MAAP-018260

Power Amplifier
18 - 26 GHz

Rev. V2

Features

- Fully Integrated Power Amplifier
- Wide Bandwidth 17.7 - 26.5 GHz
- 27 dB Small Signal Gain
- 40 dBm Third Order Intercept Point (OIP3)
- 30 dBm Output P1dB
- Integrated Power Detector
- Typical Bias 5 V, 1.3 A
- Lead-Free 5 mm 24-lead QFN Package
- RoHS*

Description

The MAAP-018260 is a packaged linear power amplifier that operates over the frequency range 17.7 - 26.5 GHz. The device provides 27 dB of gain and 40 dBm OIP3 with more than 30 dBm of output P1dB.

This power amplifier is assembled in a lead free, fully molded 5 mm 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.

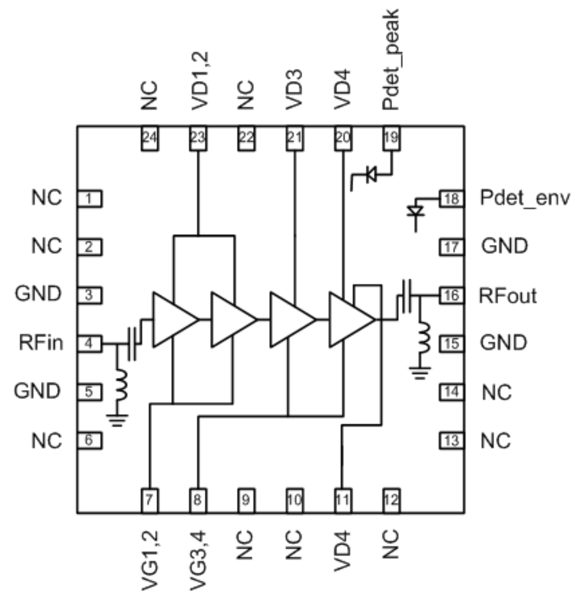
The device is well suited for use in the 18 GHz, 23 GHz, 26 GHz cellular backhaul applications.

Ordering Information[1,2]

Part Number	Package
MAAP-018260	Bulk
MAAP-018260-TR0500	Tape and Reel
MAAP-018260-001SMB	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	No Connection
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	$V_G1,2$	19	Pdet_peak
8	$V_G3,4$	20	V_D4
9	No Connection	21	V_D3
10	No Connection	22	No Connection
11	V_D4	23	$V_D1,2$
12	No Connection	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 25 24	27.5 27.0 25.0	—
P1dB, @ 1 dB Compression	17.7 - 20.0 GHz 20.0 - 24.0 GHz 24.0 - 26.5 GHz	dBm	—	30.0 30.5 30.5	—
P_{SAT}	17.7 - 20.0 GHz 20.0 - 24.0 GHz 24.0 - 26.5 GHz	dBm	31 31 31	32.0 32.5 32.7	—
OIP3	17.7 - 20.0 GHz 20.0 - 24.0 GHz 24.0 - 26.5 GHz	dBm	37.5 37.0 36.0	40.5 40.5 39.5	—
Input Return Loss	17.7 - 20.0 GHz 20.0 - 24.0 GHz 24.0 - 26.5 GHz	dB	—	15 12 10	—
Output Return Loss	17.7 - 20.0 GHz 20.0 - 24.0 GHz 24.0 - 26.5 GHz	dB	—	17 12 10	—
PAE, @ 1 dB Compression	—	%	—	15	—
Quiescent Current	—	mA	1200	1300	1365

Absolute Maximum Ratings[5,6,7]

Parameter	Rating
Drain Voltage (V_D 1,2,3,4) (Under No RF Drive)	+9.0 V
Drain Voltage (V_D 1,2,3,4) (Under RF Drive)	+5.5 V
Gate Voltage (V_G 1,2,3,4)	-3.0 V
Storage Temperature	-65°C to +150°C
Junction Temperature	+175°C

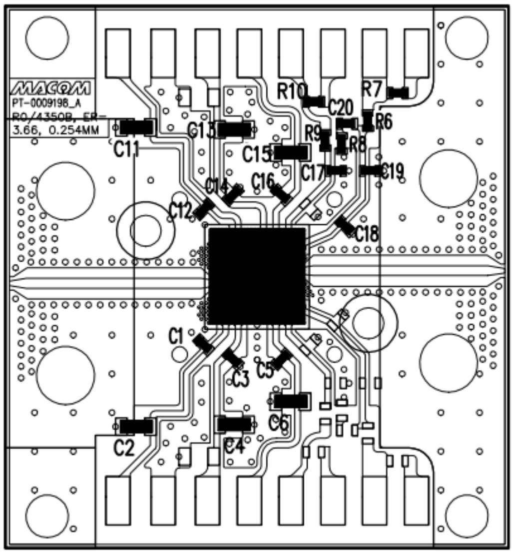
5. Exceeding any one or combination of these limits may cause permanent damage to this device.
6. MACOM does not recommend sustained operation near these survivability limits.
7. Operating at nominal conditions with $T_J \leq +150°C$ will ensure MTTF > 1×10^6 hours.

Maximum Operating Ratings[8,9]

Parameter	Rating
P_{DISS}	9.75 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 9.2°C/W.
9. For saturated performance, it is recommended that the sum of ($2V_{DD}$ + abs (V_{GG})) < 12 V.

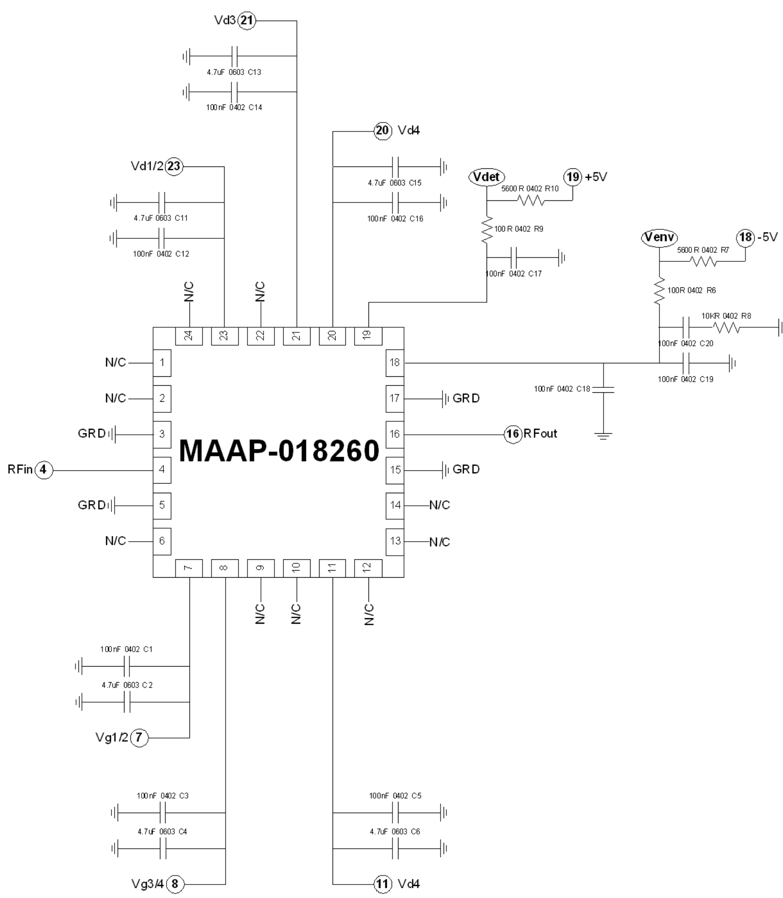
PCB Layout



Parts List

Part	Value	Case Style
C1,C3,C5,C12, C14,C16,C17, C18,C19,C20	100 nF	0402
C2,C4,C6,C11, C13, C15	4.7 µF	0603
R6,R9	100 Ω	0402
R8	10 KΩ	0402
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, $I_{D1}+I_{D2}+I_{D3}+I_{D4}$ = 1300 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-018260 includes a power and envelope detector. 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

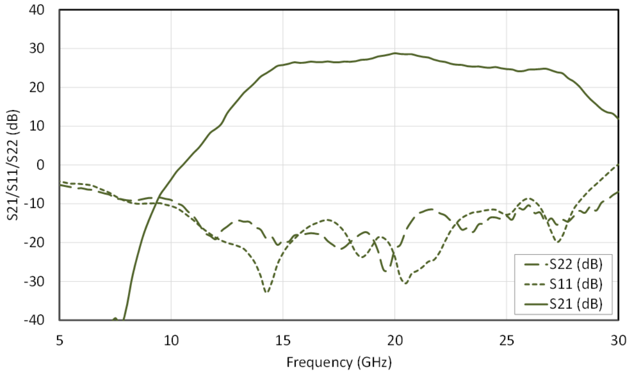
Please observe the following precautions to avoid damage:

Static Sensitivity

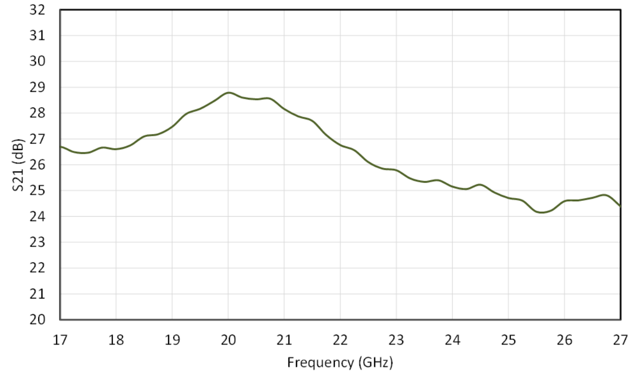
These electronic devices are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. Proper ESD control techniques should be used when handling these CDM class C1, HBM Class 0A devices.

Typical Performance Curves: V_D = 5 V, I_{DQ} = 1.3 A, V_G = -1.05 ~ -0.85 V, T_A = +25°C

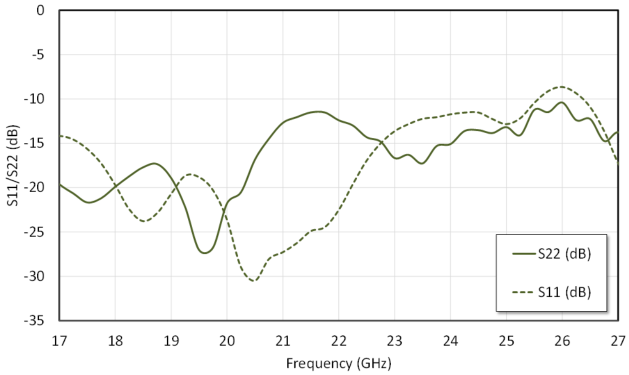
Broadband S-Parameters vs. Freq (GHz), Vd = 5V, Id = 1.3A



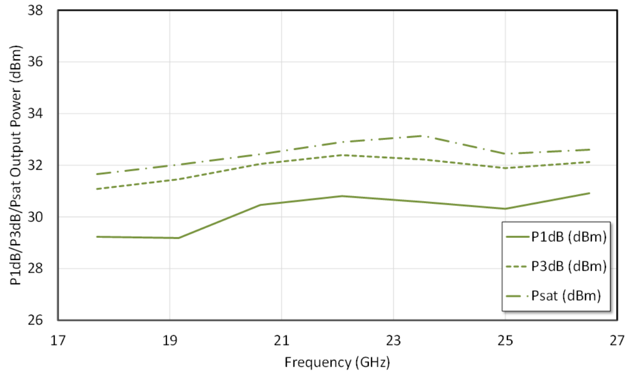
Gain (S21) vs. Freq (GHz), Vd = 5V, Id = 1.3A



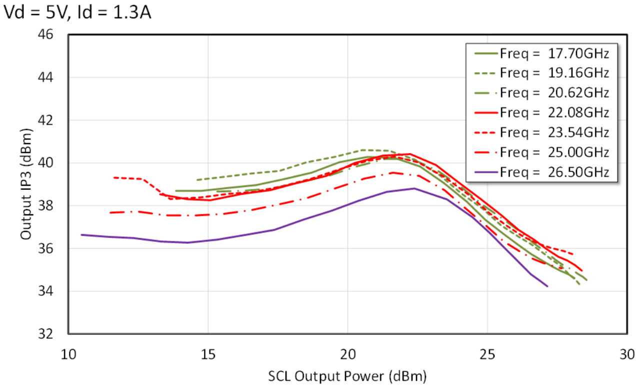
Return Loss (S11/S22) vs. Freq (GHz), Vd = 5V, Id = 1.3A



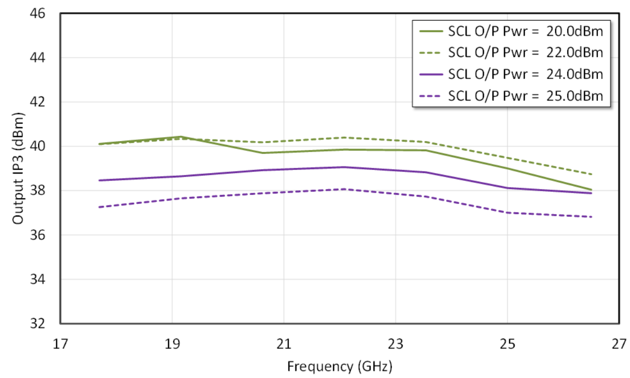
P1dB/P3dB/Psat (dBm) vs. Freq (GHz), Vd = 5V, Id = 1.3A



Output IP3 (dBm) vs. SCL Ouput Pwr (dBm),
Vd = 5V, Id = 1.3A

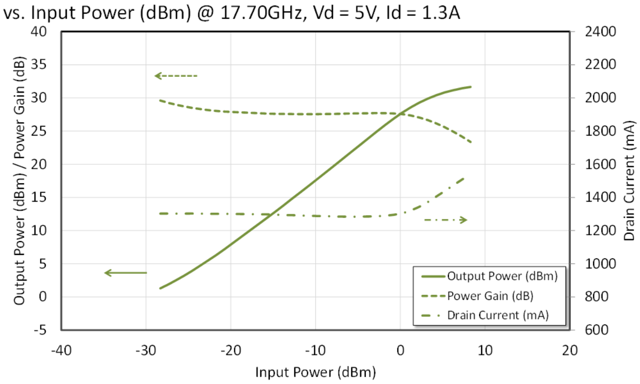


Output IP3 (dBm) vs. Freq (GHz), Vd = 5V, Id = 1.3A

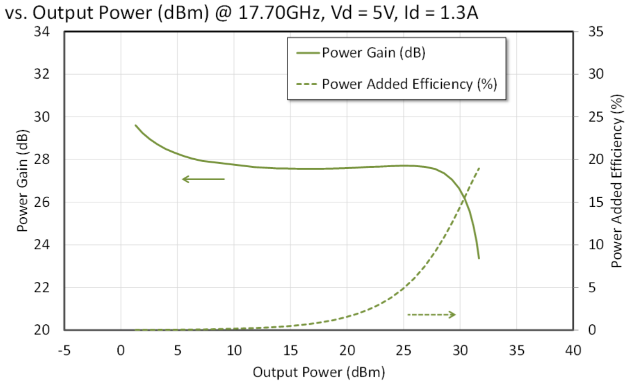


Typical Performance Curves: V_D = 5 V, I_{DQ} = 1.3 A, V_G = -1.05 ~ -0.85 V, T_A = +25°C

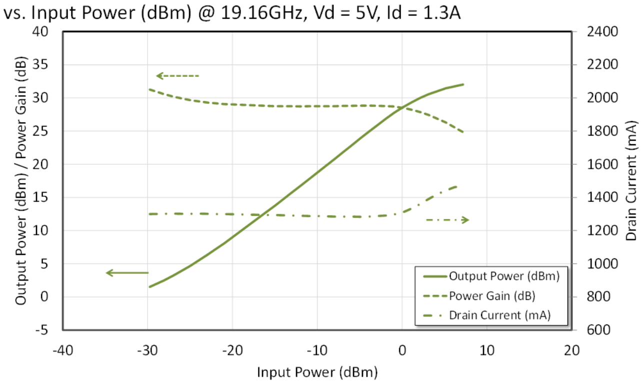
Output Power (dBm), Power Gain (dB) and Current (mA)
vs. Input Power (dBm) @ 17.70GHz, Vd = 5V, Id = 1.3A



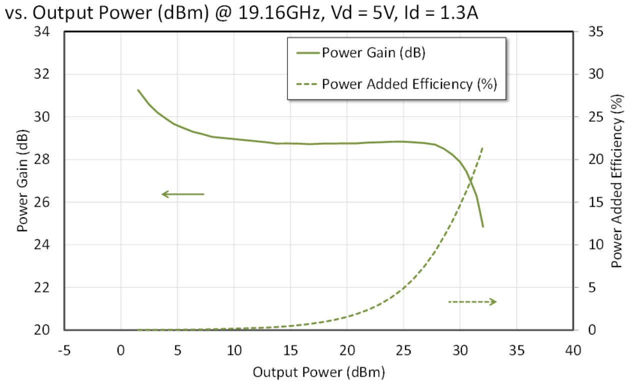
Power Gain (dB) and Power Added Efficiency (%)
vs. Output Power (dBm) @ 17.70GHz, Vd = 5V, Id = 1.3A



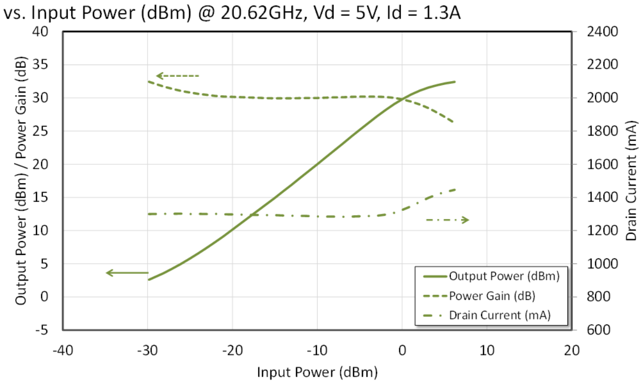
Output Power (dBm), Power Gain (dB) and Current (mA)
vs. Input Power (dBm) @ 19.16GHz, Vd = 5V, Id = 1.3A



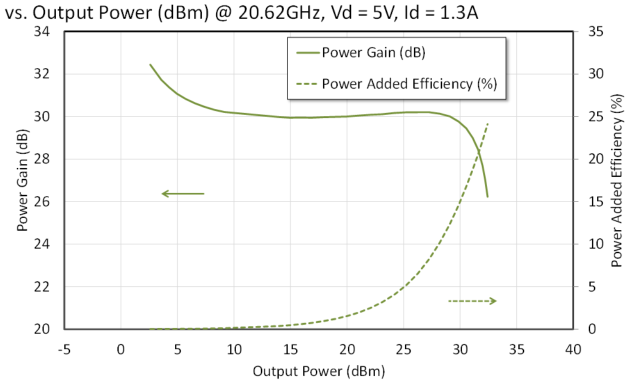
Power Gain (dB) and Power Added Efficiency (%)
vs. Output Power (dBm) @ 19.16GHz, Vd = 5V, Id = 1.3A



Output Power (dBm), Power Gain (dB) and Current (mA)
vs. Input Power (dBm) @ 20.62GHz, Vd = 5V, Id = 1.3A

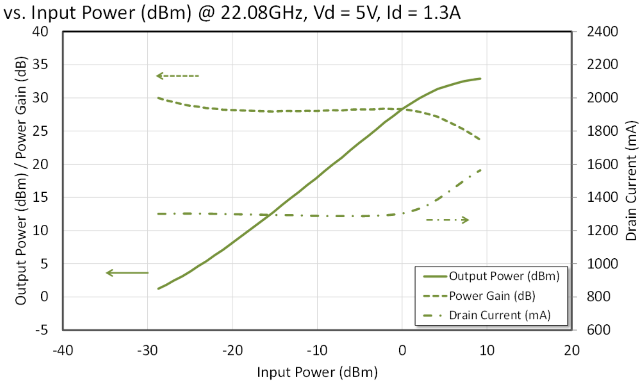


Power Gain (dB) and Power Added Efficiency (%)
vs. Output Power (dBm) @ 20.62GHz, Vd = 5V, Id = 1.3A

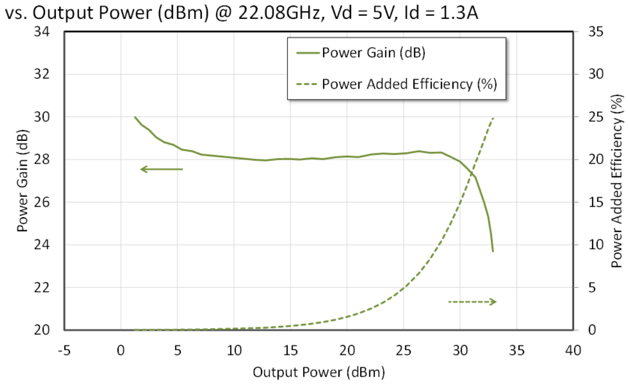


Typical Performance Curves: V_D = 5 V, I_{DQ} = 1.3 A, V_G = -1.05 ~ -0.85 V, T_A = +25°C

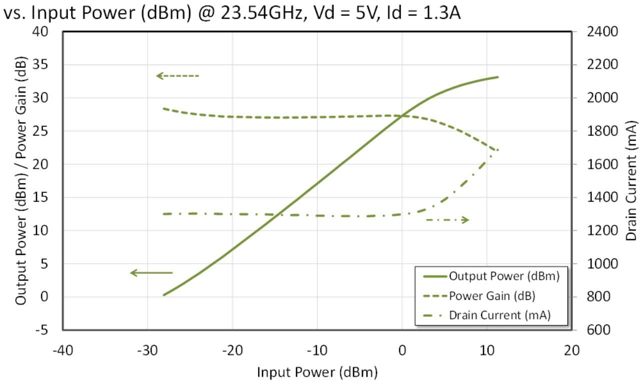
Output Power (dBm), Power Gain (dB) and Current (mA)
vs. Input Power (dBm) @ 22.08GHz, Vd = 5V, Id = 1.3A



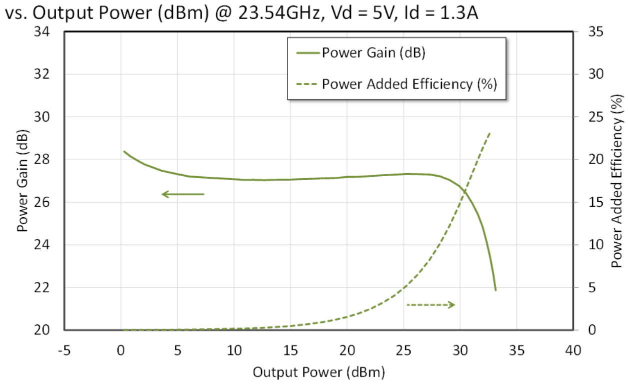
Power Gain (dB) and Power Added Efficiency (%)
vs. Output Power (dBm) @ 22.08GHz, Vd = 5V, Id = 1.3A



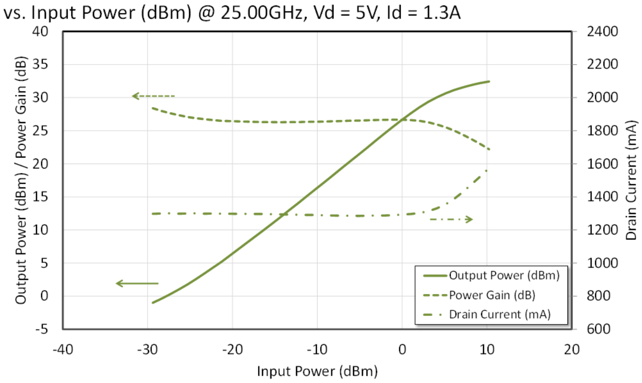
Output Power (dBm), Power Gain (dB) and Current (mA)
vs. Input Power (dBm) @ 23.54GHz, Vd = 5V, Id = 1.3A



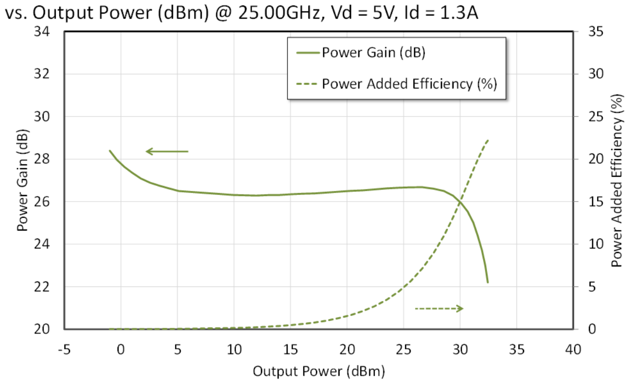
Power Gain (dB) and Power Added Efficiency (%)
vs. Output Power (dBm) @ 23.54GHz, Vd = 5V, Id = 1.3A



Output Power (dBm), Power Gain (dB) and Current (mA)
vs. Input Power (dBm) @ 25.00GHz, Vd = 5V, Id = 1.3A

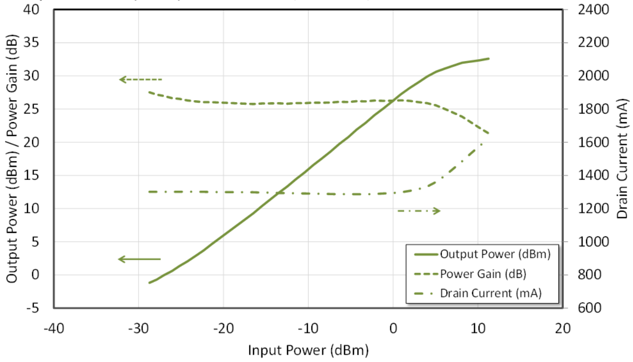


Power Gain (dB) and Power Added Efficiency (%)
vs. Output Power (dBm) @ 25.00GHz, Vd = 5V, Id = 1.3A

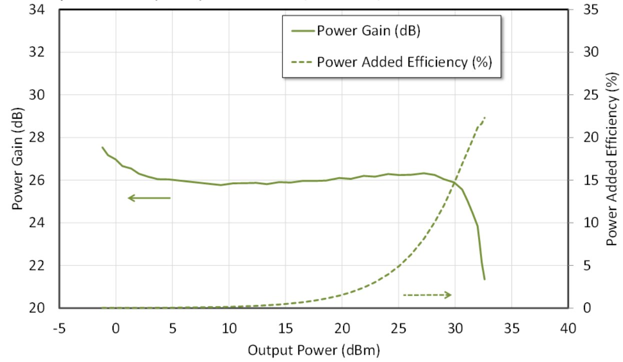


Typical Performance Curves: V_D = 5 V, I_{DQ} = 1.3 A, V_G = -1.05 ~ -0.85 V, T_A = +25°C

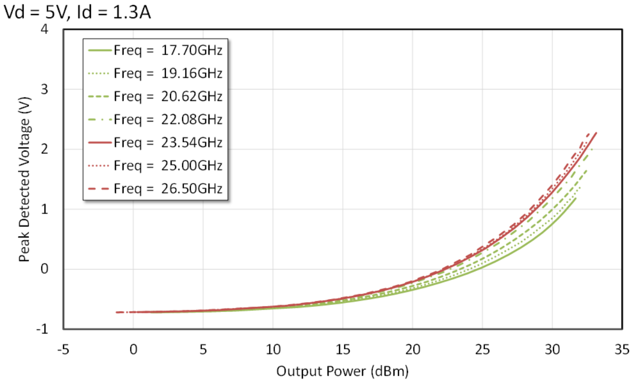
Output Power (dBm), Power Gain (dB) and Current (mA) vs. Input Power (dBm) @ 26.50GHz, Vd = 5V, Id = 1.3A



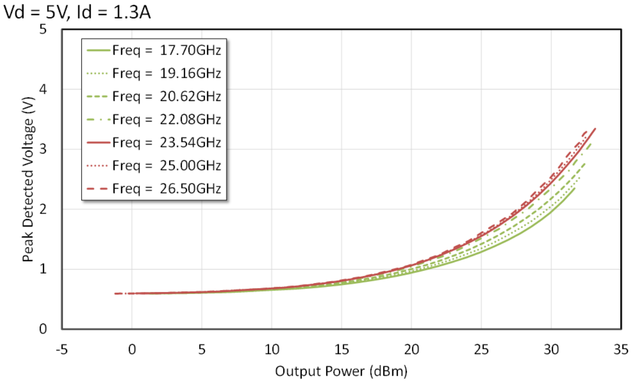
Power Gain (dB) and Power Added Efficiency (%) vs. Output Power (dBm) @ 26.5GHz, Vd = 5V, Id = 1.3A



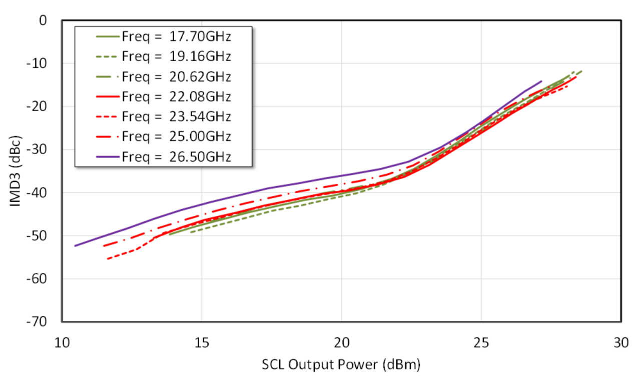
Envelope Detected Voltage (V) vs. Output Power (dBm), Vd = 5V, Id = 1.3A



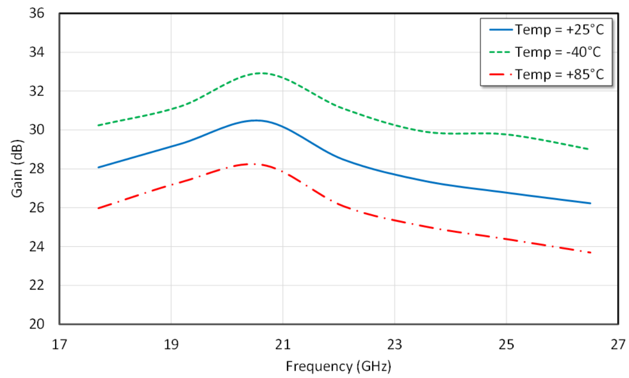
Peak Detected Voltage (V) vs. Output Power (dBm), Vd = 5V, Id = 1.3A



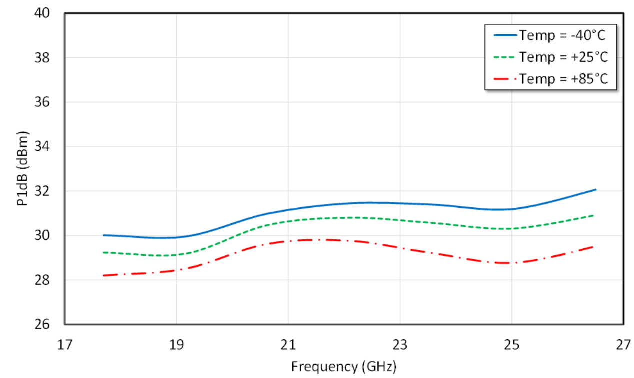
IMD3 (dBc) vs. SCL Ouput Pwr (dBm), Vd = 5V, Id = 1.3A



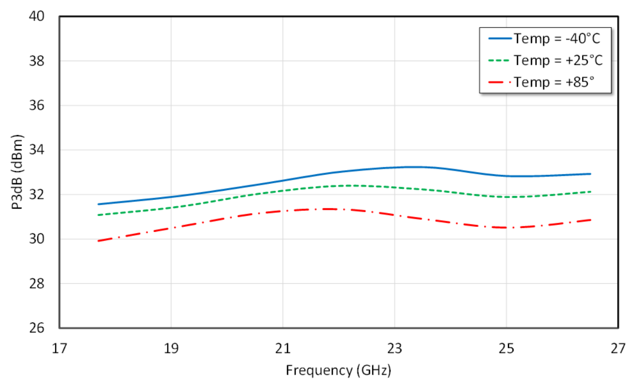
Typical Performance Curves: V_D = 5 V, I_{DQ} = 1.3 A, V_G = -1.05 ~ -0.85 V, T_A = -40°C ~ +85°C



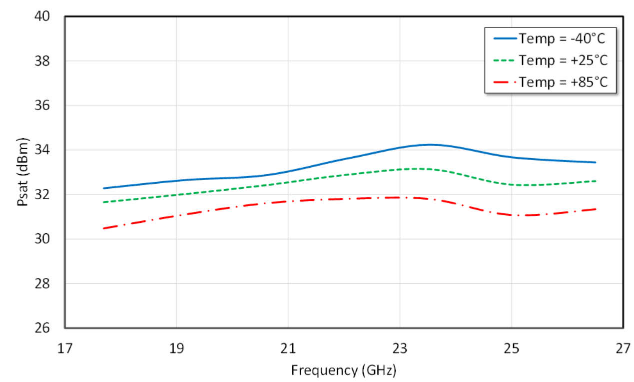
Gain (dB) vs. Frequency (GHz) , Vd = 5V, Id = 1.3A



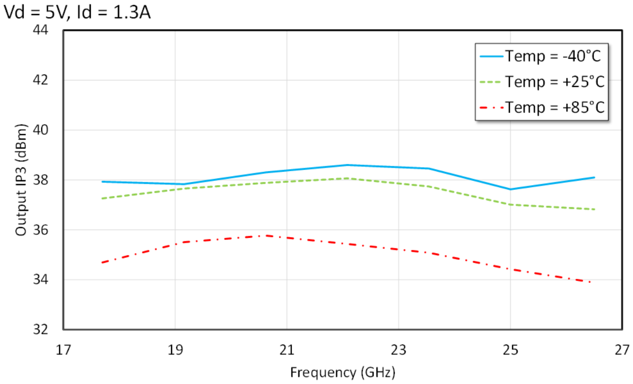
P1dB(dBm) vs. Frequency (GHz) , Vd = 5V, Id = 1.3A



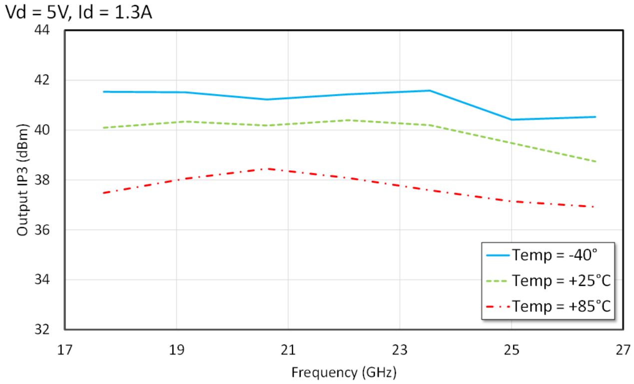
P3dB(dBm) vs. Frequency (GHz) , Vd = 5V, Id = 1.3A



Psat(dBm) vs. Frequency (GHz) , Vd = 5V, Id = 1.3A

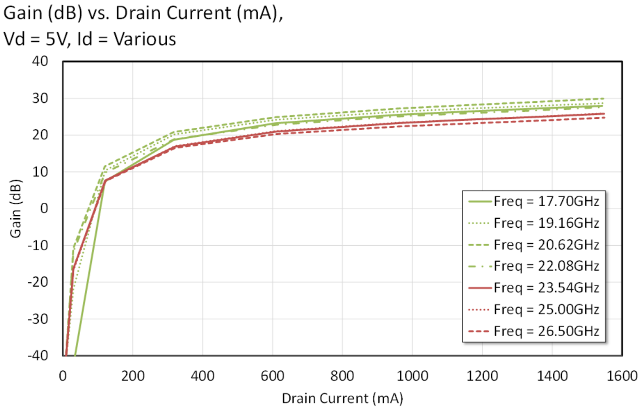


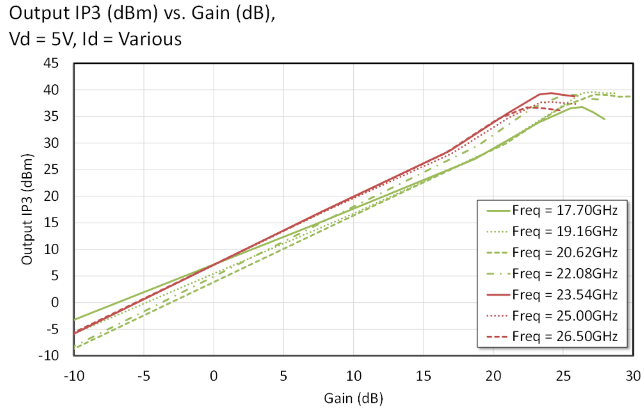
Output IP3 (dBm) vs. Freq (GHz) @ 25dBm SCL O/P Pwr,
Vd = 5V, Id = 1.3A

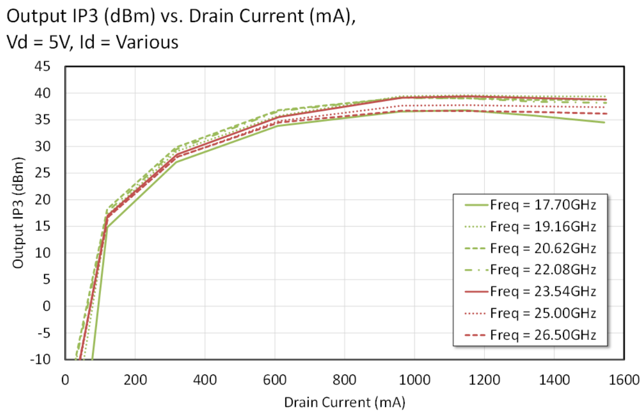


Output IP3 (dBm) vs. Freq (GHz) @ 22dBm SCL O/P Pwr,
Vd = 5V, Id = 1.3A

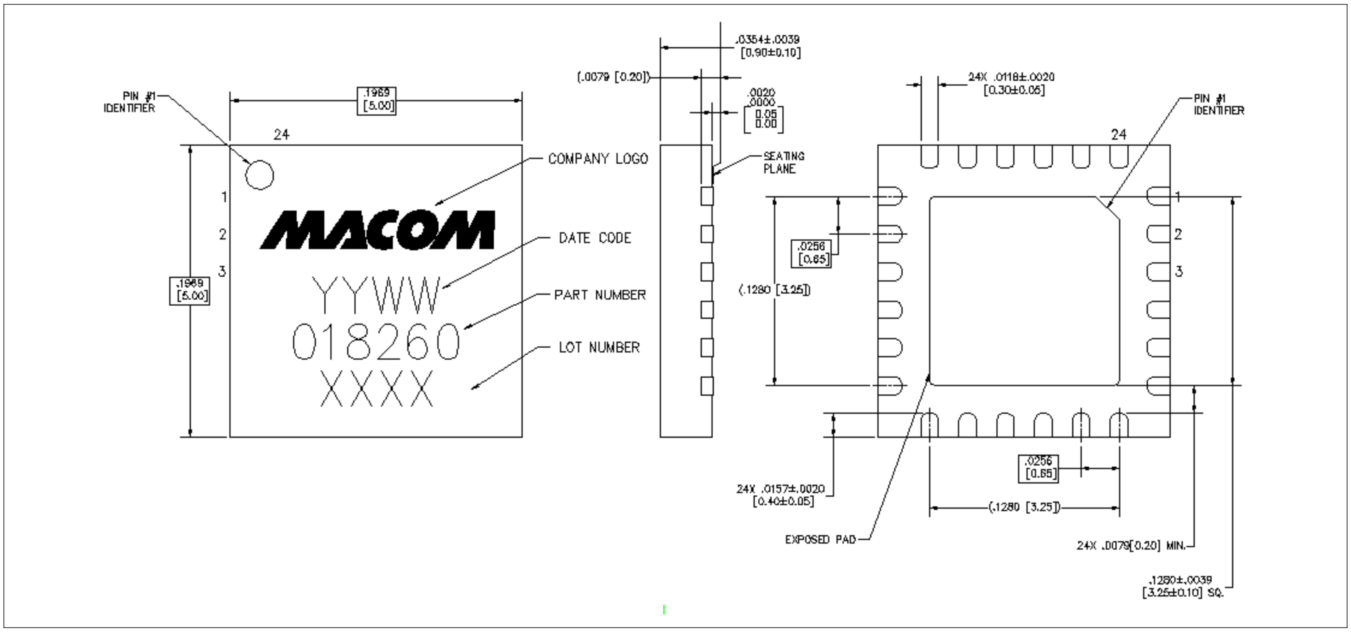
Typical Performance Curves: V_D = 5 V, I_{DQ} = Various, V_G = -0.85 ~ -1.65 V, T_A = +25°C







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