

GaAs PHEMT MMIC POWER AMPLIFIER, 17 - 24 GHz

Typical Applications

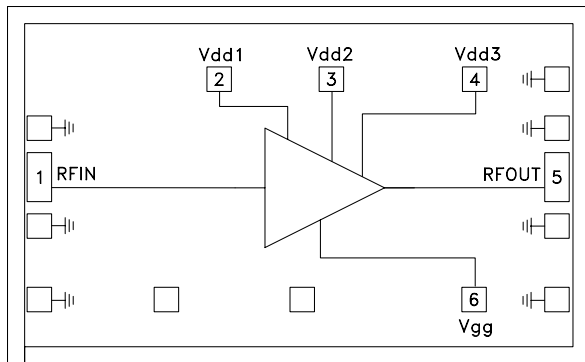
The HMC498 is ideal for use as a power amplifier for:

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

Features

- +34 dBm Output IP3
- Saturated Power: +27 dBm @ 25% PAE
- Gain: 24 dB
- Supply Voltage: +5.0 V
- 50 Ohm Matched Input/Output
- 2.38 mm x 1.46 mm x 0.1 mm

Functional Diagram



General Description

The HMC498 is a high dynamic range GaAs PHEMT MMIC Power Amplifier which operates between 17 and 24 GHz. The HMC498 provides 24 dB of gain, +27 dBm of saturated power and 25% PAE from a +5.0 V supply voltage. The HMC498 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).

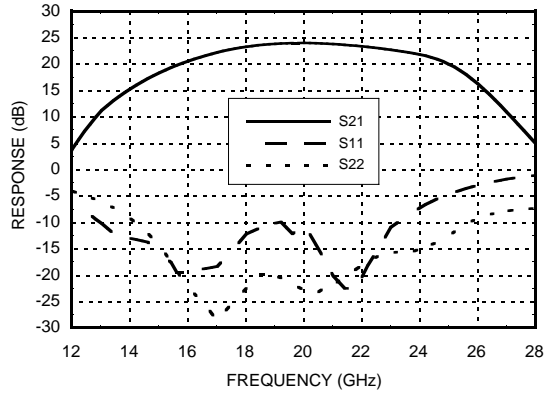
Electrical Specifications, $T_A = +25^\circ\text{C}$, $V_{dd} = 5\text{V}$, $I_{dd} = 250\text{mA}^*$

Parameter	Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	Units
Frequency Range	17.0 - 19.0			19.0 - 22.0			22.0 - 24.0			GHz
Gain	20	23		21	24		20	23		dB
Gain Variation Over Temperature		0.03	0.04		0.03	0.04		0.03	0.04	dB/ °C
Input Return Loss		11			11			8		dB
Output Return Loss		20			18			15		dB
Output Power for 1 dB Compression (P1dB)	20	23.5		22	25		21	24		dBm
Saturated Output Power (Psat)		27			26.5			25.5		dBm
Output Third Order Intercept (IP3)		34			34			34		dBm
Noise Figure		3.5			4.0			4.5		dB
Supply Current (I _{dd})(V _{dd} = 5V, V _{gg} = -0.8V Typ.)		250			250			250		mA

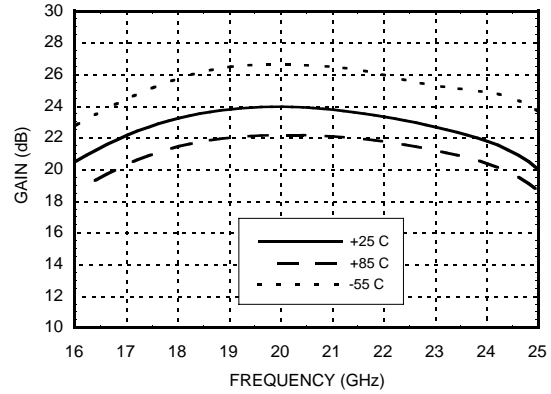
* Adjust V_{gg} between -2 to 0V to achieve I_{dd} = 250 mA typical.

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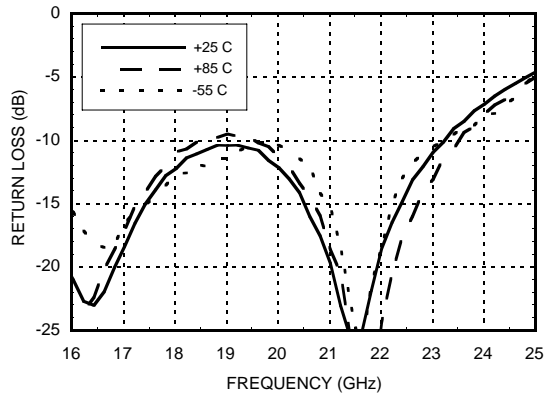
Broadband Gain & Return Loss



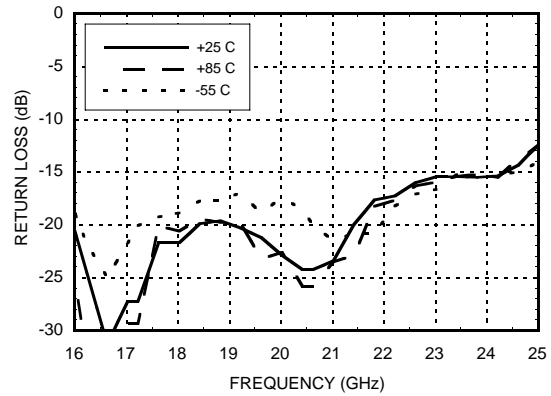
Gain vs. Temperature



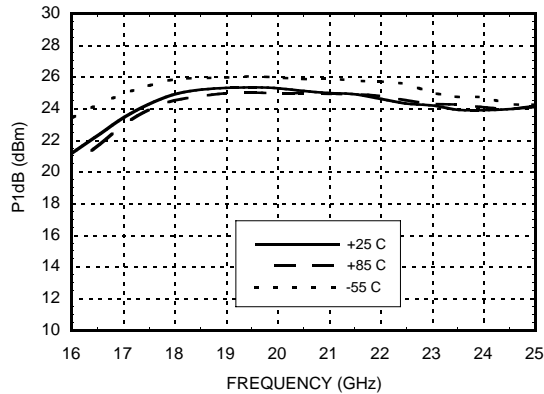
Input Return Loss vs. Temperature



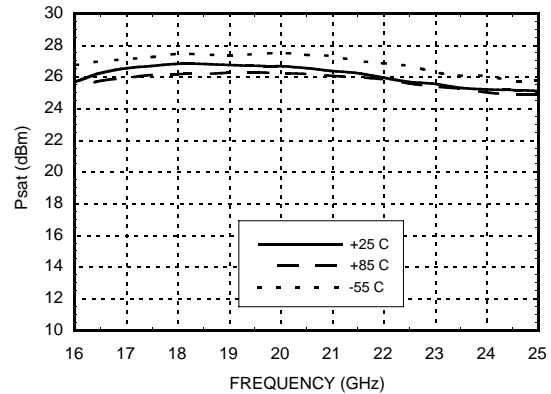
Output Return Loss vs. Temperature



P1dB vs. Temperature



Psat vs. Temperature

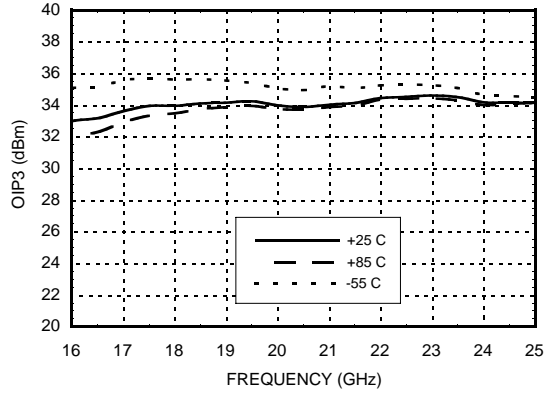


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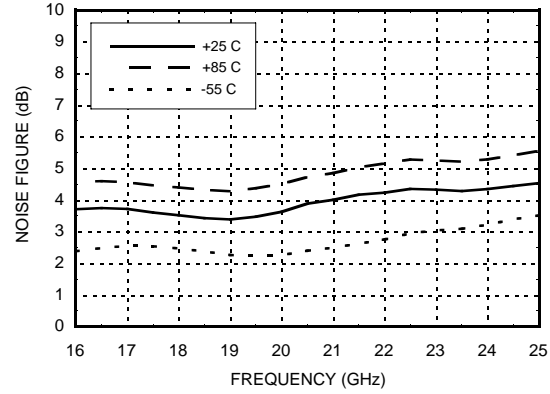
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AMPLIFIERS - CHIP

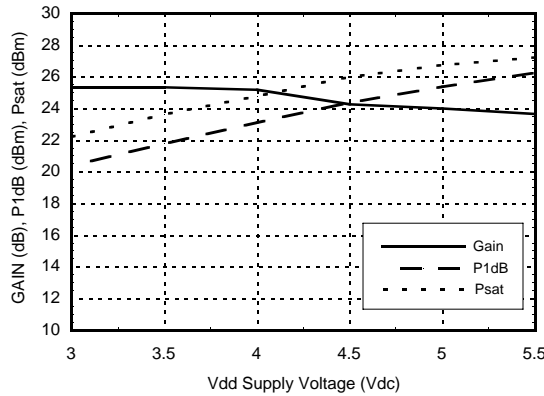
Output IP3 vs. Temperature



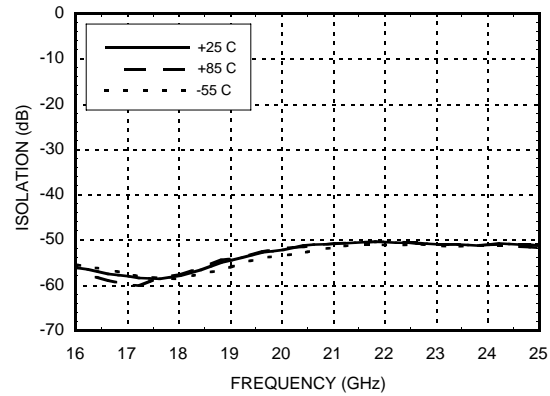
Noise Figure vs. Temperature



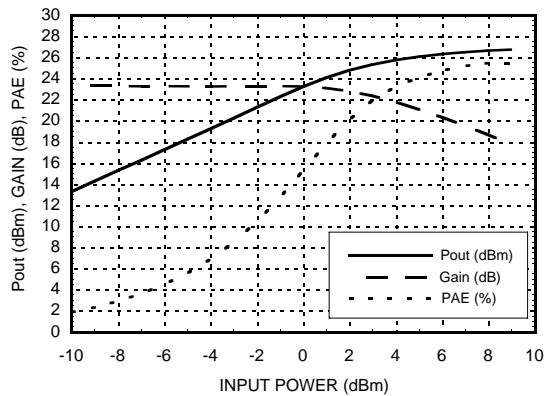
**Gain & Power vs. Supply Voltage @ 20 GHz,
I_{dd} = 250 mA**



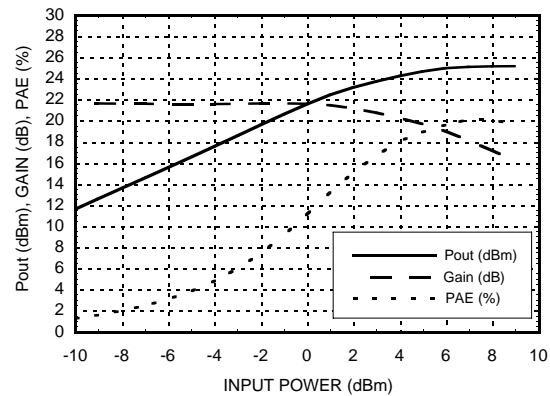
Reverse Isolation vs. Temperature



Power Compression @ 20 GHz



Power Compression @ 24 GHz



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Absolute Maximum Ratings

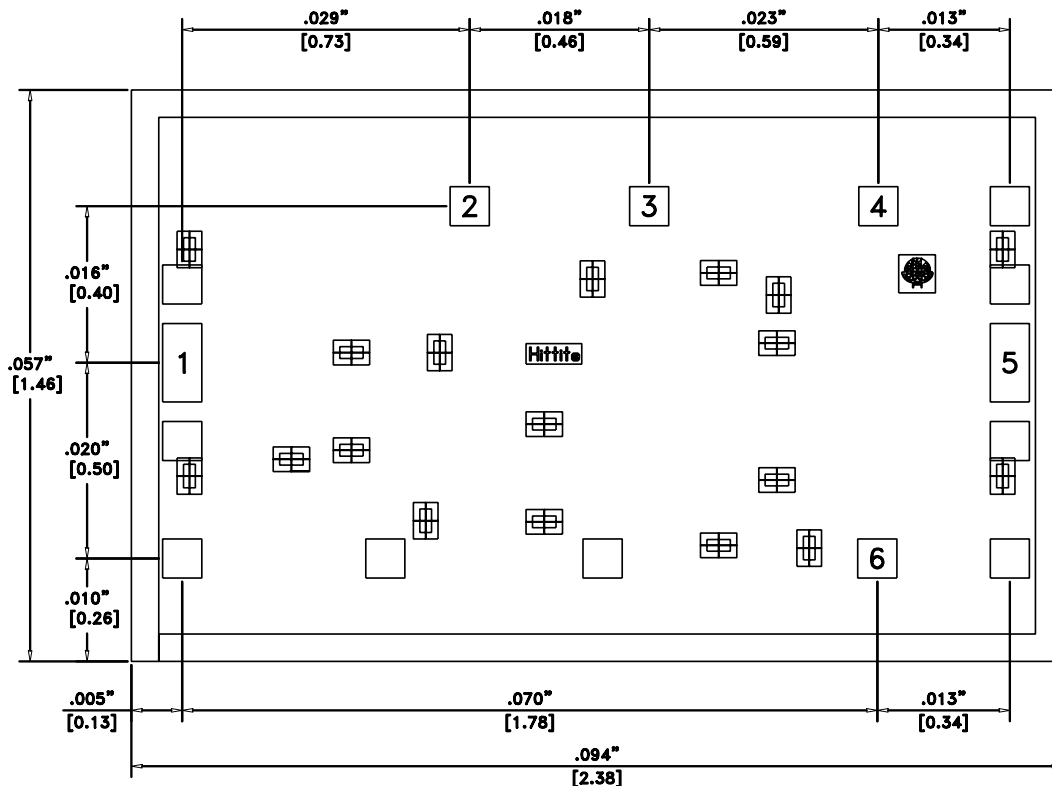
Drain Bias Voltage (Vdd1, Vdd2, Vdd3)	+5.5 Vdc
Gate Bias Voltage (Vgg)	-4.0 to 0 Vdc
RF Input Power (RFIn)(Vdd = +5.0 Vdc)	+20 dBm
Channel Temperature	175 °C
Continuous P _{diss} (T= 85 °C) (derate 29 mW/°C above 85 °C)	2.65 W
Thermal Resistance (channel to die bottom)	34 °C/W
Storage Temperature	-65 to +150 °C
Operating Temperature	-55 to +85 °C

Typical Supply Current vs. Vdd

Vdd (Vdc)	I _{dd} (mA)
+4.5	241
+5.0	250
+5.5	258
+3.0	240
+3.5	250
+4.0	259

Note: Amplifier will operate over full voltage ranges shown above. V_{gg} adjusted to achieve I_{dd}= 250 mA at +5.0V and +3.5V.

Outline Drawing



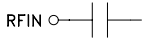
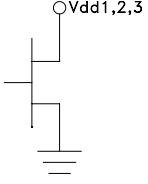
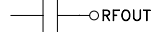


NOTES:

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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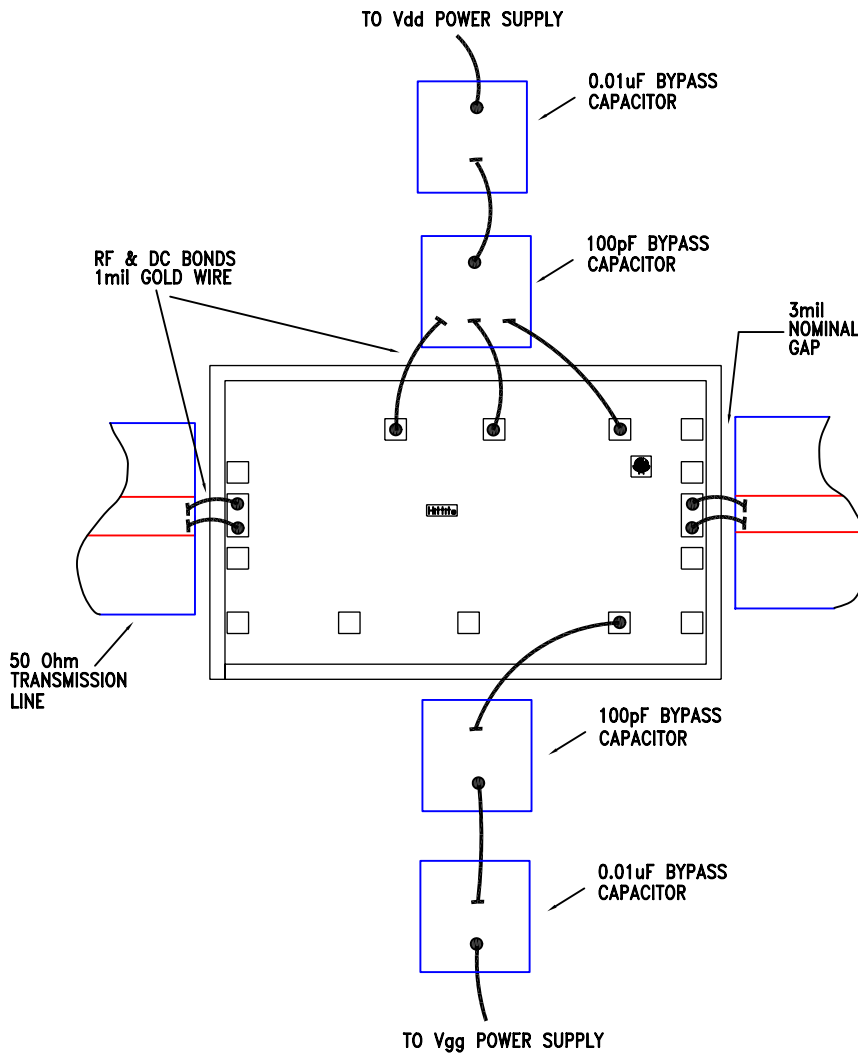
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Pad Descriptions

Pin Number	Function	Description	Interface Schematic
1	RF IN	This pad is AC coupled and matched to 50 Ohms from 17 - 24 GHz.	
2-4	Vdd1, Vdd2, Vdd3	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 17 - 24 GHz.	
6	Vgg	Gate control for amplifier. Adjust to achieve I _{dd} of 250 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
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Assembly Diagram



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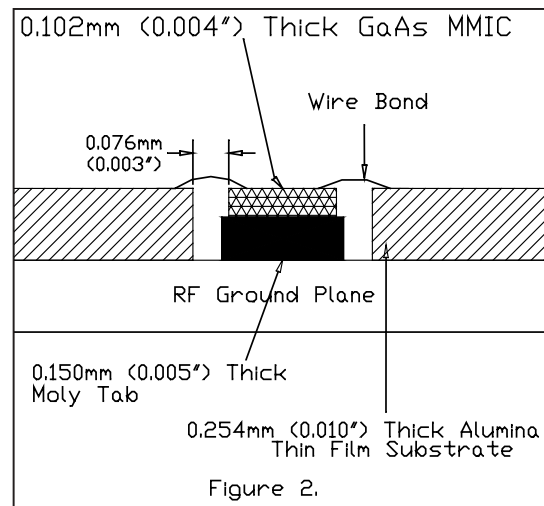
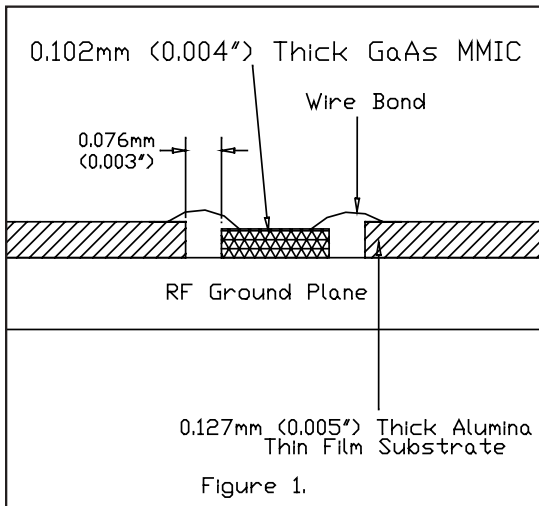
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Mounting & Bonding Techniques for Millimeterwave GaAs MMICs

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 be 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).



**GaAs PHEMT MMIC
POWER AMPLIFIER, 17 - 24 GHz****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 $> \pm 250V$ 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).