GaAs PHEMT MMIC MEDIUM POWER AMPLIFIER, 21 - 32 GHz

Typical Applications

The HMC499 is ideal for use as a power amplifier for:

- Point-to-Point Radios
- Point-to-Multi-Point Radios
- VSAT
- Military & Space

Features

+33 dBm Output IP3

+24 dBm P1dB

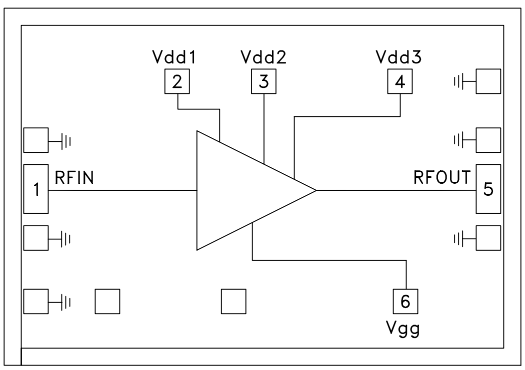
Gain: 16 dB

Supply Voltage: +5.0 V

50 Ohm Matched Input/Output

2.11 mm x 1.46 mm x 0.1 mm

Functional Diagram



General Description

The HMC499 is a high dynamic range GaAs PHEMT MMIC Medium Power Amplifier which operates between 21 and 32 GHz. The HMC499 provides 16 dB of gain, and an output power of +24 dBm at 1 dB compression from a +5.0 V supply voltage. The HMC499 amplifier can easily be integrated into Multi-Chip-Modules (MCMs) due to its small size. All data is with the chip in a 50 Ohm test fixture connected via 0.025mm (1 mil) diameter wire bonds of minimal length 0.31mm (12 mils).

Electrical Specifications, T_A = +25° C, Vdd = 5V, Idd = 200 mA*

Parameter	Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	Units
Frequency Range		21.0 - 24.0			24.0 - 28.0			28.0 - 32.0		GHz
Gain	13	16		12.5	15.5		12	15		dB
Gain Variation Over Temperature		0.03	0.04		0.03	0.04		0.03	0.04	dB/ °C
Input Return Loss		10			5			8		dB
Output Return Loss		13			12			12		dB
Output Power for 1 dB Compression (P1dB)	20	23		20	24		21	24.5		dBm
Saturated Output Power (Psat)		24			24.5			25		dBm
Output Third Order Intercept (IP3)		30			33			33.5		dBm
Noise Figure		6.5			5.0			4.5		dB
Supply Current (Idd)(Vdd = 5V, Vgg = -0.8V Typ.)		200			200			200		mA

** Adjust Vgg between -2 to 0V to achieve Idd = 200 mA typical.*

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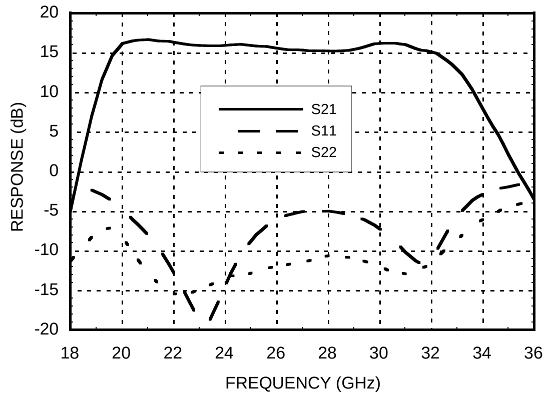
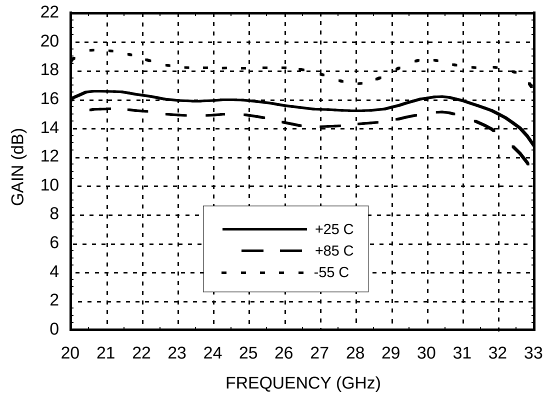
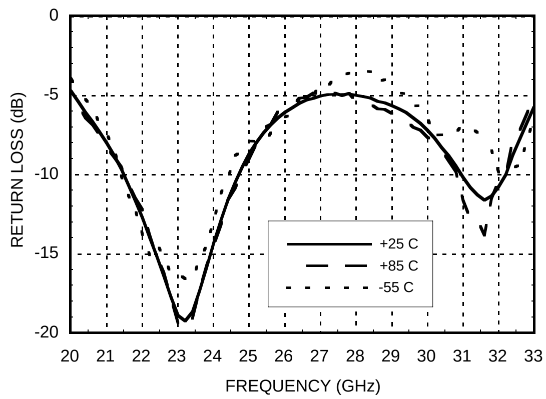
Broadband Gain & Return Loss



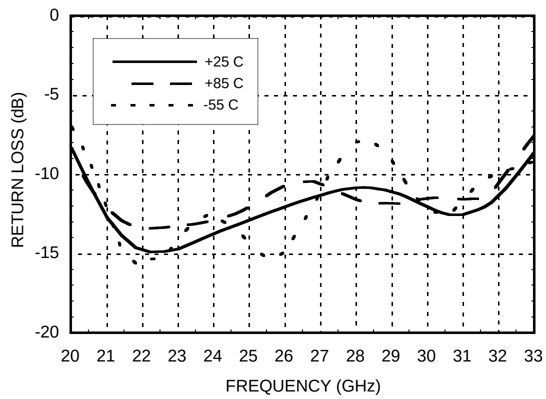
Gain vs. Temperature



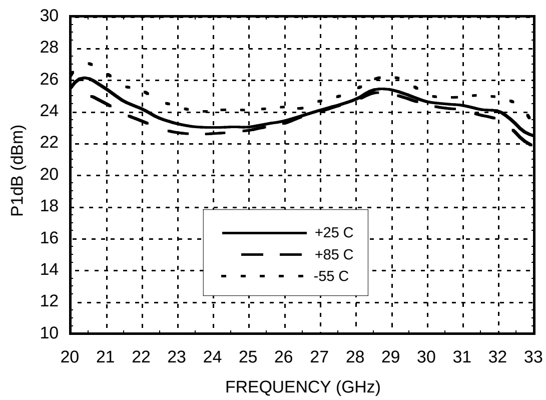
Input Return Loss vs. Temperature



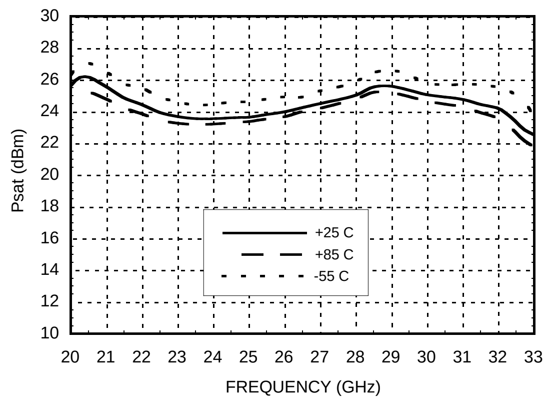
Output Return Loss vs. Temperature



P1dB vs. Temperature



Psat vs. Temperature



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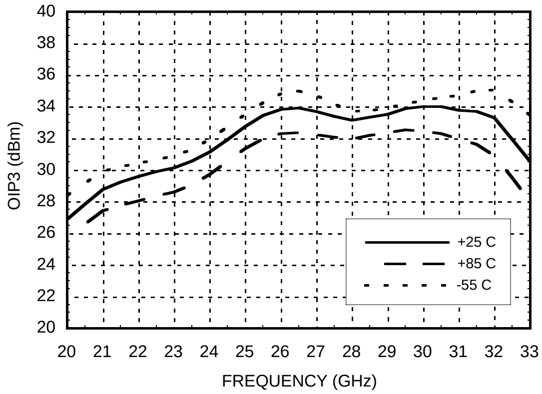
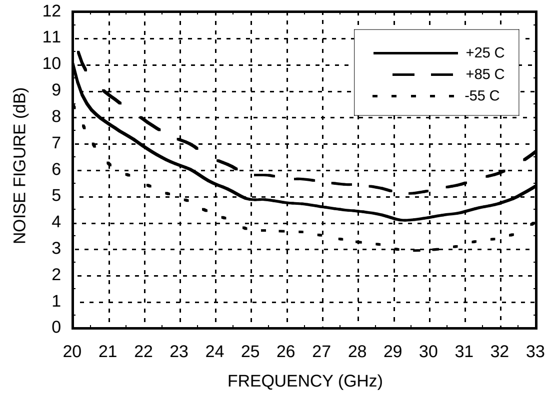
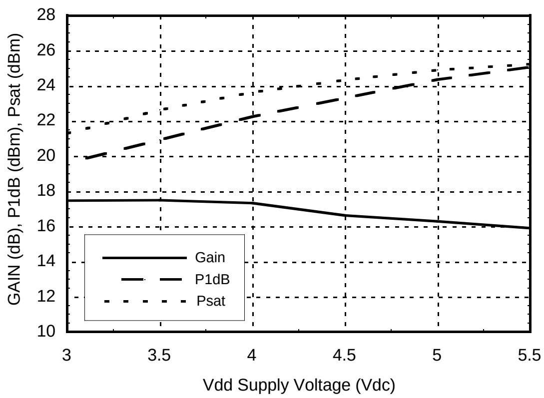
Output IP3 vs. Temperature



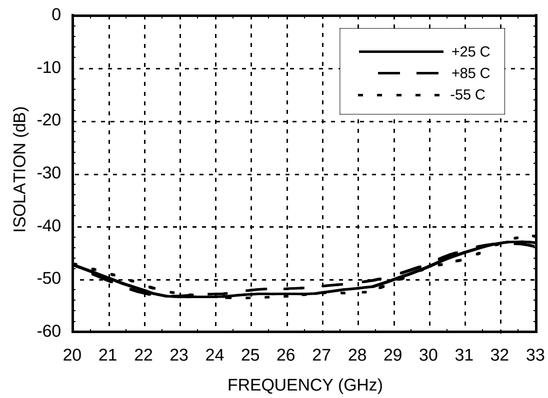
Noise Figure vs. Temperature



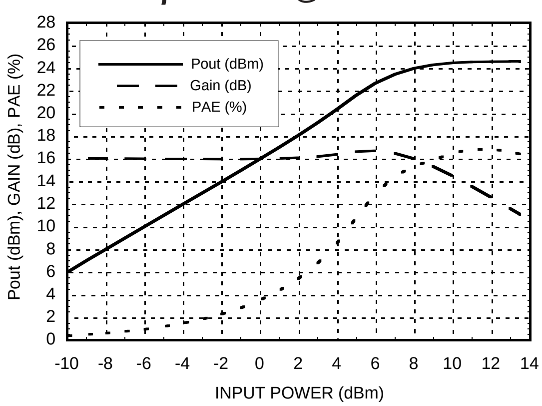
Gain & Power vs. Supply Voltage@ 30 GHz, Idd= 200 mA



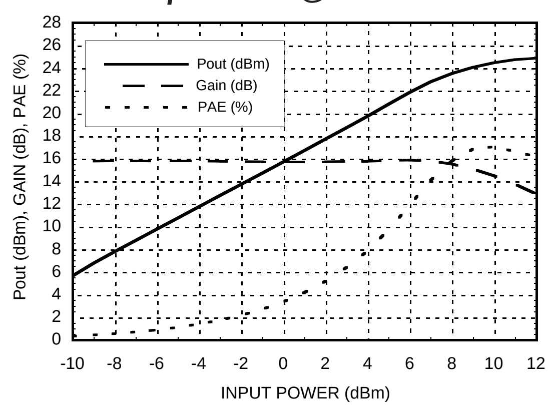
Reverse Isolation vs. Temperature



Power Compression @ 22 GHz



Power Compression @ 30 GHz



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Absolute Maximum Ratings

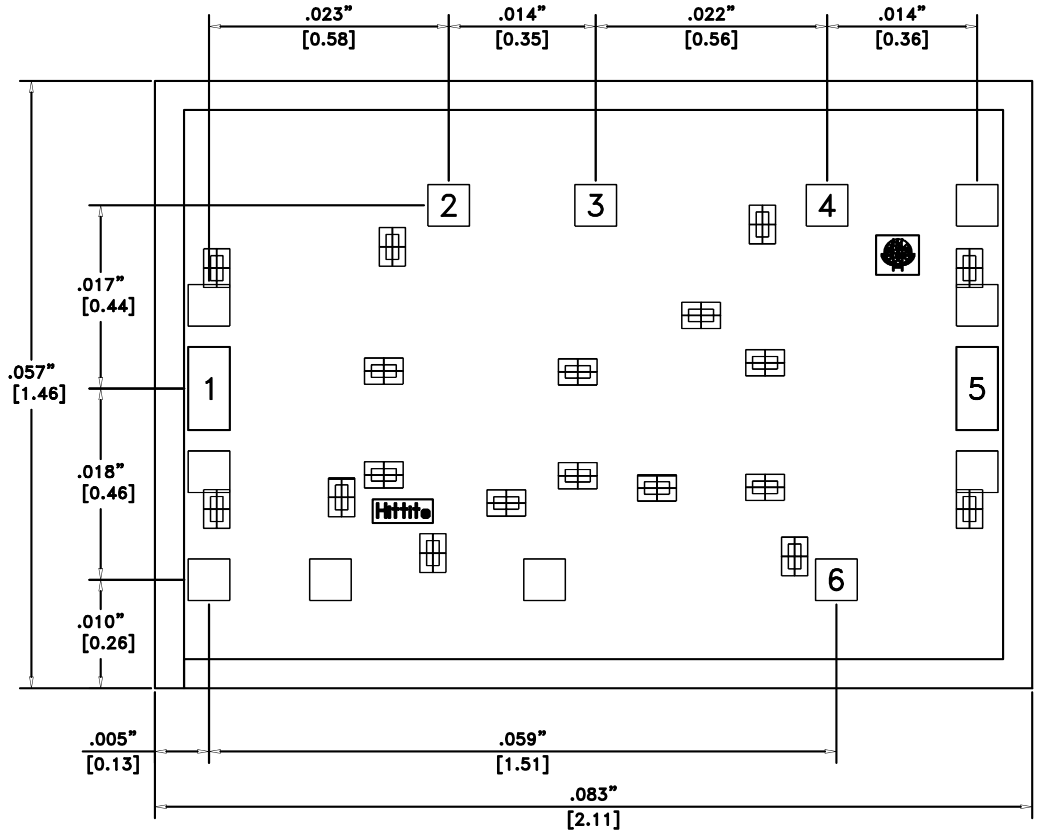
Drain Bias Voltage (Vdd1, Vdd2, Vdd3)	+5.5 Vdc
Gate Bias Voltage (Vgg)	-4.0 to 0 Vdc
RF Input Power (RFin)(Vdd = +5.0 Vdc)	+20 dBm
Channel Temperature	175 °C
Continuous Pdiss (T= 85 °C) (derate 25 mW/°C above 85 °C)	2.25 W
Thermal Resistance (channel to die bottom)	40 °C/W
Storage Temperature	-65 to +150 °C
Operating Temperature	-55 to +85 °C

Typical Supply Current vs. Vdd

Vdd (Vdc)	Idd (mA)
+4.5	193
+5.0	200
+5.5	207
+3.0	191
+3.5	200
+4.0	208

Note: Amplifier will operate over full voltage ranges shown above. Vgg adjusted to achieve Idd= 200 mA at +5.0V and +3.5V.

Outline Drawing



NOTES:

1. ALL DIMENSIONS ARE IN INCHES [MM]
2. DIE THICKNESS IS .004"
3. TYPICAL BOND IS .004" SQUARE
4. BACKSIDE METALLIZATION: GOLD
5. BOND PAD METALLIZATION: GOLD
6. BACKSIDE METAL IS GROUND.
7. CONNECTION NOT REQUIRED FOR UNLABELED BOND PADS.

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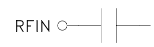
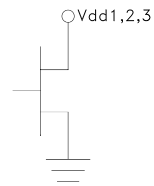
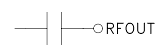
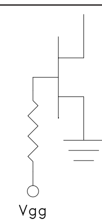
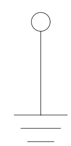
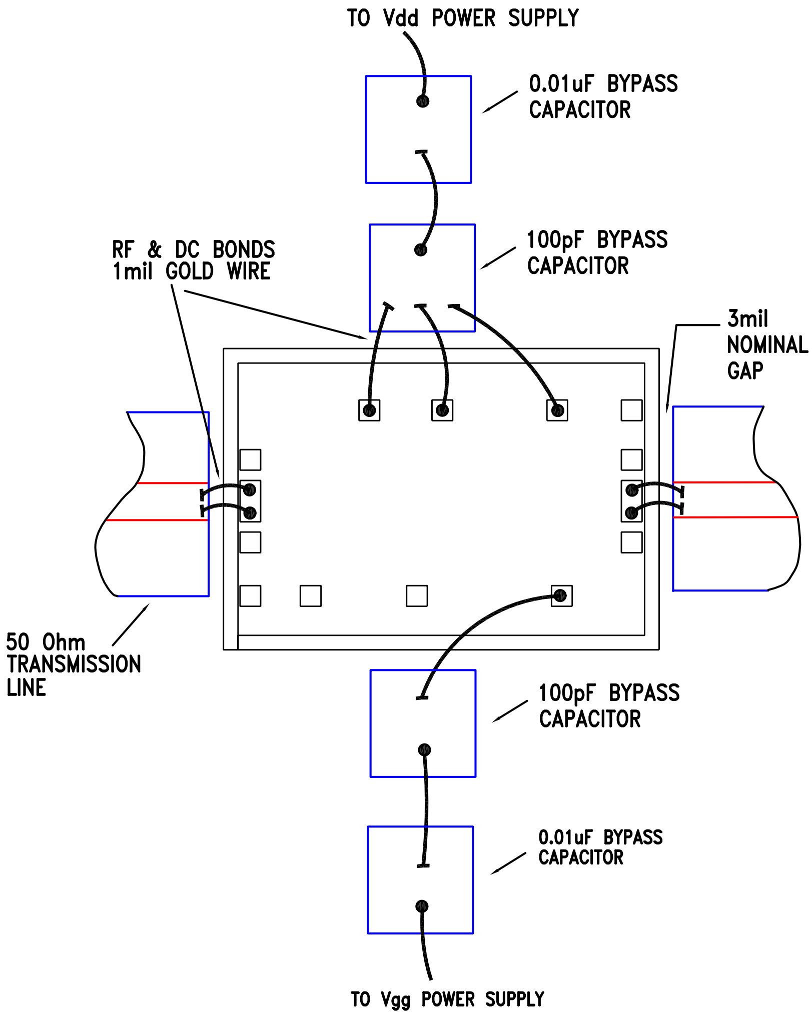
Pad Descriptions

Pin Number	Function	Description	Interface Schematic
1	RF IN	This pad is AC coupled and matched to 50 Ohms from 21 - 32 GHz.	
2-4	Vdd1, 2, 3	Power Supply Voltage for the amplifier. External bypass capacitors of 100 pF and 0.01 µF are required.	
5	RF OUT	This pad is AC coupled and matched to 50 Ohms from 21 - 32 GHz.	
6	Vgg	Gate control for amplifier. Adjust to achieve Idd of 200 mA. Please follow "MMIC Amplifier Biasing Procedure" Application Note. External bypass capacitors of 100 pF and 0.01 µF are required.	
Die Bottom	GND	Die bottom must be connected to RF/DC ground.	

GaAs PHEMT MMIC MEDIUM POWER AMPLIFIER, 17 - 24 GHz

Assembly Diagram



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Mounting & Bonding Techniques for Millimeterwave GaAs MMICs

The die should be attached directly to the ground plane eutectically or with conductive epoxy (see HMC general Handling, Mounting, Bonding Note).

50 Ohm Microstrip transmission lines on 0.127mm (5 mil) thick alumina thin film substrates are recommended for bringing RF to and from the chip (Figure 1). If 0.254mm (10 mil) thick alumina thin film substrates must be used, the die should be raised 0.150mm (6 mils) so that the surface of the die is coplanar with the surface of the substrate. One way to accomplish this is to attach the 0.102mm (4 mil) thick die to a 0.150mm (6 mil) thick molybdenum heat spreader (moly-tab) which is then attached to the ground plane (Figure 2).

Microstrip substrates should brought as close to the die as possible in order to minimize bond wire length. Typical die-to-substrate spacing is 0.076mm to 0.152 mm (3 to 6 mils).

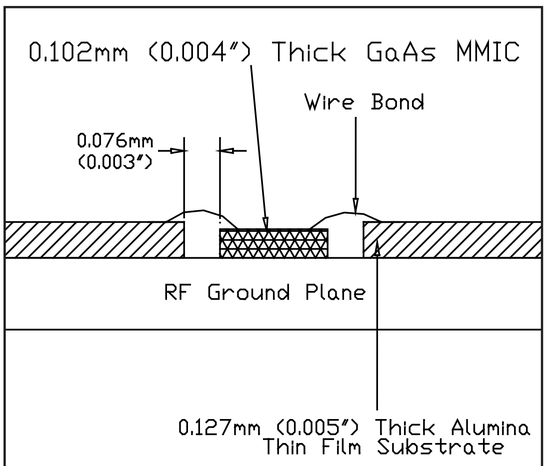

Figure 1.

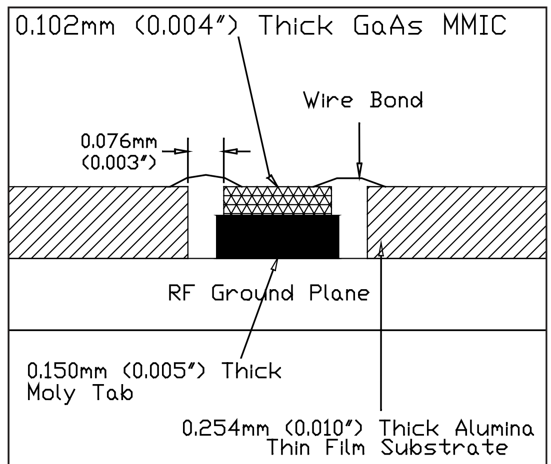

Figure 2.

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Handling Precautions

Follow these precautions to avoid permanent damage.

Cleanliness:

Handle the chips in a clean environment.
DO NOT attempt to clean the chip using liquid cleaning systems.

Static Sensitivity:

Follow ESD precautions to protect against > ± 250V ESD strikes.

Transients:

Suppress instrument and bias supply transients while bias is applied.
Use shielded signal and bias cables to minimize inductive pick-up.

General Handling:

Handle the chip along the edges with a vacuum collet or with a sharp pair of bent tweezers.
The surface of the chip has fragile air bridges and should not be touched with vacuum collet, tweezers, or fingers.

Mounting

The chip is back-metallized and can be die mounted with AuSn eutectic preforms or with electrically conductive epoxy. The mounting surface should be clean and flat.

Eutectic Die Attach:

A 80/20 gold tin preform is recommended with a work surface temperature of 255 deg. C and a tool temperature of 265 deg. C. When hot 90/10 nitrogen/hydrogen gas is applied, tool tip temperature should be 290 deg. C.
DO NOT expose the chip to a temperature greater than 320 deg. C for more than 20 seconds. No more than 3 seconds of scrubbing should be required for attachment.

Epoxy Die Attach:

Apply a minimum amount of epoxy to the mounting surface so that a thin epoxy fillet is observed around the perimeter of the chip once it is placed into position.
Cure epoxy per the manufacturer's schedule.

Wire Bonding

Ball or wedge bond with 0.025 mm (1 mil) diameter pure gold wire. Thermosonic wirebonding with a nominal stage temperature of 150 deg. C and a ball bonding force of 40 to 50 grams or wedge bonding force of 18 to 22 grams is recommended. Use the minimum level of ultrasonic energy to achieve reliable wirebonds.
Wirebonds should be started on the chip and terminated on the package or substrate. All bonds should be as short as possible <0.31 mm (12 mils).