



## GRF2171

### HIGH GAIN ULTRA LNA

### 1.17 to 5.35 GHz

#### FEATURES

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

#### Reference: 5 V / 75 mA / 3.6 GHz

- Gain: 26.8 dB
- OIP3: 35 dBm
- OP1dB: 18.7 dBm
- Evaluation Board Noise Figure: 0.8 dB

#### APPLICATIONS

- Ultra High Gain LNA
- CBRS
- Microwave Backhaul

#### DESCRIPTION

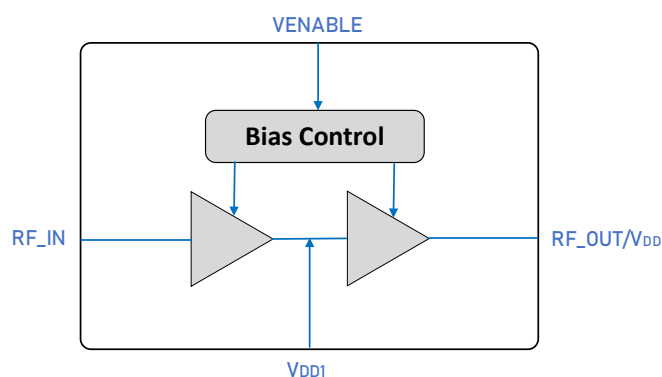
The GRF2171 is an ultra-high gain, ultra-low noise amplifier that can be tuned over a wide range of frequencies.

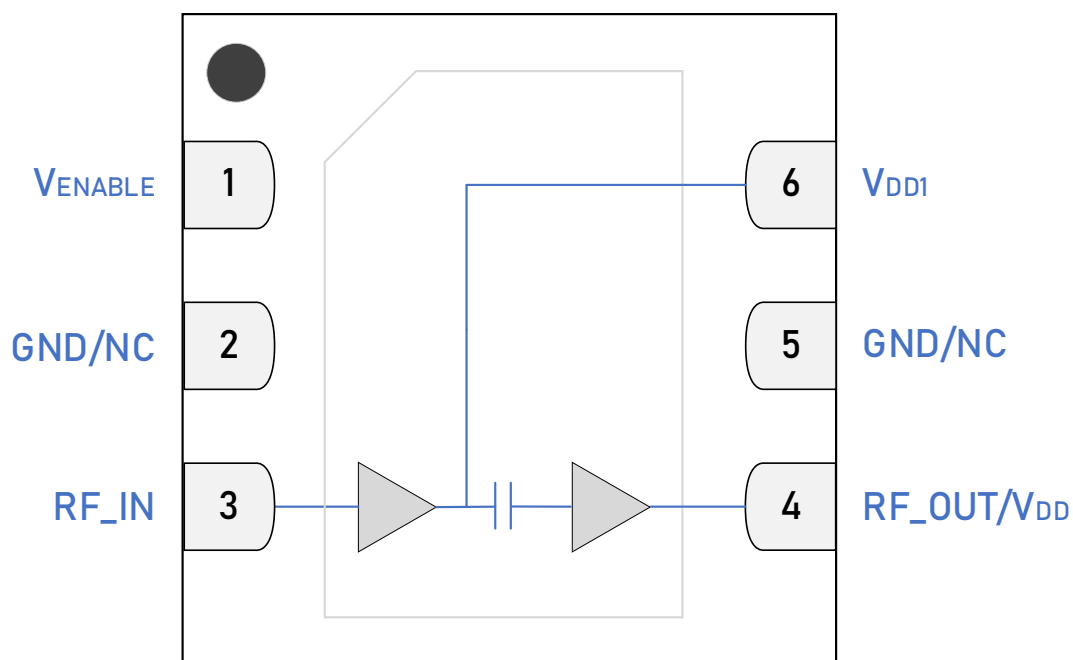
Flexible biasing allows the device to be configured for a wide range of  $V_{DD}$  and  $I_{DDQ}$  values for optimal efficiency and linearity.

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

Additional tunes can be found on the GRF2171 "Custom Tunes" product page: [GRF2171 Custom Tunes](#)

#### BLOCK DIAGRAM





1.5 x 1.5 mm DFN-6 Pin Out (Top View)

## Pin Assignments

| Pin      | Name                   | Description          | Note                                                                                                                                                                                                             |
|----------|------------------------|----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1        | V <sub>ENABLE</sub>    | Enable Voltage Input | V <sub>ENABLE</sub> and series resistor set I <sub>DDQ</sub> . V <sub>ENABLE</sub> ≤ 0.2 volts disables device. 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                  | RF Input             | An external DC blocking capacitor must be used.                                                                                                                                                                  |
| 4        | RF_OUT/V <sub>DD</sub> | RF Output            | V <sub>DD</sub> must be applied through a choke to this pin.                                                                                                                                                     |
| PKG BASE | GND                    | Ground               | Provides DC and RF ground 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                                             | $V_{DD}$        | 0    | 6    | V    |
| RF Input Power: Load VSWR < 2:1, $V_{DD} = 5$ V            | $P_{IN\ MAX}$   |      | 22   | dBm  |
| Operating Temperature (package base)                       | $T_{PKG\ BASE}$ | -40  | 115  | °C   |
| Maximum Channel Temperature (MTTF > 10 <sup>6</sup> hours) | $T_{MAX}$       |      | 170  | °C   |
| Maximum Dissipated Power                                   | $P_{DISS\ MAX}$ |      | 600  | 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 [Package Manufacturing Information | Guerrilla RF \(guerrilla-rf.com\)](#)



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                       | $V_{DD}$        | 2.7           | 5    | 6    | V        |                                                                                             |
| Operating Temperature (package base) | $T_{PKG\ BASE}$ | -40           |      | 115  | °C       |                                                                                             |
| RF Frequency Range                   | $F_{RF}$        | 1.17          | 3.6  | 5.35 | GHz      | Typical application schematic with external matching components ( <b>notes 1 &amp; 2</b> ). |
| RF_IN Port Impedance                 | $Z_{RFIN}$      |               | 50   |      | $\Omega$ |                                                                                             |
| RF_OUT Port Impedance                | $Z_{RFOUT}$     |               | 50   |      | $\Omega$ |                                                                                             |

**Note 1:** Operation outside of this range is supported by using different custom tunes. Examples of other optimized tunes can be found here: [GRF2171 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 3.4 to 3.8 GHz tuning set.  $V_{DD} = 5\text{ V}$ ,  $F_{TEST} = 3.6\text{ GHz}$ ,  $50\ \Omega$  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 Current      | $I_{DD}$     | 55            | 75   | 95   | mA   | $V_{DD} = 5\text{ V}$ , $V_{ENABLE} = 5\text{ V}$ . |
| Enable Current      | $I_{ENABLE}$ |               | 3.5  | 5    | mA   | $V_{DD} = 5\text{ V}$ , $V_{ENABLE} = 5\text{ V}$ . |
| Switching Rise Time | $T_{RISE}$   |               | 800  |      | ns   | Gain mode to Disabled mode ( <b>note 3</b> ).       |
| Switching Fall Time | $T_{FALL}$   |               | 900  |      | ns   | Disabled mode to Gain mode ( <b>note 4</b> ).       |

### Disabled Mode

|                 |               |  |     |      |               |                                                     |
|-----------------|---------------|--|-----|------|---------------|-----------------------------------------------------|
| Leakage Current | $I_{LEAKAGE}$ |  | 325 | 1000 | $\mu\text{A}$ | $V_{DD} = 5\text{ V}$ , $V_{ENABLE} = 0\text{ V}$ . |
|-----------------|---------------|--|-----|------|---------------|-----------------------------------------------------|

### Thermal Data

|                                     |               |  |    |  |                    |                                                 |
|-------------------------------------|---------------|--|----|--|--------------------|-------------------------------------------------|
| Thermal Resistance: (Infrared Scan) | $\Theta_{JC}$ |  | 40 |  | $^\circ\text{C/W}$ | On standard evaluation board ( <b>note 5</b> ). |
|-------------------------------------|---------------|--|----|--|--------------------|-------------------------------------------------|

**Note 3:** Switching Time: 50% of  $V_{ENABLE}$  to 90% of  $P_{OUT}$ .

**Note 4:** Switching Time: 50% of  $V_{ENABLE}$  to 10% of  $P_{OUT}$ .

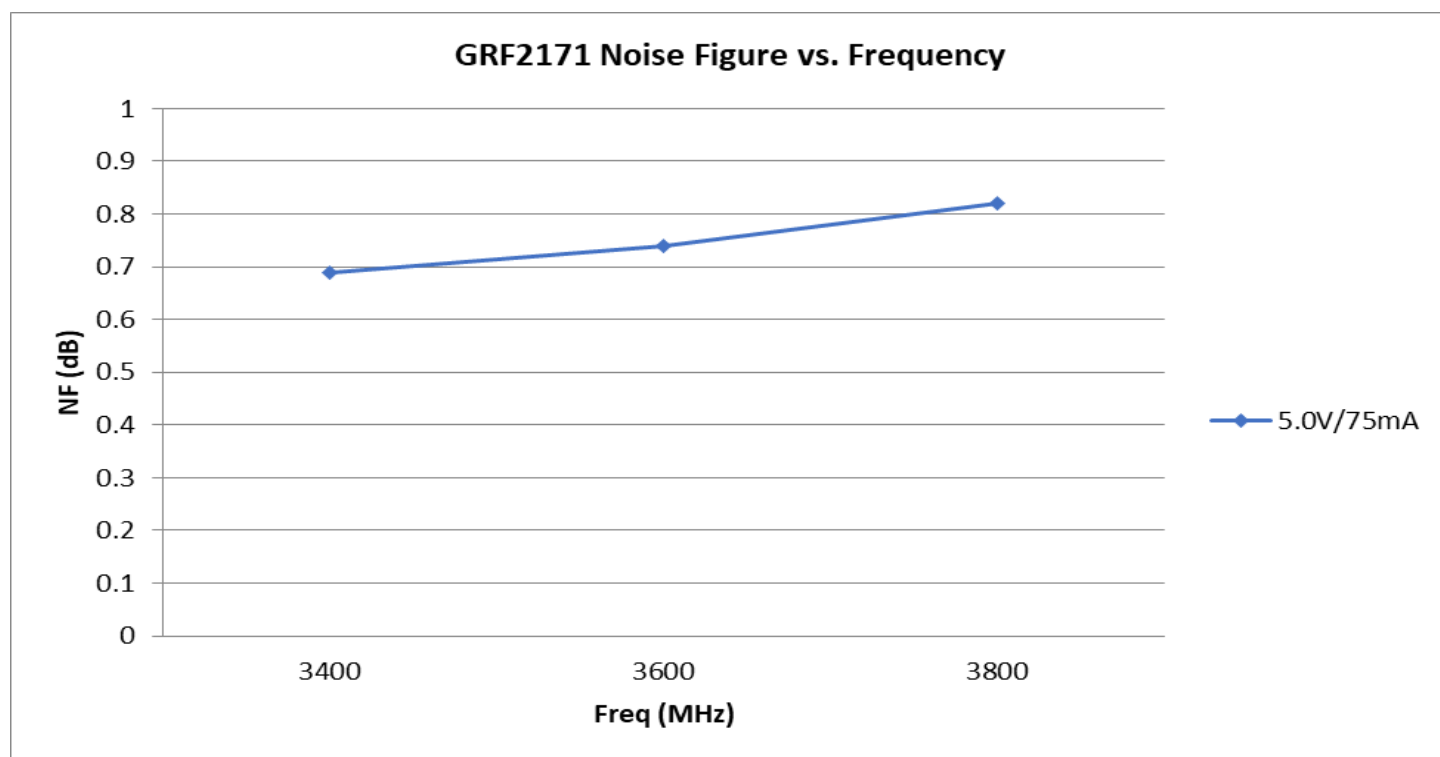
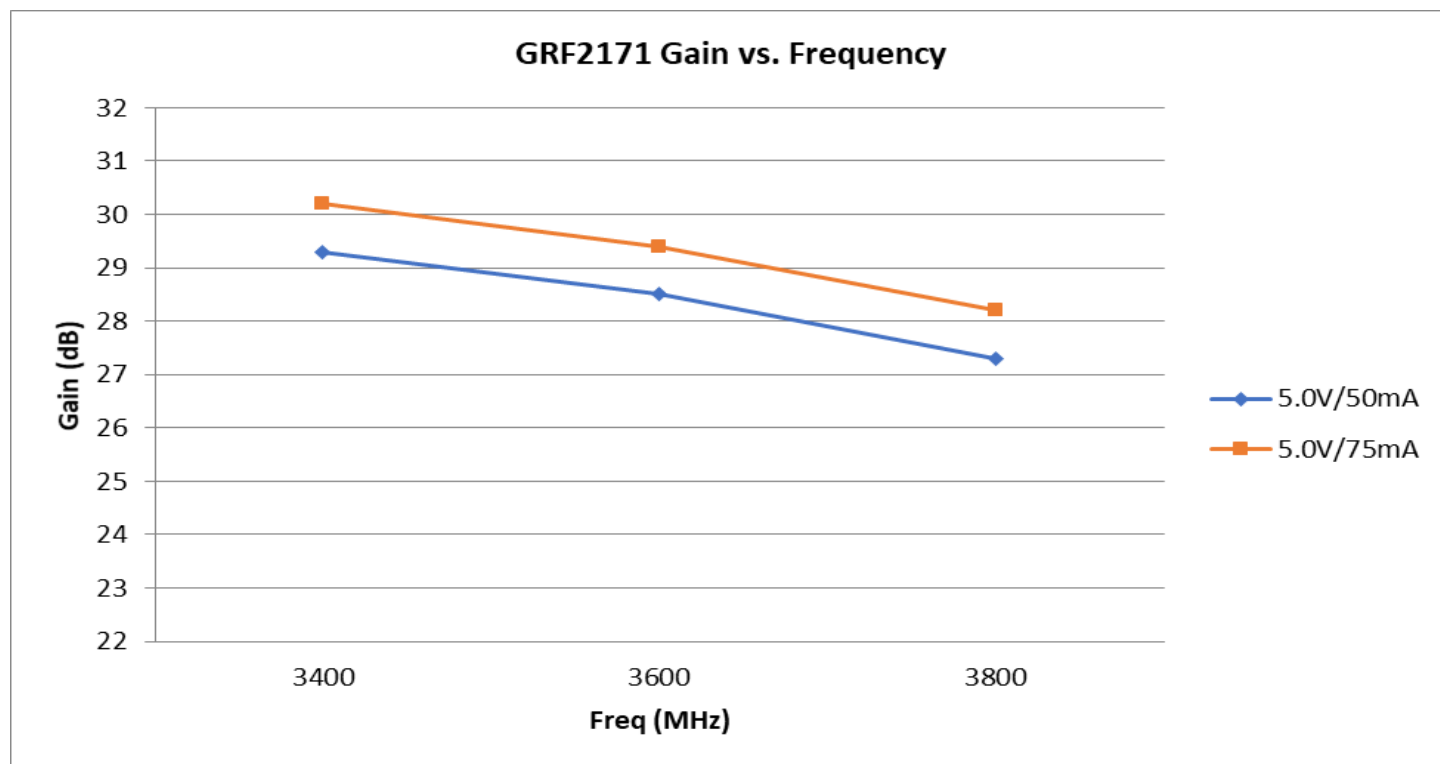
**Note 5:** MTTF >  $10^6$  hours for  $T_{CHANNEL} \leq 170\ ^\circ\text{C}$ .

## Nominal Operating Parameters – RF

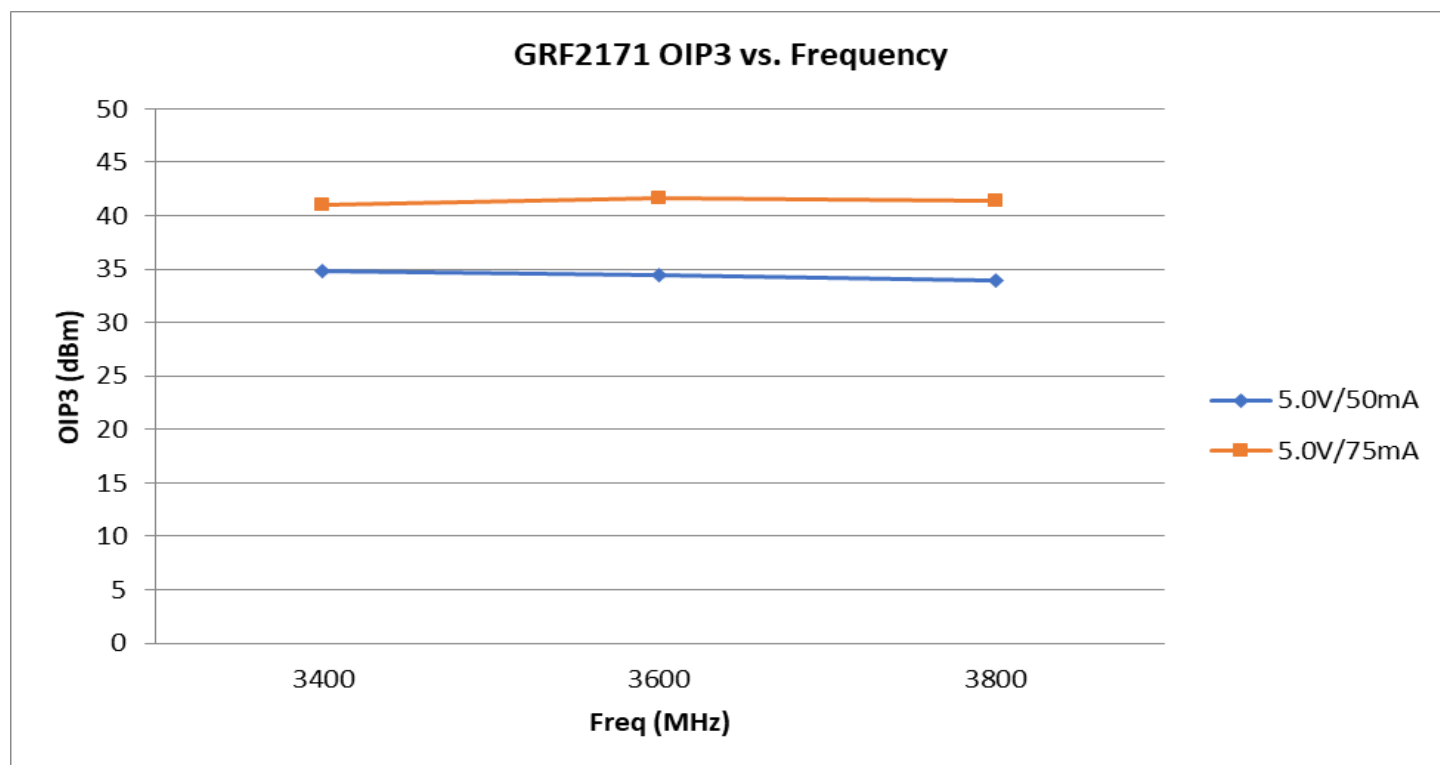
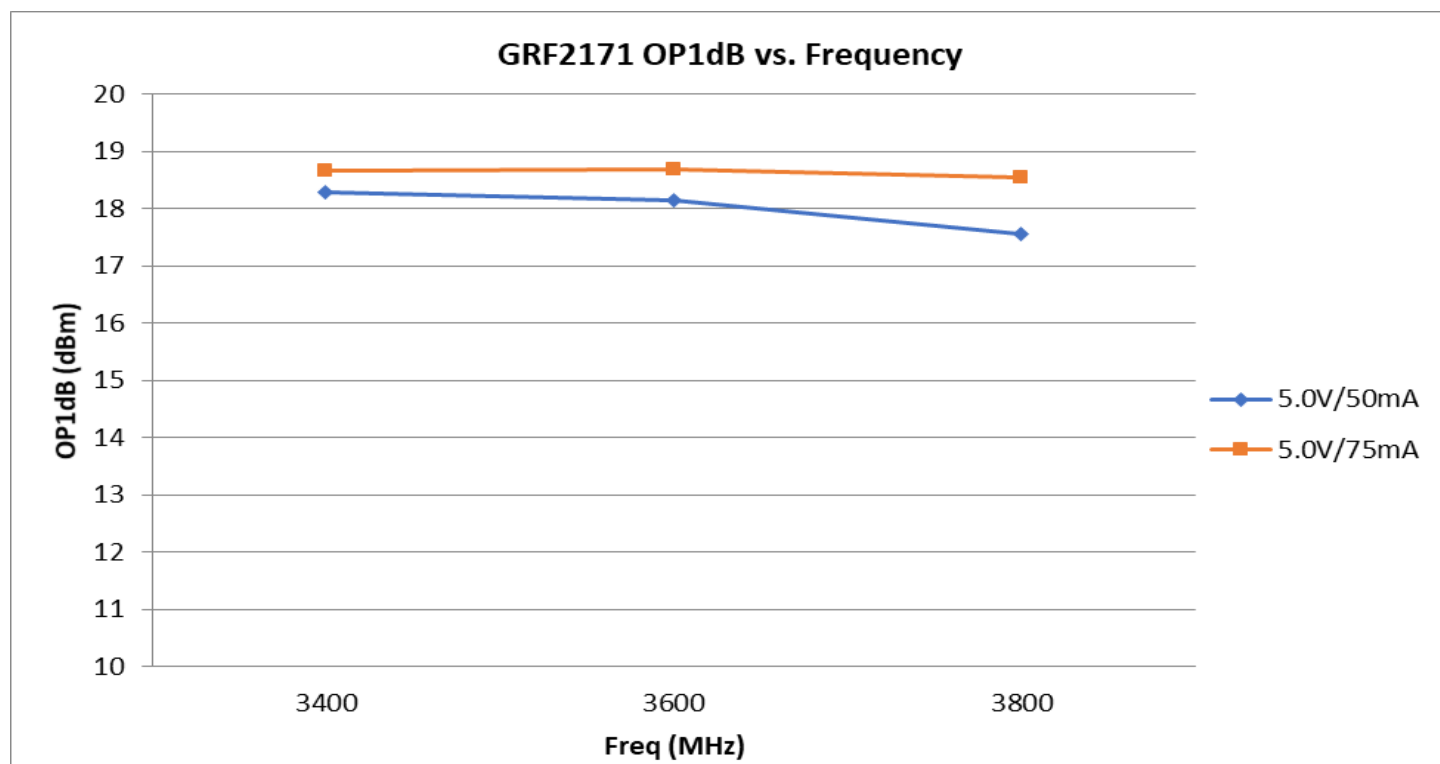
The following conditions apply unless noted otherwise: typical application schematic using the 3.4 to 3.8 GHz tuning set.  $V_{DD} = 5\text{ V}$ ,  $F_{TEST} = 3.6\text{ GHz}$ ,  $50\ \Omega$  system impedance,  $T_{PKG\ BASE} = 25\ ^\circ\text{C}$ . Evaluation board losses are included within the specifications.

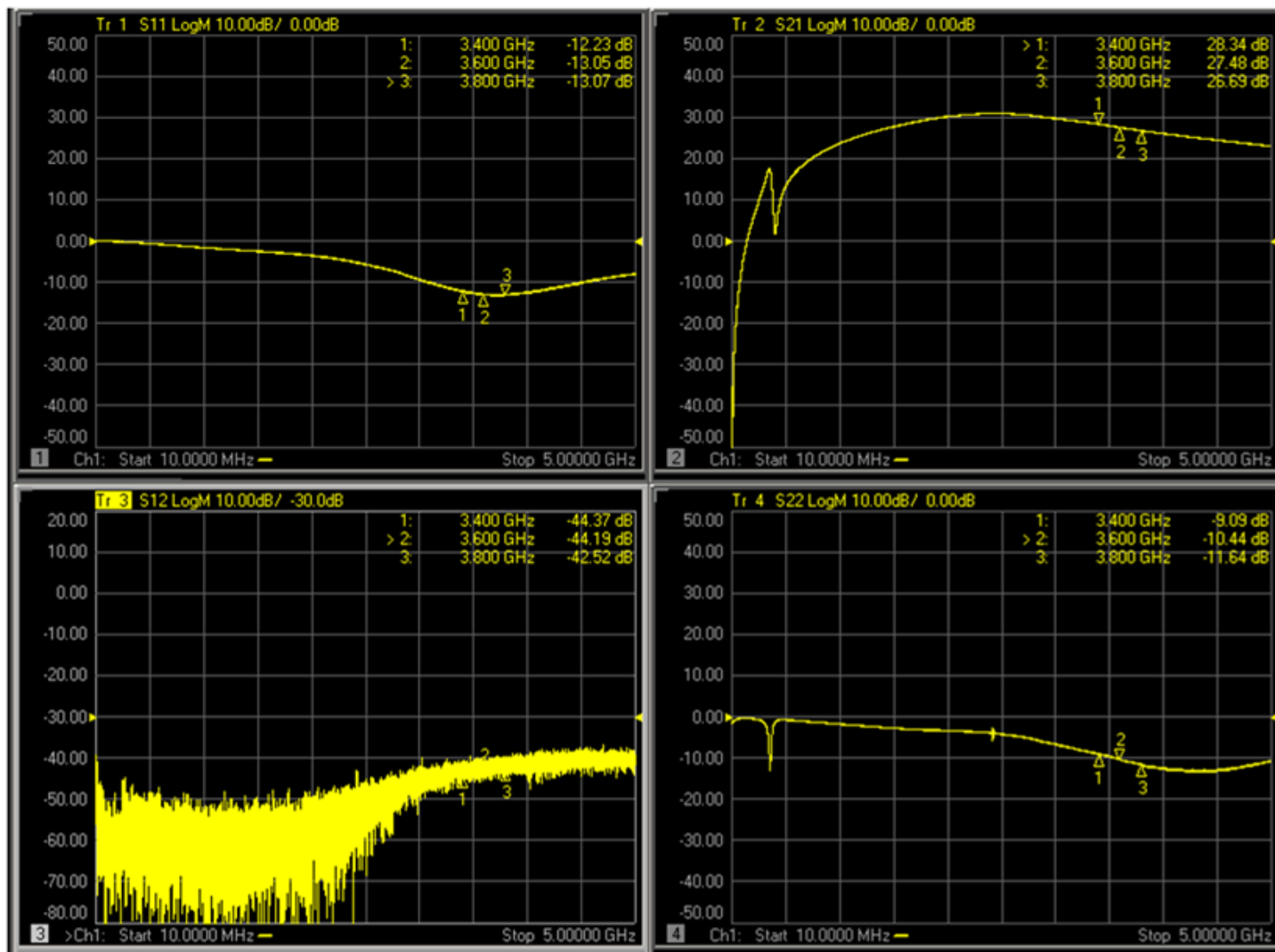
| Parameter                                    | Symbol | Specification |      |      | Unit | Condition                                                      |
|----------------------------------------------|--------|---------------|------|------|------|----------------------------------------------------------------|
|                                              |        | Min.          | Typ. | Max. |      |                                                                |
| Gain                                         | S21    | 24.8          | 26.8 |      | dB   |                                                                |
| Noise Figure                                 | NF     |               | 0.8  | 1    | dB   | On standard evaluation board.                                  |
| Output 3 <sup>rd</sup> Order Intercept Point | OIP3   |               | 35   |      | dBm  | 4 dBm $P_{OUT}$ per tone at 2 MHz spacing (3599 and 3601 MHz). |
| Output 1 dB Compression Power                | OP1dB  | 16.7          | 18.7 |      | dBm  |                                                                |

### GRF2171 Typical Operating Curves: 3.4 to 3.8 GHz Tune

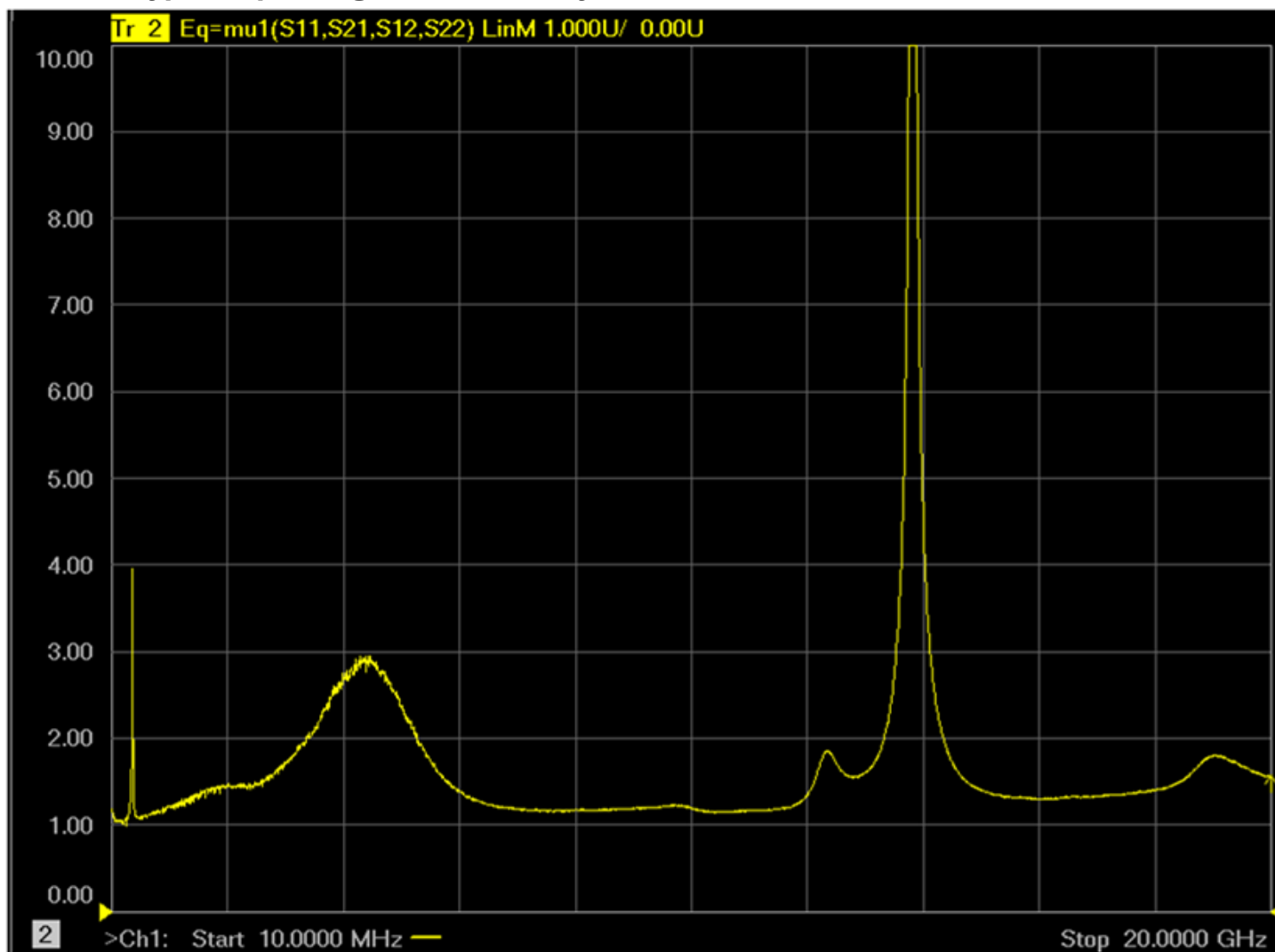


### GRF2171 Typical Operating Curves: 3.4 to 3.8 GHz Tune

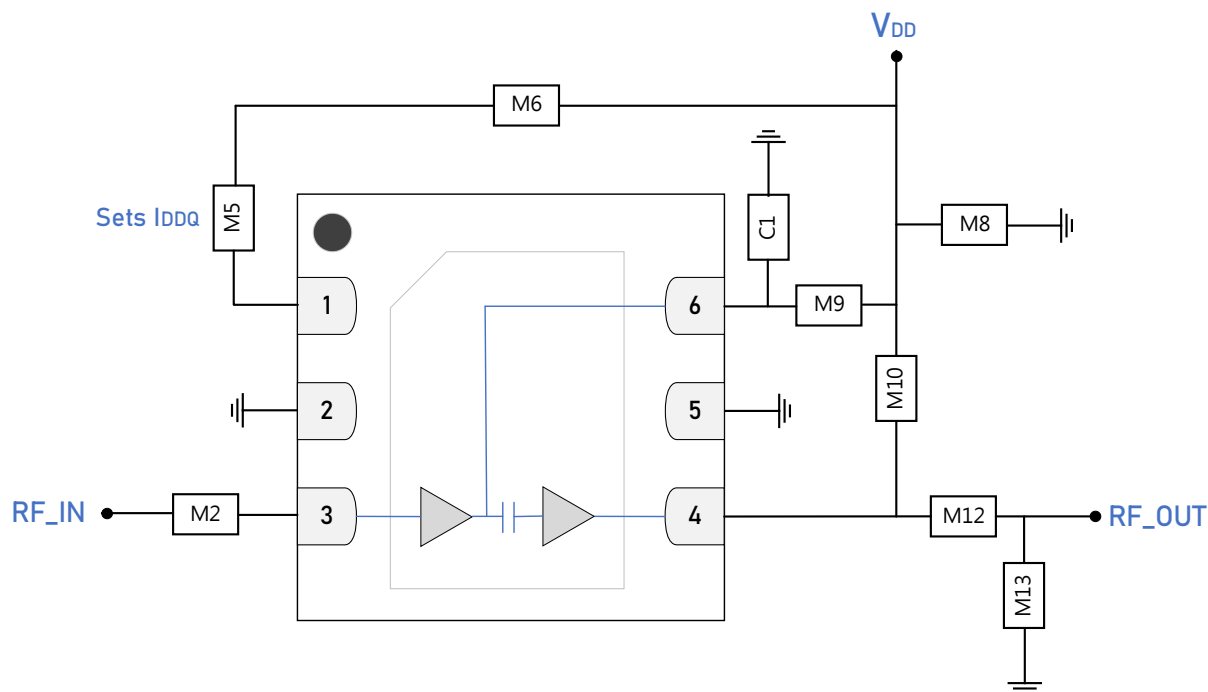


**GRF2171 Typical Operating Curves: S-Parameters (3.4 to 3.8 GHz Tune)**


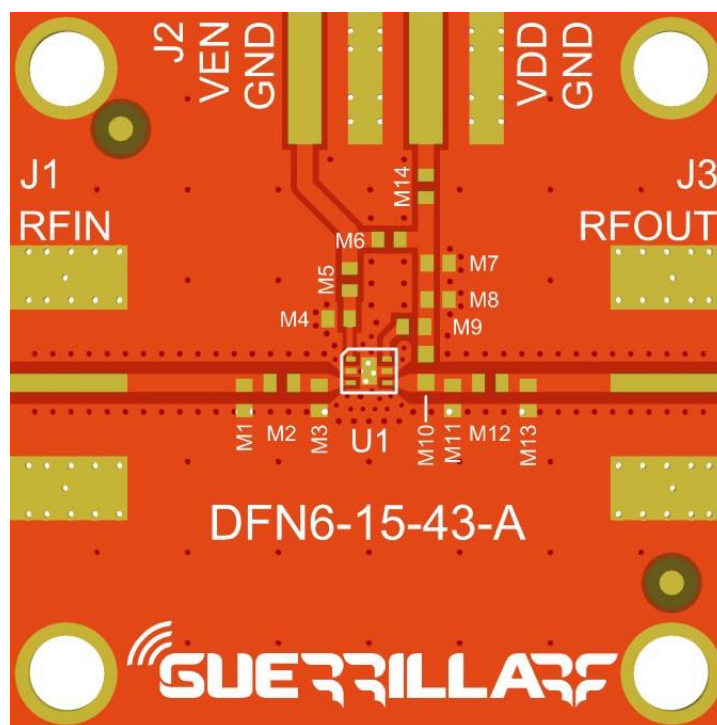
### GRF2171 Typical Operating Curves: Stability Mu Factor (10 MHz to 20 GHz)



Note:  $\mu \geq 1.0$  implies unconditional stability.



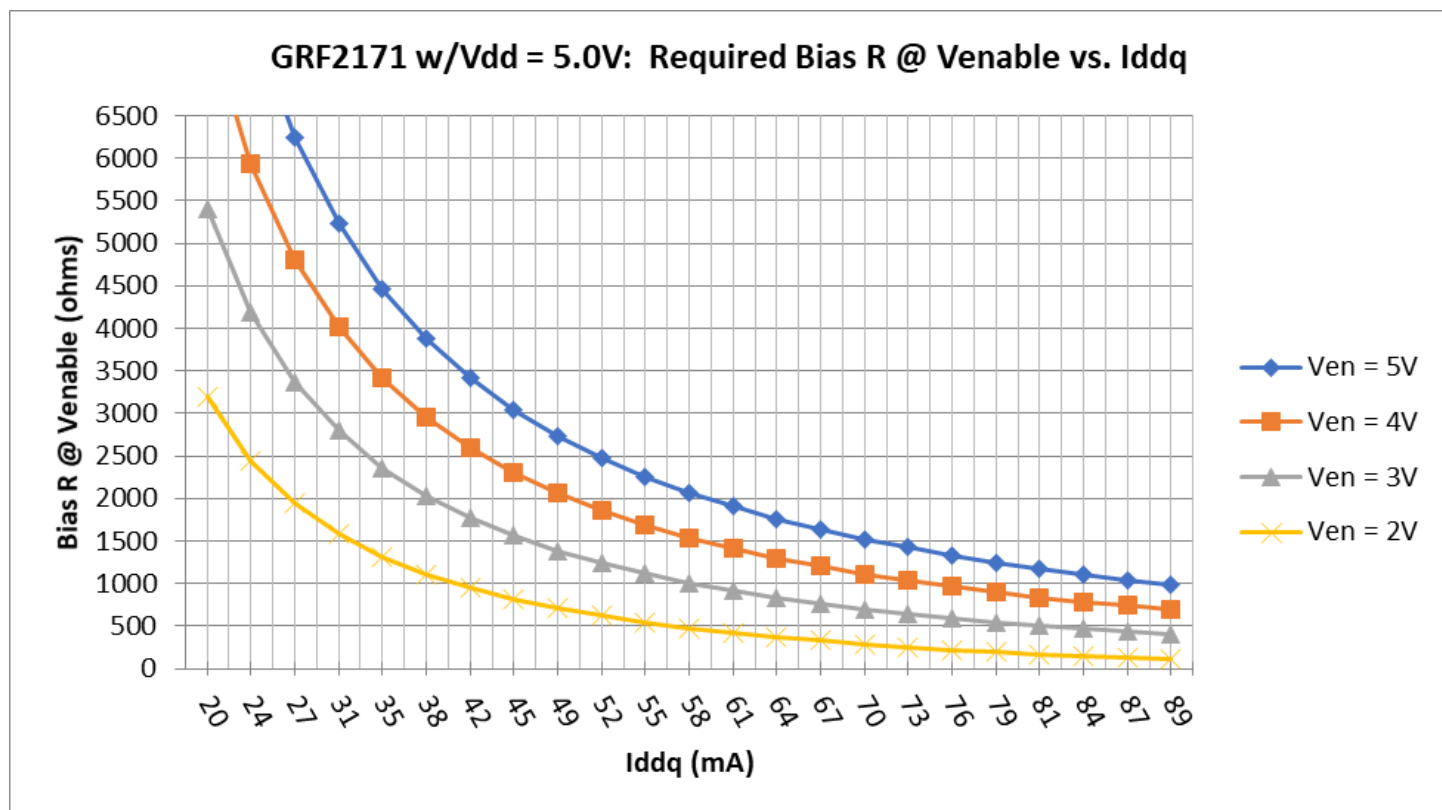
**GRF2171 Standard Evaluation Board Schematic**

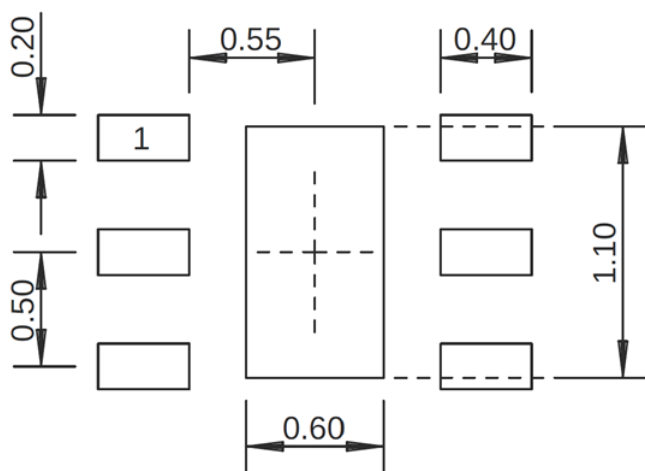


**GRF2171 Evaluation Board Assembly Diagram**

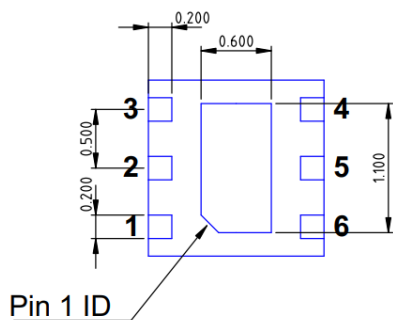
**GRF2171 Evaluation Board Assembly Diagram Reference: 3.4 to 3.8 GHz Tune**

| Component            | Type              | Manufacturer | Family | Value        | Package Size | Substitution |
|----------------------|-------------------|--------------|--------|--------------|--------------|--------------|
| M2                   | Capacitor         | Murata       | GJM    | 20 pF        | 0402         | ok           |
| M5 (sets $I_{DDQ}$ ) | Resistor          | Various      | 5%     | see curves   | 0402         | ok           |
| M6                   | Resistor (jumper) | Various      | 5%     | 0 $\Omega$   | 0402         | ok           |
| M8                   | Capacitor         | Murata       | GRM    | 0.1 $\mu$ F  | 0402         | ok           |
| M9                   | Inductor          | Murata       | LQG    | 5.6 nH       | 0402         | ok           |
| M10                  | Inductor          | Murata       | LQG    | 2.4 nH       | 0402         | ok           |
| M12                  | Capacitor         | Murata       | GRM    | 1000 pF      | 0402         | ok           |
| M13                  | Resistor          | Various      | 5%     | 500 $\Omega$ | 0402         | ok           |
| C1                   | Capacitor         | Murata       | GRM    | 0.1 $\mu$ F  | 0402         | ok           |
| Evaluation Board     | DFN6-15-43-A      |              |        |              |              |              |

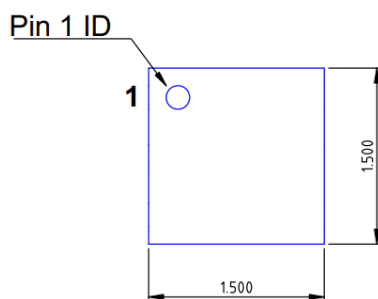
**GRF2171 Bias Resistor Selection Curves**




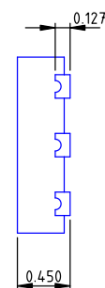
**1.5 x 1.5 mm DFN-6 Suggested PCB Footprint (Top View)**



**Bottom View**



**Top View**



**Side View**

### **DFN6 1.5x1.5mm**

Dimensions in millimeters  
Dimensional Tolerance:  $\pm 0.05$

### **1.5 x 1.5 mm DFN-6 Package Dimensions**

## Package Marking Diagram



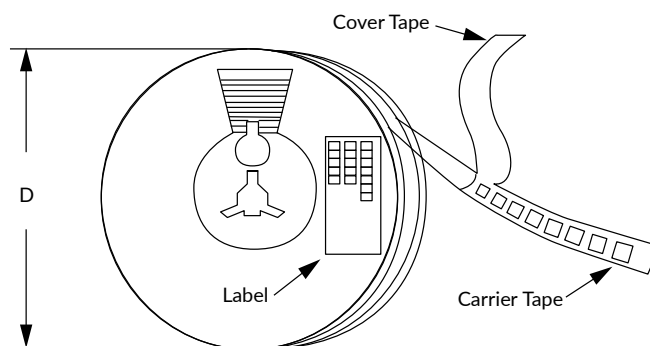
- Line 1: "Y" = YEAR (single digit). "WW" = WORK WEEK the device was assembled.
- Line 2: "XXXX" = Device PART NUMBER.

## Tape and Reel Information

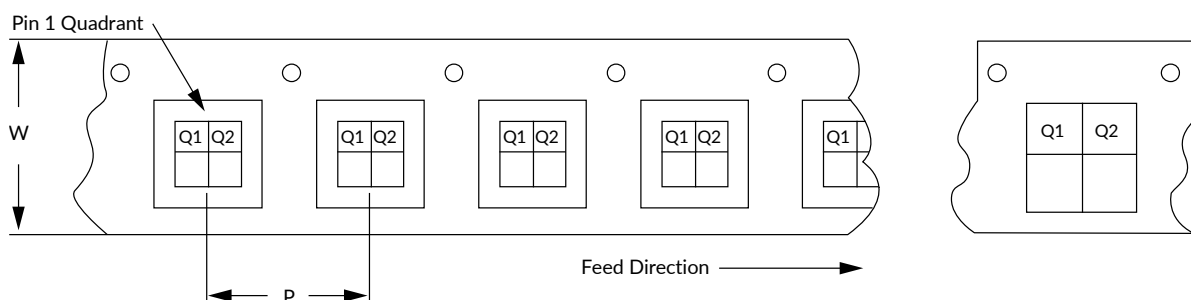
Guerrilla RF's tape and reel specification complies with Electronic Industries Alliance (EIA) standards for "Embossed Carrier Tape of Surface Mount Components for Automatic Handling" (reference EIA-481). See the following page for the Tape and Reel Specification and Device Package Information table, 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: [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                                                                                                 |
|-------------------|-----------------------------------------------------------------------------------------------------------------------|
| July 18, 2019     | Preliminary Data Sheet.                                                                                               |
| July 1, 2021      | Release A Data Sheet.                                                                                                 |
| February 27, 2025 | Upgraded Data Sheet to new format only. No change to device or device specifications.                                 |
| April 30, 2025    | Raised Maximum Operating Temperature from 105 to 115 °C. Changed Frequency Range from 2.5 – 5 GHz to 1.17 – 5.35 GHz. |



## 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 <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.                                                                                                                   |

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