GaN High Power Amplifier, 20 W
27 – 31 GHz

CMPA2H3B025F
Rev. V1

Features

- Saturated Power: 20 W
- Power Added Efficiency: 23%
- Large Signal Gain: 18 dB
- Small Signal Gain: 24 dB
- Input Return Loss: -10 dB
- Output Return Loss: -10 dB
- IM3: -22 dBc (10 W, P_{total})
- CW operation

Applications

- Satellite Uplink

Description

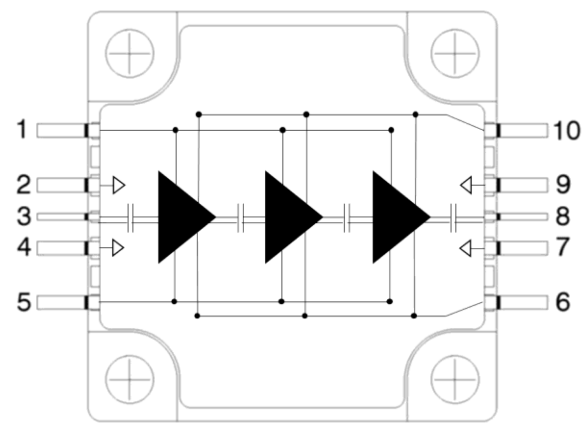
MACOM's CMPA2H3B025F is a 20 W, MMIC HPA utilizing MACOM's high performance, 0.15µm GaN on SiC production process. The CMPA2H3B025F operates from 27 – 31 GHz and targets Ka-band satellite uplinks. Under saturation, the CMPA2H3B025F achieves 20 W of typical output with 18 dB of large signal gain and 23% power-added efficiency. Operating at a backed-off average output power of 10W, this HPA achieves -22dBc IM3 with 25 dB of associated gain and 20% power-added efficiency.

Packaged in a 15x15 mm bolt-down, flange package, the CMPA2H3B025F 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)
CMPA2H3B025F	Tray (10/10)
CMPA2H3B025F-AMP	Sample Board (1/1)

Functional Schematic



Pin Configuration[1]

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

1. The backside of the MMIC must be connected to RF, DC, and thermal ground

RF Electrical Specifications: V_D = 28 V, I_{DQ} = 300 mA, CW, T_C = 25°C, Z_0 = 50 Ω

Parameter	Test Conditions	Frequency (GHz)	Units	Min.	Typ.	Max.
Output Power	P_{IN} = 25 dBm	27 29 31	dBm	42.0 42.0 42.0	43.0 43.8 43.2	—
Power Added Efficiency	P_{IN} = 25 dBm	27 29 31	%	18 16 16	23 24 23	—
Large Signal Gain	P_{IN} = 25 dBm	27 29 31	dB	17.0 17.0 17.0	18.0 18.8 18.2	—
Small Signal Gain	P_{IN} = -30 dBm	27 29 31	dB	—	24 25 20	—
Input Return Loss	P_{IN} = -30 dBm	27 - 31	dB	—	-10	—
Output Return Loss	P_{IN} = -30 dBm	27 - 31	dB	—	-10	—
IM3	P_{OUT}/Tone = 37 dBm Tone/Spacing = 300 MHz	27 29 31	dBc	—	-22 -22 -25	—

DC Electrical Specifications:

Parameter	Units	Min.	Typ.	Max.
Drain Voltage	V	—	28	—
Gate Voltage	V	—	-1.8	—
Quiescent Drain Current	mA	—	300	—
Saturated Drain Current	A	—	3.4	—

Recommended Operating Conditions

Parameter	Symbol	Unit	Min.	Typ.	Max.
Input Power	P_{IN}	dBm	—	25	—
Drain Voltage	V_D	V	—	28	—
Gate Voltage	V_G	V	—	-1.8	—
Quiescent Drain Current	I_{DQ}	mA	—	300	—
Operating Temperature	T_C	°C	-40	—	+60

Absolute Maximum Ratings[2,3]

Parameter	Symbol	Unit	Min.	Max.
Input Power	P_{IN}	dBm	—	26
Drain to Source Breakdown Voltage	V_{DS}	V	—	84
Drain Voltage	V_D	V	—	28
Gate Voltage	V_G	V	-8	+2
Drain Current	I_D	A	—	4.0
Gate Current	I_G	mA	—	15
Dissipated Power @ +85°	P_{DISS}	W	—	80
VSWR	—	Ratio	—	3:1
Junction Temperature (MTTF > 1E6 Hrs)	T_J	°C	—	+225°C
Storage Temperature	T_{STG}	°C	-55	+150
Mounting Temperature (30 seconds)	T_M	°C	—	+320
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:

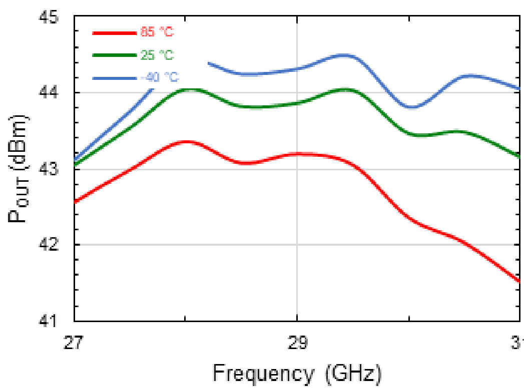
Static Sensitivity

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 HBM class 1A and CDM class C3 devices.

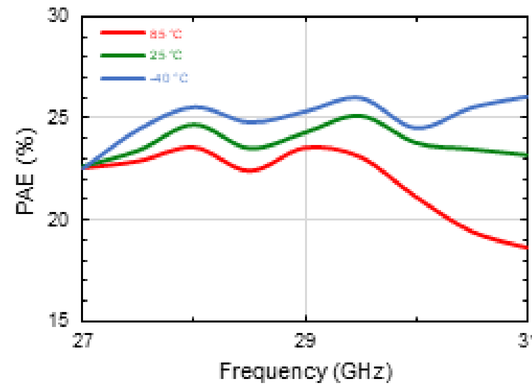
Typical Performance Curves – Large Signal over Temperature:

V_D = 28 V, I_{DQ} = 300 mA, CW, P_{IN} = 25 dBm

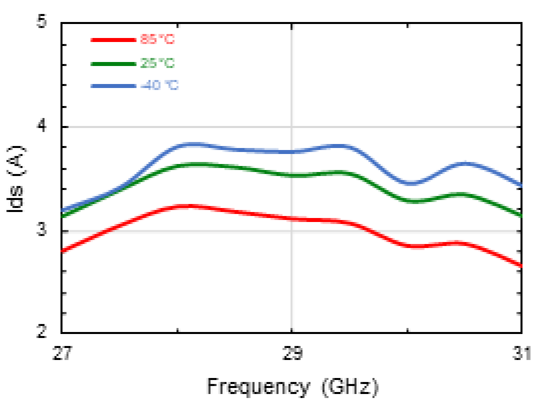
Output Power vs. Frequency



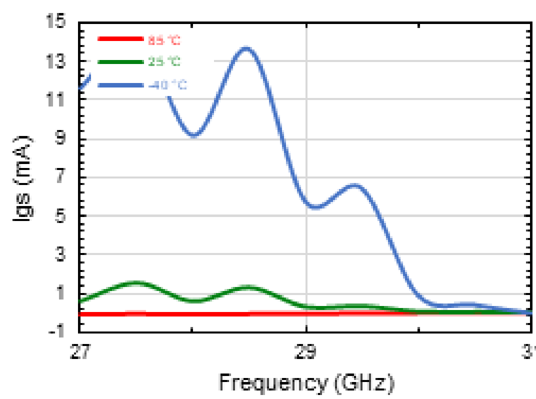
Power Added Efficiency vs. Frequency



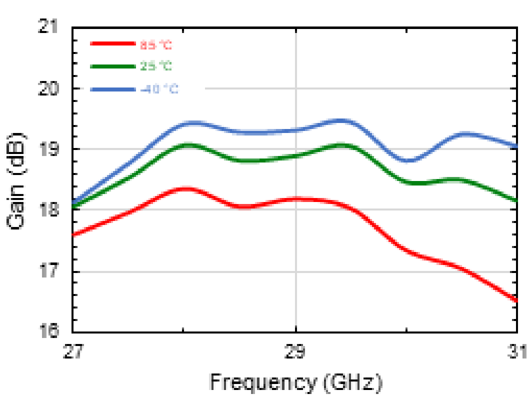
Drain Current vs. Frequency



Gate Current vs. Frequency



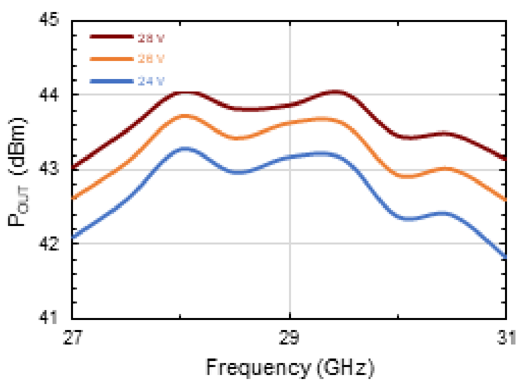
Large Signal Gain vs. Frequency



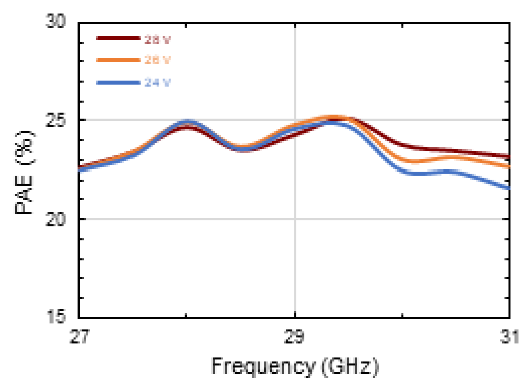
Typical Performance Curves – Large Signal over V_D:

I_{DQ} = 300 mA, CW, P_{IN} = 25 dBm, T_C = 25°C

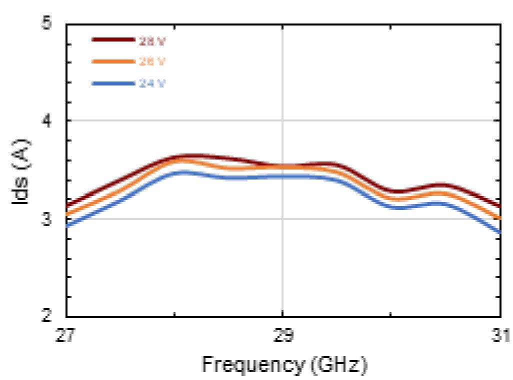
Output Power vs. Frequency



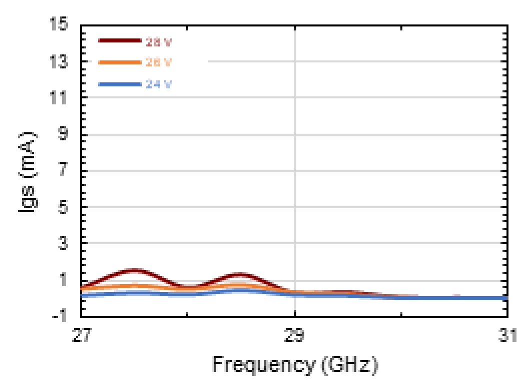
Power Added Efficiency vs. Frequency



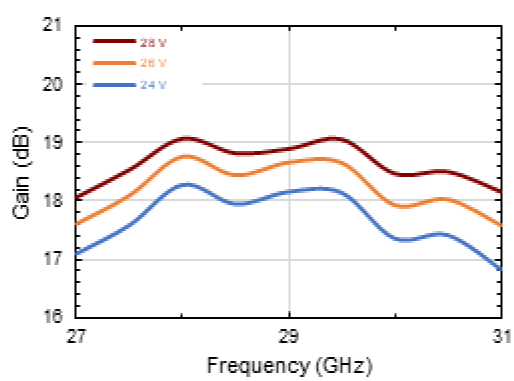
Drain Current vs. Frequency



Gate Current vs. Frequency



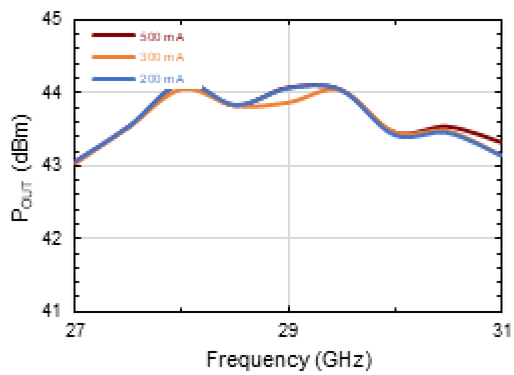
Large Signal Gain vs. Frequency



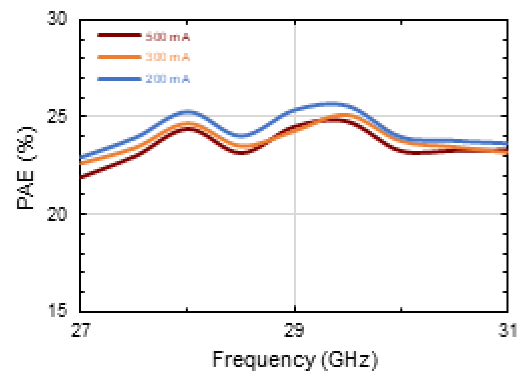
Typical Performance Curves – Large Signal over I_{DQ}:

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

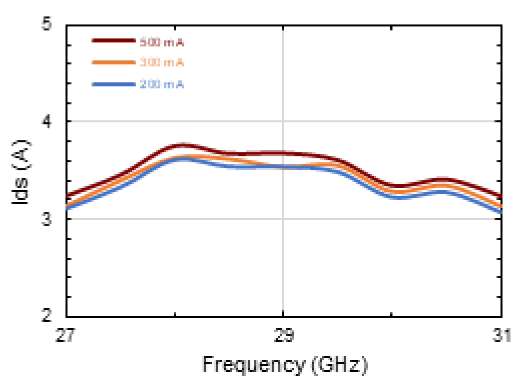
Output Power vs. Frequency



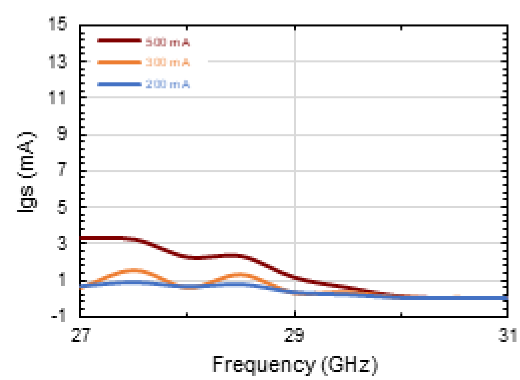
Power Added Efficiency vs. Frequency



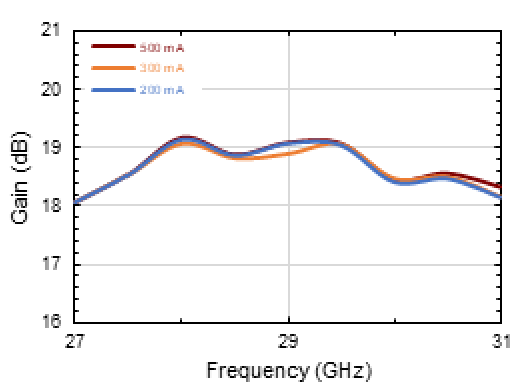
Drain Current vs. Frequency



Gate Current vs. Frequency



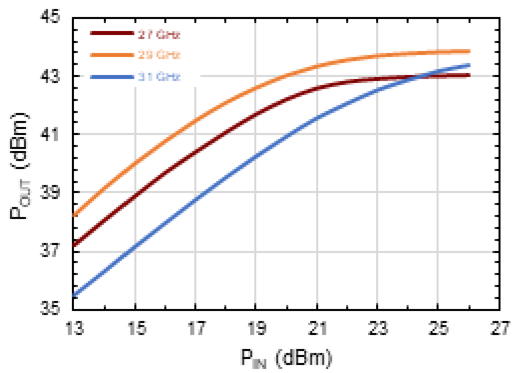
Large Signal Gain vs. Frequency



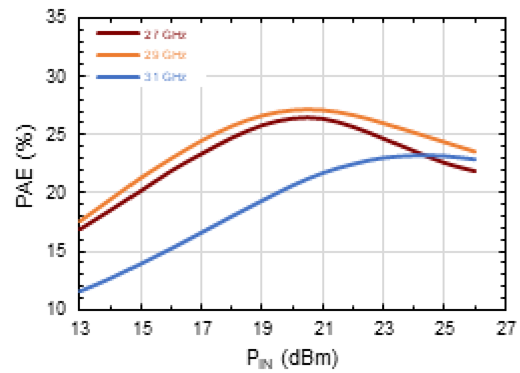
Typical Performance Curves – Drive-Up over Frequency:

V_D = 28 V, I_{DQ} = 300 mA, CW, T_C = 25°C

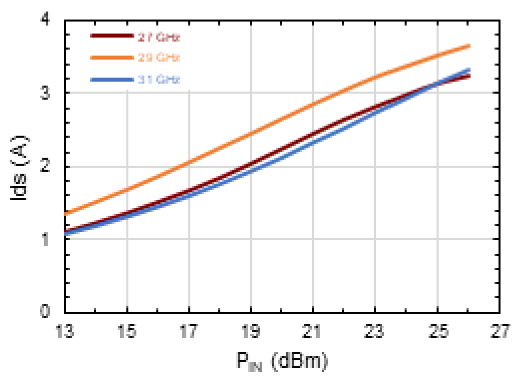
Output Power vs. Input Power



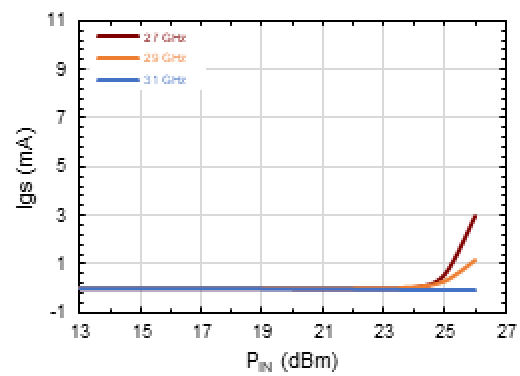
Power Added Efficiency vs. Input Power



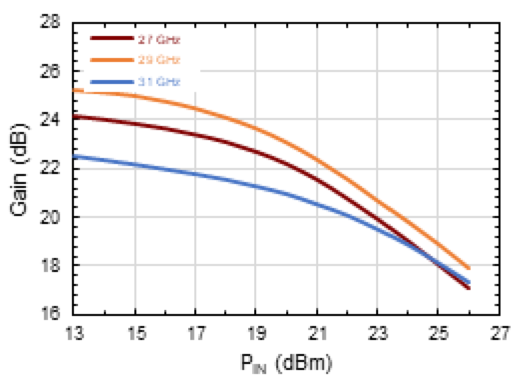
Drain Current vs. Input Power



Gate Current vs. Input Power



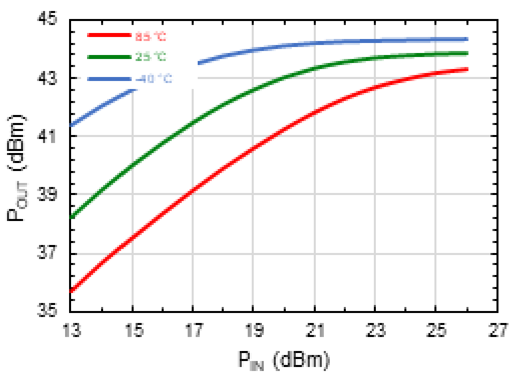
Large Signal Gain vs. Input Power



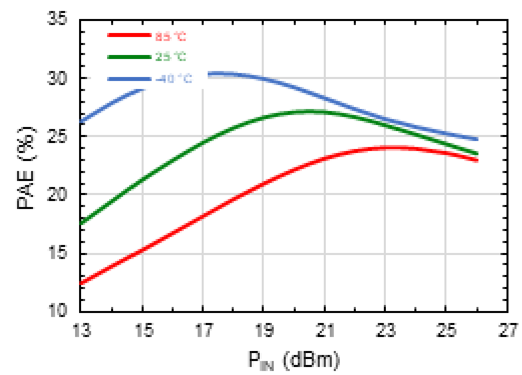
Typical Performance Curves – Drive-Up over Temperature:

V_D = 28 V, I_{DQ} = 300 mA, CW, Frequency = 29 GHz

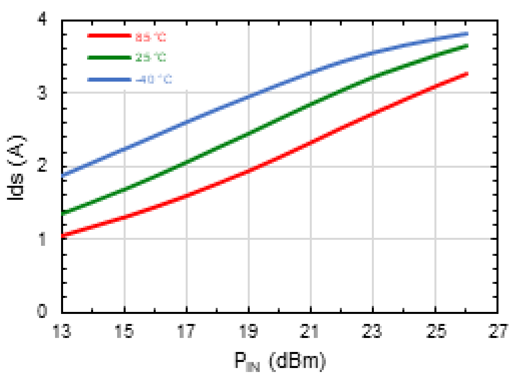
Output Power vs. Input Power



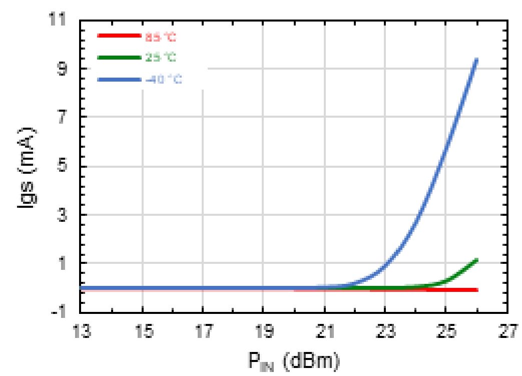
Power Added Efficiency vs. Input Power



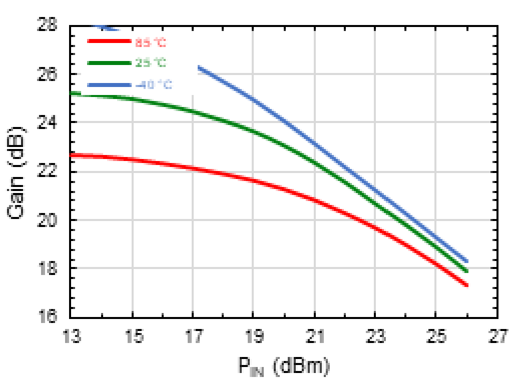
Drain Current vs. Input Power



Gate Current vs. Input Power



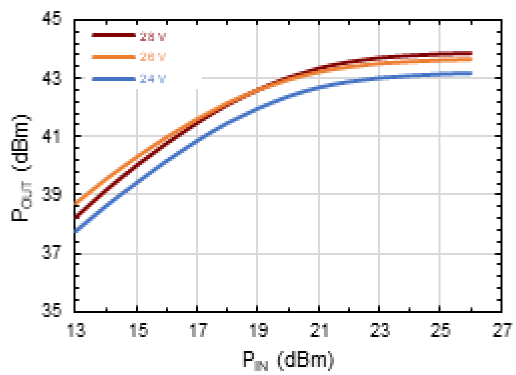
Large Signal Gain vs. Input Power



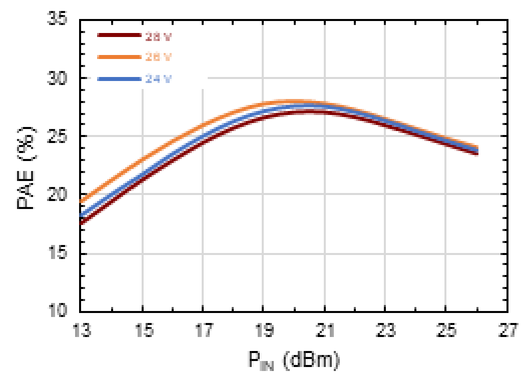
Typical Performance Curves – Drive-Up over V_D:

I_{DQ} = 300 mA, CW, T_C = 25°C, Frequency = 29 GHz

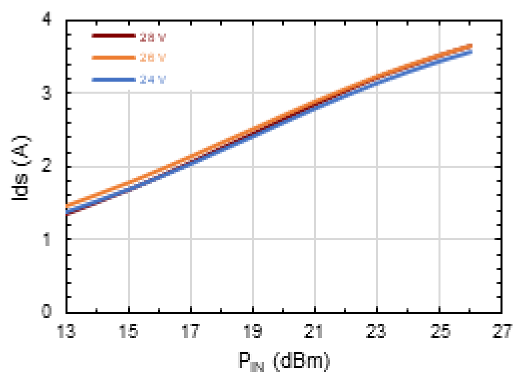
Output Power vs. Input Power



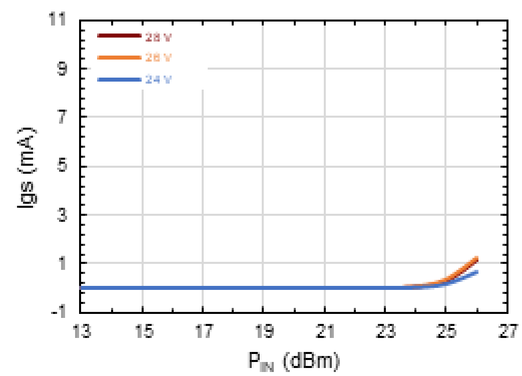
Power Added Efficiency vs. Input Power



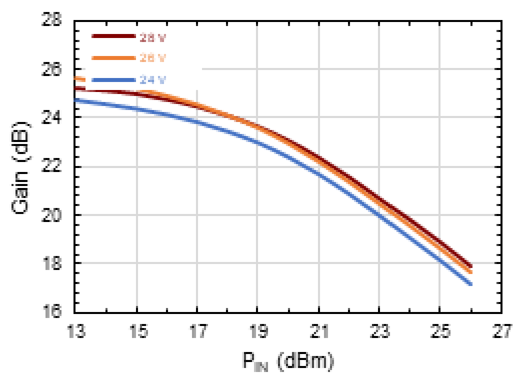
Drain Current vs. Input Power



Gate Current vs. Input Power



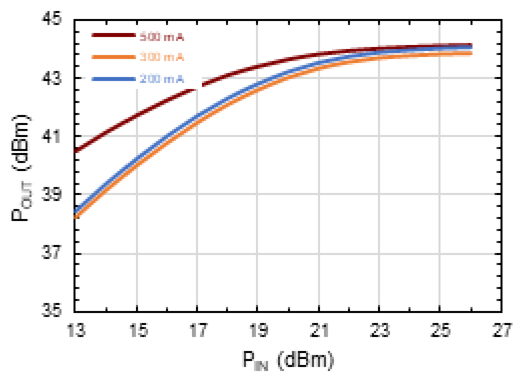
Large Signal Gain vs. Input Power



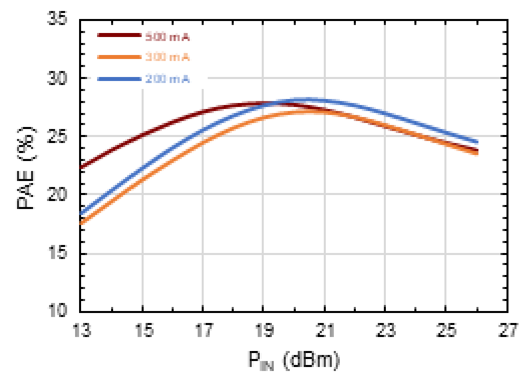
Typical Performance Curves – Drive-Up over I_{DQ}:

V_D = 28 V, CW, T_C = 25°C, Frequency = 29 GHz

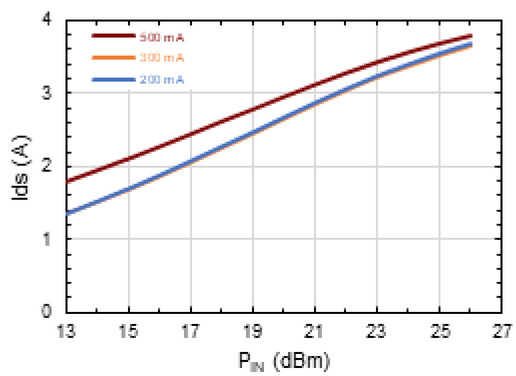
Output Power vs. Input Power



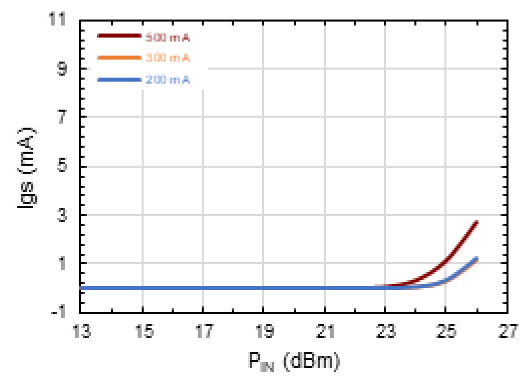
Power Added Efficiency vs. Input Power



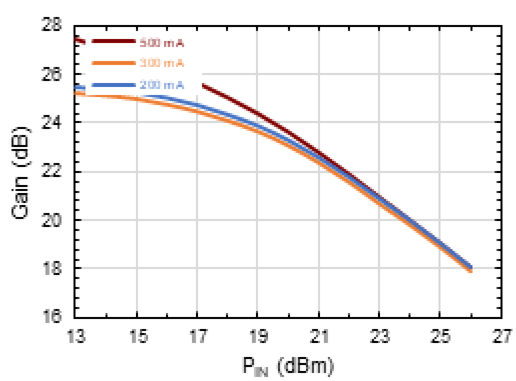
Drain Current vs. Input Power



Gate Current vs. Input Power



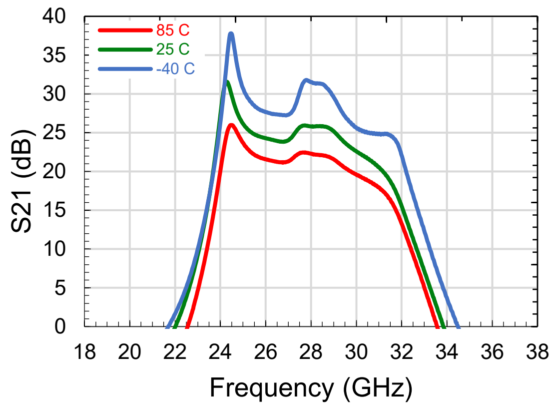
Large Signal Gain vs. Input Power



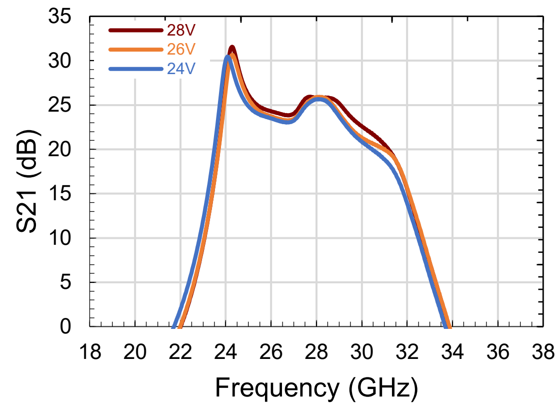
Typical Performance Curves – Small Signal over Temperature and V_D:

I_{DQ} = 300 mA, CW, P_{IN} = -30 dBm

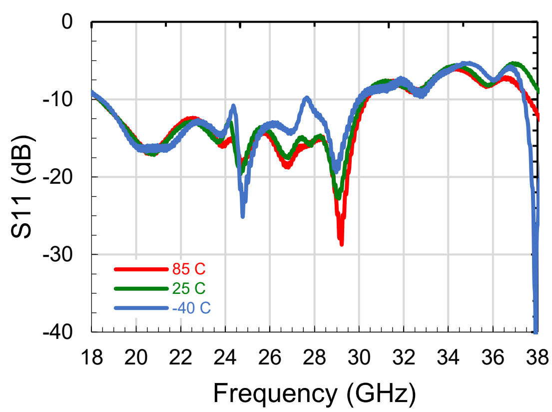
S21 vs. Frequency over Temperature @ V_D = 28 V



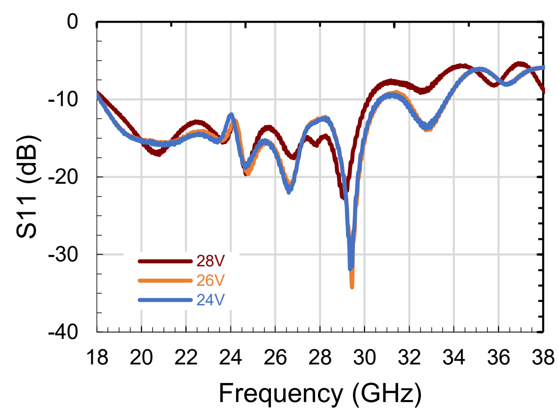
S21 vs. Frequency over V_D @ 25°C



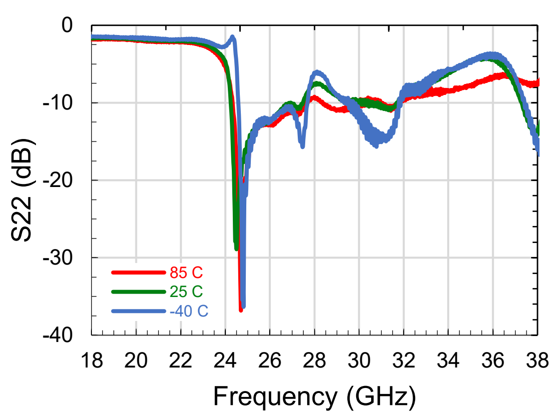
S11 vs. Frequency over Temperature @ V_D = 28 V



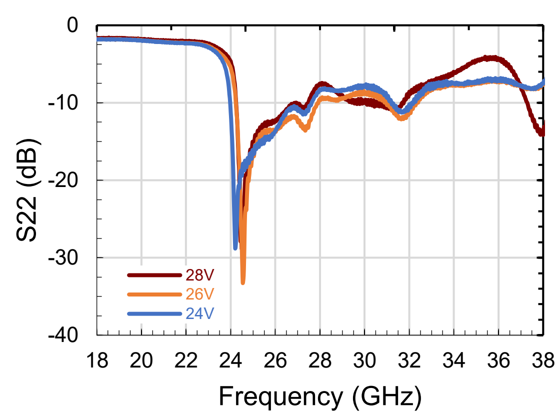
S11 vs. Frequency over V_D @ 25°C



S22 vs. Frequency over Temperature @ V_D = 28 V



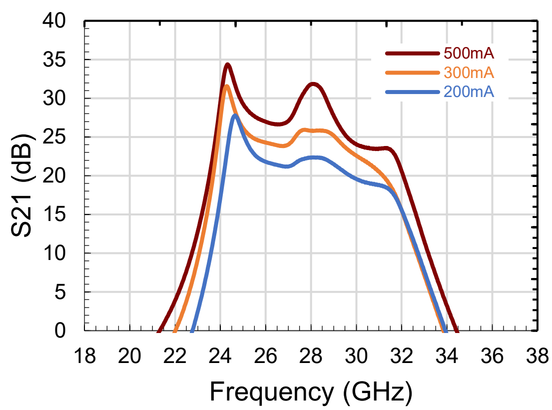
S22 vs. Frequency over V_D @ 25°C



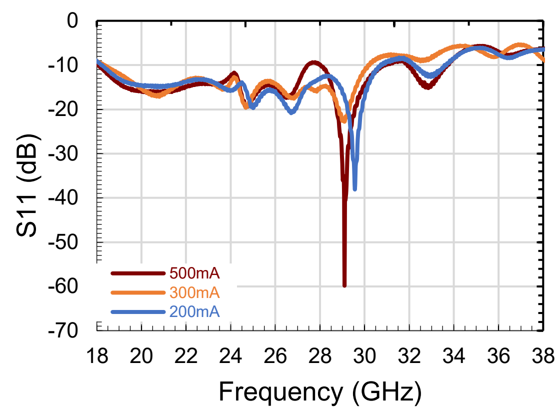
Typical Performance Curves – Small Signal over I_{DQ}:

V_D = 28 V, CW, P_{IN} = -30 dBm, T_C = 25°C

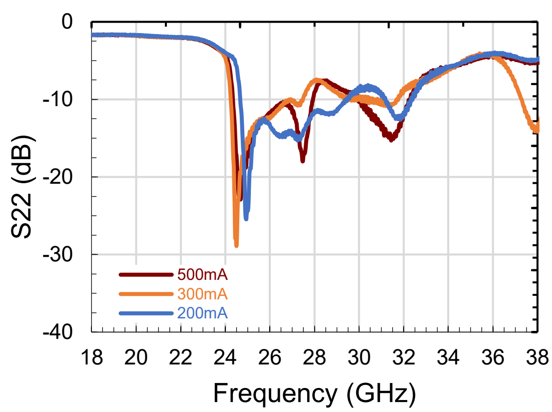
S21 vs. Frequency over I_{DQ}



S11 vs. Frequency over I_{DQ}



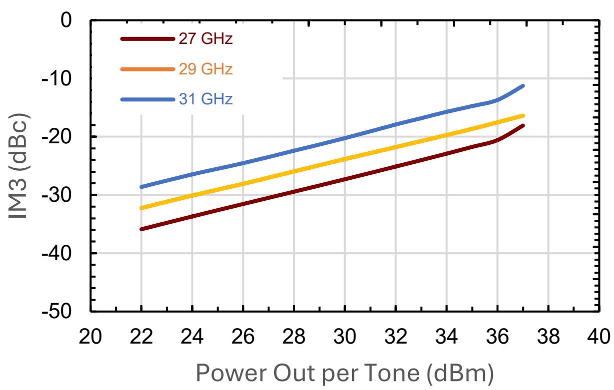
S22 vs. Frequency over I_{DQ}



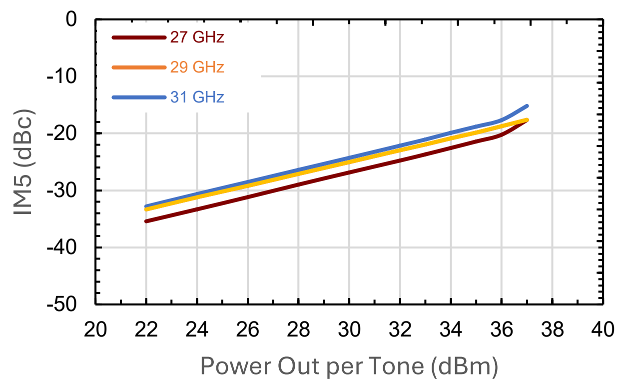
Typical Performance Curves – Linearity (IM3 and IM5):

V_D = 28 V, I_{DQ} = 300 mA, CW, Frequency = 29 GHz, Tone Spacing = 300 MHz, T_C = 25°C (unless otherwise stated)

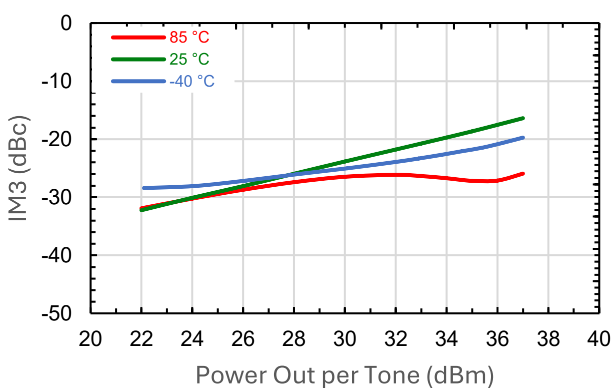
IM3 vs. P_{out}/Tone over Frequency



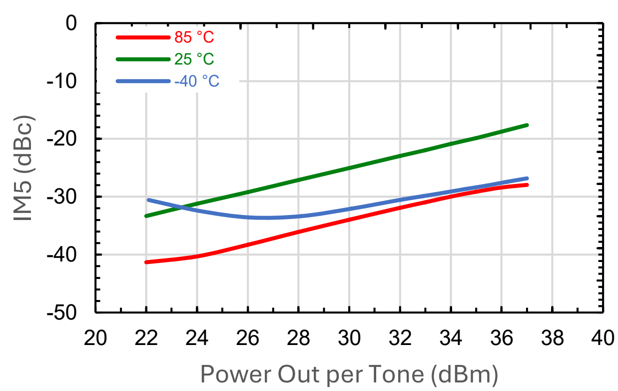
IM5 vs. P_{out}/Tone over Frequency



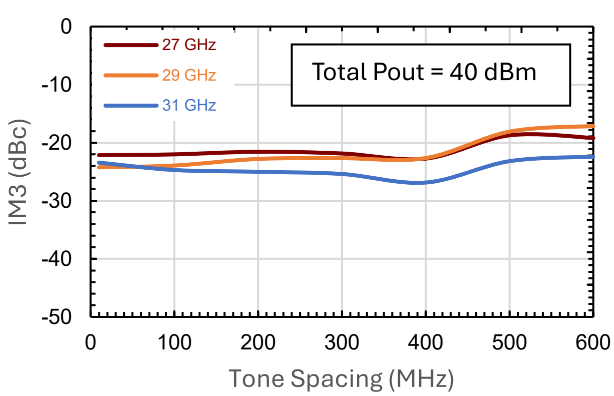
IM3 vs. P_{out}/Tone over Temperature



IM5 vs. P_{out}/Tone over Temperature



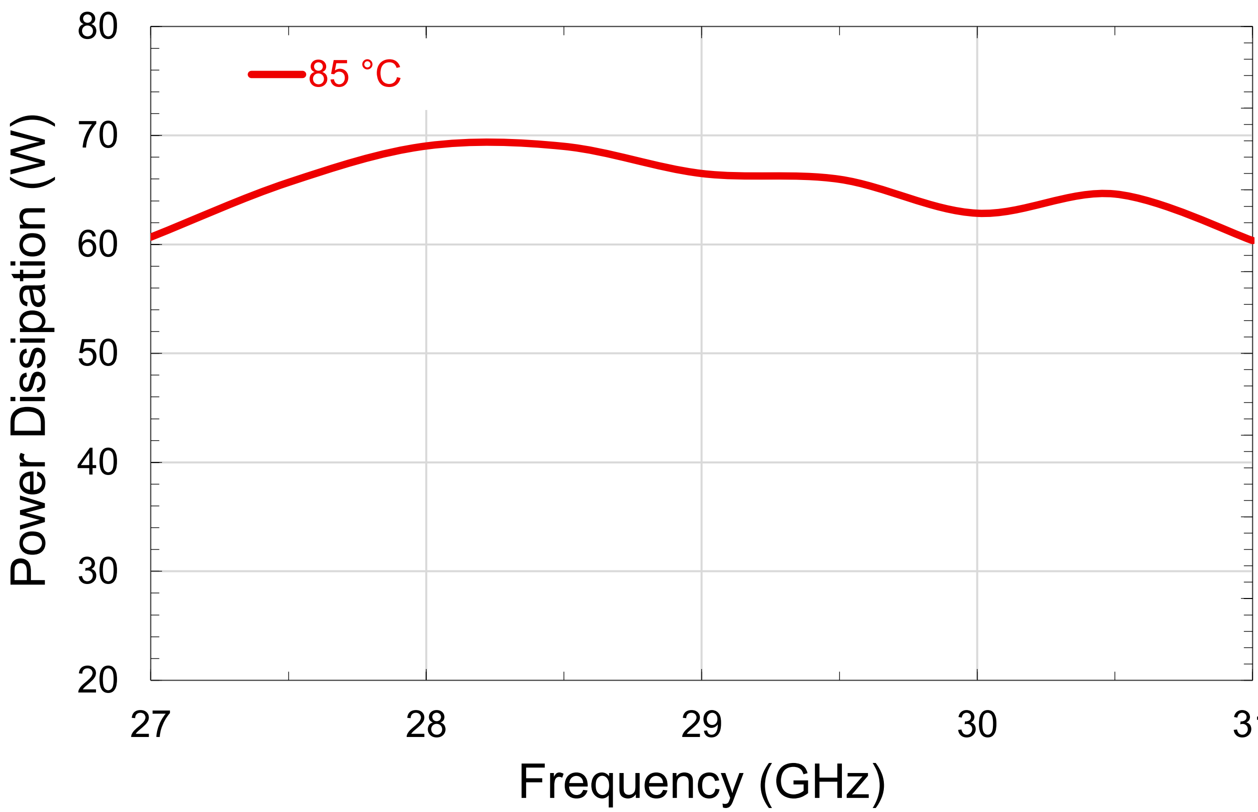
IM3 vs. Tone Spacing vs. Frequency



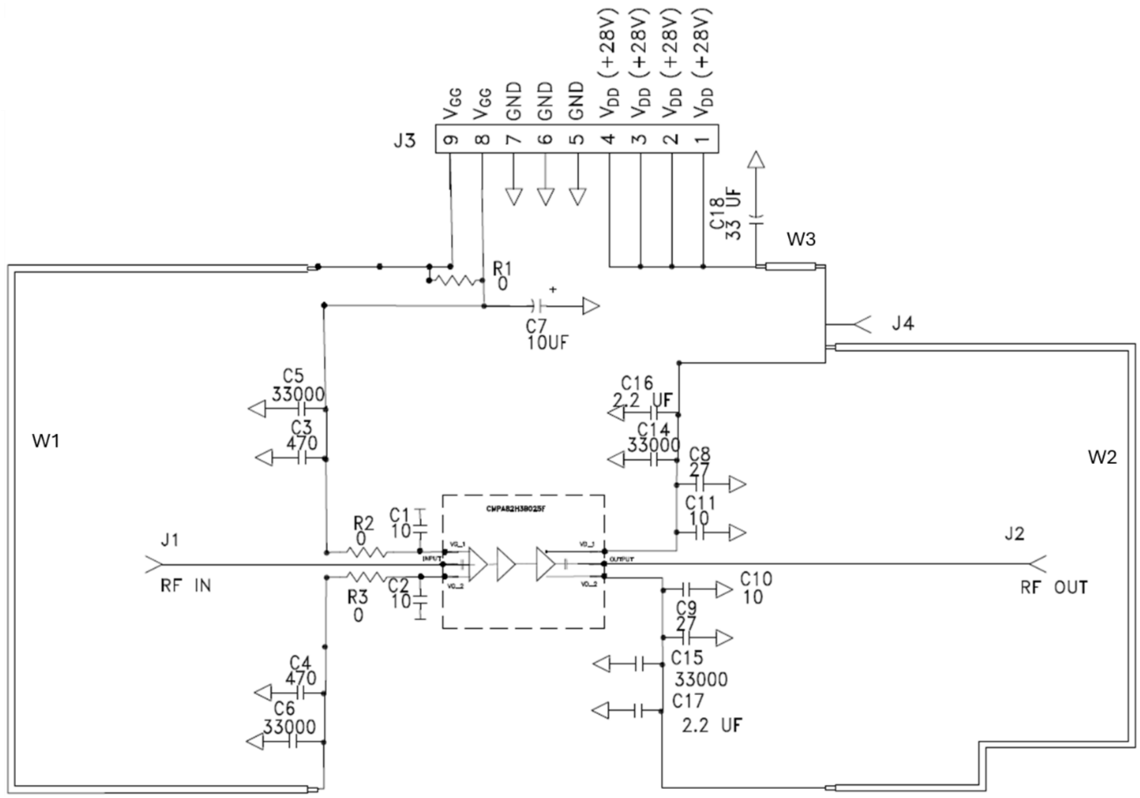
Thermal Characteristics

Parameter	Operating Conditions	Value
Operating Junction Temperature (T_J)	Freq = 29 GHz, V_D = 28 V, I_{DQ} = 300 mA, I_{DRIVE} = 3.3 A, P_{IN} = 25 dBm, P_{OUT} = 43.3 dBm, P_{DISS} = 66.5 W, T_{CASE} = 85°C, CW	197ºC
Thermal Resistance, Junction to Case ($R_{\theta JC}$)		1.68ºC/W

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



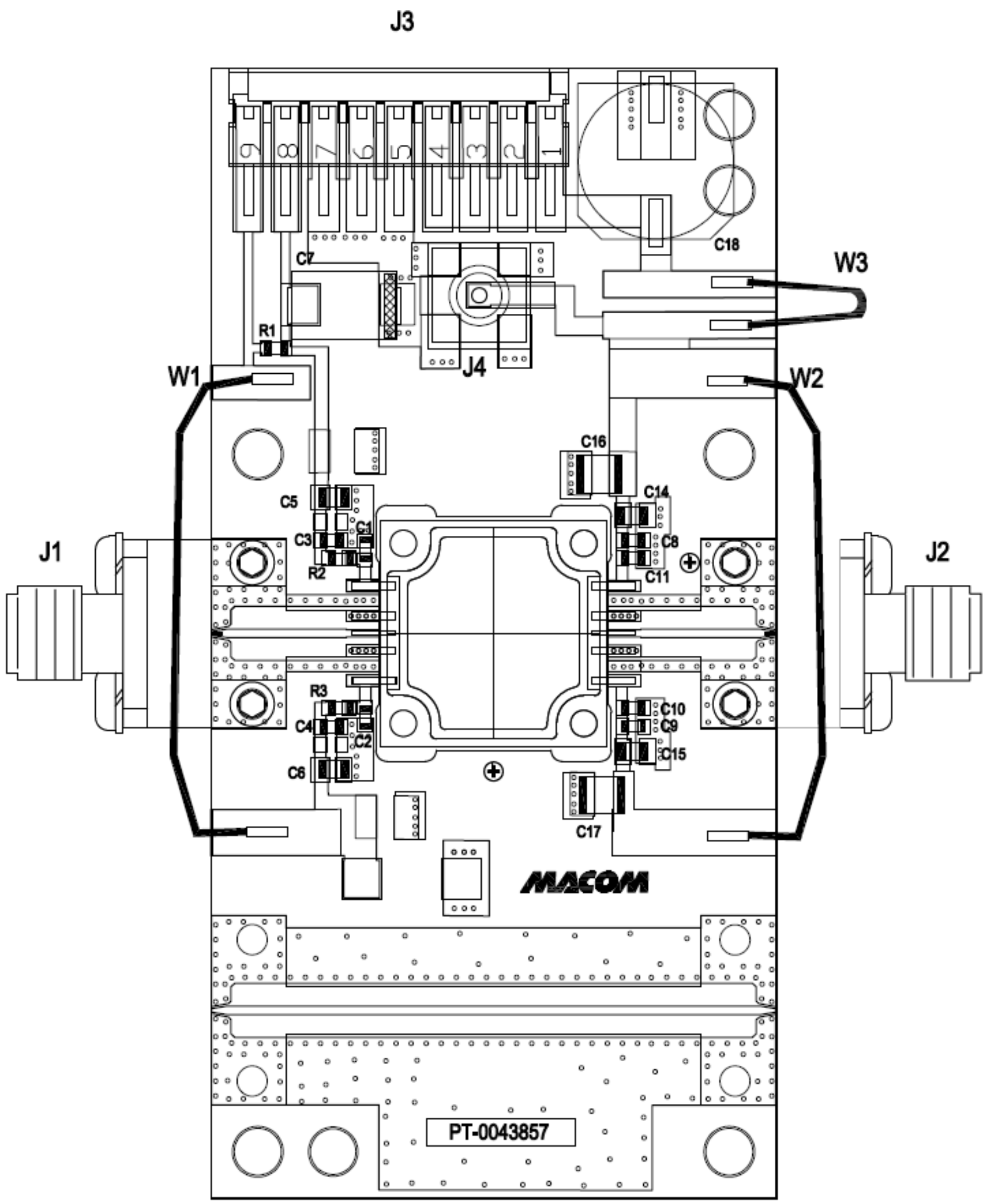
Evaluation Board Schematic (CMPA2H3B025F-AMP)



Parts List

Part	Value	Qty
R1, R2, R3	RES, 0.0 OHM, 5%, 0603 SMD	3
C18	CAP, 33uF, 20%, 50V, ELECTROLYTIC	1
C7	CAP, 10uF, 16V, TANTALUM, 2312	1
C16, C17	CAP, 2.2uF, +/-10%, 100V, 1210	2
C3, C4	CAP, 470pF, 5%, 100V, 0603	2
C8, C9	CAP, 27pF, 5%, 250V, 0603	2
C1, C2, C10, C11	CAP, 10pF, 5%, 250V, 0603	4
C5, C6, C14, C15	CAP, .033uF, 50V,0603	4
-	PCB, RO3003, .010 THK, HPHF Package	1
-	BASEPLATE 3.0x1.5x0.25Cu	1
J1, J2	CONN, SMA JACK (FEMALE) END LAUNCH CONNECTOR	2
J4	CONN, SMB, STRAIGHT JACK RECEPTACLE, SMT, 50 OHM, Au PLATED	1
J3	HEADER RT>PLZ .1CEN LK 9POS	1
W1, W2, W3	WIRE, BLACK, 22 AWG	3
U1	CMPA2H3B025F	1

Evaluation Board Assembly Drawing (CMPA2H3B025F-AMP)



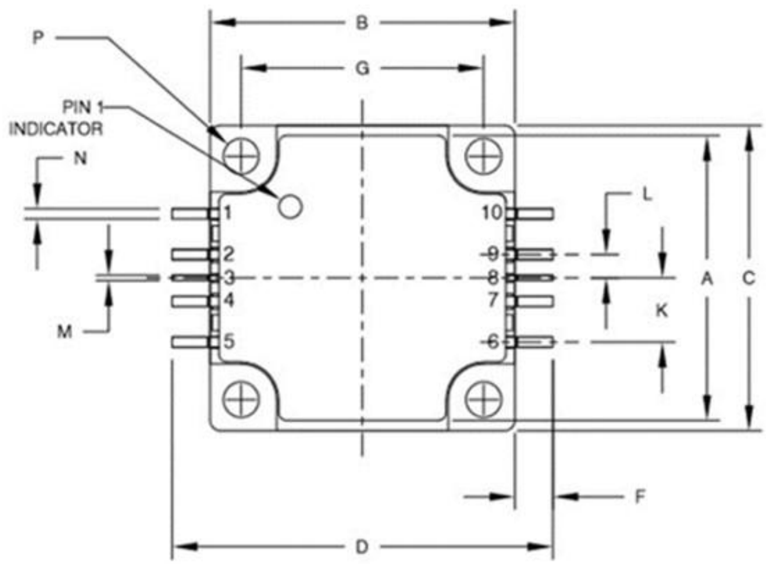
Bias On Sequence

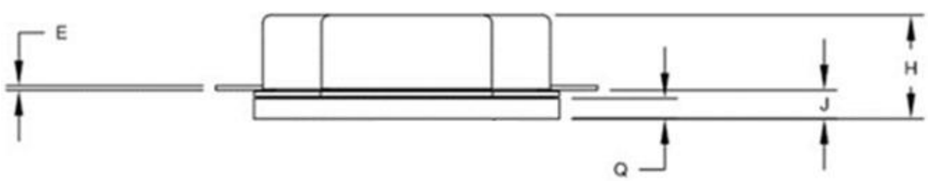
1. Ensure RF is turned-off
2. Apply pinch-off voltage of -5 V to the gate (V_G)
3. Apply nominal drain voltage (V_D)
4. Adjust Vg to obtain desired quiescent drain current (I_{DQ})
5. Apply RF

Bias Off Sequence

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

Mechanical Information

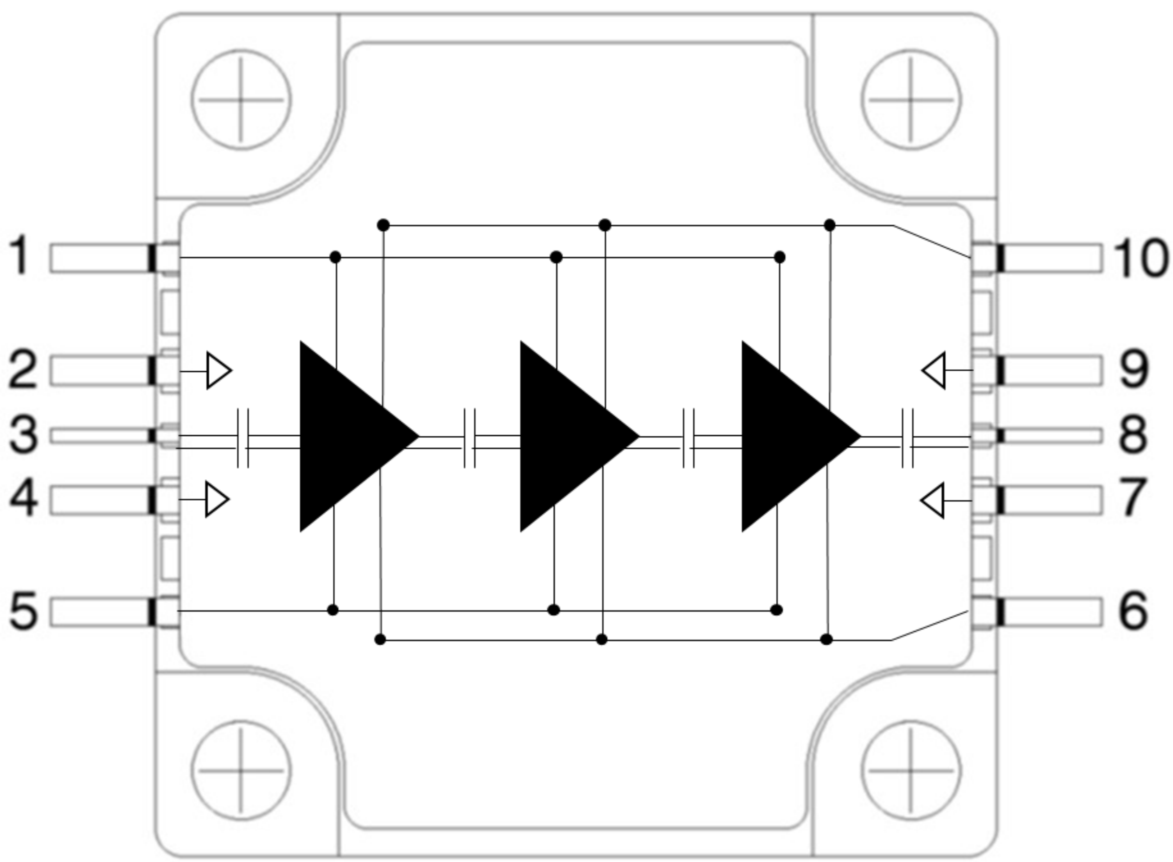




DIM	INCHES			MILLIMETERS		
	MIN	TYP	MAX	MIN	TYP	MAX
A	.555	.560	.565	14.10	14.22	14.35
B	.595	.600	.605	15.11	15.24	15.37
C	.595	.600	.605	15.11	15.24	15.37
D	-	(.750)	-	-	(19.05)	-
E	.006	.008	.010	0.15	0.20	0.25
F	.065	.075	.085	1.66	1.91	2.16
G	.473	.478	.483	12.01	12.14	12.27
H	.191	.203	.215	4.86	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, 5	VG	Pins 1 and 5 must be electrically connected to the gate bias voltage.
6, 10	VD	Pins 6 and 10 must be electrically connected to the drain bias voltage.
2, 4, 7, 9	GND	RF and DC ground.
3	RFIN	RF Input. 50-ohm matched. Internally DC blocked.
8	RFOUT	RF Output. 50-ohm matched. Internally DC blocked.
Base	GND	RF and DC ground.



Revision History

Rev	Date	Change Description
V1P	09/17/2024	Preliminary release
V1	12/19/2025	Production release