

CMPA9396025S

9.3 - 9.6 GHz, 25 W, Packaged GaN MMIC Power Amplifier

Description

The CMPA9396025S is a GaN MMIC designed specifically from 9.3 - 9.6 GHz to be compact and provide high-efficiency, which makes it ideal for marine radar amplifier applications. The MMIC delivers 25W at 100µsec pulse width and 10% duty cycle. The 50-ohm, 3-stage MMIC is available in a plastic surface-mount package.



Package Type: 6 x 6 QFN PN: CMPA9396025S

Typical Performance Over 9.3 - 9.6 GHz ($T_c = 25^{\circ}$ C)

Parameter	9.3 GHz	9.4 GHz	9.5 GHz	9.6 GHz	Units
Small Signal Gain	36.0	35.9	35.9	36.2	dB
Output Power ¹	37.0	37.5	37.5	37.0	W
Power Gain ¹	26.7	26.7	26.7	26.7	dB
Power Added Efficiency ¹	41	42	42	41	%

Note:

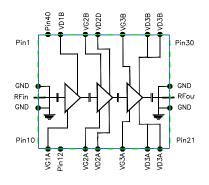
Features

- 9.3 9.6 GHz Operation
- 30 W Typical Output Power
- 27 dB Power Gain
- 50-ohm Matched for Ease of Use
- Plastic Surface-Mount Package, 6x6 mm QFN

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

Applications

- Marine radar
- Military radar





 $^{^{1}}$ P_{IN} = 19 dBm, Pulse Width = 100 μ s; Duty Cycle = 10%, V_D = 40 V, I_{DQ} = 260 mA



Absolute Maximum Ratings (not simultaneous) at 25°C

Parameter	Symbol	Rating	Units	Conditions
Drain-source Voltage	$V_{\scriptscriptstyle DSS}$	120	V	ar°c
Gate-source Voltage	V _{GS}	-10, +2	V_{DC}	25°C
Storage Temperature	T _{STG}	-65, +150	°C	
Maximum Forward Gate Current	I _G	8.6	mA	25°C
Maximum Drain Current	I _{DMAX}	8.6	Α	
Soldering Temperature	Ts	260	°C	

Electrical Characteristics (Frequency = 9.3 GHz to 9.6 GHz unless otherwise stated; $T_c = 25^{\circ}\text{C}$)

Characteristics	Symbol	Min.	Тур.	Max.	Units	Conditions
DC Characteristics ¹						
Gate Threshold Voltage	$V_{GS(th)}$	-3.6	_	-2.4	V	$V_{DS} = 10 \text{ V}, I_{D} = 8.6 \text{ mA}$
Gate Quiescent Voltage	$V_{GS(Q)}$	ı	-2.65	_	V_{DC}	V _{DD} = 40 V, I _{DQ} = 260 mA
Saturated Drain Current ²	I _{DS}	6.2	8.6	_	Α	$V_{DS} = 6.0 \text{ V}, V_{GS} = 2.0 \text{ V}$
Drain-Source Breakdown Voltage	V_{BD}	100	_	_	V	$V_{GS} = -8 \text{ V}, I_D = 8.6 \text{ mA}$
RF Characteristics ^{3,4}						
Small Signal Gain at 9.3 GHz	S21 ₁	_	36.0	_	40	
Small Signal Gain at 9.6 GHz	S21 ₂	_	36.2	_	dB	
Output Power at 9.3 GHz	P _{OUT1}	_	27.0	_	w	V = 40 V L = 260 mA
Output Power at 9.6 GHz	P _{OUT2}	ı	37.0	_	VV	$V_{DD} = 40 \text{ V}, I_{DQ} = 260 \text{ mA}$
Power Added Efficiency at 9.3 GHz	PAE ₁	-	41	_	%	
Power Added Efficiency at 9.6 GHz	PAE ₂	_	41	_	90	
Power Gain	G _P	_	26.0	_		V _{DD} = 40 V, I _{DQ} = 260 mA, P _{IN} = 19 dBm
Input Return Loss	S11	_	-11.4	_	dB	V = 40 V L = 200 mA
Output Return Loss	S22	_	-8.2	_		$V_{DD} = 40 \text{ V}, I_{DQ} = 260 \text{ mA}$
Output Mismatch Stress	VSWR	_	_	3:1	Ψ	No damage at all phase angles, V _{DD} = 40 V, I _{DQ} = 260 mA, P _{IN} = 19 dBm

Notes:

Thermal Characteristics

Parameter	Symbol	Rating	Units	Conditions
Operating Junction Temperature	T _J	225	°C	
Thermal Resistance, Junction to Case (packaged) ¹	R _{θJC}	1.94	°C/W	Pulse Width = 100μs, Duty Cycle =10%

Notes:

 $^{^{\}scriptscriptstyle 1}$ Measured on wafer prior to packaging

² Scaled from PCM data

³ Measured in CMPA9396025S high volume test fixture at 9.3 and 9.6 GHz and may not show the full capability of the device due to source inductance and thermal performance.

 $^{^4}$ P_{IN} = 19 dBm, Pulse Width = 25 μ s; Duty Cycle = 1%

 $^{^{\}rm 1}$ Measured for the CMPA9396025S at P_{DISS} = 28.6 W



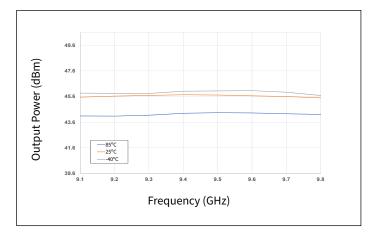


Figure 1. Output Power vs Frequency as a Function of Temperature

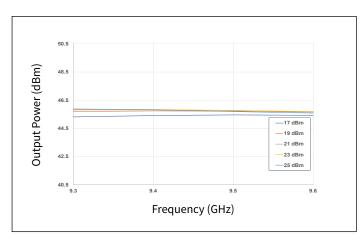


Figure 2. Output Power vs Frequency as a Function of Input Power

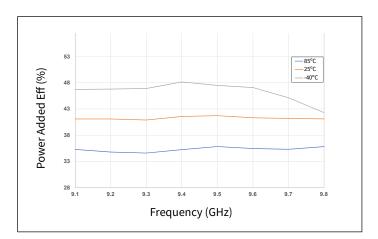


Figure 3. Power Added Eff. vs Frequency as a Function of Temperature

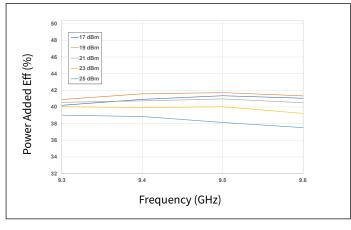


Figure 4. Power Added Eff. vs Frequency as a Function of **Input Power**

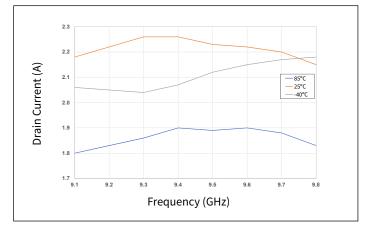


Figure 5. Drain Current vs Frequency as a Function of Temperature

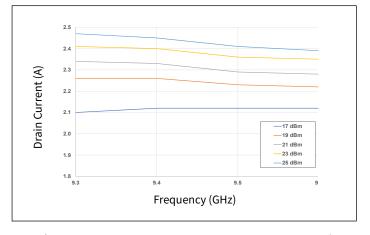


Figure 6. Drain Current vs Frequency as a Function of **Input Power**



Test conditions unless otherwise noted: $V_D = 40 \text{ V}$, $I_{DQ} = 260 \text{ mA}$, $PW = 100 \mu s$, DC = 10%, $P_{IN} = 19 \text{ dBm}$, $T_{BASE} = +25 ^{\circ} C$

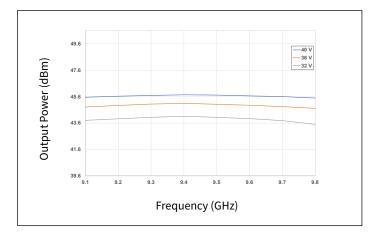


Figure 7. Output Power vs Frequency as a Function of V_D

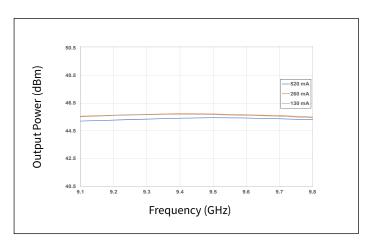


Figure 8. Output Power vs Frequency as a Function of IDQ

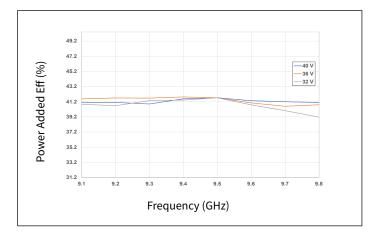


Figure 9. Power Added Eff. vs Frequency as a Function of V_D

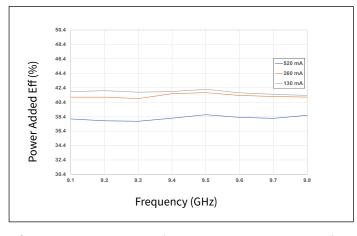


Figure 10. Power Added Eff. vs Frequency as a Function of I_{DO}

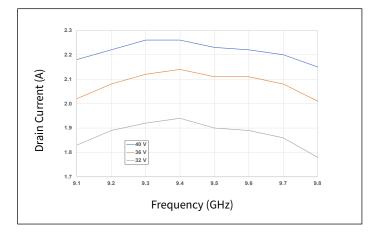


Figure 11. Drain Current vs Frequency as a Function of V_D

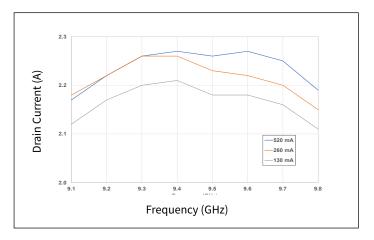


Figure 12. Drain Current vs Frequency as a Function of IDO

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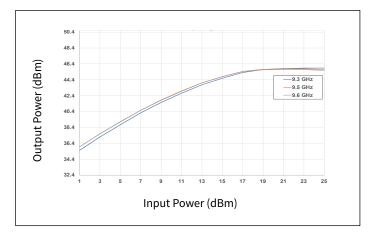


Figure 13. Output Power vs Input Power as a Function of Frequency

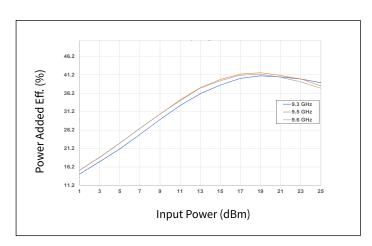


Figure 14. Power Added Eff. vs Input Power as a Function of Frequency

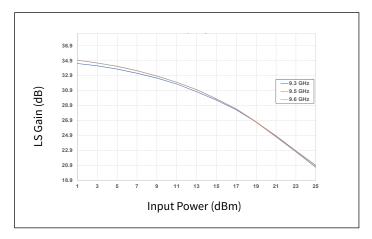


Figure 15. Large Signal Gain vs Input Power as a Function of Frequency

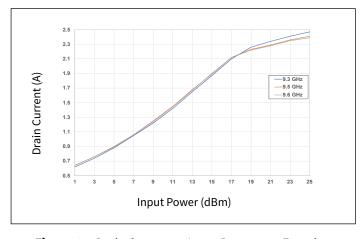


Figure 16. Drain Current vs Input Power as a Function of Frequency

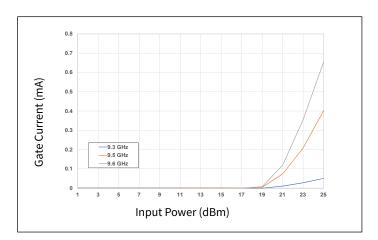


Figure 17. Gate Current vs Input Power as a Function of Frequency



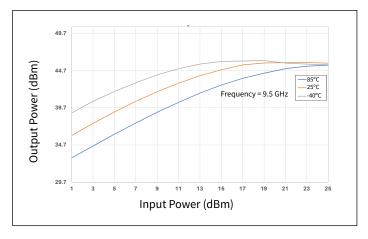
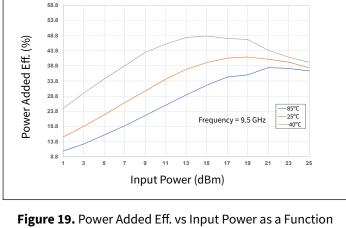


Figure 18. Output Power vs Input Power as a Function of Temperature



of Temperature

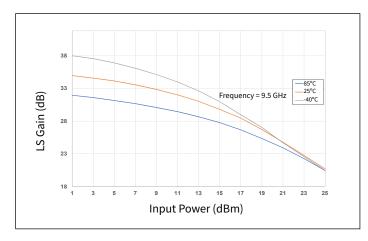


Figure 20. Large Signal Gain vs Input Power as a Function of Temperature

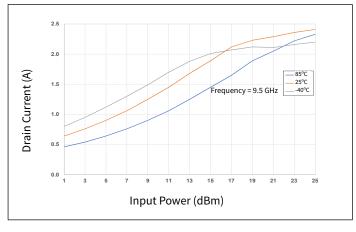


Figure 21. Drain Current vs Input Power as a Function of Temperature

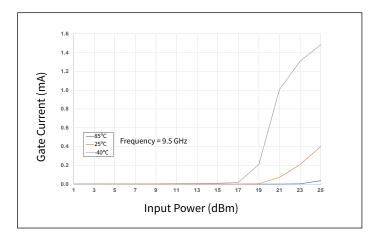


Figure 22. Gate Current vs Input Power as a Function of Temperature



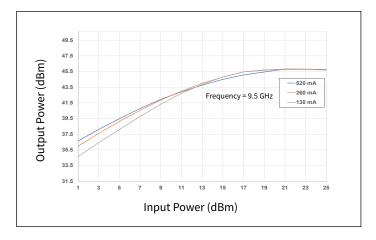


Figure 23. Output Power vs Input Power as a Function of IDQ

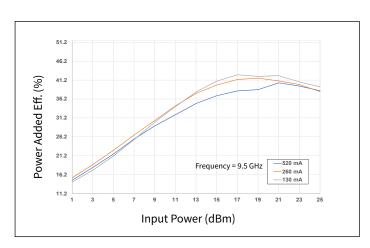


Figure 24. Power Added Eff. vs Input Power as a Function of IDQ



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

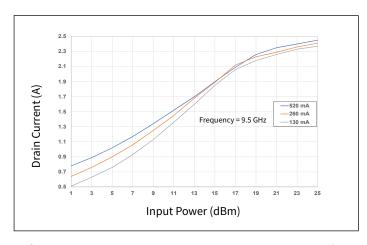


Figure 26. Drain Current vs Input Power as a Function of IDO

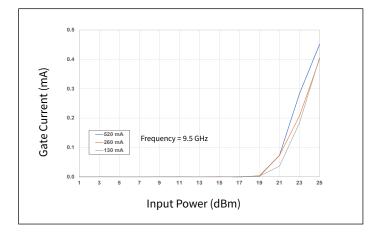


Figure 27. Gate Current vs Input Power as a Function of IDQ



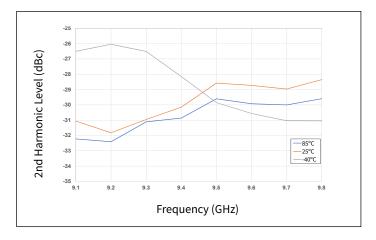


Figure 28. 2nd Harmonic vs Frequency as a Function of Temperature

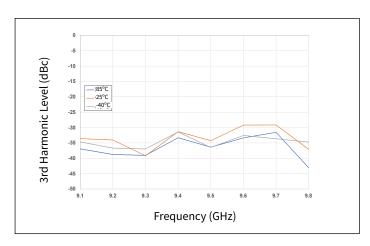


Figure 29. 3rd Harmonic vs Frequency as a Function of Temperature

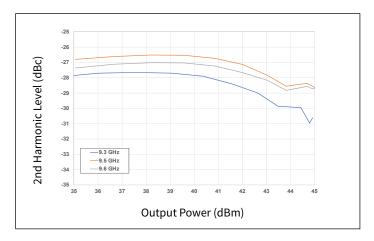


Figure 30. 2nd Harmonic vs Output Power as a Function of Frequency

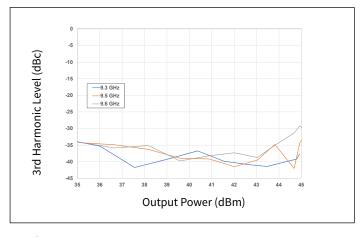


Figure 31. 3rd Harmonic vs Output Power as a Function of Frequency

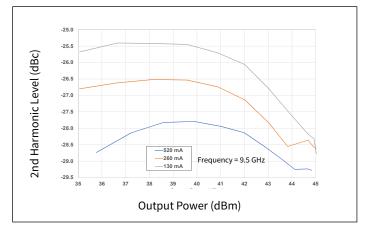


Figure 32. 2nd Harmonic vs Output Power as a Function of I_{DO}



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



Test conditions unless otherwise noted: $V_D = 40 \text{ V}$, $I_{DQ} = 260 \text{ mA}$, $P_{IN} = -30 \text{ dBm}$, $T_{BASE} = +25 ^{\circ}\text{C}$

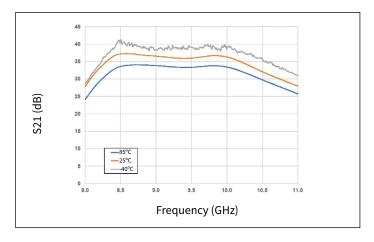


Figure 34. Gain vs Frequency as a Function of Temperature

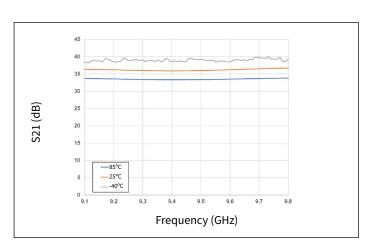


Figure 35. Gain vs Frequency as a Function of Temperature

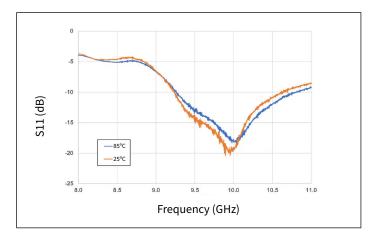


Figure 36. Input RL vs Frequency as a Function of Temperature

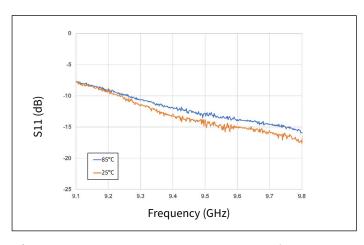


Figure 37. Input RL vs Frequency as a Function of Temperature

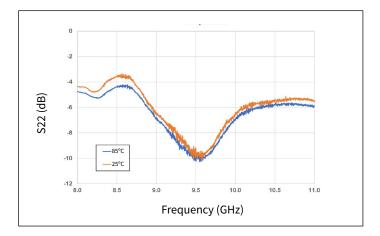


Figure 38. Output RL vs Frequency as a Function of Temperature

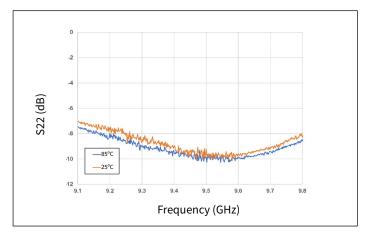


Figure 39. Output RL vs Frequency as a Function of Temperature



Test conditions unless otherwise noted: $V_D = 40 \text{ V}$, $I_{DQ} = 260 \text{ mA}$, $P_{IN} = -30 \text{ dBm}$, $T_{BASE} = +25 ^{\circ}\text{C}$

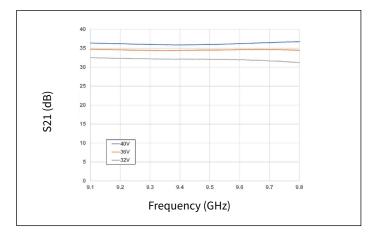


Figure 40. Gain vs Frequency as a Function of Voltage

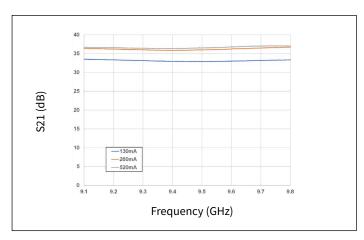


Figure 41. Gain vs Frequency as a Function of IDQ

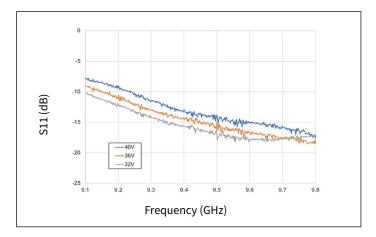


Figure 42. Input RL vs Frequency as a Function Voltage

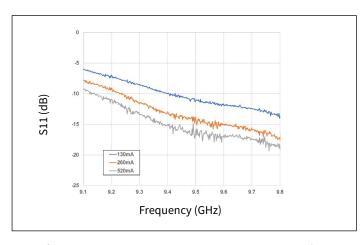


Figure 43. Input RL vs Frequency as a Function of IDO

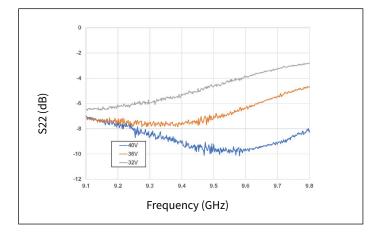


Figure 44. Output RL vs Frequency as a Function of Voltage

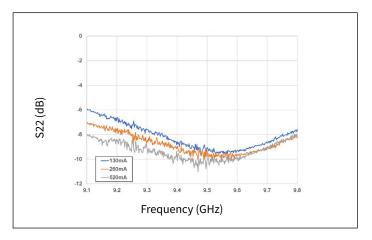
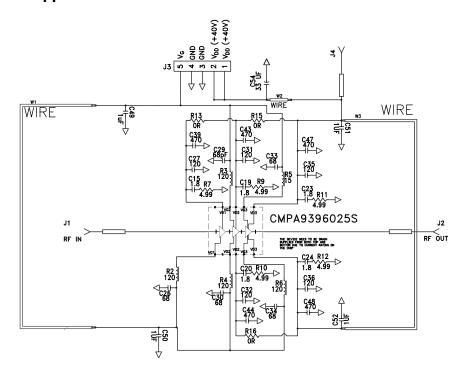


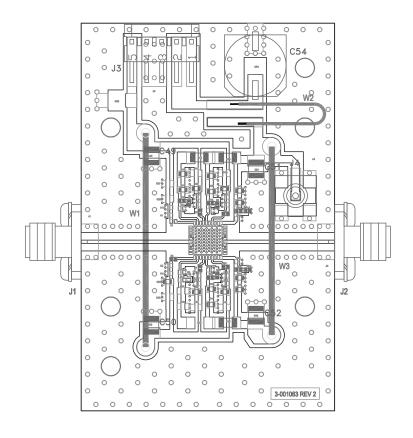
Figure 45. Output RL vs Frequency as a Function of IDQ



CMPA9396025S-AMP1 Application Circuit



CMPA9396025S-AMP1 Evaluation Board Layout





CMPA9396025S-AMP1 Evaluation Board Bill of Materials

Designator	Description	Qty
C54	CAP, 33μF, 20%, G _{CASE}	1
C49, C50, C51, C52	CAP, 1.0μF, 100V, 10%, X7R, 1210	4
C39, C43, C44, C47, C48	CAP, 470pF, 5%, 100V, 0603, X7R	5
C26, C29, C30, C33, C34	CAP, 68pF, +/-5%pF, 0603, ATC	5
C27, C31, C32, C35, C36	CAP, 120pF, +/-5%, C0G, 0603, 100V	5
C15, C19, C20, C23, C24	CAP, 1.8pF, +/-0.05pF, ATC 600L, 0402	5
R2-R6	Ferrite bead, 120 OHM, 600mA, 0402	5
R7, R9-R12	RES 4.99 OHM, +/-1%, 1/16W, 0402	5
R13, R15, R16	RES 0.0 OHM, 1/16W, 1206 SMD	3
J1, J2	CONN, SMA, PANEL MOUNT JACK, FLANGE, 4-HOLE, BLUNT POST, 20MIL	2
J3	HEADER RT>PLZ .1CEN LK 5POS	1
J4	CONN, SMB, STRAIGHT JACK RECEPTACLE, SMT, 50 OHM, Au PLATED	1
W1	WIRE, BLACK, 20 AWG ~ 1.5"	1
W2	WIRE, BLACK, 20 AWG ~ 1.3"	1
W3	WIRE, BLACK, 20 AWG ~ 1.5"	1
	PCB, TEST FIXTURE, RF35, 0.010", 6X6 3-STAGE, QFN	1
	HEATSINK, 6X6 QFN, 3-STAGE 2.600 X 1.700 X 0.250	1
	2-56 SOC HD SCREW 3/16 SS	4
	#2 SPLIT LOCKWASHER SS	4
Q1	CMPA9396025S	1

Electrostatic Discharge (ESD) Classifications

Parameter	Symbol	Class	Classification Level	Test Methodology
Human Body Model	НВМ	1A	ANSI/ESDA/JEDEC JS-001 Table 3	JEDEC JESD22 A114-D
Charge Device Model	CDM	C0b	ANSI/ESDA/JEDEC JS-002 Table 3	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 CMPA9396025S (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

 DIMENSION to 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

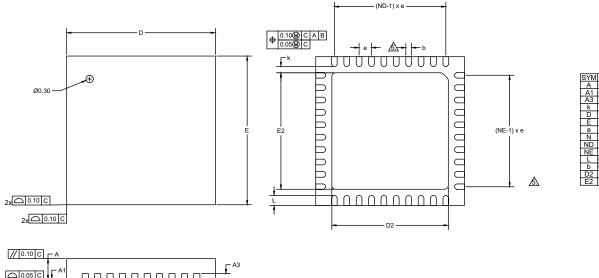
 7. MAXIMUM ALLOWABLE BURRS IS 0.076mm IN ALL DIRECTIONS

 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

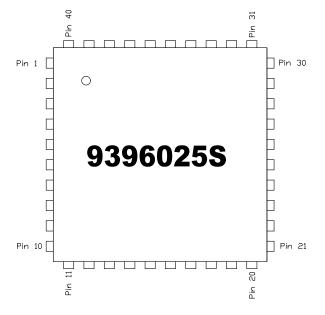
 10. THIS DRAWING CONFORMS TO JEDEC REGISTERED OUTLINE MO-220

 11. ALL PLATED SURFACES ARE TIN 0.010mm +/- 0.005mm



SYM	MIN			NOTE		
Α	0.80	0.86	0.91			
	0.00	0.03				
A3).25 RE				
k).15 MI				
D		6.0 BS				
E	_	6.0 BS	0			
е	0	1.50 BS	C			
N		40		3		
ND		10				
NE		<u>\$</u>				
L	0.35	0.40				
	0.20	0.23		<u>^</u> 5		
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	RFGND	19	VD3A	33	NC
6	RFIN	20	VD3A	34	VG3B
7	RFGND	21	NC	35	NC
8	NC	22	NC	36	VD2B
9	NC	23	NC	37	VG2B
10	NC	24	RFGND	38	NC
11	VG1A	25	RFOUT	39	VD1B
12	NC	26	RFGND	40	NC
13	NC	27	NC		
14	VG2A	28	NC		



Part Number System

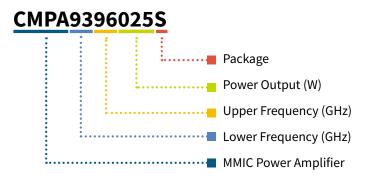


Table 1.

Parameter	Value	Units	
Lower Frequency	9.3	CII-	
Upper Frequency	9.6	GHz	
Power Output	25	W	
Package	Surface Mount	_	

Note:

Table 2.

Character Code	Code Value
А	0
В	1
С	2
D	3
E	4
F	5
G	6
Н	7
J	8
К	9
Examples	1A = 10.0 GHz 2H = 27.0 GHz

¹ Alpha characters used in frequency code indicate a value greater than 9.9 GHz. See Table 2 for value.



Product Ordering Information

Order Number	Description	Unit of Measure	Image
CMPA9396025S	Packaged GaN MMIC PA	Each	CHELLINE TO S
CMPA9396025S-AMP1	Evaluation Board with GaN MMIC Installed	Each	



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