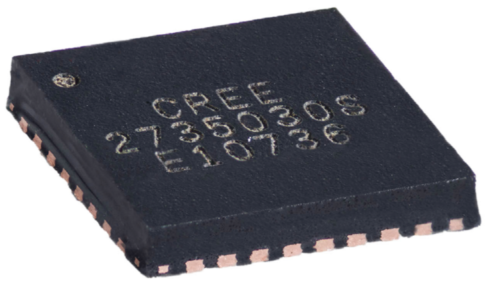
CMPA2735030S

30 W, 2.7 - 3.5 GHz, GaN MMIC, Power Amplifier

Description

Cree's CMPA2735030S is a gallium nitride (GaN) High Electron Mobility Transistor (HEMT) based monolithic microwave integrated circuit (MMIC). GaN has superior properties compared to silicon or gallium arsenide, including higher breakdown voltage, higher saturated electron drift velocity and higher thermal conductivity. GaN HEMTs also offer greater power density and wider bandwidths compared to Si and GaAs transistors. This MMIC contains a two-stage reactively matched amplifier design approach enabling high power and power added efficiency to be achieved in a 5mm x 5mm, surface mount (QFN package).



PN: CMPA2735030S
Package: 5x5 mm

Typical Performance Over 2.7 - 3.5 GHz (T_C = 25˚C)

Parameter	2.7 GHz	2.9 GHz	3.1 GHz	3.3 GHz	3.5 GHz	Units
Small Signal Gain	33.8	32.9	32.9	33.5	33.4	dB
Output Power[1]	36.5	39.7	40.6	36.0	27.8	W
Power Gain[1]	27.6	28.0	28.1	27.6	26.4	dB
PAE[1]	57	53	51	51	45	%

Note:
[1] P_{IN} = 18 dBm, Pulse Width = 100 μs; Duty Cycle = 10%

Features

- 32 dB Small Signal Gain
- Operation up to 50 V
- High Breakdown Voltage
- High Temperature Operation
- 5 mm x 5 mm Total Product Size

Applications

- Civil and Military Pulsed Radar Amplifiers

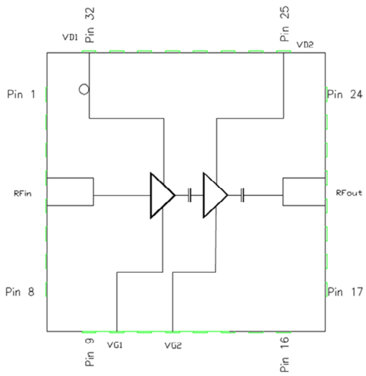


Figure 1.

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	
Maximum Forward Gate Current	I_G	15.5	mA	25°C
Soldering Temperature	T_S	260	˚C	

Electrical Characteristics (Frequency = 2.7 GHz to 3.5 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 = 7.6 mA
Gate Quiescent Voltage	$V_{GS(Q)}$	–	-2.7	–	V_{DC}	V_{DD} = 50 V, I_{DQ} = 135 mA
Saturated Drain Current[1]	I_{DS}	–	4.6	–	A	V_{DS} = 6.0 V, V_{GS} = 2.0 V
Drain-Source Breakdown Voltage	V_{BD}	–	150	–	V	V_{GS} = -8 V, I_D = 7.6 mA
RF Characteristics[2,3]						
Small Signal Gain	$S21_1$	–	33.8	–	dB	V_{DD} = 50 V, I_{DQ} = 135 mA, Freq = 2.7 GHz
Small Signal Gain	$S21_2$	–	32.9	–	dB	V_{DD} = 50 V, I_{DQ} = 135 mA, Freq = 3.1 GHz
Small Signal Gain	$S21_3$	–	33.4	–	dB	V_{DD} = 50 V, I_{DQ} = 135 mA, Freq = 3.5 GHz
Power Output	P_{OUT1}	–	36.5	–	W	V_{DD} = 50 V, I_{DQ} = 135 mA, P_{IN} = 21 dBm, Freq = 2.7 GHz
Power Output	P_{OUT2}	–	40.6	–	W	V_{DD} = 50 V, I_{DQ} = 135 mA, P_{IN} = 21 dBm, Freq = 3.1 GHz
Power Output	P_{OUT3}	–	27.8	–	W	V_{DD} = 50 V, I_{DQ} = 135 mA, P_{IN} = 21 dBm, Freq = 3.5 GHz
Power Added Efficiency	PAE_1	–	57	–	%	V_{DD} = 50 V, I_{DQ} = 135 mA, Freq = 2.7 GHz
Power Added Efficiency	PAE_2	–	51	–	%	V_{DD} = 50 V, I_{DQ} = 135 mA, Freq = 3.1 GHz
Power Added Efficiency	PAE_3	–	45	–	%	V_{DD} = 50 V, I_{DQ} = 135 mA, Freq = 3.5 GHz
Input Return Loss	$S11_1$	–	-18.2	–	dB	V_{DD} = 50 V, I_{DQ} = 135 mA, Freq = 2.7 GHz
Input Return Loss	$S11_2$	–	-13.4	–	dB	V_{DD} = 50 V, I_{DQ} = 135 mA, Freq = 3.1 GHz
Input Return Loss	$S11_3$	–	-27.0	–	dB	V_{DD} = 50 V, I_{DQ} = 135 mA, Freq = 3.5 GHz
Output Return Loss	$S22_1$	–	-14.9	–	dB	V_{DD} = 50 V, I_{DQ} = 135 mA, Freq = 2.7 GHz
Output Return Loss	$S22_2$	–	-9.5	–	dB	V_{DD} = 50 V, I_{DQ} = 135 mA, Freq = 3.1 GHz
Output Return Loss	$S22_3$	–	-16.5	–	dB	V_{DD} = 50 V, I_{DQ} = 135 mA, Freq = 3.5 GHz
Output Mismatch Stress	VSWR	–	5:1	–	Ψ	No damage at all phase angles, V_{DD} = 50 V, I_{DQ} = 135 mA, P_{IN} = 18 dBm

Notes:
[1] Scaled from PCM data
[2] Measured in CMPA2735030S high volume test fixture at 2.7, 3.1 and 3.5 GHz and may not show the full capability of the device due to source inductance and thermal performance.
[3] Pulse Width = 25 µs; Duty Cycle = 1%

Thermal Characteristics

Parameter	Symbol	Rating	Units	Conditions
Operating Junction Temperature	T_J	225	˚C	
Thermal Resistance, Junction to Case (packaged)[1]	$R_{\theta JC}$	2.62	˚C/W	Pulse Width = 500 µs, Duty Cycle =10%

Notes:
[1] Measured for the CMPA2735030S at P_{DISS} = 32 W

Typical Performance of the CMPA2735030S

Test conditions unless otherwise noted: V_D = 50 V, I_{DQ} = 130 mA, PW = 100 µs, DC = 10%, Pin = 18 dBm, T_{BASE} = +25 °C

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

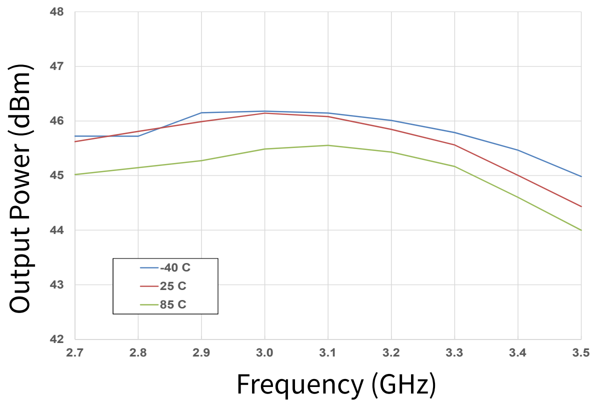


Figure 2. Output Power vs Frequency as a Function of Input Power

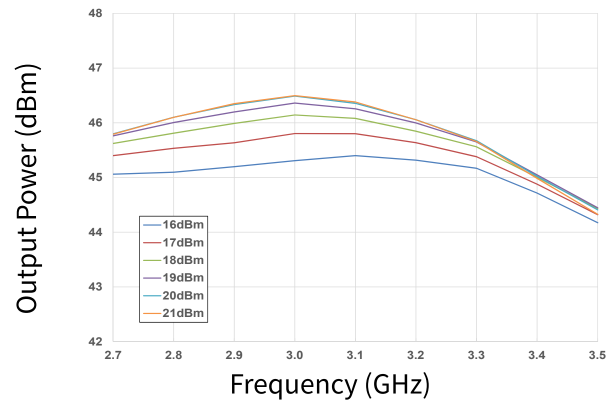


Figure 3. Power Added Eff. vs Frequency as a Function of Temperature

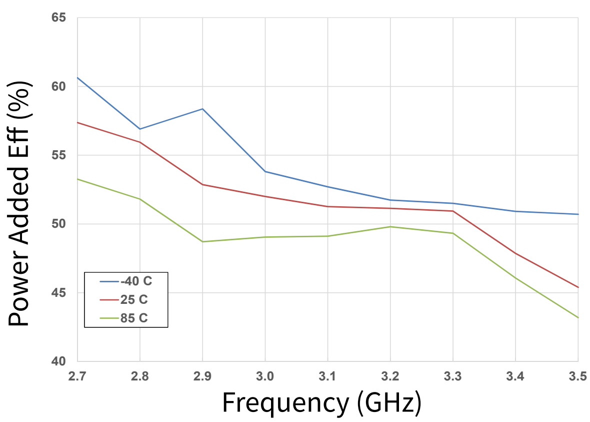


Figure 4. Power Added Eff. vs Frequency as a Function of Input Power

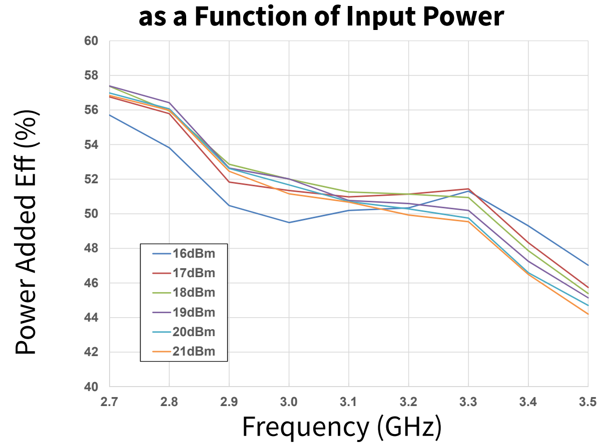


Figure 5. Drain Current vs Frequency as a Function of Temperature

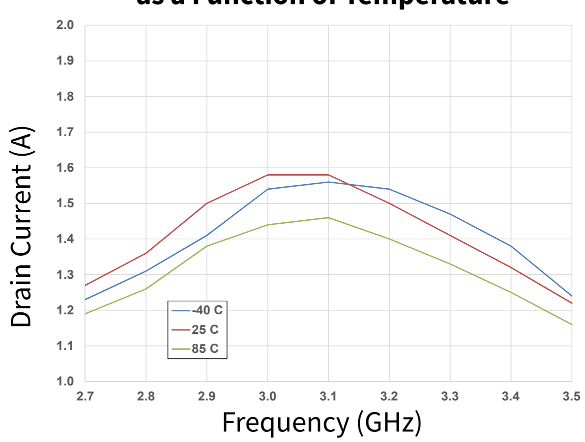
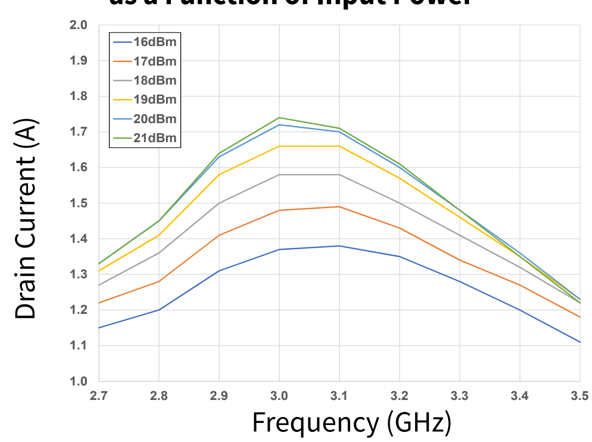


Figure 6. Drain Current vs Frequency as a Function of Input Power



Typical Performance of the CMPA2735030S

Test conditions unless otherwise noted: V_D = 50 V, I_{DQ} = 130 mA, PW = 100 µs, DC = 10%, Pin = 18 dBm, T_{BASE} = +25 °C

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

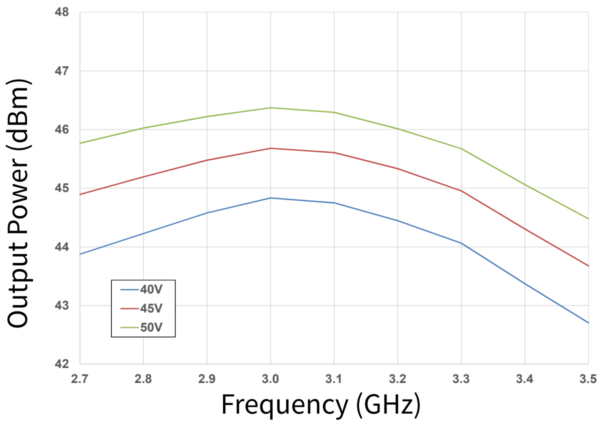


Figure 8. Output Power vs Frequency as a Function of IDQ

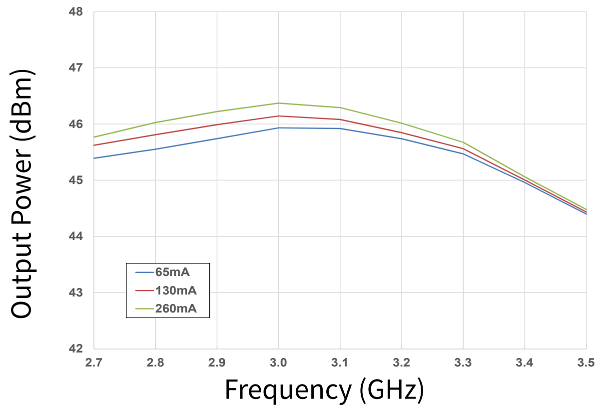


Figure 9. Power Added Eff. vs Frequency as a Function of VD

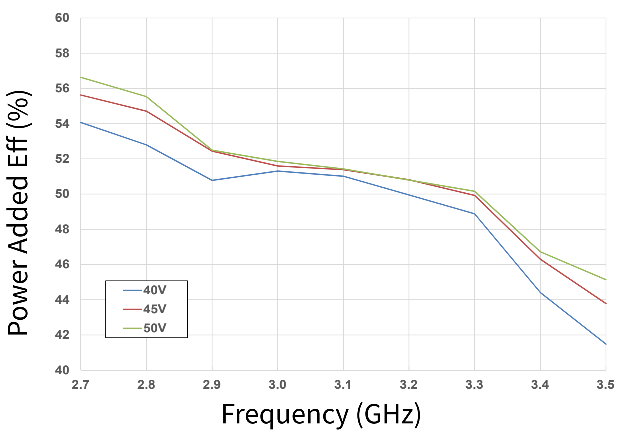


Figure 10. Power Added Eff. vs Frequency as a Function of IDQ

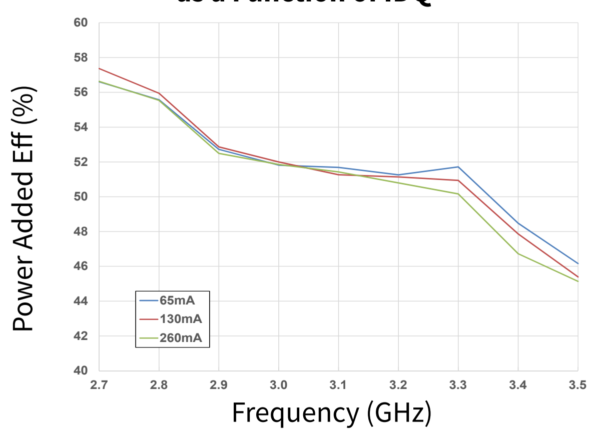


Figure 11. Drain Current vs Frequency as a Function of VD

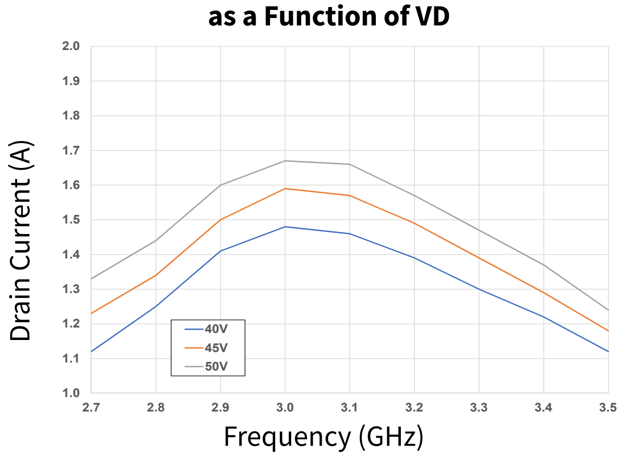
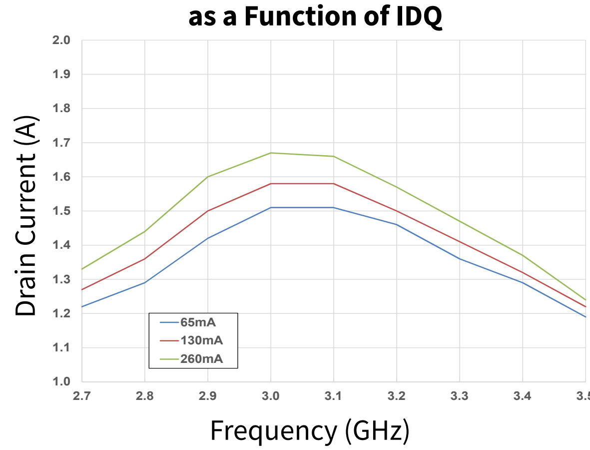


Figure 12. Drain Current vs Frequency as a Function of IDQ



Typical Performance of the CMPA2735030S

Test conditions unless otherwise noted: V_D = 50 V, I_{DQ} = 130 mA, PW = 100 µs, DC = 10%, Pin = 18 dBm, T_{BASE} = +25 °C

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

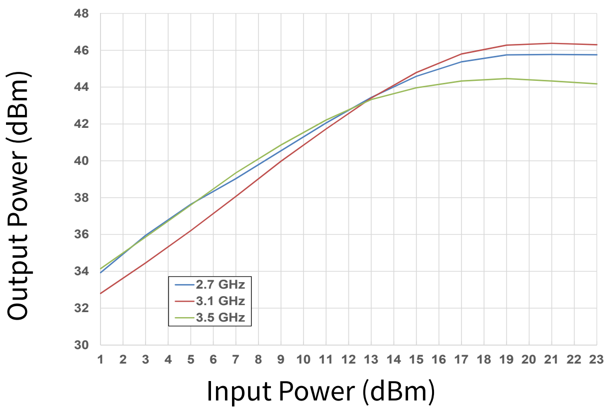


Figure 14. Power Added Eff. vs Input Power as a Function of Frequency

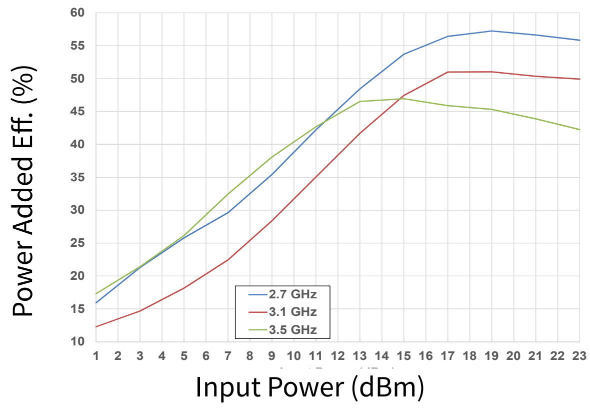


Figure 15. Large Signal Gain vs Input Power as a Function of Frequency

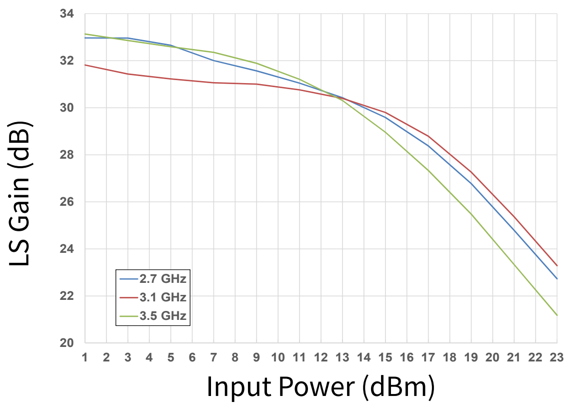


Figure 16. Drain Current vs Input Power as a Function of Frequency

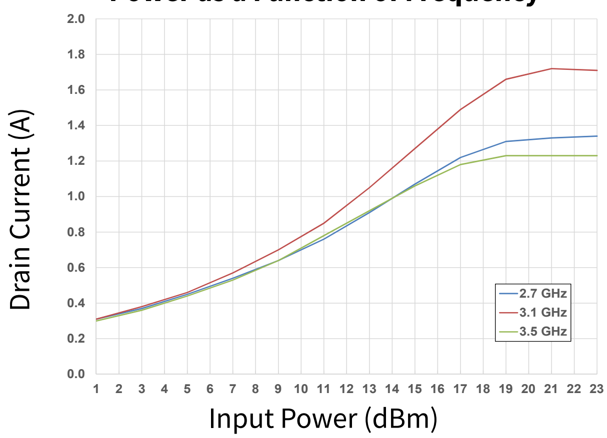
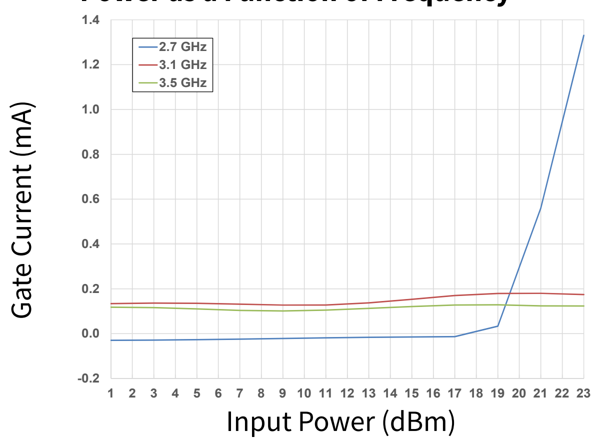


Figure 17. Gate Current vs Input Power as a Function of Frequency



Typical Performance of the CMPA2735030S

Test conditions unless otherwise noted: V_D = 50 V, I_{DQ} = 130 mA, PW = 100 µs, DC = 10%, Pin = 18 dBm, T_{BASE} = +25 °C

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

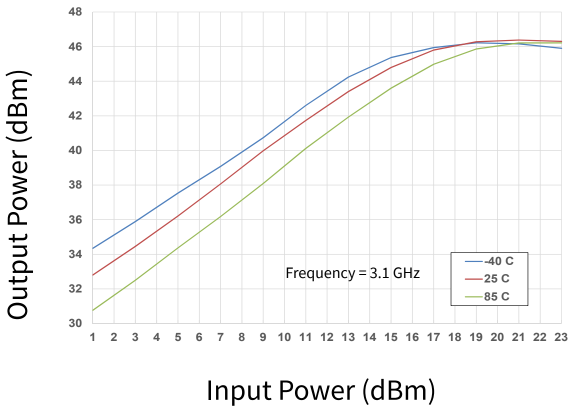


Figure 19. Power Added Eff. vs Input Power as a Function of Temperature

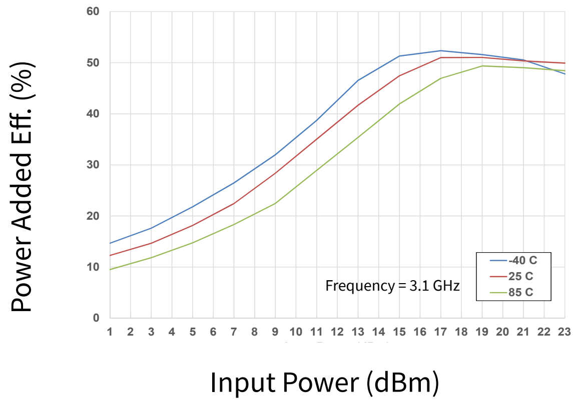


Figure 20. Large Signal Gain vs Input Power as a Function of Temperature

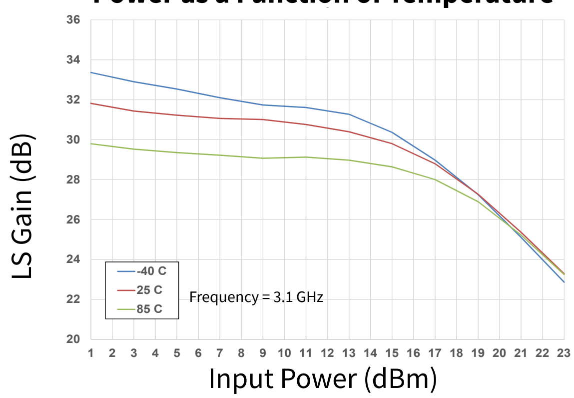


Figure 21. Drain Current vs Input Power as a Function of Temperature

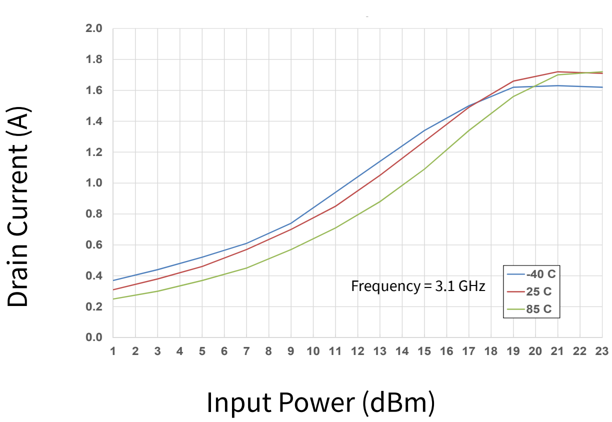
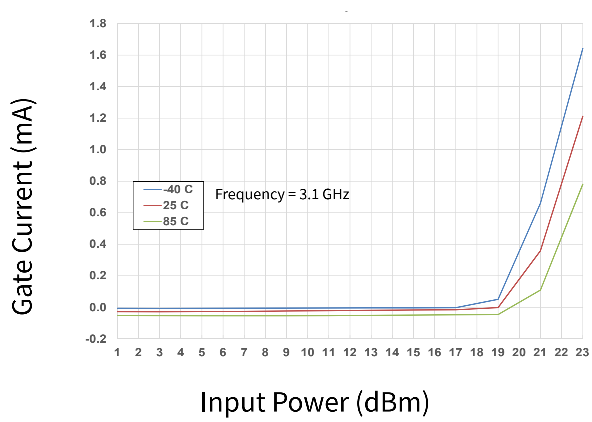


Figure 22. Gate Current vs Input Power as a Function of Temperature



Typical Performance of the CMPA2735030S

Test conditions unless otherwise noted: V_D = 50 V, I_{DQ} = 130 mA, PW = 100 µs, DC = 10%, Pin = 18 dBm, T_{BASE} = +25 °C

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

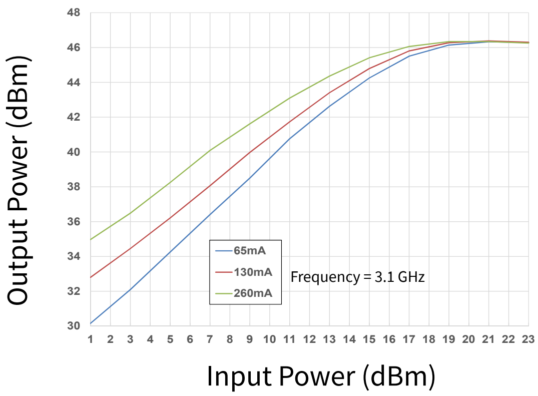


Figure 24. Power Added Eff. vs Input Power as a Function of IDQ

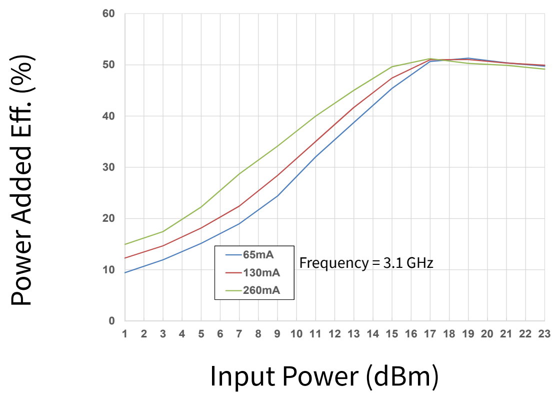


Figure 25. Large Signal Gain vs Input Power as a Function of IDQ

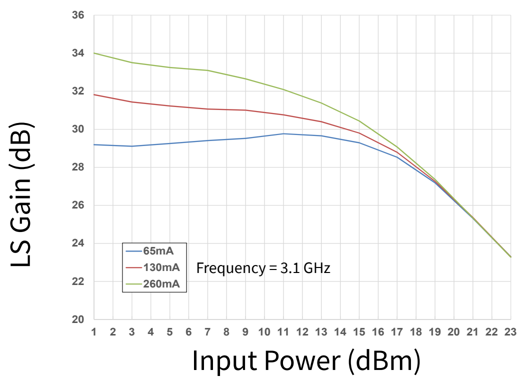


Figure 26. Drain Current vs Input Power as a Function of IDQ

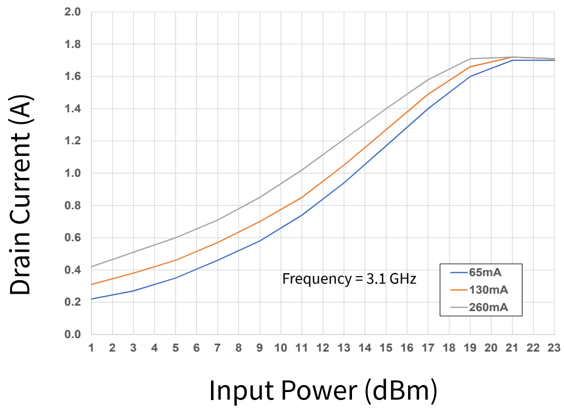
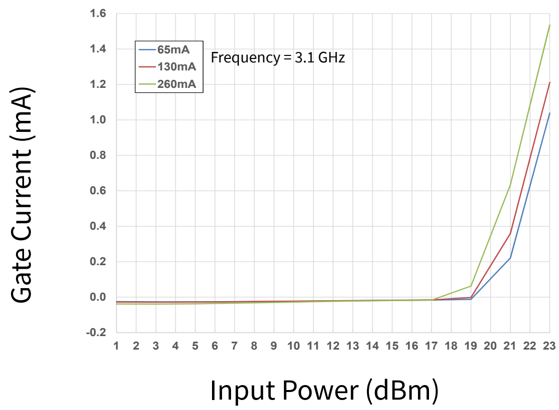


Figure 27. Gate Current vs Input Power as a Function of IDQ



Typical Performance of the CMPA2735030S

Test conditions unless otherwise noted: V_D = 50 V, I_{DQ} = 130 mA, PW = 100 µs, DC = 10%, Pin = 18 dBm, T_{BASE} = +25 °C

Figure 28. 2nd Harmonic vs Frequency as a Function of Temperature

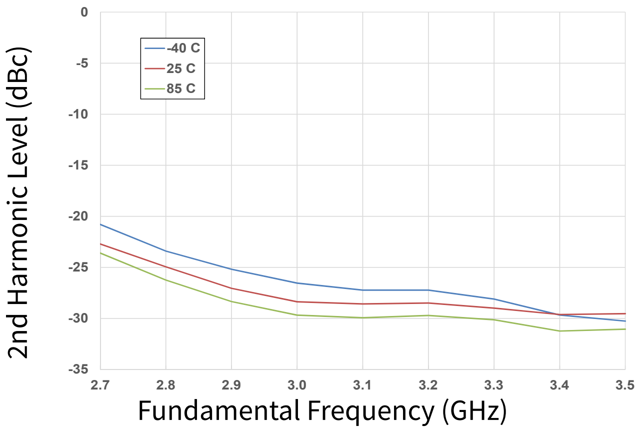


Figure 29. 3rd Harmonic vs Frequency as a Function of Temperature

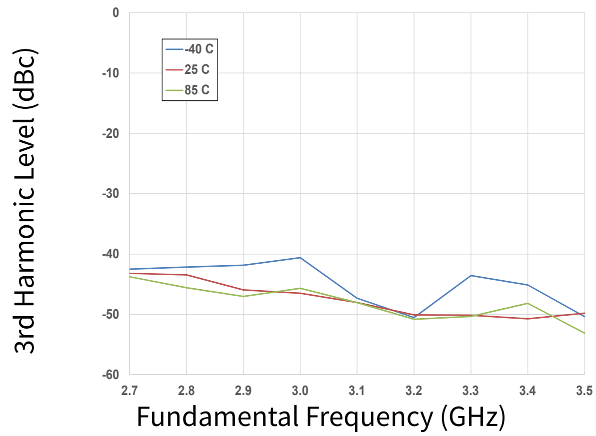


Figure 30. 2nd Harmonic vs Input Power as a Function of Frequency

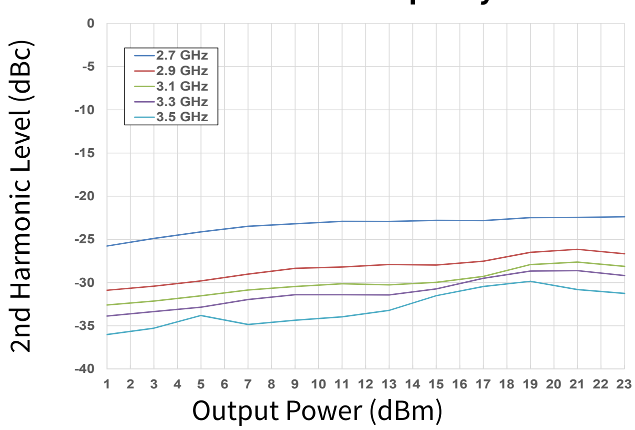


Figure 31. 3rd Harmonic vs Input Power as a Function of Frequency

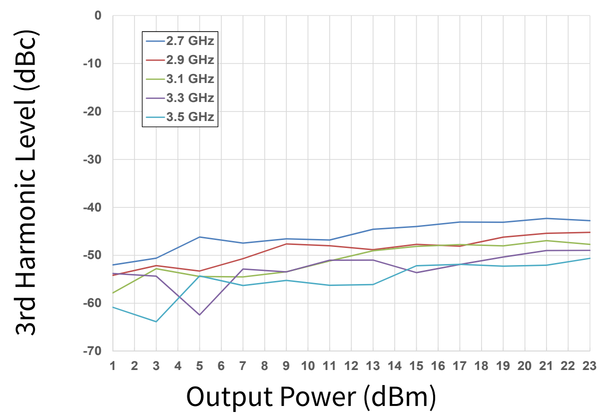


Figure 32. 2nd Harmonic vs Output Power as a Function of IDQ

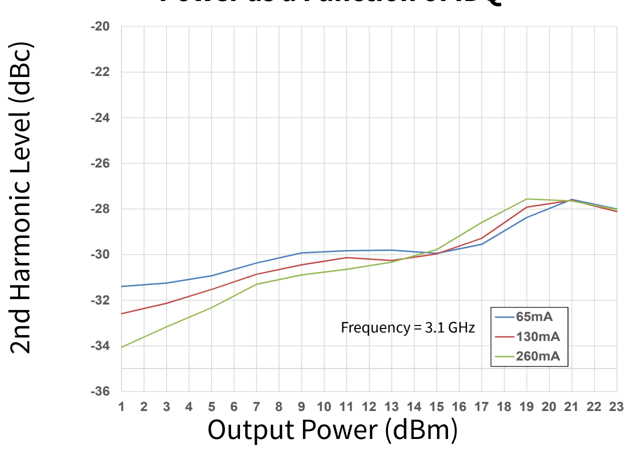
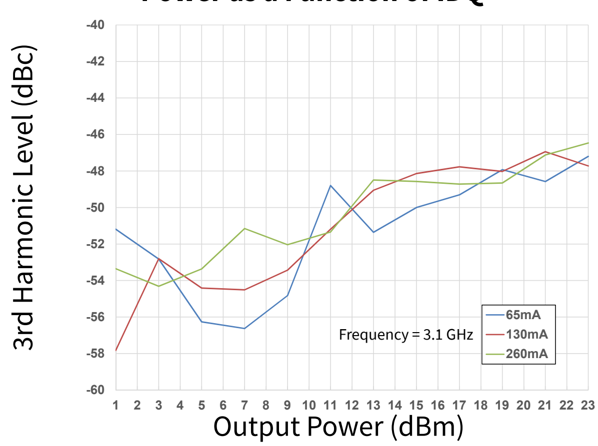


Figure 33. 3rd Harmonic vs Output Power as a Function of IDQ



Typical Performance of the CMPA2735030S

Test conditions unless otherwise noted: V_D = 50 V, I_{DQ} = 130 mA, Pin = -20 dBm, T_{BASE} = +25 °C

Figure 34. 2nd Harmonic vs Output Power as a Function of Frequency

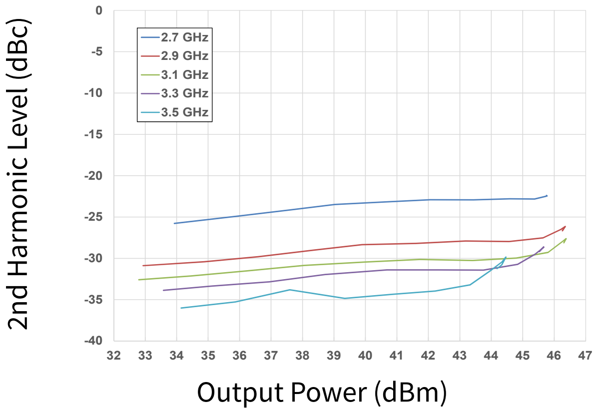


Figure 35. 3rd Harmonic vs Output Power as a Function of Frequency

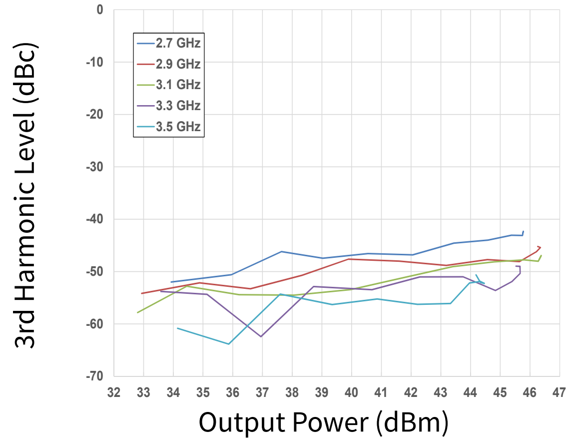


Figure 36. 2nd Harmonic vs Output Power as a Function of IDQ

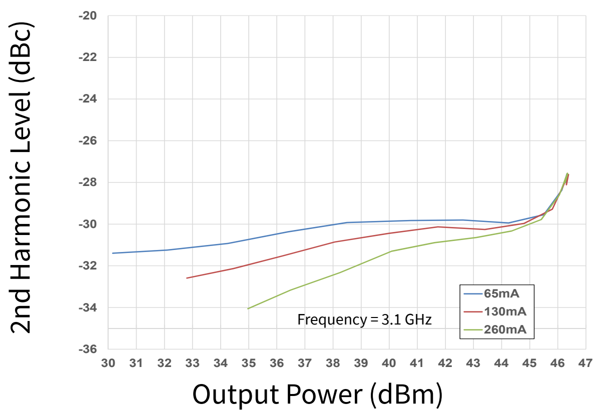
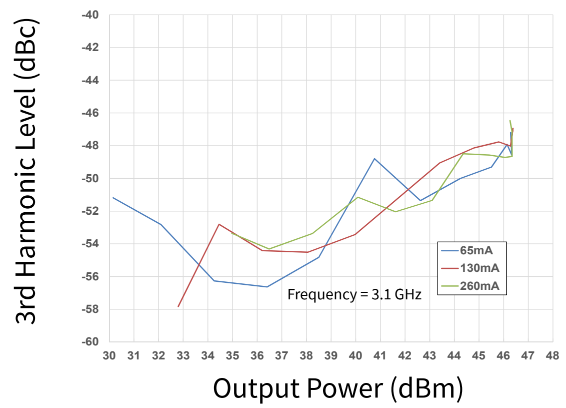


Figure 37. 3rd Harmonic vs Output Power as a Function of IDQ



Typical Performance of the CMPA2735030S

Test conditions unless otherwise noted: V_D = 50 V, I_{DQ} = 130 mA, Pin = -20 dBm, T_{BASE} = +25 °C

Figure 38. Gain vs Frequency as a Function of Temperature

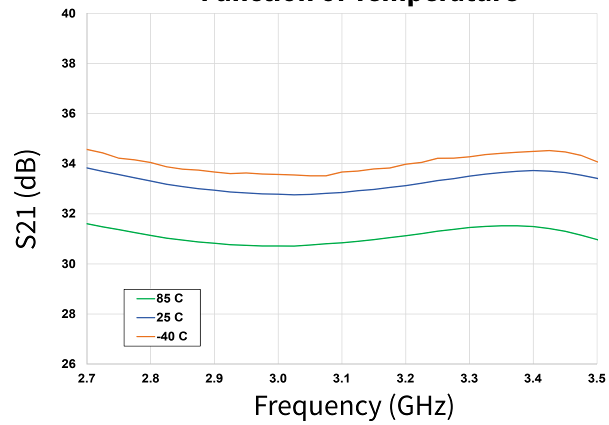


Figure 39. Gain vs Frequency as a Function of Temperature

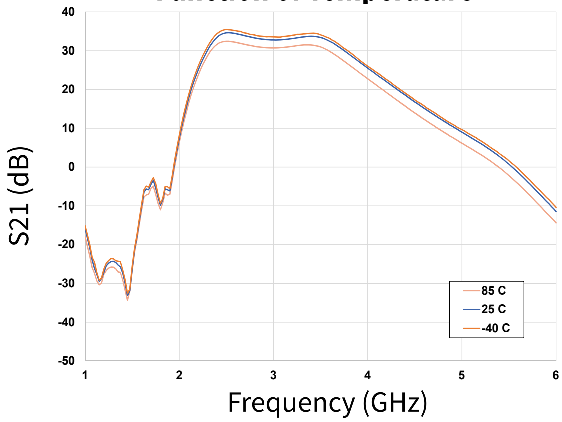


Figure 40. Input RL vs Frequency as a Function of Temperature

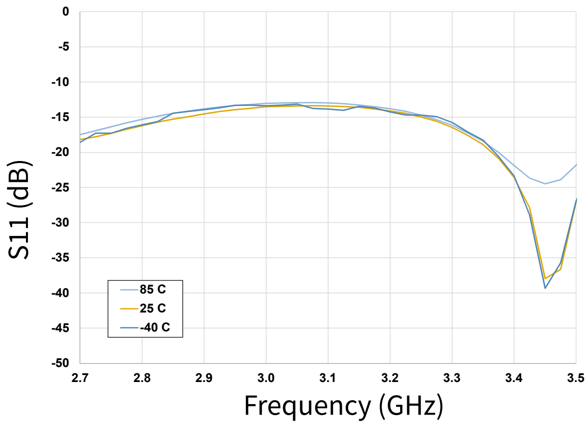


Figure 41. Input RL vs Frequency as a Function of Temperature

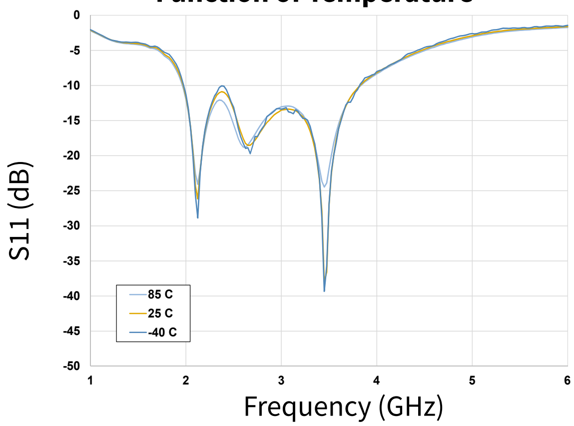


Figure 42. Output RL vs Frequency as a Function of Temperature

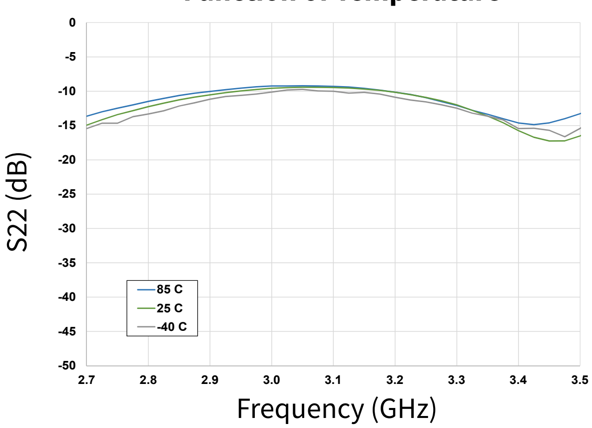
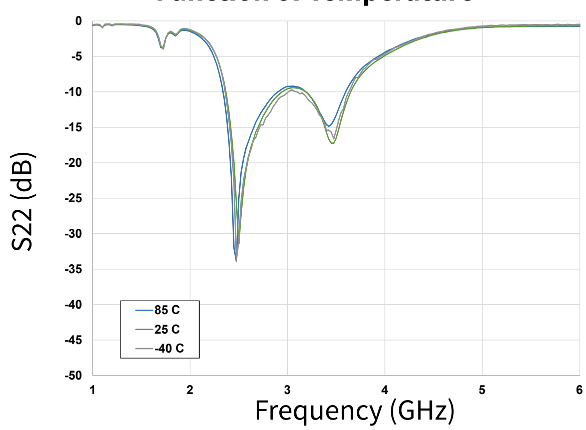


Figure 43. Output RL vs Frequency as a Function of Temperature



Typical Performance of the CMPA2735030S

Test conditions unless otherwise noted: V_D = 50 V, I_{DQ} = 130 mA, Pin = -20 dBm, T_{BASE} = +25 °C

Figure 44. Gain vs Frequency as a Function of Voltage

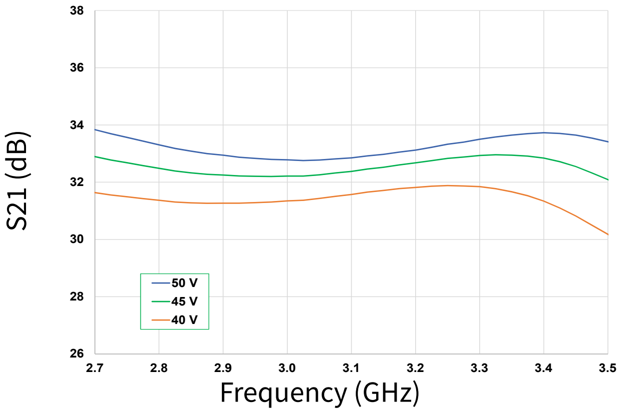


Figure 45. Gain vs Frequency as a Function of IDQ

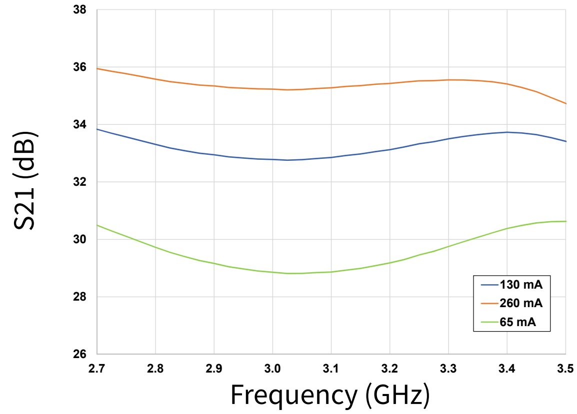


Figure 46. Input RL vs Frequency as a Function Voltage

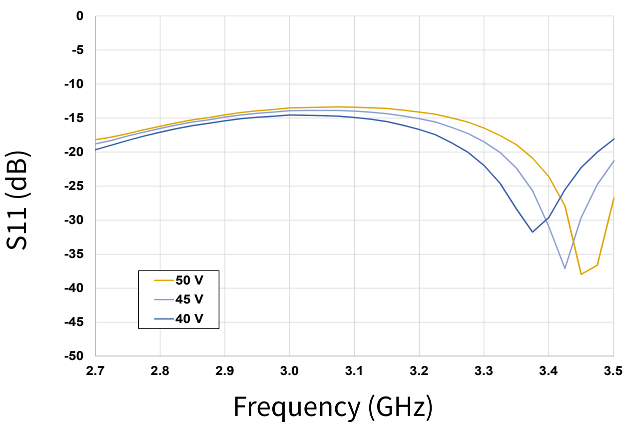


Figure 47. Input RL vs Frequency as a Function of IDQ

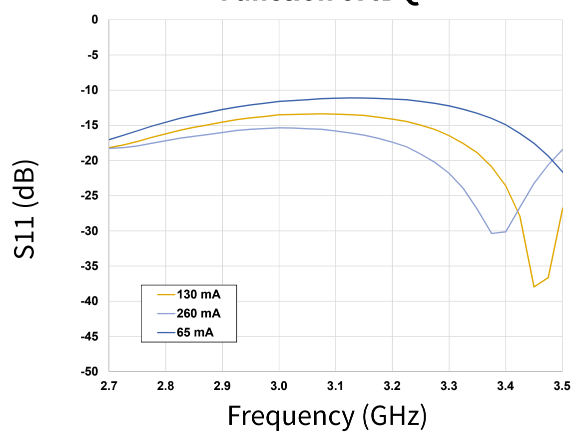


Figure 48. Output RL vs Frequency as a Function of Voltage

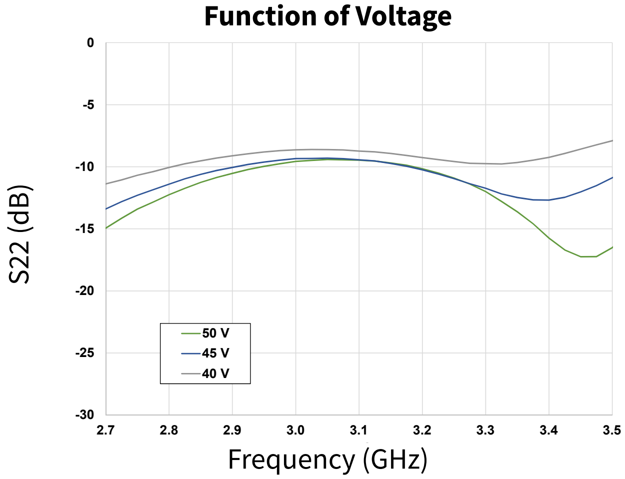
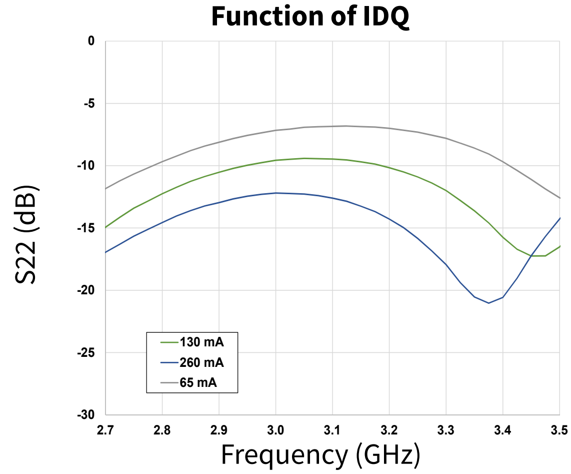


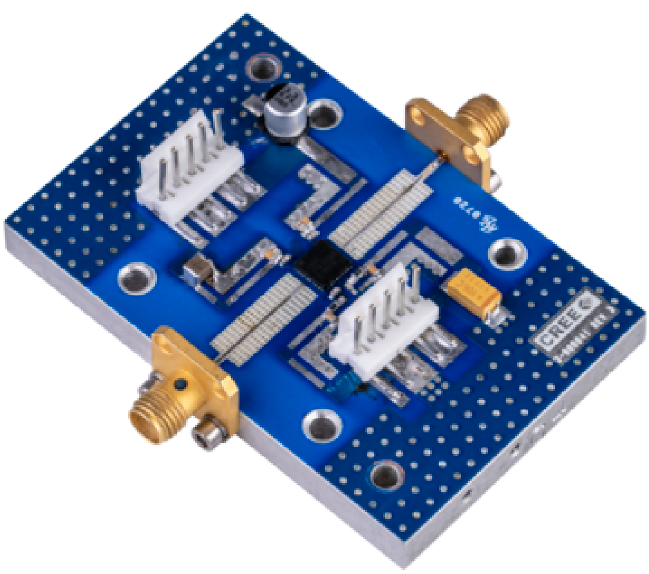
Figure 49. Output RL vs Frequency as a Function of IDQ



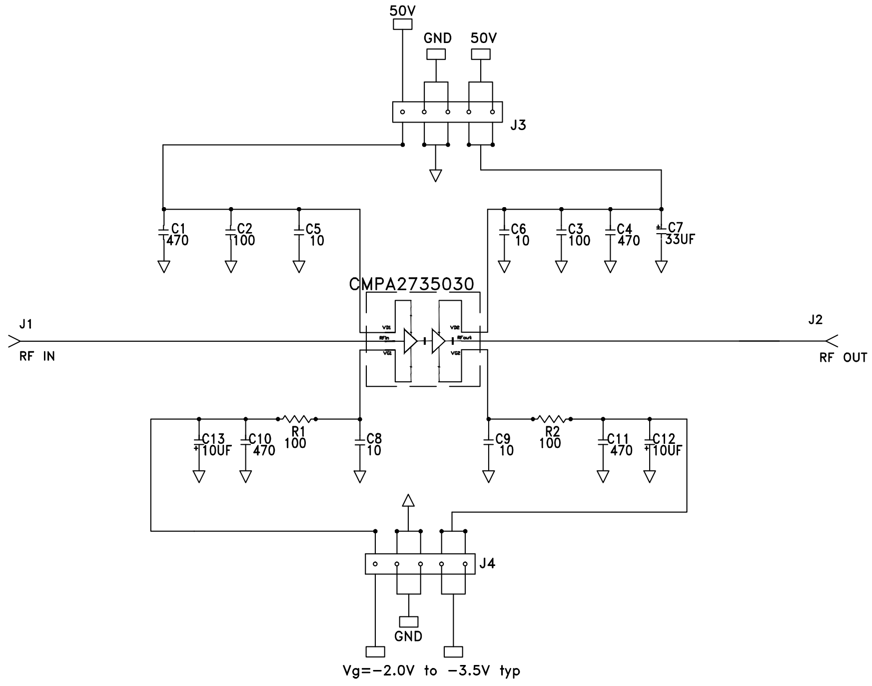
CMPA2735030S-AMP1 Evaluation Board Bill of Materials

Designator	Description	Qty
C1, C4, C10, C11	CAP, 470pF, 100V, 0603	4
C2, C3	CAP, 100pF, 100V, 0603	2
C5, C6, C8, C9	CAP, 10pF, 100V, 0402	4
C7	CAP, 33uF, 50V, ELECT, MVY, SMD	1
C12,C13	CAP, 10uF, 16V, TANTALUM, SMD	2
R1, R2	RES, 100Ohm, 1/16W, 0603	2
J1, J2	CONNECTOR, N-TYPE, FEMALE, W/0.500 SMA FLNG	2
J3, J4	CONNECTOR, HEADER, RT>PLZ .1CEN LK 5POS	2
-	PCB, RO4350B, E_R = 3.48, h = 10 mil	1
Q1	CMPA2735030S	1

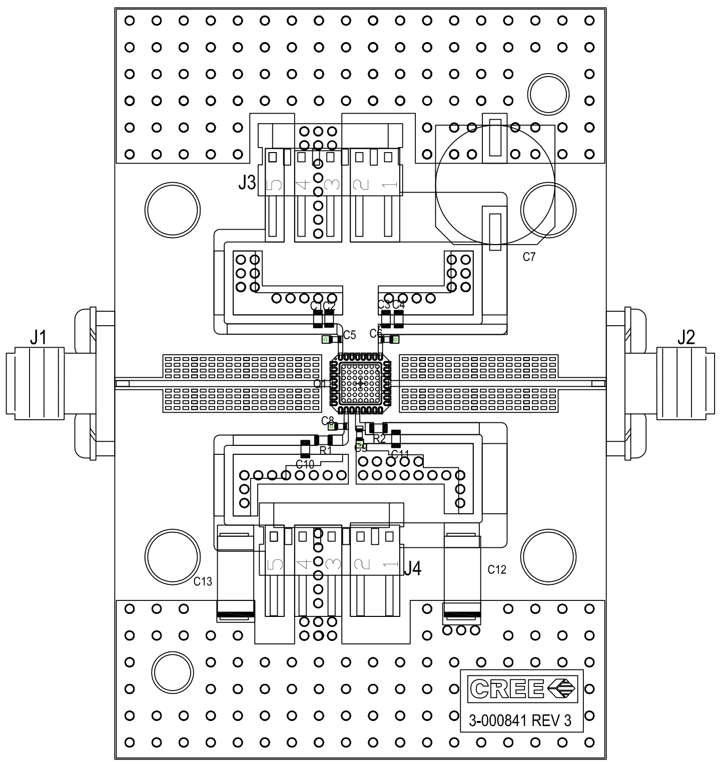
CMPA2735030S-AMP1 Evaluation Board



CMPA2735030S-AMP1 Application Circuit



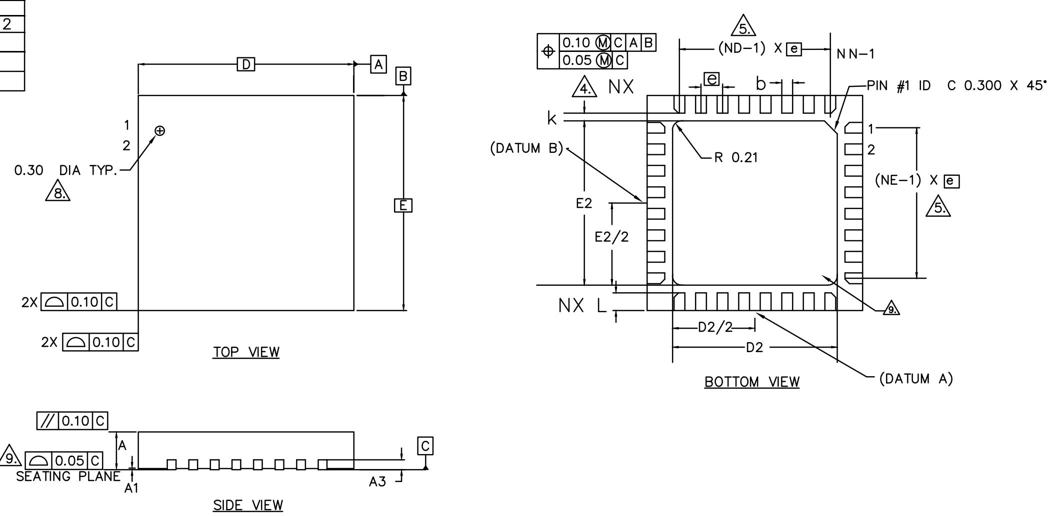
CMPA2735030S-AMP1 Evaluation Board Layout



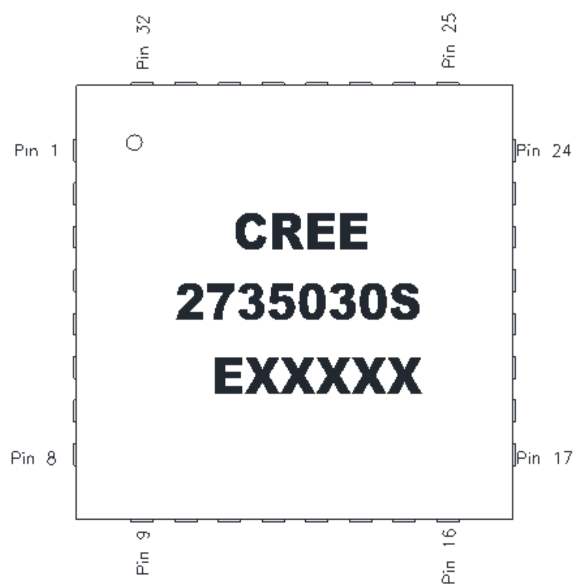
Product Dimensions CMPA2735030S (Package)

SYMBOL	MIN.	NOM.	MAX.	NOTE
A	0.80	0.86	0.91	
A1	0.00	0.03	0.06	
A3		0.20 REF.		
θ	0	——	12	2
K		0.17 MIN.		
D		5.0 BSC		
E		5.0 BSC		

SYMBOL	0.50mm LEAD PITCH MIN.	NOM.	MAX.	NOTE
e		0.50 BSC.		
N		32		3
ND		8		5
NE		8		5
L	0.35	0.41	0.46	
b	0.21	0.25	0.29	4
D2	3.76	3.82	3.88	
E2	3.76	3.82	3.88	



PIN	DESC.	PIN	DESC.	PIN	DESC.
1	NC	15	NC	29	NC
2	NC	16	NC	30	NC
3	NC	17	NC	31	NC
4	RFIN	18	NC	32	VD1
5	RFIN	19	NC		
6	NC	20	RFOUT		
7	NC	21	RFOUT		
8	NC	22	NC		
9	NC	23	NC		
10	VG1	24	NC		
11	NC	25	VD2		
12	VG2	26	NC		
13	NC	27	NC		
14	NC	28	NC		



Part Number System

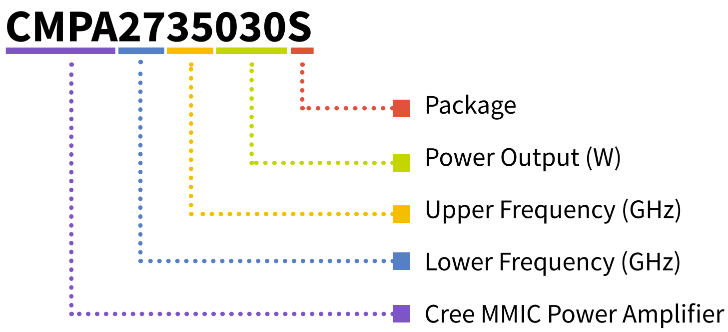


Table 1.

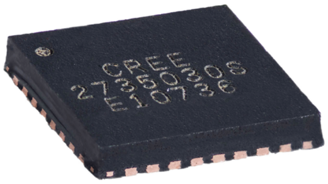
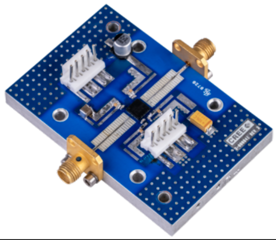
Parameter	Value	Units
Lower Frequency	2.7	GHz
Upper Frequency	3.5	GHz
Power Output	30	W
Package	Surface Mount	-

Note: 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
CMPA2735030S	GaN HEMT	Each	
CMPA2735030S-AMP1	Test board with GaN MMIC installed	Each	

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Notes

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