Wolfspeed | A CREE COMPANY

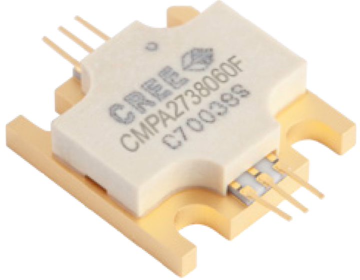
CMPA2738060F

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

Description

Cree'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.



PN: CMPA2738060F
Package Type: 440219

Typical Performance Over 2.7 - 3.8 GHz (T_C = 25˚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 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

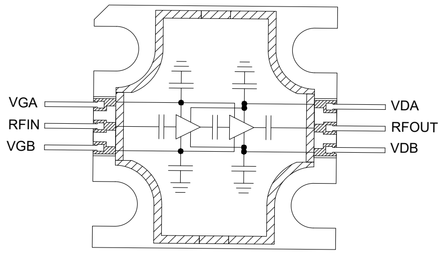


Figure 1.

RoHS COMPLIANT

Absolute Maximum Ratings (not simultaneous) at 25˚C

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

Note:
[1] Measured for the CMPA2738050F at P_{DISS} = 64 W

Electrical Characteristics (Frequency = 2.7 GHz to 3.8 GHz unless otherwise stated; T_C = 25˚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_{DC}	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$_1$	S21	–	36.1	–	dB	V_{DD} = 50 V, I_{DQ} = 280 mA, Freq = 2.7 GHz
Small Signal Gain$_2$	S21	–	34.5	–	dB	V_{DD} = 50 V, I_{DQ} = 280 mA, Freq = 3.1 GHz
Small Signal Gain$_3$	S21	–	35.0	–	dB	V_{DD} = 50 V, I_{DQ} = 280 mA, Freq = 3.8 GHz
Output Power$_1$	P_{OUT}	–	88.0	–	W	V_{DD} = 50 V, I_{DQ} = 280 mA, P_{IN} = 20 dBm, Freq = 2.7 GHz
Output Power$_2$	P_{OUT}	–	86.5	–	W	V_{DD} = 50 V, I_{DQ} = 280 mA, P_{IN} = 20 dBm, Freq = 3.1 GHz
Output Power$_3$	P_{OUT}	–	81.2	–	W	V_{DD} = 50 V, I_{DQ} = 280 mA, P_{IN} = 20 dBm, Freq = 3.8 GHz
Power Added Efficiency$_1$	PAE	–	52.5	–	%	V_{DD} = 50 V, I_{DQ} = 280 mA, Freq = 2.7 GHz
Power Added Efficiency$_2$	PAE	–	55.5	–	%	V_{DD} = 50 V, I_{DQ} = 280 mA, Freq = 3.1 GHz
Power Added Efficiency$_3$	PAE	–	51.0	–	%	V_{DD} = 50 V, I_{DQ} = 280 mA, Freq = 3.8 GHz
Input Return Loss$_1$	S11	–	-11.3	–	dB	V_{DD} = 50 V, I_{DQ} = 280 mA, Freq = 2.7 GHz
Input Return Loss$_2$	S11	–	-25.0	–	dB	V_{DD} = 50 V, I_{DQ} = 280 mA, Freq = 3.1 GHz
Input Return Loss$_3$	S11	–	-11.5	–	dB	V_{DD} = 50 V, I_{DQ} = 280 mA, Freq = 3.8 GHz
Output Return Loss$_1$	S22	–	-8.5	–	dB	V_{DD} = 50 V, I_{DQ} = 280 mA, Freq = 2.7 GHz
Output Return Loss$_2$	S22	–	-11.0	–	dB	V_{DD} = 50 V, I_{DQ} = 280 mA, Freq = 3.1 GHz
Output Return Loss$_3$	S22	–	-8.0	–	dB	V_{DD} = 50 V, I_{DQ} = 280 mA, Freq = 3.8 GHz
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 = 300 µS, Duty Cycle = 20%

Typical Performance of the CMPA2738060F

Test conditions unless otherwise noted: V_D = 50 V, I_{DQ} = 280 mA, PW = 300 us, DC = 20%, Pin = 20 dBm, -40 °C at Pin = 18 dBm, Frequency = 3.1 GHz, T_{BASE} = +25 °C

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

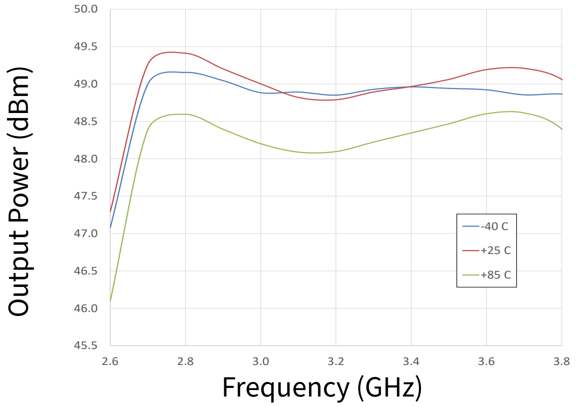


Figure 2. Output Power vs Frequency as a Function of Input Power

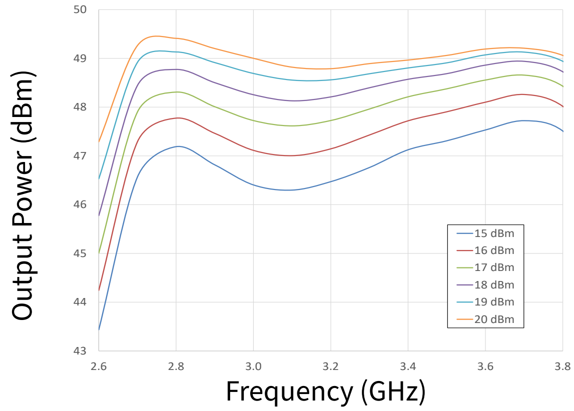


Figure 3. Power Added Eff. vs Frequency as a Function of Temperature

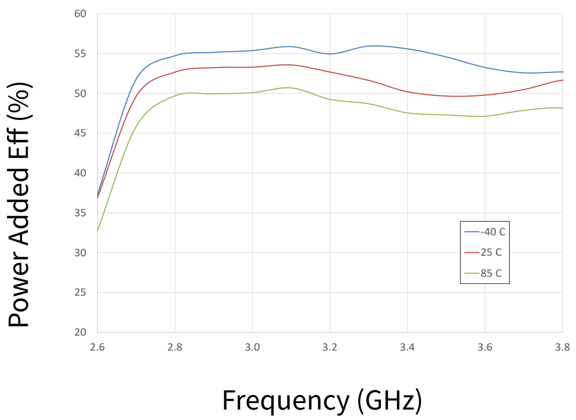


Figure 4. Power Added Eff. vs Frequency as a Function of Input Power

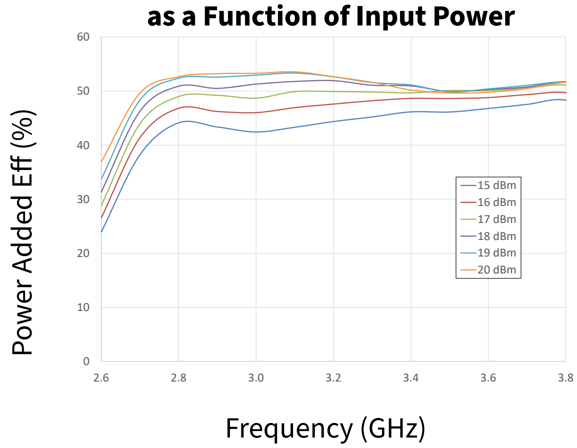


Figure 5. Drain Current vs Frequency as a Function of Temperature

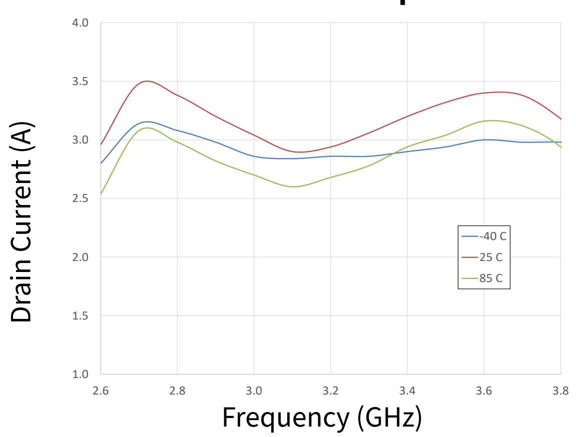
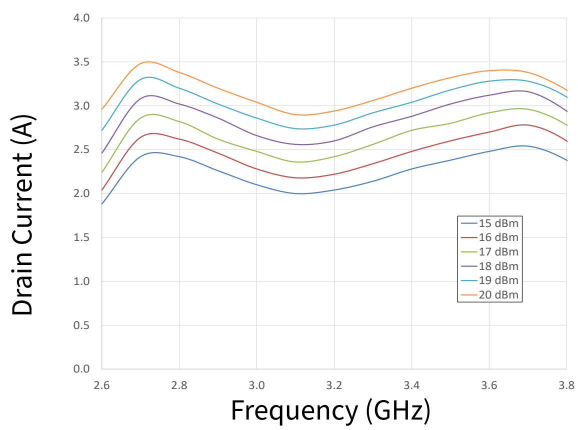


Figure 6. Drain Current vs Frequency as a Function of Input Power



Typical Performance of the CMPA2738060F

Test conditions unless otherwise noted: V_D = 50 V, I_{DQ} = 280 mA, PW = 300 us, DC = 20%, Pin = 20 dBm, Frequency = 3.1 GHz, T_{BASE} = +25 °C

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

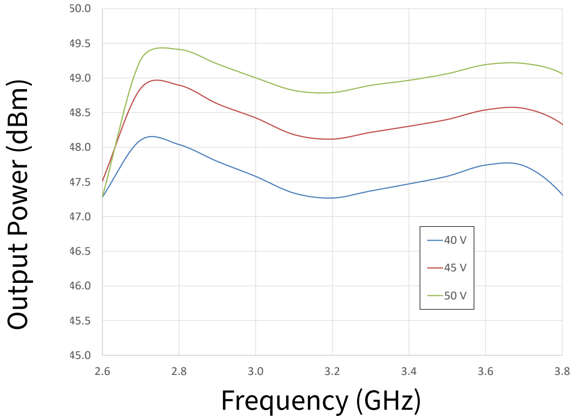


Figure 8. Output Power vs Frequency as a Function of IDQ

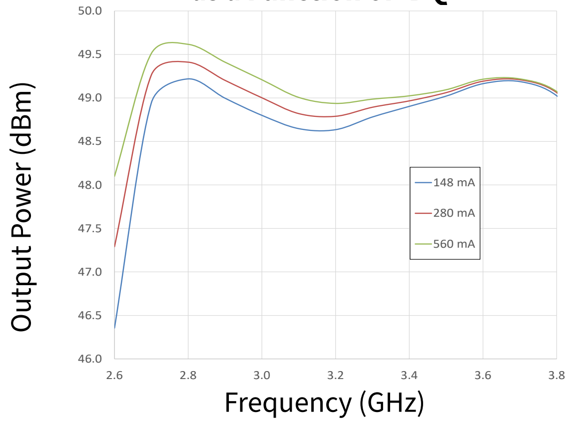


Figure 9. Power Added Eff. vs Frequency as a Function of VD

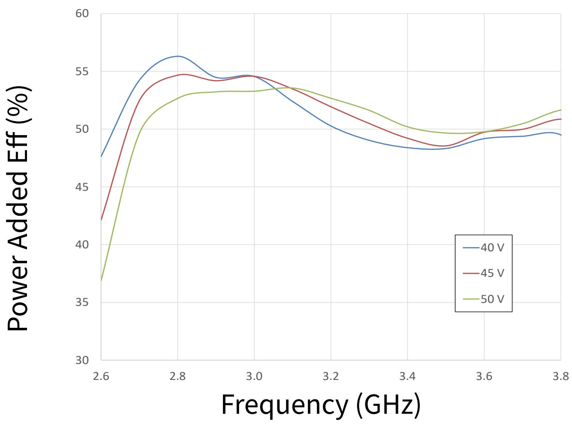


Figure 10. Power Added Eff. vs Frequency as a Function of IDQ

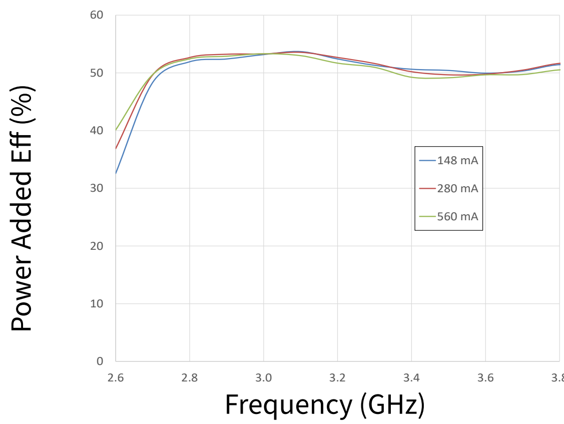


Figure 11. Drain Current vs Frequency as a Function of VD

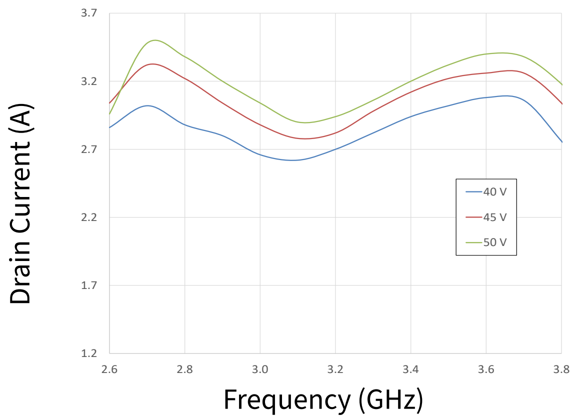
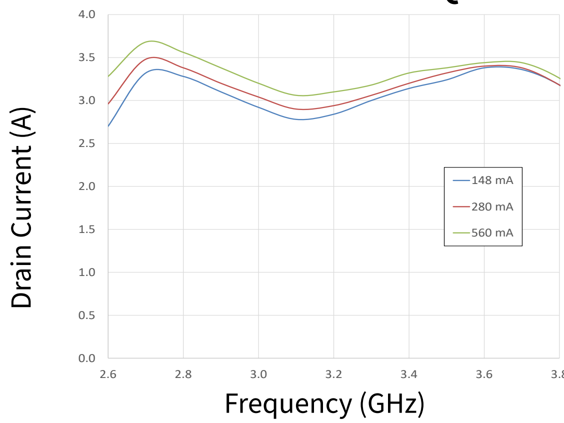


Figure 12. Drain Current vs Frequency as a Function of IDQ



Typical Performance of the CMPA2738060F

Test conditions unless otherwise noted: V_D = 50 V, I_{DQ} = 280 mA, PW = 300 us, DC = 20%, Pin = 20 dBm, Frequency = 3.1 GHz, T_{BASE} = +25 °C

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

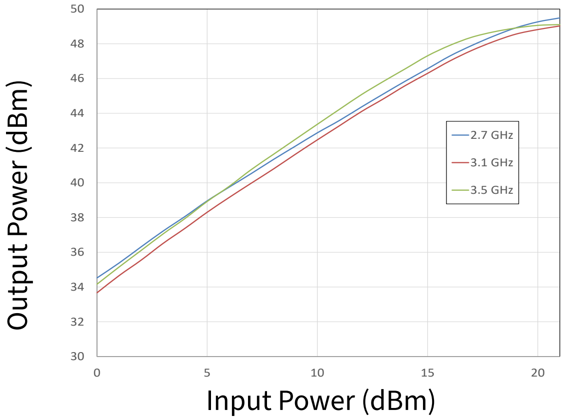


Figure 14. Power Added Eff. vs Input Power as a Function of Frequency

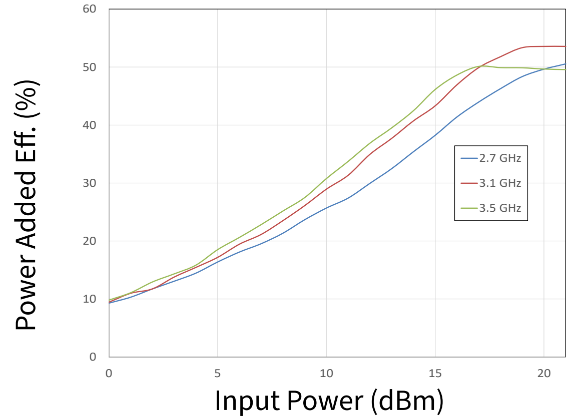


Figure 15. Large Signal Gain vs Input Power as a Function of Frequency

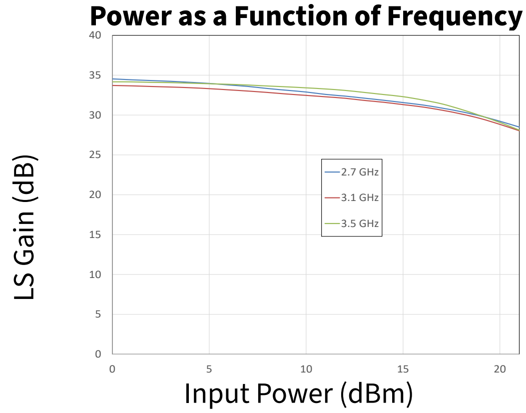


Figure 16. Drain Current vs Input Power as a Function of Frequency

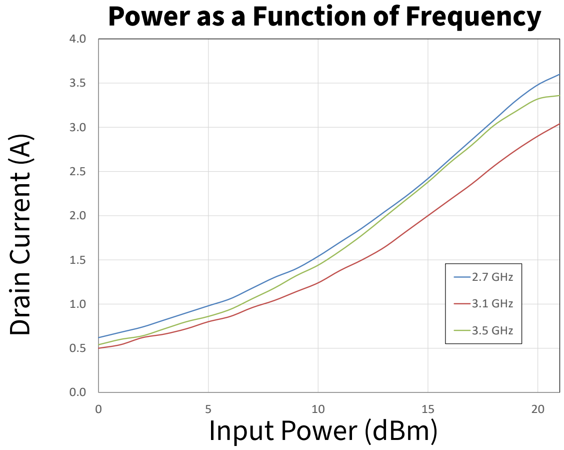
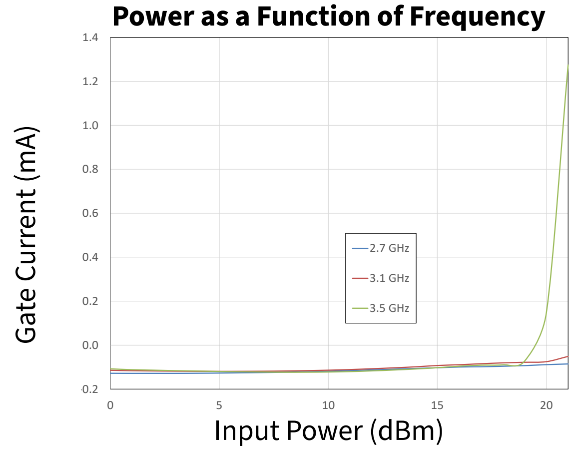


Figure 17. Gate Current vs Input Power as a Function of Frequency



Typical Performance of the CMPA2738060F

Test conditions unless otherwise noted: V_D = 50 V, I_{DQ} = 280 mA, PW = 300 us, DC = 20%, Pin = 20 dBm, Frequency = 3.1 GHz, T_{BASE} = +25 °C

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

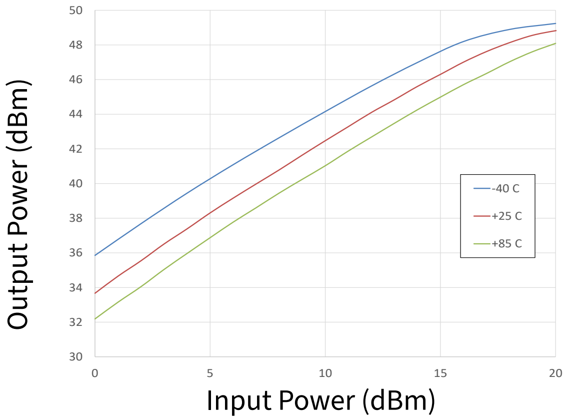


Figure 19. Power Added Eff. vs Input Power as a Function of Temperature

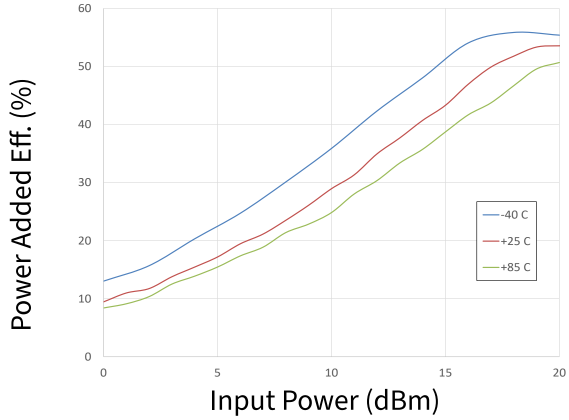


Figure 20. Large Signal Gain vs Input Power as a Function of Temperature

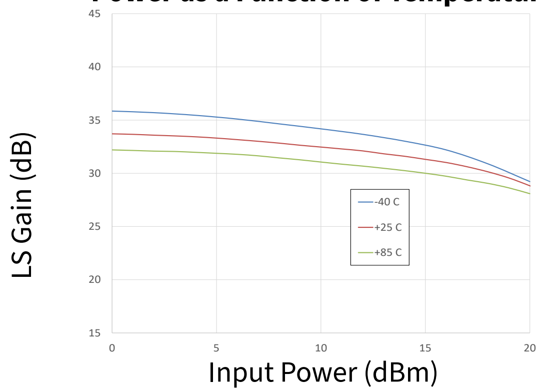


Figure 21. Drain Current vs Input Power as a Function of Temperature

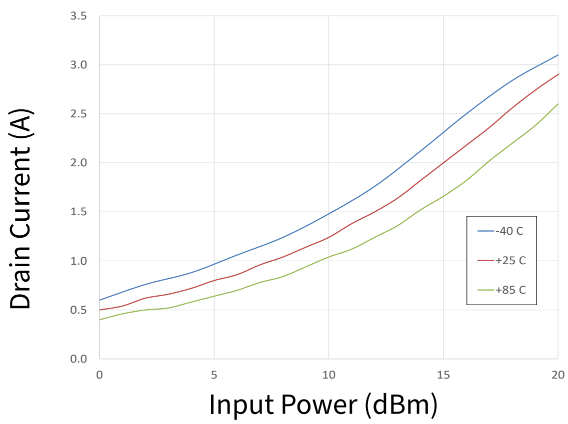
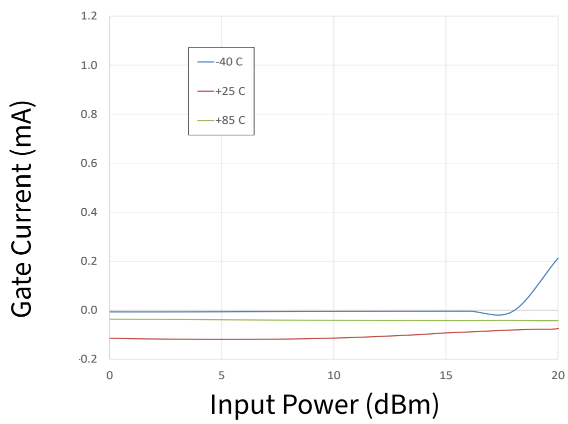


Figure 22. Gate Current vs Input Power as a Function of Temperature



Typical Performance of the CMPA2738060F

Test conditions unless otherwise noted: V_D = 50 V, I_{DQ} = 280 mA, PW = 300 us, DC = 20%, Pin = 20 dBm, Frequency = 3.1 GHz, T_{BASE} = +25 °C

Figure 23. Output Power vs Input Power as a Function of IDQ

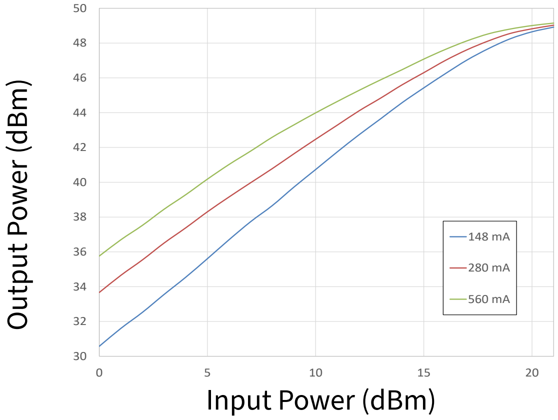


Figure 24. Power Added Eff. vs Input Power as a Function of IDQ

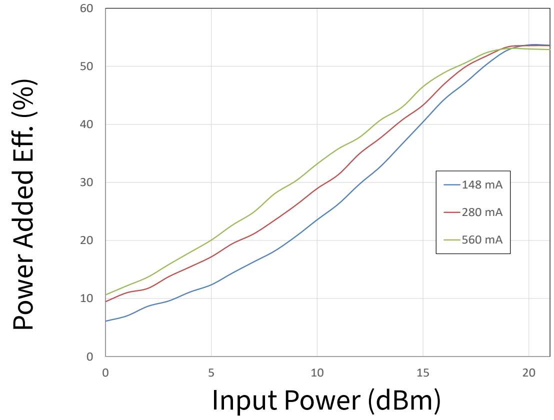


Figure 25. Large Signal Gain vs Input Power as a Function of IDQ

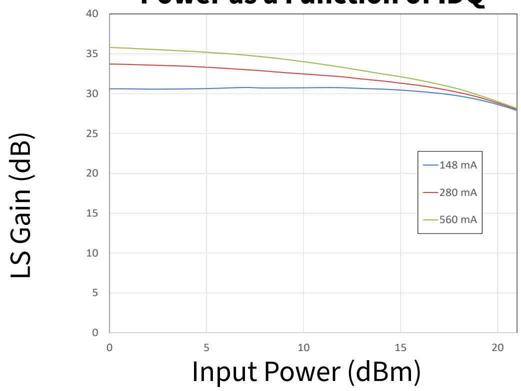


Figure 26. Drain Current vs Input Power as a Function of IDQ

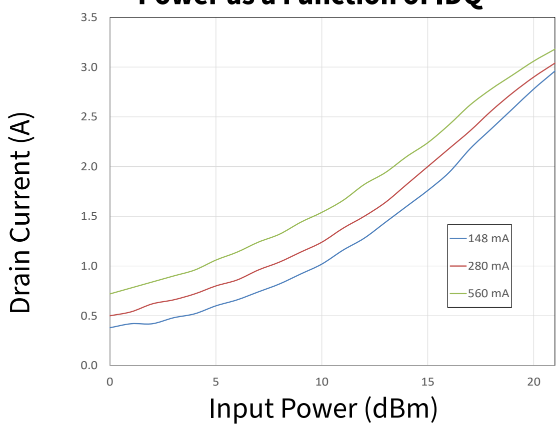
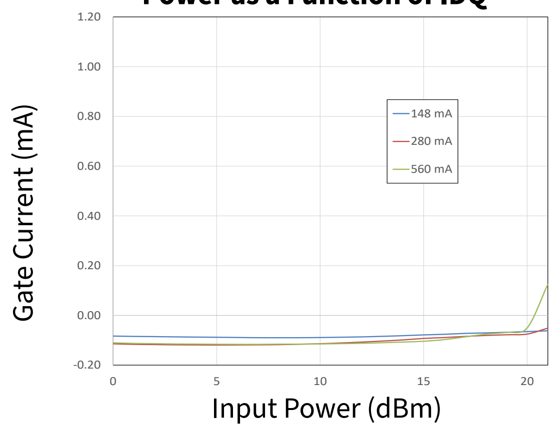


Figure 27. Gate Current vs Input Power as a Function of IDQ



Typical Performance of the CMPA2738060F

Test conditions unless otherwise noted: V_D = 50 V, I_{DQ} = 280 mA, CW, Pin = 20 dBm, Frequency = 3.1 GHz, T_{BASE} = +25°C

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

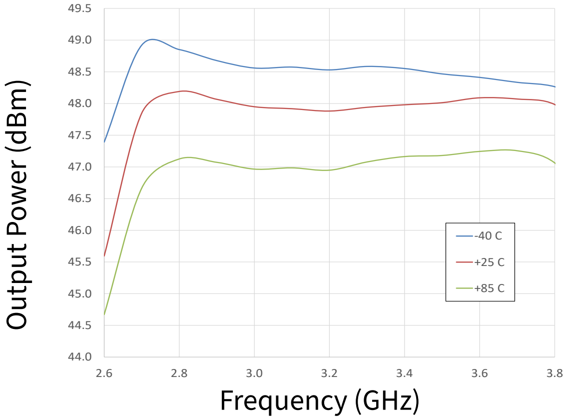


Figure 29. Output Power vs Frequency as a Function of Input Power

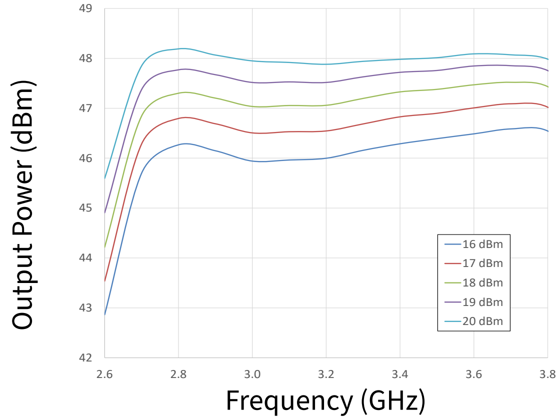


Figure 30. Power Added Eff. vs Frequency as a Function of Temperature

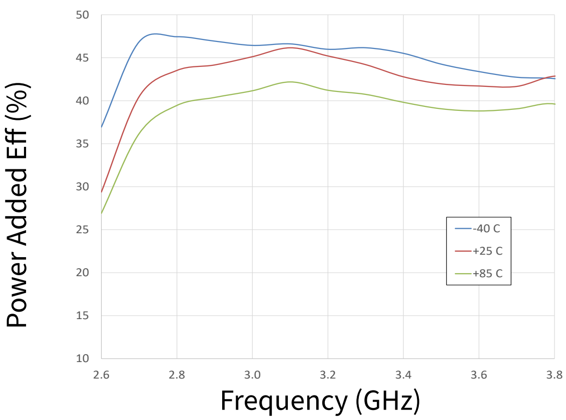


Figure 31. Power Added Eff. vs Frequency as a Function of Input Power

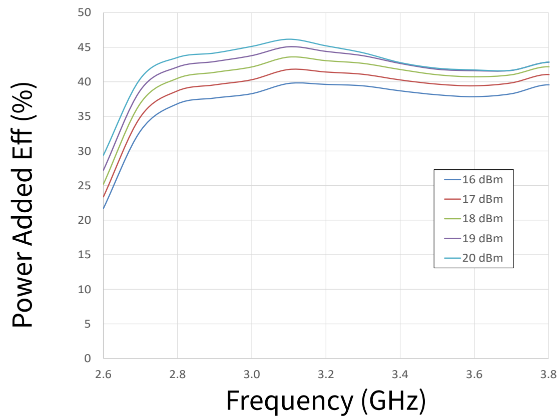


Figure 32. Drain Current vs Frequency as a Function of Temperature

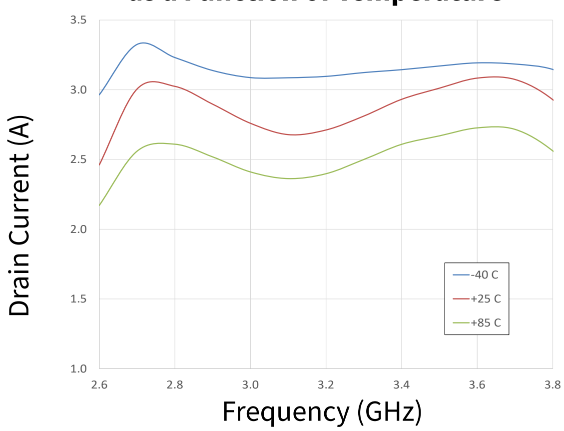
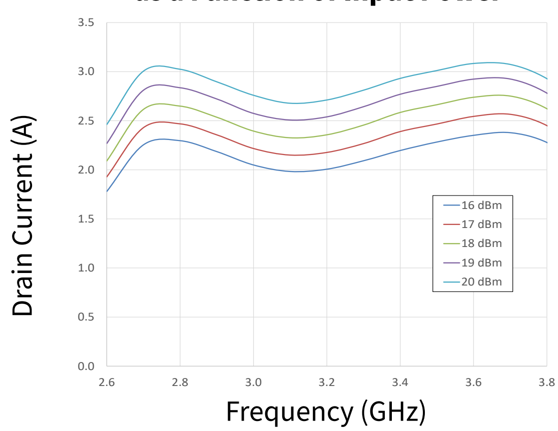


Figure 33. Drain Current vs Frequency as a Function of Input Power



Typical Performance of the CMPA2738060F

Test conditions unless otherwise noted: V_D = 50 V, I_{DQ} = 280 mA, CW, Pin = 20 dBm, Frequency = 3.1 GHz, T_{BASE} = +25°C

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

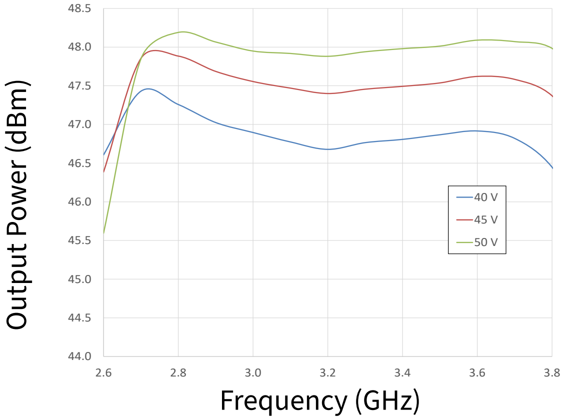


Figure 35. Drain Current vs Frequency as a Function of Input Power

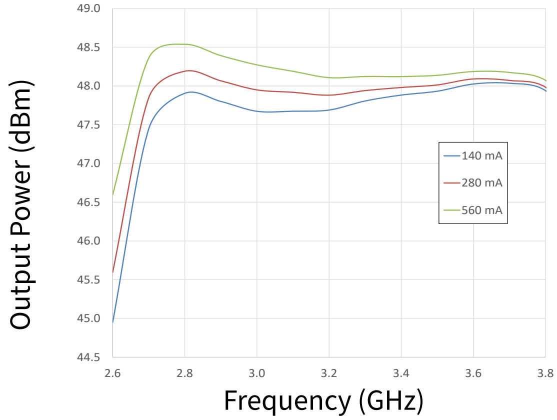


Figure 36. Power Added Eff. vs Frequency as a Function of Voltage

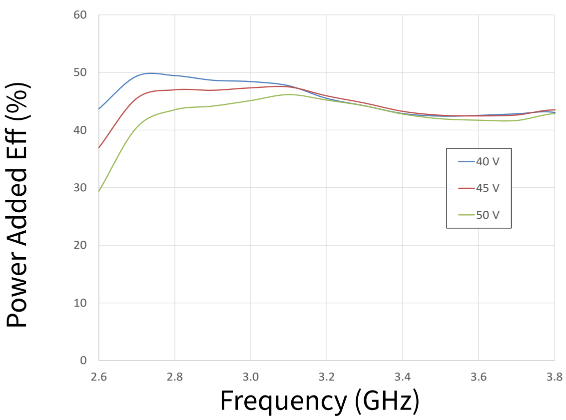


Figure 37. Power Added Eff. vs Frequency as a Function of Input Power

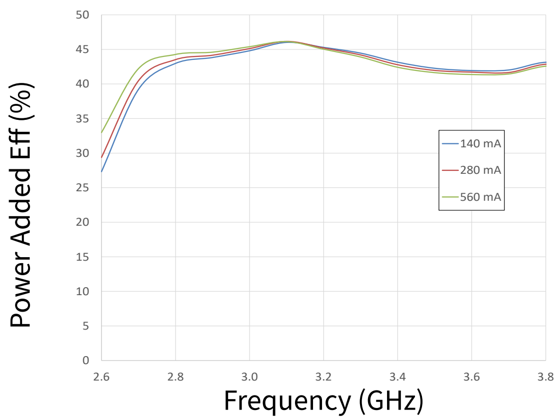


Figure 38. Drain Current vs Frequency as a Function of Voltage

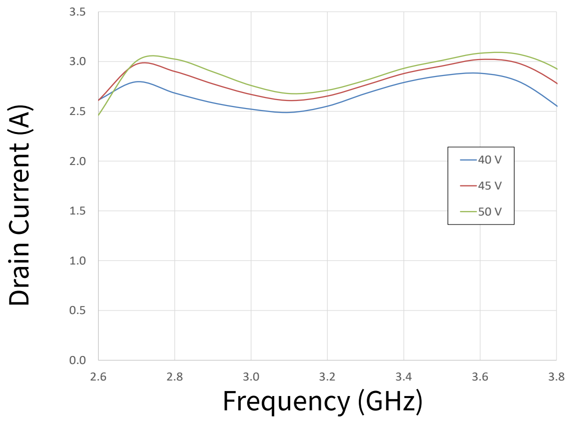
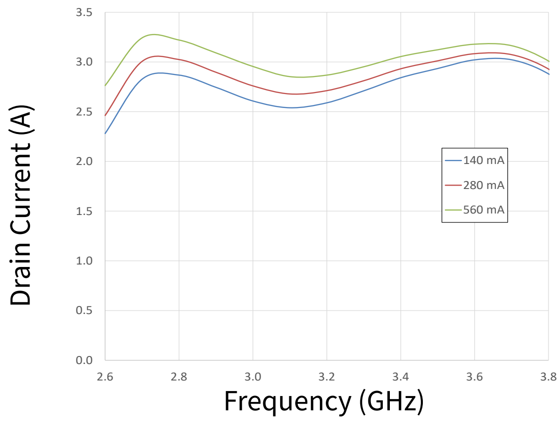


Figure 39. Drain Current vs Frequency as a Function of Input Power



Typical Performance of the CMPA2738060F

Test conditions unless otherwise noted: V_D = 50 V, I_{DQ} = 280 mA, CW, Pin = 20 dBm, Frequency = 3.1 GHz, T_{BASE} = +25°C

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

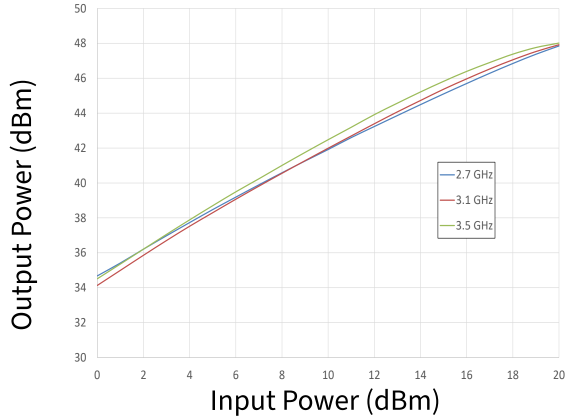


Figure 41. Power Added Eff. vs Input Power as a Function of Frequency

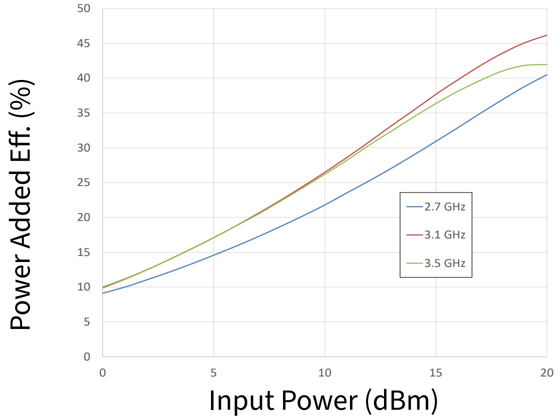


Figure 42. Large Signal Gain vs Input Power as a Function of Frequency

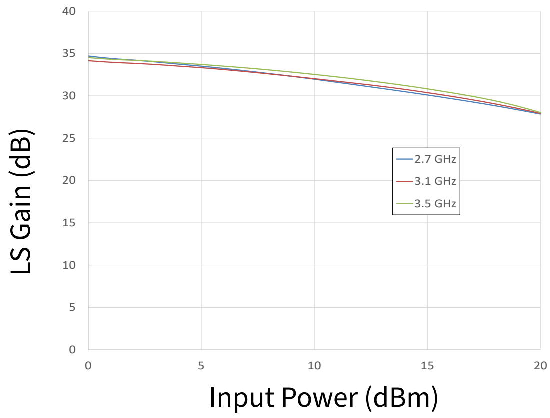


Figure 43. Drain Current vs Input Power as a Function of Frequency

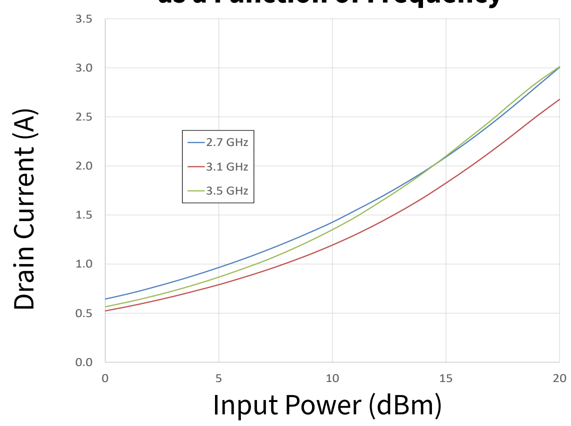
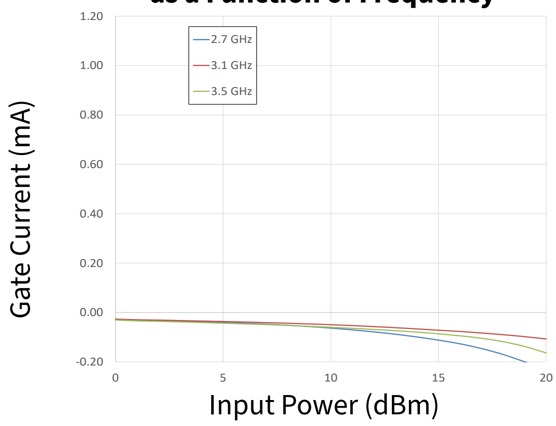


Figure 44. Gate Current vs Input Power as a Function of Frequency



Typical Performance of the CMPA2738060F

Test conditions unless otherwise noted: V_D = 50 V, I_{DQ} = 280 mA, CW, Pin = 20 dBm, Frequency = 3.1 GHz, T_{BASE} = +25°C

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

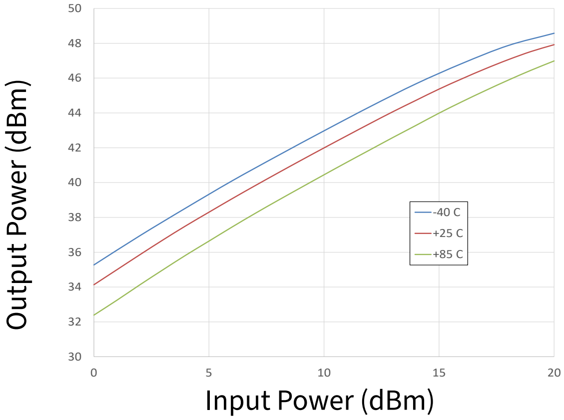


Figure 46. Power Added Eff. vs Input Power as a Function of Temperature

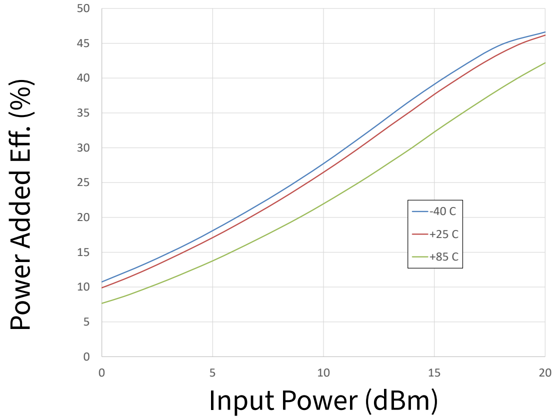


Figure 47. Large Signal Gain vs Input Power as a Function of Temperature

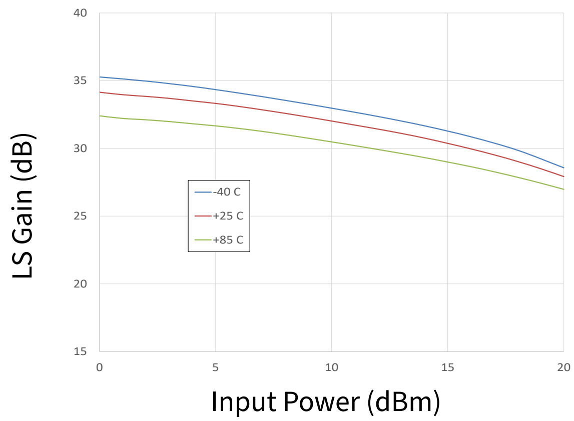


Figure 48. Drain Current vs Input Power as a Function of Temperature

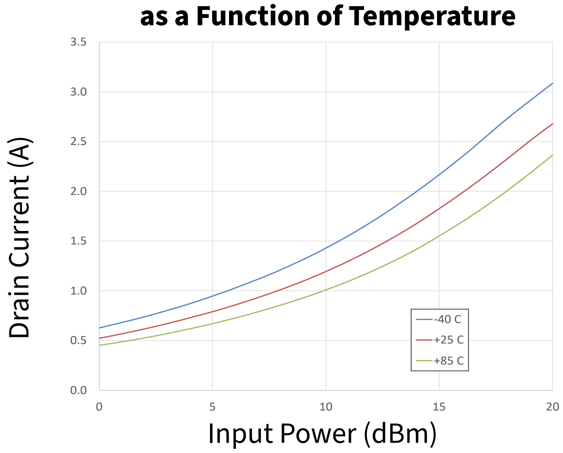
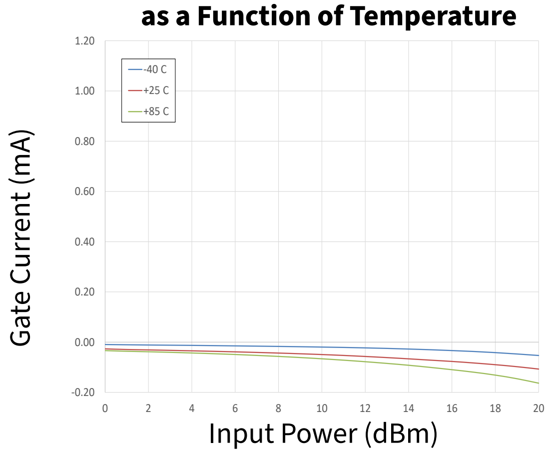


Figure 49. Gate Current vs Input Power as a Function of Temperature



Typical Performance of the CMPA2738060F

Test conditions unless otherwise noted: V_D = 50 V, I_{DQ} = 280 mA, CW, Pin = 20 dBm, Frequency = 3.1 GHz, T_{BASE} = +25°C

Figure 50. Output Power vs Input Power as a Function of IDQ

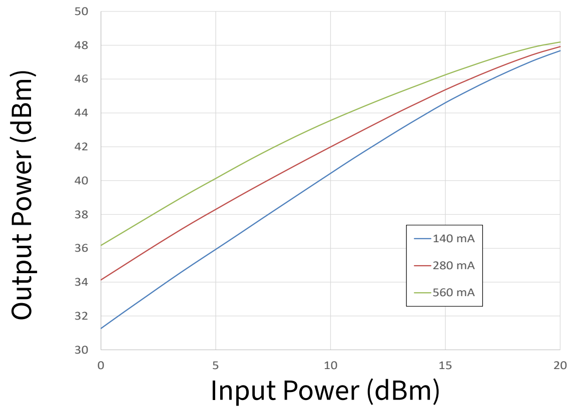


Figure 51. Power Added Eff. vs Input Power as a Function of IDQ

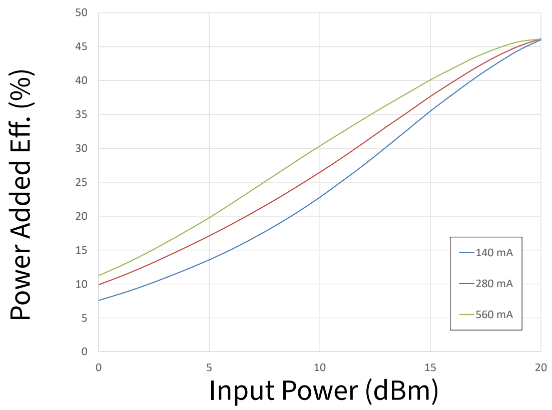


Figure 52. Large Signal Gain vs Input Power as a Function of IDQ

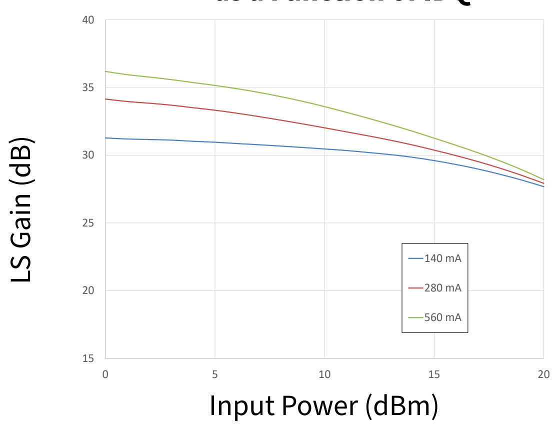


Figure 53. Drain Current vs Input Power as a Function of IDQ

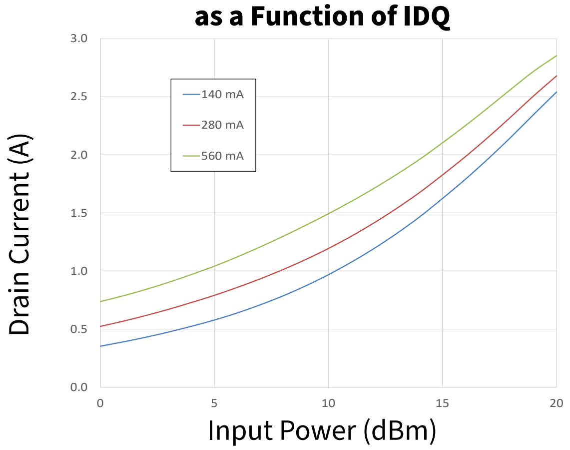
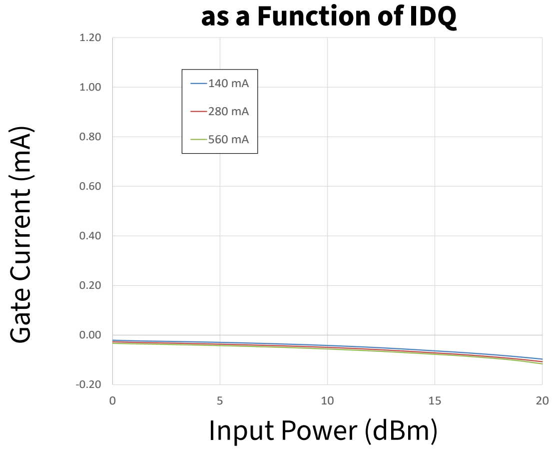


Figure 54. Gate Current vs Input Power as a Function of IDQ



Typical Performance of the CMPA2738060F

Test conditions unless otherwise noted: V_D = 50 V, I_{DQ} = 280 mA, PW = 300 us, DC = 20%, Pin = 20 dBm, Frequency = 3.1 GHz, T_{BASE} = +25 °C

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

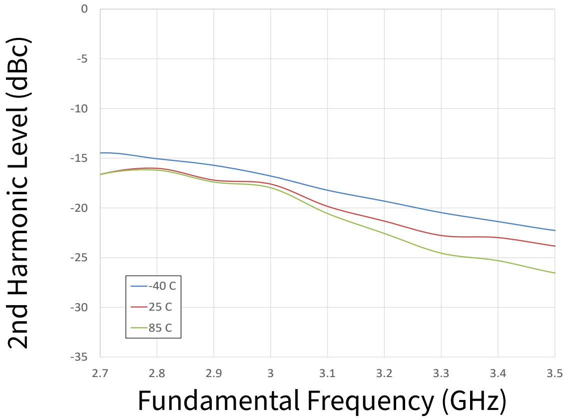


Figure 56. 3rd Harmonic vs Frequency as a Function of Temperature

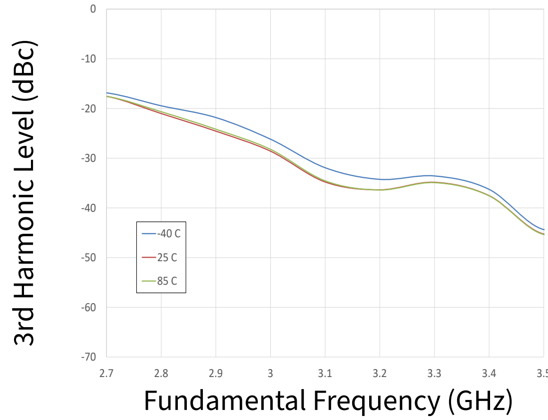


Figure 57. 2nd Harmonic vs Output Power as a Function of Frequency

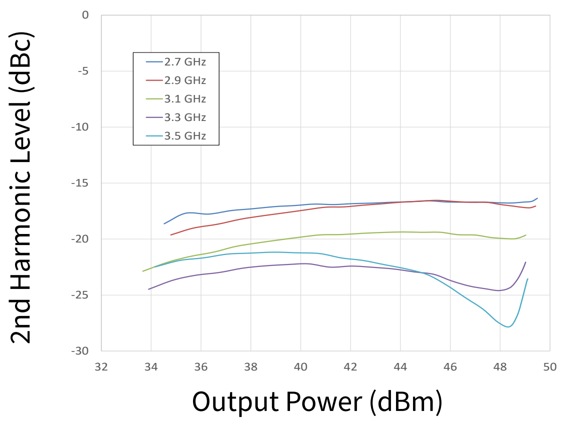


Figure 58. 3rd Harmonic vs Output Power as a Function of Frequency

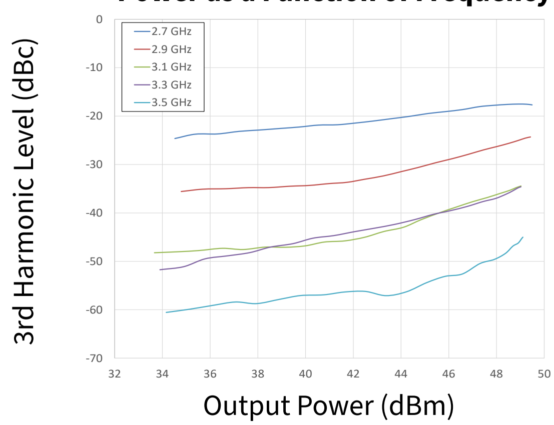


Figure 59. 2nd Harmonic vs Output Power as a Function of IDQ

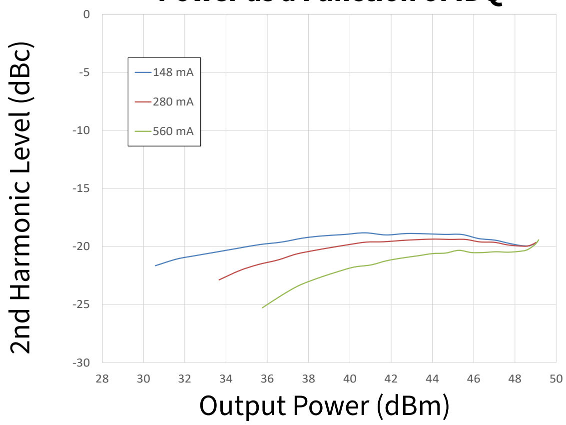
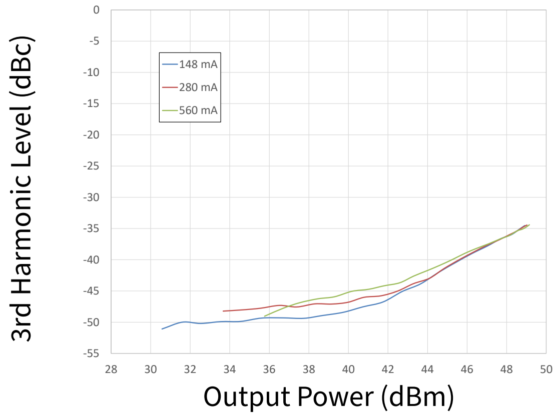


Figure 60. 3rd Harmonic vs Output Power as a Function of IDQ



Typical Performance of the CMPA2738060F

Test conditions unless otherwise noted: V_D = 50 V, I_{DQ} = 280 mA, Pin = -20 dBm, Frequency = 3.1 GHz, T_{BASE} = +25 °C

Figure 61. Gain vs Frequency as a Function of Temperature

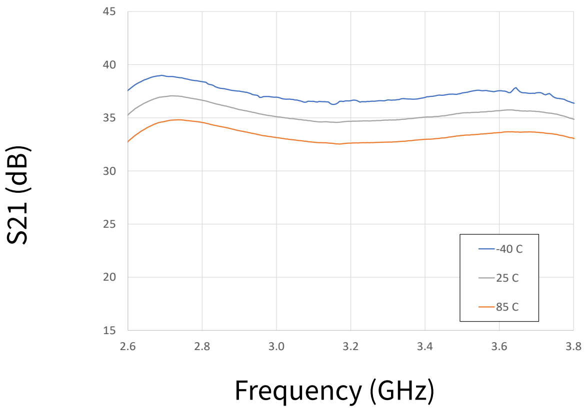


Figure 62. Gain vs Frequency as a Function of Temperature

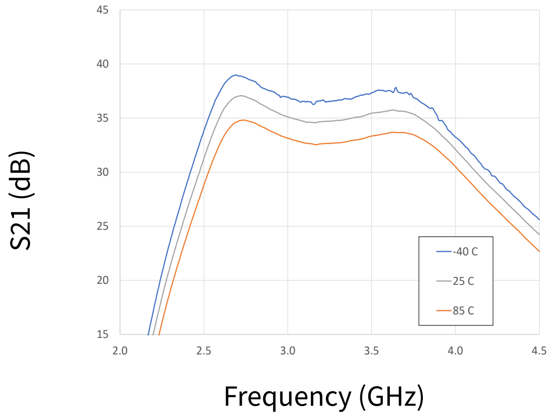


Figure 63. Input RL vs Frequency as a Function of Temperature

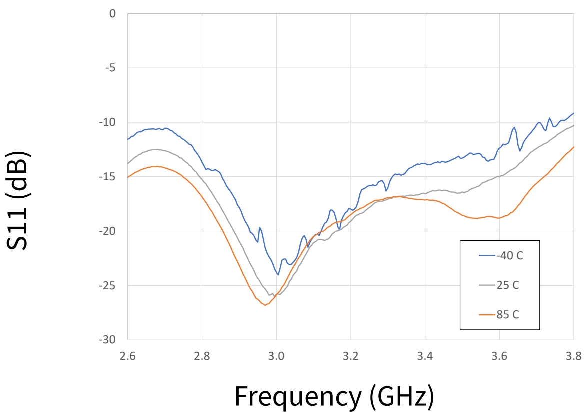


Figure 64. Input RL vs Frequency as a Function of Temperature

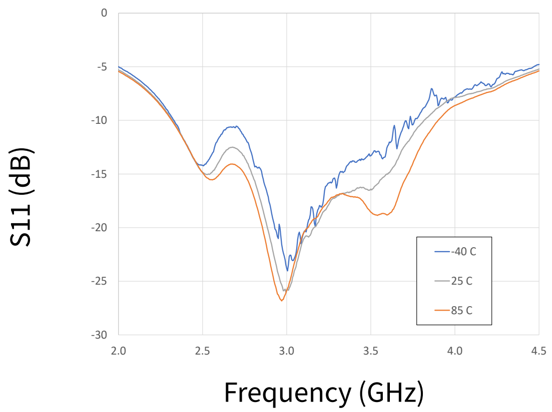


Figure 65. Output RL vs Frequency as a Function of Temperature

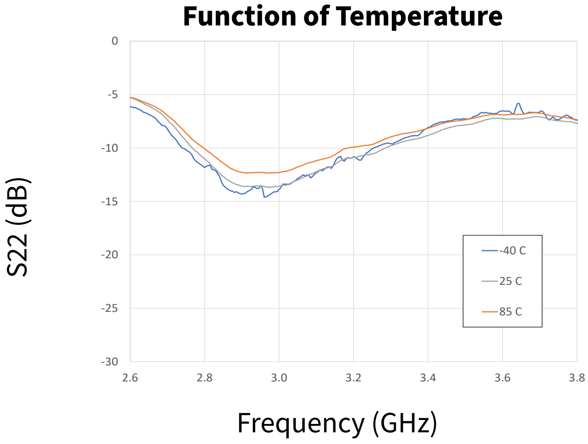
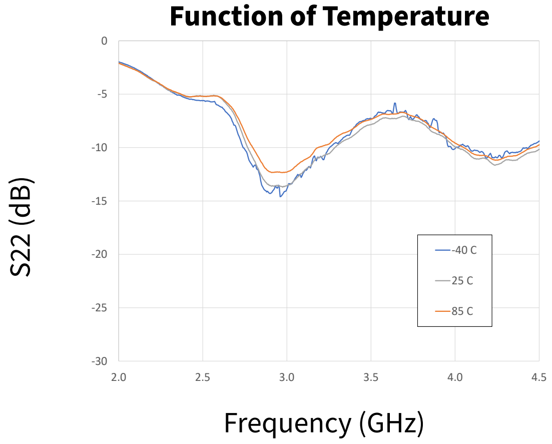


Figure 66. Output RL vs Frequency as a Function of Temperature



Typical Performance of the CMPA2738060F

Test conditions unless otherwise noted: V_D = 50 V, I_{DQ} = 280 mA, Pin = -20 dBm, Frequency = 3.1 GHz, T_{BASE} = +25 °C

Figure 67. Gain vs Frequency as a Function of Voltage

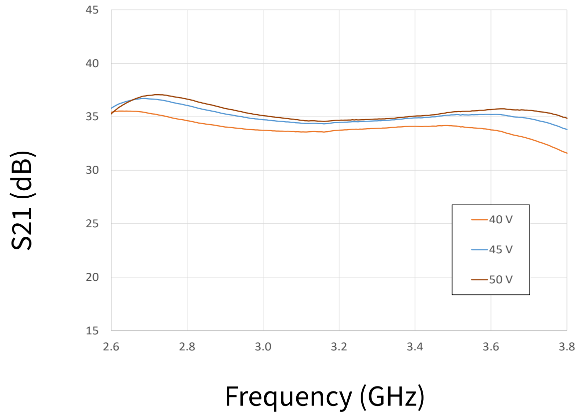


Figure 68. Gain vs Frequency as a Function of IDQ

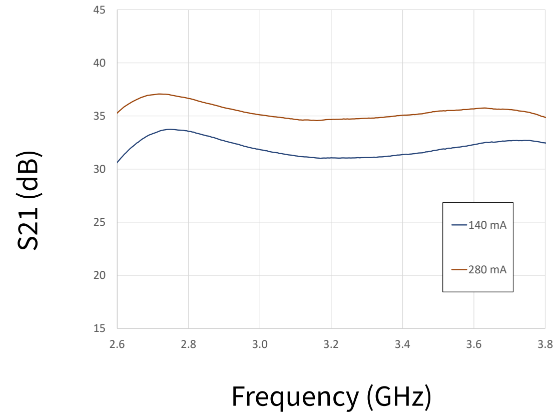


Figure 69. Input RL vs Frequency as a Function Voltage

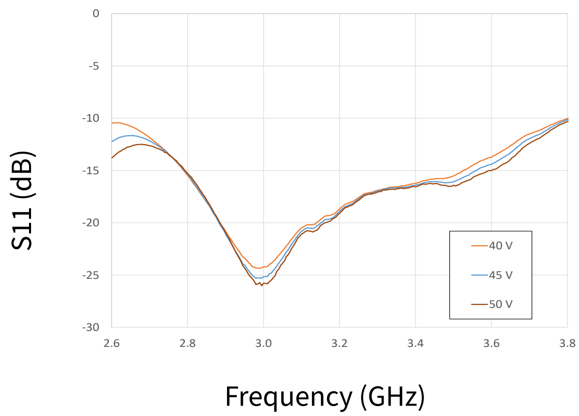


Figure 70. Input RL vs Frequency as a Function of IDQ

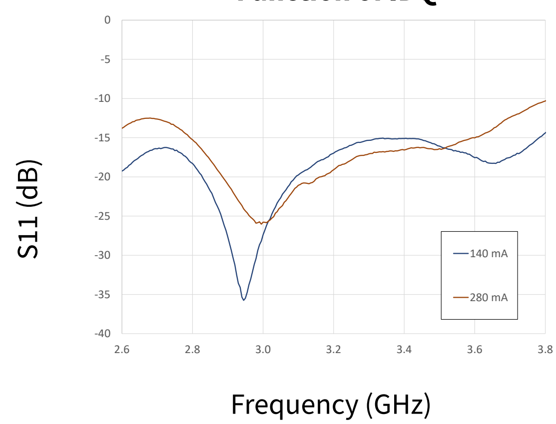


Figure 71. Output RL vs Frequency as a Function of Voltage

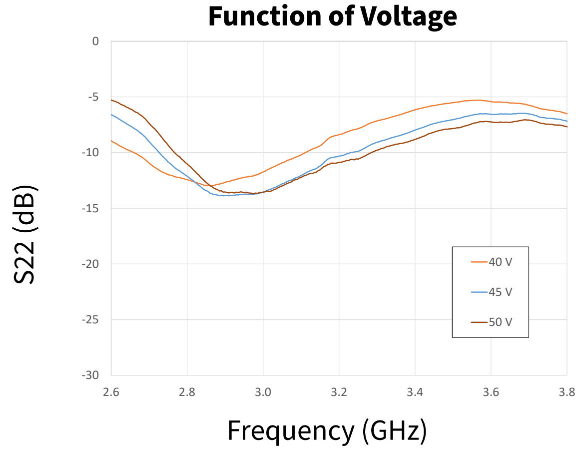
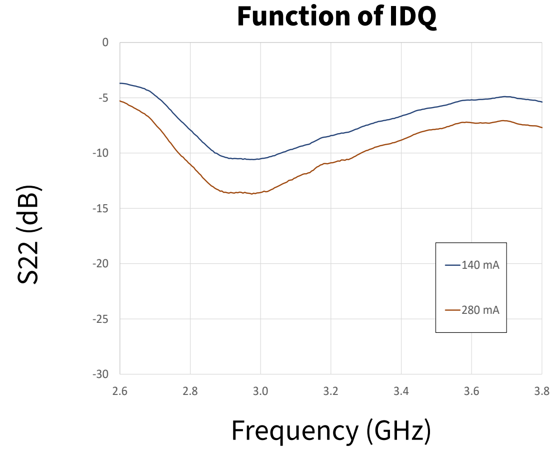
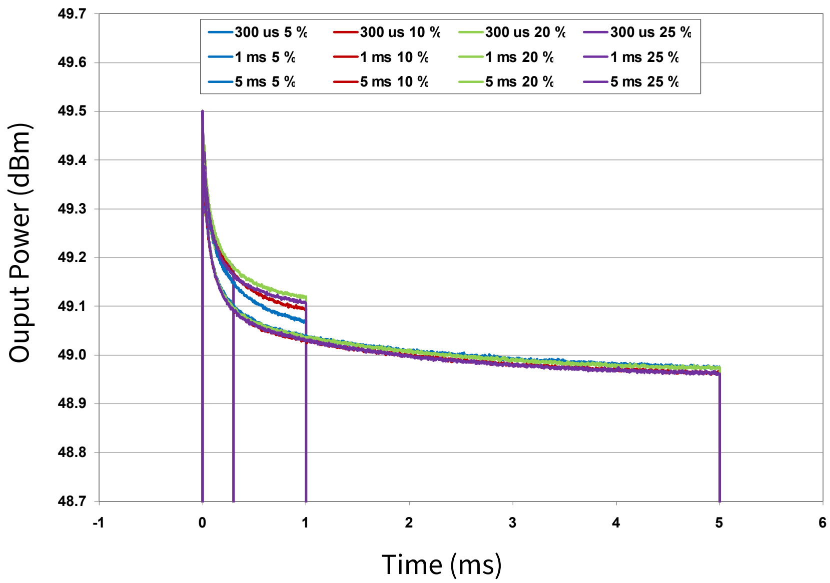


Figure 72. Output RL vs Frequency as a Function of IDQ



Typical Pulse Droop Performance



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

Electrostatic Discharge (ESD) Classifications

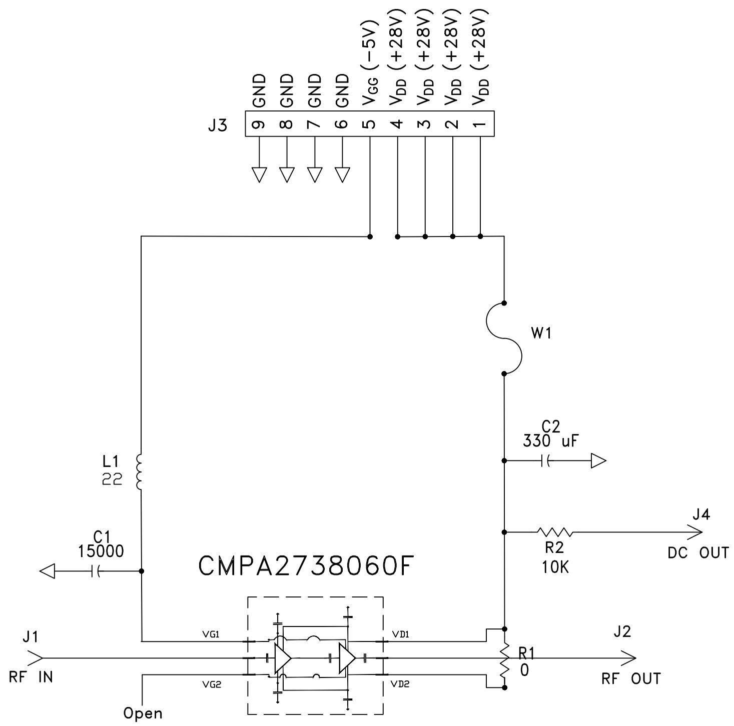
Parameter	Symbol	Class	Test Methodology
Human Body Model	HBM	1A (> 250 V)	JEDEC JESD22 A114-D
Charge Device Model	CDM	II (200 < 500 V)	JEDEC JESD22 C101-C

CMPA2738060F-AMP Demonstration Amplifier Circuit Bill of Materials

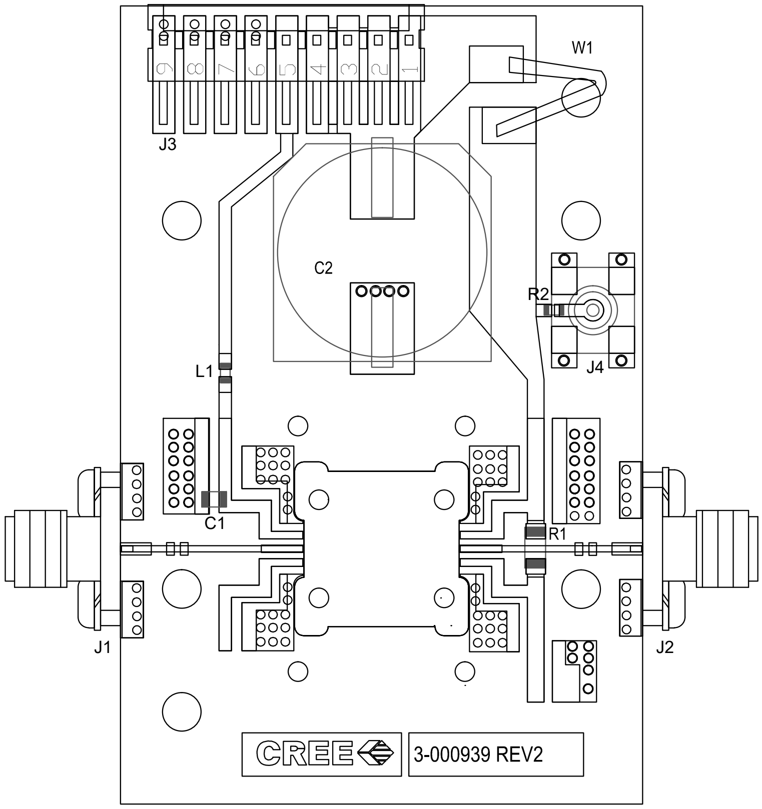
Designator	Description	Qty
C1	CAP, 15000pF, 100V, 0805, X7R	1
C2	CAP, 330uF, 20%, 100V, ELECT, MVY, SMD	1
R1	RES, 1/8W, 1206, +/-5%, 0 OHMS	1
R2	RES, 1/16W, 0603, +/-5%, 10K OHMS	1
L1	FERRITE, 22 OHM, 0805, BLM21PG220SN1	1
J1,J2	CONNECTOR, N-TYPE, FEMALE, W/0.500 SMA FLNG	2
J3	CONNECTOR, HEADER, RT>PLZ .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

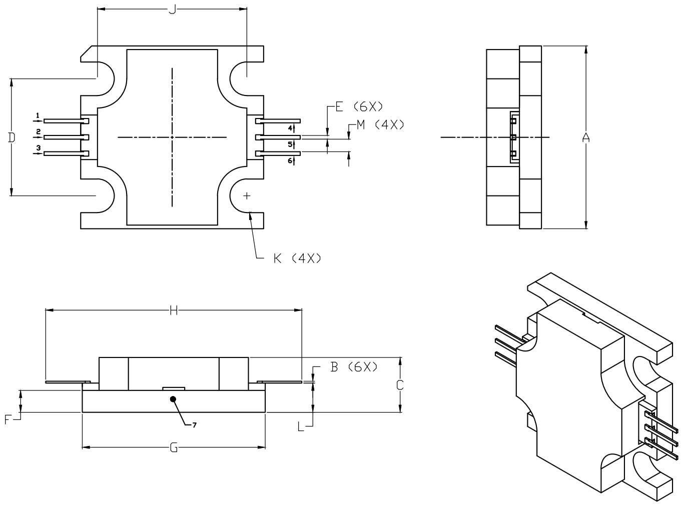
CMPA2738060F-AMP Demonstration Amplifier Circuit Schematic



CMPA2738060F-AMP Demonstration Amplifier Circuit Outline



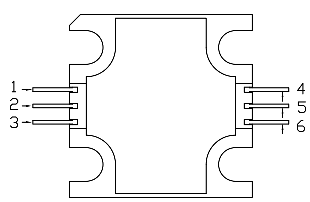
Product Dimensions CMPA2738060F (Package Type — 440219)



NOTES:

1. DIMENSIONING AND TOLERANICING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. ADHESIVE FROM LID MAY EXTEND A MAXIMUM OF 0.020" BEYOND EDGE OF LID.
4. LID MAY BE MISALIGNED TO THE BODY OF THE PACKAGE BY A MAXIMUM OF 0.008" IN ANY DIRECTION.
5. ALL PLATED SURFACES ARE NI/AU

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.495	0.505	12.57	12.82
B	0.003	0.005	0.076	0.127
C	0.140	0.160	3.56	4.06
D	0.315	0.325	8.00	8.25
E	0.008	0.012	0.204	0.304
F	0.055	0.065	1.40	1.65
G	0.495	0.505	12.57	12.82
H	0.695	0.705	17.65	17.91
J	0.403	0.413	10.24	10.49
K	ø .092		2.34	
L	0.075	0.085	1.905	2.159
M	0.032	0.040	0.82	1.02



NOT TO SCALE

PIN	Function
1	VGG
2	RFin
3	VGG
4	VDD
5	RFout
6	VDD
7	Source

Part Number System

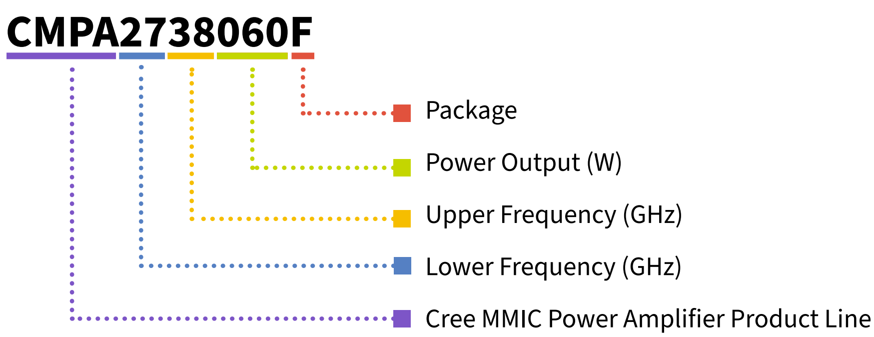


Table 1.

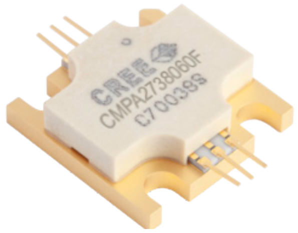
Parameter	Value	Units
Lower Frequency	2.7	GHz
Upper Frequency	3.8	GHz
Power Output	60	W
Package	Flange	-

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, North Carolina, USA 27703
www.wolfspeed.com/rf

Sales Contact
rfsales@cree.com

Notes & Disclaimer

Specifications are subject to change without notice. “Typical” parameters are the average values expected by Cree in large quantities and are provided for information purposes only. Cree products are not warranted or authorized for use as critical components in medical, life-saving, or life-sustaining applications, or other applications where a failure would reasonably be expected to cause severe personal injury or death. No responsibility is assumed by Cree for any infringement of patents or other rights of third parties which may result from use of the information contained herein. No license is granted by implication or otherwise under any patent or patent rights of Cree.