

GRF5040

31 dBm Power-LNA

0.025 to 3.8 GHz

RELEASE Ø DATA SHEET

FEATURES

- Flexible Bias Voltage and Current
- Process: GaAs pHEMT

Reference: 8 V / 200 mA / 2.5 GHz

- Gain: 15 dB
- OP1dB: 29.8 dBm
- OIP3: 46.3 dBm
- Evaluation Board NF: 0.85 dB

Reference: 10 V / 180 mA / 2.5 GHz

- Gain: 15 dB
- OP1dB: 31.5 dBm
- OIP3: 47 dBm
- Evaluation Board NF: 0.85 dB

APPLICATIONS

- Linear Driver Amplifier for High PAR Waveforms
- Distributed Antenna Systems
- Multi-stage LNA
- Microwave Backhaul



ORDERING INFORMATION

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DESCRIPTION

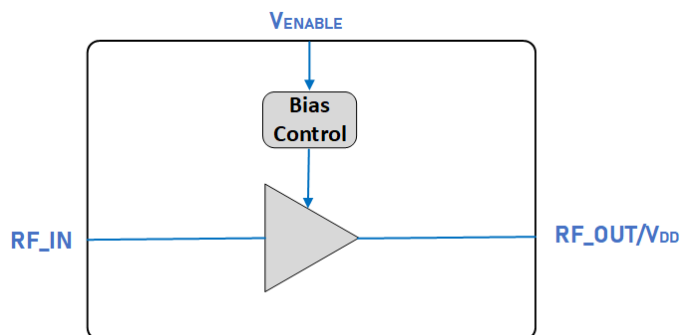
GRF5040 is a high linearity PA with ultra-low noise figure (NF). The primary tune for this device covers 1700 to 2700 MHz and it achieves outstanding P1dB, IP3 and NF over the band. The device can be tuned to deliver outstanding performance from 25 to 3800 MHz with fractional bandwidths >30%. With a 10 volt supply, the device can deliver broadband OP1dB values of 31 dBm.

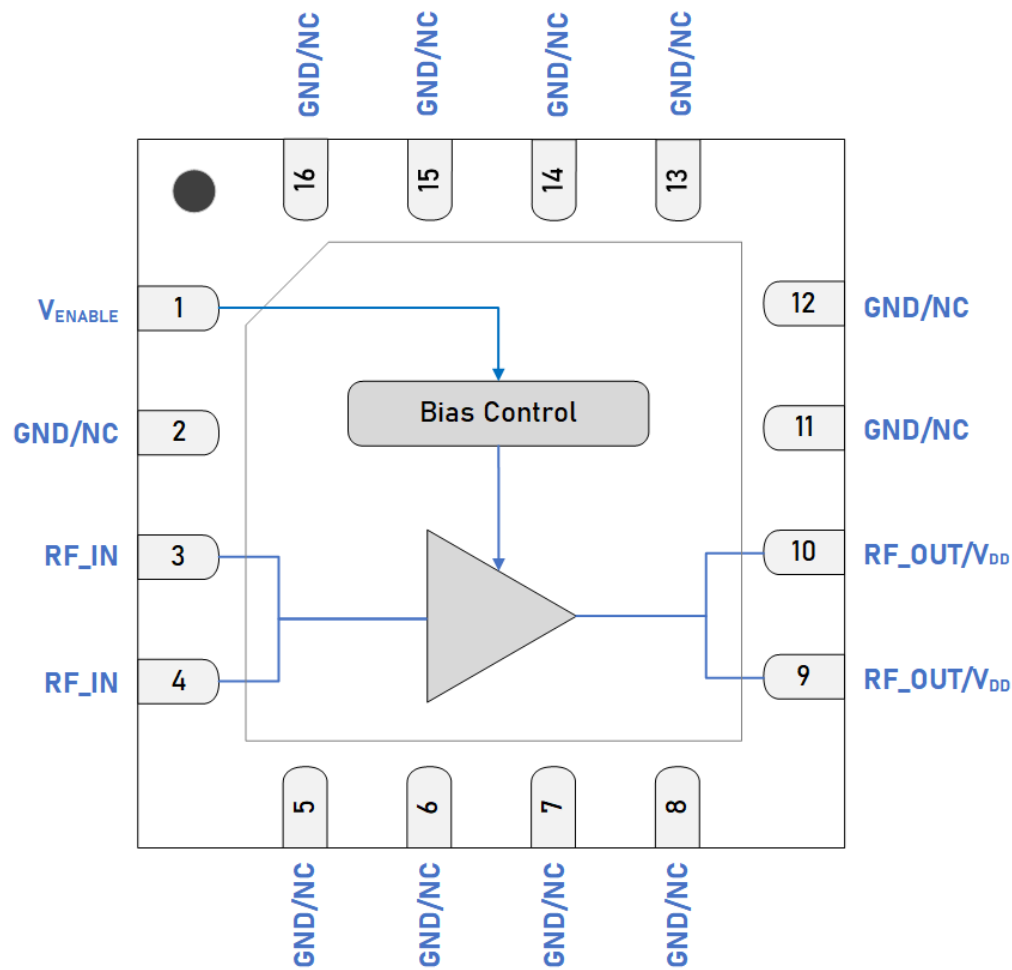
In addition to its use as a PA or linear driver, GRF5040 is well suited to demanding first, second or third stage LNA applications requiring high linearity, ruggedness and low NF.

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 GRF5040 "Custom Tunes" product page: [GRF5040 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 the device. On-die pull-down resistor turns the device off if this node is allowed to float.
2, 5, 6, 7, 8, 11, 12, 13, 14, 15, 16	GND/NC	Ground or No Connect	No internal connection to die.
3, 4	RF_IN	RF Input	Pins 3 & 4 tied together on system board.
9, 10	RF_OUT/V _{DD}	RF Output	Pins 9 & 10 tied together on system board.
PKG BASE	GND	Ground	Provides DC and RF ground for amplifiers, as well as thermal heat sink. In order to match the device's rated performance, it is strongly recommended to use multiple 8mil 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
Drain Voltage	V_{DD}		12	V
RF Input Power	$P_{IN\ MAX}$		22	dBm
Operating Temperature	T_{AMB}	-40	105	°C
Maximum Channel Temperature	T_{MAX}		170	°C
Maximum Dissipated Power	$P_{DISS\ MAX}$		1.8	W
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 - 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}	3.3	5	9	V	
Operating Temperature	$T_{PKG\ BASE}$	-40	25	105	°C	
RF Frequency Range	F_{RF}	0.7		4	GHz	Note 1 & 2.
RF1 Port Impedance	Z_{RF_IN}		50		Ω	Single-ended with 4 element match.
RF2 Port Impedance	Z_{RF_OUT}		50		Ω	Single-ended with 2 element match.

Note 1: Operation outside of this range is supported by using different custom tunes. Examples of other optimized tunes can be found here: [GRF5040 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

Parameter	Symbol	Specification			Unit	Condition
		Min.	Typ.	Max.		
Target Performance: 1.7 to 3.8 GHz						$V_{DD} = V_{ENABLE} = 8\text{ V}$. $R_{ENABLE} = 3.75\text{ k}\Omega$ (+25°C).
Test Frequency	F_{TEST}		2.5		GHz	
Switching Rise Time	T_{RISE}		200		ns	Disabled mode to Gain mode (note 3) .
Switching Fall Time	T_{FALL}		200		ns	Gain mode to Disabled mode (note 4) .
Quiescent Supply Current	I_{DDQ}		200		mA	
Enable Current	I_{ENABLE}		4		mA	

Disabled Mode

Supply Current (Leakage)	I_{DDQ}		370		μA	$V_{DD} = 8\text{ V}$, $V_{ENABLE} = 0\text{ V}$.
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Thermal Data

Thermal Resistance (Infrared Scan)	Θ_{JC}		35		$^{\circ}\text{C}/\text{W}$	On 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} .

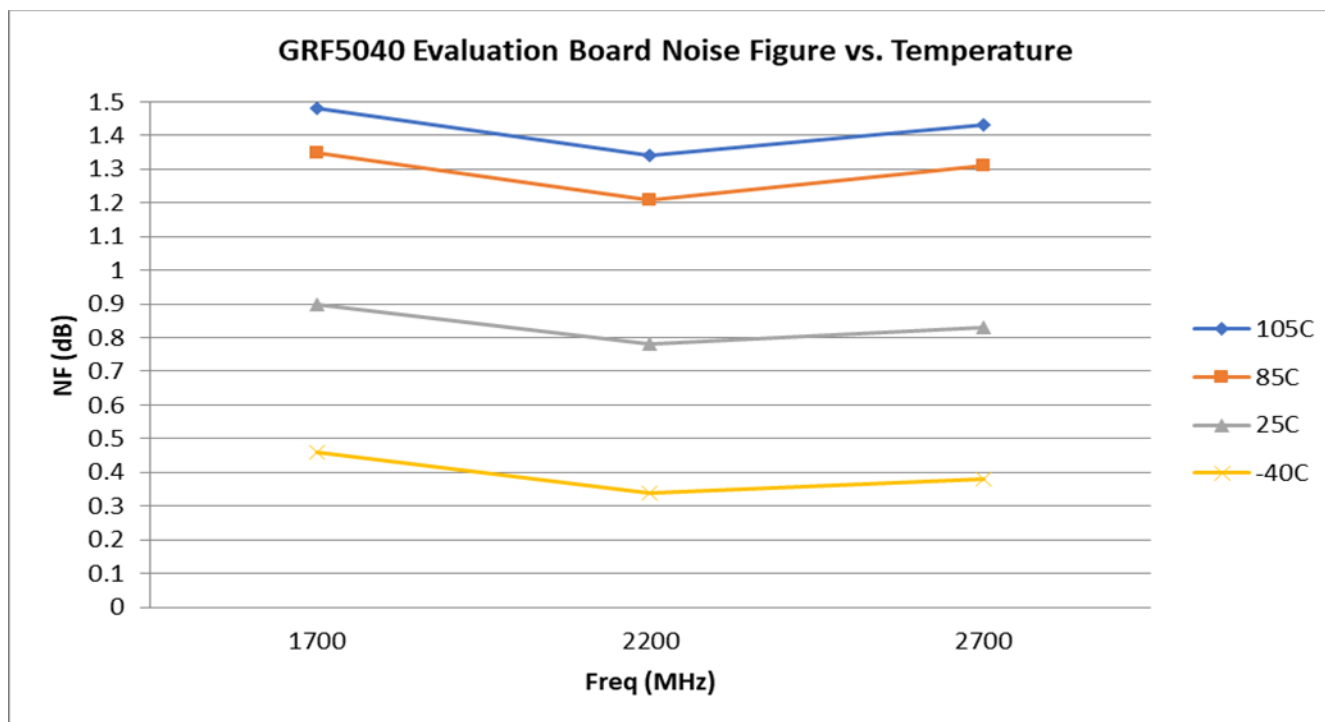
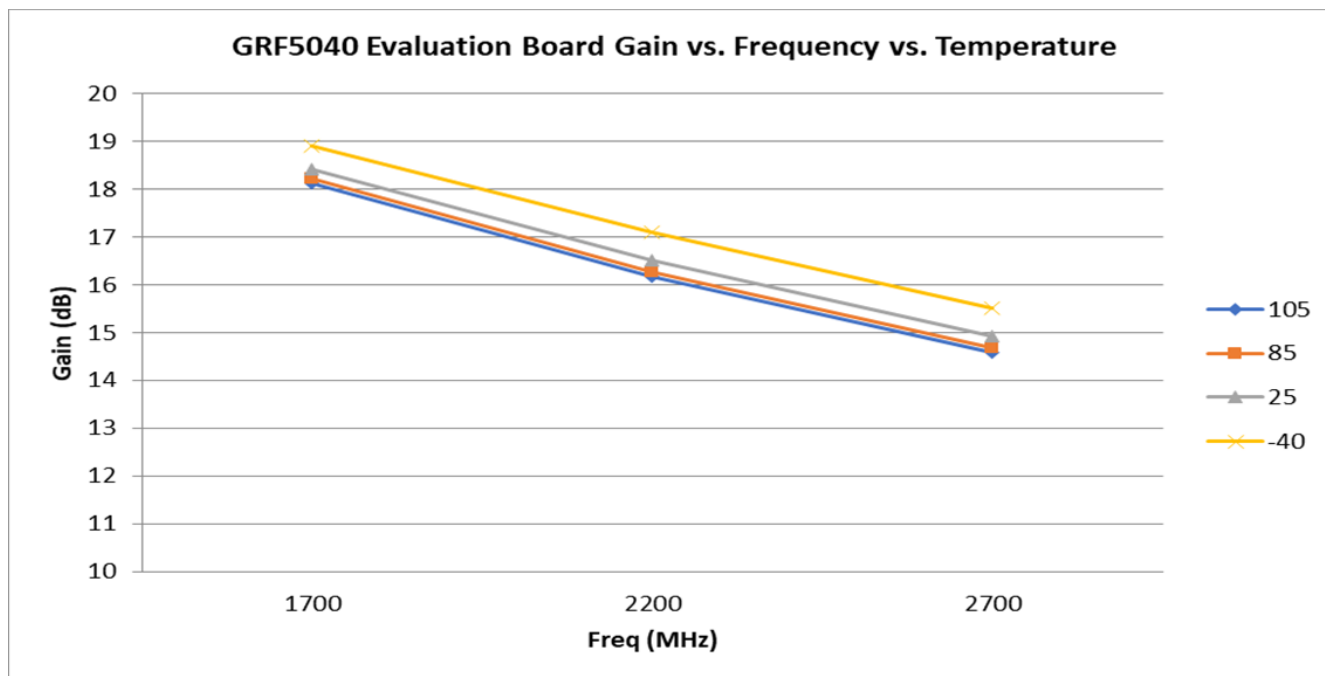
Note 5: MTTF > 10^6 hours for $T_j \leq 170\text{ }^{\circ}\text{C}$

Nominal Operating Parameters - RF

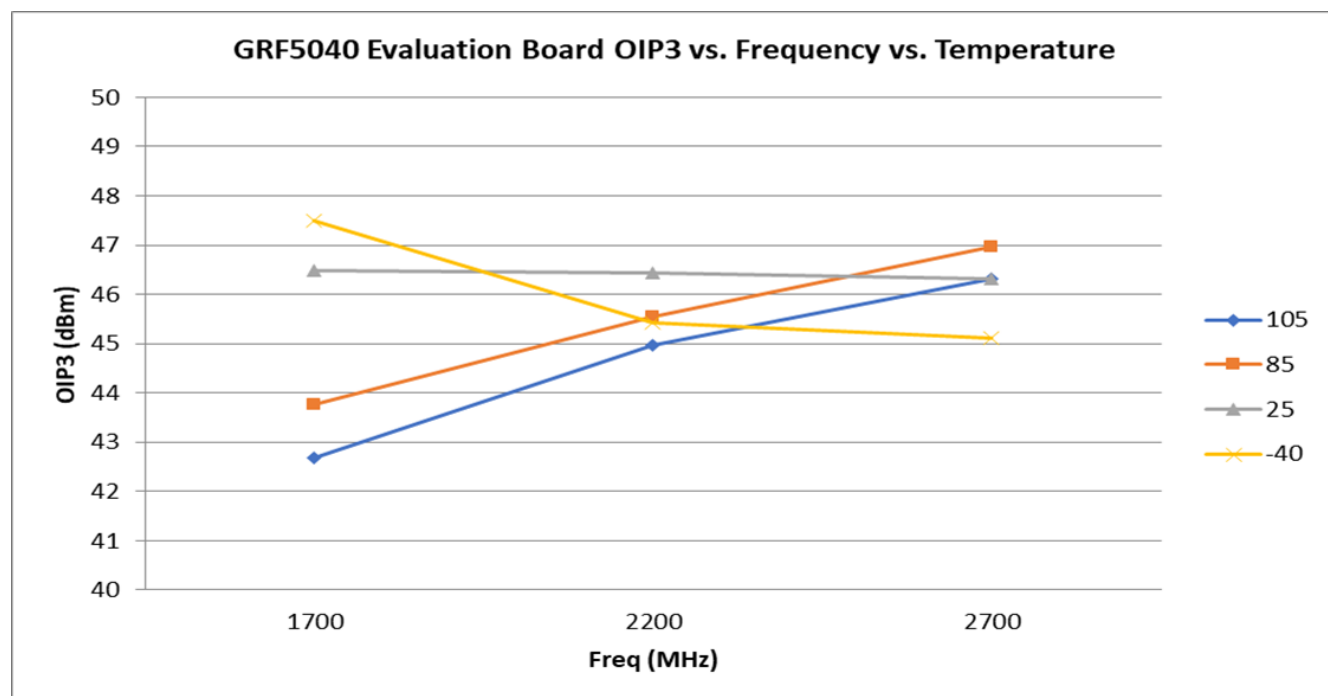
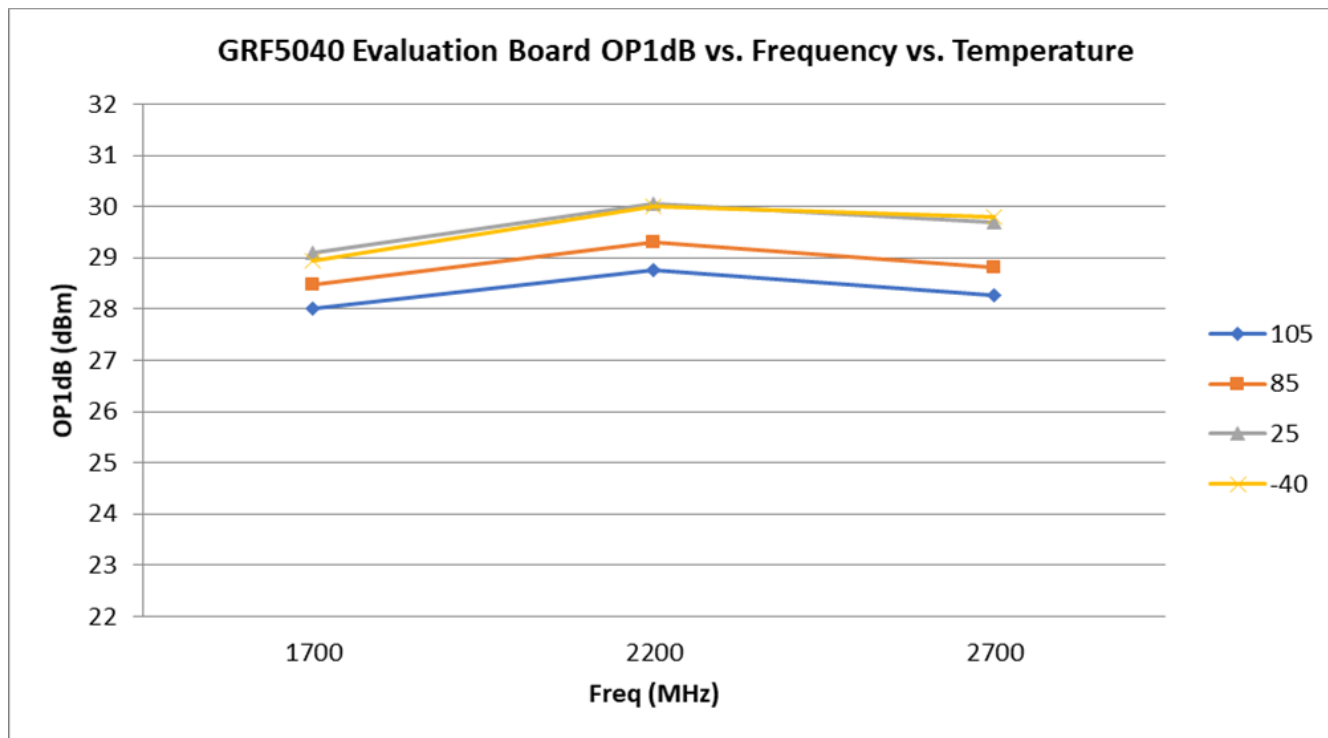
The following conditions apply unless noted otherwise; Typical Application Schematic, $V_{DD} = 8\text{ V}$, $I_{DD} = 200\text{ mA}$, $F_{TEST} = 2.5\text{ GHz}$, $50\ \Omega$ system impedance, $T_{PKG\ BASE} = 25\text{ }^{\circ}\text{C}$. Evaluation board losses are included within the specifications.

Parameter	Symbol	Specification			Unit	Condition
		Min.	Typ.	Max.		
Gain	S21	14	15		dB	
Output 3rd Order Intercept Point	OIP3		46.3		dBm	8 dBm Pout per tone at 2 MHz spacing (2499 and 2501 MHz).
Output 1 dB Compression Power	OP1dB	28.3	29.8		dBm	
Noise Figure	NF		0.85	1.05	dB	On standard evaluation board.

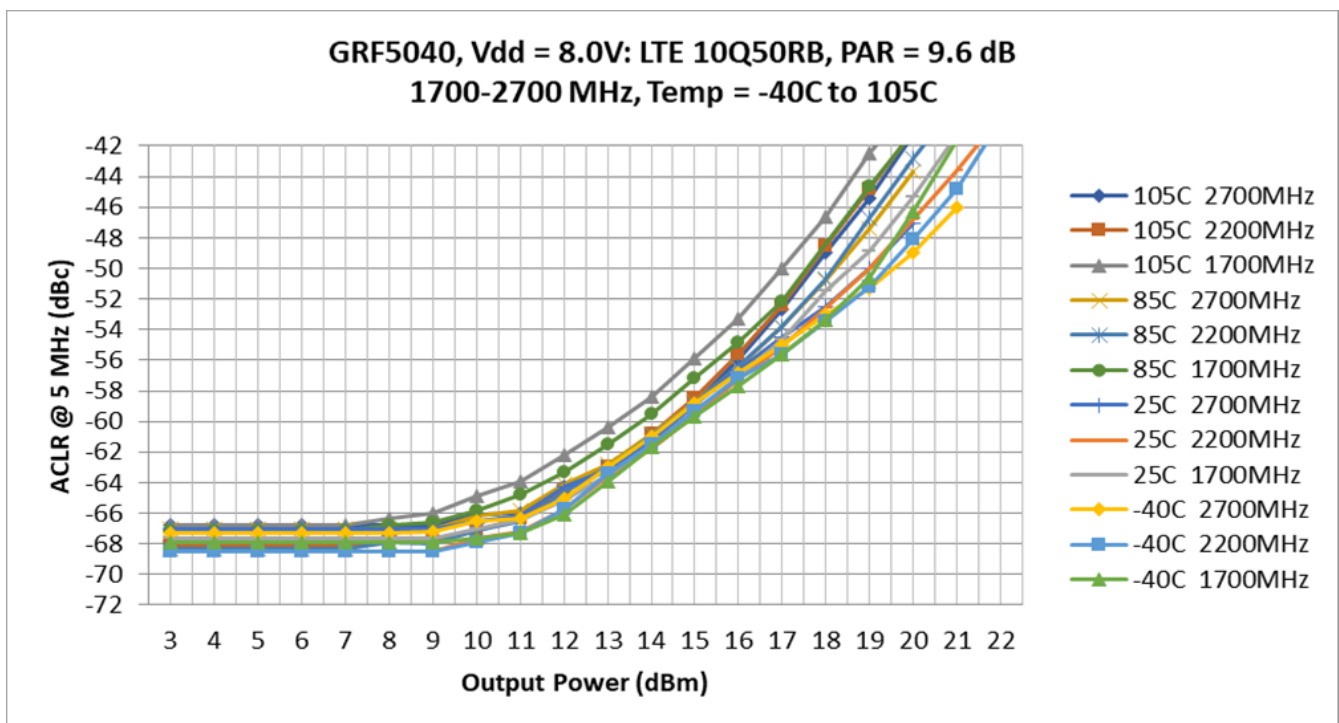
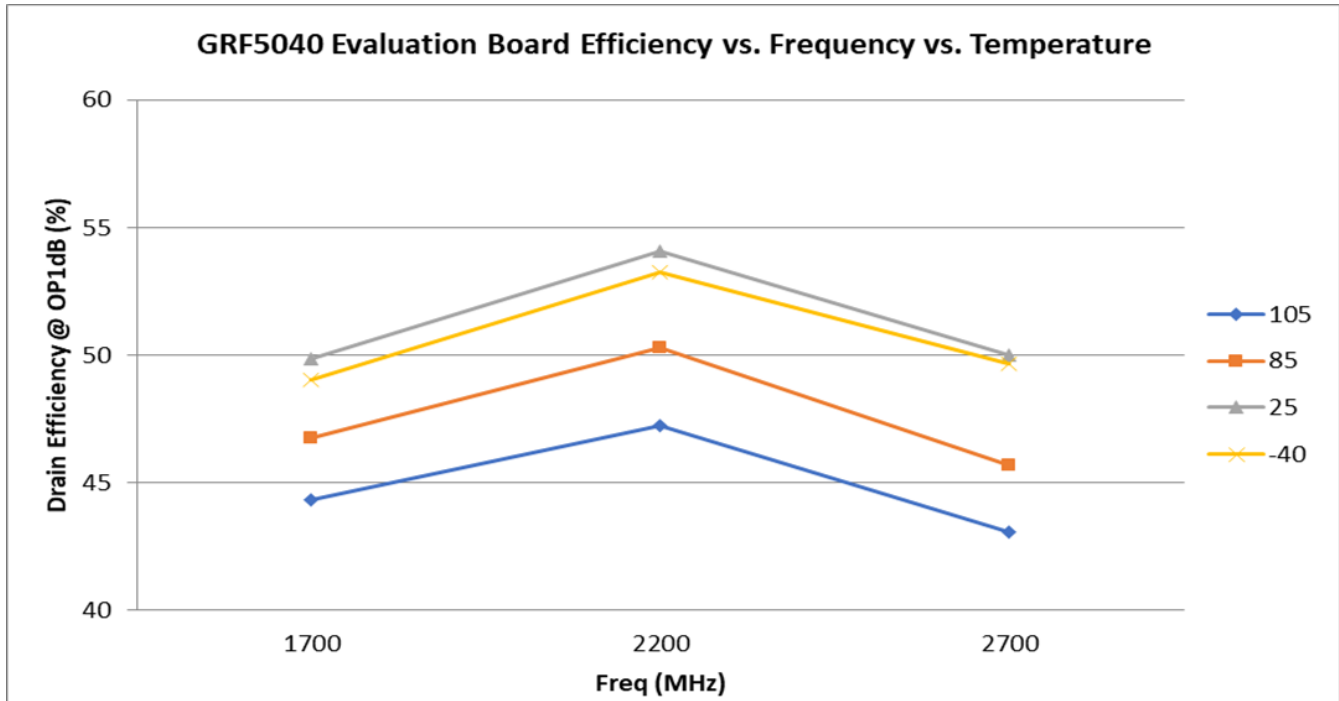
GRF5040 Typical Operating Curves: 1.7 to 2.7 GHz Tune, 8 V, 200 mA.



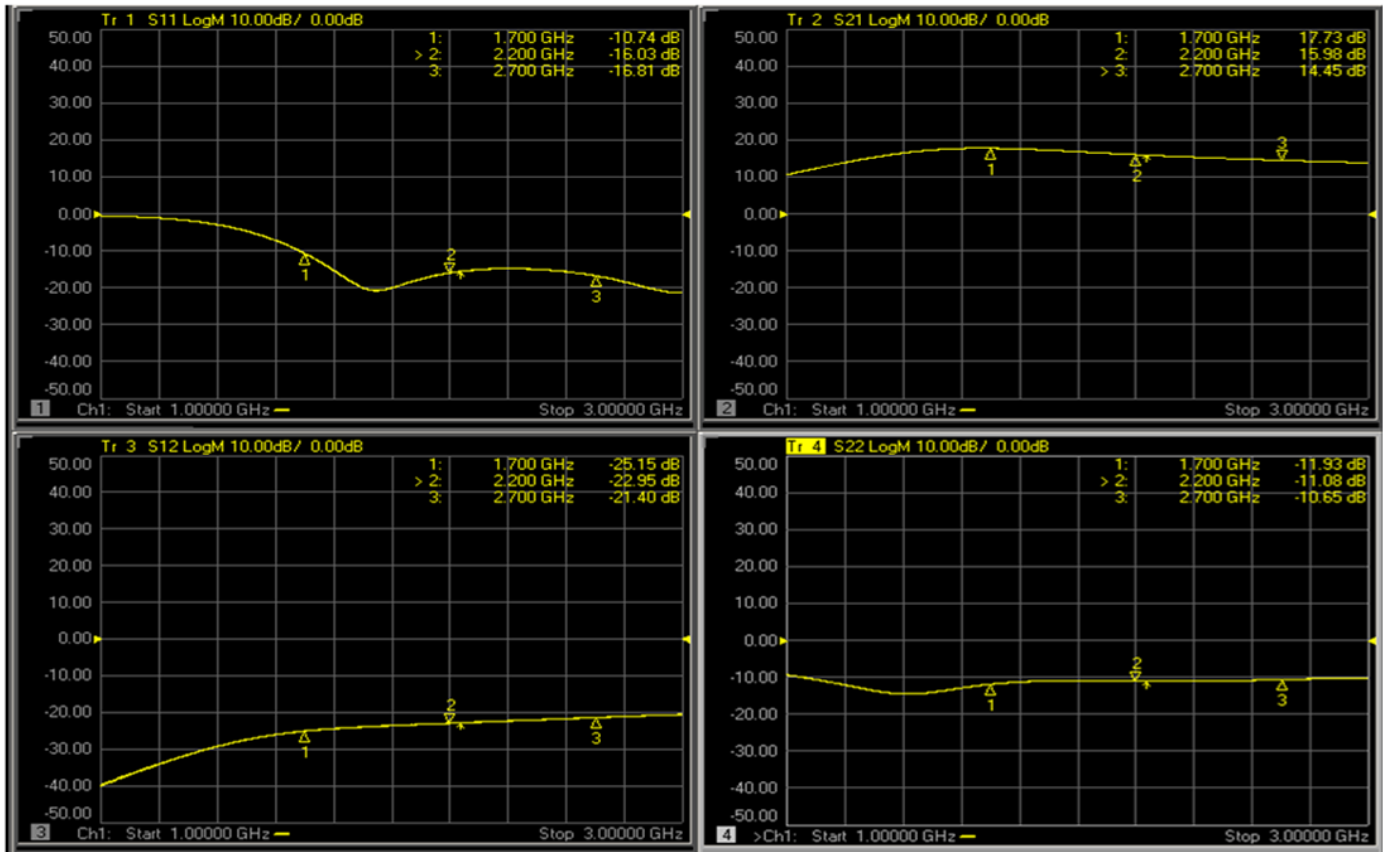
GRF5040 Typical Operating Curves: 1.7 to 2.7 GHz, 8 V, 200 mA.



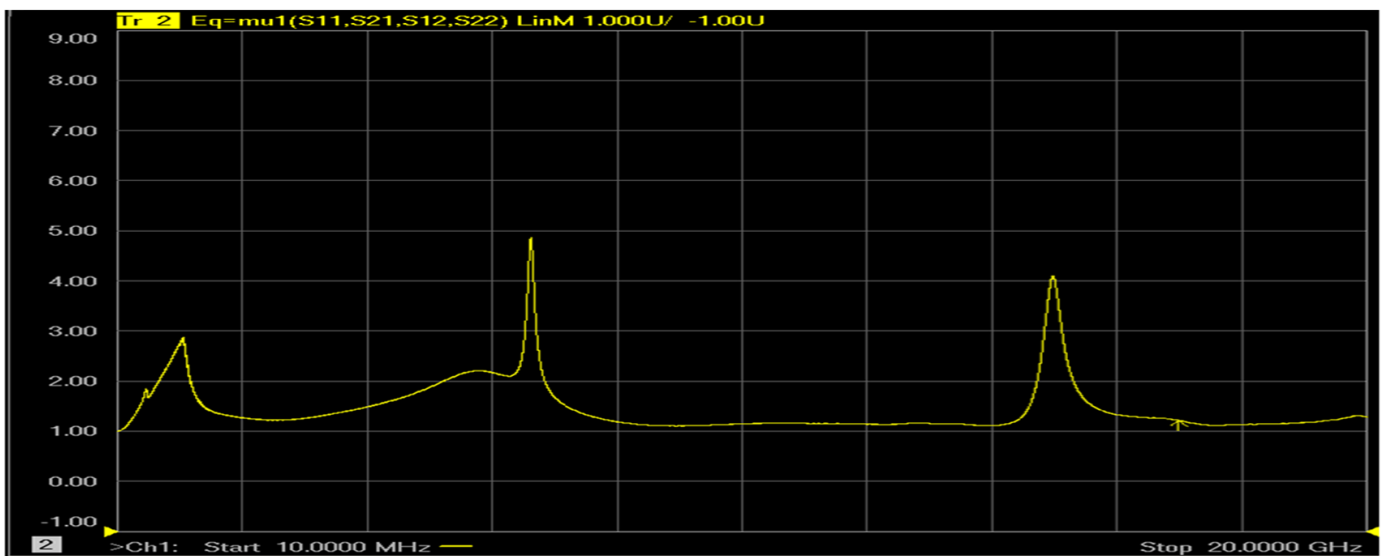
GRF5040 Typical Operating Curves: 1.7 to 2.7 GHz, 8 V, 200 mA.



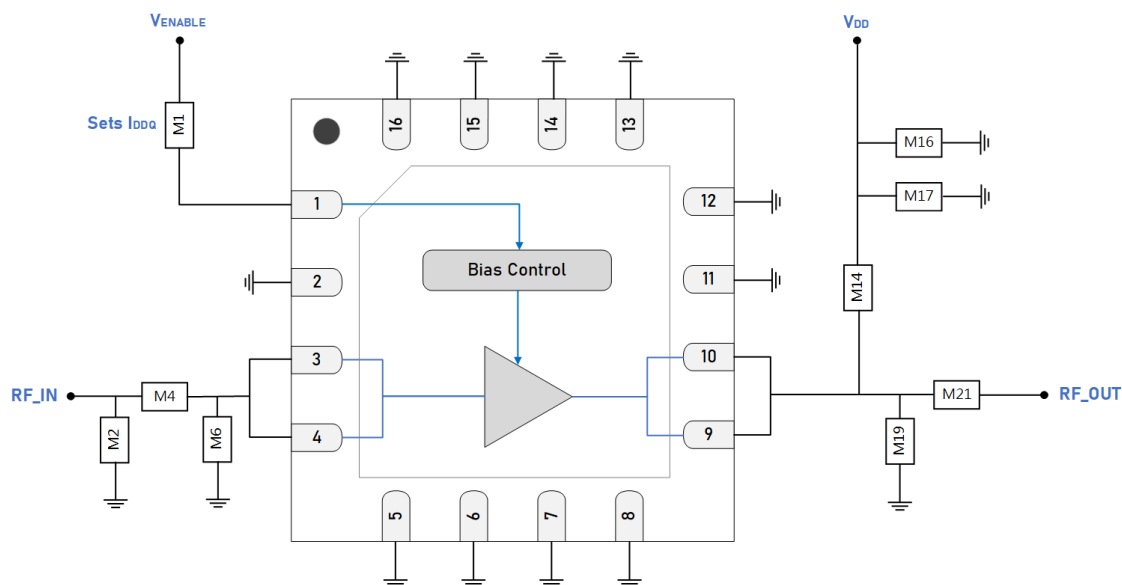
GRF5040 Typical Operating Curves: S-Parameters (1.7 to 2.7 GHz Tune, 8 V, 200 mA).



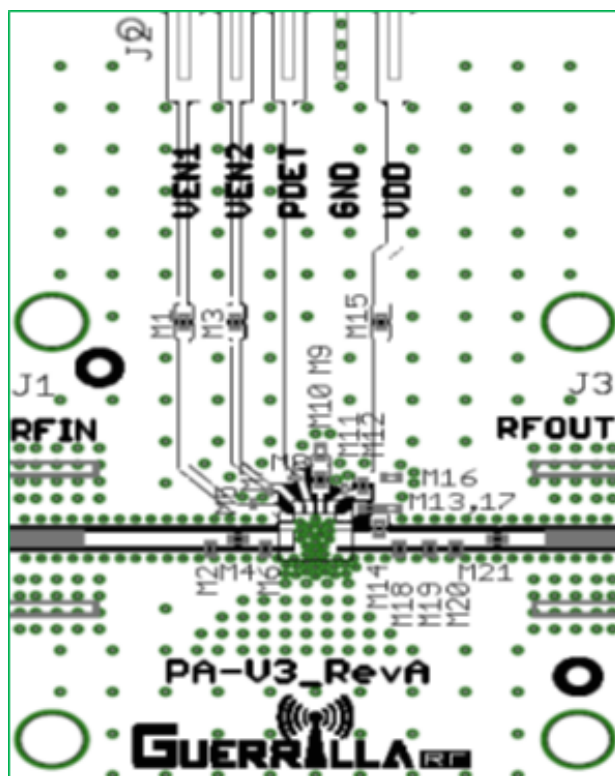
GRF5040: Mu Factor (1.7 to 2.7 GHz Tune, 8 V, 200 mA).



Note: Mu Factor ≥ 1.0 implies unconditional stability.



GRF5040 Standard Evaluation Board Schematic

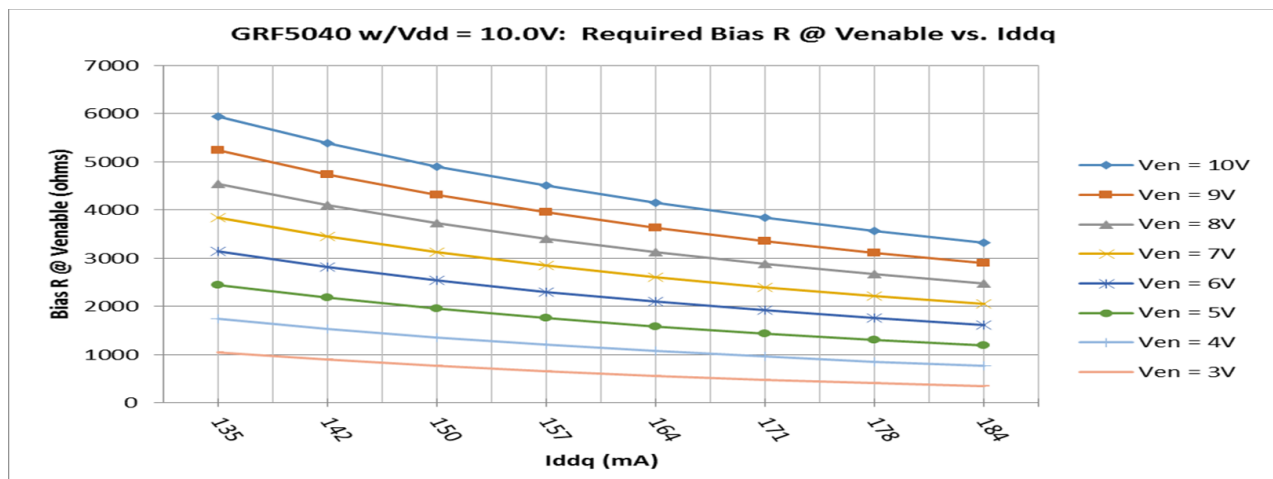
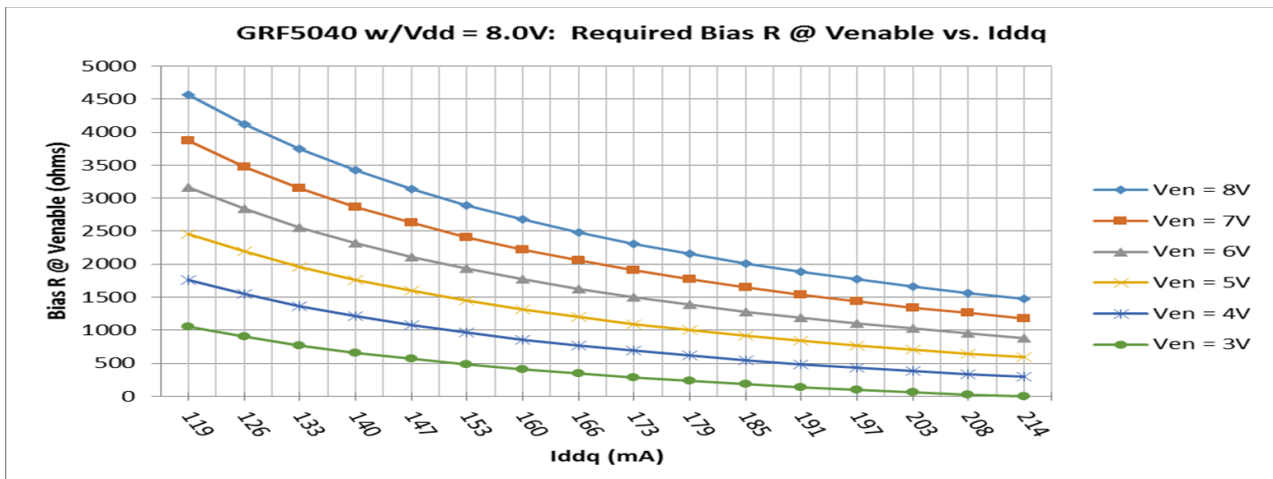
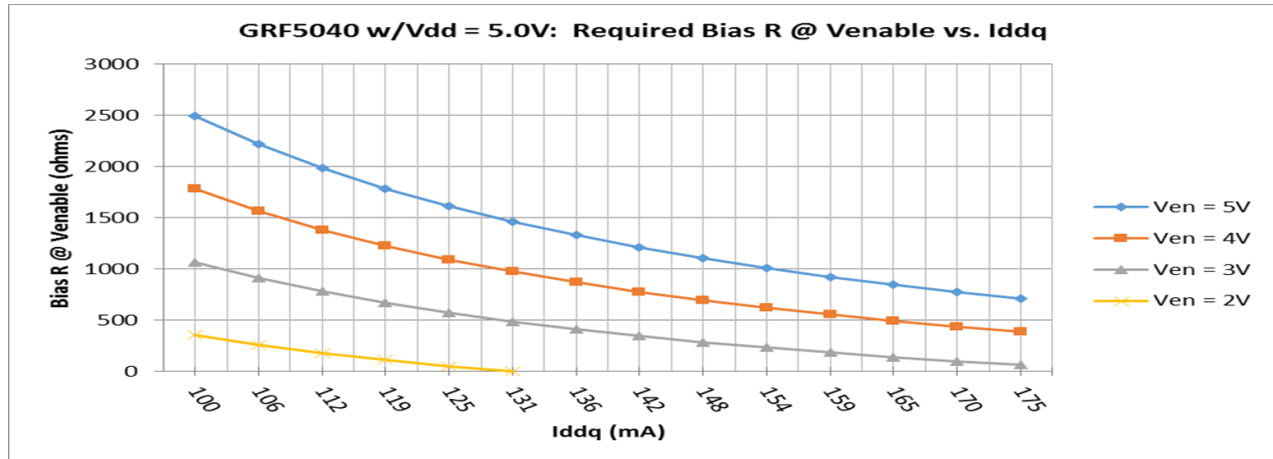


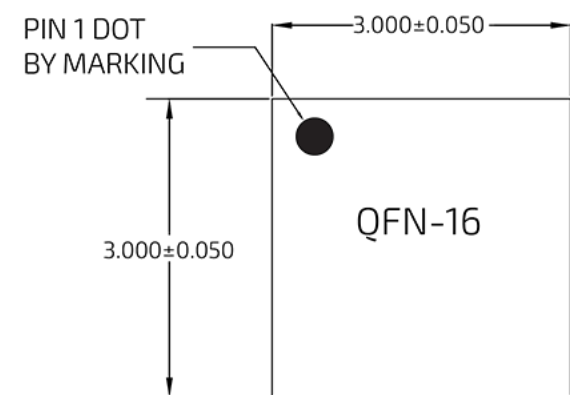
GRF5040 Evaluation Board Assembly Drawing

GRF5040 Evaluation Board Assembly Diagram Reference: 1.7 to 2.7 GHz Tune

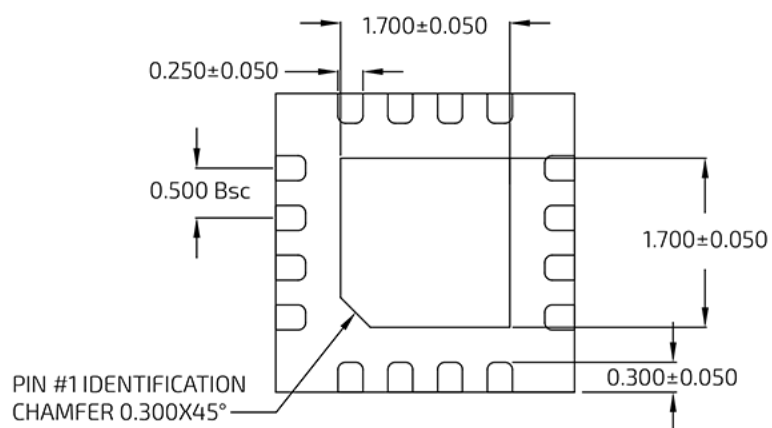
Component	Type	Manufacturer	Family	Value	Package Size	Substitution
M1 (sets I _{DDQ})	Resistor	Various	5%	see curves	0402	ok
M2	Inductor	Coilcraft	HP	3.3 nH	0402	ok
M4	Capacitor	Murata	GJM	1.8 pF	0402	ok
M6	Capacitor	Murata	GJM	1.5 pF	0402	ok
M14	Inductor	Coilcraft	HP	15 nH	0402	ok
M16	Capacitor	Murata	GRM	0.1 µF	0402	ok
M17	Capacitor	Murata	GRM	100 pF	0402	ok
M19	Capacitor	Murata	GJM	0.5 pF	0402	ok
M21	Capacitor	Murata	GJM	18 pF	0402	ok
Evaluation Board	PA-V3_RevA					

GRF5040 Bias Resistor Selection Curves:

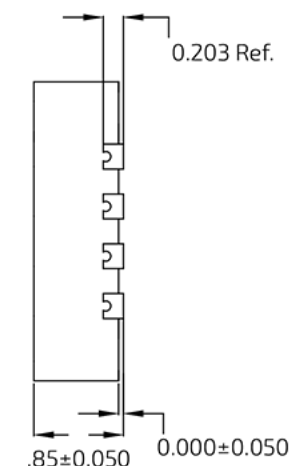




TOP VIEW

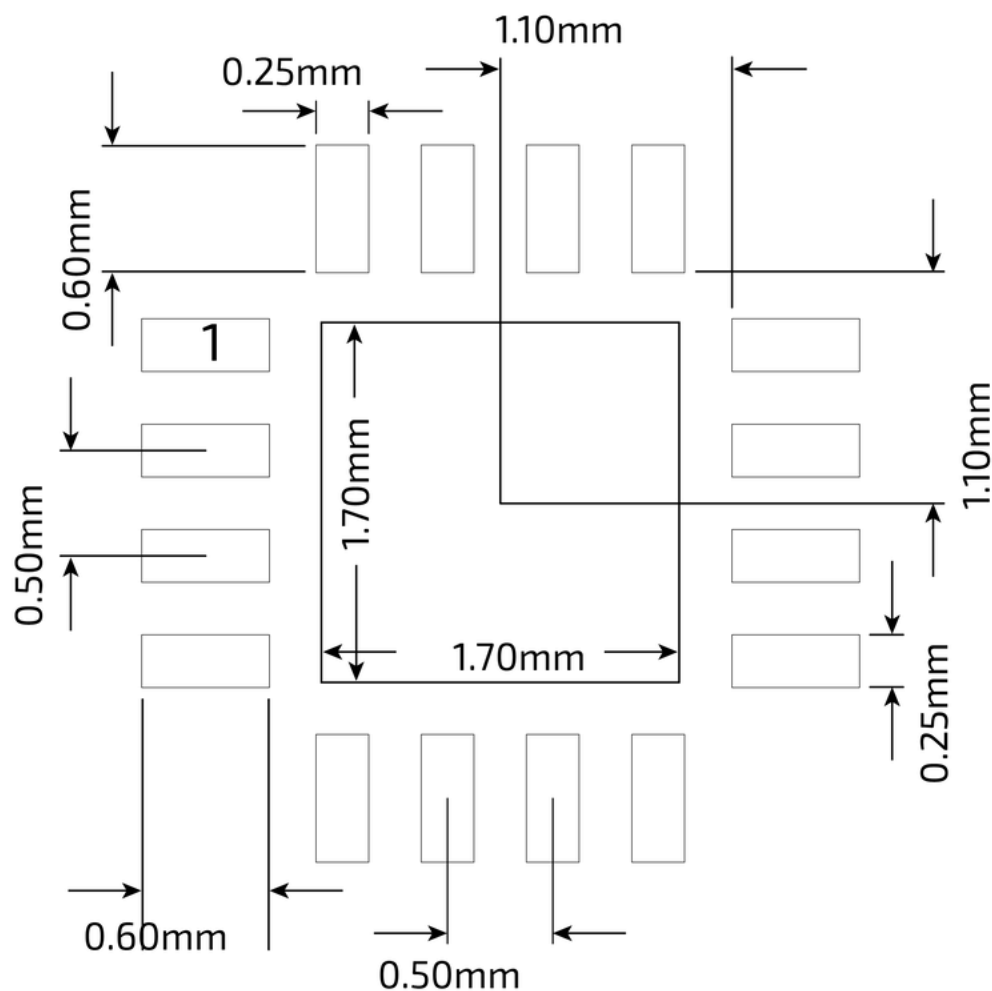


BOTTOM VIEW



SIDE VIEW

QFN 16 3x3mm Package Dimensions



QFN 16 3x3mm Suggested PCB Footprint (Top View)

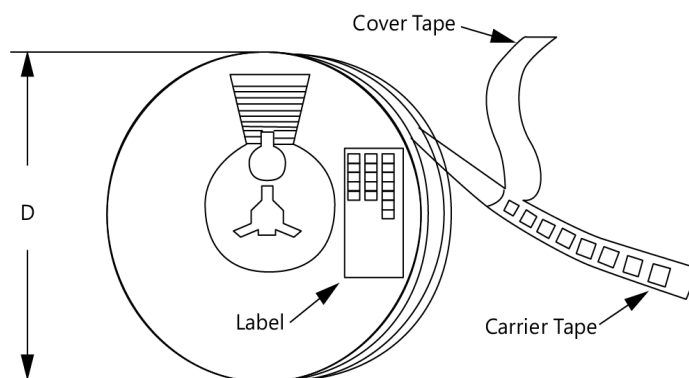
Package Marking Diagram



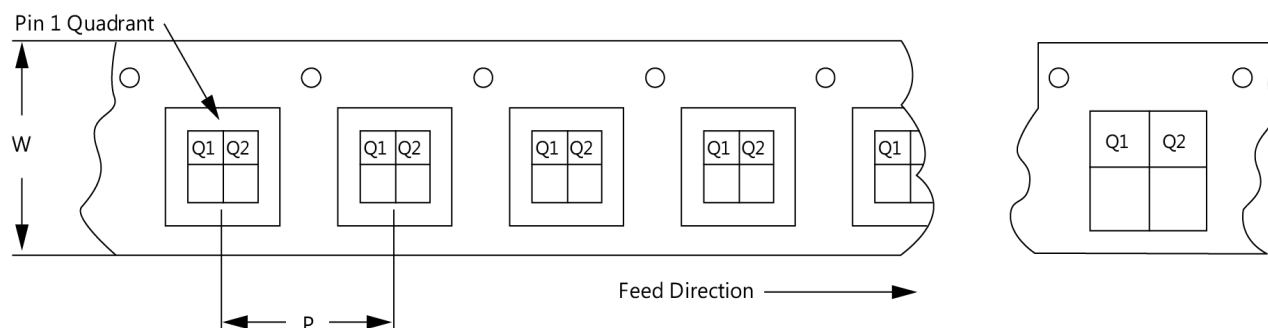
Line 1: "YY" = Year. "WW" = WORK WEEK the Device was assembled.
 Line 2: "GRF" = Guerrilla RF
 Line 3: "XXXX" = Device Part Number.

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



Revision History

Revision Date	Description of Change
January 13, 2017	Release Ø Data Sheet.
May 6, 2024	Upgraded Data Sheet to new format. Raised 8 volt I_{DDQ} from 130 to 200mA to match PTP. Added R_{ENABLE} resistor (1.54 k Ω). Raised 10 volt I_{DDQ} from 170 to 180mA. Lowered Maximum Dissipated Power specification from 2.2 to 1.8w. Removed Channel Temperature specification from Nominal Operating Parameters Table.
September 30, 2024	Changed R_{ENABLE} to 3.75 k Ω .
June 19, 2025	Extended lower frequency range from 100 MHz to 25 MHz.



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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