

InGaP HBT GAIN BLOCK MMIC AMPLIFIER, DC - 1 GHz



Typical Applications

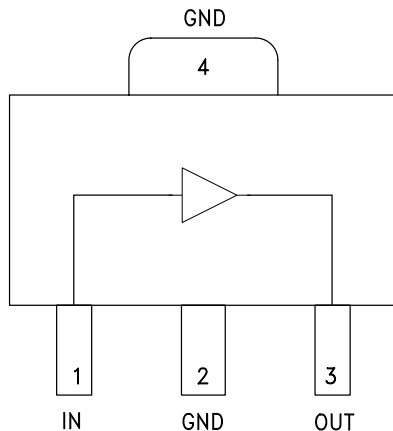
The HMC580ST89 / HMC580ST89E is ideal for:

- Cellular / PCS / 3G
- Fixed Wireless & WLAN
- CATV, Cable Modem & DBS
- Microwave Radio & Test Equipment
- IF & RF Applications

Features

- P1dB Output Power: +22 dBm
- Gain: 22 dB
- Output IP3: +37 dBm
- Cascadable 50 Ohm I/Os
- Single Supply: +5V
- Industry Standard SOT89 Package

Functional Diagram



General Description

The HMC580ST89 & HMC580ST89E are InGaP Heterojunction Bipolar Transistor (HBT) Gain Block MMIC SMT amplifiers covering DC to 1 GHz. Packaged in an industry standard SOT89, the amplifier can be used as a cascadable 50 Ohm RF or IF gain stage as well as a PA or LO driver with up to +26 dBm output power. The HMC580ST89(E) offers 22 dB of gain with a +37 dBm output IP3 at 250 MHz, and can operate directly from a +5V supply. The HMC580ST89(E) exhibits excellent gain and output power stability over temperature, while requiring a minimal number of external bias components.

Electrical Specifications, $V_s = 5.0\text{ V}$, $R_{bias} = 1.8\text{ Ohm}$, $T_A = +25^\circ\text{ C}$

| Parameter | Min. | Typ. | Max. | Units |
|---|-----------------|------|-------|--------|
| Gain | DC - 0.25 GHz | 19 | 22 | dB |
| | 0.25 - 0.50 GHz | 18.5 | 21 | dB |
| | 0.50 - 1.00 GHz | 15 | 17 | dB |
| Gain Variation Over Temperature | DC - 1.0 GHz | | 0.005 | dB/ °C |
| Input Return Loss | DC - 0.25 GHz | | 35 | dB |
| | 0.25 - 0.50 GHz | | 28 | dB |
| | 0.50 - 1.00 GHz | | 19 | dB |
| Output Return Loss | DC - 0.50 GHz | | 12 | dB |
| | 0.50 - 1.00 GHz | | 11 | dB |
| Reverse Isolation | DC - 1.0 GHz | | 23 | dB |
| Output Power for 1 dB Compression (P1dB) | DC - 0.25 GHz | 19 | 22 | dBm |
| | 0.25 - 0.50 GHz | 17.5 | 20.5 | dBm |
| | 0.50 - 1.00 GHz | 16 | 19 | dBm |
| Output Third Order Intercept (IP3) (Pout= 0 dBm per tone, 1 MHz spacing) | DC - 0.25 GHz | | 37 | dBm |
| | 0.25 - 0.50 GHz | | 35 | dBm |
| | 0.50 - 1.00 GHz | | 33 | dBm |
| Noise Figure | DC - 1.0 GHz | | 2.8 | dB |
| Supply Current (Icc) | | 88 | 110 | mA |

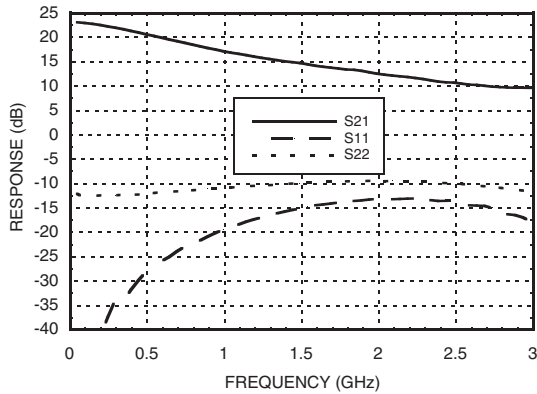
Note: Data taken with broadband bias tee on device output.



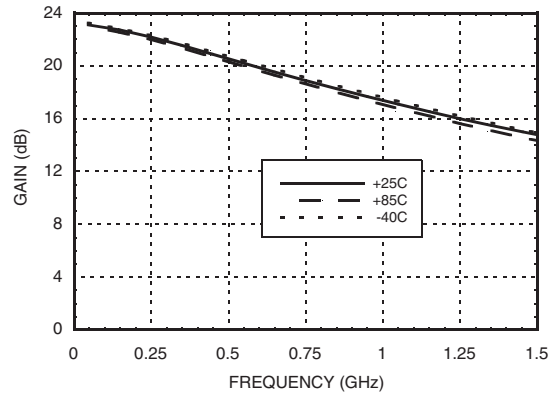
HMC580ST89 / 580ST89E

InGaP HBT GAIN BLOCK MMIC AMPLIFIER, DC - 1 GHz

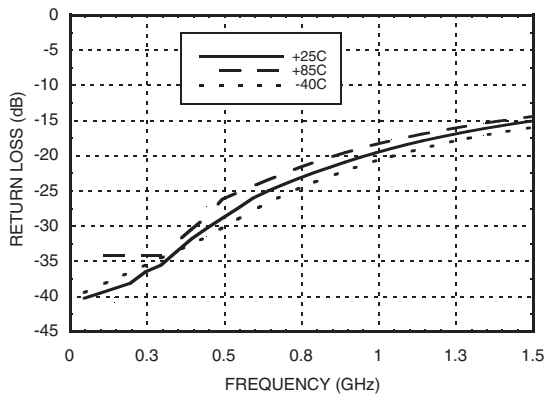
Broadband Gain & Return Loss



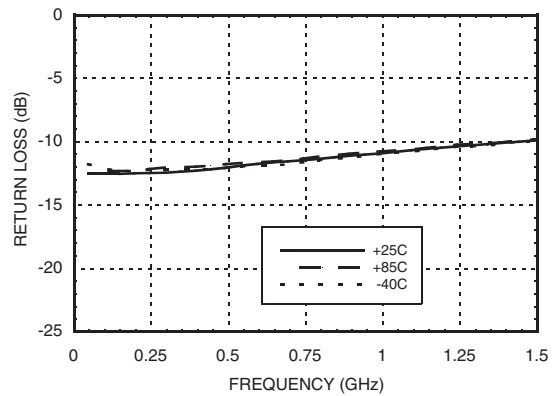
Gain vs. Temperature



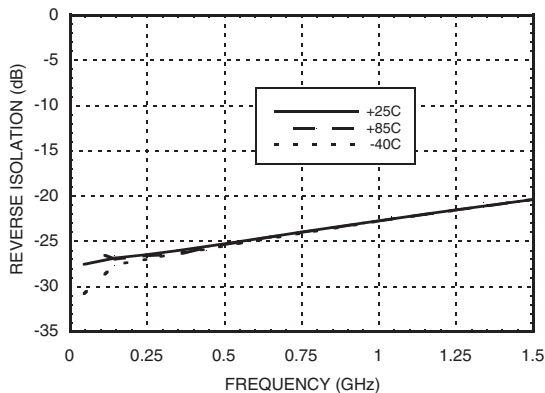
Input Return Loss vs. Temperature



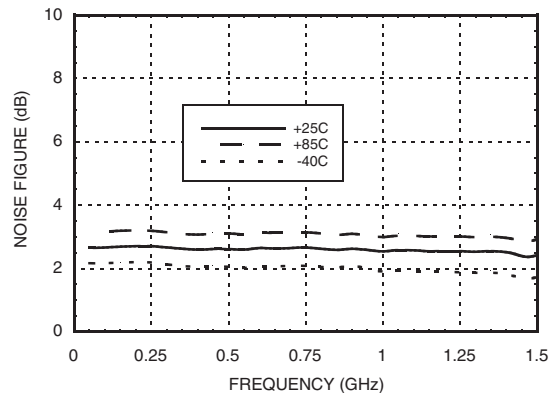
Output Return Loss vs. Temperature



Reverse Isolation vs. Temperature



Noise Figure vs. Temperature

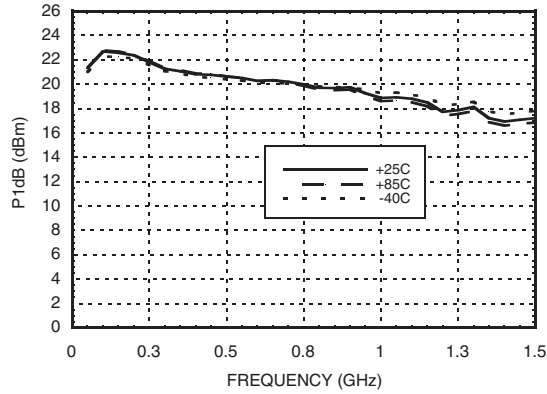




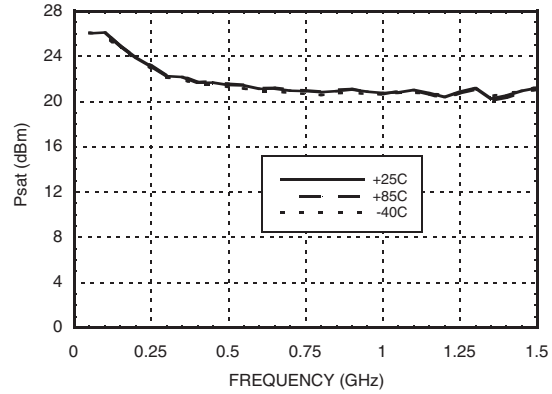
HMC580ST89 / 580ST89E

InGaP HBT GAIN BLOCK MMIC AMPLIFIER, DC - 1 GHz

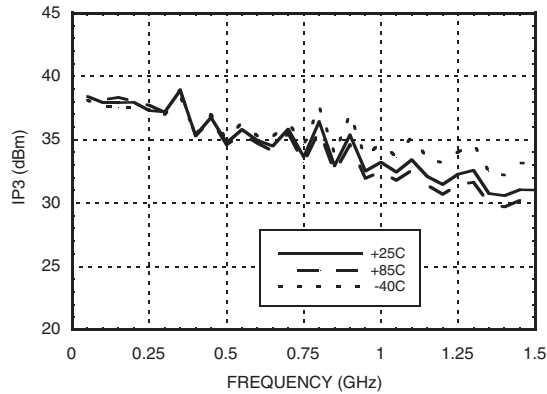
P1dB vs. Temperature



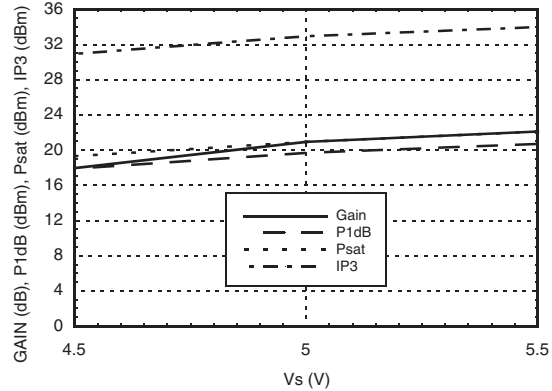
Psat vs. Temperature



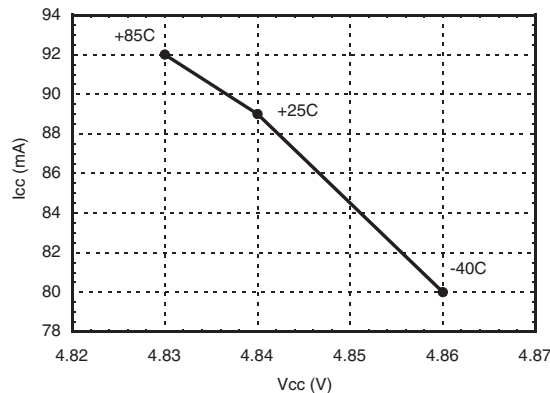
Output IP3 vs. Temperature



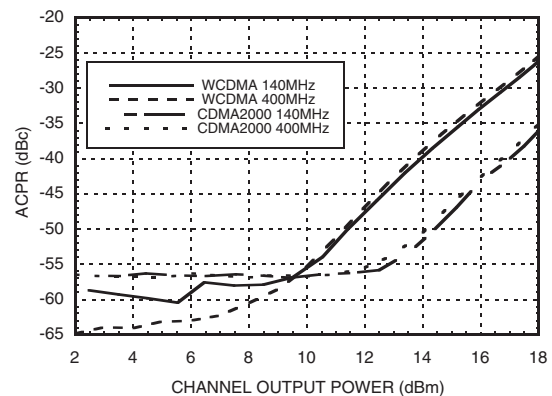
Gain, Power & OIP3 vs. Supply Voltage for Constant Icc = 88 mA @ 850 MHz



Vcc vs. Icc Over Temperature for Fixed Vs= 5V, RBIAS= 1.8 Ohms



ACPR vs. Channel Output Power





HMC580ST89 / 580ST89E

InGaP HBT GAIN BLOCK MMIC AMPLIFIER, DC - 1 GHz

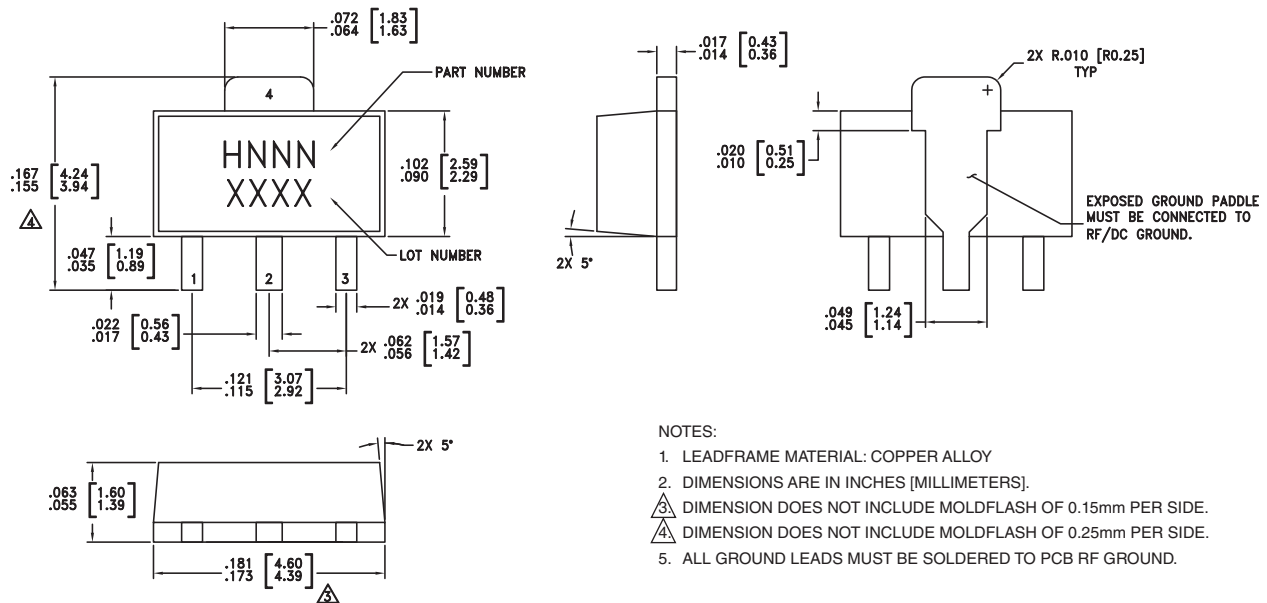
Absolute Maximum Ratings

| | |
|--|----------------|
| Collector Bias Voltage (Vcc) | +5.5 Vdc |
| RF Input Power (RFIN)(Vcc = +4.2 Vdc) | +10 dBm |
| Junction Temperature | 150 °C |
| Continuous Pdiss (T = 85 °C) (derate 9 mW/°C above 85 °C) | 0.59 W |
| Thermal Resistance (junction to lead) | 110 °C/W |
| Storage Temperature | -65 to +150 °C |
| Operating Temperature | -40 to +85 °C |
| ESD Sensitivity (HMB) | Class 1C |



ELECTROSTATIC SENSITIVE DEVICE
OBSERVE HANDLING PRECAUTIONS

Outline Drawing



Package Information

| Part Number | Package Body Material | Lead Finish | MSL Rating | Package Marking ^[3] |
|-------------|--|---------------|---------------------|--------------------------------|
| HMC580ST89 | Low Stress Injection Molded Plastic | Sn/Pb Solder | MSL1 ^[1] | H580 XXXX |
| HMC580ST89E | RoHS-compliant Low Stress Injection Molded Plastic | 100% matte Sn | MSL1 ^[2] | H580 XXXX |

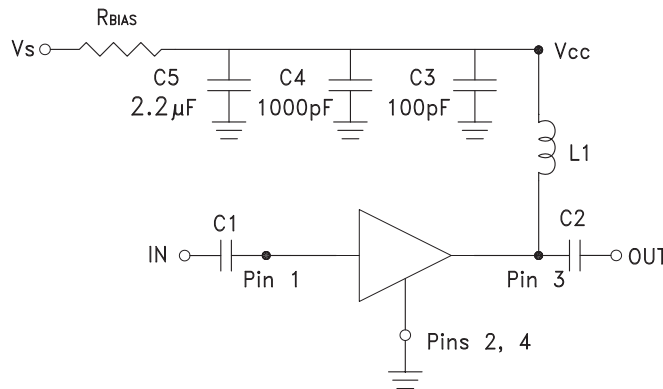
[1] Max peak reflow temperature of 235 °C
 [2] Max peak reflow temperature of 260 °C
 [3] 4-Digit lot number XXXX



Pin Descriptions

| Pin Number | Function | Description | Interface Schematic |
|------------|----------|---|---------------------|
| 1 | IN | This pin is DC coupled. An off chip DC blocking capacitor is required. | |
| 3 | OUT | RF output and DC Bias (Vcc) for the output stage. | |
| 2, 4 | GND | These pins and package bottom must be connected to RF/DC ground. | |

Application Circuit



**Recommended Bias Resistor Values
 for $I_{cc} = 88 \text{ mA}$, $R_{bias} = (V_s - V_{cc}) / I_{cc}$, $V_s > +5V$**

| | | |
|--------------------------|-------------|-------------|
| Supply Voltage (V_s) | 6V | 8V |
| R_{BIAS} VALUE | 13 Ω | 36 Ω |
| R_{BIAS} POWER RATING | ¼ W | ½ W |

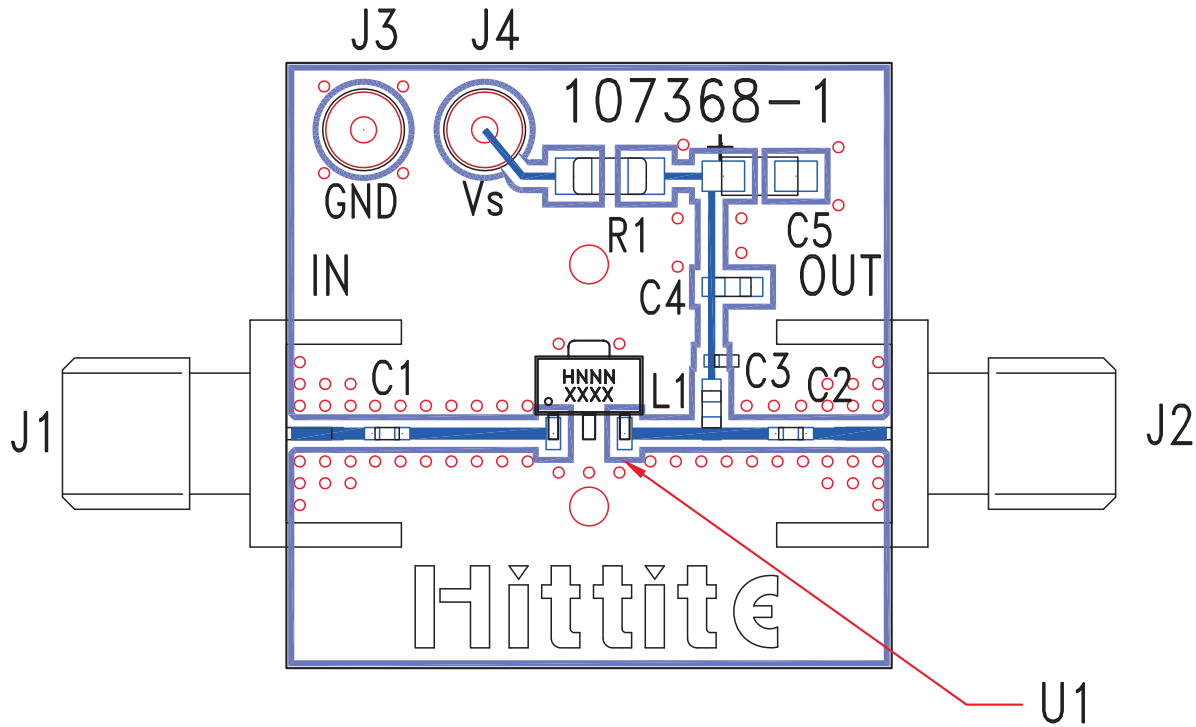
- Note:
1. External blocking capacitors are required on R_{FIN} and R_{FOUT} .
 2. R_{BIAS} provides DC bias stability over temperature.

Recommended Component Values for Key Application Frequencies with $V_s = +5V$

| Component | Frequency (MHz) | | | |
|------------|--------------------|----------|----------|----------|
| | 50 | 250 | 400 | 900 |
| L1 | 270 nH | 110 nH | 110 nH | 56 nH |
| C1, C2 | 0.01 μF | 820 pF | 820 pF | 100 pF |
| R_{bias} | 0 Ohms | 1.5 Ohms | 1.5 Ohms | 1.8 Ohms |



Evaluation PCB



List of Materials for Evaluation PCB 116402 [1]

| Item | Description |
|---------|---------------------------------|
| J1 - J2 | PCB Mount SMA Connector |
| J3 - J4 | DC Pin |
| C1, C2 | Capacitor, 0402 Pkg. |
| C3 | 100 pF Capacitor, 0402 Pkg. |
| C4 | 1000 pF Capacitor, 0603 Pkg. |
| C5 | 2.2 μ F Capacitor, Tantalum |
| R1 | Resistor, 1206 Pkg. |
| L1 | Inductor, 0603 Pkg. |
| U1 | HMC580ST89 / HMC580ST89E |
| PCB [2] | 107368 Evaluation PCB |

[1] Reference this number when ordering complete evaluation PCB

[2] Circuit Board Material: Rogers 4350

[3] Evaluation board tuned for 900 MHz operation

The circuit board used in the final application should use RF circuit design techniques. Signal lines should have 50 ohm impedance while the package ground leads and package bottom should be connected directly to the ground plane similar to that shown. A sufficient number of via holes should be used to connect the top and bottom ground planes. The evaluation board should be mounted to an appropriate heat sink. The evaluation circuit board shown is available from Hittite upon request.