GaN High Power Amplifier, 60 W
17.3 - 18.4 GHz

CMPA1H1J050F
Rev. V1

Features

- Saturated Power: 60 W
- Power Added Efficiency: 30 %
- Large Signal Gain: 25 dB
- Small Signal Gain: 30 dB
- Input Return Loss: -10 dB
- Output Return Loss: -6 dB
- CW operation

Applications

- Direct Broadcast Satcom

Description

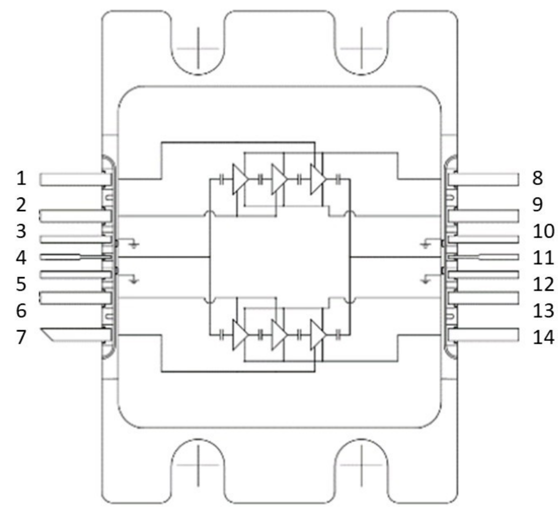
The CMPA1H1J050F is a 60 W package MMIC HPA utilizing MACOM's high performance, 0.15 µm GaN-on-SiC production process. The CMPA1H1J050F operates from 17.3 - 18.4 GHz and supports Direct Broadcast Satellite communications. The CMPA1H1J050F achieves 60 W of saturated output power with 25 dB of large signal gain and typically 30% power-added efficiency under CW operation.

Packaged in a 17.5 x 24 mm bolt-down, flange package, the CMPA1H1J050F 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)
CMPA1H1J050F	Tray (10/10)
CMPA1H1J050F-AMP	Sample Board (1/1)

Functional Schematic



Pin Configuration[1]

Pin #	Function
1, 2	Gate Bias - Top MMIC
3, 5, 10, 12	GND
4	RF Input
6, 7	Gate Bias - Bot MMIC
8, 9	Bias Drain - Top MMIC
11	RF Output
13, 14	Bias Drain - Bot MMIC

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

RF Electrical Specifications: V_D = 28 V, I_{DQ} = 700 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	17.3 17.8 18.4	dBm	46.0 47.0 46.0	47.0 48.5 48.0	—
Power Added Efficiency		17.3 17.8 18.4	%	29 30 29	30 32 32	—
Large Signal Gain		17.3 17.8 18.4	dB	23.0 24.0 23.0	24.0 25.5 25.0	—
Small Signal Gain	P_{IN} = -20 dBm	17.3 - 18.4	dB	—	30	—
Input Return Loss		17.3 - 18.4	dB	—	-10	—
Output Return Loss		17.3 - 18.4	dB	—	-6	—
IM3	P_{OUT}/Tone = 41 dBm Tone/Spacing = 600 MHz	17.3 17.8 18.4	dBc	—	-26 -27 -27	—

DC Electrical Specifications:

Parameter	Units	Min.	Typ.	Max.
Drain Voltage	V	—	28	—
Gate Voltage	V	—	-1.9	—
Quiescent Drain Current	mA	—	700	—
Saturated Drain Current	A	—	7.8	—

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	—	-1.9	—
Quiescent Drain Current	I_{DQ}	mA	—	700	—
Operating Temperature	T_C	°C	-40	—	+85

Absolute Maximum Ratings[2,3]

Parameter	Symbol	Unit	Min.	Max.
Input Power	P_{IN}	dBm	—	26
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	—	12.8
Gate Current	I_G	mA	—	24.6
Dissipated Power @ +85°	P_{DISS}	W	—	160
VSWR	—	Ratio	—	3:1
Junction Temperature (MTTF > 1E6 Hrs)	T_J	°C	—	+225
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:

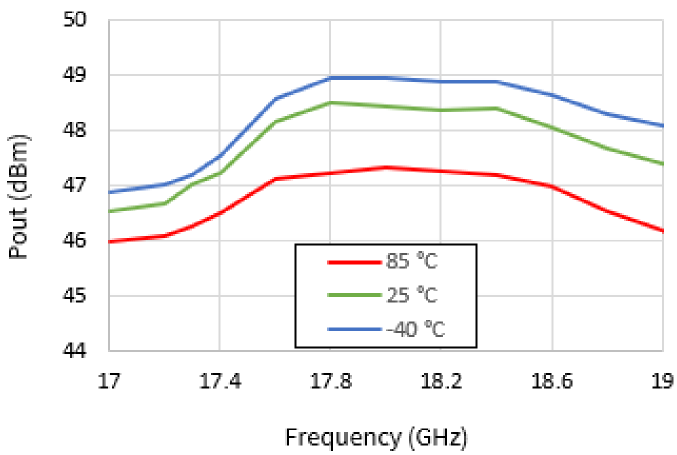
Static Sensitivity

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 devices.

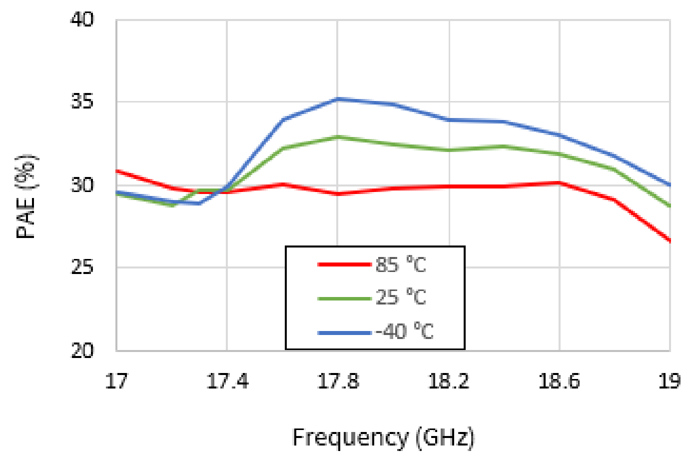
Typical Performance Curves - Large Signal over Temperature

V_D = 28 V, I_{DQ} = 700 mA, CW, P_{IN} = 23 dBm

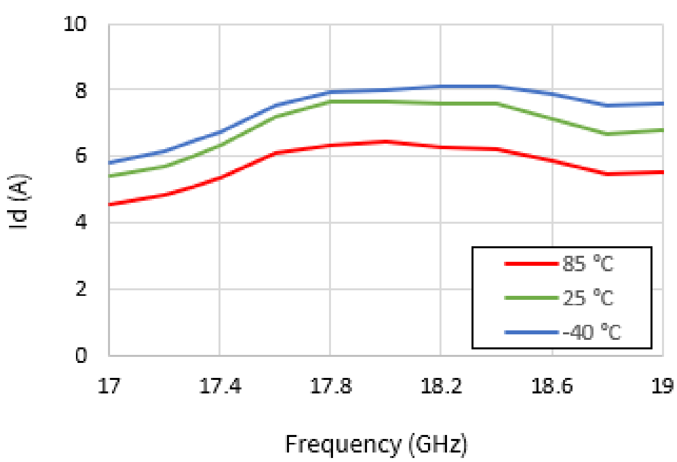
Output Power vs. Frequency



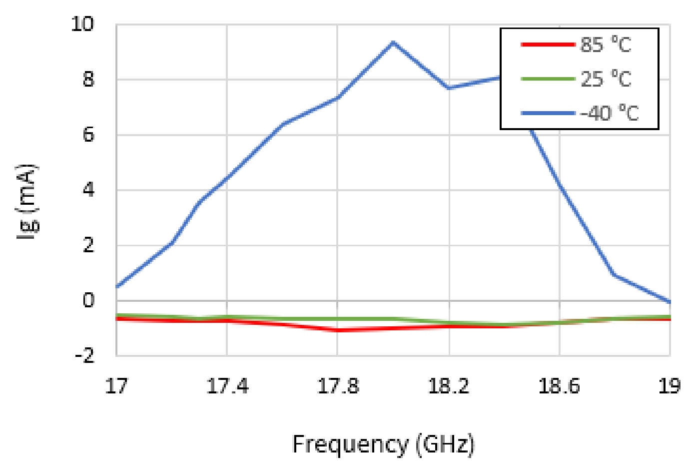
Power Added Efficiency vs. Frequency



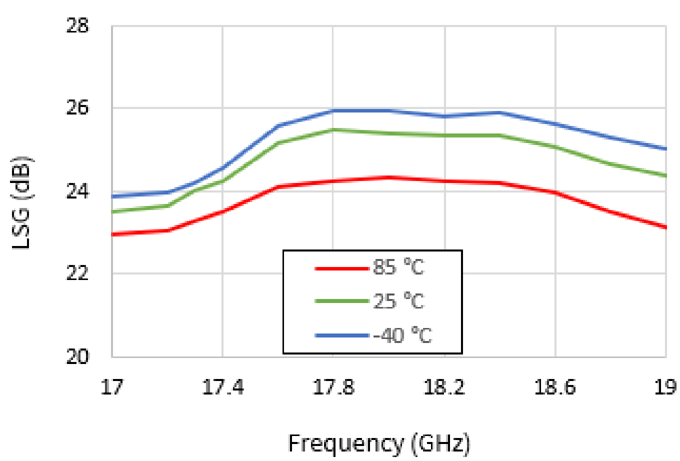
Drain Current vs. Frequency



Gate Current vs. Frequency



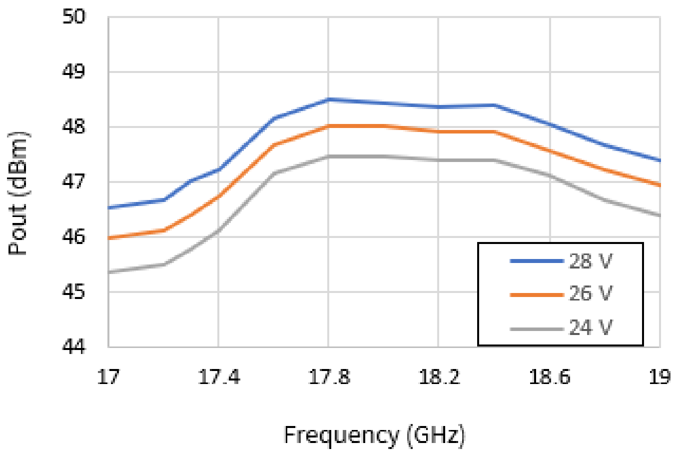
Large Signal Gain vs. Frequency



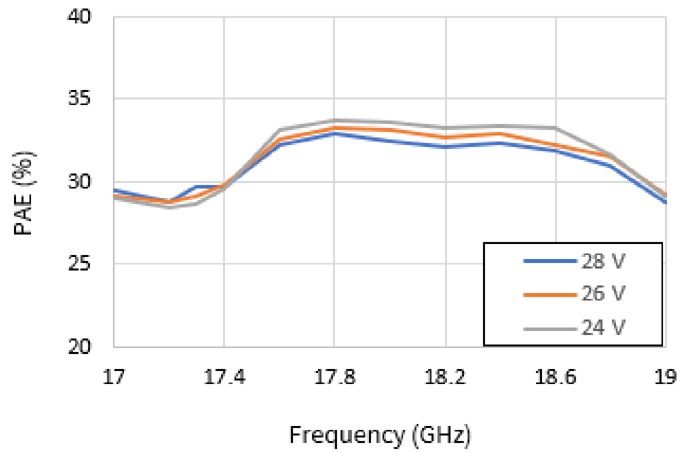
Typical Performance Curves - Large Signal over V_D

I_{DQ} = 700 mA, CW, P_{IN} = 23 dBm, T_C = 25°C

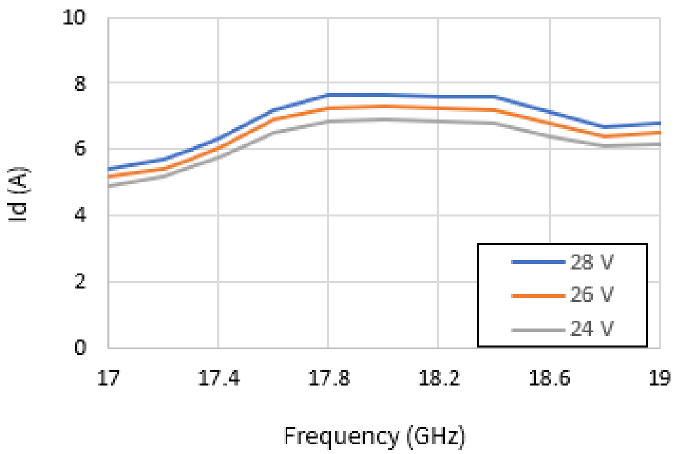
Output Power vs. Frequency



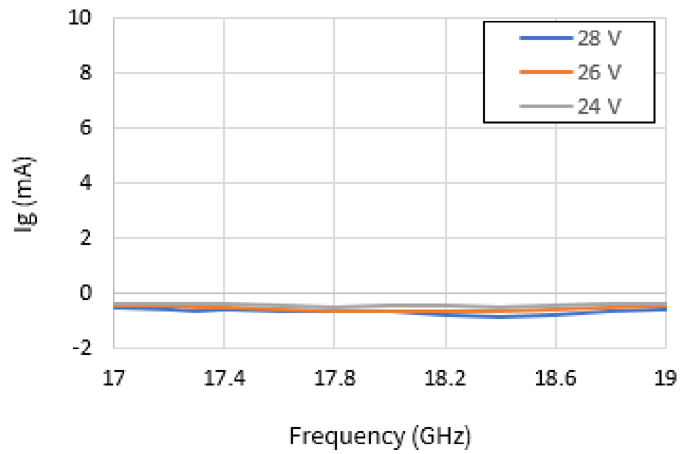
Power Added Efficiency vs. Frequency



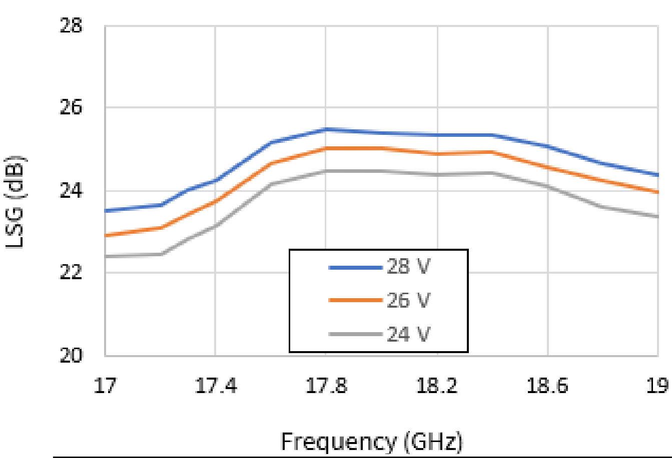
Drain Current vs. Frequency



Gate Current vs. Frequency



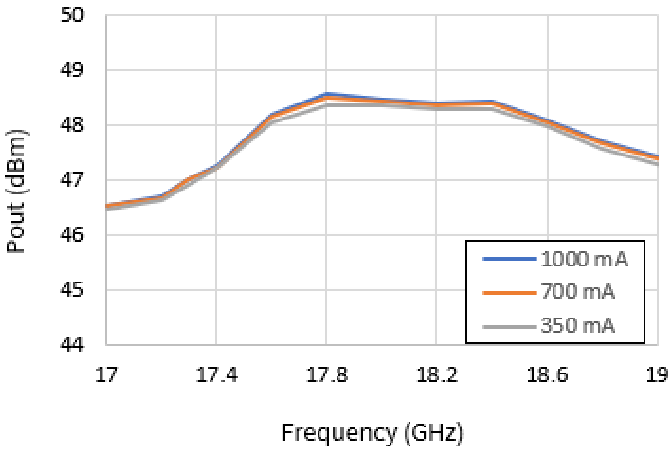
Large Signal Gain vs. Frequency



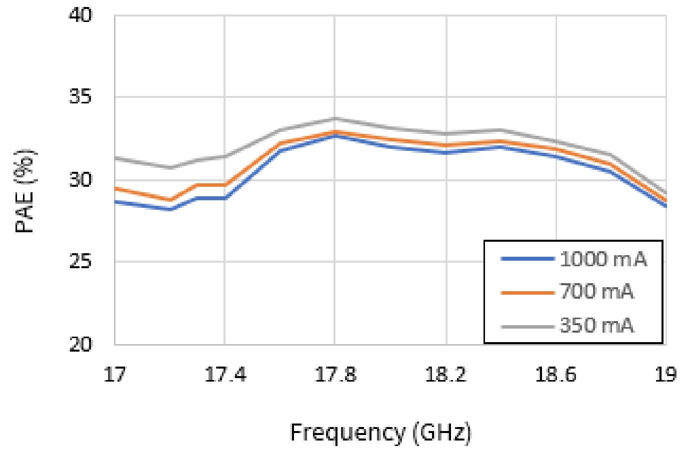
Typical Performance Curves - Large Signal over I_{DQ}

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

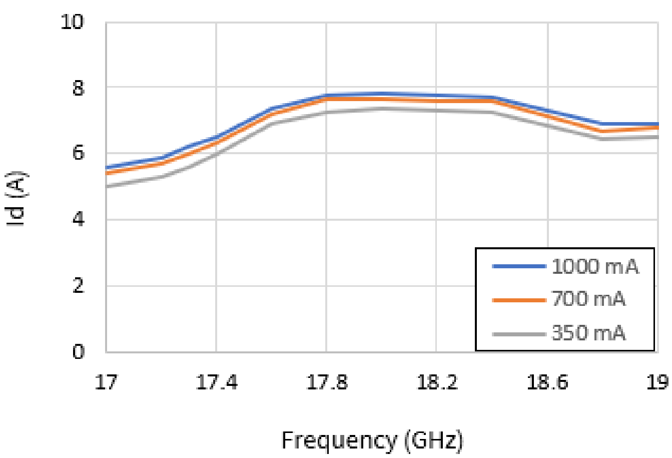
Output Power vs. Frequency



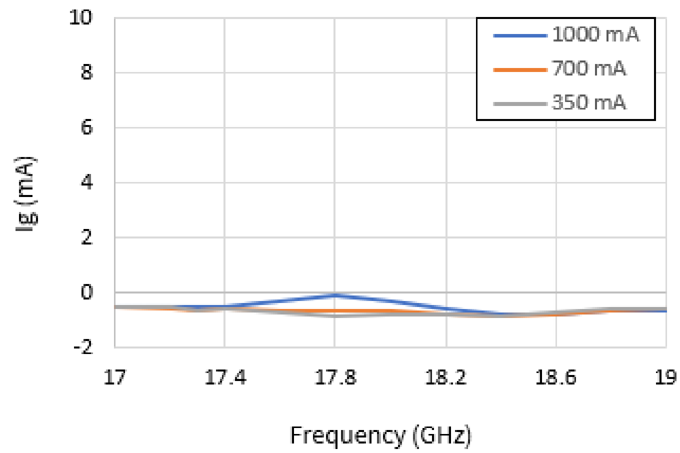
Power Added Efficiency vs. Frequency



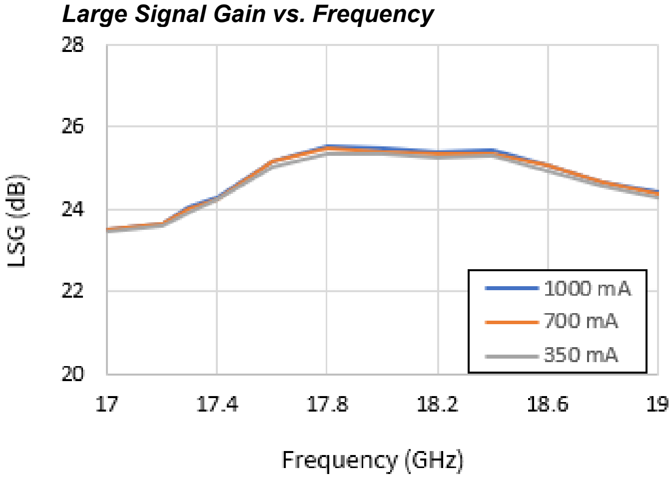
Drain Current vs. Frequency



Gate Current vs. Frequency



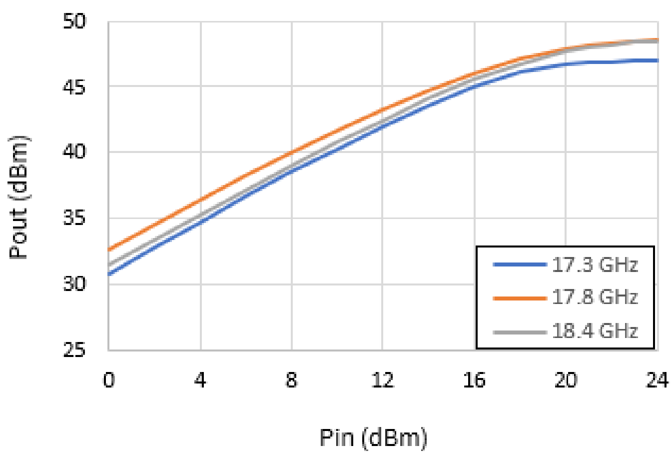
Large Signal Gain vs. Frequency



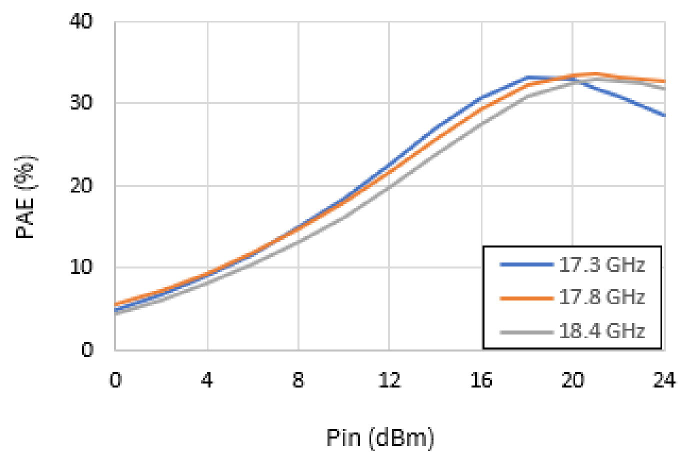
Typical Performance Curves - Drive-Up over Frequency

V_D = 28 V, I_{DQ} = 700 mA, CW, T_C = 25°C

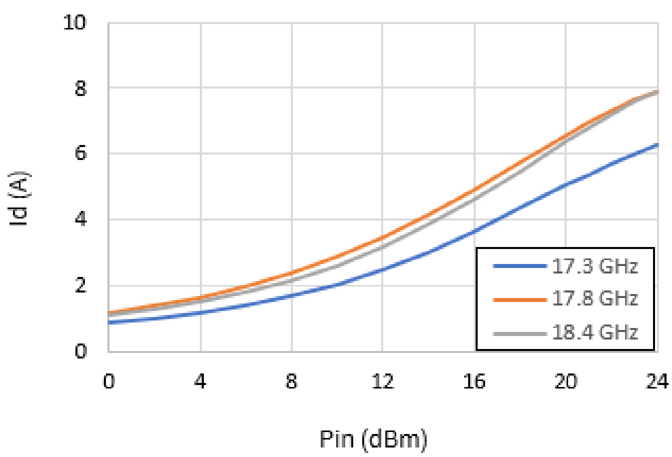
Output Power vs. Input Power



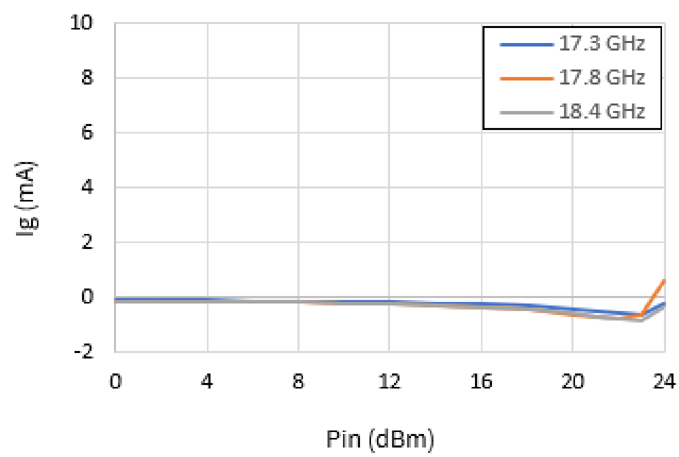
Power Added Efficiency vs. Input Power



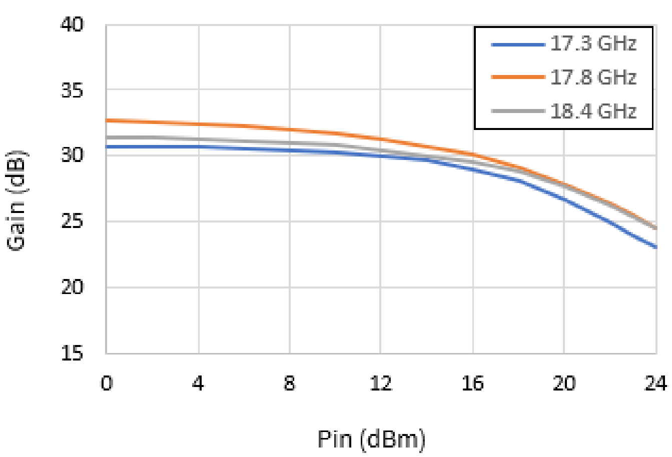
Drain Current vs. Input Power



Gate Current vs. Input Power



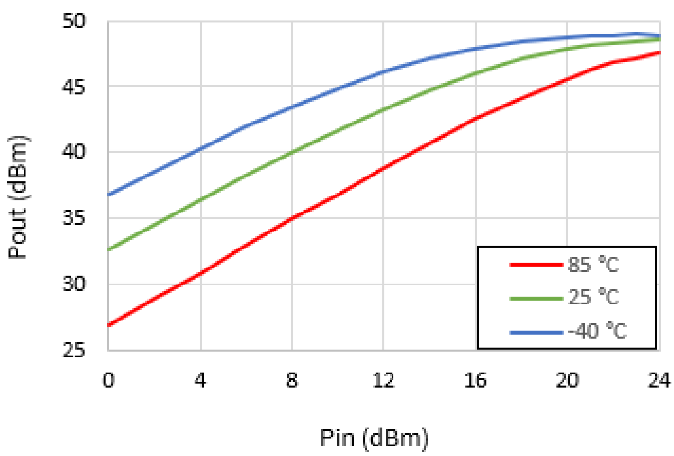
Gain vs. Input Power



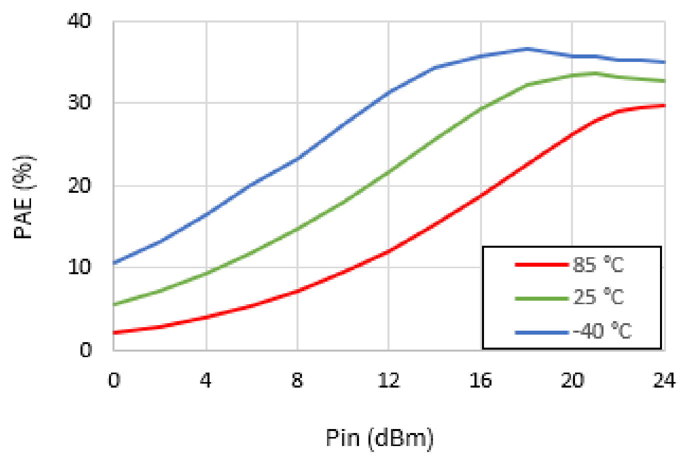
Typical Performance Curves - Drive-Up over Temperature

V_D = 28 V, I_{DQ} = 700 mA, CW, Frequency = 17.8 GHz

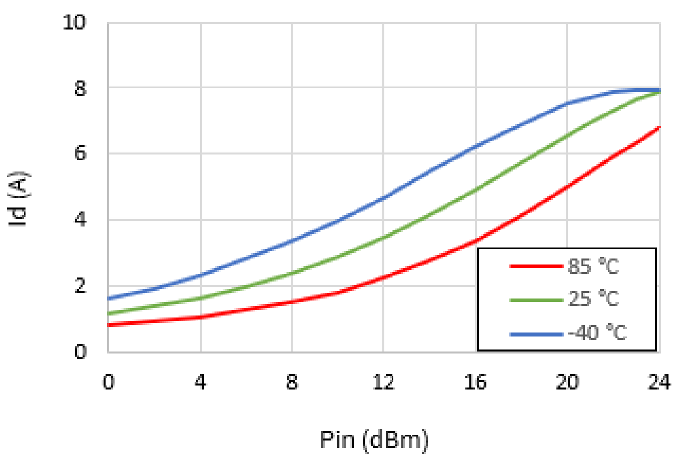
Output Power vs. Input Power



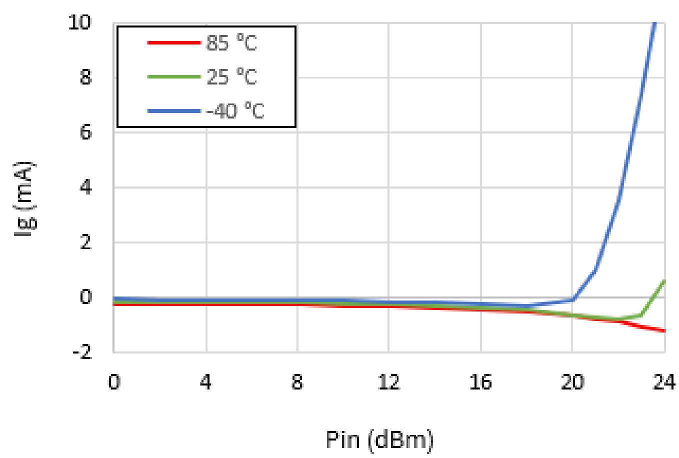
Power Added Efficiency vs. Input Power



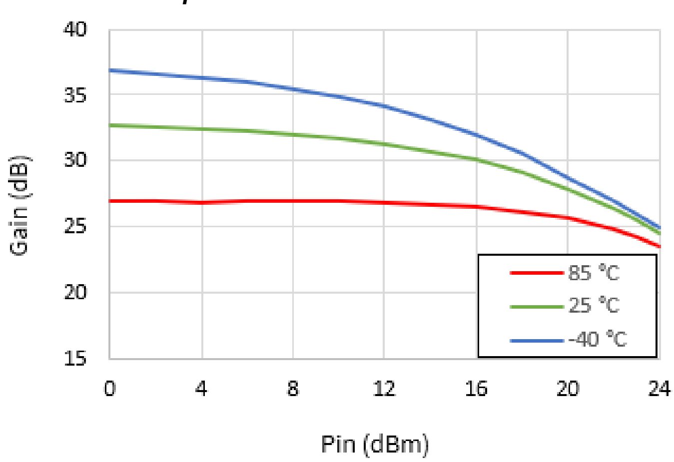
Drain Current vs. Input Power



Gate Current vs. Input Power



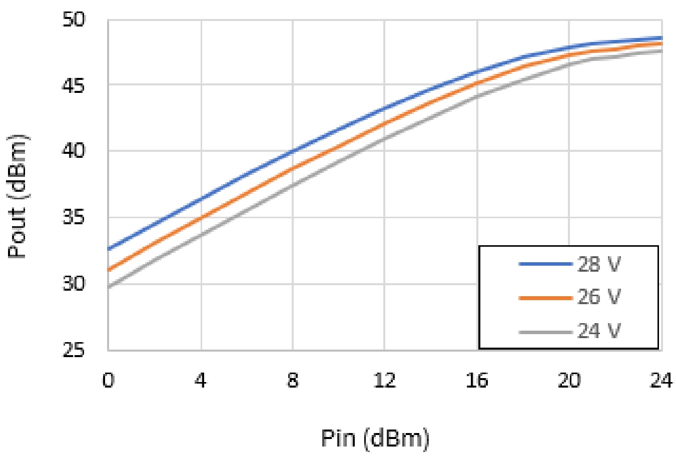
Gain vs. Input Power



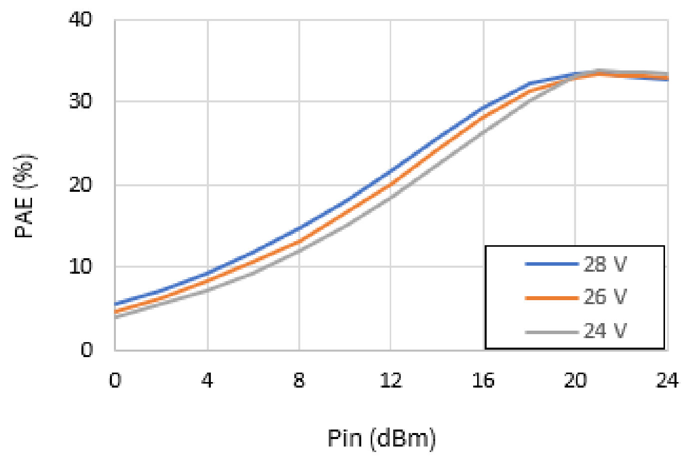
Typical Performance Curves - Drive-Up over V_D

I_{DQ} = 700 mA, CW, Frequency = 17.8 GHz, T_C = 25°C

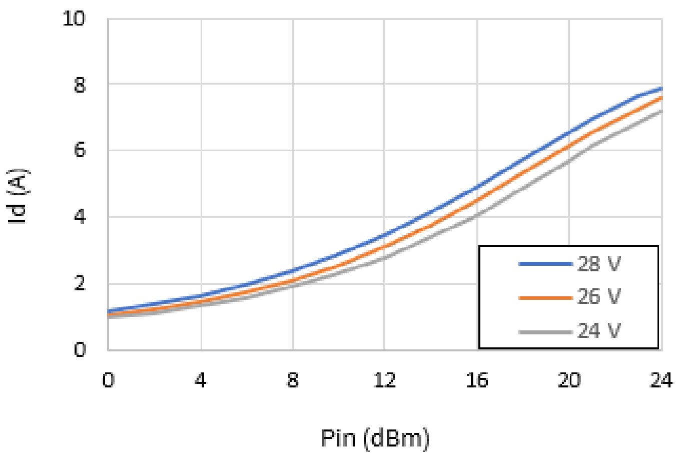
Output Power vs. Input Power



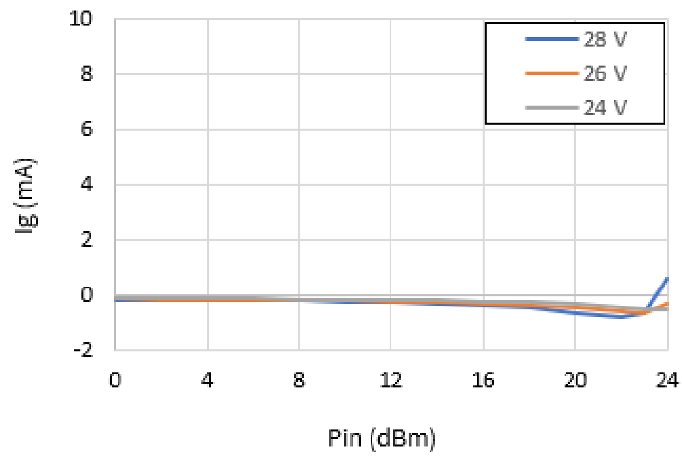
Power Added Efficiency vs. Input Power



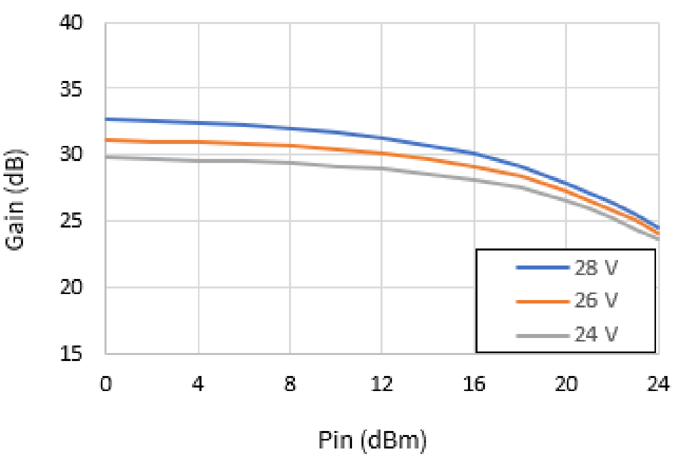
Drain Current vs. Input Power



Gate Current vs. Input Power



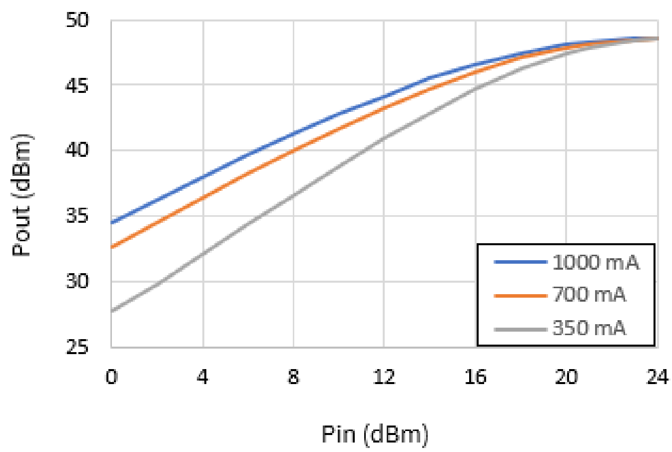
Gain vs. Input Power



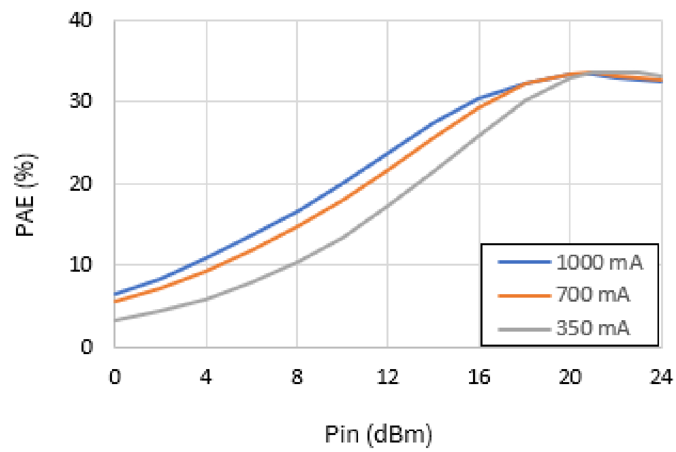
Typical Performance Curves - Drive-Up over I_{DQ}

V_D = 28 V, CW, Frequency = 17.8 GHz, T_C = 25°C

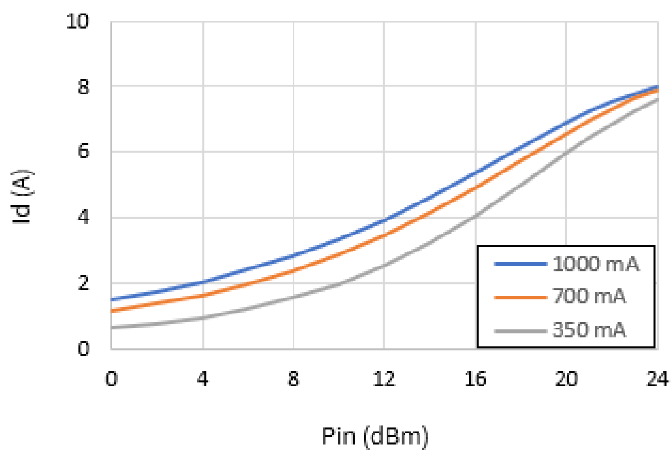
Output Power vs. Input Power



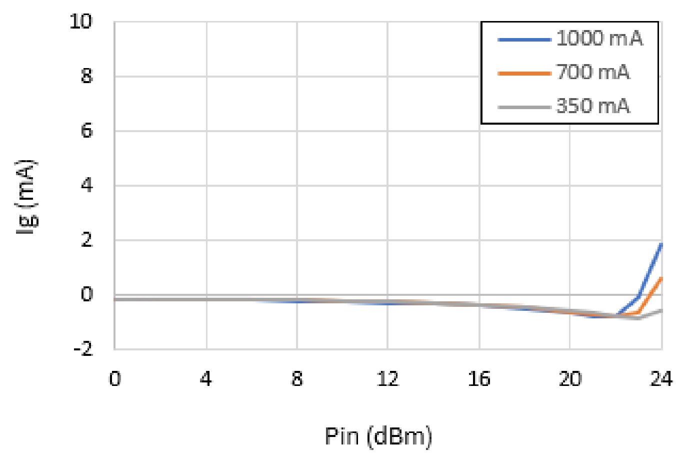
Power Added Efficiency vs. Input Power



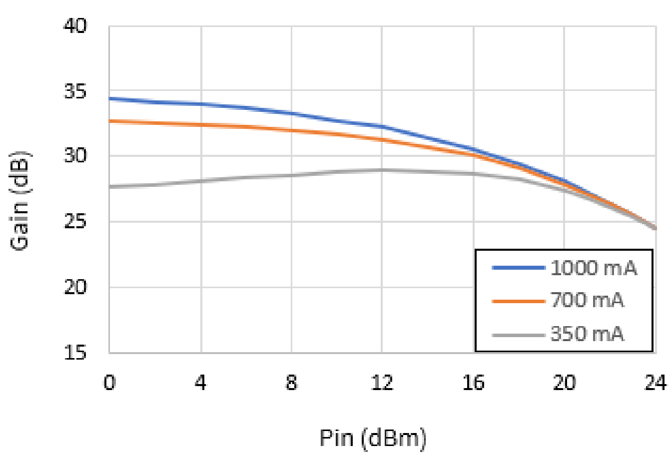
Drain Current vs. Input Power



Gate Current vs. Input Power



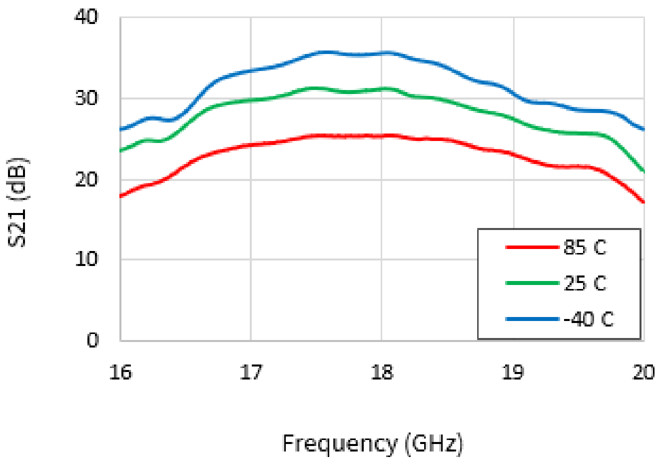
Large Signal Gain vs. Input Power



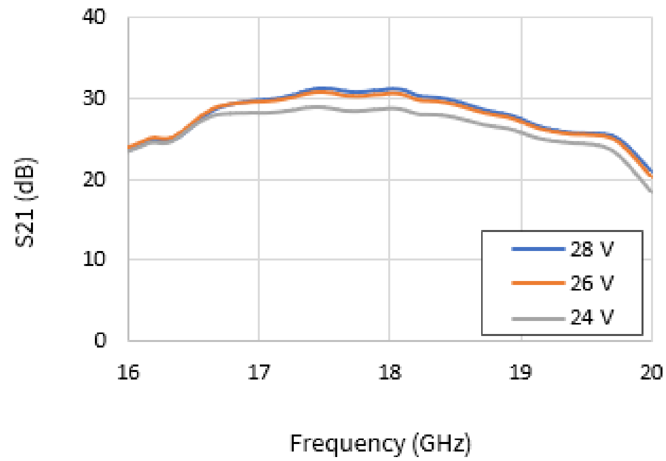
Typical Performance Curves - Small Signal over Temperature and V_D

I_{DQ} = 700 mA, CW, P_{IN} = -20 dBm

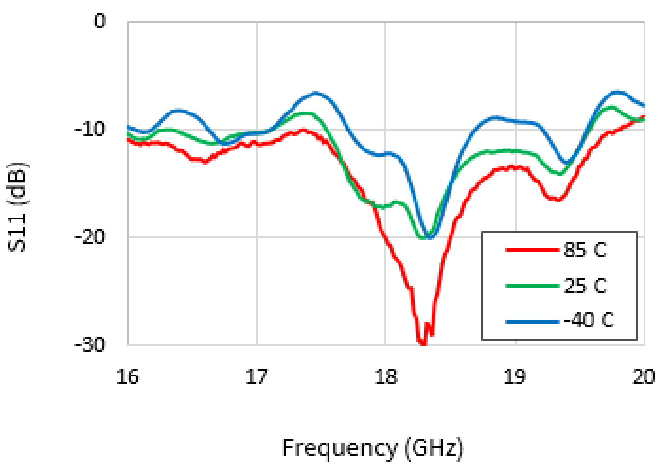
S21 vs. Frequency over Temperature @ V_D = 28 V



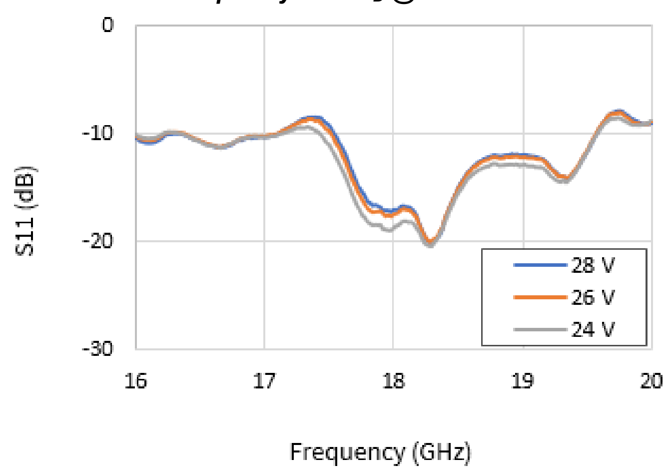
S21 vs. Frequency over V_D @ 25°C



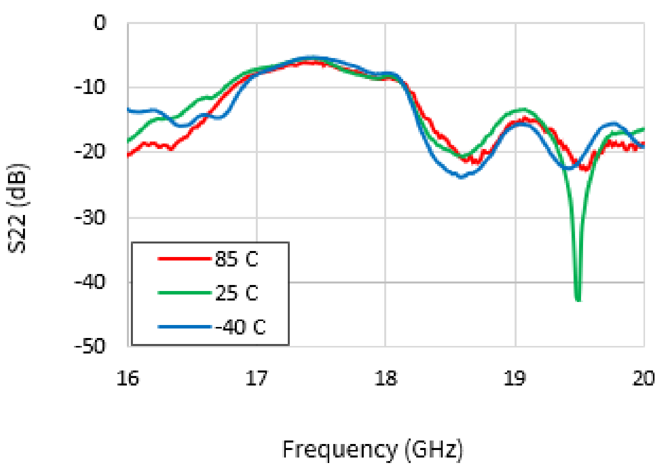
S11 vs. Frequency over Temperature @ V_D = 28 V



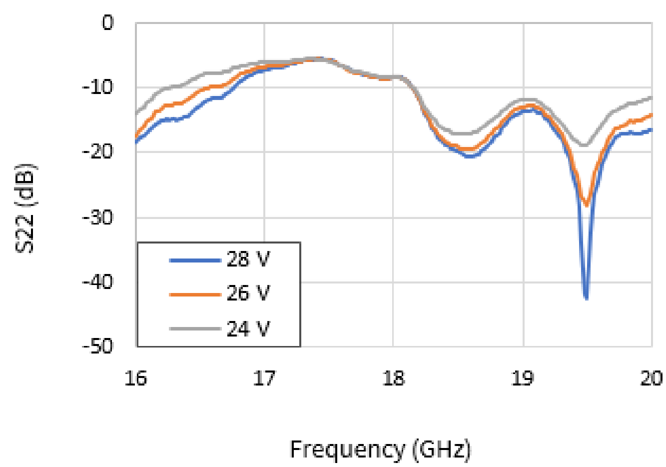
S11 vs. Frequency over V_D @ 25°C



S22 vs. Frequency over Temperature @ V_D = 28 V



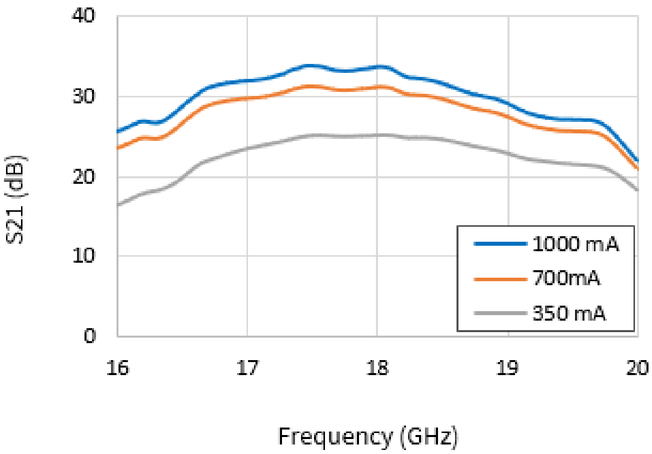
S22 vs. Frequency over V_D @ 25°C



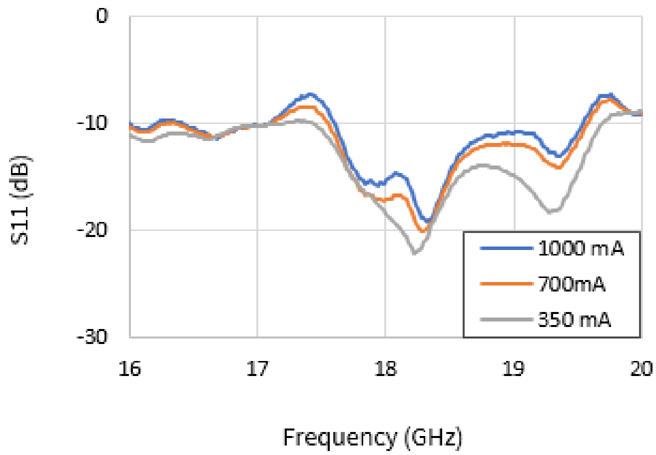
Typical Performance Curves - Small Signal over I_{DQ}

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

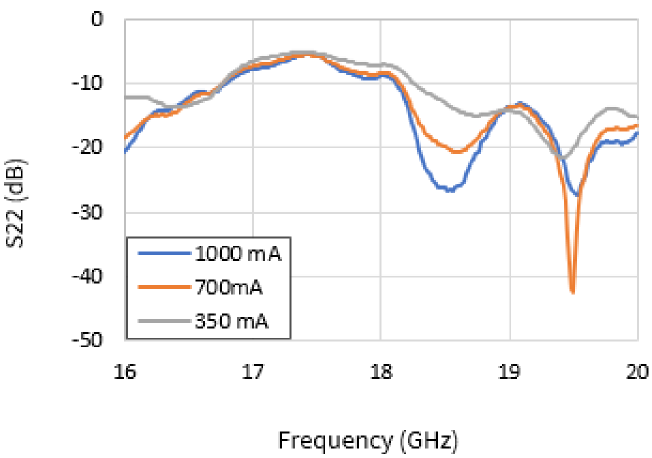
S21 vs. Frequency over I_{DQ}



S11 vs. Frequency over I_{DQ}



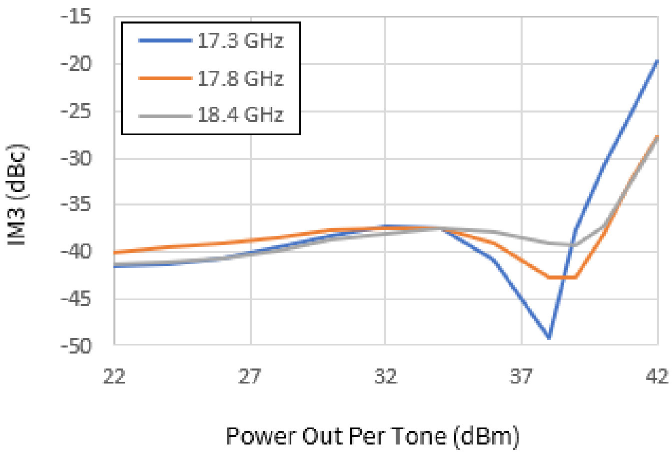
S22 vs. Frequency over I_{DQ}



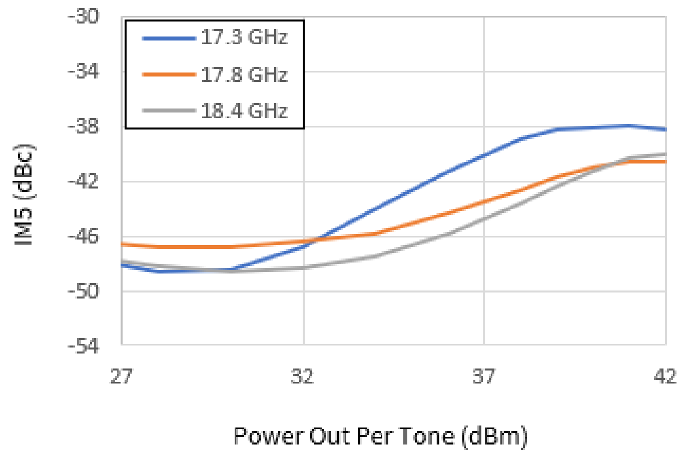
Typical Performance Curves - Linearity (IM3 and IM5)

V_D = 28 V, I_{DQ} = 700 mA, CW, Frequency = 17.8 GHz, Tone Spacing = 10 MHz, T_C = 25°C (unless otherwise stated)

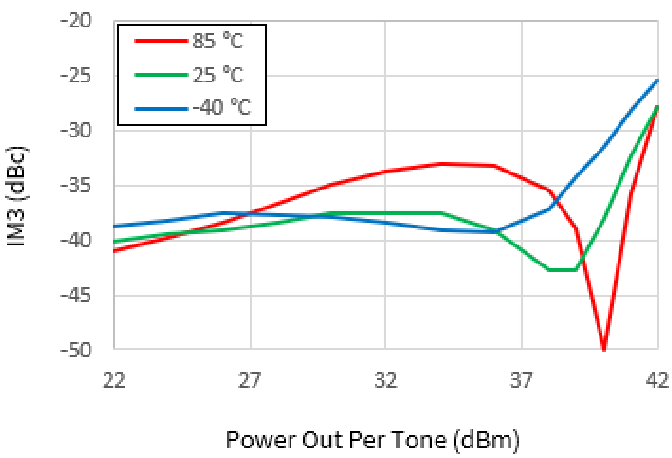
IM3 vs. Output Power / Tone over Frequency



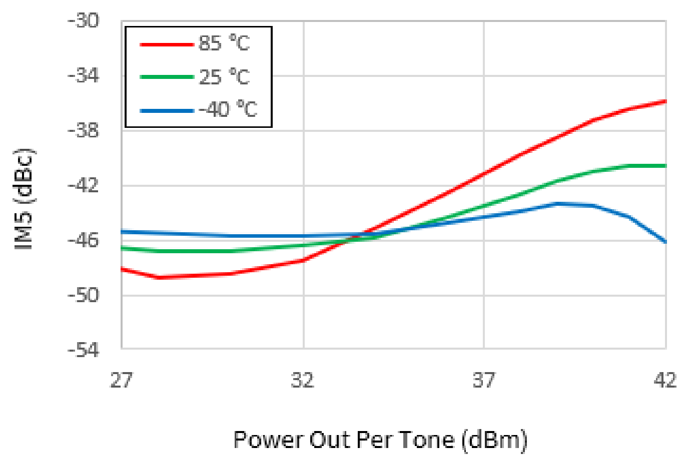
IM5 vs. Output Power / Tone over Frequency



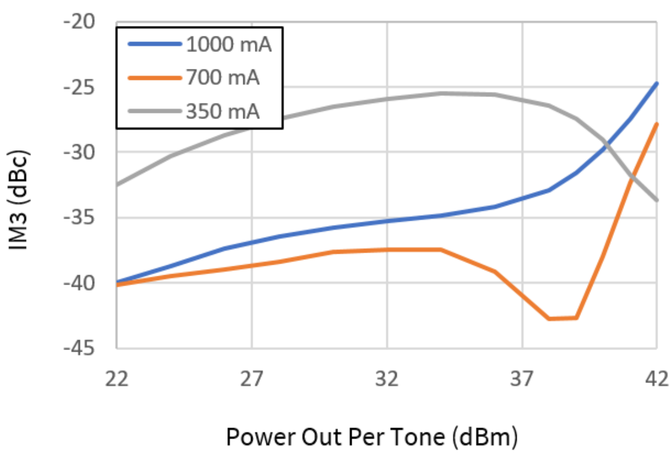
IM3 vs. Output Power / Tone over Temperature



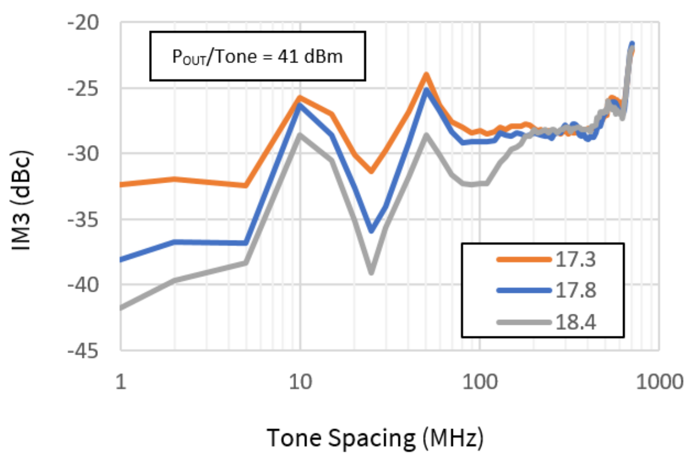
IM5 vs. Output Power / Tone over Temperature



IM3 vs. Output Power / Tone over I_{DQ}



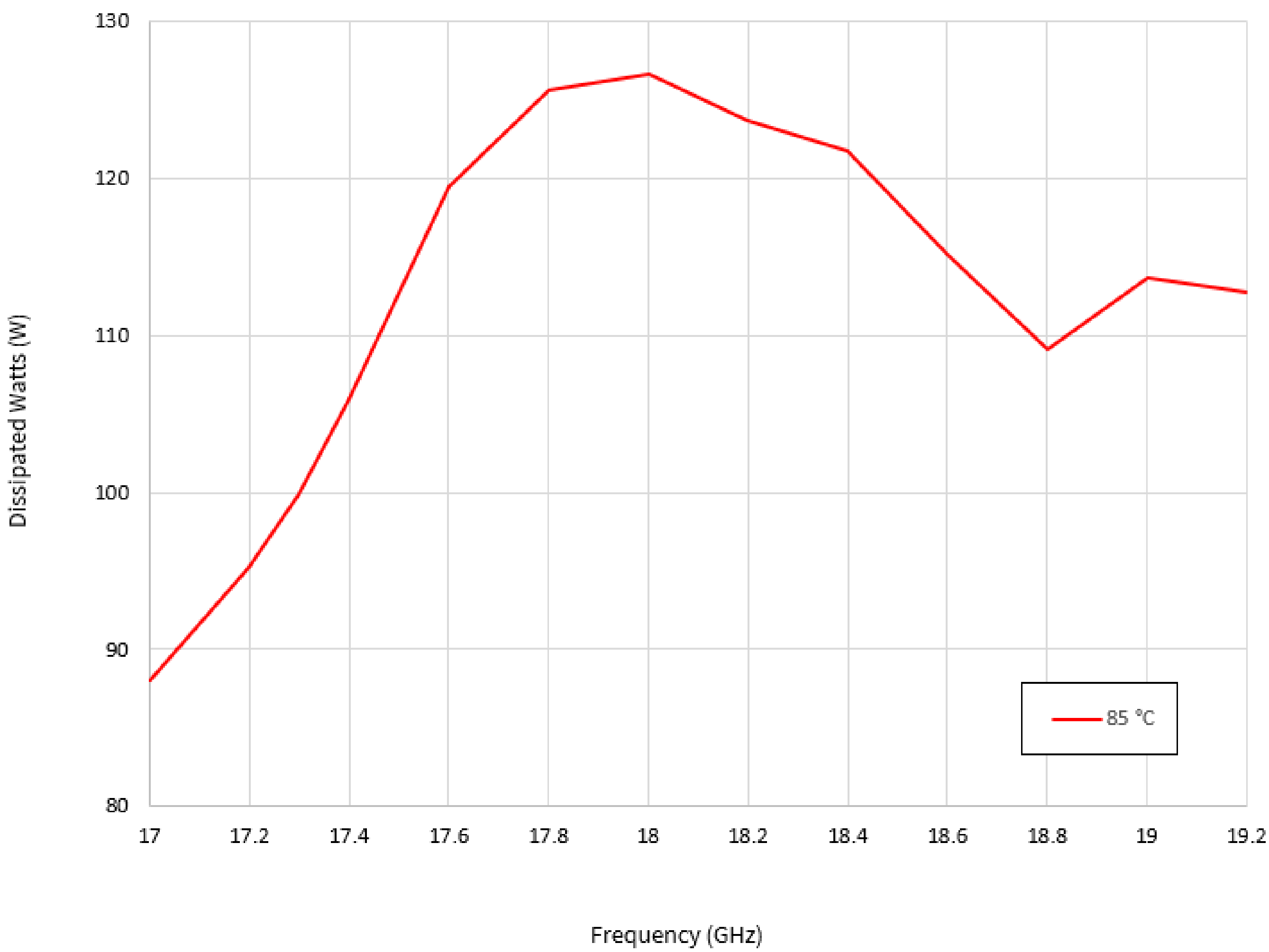
IM3 vs. Tone Spacing over Frequency



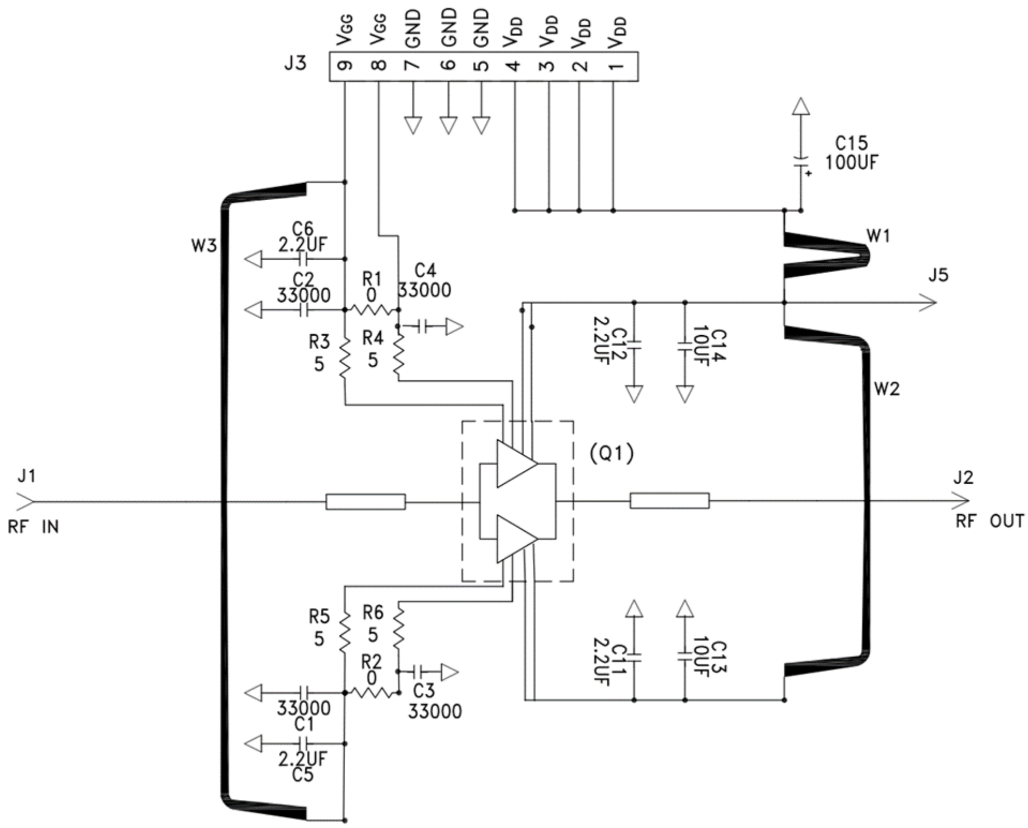
Thermal Characteristics

Parameter	Operating Conditions	Value
Operating Junction Temperature (T_J)	Freq = 17.8 GHz, V_D = 28 V, I_{DQ} = 700 mA, I_{DRIVE} = 6.35 A, P_{IN} = 23 dBm, P_{OUT} = 47.2 dBm, P_{DISS} = 125.3 W, T_{CASE} = 85°C, CW	215.3ºC
Thermal Resistance, Junction to Case ($R_{\theta JC}$)		1.04ºC/W

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



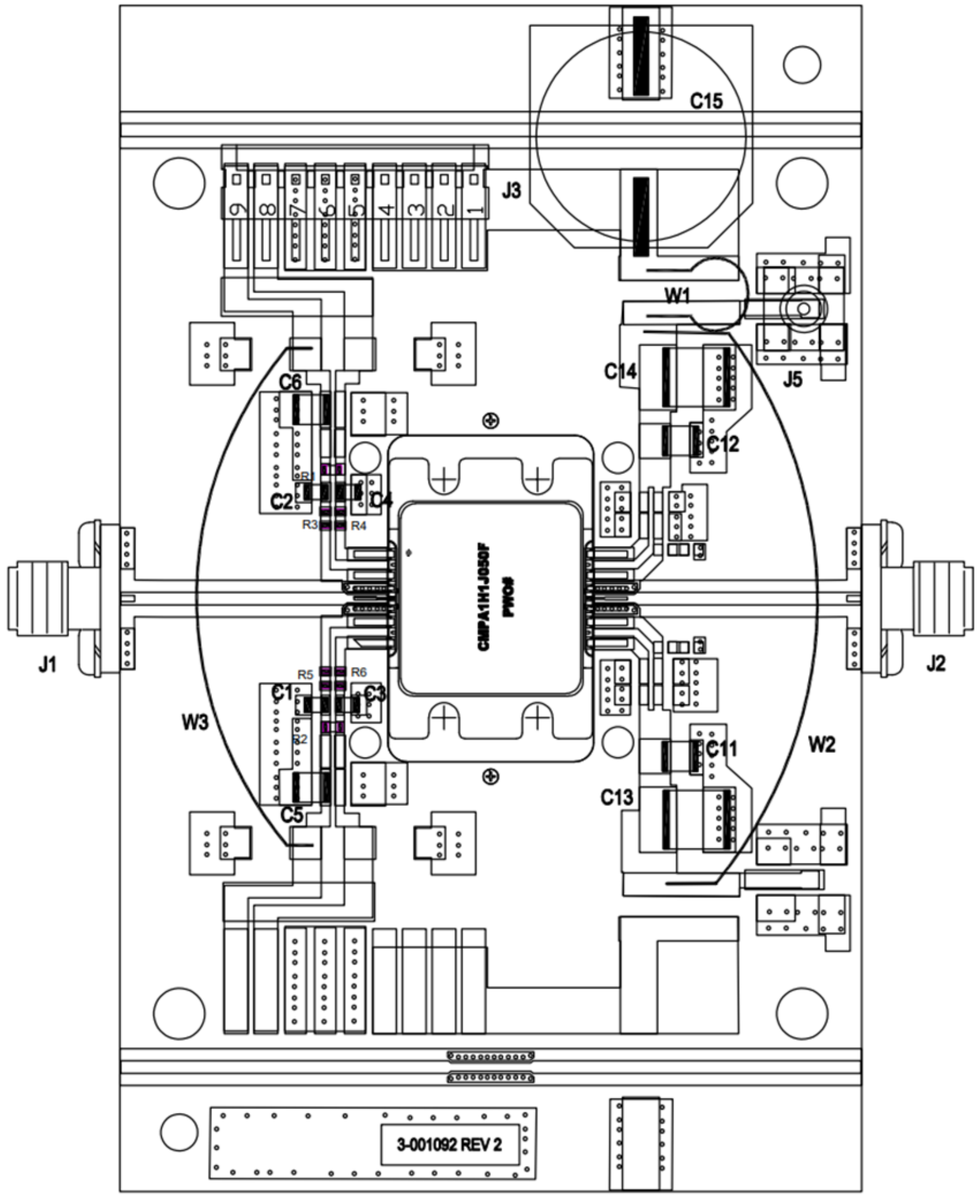
Evaluation Board Schematic (CMPA1H1J050F-AMP)



Parts List

Part	Value	Qty.
C1,C3,C2,C4	CAP, 33000 pF, 0805,100V, X7R	4
C5,C6,C11,C12	CAP, 2.2 µF, 100V, 10%, X7R, 1210	4
C13,C14	CAP, 10 µF, 100V, 10%, X7R, 2220	2
C15	CAP, 100 µF, 20%, 160V, ELEC	1
W1, W2, W3	WIRE, 18 AWG ~ 1.75"	3
J1,J2	CONN, SMA, PANEL MOUNT JACK, FLANGE, 4-HOLE, BLUNT POST, 20MIL	2
J3	HEADER RT>PLZ .1CEN LK 9POS	1
J5	CONN, SMB, STRAIGHT JACK RECEPTACLE, SMT, 50 OHM, Au PLATED	1
Q1	CMPA1H1J050F, MMIC	1
-	PCB, ROGERS 6035 HTC, 2.5x4.0x0.020 IN	1
-	BASEPLATE, CU, 2.5 X 4.0 X 0.5 IN	1
-	2-56 SOC HD SCREW 1/4 SS	4
-	#2 SPLIT LOCKWASHER SS	4
R1,R2	RES,1/16W,0603,1%,0 OHMS	2
R3,R4,R5,R6	RES,1/16W,0603,1%,5.1 OHMS	4

Evaluation Board Assembly Drawing (CMPA1H1J050F-AMP)



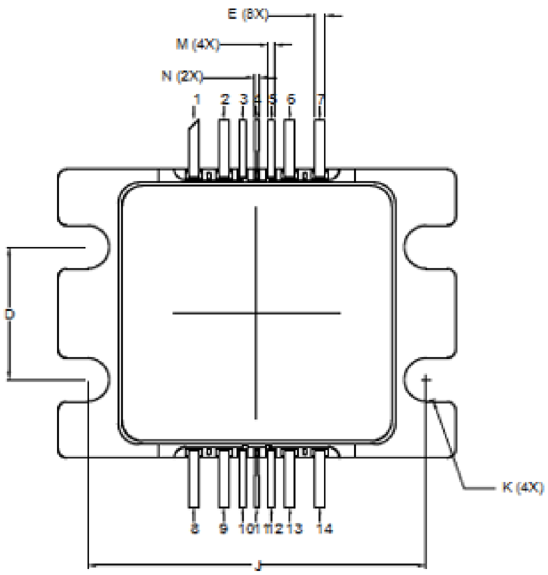
Bias On Sequence

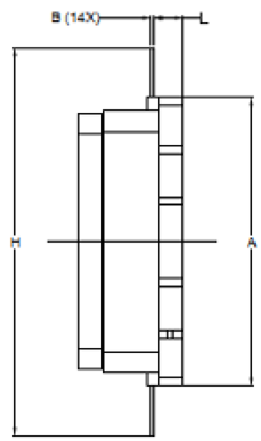
1. Ensure RF is turned-off
2. Apply pinch-off voltage of -5 V to the gate (V_G)
3. Apply nominal drain voltage (V_D)
4. Adjust Vg to obtain desired quiescent drain current (I_{DQ})
5. Apply RF

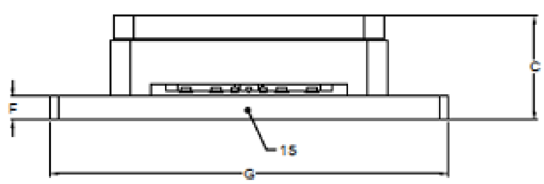
Bias Off Sequence

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†







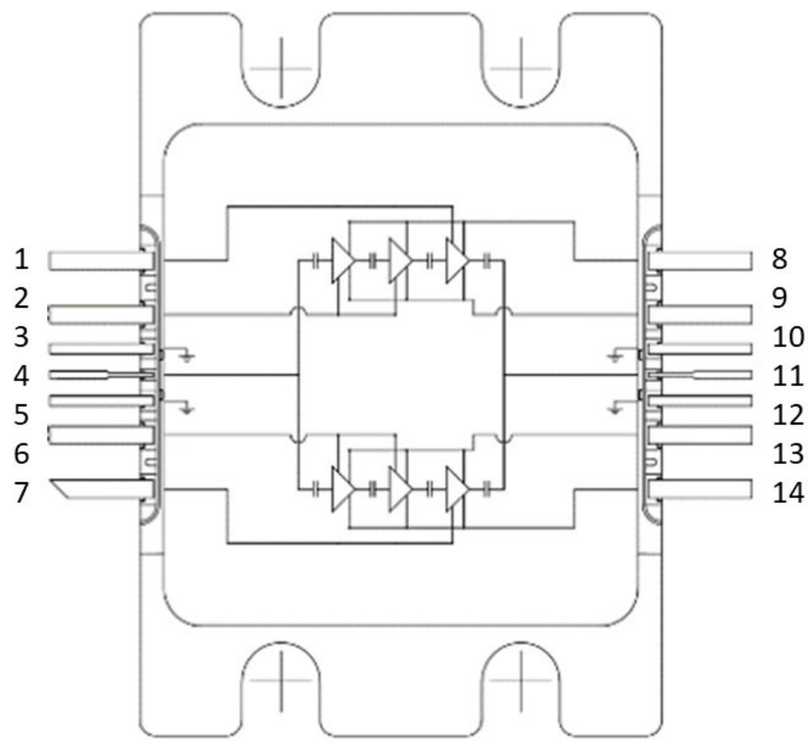
DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.679	0.691	17.25	17.55
B	0.003	0.006	0.076	0.152
C	0.234	0.261	5.94	6.63
D	0.307	0.323	7.80	8.20
E	0.016	0.032	0.406	0.813
F	0.047	0.063	1.194	1.600
G	0.936	0.954	23.77	24.23
H	0.912	0.930	23.16	23.62
J	0.795	0.811	20.19	20.60
K	ø0.094	ø0.110	ø2.39	ø2.79
L	0.062	0.078	1.575	1.981
M	0.006	0.022	0.152	0.559
N	0.004	0.018	0.102	0.457

NOTES:

1. DIMENSIONING AND TOLERANICING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. ADHESIVE FROM LID MAY EXTEND A MAXIMUM OF 0.020" BEYOND EDGE OF LID.
4. LID MAY BE MISALIGNED TO THE BODY OF THE PACKAGE BY A MAXIMUM OF 0.008" IN ANY DIRECTION.
5. ALL PLATED SURFACES ARE NI/AU

Pin Description

Pin #	Name	Description
1	VG3, Top MMIC	Gate bias - 3rd stage - Top MMIC
2	VG1-2, Top MMIC	Gate bias - 1st and 2nd stages - Top MMIC
3, 5, 10, 12	GND	RF and DC ground
4	RF Input	RF Input. 50-ohm matched. Internally DC blocked.
6	VG1-2, Bot MMIC	Gate bias - 1st and 2nd stages - Bottom MMIC
7	VG3, Bot MMIC	Gate bias - 3rd stage - Bottom MMIC
8, 9	Bias Drain—Top MMIC	Drain bias - Top MMIC - Both must be connected.
11	RF Output	RF Output. 50-ohm matched. Internally DC blocked.
13, 14	Bias Drain—Bot MMIC	Drain bias - Bottom MMIC - Both must be connected.
Base	GND	RF and DC ground



Revision History

Rev	Date	Change Description
V1	12/20/2024	Production release.