

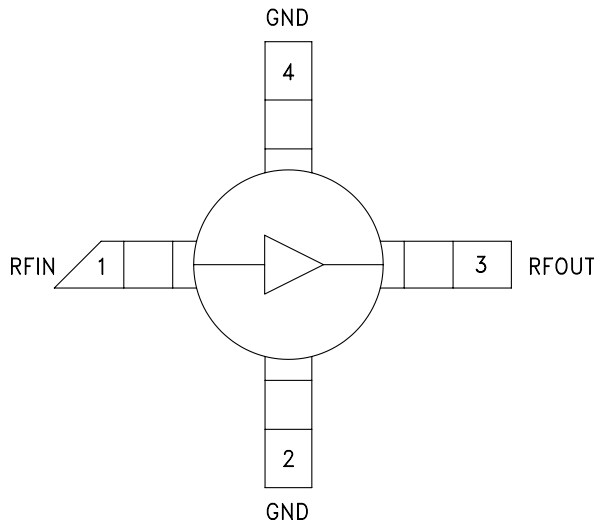
**SiGe HBT GAIN BLOCK
MMIC AMPLIFIER, DC - 4.0 GHz**

Typical Applications

The HMC478MP86 is an ideal RF/IF gain block & LO or PA driver:

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

Functional Diagram



Features

- P1dB Output Power: +18 dBm
- Gain: 22 dB
- Output IP3: +32 dBm
- Cascadable 50 Ohm I/Os
- Single Supply: +5V to +8V
- Robust 1,000V ESD, Class 1C

General Description

The HMC478MP86 is a SiGe Heterojunction Bipolar Transistor (HBT) Gain Block MMIC SMT amplifier covering DC to 4 GHz. This Micro-P packaged 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 output power. The HMC478MP86 offers 22 dB of gain with a +32 dBm output IP3 at 850 MHz while requiring only 62 mA from a single positive supply. The Darlington feedback pair used results in reduced sensitivity to normal process variations and excellent gain stability over temperature while requiring a minimal number of external bias components.

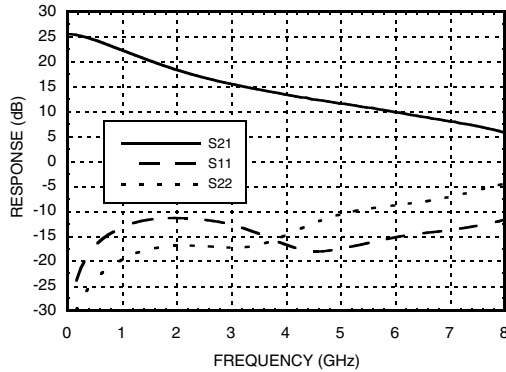
Electrical Specifications, Vs= 5.0 V, Rbias= 18 Ohm, Ta = +25° C

| Parameter | | Min. | Typ. | Max. | Units |
|---|---------------|------|-------|------|--------|
| Gain | DC - 1.0 GHz | 19 | 22 | | dB |
| | 1.0 - 2.0 GHz | 15 | 18 | | dB |
| | 2.0 - 3.0 GHz | 13 | 16 | | dB |
| | 3.0 - 4.0 GHz | 11 | 14 | | dB |
| Gain Variation Over Temperature | DC - 4.0 GHz | | 0.015 | 0.02 | dB/ °C |
| Input Return Loss | DC - 1.0 GHz | | 15 | | dB |
| | 1.0 - 3.0 GHz | | 12 | | dB |
| | 3.0 - 4.0 GHz | | 13 | | dB |
| Output Return Loss | DC - 1.0 GHz | | 20 | | dB |
| | 1.0 - 4.0 GHz | | 17 | | dB |
| Reverse Isolation | DC - 4.0 GHz | | 20 | | dB |
| Output Power for 1 dB Compression (P1dB) | 0.5 - 1.0 GHz | 15 | 18 | | dBm |
| | 1.0 - 2.0 GHz | 13 | 16 | | dBm |
| | 2.0 - 3.0 GHz | 11 | 14 | | dBm |
| | 3.0 - 4.0 GHz | 9 | 12 | | dBm |
| Output Third Order Intercept (IP3) (Pout= 0 dBm per tone, 1 MHz spacing) | 0.5 - 2.0 GHz | | 32 | | dBm |
| | 2.0 - 3.0 GHz | | 29 | | dBm |
| | 3.0 - 4.0 GHz | | 25 | | dBm |

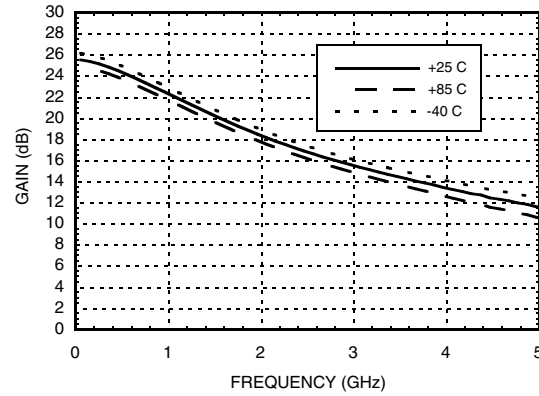
Note: Data taken with broadband bias tee on device output.

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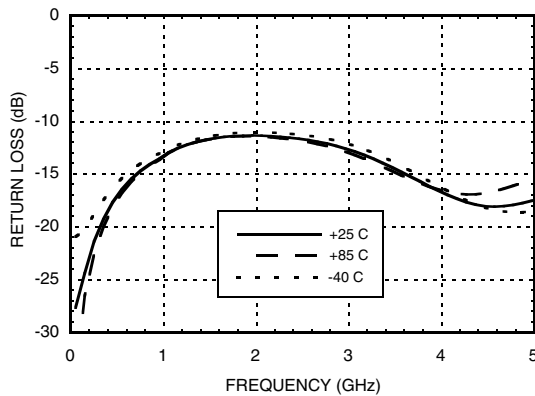
Broadband Gain & Return Loss



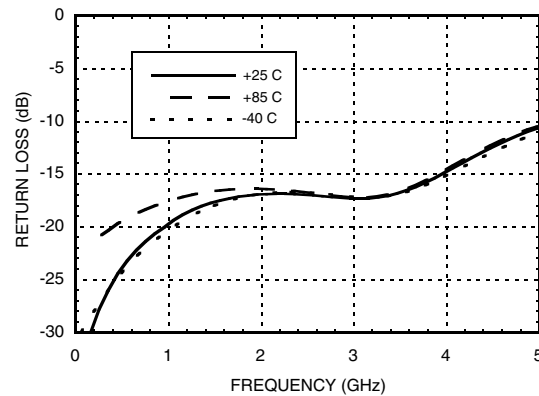
Gain vs. Temperature



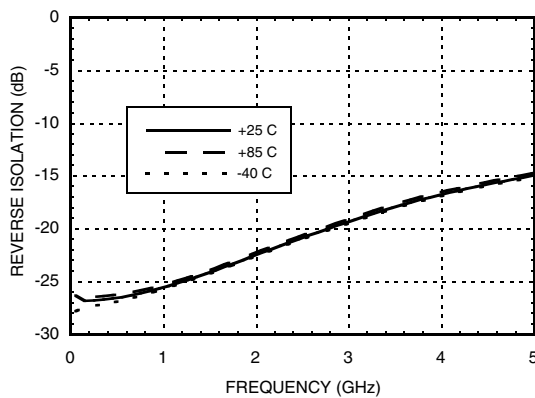
Input Return Loss vs. Temperature



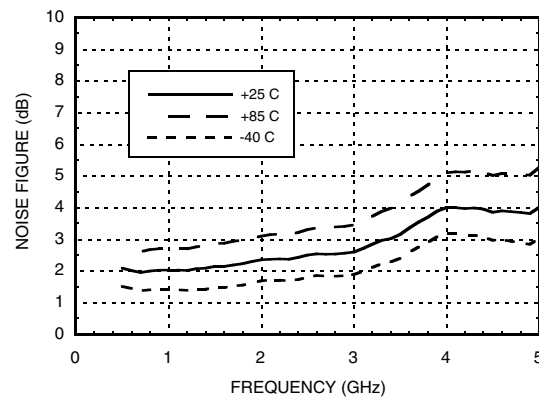
Output Return Loss vs. Temperature



Reverse Isolation vs. Temperature

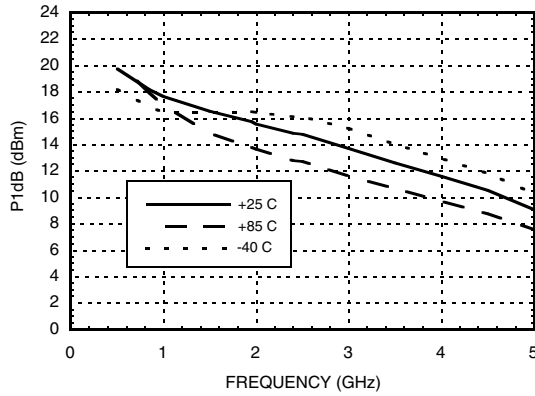


Noise Figure vs. Temperature

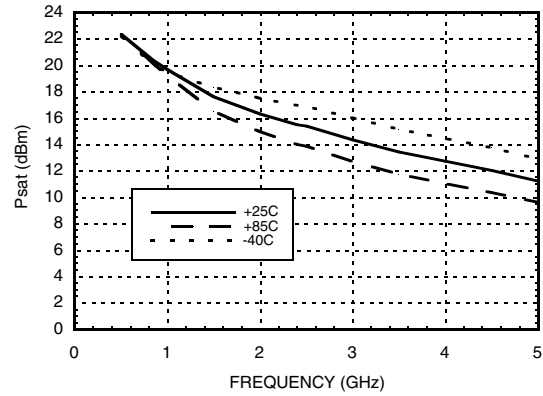


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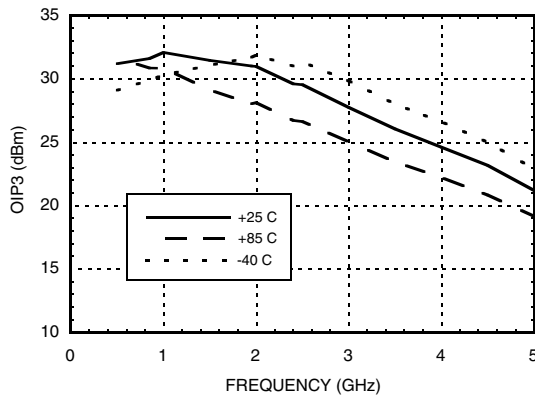
P1dB vs. Temperature



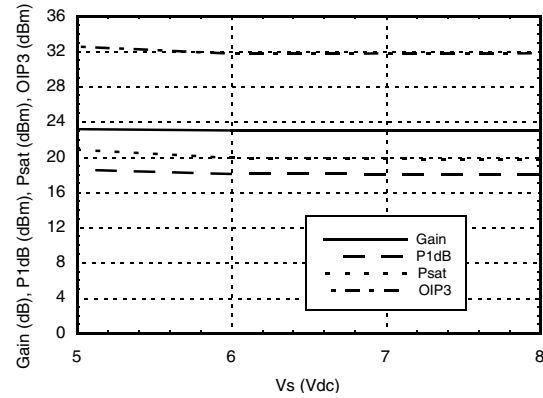
Psat vs. Temperature



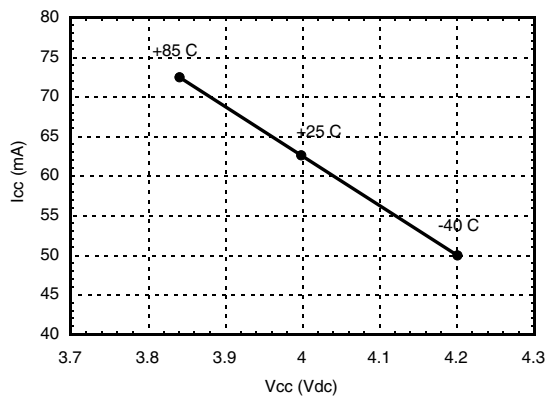
Output IP3 vs. Temperature



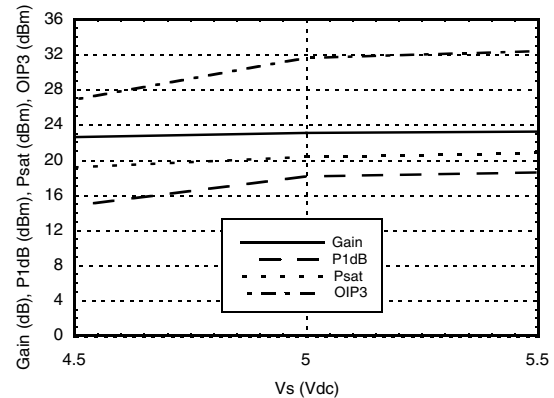
Gain, Power & OIP3 vs. Supply Voltage for Constant Icc= 62 mA @ 850 MHz



Vcc vs. Icc Over Temperature for Fixed Vs= 5V, RBIAS= 18 Ohms



Gain, Power & OIP3 vs. Supply Voltage for Rs = 18 Ohms @ 850 MHz



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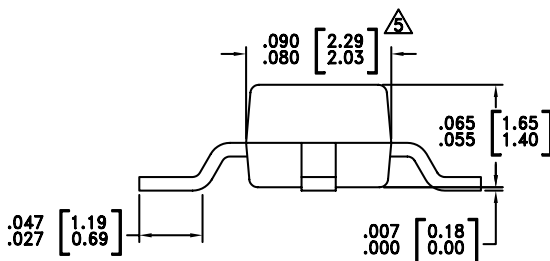
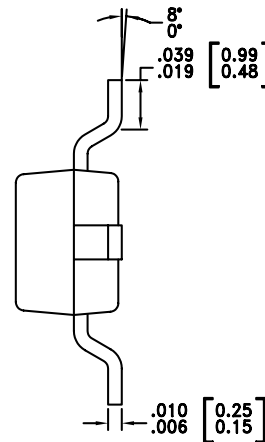
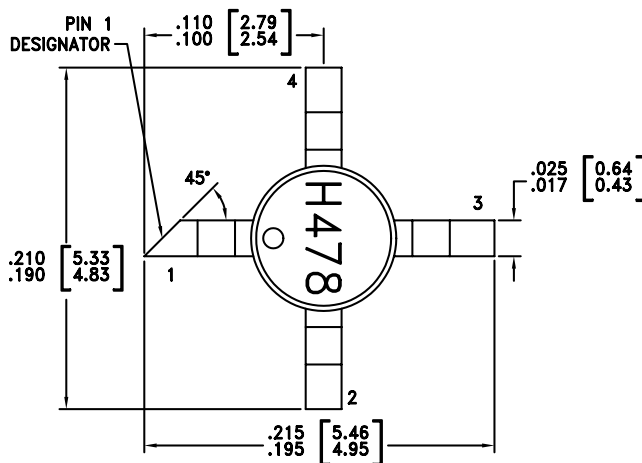
Absolute Maximum Ratings

| | |
|--|----------------|
| Collector Bias Voltage (Vcc) | +6.0 Vdc |
| Collector Bias Current (Icc) | 100 mA |
| RF Input Power (RFIn)(Vcc = +4.3 Vdc) | +5 dBm |
| Junction Temperature | 150 °C |
| Continuous P _{diss} (T = 85 °C) (derate 9 mW/°C above 85 °C) | 0.583 W |
| Thermal Resistance (junction to lead) | 111.5 °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



NOTES:

1. PACKAGE BODY MATERIAL: LOW STRESS INJECTION MOLDED PLASTIC SILICA AND SILICON IMPREGNATED.
2. LEADFRAME MATERIAL: COPPER ALLOY
3. LEADFRAME PLATING: Sn/Pb SOLDER
4. DIMENSIONS ARE IN INCHES [MILLIMETERS].
5. DIMENSION DOES NOT INCLUDE MOLDFLASH OF 0.15mm PER SIDE.
6. ALL GROUND LEADS MUST BE SOLDERED TO PCB RF GROUND.
7. THE MICRO-P PACKAGE IS DIMENSIONALLY COMPATIBLE WITH THE "MICRO-X PACKAGE"
8. CLASSIFIED AS MOISTURE SENSITIVITY LEVEL (MSL) 1.

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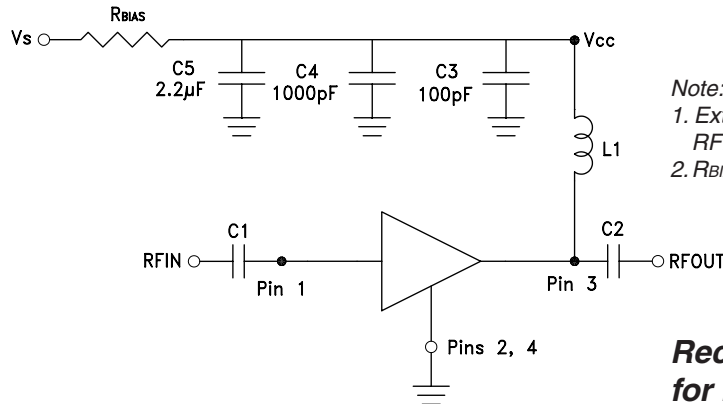
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AMPLIFIERS - SMT

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 must be connected to RF/DC ground. | |

Application Circuit



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

Recommended Bias Resistor Values for $I_{cc} = 62 \text{ mA}$, $R_{bias} = (V_s - V_{cc}) / I_{cc}$

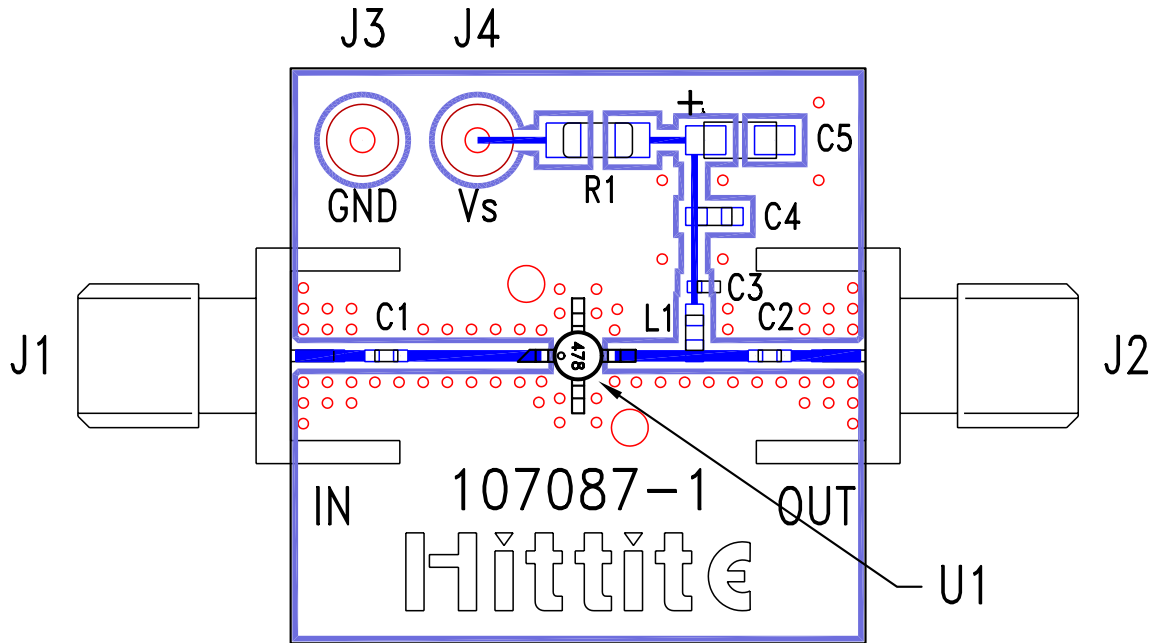
| Supply Voltage (Vs) | 5V | 6V | 8V |
|---------------------|-------|-------|-------|
| RBIAS VALUE | 18 Ω | 35 Ω | 67 Ω |
| RBIAS POWER RATING | 1/8 W | 1/4 W | 1/2 W |

Recommended Component Values for Key Application Frequencies

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

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Evaluation PCB



List of Materials for Evaluation PCB 110170*

| Item | Description |
|---------|---------------------------------|
| J1 - J2 | PC 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 | HMC478MP86 |
| PCB** | 107087 Evaluation PCB |

** Circuit Board Material: Rogers 4350

* Reference this number when ordering complete evaluation PCB.

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 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.