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

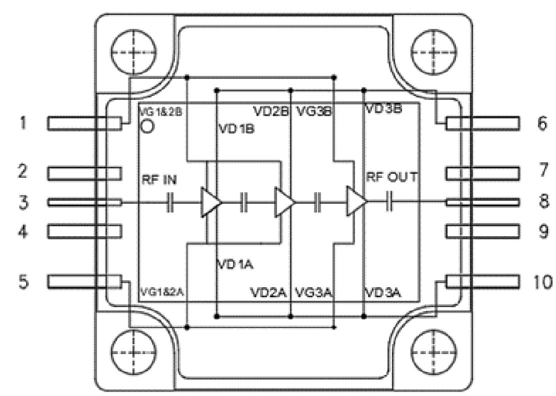
Description

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 25ºC. 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.

Functional Schematic



Ordering Information

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

Pin Configuration[1]

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.

RF Electrical Specifications: V_D = 28 V, I_{DQ} = 800 mA, CW, T_C = 25°C, Z_0 = 50 Ω

Parameter	Test Conditions	Frequency (GHz)	Units	Min.	Typ.	Max.
Output Power	P_{IN} = 18 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 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	—

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:

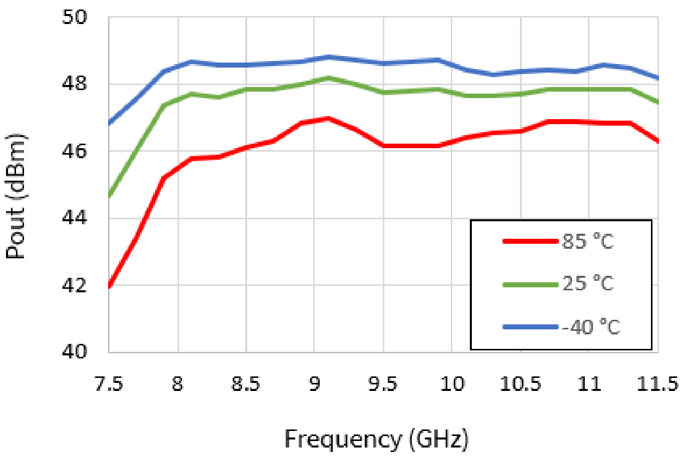
Static Sensitivity

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.

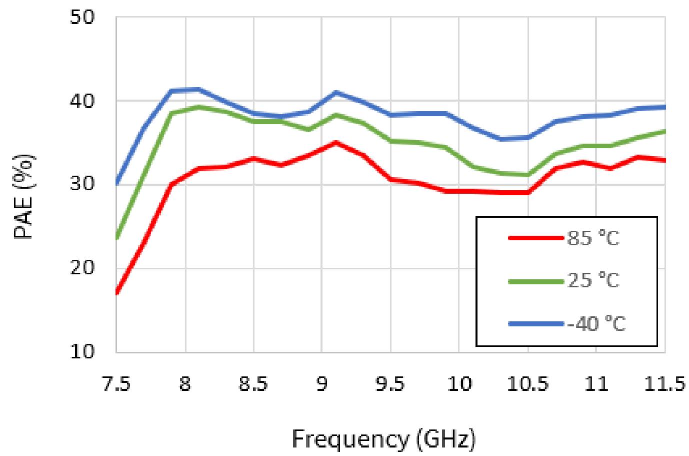
Typical Performance Curves - Large Signal over Temperature:

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

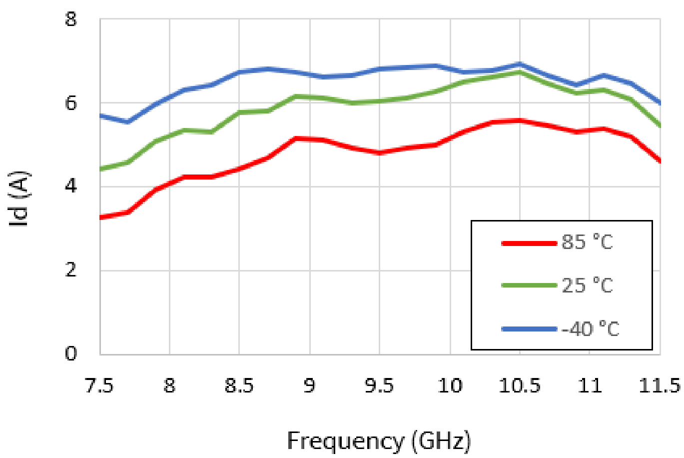
Output Power vs. Frequency



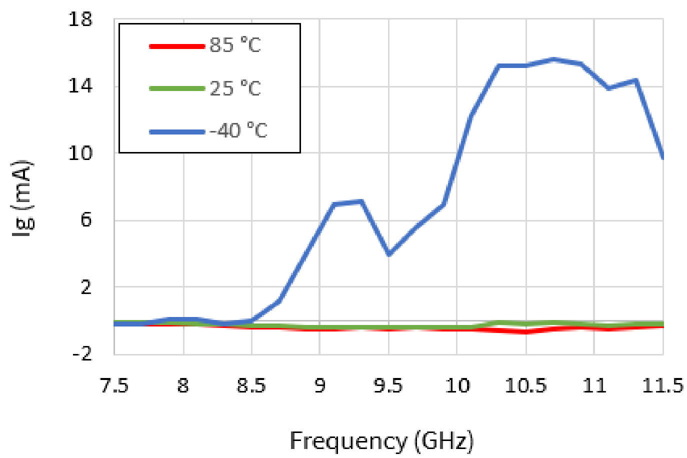
Power-Added Efficiency vs. Frequency



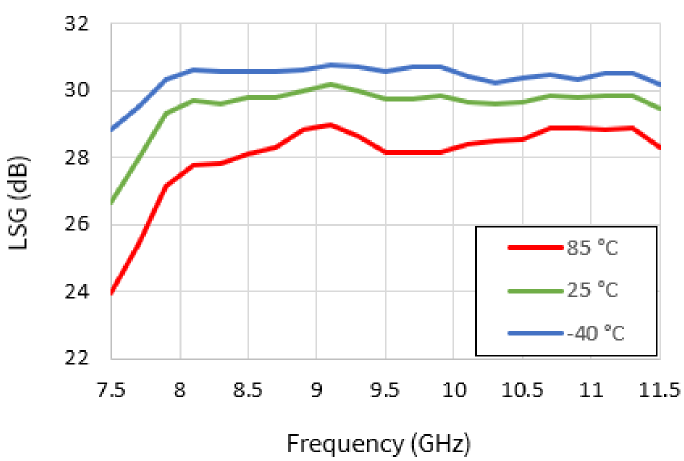
Drain Current vs. Frequency



Gate Current vs. Frequency



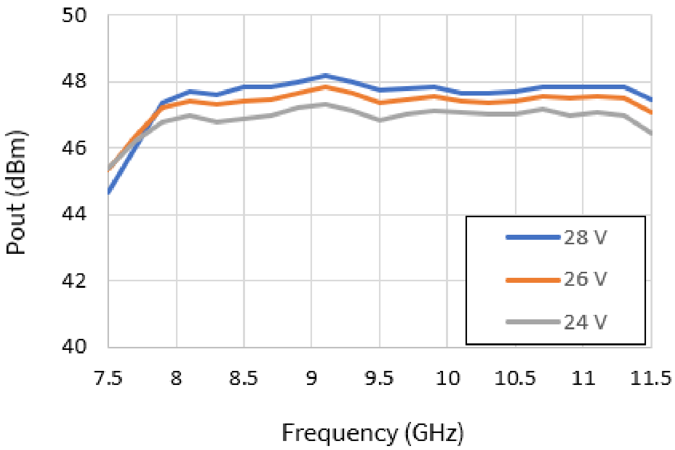
Large Signal Gain vs. Frequency



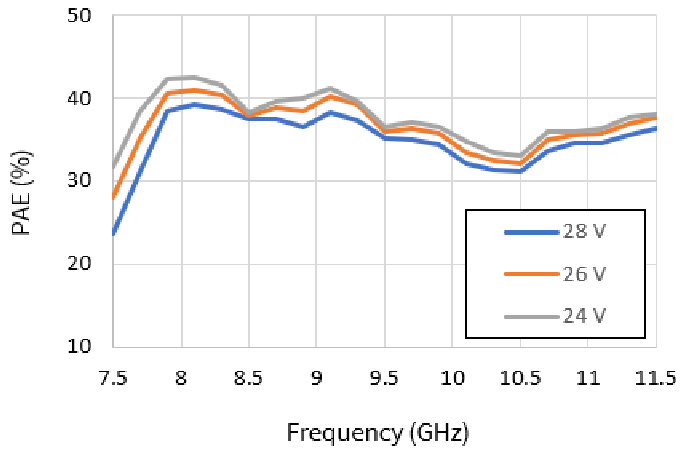
Typical Performance Curves - Large Signal over V_D:

I_{DQ} = 800 mA, CW, P_{IN} = 18 dBm, T_C = 25°C

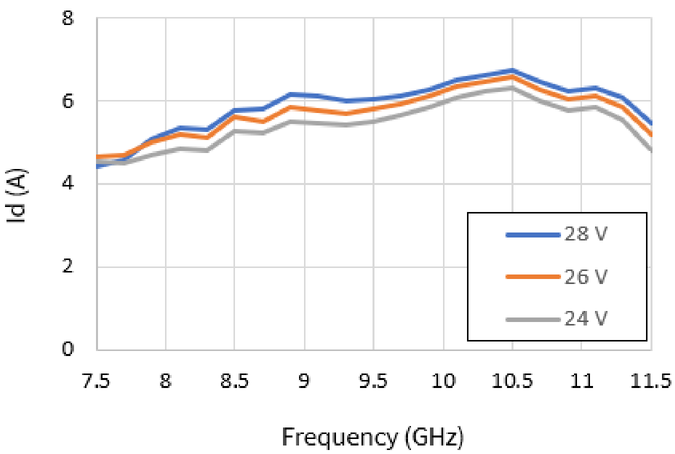
Output Power vs. Frequency



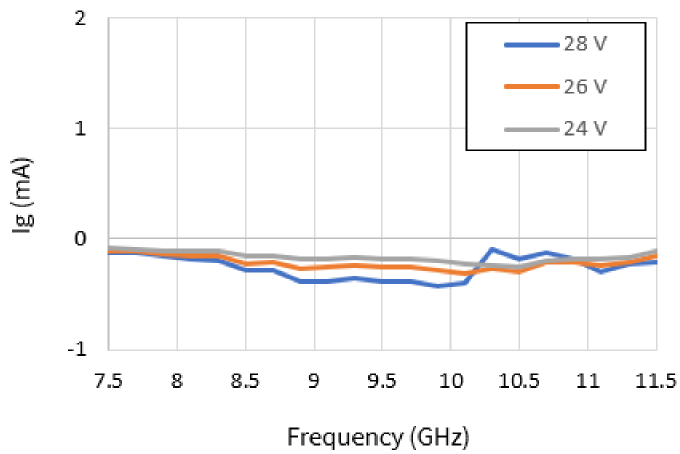
Power-Added Efficiency vs. Frequency



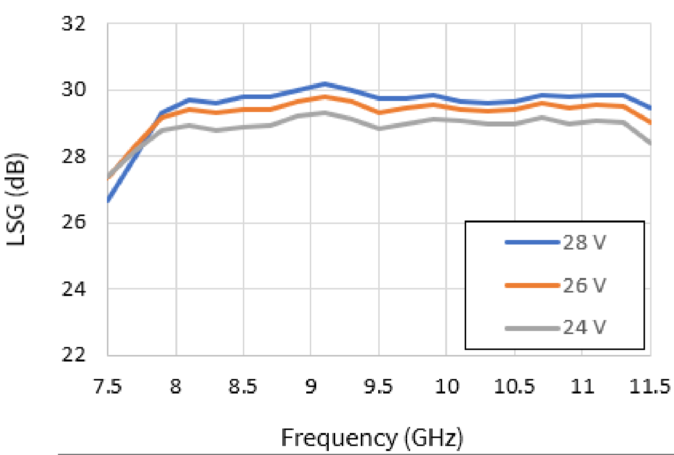
Drain Current vs. Frequency



Gate Current vs. Frequency



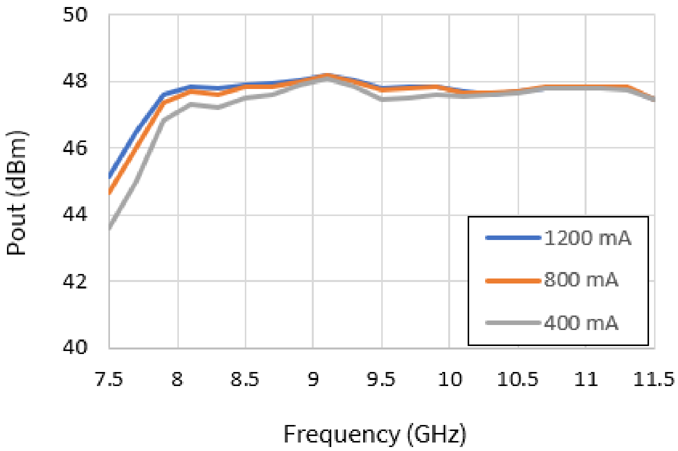
Large Signal Gain vs. Frequency



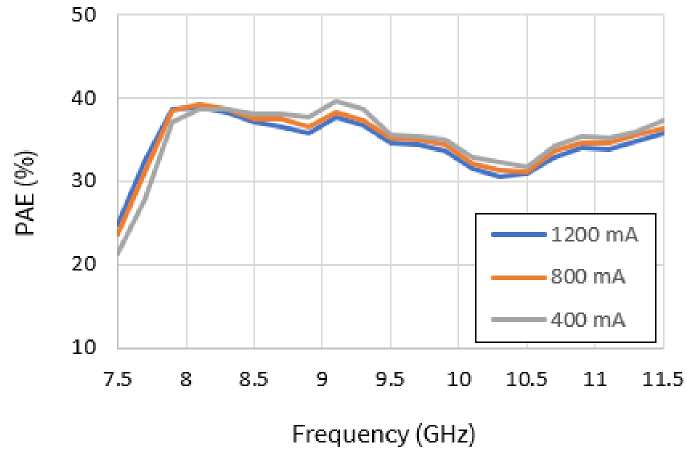
Typical Performance Curves - Large Signal over I_{DQ}:

V_D = 28 V, CW, P_{IN} = 18 dBm, T_C = 25°C

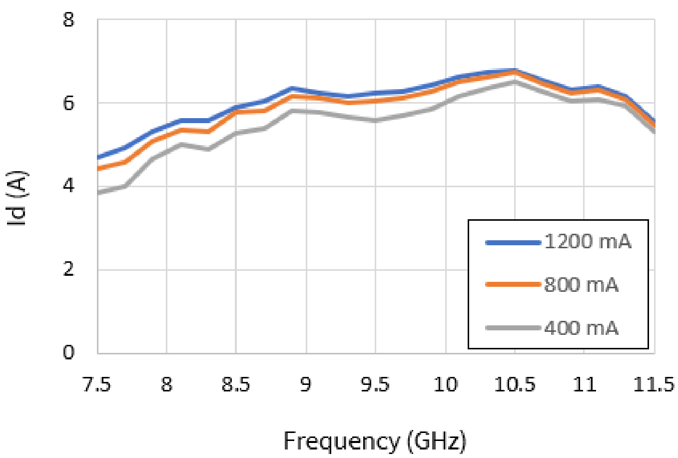
Output Power vs. Frequency



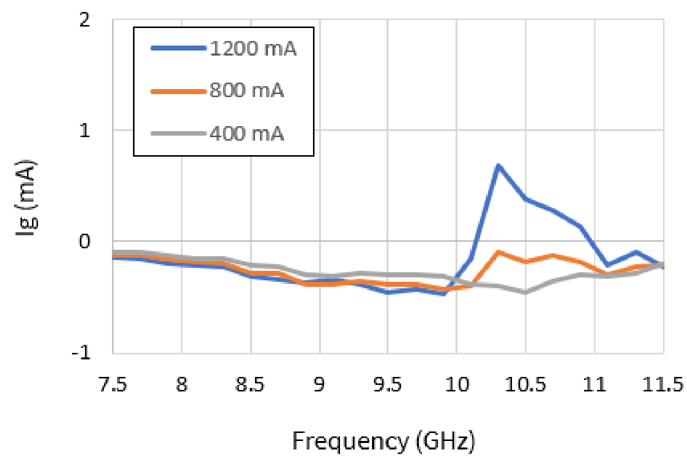
Power-Added Efficiency vs. Frequency



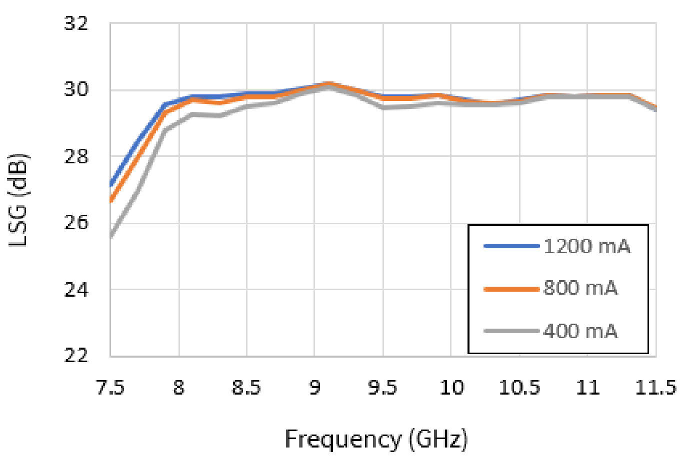
Drain Current vs. Frequency



Gate Current vs. Frequency



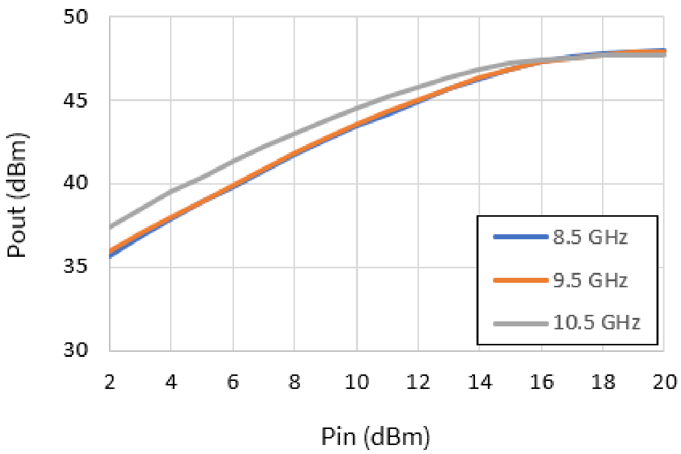
Large Signal Gain vs. Frequency



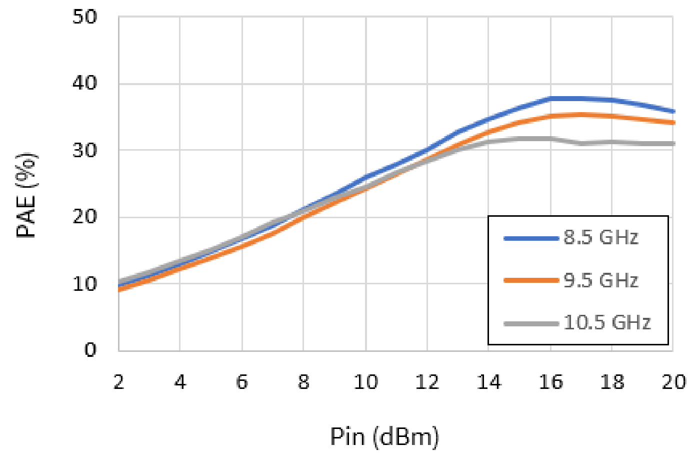
Typical Performance Curves - Drive-Up over Frequency:

V_D = 28 V, I_{DQ} = 800 mA, CW, T_C = 25°C

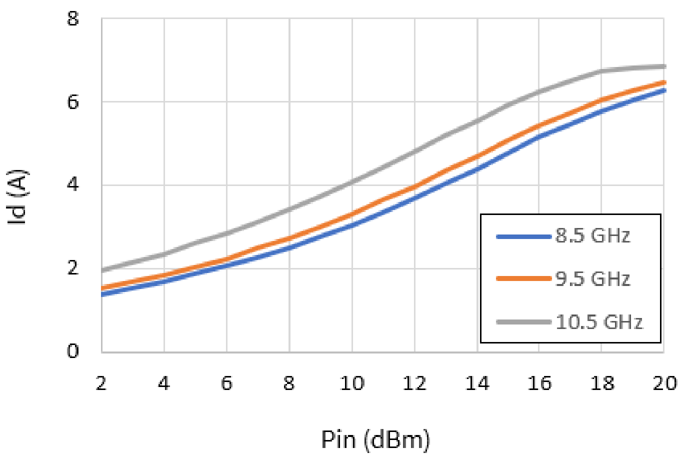
Output Power vs. Input Power



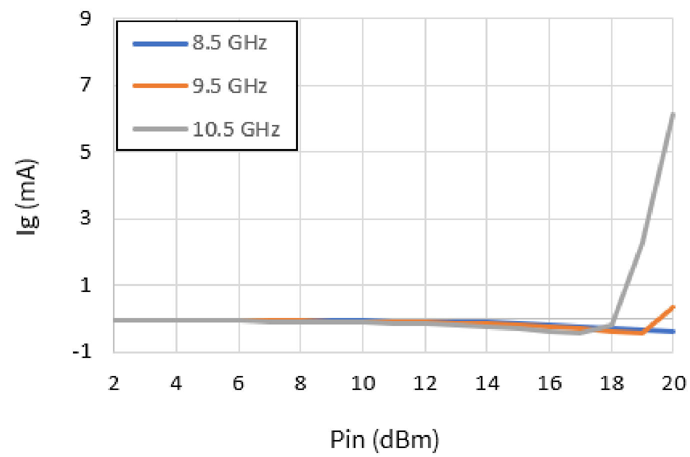
Power-Added Efficiency vs. Input Power



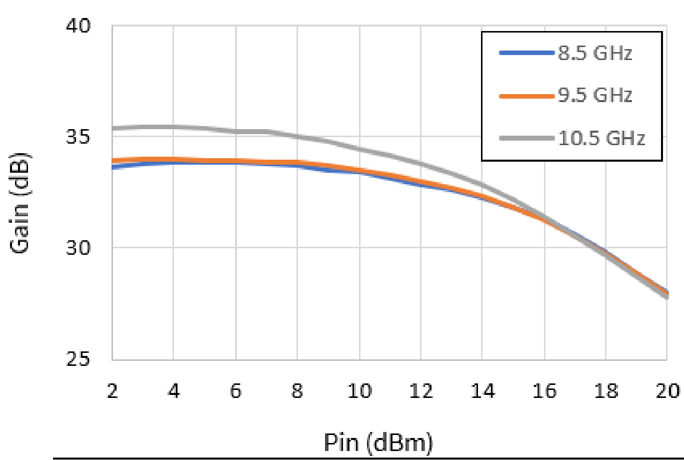
Drain Current vs. Input Power



Gate Current vs. Input Power



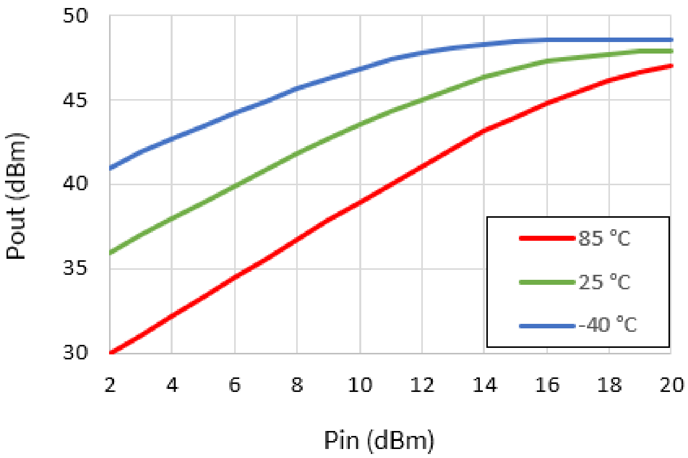
Gain vs. Input Power



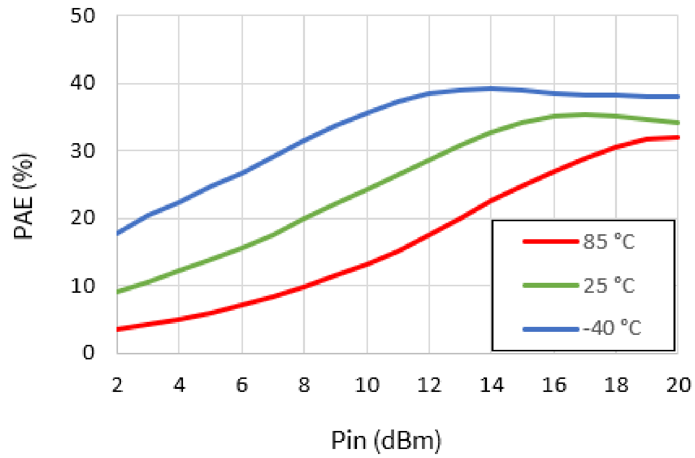
Typical Performance Curves - Drive-Up over Temperature:

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

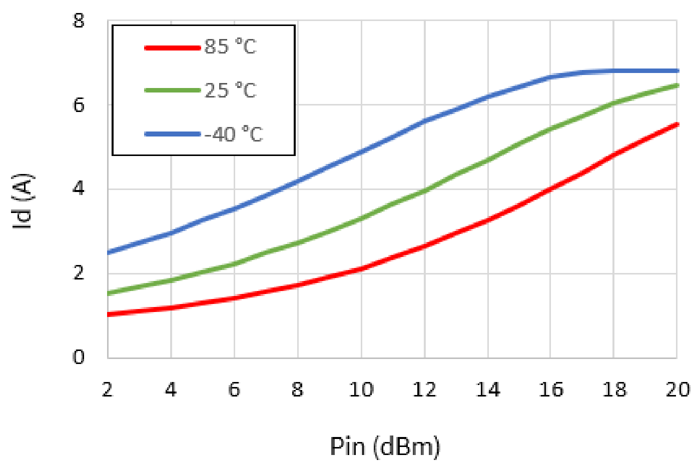
Output Power vs. Input Power



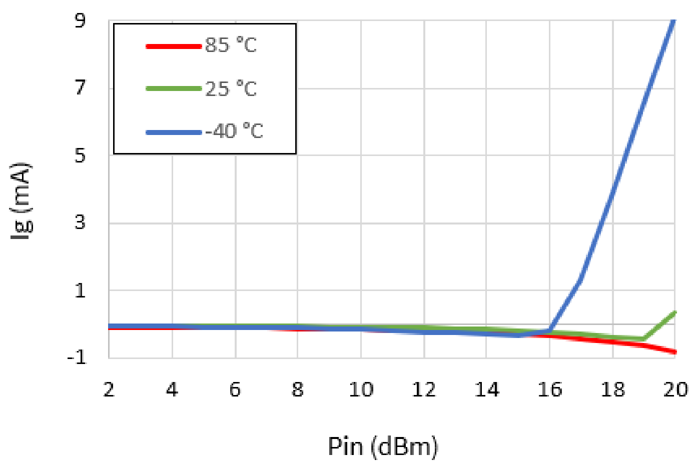
Power-Added Efficiency vs. Input Power



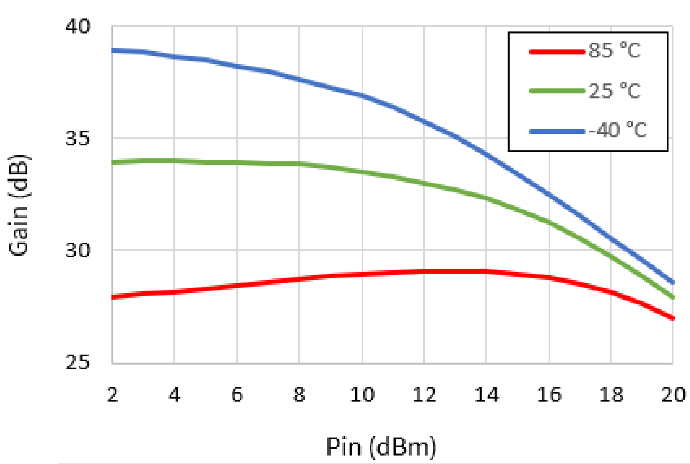
Drain Current vs. Input Power



Gate Current vs. Input Power



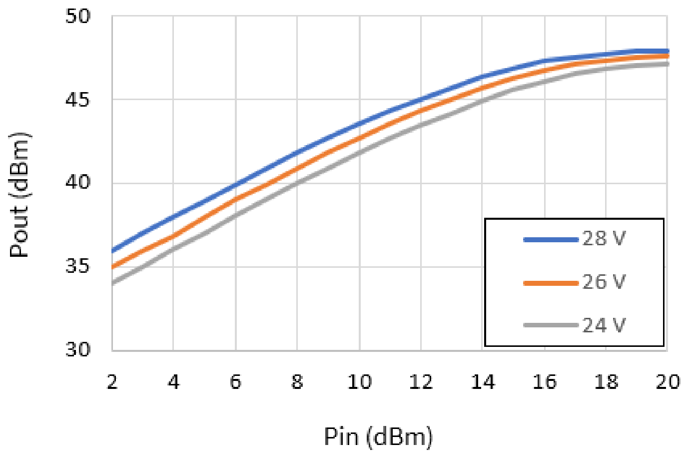
Gain vs. Input Power



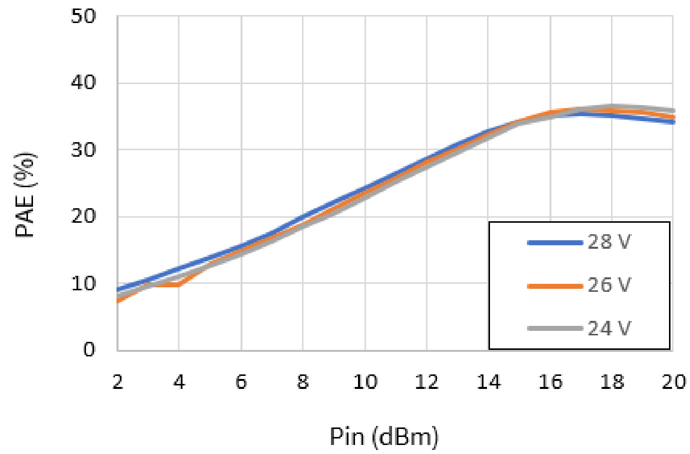
Typical Performance Curves - Drive-Up over V_D:

I_{DQ} = 800 mA, CW, T_C = 25°C, Frequency: 9.5 GHz

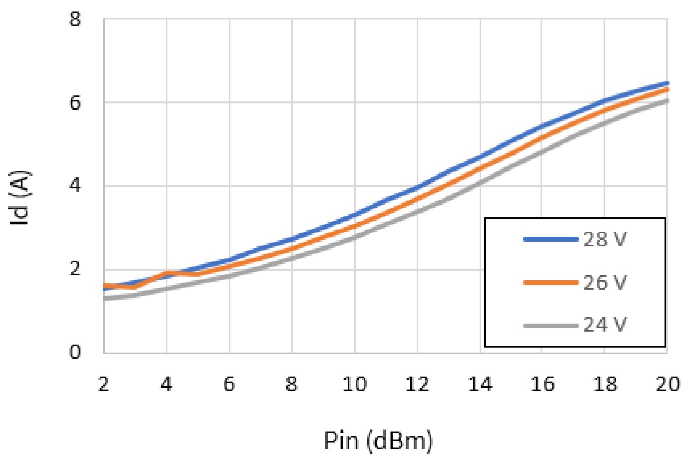
Output Power vs. Input Power



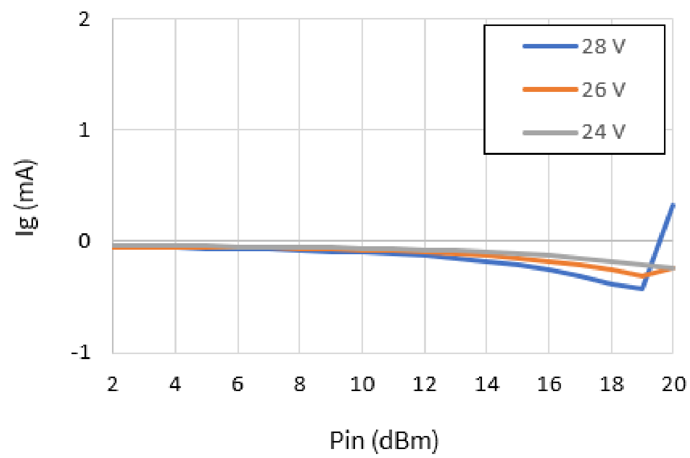
Power-Added Efficiency vs. Input Power



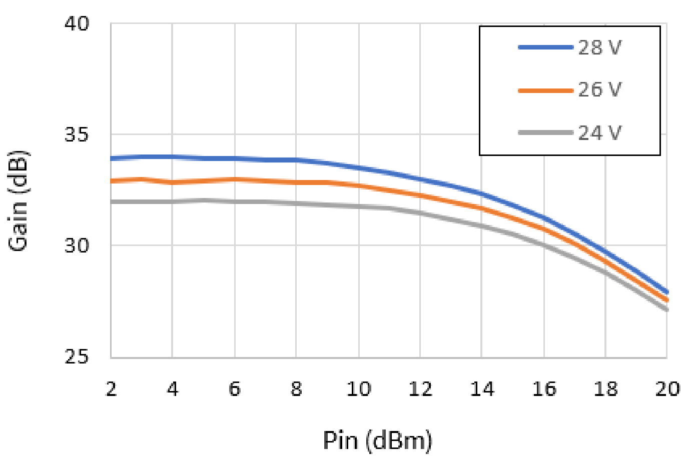
Drain Current vs. Input Power



Gate Current vs. Input Power



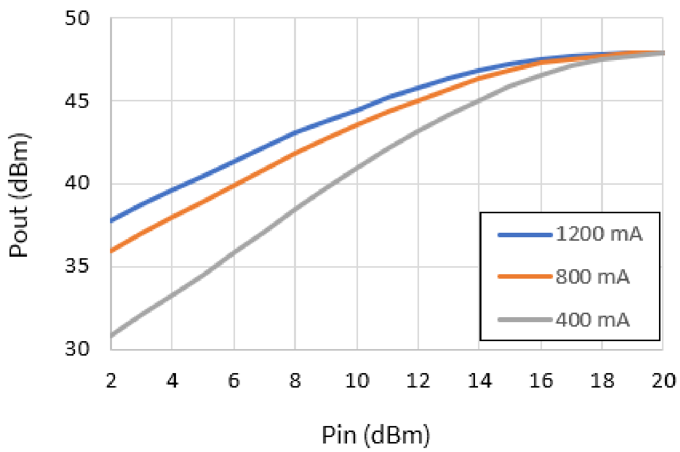
Gain vs. Input Power



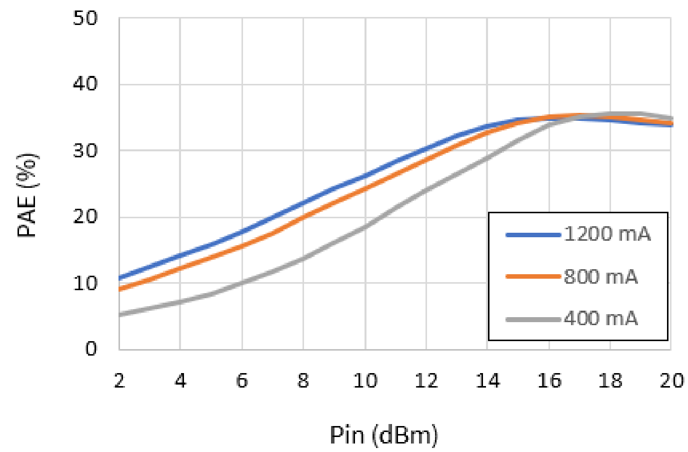
Typical Performance Curves - Drive-Up over I_{DQ}:

V_D = 28 V, CW, T_C = 25°C, Frequency: 9.5 GHz

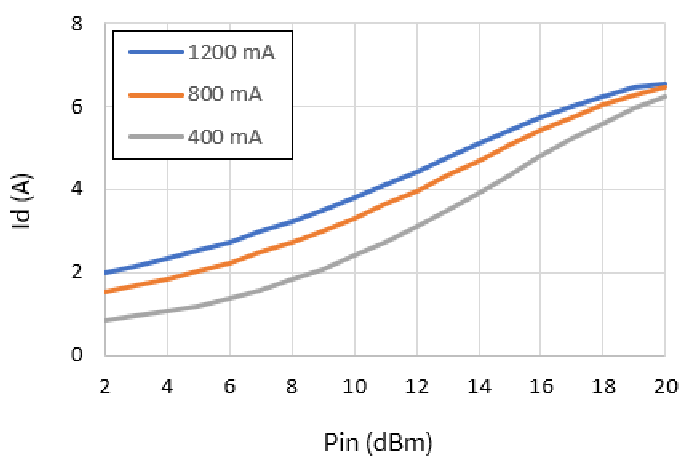
Output Power vs. Input Power



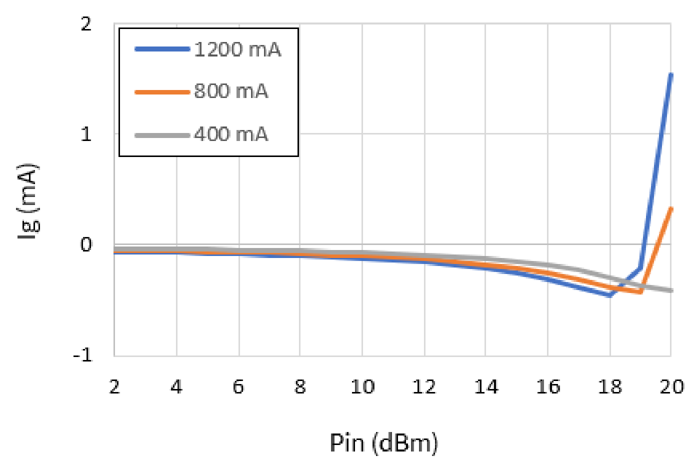
Power-Added Efficiency vs. Input Power



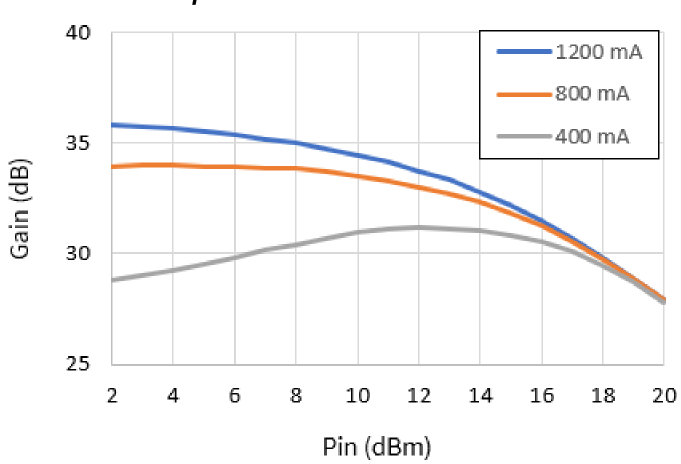
Drain Current vs. Input Power



Gate Current vs. Input Power



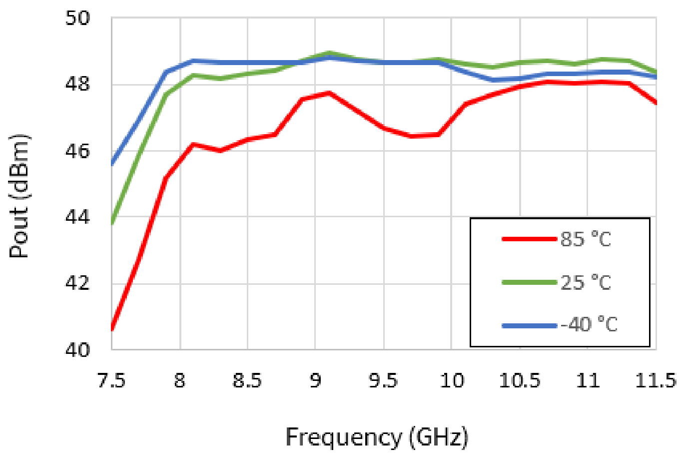
Gain vs. Input Power



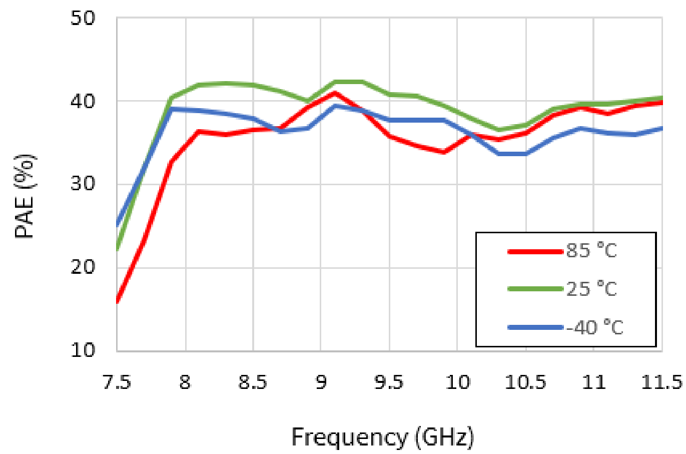
Typical Performance Curves - Large Signal over Temperature:

V_D = 28 V, I_{DQ} = 800 mA, PW = 100 µs, DC = 10%, P_{IN} = 18 dBm

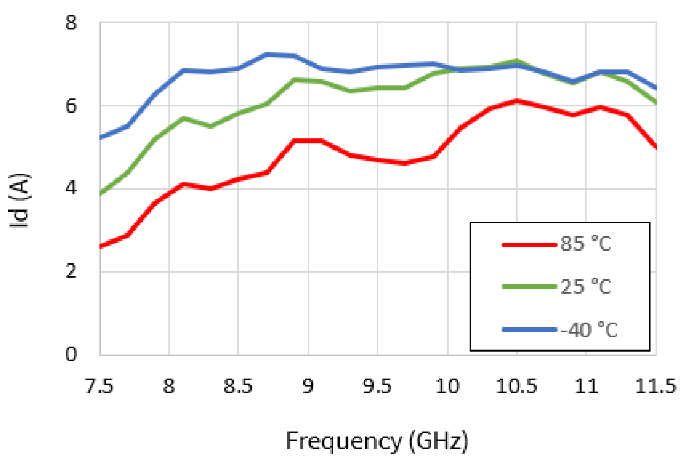
Output Power vs. Frequency



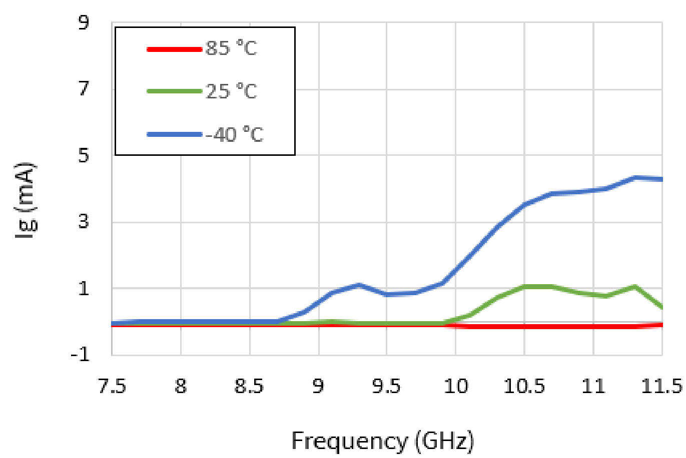
Power-Added Efficiency vs. Frequency



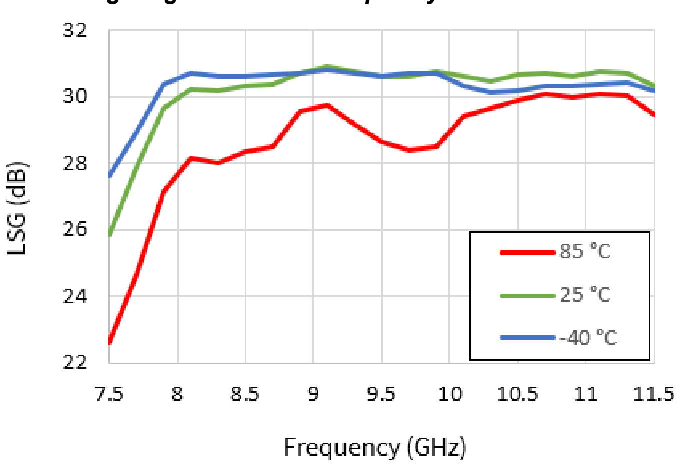
Drain Current vs. Frequency



Gate Current vs. Frequency



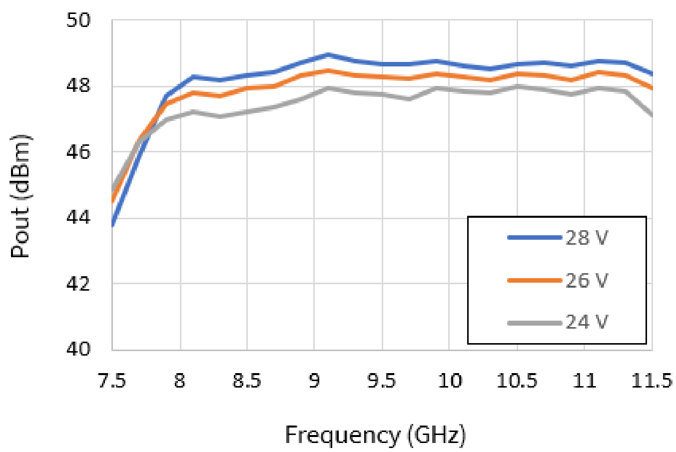
Large Signal Gain vs. Frequency



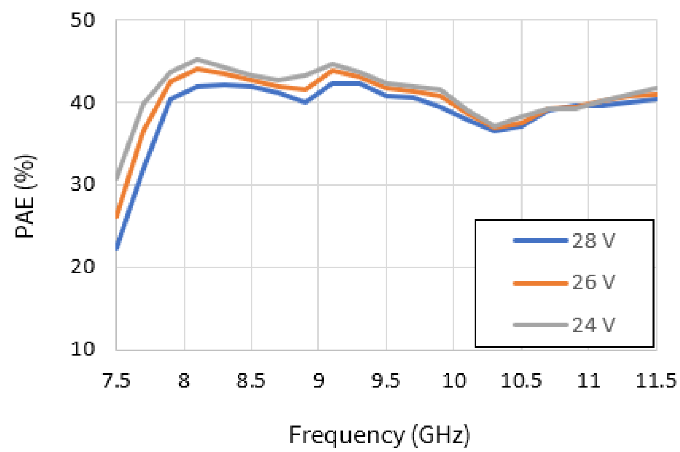
Typical Performance Curves - Large Signal over V_D:

I_{DQ} = 800 mA, PW = 100 µs, DC = 10%, P_{IN} = 18 dBm, T_C = 25°C

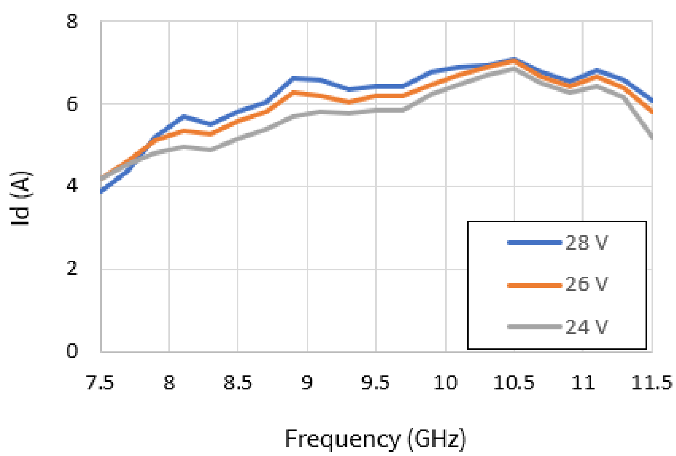
Output Power vs. Frequency



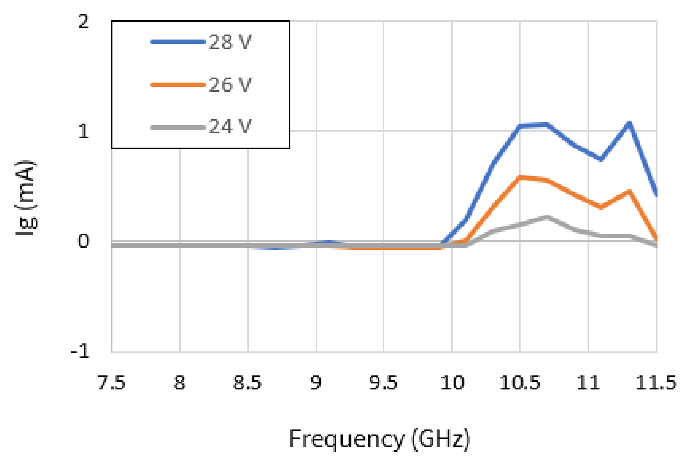
Power-Added Efficiency vs. Frequency



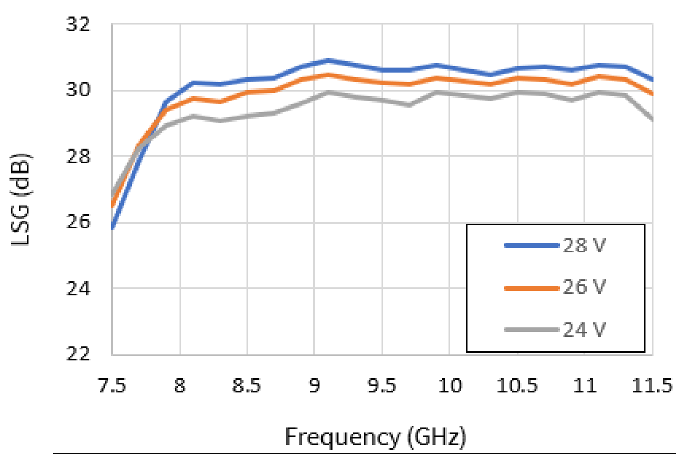
Drain Current vs. Frequency



Gate Current vs. Frequency



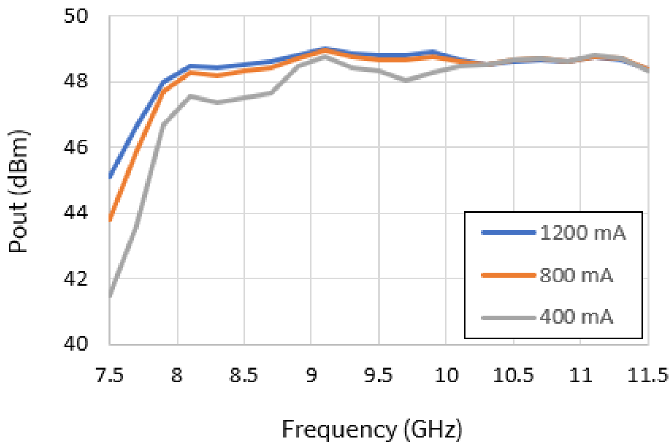
Large Signal Gain vs. Frequency



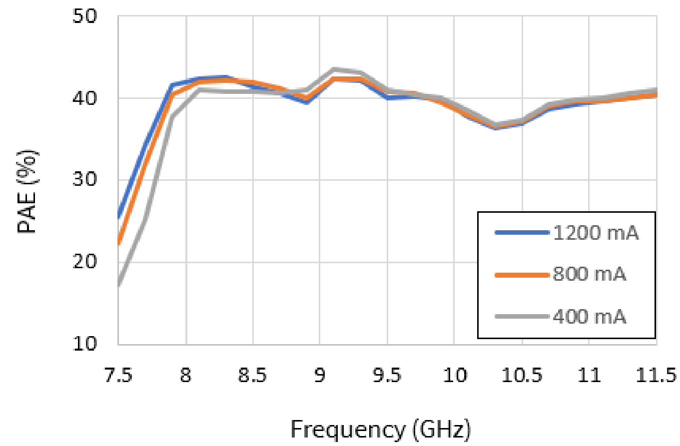
Typical Performance Curves - Large Signal over I_{DQ}:

V_D = 28 V, PW = 100 µs, DC = 10%, P_{IN} = 18 dBm, T_C = 25°C

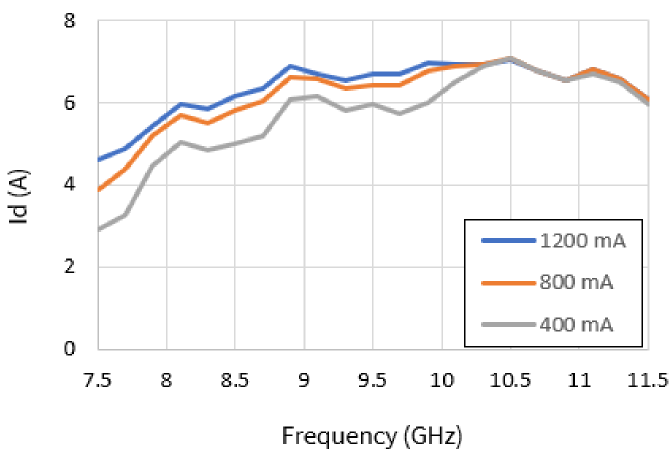
Output Power vs. Frequency



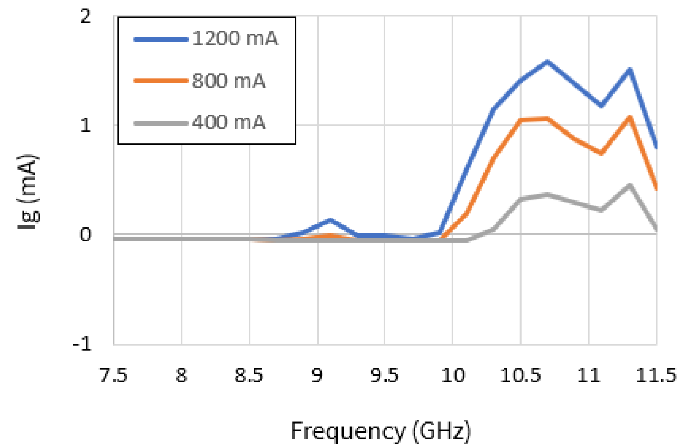
Power-Added Efficiency vs. Frequency



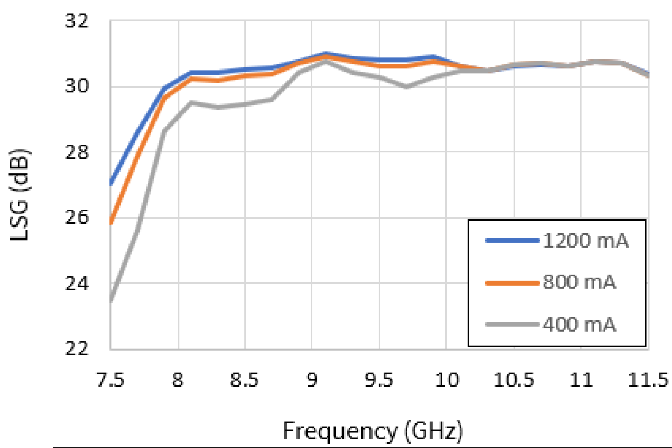
Drain Current vs. Frequency



Gate Current vs. Frequency



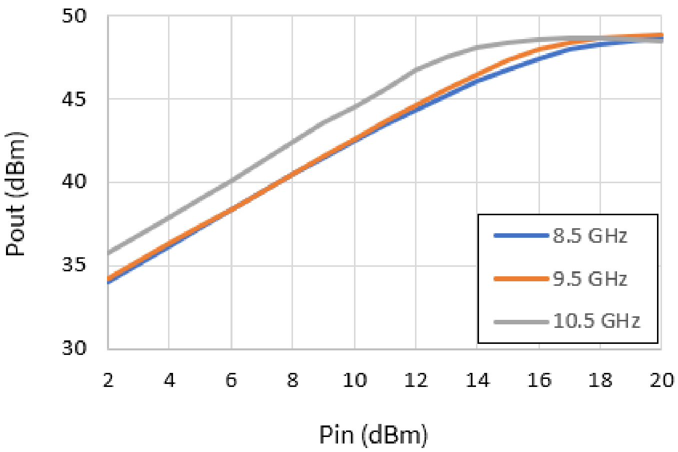
Large Signal Gain vs. Frequency



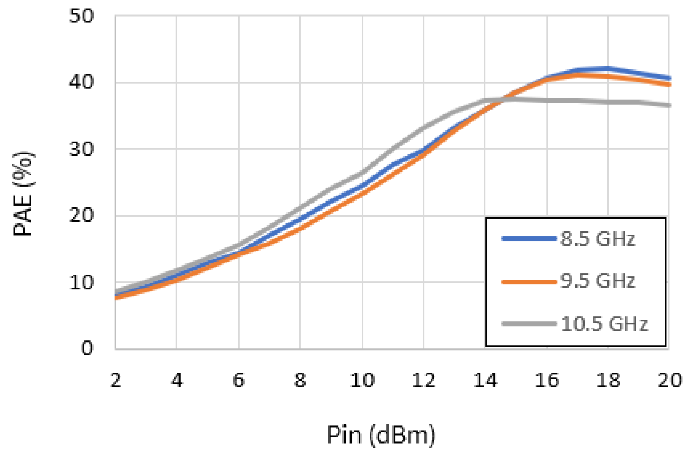
Typical Performance Curves - Drive-Up over Frequency:

V_D = 28 V, I_{DQ} = 800 mA, PW = 100 µs, DC = 10%, T_C = 25°C

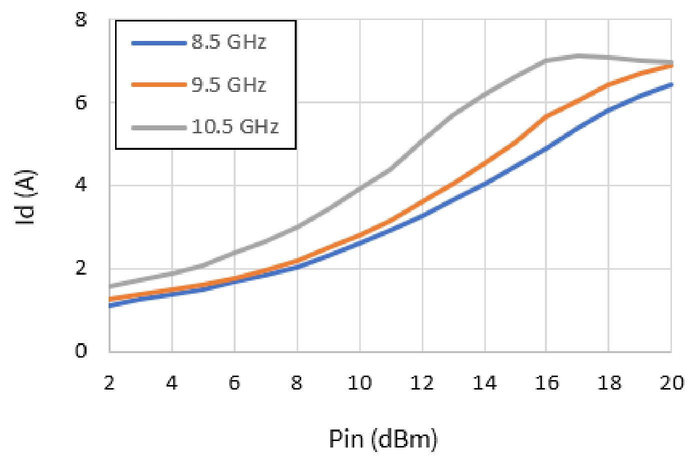
Output Power vs. Input Power



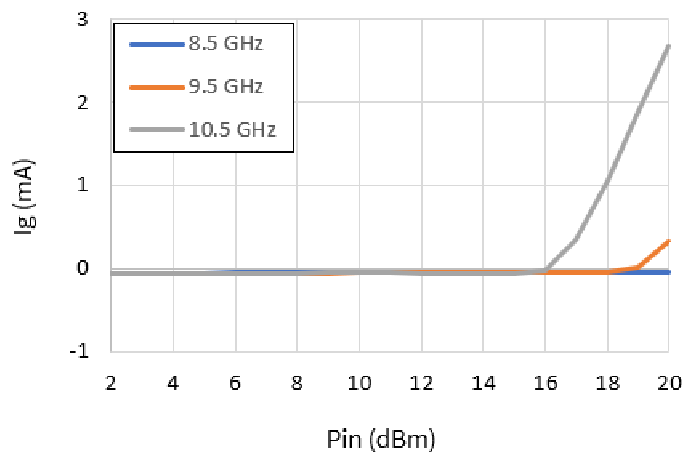
Power-Added Efficiency vs. Input Power



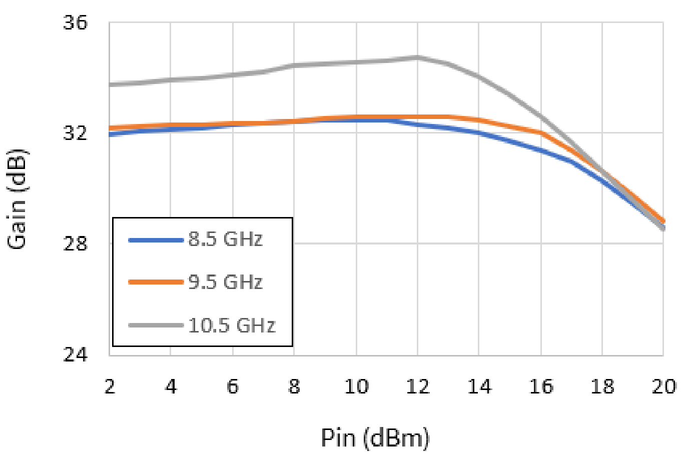
Drain Current vs. Input Power



Gate Current vs. Input Power



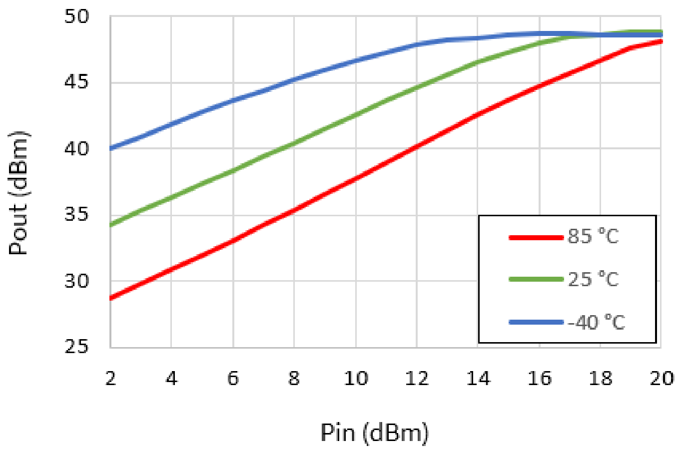
Gain vs. Input Power



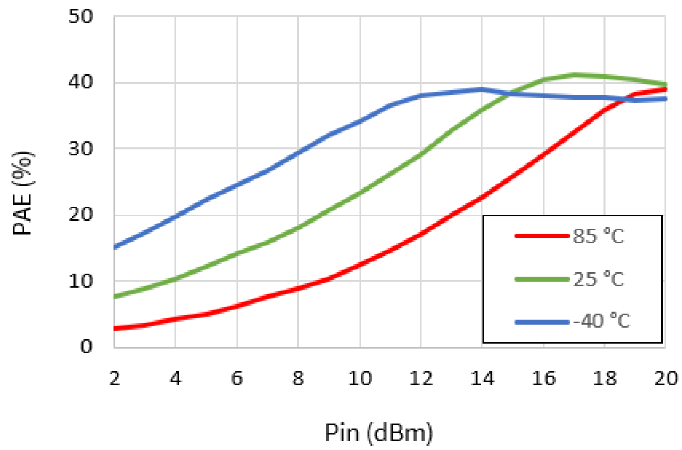
Typical Performance Curves - Drive-Up over Temperature:

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

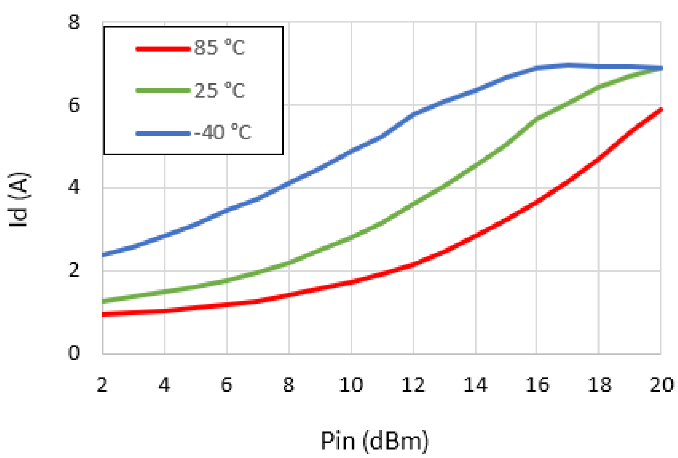
Output Power vs. Input Power



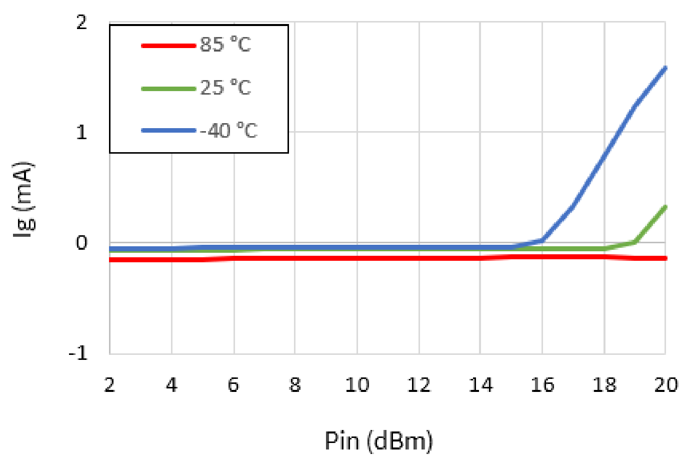
Power-Added Efficiency vs. Input Power



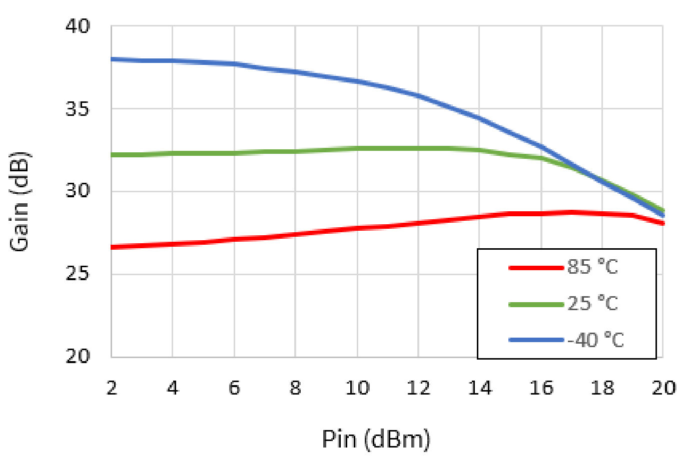
Drain Current vs. Input Power



Gate Current vs. Input Power



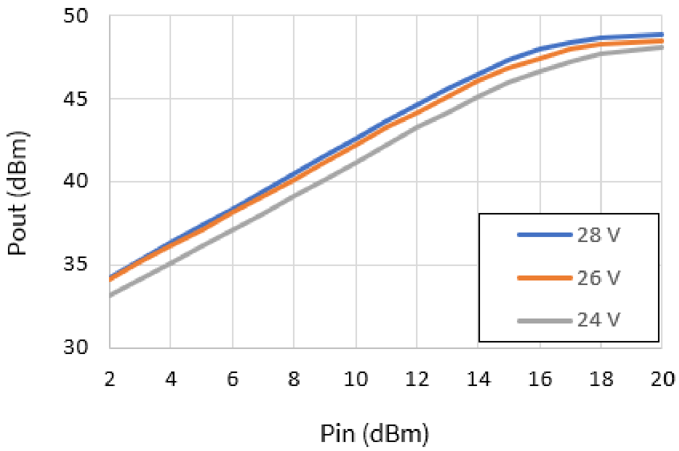
Gain vs. Input Power



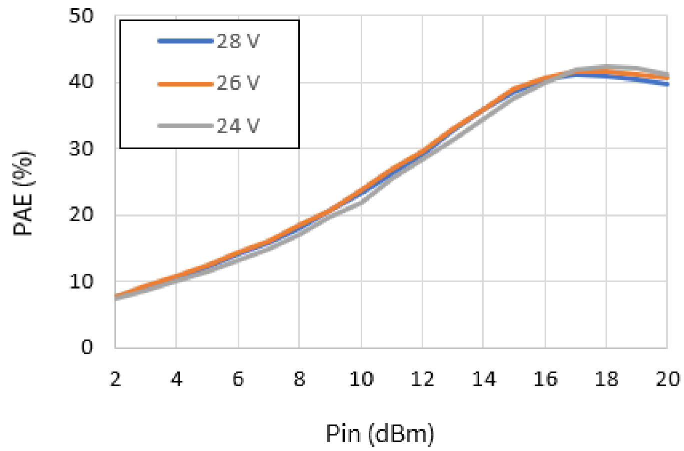
Typical Performance Curves - Drive-Up over V_D:

I_{DQ} = 800 mA, PW = 100 µs, DC = 10%, T_C = 25°C, Frequency: 9.5 GHz

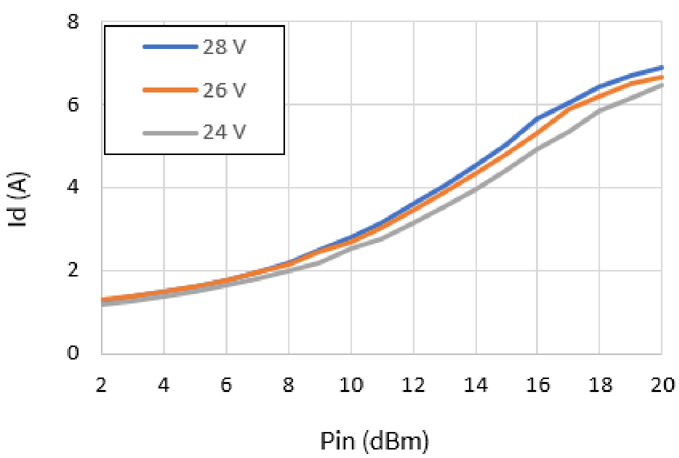
Output Power vs. Input Power



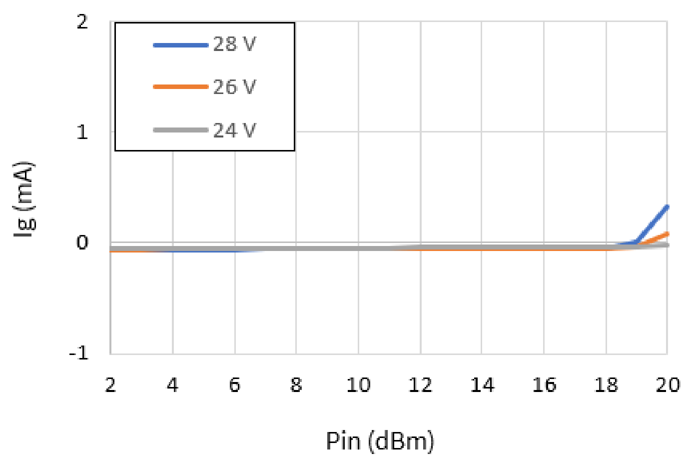
Power-Added Efficiency vs. Input Power



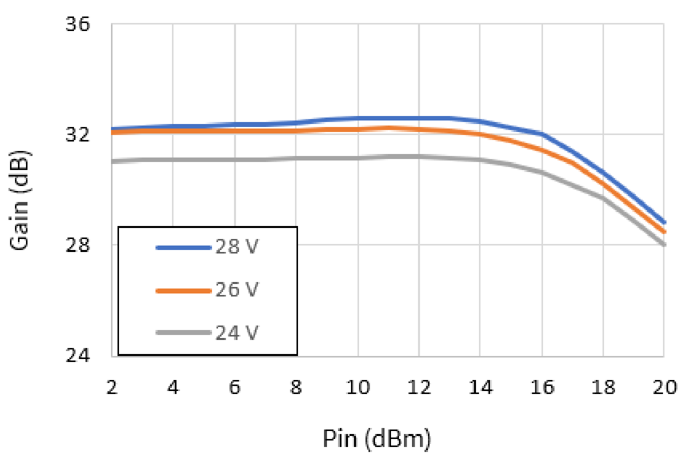
Drain Current vs. Input Power



Gate Current vs. Input Power



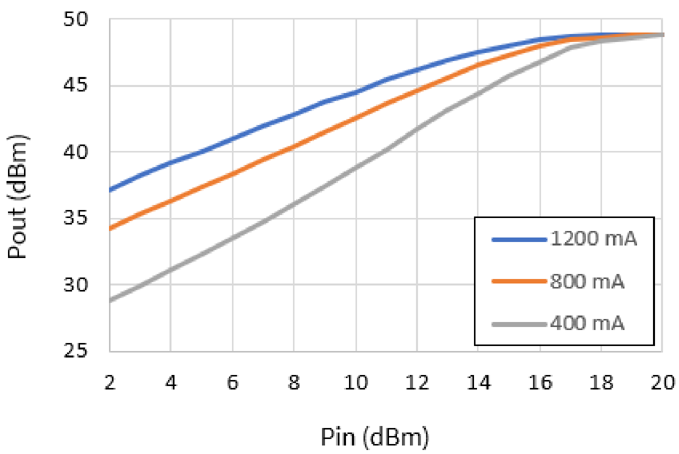
Gain vs. Input Power



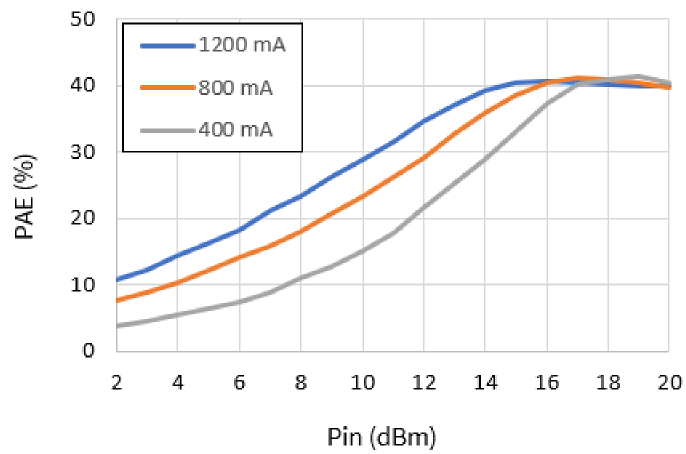
Typical Performance Curves - Drive-Up over I_{DQ}:

V_D = 28 V, PW = 100 µs, DC = 10%, T_C = 25°C, Frequency: 9.5 GHz

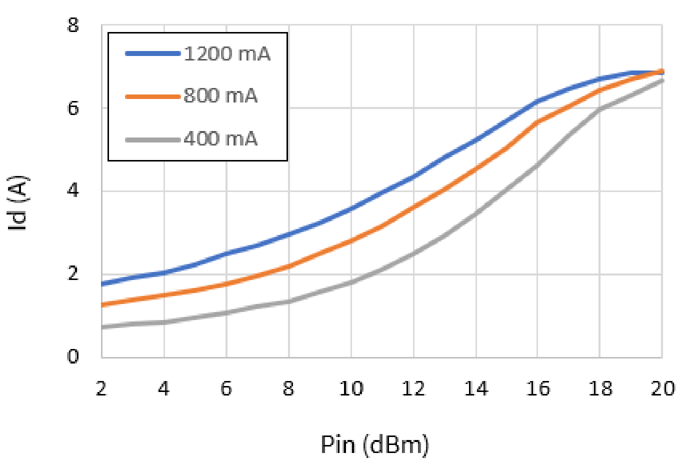
Output Power vs. Input Power



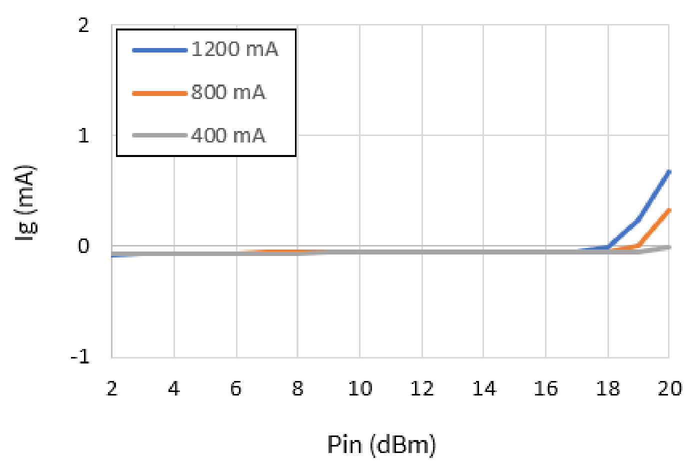
Power-Added Efficiency vs. Input Power



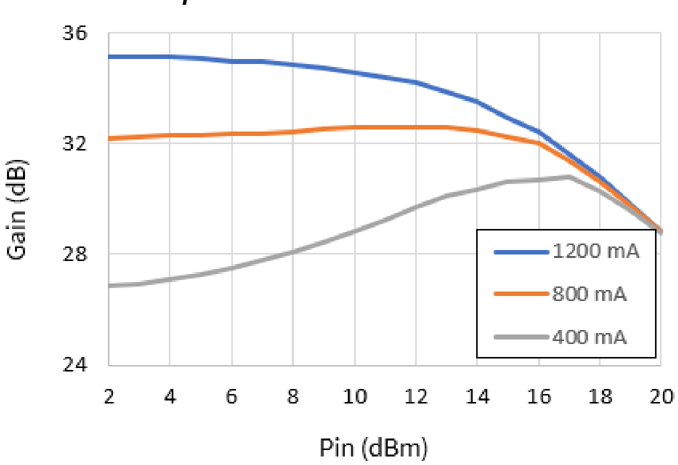
Drain Current vs. Input Power



Gate Current vs. Input Power



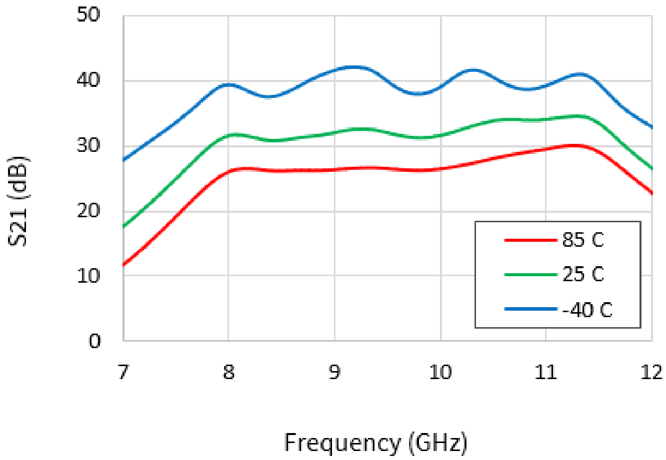
Gain vs. Input Power



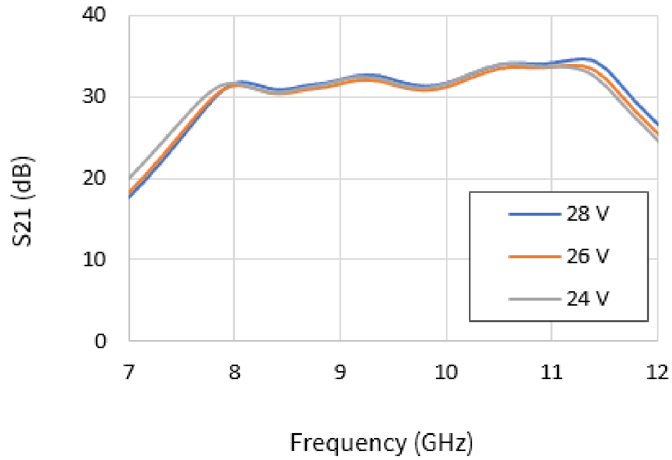
Typical Performance Curves - Small Signal over Temperature and V_D:

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

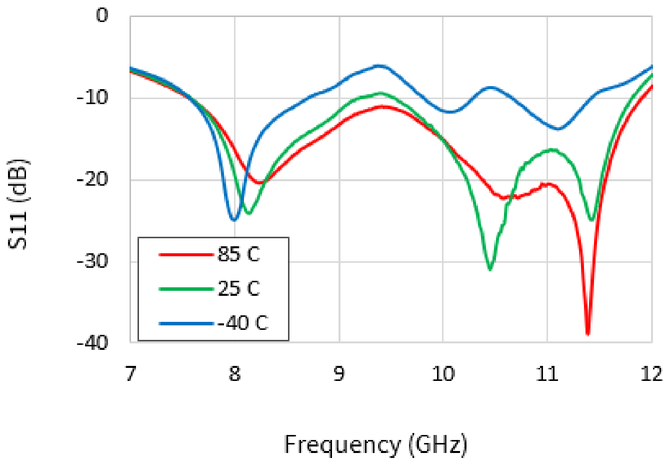
S21 vs. Frequency over Temperature @ V_D = 28 V



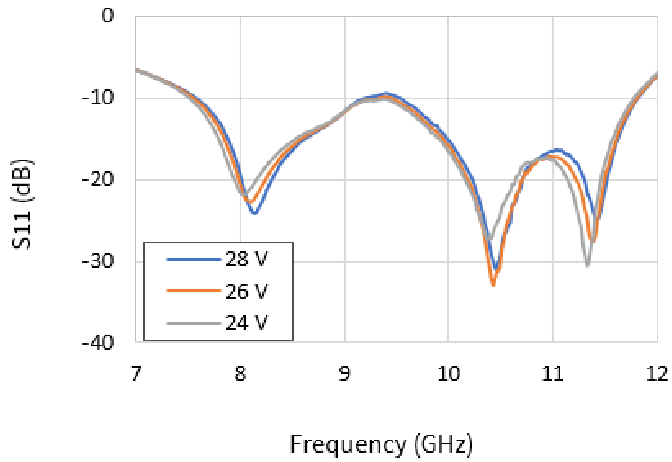
S21 vs. Frequency over V_D @ 25°C



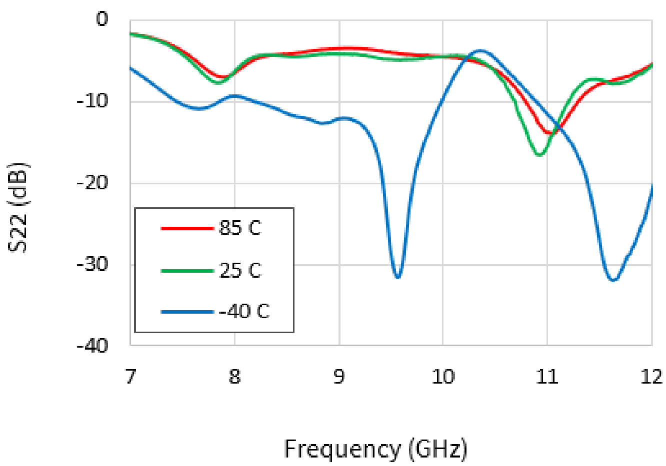
S11 vs. Frequency over Temperature @ V_D = 28 V



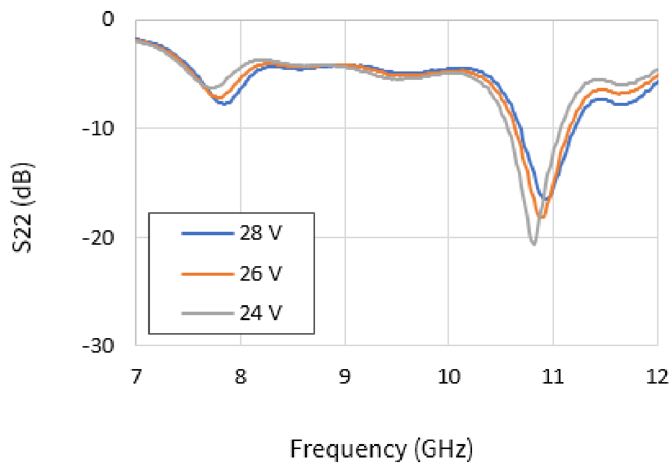
S11 vs. Frequency over V_D @ 25°C



S22 vs. Frequency over Temperature @ V_D = 28 V



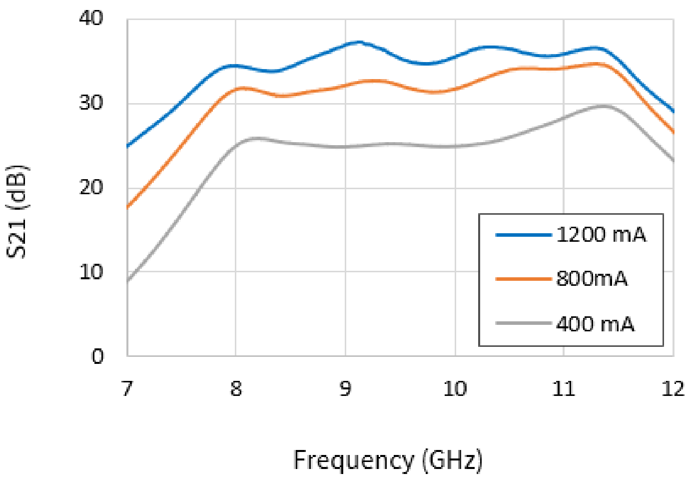
S22 vs. Frequency over V_D @ 25°C



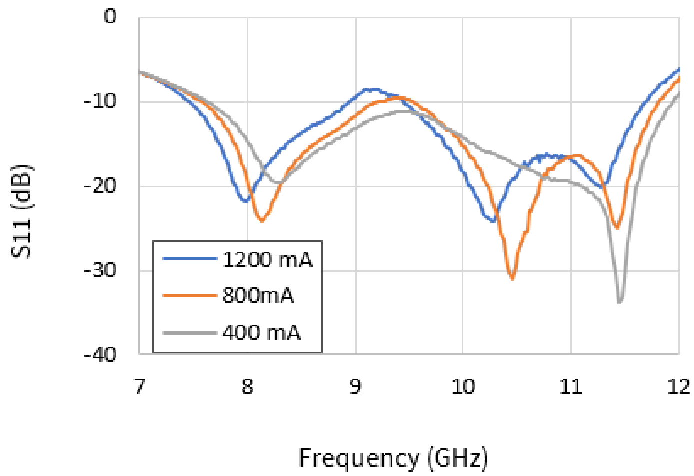
Typical Performance Curves - Small Signal over I_{DQ}:

V_D = 28 V, CW, P_{IN} = -20 dBm, T_C = 25°C

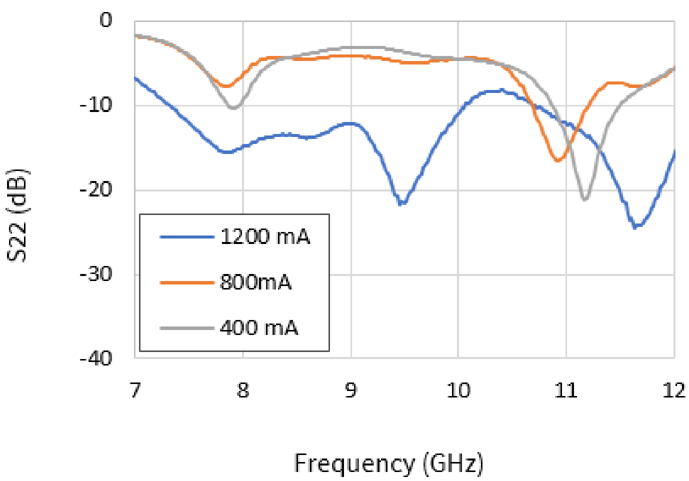
S21 vs. Frequency over Idq



S11 vs. Frequency over Idq



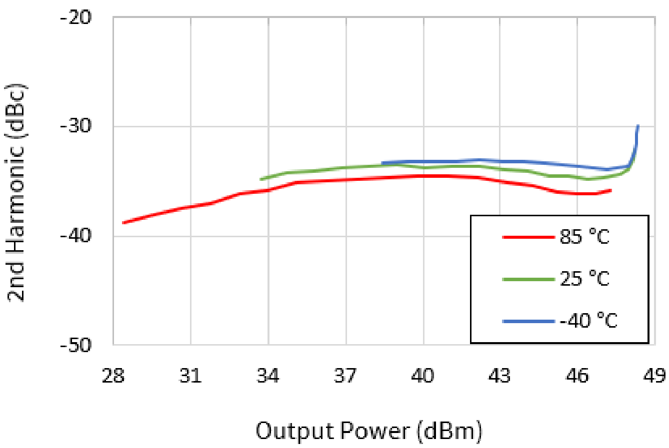
S22 vs. Frequency over Idq



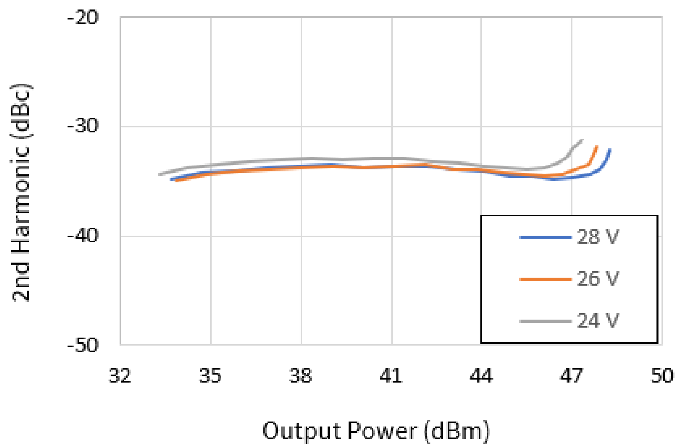
Typical Performance Curves - Harmonics over Temperature and V_D:

V_D = 28 V, I_{DQ} = 800 mA, PW = 100 µs, DC = 10% , T_C = 25°C (unless otherwise noted)

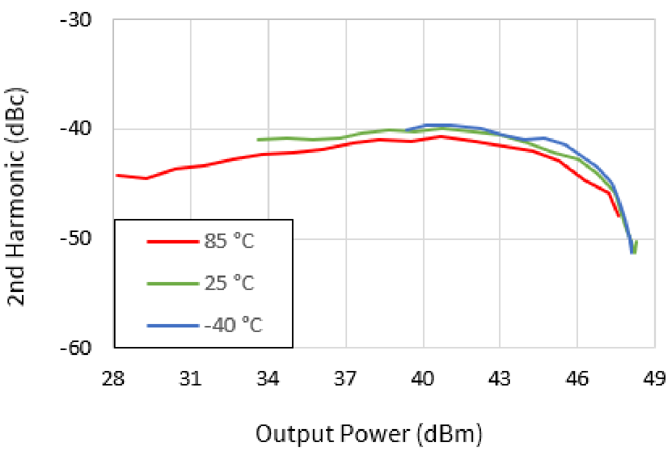
2f vs. Output Power over Temperature @ 8.5 GHz



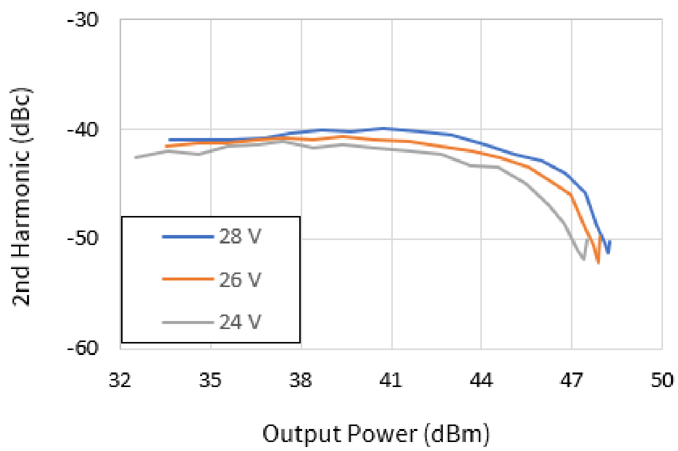
2f vs. Output Power over V_D @ 8.5 GHz



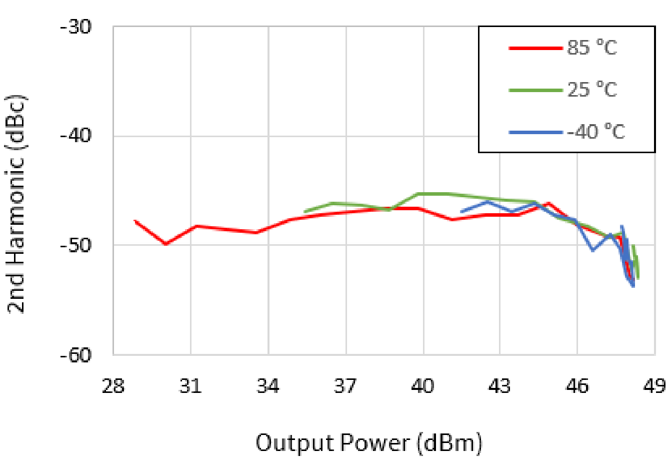
2f vs. Output Power over Temperature @ 9.5 GHz



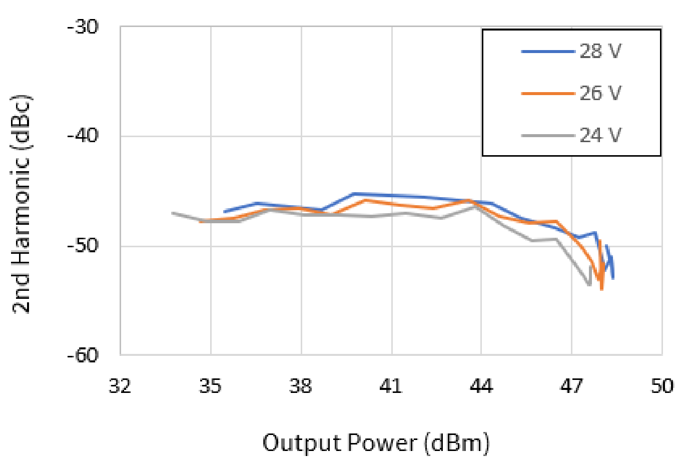
2f vs. Output Power over V_D @ 9.5 GHz



2f vs. Output Power over Temperature @ 10.5 GHz



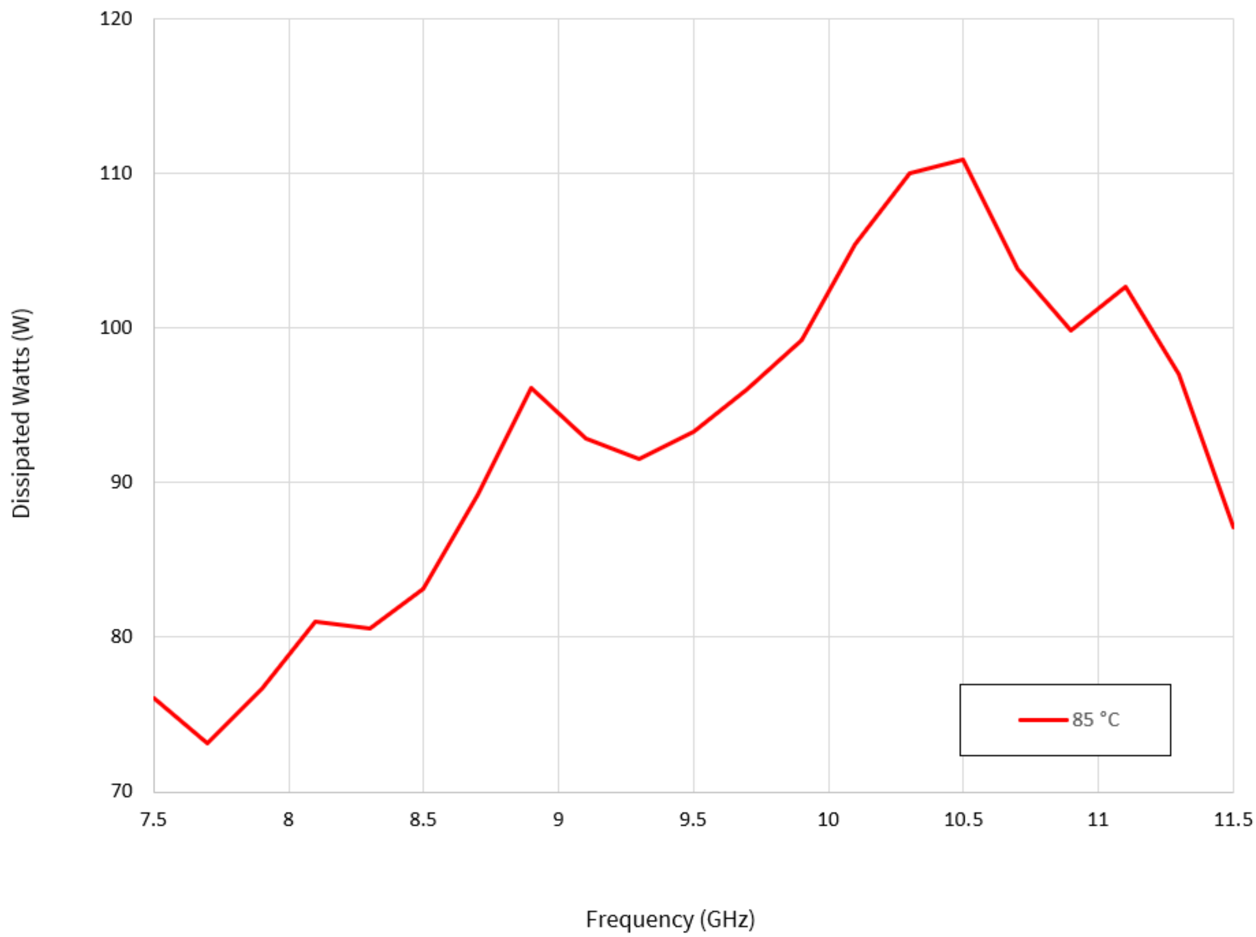
2f vs. Output Power over V_D @ 10.5 GHz



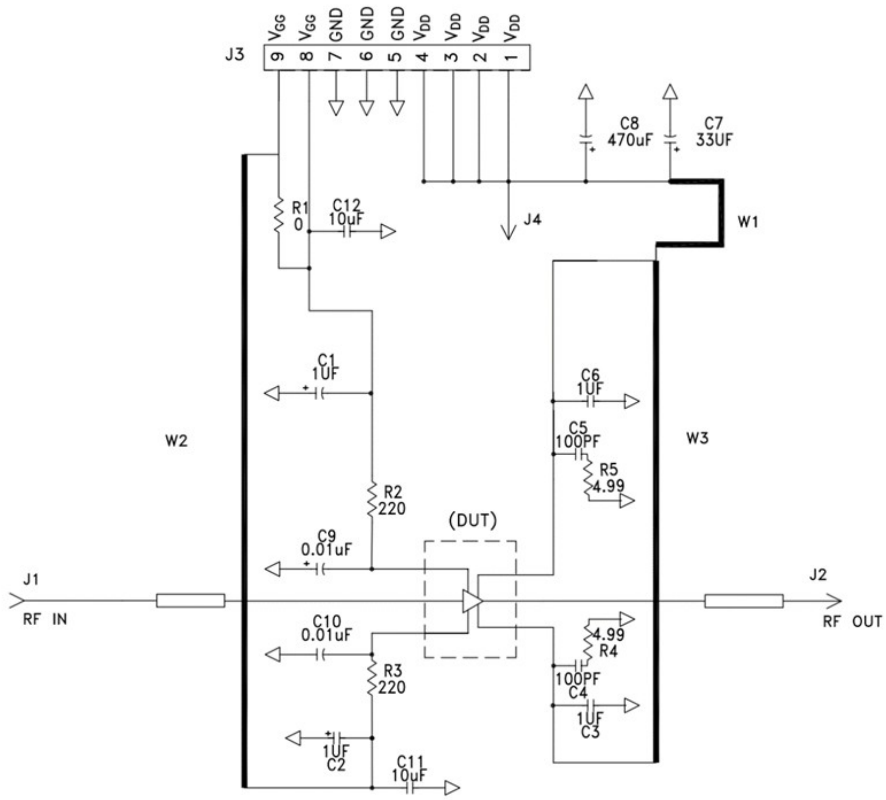
Thermal Characteristics

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°C, CW	208ºC
Thermal Resistance, Junction to Case ($R_{θJC}$)		1.3ºC/W

Power Dissipation vs. Frequency (T_C = 85°C)



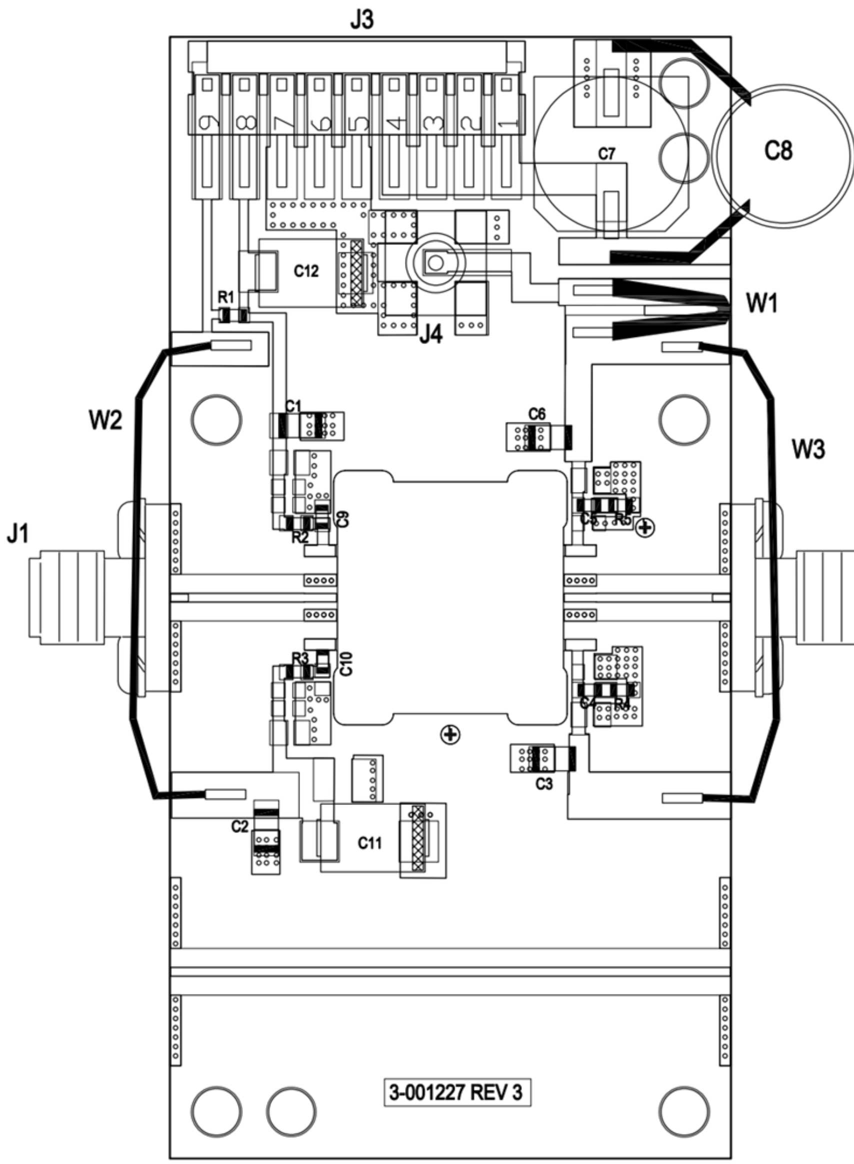
Evaluation Board Schematic (CMPA851A050F-AMP)



Parts List

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)



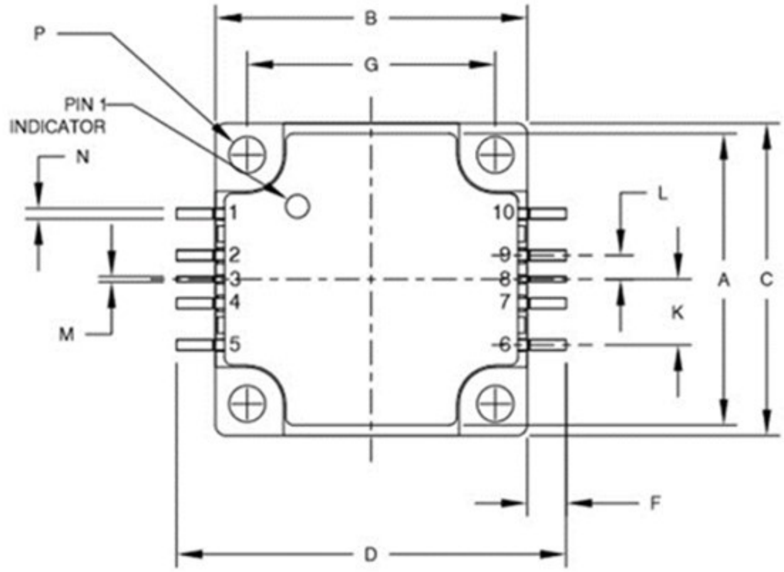
Bias On Sequence

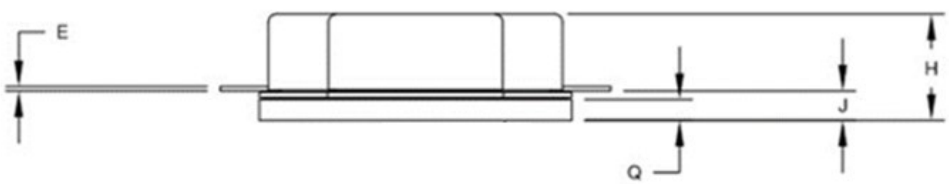
1. Ensure RF is turned-off
2. Apply pinch-off voltage of -5 V to the gate (V_G)
3. Apply nominal drain voltage (V_D)
4. Adjust Vg to obtain desired quiescent drain current (I_{DQ})
5. Apply RF

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

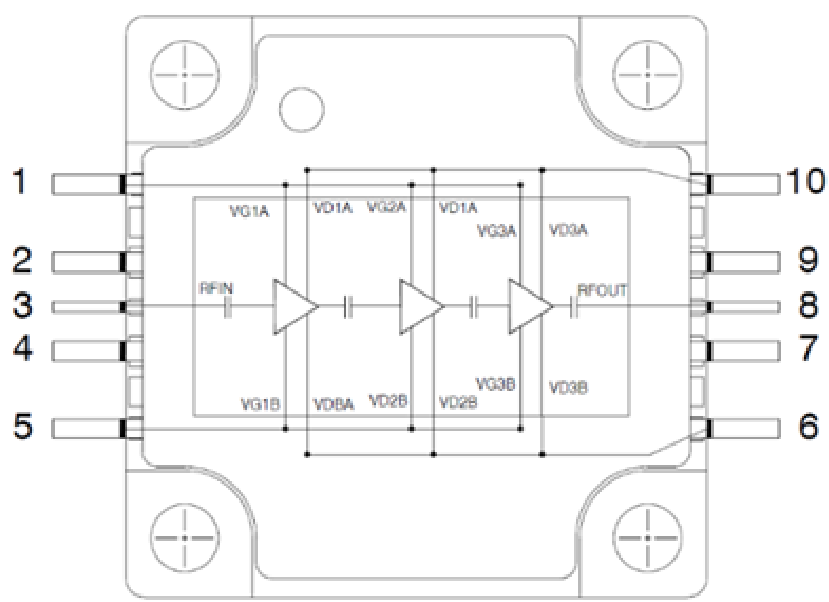




DIM	INCHES			MILLIMETERS		
	MIN	TYP	MAX	MIN	TYP	MAX
A	.555	.560	.565	14.10	14.22	14.35
B	.595	.600	.605	15.11	15.24	15.37
C	.595	.600	.605	15.11	15.24	15.37
D	-	(.750)	-	-	(19.05)	-
E	.006	.008	.010	0.15	0.20	0.25
F	.065	.075	.085	1.66	1.91	2.16
G	.473	.478	.483	12.01	12.14	12.27
H	.191	.203	.215	4.86	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

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



Revision History

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