Ultra Low Phase Noise Amplifier
6 - 12 GHz

MAAL-011155
Rev. V3

Features

- Wideband Performance
- Phase Noise: -167 dBc/Hz @ 10 kHz Offset
- Noise Figure: 5 dB @ 6 GHz
- Bias Voltage: 5 V
- Bias Current: 90 mA
- 50 Ω Matched Input / Output
- Positive Voltage Only
- Lead-Free 4 mm 16-lead PQFN Package
- RoHS* Compliant

Applications

- Test & Measurement, EW, ECM, and Radar

Description

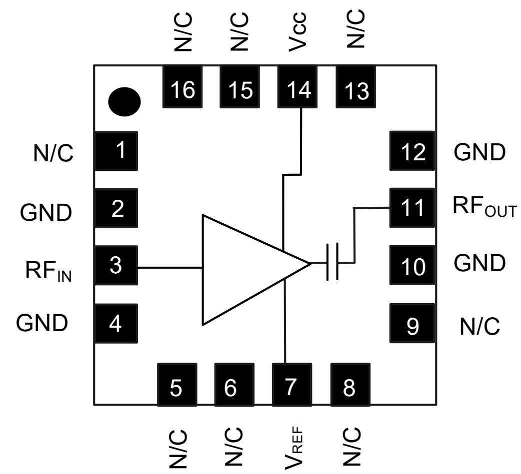
The MAAL-011155 is an easy to use, wideband ultra low phase noise distributed amplifier in a lead-free 4 mm 16-lead PQFN package. It operates from 6 to 12 GHz and provides -167 dBc/Hz phase noise, 15.6 dB of linear gain, 20 dBm of P1dB, and 5 dB of noise figure. The input and output are fully matched to 50 Ω with typical return loss of 16 dB.

The RF output port is DC blocked. Amplifier control is available through the use of a control circuit.

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

The MAAL-011155 can be used as a low noise amplifier stage for signal generation applications. This device is ideally suited for Test and Measurement, EW, ECM, and Radar applications where ultra low phase noise and drive power is required.

Functional Schematic



Pin Configuration

Pin #	Pin Name	Description
1,5,6,8,9,13,15,16	N/C[3]	No Connection
2,4,10,12	GND	Ground
3	RF_{IN}	RF Input
7	V_{REF}	Reference Voltage
11	RF_{OUT}	RF Output
14	V_{CC}	Collector Voltage
Paddle[4]	GND	Ground

3. MACOM recommends connecting unused package pins to ground.
4. The exposed pad centered on the package bottom must be connected to RF, DC and thermal ground.

Ordering Information[1,2]

Part Number	Package
MAAL-011155-TR0100	100 piece reel
MAAL-011155-SMB	Sample Board

1. Reference Application Note M513 for reel size information.
2. All sample boards include 3 loose parts.

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

Electrical Specifications: Freq. = 6 - 12 GHz, T_A = +25°C, V_{CC} = +5 V, Z_0 = 50 Ω

Parameter	Test Conditions	Units	Min.	Typ.	Max.
Gain	P_{IN} = -15 dBm 6 GHz 9 GHz 12 GHz	dB	13.5 13.0 12.5	16.0 15.5 15.0	—
Gain Flatness	—	dB	—	±0.4	—
Gain Variation over Temperature	—	dB/°C	—	0.017	—
Output Power	P_{IN} = 5.0 dBm, 6 GHz P_{IN} = 4.7 dBm, 9 GHz P_{IN} = 3.0 dBm, 12 GHz	dBm	17.0 17.0 14.5	20.0 20.0 17.5	—
Noise Figure	—	dB	—	5	—
Input Return Loss	—	dB	—	16	—
Output Return Loss	—	dB	—	16	—
P1dB	6 GHz	dBm	—	20	—
P3dB	6 GHz	dBm	—	23	—
OIP3	6 GHz, -10 dBm per tone	dBm	—	31.5	—
Phase Noise	6 GHz, P1dB 100 Hz 1 kHz 10 kHz 1 MKz	dBc/Hz	—	146 160 167 175	—
Icq	—	mA	—	90	—

Maximum Operating Conditions

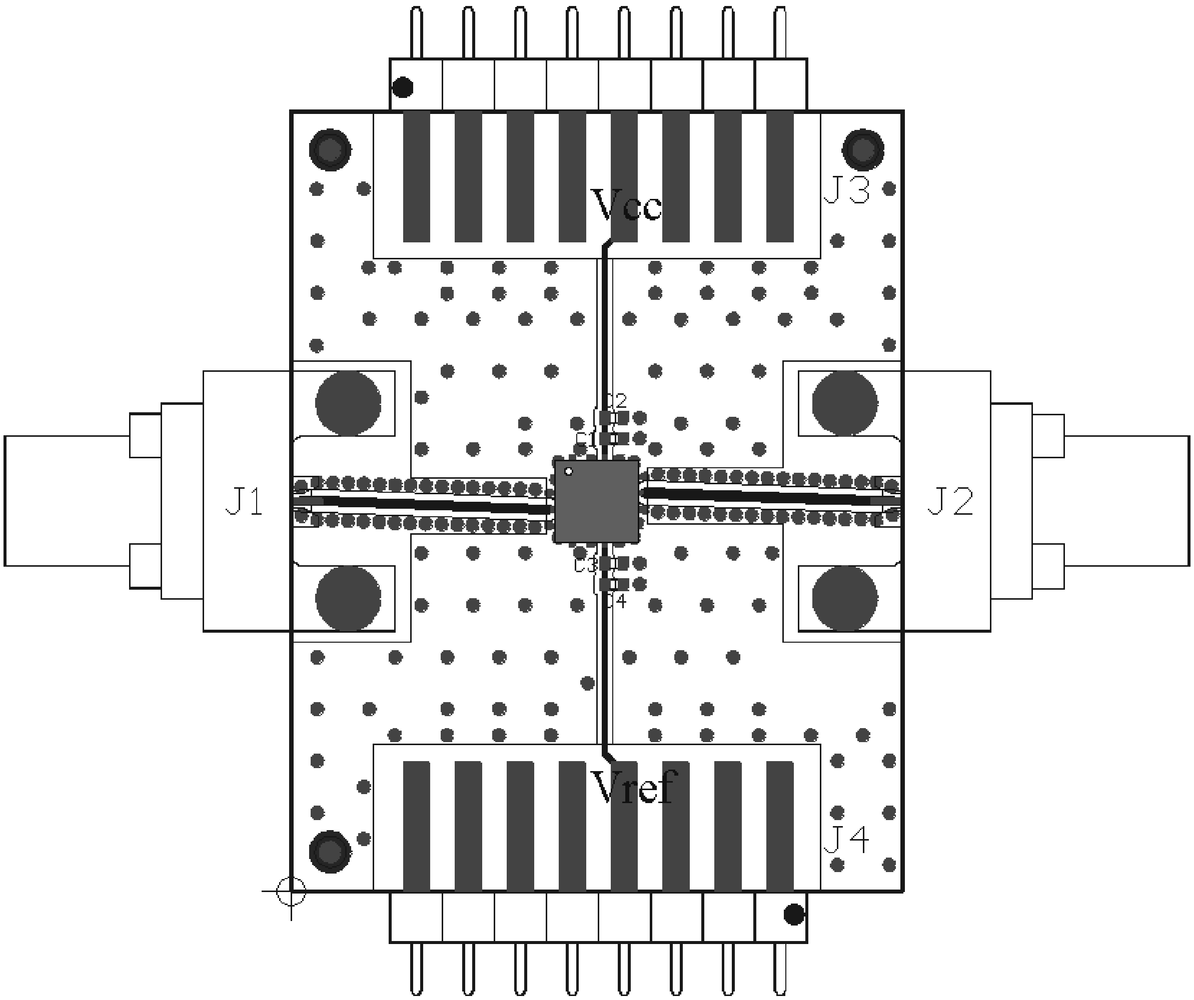
Parameter	Maximum
P_{IN}	12 dBm
V_{CC}	6 V
Icq	105 mA
Junction Temperature[5,6]	+130°C
Operating Temperature	-40°C to +85°C
Storage Temperature	-40°C to +150°C

Absolute Maximum Ratings[7,8]

Parameter	Absolute Maximum
Input Power	20 dBm
V_{CC}	6.5 V
Icq	170 mA
Junction Temperature[5,6]	+150°C
Operating Temperature	-40°C to +85°C
Storage Temperature	-40°C to +150°C

5. Operating at nominal conditions with $T_J \leq$ +150°C will ensure MTTF > 1 x 10^6 hours.
6. Junction Temperature (T_J) = T_C + Θjc * (V * I)
   Typical thermal resistance (Θjc) = 21.0°C/W.
   a) For T_C = +25°C,
      T_J = 38.2°C @ 6 V, 105 mA
   b) For T_C = +85°C,
      T_J = 98.2°C @ 6 V, 105 mA
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.

PCB Layout



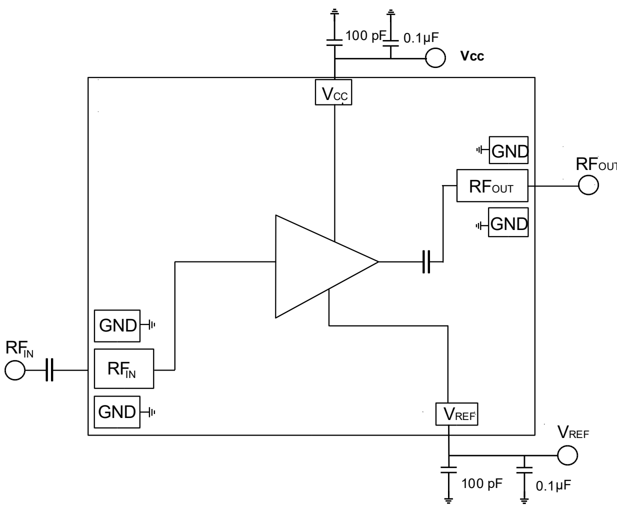
Parts List

Part	Value	Case Style
C1,C3	100 pF	0402
C2,C4	0.1 µF	0402

Evaluation PCB Specifications

Top Layer: 1 oz Copper Cladding, 0.034 mm thickness
Dielectric Layer: Rogers RO4350B 0.245 mm thickness
Bottom Layer: 1 oz Copper Cladding, 0.034 mm thickness
Finished overall thickness: 0.313 mm

Application Schematic



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 devices.

Operation

The technology is HBT; so, the turn-on and turn-off procedure is fairly simple.

To turn-on simply:

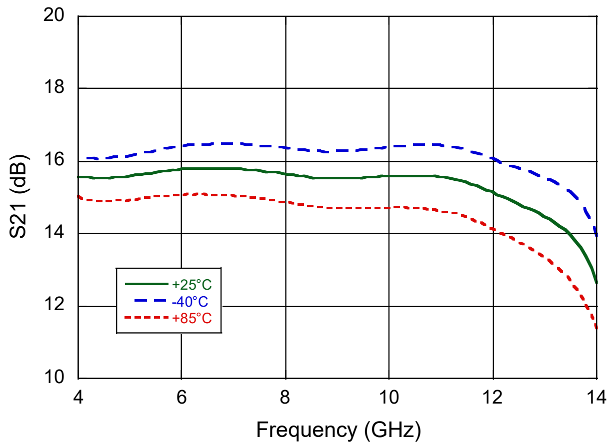
1. Apply +5 V to V_{CC}
2. Starting at 0 V, adjust V_{REF} for target I_{CC}

To turn-off:

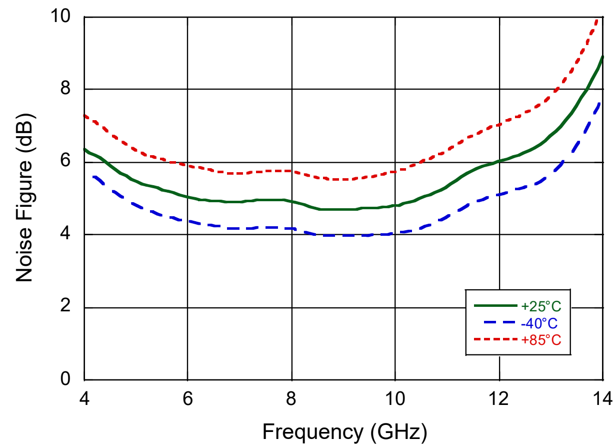
1. Set V_{REF} to 0 V
2. Set V_{CC} to 0 V

Typical Performance Curves: V_{CC} = 5 V, I_{CC} = 90 mA

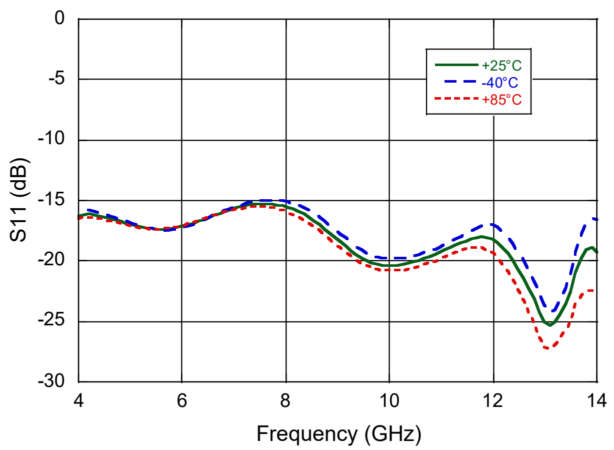
Gain



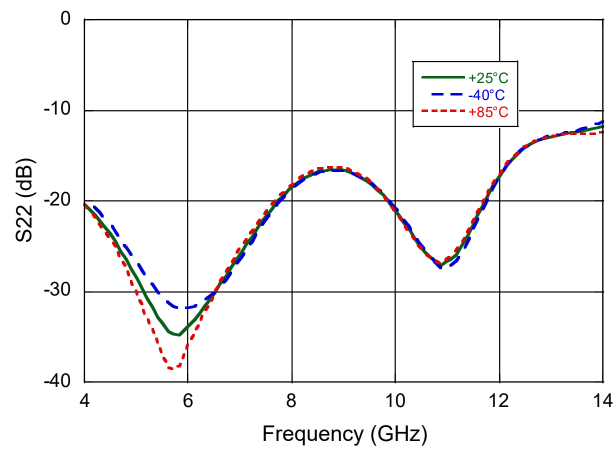
Noise Figure



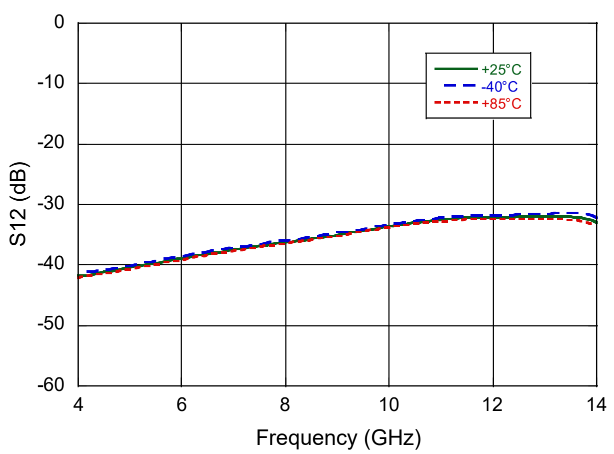
Input Return Loss



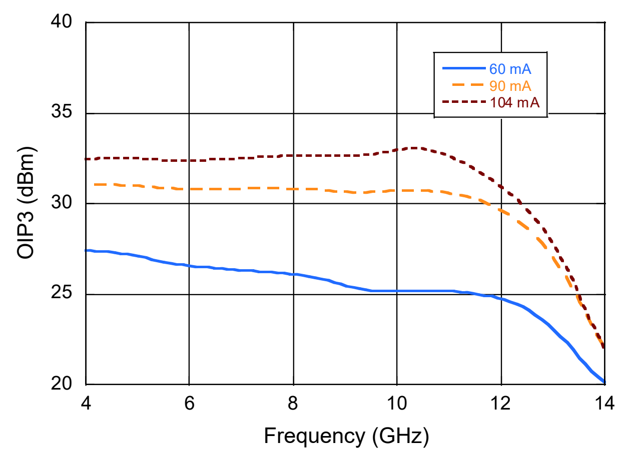
Output Return Loss



Reverse Isolation

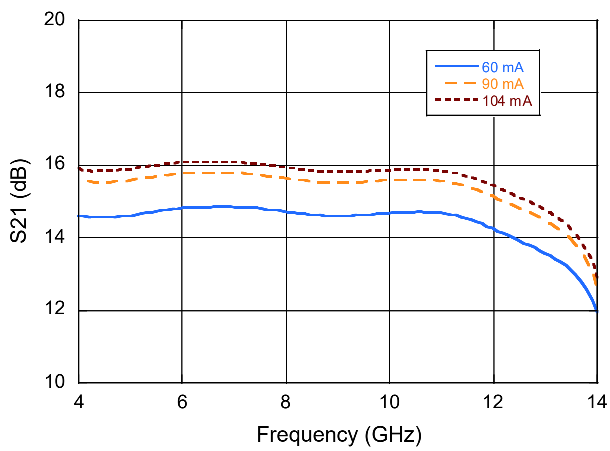


Output IP3
(10 MHz Tone Spacing, P_{IN} = -10 dBm per tone)

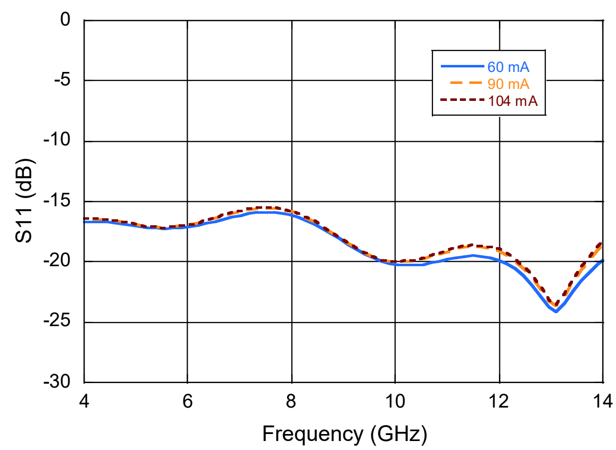


Typical Performance Curves: V_{CC} = 5 V, +25°C

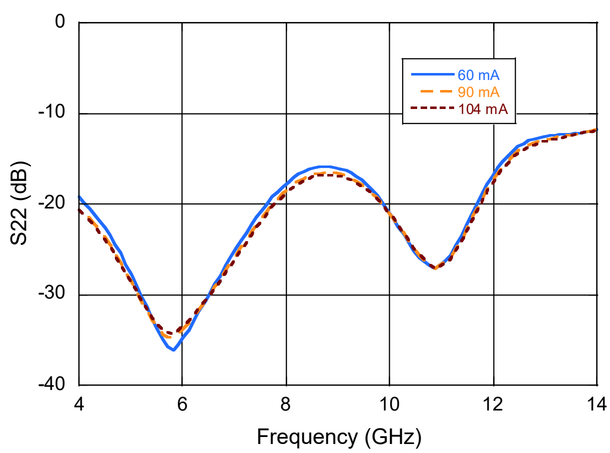
Gain



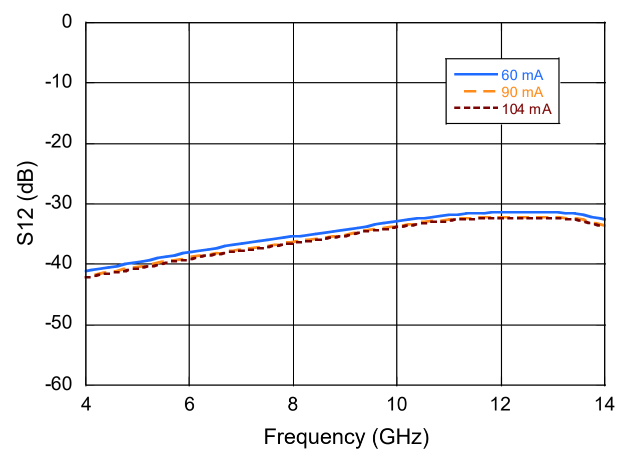
Input Return Loss



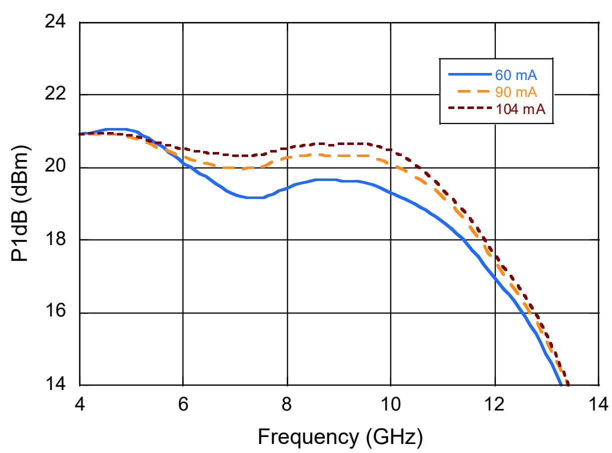
Output Return Loss



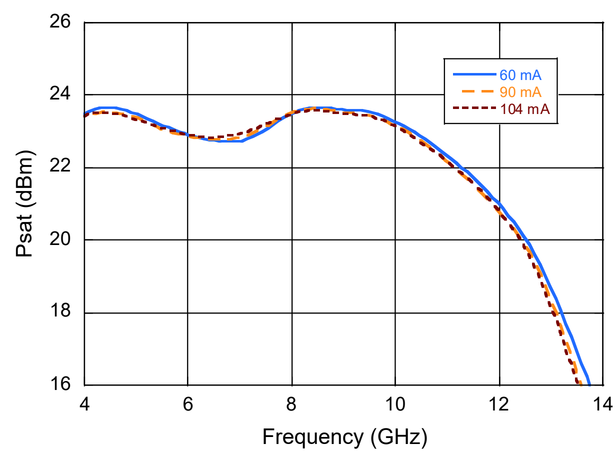
Reverse Isolation



P1dB

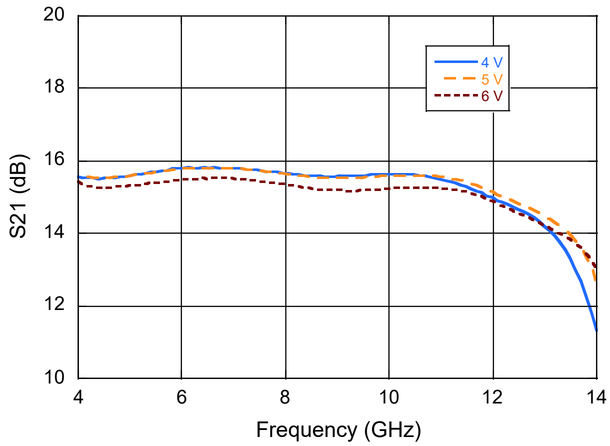


P_{SAT}

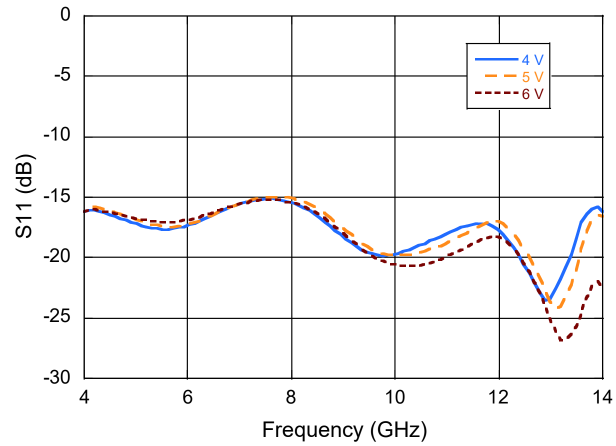


Typical Performance Curves: I_{CC} = 90 mA, +25°C

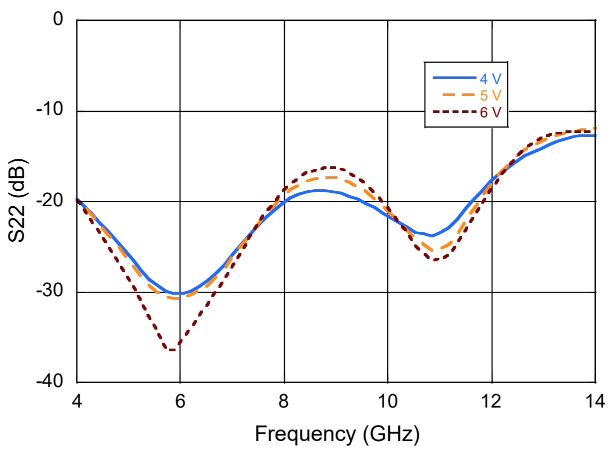
Gain



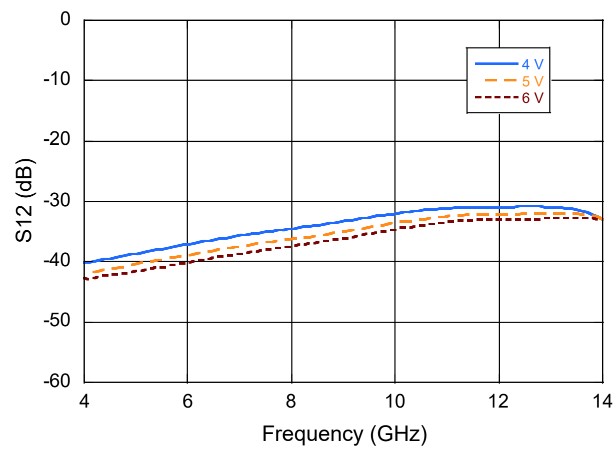
Input Return Loss



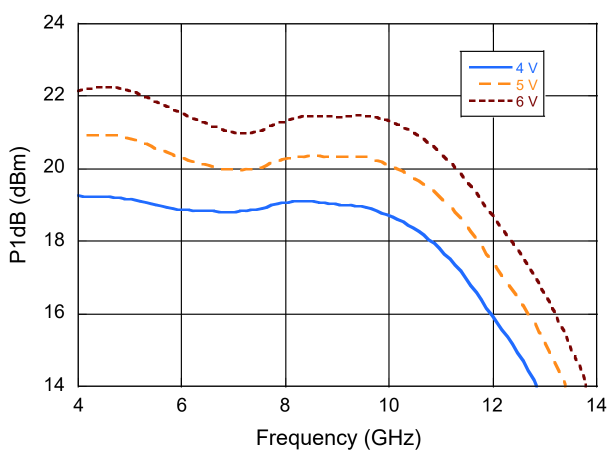
Output Return Loss



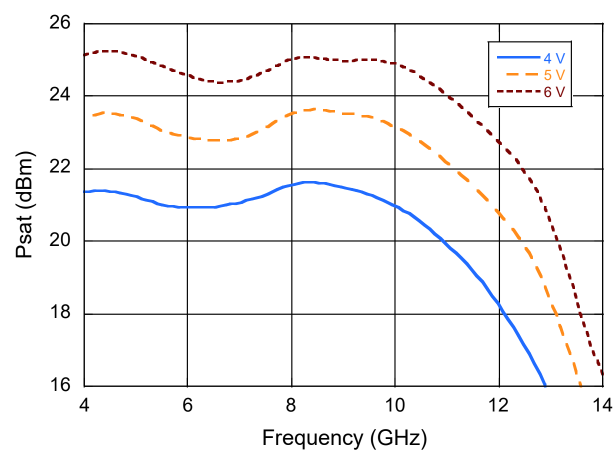
Reverse Isolation



P1dB

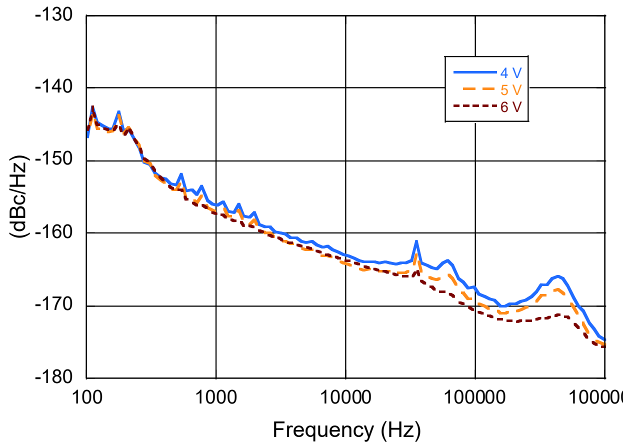


P_{SAT}

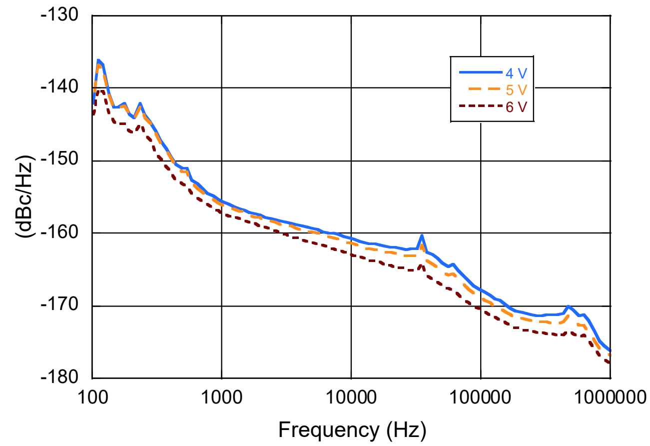


Typical Performance Curves: I_{CC} = 90 mA, +25°C

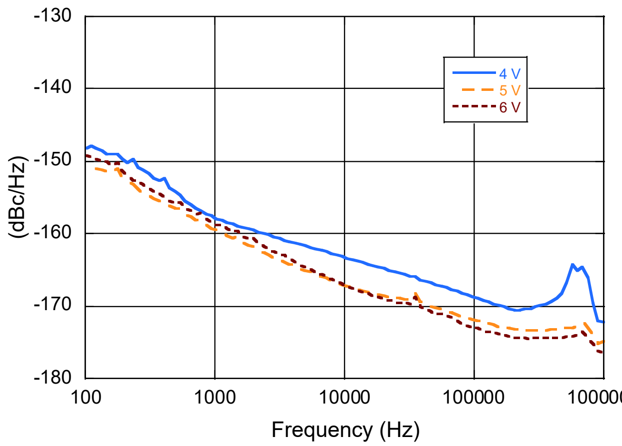
Phase Noise @ 6 GHz, P1dB



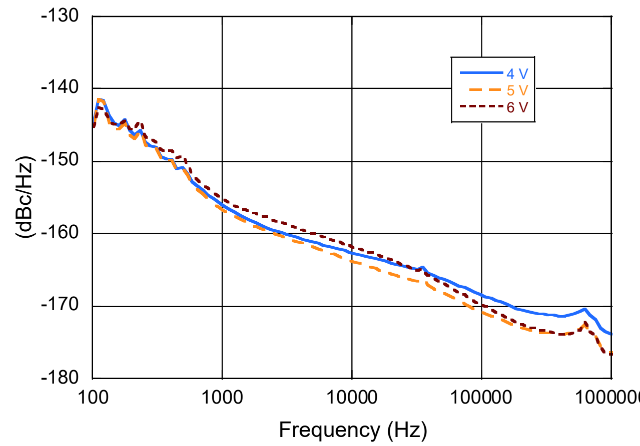
Phase Noise @ 6 GHz, P4dB



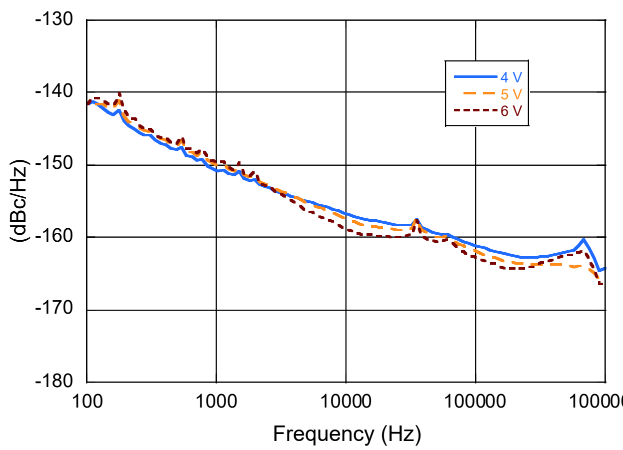
Phase Noise @ 9 GHz, P1dB



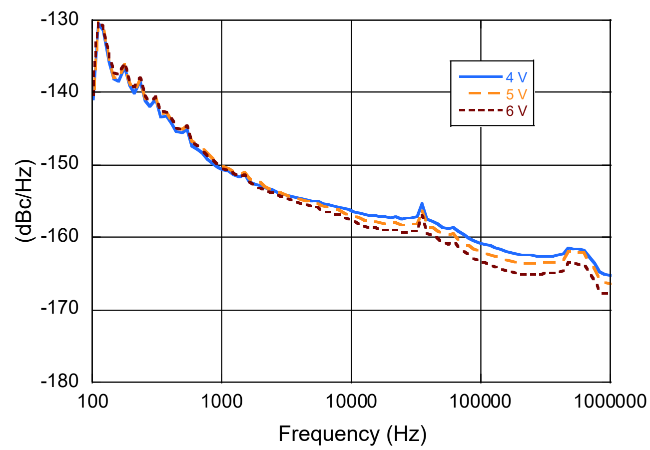
Phase Noise @ 9 GHz, P4dB



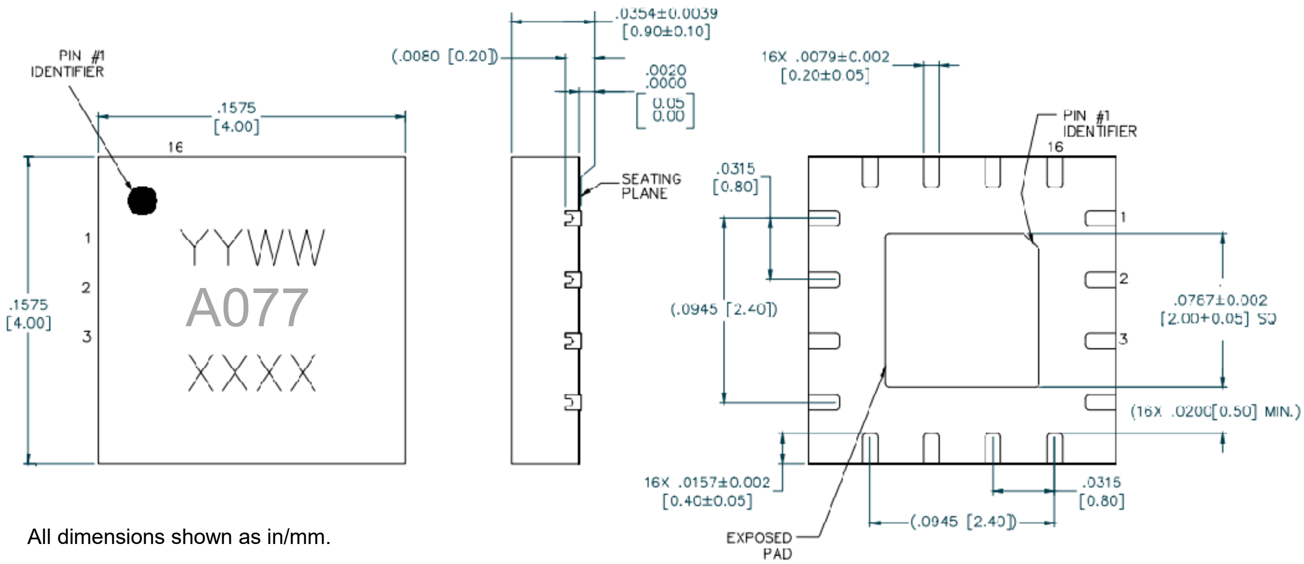
Phase Noise @ 12 GHz, P1dB



Phase Noise @ 12 GHz, P4dB



Lead-Free 4 mm 16-Lead PQFN Package



All dimensions shown as in/mm.

† Reference Application Note S2083 for lead-free solder reflow recommendations.
Meets JEDEC moisture sensitivity level 1 requirements.
Plating is NiPdAuAg.