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

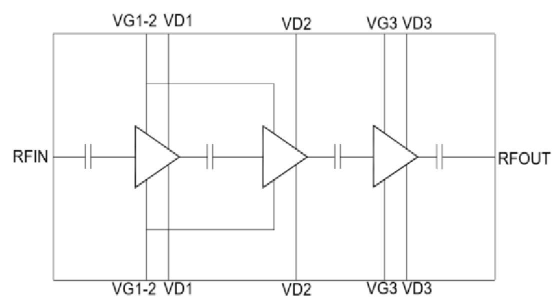


Figure 2. Functional Block Diagram

Features

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

Applications

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

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

RoHS compliant

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

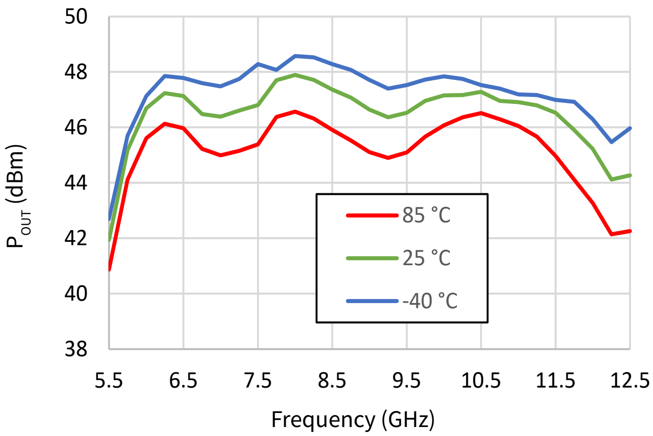


Figure 3. P_{OUT} v. Frequency v. Temperature

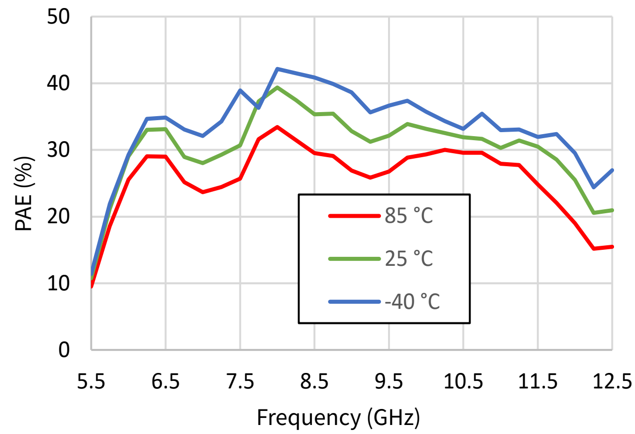


Figure 4. PAE v. Frequency v. Temperature

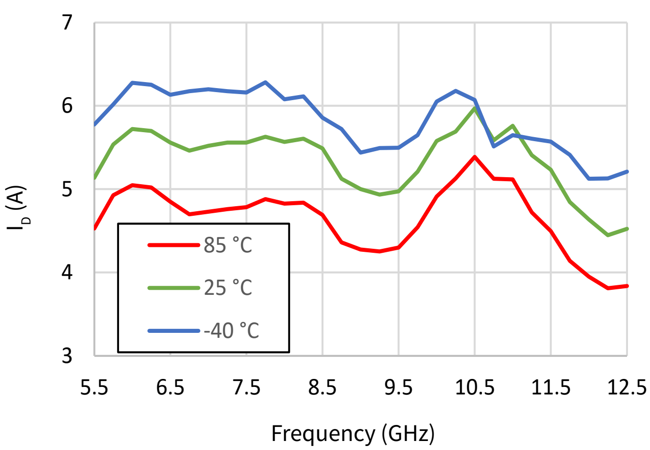


Figure 5. I_D v. Frequency v. Temperature

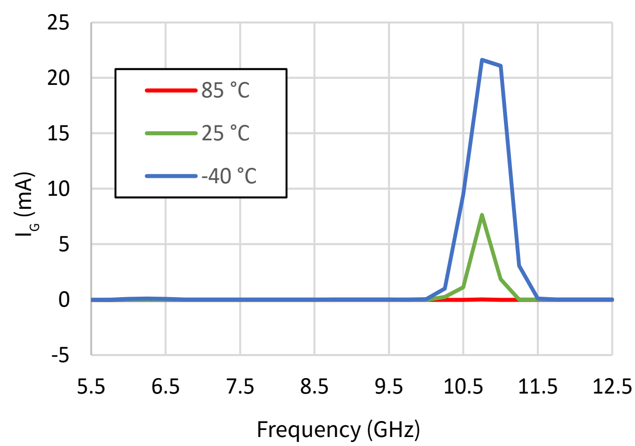


Figure 6. I_G v. Frequency v. Temperature

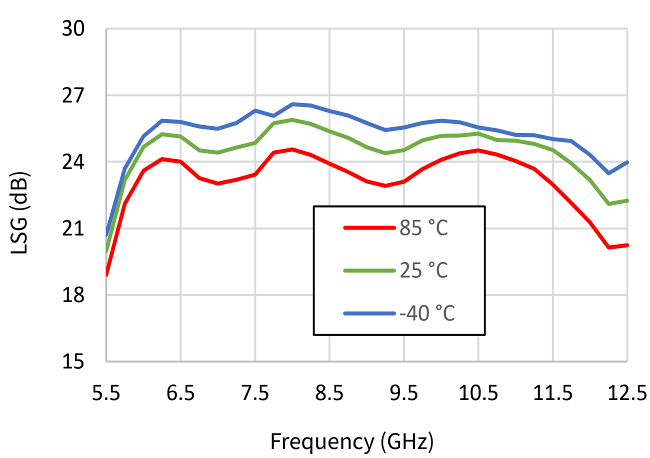


Figure 7. LSG v. Frequency v. Temperature

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

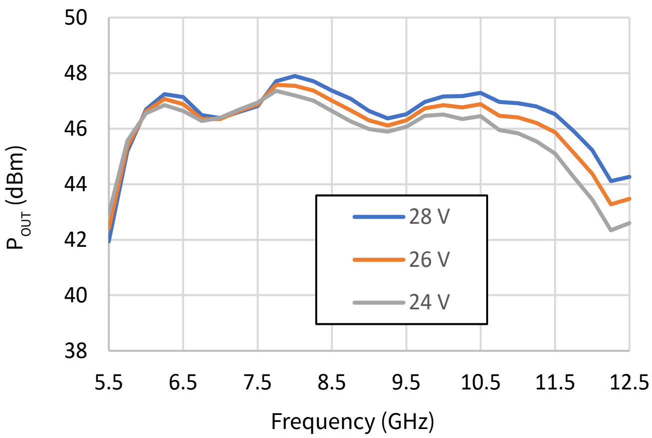


Figure 8. P_{OUT} v. Frequency v. V_D

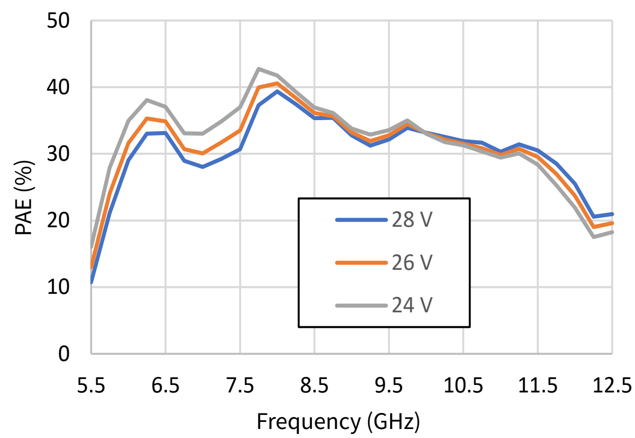


Figure 9. PAE v. Frequency v. V_D

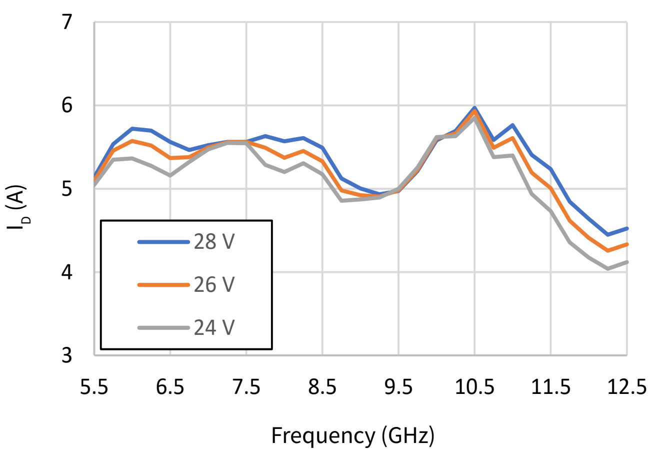


Figure 10. I_D v. Frequency v. V_D

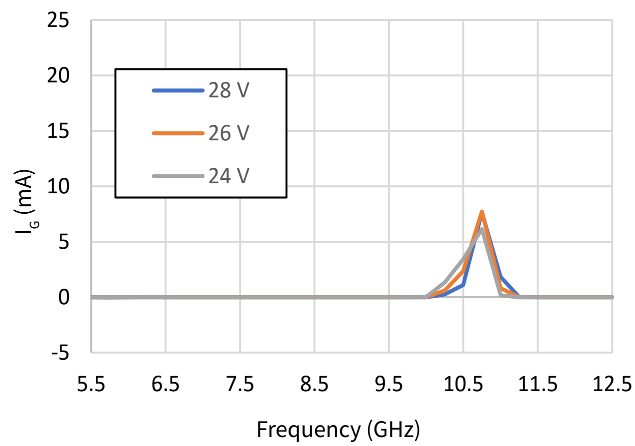


Figure 11. I_G v. Frequency v. V_D

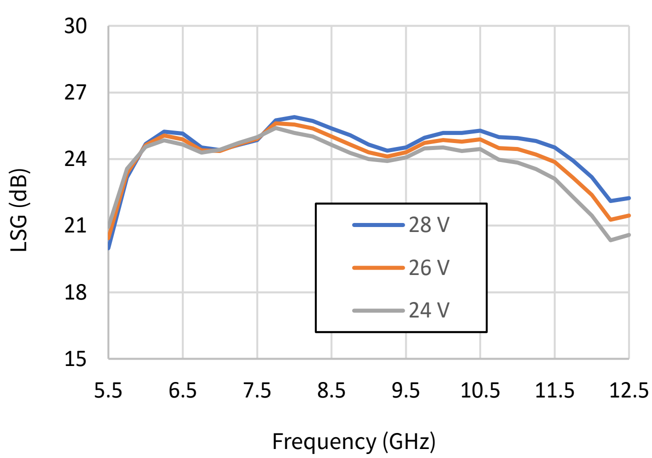


Figure 12. LSG v. Frequency v. V_D

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

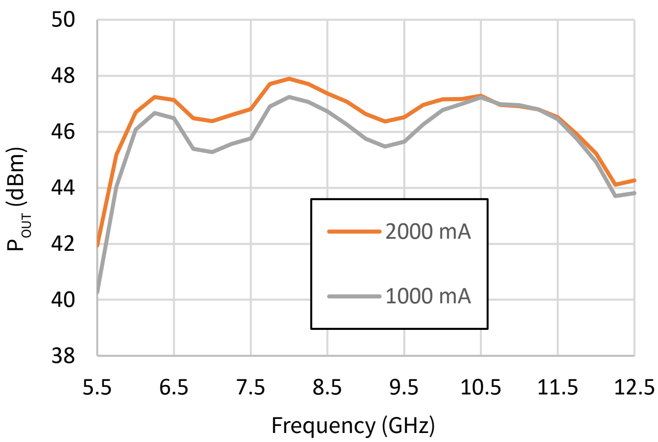


Figure 13. P_{OUT} v. Frequency v. I_{DQ}

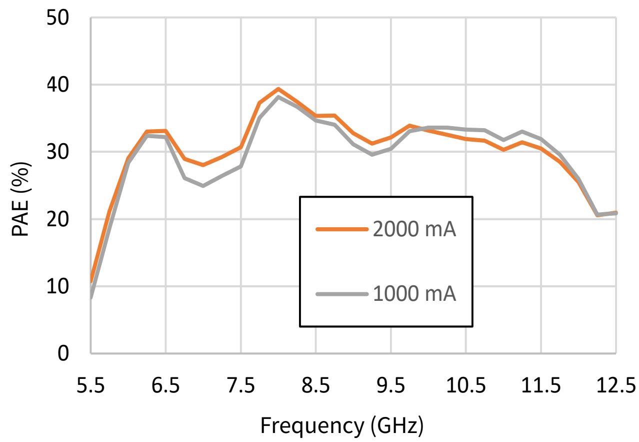


Figure 14. PAE v. Frequency v. I_{DQ}

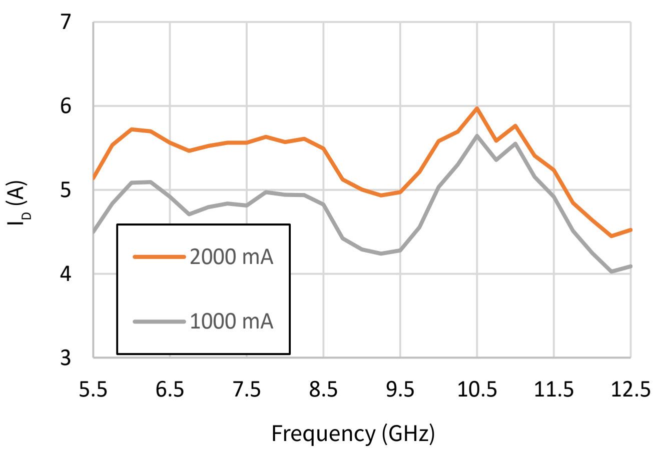


Figure 15. I_D v. Frequency v. I_{DQ}

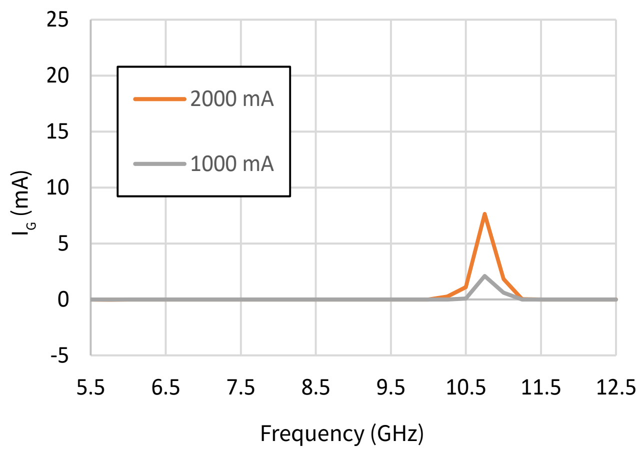


Figure 16. I_G v. Frequency v. I_{DQ}

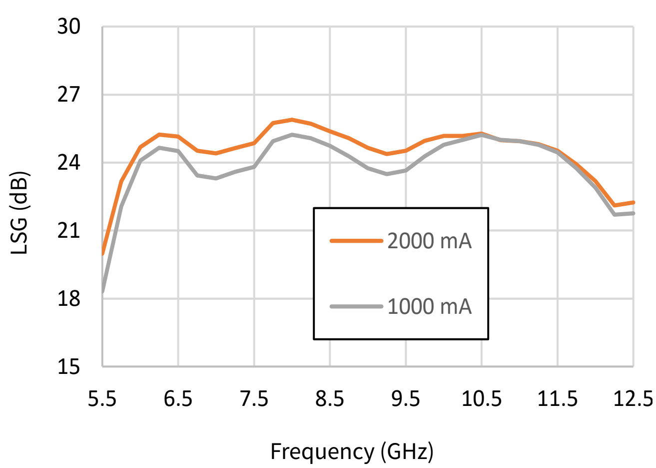


Figure 17. LSG v. Frequency v. I_{DQ}

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

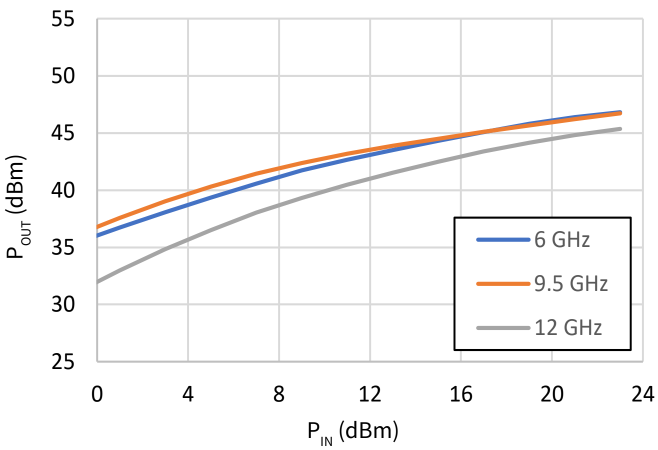


Figure 18. P_{OUT} v. P_{IN} v. Frequency

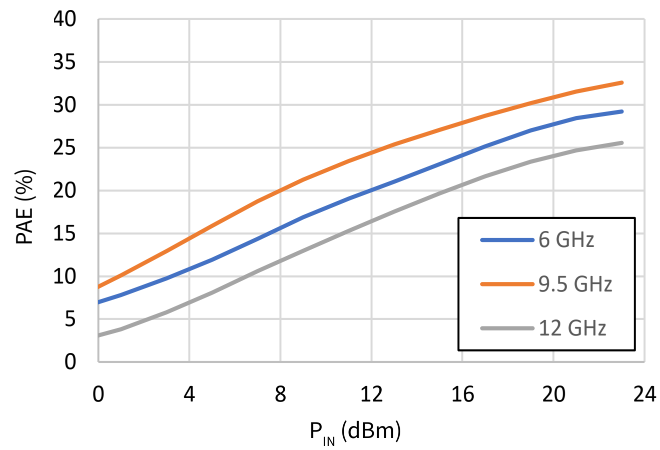


Figure 19. PAE v. P_{IN} v. Frequency

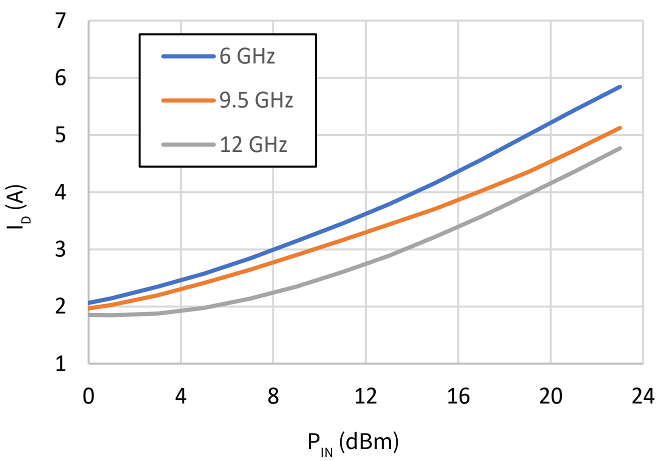


Figure 20. I_D v. P_{IN} v. Frequency

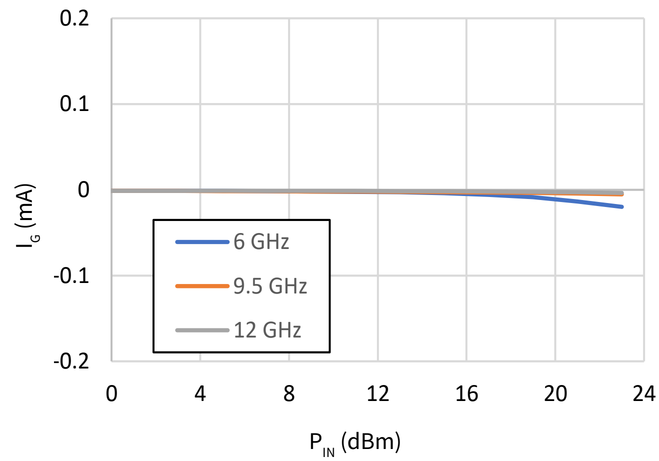


Figure 21. I_G v. P_{IN} v. Frequency

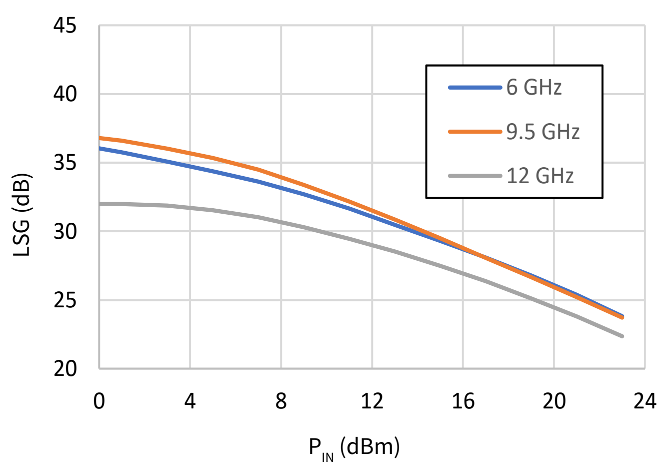


Figure 22. Gain v. P_{IN} v. Frequency

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

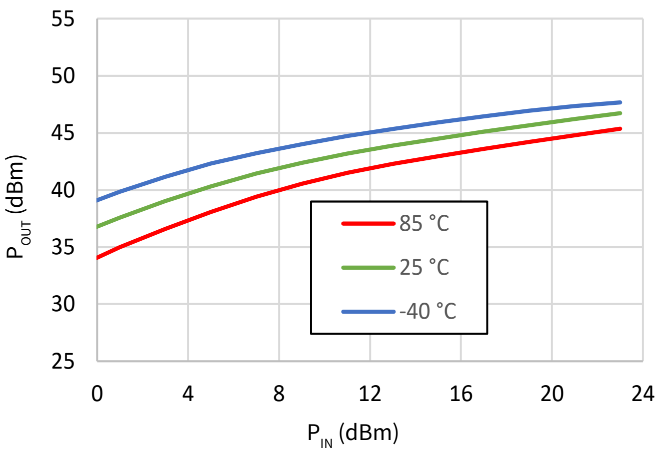


Figure 23. P_{OUT} v. P_{IN} v. Temperature

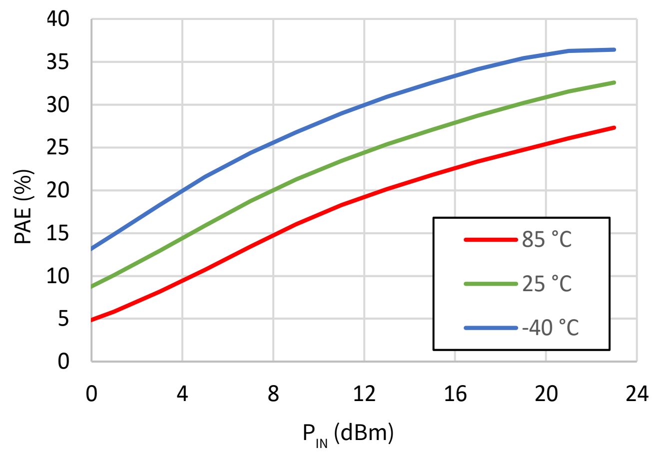


Figure 24. PAE v. P_{IN} v. Temperature

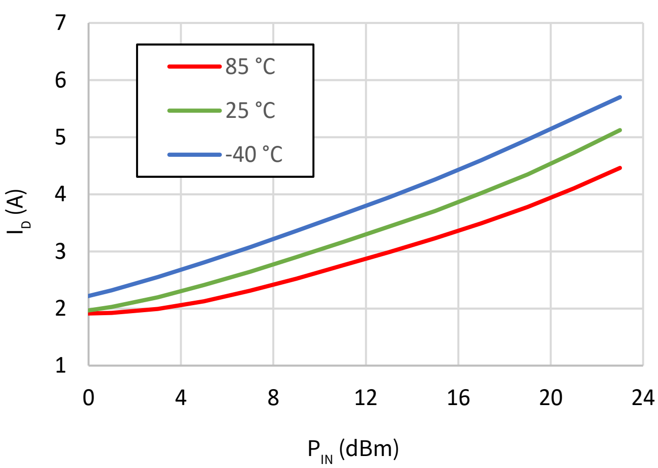


Figure 25. I_D v. P_{IN} v. Temperature

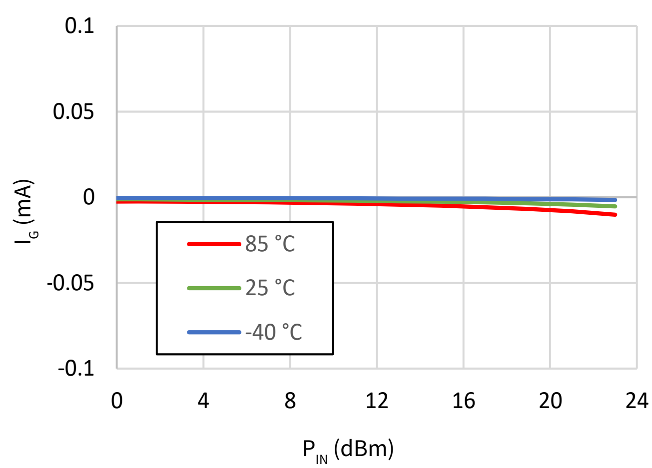


Figure 26. I_G v. P_{IN} v. Temperature

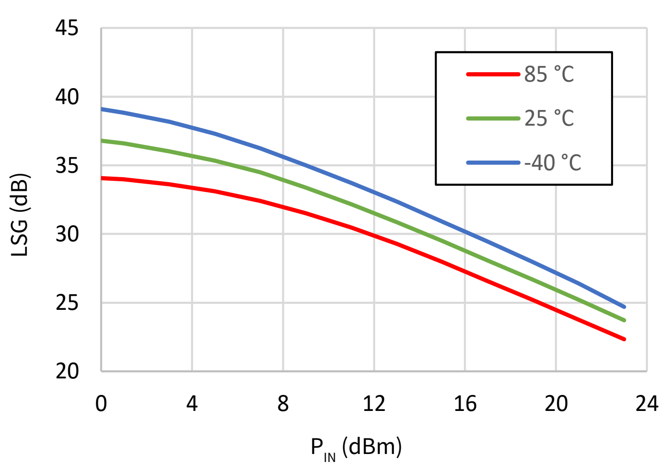


Figure 27. Gain v. P_{IN} v. Temperature

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

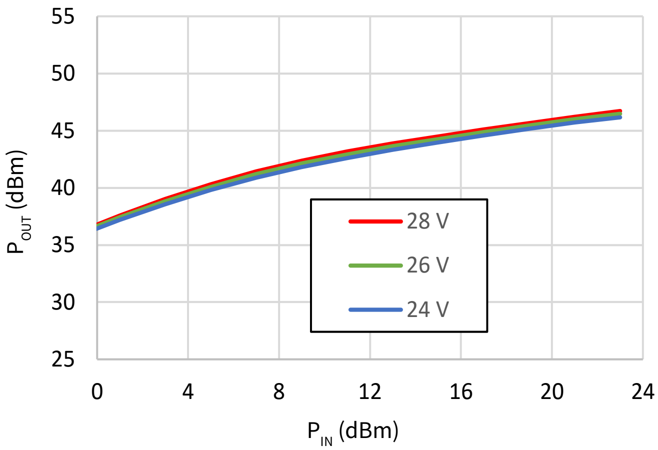


Figure 28. P_{OUT} v. P_{IN} v. V_D

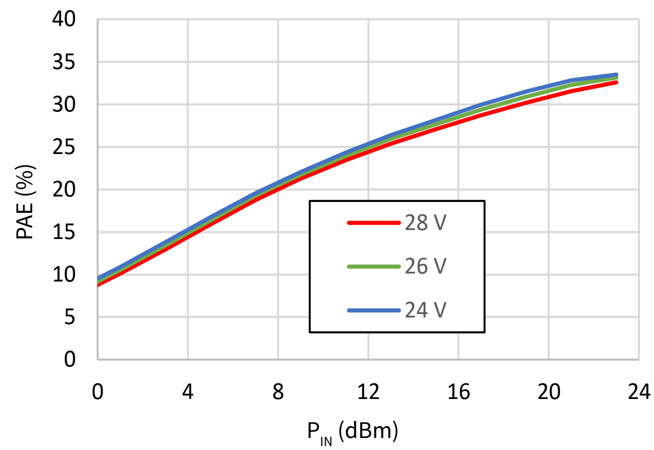


Figure 29. PAE v. P_{IN} v. V_D

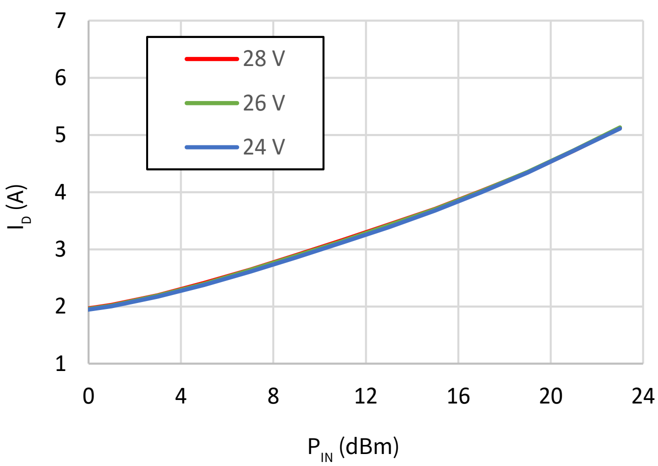


Figure 30. I_D v. P_{IN} v. V_D

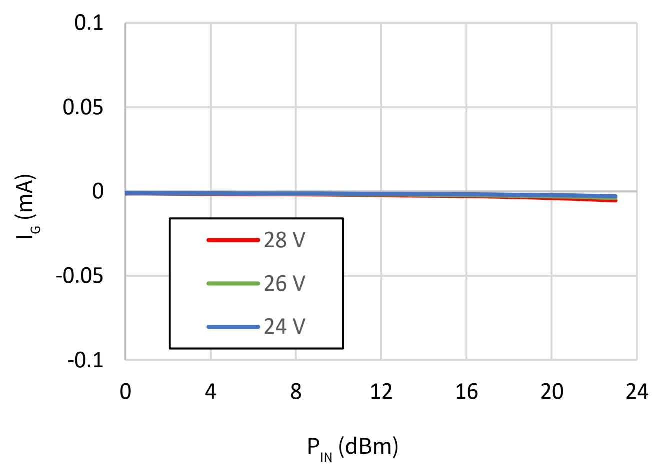


Figure 31. I_G v. P_{IN} v. V_D

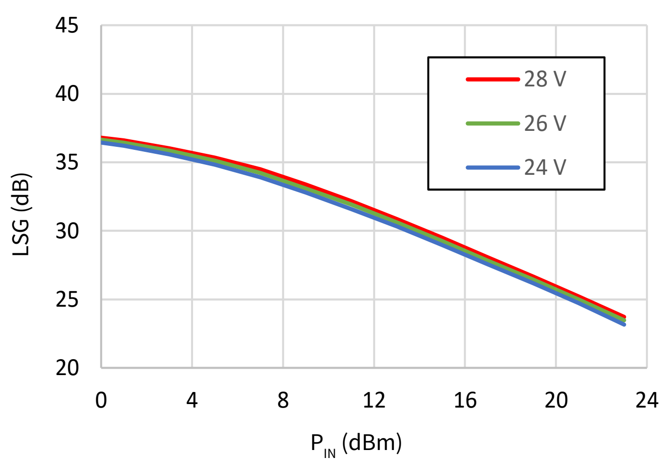


Figure 32. Gain v. P_{IN} v. V_D

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

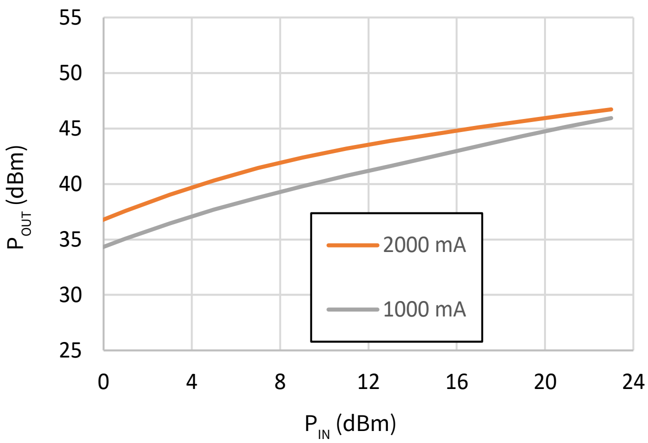


Figure 33. P_{OUT} v. P_{IN} v. I_{DQ}

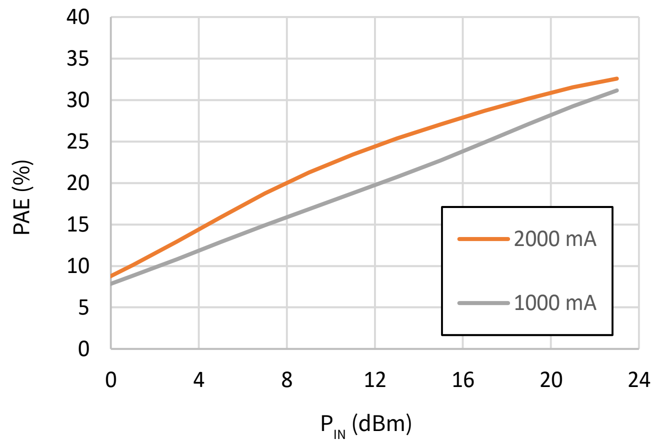


Figure 34. PAE v. P_{IN} v. I_{DQ}

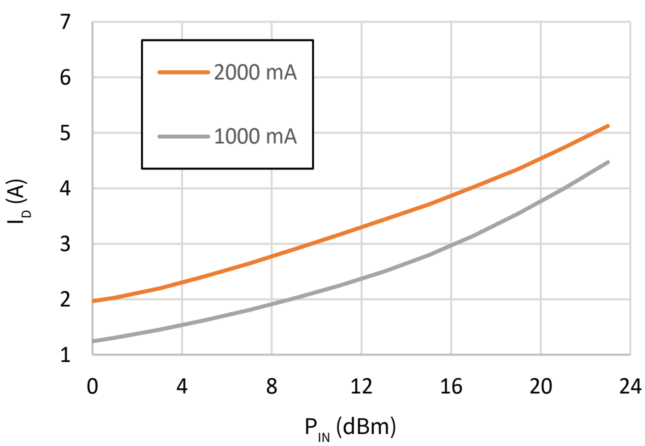


Figure 35. I_D v. P_{IN} v. I_{DQ}

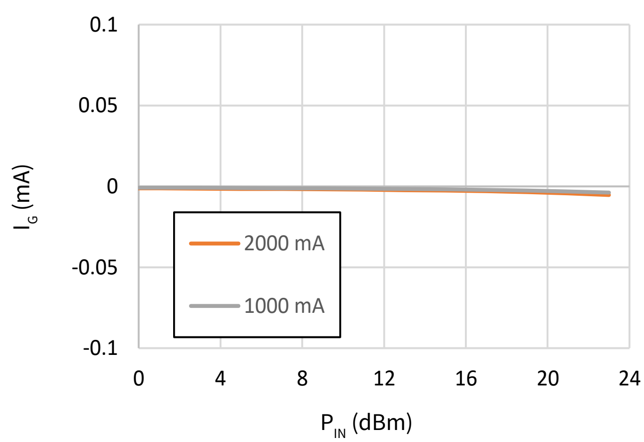


Figure 36. I_G v. P_{IN} v. I_{DQ}

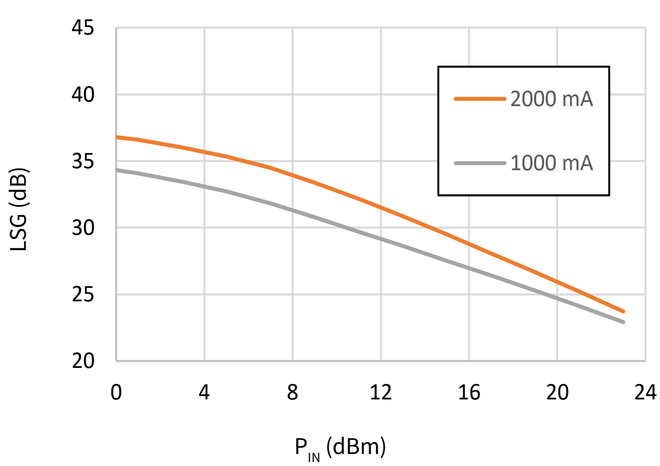


Figure 37. Gain v. P_{IN} v. I_{DQ}

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

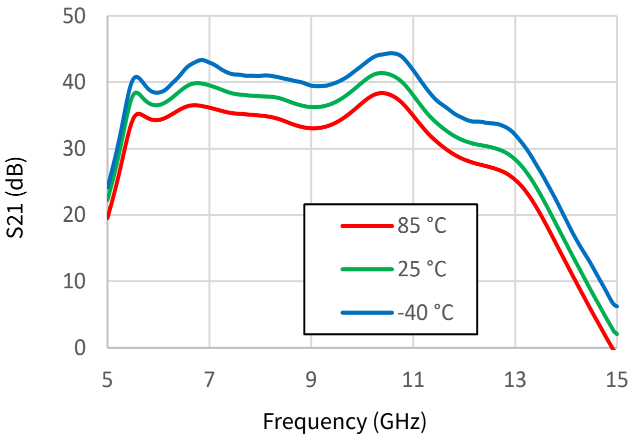


Figure 38. S21 v. Frequency v. Temperature

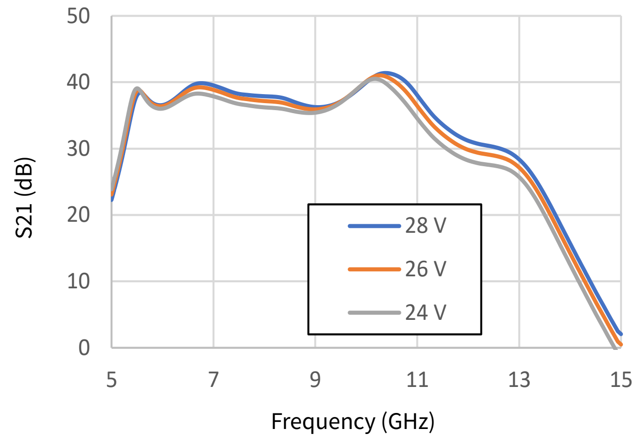


Figure 39. S21 v. Frequency v. V_D

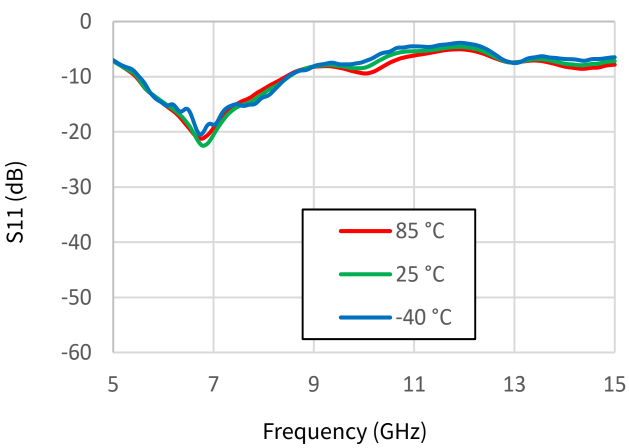


Figure 40. S11 v. Frequency v. Temperature

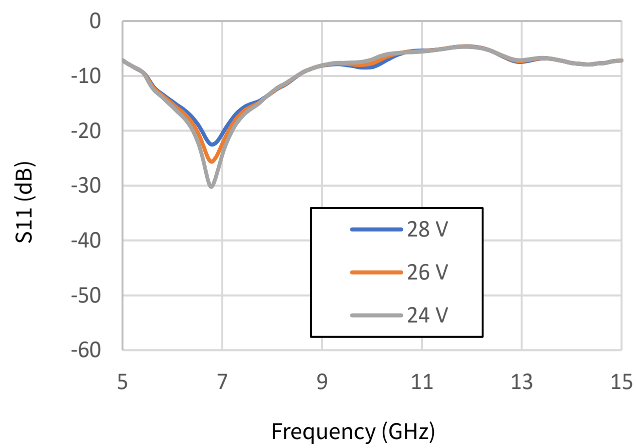


Figure 41. S11 v. Frequency v. V_D

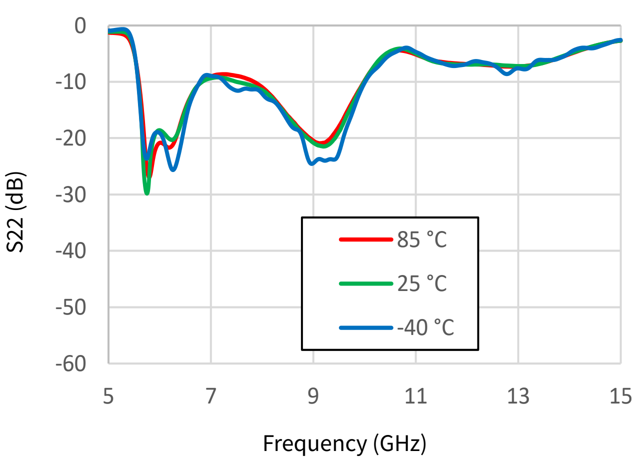


Figure 42. S22 v. Frequency v. Temperature

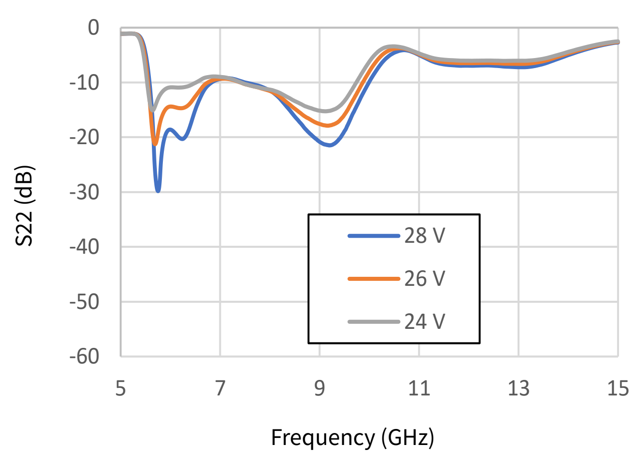


Figure 43. S22 v. Frequency v. V_D

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

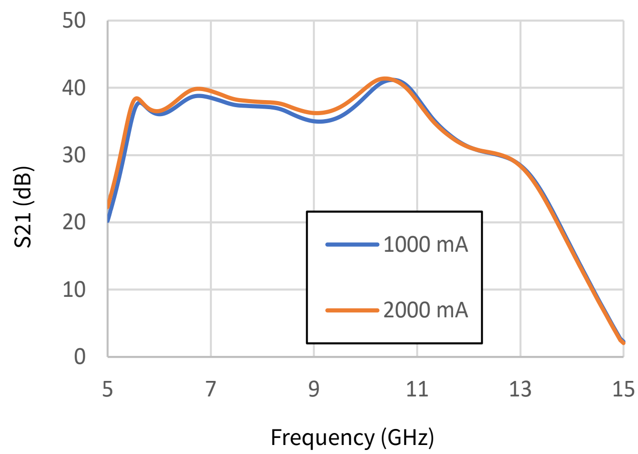


Figure 44. S21 v. Frequency v. I_{DQ}

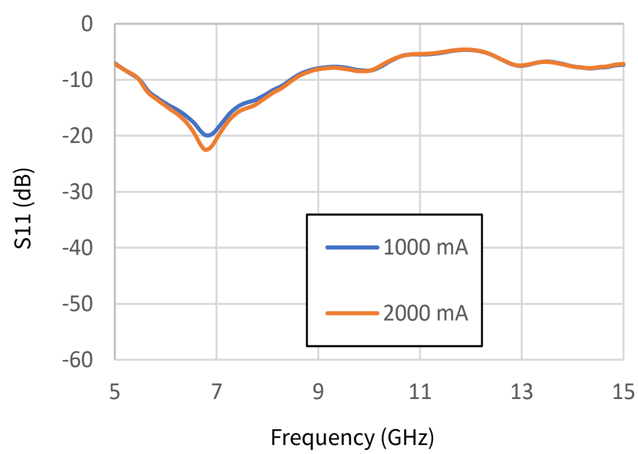


Figure 45. S11 v. Frequency v. I_{DQ}

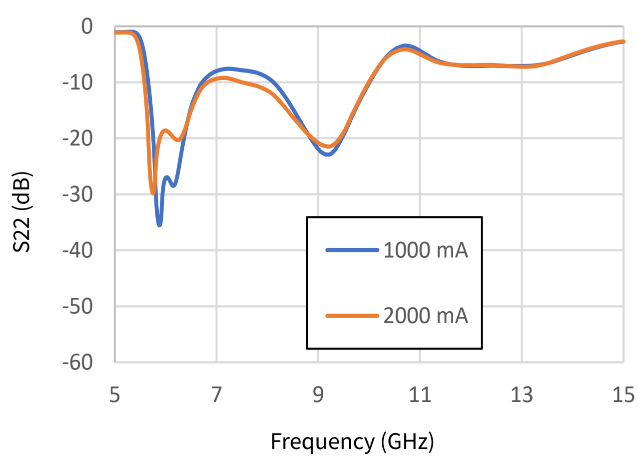


Figure 46. S22 v. Frequency v. I_{DQ}

Harmonics

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

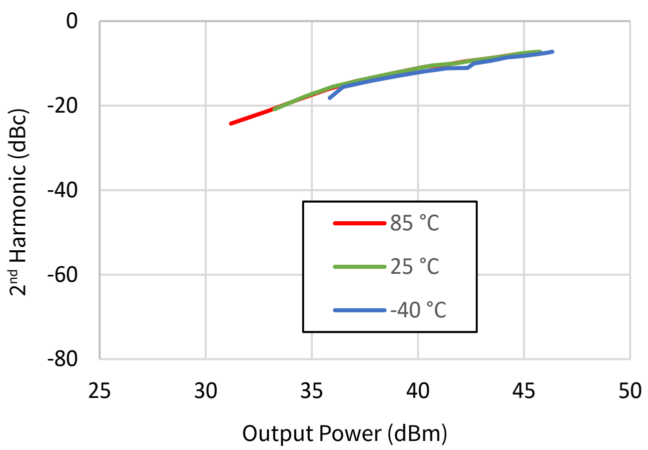


Figure 47. 2f v. P_{OUT} v. Temperature, 6 GHz

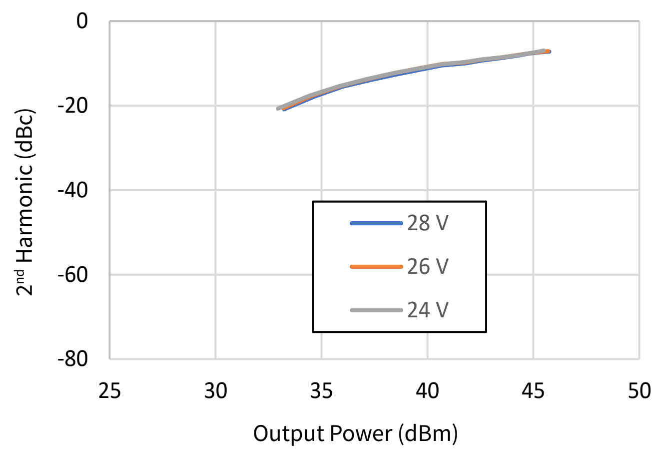


Figure 48. 2f v. P_{OUT} v. V_D, 6 GHz

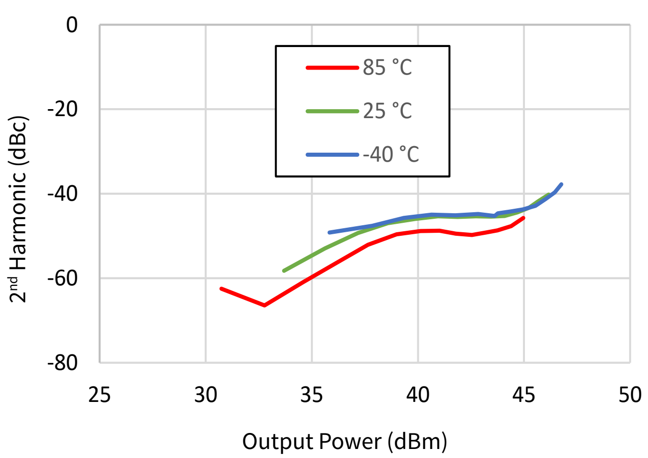


Figure 49. 2f v. P_{OUT} v. Temperature, 9.5 GHz

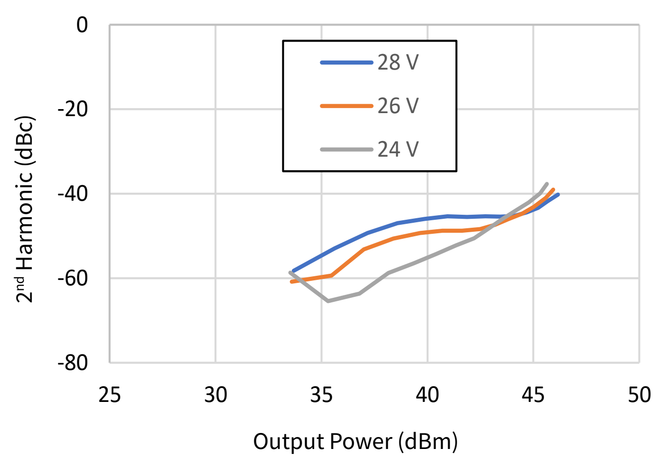


Figure 50. 2f v. P_{OUT} v. V_D, 9.5 GHz

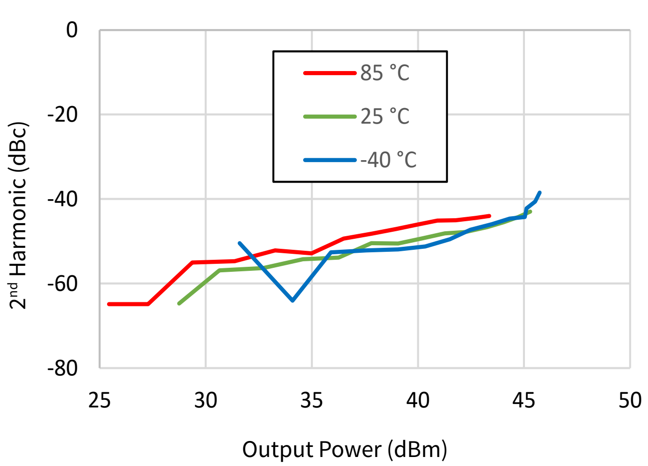


Figure 51. 2f v. P_{OUT} v. Temperature, 12 GHz

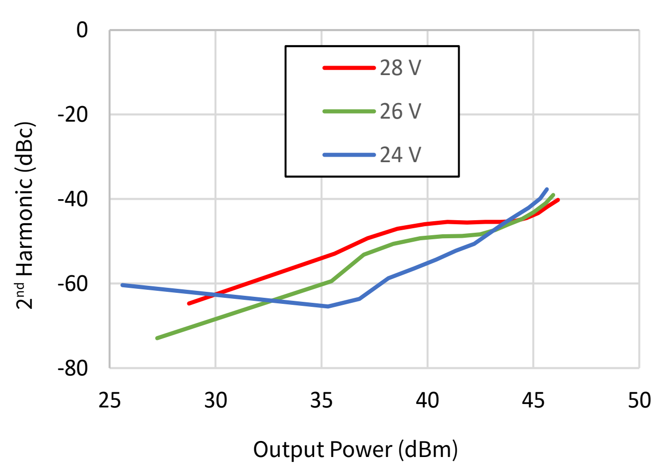
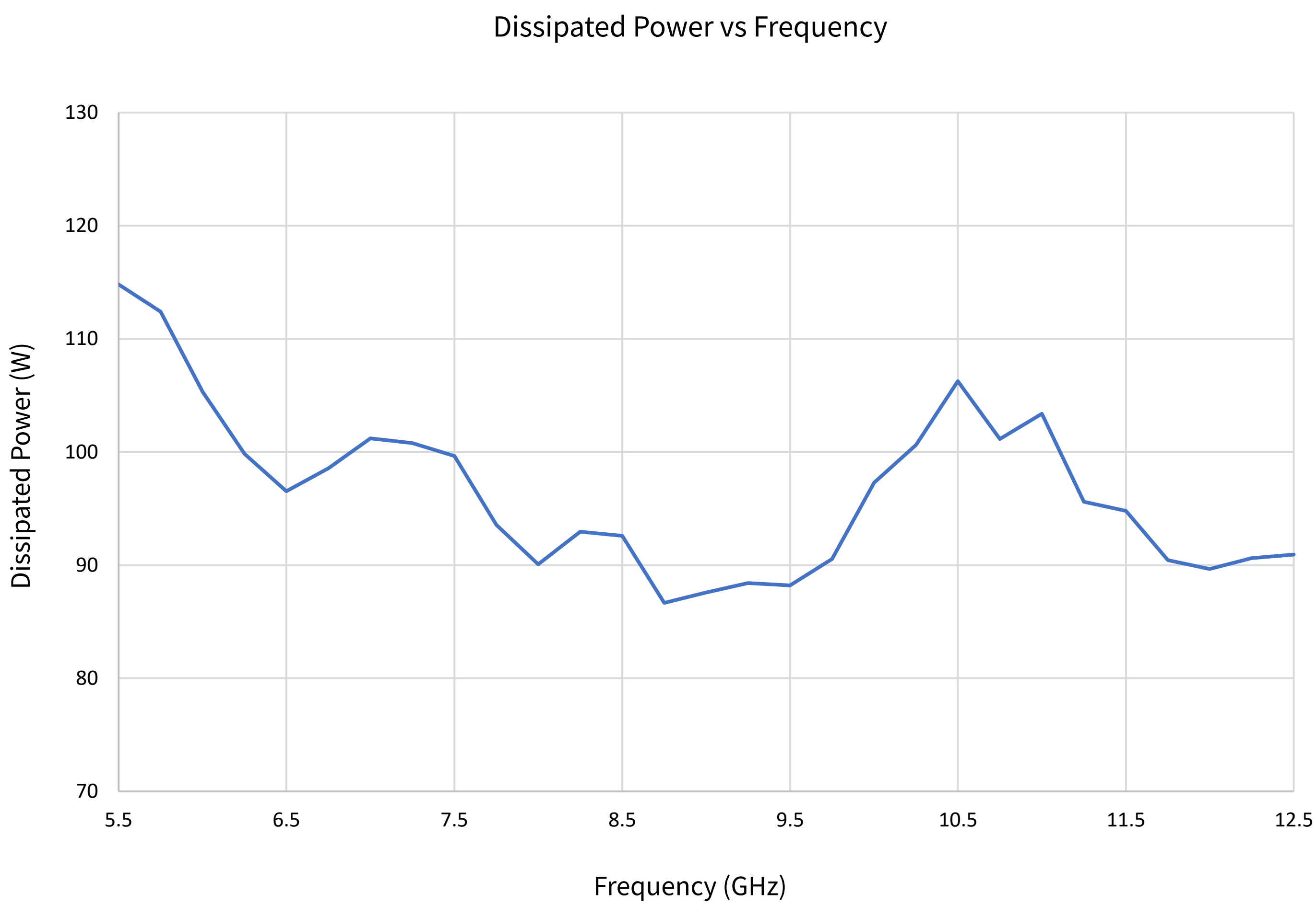


Figure 52. 2f v. P_{OUT} v. V_D, 12 GHz

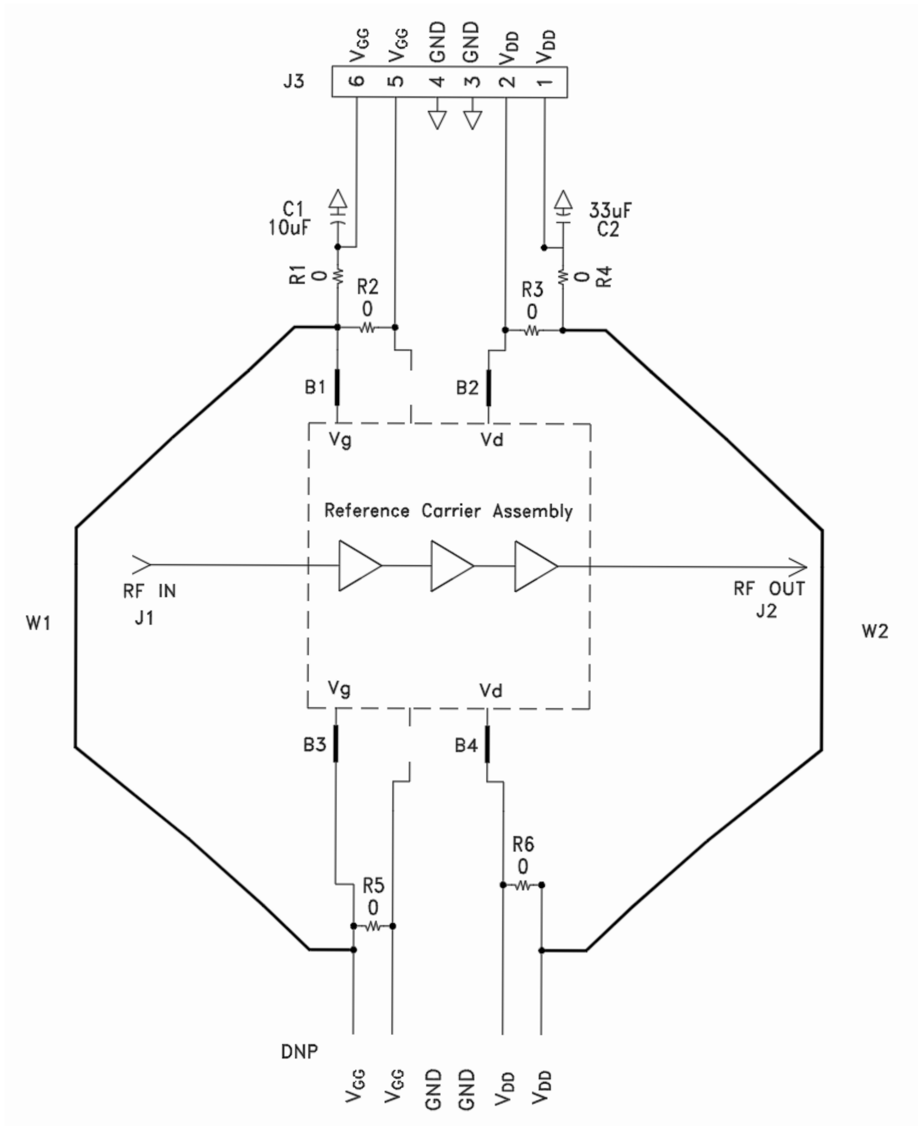
Thermal Characteristics

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

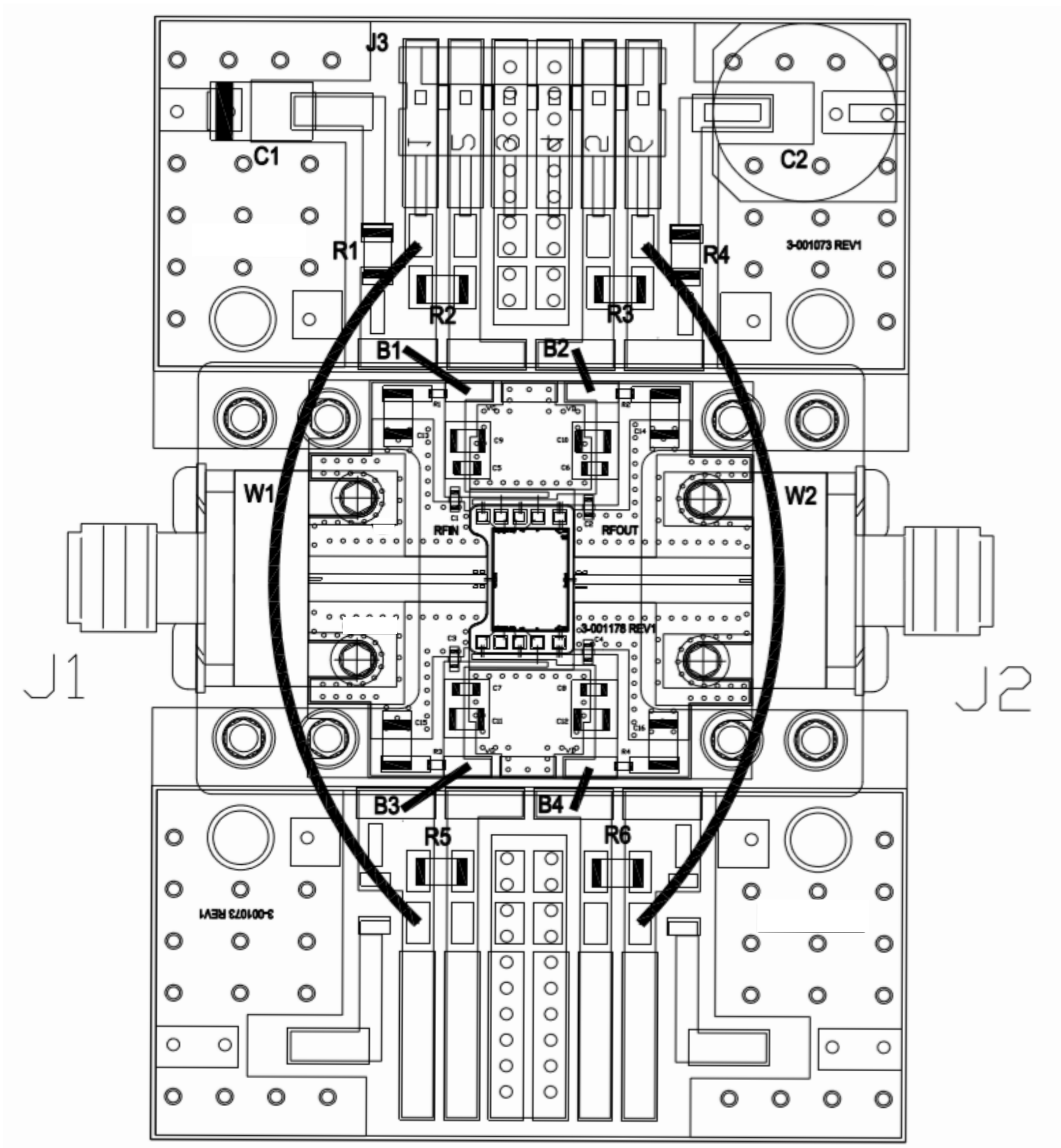


CMPA601C025D-AMP Evaluation Board Bill of Materials

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

Rev. 3.2, OCTOBER 2023

CMPA601C025D-AMP Evaluation Board Assembly Drawing



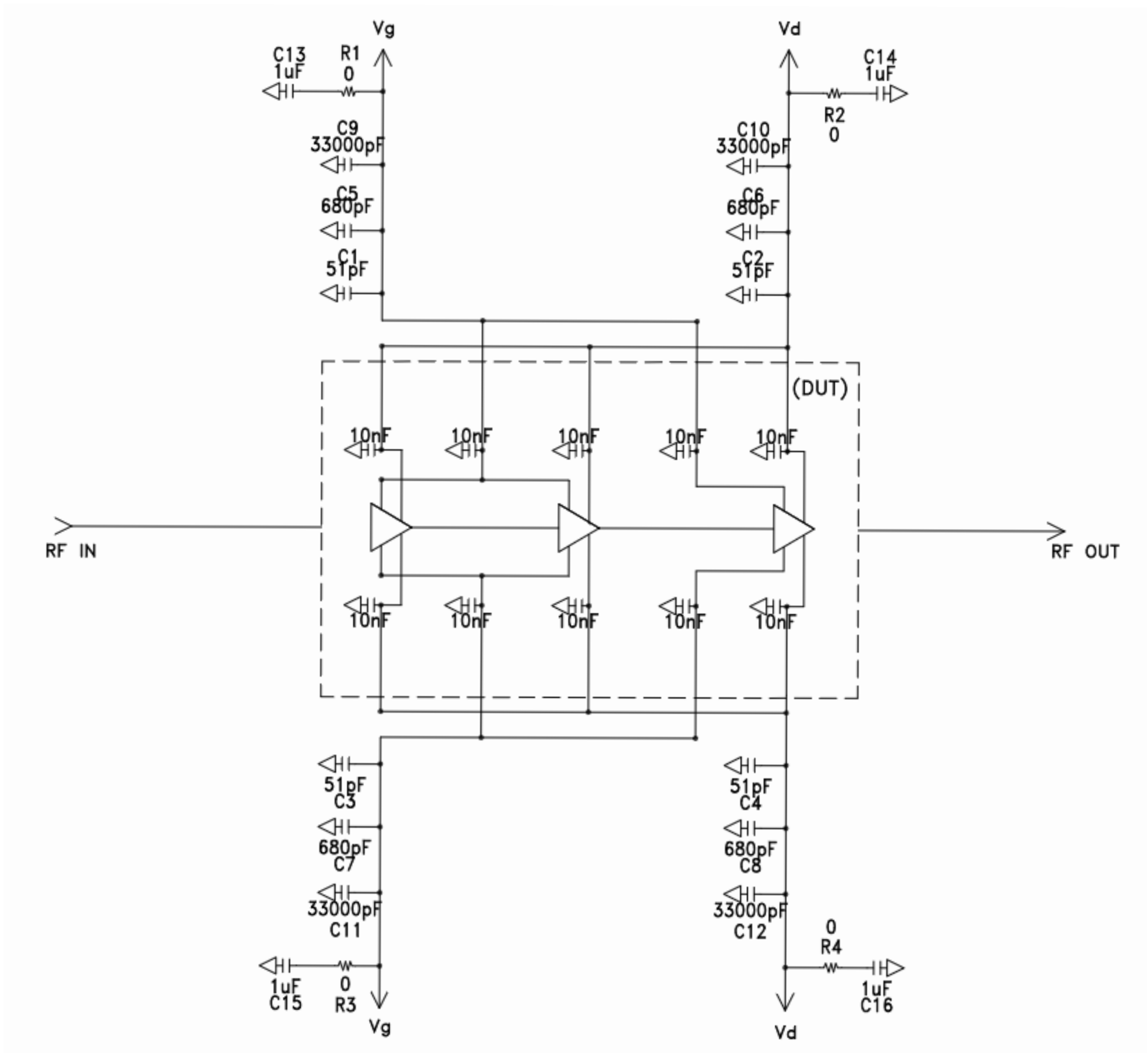
Bias On Sequence

- 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)

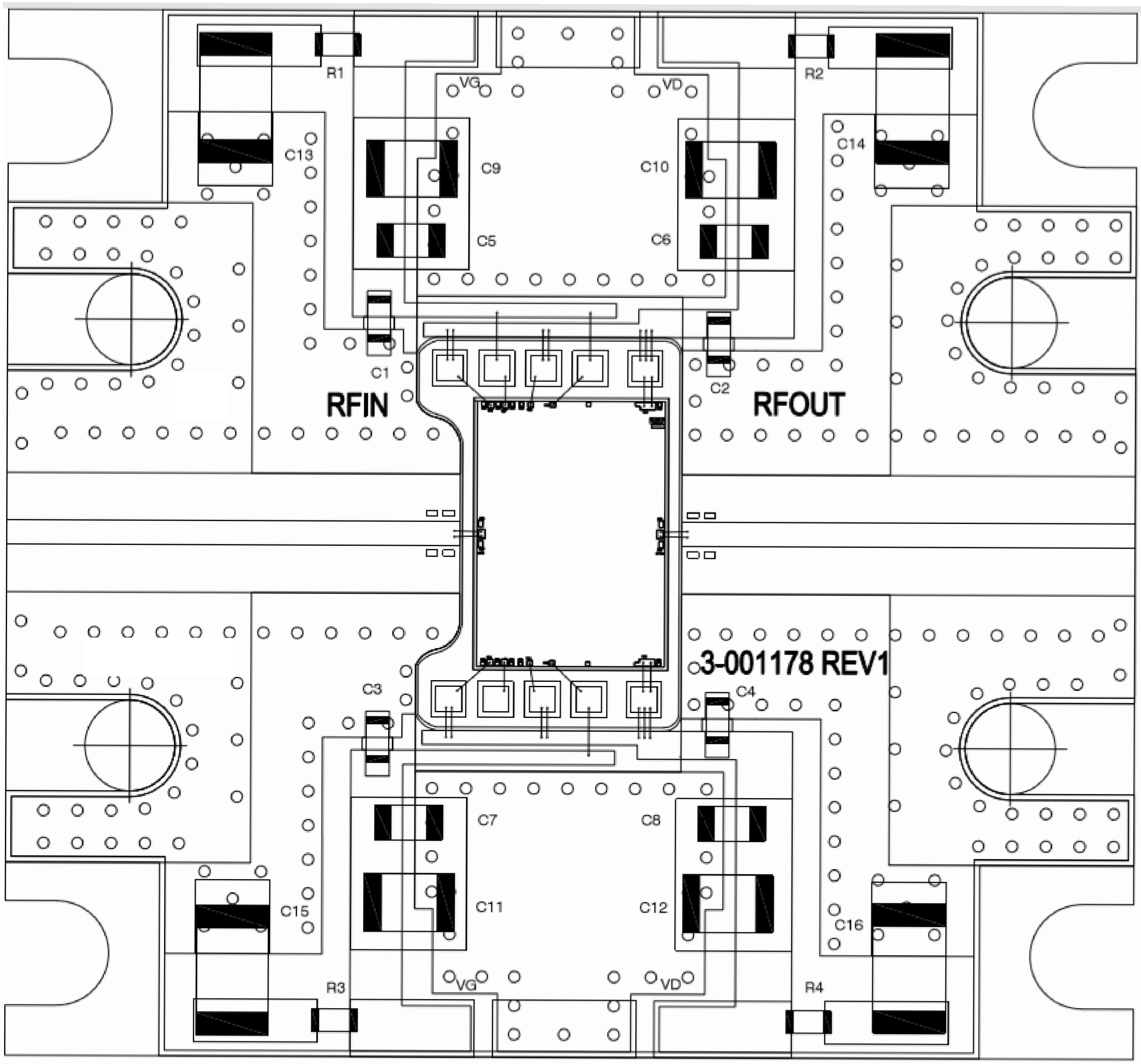
CMPA601C025D-AMP Carrier Schematic Drawing



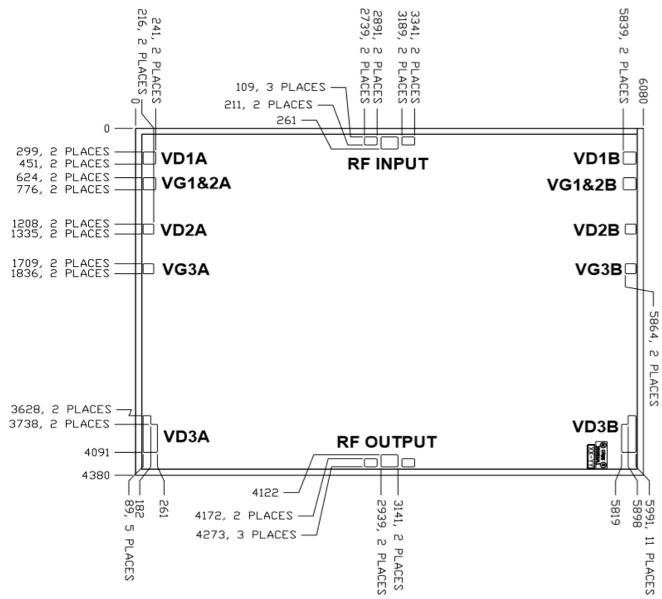
CMPA601C025D-AMP Carrier Bill of Materials

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	

Notes & Disclaimer

These materials are provided in connection with MACOM’s products as a service to its customers and may be used for informational purposes only. Except as provided in its Terms and Conditions of Sale or any separate agreement, MACOM assumes no liability or responsibility whatsoever, including for (i) errors or omissions in these materials; (ii) failure to update these materials; or (iii) conflicts or incompatibilities arising from future changes to specifications and product descriptions, which MACOM may make at any time, without notice. These materials grant no license, express or implied, to any intellectual property rights.

THESE MATERIALS ARE PROVIDED "AS IS" WITH NO WARRANTY OR LIABILITY, EXPRESS OR IMPLIED, RELATING TO SALE AND/OR USE OF MACOM PRODUCTS INCLUDING FITNESS FOR A PARTICULAR PURPOSE, MERCHANTABILITY, INFRINGEMENT OF INTELLECTUAL PROPERTY RIGHT, ACCURACY OR COMPLETENESS, OR SPECIAL, INDIRECT, INCIDENTAL, OR CONSEQUENTIAL DAMAGES WHICH MAY RESULT FROM USE OF THESE MATERIALS.

MACOM products are not intended for use in medical, lifesaving or life sustaining applications. MACOM customers using or selling MACOM products for use in such applications do so at their own risk and agree to fully indemnify MACOM for any damages resulting from such improper use or sale.