Features

- Phase Noise: -164 dBc/Hz @ 10 kHz
- Gain: 23 dB
- P_{SAT}: 25 dBm
- Bias Voltage: V_{CC} = 6 V
- Bias Current: I_{CQ} = 215 mA
- 50 Ω Matched Input and Output
- Positive Voltage Only
- Die Size: 3000 x 2700 x 100 µm
- RoHS* Compliant

Applications

- Radar
- Electronic Countermeasures
- Test and Measurement
- Microwave Communication Systems

Description

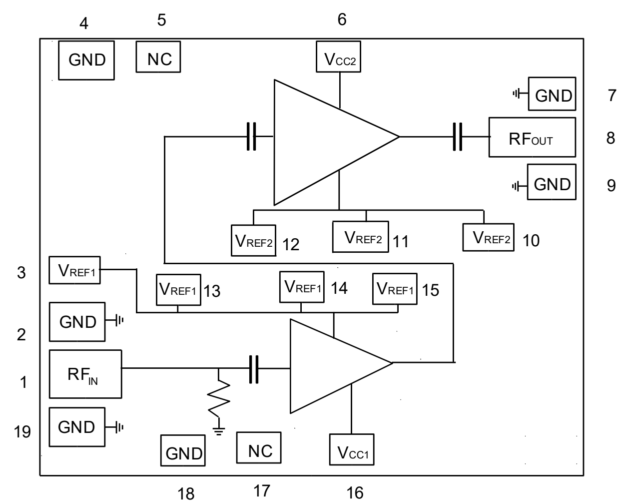
The MAAL-011159-DIE is an easy to use low phase noise amplifier chip. It operates from 2 - 27 GHz and provides -164 dBc/Hz phase noise, 23 dB gain and 25 dBm P_{SAT}. The input and output are fully matched to 50 Ω with typical return loss >14 dB.

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

Ordering Information

Part Number	Package
MAAL-011159-DIE	Gel Pack

Functional Schematic



Pad Configuration[1]

Pad #	Pad Name	Description
1	RF_{IN}	RF Input
2,4,7,9,18,19	GND	DC + RF Ground to Backside Via
3,13,14,15	V_{REF1}	Reference Voltage 1
5,17	NC	Not Connected
6	V_{CC2}	Supply Voltage 2
8	RF_{OUT}	RF Output
10,11,12	V_{REF2}	Reference Voltage 2
16	V_{CC1}	Supply Voltage 1

1. Backside of die must be connected to RF, DC and thermal ground.

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

Electrical Specifications: Freq. = 2 - 27 GHz, T_A = +25°C, V_{CC} = 6 V, Z_0 = 50 Ω (Based on probed die production data)

Parameter	Test Conditions	Units	Min.	Typ.	Max.
Gain	P_{IN} = -10 dBm, 6 GHz P_{IN} = -10 dBm, 18 GHz P_{IN} = -10 dBm, 27 GHz	dB	21 21 15	24 24 19	—
Gain Flatness	—	dB	—	±2	—
Gain Variation over Temperature	—	dB/°C	—	0.028	—
Output Power	P_{IN} = -1.0 dBm, 6 GHz P_{IN} = -2.2 dBm, 18 GHz P_{IN} = -1.0 dBm, 27 GHz	dBm	20.0 18.5 14.0	22.5 21.0 17.5	—
Noise Figure	—	dB	—	4.5	—
Input Return Loss	—	dB	—	15	—
Output Return Loss	—	dB	—	14	—
P1dB	16 GHz	dBm	—	22	—
Psat	16 GHz	dBm	—	25	—
OIP3	16 GHz, -10 dBm P_{IN} per tone	dBm	—	32.5	—
Phase Noise	12 GHz, Psat 100 Hz 1 kHz 10 kHz 1 MHz	dBc/Hz	—	 -145 -157 -164 -172	—
Icq	—	mA	—	215	—

Absolute Maximum Ratings[2,3]

Parameter	Absolute Maximum
Input Power	8 dBm
V_{CC}	7.5 V
I_{CC}	520 mA
Junction Temperature[4,5]	+130°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 $T_J \leq$ +130°C will ensure MTTF > 1 x 10^6 hours.
5. Junction Temperature (T_J) = T_C + Θjc * (V * I)
   Typical thermal resistance (Θjc) = 13.2 °C/W.
   a) For T_C = +25°C,
      T_J = 67.5°C @ 7.0 V, 460 mA
   b) For T_C = +85°C,
      T_J = 127.5°C @ 7.0 V, 460 mA

Maximum Operating Conditions

Parameter	Maximum
Input Power	5 dBm
V_{CC}	7.0 V
I_{CC}	460 mA
Junction Temperature	+130°C
Operating Temperature	-40°C to +85°C
Storage Temperature	-65°C to +125°C

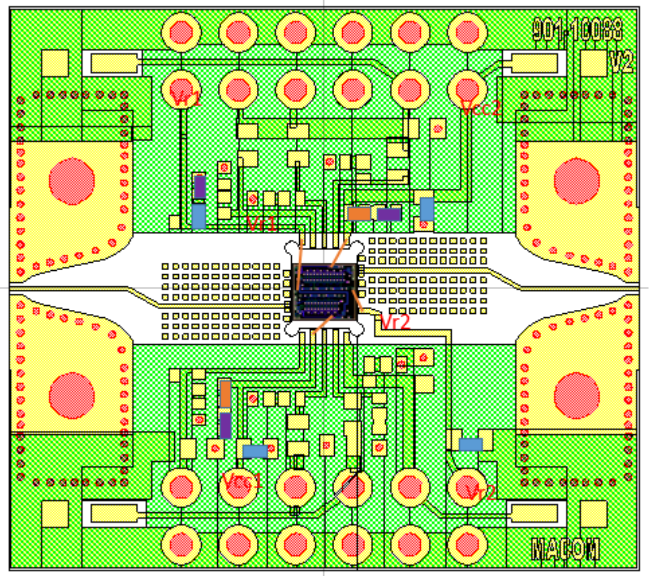
Handling Procedures

Please observe the following precautions to avoid damage:

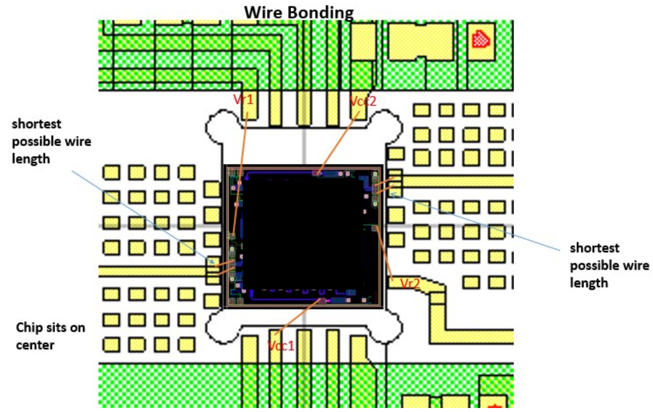
Static Sensitivity

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 HBM Class 1A, 250 V devices.

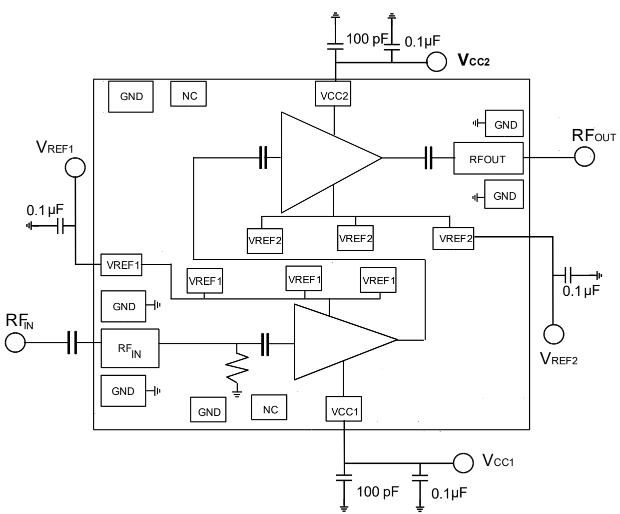
PCB Layout



0.1 uF, 0402 cap
100pF, 0402 cap
0 ohm resistor or 5 ohm



Application Schematic



Operation

To turn-on:

1. Apply +5 V to V_{CC1} and V_{CC2}
2. Starting at 0 V, adjust V_{REF1} and V_{REF2} connected together for target I_{CC}

To turn-off:

1. Set V_{REF1} and V_{REF2} connected together to 0 V
2. Set V_{CC1} and V_{CC2} to 0 V

Evaluation PCB Specifications

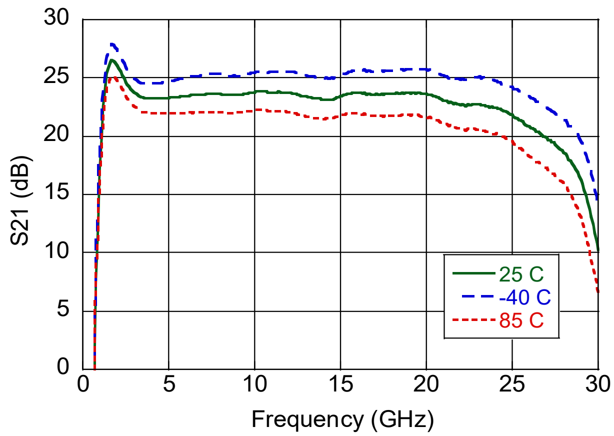
Top Layer: 1/2 oz Copper Cladding, 0.017 mm thickness
Dielectric Layer: Rogers RO4350B 0.101 mm thickness
Bottom Layer: 1/2 oz Copper Cladding, 0.017 mm thickness
Finished overall thickness: 0.135 mm

Parts List

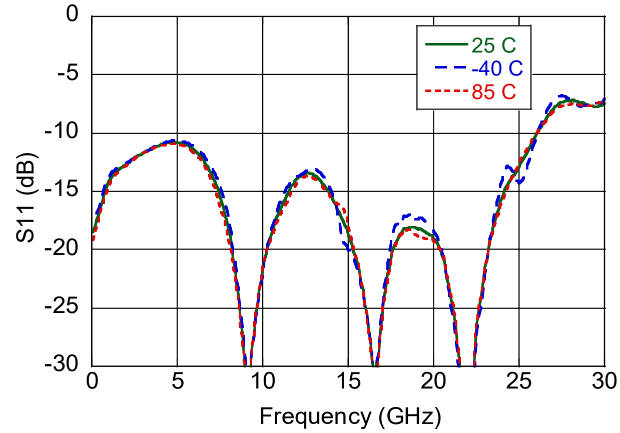
Part	Value	Case Style	MFG	MFG Part #
C5, C6	100 pF	0402	KYOCERA	04025C101KAT4A
C1 - C4	0.1 µF	0402	KYOCERA	04023C103KAT2A
R1 - R3	0 Ω	0402	VISHAY	CRCW04020000Z0ED

Typical Performance Curves: V_{CC} = 6 V, I_{CC} = 215 mA

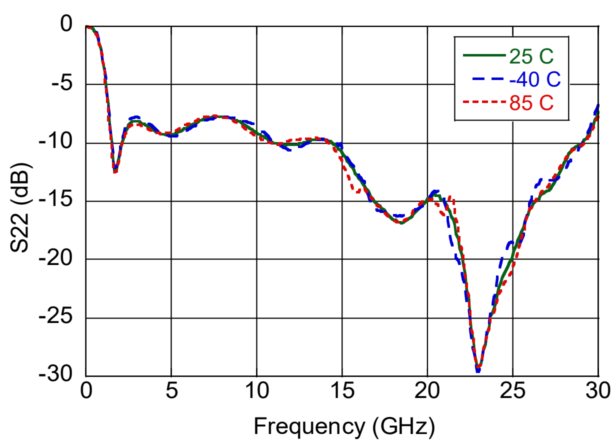
Gain



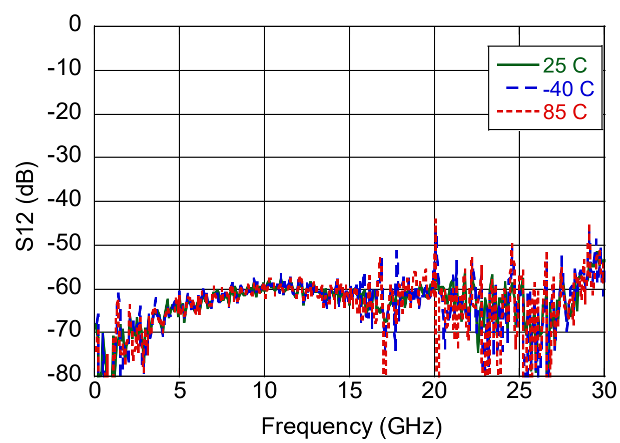
Input Return Loss



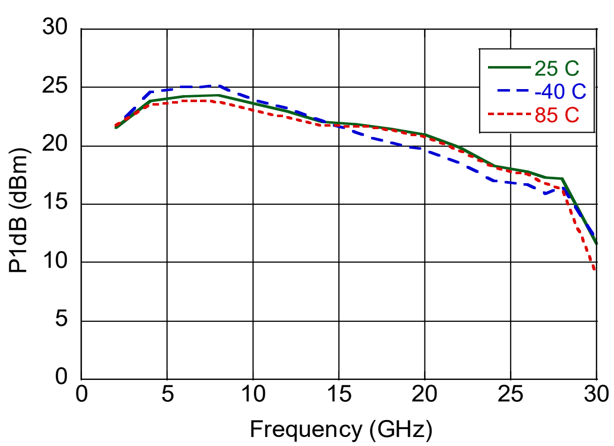
Output Return Loss



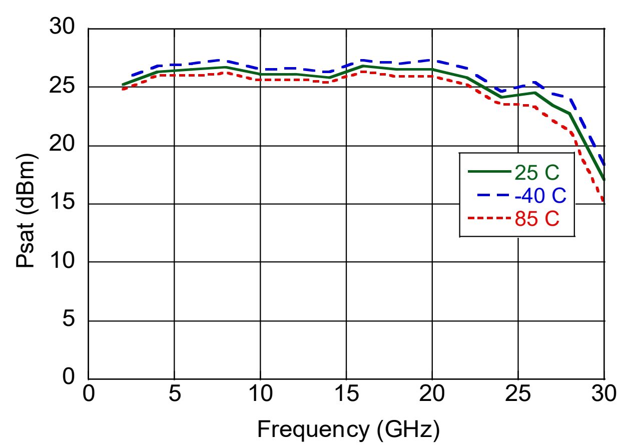
Reverse Isolation



P1dB

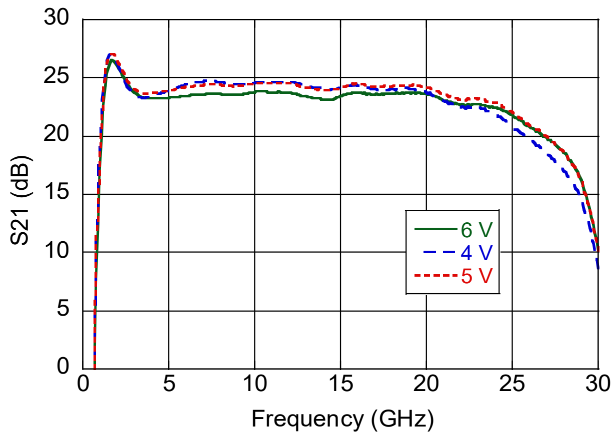


P_{SAT}

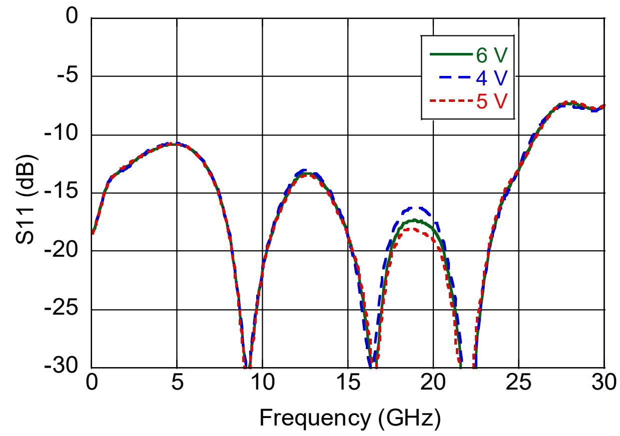


Typical Performance Curves: I_{CC} = 215 mA, +25°C

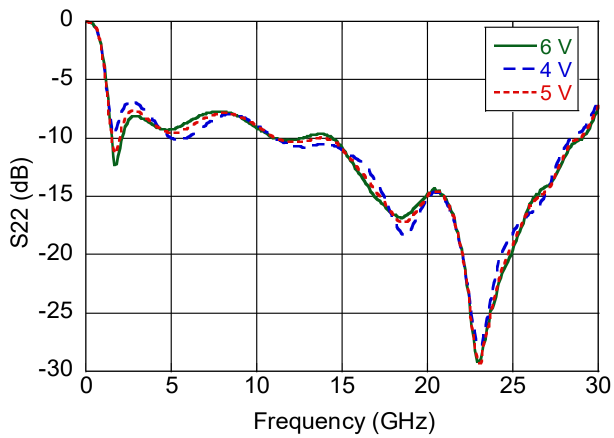
Gain



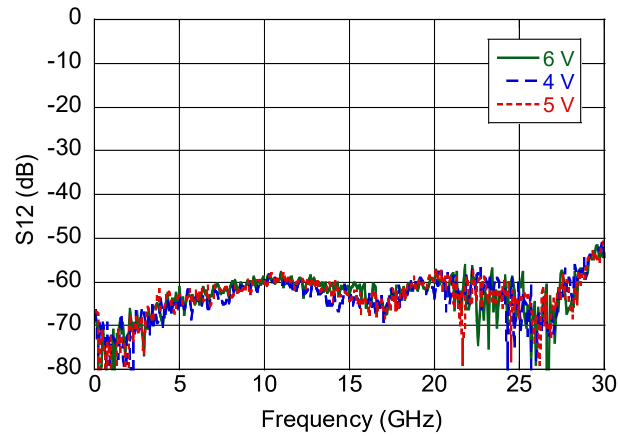
Input Return Loss



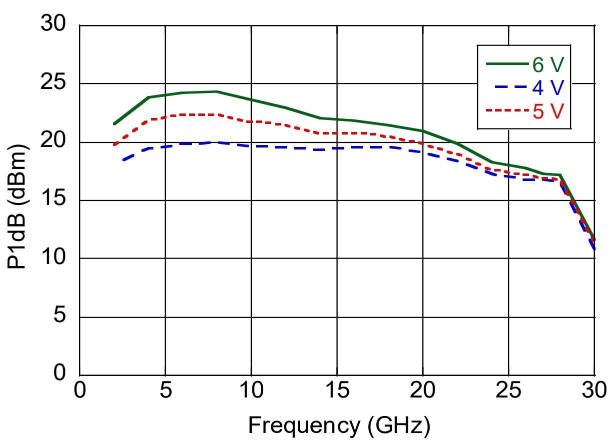
Output Return Loss



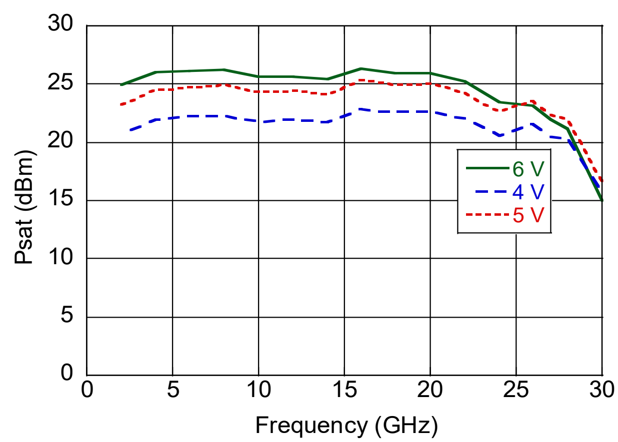
Reverse Isolation



P1dB

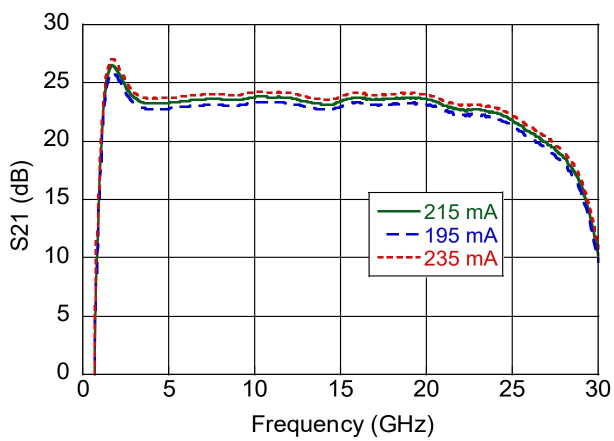


P_{SAT}

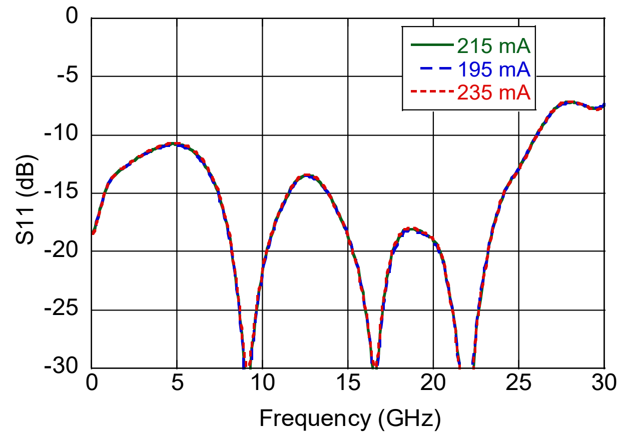


Typical Performance Curves: V_{CC} = 6 V, +25°C

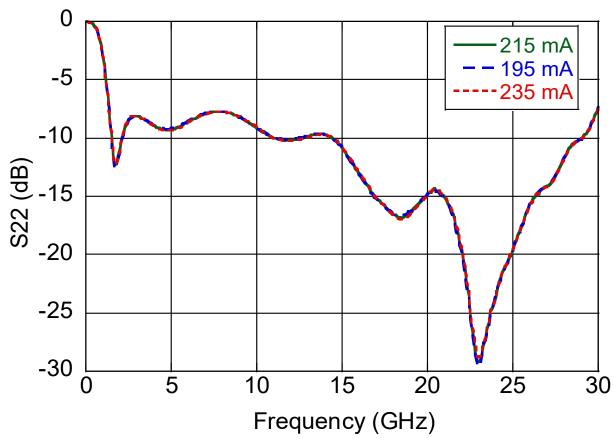
Gain



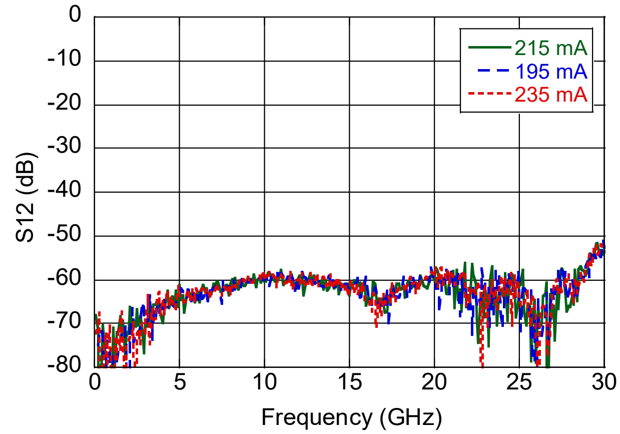
Input Return Loss



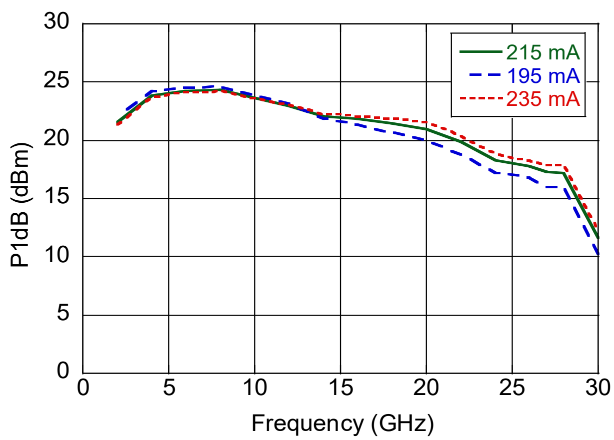
Output Return Loss



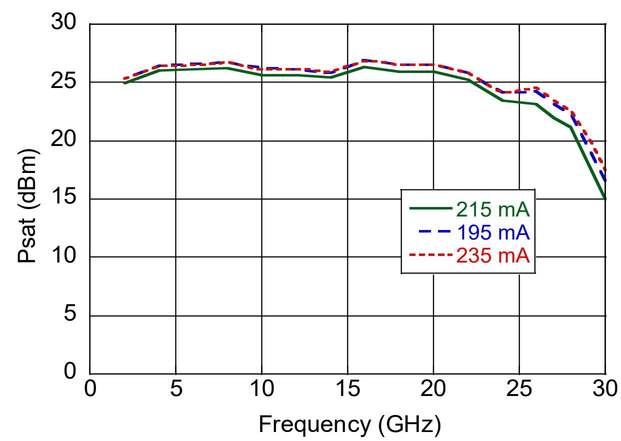
Reverse Isolation



P1dB

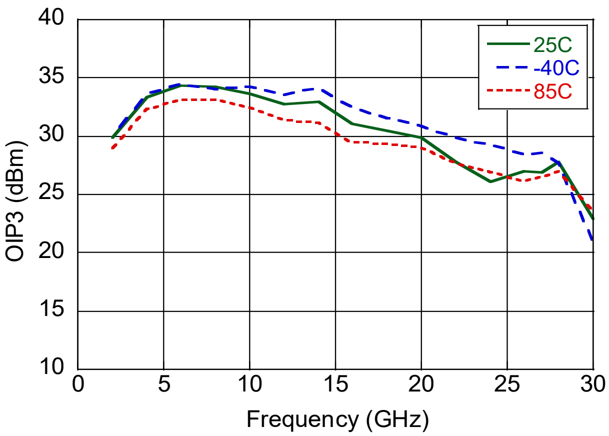


P_{SAT}

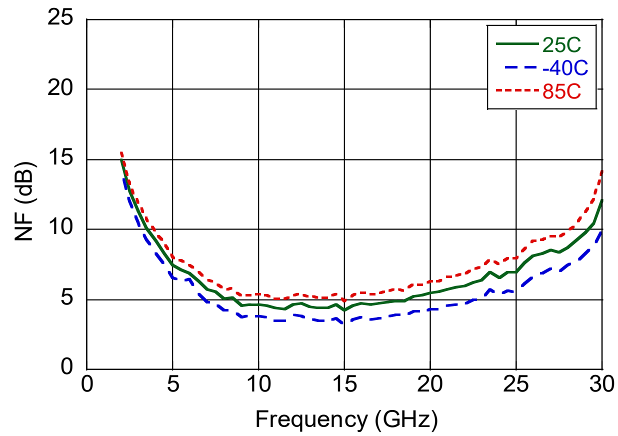


Typical Performance Curves: V_{CC} = 6 V, I_{CC} = 215 mA, +25°C

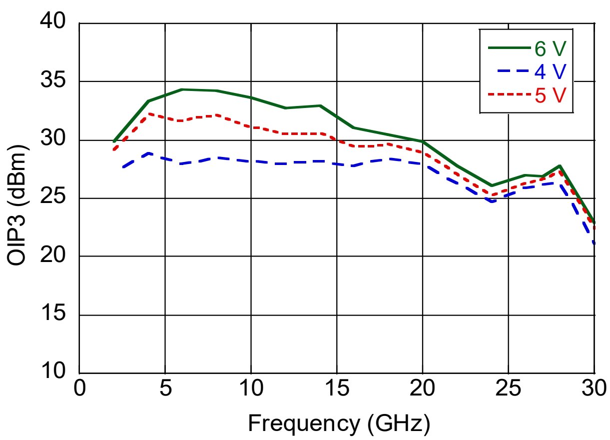
Output IP3
(10 MHz Tone Spacing, P_{IN} = -10 dBm per tone)



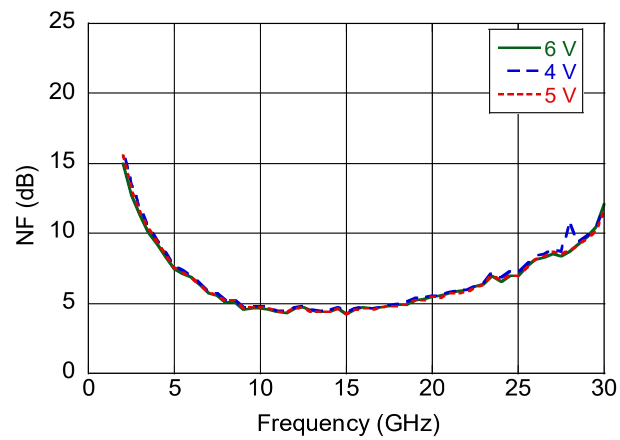
Noise Figure



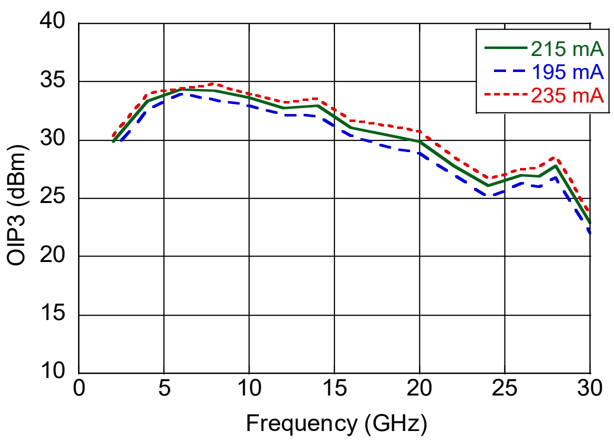
Output IP3
(10 MHz Tone Spacing, P_{IN} = -10 dBm per tone)



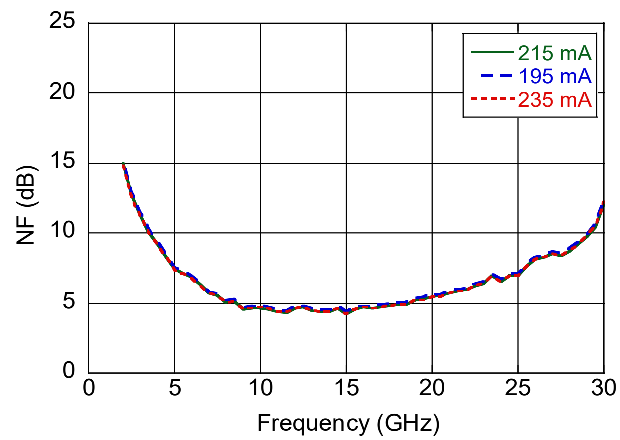
Noise Figure



Output IP3
(10 MHz Tone Spacing, P_{IN} = -10 dBm per tone)

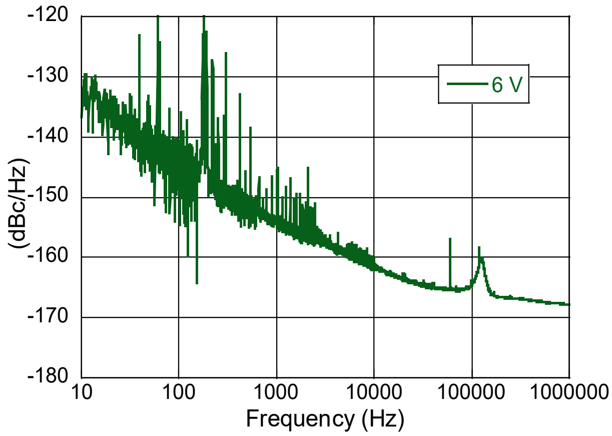


Noise Figure

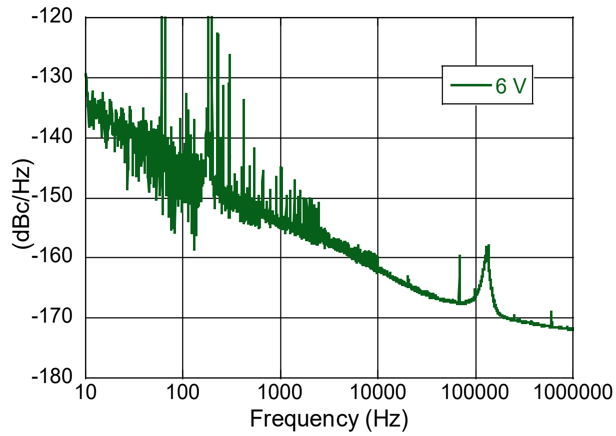


Typical Performance Curves[6]: I_{CC} = 135 mA, +25°C

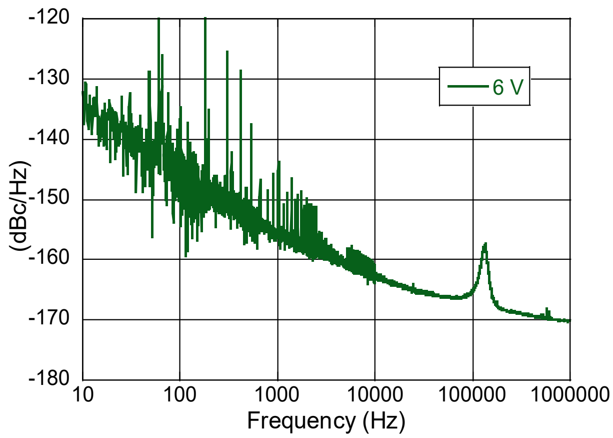
Phase Noise @ 4 GHz, P1dB



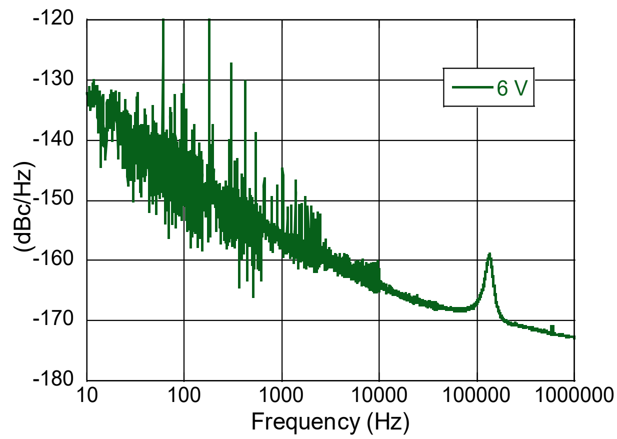
Phase Noise @ 4 GHz, P3dB



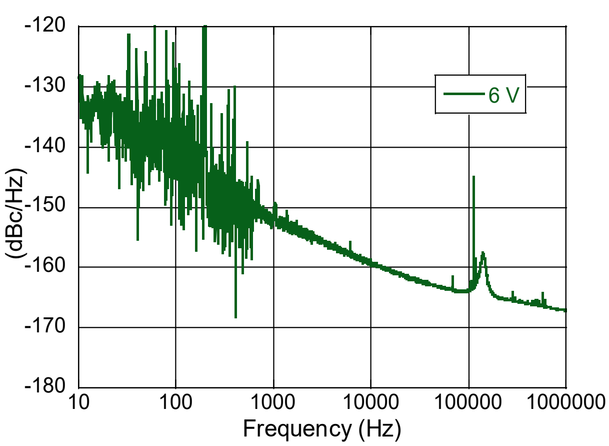
Phase Noise @ 12 GHz, P1dB



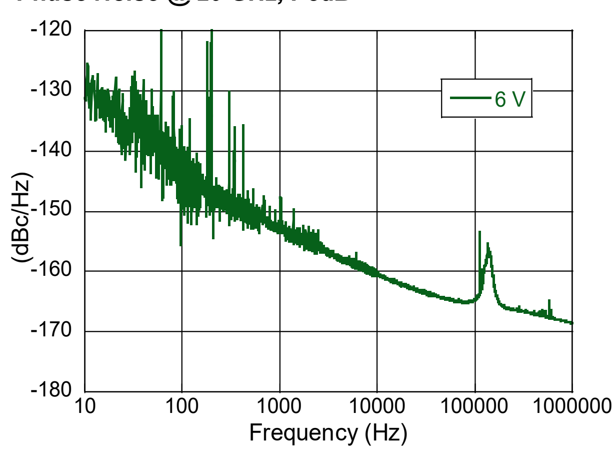
Phase Noise @ 12 GHz, P3dB



Phase Noise @ 20 GHz, P1dB



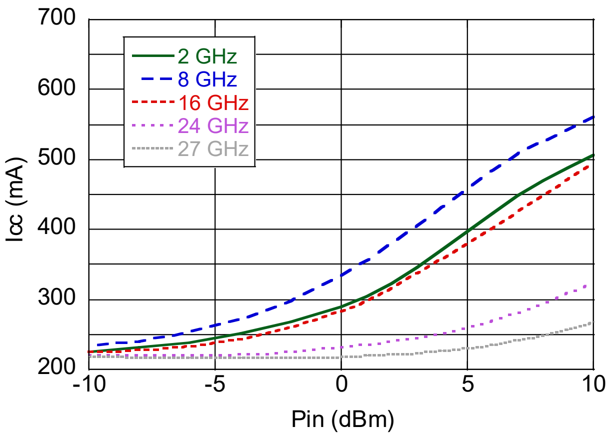
Phase Noise @ 20 GHz, P3dB



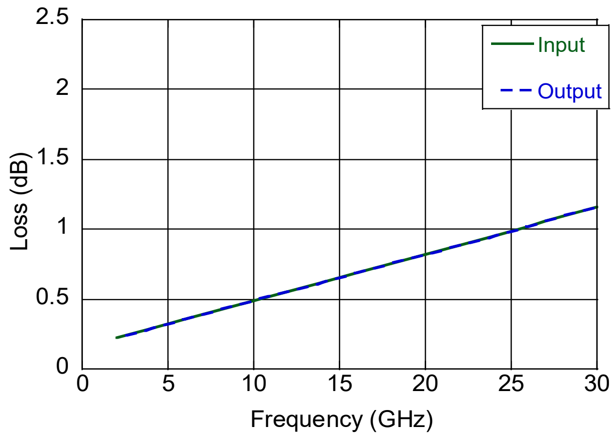
6. The aberration in the phase noise data at approximately 500MHz is due to the test equipment used and not the amplifier itself.

Typical Performance Curves: V_{CC} = 6 V, I_{CC} = 135 mA, +25°C

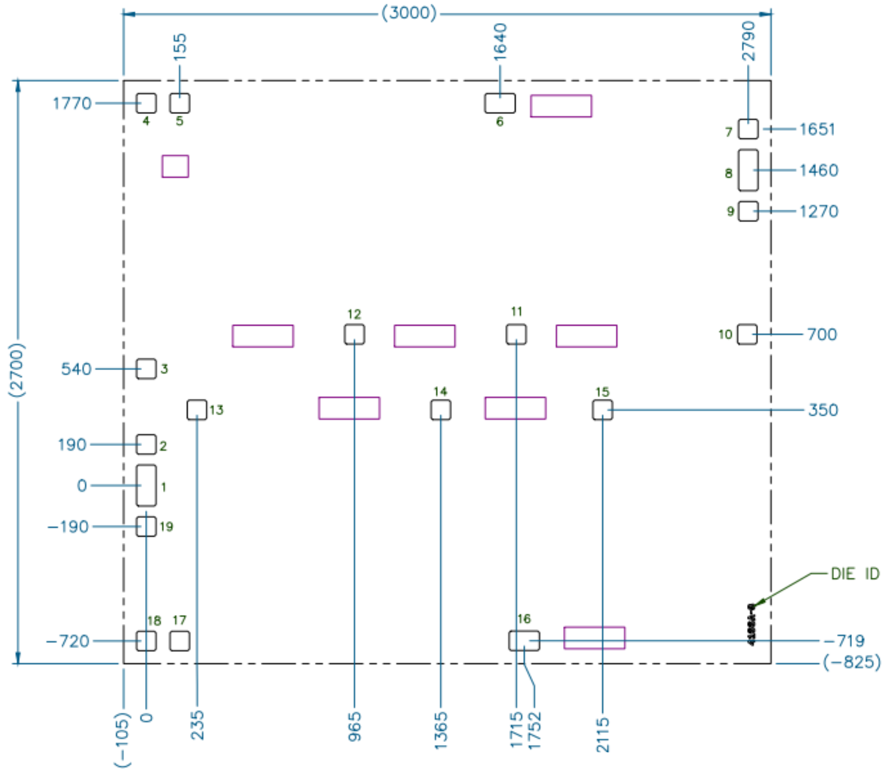
Bias Current vs Input Power



Test Board Loss including Connectors



MMIC Die Outline



BONDPAD DETAIL		
PAD	SIZE(x)	SIZE(y)
1,8	100	200
2,3,4,5,7,9, 10,11,12,13, 14,15,17,18,19	100	100
6,16	150	100

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.