



GRF4012W

LOW NOISE GAIN BLOCK

0.03 to 7.125 GHz

RELEASE A DATA SHEET

FEATURES

- Flexible Bias Voltage and Current
- Process GaAs pHEMT
- Compact 1.5 x 1.5 mm DFN-6 Package

AEC-Q100 Grade 2 Qualified

- 100% Device Reflow at Assembly
- 100% Optical Die Inspection

Reference: 5 V / 2332.5 MHz / 50 mA

- Gain: 17.8 dB
- OIP3: 33 dBm
- OP1dB: 22.5 dBm
- Evaluation Board Noise Figure: 0.9 dB

APPLICATIONS

- SDARS Stage 2 LNA
- Cellular Repeaters
- Automotive Cellular Compensators
- General Purpose Linear LNA

ORDERING INFORMATION

Buy it Now

DESCRIPTION

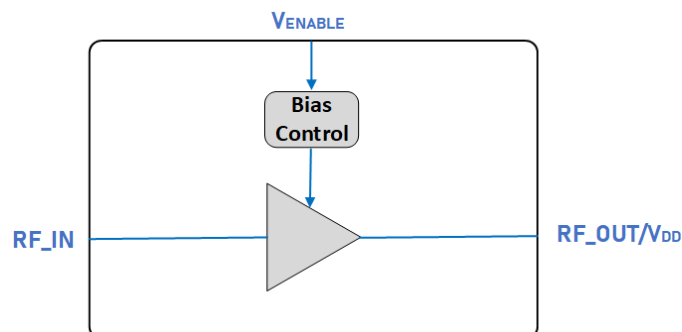
The GRF4012W is a broadband low-noise gain block designed for automotive applications including SDARS and cellular compensators, small cells, wireless infrastructure, and other high-performance use cases. It is a derivative of the GRF4002/4002W with slightly higher gain and an application schematic designed for reduced I_{DDQ} variation over process and temperature.

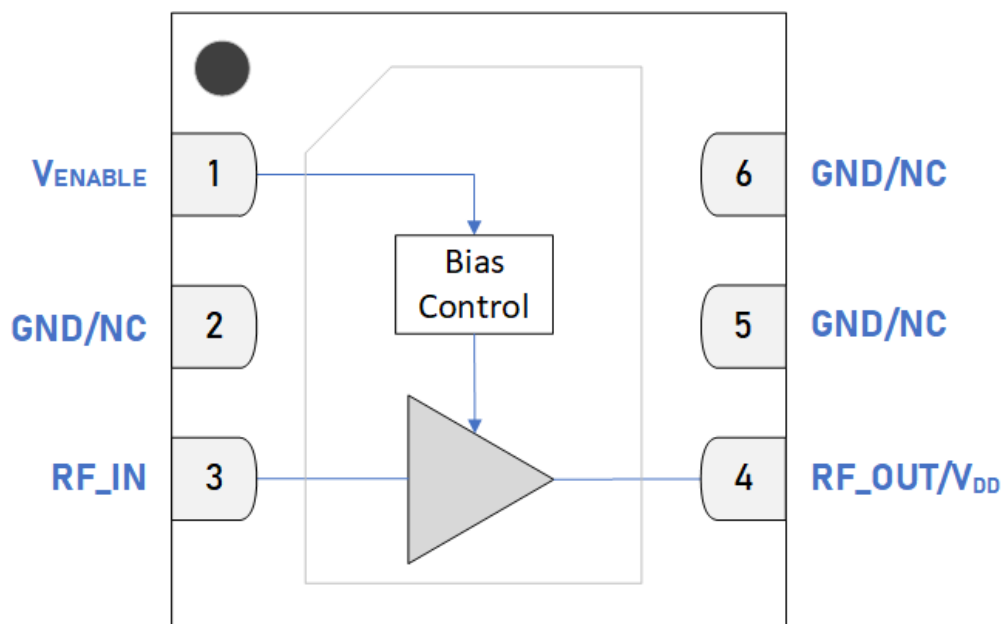
The device is operated from a supply voltage (V_{DD}) of 1.8 to 5 V with a selectable I_{DDQ} range of 20 to 80 mA for optimal efficiency and linearity.

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

Additional tunes can be found on the GRF4012W "Custom Tunes" product page: [GRF4012W Custom Tunes](#)

BLOCK DIAGRAM





Pin Out (Top View)

Pin Assignments

Pin	Name	Description	Note
1	V _{ENABLE}	Enable Voltage Input	V _{ENABLE} and series resistor set I _{DDQ} . V _{ENABLE} ≤ 0.2 volts disables device.
2, 5, 6	GND/NC	Ground or No Connect	No internal connection to die. We recommend connecting these pins to Ground.
3	RF_IN	LNA RF Input	Internally matched 50 Ω. An external DC blocking capacitor must be used.
4	RF_OUT/V _{DD}	LNA RF Output	Internally matched 50 Ω. V _{DD} must be applied through a 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	6	V
RF Input Power: Load VSWR < 2:1, $V_{DD} = 5$ V	$P_{IN\ MAX}$		27	dBm
Operating Temperature (Package Base)	$T_{PKG\ BASE}$	-40	110	°C
Maximum Channel Temperature (MTTF > 10 ⁶ hours)	T_{MAX}		170	°C
Maximum Dissipated Power	$P_{DISS\ MAX}$		500	mW
Electrostatic Discharge				
Human Body Model	HBM	500		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 - Packaging and Manufacturing Information](#).



All Guerrilla RF products are provided in RoHS compliant lead (Pb)-free packaging. For additional information, please refer to the [Certificate of RoHS Compliance](#).

Recommended Operating Conditions

Parameter	Symbol	Specification			Unit	Condition
		Min.	Typ.	Max.		
Supply Voltage	V_{DD}	1.8	5	6	V	
Operating Temperature (Package Base)	$T_{PKG\ BASE}$	-40		110	°C	
RF Frequency Range	F_{RF}	30	2332.5	7125	MHz	Typical Application Schematic with external matching components (notes 1 & 2).
RF1 Port Impedance	Z_{RFIN}		50		Ω	
RF2 Port Impedance	Z_{RFOUT}		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: [GRF4012W 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 2.32 to 2.345 GHz tuning set. $M5 = 3\text{ k}\Omega$, $V_{DD} = 5\text{ V}$, $V_{ENABLE} = 5\text{ V}$, $I_{DD} = 50\text{ mA}$. $F_{TEST} = 2332.5\text{ MHz}$. $T_{PKG\text{ BASE}} = 25\text{ }^{\circ}\text{C}$. Evaluation board losses are included within the specifications.

Parameter	Symbol	Specification			Unit	Condition
		Min.	Typ.	Max.		
Supply Current	I_{DD}	35	50	70	mA	$V_{DD} = 5\text{ V}$, $V_{ENABLE} = 5\text{ V}$, $M5 = 3\text{ k}\Omega$
Enable Current	I_{ENABLE}		2.2	5	mA	$V_{DD} = 5\text{ V}$, $V_{ENABLE} = 5\text{ V}$, $M5 = 3\text{ k}\Omega$
Switching Rise Time	T_{RISE}		100		ns	Disabled mode to Gain mode. $P_{OUT} = 0\text{ dBm}$ (note 3).
Switching Fall Time	T_{FALL}		50		ns	Gain mode to Disabled mode. $P_{OUT} = 0\text{ dBm}$ (note 4).

Disabled Mode

Leakage Current	$I_{LEAKAGE}$		1	5	μA	$V_{DD} = 5\text{ V}$, $V_{ENABLE} = 0\text{ V}$.
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Thermal Data

Thermal Resistance (Infrared Scan)	Θ_{JC}		113		$^{\circ}\text{C/W}$	On Standard Evaluation Board (note 5).
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Note 3: Switching Time: 50% of V_{ENABLE} to 90% of P_{OUT} .

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

Note 5: MTTF > 10^6 hours for $T_{CHANNEL} < 170\text{ }^{\circ}\text{C}$.

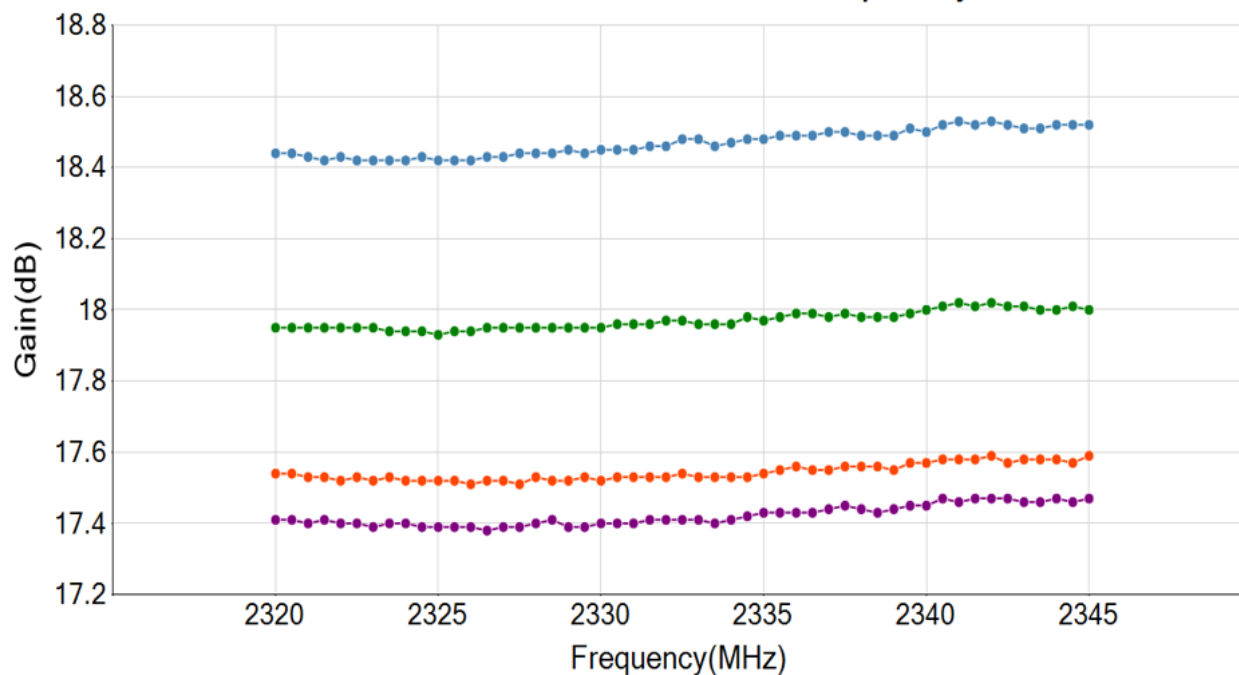
Nominal Operating Parameters - RF

The following conditions apply unless noted otherwise: typical application schematic using the 2.32 to 2.345 GHz tuning set. $M5 = 3\text{ k}\Omega$, $V_{DD} = 5\text{ V}$, $V_{ENABLE} = 5\text{ V}$, $I_{DD} = 50\text{ mA}$. $F_{TEST} = 2332.5\text{ MHz}$. $T_{PKG\text{ BASE}} = 25\text{ }^{\circ}\text{C}$. Evaluation board losses are included within the specifications.

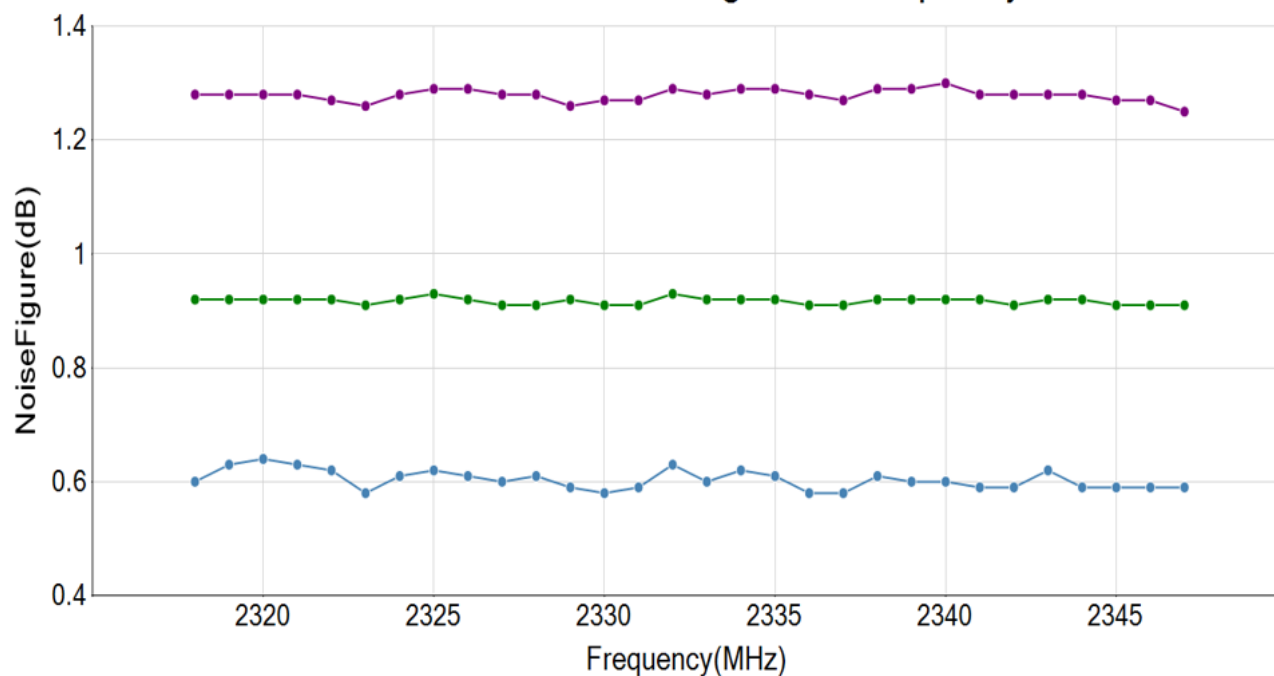
Parameter	Symbol	Specification			Unit	Condition
		Min.	Typ.	Max.		
Gain	S21	15.5	17.8		dB	
Reverse Isolation	S12		< -23		dB	SDARS Tune
Evaluation Board Noise Figure	NF		0.9		dB	
Output 3rd Order Intercept Point	OIP3		33		dBm	2 dBm P_{OUT} per tone at 2 MHz spacing.
Output 1 dB Compression Power	OP1dB	19	22.5		dBm	

GRF4012W Typical Operating Curves: SDARS Tune

GRF4012 Gain vs Frequency

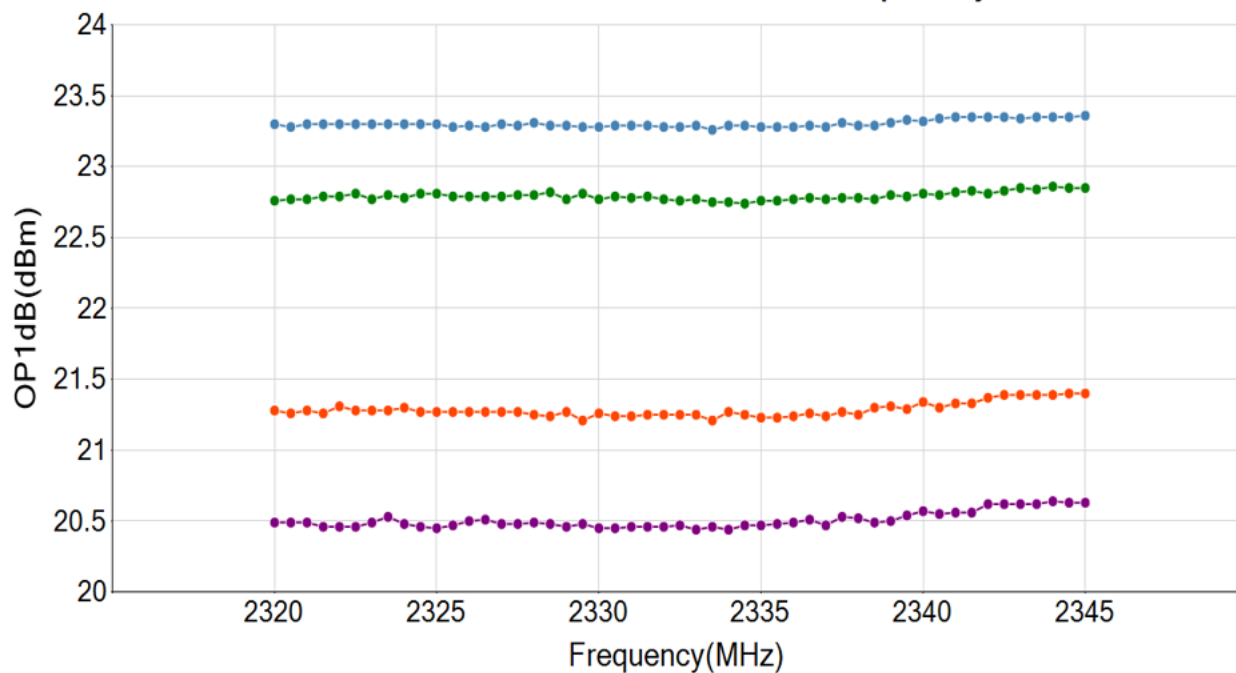


GRF4012 Noise Figure vs Frequency

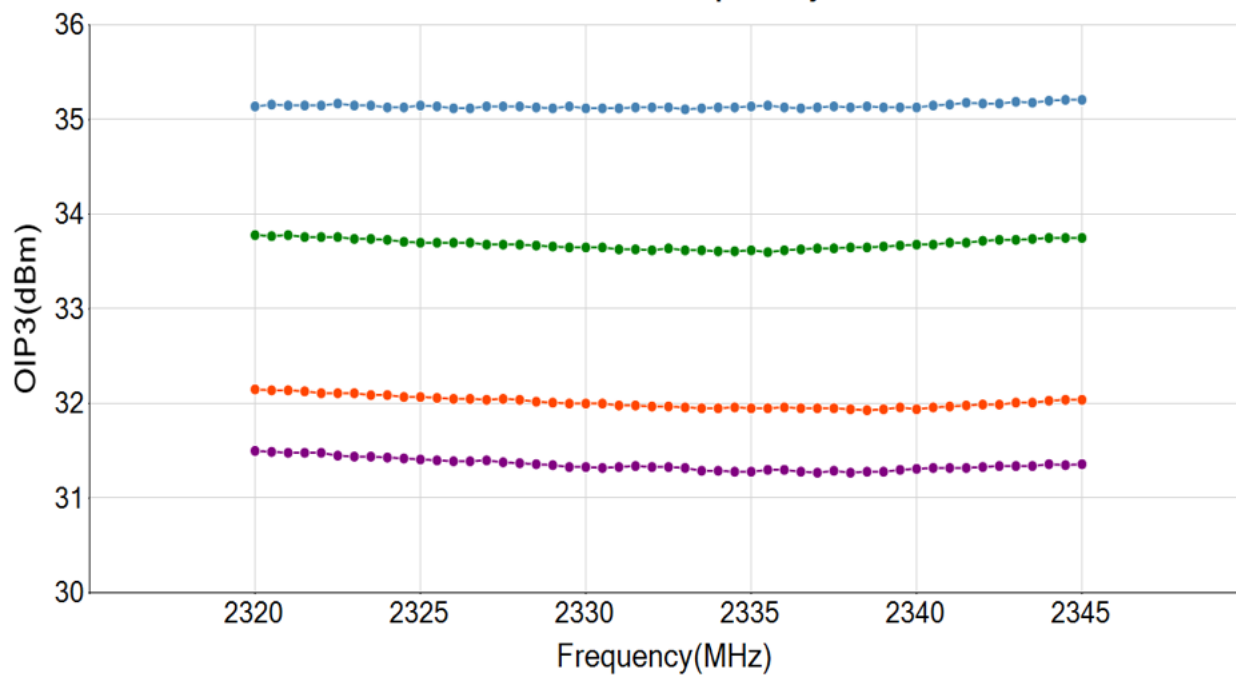


GRF4012W Typical Operating Curves: SDARS Tune

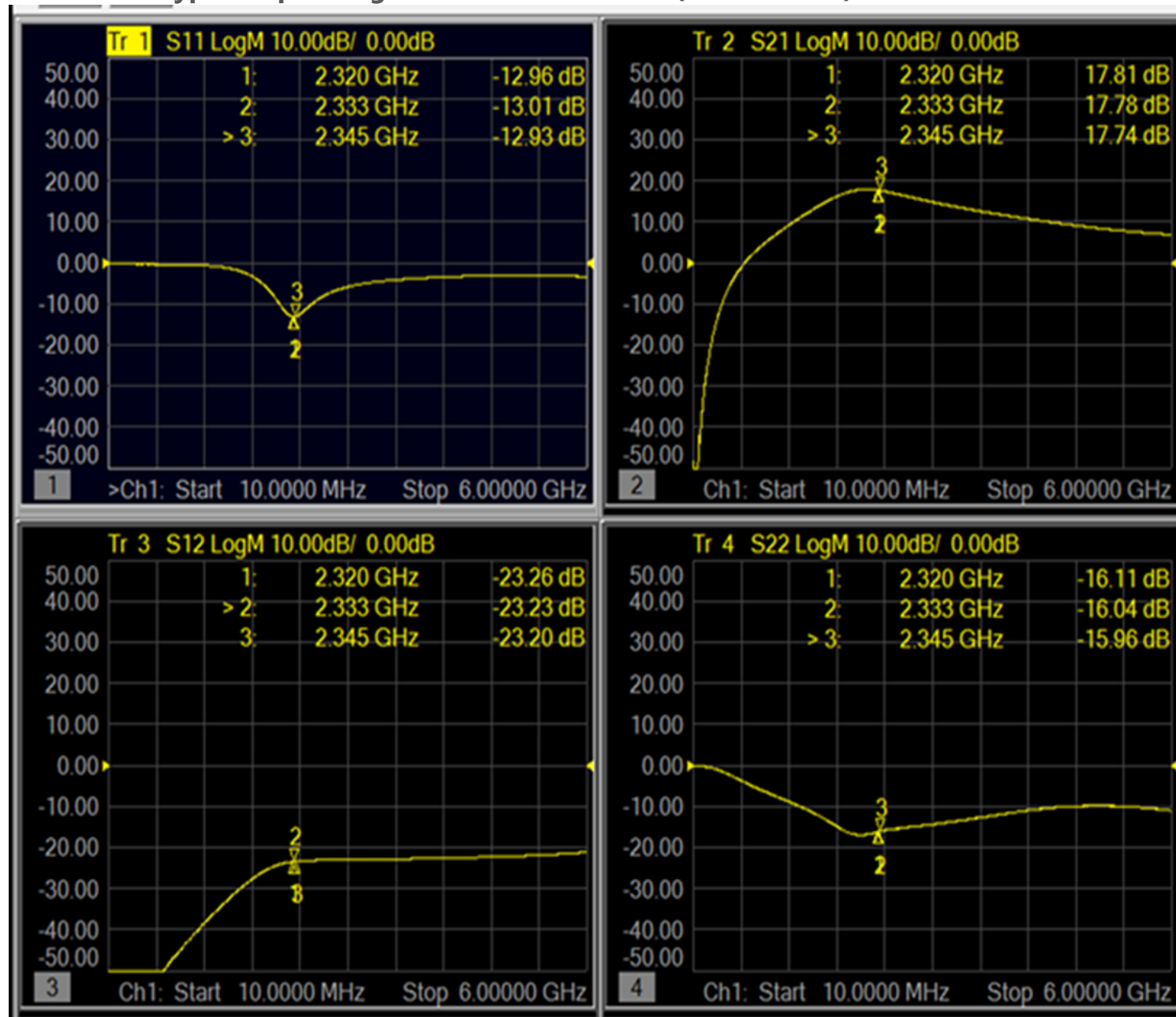
GRF4012 OP1dB vs Frequency



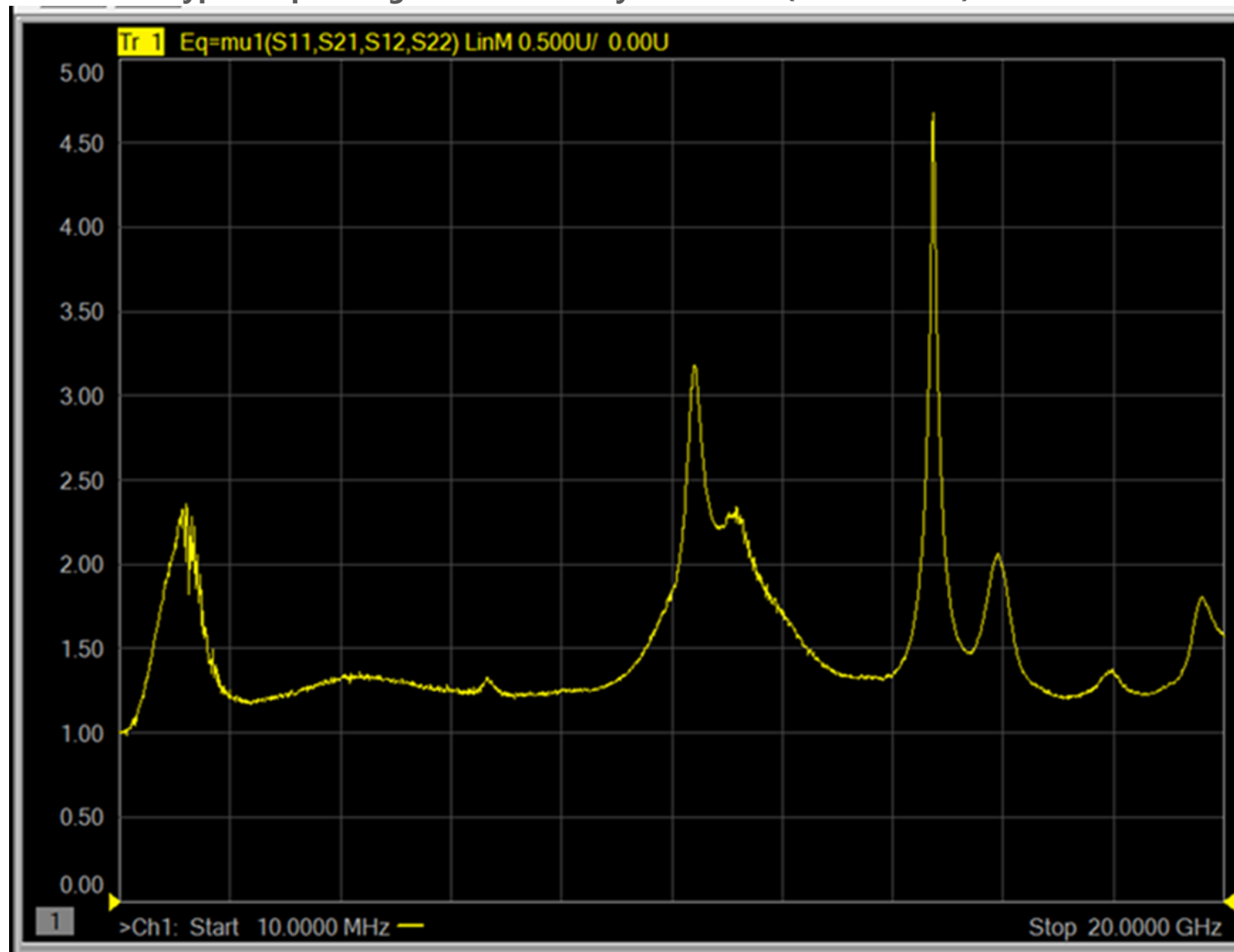
GRF4012 OIP3 vs Frequency at Pout = 2 dBm



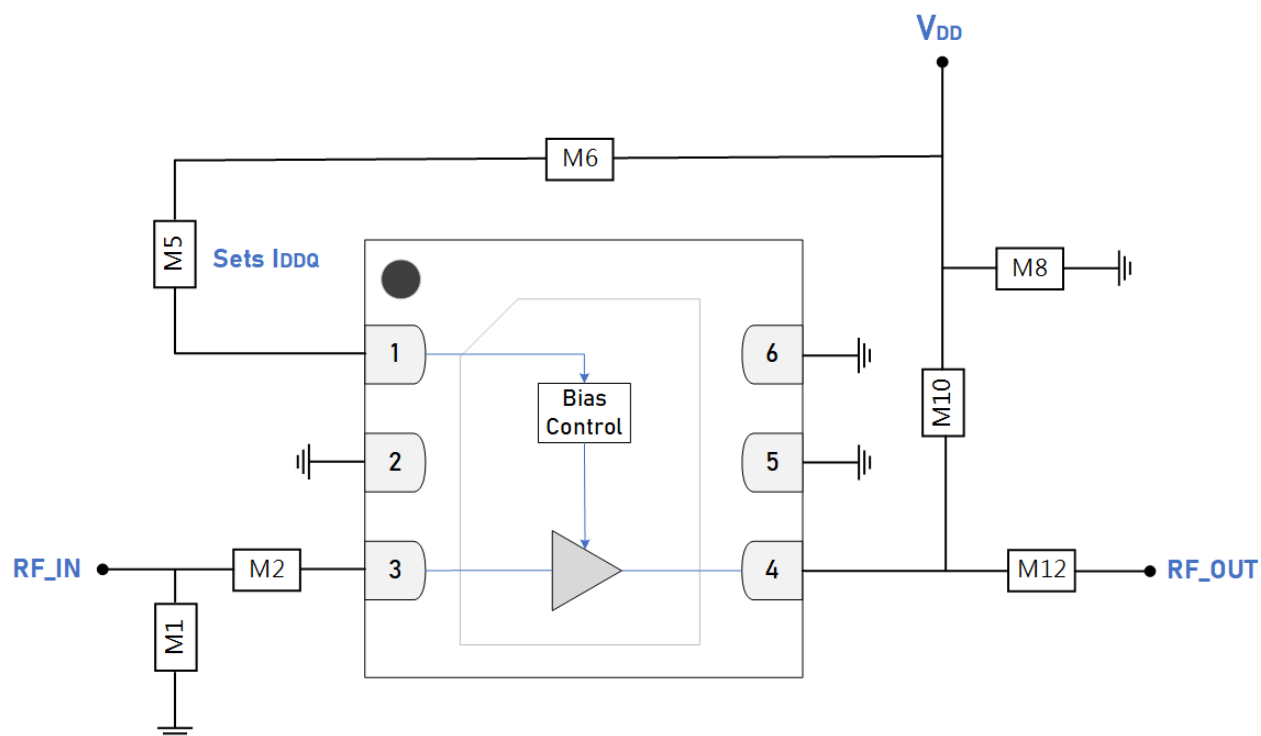
GRF4012W Typical Operating Curves: S-Parameters (SDARS Tune)



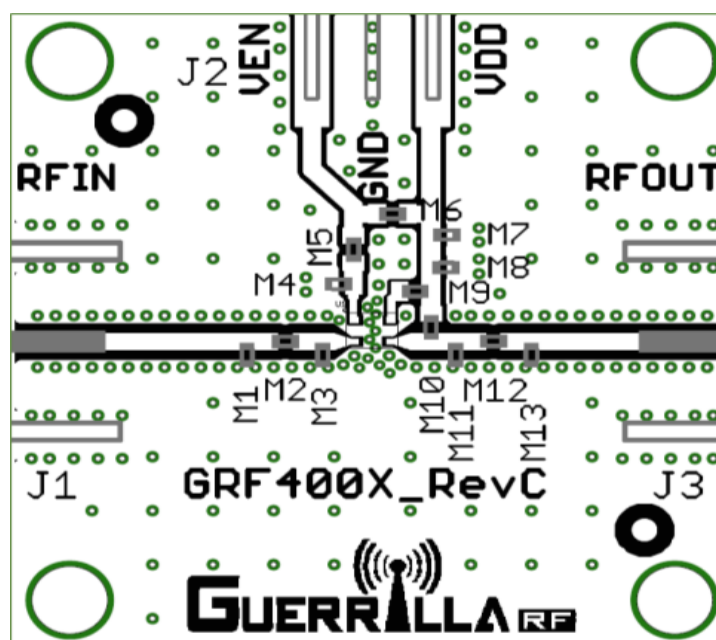
GRF4012W Typical Operating Curves: Stability Mu Factor (SDARS Tune)



Note: $\mu \geq 1.0$ implies unconditional stability.



GRF4012W Standard Evaluation Board Schematic



GRF4012W Evaluation Board Assembly Diagram

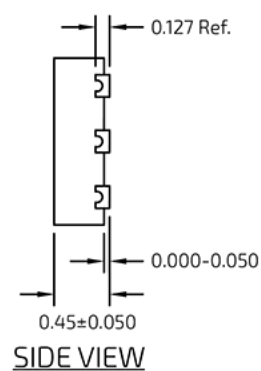
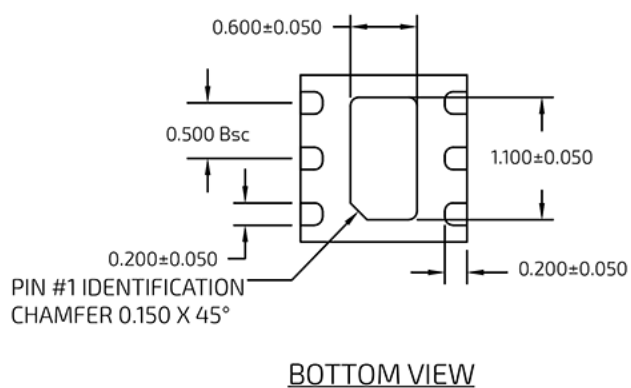
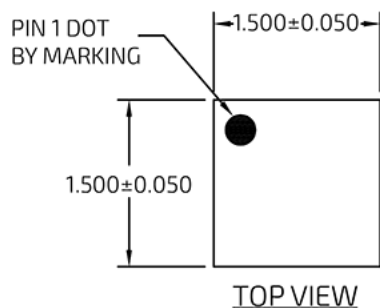


GRF4012W LOW NOISE GAIN BLOCK 0.03 to 7.125 GHz

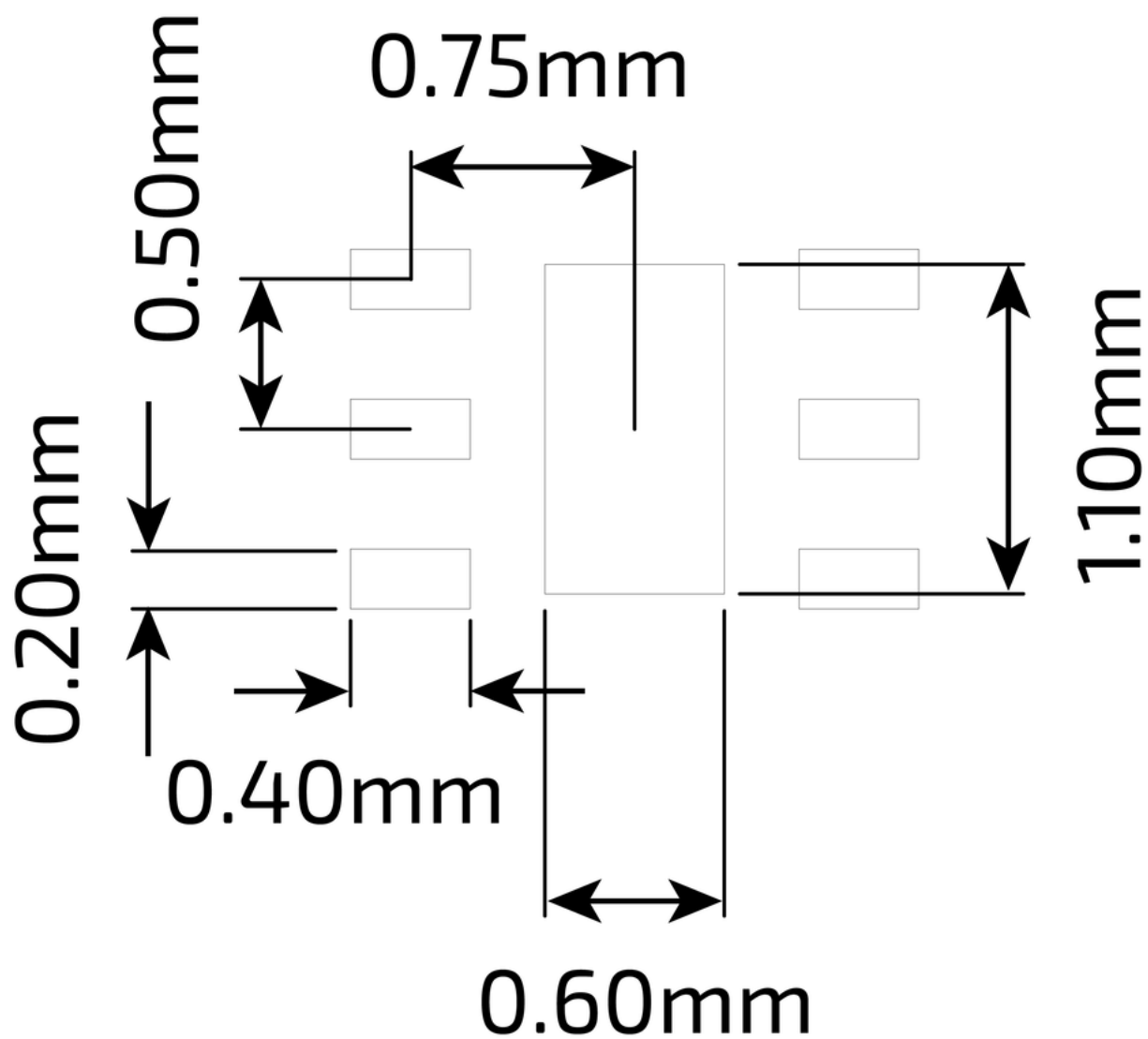
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GRF4012W Evaluation Board Assembly Diagram Reference: 2.32 to 2.345 GHz Tune

Component	Type	Manufacturer	Family	Value	Package Size	Substitution
M1	Inductor	Murata	LQG	2.0 nH	0402	ok
M2	Capacitor	Murata	GJM	1.7 pF	0402	ok
M5	Resistor	Various	5%	3 k Ω	0402	ok
M6	Resistor (jumper)	Various	5%	0 Ω	0402	ok
M8	Capacitor	Murata	GRM	0.1 μ F	0402	ok
M10	Inductor	Murata	LQG	10.0 nH	0402	ok
M12	Capacitor	Murata	GRM	10.0 pF	0402	ok
Evaluation Board	GRF400X_RevC					



DFN 6 1.5x1.5mm Package Dimensions



DFN 6 1.5x1.5mm Suggested PCB Footprint (Top View)

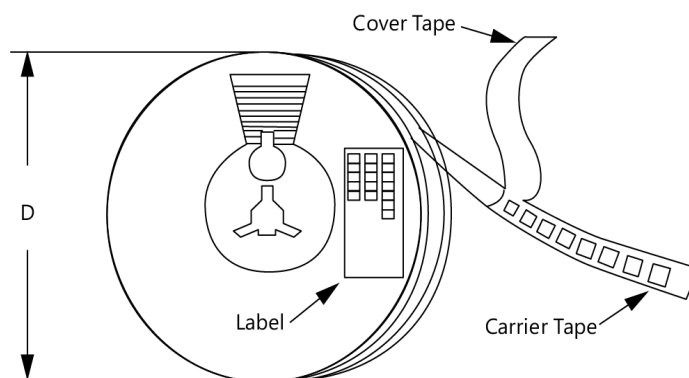
Package Marking Diagram



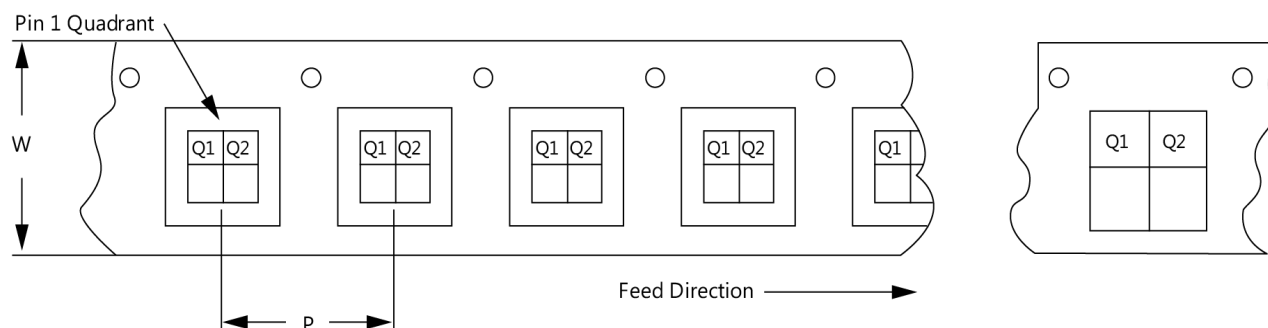
Line 1: "Y" = YEAR (single digit). "WW" = WORK WEEK and "w" = W for automotive.
Line 2: "XXXX" = Device Part Number.

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). 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 latest reel specifications and package information (including units/reel), please visit [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 2, 2021	Preliminary Data Sheet.
December 6, 2021	Upgraded Data Sheet to new format only.
February 17, 2022	Removed CDM parameter from Absolute Ratings table. Updated I_{DDQ} limits in Nominal Operating Parameters table.
April 11, 2022	Changed M5 resistor value. Updated Typical Operating Curves.
June 6, 2022	Changed M5 resistor value to 3 k Ω . Changed supply current upper limit to 70 mA.
August 25, 2022	Added new Noise Figure Plot.
September 9, 2022	AEC-Q100 Grade 2 Qualification complete.
November 21, 2022	Release Ø Data Sheet.
December 9, 2022	Added new Switching Times.
December 20, 2022	Raised RF Input Power ($P_{IN\ MAX}$) from 22 to 27 dBm.
March 24, 2023	Release A Data Sheet.
May 7, 2024	Upgraded Data Sheet to newest format only.
February 12, 2025	Raised Operating Temperature from 105 to 110 °C.
May 13, 2025	Extended frequency range from 400 - 4200 MHz to 30 - 7125 MHz.
June 5, 2025	Changed Thermal Resistance from 131 to 113 °C/W.



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 <i>estimated</i> 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 <i>production-released</i> material. TYP values are based on a combination of ATE and bench-level measurements, with MIN/MAX limits defined using <i>modelled estimates</i> 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 <i>derived from multiple lots which have been fabricated over an extended period of time</i> . 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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