Features
- Low Noise Figure: 1.5 dB @ 20 GHz
- Gain: 27 dB @ 20 GHz
- P1dB: 19 dBm @ 20 GHz
- OIP3: 29 dBm @ 20 GHz
- Bias Voltage: V_{DD} = +3.5 V
- Bias Current: I_{DSQ} = 90 mA
- 50 Ω Matched Input and Output
- 3 mm AQFN-12LD Package
- RoHS* Compliant

Applications
- Satellite Communications
- Low Earth Orbit Space Payloads
- GEO High Throughput Satellite
- Radar
- EW

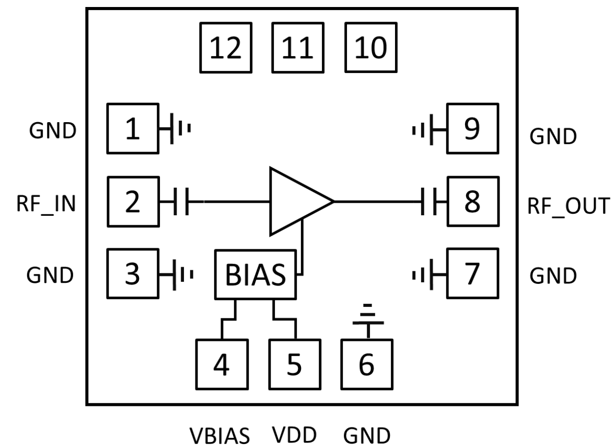
Description
The MAAL-011286 is an easy to use low noise amplifier. It operates from 15 to 24 GHz and provides 1.5 dB noise figure, 27 dB gain and a P1dB of +19 dBm. The input and output are fully matched to 50 Ω with typical return loss >12 dB.

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

This amplifier 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 downlink satellite communication systems.

The MAAL-011286 is also available in die form under MAAL-011286-DIE part number.

Functional Schematic



Pin Configuration

Pin #	Function	Description
1,3,6,7,9	GND	Ground
2	RF_{IN}	RF Input
4	VBIAS	Bias Voltage
5	VDD	Drain Supply
8	RF_{OUT}	RF Output
10,11,12	NC	Not Connected[2]
Paddle	GND[3]	Gound pad

2. These pins are not connected internally. MACOM recommends these are grounded on the application PCB.
3. The exposed pad centered on the package bottom must be connected to RF, DC and thermal ground.

Ordering Information[1]

Part Number	Package
MAAL-011286-TR1000	1000 Piece Reel
MAAL-011286-TR3000	3000 Piece Reel
MAAL-011286-SB1	Sample Board

1. Reference Application Note M513 for reel size information.

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

Electrical Specifications: T_A = 25°C, V_D = +3.5 V, I_{DSQ} = 90 mA, Z_0 = 50 Ω

Parameter	Test Conditions	Units	Min.	Typ.	Max.
Small Signal Gain	P_{IN} = -30 dBm 17.0 GHz 21.5 GHz	dB	24 25	27 28	—
Small Signal Gain Variation over Temperature	—	dB/°C	—	0.06	—
Gain Flatness	—	dB	—	0.7	—
Noise Figure	19.25 GHz	dB	—	1.5	2
Input Return Loss	—	dB	—	12	—
Output Return Loss	—	dB	—	12	—
P1dB	17.0 GHz 21.5 GHz	dBm	16.5 17	19 19.5	—
Output 3rd Order Intercept	-20 dBm / tone, 10 MHz spacing	dBm	—	29	—
Supply Current	—	mA	—	90	—

Maximum Operating Conditions

Parameter	Maximum
Input Power	0 dBm
V_{DD}	4.5 V
Junction Temperature[6,7]	+150°C
Operating Temperature	-40°C to +85°C

Handling Procedures

Please observe the following precautions to avoid damage:

Static Sensitivity

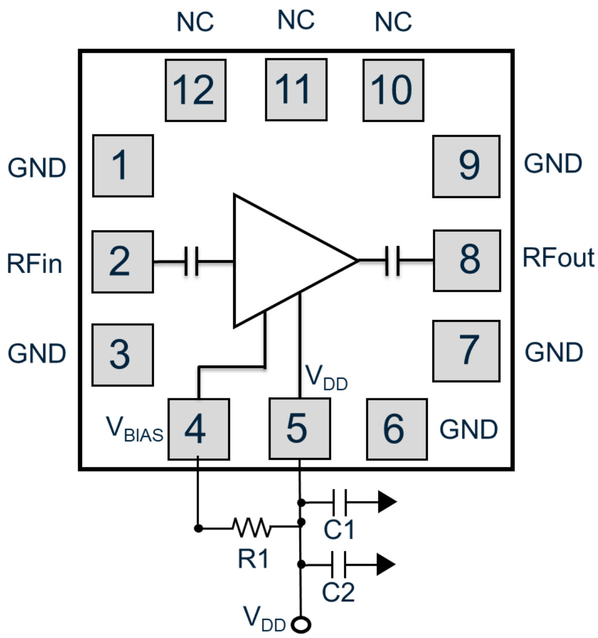
These electronic devices are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. Proper ESD control techniques should be used when handling these Class 1A HBM (250 V), Class C2a CDM (500 V) devices.

Absolute Maximum Ratings[4,5]

Parameter	Absolute Maximum
Input Power	20 dBm
V_{DD}	5 V
Junction Temperature[6,7]	+150°C
Operating Temperature	-40°C to +85°C
Storage Temperature	-65°C to +125°C

4. Exceeding any one or combination of these limits may cause permanent damage to this device.
5. MACOM does not recommend sustained operation near these survivability limits.
6. Operating at nominal conditions with $T_J \leq$ +150°C will ensure MTTF > 1 x 10^6 hours.
7. Junction Temperature (T_J) = T_C + Θjc * (V * I)
   Typical thermal resistance (Θjc) = 66.5 °C/W.
   a) For TC = +25°C,
      TJ = 50.6 °C @ 3.5 V, 110 mA
   b) For TC = +85°C,
      TJ = 110.6 °C @ 3.5 V, 110 mA

Application Schematic



Parts List

Part	Value	Case Style
C1	100 pF	0402
C2	0.1 µF	0402
R1	—	0402

Application Circuit and Operation

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

Set IDQ by adjusting R1

Value of R1 sets IDQ according to the table below:

R1 (Ω)	IDQ (mA)
6.55K	45
5.15K	50
3.62K	60
2.65K	70
2.05k	80
1.65k	90
1.34K	100
1.12K	110
970	120

Operating the MAAL-011286

Turn-on

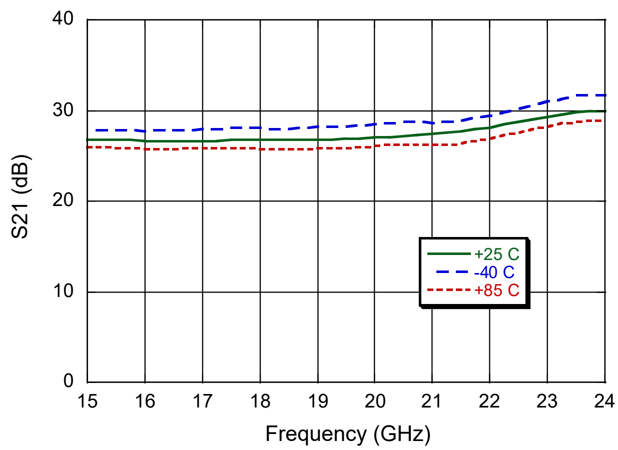
1. Apply V_D (+3.5 V)
2. Apply RF_{IN} signal

Turn-off

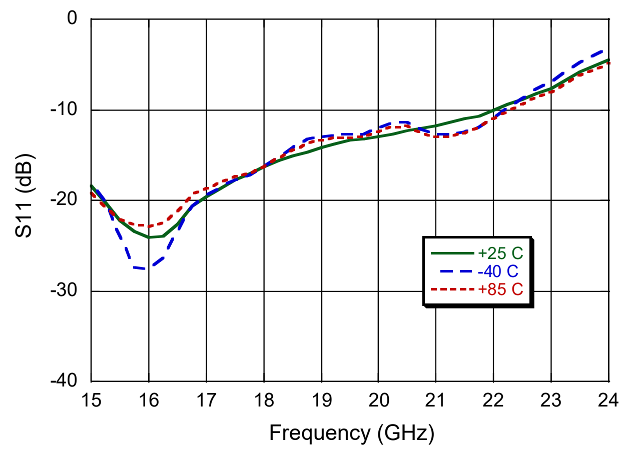
1. Remove RF_{IN} signal.
2. Decrease V_D to 0 V

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

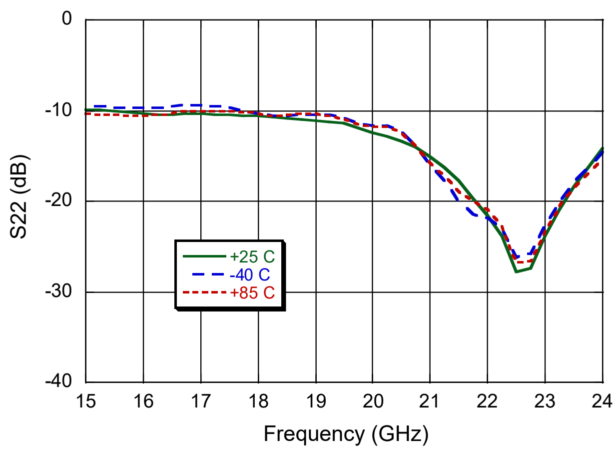
Gain



Input Return Loss

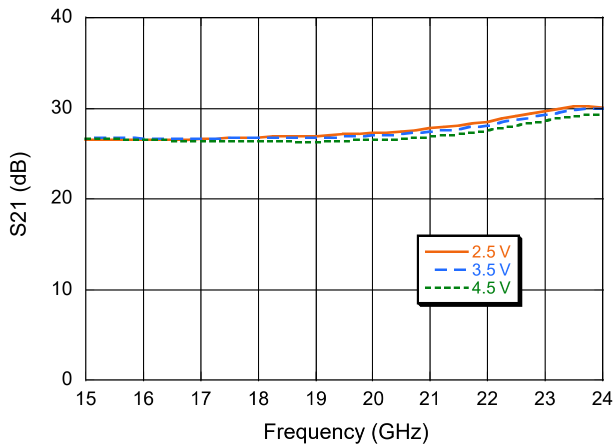


Output Return Loss

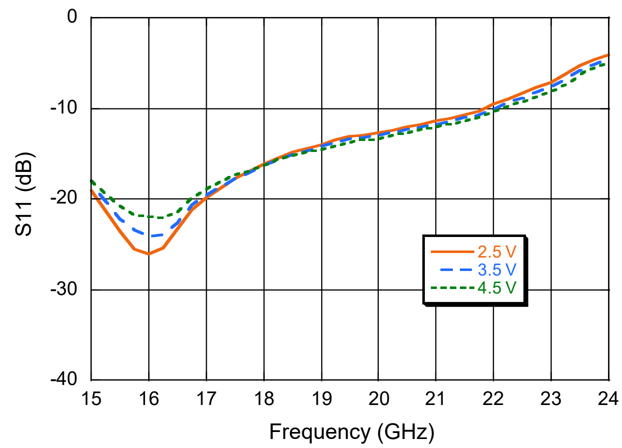


Typical Performance Curves @ I_D = 90 mA, Z_0 = 50 Ω

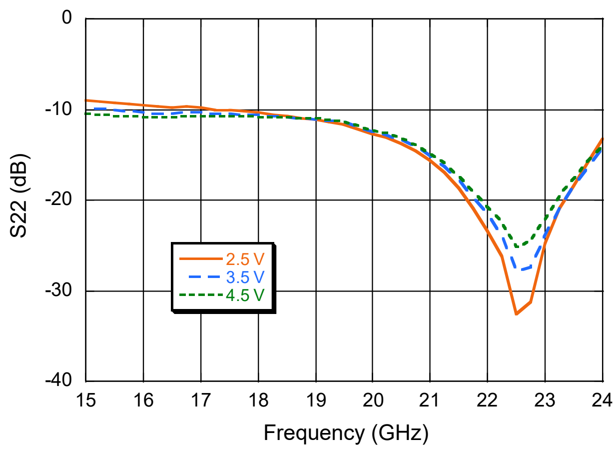
Gain



Input Return Loss

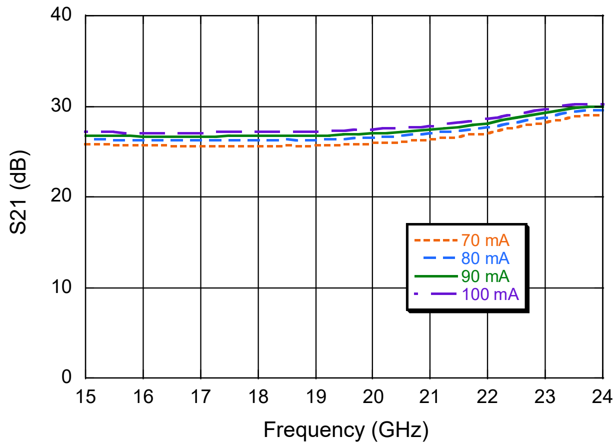


Output Return Loss

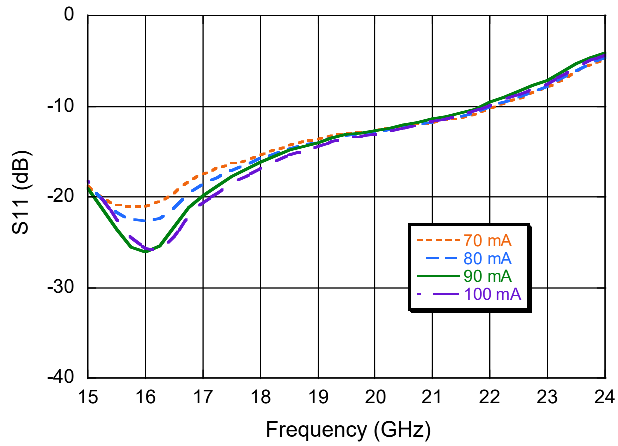


Typical Performance Curves @ V_D = 3.5 V, Z_0 = 50 Ω

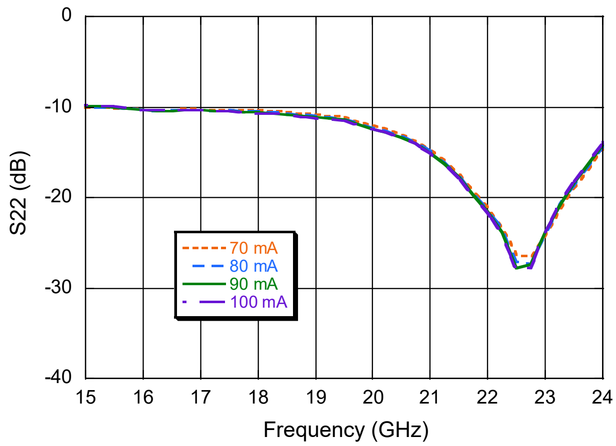
Gain



Input Return Loss

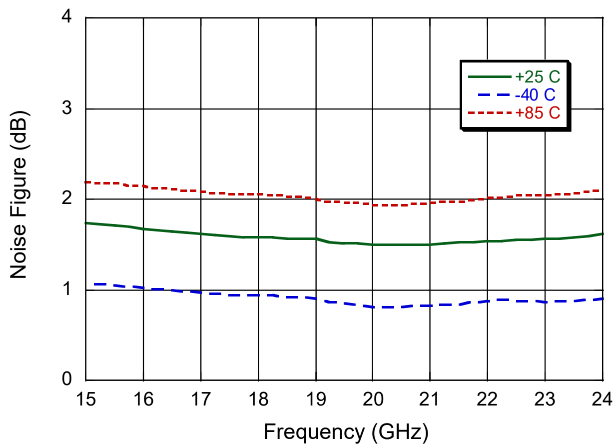


Output Return Loss

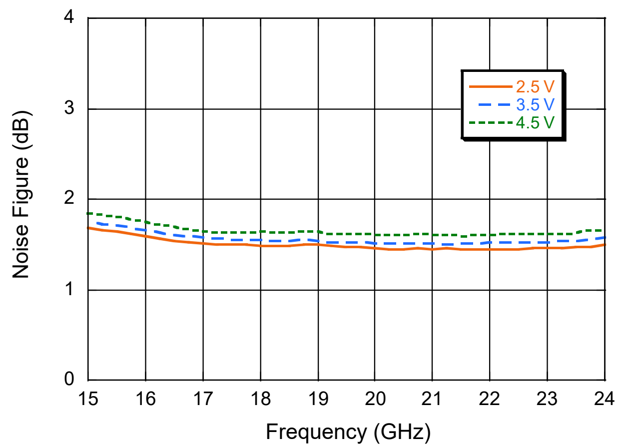


Typical Performance Curves @ V_D = 3.5 V, I_D = 90 mA, 25 C, Z_0 = 50 Ω

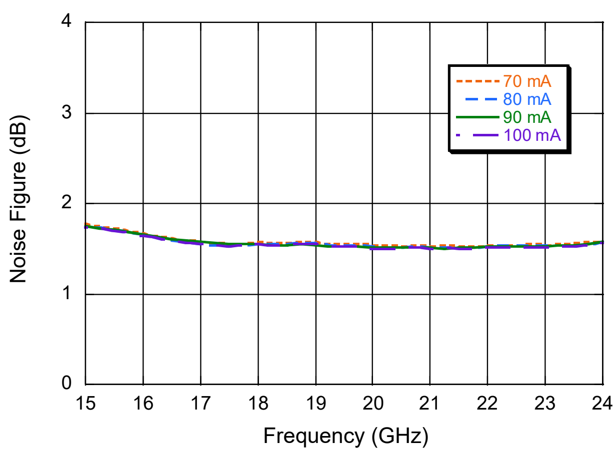
Noise Figure over Temperature



Noise Figure over Voltage

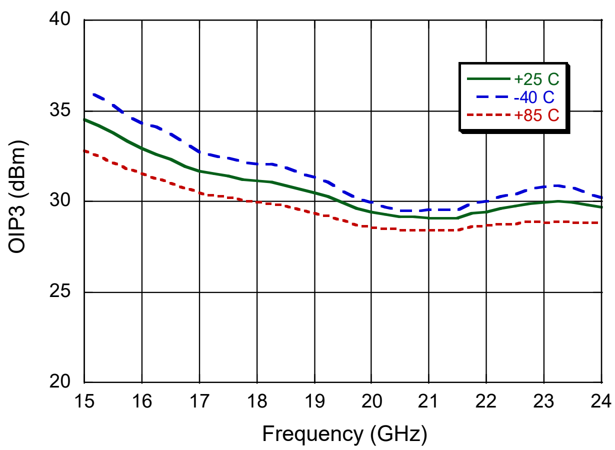


Noise Figure over Current

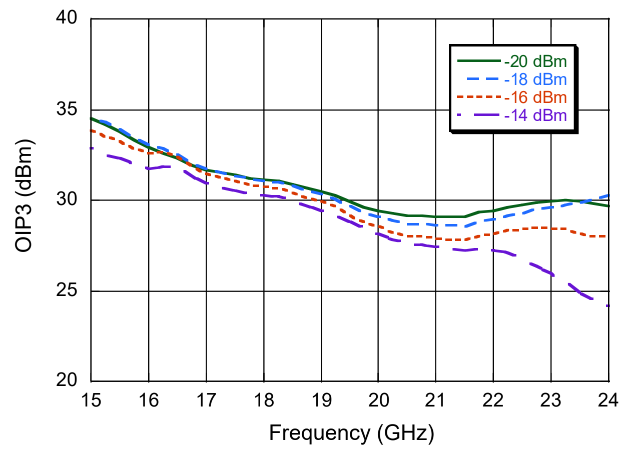


Typical Performance Curves @ V_D = 3.5 V, I_D = 90 mA, Pin = -20 dBm, 25 C, Z_0 = 50 Ω

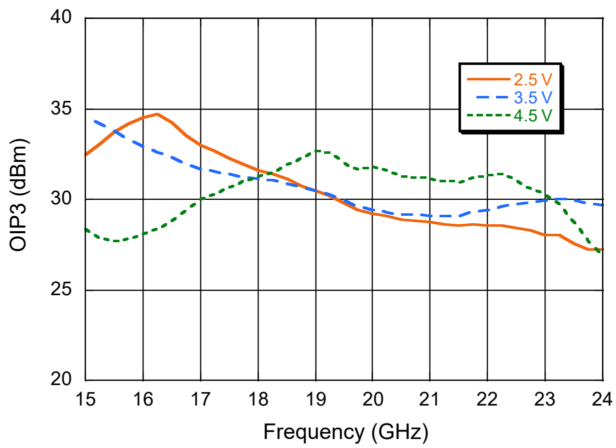
OIP3 vs Temperature



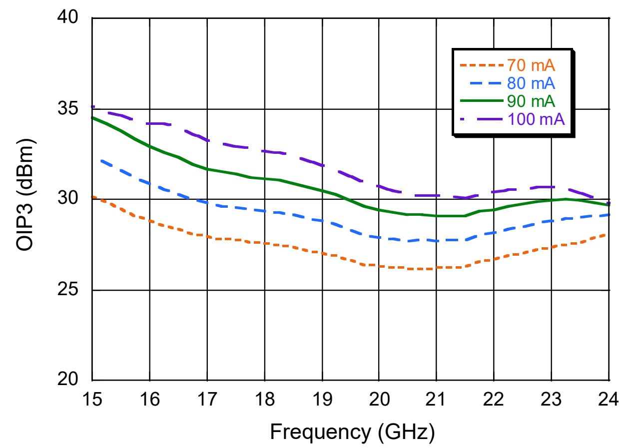
OIP3 vs Pin



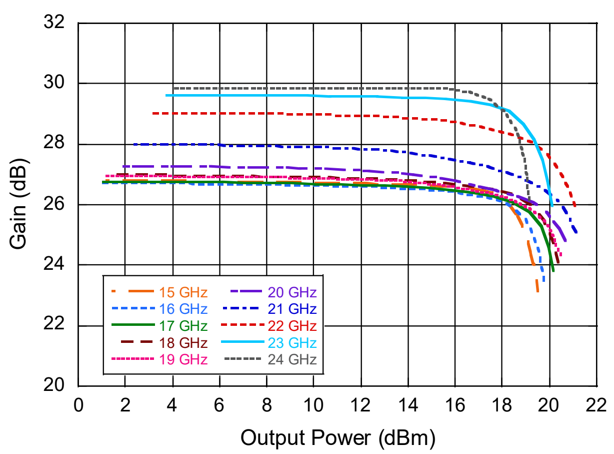
OIP3 vs Bias Voltage



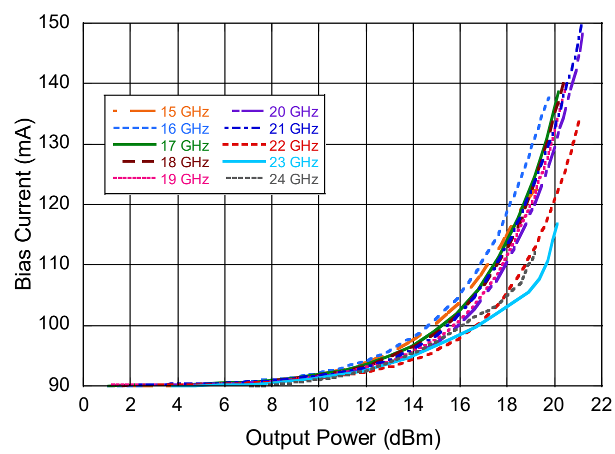
OIP3 vs Bias Current



Gain vs Output Power over Frequency

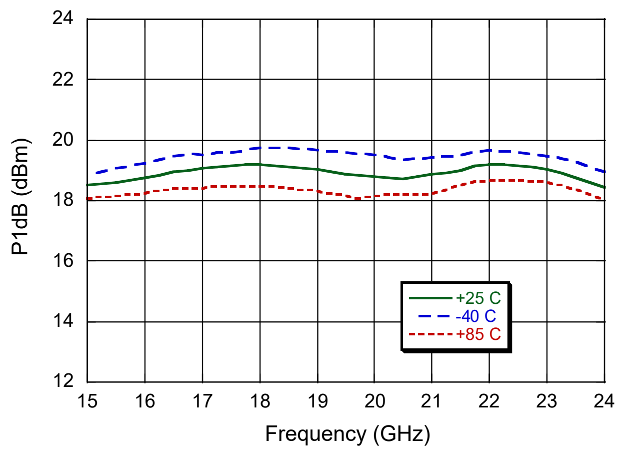


Bias Current vs Output Power over Frequency

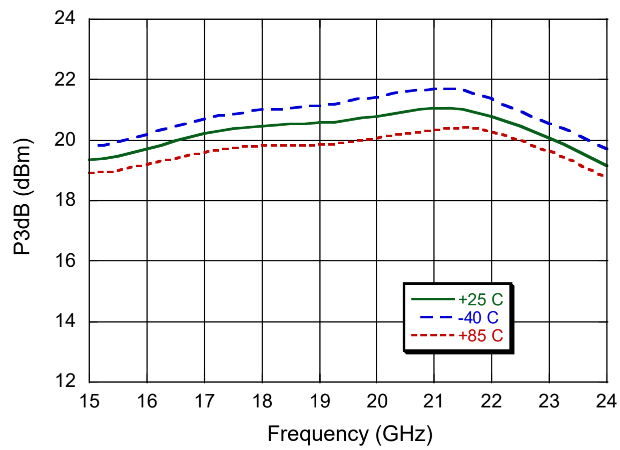


Typical Performance Curves @ V_D = 3.5 V, I_D = 90 mA, 25 C, Z_0 = 50 Ω

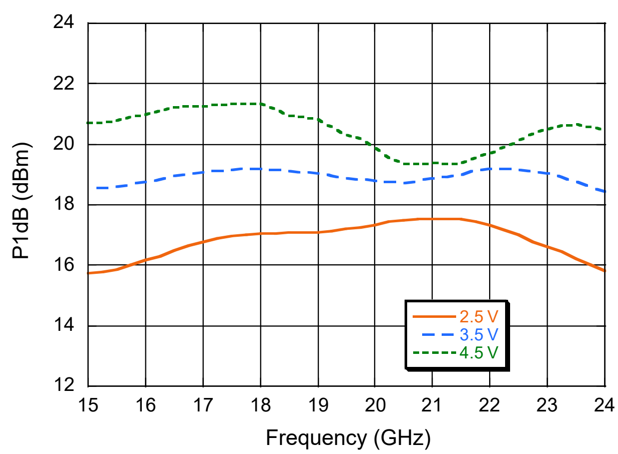
P1dB vs Temperature



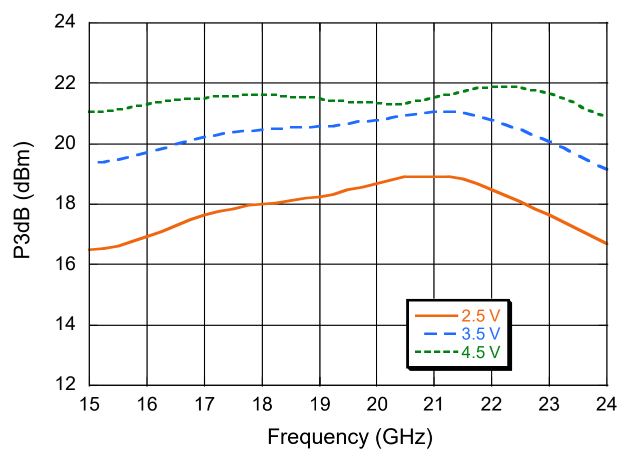
P3dB vs Temperature



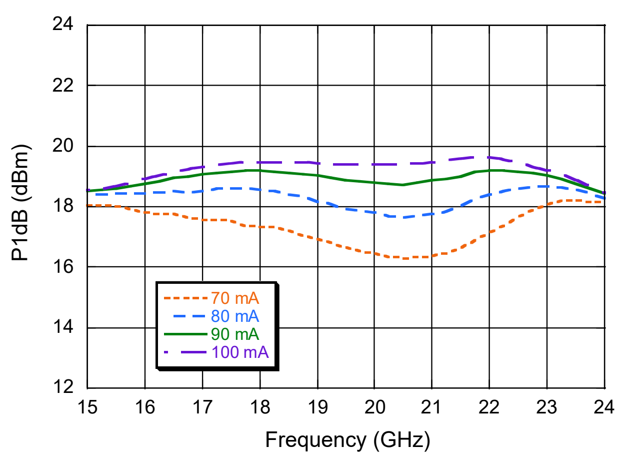
P1dB vs Bias Voltage



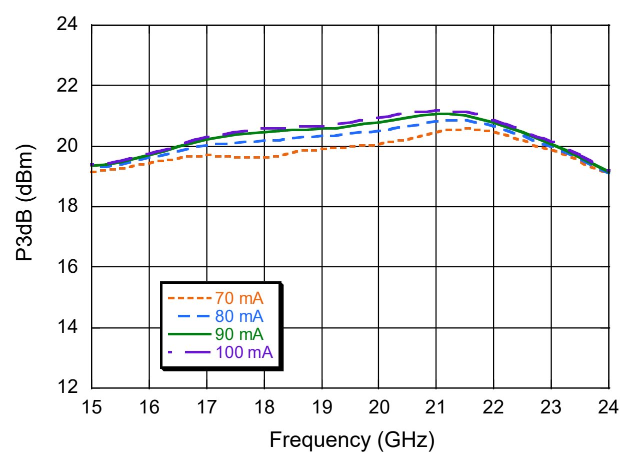
P3dB vs Bias Voltage



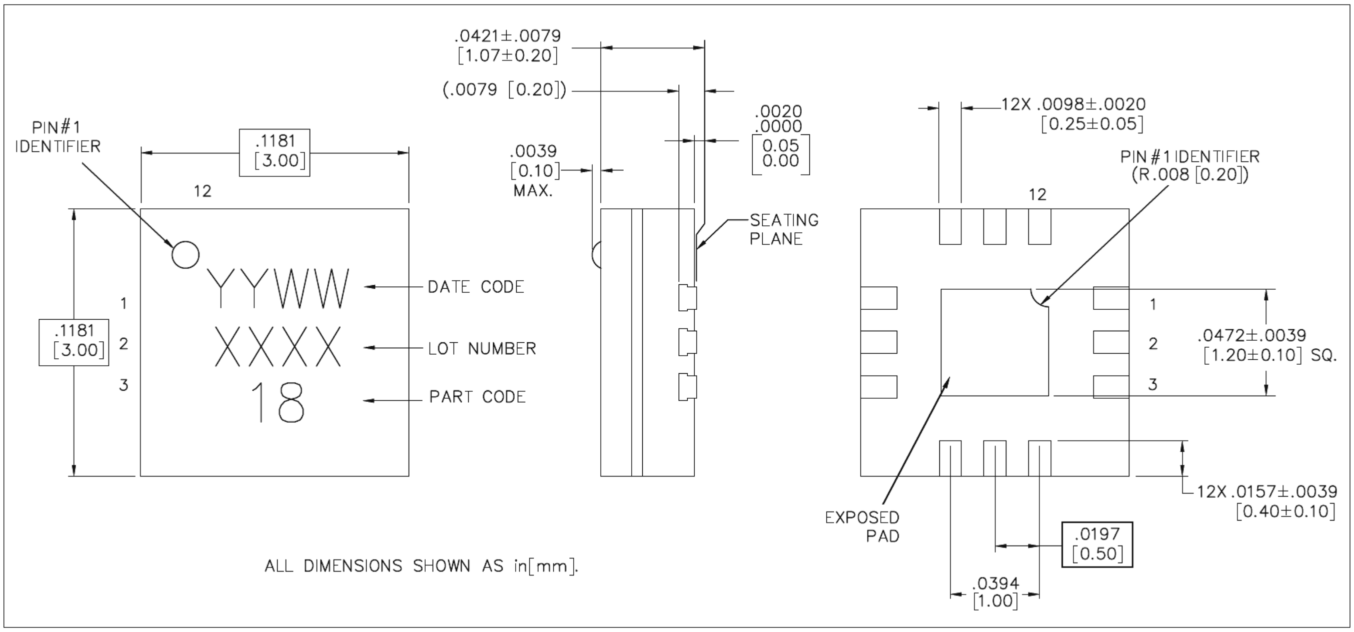
P1dB vs Bias Current



P3dB vs Bias Current



Outline: Lead-Free 3 mm AQFN-12LD [8,9,10,11,12]



8. All units are in[mm], unless otherwise noted, with a tolerance of .xxxx = ±.0005 in and .xxx = ±.005 in.
9. Lead finish: NiPdAu plating
10. Marking: line 2 part number; line 3 wafer lot number; line 4 c = country of origin (T = Thailand), yyww = date code, N = Nickel/Palladium/ Gold plating
11. Reference Application Note S2083 for lead-free solder reflow recommendations.
12. Meets JEDEC moisture sensitivity level 3 requirements.