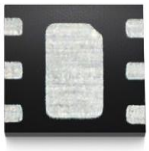
Data Sheet

RELEASE A DATA SHEET



GRF2100

LOW-CURRENT LNA 0.1 to 3.8 GHz

FEATURES

- Flexible Bias Voltage and Current
- Internally Matched to 50 Ω
- Process: GaAs pHEMT
- Compact 1.5 x 1.5 mm DFN-6 Package

Reference: 3.3 V / 15 mA / 2.5 GHz

- Gain: 16.5 dB
- OIP3: 19 dBm
- OP1dB: 10 dBm
- Evaluation Board Noise Figure: 0.8 dB

APPLICATIONS

- ISM LNA
- 2.4 GHz Drones
- Small Cells and Cellular Repeaters
- Distributed Antenna Systems

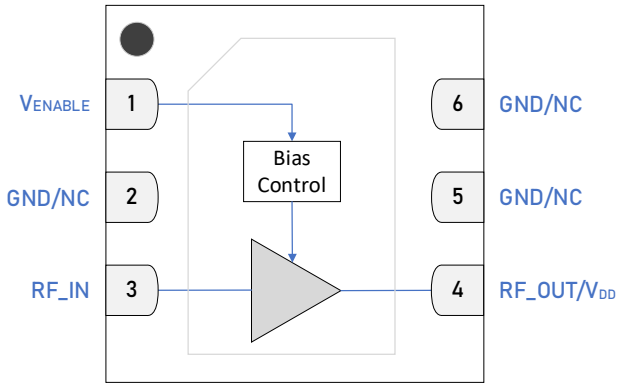
DESCRIPTION

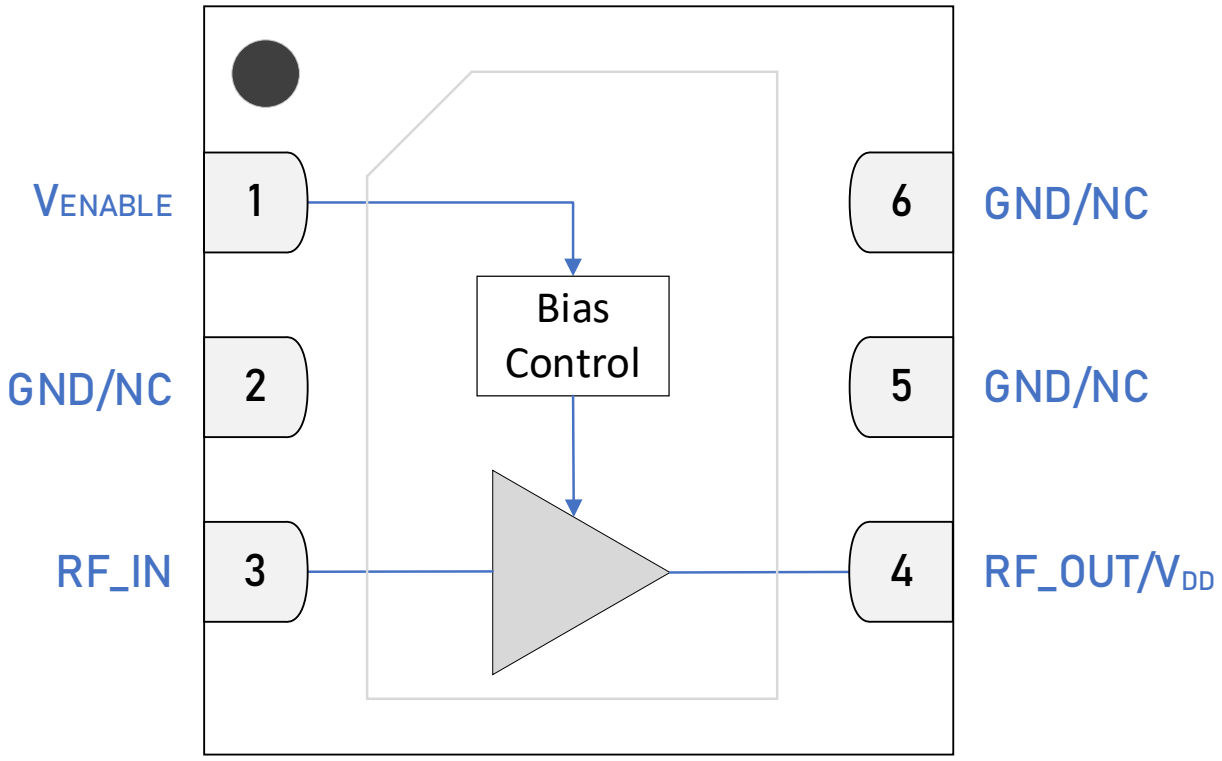
The GRF2100 is a high-gain, low-current LNA tunable over 0.1 to 3.8 GHz. It exhibits outstanding gain and NF with I_{DDQ} levels as low as 8 mA.

The device is operated from a Supply Voltage (V_{DD}) of 1.8 to 5 V with a selectable I_{DDQ} range of 8 to 30 mA for optimal efficiency and linearity.

Consult with the GRF applications engineering team for custom tuning/evaluation board data and device S-parameters.

BLOCK DIAGRAM





1.5 x 1.5mm DFN-6 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}. $V_{ENABLE} \leq 0.2$ volts disables the device. On-die pull-down resistor will turn the device off if this node is allowed to float.
2, 5, 6	NC	Ground or No Connect	No internal connection to die.
3	RF_IN	LNA RF Input	An external DC blocking capacitor must be used.
4	RF_OUT/ V_{DD}	LNA RF Output	V_{DD} must be applied through an RF choke to this pin.
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
Supply Voltage	V_{DD}	0	5.5	V
RF Input Power (Load VSWR < 2:1, $V_{DD} \leq 5$ V)	$P_{IN\ MAX}$		18	dBm
Operating Temperature (Package Heat Sink)	$T_{PKG\ HEAT\ SINK}$	-40	105	°C
Maximum Channel Temperature (MTTF >10^6 Hours)	T_{MAX}		170	°C
Maximum Dissipated Power	$P_{DISS\ MAX}$		150	mW

Electrostatic Discharge

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 *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*

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Recommended Operating Conditions

Parameter	Symbol	Specification			Unit	Condition
		Min.	Typ.	Max.		
Supply Voltage	V_{DD}	0	3.3	5.5	V	
Operating Temperature (Package Heat Sink)	$T_{PKG\ HEAT\ SINK}$	-40		105	°C	
RF Frequency Range	F_{TEST}	0.1	2.5	3.8	GHz	Typical application schematic with external matching components **(note 1 & 2)**.
RF_IN Port Impedance	Z_{RFIN}		50		Ω	Single Ended.
RF_OUT Port Impedance	Z_{RFOUT}		50		Ω	Single Ended.

Note 1: Operation outside this range is possible, but with degraded performance of some parameters.
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 Measurement Schematic using the 0.1 to 3.8 GHz tuning set, 50 Ω system impedance, M5 = 6 kΩ, V_{DD} = 3.3 V, V_{ENABLE} = 3.3 V, I_{DD} = 15 mA, F_{TEST} = 2.5 GHz, $T_{PKG\ HEAT\ SINK}$ = 25 °C. Evaluation Board losses are included within the specifications. MIN/MAX specifications listed in italics are guaranteed via production test screening. All other parameters are guaranteed by design and characterization.

Parameter	Symbol	Specification			Unit	Condition
		Min.	Typ.	Max.		
Switching Rise Time	T_{RISE}		800		ns	
Switching Fall Time	T_{FALL}		200		ns	
Supply Current	I_{DD}	*10*	15	*21*	mA	V_{DD} = V_{ENABLE} = 3.3 V, R_{BIAS} = 6 kΩ
Enable Current	I_{ENABLE}		0.2		mA	
Disabled Mode						
Leakage Current	$I_{LEAKAGE}$		1		µA	V_{DD} = 3.3 V, V_{ENABLE} = 0 V
Thermal Data						
Thermal Resistance (Infrared Scan)	Θ_{JC}		300		°C/W	On Standard Evaluation Board **(note 3)**.

Note 3: MTTF >10^6 hours for $T_{CHANNEL}$ ≤170 °C.

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Nominal Operating Parameters – RF

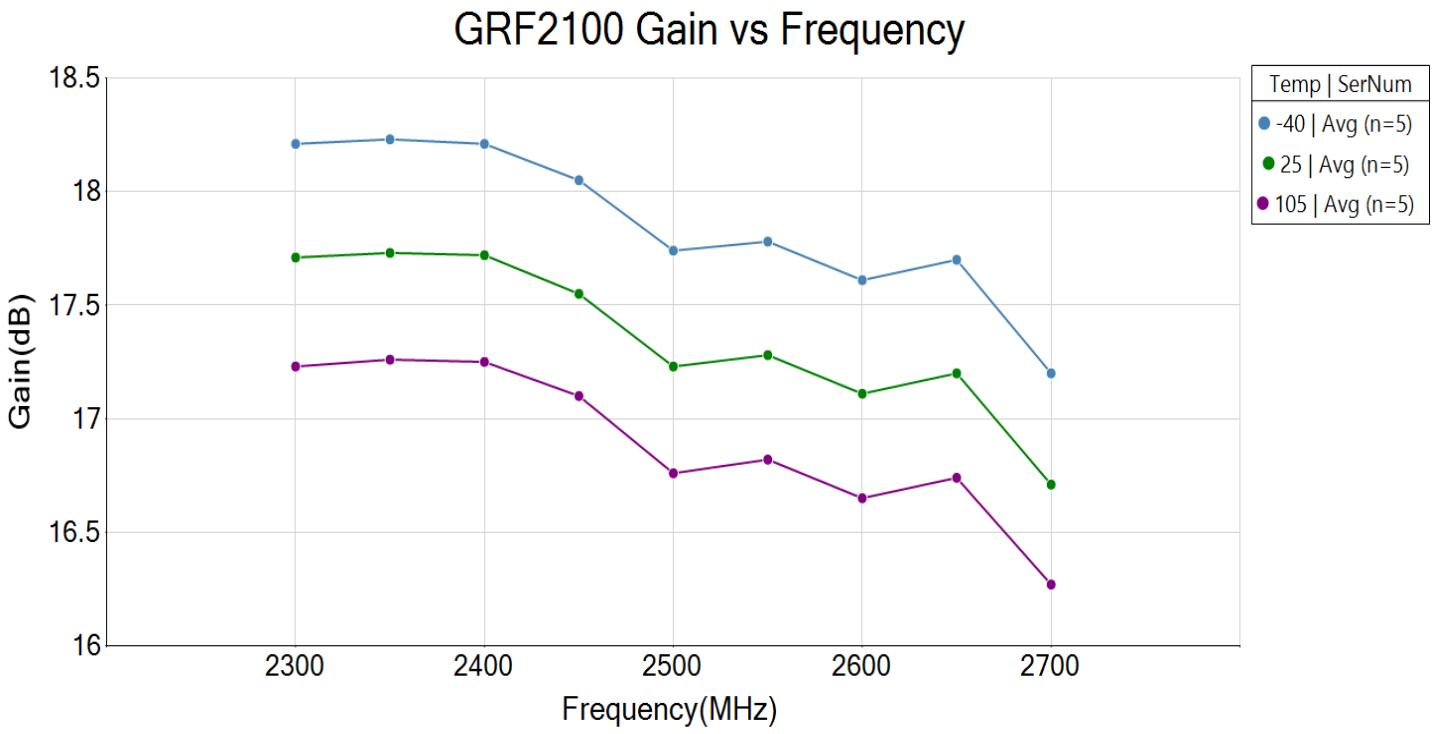
The following conditions apply unless noted otherwise: Typical Measurement Schematic using the 0.1 to 3.8 GHz tuning set. 50 Ω system impedance. M5 = 6 kΩ. V_{DD} = 3.3 V, V_{ENABLE} = 3.3 V, I_{DD} = 15 mA. F_{TEST} = 2.5 GHz. $T_{PKG\ HEAT\ SINK}$ = 25 °C. Evaluation Board losses are included within the specifications. MIN/MAX specifications listed in italics are guaranteed via production test screening. All other parameters are guaranteed by design and characterization.

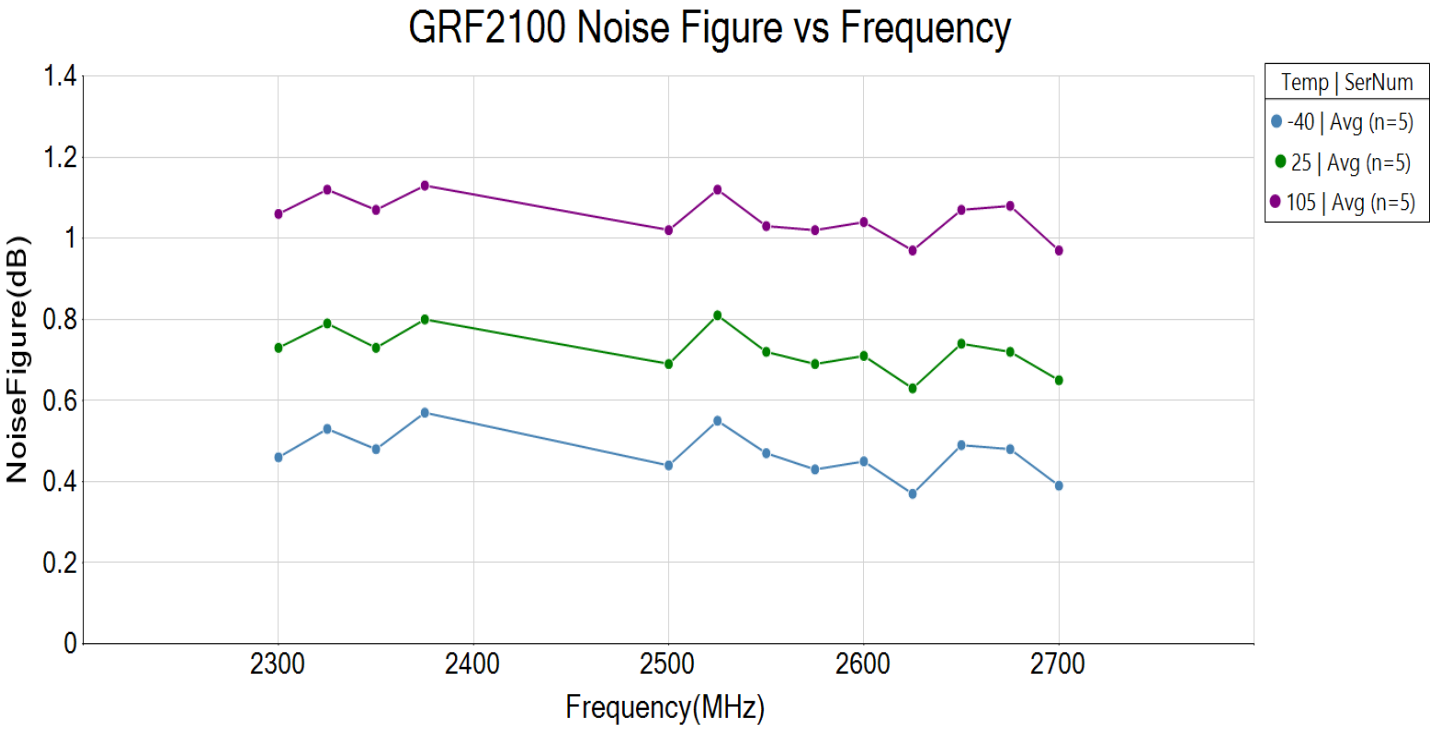
Parameter	Symbol	Specification			Unit	Condition
		Min.	Typ.	Max.		
Gain	S21	*15*	16.5		dB	
Reverse Isolation	S12		> 20		dB	F_{RF} = 0.4 to 3.8 GHz.
Evaluation Board Noise Figure	NF		0.8	*1*	dB	
Output 3rd Order Intercept	OIP3		19		dBm	-5 dBm P_{OUT} per tone at 2 MHz spacing (2499 and 2501 MHz).
Output 1 dB Compression Power	OP1dB	*8*	10		dBm	

Typical Operating Curve Conditions

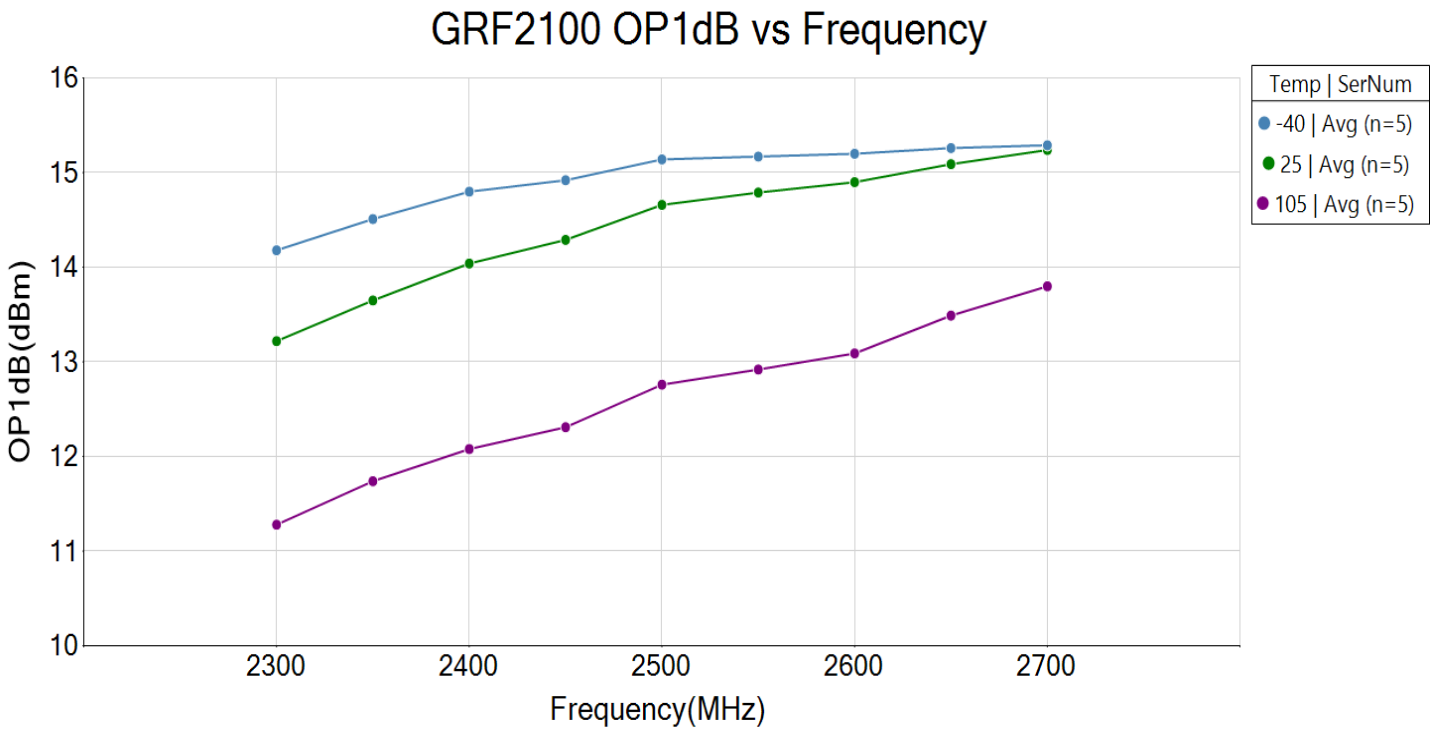
The following conditions apply unless noted otherwise: Typical Measurement Schematic using the 0.1 to 3.8 GHz tuning set. 50 Ω system impedance. M5 = 6 kΩ. V_{DD} = 3.3 V, V_{ENABLE} = 3.3 V, I_{DD} = 15 mA. F_{TEST} = 2.5 GHz. $T_{PKG\ HEAT\ SINK}$ = 25 °C. Evaluation board losses are included within the specifications.

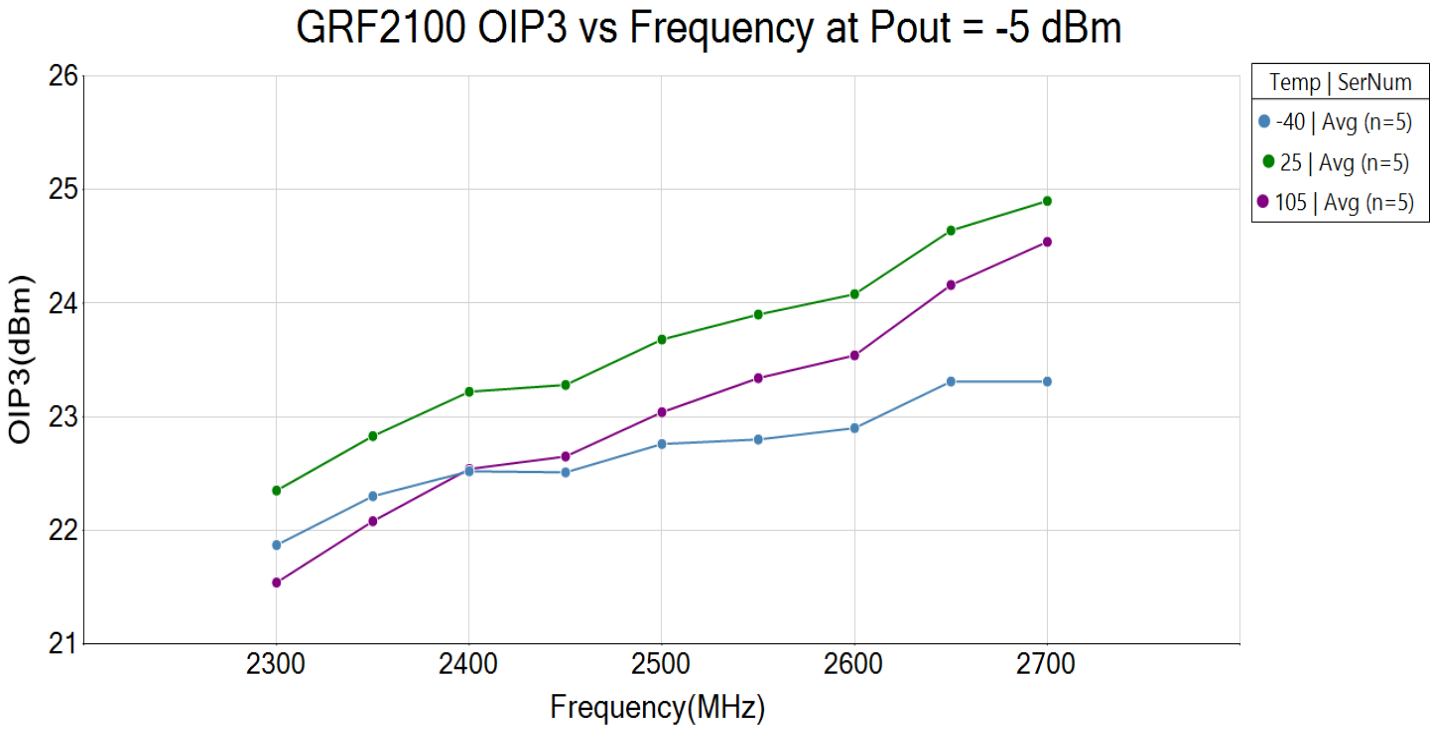
GRF2100 Typical Operating Curves: 2.3 to 2.7 GHz Tune, 3.3 V / 15 mA



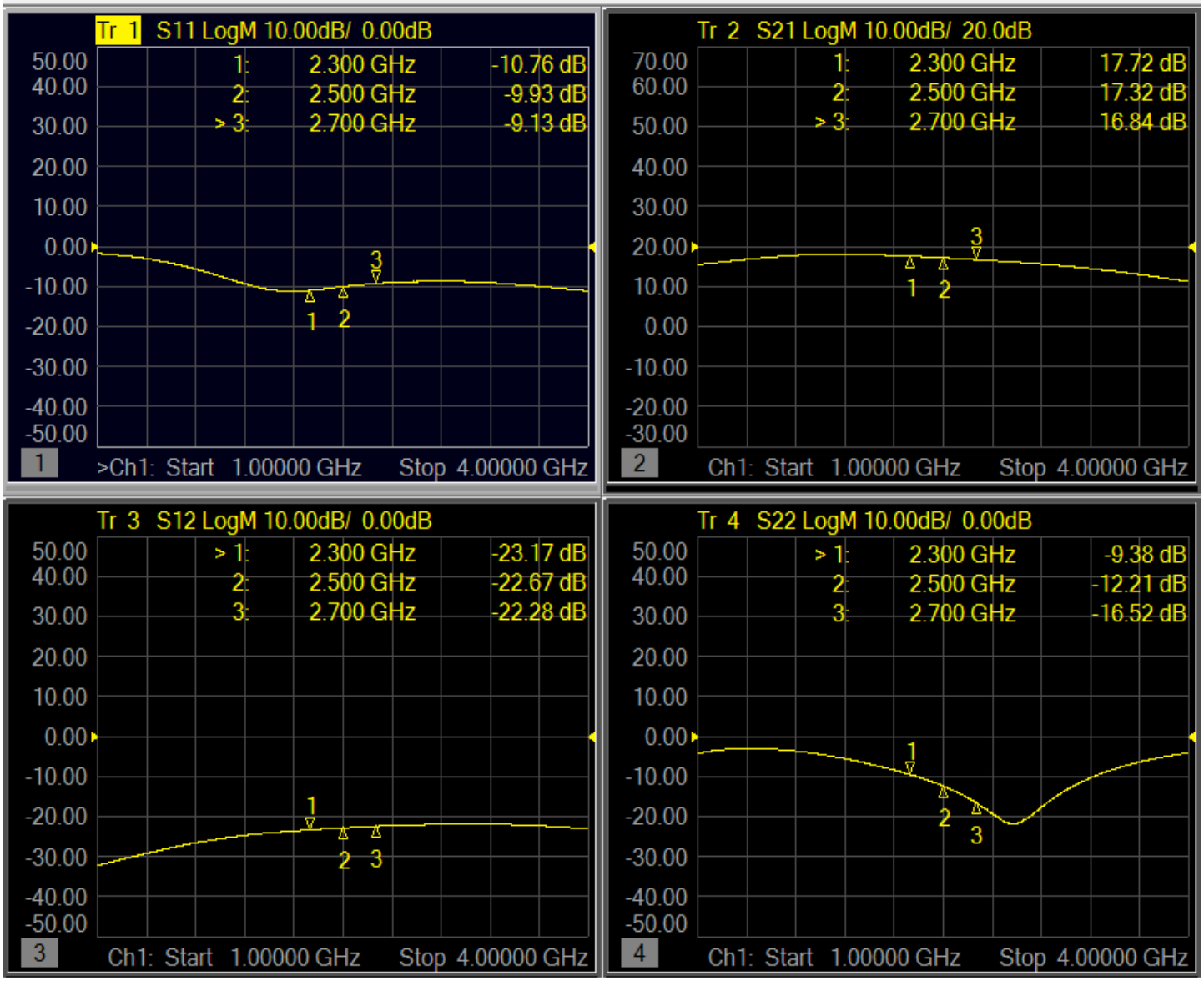


GRF2100 Typical Operating Curves: 2.3 to 2.7 GHz Tune, 3.3 V / 15 mA





GRF2100 Typical Operating Curves: S-Parameters (2.3 to 2.7 GHz Tune)



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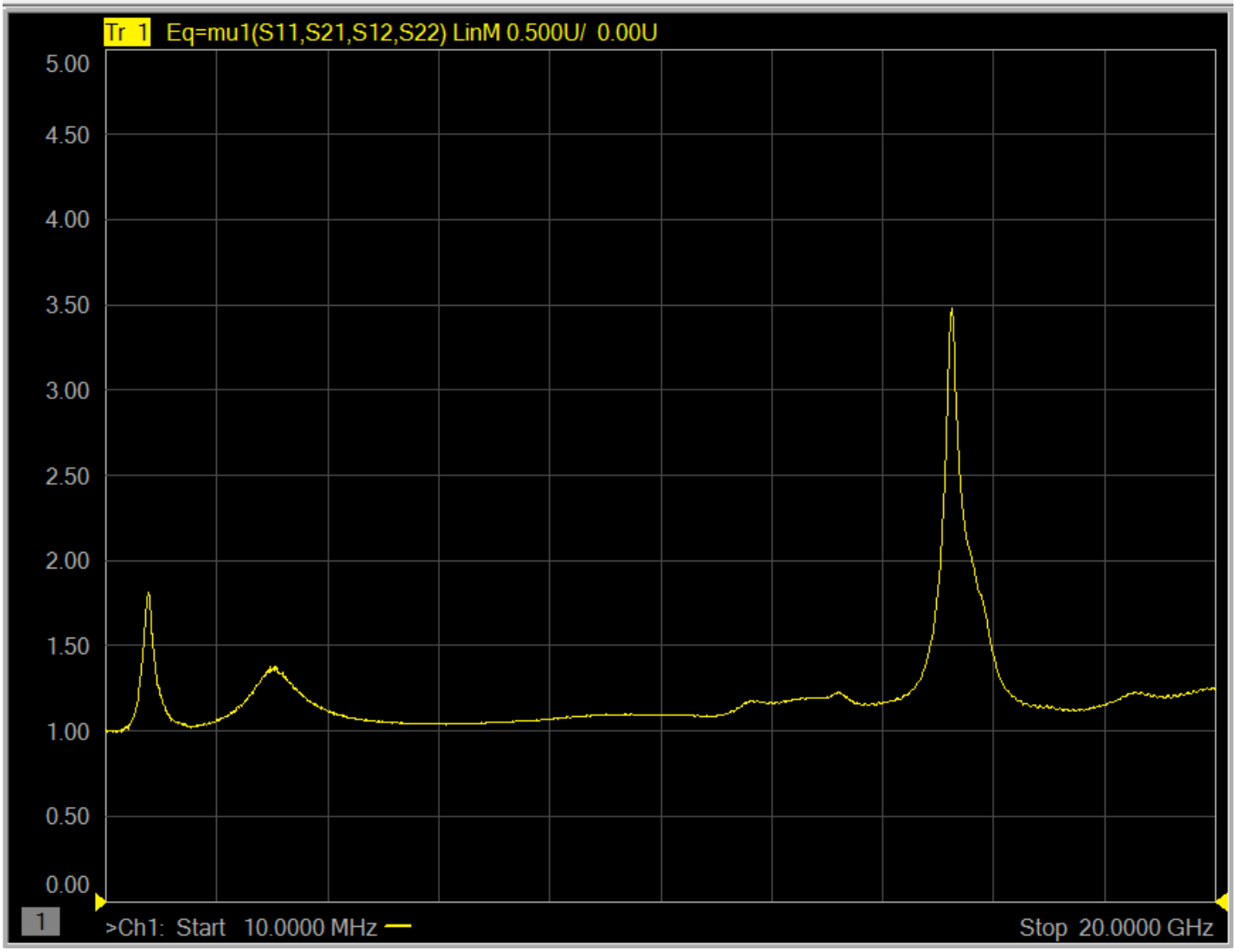
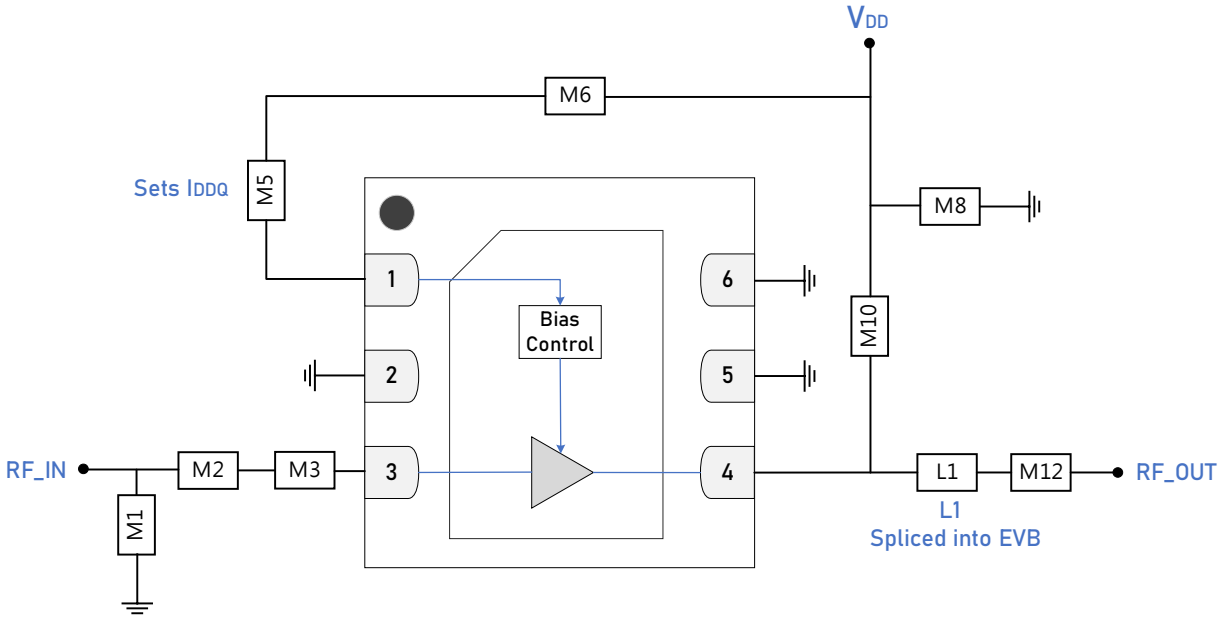
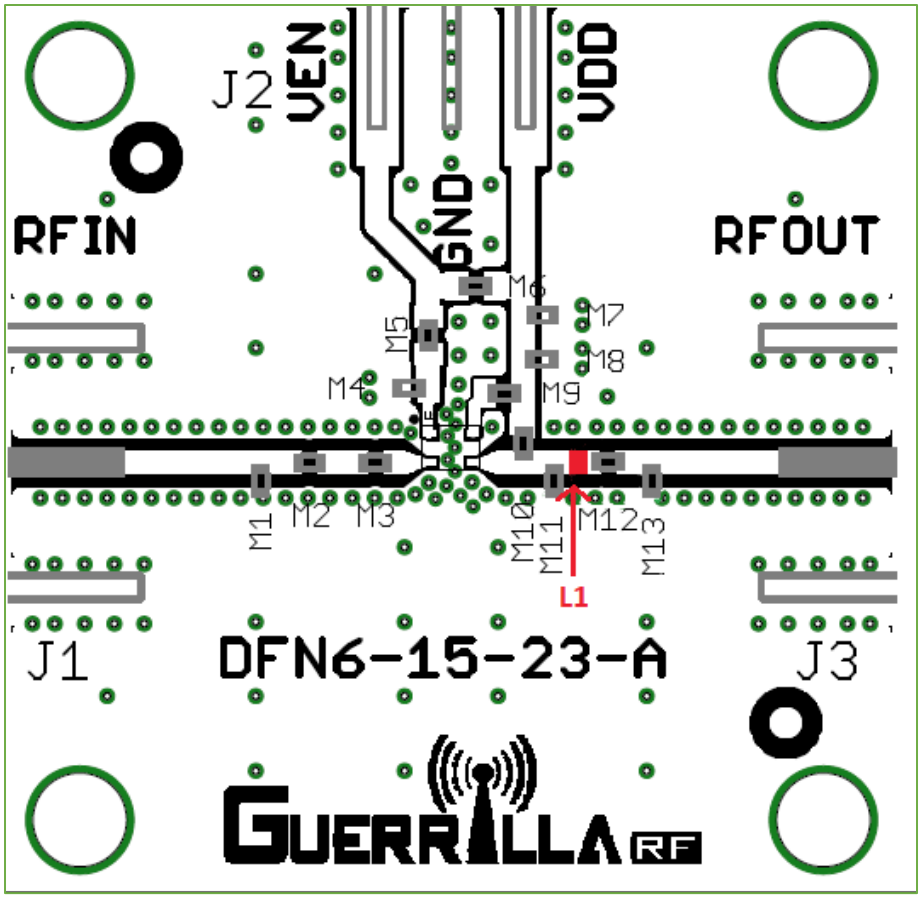
GRF2100 Typical Operating Curves: Stability Mu Factor (2.3 to 2.7 GHz Tune)



Note: Mu factor ≥ 1.0 implies unconditional stability.



GRF2100 Standard Test Schematic

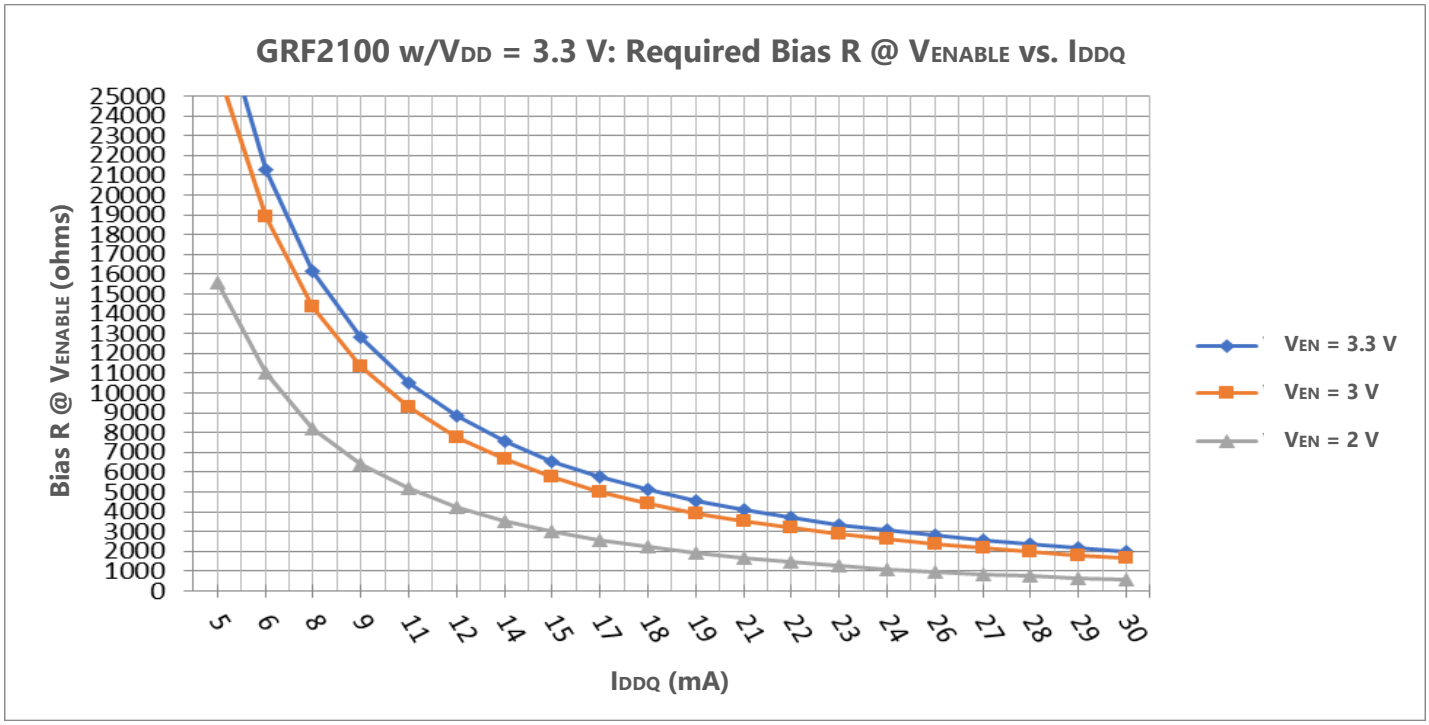


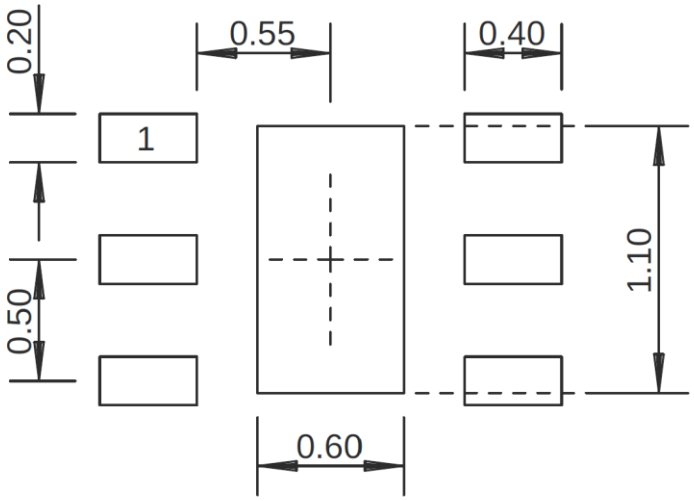
GRF2100 Evaluation Board Assembly Diagram

GRF2100 Evaluation Board Assembly Diagram Reference: 2.3 to 2.7 GHz Tune

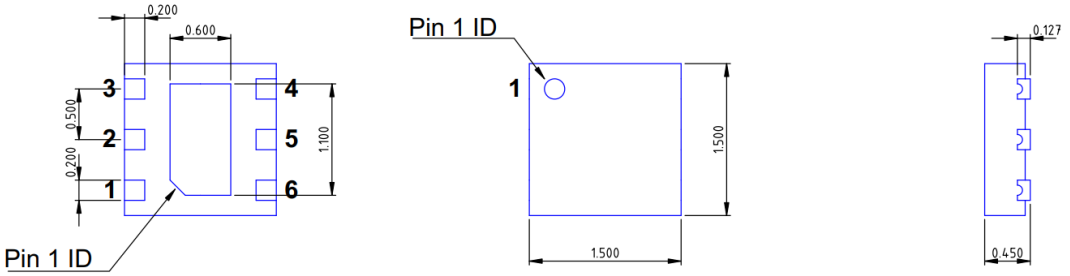
Component	Type	Manufacturer	Family	Value	Package Size	Substitution
M1	Inductor	Murata	LQG	3.9 nH	0402	ok
M2	Capacitor	Murata	GJM	8.2 pF	0402	ok
M3	Resistor (Jumper)	Various	--	0 Ω	0402	ok
M5 (Sets I_{DDQ})	Resistor	Various	5%	6 kΩ	0402	ok
M6	Resistor (Jumper)	Various	-	0 Ω	0402	ok
M8	Capacitor	Murata	GRM	0.1 uF	0402	ok
M10	Inductor	Murata	LQG	10.0 nH	0402	ok
L1	Inductor (spliced in)	Murata	LQG	3.0 nH	0402	ok
M12	Capacitor	Murata	GJM/GRM	2.7 pF	0402	ok
Evaluation Board	DFN6-15-23-A (modified for inclusion of L1)					

GRF2100 Bias Resistor Selection Curves





1.5 x 1.5 mm DFN-6 Suggested PCB Footprint (Top View)



Bottom View **Top View** **Side View**

DFN6 1.5x1.5mm
Dimensions in millimeters
Dimensional Tolerance: ±0.05

1.5 x 1.5 mm DFN-6 Package Dimensions

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Package Marking Diagram

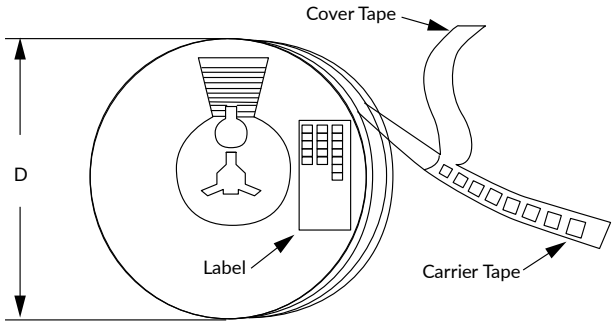
- Line 1: "Y" = YEAR (single digit). "WW" = WORK WEEK the Device was assembled.
- Line 2: "XXXX" = Device Part Number.

Tape and Reel Information

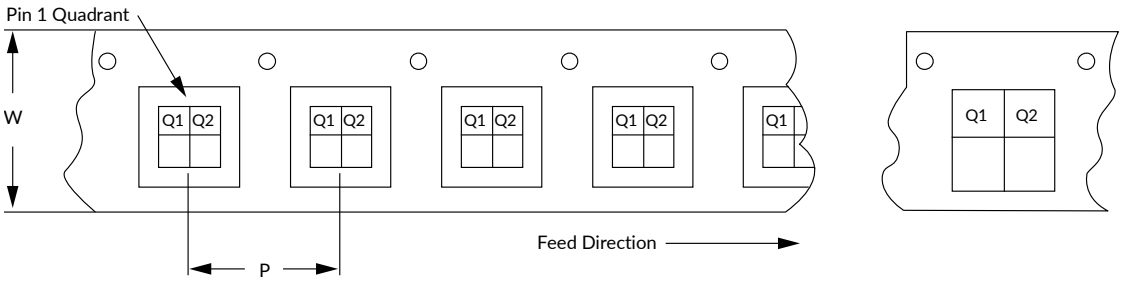
Guerrilla RF's tape and reel specification complies with Electronics Industries Association (EIA) standards for "Embossed Carrier Tape of Surface Mount Components for Automatic Handling" (reference EIA-481). See the following page for the Tape and Reel Specification and Device Package Information table, 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
June 29, 2021	Release A update.
February 17, 2022	Converted format to new template.
March 11, 2022	Updated Data Plots to new format.
September 6, 2022	Updated Evaluation Board BOM and schematic for new Tune. Added updated Characterization Data Plots. Lowered Enable Current from 0.5 to 0.2 mA to match Production Test Plan.

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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 evaluation board measurements taken within the Guerrilla RF Applications Lab. Any MIN/MAX limits represented within the data sheet are based solely on *estimated* part-to-part variations and process spreads. 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.