0.25 W Ka-Band Amplifier 27 - 31.5 GHz

Features

- 24 dB Gain
- 33 dBm Output IP3
- 24 dBm P1dB
- 25 dBm P3dB
- 5.5 V Drain Supply
- Bare Die
- RoHS* Compliant

Applications

- Ka-band Satellite Communication

Description

The MAAP-011340-DIE is a 1/4 W Ka-band amplifier. The amplifier has a 24 dBm typical P1dB and a 25 dBm typical P3dB with 24 dB of gain. The typical OIP3 is 33 dBm. The drain bias supply is 5.5 V. The gate voltage is adjusted to set the drain current to 275 mA.

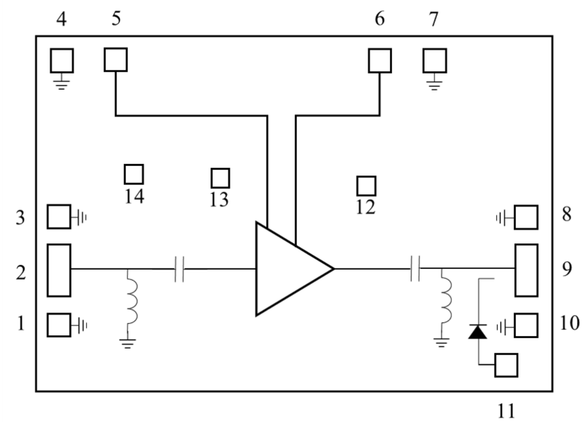
Die size with power detector is 1.430 mm x 0.985 mm x 0.050 mm.

Ordering Information

Part Number	Package
MAAP-011340-DIE	Gel Pack[1]
MAAP-011340-DIESMB	Sample Board

1. Die quantity varies.

Block Diagram



Pad Configuration[2,3,4]

Pad #	Pad Name	Description
1, 3, 4, 7, 8, 10	GND	Ground
2	RF_{IN}	RF Input
5	V_{GG}	Gate Voltage
6	V_{DD}	Drain Voltage
9	RF_{OUT}	RF Output
11	V_{DET}	Detector Output Voltage
12 - 14	NC	No Connection

2. Pads 1, 3, 8, and 10 are connected to ground on the die through backside vias. Bonds from these ground pads to ground on the application PCB are recommended to form a coplanar transition for improved return losses.
3. Pads 4, 7, 12, 13, and 14 are bond pads for DC screening only in production test environment.
4. The backside of the die must be connected to RF, DC, and thermal ground.

* Restrictions on Hazardous Substances, compliant to current RoHS EU directive.

Electrical Specifications:
V_{DD} = +5.5 V, I_{DQ} = 275 mA, T_A = 25°C, Z_0 = 50 Ω (All data is GSG probed)

Parameter	Test Conditions	Units	Min.	Typ.	Max.
Gain	27 - 31.5 GHz	dB	22	24	—
Gain Flatness	27 - 31.5 GHz	dB	—	± 0.7	—
Input Return Loss	27 - 31.5 GHz	dB	—	12	—
Output Return Loss	27 - 31.5 GHz	dB	—	20	—
P1dB	27 - 31.5 GHz	dBm	—	24	—
P_{OUT}	27 GHz, P_{IN} = 4.2 dBm 31.5 GHz, P_{IN} = 3.1 dBm	dBm	25 23.5	26 25	—
OIP3	27 - 31.5 GHz, P_{OUT} = 16 dBm per tone with 10 MHz spacing	dBm	—	33	—
Noise Figure	27 - 31.5 GHz	dB	—	5.9	—
V_{DET}	0 dBm Output Power 24 dBm Output Power	V	— 1.4	0.6 1.7	— 2.1
V_{GG}	Small signal	V	—	-0.68	—
I_{GG}	Small signal P3dB	mA	—	-0.7 -0.8	—
I_{DD}	P1dB P3dB	mA	—	300 320	—

Maximum Operating Conditions

Parameter	Maximum
RF Input Power	5 dBm
V_{DD}	+6 V
V_{GG}	-3 to 0 V
Junction Temperature[5,6]	+160°C
Operating Temperature	-40°C to +85°C

5. Operating at nominal conditions with $T_J \leq$ +160°C will ensure MTTF > 1 x 10^6 hours.
6. Junction Temp. (T_J) = T_C + Θjc * ((V * I) - (P_{OUT} - P_{IN})).
   Typical thermal resistance (Θjc) = 42°C/W.
   a) For T_C = +85°C,
      T_J = 148.5°C @ 5.5 V, 275 mA

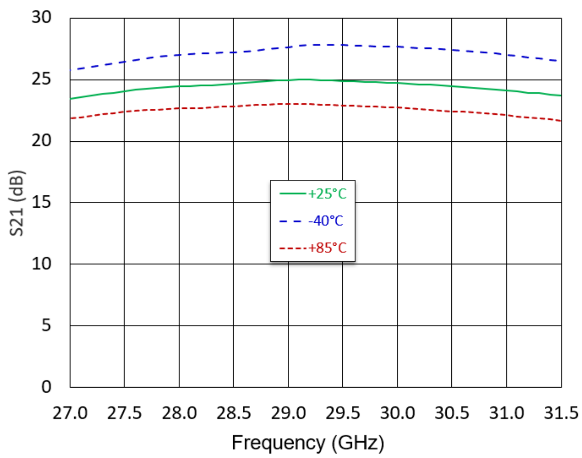
Absolute Maximum Ratings[7,8]

Parameter	Absolute Maximum
RF Input Power	8 dBm
V_{DD}	+6.5 V
V_{GG}	-5 to 0 V
Junction Temperature[9]	+175°C
Storage Temperature	-65°C to +125°C

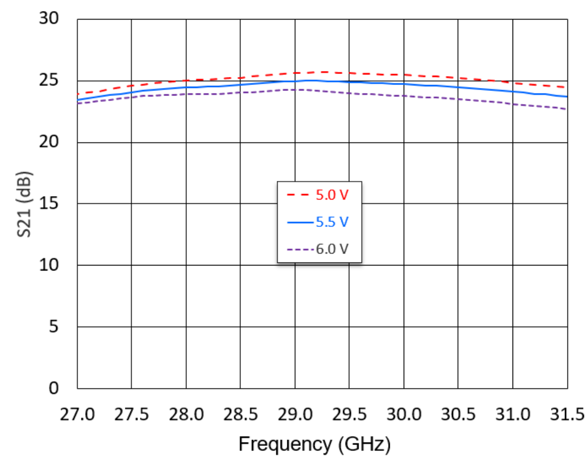
7. Exceeding any one or combination of these limits may cause permanent damage to this device.
8. MACOM does not recommend sustained operation near these survivability limits.
9. Junction temperature directly effects device MTTF. Junction temperature should be kept as low as possible to maximize lifetime.

Typical Performance Curves:

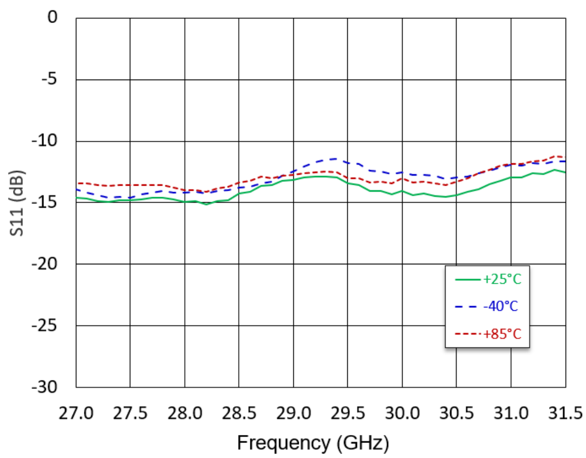
Small Signal Gain vs. Frequency over Temperature



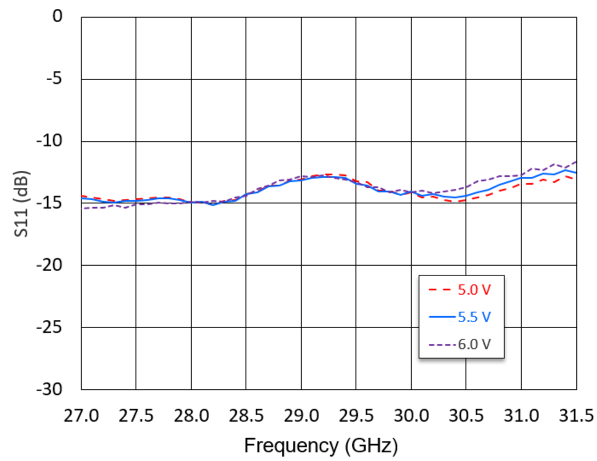
Small Signal Gain vs. Frequency over Bias Voltage



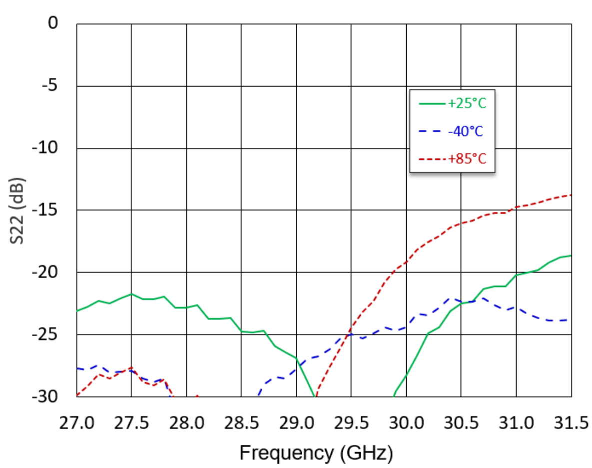
Input Return Loss vs. Frequency over Temperature



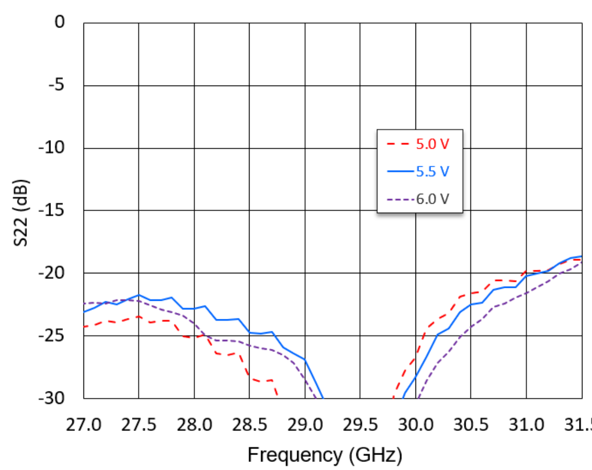
Input Return Loss vs. Frequency over Bias Voltage



Output Return Loss vs. Frequency over Temperature

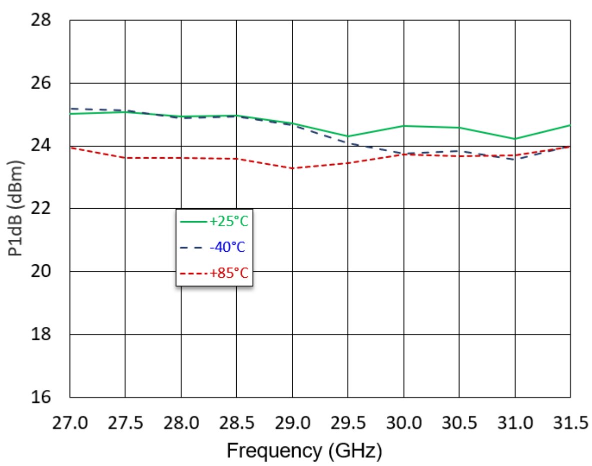


Output Return Loss vs. Frequency over Bias Voltage

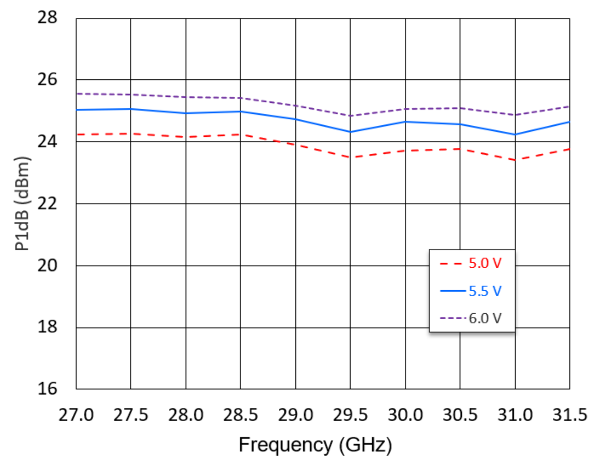


Typical Performance Curves:

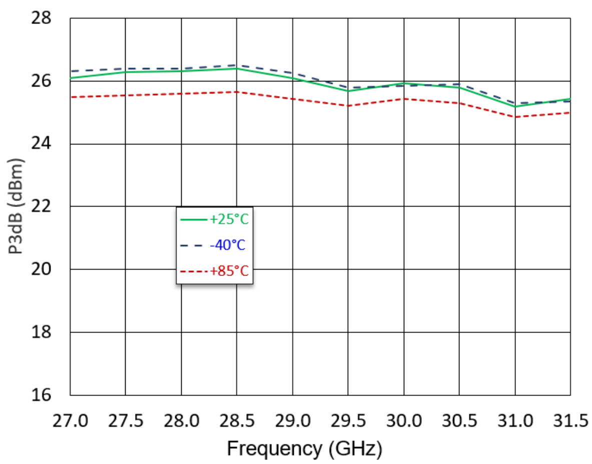
P1dB vs. Frequency over Temperature



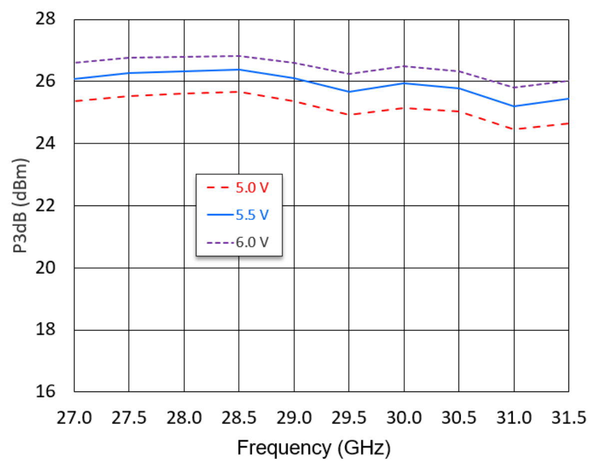
P1dB vs. Frequency over Bias Voltage



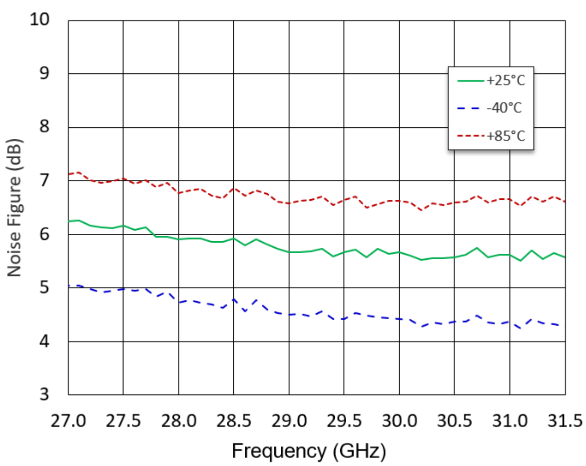
P3dB vs. Frequency over Temperature



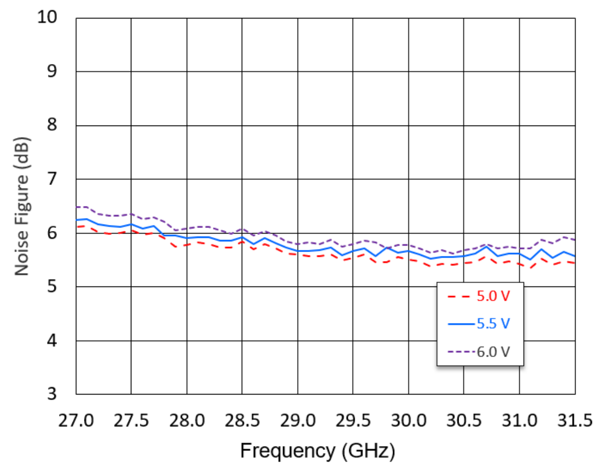
P3dB vs. Frequency over Bias Voltage



Noise Figure vs. Frequency over Temperature

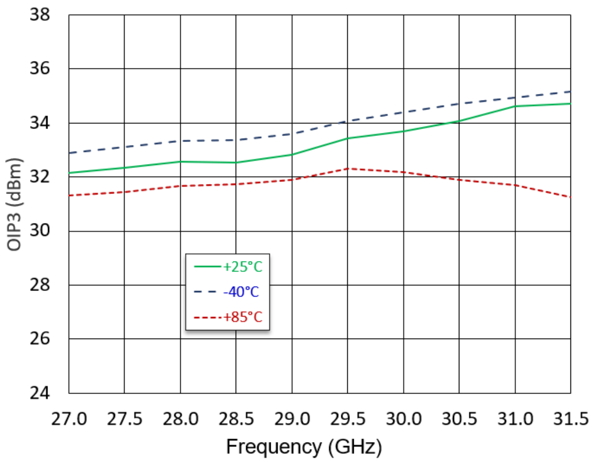


Noise Figure vs. Frequency over Bias Voltage

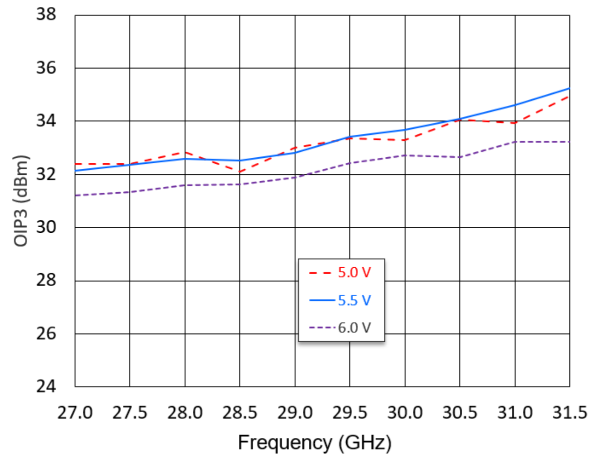


Typical Performance Curves:

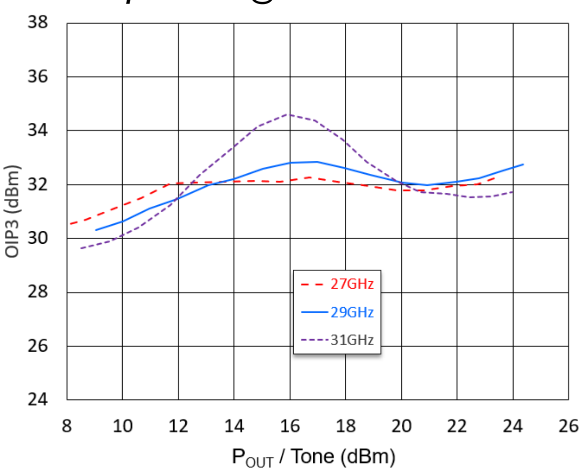
OIP3 over Temperature (P_{OUT} = 16 dBm / Tone)



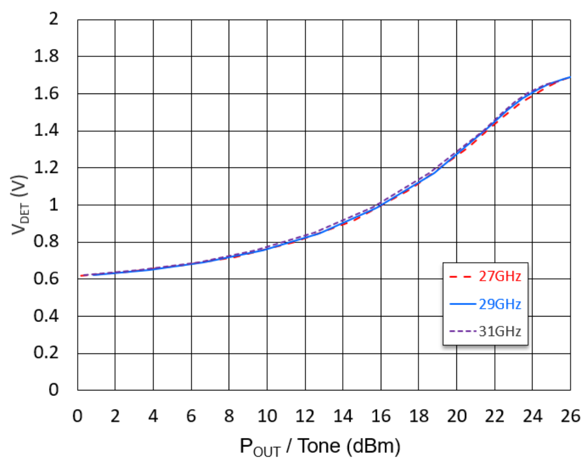
OIP3 over Bias Voltage (P_{OUT} = 16 dBm / Tone)



OIP3 vs. Output Power @ 25°C



Detector Voltage vs. Output Power @ 25°C



Bias Sequence

All gate voltages must be applied prior to applying drain voltages.

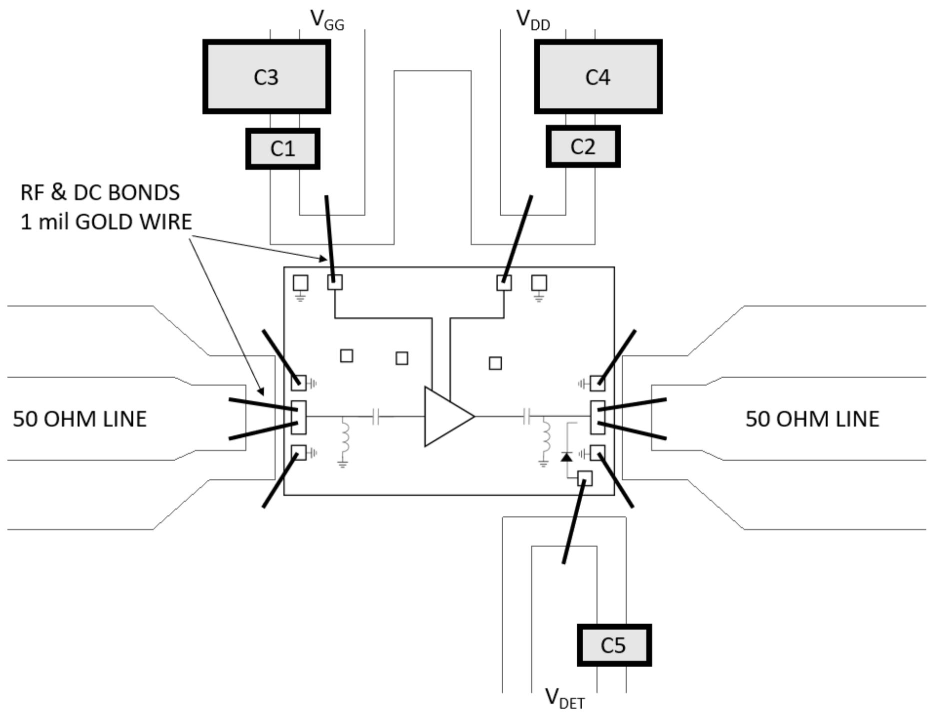
1. Apply V_{GG} (-2.0 V) to pad 5.
2. Apply V_{DD} (+5.5 V) to pad 6.
3. Adjust V_{GG} (approximately -0.7 V) to set I_{DQ} to 275 mA.

Shut down by removing V_{DD} first.

Static Sensitivity

These electronic devices are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. Proper ESD control techniques should be used when handling these HBM Class 1C devices.

Recommended Bonding Diagram



Die Attachment

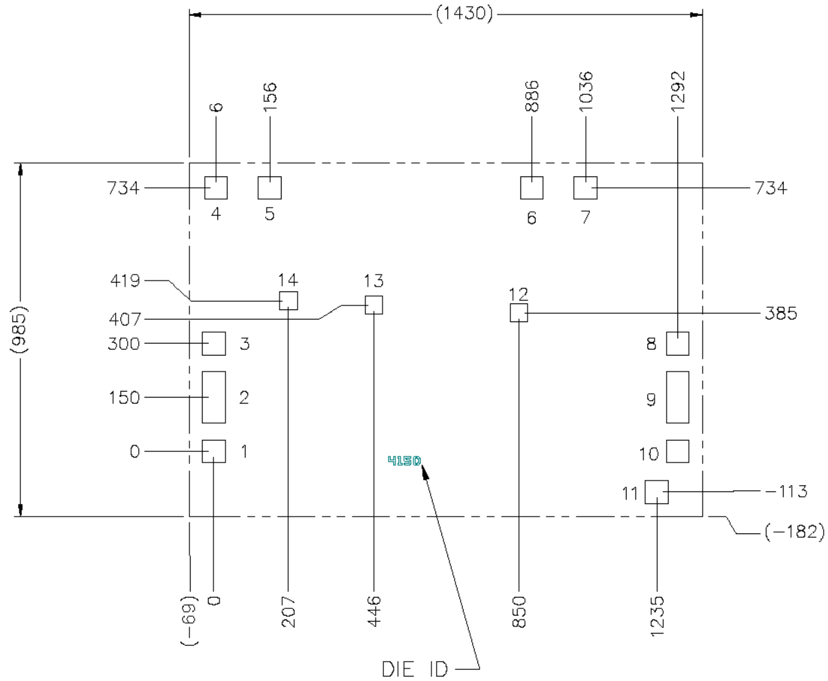
This product is manufactured from 0.050 mm (0.002”) thick GaAs substrate and has vias through to the backside to enable grounding to the circuit.

Recommended conductive epoxy is Namics Unimec XH9890-6. Epoxy should be applied and cured in accordance with the manufacturer’s specifications and should avoid contact with the top of the die.

Parts List

Part #	Value	Case Style
C1, C2	1 nF	0402
C3, C4	10 µF	1210
C5	1 µF	0402

Die Outline[10,11] (1.430 x 0.985 x 0.050 mm)



BOND PAD DIM. (µm)			
PAD #	**Size (x)**	**Size (y)**	**Description**
1, 3, 4, 7, 8, 10	64	64	GND
2	64	144	RF_{IN}
5	64	64	V_{GG}
6	64	64	V_{DD}
9	64	144	RF_{OUT}
11	64	64	V_{DET}
12 - 14	50	50	No Connection

10. Dimensions are in microns unless otherwise noted.
11. GND bond pads 1, 3, 4, 7, 8 and 10 are connected to the backside of the die through via holes. Bond pads 4 and 7 do not require bond wires.