Wideband Distributed Amplifier
100 kHz - 67.5 GHz

MAAM-011238-DIE
Rev. V4

Features

- Gain: 14 dB @ 6 V, 30 GHz
- P1dB: 18 dBm @ 6 V, 30 GHz
- P3dB: 20 dBm @ 6 V, 30 GHz
- Integrated Power Detector
- Gain Control with Only Positive Bias Voltages
- 50 Ω Input and Output Match
- Bias Voltage: V_{DD} = 4 - 6 V
- Bias Current: I_{DSQ} = 125 - 150 mA
- Die size: 2.1 x 1.05 mm
- RoHS* Compliant

Description

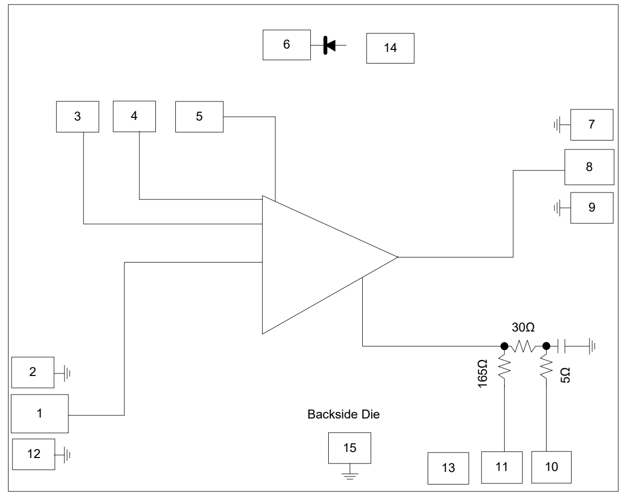
MAAM-011238-DIE is an easy-to-use, wideband amplifier that operates from 100 kHz to 67.5 GHz. The amplifier provides 14 dB gain, 4.5 dB noise figure and 20 dBm of P3dB output power @ 30 GHz. It is matched to 50 Ω with typical return loss better than 12 dB. The amplifier requires only positive bias voltages and would typically be operated at 6 V and 135 mA.

MAAM-011238-DIE is suitable for a wide range of applications in instrumentation and communication systems.

Ordering Information

Part Number	Package
MAAM-011238-DIE	Die in Gel Pak

Functional Schematic



Pad Configuration[1]

Pin #	Pin Name	Description
1	RF_{IN}	RF Input / Gate Voltage
2, 7, 9, 12,15	GND	DC & RF Ground to Backside Via
3	V_G2	Gate Voltage 2
4	V_{DD}	Drain Voltage
5	VD_{AUX}	Auxiliary Drain Voltage
6	V_{DET}	Detector Voltage
8	RF_{OUT}	RF Output / Drain Voltage
10	VG_{AUX}	Auxiliary Gate Voltage
11	V_G1	Gate Voltage 1
13,14	NC	Not Connected

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: T_C = +25°C, V_D = 6 V, Z_0 = 50 Ω

Parameter	Test Conditions	Units	Min.	Typ.	Max.
Gain	0.0001 - 10 GHz 10 - 20 GHz 20 - 30 GHz 30 - 40 GHz 40 - 50 GHz 50 - 60 GHz 60 - 67.5 GHz	dB	14 13.8 13.3 12.5 11.5 — —	15.9 15.5 15.0 14.0 13.0 11.5 7.0	—
Noise Figure	2.8 - 10 GHz 10 - 20 GHz 20 - 30 GHz 30 - 40 GHz 40 - 50 GHz	dB	—	6.0 4.1 4.7 6.0 9.0	—
Input Return Loss	0.0001 - 10 GHz 10 - 20 GHz 20 - 30 GHz 30 - 40 GHz 40 - 67.5 GHz	dB	—	18.0 17.0 17.0 16.6 15.0	—
Output Return Loss	0.0001 - 10 GHz 10 - 20 GHz 20 - 30 GHz 30 - 40 GHz 40 - 67.5 GHz	dB	—	17.0 15.0 13.0 13.5 12.0	—
P1dB	40 GHz	dBm	15	17.6	—
P3dB	0.0001 - 10 GHz 10 - 20 GHz 20 - 30 GHz 30 - 40 GHz 40 - 50 GHz 50 - 60 GHz 60 - 67.5 GHz	dBm	—	22.0 21.0 20.0 19.0 18.0 16.0 14.0	—
Output IP3	0.0001 - 10 GHz 10 - 20 GHz 20 - 30 GHz 30 - 40 GHz 40 - 50 GHz 50 - 60 GHz 60 - 67.5 GHz	dBm	—	29.0 28.0 27.0 26.5 25.0 22.0 16.0	—
Drain Current	Quiescent Bias	mA	—	135	—

Electrical Specifications: T_C = +25°C, V_D = 5 V, Z_0 = 50 Ω

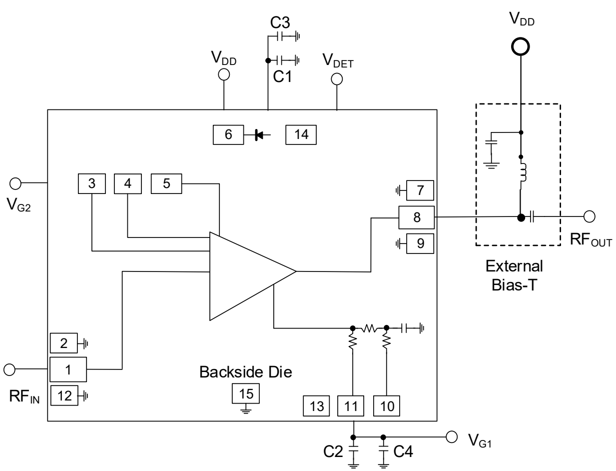
Parameter	Test Conditions	Units	Min.	Typ.	Max.
Gain	0.0001 - 10 GHz 10 - 20 GHz 20 - 30 GHz 30 - 40 GHz 40 - 50 GHz 50 - 60 GHz 60 - 67.5 GHz	dB	—	16.5 16.0 16.0 16.0 16.0 15.0 12.0	—
Noise Figure	2.8 - 10 GHz 10 - 20 GHz 20 - 30 GHz 30 - 40 GHz 40 - 50 GHz	dB	—	6.0 4.1 4.7 6.0 9.0	—
Input Return Loss	0.0001 - 10 GHz 10 - 20 GHz 20 - 30 GHz 30 - 40 GHz 40 - 67.5 GHz	dB	—	18.0 17.0 17.0 16.6 15.0	—
Output Return Loss	0.0001 - 10 GHz 10 - 20 GHz 20 - 30 GHz 30 - 40 GHz 40 - 67.5 GHz	dB	—	17.0 15.0 13.0 13.5 12.0	—
P1dB	0.0001 - 10 GHz 10 - 20 GHz 20 - 30 GHz 30 - 40 GHz 40 - 50 GHz 50 - 60 GHz 60 - 67.5 GHz	dBm	—	18.0 17.6 17.0 17.5 15.5 15.0 14.0	—
P3dB	0.0001 - 10 GHz 10 - 20 GHz 20 - 30 GHz 30 - 40 GHz 40 - 50 GHz 50 - 60 GHz 60 - 67.5 GHz	dBm	—	21.5 21.0 19.5 18.5 17.5 17.0 16.0	—
Output IP3	0.0001 - 10 GHz 10 - 20 GHz 20 - 30 GHz 30 - 40 GHz 40 - 50 GHz 50 - 60 GHz 60 - 67.5 GHz	dBm	—	25.0 26.0 25.5 25.5 24.0 22.5 17.0	—
Drain Current	Quiescent bias	mA	—	150	—

Absolute Maximum Ratings[3,4]

Parameter	Absolute Maximum
Input Power	16 dBm
Drain Supply Voltage	8 V
Junction Temperature[5,6]	+150°C
Operating Temperature	-40°C to +85°C
Storage Temperature	-65°C to +150°C

3. Exceeding any one or combination of these limits may cause permanent damage to this device.
4. MACOM does not recommend sustained operation near these survivability limits.
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_A + Θ_{JC} * ((V * I) - (P_{OUT} - P_{IN}))
   Typical thermal resistance (Θ_{JC}) = 22.1 °C/W.
   For T_A = +85°C,
   T_J = +103 °C at V = 6 V, I = 0.135 A

Application Schematic



Component List

Part	Value	Size	Part Number
C1, C2	1200 pF	25 mil	TECDIA SKT03C122V12A6
C3, C4	10 µF	0603	any

Operating Conditions

One of the recommended biasing conditions is V_{DD} = 6 V, I_{DSQ} = 135 mA. (controlled with V_{G1}). I_{DSQ} is set by adjusting V_{G1} after correctly setting V_{DD}. (Refer to turn on sequence.)

There are 3 possible bias methods:

1. The use of an external DC block on the input and a bias tee. The required V_{DD} is applied at RF_{OUT}/V_{DD} through the bias tee and V_G is set to provide the required current bias (I_{DSQ}) This provides wide band performance of 40 MHz - 67.5 GHz. (depending on the bandwidth of the bias tee)

2. The direct application of drain voltage to V_{DD} using a wideband conical. No external bias tee is required. However DC blocking is required on both the RF_{IN} and RF_{OUT}. Using this method provides for an operational frequency of 40 MHz - 67.5 GHz.

3. For compatibility with systems requiring V_G1 > 3 V VG_{AUX} can be grounded.
   Note that this configuration will cause I_G1 to be 21 mA (instead of 0.65 V @ 1 mA).

For low frequency extension, the addition of 2 bypass capacitors on V_{G1} and VD_{AUX} of 1200 pF and 10 µF will improve the frequency of operation down to 100 kHz.. These capacitors should be positioned as close to the device as possible.

Dynamic gain control is available when operating in the linear gain region through the application of 0 to 1.6 V to V_{G2}.

The evaluation board is configured with bias option 1. Bypass capacitors on V_G1 and V_{AUX} are also included for operation down to 100 kHz. Data in this datasheet was measured using option 1.

Operating the MAAM-011238-DIE

Turn-on

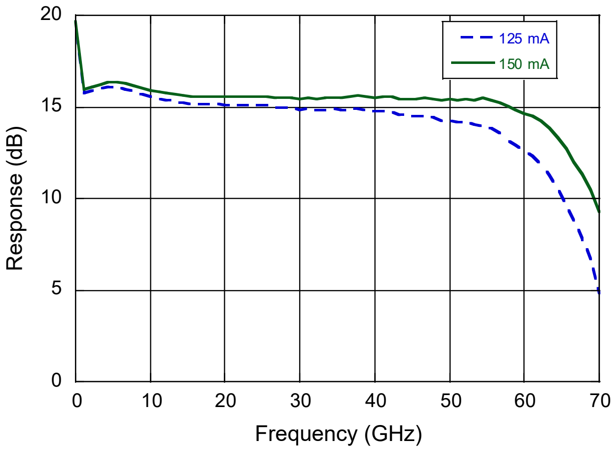
1. Apply V_G1 to 0 V.
2. Apply V_{DD} to 6 V.
3. Set I_{DSQ} by adjusting V_G1 more positive. (typically 0.65 V for I_{DSQ} = 135 mA).
4. Apply RF_{IN} signal.

Turn-off

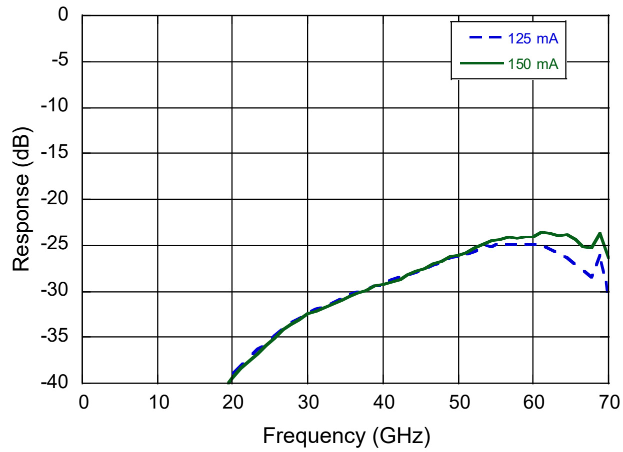
1. Remove RF_{IN} signal.
2. Decrease V_G1 to 0 V.
3. Decrease V_{DD} to 0 V.

Typical Performance Curves: V_D = 6 V, T_A = +25°C

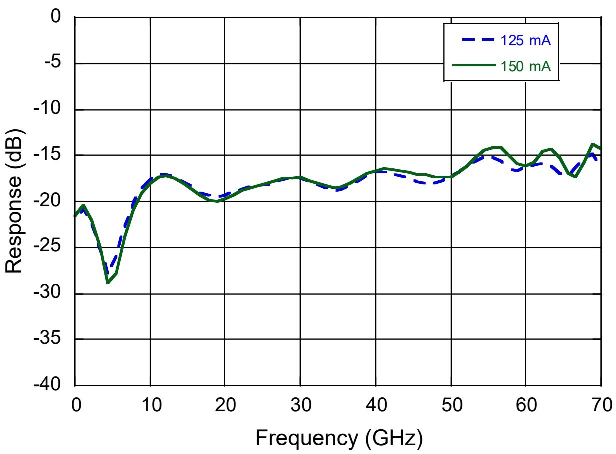
Gain



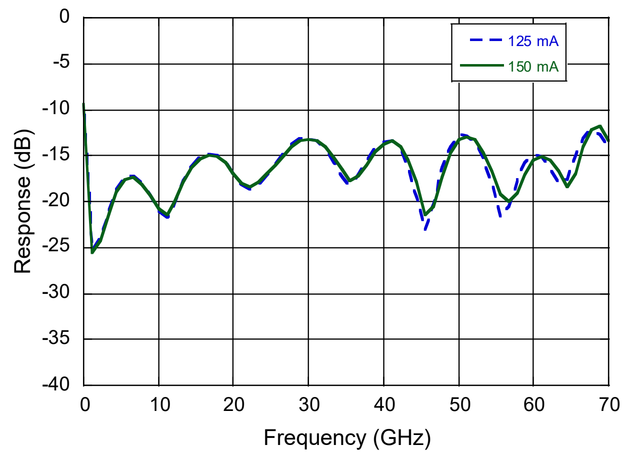
Reverse Isolation



Input Return Loss

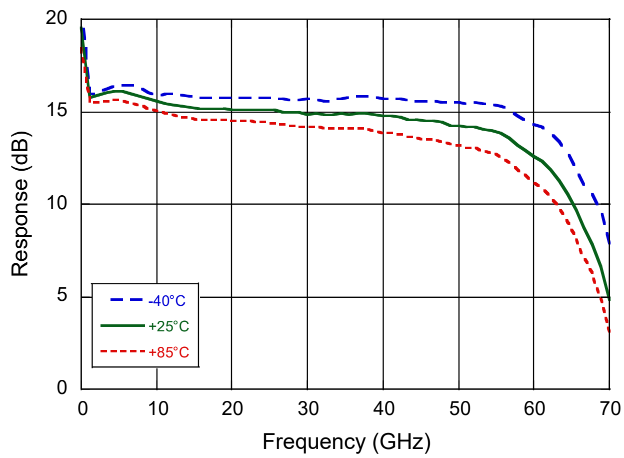


Output Return Loss

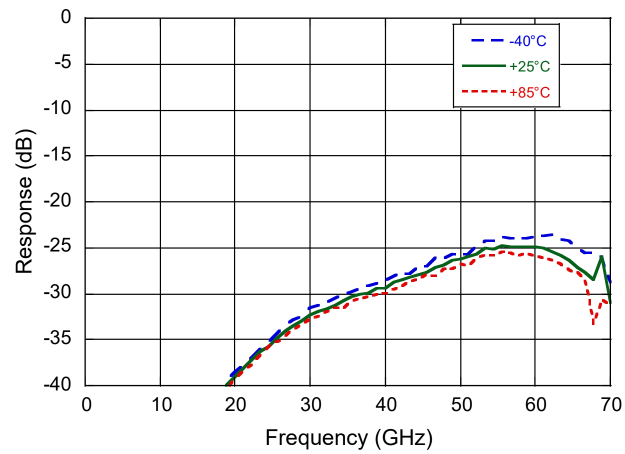


Typical Performance Curves: V_D = 6 V, I_D = 125 mA

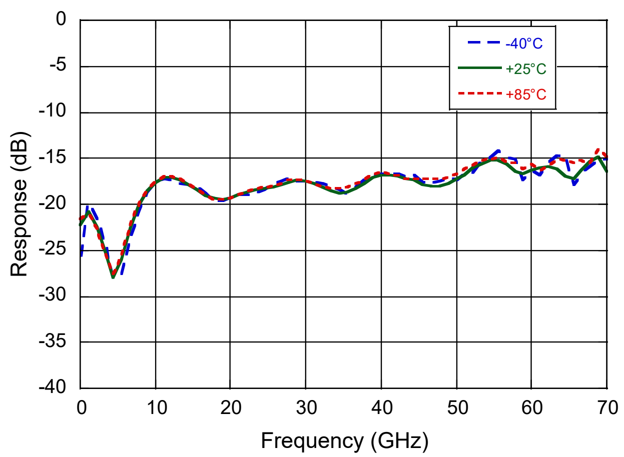
Gain



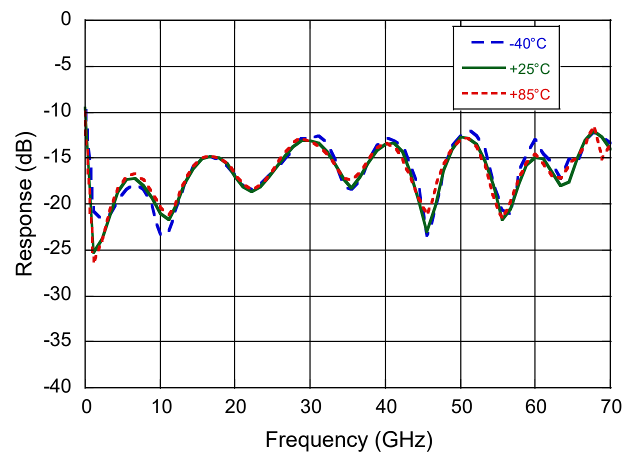
Reverse Isolation



Input Return Loss

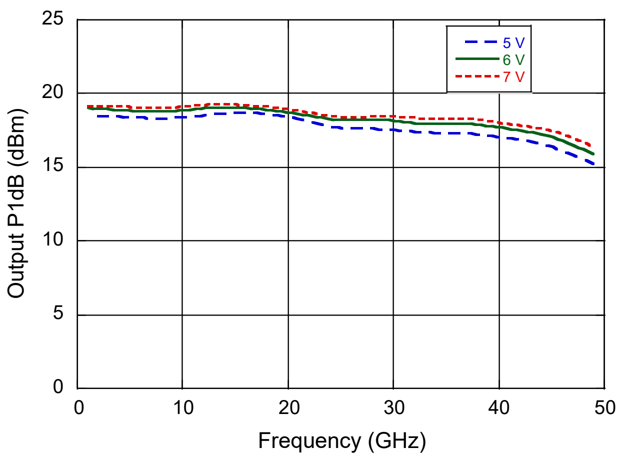


Output Return Loss

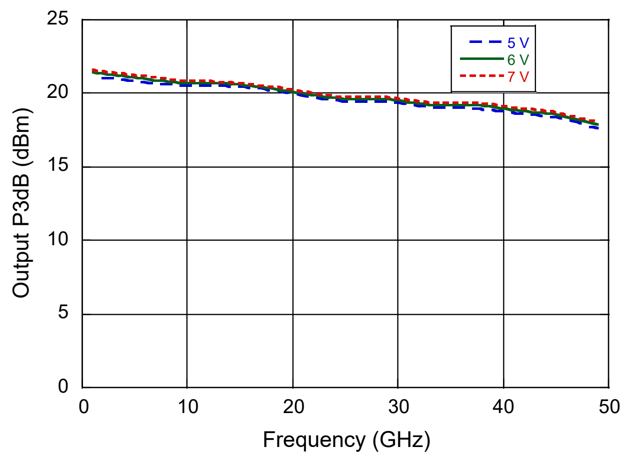


Typical Performance Curves: V_D = 6 V, I_D = 135 mA, T_A = +25°C

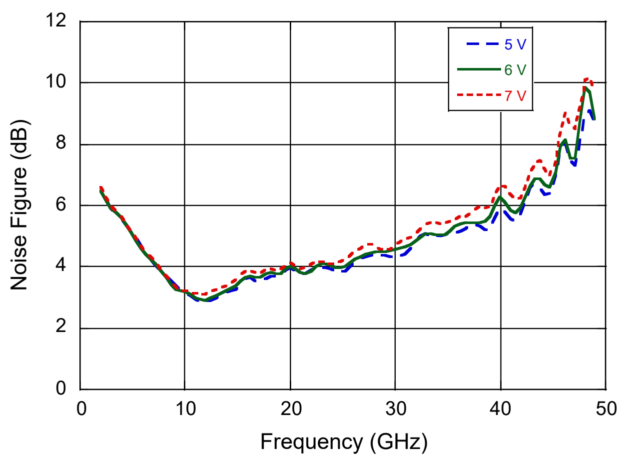
Output P1dB



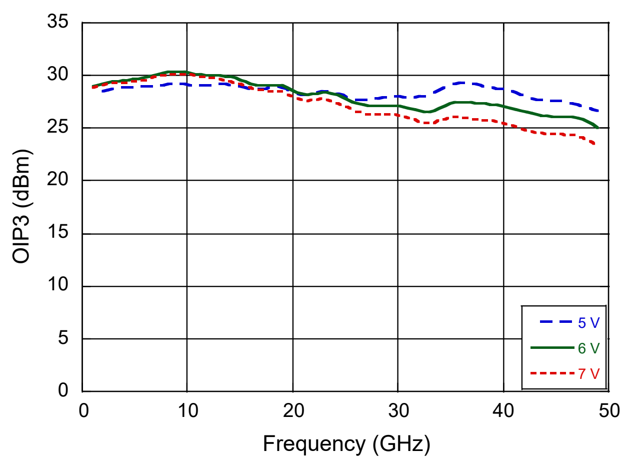
Output P3dB



Noise Figure at T_A = 25°C

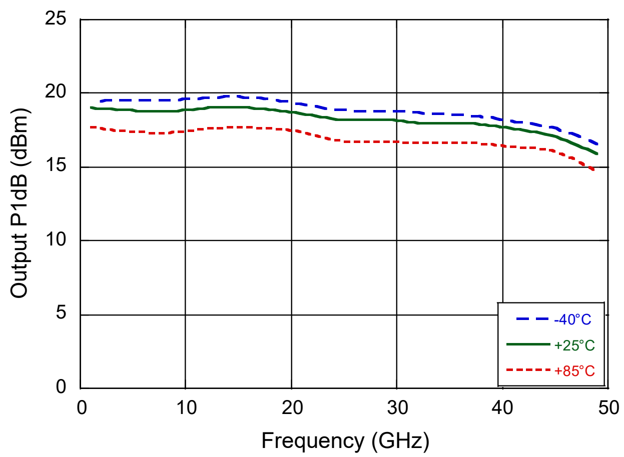


OIP3 at T_A = 25°C

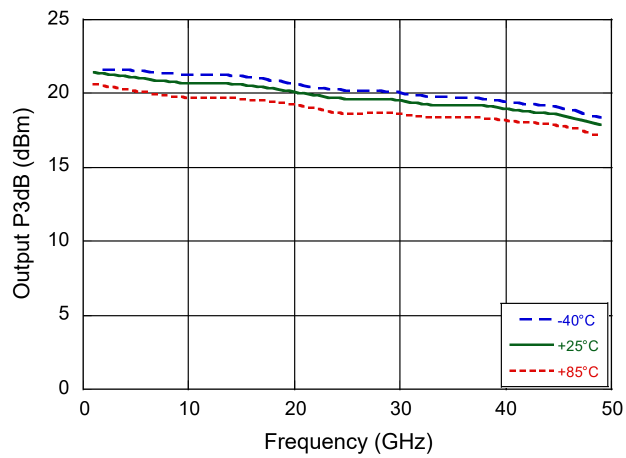


Typical Performance Curves: V_D = 6 V, I_D = 135 mA

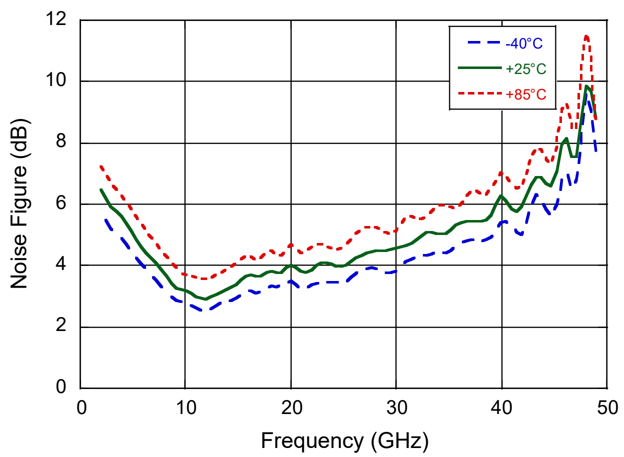
Output P1dB



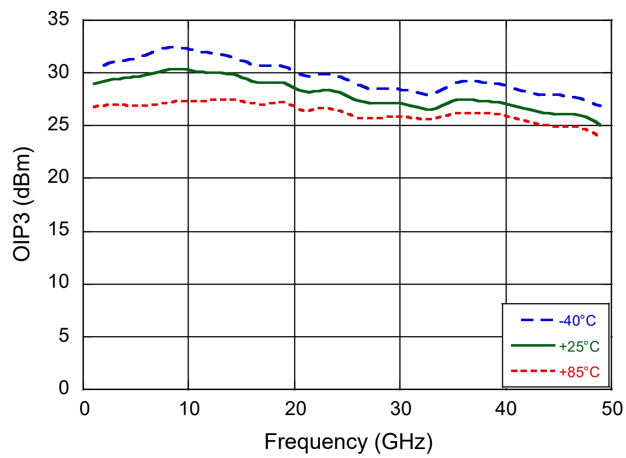
Output P3dB



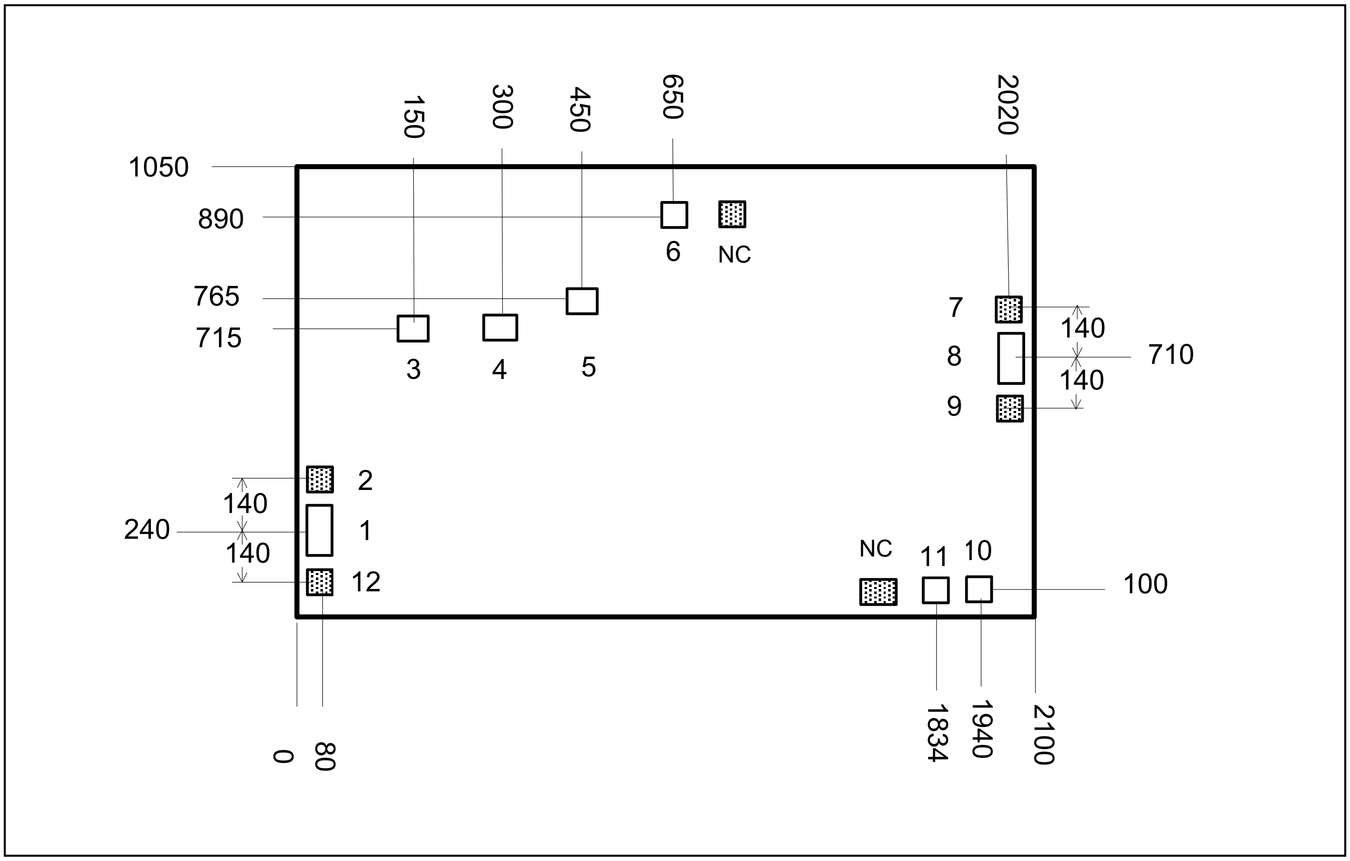
Noise Figure



OIP3



Die Dimensions[7,8]



Bond Pad Detail

Pin #	Size (x)	Size (y)
1	99	155
2, 6,10,11,12	69	69
3, 4, 5	69	89
7,9	89	69
8	69	168

7. All dimensions shown as microns (µm) with a tolerance of +/-5 µm, unless otherwise noted.
8. Die thickness is 100 µm +/- 10 µm.

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 1C devices.