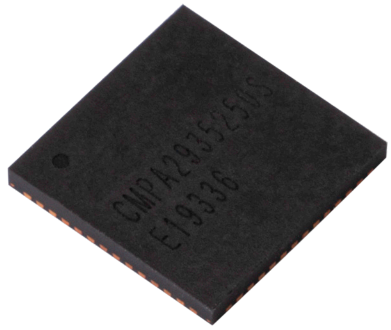
CMPA2935250S

250 W, 3.1 - 3.7 GHz, GaN MMIC, Power Amplifier

Description

The CMPA2935250S 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 8 mm x 8 mm surface mount (QFN package).



PN: CMPA2935250S
Package Type: 8 x 8 QFN

Typical Performance Over 3.1 - 3.5 GHz (T_C = 25 ˚C)

Parameter	3.1 GHz	3.3 GHz	3.5 GHz	Units
Small Signal Gain[1,2]	28.7	28.8	27.5	dB
Output Power[1,3]	54.2	54.6	54.4	dBm
Power Gain[1,3]	24.2	24.6	24.4	dB
Power Added Efficiency[1,3]	61	63	59	%

Notes:
[1] V_{DD} = 50 V, I_{DQ} = 500 mA
[2] Measured at Pin = -30 dBm
[3] Measured at Pin = 30 dBm and 300 µs; Duty Cycle = 20%

Features

- >60% Typical Power Added Efficiency
- 28 dB Small Signal Gain
- 250 W Typical P_{SAT}
- Operation up to 50 V
- High Breakdown Voltage
- High Temperature Operation

Note: Features are typical performance across frequency under 25°C operation. Please reference performance charts for additional details.

Applications

- Civil and Military Pulsed Radar Amplifiers

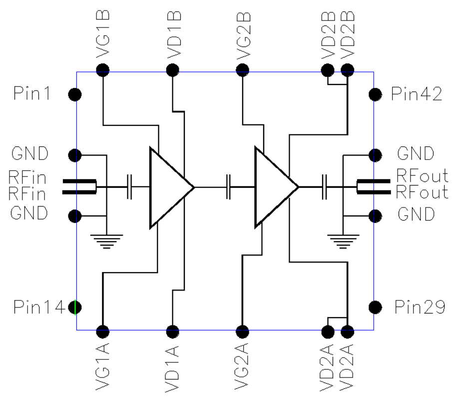


Figure 1.

Rev 0.0 – December 2020

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}	-55, +150	˚C	
Maximum Forward Gate Current	I_G	57.6	mA	25°C
Maximum Drain Current	I_{DMAX}	10.5	A	
Soldering Temperature	T_S	260	˚C	
Maximum Input Power	P_{IN}	34	dBm	

Electrical Characteristics (Frequency = 3.1 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 = 57.6 mA
Gate Quiescent Voltage	$V_{GS(Q)}$	–	-2.7	–	V_{DC}	V_{DD} = 50 V, I_{DQ} = 500 mA
Saturated Drain Current[1]	I_{DS}	37.4	53.6	–	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 = 57.6 mA
RF Characteristics[2,3]						
Small Signal Gain	$S21_1$	–	28	–	dB	Pin = -30 dBm, Freq = 3.1 - 3.5 GHz
Output Power	P_{OUT1}	–	54.2	–	dBm	V_{DD} = 50 V, I_{DQ} = 500 mA, P_{IN} = 30 dBm, Freq = 3.1 GHz
Output Power	P_{OUT2}	–	54.6	–	dBm	V_{DD} = 50 V, I_{DQ} = 500 mA, P_{IN} = 30 dBm, Freq = 3.3 GHz
Output Power	P_{OUT3}	–	54.4	–	dBm	V_{DD} = 50 V, I_{DQ} = 500 mA, P_{IN} = 30 dBm, Freq = 3.5 GHz
Power Added Efficiency	PAE_1	–	61	–	%	V_{DD} = 50 V, I_{DQ} = 500 mA, P_{IN} = 30 dBm, Freq = 3.1 GHz
Power Added Efficiency	PAE_2	–	63	–	%	V_{DD} = 50 V, I_{DQ} = 500 mA, P_{IN} = 30 dBm, Freq = 3.3 GHz
Power Added Efficiency	PAE_3	–	59	–	%	V_{DD} = 50 V, I_{DQ} = 500 mA, P_{IN} = 30 dBm, Freq = 3.5 GHz
Power Gain	G_{P1}	-	24.2	–	dB	V_{DD} = 50 V, I_{DQ} = 500 mA, P_{IN} = 30 dBm, Freq = 3.1 GHz
Power Gain	G_{P2}	–	24.6	–	dB	V_{DD} = 50 V, I_{DQ} = 500 mA, P_{IN} = 30 dBm, Freq = 3.3 GHz
Power Gain	G_{P3}	–	24.4	–	dB	V_{DD} = 50 V, I_{DQ} = 500 mA, P_{IN} = 30 dBm, Freq = 3.5 GHz
Input Return Loss	S11	–	-15	–	dB	Pin = -30 dBm, 3.1 - 3.5 GHz
Output Return Loss	S22	–	-10	–	dB	Pin = -30 dBm, 3.1 - 3.5 GHz
Output Mismatch Stress	VSWR	–	–	3 : 1	Ψ	No damage at all phase angles

Notes:
[1] Scaled from PCM data
[2] Measured in CMPA2935250S high volume test fixture at 3.1, 3.3 and 3.5 GHz and may not show the full capability of the device due to source inductance and thermal performance.
[3] Unless otherwise noted: 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]	$R_{\theta JC}$	0.47	˚C/W	Pulse Width = 300 µs, Duty Cycle =20%

Notes:
[1] Simulated for the CMPA2935250S at P_{DISS} = 149 W

Typical Performance of the CMPA2935250S

Test conditions unless otherwise noted: V_D = 50 V, I_{DQ} = 500 mA, Pulse Width = 300 µs, Duty Cycle = 20%, Pin = 30 dBm, T_{BASE} = +25 °C

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

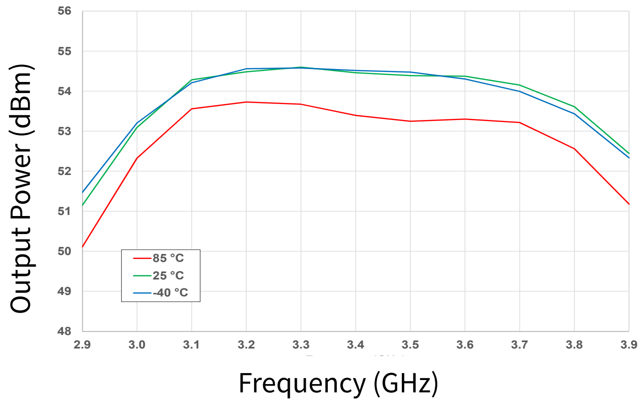


Figure 2. Output Power vs Frequency as a Function of Input Power

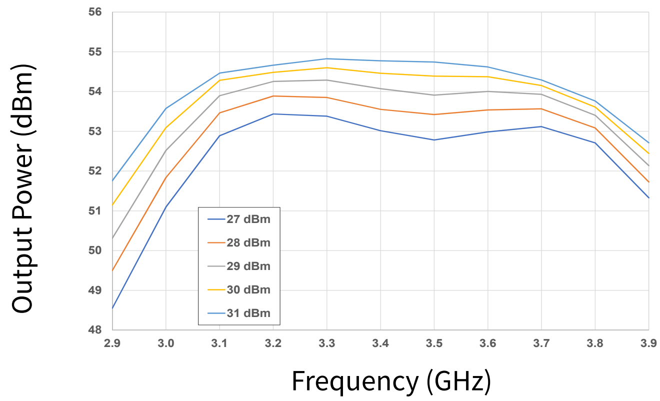


Figure 3. Power Added Eff. vs Frequency as a Function of Temperature

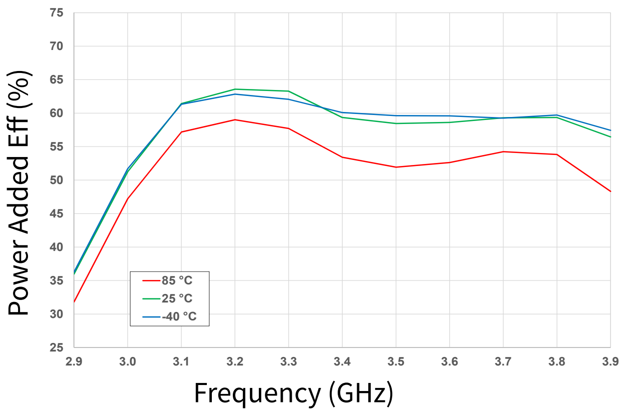


Figure 4. Power Added Eff. vs Frequency as a Function of Input Power

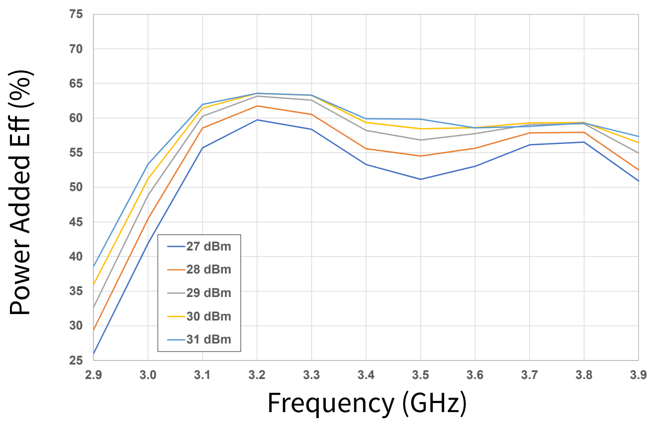


Figure 5. Drain Current vs Frequency as a Function of Temperature

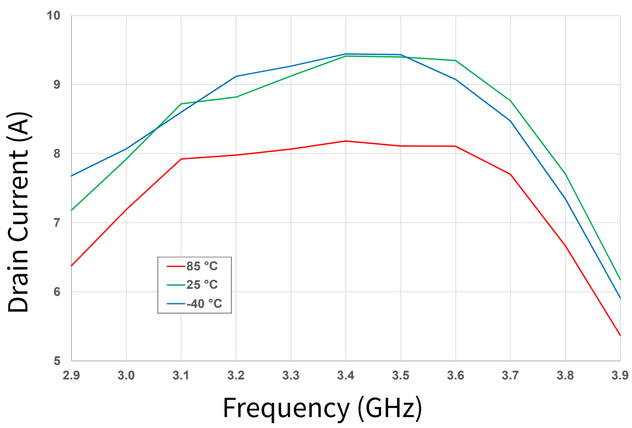
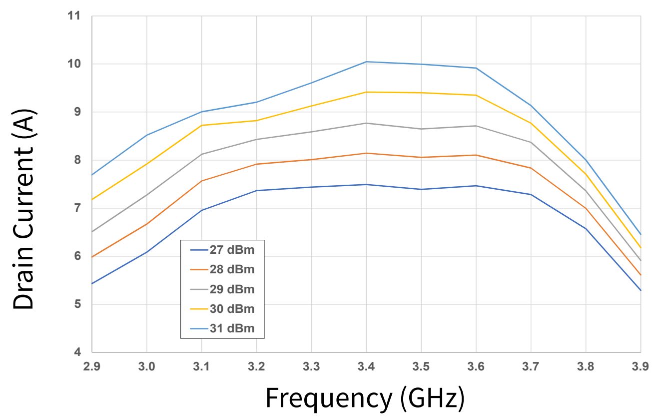


Figure 6. Drain Current vs Frequency as a Function of Input Power



Typical Performance of the CMPA2935250S

Test conditions unless otherwise noted: V_D = 50 V, I_{DQ} = 500 mA, Pulse Width = 300 µs, Duty Cycle = 20%, Pin = 30 dBm, T_{BASE} = +25 °C

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

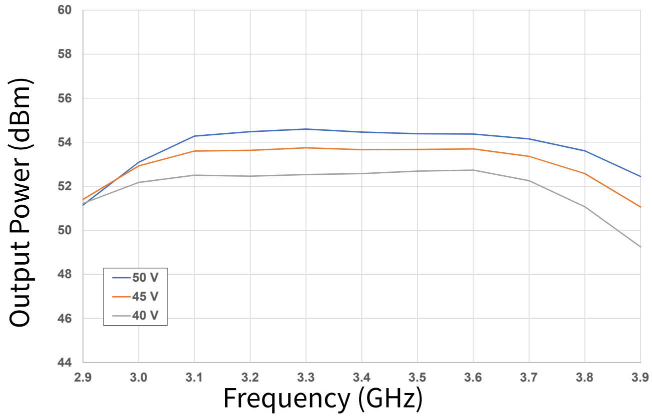


Figure 8. Output Power vs Frequency as a Function of IDQ

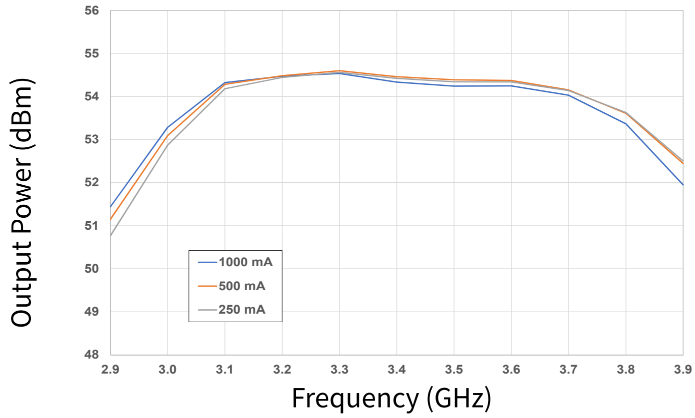


Figure 9. Power Added Eff. vs Frequency as a Function of VD

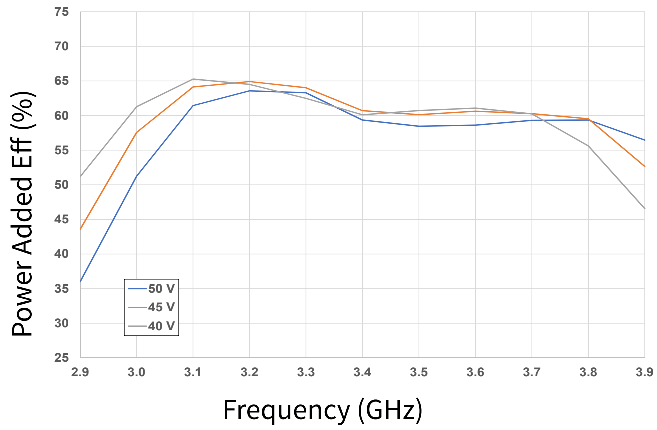


Figure 10. Power Added Eff. vs Frequency as a Function of IDQ

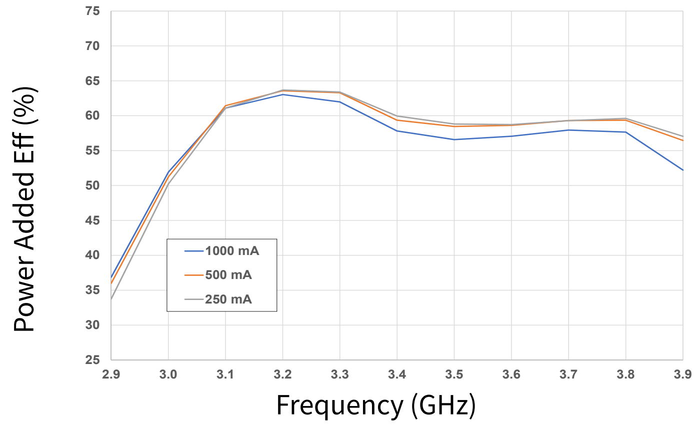


Figure 11. Drain Current vs Frequency as a Function of VD

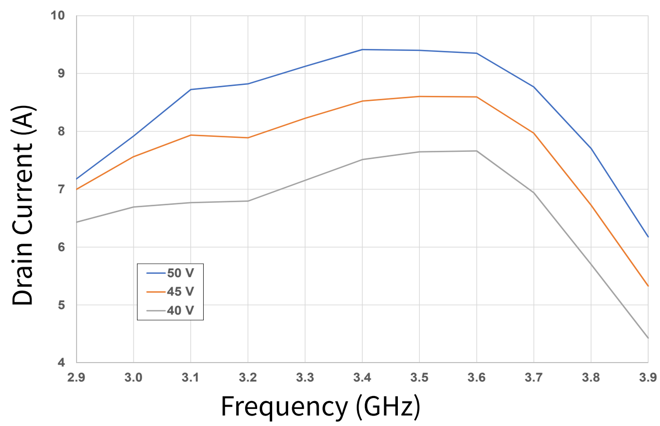
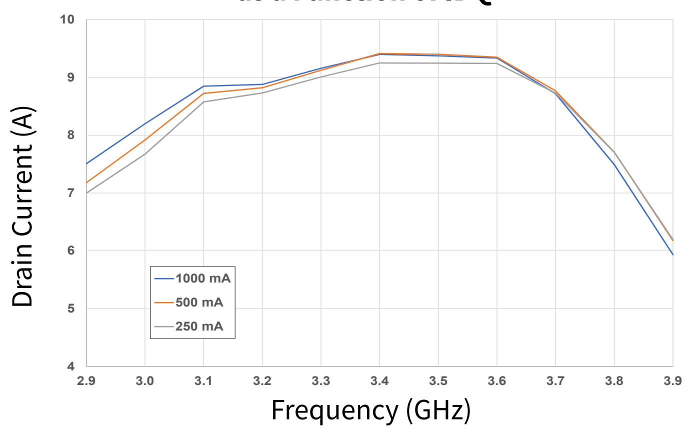


Figure 12. Drain Current vs Frequency as a Function of IDQ



Typical Performance of the CMPA2935250S

Test conditions unless otherwise noted: V_D = 50 V, I_{DQ} = 500 mA, Pulse Width = 300 µs, Duty Cycle = 20%, Pin = 30 dBm, T_{BASE} = +25 °C

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

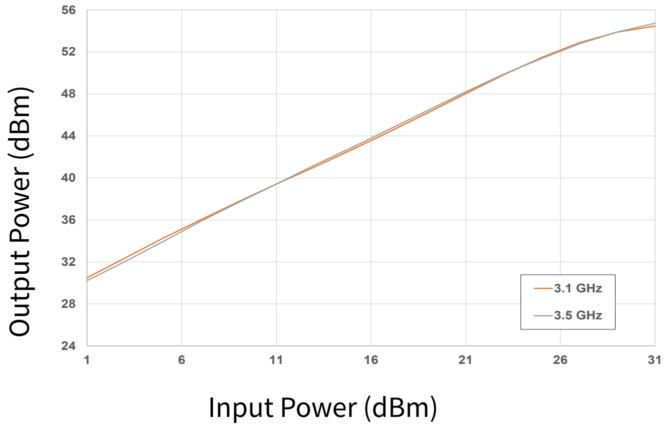


Figure 14. Power Added Eff. vs Input Power as a Function of Frequency

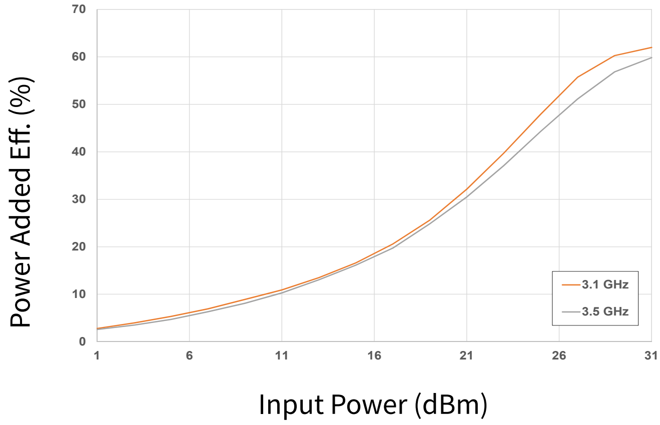


Figure 15. Large Signal Gain vs Input Power as a Function of Frequency

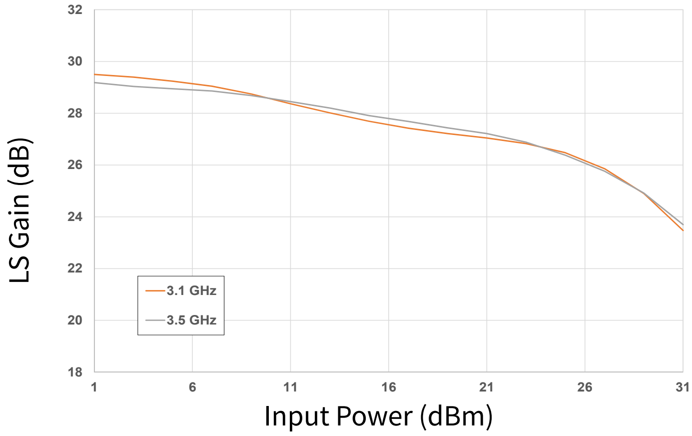


Figure 16. Drain Current vs Input Power as a Function of Frequency

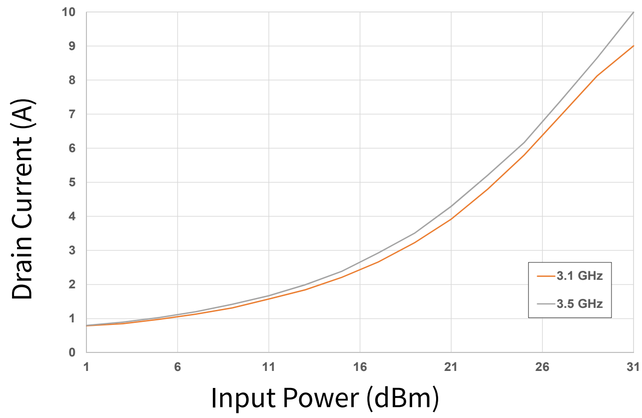
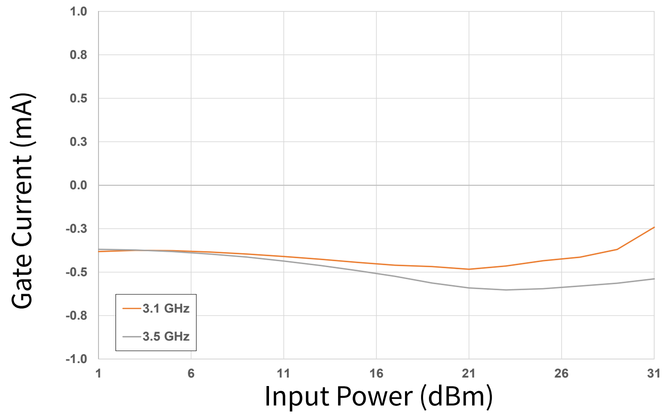


Figure 17. Gate Current vs Input Power as a Function of Frequency



Typical Performance of the CMPA2935250S

Test conditions unless otherwise noted: V_D = 50 V, I_{DQ} = 500 mA, Pulse Width = 300 µs, Duty Cycle = 20%, Pin = 30 dBm, T_{BASE} = +25 °C

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

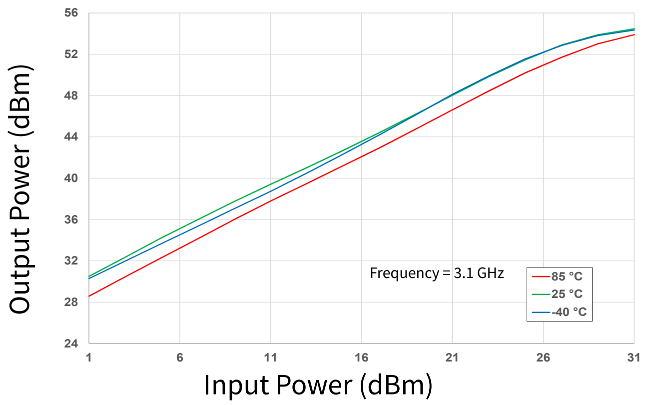


Figure 19. Power Added Eff. vs Input Power as a Function of Temperature

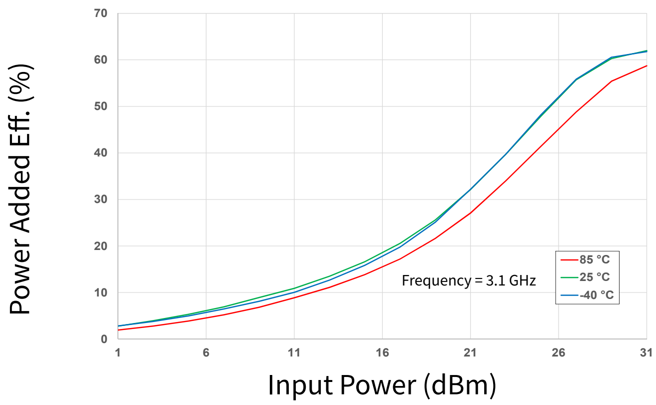


Figure 20. Large Signal Gain vs Input Power as a Function of Temperature

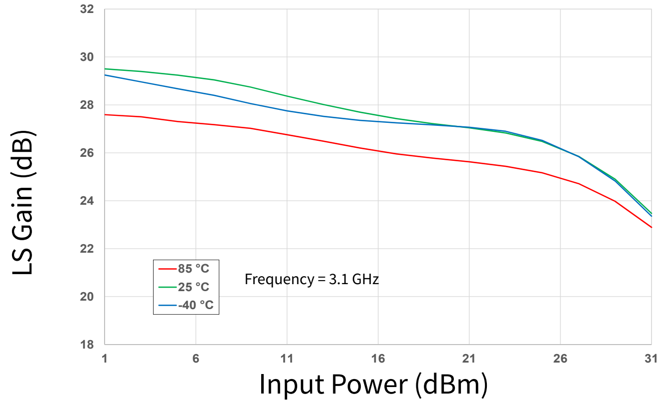


Figure 21. Drain Current vs Input Power as a Function of Temperature

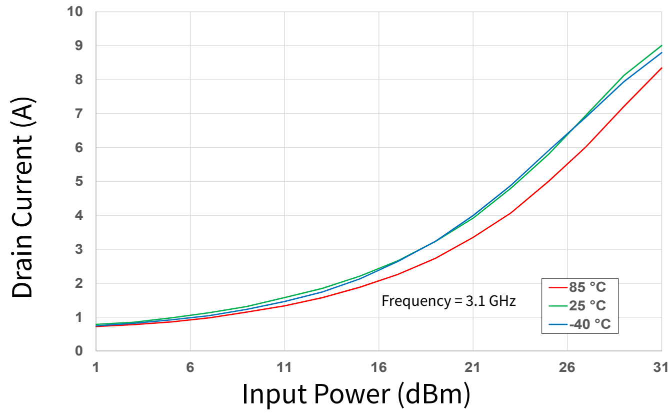
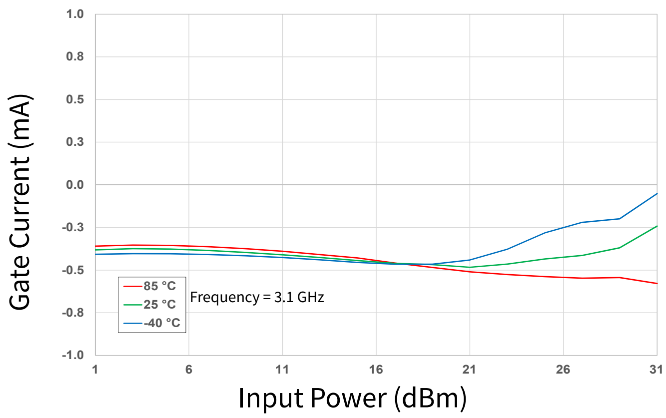


Figure 22. Gate Current vs Input Power as a Function of Temperature



Typical Performance of the CMPA2935250S

Test conditions unless otherwise noted: V_D = 50 V, I_{DQ} = 500 mA, Pulse Width = 300 µs, Duty Cycle = 20%, Pin = 30 dBm, T_{BASE} = +25 °C

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

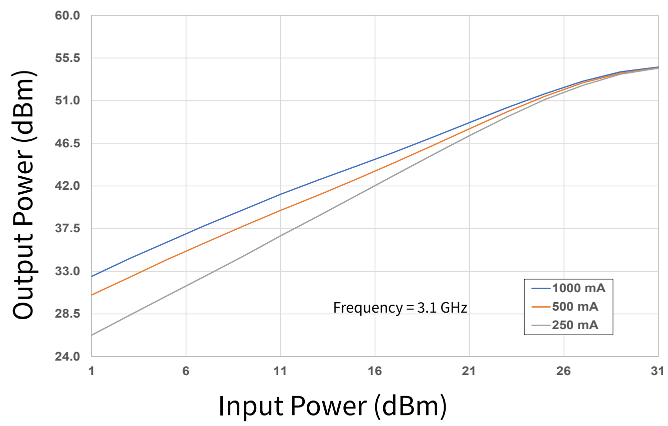


Figure 24. Power Added Eff. vs Input Power as a Function of IDQ

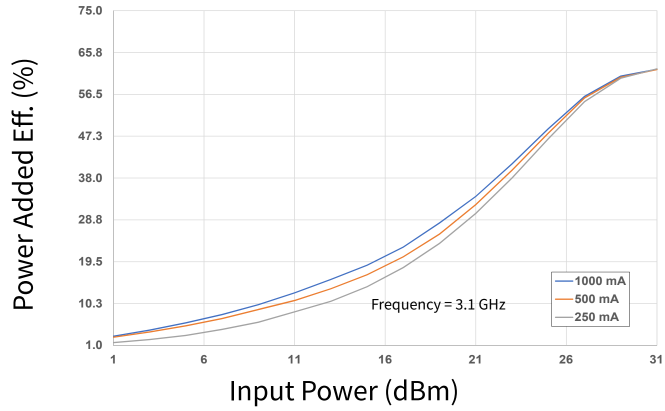


Figure 25. Large Signal Gain vs Input Power as a Function of IDQ

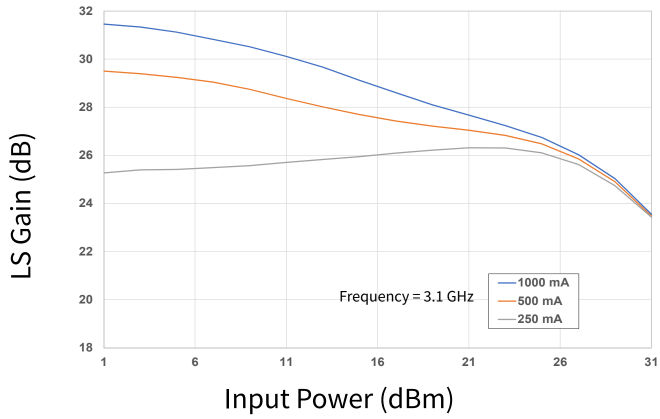


Figure 26. Drain Current vs Input Power as a Function of IDQ

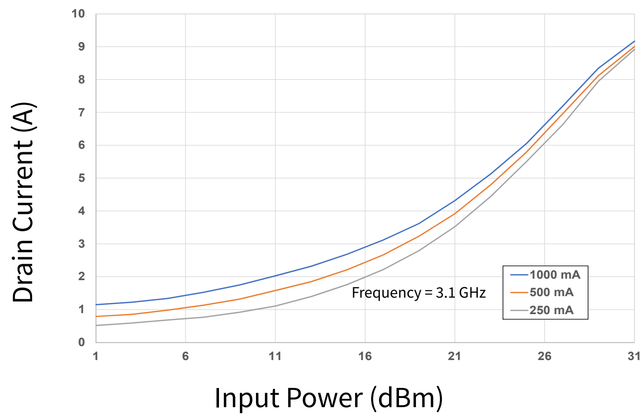
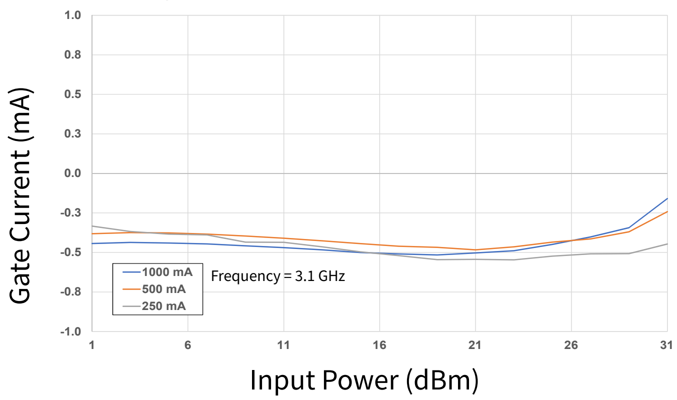


Figure 27. Gate Current vs Input Power as a Function of IDQ



Typical Performance of the CMPA2935250S

Test conditions unless otherwise noted: V_D = 50 V, I_{DQ} = 500 mA, Pulse Width = 300 µs, Duty Cycle = 20%, Pin = 30 dBm, T_{BASE} = +25 °C

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

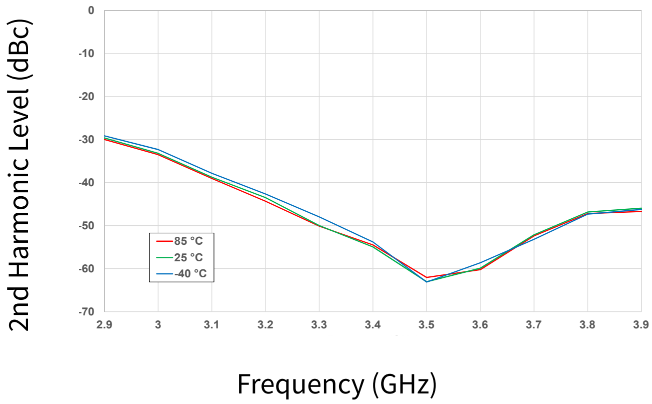


Figure 29. 3rd Harmonic vs Frequency as a Function of Temperature

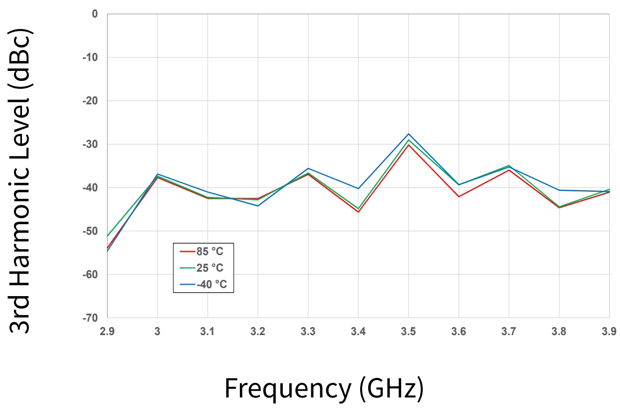


Figure 30. 2nd Harmonic vs Output Power as a Function of Frequency

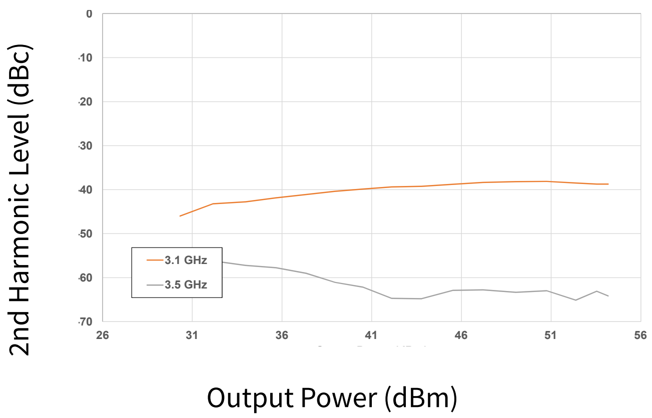


Figure 31. 3rd Harmonic vs Output Power as a Function of Frequency

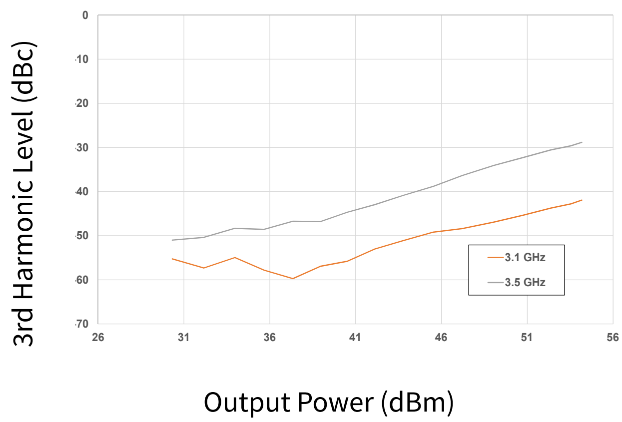


Figure 32. 2nd Harmonic vs Output Power as a Function of IDQ

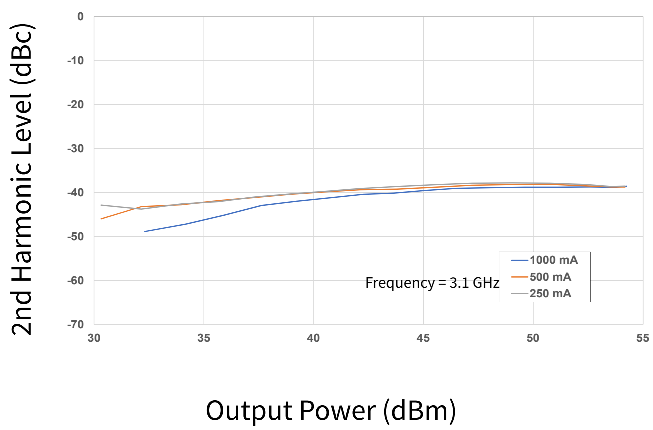
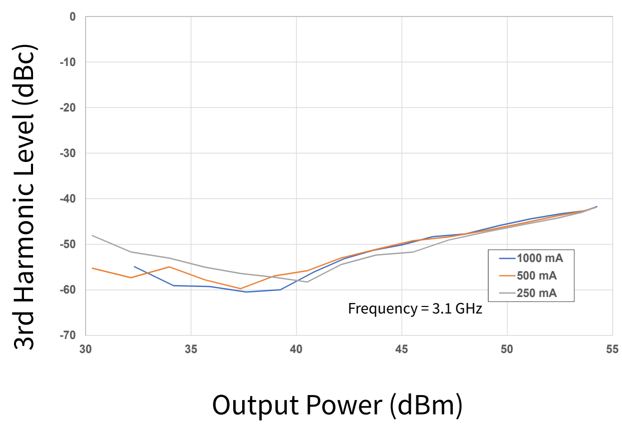


Figure 33. 3rd Harmonic vs Output Power as a Function of IDQ



Typical Performance of the CMPA2935250S

Test conditions unless otherwise noted: V_D = 50 V, I_{DQ} = 500 mA, Pin = -30 dBm, T_{BASE} = +25 °C

Figure 34. Gain vs Frequency as a Function of Temperature

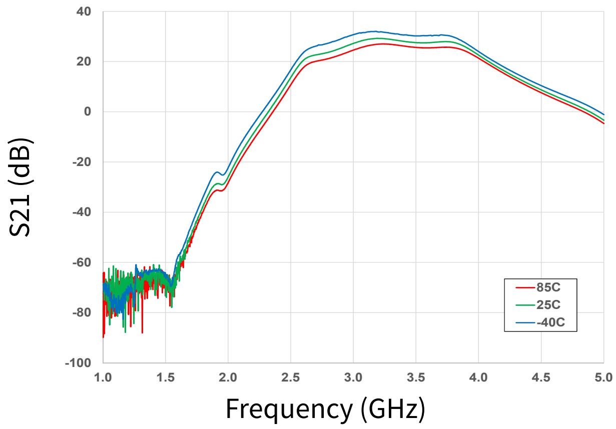


Figure 35. Gain vs Frequency as a Function of Temperature

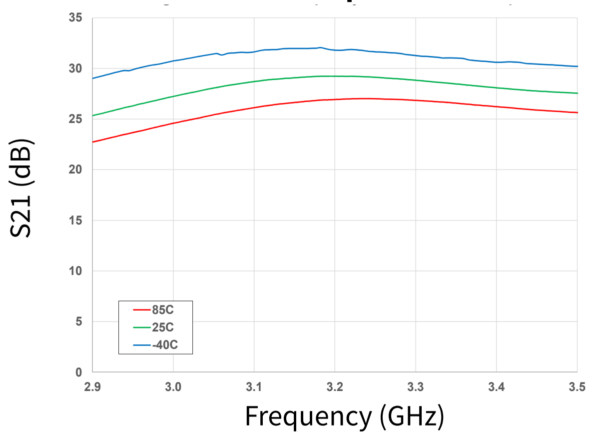


Figure 36. Input RL vs Frequency as a Function of Temperature

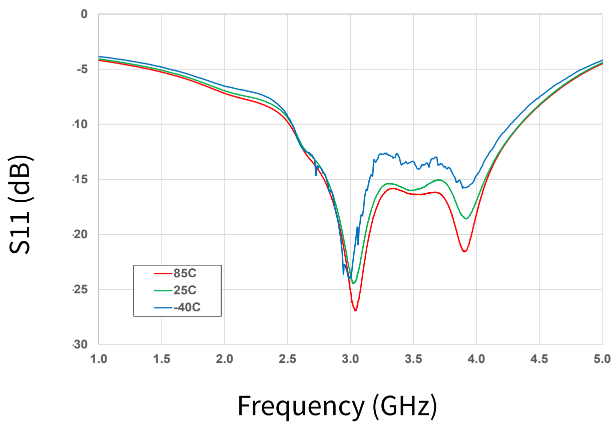


Figure 37. Input RL vs Frequency as a Function of Temperature

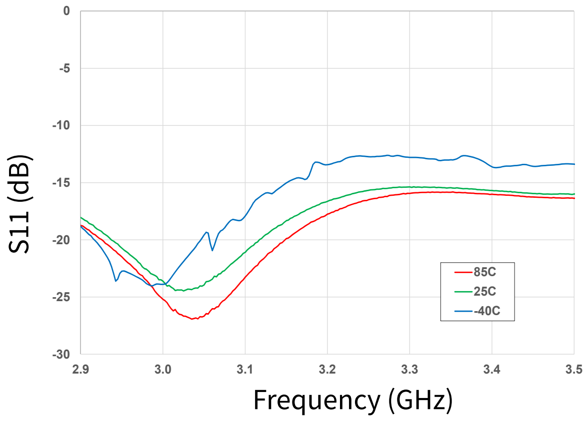


Figure 38. Output RL vs Frequency as a Function of Temperature

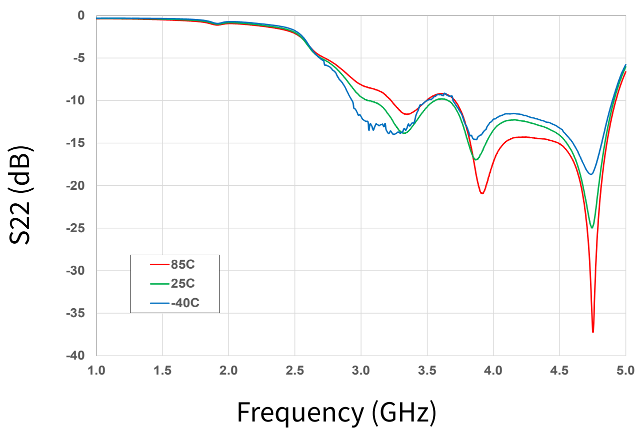
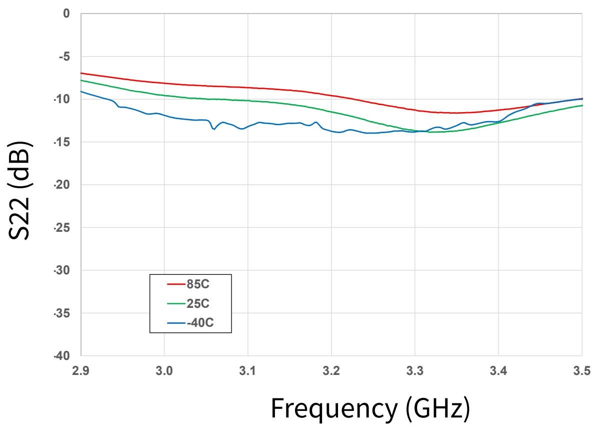


Figure 39. Output RL vs Frequency as a Function of Temperature



Typical Performance of the CMPA2935250S

Test conditions unless otherwise noted: V_D = 50 V, I_{DQ} = 500 mA, Pin = -30 dBm, T_{BASE} = +25 °C

Figure 40. Gain vs Frequency as a Function of Voltage

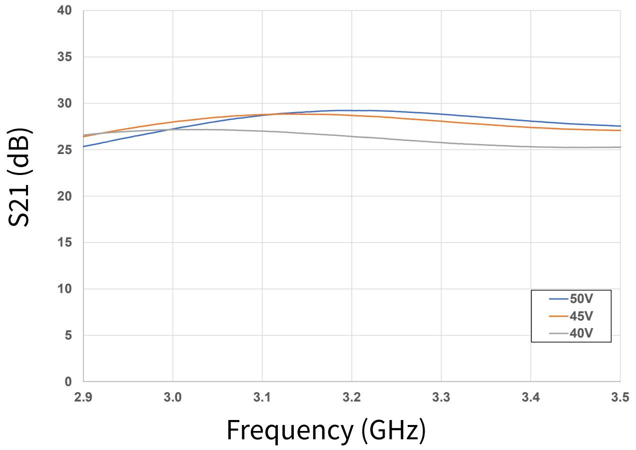


Figure 41. Gain vs Frequency as a Function of IDQ

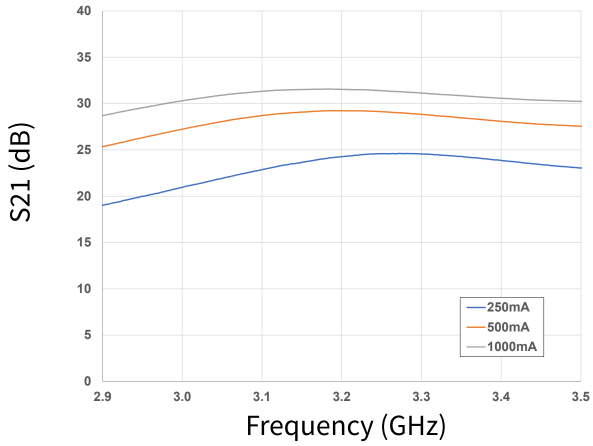


Figure 42. Input RL vs Frequency as a Function Voltage

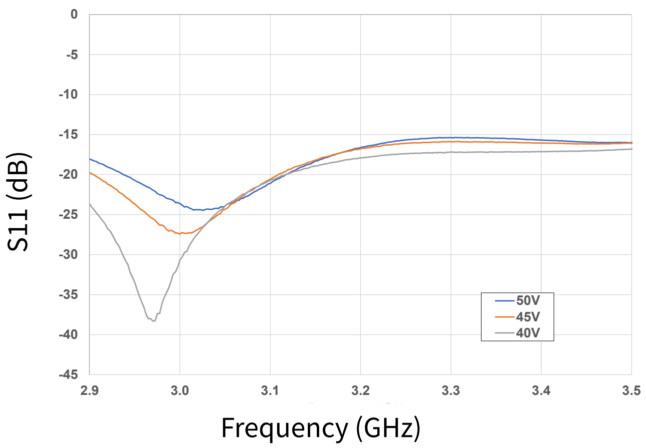


Figure 43. Input RL vs Frequency as a Function of IDQ

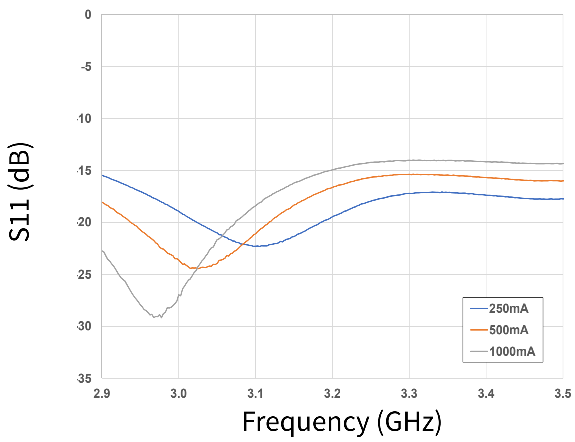


Figure 44. Output RL vs Frequency as a Function of Voltage

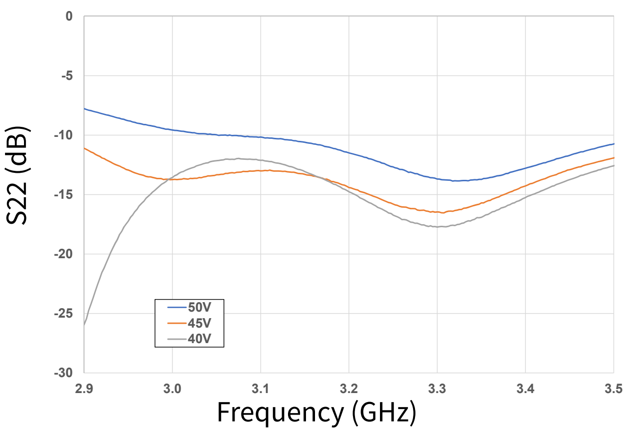
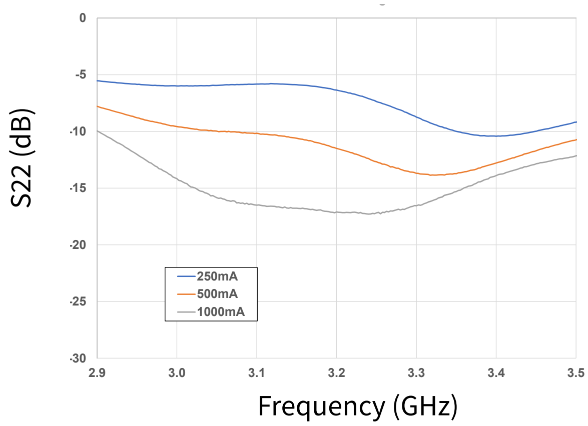
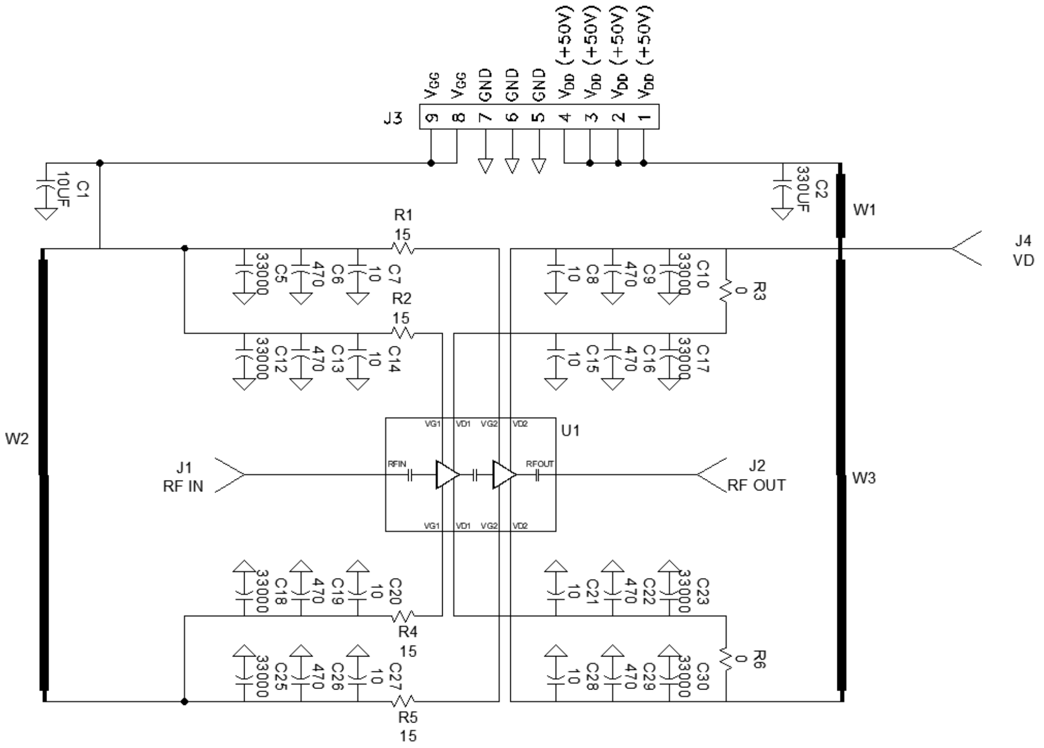


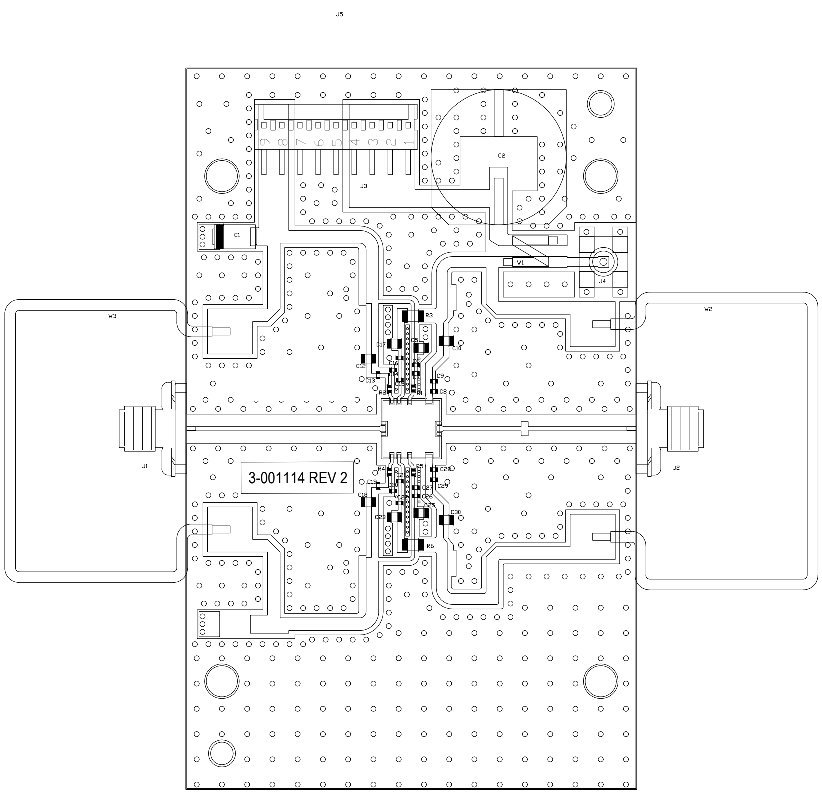
Figure 45. Output RL vs Frequency as a Function of IDQ



CMPA2935250S-AMP1 Demonstration Amplifier Schematic



CMPA2935250S-AMP1 Demonstration Amplifier Circuit Outline



CMPA2935250S-AMP1 Demonstration Amplifier Circuit Bill of Materials

Designator	Description	Qty
C7, C8, C14, C15, C20, C21, C27, C28	CAP, 10pF, +/-5%, pF,200V, 0402	8
C6, C9, C13, C16, C19, C22, C26, C29	CAP, 470PF, 10%, 100V, 0402, X7R	8
C5, C10, C12, C17, C18, C23, C25, C30	CAP, 33000PF, 0805,100V, X7R	8
C2	CAP, 330 UF, 20%, K16 CASE	1
C1	CAP, 10UF, 16V, TANTALUM	1
R1, R2, R4, R5	RES 15 OHM, +/-1%, 1/16W, 0402	4
R3, R6	RES 0.0 OHM 1/16W 1206 SMD	2
J1, J2	CONN, SMA, PANEL MOUNT JACK, FLANGE, 4-HOLE, BLUNT POST, 20MIL	2
J4	CONN, SMB, STRAIGHT JACK RECEPTACLE, SMT, 50 OHM, Au PLATED	1
J3	HEADER RT>PLZ .1CEN LK 9POS	1
W2, W3	WIRE, BLACK, 20 AWG ~ 2.5”	2
W1	WIRE, BLACK, 20 AWG ~ 3.0”	1
	PCB, TEST FIXTURE, RF-35TC, 0.010 THK, 8x8 Over-mold QFN EVAL BOARD	1
	2-56 SOC HD SCREW 3/16 SS	4
	#2 SPLIT LOCKWASHER SS	4
U1	CMPA2935250S	1
	CU BASEPLATE 2.5 X 4.0 X 0.25”	1
J5	WIRE ASSEMBLY, 9-PIN, CGH40090PP-TB	1

Electrostatic Discharge (ESD) Classifications

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

Moisture Sensitivity Level (MSL) Classification

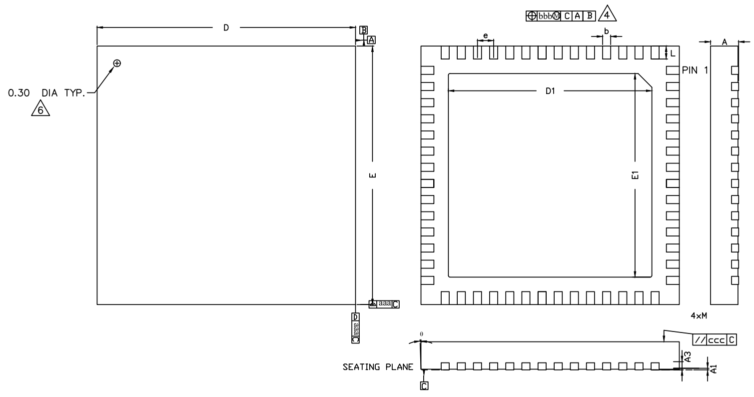
Parameter	Symbol	Level	Test Methodology
Moisture Sensitivity Level	MSL	3 (168 hours)	IPC/JEDEC J-STD-20

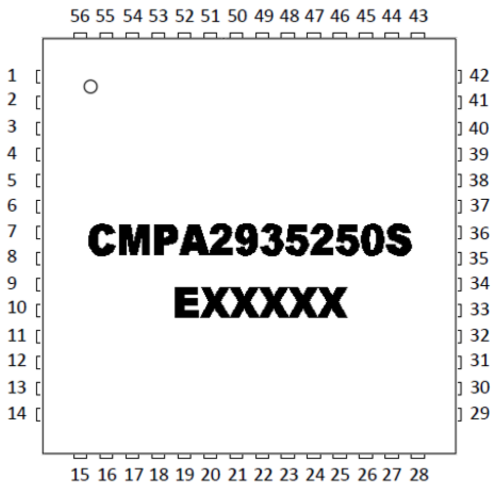
Product Dimensions CMPA2935250S (Package 8 x 8 QFN)

NOTES :

1. DIMENSIONING AND TOLERANCING CONFORM TO ASME Y14.5M. – 1994.
2. ALL DIMENSIONS ARE IN MILLIMETERS, θ IS IN DEGREES.
3. N IS THE TOTAL NUMBER OF TERMINALS.
4. (△4) DIMENSION b APPLIES TO METALLIZED TERMINAL AND IS MEASURED BETWEEN 0.15 AND 0.30mm FROM TERMINAL TIP.
5. (△5) DIMENSION N REFERS TO THE NUMBER OF TERMINALS.
6. (△6) PIN #1 ID ON TOP WILL BE LASER MARKED.
7. BILATERAL COPLANARITY ZONE APPLIES TO THE EXPOSED HEAT SINK SLUG AS WELL AS THE TERMINALS.
8. THIS DRAWING CONFORMS TO JEDEC REGISTERED OUTLINE MO-220
9. ALL PLATED SURFACES ARE 100% TIN MATTE 0.010 mm +/- 0.005 mm.
10. M: THE MAXIMUM ALLOWABLE CORNER ON THE MOLDED PLASTIC BODY CORNERS.
11. DIMENSION 'D' DOES NOT INCLUDE MOLD PROTRUSIONS OR GATE BURRS. MOLD PROTRUSIONS AND GATE BURRS SHALL NOT EXCEED 0.15mm PER SIDE.
12. DIMENSIONS 'E' DOES NOT INCLUDE INTERTERMINAL MOLD PROTRUSIONS OR TERMINAL PROTRUSIONS. INTERTERMINAL MOLD PROTRUSIONS AND/OR TERMINAL PROTRUSIONS SHALL NOT EXCEED 0.20mm PER SIDE.
13. DIMENSION A1 IS PRIMARILY TERMINAL PLATING, BUT MAY OR MAY NOT INCLUDE A SMALL PROTRUSION OF TERMINAL BELOW THE BOTTOM SURFACE OF THE PACKAGE.

SYMBOLS	DIMENSIONS IN MILLIMETERS		
	MIN	NOM	MAX
A	0.80	0.90	1.00
A1	0	0.02	0.05
A3	---	0.203REF.	---
b	0.18	0.23	0.30
D		8.0 BSC	
D1	---	6.30BSC	---
E		8.0 BSC	
E1	---	6.30BSC	---
e	---	0.50BSC	---
L	0.35	0.40	0.45
θ	0	---	12
aaa	---	0.25	---
bbb	---	0.10	---
ccc	---	0.10	---
M	---	---	0.05
N (△5)	---	56	---





PIN	DESC.	PIN	DESC.	PIN	DESC.	PIN	DESC.
1	NC	15	NC	29	NC	43	NC
2	NC	16	VG1A	30	NC	44	VD2B
3	NC	17	NC	31	NC	45	VD2B
4	NC	18	VD1A	32	NC	46	NC
5	RFGND	19	NC	33	RFGND	47	NC
6	NC	20	NC	34	NC	48	NC
7	RFIN	21	VG2A	35	RFOUT	49	NC
8	RFIN	22	NC	36	RFOUT	50	VG2B
9	NC	23	NC	37	NC	51	NC
10	RFGND	24	NC	38	RFGND	52	NC
11	NC	25	NC	39	NC	53	VD1B
12	NC	26	VD2A	40	NC	54	NC
13	NC	27	VD2A	41	NC	55	VG1B
14	NC	28	NC	42	NC	56	NC

Part Number System

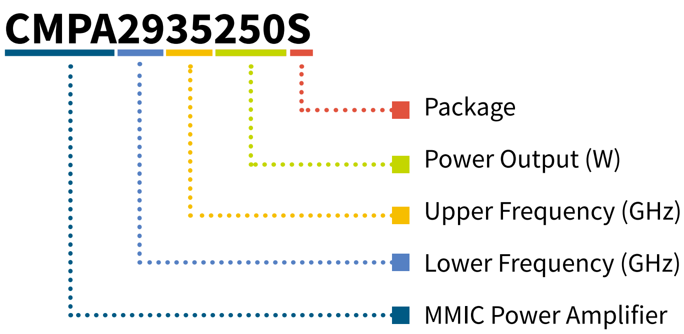


Table 1.

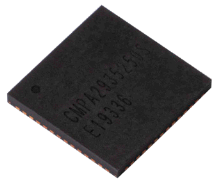
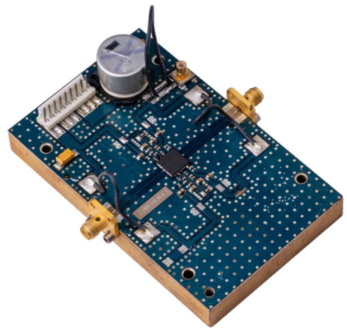
Parameter	Value	Units
Lower Frequency	3.1	GHz
Upper Frequency	3.5	GHz
Power Output	250	W
Package	Surface Mount	-

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
CMPA2935250S	GaN HEMT	Each	
CMPA2935250S-AMP1	Test board with GaN MMIC installed	Each	

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