DATA SHEET

RELEASE Ø DATA SHEET





GRF2070

Ultra-Low Noise Amplifier 0.01 to 1.7 GHz

FEATURES

- Excellent NF Performance
- High Gain
- Outstanding Linearity
- Flexible Bias Voltage and Current
- Compact 2.0 x 2.0 mm DFN-8 Package
- Process: GaAs pHEMT

Reference: 5 V / 70 mA / 0.9 GHz

- Gain: 21 dB
- OIP3: 39 dBm
- OP1dB: 20 dBm
- Evaluation Board Noise Figure: 0.4 dB

APPLICATIONS

- Cellular Infrastructure
- Small Cells and Cellular Repeaters
- Distributed Antenna Systems

DESCRIPTION

The GRF2070 is a broadband, linear, ultra-low noise amplifier designed for small cell, wireless infrastructure, and other high performance RF applications requiring ultra-low noise figure (NF), high gain, and linearity.

This device is a member of a family of pin-compatible, ultra-low noise devices which cover a wide range of frequency bands with industry leading NF and gain:

GRF2070: 0.01 to 1.7 GHz GRF2071: 0.7 to 2.7 GHz

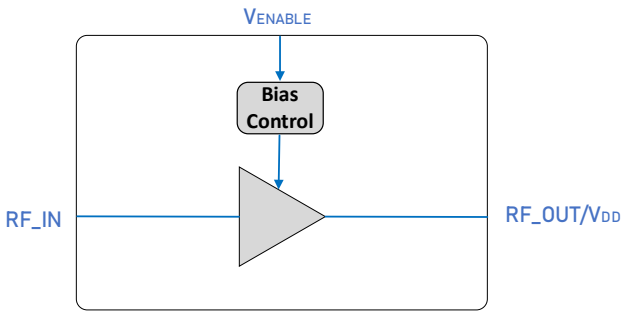
GRF2072: 1.17 to 3.8 GHz GRF2073: 1.0 to 6.8 GHz

GRF2074: 1.0 to 6.0 GHz

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

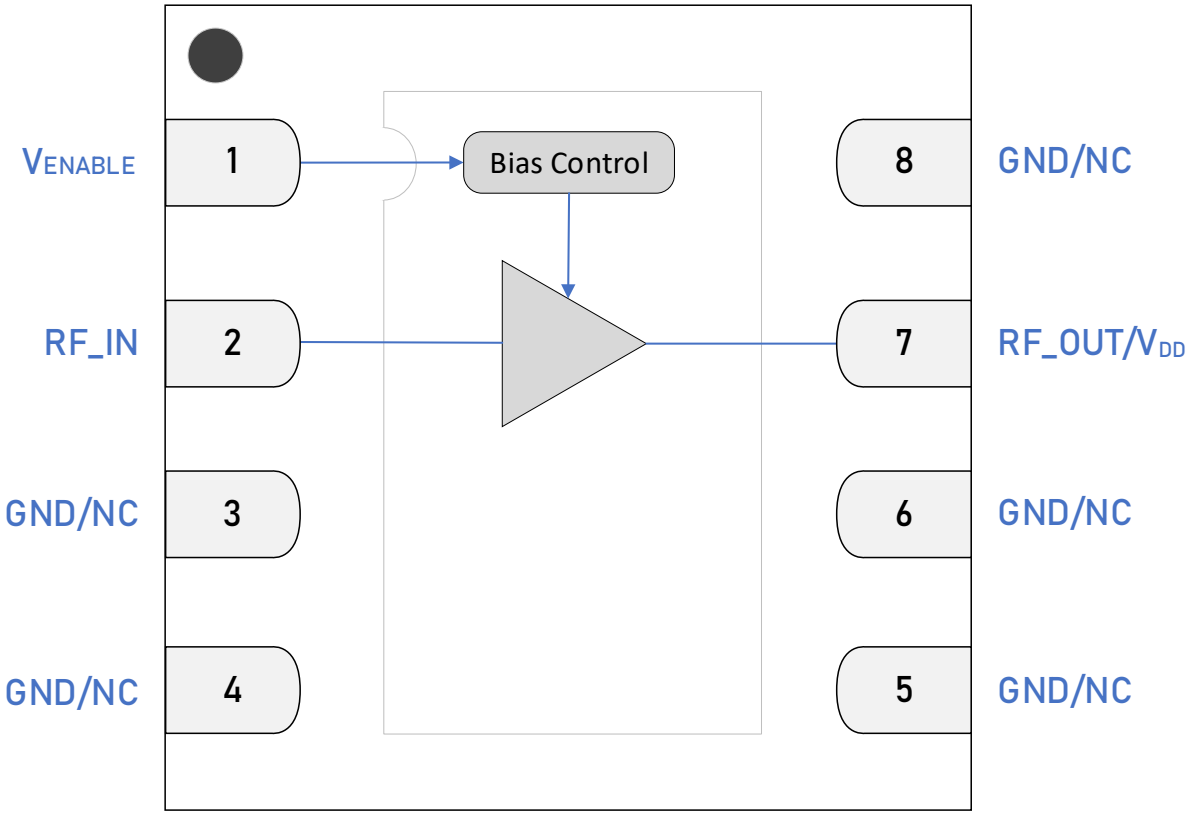
Additional tunes can be found on the GRF2070 "Custom Tunes" product page: GRF2070 Custom Tunes

BLOCK DIAGRAM



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2.0 x 2.0 mm DFN-8 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 sets I_{DDQ}. V_{ENABLE} ≤ 0.2 volts disables device.
2	RF_IN	RF Input	External match must provide DC block.
3, 4, 5, 6, 8	GND/NC	Ground or No Connect	No internal connection to die. We recommend connecting these pins to ground.
7	RF_Out/V_{DD}	RF Output	Provides device V_{DD} via external bias inductor.
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.

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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	$P_{IN\ MAX}$		23	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	$P_{DISS\ MAX}$		500	mW

Electrostatic Discharge

Charged Device Model	CDM	1500		V
Human Body Model	HBM	500		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. For additional information, please refer to the ROHS Compliance | Guerrilla RF (guerrilla-rf.com)

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Recommended Operating Conditions

Parameter	Symbol	Specification			Unit	Condition
		Min.	Typ.	Max.		
Supply Voltage	V_{DD}	2.7	5	6	V	
RF Frequency Range	F_{RF}	0.01	0.9	1.7	GHz	Typical application schematic with external matching components **(notes 1 & 2)**.
Operating Temperature (package base)	$T_{PKG\ BASE}$	-40		105	°C	
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: GRF2070 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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Nominal Operating Parameters – General

The following conditions apply unless noted otherwise: typical application schematic using the 0.1 to 1.5 GHz tuning set, V_{DD} = 5 V, V_{ENABLE} = 5 V, I_{DD} = 70 mA, F_{TEST} = 0.9 GHz, M3 = 900 Ω, $T_{PKG\ BASE}$ = 25 °C. Evaluation board losses are included within the specifications.

Parameter	Symbol	Specification			Unit	Condition
		Min.	Typ.	Max.		
Supply Current	I_{DD}	50	70	90	mA	Adjustable for optimal IP3.
Enable Current	I_{ENABLE}		3.5		mA	
Switching Rise Time	T_{RISE}		1800		ns	Disabled mode to Gain mode **(note 3)**.
Switching Fall Time	T_{FALL}		900		ns	Gain mode to Disabled mode **(note 4)**.

Thermal Data

Thermal Resistance: (Infrared Scan)	Θ_{JC}		60		°C/W	On standard evaluation board **(note 5)**.

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 $T_{CHANNEL}$ ≤170 °C.

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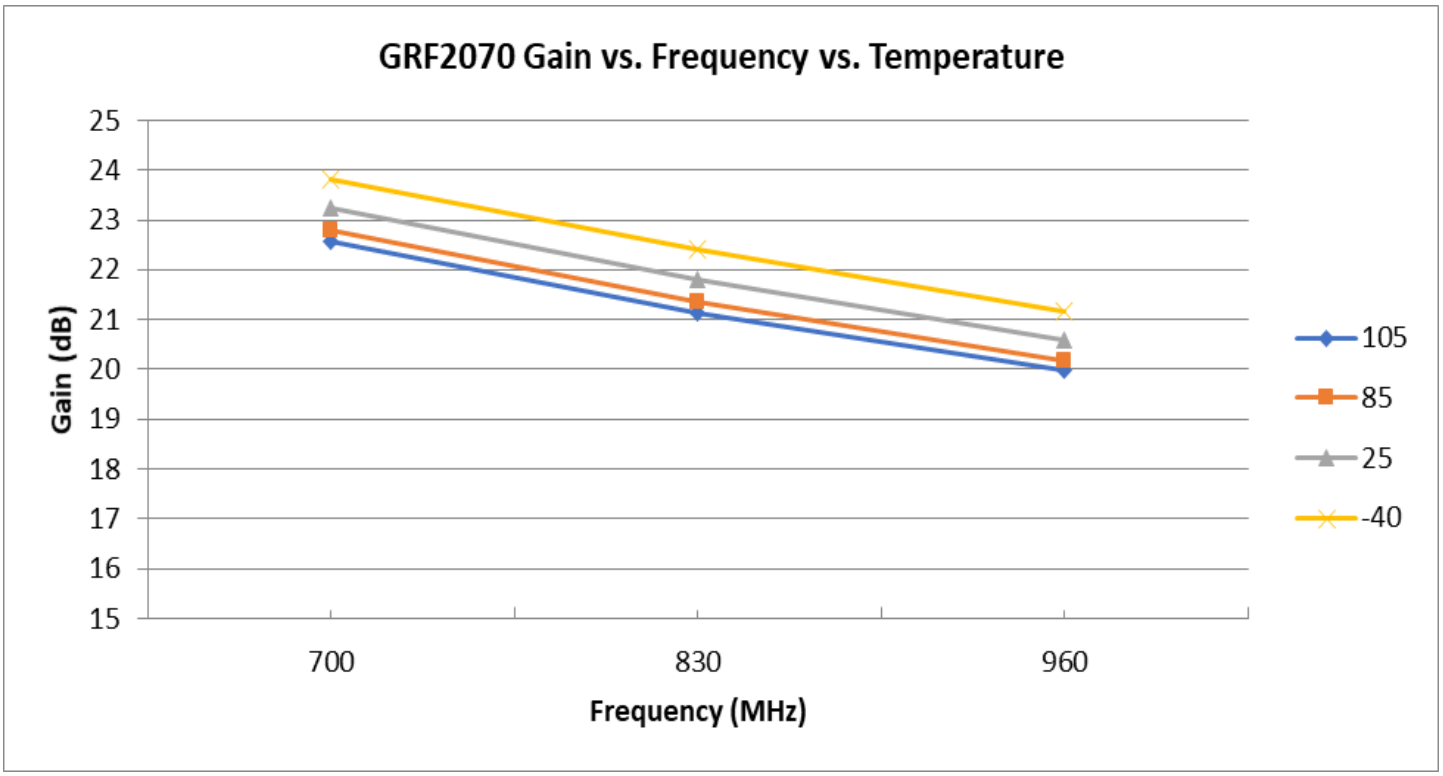
Nominal Operating Parameters – RF

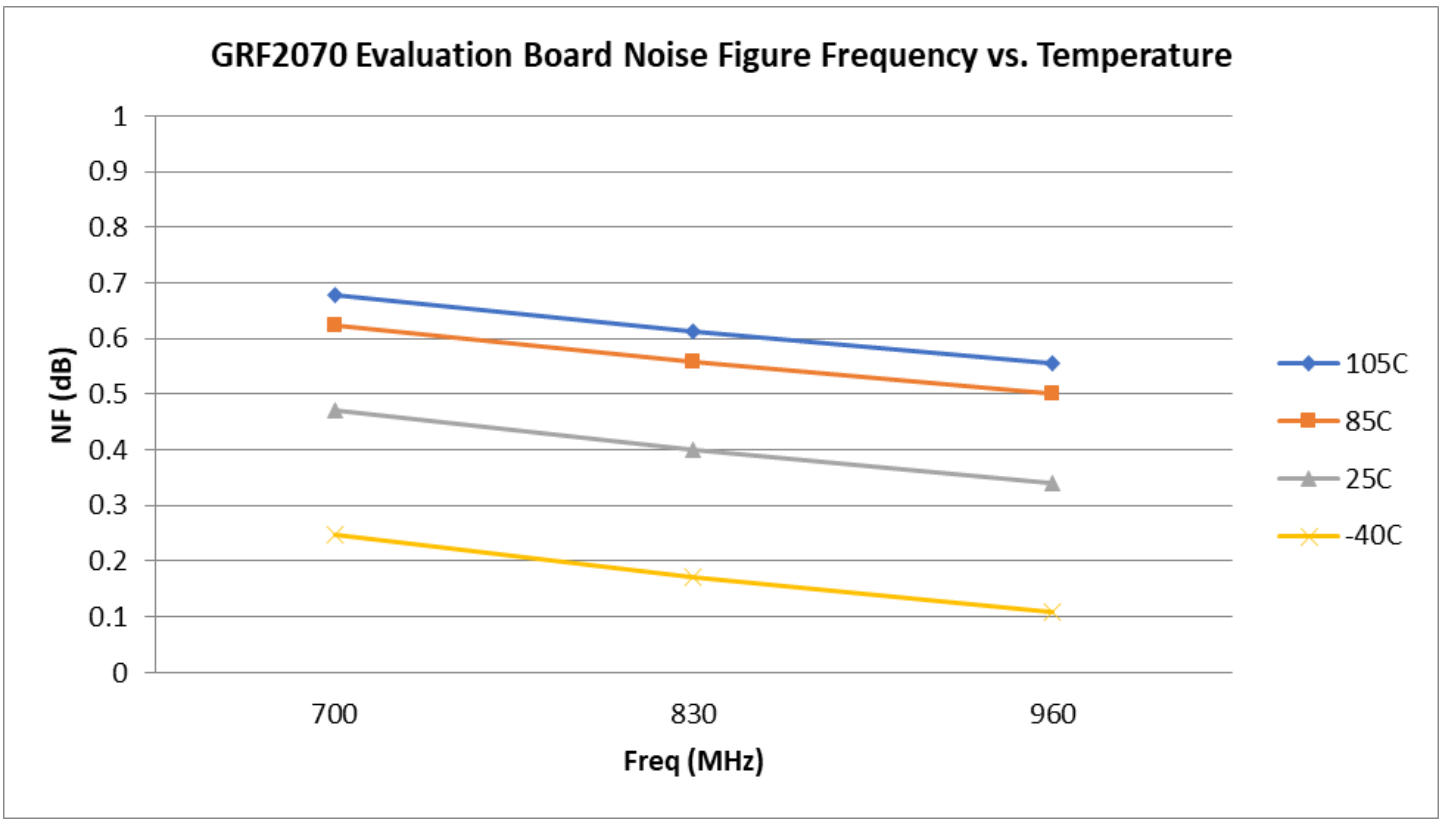
The following conditions apply unless noted otherwise: typical application schematic using the 0.1 to 1.5 GHz tuning set, V_{DD} = 5 V, V_{ENABLE} = 5 V, I_{DD} = 70 mA, F_{TEST} = 0.9 GHz, M3 = 900 Ω, $T_{PKG\ BASE}$ = 25 °C. Evaluation board losses are included within the specifications.

Parameter	Symbol	Specification			Unit	Condition
		Min.	Typ.	Max.		
Gain	S21	20	21		dB	
Reverse Isolation	S12		-26		dB	F_{RF}: 0.7 to 0.96 GHz.
Noise Figure	NF		0.4	0.6	dB	On standard evaluation board.
Output 3rd Order Intercept Point	OIP3		39		dBm	+4 dBm P_{OUT} per tone at 2 MHz spacing (899 and 901 MHz).
Output 1 dB Compression Power	OP1dB	18.6	20		dBm	

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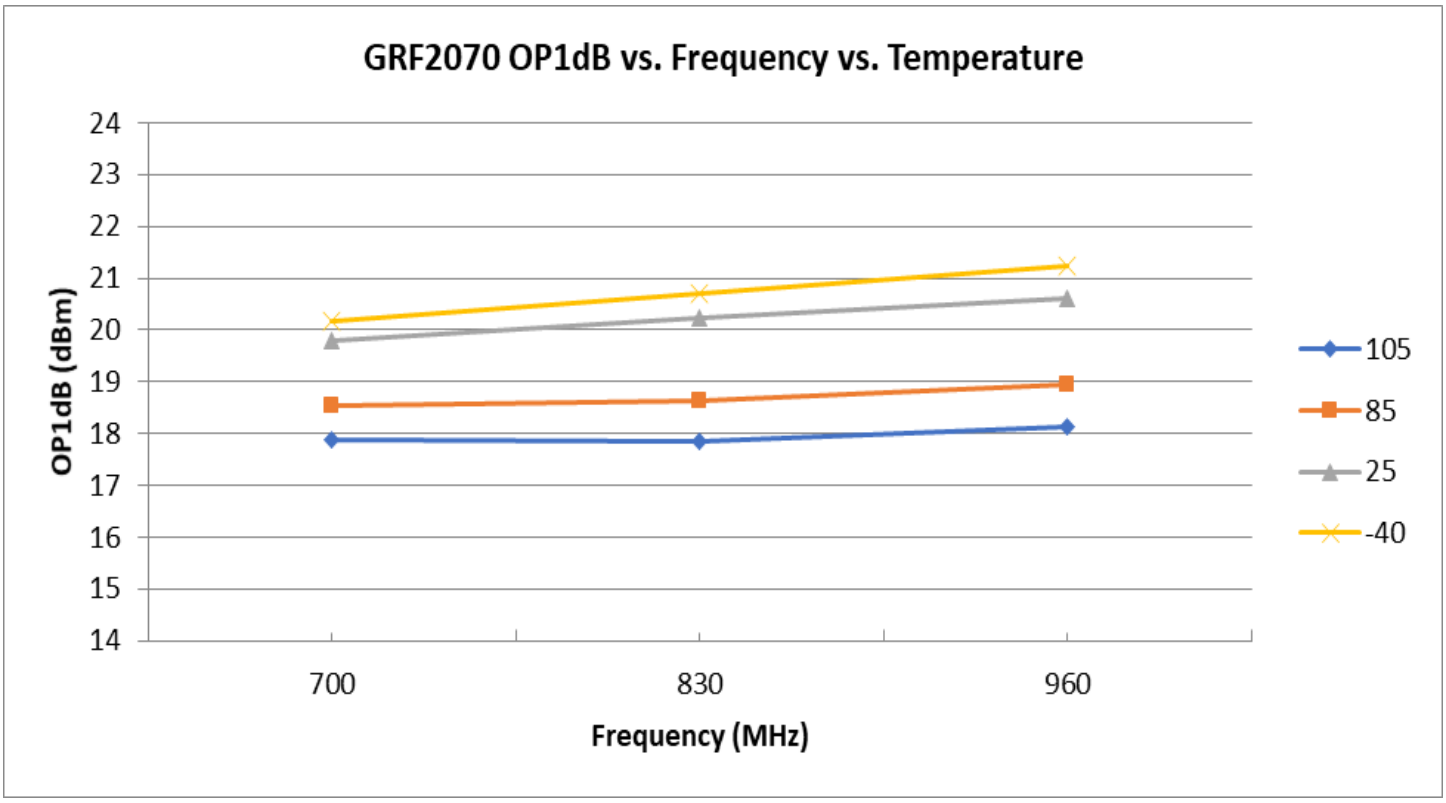
GRF2070 Typical Operating Curves: 5 V, 0.7 to 0.96 GHz Tune

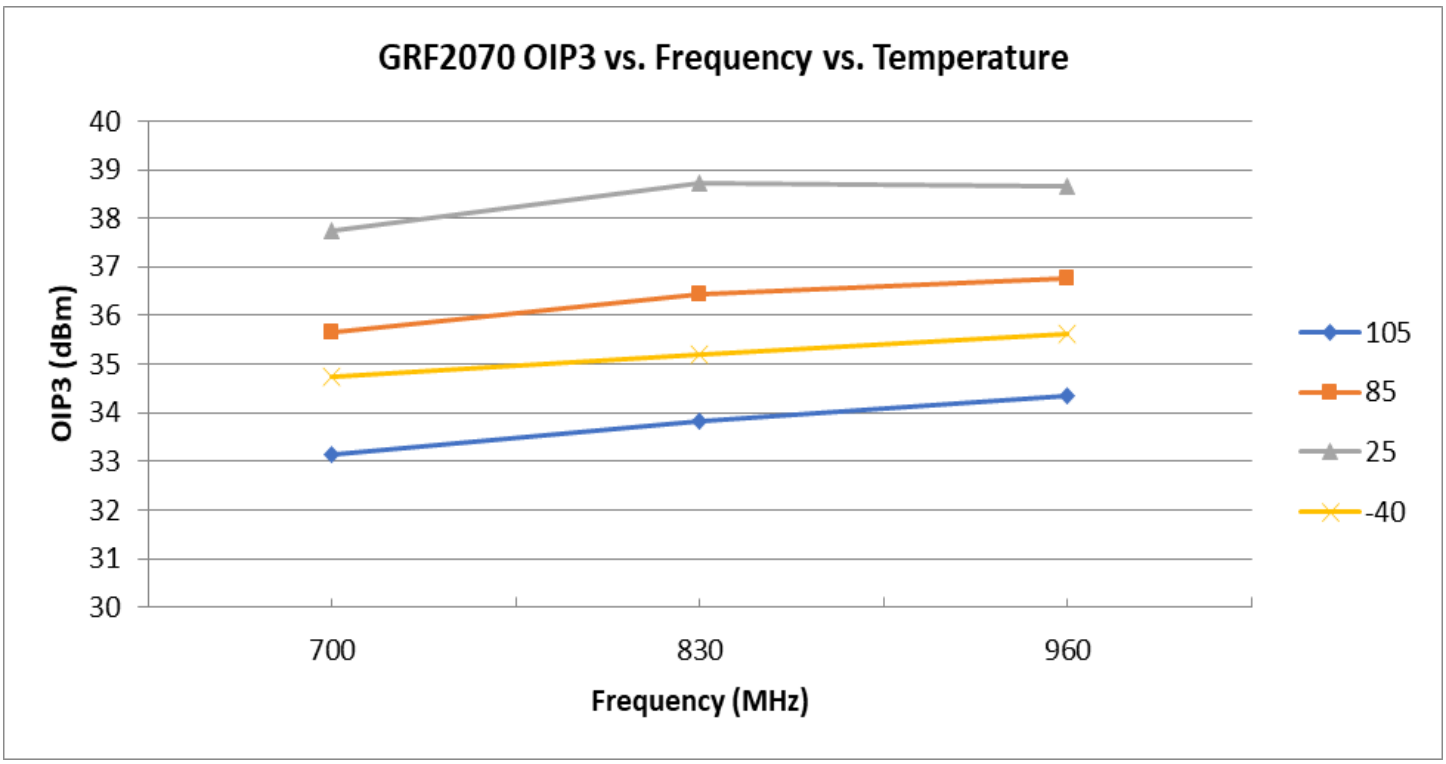




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GRF2070 Typical Operating Curves: 5 V, 0.7 to 0.96 GHz Tune

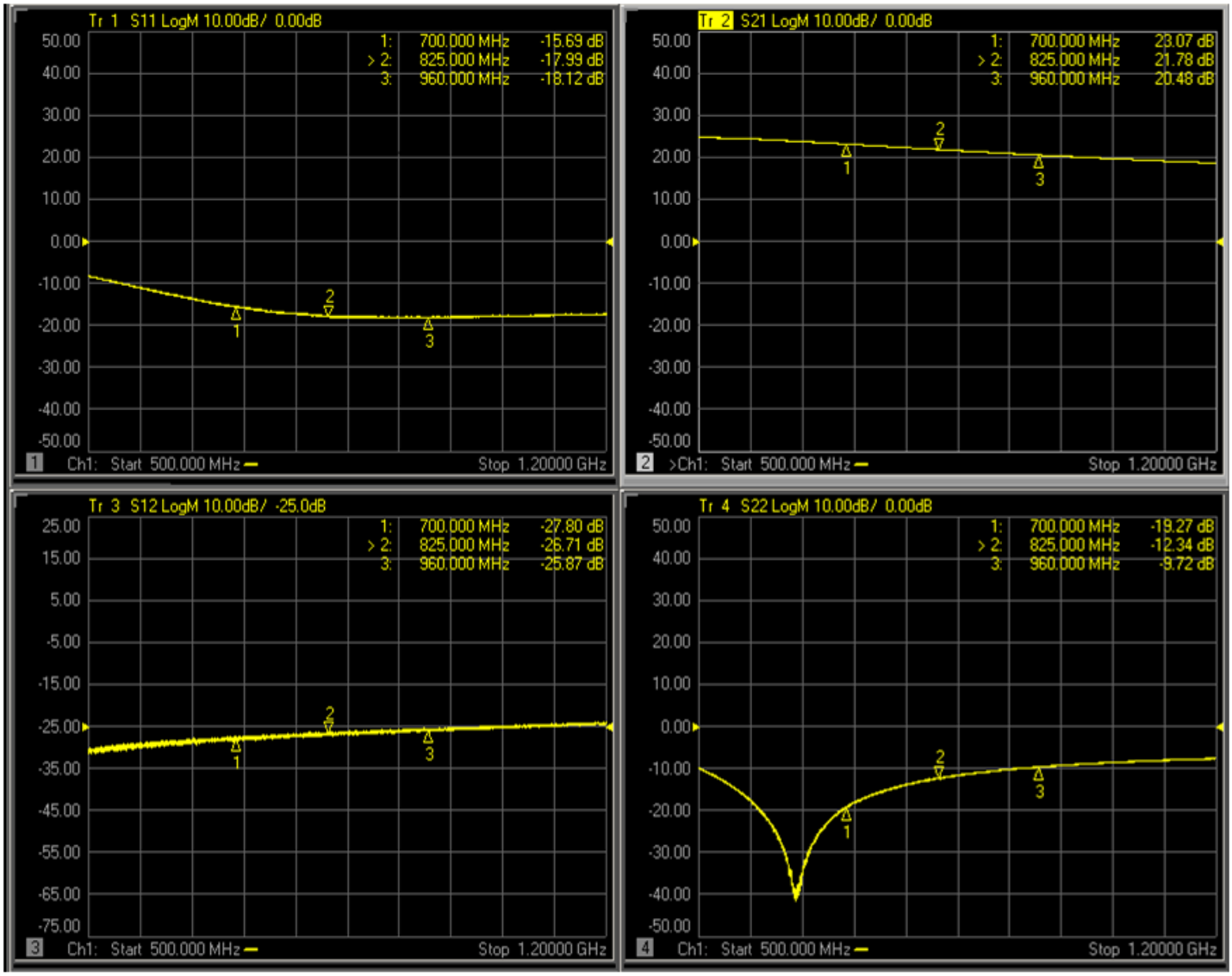




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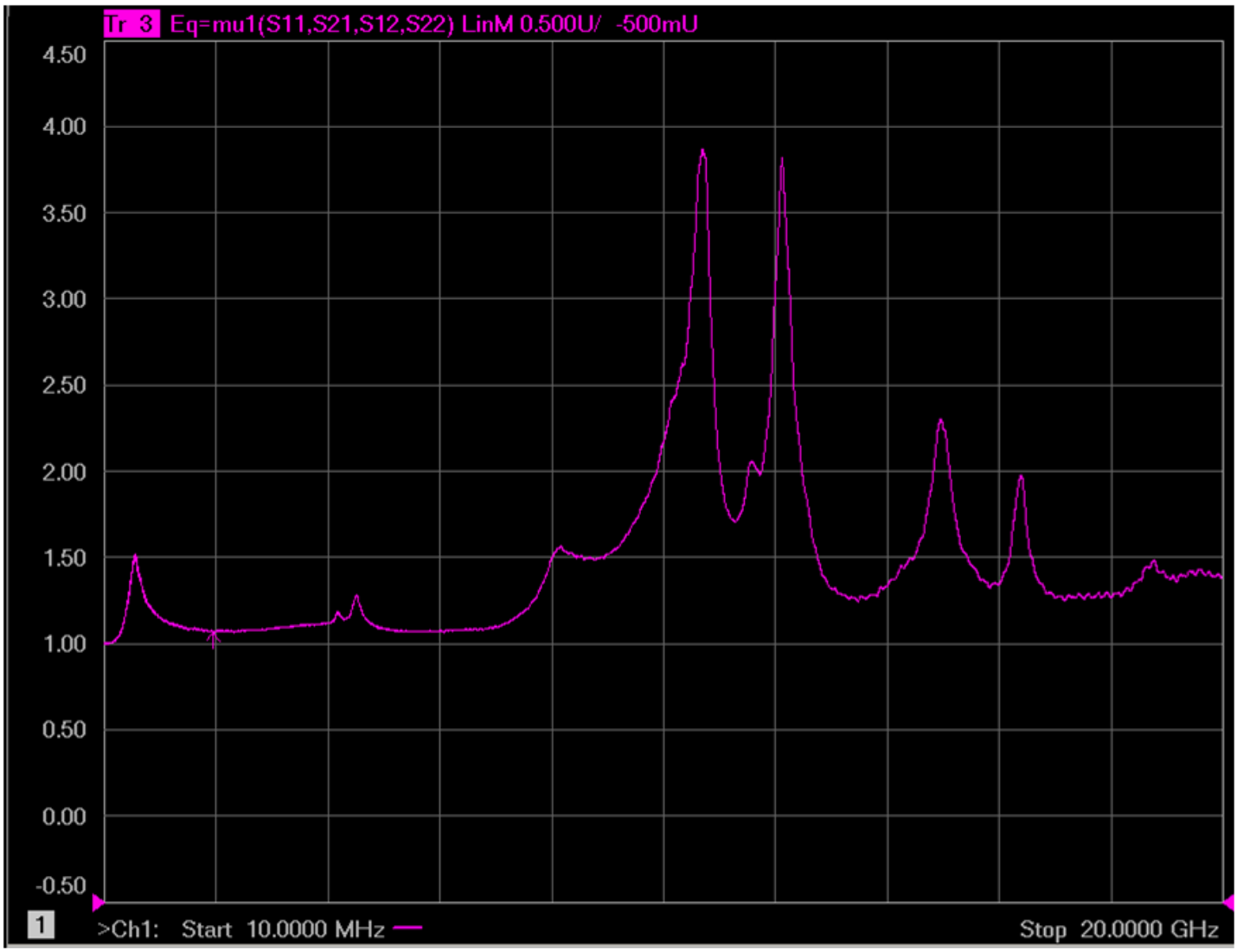
GRF2070 Typical Operating Curves: S-Parameters (0.7 to 0.96 GHz Tune)



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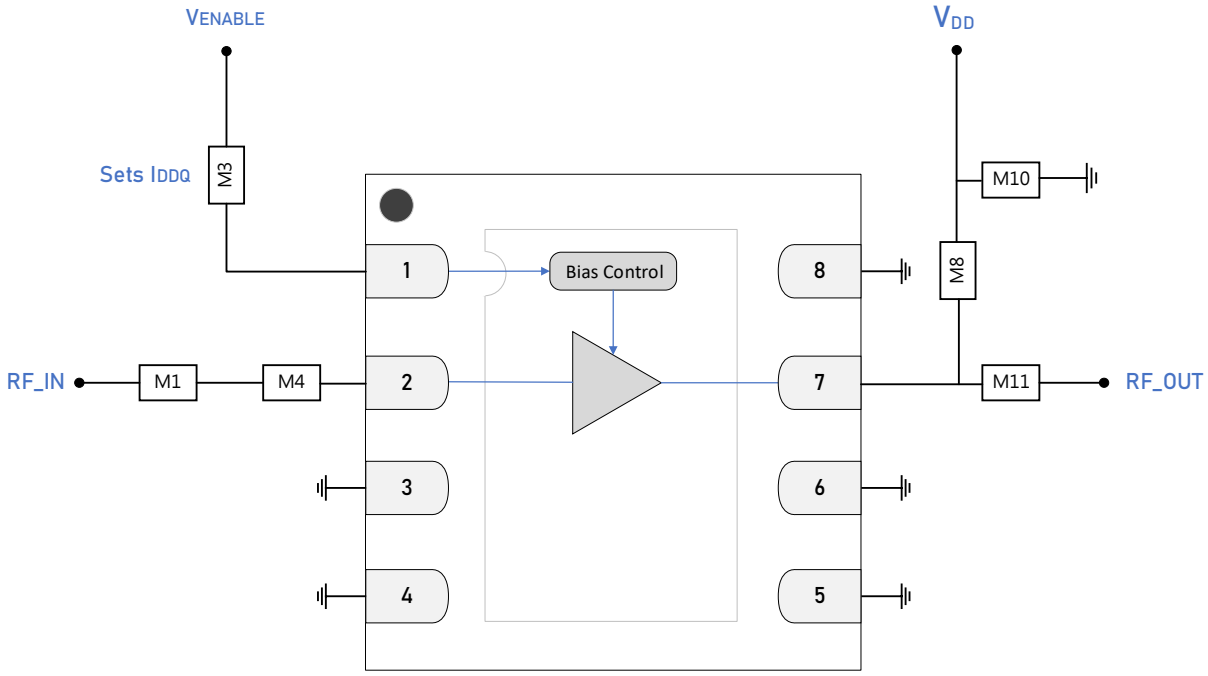
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GRF2070 Typical Operating Curves: S-Parameters (10 MHz to 20 GHz)

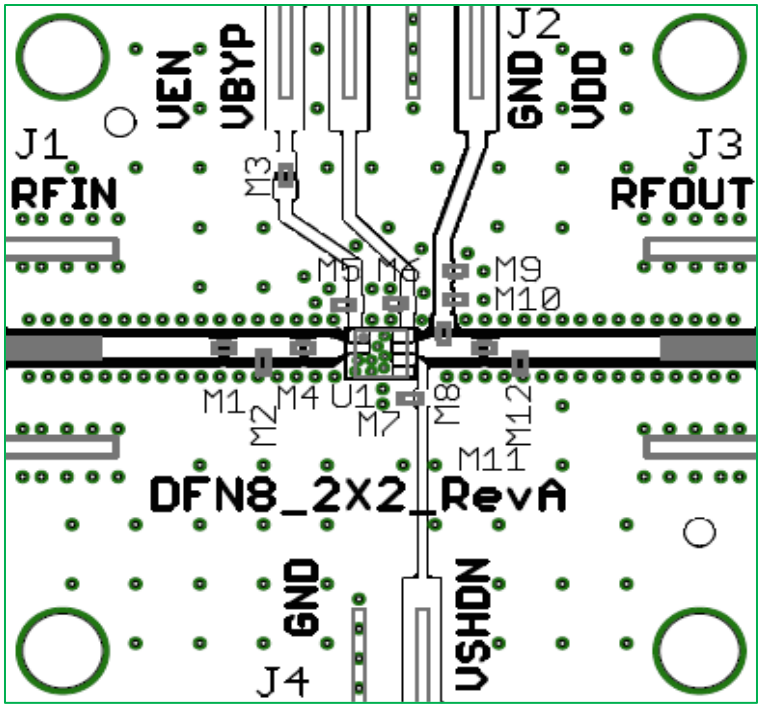


Note: Mu Factor ≥ 1.0 implies unconditional stability.

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GRF2070 Standard Evaluation Board Schematic



GRF2070 Evaluation Board Assembly Diagram

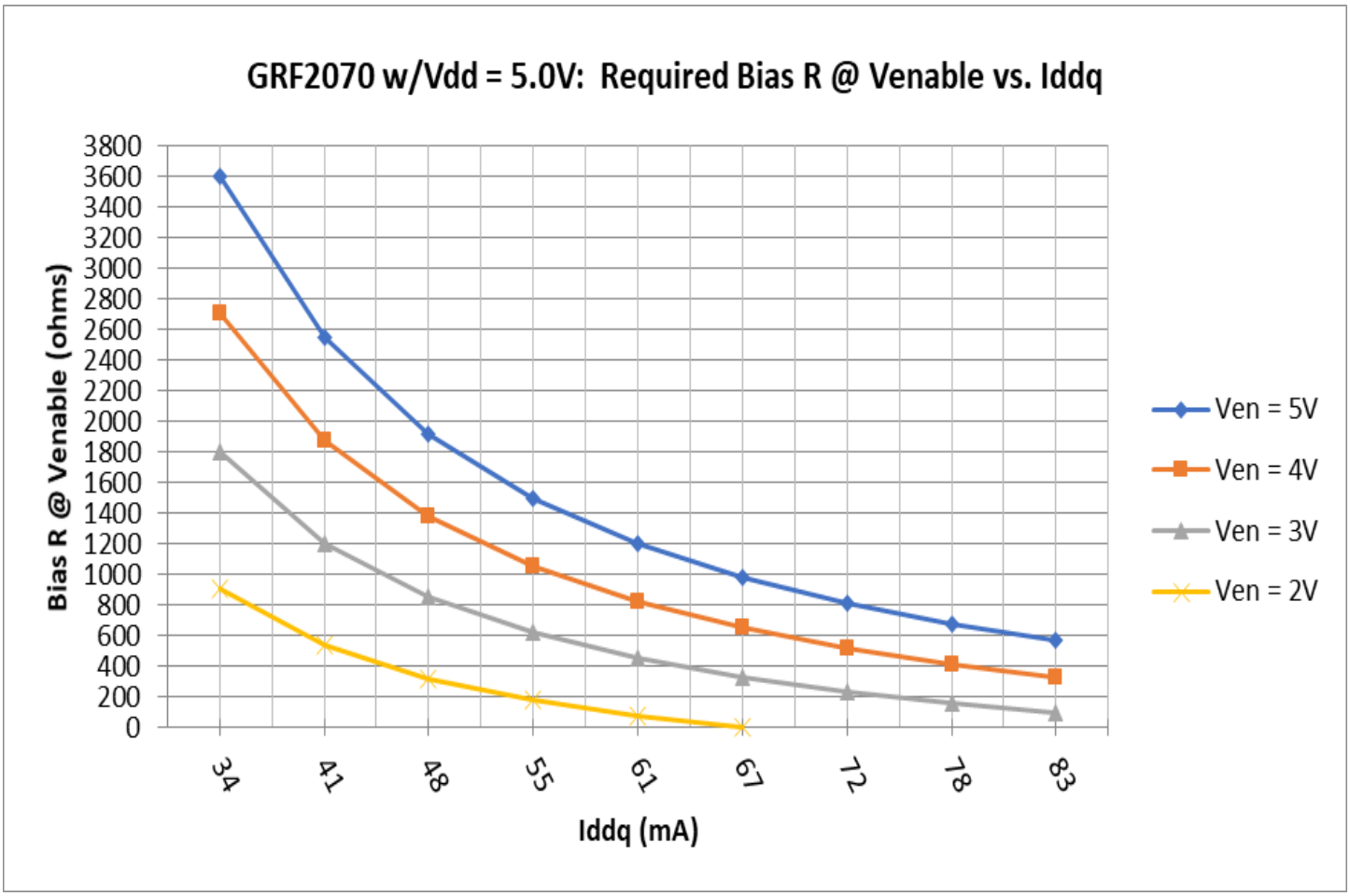
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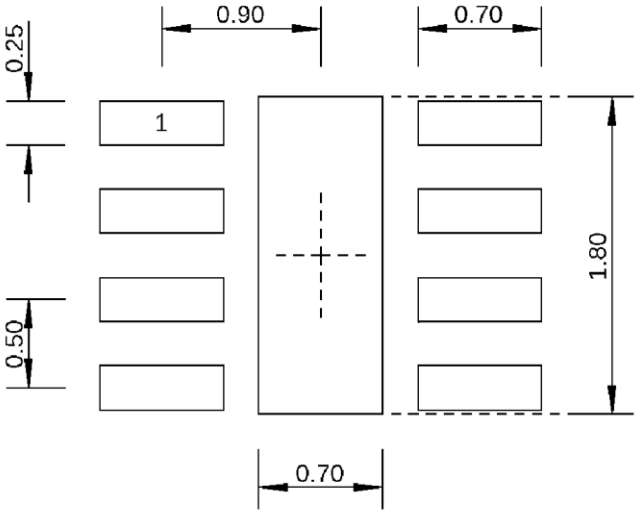
GRF2070 Evaluation Board Assembly Diagram Reference: 0.7 to 0.96 GHz Tune

Component	Type	Manufacturer	Family	Value	Package Size	Substitution
M1	Resistor (Jumper)	Various	--	0 Ω	0402	ok
M3 (sets I_{DDQ})	Resistor	Various	5%	See Curves	0402	ok
M4	Capacitor	Murata	GJM	47 pF	0402	ok
M8	Inductor	Murata	LQW	22 nH	0402	ok
M10	Capacitor	Murata	GRM	0.1 µF	0402	ok
M11	Capacitor	Murata	GRM	4.7 pF	0402	ok
Evaluation Board	DFN8_2x2_RevA					

GRF2070 Bias Resistor Selection Curves

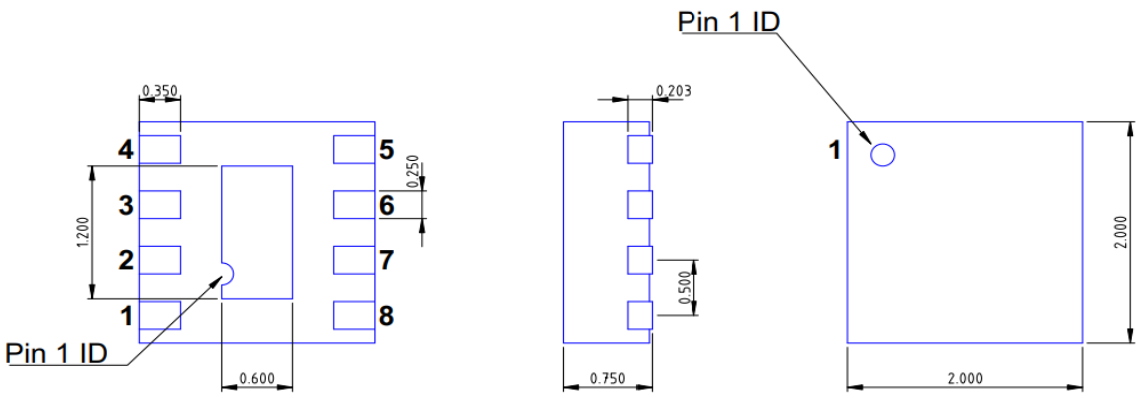


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Dimensions in millimeters

2.0 x 2.0 mm DFN-8 Suggested PCB Footprint (Top View)



Bottom View **Side View** **Top View**

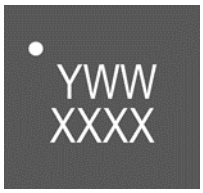
DFN8_2X2MM
Dimensions in millimeters
Dimensional Tolerance: ±0.05

2.0 x 2.0 mm DFN-8 Package Dimensions

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Package Marking Diagram



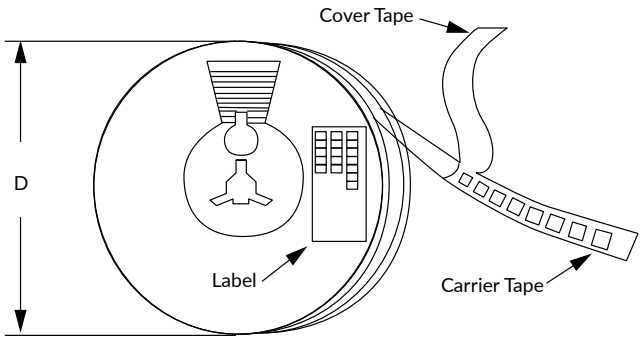
- Line 1: "Y" = YEAR (single digit). "WW" = WORK WEEK the Device was assembled.
- Line 2: "XXXX" = Device PART NUMBER.

Tape and Reel Information

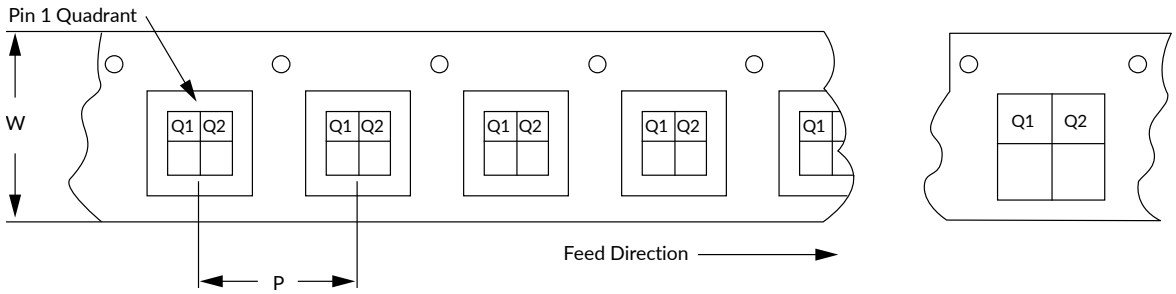
Guerrilla RF's tape and reel specification complies with Electronics Industries Alliance (EIA) standards for "Embossed Carrier Tape of Surface Mount Components for Automatic Handling" (reference EIA-481). See the following page for the Tape and Reel Specification and Device Package Information table, 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
November 8, 2018	Release Ø Data Sheet.
July 26, 2021	Upgraded Data Sheet to new format only.
May 25, 2023	Added Supply Current (I_{DD}) Min/Max limits to match Production Test Plan.
May 21, 2025	Extended frequency range from 100 - 1500 MHz to 10 - 1700 MHz. Updated frequency range of family of part numbers listed on page 1.

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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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