DATA SHEET

GRF9163

PRELIMINARY DATA SHEET

CATV and General Purpose Amplifier 5 to 2000 MHz

FEATURES

- 5 to 2000 MHz Operation
- Outstanding Noise Figure and Linearity
- Compact 3.0 x 3.0 mm QFN-16 Package
- Process: GaAs pHEMT

Reference: 5 V / 280 mA / 1218 MHz

- Flat Gain: 20 dB
- OP1dB: 25 dBm
- OIP3: 41 dBm
- OIP2L: 74 dBm
- OIP2H: 53 dBm
- Evaluation Board Noise Figure: 1.8 dB

APPLICATIONS

- Cable, Terrestrial, and Satellite
- DOCSIS
- CATV, Cable Modem and Set Top Box
- General Purpose Gain Block

ORDERING INFORMATION

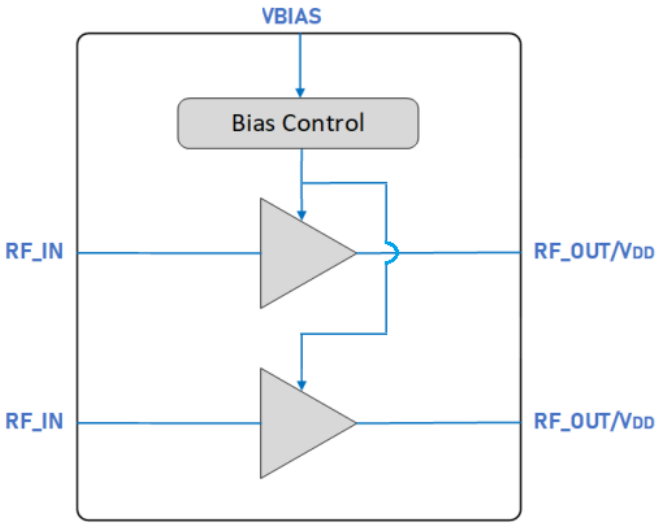
Buy it Now

DESCRIPTION

The GRF9163 is a broadband, linear, dual/balanced gain block designed for use in 75 Ω CATV and 50 Ω general purpose applications.

Please consult with the GRF applications engineering team for application notes and custom tuning/evaluation board data. De-embedded S-Parameters are available on the GRF website.

BLOCK DIAGRAM



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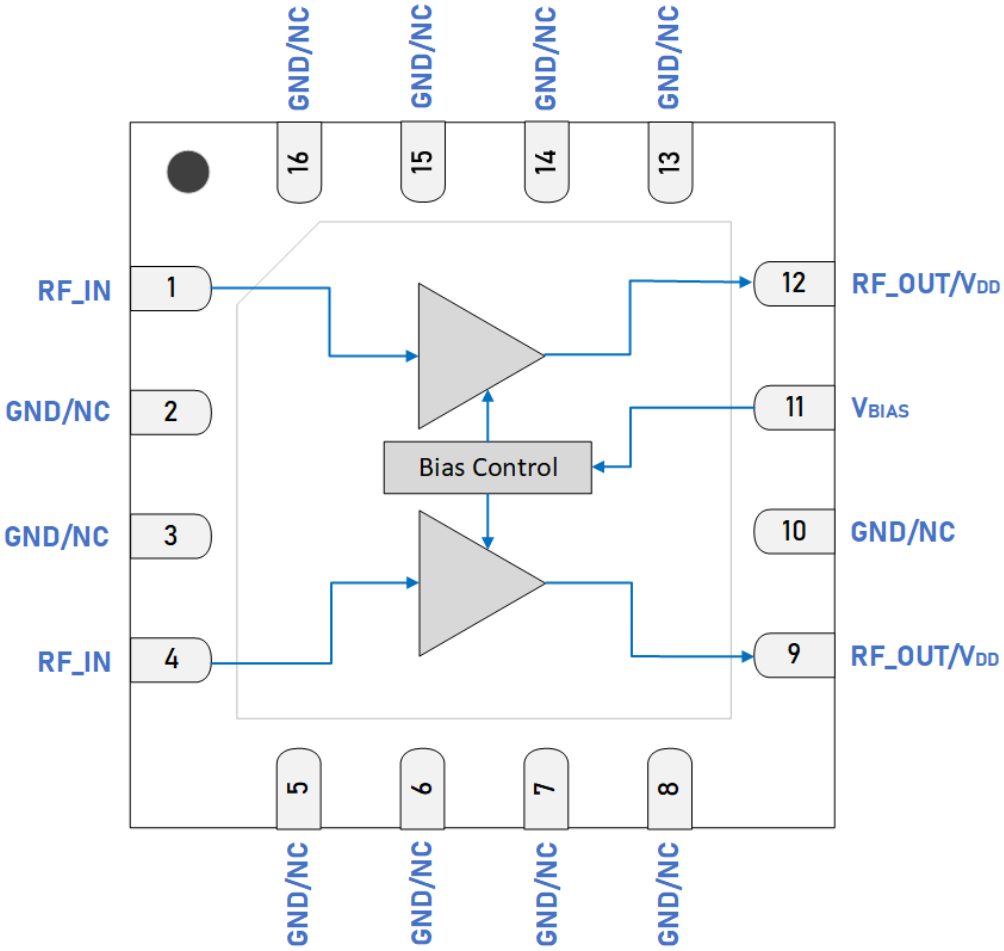

Pin Out (Top View)

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Pin Assignments

Pin	Name	Description	Note
1, 4	RF_IN	RF Input	External match must provide DC Block.
2, 3, 5, 6, 7, 8, 10, 13, 14, 15, 16	GND/NC	Ground or No Connect	No internal connection to die. We recommend connecting these pins to ground.
9, 12	RF_OUT/V_{DD}	RF Output	Provides device V_{DD} via external bias inductor/ferrite bead. DC block required at evaluation board output.
11	V_{BIAS}	Bias Voltage	Applied through series resistor.
PKG BASE	GND	Ground	Provides DC and RF ground 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.

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Absolute Ratings

Parameter	Symbol	Min.	Max.	Unit
Supply Voltage	V_{DD}	0	5.25	V
RF Input Power: CW, Load VSWR < 2:1, V_{DD} = 5 V	$P_{in\ Max}$		TBD	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	$P_{DISS\ MAX}$		TBD	mW
Electrostatic Discharge				
Charged Device Model	CDM	TBD		V
Human Body Model	HBM	TBD		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.

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Recommended Operating Conditions

Parameter	Symbol	Specification			Unit	Condition
		Min.	Typ.	Max.		
Supply Voltage	V_{DD}	3	5	5.25	V	
Operating Temperature Range	$T_{PKG\ BASE}$	-40		85	°C	
RF Frequency Range	F_{RF}	5	1218	2000	MHz	Typical applications schematic with external matching components **(notes 1 & 2)**.
RF_IN Port Impedance	Z_{RFIN}		75		Ω	Single-ended.
RF_OUT Port Impedance	Z_{RFOUT}		75		Ω	Single-ended.

Note 1: Operation outside of 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.

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Nominal Operating Parameters - General

Parameter	Symbol	Specification			Unit	Condition
		Min.	Typ.	Max.		
Supply Current	I_{DD}		280		mA	
Thermal Data						
Thermal Resistance (Infrared Scan)	Θ_{JC}		TBD		°C/W	On standard evaluation board **(note 3)**.

Note 3: MTTF > 10^6 hours for $T_j \leq 170$ °C

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Nominal Operating Parameters - RF

Typical Application Schematic: V_{DD} = 5 V, I_{DD} = 280 mA. Evaluation board losses included within the specifications.

Parameter	Symbol	Specification			Unit	Condition
		Min.	Typ.	Max.		
Gain	S21		19.8		dB	50 MHz
			20		dB	1218 MHz
			20.3		dB	1800 MHz
S-Parameters	S11		< -18		dB	50 - 1800 MHz
	S12		< -22.5		dB	50 - 1800 MHz
	S22		< - 19		dB	50 - 1800 MHz
Noise Figure	NF		1.6		dB	50 MHz (evaluation board F to F)
			1.8		dB	1218 MHz (evaluation board F to F)
			2.1		dB	1800 MHz (evaluation board F to F)
Output 2nd Order Intercept Point Low	OIP2L		86		dBm	+12 dBm P_{OUT} per tone. 30 MHz spacing at 50 MHz
			72		dBm	+12 dBm P_{OUT} per tone. 30 MHz spacing at 1218 MHz
			80		dBm	+12 dBm P_{OUT} per tone. 30 MHz spacing at 1800 MHz
Output 2nd Order Intercept Point High	OIP2H		86		dBm	+12 dBm P_{OUT} per tone. 30 MHz spacing at 50 MHz
			53		dBm	+12 dBm P_{OUT} per tone. 30 MHz spacing at 1218 MHz
			58		dBm	+12 dBm P_{OUT} per tone. 30 MHz spacing at 1800 MHz
Output 3rd Order Intercept Point	OIP3		42.5		dBm	+12 dBm P_{OUT} per tone. 6 MHz spacing at 50 MHz
			41		dBm	+12 dBm P_{OUT} per tone. 6 MHz spacing at 1218 MHz
			39.2		dBm	+12 dBm P_{OUT} per tone. 6 MHz spacing at 1800 MHz
Output 1dB Compression Power	OP1dB		26.2		dBm	50 MHz
			25.1		dBm	1218 MHz
			24.5		dBm	1800 MHz

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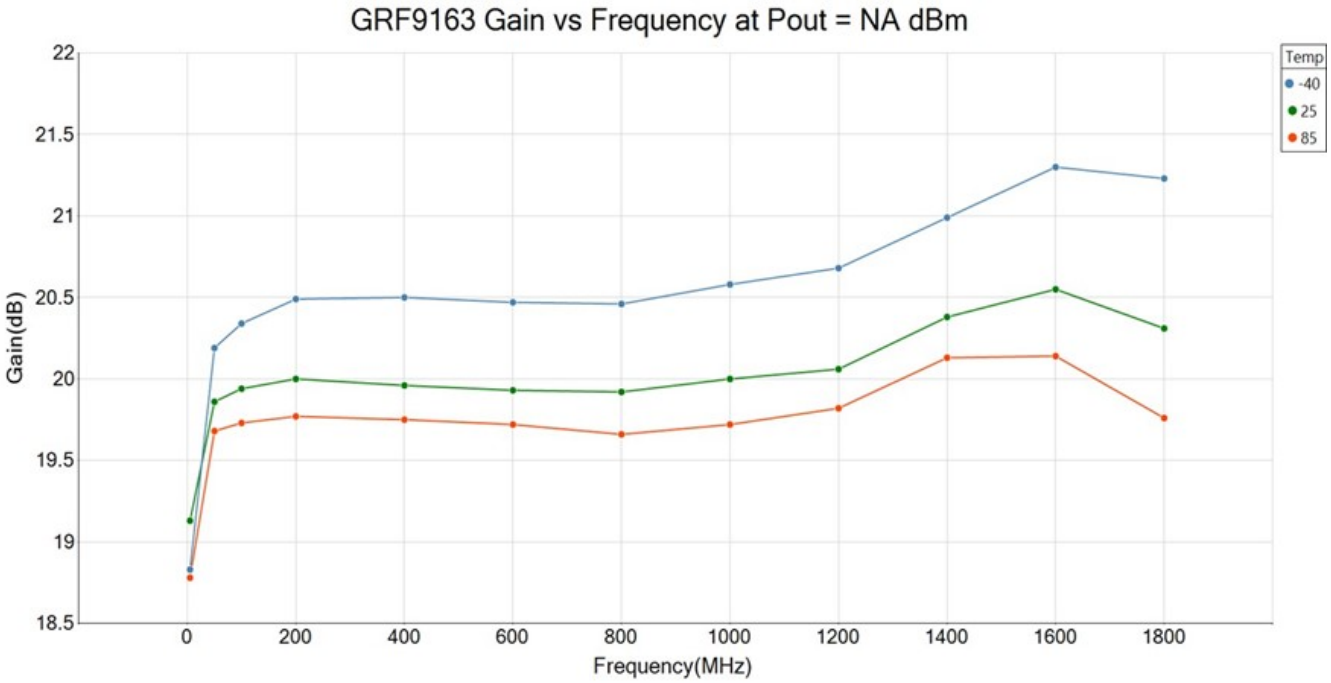
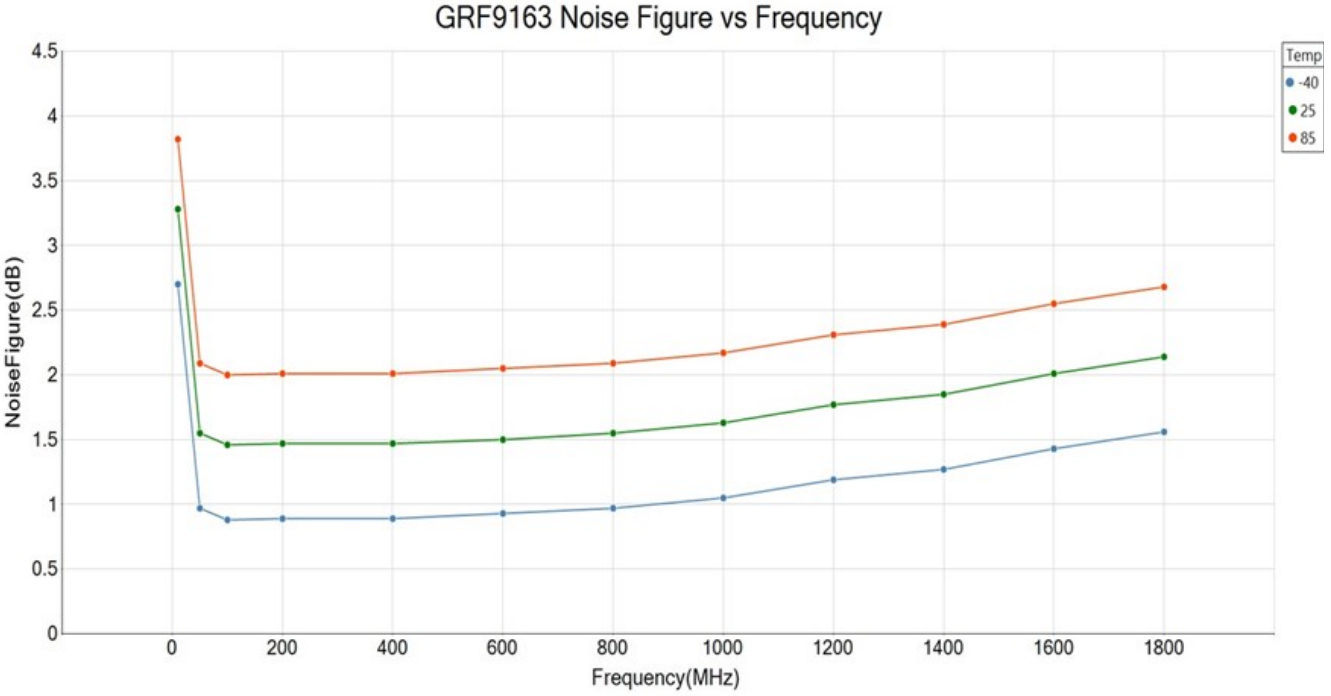
GRF9163 Typical Operating Curves: 5 V, 5 to 1800 MHz Tune





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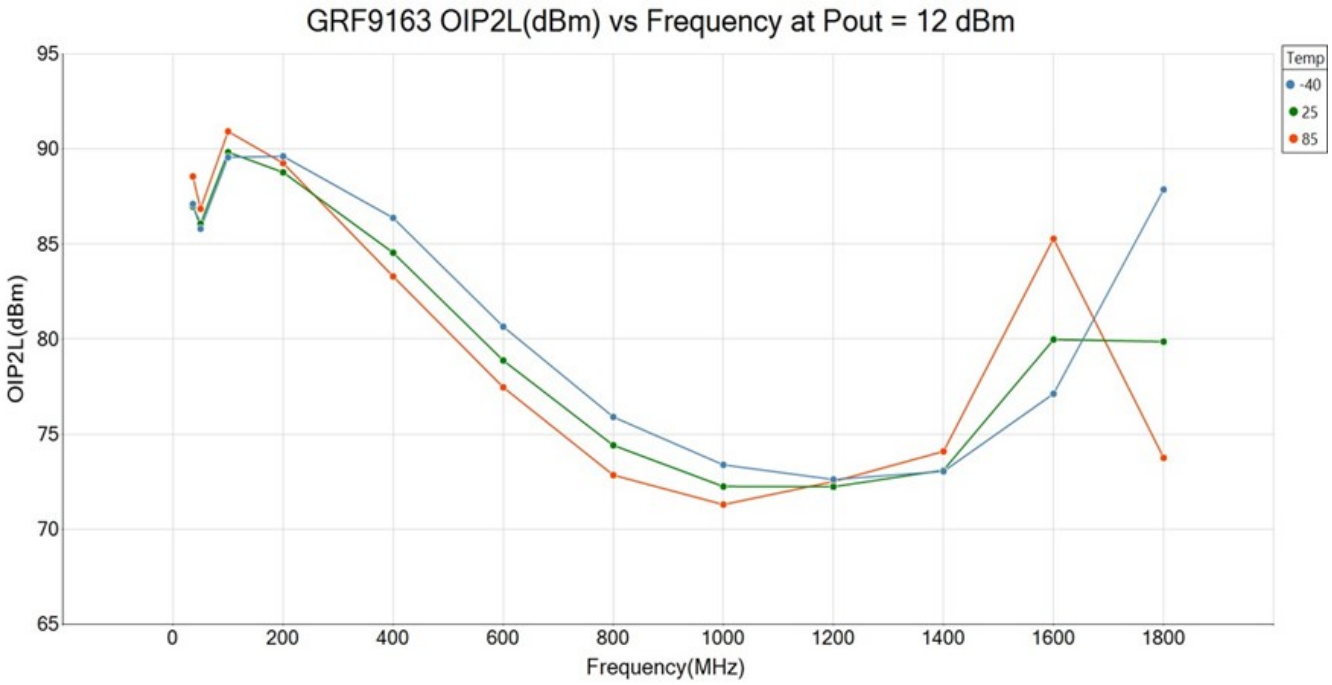
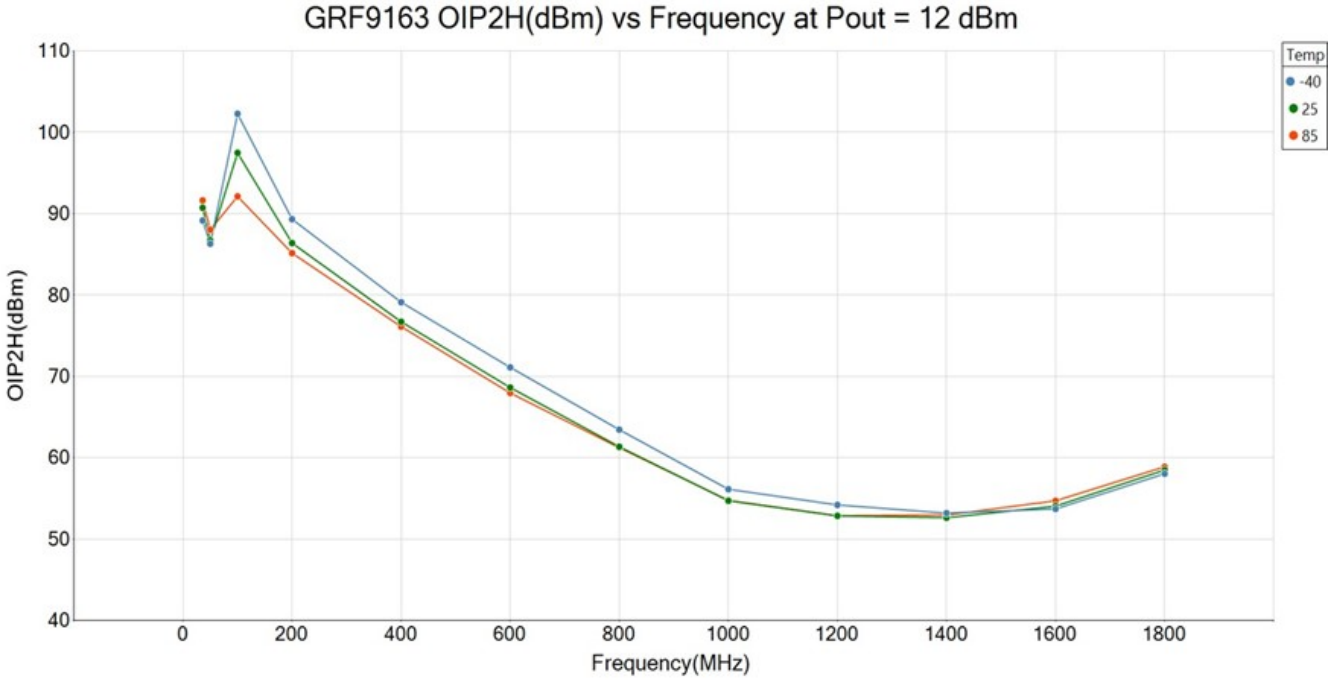
GRF9163 Typical Operating Curves: 5 V, 5 to 1800 MHz Tune





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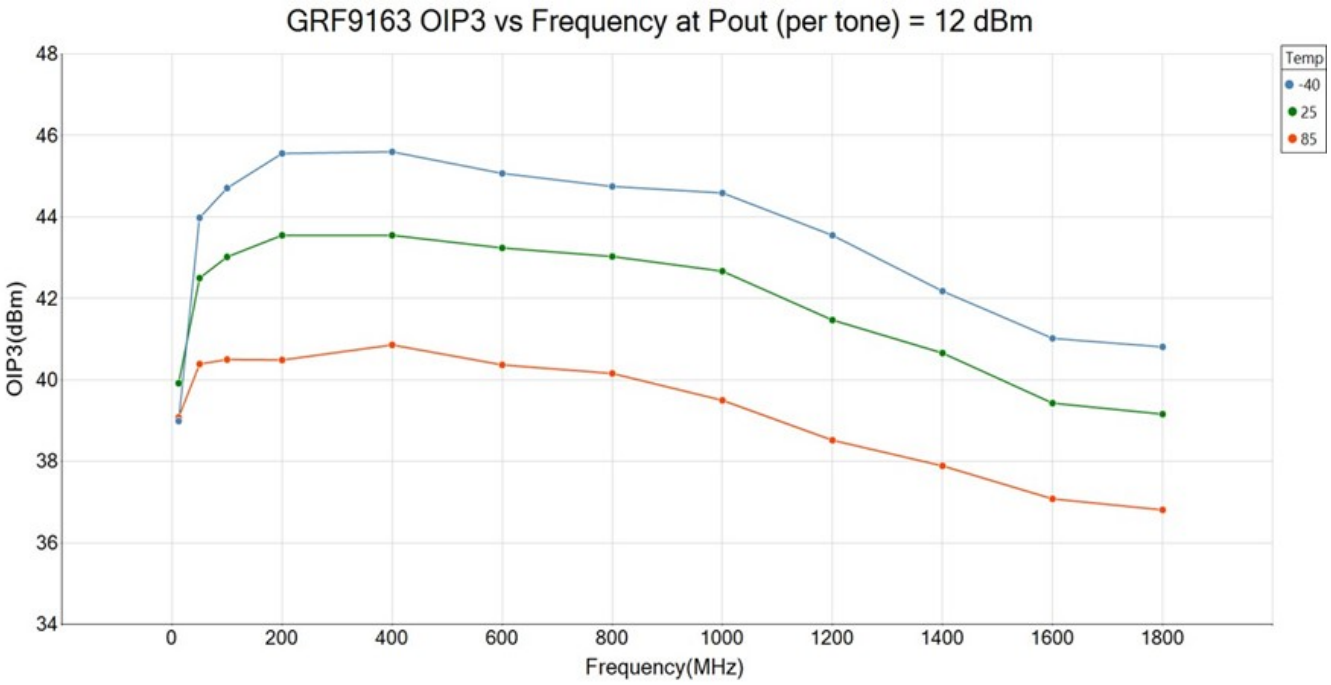

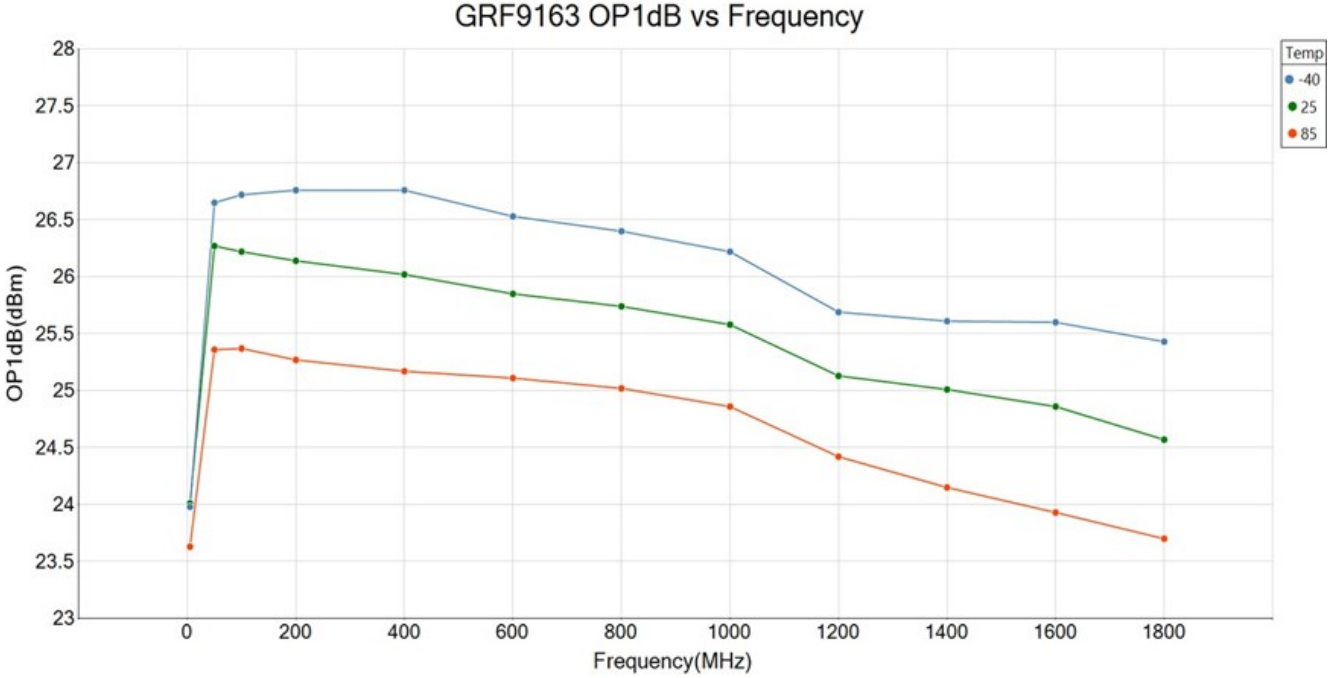

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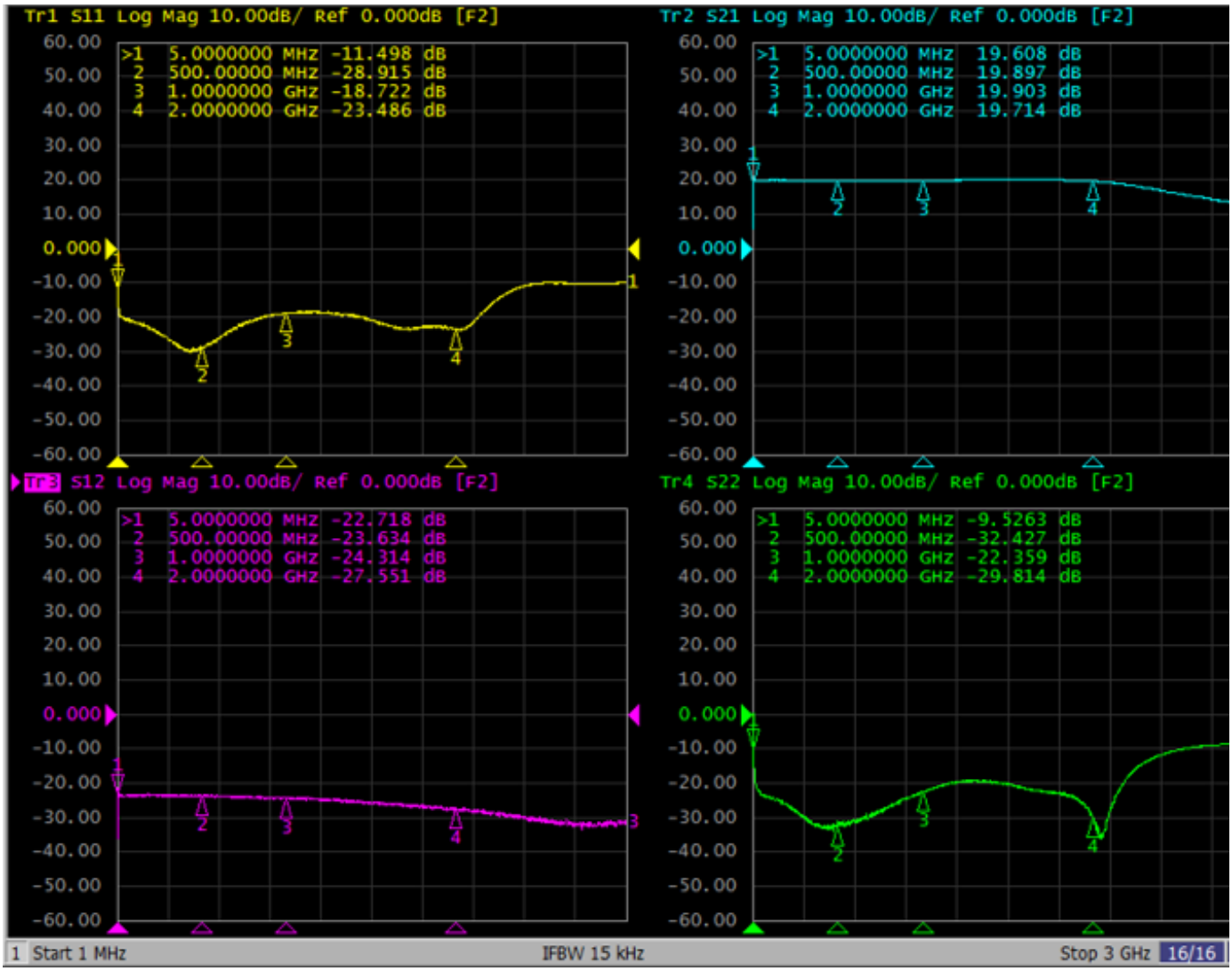
GRF9163 Typical Operating Curves: S-Parameters (1 to 3000 MHz in 75 Ω System)



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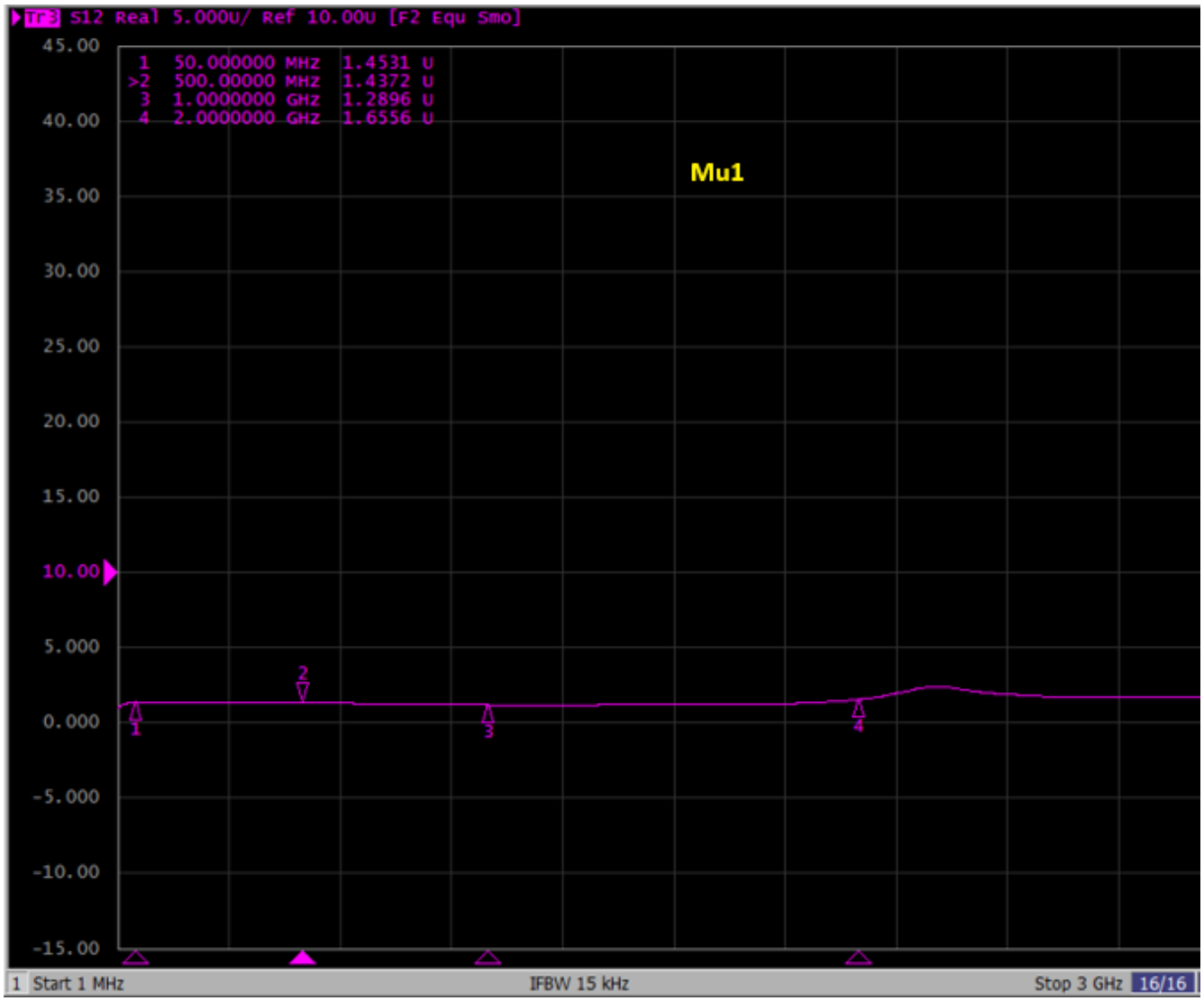
GRF9163 Typical Operating Curves: Stability Mu Factor (1 to 3000 MHz in 75 Ω System)



Note: Mu Factor ≥ 1.0 implies unconditional stability.

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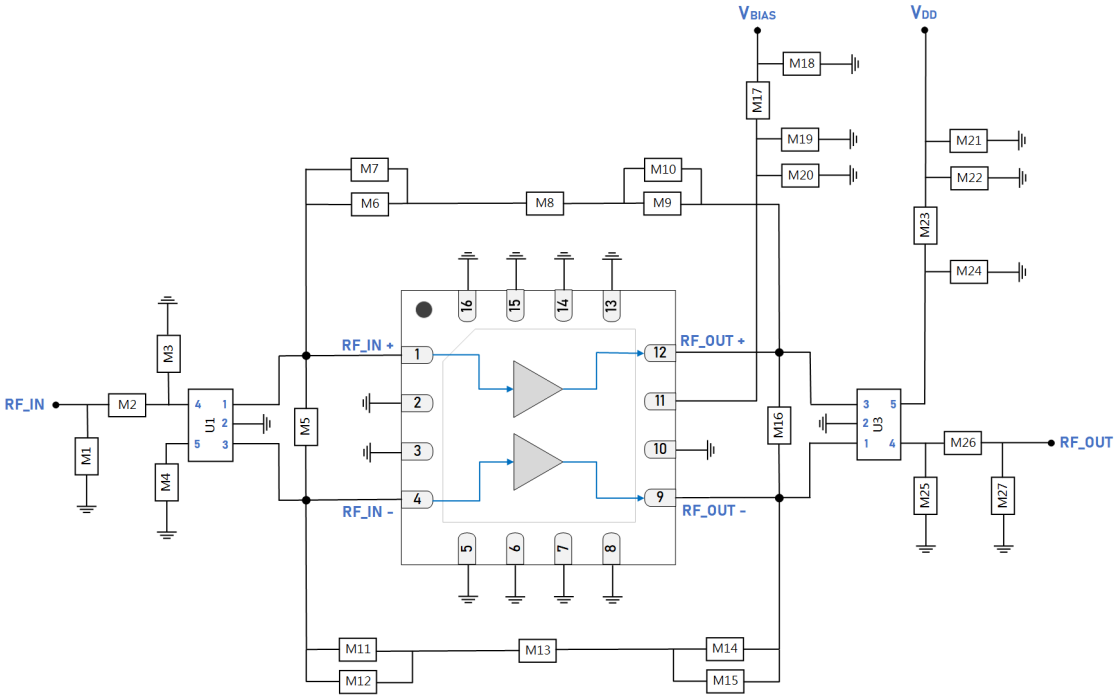
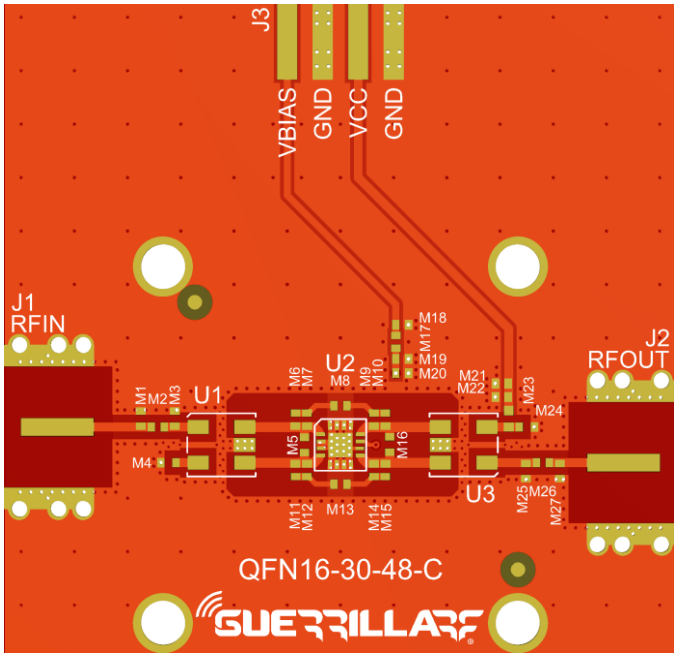


GRF9163 Standard Evaluation Board Schematic



GRF9163 Evaluation Board Assembly

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GRF9163 Evaluation Board Assembly Diagram Reference: 5 to 1800 MHz Tune

Component	Type	Manufacturer	Family	Value	Package	Substitution
M1, M3, M5, M12, M16, M19, M20, M25, M27	DNP					
M2, M4, M8, M13, M18, M21, M24, M26	Capacitor	Murata	GRM	0.1 µF	0402	Ok
M6, M11	Resistor	Various	5%	604 Ω	0402	Ok
M9, M14	Resistor	Various	5%	82 Ω	0402	Ok
M10, M15	Inductor	Murata	LQG15WH	22 nH	0402	Ok
M17	Resistor	Various	5%	22 kΩ	0402	Ok
M22	Capacitor	Murata	GRM	1000 pF	0402	Ok
M23	Ferrite	Murata	BLM15PX601SZ1	N/A	0402	No
U1, U3	Balun	MiniRF	MRFXF0837	N/A	N/A	No
Evaluation Board	QFN16-30-48-C					

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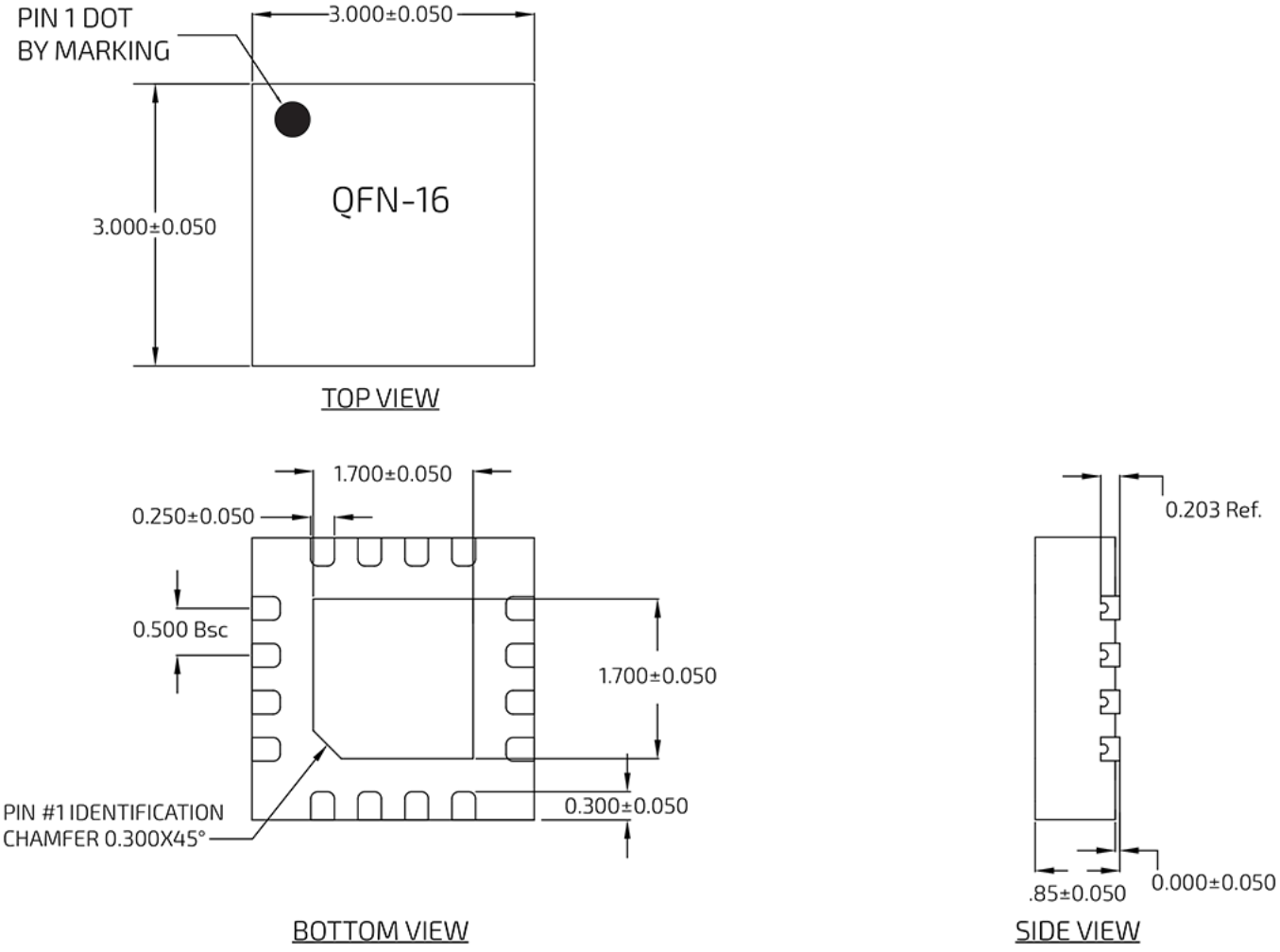

QFN 16 3x3mm Package Dimensions

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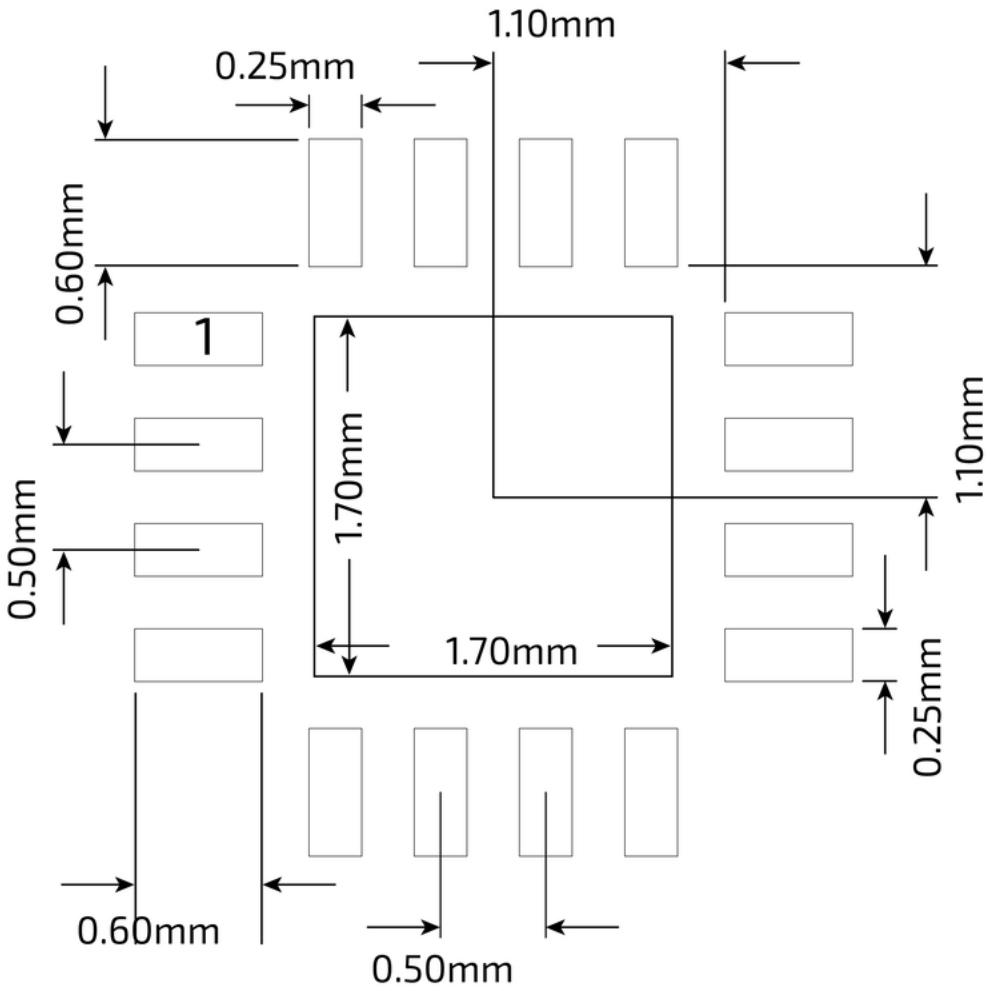

QFN 16 3x3mm Suggested PCB Footprint (Top View)

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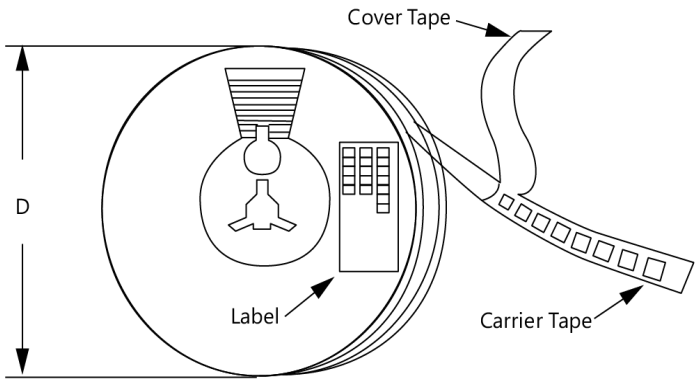
Package Marking Diagram

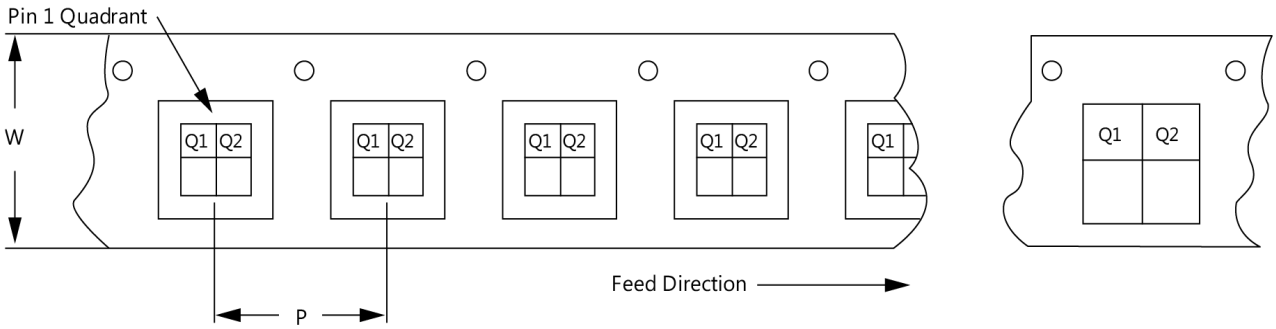
Line 1: “YY” = Year. “WW” = WORK WEEK the Device was assembled.
Line 2: “GRF” = Guerrilla RF
Line 3: “XXXX” = Device Part Number.

Tape and Reel Information

Guerrilla RF's tape and reel specification complies with 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

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Revision History

Revision Date	Description of Change
March 12, 2024	Advance Data Sheet.
October 8, 2024	Preliminary Data Sheet.

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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.

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