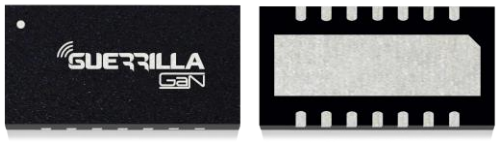
DATA SHEET

RELEASE Ø DATA SHEET

GRF0135
GaN HEMT Power Transistor
150 Watt P3dB
DC to 3.2 GHz



FEATURES

- Operating Frequency Range: DC to 3.2 GHz
- Operating Drain Voltage: 28 and 50 Volt
- Maximum Output Power: 150 Watt (P3dB)
- Suitable for Pulsed, Linear Applications
- 100% DC & RF Production Tested
- Compact 6 x 3 mm DFN-14 Package

Reference: 50 V / 150 mA / 3.2 GHz

- Saturated Gain: 13.8 dB
- Saturated Drain Efficiency: 57 %
- Saturated Output Power: 51.8 dBm

APPLICATIONS

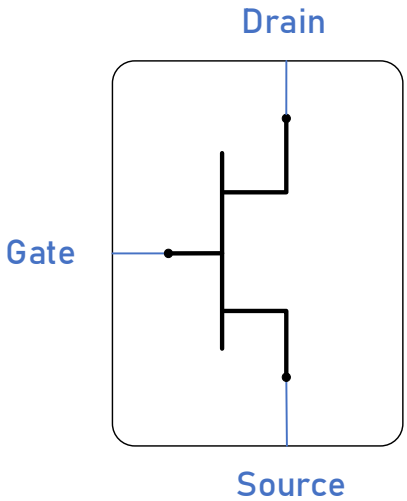
- Cellular Infrastructure
- Radar
- Communications
- Test Instrumentation

DESCRIPTION

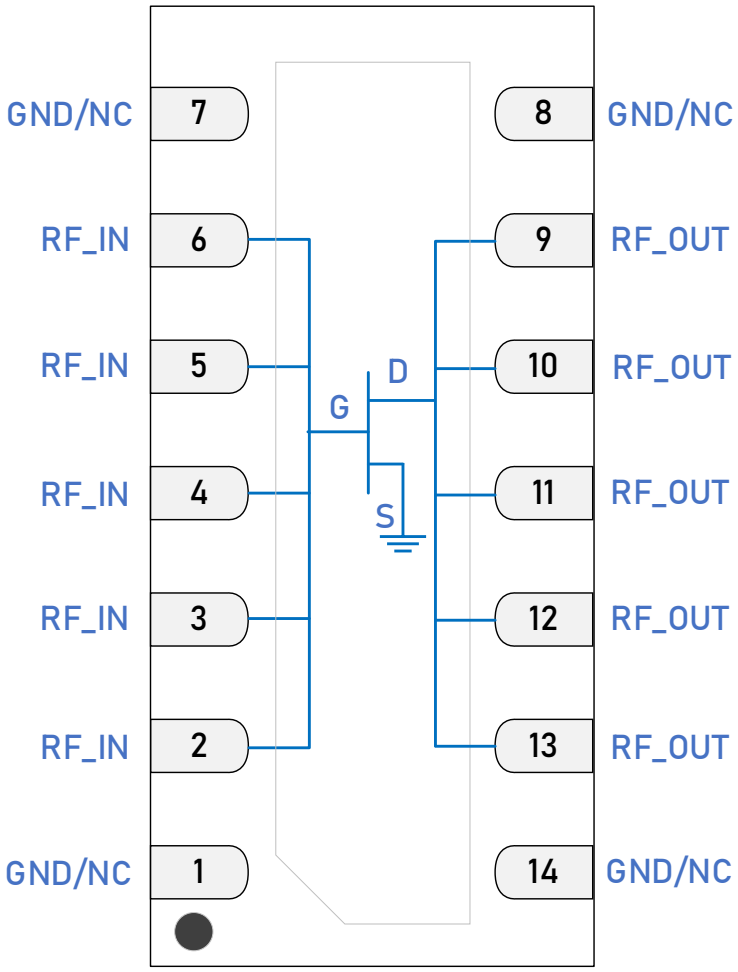
The GRF0135 is a 150 W (P3dB) unmatched discrete GaN-on-SiC HEMT which operates from DC to 3.2 GHz on a 50 V supply rail. The wide bandwidth makes the GRF0135 suitable for a variety of applications including cellular infrastructure, radar, communications, and test instrumentation, and can support both linear and pulse operations. The device is housed in an industry-standard 6 x 3 mm surface mount DFN-14 plastic package. Lead free and RoHS compliant.

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

BLOCK DIAGRAM



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6 x 3 mm Pin Out (Top View)

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Pin Assignments

Pin	Name	Description	Note
1, 7, 8, 14	GND/NC	Ground or No Connect	No internal connection to die. It is strongly recommended that these pins be connected to ground.
2, 3, 4, 5, 6	RF_IN	Gate Voltage	Connected to GATE terminal of GaN transistor.
9, 10, 11, 12, 13	RF_OUT	Drain Voltage	Connected to DRAIN terminal of GaN transistor.
PKG BASE	SOURCE	Source Connection	Connected to the SOURCE terminals of the GaN transistor. Provides DC and RF ground as well as thermal heat sink. **In order to match the device's rated performance, it is strongly recommended to use multiple thermal vias beneath the package for optimal RF and thermal performance**. Refer to evaluation board top layer graphic on schematic page.

GaN HEMT Power-up / Power-down Procedure:

To turn the transistor ON:

1. Set V_{GS} to -5 V.
2. Turn on V_{DS} to normal operation voltage (50 V).
3. Slowly increase V_{GS} to set I_{DS} current to 150 mA.
4. Apply RF power.

To turn the transistor OFF:

1. Turn the RF power off.
2. Decrease V_{GS} to -5 V.
3. Turn off V_{DS}. Wait a few seconds for Drain capacitor to discharge.
4. Turn off V_{GS}.

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Absolute Ratings

Parameter	Symbol	Min.	Max.	Unit
Operating Voltage	V_{DS}		55	V
Drain to Gate Breakdown Voltage	B_{VDG}		TBD	V
Drain to Source Voltage	V_{DS}		150	V
Gate to Source Voltage	V_{GS}	-8	2	V
Drain Current	I_D		TBD	mA
RF Input Power: 50 Ω, V_{DS} = 50 V, I_{DS} = 150 mA, $T_{PKG\ BASE}$ = 85 °C.	$P_{IN\ MAX}$		TBD	dBm
RF Input Power: 10:1 VSWR, V_{DS} = 50 V, I_{DS} = 150 mA, $T_{PKG\ BASE}$ = 85 °C.	$P_{IN\ MAX}$		TBD	dBm
Output Mismatch Stress: V_{DS} = 50 V, P_{OUT} = P_{SAT} pulsed = TBD.	$VSWR_{MAX}$		TBD	
Operating Temperature (package base).	$T_{PKG\ BASE}$	-40	105	°C
Maximum Junction Temperature (MTTF > 10^6 hours).	$T_{J\ MAX}$		225	°C
Maximum Dissipated Power	$P_{DISS\ MAX}$		TBD	W

Electrostatic Discharge

Human Body Model	HBM	TBD		V
Charged Device Model	CDM	TBD		V

Storage

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

Note 1: Exceeding any of these limits may cause permanent damage to the device or reduce the lifetime (MTTF).
Note 2: Guerrilla-RF does not recommend sustained operation above the maximum operating conditions.

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.		
RF Frequency Range	F_{TEST}	DC	3.2	3.2	GHz	Typical application schematic **(notes 3 & 4)**.
Drain to Source Voltage	V_{DS}	TBD	50	TBD	V	Typical application schematic.
Drain Current (Quiescent)	I_{DQ}		150		mA	Typical application schematic.
Drain Current: RF	$I_{D\text{-}DRIVE}$		TBD		mA	Typical application schematic.
Gate Voltage	V_{GS}		-2.5		V	Typical application schematic.
Gate Current: RF	$I_{G\text{-}DRIVE}$		TBD		mA	Typical application schematic, P_{OUT} = 150 W.
Operating Temperature	$T_{PKG\ BASE}$	-40		85	°C	On package base.
Gate Port Impedance	Z_{RFIN}		50		Ω	Typical application schematic.
Drain Port Impedance	Z_{RFOUT}		50		Ω	Typical application schematic.

Note 3: Operation outside of this range is possible, but with degraded performance of some parameters.

Note 4: 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 2.2 to 3.2 GHz tuning set, V_{DS} = 50 V, I_{DS} = 150 mA, P_{OUT} = 150 W, F_{TEST} = 3.2 GHz, Pulsed CW (100 µs pulse width, 10% duty cycle, no modulation), 50 Ω system impedance, T_{AMB} = 25 °C, $T_{PKG\ BASE}$ = -40 to 85 °C. Evaluation board losses are included within the specifications.

Parameter	Symbol	Specification			Unit	Condition
		Min.	Typ.	Max.		
Drain Source Breakdown Voltage	B_{VDS}	150			V	
Drain Source Leakage Current	I_{DLK}		13		mA	V_{GS} = -8 V, V_{DS} = 50 V.
Drain Current: Quiescent	I_{DQ}		150		mA	No RF applied.
Gate Threshold Voltage	V_{GS}	-3.4		-1.5	V	V_{DS} = 50 V.
Gate Bias Voltage	V_{GS}		-2.5		V	
Drain Voltage	V_{DS}		50		V	
Drain Current: RF	$I_{D\text{-}DRIVE}$		TBD		mA	RF applied, P_{OUT} = 150 W.
Gate Current: RF	$I_{G\text{-}DRIVE}$		TBD		mA	RF applied, P_{OUT} = 150 W.
Gate Leakage Current	$I_{G\text{-}LEAK}$		TBD		µA	

Thermal And Reliability Information: Pulsed CW, $T_{CHANNEL}$ = 85 °C

Thermal Resistance (Infrared Scan)	θ_{JC}		TBD		°C /W	P_{OUT} = TBD. On standard evaluation board.
Channel Temperature	$T_{CHANNEL}$		TBD		°C	

Note 5: MIN/MAX limits defined using modelled estimates that account for part-to-part variations and expected process spreads. As additional production lots are fabricated, accumulated test data will be used to refine the MIN/MAX limits.

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Nominal Operating Parameters – RF: DC to 3.2 GHz

The following conditions apply unless noted otherwise: typical application schematic using the 2.2 to 3.2 GHz tuning set, V_{DS} = 50 V, I_{DS} = 150 mA, P_{OUT} = 150 W, F_{TEST} = 3.2 GHz, Pulsed CW (100 µs pulse width, 10% duty cycle, no modulation), 50 Ω system impedance, T_{AMB} = 25 °C, $T_{PKG\ BASE}$ = -40 to 85 °C. Evaluation board losses are included within the specifications.

Parameter	Symbol	Specification			Unit	Condition
		Min.	Typ.	Max.		
Small Signal Gain	G_{SS}		12.5		dB	At I_{DS} ≤ 1.1* I_{DS}.
Power Gain	G_{MAX}		13.5		dB	Max gain vs. power.
Saturated Gain	G_{SAT}		13.8		dB	At 3 dB compression referenced to G_{MAX}.
Saturated Drain Efficiency	$D_{Eff\ (SAT)}$		57		%	
Saturated Output Power	P_{SAT}		51.8		dBm	
Ruggedness	Ψ	At 3 dB compression. Output VSWR = 10:1 (all angles)				No damage or shift in performance.

Note 6: MIN/MAX limits defined using *modelled estimates* that account for part-to-part variations and expected process spreads. As additional production lots are fabricated, accumulated test data will be used to refine the MIN/MAX limits.

Typical Performance:

Single-Tone Pulse CW (10% duty cycle, 100 µs pulse width). 2nd Harmonic not optimized.

1. Optimum Peak Power at 3 dB compression.
2. Optimum Peak Efficiency at 3 dB compression.

V_{DS} = 50 V, I_{DS} = 150 mA, T_{AMB} = 25 °C

Frequency (MHz)	P_{OUT}(1) (dBm)	Gain(2) (dB)	Drain Eff(2) (%)
1000	51.4	24.2	64.4
1200	51.8	22.7	67.3
1400	51.8	21.8	66.1
1600	51.8	20.4	66.1
1800	51.9	19.6	66.1
2000	51.7	18.4	63.8
2200	51.7	17.9	64.3
2400	51.7	17	62.3
2600	51.9	16.3	66.1
2800	51.7	16	64.2

V_{DS} = 28 V, I_{DS} = 150 mA, T_{AMB} = 25 °C

Frequency (MHz)	P_{OUT}(1) (dBm)	Gain(2) (dB)	Drain Eff(2) (%)
1000	48.5	23.5	64.1
1200	49.4	20.2	64.7
1400	49	19.7	67.3
1600	49.4	18.6	67.1
1800	49.4	17.4	68.5
2000	49.3	16.6	66.3
2200	49.3	15.9	66.5
2400	49.3	15	63.7
2600	49.4	14.2	67.4
2800	49.1	13.8	65.5

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Typical Performance:

Load Pull Measurements: V_{DS} = 50 V, I_{DS} = 150 mA. Single-Tone Pulse CW (10% duty cycle, 100 µs pulse width).

For Optimum Peak Power at 3 dB Compression

Frequency (MHz)	Z_{IN} (F0)	ZI (F0)	Gain (dB)	P_{OUT} (dBm)	P_{OUT} (W)	Eff (%)	AMPM (deg)
1000	0.8 j -3.8	6.19 +j1.19	23.8	51.8	151.4	59.8	-0.2
1200	0.7 j -2.8	5.61 +j2.06	23.0	51.9	154.9	62.0	-0.6
1400	0.8 j -2.3	5.07 +j1.45	20.9	52.0	158.5	59.2	-0.4
1600	0.9 j -1.5	4.69 +j0.58	19.2	52.1	162.2	56.3	0.1
1800	0.8 j -1.0	4.82 +j1.80	19.1	52.1	162.2	63.2	-1.0
2000	0.8 j -0.6	4.47 +j0.78	17.5	52.0	158.5	57.3	-0.8
2200	0.7 j -0.2	4.79 +j0.57	17.0	52.1	162.2	58.6	-1.8
2400	0.7 j 0.3	3.95 +j0.57	16.3	52.0	158.5	58.8	-2.9
2600	0.8 j 0.7	3.22 +j0.51	15.7	52.0	158.5	58.2	-2.2
2800	0.8 j 1.1	3.42 +j0.54	14.9	52.0	158.5	58.1	-1.7
3000	0.7 j 1.5	3.40 -j0.16	14.2	51.9	154.9	53.5	-2.3

For Optimum Peak Efficiency at 3 dB Compression

Frequency (MHz)	Z_{IN} (F0)	ZI (F0)	Gain (dB)	P_{OUT} (dBm)	P_{OUT} (W)	Eff (%)	AMPM (deg)
1000	0.8 j -3.2	12.09 +j4.31	22.8	50.6	114.8	68.2	2.2
1200	0.7 j -2.5	7.33 +j3.82	22.8	51.4	138.0	68.0	-1.2
1400	0.6 j -1.6	5.78 +j4.95	22.4	50.7	117.5	66.1	-3.0
1600	0.6 j -1.0	5.28 +j4.66	21.0	50.9	123.0	67.4	-3.2
1800	0.6 j -0.5	4.50 +j4.60	20.3	50.6	114.8	68.3	-3.9
2000	0.6 j -0.3	4.54 +j3.58	18.7	51.2	131.8	66.3	-2.8
2200	0.6 j 0.3	4.44 +j4.16	18.3	50.7	117.5	67.5	-4.0
2400	0.6 j 0.6	4.15 +j3.13	17.2	51.0	125.9	66.5	-2.4
2600	0.6 j 1.1	3.07 +j3.47	16.5	50.1	102.3	67.0	-3.3
2800	0.6 j 1.5	2.62 +j3.21	16.1	50.0	100.0	65.9	-3.1
3000	0.6 j 1.7	2.89 +j2.59	15.6	50.6	114.8	64.5	-2.8

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Typical Performance:

Load Pull Measurements: V_{DS} = 28 V, I_{DS} = 150 mA. Single-Tone Pulse CW (10% duty cycle, 100 µs pulse width).

For Optimum Peak Power at 3 dB Compression

Frequency (MHz)	Z_{IN} (F0)	ZI (F0)	Gain (dB)	P_{OUT} (dBm)	P_{OUT} (W)	Eff (%)	AMPM (deg)
1000	1.0 j -3.9	3.57 -j1.42	20.2	48.9	77.6	52.7	0.6
1200	0.8 j -3.1	3.00 -j0.58	20.1	48.8	75.9	52.1	-0.1
1400	0.9 j -2.1	3.72 -j0.71	18.5	49.1	80.4	57.7	-0.3
1600	0.7 j -1.4	3.27 -j0.68	17.7	49.1	81.3	56.4	-1.2
1800	0.8 j -1.0	3.25 -j0.69	16.9	49.0	79.4	57.1	-0.7
2000	0.6 j -0.5	2.56 -j0.73	16.1	49.0	79.4	52.8	-2.8
2200	0.7 j -0.1	3.53 -j0.98	15.5	49.1	81.3	58.8	-1.5
2400	0.7 j 0.3	2.74 -j1.38	14.4	49.0	79.4	54.2	-1.7
2600	0.7 j 0.8	2.76 -j1.16	13.9	49.1	81.3	57.0	-2.9
2800	0.7 j 1.2	2.86 -j1.13	13.4	49.0	79.4	57.0	-1.5
3000	0.7 j 1.5	2.78 -j1.19	13.2	49.0	79.4	56.8	-1.5

For Optimum Peak Efficiency at 3 dB Compression

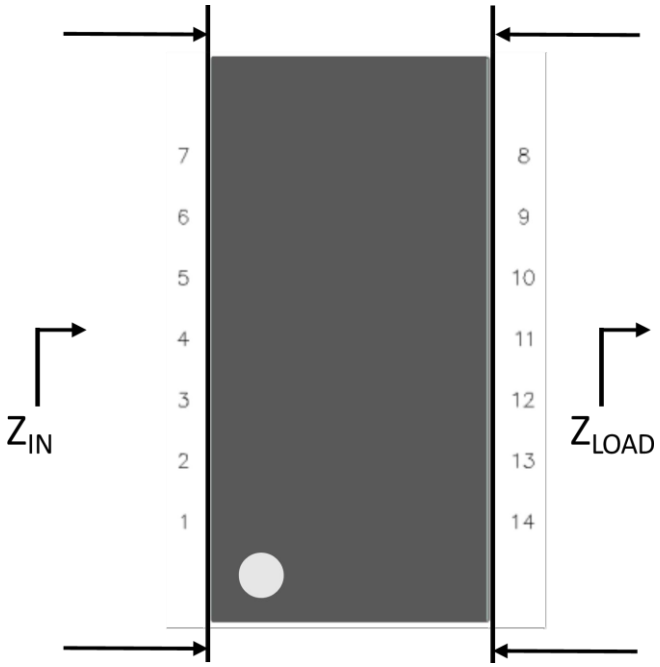
Frequency (MHz)	Z_{IN} (F0)	ZI (F0)	Gain (dB)	P_{OUT} (dBm)	P_{OUT} (W)	Eff (%)	AMPM (deg)
1000	0.8 j -2.9	9.02 +j1.47	20.9	47.1	51.3	66.6	-0.8
1200	0.7 j -2.3	7.37 +j2.41	20.3	47.3	53.7	68.5	-0.1
1400	0.7 j -1.6	5.79 +j3.2	19.8	47.1	51.3	67.5	-1.0
1600	0.7 j -0.8	5.23 +j3.03	18.7	47.2	52.5	68.3	-1.9
1800	0.6 j -0.5	4.40 +j2.7	18.1	47.2	52.5	68.5	-2.7
2000	0.6 j -0.0	3.74 +j2.05	17.3	47.6	57.5	66.8	-2.7
2200	0.6 j 0.3	4.03 +j2.01	16.5	47.5	56.2	67.5	-3.0
2400	0.6 j 0.7	3.48 +j1.23	15.5	47.7	58.9	66.7	-3.7
2600	0.6 j 1.2	2.72 +j1.31	15.1	47.3	53.7	66.8	-4.8
2800	0.7 j 1.5	2.74 +j1.45	14.2	47.2	52.5	65.8	-3.7
3000	0.6 j 1.7	2.83 +j0.78	13.9	47.7	58.9	64.5	-3.7

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Load Pull Measurement Notes:

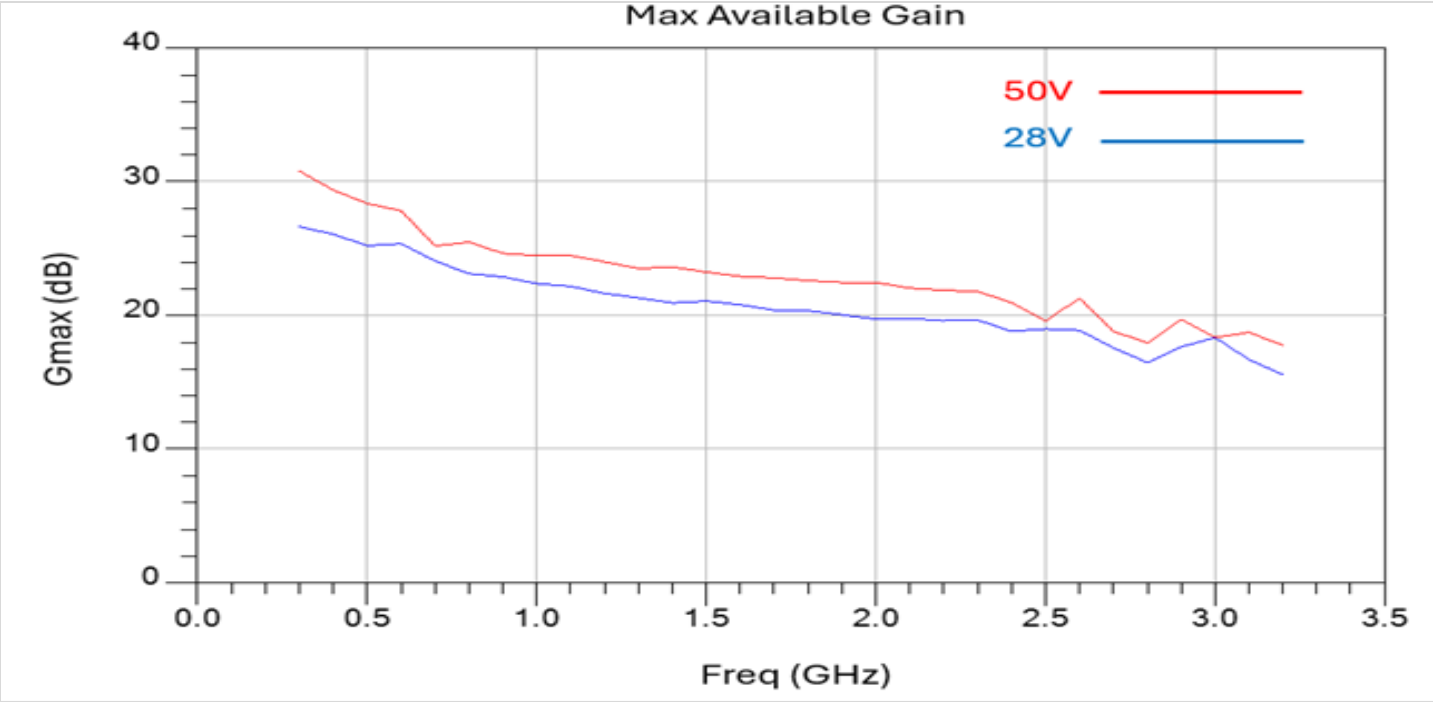
1. Source and load impedance at 2nd harmonic are set to 10 Ω.
2. With proper 2nd harmonic termination, expect +5% efficiency for Source and similar with Drain 2nd harmonic.
3. Z_{LOAD}: measured impedance presented to the output of the device in the reference plane.
4. Z_{IN}: measured input impedance at the input of the device in the reference plane.

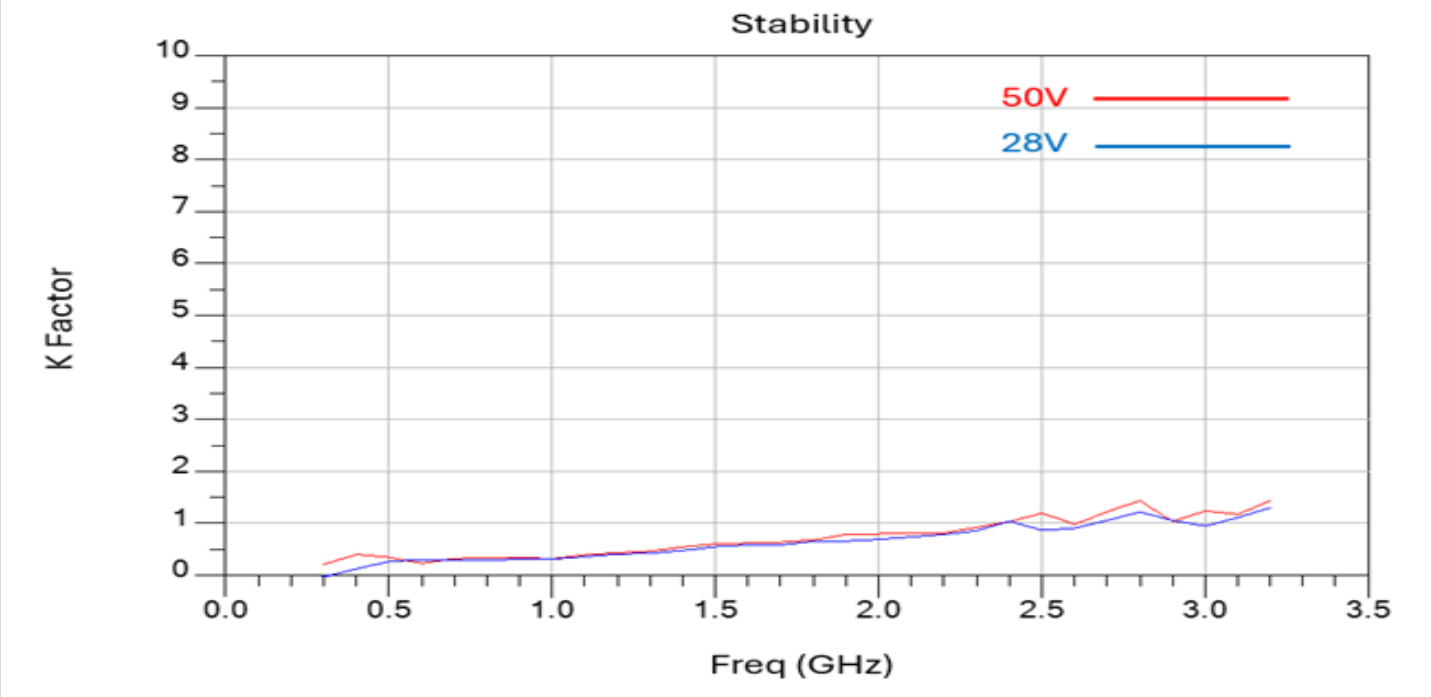
Impedance Reference Plane



Raw data and full Load Pull measurement report available at request: sales@guerrilla-rf.com

Typical Operating Curves: Maximum Available Gain and Stability vs. Frequency

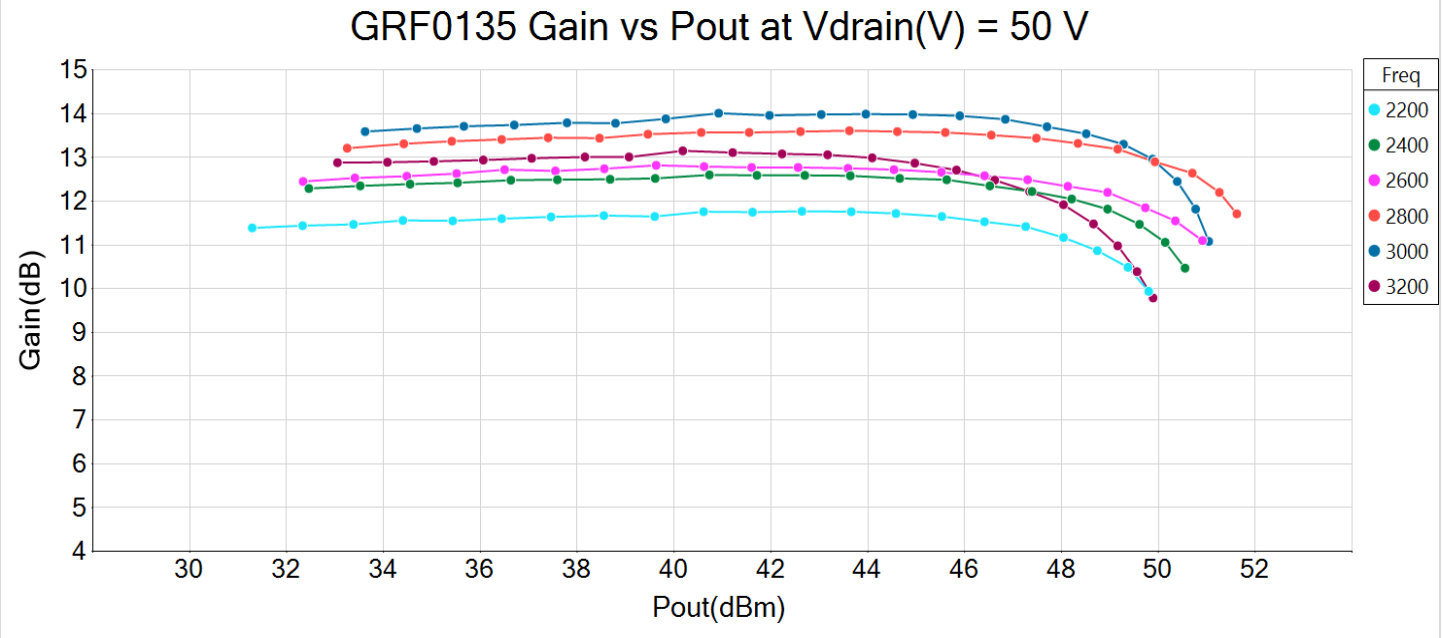




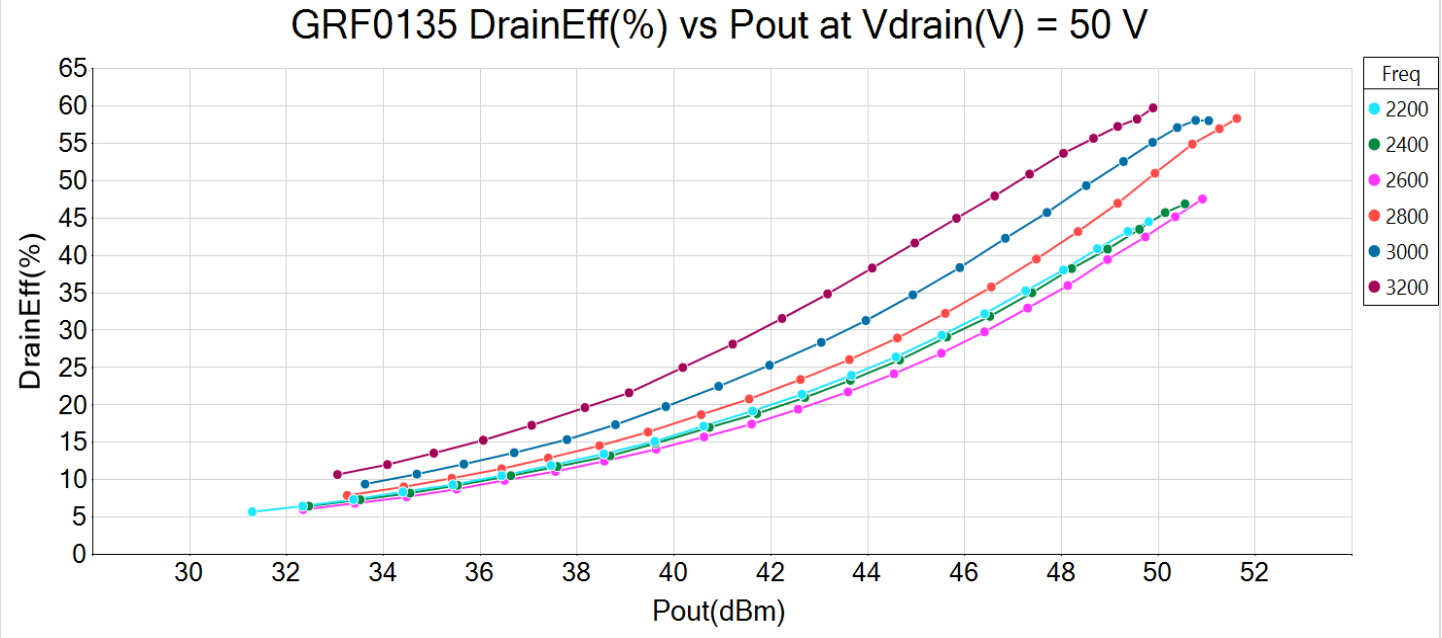
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Typical Operating Curves: 2.2 to 3.2 GHz, 50 V, Pulsed CW (10% duty cycle, 100 µs pulse width)

Gain vs. Output Power and Frequency



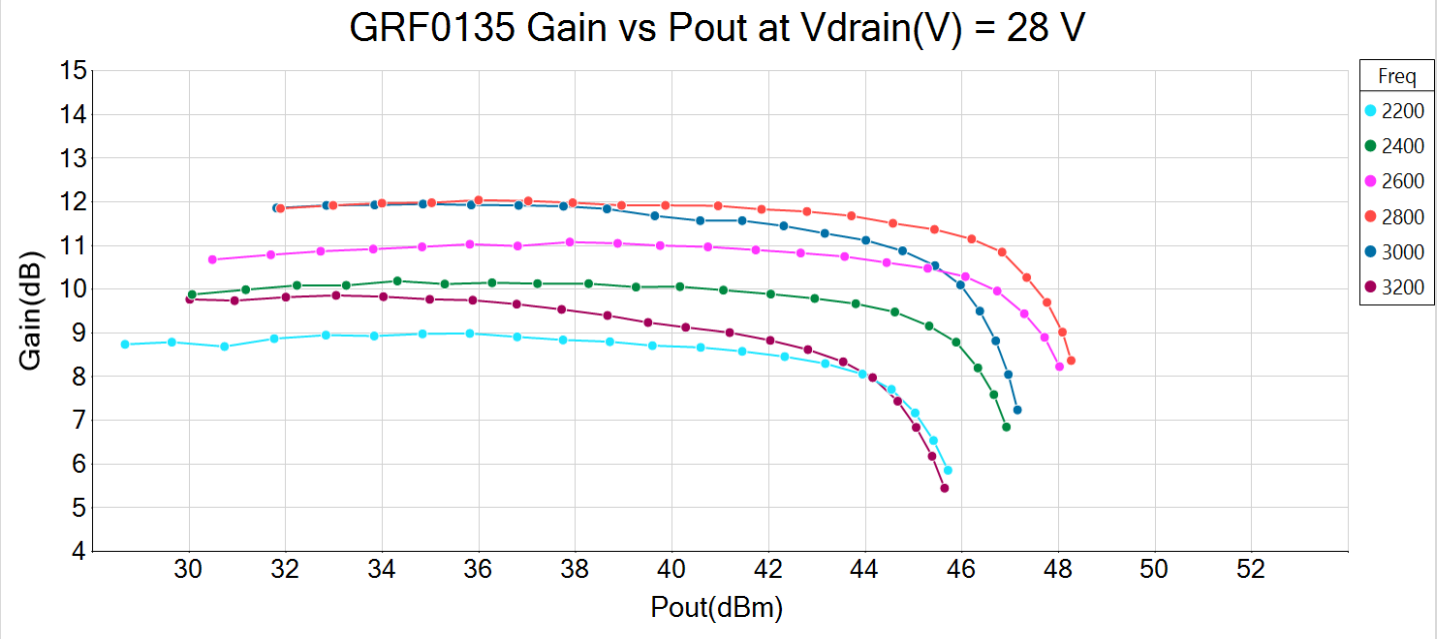
Drain Efficiency vs. Output Power and Frequency



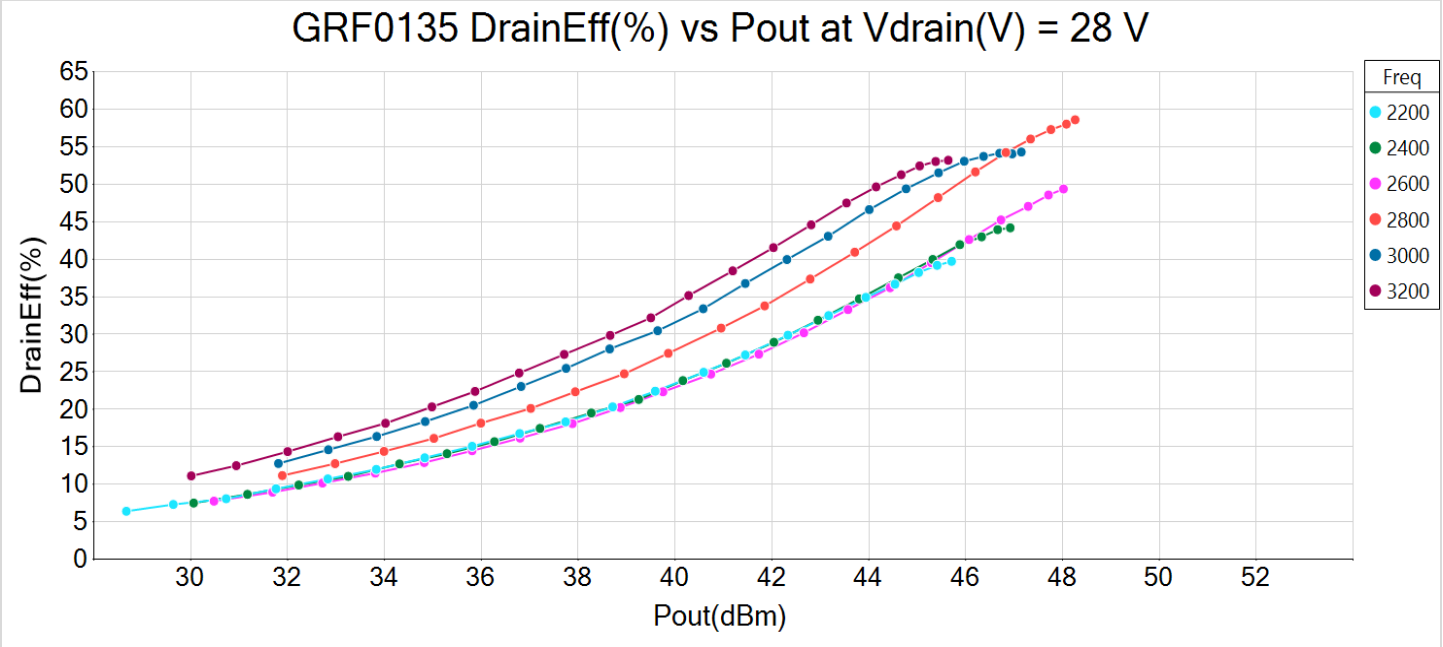
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Typical Operating Curves: 2.2 to 3.2 GHz, 28 V, Pulsed CW (10% duty cycle, 100 µs pulse width)

Gain vs. Output Power and Frequency



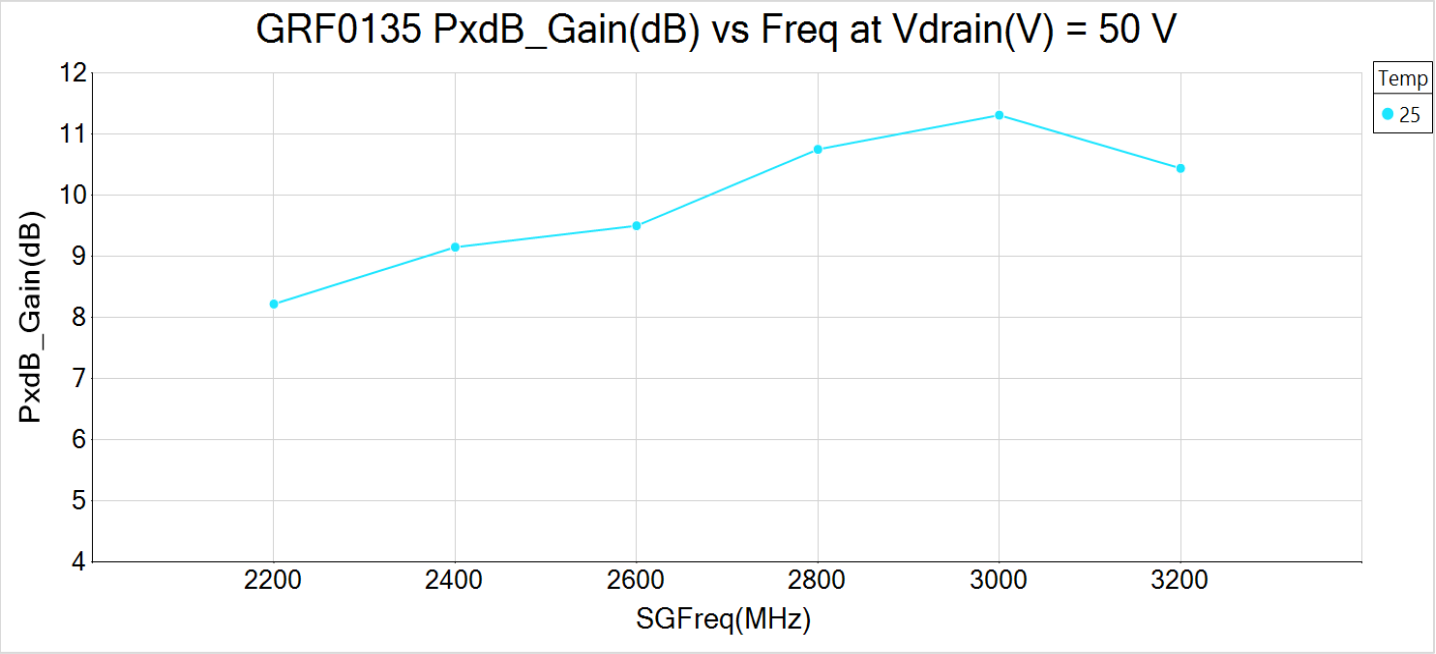
Drain Efficiency vs. Output Power and Frequency



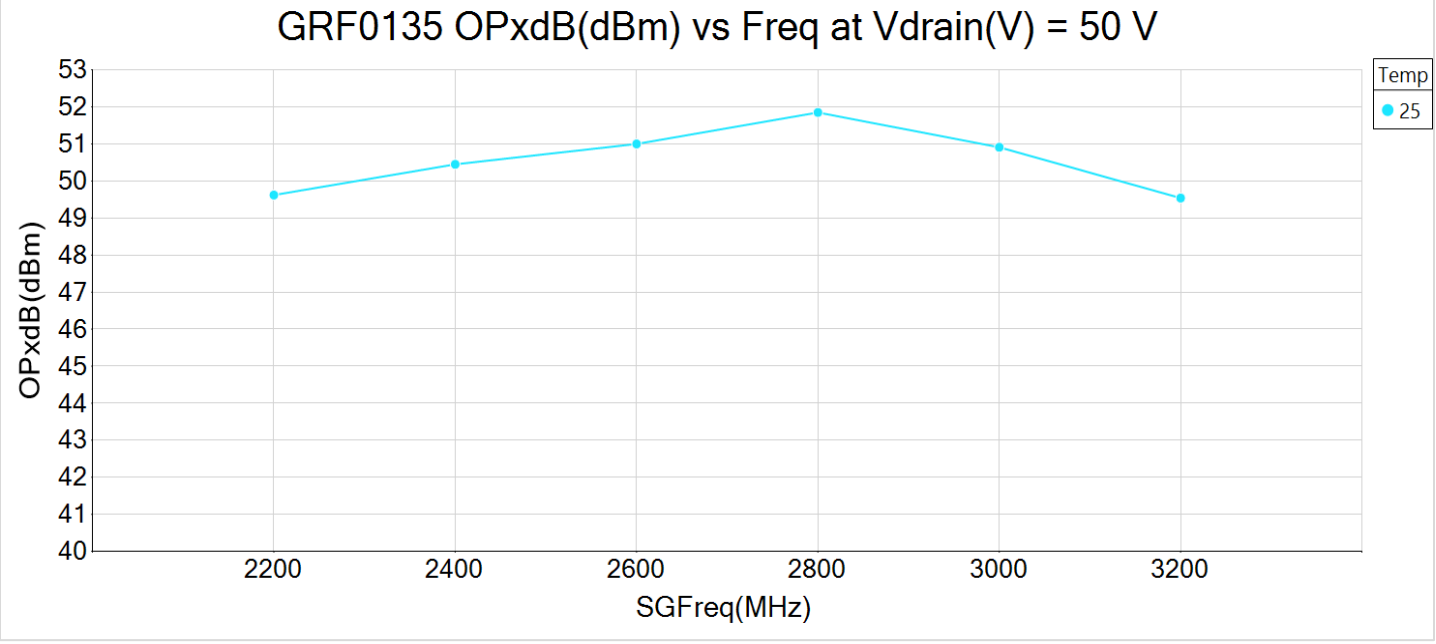
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Typical Operating Curves: 2.2 to 3.2 GHz, 50 V, Pulsed CW (10% duty cycle, 100 µs pulse width)

Gain vs. Frequency: 2.5 dB Compression



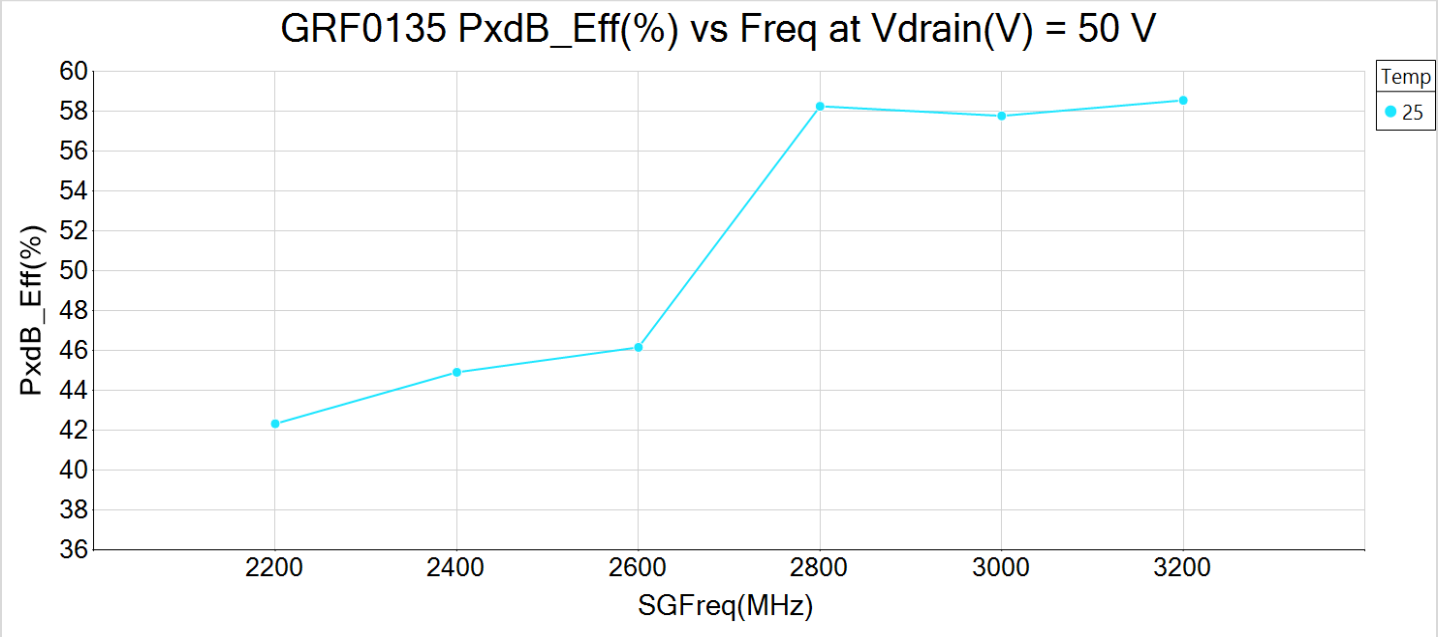
P_{OUT} vs. Frequency: 2.5 dB Compression



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Typical Operating Curves: 2.2 to 3.2 GHz, 50 V, Pulsed CW (10% duty cycle, 100 µs pulse width)

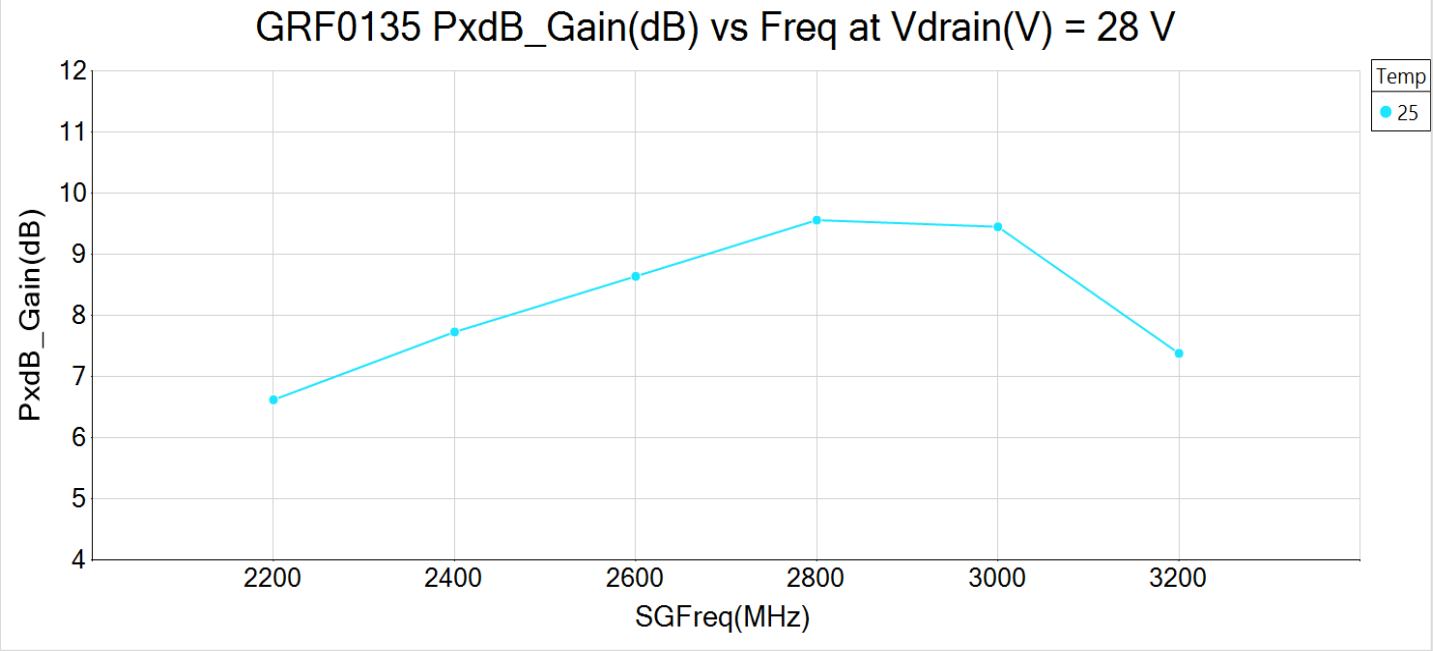
Drain Efficiency vs. Frequency: 2.5 dB Compression



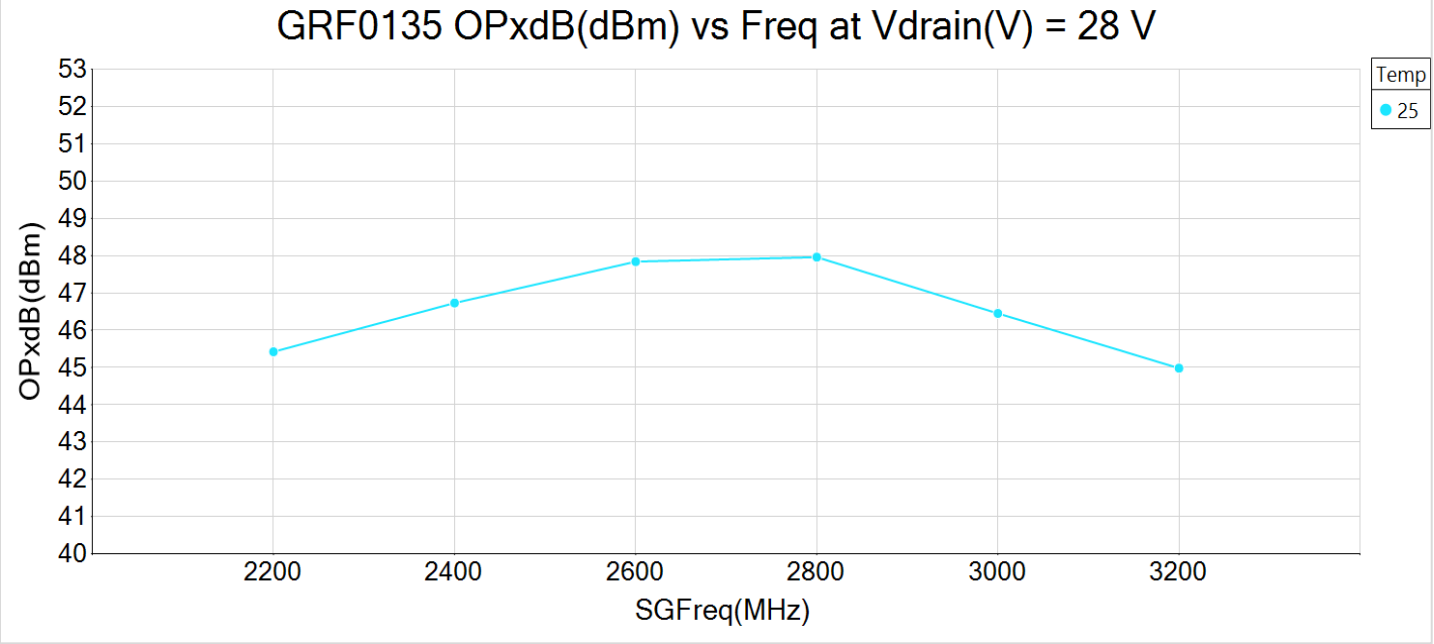
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Typical Operating Curves: 2.2 to 3.2 GHz, 28 V, Pulsed CW (10% duty cycle, 100 µs pulse width)

Gain vs. Frequency: 2.5 dB Compression



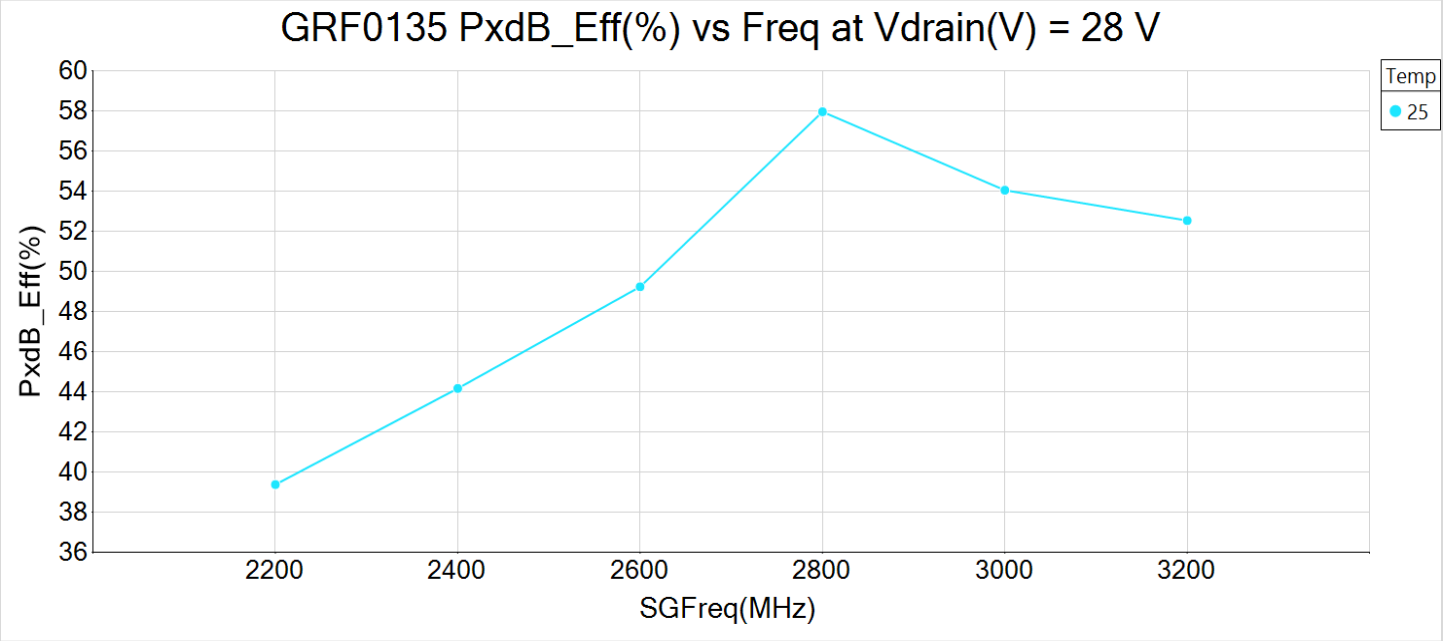
P_{OUT} vs. Frequency: 2.5 dB Compression



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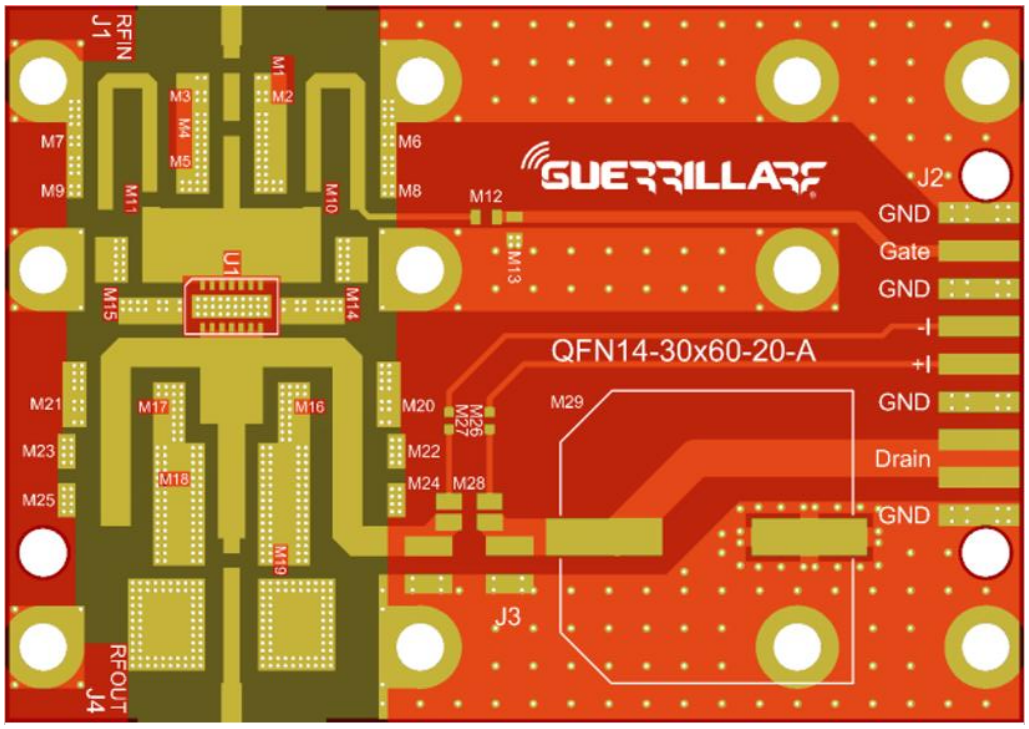
Typical Operating Curves: 2.2 to 3.2 GHz, 28 V, Pulsed CW (10% duty cycle, 100 µs pulse width)

Drain Efficiency vs. Frequency: 2.5 dB Compression



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GRF0135 Evaluation Board Assembly Diagram



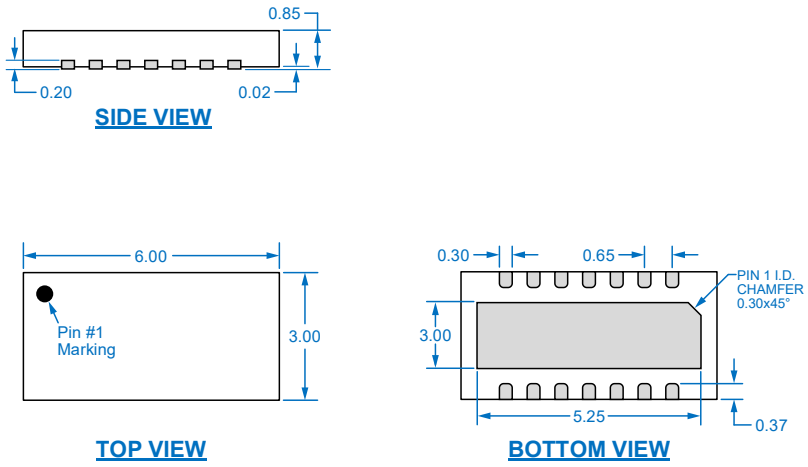
GRF0135 Evaluation Board Assembly Diagram Reference: 2.2 to 3.2 GHz Tune

Component	Type	Manufacturer	Family	Value	Package Size	Substitution
M1	Resistor	Various	5%	2 Ω	0805	ok
M2, M3	Resistor	Various	5%	1 kΩ	0805	ok
M4	Capacitor	ATC	N/A	3.3 pF	0805	ok (Murata)
M5	Capacitor	ATC	N/A	0.7 pF	0805	ok (Murata)
M6, M19, M20, M21	Capacitor	ATC	N/A	6.8 pF	0805	ok (Murata)
M7, M9, M11	DNP	--	--	--	--	--
M8, M13	Capacitor	Murata	GRM	10 µF	0805	ok
M10	Resistor	Various	5%	5.1 Ω	0805	ok
M12	Resistor	Various	5%	0 Ω	0805	ok
M14, M15	Capacitor	ATC	N/A	1.2 pF	0805	ok (Murata)
M16, M17	Capacitor	ATC	N/A	1.5 pF	0805	ok (Murata)
M18	Capacitor	ATC	N/A	0.1 pF	0805	ok (Murata)
M22, M23, M24, M25	Capacitor	Murata	GRM	10 µF	1210	ok
M26, M27	Resistor	Various	5%	1 kΩ	0603	ok
M28	Resistor	Ohmite	5%	0.01 Ω	1206	ok
U1	GaN PA GRF0135	Guerrilla-RF	--	--	6 x 3 mm	no
J1, J4	SMA Connector	Various	--	--	--	--
J2	DC Connector	Various	--	--	--	--
J3	DNP	--	--	--	--	--
Evaluation Board	QFN14-30x60-20-A	--	--	--	--	--

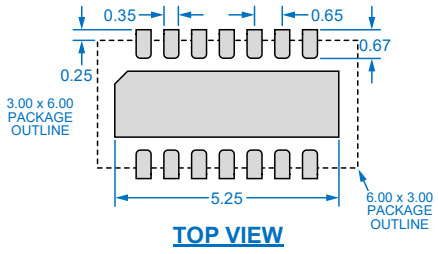
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Package Outline Drawing

Package Outline Drawing



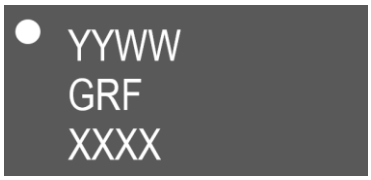
Recommended PCB Footprint



6 x 3 mm DFN-14 Package Dimensions

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Package Marking Diagram

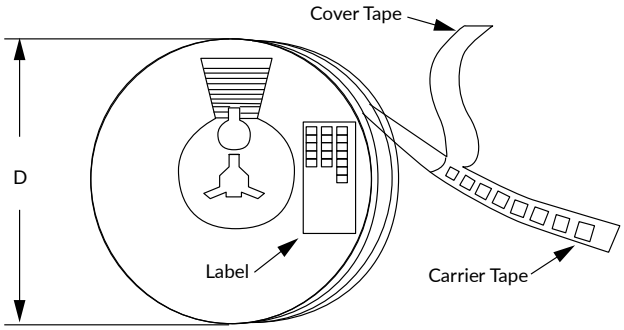


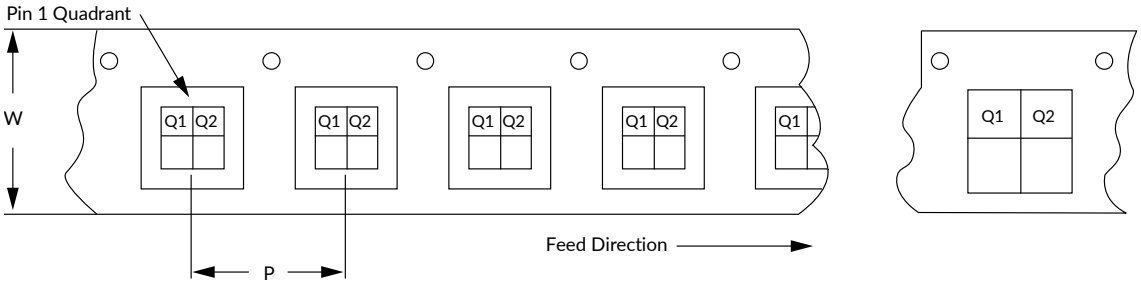
- Line 1: "YY" = YEAR. "WW" = WORK WEEK the device was assembled.
- Line 2: "GRF" = Guerrilla RF.
- Line 3: "XXXX" = Device PART NUMBER.

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





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 22, 2025	Preliminary Data Sheet.
July 22, 2025	Updated Load Pull data, Gain Max and Stability plots.
September 8, 2025	Release Ø Data Sheet. Added characterization plots.
December 16, 2025	Page-12: updated Max Gain and Stability plots.

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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.

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