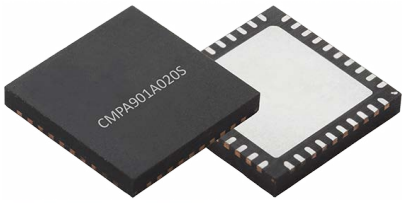
CMPA901A020S

9.0 - 10.0 GHz, 20 W, Packaged GaN MMIC Power Amplifier

Description

The CMPA901A020S is a packaged, 20 W HPA utilizing the high performance, 0.15 um GaN on SiC production process. The CMPA901A020S operates from 9 - 10 GHz and targets pulsed radar applications such as marine weather radar. With 3 stages of gain, this high performance amplifier provides >30 dB of large signal gain, potentially lowering the transmit BOM count, and >50% efficiency to support lower system DC power requirements and simplify system thermal management solutions. Packaged in a small 6 x 6 mm plastic overmold QFN, the CMPA901A020S also supports reduced board space requirements and high-throughput manufacturing lines.



Package Types: 6 x 6 QFN
PN's: CMPA901A020S

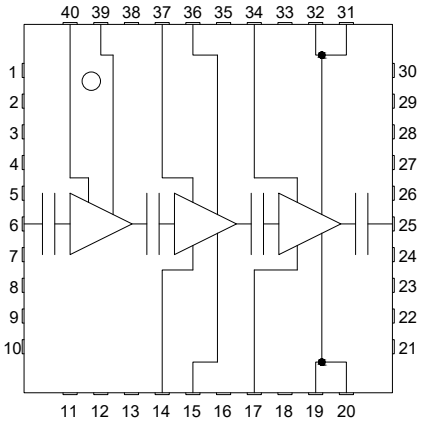
Features

- Freq: 9 – 10 GHz
- P_{sat} >20 W
- PAE >45%
- LS Gain >30 dB
- 6 x 6 mm overmold QFN
- Lower system costs
- Reduced board area

Applications

- X-band pulsed radar
- Marine weather radar
- Military radar

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



Typical Performance Over 9.0 - 10.0 GHz (T_C = 25 °C)

Parameter	9.0 GHz	9.5 GHz	10.0 GHz	Units
Small Signal Gain	35.7	35.35	35.86	dB
P_{OUT} @ P_{IN} = 12 dBm	25.25	23.5	22.8	W
Power Gain @ P_{IN} = 12 dBm	32.0	31.7	31.5	dB
PAE @ P_{IN} = 12 dBm	53.6	51.1	49.0	%

RoHS compliant

Absolute Maximum Ratings (Not Simultaneous) at 25 °C

Parameter	Symbol	Rating	Units	Conditions
Drain-Source Voltage	V_{DSS}	84	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	8	mA	25 °C
Maximum Drain Current	I_{DMAX}	3.8	A	
Soldering Temperature	T_S	260	°C	

Electrical Characteristics (Frequency = 9.0 GHz to 10.0 GHz Unless Otherwise Stated; T_C = 25 °C)

Characteristics	Symbol	Min.	Typ.	Max.	Units	Conditions
DC Characteristics						
Gate Threshold Voltage	$V_{GS(TH)}$	-2.6	-2.1	-1.6	V	V_{DS} = 10 V, I_D = 8 mA
Gate Quiescent Voltage	$V_{GS(Q)}$	–	-1.9	–	V_{DC}	V_{DD} = 28 V, I_D = 235 mA
Saturated Drain Current[1]	I_{DS}	1.5	2.9	–	A	V_{DS} = 6.0 V, V_{GS} = 2.0 V
Drain-Source Breakdown Voltage	V_{BD}	84	–	–	V	V_{GS} = -8 V, I_D = 8 mA
RF Characteristics[2, 3]						
Small Signal Gain	S21	–	35.0	–	dB	V_{DD} = 28 V, I_{DQ} = 800 mA, Freq = 9 - 10 GHz
Input Return Loss	S11	–	-23.8	–	dB	V_{DD} = 28 V, I_{DQ} = 800 mA, Freq = 9 - 10 GHz
Output Return Loss	S22	–	-9.4	–	dB	V_{DD} = 28 V, I_{DQ} = 800 mA, Freq = 9 - 10 GHz
Output Power	P_{OUT1}	–	44.0	–	dBm	V_{DD} = 28 V, I_{DQ} = 235 mA, P_{IN} = 12 dBm, Freq = 9.0 GHz
Output Power	P_{OUT2}	–	43.7	–	dBm	V_{DD} = 28 V, I_{DQ} = 235 mA, P_{IN} = 12 dBm, Freq = 9.5 GHz
Output Power	P_{OUT3}	–	43.6	–	dBm	V_{DD} = 28 V, I_{DQ} = 235 mA, P_{IN} = 12 dBm, Freq = 10.0 GHz
Power Gain	G_1	–	32.0	–	dB	V_{DD} = 28 V, I_{DQ} = 235 mA, P_{IN} = 12 dBm, Freq = 9.0 GHz
Power Gain	G_2	–	31.7	–	dB	V_{DD} = 28 V, I_{DQ} = 235 mA, P_{IN} = 12 dBm, Freq = 9.5 GHz
Power Gain	G_3	–	31.5	–	dB	V_{DD} = 28 V, I_{DQ} = 235 mA, P_{IN} = 12 dBm, Freq = 10.0 GHz
Power Added Efficiency	PAE_1	–	53.6	–	%	V_{DD} = 28 V, I_{DQ} = 235 mA, P_{IN} = 12 dBm, Freq = 9.0 GHz
Power Added Efficiency	PAE_2	–	51.1	–	%	V_{DD} = 28 V, I_{DQ} = 235 mA, P_{IN} = 12 dBm, Freq = 9.5 GHz
Power Added Efficiency	PAE_3	–	49.0	–	%	V_{DD} = 28 V, I_{DQ} = 235 mA, P_{IN} = 12 dBm, Freq = 10.0 GHz
Output Mismatch Stress	VSWR	–	–	5:1	Ψ	No Damage at All Phase Angles, V_{DD} = 28 V, I_{DQ} = 235 mA, Pulse Width = 100 µs, Duty Cycle = 10%, P_{OUT} = 20 W

Notes:
[1] Scaled from PCM data.
[2] All data tested in CMPA901A020S-AMP1.
[3] Pulse width = 100 µs; duty cycle = 10%.

Thermal Characteristics

Parameter	Symbol	Rating	Units	Conditions
Operating Junction Temperature	T_J	225	°C	
Thermal Resistance, Junction to Case (Packaged)	$R_{\theta JC}$	2.2	°C/W	100 µs, 10%, P_{DISS} = 25.5 W

Typical Performance of the CMPA901A020S

Test conditions unless otherwise noted: V_D = 28 V, I_{DQ} = 240 mA, PW = 100 µs, DC = 10%, P_{IN} = 12 dBm, T_{BASE} = +25 °C

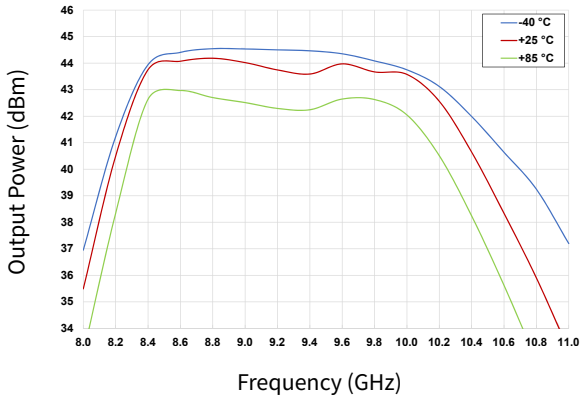


Figure 1. Output Power vs Frequency as a Function of Temperature

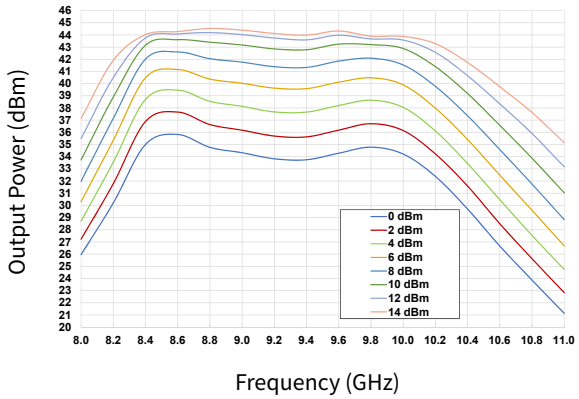


Figure 2. Output Power vs Frequency as a Function of Input Power

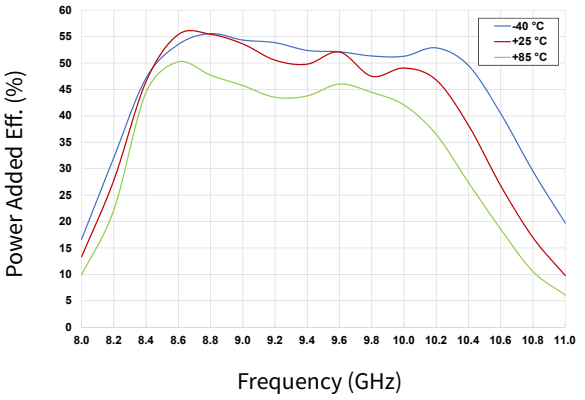


Figure 3. Power Added Eff. vs Frequency as a Function of Temperature

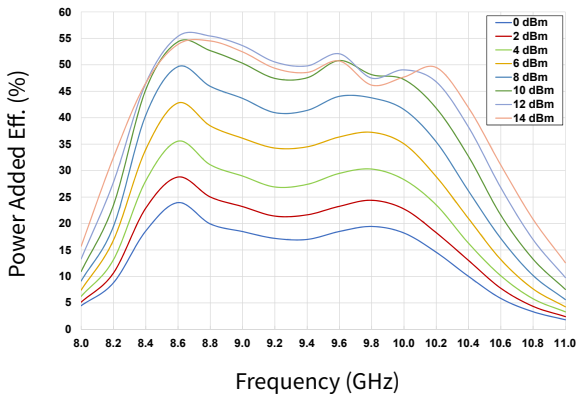


Figure 4. Power Added Eff. vs Frequency as a Function of Input Power

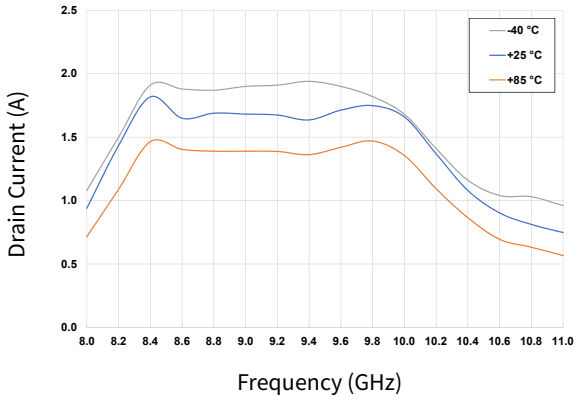


Figure 5. Drain Current vs Frequency as a Function of Temperature

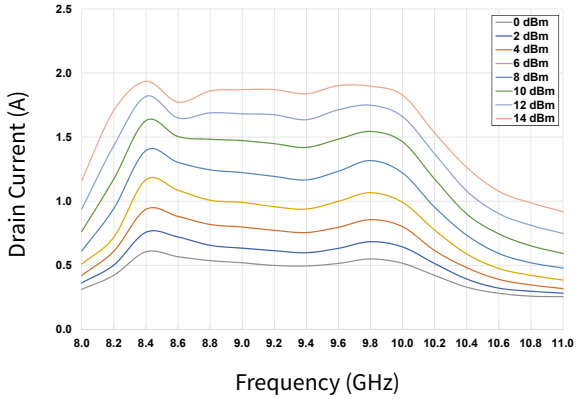


Figure 6. Drain Current vs Frequency as a Function of Input Power

Typical Performance of the CMPA901A020S

Test conditions unless otherwise noted: V_D = 28 V, I_{DQ} = 240 mA, PW = 100 µs, DC = 10%, P_{IN} = 12 dBm, T_{BASE} = +25 °C

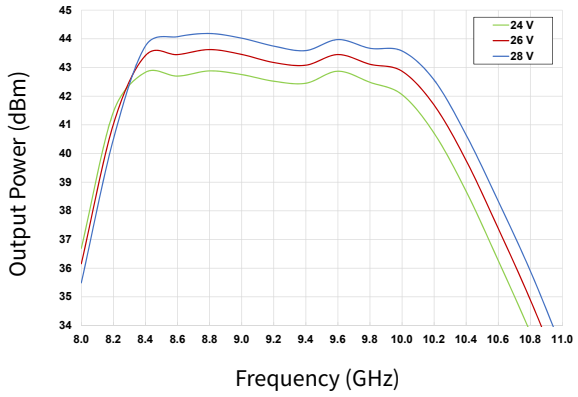


Figure 7. Output Power vs Frequency as a Function of V_D

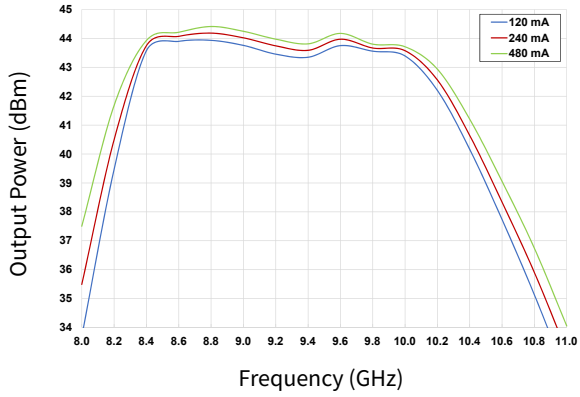


Figure 8. Output Power vs Frequency as a Function of I_{DQ}

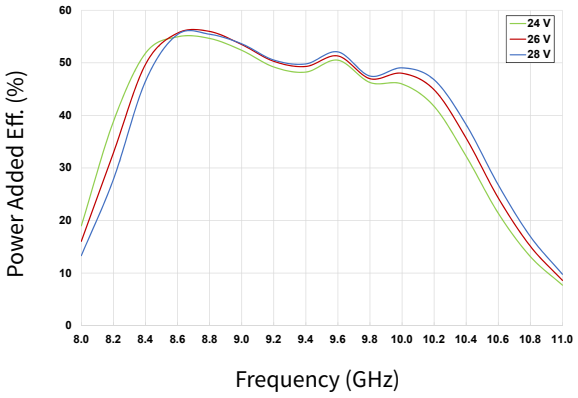


Figure 9. Power Added Eff. vs Frequency as a Function of V_D

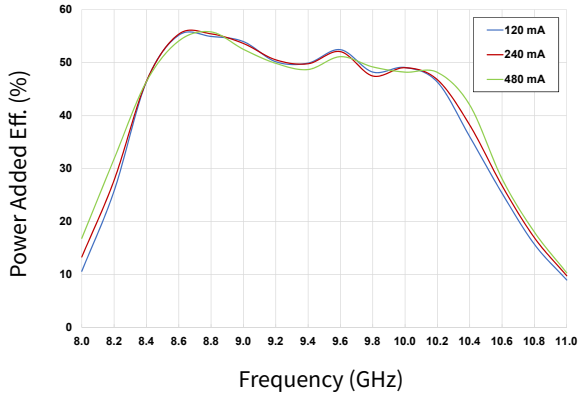


Figure 10. Power Added Eff. vs Frequency as a Function of I_{DQ}

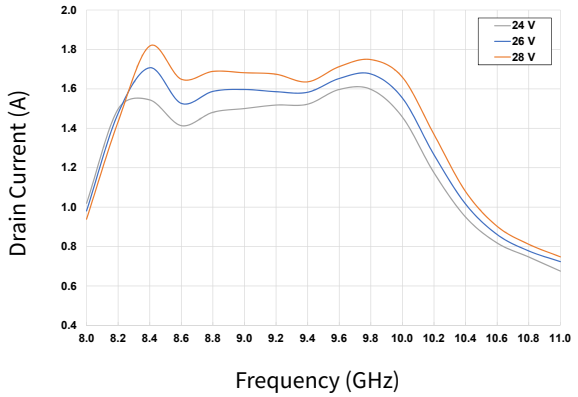


Figure 11. Drain Current vs Frequency as a Function of V_D

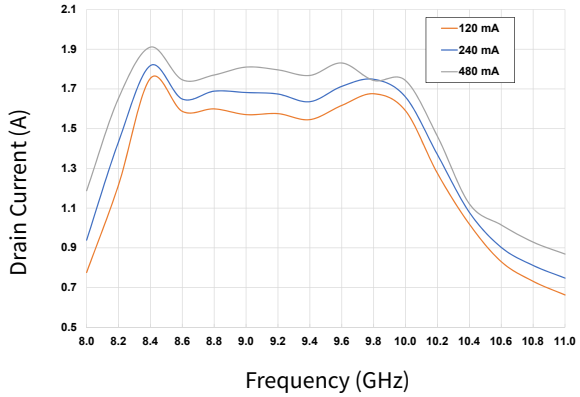


Figure 12. Drain Current vs Frequency as a Function of I_{DQ}

Typical Performance of the CMPA901A020S

Test conditions unless otherwise noted: V_D = 28 V, I_{DQ} = 240 mA, PW = 100 µs, DC = 10%, P_{IN} = 12 dBm, T_{BASE} = +25 °C

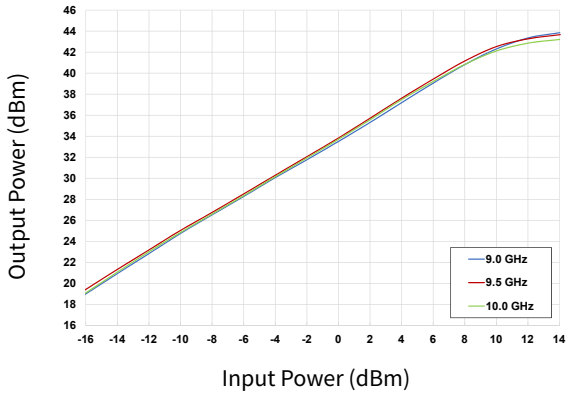


Figure 13. Output Power vs Input Power as a Function of Frequency

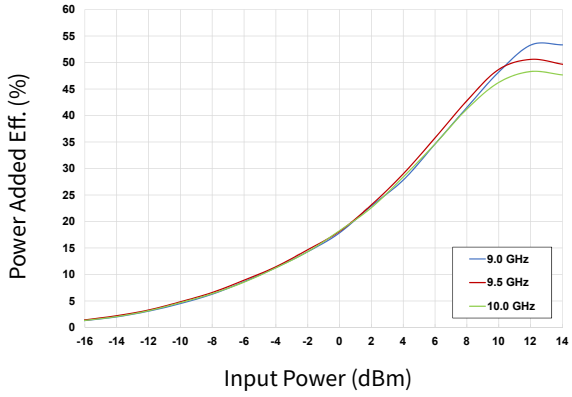


Figure 14. Power Added Eff. vs Input Power as a Function of Frequency

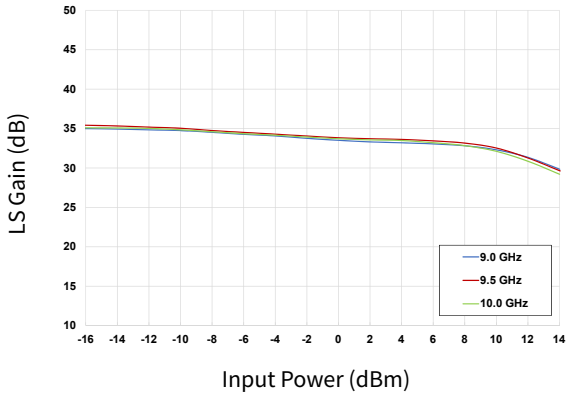


Figure 15. Large Signal Gain vs Input Power as a Function of Frequency

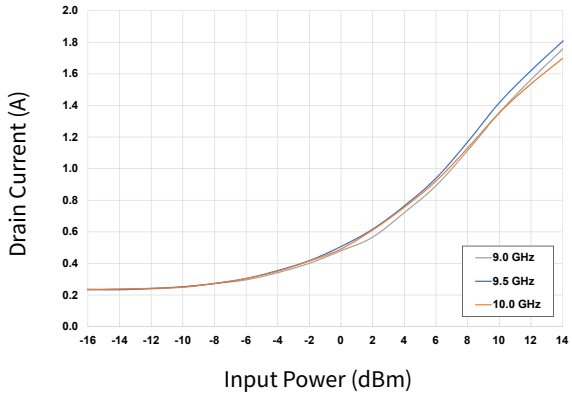


Figure 16. Drain Current vs Input Power as a Function of Frequency

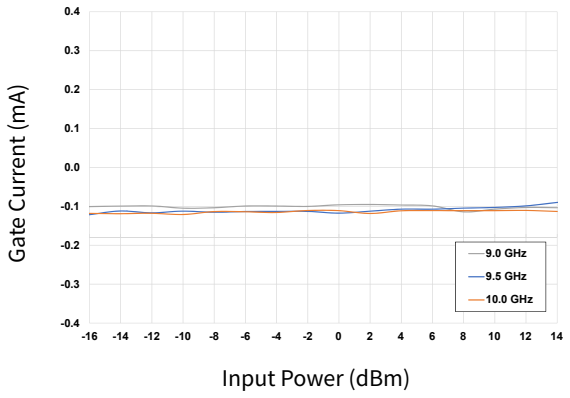


Figure 17. Gate Current vs Input Power as a Function of Frequency

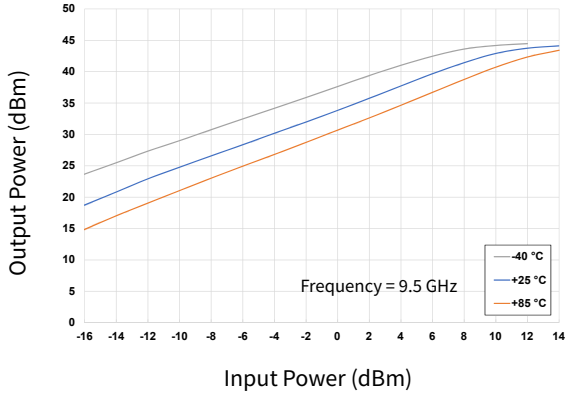


Figure 18. Output Power vs Input Power as a Function of Temperature

Typical Performance of the CMPA901A020S

Test conditions unless otherwise noted: V_D = 28 V, I_{DQ} = 240 mA, PW = 100 µs, DC = 10%, P_{IN} = 12 dBm, T_{BASE} = +25 °C

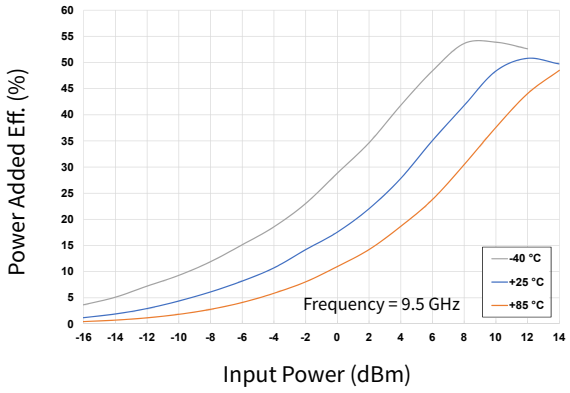


Figure 19. Power Added Eff. vs Input Power as a Function of Temperature

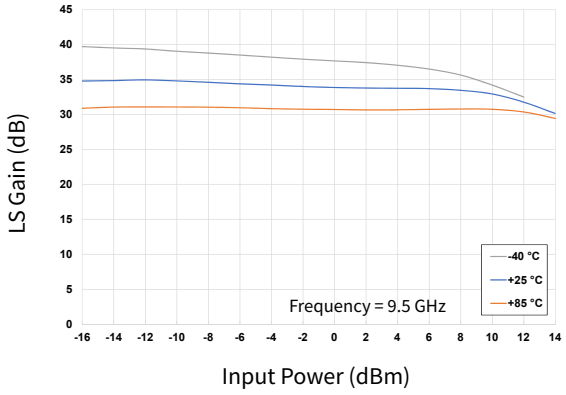


Figure 20. Large Signal Gain vs Input Power as a Function of Temperature

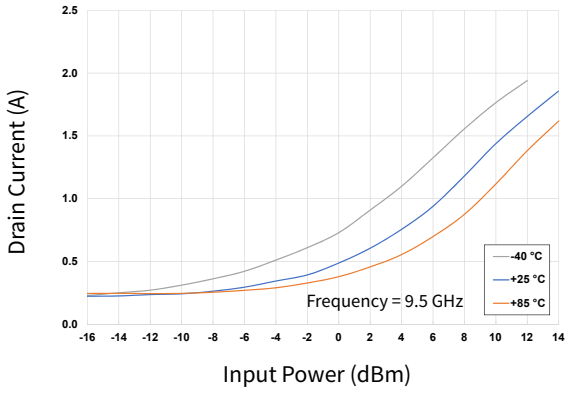


Figure 21. Drain Current vs Input Power as a Function of Temperature

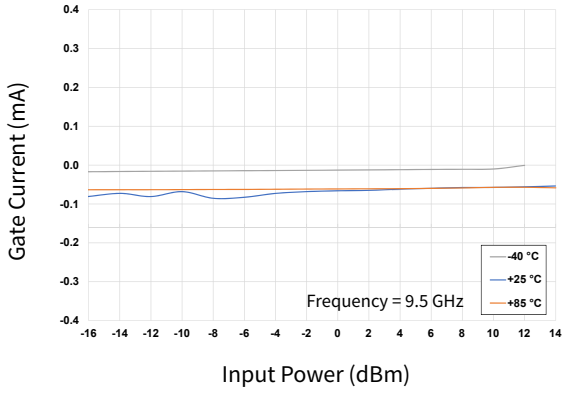


Figure 22. Gate Current vs Input Power as a Function of Temperature

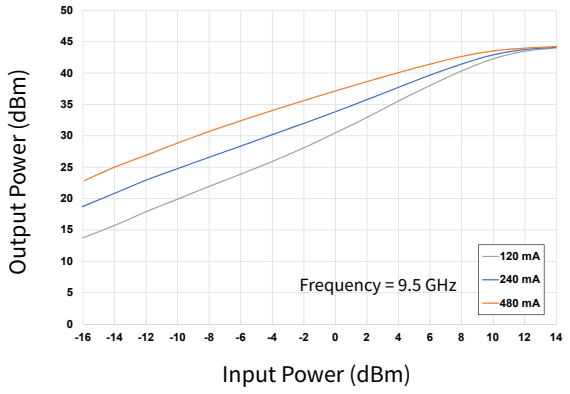


Figure 23. Output Power vs Input Power as a Function of I_{DQ}

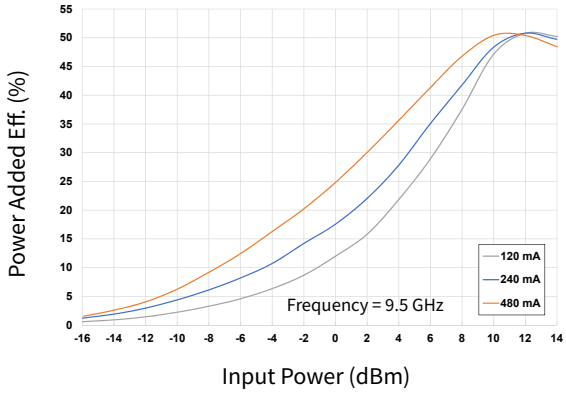


Figure 24. Power Added Eff. vs Input Power as a Function of I_{DQ}

Typical Performance of the CMPA901A020S

Test conditions unless otherwise noted: V_D = 28 V, I_{DQ} = 240 mA, PW = 100 µs, DC = 10%, P_{IN} = 12 dBm, T_{BASE} = +25 °C

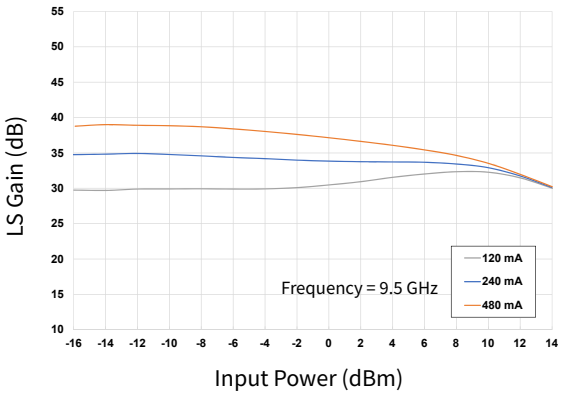


Figure 25. Large Signal Gain vs Input Power as a Function of I_{DQ}

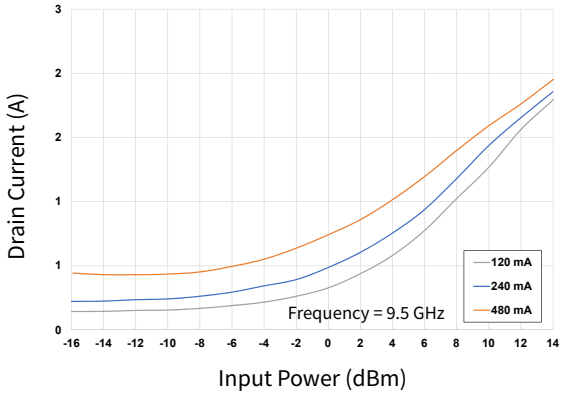


Figure 26. Drain Current vs Input Power as a Function of I_{DQ}

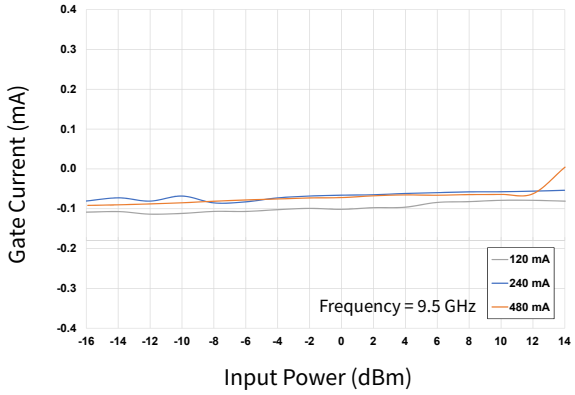


Figure 27. Gate Current vs Input Power as a Function of I_{DQ}

Typical Performance of the CMPA901A020S

Test conditions unless otherwise noted: V_D = 28 V, I_{DQ} = 240 mA, P_{IN} = -20 dBm, T_{BASE} = +25 °C

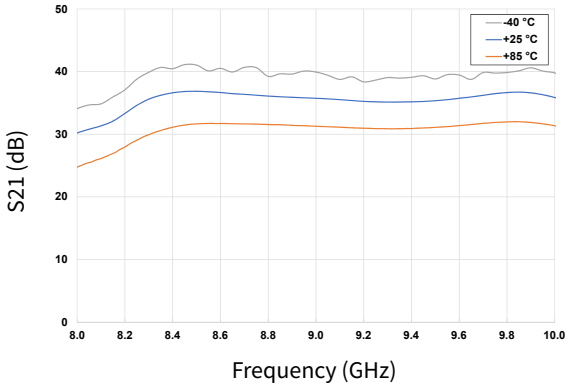


Figure 28. Gain vs Frequency as a Function of Temperature

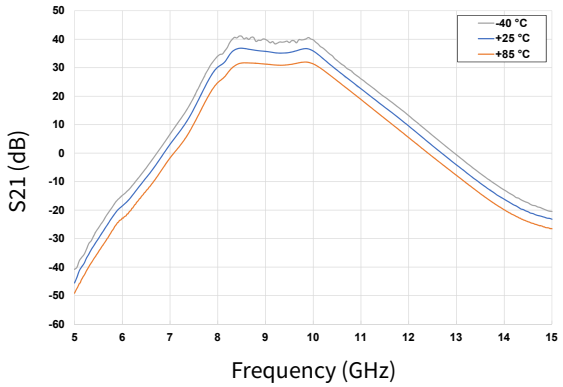


Figure 29. Gain vs Frequency as a Function of Temperature

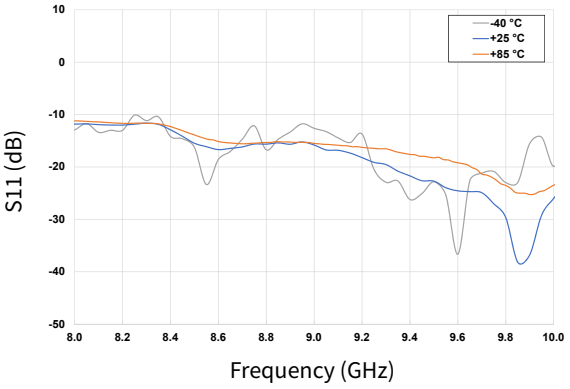


Figure 30. Input RL vs Frequency as a Function of Temperature

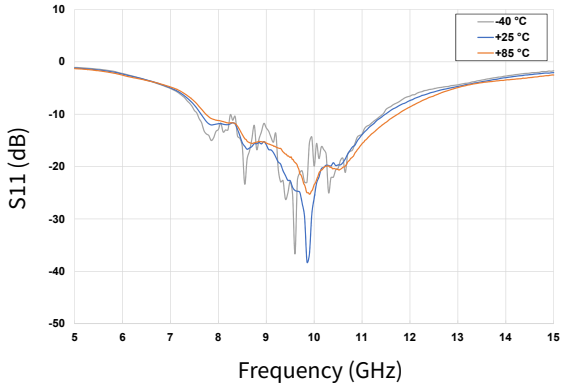


Figure 31. Input RL vs Frequency as a Function of Temperature

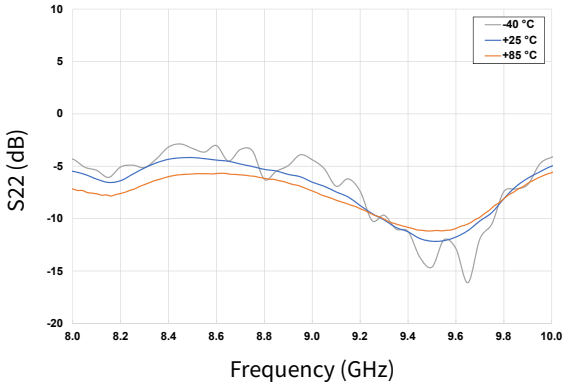


Figure 32. Output RL vs Frequency as a Function of Temperature

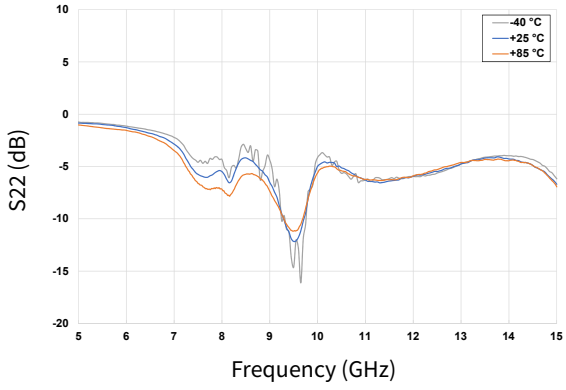


Figure 33. Output RL vs Frequency as a Function of Temperature

Typical Performance of the CMPA901A020S

Test conditions unless otherwise noted: V_D = 28 V, I_{DQ} = 240 mA, P_{IN} = -20 dBm, T_{BASE} = +25 °C

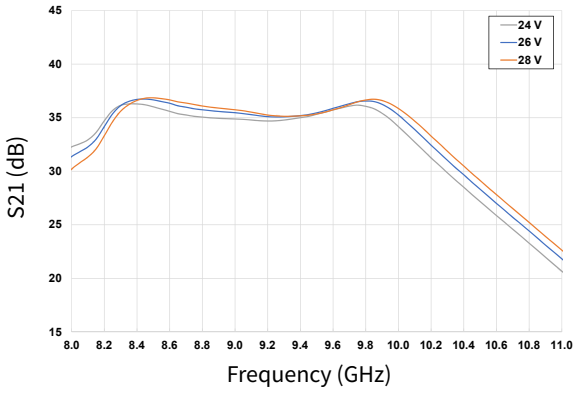


Figure 34. Gain vs Frequency as a Function of Voltage

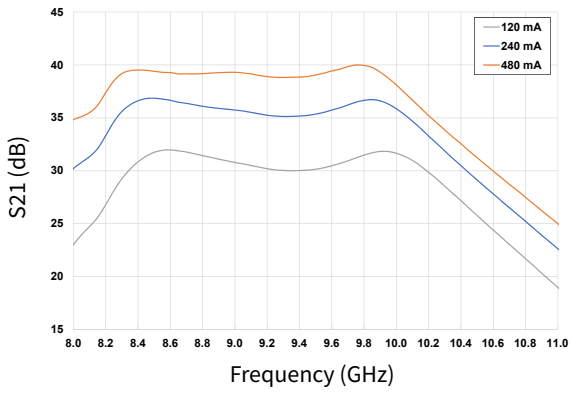


Figure 35. Gain vs Frequency as a Function of I_{DQ}

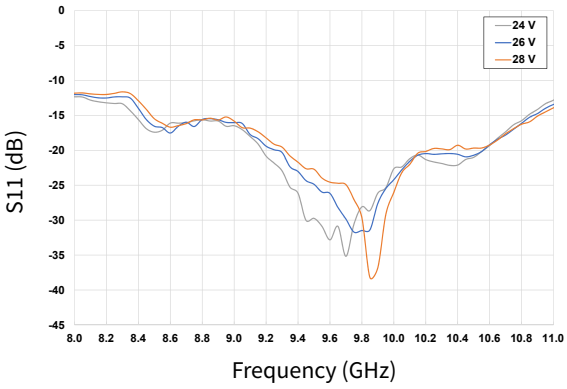


Figure 36. Input RL vs Frequency as a Function of Voltage

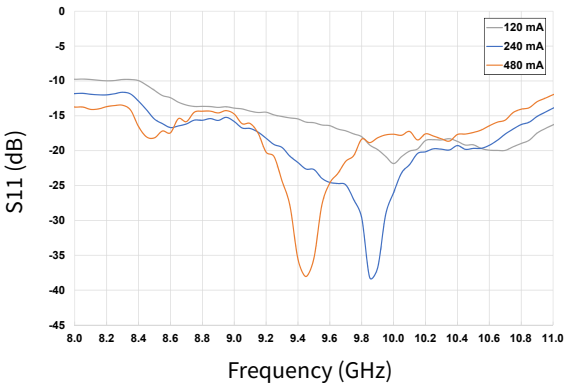


Figure 37. Input RL vs Frequency as a Function of I_{DQ}

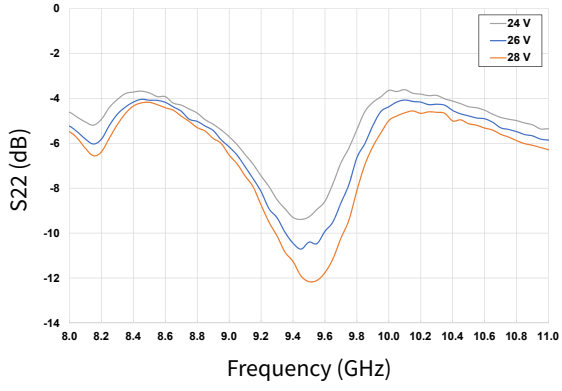


Figure 38. Output RL vs Frequency as a Function of Voltage

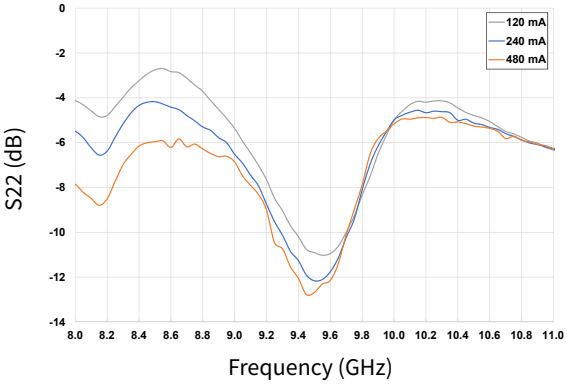
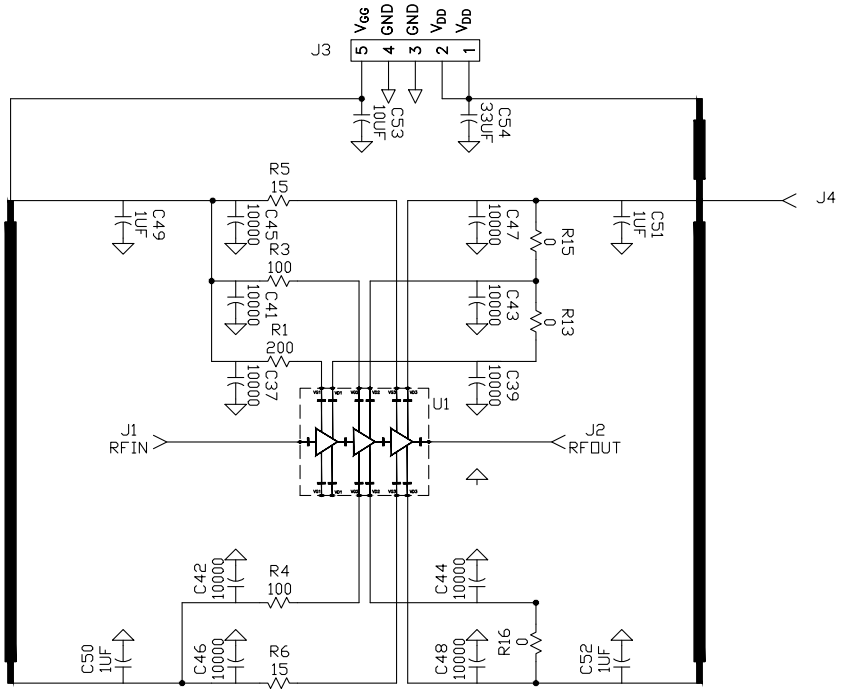
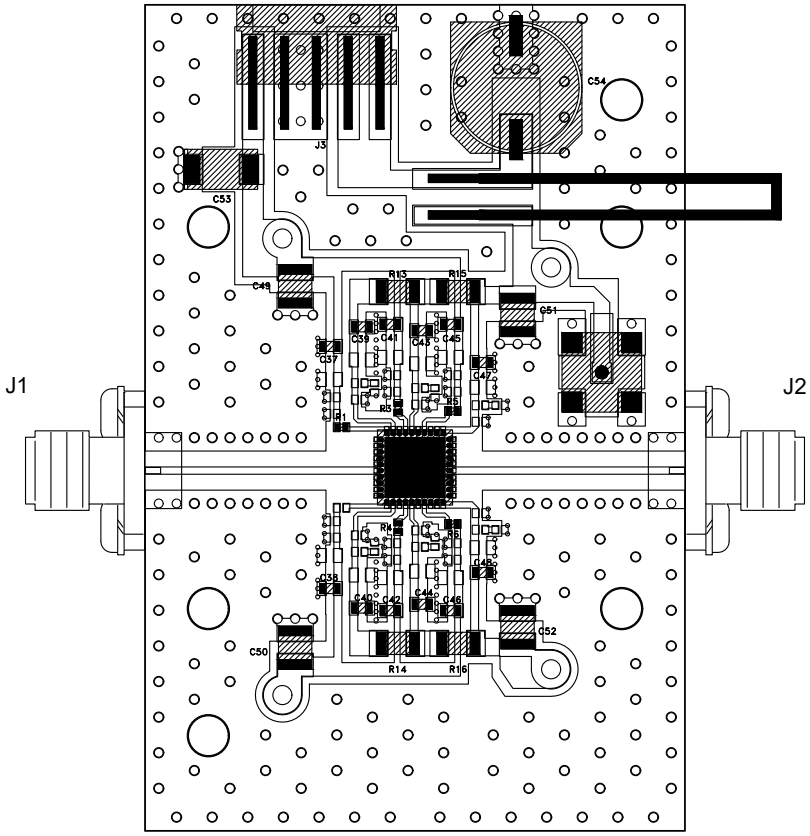


Figure 39. Output RL vs Frequency as a Function of I_{DQ}

CMPA901A020S-AMP1 Application Circuit



CMPA901A020S-AMP1 Evaluation Board Layout



CMPA091A020S-AMP1 Evaluation Board Bill of Materials

Designator	Description	Qty
C37-C48	CAP, 10000 PF, 0603, 100 V, X7R	12
C54	CAP, 33 UF, 20%, G CASE	1
C53	CAP, 10 UF, 16 V, TANTALUM	1
R5, R6	RES 15 OHM, +/-1%, 1/16 W, 0402	4
R3, R4	RES 100 OHM, +/-1%, 1/16 W, 0402	
R1	RES 200 OHM, +/-1%, 1/16 W, 0402	
C49-C52	CAP, 1.0 UF, 100 V, 10%, X7R, 1210	4
R13-R16	RES 0.0 OHM 1/16 W 1206 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 5POS	1
W2, W3	WIRE, BLACK, 20 AWG ~ 2.5”	2
W1	WIRE, BLACK, 20 AWG ~ 3.0”	1
	PCB, EVAL, CMPA901A020S, RF-35TC, .010”	1
	BASEPLATE, 2.6" x 1.7" x 0.25", AL, 6 x 6 QFN	
	2-56 SOC HD SCREW 3/16 SS	4
	2 # 2 SPLIT LOCKWASHER SS	4
U1	MMIC CMPA901A020S	1

Electrostatic Discharge (ESD) Classifications

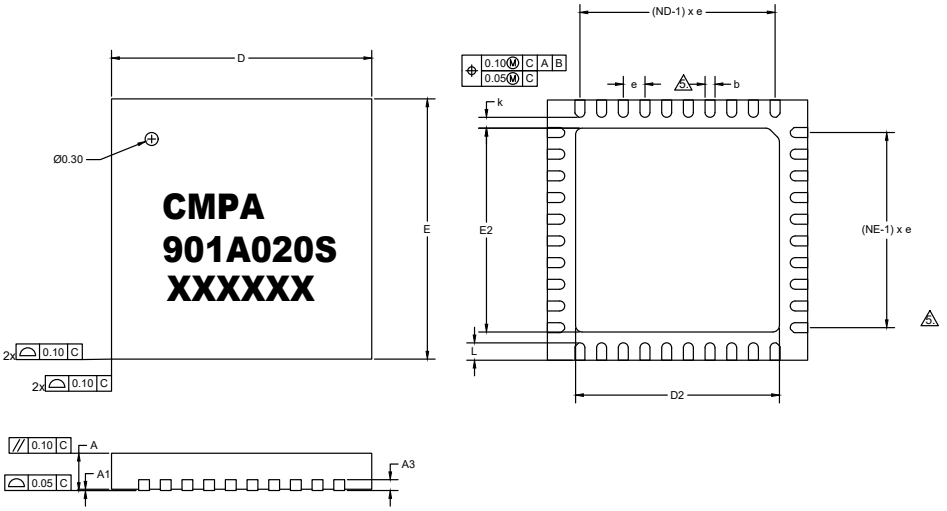
Parameter	Symbol	Class	Test Methodology
Human Body Model	HBM	1 B (≥ 500 V)	JEDEC JESD22 A114-D
Charge Device Model	CDM	II (≥ 200 V)	JEDEC JESD22 C101-C

Moisture Sensitivity Level (MSL) Classification

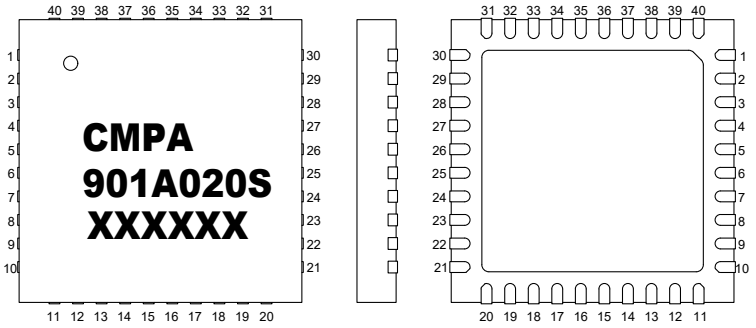
Parameter	Symbol	Level	Test Methodology
Moisture Sensitivity Level	MSL	3 (168 hours)	IPC/JEDEC J-STD-20

Product Dimensions CMPA901A020S (Package 6 x 6 QFN)

1. DIMENSIONING AND TOLERANCING CONFORM TO ASME Y14.5M. - 1994
2. ALL DIMENSIONS ARE IN MILLIMETERS, 0 IS IN DEGREES
3. N IS THE TOTAL NUMBER OF TEMRINALS
4. DIMENSION b APPLIES TO THE METALLIZED TERMINAL AND IS MEASURED BETWEEN 0.15 AND 0.30mm FROM TERMINAL TIP
5. ND AND NE REFER TO THE NUMBER OF TERMINALS ON EACH D AND E SIDE RESPECTIVELY
6. MAX. PACKAGE WARPAGE IS 0.05mm
7. MAXIMUM ALLOWABLE BURRS IS 0.076mm IN ALL DIRECTIONS
8. PIN #1 ID ON TOP WILL BE LASER MARKED
9. B ILATERAL COPLANARITY ZONE APPLIES TO THE EXPOSED HEAT SINK SLUG AS WELL AS THE TERMINALS
10. THIS DRAWING CONFORMS TO JEDEC REGISTERED OUTLINE MO-220
11. ALL PLATED SURFACES ARE TIN 0.010mm +/- 0.005mm



SYM	MIN	NOM	MAX	NOTE
A	0.80	0.86	0.91	
A1	0.00	0.03	0.06	
A3		0.25 REF		
k		0.15 MIN		
D		6.0 BSC		
E		6.0 BSC		
e		0.50 BSC		
N		40		3
ND		10		5
NE		10		5
L	0.35	0.40	0.46	
b	0.20	0.23	0.28	4
D2	4.60	4.70	4.80	
E2	4.60	4.70	4.80	



Pin	Desc.	Pin	Desc.	Pin	Desc.
1	NC	15	VD2A	29	NC
2	NC	16	NC	30	NC
3	NC	17	VG3A	31	VD3B
4	NC	18	NC	32	VD3B
5	RF_GND	19	VD3A	33	NC
6	RF_IN	20	VD3A	34	VG3B
7	RF_GND	21	NC	35	NC
8	NC	22	NC	36	VD2B
9	NC	23	NC	37	VG2B
10	NC	24	RF_GND	38	NC
11	NC	25	RF_OUT	39	VD1B
12	NC	26	RF_GND	40	VG1B
13	NC	27	NC		
14	VG2A	28	NC		

Part Number System

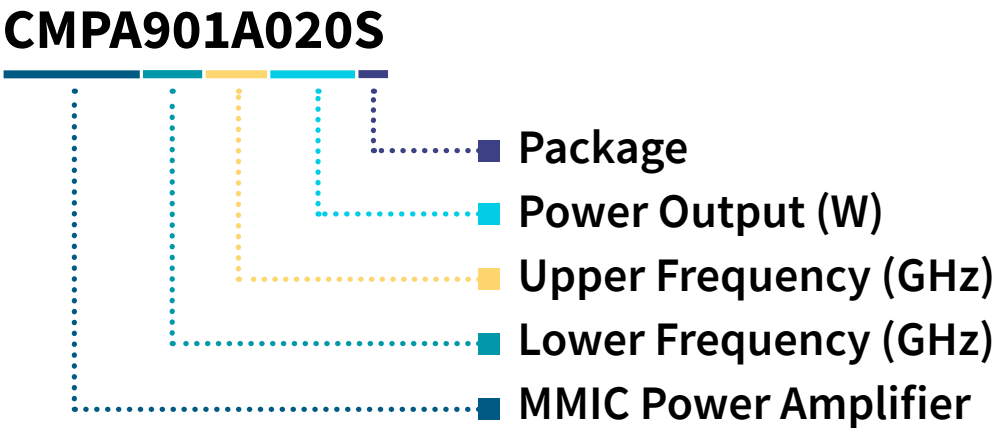


Table 1.

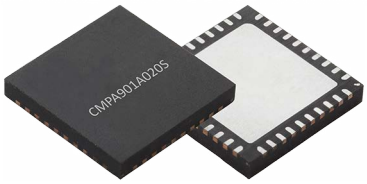
Parameter	Value	Units
Lower Frequency	9.0	GHz
Upper Frequency	10.0	GHz
Power Output	20	W
Package	Surface Mount	–

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
CMPA901A020S	Packaged GaN MMIC PA	Each	
CMPA901A020S-AMP1	Evaluation Board with GaN MMIC Installed	Each	

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