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InGaP HBT GAIN BLOCK MMIC AMPLIFIER, DC - 4 GHz

Typical Applications

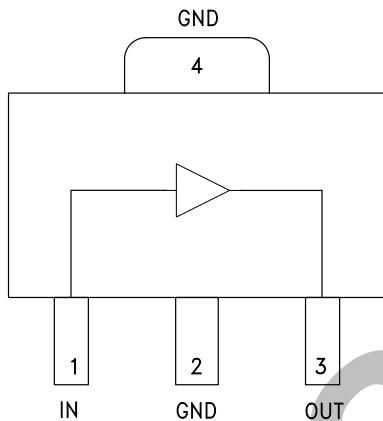
The HMC589ST89 / HMC589ST89E is ideal for:

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

Features

- P1dB Output Power: +21 dBm
- Gain: 21 dB
- Output IP3: +33 dBm
- Single Supply: +5V
- Industry Standard SOT89 Package

Functional Diagram



General Description

The HMC589ST89 & HMC589ST89E are InGaP HBT Gain Block MMIC SMT amplifiers covering DC to 4 GHz and 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 LO or PA driver with up to +19 dBm P1dB output power for cellular/3G, FWA, CATV, microwave radio and test equipment applications. The HMC589ST89(E) offers 20 dB gain and +33 dBm output IP3 at 1 GHz while requiring only 82 mA from a single positive supply. The HMC589ST89(E) InGaP HBT gain block offers excellent output power and gain stability over temperature.

Electrical Specifications, $V_s = 5V$, $R_{bias} = 1.8 \text{ Ohm}$, $T_A = +25^\circ \text{ C}$

| Parameter | | Min. | Typ. | Max. | Units |
|---|---------------|------|-------|------|--------|
| Gain | DC - 1.0 GHz | 19 | 21 | 25 | dB |
| | 1.0 - 2.0 GHz | 16 | 19 | 23 | dB |
| | 2.0 - 3.0 GHz | 14 | 17 | 22 | dB |
| | 3.0 - 4.0 GHz | 13 | 15 | 20 | dB |
| Gain Variation Over Temperature | DC - 5 GHz | | 0.008 | | dB/ °C |
| Input Return Loss | DC - 1.0 GHz | 13 | 17 | | dB |
| | 1.0 - 4.0 GHz | 8 | 11 | | dB |
| Output Return Loss | DC - 1.0 GHz | 8 | 12 | | dB |
| | 1.0 - 4.0 GHz | 7 | 10 | | dB |
| Reverse Isolation | DC - 4 GHz | | 23 | | dB |
| Output Power for 1 dB Compression (P1dB) | 0.5 - 1.0 GHz | 17.5 | 21 | | dBm |
| | 1.0 - 2.0 GHz | 16 | 19 | | dBm |
| | 2.0 - 3.0 GHz | 16 | 19 | | dBm |
| | 3.0 - 4.0 GHz | 14.5 | 17.5 | | dBm |
| Output Third Order Intercept (IP3) (Pout= 0 dBm per tone, 1 MHz spacing) | 0.5 - 1.0 GHz | | 33 | | dBm |
| | 1.0 - 2.0 GHz | | 32 | | dBm |
| | 2.0 - 3.0 GHz | | 30.5 | | dBm |
| | 3.0 - 4.0 GHz | | 29 | | dBm |
| Noise Figure | DC - 2.0 GHz | | 4.0 | | dB |
| | 2.0 - 4.0 GHz | | 4.5 | | dB |
| Supply Current (Icq) | | | 82 | 102 | mA |

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

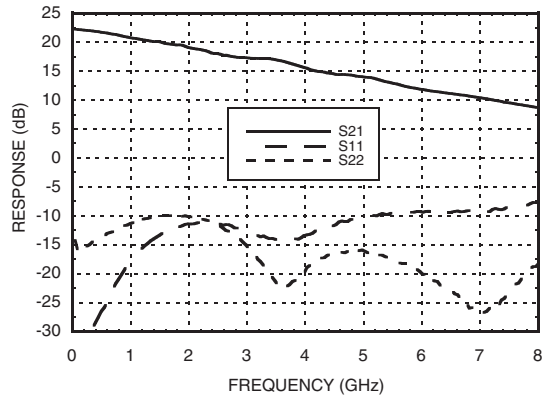
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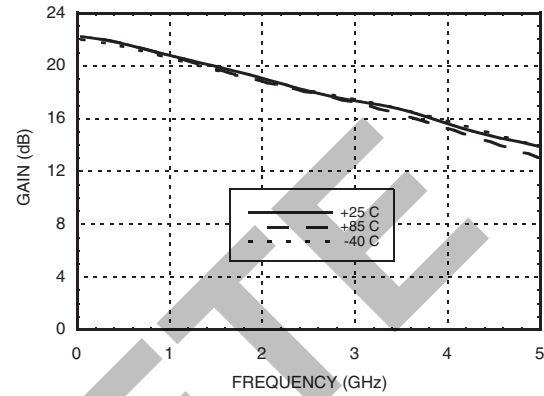


**InGaP HBT GAIN BLOCK
MMIC AMPLIFIER, DC - 4 GHz**

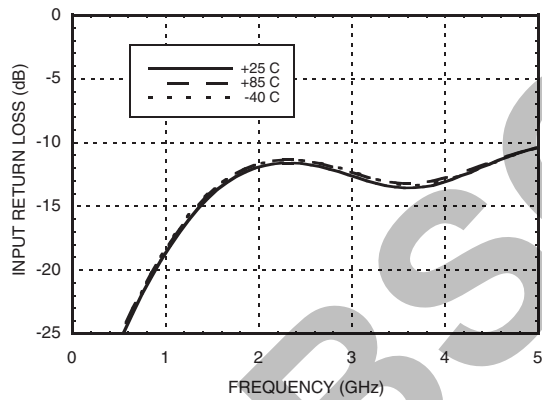
Broadband Gain & Return Loss



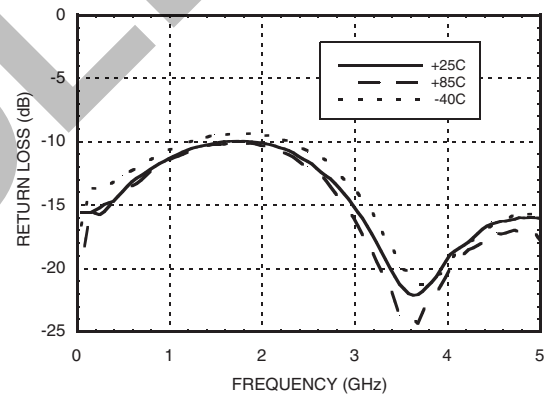
Gain vs. Temperature



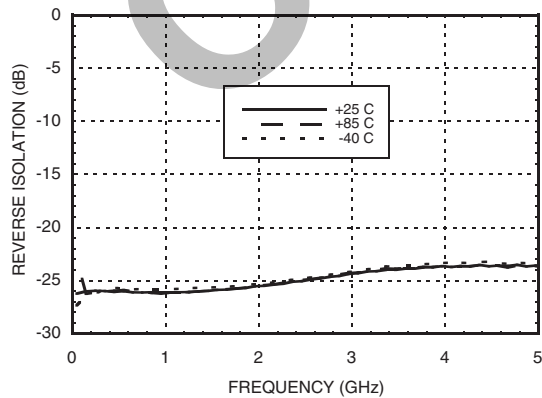
Input Return Loss vs. Temperature



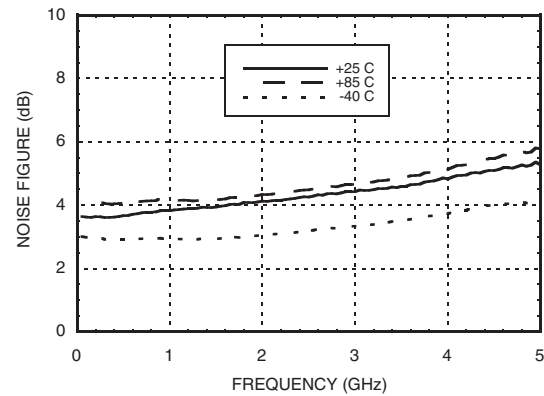
Output Return Loss vs. Temperature



Reverse Isolation vs. Temperature



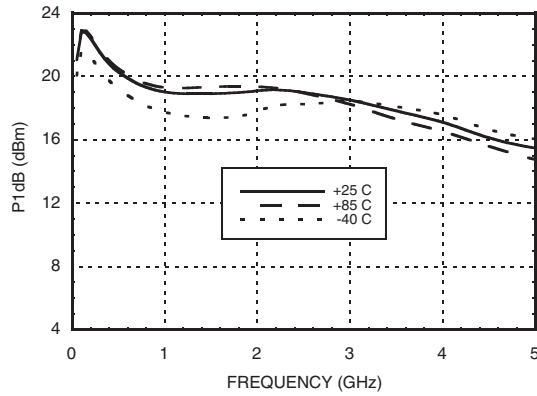
Noise Figure vs. Temperature



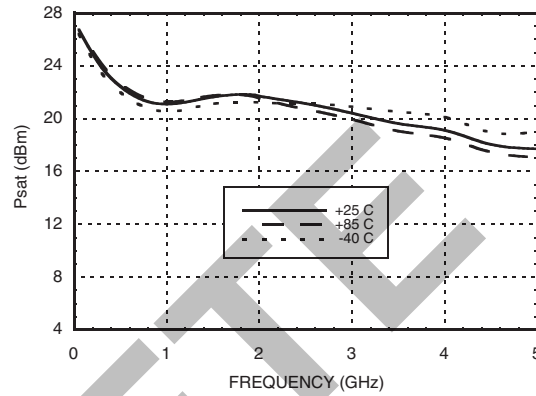


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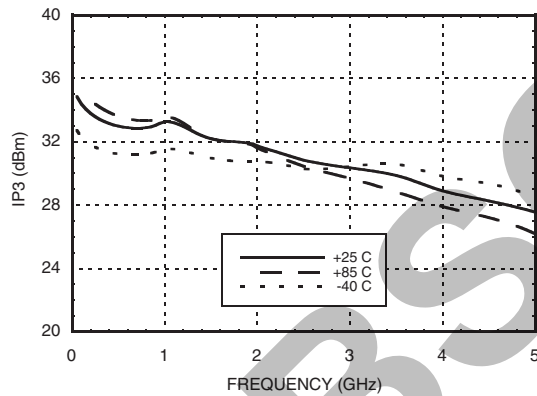
P1dB vs. Temperature



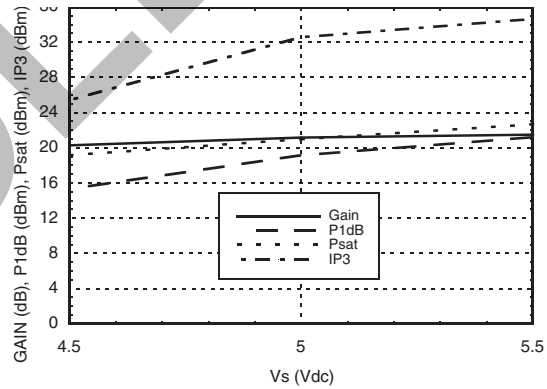
Psat vs. Temperature



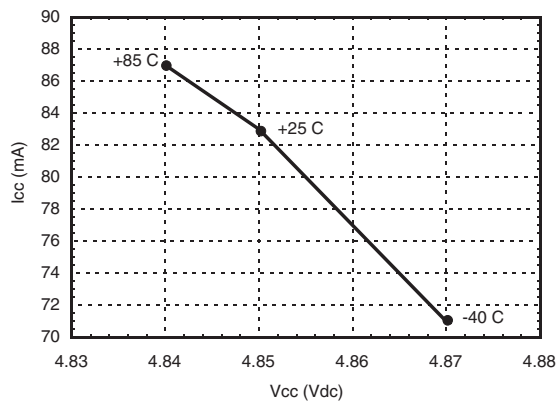
Output IP3 vs. Temperature



**Gain, Power & OIP3 vs. Supply Voltage
@ 850 MHz, Rbias = 1.8 Ohms**



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





InGaP HBT GAIN BLOCK MMIC AMPLIFIER, DC - 4 GHz

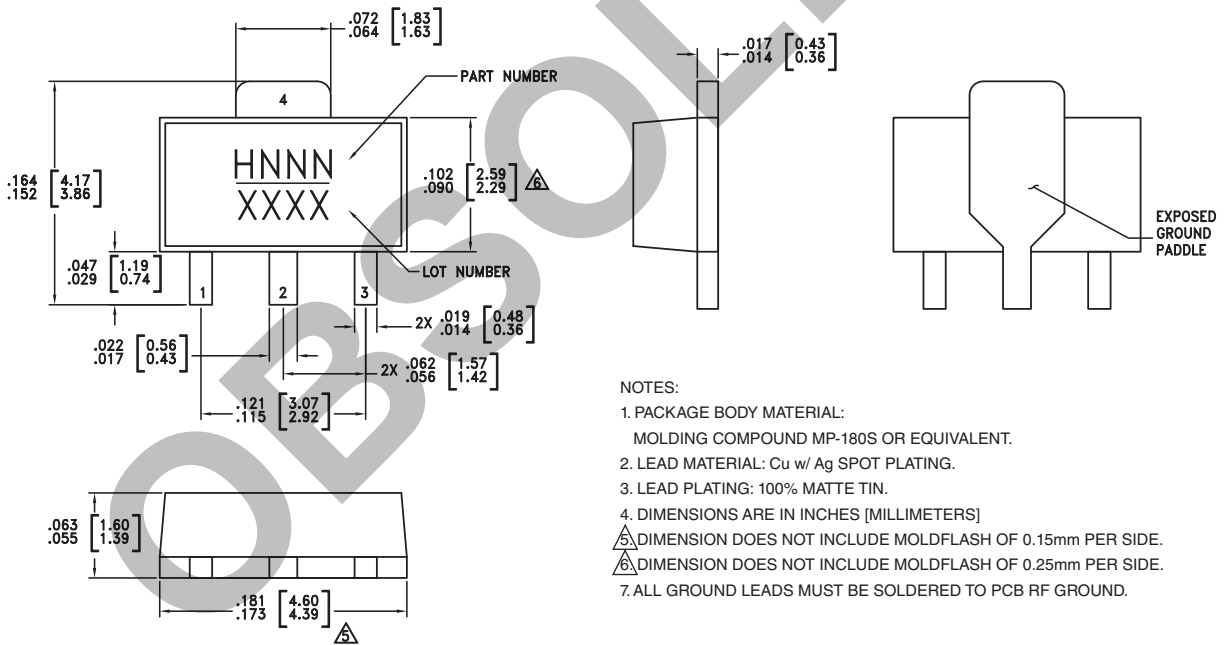
Absolute Maximum Ratings

| | |
|--|--|
| Collector Bias Voltage (Vcc) | +5.5 Vdc |
| RF Input Power (RFIN)(Vcc = +5 Vdc) | +10 dBm up to 1 GHz +8 dBm from 1-4 GHz |
| Junction Temperature | 150 °C |
| Continuous Pdiss (T = 85 °C) (derate 8.4 mW/°C above 85 °C) | 0.546 W |
| Thermal Resistance (junction to ground paddle) | 119 °C/W |
| Storage Temperature | -65 to +150 °C |
| Operating Temperature | -40 to +85 °C |
| ESD Sensitivity (HBM) | Class 1C |



ELECTROSTATIC SENSITIVE DEVICE
OBSERVE HANDLING PRECAUTIONS

Outline Drawing



Package Information

| Part Number | Package Body Material | Lead Finish | MSL Rating | Package Marking ^[3] |
|-------------|--|---------------|---------------------|--------------------------------|
| HMC589ST89 | Low Stress Injection Molded Plastic | Sn/Pb Solder | MSL1 ^[1] | H589 XXXX |
| HMC589ST89E | RoHS-compliant Low Stress Injection Molded Plastic | 100% matte Sn | MSL1 ^[2] | H589 XXXX |

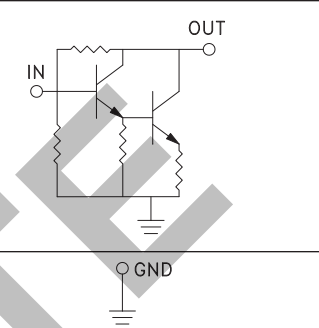
[1] Max peak reflow temperature of 235 °C

[2] Max peak reflow temperature of 260 °C

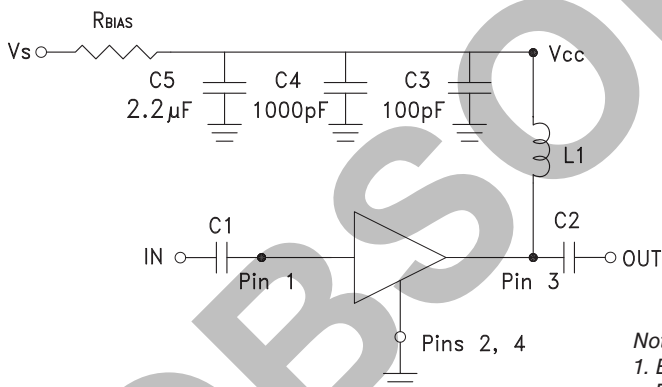
[3] 4-Digit lot number XXXX



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



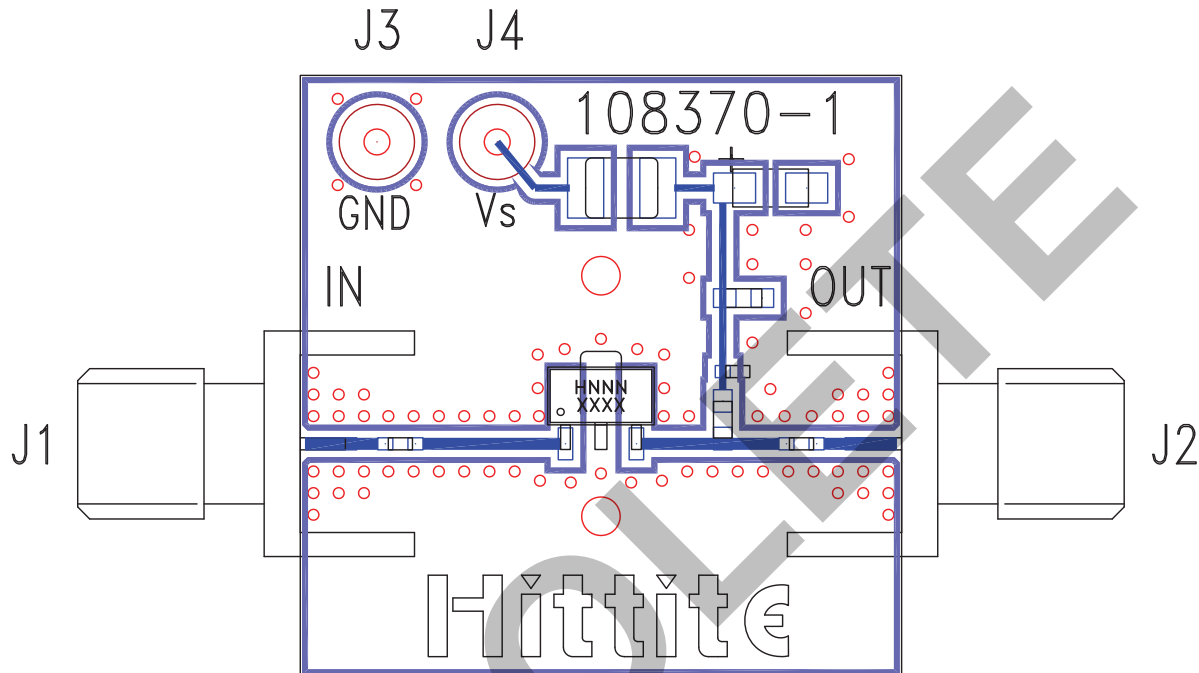
- Note:
- External blocking capacitors are required on RFIN and RFOUT.
 - R_{BIAS} provides DC bias stability over temperature.

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

| Supply Voltage (V_s) | 5V | 6V | 8V |
|--------------------------|--------------|-------------|-------------|
| R_{BIAS} VALUE | 1.8 Ω | 13 Ω | 38 Ω |
| R_{BIAS} POWER RATING | 1/8 W | 1/4 W | 1/2 W |

Recommended Component Values for Key Application Frequencies

| Component | Frequency (MHz) | | | | | | |
|-----------|-----------------|--------|--------|--------|--------|--------|--------|
| | 50 | 900 | 1900 | 2200 | 2400 | 3500 | 4000 |
| L1 | 270 nH | 56 nH | 24 nH | 24 nH | 15 nH | 8.2 nH | 8.2 nH |
| C1, C2 | 0.01 μ F | 100 pF | 100 pF | 100 pF | 100 pF | 100 pF | 100 pF |

Evaluation PCB

List of Materials for Evaluation PCB 116405 [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 | HMC589ST89 / HMC589ST89E |
| PCB [2] | 108370 Evaluation PCB |

[1] Reference this number when ordering complete evaluation PCB

[2] Circuit Board Material: Rogers 4350

[3] Evaluation board tuned for 1.9 GHz 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.