

# Low Noise, Cascadable Silicon Bipolar MMIC Amplifier

## Technical Data

**INA-03170**

### Features

- **Cascadable 50  $\Omega$  Gain Block**
- **Low Noise Figure:**  
2.5 dB Typical at 1.5 GHz
- **High Gain:**  
26.0 dB Typical at 1.5 GHz
- **3 dB Bandwidth:**  
DC to 2.8 GHz
- **Unconditionally Stable**  
( $k > 1$ )
- **Low Power Dissipation**
- **Hermetic Gold-Ceramic  
Surface Mount Package**

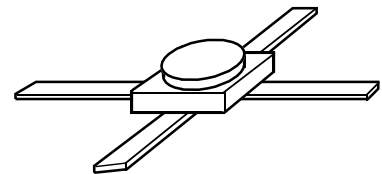
### Description

The INA-03170 is a low-noise silicon bipolar Monolithic Microwave Integrated Circuit (MMIC)

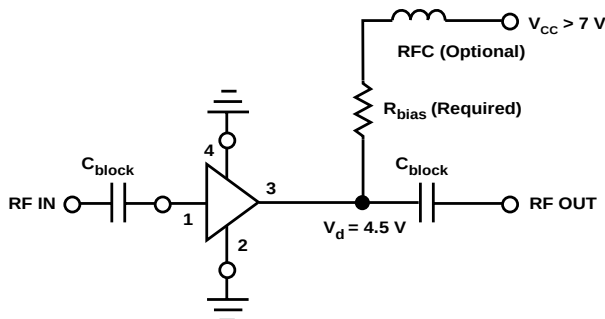
feedback amplifier housed in a hermetic, high reliability package. It is designed for narrow or wide bandwidth commercial, industrial and military applications that require high gain and low noise IF or RF amplification with minimum power consumption.

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.

### 70 mil Package



### Typical Biasing Configuration



## INA-03170 Absolute Maximum Ratings

| Parameter                          | Absolute Maximum <sup>[1]</sup> |
|------------------------------------|---------------------------------|
| Device Current                     | 25 mA                           |
| Power Dissipation <sup>[2,3]</sup> | 200 mW                          |
| RF Input Power                     | +13 dBm                         |
| Junction Temperature               | 200°C                           |
| Storage Temperature                | -65 to 200°C                    |

### Thermal Resistance<sup>[2,4]</sup>:

$$\theta_{jc} = 150^{\circ}\text{C/W}$$

#### Notes:

1. Permanent damage may occur if any of these limits are exceeded.
2.  $T_{\text{CASE}} = 25^{\circ}\text{C}$ .
3. Derate at  $6.7 \text{ mW}/^{\circ}\text{C}$  for  $T_C > 170^{\circ}\text{C}$ .
4. See MEASUREMENTS section "Thermal Resistance" for more information.

## INA-03170 Electrical Specifications<sup>[1]</sup>, $T_A = 25^{\circ}\text{C}$

| Symbol           | Parameters and Test Conditions: $I_d = 12 \text{ mA}$ , $Z_0 = 50 \Omega$ | Units                  | Min. | Typ.               | Max. |
|------------------|---------------------------------------------------------------------------|------------------------|------|--------------------|------|
| $G_P$            | Power Gain ( $ S_{21} ^2$ ) $f = 1.5 \text{ GHz}$                         | dB                     | 24.5 | 28.0               | 30.0 |
| $\Delta G_P$     | Gain Flatness $f = 0.01 \text{ to } 2.0 \text{ GHz}$                      | dB                     |      | $\pm 0.5$          |      |
| $f_3 \text{ dB}$ | 3 dB Bandwidth <sup>[2]</sup>                                             | GHz                    |      | 2.8                |      |
| ISO              | Reverse Isolation ( $ S_{12} ^2$ ) $f = 0.01 \text{ to } 2.0 \text{ GHz}$ | dB                     |      | 37                 |      |
| VSWR             | Input VSWR $f = 0.01 \text{ to } 2.0 \text{ GHz}$                         |                        |      | 2.0 <sup>[3]</sup> |      |
|                  | Output VSWR $f = 0.01 \text{ to } 2.0 \text{ GHz}$                        |                        |      | 3.0 <sup>[3]</sup> |      |
| NF               | 50 $\Omega$ Noise Figure $f = 1.5 \text{ GHz}$                            | dB                     |      | 2.5                | 3.0  |
| $P_1 \text{ dB}$ | Output Power at 1 dB Gain Compression $f = 1.5 \text{ GHz}$               | dBm                    |      | 1.0                |      |
| $IP_3$           | Third Order Intercept Point $f = 1.5 \text{ GHz}$                         | dBm                    |      | 10                 |      |
| $t_D$            | Group Delay $f = 1.5 \text{ GHz}$                                         | psec                   |      | 200                |      |
| $V_d$            | Device Voltage $f = 1.5 \text{ GHz}$                                      | V                      | 4.0  | 5.3                | 6.0  |
| dV/dT            | Device Voltage Temperature Coefficient                                    | mV/ $^{\circ}\text{C}$ |      | +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. Referenced from 10 MHz Gain ( $G_P$ ).
3. VSWR can be improved by bypassing the bias directly to ground.

## INA-03170 Typical Scattering Parameters ( $Z_0 = 50 \Omega$ , $T_A = 25^{\circ}\text{C}$ , $I_d = 12 \text{ mA}$ )

| Freq.<br>GHz | $S_{11}$ |     | $S_{21}$ |       |      | $S_{12}$ |      |     | $S_{22}$ |     | k    |
|--------------|----------|-----|----------|-------|------|----------|------|-----|----------|-----|------|
|              | Mag      | Ang | dB       | Mag   | Ang  | dB       | Mag  | Ang | Mag      | Ang |      |
| 0.05         | .35      | 178 | 26.6     | 21.48 | -4   | -35.9    | .016 | 9   | .56      | -1  | 1.24 |
| 0.10         | .35      | 176 | 26.6     | 21.42 | -7   | -36.5    | .015 | 6   | .56      | -4  | 1.29 |
| 0.20         | .34      | 172 | 26.6     | 21.37 | -14  | -36.5    | .015 | -1  | .56      | -7  | 1.30 |
| 0.40         | .34      | 164 | 26.5     | 21.19 | -28  | -36.5    | .015 | -5  | .54      | -13 | 1.33 |
| 0.60         | .33      | 158 | 26.4     | 20.91 | -41  | -38.4    | .012 | 2   | .53      | -18 | 1.58 |
| 0.80         | .32      | 152 | 26.3     | 20.69 | -54  | -37.1    | .014 | 5   | .51      | -22 | 1.46 |
| 1.00         | .32      | 147 | 26.2     | 20.48 | -67  | -36.5    | .015 | 4   | .50      | -27 | 1.41 |
| 1.20         | .32      | 141 | 26.2     | 20.40 | -80  | -39.2    | .011 | 13  | .49      | -32 | 1.79 |
| 1.40         | .31      | 133 | 26.3     | 20.73 | -93  | -37.7    | .013 | 25  | .48      | -38 | 1.57 |
| 1.60         | .31      | 125 | 26.5     | 21.15 | -106 | -37.1    | .014 | 28  | .47      | -45 | 1.47 |
| 1.80         | .30      | 117 | 26.8     | 21.84 | -121 | -35.4    | .017 | 30  | .46      | -52 | 1.28 |
| 2.00         | .27      | 106 | 26.9     | 22.20 | -138 | -37.1    | .014 | 33  | .42      | -62 | 1.48 |
| 2.50         | .15      | 94  | 26.6     | 21.48 | -177 | -35.4    | .017 | 23  | .31      | -79 | 1.44 |
| 3.00         | .16      | 159 | 23.7     | 15.32 | 133  | -34.4    | .019 | 42  | .16      | -72 | 1.78 |
| 3.50         | .28      | 150 | 19.8     | 9.81  | 99   | -35.4    | .017 | 28  | .19      | -60 | 2.71 |

## INA-03170 Typical Performance, $T_A = 25^\circ\text{C}$

(unless otherwise noted)

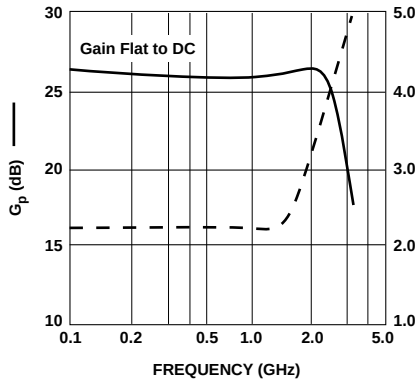


Figure 1. Typical Gain and Noise Figure vs. Frequency,  $T_A = 25^\circ\text{C}$ ,  $I_d = 12\text{ mA}$ .

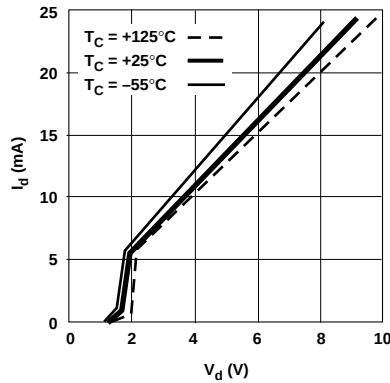


Figure 2. Device Current vs. Voltage.

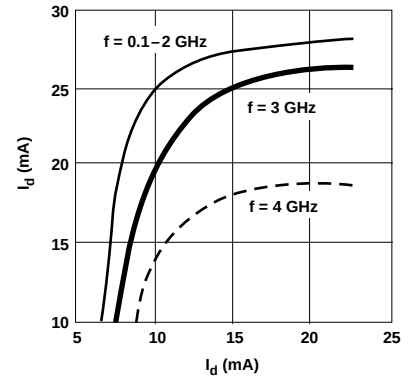


Figure 3. Power Gain vs. Current.

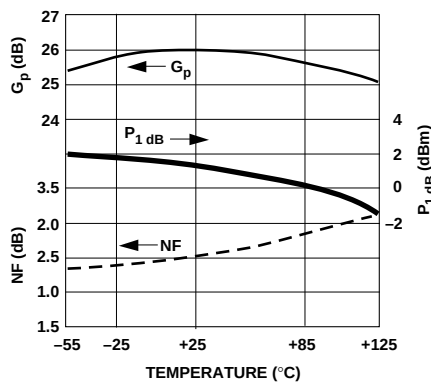


Figure 4. Output Power and 1 dB Gain Compression, NF and Power Gain vs. Case Temperature,  $f = 1.5\text{ GHz}$ ,  $I_d = 12\text{ mA}$ .

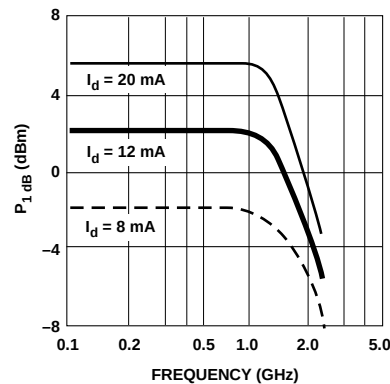


Figure 5. Output Power at 1 dB Gain Compression vs. Frequency.

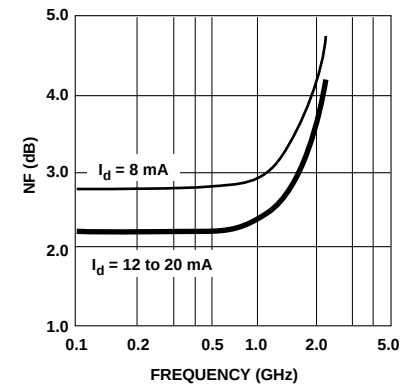


Figure 6. Noise Figure vs. Frequency.

## 70 mil Package Dimensions

