# SBW-5089
# SBW-5089Z

RoHS Compliant & Green Package

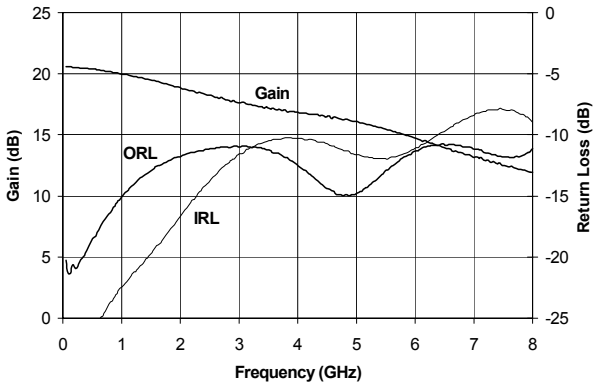
## DC-8 GHz Cascadable InGaP/GaAs HBT MMIC Amplifier

## Product Description

The SBW-5089(Z) is a high performance InGaP/GaAs HBT MMIC Amplifier. A Darlington circuit fabricated with InGaP process technology provides broadband RF performance up to 8 GHz and excellent thermal performance. The heterojunction increases breakdown voltage and minimizes leakage current between junctions. Cancellation of emitter junction non-linearities results in high suppression of intermodulation products. Operation requires only a single positive voltage supply, 2 DC-blocking capacitors, a bias resistor and an RF choke.

The matte tin finish on Sirenza's lead-free "Z" package is applied using a post annealing process to mitigate tin whisker formation and is RoHS compliant per EU Directive 2002/95. The package body is manufactured with green molding compounds that contain no antimony trioxide or halogenated fire retardants.

**Gain & Return Loss vs. Frequency**
**$I_D$= 80 mA (Typ.) Tuned Application Circuit (fig.1)**




## Product Features

- **Available in Lead Free, RoHS Compliant green package ( Z Suffix )**
- **50 Ohm Cascadable Gain Block**
- **Wideband Flat Gain to 3 GHz: +/-1.4dB**
- **P1dB = 13.4 @ 6 GHz**
- **Input / Output VSWR < 2:3 to 8 GHz**
- **Patented Thermal Design**
- **Single Voltage Supply Operation**

## Applications

- **Wideband Instrumentation**
- **Fiber Optic Driver**
- **OC-48**
- **Basestation**
- **SAT COM**

| Symbol | Parameter | Units | Frequency | Min. | Typ. | Max. |
|---|---|---|---|---|---|---|
| G | Small Signal Gain<br>( PC board and connector losses de-embeded ) | dB | 850 MHz<br>3000 MHz<br>4200 MHz<br>6000 MHz | 19.3<br>17.0<br><br>14.5 | 20.3<br>18.0<br>17.2<br>15.5 | 21.3<br>19.0<br><br>16.5 |
| $P_{1dB}$ | Output Power at 1dB Compression | dBm | 850 MHz<br>1950 MHz | <br>18.4 | 20.1<br>19.4 | |
| $OIP_3$ | Output Third Order Intercept Point | dBm | 850 MHz<br>1950 MHz | <br>32.0 | 35.5<br>34.0 | |
| Pout | Output Power @ -45dBc ACP IS-95<br>9 Forward Channels | dBm | 1950MHz | | 13.0 | |
| Bandwidth | Determined by Return Loss (>10dB) | MHz | | | 6000 | |
| IRL | Worst case Input Return Loss | dB | DC-6000MHz | 7 | 10 | |
| ORL | Worst case Output Return Loss | dB | DC-6000MHz | 8 | 10 | |
| NF | Noise Figure | dB | 1950 MHz | | 3.9 | 4.4 |
| $V_D$ | Device Operating Voltage | V | | 4.5 | 4.9 | 5.3 |
| $I_D$ | Device Operating Current | mA | | 72 | 80 | 88 |
| $R_{TH}$, j-l | Thermal Resistance (junction to lead) | °C/W | | | 70 | |

**Test Conditions:** $V_S$ = 8 V $I_D$ = 80 mA Typ. Bias Resistance = 39 Ohms; $OIP_3$ Tone Spacing = 1 MHz Pout per tone = 0 dBm; $T_L$ = 25°C $Z_S = Z_L$ = 50 Ohms



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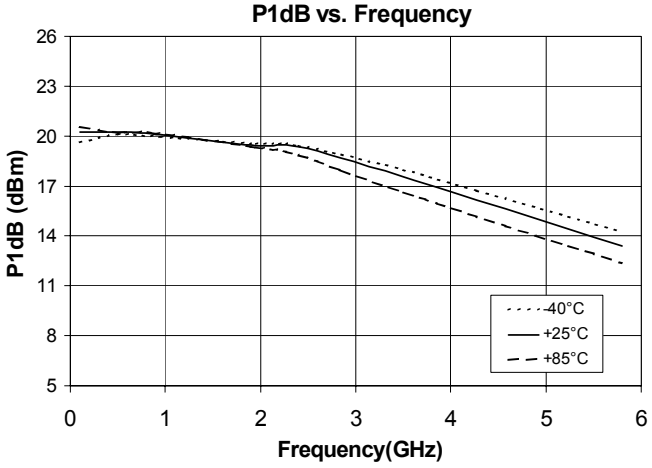
## Typical RF Performance at Key Operating Frequencies

| Symbol | Parameter | Units | Frequency (MHz) | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | 500 | 850 | 1950 | 2400 | 3500 | 5800 |
| G | Small Signal Gain | dB | 20.5 | 20.3 | 19.1 | 18.7 | 17.3 | 15.1 |
| $OIP_3$ | Output Third Order Intercept Point | dBm | 36.5 | 35.5 | 34.0 | 33.0 | 30.5 | 25.5 |
| $P_{1dB}$ | Output Power at 1dB Compression | dBm | 20.2 | 20.1 | 19.4 | 19.4 | 17.5 | 13.4 |
| IRL | Input Return Loss | dB | 26 | 26 | 19 | 15 | 12 | 12.5 |
| ORL | Output Return Loss | dB | 19 | 17.5 | 12 | 11 | 10.5 | 10.9 |
| $S_{12}$ | Reverse Isolation | dB | 22 | 23 | 23 | 23 | 23 | 23 |
| NF | Noise Figure | dB | 3.6 | 3.6 | 3.9 | 3.9 | 4.1 | 4.3 |

**Test Conditions:** $V_S$ = 8 V $I_D$ = 80 mA Typ. Bias Resistance = 39 Ohms; $OIP_3$ Tone Spacing = 1 MHz Pout per tone = 0 dBm; $T_{LEAD}$ = 25ºC $Z_S = Z_L$ = 50 Ohms

* 5.8GHz data measured with tuned app circuit in fig. 2.

P1dB vs. Frequency




## Absolute Maximum Ratings

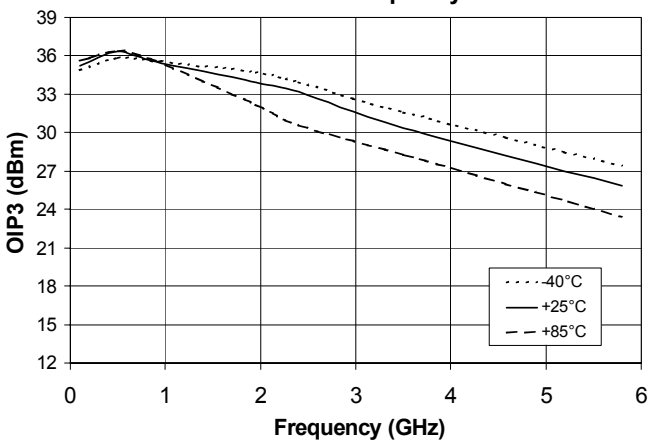
| Parameter | Absolute Limit |
|---|---|
| Max. Device Current ($I_D$) | 130 mA |
| Max. Device Voltage ($V_D$) | 6 V |
| Max. RF Input Power | +17 dBm |
| Max. Operating Dissipated Power | 0.65 W |
| Max. Junction Temp. ($T_J$) | +150°C |
| Operating Temp. Range ($T_L$) | -40°C to +85°C |
| Max. Storage Temp. | +150°C |

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

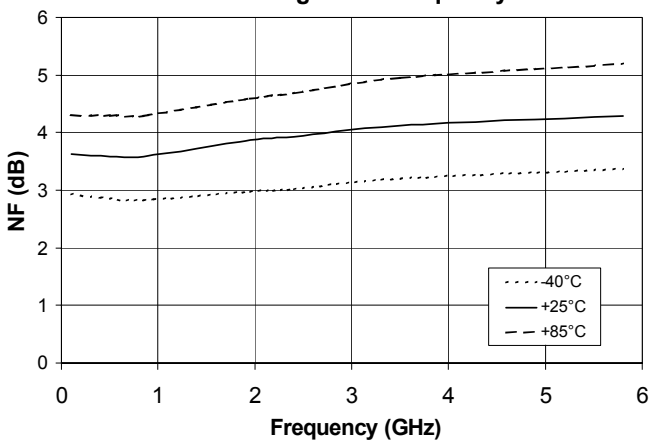
Bias conditions should also satisfy the following expression:

$$I_D V_D < (T_J - T_L) / R_{TH}, j\text{-}l$$

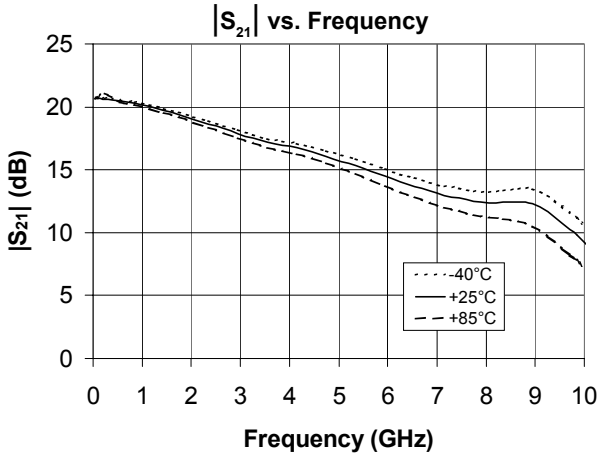
OIP3 vs. Frequency

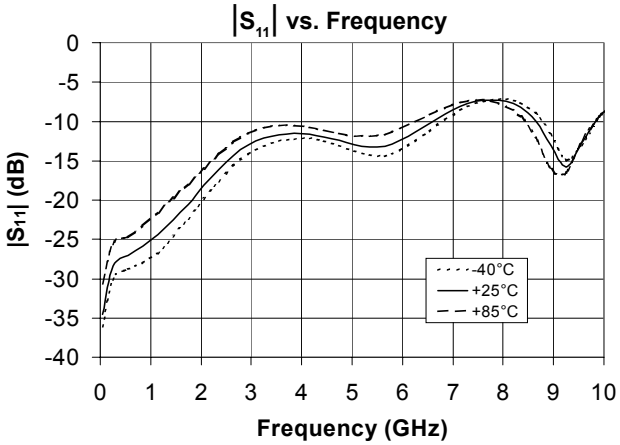


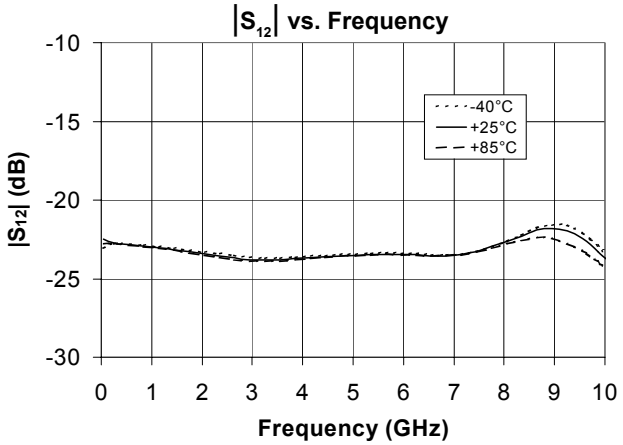

Noise Figure vs. Frequency

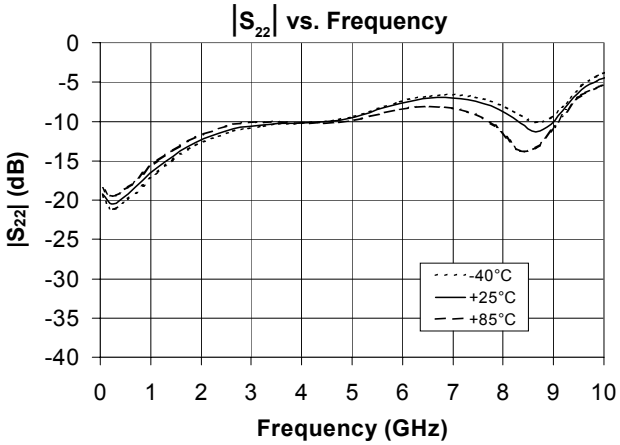


## Typical RF Performance Over Lead Temperature In Basic Application Circuit (Fig.2) ( Bias: $I_D$= 80 mA Typ.)

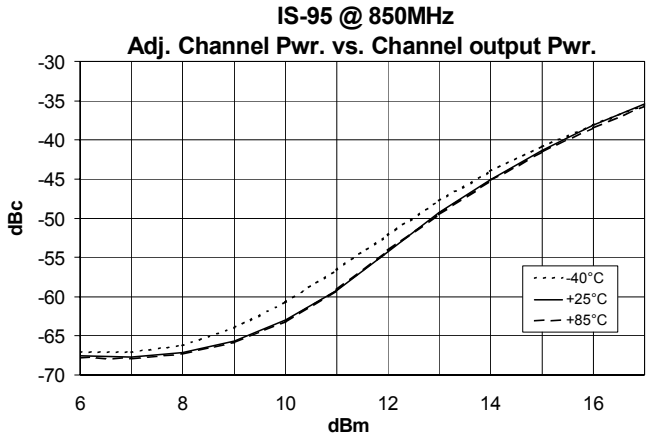


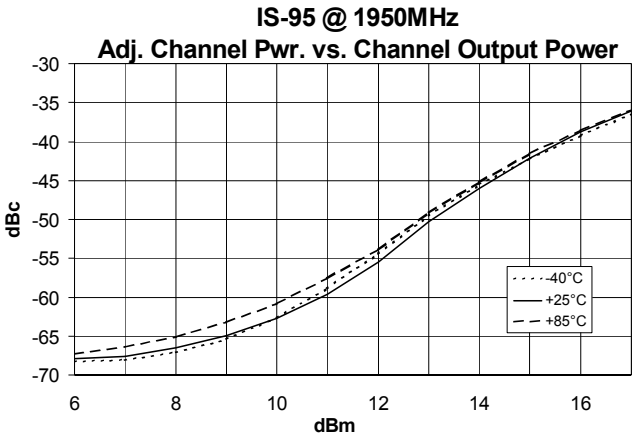



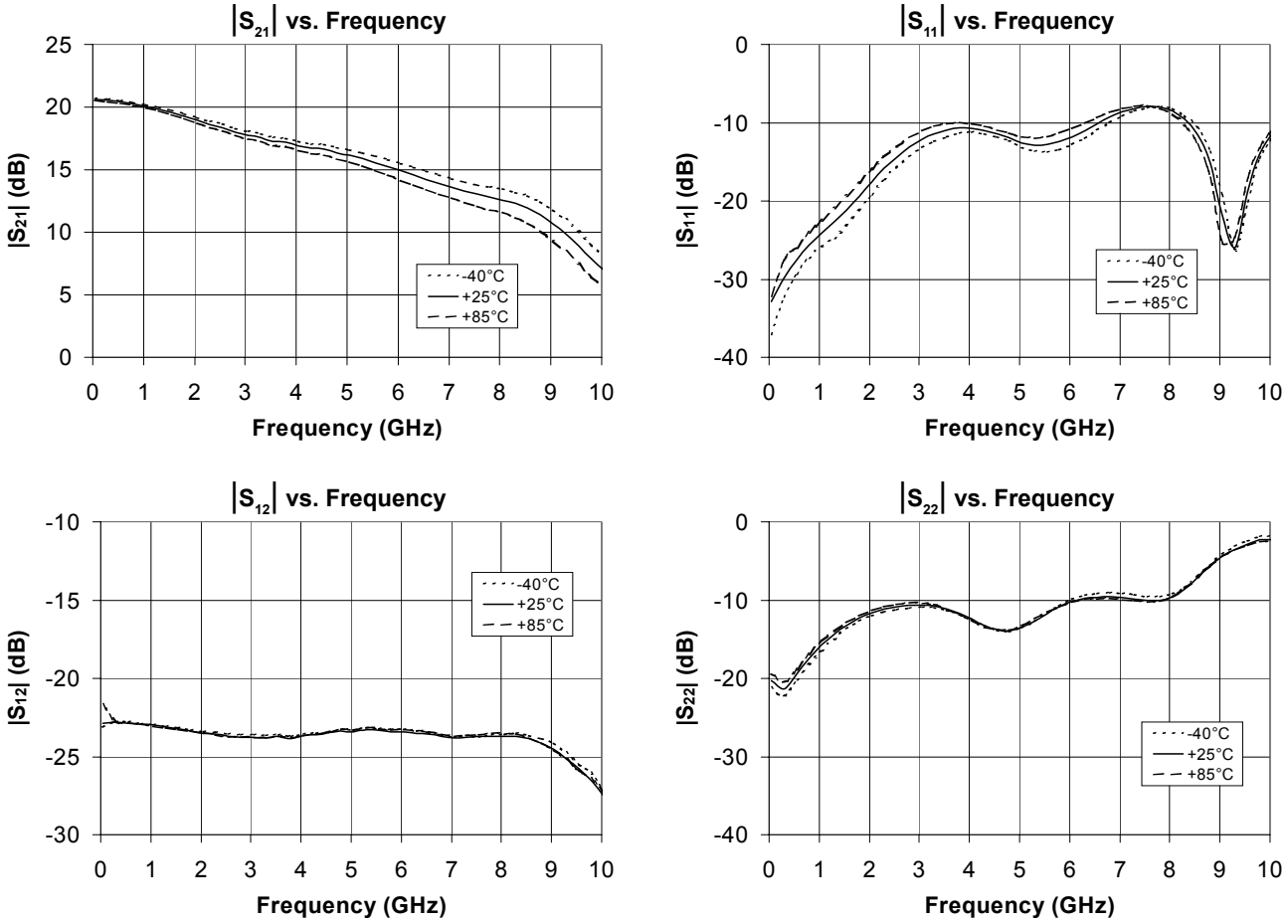




NOTE: Full S-parameter data available at *www.sirenza.com*



## Typical RF Performance Over Lead Temperature In Tuned Application Circuit (Fig.1) ( Bias: $I_D$= 80 mA Typ.)




NOTE: Full S-parameter data available at *www.sirenza.com*

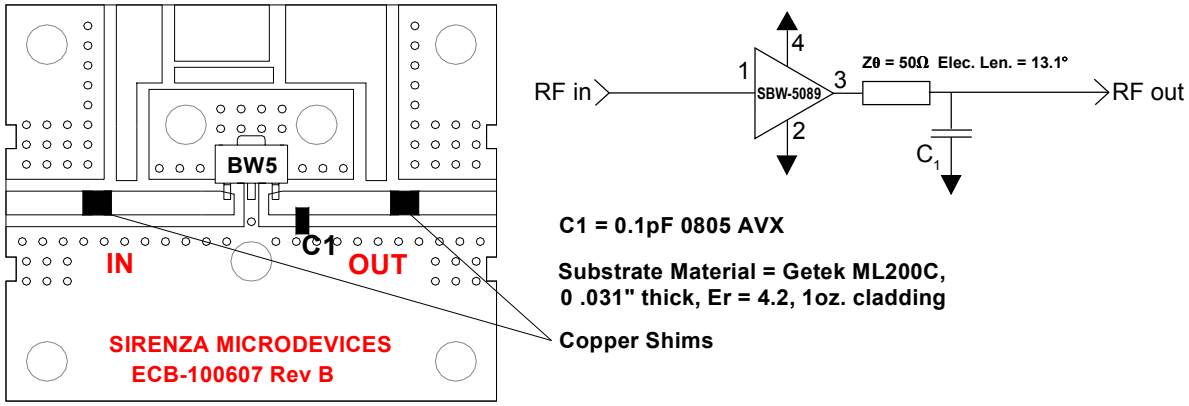
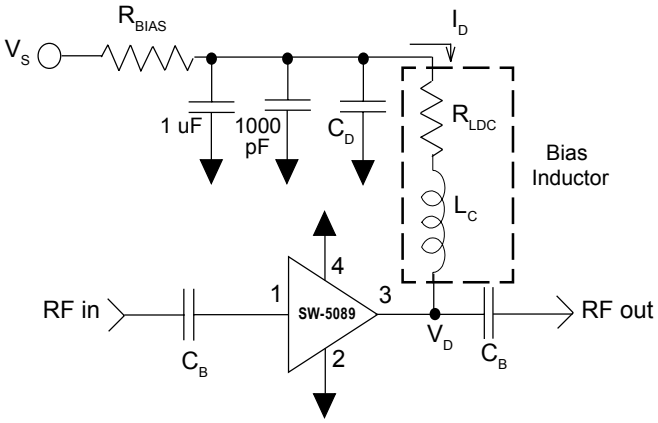
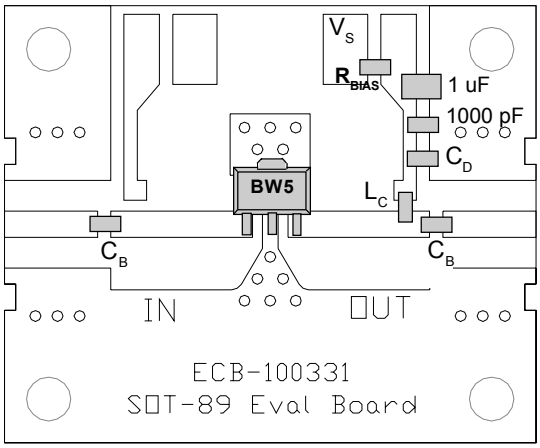



Figure 1. Tuned Application Circuit

## Fig. 2 Basic Application Circuit




| Application Circuit Element Values | | | | | | |
|---|---|---|---|---|---|---|
| Reference Designator | Frequency (Mhz) | | | | | |
| | 100 | 500 | 850 | 1950 | 2400 | 3500 |
| $C_B$ | 1000 pF | 220 pF | 100 pF | 68 pF | 56 pF | 39 pF |
| $C_D$ | 100 pF | 100 pF | 68 pF | 22 pF | 22 pF | 15 pF |
| $L_C$ | 470 nH | 68 nH | 33 nH | 22 nH | 18 nH | 15 nH |

| Recommended Bias Resistance for $I_D$ = 80 mA | | | | | | | |
|---|---|---|---|---|---|---|---|
| Supply Voltage ($V_S$) (Volts) | < 7 | 7 | 7.5 | 8 | 9 | 10 | 12 |
| Bias Resistance* (Ohms) | N/R | 26 | 33 | 39 | 52 | 64 | 89 |

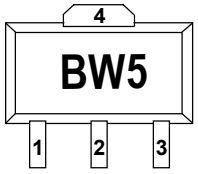
*** Bias Resistance = $R_{BIAS}$ + $R_{LDC}$ = ( $V_S$-$V_D$ ) / $I_D$**

Select $R_{BIAS}$ so that $R_{BIAS}$ + $R_{LDC}$ ~ the recommended bias resistance. Use 1% or 5 % tolerance resisistors or parallel combinations to attain the recommended bias resistance +/- 3%. $R_{BIAS}$ provides current stability over temperature.

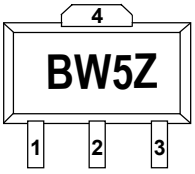
* N/R=Not Recommended. Contact Sirenza technical support for guidance when available supply voltage is <7 V.

| Device Pin Out Guide | | |
|---|---|---|
| Pin # | Function | Description |
| 1 | RF IN | RF input pin. This pin requires the use of an external DC blocking capacitor chosen for the frequency of operation. |
| 2, 4 | GND | Connection to ground. Provide via holes as close to the device ground leads as possible to reduce ground inductance and achieve optimum RF performance. |
| 3 | RF OUT / DC BIAS | RF output and bias pin. This pin requires the use of an external DC blocking capacitor chosen for the frequency of operation. |

### Part Identification Marking




Tin-Lead




Lead Free
RoHs Compliant

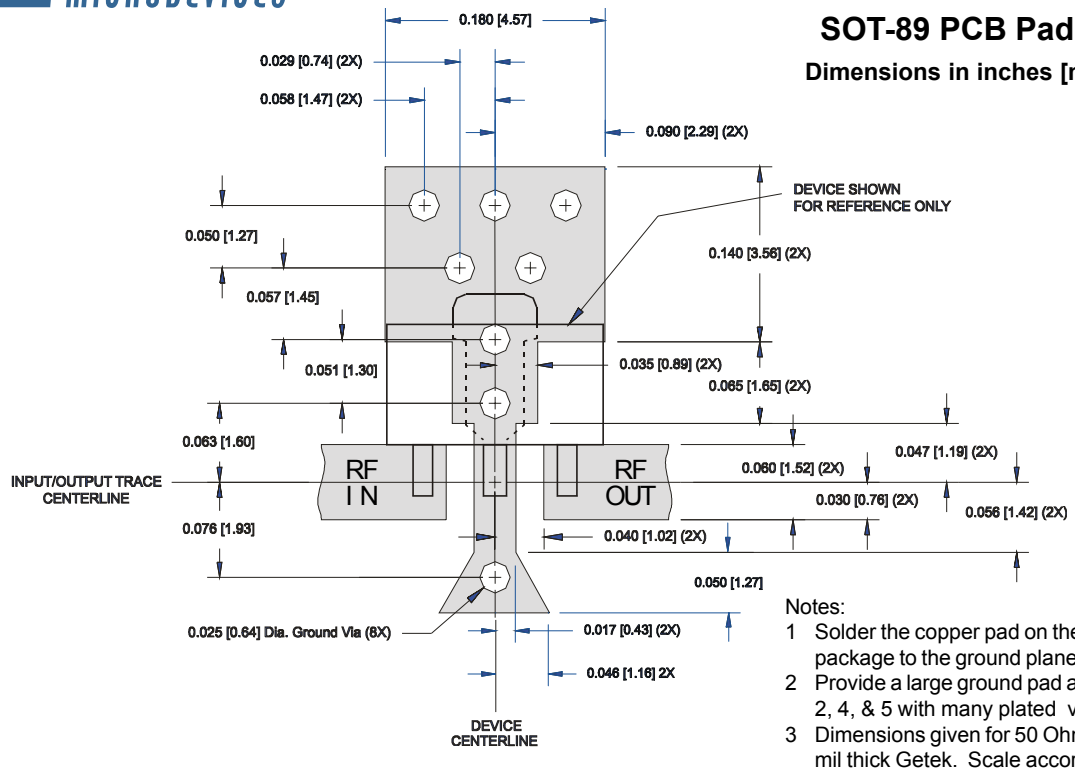
| Reliability & Qualification Information | |
|---|---|
| Parameter | Rating |
| ESD Rating - Human Body Model (HBM) | Class 1C |
| Moisture Sensitivity Level | MSL 1 |
| **The product qualification report may be downloaded at *www.sirenza.com*** | |

**Caution: ESD sensitive**
**Appropriate precautions in handling, packaging and testing devices must be observed.**

| Part Ordering Information | | | |
|---|---|---|---|
| Part Number | Package / Lead Composition | Reel Size | Devices / Reel |
| SBW-5089 | Tin-Lead | 7" | 1000 |
| SBW-5089Z | Lead Free, RoHs Compliant | 7" | 1000 |

## SOT-89 PCB Pad Layout

**Dimensions in inches [millimeters]**




Notes:

1 Solder the copper pad on the backside of the device package to the ground plane.
2 Provide a large ground pad area under device pins 1, 2, 4, & 5 with many plated via holes as shown.
3 Dimensions given for 50 Ohm RF I/O lines are for 31 mil thick Getek. Scale accordingly for different board thicknesses and dielectric contants.
4. We recommend 1 or 2 ounce copper. Measurements for this data sheet were made on a 31 mil thick Getek with 1 ounce copper on both sides.

## SOT-89 Nominal Package Dimensions

**Dimensions in inches [millimeters]**

**A link to the SOT-89 package outline drawing with full dimensions and tolerances may be found on the product web page at www.sirenza.com.**