MAAP-118260

Power Amplifier
18 - 26 GHz

Rev. V1

Features

- Fully Integrated Power Amplifier
- Wide Bandwidth 17.7 - 26.5 GHz
- 28.5 dB Small Signal Gain
- 37.0 dBm Third Order Intercept Point (OIP3)
- 28.5 dBm Output P1dB
- Integrated Power Detector
- Typical Bias 5 V, 650 mA
- Lead-Free 5 mm 24-lead QFN Package

Description

The MAAP-118260 is a packaged linear power amplifier that operates over the frequency range 17.7 - 26.5 GHz. The device provides 28.5 dB of gain and 37.0 dBm Output Third Order Intercept Point (OIP3) with more than 28.5 dBm of Output P1dB.

This power amplifier is assembled in a lead free, fully molded 5 mm, 24 lead, QFN package and consists of a four stage power amplifier with integrated, on-chip power and envelope detectors. The device includes on-chip ESD protection structures to ease the implementation and volume assembly.

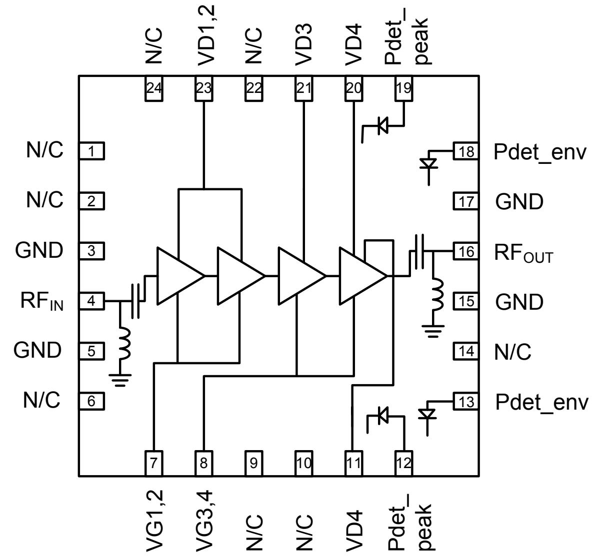
The device is well suited for use in the 18 GHz, 23 GHz, 26 GHz cellular backhaul applications.

Ordering Information[1,2]

Part Number	Package
MAAP-118260	Bulk
MAAP-118260-TR0500	Tape and Reel
MAAP-118260-001SMB	Sample Board

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

Functional Schematic



Pin Configuration[3,4]

Pin No.	Function	Pin No.	Function
1	No Connection	13	Pdet_env
2	No Connection	14	No Connection
3	GND	15	GND
4	RF_{IN}	16	RF_{OUT}
5	GND	17	GND
6	No Connection	18	Pdet_env
7	$V_{G}1,2$	19	Pdet_peak
8	$V_{G}3,4$	20	$V_{D}4$
9	No Connection	21	$V_{D}3$
10	No Connection	22	No Connection
11	$V_{D}4$	23	$V_{D}1,2$
12	Pdet_peak	24	No Connection

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.

* Restrictions on Hazardous Substances, European Union Directive 2011/65/EU.

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 - 20.0 GHz 20.0 - 24.0 GHz 24.0 - 26.5 GHz	dB	25 24 23	29.5 28.5 25.5	—
P1dB, @ 1 dB Compression	17.7 - 20.0 GHz 20.0 - 24.0 GHz 24.0 - 26.5 GHz	dBm	—	28.0 29.0 28.5	—
P_{SAT}	17.7 - 20.0 GHz 20.0 - 24.0 GHz 24.0 - 26.5 GHz	dBm	29 29 29	30.5 31.0 30.5	—
OIP3	17.7 - 20.0 GHz 20.0 - 24.0 GHz 24.0 - 26.5 GHz	dBm	36 34 34	37.0 36.7 36.5	—
Input Return Loss	17.7 - 20.0 GHz 20.0 - 24.0 GHz 24.0 - 26.5 GHz	dB	—	13 9.5 14	—
Output Return Loss	17.7 - 20.0 GHz 20.0 - 24.0 GHz 24.0 - 26.5 GHz	dB	—	12 11 15	—
PAE, @ 1 dB Compression	—	%	—	18	—
Quiescent Current	—	mA	590	—	662

Absolute Maximum Ratings[5,6,7]

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
Storage Temperature	-65°C to +150°C
Junction Temperature	+175°C

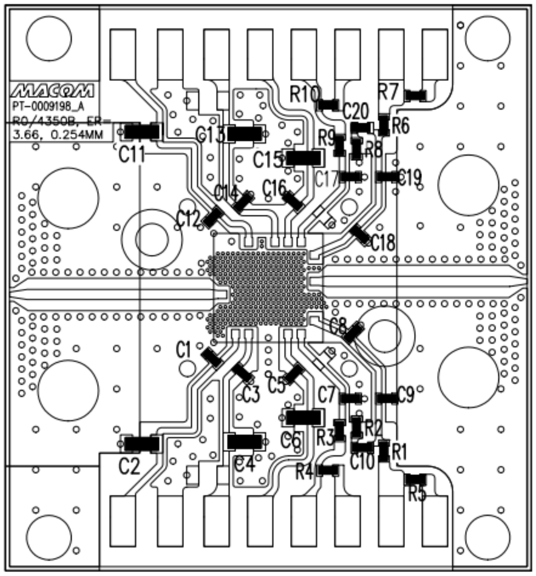
5. Exceeding any one or combination of these limits may cause permanent damage to this device.
6. MACOM does not recommend sustained operation near these survivability limits.
7. Operating at nominal conditions with $T_J \leq +150°C$ will ensure MTTF > 1×10^6 hours.

Maximum Operating Ratings[8,9]

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

8. 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.
9. For saturated performance, it is recommended that the sum of $(2V_{DD} + \text{abs}(V_{GG})) < 12$ V.

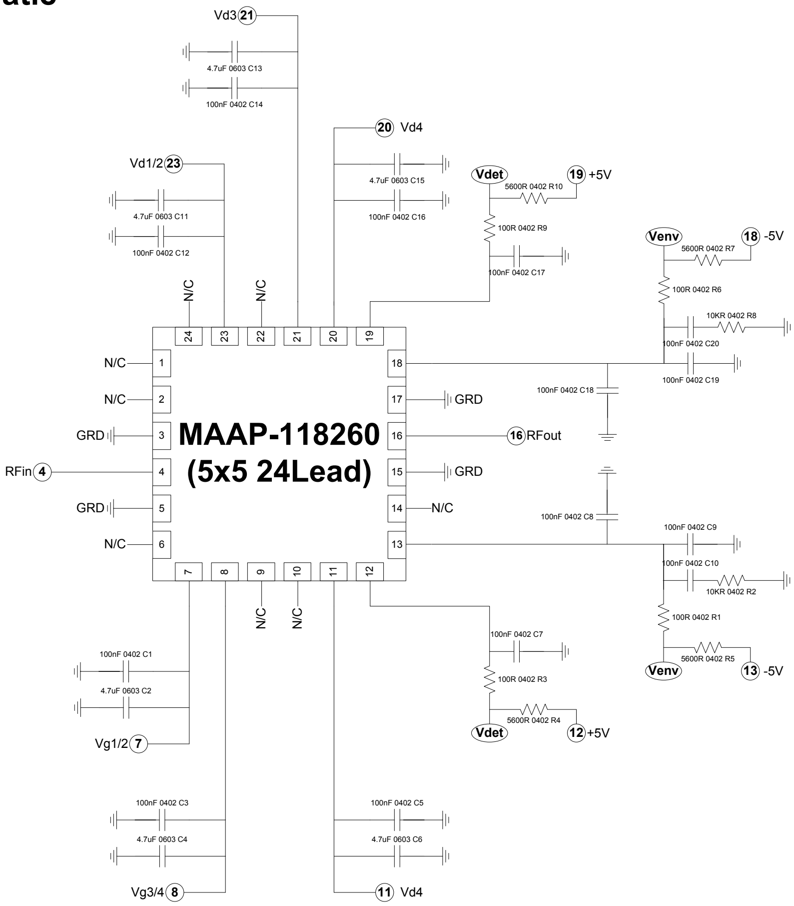
PCB Layout



Parts List

Part	Value	Case Style
C1,C3,C5,C7, C8 - C10,C12, C14,C16 - C20	100 nF	0402
C2,C4,C6,C11, C13,C15	4.7 µF	0603
R1,R3,R6,R9	100 Ω	0402
R2,R8	10 KΩ	0402
R4,R5,R7,R10	5600 Ω	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 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 includes dual power and envelope detectors. These are included on both sides of the device to ease integration onto larger radio boards. 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

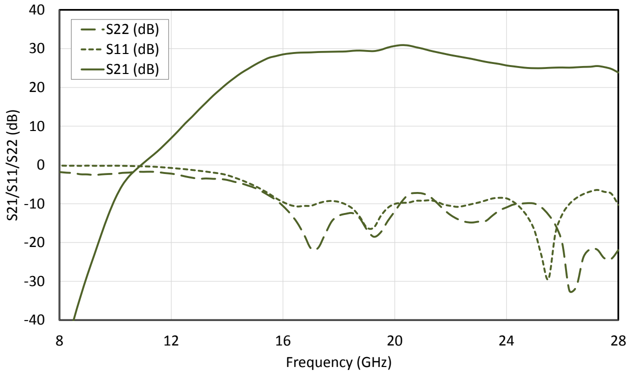
Please observe the following precautions to avoid damage:

Static Sensitivity

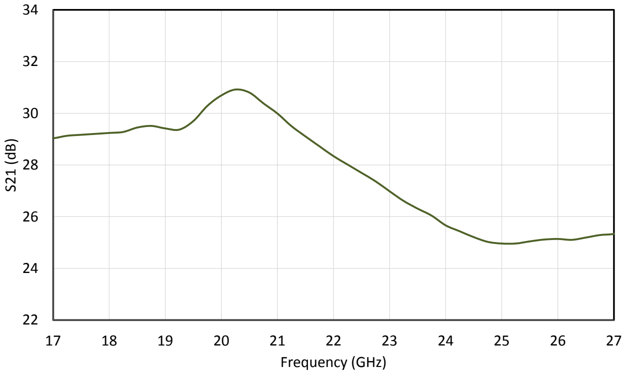
These electronic devices are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. Proper ESD control techniques should be used when handling these CDM class C1, HBM Class 0A devices.

Typical Performance Curves: V_D = 5 V, I_{DQ} = 0.65 A, V_G = -1.05 ~ -0.85 V, T_A = +25°C

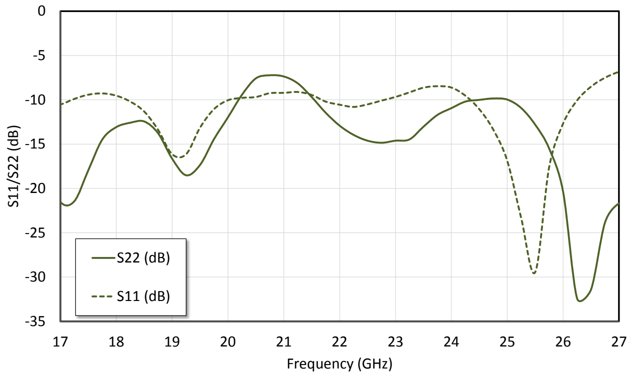
Broadband S-Parameters vs. Freq (GHz), Vd = 5V, Id = 0.65A



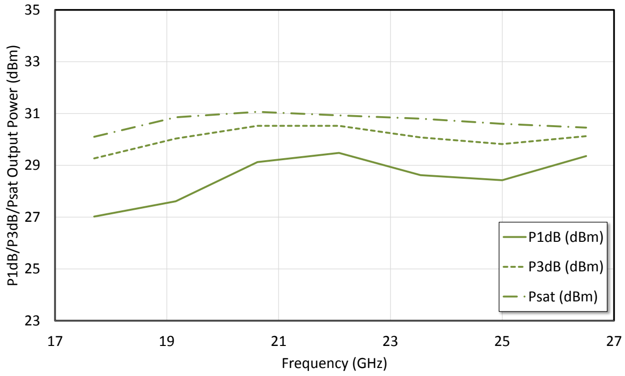
Gain (S21) vs. Freq (GHz), Vd = 5V, Id = 0.65A



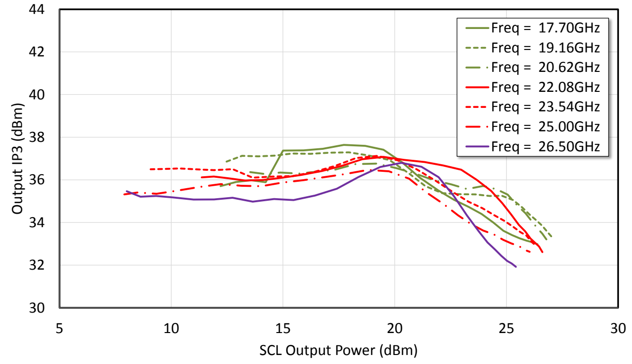
Return Loss (S11/S22) vs. Freq (GHz), Vd = 5V, Id = 0.65A



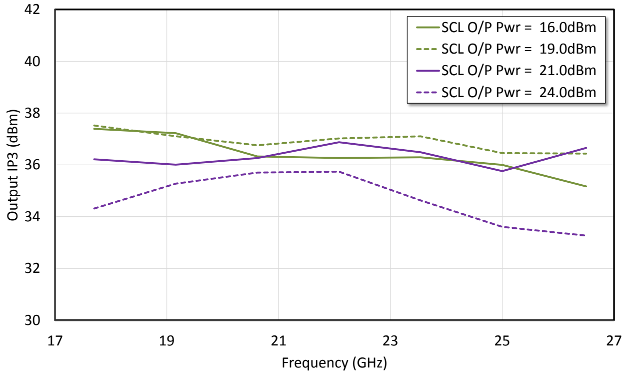
P1dB/P3dB/Psat (dBm) vs. Freq (GHz), Vd = 5V, Id = 650mA



Output IP3 (dBm) vs. SCL Output Power,
Vd = 5V, Id = 650mA

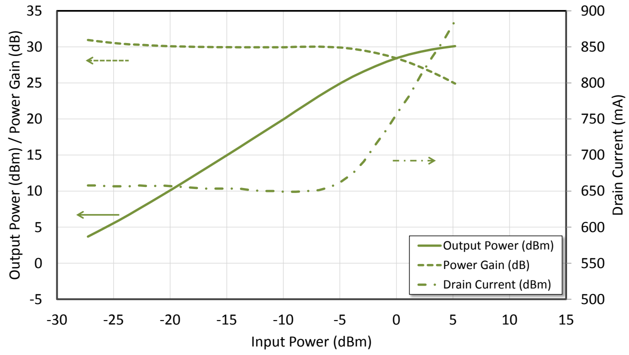


Output IP3 (dBm) vs. Freq (GHz), Vd = 5V, Id = 650mA

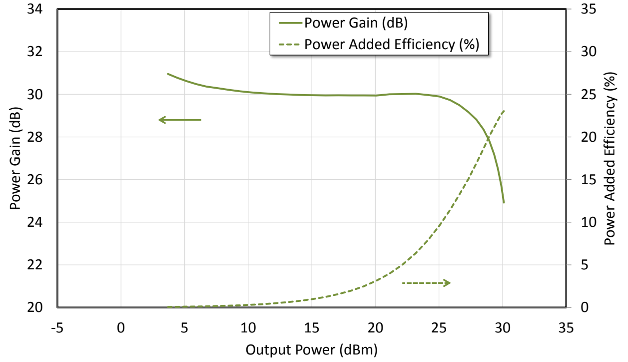


Typical Performance Curves: V_D = 5 V, I_{DQ} = 0.65 A, V_G = -1.05 ~ -0.85 V, T_A = +25°C

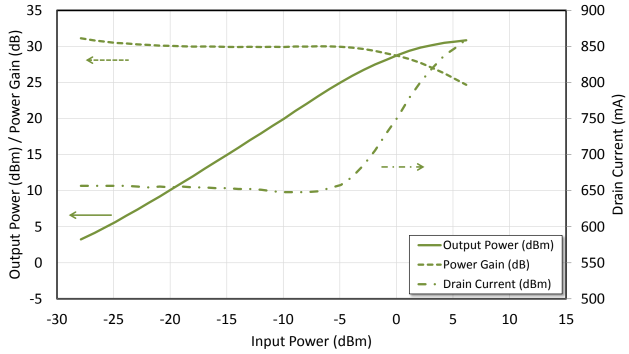
Output Power (dBm), Power Gain (dB), Drain Current (mA) vs. Input Power (dBm) @ 17.70GHz, Vd = 5V, Id = 650mA



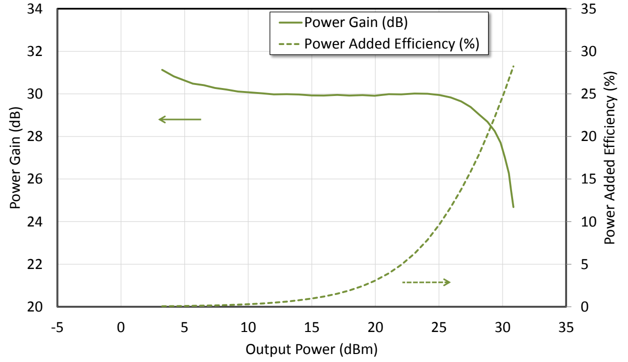
Power Gain (dB) and Power Added Efficiency (%) vs. Output Power (dBm) @ 17.70GHz, Vd = 5V, Id = 650mA



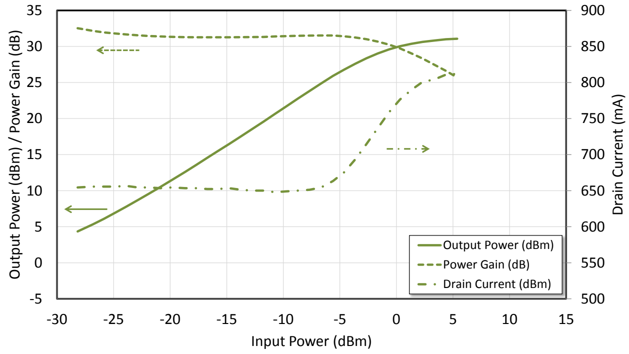
Output Power (dBm), Power Gain (dB), Drain Current (mA) vs. Input Power (dBm) @ 19.16GHz, Vd = 5V, Id = 650mA



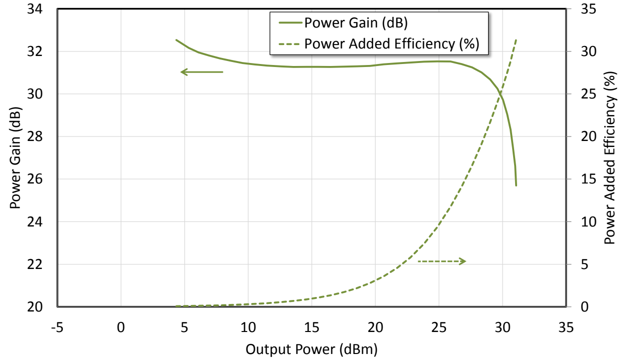
Power Gain (dB) and Power Added Efficiency (%) vs. Output Power (dBm) @ 19.16GHz, Vd = 5V, Id = 650mA



Output Power (dBm), Power Gain (dB), Drain Current (mA) vs. Input Power (dBm) @ 20.62GHz, Vd = 5V, Id = 650mA

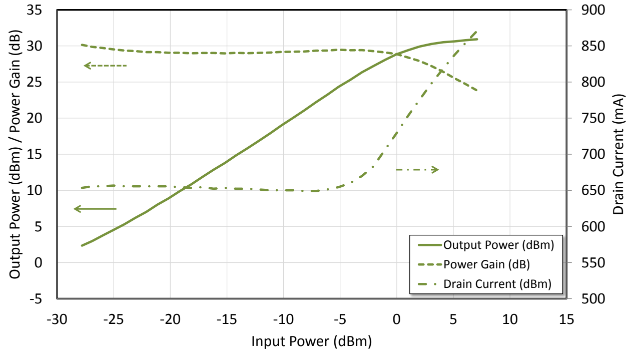


Power Gain (dB) and Power Added Efficiency (%) vs. Output Power (dBm) @ 20.62GHz, Vd = 5V, Id = 650mA

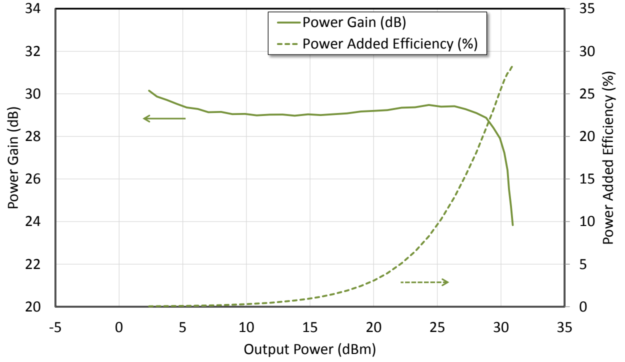


Typical Performance Curves: V_D = 5 V, I_{DQ} = 0.65 A, V_G = -1.05 ~ -0.85 V, T_A = +25°C

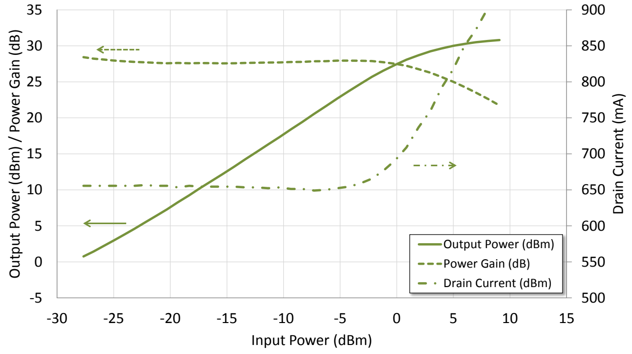
Output Power (dBm), Power Gain (dB), Drain Current (mA) vs. Input Power (dBm) @ 22.08GHz, Vd = 5V, Id = 650mA



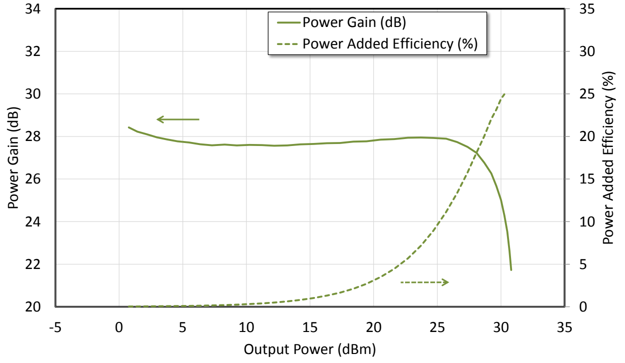
Power Gain (dB) and Power Added Efficiency (%) vs. Output Power (dBm) @ 22.08GHz, Vd = 5V, Id = 650mA



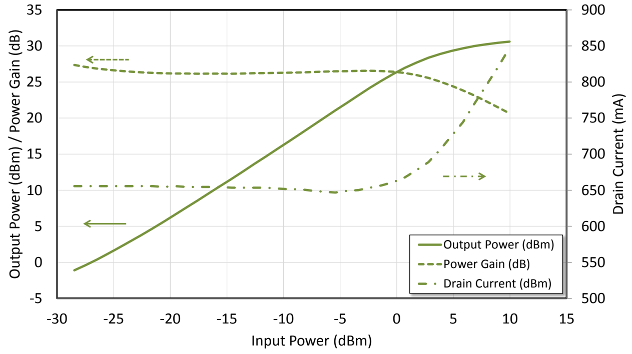
Output Power (dBm), Power Gain (dB), Drain Current (mA) vs. Input Power (dBm) @ 23.54GHz, Vd = 5V, Id = 650mA



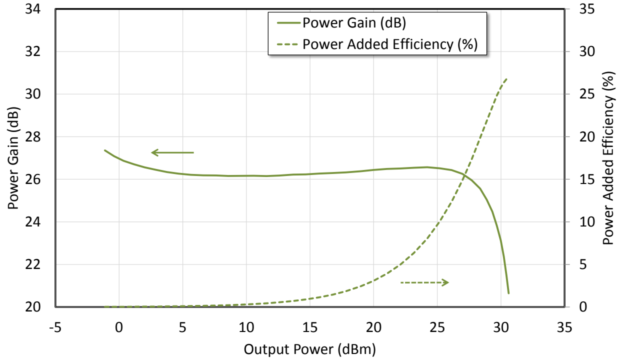
Power Gain (dB) and Power Added Efficiency (%) vs. Output Power (dBm) @ 23.54GHz, Vd = 5V, Id = 650mA



Output Power (dBm), Power Gain (dB), Drain Current (mA) vs. Input Power (dBm) @ 25.00GHz, Vd = 5V, Id = 650mA

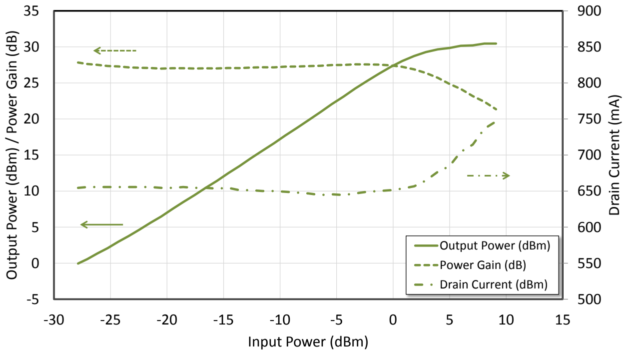


Power Gain (dB) and Power Added Efficiency (%) vs. Output Power (dBm) @ 25.00GHz, Vd = 5V, Id = 650mA

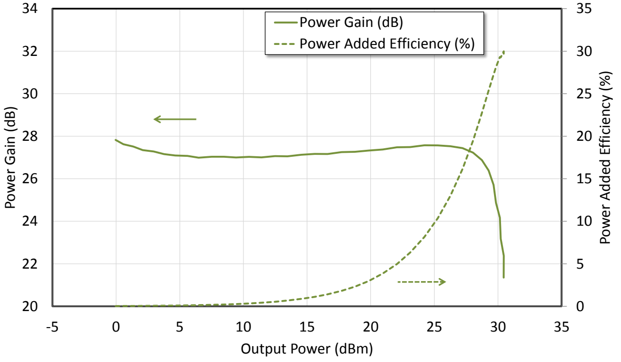


Typical Performance Curves: V_D = 5 V, I_{DQ} = 0.65 A, V_G = -1.05 ~ -0.85 V, T_A = +25°C

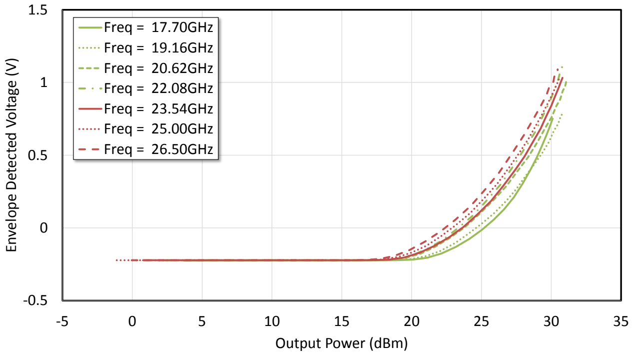
Output Power (dBm), Power Gain (dB), Drain Current (mA) vs. Input Power (dBm) @ 26.50GHz, Vd = 5V, Id = 650mA



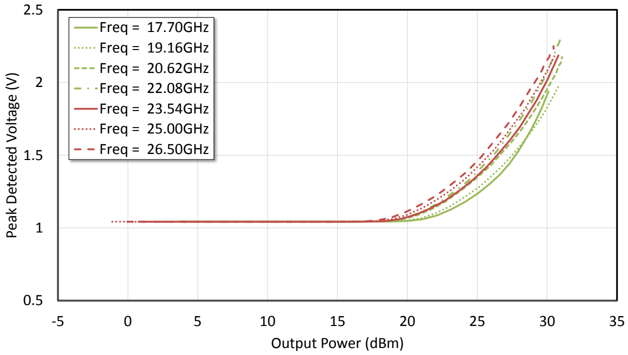
Power Gain (dB) and Power Added Efficiency (%) vs. Output Power (dBm) @ 26.50GHz, Vd = 5V, Id = 650mA



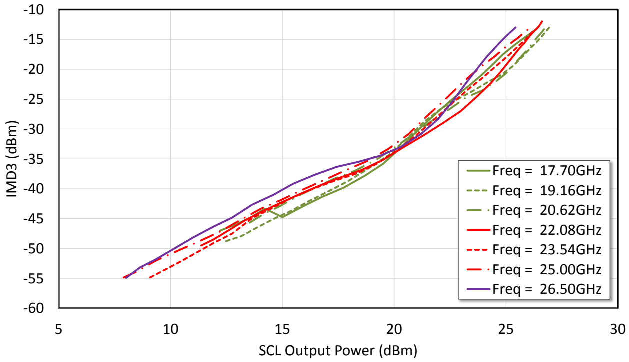
Envelope Detector Voltage (V) vs. Ouput Power, Vd = 5V, Id = 650mA



Peak Detector Voltage (V) vs. Ouput Power, Vd = 5V, Id = 650mA

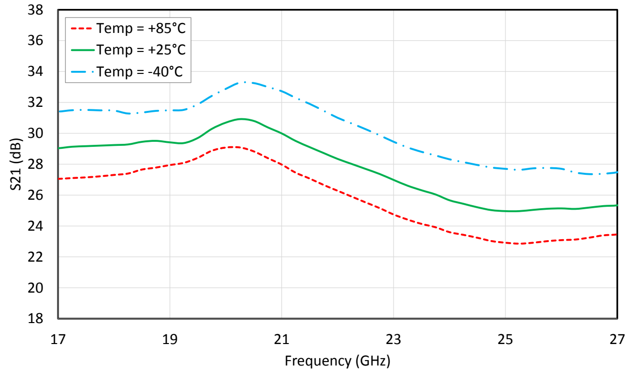


3rd Order Intermodulation (dBm) vs. SCL Output Power, Vd = 5V, Id = 650mA

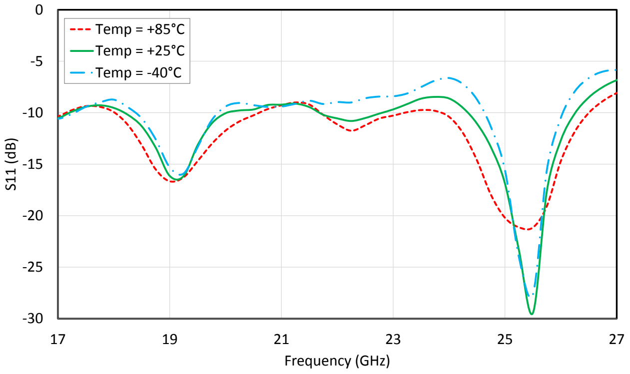


Typical Performance Curves: V_D = 5 V, I_{DQ} = 0.65A, V_G = -1.05 ~ -0.85 V, T_A = -40°C ~ +85°C

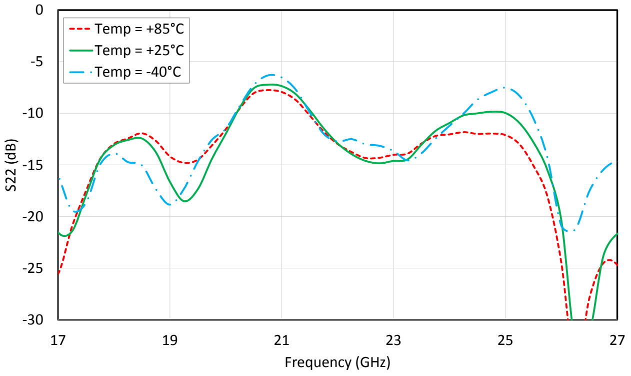
S21 (dB) vs. Freq (GHz), Vd = 5V, Id = 0.65A



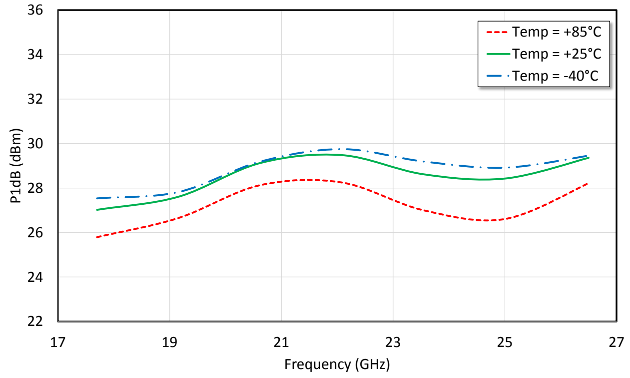
S11 (dB) vs. Freq (GHz), Vd = 5V, Id = 0.65A



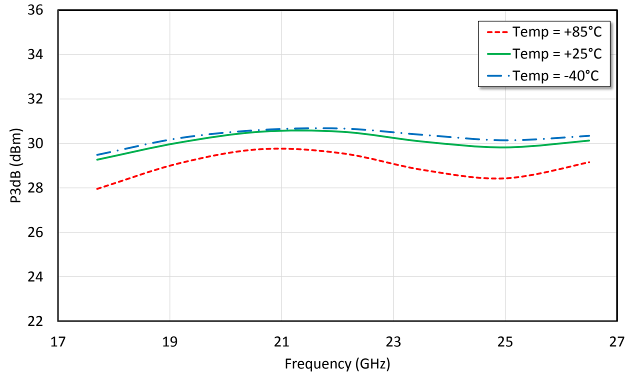
S22 (dB) vs. Freq (GHz), Vd = 5V, Id = 0.65A



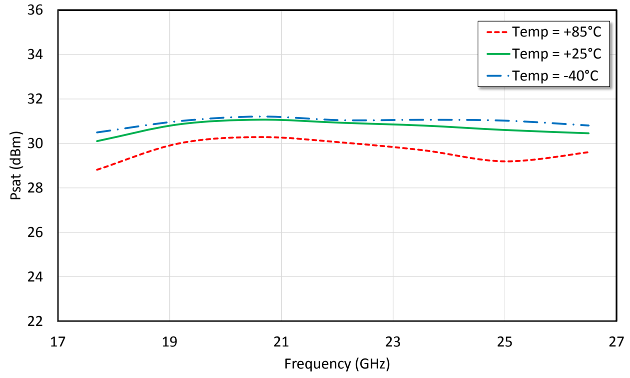
P1dB (dBm) vs. Frequency (GHz), Vd = 5V, Id = 650mA



P3dB (dBm) vs. Frequency (GHz), Vd = 5V, Id = 650mA

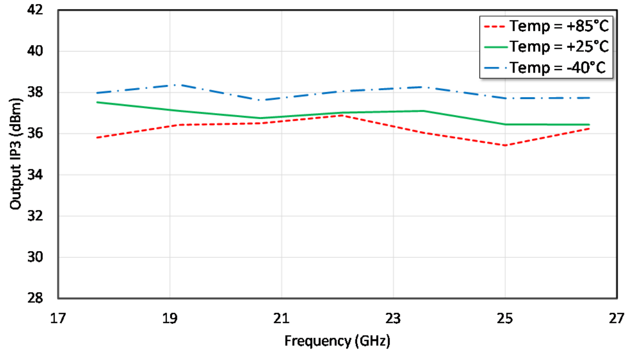


Psat (dBm) vs. Frequency (GHz), Vd = 5V, Id = 650mA

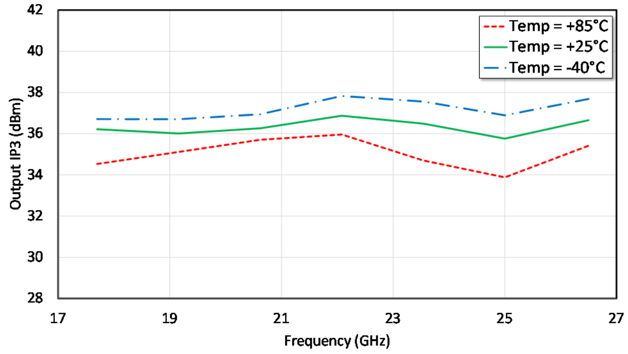


Typical Performance Curves: V_D = 5 V, I_{DQ} = 0.65A, V_G = -1.05 ~ -0.85 V, T_A = -40°C ~ +85°C

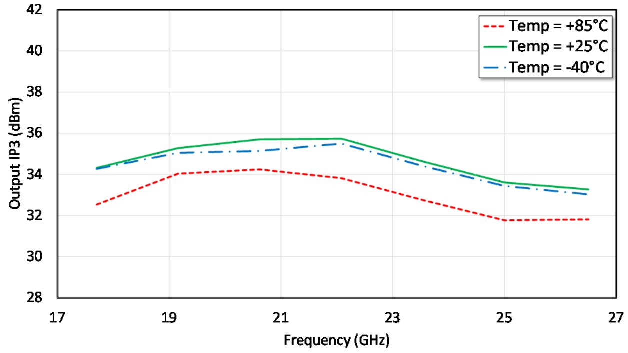
Output IP3 (dBm) @ 19dBm SCL O/P Power vs. Freq (GHz), Vd = 5V, Id = 650mA



Output IP3 (dBm) @ 21dBm SCL O/P Power vs. Freq (GHz), Vd = 5V, Id = 650mA

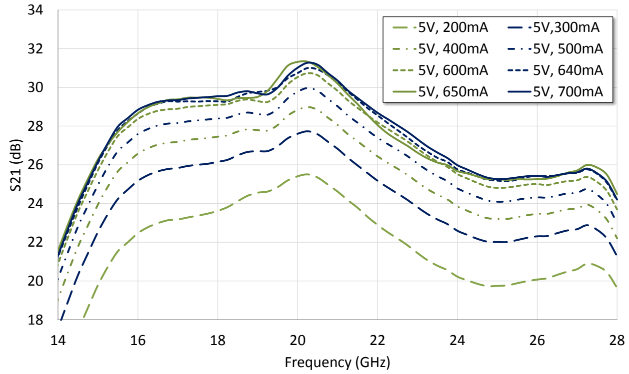


Output IP3 (dBm) @ 24dBm SCL O/P Power vs. Freq (GHz), Vd = 5V, Id = 650mA

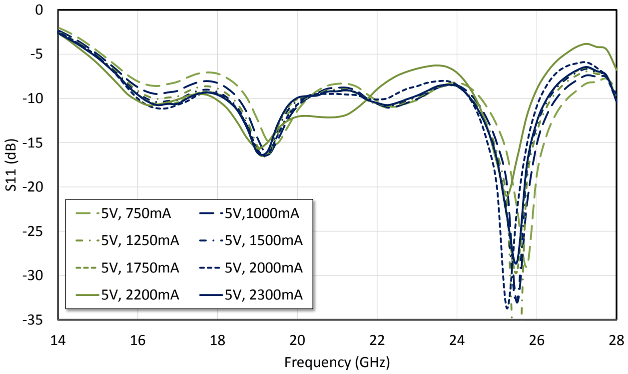


Typical Performance Curves: V_D = 5 V, I_{DQ} = Various, V_G = -0.85 ~ -1.65 V, T_A = +25°C

Gain (S21) vs. Freq (GHz), Various Bias Points

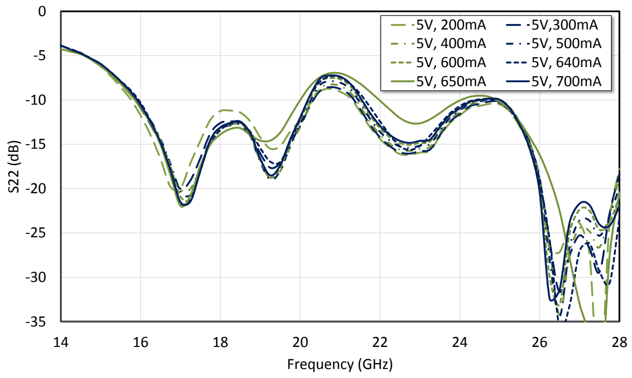


Input Return Loss (S11) vs. Freq (GHz), Various Bias Points

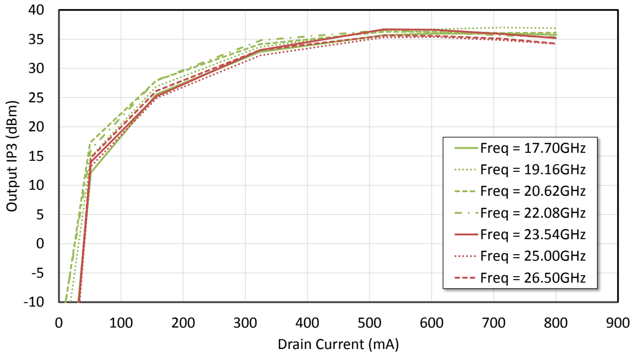


Typical Performance Curves: V_D = 5 V, I_{DQ} = Various, V_G = -0.85 ~ -1.65 V, T_A = +25°C

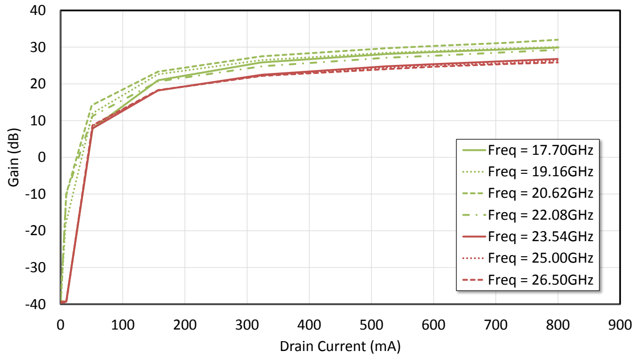
Output Return Loss (S22) vs. Freq (GHz), Various Bias Points



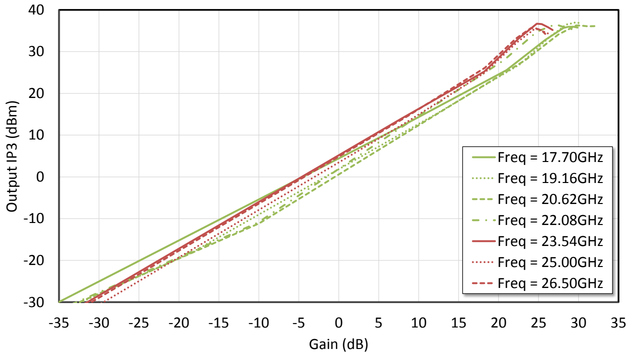
Output IP3 (dBm) vs. Drain Current (mA),
Vd = 5V, Id = Various



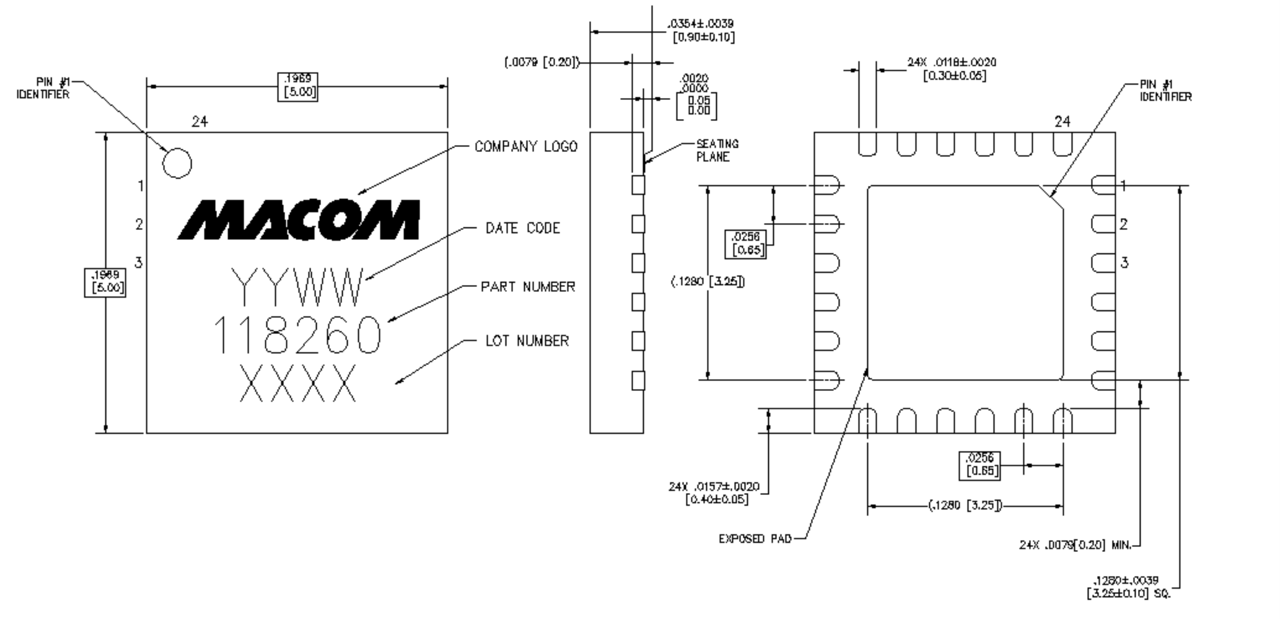
Gain (dB) vs. Drain Current (mA),
Vd = 5V, Id = Various



Output IP3 (dBm) vs. Gain (dB),
Vd = 5V, Id = Various



Lead-Free 5 mm 24-Lead PQFN†



† Reference Application Note S2083 for lead-free solder reflow recommendations.
Meets JEDEC moisture sensitivity level 3 requirements.
Plating is NiPdAu

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