

GaN High Power Amplifier, 50 W 8.5 - 10.5 GHz



CMPA851A050F

Rev. V1

Features

- Saturated Power: 50 W
- Power Added Efficiency: 35%
- Large Signal Gain: 29 dB
- Small Signal Gain: 31 dB
- Input Return Loss: -10 dB
- Output Return Loss: -5 dB
- CW Operation

Applications

- Military and Commercial Radar

Description

MACOM's CMPA851A050F is a 50W package MMIC HPA utilizing MACOM's high performance, 0.15μm GaN on SiC production process. The CMPA851A050F operates from 8.5-10.5 GHz and supports both defense and commercial-related radar applications. The CMPA851A050F achieves 50 W of saturated output power with 29 dB of large signal gain and typically 35% power-added efficiency under CW operation. Pulsed operation is an option; however, you might prefer the CMPA851A050S for a pulsed SMT solution.

Above stated performance is typical across frequency at 25°C. Please reference included specification tables and performance curves for additional details.

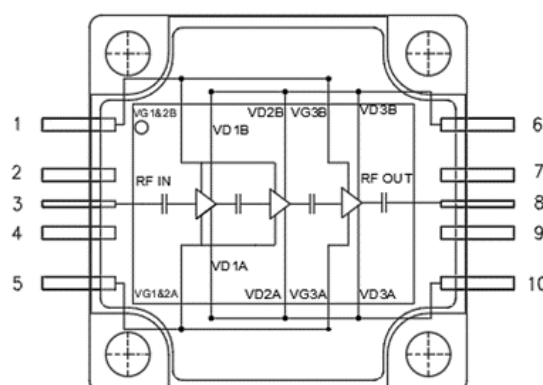
Packaged in a 15x15 mm bolt-down, flange package, the CMPA851A050F provides superior RF performance and thermal management allowing customers to improve SWaP-C benchmarks in their next-generation systems.

Ordering Information

Part Number	Package (MOQ/ Mult)
CMPA851A050F	Tray (10/10)
CMPA851A050F-AMP	Sample Board (1/1)



Functional Schematic



Pin Configuration¹

Pin #	Function
1, 5	VG
2, 4, 7, 9	GND
3	RF Input
6, 10	VD
8	RF Output

1. The base of the package must be connected to RF, DC and thermal ground.

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RF Electrical Specifications: $V_D = 28\text{ V}$, $I_{DQ} = 800\text{ mA}$, CW, $T_C = 25^\circ\text{C}$, $Z_0 = 50\ \Omega$

Parameter	Test Conditions	Frequency (GHz)	Units	Min.	Typ.	Max.
Output Power	$P_{IN} = 18\text{ dBm}$	8.5 9.5 10.5	dBm	46.5 46.0 47.5	48.0 47.5 48.5	—
Power Added Efficiency		8.5 9.5 10.5	%	34 35 35	39 41 40	—
Large Signal Gain		8.5 9.5 10.5	dB	—	29.5 29.5 29.5	—
Small Signal Gain	$P_{IN} = -20\text{ dBm}$	8.5 9.5 10.5	dB	—	31 31 33	—
Input Return Loss		8.5 - 10.5	dB	—	-10	—
Output Return Loss		8.5 - 10.5	dB	—	-5	—

DC Electrical Specifications:

Parameter	Units	Min.	Typ.	Max.
Drain Voltage	V	—	28	—
Gate Voltage	V	—	-2.1	—
Quiescent Drain Current	mA	400	800	1200
Saturated Drain Current	A	—	6.0	—

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Recommended Operating Conditions

Parameter	Symbol	Unit	Min.	Typ.	Max.
Input Power	P_{IN}	dBm		18	
Drain Voltage	V_D	V		28	
Gate Voltage	V_G	V		-2.1	
Quiescent Drain Current	I_{DQ}	mA		800	
Operating Temperature	T_C	°C	-40		+85

Absolute Maximum Ratings^{2,3}

Parameter	Symbol	Unit	Min.	Max.
Input Power	P_{IN}	dBm		20
Drain to Source Breakdown Voltage	BV_{DS}	V		84
Drain Voltage	V_D	V		28
Gate Voltage	V_G	V	-8	+2
Drain Current	I_D	A		7.0
Gate Current	I_G	mA		25
Dissipated Power @ +85°	P_{DISS}	W		145
VSWR		Ratio		7:1
Junction Temperature (MTTF > 1E6 Hrs)	T_J	°C		+225
Storage Temperature	T_{STG}	°C	-65	+150
Mounting Temperature (30 seconds)	T_M	°C		+260
Screw Torque	τ	in-oz		40

2. Exceeding any one or combination of these limits may cause permanent damage to this device.

3. MACOM does not recommend sustained operation near these survivability limits.

Handling Procedures

Please observe the following precautions to avoid damage:

Static Sensitivity

These electronic devices are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. Proper ESD control techniques should be used when handling these devices.

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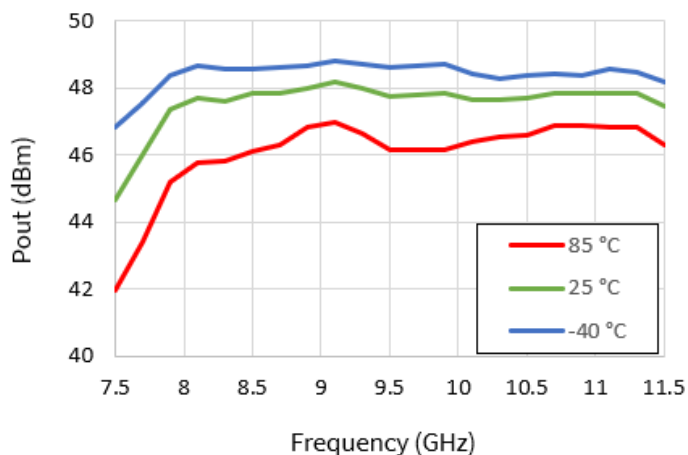
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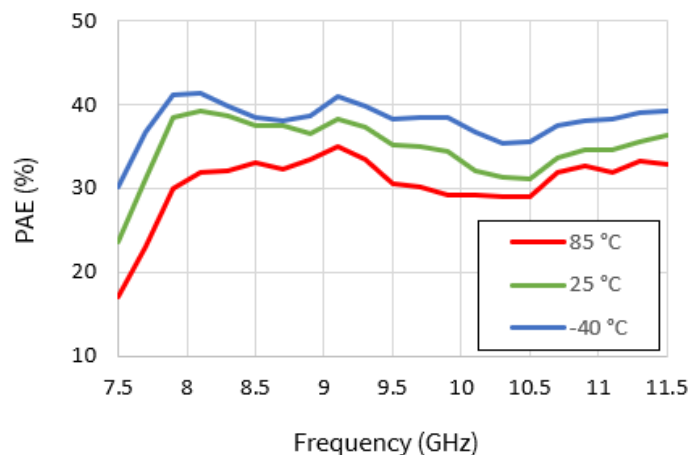
Typical Performance Curves - Large Signal over Temperature:

$V_D = 28$ V, $I_{DQ} = 800$ mA, CW, $P_{IN} = 18$ dBm

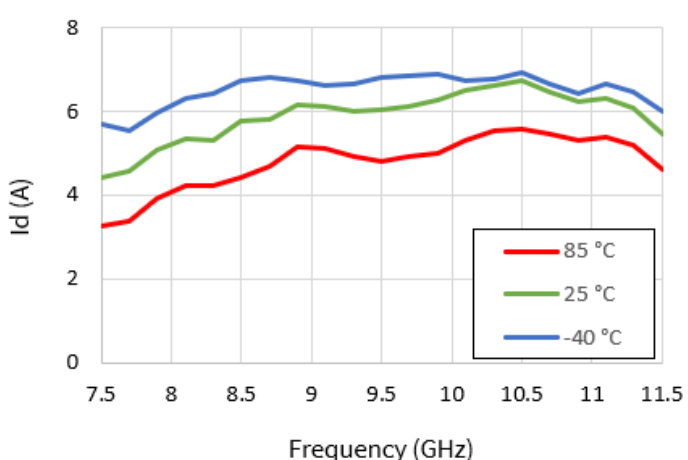
Output Power vs. Frequency



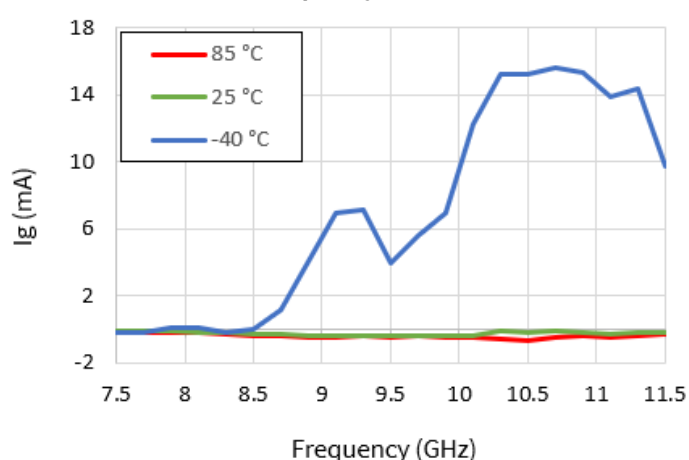
Power-Added Efficiency vs. Frequency



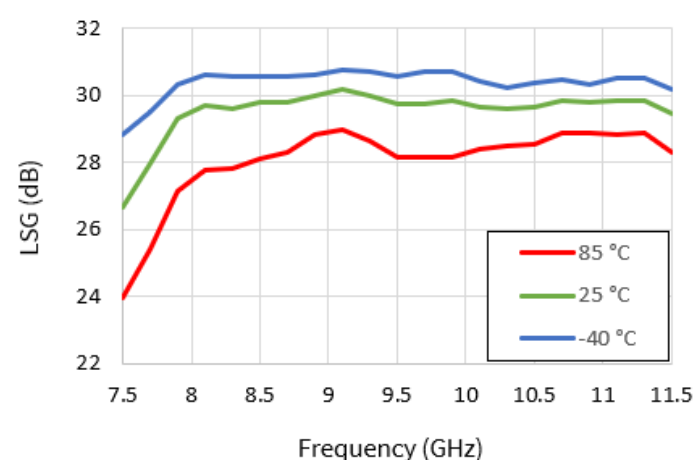
Drain Current vs. Frequency



Gate Current vs. Frequency



Large Signal Gain vs. Frequency



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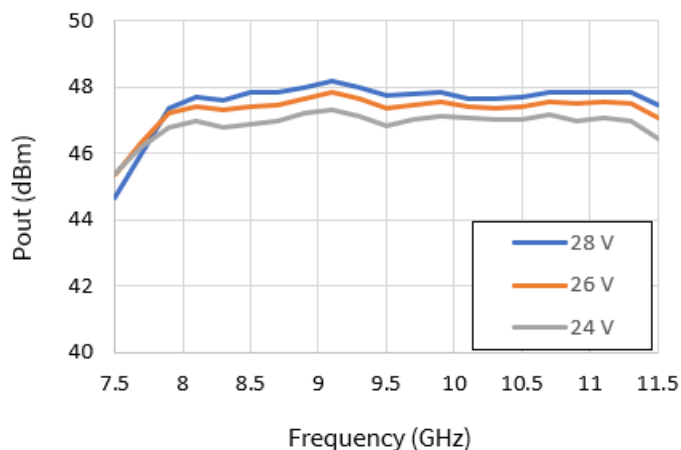
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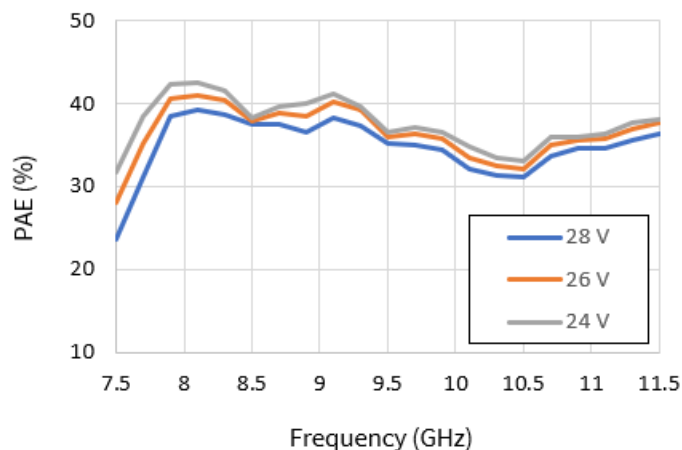
Typical Performance Curves - Large Signal over V_D :

$I_{DQ} = 800$ mA, CW, $P_{IN} = 18$ dBm, $T_C = 25^\circ\text{C}$

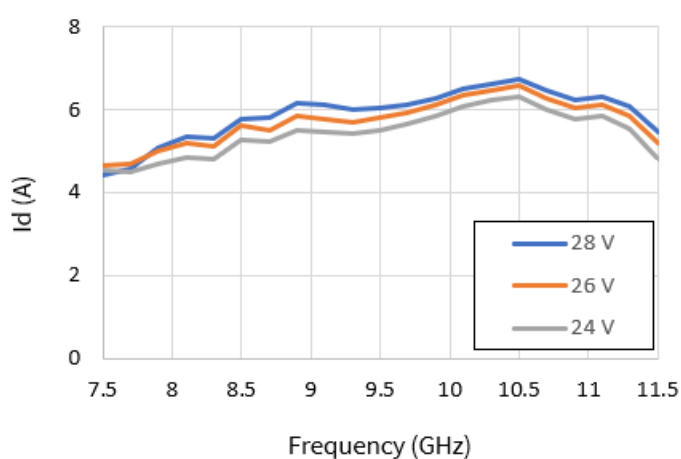
Output Power vs. Frequency



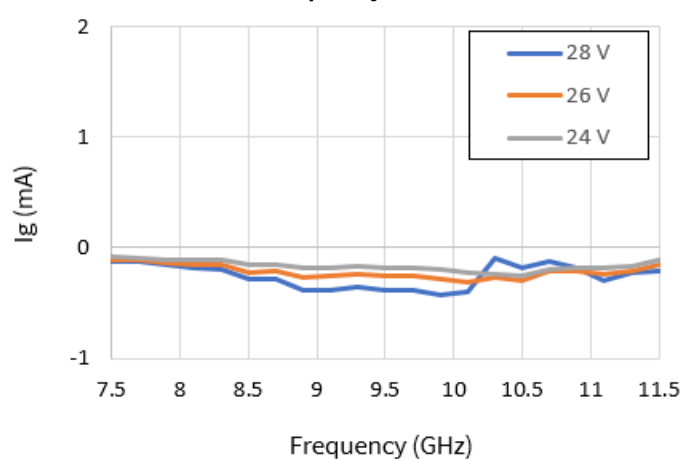
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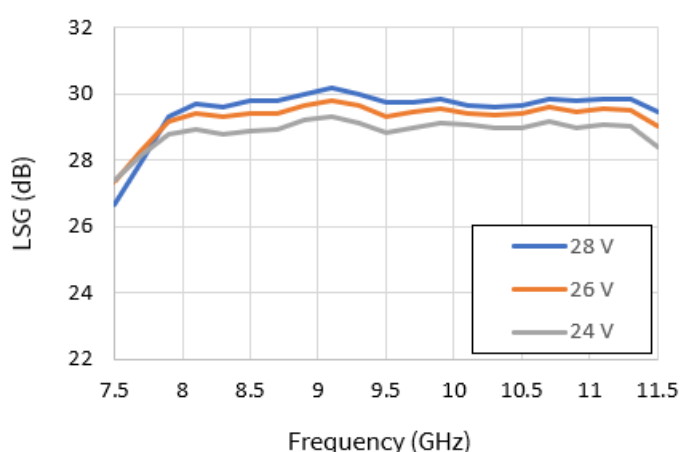
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Large Signal Gain vs. Frequency



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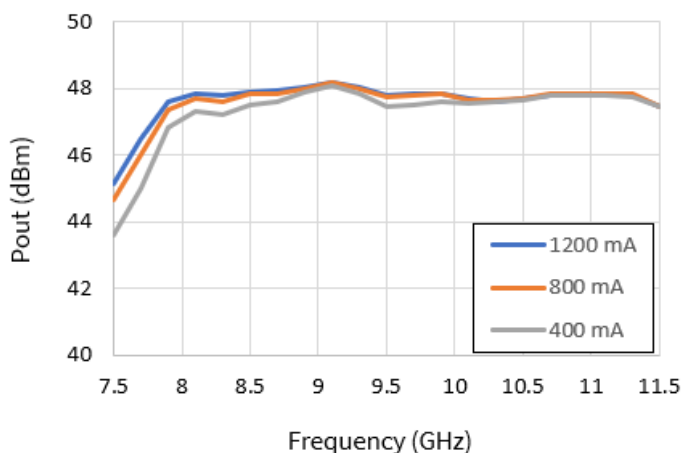
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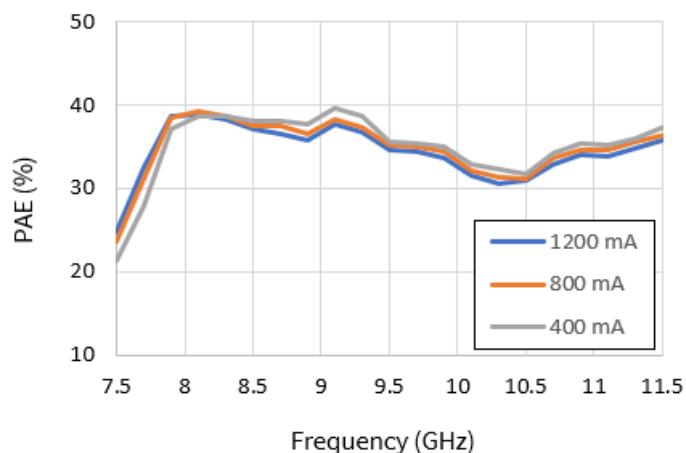
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$V_D = 28$ V, CW, $P_{IN} = 18$ dBm, $T_C = 25^\circ\text{C}$

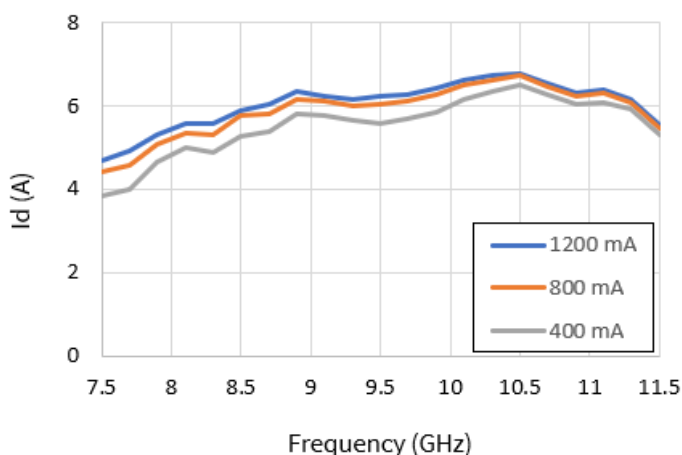
Output Power vs. Frequency



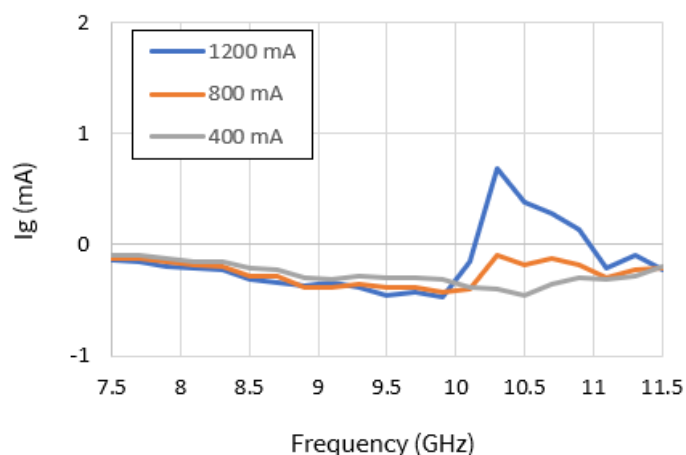
Power-Added Efficiency vs. Frequency



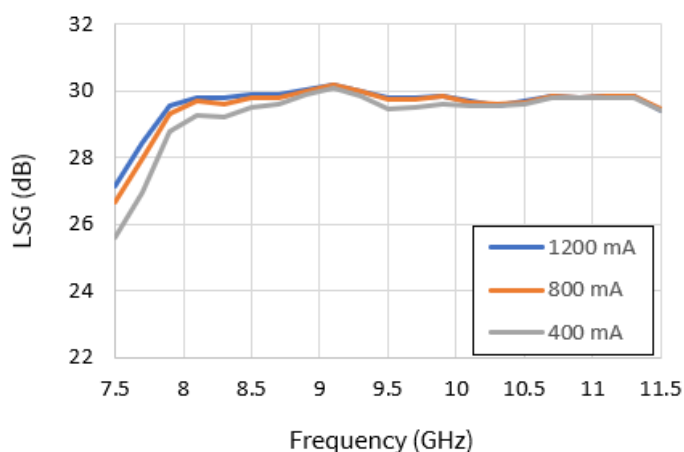
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Gate Current vs. Frequency



Large Signal Gain vs. Frequency



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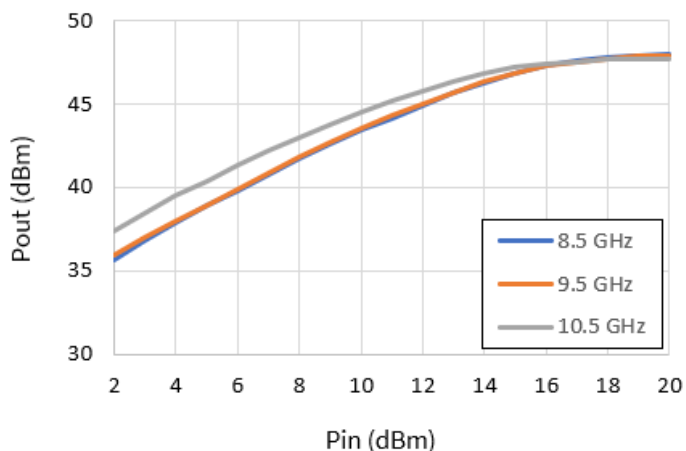
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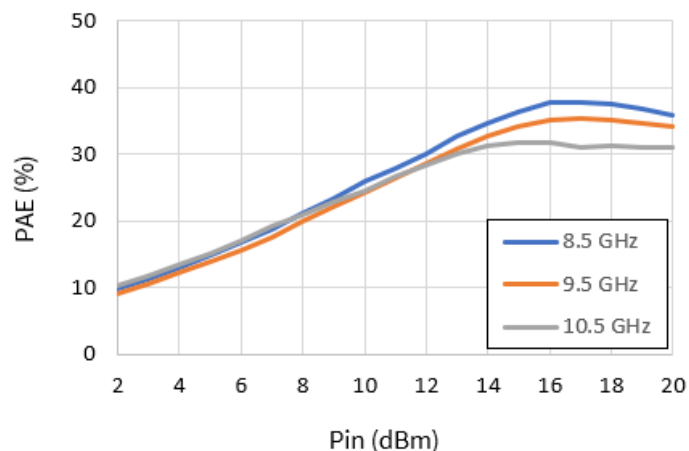
Typical Performance Curves - Drive-Up over Frequency:

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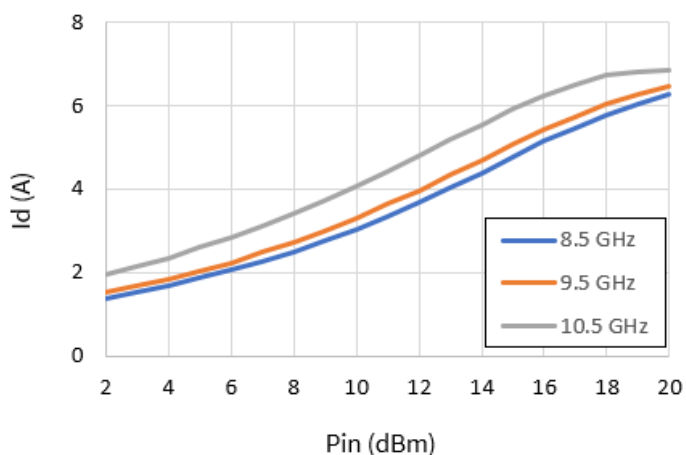
Output Power vs. Input Power



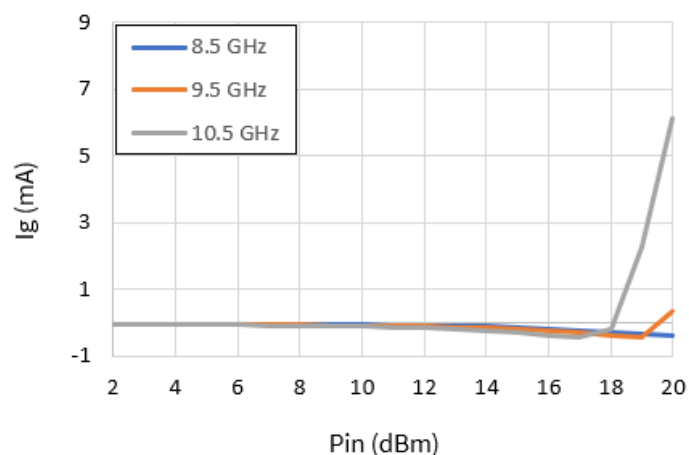
Power-Added Efficiency vs. Input Power



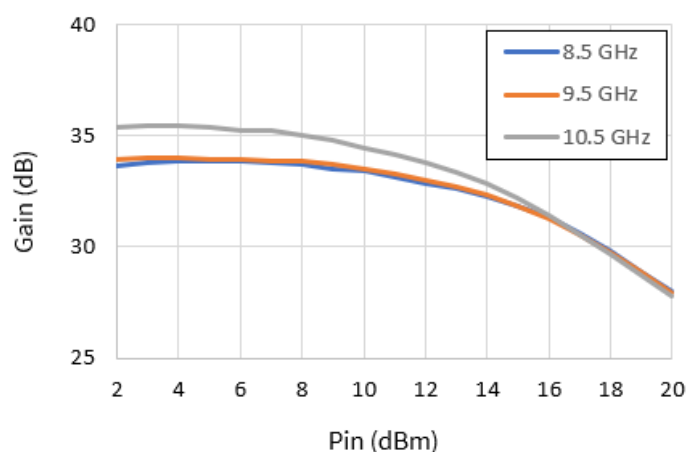
Drain Current vs. Input Power



Gate Current vs. Input Power



Gain vs. Input Power



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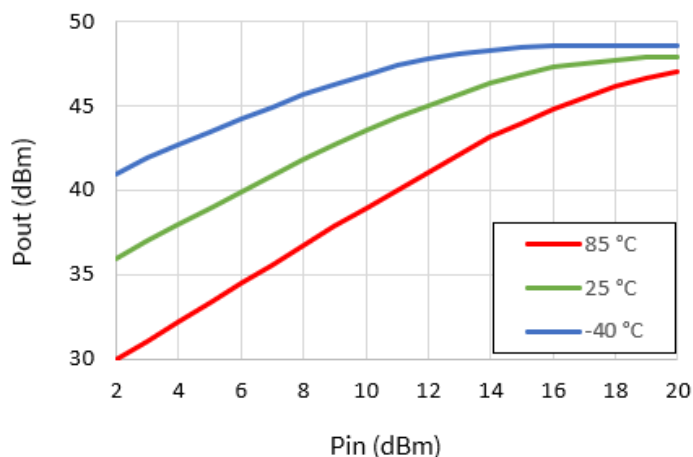
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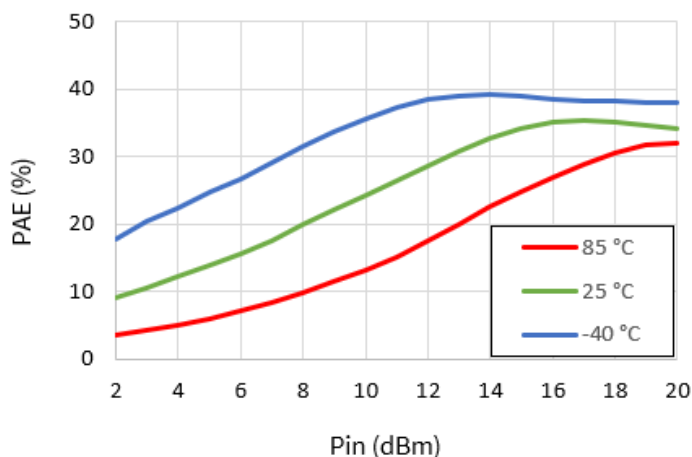
Typical Performance Curves - Drive-Up over Temperature:

$V_D = 28\text{ V}$, $I_{DQ} = 800\text{ mA}$, CW, Frequency: 9.5 GHz

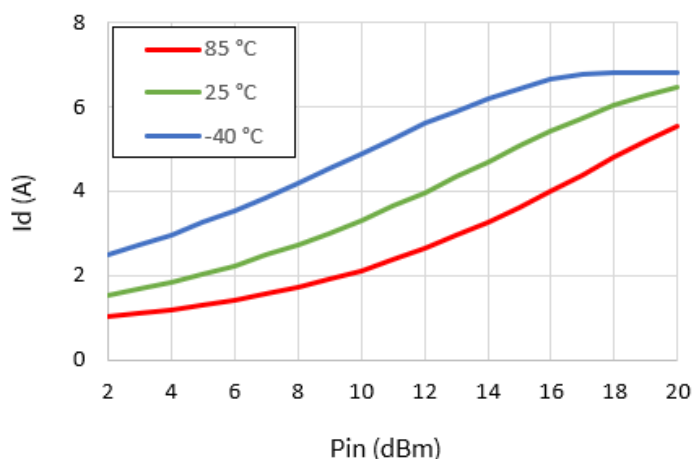
Output Power vs. Input Power



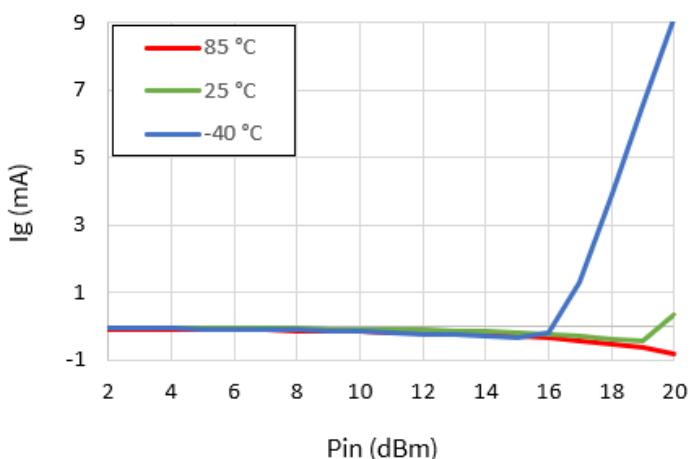
Power-Added Efficiency vs. Input Power



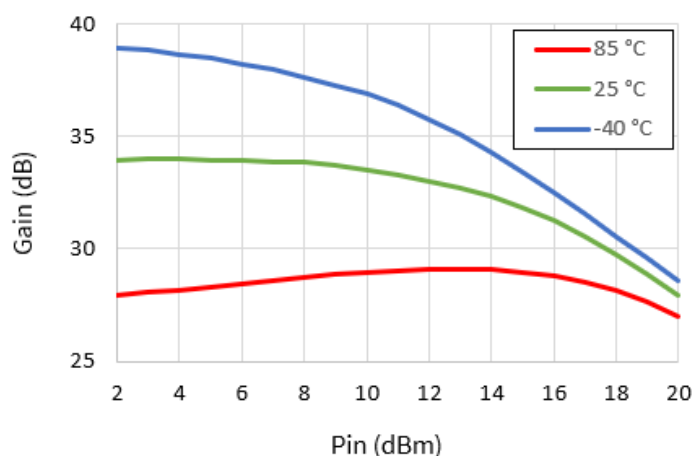
Drain Current vs. Input Power



Gate Current vs. Input Power



Gain vs. Input Power



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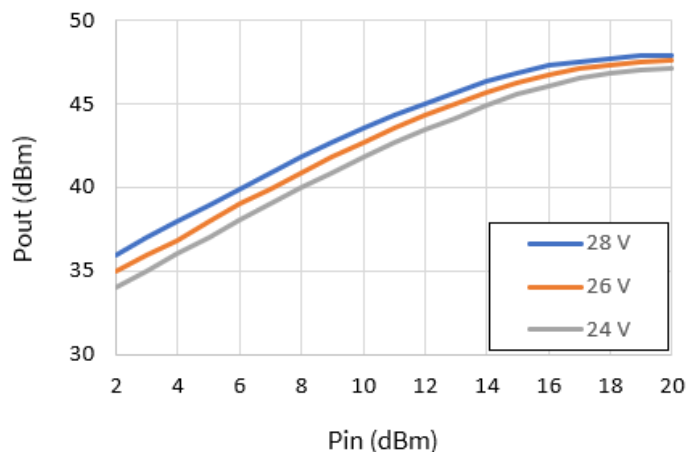
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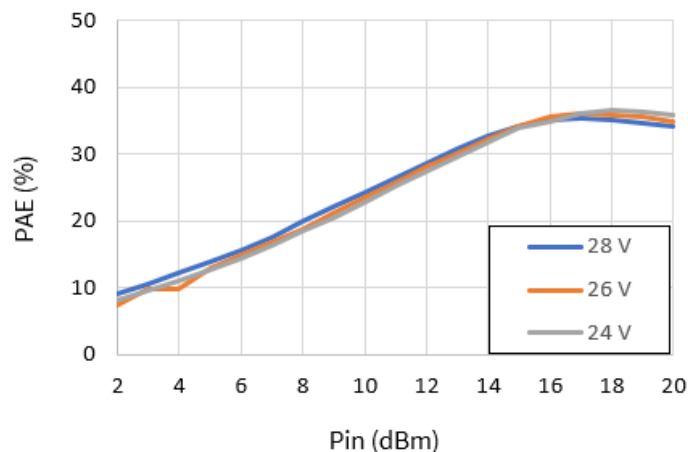
Typical Performance Curves - Drive-Up over V_D :

$I_{DQ} = 800$ mA, CW, $T_C = 25^\circ\text{C}$, Frequency: 9.5 GHz

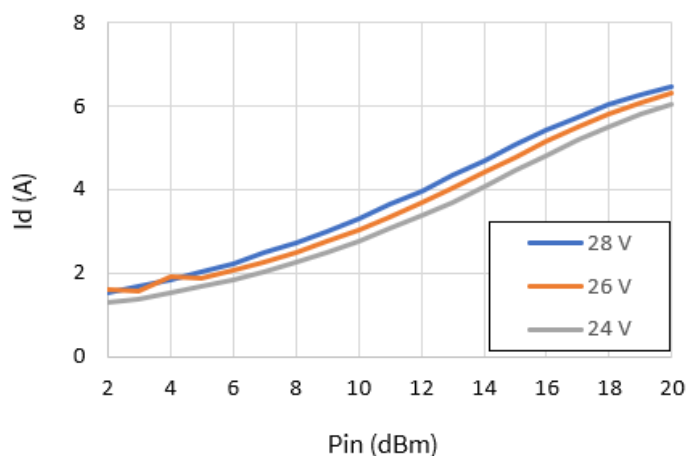
Output Power vs. Input Power



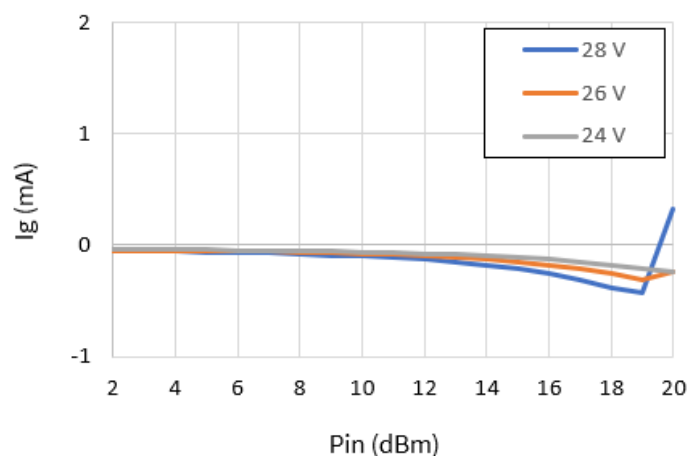
Power-Added Efficiency vs. Input Power



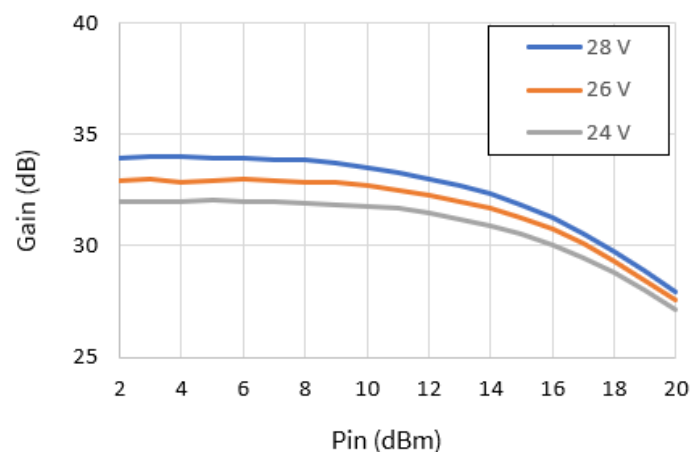
Drain Current vs. Input Power



Gate Current vs. Input Power



Gain vs. Input Power



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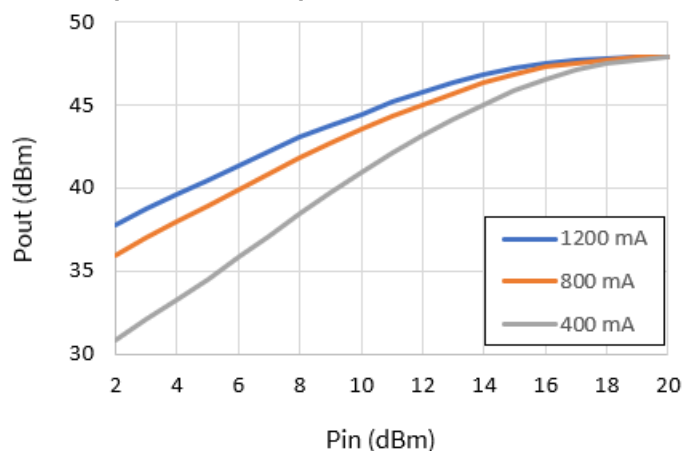
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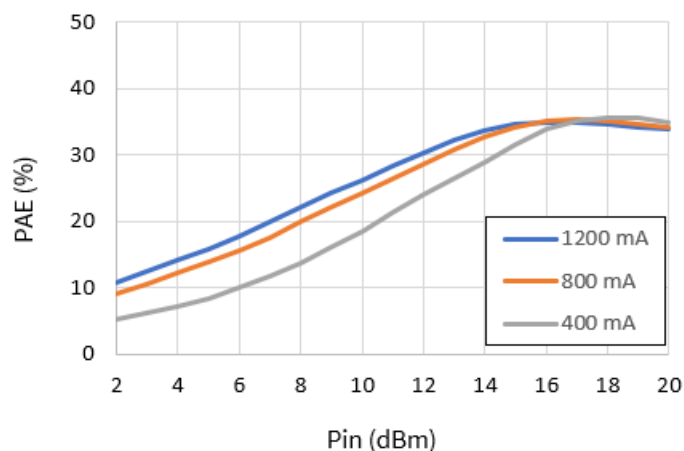
Typical Performance Curves - Drive-Up over I_{DQ} :

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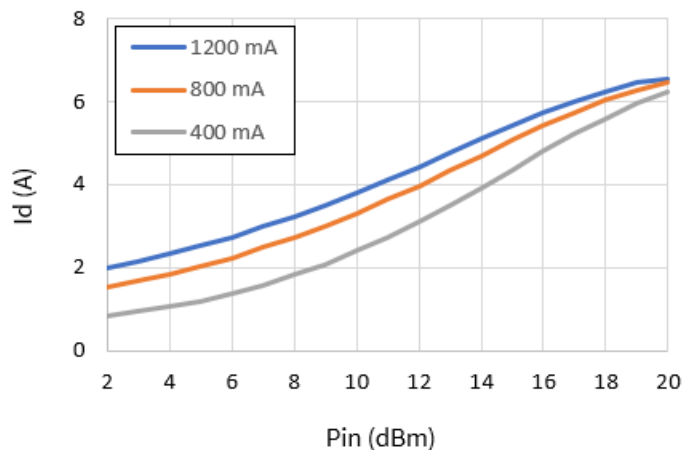
Output Power vs. Input Power



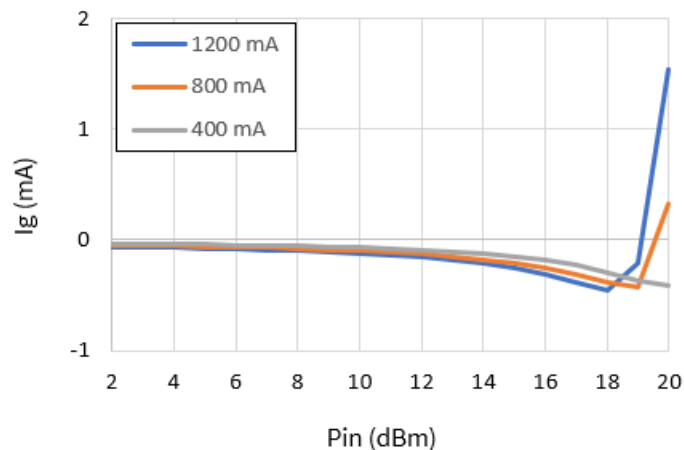
Power-Added Efficiency vs. Input Power



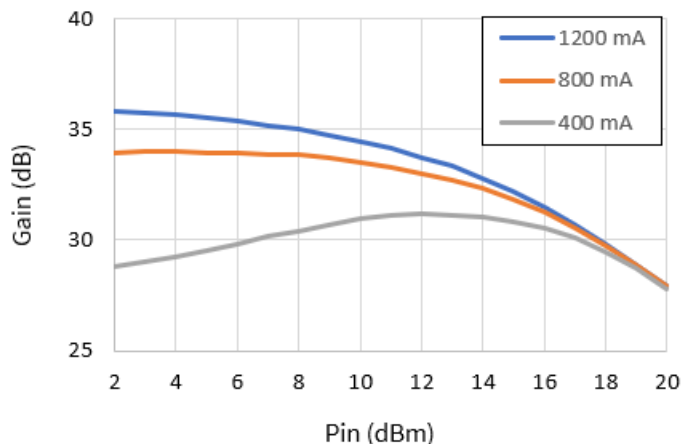
Drain Current vs. Input Power



Gate Current vs. Input Power



Gain vs. Input Power



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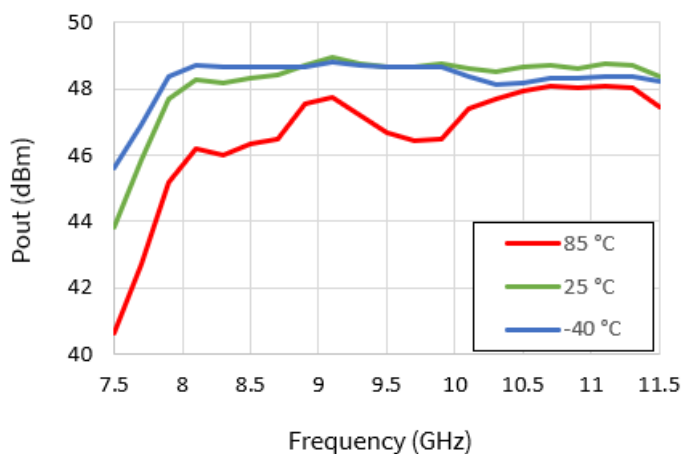
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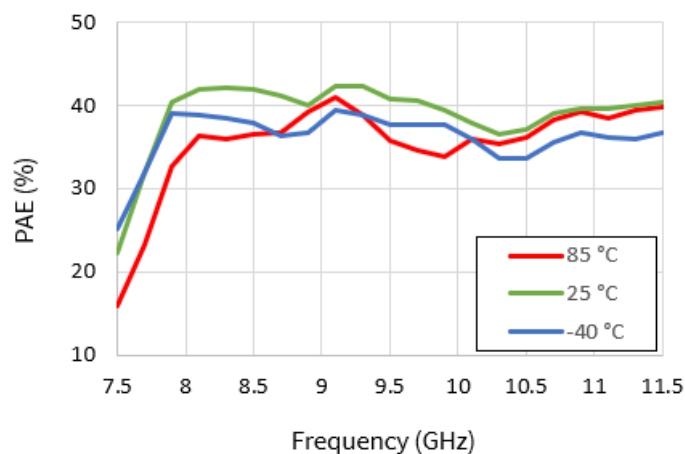
Typical Performance Curves - Large Signal over Temperature:

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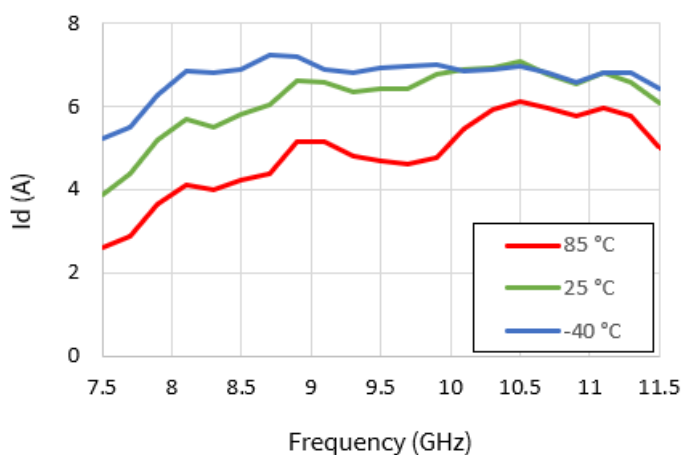
Output Power vs. Frequency



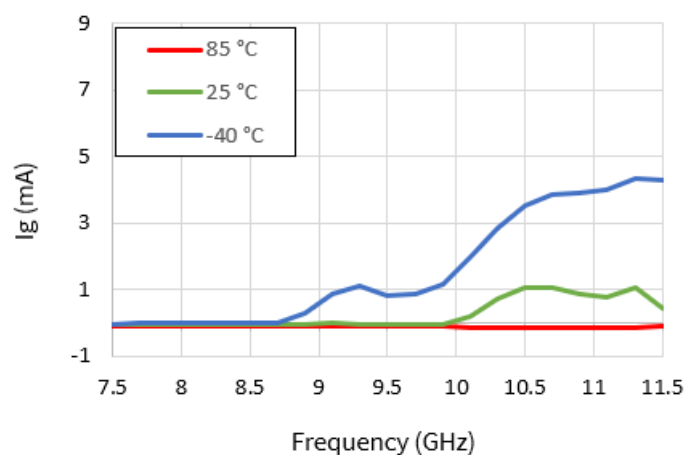
Power-Added Efficiency vs. Frequency



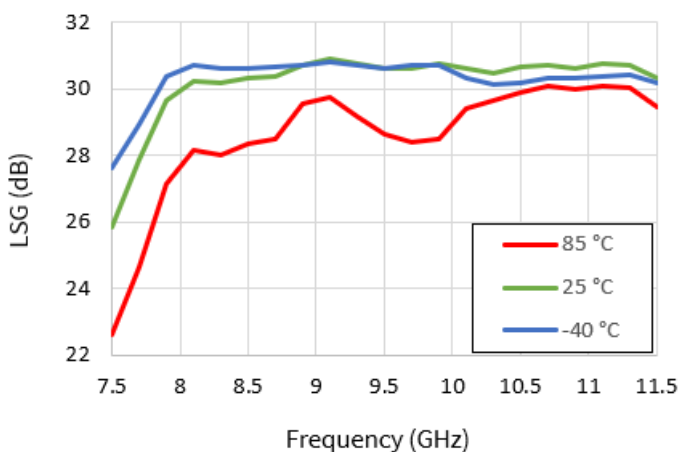
Drain Current vs. Frequency



Gate Current vs. Frequency



Large Signal Gain vs. Frequency



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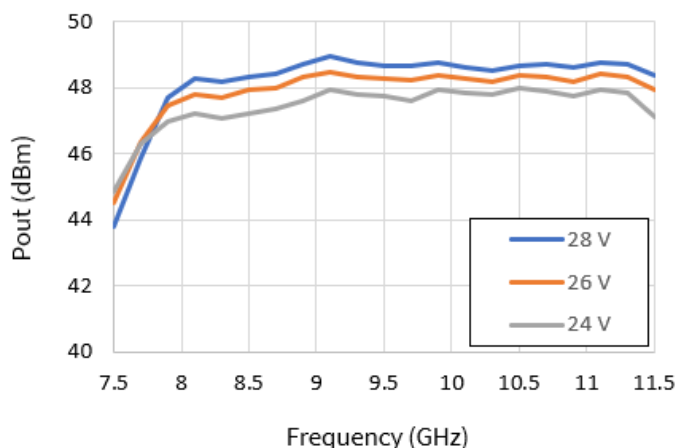


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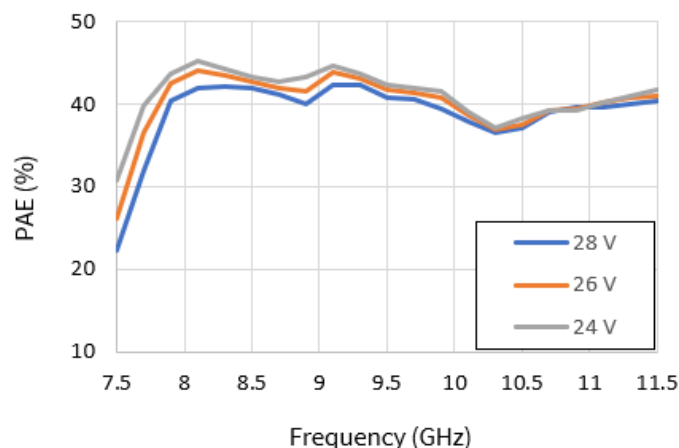
Typical Performance Curves - Large Signal over V_D :

$I_{DQ} = 800$ mA, $PW = 100$ μ s, $DC = 10\%$, $P_{IN} = 18$ dBm, $T_C = 25^\circ$ C

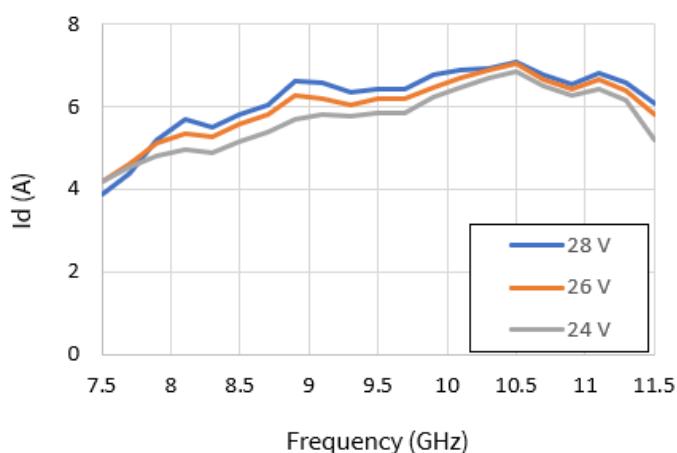
Output Power vs. Frequency



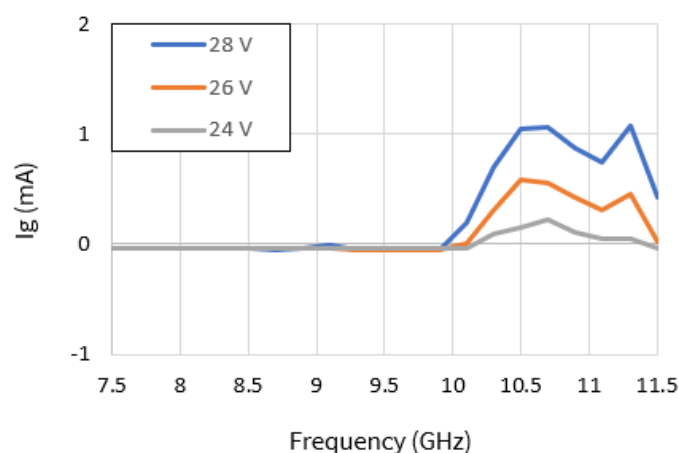
Power-Added Efficiency vs. Frequency



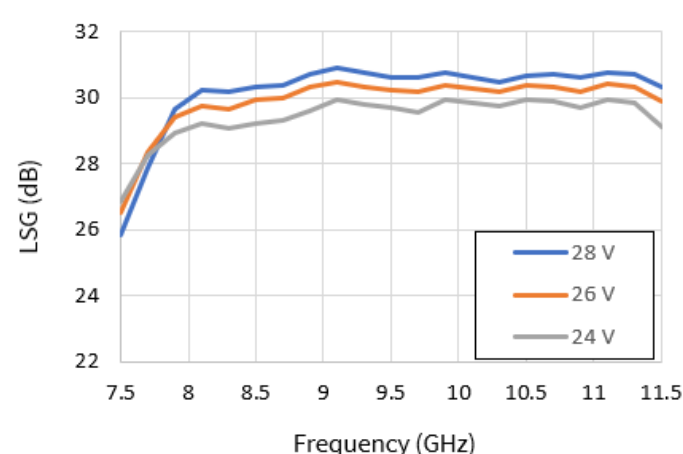
Drain Current vs. Frequency



Gate Current vs. Frequency



Large Signal Gain vs. Frequency



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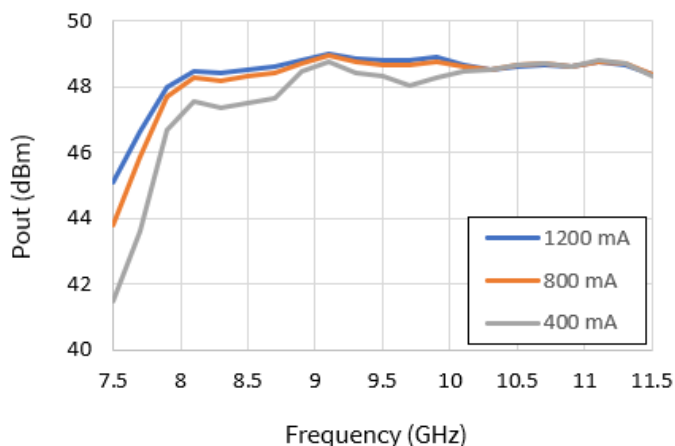
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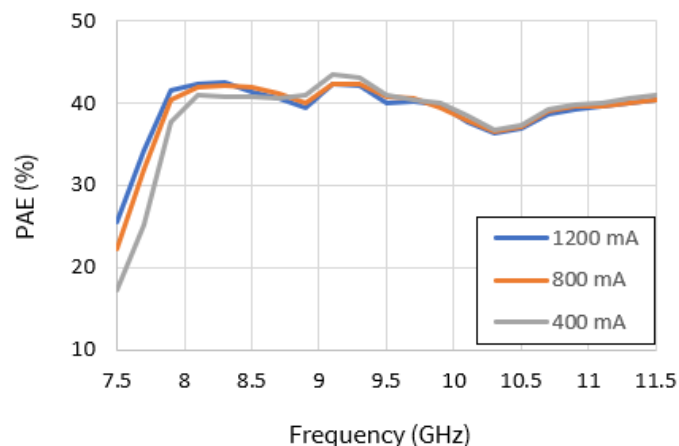
Typical Performance Curves - Large Signal over I_{DQ} :

$V_D = 28$ V, $P_W = 100$ μ s, DC = 10%, $P_{IN} = 18$ dBm, $T_C = 25^\circ$ C

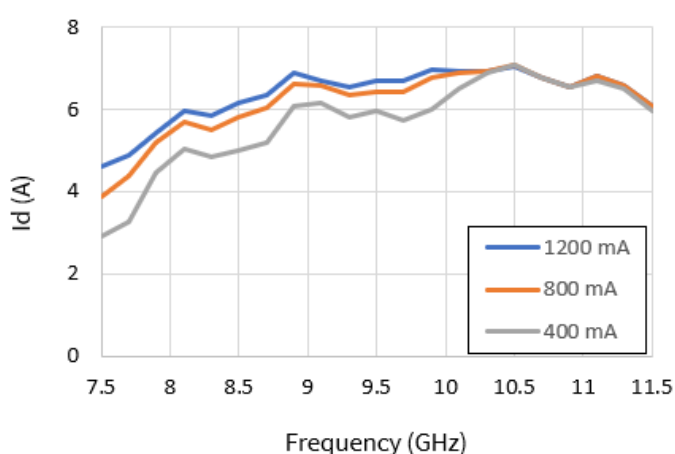
Output Power vs. Frequency



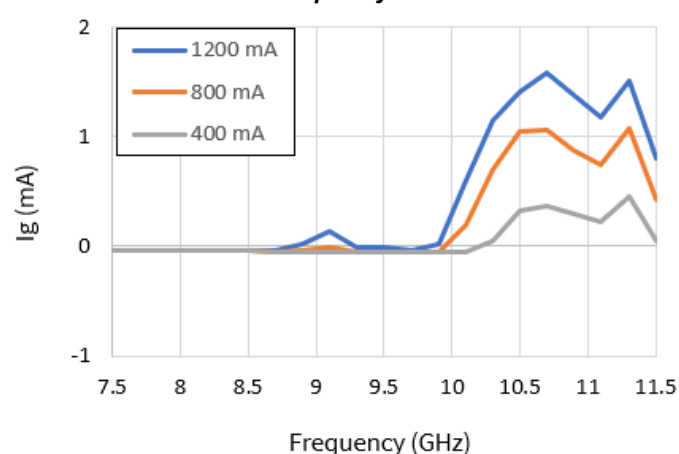
Power-Added Efficiency vs. Frequency



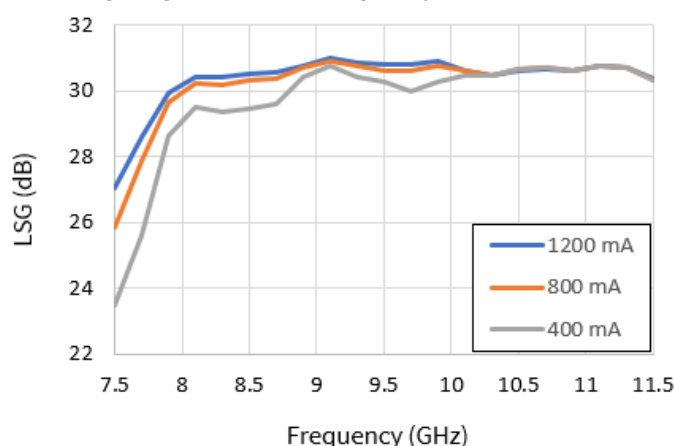
Drain Current vs. Frequency



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Large Signal Gain vs. Frequency



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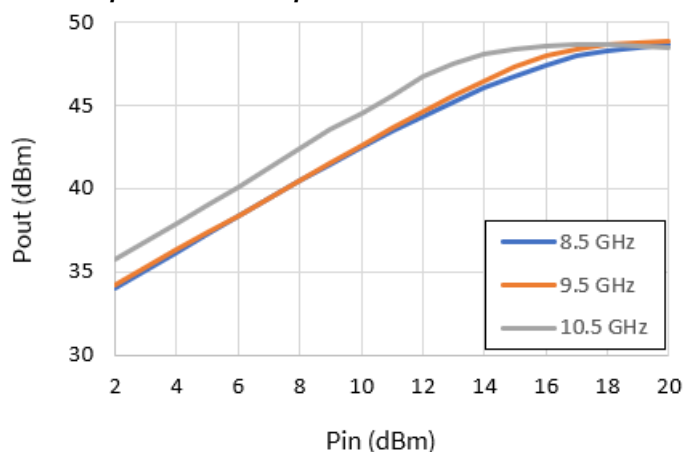
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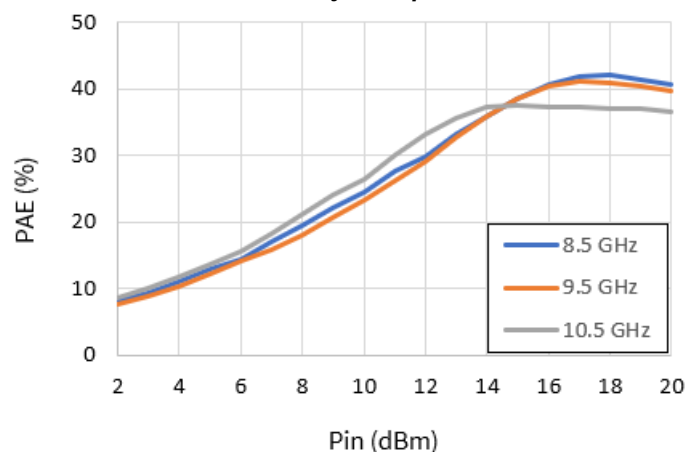
Typical Performance Curves - Drive-Up over Frequency:

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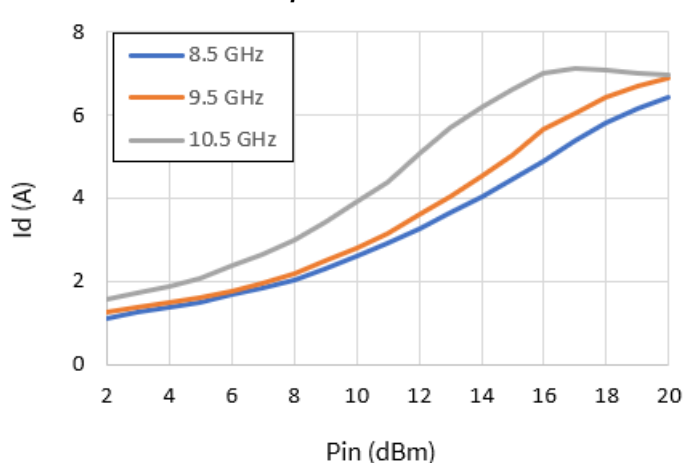
Output Power vs. Input Power



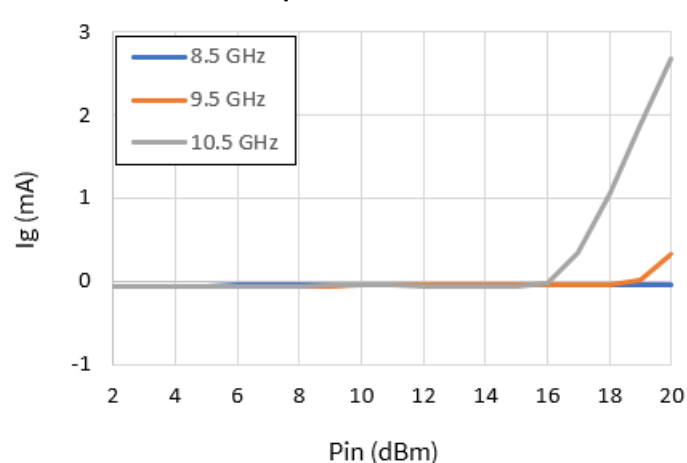
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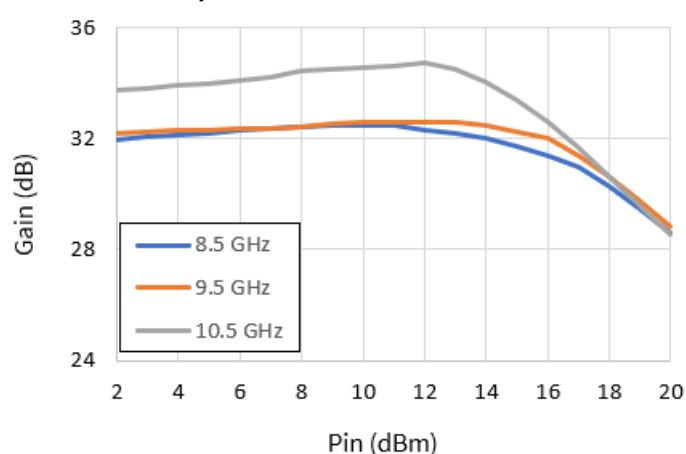
Drain Current vs. Input Power



Gate Current vs. Input Power



Gain vs. Input Power



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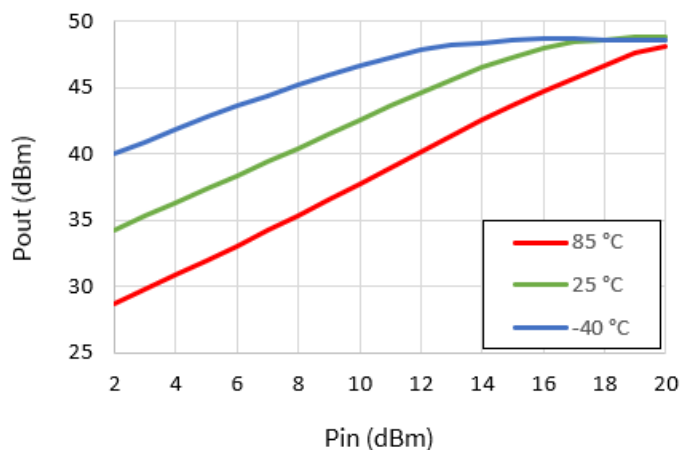
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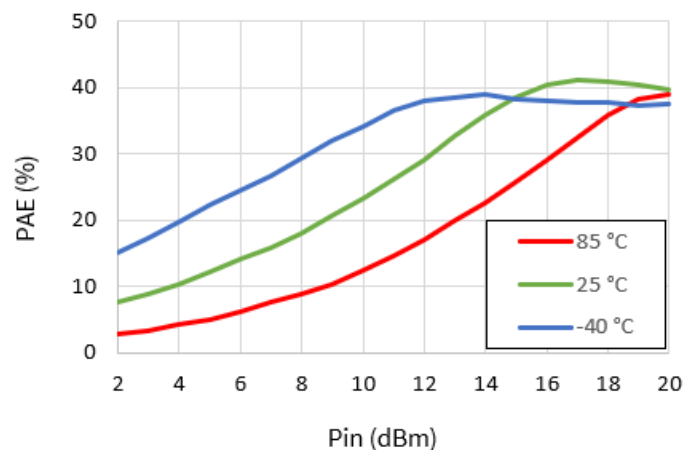
Typical Performance Curves - Drive-Up over Temperature:

$V_D = 28$ V, $I_{DQ} = 800$ mA, $PW = 100$ μ s, DC = 10%, Frequency: 9.5 GHz

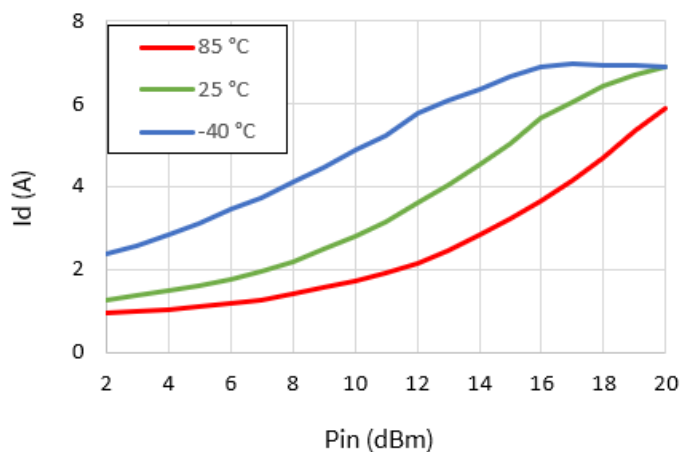
Output Power vs. Input Power



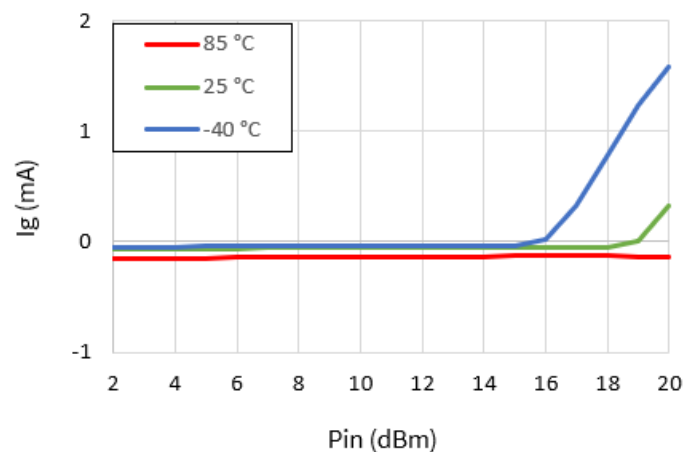
Power-Added Efficiency vs. Input Power



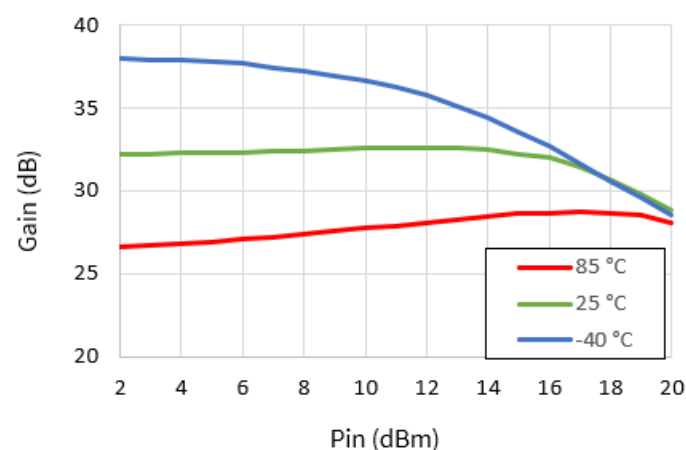
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Gate Current vs. Input Power



Gain vs. Input Power



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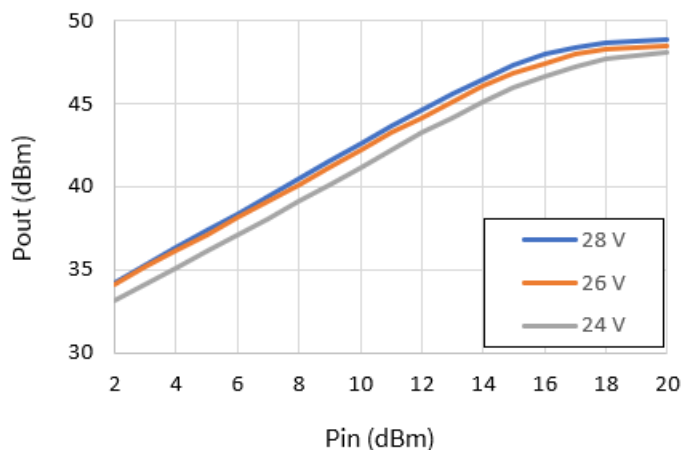
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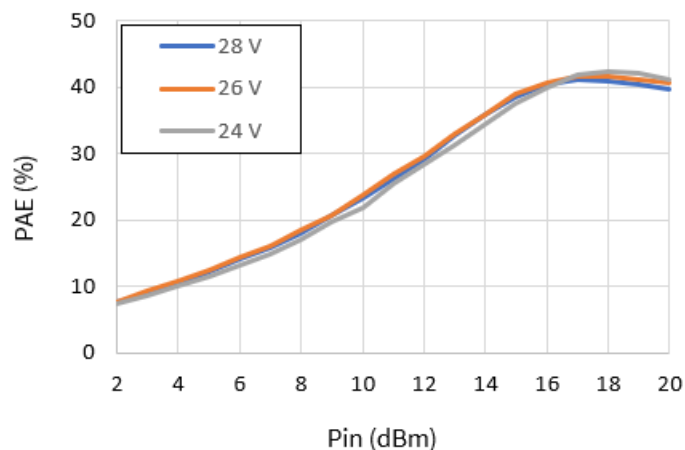
Typical Performance Curves - Drive-Up over V_D :

$I_{DQ} = 800$ mA, $PW = 100$ μ s, $DC = 10\%$, $T_C = 25^\circ$ C, Frequency: 9.5 GHz

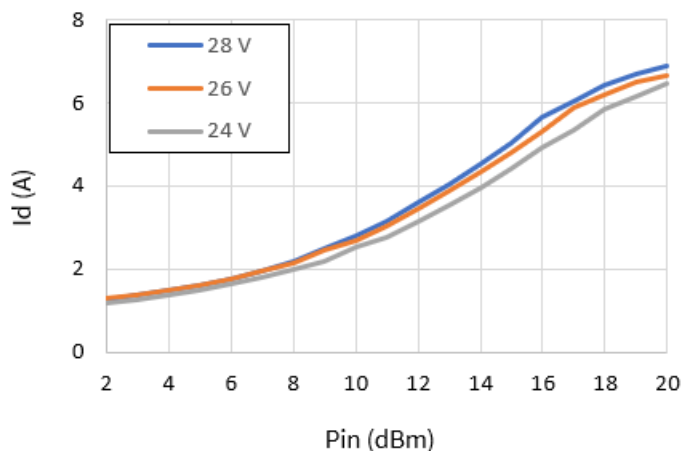
Output Power vs. Input Power



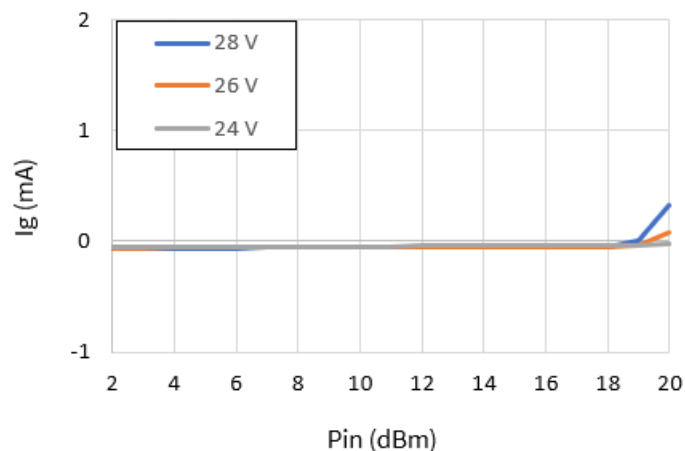
Power-Added Efficiency vs. Input Power



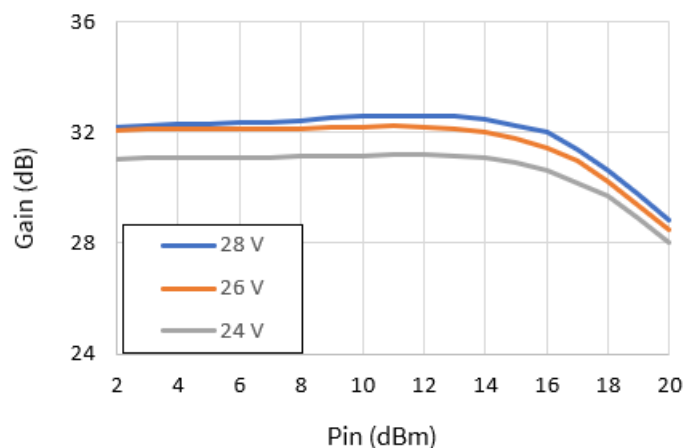
Drain Current vs. Input Power



Gate Current vs. Input Power



Gain vs. Input Power



GaN High Power Amplifier, 50 W 8.5 - 10.5 GHz



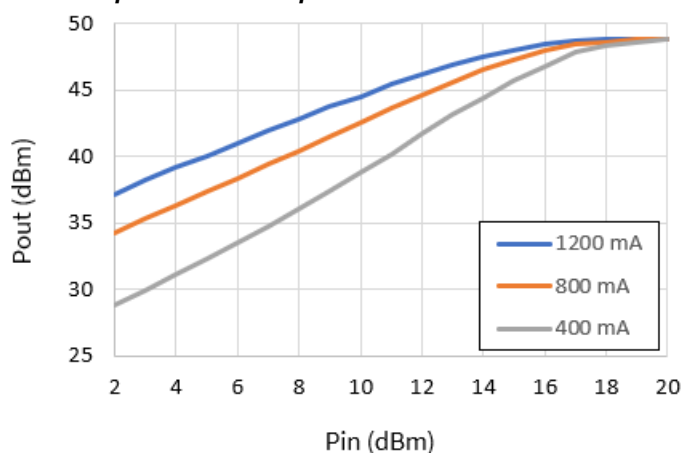
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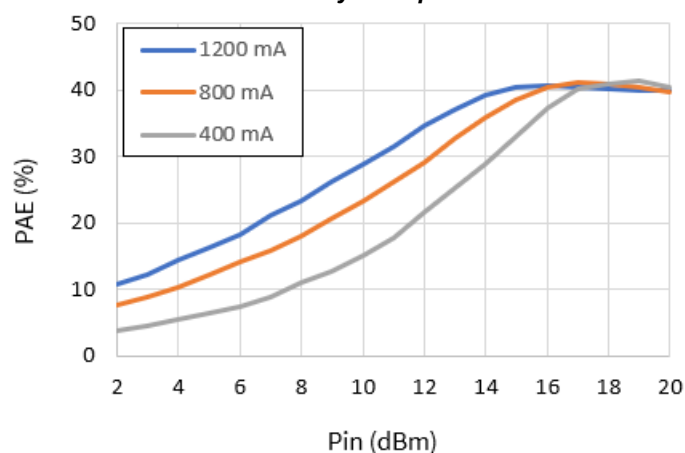
Typical Performance Curves - Drive-Up over I_{DQ} :

$V_D = 28$ V, $PW = 100$ μ s, $DC = 10\%$, $T_C = 25^\circ$ C, Frequency: 9.5 GHz

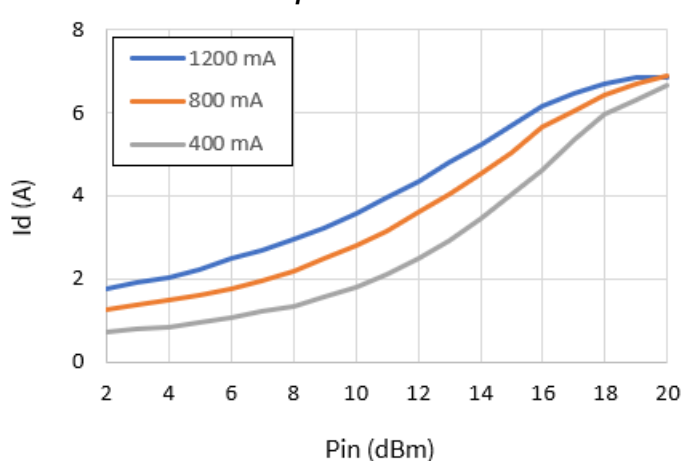
Output Power vs. Input Power



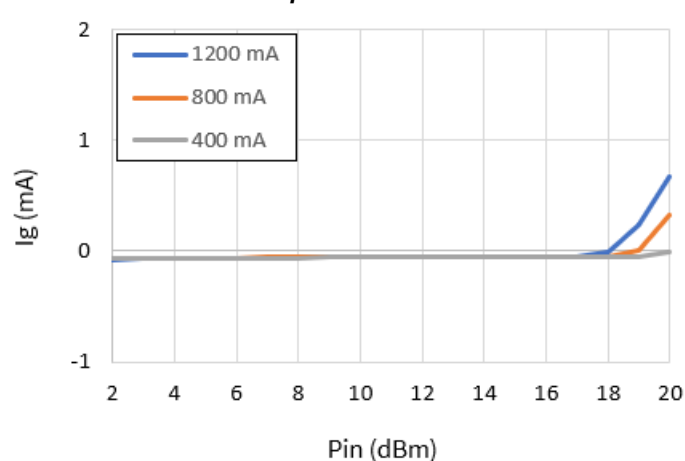
Power-Added Efficiency vs. Input Power



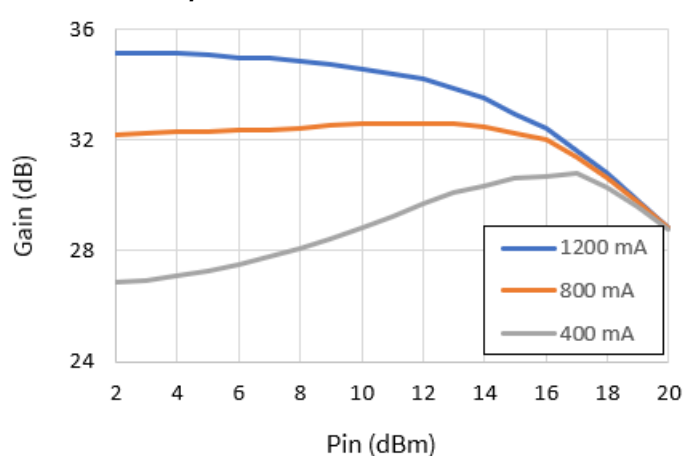
Drain Current vs. Input Power



Gate Current vs. Input Power



Gain vs. Input Power



GaN High Power Amplifier, 50 W 8.5 - 10.5 GHz



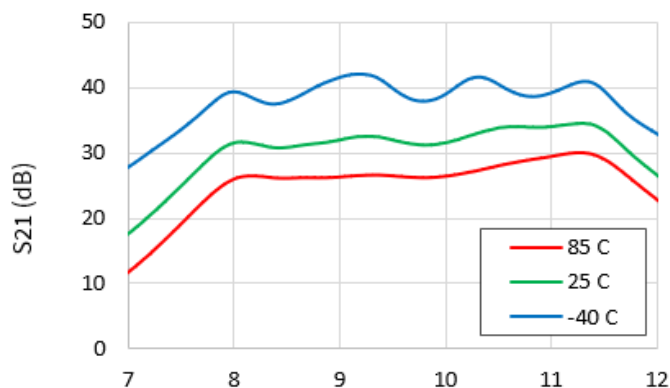
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Typical Performance Curves - Small Signal over Temperature and V_D :

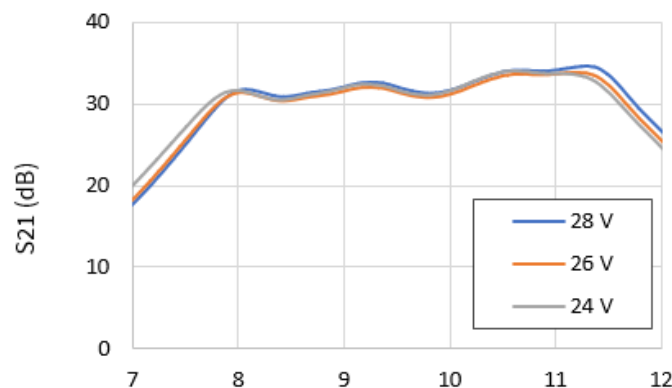
$I_{DQ} = 800$ mA, CW, $P_{IN} = -20$ dBm

S_{21} vs. Frequency over Temperature @ $V_D = 28$ V



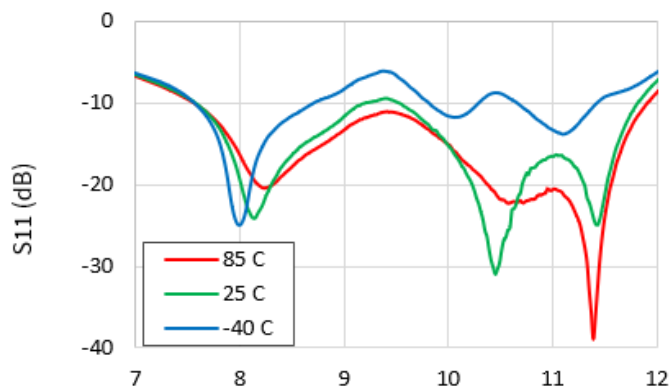
Frequency (GHz)

S_{21} vs. Frequency over V_D @ 25°C



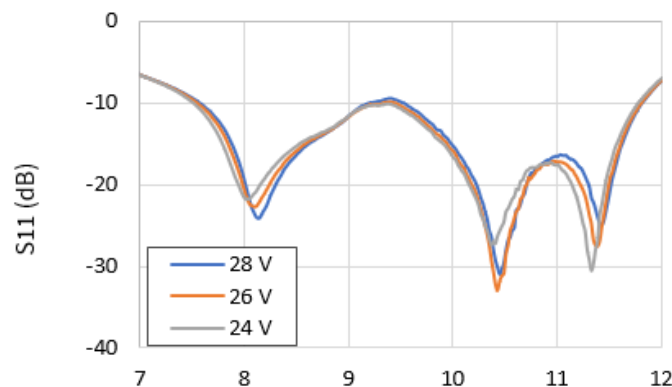
Frequency (GHz)

S_{11} vs. Frequency over Temperature @ $V_D = 28$ V



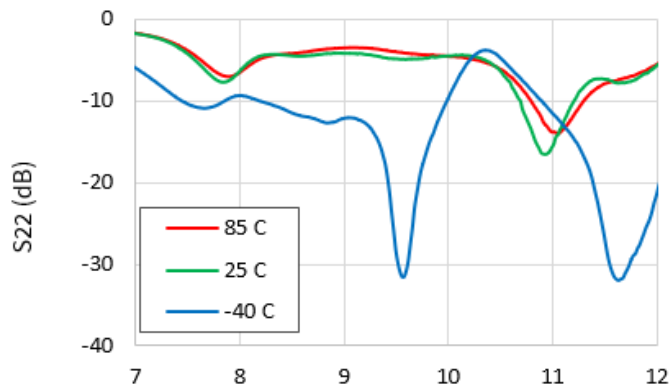
Frequency (GHz)

S_{11} vs. Frequency over V_D @ 25°C



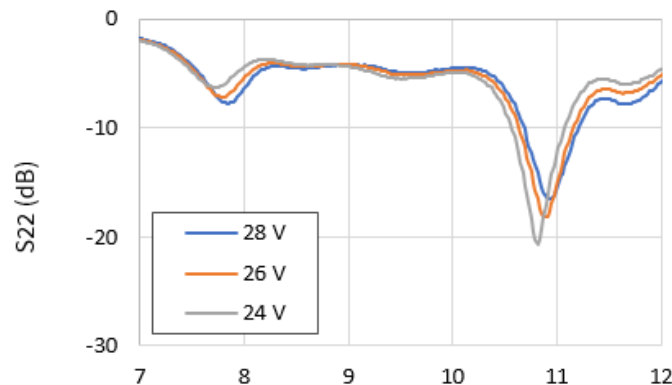
Frequency (GHz)

S_{22} vs. Frequency over Temperature @ $V_D = 28$ V



Frequency (GHz)

S_{22} vs. Frequency over V_D @ 25°C



Frequency (GHz)

GaN High Power Amplifier, 50 W 8.5 - 10.5 GHz



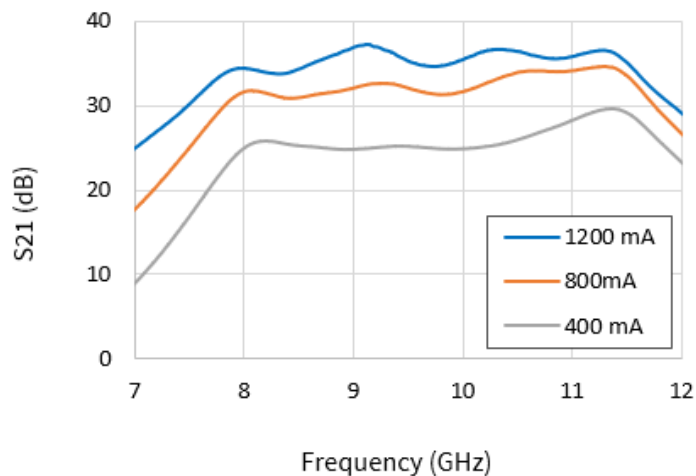
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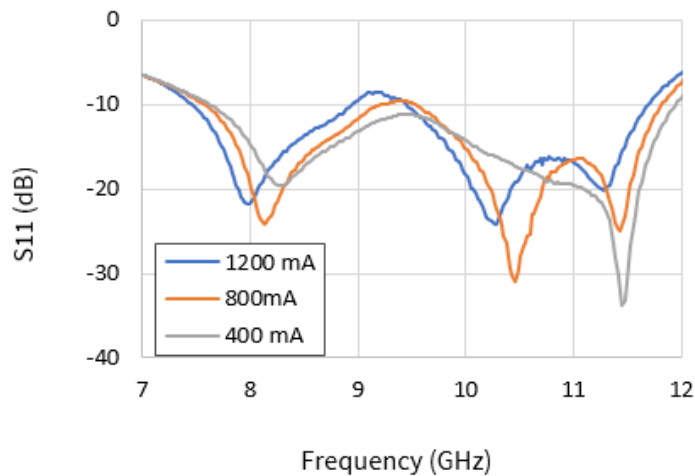
Typical Performance Curves - Small Signal over I_{DQ} :

$V_D = 28$ V, CW, $P_{IN} = -20$ dBm, $T_C = 25^\circ\text{C}$

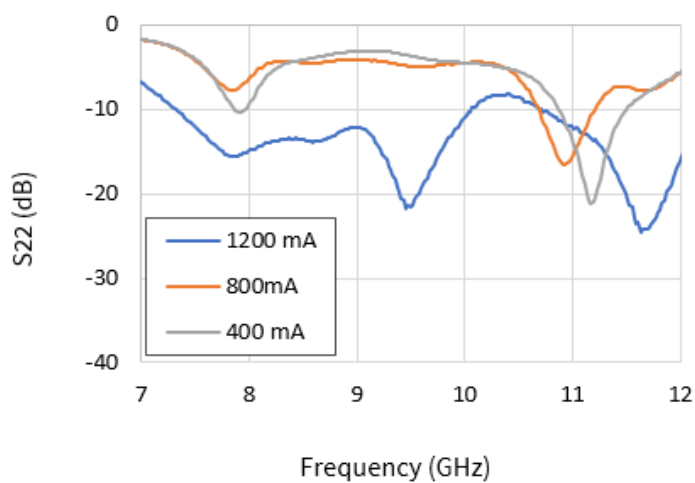
S₂₁ vs. Frequency over I_{DQ}



S₁₁ vs. Frequency over I_{DQ}



S₂₂ vs. Frequency over I_{DQ}



GaN High Power Amplifier, 50 W 8.5 - 10.5 GHz



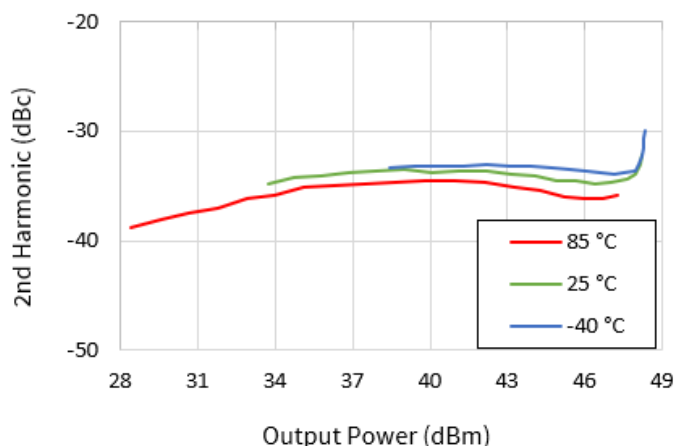
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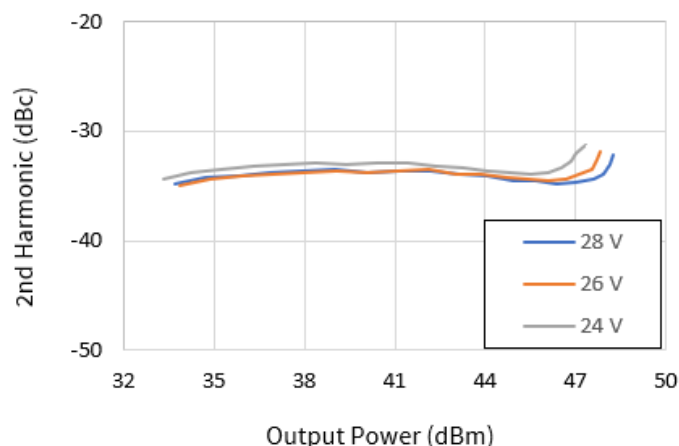
Typical Performance Curves - Harmonics over Temperature and V_D :

$V_D = 28$ V, $I_{DQ} = 800$ mA, $PW = 100$ μ s, $DC = 10\%$, $T_C = 25^\circ\text{C}$ (unless otherwise noted)

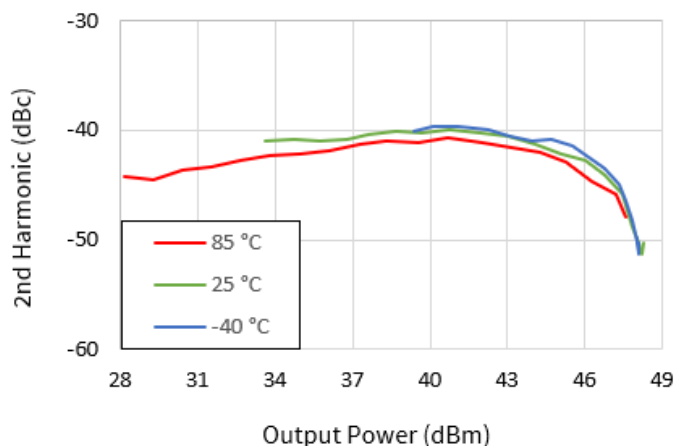
2f vs. Output Power over Temperature @ 8.5 GHz



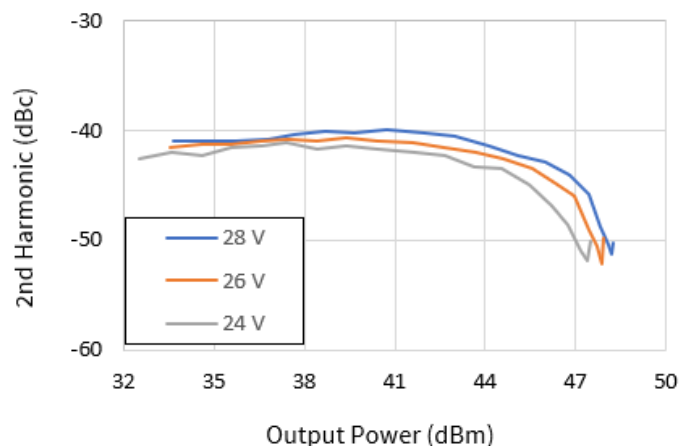
2f vs. Output Power over V_D @ 8.5 GHz



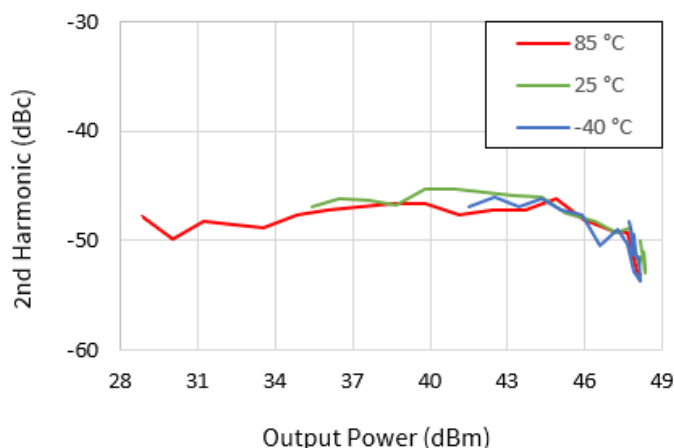
2f vs. Output Power over Temperature @ 9.5 GHz



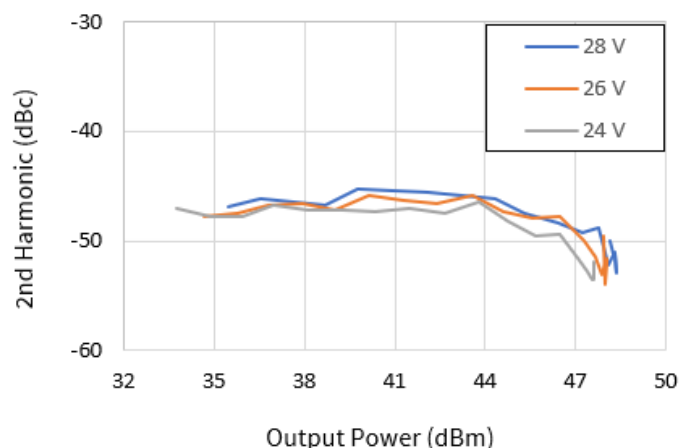
2f vs. Output Power over V_D @ 9.5 GHz



2f vs. Output Power over Temperature @ 10.5 GHz



2f vs. Output Power over V_D @ 10.5 GHz



GaN High Power Amplifier, 50 W 8.5 - 10.5 GHz

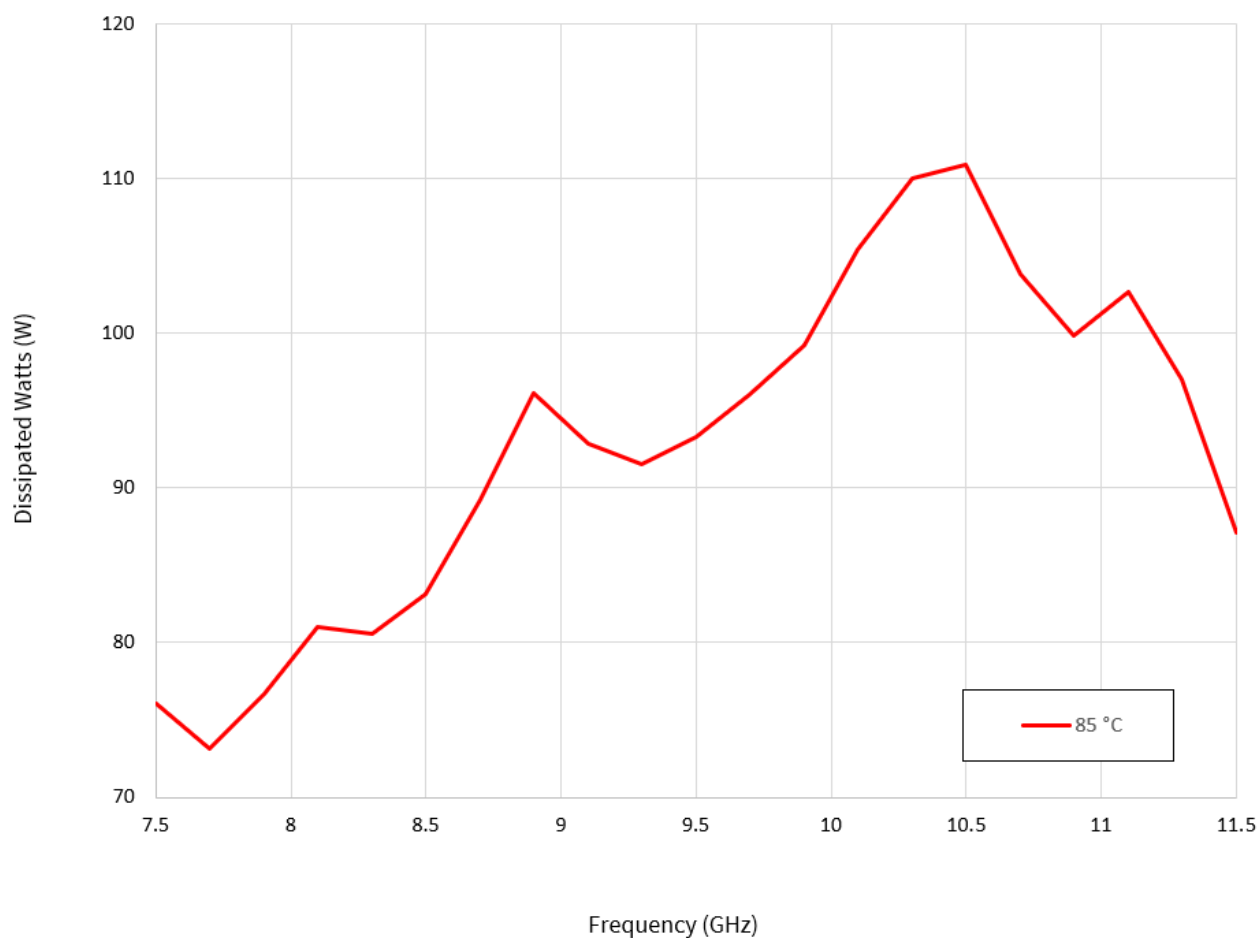


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Thermal Characteristics

Parameter	Operating Conditions	Value
Operating Junction Temperature (T_J)	Freq = 9.5 GHz, $V_D = 28$ V, $I_{DQ} = 800$ mA, $I_{DRIVE} = 4.9$ A , $P_{IN} = 18$ dBm, $P_{OUT} = 46.3$ dBm, $P_{DISS} = 94$ W, $T_C = 85^\circ\text{C}$, CW	208°C
Thermal Resistance, Junction to Case ($R_{\theta JC}$)		1.3°C/W

Power Dissipation vs. Frequency ($T_C = 85^\circ\text{C}$)



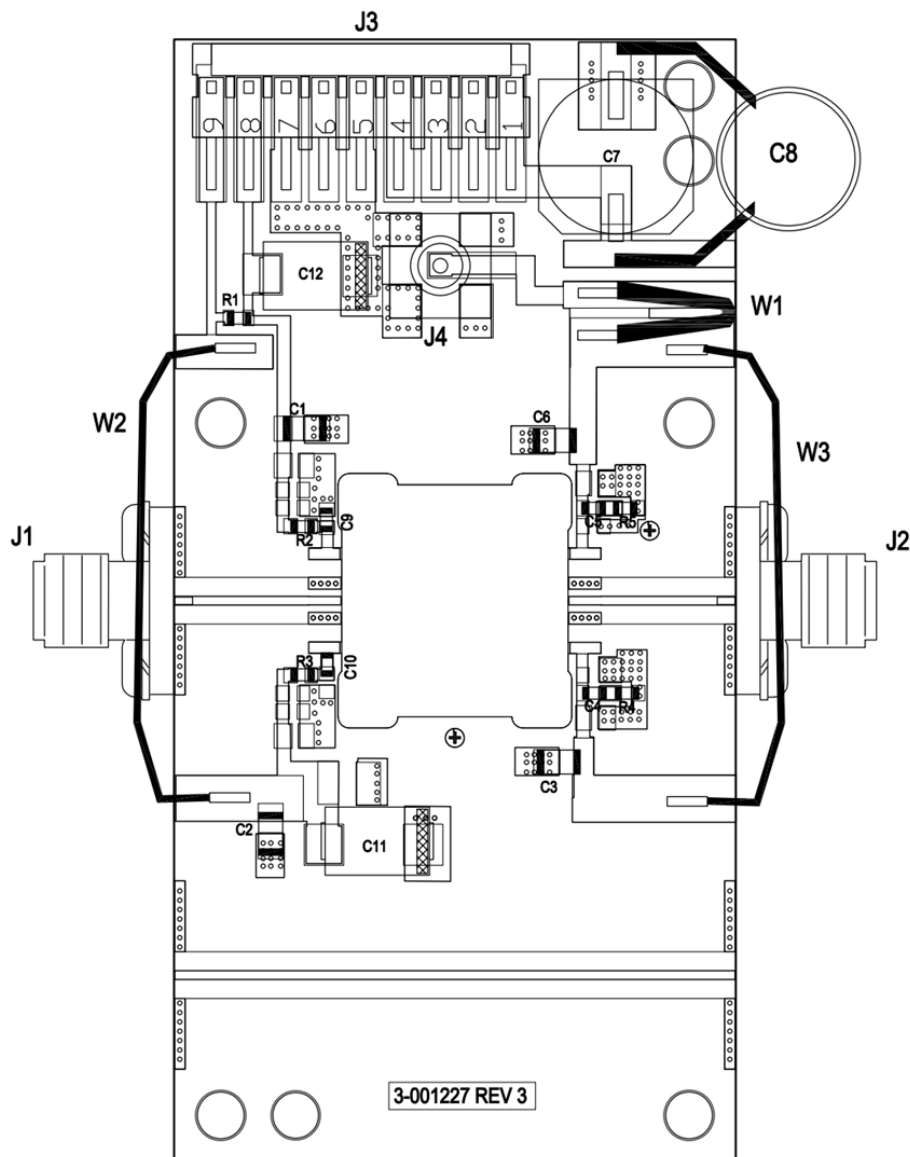
The schematic diagram illustrates a 100-MHz CMOS differential amplifier. The circuit is divided into three main sections: W1, W2, and W3.

- Section W1:** Contains the input stage, including a differential pair of NMOS and PMOS transistors (DUT). The input is connected to J1 (RF IN) and the output to J2 (RF OUT). The circuit includes various capacitors (C1-C12) and resistors (R1-R5) for biasing and signal conditioning.
- Section W2:** Contains the biasing network, including a 1.8V source (VDD) and ground (GND). The circuit includes various capacitors (C1-C12) and resistors (R1-R5) for biasing and signal conditioning.
- Section W3:** Contains the output stage, including a differential pair of NMOS and PMOS transistors (DUT). The output is connected to J2 (RF OUT) and the circuit includes various capacitors (C1-C12) and resistors (R1-R5) for biasing and signal conditioning.

The circuit is powered by a 1.8V source (VDD) and ground (GND). The input and output are differential signals. The circuit includes various capacitors (C1-C12) and resistors (R1-R5) for biasing and signal conditioning.

Part	Value	Qty.
R1	RES 0 Ohm, 0603	1
R2,R3	IND, FERRITE, 220 OHM, 0603	2
R4,R5	RES, 4.99OHM, +/-1%, 1/16W, 0402	2
C1,C2,C3,C6	CAP, 1uF, +/-15%, 100V, 1206, X7R	4
C4,C5	CAP, 100pF, 0402	2
C7	CAP, 33 uF, 20%, G CASE	1
C8	CAP, 470uF	1
C11,C12	CAP,10UF	2
C9,C10	CAP, 0.01 uF, 0402 X7R	2
-	BASEPLATE, CU	1
-	PCB 3.0" x 1.5" x 0.010" (RO3003, DK 3.0), TEST FIXTURE CMPA851A050F	1
-	2-56 SOC HD SCREW 3/16 SS	4
-	#2 SPLIT LOCKWASHER SS	4
J1,J2	CONN, SMA, PANEL MOUNT JACK, FLANGE, 4-HOLE, BLUNT POST, 20MIL	2
J3	HEADER RT>PLZ .1CEN LK 9POS	1
J4	SMB Connector	1
W1	WIRE, 30AWG	1
W2,W3	WIRE, 22AWG	2
-	CMPA851A050F	1

Evaluation Board Assembly Drawing (CMPA851A050F-AMP)



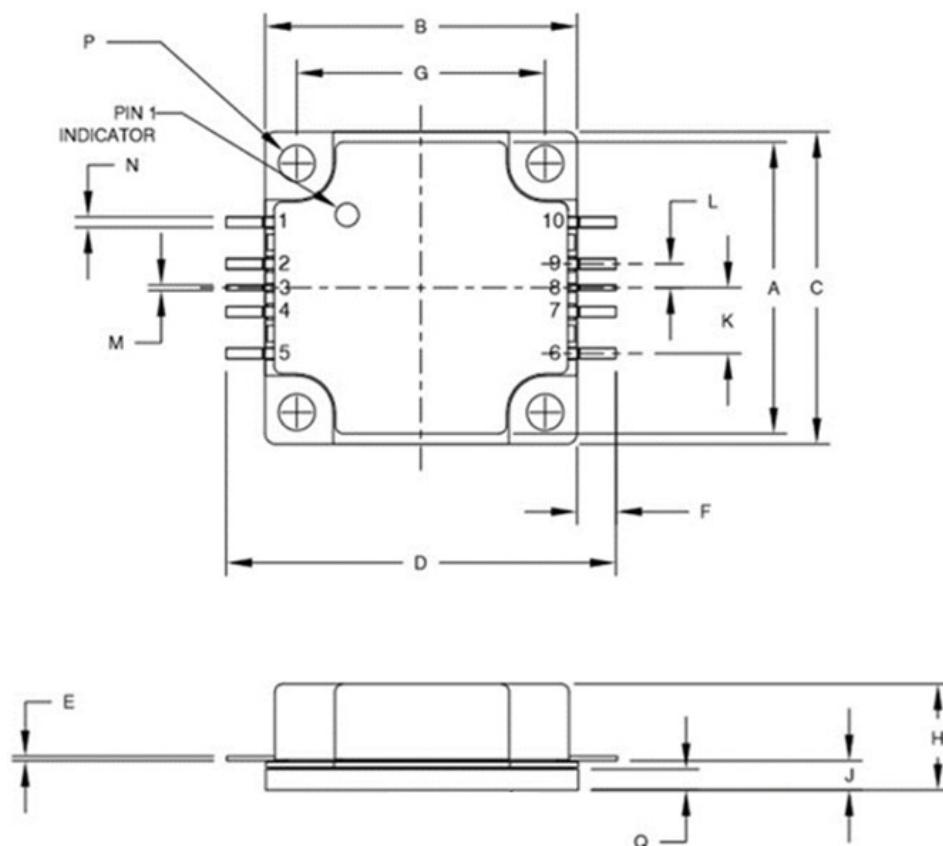
Bias On Sequence

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

Bias Off Sequence

1. Turn RF off
2. Apply pinch-off to the gate ($V_G = -5$ V)
3. Turn off drain voltage (V_D)
4. Turn off gate voltage (V_G)

Mechanical Information



DIM	INCHES			MILLIMETERS		
	MIN	TYP	MAX	MIN	TYP	MAX
A	.555	.560	.565	14.10	14.22	14.35
B	.595	.600	.605	15.11	15.24	15.37
C	.595	.600	.605	15.11	15.24	15.37
D	-	(.750)	-	-	(19.05)	-
E	.006	.008	.010	0.15	0.20	0.25
F	.065	.075	.085	1.66	1.91	2.16
G	.473	.478	.483	12.01	12.14	12.27
H	.191	.203	.215	4.86	5.16	5.46
J	.049	.056	.063	1.24	1.42	1.60
K	.121	.126	.131	3.07	3.20	3.33
L	.041	.046	.051	1.04	1.17	1.30
M	.005	.010	.015	0.13	.25	0.38
N	.015	.020	.025	0.38	.51	0.63
P	.065	.070	.075	1.65	1.78	1.90
Q	.038	.040	.042	0.97	1.02	1.07

GaN High Power Amplifier, 50 W

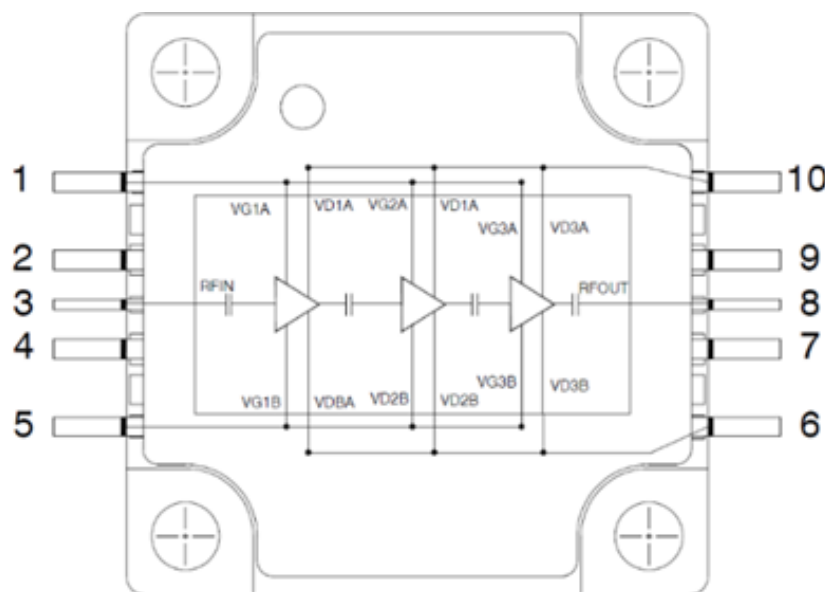
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Pin Description

Pin #	Name	Description
1	VG	Pins 1 and 5 must be electrically connected to the gate bias voltage.
2	RFGND	RF and DC ground
3	RF Input	DC blocked on MMIC
4	RFGND	RF and DC ground
5	VG	Pins 1 and 5 must be electrically connected to the gate bias voltage.
6	VD	Pins 6 and 10 must be electrically connected to the drain bias voltage.
7	RFGND	RF and DC ground
8	RF Output	DC blocked on MMIC
9	RFGND	RF and DC ground
10	VD	Pins 6 and 10 must be electrically connected to the drain bias voltage.
Base		RF and DC ground



GaN High Power Amplifier, 50 W

8.5 - 10.5 GHz



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Revision History

Rev	Date	Change Description
V1P	09/20/2024	Initial preliminary release.
V1	09/29/2025	Production release.

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