# SNA-686

## DC-6 GHz, Cascadable GaAs HBT MMIC Amplifier

**Not Recommended for New Designs**
**See Application Note AN-019 for Alternates**

## Product Description

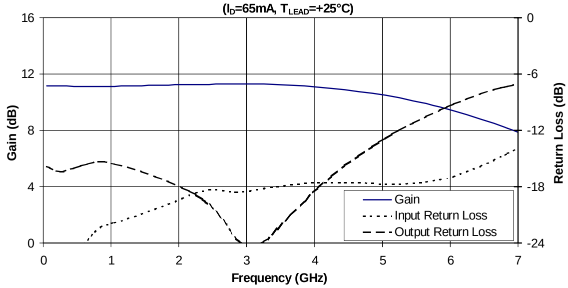
Sirenza Microdevices' SNA-686 is a GaAs HBT MMIC Amplifier housed in a low-cost, surface-mountable plastic package. The heterojunction increases breakdown voltage and minimizes leakage current between junctions. Cancellation of emitter junction non-linearities results in higher suppression of intermodulation products.

The use of an external resistor allows for bias flexibility and stability. These unconditionally stable amplifiers are designed for use as general purpose 50 ohm gain blocks.

Also available in chip form (SNA-600), its small size (0.38mm x 0.38mm) and gold metallization make it an ideal choice for use in hybrid circuits.

**Gain & Return Loss vs. Frequency**

($I_D$=65mA, $T_{LEAD}$=+25°C)




## Product Features

- Patented GaAs HBT Technology
- Cascadable 50 Ohm Gain Block
- 34 dBm Output IP3 @ 850 MHz
- Operates From Single Supply
- Low Cost Surface Mount Plastic Package

## Applications

- Cellular, PCS, CDPD, Wireless Data, SONET

| Symbol | Parameter | Frequency | Units | Min. | Typ. | Max. |
|---|---|---|---|---|---|---|
| $P_{1dB}$ | Output Power at 1dB Compression | 850 MHz<br>1950 MHz<br>2400 MHz | dBm<br>dBm<br>dBm | 15.7 | 17.6<br>17.7<br>17.4 | |
| $IP_3$ | Third Order Intercept Point | 850 MHz<br>1950 MHz<br>2400 MHz | dBm<br>dBm<br>dBm | 29.1 | 34.0<br>32.1<br>30.0 | |
| $S_{21}$ | Small Signal Gain | 850 MHz<br>1950 MHz<br>2400 MHz | dB<br>dB<br>dB | 10.0<br>10.1 | 11.1<br>11.2<br>11.3 | 12.2<br>12.3 |
| Bandwidth | (Determined by $S_{11}$, $S_{22}$ Values) | | MHz | | 6000 | |
| $VSWR_{IN}$ | Input VSWR | DC-6000 MHz | - | | 1.3:1 | |
| $VSWR_{OUT}$ | Output VSWR | DC-6000 MHz | - | | 1.4:1 | |
| $S_{12}$ | Reverse Isolation | 850 MHz<br>1950 MHz<br>2400 MHz | dB<br>dB<br>dB | | 16.3<br>16.5<br>16.6 | |
| NF | Noise Figure | 1950 MHz | dB | | 7.3 | 8.8 |
| $V_D$ | Device Operating Voltage | | V | 5.0 | 5.3 | 5.6 |
| $I_D$ | Device Operating Current | | I | 58 | 65 | 72 |
| $R_{TH}$, j-l | Thermal Resistance (junction - lead) | | ° C/W | | 261 | |

**Test Conditions:** $V_S$ = 8 V, $R_{BIAS}$ = 43 Ohms; $I_D$ = 65 mA Typ., $T_L$ = 25ºC; $OIP_3$ Tone Spacing = 1 MHz, Pout per tone = 0 dBm, $Z_S = Z_L$ = 50 Ohms

## Typical RF Performance at Key Operating Frequencies

| Symbol | Parameter | Unit | Frequency (MHz) 100 | 500 | 850 | 1950 | 2400 | 3500 |
|---|---|---|---|---|---|---|---|---|
| G | Small Signal Gain | dB | 11.1 | 11.1 | 11.1 | 11.2 | 11.3 | 11.3 |
| $OIP_3$ | Output Third Order Intercept Point | dBm | | 35.0 | 34.0 | 32.1 | 30.0 | |
| $P_{1dB}$ | Output Power at 1dB Compression | dBm | | 17.5 | 17.6 | 17.7 | 17.4 | |
| IRL | Input Return Loss | dB | 29.5 | 25.2 | 22.3 | 19.6 | 18.4 | 17.9 |
| ORL | Output Return Loss | dB | 16.0 | 15.9 | 15.3 | 17.8 | 19.6 | 22.2 |
| $S_{12}$ | Reverse Isolation | dB | 16.2 | 16.2 | 16.3 | 16.5 | 16.6 | 17.0 |
| NF | Noise Figure | dB | | 7.2 | 7.3 | 7.3 | | |

Test Conditions: $V_S$ = 8v, $I_D$ = 65mA Typ., OIP3 Tone Spacing = 1 MHz, Pout per tone = 0 dBm; $R_{BIAS}$ = 43 Ohms, $T_L$ = 25ºC, $Z_S = Z_L$ = 50 Ohms

### Absolute Maximum Ratings

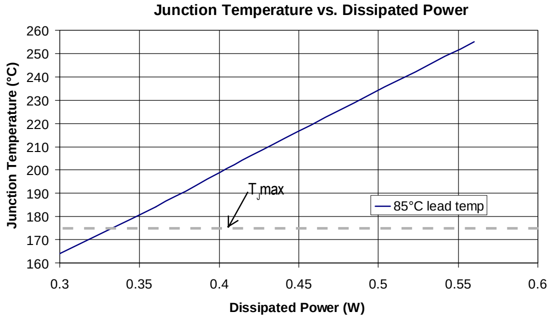
Operation of this device beyond any one of these limits may cause permanent damage. For reliable continous operation, the device voltage and current must not exceed the maximum operating values specified in the table on page one.

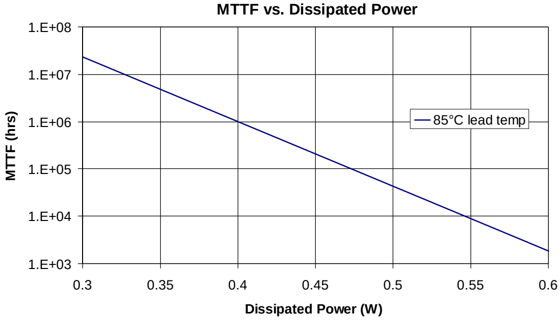
Bias Conditions should also satisfy the following expression:

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

| Parameter | Absolute Limit |
|---|---|
| Max. Device Current ($I_D$) | 120 mA |
| Max. Device Voltage ($V_D$) | 7 V |
| Max. RF Input Power | +16 dBm |
| Max. Junction Temp. ($T_J$) | +175°C |
| Operating Temp. Range ($T_L$) | -40°C to +85°C |
| Max. Storage Temp. | +150°C |

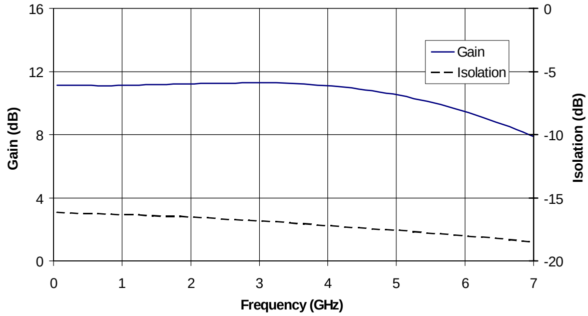
**NOTE:** While the SNA-686 can be operated at different bias currents, 65 mA is the recommended bias for lower junction temperature and longer life. This reflects typical operating conditions which we have found to be an optimal balance between high IP3 and MTTF. In general, MTTF is improved to more than 100,000 hours when biasing at 65 mA and operating up to 85°C ambient temperature.



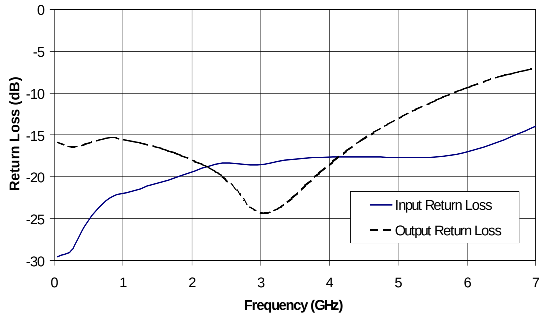



## Typical RF Performance (V$_{DS}$ = 5.3V, I$_{DS}$ = 65mA, T$_{LEAD}$=25° C)

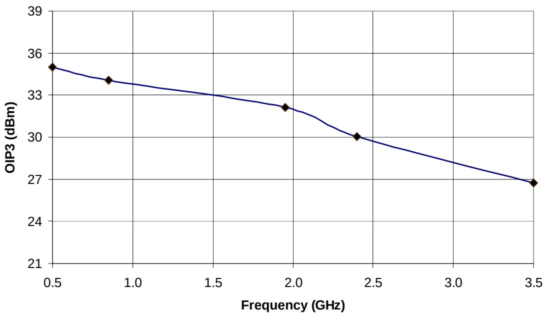
Gain & Isolation vs. Frequency



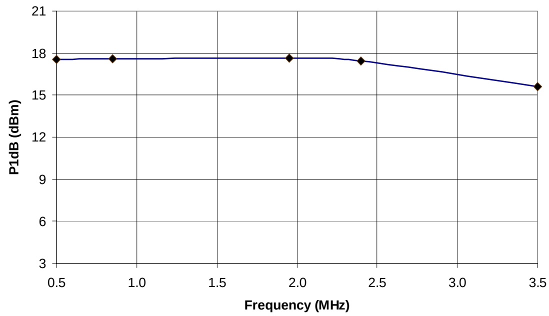

Return Loss vs. Frequency



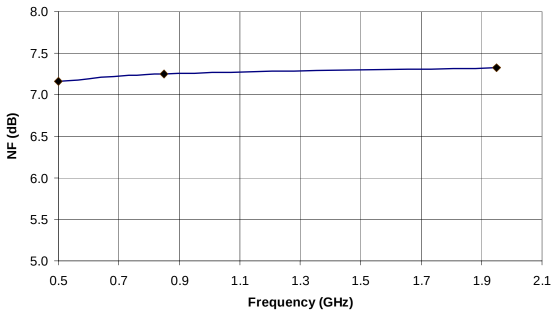

Output IP3 vs. Frequency




P1dB vs. Frequency

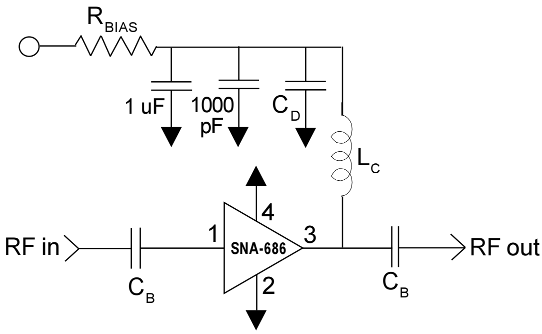


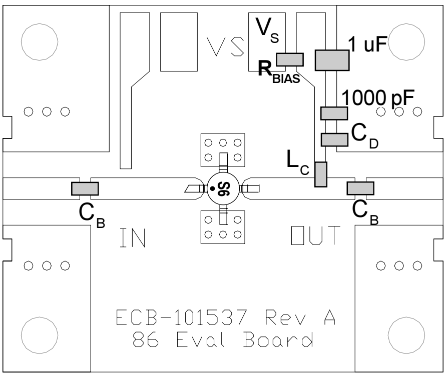

Noise Figure vs. Frequency



# SNA-686 DC-6GHz Cascadable MMIC Amplifier

## Typical Application Circuit




## Application Circuit Element Values

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

| Recommended Bias Resistor Values for $I_D$=65mA $R_{BIAS}$=( $V_S$-$V_D$ ) / $I_D$ | | | | |
|---|---|---|---|---|
| Supply Voltage($V_S$) | 8 V | 9 V | 12 V | 15 V |
| $R_{BIAS}$ | 43 Ω | 56 Ω | 100 Ω | 150 Ω |

Note: $R_{BIAS}$ provides DC bias stability over temperature.

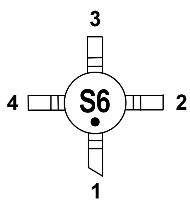
### Mounting Instructions

1. Use a large ground pad area under device pins 2 and 4 with many plated through-holes as shown.

2. We recommend 1 or 2 ounce copper. Measurements for this data sheet were made on a 31 mil thick FR-4 board with 1 ounce copper on both sides.

### Part Identification Marking

The part will be marked with an "S6" designator on the top surface of the package.




| 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. For optimum RF performance, use via holes as close to ground leads as possible to reduce lead inductance. |
| 3 | RF OUT/ BIAS | RF output and bias pin. DC voltage is present on this pin, therefore a DC blocking capacitor is necessary for proper operation. |

**Caution: ESD sensitive**

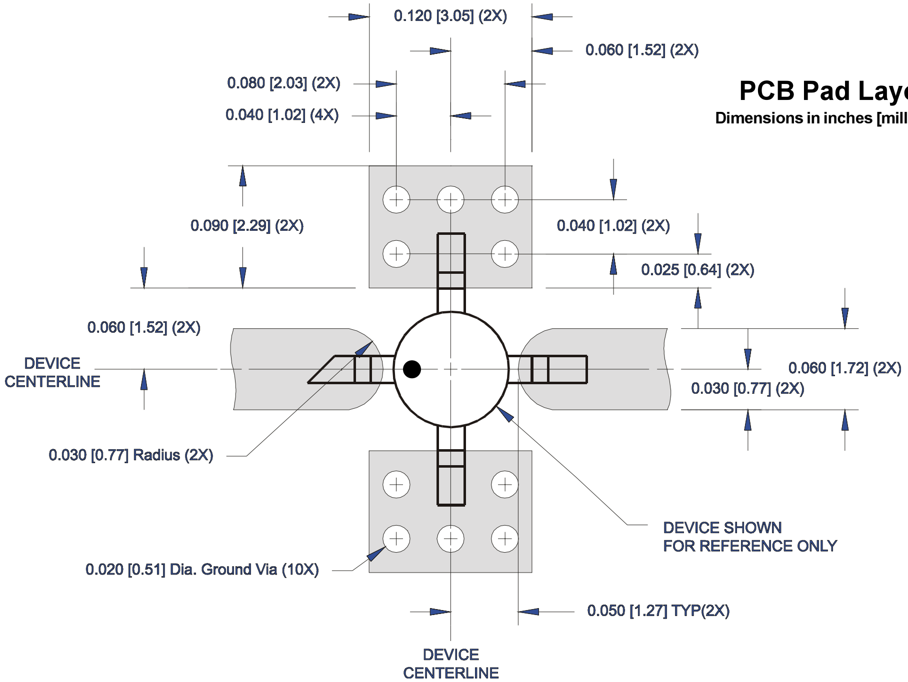
Appropriate precautions in handling, packaging and testing devices must be observed.

### Part Number Ordering Information

| Part Number | Reel Size | Devices/Reel |
|---|---|---|
| SNA-686 | 7" | 1000 |

## PCB Pad Layout

Dimensions in inches [millimeters]




## Nominal Package Dimensions

Dimensions in inches [millimeters]

Refer to drawing posted at *www.sirenza.com* for tolerances.