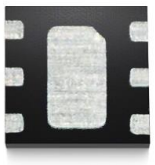
DATA SHEET

RELEASE A DATA SHEET



GRF2710

HIGH GAIN, X-Band LNA 8 to 12.7 GHz

FEATURES

- Flexible Bias Voltage and Current
- Process: GaAs pHEMT
- Compact 1.5 x 1.5 mm DFN-6 Package

Reference: 5 V / 25 mA / 10 GHz

- Gain: 13.2 dB
- OIP3: 24 dBm
- OP1dB: 12.8 dBm
- Evaluation Board Noise Figure: 1.9 dB

APPLICATIONS

- X-Band LNA
- Microwave Oscillator
- LO Buffer
- RFID
- Motion Detection
- Microwave Backhaul

DESCRIPTION

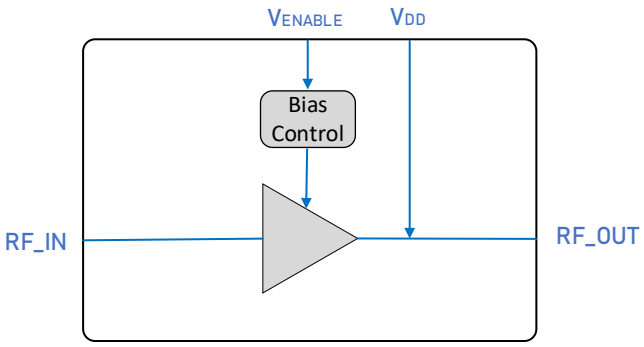
The GRF2710 is a high gain, low noise, linear amplifier designed for high performance 8 to 12 GHz X-band applications. Over this frequency range, it exhibits excellent gain and compression point.

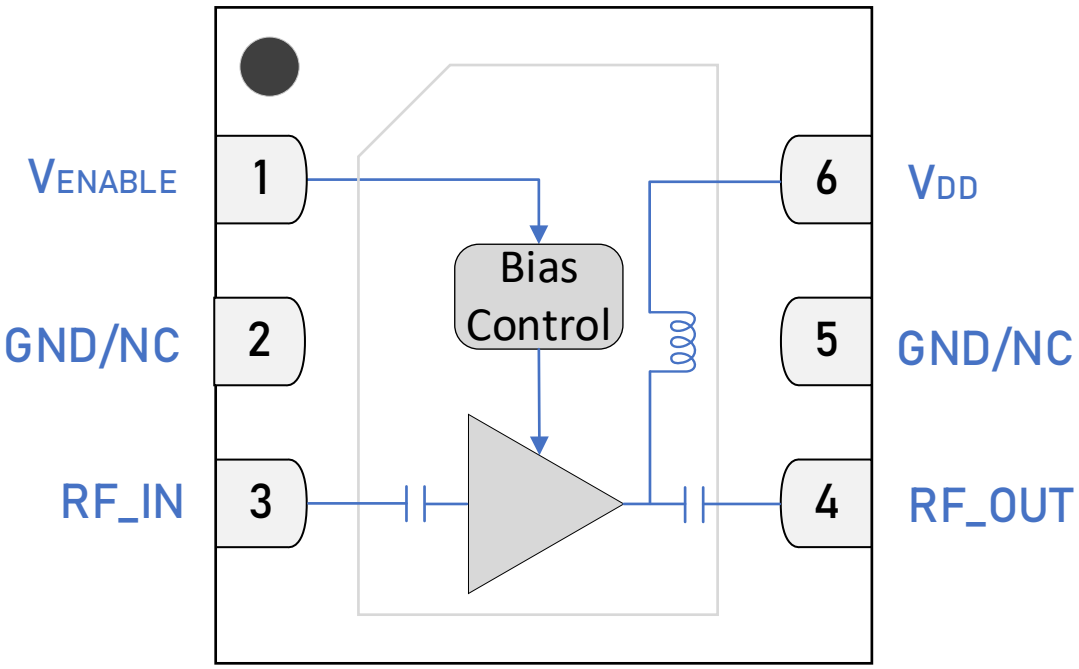
The device is operated from a single positive supply of 3 to 5 V with a typical bias condition of 5 V and 25 mA. The application schematic requires a minimal number of matching components to cover the 8 to 12.7 GHz band.

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

Additional tunes can be found on the GRF2710 "Custom Tunes" product page: GRF2710 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}	LNA Enable Input	V_{ENABLE} and series resistor sets I_{DDQ}. V_{ENABLE} < 0.2 volts disables device. On-die pull-down resistor will turn the part off if this node is allowed to float.
2, 5	GND/NC	Ground or No Connect	No internal connection to die. These pins can be left unconnected, or be connected to ground (recommended). Use a via as close to the pin as possible if grounded.
3	RF_IN	RF Input	Internally DC blocked. Internally pre-matched to 50 Ω. These Ports may be DC connected to ground externally, but no DC voltage > 0.2 volts should be applied to these ports.
4	RF_OUT	RF Output	Internally DC blocked. Internally pre-matched to 50 Ω. These Ports may be DC connected to ground externally, but no DC voltage > 0.2 volts should be applied to these ports.
6	V_{DD}	Supply Voltage	The distance of cap at M7 to pin 6 strongly influences the device match. Consult evaluation board Gerber files for an effective method of placing this cap that allows tuning flexibility. The value of this cap also affects the gain notch at 2.45 GHz.
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.

Truth Table

V_{DD}	V_{ENABLE}	Mode
High	≥ 1.8 V	LNA On
High	< 0.2 V	LNA Off

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)	$P_{IN\ MAX}$		15	dBm
Operating Temperature (package base)	$T_{PAG\ BASE}$	-40	105	°C
Maximum Channel Temperature (MTTF > 10^6 hours)	T_{MAX}		170	°C
Maximum Dissipated Power	$P_{DISS\ MAX}$		300	mW

Electrostatic Discharge

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 to the device.

Note: For additional information, please refer to *Manufacturing Note MN-001 — Package and Manufacturing Information.*

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}	0	5	6	V	
Operating Temperature (package base)	$T_{PKG\ BASE}$	-40		105	°C	
RF Frequency Range	F_{RF}	8	10	12.7	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: GRF2710 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 8 to 12 GHz tuning set. V_{DD} = 5 V, I_{DDQ} = 25 mA. M3 = 3 kΩ. F_{TEST} = 10 GHz. 50 Ω system impedance, $T_{PKG\ BASE}$ = 25 °C. Evaluation board losses are included within the specifications.

Parameter	Symbol	Specification			Unit	Condition
		Min.	Typ.	Max.		
Supply Current (Quiescent)	I_{DDQ}		25		mA	
Enable Current	I_{ENABLE}		1.5		mA	
Switching Rise Time	T_{RISE}		300		ns	Disabled mode to Gain mode **(note 3)**.
Switching Fall Time	T_{FALL}		100		ns	Gain mode to Disabled mode **(note 4)**.
Disabled Mode						
Leakage Current	$I_{LEAKAGE}$		160		µA	V_{DD} = 5 V, V_{ENABLE} = 0 V
Thermal Data						
Thermal Resistance (Infrared Scan)	Θ_{JC}		140		°C/W	
Channel Temperature at 85 °C reference (Package Base)	$T_{CHANNEL}$		105		°C	V_{DD} = 5 V, I_{DDQ} = 25 mA, No RF applied, P_{DISS} = 125 mW **(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}.

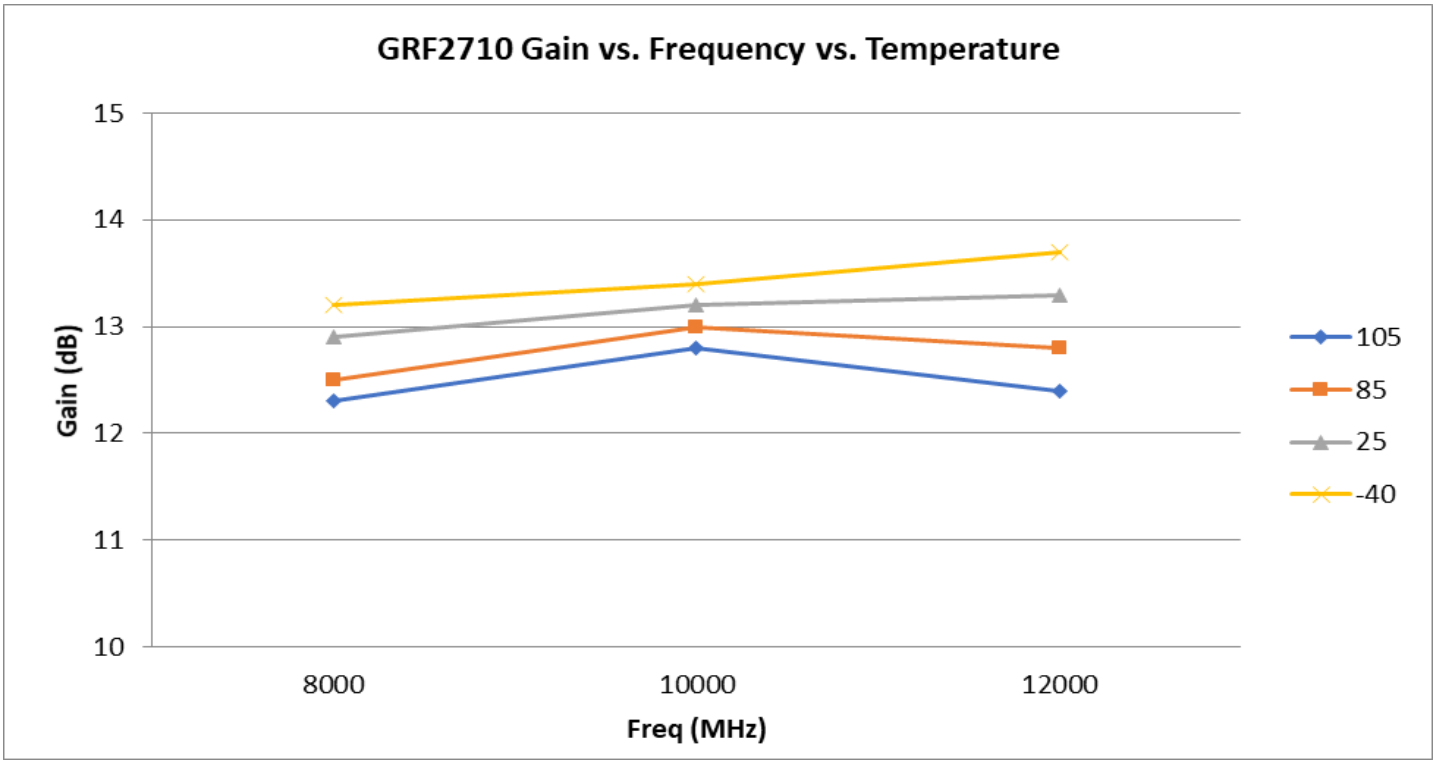
Note 5: MTTF > 10^6 hours for $T_{CHANNEL}$ <170 °C.

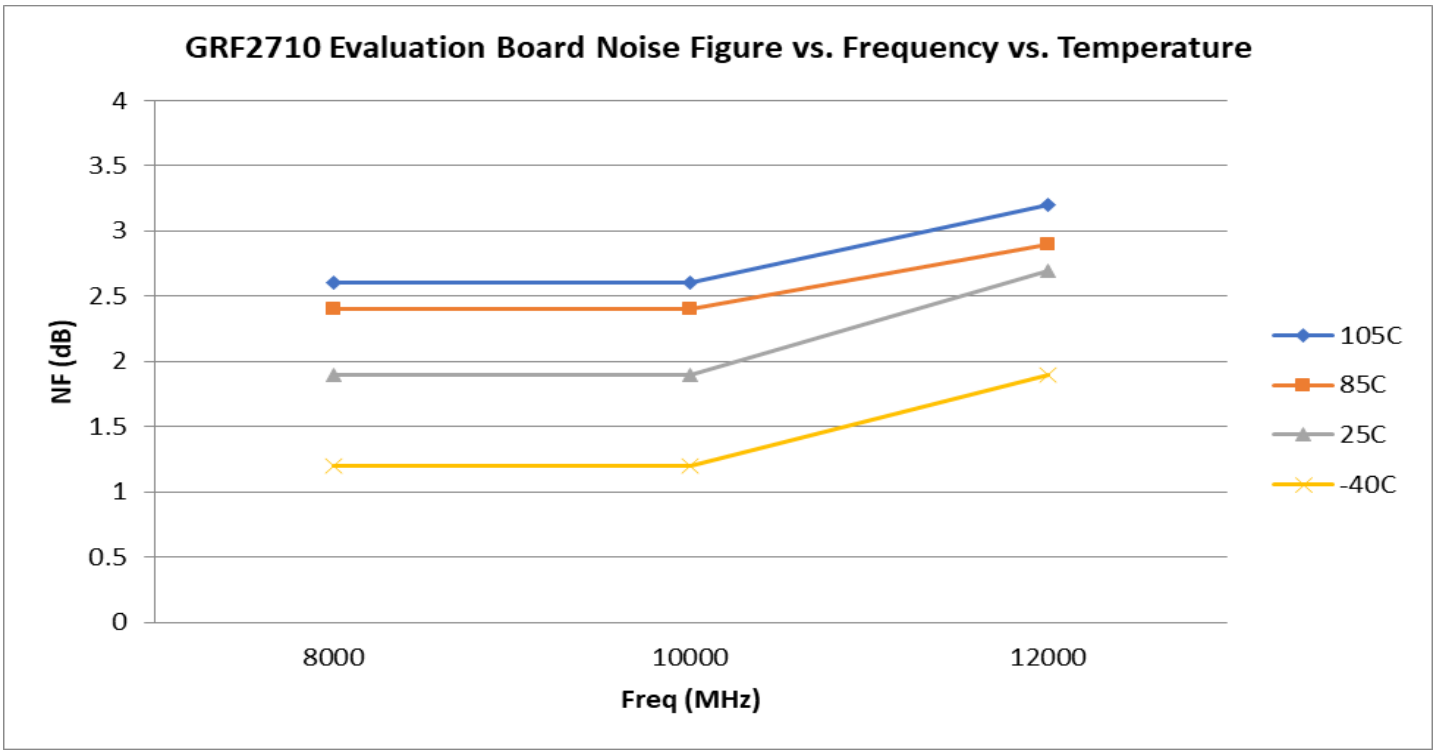
Nominal Operating Parameters – RF

The following conditions apply unless noted otherwise: typical application schematic using the 8 to 12 GHz tuning set. V_{DD} = 5 V, I_{DDQ} = 25 mA, M3 = 3 kΩ, F_{TEST} = 10 GHz. 50 Ω system impedance, $T_{PKG\ BASE}$ = 25 °C. Evaluation board losses are included within the specifications.

Parameter	Symbol	Specification			Unit	Condition
		Min.	Typ.	Max.		
Gain	S21	11.7	13.2		dB	
Noise Figure	NF		1.9	2.3	dB	On standard evaluation board.
Output 3rd Order Intercept Point	OIP3		24		dBm	-5 dBm P_{OUT} per tone, 2 MHz spacing (9.999 and 10.001 GHz).
Output 1 dB Compression Power	OP1dB	10.8	12.8		dBm	

GRF2710 Typical Operating Curves: 8 to 12 GHz Tune





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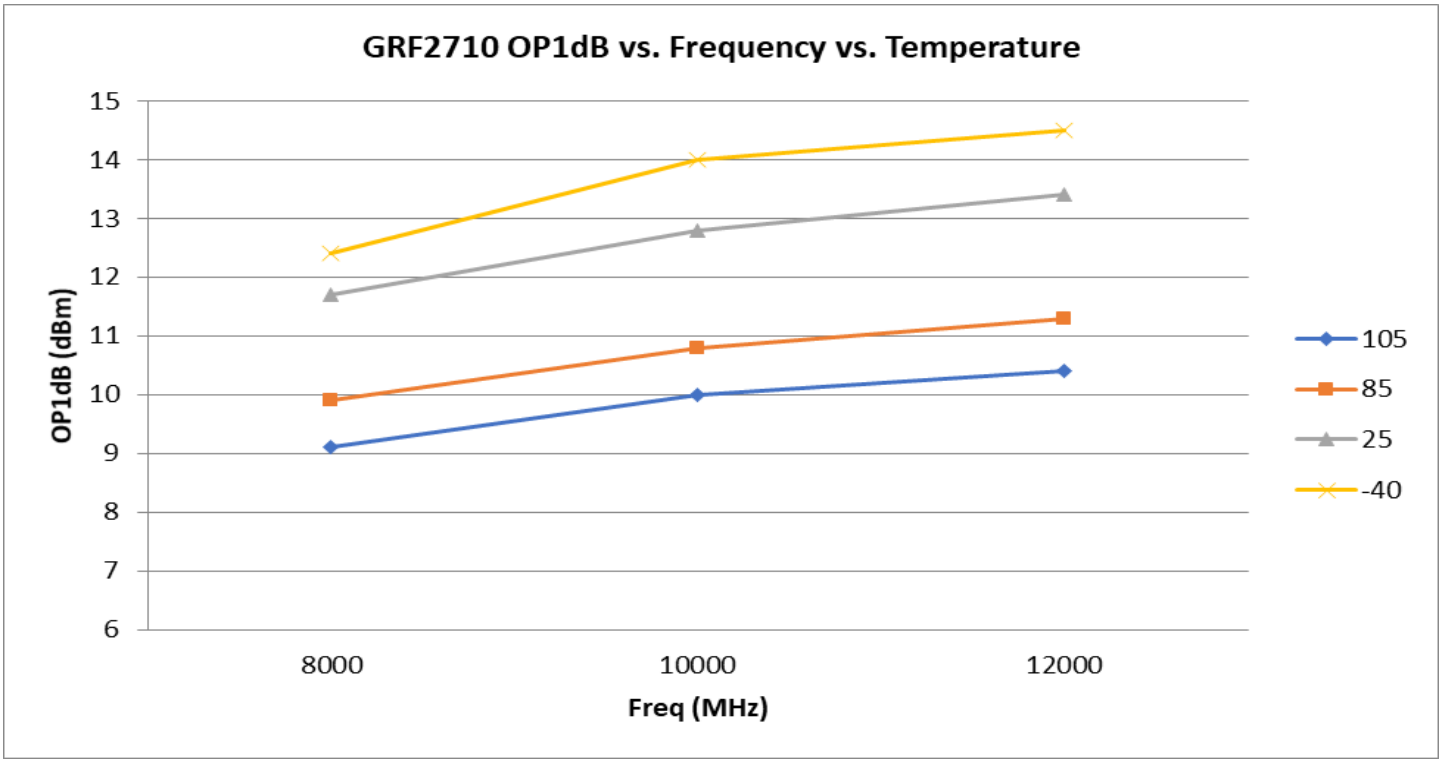
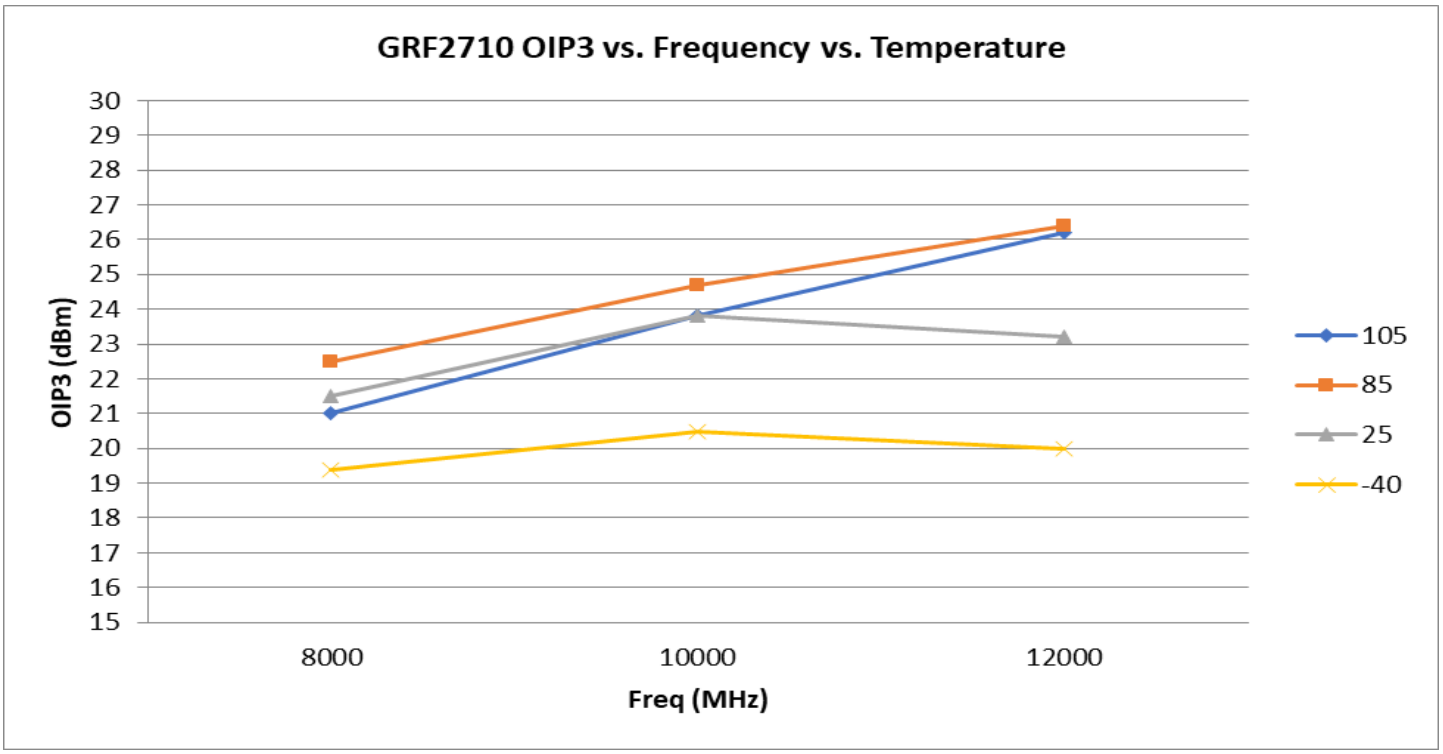
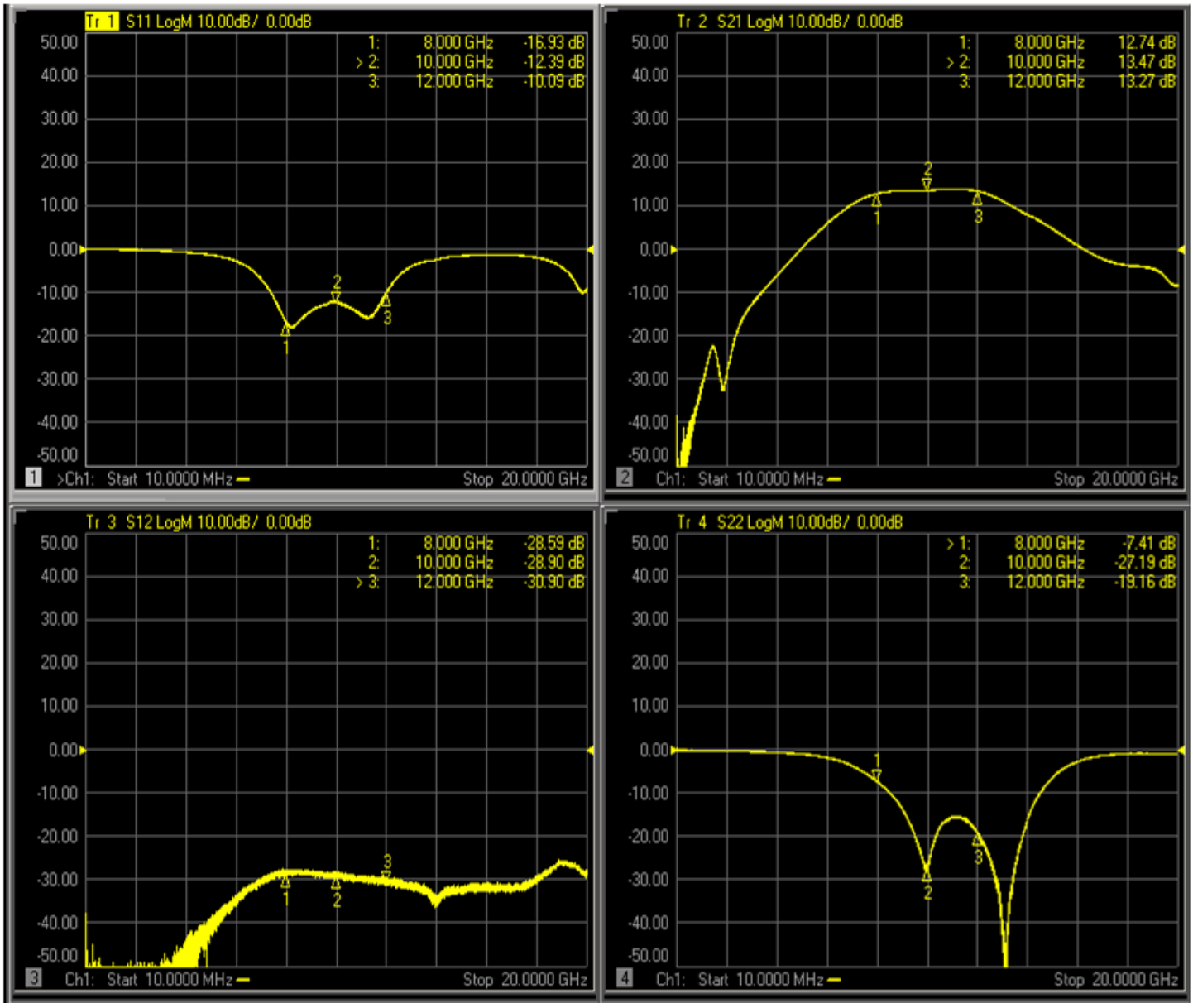
GRF2710 Typical Operating Curves: 8 to 12 GHz Tune





GRF2710 Typical Operating Curves: S-Parameters (8 to 12 GHz Tune)



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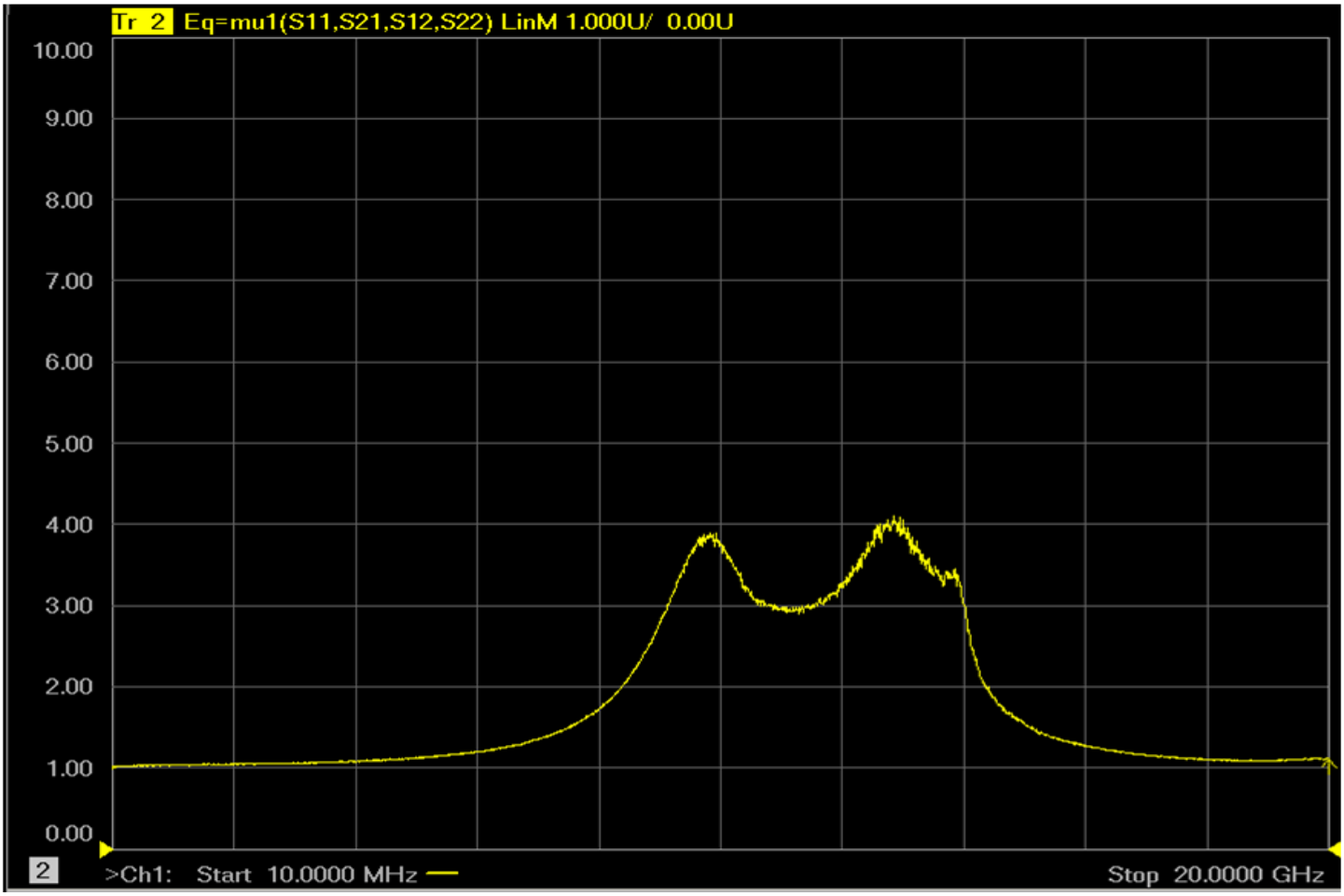
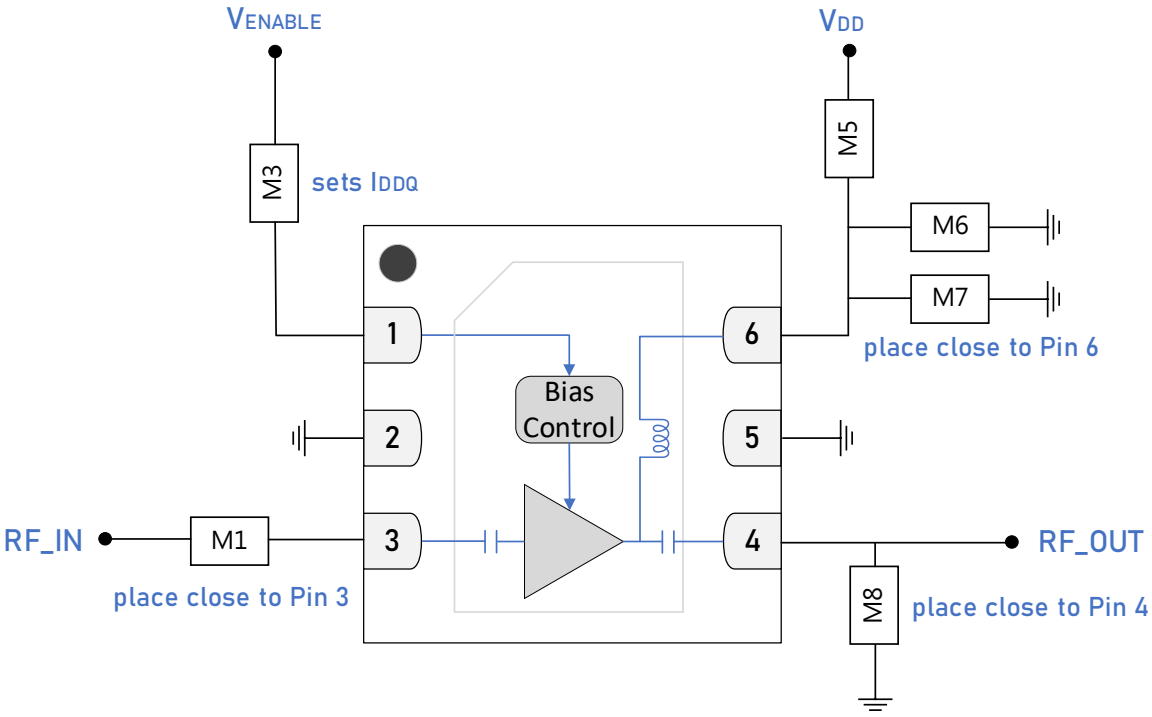
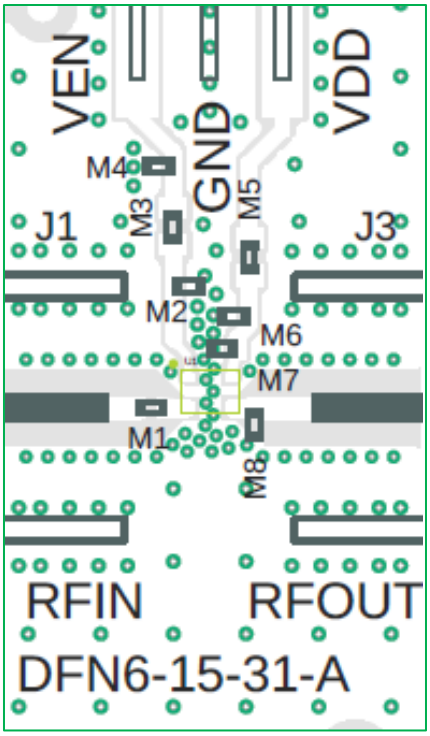
GRF2710 Typical Operating Curves: Stability Mu Factor (10 MHz to 20 GHz)



Note: Mu factor ≥ 1 implies unconditional stability.



GRF2710 Standard Evaluation Board Schematic

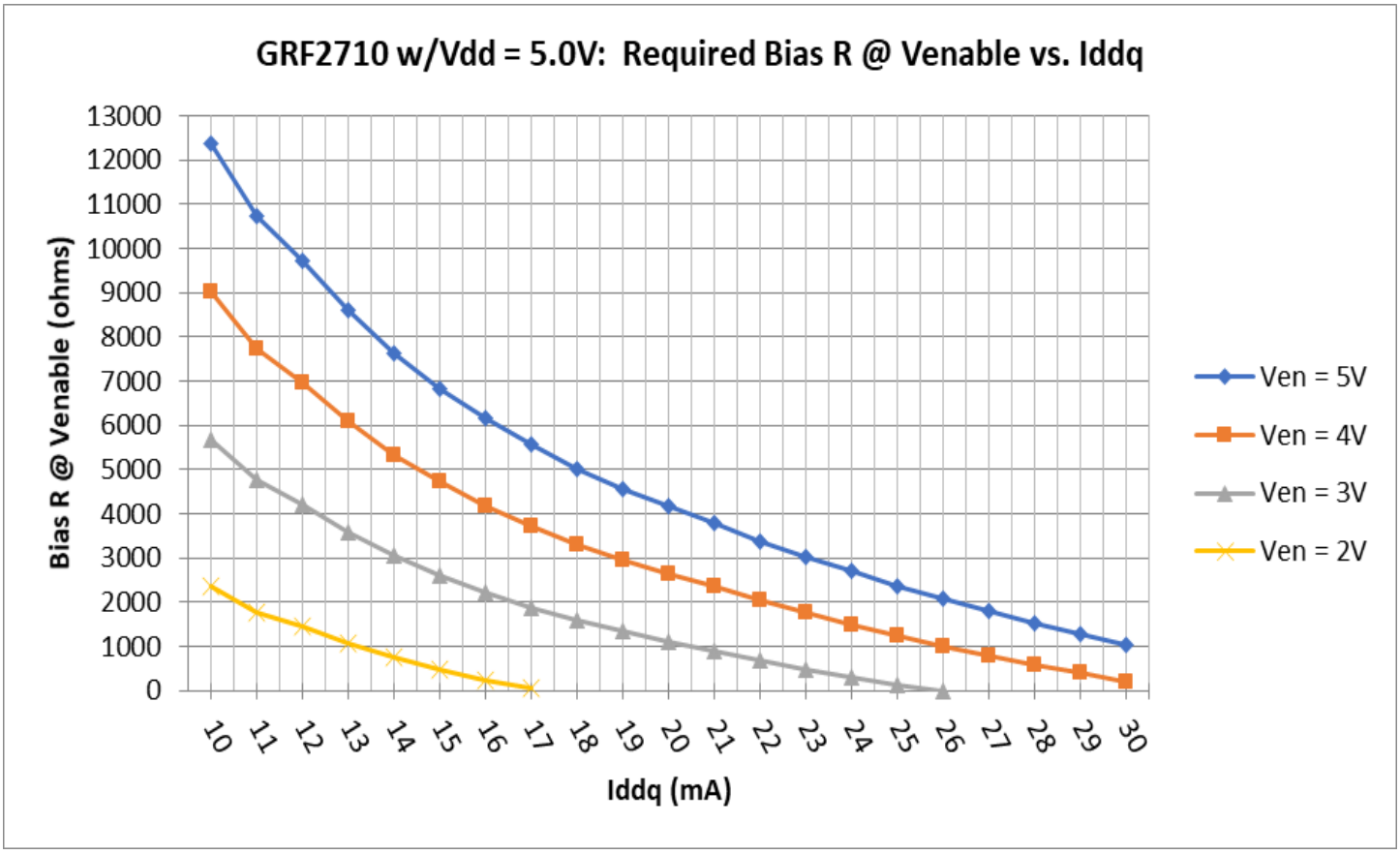


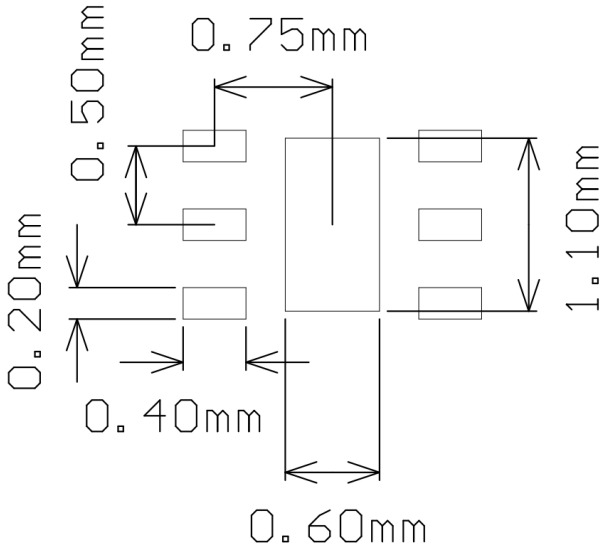
GRF2710 Evaluation Board Assembly Diagram

GRF2710 Evaluation Board Assembly Diagram Reference: 8 to 12 GHz Tune

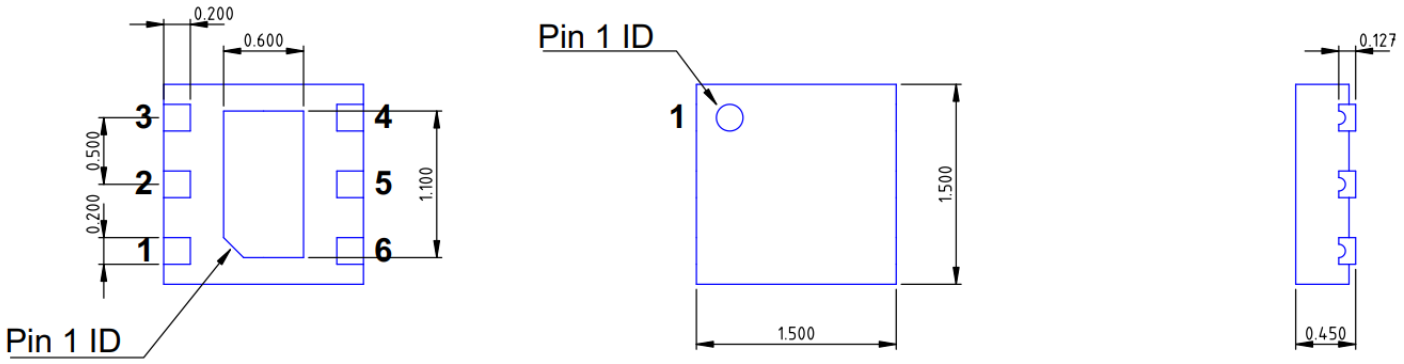
Component	Type	Manufacturer	Family	Value	Package Size	Substitution
M1	Capacitor	Murata	GJM	0.7 pF	0402	ok
M3 (sets I_{DDQ})	Resistor	Various	5%	see curves	0402	ok
M5	Resistor (jumper)	Various	--	0 Ω	0402	ok
M6	Capacitor	Murata	GRM	0.1 µF	0402	ok
M7	Capacitor	Murata	GJM	10 pF	0402	ok
M8	Inductor	Murata	LQG	1.7 nH	0402	ok
Evaluation Board	DFN6-15-31-A					

GRF2710 Bias Resistor Selection Curves





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

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Package Marking Diagram

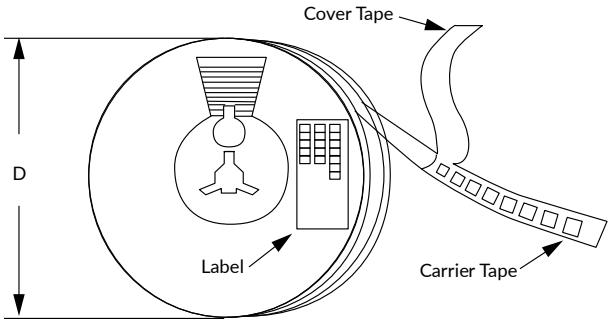
- Line 1: "Y" = YEAR (single digit). "WW" = WORK WEEK the device was assembled.
- Line 2: "XXXX" = Device PART NUMBER.

Tape and Reel Information

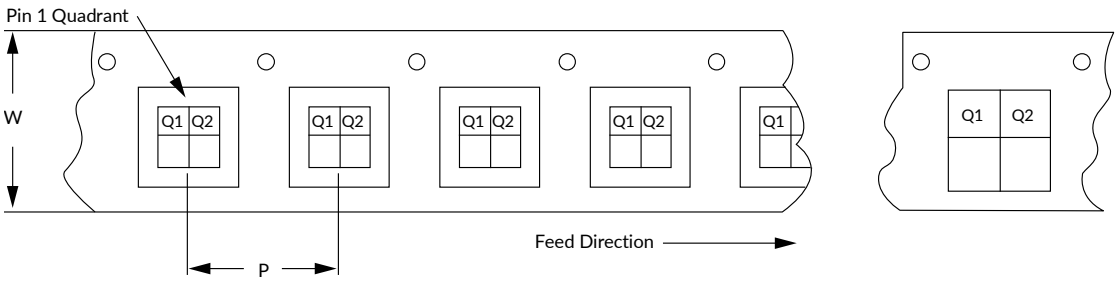
Guerrilla RF's tape and reel specification complies with Electronic Industries Alliance (EIA) standards for "Embossed Carrier Tape of Surface Mount Components for Automatic Handling" (reference EIA-481). See the following page for the Tape and Reel Specification and Device Package Information table, 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: *https://www.guerrilla-rf.com/prodFiles/Manufacturing/MN001.pdf*



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
December 21, 2017	Preliminary Data Sheet.
September 15, 2021	Release Ø Data Sheet.
July 21, 2022	Release A Data Sheet. Upgraded Data Sheet to new format. Changed M8 on evaluation board BOM from 1.8 nH LQP to 1.7 nH LQG Family. Added OIP3 measurement test conditions.
June 3, 2025	Extended upper frequency range from 12 GHz to 12.7 GHz.

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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.