GRF2140
Low Current LNA with Bypass
0.085 to 4.2 GHz

▤ FEATURES

- Flexible Bias Voltage
- Optimal for Low I_{DDQ} to 8 mA
- Simple Matching to 50 Ω
- Process: GaAs pHEMT
- Compact 1.5 x 1.5 mm DFN-6 Package

Reference: 3.3 V / 18 mA / 1.95 GHz

Gain Mode
- Gain: 17.8 dB
- OP1dB: 9.3 dBm
- OIP3: 20 dBm
- Evaluation Board Noise Figure: 1.1 dB

Bypass Mode
- Gain: -2.5 dB
- OP1dB: 21.8 dBm
- OIP3: 39 dBm

◈ APPLICATIONS

- WiFi Access Points
- Mobile WiFi Devices
- Cellular Boosters
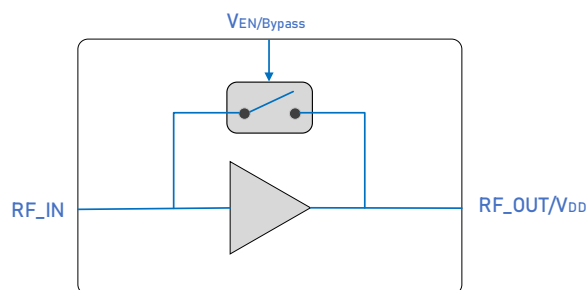- Drones
- UHF/900/2400 ISM

▤ DESCRIPTION

The GRF2140 is a low noise amplifier (LNA) with bypass designed for high-performance WLAN/ISM and other applications up to 4.2 GHz.
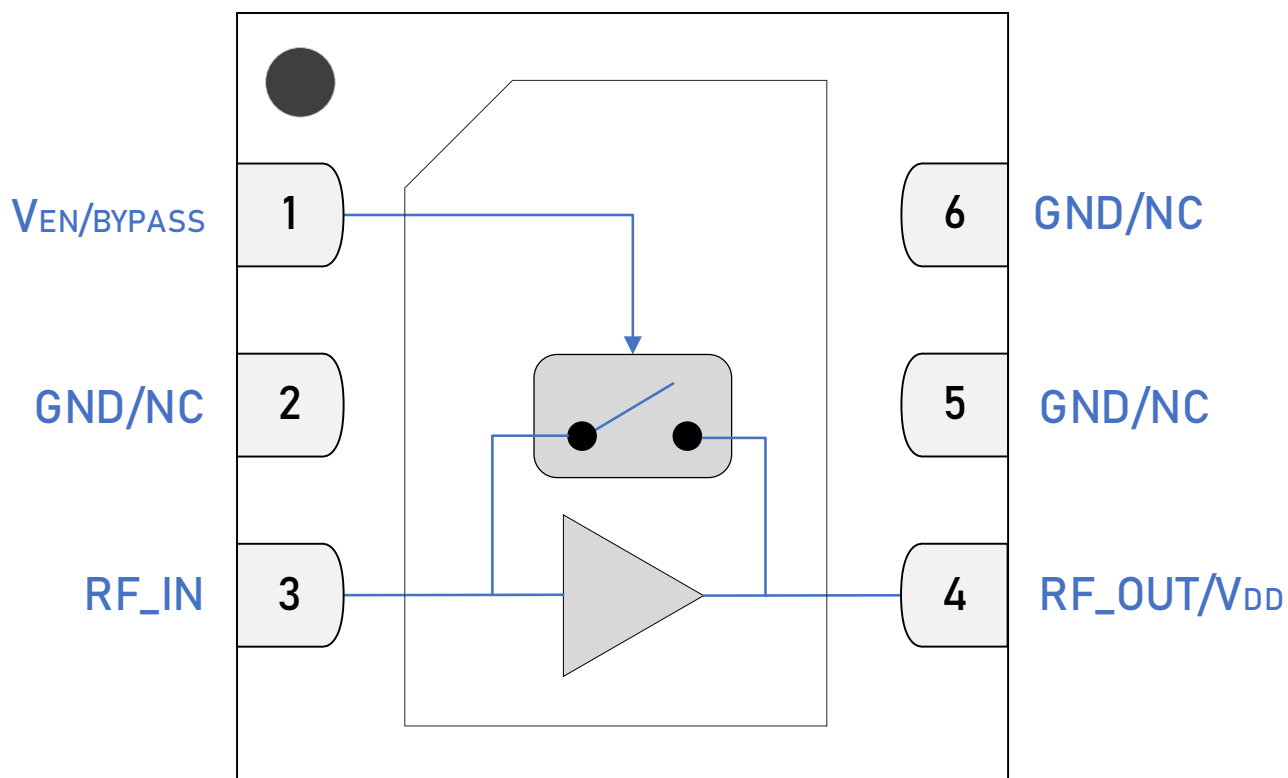
The device can be operated from a single supply voltage of 2.7 to 5 volts with a typical bias condition of 3.3 volts and 18 mA.

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 GRF2140 "Custom Tunes" product page: GRF2140 Custom Tunes

▦ BLOCK DIAGRAM

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

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Pin Assignments

Pin	Name	Description	Note
1	$V_{ENABLE/BYPASS}$	$V_{EN/BYPASS}$ Control	$V_{EN/BYPASS}$ and series resistor set I_{DDQ}. $V_{EN/BYPASS}$ < 0.3 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. It is recommended these pins be connected to ground.
3	RF_IN	RF Input	Requires external DC block.
4	RF_OUT/V_{DD}	RF Output	Requires external bias inductor followed by DC block.
PKG BASE	GND	Ground	Provides DC and RF ground for device, 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.

Control Logic Truth Table

Mode	Description	$V_{EN/BYPASS}$
High Gain	High Gain	1
Bypass	Bypass Mode	0
Logic Level "0"	Logic Low	0 V to 0.3 V
Logic Level "1"	Logic High	1.5 V to V_{DD}

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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, $V_{EN/BYPASS}$ = 5 V (Gain Mode)	$P_{IN\ MAX}$		15	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	$P_{DISS\ MAX}$		200	mW

Electrostatic Discharge

	Symbol	Min.	Max.	Unit
Human Body Model	HBM	100		V

Storage

	Symbol	Min.	Max.	Unit
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}	2.7	3.3	5	V	
Operating Temperature (package base)	$T_{PKG\ BASE}$	-40		105	°C	
RF Frequency Range	F_{RF}	0.085	1.95	4.2	GHz	Typical application schematic with external matching components **(notes 1 & 2)**.
RF_IN Port Impedance	Z_{RFIN}		50		Ω	Single-ended.
RF_OUT Port Impedance	Z_{RFOUT}		50		Ω	Single-ended.

Note 1: Operation outside of this range is supported by using different custom tunes. Examples of other optimized tunes can be found here: GRF2140 Custom Tunes

Note 2: Contact the Guerrilla RF Applications team for guidance on optimizing the tuning of the device for alternative bands.

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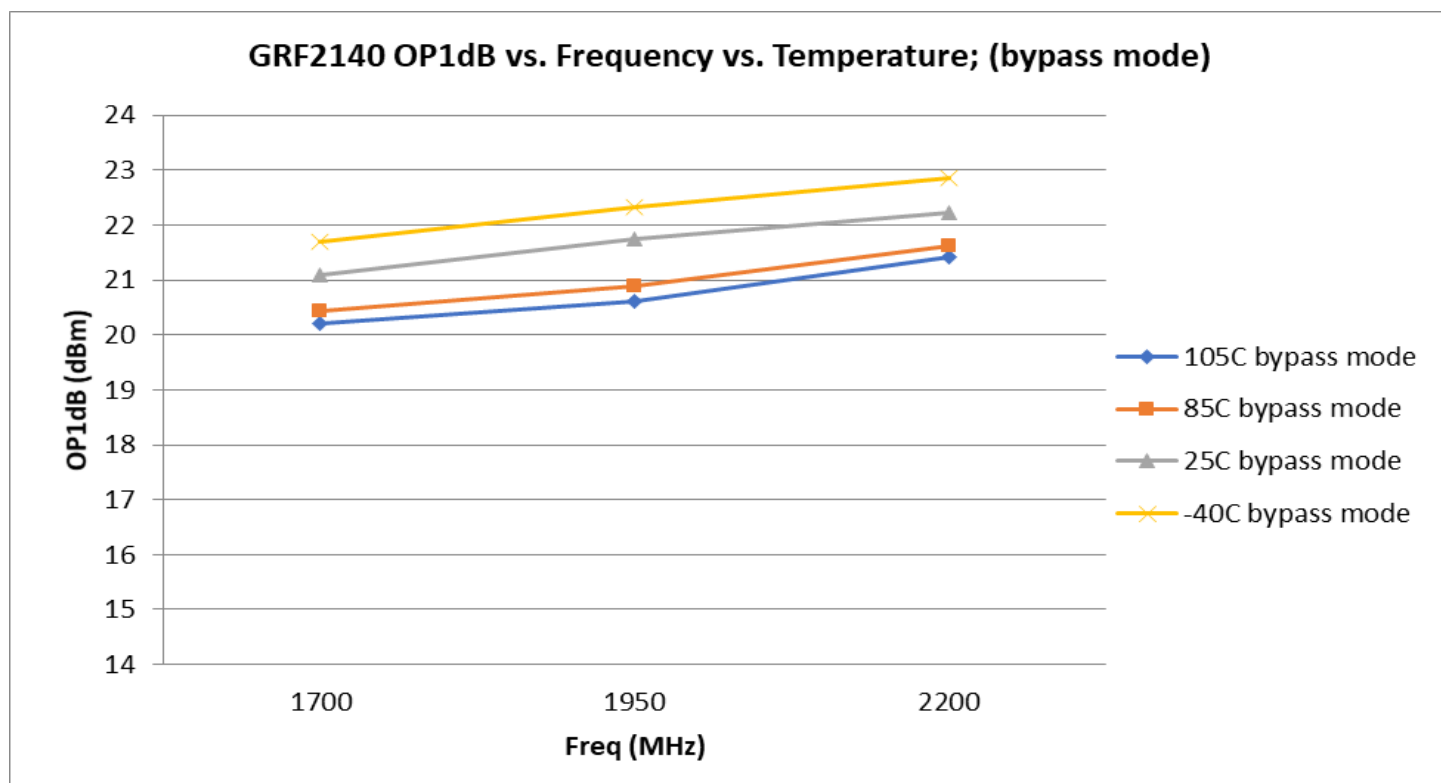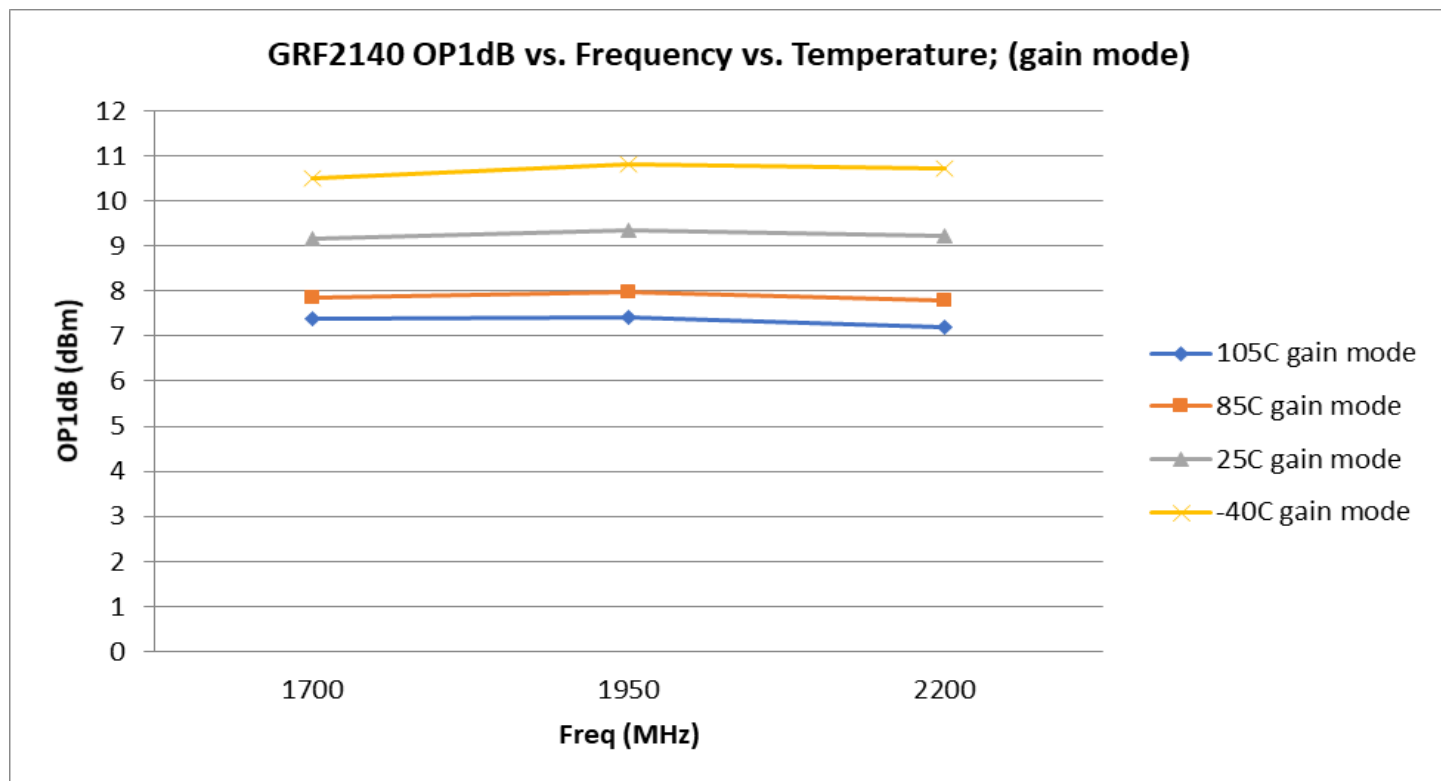
5

Nominal Operating Parameters – General

The following conditions apply unless noted otherwise: typical application schematic using the 1.7 to 2.2 GHz tuning set. V_{DD} = 3.3 V, $V_{EN/BYPASS}$ = 3.3 V, I_{DDQ} = 18 mA. M5 = 500 Ω, F_{TEST} = 1.95 GHz, $T_{PKGBASE}$ = 25 °C. Evaluation board losses are included within the specifications.

Parameter	Symbol	Specification			Unit	Condition
		Min.	Typ.	Max.		
Supply Current	I_{DDQ}	13	18	25	mA	V_{DD} = 3.3 V, $V_{EN/BYPASS}$ = 3.3 V.
Enable Current	I_{ENABLE}		1	3	mA	V_{DD} = 3.3 V, $V_{EN/BYPASS}$ = 3.3 V.
Switching Rise Time	T_{RISE}		100		ns	Bypass mode to Gain mode **(note 3).**
Switching Fall Time	T_{FALL}		50		ns	Gain mode to Bypass mode **(note 4).**

Disabled Mode

Parameter	Symbol	Specification			Unit	Condition
Leakage Current	$I_{LEAKAGE}$		500		µA	V_{DD} = 3.3 V, $V_{EN/BYPASS}$ = 0 V.

Thermal Data

Parameter	Symbol	Specification			Unit	Condition
Thermal Resistance (Infrared Scan)	Θ_{JC}		235		°C/W	On standard evaluation board **(note 5).**
Channel Temperature @ 85 °C reference (package base).	$T_{CHANNEL}$		99		°C	V_{DD} = 3.3 V, I_{DDQ} = 18 mA. No RF applied. Dissipated Power = 59 mW **(note 5).**

Note 3: Switching Time: 50% of $V_{EN/BYPASS}$ to 90% of Pout.

Note 4: Switching Time: 50% of $V_{EN/BYPASS}$ to 10% of Pout.

Note 5: 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 2.2 GHz tuning set. V_{DD} = 3.3 V, $V_{EN/BYPASS}$ = 3.3 V, I_{DDQ} = 18 mA. M5 = 500 Ω. F_{TEST} = 1.95 GHz. $T_{PKG\ BASE}$ = 25 °C. Evaluation board losses are included within the specifications.

Parameter	Symbol	Specification			Unit	Condition
		Min.	Typ.	Max.		
High Gain Mode						V_{DD} = 3.3 V, $V_{EN/BYPASS}$ = 3.3 V.
Gain	S21	*16.3*	17.8		dB	
Output 3rd Order Intercept Point	OIP3		20		dBm	2 MHz spacing (1949 and 1951 MHz).
Output 1 dB Compression Point	OP1dB	*7.3*	9.3		dBm	
Noise Figure	NF		1.1	*1.3*	dB	On standard evaluation board.
Bypass Mode						V_{DD} = 3.3 V, $V_{EN/BYPASS}$ = 0 V.
Gain	S21	*-3.5*	-2.5		dB	
Output 3rd Order Intercept Point	OIP3		39		dBm	2 MHz spacing (1949 and 1951 MHz).
Output 1 dB Compression Power	OP1dB		21.8		dBm	

GRF2140 Evaluation Board Data: 1.7 to 2.2 GHz Tune
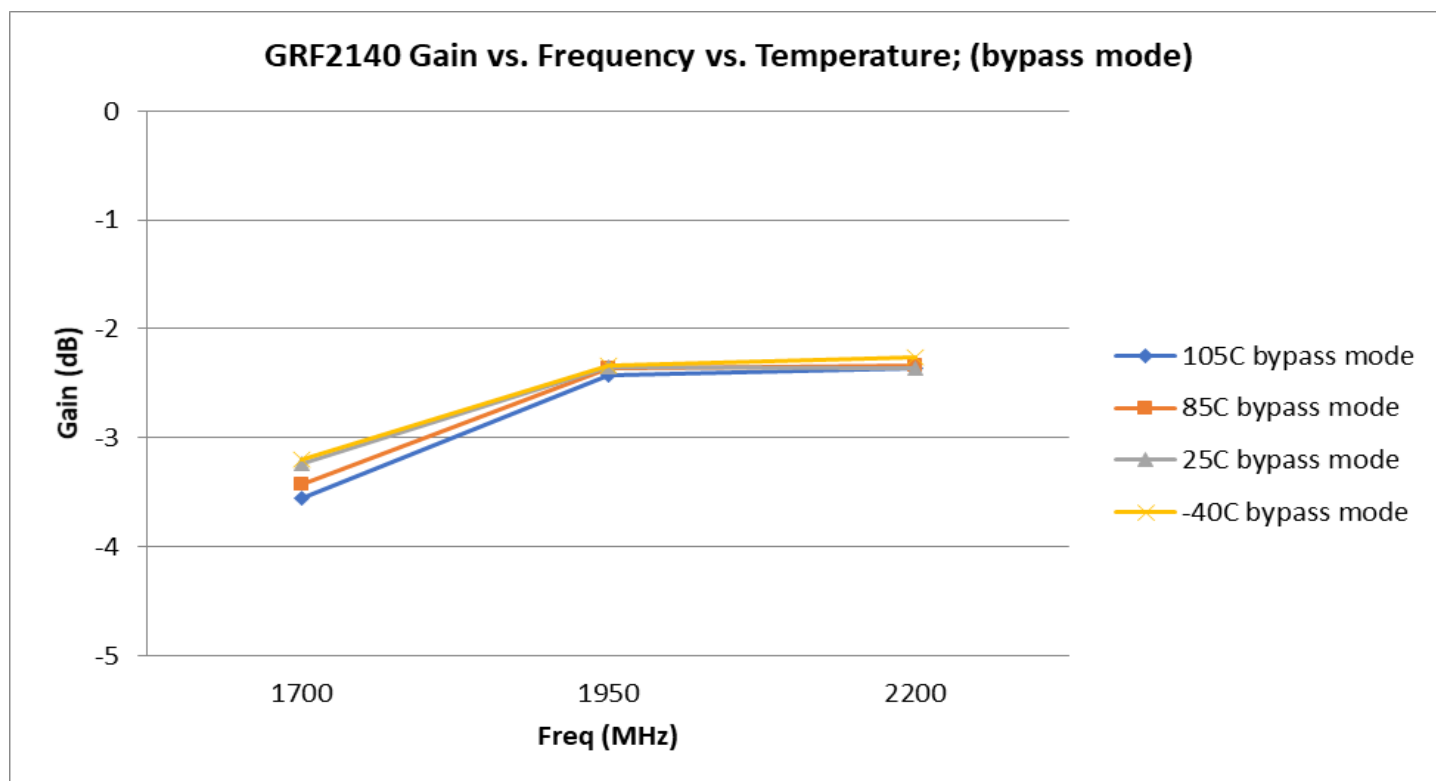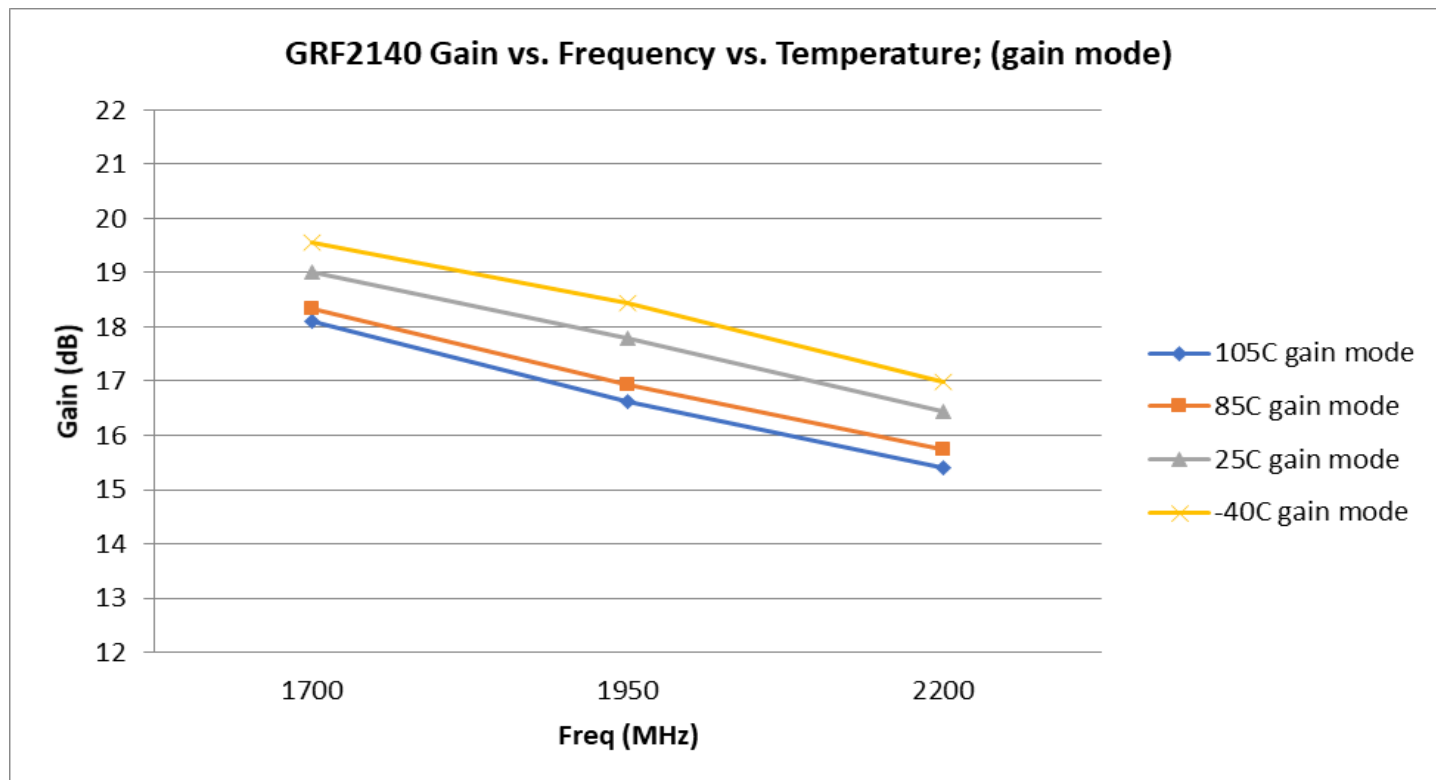
GRF2140 Evaluation Board Data: 1.7 to 2.2 GHz Tune

GRF2140 OP1dB vs. Frequency vs. Temperature; (gain mode)

GRF2140 OP1dB vs. Frequency vs. Temperature; (bypass mode)

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GRF2140 Evaluation Board Data: 1.7 to 2.2 GHz Tune

GRF2140 Evaluation Board Data: 1.7 to 2.2 GHz Tune

GRF2140 Evaluation Board Noise Figure vs. Temperature: 3.3V/15mA
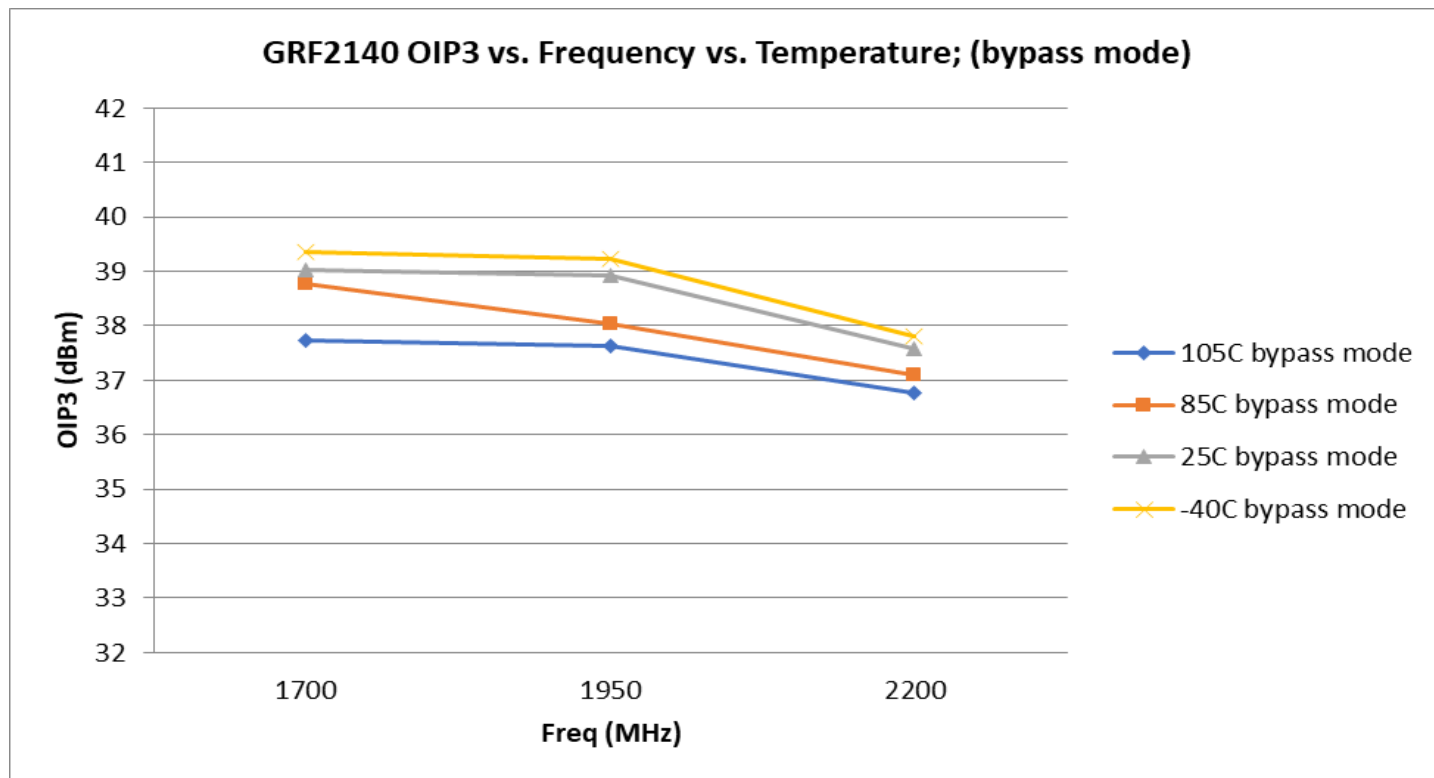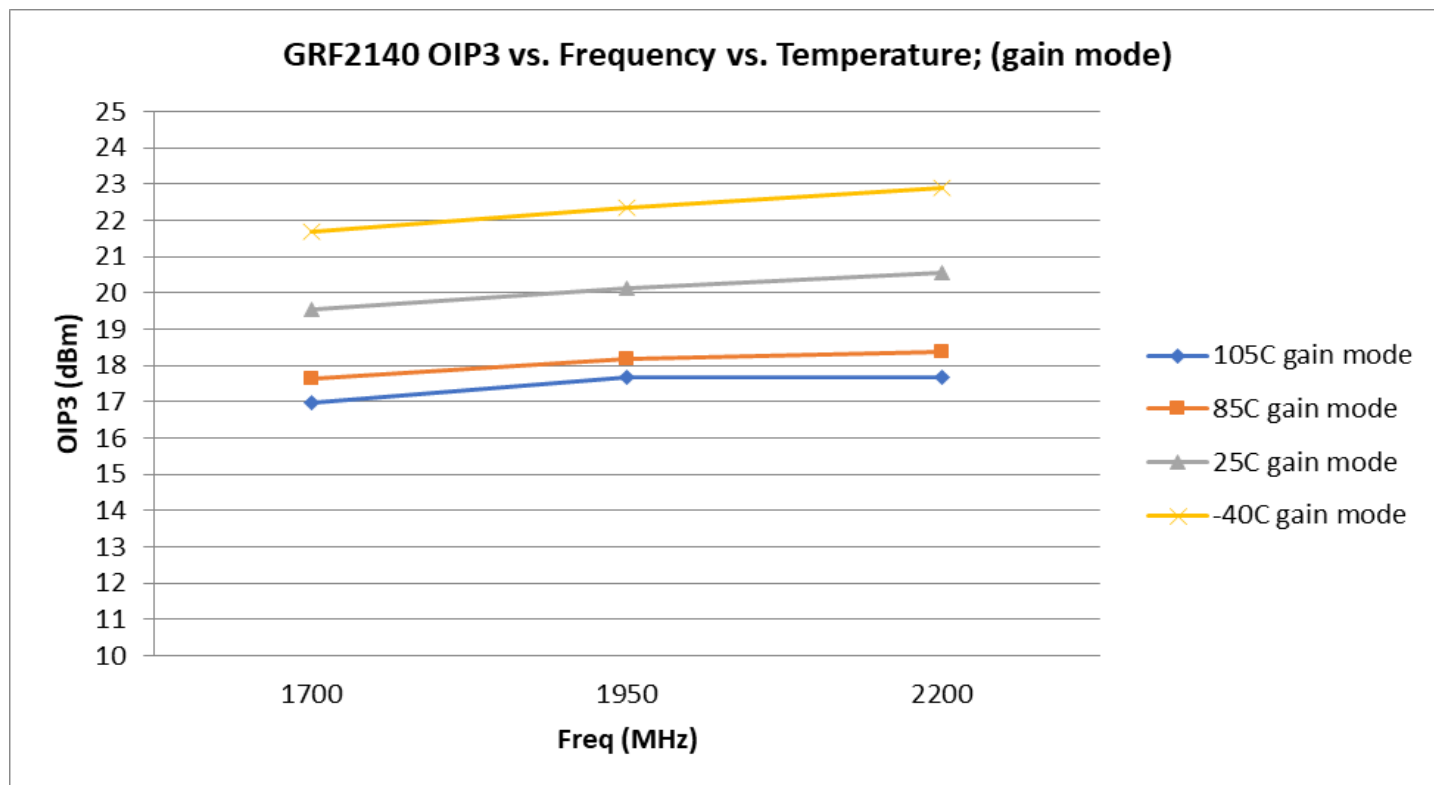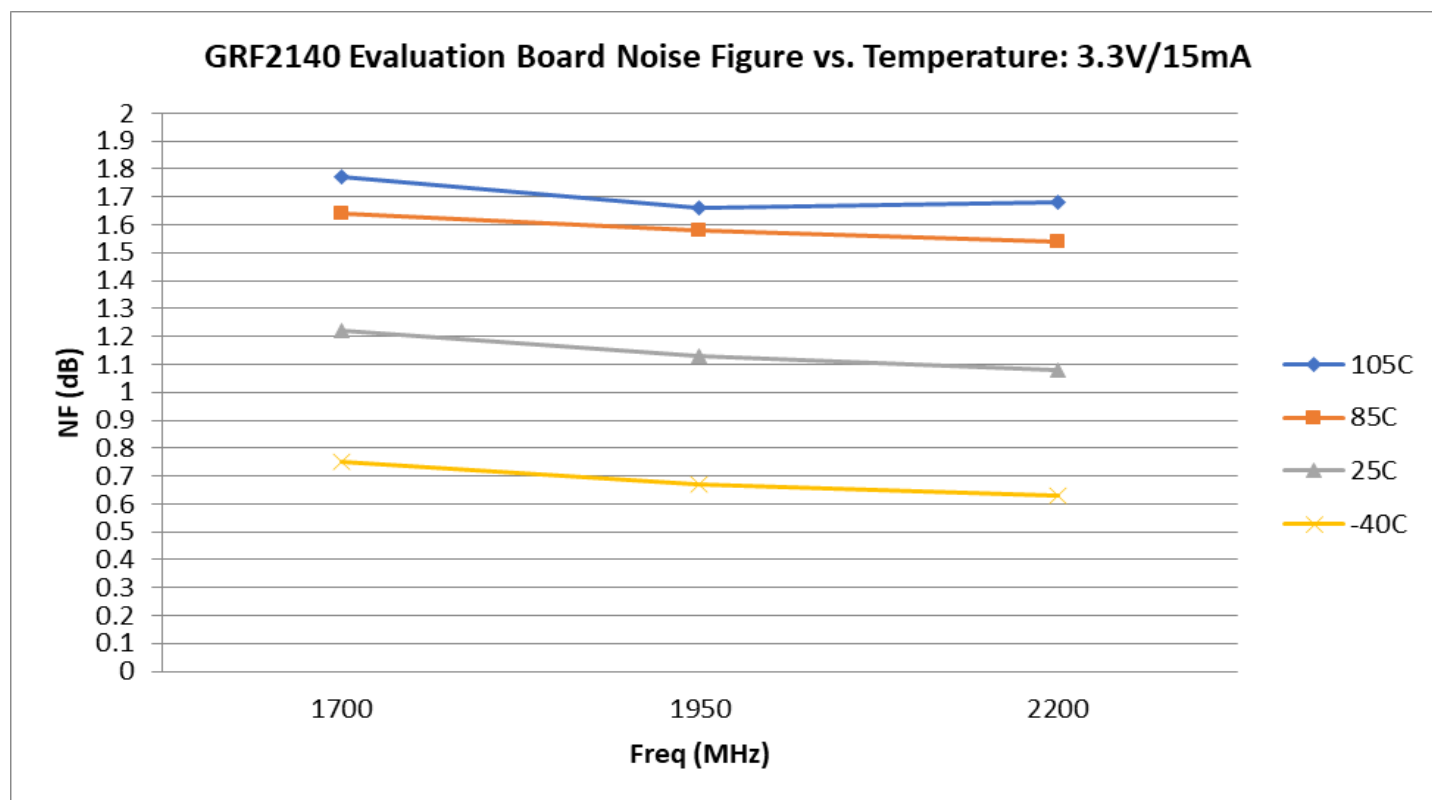
GRF2140 Typical Operating Curves: S-Pars: Gain Mode (1.7 to 2.2 GHz Tune)

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GRF2140 Typical Operating Curves: S-Pars: Bypass Mode (1.7 to 2.2 GHz Tune)

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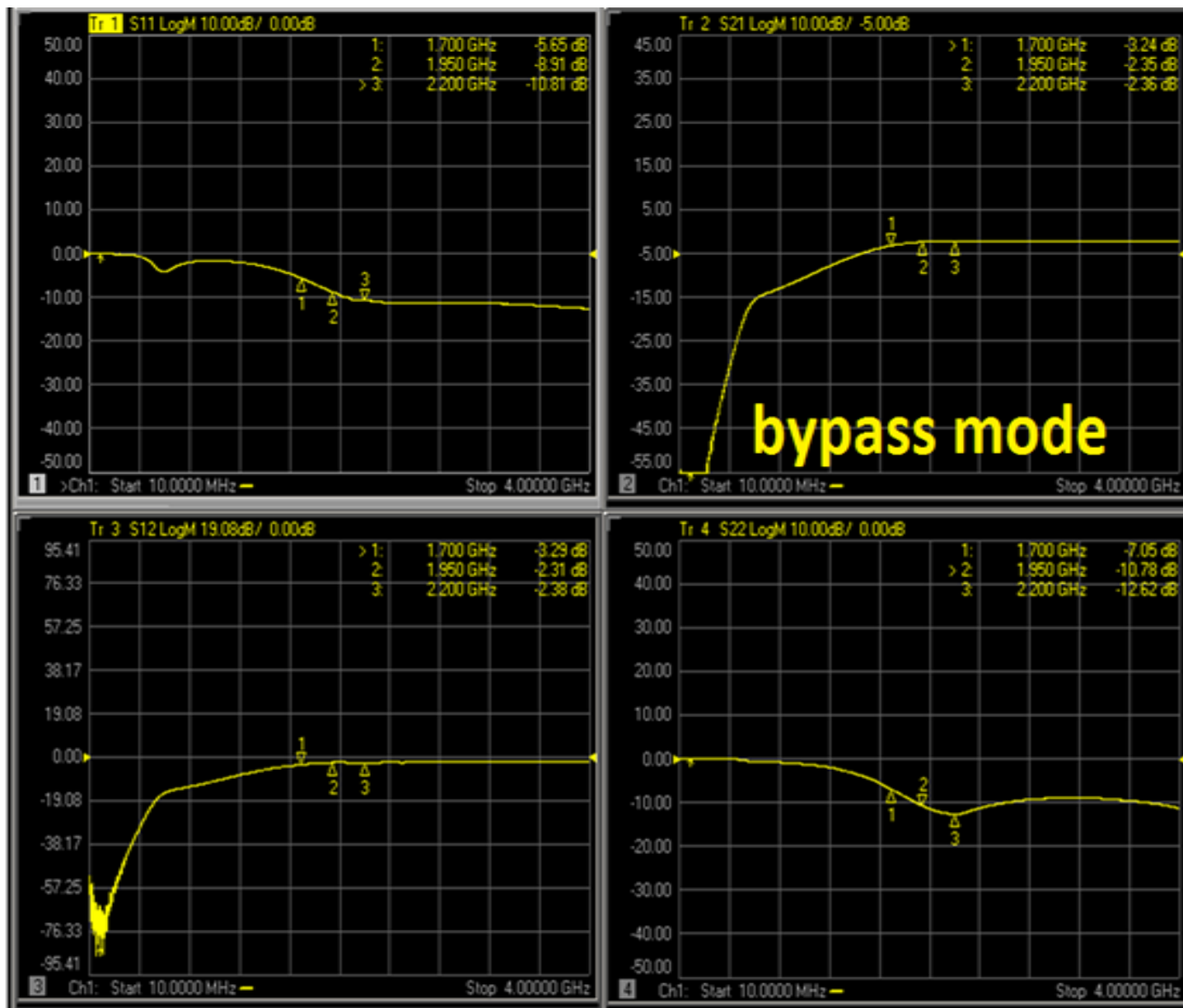
GRF2140 Typical Operating Curves: Stability Mu Factor (10 MHz to 20 GHz)
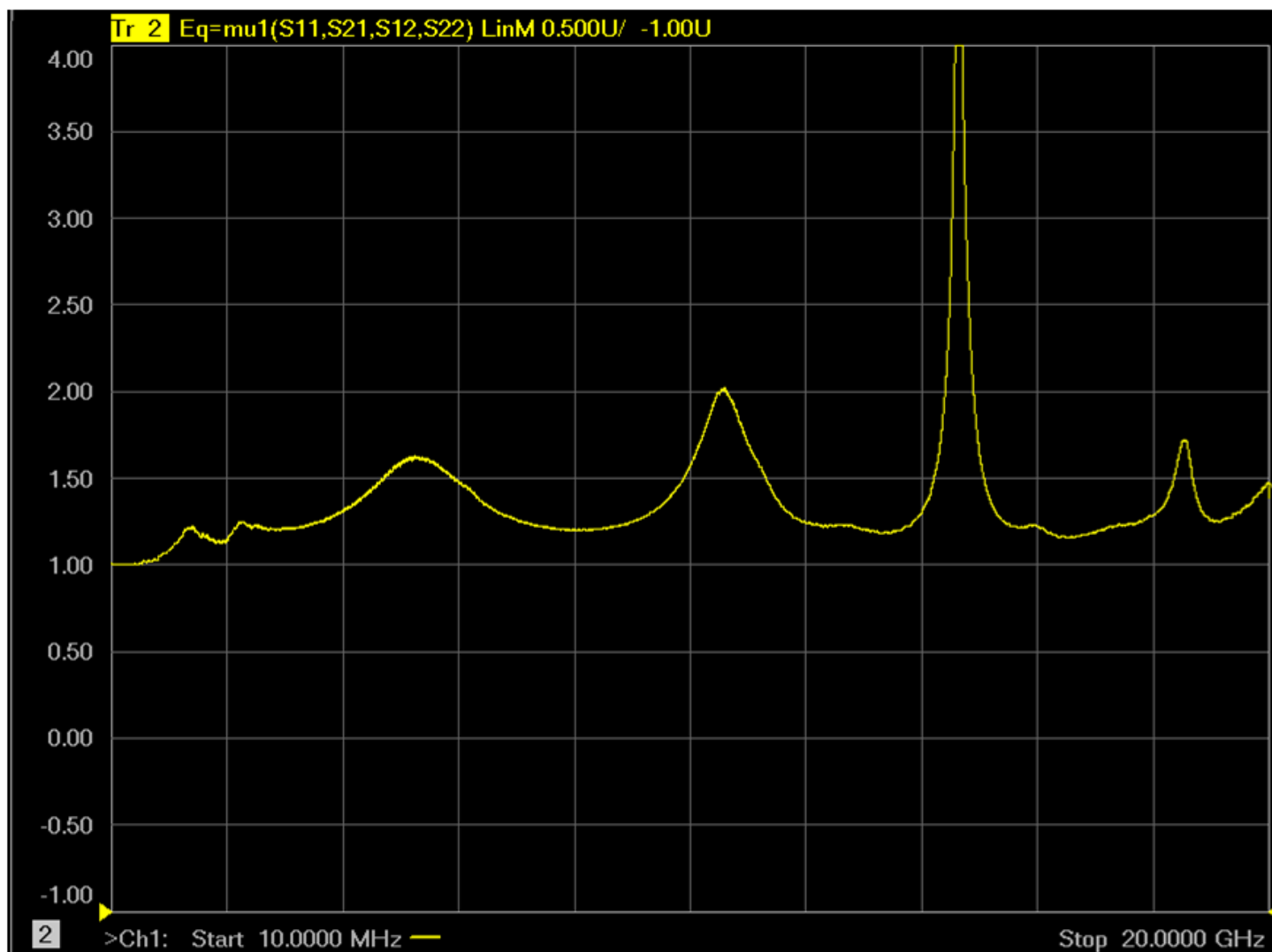
Note: Mu factor >= 1.0 implies unconditional stability.

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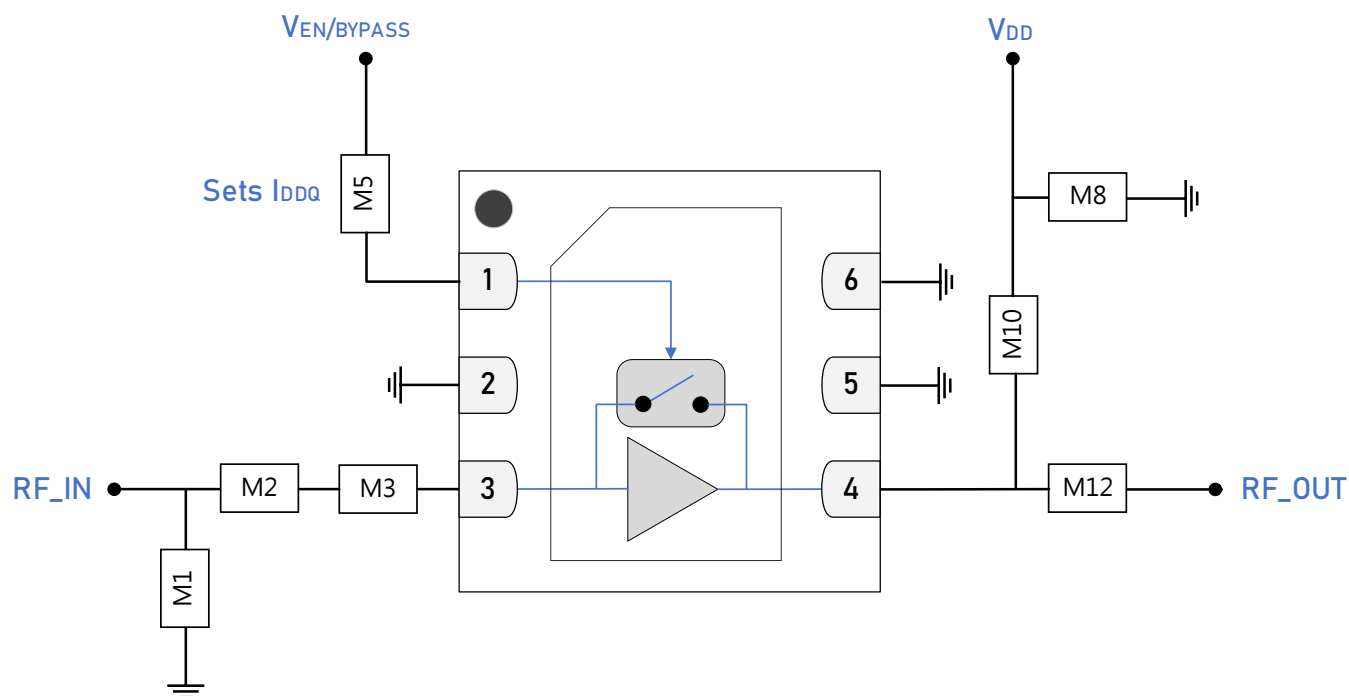
GRF2140 Standard Evaluation Board Schematic

GRF2140 Evaluation Board Assembly Diagram

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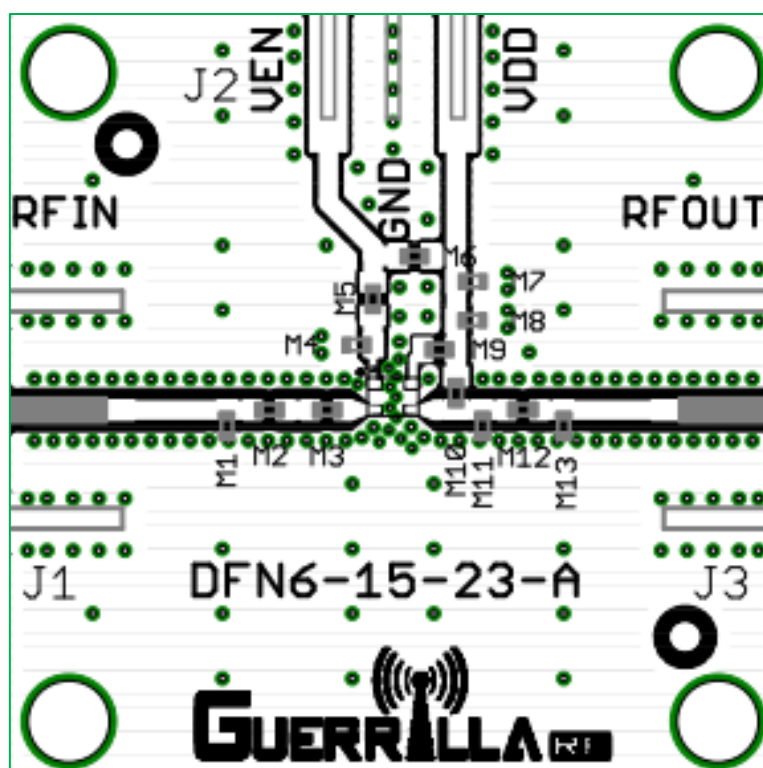
GRF2140 Evaluation Board Assembly Diagram Reference: 1.7 to 2.2 GHz Tune

Component	Type	Manufacturer	Family	Value	Package Size	Substitution
M1	Inductor	Murata	LQG	3.9 nH	0402	ok
M2	Capacitor	Murata	GJM	30 pF	0402	ok
M3	Inductor	Murata	LQG	1.5 nH	0402	ok
M5 (sets I$_{DDQ}$)	Resistor	Various	5%	see curves	0402	ok
M8	Capacitor	Murata	GRM	0.1 µF	0402	ok
M10	Inductor	Murata	LQG	3.3 nH	0402	ok
M12	Capacitor	Murata	GRM	2.2 pF	0402	ok
Evaluation Board	DFN6-15-23-A					

GRF2140 Bias Resistor Selection Curve
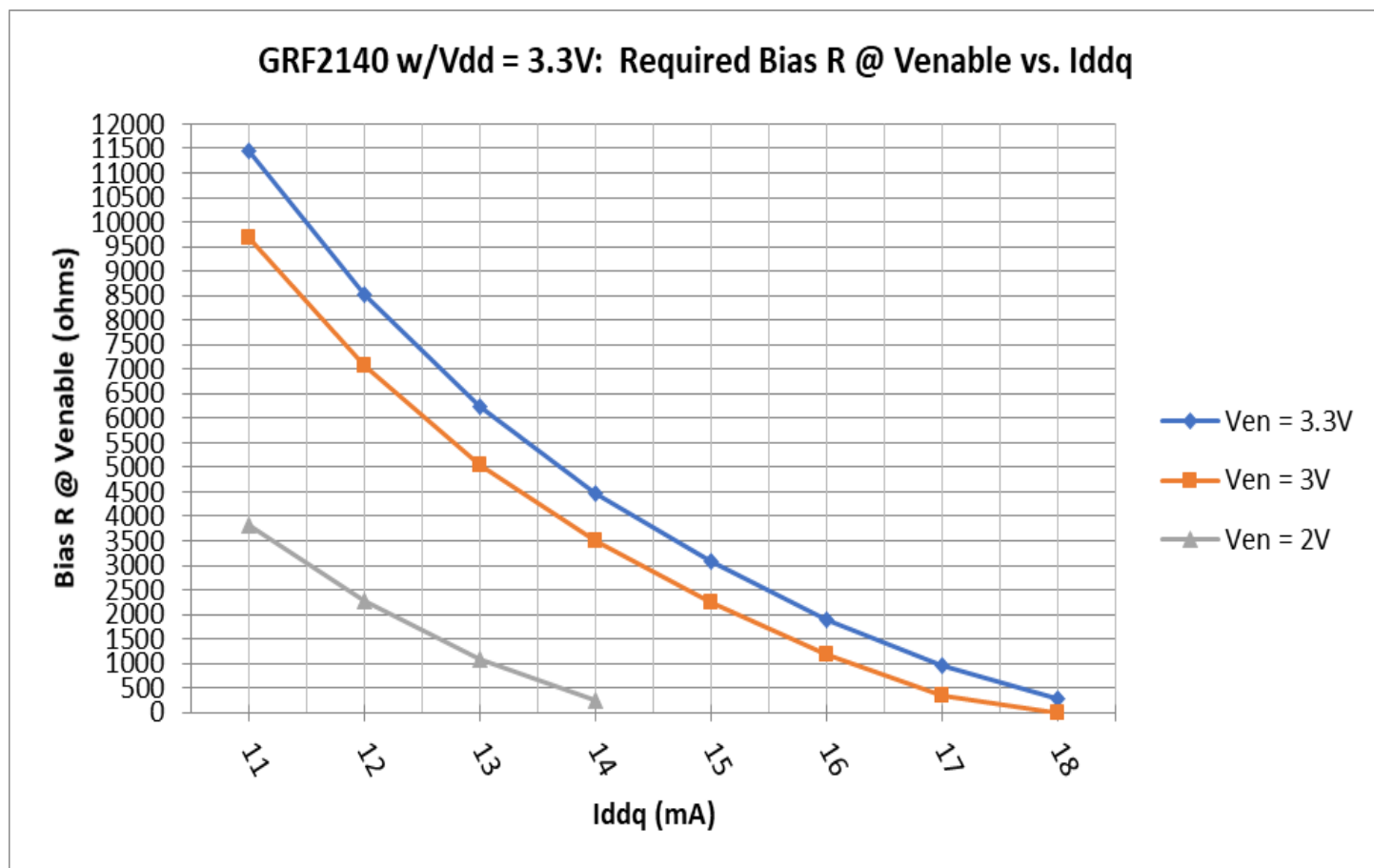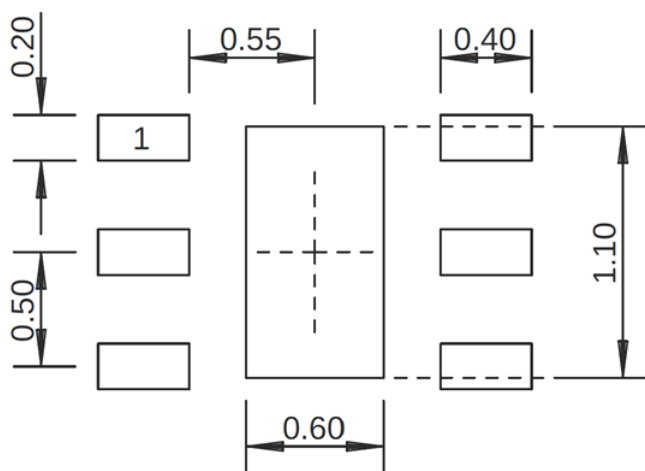
1.5 x 1.5 mm DFN-6 Suggested PCB Footprint (Top View)
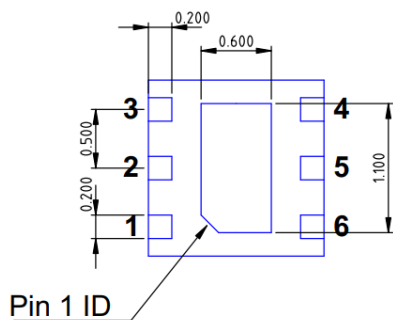
Bottom View
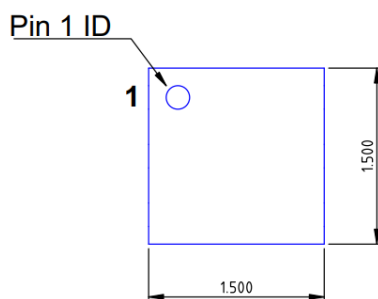
Top View
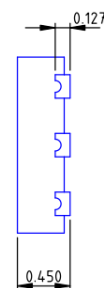
Side View

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)*
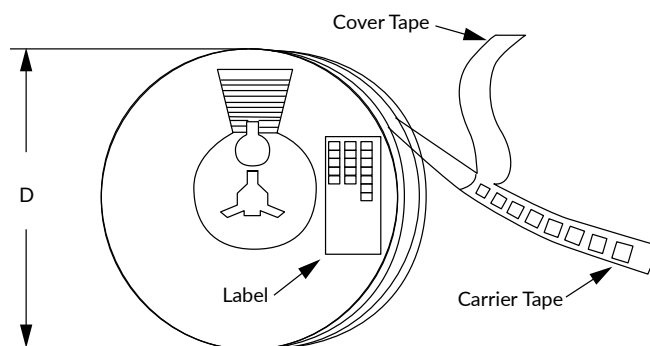
Tape and Reel Packaging with Reel Diameter Noted (D)
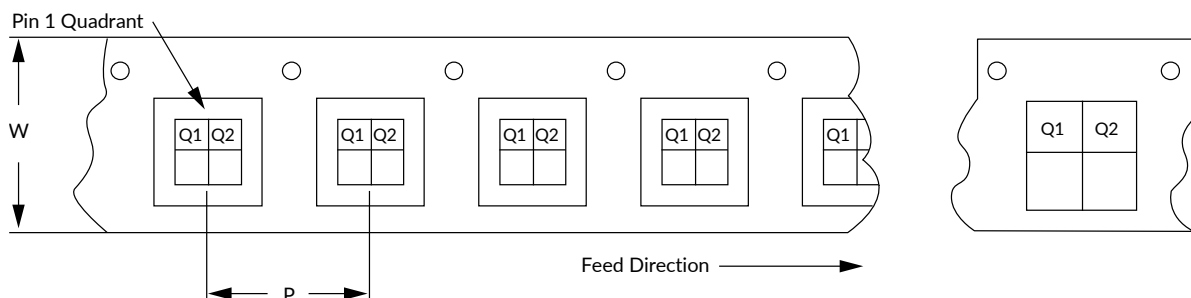
Carrier Tape Width (W), Pitch (P), Feed Direction and Pin 1 Quadrant Information

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Revision History

Revision Date	Description of Change
December 12, 2017	Preliminary Data Sheet.
October 24, 2019	Release Ø Data Sheet.
May 9, 2023	Release A Data Sheet. Upgraded Data Sheet to new format.
June 2, 2025	Extended frequency range from 100 - 3800 MHz to 85 - 4200 MHz.

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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 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.

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