Features

- High Gain: 11.5 dB
- P1dB: 27 dBm
- P3dB: 28 dBm
- Output IP3: 35 dBm
- Bias Voltage: V_{DD} = 10 V
- Bias Current: I_{DSQ} = 250 mA
- 50 Ω Matched Input / Output
- Temperature Compensated Output Power Detector
- Die Size: 2800 x 1300 x 100 µm
- RoHS* Compliant

Applications

- Test & Measurement, EW, ECM, and Radar

Description

The MAAP-011325-DIE is a 0.25 W distributed power amplifier offered in die form. The power amplifier operates from DC to 40 GHz and provides 11.5 dB of linear gain and 28 dBm of output power at 3-dB compression. The device is fully matched across the band and includes a temperature compensated output power detector.

The MAAP-011325-DIE can be used as a power amplifier stage or as a driver stage in higher power applications. This device is ideally suited for test and measurement, EW, ECM, and radar applications.

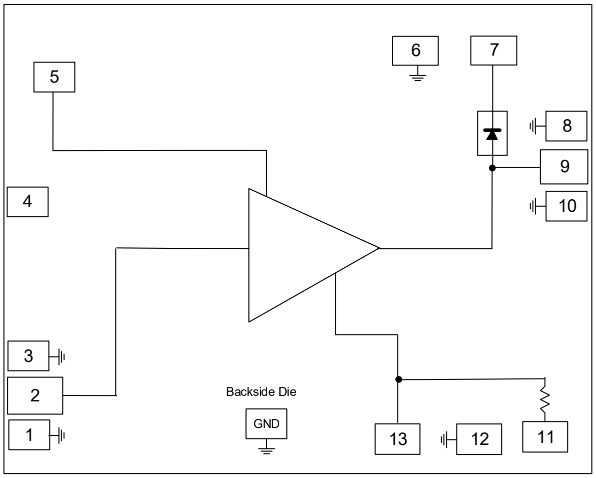
This product is fabricated using a GaAs pHEMT process which features full passivation for enhanced reliability.

Ordering Information[1,2]

Part Number	Package
MAAP-011325-DIE	Bulk
MAAP-011325-DIESMB	Sample Board

1. Reference Application Note M513 for reel size information.
2. All sample boards include 5 loose parts

Functional Schematic



Pin Configuration[3]

Pin #	Pin Name	Description
1, 3, 6, 8, 10,12	GND	Ground
2	RF_{IN}	RF Input
4	Not Used	Not Used
5	VD_AUX	Vd_Auxiliary
7	DET	Power Detector
9	RF_{OUT}/V_{DD}	RF Output / Drain Voltage
11	VG_AUX	Vg_Auxiliary
13	V_G	Gate Voltage

3. 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_A = +25°C, V_{DD} = 10 V, I_{DSQ} = 250 mA, Z_0 = 50 Ω

Parameter	Test Conditions	Units	Min.	Typ.	Max.
Gain	2 GHz 22 GHz 40 GHz	dB	9.0 9.0 5.2	11.5 11.0 7.0	—
P3dB	2 GHz 22 GHz 40 GHz	dBm	—	30.0 27.5 22.0	—
P1dB	2 GHz 22 GHz 35 GHz 40 GHz	dBm	26.5 — 21.0 —	29.0 26.5 23.5 21.5	—
OIP3	P_{out} = +18 dBm/tone (10 MHz Tone Spacing) 2 GHz 22 GHz 40 GHz	dBm	—	46.5 37.0 31.0	—
PAE	@ P3dB 2 GHz 22 GHz 40 GHz	%	—	29 24 5	—
Input Return Loss	P_{IN} = -10 dBm	dB	—	10	—
Output Return Loss	P_{IN} = -10 dBm	dB	—	10	—
I_{DD} (with RF drive)	P_{IN} = +12 dBm	mA	—	300	—
I_G	—	mA	—	1	—

Maximum Operating Ratings

Parameter	Rating
Input Power	22 dBm
Junction Temperature[4,5]	+150°C
Operating Temperature	-40°C to +85°C

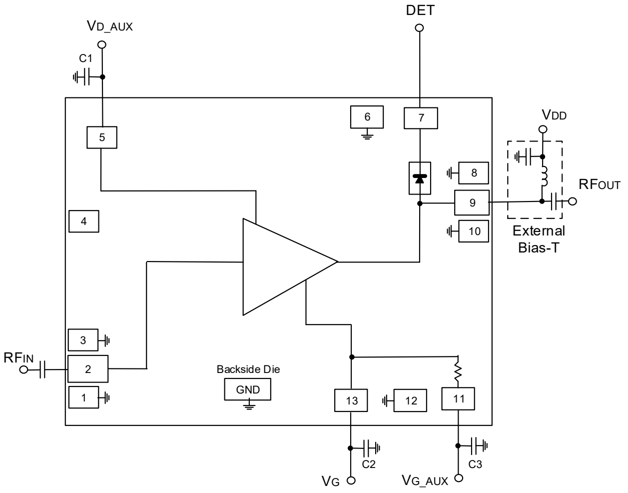
4. Operating at nominal conditions with junction temperature ≤ +150°C will ensure MTTF > 1 x 10^6 hours.
5. Junction Temperature (T_J) = T_C + $Ө_{JC}$ * ((V * I) - (P_{OUT} - P_{IN}))
   Typical thermal resistance ($Ө_{JC}$) = 10.1°C/W.
   a) For T_C = +85°C, defined as backside of die, T_J = 113.7°C
   @P3, 40 GHz: Pout = 200 mW (23 dBm)
   Pin = 40 mW (16 dBm)
   Ids (+85C, P3dB) = 300 mA
   Vds = 10 V

Absolute Maximum Ratings[6,7]

Parameter	Absolute Maximum
Input Power	24 dBm
Drain Voltage	+11 V
Gate Voltage	-5 to 0 V
Junction Temperature[8]	+175°C
Storage Temperature	-65°C to +125°C

6. Exceeding any one or combination of these limits may cause permanent damage to this device.
7. MACOM does not recommend sustained operation near these survivability limits.
8. Junction temperature directly effects device MTTF. Junction temperature should be kept as low as possible to maximize lifetime.

Application Schematic



Bill of Materials

Part	Value	Size	Comment
C1-C3	0.1 µF	0402	bypass

Operating the MAAP-011325-DIE
Turn-on

1. Apply V_G -4.5 V.
2. Increase V_{DD} to 10V.
3. Set I_{DSQ} by adjusting V_G more positive. (typically –0.5 V for I_{DSQ} = 250 mA).
4. Apply RF_{IN} signal.

Turn-off

1. Remove RF_{IN} signal.
2. Decrease V_G to -4.5 V.
3. Decrease V_{DD} to 0 V.

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.

Biasing Conditions

Recommended biasing conditions are V_{DD} = 10 V, I_{DSQ} = 250 mA (controlled with V_G).

By-pass capacitor C1 for the auxiliary pad is for a low frequency operation extension (below 1 GHz).

There are 2 possible methods to bias the drain:

1. The required VDD is applied at RFOUT/VDD through the bias tee. This provides wide band performance of 100 kHz - 40 GHz (depending on the bandwidth of the bias tees).

2. The required VDD is applied at VD_AUX through a wideband conical inductor. No external bias tee is required at the RFOUT/VDD but an external DC block is required. This provides wide band performance of 100 kHz - 40 GHz (depending on the bandwidth of the bias tee).

There are 2 possible methods to bias the gate:

1. VG is applied using the VG pad (pin 13) and set using to provide the required current bias (IDSQ). No external bias tee is required at the RF input but an external DC block is required. This provides wide band performance of 100 kHz - 40 GHz (depending on the bandwidth of the bias tee).

2. VG is applied at the RF input (pin 2) through an external bias tee on the RF input line and set to provide the required current bias (IDSQ). This provides wide band performance of 100 kHz - 40 GHz (depending on the bandwidth of the bias tees).

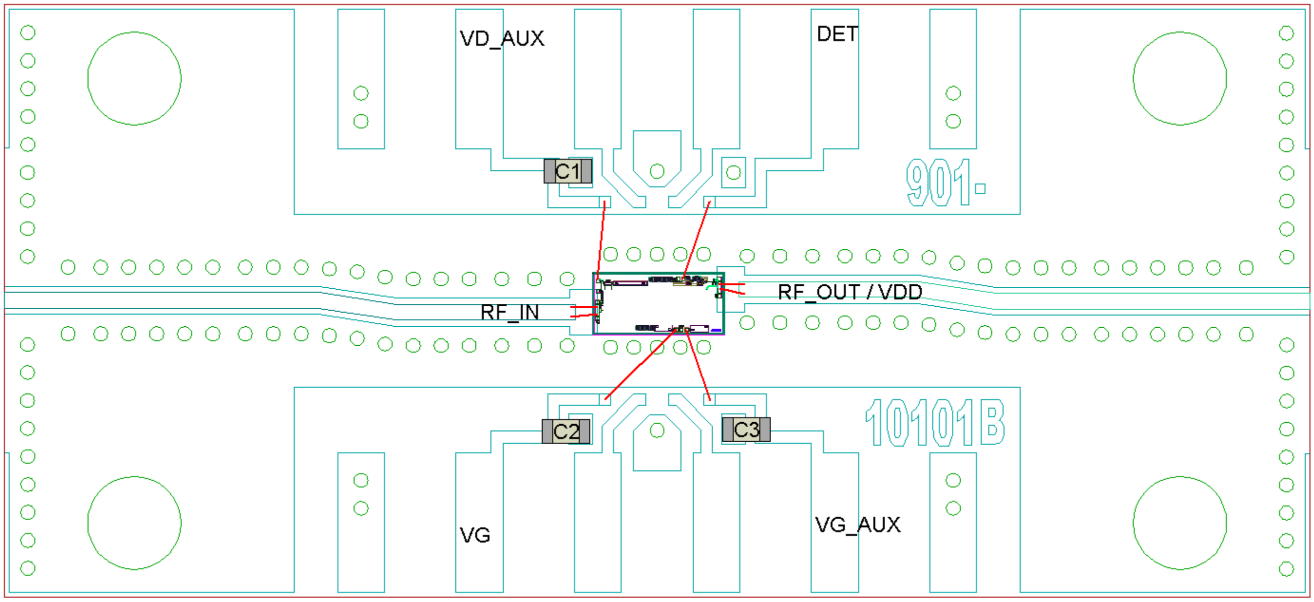
Recommended PCB Information

RF input and output are 50 Ω transmission lines.
Single layer 8 mil Rogers RO4003C with 1/2 oz. Cu.
Use copper filled vias under ground paddle.

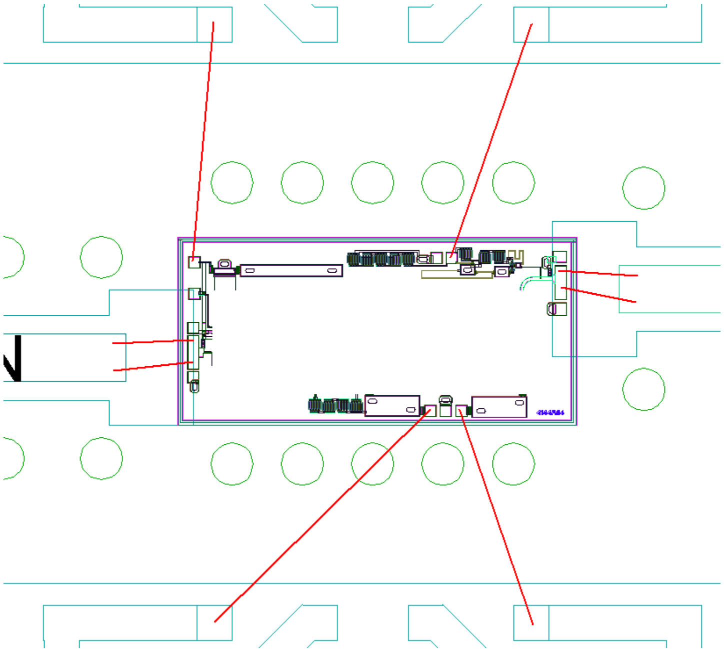
Grounding

It is recommended that the total ground (common mode) inductance not exceed 0.03 nH (30 pH). This is equivalent to placing at least four 8-mil (200-µm) diameter vias under the device, assuming an 8-mil (200-µm) thick RF layer to ground.

PCB Layout and Assembly:

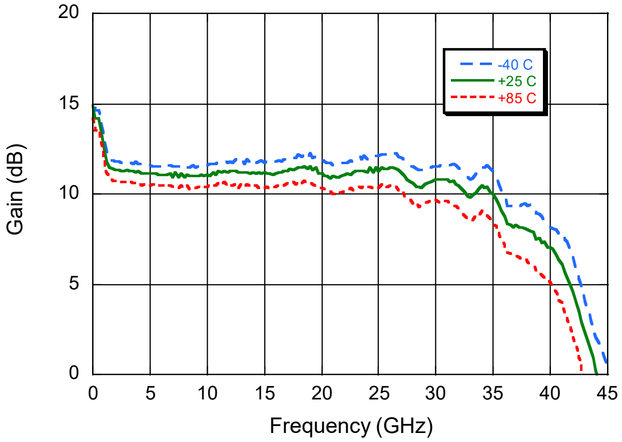


Bond Wire Close Up:

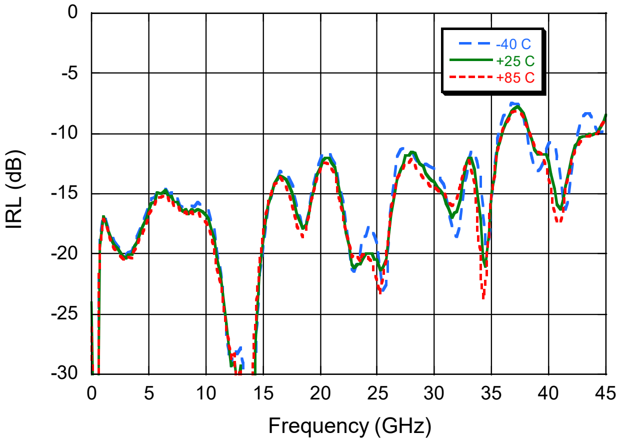


Typical Performance Curves: V_D = 10 V, I_{DSQ} = 250 mA

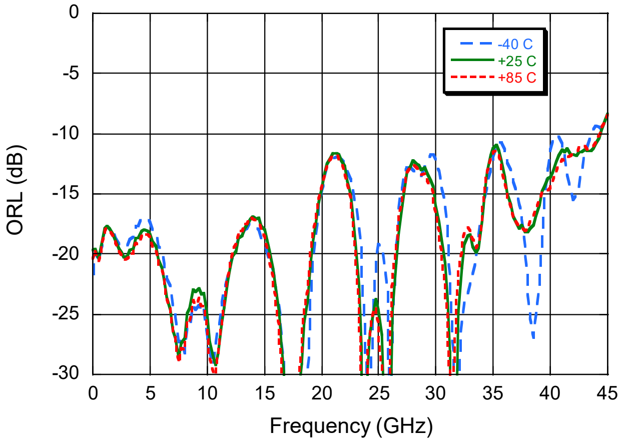
Small Signal Gain vs. Frequency and Temperature



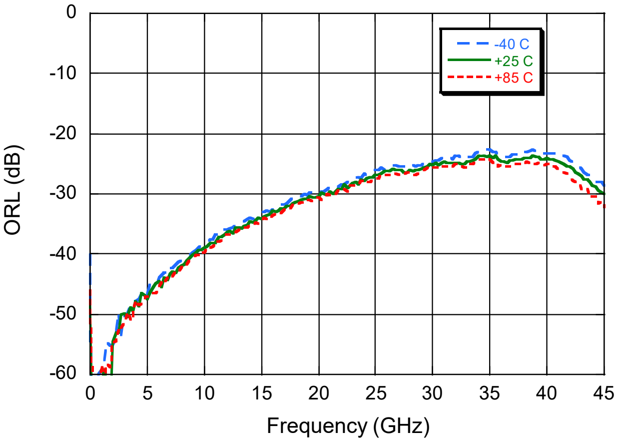
Input Return Loss vs. Frequency and Temperature



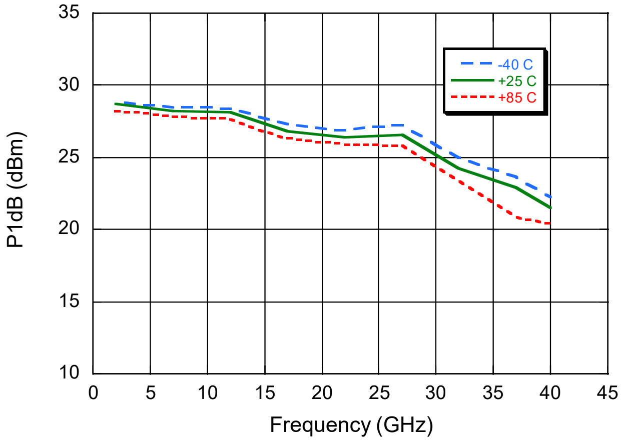
Output Return Loss vs. Frequency and Temperature



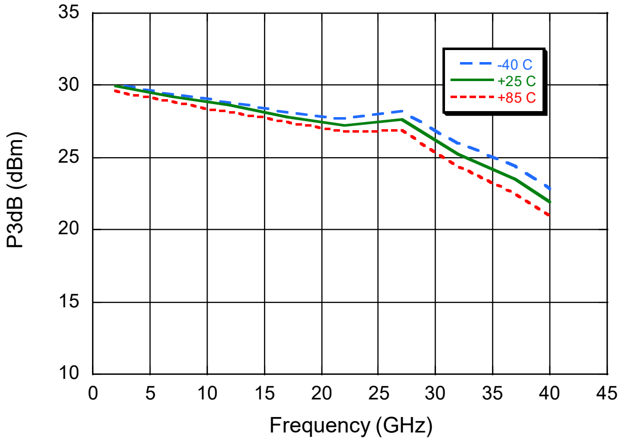
Isolation vs. Frequency and Temperature



P1dB vs. Frequency and Temperature

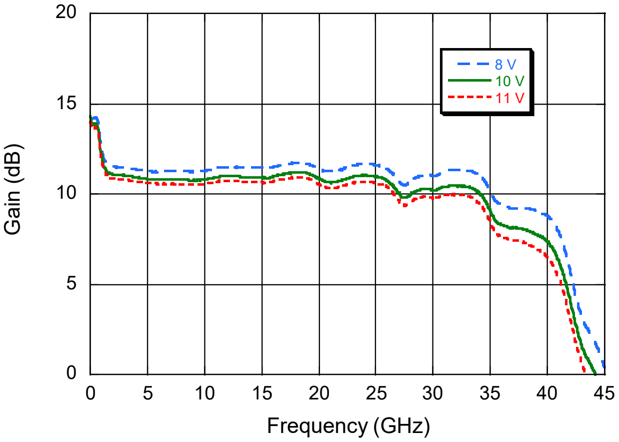


P3dB vs. Frequency and Temperature

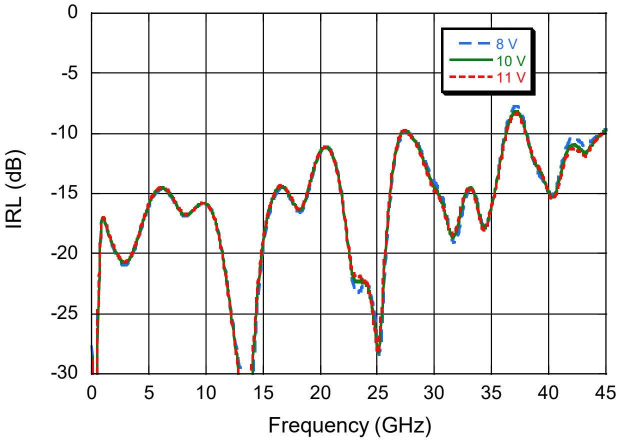


Typical Performance Curves: I_{DSQ} = 250 mA, T_A = +25°C

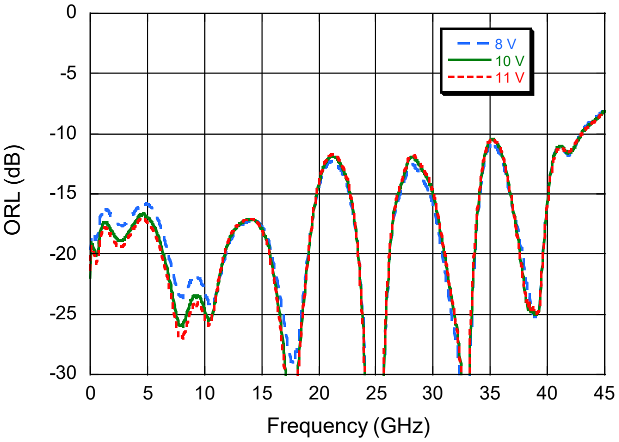
Small Signal Gain vs. Frequency and Voltage



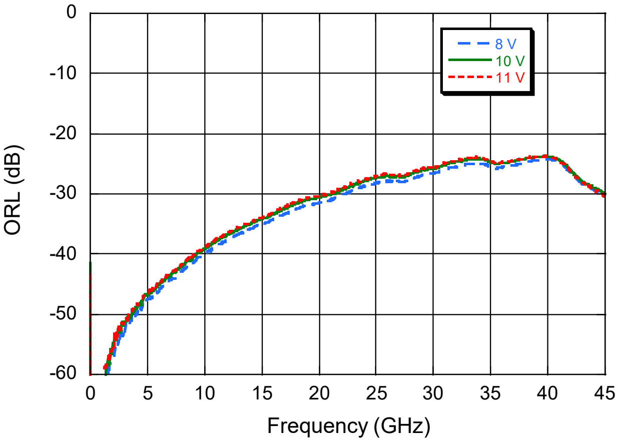
Input Return Loss vs. Frequency and Voltage



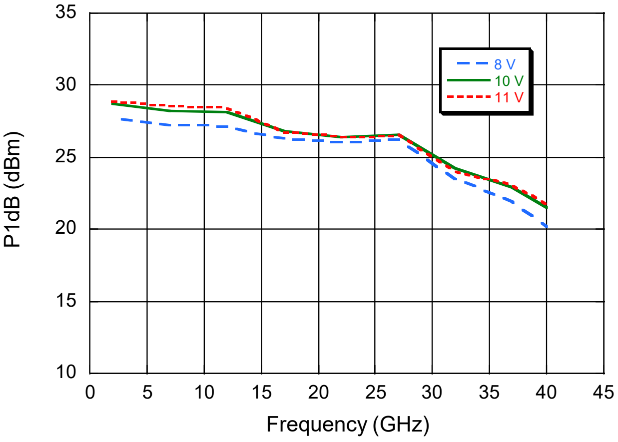
Output Return Loss vs. Frequency and Voltage



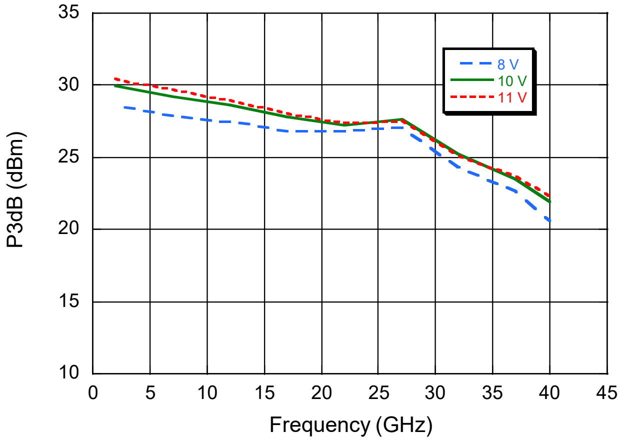
Isolation vs. Frequency and Voltage



P1dB vs. Frequency and Voltage

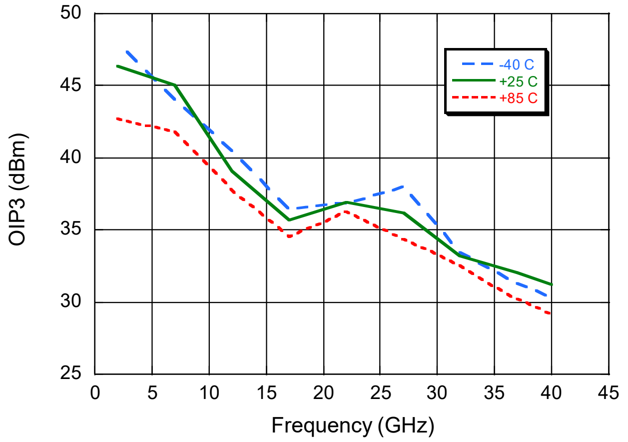


P3dB vs. Frequency and Voltage

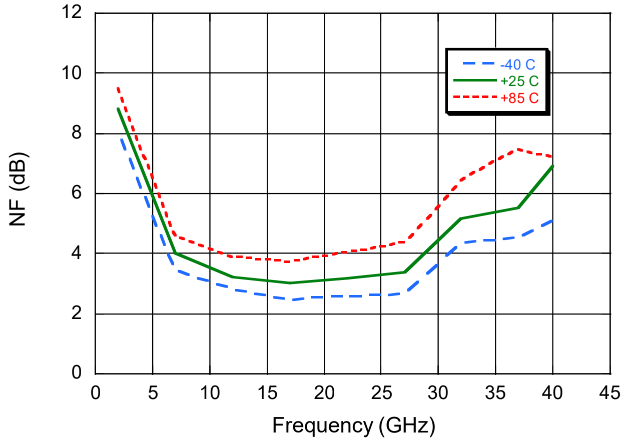


Typical Performance Curves: V_D = 10 V, I_{DSQ} = 250 mA

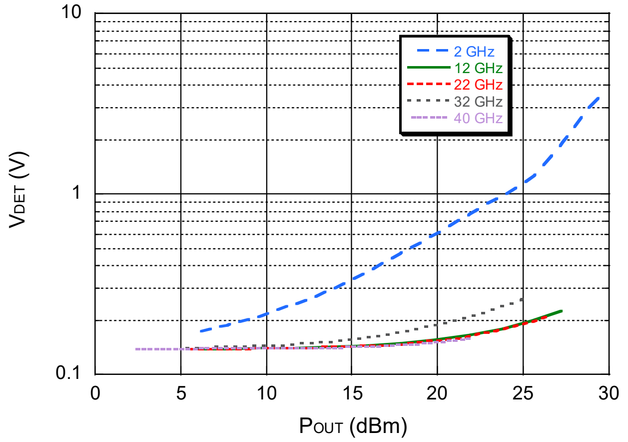
OIP3 vs. Frequency and Temperature (10 MHz separation and +18 dBm P_{OUT} per tone)



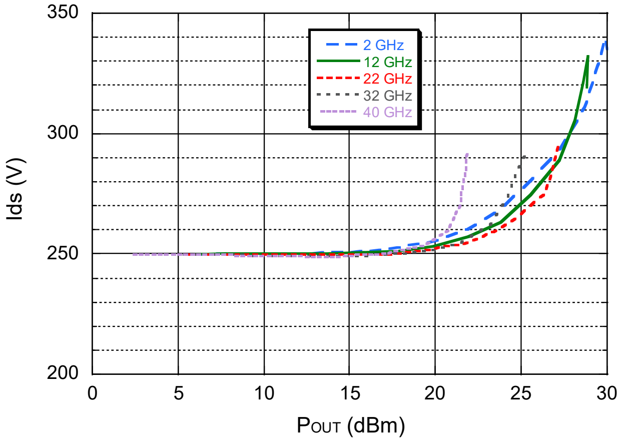
Noise Figure vs. Frequency and Temperature



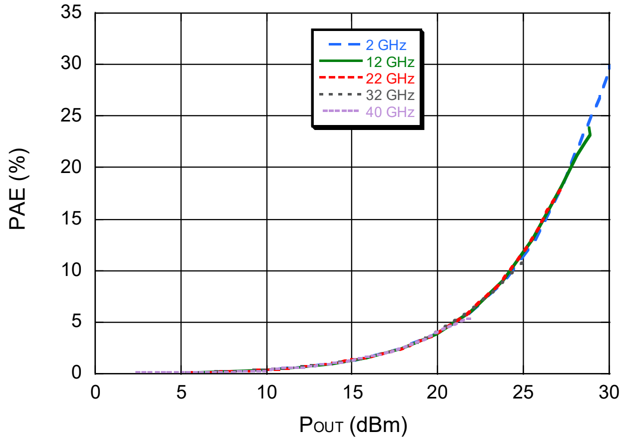
Detector Voltage vs. Pout and Frequency @ +25 C



Bias Current vs. P_{OUT} and Frequency @ +25°C

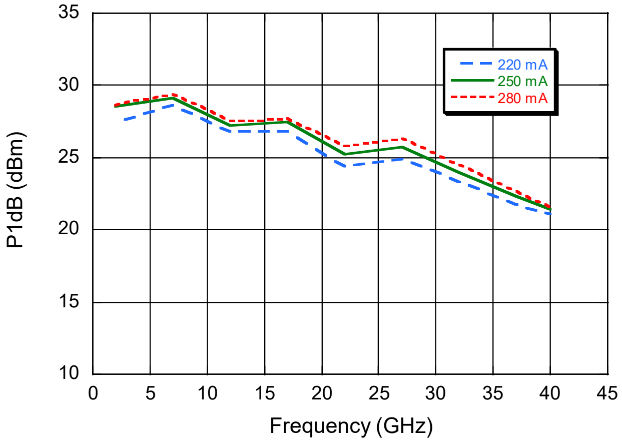


PAE vs. P_{OUT} and Frequency @ +25°C

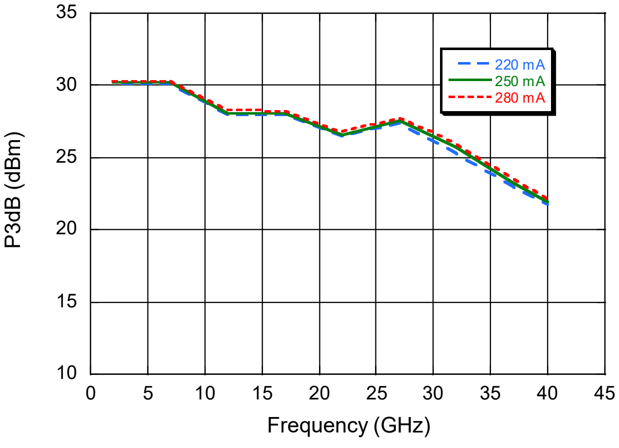


Typical Performance Curves: V_{BIAS} = 10 V, T_A = +25°C

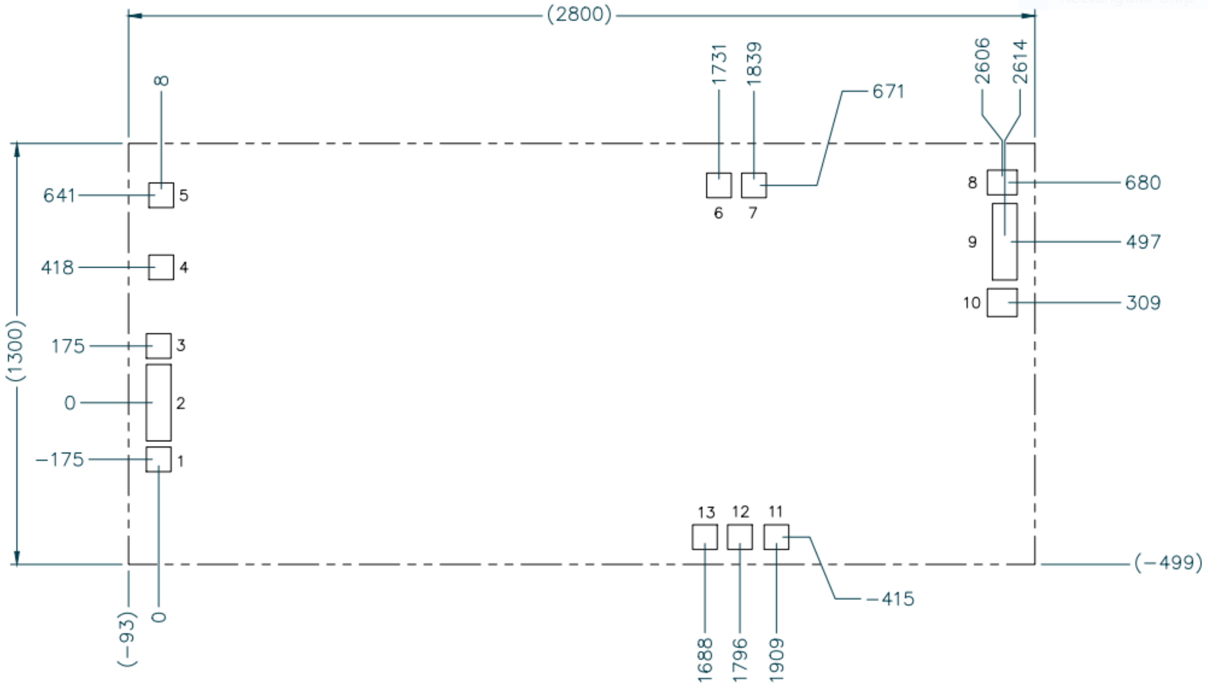
P1dB vs. Frequency and Current



P3dB vs. Frequency and Current



Die Dimensions[9,10,11,12]



9. All units in µm, unless otherwise noted, with a tolerance of ± 5 µm.
10. Die thickness is 100 ± 10 µm.
11. Die size reflects un-cut dimensions. Laser kerf reduces die size by ~ 25 µm each dimension.
12. Bond Pad / Backside Metallization: Gold

Bond Pad Dimensions

Pad#	X (µm)	Y (µm)
1,3,4,5,6, 7,11,12,13	76	76
2,9	76	236
8,10	92	86

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