Ka Band, Low Noise Amplifier
27.0 - 31.5 GHz

MAAL-011240-DIE
Rev. V1

Features

- 27 - 31.5 GHz
- Low Noise Figure: 1.2 dB
- Gain: 25 dB
- P1dB: +18 dBm
- Bias Voltage: V_{DD} = +3.5 V
- Bias Current: I_{DSQ} = 90 mA
- 50 Ω Matched Input and Output
- 1.38 mm x 0.78 mm x 0.1 mm DIE
- RoHS* Compliant

Applications

- Satellite communications
- Radar
- EW

Description

The MAAL-011240-DIE is an easy to use low noise amplifier. It operates from 27 GHz to 31.5 GHz and provides 1.2 dB noise figure, 25 dB gain and a P1dB of +18 dBm. The input and output are fully matched to 50 Ω with typical return loss >12 dB.

This product is fabricated using a GaAs pHEMT process which features full passivation for enhanced reliability.

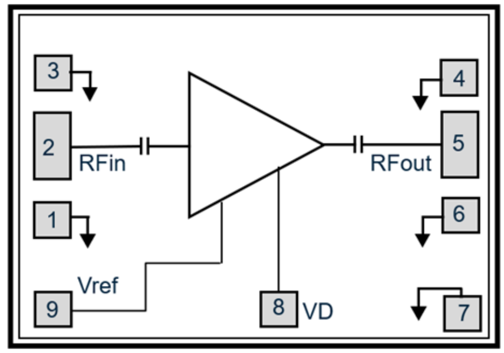
The MAAL-011240-DIE can be used as a low noise amplifier stage or as a driver stage in higher power applications. This device is ideally suited for Ka-band satellite communication systems.

The MAAL-011240-DIE is also available in package form in standard QFN package under MAAL-011240 part number.

Ordering Information

Part Number	Package
MAAL-011240-DIE	Bulk

Functional Schematic



Pin Configuration[1]

Pad #	Function	Description
1,3,4,6,7	GND	Ground
2	RF_IN	RF Input
5	RF_OUT	RF Output
8	VD	Drain Voltage
9	Vref	Bias Voltage

1. 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: Freq. = 27.0 - 31.5 GHz, T_A = 25°C, V_D = +3.5 V, Z_0 = 50 Ω

Parameter	Test Conditions	Units	Min.	Typ.	Max.
Small Signal Gain	P_{IN} = -20 dBm 27 GHz 31.5 GHz	dB	21.5 21.5	24.5 25	—
Small Signal Gain Variation over Temperature	—	dB/°C	—	0.02	—
Gain Flatness	—	dB	—	0.5	—
Noise Figure	—	dB	—	1.2	—
Input Return Loss	—	dB	—	12	—
Output Return Loss	—	dB	—	15	—
P1dB	27 GHz 31.5 GHz	dBm	15 16.5	17.5 19.5	—
Output 3rd Order Intercept	P_{IN} = -30 dBm/tone, 10 MHz spacing	dBm	—	28	—
Supply Current	—	mA	—	90	—

Absolute Maximum Ratings[2,3]

Parameter	Absolute Maximum
Input Power	20 dBm
V_D	5 V
Junction Temperature[4,5]	+160°C
Operating Temperature	-40°C to +85°C
Storage Temperature	-65°C to +125°C

2. Exceeding any one or combination of these limits may cause permanent damage to this device.
3. MACOM does not recommend sustained operation near these survivability limits.
4. Operating at nominal conditions with $T_J \leq$ +150°C will ensure MTTF > 1 x 10^6 hours.
5. Junction Temperature (T_J) = T_C + Θjc * (V * I)
   Typical thermal resistance (Θjc) = 65.4 °C/W.
   a) For T_C = +25°C,
      T_J = 50.2 °C @ 3.5 V, 110 mA
   b) For T_C = +85°C,
      T_J = 110.2 °C @ 3.5 V, 110 mA

Maximum Operating Conditions

Parameter	Maximum
TX Input Power	0 dBm
V_{DD}	3.5 V
Junction Temperature[4,5]	+150°C
Operating Temperature	-40°C to +85°C

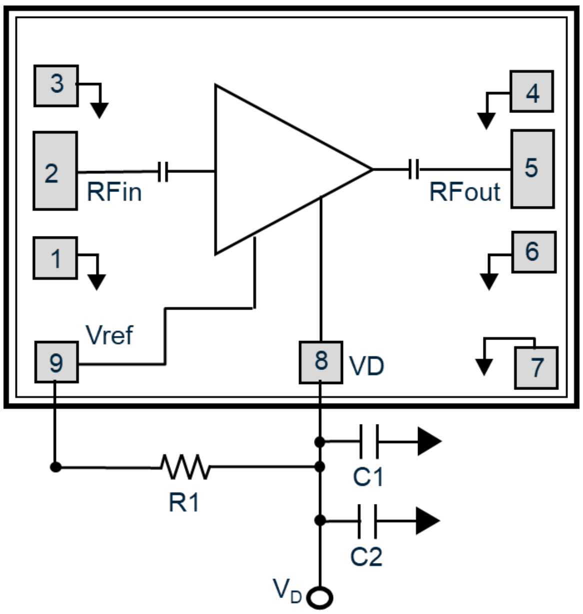
Handling Procedures

Please observe the following precautions to avoid damage:

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 Class 1A (250 V) devices.

Application Schematic



Parts List

Part	Value	Case Style
C1	100 pF	Chip capacitor MKVC-050100-1453
C2	0.1 µF	0402
R1	900 Ohm	0402

Operating the MAAL-011240-DIE
Turn-on
1. Apply V_D (+3.5 V)
2. Set I_{DQ} (90 mA) by adjusting R1
3. Apply RF_{IN} signal

Turn-off
1. Remove RF_{IN} signal.
2. Decrease V_D to 0V

Application Circuit and Operation
The basic application circuit is shown below. Place C1 capacitor as close to the package as physically possible. The position of the C2 capacitor is not as critical but should also be placed as closely as practically possible.

Die Attach

For mounting the die either an electrically conductive epoxy, or an AuSn eutectic preform can be used.

If using eutectic, an 80% Au / 20% Sn preform is recommended.

Wire Bonding

The loop height of the RF bonds should be minimized. Where the die is mounted above the PCB, it is recommended to use Reverse Ball-Stitch-on-Ball bonds (BSOB). If the die is mounted inside a cavity on the board, forward loop bonding may result in a lower loop height. V-shape RF bond with two wires (diameter = 25 µm) is recommended for optimum RF performance. RF bond wire length to be minimized to reduce the inductance effect.

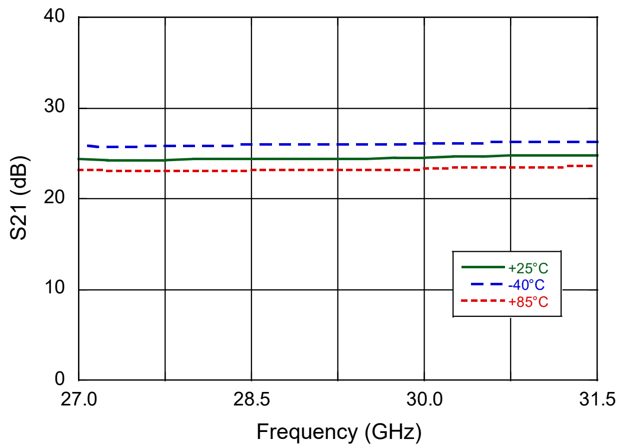
Alternatively, a 3 mil bond ribbon could be used.

Handling the Die

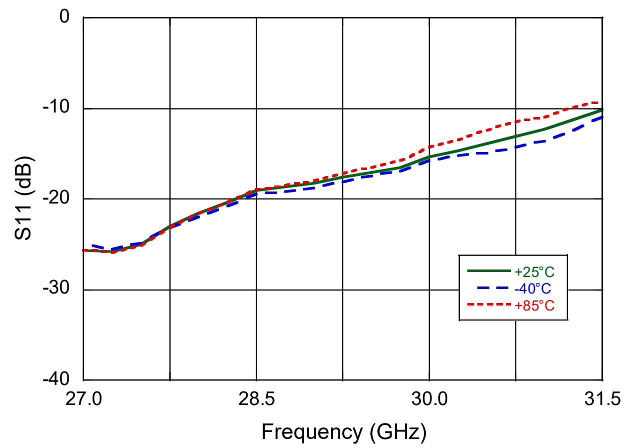
This MMIC has fragile exposed airbridges on its surface and must be handled on the edges only using a vacuum collet or suitable tweezers. Do not touch the surface of the chip with a vacuum collet, tweezers, or fingers.

Typical Performance Curves @ V_D = 3.5 V, I_D = 90 mA, Z_0 = 50 Ω

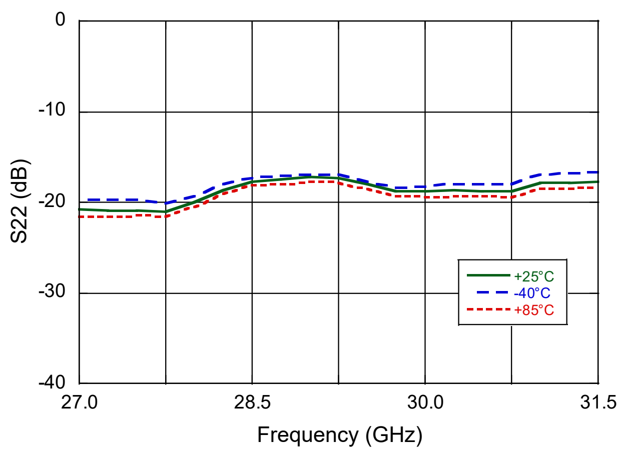
Gain



Input Return Loss

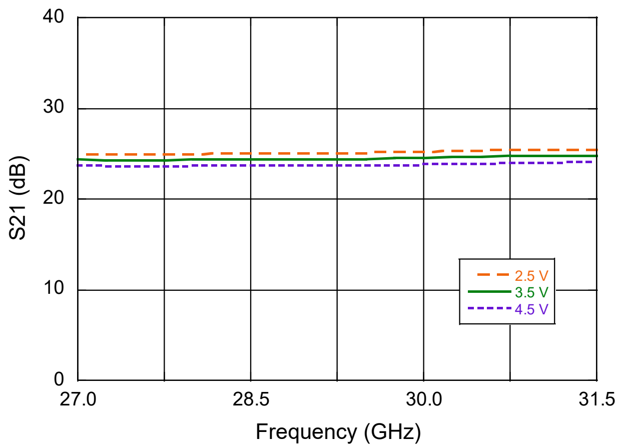


Output Return Loss

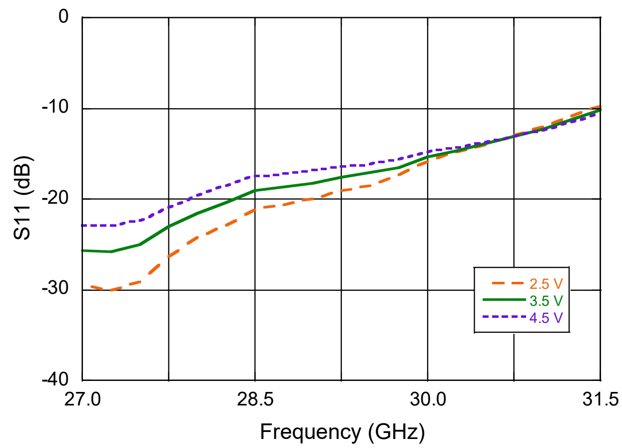


Typical Performance Curves @ I_D = 90 mA, Z_0 = 50 Ω

Gain



Input Return Loss



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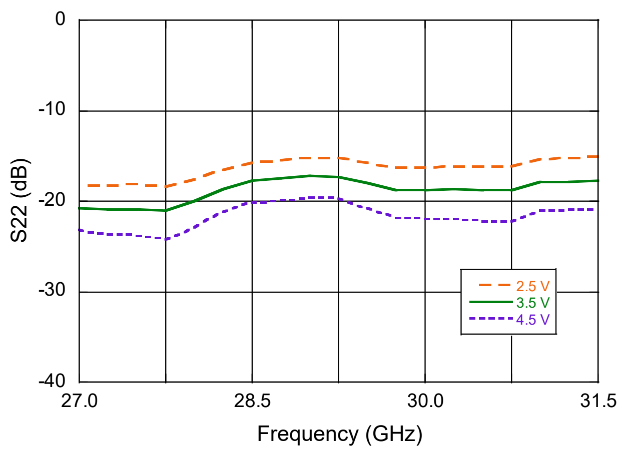
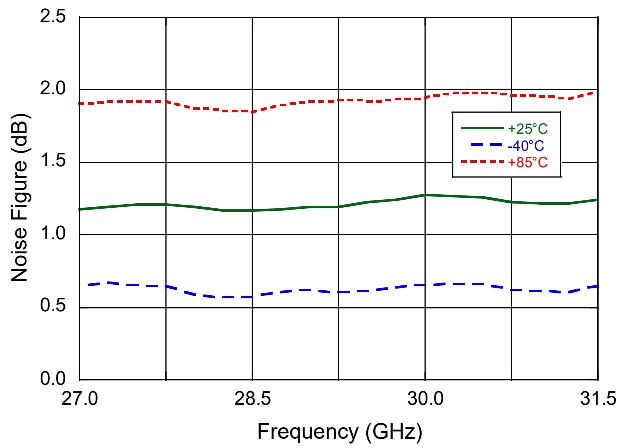
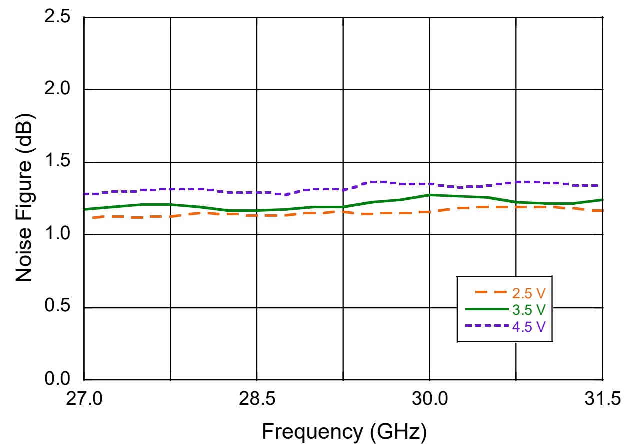


Typical Performance Curves @ V_D = 3.5 V, I_D = 90 mA, 25°C, Z_0 = 50 Ω

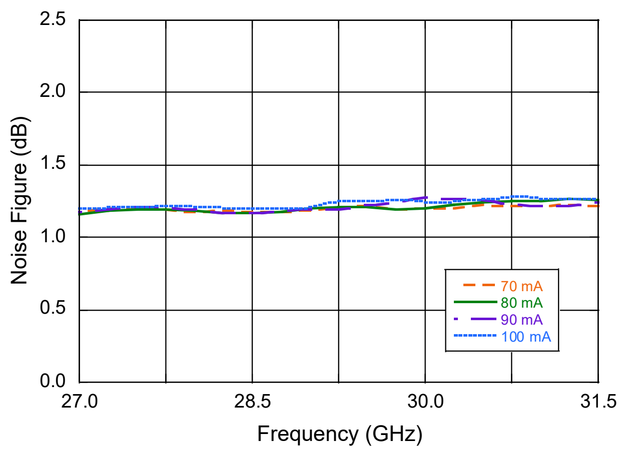
Noise Figure over Temperature



Noise Figure over Voltage

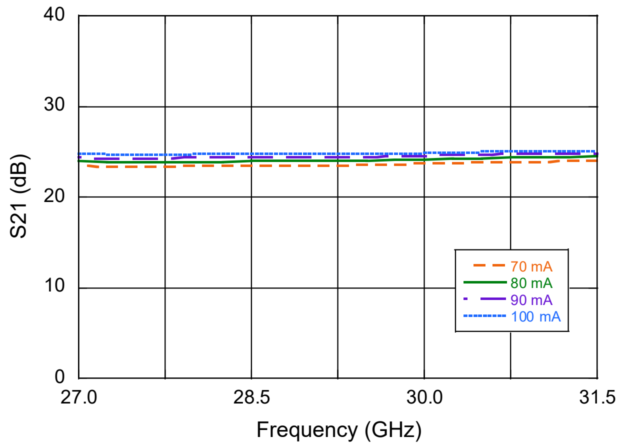


Noise Figure over Current

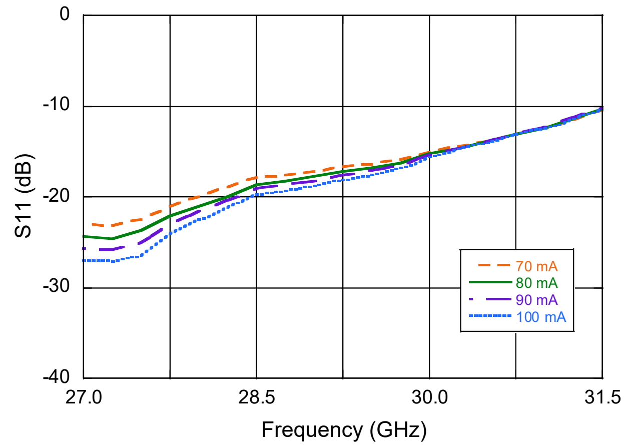


Typical Performance Curves @ V_D = 3.5 V, Z_0 = 50 Ω

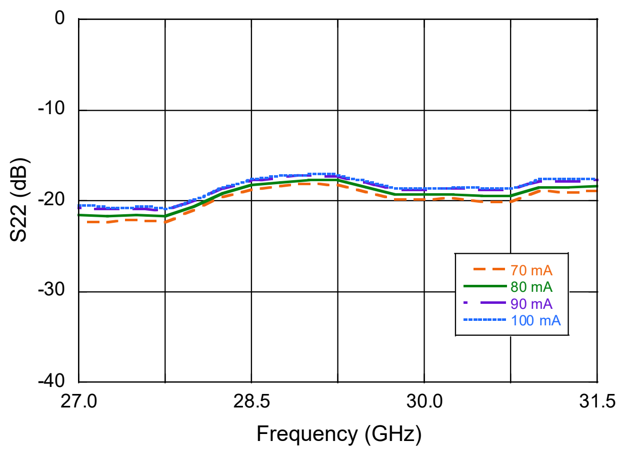
Gain



Input Return Loss

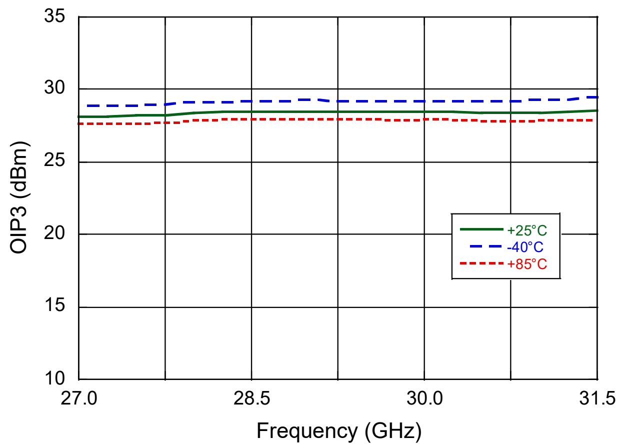


Output Return Loss

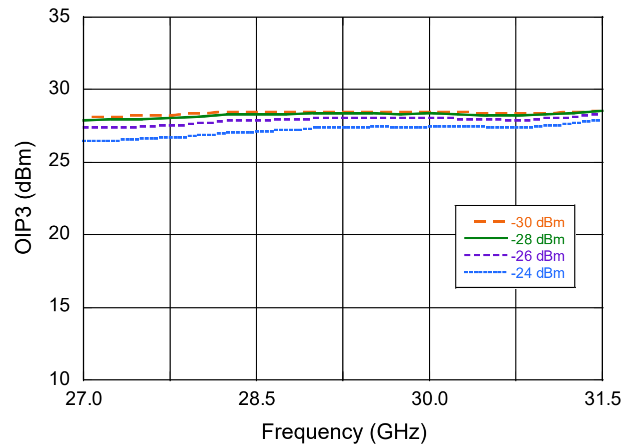


Typical Performance Curves @ V_D = 3.5 V, I_D = 90 mA, P_{IN} = -20 dBm, 25°C, Z_0 = 50 Ω

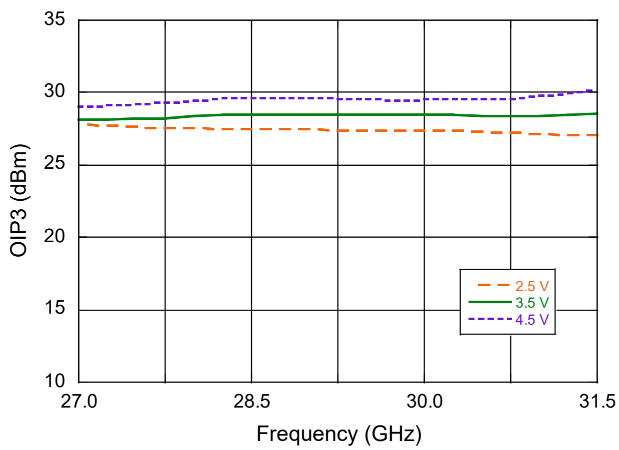
OIP3 vs Temperature



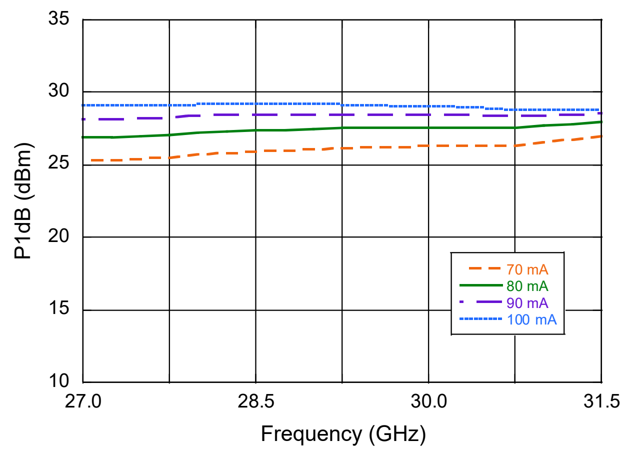
OIP3 vs Input Power



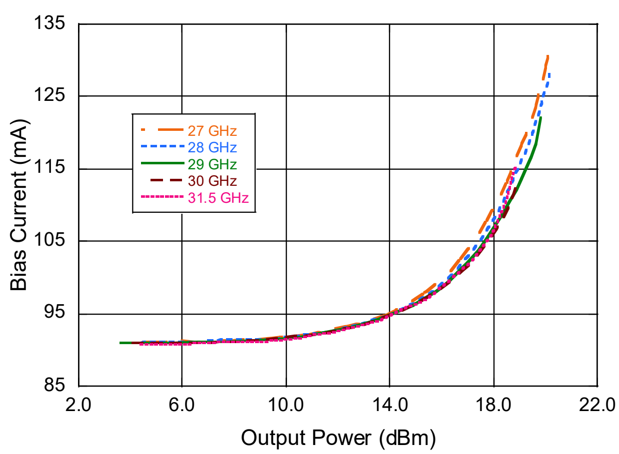
OIP3 vs Bias Voltage



OIP3 vs Bias Current

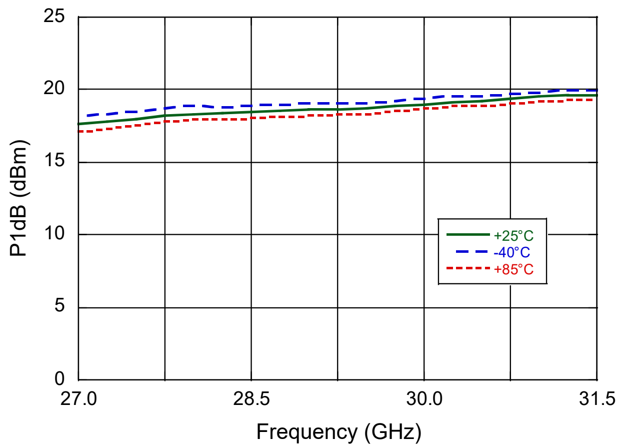


Bias Current vs Output Power

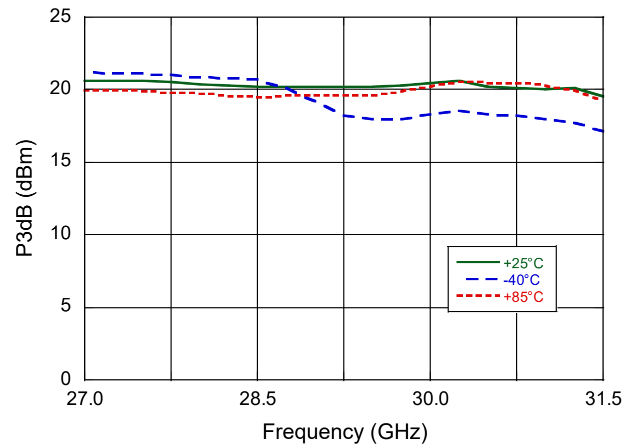


Typical Performance Curves @ V_D = 3.5 V, I_D = 90 mA, 25°C, Z_0 = 50 Ω

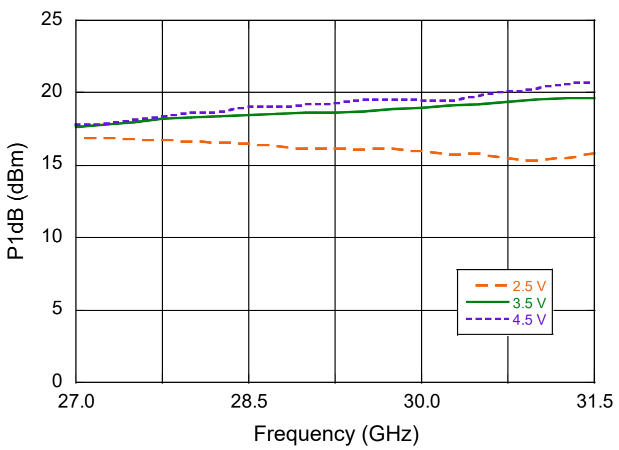
P1dB vs Temperature



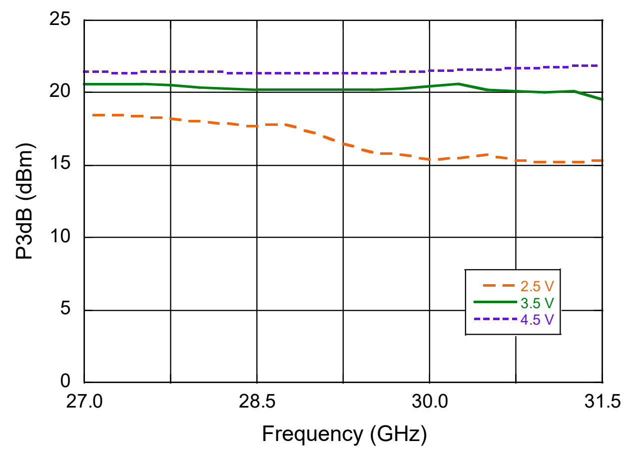
P3dB vs Temperature



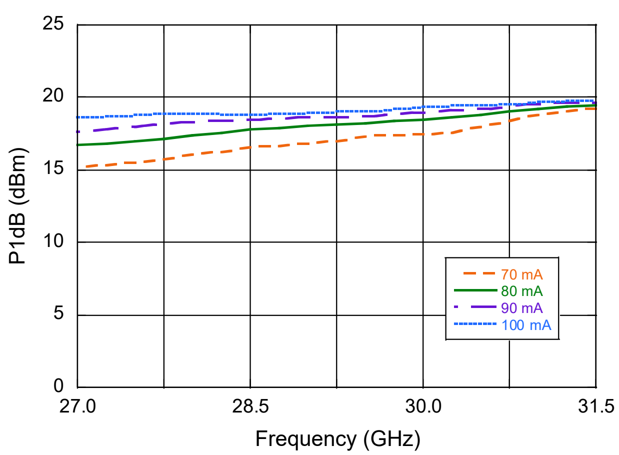
P1dB vs Bias Voltage



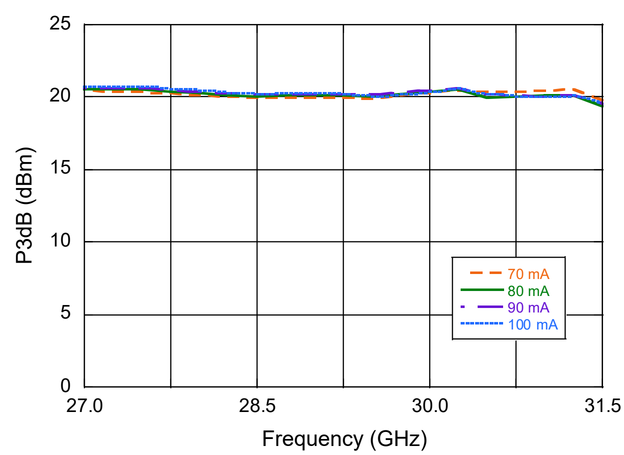
P3dB vs Bias Voltage



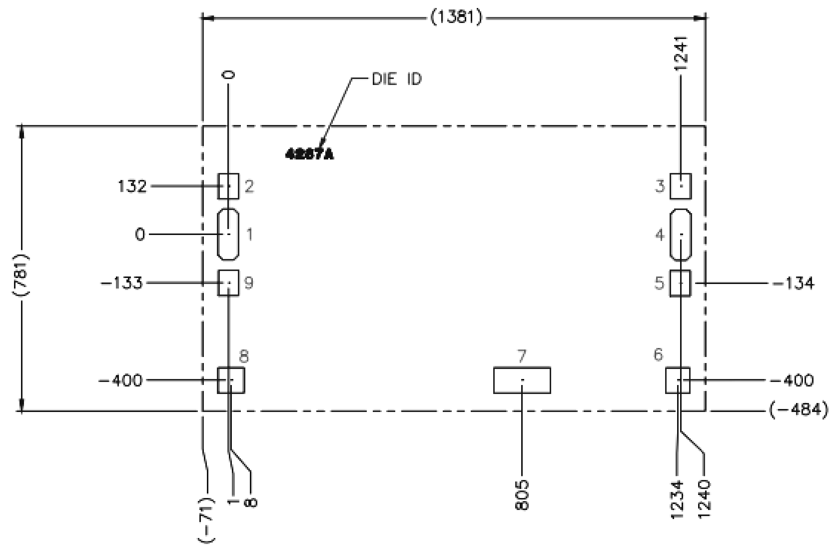
P1dB vs Bias Current



P3dB vs Bias Current



Chip Outline Drawing



BOND PAD SIZE	
PAD	SQ(µm)
1,4	55x140
2,3,5,9	55x70
6	65x70
7	155x70
8	70.5x70

NOTES:
1. UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS SHOWN ARE µm WITH A TOLERANCE OF ±5µm.
2. DIE THICKNESS IS 100 ±10µm
3. BOND/PAD BACKSIDE METALLIZATION: GOLD
4. DIE SIZE REFLECTS FINAL DIMENSIONS.