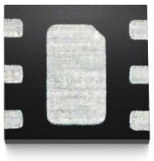
DATA SHEET

RELEASE A DATA SHEET



GRF4014W

Broadband LNA/Linear Driver 0.01 to 6 GHz

FEATURES

- Flexible Bias Voltage and Current
- Internally Matched to 50 Ω
- Process: GaAs pHEMT
- Compact 1.5 x 1.5 mm DFN-6 Package

Tested to AEC-Q100 Grade 2

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

Reference: 5 V / 60 mA / 2332.5 MHz

- Gain: 17.5 dB
- OP1dB: 24 dBm
- OIP3: 39 dBm
- Evaluation Board Noise Figure: 0.8 dB

APPLICATIONS

- SDARS Stage 2 LNA
- Compensator
- Linear Driver/LNA
- Small Cells and Cellular Repeaters
- Distributed Antenna Systems

DESCRIPTION

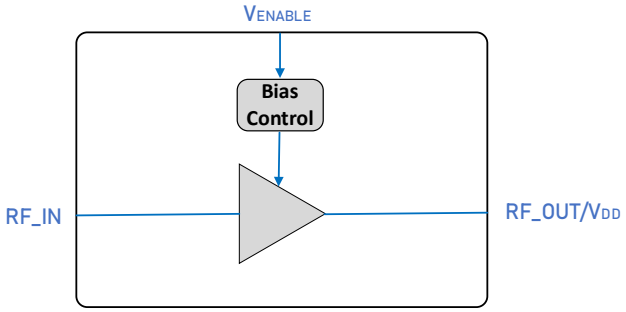
The GRF4014W is a broadband low noise gain block designed for SDARS, small cell, wireless infrastructure and other high-performance automotive applications. With simple external matching, it exhibits outstanding broadband noise figure, linearity and return losses over wide fractional bandwidths with a single match.

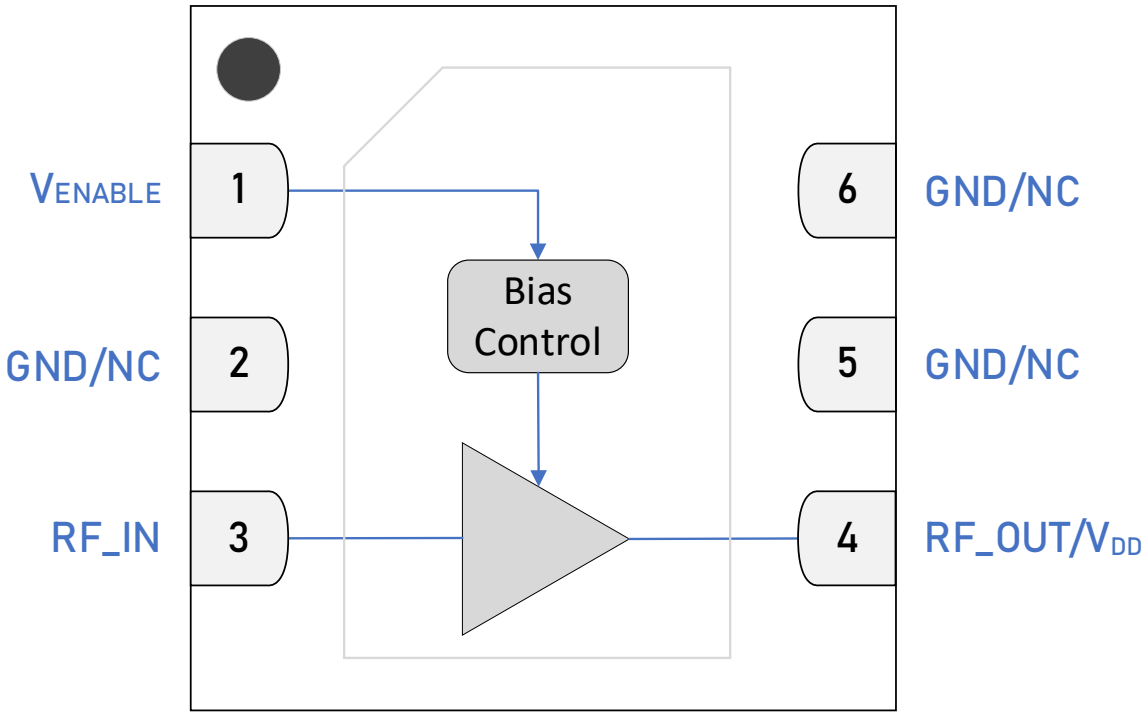
The device is operated from a supply voltage (V_{DD}) of 3 to 8 V. I_{DDQ} can be adjusted over a wide range for optimal efficiency and linearity.

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 GRF4014W "Custom Tunes" product page: GRF4014W Custom Tunes

BLOCK DIAGRAM





1.5 x 1.5 mm DFN-6 Pin Out (Top View)

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Pin Assignments

Pin	Name	Description	Note
1	V_{ENABLE}	Enable Voltage Input	V_{ENABLE} and series resistor set I_{DDQ}. $V_{ENABLE} \leq 0.2$ volts disables device. On-die pull-down resistor will turn the device off if this node is allowed to float.
2, 5, 6	GND/NC	Ground or No Connect	No internal connection to die. We recommend connecting these pins to GND.
3	RF_IN	LNA RF Input	An external DC blocking capacitor must be used.
4	RF_OUT	LNA RF Output	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	9	V
RF Input Power: Load VSWR < 2:1, V_{DD} = 5 V	$P_{IN\ MAX}$		22	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	$P_{DISS\ MAX}$		1100	mW

Electrostatic Discharge

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 *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_{DD}	3	5	8	V	
Operating Temperature (package base)	$T_{PKG\ BASE}$	-40		105	°C	
RF Frequency Range	F_{RF}	10	2332.5	6000	MHz	Typical application schematic with external matching components (**notes 1 & 2**).
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: GRF4014W 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 1.7 to 3.8 GHz tuning set, V_{DD} = 5 V, V_{ENABLE} = 5 V, M5 = 2 kΩ, I_{DDQ} = 60 mA, F_{TEST} = 2332.5 MHz, $T_{PKG\ BASE}$ = 25 °C. Evaluation board losses are included within the specifications.

Parameter	Symbol	Specification			Unit	Condition
		Min.	Typ.	Max.		
Supply Current	I_{DD}	45	60	75	mA	V_{DD} = 5 V, V_{ENABLE} = 5 V. Adjustable for optimal IP3.
Disabled Mode						
Supply Current (leakage)	$I_{LEAKAGE}$		250		µA	V_{DD} = 5 V, V_{ENABLE} = 0 V.
Thermal Data						
Thermal Resistance: (Infrared Scan)	Θ_{JC}		50		°C/W	On standard evaluation board **(note 3)**.
Channel Temperature @ 85 °C reference (package base)	$T_{CHANNEL}$		100		°C	V_{DD} = 5 V, I_{DDQ} = 60 mA, No RF applied. P_{DISS} = 300 mW **(note 3)**.

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

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Nominal Operating Parameters – RF

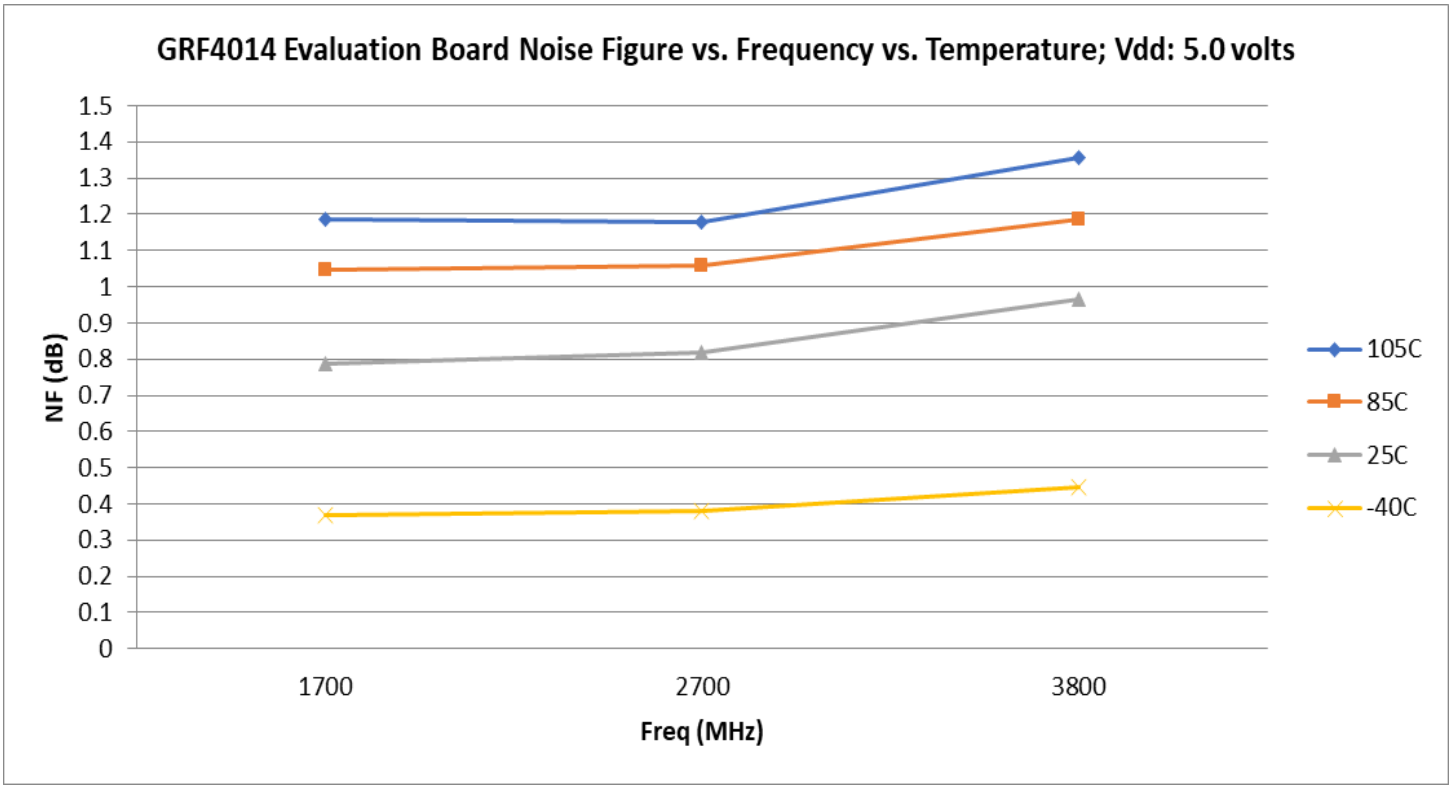
The following conditions apply unless noted otherwise: typical application schematic using the 1.7 to 3.8 GHz tuning set, V_{DD} = 5 V, V_{ENABLE} = 5 V, M5 = 2 kΩ, I_{DDQ} = 60 mA, F_{TEST} = 2332.5 MHz, $T_{PKG\ BASE}$ = 25 °C. Evaluation board losses are included within the specifications.

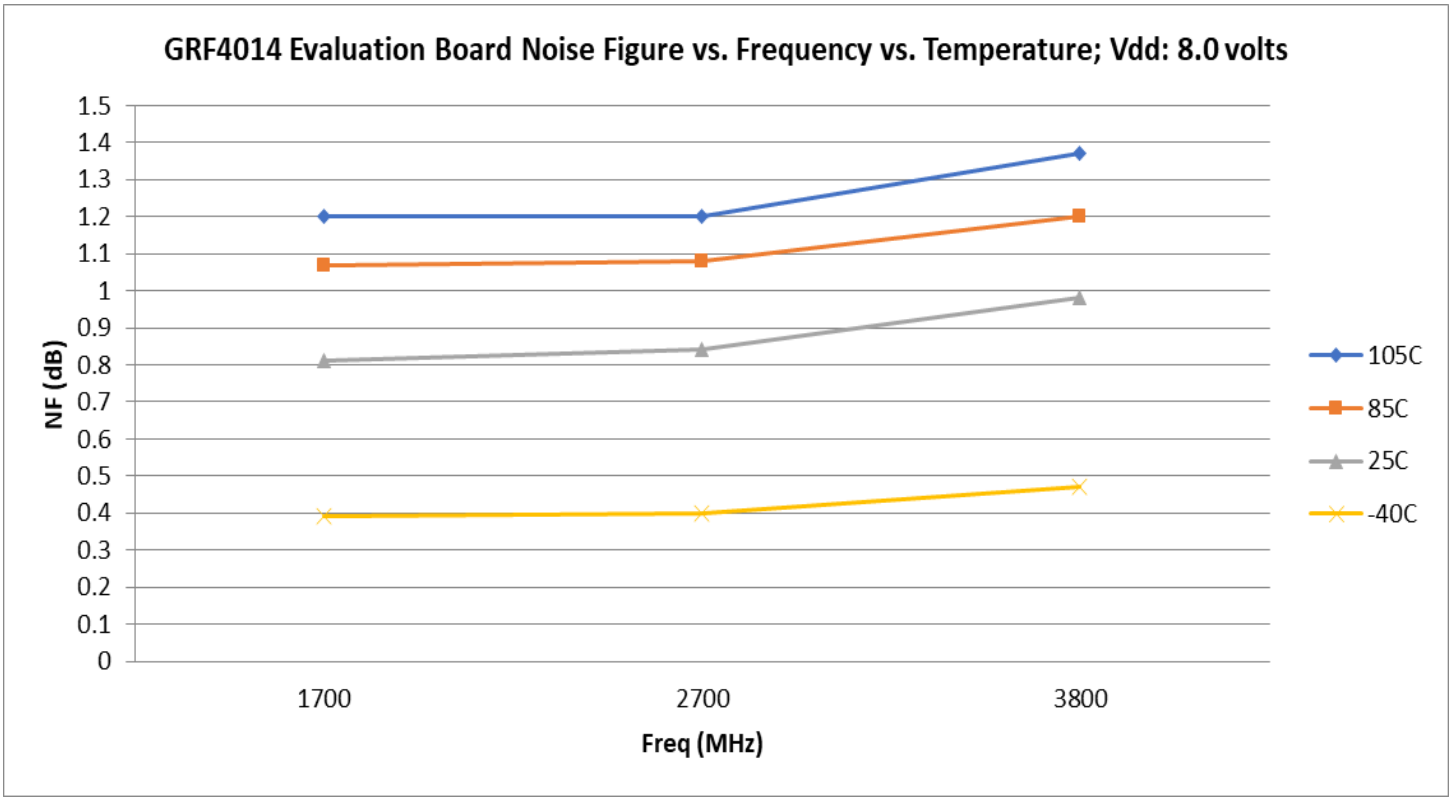
Parameter	Symbol	Specification			Unit	Condition
		Min.	Typ.	Max.		
Gain	S21	16	17.5	19	dB	V_{DD} = 5 V, V_{ENABLE} = 5 V.
Noise Figure	NF		0.8	1	dB	On standard evaluation board.
Output 1 dB Compression Power	OP1dB	22.5	24		dBm	
Output 3rd Order Intercept Point	OIP3		39		dBm	8 dBm Pout per tone at 2 MHz spacing (2331.5 and 2333.5 MHz).
Switching Rise Time	T_{RISE}		200		ns	Disabled mode to Gain mode **(note 4)**.
Switching Fall Time	T_{FALL}		200		ns	Gain mode to Disabled mode **(note 5)**.

Note 4: Switching Time: 50% of V_{ENABLE} to 90% of P_{OUT}.

Note 5: Switching Time: 50% of V_{ENABLE} to 10% of P_{OUT}.

GRF4014W Typical Operating Curves: 1.7 to 3.8 GHz Tune





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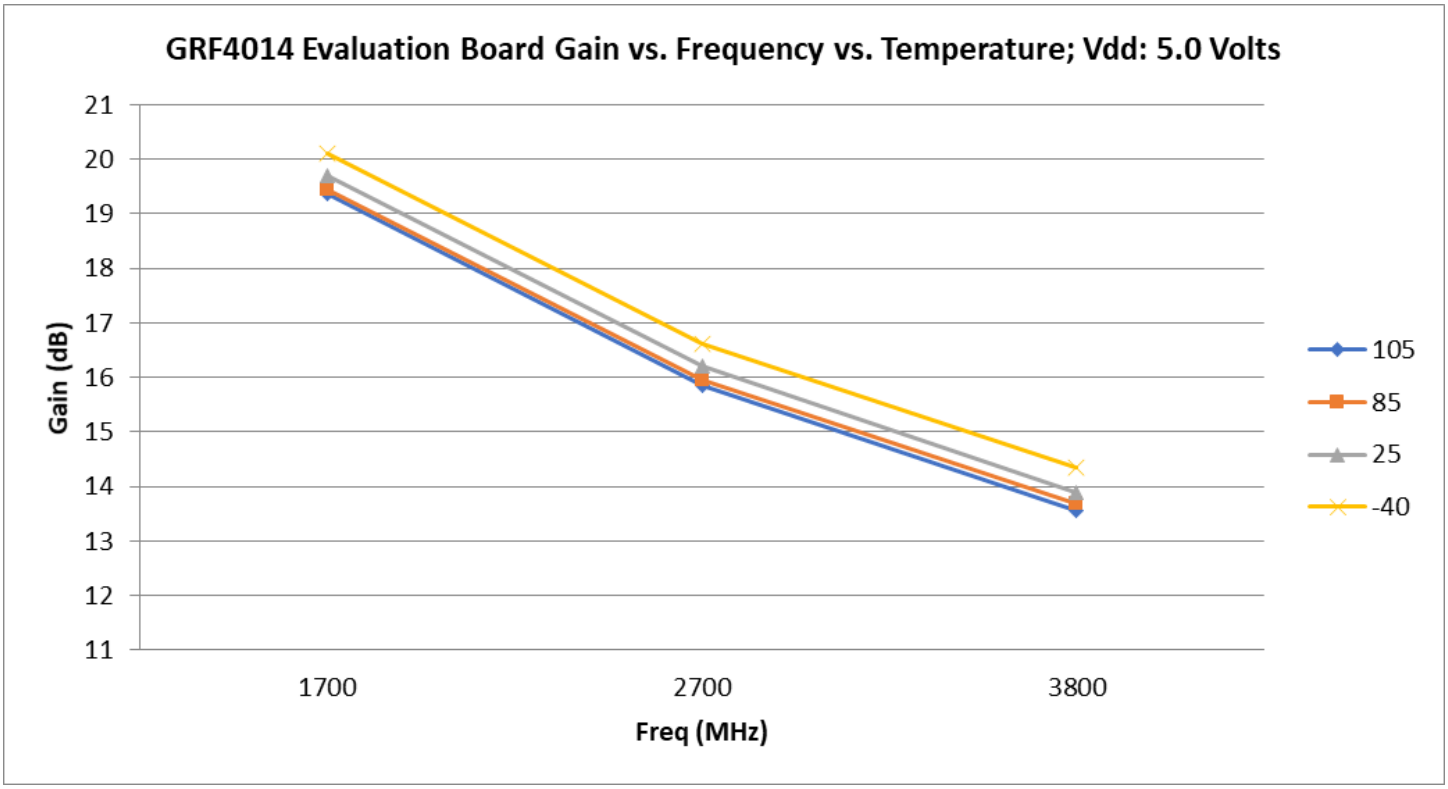
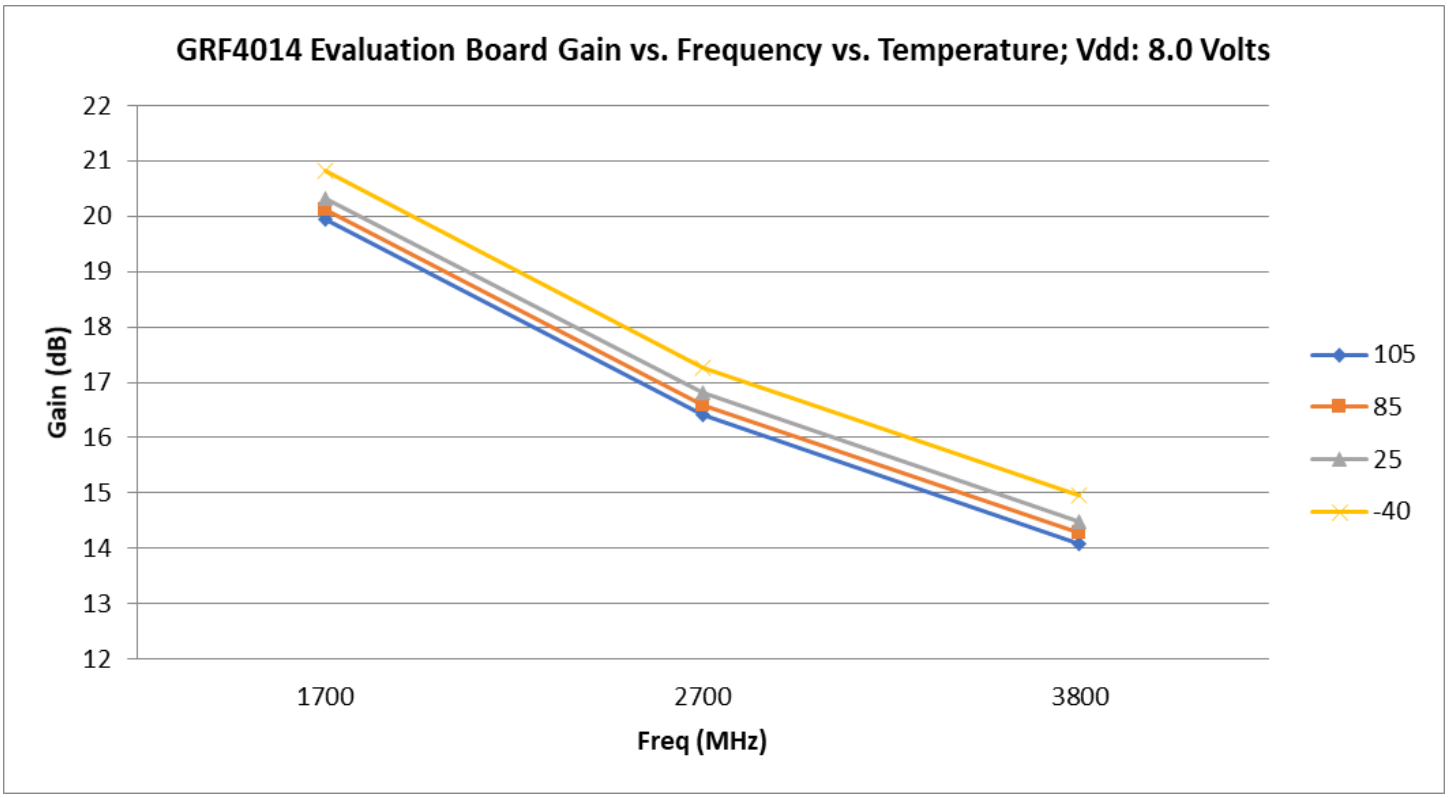
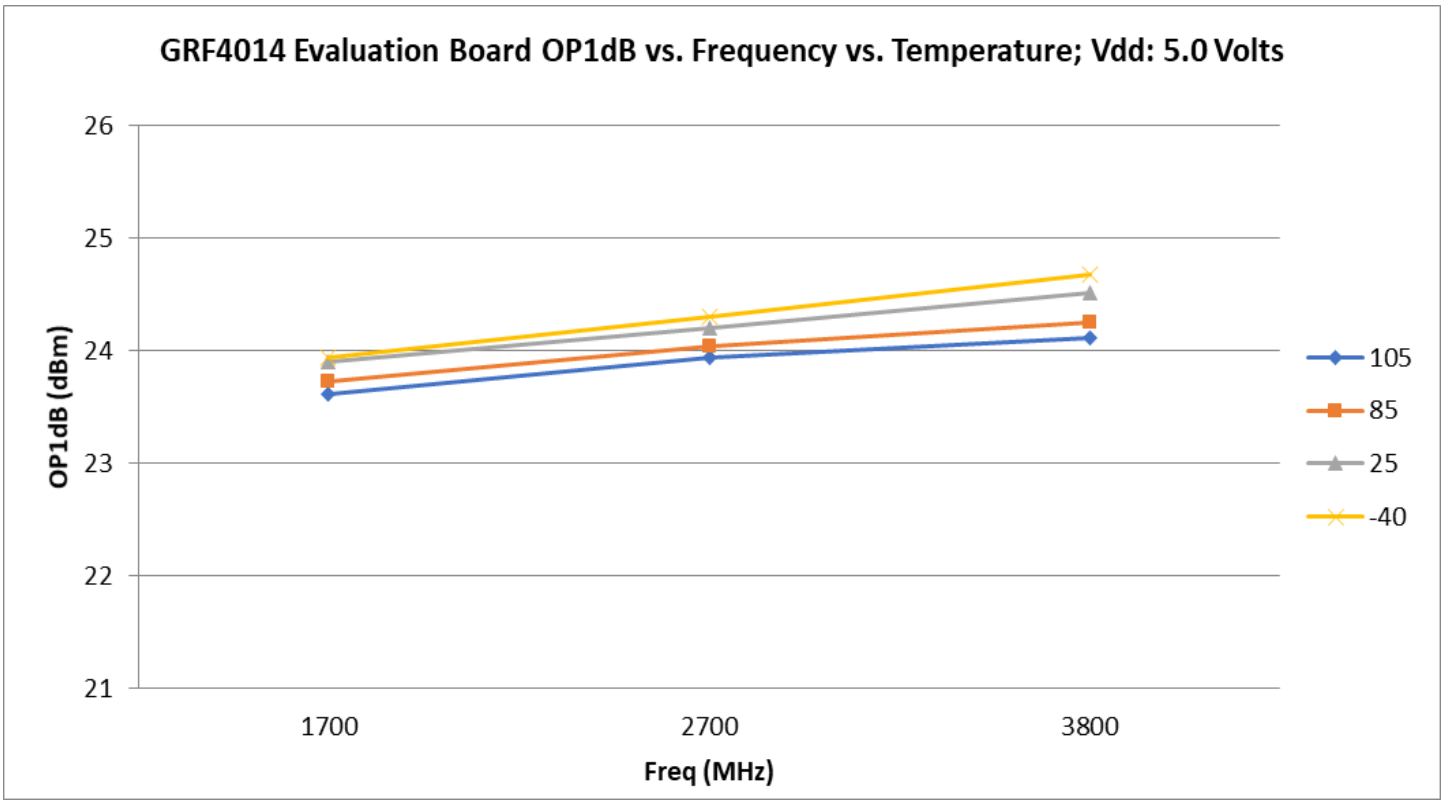
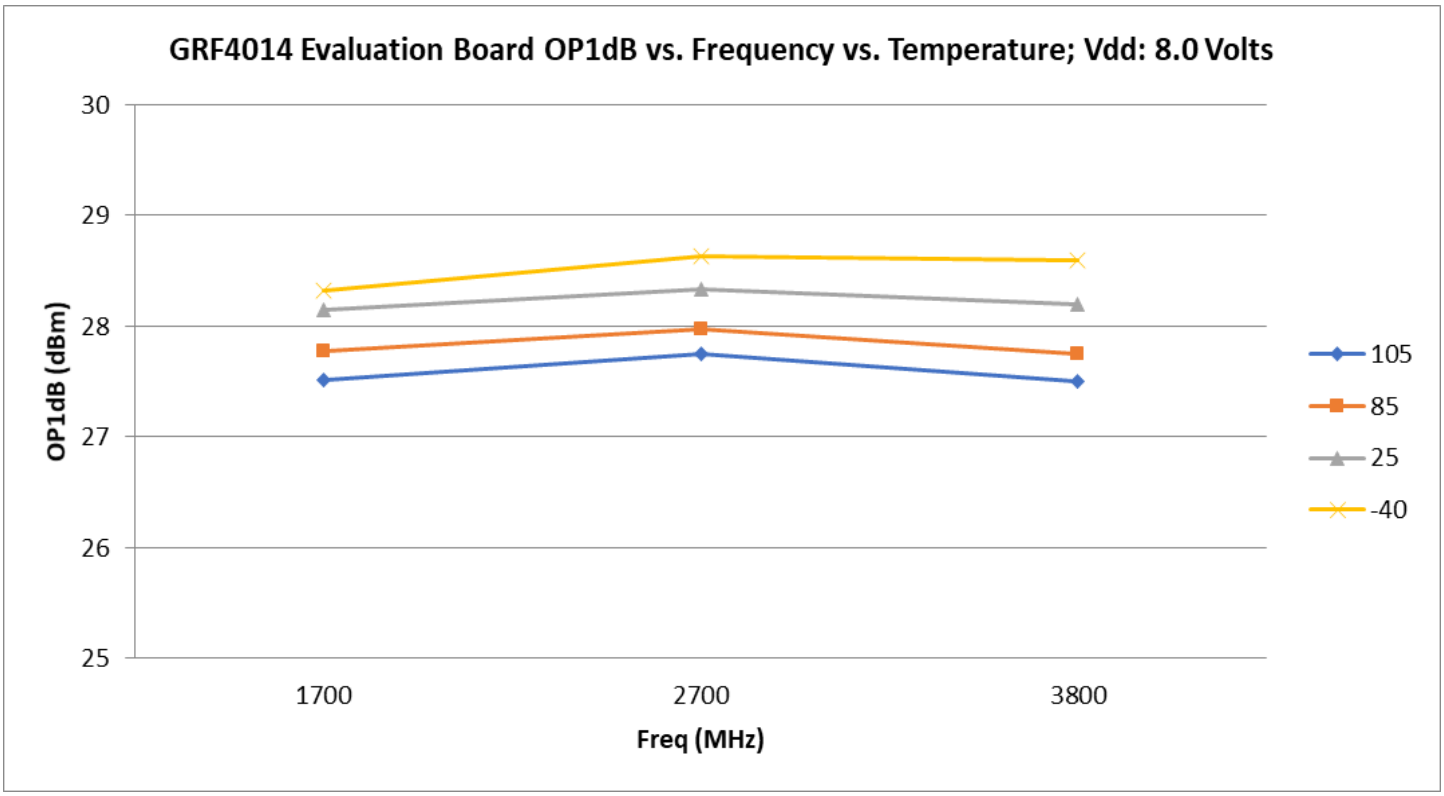
GRF4014W Typical Operating Curves: 1.7 to 3.8 GHz Tune





GRF4014W Typical Operating Curves: 1.7 to 3.8 GHz Tune





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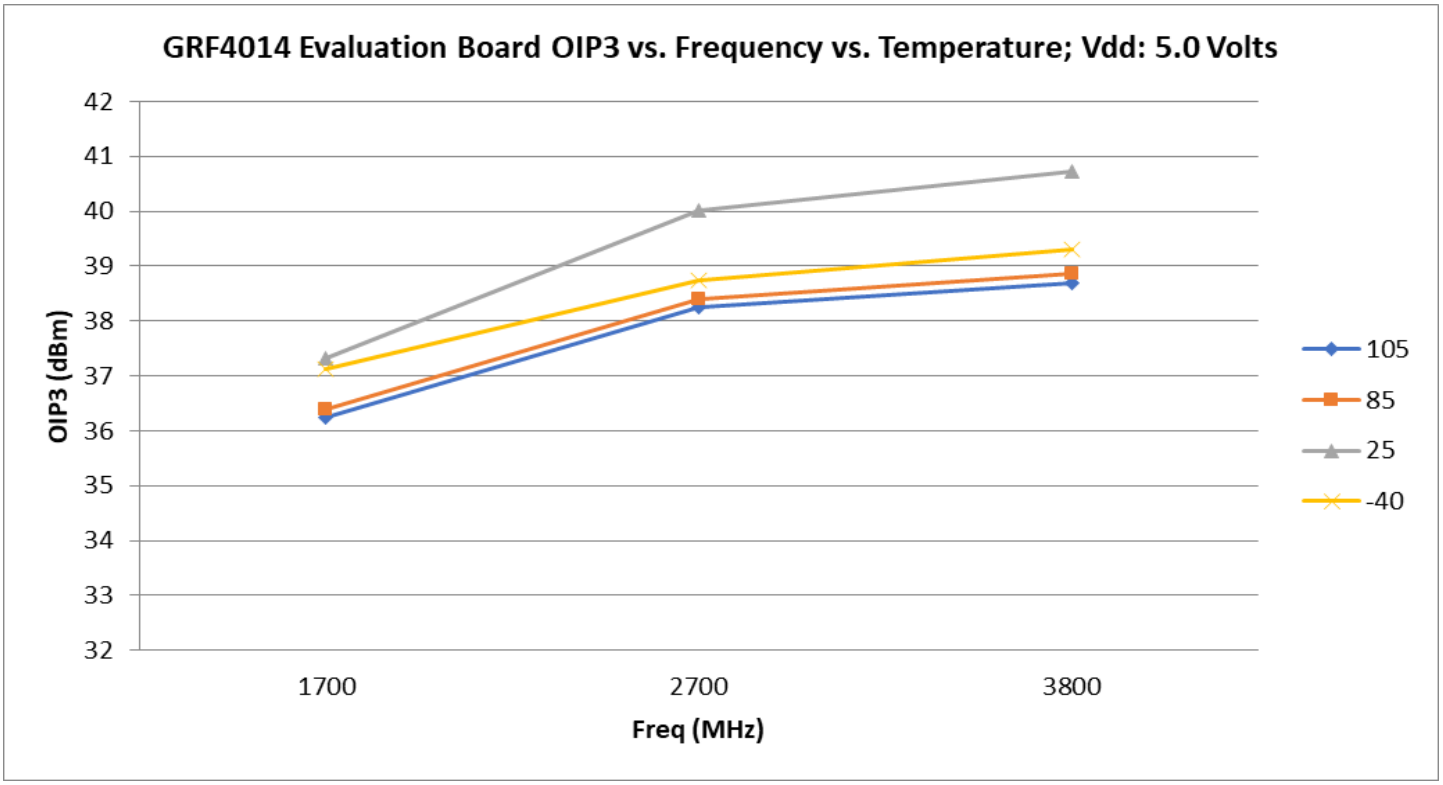
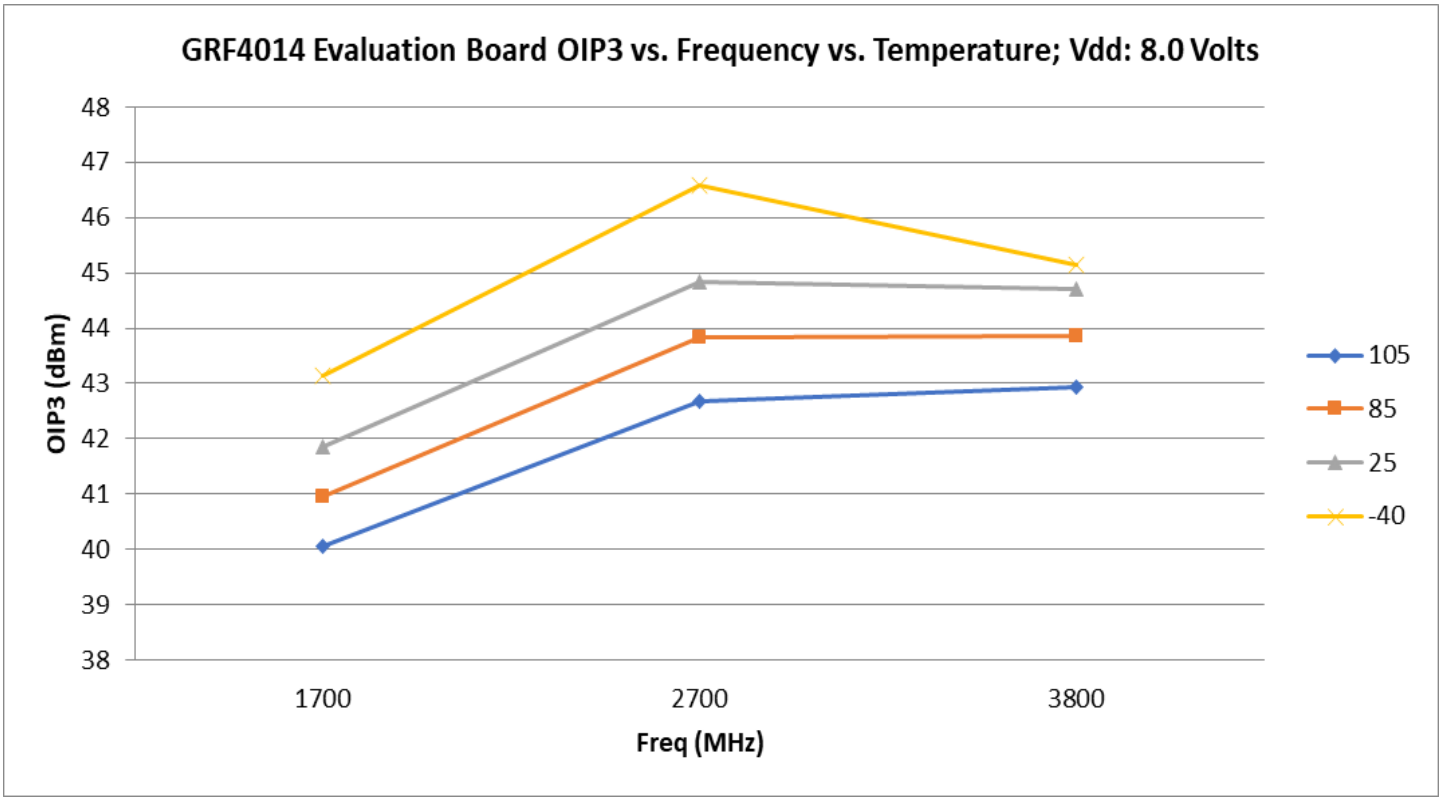
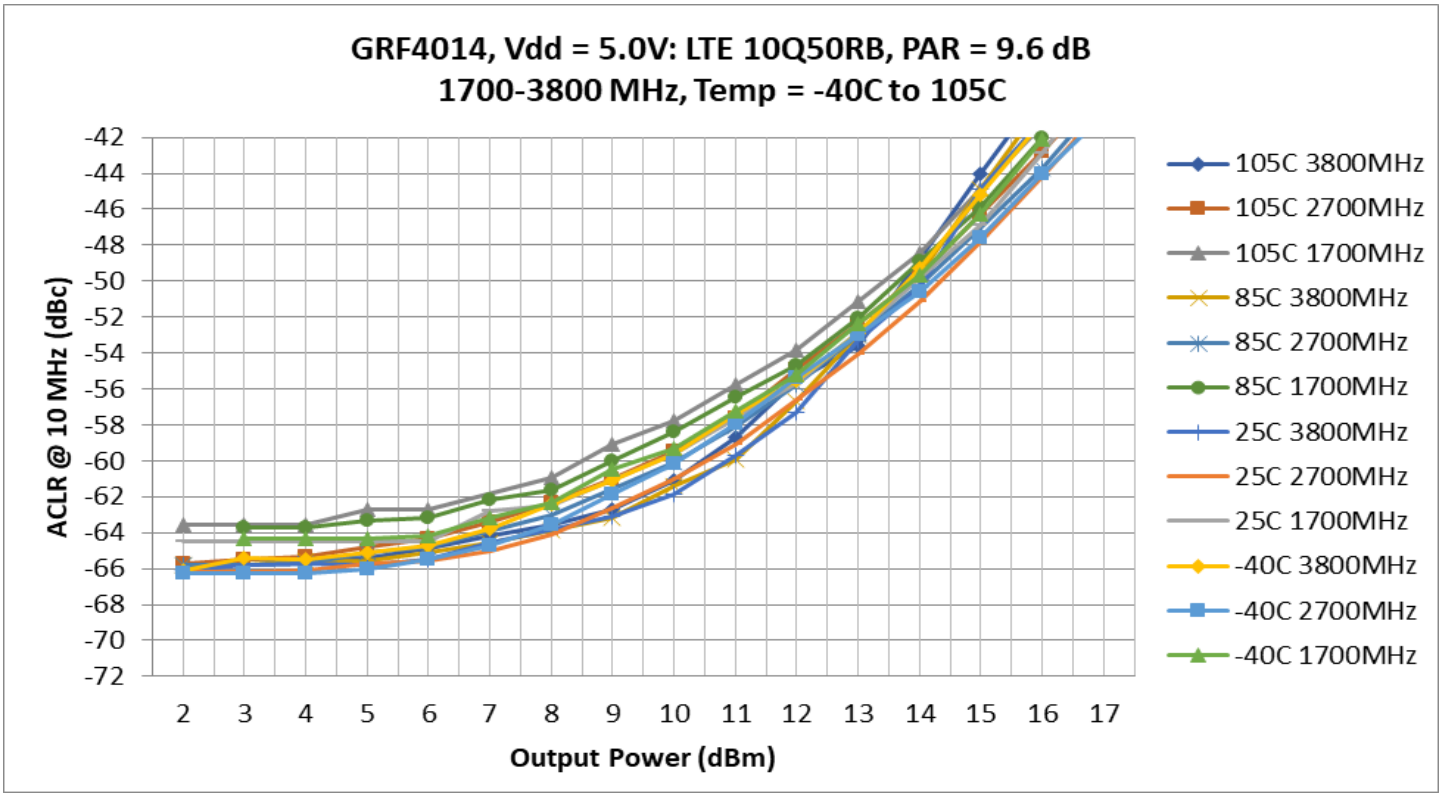
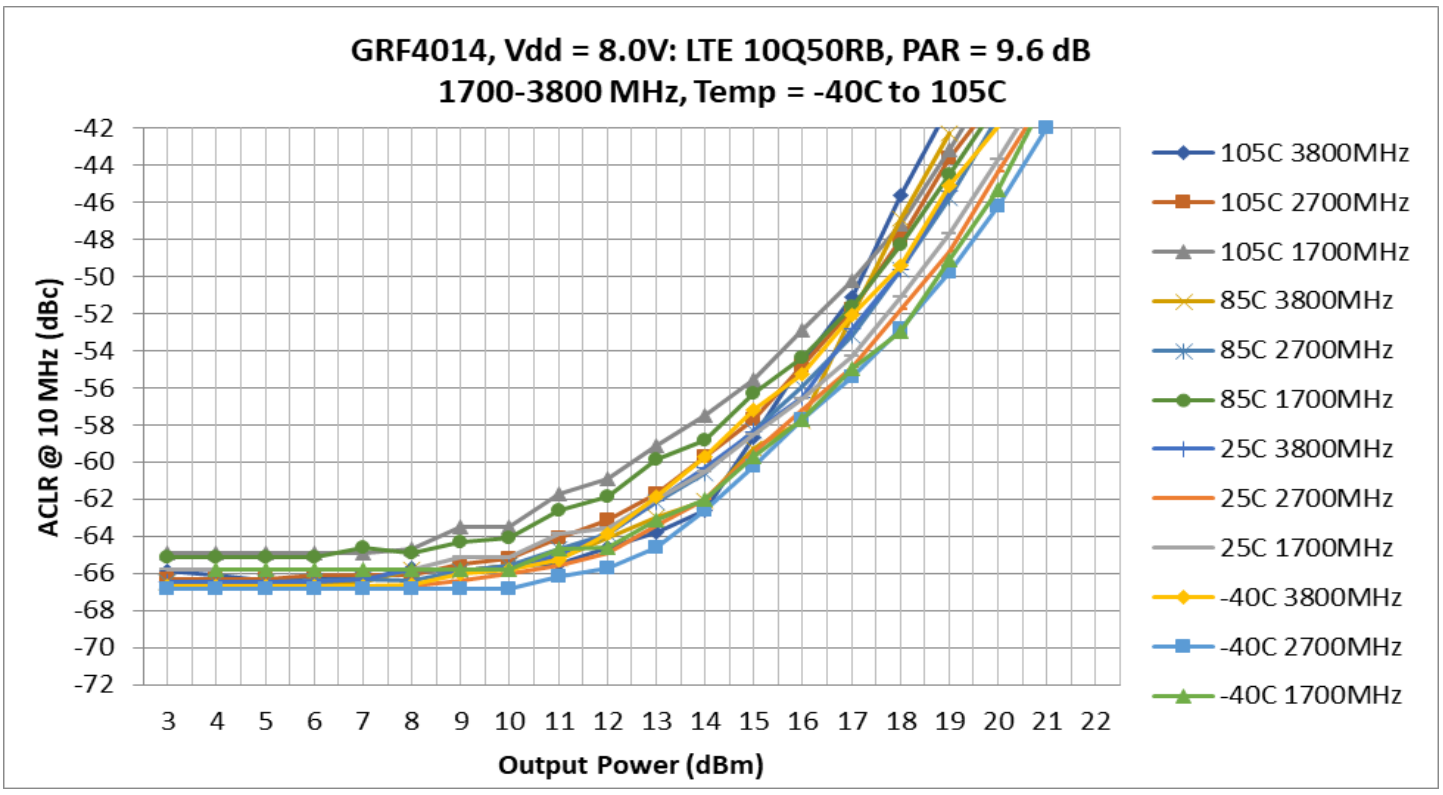
GRF4014W Typical Operating Curves: 1.7 to 3.8 GHz Tune





GRF4014W Typical Operating Curves: 1.7 to 3.8 GHz Tune





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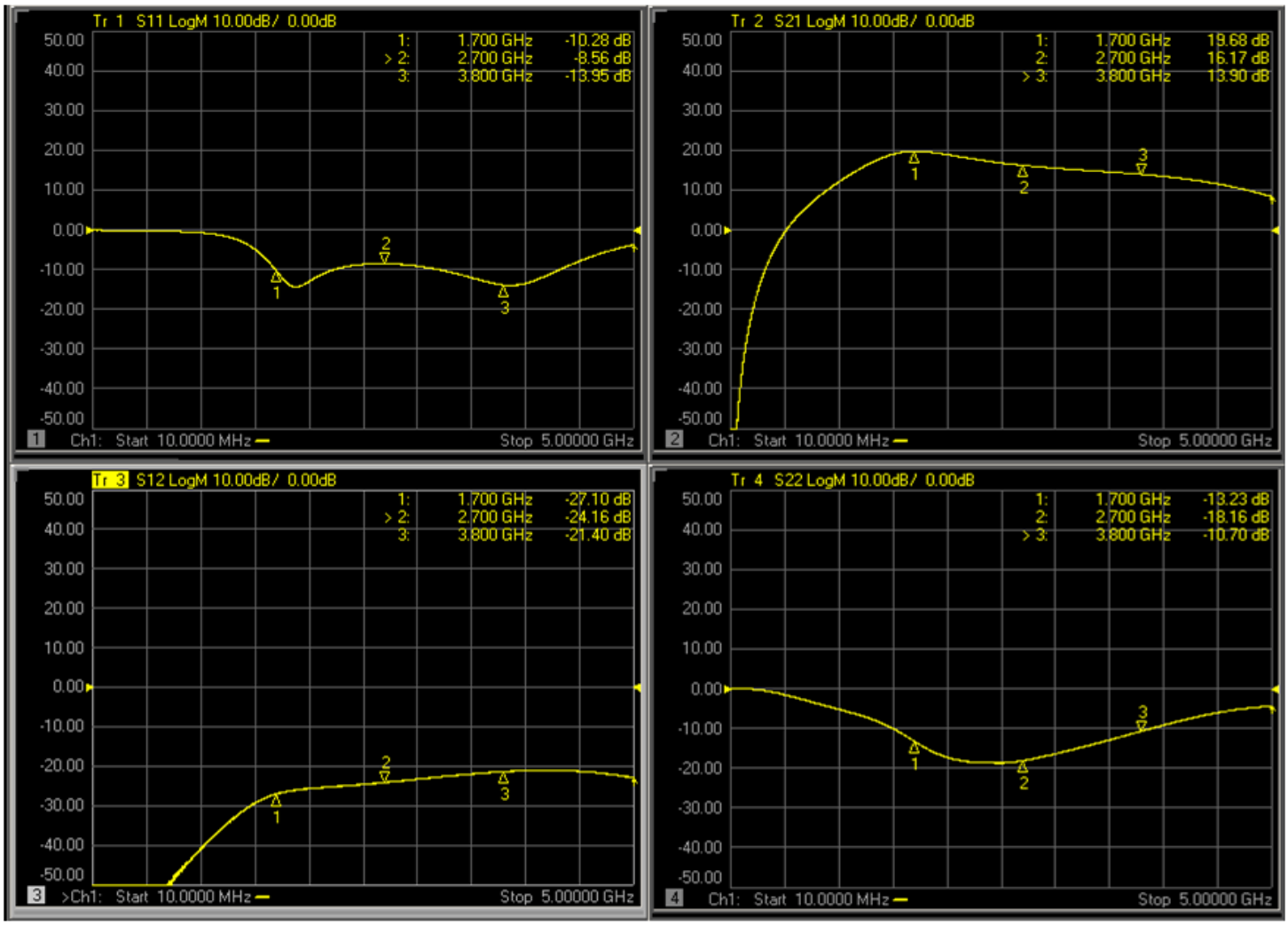
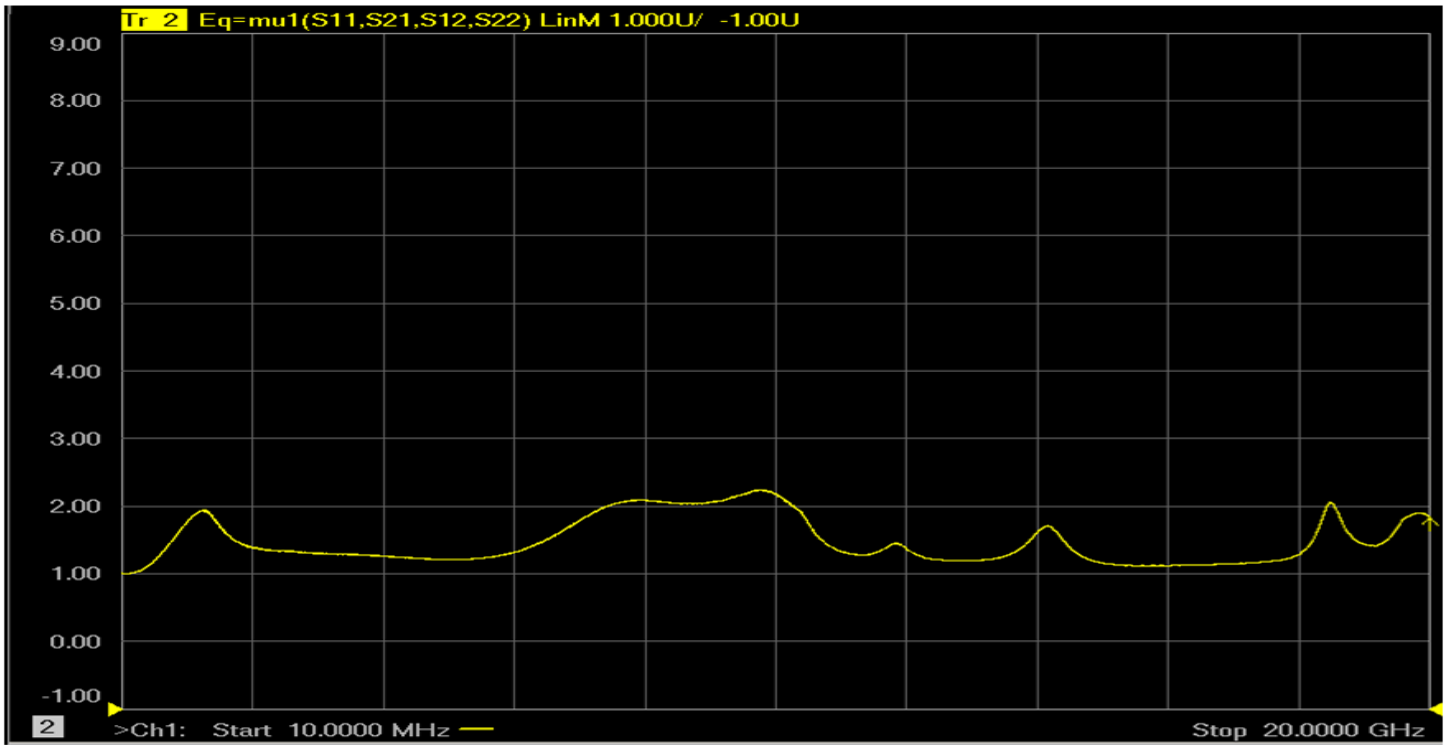
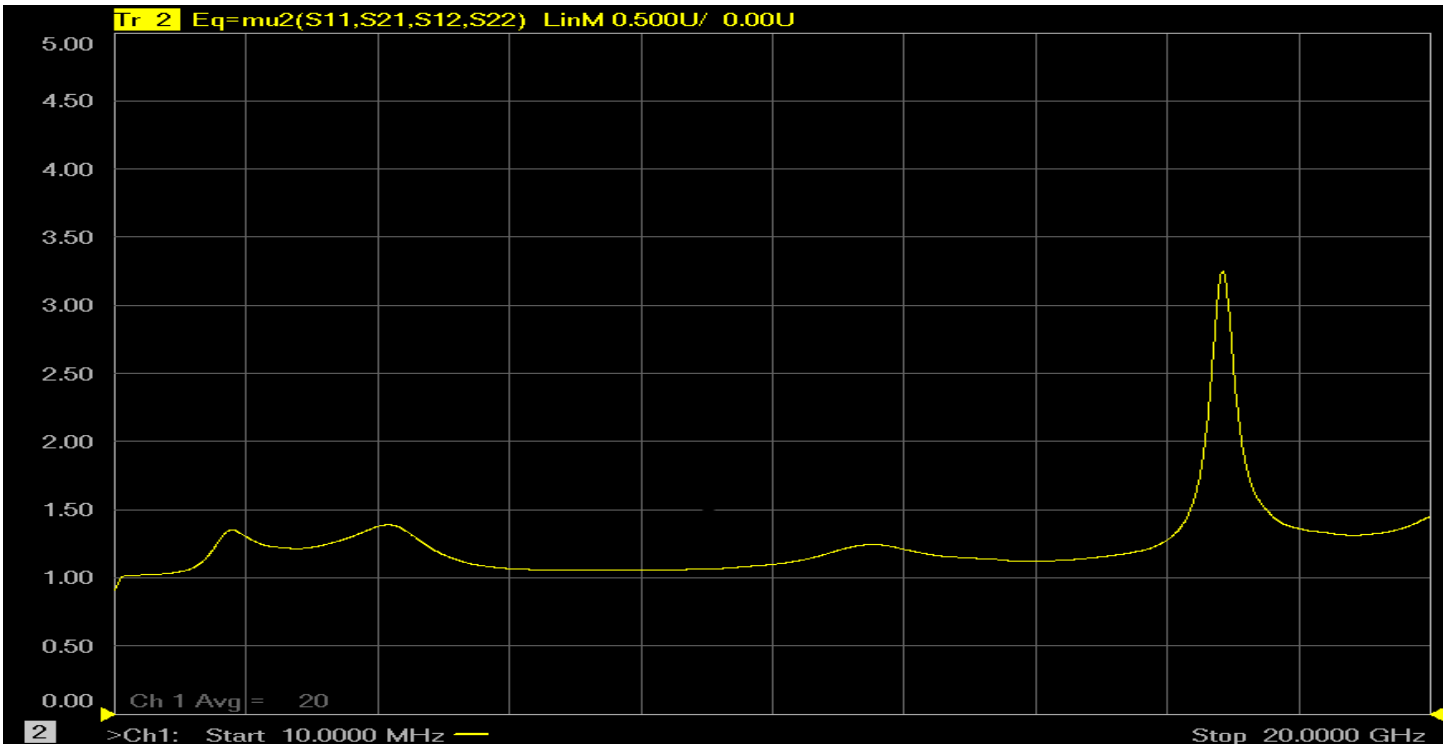
GRF4014W Typical Operating Curves: S-Parameters: 1.7 to 3.8 GHz Tune



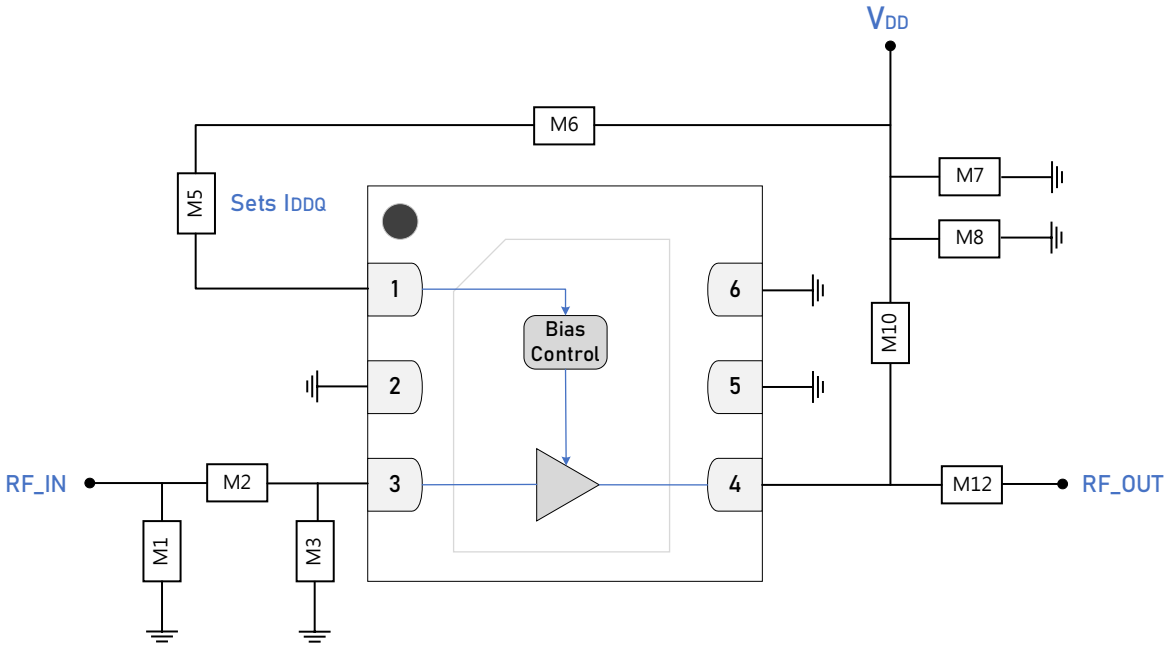
GRF4014W Typical Operating Curves: Stability Mu/ Mu Prime Factors: 10 MHz to 20 GHz



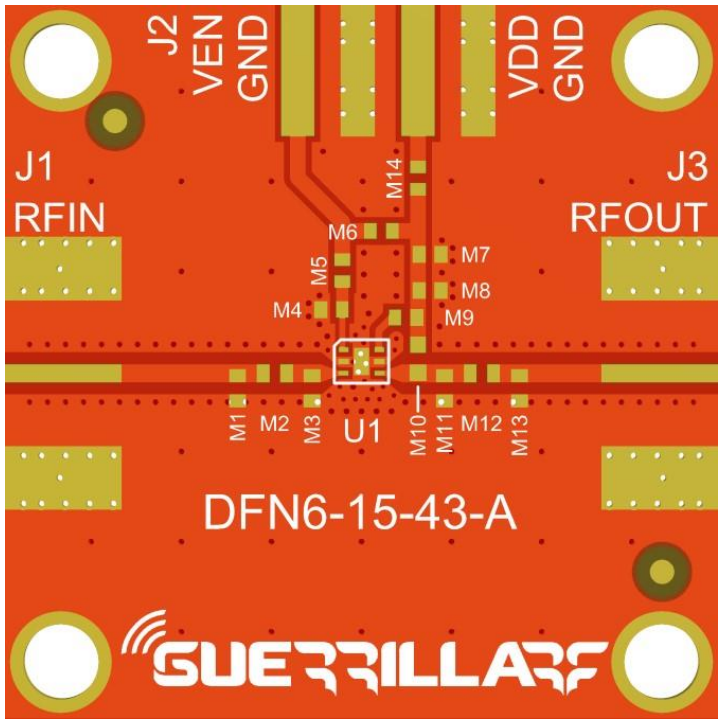
Note: Mu ≥ 1.0 implies unconditional stability.



Note: Mu Prime ≥ 1.0 implies unconditional stability.



GRF4014W Standard Evaluation Board Schematic



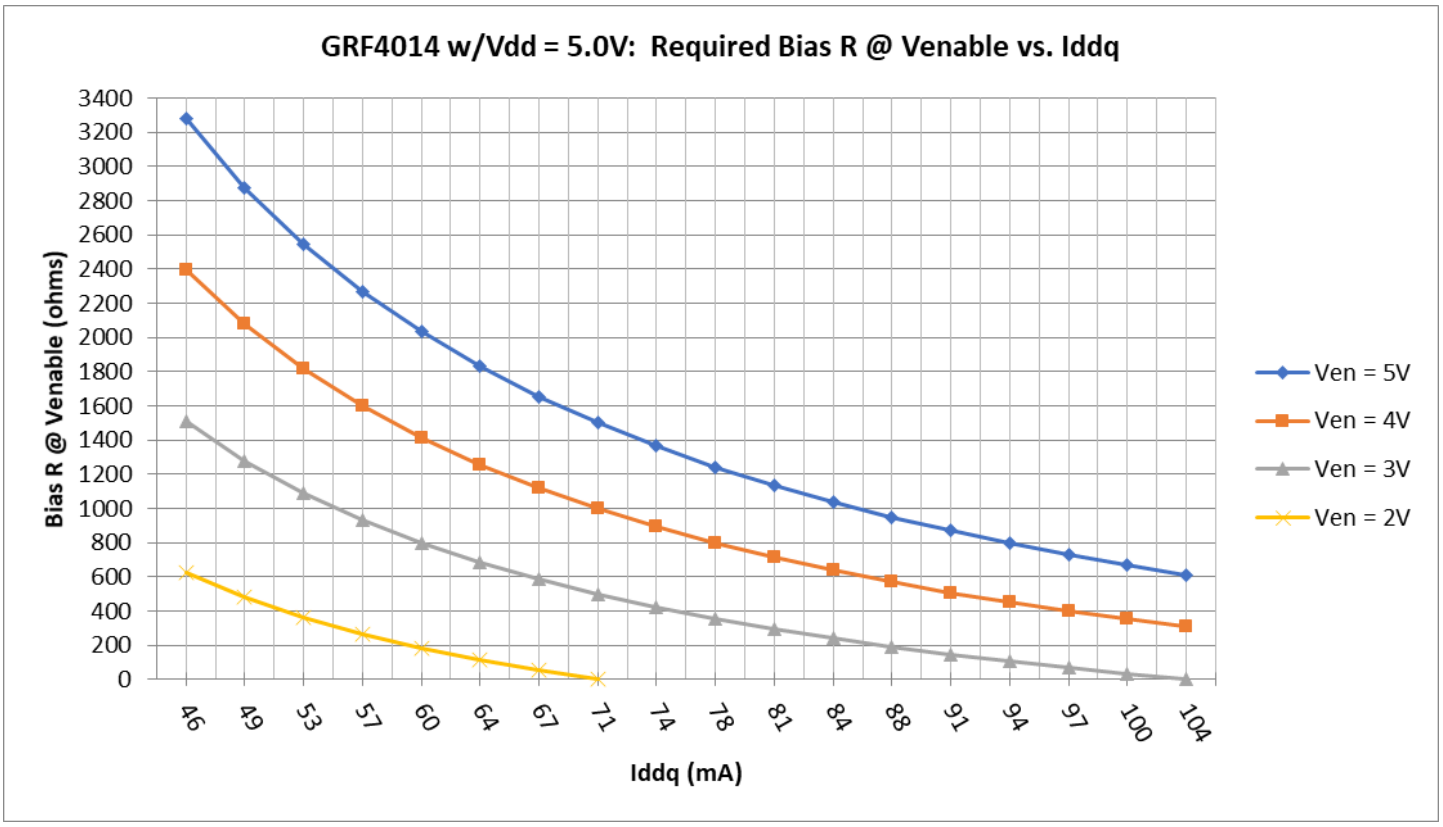
GRF4014W Evaluation Board Assembly Diagram

GRF4014W Evaluation Board Assembly Diagram Reference: 1.7 to 3.8 GHz Tune

Component	Type	Manufacturer	Family	Value	Package Size	Substitution
M1	Inductor	Coilcraft	HP	3.6 nH	0402	ok
M2	Capacitor	Murata	GJM	2.0 pF	0402	ok
M3	Capacitor	Murata	GJM	1.0 pF	0402	ok
M5	Resistor (sets IDDQ)	Various	5%	see curves	0402	ok
M6	Resistor (jumper)	Various	5%	0 Ω	0402	ok
M7	Capacitor	Murata	GRM	0.1 µF	0402	ok
M8	Capacitor	Murata	GRM	100 pF	0402	ok
M10	Inductor	Murata	LQG	6.8 nH	0402	ok
M12	Capacitor	Murata	GJM	8.2 pF	0402	ok
Evaluation Board	DFN6-15-43-A					

Note: Standard evaluation board bias: V_{DD} = 5 V, V_{ENABLE} = 5 V, M5 = 2 kΩ.

GRF4014W Bias Resistor Selection Curve: V_{DD} = 5 V



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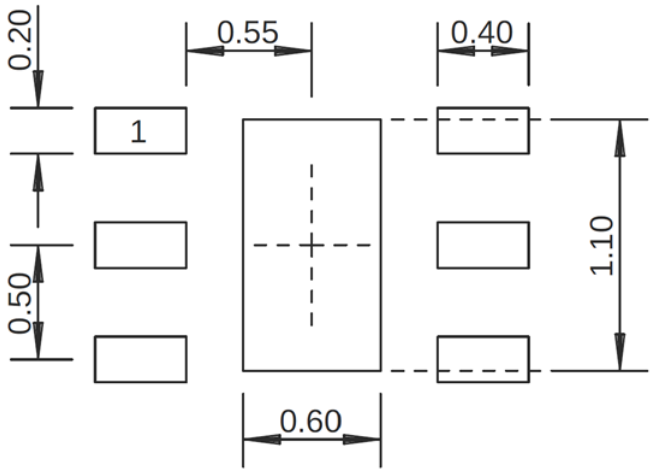
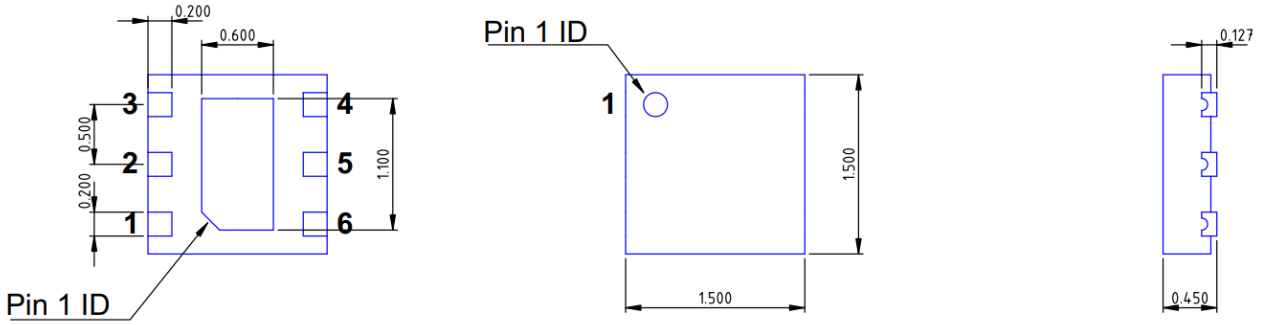


1.5 x 1.5 mm DFN-6 Suggested PCB Footprint (Top View)



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

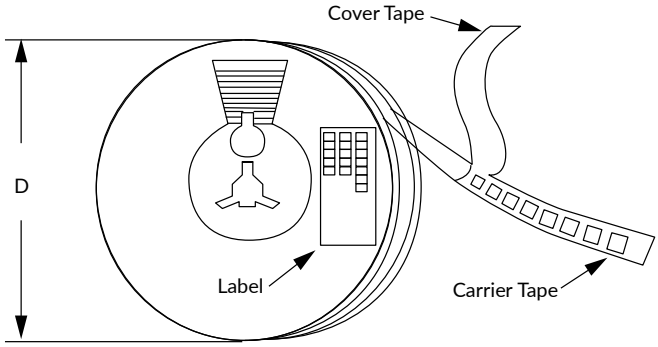
- Line 1: "Y" = YEAR (single digit). "WW" = WORK WEEK and "w" = W for automotive.
- Line 2: "XXXX" = Device PART NUMBER.

Tape and Reel Information

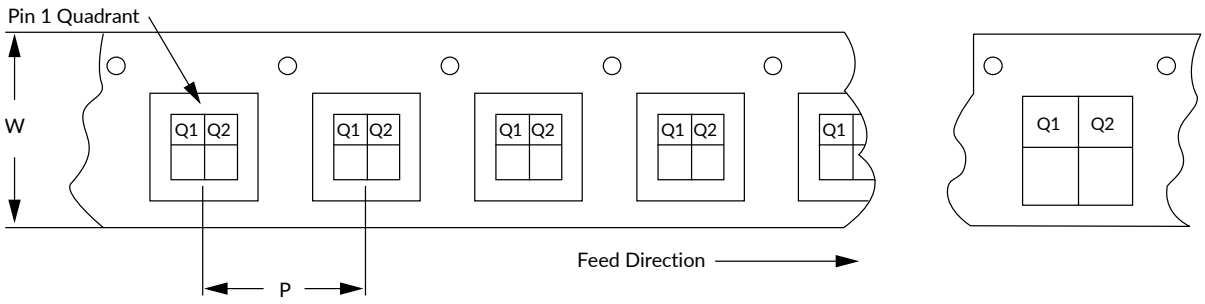
Guerrilla RF's tape and reel specification complies with Electronic Industries Alliance (EIA) standards for "Embossed Carrier Tape of Surface Mount Components for Automatic Handling" (reference EIA-481). See the following page for the Tape and Reel Specification and Device Package Information table, 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
September 9, 2019	Preliminary Data Sheet.
September 9, 2022	Release Ø Data Sheet.
February 16, 2023	Release A Data Sheet.
May 11, 2023	Upgraded Data sheet to new format only.
May 7, 2025	Extended minimum frequency from 0.1 GHz to 0.01 GHz.

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.