



Package: SOT-89

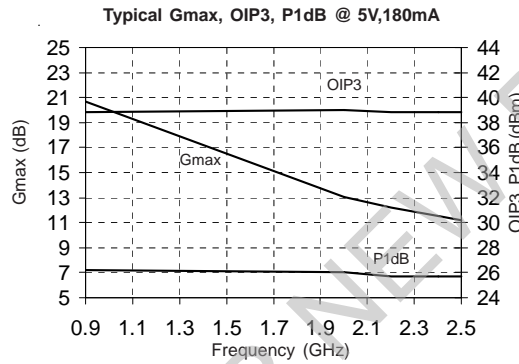


### Product Description

RFMD's SGA9189Z is a high performance transistor designed for operation to 3GHz. With optimal matching at 2GHz, OIP3 = 39dBm, and P1dB = 25.5dBm. This RF device is based on a silicon germanium heterostructure bipolar transistor (SiGe HBT) process. The SGA9189Z is cost-effective for applications requiring high linearity even at moderate biasing levels. It is well suited for operation at both 5V and 3V. The matte tin finish on the lead-free package utilizes a post annealing process to mitigate tin whisker formation and is RoHS compliant per EU Directive 2002/95. This package is also manufactured with green molding compounds that contain no antimony trioxide nor halogenated fire retardants.

#### Optimum Technology Matching® Applied

- GaAs HBT
- GaAs MESFET
- InGaP HBT
- SiGe BiCMOS
- Si BiCMOS
- SiGe HBT
- GaAs pHEMT
- Si CMOS
- Si BJT
- GaN HEMT
- RF MEMS



### Features

- 50MHz to 3000MHz Operation
- 39dBm Output IP3 Typ. at 1.96GHz
- 12.2dB Gain Typ. at 1.96GHz
- 25.5dBm P1dB Typ. at 1.96GHz
- 2.1dB NF Typ. at 0.9GHz
- Cost-Effective
- 3V to 5V Operation

### Applications

- Wireless Infrastructure Driver Amplifiers
- CATV Amplifiers
- Wireless Data, WLL Amplifiers
- AN-021 Contains Detailed Application Circuits

| Parameter                          | Specification |      |      | Unit | Condition                                                                                                            |
|------------------------------------|---------------|------|------|------|----------------------------------------------------------------------------------------------------------------------|
|                                    | Min.          | Typ. | Max. |      |                                                                                                                      |
| Maximum Available Gain             |               | 20.5 |      | dB   | 900MHz, Z <sub>S</sub> = Z <sub>S</sub> *, Z <sub>L</sub> = Z <sub>L</sub> *                                         |
|                                    |               | 13.2 |      | dB   | 1960MHz                                                                                                              |
| Power Gain                         | 17.5          | 19.0 | 20.5 | dB   | 900MHz [1], Z <sub>S</sub> = Z <sub>SOPT</sub> , Z <sub>L</sub> = Z <sub>LOPT</sub>                                  |
|                                    | 11.2          | 12.2 | 13.2 | dB   | 1960MHz [2]                                                                                                          |
| Output Power at 1dB Compression    |               | 40   |      | dBm  | 900MHz, Z <sub>S</sub> = Z <sub>SOPT</sub> , Z <sub>L</sub> = Z <sub>LOPT</sub>                                      |
|                                    | 23.5          | 25.5 |      | dBm  | 1960MHz [2]                                                                                                          |
| Output Third Order Intercept Point |               | 40.0 |      | dBm  | 900MHz, Z <sub>S</sub> = Z <sub>SOPT</sub> , Z <sub>L</sub> = Z <sub>LOPT</sub> , P <sub>OUT</sub> = +10dBm per tone |
|                                    | 36.5          | 39.0 |      | dBm  | 1960MHz [2]                                                                                                          |
| Noise Figure                       |               | 2.1  |      | dB   | 900MHz, Z <sub>S</sub> = Z <sub>SOPT</sub> , Z <sub>L</sub> = Z <sub>LOPT</sub>                                      |
|                                    |               | 2.6  |      | dB   | 1960MHz                                                                                                              |
| DC Current Gain                    | 100           | 180  | 300  |      |                                                                                                                      |
| Breakdown Voltage                  | 7.5           | 8.5  |      | V    | collector - emitter                                                                                                  |
| Thermal Resistance                 |               | 47   |      | °C/W | junction - lead                                                                                                      |
| Device Operating Voltage           |               | 5.5  |      | V    | collector - emitter                                                                                                  |
| Operating Current                  | 155           | 180  | 195  | mA   |                                                                                                                      |

Test Conditions: V<sub>CE</sub> = 5V, I<sub>CO</sub> = 180mA (unless otherwise noted), T<sub>L</sub> = 25 °C.

[1] 100% Tested [2] Sample Tested

## Absolute Maximum Ratings

| Parameter                            | Rating    | Unit |
|--------------------------------------|-----------|------|
| Max Base Current (IB)                | 5         | mA   |
| Max Device Current (ICE)             | 200       | mA   |
| Max Collector-Emitter Voltage (VCE0) | 7         | V    |
| Max Collector-Base Voltage (VCBO)    | 20        | V    |
| Max Emitter-Base Voltage (VEBO)      | 4.8       | V    |
| Max Junction Temp (TJ)               | +150      | °C   |
| Operating Temp Range (TL)            | See Graph |      |
| Max Storage Temp                     | +150      | °C   |



**Caution!** ESD sensitive device.

Exceeding any one or a combination of the Absolute Maximum Rating conditions may cause permanent damage to the device. Extended application of Absolute Maximum Rating conditions to the device may reduce device reliability. Specified typical performance or functional operation of the device under Absolute Maximum Rating conditions is not implied.

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RFMD Green: RoHS compliant per EU Directive 2002/95/EC, halogen free per IEC 61249-2-21, < 1000ppm each of antimony trioxide in polymeric materials and red phosphorus as a flame retardant, and <2% antimony in solder.

\*Note: Load condition<sup>1</sup>,  $Z_L = 50\Omega$ .

Operation of this device beyond any one of these limits may cause permanent damage. For reliable continuous operation, the device voltage and current must not exceed the maximum operating values specified in the table on page one.

Bias Conditions should also satisfy the following expression:  $I_D V_D < (T_J - T_L) / R_{TH,j} - I$  and  $T_L = T_{LEAD}$

## Typical Performance with Engineering Application Circuit

| Freq (MHz) | VCE (V) | ICQ (mA) | P1dB (dBm) | OIP3 <sup>1</sup> (dBm) | Gain (dB) | S11 (dB) | S22 (dB) | NF (dB) | ZSOPT ( $\Omega$ ) | ZLOPT ( $\Omega$ ) |
|------------|---------|----------|------------|-------------------------|-----------|----------|----------|---------|--------------------|--------------------|
| 945        | 5       | 184      | 25.8       | 39.5                    | 18.8      | -14      | -26      | 2.1     | 6.8 - j0.85        | 16 + j5.9          |
| 1960       | 5       | 179      | 25.5       | 40.0                    | 12.2      | -23      | -21      | 2.4     | 7.6 - j11.2        | 22.8 + j0.7        |
| 2140       | 5       | 180      | 25.4       | 39.0                    | 11.3      | -20      | -14      | 2.6     | 18.1 + j3.4        | 23.8 - j9.0        |
| 2440       | 5       | 180      | 25.4       | 40.0                    | 10.2      | -20      | -17      | 2.7     | 5.6 - j15.1        | 23.1 - j2.7        |

<sup>1</sup> P<sub>OUT</sub> = +10dBm per tone for V<sub>CE</sub> = 5V, 1MHz tone spacing

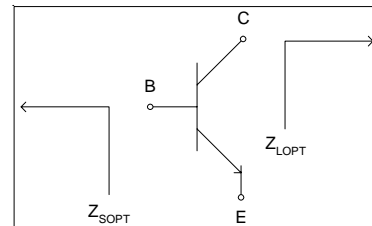
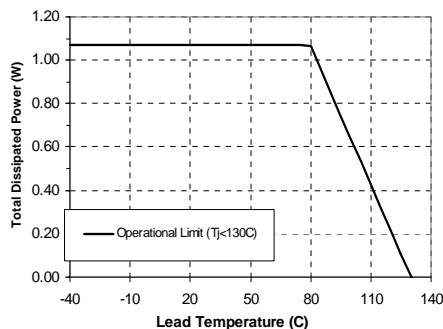
## Typical Performance with Engineering Application Circuit

| Freq (MHz) | VCE (V) | ICQ (mA) | P1dB (dBm) | OIP3 <sup>2</sup> (dBm) | Gain (dB) | S11 (dB) | S22 (dB) | NF (dB) | ZSOPT ( $\Omega$ ) | ZLOPT ( $\Omega$ ) |
|------------|---------|----------|------------|-------------------------|-----------|----------|----------|---------|--------------------|--------------------|
| 945        | 3       | 165      | 22.1       | 34.3                    | 17.7      | -18      | -11      | 2.1     | 9.6 - j1.6         | 11.0 + j1.4        |
| 1960       | 3       | 162      | 22.4       | 35.0                    | 11.8      | -18      | -16      | 2.2     | 7.8 - j13.1        | 19.3 - j2.9        |
| 2440       | 3       | 165      | 23.2       | 35.3                    | 9.9       | -20      | -15      | 2.6     | 8.1 - j16.0        | 21.0 - j6.5        |

<sup>2</sup> P<sub>OUT</sub> = +6dBm per tone for V<sub>CE</sub> = 3V, 1MHz tone spacing

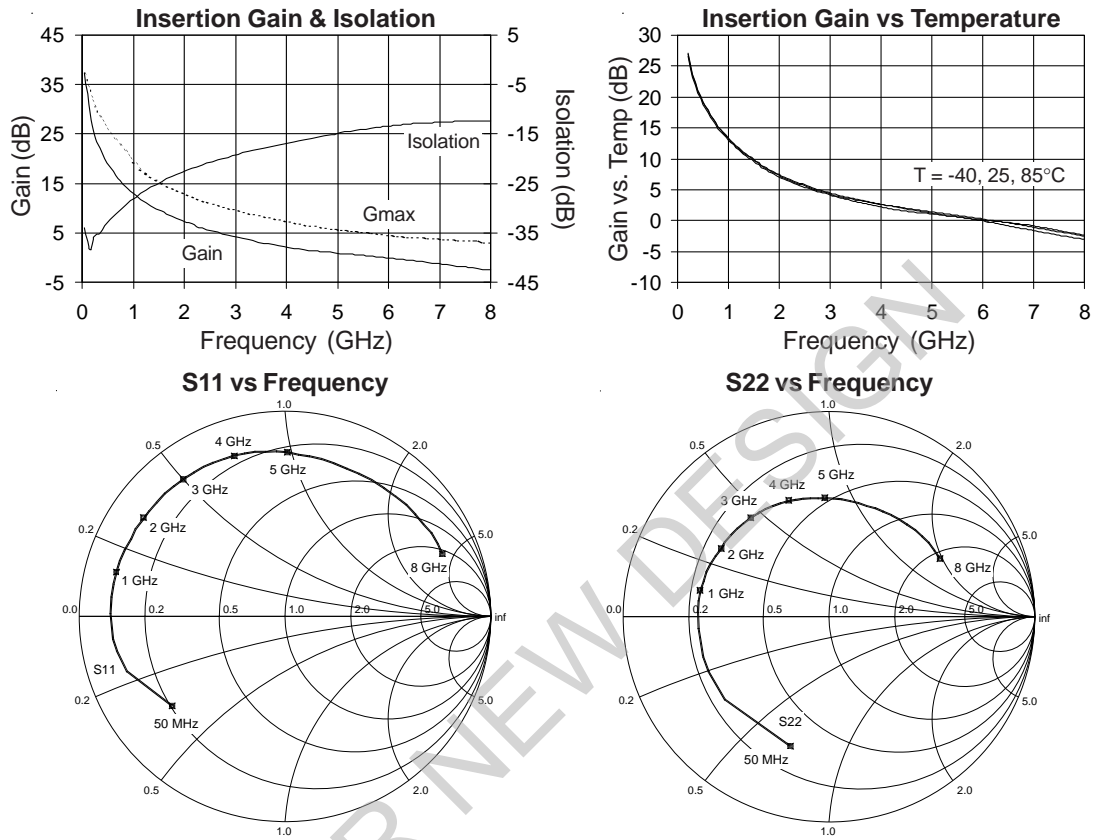
Data above represents typical performance of the application circuits notes in Application Note AN-021. Refer to the application note for additional RF data, PCB layouts, and BOMs for each application circuit. The application note also includes biasing instructions and other key issues to be considered. For the latest application notes please visit our site at [www.RFMD.com](http://www.RFMD.com) or call your local sales representative.

Maximum Recommended Operational Dissipated Power

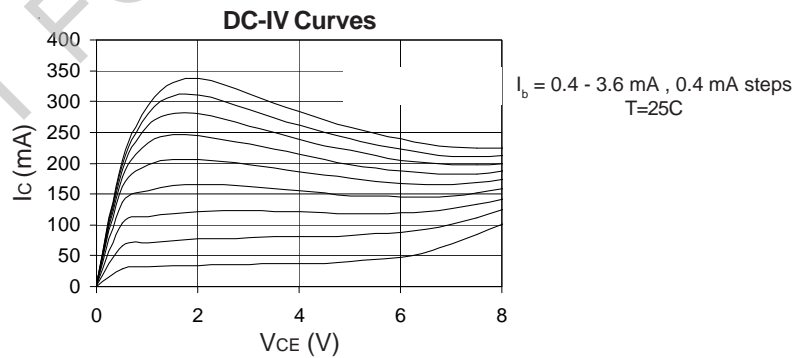


## De-embedded S-parameters

( $Z_S = Z_L = 50\Omega$ ,  $V_{CE} = 5V$ ,  $I_{CQ} = 185mA$ ,  $25^\circ C$ )



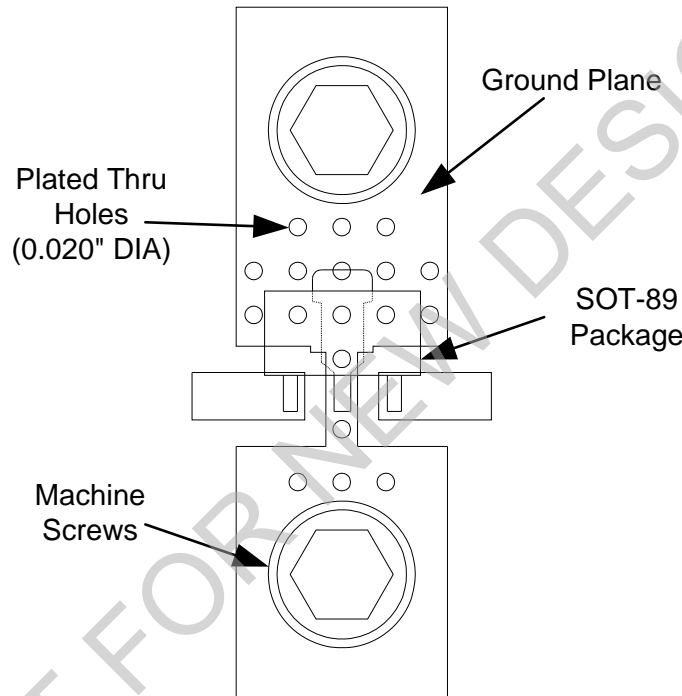
Note: S-parameters are de-embedded to the device leads with  $Z_S = Z_L = 50\Omega$ . The data represents typical performance of the device. De-embedded s-parameters can be downloaded from our website ([www.sirenza.com](http://www.sirenza.com)).



## Pin Names and Descriptions

| Pin | Name      | Description                                                                                                     |
|-----|-----------|-----------------------------------------------------------------------------------------------------------------|
| 1   | Base      | RF input.                                                                                                       |
| 2   | Emitter   | Connection to ground. Use via holes to reduce lead inductance. Place vias as close to ground leads as possible. |
| 3   | Collector | RF output.                                                                                                      |
| 4   | Emitter   | Same as pin 2.                                                                                                  |

## Recommended Mounting Configuration for Optimum RF and Thermal Performance



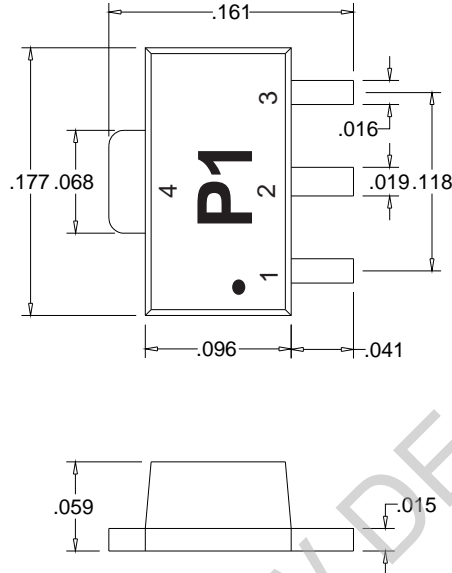
### Mounting and Thermal Considerations

It is very important that adequate heat sinking be provided to minimize the device junction temperature. The following items should be implemented to maximize MTTF and RF performance.

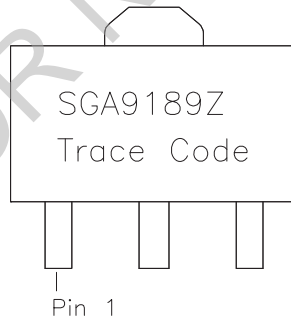
1. Multiple solder-filled vias are required directly below the ground tab (pin 4). [CRITICAL]
2. Incorporate a large ground pad area with multiple plated-through vias around pin 4 of the device. [CRITICAL]
3. Use two point board seating to lower the thermal resistance between the PCB and mounting plate. Place machine screws as close to the ground tab (pin 4) as possible. [RECOMMENDED]
4. Use 2 ounce copper to improve the PCB's heat spreading capability. [RECOMMENDED]

## Package Drawing

Dimensions in inches (millimeters)  
 Refer to drawing posted at [www.rfmd.com](http://www.rfmd.com) for tolerances.



## Part Identification



## Ordering Information

| Part Number   | Description                           |
|---------------|---------------------------------------|
| SGA9189Z      | 13" Reel with 3000 pieces             |
| SGA9189ZSQ    | Sample Bag with 25 pieces             |
| SGA9189ZSR    | 7" Reel with 100 pieces               |
| SGA9189Z-EVB1 | 870MHz to 960MHz, 8V Operation PCBA   |
| SGA9189Z-EVB2 | 1930MHz to 1990MHz, 8V Operation PCBA |
| SGA9189Z-EVB3 | 2110MHz to 2170MHz, 8V Operation PCBA |
| SGA9189Z-EVB4 | 2400MHz to 2500MHz, 8V Operation PCBA |