CMPA601C025D

6 - 12 GHz, 40 W GaN HPA

Description

The CMPA601C025D is a 40 W MMIC HPA utilizing the high performance, 0.25 um GaN on SiC production process. The CMPA601C025D operates from 6 - 12 GHz and supports both defense and commercial-related radar and electronic warfare applications. The CM-PA601C025D achieves 40 W of saturated output power with 25 dB of large signal gain and typically 30% power-added efficiency under CW operation.

The CMPA601C025D provides superior, broadband performance allowing customers to improve SWaP-C benchmarks in their next-generation systems.

Figure 1. CMPA601C025D

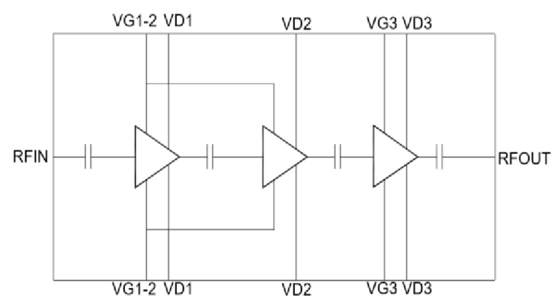


Figure 2. Functional Block Diagram

Features

- P_{SAT}: 40 W
- PAE: 30%
- LSG: 25 dB
- S21: 37 dB
- S11: <-5 dB
- S22: <-5 dB
- CW operation

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

Applications

- Military and commercial radar
- Electronic warfare
- Test instrumentation
- General broadband amplifiers

RoHS compliant

MACOM

Absolute Maximum Ratings

Parameter	Symbol	Units	Value	Conditions
Drain Voltage	V_D	V	28	
Gate Voltage	V_G	V	-10, +2	
Drain Current	I_D	A	7.1	
Gate Current	I_G	mA	15	
Input Power	P_{IN}	dBm	26	CW
Dissipated Power	P_{DISS}	W	120	85 °C
Storage Temperature	T_{STG}	°C	-65, +150	
Mounting Temperature	T_J	°C	260	30 Seconds
Junction Temperature	T_J	°C	225	MTTF > 1E6
Output Mismatch Stress	VSWR	Ψ	5:1	

Recommended Operating Conditions

Parameter	Symbol	Units	Typical Value	Conditions
Drain Voltage	V_D	V	28	
Gate Voltage	V_G	V	-2.8	
Drain Current	I_{DQ}	A	2	
Input Power	P_{IN}	dBm	22	
Case Temperature	T_{CASE}	°C	-40 to 85	

RF Specifications[1]

Test conditions unless otherwise noted: V_D = 28 V, I_{DQ} = 2400 mA, PW = 10 us, DC = 0.1%, T_{BASE} = 25 °C

Parameter	Units	Frequency	Min.	Typical	Max.	Conditions
Frequency	GHz		6		12	
Output Power	dBm	6	45.5	47		P_{IN} = 19 dBm
		10	45.5	47		
		12	45.5	47		
Power-Added Efficiency	%	6	23	30		P_{IN} = 19 dBm
		10	23.3	32		
		12	23.7	31		
LSG	dB	6		28		P_{IN} = 19 dBm
		10		28		
		12		28		
Small-Signal Gain (S21)	dB	6	29.8	35		P_{IN} = 10 dBm
		10	30.2	35		
		12	27.8	35		
Input Return Loss	dB			-10		
Output Return Loss	dB			-8		

Note:
[1] Above RF specifications are screened at on-wafer probe under short pulse operation. Subsequent data plots in this document represent fixture performance under CW operation as noted.

Large Signal Performance versus Temperature

Test conditions unless otherwise noted: V_D = 28 V, I_{DQ} = 2000 mA, CW, P_{IN} = 22 dBm, T_{BASE} = 25 °C, frequency = 9.5 GHz

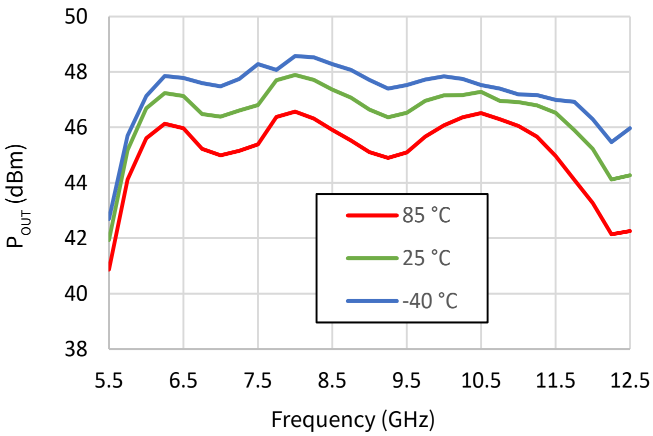


Figure 3. P_{OUT} v. Frequency v. Temperature

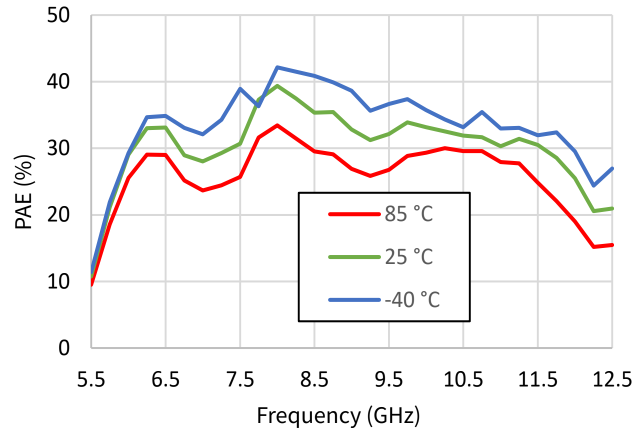


Figure 4. PAE v. Frequency v. Temperature

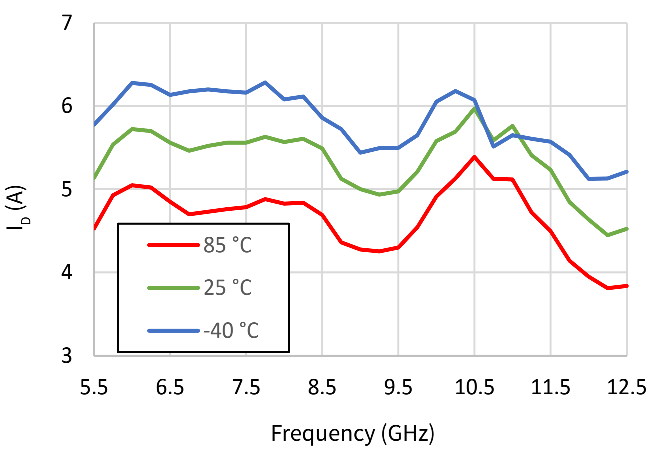


Figure 5. I_D v. Frequency v. Temperature

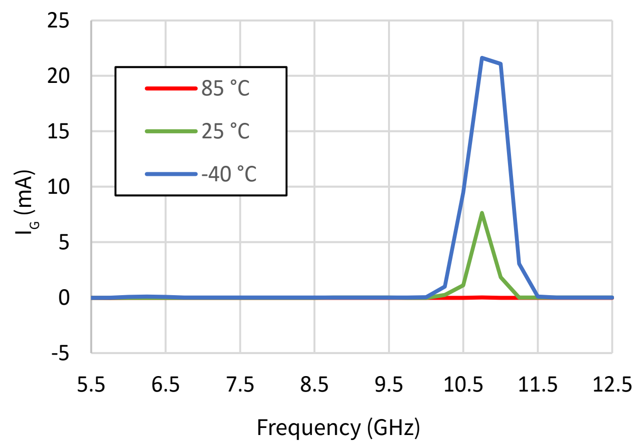


Figure 6. I_G v. Frequency v. Temperature

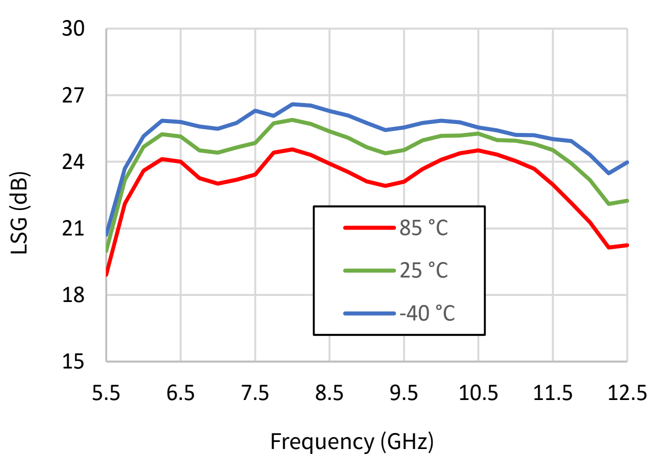


Figure 7. LSG v. Frequency v. Temperature

Large Signal Performance versus V_D

Test conditions unless otherwise noted: V_D = 28 V, I_{DQ} = 2000 mA, CW, P_{IN} = 22 dBm, T_{BASE} = 25 °C, frequency = 9.5 GHz

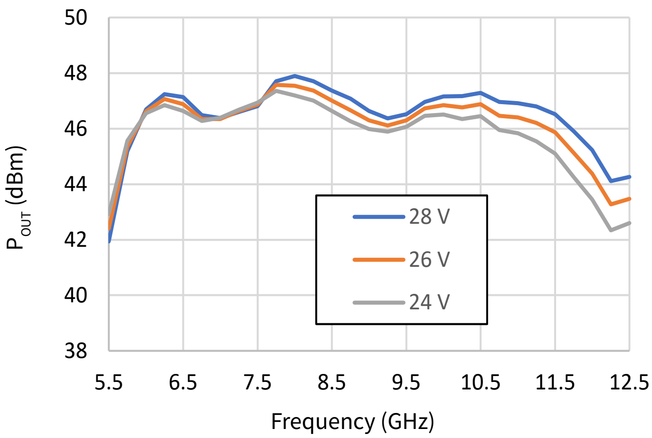


Figure 8. P_{OUT} v. Frequency v. V_D

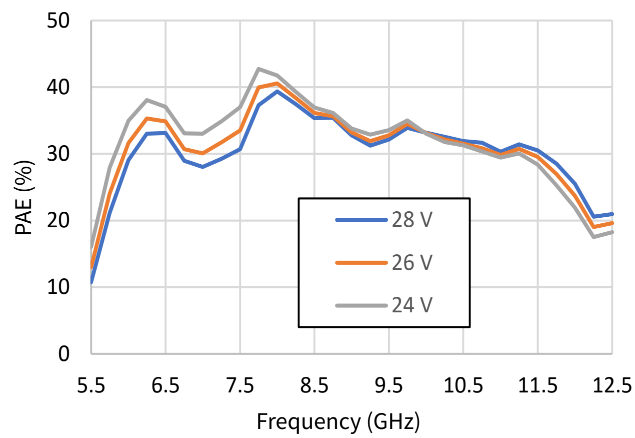


Figure 9. PAE v. Frequency v. V_D

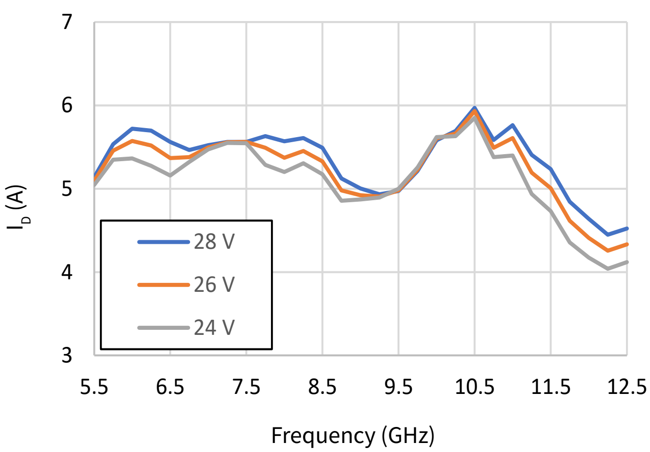


Figure 10. I_D v. Frequency v. V_D

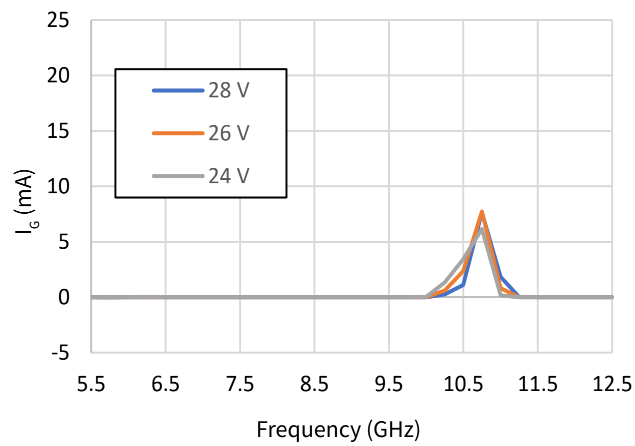


Figure 11. I_G v. Frequency v. V_D

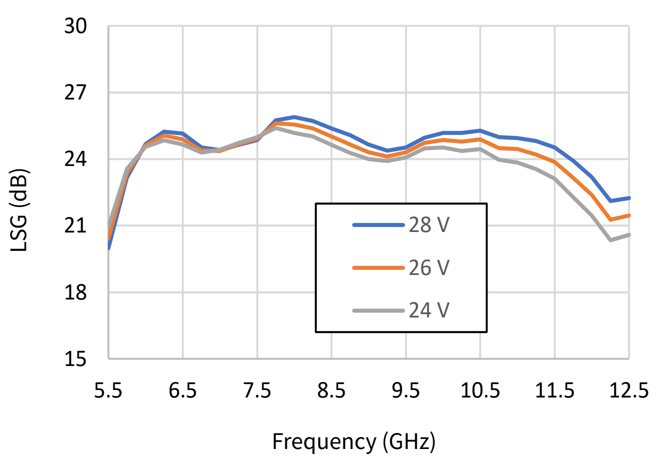


Figure 12. LSG v. Frequency v. V_D

Large Signal Performance versus I_{DQ}

Test conditions unless otherwise noted: V_D = 28 V, I_{DQ} = 2000 mA, CW, P_{IN} = 22 dBm, T_{BASE} = 25 °C, frequency = 9.5 GHz

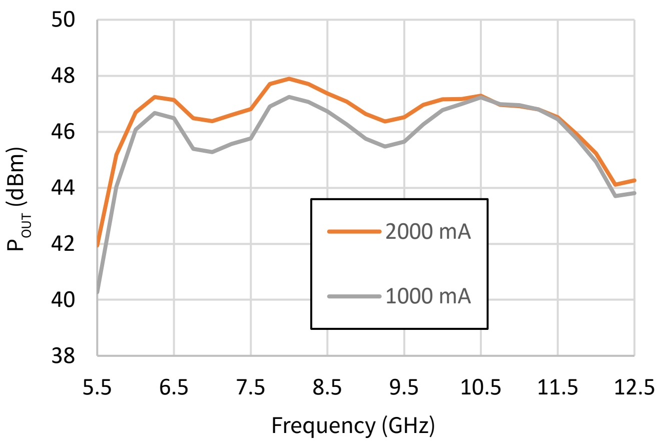


Figure 13. P_{OUT} v. Frequency v. I_{DQ}

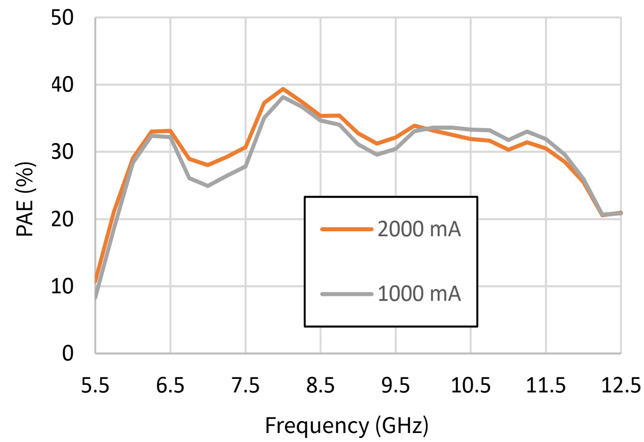


Figure 14. PAE v. Frequency v. I_{DQ}

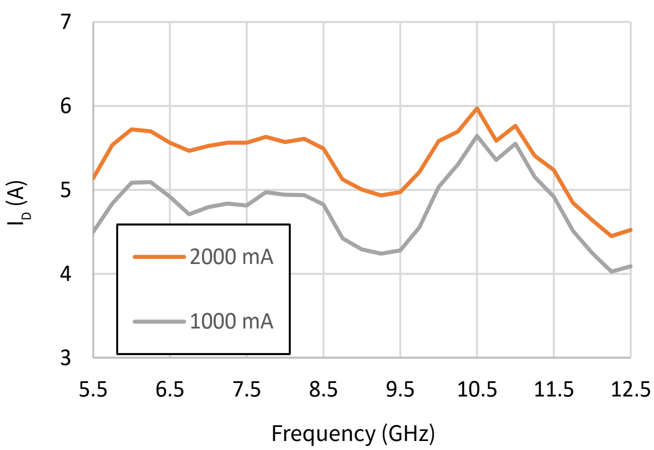


Figure 15. I_D v. Frequency v. I_{DQ}

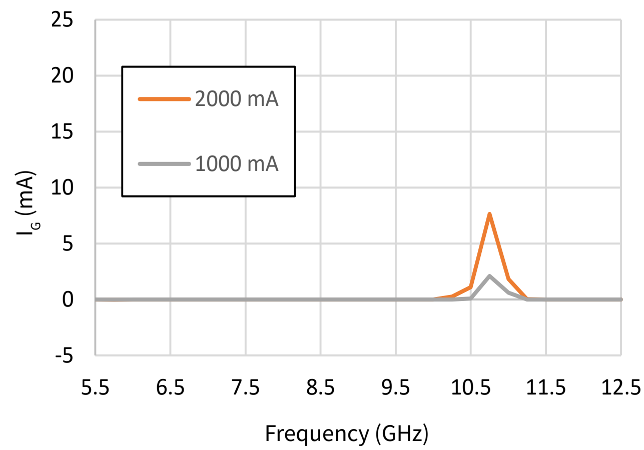


Figure 16. I_G v. Frequency v. I_{DQ}

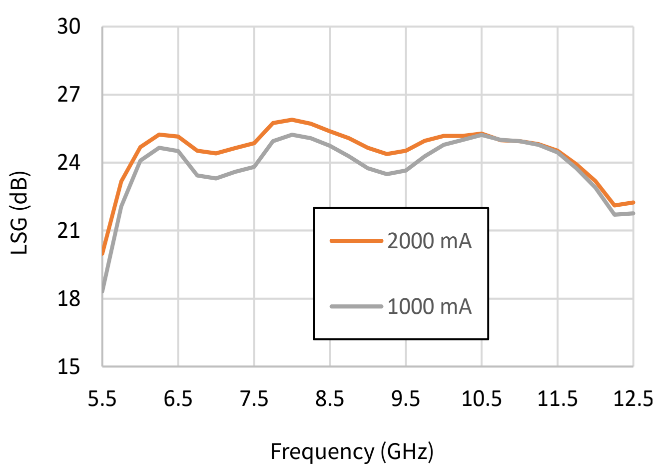


Figure 17. LSG v. Frequency v. I_{DQ}

Drive-Up versus Frequency

Test conditions unless otherwise noted: V_D = 28 V, I_{DQ} = 2000 mA, CW, P_{IN} = 22 dBm, T_{BASE} = 25 °C, frequency = 9.5 GHz

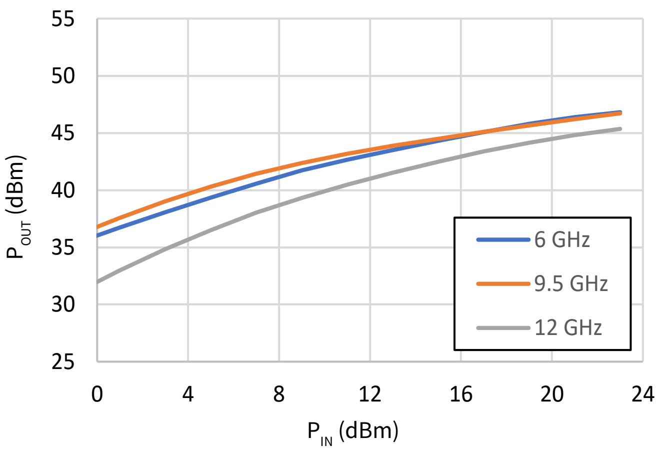


Figure 18. P_{OUT} v. P_{IN} v. Frequency

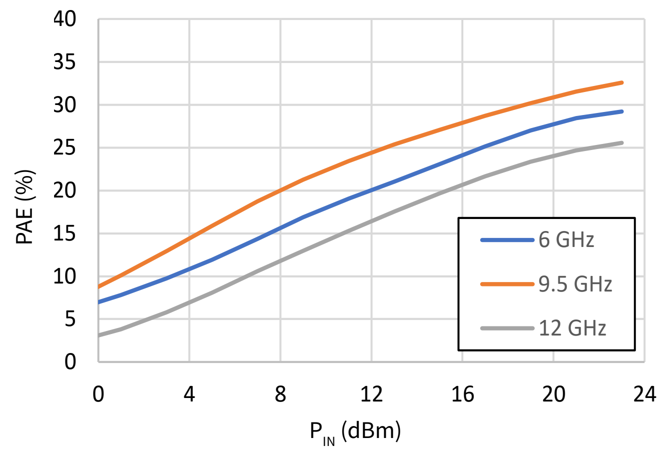


Figure 19. PAE v. P_{IN} v. Frequency

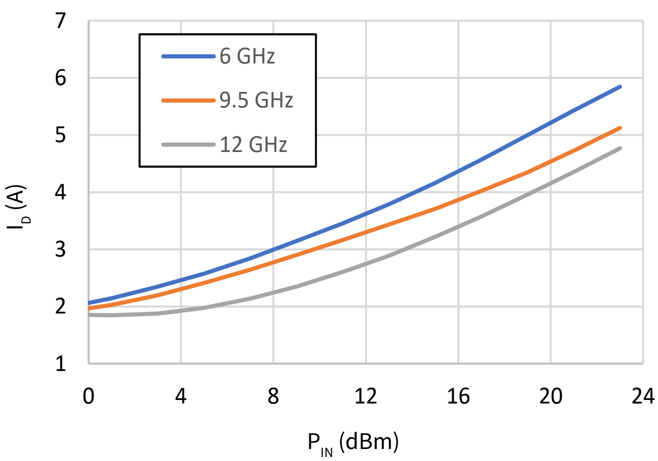


Figure 20. I_D v. P_{IN} v. Frequency

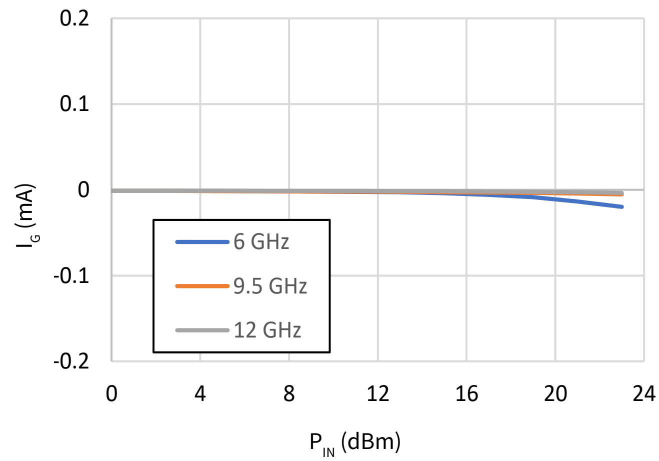


Figure 21. I_G v. P_{IN} v. Frequency

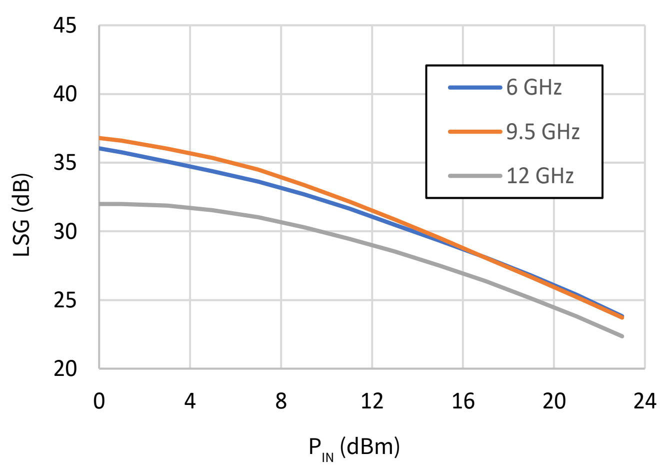


Figure 22. Gain v. P_{IN} v. Frequency

Drive-Up versus Temperature

Test conditions unless otherwise noted: V_D = 28 V, I_{DQ} = 2000 mA, CW, P_{IN} = 22 dBm, T_{BASE} = 25 °C, frequency = 9.5 GHz

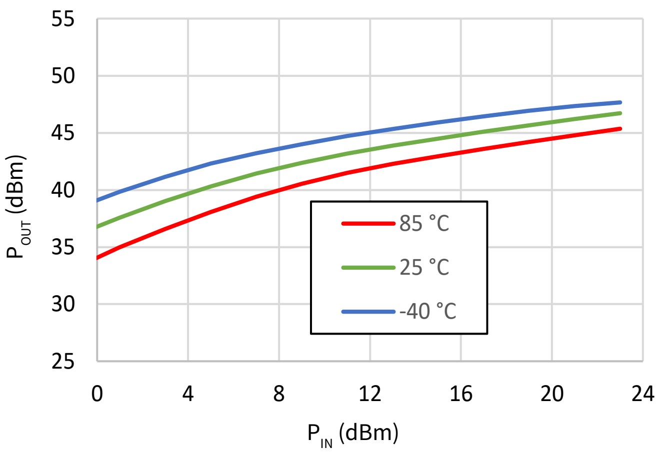


Figure 23. P_{OUT} v. P_{IN} v. Temperature

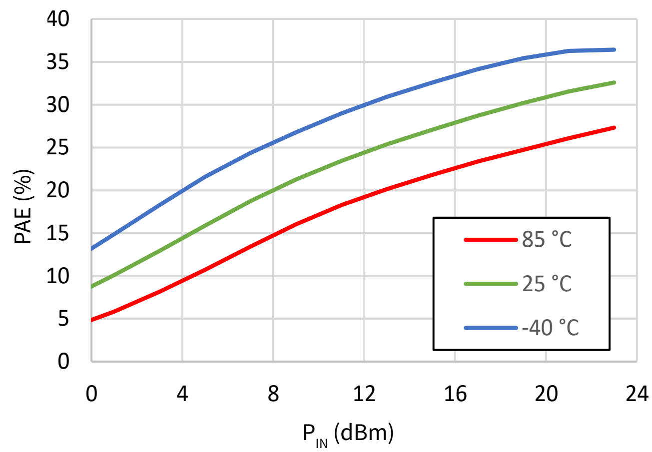


Figure 24. PAE v. P_{IN} v. Temperature

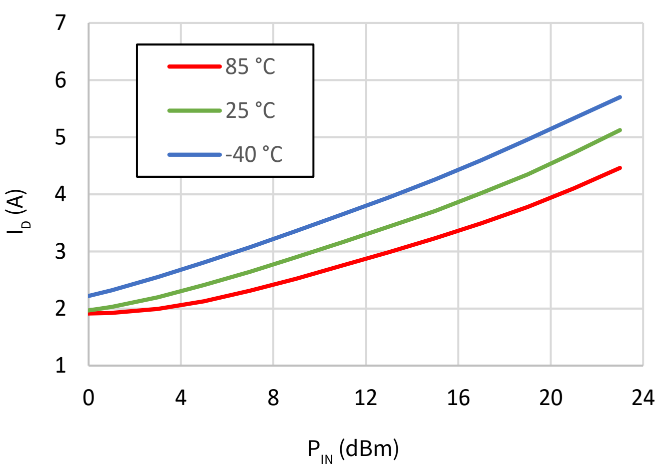


Figure 25. I_D v. P_{IN} v. Temperature

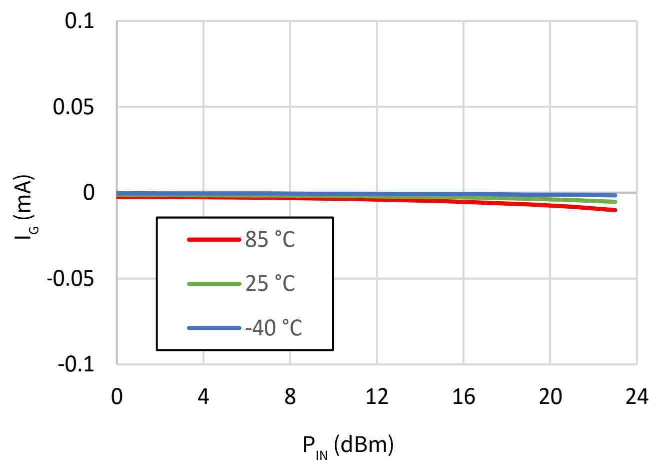


Figure 26. I_G v. P_{IN} v. Temperature

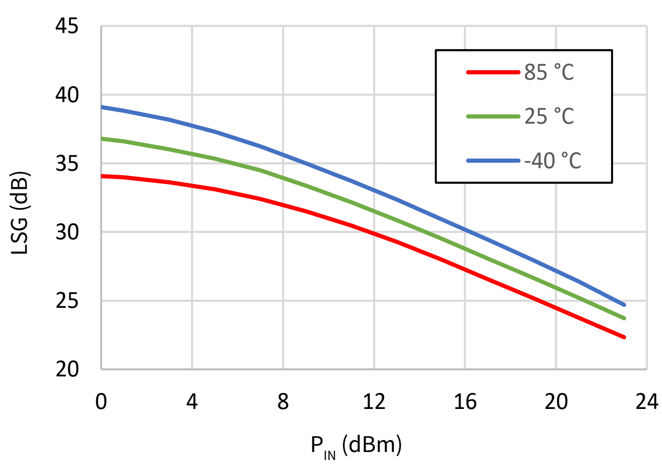


Figure 27. Gain v. P_{IN} v. Temperature

Drive-Up versus V_D

Test conditions unless otherwise noted: V_D = 28 V, I_{DQ} = 2000 mA, CW, P_{IN} = 22 dBm, T_{BASE} = 25 °C, frequency = 9.5 GHz

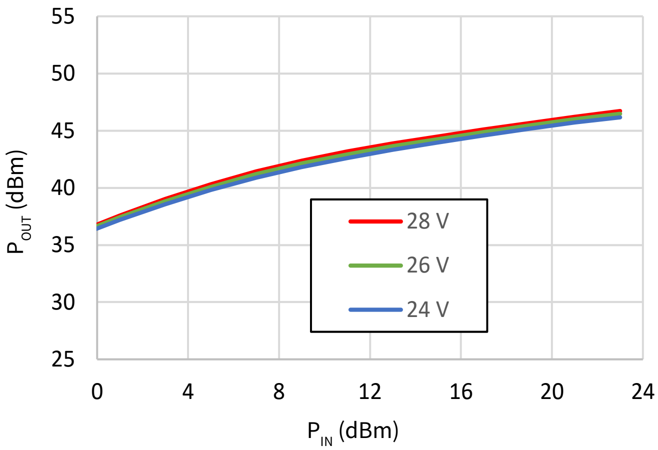


Figure 28. P_{OUT} v. P_{IN} v. V_D

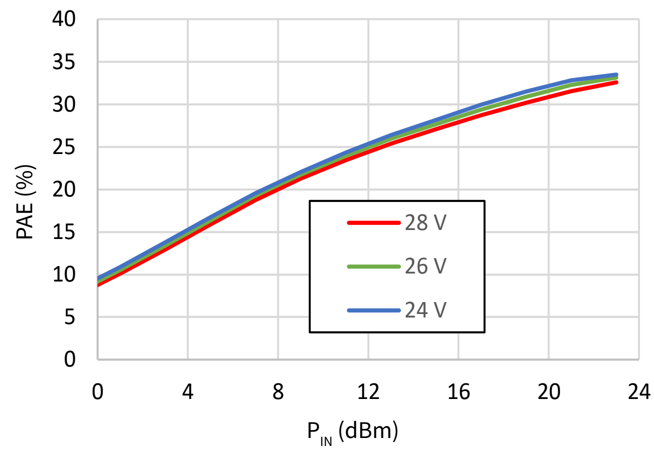


Figure 29. PAE v. P_{IN} v. V_D

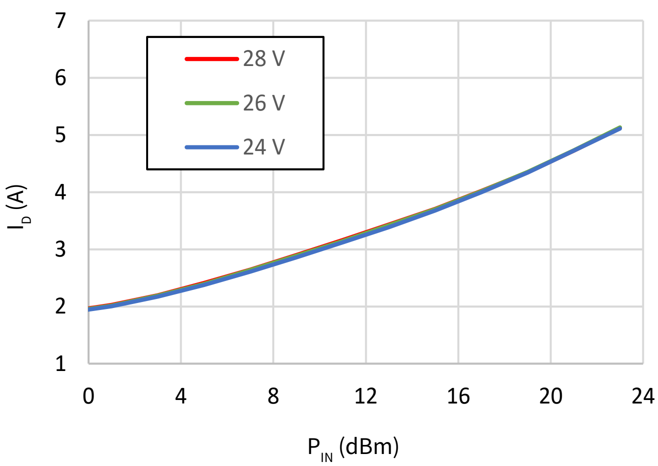


Figure 30. I_D v. P_{IN} v. V_D

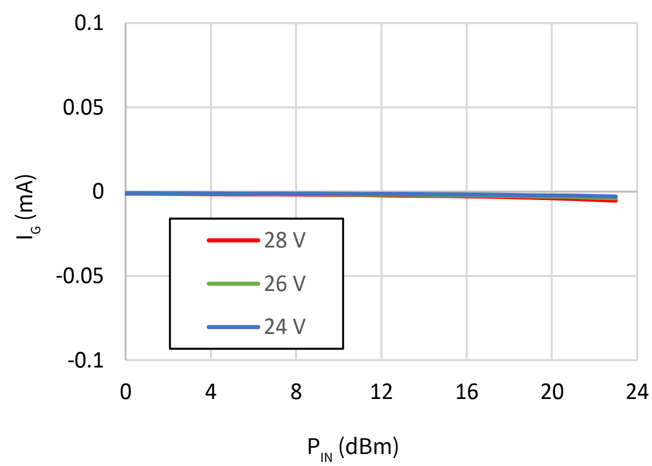


Figure 31. I_G v. P_{IN} v. V_D

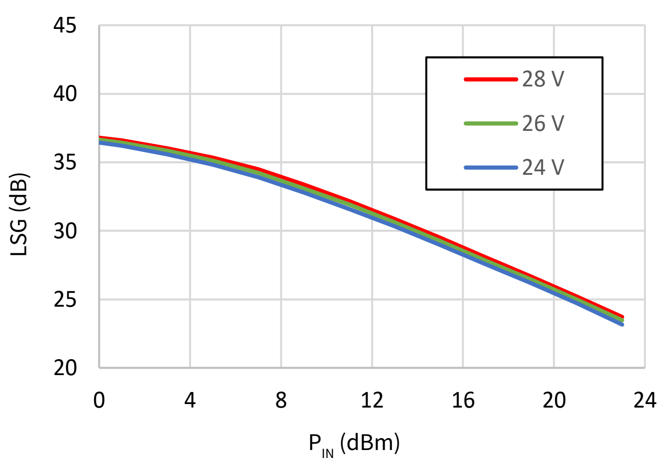


Figure 32. Gain v. P_{IN} v. V_D

Drive-Up versus I_{DQ}

Test conditions unless otherwise noted: V_D = 28 V, I_{DQ} = 2000 mA, CW, P_{IN} = 22 dBm, T_{BASE} = 25 °C, frequency = 9.5 GHz

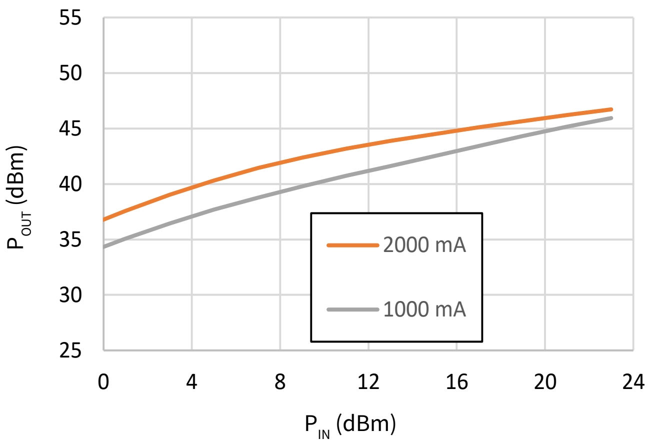


Figure 33. P_{OUT} v. P_{IN} v. I_{DQ}

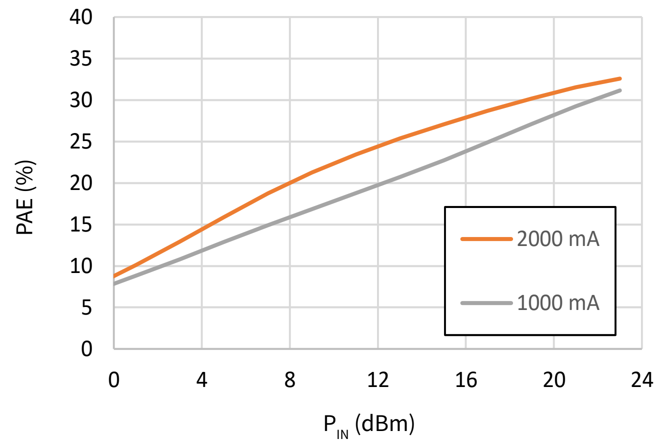


Figure 34. PAE v. P_{IN} v. I_{DQ}

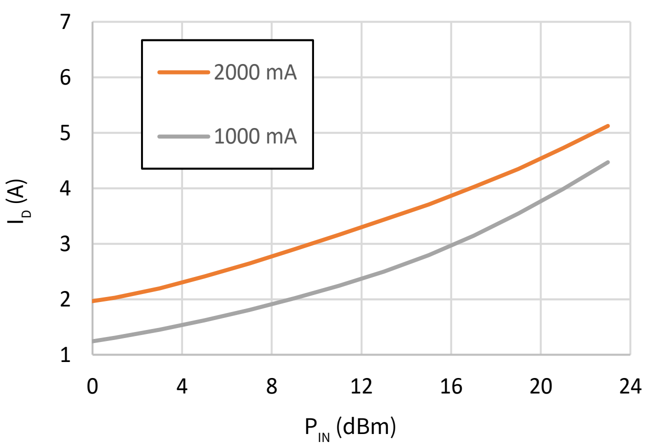


Figure 35. I_D v. P_{IN} v. I_{DQ}

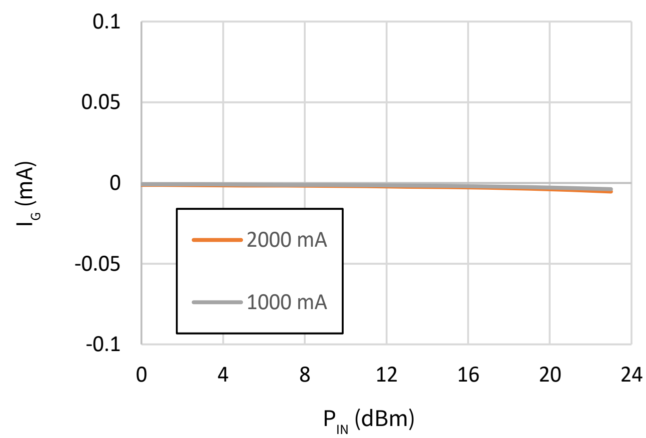


Figure 36. I_G v. P_{IN} v. I_{DQ}

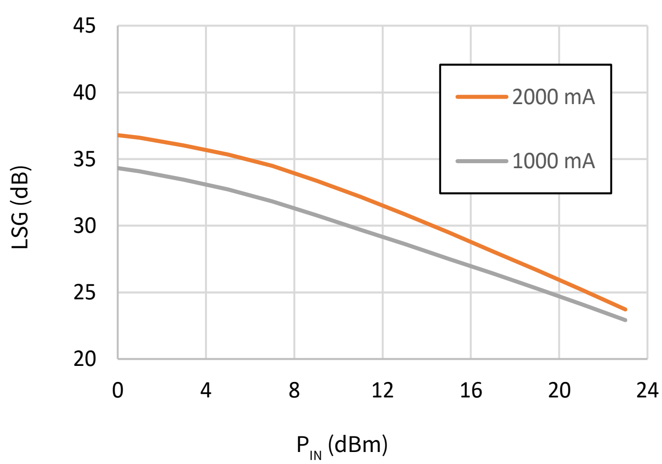


Figure 37. Gain v. P_{IN} v. I_{DQ}

Small Signal v. Temperature and V_D

Test conditions unless otherwise noted: V_D = 28 V, I_{DQ} = 2000 mA, P_{IN} = -30 dBm, T_{BASE} = 25 °C

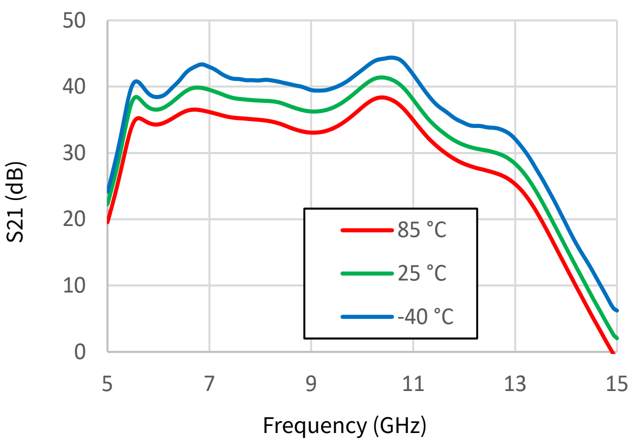


Figure 38. S21 v. Frequency v. Temperature

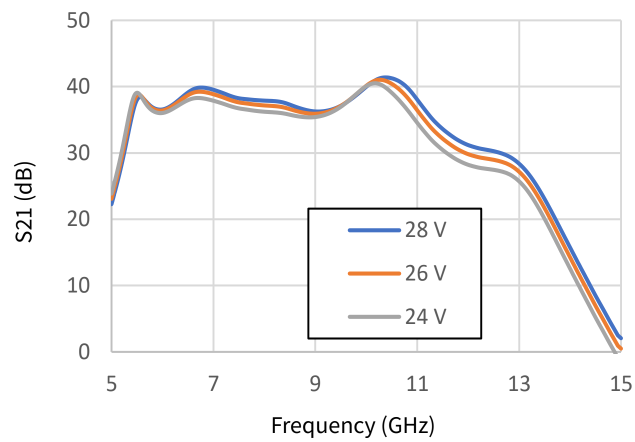


Figure 39. S21 v. Frequency v. V_D

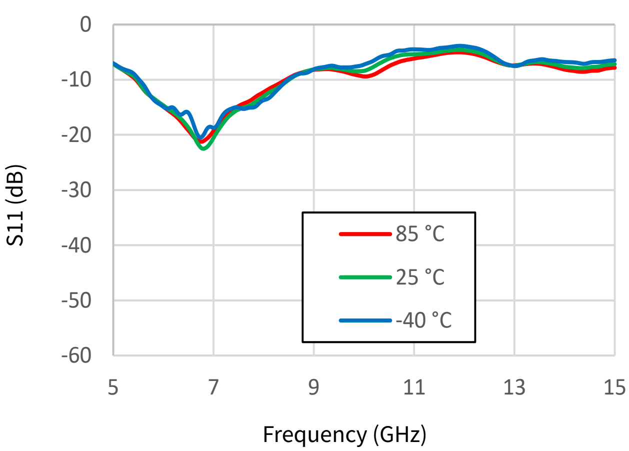


Figure 40. S11 v. Frequency v. Temperature

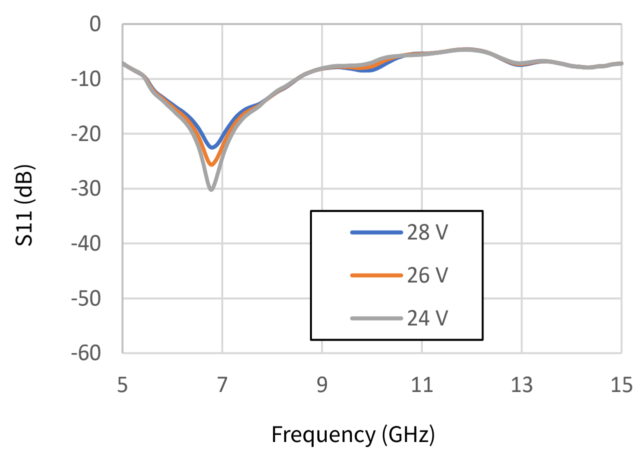


Figure 41. S11 v. Frequency v. V_D

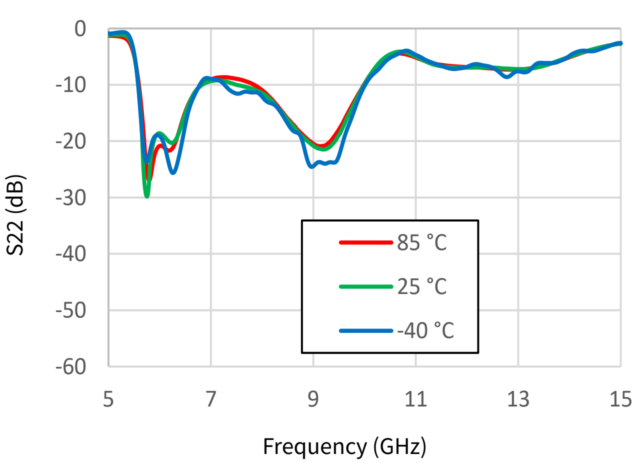


Figure 42. S22 v. Frequency v. Temperature

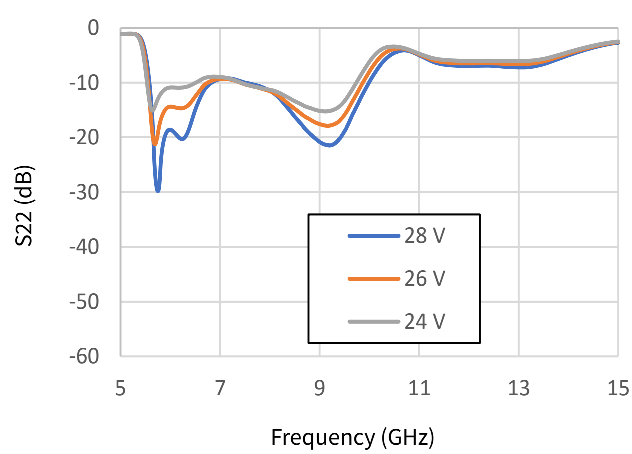


Figure 43. S22 v. Frequency v. V_D

Small Signal v. I_{DQ}

Test conditions unless otherwise noted: V_D = 28 V, I_{DQ} = 2000 mA, P_{IN} = -30 dBm, T_{BASE} = 25 °C

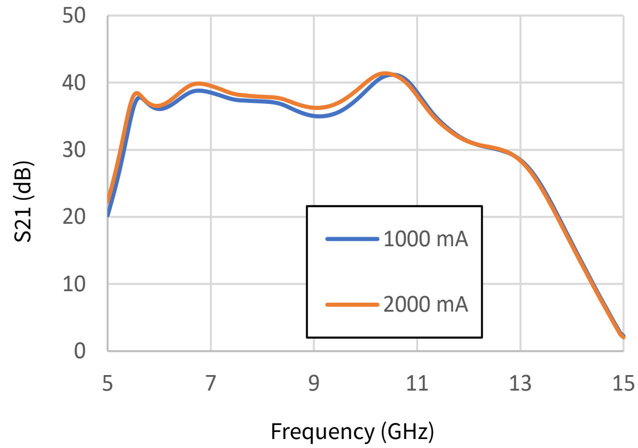


Figure 44. S21 v. Frequency v. I_{DQ}

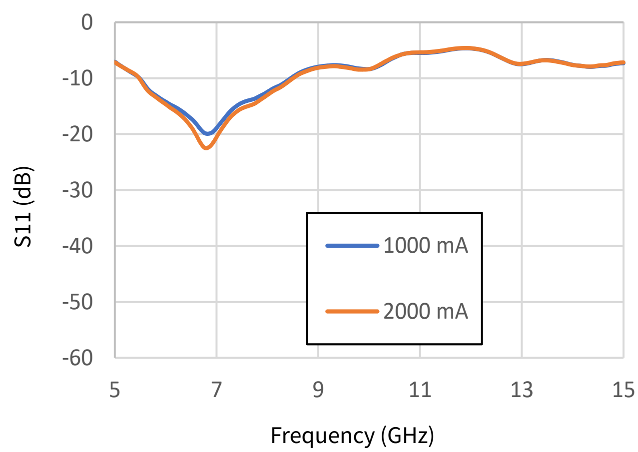


Figure 45. S11 v. Frequency v. I_{DQ}

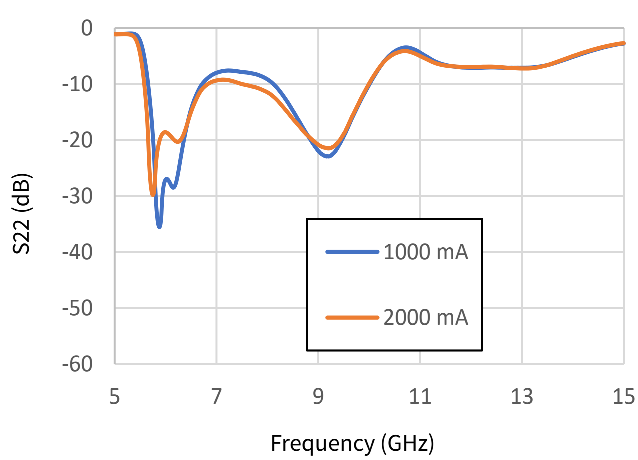


Figure 46. S22 v. Frequency v. I_{DQ}

Harmonics

Test conditions unless otherwise noted: V_D = 28 V, I_{DQ} = 2000 mA, CW, P_{IN} = 22 dBm, T_{BASE} = 25 °C

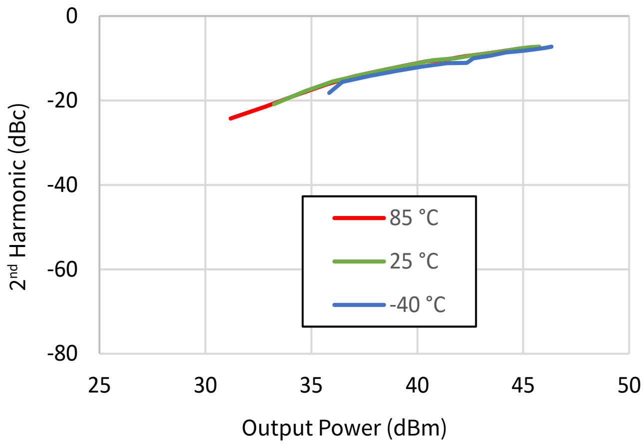


Figure 47. 2f v. P_{OUT} v. Temperature, 6 GHz

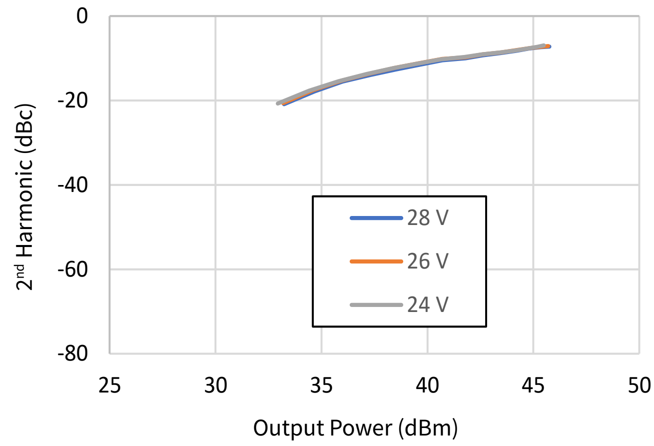


Figure 48. 2f v. P_{OUT} v. V_D, 6 GHz

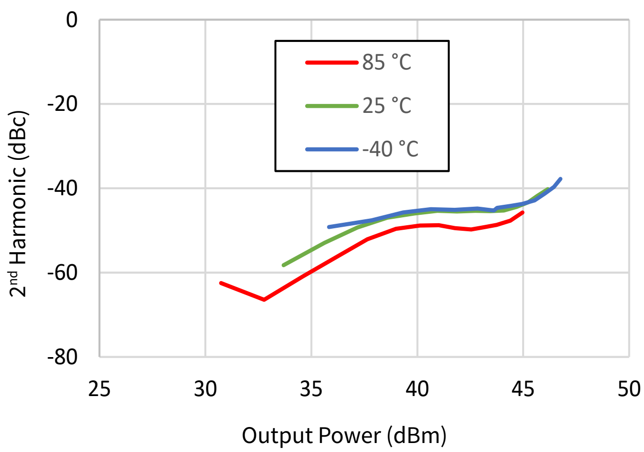


Figure 49. 2f v. P_{OUT} v. Temperature, 9.5 GHz

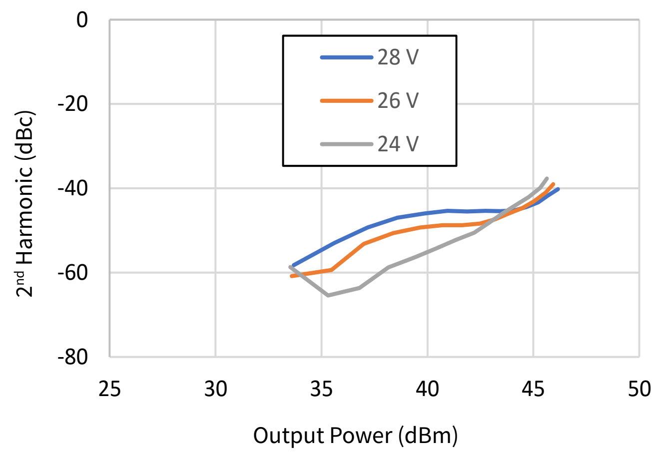


Figure 50. 2f v. P_{OUT} v. V_D, 9.5 GHz

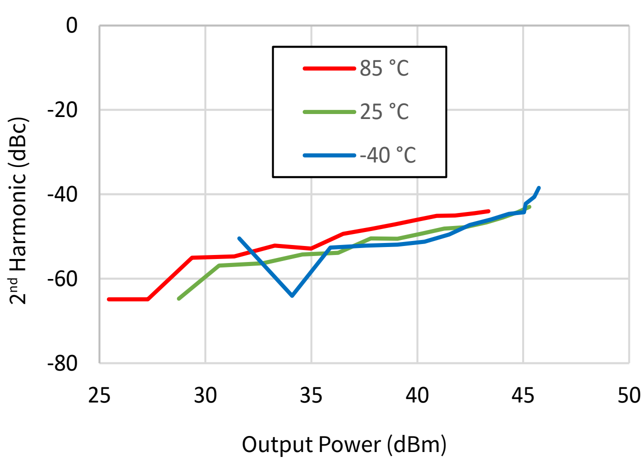


Figure 51. 2f v. P_{OUT} v. Temperature, 12 GHz

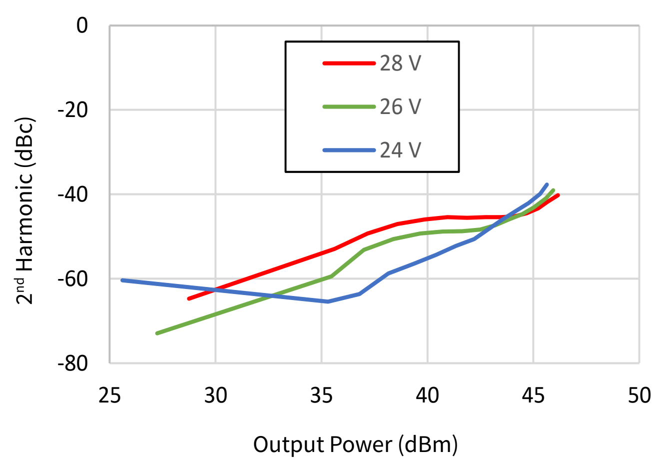
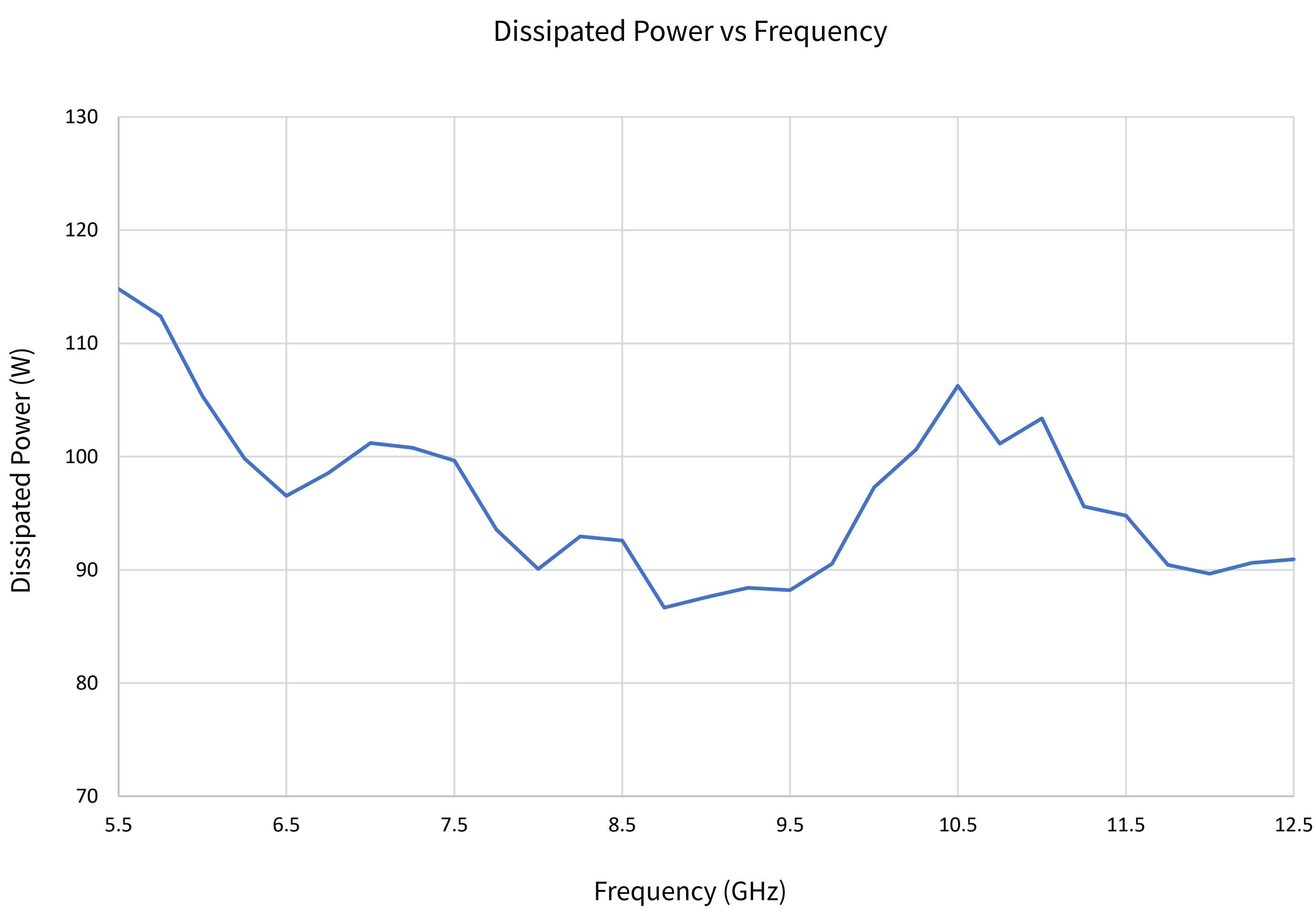


Figure 52. 2f v. P_{OUT} v. V_D, 12 GHz

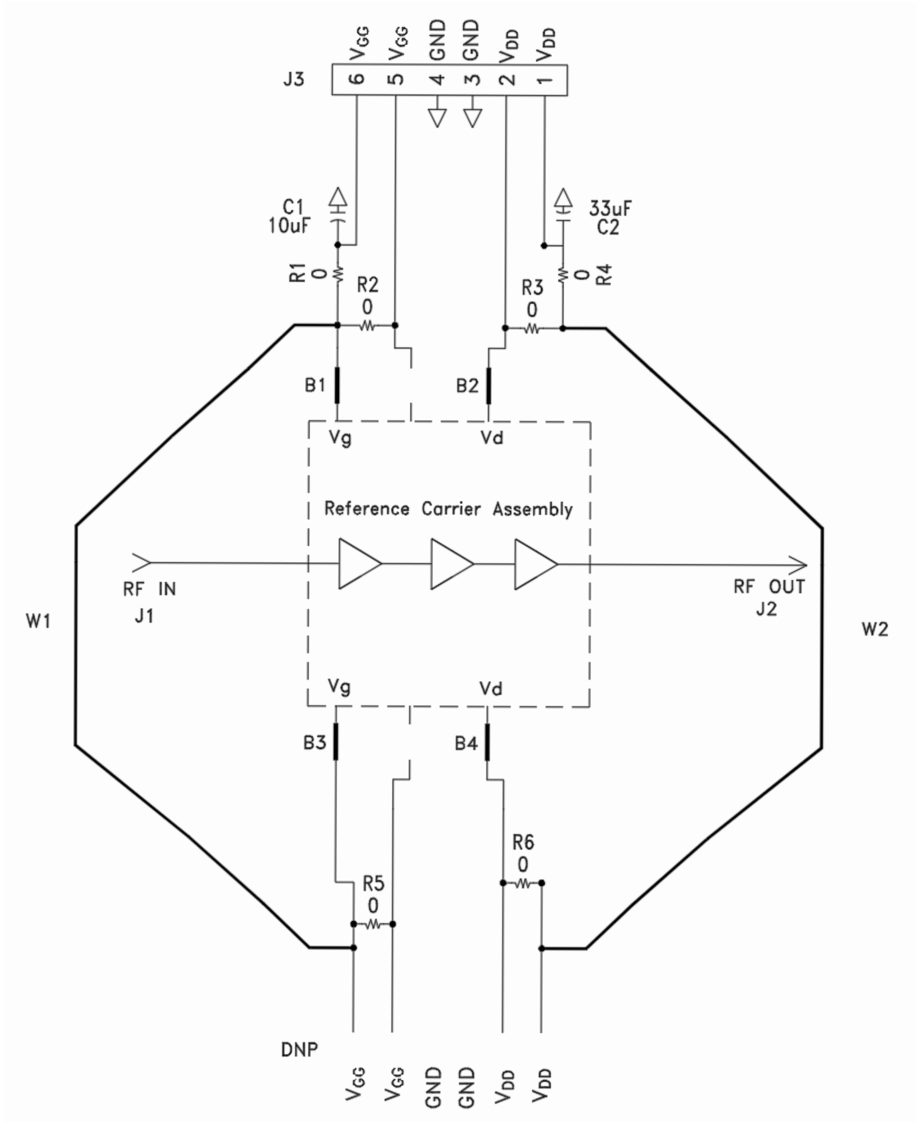
Thermal Characteristics

Parameter	Symbol	Value	Operating Conditions
Operating Junction Temperature	T_J	116.5 °C	Freq = 9 GHz, V_D = 28 V, I_{DQ} = 2 A, I_{DRIVE} = 4.28 A, P_{IN} = 22 dBm, P_{OUT} = 45.1 dBm, P_{DISS} = 87.6 W, T_{BASE} = 85 °C, CW
Thermal Resistance, Junction to Back of Die	$R_{\theta JC}$	0.36 °C/W	

Power Dissipation vs Frequency (T_{CASE} = 85 °C)



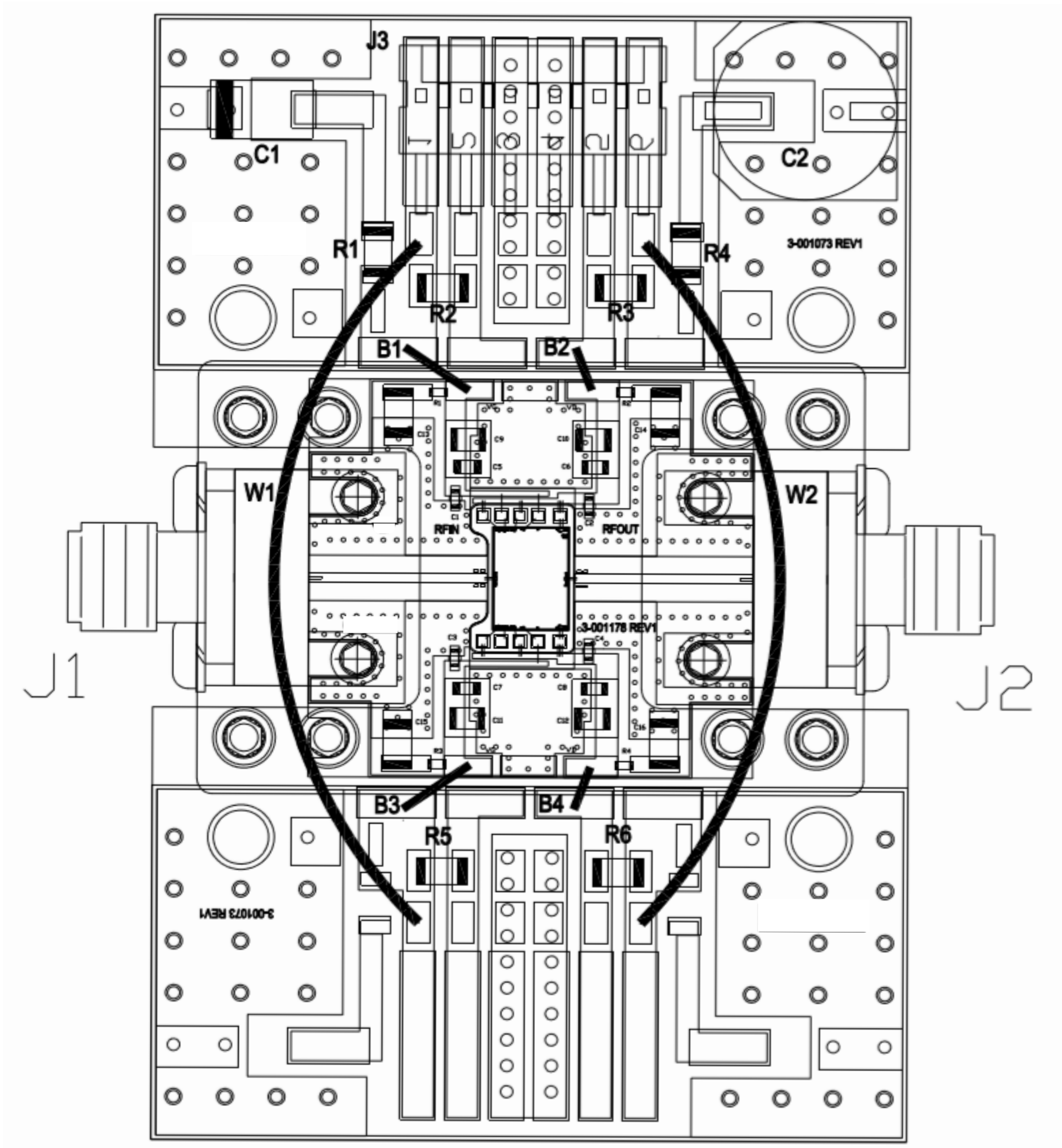
CMPA601C025D-AMP Evaluation Board Schematic Drawing



CMPA601C025D-AMP Evaluation Board Bill of Materials

Reference Designator	Description	Qty
J1, J2	CONNECTOR SMA JACK (FEMALE) END LAUNCH	2
J3	6-PIN DC HEADER, RIGHT ANGLE	1
R1 - R6	RESISTOR, 0 OHMS, 1206	6
C1	CAPACITOR, 10 UF, TANTALUM	1
C2	CAPACITOR, 33 UF, ELECTROLYTIC	1
B1 - B4	JUMPER WIRE	4
W1 - W2	WIRE, BLACK, 22 AWG (~2”)	2

CMPA601C025D-AMP Evaluation Board Assembly Drawing



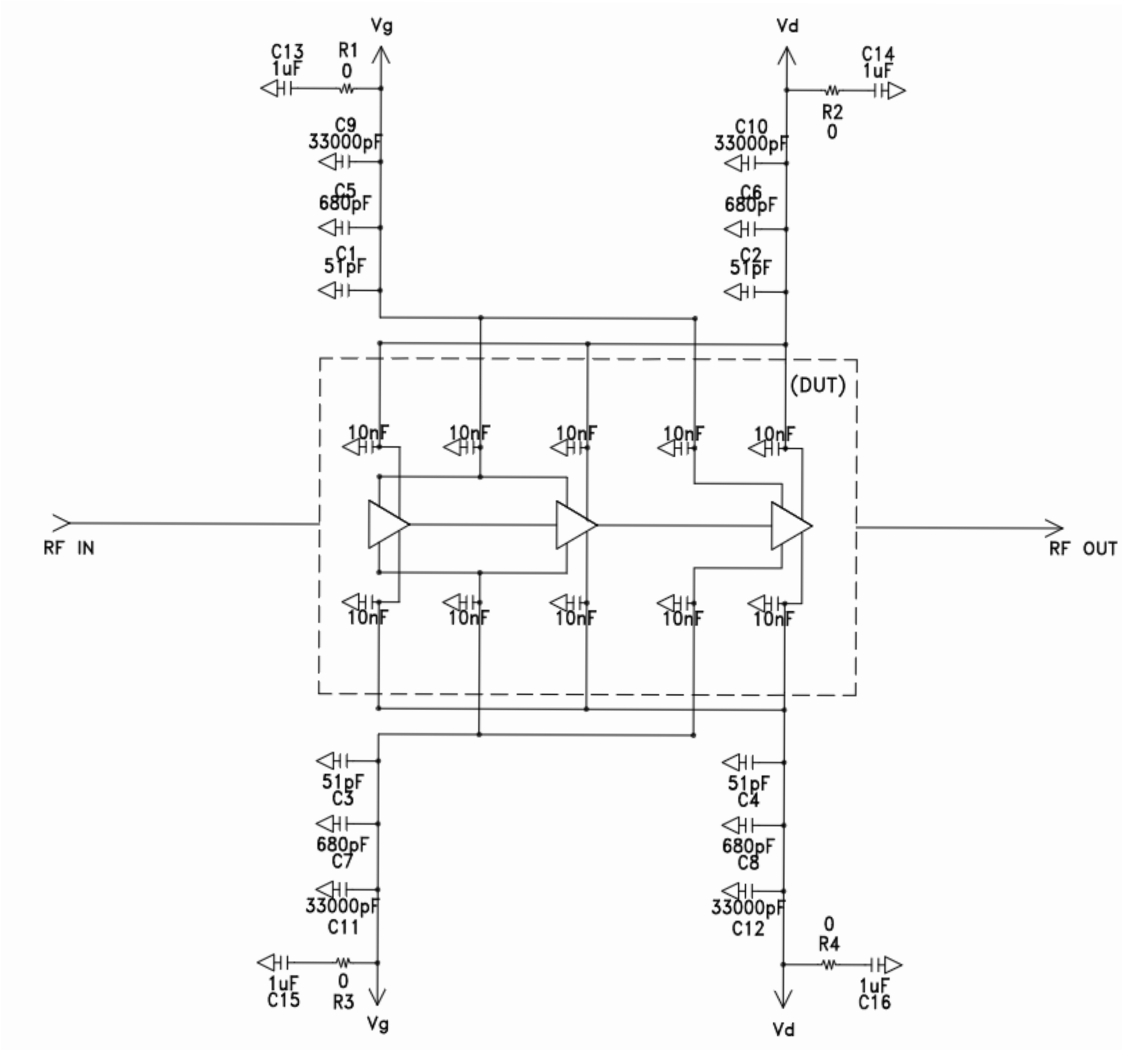
Bias On Sequence

- Ensure RF is turned-off
- Apply pinch-off voltage of -5 V to the gate (V_G)
- Apply nominal drain voltage (V_D)
- Adjust V_G to obtain desired quiescent drain current (I_{DQ})
- Apply RF

Bias Off Sequence

- Turn RF off
- Apply pinch-off to the gate (V_G = -5 V)
- Turn off drain voltage (V_D)
- Turn off gate voltage (V_G)

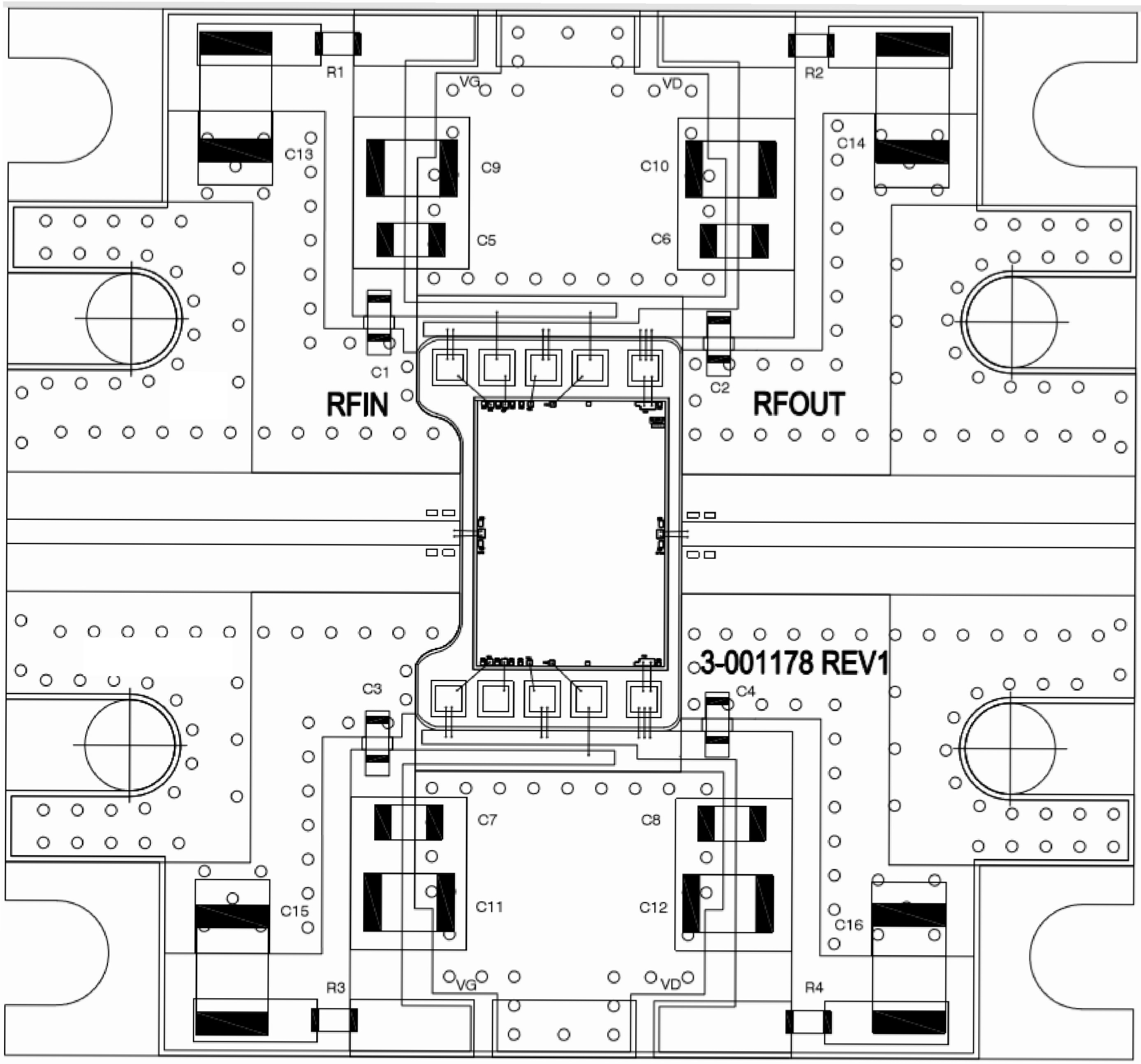
CMPA601C025D-AMP Carrier Schematic Drawing



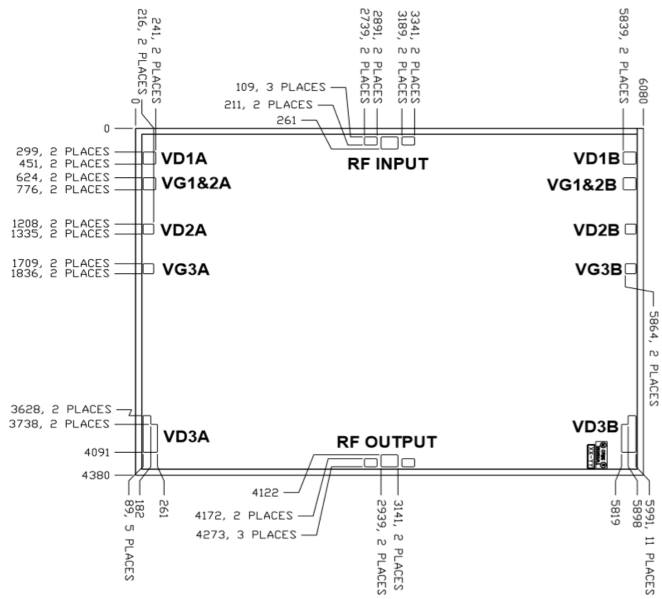
CMPA601C025D-AMP Carrier Bill of Materials

Reference Designator	Description	Qty
C1 - C4	CAPACITOR, 51 pF, 5%, 0402, AVX	4
C5 - C8	CAPACITOR, 680 pF, 5%, 0603, Vishay	4
C9 - C12	CAPACITOR, 33000 pF, 0805, 100 V, X7R	4
C13 - C16	CAPACITOR, 1 uF, +/-15%, 100 V, 1206, X7R	4
R1 - R4	RESISTOR, 0402, 0 OHMS	4

CMPA601C025D-AMP Carrier Assembly Drawing



Product Dimensions (Units in microns)



Overall Die Size 4380 x 6080 (+0/-50) microns, Die Thickness 100 (+/-10) microns.
All Gate and Drain Pads Must be Wire Bonded for Electrical Connection.

Function	Description	Pad Size (um)	Note
RF IN	RF-Input Pad. Matched to 50 ohms. The DC Impedance ~ 0 ohm Due Matching Circuit	152 x 202	4
VD1_A	Drain Supply for Stage 1A. V_D = 28 V	152 x 152	1
VD1_B	Drain Supply for Stage 1B. V_D = 28 V	152 x 152	1
VG1 & 2_A	Gate Control for Stage 1 & 2A. V_G = -2.0 to -3.5 V	152 x 152	1, 2
VG1 & 2_B	Gate Control for Stage 1 & 2B. V_G = -2.0 to -3.5 V	152 x 152	1, 2
VD2_A	Drain Supply for Stage 2A. V_D = 28 V	127 x 127	1
VD2_B	Drain Supply for Stage 2B. V_D = 28 V	127 x 127	1
VG3_A	Gate Control for Stage 3A. V_G = -2.0 to -3.5 V	127 x 127	1, 3
VG3_B	Gate Control for Stage 3B. V_G = -2.0 to -3.5 V	127 x 127	1, 3
VD3_A	Drain Supply for Stage 3A. V_D = 28 V	–	1
VD3 _B	Drain Supply for Stage 3B. V_D = 28 V	–	1
RF OUT	RF Output Pad. Matched to 50 ohms	152 x 202	4

Notes:
[1] Attach bypass capacitor to pads per application circuit.
[2] VG1 & 2_A and VG1 & 2_B are connected internally so it would be enough to connect either one for proper orientation.
[3] VG3_A and VG3_B are connected internally so it would be enough to connect either one for proper orientation.
[4] The RF input and output pad have a ground-signal-ground with a nominal pitch of 250 um. The RF ground pads are 100 x 100 microns.

Electrostatic Discharge (ESD) Classifications

Parameter	Symbol	Class	Test Methodology
Human Body Model	HBM	TBD	JEDEC JESD22 A114-D
Charge Device Model	CDM	TBD	JEDEC JESD22 C101-C

Product Ordering Information

Part Number	Description	MOQ Increment	Image
CMPA601C025D	6 - 12 GHz, 40 W GaN MMIC	1 Each	
CMPA601C025D-AMP	Evaluation Board W/PA	1 Each	

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