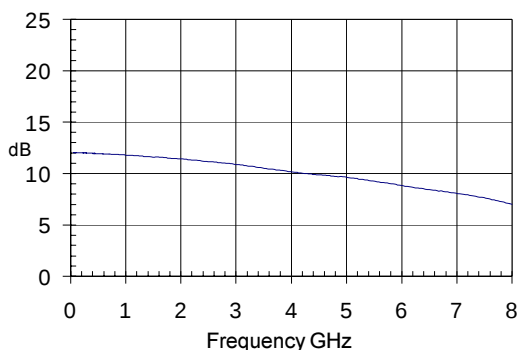




## Product Description

Sirenza Microdevices' NGA-686 is a high performance Gallium Arsenide Heterojunction Bipolar Transistor MMIC Amplifier. Designed with InGaP process technology for improved reliability, a Darlington configuration is utilized for broadband performance up to 6 GHz. The heterojunction increases breakdown voltage and minimizes leakage current between junctions. Cancellation of emitter junction non-linearities results in higher suppression of intermodulation products.

Small Signal Gain vs. Frequency



## NGA-686

### DC-6000 MHz, Cascadable GaAs HBT MMIC Amplifier



# OBSOLETE

See Application Note AN-059 for Alternates

## Product Features

- 11.4dB Gain, 19.2 dBm P1dB at 1950Mhz
- Cascadable 50 ohm: 1.2:1 VSWR
- Operates from Single Supply
- Low Thermal Resistance Package
- Unconditionally Stable

## Applications

- PA Driver Amplifier
- Cellular, PCS, GSM, UMTS
- IF Amplifier
- Wireless Data, Satellite

| Symbol                | Parameter                             | Units | Frequency                       | Min. | Typ.                 | Max. |
|-----------------------|---------------------------------------|-------|---------------------------------|------|----------------------|------|
| P <sub>1dB</sub>      | Output Power at 1dB Compression       | dBm   | 850 MHz<br>1950 MHz<br>2400 MHz |      | 19.8<br>19.2<br>17.9 |      |
| OIP <sub>3</sub>      | Output Third Order Intercept Point    | dBm   | 850 MHz<br>1950 MHz<br>2400 MHz |      | 38.4<br>34.9<br>32.7 |      |
| G                     | Small Signal Gain                     | dB    | 850 MHz<br>1950 MHz<br>2400 MHz | 10.7 | 11.9<br>11.4<br>11.2 | 13.1 |
| Bandwidth             | Determined by Return Loss (>10dB)     | MHz   |                                 |      | 5800                 |      |
|                       | Input VSWR                            | -     | DC - 6000 MHz                   |      | 1.2:1                |      |
|                       | Output VSWR                           | -     | DC - 6000 MHz                   |      | 1.3:1                |      |
| NF                    | Noise Figure                          | dB    | 2000 MHz                        |      | 6.1                  |      |
| V <sub>D</sub>        | Device Operating Voltage              | V     |                                 | 5.3  | 5.8                  | 6.3  |
| I <sub>D</sub>        | Device Operating Current              | mA    |                                 | 72   | 80                   | 88   |
| R <sub>TH</sub> , j-I | Thermal Resistance (junction to lead) | °C/W  |                                 |      | 121                  |      |

#### Test Conditions:

$$V_S = 8 \text{ V}$$

$$R_{BIAS} = 27 \text{ Ohms}$$

$$I_D = 80 \text{ mA Typ.}$$

$$T_L = 25^\circ\text{C}$$

$$OIP_3 \text{ Tone Spacing} = 1 \text{ MHz, } P_{out} \text{ per tone} = 0 \text{ dBm}$$

$$Z_S = Z_L = 50 \text{ Ohms}$$

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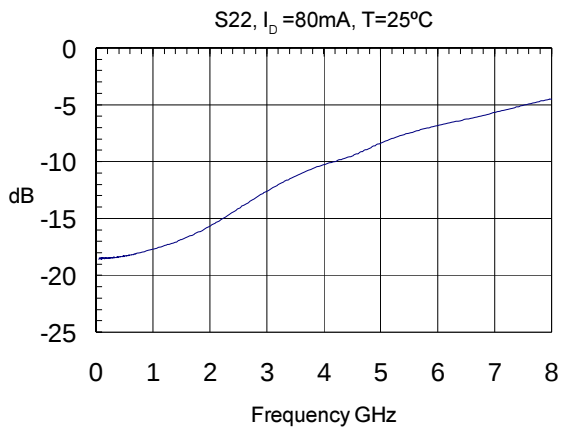
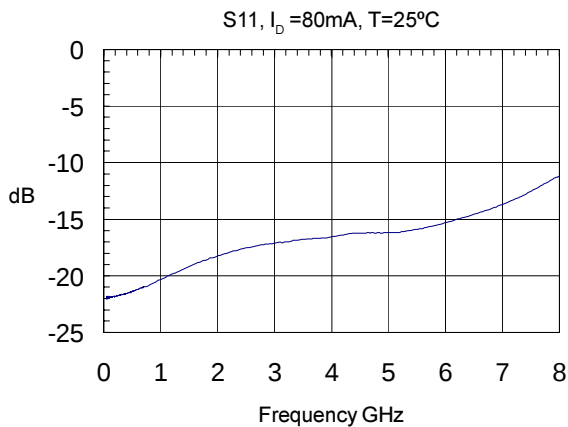
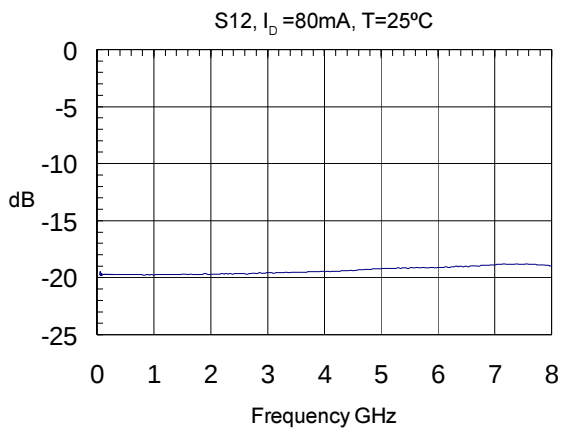
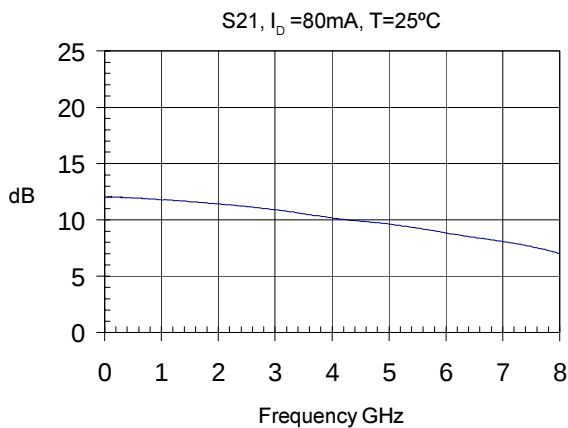
**Key parameters, at typical operating frequencies:**

| Parameter         | Typical<br>25°C | Unit | Test Condition<br>( $I_D = 80\text{mA}$ , unless otherwise noted) |
|-------------------|-----------------|------|-------------------------------------------------------------------|
| <b>500 MHz</b>    |                 |      |                                                                   |
| Gain              | 11.9            | dB   | Tone spacing = 1 MHz, Pout per tone = 0dBm                        |
| Output IP3        | 38.5            | dBm  |                                                                   |
| Output P1dB       | 19.9            | dBm  |                                                                   |
| Input Return Loss | 21.4            | dB   |                                                                   |
| Isolation         | 19.7            | dB   |                                                                   |
| <b>850 MHz</b>    |                 |      |                                                                   |
| Gain              | 11.9            | dB   | Tone spacing = 1 MHz, Pout per tone = 0dBm                        |
| Output IP3        | 38.4            | dBm  |                                                                   |
| Output P1dB       | 19.8            | dBm  |                                                                   |
| Input Return Loss | 20.7            | dB   |                                                                   |
| Isolation         | 19.8            | dB   |                                                                   |
| <b>1950 MHz</b>   |                 |      |                                                                   |
| Gain              | 11.4            | dB   | Tone spacing = 1 MHz, Pout per tone = 0dBm                        |
| Output IP3        | 34.9            | dBm  |                                                                   |
| Output P1dB       | 19.2            | dBm  |                                                                   |
| Input Return Loss | 18.4            | dB   |                                                                   |
| Isolation         | 19.7            | dB   |                                                                   |
| <b>2400 MHz</b>   |                 |      |                                                                   |
| Gain              | 11.2            | dB   | Tone spacing = 1 MHz, Pout per tone = 0dBm                        |
| Output IP3        | 32.7            | dBm  |                                                                   |
| Output P1dB       | 17.9            | dBm  |                                                                   |
| Input Return Loss | 17.6            | dB   |                                                                   |
| Isolation         | 19.7            | dB   |                                                                   |

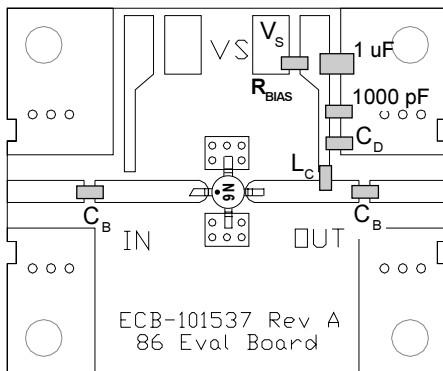
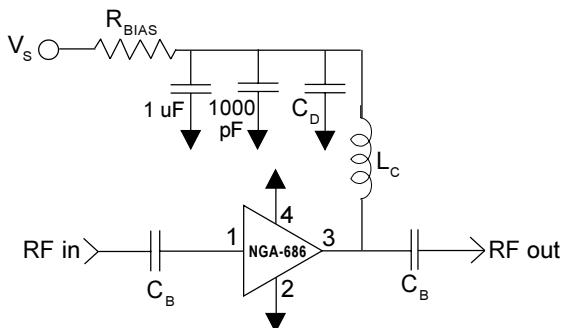
**Absolute Maximum Ratings**

| Parameter                                                                                                                                                                                                                                                                                                                                                       | Absolute Limit |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| Max. Device Current ( $I_D$ )                                                                                                                                                                                                                                                                                                                                   | 120 mA         |
| Max. Device Voltage ( $V_D$ )                                                                                                                                                                                                                                                                                                                                   | 7 V            |
| Max. RF Input Power                                                                                                                                                                                                                                                                                                                                             | +13 dBm        |
| Max. Junction Temp. ( $T_J$ )                                                                                                                                                                                                                                                                                                                                   | +150°C         |
| Operating Temp. Range ( $T_L$ )                                                                                                                                                                                                                                                                                                                                 | -40°C to +85°C |
| Max. Storage Temp.                                                                                                                                                                                                                                                                                                                                              | +150°C         |
| <p>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.</p> <p>Bias Conditions should also satisfy the following expression:</p> $I_D V_D < (T_J - T_L) / R_{TH} \text{ J-I}$ |                |

### S-parameters over frequency, at 25°C

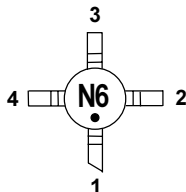


## Basic Application Circuit



### Part Identification Marking

The part will be marked with an "N6" designator on the top surface of the package.



### Caution: ESD sensitive

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

### Application Circuit Element Values

| Reference Designator | Frequency (Mhz) |        |       |       |       |
|----------------------|-----------------|--------|-------|-------|-------|
|                      | 500             | 850    | 1950  | 2400  | 3500  |
| C <sub>B</sub>       | 220 pF          | 100 pF | 68 pF | 56 pF | 39 pF |
| C <sub>D</sub>       | 100 pF          | 68 pF  | 22 pF | 22 pF | 15 pF |
| L <sub>C</sub>       | 68 nH           | 33 nH  | 22 nH | 18 nH | 15 nH |

### Recommended Bias Resistor Values for I<sub>b</sub>=80mA

$$R_{BIAS} = (V_S - V_D) / I_D$$

| Supply Voltage(V <sub>S</sub> ) | 8 V  | 9 V  | 10 V | 12 V |
|---------------------------------|------|------|------|------|
| R <sub>BIAS</sub>               | 27 Ω | 39 Ω | 51 Ω | 75 Ω |

Note: R<sub>BIAS</sub> provides DC bias stability over temperature.

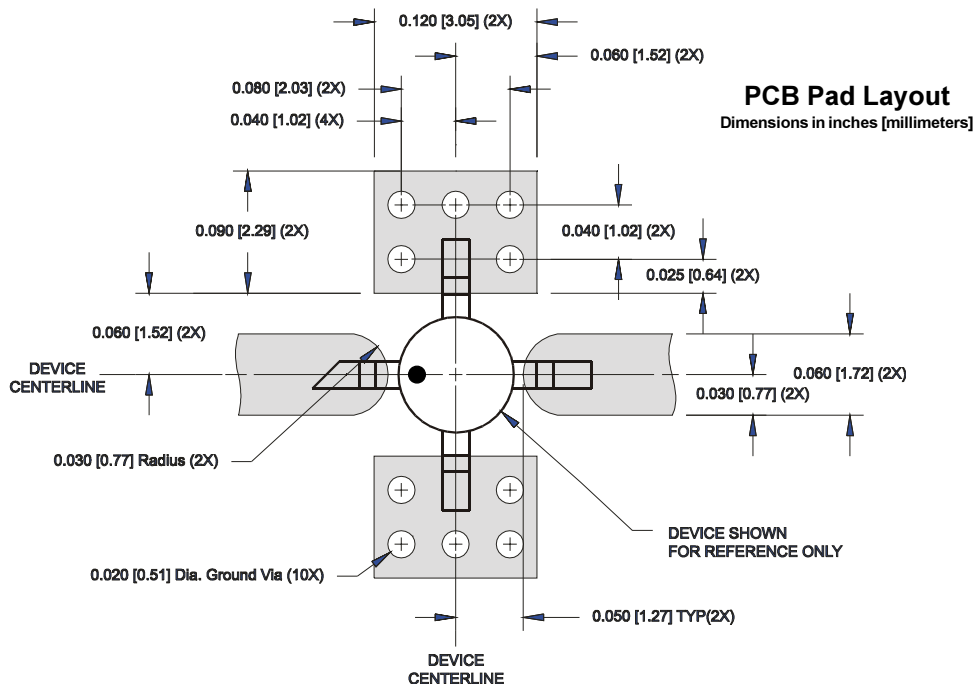
### Mounting Instructions

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.

| 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. Use via holes for best performance to reduce lead inductance as close to ground leads as possible.        |
| 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. |

### Part Number Ordering Information

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



## Nominal Package Dimensions

**Dimensions in inches [millimeters]**

Refer to drawing posted at [www.sirenza.com](http://www.sirenza.com) for tolerances.

