



InGaP HBT GAIN BLOCK MMIC AMPLIFIER, DC - 5 GHz

Typical Applications

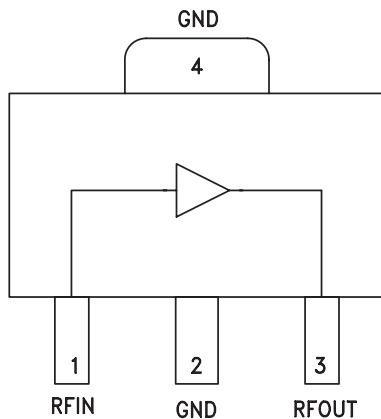
The HMC480ST89 / HMC480ST89E is an ideal RF/IF gain block & LO or PA driver for:

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

Features

- P1dB Output Power: +19 dBm to 2.5 GHz
- Gain: 19 dB @ 1 GHz
16 dB @ 2 GHz
- +34 dBm Output IP3
- Single Supply: +6V to +8V
- Industry Standard SOT89 Package
- Included in the HMC-DK001 Designer's Kits

Functional Diagram



General Description

The HMC480ST89 & HMC480ST89E are InGaP HBT Gain Block MMIC SMT amplifiers covering DC to 5 GHz and packaged in an industry standard SOT89. The amplifier can be used as a cascadable 50 Ohm RF/IF gain stage as well as a LO or PA driver with up to +20 dBm P1dB output power for cellular/3G, FWA, CATV, microwave radio and test equipment applications. The HMC480ST89(E) offers 19 dB of gain with a +34 dBm output IP3 at 1 GHz while requiring only 82 mA from a single positive supply. The HMC480ST89(E) InGaP gain blocks offer excellent output IP3 and flat +19 to +20dBm output power performance through 5 GHz compared to equivalent SiGe based products.

Electrical Specifications, $V_s = 8.0\text{ V}$, $R_{bias} = 39\text{ Ohm}$, $T_A = +25^\circ\text{ C}$

| Parameter | Min. | Typ. | Max. | Units | |
|---|---------------|------|-------|-------|--------|
| Gain | DC - 1.0 GHz | 17 | 19 | dB | |
| | 1.0 - 2.0 GHz | 14 | 17 | dB | |
| | 2.0 - 3.0 GHz | 12 | 15 | dB | |
| | 3.0 - 4.0 GHz | 10 | 13 | dB | |
| | 4.0 - 5.0 GHz | 8 | 11 | dB | |
| Gain Variation Over Temperature | DC - 5 GHz | | 0.008 | 0.016 | dB/ °C |
| Input Return Loss | DC - 1.0 GHz | | 17 | dB | |
| | 1.0 - 5.0 GHz | | 10 | dB | |
| Output Return Loss | DC - 1.0 GHz | | 17 | dB | |
| | 1.0 - 5.0 GHz | | 10 | dB | |
| Reverse Isolation | DC - 5 GHz | | 20 | dB | |
| Output Power for 1 dB Compression (P1dB) | 0.5 - 1.0 GHz | 16 | 20 | dBm | |
| | 1.0 - 2.0 GHz | 15.5 | 18.5 | dBm | |
| | 2.0 - 3.5 GHz | 14.5 | 17.5 | dBm | |
| | 3.5 - 5.0 GHz | 13 | 16 | dBm | |
| Output Third Order Intercept (IP3) (Pout= 0 dBm per tone, 1 MHz spacing) | 0.5 - 1.0 GHz | | 34 | dBm | |
| | 1.0 - 2.0 GHz | | 33 | dBm | |
| | 2.0 - 3.5 GHz | | 32 | dBm | |
| | 3.5 - 5.0 GHz | | 30 | dBm | |
| Noise Figure | DC - 4 GHz | | 3.25 | dB | |
| | 4.0 - 5.0 GHz | | 4.0 | dB | |
| Supply Current (Icq) | | | 82 | mA | |

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

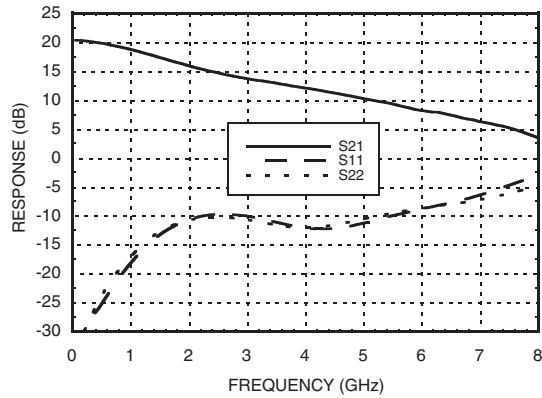
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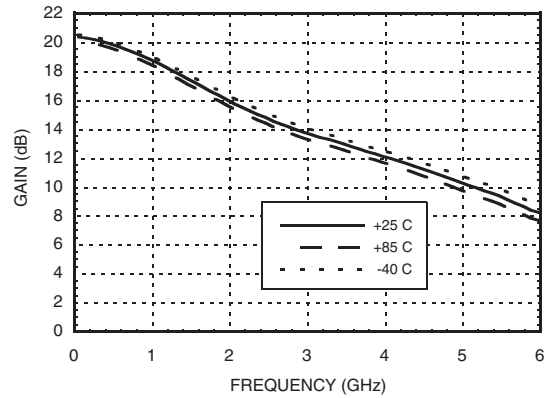


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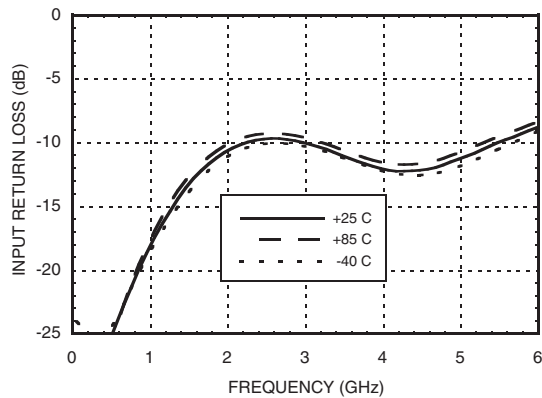
Broadband Gain & Return Loss



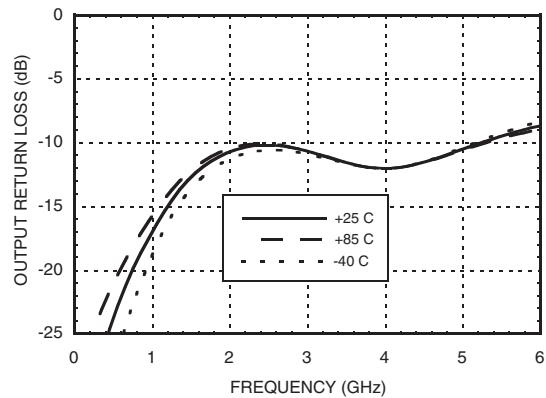
Gain vs. Temperature



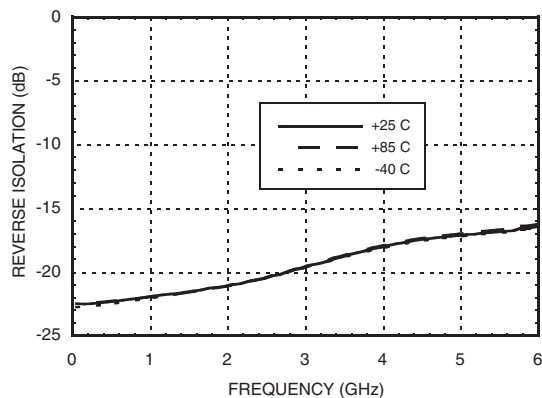
Input Return Loss vs. Temperature



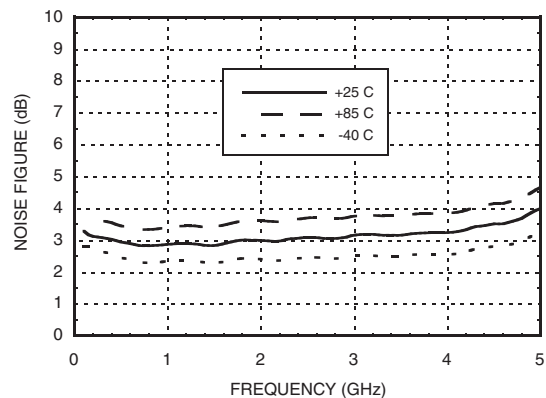
Output Return Loss vs. Temperature



Reverse Isolation vs. Temperature



Noise Figure vs. Temperature



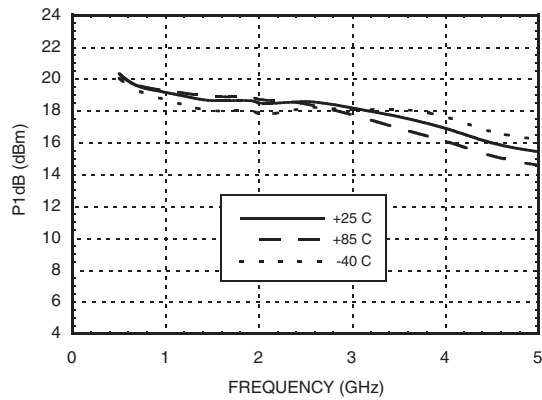
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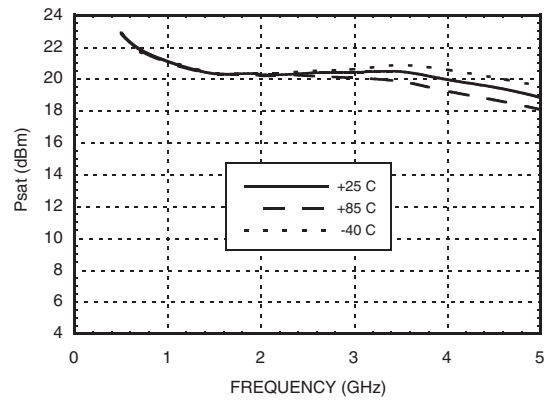


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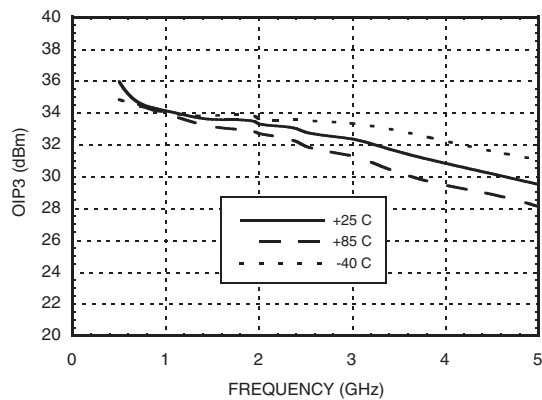
P1dB vs. Temperature



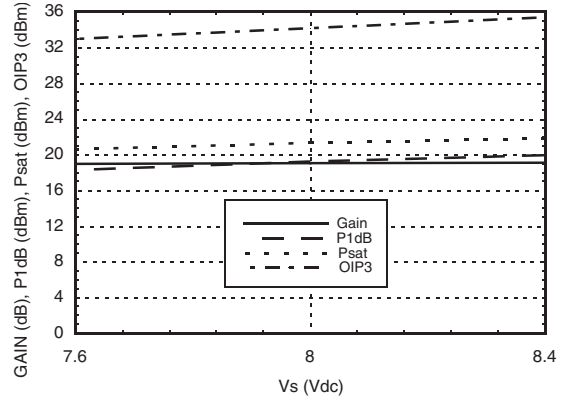
Psat vs. Temperature



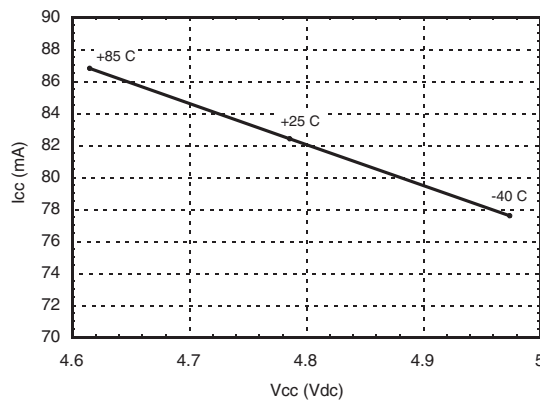
Output IP3 vs. Temperature



**Gain, Power & OIP3 vs. Supply Voltage
@ 850 MHz, Rbias= 39 Ohms**



**Vcc vs. Icc Over Temperature for
Fixed Vs= 8V, RBIAS= 39 Ohms**





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Absolute Maximum Ratings

| | |
|---|----------------|
| Collector Bias Voltage (Vcc) | +6.0 Vdc |
| RF Input Power (RFIN)(Vcc = +5 Vdc) | +11 dBm |
| Junction Temperature | 150 °C |
| Continuous P _{diss} (T = 85 °C) (derate 8.25 mW/°C above 85 °C) | 0.536 W |
| Thermal Resistance (junction to ground paddle) | 122 °C/W |
| Storage Temperature | -65 to +150 °C |
| Operating Temperature | -40 to +85 °C |

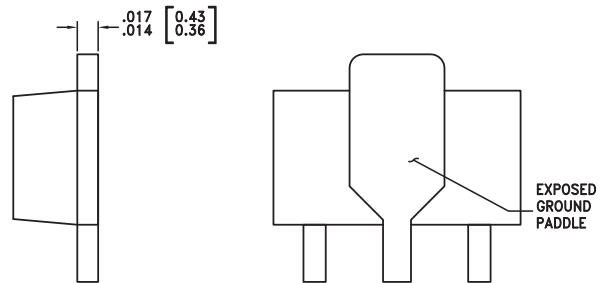
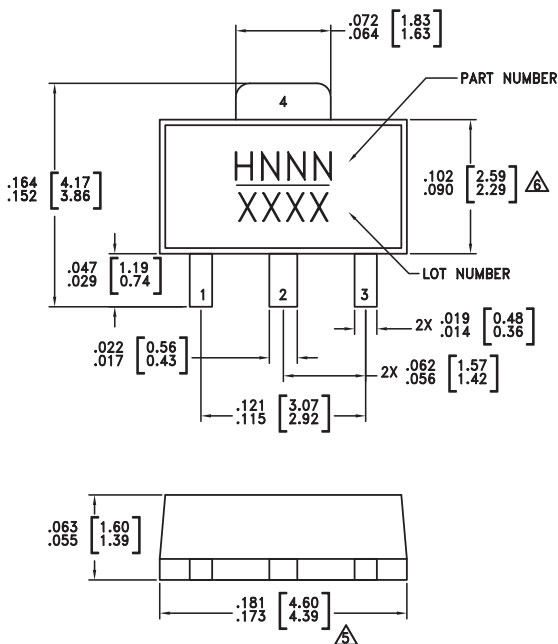


ELECTROSTATIC SENSITIVE DEVICE
OBSERVE HANDLING PRECAUTIONS

8

AMPLIFIERS - DRIVER & GAIN BLOCK - SMT

Outline Drawing



NOTES:

- PACKAGE BODY MATERIAL:
MOLDING COMPOUND MP-180S OR EQUIVALENT.
- LEAD MATERIAL: Cu w/ Ag SPOT PLATING.
- LEAD PLATING: 100% MATTE TIN.
- DIMENSIONS ARE IN INCHES [MILLIMETERS]
- DIMENSION DOES NOT INCLUDE MOLDFLASH OF 0.15mm PER SIDE.
- DIMENSION DOES NOT INCLUDE MOLDFLASH OF 0.25mm PER SIDE.
- ALL GROUND LEADS MUST BE SOLDERED TO PCB RF GROUND.

Package Information

| Part Number | Package Body Material | Lead Finish | MSL Rating | Package Marking ^[3] |
|-------------|---|---------------|---------------------|--------------------------------|
| HMC480ST89 | Low Stress Injection Molding Plastic | Sn/Pb Solder | MSL1 ^[1] | H480 XXXX |
| HMC480ST89E | RoHS-compliant Low Stress Injection Molding Plastic | 100% matte Sn | MSL1 ^[2] | <u>H480</u> XXXX |

[1] Max peak reflow temperature of 235 °C

[2] Max peak reflow temperature of 260 °C

[3] 4-Digit lot number XXXX

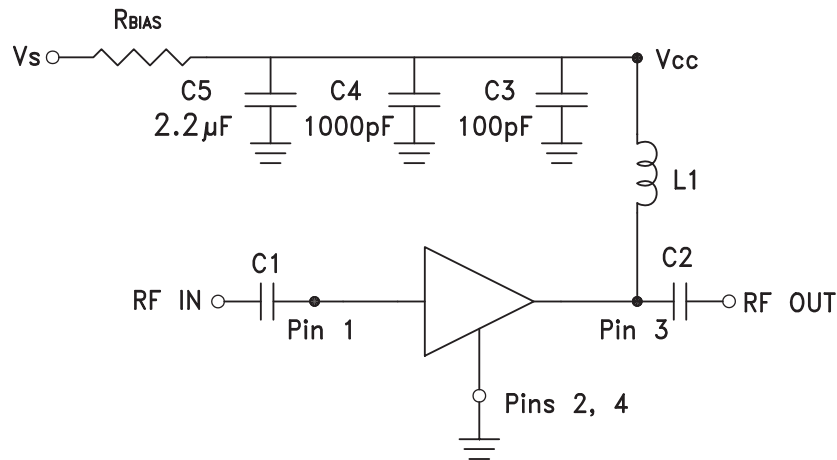
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Pin Descriptions

| Pin Number | Function | Description | Interface Schematic |
|------------|----------|---|---------------------|
| 1 | RFIN | This pin is DC coupled. An off chip DC blocking capacitor is required. | |
| 3 | RFOUT | 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 $I_{CC} = 82 \text{ mA}$, $R_{BIAS} = (V_s - V_{CC}) / I_{CC}$

| Supply Voltage (Vs) | 6V | 8V |
|---------------------|-------|-------|
| RBIAS VALUE | 12 Ω | 39 Ω |
| RBIAS POWER RATING | 1/8 W | 1/4 W |

Note:

- External blocking capacitors are required on RFIN and RFOUT.
- RBIAS provides DC bias stability over temperature.

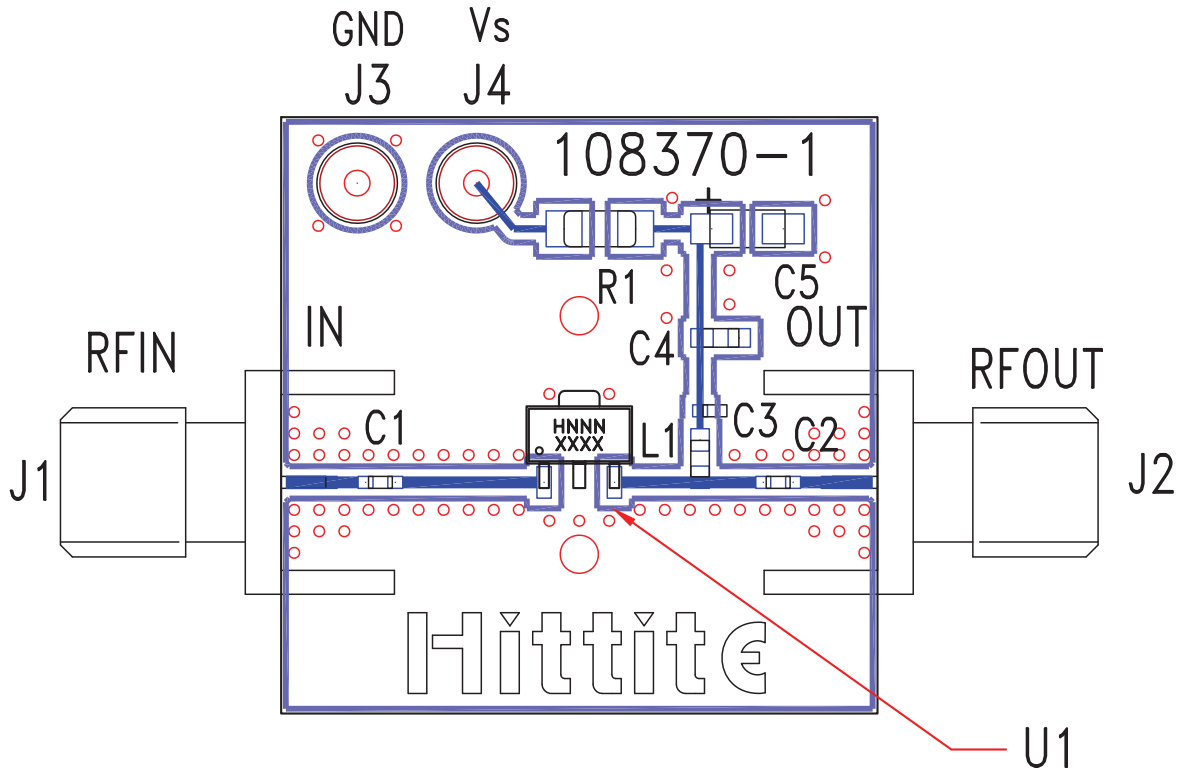
Recommended Component Values for Key Application Frequencies

| Component | Frequency (MHz) | | | | | | |
|-----------|-----------------|--------|--------|--------|--------|--------|--------|
| | 50 | 900 | 1900 | 2200 | 2400 | 3500 | 5000 |
| L1 | 270 nH | 56 nH | 18 nH | 18 nH | 15 nH | 8.2 nH | 6.8 nH |
| C1, C2 | 0.01 μF | 100 pF | 100 pF | 100 pF | 100 pF | 100 pF | 100 pF |



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Evaluation PCB



List of Materials for Evaluation PCB 108371 [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, 1210 Pkg. |
| L1 | Inductor, 0603 Pkg. |
| U1 | HMC480ST89 / HMC480ST89E |
| PCB [2] | 108370 Evaluation PCB |

[1] Reference this number when ordering complete evaluation PCB

[2] Circuit Board Material: Rogers 4350

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.

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