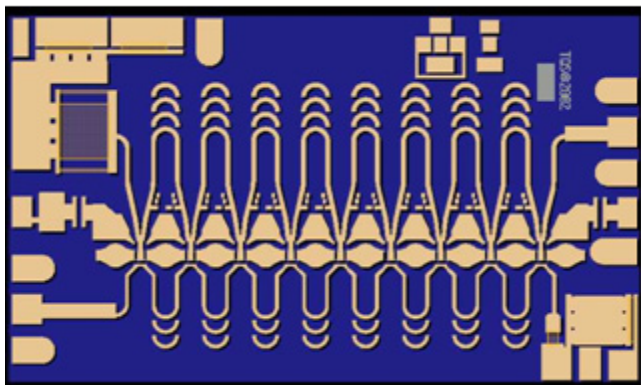


# 12.5Gb/s Modulator Driver Amplifier

## Metro and Long Haul Applications

**TGA4802**



### Key Features and Performance

- Frequency Range: DC - 25 GHz
- Single-ended Input / Output
- 15 dB Small Signal Gain
- 18 GHz Small Signal Bandwidth
- Wide Drive Range (3V to 7V)
- 15ps Edge Rates (20/80)
- Power Dissipation 1.2 Watts
- 0.25um pHEMT 2MI Technology
- Die Size: 3.3 x 2.0 x 0.1 mm  
(0.131 x 0.79 x 0.004 inches)

### Description

The TriQuint TGA4802 is part of a series of optical driver amplifiers suitable for a variety of driver applications.

The TGA4802 is a medium power wideband AGC amplifier MMIC die that typically provides 15dB small signal gain with 10dB AGC range. RF ports are DC coupled enabling the user to customize system corner frequencies.

The TGA4802 is an excellent choice for 12.5Gb/s optical modulator driver applications. The TGA4802 has demonstrated capability to amplify a 2V input signal to 7Vpp saturated.

The TGA4802 requires off-chip decoupling, a DC block and a bias tee. The TGA4802 is available in die form.

### Primary Applications

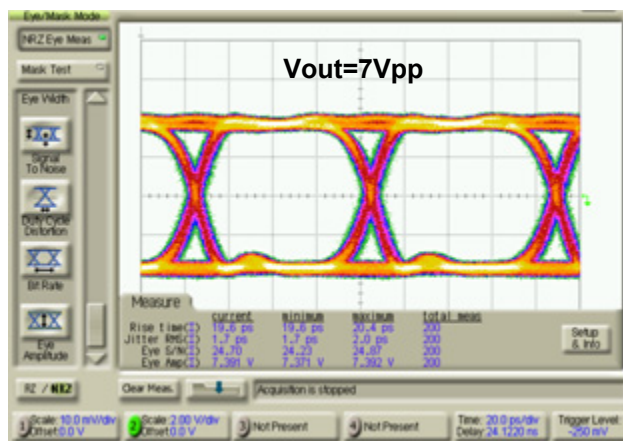
- Mach-Zehnder Modulator Driver for Metro and Long Haul

### Measured Performance

TGA4802 Fixtured Data  
Vd(Rfout)=6V, Id=170mA, (Pdc=1.2W)  
Vout=7Vpp, Vin = 2Vpp  
Scale: 2V/div, 20ps/div

12.5Gb/s

Vin=2V



Note: Datasheet is subject to change without notice.

**TABLE I**  
**MAXIMUM RATINGS 1/**

SYMBOL	PARAMETER	VALUE	NOTES
V <sub>d</sub>	POSITIVE SUPPLY VOLTAGE Drain Voltage at RF output	7 V	2/
I <sub>d</sub>	POSITIVE SUPPLY CURRENT Drain Current	200 mA	2/
P <sub>d</sub>	POWER DISSIPATION	1.4 W	2/, 3/
V <sub>g</sub> I <sub>g</sub>	NEGATIVE GATE Voltage Gate Current	0 V to -3 V 5 mA	
V <sub>ctrl</sub> I <sub>ctrl</sub>	CONTROL GATE Voltage Gate Current	V <sub>d</sub> /2 to -3 V 5 mA	4/
P <sub>IN</sub>	RF INPUT Sinusoidal Continuous Wave Power	23 dBm	
T <sub>CH</sub>	OPERATING CHANNEL TEMPERATURE	150 °C	5/, 6/
T <sub>M</sub>	MOUNTING TEMPERATURE (30 SECONDS)	320 °C	
T <sub>STG</sub>	STORAGE TEMPERATURE	-65 to 150 °C	

**Notes:**

- 1/ These ratings represent the maximum operable values for the device.  
2/ Assure the combination of V<sub>d</sub> and I<sub>d</sub> does not exceed maximum power dissipation rating.  
3/ Assure V<sub>ctrl</sub> never exceeds V<sub>d</sub> during bias on and off sequences, and normal operation.  
4/ When operated at this bias condition with a base plate temperature of 70°C, the median life is reduced.  
5/ Junction operating temperature will directly affect the device median time to failure (MTTF). For maximum life, it is recommended that junction temperatures be maintained at the lowest possible levels.  
6/ These ratings apply to each individual FET.

**TABLE II**  
**DC PROBE TEST**  
(T<sub>A</sub> = 25 °C, nominal)

NOTES	SYMBOL	LIMITS		UNITS
		MIN	MAX	
1/	V <sub>BVGS</sub>	11	30	V
1/	V <sub>BVGD</sub>	11	30	V

**Notes:**

- 1 V<sub>BVGS</sub> and V<sub>BVDS</sub> are negative.

**TABLE III**  
**RF SPECIFICATIONS**

(T<sub>A</sub> = 25°C Nominal)

Bias Conditions: V<sub>d</sub> = 7V I<sub>d</sub> = 170 mA

NOTE	TEST	MEASUREMENT CONDITIONS	VALUE			UNITS
			MIN	TYP	MAX	
	SMALL SIGNAL BW			18		GHz
<u>1/</u>	SMALL-SIGNAL GAIN MAGNITUDE	2 - 10 GHz 12 - 18 GHz	14 10			dB
<u>1/</u>	INPUT RETURN LOSS MAGNITUDE	2 - 14 GHz		10		dB
<u>1/</u>	OUTPUT RETURN LOSS MAGNITUDE	2 - 14 GHz		12		dB
<u>2/ 3/</u>	SATURATED OUTPUT POWER	2 - 12 GHz	22			dBm
<u>2/ 3/</u>	EYE AMPLITUDE	V <sub>d</sub> (RF <sub>out</sub> ) = 6V V <sub>d</sub> (RF <sub>out</sub> ) = 5V V <sub>d</sub> (RF <sub>out</sub> ) = 4V	7.0 6.0 5.0			V <sub>pp</sub>
<u>2/ 4/</u>	ADDITIVE JITTER			5		ps
<u>2/ 4/</u>	RISE TIME (20/80)			15		ps

**Notes:**

1/ RF Probe Bias: V<sup>+</sup> = 8 V, adjust V<sub>g1</sub> to achieve I<sub>d</sub> = 80 mA, V<sub>ctrl</sub> = +1.5 V

2/ Verified by design, TGA4802 assembled onto an evaluation platform as shown on page 9 then tested using the application circuit and bias procedure detailed on pages 7 and 8.

3/ V<sub>in</sub> = 2 V, Data Rate = 12.5 Gb/s, V<sub>ctrl</sub> and V<sub>g</sub> are adjusted for maximum output.

4/ Computed using RSS Method where J<sub>pp\_additive</sub> = SQRT(J<sub>pp\_out</sub><sup>2</sup> - J<sub>pp\_in</sub><sup>2</sup>)

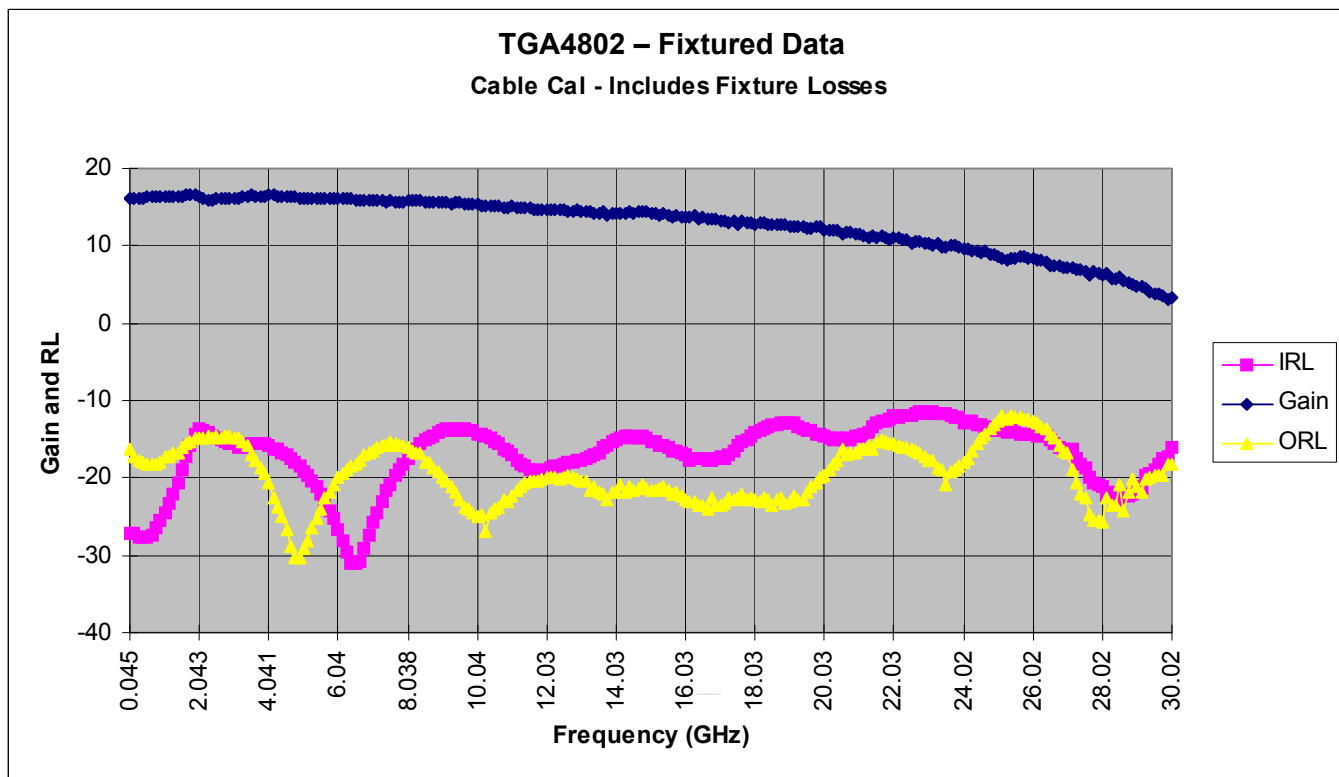
**TABLE IV**  
**THERMAL INFORMATION\***

PARAMETER	TEST CONDITIONS	T <sub>CH</sub> (°C)	R <sub>θJC</sub> (°C/W)	T <sub>M</sub> (HRS)
R <sub>θJC</sub> Thermal Resistance (channel to backside of carrier)	V <sub>d</sub> (RF out) = 7 V I <sub>D</sub> = 170 mA P <sub>diss</sub> = 1.2 W	110	32.7	4.2 E+7

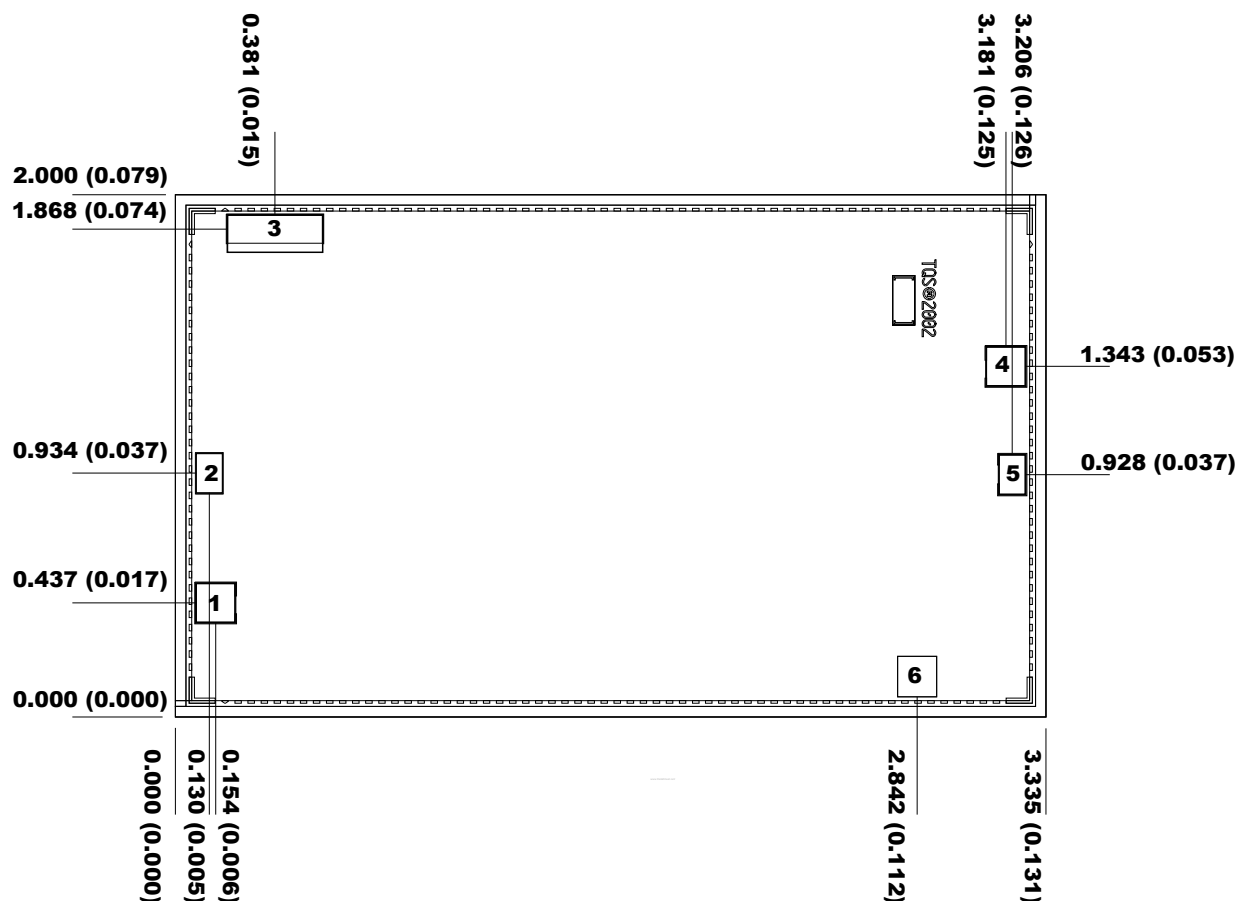
Note: Assumes eutectic attach using 1.5 mil 80/20 AuSn mounted to a 20 mil CuMo Carrier at 70°C baseplate temperature. Worst case condition with no RF applied, 100% of DC power is dissipated. Thermal transfer is conducted thru the bottom of the TGA4802 into the mounting carrier. Design the mounting interface to assure adequate thermal transfer to the base plate.

**Measured Fixtured Data**

**Bias Conditions:  $V_d = 7V$ ,  $I_d = 170mA$**



## Mechanical Drawing



**Units: millimeters (inches)**

**Thickness: 0.100 (0.004)**

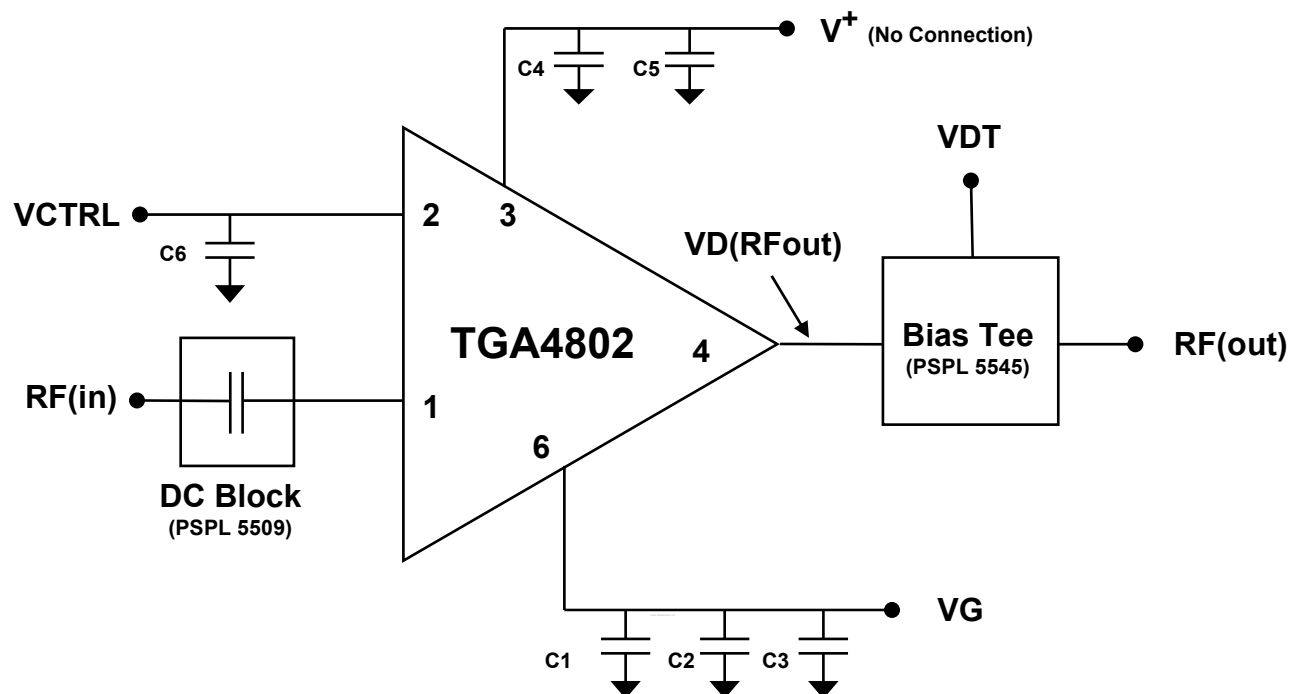
**Chip edge to bond pad dimensions are shown to center of bond pad**

**Chip size tolerance: +/- 0.051 (0.002)**

<b>Bond pad #1</b>	<b>(RF In)</b>	<b>0.150 x 0.150 (0.006 x 0.006)</b>
<b>Bond pad #2</b>	<b>(Vctrl)</b>	<b>0.100 x 0.150 (0.004 x 0.006)</b>
<b>Bond pad #3</b>	<b>(V+)</b>	<b>0.366 x 0.108 (0.014 x 0.004)</b>
<b>Bond pad #4</b>	<b>(RF Out)</b>	<b>0.155 x 0.155 (0.006 x 0.006)</b>
<b>Bond pad #5</b>	<b>(Vctrl aux)</b>	<b>0.100 x 0.150 (0.004 x 0.006)</b>
<b>Bond pad #6</b>	<b>(Vg)</b>	<b>0.150 x 0.150 (0.006 x 0.006)</b>

*GaAs MMIC devices are susceptible to damage from Electrostatic Discharge. Proper precautions should be observed during handling, assembly and test.*

## TGA4802 Application Circuit



### Notes:

Recommended Components are detailed on page 9.

## Bias Procedure for 7V Output

### Bias ON

1. Disable the RF source (PPG)
2. Set  $V_{dT}=0V$   $V_{ctrl}=0V$  and  $V_g=0V$
3. Set  $V_g=-1.5V$
4. Increase  $V_{dT}$  to 7V observing  $I_d$ .
  - Assure  $I_d=0mA$
5. Set  $V_{ctrl}=+1.0V$ 
  - $I_d$  should still be 0mA
6. Make  $V_g$  more positive until  $I_{dd}=170mA$ .
  - Typical value for  $V_g$  is  $-0.2V$
7. Measure  $V^+$ , adjust  $V_{dT}$  such that  $V^+$  is 6V.
  - This will set  $V_d(RF_{out})$  to approximately 6V.
  - $I_{dd}$  will increase slightly
8. Adjust  $V_g$  such that  $I_{dd}=170mA$ .
9. Enable the RF source (PPG)
  - Set  $V_{in}=2V$
10. Output Swing Adjust: Adjust  $V_{ctrl}$  slightly positive to increase output swing or adjust  $V_{ctrl}$  slightly negative to decrease the output swing.
  - Typical value for  $V_{ctrl}$  is  $+1.0V$  for  $V_o=7V$ .
11. Crossover Adjust: Adjust  $V_g$  slightly positive to push the crossover down or adjust  $V_g$  slightly negative to push the crossover up.
  - Typical value for  $V_g$  is  $-0.2V$  to center crossover with  $V_o=7V$ .

### Bias OFF

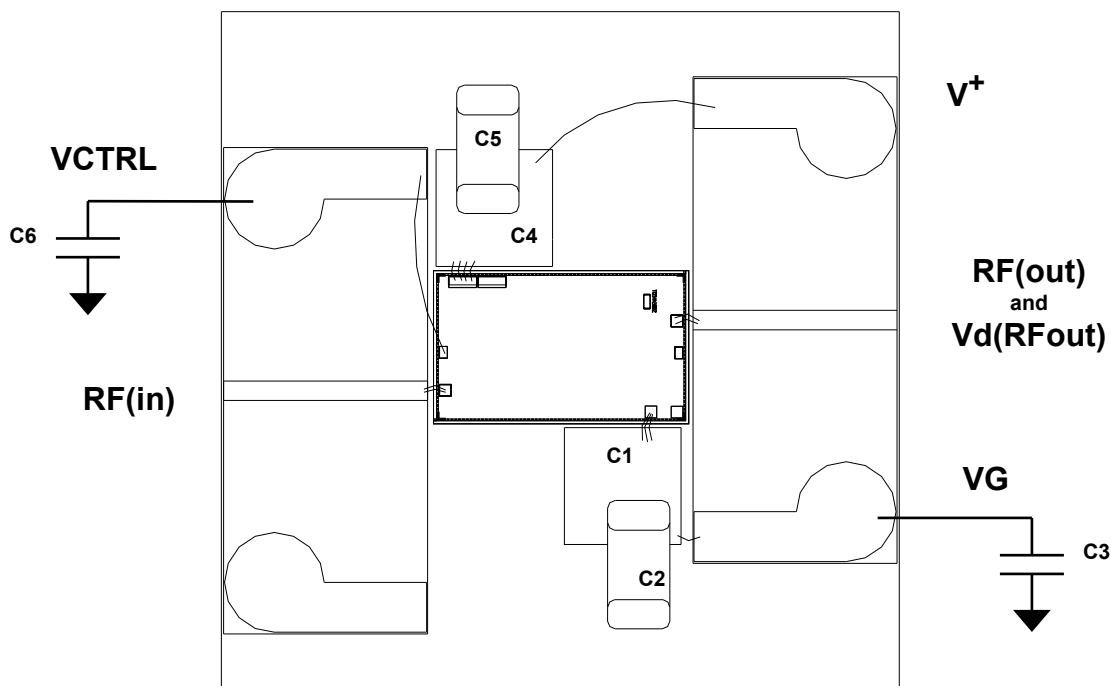
1. Disable the output of the PPG
2. Set  $V_{ctrl}=0V$
3. Set  $V_{dT}=0V$
4. Set  $V_g=0V$

### Notes:

1. Assure  $V_{ctrl}$  never exceeds  $V_d$  during Bias ON and Bias OFF sequences and during normal operation.



## Evaluation Platform Assembly Diagram



### Recommended Components:

DESIGNATOR	DESCRIPTION	MANUFACTURER	PART NUMBER
C1, C4	1500pF Capacitor SLC	Presidio	SL5050X7R1522H5
C2, C5	0.1uF Capacitor MLC Ceramic	AVX	0603YC104KAT
C3	10uF Capacitor MLC Ceramic	AVX	0603YC102KAT
C6	0.01 uF Capacitor MLC	AVX	0603YC103KAT

**GaAs MMIC devices are susceptible to damage from Electrostatic Discharge. Proper precautions should be observed during handling, assembly and test.**

## **Evaluation Platform Assembly Notes**

### Assembly Notes:

#### Reflow Attachment:

Use AuSn (80/20) solder with limited exposure to temperatures at or above 300°C  
Use alloy station or conveyor furnace with reducing atmosphere  
No fluxes should be utilized  
Coefficient of thermal expansion matching is critical for long-term reliability  
Storage in dry nitrogen atmosphere

#### Adhesive Attachment:

Organic attachment can be used in low-power applications  
Curing should be done in a convection oven; proper exhaust is a safety concern  
Microwave or radiant curing should not be used because of differential heating  
Coefficient of thermal expansion matching is critical

#### Component Pickup and Placement:

Vacuum pencil and/or vacuum collet preferred method of pick up  
Avoidance of air bridges during placement  
Force impact critical during auto placement

#### Interconnect:

Thermosonic ball bonding is the preferred interconnect technique  
Force, time, and ultrasonics are critical parameters  
Aluminum wire should not be used  
Discrete FET devices with small pad sizes should be bonded with 0.0007-inch wire  
Maximum stage temperature: 200°C