



SiGe HBT GAIN BLOCK MMIC AMPLIFIER, DC - 4 GHz

Typical Applications

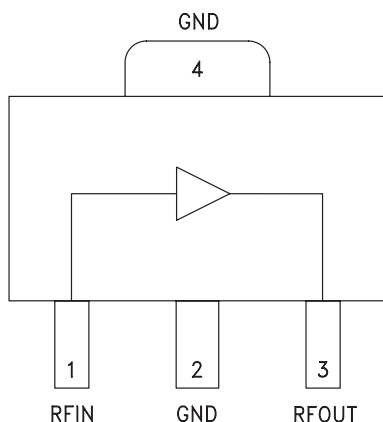
The HMC478ST89 / HMC478ST89E is an ideal RF/IF gain block & LO or PA driver:

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

Features

- P1dB Output Power: +18 dBm
- Gain: 22 dB
- Output IP3: +30 dBm
- Cascadable 50 Ohm I/Os
- Single Supply: +5V to +8V
- Industry Standard SOT89 Package
- Robust 1,000V ESD, Class 1C
- Included in the HMC-DK001 Designer's Kit

Functional Diagram



General Description

The HMC478ST89 & HMC478ST89E are SiGe Heterojunction Bipolar Transistor (HBT) Gain Block MMIC SMT amplifiers covering DC to 4 GHz. 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 output power. The HMC478ST89(E) offers 22 dB of gain with a +30 dBm output IP3 at 850 MHz while requiring only 62mA 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, $V_s = 5V$, $R_{bias} = 18 \text{ Ohm}$, $T_A = +25^\circ \text{C}$

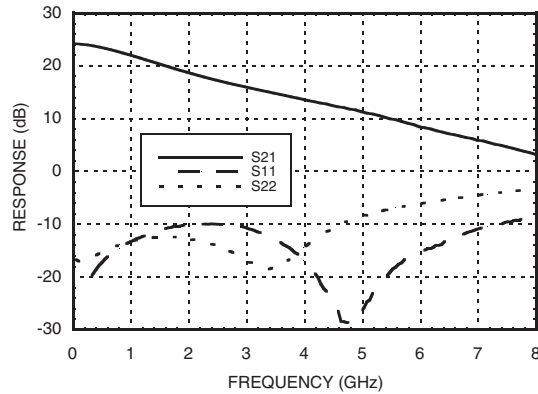
Parameter	Min.	Typ.	Max.	Units
Gain	DC - 1.0 GHz	19	22	dB
	1.0 - 2.0 GHz	16	19	dB
	2.0 - 3.0 GHz	13	16	dB
	3.0 - 4.0 GHz	11	14	dB
Gain Variation Over Temperature	DC - 4 GHz	0.015	0.02	dB/ °C
Input Return Loss	DC - 1.0 GHz	15		dB
	1.0 - 3.0 GHz	10		dB
	3.0 - 4.0 GHz	13		dB
Output Return Loss	DC - 3.0 GHz	13		dB
	3.0 - 4.0 GHz	15		dB
Reverse Isolation	DC - 4 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	10	13	dBm
	3.0 - 4.0 GHz	8	11	dBm
Output Third Order Intercept (IP3) (Pout= 0 dBm per tone, 1 MHz spacing)	0.5 - 2.0 GHz	30		dBm
	2.0 - 3.0 GHz	28		dBm
	3.0 - 4.0 GHz	25		dBm
Noise Figure	DC - 2.0 GHz	3		dB
	2.0 - 4.0 GHz	4		dB
Supply Current (Icq)		62	82	mA

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

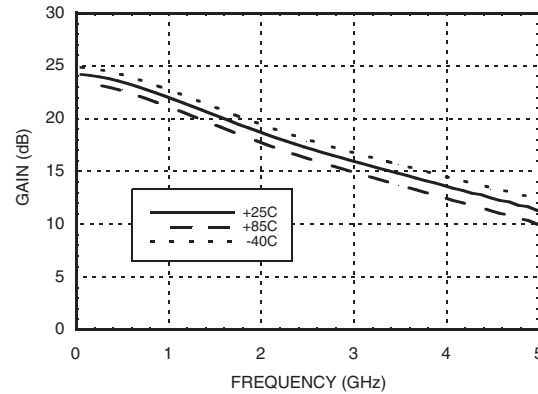
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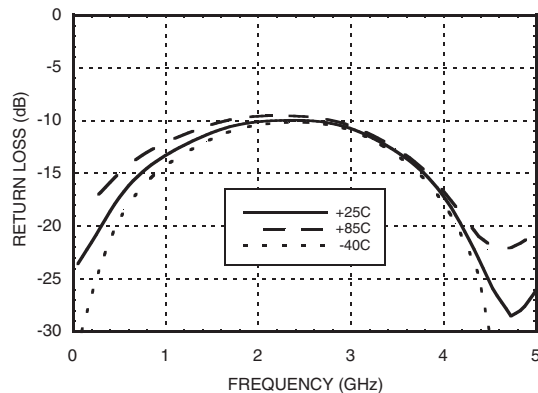
Broadband Gain & Return Loss



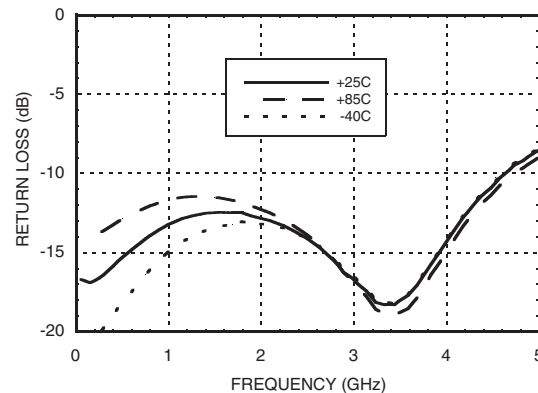
Gain vs. Temperature



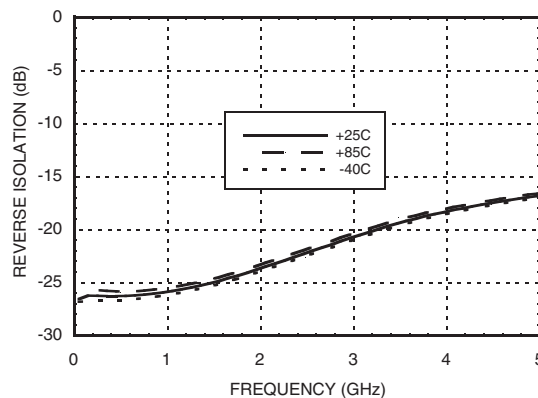
Input Return Loss vs. Temperature



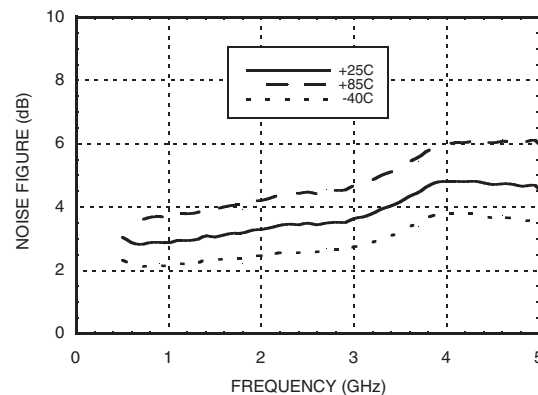
Output Return Loss vs. Temperature

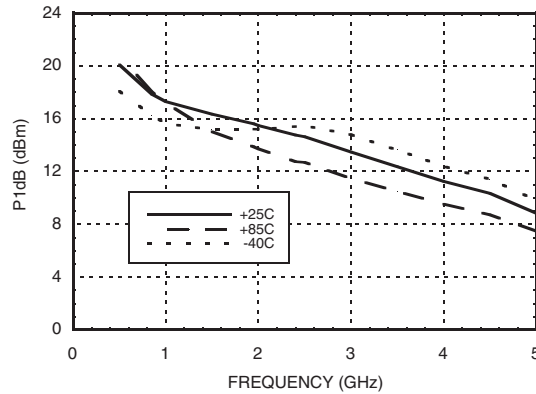
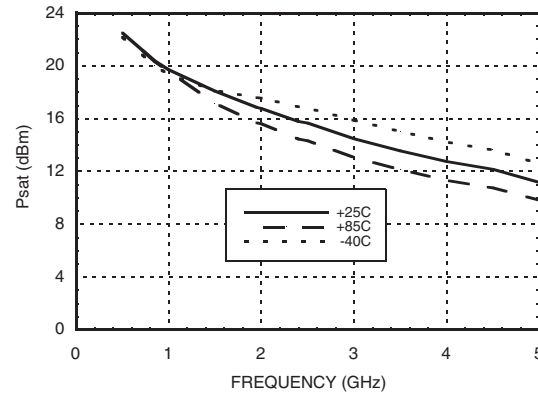
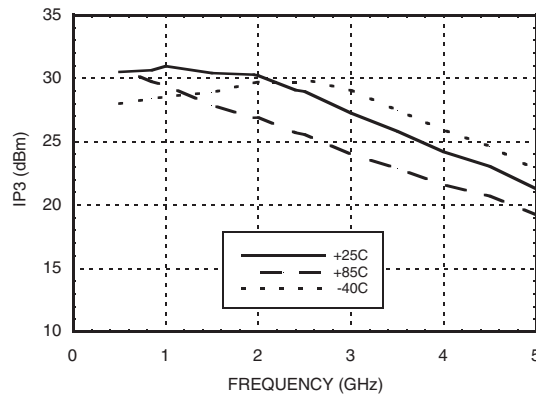
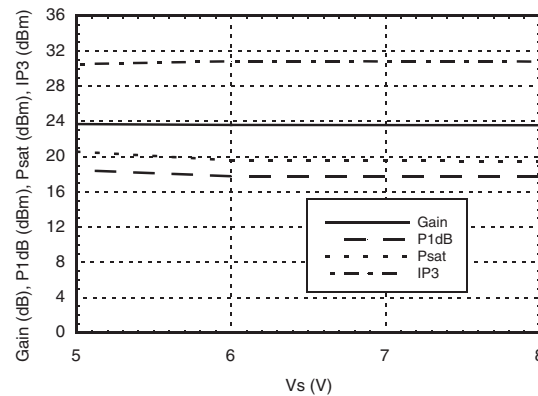
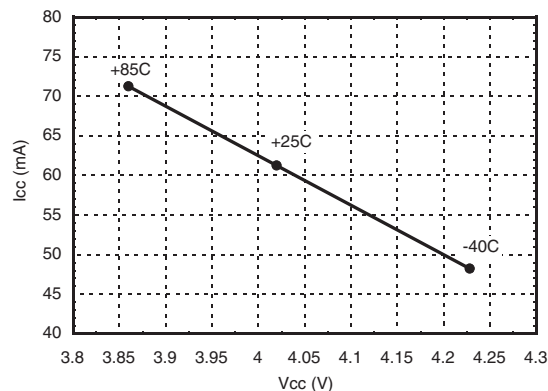
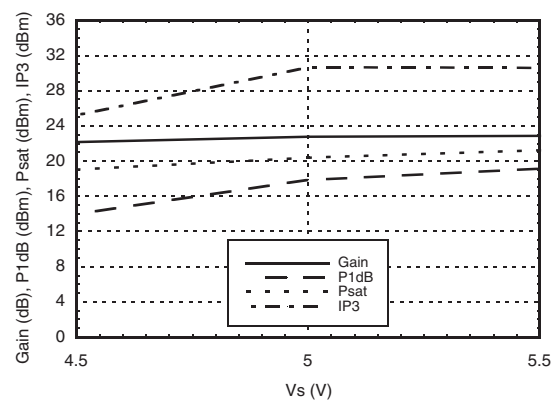


Reverse Isolation vs. Temperature



Noise Figure vs. Temperature



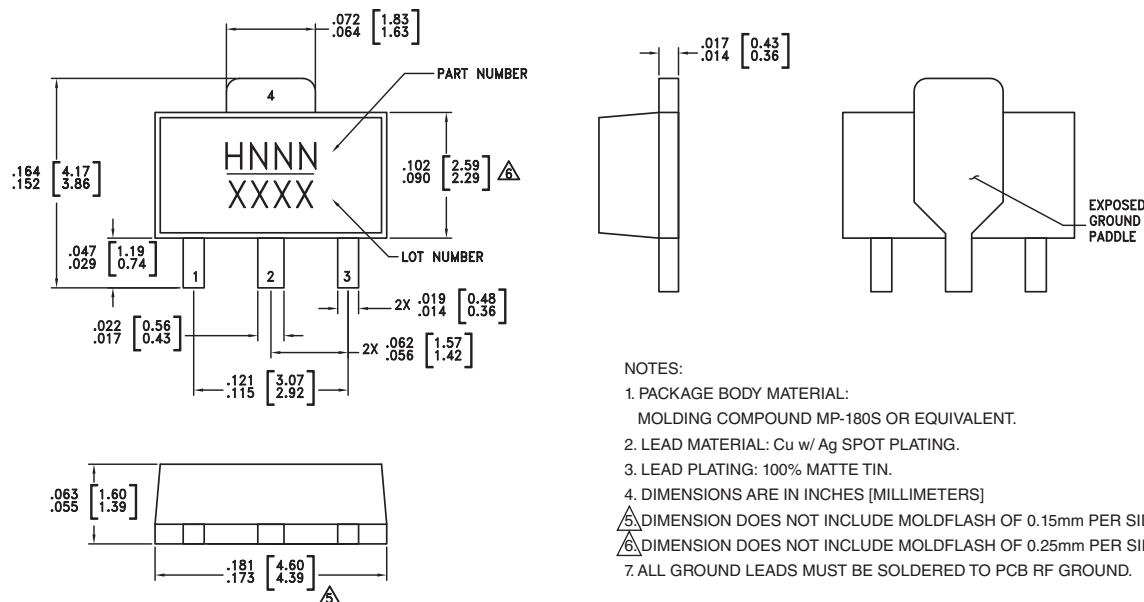
**SiGe HBT GAIN BLOCK
MMIC AMPLIFIER, DC - 4 GHz**
P1dB vs. Temperature

Psat vs. Temperature

Output IP3 vs. Temperature

**Gain, Power & Output IP3 vs. Supply
Voltage for Constant Icc= 62 mA @ 850 MHz**

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

**Gain, Power & Output IP3 vs. Supply
Voltage for Rs = 18 Ohms @ 850 MHz**



**SiGe HBT GAIN BLOCK
MMIC AMPLIFIER, DC - 4 GHz**
Absolute Maximum Ratings

Collector Bias Voltage (Vcc)	+6 Vdc
RF Input Power (RFIN)(Vcc = +4.2 Vdc)	+5 dBm
Junction Temperature	150 °C
Continuous P _{diss} (T = 85 °C) (derate 9.5 mW/°C above 85 °C)	0.615 W
Thermal Resistance (junction to lead)	105.6 °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]
HMC478ST89	Low Stress Injection Molded Plastic	Sn/Pb Solder	MSL1 ^[1]	H478 XXXX
HMC478ST89E	RoHS-compliant Low Stress Injection Molded Plastic	100% matte Sn	MSL1 ^[2]	H478 XXXX

[1] Max peak reflow temperature of 235 °C

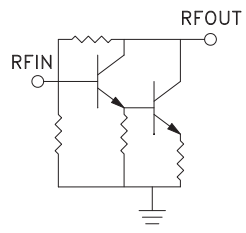
[2] Max peak reflow temperature of 260 °C

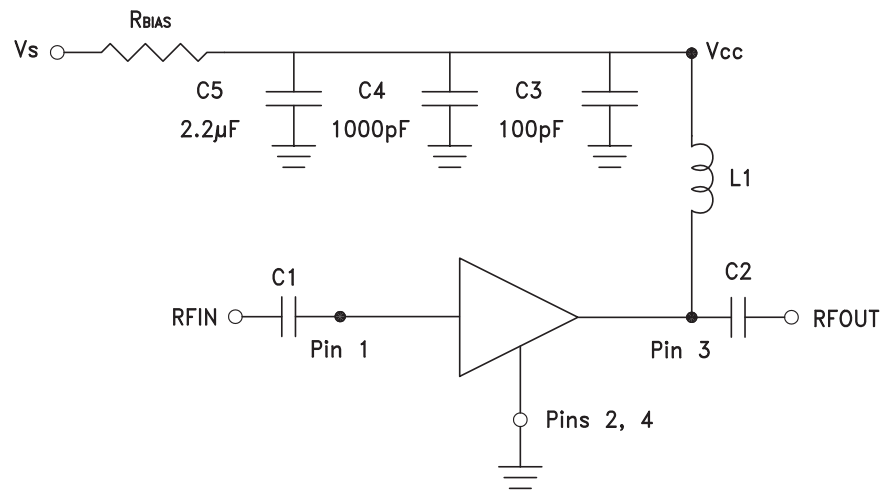
[3] 4-Digit lot number XXXX

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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 $I_{CC} = 62 \text{ mA}$, $R_{BIAS} = (V_S - V_{CC}) / I_{CC}$**

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

Note:

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

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

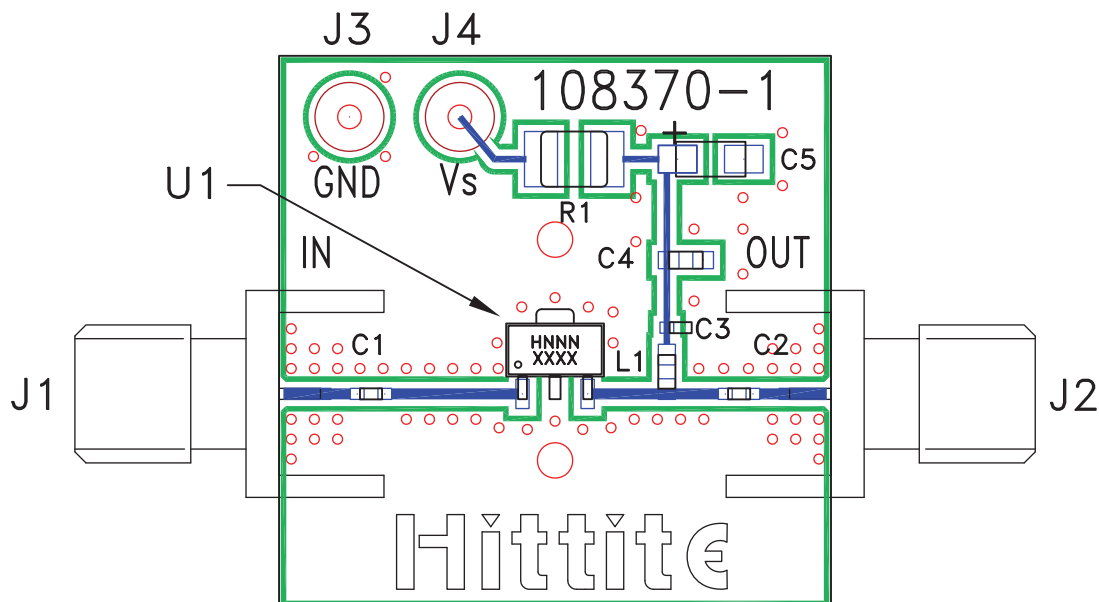
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Evaluation PCB



List of Materials for Evaluation PCB 110161 [1]

Item	Description
J1 - J2	PC Mount SMA Connector
J3 - J4	DC Pin
C1 - C3	100 pF Capacitor, 0402 Pkg.
C4	1000 pF Capacitor, 0603 Pkg.
C5	2.2 μ F Capacitor, Tantalum
R1	Resistor, 1210 Pkg.
L1	18 nH Inductor, 0603 Pkg.
U1	HMC478ST89 / HMC478ST89E
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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