v05.0710

HMC478ST89 / 478ST89E

SiGe HBT GAIN BLOCK MMIC AMPLIFIER, DC - 4 GHz

Designer's Kit Available

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

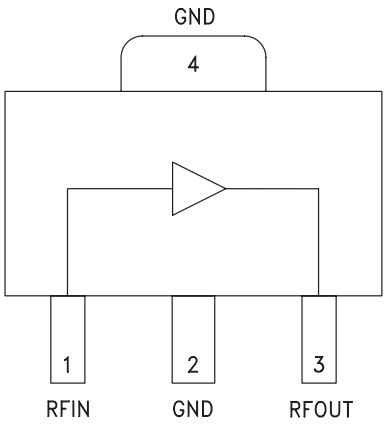
Single Supply: +5V to +8V

Industry Standard SOT89 Package

Robust 1,000V ESD, Class 1C

Included in the HMC-DK001 Designer's Kit

Functional Diagram



General Description

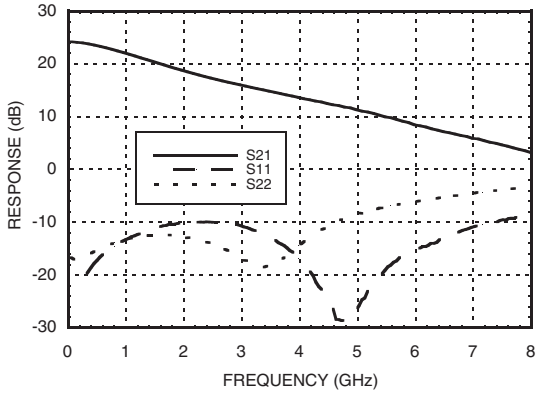
The HMC478ST89 & HMC478ST89E are SiGe Heterojunction Bipolar Transistor (HBT) Gain Block MMIC SMT amplifiers covering DC to 4 GHz. Packaged in an industry standard SOT89, the amplifier can be used as a cascadable 50 Ohm RF/IF gain stage as well as a LO or PA driver with up to +20 dBm output power. The 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, Vs= 5V, Rbias= 18 Ohm, T_A = +25° C

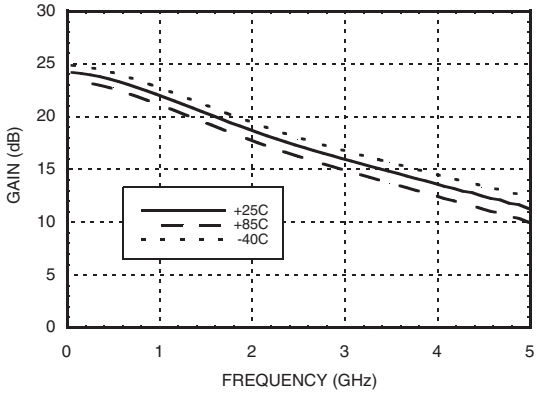
Parameter		Min.	Typ.	Max.	Units
Gain	DC - 1.0 GHz 1.0 - 2.0 GHz 2.0 - 3.0 GHz 3.0 - 4.0 GHz	19 16 13 11	22 19 16 14		dB dB dB dB
Gain Variation Over Temperature	DC - 4 GHz		0.015	0.02	dB/ °C
Input Return Loss	DC - 1.0 GHz 1.0 - 3.0 GHz 3.0 - 4.0 GHz		15 10 13		dB dB dB
Output Return Loss	DC - 3.0 GHz 3.0 - 4.0 GHz		13 15		dB dB
Reverse Isolation	DC - 4 GHz		20		dB
Output Power for 1 dB Compression (P1dB)	0.5 - 1.0 GHz 1.0 - 2.0 GHz 2.0 - 3.0 GHz 3.0 - 4.0 GHz	15 13 10 8	18 16 13 11		dBm dBm dBm dBm
Output Third Order Intercept (IP3) (Pout= 0 dBm per tone, 1 MHz spacing)	0.5 - 2.0 GHz 2.0 - 3.0 GHz 3.0 - 4.0 GHz		30 28 25		dBm dBm dBm
Noise Figure	DC - 2.0 GHz 2.0 - 4.0 GHz		3 4		dB dB
Supply Current (Icq)			62	82	mA

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

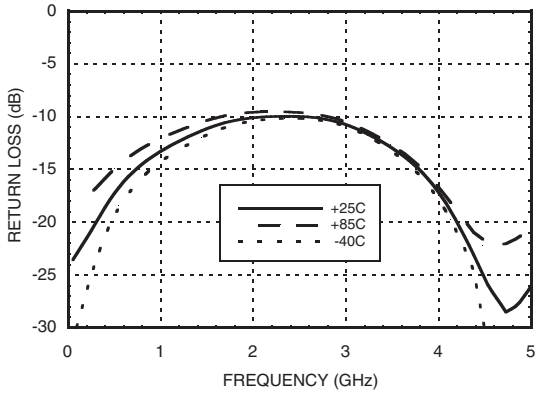
Broadband Gain & Return Loss



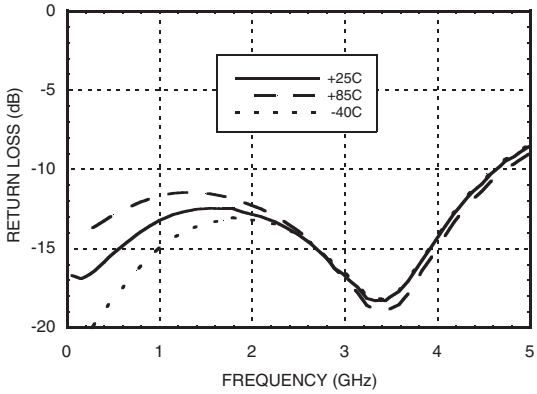
Gain vs. Temperature



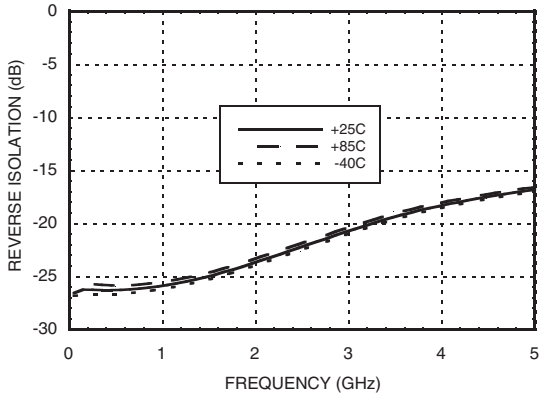
Input Return Loss vs. Temperature



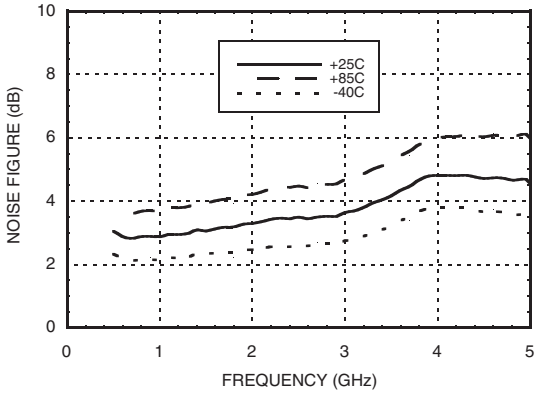
Output Return Loss vs. Temperature



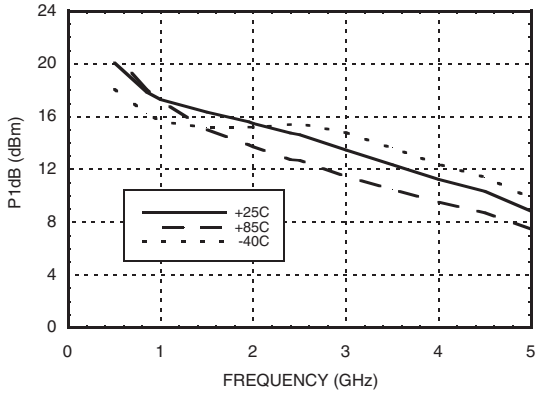
Reverse Isolation vs. Temperature



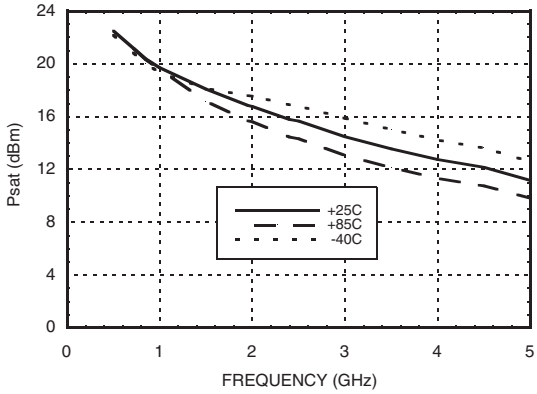
Noise Figure vs. Temperature



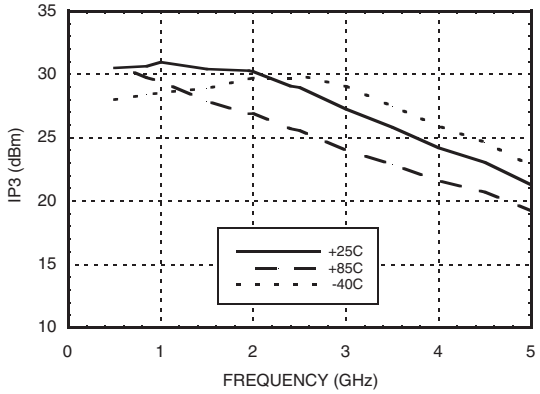
P1dB vs. Temperature



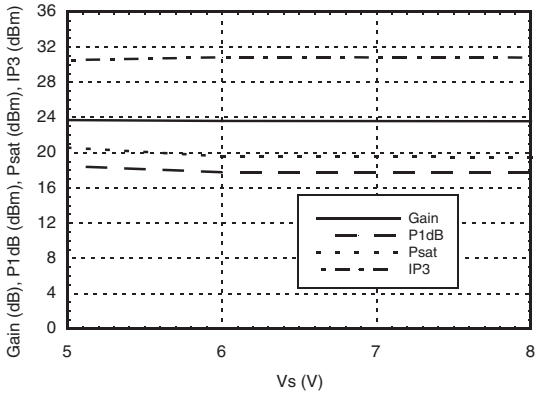
Psat vs. Temperature



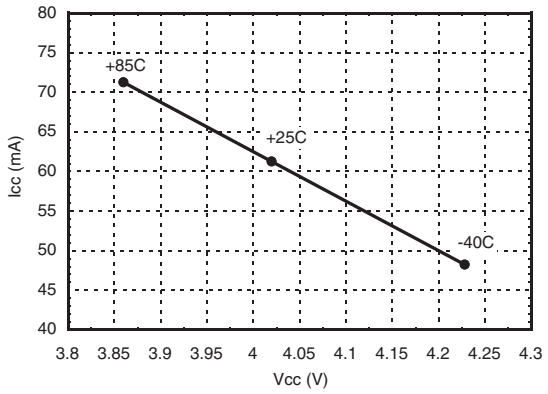
Output IP3 vs. Temperature



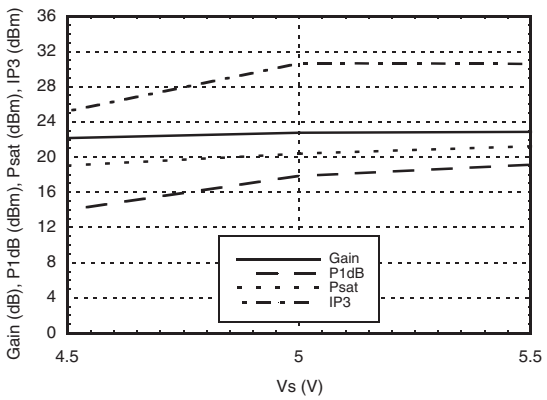
Gain, Power & Output IP3 vs. Supply Voltage for Constant Icc= 62 mA @ 850 MHz



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

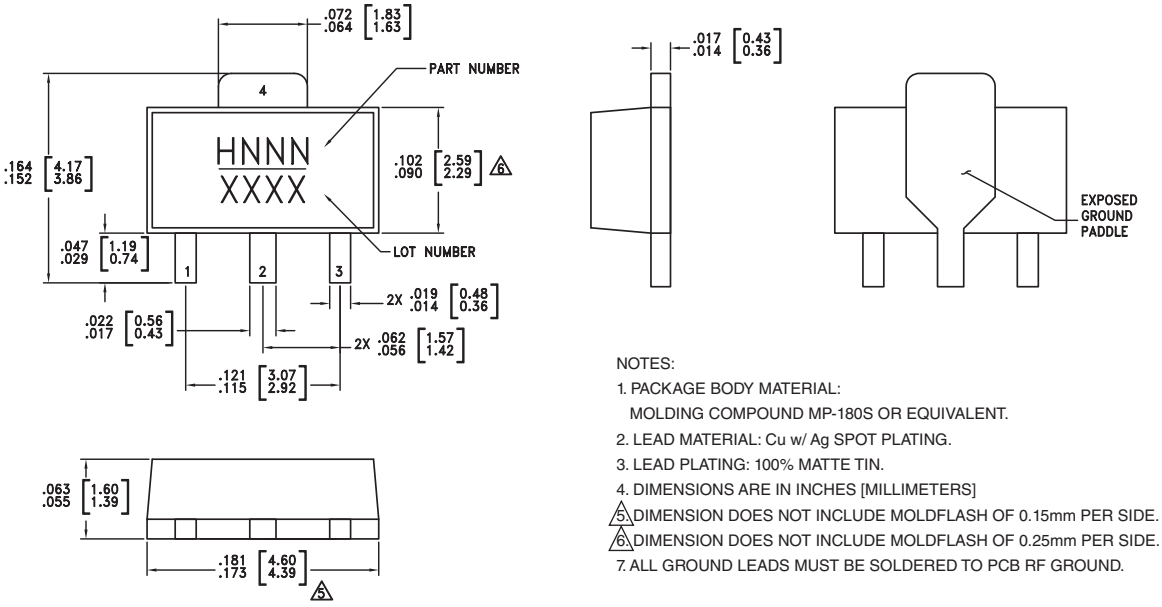


Absolute Maximum Ratings

Collector Bias Voltage (Vcc)	+6 Vdc
RF Input Power (RFIN)(Vcc = +4.2 Vdc)	+5 dBm
Junction Temperature	150 °C
Continuous Pdiss (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



NOTES:

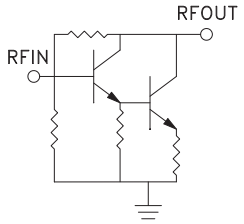
1. PACKAGE BODY MATERIAL:
   MOLDING COMPOUND MP-180S OR EQUIVALENT.
2. LEAD MATERIAL: Cu w/ Ag SPOT PLATING.
3. LEAD PLATING: 100% MATTE TIN.
4. DIMENSIONS ARE IN INCHES [MILLIMETERS]
5. DIMENSION DOES NOT INCLUDE MOLDFLASH OF 0.15mm PER SIDE.
6. DIMENSION DOES NOT INCLUDE MOLDFLASH OF 0.25mm PER SIDE.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

Package Information

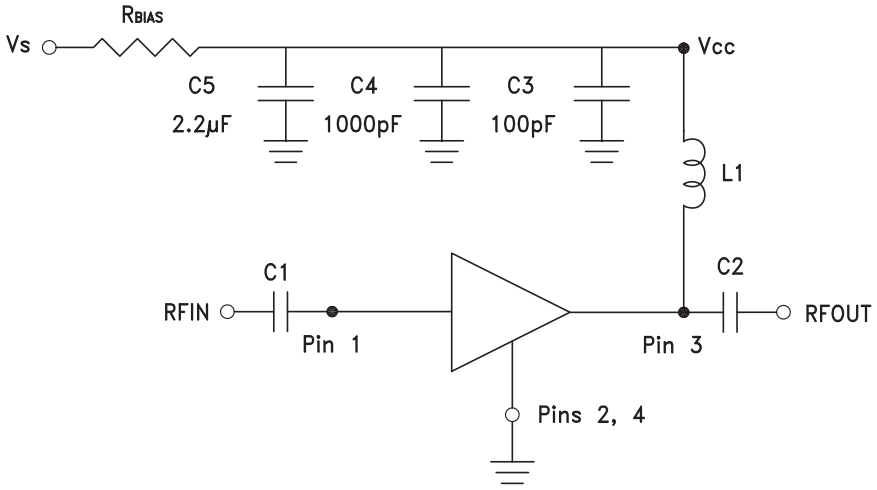
Part Number	Package Body Material	Lead Finish	MSL Rating	Package Marking [3]
HMC478ST89	Low Stress Injection Molded Plastic	Sn/Pb Solder	MSL1 [1]	H478 XXXX
HMC478ST89E	RoHS-compliant Low Stress Injection Molded Plastic	100% matte Sn	MSL1 [2]	H478 XXXX

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

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 Icc= 62 mA, Rbias= (Vs - Vcc) / Icc

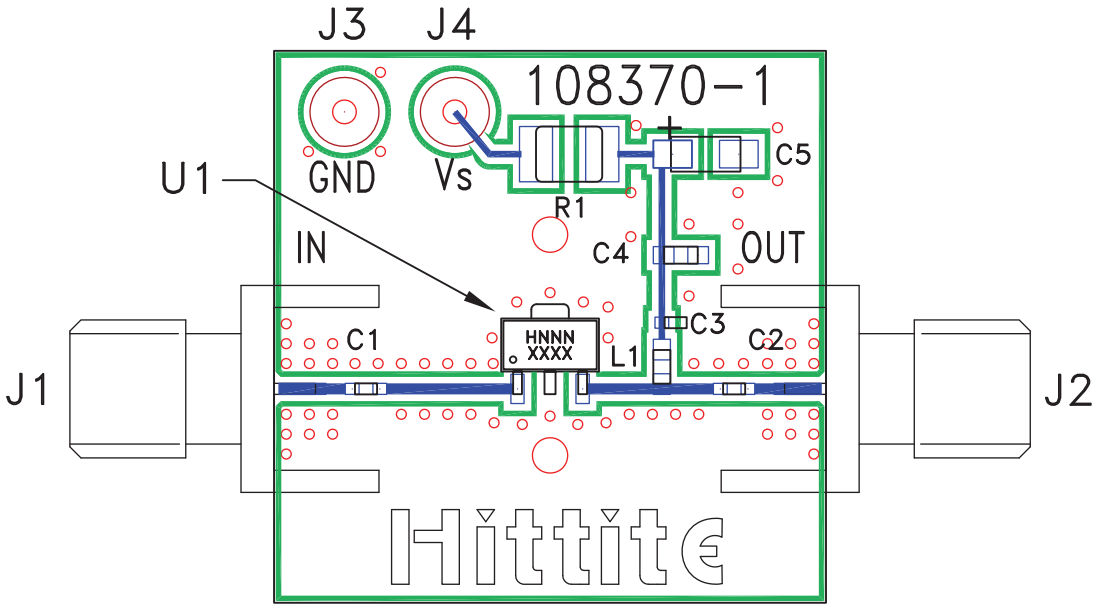
Supply Voltage (Vs)	5V	6V	8V
RBIAS VALUE	18 Ω	35 Ω	67 Ω
RBIAS POWER RATING	1/8 W	1/4 W	1/2 W

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

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 µF 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.