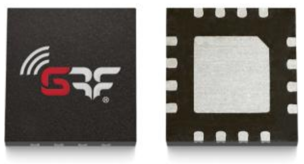
DATA SHEET

RELEASE 0 DATA SHEET



GRF5236

High Gain Linear Driver
3.1 to 4.2 GHz

FEATURES

- 1 dB Typical Gain Flatness (3.3 to 4.2 GHz) with a Single Tune
- Excellent Linearity Performance Over Wide Bandwidths
- Flexible Biasing Provides Latitude for Linearity Optimization
- 95 mA Native Mode Quiescent Current Consumption
- 50 Ω Single-Ended Input and Output Impedances
- -40 to 115 °C Operating Temperature Range
- Compact 3 x 3 mm QFN-16 Package
- Process: InGaP HBT

Reference: 5 V / 95 mA / 3.8 GHz

- Gain: 36.7 dB
- OP1dB: 30.1 dBm
- OIP3: 33.8 dBm
- Evaluation Board Noise Figure: 4.1 dB

APPLICATIONS

- Linear Driver / Pre-Driver Amplifiers
- 5G Sub-6 GHz Massive MIMO Base Stations
- Small Cells and Cellular Repeaters
- Millimeter Wave IF Stages
- High-Performance RF Infrastructure

DESCRIPTION

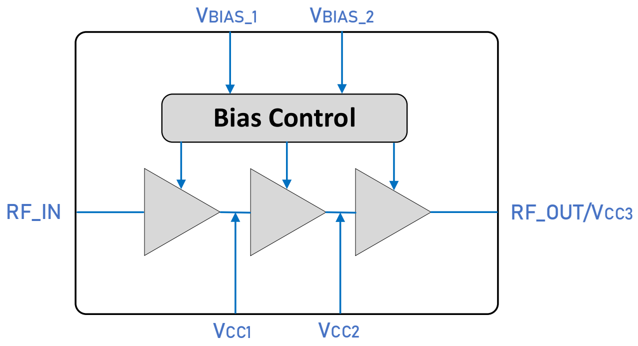
The GRF5236 is a high-gain, three-stage driver amplifier targeting 3.3 to 4.2 GHz wireless infrastructure applications. The device delivers up to 30.1 dBm of OP1dB, 33.8 dBm of OIP3, and a low noise figure (NF) of less than 4.1 dB over its targeted band of operation. OP1dB can be tuned down to 3.1 GHz, but the high frequency of the rated operating range will degrade.

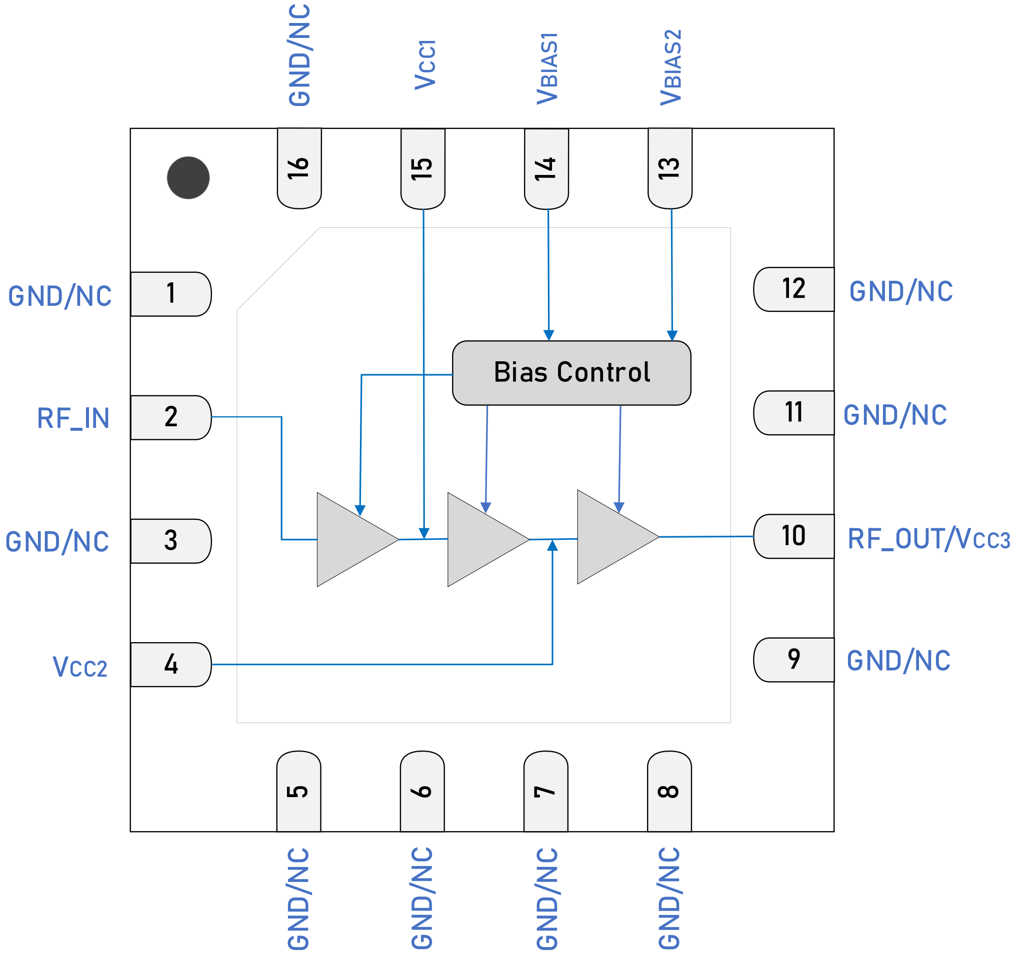
For optimal efficiency and linearity, the amplifier was designed to operate with a single 5 volt supply voltage while using only 85-105 mA of quiescent current. 3.3 volt supply voltages can also be used while still yielding 26.3 dBm of OP1dB. If desired, I_{CCQ} can be increased beyond the native biasing point for enhanced linearity performance.

The GRF5236 is designed for 50 Ω systems, typically needing only a two-element shunt-series match on the output port.

Additional tunes can be found on the GRF5236 “Custom Tunes” product page: GRF5236 Custom Tunes

BLOCK DIAGRAM





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

Pin Assignments

Pin	Name	Description	Note
1, 3, 5, 6, 7, 8, 9, 11, 12, 16	GND/NC	Ground or No Connect	No internal connection to die. These pins can be left unconnected or can be connected to ground (recommended). Use a via as close to the pin as possible if grounded.
2	RF_IN	RF Input	RF input is fully matched to 50 Ω and contains an internal DC blocking capacitor.
4	V_{CC2}	V_{CC} Bias Voltage	Pull up to V_{CC} through inductor and use bypass capacitors as close to the pin as possible. In addition to supplying the device with a DC voltage, there is also an RF signal present.
10	RF_OUT/V_{CC3}	RF Output/V_{CC3} Bias Voltage	V_{CC} must be applied through an RF choke to this pin.
13	V_{BIAS2}	2nd Bias Set	Connect via resistor to a common V_{CC}. V_{BIAS2} and series resistor sets I_{CCQ3}. Setting $V_{BIAS2} \leq 0.2$ volts will disable the final stage of the device.
14	V_{BIAS1}	1st Bias Set	Connect via resistor to a common V_{CC}. V_{BIAS1} and series resistor sets I_{CCQ1} and I_{CCQ2}. Setting $V_{BIAS1} \leq 0.2$ volts will disable the 1st and 2nd stage of the device.
15	V_{CC1}	V_{CC} Bias Voltage	Connect to a common V_{CC}. Place bypass capacitors as close to the pin as possible.
PKG BASE	GND	Ground	Provides DC and RF ground for the amplifier, 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_{CC}	3	5.5	V
RF Input Power: Load VSWR ≤ 2:1, all phase angles, V_{CC} = 5 V, CW Tone, 100% Duty Cycle, $T_{PKG\ BASE}$ = -40 to 115 °C.	$P_{IN\ MAX}$		23	dBm
Operating Temperature (package base).	$T_{PKG\ BASE}$	-40	115	°C
Maximum Junction Temperature (MTTF > 10^6 hours).	$T_{J\ MAX}$		190	°C
Maximum Dissipated Power Stage 1 (DC only, no RF applied).	$P_{DISS\ MAX}$		60	mW
Maximum Dissipated Power Stage 2 (DC only, no RF applied).	$P_{DISS\ MAX}$		190	mW
Maximum Dissipated Power Stage 3 (DC only, no RF applied).	$P_{DISS\ MAX}$		300	mW

Electrostatic Discharge

Charged Device Model	CDM	750		V
Human Body Model	HBM	1000		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.*

Recommended Operating Conditions

Parameter	Symbol	Specification			Unit	Condition
		Min.	**Typ.**	**Max.**		
Supply Voltage	V_{CC}	3	5	5.5	V	
RF Frequency Range	F_{RF}	3.3		4.2	GHz	**Notes 1 & 2.**
Operating Temperature (package base)	$T_{PKG\ BASE}$	-40		115	°C	
RF_IN Port Impedance	Z_{RF_IN}		50		Ω	
RF_OUT Port Impedance	Z_{RF_OUT}		50		Ω	

Note 1: Operation outside of this range is supported by using different custom tunes. Examples of other optimized tunes can be found here: GRF5236 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 3.3 to 4.2 GHz tuning set. V_{CC} = 5 V, R_{BIAS1} = 453 Ω, R_{BIAS2} = 2940 Ω, P_{OUT} = 4 dBm, F_{TEST} = 3.8 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.		
V_{BIAS1} Logic Input Low	V_{IL}	0		0.2	V	Measured at V_{BIAS1} node with bias-setting resistor in line between node and pin 14.
V_{BIAS1} Logic Input High	V_{IH}	1.5		V_{CC}	V	
V_{BIAS2} Logic Input Low	V_{IL}	0		0.2	V	Measured at V_{BIAS2} node with bias-setting resistor in line between node and pin 13.
V_{BIAS2} Logic Input High	V_{IH}	1.5		V_{CC}	V	
V_{BIAS1} Logic Low Current	I_{IL}		20		nA	V_{BIAS1} = 0.2 V.
V_{BIAS1} Logic High Current	I_{IH}		5.7		mA	V_{BIAS1} = 5 V.
V_{BIAS2} Logic Low Current	I_{IL}		30		nA	V_{BIAS2} = 0.2 V.
V_{BIAS2} Logic High Current	I_{IH}		0.7		mA	V_{BIAS2} = 5 V.
Standby Switching Rise Time	$t_{STBY-RISE}$		120		ns	Turn ON time: V_{BIAS1} and V_{BIAS2} Low to High **(note 3)**.
Standby Switching Fall Time	$t_{STBY-FALL}$		15		ns	Turn OFF time: V_{BIAS1} and V_{BIAS2} High to Low **(note 4)**.

Disabled Mode

Standby Current	I_{STBY}		145		nA	V_{CC} = 5 V, V_{BIAS1} = V_{BIAS2} = 0 V.

Thermal Data

Thermal Resistance (Infrared Scan)	Θ_{JC}		71		°C/W	On standard evaluation board.
Junction Temperature at 115 °C (reference package base).	$T_{JUNCTION}$		171		°C	V_{CC} = 5 V, I_{CCQ} = 115 mA, P_{DISS} = 600 mW. No RF applied **(note 5)**.

Note 3: Switching Rise Time: 50% of V_{BIAS} to 90% of P_{OUT}.

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

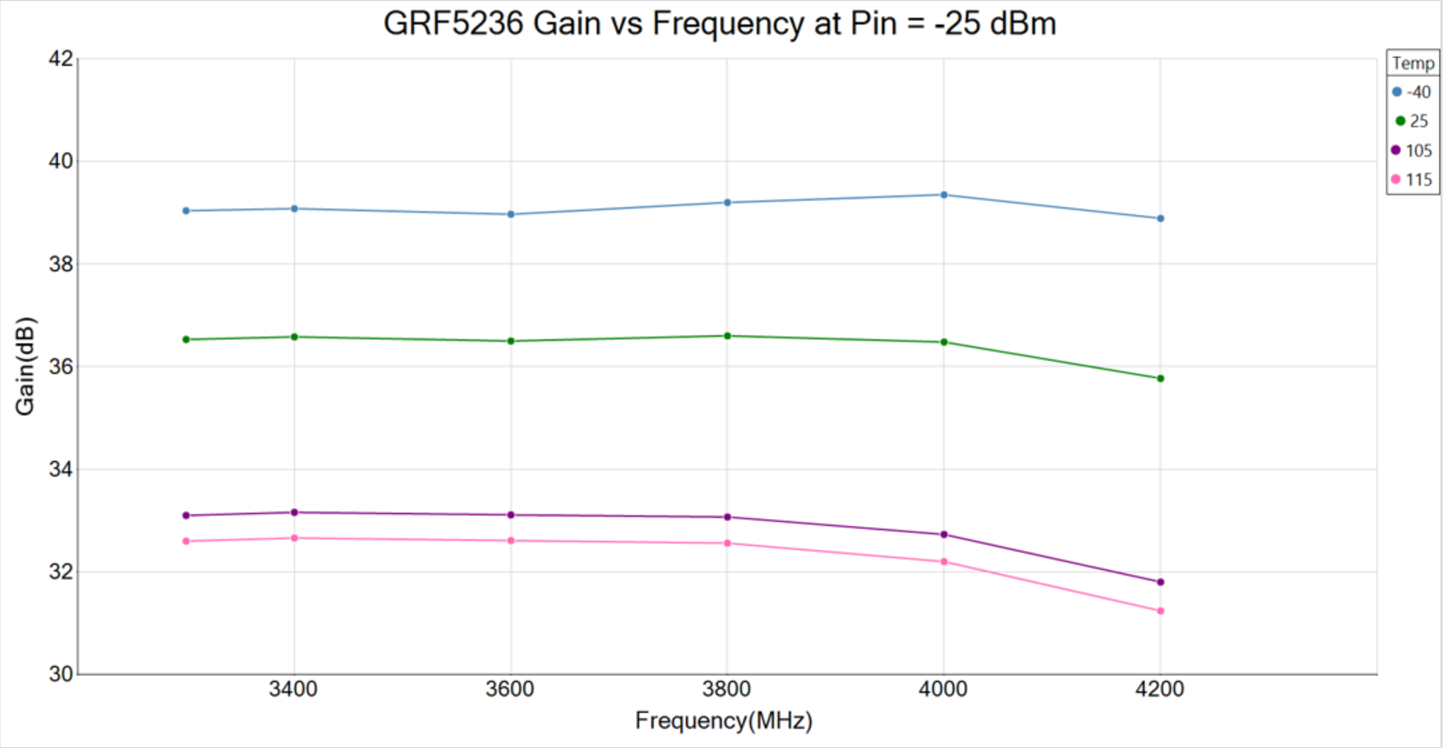
Note 5: MTTF > 10^6 hours for $T_{JUNCTION}$ ≤ 190 °C.

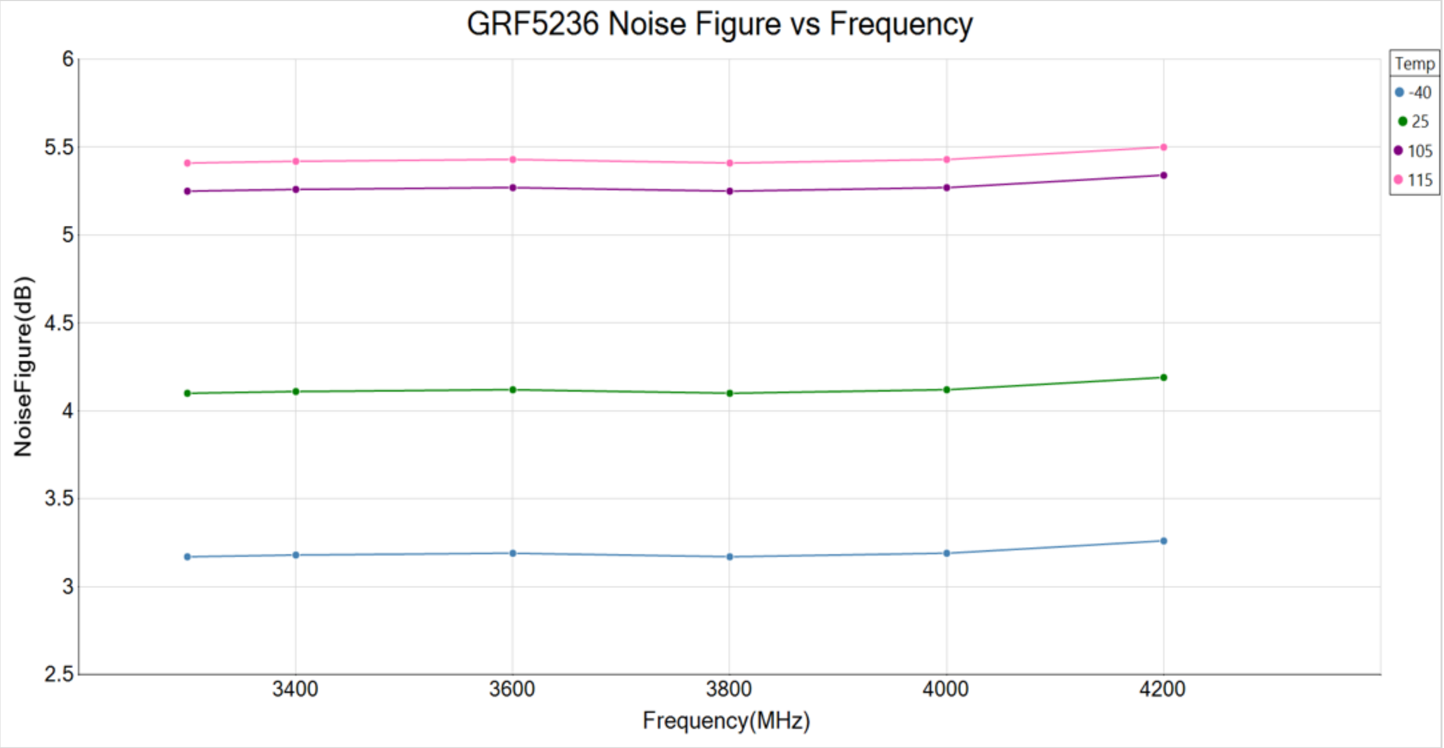
Nominal Operating Parameters – RF

The following conditions apply unless noted otherwise: typical application schematic using the 3.3 to 4.2 GHz tuning set. V_{CC} = 5 V, R_{BIAS1} = 453 Ω, R_{BIAS2} = 2940 Ω, P_{OUT} = 4 dBm, F_{TEST} = 3.8 GHz, 50 Ω system impedance, $T_{PKG\ BASE}$ = 25 °C. Evaluation board losses are included within the specifications.

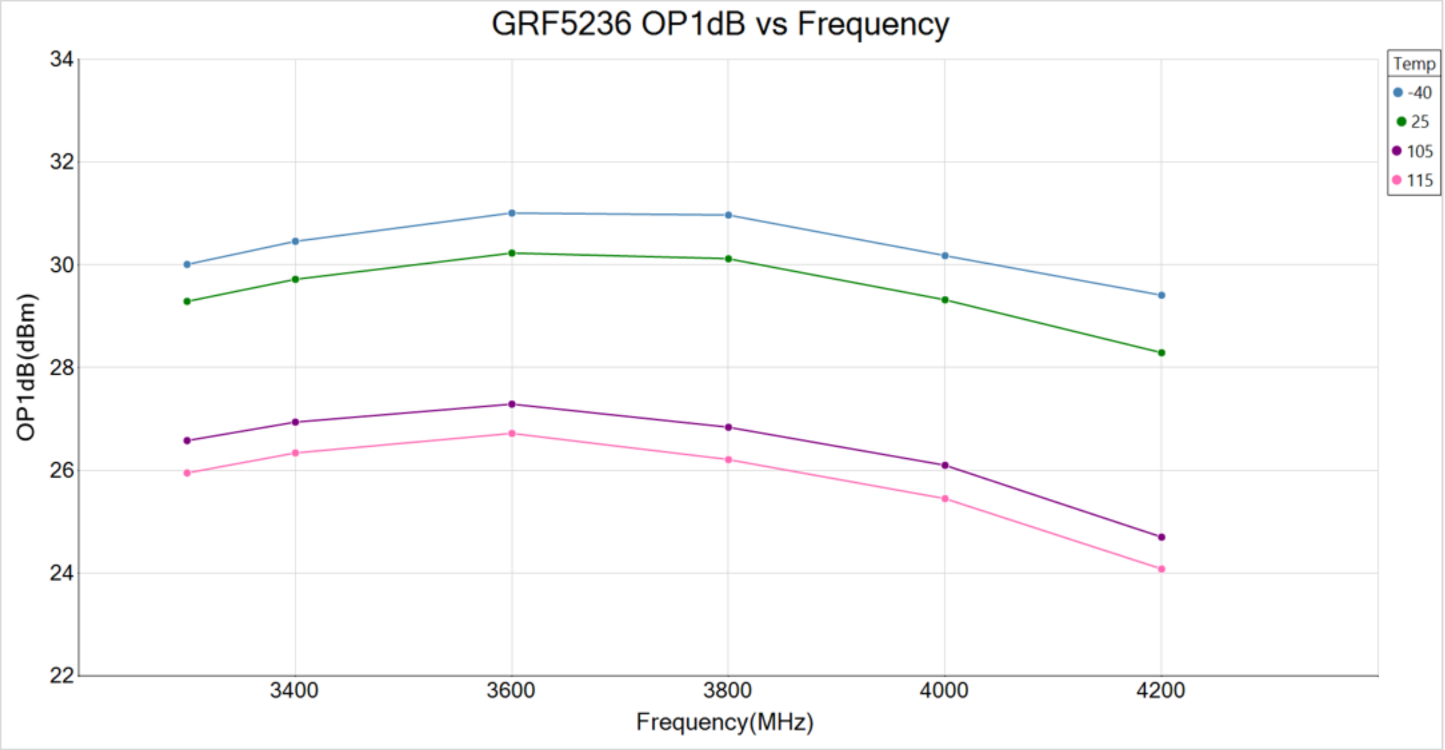
Parameter	Symbol	Specification			Unit	Condition
		Min.	Typ.	Max.		
Supply Current (Quiescent)	I_{CCQ}		95		mA	
Supply Current with RF applied	I_{CC}		116		mA	P_{OUT} = 14 dBm.
Gain	S21		36.7		dB	
Gain Flatness	$S21_{FLAT}$		0.8		dB	F_{RF} = 3.3 to 4.2 GHz.
Gain (Standby Mode)	$S21_{STBY}$		-46		dB	V_{BIAS1} < 0.2 V, V_{BIAS2} < 0.2 V.
Input Return Loss	S11		-13		dB	F_{RF} = 3.3 to 4.2 GHz.
Output Return Loss	S22		-3.4		dB	F_{RF} = 3.3 to 4.2 GHz.
Reverse Isolation	S12		-48		dB	F_{RF} = 3.3 to 4.2 GHz.
Noise Figure	NF		4.1		dB	On standard evaluation board.
Output 3rd Order Intercept Point	OIP3		33.8		dBm	P_{OUT} = 4 dBm per tone at 2 MHz spacing.
Output 1 dB Compression Power	OP1dB		30.1		dBm	

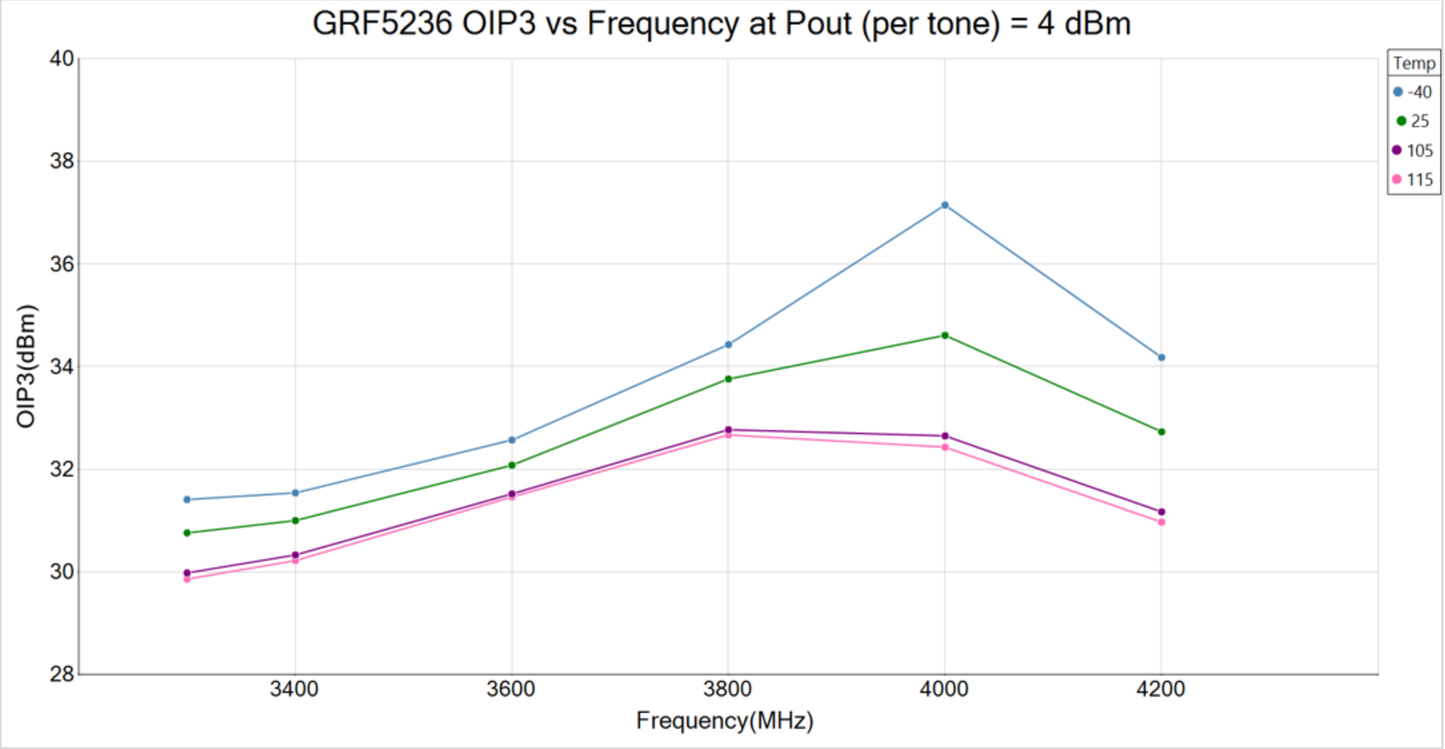
GRF5236 Typical Operating Curves: 5 V, 3.3 to 4.2 GHz Tune



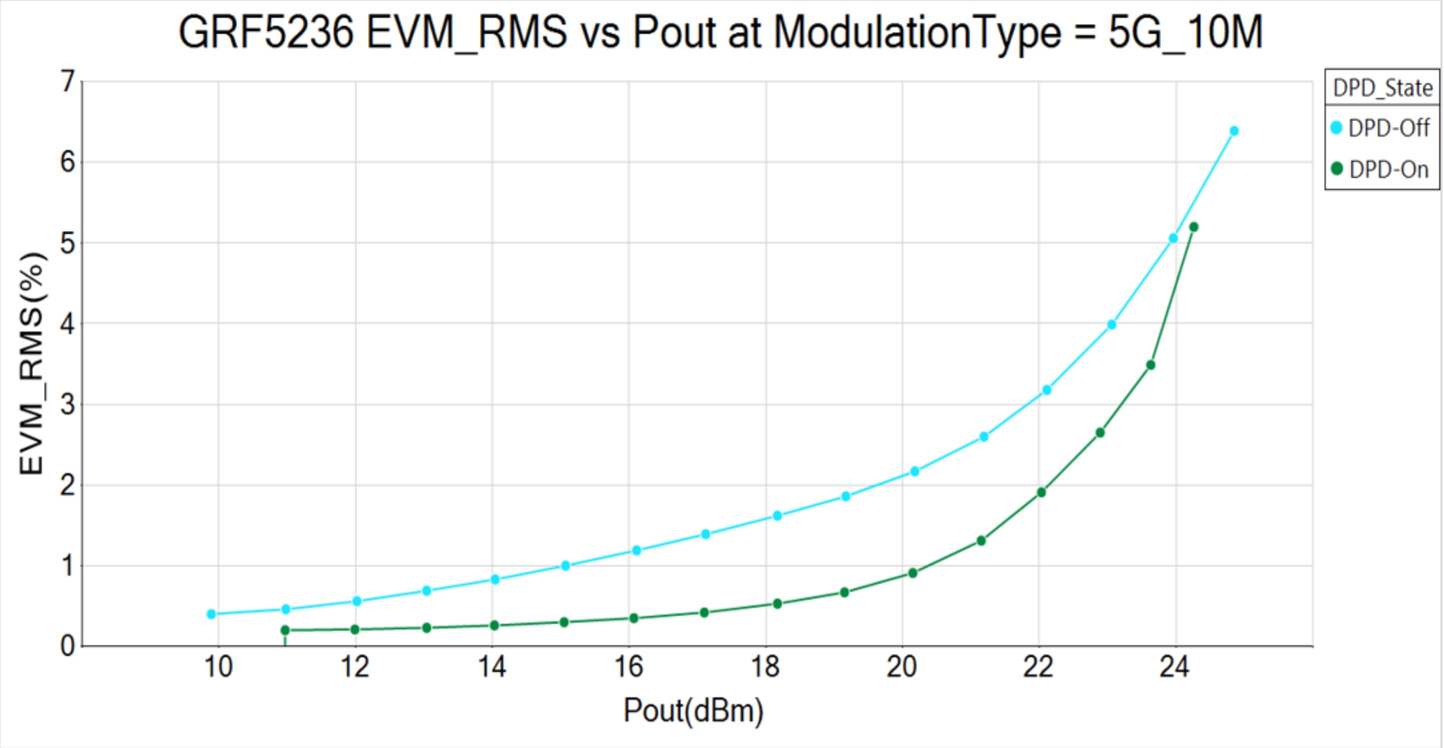


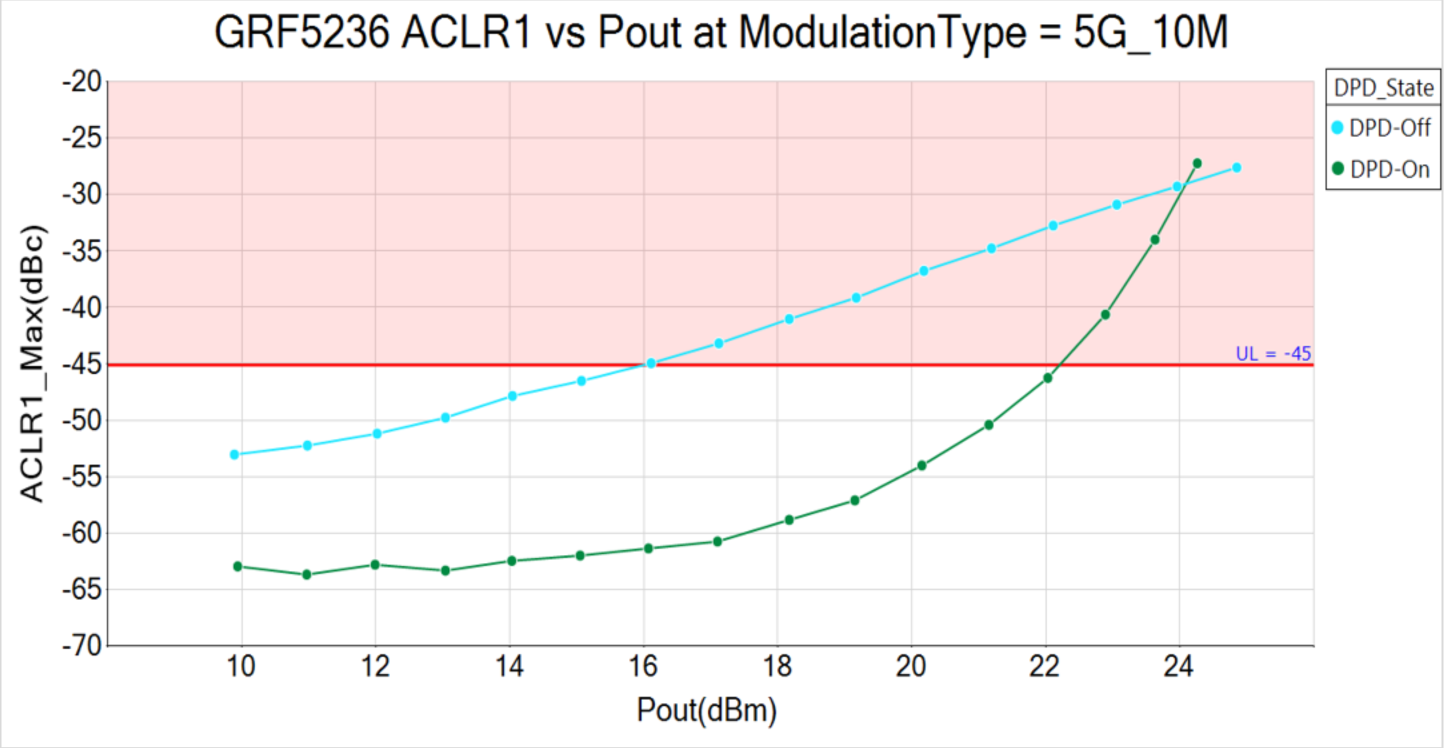
GRF5236 Typical Operating Curves: 5 V, 3.3 to 4.2 GHz Tune



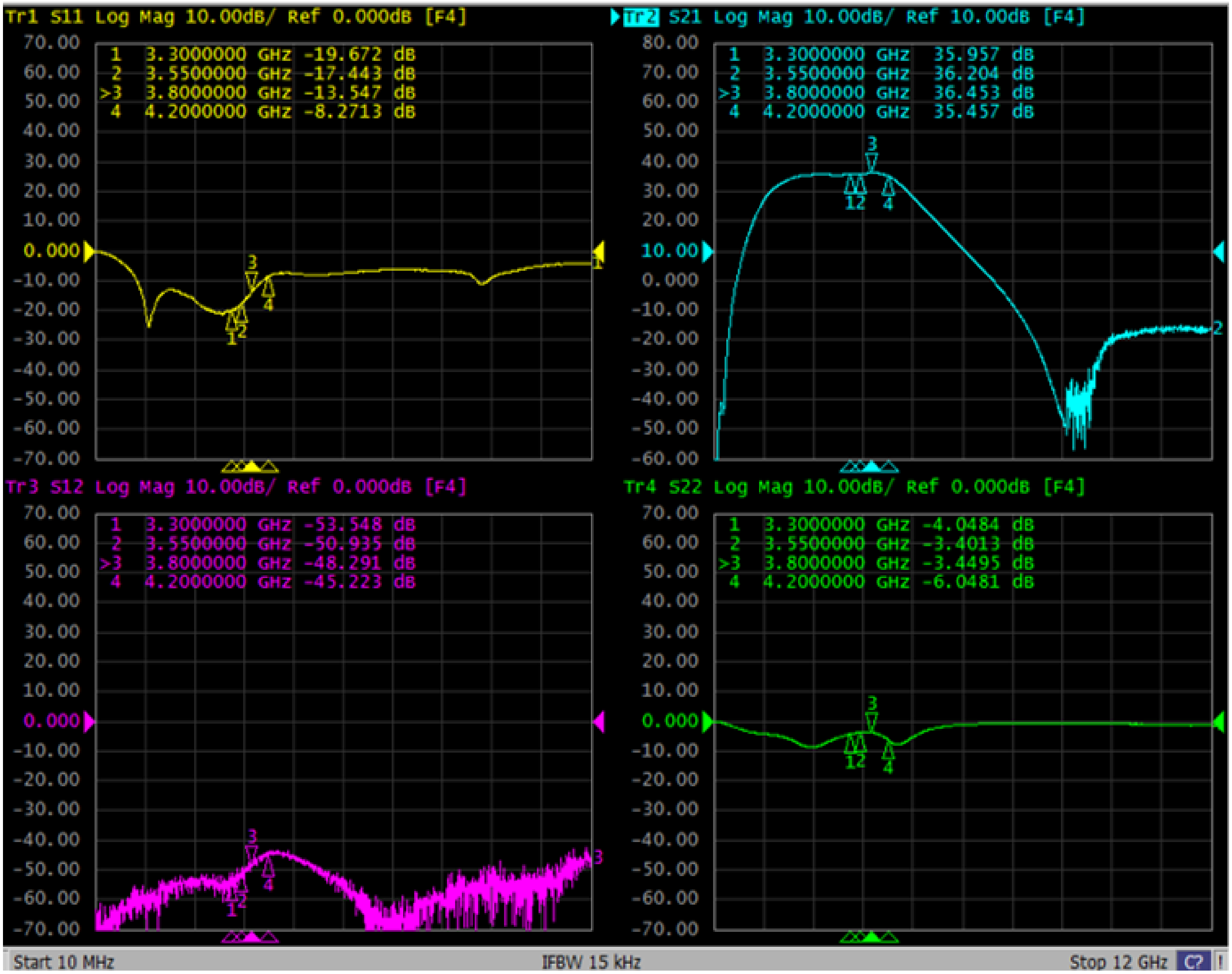


GRF5236 Typical Operating Curves: 5 V, 3.3 to 4.2 GHz Tune



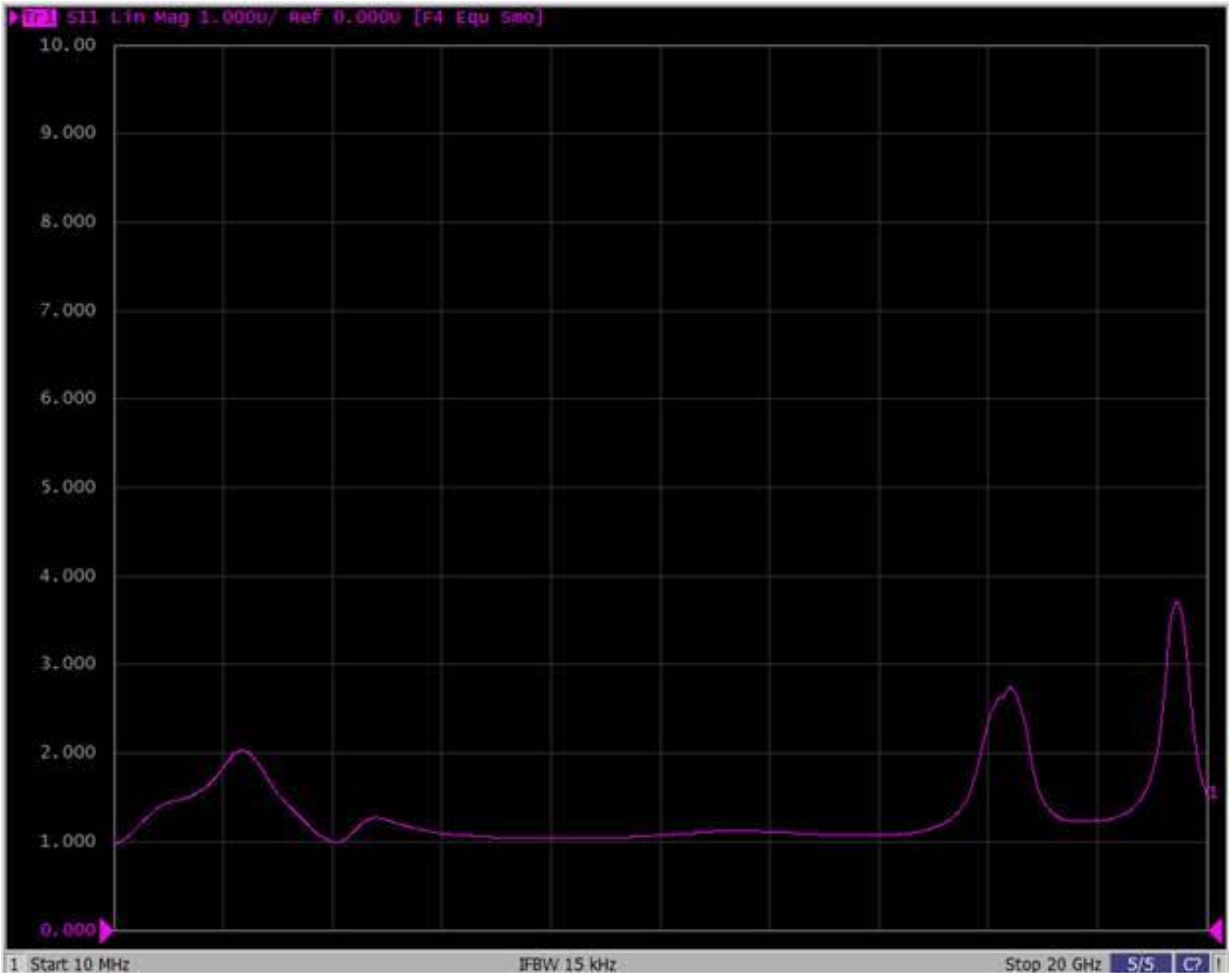


GRF5236 Typical Operating Curves: S-Parameters (5 V, 3.3 to 4.2 GHz Tune)

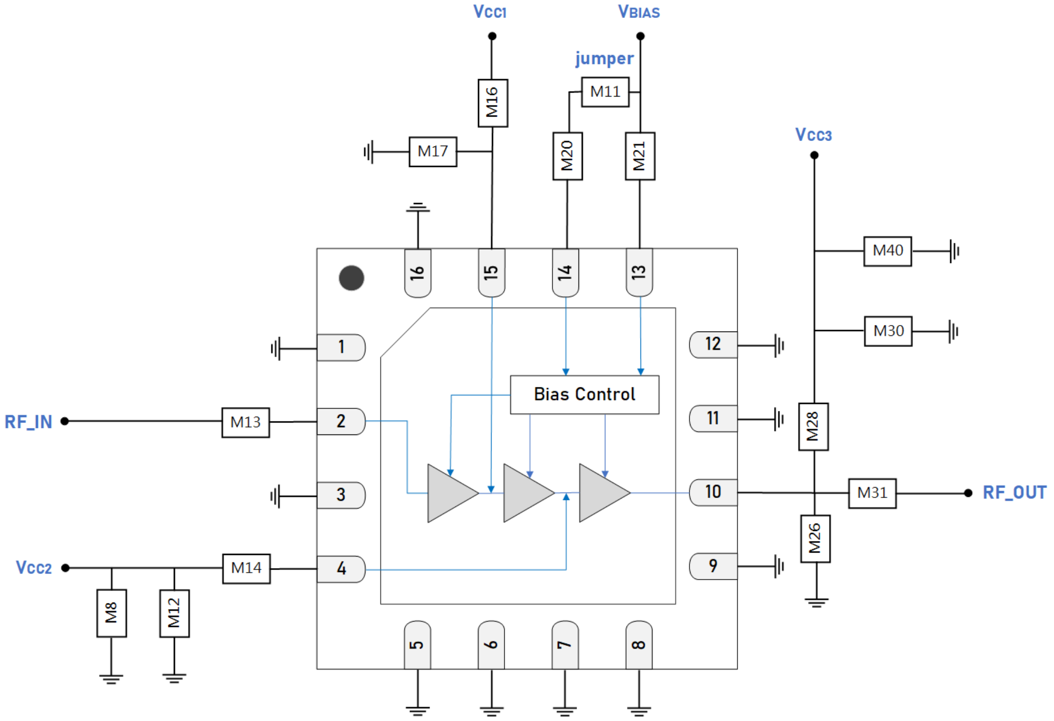


```
Tr1 S11 Log Mag 10.00dB/ Ref 0.000dB [F4]
 1  3.3000000 GHz -19.672 dB
 2  3.5500000 GHz -17.443 dB
>3  3.8000000 GHz -13.547 dB
 4  4.2000000 GHz -8.2713 dB

Tr2 S21 Log Mag 10.00dB/ Ref 10.00dB [F4]
 1  3.3000000 GHz  35.957 dB
 2  3.5500000 GHz  36.204 dB
>3  3.8000000 GHz  36.453 dB
 4  4.2000000 GHz  35.457 dB

Tr3 S12 Log Mag 10.00dB/ Ref 0.000dB [F4]
 1  3.3000000 GHz -53.548 dB
 2  3.5500000 GHz -50.935 dB
>3  3.8000000 GHz -48.291 dB
 4  4.2000000 GHz -45.223 dB

Tr4 S22 Log Mag 10.00dB/ Ref 0.000dB [F4]
 1  3.3000000 GHz -4.0484 dB
 2  3.5500000 GHz -3.4013 dB
>3  3.8000000 GHz -3.4495 dB
 4  4.2000000 GHz -6.0481 dB

Start 10 MHz                    IFBW 15 kHz                    Stop 12 GHz
```

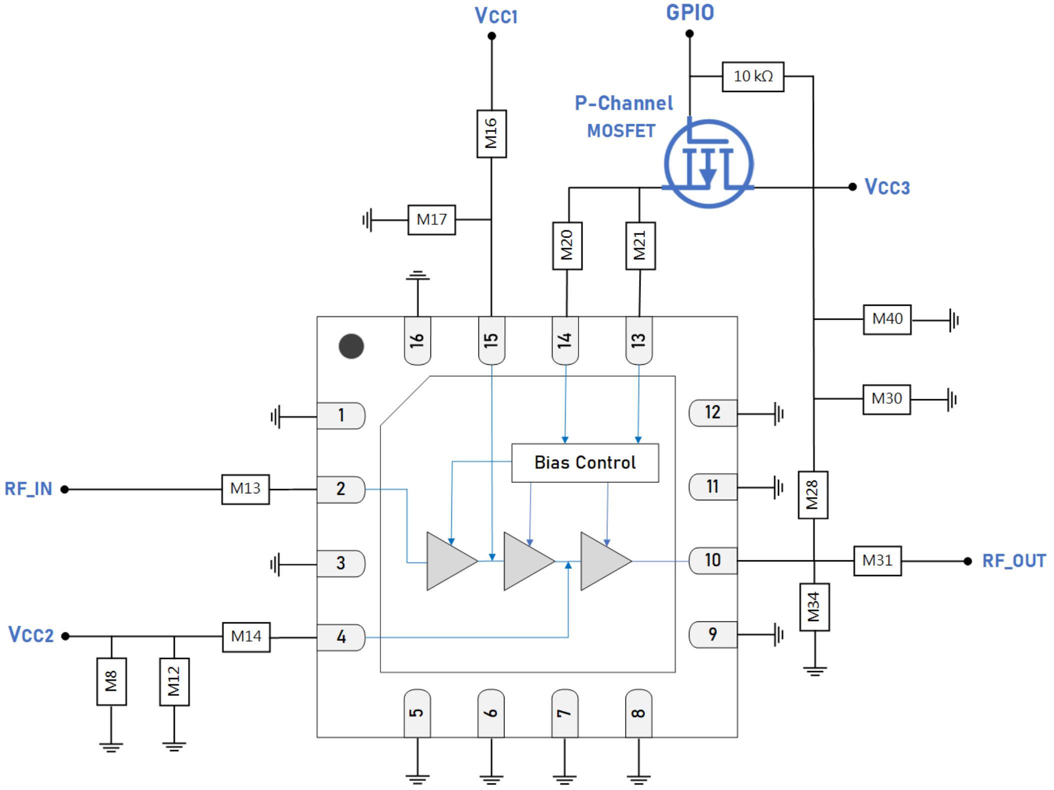
GRF5236 Typical Operating Curves: Stability Mu Factor (10 MHz to 20 GHz)



Note: Mu Prime factor ≥ 1.0 implies unconditional stability.

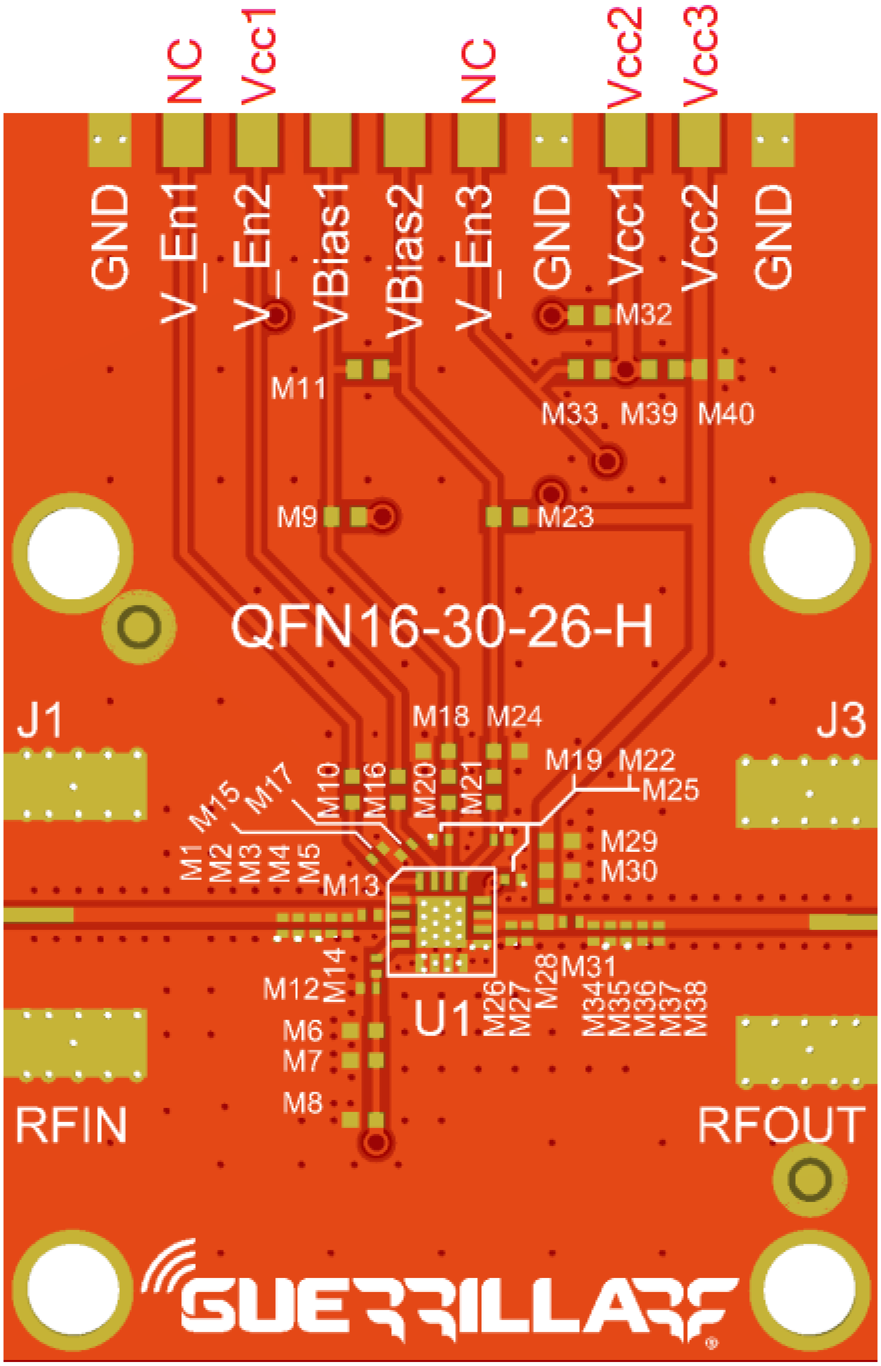


GRF5236 Standard Evaluation Board Schematic



GRF5236 recommended schematic for applications using low current GPIO to toggle V_{BIAS1} and V_{BIAS2}

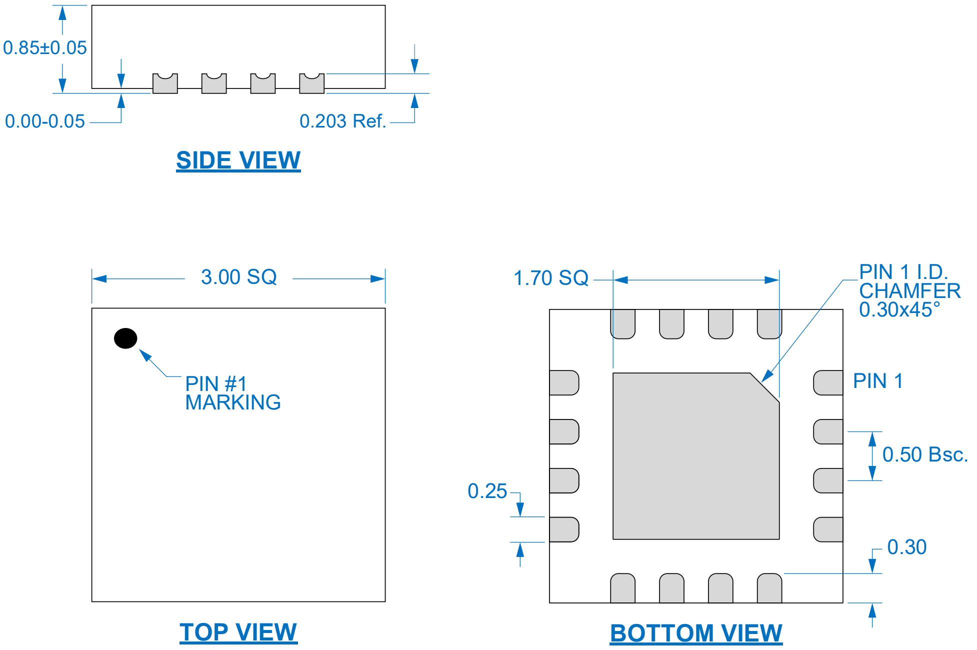
GRF5236 Evaluation Board Assembly Diagram



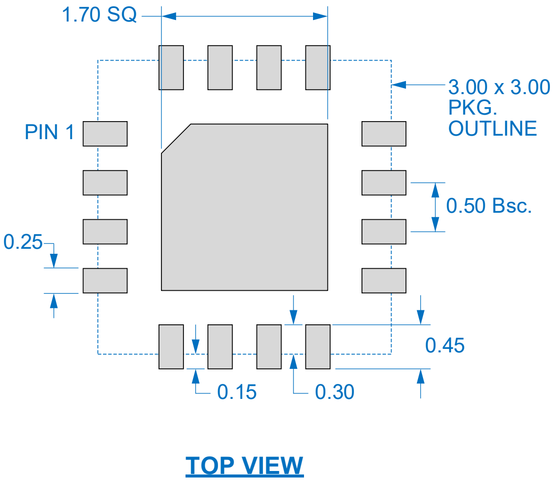
GRF5236 Evaluation Board Assembly Diagram Reference: 3.3 to 4.2 GHz Tune

Component	Type	Manufacturer	Family	Value	Package Size	Substitution
M8	Capacitor	Murata	GRM	10 µF	0402	ok
M11	Resistor (jumper)	Various	5%	0 Ω	0402	ok
M12	Capacitor	Murata	GRM	0.1 µF	0201	ok
M13	Resistor	Various	5%	0 Ω	0402	ok
M14	Inductor	Murata	LQP-TN	6.2 nH	0201	ok
M16	Resistor	Various	5%	0 Ω	0402	ok
M17	Capacitor	Murata	GRM	0.1 µF	0201	ok
M20	Resistor	Various	5%	453 Ω	0402	ok
M21	Resistor	Various	5%	2940 Ω	0402	ok
M26	Capacitor	Murata	GJM	1.2 pF	0201	ok
M28	Inductor	Murata	LQW	6.2 nH	0402	ok
M30	Capacitor	Murata	GRM	0.1 µF	0402	ok
M31	Capacitor	Murata	GJM	5.1 pF	0201	ok
M40	Capacitor	Murata	GRM	10 µF	0402	ok
Evaluation Board	QFN16-30-26-H					

Package Outline Drawing



Recommended PCB Footprint



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

Package Marking Diagram

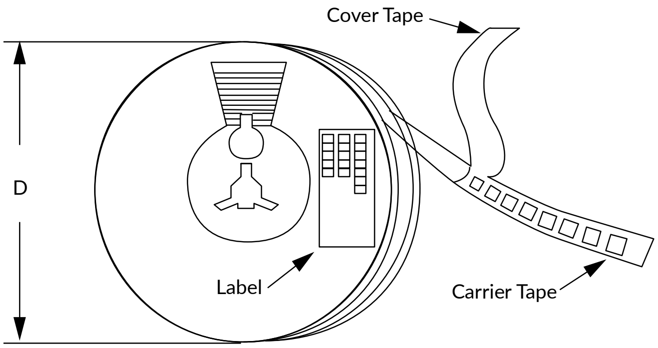
- Line 1: “YY” = YEAR. “WW” = WORK WEEK the device was assembled.
- Line 2: “GRF” = Guerrilla RF.
- Line 3: “XXXX” = Device PART NUMBER.

Tape and Reel Information

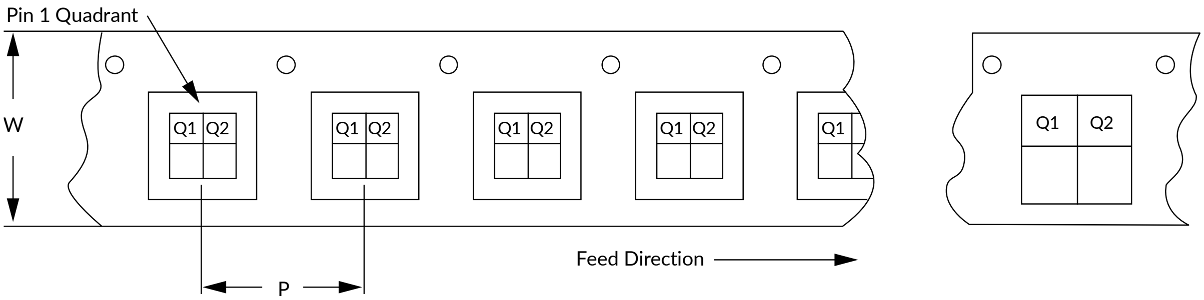
Guerrilla RF’s tape and reel specification complies with Electronic Industries Alliance (EIA) standards for “Embossed Carrier Tape of Surface Mount Components for Automatic Handling” (reference EIA-481). See the following page for the Tape and Reel Specification and Device Package Information table,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

Revision History

Revision Date	Description of Change
February 19, 2024	Advance Data Sheet.
May 31, 2024	Preliminary Data Sheet.
October 17, 2024	Page-1 header frequency range: lowered low end of frequency range from 3.3 to 3.1 GHz.
June 4, 2025	Release Ø Data Sheet.
February 10, 2026	Upgraded Data Sheet to new format. No change to device or device specifications.

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.

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

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