GaN High Power Amplifier, 25 W
27 - 31 GHz

CMPA2H3B025D
Rev. V1

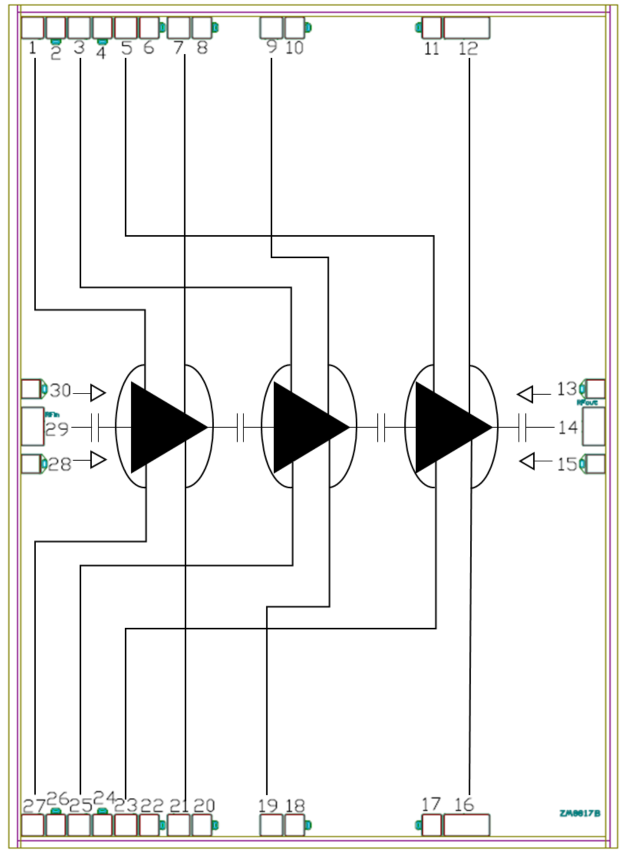
Features
- Saturated Power: 25 W
- Power Added Efficiency: 26%
- Large Signal Gain: 21 dB
- Small Signal Gain: 25 dB
- Input Return Loss: <-10 dB
- Output Return Loss: <-10 dB
- IM3: <-25 dBc @ 40 dBm Pout
- CW operation

Applications
- Ka-Band Satcom Uplink

Description
The CMPA2H3B025D is a 25 W, MMIC HPA utilizing MACOM's high performance, 0.15 µm GaN-on-SiC production process. This amplifier operates from 27 – 31 GHz and targets both defense and commercial satellite communications applications. Under saturation, this amplifier achieves 25 W of typical output power with 21 dB of large signal gain and > 25% power-added efficiency. Targeting an IM3 level of -25 dBc or better, this HPA delivers 10 W of output power with 26 dB of gain and 20% power-added efficiency.

The bare die solution provides peak performance while minimizing required board space.

Functional Schematic



Pin Configuration[1]

Pin #	Name
13, 15, 28, 30	GND
1, 27	VG1
3, 25	VG2
5, 23	VG3
7, 21	VD1
9, 19	VD2
12, 16	VD3
14	RF_{OUT}
29	RF_{IN}

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

Ordering Information

Part Number	Package (MOQ/ Mult)
CMPA2H3B025D	Gel Pack (10/10)
CMPA2H3B025D-AMP	Sample Board (1/1)

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} = 23 dBm	27 29 31	dBm	42.9 43.1 42.7	44.0 44.2 43.8	—
Power Added Efficiency	P_{IN} = 23 dBm	27 29 31	%	23 21 22	26 27 25	—
Large Signal Gain	P_{IN} = 23 dBm	27 29 31	dB	—	21.0 21.2 20.8	—
Small Signal Gain	P_{IN} = -20 dBm	27 29 31	dB	—	25.0 25.0 25.0	—
Input Return Loss	P_{IN} = -20 dBm	27-31	dB	—	-10	—
Output Return Loss	P_{IN} = -20 dBm	27-31	dB	—	-10	—
IM3	P_{OUT}/Tone = 37 dBm Tone/Spacing = 300 MHz	27 29 31	dBc	—	-25 -25 -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	—	23	—
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	—	+85

Absolute Maximum Ratings[2,3]

Parameter	Symbol	Unit	Min.	Max.
Input Power	P_{IN}	dBm	—	25
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	—	5.5
Gate Current	I_G	mA	—	10
Dissipated Power @ +85°	P_{DISS}	W	—	66
VSWR	—	Ratio	—	5:1
Junction Temperature (MTTF > 1E6 Hrs)	T_J	°C	—	+225°C
Storage Temperature	T_{STG}	°C	-65	+150
Mounting Temperature (30 seconds)	T_M	°C	—	+320

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:

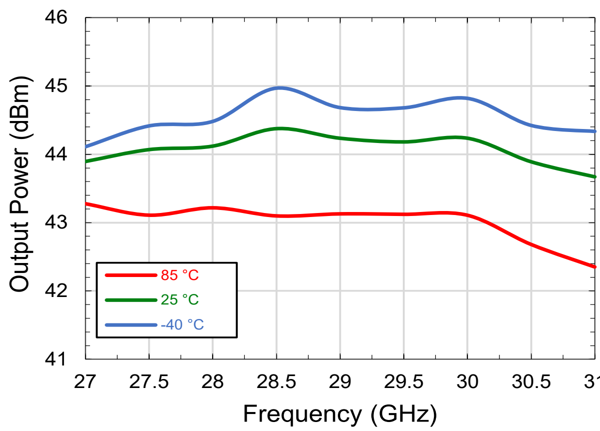
Static Sensitivity

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 devices.

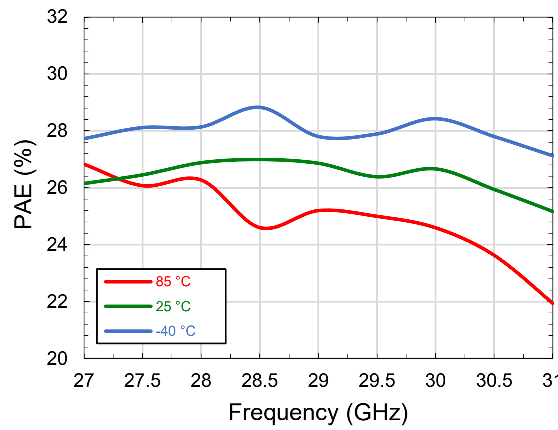
Typical Performance Curves - Large Signal over Temperature:

V_D = 28 V, I_{DQ} = 300 mA, CW, P_{IN} = 23 dBm

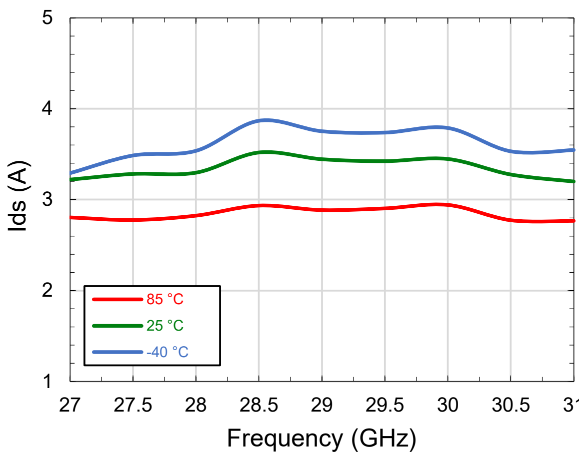
Output Power vs. Frequency



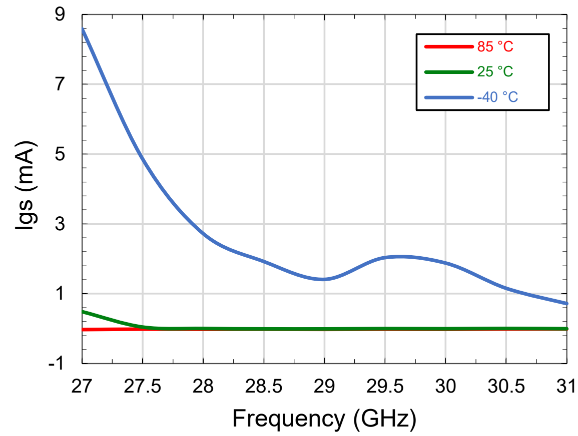
Power Added Efficiency vs. Frequency



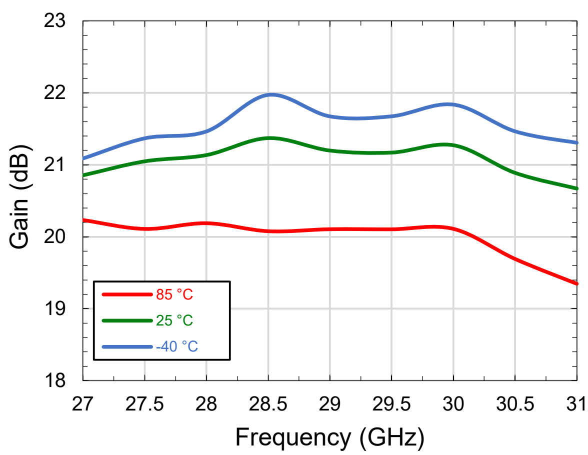
Drain Current vs. Frequency



Gate Current vs. Frequency



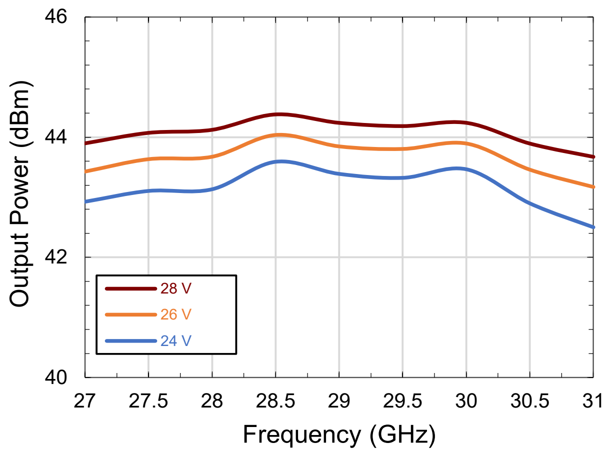
Large Signal Gain vs. Frequency



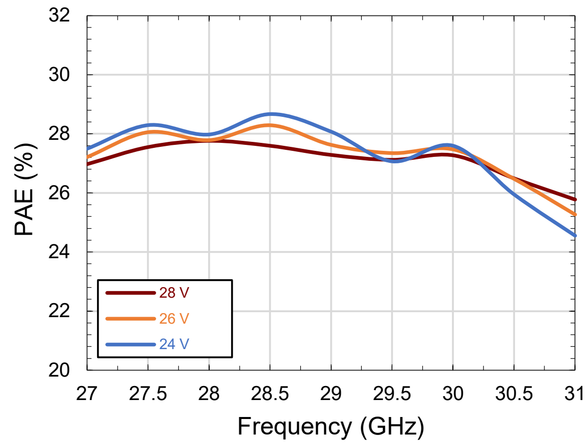
Typical Performance Curves - Large Signal over V_D:

I_{DQ} = 300 mA, CW, P_{IN} = 23 dBm, T_C = 25°C

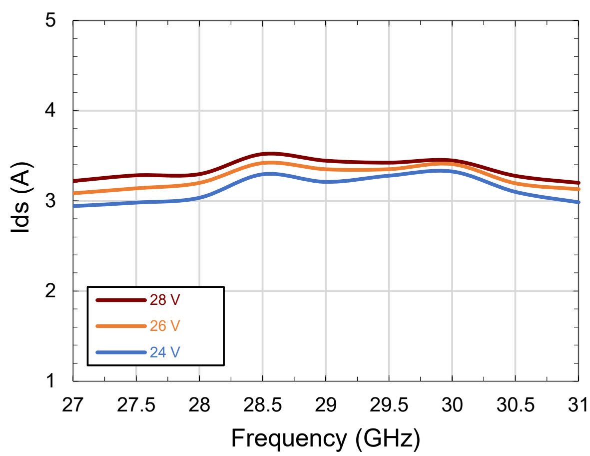
Output Power vs. Frequency



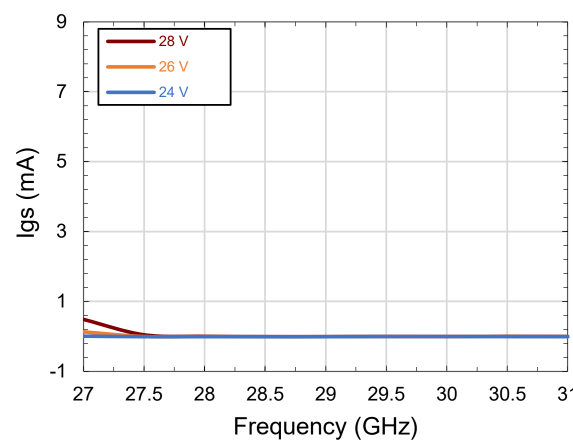
Power Added Efficiency vs. Frequency



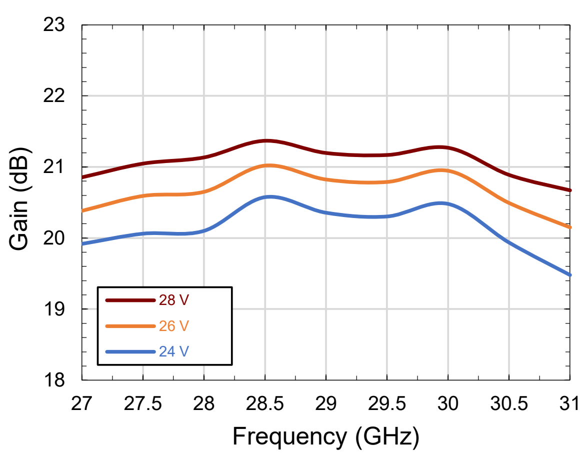
Drain Current vs. Frequency



Gate Current vs. Frequency



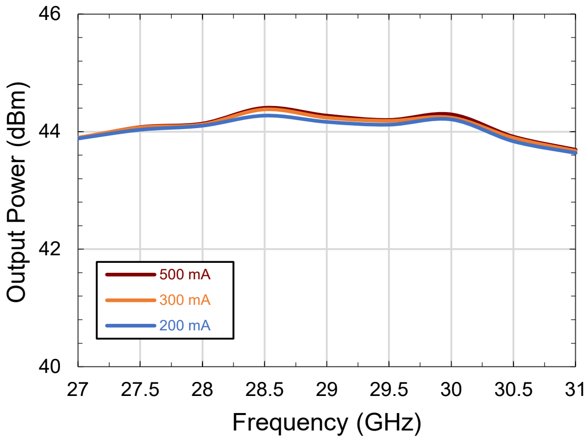
Large Signal Gain vs. Frequency



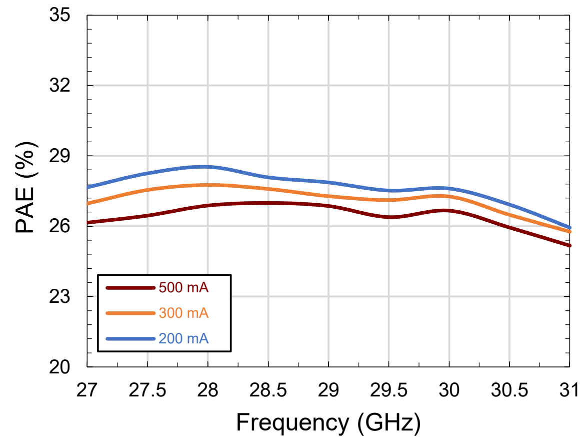
Typical Performance Curves - Large Signal over I_{DQ}:

V_D = 28 V, CW, P_{IN} = 23 dBm, T_C = 25°C

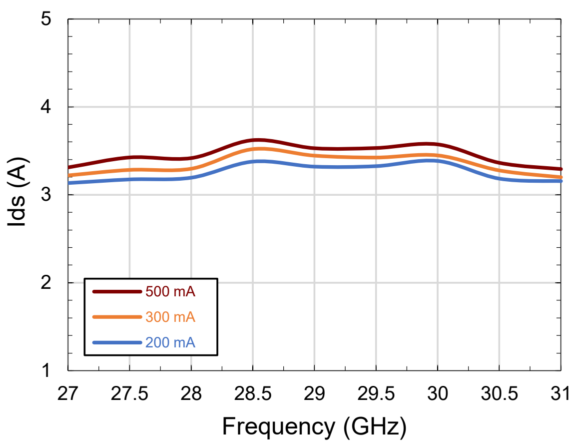
Output Power vs. Frequency



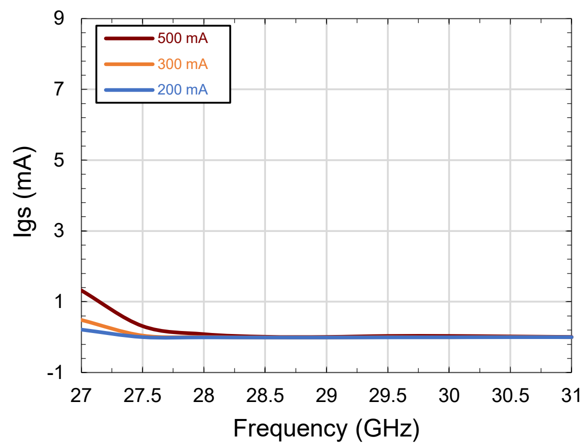
Power Added Efficiency vs. Frequency



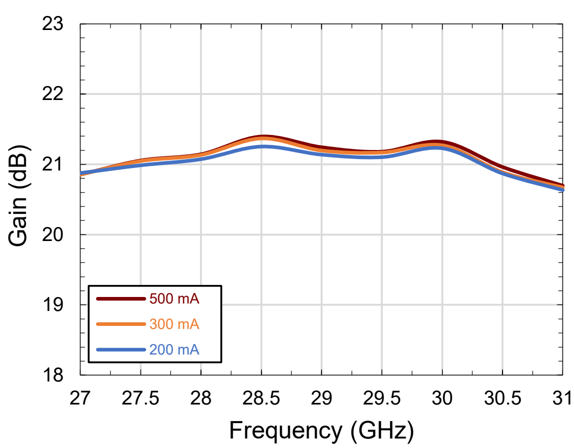
Drain Current vs. Frequency



Gate Current vs. Frequency



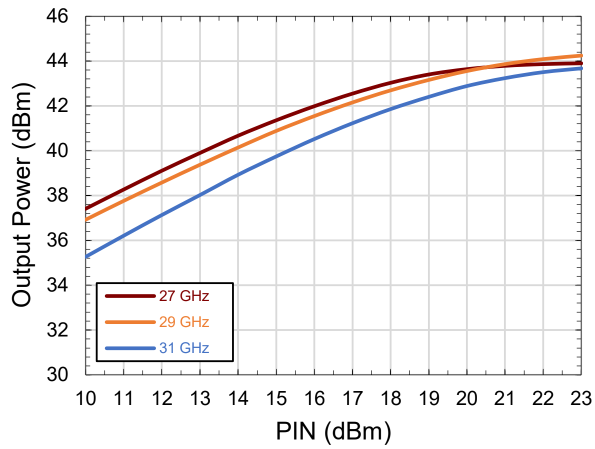
Large Signal Gain vs. Frequency



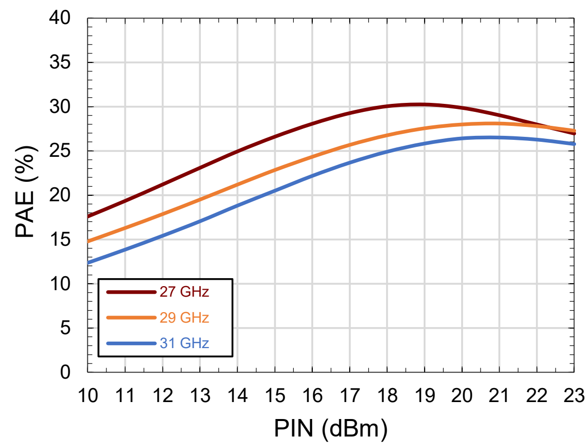
Typical Performance Curves - Drive-Up over Frequency:

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

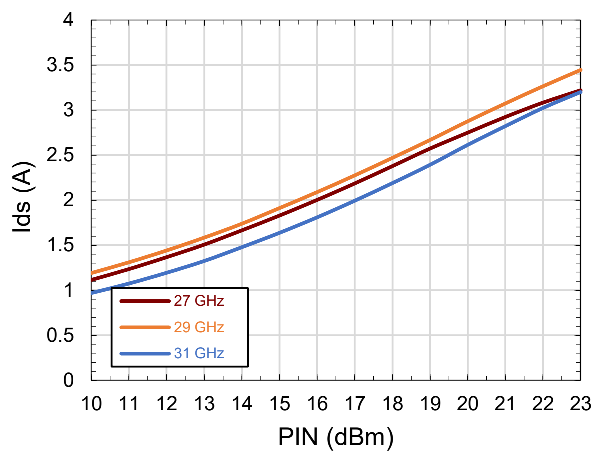
Output Power vs. Input Power



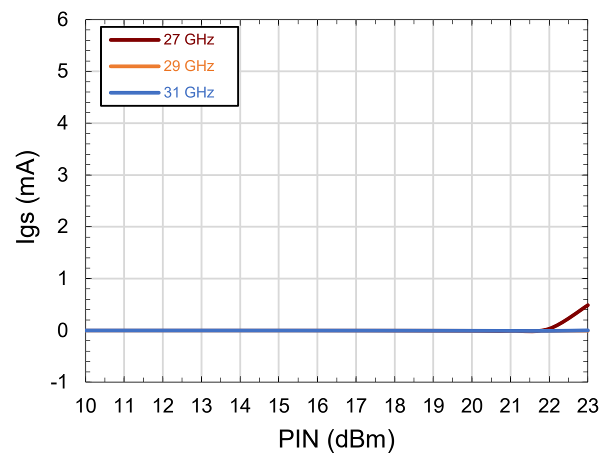
Power Added Efficiency vs. Input Power



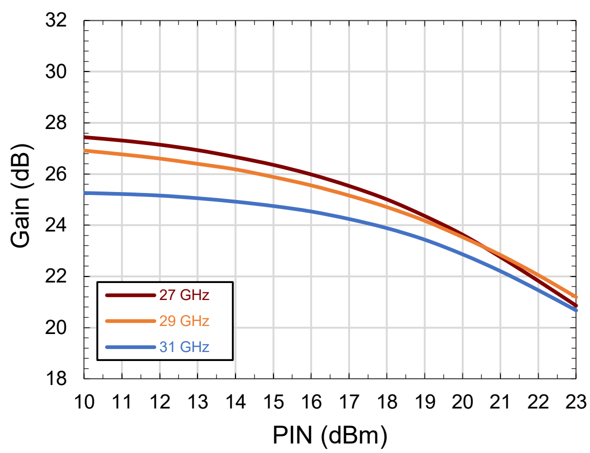
Drain Current vs. Input Power



Gate Current vs. Input Power



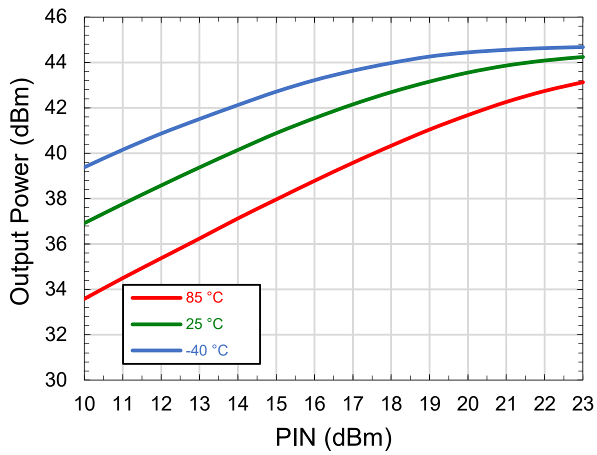
Gain vs. Input Power



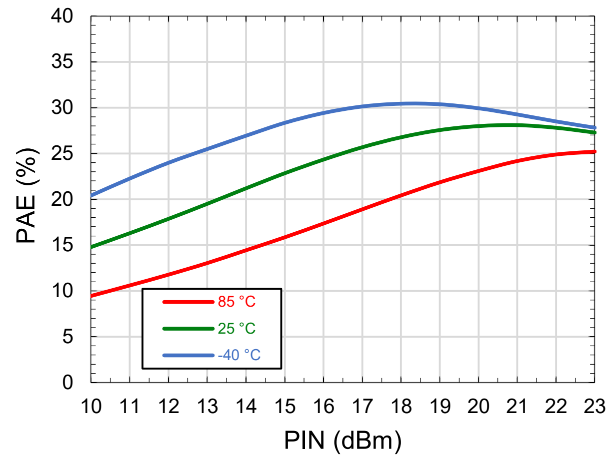
Typical Performance Curves - Drive-Up over Temperature:

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

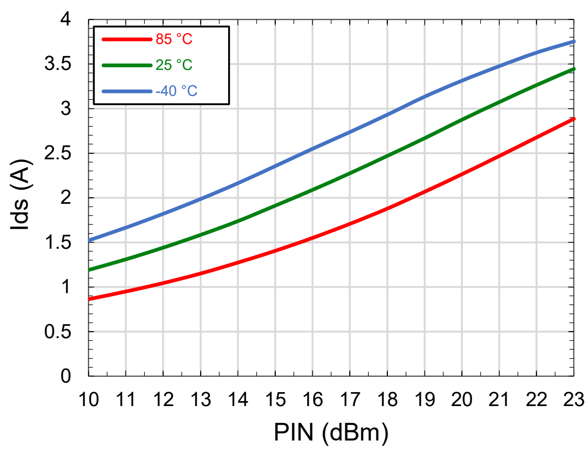
Output Power vs. Input Power



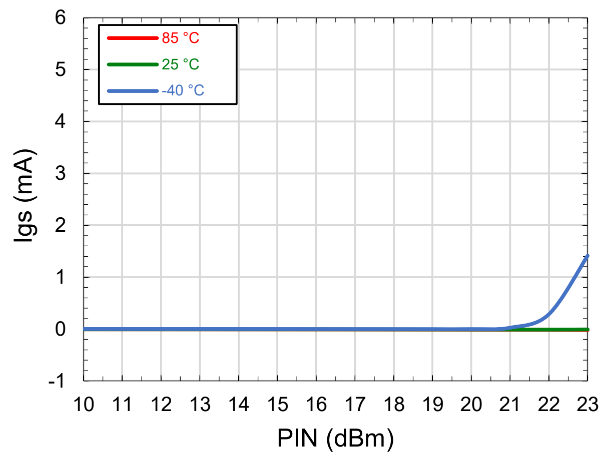
Power Added Efficiency vs. Input Power



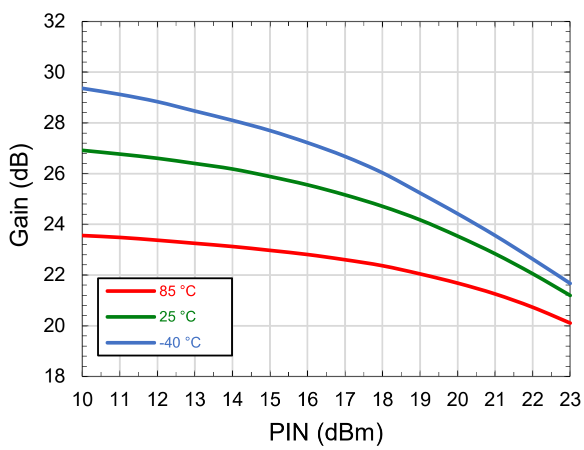
Drain Current vs. Input Power



Gate Current vs. Input Power



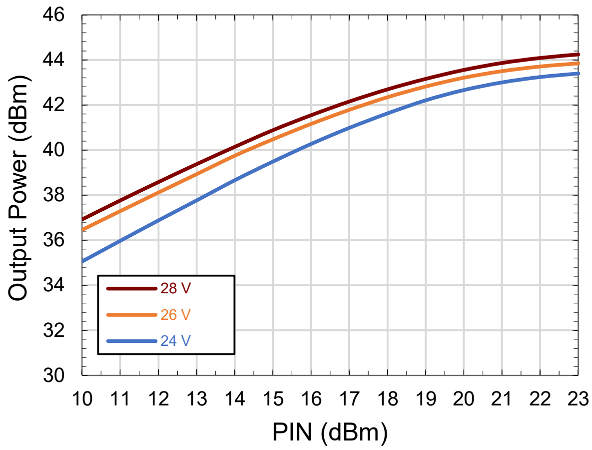
Gain vs. Input Power



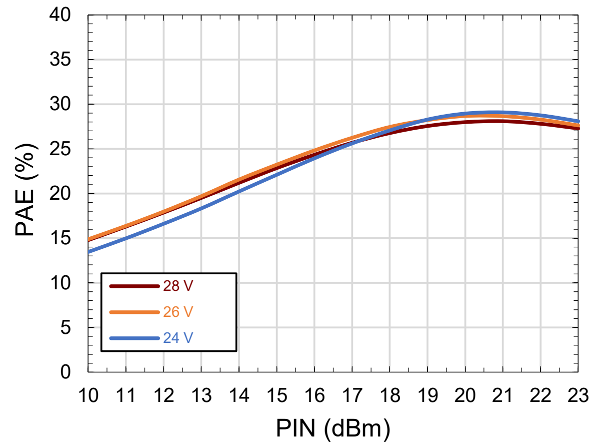
Typical Performance Curves - Drive-Up over V_D:

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

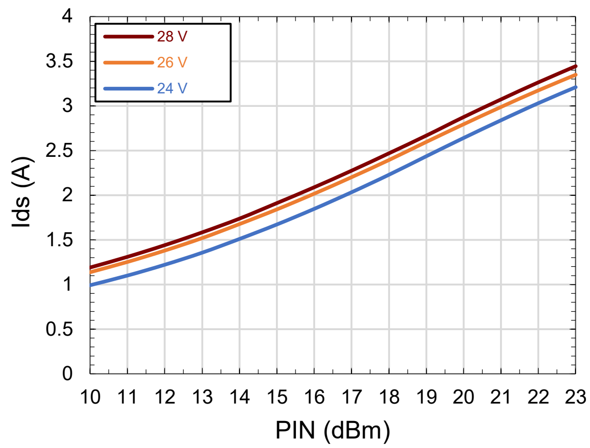
Output Power vs. Input Power



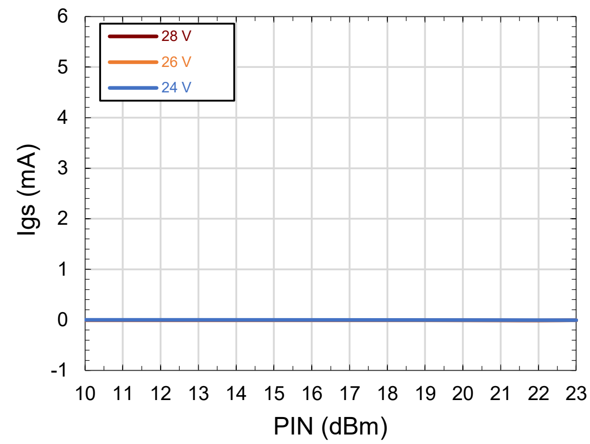
Power Added Efficiency vs. Input Power



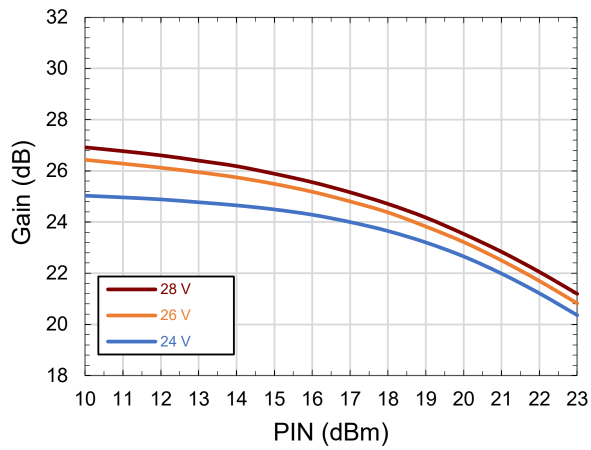
Drain Current vs. Input Power



Gate Current vs. Input Power



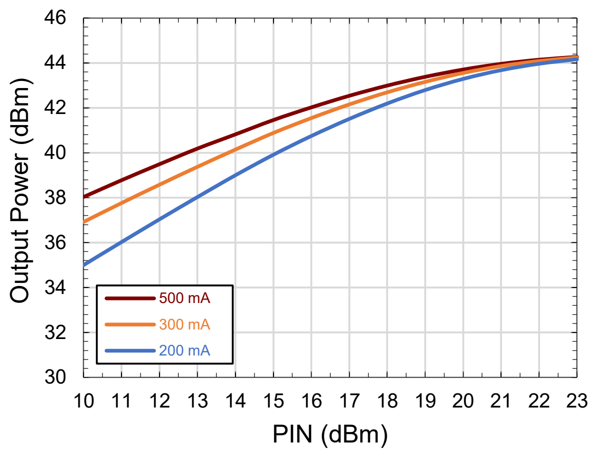
Gain vs. Input Power



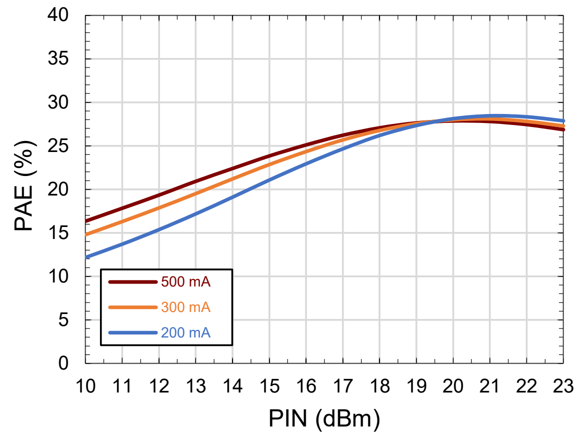
Typical Performance Curves - Drive-Up over I_{DQ}:

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

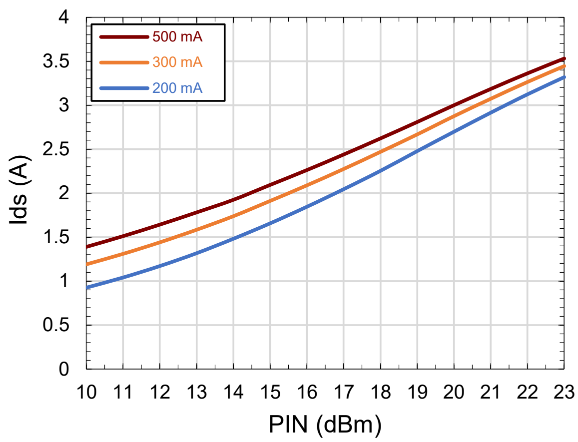
Output Power vs. Input Power



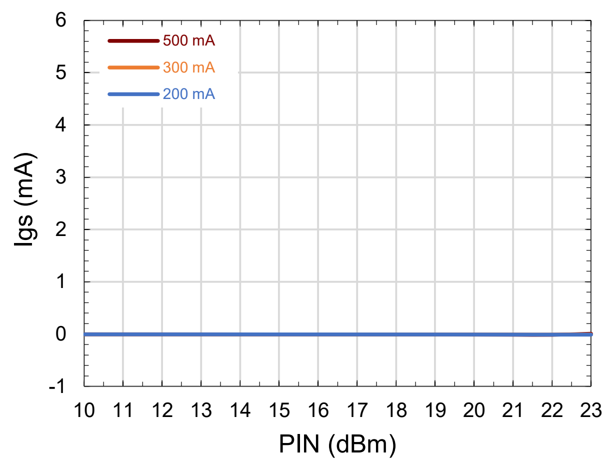
Power Added Efficiency vs. Input Power



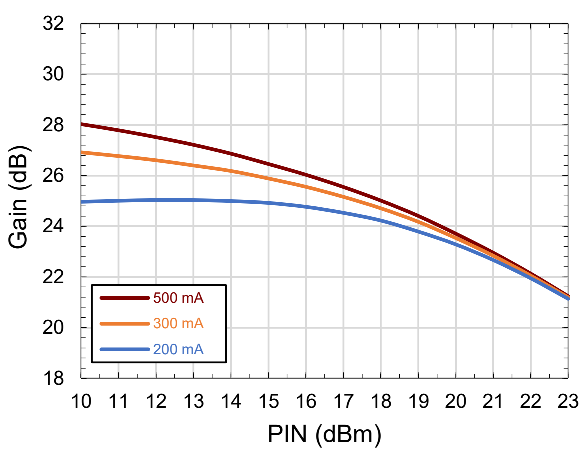
Drain Current vs. Input Power



Gate Current vs. Input Power



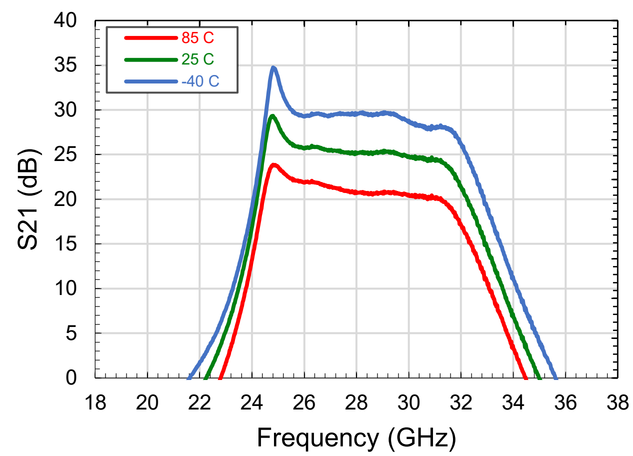
Large Signal Gain vs. Input Power



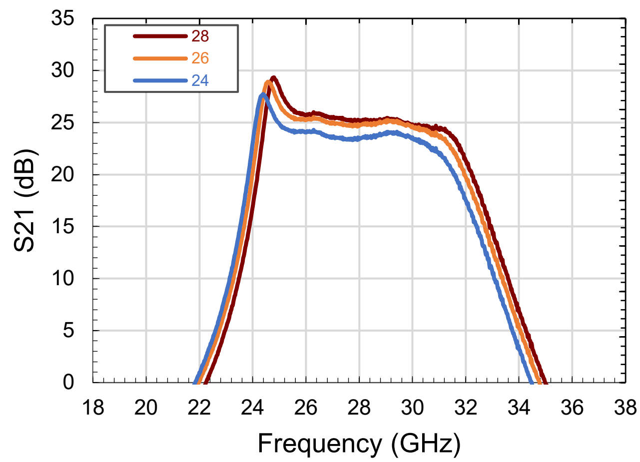
Typical Performance Curves - Small Signal over Temperature and V_D:

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

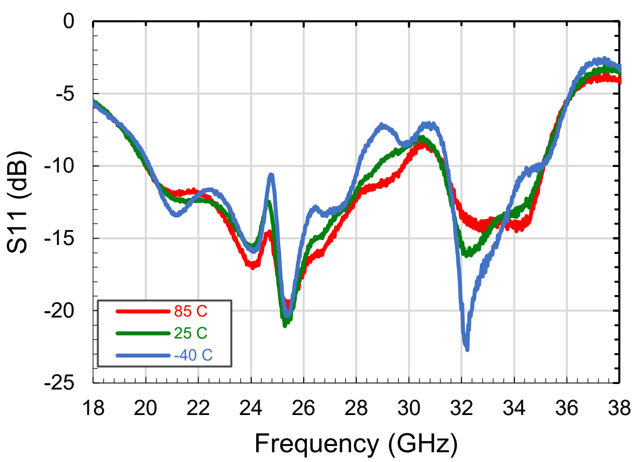
S21 vs. Frequency over Temperature @ V_D = 28 V



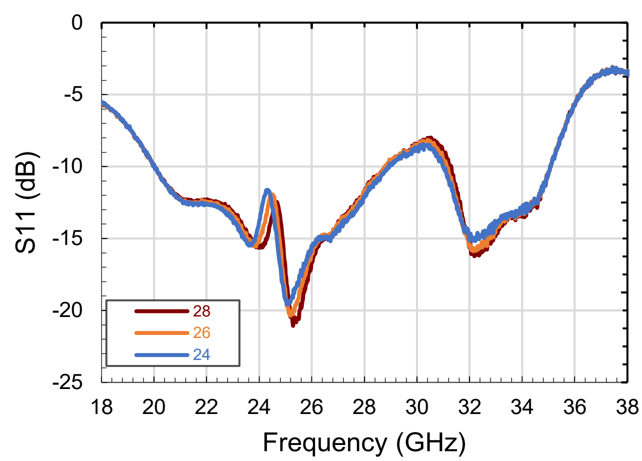
S21 vs. Frequency over V_D @ 25°C



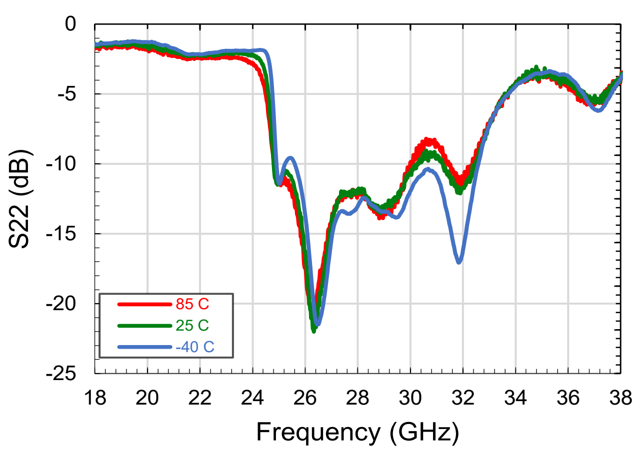
S11 vs. Frequency over Temperature @ V_D = 28 V



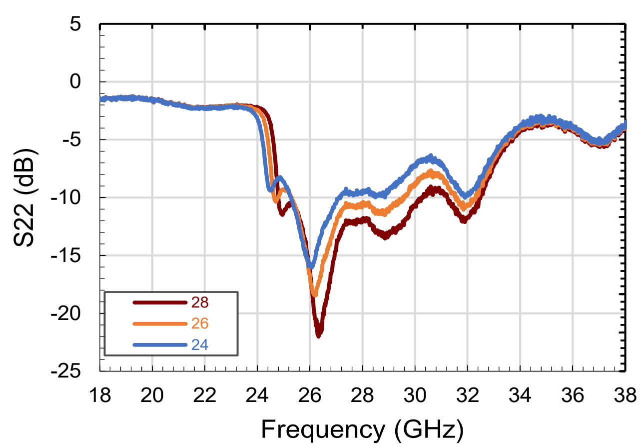
S11 vs. Frequency over V_D @ 25°C



S22 vs. Frequency over Temperature @ V_D = 28 V



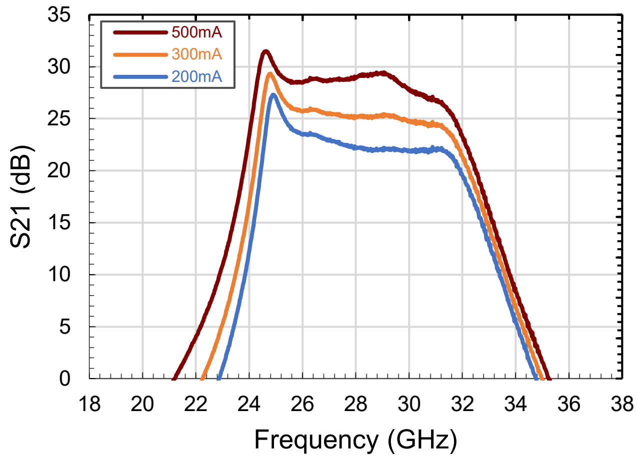
S22 vs. Frequency over V_D @ 25°C



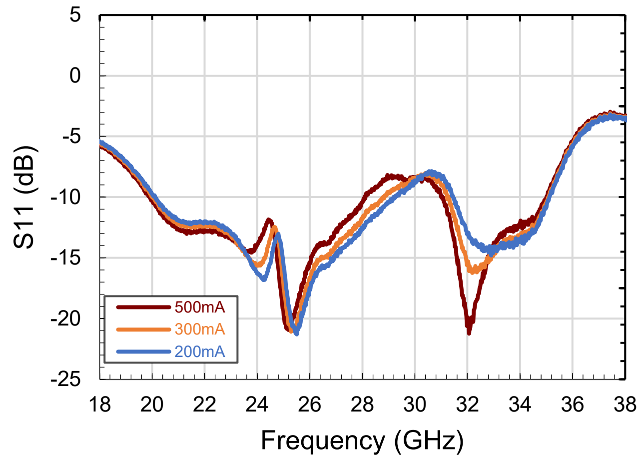
Typical Performance Curves - Small Signal over I_{DQ}:

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

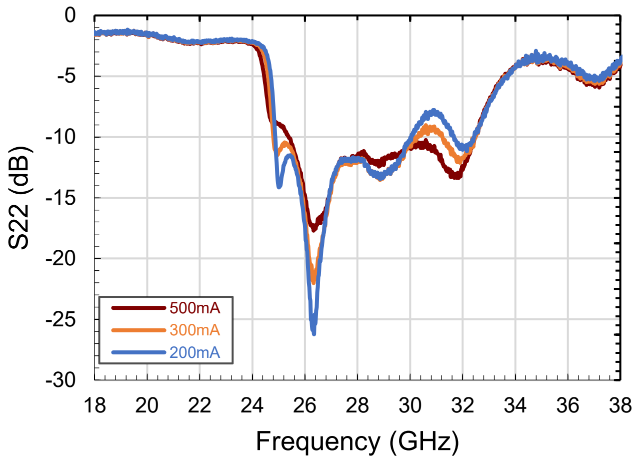
S21 vs. Frequency over I_{DQ}



S11 vs. Frequency over I_{DQ}



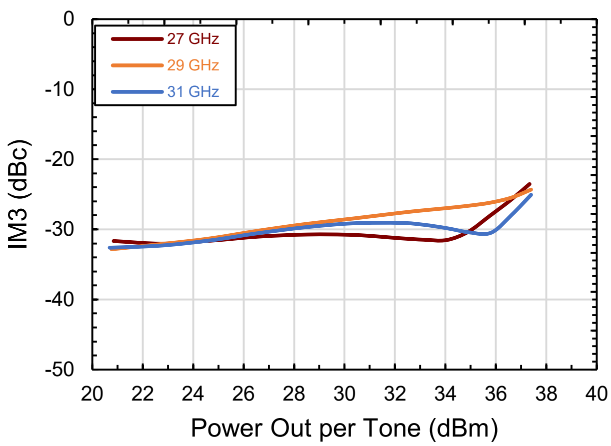
S22 vs. Frequency over I_{DQ}



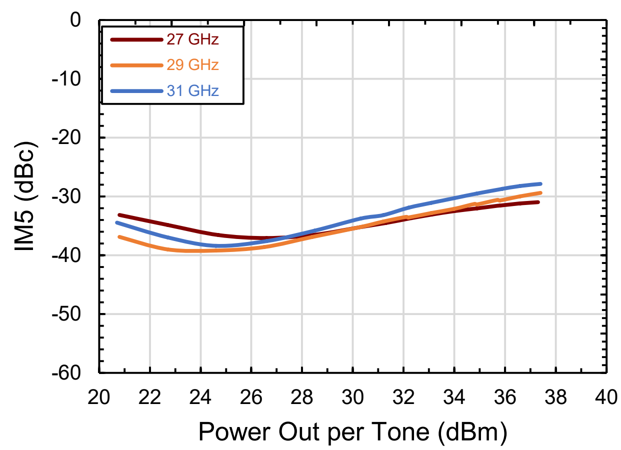
Typical Performance Curves - Linearity (IM3 and IM5)

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

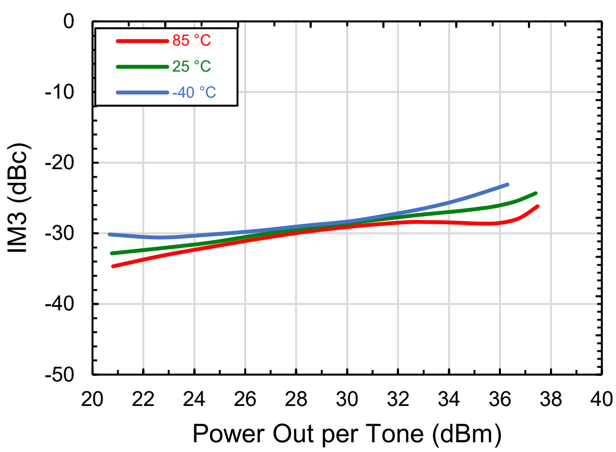
IM3 v. Output Power/Tone v. Frequency



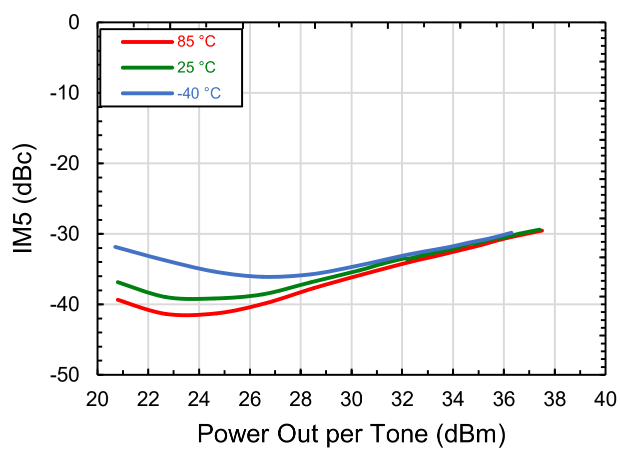
IM5 v. Output Power/Tone v. Frequency



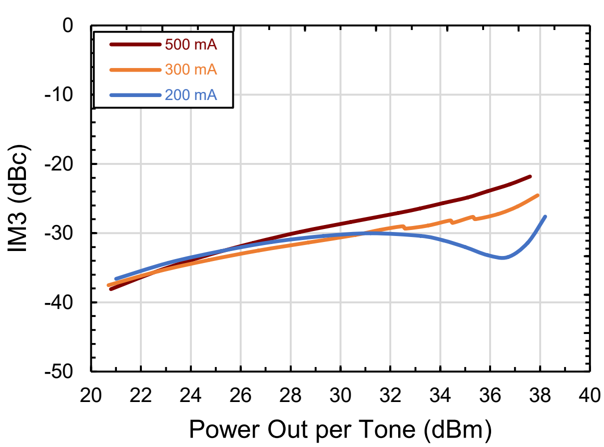
IM3 v. Output Power/Tone v. Temperature



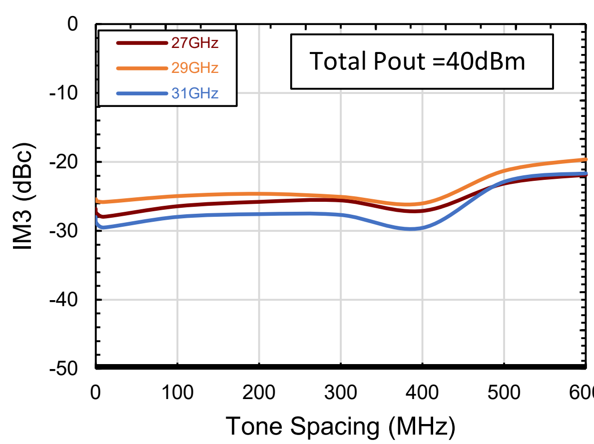
IM5 v. Output Power/Tone v. Temperature



IM3 v. Output Power/Tone v. I_{DQ}



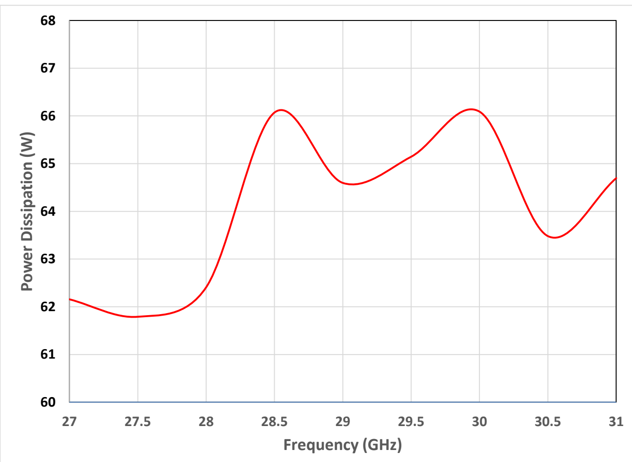
IM3 v. Tone Spacing v. Frequency



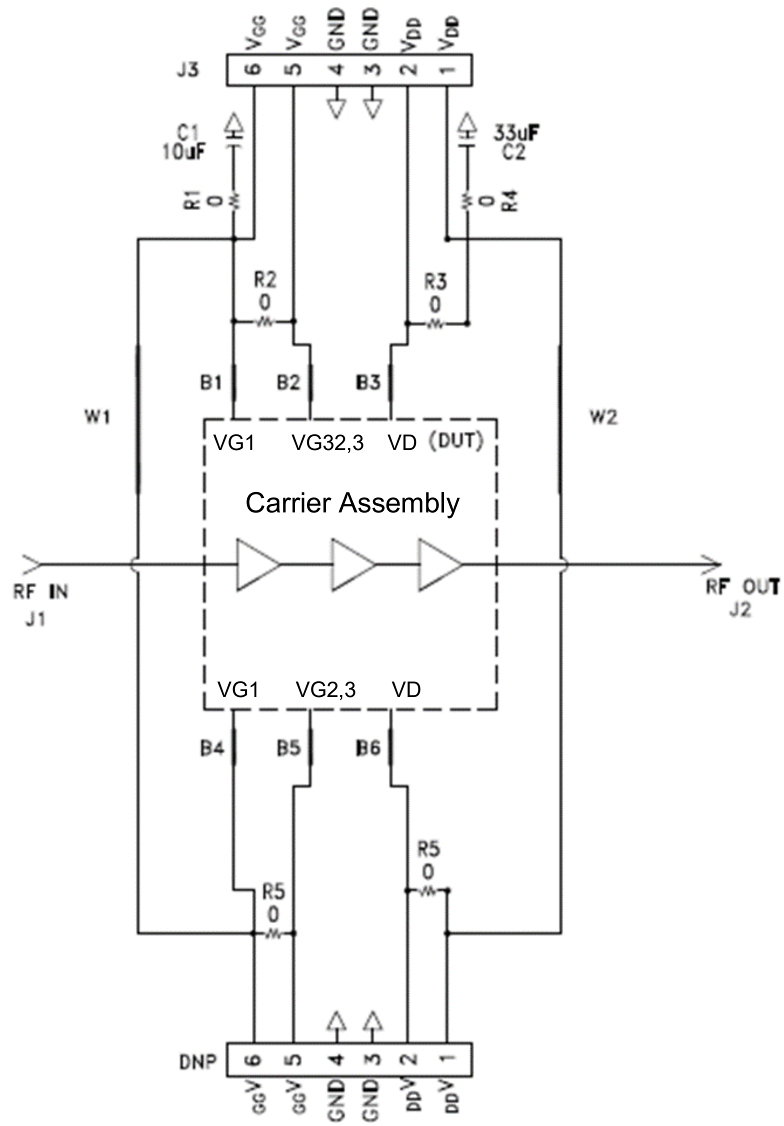
Thermal Characteristics

Parameter	Operating Conditions	Value
Operating Junction Temperature (T_J)	Freq = 29 GHz, V_D = 28 V, I_{DQ} = 300 mA, I_{DRIVE} = 3.1 A , P_{IN} = 24 dBm, P_{OUT} = 43 dBm, P_{DISS} = 65 W, T_{CASE} = 85°C, CW	170ºC
Thermal Resistance, Junction to Case ($R_{θJC}$)		1.31ºC/W

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



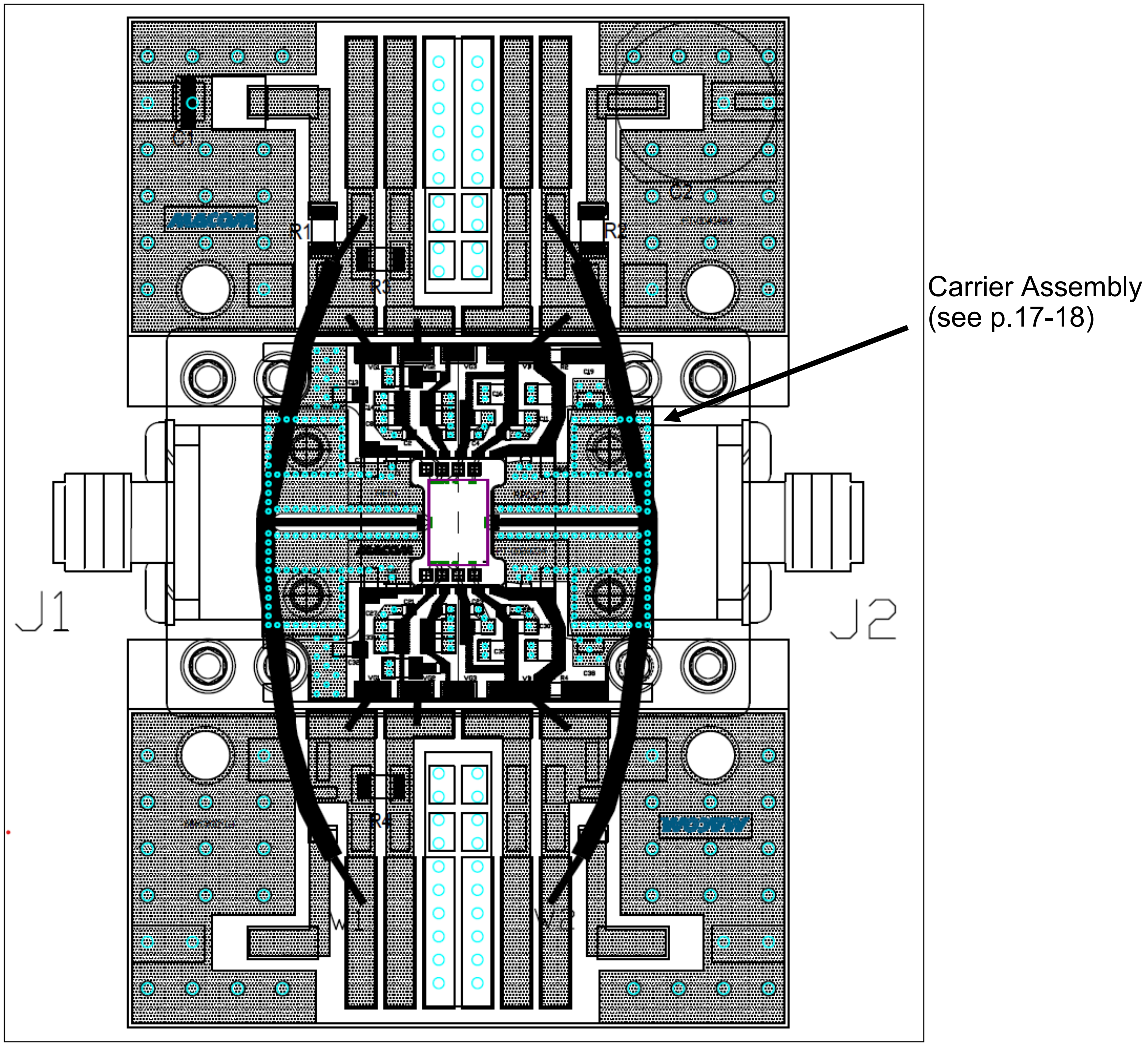
Evaluation Board Schematic (CMPA2H3B025D-AMP)



Parts List

Part	Value	Qty.
C1	10 µF Tantalum Capacitor	1
C2	33 µF Electrolytic Capacitor	1
B1-B6	Jumper Wire	6
W1, W2	WIRE, BLACK, 22 AWG (~2“)	2
J1, J2	SMA Female End Launch RF Connector, .007” Pin, .048” Coax	2
J3	6-Pin DC Header, Right Angle	1
R1-R6	0 Ohm Resistors, 1206	6

Evaluation Board Assembly Drawing (CMPA2H3B025D-AMP)



Note: Gate and drain should be biased on both sides of the die in order to achieve optimum video bandwidth performance.

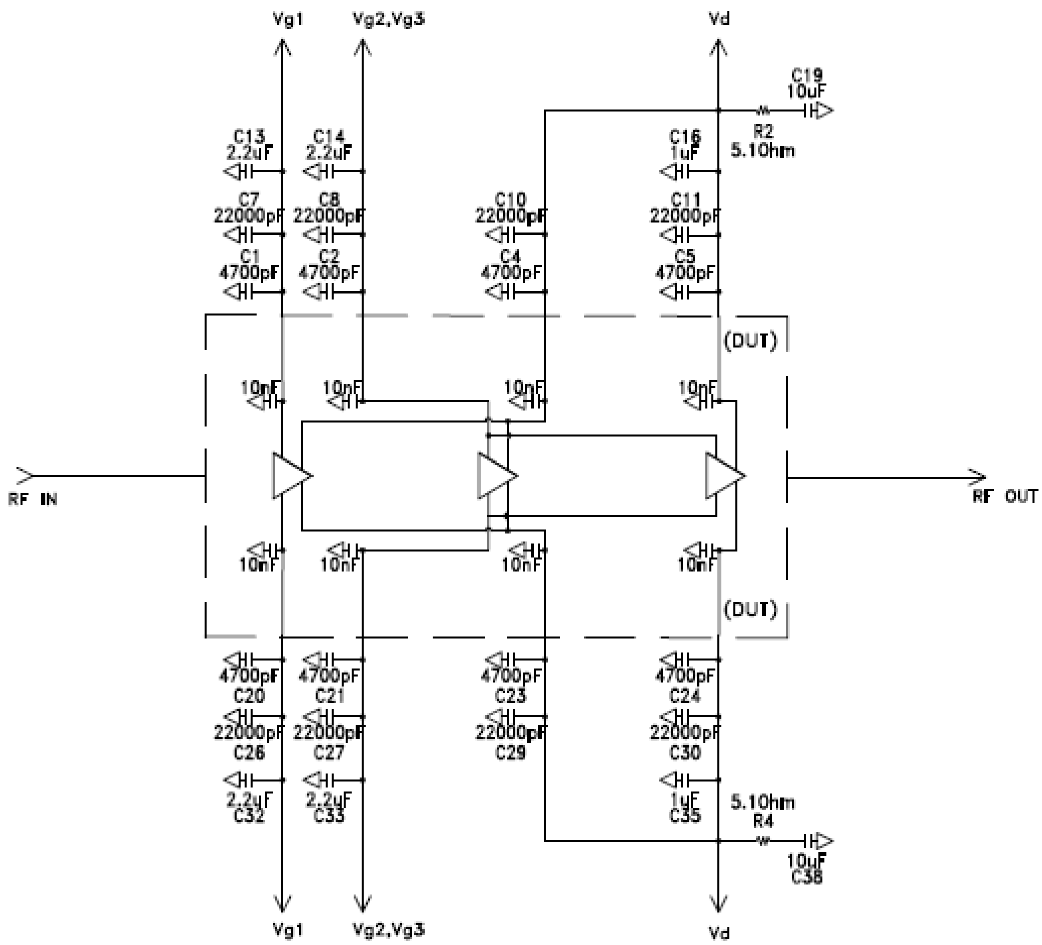
Bias On Sequence

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)

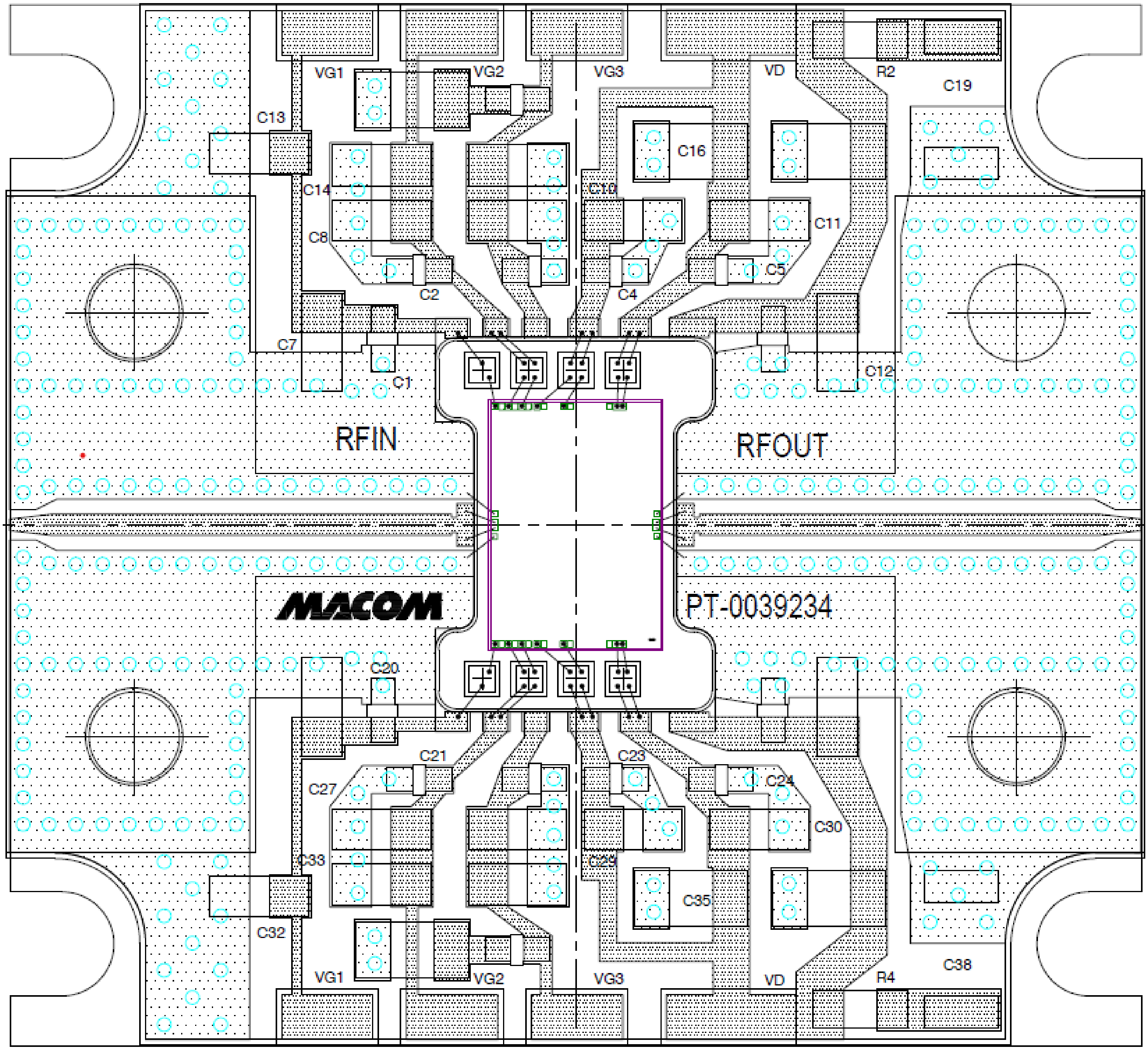
Carrier Schematic Drawing (CMPA2H3B025D-AMP)



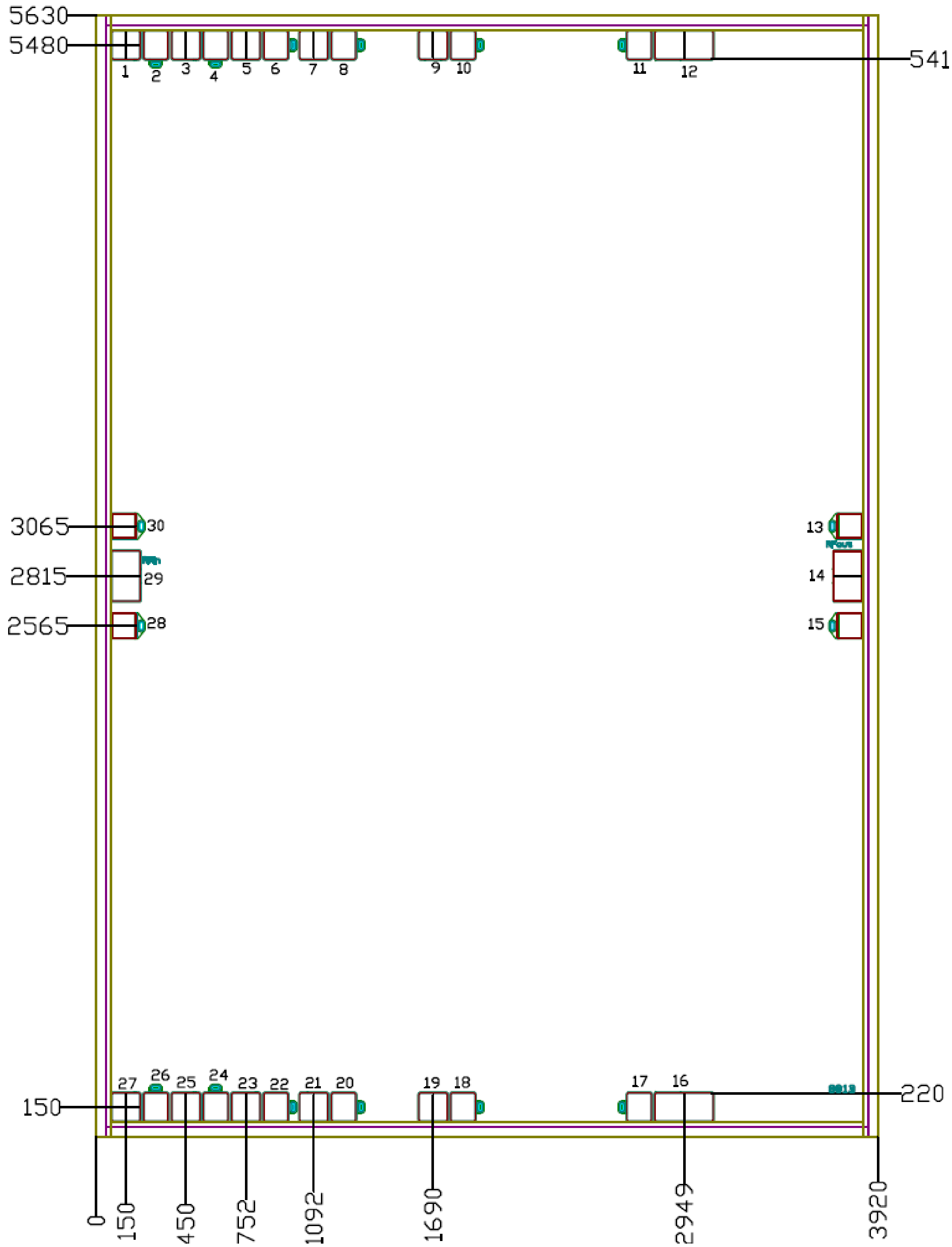
Parts List

Part	Value	Qty.
C1, 2, 4, 5, 20, 21, 23, 24	CAPACITOR, 0402, 4700 pF, 50V	8
C7, 8, 10, 11, 26, 27, 29, 30	CAPACITOR, 0603, 0.022 µF, 50V	8
C13, C14, C32, C33	CAPACITOR, 0603, 2.2 µF, 50V	4
C19, C38	CAPACITOR, 1206, 10 µF, 50V	2
C41-C48	CAPACITOR, Single Layer 0303, 10 nF, 100V	8
C16, C35	CAPACITOR, 0805, 1 µF, 50V	2
R2, R4	RESISTOR, 0603, 5.1 Ω	2

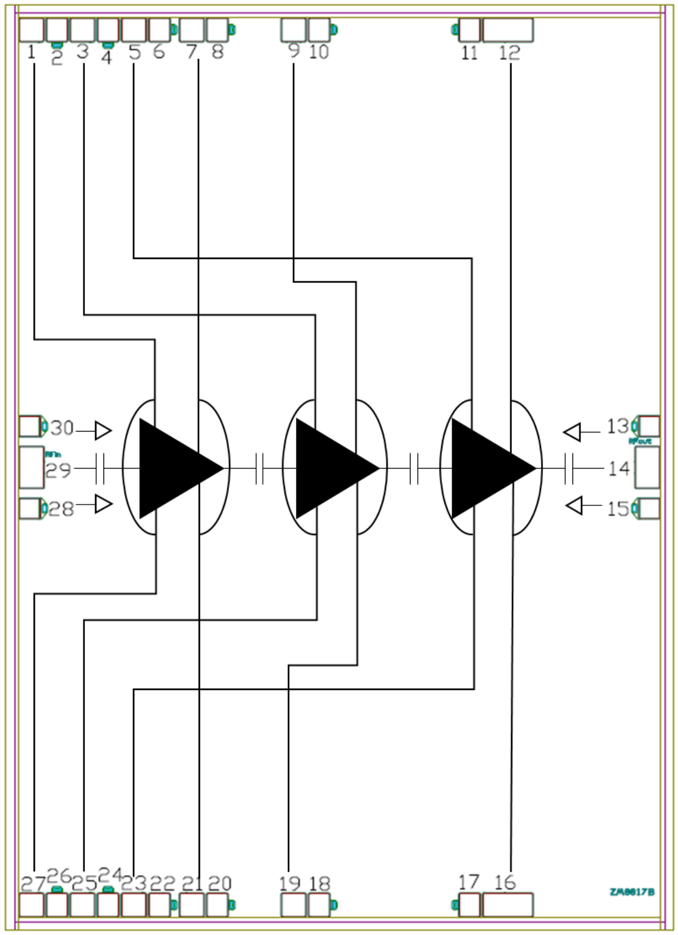
Carrier Assembly Drawing (CMPA2H3B025D-AMP)



Mechanical Information



Notes
1) Die size: 3920 µm x 5630 µm (+0/-50 µm)
2) Die thickness: 75 µm (+/- 10 µm)
3) Unless otherwise specified, all dimensions shown are µm with a tolerance of +/- 5 µm.



Pin Description

Pin #	Name	Description	Pad Size (µm)
2,4,6,8,10,11,13,15,17, 18,20,22,24,26,28,30	GND	RF and DC ground.	120 x 140
1, 27	VG1	Gate bias for stage 1. Both pins must be connected.	140 x 140
3, 25	VG2	Gate bias for stage 2. Both pins must be connected.	140 x 140
5, 23	VG3	Gate bias for stage 3. Both pins must be connected.	140 x 140
7, 21	VD1	Drain bias for stage 1. Both pins must be connected.	140 x 140
9, 19	VD2	Drain bias for stage 2. Both pins must be connected.	140 x 140
12, 16	VD3	Drain bias for stage 3. Both pins must be connected.	140 x 290
14	RF_{OUT}	RF Output. 50-ohm matched. Internally DC blocked.	140 x 240
29	RF_{IN}	RF Input. 50-ohm matched. Internally DC blocked.	140 x 240
MMIC backside	GND	RF and DC ground.	NA

Revision History

Rev	Date	Change Description
V1	06/242025	Production release.