

GRF5710

High Linearity Power Amplifier 0.4 to 1.8 GHz

FEATURES

- High Linearity
- Standard tunes cover 20 – 30% bandwidth
- Flexible Biasing
- 500 mA Native Mode Quiescent Current Consumption
- 5 V Supply Voltage
- -40 to 85 °C Operating Temperature Range
- Rugged Design is Extremely Resilient to Mismatched Loads
- Compact 4 x 4 mm QFN-24 Package

Reference: 5 V / 500 mA I_{CCQ} / 0.475 GHz

- Gain: 17.4 dB
- OP1dB: 33.8 dBm
- OIP3: 49.3 dBm
- PAE at OP1dB: 47.2 %

APPLICATIONS

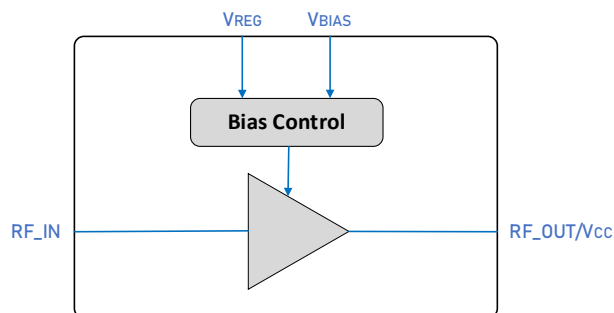
- Mobile infrastructure
- Repeaters
- Driver amplifier
- General purpose wireless

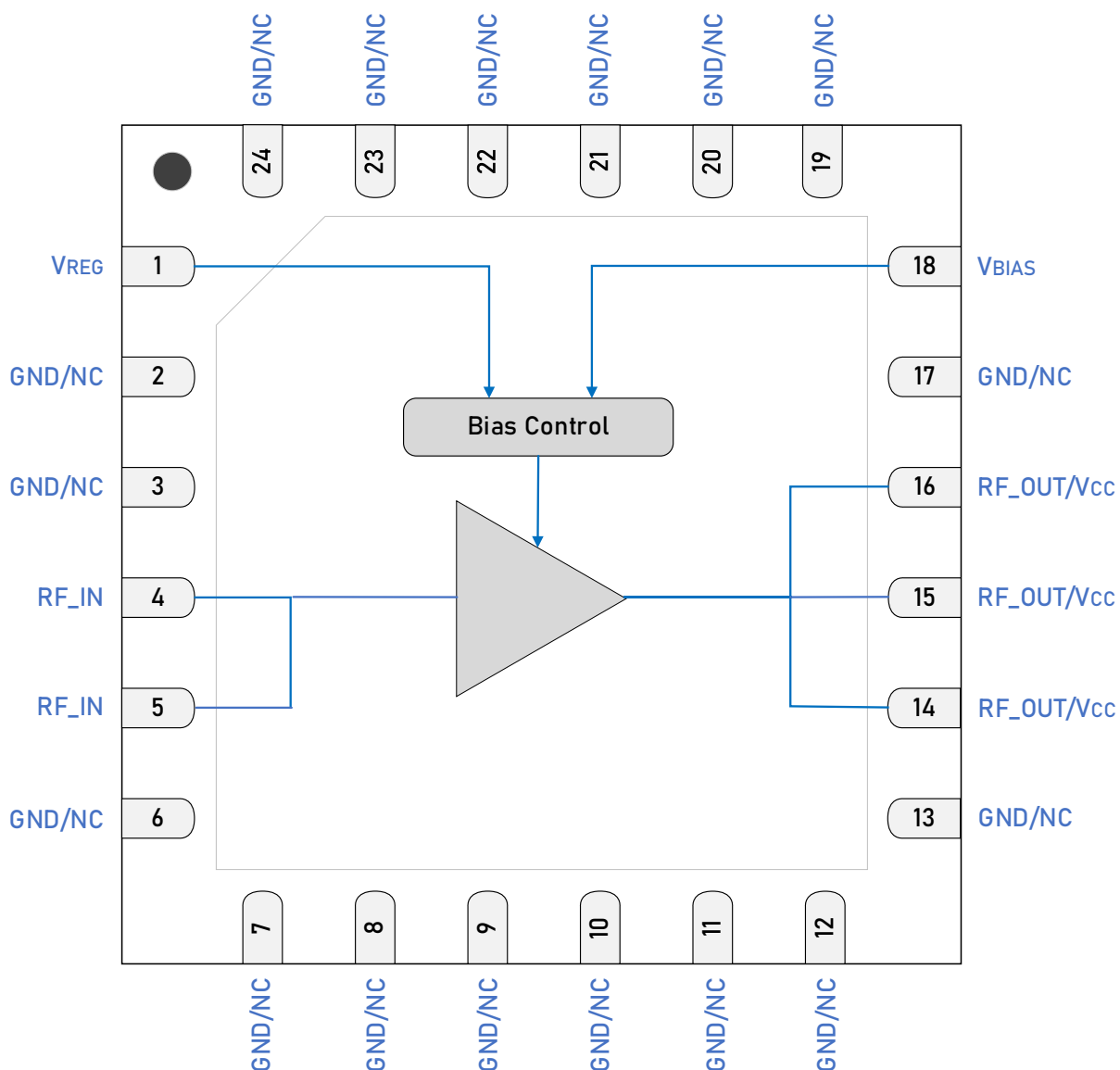
DESCRIPTION

The GRF5710 is a high linearity power amplifier packaged in an industry standard QFN-24 package.

Please consult with the GRF applications engineering team for custom tuning/evaluation board data.

BLOCK DIAGRAM





4 x 4 mm QFN-24 Pin Out (Top View)

Pin Assignments

Pin	Name	Description	Note
1	V _{REG}	Current Reference	Current reference for internal bias circuit created by an external regulated voltage and a precision resistor. Sets quiescent current for the amplifier. Can also be used to enable / disable the amplifier.
2, 3, 6, 7, 8, 9, 10, 11, 12, 13, 17, 19, 20, 21, 22, 23, 24	GND/NC	Ground	No internal connection to die. These pins should be connected to ground.
4, 5	RF_IN	RF Input	Pins 4 and 5 are tied together on the system board. An external DC blocking capacitor must be used.
14, 15, 16	RF_OUT/V _{CC}	PA Output/Bias Voltage	Pins 14, 15 and 16 are tied together on the system board. V _{CC} must be applied to this pin via an RF choke.
18	V _{BIAS}	Bias Circuit Supply	Voltage supply for active bias circuit. Connect to V _{CC} .
PKG BASE	GND	Ground	Provides DC and RF ground for the amplifier, 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_{CC}		5.25	V
RF Input Power	50 Ω , $V_{CC} = 5$ V, CW Tone, 100% Duty Cycle, $T_{PKG\ BASE} = 25$ °C.	$P_{IN\ MAX - 1:1}$		TBD	dBm
	Load VSWR $\leq 8:1$, all phase angles, $V_{CC} = 5$ V, CW Tone, 100% Duty Cycle, $T_{PKG\ BASE} = -40$ to 85 °C.	$P_{IN\ MAX - 8:1}$		TBD	
Operating Temperature (evaluation board base).		$T_{EV\ BASE}$	-40	85	°C
Maximum Junction Temperature (MTTF > 10 ⁶ hours).		$T_{J\ MAX}$		190	°C
Maximum Dissipated Power		$P_{DISS\ MAX}$		3900	mW

Electrostatic Discharge

Human Body Model	HBM	TBD		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 [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](#)

Recommended Operating Conditions

Parameter	Symbol	Specification			Unit	Condition
		Min.	Typ.	Max.		
Supply Voltage	V_{CC}		5	5.25	V	
RF Frequency Range	F_{RF}	400		1800	MHz	Refer to standard tuning sets (notes 1 & 2).
Operating Temperature (EVB base)	$T_{EVB \text{ BASE}}$	-40		85	°C	
RF_IN Port Impedance	Z_{RFIN}		50		Ω	Single-ended with external matching network.
RF_OUT Port Impedance	Z_{RFOUT}		50		Ω	Single-ended with external matching network.

Note 1: Operation outside of this range is possible although some parameters may degrade.

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

Nominal Operating Parameters

The following conditions apply unless noted otherwise: typical application schematic using the 400 to 550 MHz tuning set. $V_{CC}/V_{BIAS}/V_{REF} = 5\text{ V}$, $50\ \Omega$ system impedance, $T_{PKG\ BASE} = 25\ ^\circ\text{C}$, Evaluation board losses are included within the specifications.

Parameter	Symbol	Specification			Unit	Condition
		Min.	Typ.	Max.		
Supply Quiescent Current	I_{CCQ}		500		mA	no RF applied.
Vref Current	I_{REF}		6.5		mA	no RF applied.
Vbias Current	I_{BIAS}		4		mA	no RF applied.
Small Signal Gain	S21		17.4		dB	RF test frequency = 475 MHz
Input Return Loss	S11		12		dB	RF test frequency = 475 MHz
Output Return Loss	S22		10		dB	RF test frequency = 475 MHz
Reverse Isolation	S12		29.5		dB	RF test frequency = 475 MHz
Noise Figure	NF		6.2		dB	RF test frequency = 475 MHz
Output 1dB Compression Power	OP1dB		33.8		dBm	RF test frequency = 475 MHz
Output 3 rd Order Intercept Point	OIP3		49		dBm	RF test frequencies = 475 MHz, 475.5 MHz, +24 dBm per tone

Thermal Data:

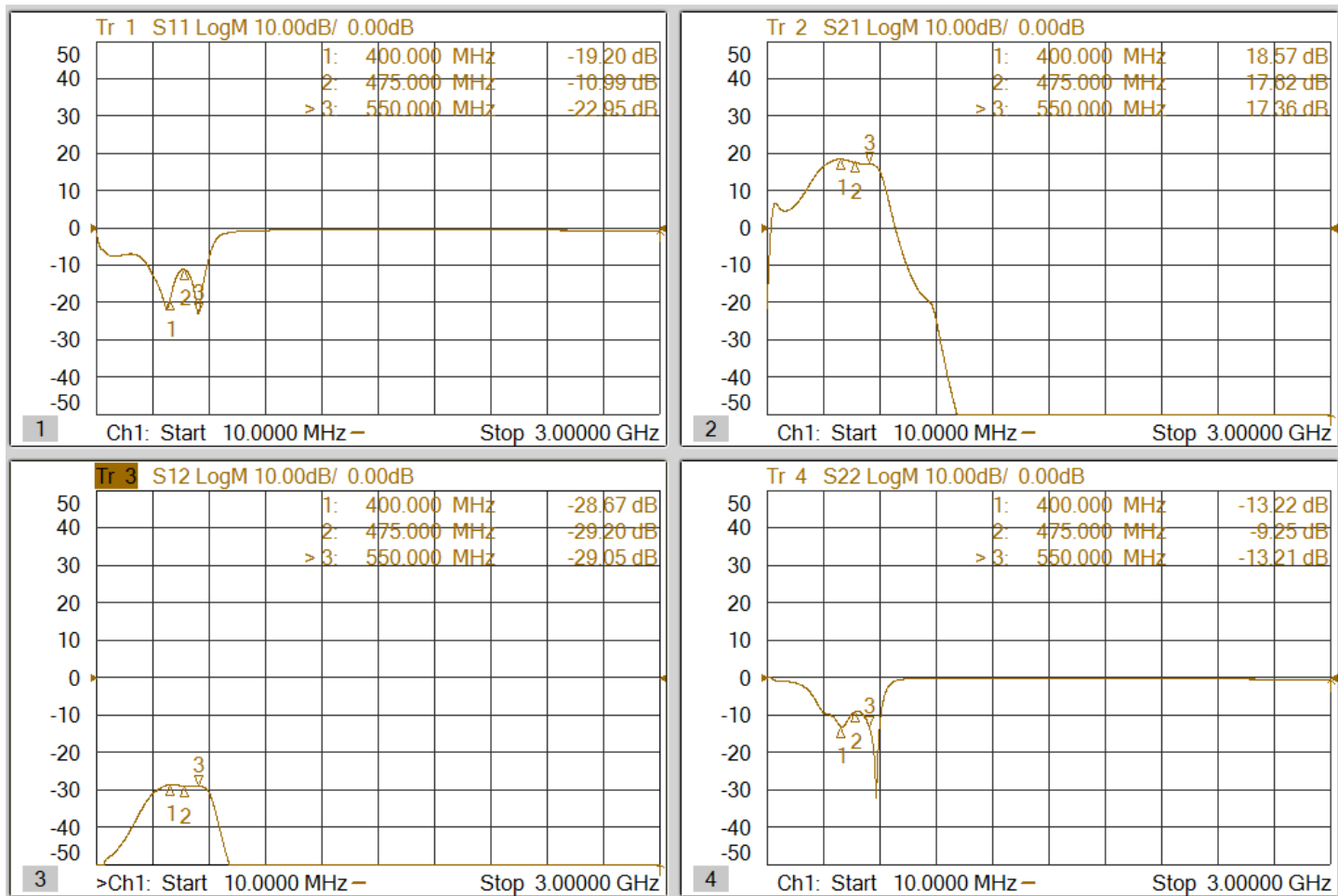
Thermal Resistance (Infrared Scan). DC only (no RF applied).	Θ_{Jref}		26.5		$^\circ\text{C}/\text{W}$	
--	-----------------	--	------	--	---------------------------	--

Note: MTTF > 10^6 hours for $T_J \leq 190\ ^\circ\text{C}$.

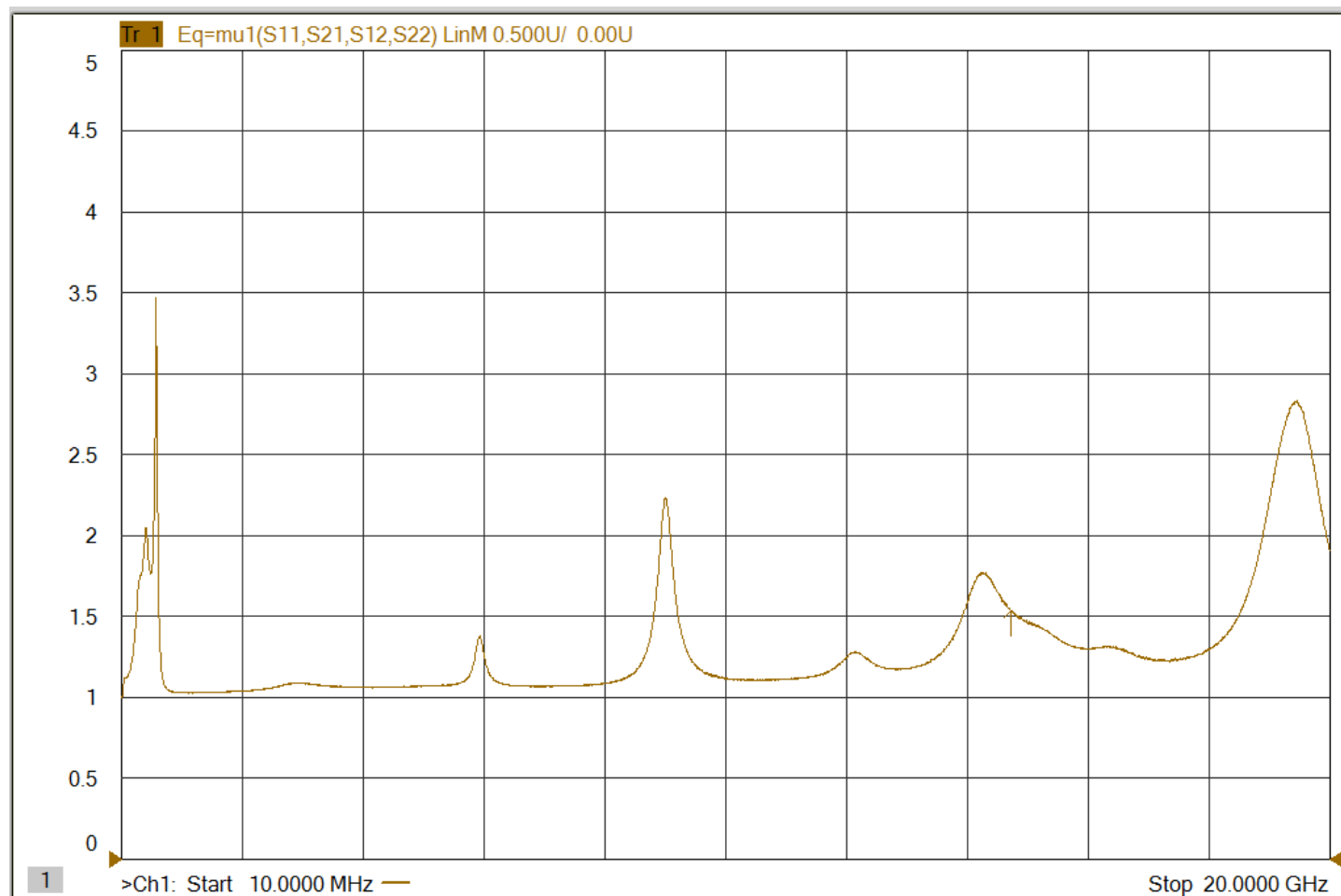
Typical Performance – RF: 400 to 550 MHz

The following conditions apply unless noted otherwise: typical application schematic using the 400 to 550 MHz tuning set. $V_{CC}/V_{BIAS}/V_{REF} = 5\text{ V}$, $I_{CQ} = 500\text{ mA}$, $50\ \Omega$ system impedance, $T_{PKG\ BASE} = 25\ ^\circ\text{C}$, Evaluation board losses are included within the specifications.

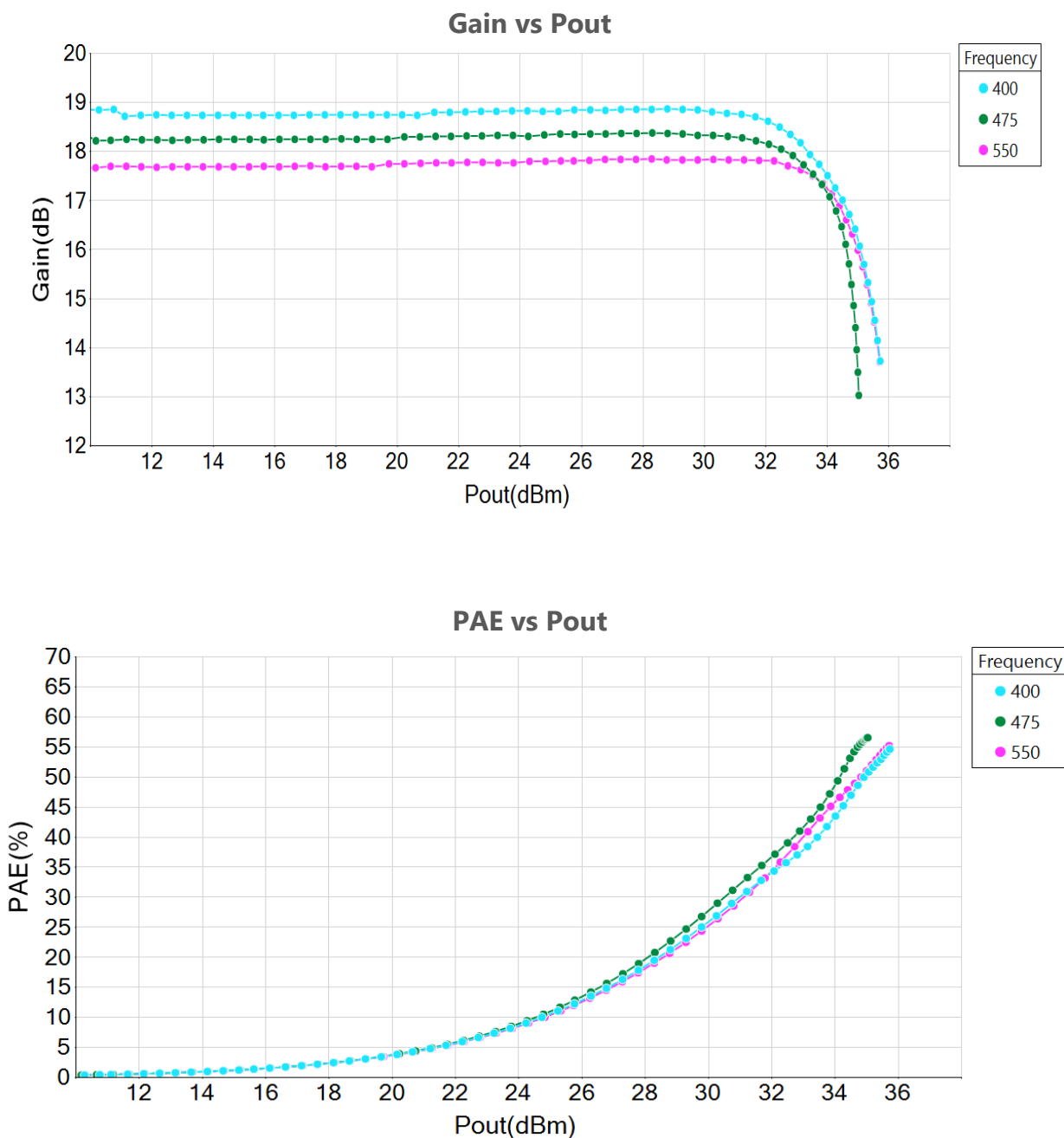
Parameter	Symbol	Specification			Unit	Condition
		400 MHz	475 MHz	550 MHz		
Small Signal Gain	S21	18.2	17.4	17	dB	Pin = -20 dBm
Input Return Loss	S11	18.8	11.7	19.6	dB	Pin = -20 dBm
Output Return Loss	S22	13.0	9.8	14.3	dB	Pin = -20 dBm
Reverse Isolation	S12	28.9	29.4	29.3	dB	Pin = -20 dBm
Noise Figure	NF	6.3	6.2	6.4	dB	On standard evaluation board.
Output 1 dB Compression Power	OP1dB	33.7	33.8	34.6	dBm	
Output 3 rd Order Intercept Point	OIP3	48.9	49.3	47.7	dBm	Pout = 24 dBm, $\Delta f = 0.5\text{ MHz}$

GRF5710 Typical Operating Curves: S-parameters (400 to 550 MHz Tune)


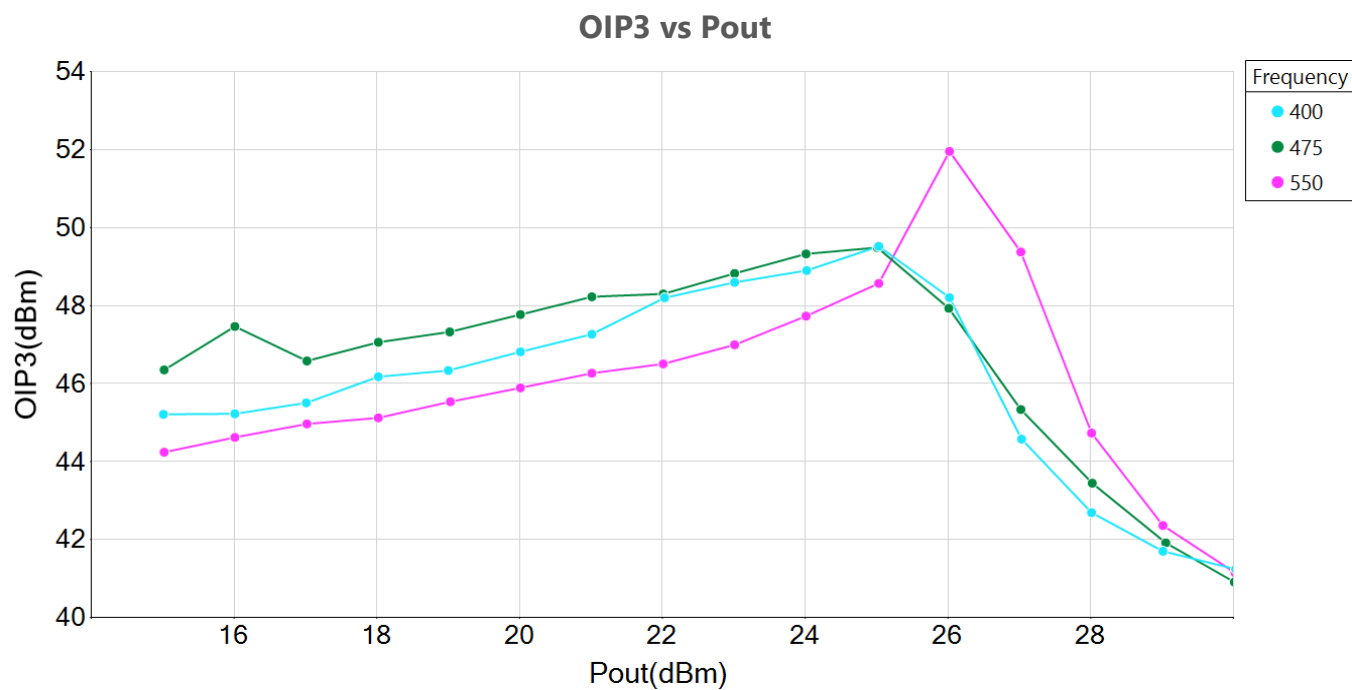
GRF5710 Typical Operating Curves: Mu Factor (400 to 550 MHz Tune)



Note: Mu Factor ≥ 1.0 implies unconditional stability.

GRF5710 Typical Operating Curves: 400 to 550 MHz Tune


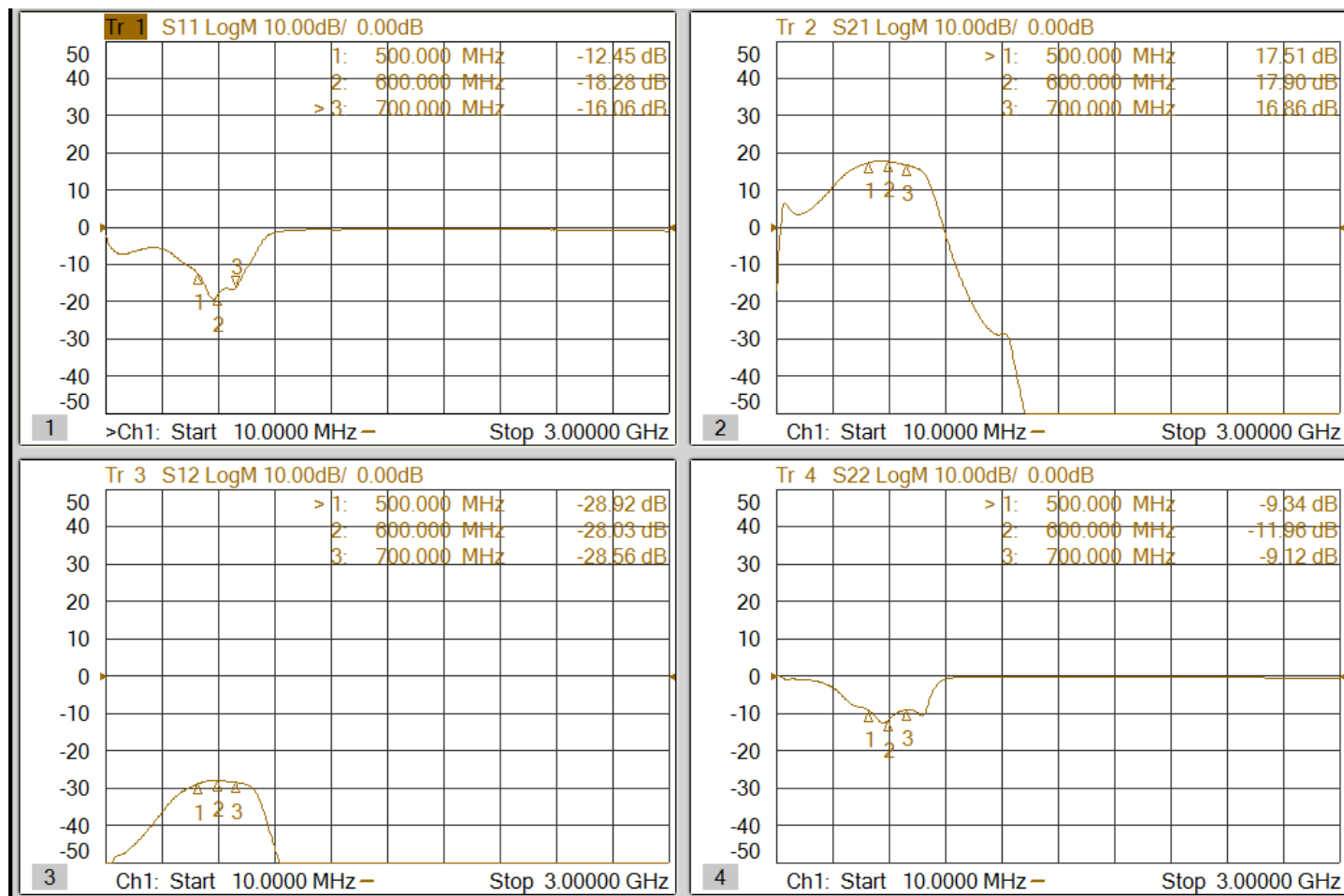
GRF5710 Typical Operating Curves: 400 to 550 MHz Tune



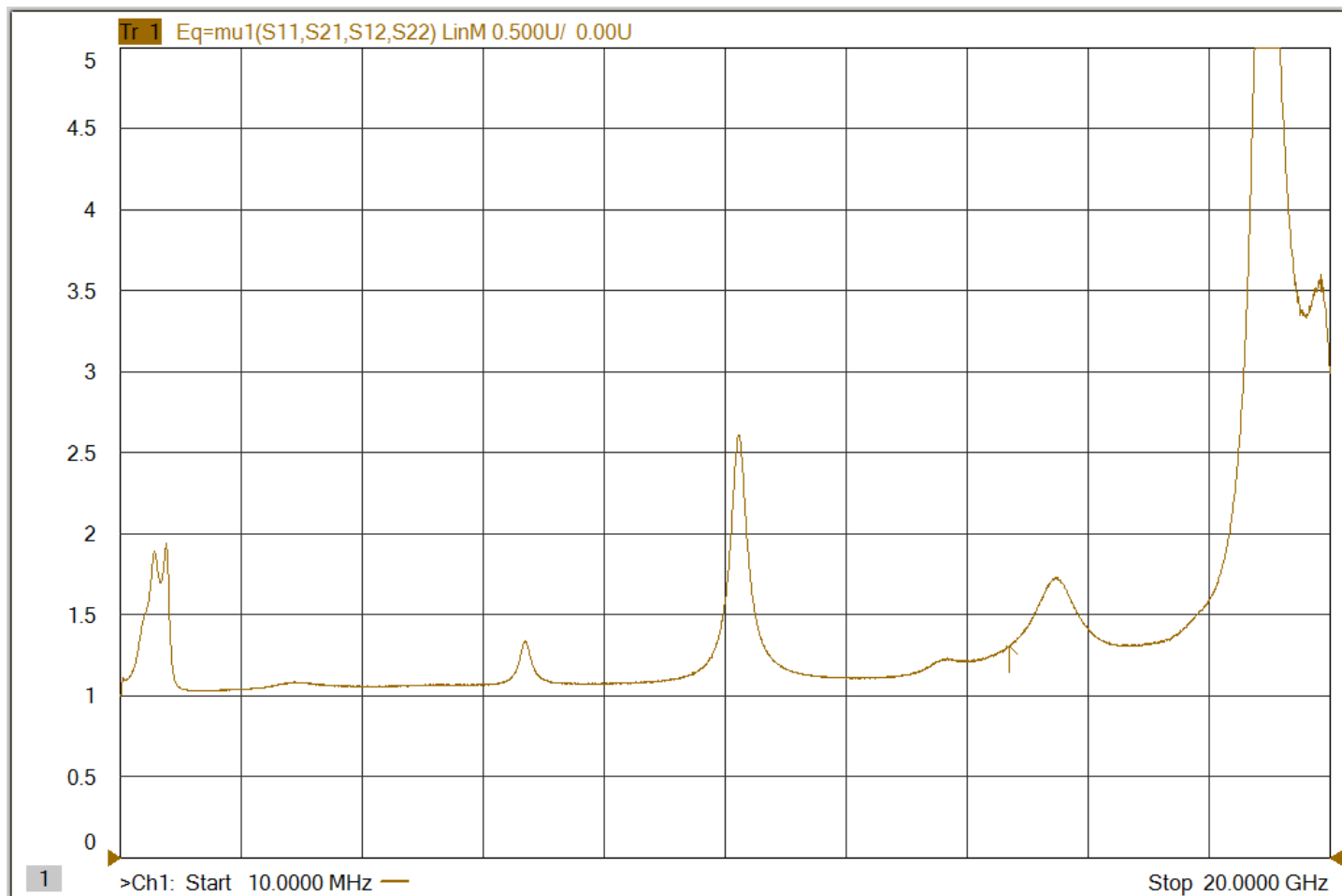
Typical Performance – RF: 500 to 700 MHz

The following conditions apply unless noted otherwise: typical application schematic using the 500 to 700 MHz tuning set. $V_{CC}/V_{BIAS}/V_{REF} = 5\text{ V}$, $I_{CQ} = 500\text{ mA}$, $50\ \Omega$ system impedance, $T_{PKG\ BASE} = 25\ ^\circ\text{C}$, Evaluation board losses are included within the specifications.

Parameter	Symbol	Specification			Unit	Condition
		500 MHz	600 MHz	700 MHz		
Small Signal Gain	S21	17.8	18	17	dB	Pin = -20 dBm
Input Return Loss	S11	12.5	18.3	16.1	dB	Pin = -20 dBm
Output Return Loss	S22	9.3	12.0	9.1	dB	Pin = -20 dBm
Reverse Isolation	S12	28.9	28.0	28.6	dB	Pin = -20 dBm
Noise Figure	NF	6.0	5.8	6.1	dB	On standard evaluation board.
Output 1 dB Compression Power	OP1dB	34.6	34.4	35	dBm	
Output 3 rd Order Intercept Point	OIP3	50.7	47.3	46.7	dBm	Pout = 24 dBm, $\Delta f = 0.5\text{ MHz}$

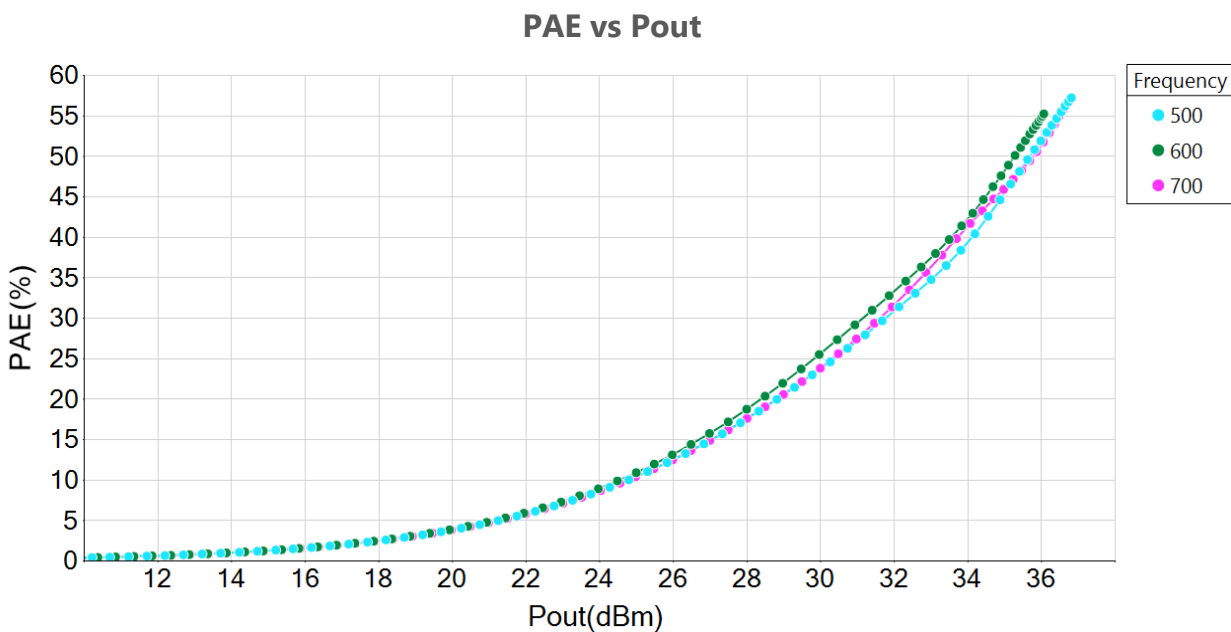
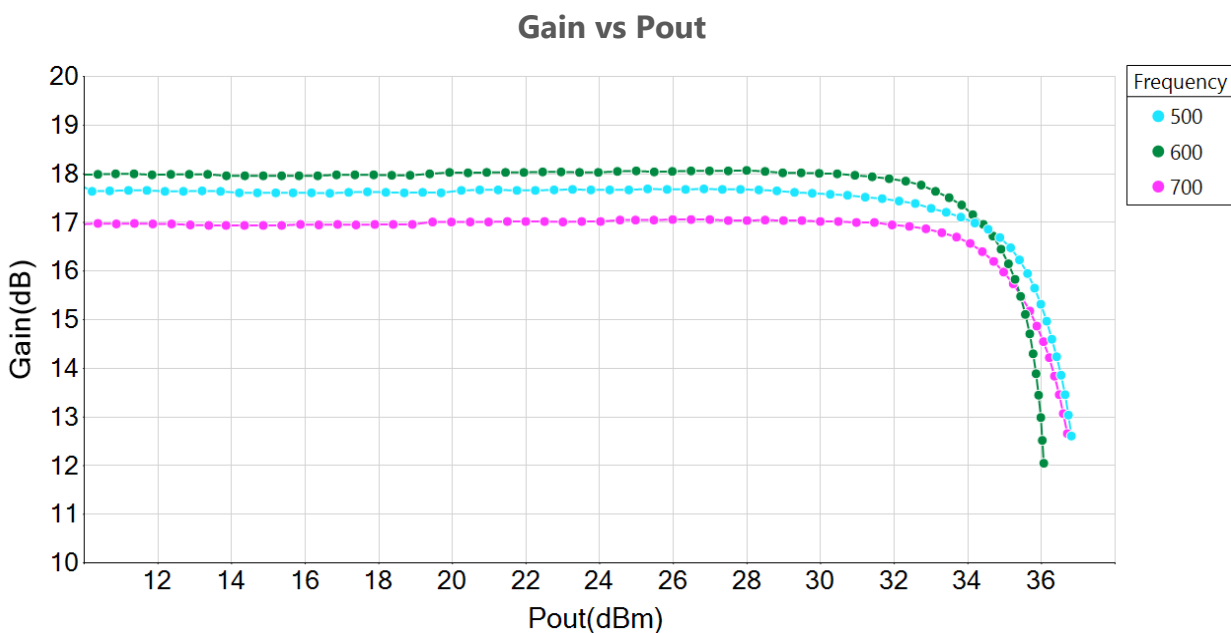
GRF5710 Typical Operating Curves: S-parameters (500 to 700 MHz Tune)


GRF5710 Typical Operating Curves: Mu Factor (500 to 700 MHz Tune)

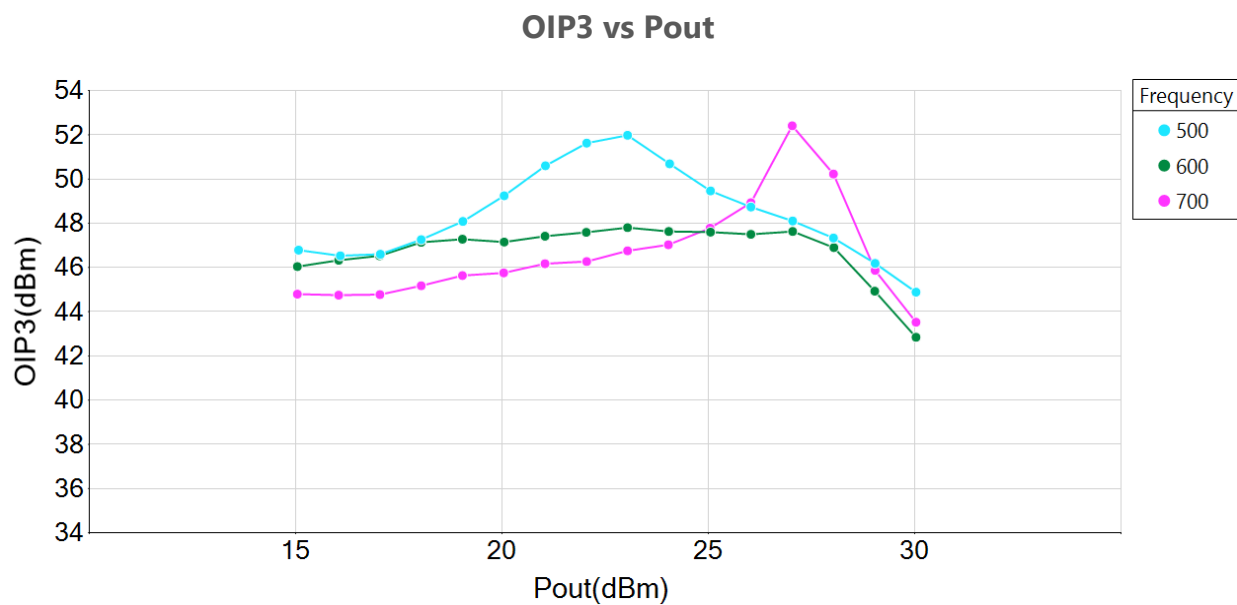


Note: Mu Factor ≥ 1.0 implies unconditional stability.

GRF5710 Typical Operating Curves: 500 to 700 MHz Tune



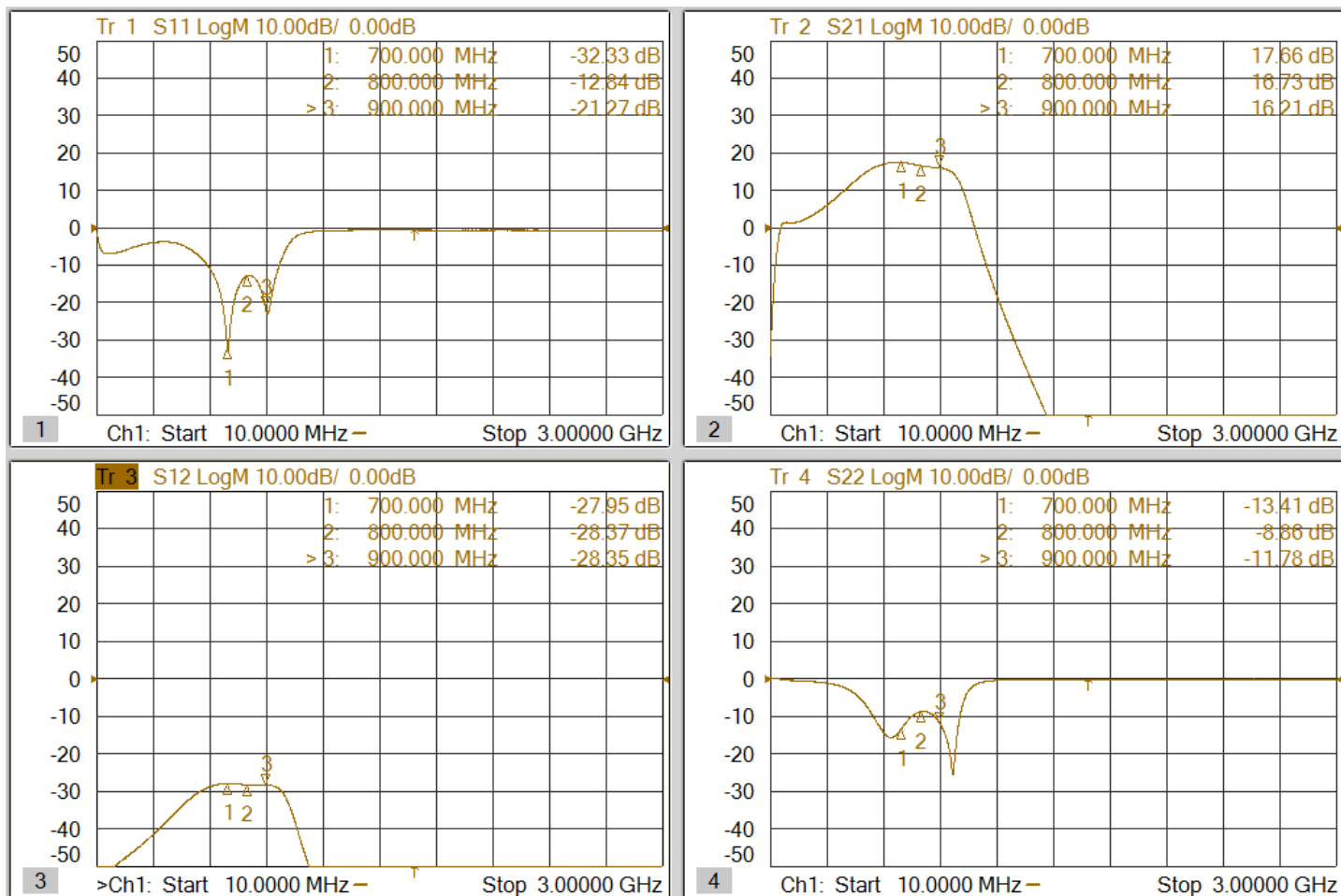
GRF5710 Typical Operating Curves: 500 to 700 MHz Tune



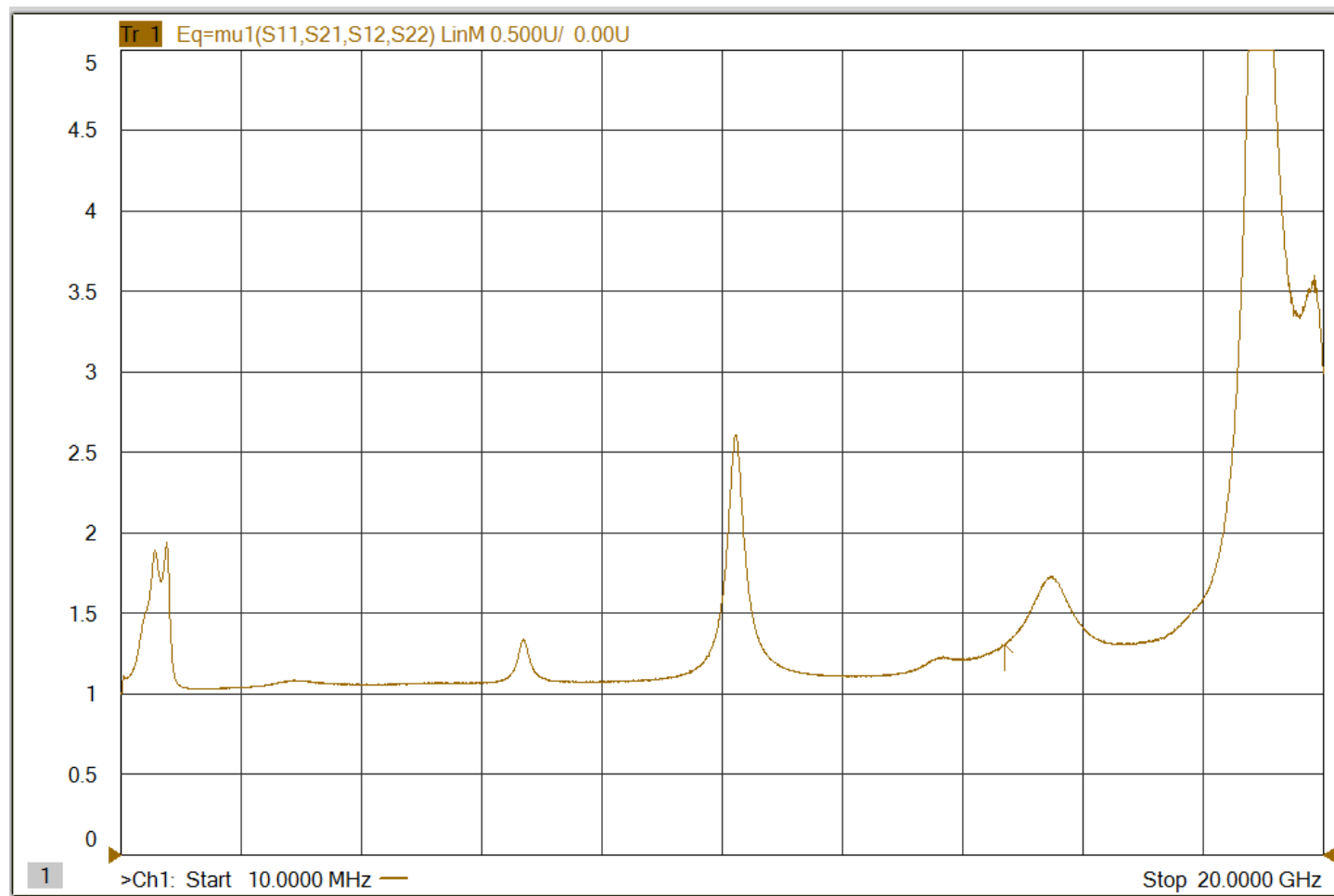
Typical Performance – RF: 700 to 900 MHz

The following conditions apply unless noted otherwise: typical application schematic using the 700 to 900 MHz tuning set. $V_{CC}/V_{BIAS}/V_{REF} = 5\text{ V}$, $I_{CQ} = 500\text{ mA}$, $50\ \Omega$ system impedance, $T_{PKG\ BASE} = 25\ ^\circ\text{C}$, Evaluation board losses are included within the specifications.

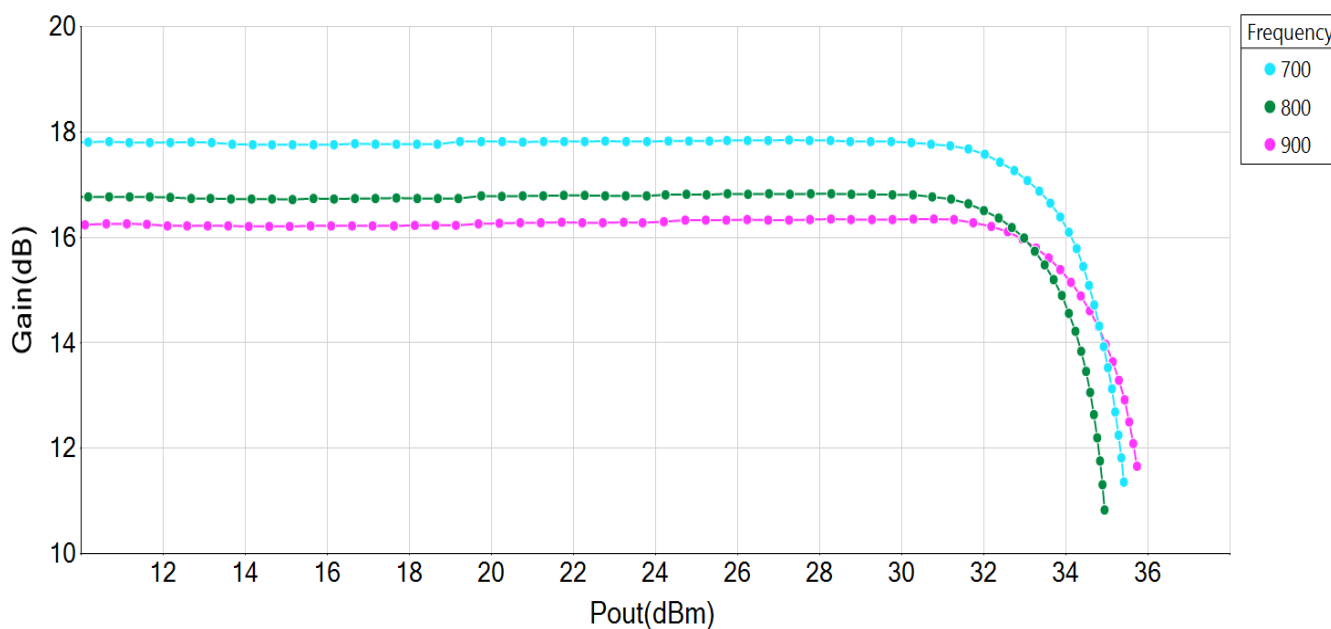
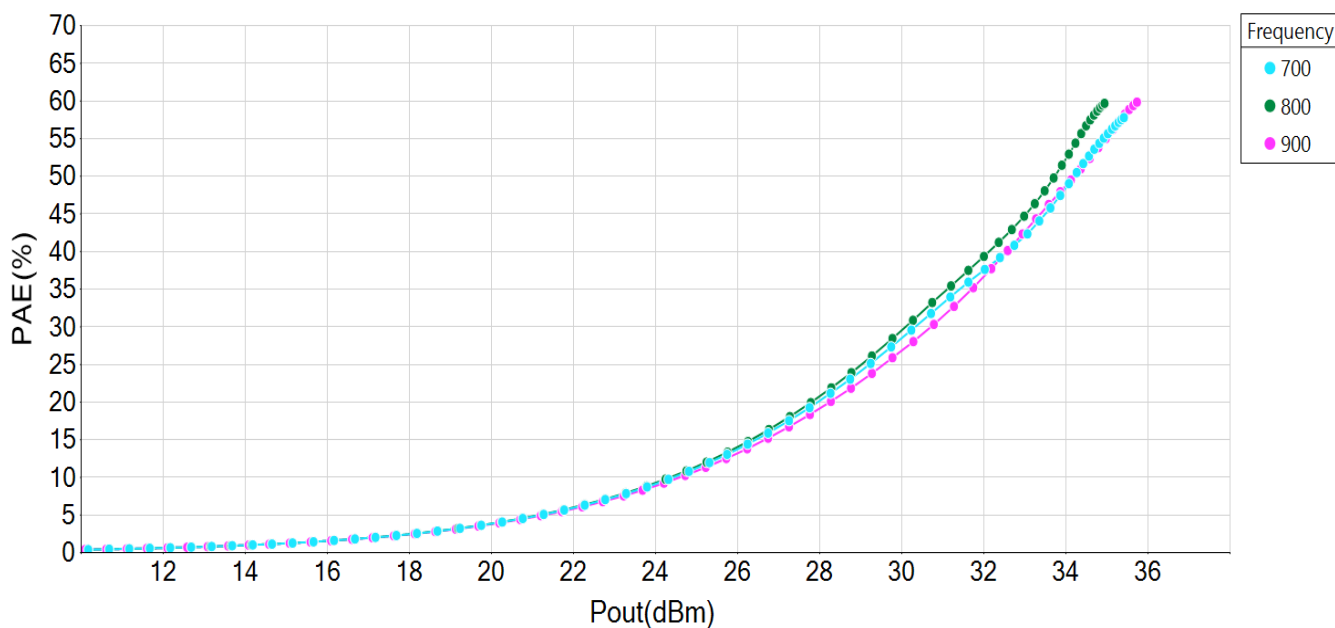
Parameter	Symbol	Specification			Unit	Condition
		700 MHz	800 MHz	900 MHz		
Small Signal Gain	S21	17.7	16.7	16.2	dB	Pin = -20 dBm
Input Return Loss	S11	-32.3	-12.8	-21.3	dB	Pin = -20 dBm
Output Return Loss	S22	-13.4	-8.9	-11.8	dB	Pin = -20 dBm
Reverse Isolation	S12	-28.0	-28.4	-28.4	dB	Pin = -20 dBm
Noise Figure	NF	5.6	5.7	6.2	dB	On standard evaluation board.
Output 1 dB Compression Power	OP1dB	33.4	33.2	34.0	dBm	
Output 3 rd Order Intercept Point	OIP3	49.4	49.1	47.2	dBm	Pout = 24 dBm, $\Delta f = 0.5\text{ MHz}$

GRF5710 Typical Operating Curves: S-parameters (700 to 900 MHz Tune)


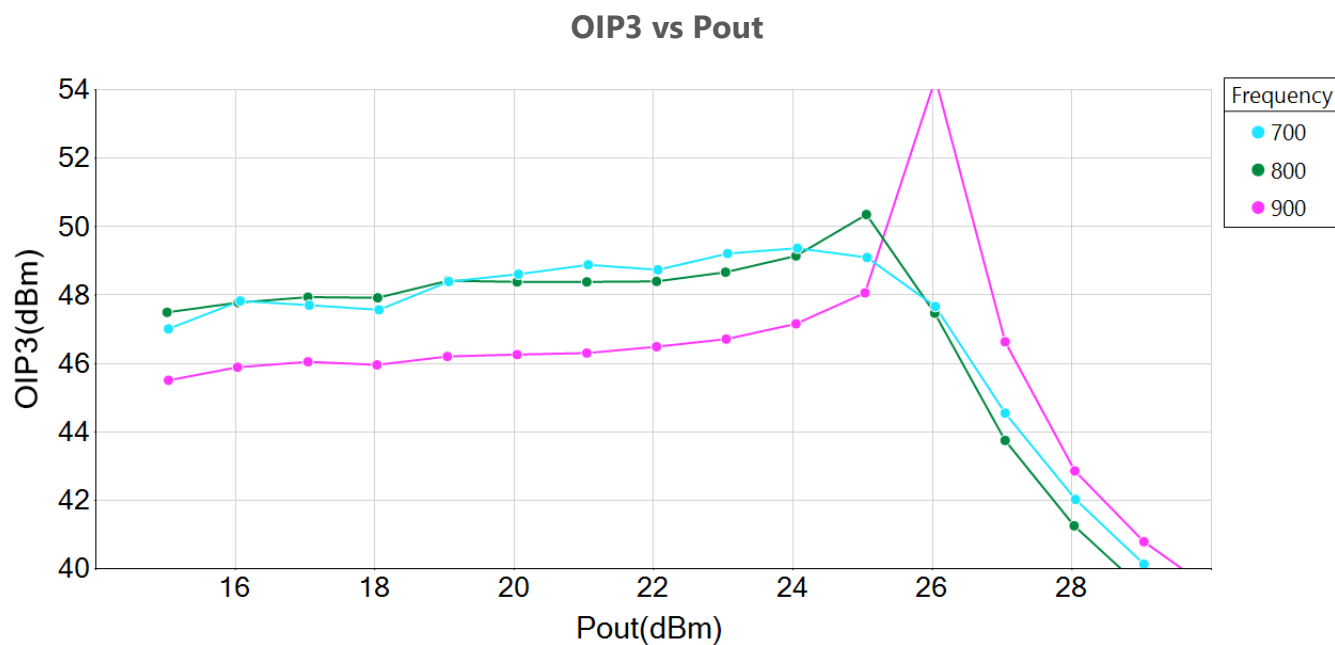
GRF5710 Typical Operating Curves: Mu Factor (700 to 900 MHz Tune)



Note: Mu Factor ≥ 1.0 implies unconditional stability.

GRF5710 Typical Operating Curves: 700 to 900 MHz Tune
Gain vs Pout

PAE vs Pout


GRF5710 Typical Operating Curves: 700 to 900 MHz Tune

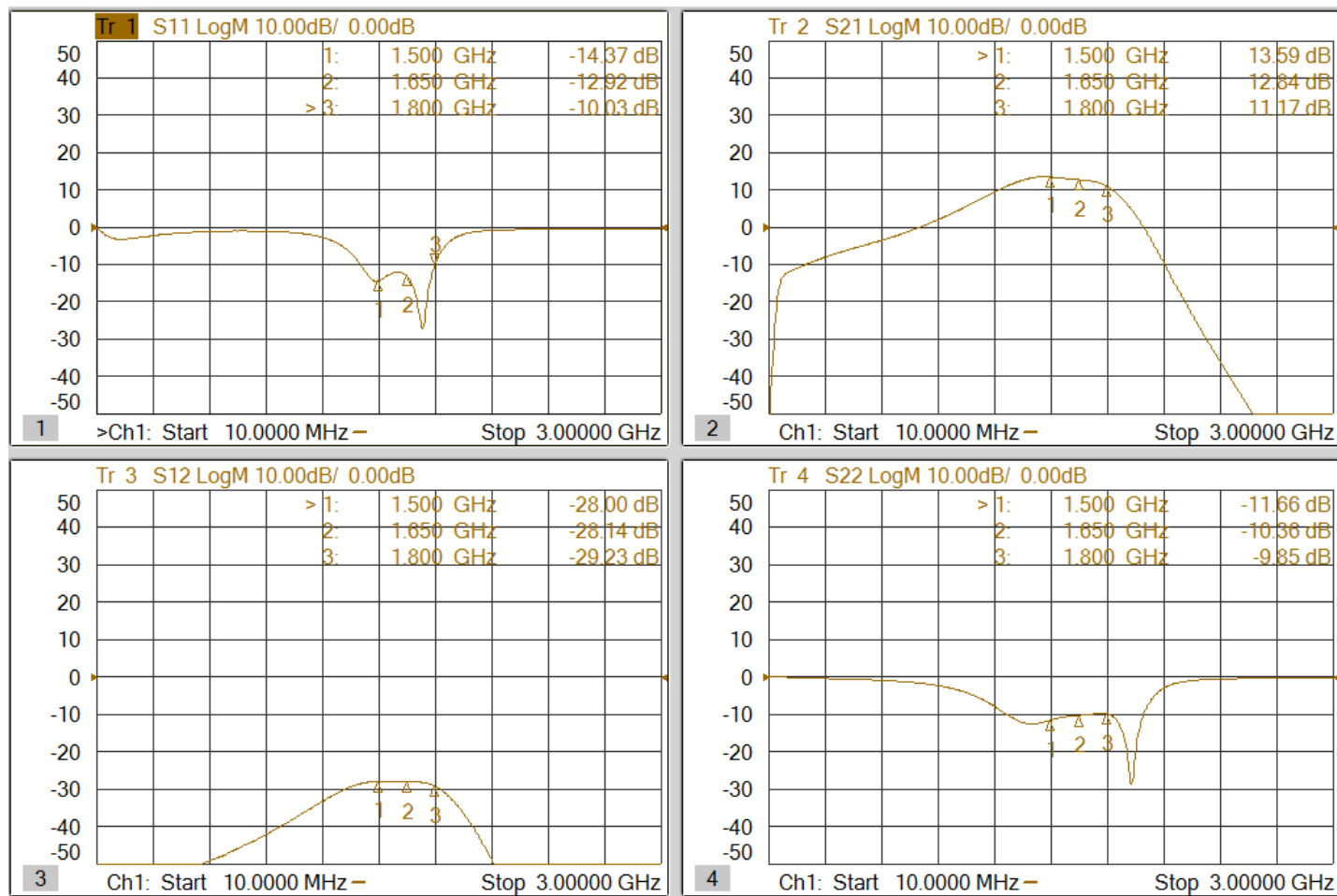


Typical Performance – RF: 1500 to 1800 MHz

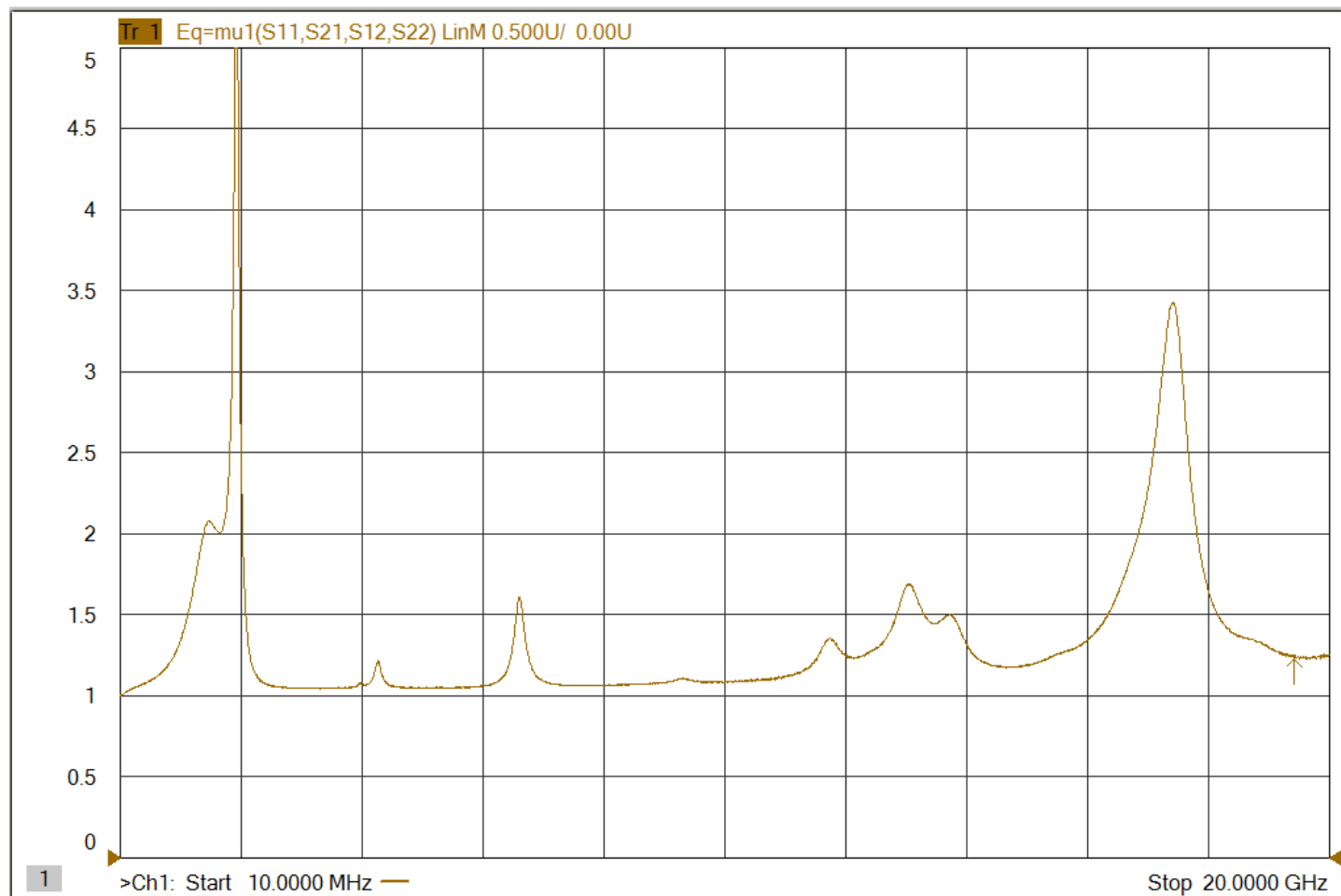
The following conditions apply unless noted otherwise: typical application schematic using the 1500 to 1800 MHz tuning set. $V_{CC}/V_{BIAS}/V_{REF} = 5\text{ V}$, $I_{CQ} = 500\text{ mA}$, $50\ \Omega$ system impedance, $T_{PKG\ BASE} = 25\ ^\circ\text{C}$, Evaluation board losses are included within the specifications.

Parameter	Symbol	Specification			Unit	Condition
		1500 MHz	1650 MHz	1800 MHz		
Small Signal Gain	S21	13.9	13	11.4	dB	Pin = -20 dBm
Input Return Loss	S11	14.4	12.9	10.0	dB	Pin = -20 dBm
Output Return Loss	S22	11.7	10.4	9.9	dB	Pin = -20 dBm
Reverse Isolation	S12	28	28.1	29.2	dB	Pin = -20 dBm
Noise Figure	NF	5.5	5.5	6.9	dB	On standard evaluation board.
Output 1 dB Compression Power	OP1dB	33.4	33.3	33.8	dBm	
Output 3 rd Order Intercept Point	OIP3	48.9	48.3	45.6	dBm	Pout = 24 dBm, $\Delta f = 0.5\text{ MHz}$

GRF5710 Typical Operating Curves: S-parameters (1500 to 1800 MHz Tune)

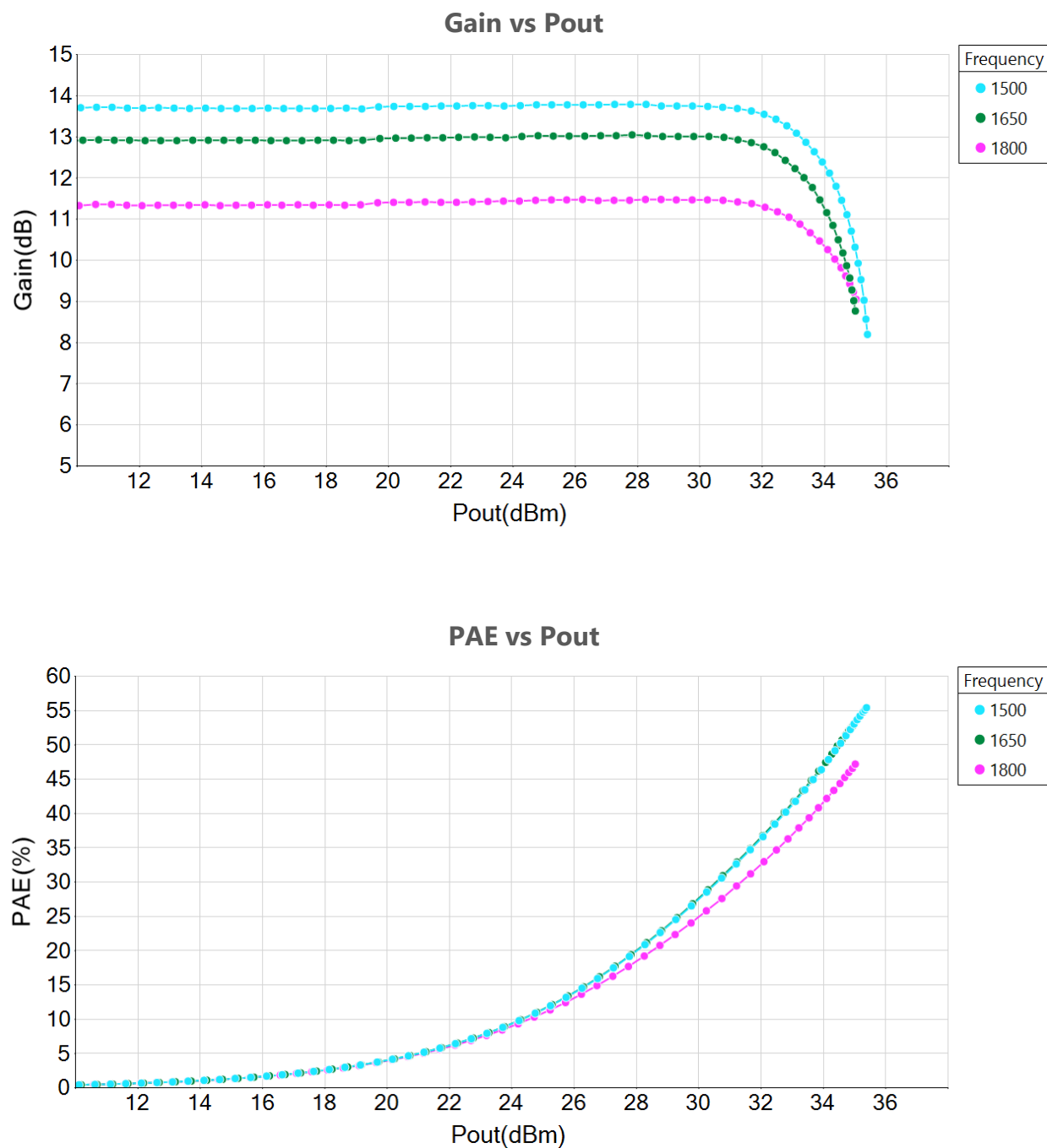


GRF5710 Typical Operating Curves: Mu Factor (1500 to 1800 MHz Tune)

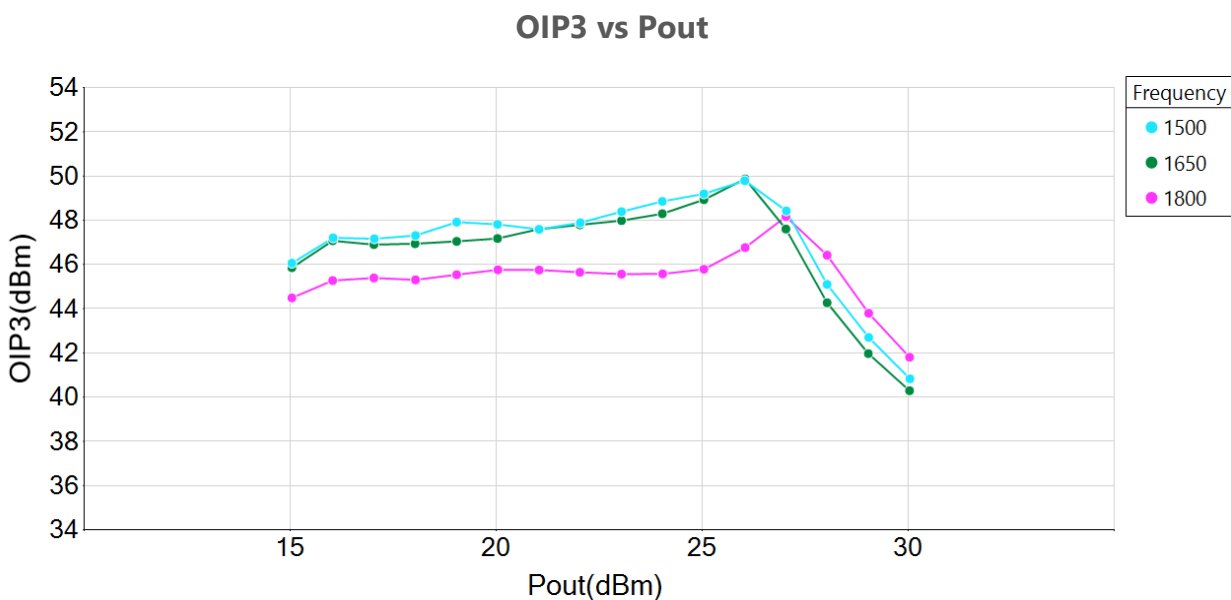


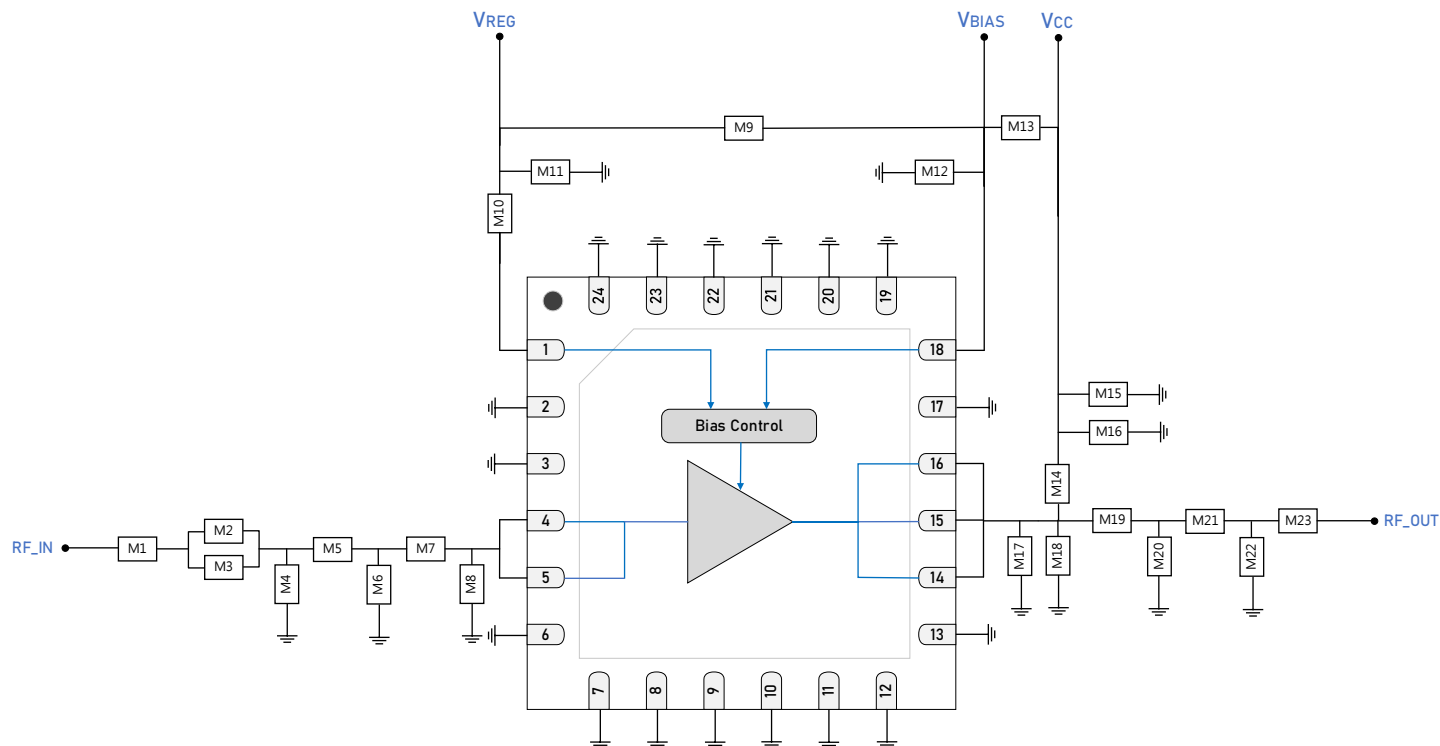
Note: Mu Factor ≥ 1.0 implies unconditional stability.

GRF5710 Typical Operating Curves: 1500 to 1800 MHz Tune

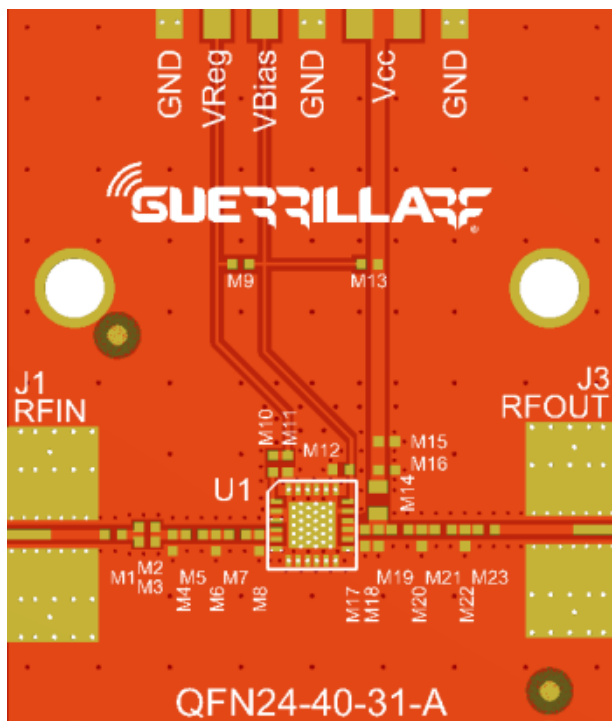


GRF5710 Typical Operating Curves: 1500 to 1800 MHz Tune

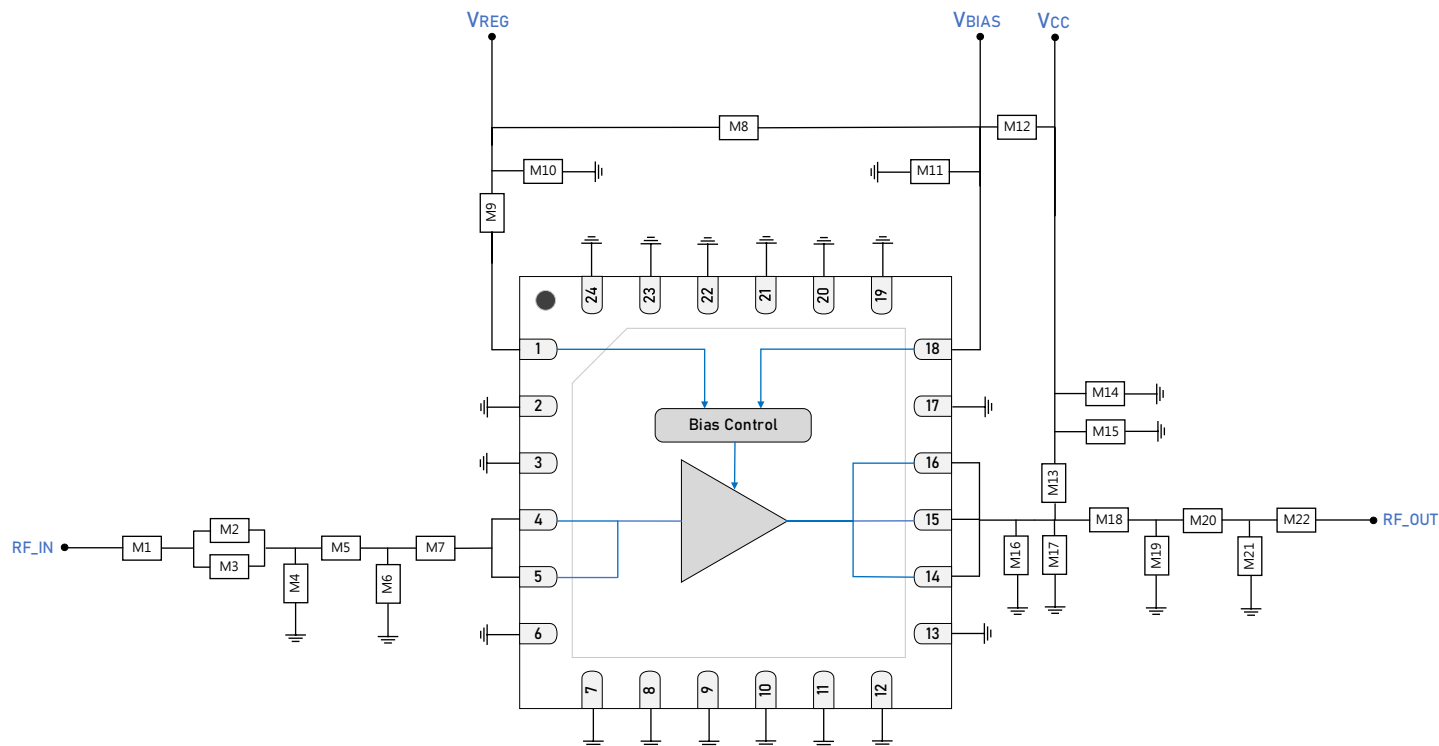




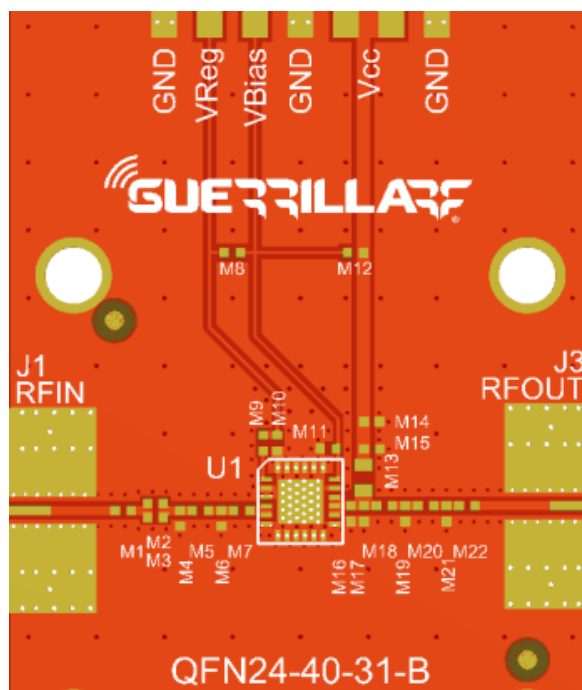
GRF5710 Standard Evaluation Board Schematic: 400 to 900 MHz Tune



GRF5710 Evaluation Board Assembly Diagram



GRF5710 Standard Evaluation Board Schematic: 1500 to 1800 MHz Tune



GRF5710 Evaluation Board Assembly Diagram

GRF5710 Evaluation Board Assembly Diagram Reference: 400 to 550 MHz Tune

Component	Type	Manufacturer	Family	Value	Package Size	Substitution
M1, M23	Capacitor	Murata	GRM	100 pF	0402	ok
M2	Resistor	Various	1%	49.9 Ω	0402	ok
M3	Capacitor	Murata	GJM	22 pF	0402	ok
M4	Capacitor	Murata	GJM	12 pF	0402	ok
M5	Inductor	Murata	LQG	6.8 nH	0402	ok
M6	Capacitor	Murata	GJM	47 pF	0402	ok
M7	Inductor	Murata	LQG	1.0 nH	0402	ok
M8	Capacitor	Murata	GJM	39 pF	0402	ok
M9, M13, M18	DNP	--	--	--	--	--
M10	Resistor	Various	1%	360 Ω	0402	ok
M11, M12, M16	Capacitor	Murata	GRM	0.1 μ F	0402	ok
M14	Inductor	Murata	LQW	8.2 nH	0805	ok
M15	Capacitor	Murata	GRM	10 μ F	0402	ok
M17	Capacitor	Murata	GJM	12 pF	0402	ok
M19	Inductor	Murata	LQG	1.5 nH	0402	ok
M20	Capacitor	Murata	GJM	39 pF	0402	ok
M21	Inductor	Coilcraft	0402 DC	7.8 nH	0402	ok
M22	Capacitor	Murata	GJM	12 pF	0402	ok
Evaluation Board	QFN24-40-31-A					

GRF5710 Evaluation Board Assembly Diagram Reference: 500 to 700 MHz Tune

Component	Type	Manufacturer	Family	Value	Package Size	Substitution
M1, M23	Capacitor	Murata	GRM	100 pF	0402	ok
M2	Resistor	Various	1%	49.9 Ω	0402	ok
M3	Capacitor	Murata	GJM	22 pF	0402	ok
M4	Capacitor	Murata	GJM	8.2 pF	0402	ok
M5	Inductor	Murata	LQG	5.1 nH	0402	ok
M6	Capacitor	Murata	GJM	33 pF	0402	ok
M7	Inductor	Murata	LQGWH	0.7 nH	0402	ok
M8	Capacitor	Murata	GJM	27 pF	0402	ok
M9, M13, M18	DNP	--	--	--	--	--
M10	Resistor	Various	1%	360 Ω	0402	ok
M11, M12, M16	Capacitor	Murata	GRM	0.1 μ F	0402	ok
M14	Inductor	Murata	LQW	8.2 nH	0805	ok
M15	Capacitor	Murata	GRM	10 μ F	0402	ok
M17	Capacitor	Murata	GJM	8.2 pF	0402	ok
M19	Inductor	Murata	LQGWH	0.8 nH	0402	ok
M20	Capacitor	Murata	GJM	33 pF	0402	ok
M21	Inductor	Coilcraft	0402 DC	5.2 nH	0402	ok
M22	Capacitor	Murata	GJM	10 pF	0402	ok
Evaluation Board	QFN24-40-31-A					

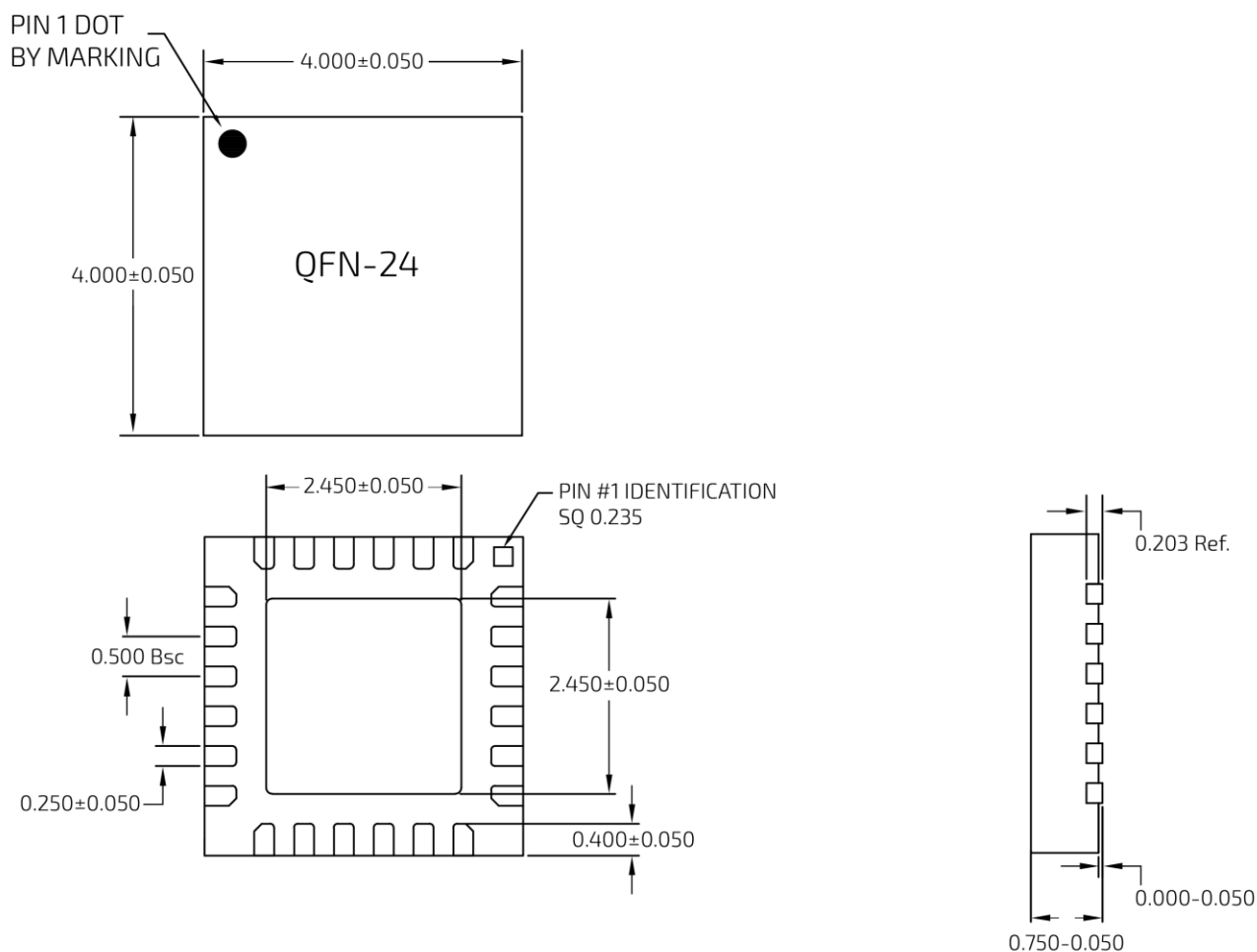
GRF5710 Evaluation Board Assembly Diagram Reference: 700 to 900 MHz Tune

Component	Type	Manufacturer	Family	Value	Package Size	Substitution
M1	Capacitor	Murata	GRM	100 pF	0402	ok
M2	Resistor	Various	1%	49.9 Ω	0402	ok
M3	Capacitor	Murata	GJM	22 pF	0402	ok
M4, M9, M13, M18	DNP	--	--	--	--	--
M5, M19	Resistor (jumper)	Various	5%	0 Ω	0402	ok
M6	Capacitor	Murata	GJM	8.2 pF	0402	ok
M7	Inductor	Murata	LQG	3.3 nH	0402	ok
M8	Capacitor	Murata	GJM	33 pF	0402	ok
M10	Resistor	Various	1%	360 Ω	0402	ok
M11, M12, M16	Capacitor	Murata	GRM	0.1 μ F	0402	ok
M14	Inductor	Murata	LQW	3.6 nH	0805	ok
M15	Capacitor	Murata	GRM	10 μ F	0402	ok
M17	Capacitor	Murata	GJM	5.1 pF	0402	ok
M20	Capacitor	Murata	GJM	22 pF	0402	ok
M21	Inductor	Coilcraft	0402 DC	4.5 nH	0402	ok
M22	Capacitor	Murata	GJM	6.8 pF	0402	ok
M23	Capacitor	Murata	GRM	47 pF	0402	ok
Evaluation Board	QFN24-40-31-A					

GRF5710 Evaluation Board Assembly Diagram Reference: 1500 to 1800 MHz Tune

Component	Type	Manufacturer	Family	Value	Package Size	Substitution
M1, M22	Resistor (jumper)	Various	5%	0 Ω	0402	ok
M2	Resistor	Various	1%	49.9 Ω	0402	ok
M3	Capacitor	Murata	GJM	22 pF	0402	ok
M4	Capacitor	Murata	GJM	4.3 pF	0402	ok
M5	Inductor	Murata	LQG	1.5 nH	0402	ok
M6	Capacitor	Murata	GJM	12 pF	0402	ok
M7	Capacitor	Murata	GJM	10 pF	0402	ok
M8, M12, M21	DNP	--	--	--	--	--
M9	Resistor	Various	1%	360 Ω	0402	ok
M10, M11, M15	Capacitor	Murata	GRM	0.1 μ F	0402	ok
M13	Inductor	Murata	LQW	3.2 nH	0805	ok
M14	Capacitor	Murata	GRM	10 μ F	0402	ok
M16	Capacitor	Murata	GJM	6.8 pF	0402	ok
M17	Capacitor	Murata	GJM	4.3 pF	0402	ok
M18	Inductor	Coilcraft	0402 DC	1.8 nH	0402	ok
M19	Capacitor	Murata	GJM	3.3 pF	0402	ok
M20	Capacitor	Murata	GJM	22 pF	0402	ok
Evaluation Board	QFN24-40-31-B					

Package Outline Drawing



4 x 4 mm QFN-24 Package Dimensions

Package Marking Diagram



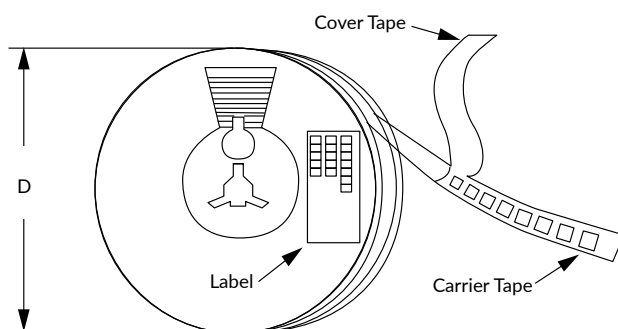
- Line 1: "YY" = YEAR. "WW" = WORK WEEK the device was assembled.
- Line 2: "GRF" = Guerrilla RF.
- Line 3: "XXXX" = Device PART NUMBER.

Tape and Reel Information

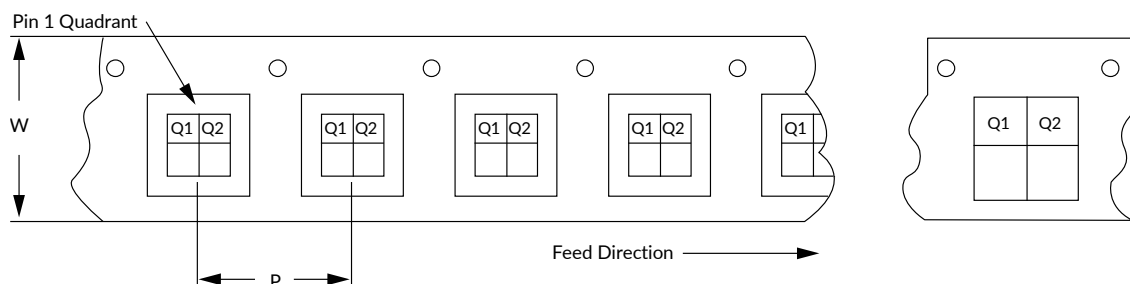
Guerrilla RF's tape and reel specification complies with Electronic Industries Alliance (EIA) standards for "Embossed Carrier Tape of Surface Mount Components for Automatic Handling" (reference EIA-481). See the following page for the Tape and Reel Specification and Device Package Information table, 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
June 24, 2025	Preliminary Data Sheet.



Datasheet 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 <i>production-released</i> material. TYP values are based on a combination of ATE and bench-level measurements, with MIN/MAX limits defined using <i>modelled estimates</i> 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 <i>derived from multiple lots which have been fabricated over an extended period of time</i> . MIN/MAX limits may be refined over previous releases as more statistically significant data is collected to account for process spreads.

Information in this datasheet is specific to the Guerrilla RF, Inc. ("Guerrilla RF") product identified.

This datasheet, including the information contained in it, is provided by Guerrilla RF as a service to its customers and may be used for informational purposes only by the customer. Guerrilla RF assumes no responsibility for errors or omissions on this datasheet or the information contained herein. Information provided is believed to be accurate and reliable, however, no responsibility is assumed by Guerrilla RF for its use, nor for any infringement of patents, or other rights of third parties, resulting from its use. Guerrilla RF assumes no liability for any datasheet, datasheet information, materials, products, product information, or other information provided hereunder, including the sale, distribution, reproduction or use of Guerrilla RF products, information or materials.

No license, whether express, implied, by estoppel, by implication or otherwise is granted by this datasheet for any intellectual property of Guerrilla RF, or any third party, including without limitation, patents, patent rights, copyrights, trademarks and trade secrets. All rights are reserved by Guerrilla RF.

All information herein, products, product information, datasheets, and datasheet information are subject to change and availability without notice. Guerrilla RF reserves the right to change component circuitry, recommended application circuitry and specifications at any time without prior notice. Guerrilla RF may further change its datasheet, product information, documentation, products, services, specifications or product descriptions at any time, without notice. Guerrilla RF makes no commitment to update any materials or information and shall have no responsibility whatsoever for conflicts, incompatibilities, or other difficulties arising from any future changes.

GUERRILLA RF INFORMATION, PRODUCTS, PRODUCT INFORMATION, DATASHEETS AND DATASHEET INFORMATION ARE PROVIDED "AS IS" AND WITHOUT WARRANTY OF ANY KIND, WHETHER EXPRESS, IMPLIED, STATUTORY, OR OTHERWISE, INCLUDING FITNESS FOR A PARTICULAR PURPOSE OR USE, MERCHANTABILITY, PERFORMANCE, QUALITY OR NON-INFRINGEMENT OF ANY INTELLECTUAL PROPERTY RIGHT; ALL SUCH WARRANTIES ARE HEREBY EXPRESSLY DISCLAIMED. GUERRILLA RF DOES NOT WARRANT THE ACCURACY OR COMPLETENESS OF THE INFORMATION, TEXT, GRAPHICS OR OTHER ITEMS CONTAINED WITHIN THESE MATERIALS. GUERRILLA RF SHALL NOT BE LIABLE FOR ANY DAMAGES, INCLUDING BUT NOT LIMITED TO ANY SPECIAL, INDIRECT, INCIDENTAL, STATUTORY, OR CONSEQUENTIAL DAMAGES, INCLUDING WITHOUT LIMITATION, LOST REVENUES OR LOST PROFITS THAT MAY RESULT FROM THE USE OF THE MATERIALS OR INFORMATION, WHETHER OR NOT THE RECIPIENT OF MATERIALS HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGE.

Customers are solely responsible for their use of Guerrilla RF products in the Customer's products and applications or in ways which deviate from Guerrilla RF's published specifications, either intentionally or as a result of design defects, errors, or operation of products outside of published parameters or design specifications. Customers should include design and operating safeguards to minimize these and other risks. Guerrilla RF assumes no liability or responsibility for applications assistance, customer product design, or damage to any equipment resulting from the use of Guerrilla RF products outside of stated published specifications or parameters.