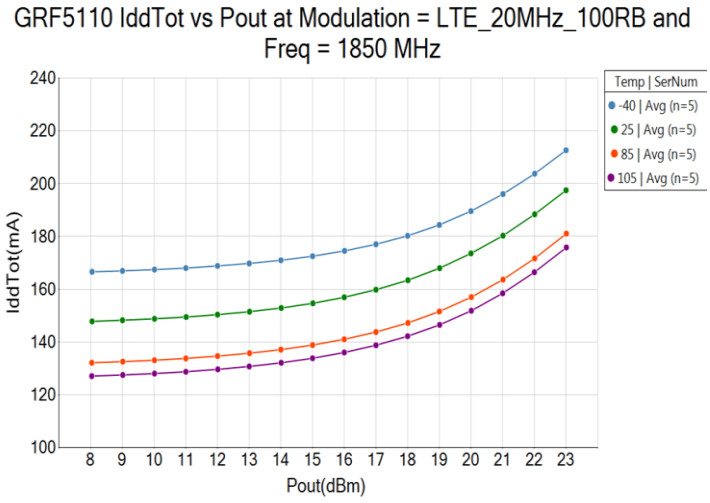


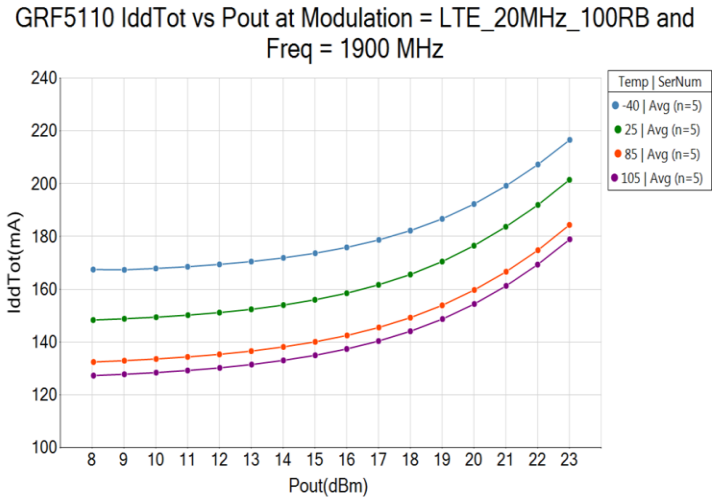


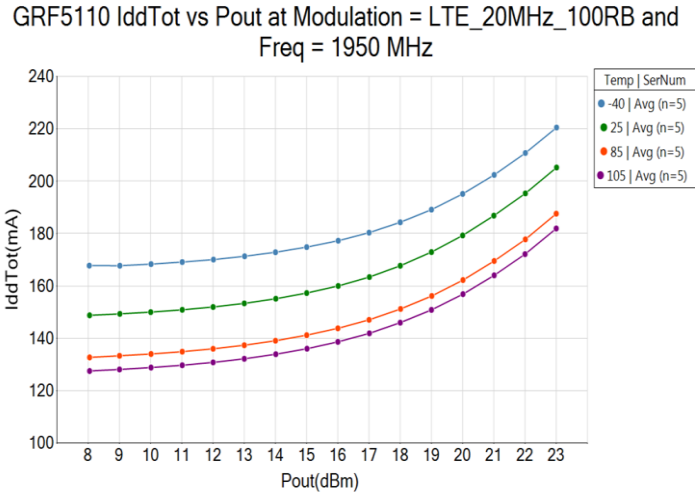


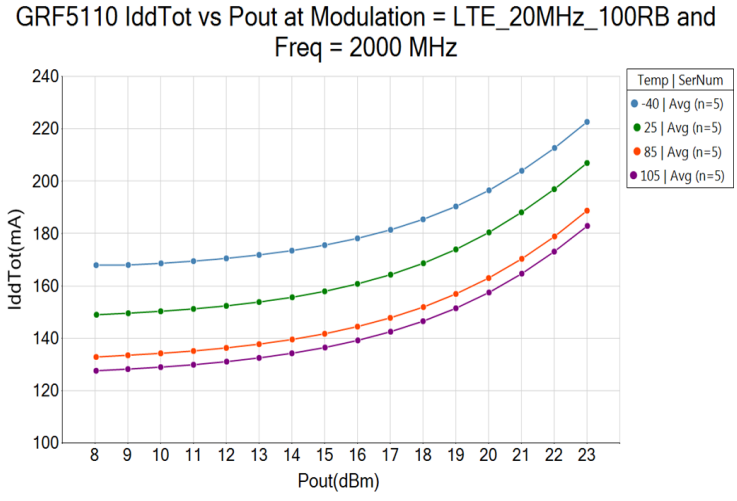


GRF5110 Typical Operating Curves: $I_{DD}T_{OT}$ vs. P_{OUT} (9.8 dB PAR)

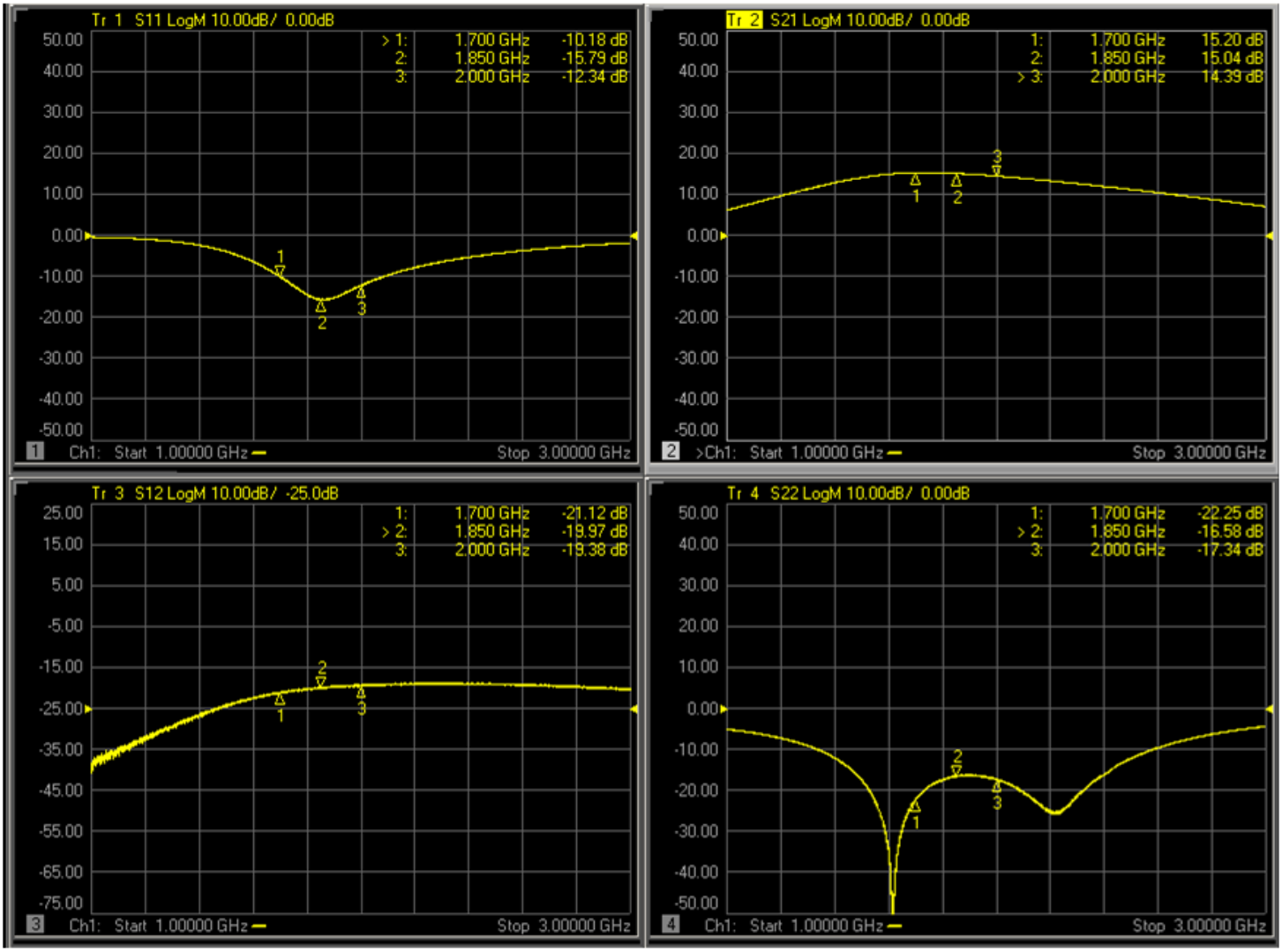








GRF5110 Typical Operating Curves: S-Parameters (1.7 to 2.0 GHz Tune)



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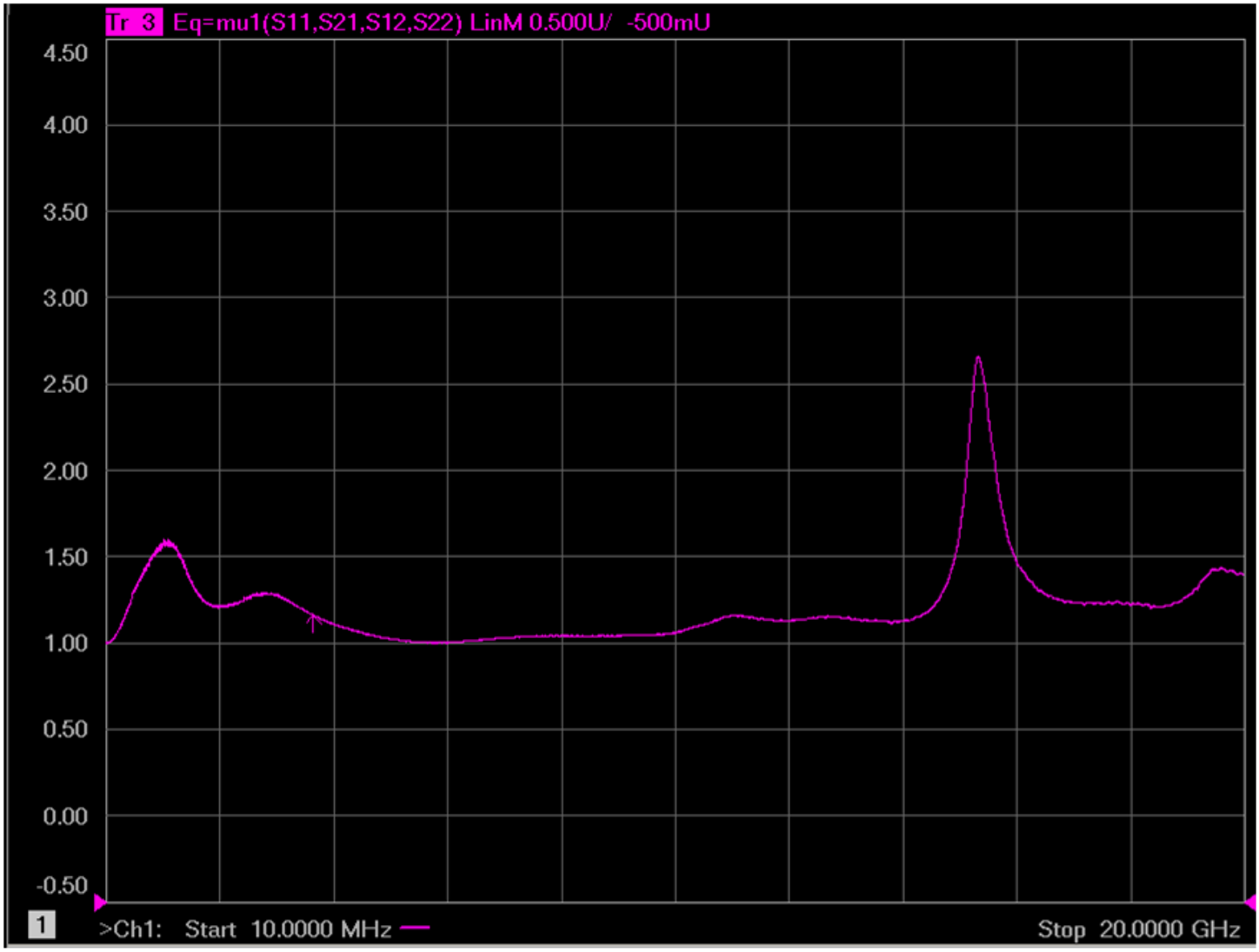
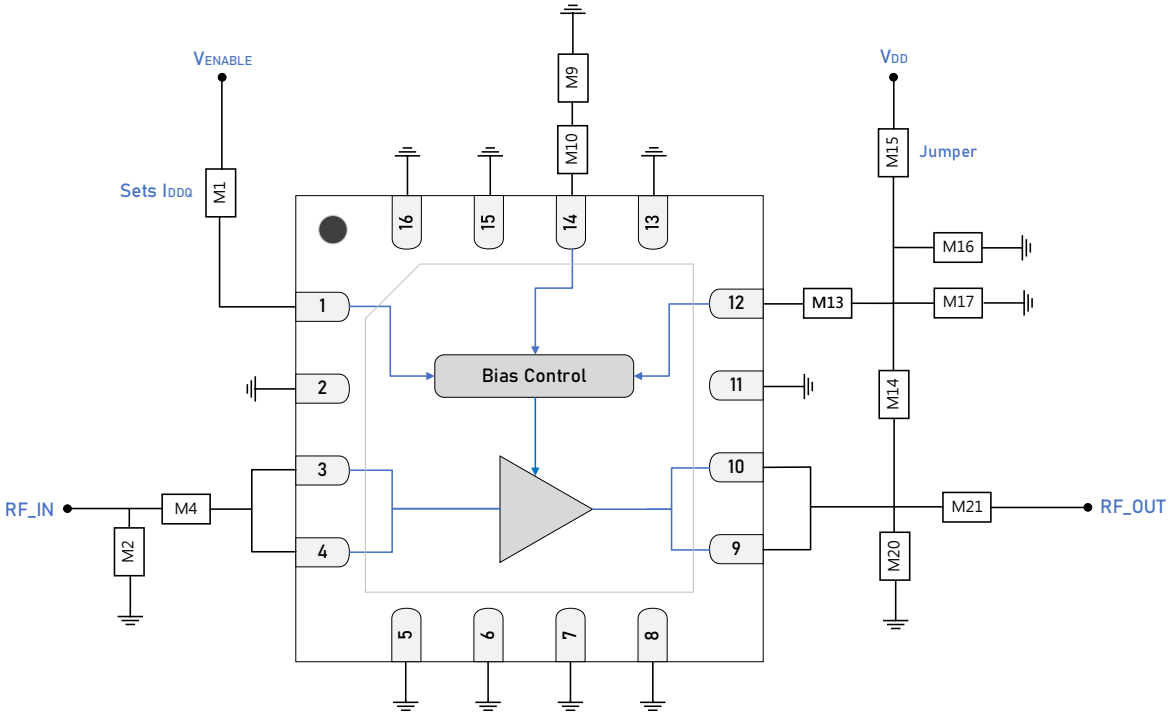
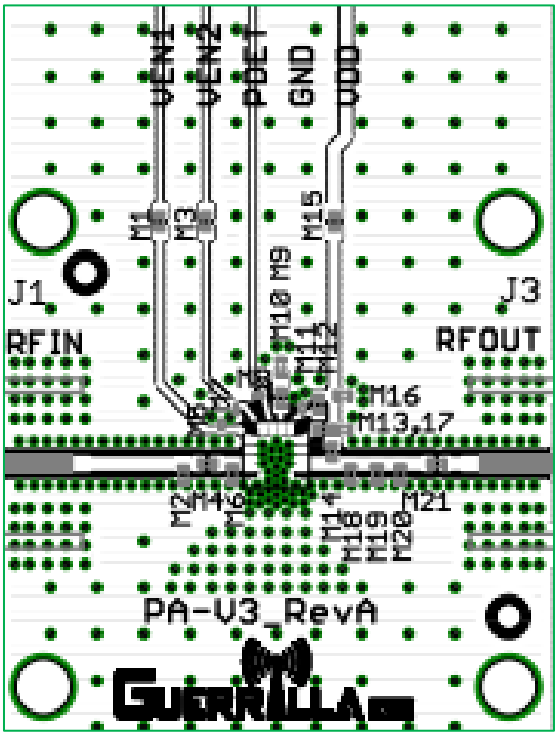
GRF5110 Typical Operating Curves: Mu Factor (10 MHz to 20 GHz)



Note: Mu Factor ≥ 1.0 implies unconditional stability.



GRF5110 Standard Evaluation Board Schematic



GRF5110 Evaluation Board Assembly Diagram

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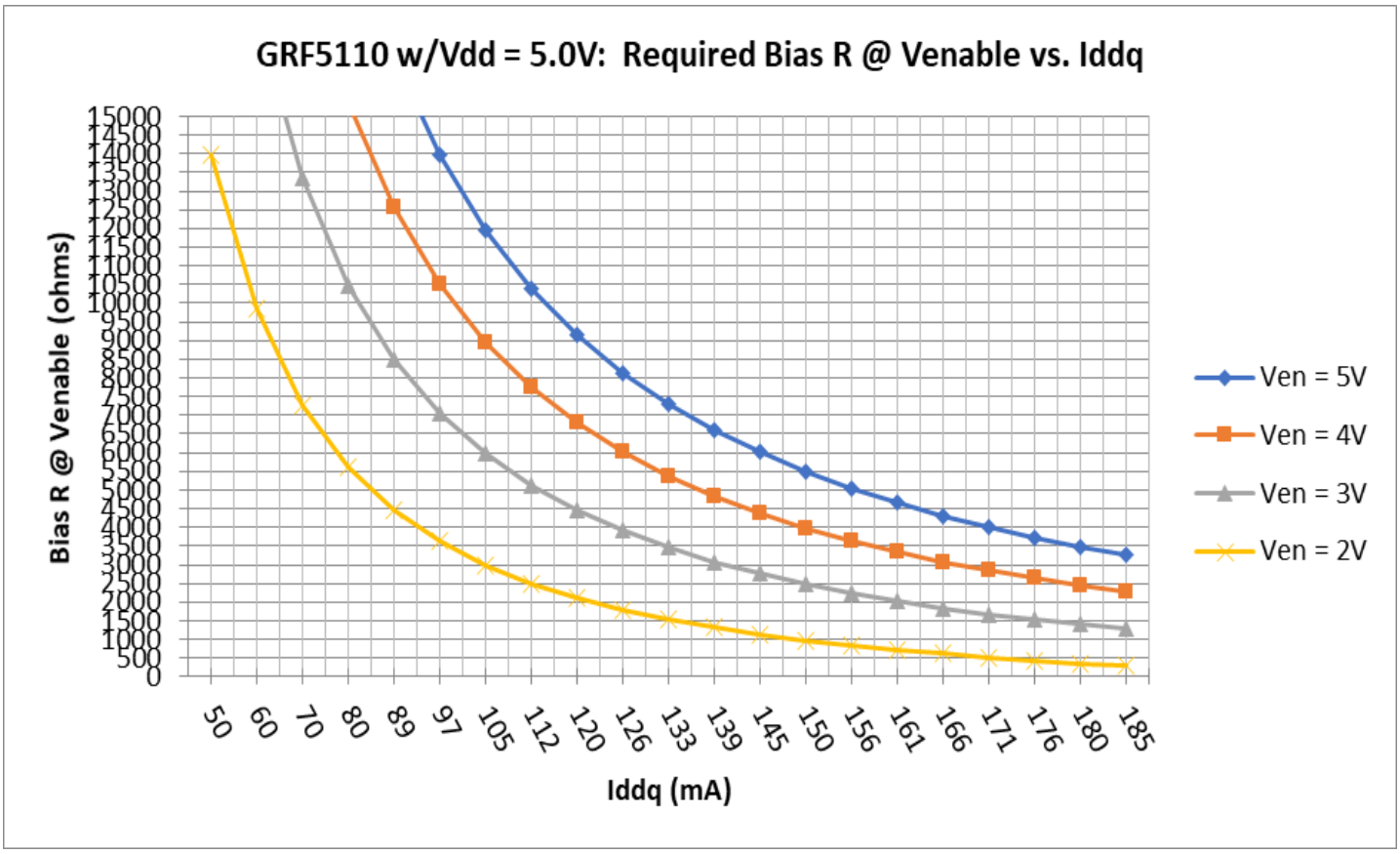
GRF5110 Evaluation Board Assembly Diagram Reference

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	2.7 nH	0402	ok
M4	Capacitor: High Q	Murata	GJM	2.0 pF	0402	ok
M9	Resistor	Various	5%	0 Ohm	0402	ok
M10	Inductor	Murata	LQP/LQG	12 nH	0402	ok
M13	Resistor	Various	5%	0 Ohm	0402	ok
M14	Inductor: High Q	Coilcraft	HP	18 nH	0402	ok
M15	Resistor (jumper)	Various	Various	0 Ohm	0402	ok
M16	Capacitor	Murata	GRM	0.1 uF	0402	ok
M17	Capacitor	Murata	GRM	100 pF	0402	ok
M20	Capacitor	Murata	GJM	1.5 pF	0402	ok
M21	Capacitor	Murata	GJM	10 pF	0402	ok
Evaluation Board	PA-V3_RevA					

GRF5110 Bias Resistor Selection Curves



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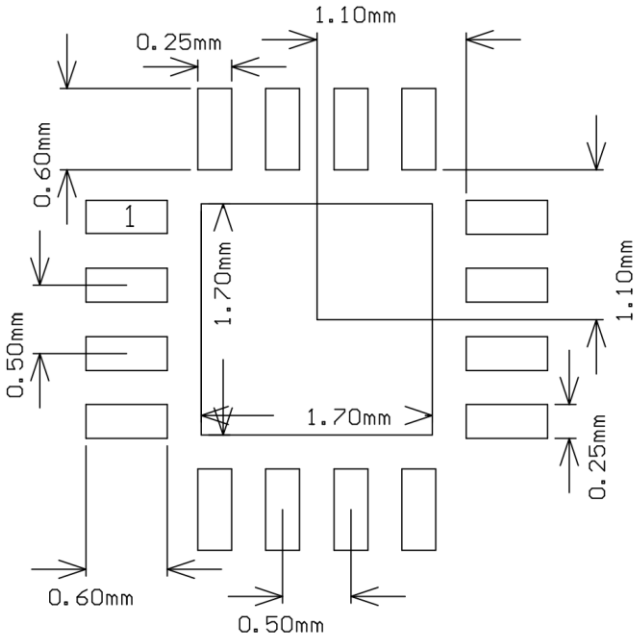
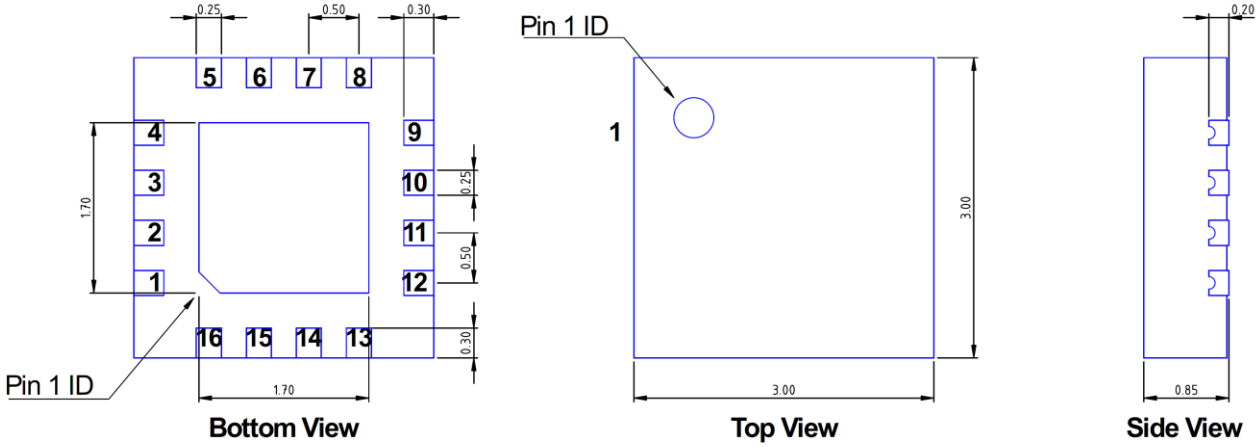


3 x 3 mm QFN-16 Suggested PCB Footprint (Top View)



3 x 3 mm QFN-16 Package Dimensions

Package Marking Diagram

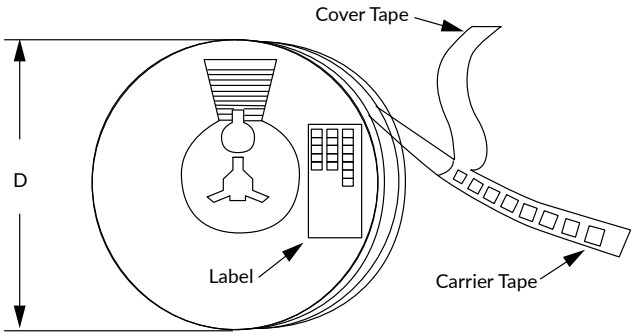
- Line 1: "XXXX" = PART NUMBER.
- Line 2: "YY" = YEAR. "WW" = WORK WEEK the device was assembled.

Tape and Reel Information

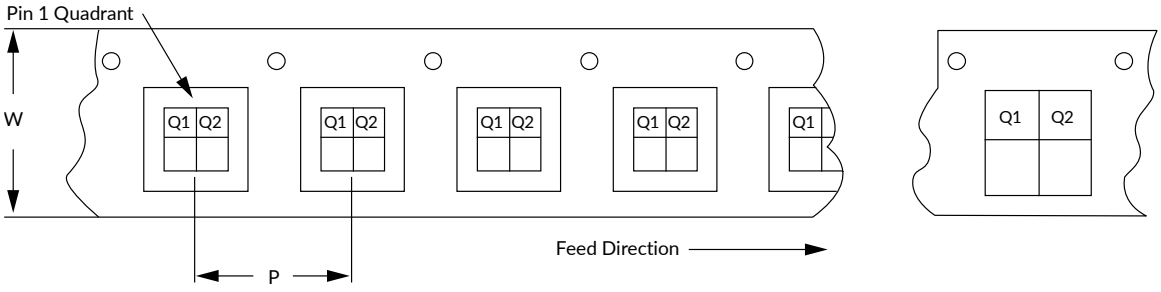
Guerrilla RF's tape and reel specification complies with Electronic Industries Alliance (EIA) standards for "Embossed Carrier Tape of Surface Mount Components for Automatic Handling" (reference EIA-481). See the following page for the Tape and Reel Specification and Device Package Information table, 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
April 11, 2018	Release Ø Data Sheet.
May 24, 2021	Releaae A Data Sheet. Converted Data Sheet to new format. Added typical operating curves.
March 3, 2025	Upgraded Data Sheet with cosmetic changes only. No change to device or device specifications.
June 9, 2025	Extended frequency range from 1500 - 3800 MHz to 470 - 3900 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.