Power Amplifier
18 - 26 GHz

MAAP-118260-DIE
Rev. V2

Features
- Fully Integrated Power Amplifier
- Wide Bandwidth 17.7 - 26.5 GHz
- Small Signal Gain:25.5 dB
- Third Order Intercept Point (OIP3): 36.5 dBm
- Output P1dB: 28.5 dBm
- Integrated Power Detector
- Bias 5 V, 650 mA

Applications
- Point to Point
- Infrastructure

Description
The MAAP-118260-DIE is a linear power amplifier that operates over the frequency range 17.7 - 26.5 GHz. The device provides 25.5 dB of gain and 36.5 dBm Output Third Order Intercept Point (OIP3) with more than 28.5 dBm of Output P1dB.

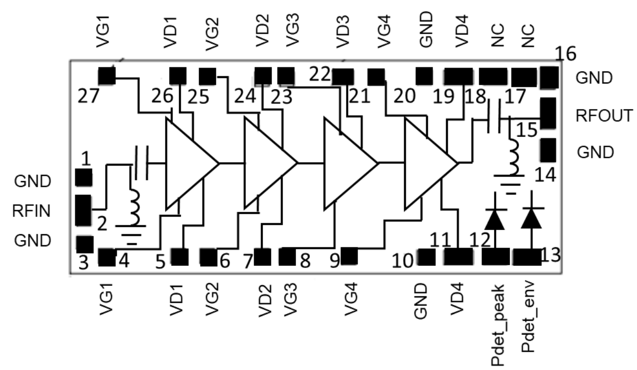
This power amplifier consists of a four stage power amplifier with integrated, on-chip power and envelope detector. The device includes on-chip ESD protection structures to ease the implementation and volume assembly.

The device is well suited for use in the 18 GHz, 23 GHz, 26 GHz cellular backhaul applications. This product is in bare die form. MAAP-118260 is also available in a 5 mm 24 lead QFN package.

Ordering Information

Part Number	Package
MAAP-118260-DIE	Die in Gel Pack
MAAP-118260-DIESMB	Sample Board

Functional Schematic



Pin Configuration[1]

Pin #	Function
1, 3, 10, 14, 16, 20	GND
2	RF_{IN}
4, 27	V_G1
5, 26	V_D1
6, 25	V_G2
7, 24	V_D2
8, 23	V_G3
9, 21	V_G4
11, 19	V_D4
12	Pdet_peak
13	Pdet_env
15	RF_{OUT}
17, 18	Not Connected
22	V_D3

1. The backside of the die must be connected to RF, DC and thermal ground.

DC-0018797

Electrical Specifications: Freq. = 17.7 - 26.5 GHz, T_A = 25°C, V_D = +5 V, Z_0 = 50 Ω

Parameter	Test Conditions	Units	Min.	Typ.	Max.
Gain	17.7 - 26.5 GHz	dB	23	25.5	—
P1dB	17.7 - 26.5 GHz	dBm	—	28.5	—
P3dB	17.7 - 26.5 GHz	dBm	—	29	—
Pout @ Pin = +8dBm	17.7 - 26.5 GHz	dBm	28.5	30.5	—
OIP3	17.7 - 26.5 GHz	dBm	34	36.5	—
Input Return Loss	17.7 - 26.5 GHz	dB	—	9.5	—
Output Return Loss	17.7 - 26.5 GHz	dB	—	11	—
PAE @ 1 dB Compression	—	%	—	18	—
Quiescent Current[2]	—	mA	—	650	—

2. The Recommended Quiescent Bias Current is ID1,2 = 110 mA and ID3,4 = 540 mA (650 mA total).

Absolute Maximum Ratings[3,4,5]

Parameter	Rating
Drain Voltage (V_D 1,2,3,4) (Under No RF Drive)	9 V
Drain Voltage (V_D 1,2,3,4) (Under RF Drive)	5.5 V
Gate Voltage (V_G 1,2,3,4)	-3 V
Input Power	+10 dBm
Storage Temperature	-65°C to +150°C
Junction Temperature	+175°C

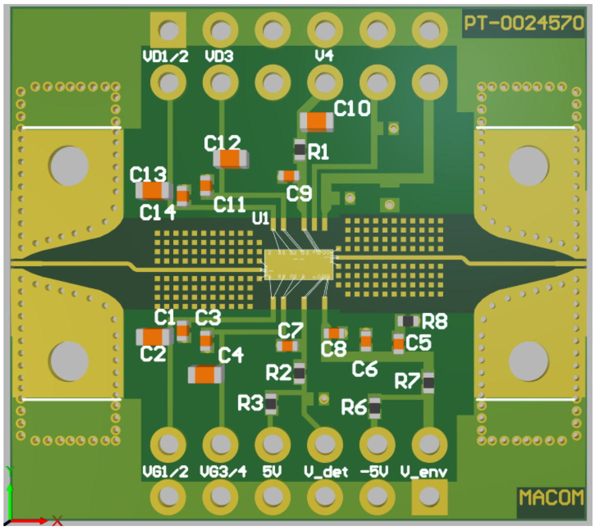
3. Exceeding any one or combination of these limits may cause permanent damage to this device.
4. MACOM does not recommend sustained operation near these survivability limits.
5. Operating at nominal conditions with $T_J \leq +150$°C will ensure MTTF > 1 x 10^6 hours.

Maximum Operating Ratings[6,7]

Parameter	Rating
P_{DISS}	4.87 W
Operating Temperature	-40°C to +85°C
Junction Temperature	+150°C

6. Junction temperature directly affects device MTTF. Junction temperature should be kept as low as possible to maximize lifetime. Thermal resistance, Θjc is 18.4 °C/W.
7. For saturated performance, it is recommended that the sum of ($2V_{DD}$ + abs (V_{GG})) < 12 V.

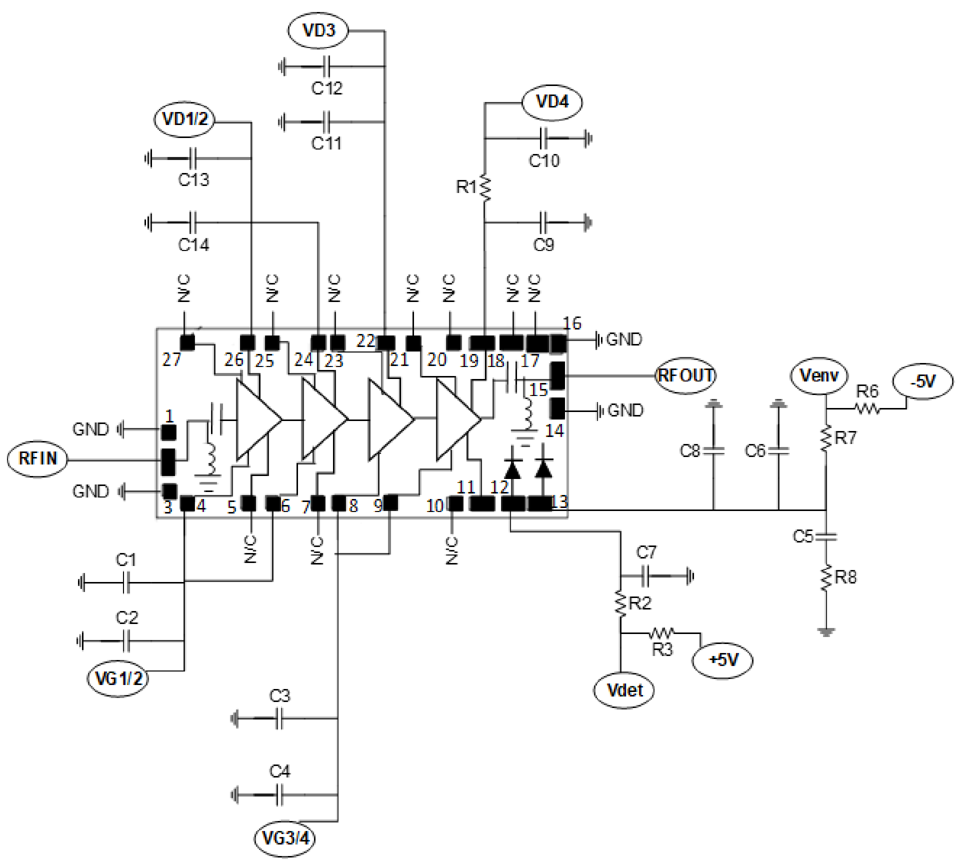
PCB Layout



Parts List

Part	Value	Case Style
C1, C3, C5-C9, C11, C14	100 nF	0402
C2, C4, C10, C12, C13	4.7 µF	0603
R1	0 Ω	0402
R2, R7	100 Ω	0402
R3, R6	5600 Ω	0402
R8	10 kΩ	0402

Application Schematic



Biasing

All gates should be pinched-off, V_G <-2 V, before applying the drain voltage, V_D = 5 V (do not exceed maximum V_{DG} value for RF drive condition). Then the gate voltages can be increased until the desired quiescent drain current is reached in each stage. The recommended quiescent bias is V_D = 5 V, $I_{D1,2} + I_{D3} + I_{D4}$ = 650 mA (total). The total gate current is less than 1mA for all recommended operating conditions. The performance in this datasheet has been measured with a fixed gate voltage and no drain current regulation under large signal operation. It is also possible to regulate the drain current dynamically, to limit the DC power dissipation under RF drive. To turn off the device, the turn on bias sequence should be followed in reverse.

Detector Operation

MAAP-118260-DIE includes dual power and envelope detectors. As per the application schematic, the power detector requires an external 5 V supply and the envelope detector requires -5 V. The output from the resistive voltage divider can be fed into a ADC or multimeter for the result.

Bias Arrangement

Each DC pin ($V_{D1,2}$, V_{D3}, V_{D4} and $V_{G1,2}$, $V_{G3,4}$) needs to have bypass capacitance of 100 nF mounted as close to the packaged device as possible.

Handling Procedures

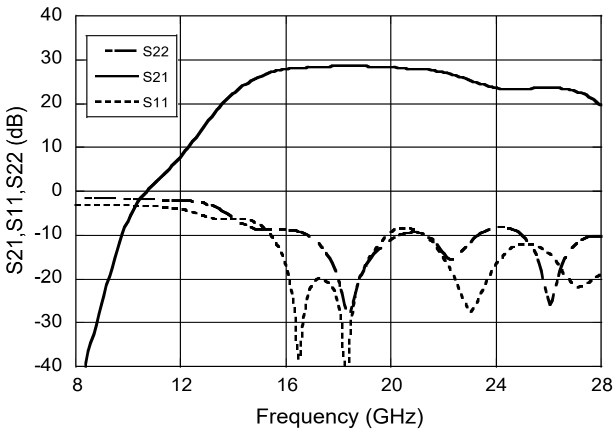
Please observe the following precautions to avoid damage:

Static Sensitivity

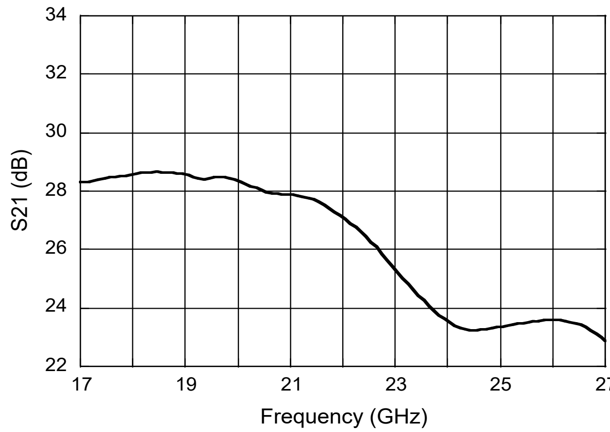
These electronic devices are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. Proper ESD control techniques should be used when handling these HBM Class 1A devices.

Typical Performance Curves: V_D = 5 V, I_{DQ} = 0.65 A, T_A = +25°C

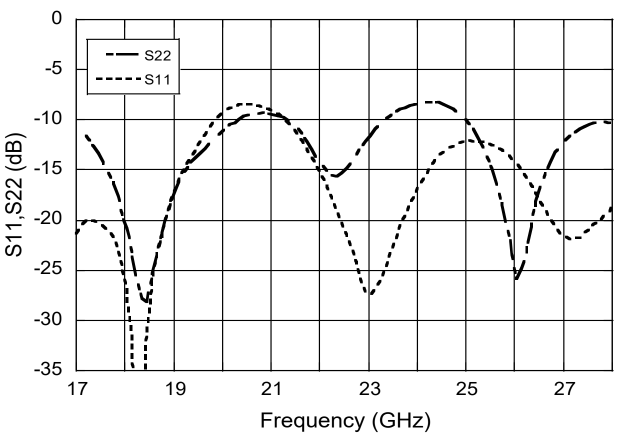
Broadband S-Parameters



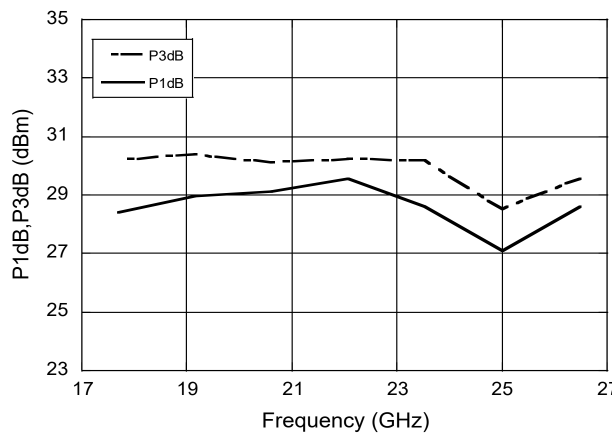
Gain



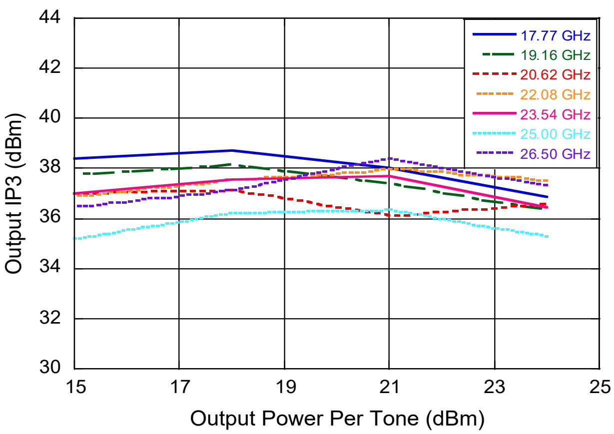
Return Loss (S11 and S22)



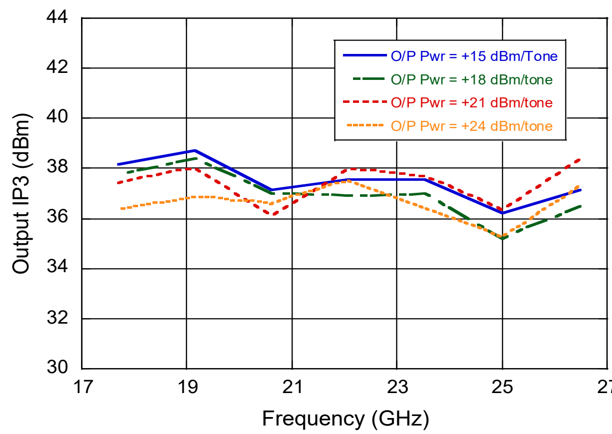
P1dB and P3dB



Output IP3 vs Output Power Per Tone

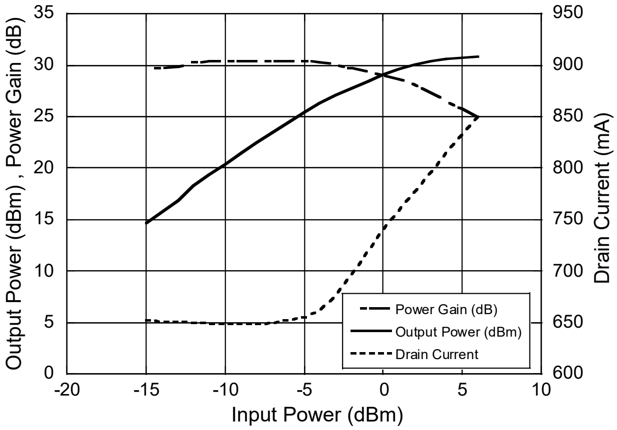


Output IP3 vs Frequency (GHz)

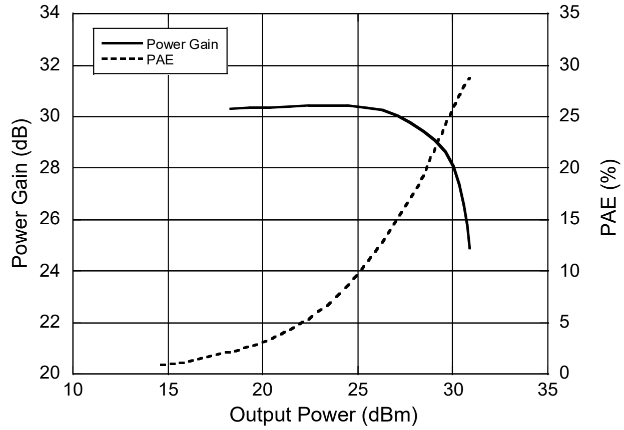


Typical Performance Curves: V_D = 5 V, I_{DQ} = 0.65 A, T_A = +25°C

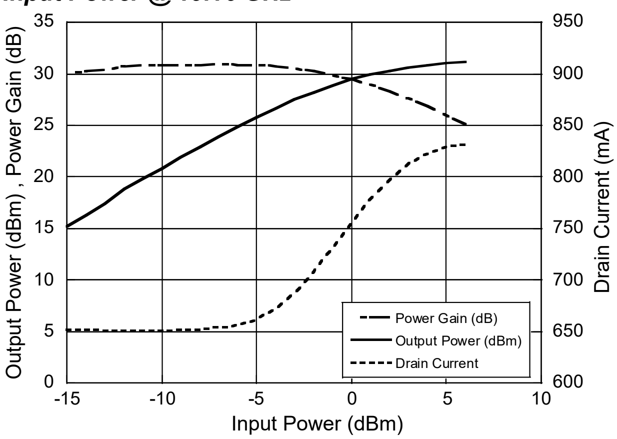
Output Power, Power Gain and Drain Current vs Input Power @ 17.70 GHz



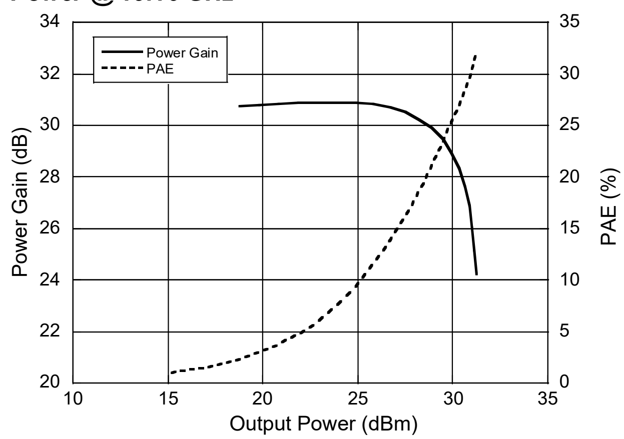
Power Gain and Power Added Efficiency vs Input Power @ 17.70 GHz



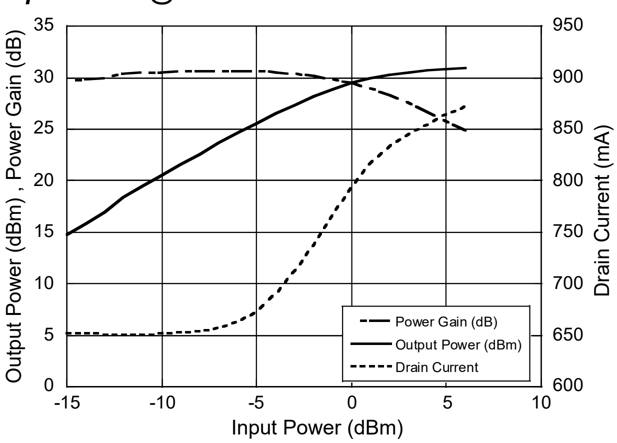
Output Power, Power Gain and Drain Current vs Input Power @ 19.16 GHz



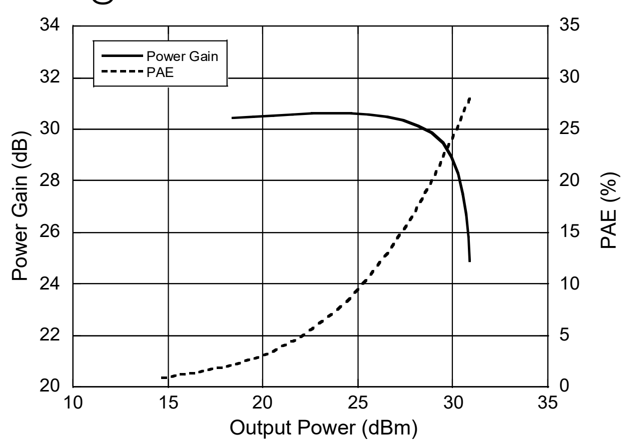
Power Gain and Power Added Efficiency vs Input Power @ 19.16 GHz



Output Power, Power Gain and Drain Current vs Input Power @ 20.62 GHz

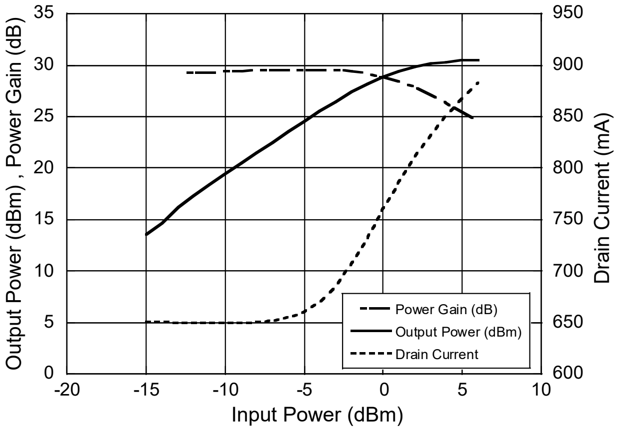


Power Gain and Power Added Efficiency vs Input Power @ 20.62 GHz

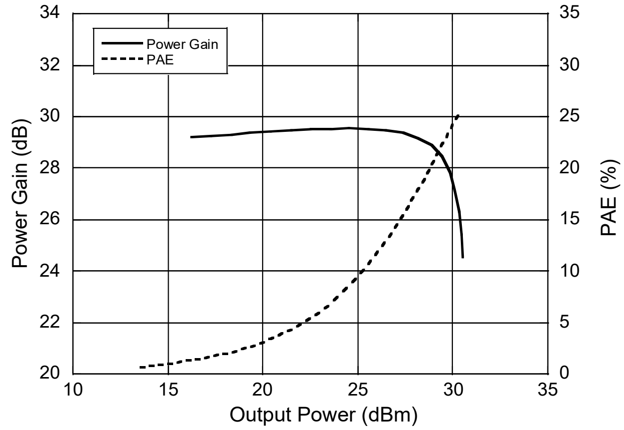


Typical Performance Curves: V_D = 5 V, I_{DQ} = 0.65 A, T_A = +25°C

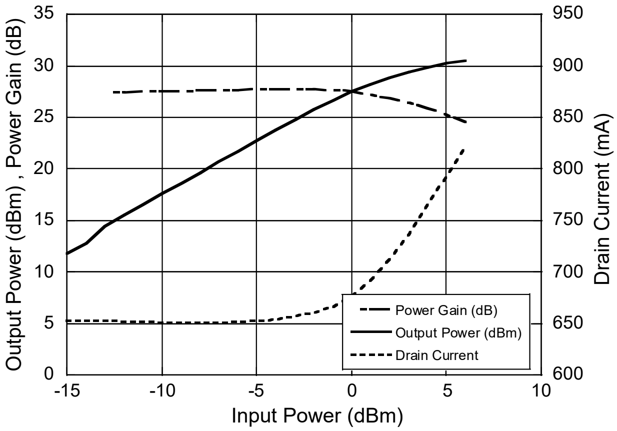
Output Power, Power Gain and Drain Current vs Input Power @ 22.08 GHz



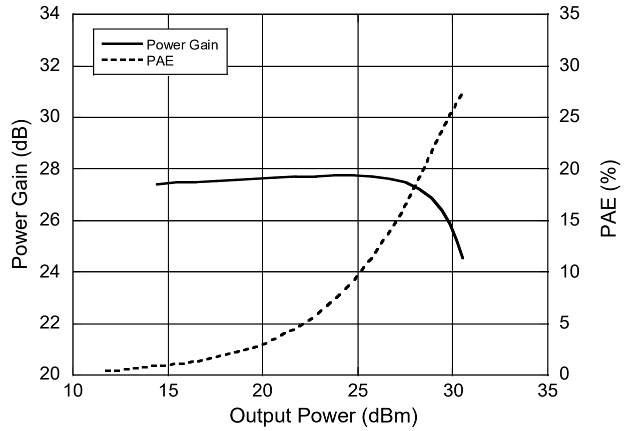
Power Gain and Power Added Efficiency vs Input Power @ 22.08 GHz



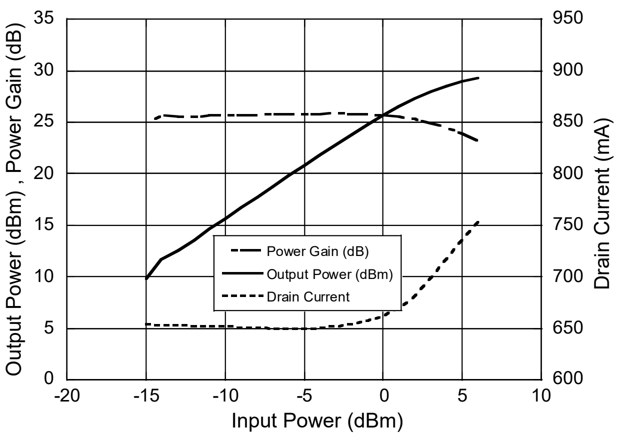
Output Power, Power Gain and Drain Current vs Input Power @ 23.54 GHz



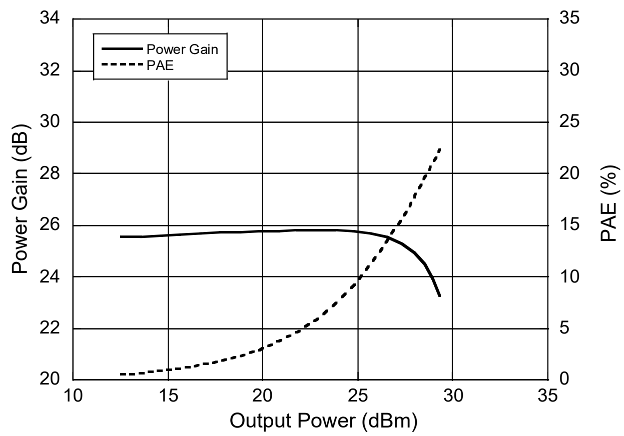
Power Gain and Power Added Efficiency vs Input Power @ 23.54 GHz



Output Power, Power Gain and Drain Current vs Input Power @ 25.00 GHz

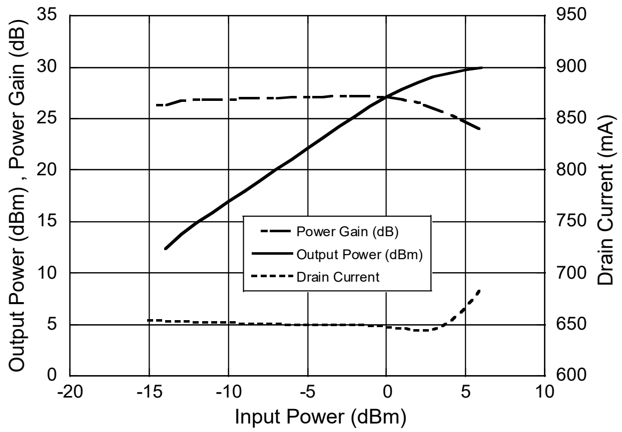


Power Gain and Power Added Efficiency vs Input Power @ 25.00 GHz

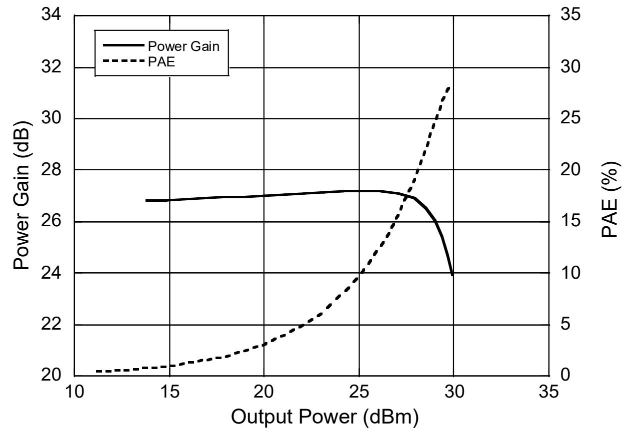


Typical Performance Curves: V_D = 5 V, I_{DQ} = 0.65 A, T_A = +25°C

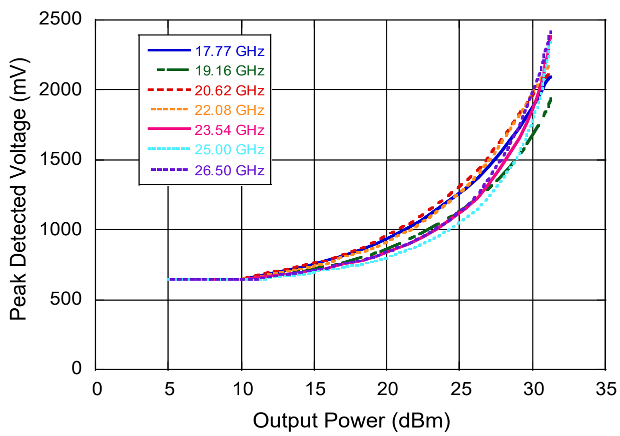
Output Power, Power Gain and Drain Current vs Input Power @ 26.50 GHz



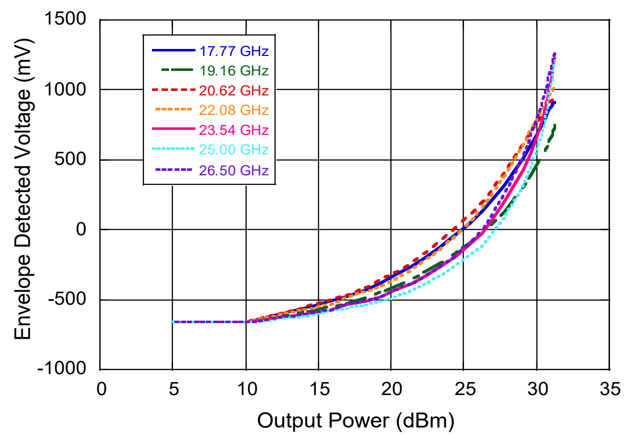
Power Gain and Power Added Efficiency vs Input Power @ 26.50 GHz



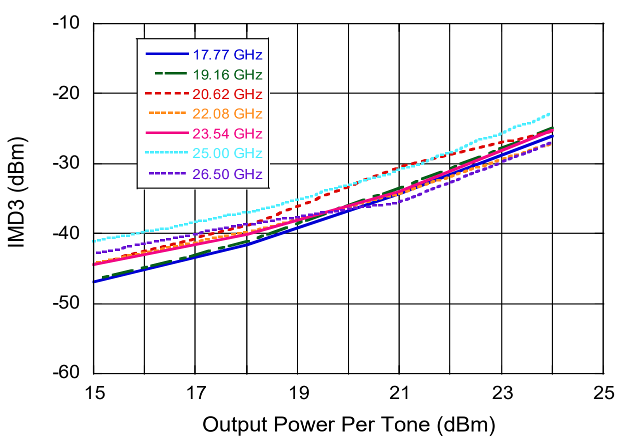
Envelope Detector Voltage vs Output Power



Peak Detector Voltage vs Output Power

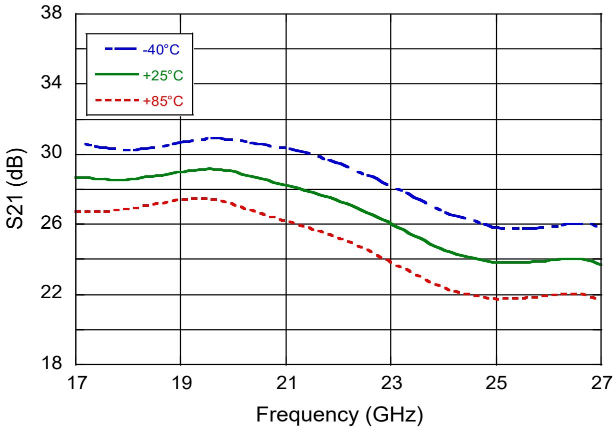


Third Order Intermodulation vs Output Power Per Tone

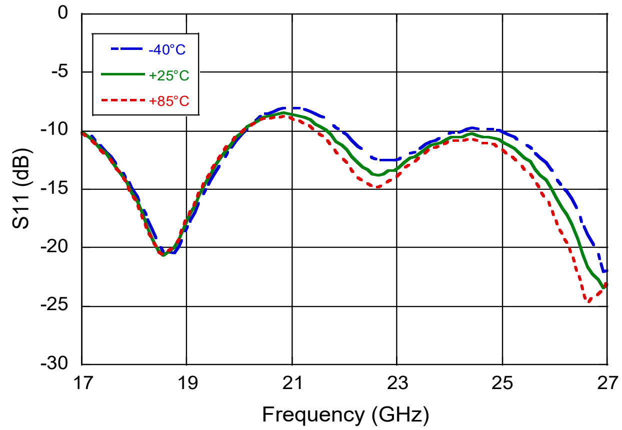


Typical Performance Curves: V_D = 5 V, I_{DQ} = 0.65A

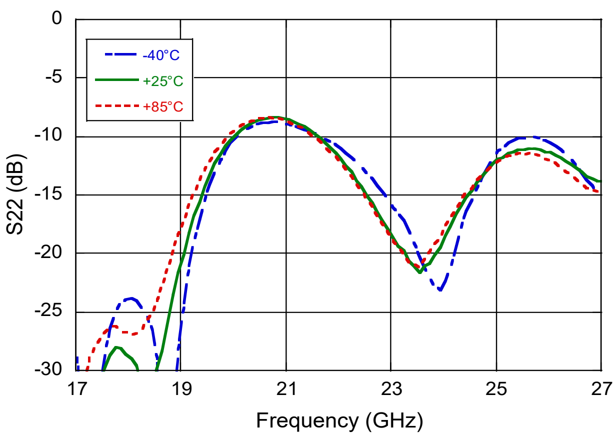
Gain



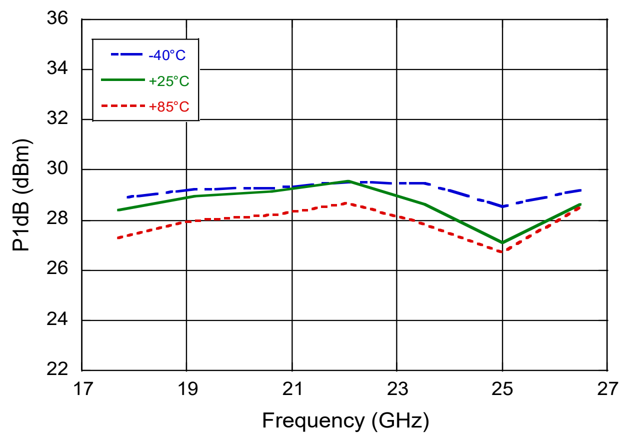
Input Return Loss



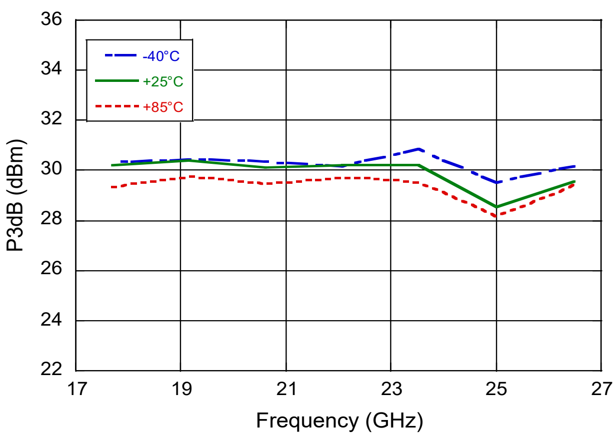
Output Return Loss



P1dB

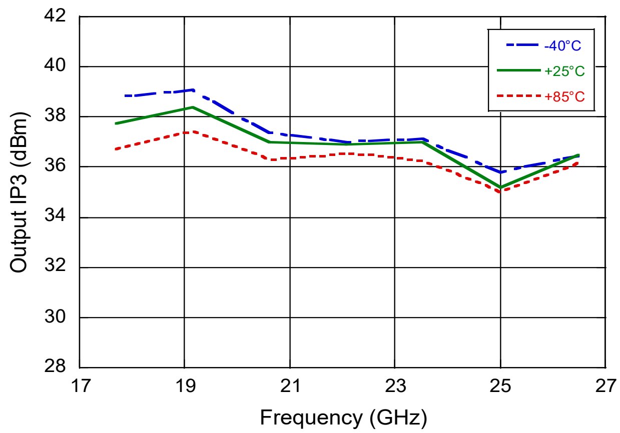


P3dB

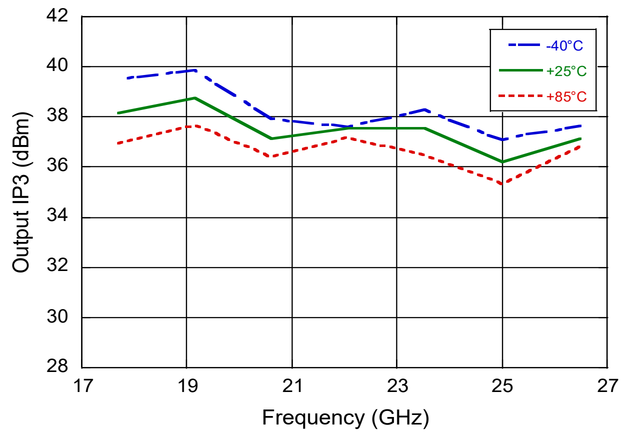


Typical Performance Curves: V_D = 5 V, I_{DQ} = 0.65A

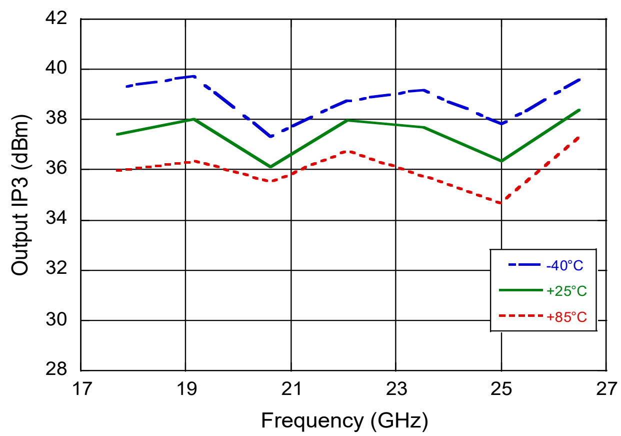
Output IP3 @ 15 dBm Per Tone Output Power



Output IP3 @ 18 dBm Per Tone Output Power

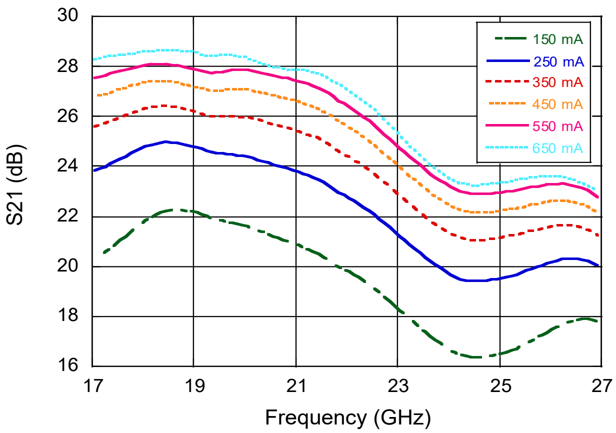


Output IP3 @ 21 dBm Per Tone Output Power

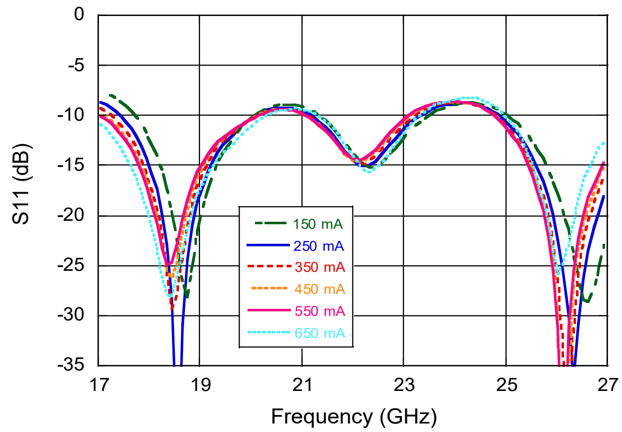


Typical Performance Curves: V_D = 5 V, I_{DQ} = Various, V_G = -0.85 ~ -1.65 V, T_A = +25°C

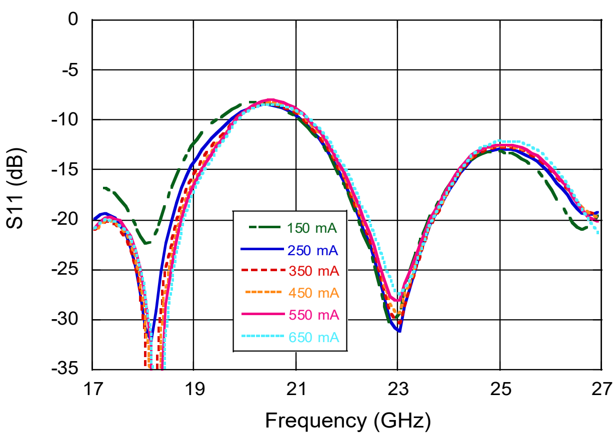
Gain



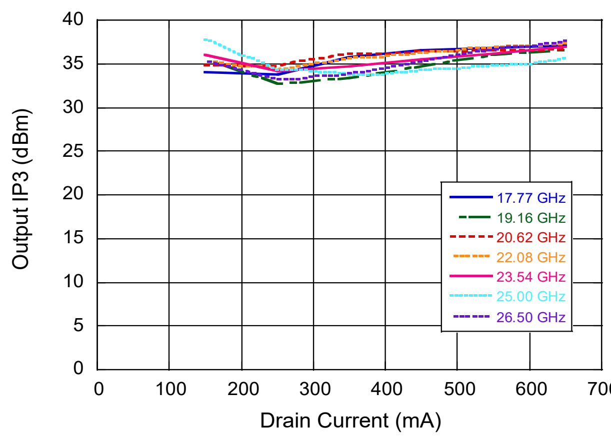
Input Return Loss



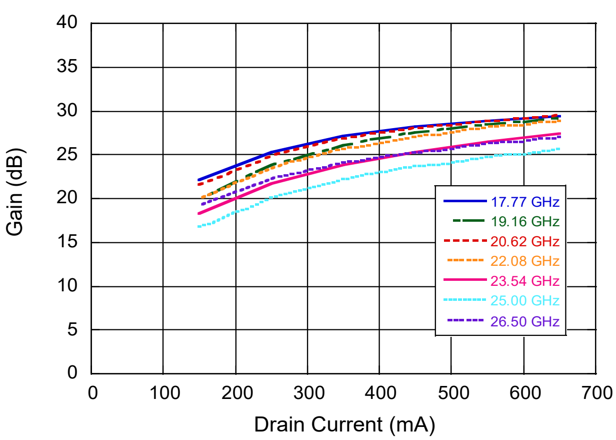
Output Return Loss



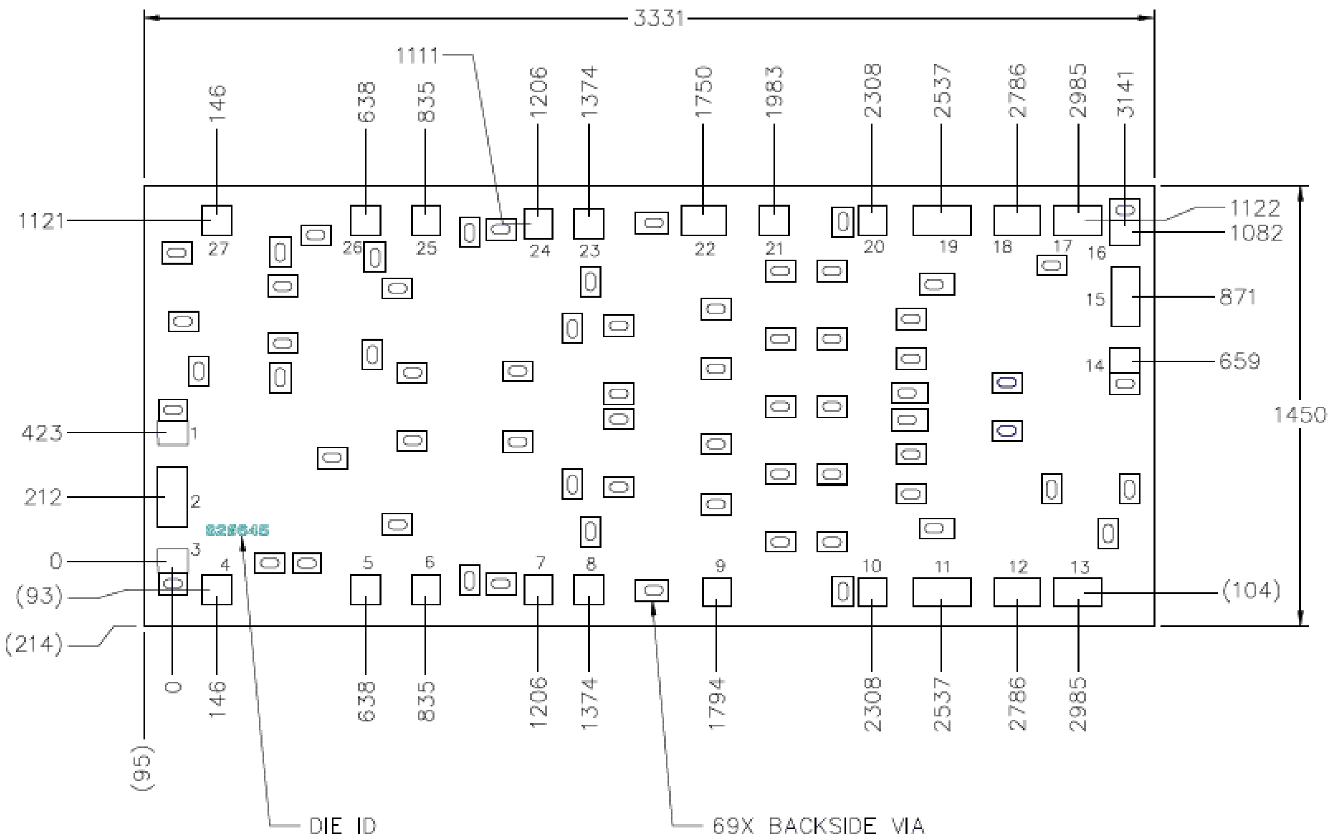
Output IP3 vs Drain Current



Gain vs Drain Current



Die Dimensions[8,9,10]



8. All units in µm, unless otherwise noted, with a tolerance of ± 5 µm.
9. Die thickness is 100 ± 10 µm.
10. Die size reflects un-cut dimensions. Laser kerf reduces die size by ~ 25 µm each dimension.

Bond Pad Detail[11]

Pad	Size (x)	Size (y)
1, 3, 14, 16	99	81
2, 15	96	196
4-10, 20, 21, 23-27	96	96
11, 19	196	96
12, 13, 17, 18, 22	146	96

11. The dimensions for pads 1, 3, 14 and 16 reference the bondable area only and exclude the backside via area which must not be bonded to.