

CMPA2738060F

60 W, 2.7 - 3.8 GHz, GaN MMIC,
Power Amplifier

Description

Wolfspeed's CMPA2738060F is a packaged, high-power MMIC amplifier producing 85W of saturated output power over the 2.7 - 3.8 GHz frequency range. With 27dB of large signal gain and achieving 50% power-added efficiency or higher, the CMPA2738060F is ideally suited to support a variety of S-Band radar applications.

The CMPA2738060F also supports ease of use and straight-forward system integration. Matched to 50 ohms at both RF ports along with DC blocking capacitors, thermal-management is further enhanced in a bolt-down, flanged package allowing for long-pulse operation.



Package Type: 440219
PN: CMPA2738060F

Typical Performance Over 2.7 - 3.8 GHz ($T_c = 25^\circ\text{C}$)

Parameter	2.7 GHz	2.9 GHz	3.1 GHz	3.5 GHz	3.8 GHz	Units
Small Signal Gain	36.1	36.0	34.5	35.7	35.0	dB
Output Power ¹	88.0	86.5	74.0	81.0	81.2	W
Power Gain ¹	29.4	29.4	28.7	29.1	29.1	dB
PAE ¹	52.5	55.5	50.4	53.0	51.0	%

Note:

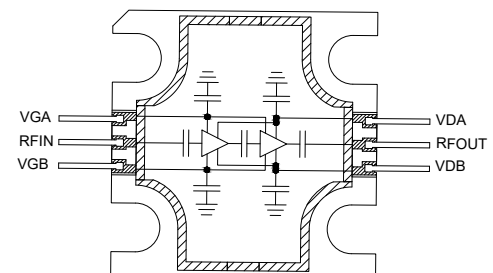
¹ $P_{IN} = 20 \text{ dBm}$

Features

- 35 dB Small Signal Gain
- 80 W Typical P_{SAT}
- Operation up to 50 V
- High Breakdown Voltage
- High Temperature Operation
- 0.5" x 0.5" Total Product Size

Applications

- Civil and Military Pulsed Radar Amplifiers





Absolute Maximum Ratings (not simultaneous) at 25°C

Parameter	Symbol	Rating	Units	Conditions
Drain-source Voltage	V_{DSS}	150	V_{DC}	25°C
Gate-source Voltage	V_{GS}	-10, +2		
Storage Temperature	T_{STG}	-65, +150	°C	
Operating Junction Temperature	T_J	225		
Maximum Forward Gate Current	I_{GMAX}	12	mA	25°C
Screw Torque	τ	40	in-oz	
Thermal Resistance, Junction to Case (packaged) ¹	$R_{\theta JC}$	0.77	°C/W	300µsec, 20%, 85°C
		1.44		CW, 85°C

Note:

¹ Measured for the CMPA2738050F at $P_{DISS} = 64\text{ W}$

Electrical Characteristics (Frequency = 2.7 GHz to 3.8 GHz unless otherwise stated; $T_c = 25^\circ\text{C}$)

Characteristics	Symbol	Min.	Typ.	Max.	Units	Conditions
DC Characteristics						
Gate Threshold Voltage	V _{GS(th)}	-3.8	-3.0	-2.3	V	V _{DS} = 10 V, I _D = 15.2 mA
Gate Quiescent Voltage	V _{GS(Q)}	—	-2.7	—	V _{DC}	V _{DD} = 50 V, I _{DQ} = 280 mA
Saturated Drain Current ¹	I _{DS}	9.9	14.1	—	A	V _{DS} = 6.0 V, V _{GS} = 2.0 V
Drain-Source Breakdown Voltage	V _{BD}	100	—	—	V	V _{GS} = -8 V, I _D = 15.2 mA
RF Characteristics ^{2,3}						
Small Signal Gain at 2.7 GHz	S ₂₁	—	36.1	—	dB	V _{DD} = 50 V, I _{DQ} = 280 mA
Small Signal Gain at 3.1 GHz		—	34.5	—		
Small Signal Gain at 3.8 GHz		—	35.0	—		
Output Power at 2.7 GHz	P _{OUT}	—	88.0	—	W	V _{DD} = 50 V, I _{DQ} = 280 mA, P _{IN} = 20 dBm
Output Power at 3.1 GHz		—	86.5	—		
Output Power at 3.8 GHz		—	81.2	—		
Power Added Efficiency at 2.7 GHz	PAE	—	52.5	—	%	V _{DD} = 50 V, I _{DQ} = 280 mA
Power Added Efficiency at 3.1 GHz		—	55.5	—		
Power Added Efficiency at 3.8 GHz		—	51.0	—		
Input Return Loss at 2.7 GHz	S ₁₁	—	-11.3	—	dB	
Input Return Loss at 3.1 GHz		—	-25.0	—		
Input Return Loss at 3.8 GHz		—	-11.5	—		
Output Return Loss at 2.7 GHz	S ₂₂	—	-8.5	—		
Output Return Loss at 3.1 GHz		—	-11.0	—		
Output Return Loss at 3.8 GHz		—	-8.0	—		
Output Mismatch Stress	VSWR	—	—	5:1	Ψ	No damage at all phase angles, V _{DD} = 50 V, I _{DQ} = 280 mA, P _{OUT} = 60 W

Notes:

¹ Scaled from PCM data

² All data pulse tested in CMPA2738060F-AMP

³ Pulse Width = 300µs, Duty Cycle = 20%

Typical Performance of the CPMA2738060F

Test conditions unless otherwise noted: $V_D = 50\text{ V}$, $I_{DQ} = 280\text{ mA}$, $PW = 300\mu\text{s}$, $DC = 20\%$, $P_{IN} = 20\text{ dBm}$, -40°C at $P_{IN} = 18\text{ dBm}$, Frequency = 3.1 GHz , $T_{BASE} = +25^\circ\text{C}$

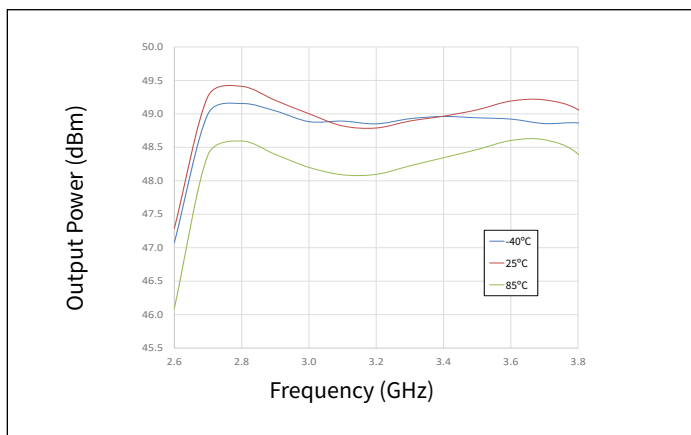


Figure 1. Output Power vs Frequency as a Function of Temperature

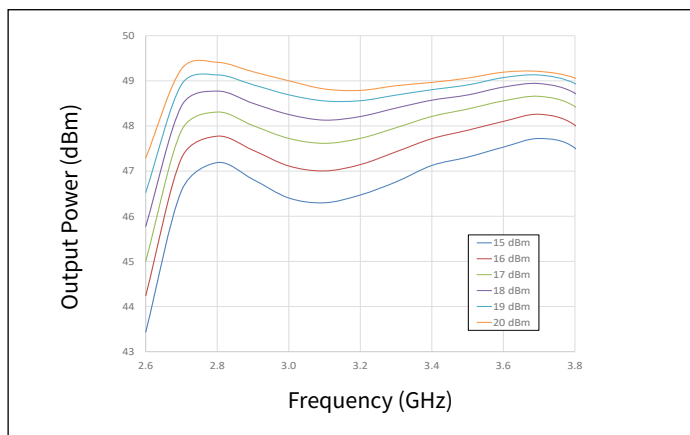


Figure 2. Output Power vs Frequency as a Function of Input Power

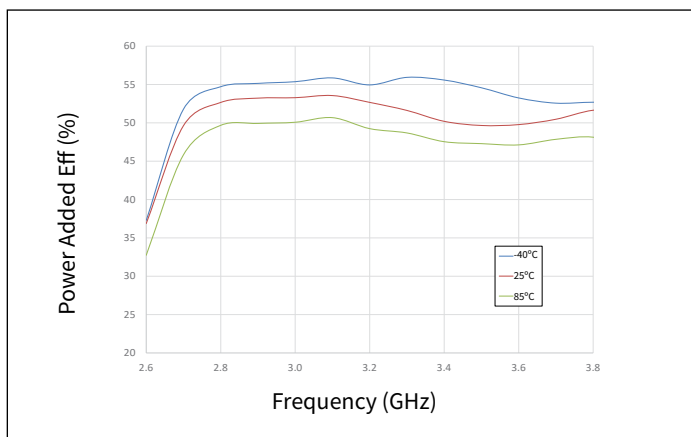


Figure 3. Power Added Eff. vs Frequency as a Function of Temperature

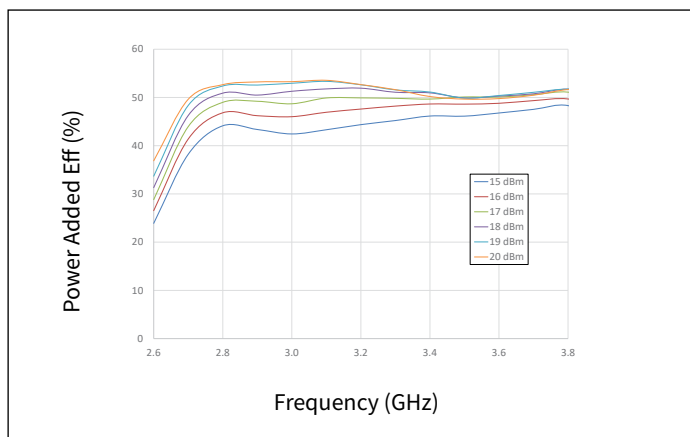


Figure 4. Power Added Eff. vs Frequency as a Function of Input Power

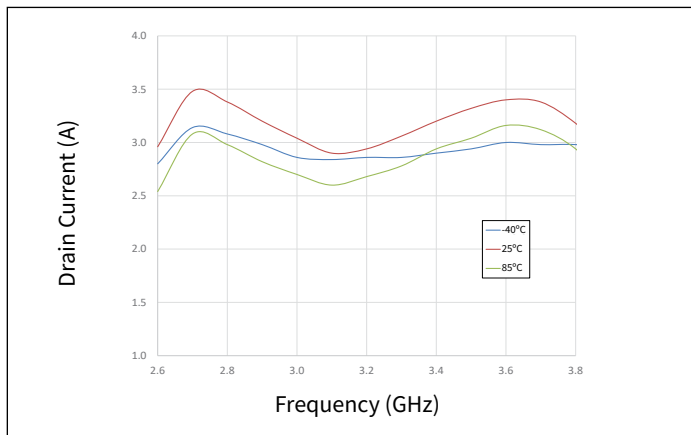


Figure 5. Drain Current vs Frequency as a Function of Temperature

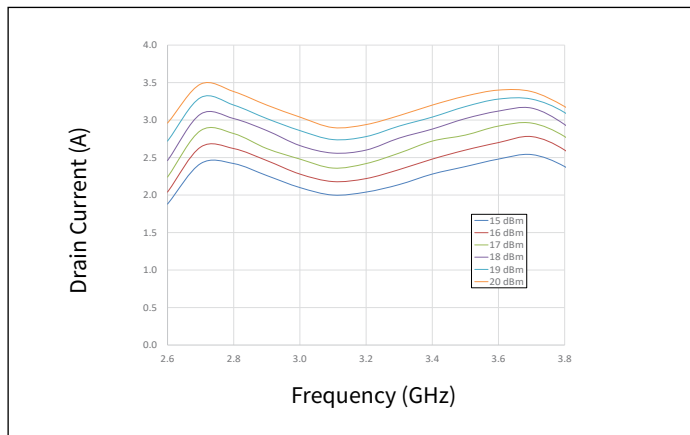


Figure 6. Drain Current vs Frequency as a Function of Input Power

Typical Performance of the CPMA2738060F

Test conditions unless otherwise noted: $V_D = 50\text{ V}$, $I_{DQ} = 280\text{ mA}$, $PW = 300\mu\text{s}$, $DC = 20\%$, $P_{IN} = 20\text{ dBm}$, Frequency = 3.1 GHz , $T_{BASE} = +25^\circ\text{C}$

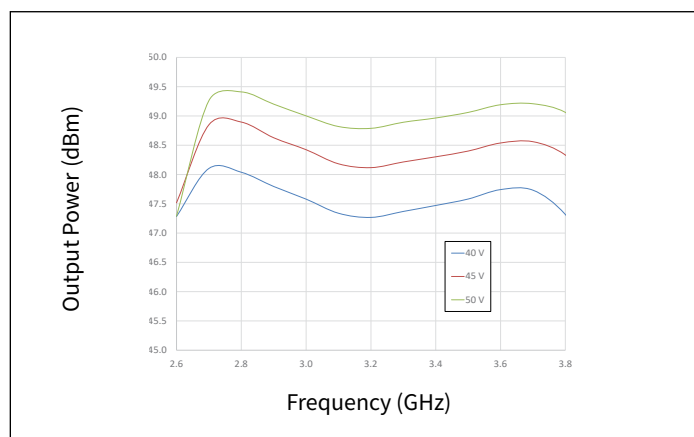


Figure 7. Output Power vs Frequency as a Function of V_D

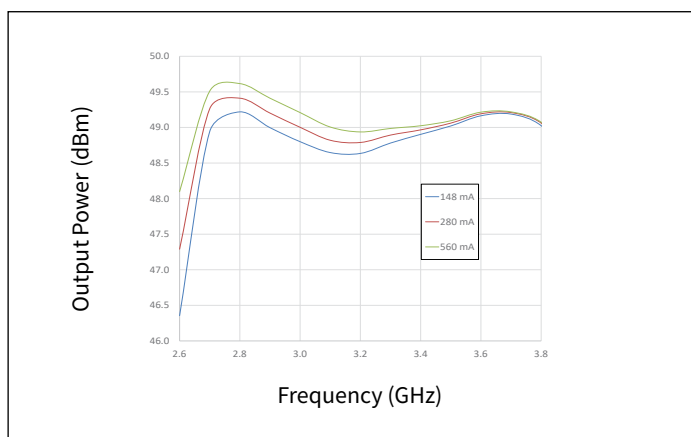


Figure 8. Output Power vs Frequency as a Function of I_{DQ}

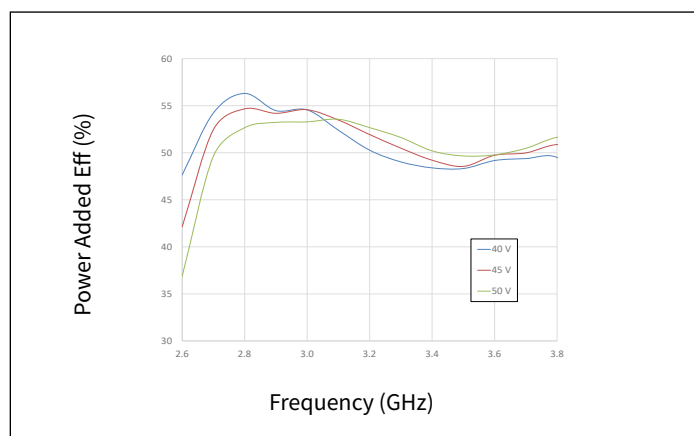


Figure 9. Power Added Eff. vs Frequency as a Function of V_D

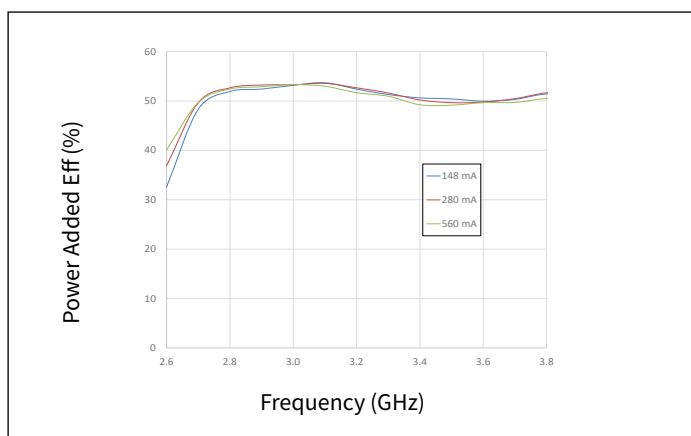


Figure 10. Power Added Eff. vs Frequency as a Function of I_{DQ}

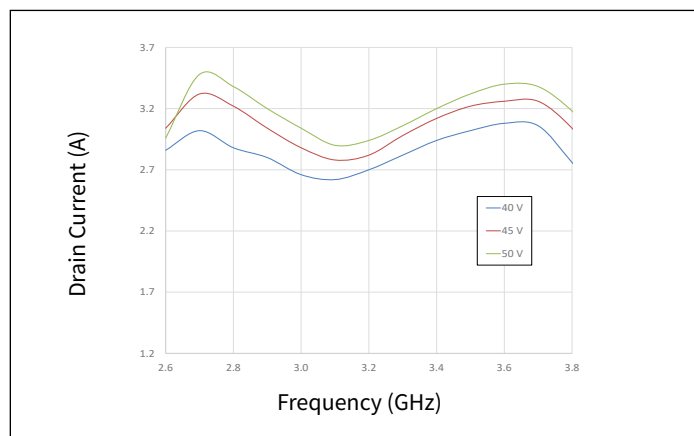


Figure 11. Drain Current vs Frequency as a Function of V_D

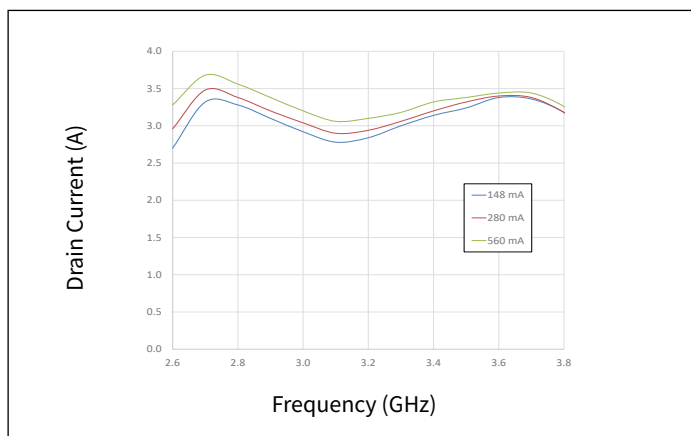


Figure 12. Drain Current vs Frequency as a Function of I_{DQ}

Typical Performance of the CPMA2738060F

Test conditions unless otherwise noted: $V_D = 50\text{ V}$, $I_{DQ} = 280\text{ mA}$, $PW = 300\mu\text{s}$, $DC = 20\%$, $P_{IN} = 20\text{ dBm}$, Frequency = 3.1 GHz , $T_{BASE} = +25^\circ\text{C}$

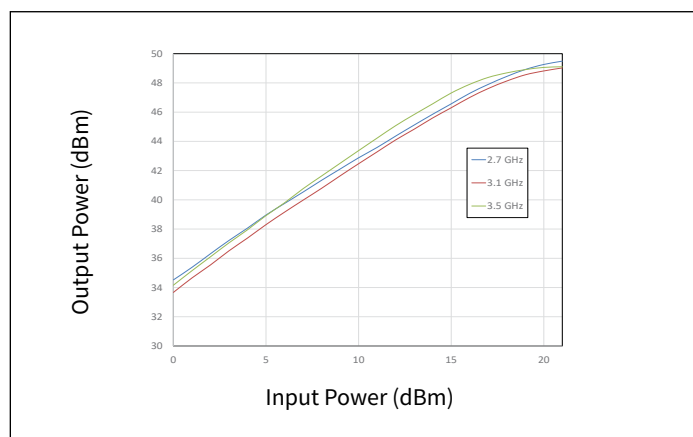


Figure 13. Output Power vs Input Power as a Function of Frequency

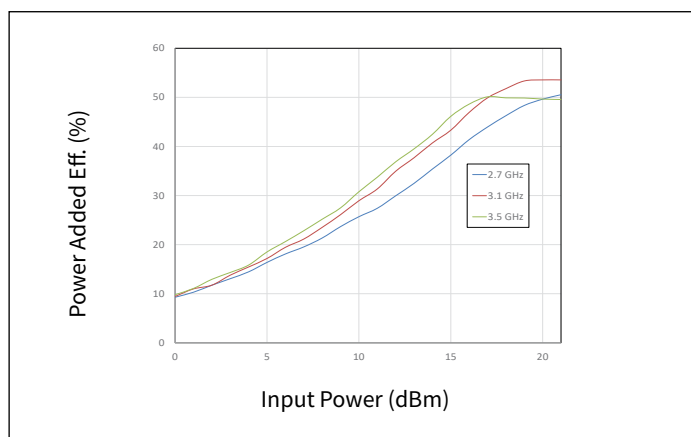


Figure 14. Power Added Eff. vs Input Power as a Function of Frequency

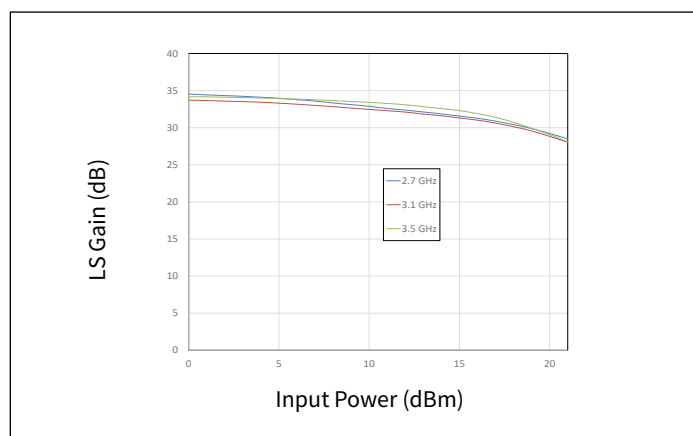


Figure 15. Large Signal Gain vs Input Power as a Function of Frequency

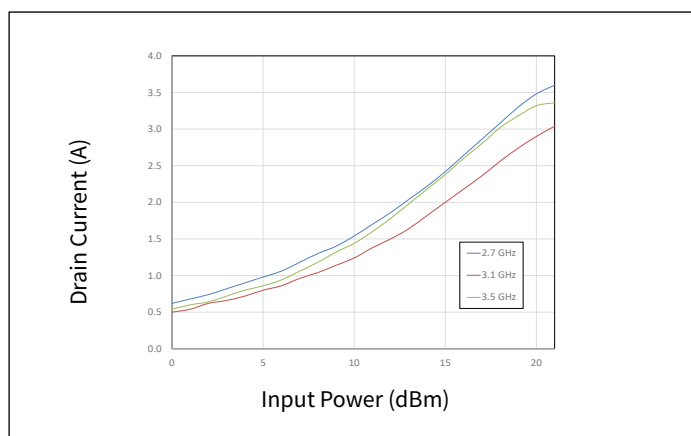


Figure 16. Drain Current vs Input Power as a Function of Frequency

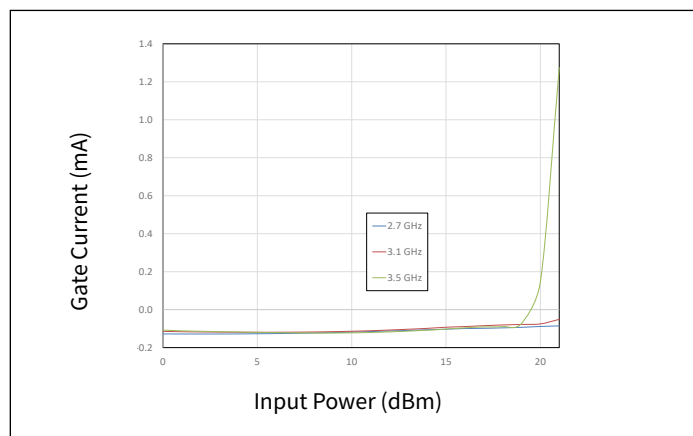


Figure 17. Gate Current vs Input Power as a Function of Frequency



Typical Performance of the CMPA2738060F

Test conditions unless otherwise noted: $V_D = 50\text{ V}$, $I_{DQ} = 280\text{ mA}$, $PW = 300\mu\text{s}$, $DC = 20\%$, $P_{IN} = 20\text{ dBm}$, Frequency = 3.1 GHz , $T_{BASE} = +25^\circ\text{C}$

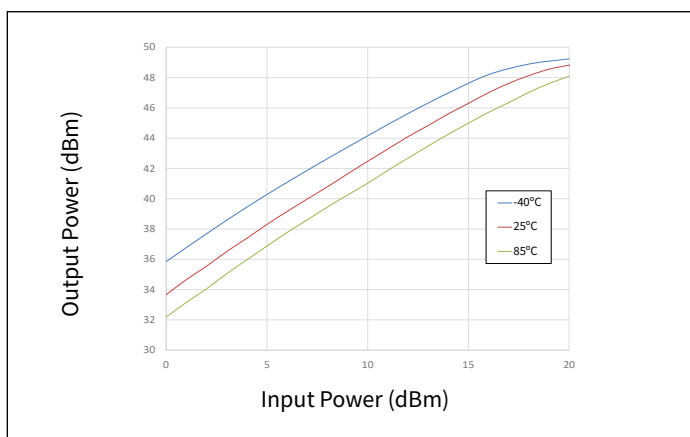


Figure 18. Output Power vs Input Power as a Function of Temperature

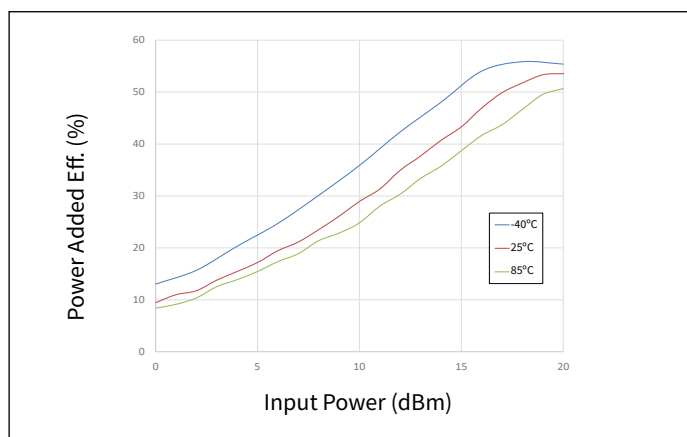


Figure 19. Power Added Eff. vs Input Power as a Function of Temperature

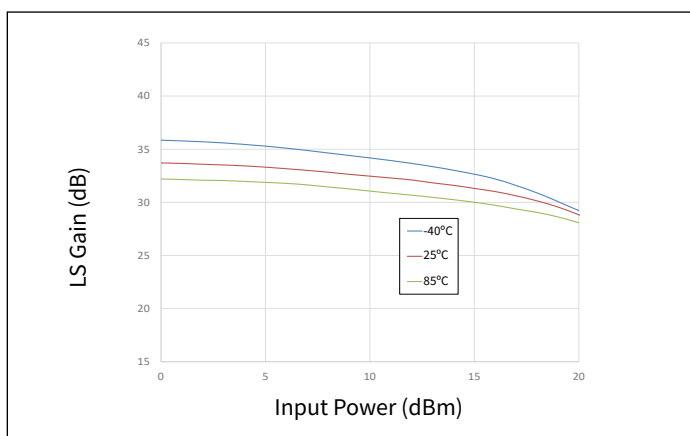


Figure 20. Large Signal Gain vs Input Power as a Function of Temperature

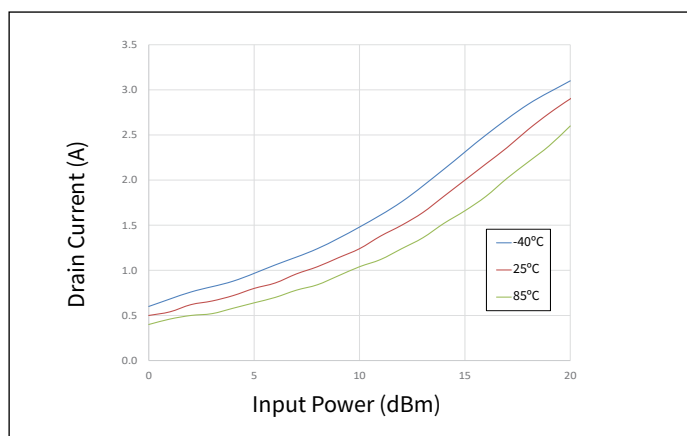


Figure 21. Drain Current vs Input Power as a Function of Temperature

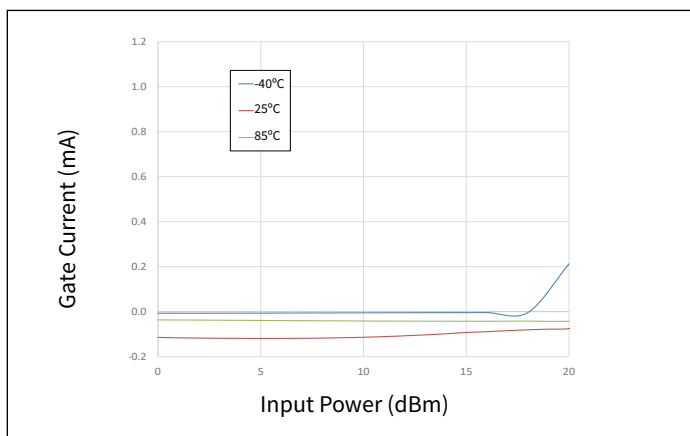


Figure 22. Gate Current vs Input Power as a Function of Temperature

Typical Performance of the CMPA2738060F

Test conditions unless otherwise noted: $V_D = 50\text{ V}$, $I_{DQ} = 280\text{ mA}$, $PW = 300\mu\text{s}$, $DC = 20\%$, $P_{IN} = 20\text{ dBm}$, Frequency = 3.1 GHz , $T_{BASE} = +25^\circ\text{C}$

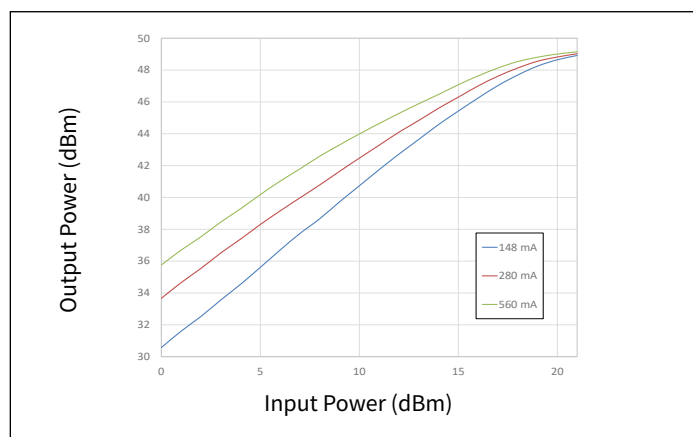


Figure 23. Output Power vs Input Power as a Function of I_{DQ}

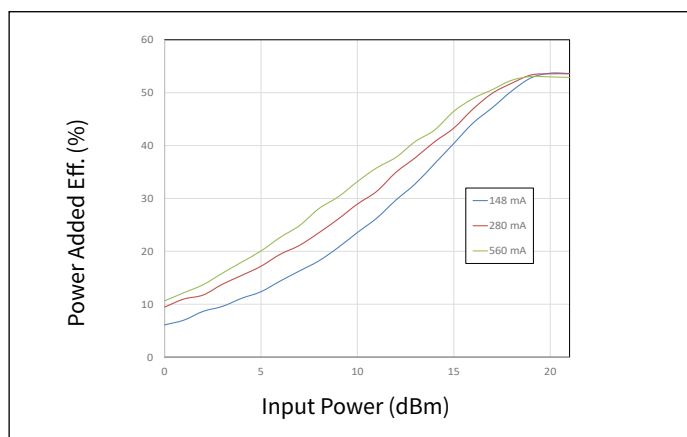


Figure 24. Power Added Eff. vs Input Power as a Function of I_{DQ}

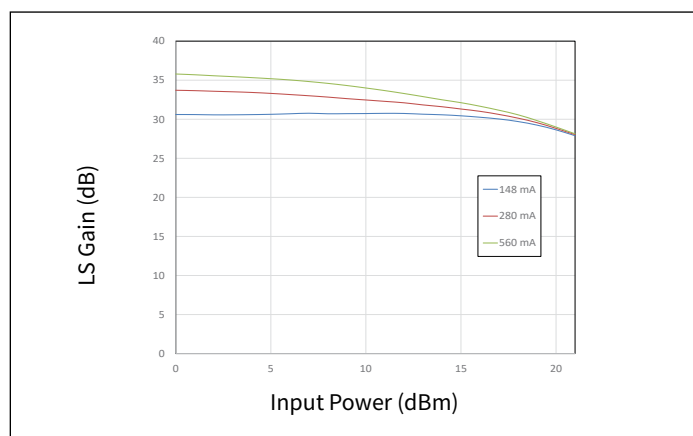


Figure 25. Large Signal Gain vs Input Power as a Function of I_{DQ}

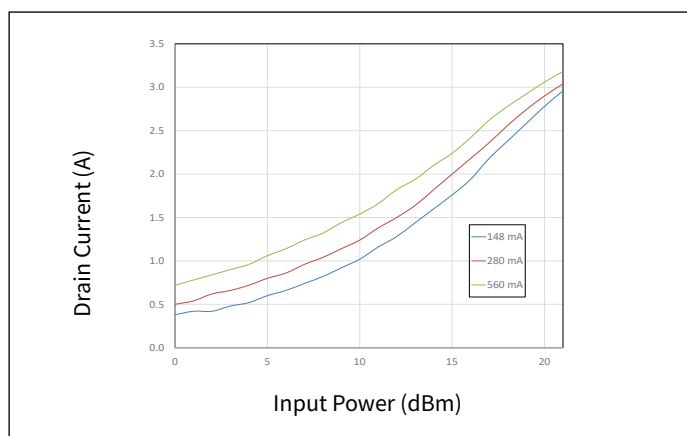


Figure 26. Drain Current vs Input Power as a Function of I_{DQ}

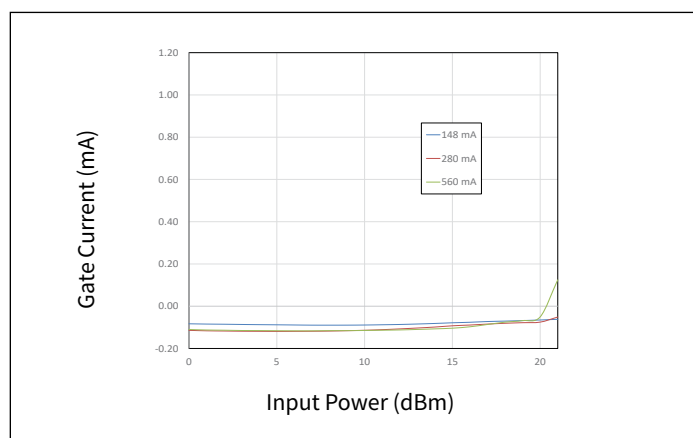


Figure 27. Gate Current vs Input Power as a Function of I_{DQ}



Typical Performance of the CPMA2738060F

Test conditions unless otherwise noted: $V_D = 50\text{ V}$, $I_{DQ} = 280\text{ mA}$, CW, $P_{IN} = 20\text{ dBm}$, Frequency = 3.1 GHz , $T_{BASE} = +25^\circ\text{C}$

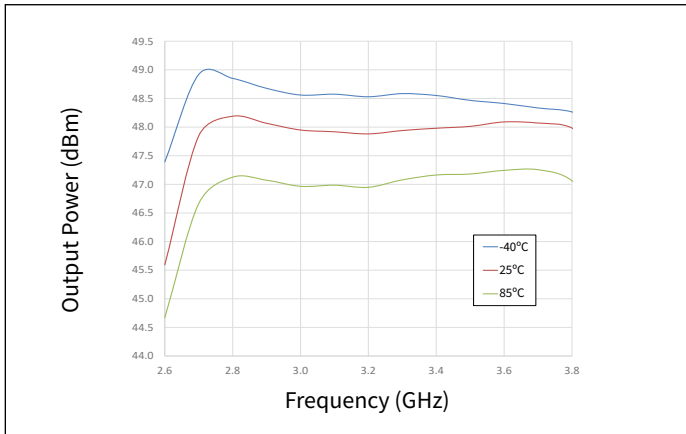


Figure 28. Output Power vs Frequency as a Function of Temperature

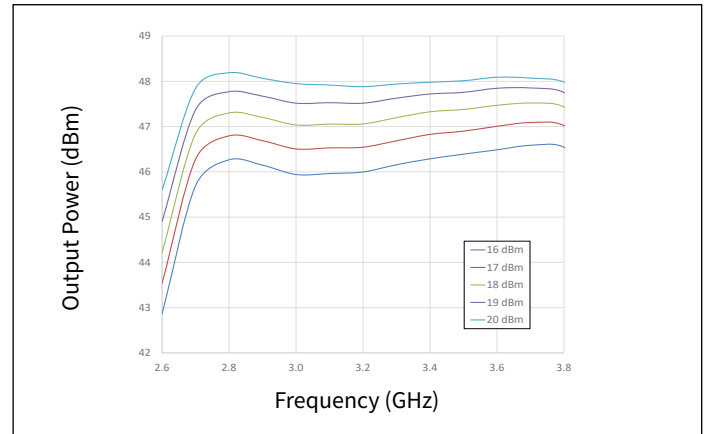


Figure 29. Output Power vs Frequency as a Function of Input Power

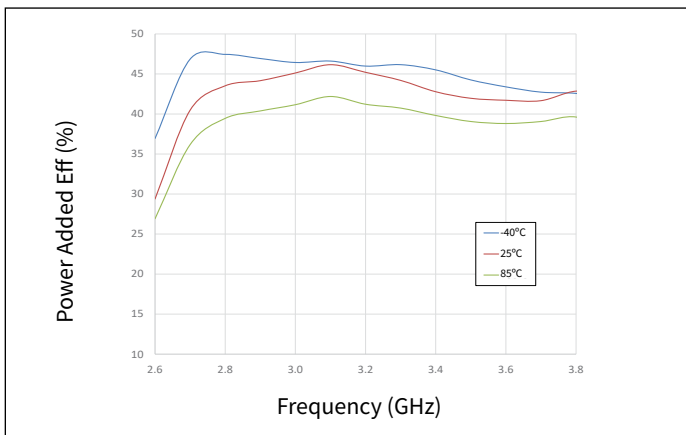


Figure 30. Power Added Eff. vs Frequency as a Function of Temperature

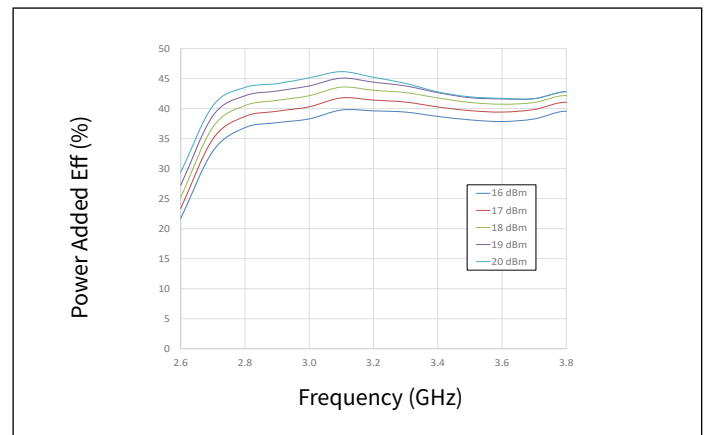


Figure 31. Power Added Eff. vs Frequency as a Function of Input Power

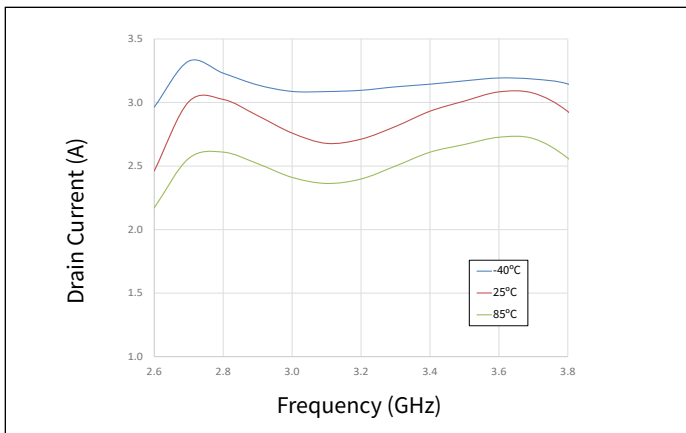


Figure 32. Drain Current vs Frequency as a Function of Temperature

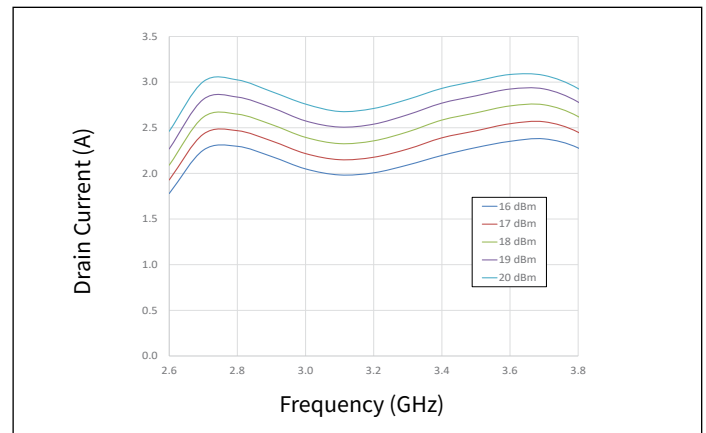


Figure 33. Drain Current vs Frequency as a Function of Input Power



Typical Performance of the CPMA2738060F

Test conditions unless otherwise noted: $V_D = 50\text{ V}$, $I_{DQ} = 280\text{ mA}$, CW, $P_{IN} = 20\text{ dBm}$, Frequency = 3.1 GHz , $T_{BASE} = +25^\circ\text{C}$

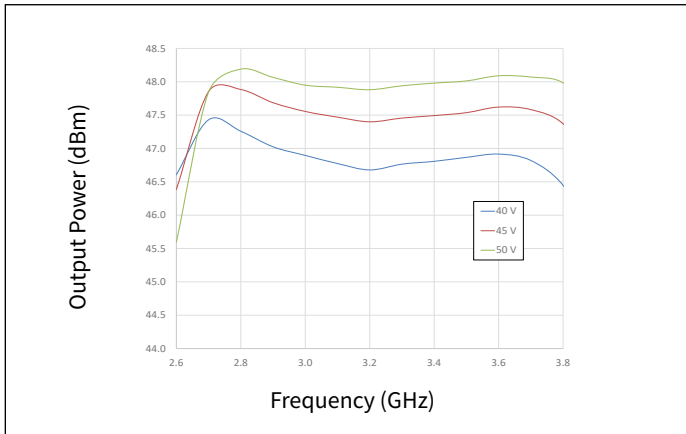


Figure 34. Output Power vs Frequency as a Function of Voltage

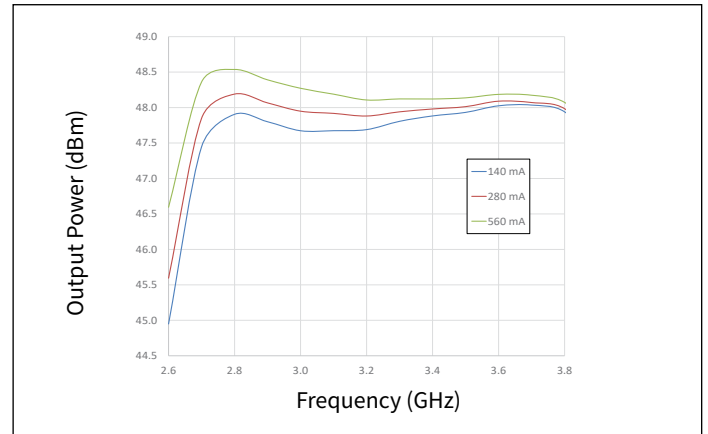


Figure 35. Drain Current vs Frequency as a Function of Input Power

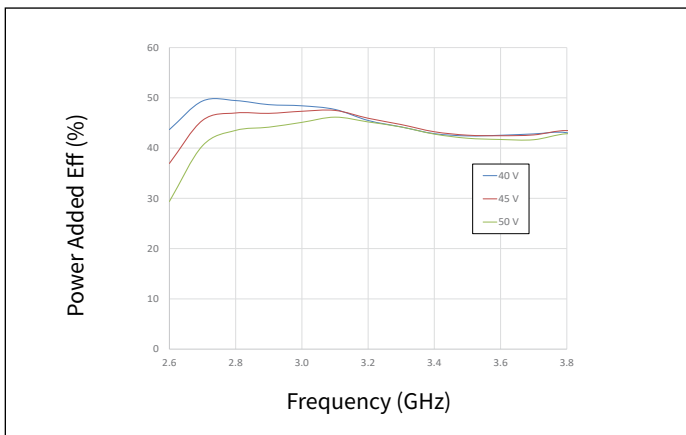


Figure 36. Power Added Eff. vs Frequency as a Function of Voltage

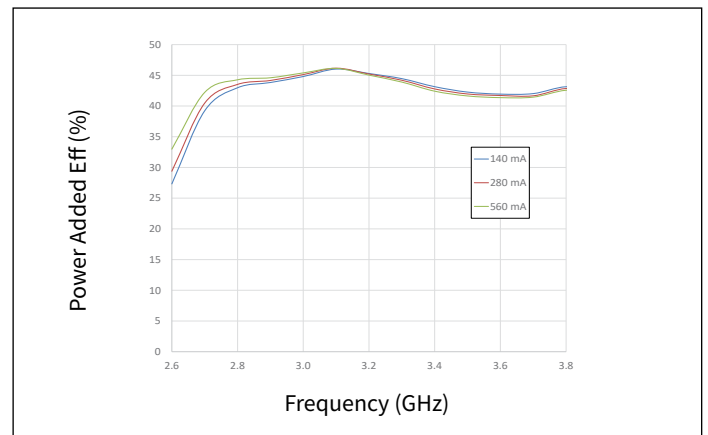


Figure 37. Power Added Eff. vs Frequency as a Function of Input Power

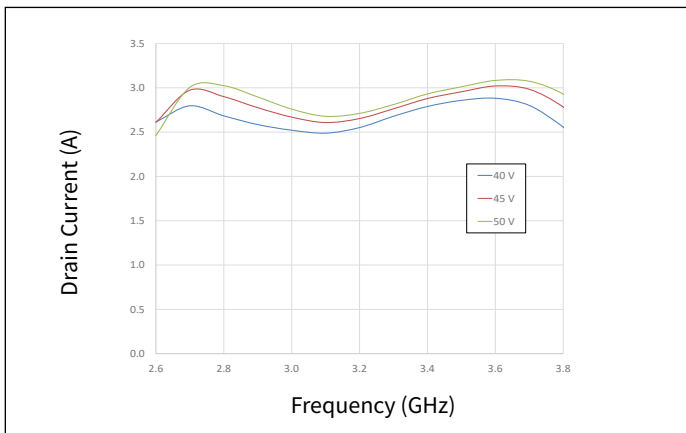


Figure 38. Drain Current vs Frequency as a Function of Voltage

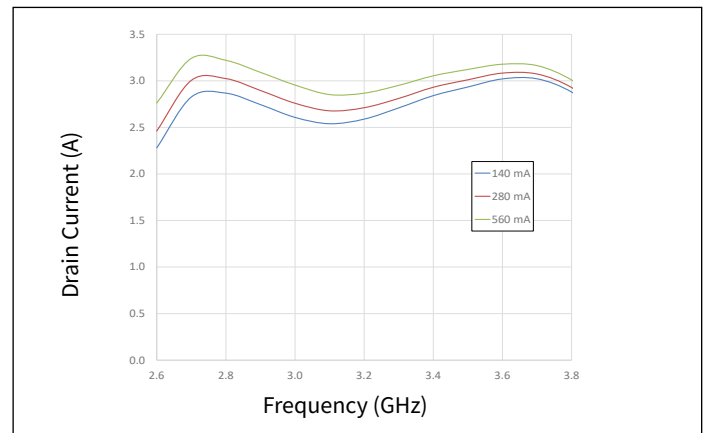


Figure 39. Drain Current vs Frequency as a Function of Input Power

Typical Performance of the CPMA2738060F

Test conditions unless otherwise noted: $V_D = 50$ V, $I_{DQ} = 280$ mA, CW, $P_{IN} = 20$ dBm, Frequency = 3.1 GHz, $T_{BASE} = +25^\circ\text{C}$

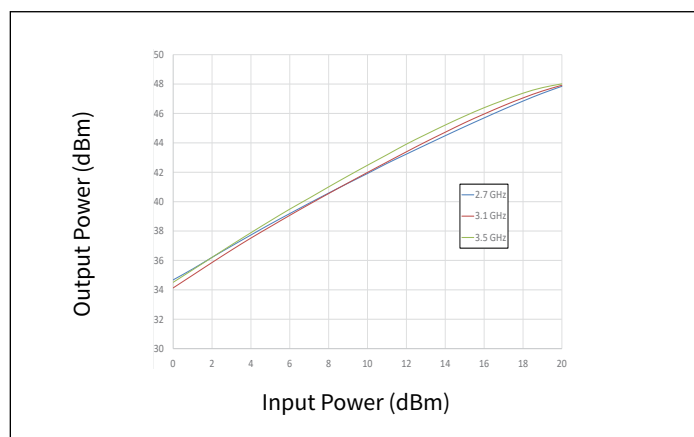


Figure 40. Output Power vs Input Power as a Function of Frequency

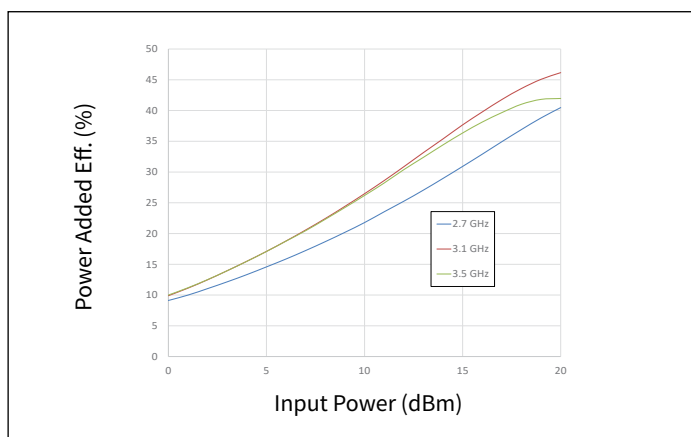


Figure 41. Power Added Eff. vs Input Power as a Function of Frequency

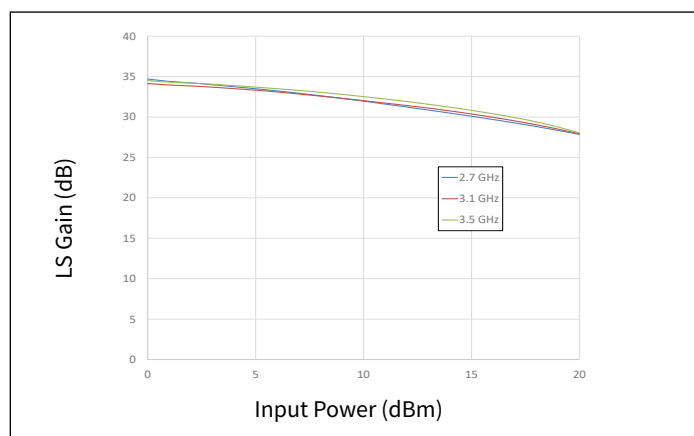


Figure 42. Large Signal Gain vs Input Power as a Function of Frequency

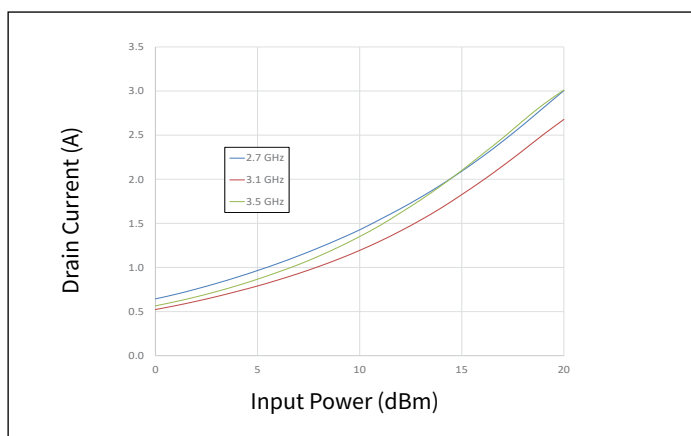


Figure 43. Drain Current vs Input Power as a Function of Frequency

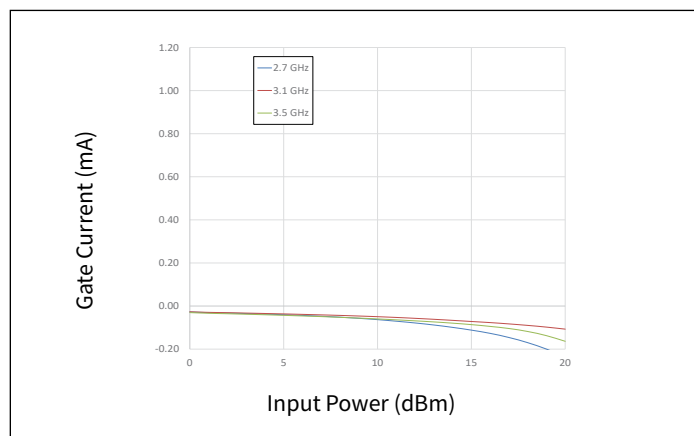


Figure 44. Gate Current vs Input Power as a Function of Frequency

Typical Performance of the CPMA2738060F

Test conditions unless otherwise noted: $V_D = 50$ V, $I_{DQ} = 280$ mA, CW, $P_{IN} = 20$ dBm, Frequency = 3.1 GHz, $T_{BASE} = +25^\circ\text{C}$

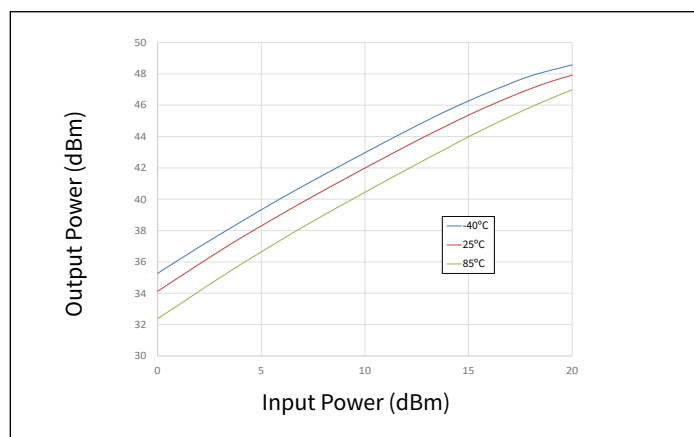


Figure 45. Output Power vs Input Power as a Function of Temperature

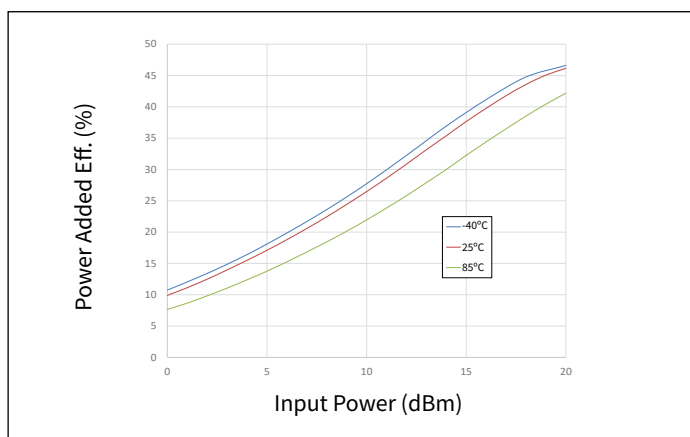


Figure 46. Power Added Eff. vs Input Power as a Function of Temperature

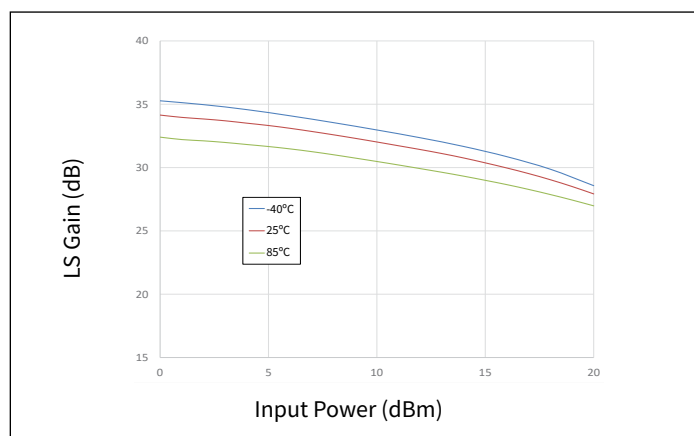


Figure 47. Large Signal Gain vs Input Power as a Function of Temperature

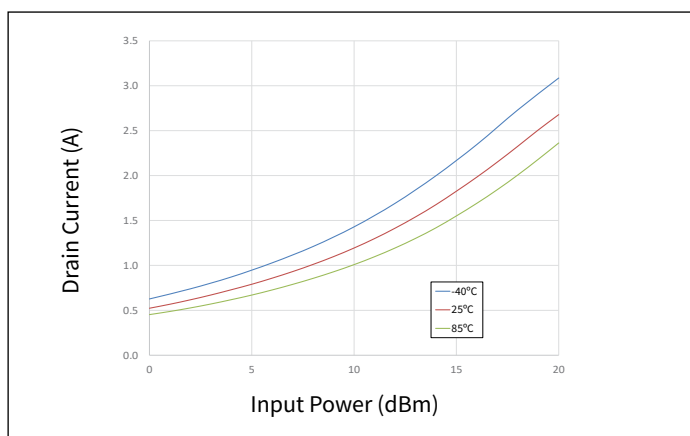


Figure 48. Drain Current vs Input Power as a Function of Temperature

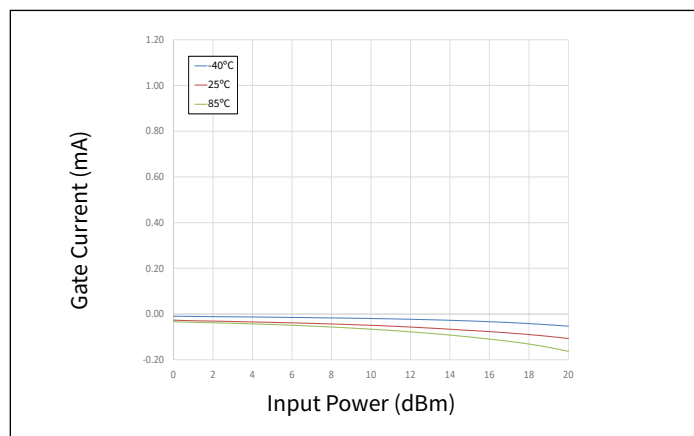


Figure 49. Gate Current vs Input Power as a Function of Temperature



Typical Performance of the CMPA2738060F

Test conditions unless otherwise noted: $V_D = 50\text{ V}$, $I_{DQ} = 280\text{ mA}$, CW, $P_{IN} = 20\text{ dBm}$, Frequency = 3.1 GHz , $T_{BASE} = +25^\circ\text{C}$

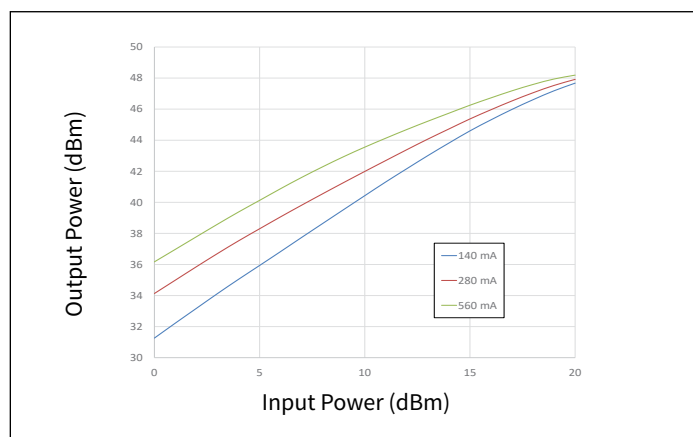


Figure 50. Output Power vs Input Power as a Function of I_{DQ}

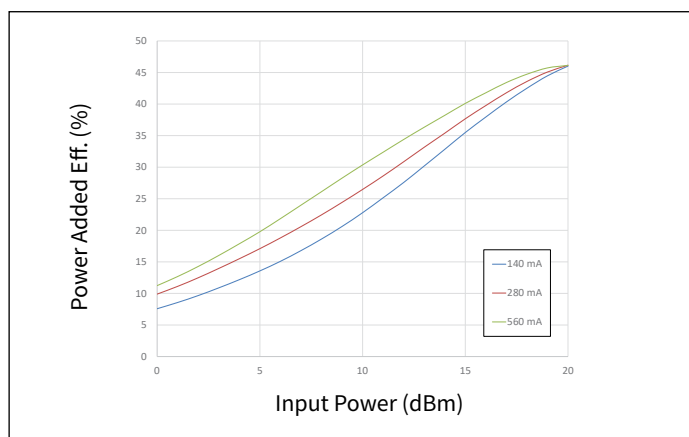


Figure 51. Power Added Eff. vs Input Power as a Function of I_{DQ}

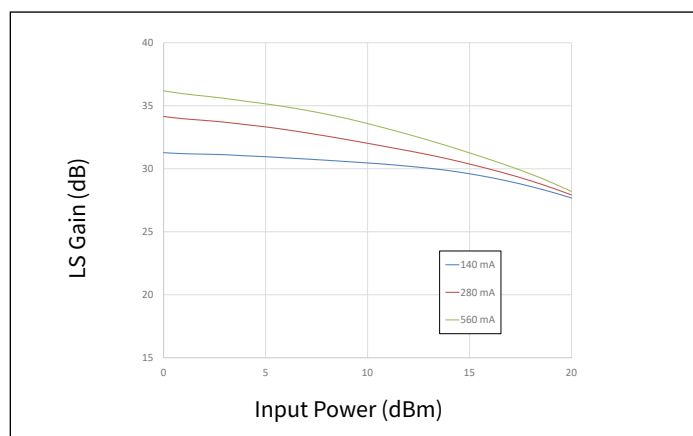


Figure 52. Large Signal Gain vs Input Power as a Function of I_{DQ}

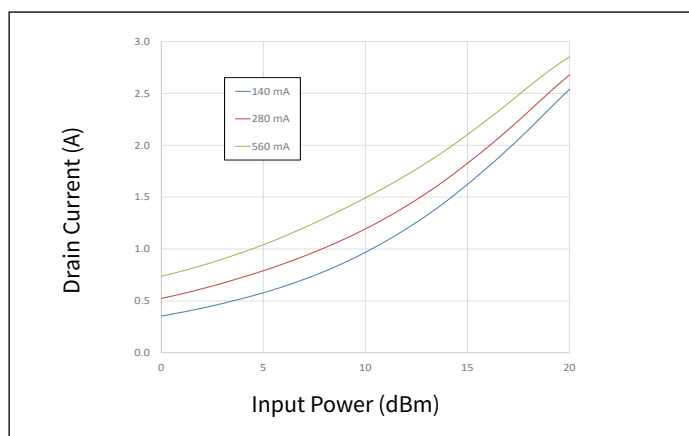


Figure 53. Drain Current vs Input Power as a Function of I_{DQ}

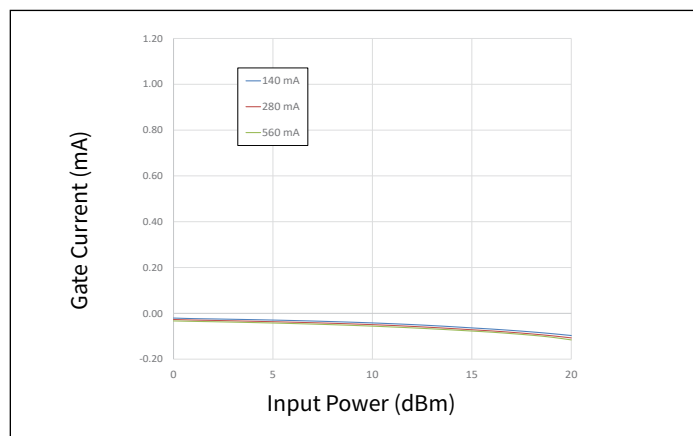


Figure 54. Gate Current vs Input Power as a Function of I_{DQ}

Typical Performance of the CPMA2738060F

Test conditions unless otherwise noted: $V_D = 50$ V, $I_{DQ} = 280$ mA, $P_W = 300\mu\text{s}$, $DC = 20\%$, $P_{IN} = 20$ dBm, Frequency = 3.1 GHz, $T_{BASE} = +25^\circ\text{C}$

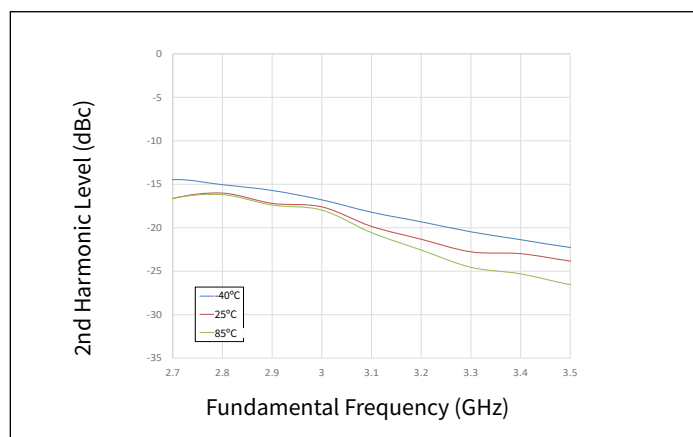


Figure 55. 2nd Harmonic vs Frequency as a Function of Temperature

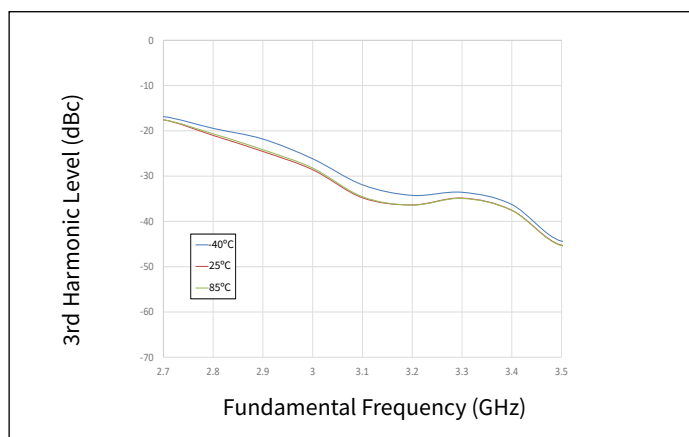


Figure 56. 3rd Harmonic vs Frequency as a Function of Temperature

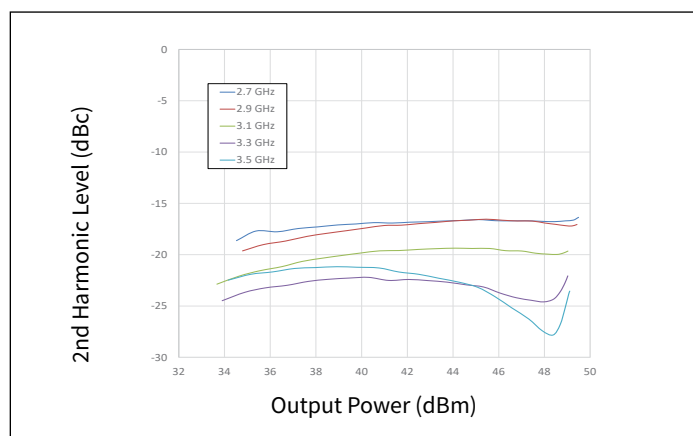


Figure 57. 2nd Harmonic vs Output Power as a Function of Frequency

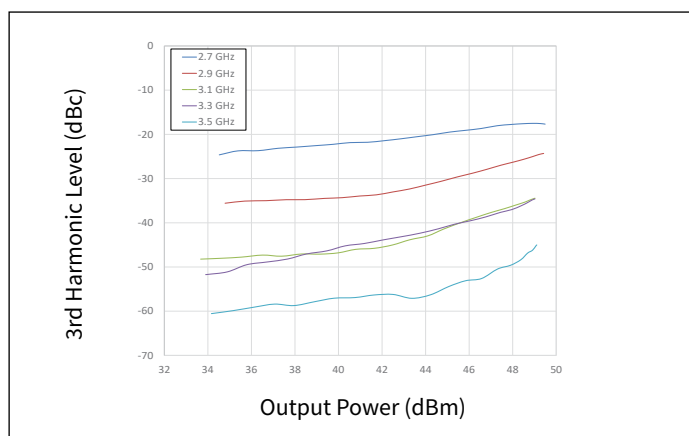


Figure 58. 3rd Harmonic vs Output Power as a Function of Frequency

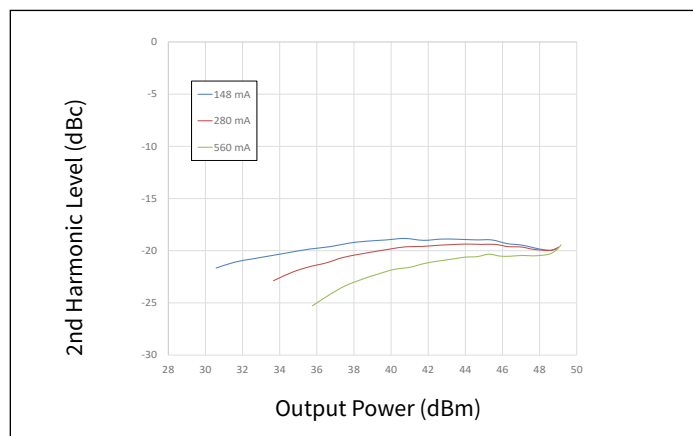


Figure 59. 2nd Harmonic vs Output Power as a Function of I_{DQ}

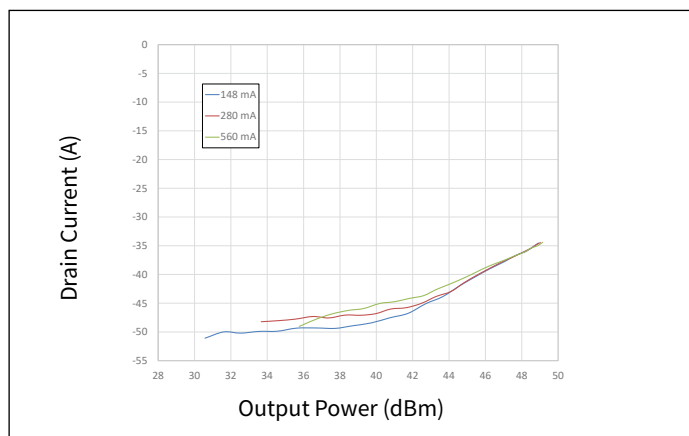


Figure 60. 3rd Harmonic vs Output Power as a Function of I_{DQ}

Typical Performance of the CPMA2738060F

Test conditions unless otherwise noted: $V_D = 50$ V, $I_{DQ} = 280$ mA, $P_{IN} = -20$ dBm, Frequency = 3.1 GHz, $T_{BASE} = +25^\circ\text{C}$

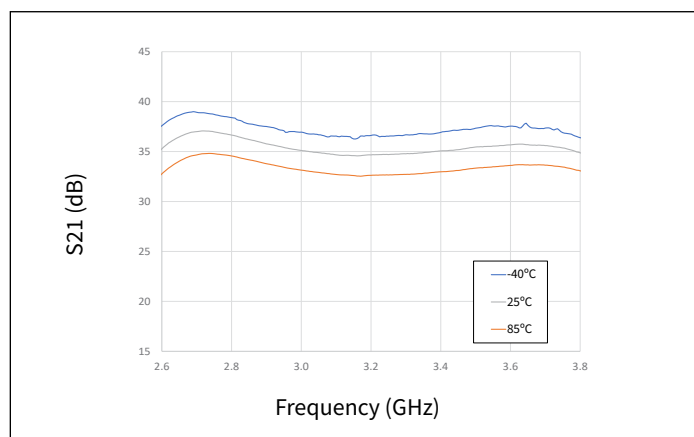


Figure 61. Gain vs Frequency as a Function of Temperature

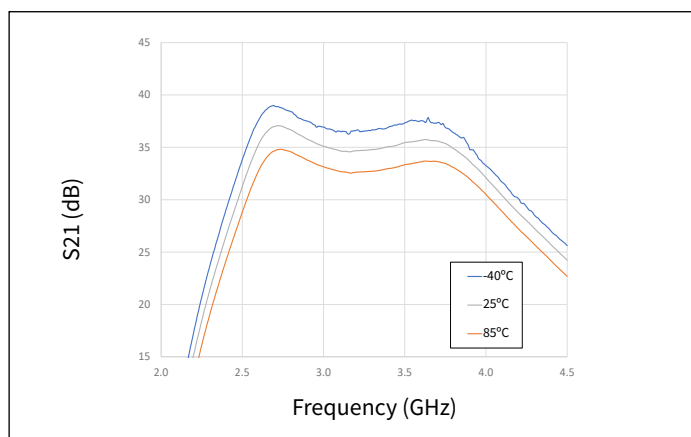


Figure 62. Gain vs Frequency as a Function of Temperature

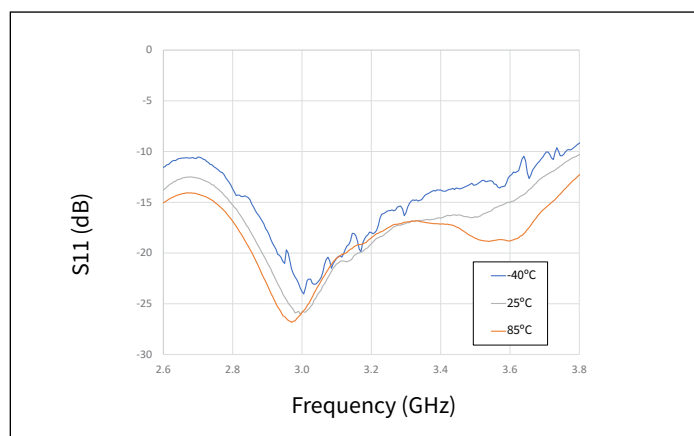


Figure 63. Input RL vs Frequency as a Function of Temperature

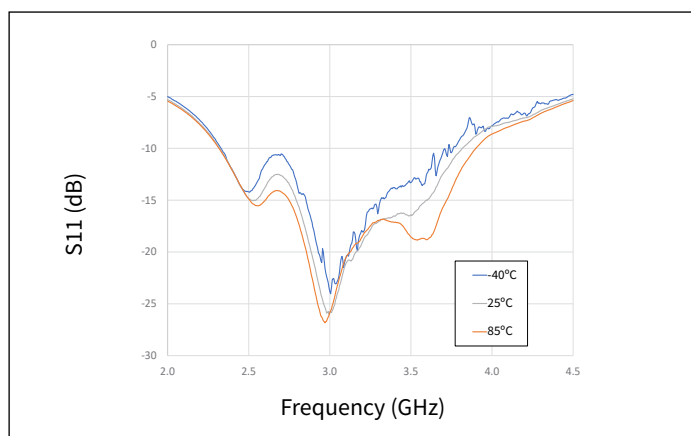


Figure 64. Input RL vs Frequency as a Function of Temperature

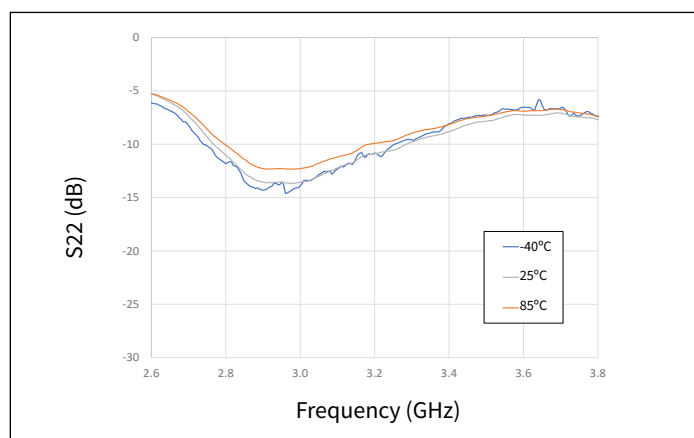


Figure 65. Output RL vs Frequency as a Function of Temperature

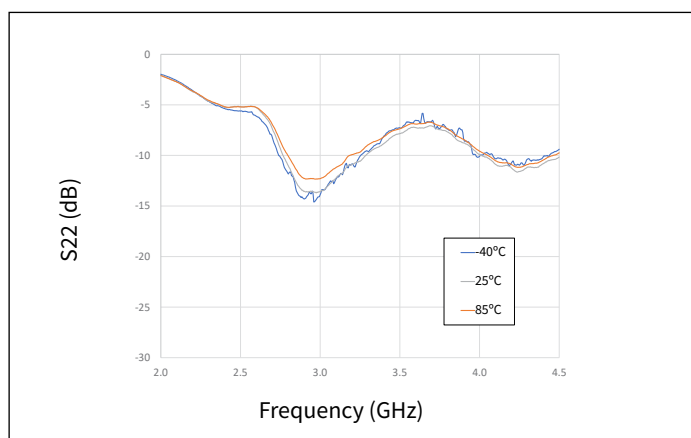


Figure 66. Output RL vs Frequency as a Function of Temperature

Typical Performance of the CPMA2738060F

Test conditions unless otherwise noted: $V_D = 50$ V, $I_{DQ} = 280$ mA, $P_{IN} = -20$ dBm, Frequency = 3.1 GHz, $T_{BASE} = +25^\circ\text{C}$

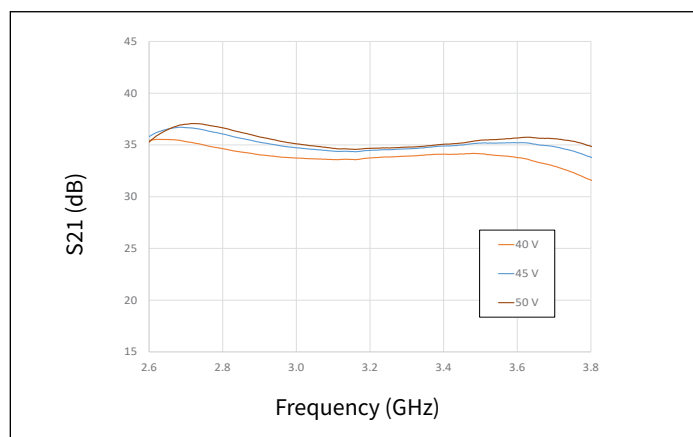


Figure 67. Gain vs Frequency as a Function of Voltage

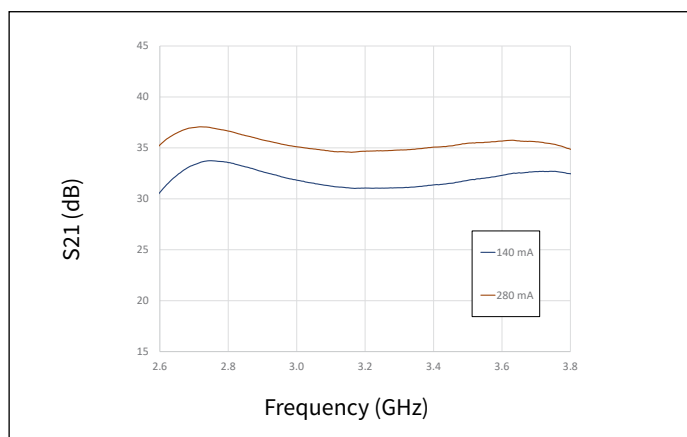


Figure 68. Gain vs Frequency as a Function of I_{DQ}

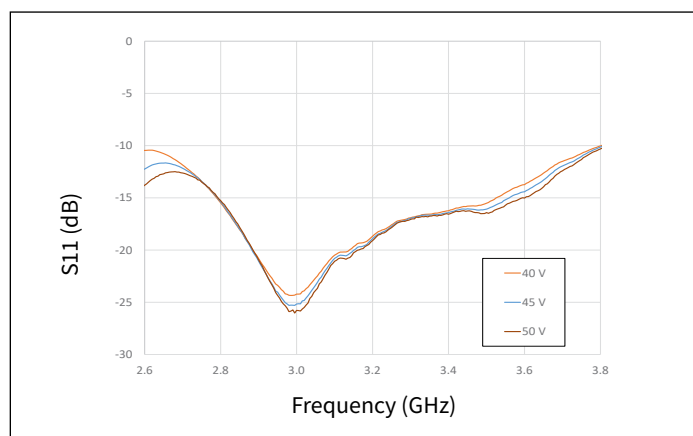


Figure 69. Input RL vs Frequency as a Function of Voltage

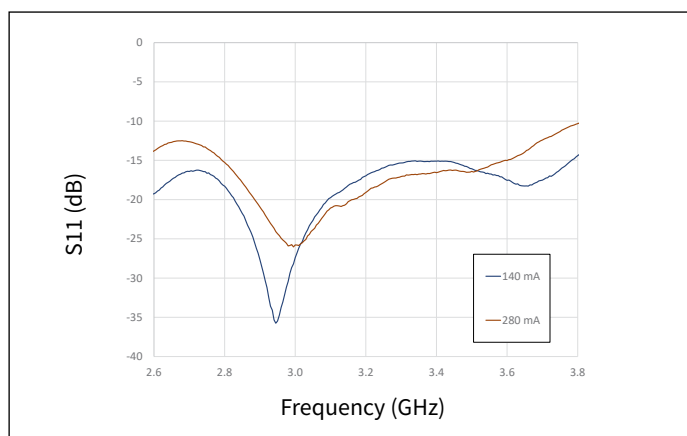


Figure 70. Input RL vs Frequency as a Function of I_{DQ}

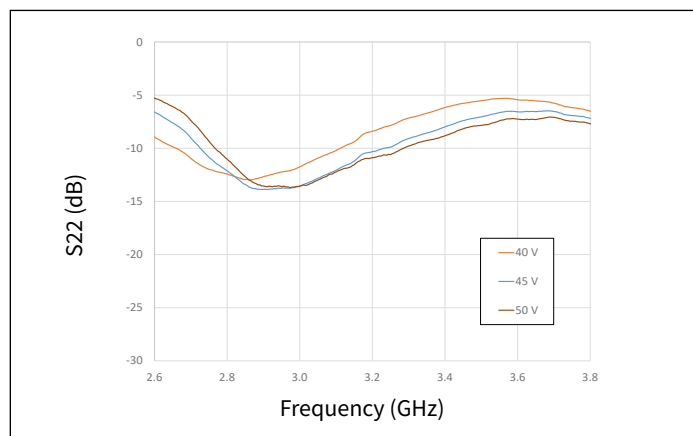


Figure 71. Output RL vs Frequency as a Function of Voltage

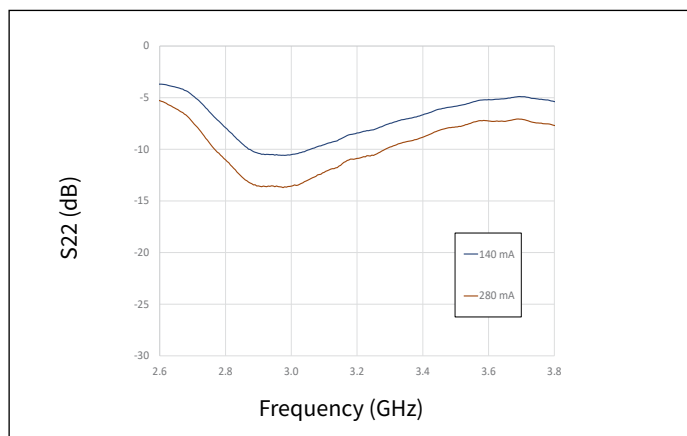
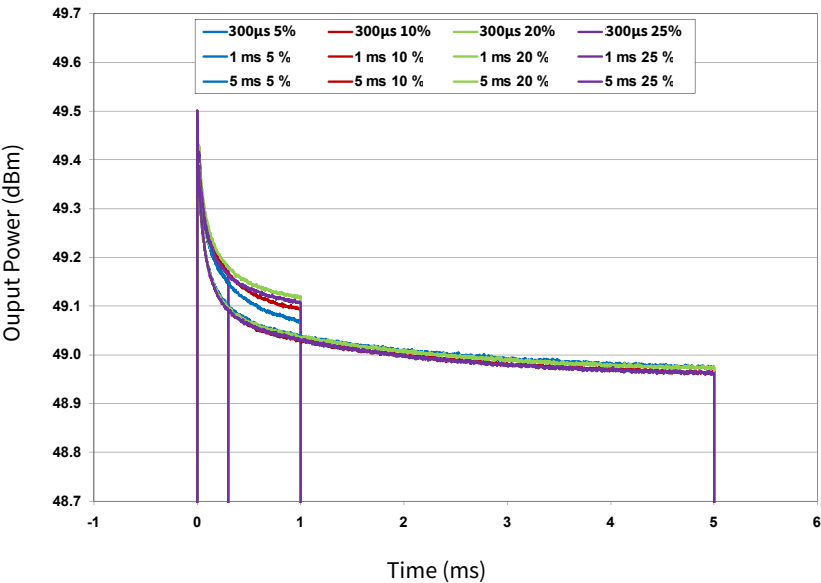


Figure 72. Output RL vs Frequency as a Function of I_{DQ}

Typical Pulse Droop Performance



Pulse Width	Duty Cycle (%)	Droop (dB)
10µs	5-25	0.30
50µs	5-25	0.30
100µs	5-25	0.30
300µs	5-25	0.35
1ms	5-25	0.40
5ms	5-25	0.55

Electrostatic Discharge (ESD) Classifications

Parameter	Symbol	Class	Classification Level	Test Methodology
Human Body Model	HBM	TBD	ANSI/ESDA/JEDEC JS-001 Table 3	JEDEC JESD22 A114-D
Charge Device Model	CDM	TBD	ANSI/ESDA/JEDEC JS-002 Table 3	JEDEC JESD22 C101-C

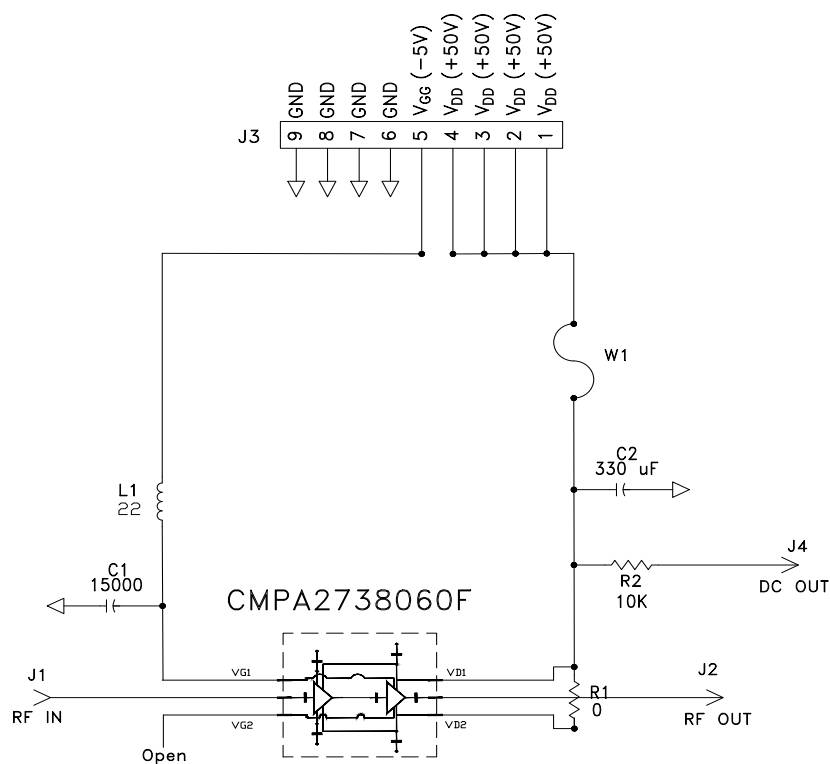
CMPA2738060F-AMP Evaluation Board Bill of Materials

Designator	Description	Qty
C1	CAP, 15000pF, 100V, 0805, X7R	1
C2	CAP, 330µF, 20%, 100V, ELECT, MVY, SMD	1
R1	RES, 1/8W, 1206, +/-5%, 0 OHMS	1
R2	RES, 1/16W, 0603, +/-5%, 10K OHMS	1
L1	FERRITE, 22 OHM, 0805, BLM21PG220SN1	1
J1,J2	CONNECTOR, N-TYPE, FEMALE, W/0.500 SMA FLNG	2
J3	CONNECTOR, HEADER, RT>PLZ .1CEN LK 9POS	1
J4	CONNECTOR, SMB, STRAIGHT JACK, SMD	1
-	PCB, TACONIC, RF-35-0100-CH/CH	1
Q1	CMPA2738060F	1

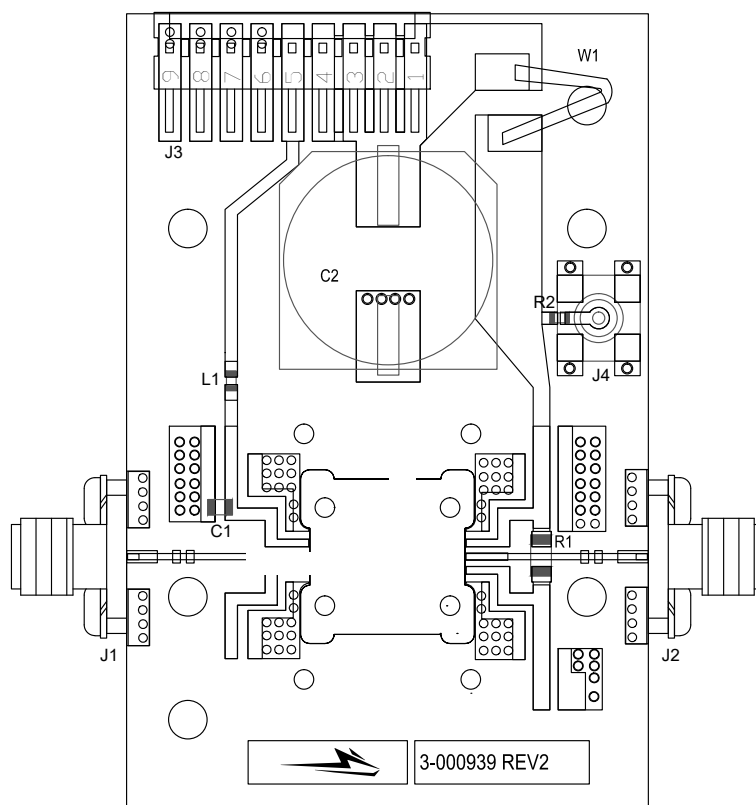
CMPA2738060F-AMP Demonstration Amplifier Circuit



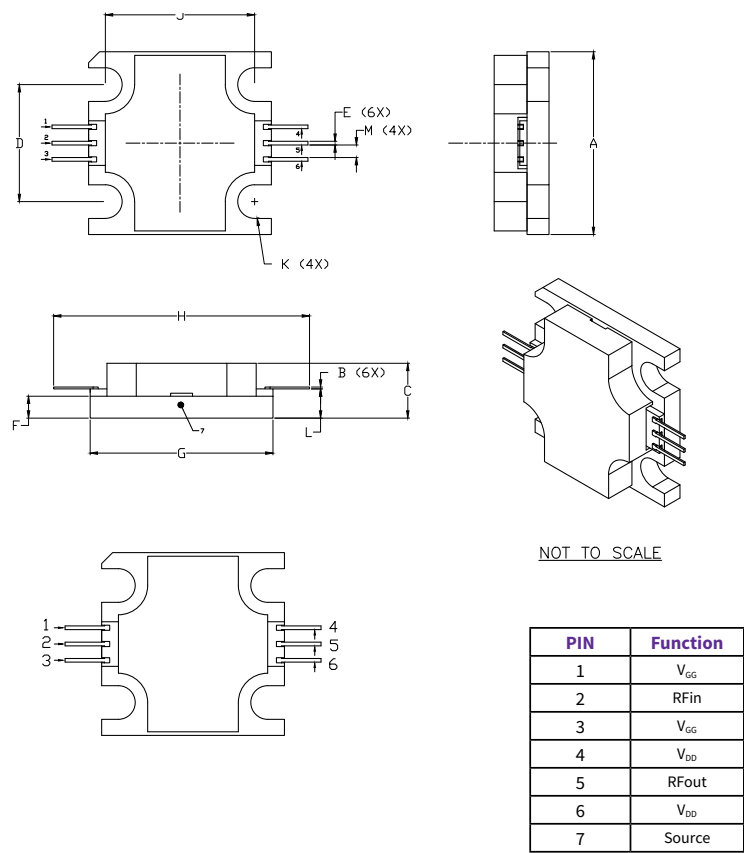
CMPA2738060F-AMP Demonstration Amplifier Circuit Schematic



CMPA2738060F-AMP Demonstration Amplifier Circuit Outline



Product Dimensions CMPA2738060F (Package Type — 440219)



Part Number System

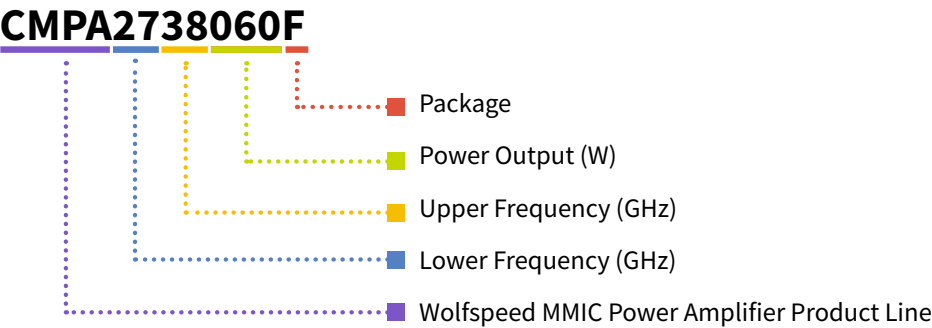


Table 1.

Parameter	Value	Units
Lower Frequency	2.7	GHz
Upper Frequency	3.8	
Power Output	60	W
Package	Flange	—

Note:
¹ Alpha characters used in frequency code indicate a value greater than 9.9 GHz. See Table 2 for value.

Table 2.

Character Code	Code Value
A	0
B	1
C	2
D	3
E	4
F	5
G	6
H	7
J	8
K	9
Examples	1A = 10.0 GHz 2H = 27.0 GHz

Product Ordering Information

Order Number	Description	Unit of Measure	Image
CMPA2738060F	GaN MMIC	Each	
CMPA2738060F-AMP	Test board with GaN MMIC installed	Each	

**For more information, please contact:**

4600 Silicon Drive
Durham, NC 27703 USA
Tel: +1.919.313.5300
www.wolfspeed.com/RF

Sales Contact
RFSales@wolfspeed.com

RF Product Marketing Contact
RFMarketing@wolfspeed.com

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