

## GaAs MMIC SUB-HARMONICALLY PUMPED DOWNCONVERTER 20 - 32 GHz

FEBRUARY 2000

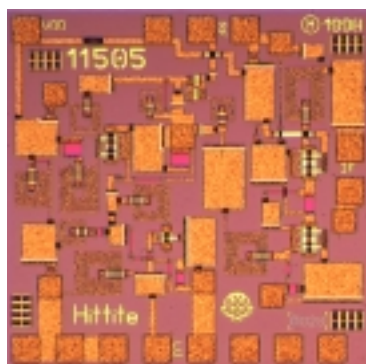
### Features

INTEGRATED LO AMPLIFIER: -4dBm INPUT

SUB-HARMONICALLY PUMPED (x2) LO

INTEGRATED IF AMPLIFIER: > 3 dB GAIN

SMALL SIZE: 1.32mm x 1.32mm



### General Description

The HMC265 chip is a sub-harmonically pumped (x2) MMIC downconverter with integrated LO & IF amplifiers. The chip utilizes a GaAs PHEMT technology that results in a small overall chip area of 1.74mm<sup>2</sup>. The 2LO to RF isolation is excellent eliminating the need for additional filtering. The LO amplifier is a single bias (+3V to +4V) two stage design with only -4dBm nominal drive requirement. This mixer chip is designed to be used in Local Multi-Point Distribution (LMDS) systems, microwave point-to-point radios, and SATCOM applications. All data is with the chip in a 50 ohm test fixture connected via 0.025 mm (1 mil) diameter wire bonds of minimal length <0.31 mm (<12 mils). This downconverter IC is an excellent, smaller, and more reliable replacement to hybrid diode based downconverter MIC assemblies.

### Guaranteed Performance, LO Drive= -4 dBm, - 55 to + 85 deg C

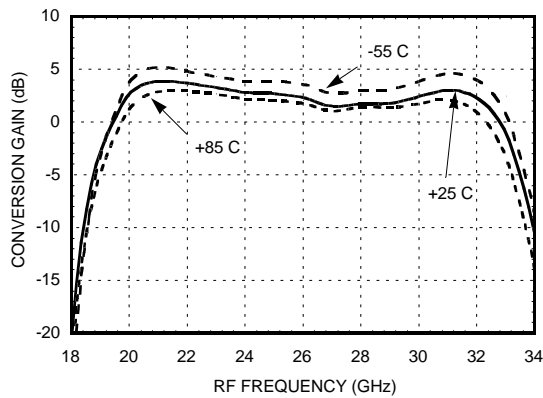
Parameter	IF = 1 GHz Vdd = +4V			IF = 1 GHz Vdd = +4V			Units
	Min.	Typ.	Max.	Min.	Typ.	Max.	
Frequency Range, RF		20 - 32			27 - 30		GHz
Frequency Range LO		10 - 16			13.5 - 15		GHz
Frequency Range, IF		0.7 - 3.0			0.7 - 3.0		GHz
Conversion Gain (RF to IF)	-2	3	7	-2	2	5	dB
Noise Figure (SSB)		13			13		dB
2LO to RF Isolation	17	20 ~ 40		28	35		dB
2LO to IF Isolation	40	50 ~ 60		45	55		dB
IP3 (Input)	2	10		9	13		dBm
1 dB Compression (Input)	-5	2		-2	2		dBm
Local Oscillator Drive Level	-8	-4	+8	-8	-4	+8	dBm
Supply Voltage (Vdd)	3.75	4.0	4.25	3.75	4.0	4.25	Vdc
Supply Current (Idd) ( Vdd = +4.0 Vdc)		50	65		50	65	mA



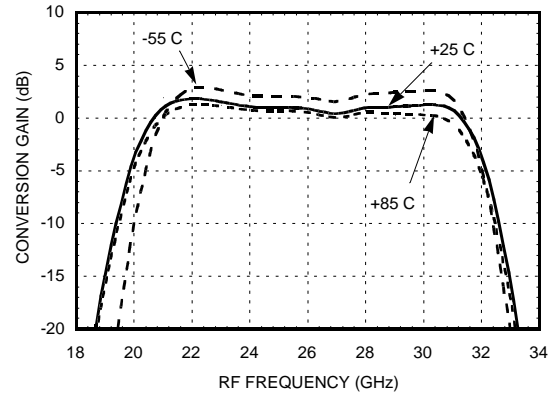
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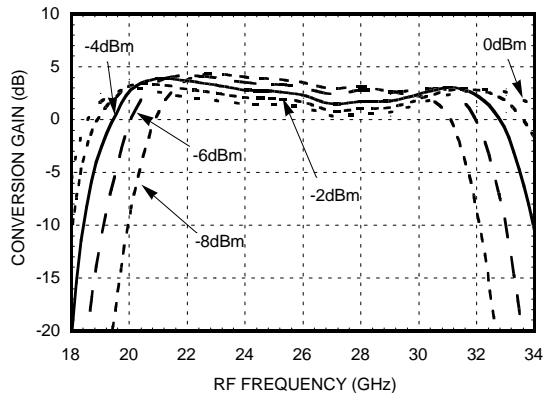
**Conversion Gain vs. Temperature**  
**@ LO = -4 dBm Vdd = +4V**



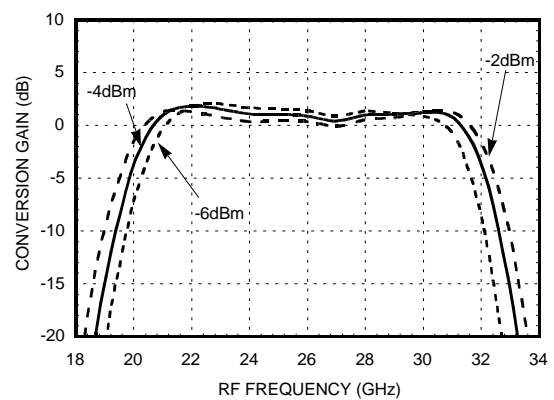
**Conversion Gain vs. Temperature**  
**@ LO = -4 dBm Vdd = +3V**



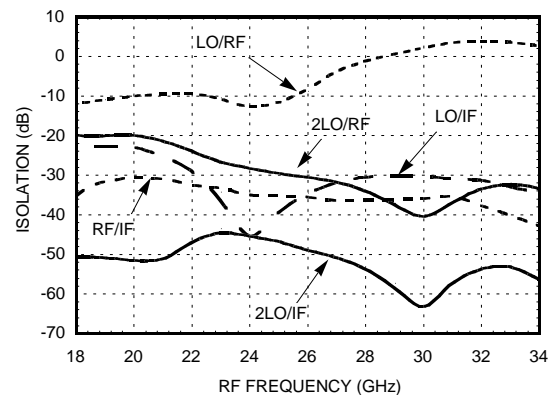
**Conversion Gain vs. LO Drive**  
**@ Vdd = +4V**



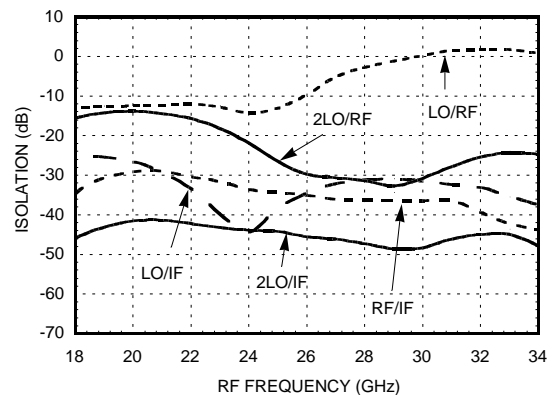
**Conversion Gain vs. LO Drive**  
**@ Vdd = +3V**



**Isolation @ LO = -4 dBm, Vdd = +4V**



**Isolation @ LO = -4 dBm, Vdd = +3V**



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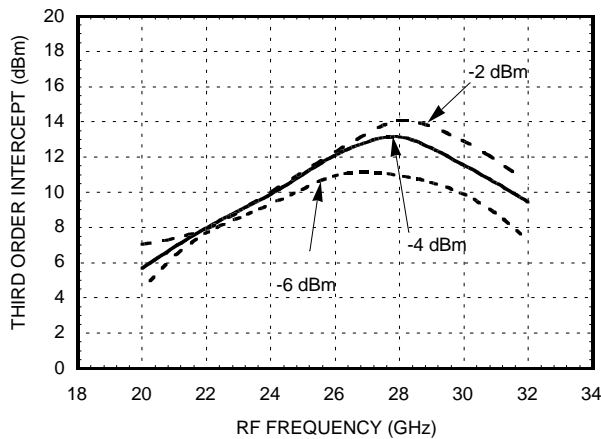
DIE



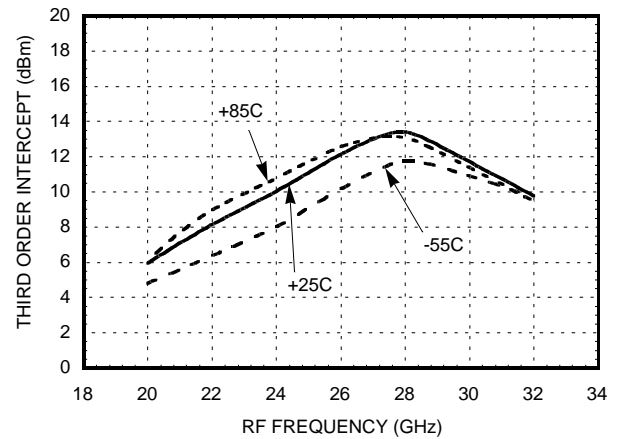
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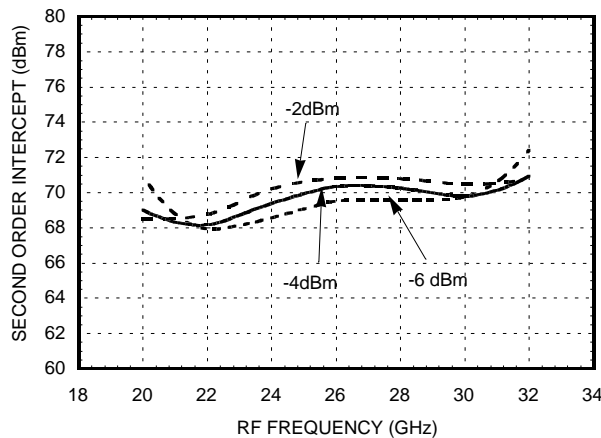
**IP3 vs LO Drive @  $V_{dd} = +4V$**



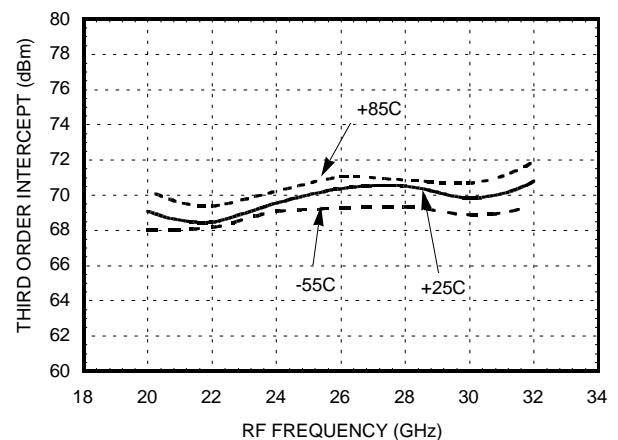
**IP3 vs Temperature  
@  $LO = -4$  dBm,  $V_{dd} = +4V$**



**IP2 vs LO Drive @  $V_{dd} = +4V$**



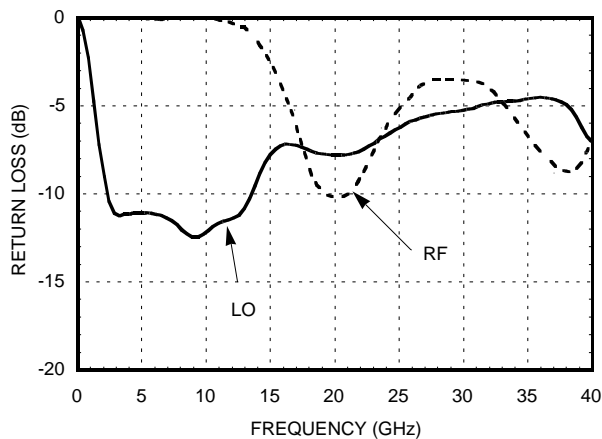
**IP2 vs Temperature  
@  $LO = -4$  dBm,  $V_{dd} = +4V$**



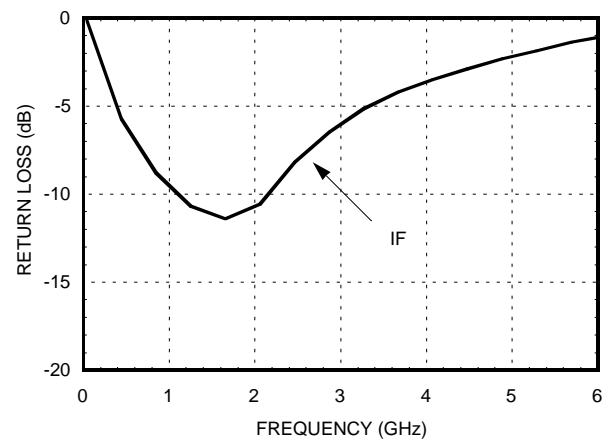
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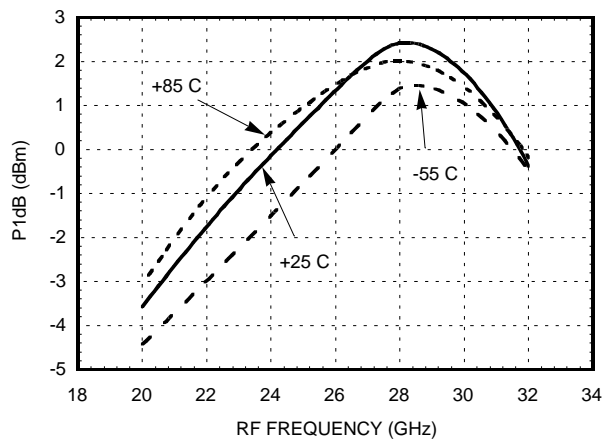
**LO & RF Return Loss**  
@ LO = -4 dBm, Vdd = +4V



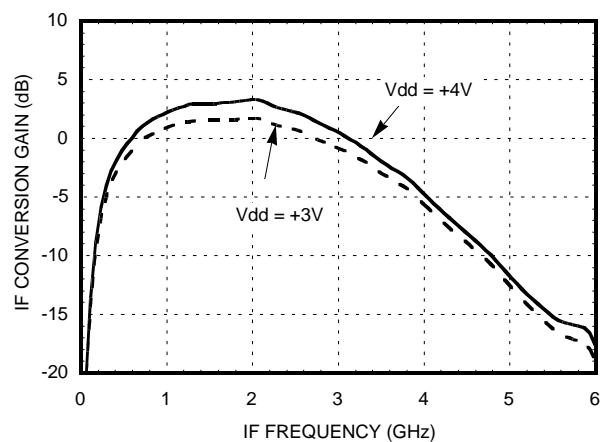
**IF Return Loss**  
@ LO = -4 dBm, Vdd = +4V



**P1dB vs. Temperature**  
@ LO = -4 dBm, Vdd = +4V



**IF Bandwidth @ LO = -4dBm**



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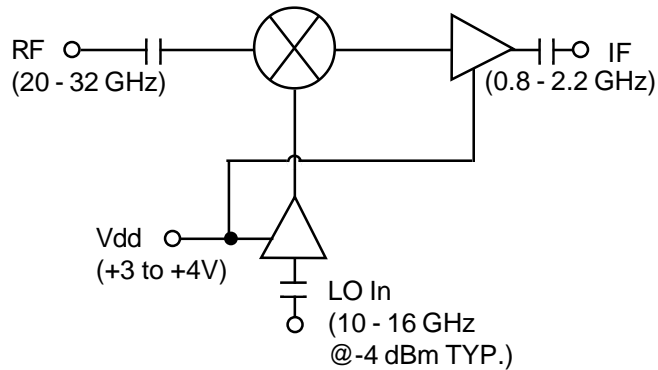
DIE



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### Schematic

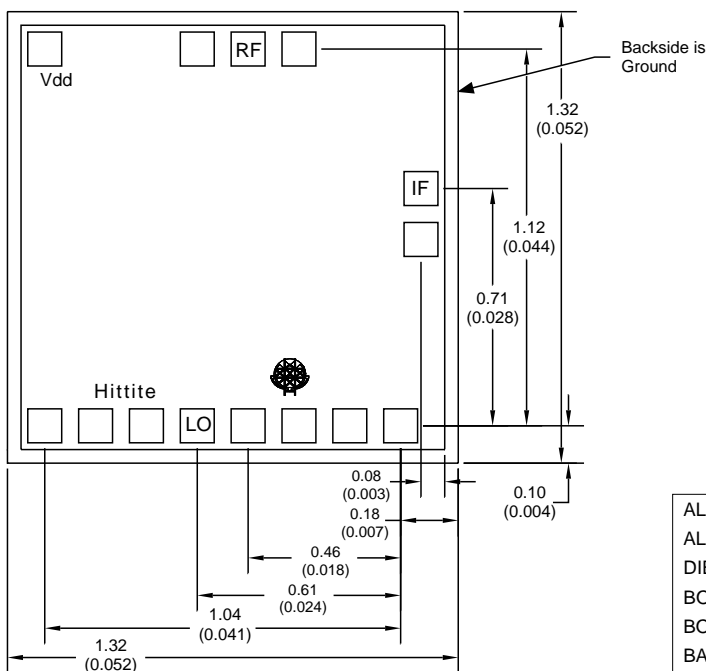


### Absolute Maximum Ratings

RF / IF Input (Vdd = +4V)	+13 dBm
LO Drive (Vdd = +4V)	+13 dBm
Vdd	+5.5 Vdc
Storage Temperature	-65 to +150 deg C
Operating Temperature	-55 to +85 deg C

NOTE: A 100pF single layer chip bypass capacitor is recommended on the Vdd port no further than 0.762 mm (30mils) from the HMC265

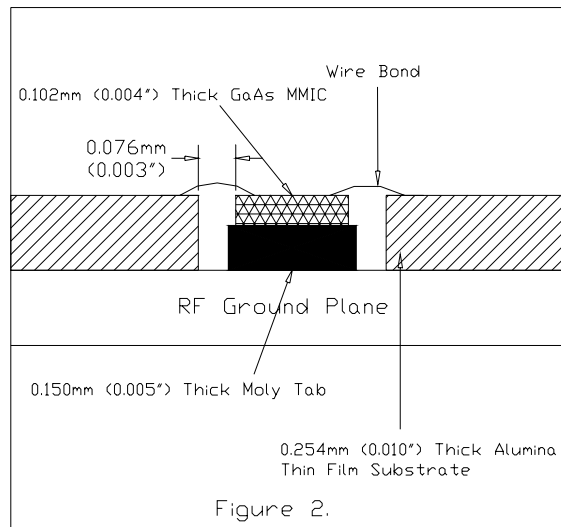
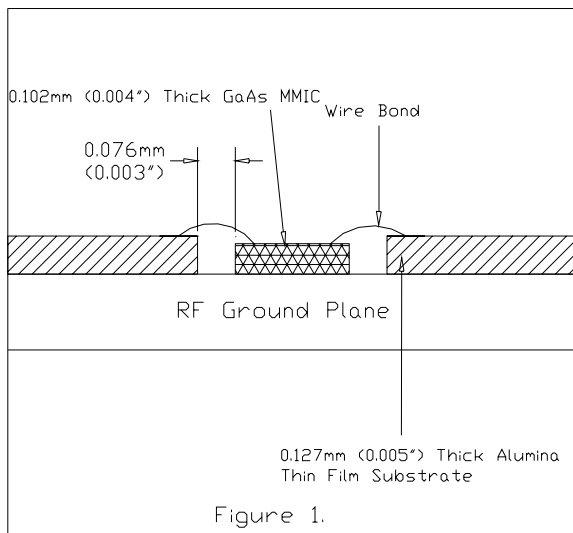
### Outline Drawing ( See Die Handling, Mounting, Bonding Note Page 4-58)



ALL DIMENSION IN MILLIMETERS (INCHES)  
ALL TOLERANCES ARE  $\pm 0.025$  (0.001)  
DIE THICKNESS IS 0.100 (0.004) BACKSIDE IS GROUND  
BOND PADS ARE 0.100 (0.004) SQUARE  
BOND PAD SPACING, CTR-CTR: 0.150 (0.006)  
BACKSIDE METALLIZATION: GOLD  
BOND PAD METALLIZATION: GOLD



### MIC Assembly Techniques for HMC265



### 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 (3 mils).

An RF bypass capacitor should be used on the Vdd input. A 100 pF single layer capacitor (mounted eutectically or by conductive epoxy) placed no further than 0.762mm (30 Mils) from the chip is recommended. The photo in figure 3 shows a typical assembly for the HMC265 MMIC chip.

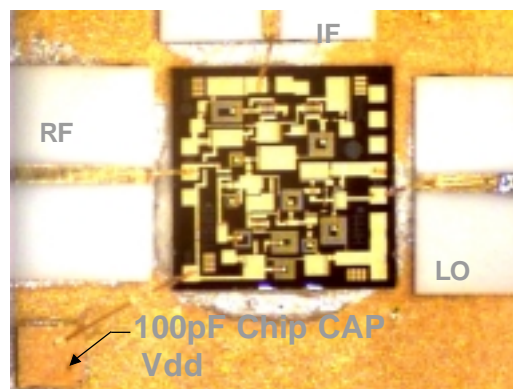


Figure 3: Typical HMC265 Assembly



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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  $\pm 250\text{V}$  ESD strikes ( see page 8 - 2 ).

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  $<0.31\text{ mm}$  (12 mils).



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### NOTES:

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