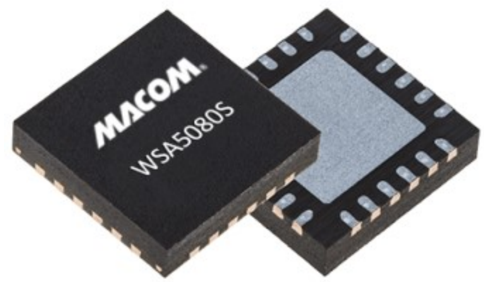
GaN High Power Amplifier, 5 W
8 - 10.5 GHz

MACOM

WSA5080S
Rev. V1

Features
- Saturated Power: 5 W
- Power Added Efficiency: 45%
- Large Signal Gain: 32 dB
- Small Signal Gain: 40 dB
- Input Return Loss: -15 dB
- Output Return Loss: -5 dB
- Pulsed / CW Operation
- Small 4x4 mm footprint

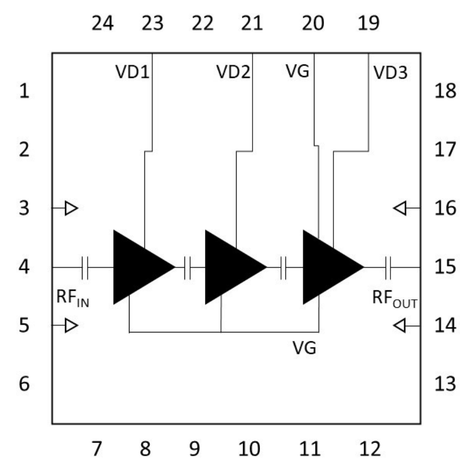


Applications
- Military and Commercial Radar
- Satellite Communications

Description
MACOM's WSA5080S is a 5W packaged MMIC HPA utilizing MACOM's high performance, 0.15µm GaN on SiC production process. The WSA5080S operates from 8-10.5 GHz and supports both defense and commercial-related radar applications. The WSA5080S achieves 5 W of saturated output power with 32 dB of large signal gain and typically 45% power-added efficiency under pulsed operation. CW operation is also an option.

Packaged in a 4x4 mm plastic overmold QFN, the WSA5080S provides superior performance and environmental robustness in a small form factor allowing customers to improve SWaP-C benchmarks in their next-generation systems. Ideal for automated assembly.

Functional Schematic



Pin Configuration[1]

Pin #	Function
1-2, 6-13, 17-18, 22, 24	No Connection
3, 5, 14, 16	RF Ground
4	RF Input
15	RF Output
20	VG
23	VD1
21	VD2
19	VD3

1. MACOM recommends connecting No Connection (N/C) pins to ground.
2. The exposed pad centered on the package bottom must be connected to RF, DC and thermal ground.

Ordering Information

Part Number	Package (MOQ/ Mult)
WSA5080S	Tape & Reel (50/50)
WSA5080S-AMP1	Sample Board (1/1)

RF Electrical Specifications: V_D = 28 V, I_{DQ} = 40 mA, T_C = 25°C, Z_0 = 50 Ω

Parameter	Test Conditions	Frequency (GHz)	Units	Min.	Typ.	Max.
Output Power	P_{IN} = 5 dBm Pulse: 100 µs, 10%	8.5 9.5 10.5	dBm	37 37 37	38 38 38	—
Power Added Efficiency		8.5 9.5 10.5	%	44 47 44	47 49 45	—
Large Signal Gain		8.5 9.5 10.5	dB	32 32 32	33 33 33	—
Small Signal Gain	P_{IN} = -20 dBm CW	8.5 9.5 10.5	dB	—	40 40 37	—
Input Return Loss		8.5 – 10.5	dB	—	-15	—
Output Return Loss		8.5 – 10.5	dB	—	-5	—

DC Electrical Specifications:

Parameter	Units	Min.	Typ.	Max.
Drain Voltage	V	—	28	—
Gate Voltage	V	—	-1.84	—
Quiescent Drain Current	mA	20	40	80
Saturated Drain Current	mA	—	450	—

Recommended Operating Conditions

Parameter	Symbol	Unit	Min.	Typ.	Max.
Input Power	P_{IN}	dBm		5	
Drain Voltage	V_D	V		28	
Gate Voltage	V_G	V		-1.84	
Quiescent Drain Current	I_{DQ}	mA		40	
Operating Temperature	T_C	°C	-40		+85

Absolute Maximum Ratings[3,4]

Parameter	Symbol	Unit	Min.	Max.
Input Power	P_{IN}	dBm		8
Drain to Source Voltage	V_{DS}	V		84
Drain Voltage	V_D	V		28
Gate Voltage	V_G	V	-8	+2
Drain Current	I_D	A		1.14
Gate Current	I_G	mA		0.4
Dissipated Power @ +85°	P_{DISS}	W		21.63
VSWR		Ratio		5:1
Junction Temperature (MTTF > 1E6 Hrs)	T_J	°C		+225
Storage Temperature	T_{STG}	°C	-65	+150
Mounting Temperature (30 seconds)	T_M	°C		+260

3. Exceeding any one or combination of these limits may cause permanent damage to this device.
4. MACOM does not recommend sustained operation near these survivability limits.

Handling Procedures

Please observe the following precautions to avoid damage:

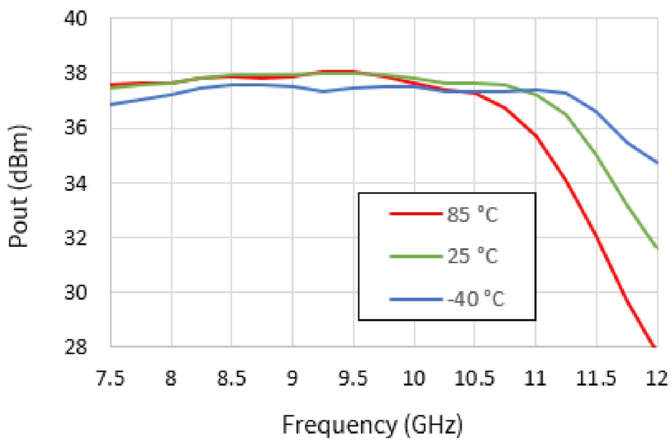
Static Sensitivity

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 HBM Class 1A and CDM Class C2a devices.

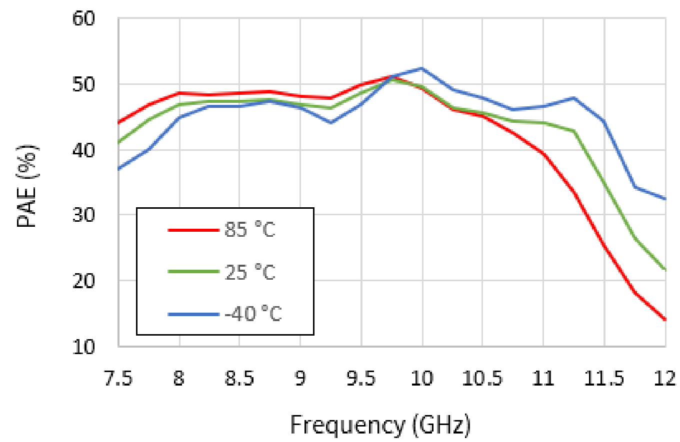
Typical Performance Curves - Large Signal over Temperature:

V_D = 28 V, I_{DQ} = 40 mA, PW = 100 µs, DC = 10%, Pin = 5 dBm

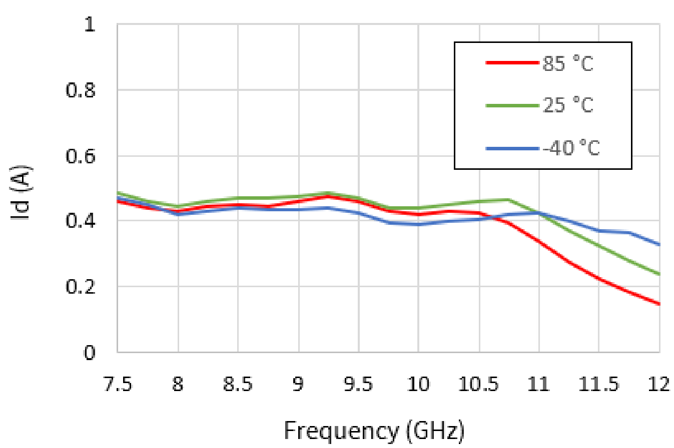
Pout vs. Frequency



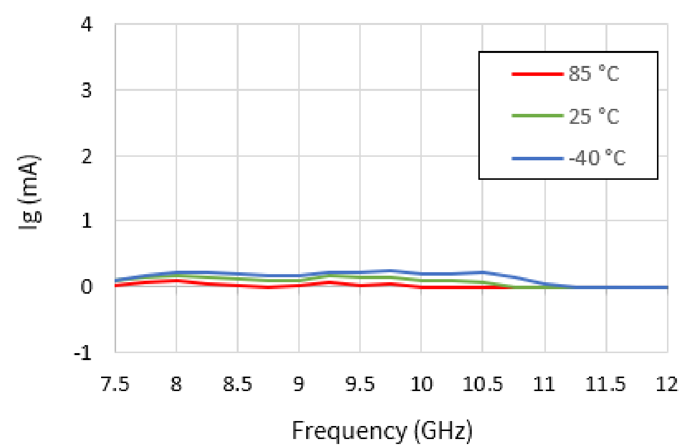
PAE vs. Frequency



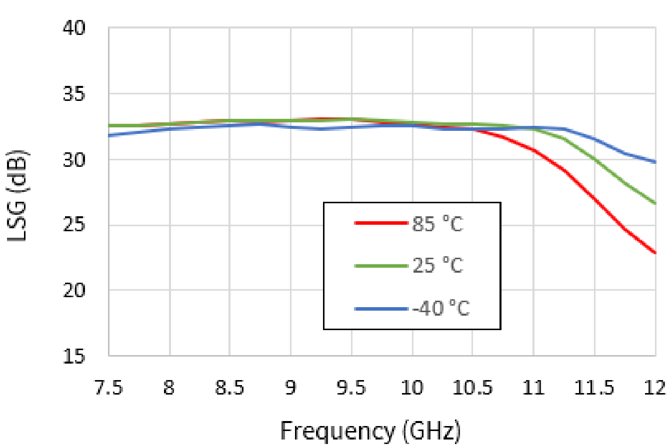
Drain Current vs. Frequency



Gate Current vs. Frequency



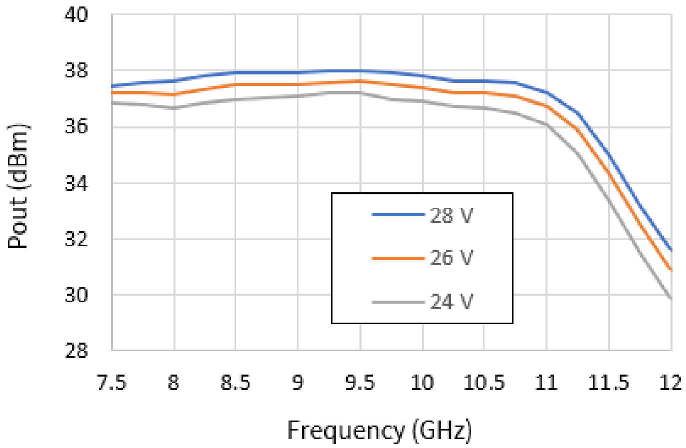
Large Signal Gain vs. Frequency



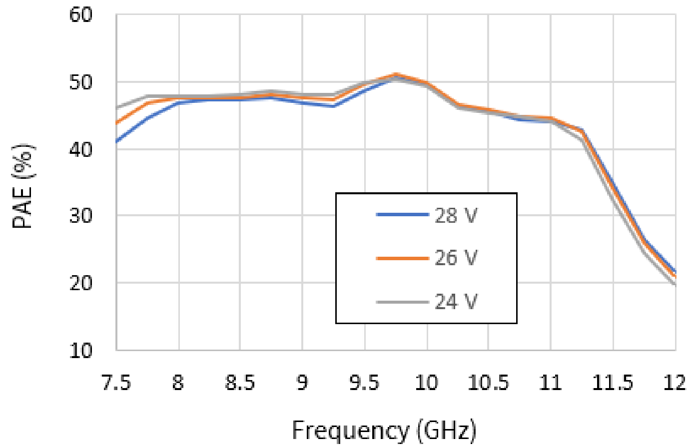
Typical Performance Curves - Large Signal over V_D:

I_{DQ} = 40 mA, PW = 100 µs, DC = 10%, Pin = 5 dBm, T_C = 25°C

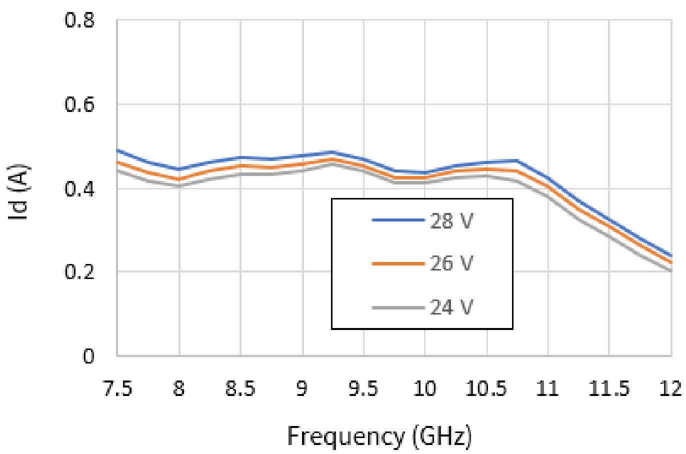
Pout vs. Frequency



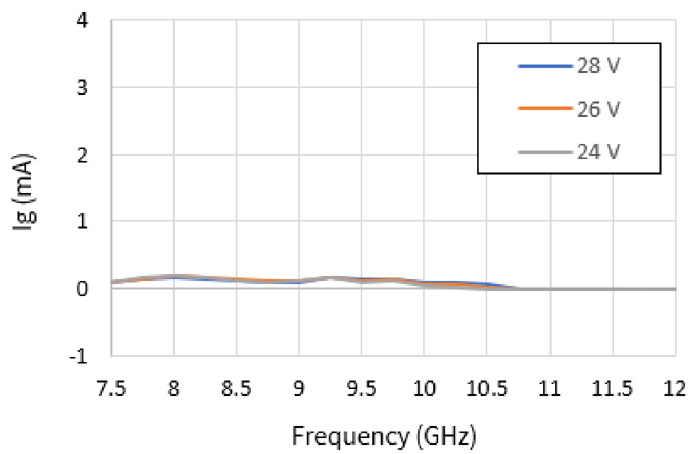
PAE vs. Frequency



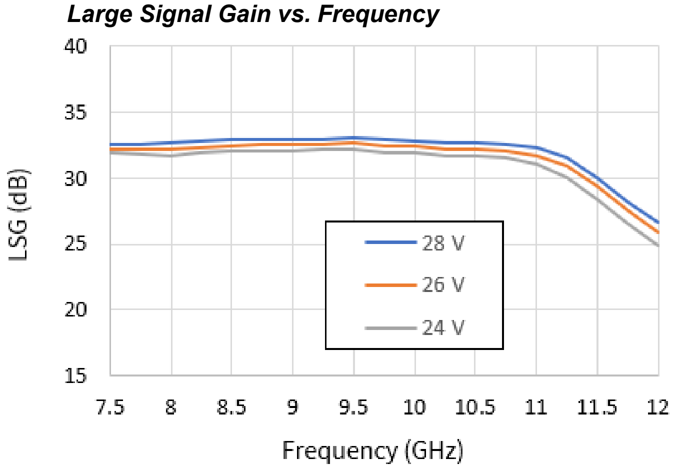
Drain Current vs. Frequency



Gate Current vs. Frequency



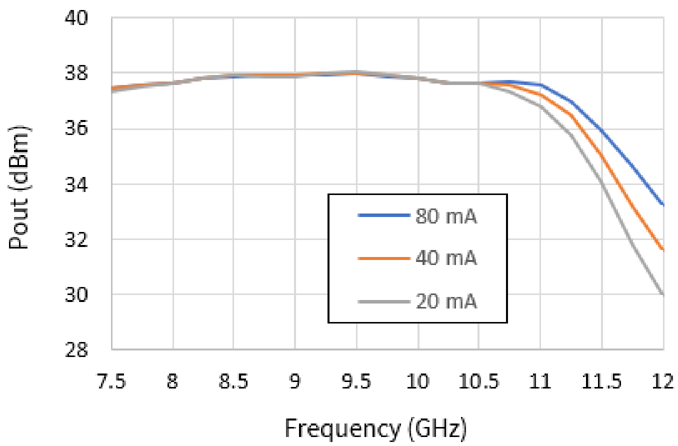
Large Signal Gain vs. Frequency



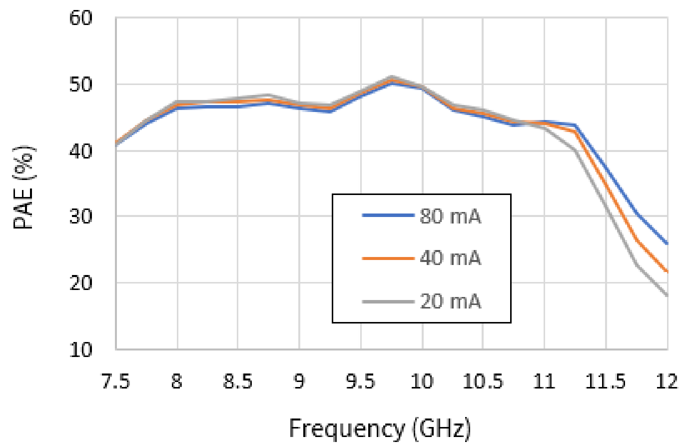
Typical Performance Curves - Large Signal over I_{DQ}:

V_D = 28 V, PW = 100 µs, DC = 10%, Pin = 5 dBm, T_C = 25°C

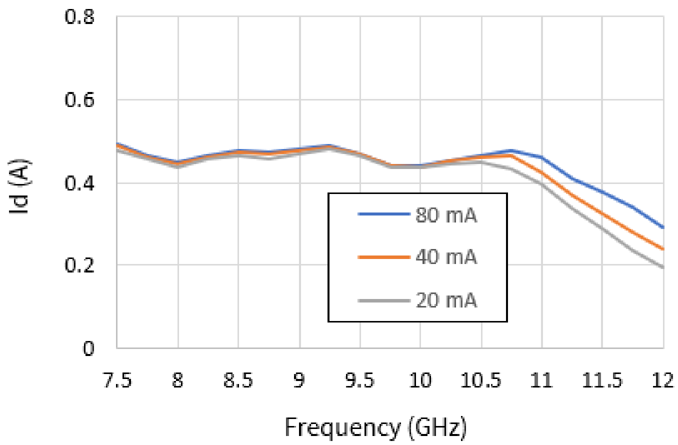
Pout vs. Frequency



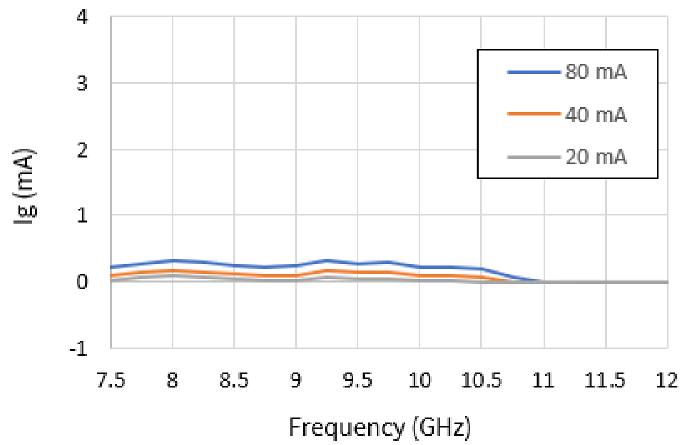
PAE vs. Frequency



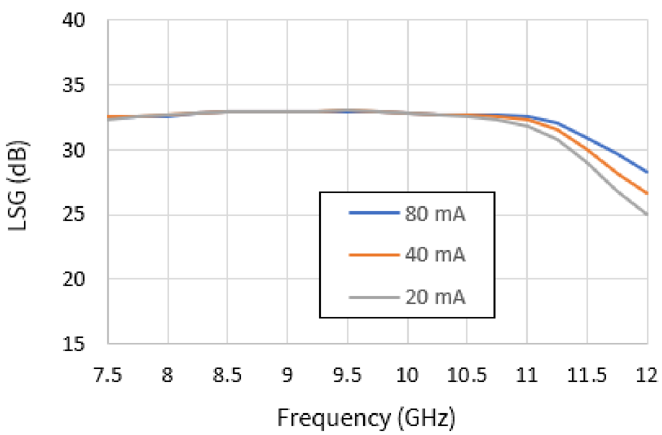
Drain Current vs. Frequency



Gate Current vs. Frequency



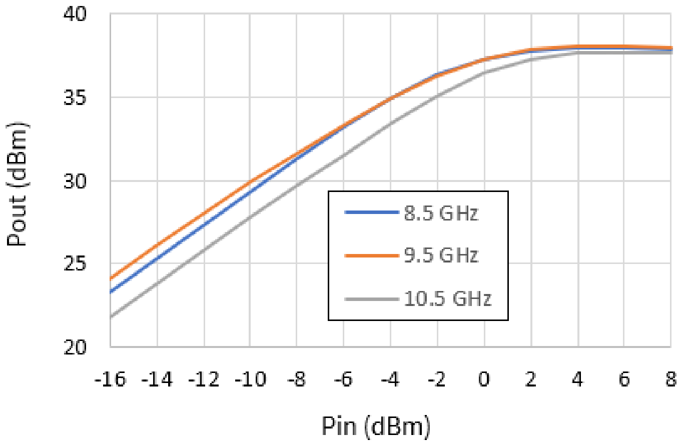
Large Signal Gain vs. Frequency



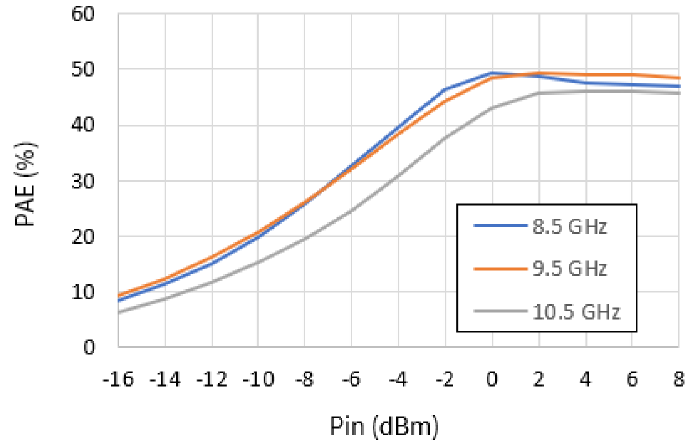
Typical Performance Curves - Drive-Up over Frequency:

V_D = 28 V, I_{DQ} = 40 mA, PW = 100 µs, DC = 10%, T_C = 25°C

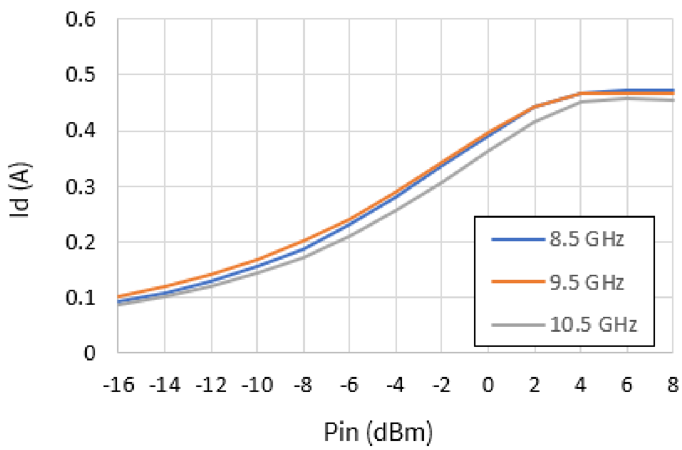
Pout vs. Input Power



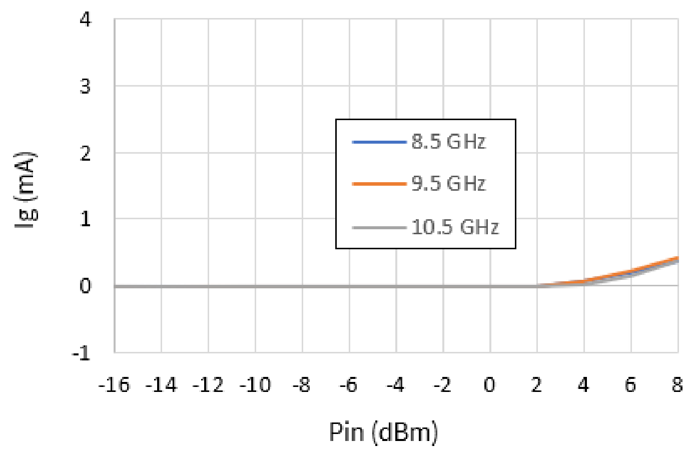
PAE vs. Input Power



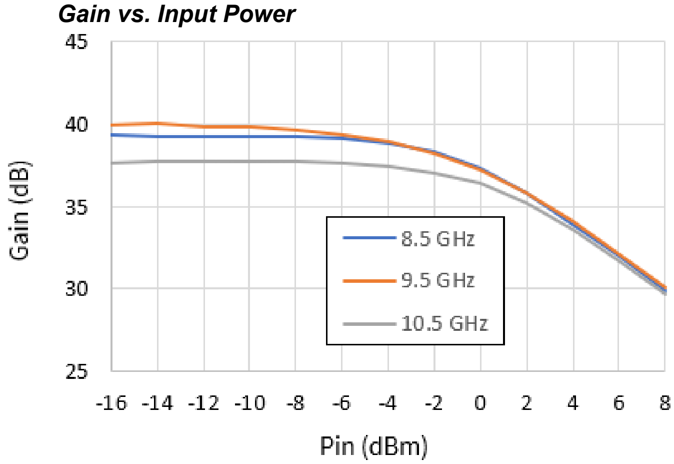
Drain Current vs. Input Power



Gate Current vs. Input Power



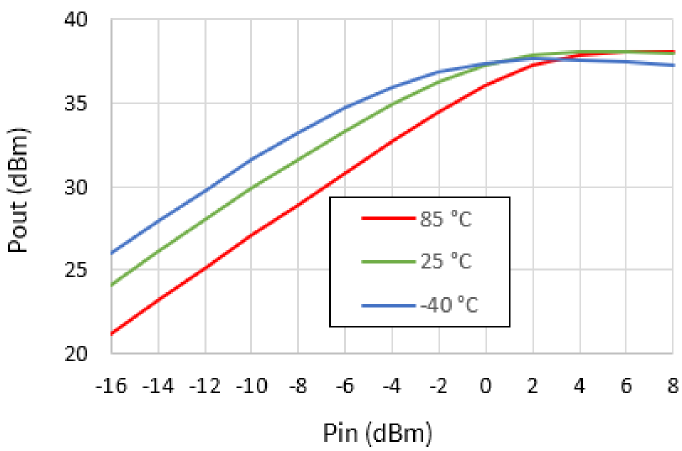
Gain vs. Input Power



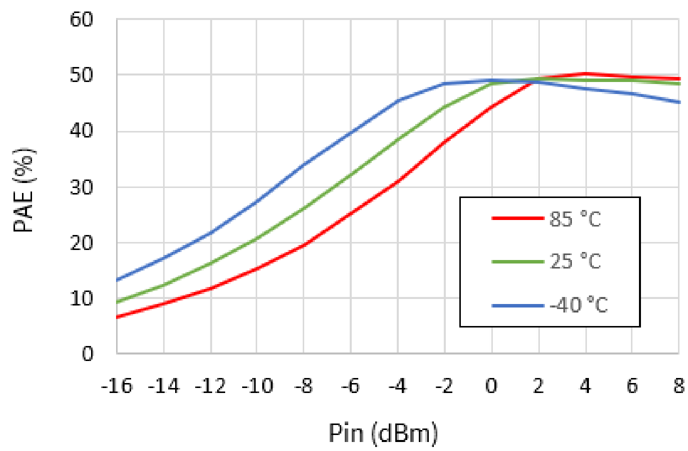
Typical Performance Curves - Drive-Up over Temperature:

V_D = 28 V, I_{DQ} = 40 mA, PW = 100 µs, DC = 10%, Frequency = 9.5 GHz

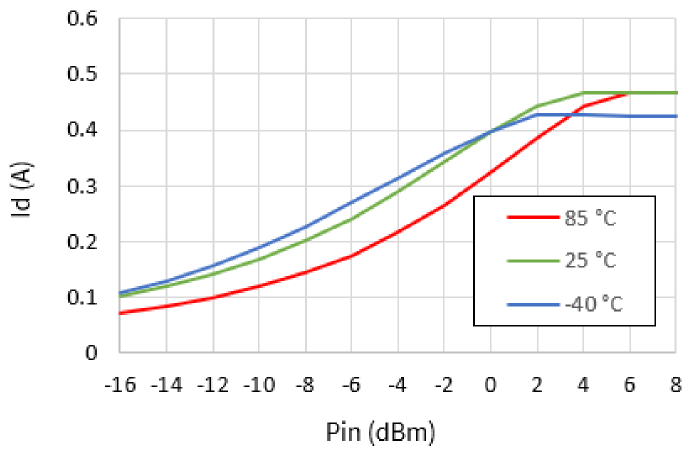
Pout vs. Input Power



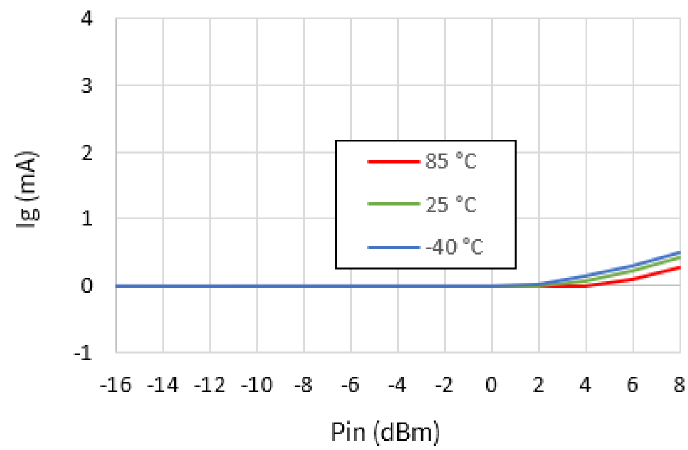
PAE vs. Input Power



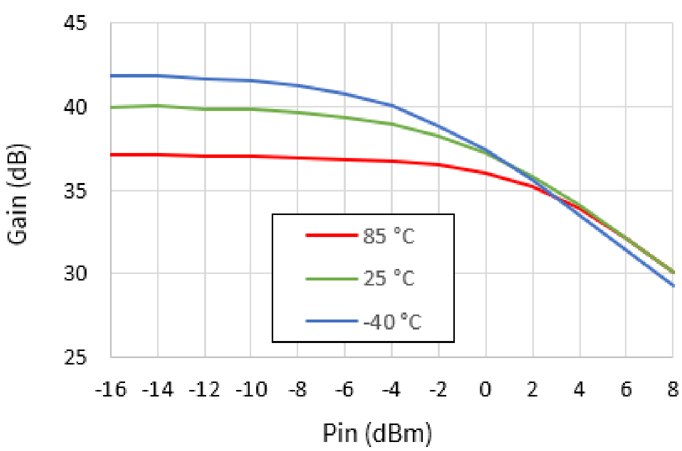
Drain Current vs. Input Power



Gate Current vs. Input Power



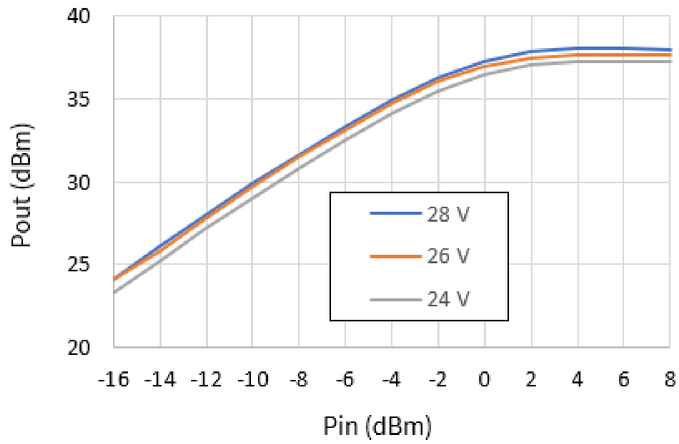
Gain vs. Input Power



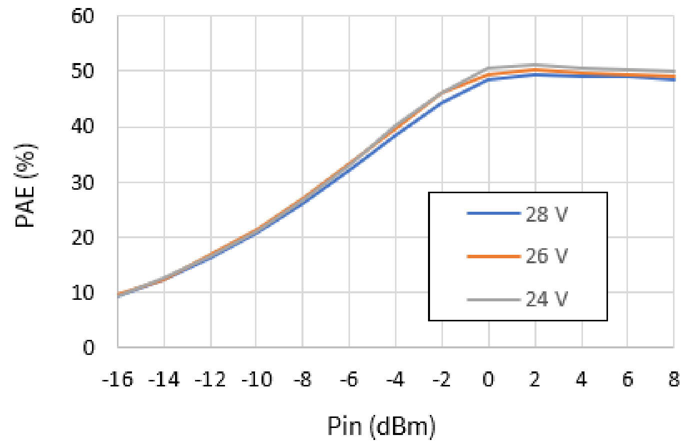
Typical Performance Curves - Drive-Up over V_D:

I_{DQ} = 40 mA, PW = 100 µs, DC = 10%, T_C = 25°C, Frequency = 9.5 GHz

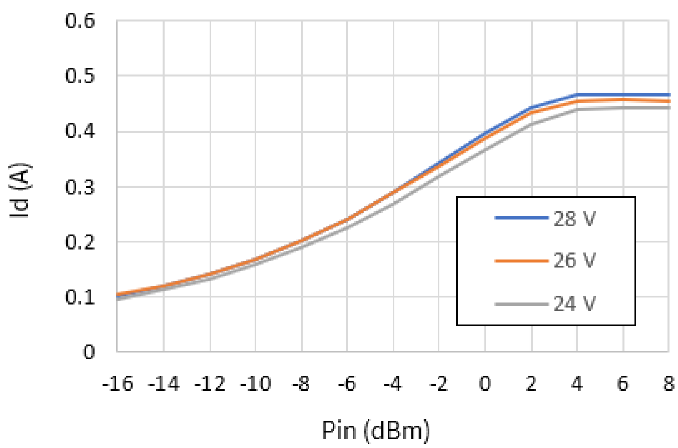
Pout vs. Input Power



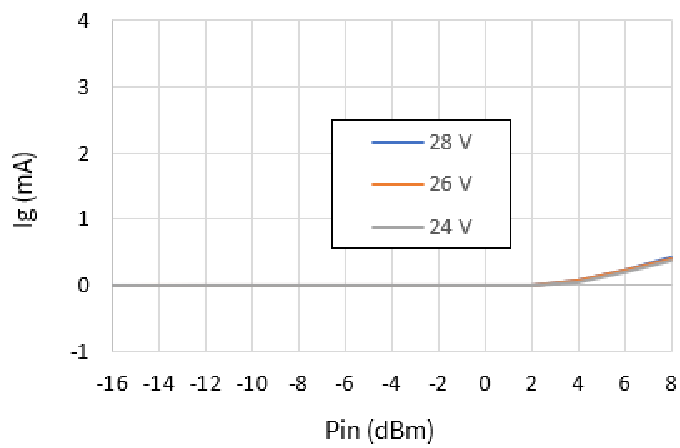
PAE vs. Input Power



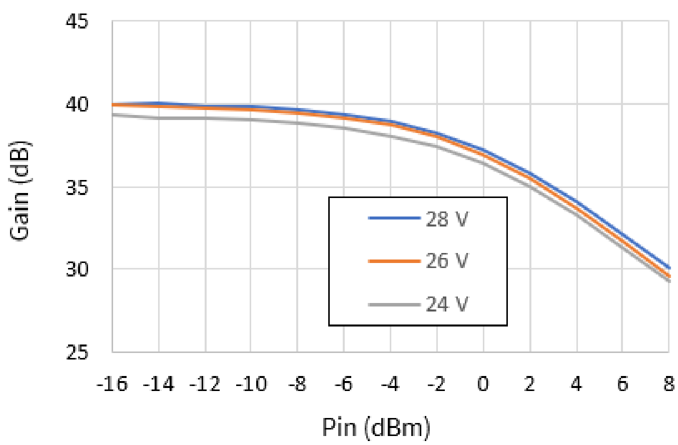
Drain Current vs. Input Power



Gate Current vs. Input Power



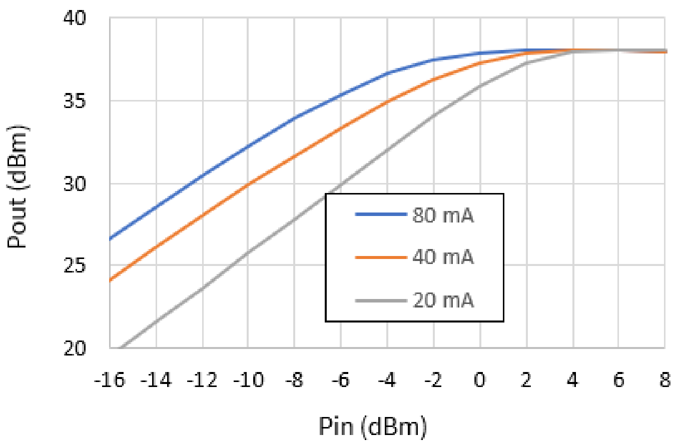
Gain vs. Input Power



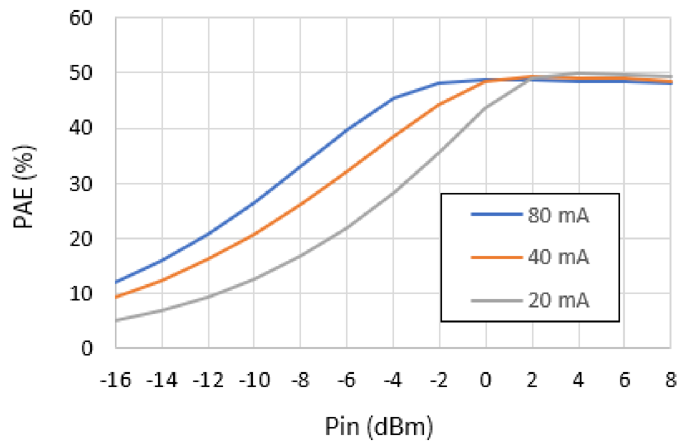
Typical Performance Curves - Drive-Up over I_{DQ}:

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

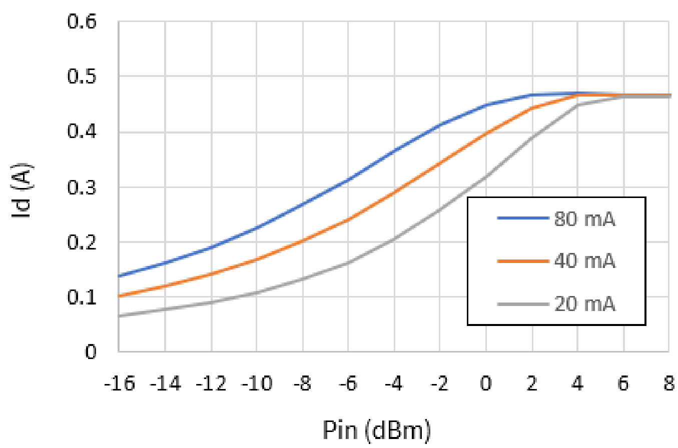
Pout vs. Input Power



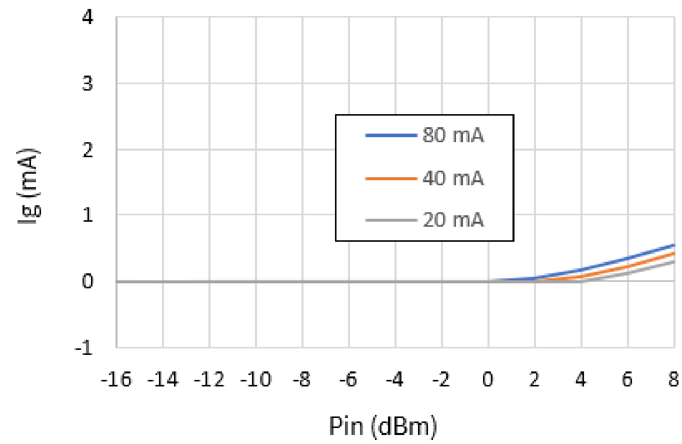
PAE vs. Input Power



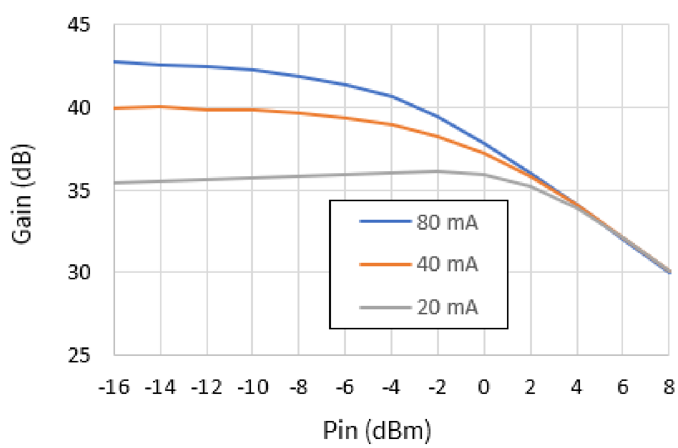
Drain Current vs. Input Power



Gate Current vs. Input Power



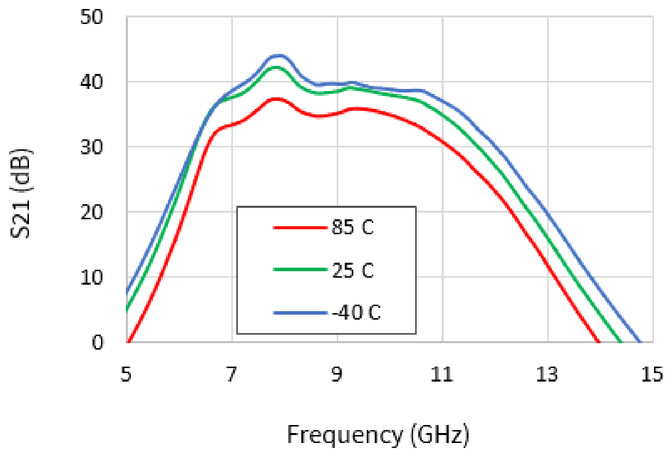
Large Signal Gain vs. Input Power



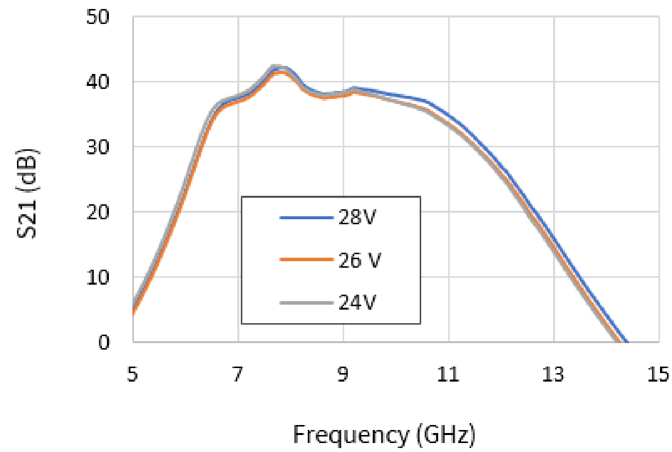
Typical Performance Curves - Small Signal over Temperature and V_D:

I_{DQ} = 40 mA, CW, Pin = -20 dBm

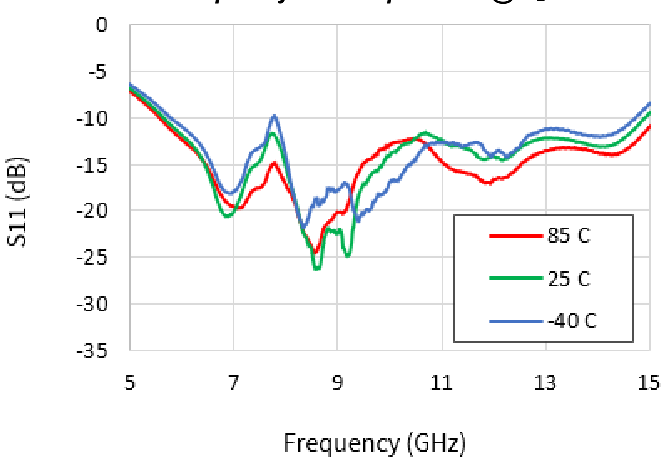
S21 vs. Frequency over Temperature @ V_D = 28 V



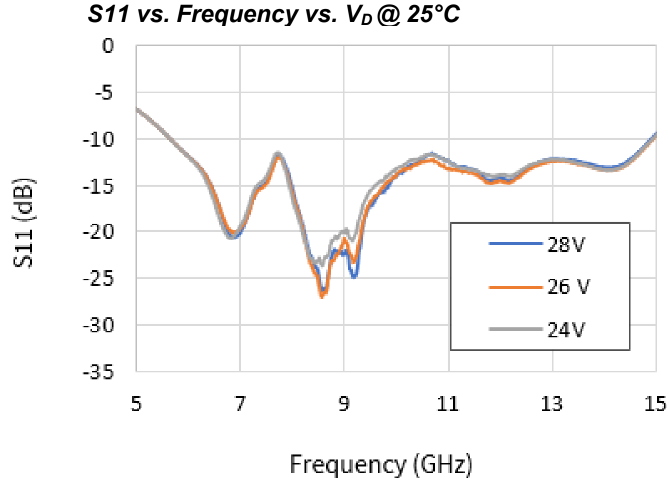
S21 vs. Frequency over V_D @ 25°C



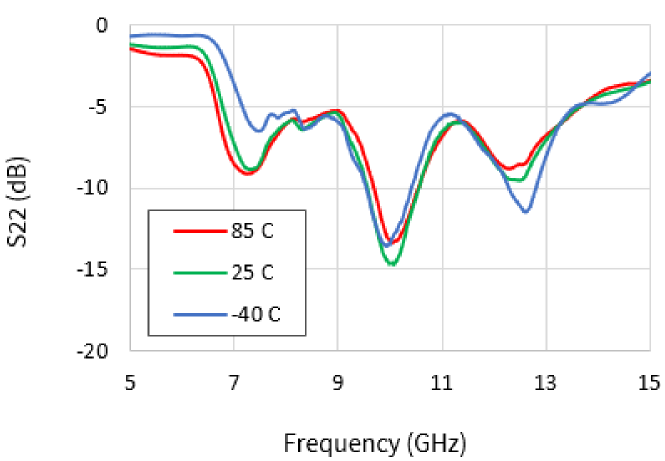
S11 vs. Frequency vs. Temperature @ V_D = 28 V



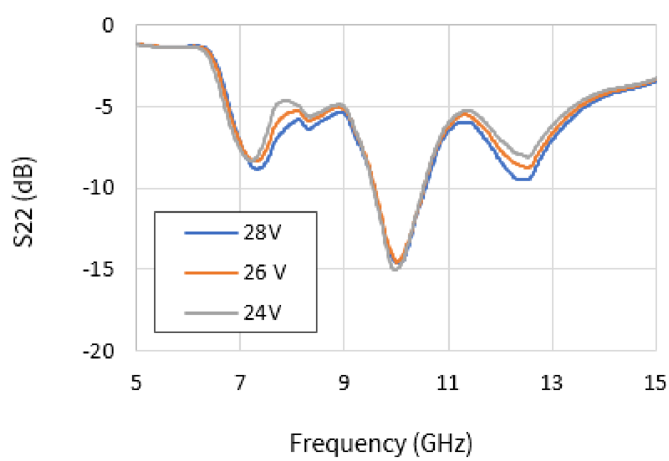
S11 vs. Frequency vs. V_D @ 25°C



S22 vs. Frequency vs. Temperature @ V_D = 28 V



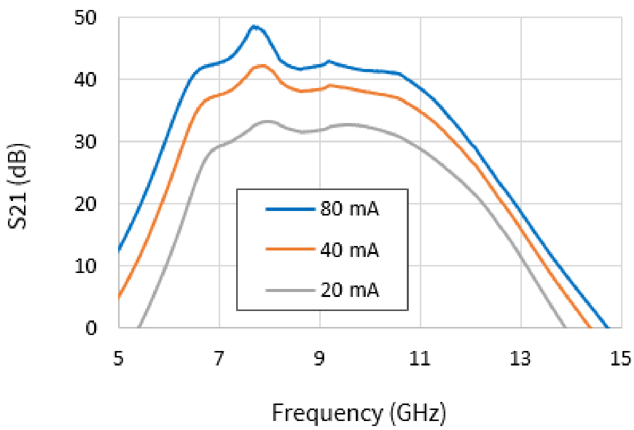
S22 vs. Frequency vs. V_D @ 25°C



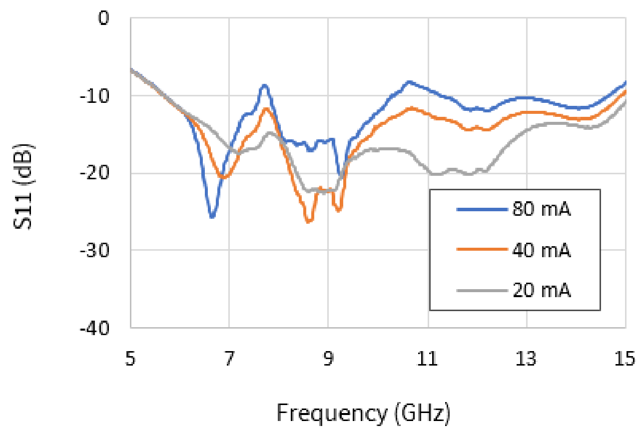
Typical Performance Curves - Small Signal over I_{DQ}:

V_D = 28 V, CW, Pin = -20 dBm, T_C = 25°C

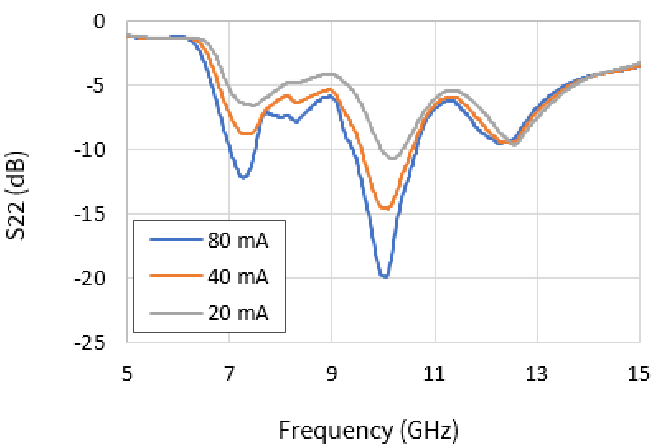
S21 vs. Frequency over I_{DQ}



S11 vs. Frequency over I_{DQ}



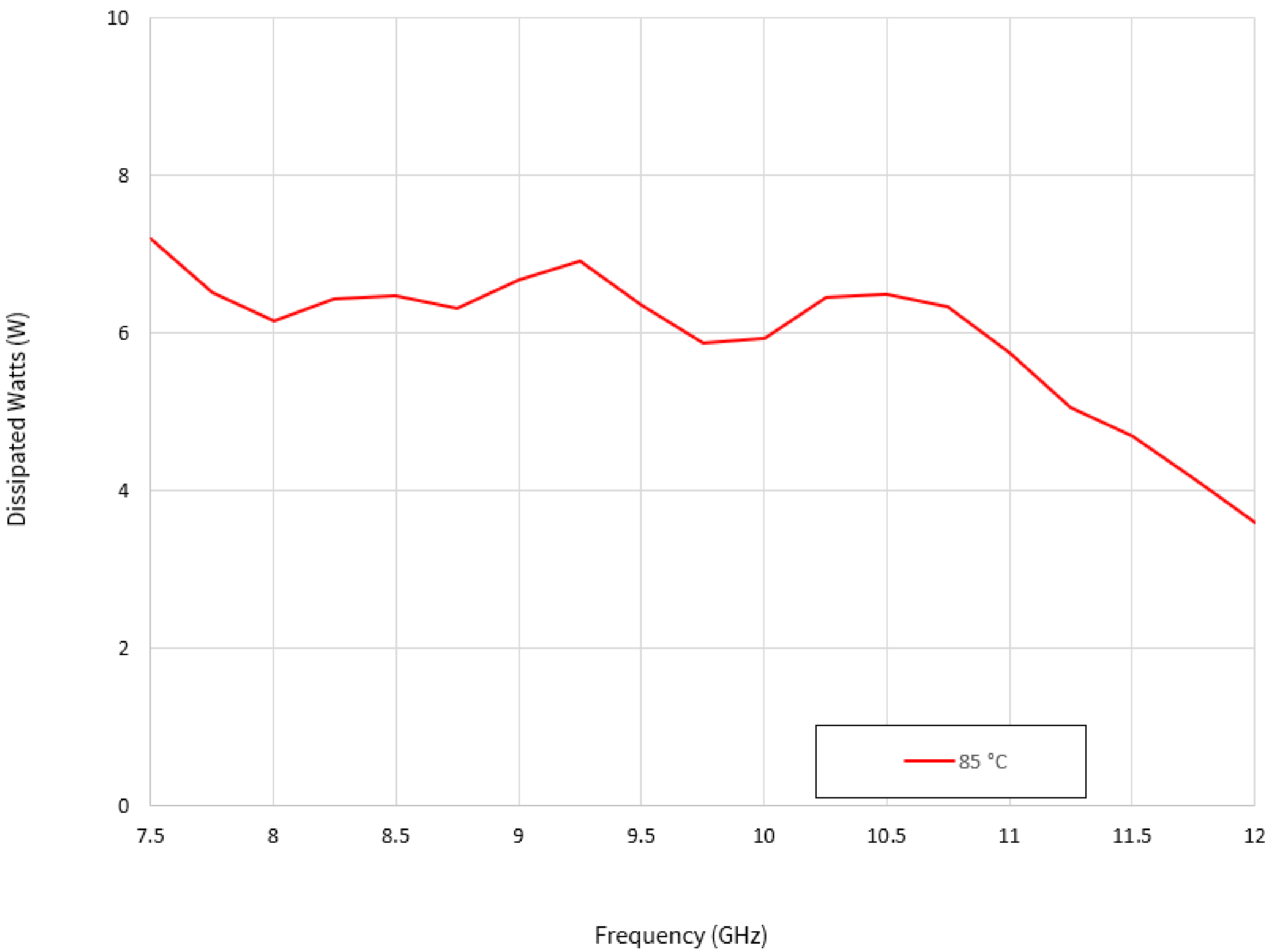
S22 vs. Frequency over I_{DQ}



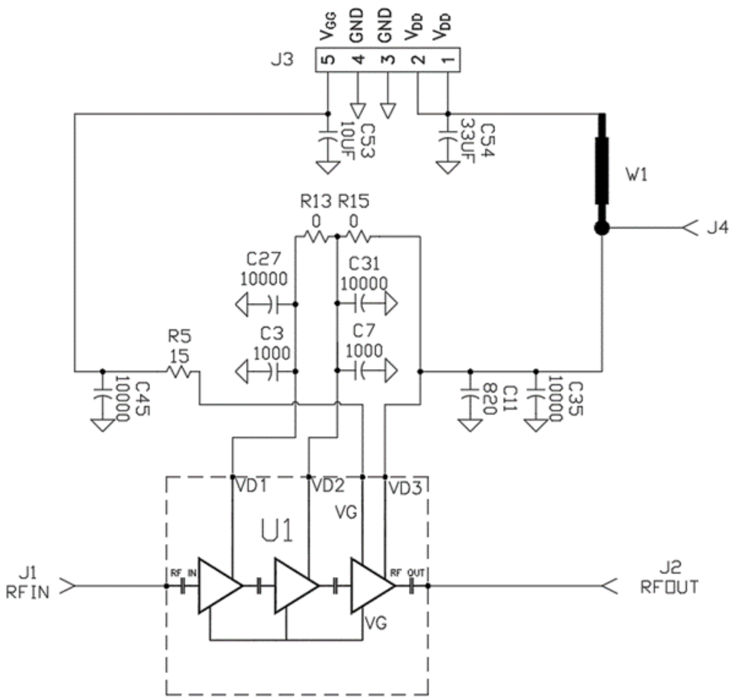
Thermal Characteristics

Parameter	Operating Conditions	Value
Operating Junction Temperature (T_J)	Freq = 9.5 GHz, V_D = 28 V, I_{DQ} = 40 mA, I_{DRIVE} = 458mA, P_{IN} = 5 dBm, P_{OUT} = 38 dBm, P_{DISS} = 6.4 W, T_{CASE} = 85°C, PW = 100 µs, DC = 10%	126°C
Thermal Resistance, Junction to Case ($R_{\theta JC}$)		6.47°C/W

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



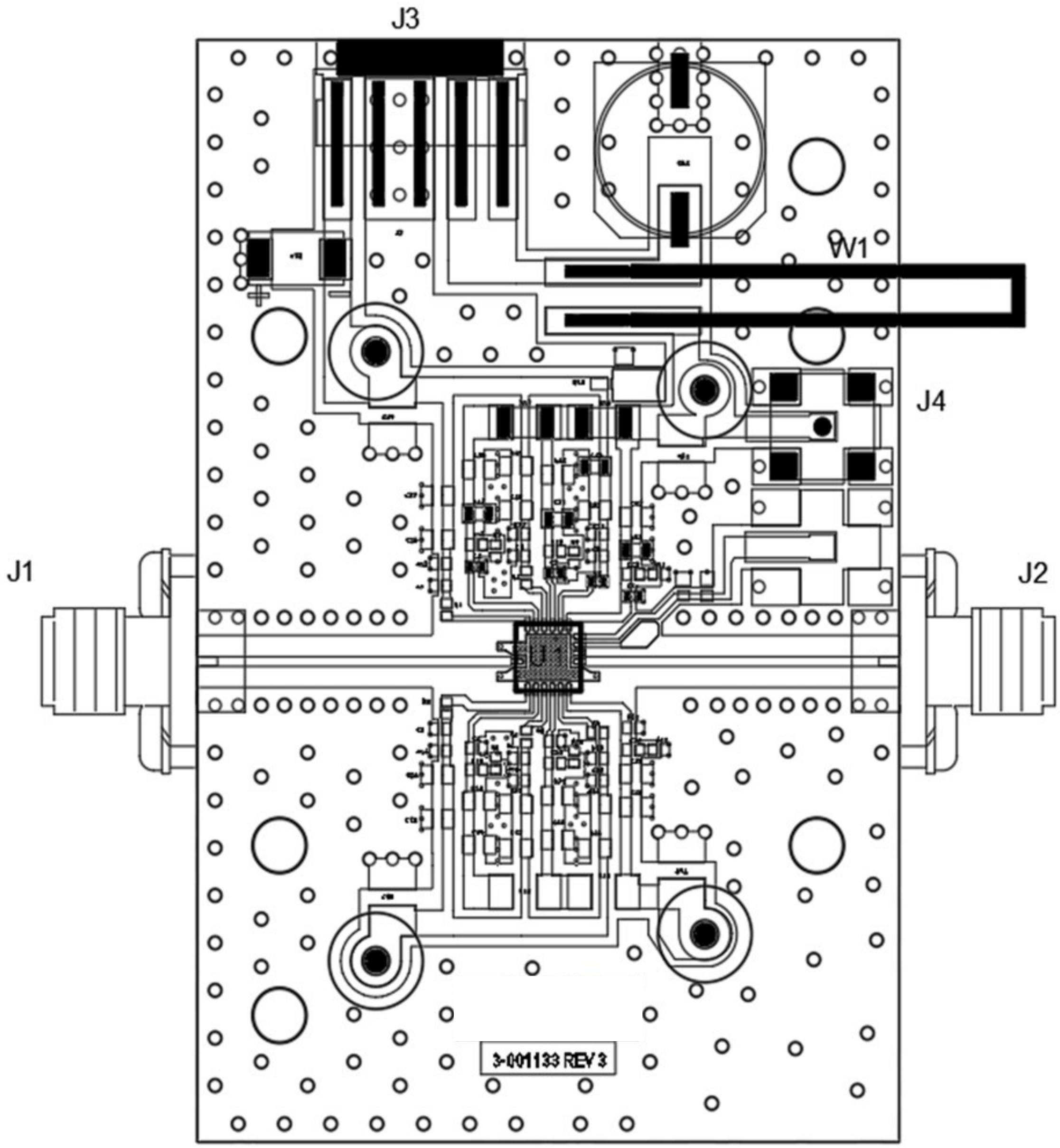
Evaluation Board Schematic (WSA5080S-AMP1)



Parts List

Part	Value	Qty.
C27, C31, C35, C45	CAP, 10nF C0G 0603	4
C3, C7	CAP, 1000pF, C0G, 100V, 0402	2
C11	CAP, 820pF, +/- 5%, 50V, 0402	1
C54	CAP, 33 UF, 20%, G CASE	1
C53	CAP, 10UF, 16V, TANTALUM	1
R5	RES 15 OHM, +/-1%, 1/16W, 0402	1
R13, R15	RES 0.0 OHM 1/16W 1206 SMD	2
J1, J2	CONN, SMA, PANEL MOUNT JACK, FLANGE, 4-HOLE, BLUNT POST, 20MIL	2
J4	CONN, SMB, STRAIGHT JACK RECEPTACLE, SMT, 50 OHM, Au PLATED	1
J3	HEADER RT>PLZ .1CEN LK 5POS	1
W1	WIRE, BLACK, 20 AWG ~ 3.0”	1
-	PCB, EVAL, WSA5080S, RF-35TC, .010”	1
-	BASEPLATE, 2.6"x1.7"x0.25", AL, 6x6 QFN	1
-	2-56 SOC HD SCREW 3/16 SS	4
-	#2 SPLIT LOCKWASHER SS	4
U1	WSA5080S	1

Evaluation Board Assembly Drawing (WSA5080S-AMP1)



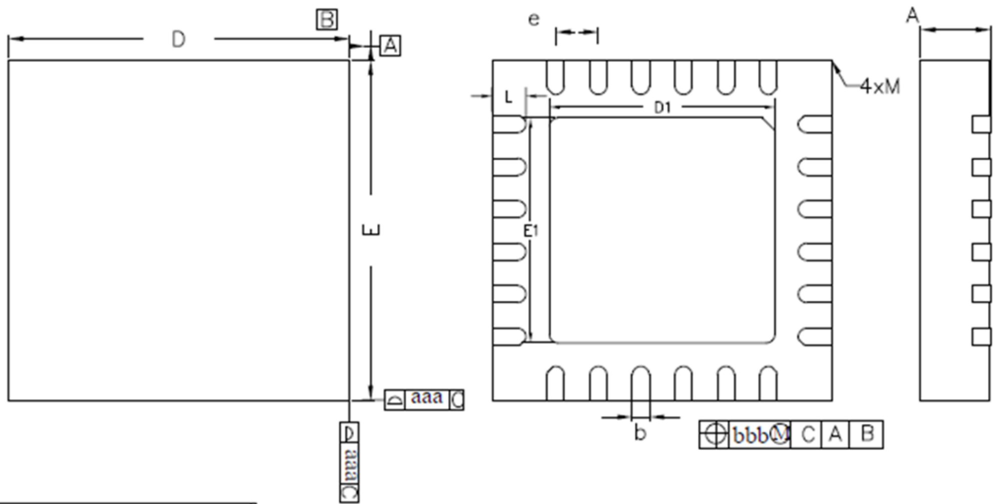
Bias On Sequence

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

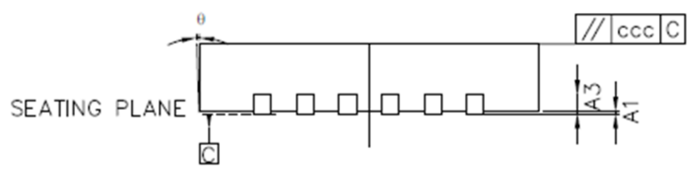
Bias Off Sequence

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



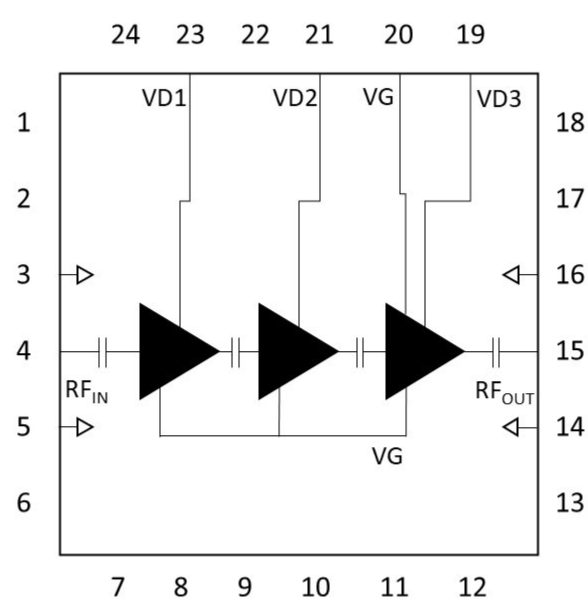
SYMBOLS	DIMENSIONS IN MILLIMETERS		
	MIN	NOM	MAX
A	0.80	0.90	1.00
A1	0	0.02	0.05
A3	---	0.25REF.	---
b	0.15	0.20	0.25
D	3.90	4.00	4.10
D1	---	2.65BSC	---
E	3.90	4.00	4.10
E1	---	2.65BSC	---
e	---	0.50BSC	---
L	0.30	0.40	0.50
θ	0	---	12
aaa	---	0.25	---
bbb	---	0.10	---
ccc	---	0.10	---
M	---	---	0.05



1.ALL DIMENSIONS ARE IN MILLMETERS,θ IS IN DEGREES.
2.M : THE MAXIMUM ALLOWABLE CORNER ON THE MOLDED PLASTIC BODY CORNERS.
3.DIMENSION 'D' DOES NOT INCLUDE MOLD PROTRUSIONS OR GATE BURRS.MOLD PROTRUSIONS AND GATE BURRS SHALL NOT EXCEED 0.15mm PER SIDE.
4.DIMENSION 'E' DOES NOT INCLUDE INTERTERMINAL MOLD PROTRUSIONS OR TERMINAL PROTRUSIONS. INTERTERMINAL MOLD PROTRUSIONS AND/OR TERMINAL PROTRUSIONS SHALL NOT EXCEED 0.20mm PER SIDE.
5.DIMENSION 'b' APPLIES TO PLATED TERMINALS. DIMENSION 'A1' IS PRIMARILY Y TERMINAL PLATING,BUT MAY OR MAY NOT INCLUDE A SMALL PROTRUSION OF TERMINAL BELOW THE BOTTOM SURFACE OF THE PACKAGE.
6.DIE PADDLE SIZE 2.9mmX2.9mm HAS 2.65mmX2.65mm(BSC) EXPOSED PAD SIZE.
7.JEDEC STANDARD MO-220.

Pin Description

Pin #	Name	Description
1,2,6,7,8,9,10,11, 12,13,17,18,22,24	NC	Recommended to connect NC pins to ground.
3	GND	RF and DC ground.
4	RFIN	RF Input. Internally DC blocked.
5	GND	RF and DC ground.
14	GND	RF and DC ground.
15	RFOUT	RF Output. Internally DC blocked.
16	GND	RF and DC ground.
19	VD3	Drain bias for stage 3.
20	VG	Gate bias for entire MMIC.
21	VD2	Drain bias for stage 2.
23	VD1	Drain bias for stage 1.
Paddle	GND	RF and DC ground.



Revision History

Rev	Date	Change Description
V1	09/13/2024	Initial production released document.