

Low Noise, Cascadable Silicon Bipolar MMIC Amplifier

Technical Data

INA-03100

Features

- **Cascadable 50 Ω Gain Block**
- **Low Noise Figure:**
2.5 dB Typical at 1.5 GHz
- **High Gain:**
26.0 dB Typical at 2.8 GHz
- **3 dB Bandwidth:**
DC to 2.8 GHz
- **Unconditionally Stable**
($k > 1$)
- **Low Power Consumption**

Description

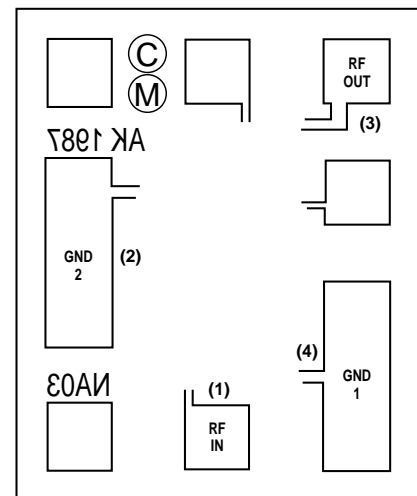
The INA-03100 is a low-noise silicon bipolar Monolithic Microwave Integrated Circuit (MMIC) feedback amplifier chip. It is designed for narrow or wide bandwidth commercial, industrial and military applications that

require high gain and low noise IF or RF amplification with minimum power consumption.

The INA series of MMICs is fabricated using HP's 10 GHz f_T , 25 GHz f_{MAX} , ISOSAT™-I silicon bipolar process which uses nitride self-alignment, submicrometer lithography, trench isolation, ion implantation, gold metallization and polyimide intermetal dielectric and scratch protection to achieve excellent performance, uniformity and reliability.

The recommended assembly procedure is gold-eutectic die attach at 400°C and either wedge or ball bonding using 0.7 mil gold wire.^[1]

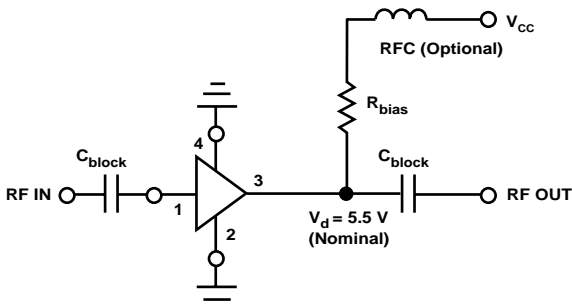
Chip Outline^[1]



Note:

1. See Application Note, "A005: Transistor Chip Use" for additional information.

Typical Biasing Configuration



INA-03100 Absolute Maximum Ratings

| Parameter | Absolute Maximum ^[1] |
|------------------------------------|---------------------------------|
| Device Current | 50 mA |
| Power Dissipation ^[2,3] | 200 mW |
| RF Input Power | +13 dBm |
| Junction Temperature | 200°C |
| Storage Temperature | -65 to 200°C |

Thermal Resistance^{[2]:}

$$\theta_{jc} = 70^{\circ}\text{C/W}$$

Notes:

1. Permanent damage may occur if any of these limits are exceeded.
2. $T_{\text{Mounting Surface}} (T_{\text{MS}}) = 25^{\circ}\text{C}$.
3. Derate at 14.3 mW/°C for $T_{\text{MS}} > 186^{\circ}\text{C}$.

INA-03100 Electrical Specifications^[1,3], $T_A = 25^{\circ}\text{C}$

| Symbol | Parameters and Test Conditions ^{[2]:} $I_d = 12 \text{ mA}$, $Z_o = 50 \Omega$ | Units | Min. | Typ. | Max. |
|-------------------|--|-------|------|------------------|------|
| G _P | Power Gain ($ S_{21} ^2$) f = 1.5 GHz | dB | | 26.0 | |
| ΔG_P | Gain Flatness f = 0.01 to 2.0 GHz | dB | | ±0.5 | |
| f _{3 dB} | 3 dB Bandwidth | GHz | | 2.8 | |
| ISO | Reverse Isolation ($ S_{12} ^2$) f = 0.01 to 2.0 GHz | dB | | 37 | |
| VSWR | Input VSWR f = 0.01 to 2.0 GHz | | | 2.0 ⁵ | |
| | Output VSWR f = 0.01 to 2.0 GHz | | | 3.0 ⁵ | |
| NF | 50 Ω Noise Figure f = 1.5 GHz | dB | | 2.5 | |
| P _{1 dB} | Output Power at 1 dB Gain Compression f = 1.5 GHz | dBm | | 1.0 | |
| IP ₃ | Third Order Intercept Point f = 1.5 GHz | dBm | | 10 | |
| t _D | Group Delay f = 1.5 GHz | psec | | 200 | |
| V _d | Device Voltage f = 1.5 GHz | V | 3.5 | 4.5 | 5.5 |
| dV/dT | Device Voltage Temperature Coefficient | mV/°C | | +5 | |

Notes:

1. The recommended operating current range for this device is 8 to 20 mA. Typical performance as a function of current is on the following page.
2. RF performance of the chip is determined by packaging and testing 10 devices per wafer.
3. The values are the achievable performance for the INA-03100 mounted in a 70 mil stripline package.

INA-03100 Typical Scattering Parameters^[1] ($Z_o = 50 \Omega$, $T_A = 25^{\circ}\text{C}$, $I_d = 12 \text{ mA}$)

| Freq. GHz | S ₁₁ | | S ₂₁ | | | S ₁₂ | | | S ₂₂ | | k |
|--------------|-----------------|-----|-----------------|------|------|-----------------|------|-----|-----------------|-----|------|
| | Mag | Ang | dB | Mag | Ang | dB | Mag | Ang | Mag | Ang | |
| 0.05 | 0.35 | 176 | 26.6 | 21.4 | -4 | -36.0 | .016 | 8 | .56 | -1 | 1.25 |
| 0.10 | 0.35 | 172 | 26.6 | 21.3 | -8 | -36.5 | .015 | -4 | .56 | -3 | 1.30 |
| 0.20 | 0.33 | 165 | 26.4 | 21.0 | -15 | -36.4 | .015 | -5 | .56 | -4 | 1.30 |
| 0.40 | 0.31 | 150 | 26.1 | 20.1 | -29 | -36.0 | .016 | -13 | .54 | -7 | 1.33 |
| 0.60 | 0.27 | 137 | 25.6 | 19.0 | -42 | -37.6 | .013 | -14 | .54 | -8 | 1.58 |
| 0.80 | 0.23 | 125 | 25.0 | 17.8 | -53 | -36.1 | .016 | -13 | .53 | -9 | 1.49 |
| 1.00 | 0.19 | 113 | 24.5 | 16.7 | -63 | -35.1 | .018 | -16 | .53 | -10 | 1.43 |
| 1.20 | 0.16 | 99 | 24.0 | 15.9 | -72 | -36.9 | .014 | -21 | .54 | -12 | 1.72 |
| 1.40 | 0.13 | 76 | 23.8 | 15.4 | -81 | -36.4 | .015 | -12 | .55 | -15 | 1.65 |
| 1.60 | 0.12 | 51 | 23.6 | 15.2 | -88 | -35.6 | .017 | -11 | .56 | -17 | 1.54 |
| 1.80 | 0.13 | 21 | 23.6 | 15.5 | -97 | -34.1 | .020 | -5 | .58 | -20 | 1.24 |
| 2.00 | 0.18 | -5 | 23.8 | 15.5 | -106 | -34.3 | .019 | -13 | .60 | -25 | 1.18 |
| 2.50 | 0.40 | -52 | 24.7 | 17.2 | -132 | -30.2 | .031 | -9 | .67 | -38 | 0.53 |
| 3.00 | 0.81 | -86 | 25.6 | 19.1 | -167 | -27.0 | .045 | -12 | .70 | -64 | 0.03 |

Note:

1. S-parameters are de-embedded from 70 mil package measured data using the package model found in the DEVICE MODELS section of the *Avantek Microwave Semiconductors* databook.

INA-03100 Typical Performance, $T_A = 25^\circ\text{C}$

(unless otherwise noted: The values are the achievable performance for the INA-03100 mounted in a 70 mil stripline package.)

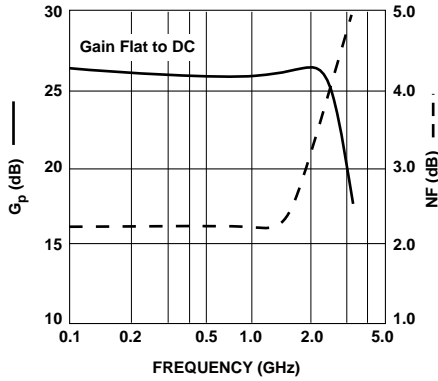


Figure 1. Typical Gain and Noise Figure vs. Frequency, $T_A = 25^\circ\text{C}$, $I_d = 12\text{ mA}$.

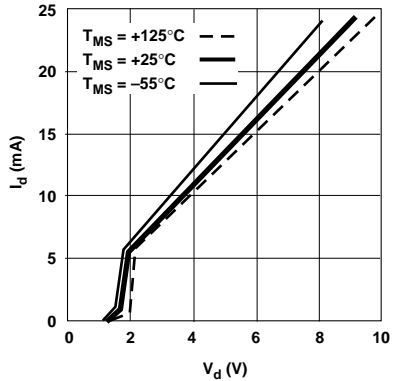


Figure 2. Device Current vs. Voltage.

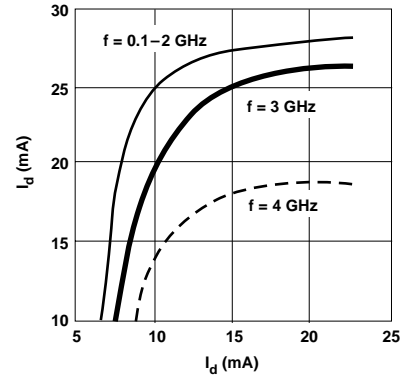


Figure 3. Power Gain vs. Current.

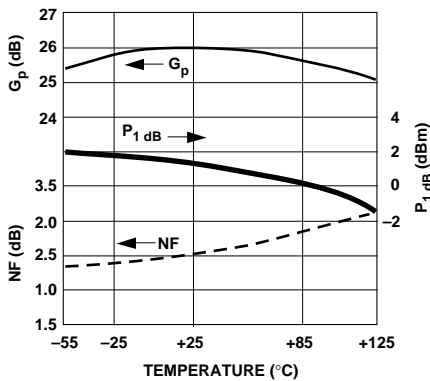


Figure 4. Output Power and 1 dB Gain Compression, NF and Power Gain vs. Case Temperature, $f = 1.5\text{ GHz}$, $I_d = 12\text{ mA}$.

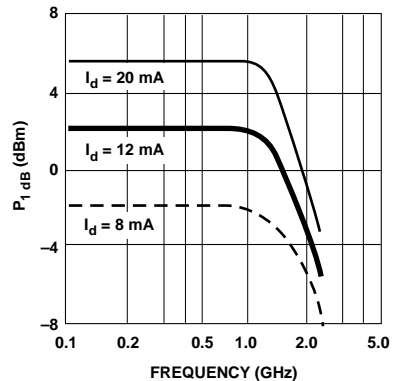


Figure 5. Output Power at 1 dB Gain Compression vs. Frequency.

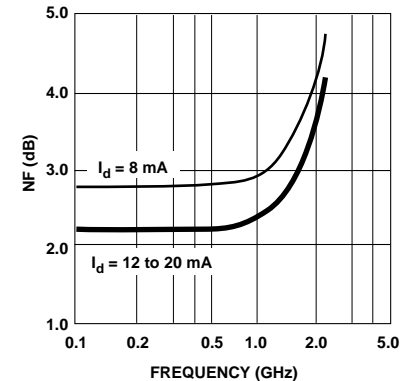
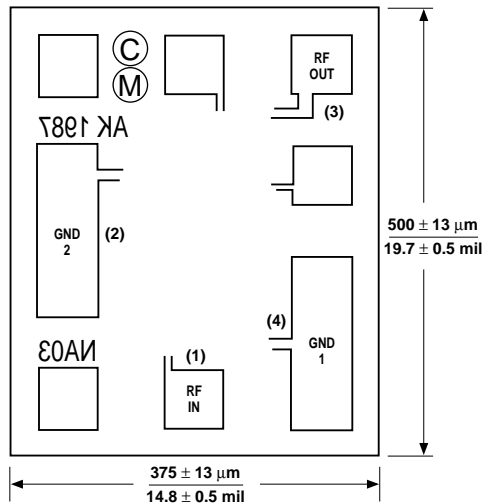


Figure 6. Noise Figure vs. Frequency.

INA-03100 Chip Dimensions



Chip thickness is $140\text{ }\mu\text{m}/5.5\text{ mil}$. Bond Pads are $41\text{ }\mu\text{m}/1.6\text{ mil}$ typical on each side. Note: Ground Bonding is Critical. Refer to Application Bulletin, "AB-0007: INA Bonding Configuration".