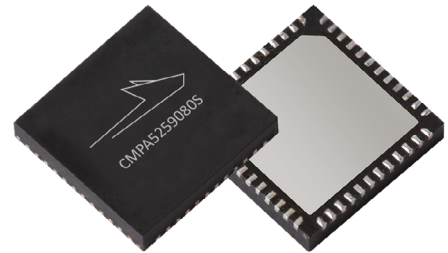


# CMPA5259080S

80 W, 5.0 - 5.9 GHz, GaN MMIC, Power Amplifier

## Description

Wolfspeed's CMPA5259080S 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 7 mm x 7 mm surface mount (QFN package).



Package Types: 7 x 7 QFN  
PN's: CMPA5259080S

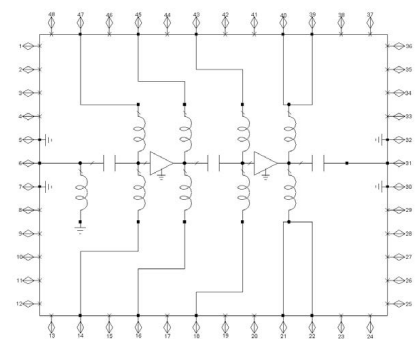
### Features

- >48% typical power added efficiency
- 29 dB small signal gain
- 110 W typical  $P_{SAT}$
- Operation up to 40 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



## Typical Performance Over 5.2 - 5.9 GHz ( $T_c = 25\text{ °C}$ )

Parameter	5.2 GHz	5.5 GHz	5.9 GHz	Units
Small Signal Gain <sup>1,2</sup>	29.0	30.5	28.1	dB
Output Power <sup>1,3</sup>	112.9	112.5	99.9	W
Power Gain <sup>1,3</sup>	21.4	21.4	21.0	dB
Power Added Efficiency <sup>1,3</sup>	47	49	47	%

Notes:

<sup>1</sup>  $V_{DD} = 40\text{ V}$ ,  $I_{DQ} = 350\text{ mA}$ .

<sup>2</sup> Measured at  $P_{IN} = -20\text{ dBm}$ .

<sup>3</sup> Measured at  $P_{IN} = 29\text{ dBm}$  and 500  $\mu\text{s}$ , duty cycle = 20%.





## Absolute Maximum Ratings (Not Simultaneous) at 25 °C

Parameter	Symbol	Rating	Units	Conditions
Drain-Source Voltage	$V_{DSS}$	120	$V_{DC}$	25 °C
Gate-Source Voltage	$V_{GS}$	-10, +2	$V_{DC}$	25 °C
Storage Temperature	$T_{STG}$	-55, +150	°C	
Maximum Forward Gate Current	$I_G$	23.2	mA	25 °C
Maximum Drain Current	$I_{DMAX}$	4.8	A	
Soldering Temperature	$T_S$	260	°C	

## Electrical Characteristics (Frequency = 5.2 GHz to 5.9 GHz Unless Otherwise Stated; $T_C = 25\text{ °C}$ )

Characteristics	Symbol	Min.	Typ.	Max.	Units	Conditions
DC Characteristics						
Gate Threshold Voltage	$V_{GS(TH)}$	-3.6	-3.1	-2.4	V	$V_{DS} = 10\text{ V}$ , $I_D = 23.2\text{ mA}$
Gate Quiescent Voltage	$V_{GS(Q)}$	–	-2.7	–	$V_{DC}$	$V_{DD} = 40\text{ V}$ , $I_{DQ} = 350\text{ mA}$
Saturated Drain Current <sup>1</sup>	$I_{DS}$	16.7	23.2	–	A	$V_{DS} = 6.0\text{ V}$ , $V_{GS} = 2.0\text{ V}$
Drain-Source Breakdown Voltage	$V_{BD}$	100	–	–	V	$V_{GS} = -8\text{ V}$ , $I_D = 23.2\text{ mA}$
RF Characteristics <sup>2,3</sup>						
Small Signal Gain	$S_{21_1}$	–	27	–	dB	$P_{IN} = -20\text{ dBm}$ , Freq = 5.2 - 5.9 GHz
Output Power	$P_{OUT1}$	–	105	–	W	$V_{DD} = 40\text{ V}$ , $I_{DQ} = 350\text{ mA}$ , $P_{IN} = 29\text{ dBm}$ , Freq = 5.2 GHz
Output Power	$P_{OUT2}$	–	102	–	W	$V_{DD} = 40\text{ V}$ , $I_{DQ} = 350\text{ mA}$ , $P_{IN} = 29\text{ dBm}$ , Freq = 5.5 GHz
Output Power	$P_{OUT3}$	–	112	–	W	$V_{DD} = 40\text{ V}$ , $I_{DQ} = 350\text{ mA}$ , $P_{IN} = 29\text{ dBm}$ , Freq = 5.9 GHz
Power Added Efficiency	$PAE_1$	–	50	–	%	$V_{DD} = 40\text{ V}$ , $I_{DQ} = 350\text{ mA}$ , $P_{IN} = 29\text{ dBm}$ , Freq = 5.2 GHz
Power Added Efficiency	$PAE_2$	–	48	–	%	$V_{DD} = 40\text{ V}$ , $I_{DQ} = 350\text{ mA}$ , $P_{IN} = 29\text{ dBm}$ , Freq = 5.5 GHz
Power Added Efficiency	$PAE_3$	–	48	–	%	$V_{DD} = 40\text{ V}$ , $I_{DQ} = 350\text{ mA}$ , $P_{IN} = 29\text{ dBm}$ , Freq = 5.9 GHz
Power Gain	$G_P$	–	21	–	dB	$V_{DD} = 40\text{ V}$ , $I_{DQ} = 350\text{ mA}$ , $P_{IN} = 29\text{ dBm}$ , Freq = 5.2 GHz
Power Gain	$G_P$	–	21	–	dB	$V_{DD} = 40\text{ V}$ , $I_{DQ} = 350\text{ mA}$ , $P_{IN} = 29\text{ dBm}$ , Freq = 5.5 GHz
Power Gain	$G_P$	–	22	–	dB	$V_{DD} = 40\text{ V}$ , $I_{DQ} = 350\text{ mA}$ , $P_{IN} = 29\text{ dBm}$ , Freq = 5.9 GHz
Input Return Loss	$S_{11}$	–	-10	–	dB	$P_{IN} = -20\text{ dBm}$ , 5.2 - 5.9 GHz
Output Return Loss	$S_{22}$	–	-4	–	dB	$P_{IN} = -20\text{ dBm}$ , 5.2 - 5.9 GHz
Output Mismatch Stress	VSWR	–	–	3 : 1	$\Psi$	No Damage at All Phase Angles

Notes:

<sup>1</sup> Scaled from PCM data.

<sup>2</sup> Measured in CMPA5259080S high volume test fixture at 5.2, 5.5 and 5.9 GHz and may not show the full capability of the device due to source

inductance and thermal performance.

<sup>3</sup> Unless otherwise noted: Pulse width = 25  $\mu\text{s}$ , duty cycle = 1%.

## Thermal Characteristics

Parameter	Symbol	Rating	Units	Conditions
Operating Junction Temperature	$T_J$	225	°C	
Thermal Resistance, Junction to Case (Packaged) <sup>1</sup>	$R_{\theta JC}$	0.95	°C/W	Pulse Width = 500 $\mu\text{s}$ , Duty Cycle = 20%

Note:

<sup>1</sup> Simulated for the CMPA5259080S at  $P_{DISS} = 120\text{ W}$ .

## Typical Performance of the CMPA5259080S

Test conditions unless otherwise noted:  $V_D = 40\text{ V}$ ,  $I_{DQ} = 350\text{ mA}$ , pulse width =  $500\text{ }\mu\text{s}$ , duty cycle = 20%,  $P_{IN} = 29\text{ dBm}$ ,  $T_{BASE} = +25\text{ }^\circ\text{C}$

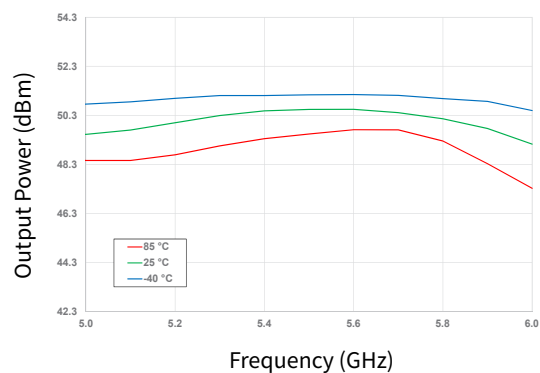


Figure 1. Output Power vs Frequency as a Function of Temperature

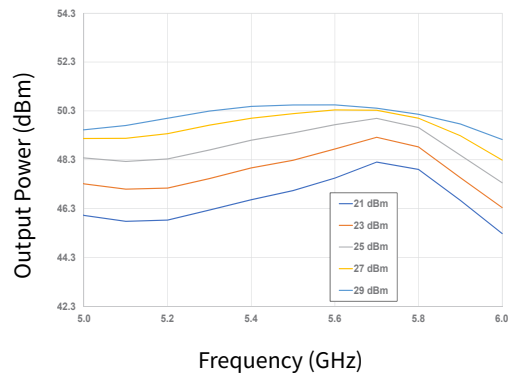


Figure 2. Output Power vs Frequency as a Function of Input Power

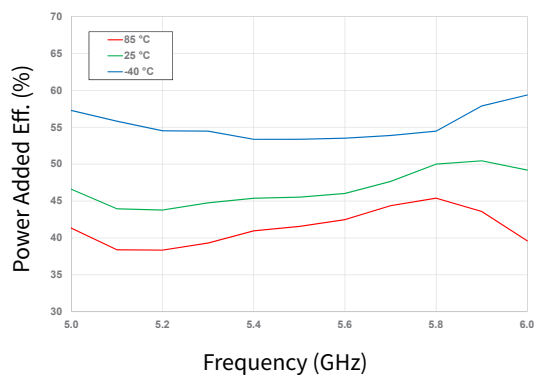


Figure 3. Power Added Eff. vs Frequency as a Function of Temperature

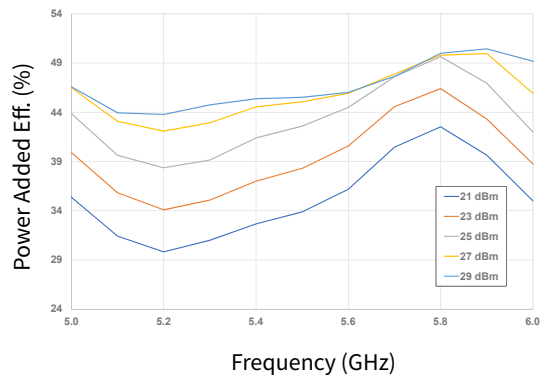


Figure 4. Power Added Eff. vs Frequency as a Function of Input Power

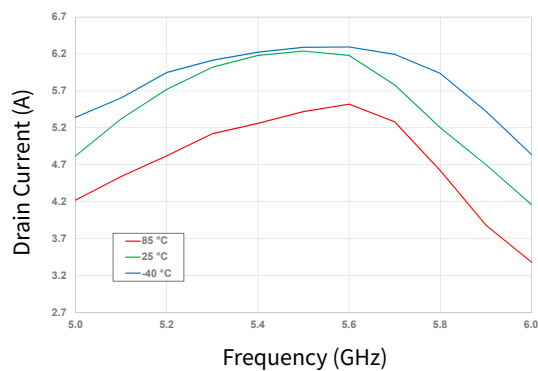


Figure 5. Drain Current vs Frequency as a Function of Temperature

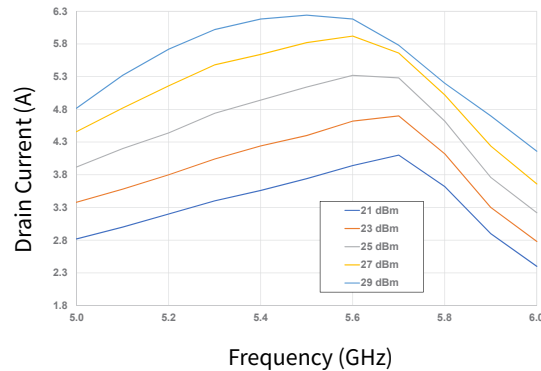


Figure 6. Drain Current vs Frequency as a Function of Input Power



## Typical Performance of the CPMA5259080S

Test conditions unless otherwise noted:  $V_D = 40\text{ V}$ ,  $I_{DQ} = 350\text{ mA}$ , pulse width =  $500\text{ }\mu\text{s}$ , duty cycle = 20%,  $P_{IN} = 29\text{ dBm}$ ,  $T_{BASE} = +25\text{ }^\circ\text{C}$

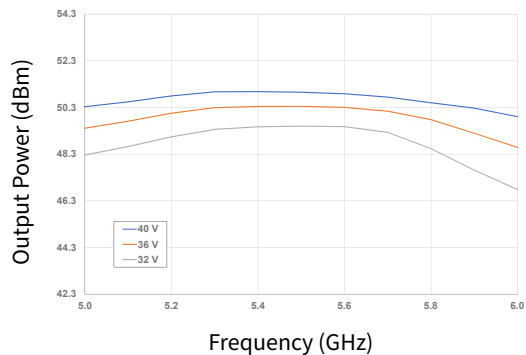


Figure 7. Output Power vs Frequency as a Function of  $V_D$

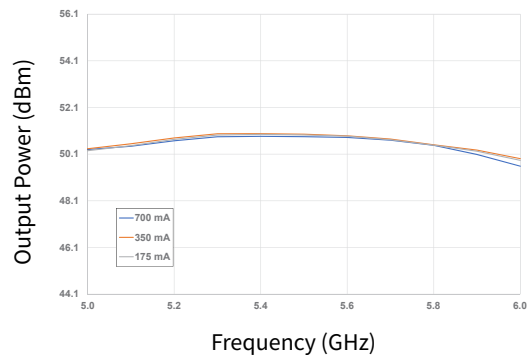


Figure 8. Output Power vs Frequency as a Function of  $I_{DQ}$

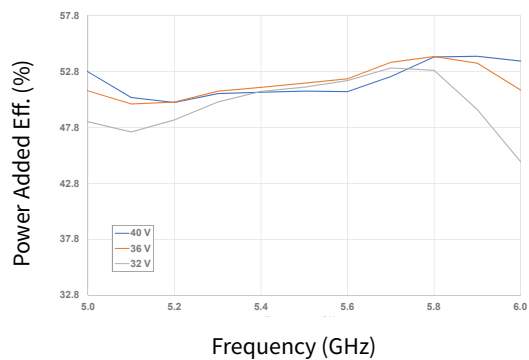


Figure 9. Power Added Eff. vs Frequency as a Function of  $V_D$

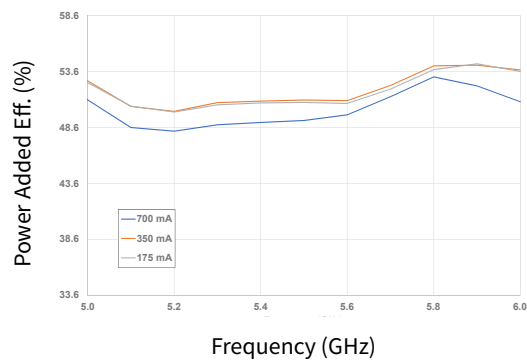


Figure 10. Power Added Eff. vs Frequency as a Function of  $I_{DQ}$

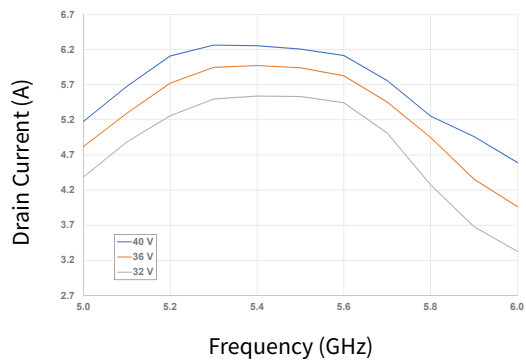


Figure 11. Drain Current vs Frequency as a Function of  $V_D$

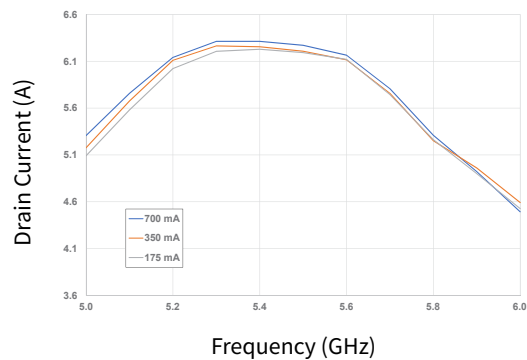


Figure 12. Drain Current vs Frequency as a Function of  $I_{DQ}$

## Typical Performance of the CPMA5259080S

Test conditions unless otherwise noted:  $V_D = 40$  V,  $I_{DQ} = 350$  mA, pulse width = 500  $\mu$ s, duty cycle = 20%,  $P_{IN} = 29$  dBm,  $T_{BASE} = +25$  °C

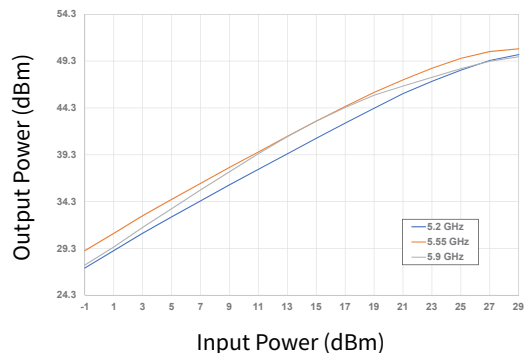


Figure 13. Output Power vs Input Power as a Function of Frequency

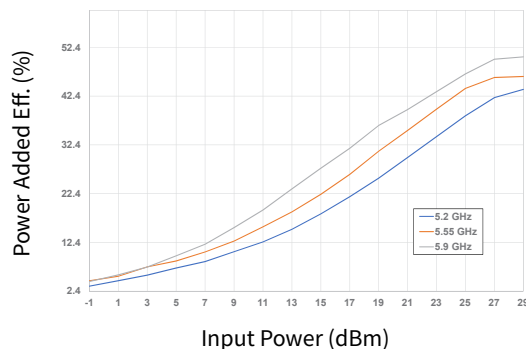


Figure 14. Power Added Eff. vs Input Power as a Function of Frequency

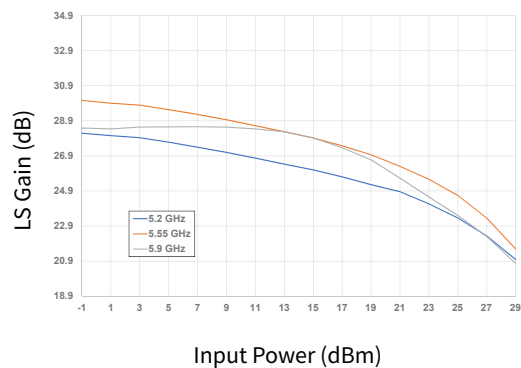


Figure 15. Large Signal Gain vs Input Power as a Function of Frequency

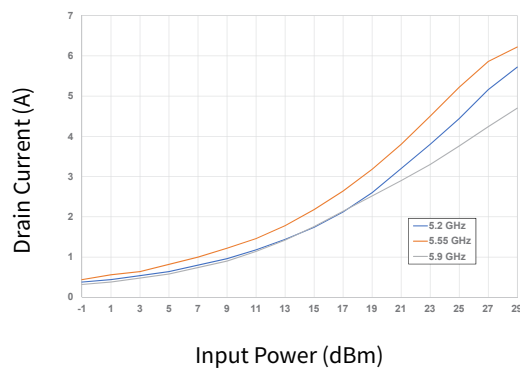


Figure 16. Drain Current vs Input Power as a Function of Frequency

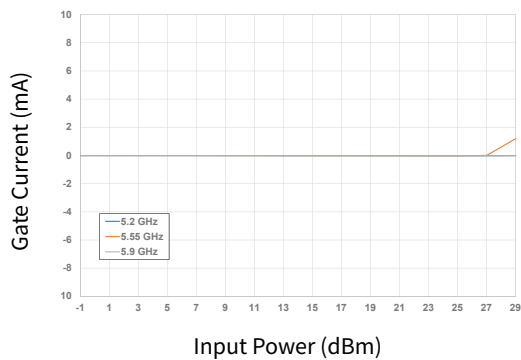


Figure 17. Gate Current vs Input Power as a Function of Frequency

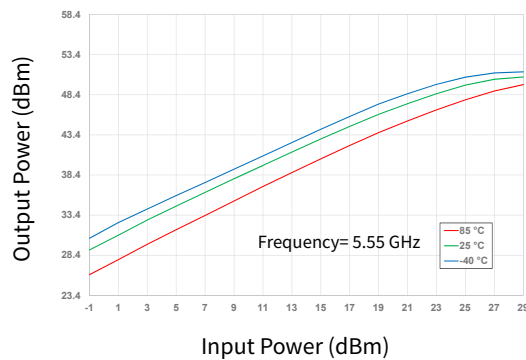


Figure 18. Output Power vs Input Power as a Function of Temperature

## Typical Performance of the CPMA5259080S

Test conditions unless otherwise noted:  $V_D = 40\text{ V}$ ,  $I_{DQ} = 350\text{ mA}$ , pulse width =  $500\text{ }\mu\text{s}$ , duty cycle = 20%,  $P_{IN} = 29\text{ dBm}$ ,  $T_{BASE} = +25\text{ }^\circ\text{C}$

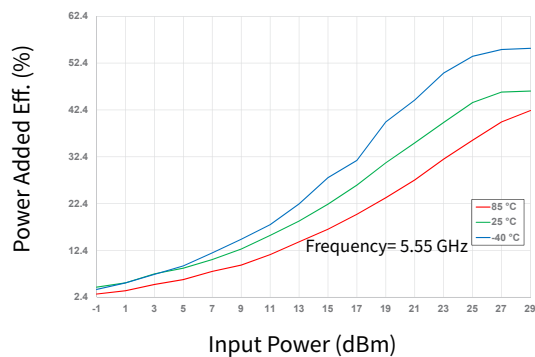


Figure 19. Power Added Eff. vs Input Power as a Function of Temperature

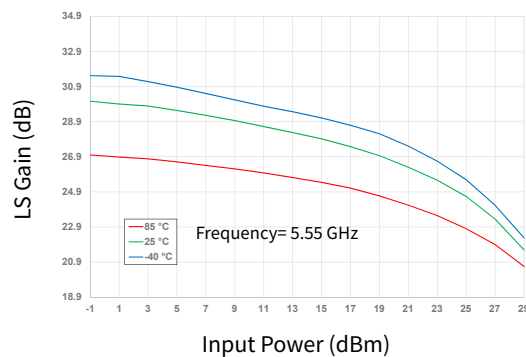


Figure 20. Large Signal Gain vs Input Power as a Function of Temperature

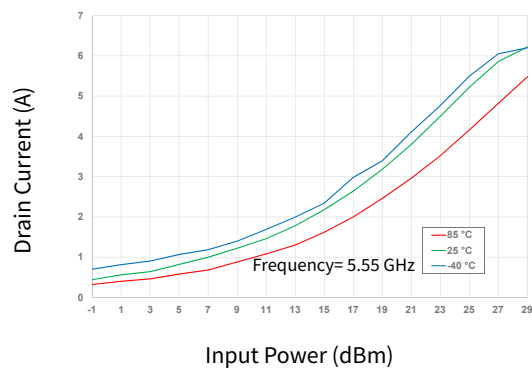


Figure 21. Drain Current vs Input Power as a Function of Temperature

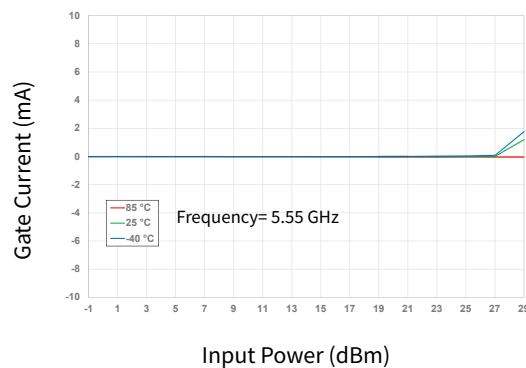


Figure 22. Gate Current vs Input Power as a Function of Temperature

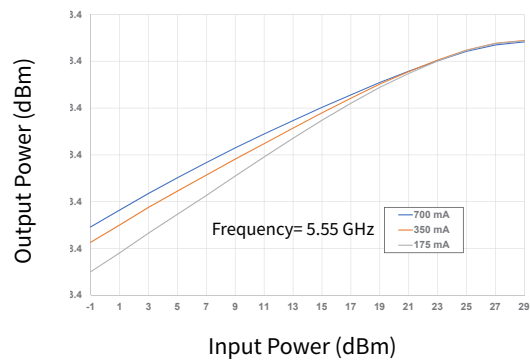


Figure 23. Output Power vs Input Power as a Function of  $I_{DQ}$

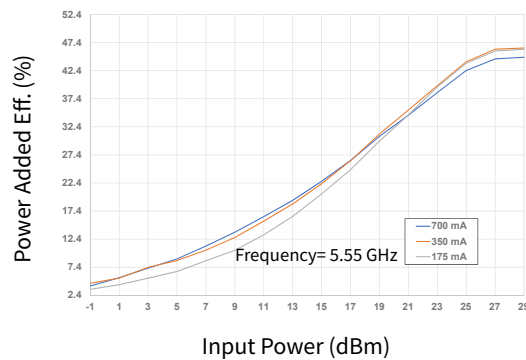


Figure 24. Power Added Eff. vs Input Power as a Function of  $I_{DQ}$

## Typical Performance of the CPMA5259080S

Test conditions unless otherwise noted:  $V_D = 40$  V,  $I_{DQ} = 350$  mA, pulse width = 500  $\mu$ s, duty cycle = 20%,  $P_{IN} = 29$  dBm,  $T_{BASE} = +25$  °C

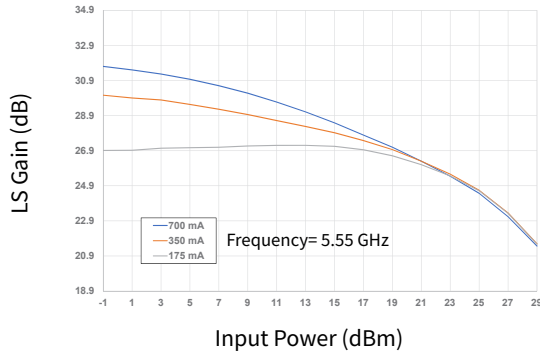


Figure 25. Large Signal Gain vs Input Power as a Function of  $I_{DQ}$

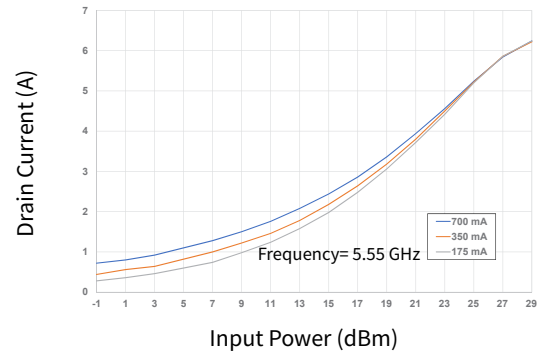


Figure 26. Drain Current vs Input Power as a Function of  $I_{DQ}$

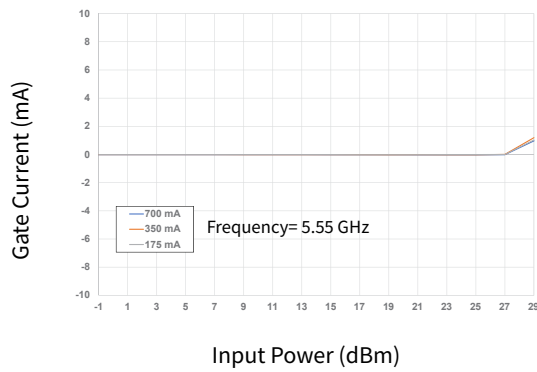


Figure 27. Gate Current vs Input Power as a Function of  $I_{DQ}$

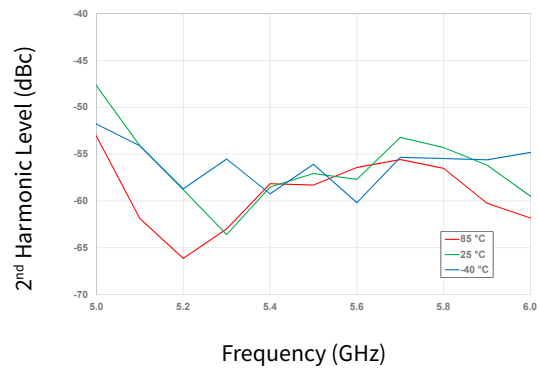


Figure 28. 2<sup>nd</sup> Harmonic vs Frequency as a Function of Temperature

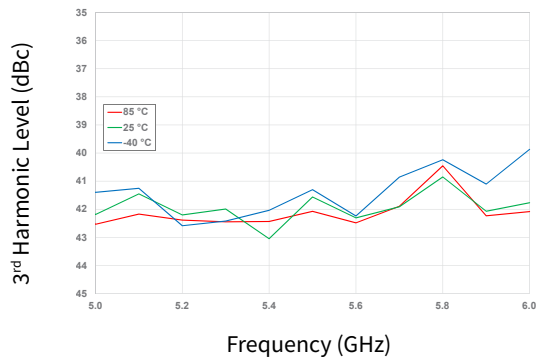


Figure 29. 3<sup>rd</sup> Harmonic vs Frequency as a Function of Temperature

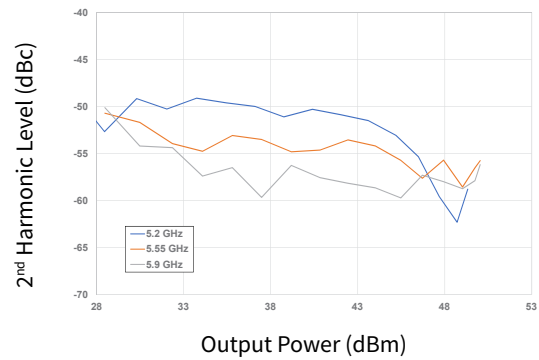


Figure 30. 2<sup>nd</sup> Harmonic vs Output Power as a Function of Frequency



## Typical Performance of the CPMA5259080S

Test conditions unless otherwise noted:  $V_D = 40$  V,  $I_{DQ} = 350$  mA, pulse width = 500  $\mu$ s, duty cycle = 20%,  $P_{IN} = 29$  dBm,  $T_{BASE} = +25$  °C

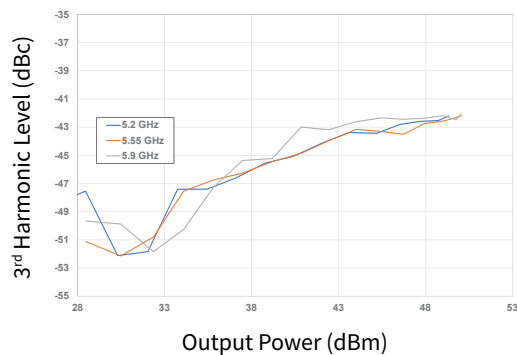


Figure 31. 3<sup>rd</sup> Harmonic vs Output Power as a Function of Frequency

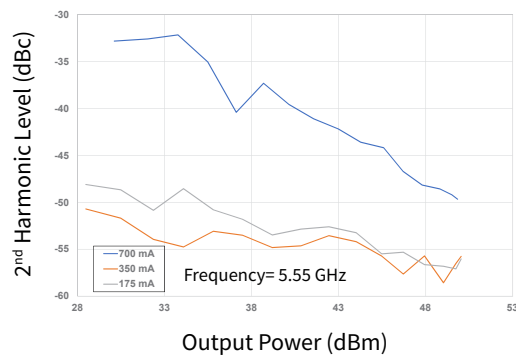


Figure 32. 2<sup>nd</sup> Harmonic vs Output Power as a Function of  $I_{DQ}$

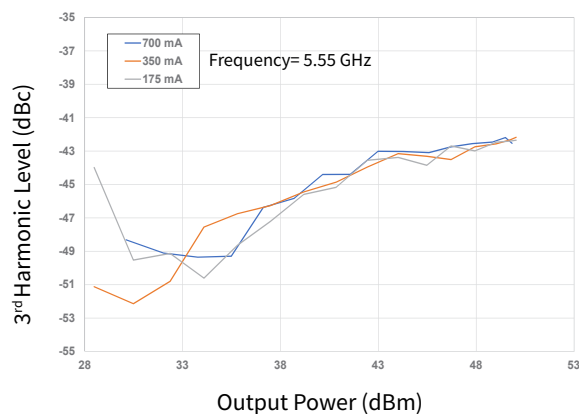


Figure 33. 3<sup>rd</sup> Harmonic vs Output Power as a Function of  $I_{DQ}$



## Typical Performance of the CPMA5259080S

Test conditions unless otherwise noted:  $V_D = 40$  V,  $I_{DQ} = 350$  mA,  $P_{IN} = -20$  dBm,  $T_{BASE} = +25$  °C

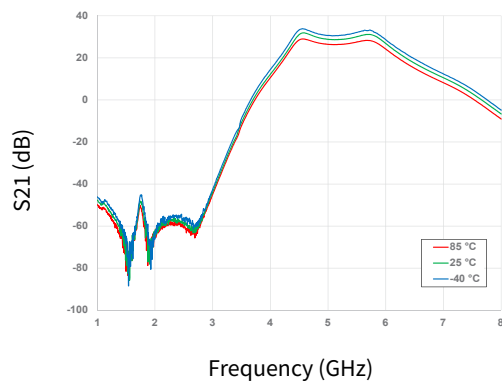


Figure 34. Gain vs Frequency as a Function of Temperature

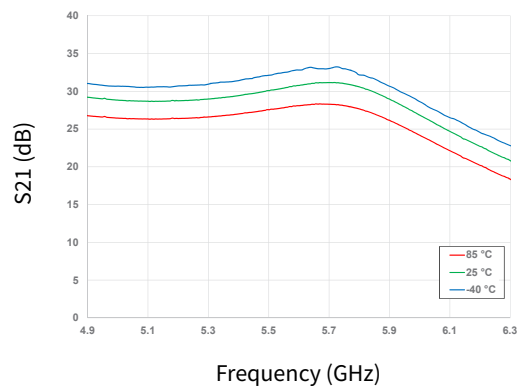


Figure 35. Gain vs Frequency as a Function of Temperature

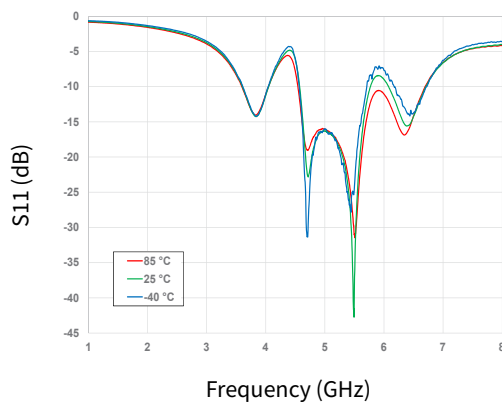


Figure 36. Input RL vs Frequency as a Function of Temperature

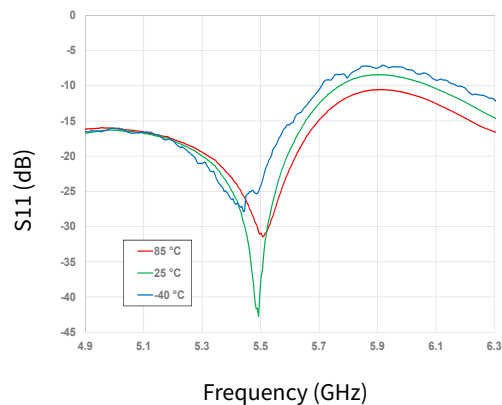


Figure 37. Input RL vs Frequency as a Function of Temperature

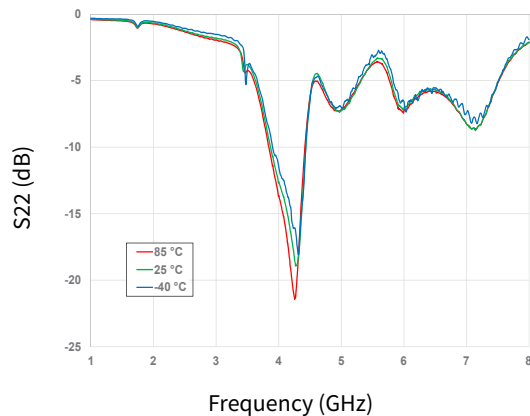


Figure 38. Output RL vs Frequency as a Function of Temperature

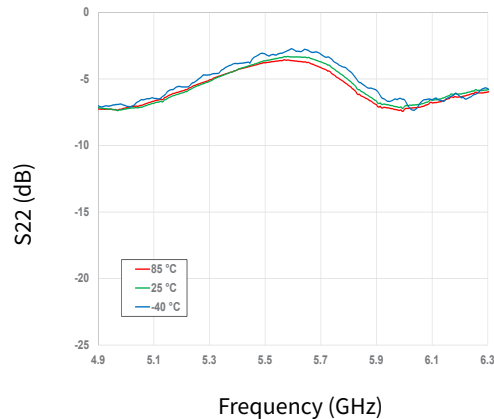


Figure 39. Output RL vs Frequency as a Function of Temperature

## Typical Performance of the CPA5259080S

Test conditions unless otherwise noted:  $V_D = 40$  V,  $I_{DQ} = 350$  mA,  $P_{IN} = -20$  dBm,  $T_{BASE} = +25$  °C

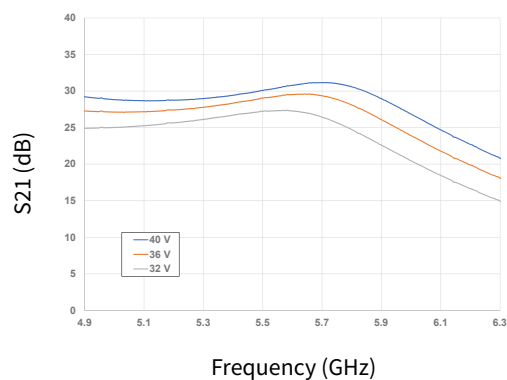


Figure 40. Gain vs Frequency as a Function of Voltage

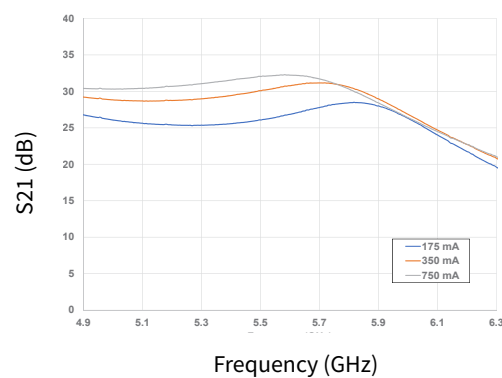


Figure 41. Gain vs Frequency as a Function of  $I_{DQ}$

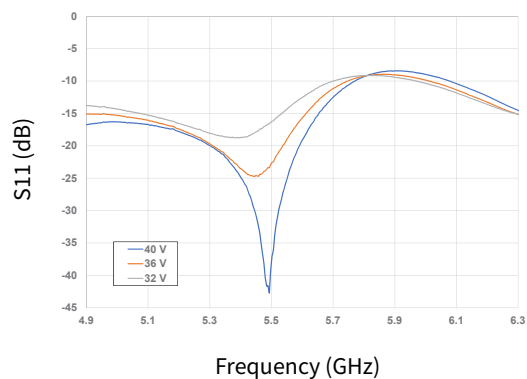


Figure 42. Input RL vs Frequency as a Function of Voltage

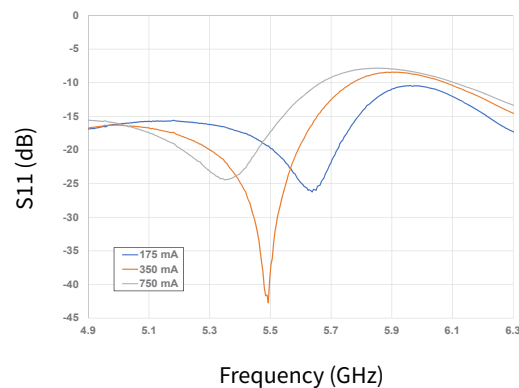


Figure 43. Input RL vs Frequency as a Function of  $I_{DQ}$

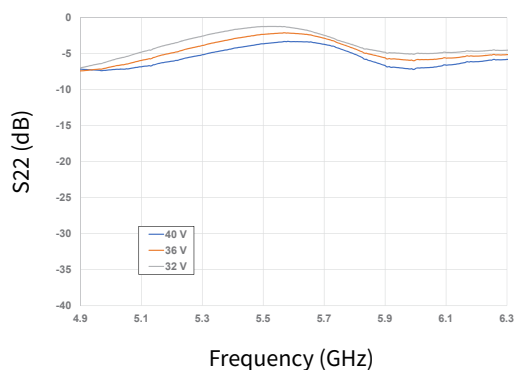


Figure 44. Output RL vs Frequency as a Function of Voltage

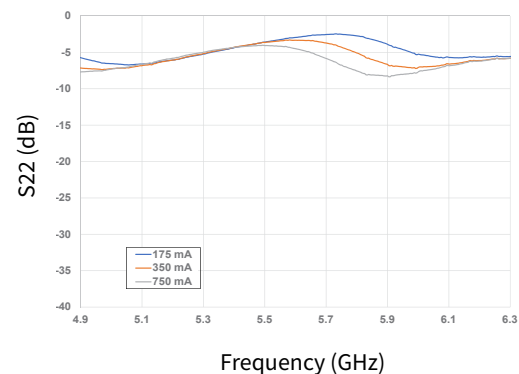
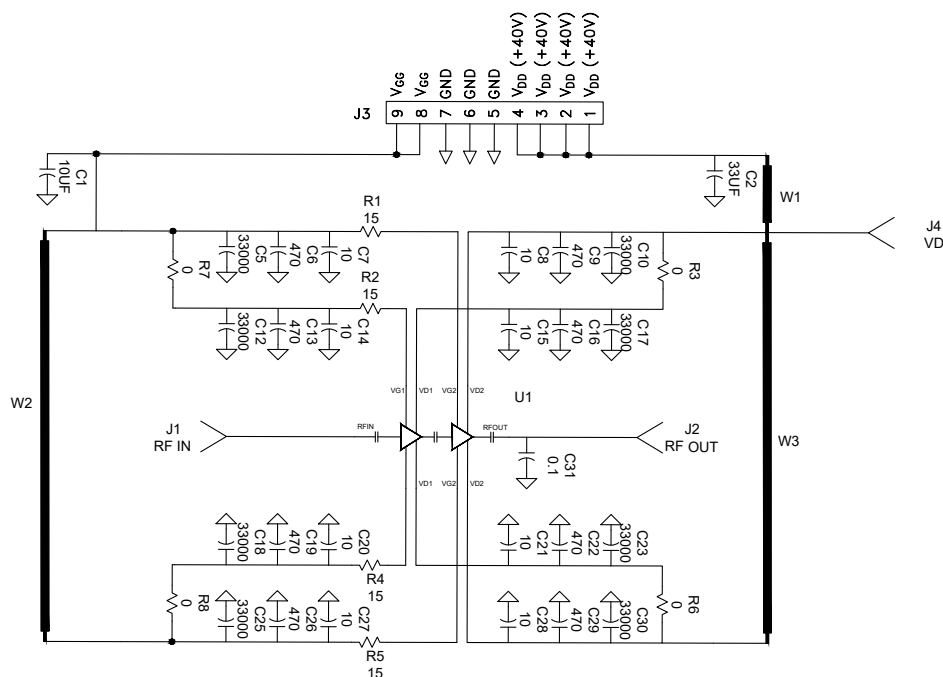
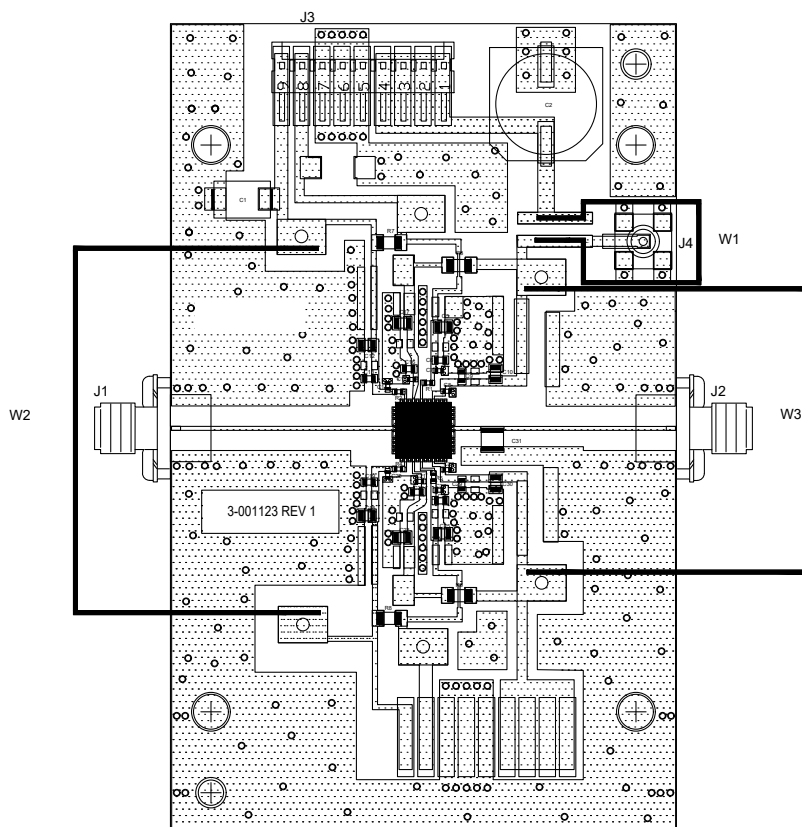


Figure 45. Output RL vs Frequency as a Function of  $I_{DQ}$

## CMPA5259080S-AMP1 Demonstration Amplifier Schematic



## CMPA5259080S-AMP1 Demonstration Amplifier Circuit Outline





## CMPA5259080S-AMP1 Demonstration Amplifier Circuit Bill of Materials

Designator	Description	Qty
C7, C8, C14, C15, C20, C21, C27, C28	CAP, 10 pF, +/-5%, pF, 200 V, 0402	8
C6, C9, C13, C16, C29, C22, C26, C29	CAP, 470 pF, 5%, 100 V, 0603, X	8
C5, C10, C12, C17, C18, C23, C25, C30	CAP, 33000 pF, 0805, 100 V, X7R	8
C2	CAP, 33 uF, 20%, G CASE	1
C1	CAP, 10 uF, 16 V, TANTALUM	1
C31	CAP, 0.1 pF, ATC 100 B	1
R1, R2, R4, R5	RES 15 OHM, +/-1%, 1/16 W, 0402	4
R3, R6, R7, R8	RES 0.0 OHM 1/16 W 0402 SMD	2
J1, J2	CONN, SMA, PANEL MOUNT JACK, FLANGE, 4-HOLE, BLUNT POST, 20 MIL	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, 22 AWG ~ 2.5"	2
W1	WIRE, BLACK, 22 AWG ~ 3.0"	1
	PCB, TEST FIXTURE, RF-35 TC, 0.010 THK, 7x7 AIR CAVITY QFN, EVAL BOARD	1
	2-56 SOC HD SCREW 3/16 SS	4
	#2 SPLIT LOCKWASHER SS	4
U1	CMPA5259080S	1

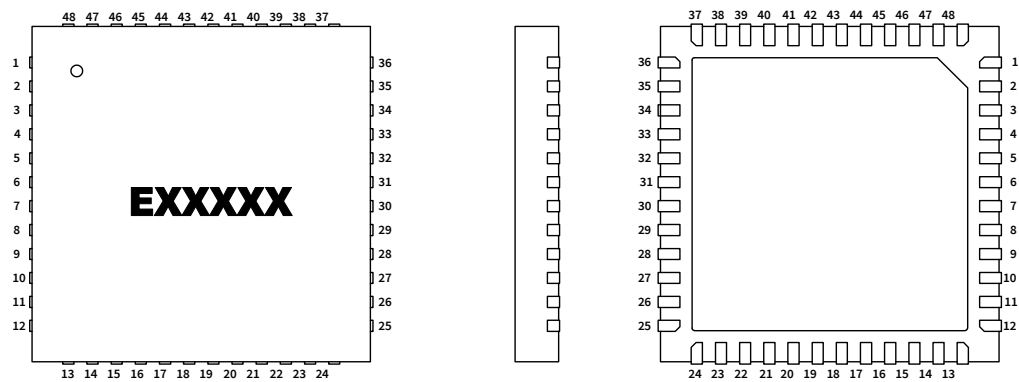
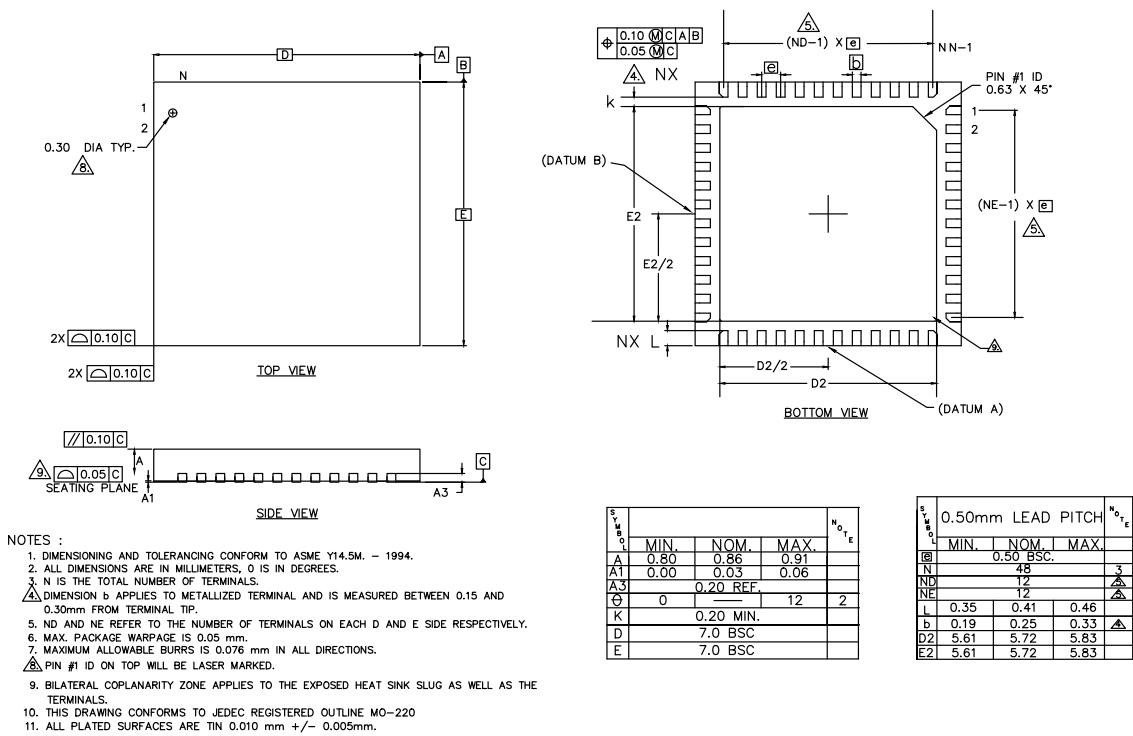
## Electrostatic Discharge (ESD) Classifications

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

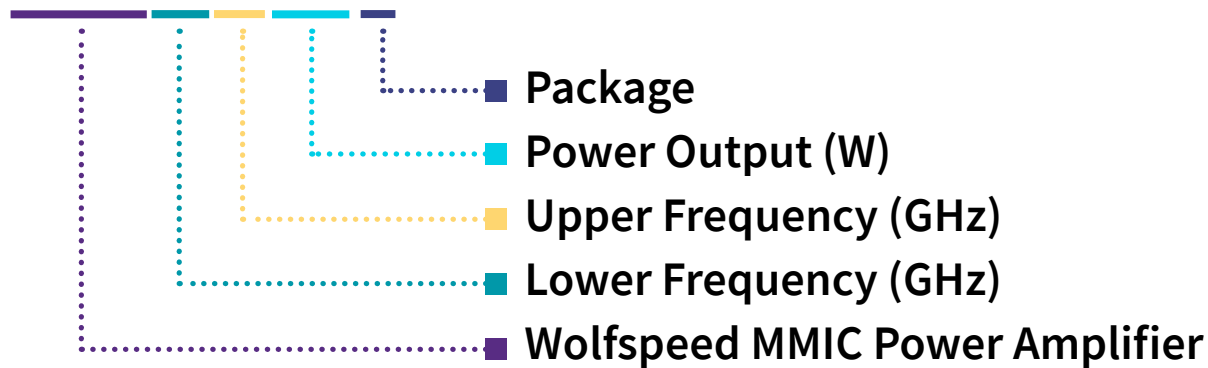
Product Dimensions CMPA5259080S (Package 7 x 7 QFN)



Pin	Desc.	Pin	Desc.	Pin	Desc.	Pin	Desc.	Pin	Desc.
1	NC	11	NC	21	VD2A	31	RF_OUT	41	NC
2	NC	12	NC	22	VD2A	32	RF_GND	42	NC
3	NC	13	NC	23	NC	33	NC	43	VG2B
4	NC	14	VG1A	24	NC	34	NC	44	NC
5	RF_GND	15	NC	25	NC	35	NC	45	VD1B
6	RF_IN	16	VD1A	26	NC	36	NC	46	NC
7	RF_GND	17	NC	27	NC	37	NC	47	VG1B
8	NC	18	VG2A	28	NC	38	NC	48	NC
9	NC	19	NC	29	NC	39	VD2B		
10	NC	20	NC	30	RF_GND	40	VD2B		

## Part Number System

# CMPA5259080S

**Table 1.**

Parameter	Value	Units
Lower Frequency	5.2	GHz
Upper Frequency	5.9	GHz
Power Output	80	W
Package	Surface Mount	–

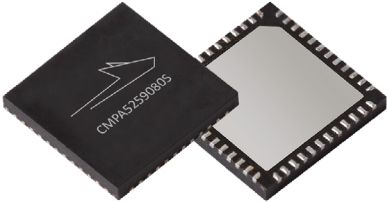

Note:  
Alpha characters used in frequency code indicate a value greater than 9.9 GHz. See Table 2 for value.

**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:	1 A = 10.0 GHz 2 H = 27.0 GHz



Product Ordering Information

Order Number	Description	Unit of Measure	Image
CMPA5259080S	GaN HEMT	Each	
CMPA5259080S-AMP1	Test Board with GaN MMIC Installed	Each	

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## Notes & Disclaimer

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