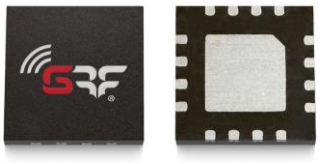
DATA SHEET

RELEASE Ø DATA SHEET



GRF5217

HIGH EFFICIENCY POWER AMPLIFIER 1500 to 2200 MHz

FEATURES

- Utilizing DPD:
  - +22 dBm Linear Output Power
  - PAE = 30 %
  - ACLR ≤ -55 dBc
  - LTE 10 MHz Downlink CFR 8.2 dB
- 37 mA Native Mode Quiescent Current Consumption
- 4 V Nominal Supply Voltage
- 50 Ω Single-ended Input and Output Impedances
- Digital Shutdown
- Rugged Design is Extremely Resilient to Mismatched Loads
- -40 to 115 °C Operating Temperature Range
- Compact 3 x 3 mm QFN-16 Package

Reference: 4 V / 37 mA I_{CCQ} / 1880 MHz

- Gain: 31 dB (22 dBm Pout)
- PAE: 29 % (22 dBm Pout)
- Evaluation Board Noise Figure: 3.8 dB

APPLICATIONS

- DTC/Cellular NTN Satellite Arrays
- Cellular Boosters
- Automotive Compensators
- Picocells/Femtocells
- Customer Premise Equipment

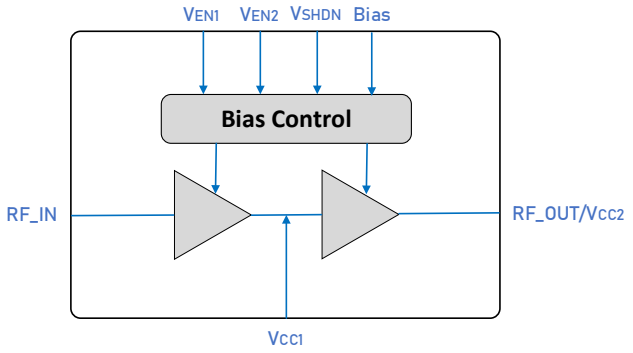
DESCRIPTION

The GRF5217 is a high gain, two-stage InGaP HBT power amplifier designed to deliver excellent ACLR performance over the 1500 to 2200 MHz band using DPD (digital predistortion).

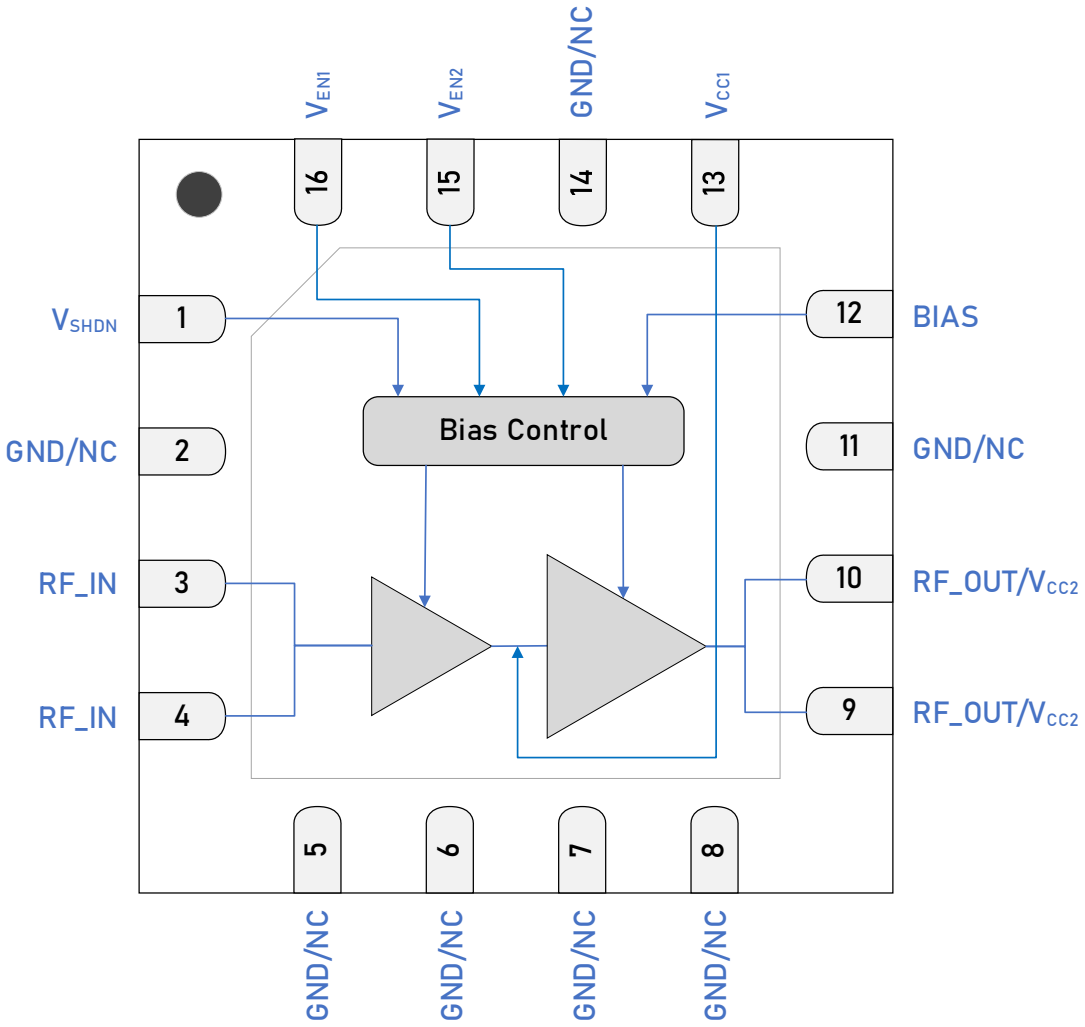
Please consult with the GRF applications engineering team for custom tuning/evaluation board data.

Additional tunes can be found on the GRF5217 "Custom Tunes" product page: GRF5217 Custom Tunes

BLOCK DIAGRAM



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

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Pin Assignments

Pin	Name	Description	Note
1	V_{SHDN}	Digital Shutdown Pin	$V_{SHDN} \geq 1.8$ V (Logic HIGH) disables device. $V_{SHDN} \leq 0.8$ 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 capacitor 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 with capacitive termination above (see applications schematic).
15	V_{EN2}	Enable2 Voltage Input	V_{EN2} and series resistor set I_{CCQ} for the output stage. $V_{EN2} \leq 0.2$ volts disables stage 2.
16	V_{EN1}	Enable1 Voltage Input	V_{EN1} and series resistor set I_{CCQ} for the input stage. $V_{EN1} \leq 0.2$ volts disables stage 1.
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

Absolute Ratings

Parameter	Symbol	Min.	Max.	Unit
Supply Voltage	V_{CC}	0	5.25	V
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).	$P_{DISS\ MAX}$		* 200	mW
Maximum Dissipated Power: Stage 2: DC only (no RF applied).	$P_{DISS\ MAX}$		* 500	mW
Shutdown Voltage	V_{SHDN}		** 5.25	V

Electrostatic Discharge

Human Body Model	HBM	750		V

Storage

Storage Temperature	T_{STG}	-65	150	°C
Moisture Sensitivity Level	MSL		1	--

* Bias resistors M5/M9 have been empirically optimized for linearity. Thus, there will be no benefit in decreasing resistance (thereby increasing I_{CCQ}).

** M4 = 0 Ω. V_{SHDN} = 5.25 V yields I_{SHDN} = 540 µA. I_{SHDN} decreases linearly vs V_{SHDN} (to 65 µA with V_{SHDN} = 1.8 V).

Said linear relationship can be used to scale M4 for higher V_{SHDN} voltage: use the pin condition V_{SHDN_pin}/I_{SHDN} = 2.4V/147µA.

Calculate M4 for V_{SHDN}/I_{SHDN} = 4V/147µA: M4 = (4–2.4)/(0.000147) = 10.9 kΩ.

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}	3	4	5.25	V	
Operating Temperature (Package Base)	$T_{PKG\ BASE}$	-40		115	°C	
RF Frequency Range	F_{RF}	1500	1880	2200	MHz	Typical application schematic using the 1525 to 2200 MHz tuning set **(notes 1 & 2)**.
RF_IN Port Impedance	Z_{RF_IN}		50		Ω	Single-ended with 4-element match.
RF_OUT Port Impedance	Z_{RF_OUT}		50		Ω	Single-ended with 5-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: GRF5217 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 1525 to 2200 MHz tuning set. V_{CC} = 4 V, V_{SHDN} = LOW, I_{CCQ} = 37 mA, M5 = 3.3 kΩ, M9 = 3.16 kΩ, P_{OUT} = 22 dBm, F_{TEST} = 1880 MHz, 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}		37		mA	I_{CCQ1} + I_{CCQ2}. No RF applied.
Supply Current with RF Applied	I_{CC}		135		mA	I_{CC1} + I_{CC2}. P_{OUT} = 22 dBm.
Enable Current 1	$I_{ENABLE1}$		0.7		mA	$V_{CC}/V_{EN1}/V_{EN2}$ = 4 V.
Enable Current 2	$I_{ENABLE2}$		0.3		mA	$V_{CC}/V_{EN1}/V_{EN2}$ = 4 V.
Operating Temperature Range	$T_{PKG\ BASE}$	-40		85	°C	Measured on Package Base.
Logic Input Low	V_{IL}	0		0.8	V	Applies to V_{SHDN} Input.
Logic Input High	V_{IH}	1.8		V_{CC}	V	Applies to V_{SHDN} Input.
Logic Current Low	I_{IL}		1.3		nA	Applies to V_{SHDN} Input, V_{IL} = 0.8 V.
Logic Current High	I_{IH}		65		µA	Applies to V_{SHDN} Input, V_{IH} = 1.8 V.
			265			Applies to V_{SHDN} Input, V_{IH} = 3.3 V.
Switching Rise Time	T_{RISE}		15		ns	Applies to V_{SHDN} Input.
Switching Fall Time	T_{FALL}		15		ns	Applies to V_{SHDN} Input.

Disabled Mode

Supply Quiescent Current	$I_{CCQ-SHDN}$		4		µA	V_{CC} = 4 V, $V_{SHDN}/V_{EN1}/V_{EN2}$ = HIGH.
Enable Current 1	$I_{ENABLE1-SHDN}$		1.1		mA	V_{CC} = 4 V, $V_{SHDN}/V_{EN1}/V_{EN2}$ = HIGH.
Enable Current 2	$I_{ENABLE2-SHDN}$		1		mA	V_{CC} = 4 V, $V_{SHDN}/V_{EN1}/V_{EN2}$ = HIGH.

Thermal Data (Stage 1 and Stage 2)

See plot of Junction Temp vs. Output Power						On standard evaluation board. T_{STAGE} = 85C.

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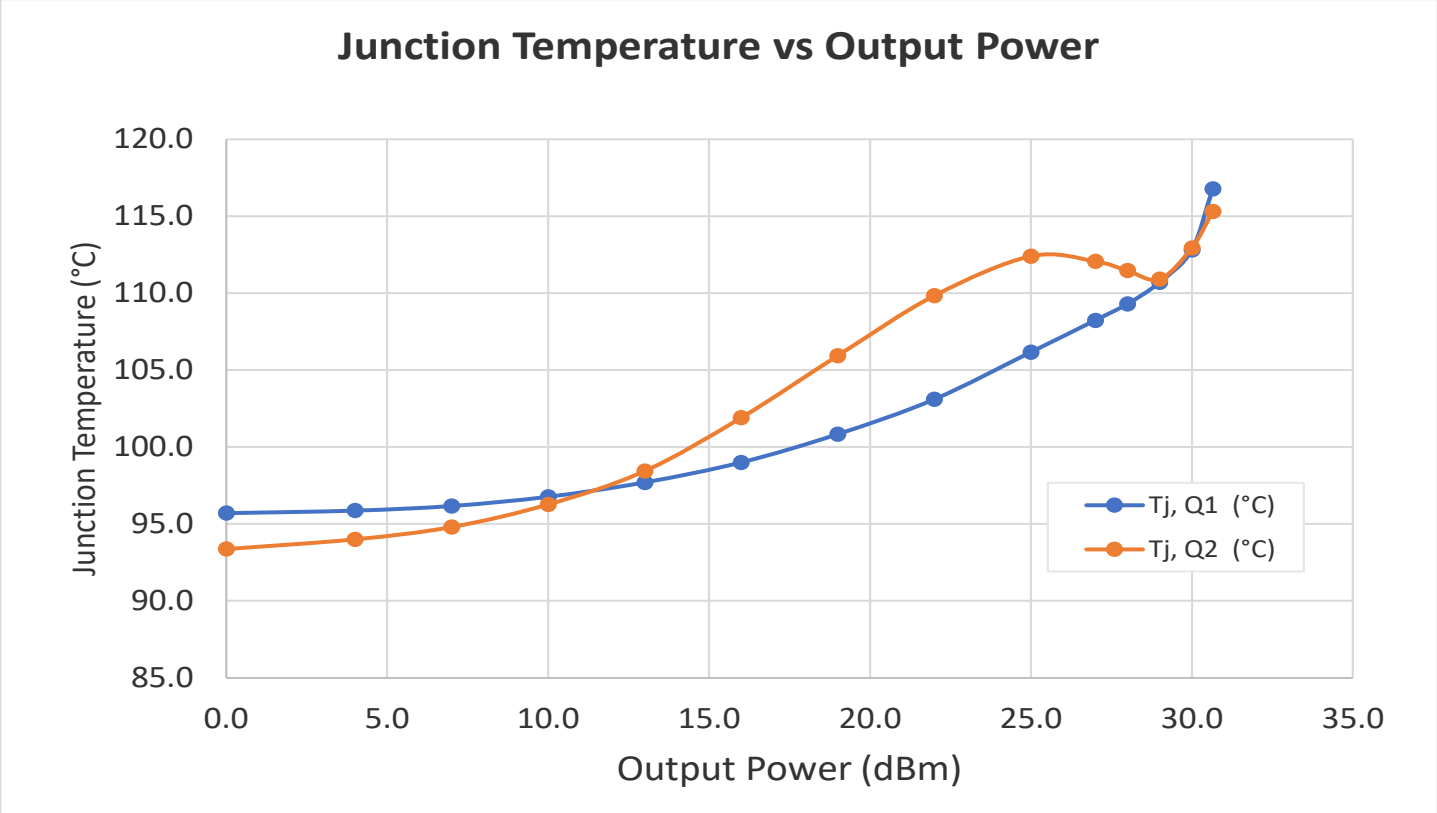
Nominal Operating Parameters – RF (1525 to 2200 MHz, 4 V Operation)

The following conditions apply unless noted otherwise: Typical Application Schematic using the 1525 to 2200 MHz tuning set. V_{CC} = 4 V, V_{SHDN} = LOW, I_{CCQ} = 37 mA, M5 = 3.3 kΩ, M9 = 3.16 kΩ, P_{OUT} = 22 dBm, F_{TEST} = 1880 MHz, 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.		
Large Signal Gain	S21		31		dB	V_{CC} = 4 V. F_{TEST} = 1880 MHz, P_{IN} = -9 dBm.
Standby Mode Gain	$S21_{STBY}$		-40		dB	Disabled Mode: $V_{SHDN}/V_{EN1}/V_{EN2}$ = HIGH. P_{IN} = 0 dBm.
Input Return Loss	S11		< -10		dB	F_{RF} = 1525 to 2200 MHz.
Output Return Loss	S22		< -2.5		dB	F_{RF} = 1525 to 2200 MHz.
Reverse Isolation	S12		< -40		dB	F_{RF} = 1525 to 2200 MHz.
Noise Figure	NF		3.8		dB	On standard evaluation board.
Saturated Output Power	Psat		30.6		dBm	V_{CC} = 4 V, F_{TEST} = 1880 MHz (sine wave input).
Adjacent Channel Leakage Ratio	ACLR		-58		dBc	V_{CC} = 4 V, P_{OUT} = 22 dBm, LTE 10 MHz Downlink CFR 8.2 dB, F_{TEST} = 1525 to 2200 MHz.

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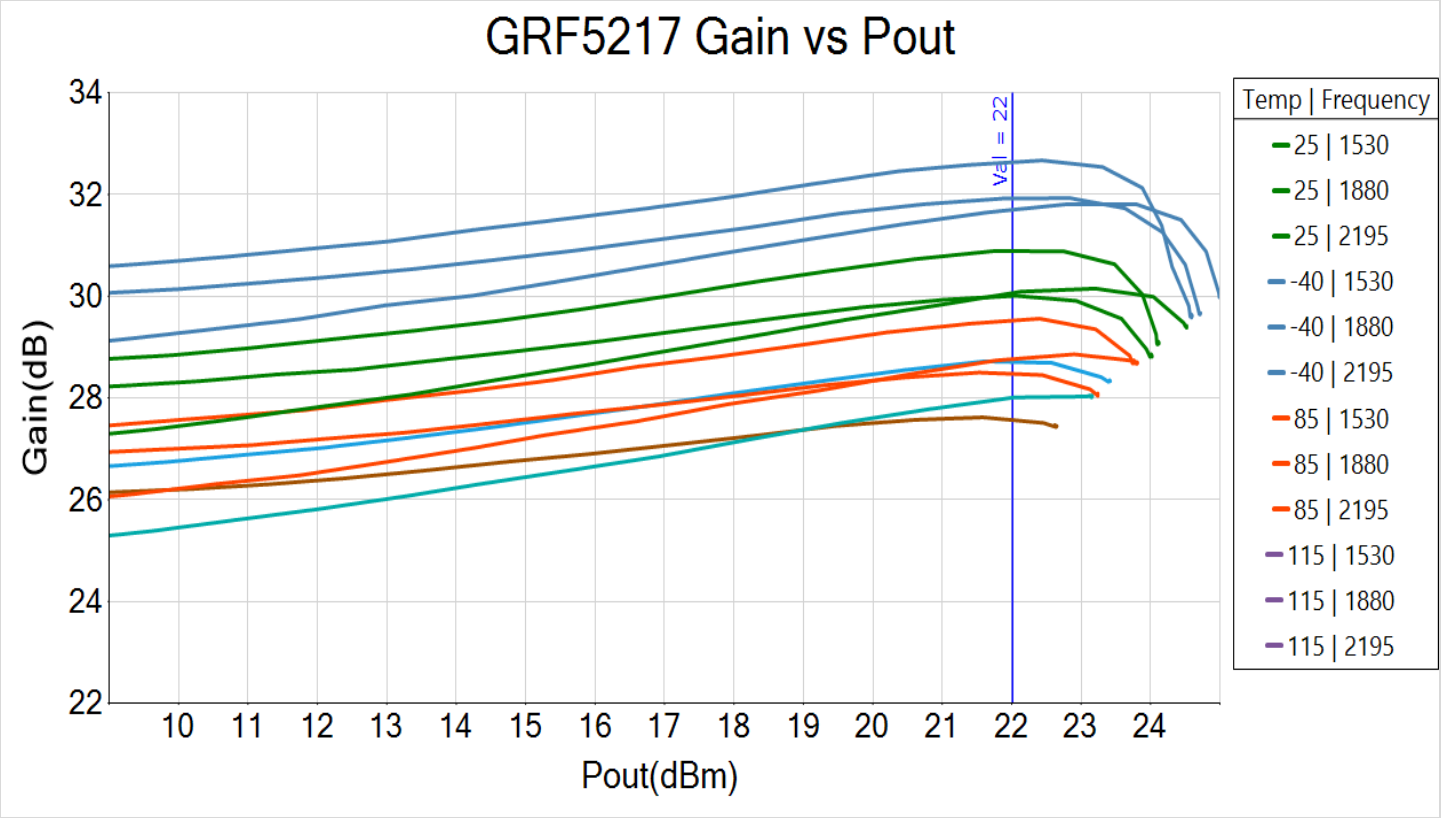
GRF5217 Typical Operating Curves: Thermal Data



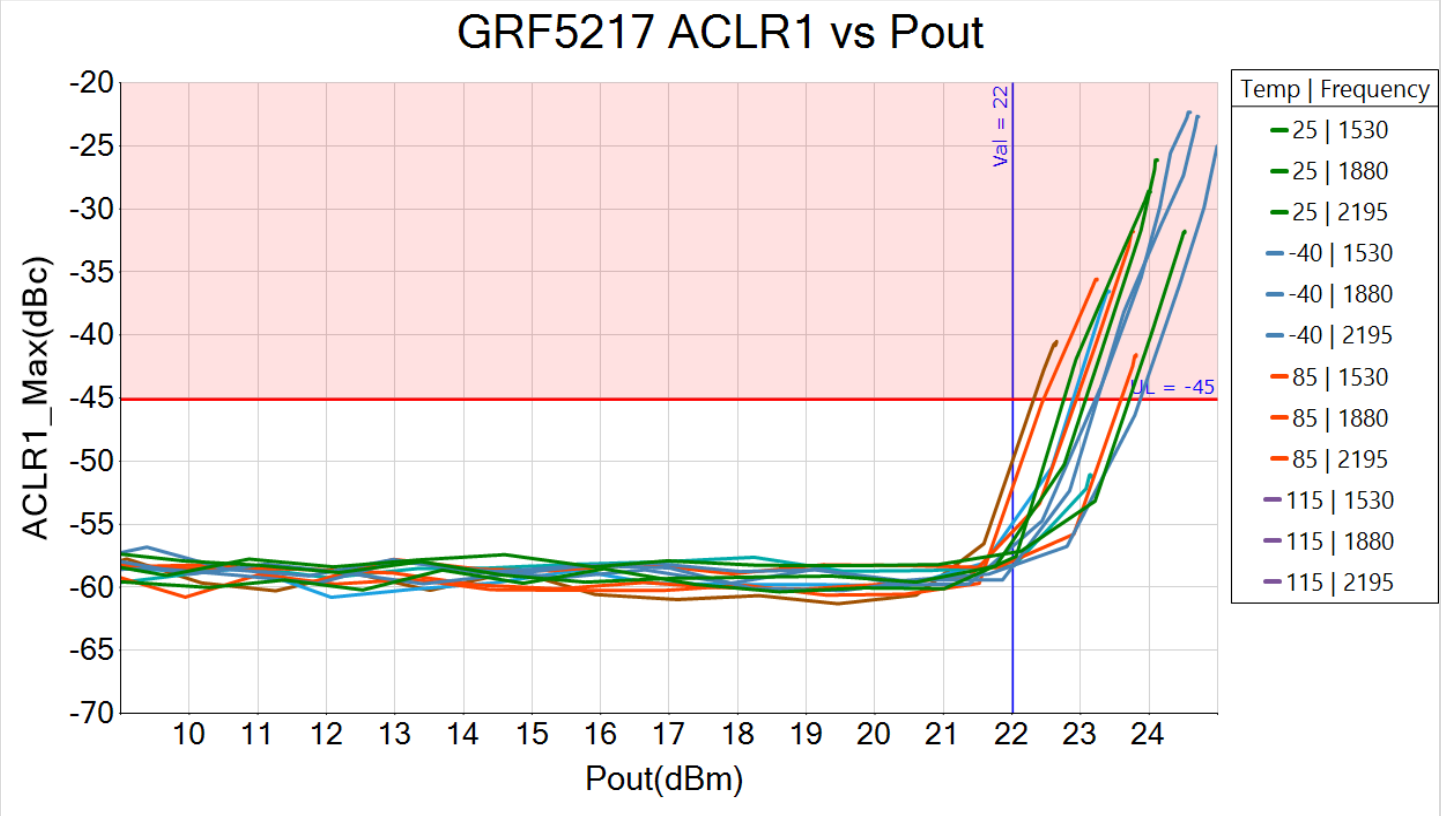
Note 3: T_{STAGE} = 85 °C.

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GRF5217 Typical Operating Curves: Gain vs. P_{OUT} vs. Temperature (LTE 10 MHz CFR 8.2 dB w/DPD)

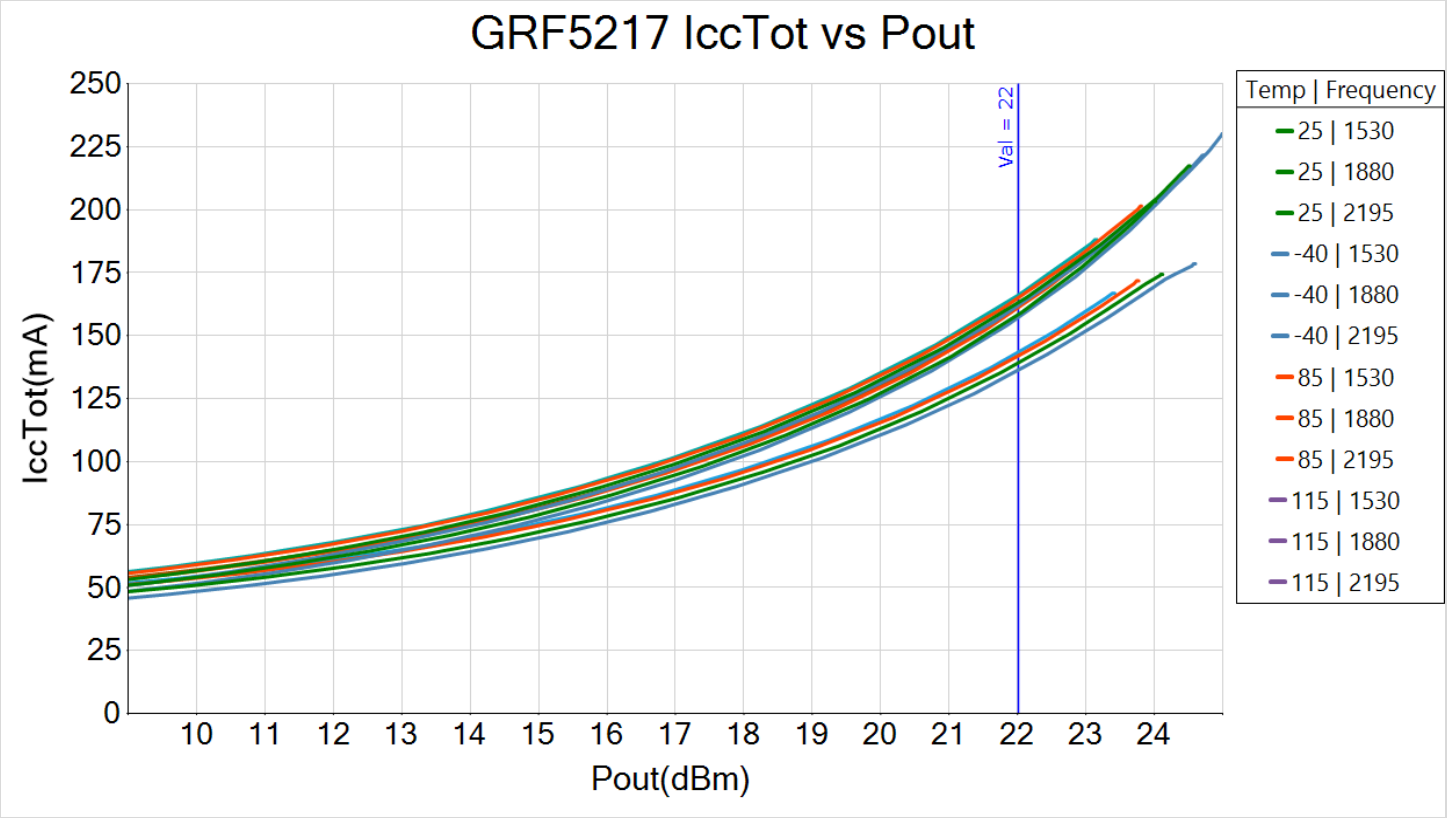


GRF5217 Typical Operating Curves: ACLR1 vs. P_{OUT} vs. Temperature (LTE 10 MHz CFR 8.2 dB w/DPD)



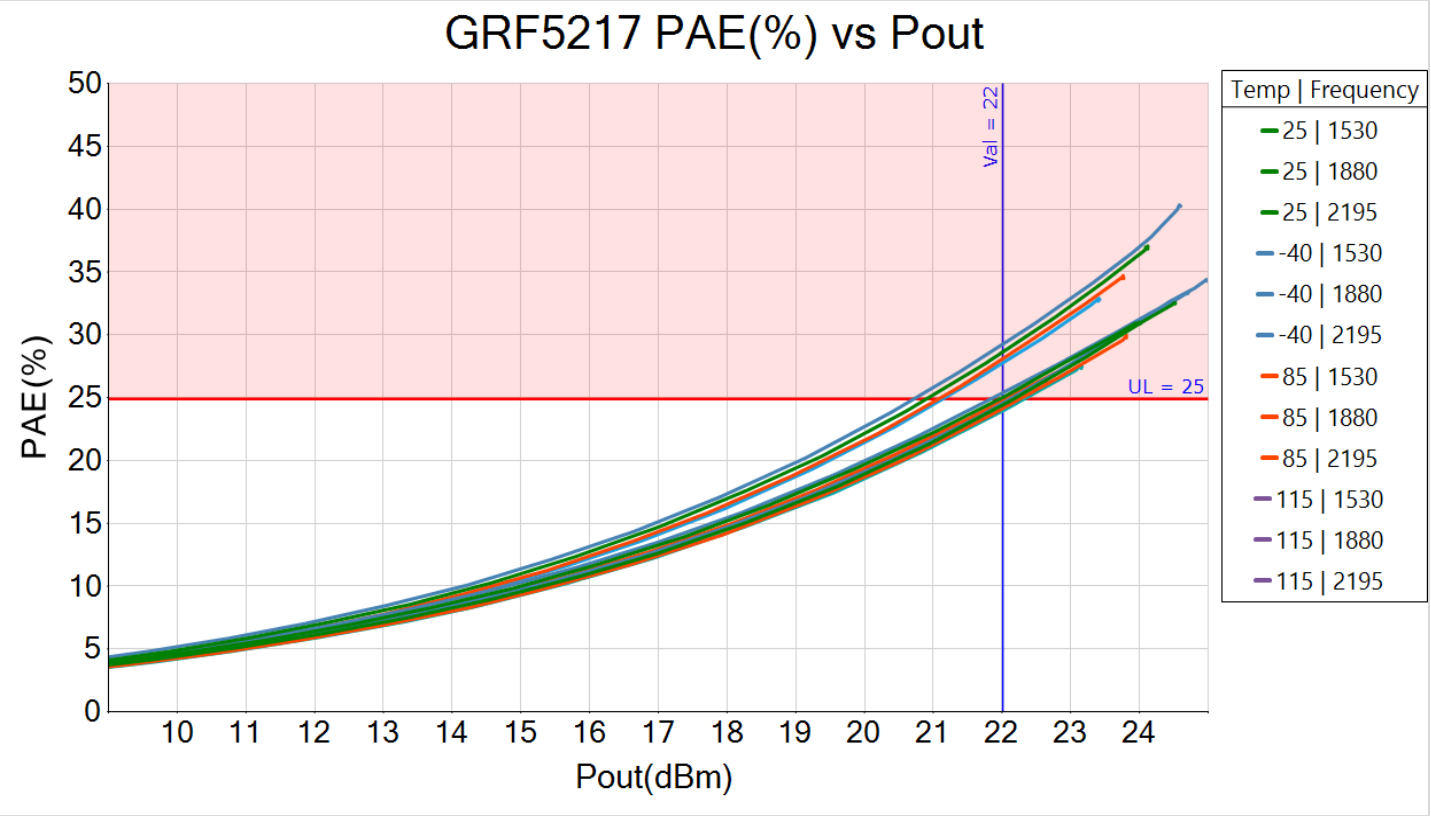
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GRF5217 Typical Operating Curves: Stage1+ Stage2 $I_{CC\ vs.}$ $P_{OUT\ vs}$ Temperature LTE 10 MHz CFR 8.2 dB w/DPD)



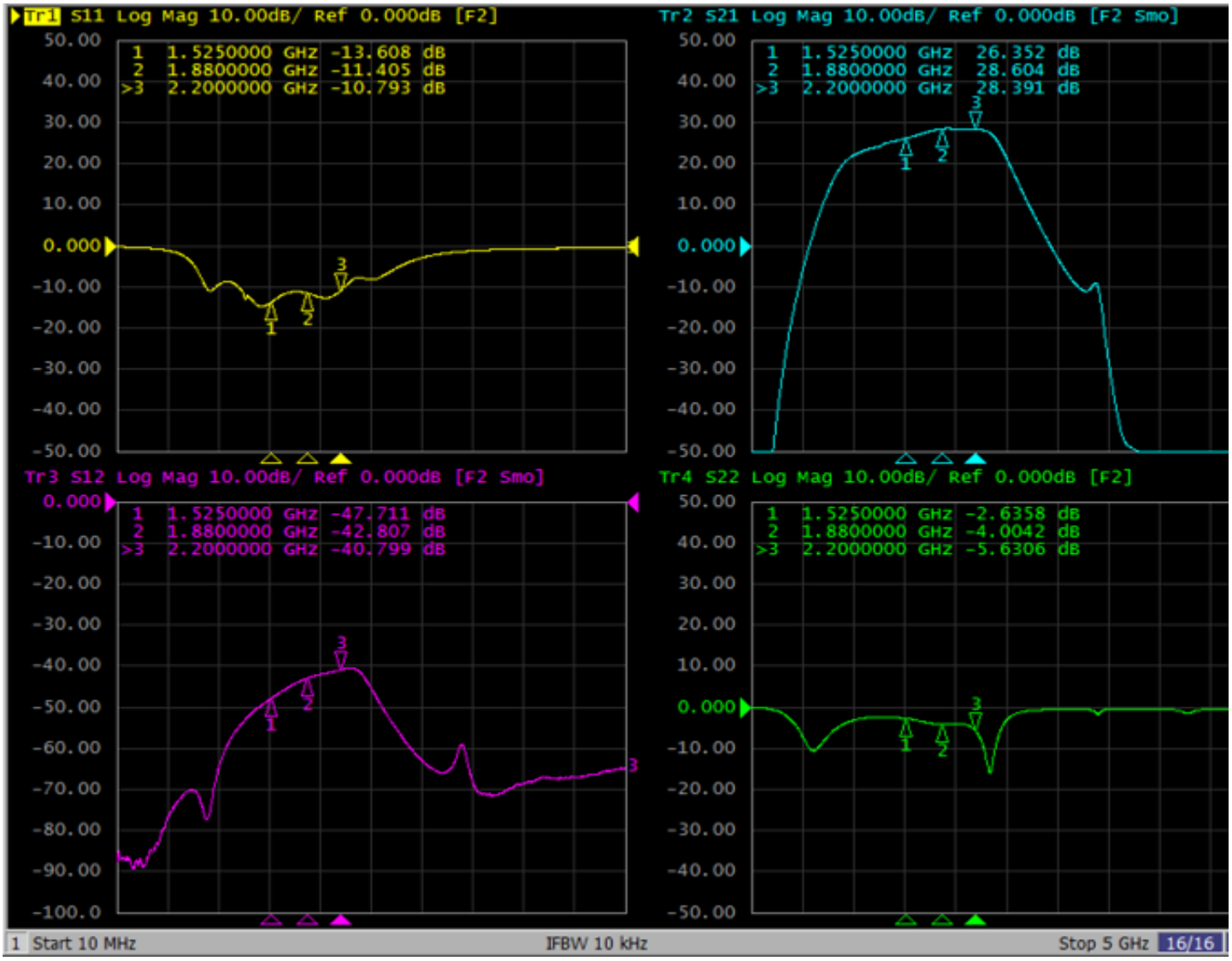
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GRF5217 Typical Operating Curves: PAE vs. P_{OUT} vs Temperature (LTE 10 MHz CFR 8.2 dB w/DPD)

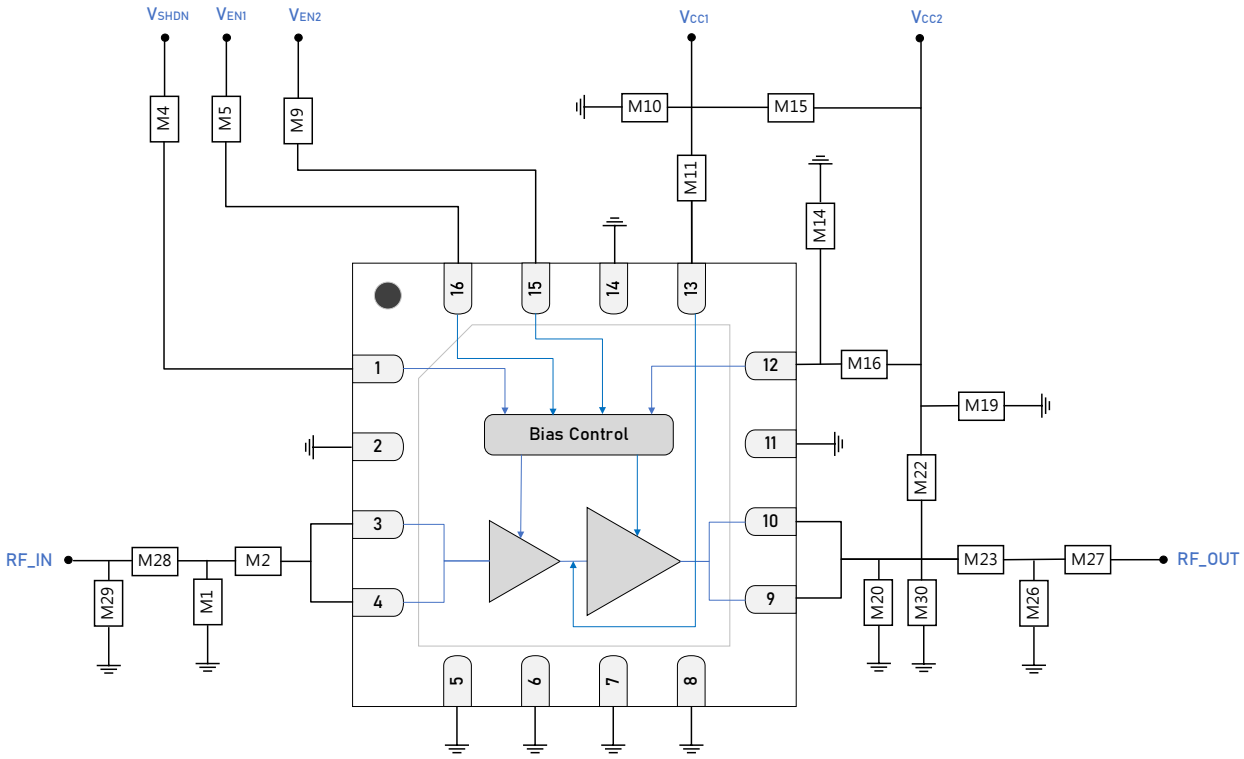


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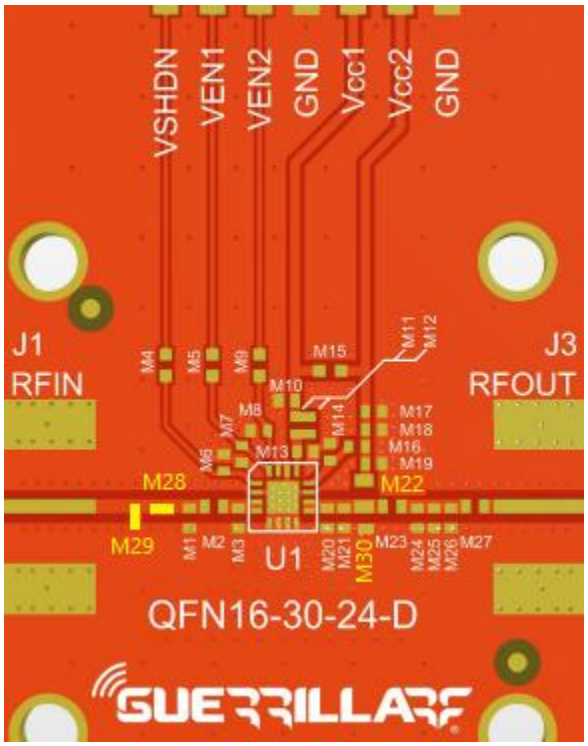
GRF5217 Typical Operating Curves: S-Parameters (1525 to 2200 MHz Tune)



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GRF5217 Standard Evaluation Board Schematic



GRF5217 Evaluation Board Assembly Diagram

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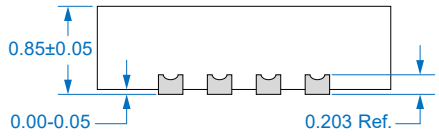
GRF5217 Evaluation Board Assembly Diagram Reference

Component	Type	Manufacturer	Family	Value	Package Size	Substitution
M1	Inductor	Murata	LQG	5.1 nH	0402	ok
M2, M27	Capacitor	Murata	GJM	22 pF	0402	ok
M5	Resistor	Various	1%	3.3 kΩ	0402	ok
M9	Resistor	Various	1%	3.16 kΩ	0402	ok
M10	Capacitor	Murata	GRM	0.1 µF	0402	ok
M11	Inductor	Murata	LQGWH	2.2 nH	0402	ok
M4, M15, M16	Resistor	Various	5%	0 Ω	0402	ok
M14, M19	Capacitor	Murata	** GRM	10 µF	0402	ok
M20, M30	Capacitor	Murata	GJM	4.3 pF	0402	ok
M22	Inductor	Murata	LQW18AN	3.9 nH	0603	ok
M23	Inductor	CoilCraft	0402 HP	1.0 nH	0402	ok
M26	Capacitor	Murata	GJM	2.3 pF	0402	ok
M28	Inductor	Murata	LQG	1.5 nH	0402	ok
M29	Capacitor	Murata	GJM	1.3 pF	0402	ok
Evaluation Board	QFN16-30-24-D					

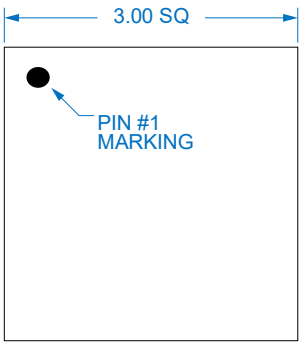
Notes:
Standard evaluation board bias: V_{CC} = 4 V, V_{ENABLE} = 4 V.
** 10 µF must be rated for > 5 V at maximum ambient temperature. Manufacturer Part Number in this case = GRM155C80J106ME11D.

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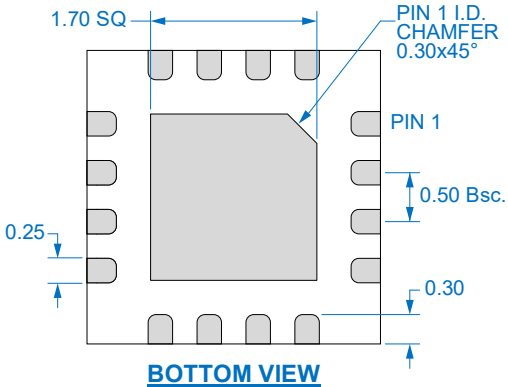
Package Outline Drawing



SIDE VIEW

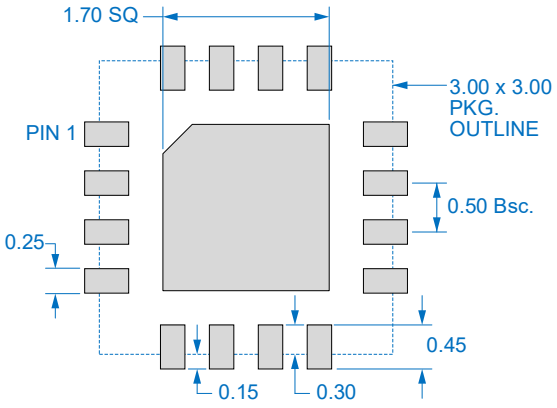


TOP VIEW



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



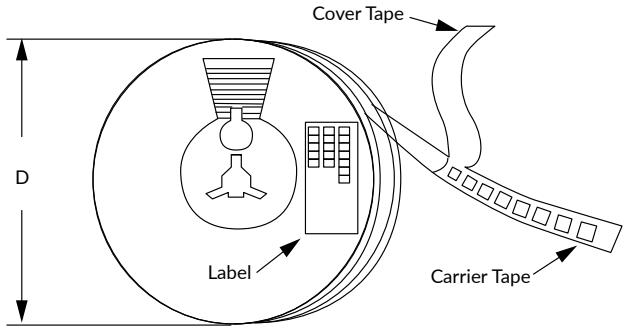
- Line 1: "YY" = YEAR. "WW" = WORK WEEK the device was assembled.
- Line 2: "GRF" = Guerrilla RF.
- Line 3: "XXXX" = Device PART NUMBER.

Tape and Reel Information

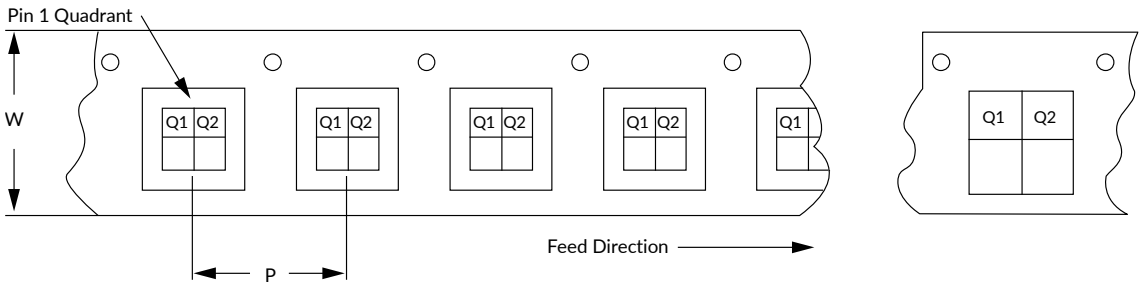
Guerrilla RF's tape and reel specification complies with Electronic Industries Alliance (EIA) standards for "Embossed Carrier Tape of Surface Mount Components for Automatic Handling" (reference EIA-481). See the following page for the Tape and Reel Specification and Device Package Information table, 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: *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
November 5, 2024	Preliminary Data sheet.
January 22, 2025	Rerouted V_{CC1} to Stage 1 output on block diagram, pinout and schematic.
January 7, 2026	Release Ø Data Sheet. Updated specifications and plots.
March 5, 2026	Updated Applications list on page 1. Added new package outline drawing.

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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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