DATA SHEET

GRF2043

LINEAR GAIN BLOCK WITH BYPASS
0.15 to 6 GHz

RELEASE Ø DATA SHEET

FEATURES

- Flexible Bias Voltage and Current
- Process: GaAs pHEMT
- Single Control Logic Input
- Internally Matched to 50 Ω
- Compact 1.5 x 1.5 mm DFN-6 Package
- RoHS Compliant

Reference: 5 V / 80 mA / 1.9 GHz

- Gain: 18.5 dB
- OP1dB: 22 dBm
- OIP3: 36 dBm
- Evaluation Board Noise Figure: 1.8 dB
- Bypass Mode Gain: -1.5 dB
- Bypass Mode OP1dB: 23 dBm
- Bypass Mode OIP3: 45 dBm

APPLICATIONS

- Cellular Repeaters and Signal Boosters
- Cellular Infrastructure
- VHF/UHF and ISM Radios

ORDERING INFORMATION

Buy it Now

DESCRIPTION

The GRF2043 is a broadband gain block with bypass for small cell, wireless infrastructure and other high-performance applications. It exhibits flat gain, outstanding noise figure (NF), and linearity over 400 to 2700 MHz with a single match.

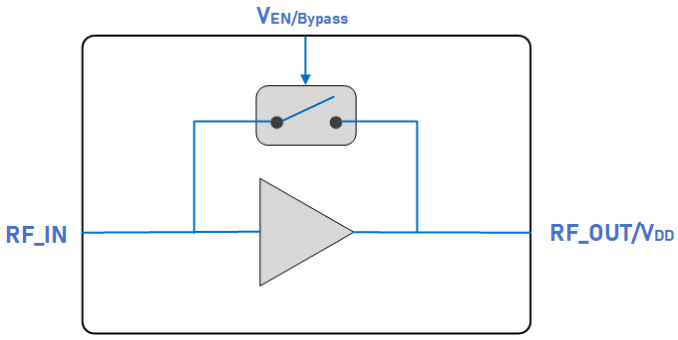
The device can be operated from a supply voltage of 2.7 to 6 V with a selectable I_{DDQ} range of 20 to 100 mA for optimal efficiency and linearity.

The GRF2043 is internally matched to 50 Ω at the input and output ports needing only external DC blocks and a bias choke on the output.

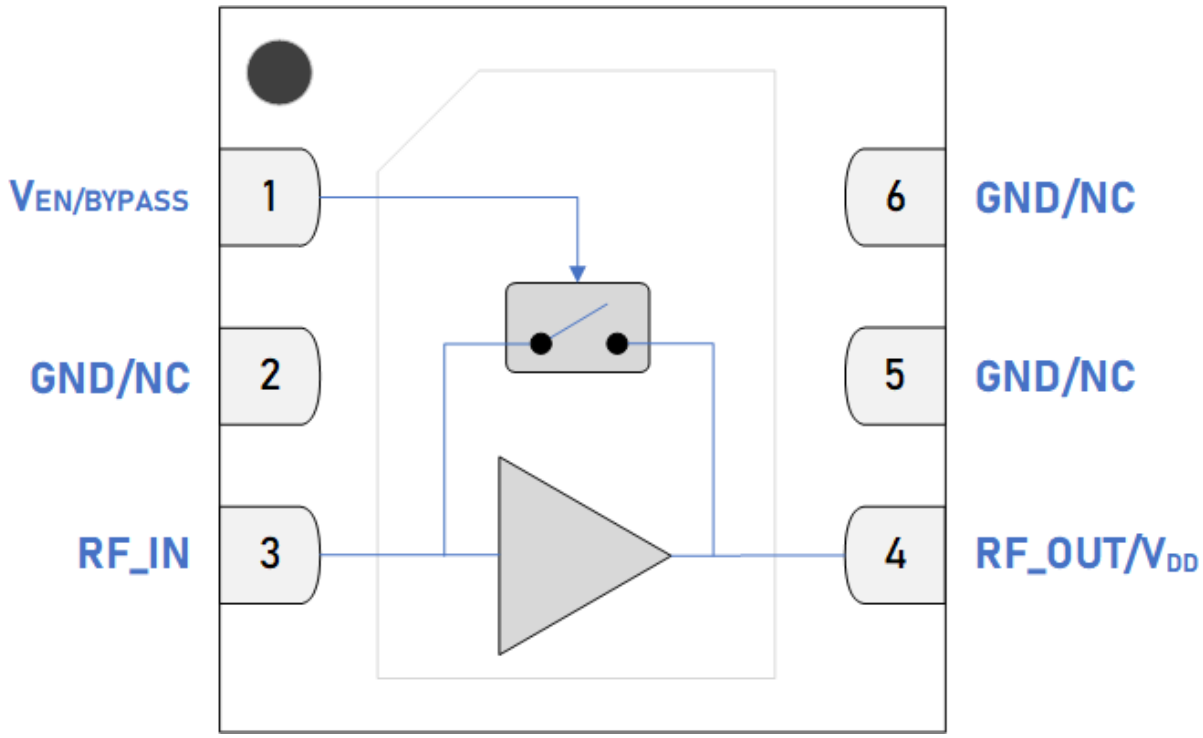
Consult with the GRF applications engineering team for custom tuning/evaluation board data and device S-parameters.

Additional tunes can be found on the GRF2043 “Custom Tunes” product page: GRF2043 Custom Tunes

BLOCK DIAGRAM



www.guerrilla-rf.com • (336) 510-7840 • sales@guerrilla-rf.com • 2000 Pisgah Church Rd., Greensboro, NC 27455



Pin Out (Top View)

Pin Assignments

Pin	Name	Description	Note
1	$V_{ENABLE/BYPASS}$	$V_{EN/BYPASS}$ Voltage Input	$V_{EN/BYPASS} \leq 0.2$ volts sets Bypass Mode. $V_{EN/BYPASS}$ and external series resistor control the device I_{DDQ} when $V_{EN/BYPASS}$ is high.
2, 5, 6	GND/NC	Ground or No Connect	No internal connection to die. These pins can be left unconnected or connected to ground (highly recommended). Use a via as close to the pin as possible if grounded.
3	RF_IN	RF Input	Internally matched 50 Ω. An external DC-blocking capacitor must be used.
4	RF_OUT/V_{DD}	RF Output	Internally matched 50 Ω. V_{DD} must be applied through a choke to this pin.
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_{DD}	$V_{EN/BYPASS}$
High Gain	High Gain	1	1
Bypass	Linear Bypass Mode	1	0
Logic Level "0"	Logic Low	0 to 0.2 V	0 to 0.2 V
Logic Level "1"	Logic High	1.8 to 5 V	1.5 V to V_{DD}

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	$P_{IN\ MAX}$		27	dBm
RF Input Power: Load VSWR < 2:1. V_{DD} = 5 V, $V_{EN/BYPASS}$ = 0 V. Bypass Mode	$P_{IN\ MAX}$		27	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	$P_{DISS\ MAX}$		600	mW

Electrostatic Discharge

Human Body Model	HBM	250		V

Storage

Storage Temperature	TSTG	-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}	2.7	5	6	V	
Operating Temperature (Package Base)	$T_{PKG\ BASE}$	-40		105	°C	
RF Frequency Range	F_{RF}	0.15	1.9	6	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: GRF2043 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 0.4 to 2.7 GHz tuning set. V_{DD} = 5 V, $V_{EN/BYPASS}$ = 5 V, I_{DDQ} = 80 mA, F_{TEST} = 1.9 GHz. $T_{PKG\ BASE}$ = 25 °C. Evaluation board losses are included within the specifications.

Parameter	Symbol	Specification			Unit	Condition
		Min.	Typ.	Max.		
Supply Current	I_{DDQ}		80		mA	V_{DD} = 5 V, $V_{EN/BYPASS}$ = 5 V
Enable Current	I_{ENABLE}		5		mA	V_{DD} = 5 V, $V_{EN/BYPASS}$ = 5 V
Switching Rise Time	T_{RISE}		200		ns	Bypass Mode to Gain Mode. Pin = +5.2 dBm **(note 3)**.
Switching Fall Time	T_{FALL}		50		ns	Gain Mode to Bypass Mode. Pin = +5.3 dBm **(note 4)**.

Disabled Mode

Leakage Current	$I_{LEAKAGE}$		500		µA	V_{DD} = 5 V, $V_{EN/BYPASS}$ = 0 V.

Thermal Data

Thermal Resistance: Infrared Scan	Θ_{JC}		80		°C/W	On standard evaluation board **(note 5)**.

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

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

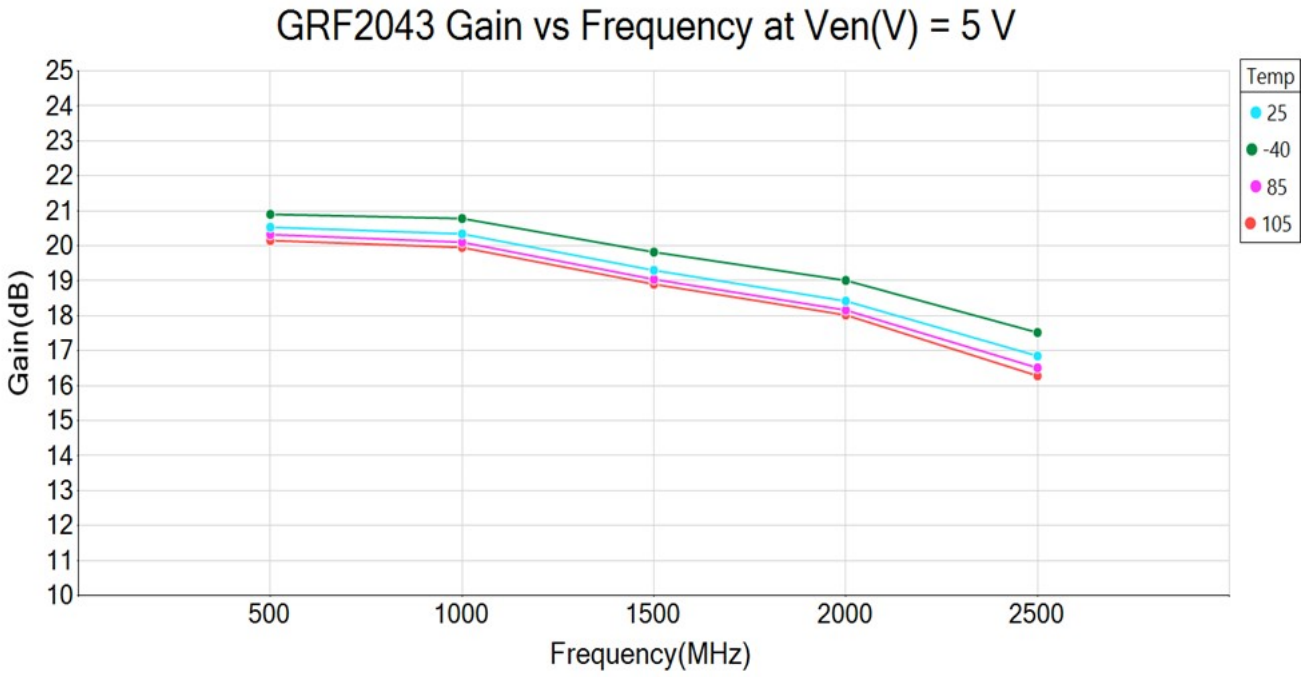
Note 5: MTTF > 10^6 hours for $T_{CHANNEL}$ ≤ 170 °C.

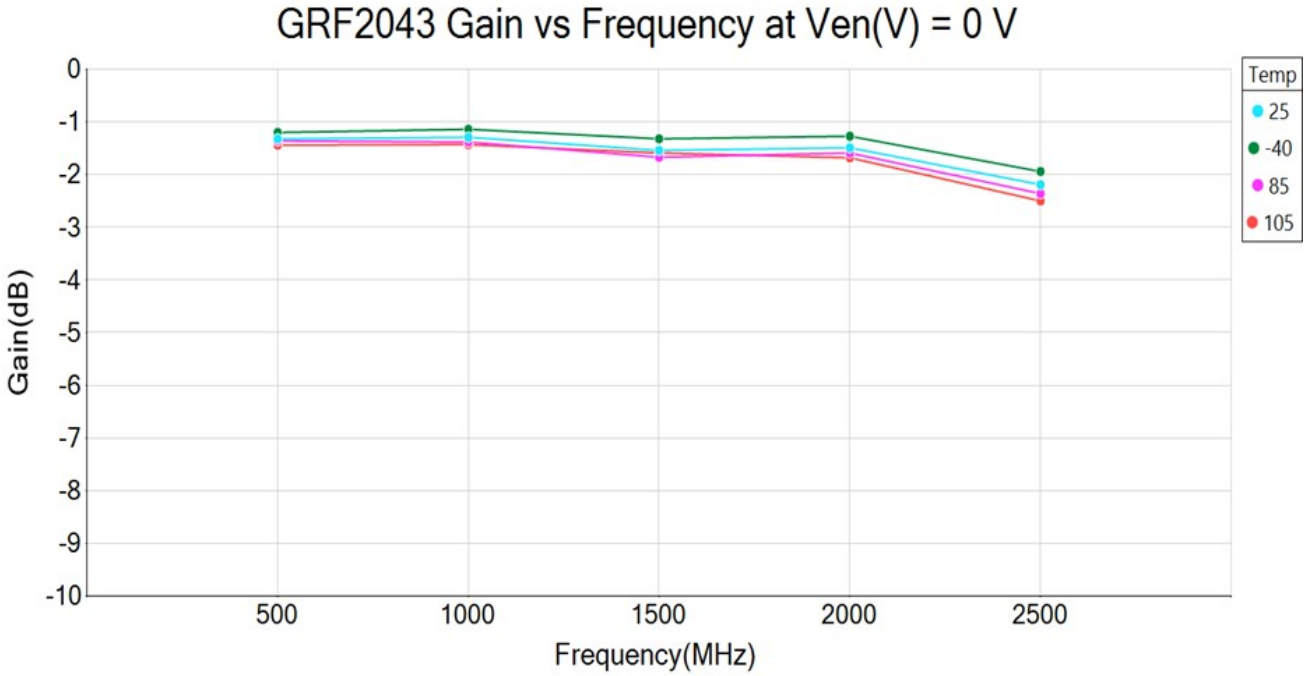
Nominal Operating Parameters - RF

The following conditions apply unless noted otherwise: typical application schematic using the 0.4 to 2.7 GHz tuning set. V_{DD} = 5 V, $V_{EN/BYPASS}$ = 5 V, I_{DDQ} = 80 mA. F_{TEST} = 1.9 GHz. $T_{PKG\ BASE}$ = 25 °C. Evaluation board losses are included within the specifications.

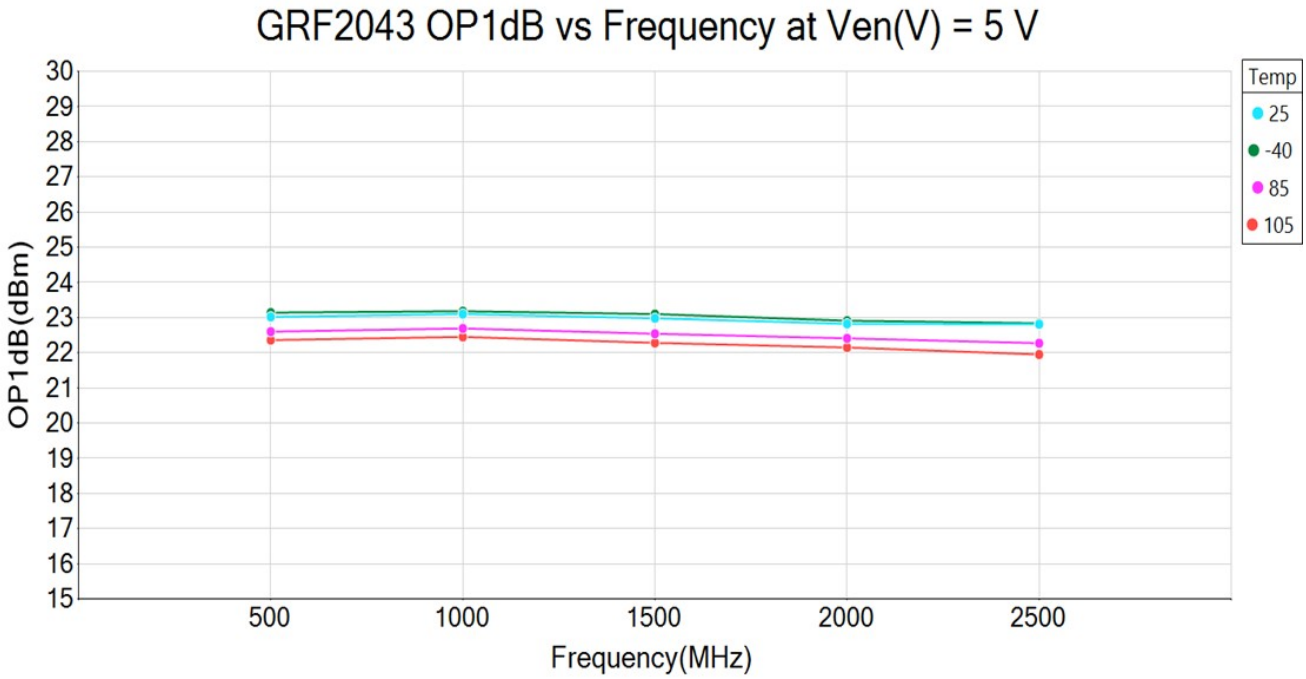
Parameter	Symbol	Specification			Unit	Condition
		Min.	Typ.	Max.		
High Gain Mode						V_{DD} = 5 V, $V_{EN/BYPASS}$ = 5 V
Gain	S21	16.8	18.5		dB	
Output 3rd Order Intercept Point	OIP3		36		dBm	2 dBm P_{OUT} per tone at 2 MHz spacing (1899 and 1901 MHz).
Output 1 dB Compression Power	OP1dB	20.4	22		dBm	
Noise Figure	NF		1.8		dB	On standard evaluation board.
Bypass Mode						V_{DD} = 5 V, $V_{EN/BYPASS}$ = 5 V
Gain	S21	-3.4	-1.5		dB	
Output 3rd Order Intercept Point	OIP3		45		dBm	8 dBm P_{OUT} per tone at 2 MHz spacing (1899 and 1901 MHz).
Output 1 dB Compression Power	OP1dB		23		dBm	

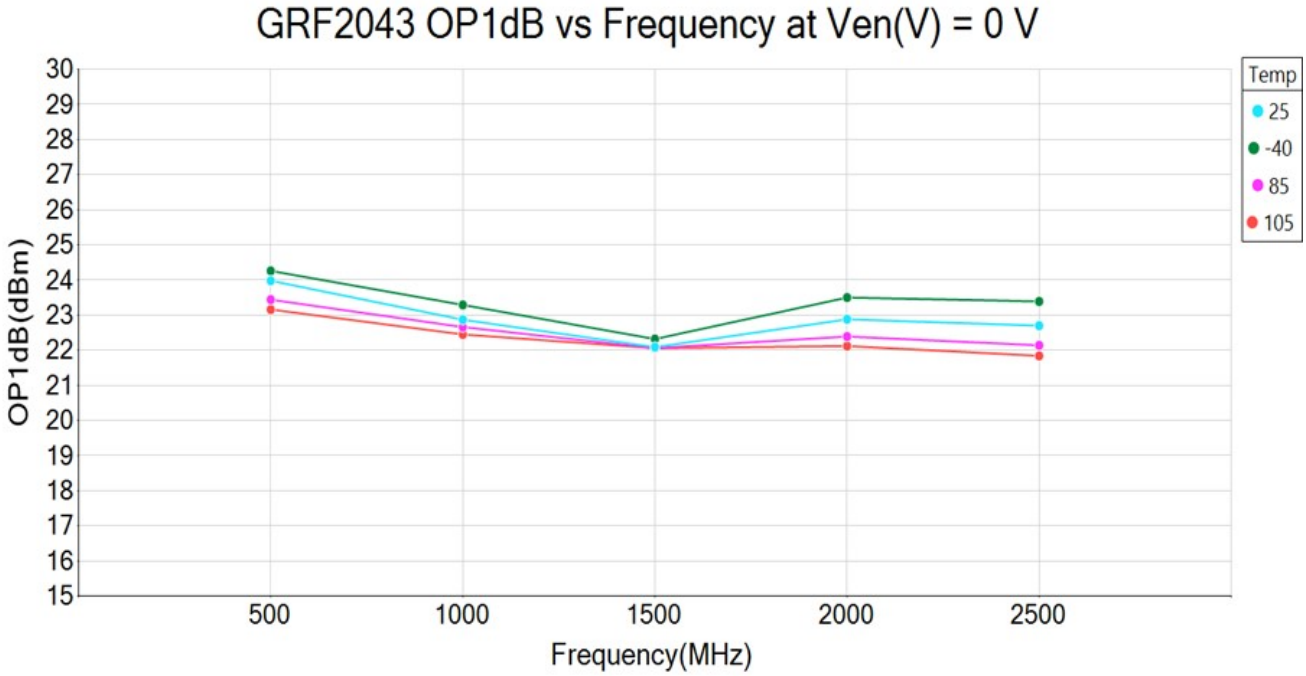
GRF2043 Typical Operating Curves: 0.4 to 2.5 GHz Tune



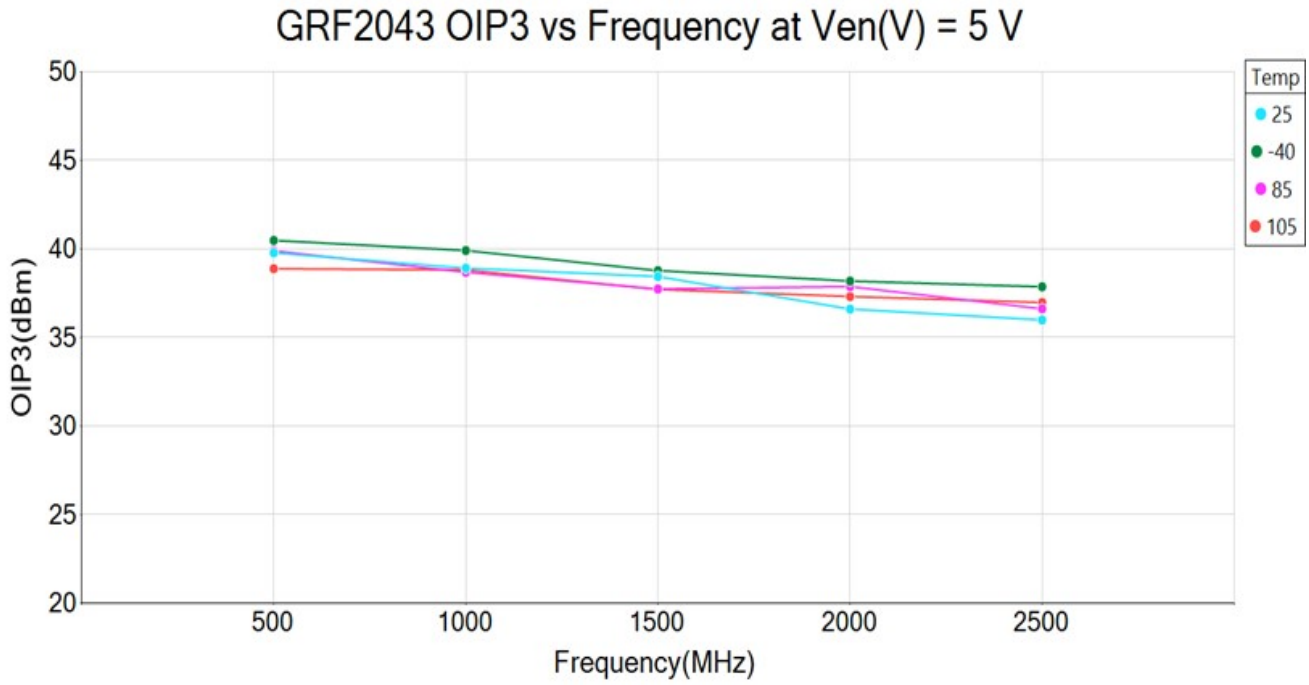


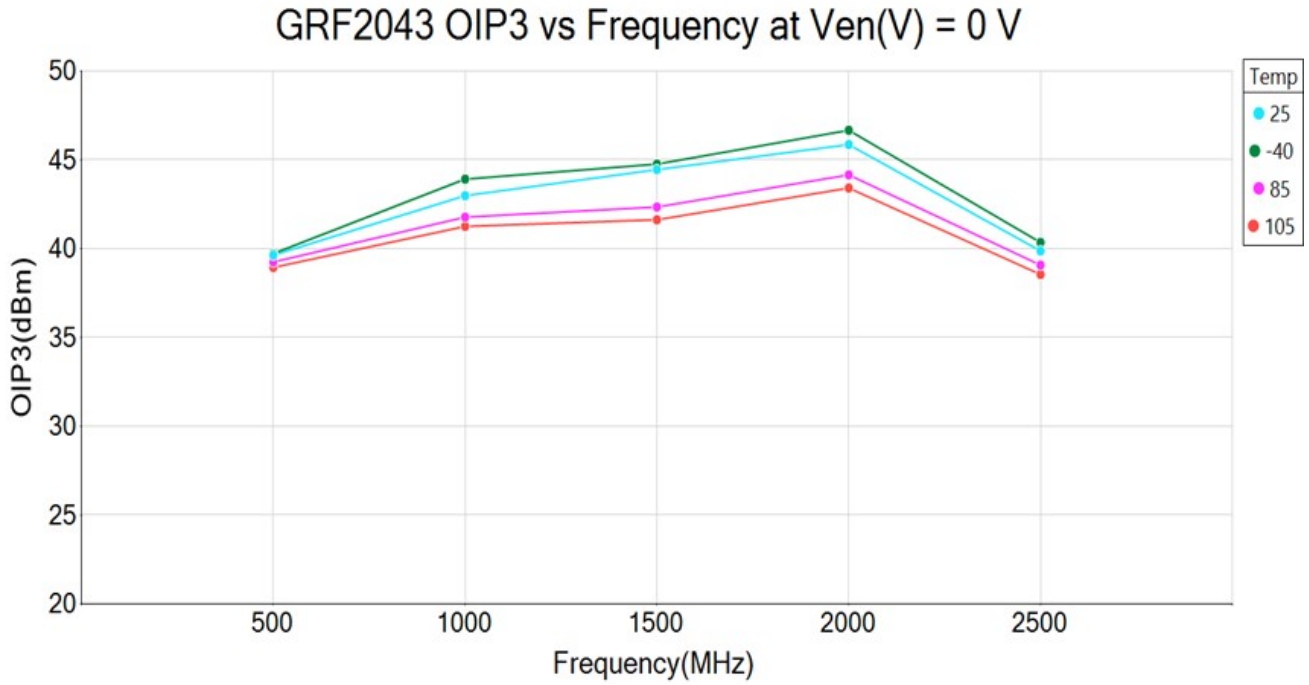
GRF2043 Typical Operating Curves: 0.4 to 2.5 GHz Tune



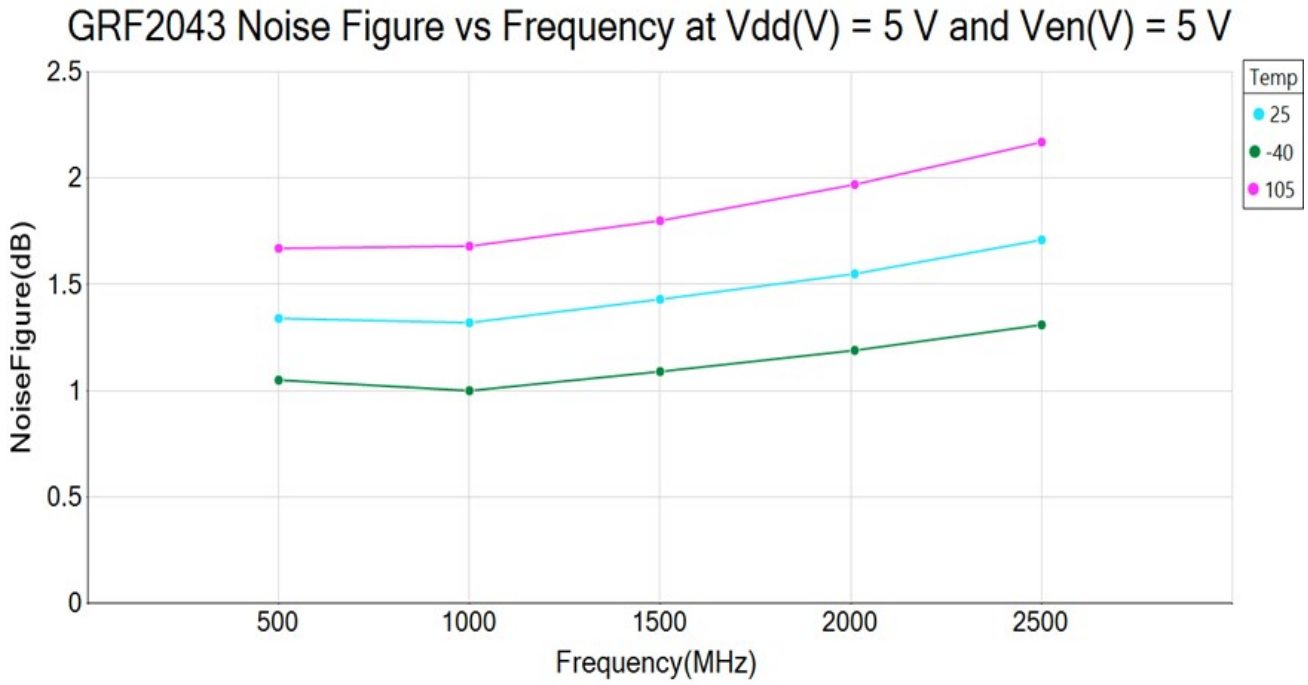


GRF2043 Typical Operating Curves: 0.4 to 2.5 GHz Tune

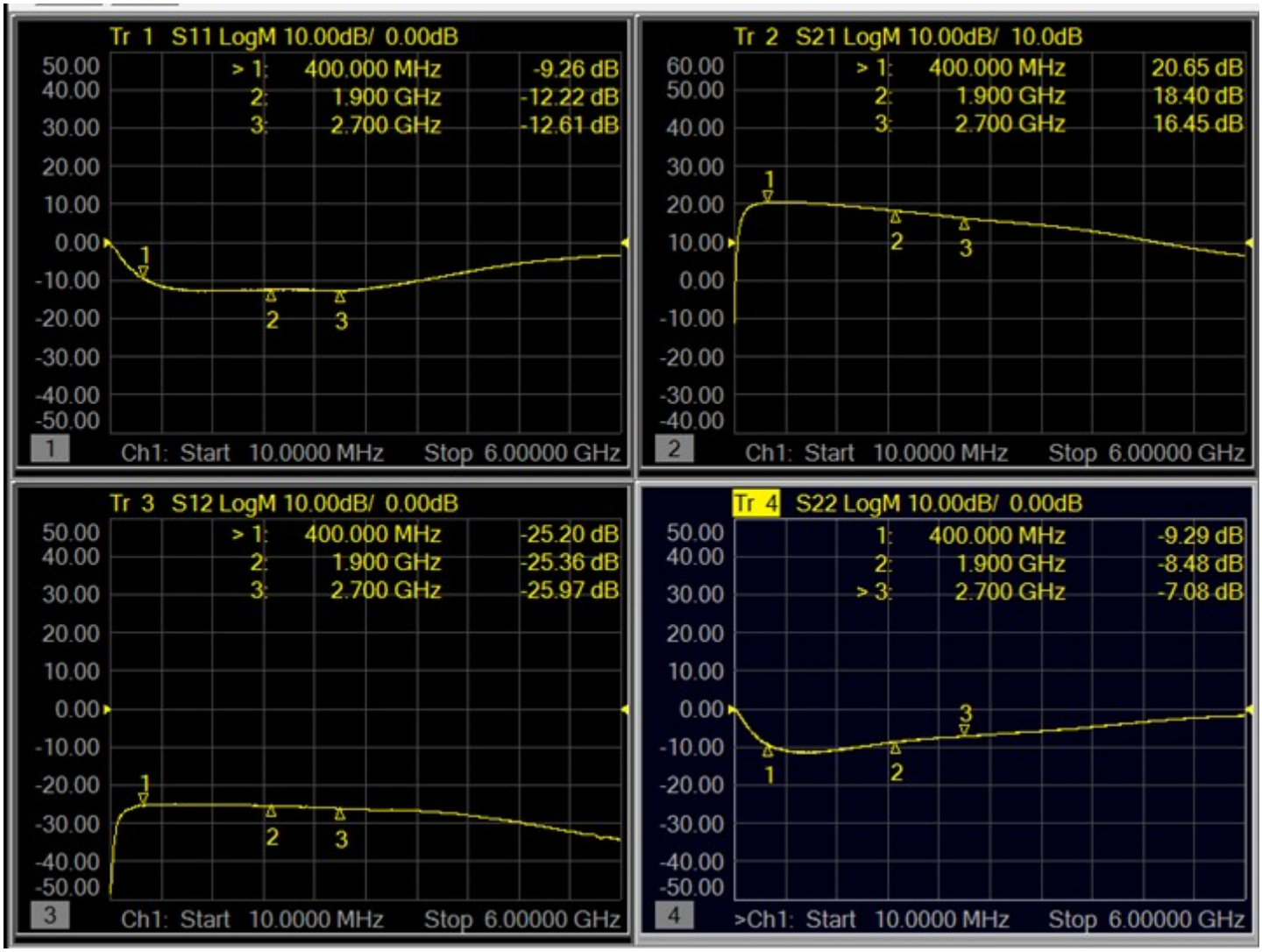




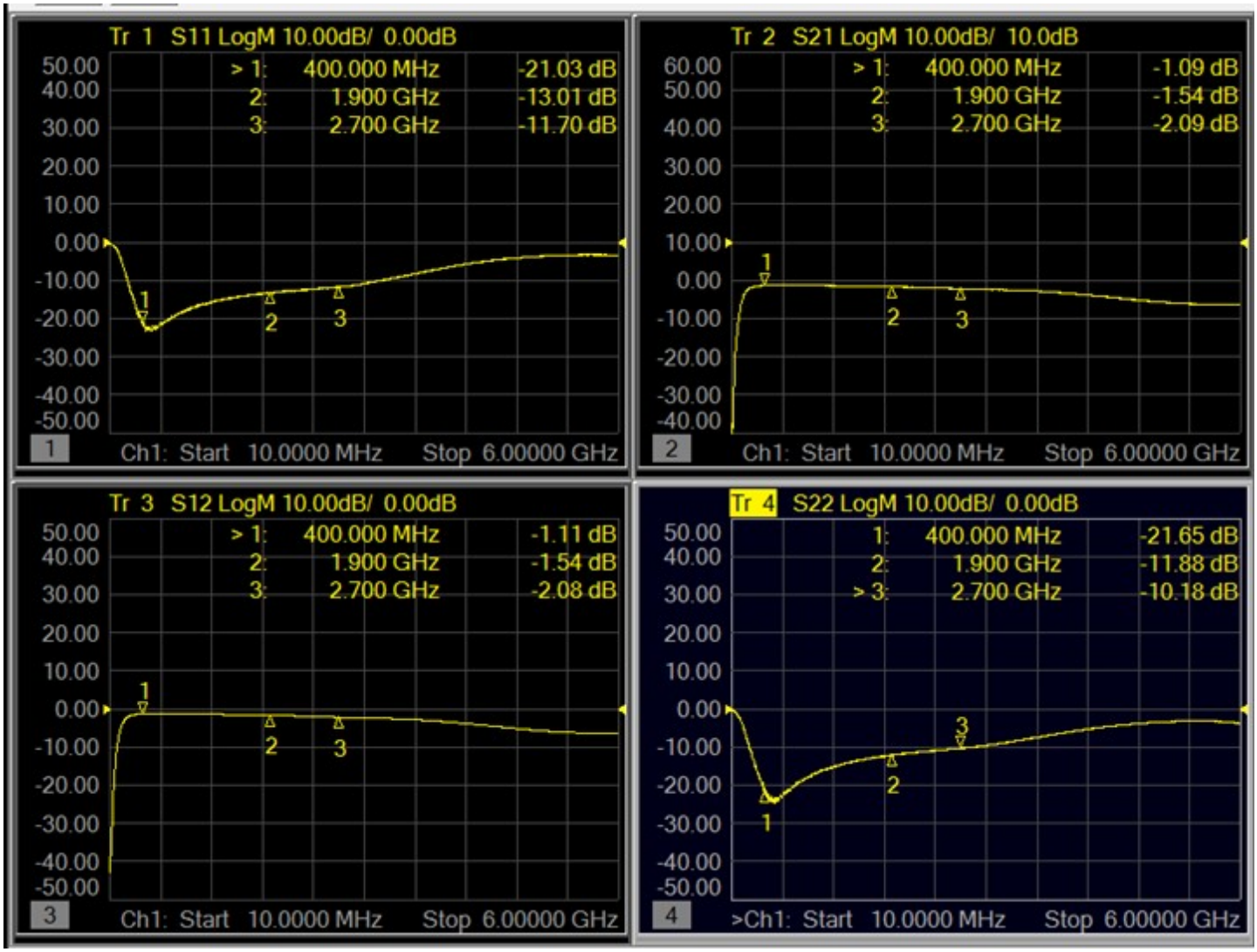
GRF2043 Typical Operating Curves: 0.4 to 2.5 GHz Tune



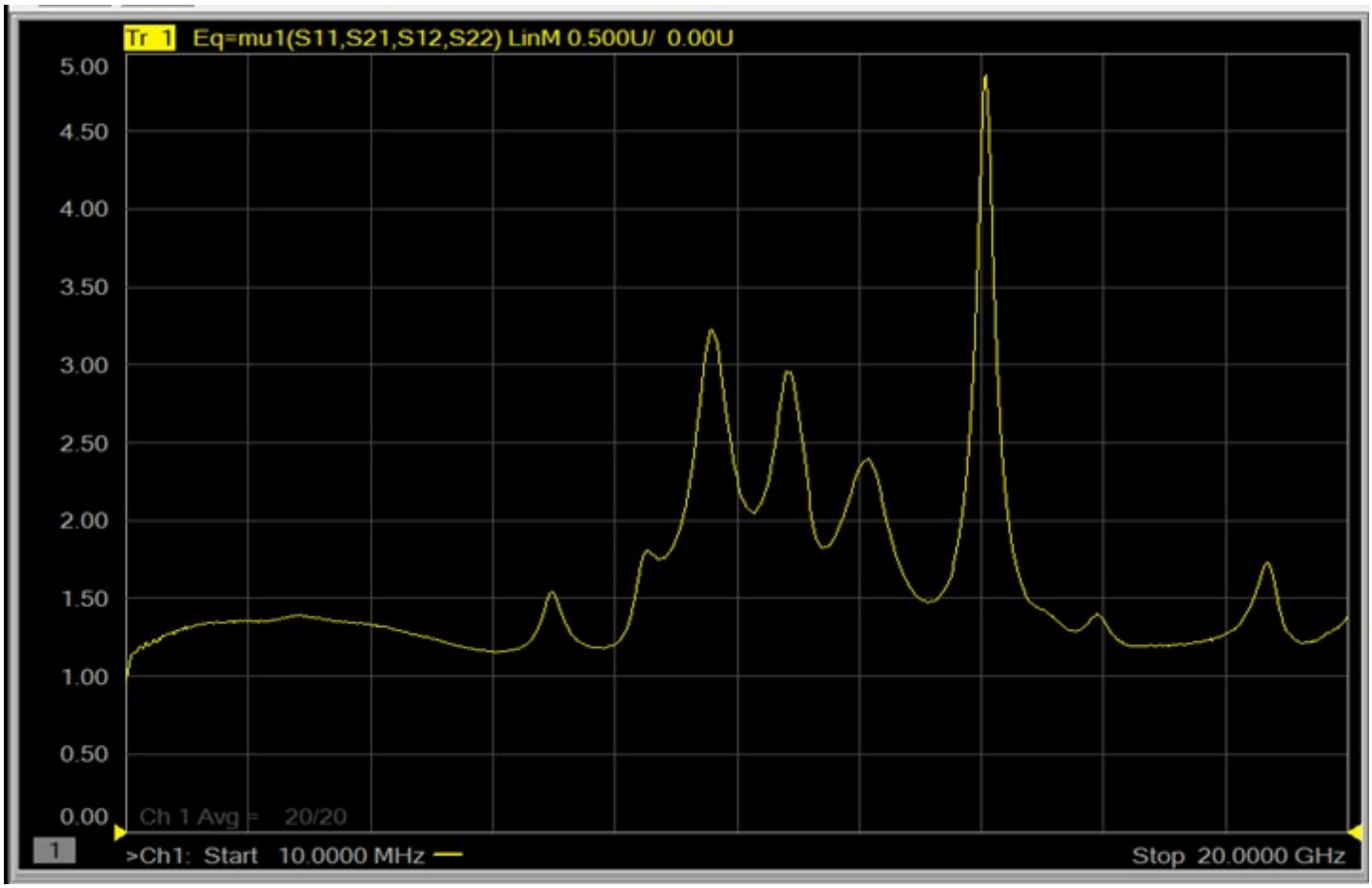
GRF2043 Typical Operating Curves: S-parameters: Gain Mode (0.4 to 2.7 GHz Tune)



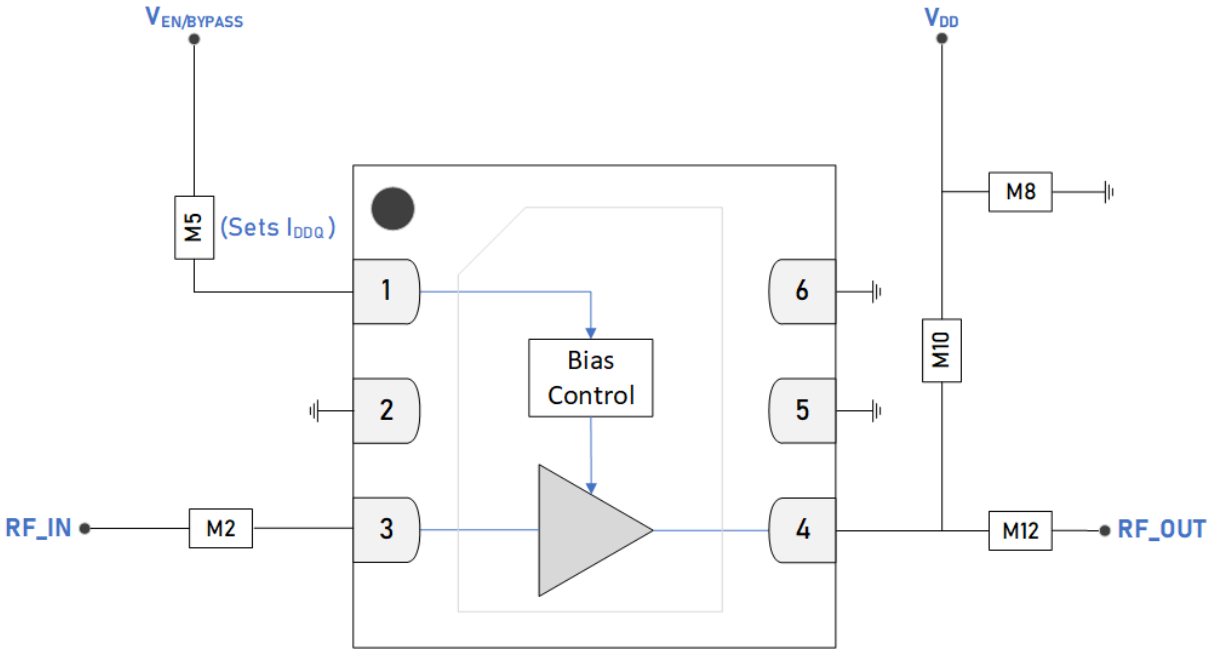
GRF2043 Typical Operating Curves: S-parameters: Bypass Mode (0.4 to 2.7 GHz Tune)



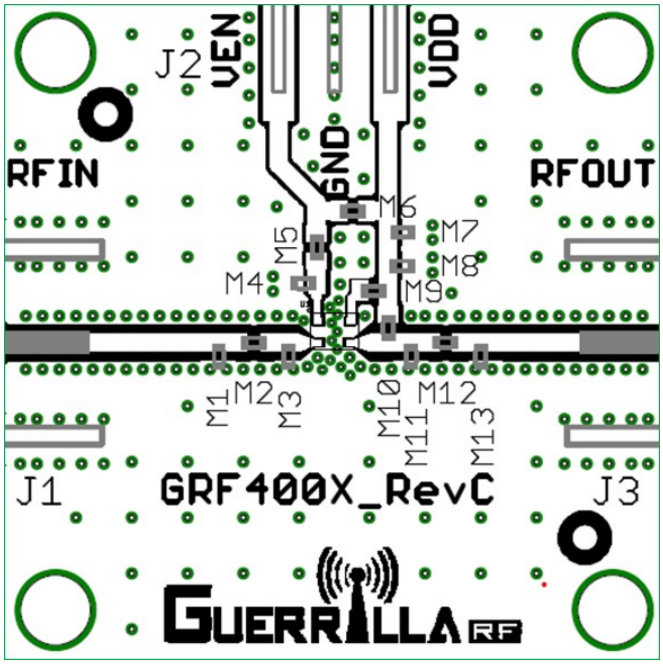
GRF2043 Typical Operating Curves: Stability Mu Factor (10 MHz to 20 GHz)



Note: Mu ≥ 1.0 implies unconditional stability.



Standard Evaluation Board Schematic

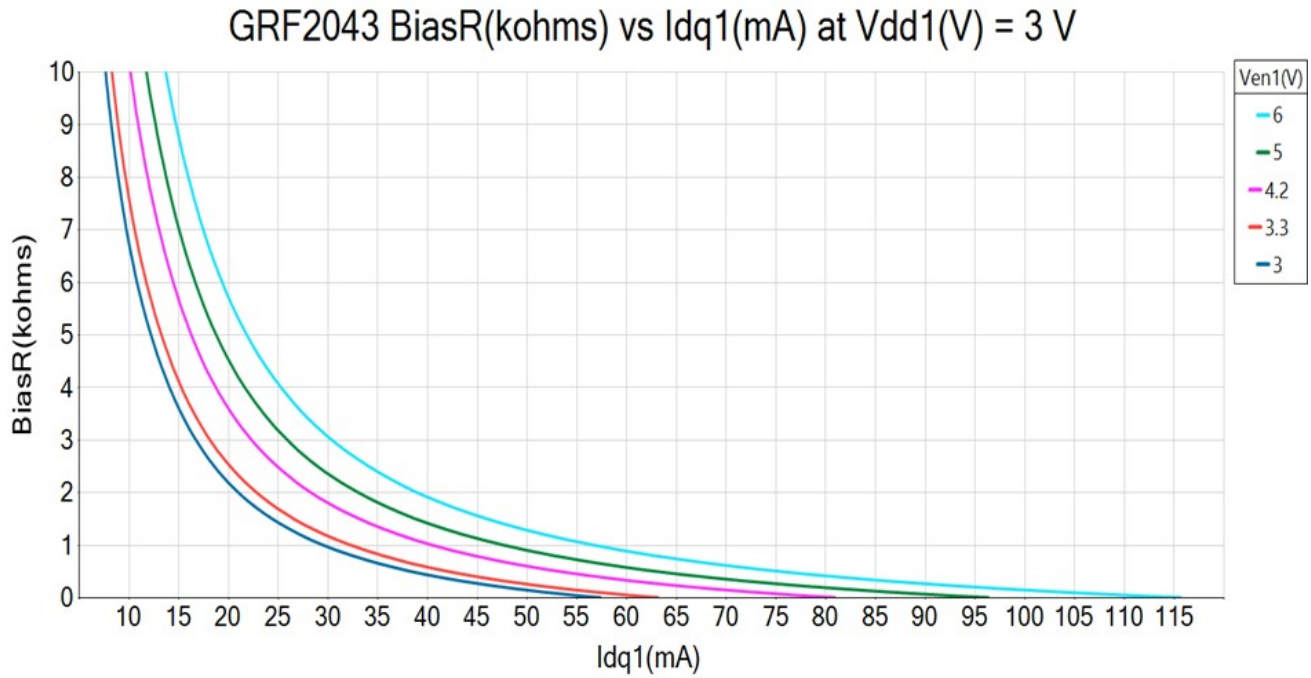


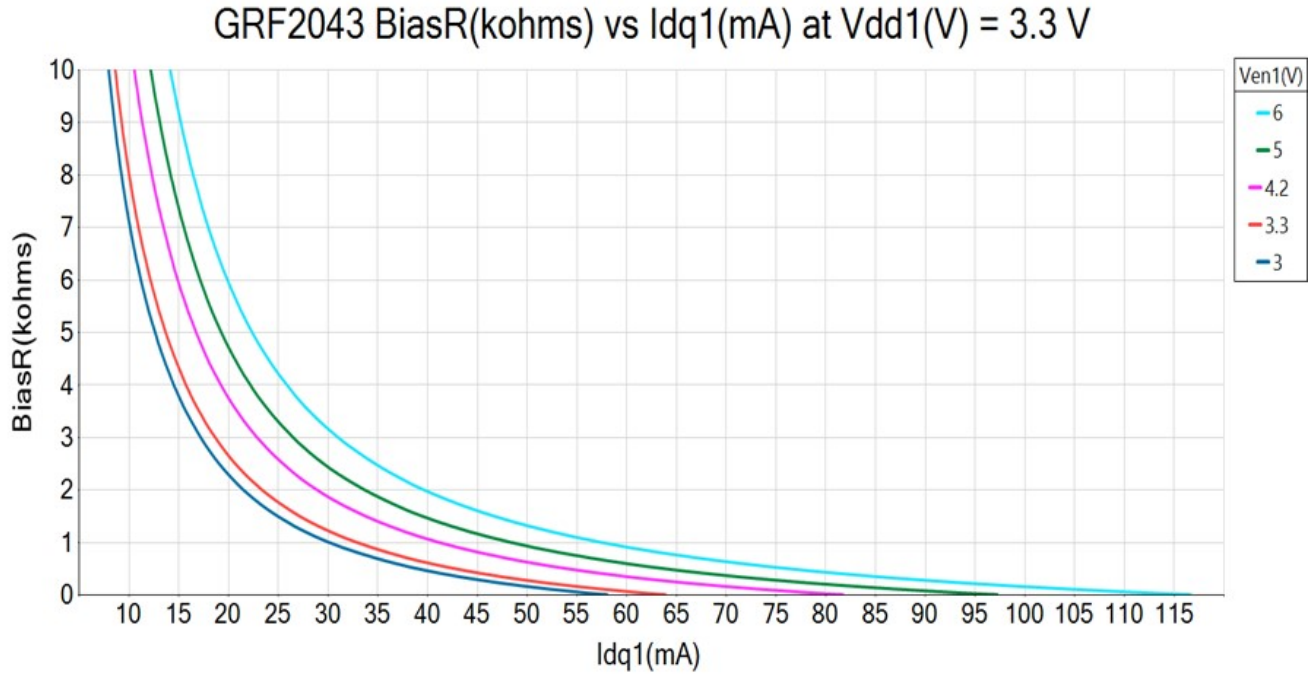
GRF2043 Evaluation Board Assembly Diagram

GRF2043 Evaluation Board Assembly Diagram Reference: 0.4 to 2.7 GHz Tune

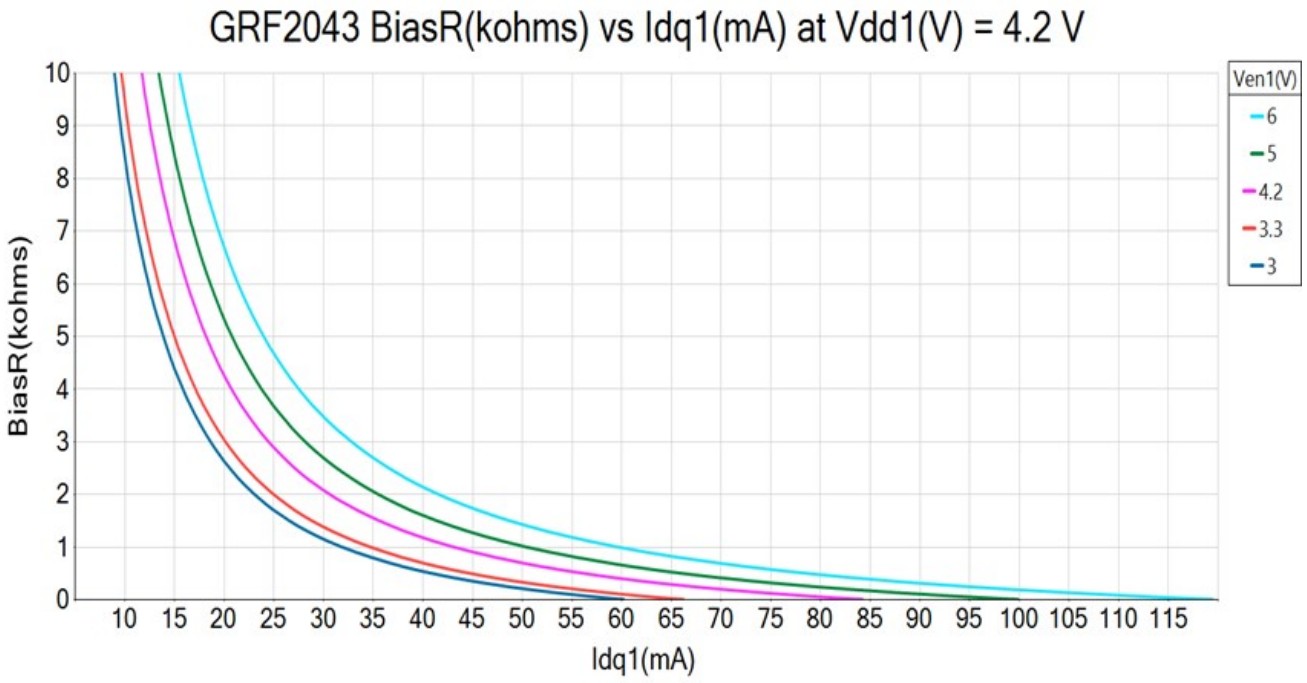
Component	Type	Manufacturer	Family	Value	Package Size	Substitution
M1, M3, M4, M6, M7, M9, M11, M13	DNP					
M2	Capacitor	Murata	GJM	100 pF	0402	ok
M5 (sets I_{DDQ})	Resistor	Various	5%	see curves	0402	ok
M8	Capacitor	Murata	GRM	0.1 µF	0402	ok
M10	Inductor	Murata	LQG	33 nH	0402	ok
M12	Capacitor	Murata	GRM	100 pF	0402	ok
Evaluation Board	GRF400X_RevC					

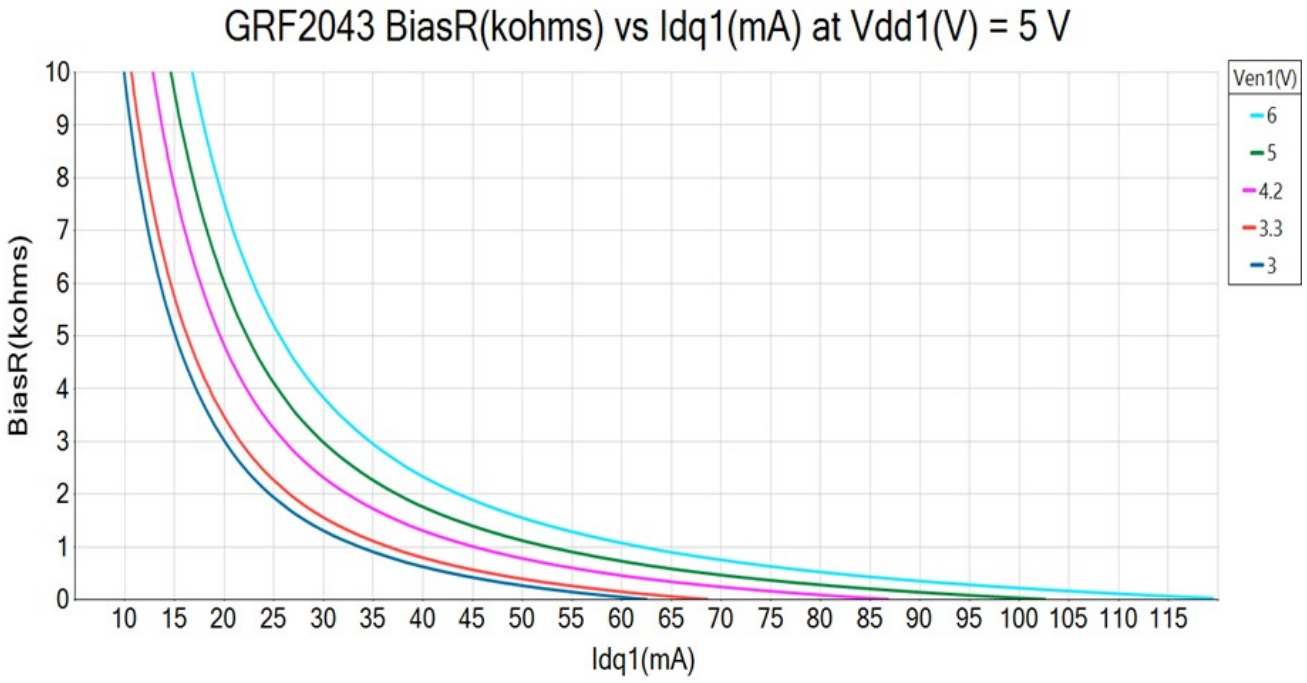
GRF2043 Bias Resistor Selection Curves



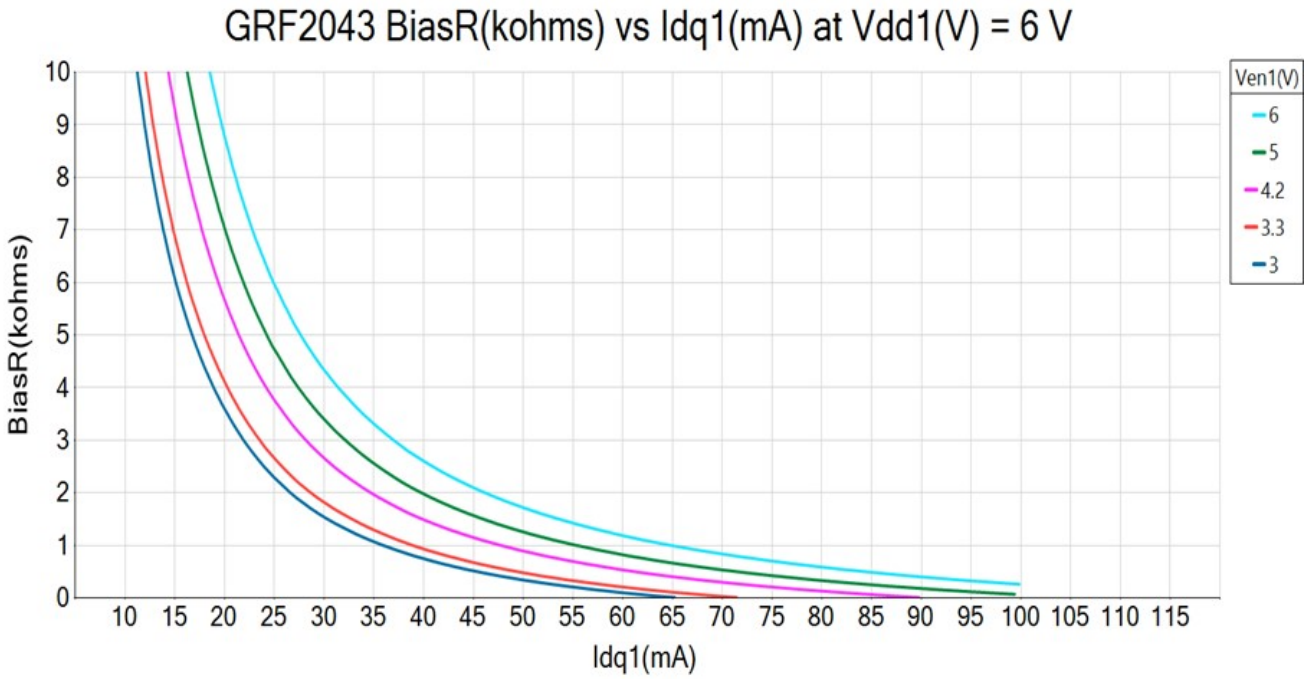


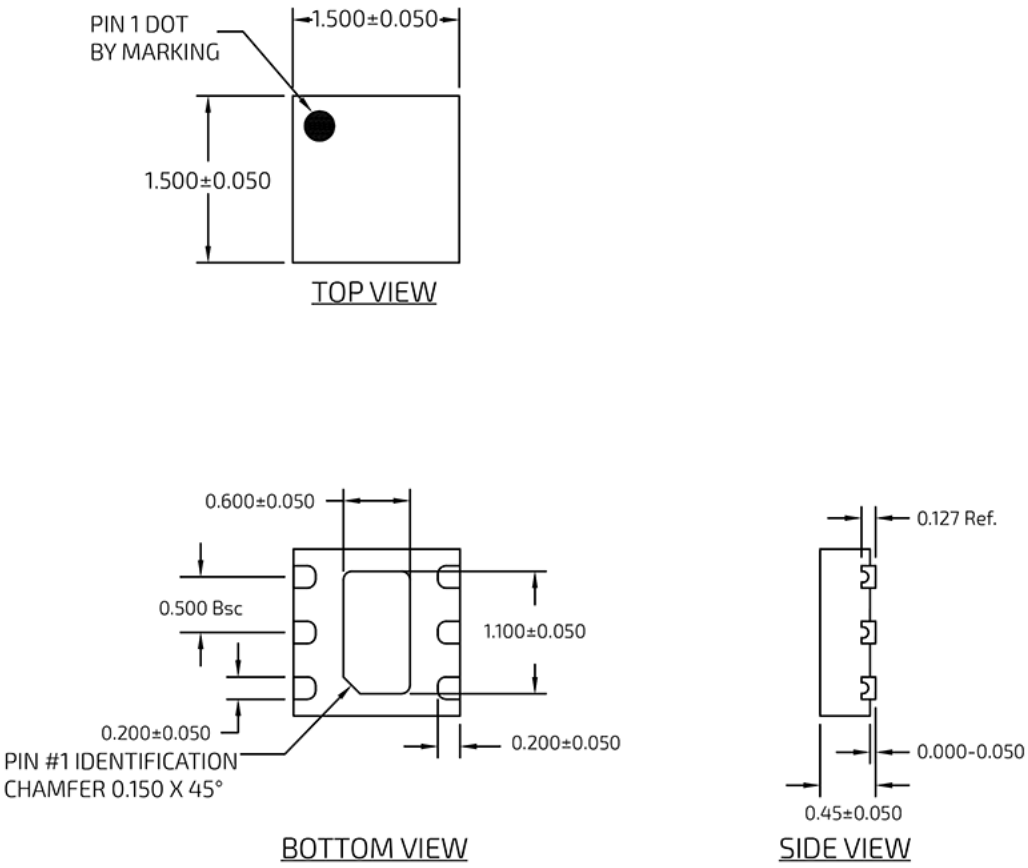
GRF2043 Bias Resistor Selection Curves



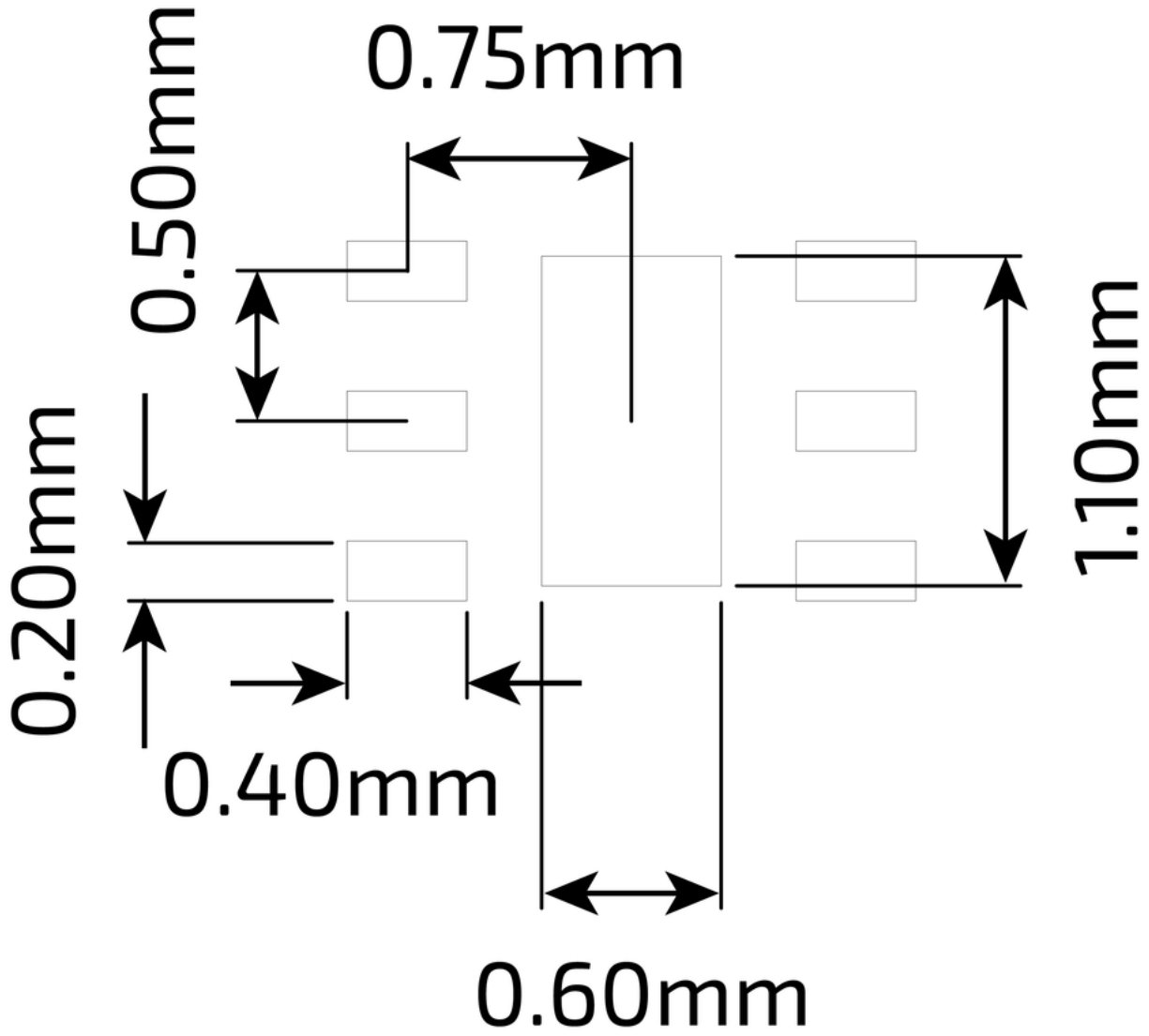


GRF2043 Bias Resistor Selection Curves





DFN 6 1.5x1.5mm Package Dimensions



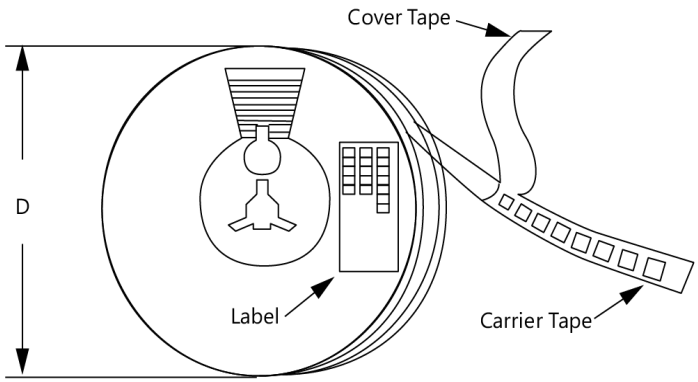
DFN 6 1.5x1.5mm Suggested PCB Footprint (Top View)

Package Marking Diagram

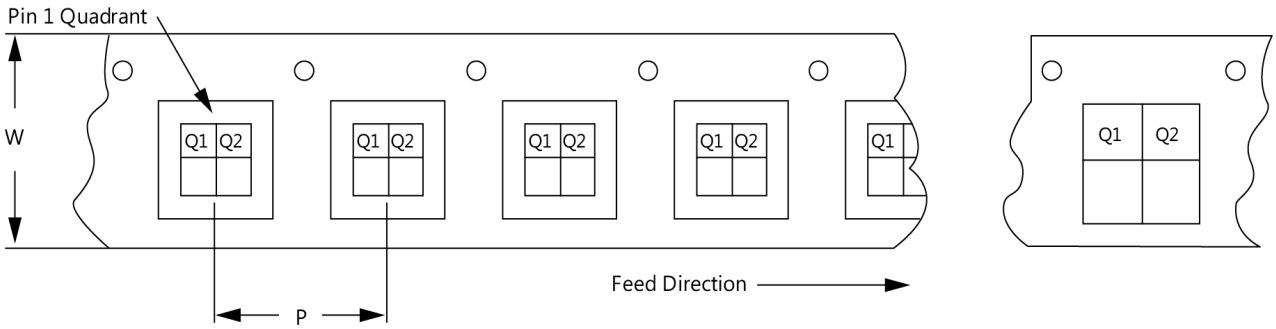
Line 1: "Y" = YEAR (single digit). "WW" = WORK WEEK the Device was assembled.
Line 2: "XXXX" = Device Part Number.

Tape and Reel Information

Guerrilla RF's tape and reel specification complies with 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
March 2, 2020	Preliminary Data Sheet.
November 18, 2022	Release Ø Data Sheet. Upgraded Data Sheet to new format. Added new Characterization Plots. Added new Bias Resistor Selection Curves.
December 20, 2022	Raised RF Input Power ($P_{IN\ MAX}$) from 10 to 27 dBm in Gain Mode. Added RF Input Power ($P_{IN\ MAX}$) in Bypass Mode.
June 25, 2024	Upgraded Data Sheet to newest format only.

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.

www.guerrilla-rf.com • (336) 510-7840 • sales@guerrilla-rf.com • 2000 Pisgah Church Road, Greensboro, NC 27455