

GRF2052

Ultra-Low Noise Amplifier 1.7 to 4.5 GHz

FEATURES

- Flexible Bias Voltage and Current
- Compact 2.0 x 2.0 mm QFN-12 Package
- Process: GaAs pHEMT

Reference: 5 V / 70 mA / 2.5 GHz

- Gain: 19.2 dB
- OIP3: 38 dBm
- OP1dB: 21 dBm
- Evaluation Board Noise Figure: 0.5 dB

APPLICATIONS

- Cellular Infrastructure
- Small Cells and Cellular Repeaters
- Distributed Antenna Systems

DESCRIPTION

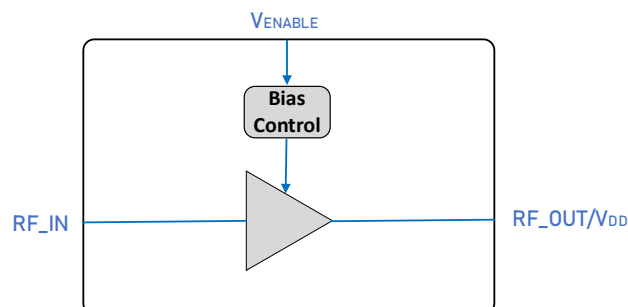
The GRF2052 is an ultra-low noise amplifier designed for wireless infrastructure and other high-performance RF applications requiring the absolute lowest possible noise figure (NF), high gain and outstanding linearity. Broadband external matches deliver outstanding RF performance from 1.7 to 4.5 GHz.

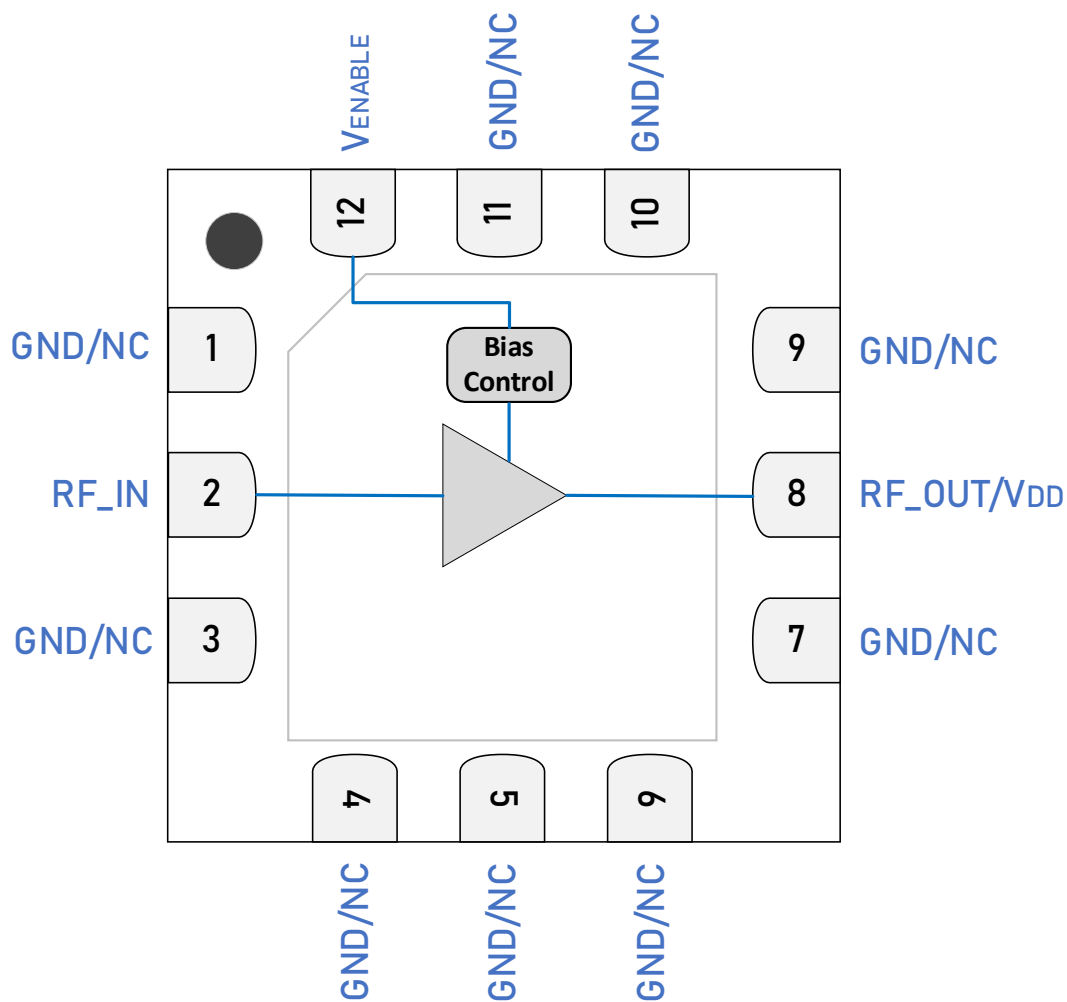
Configured as a first stage LNA, linear driver or cascaded gain block, the GRF2052 flexible biasing capability offers high levels of reuse both within a design and across platforms. For lower gain applications from 0.7 GHz up to 3.8 GHz, the pin compatible GRF2051 should be used.

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

Additional tunes can be found on the GRF2052 "Custom Tunes" product page: [GRF2052 Custom Tunes](#)

BLOCK DIAGRAM





2.0 x 2.0 mm QFN-12 Pin Out (Top View)

Pin Assignments

Pin	Name	Description	Note
1, 3, 4, 5, 6, 7, 9, 10, 11	GND/NC	Ground or No Connect	No internal connection to die. We recommend these pins be connected to ground.
2	RF_IN	RF Input	External match must provide DC block.
8	RF_OUT	RF Output	Provides device V_{DD} via external bias inductor.
12	V _{ENABLE}	Enable Voltage Input	V _{ENABLE} and series resistor sets I _{DDQ} . V _{ENABLE} ≤ 0.2 volts disables device. On-die-pull-down resistor turns device off if this node is allowed to float.
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.

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	$P_{IN\ MAX}$		20	dBm
Operating Temperature (package base)	$T_{PKG\ BASE}$	-40	105	°C
Maximum Channel Temperature (MTTF > 10 ⁶ Hours)	T_{MAX}		170	°C
Maximum Dissipated Power	$P_{DISS\ MAX}$		500	mW

Electrostatic Discharge

Charged Device Model	CDM	1500		V
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.

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](#)

Recommended Operating Conditions

Parameter	Symbol	Specification			Unit	Condition
		Min.	Typ.	Max.		
Supply Voltage	V_{DD}	2.7	5	6	V	
Operating Temperature (package base)	$T_{PKG\ BASE}$	-40		105	°C	
RF Frequency Range	F_{RF}	1.7	2.5	4.5	GHz	Typical application schematic with external matching components (note 1).
RF_IN Port Impedance	Z_{RFIN}		50		Ω	
RF_OUT 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: [GRF2052 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, $V_{DD} = 5\text{ V}$, $V_{ENABLE} = 5\text{ V}$, $I_{DD} = 70\text{ mA}$, $f_{RF} = 2.5\text{ GHz}$, $T_{PKG\text{ BASE}} = 25\text{ }^{\circ}\text{C}$. Evaluation board losses are included within the specifications.

Parameter	Symbol	Specification			Unit	Condition
		Min.	Typ.	Max.		
Supply Current	I_{DD}		70		mA	$V_{DD} = 5\text{ V}$, $V_{ENABLE} = 5\text{ V}$.
Enable Current	I_{ENABLE}		4	8	mA	
Switching Rise Time	T_{RISE}		400		ns	Gain mode to Disabled mode (note 3).
Switching Fall Time	T_{FALL}		400		ns	Disabled mode to Gain mode (note 4).

Disabled Mode

Leakage Current	$I_{LEAKAGE}$		10	150	μA	$V_{DD} = 5\text{ V}$, $V_{ENABLE} = 0\text{ V}$.
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Thermal Data

Thermal Resistance: (Infrared Scan)	Θ_{JC}		60		$^{\circ}\text{C}/\text{W}$	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} .

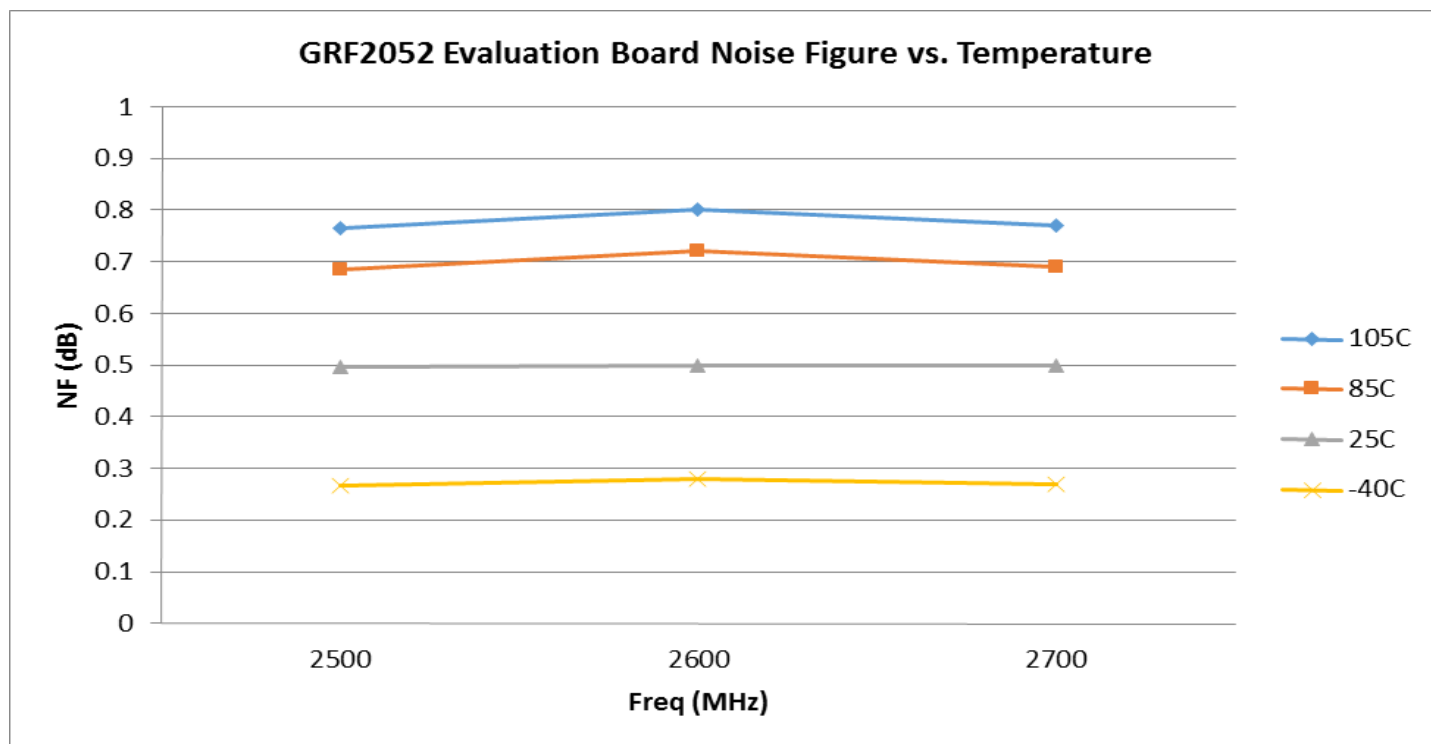
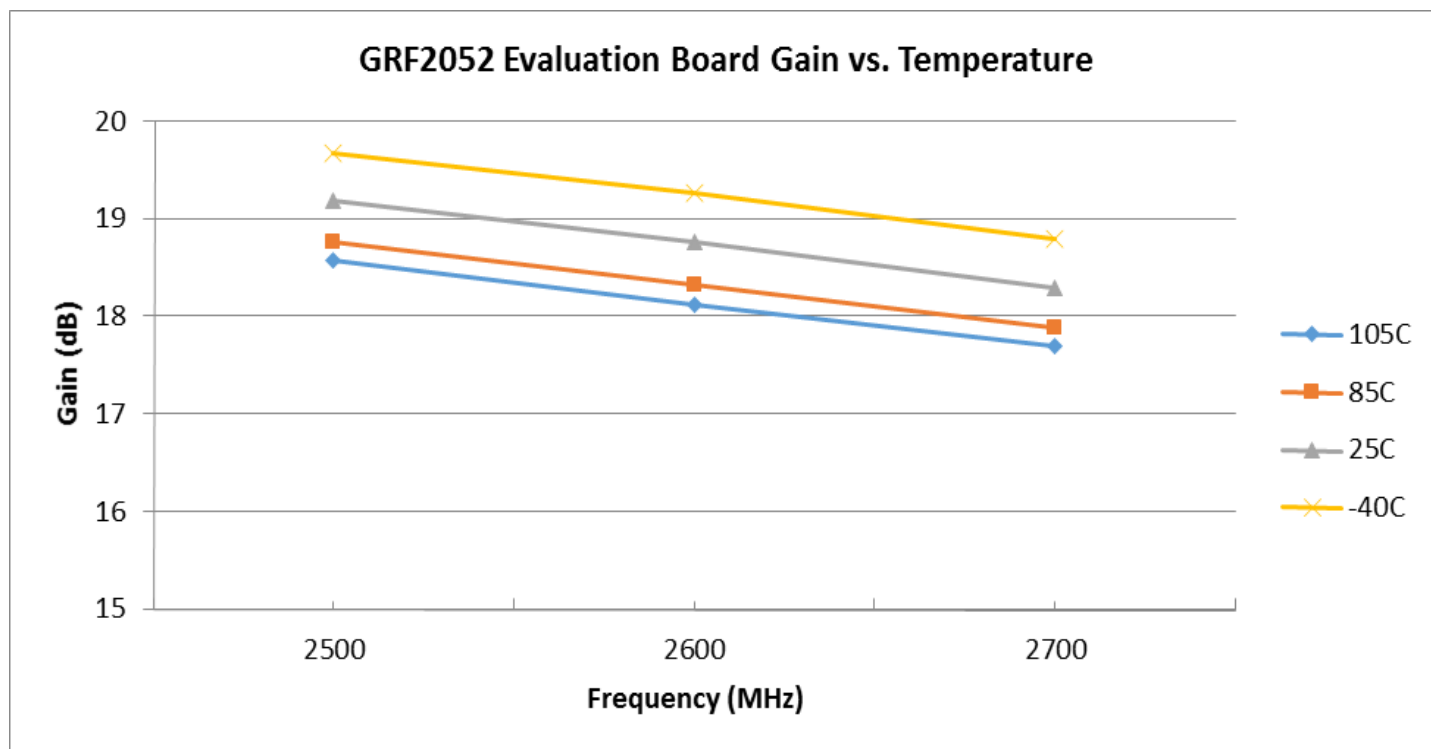
Note 5: MTTF > 10^6 hours for $T_{CHANNEL} \leq 170\text{ }^{\circ}\text{C}$.

Nominal Operating Parameters – RF

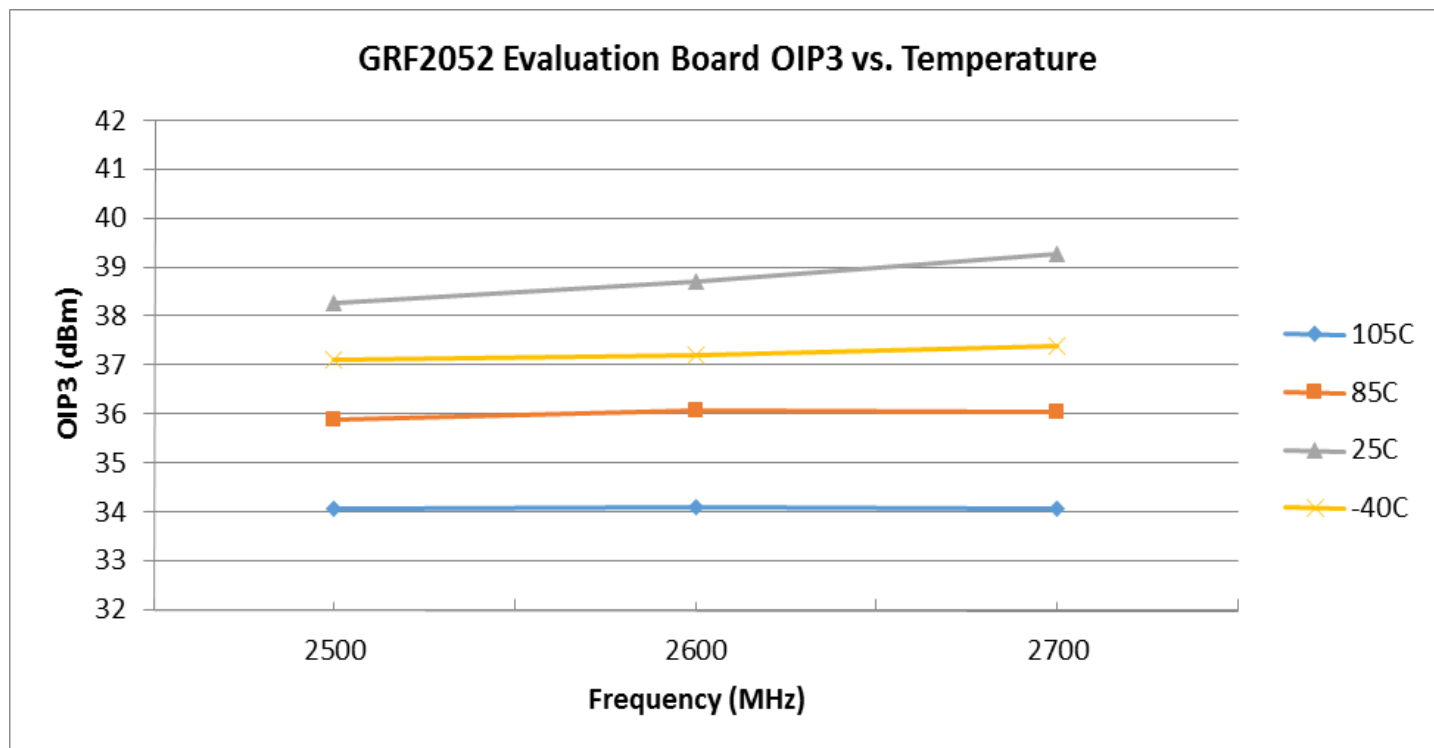
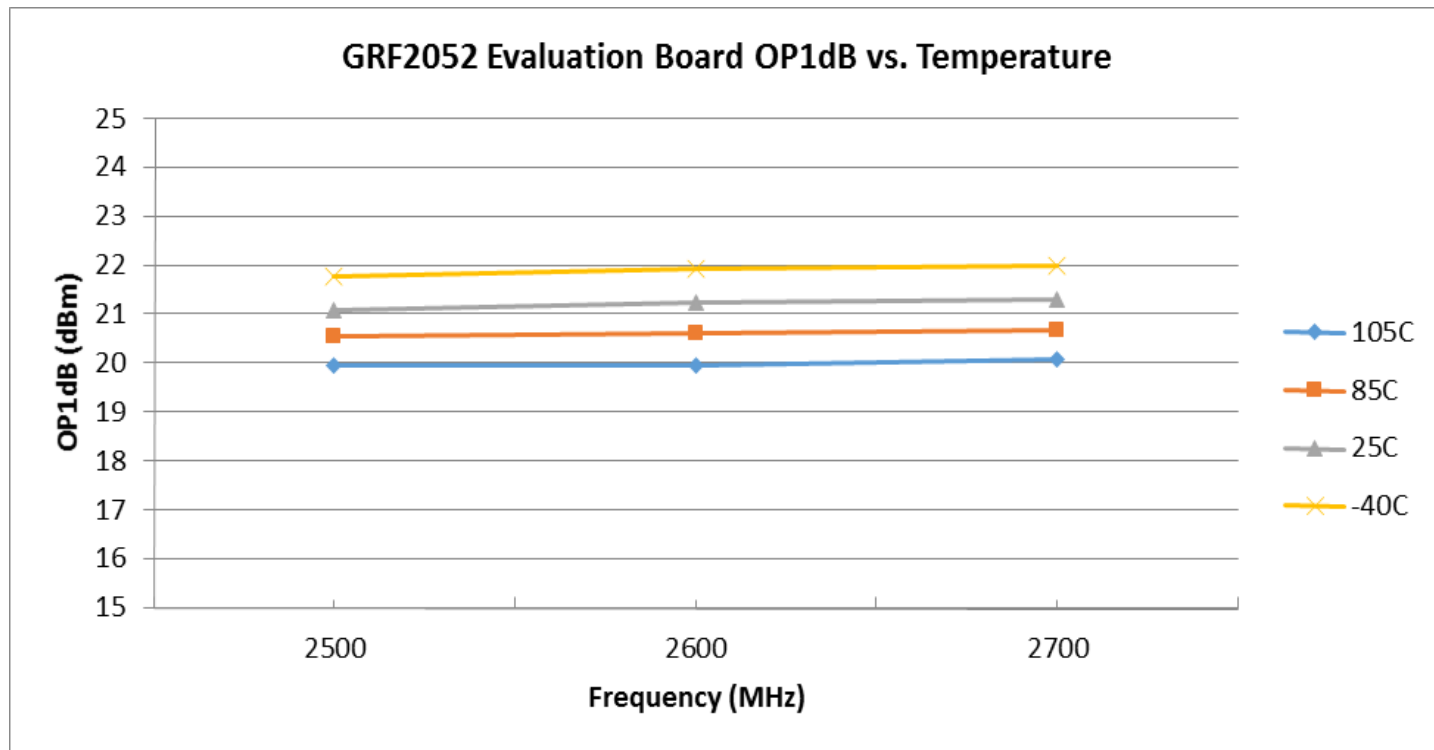
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Parameter	Symbol	Specification			Unit	Condition
		Min.	Typ.	Max.		
Gain	S21	18	19		dB	
Noise Figure	NF		0.5	0.7	dB	On standard evaluation board.
Output 3rd Order Intercept Point	OIP3		38.2		dBm	3 dBm P_{OUT} per tone at 2 MHz spacing (2499 and 2501 MHz).
Output P1dB Compression Power	OP1dB	19.5	21		dBm	

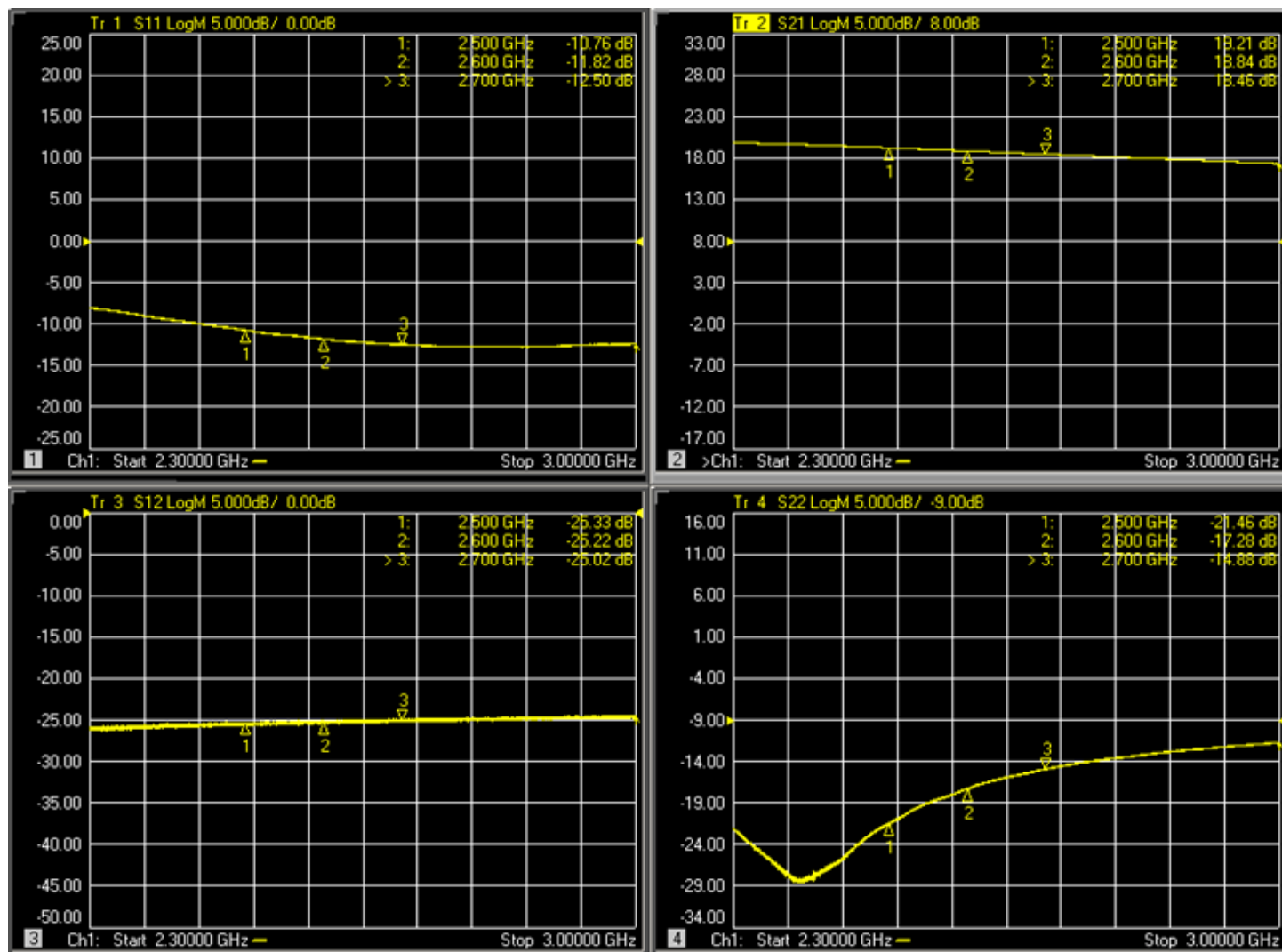
GRF2052 Typical Operating Curves: 2.5 to 2.7 GHz Tune



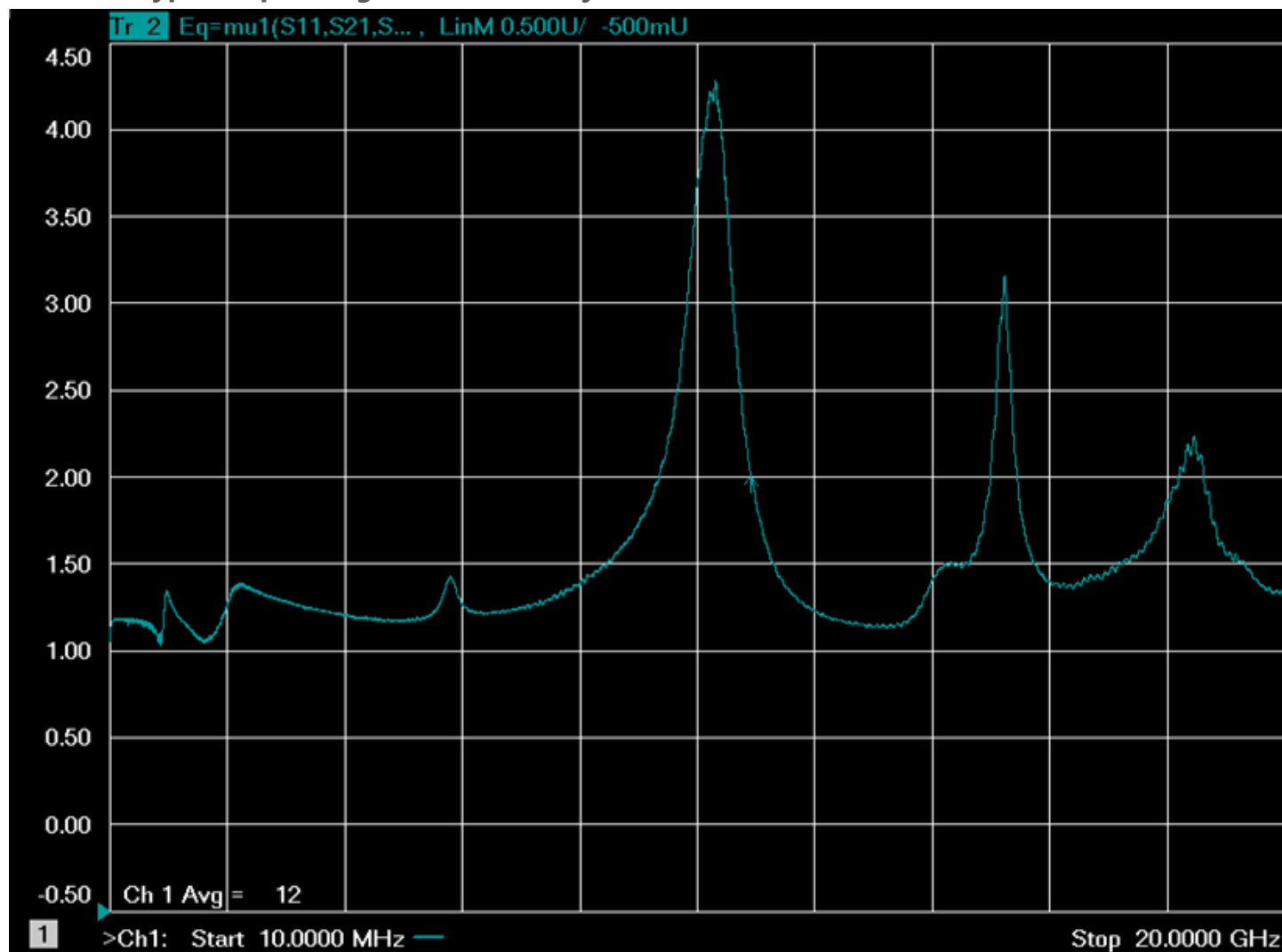
GRF2052 Typical Operating Curves: 2.5 to 2.7 GHz Tune



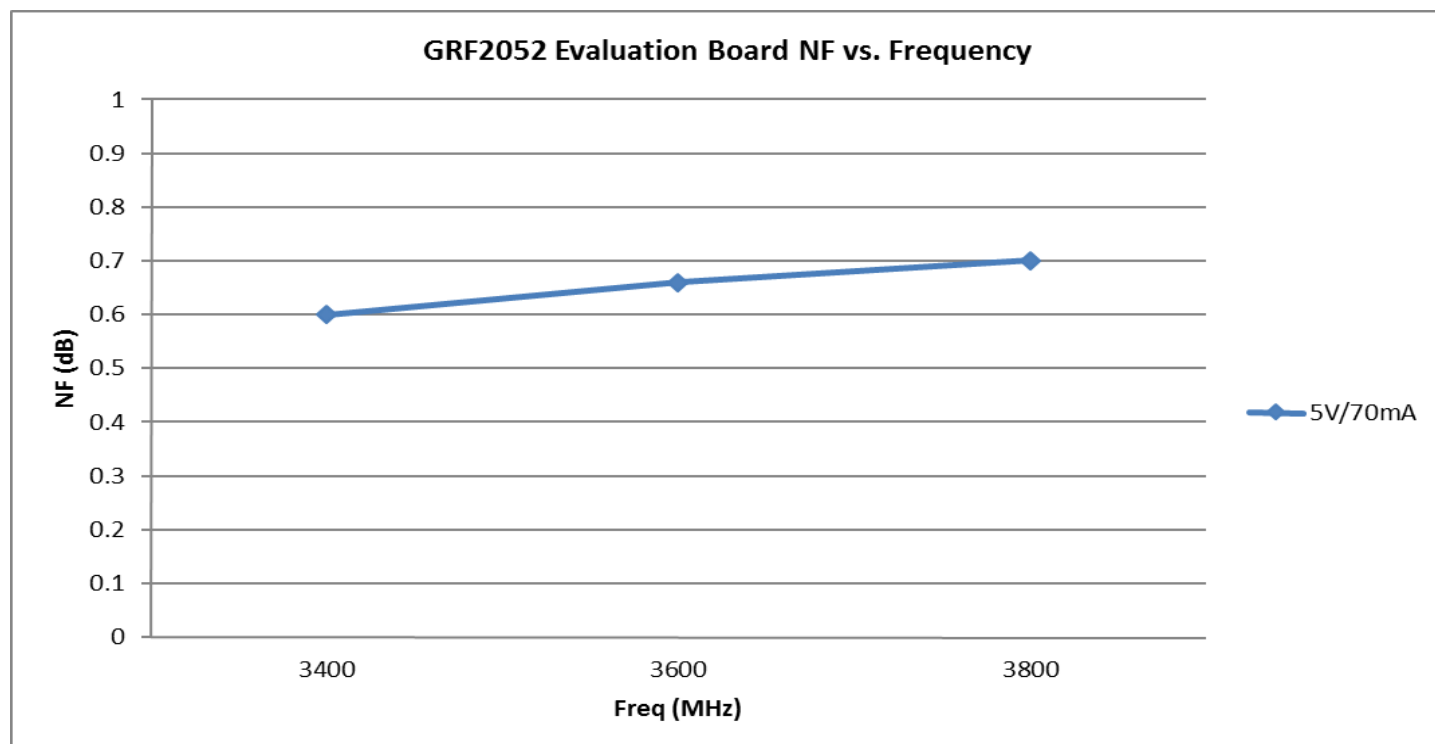
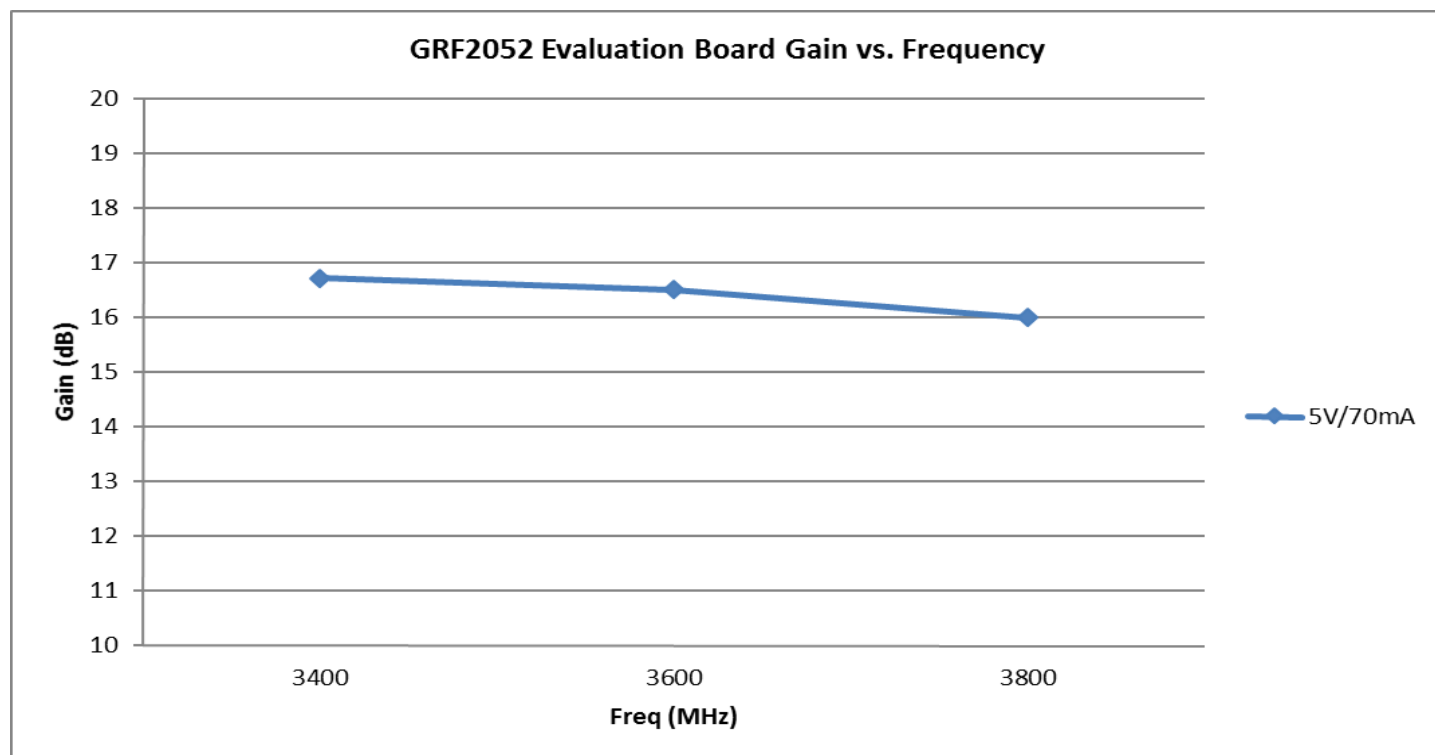
GRF2052 Typical Operating Curves: S-Parameters (2.5 to 2.7 GHz Tune)



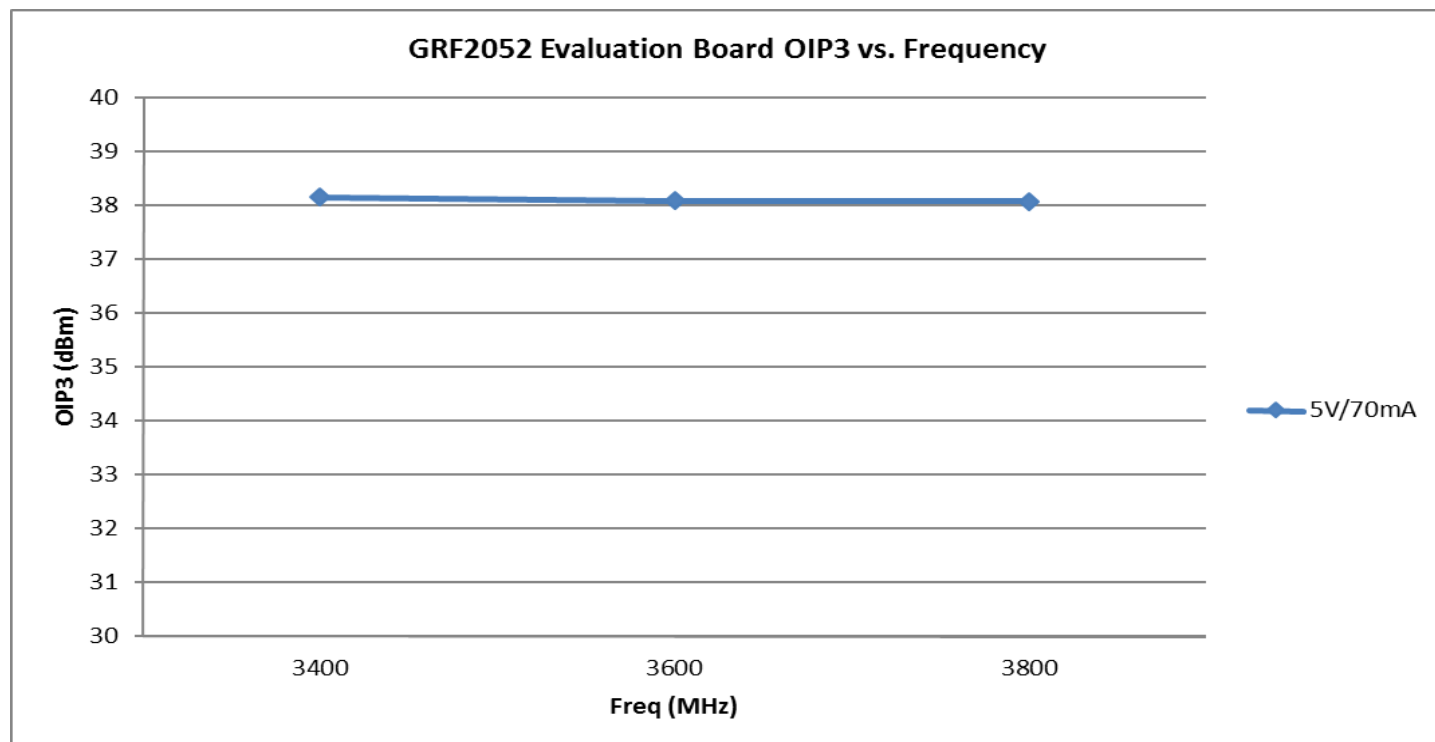
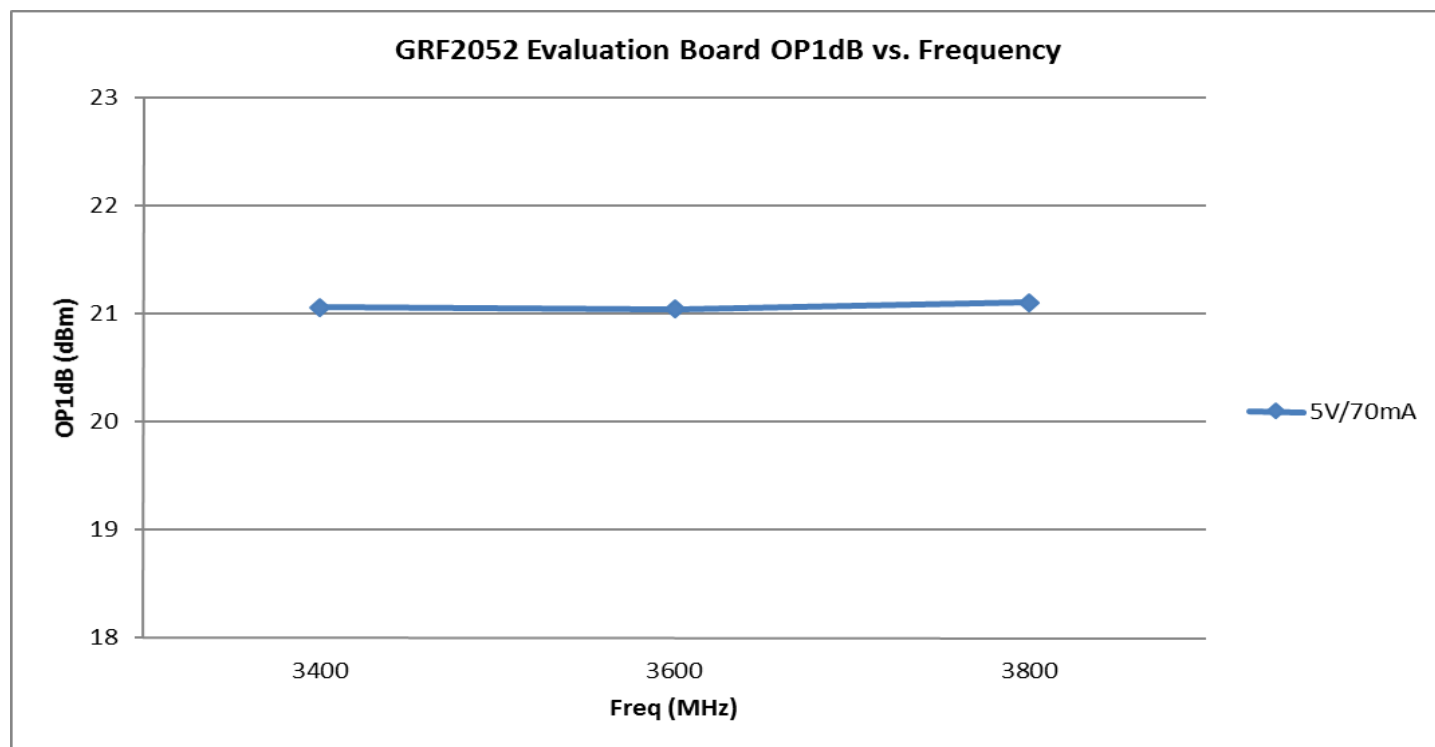
GRF2052 Typical Operating Curves: Stability Mu Factor (10 MHz to 20 GHz)



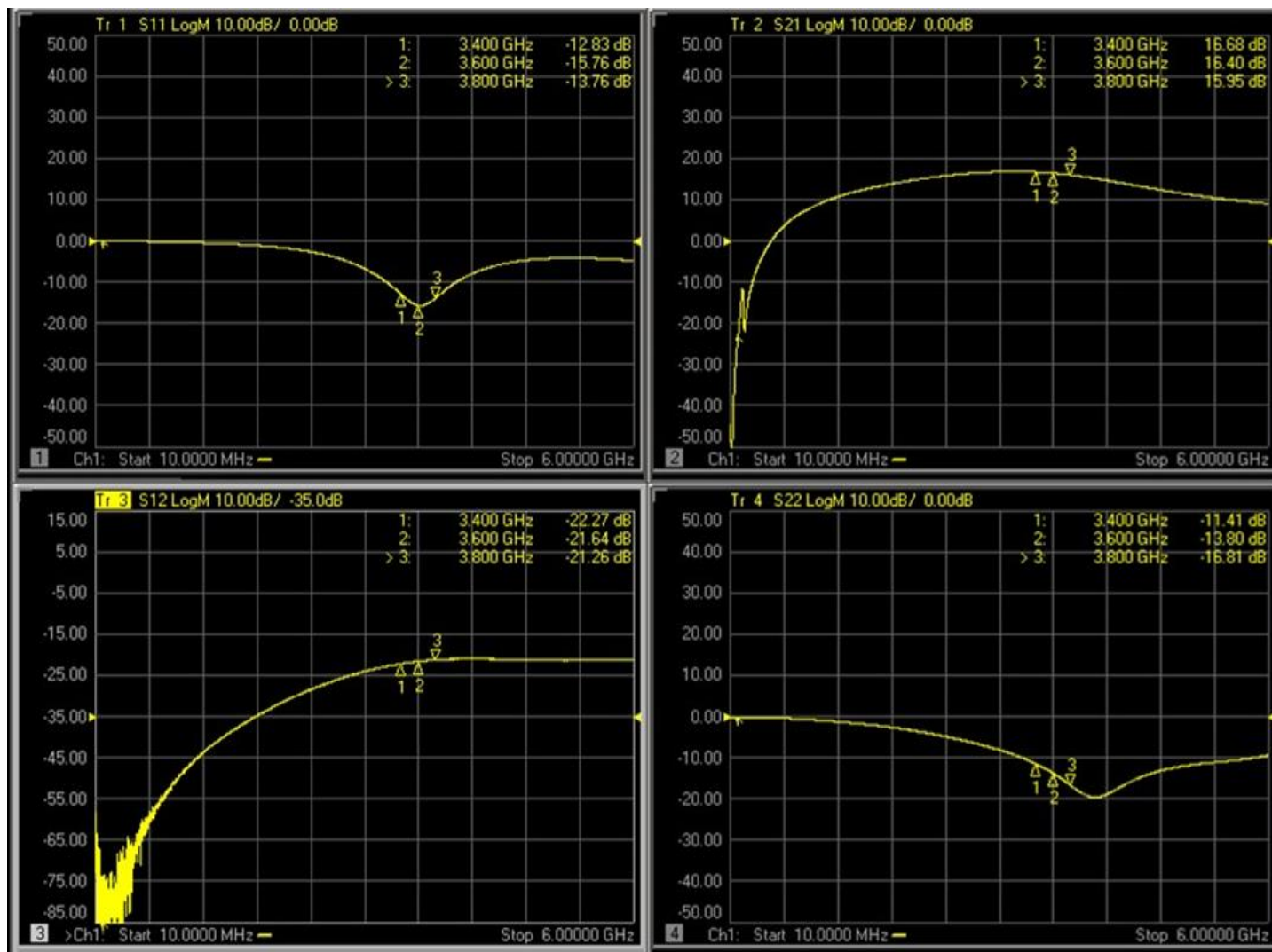
GRF2052 Typical Operating Curves: 3.4 to 3.8 GHz Tune



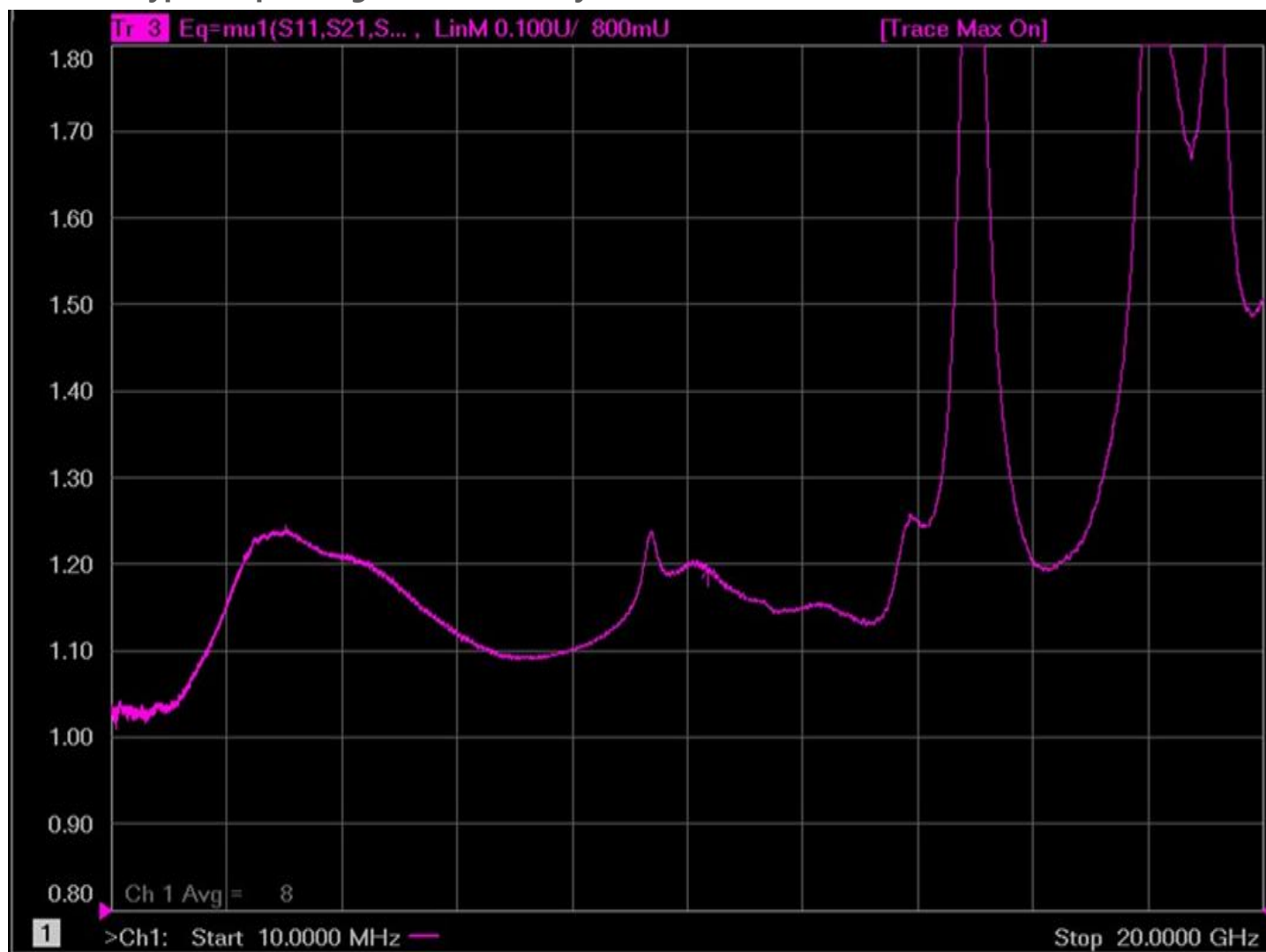
GRF2052 Typical Operating Curves: 3.4 to 3.8 GHz Tune

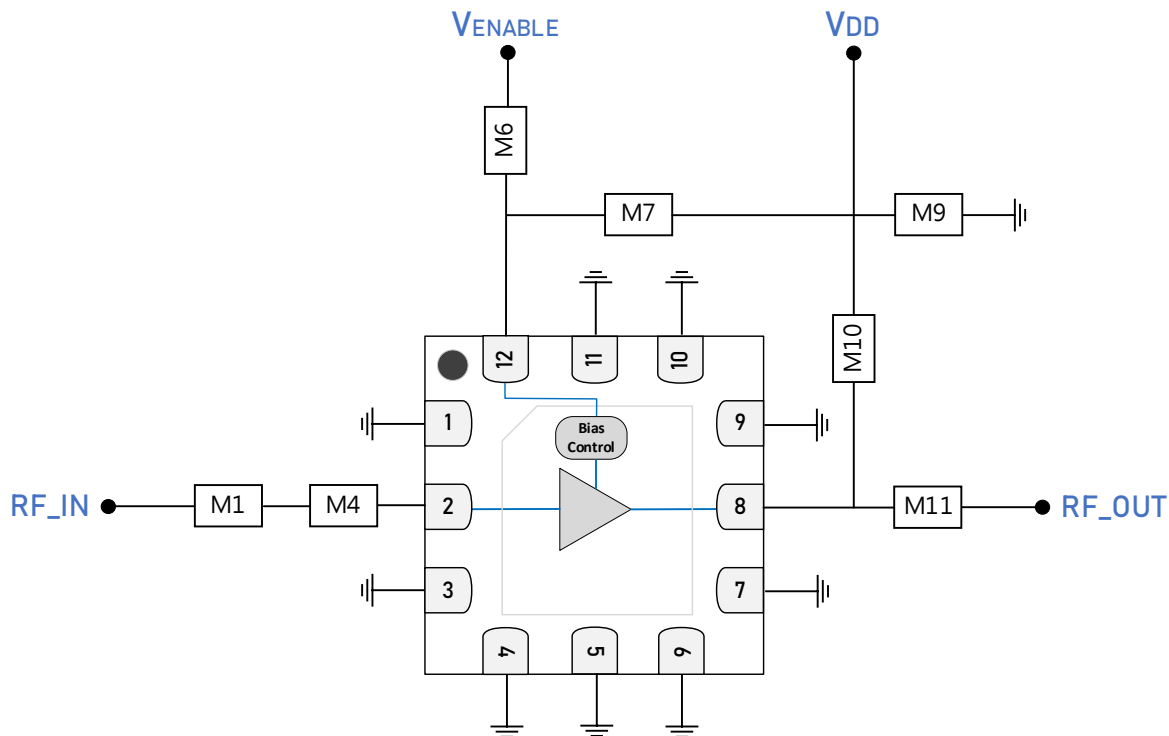


GRF2052 Typical Operating Curves: S-Parameters (3.4 to 3.8 GHz Tune)

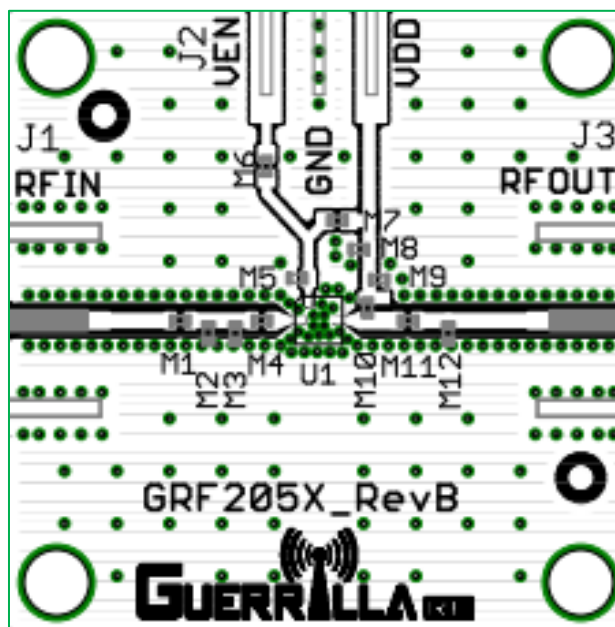


GRF2052 Typical Operating Curves: Stability Mu Factor (10 MHz to 20 GHz)





GRF2052 Standard Evaluation Board Schematic

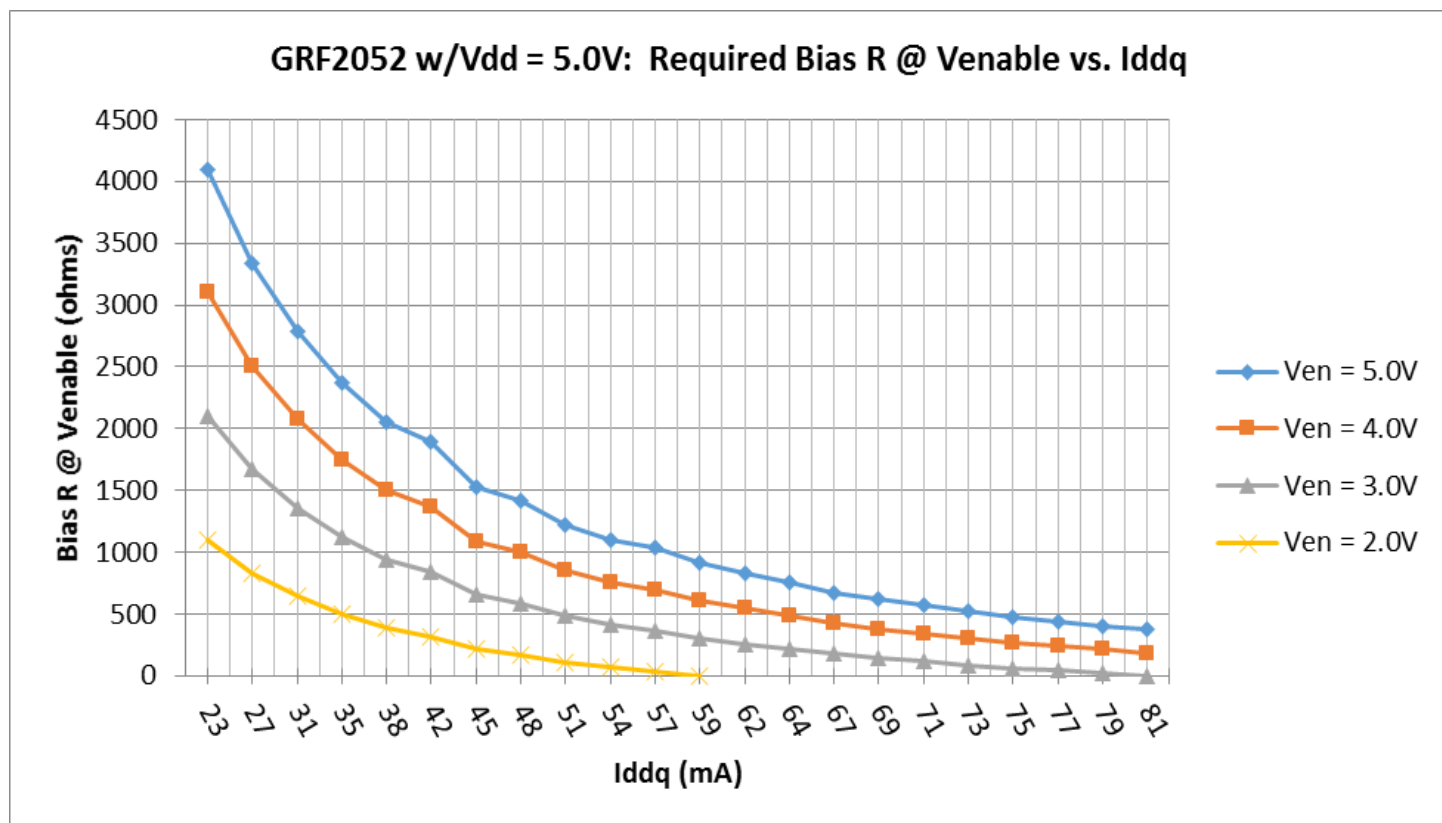


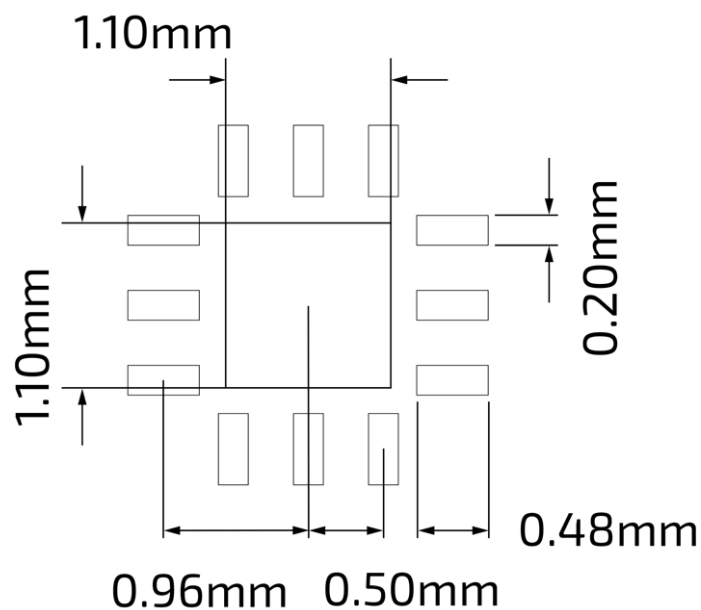
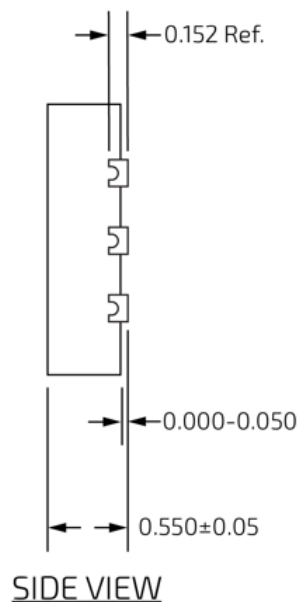
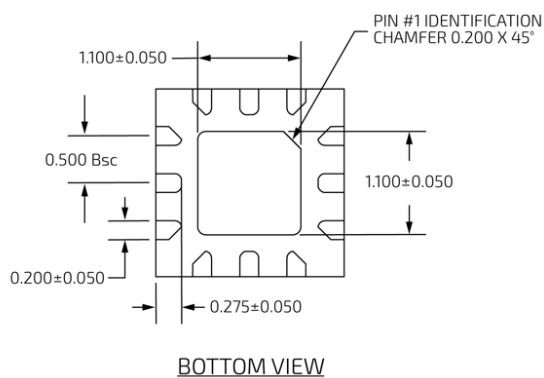
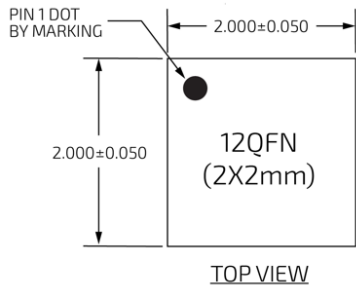
GRF2052 Evaluation Board Assembly Diagram

GRF2052 Evaluation Board BOM: 2.5 to 2.7 GHz Tune

Component	Type	Manufacturer	Family	Value	Package Size	Substitution
M1	Capacitor – High Q	Murata	GJM	2.4 pF	0402	ok
M4	Inductor	Murata	LQW	1.0 nH	0402	ok
M6	Resistor	Various	5%	see curves	0402	ok
M7	Resistor (jumper)	Various	5%	0 Ω	0402	ok
M9	Capacitor	Murata	GRM	0.1 μ F	0402	ok
M10	Inductor	Various	MLC	2.7 nH	0402	ok
M11	Capacitor	Murata	GJM	2.4 pF	0402	ok
Evaluation Board	GRF205X_RevB					

Note: Standard evaluation board bias: $V_{DD} = 5\text{ V}$, $V_{ENABLE} = 5\text{ V}$.

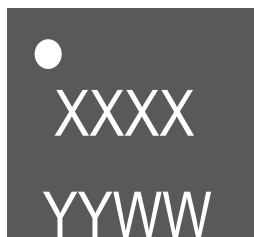
GRF2052 Bias Resistor Selection Curves



2.0 x 2.0 mm QFN-12 Suggested PCB Footprint (Top View)


Dimensions in millimeters

2.0 x 2.0 mm QFN-12 Package Dimensions

Package Marking Diagram



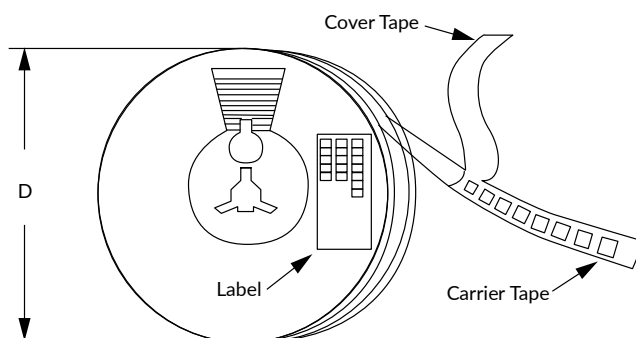
- Line 1: "XXXX" = Device PART NUMBER.
- Line 2: "YY" = YEAR. "WW" = WORK WEEK the device was assembled.

Tape and Reel Information

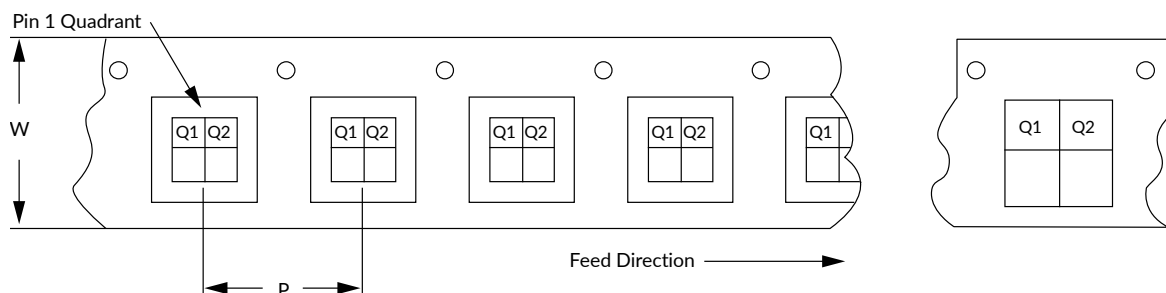
Guerrilla RF's tape and reel specification complies with Electronic Industries Alliance (EIA) standards for "Embossed Carrier Tape of Surface Mount Components for Automatic Handling" (reference EIA-481). See the following page for the Tape and Reel Specification and Device Package Information table, 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 \(guerrilla-rf.com\)](https://www.guerrilla-rf.com/package-manufacturing-information)



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
January 16, 2017	Release A Data Sheet.
February 25, 2025	Upgraded Data Sheet to new format only. No change to device or device specifications.



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 <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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