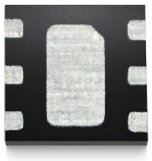
DATA SHEET

RELEASE Ø DATA SHEET



GRF3012

ULTRA-BROADBAND GAIN BLOCK
Near DC to 12 GHz

FEATURES

- Internally Matched to 50 Ω
- Process: InGaP HBT
- Compact 1.5 x 1.5 mm DFN-6 Package

Reference: 5 V / 22 mA / 5 GHz

- Gain: 11 dB
- OIP3: 18 dBm
- OP1dB: 5 dBm
- Evaluation Board Noise Figure: 5 dB

APPLICATIONS

- Microwave Backhaul
- C-Band Amplifiers
- X-Band Amplifiers
- General Purpose Amplifiers
- Instrumentation

DESCRIPTION

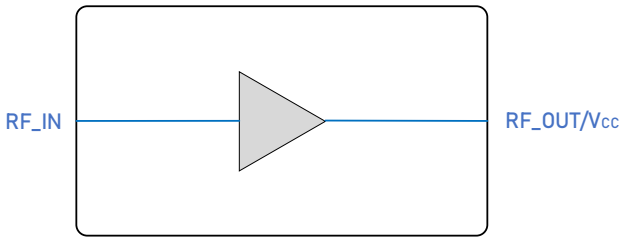
The GRF3012 is a broadband gain block designed for RF applications from near DC through X-Band.

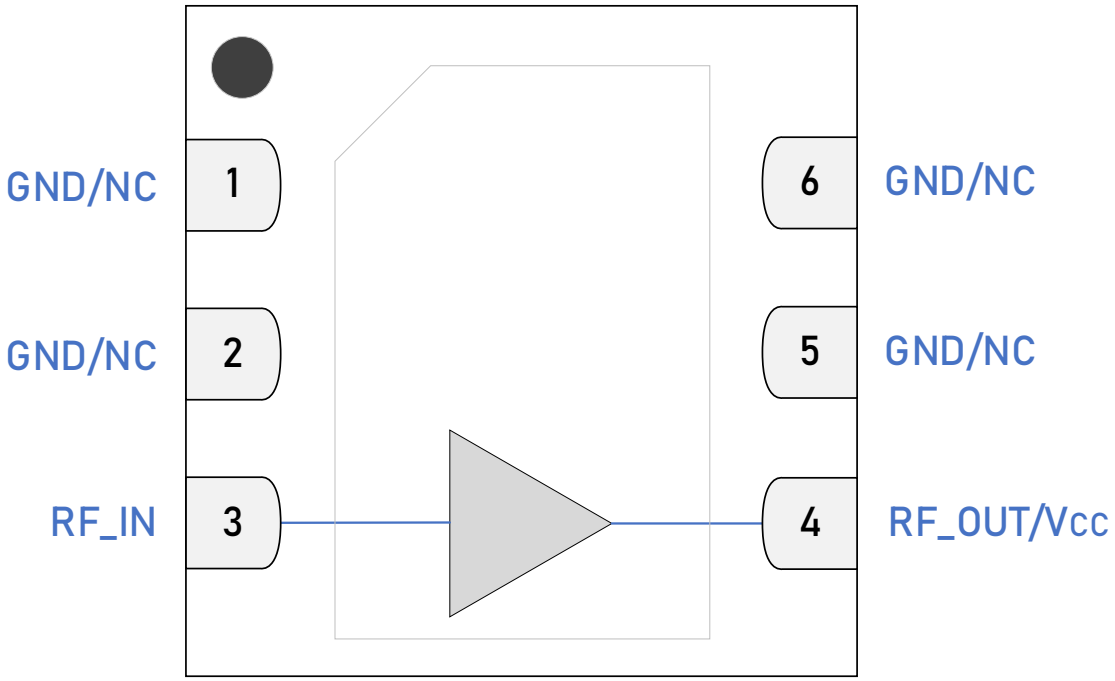
This resistively biased device employs an external resistor in series with V_{CC} to set a nominal I_{CCQ} of 22 mA. The GRF3012 is internally matched to 50 Ω at the input and output ports.

The device can be operated down to low frequency via the selection of suitably large input/output caps and bias inductor.

Please 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)

Pin Assignments

Pin	Name	Description	Note
1, 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_{CC}	LNA RF Output	Internally matched 50 Ω. V_{CC} must be applied through a choke to this pin.
PKG BASE	GND	Ground	Provides DC and RF ground for gain block 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_{CC}	0	9	V
RF Input Power: Load VSWR < 2:1	$P_{IN\ MAX}$		10	dBm
Operating Temperature (Package Base)	$T_{PKG\ BASE}$	-40	85	°C
Maximum Channel Temperature (MTTF >10^6 Hours)	T_{MAX}		170	°C
Maximum Dissipated Power	$P_{DISS\ MAX}$		340	mW

Electrostatic Discharge

Human Body Model	HBM	1500		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_{CC}	4.5	5	9	V	
Operating Temperature (Package Base)	$T_{PKG\ BASE}$	-40		85	°C	
RF Frequency Range	F_{TEST}	Near DC	5	12	GHz	Typical application schematic using broadband Bias T.
RF_IN Port Impedance	Z_{RFIN}		50		Ω	Single-ended.
RF_OUT Port Impedance	Z_{RFOUT}		50		Ω	Single-ended.

Nominal Operating Parameters – General

The following conditions apply unless noted otherwise: Typical measurement schematic using broadband Bias T, V_{CC} = 5 V, I_{CC} = 22 mA, R_{BIAS} = 45 Ω, F_{TEST} = 5 GHz, 50 Ω system impedance, $T_{PKGBASE}$ = 25 °C. Evaluation board losses are included within the specifications.

Parameter	Symbol	Specification			Unit	Condition
		Min.	Typ.	Max.		
Supply Current	I_{CC}		22		mA	V_{CC} = 5 V, R_{BIAS} = 45 Ω

Thermal Data

Thermal Resistance (Infrared Scan)	Θ_{JC}		250		°C/W	On standard evaluation board **(note 3)**.

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

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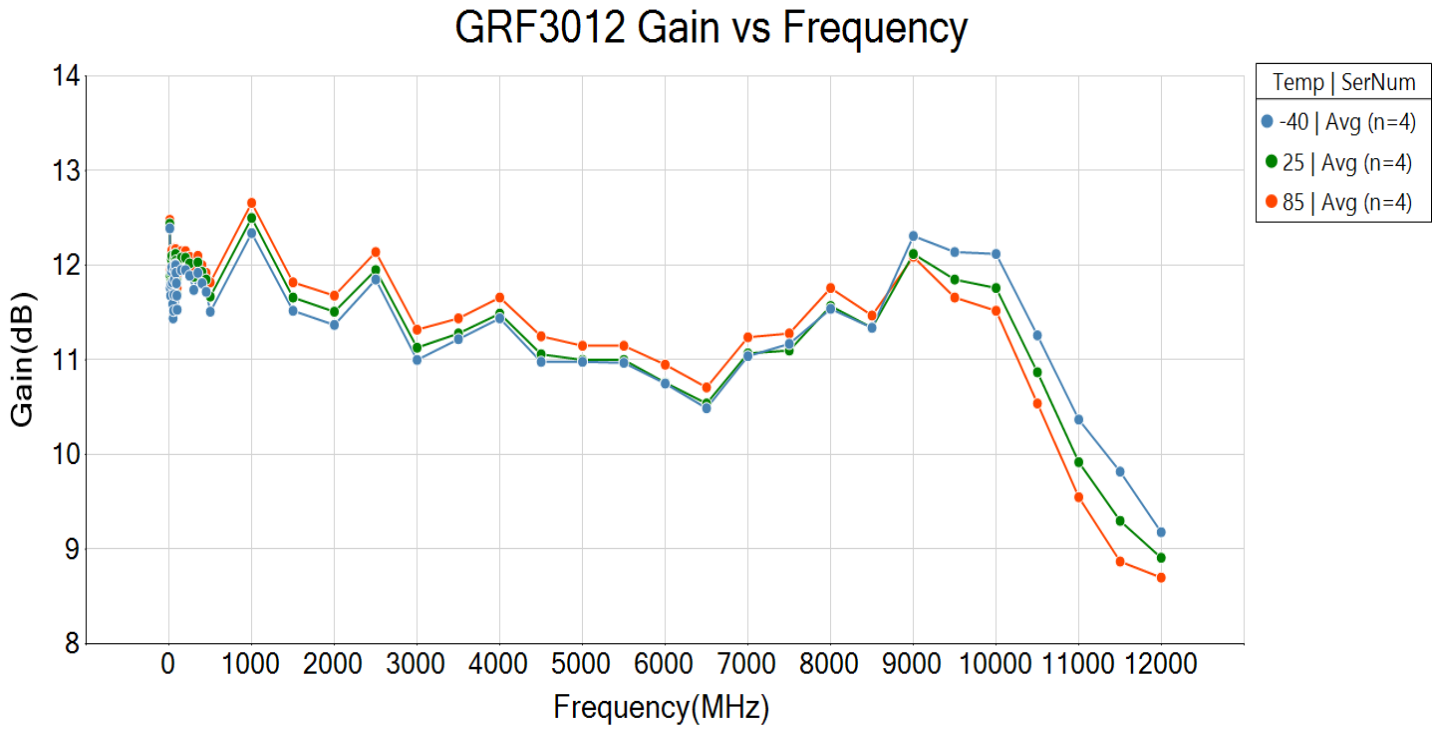
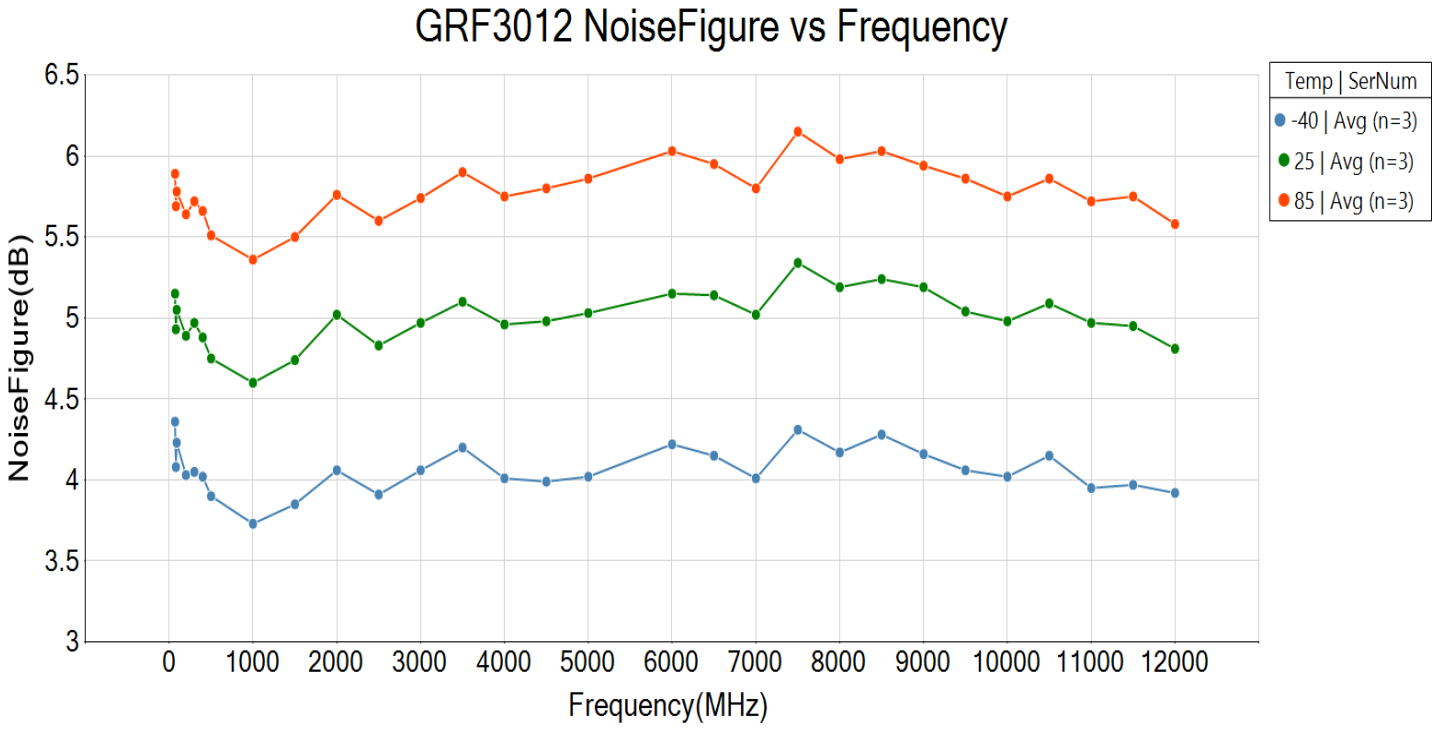
Nominal Operating Parameters – RF

The following conditions apply unless noted otherwise: Typical measurement schematic using broadband Bias T, V_{CC} = 5 V, I_{CC}= 22 mA, R_{BIAS} = 45 Ω, F_{TEST} = 5 GHz, 50 Ω system impedance, $T_{PKGBASE}$ = 25 °C. Evaluation board losses are included within the specifications.

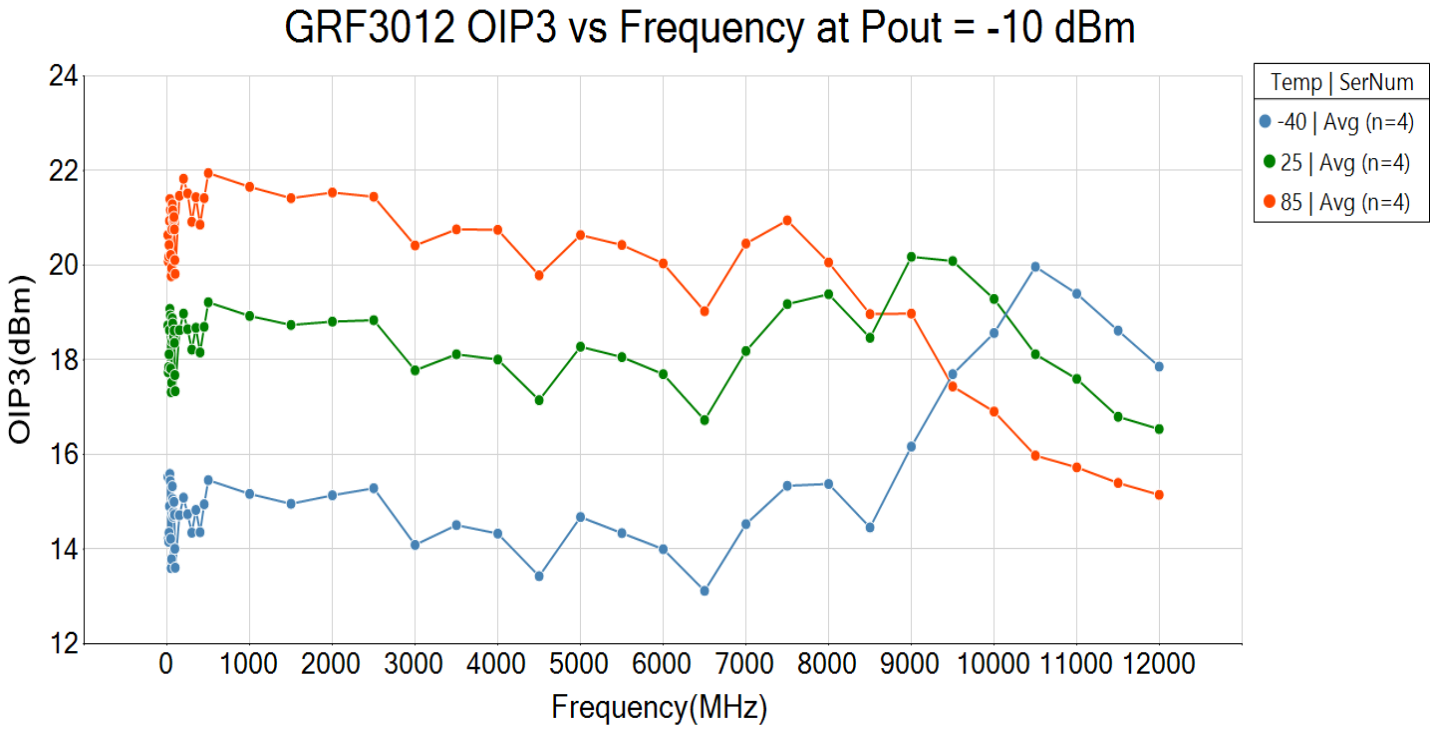
Parameter	Symbol	Specification			Unit	Condition
		Min.	Typ.	Max.		
Gain	S21	10	11		dB	
Noise Figure	NF		5		dB	On standard evaluation board.
Output 3rd Order Intercept Point	OIP3		18		dBm	-10 dBm P_{OUT} per tone at 2 MHz spacing (4,999 and 5,001 MHz)
Output 1 dB Compression Power	OP1dB	3.5	5		dBm	

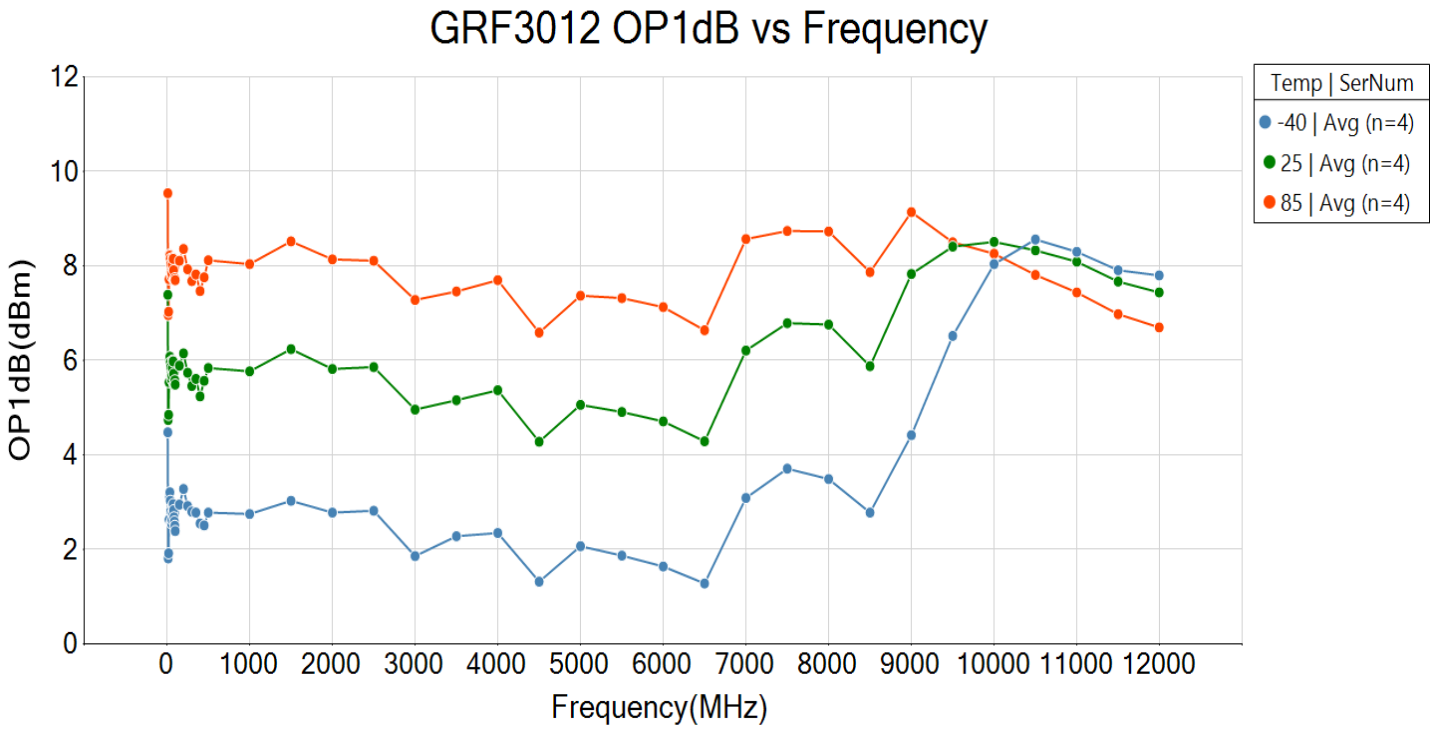
GRF3012 Typical Operating Curves: Biased with broadband Bias T, 5 V / 22 mA



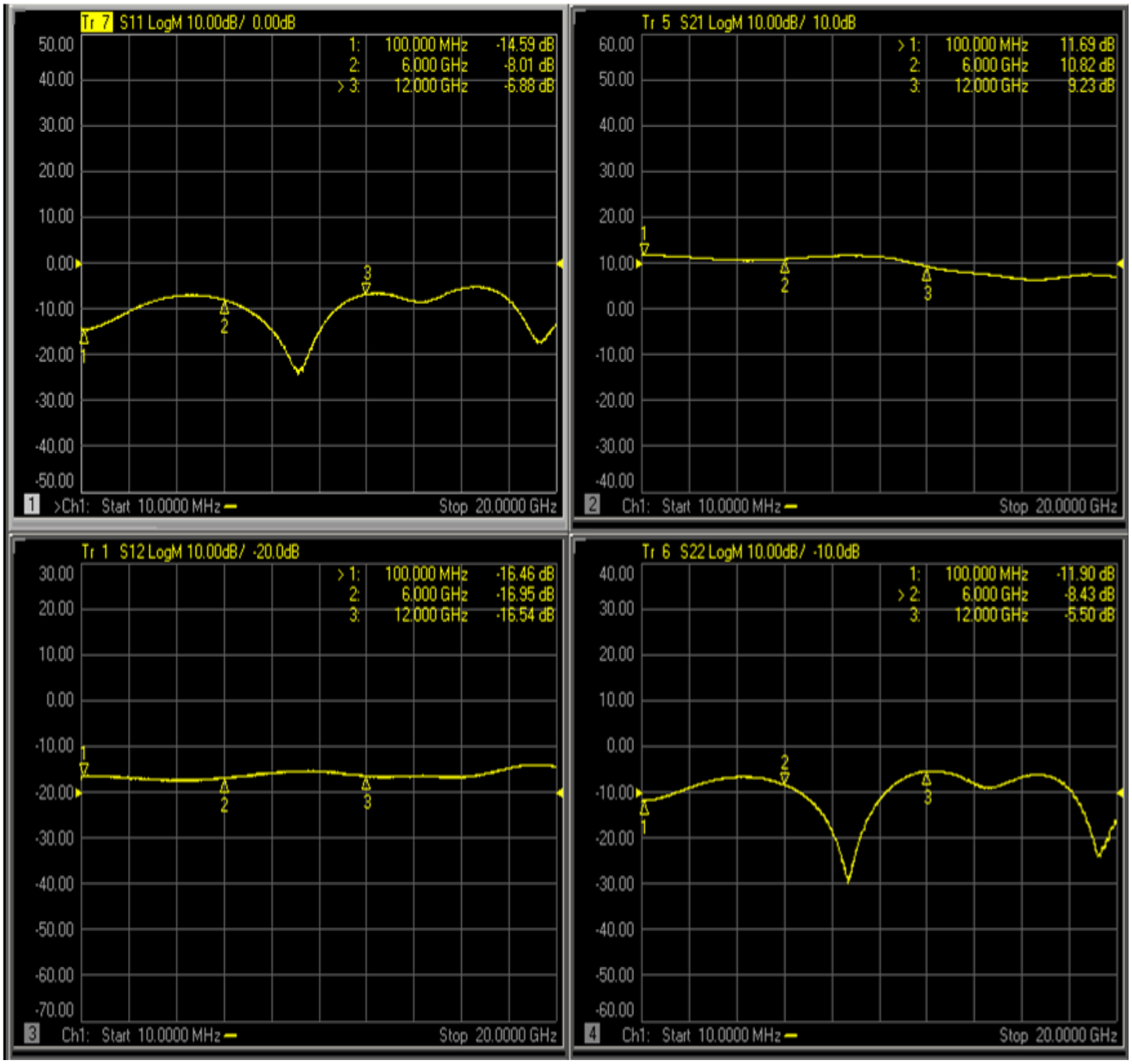


GRF3012 Typical Operating Curves: Biased with broadband Bias T, 5 V / 22 mA





GRF3012 Typical Operating Curves: S-Parameters using VNA Bias T (0.1 to 12 GHz)



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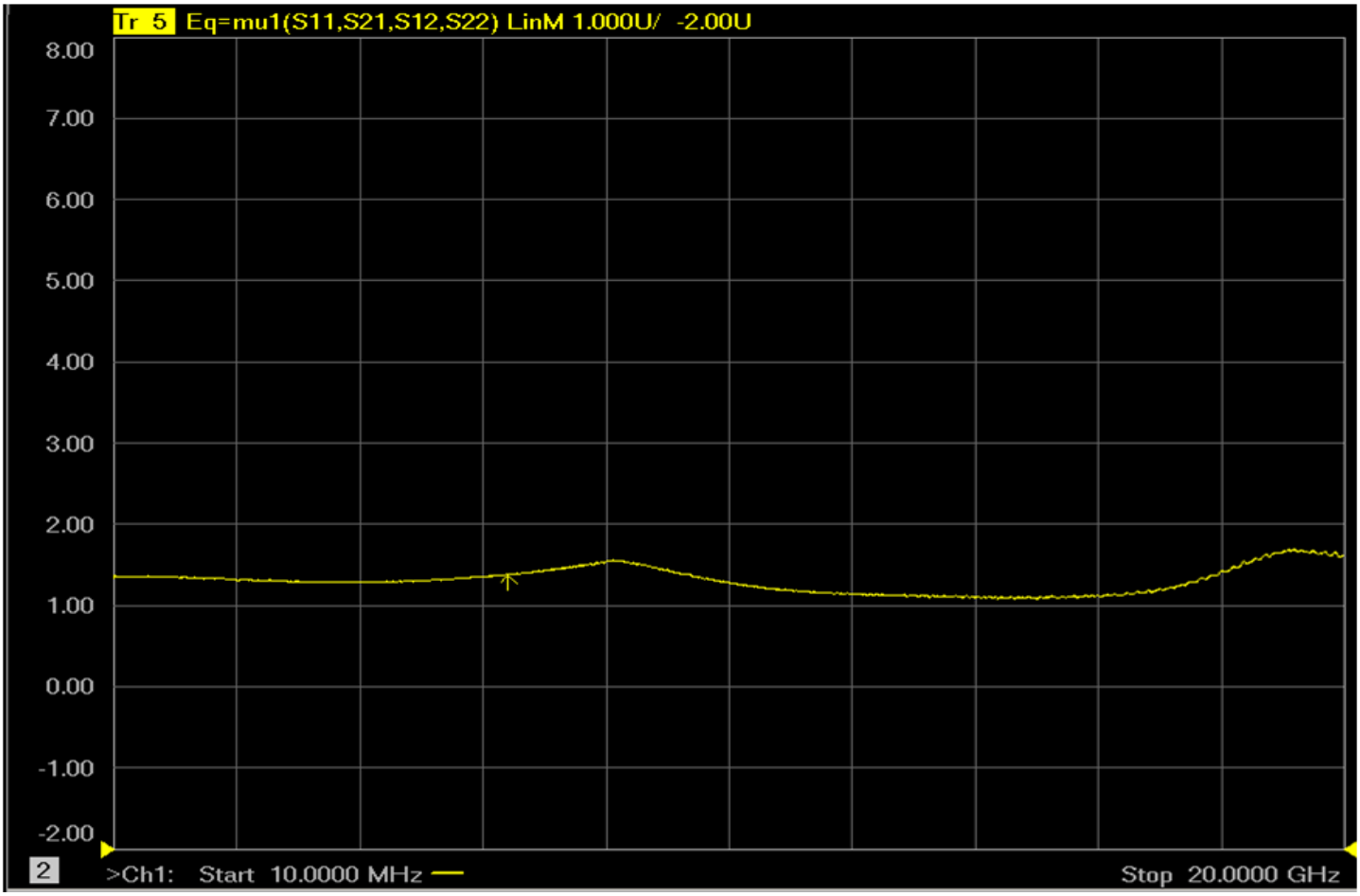
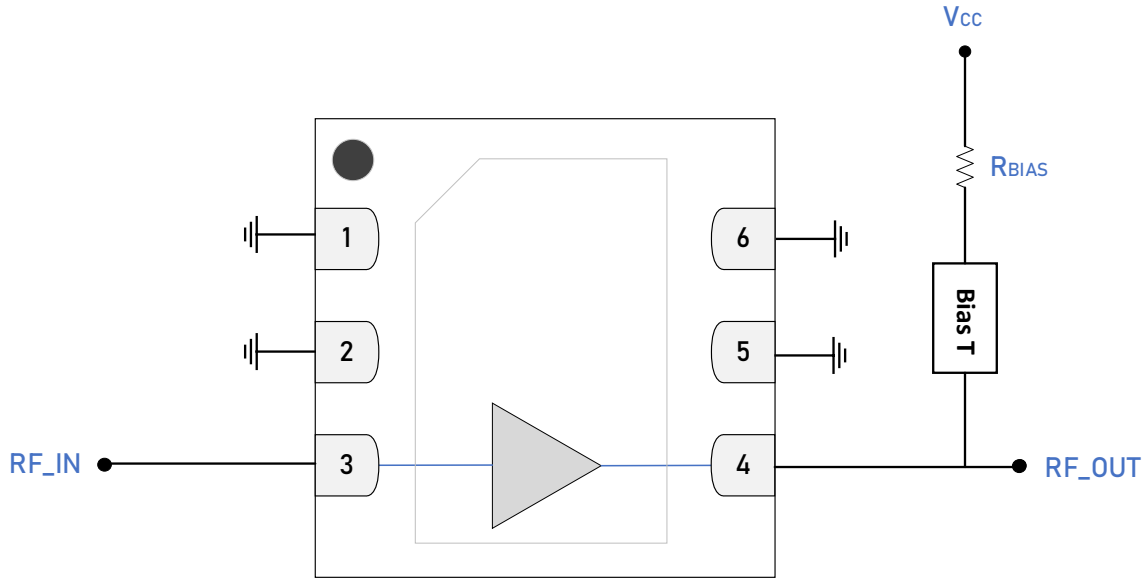
GRF3012 Typical Operating Curves: Stability Mu Factor using VNA Bias T (10 MHz to 20 GHz)

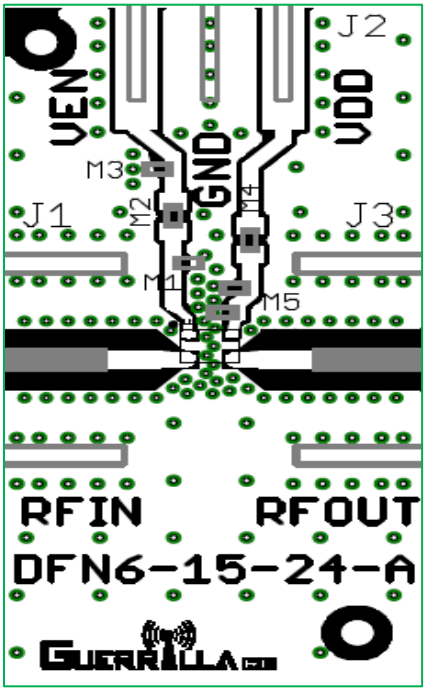


Note: Mu factor ≥ 1.0 implies unconditional stability



NOTE: For 4.5 V operation R_{BIAS} = 22 Ω, 5 V = 45 Ω, 6 V = 91 Ω, 7 V = 137 Ω, 8 V = 178 Ω, 9 V = 226 Ω

GRF3012 Standard Evaluation Board Schematic



GRF3012 Evaluation Board Assembly Diagram

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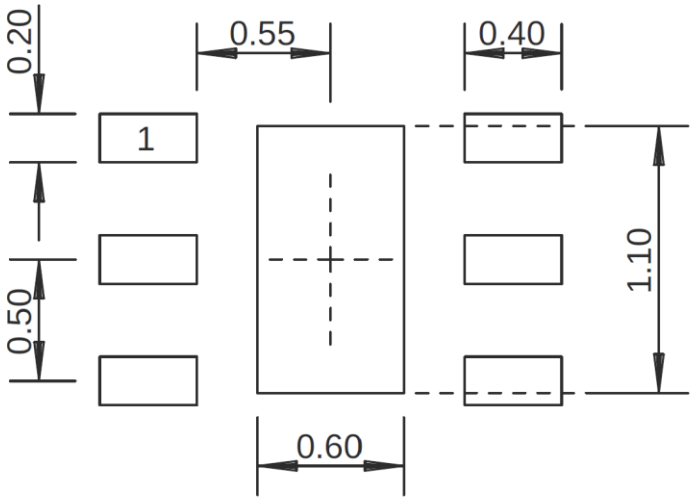
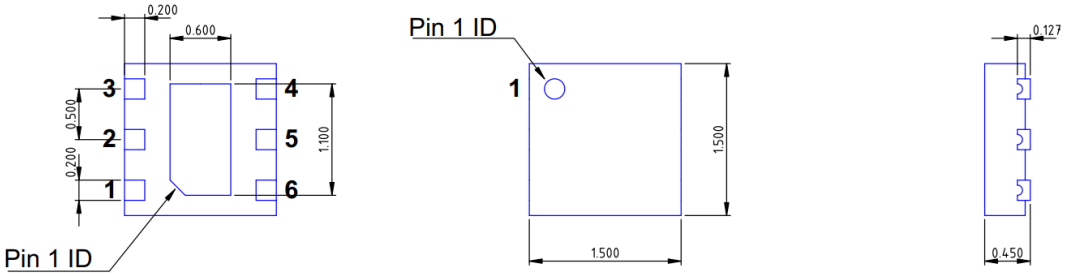


1.5 x 1.5 mm DFN-6 Suggested PCB Footprint (Top View)



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

Package Marking Diagram

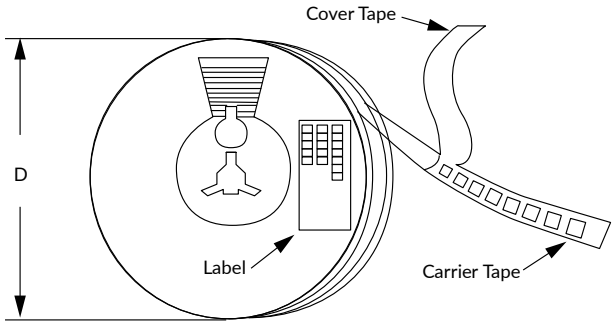
- Line 1: "Y" = YEAR (single digit). "WW" = WORK WEEK the device was assembled.
- Line 2: "XXXX" = Device Part Number.

Tape and Reel Information

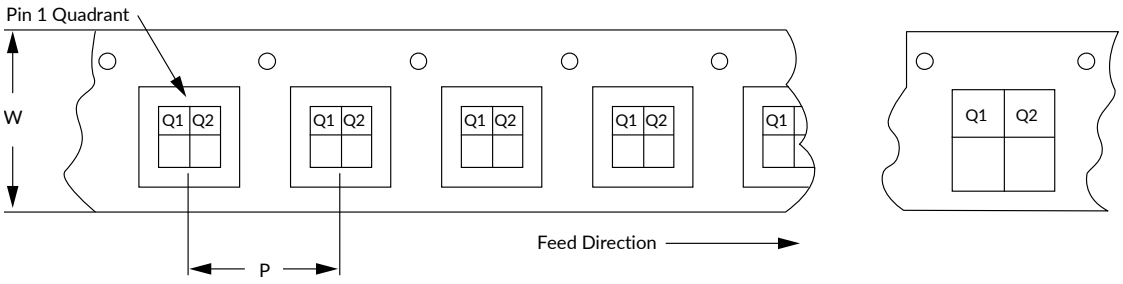
Guerrilla RF's tape and reel specification complies with Electronic Industries Alliance (EIA) standards for "Embossed Carrier Tape of Surface Mount Components for Automatic Handling" (reference EIA-481). See the following page for the Tape and Reel Specification and Device Package Information table, 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: *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
October 24, 2019	Preliminary Data Sheet.
February 9, 2022	Release Ø Data Sheet. Upgraded Data Sheet to new format.

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.