DATA SHEET

# GRF2100

## Low-Current Low Noise Amplifier 0.08 to 5.3 GHz

RELEASE B DATA SHEET

### FEATURES

- Flexible Bias Voltage and Current
- Internally Matched to 50 Ω
- Process: GaAs pHEMT
- Compact 1.5 x 1.5 mm DFN-6 Package

**Reference: 3.3 V / 15 mA / 2.5 GHz**

- Gain: 16.5 dB
- OIP3: 19 dBm
- OP1dB: 10 dBm
- Evaluation Board Noise Figure: 0.8 dB

### APPLICATIONS

- ISM LNA
- 2.4 GHz Drones
- Small Cells and Cellular Repeaters
- Distributed Antenna Systems

### ORDERING INFORMATION

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### DESCRIPTION

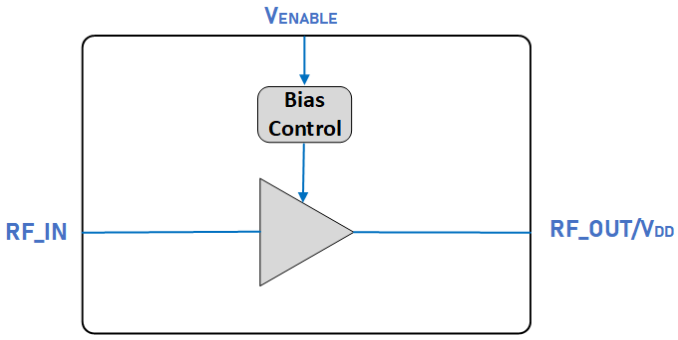
The GRF2100 is a high-gain, low-current LNA tunable over 0.08 to 5.3 GHz. It exhibits outstanding gain and noise figure (NF) with $I_{DDQ}$ levels as low as 8 mA.

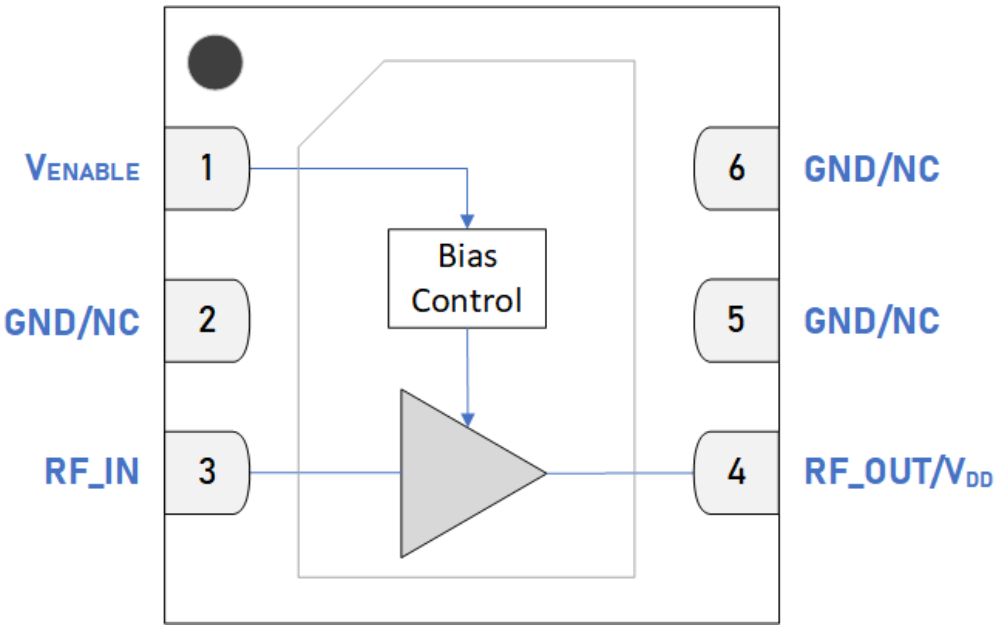
The device is operated from a Supply Voltage ($V_{DD}$) of 1.8 to 5 V with a selectable $I_{DDQ}$ range from 8 to 30 mA for optimal efficiency and linearity.

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 GRF2100 "Custom Tunes" product page: GRF2100 Custom Tunes

### BLOCK DIAGRAM






**Pin Out (Top View)**

## Pin Assignments

| Pin | Name | Description | Note |
|---|---|---|---|
| 1 | $V_{ENABLE}$ | Enable Voltage Input | $V_{ENABLE}$ and series resistor set $I_{DDQ}$. $V_{ENABLE} \leq 0.2$ volts disables the device. The 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. We recommend connecting these pins to ground. |
| 3 | RF_IN | LNA RF Input | An external DC blocking capacitor must be used. |
| 4 | RF_OUT/$V_{DD}$ | LNA RF Output | $V_{DD}$ must be applied to this pin through an RF choke. |
| PKG BASE | GND | Ground | Provides DC and RF ground for LNA, as well as a thermal heat sink. Recommend multiple 8 mil vias beneath the package for optimal RF and thermal performance. Refer to the evaluation board top layer graphic on the schematic page. |

## Absolute Ratings

| Parameter | Symbol | Min. | Max. | Unit |
|---|---|---|---|---|
| Supply Voltage | $V_{DD}$ | 0 | 5.5 | V |
| RF Input Power: Load VSWR < 2:1, $V_{DD} \leq 5$ V, $V_{EN} = 5$ V | $P_{IN\ MAX\ ON}$ | | 15 | dBm |
| RF Input Power: Load VSWR < 2:1, $V_{DD} \leq 5$ V, $V_{EN} = 0$ V | $P_{IN\ MAX\ OFF}$ | | 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 | $P_{DISS\ MAX}$ | | 150 | mW |

### Electrostatic Discharge

| | | | | |
|---|---|---|---|---|
| Human Body Model | HBM | 250 | | 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 - 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 | $V_{DD}$ | 0 | 3.3 | 5.5 | V | |
| Operating Temperature (Package Base) | $T_{PKG\ BASE}$ | -40 | | 105 | °C | |
| RF Frequency Range | $F_{TEST}$ | 0.08 | 2.5 | 5.3 | GHz | Typical application schematic with external matching components **(note 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: GRF2100 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 Measurement Schematic using the 0.1 to 3.8 GHz tuning set, 50 Ω system impedance, M5 = 6 kΩ, $V_{DD}$ = 3.3 V, $V_{ENABLE}$ = 3.3 V, $I_{DD}$ = 15 mA, $F_{TEST}$ = 2.5 GHz, $T_{PKG\ BASE}$ = 25 °C. Evaluation Board losses are included within the specifications.

| Parameter | Symbol | Specification | | | Unit | Condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Switching Rise Time | $T_{RISE}$ | | 800 | | ns | Disabled Mode to Gain Mode **(note 3)**. |
| Switching Fall Time | $T_{FALL}$ | | 200 | | ns | Gain Mode to Disabled Mode **(note 4)**. |
| Supply Current | $I_{DD}$ | 10 | 15 | 21 | mA | $V_{DD}$ = $V_{ENABLE}$ = 3.3 V, $R_{BIAS}$ = 6 kΩ |
| Enable Current | $I_{ENABLE}$ | | 0.2 | | mA | |

### Disabled Mode

| | | | | | | |
|---|---|---|---|---|---|---|
| Leakage Current | $I_{LEAKAGE}$ | | 1 | | µA | $V_{DD}$ = 3.3 V, $V_{ENABLE}$ = 0 V. |

### Thermal Data

| | | | | | | |
|---|---|---|---|---|---|---|
| Thermal Resistance (Infrared Scan) | $\Theta_{JC}$ | | 300 | | °C/W | On standard evaluation board **(note 5)**. |

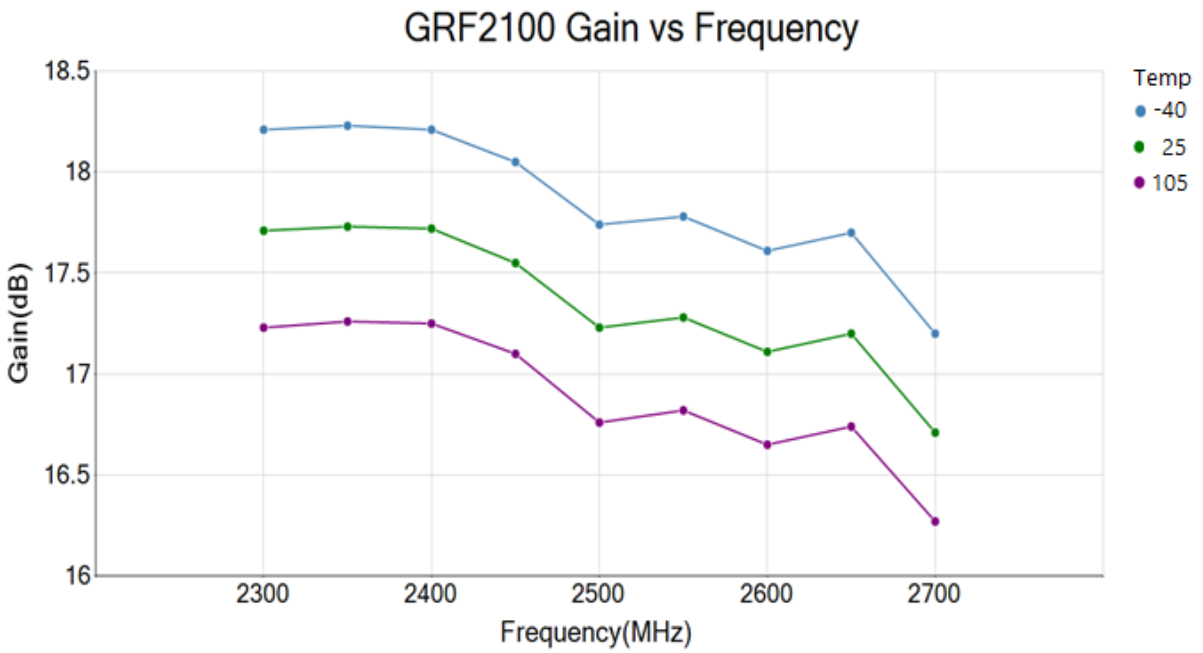
**Note 3:** Switching time: 50% of $V_{ENABLE}$ to 90% of $P_{OUT}$.
**Note 4:** Switching time: 50% of $V_{ENABLE}$ to 10% of $P_{OUT}$.
**Note 5:** MTTF > 10^6 hours for $T_{CHANNEL}$ < 170 °C.

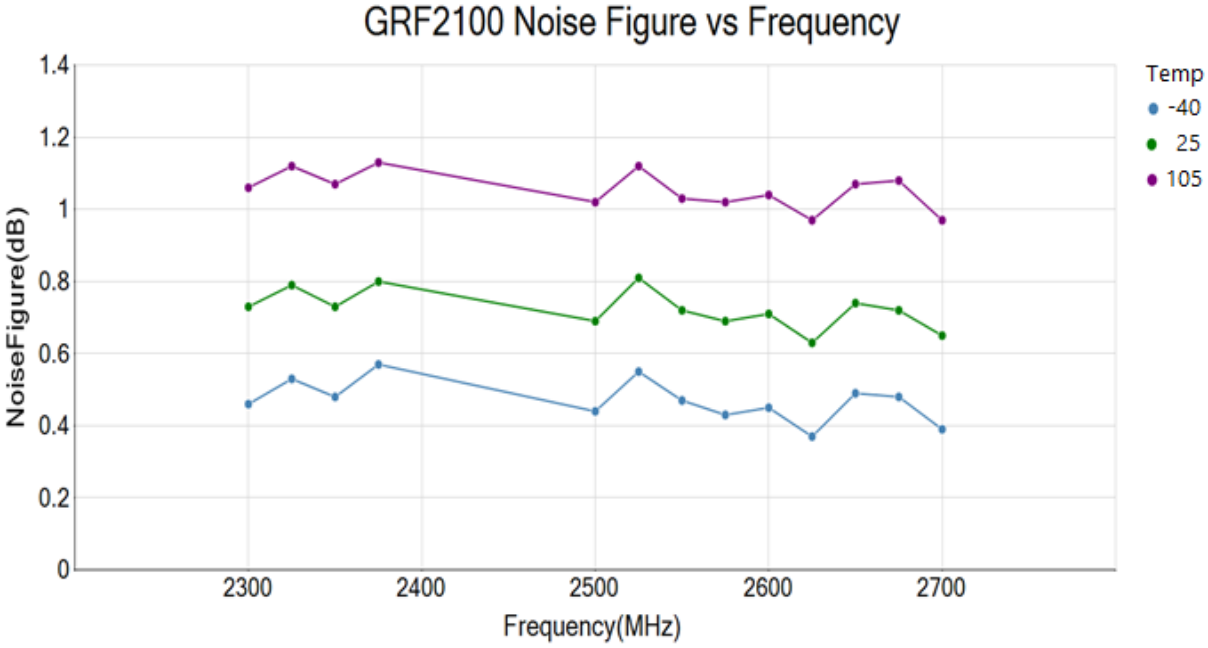
## Nominal Operating Parameters - RF

The following conditions apply unless noted otherwise: Typical Measurement Schematic using the 0.1 to 3.8 GHz tuning set. 50 Ω system impedance. M5 = 6 kΩ. $V_{DD}$ = 3.3 V, $V_{ENABLE}$ = 3.3 V, $I_{DD}$ = 15 mA. $F_{TEST}$ = 2.5 GHz. $T_{PKG\ BASE}$ = 25 °C. Evaluation Board losses are included within the specifications.

| Parameter | Symbol | Specification | | | Unit | Condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Gain | S21 | 15 | 16.5 | | dB | |
| Reverse Isolation | S12 | | < -20 | | dB | $F_{RF}$ = 0.4 to 3.8 GHz. |
| Evaluation Board Noise Figure | NF | | 0.8 | 1 | dB | |
| Output 3rd Order Intercept Point | OIP3 | | 19 | | dBm | -5 dBm $P_{OUT}$ per tone at 2 MHz spacing (2499 and 2501 MHz). |
| Output 1 dB Compression Power | OP1dB | 8 | 10 | | dBm | |

## GRF2100 Typical Operating Curves: 3.3 V, 15 mA, 2.3 to 2.7 GHz Tune



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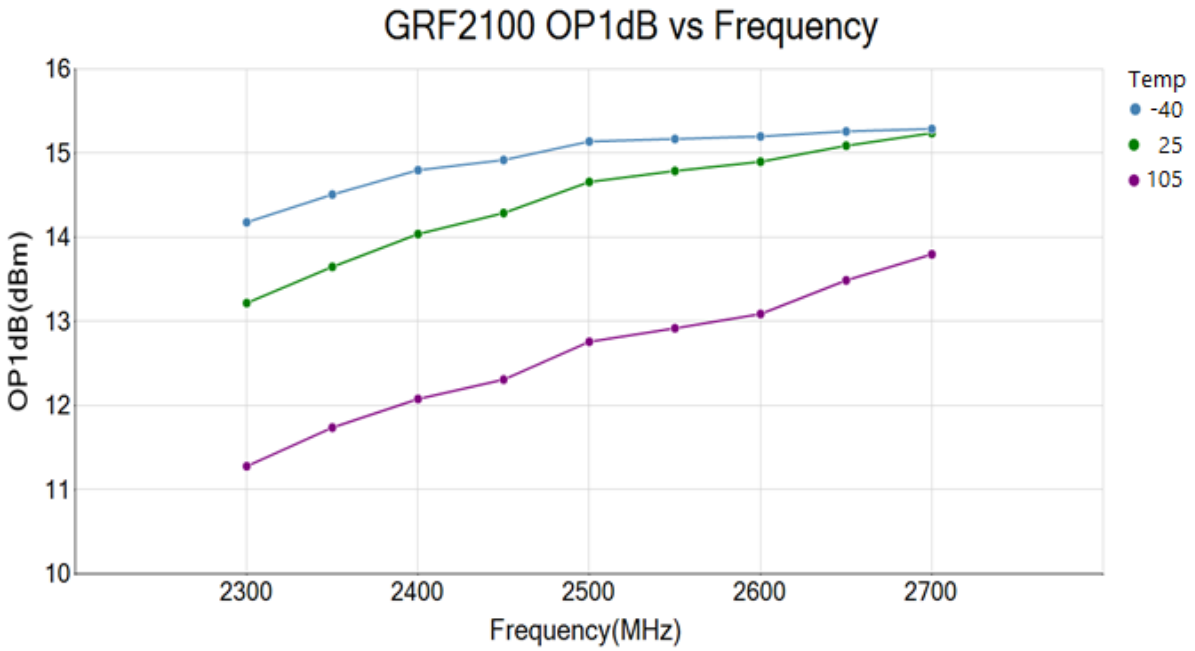
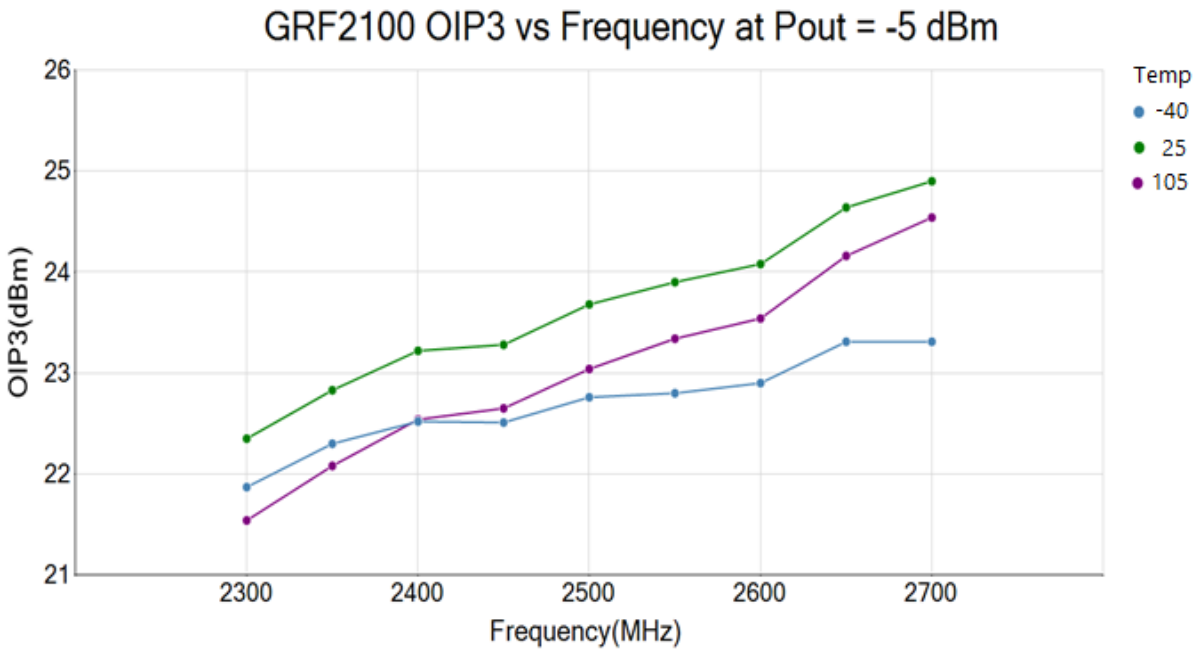
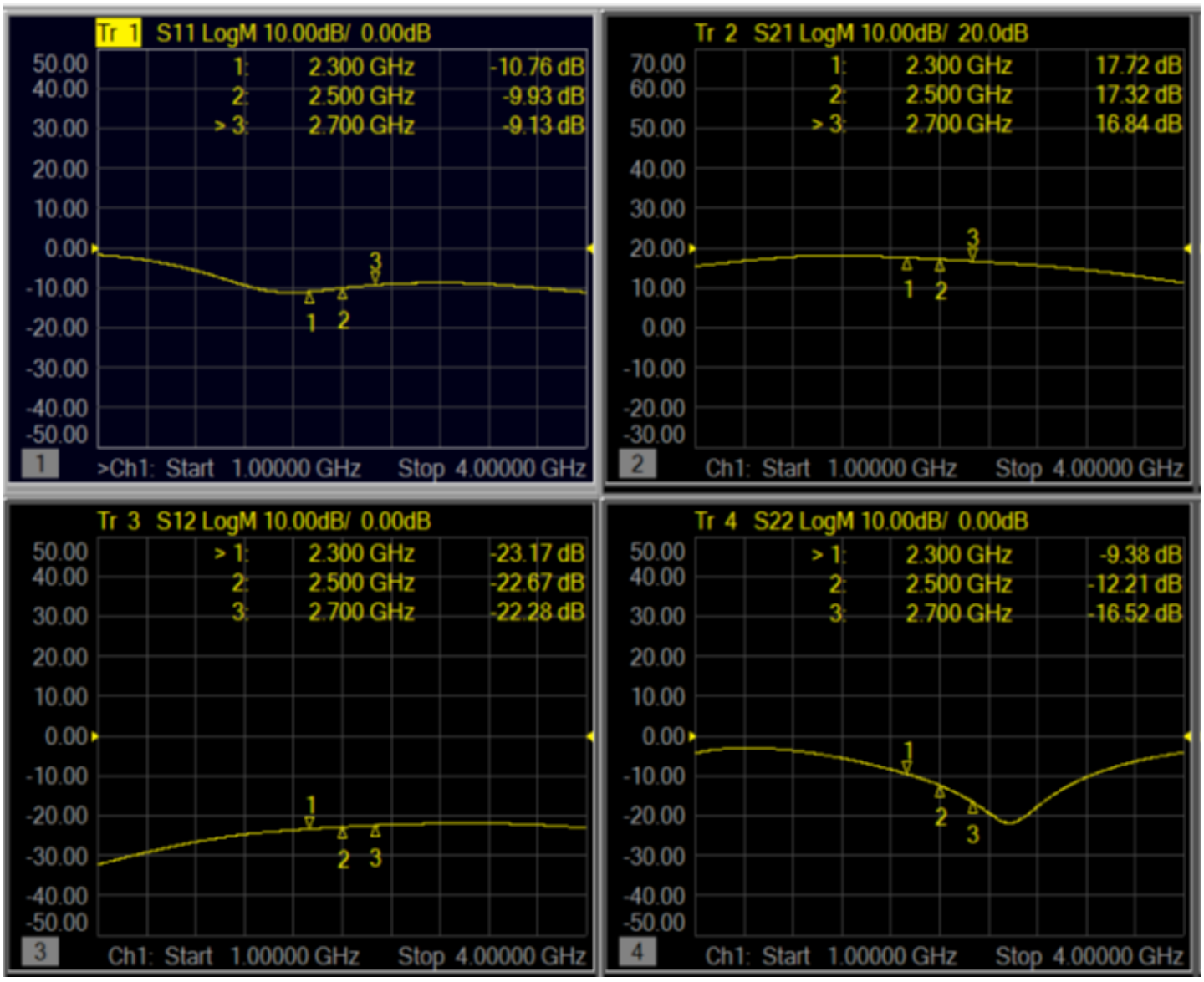
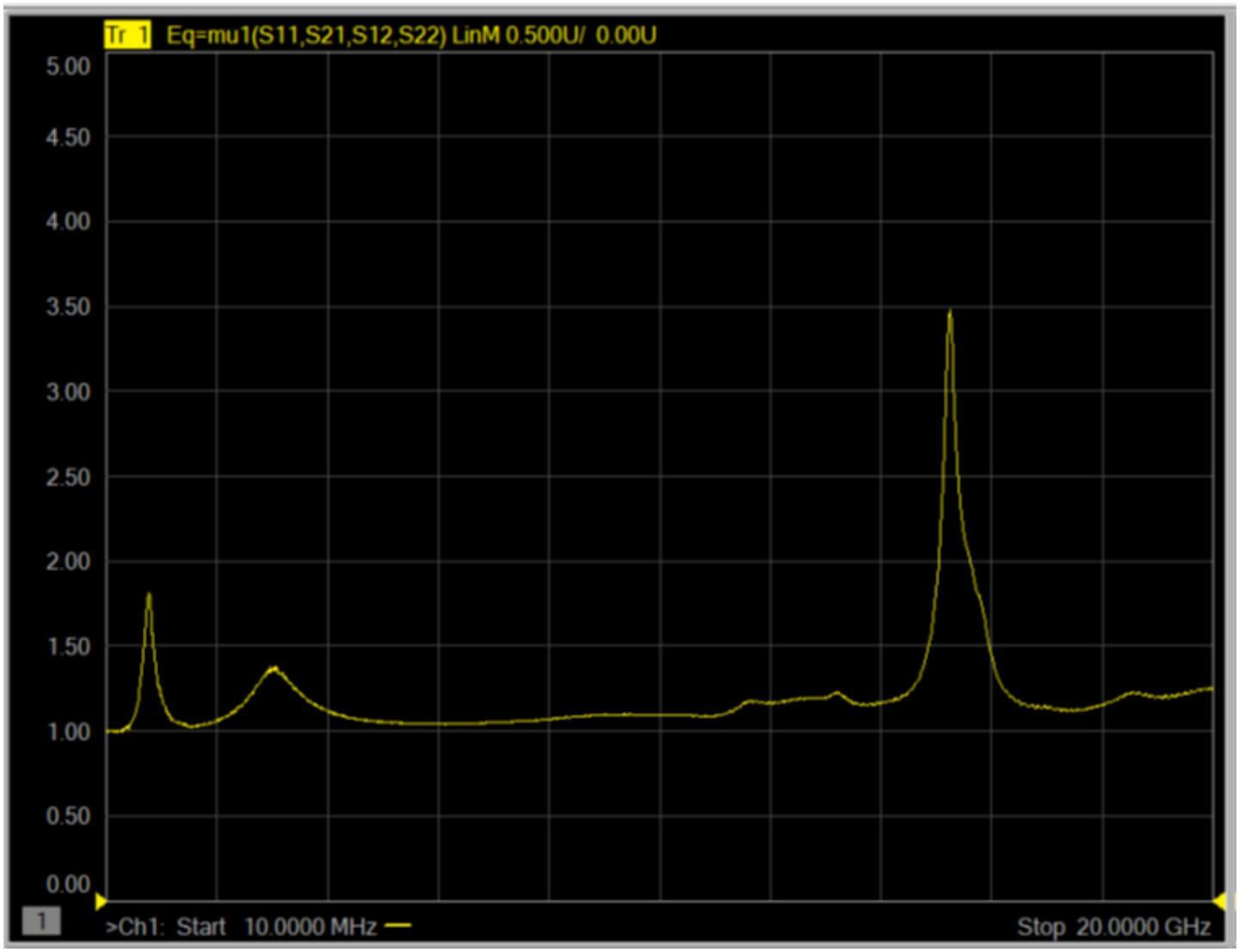


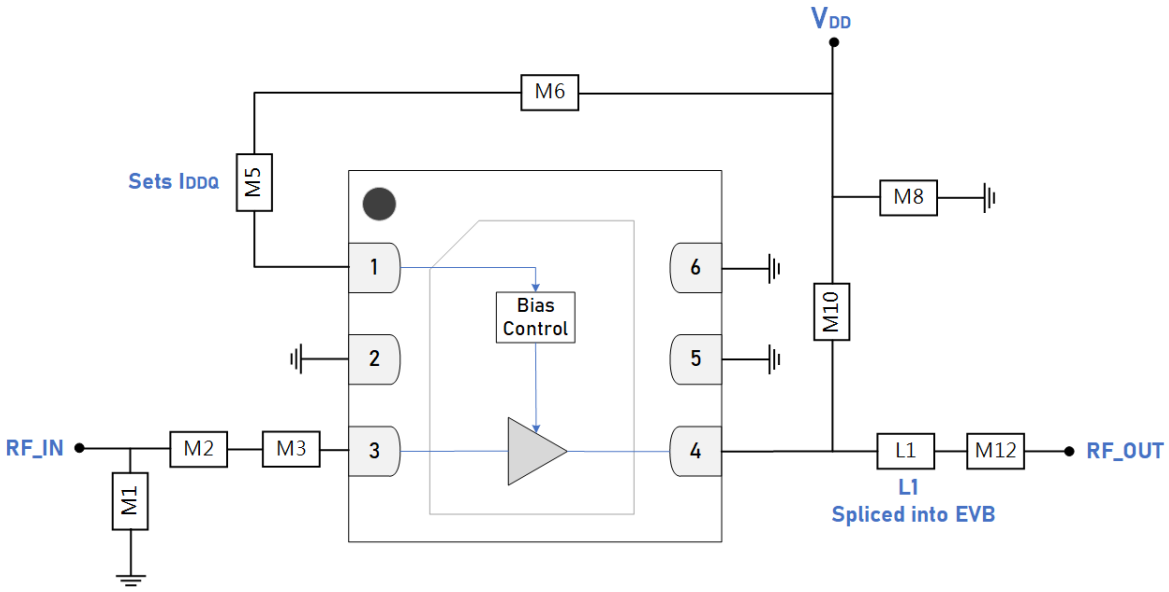
## GRF2100 Typical Operating Curves: S-Parameters (2.3 to 2.7 GHz Tune)



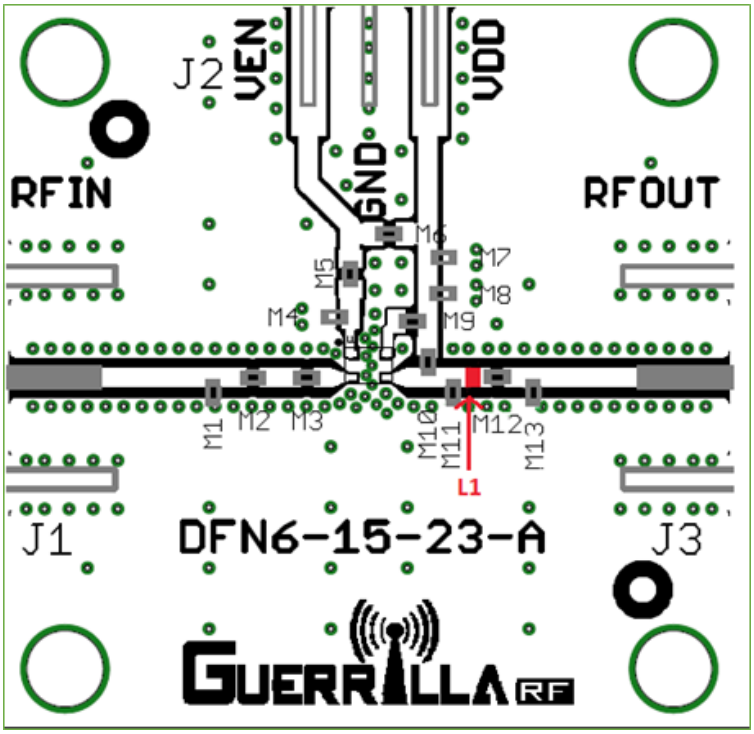
## GRF2100 Typical Operating Curves: Stability Mu Factor (10 MHz to 20 GHz)




**Note: Mu factor ≥ 1.0 implies unconditional stability.**




**GRF2100 Standard Evaluation Board Schematic**

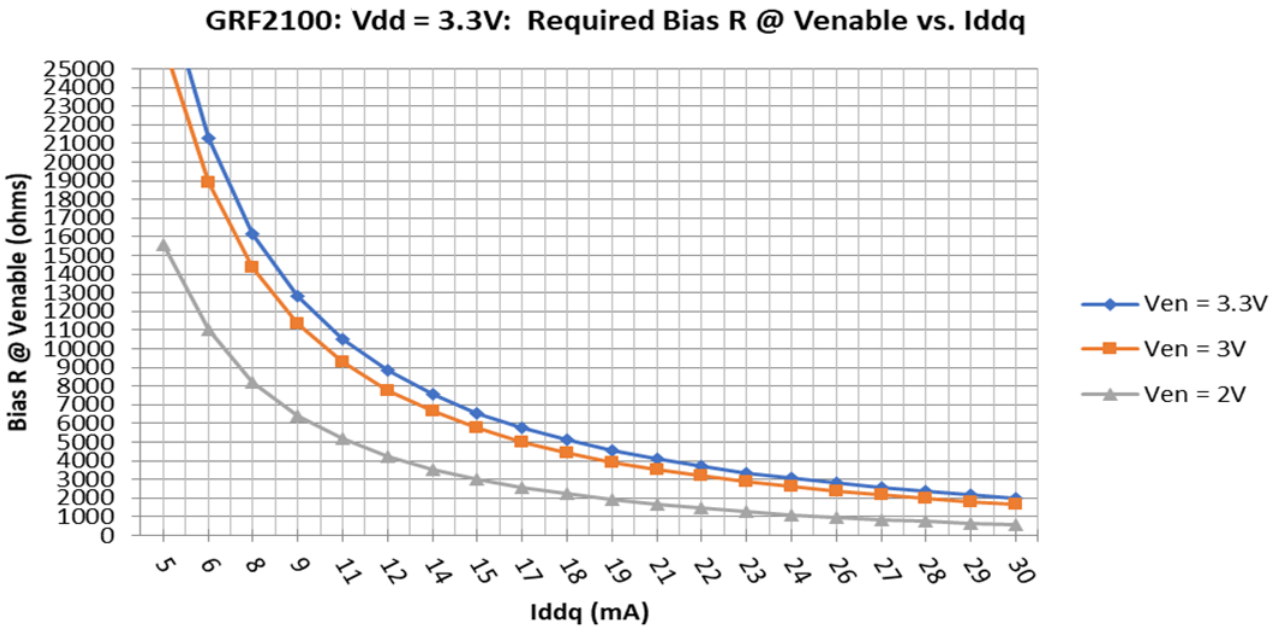


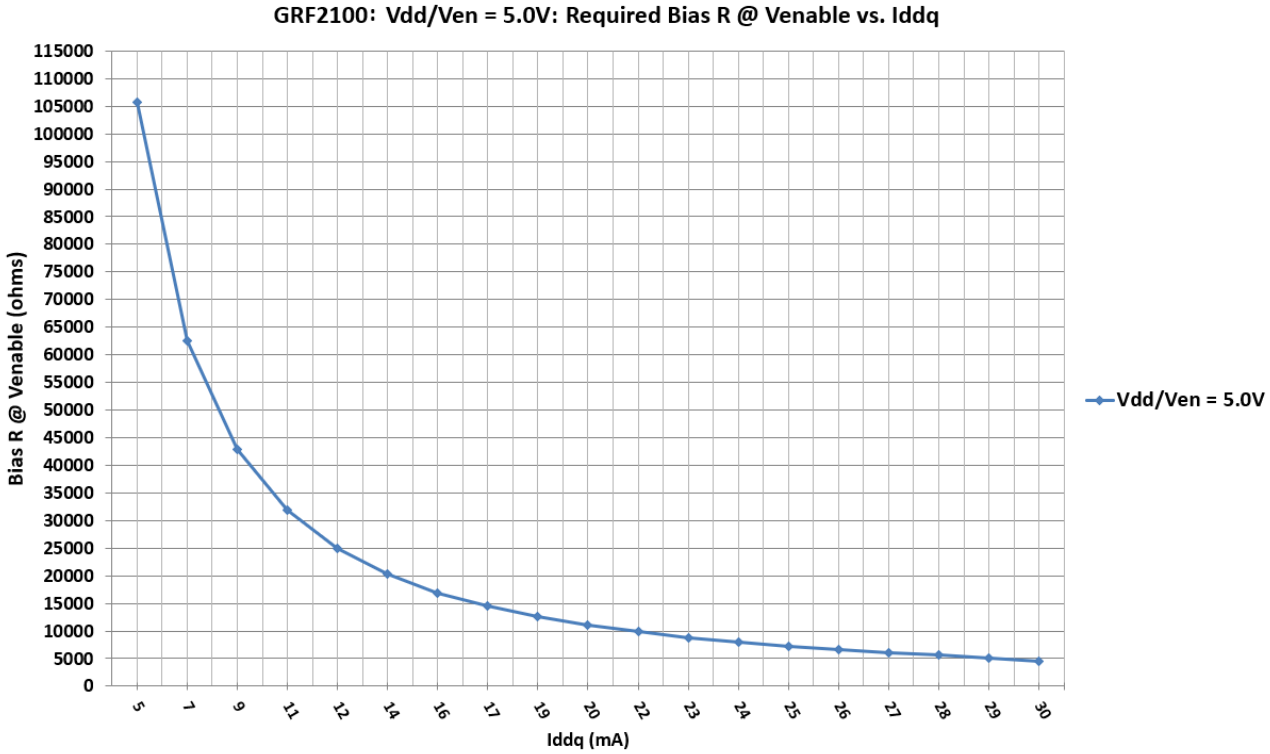

**GRF2100 Evaluation Board Assembly Diagram**

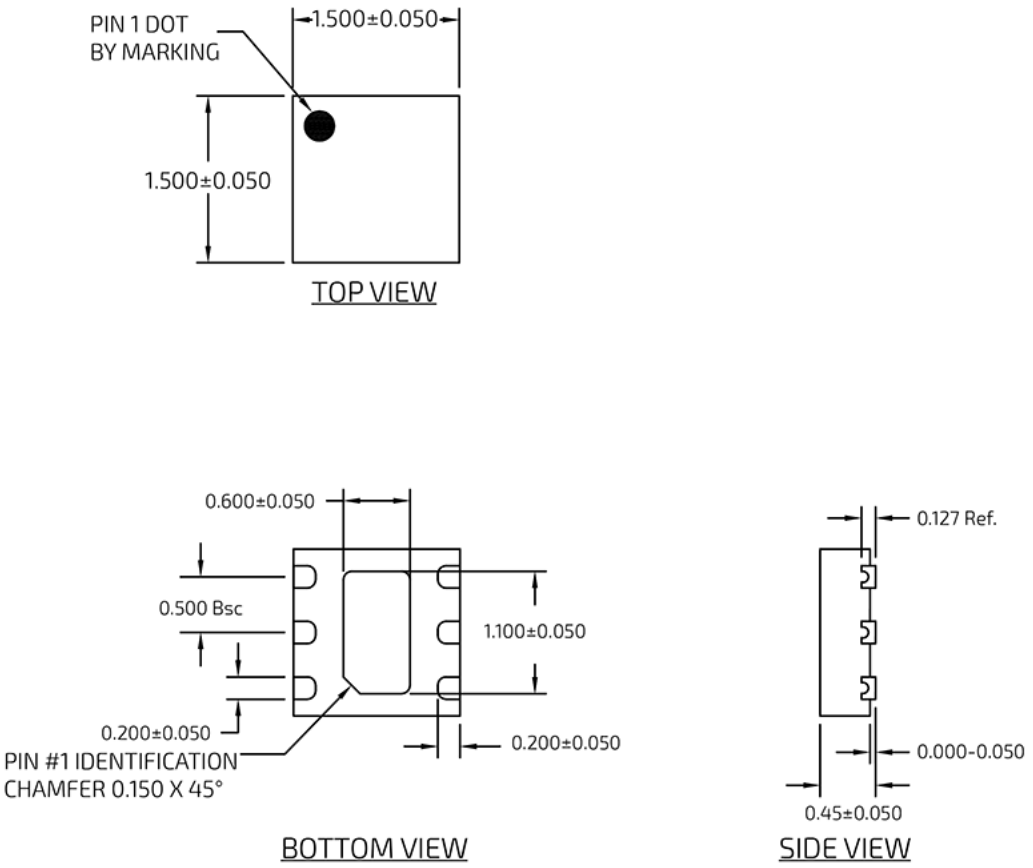
## GRF2100 Evaluation Board Assembly Diagram Reference: 2.3 to 2.7 GHz

| Component | Type | Manufacturer | Family | Value | Package Size | Substitution |
|---|---|---|---|---|---|---|
| M1 | Inductor | Murata | LQG | 3.9 nH | 0402 | ok |
| M2 | Capacitor | Murata | GJM | 8.2 pF | 0402 | ok |
| M3 | Resistor (jumper) | Various | 5% | 0 Ω | 0402 | ok |
| M5 (sets $I_{DDQ}$) | Resistor | Various | 5% | 6 kΩ | 0402 | ok |
| M6 | Resistor (jumper) | Various | 5% | 0 Ω | 0402 | ok |
| M8 | Capacitor | Murata | GRM | 0.1 µF | 0402 | ok |
| M10 | Inductor | Murata | LQG | 10 nH | 0402 | ok |
| M12 | Capacitor | Murata | GJM/GRM | 2.7 pF | 0402 | ok |
| L1 | Inductor (spliced in) | Murata | LQG | 3 nH | 0402 | ok |
| Evaluation Board | DFN6-15-23-A | | | | | |

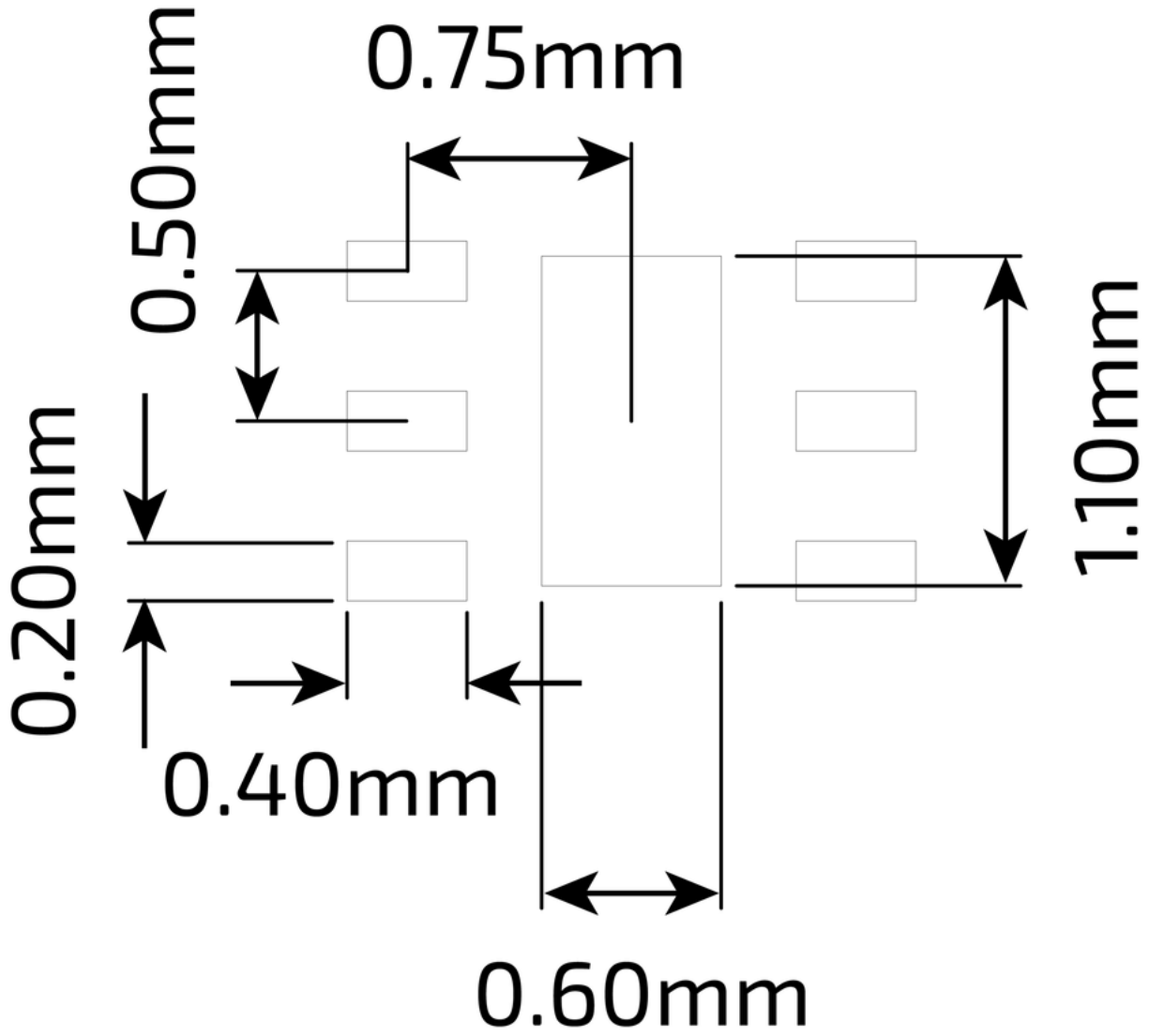
## GRF2100 Bias Resistor Selection Curves:






**DFN 6 1.5x1.5mm Package Dimensions**



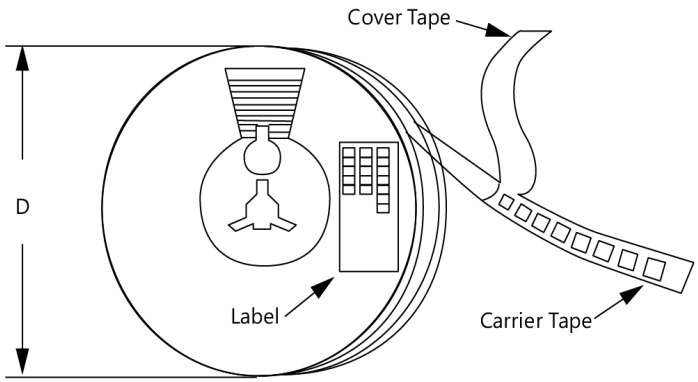

**DFN 6 1.5x1.5mm Suggested PCB Footprint (Top View)**

### Package Marking Diagram

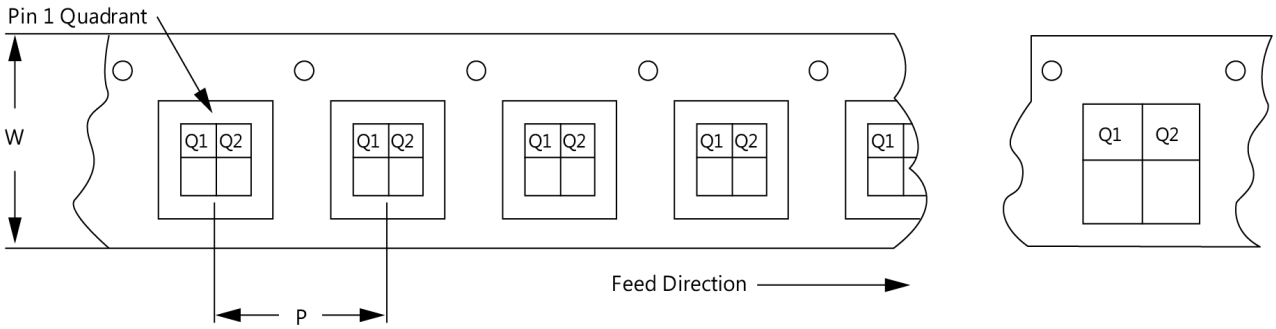

Line 1: “Y” = YEAR (single digit). “WW” = WORK WEEK the Device was assembled.
Line 2: “XXXX” = Device Part Number.

### 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 |
|---|---|
| June 29, 2021 | Release Ø Data Sheet. |
| July 26, 2021 | Release A Data Sheet. |
| February 17, 2022 | Upgraded Data Sheet to new format only. |
| March 11, 2022 | Updated data plots to new format. |
| September 6, 2022 | Updated evaluation board BOM and schematic for new tune. Added updated characterization plots. Lowered Enable Current from 0.5 to 0.2 mA to match production test plan. |
| November 27, 2023 | Release B Data Sheet. Added "Pin Max Off" parameter to Absolute Ratings Table. |
| March 13, 2024 | Upgraded Data Sheet to newest format only. |
| May 12, 2025 | Extended frequency range from 100 - 3800 MHz to 80 - 5300 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 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. |






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