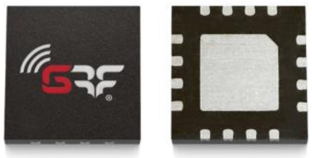
DATA SHEET

PRELIMINARY DATA SHEET



GRF5619

HIGH LINEARITY POWER AMPLIFIER 1920 to 1990 MHz

FEATURES

- Excellent OP1dB, OIP3, ACLR and IM3 Performance
- Native Linearity Provides up to +25 dBm P_{OUT} with > 45 dBc ACLR – Without the Need for Digital Predistortion Correction
- +25 dBm Linear Output Power Maintained at 85 °C
- Flexible Biasing Provides Latitude for Linearity Optimization
- 275 mA Native Mode Quiescent Current Consumption
- 5 V Supply Voltage
- 50 Ω Single-ended Input and Output Impedances
- Digital Shutdown
- Rugged Design is Extremely Resilient to Mismatched Loads
- -40 to 85 °C Operating Temperature Range
- Compact 3 x 3 mm QFN-16 Package

Reference: 5 V / 275 mA I_{CCQ} / 1950 MHz

- Gain: 29 dB
- OIP3: 48 dBm @ 26 dBm P_{OUT}/tone
- OP1dB: 34 dBm
- Evaluation Board Noise Figure: 3.3 dB

APPLICATIONS

- Cellular Boosters
- Automotive Compensators
- Picocells/Femtocells
- Customer Premise Equipment

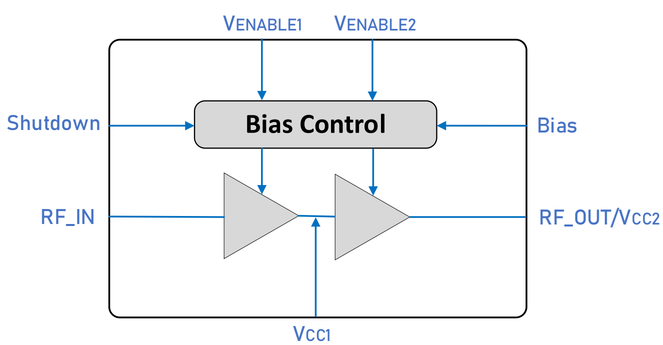
DESCRIPTION

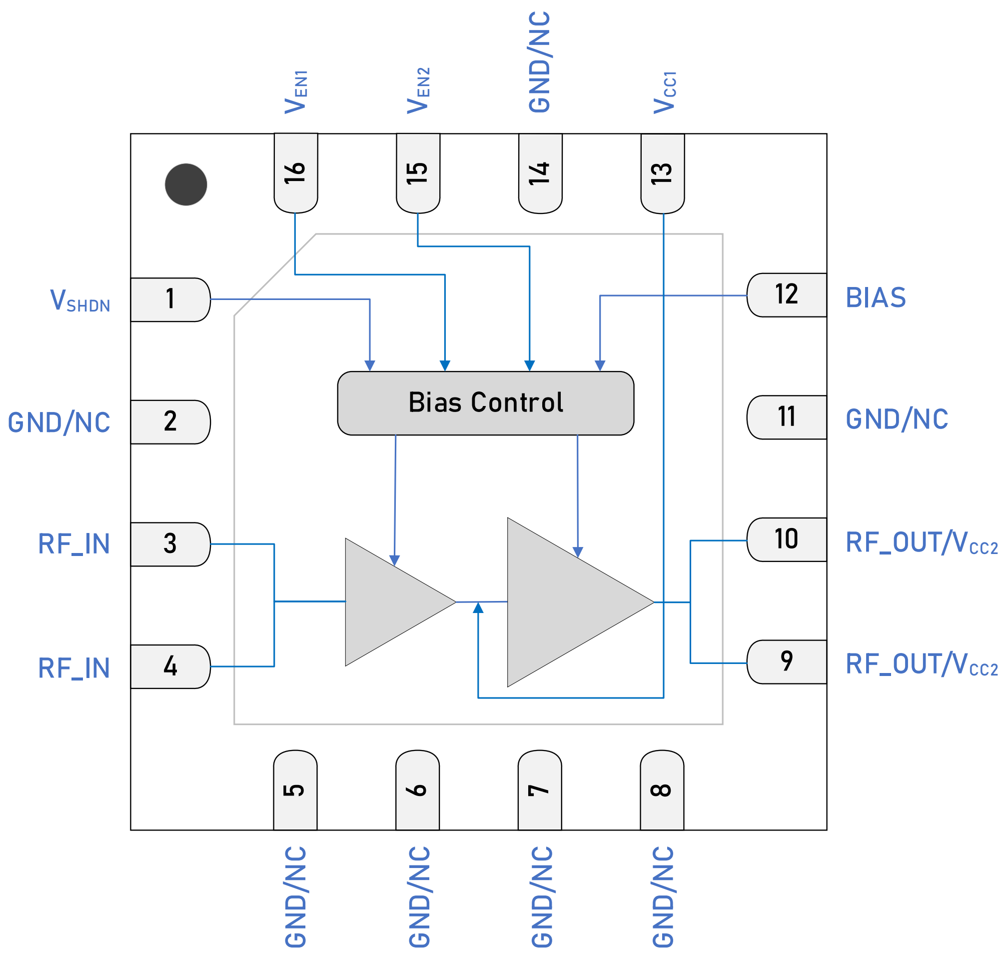
The GRF5619 is a high gain, two-stage InGaP HBT Power Amplifier designed to deliver excellent P1dB, ACLR and IM3 performance over the 1920 to 1990 MHz band. Its exceptional native linearity makes it an ideal choice for transmitter applications that typically do not employ digital predistortion correction schemes.

Please consult with the GRF applications engineering team for custom tuning/evaluation board data.

Additional tunes can be found on the GRF5619 "Custom Tunes" product page: GRF5619 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_{SHDN}	Digital Shutdown Pin	V_{SHDN} ≥ 1.5 V (Logic HIGH) disables device. V_{SHDN} ≤ 0.9 V (Logic LOW) enables device.
2, 5, 6, 7, 8, 11, 14	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 and 4 tied together on system board. An external DC blocking cap must be used.
9, 10	RF_OUT/V_{CC2}	PA Output/Bias Voltage	Pins 9 and 10 tied together on system board. V_{CC2} must be applied to this pin via an RF choke.
12	Bias	Bias Circuit Supply	Connect to V_{CC2} through external resistor.
13	V_{CC1}	Bias Voltage	Connect to V_{CC1} through external inductor or 0 Ω resistor.
15	V_{EN2}	Enable2 Voltage Input	V_{EN2} and series resistor set I_{CCQ} for the output stage. V_{EN2} ≤ 0.2 V disables stage 2.
16	V_{EN1}	Enable1 Voltage Input	V_{EN1} and series resistor set I_{CCQ} for the input stage. V_{EN1} ≤ 0.2 V disables stage 1. Connecting an external de-coupling capacitor to ground is required for optimal NF performance.
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.

Truth Table

Pin	Logic	Condition
V_{SHDN}	LOW	Full Operation
	HIGH	All Amplifiers Off
V_{EN1}	LOW	Stage 1 Amplifier Off
	HIGH	Stage 1 Amplifier On
V_{EN2}	LOW	Stage 2 Amplifier Off
	HIGH	Stage 2 Amplifier On

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Absolute Ratings

Parameter		Symbol	Min.	Max.	Unit
Supply Voltage		V_{CC}		TBD	V
RF Input Power	50 Ω, V_{CC} = 5 V, CW Tone, 100% Duty Cycle, $T_{PKG\ BASE}$ = 25 °C	$P_{IN\ MAX-1:1}$		TBD	dBm
	Load VSWR ≤ 8:1, all phase angles, V_{CC} = 5 V, CW Tone, 100% Duty Cycle, $T_{PKG\ BASE}$ = -40 to 85 °C	$P_{IN\ MAX-8:1}$		TBD	
Operating Temperature (package base)		$T_{PKG\ BASE}$	-40	85	°C
Maximum Junction Temperature (MTTF > 10^6 Hours)		$T_{J\ MAX}$		170	°C
Maximum Dissipated Power: Stage 1		$P_{DISS\ MAX}$		TBD	mW
Maximum Dissipated Power: Stage 2		$P_{DISS\ MAX}$		TBD	mW
Shutdown Voltage		V_{SHDN}		TBD	V

Electrostatic Discharge

Charged Device Model	CDM	TBD		V
Human Body Model	HBM	TBD		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 *Manufacturing Note MN-001 — Package and Manufacturing Information.*

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_{CC}	TBD	5	TBD	V	
Operating Temperature (package base)	$T_{PKG\ BASE}$	-40		85	°C	
RF Frequency Range	F_{RF}	1920		1990	MHz	
RF_IN Port Impedance	Z_{RFIN}		50		Ω	Single-ended with 3-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: GRF5619 Custom Tunes

Note 2: Operation outside this range is possible, but with degraded performance of some parameters.

Nominal Operating Parameters – General

The following conditions apply unless noted otherwise: typical application schematic using the 1920 to 1990 MHz tuning set, V_{CC} = 5 V, V_{SHDN} = LOW, I_{CCQ} = 275 mA, P_{OUT} = 26 dBm, F_{TEST} = 1950 MHz, M5 = 1650 Ω, M9 = 806 Ω, 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_{CCQ}		275		mA	I_{CCQ1} + I_{CCQ2}, no RF applied.
Supply Current with RF Applied	I_{CC}		455		mA	I_{CC1} + I_{CC2}, RF applied with P_{OUT} = 26 dBm.
Enable Current 1	$I_{ENABLE1}$		1.2		mA	V_{CC} = 5 V.
Enable Current 2	$I_{ENABLE2}$		1.6		mA	V_{CC} = 5 V.
Operating Temperature Range	$T_{PKG\ BASE}$	-40		85	°C	Measured on package base.
Logic Input Low	V_{IL}	0		0.9	V	Applies to V_{SHDN} Input.
Logic Input High	V_{IH}	1.7		V_{CC}	V	Applies to V_{SHDN} Input.
Logic Current Low	I_{IL}		1.3		nA	Applies to V_{SHDN} Input, V_{IL} = 0.9 V.
Logic Current High	I_{IH}		45		µA	Applies to V_{SHDN} Input, V_{IH} = 1.8 V.
			285			Applies to V_{SHDN} Input, V_{IH} = 3.3 V.
Switching Rise Time	T_{RISE}		500		ns	Applies to V_{SHDN} Input.
Switching Fall Time	T_{FALL}		500		ns	Applies to V_{SHDN} Input.

Disabled Mode

Supply Quiescent Current	$I_{CCQ-SHDN}$		TBD		µA	V_{CC} = 5 V, $V_{SHDN}/V_{EN1}/V_{EN2}$ = HIGH.
Enable Current 1	$I_{ENABLE1-SHDN}$		TBD		mA	V_{CC} = 5 V, $V_{SHDN}/V_{EN1}/V_{EN2}$ = HIGH.
Enable Current 2	$I_{ENABLE2-SHDN}$		TBD		mA	V_{CC} = 5 V, $V_{SHDN}/V_{EN1}/V_{EN2}$ = HIGH.

Thermal Data (Stage 1 and Stage 2)

See plot of Die Temp vs. Output Power			TBD			On standard evaluation board.

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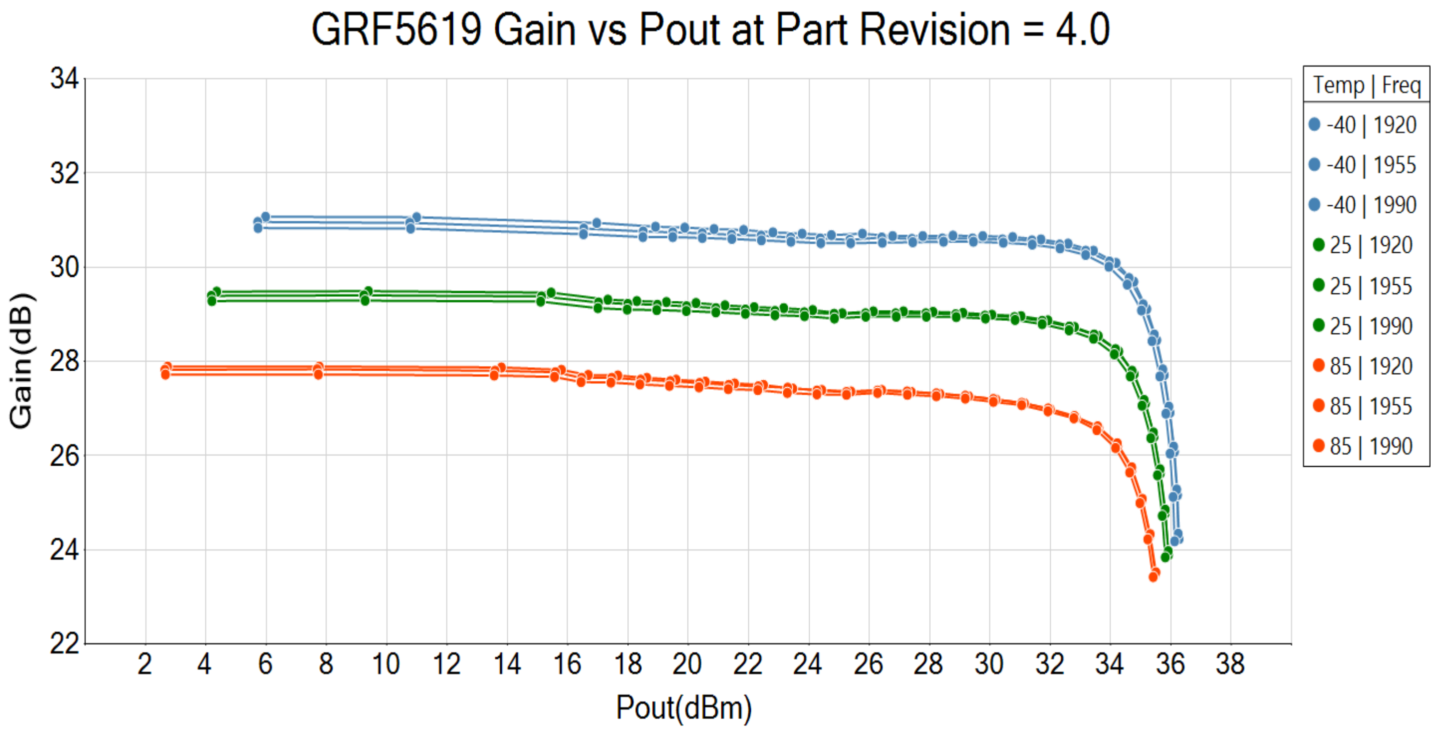
Nominal Operating Parameters – RF: 1920 to 1990 MHz

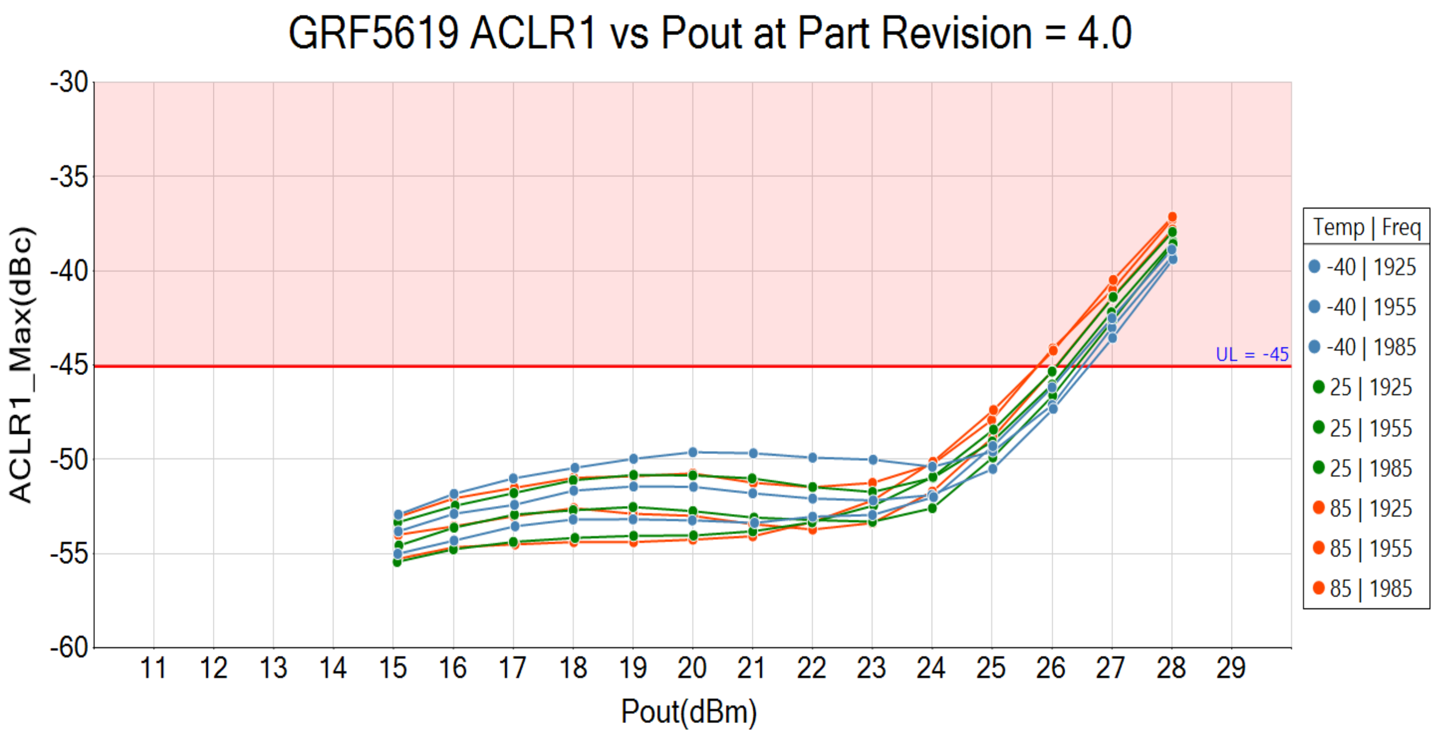
The following conditions apply unless noted otherwise: typical application schematic using the 1920 to 1990 MHz tuning set, V_{CC} = 5 V, V_{SHDN} = LOW, I_{CCQ} = 275 mA, P_{OUT} = 26 dBm, F_{TEST} = 1950 MHz, M5 = 1650 Ω, M9 = 806 Ω, 50 Ω system impedance. $T_{PKG\ BASE}$ = 25 °C. Evaluation board losses are included within the specifications.

Parameter	Symbol	Specification			Unit	Condition
		Min.	Typ.	Max.		
Small Signal Gain	S21		29		dB	F_{TEST} = 1950 MHz, V_{CC} = 5 V, P_{IN} = -25 dBm.
Standby Mode Gain	$S21_{STBY}$		TBD		dB	Disabled Mode, V_{SHDN}/V_{EN1}/V_{EN2} = HIGH, P_{IN} = 0 dBm.
Input Return Loss	S11		< -9		dB	F_{RF} = 1920 to 1990 MHz small signal.
Output Return Loss	S22		< -5		dB	F_{RF} = 1920 to 1990 MHz small signal.
Reverse Isolation	S12		< -40		dB	F_{RF} = 1920 to 1990 MHz small signal.
Noise Figure	NF		3.3		dB	On standard evaluation board.
Output 3rd Order Intercept Point	OIP3		48		dBm	26 dBm P_{OUT} per tone at 600 kHz spacing.
Output 1 dB Compression Power	OP1dB		34		dBm	V_{CC} = 5 V, sine wave input.
Adjacent Channel Leakage Ratio	ACLR		-47		dBc	V_{CC} = 5 V, P_{OUT} = 25 dBm, LTE 10MHz 50RB TM1.1 Downlink Waveform with 9.6dB PAR, F_{TEST} = 1950 MHz.

GRF5619 Typical Operating Curves: 1920 to 1990 MHz Tune



Note: ACLR vs. P_{OUT} (LTE 9.6 dB PAR)



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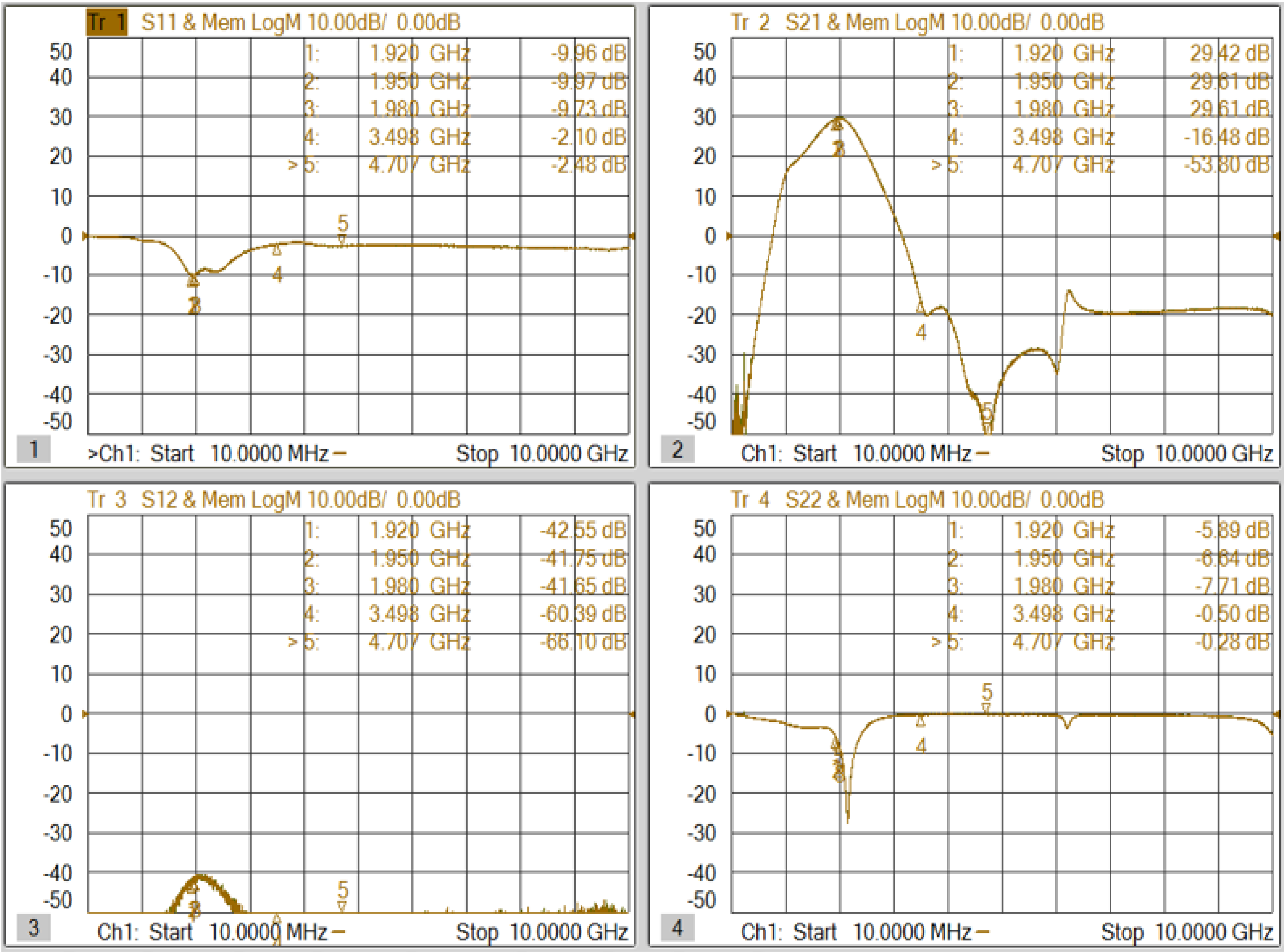
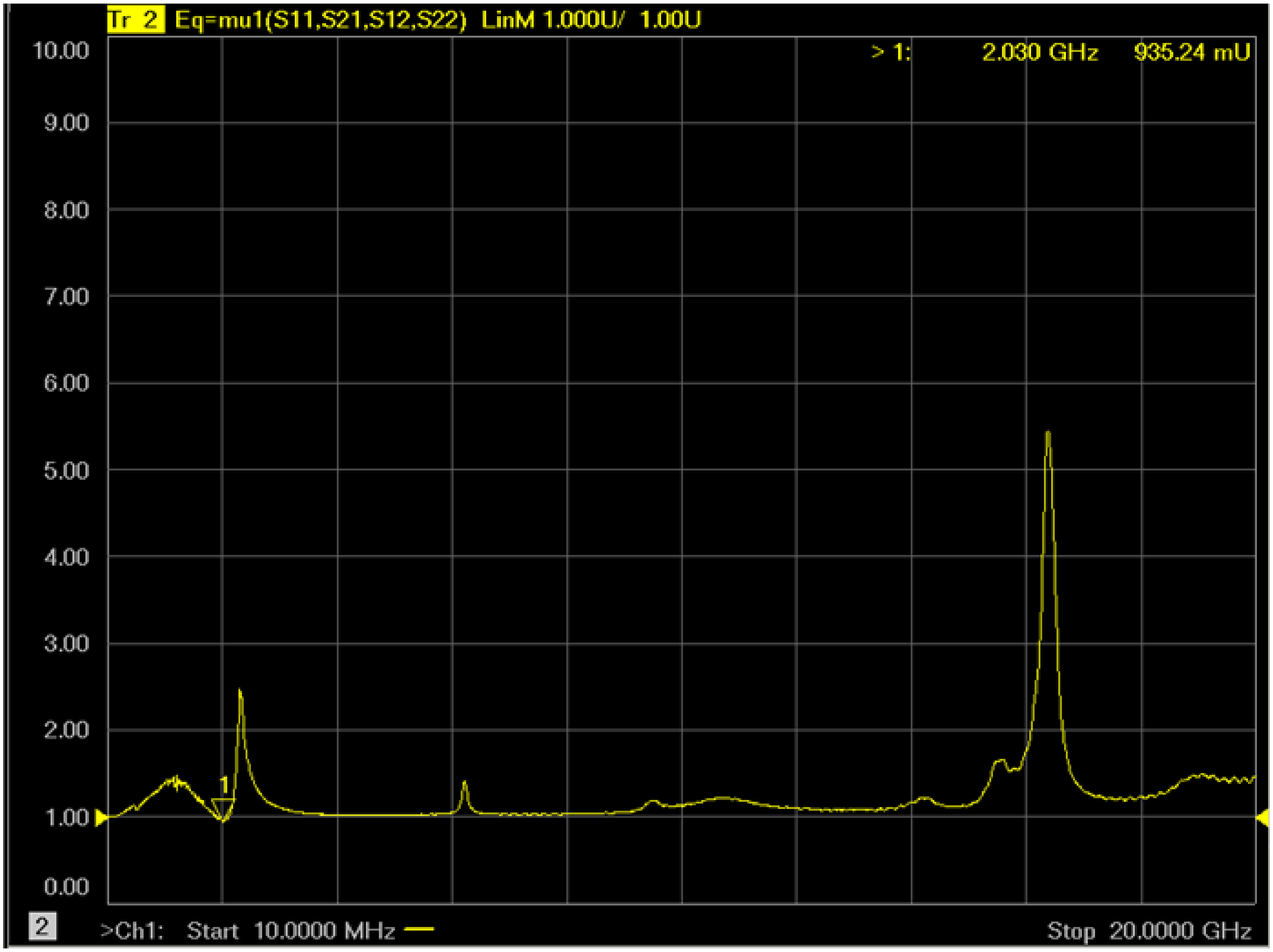
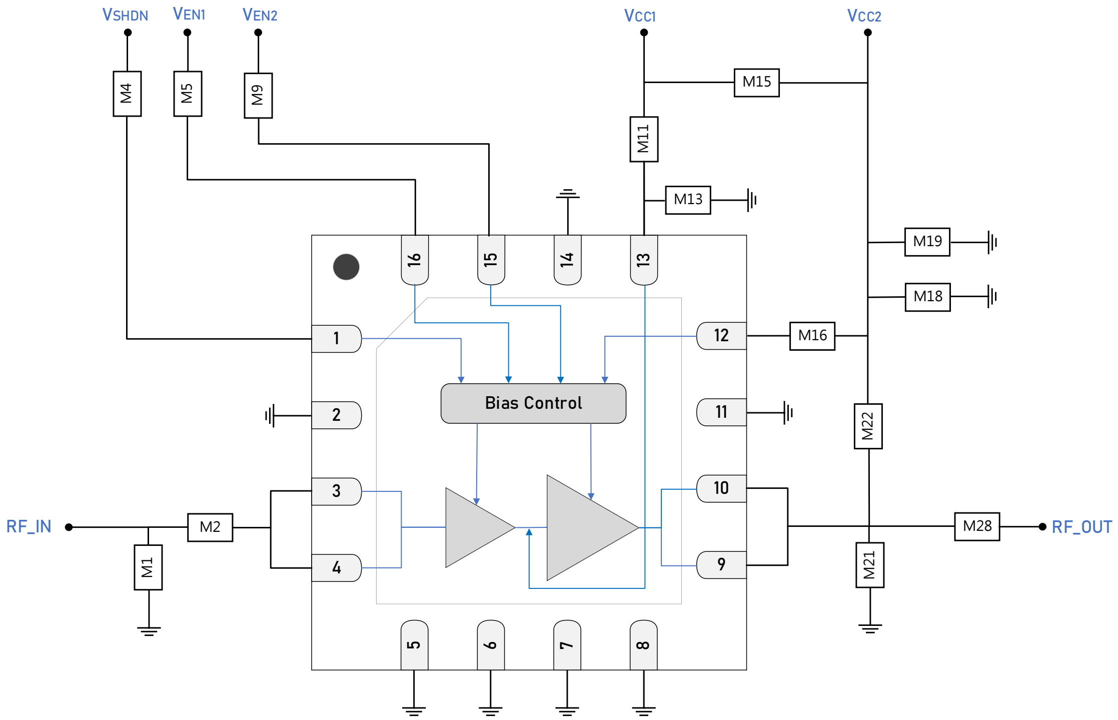
GRF5619 Typical Operating Curves: S-Parameters (1920 to 1990 MHz Tune)



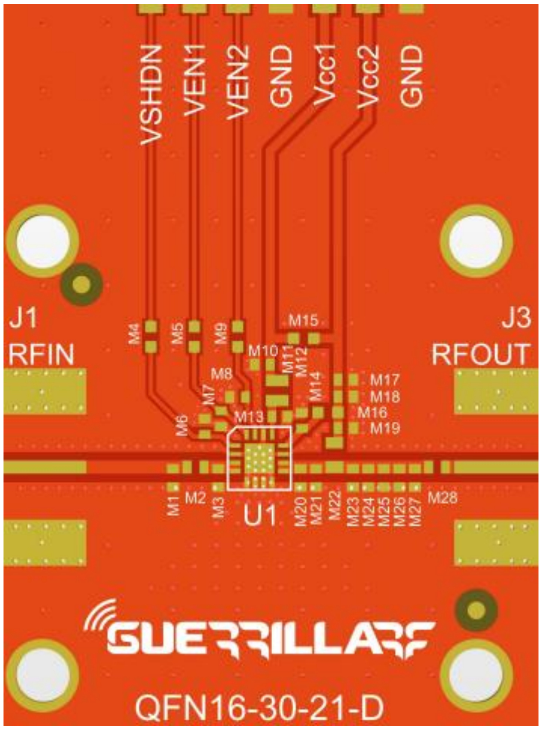
GRF5619 Typical Operating Curves: Stability Mu (10 MHz to 20 GHz)



Note: Mu factor ≥ 1.0 implies unconditional stability.



GRF5619 Standard Evaluation Board Schematic



GRF5619 Evaluation Board Assembly Diagram

GRF5619 Evaluation Board Assembly Diagram Reference: 1920 to 1990 MHz Tune

Component	Type	Manufacturer	Family	Value	Package Size	Substitution
M1	Inductor	Murata	LQG	2.4 nH	0402	ok
M2	Capacitor	Murata	GJM	2.4 pF	0402	ok
M4	Resistor	Various	--	0 Ω	0402	ok
M5	Resistor	Various	1%	1650 Ω	0402	ok
M9	Resistor	Various	1%	806 Ω	0402	ok
M11	Resistor	Various	--	0 Ω	0402	ok
M13	Capacitor	Murata	GJM	0.1 µF	0402	ok
M15	Resistor (jumper)	Various	--	0 Ω	0402	ok
M16	Resistor (jumper)	Various	--	0 Ω	0402	ok
M18	Capacitor	Murata	GRM	4.7 µF	0402	ok
M19	Capacitor	Murata	GRM	100 pF	0402	ok
M21	Capacitor	Murata	GJM	* 2.4 pF (qty = 2)	0402	ok
M22	Inductor: High Q	Murata	LQG	12 nH	0402	ok
M28	Capacitor	Murata	GJM	5.1 pF	0402	ok
Evaluation Board	QFN16-30-21-D					

Notes:
Standard evaluation board bias: V_{CC} = 5 V, $V_{ENABLE1}$ & $V_{ENABLE2}$ = 5 V.
* For M21: place two 2.4 pF capacitors as close together as possible.

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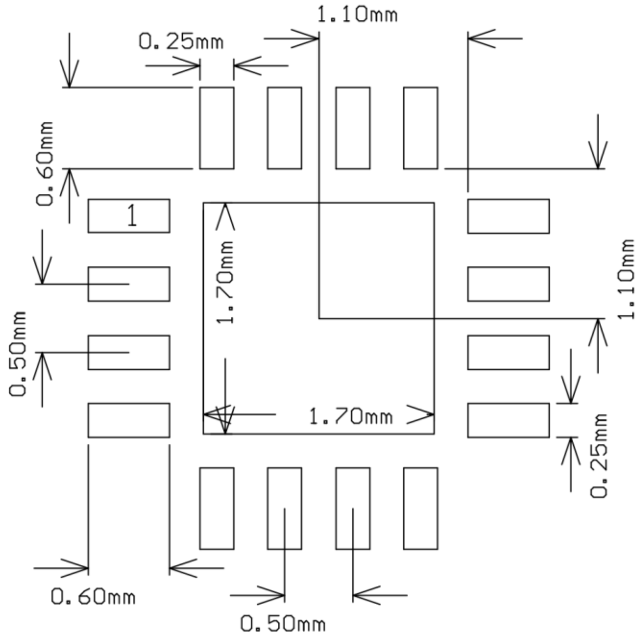
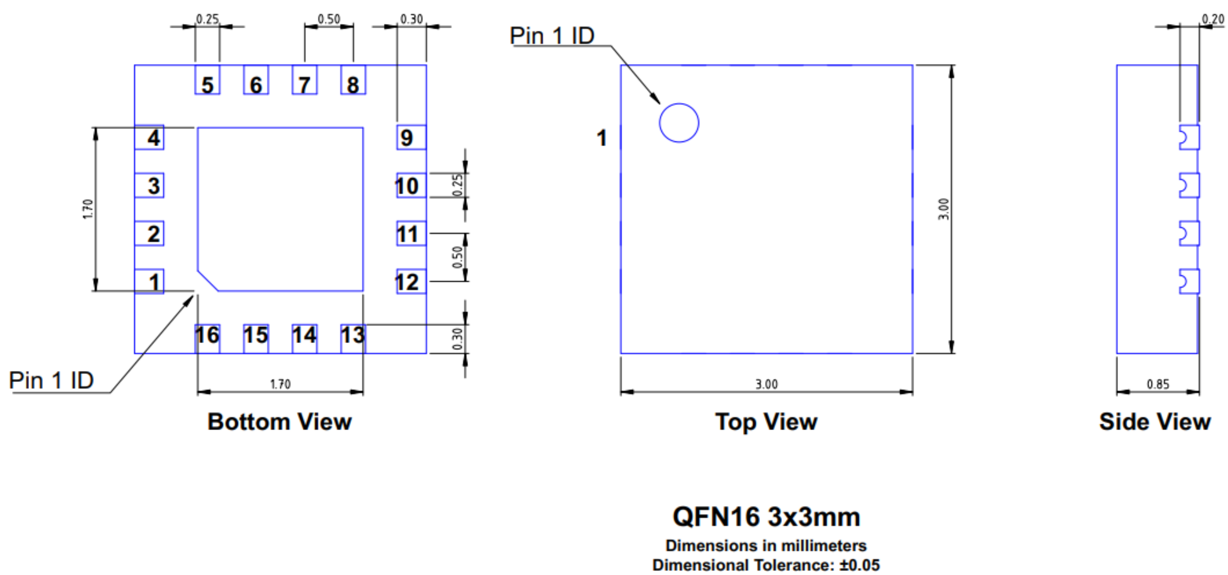


3 x 3 mm QFN-16 Suggested PCB Footprint (Top View)



3 x 3 mm QFN-16 Package Dimensions

Package Marking Diagram

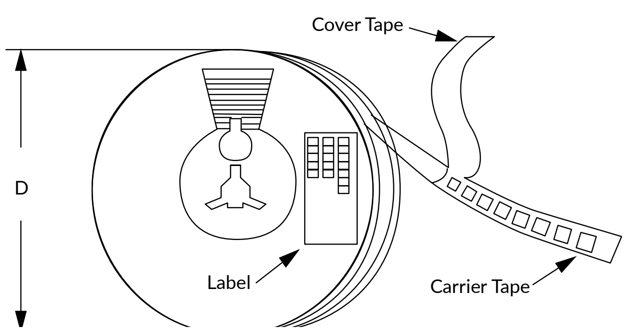
- Line 1: “YY” = YEAR. “WW” = WORK WEEK the device was assembled.
- Line 2: “GRF” = Guerrilla RF.
- Line 3: “XXXX” = Device PART NUMBER.

Tape and Reel Information

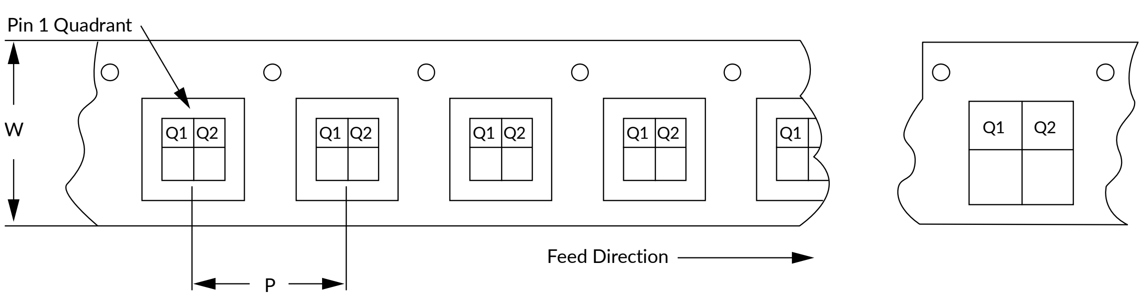
Guerrilla RF’s tape and reel specification complies with Electronic Industries Alliance (EIA) standards for “Embossed Carrier Tape of Surface Mount Components for Automatic Handling” (reference EIA-481). See the following page for the Tape and Reel Specification and Device Package Information table,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

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Revision History

Revision Date	Description of Change
December 12, 2024	Preliminary Data Sheet.

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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.