Features

- Saturated Power: 50 W
- Power Added Efficiency: 38%
- Large Signal Gain: 25 dB
- Small Signal Gain: 29 dB
- Input Return Loss: -16 dB
- Output Return Loss: -10 dB
- IM3: -25dBc (25W P_{total})
- Pulsed/CW Operation

Applications

- Satellite Uplink
- Common Data Links

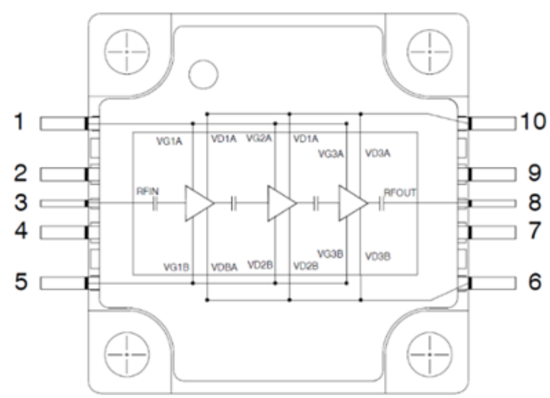
Description

MACOM's CMPA1E1F060F is a 50 W, MMIC HPA utilizing MACOM's high performance, 0.15µm GaN on SiC production process. The CMPA1E1F060F operates from 13.4 – 15.5 GHz and targets lower Ku-band radar applications, as well as, satellite uplinks and common datalink applications. Under saturation, the CMPA1E1F060F achieves 50 W of typical output with 25 dB of large signal gain and > 38% power-added efficiency. Targeting an IM3 level of -25 dBc or better, this HPA delivers 25 W of output power with 31 dB of gain and > 32% power-added efficiency.

Above stated performance is typical across frequency at 25°C. Please reference included specification tables and performance curves for additional details.

Packaged in a 15x15 mm bolt-down, flange package, the CMPA1E1F060F provides superior RF performance and thermal management allowing customers to improve SWaP-C benchmarks in their next-generation systems.

Functional Schematic



Pin Configuration[1]

Pin #	Function
1, 5	VG
2, 4, 7, 9	RF/DC Ground
3	RF Input
6, 10	VD
8	RF Output

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

Ordering Information

Part Number	Package (MOQ/ Mult)
CMPA1E1F060F	Tray (10/10)
CMPA1E1F060F-AMP	Sample Board (1/1)

RF Electrical Specifications: V_D = 28 V, I_{DQ} = 650 mA, CW, T_C = 25°C, Z_0 = 50 Ω

Parameter	Test Conditions	Frequency (GHz)	Units	Min.	Typ.	Max.
Output Power	Pin = 22 dBm	13.4 13.75 14.5 15.5	dBm	47.0 46.8 46.5 46.0	48 48 47.5 47	—
Power Added Efficiency	Pin = 22 dBm	13.4 13.75 14.5 15.5	%	30 30 29 29	37 36 35 36	—
Large Signal Gain	Pin = 22 dBm	13.4 13.75 14.5 15.5	dB	—	26 26 25.5 25	—
Small Signal Gain	Pin = -20 dBm	13.4 - 15.5	dB	—	29	—
Input Return Loss	Pin = -20 dBm	13.4 - 15.5	dB	—	-16	—
Output Return Loss	Pin = -20 dBm	13.4 - 15.5	dB	—	-10	—
IM3	Pout/Tone=41dBm; Spacing=300MHz	13.75 14.5 15.5	dBc	—	-25 -25 -25	—

DC Electrical Specifications:

Parameter	Units	Min.	Typ.	Max.
Drain Voltage	V	—	28	—
Gate Voltage	V	—	-2.1	—
Quiescent Drain Current	mA	325	650	1000
Saturated Drain Current	A	—	5.0	—

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Recommended Operating Conditions

Parameter	Symbol	Unit	Min.	Typ.	Max.
Input Power	P_{IN}	dBm		22	
Drain Voltage	V_D	V		28	
Gate Voltage	V_G	V		-2.1	
Quiescent Drain Current	I_{DQ}	mA		650	
Case Temperature	T_C	°C	-40		+85

Absolute Maximum Ratings[2,3]

Parameter	Symbol	Unit	Min.	Max.
Input Power	P_{IN}	dBm		24
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		7.8
Gate Current	I_G	mA		15
Dissipated Power @ +85°	P_{DISS}	W		101
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
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.

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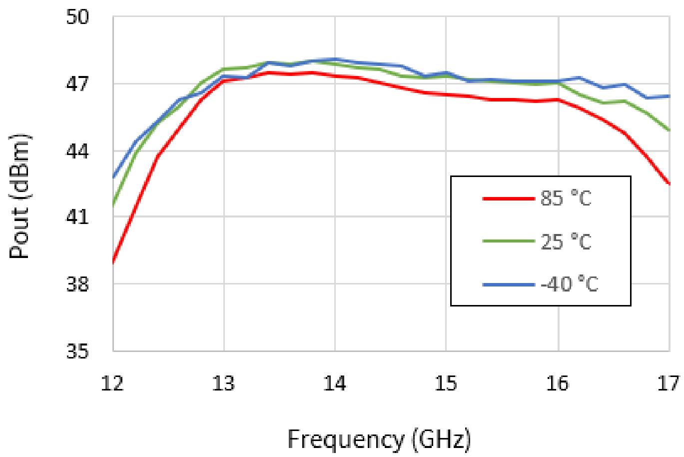
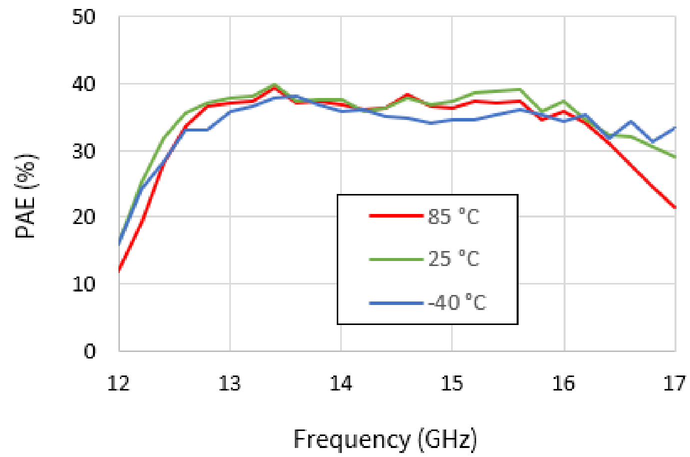
Typical Performance Curves - Large Signal over Temperature:

V_D = 28 V, I_{DQ} = 650 mA, CW, P_{IN} = 22 dBm

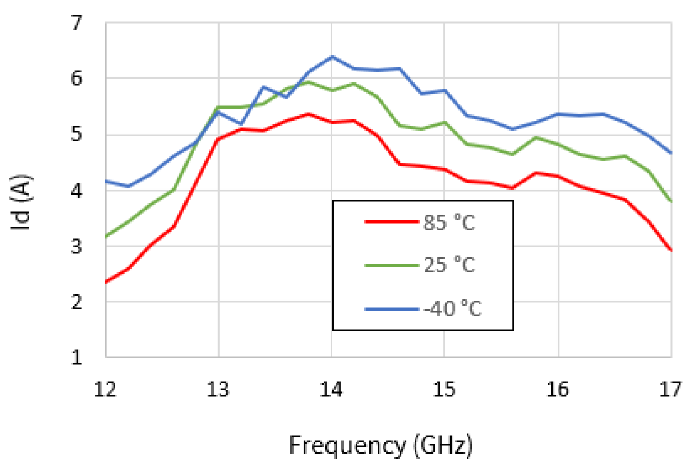
Output Power vs. Frequency



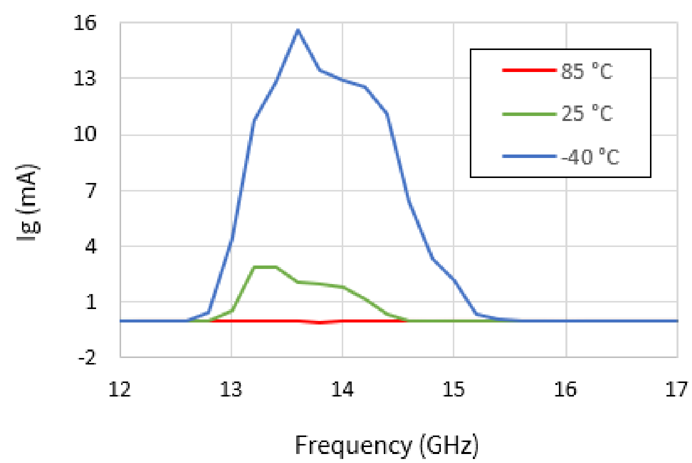
Power-Added Efficiency vs. Frequency



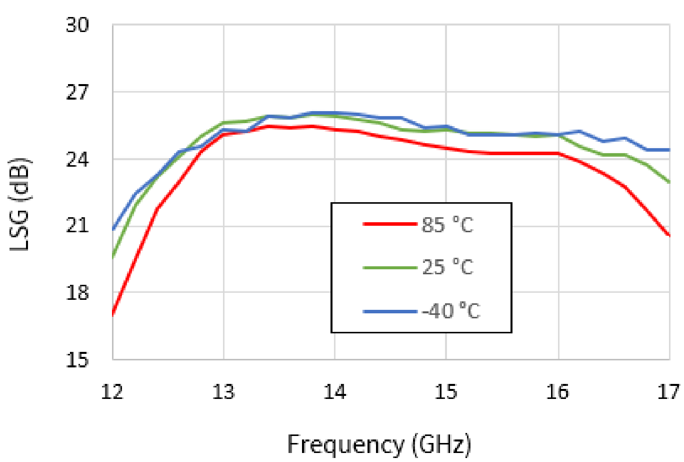
Drain Current vs. Frequency



Gate Current vs. Frequency



Large Signal Gain vs. Frequency



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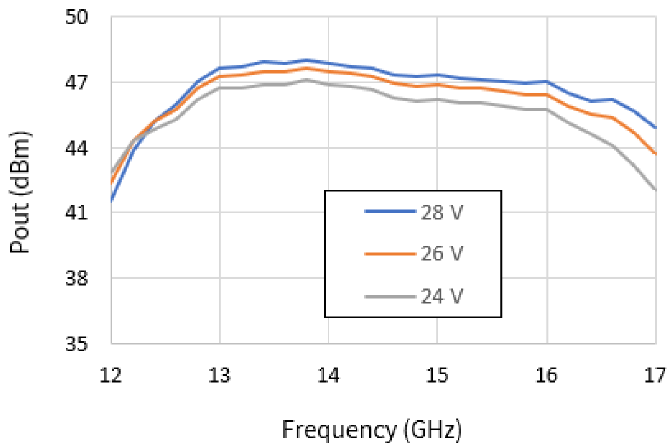
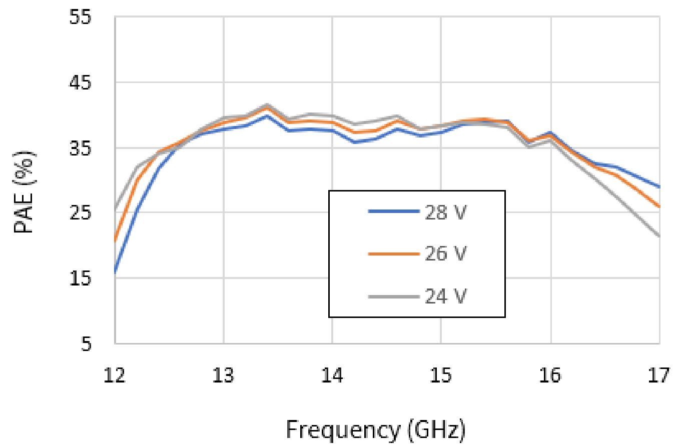
Typical Performance Curves - Large Signal over V_D:

I_{DQ} = 650 mA, CW, P_{IN} = 22 dBm, T_C=25°C

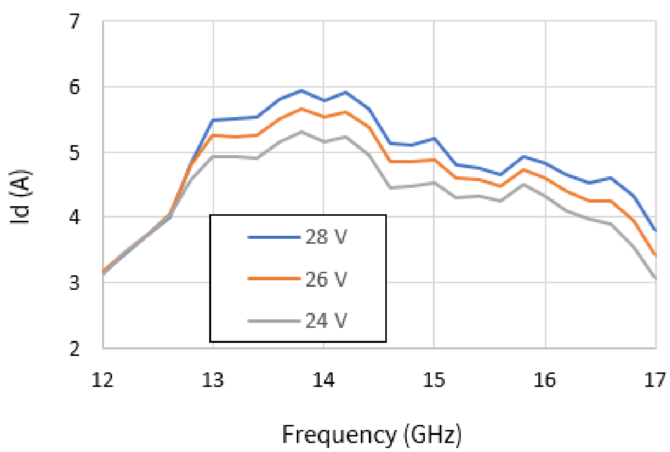
Output Power vs. Frequency



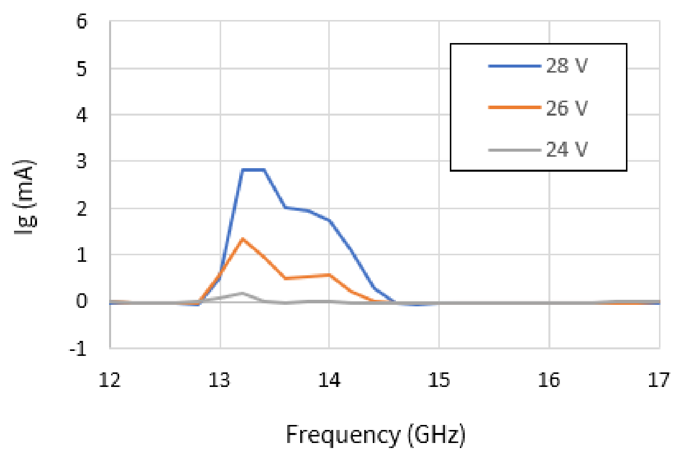
Power-Added Efficiency vs. Frequency



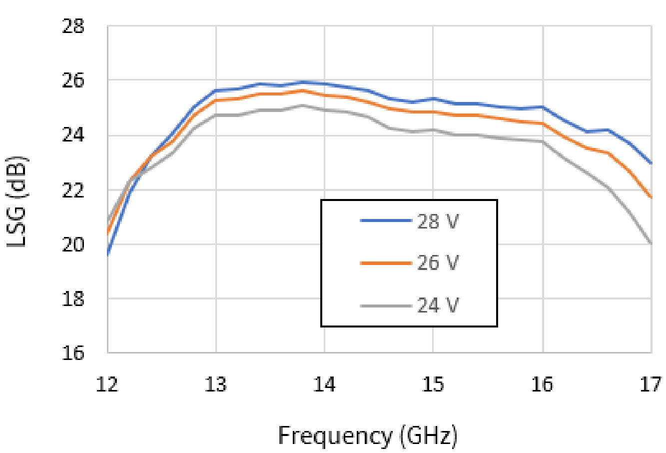
Drain Current vs. Frequency



Gate Current vs. Frequency



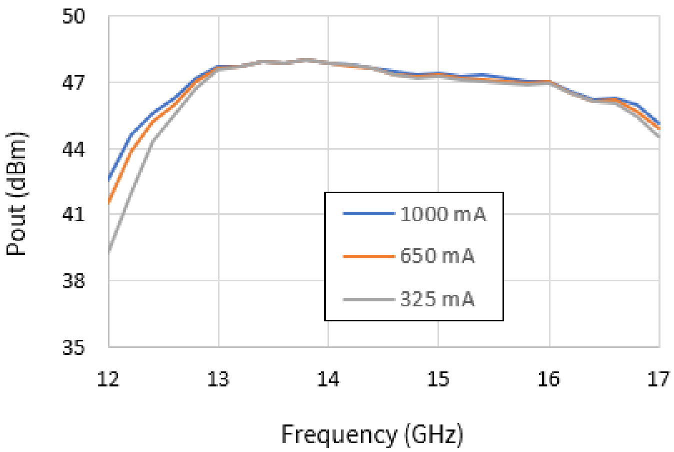
Large Signal Gain vs. Frequency



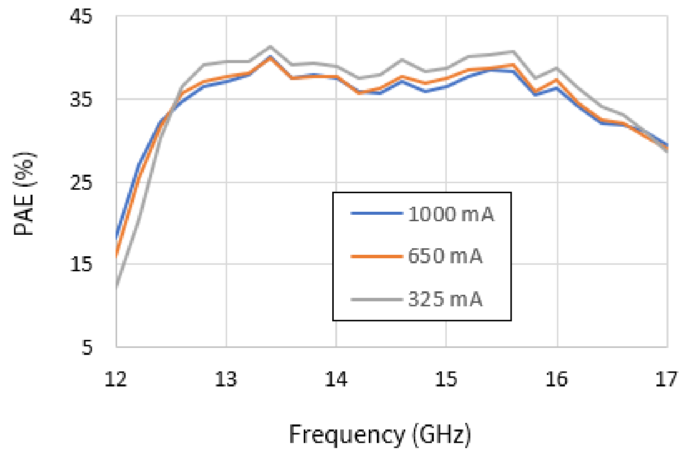
Typical Performance Curves - Large Signal over I_{DQ}:

V_D = 28 V, CW, P_{IN} = 22 dBm, T_C=25°C

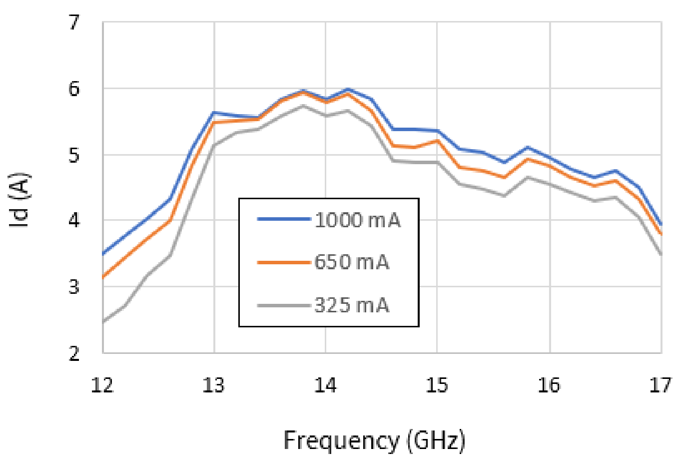
Output Power vs. Frequency



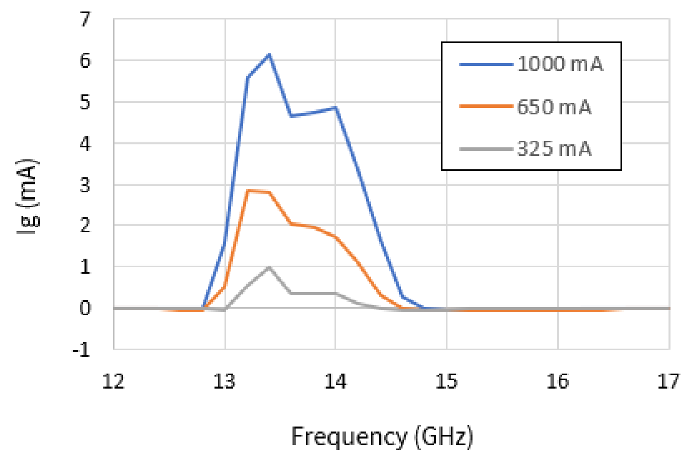
Power-Added Efficiency



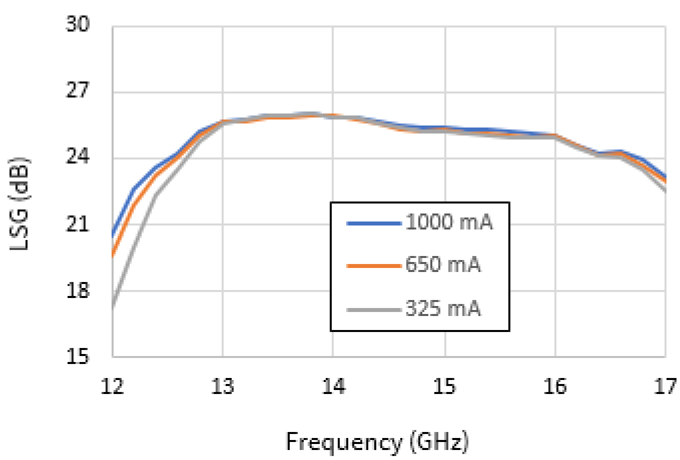
Drain Current vs. Frequency



Gate Current vs. Frequency



Large Signal Gain vs. Frequency



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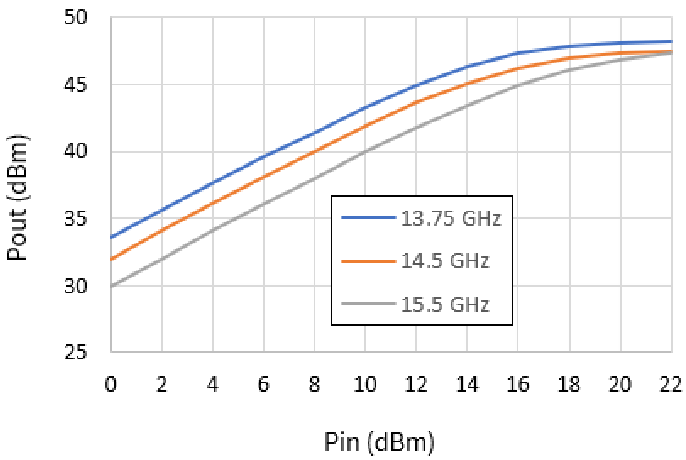
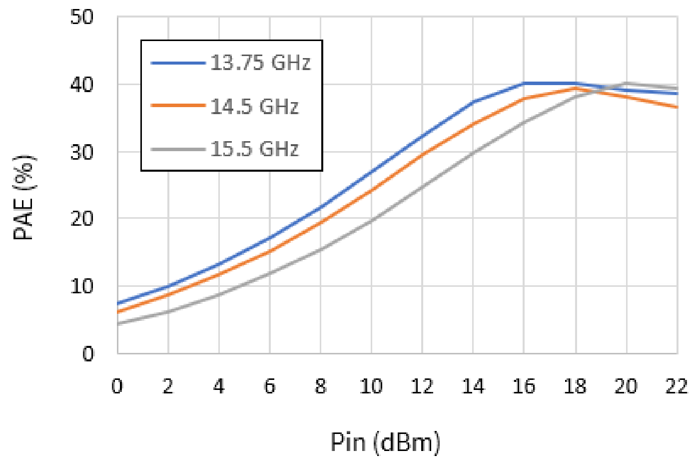
Typical Performance Curves - Drive-Up over Frequency:

V_D = 28 V, I_{DQ} = 650 mA, CW, T_C = 25°C

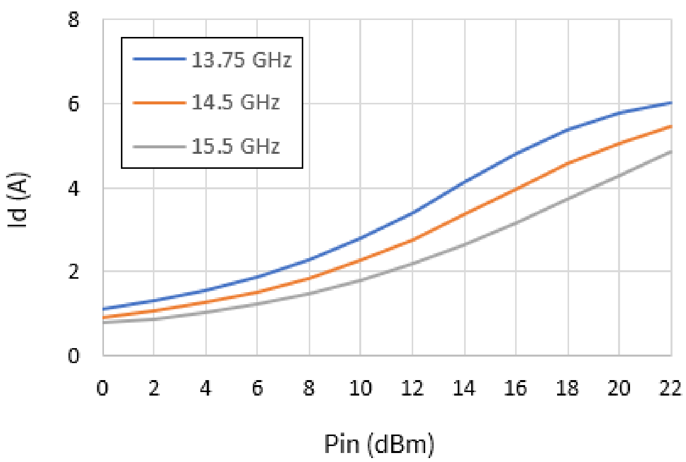
Output Power vs. Input Power



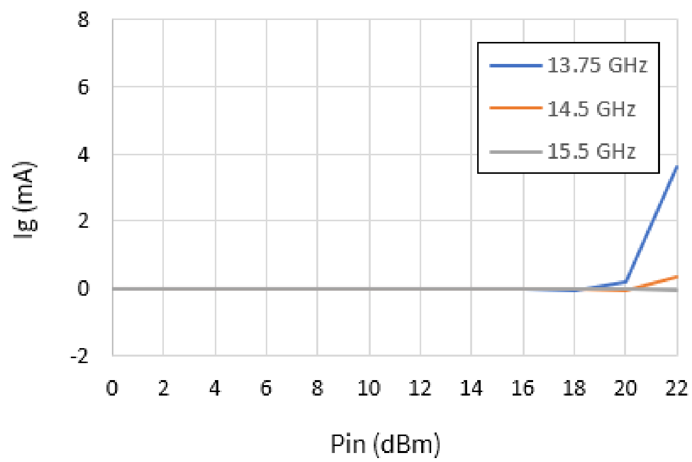
Power-Added Efficiency vs. Input Power



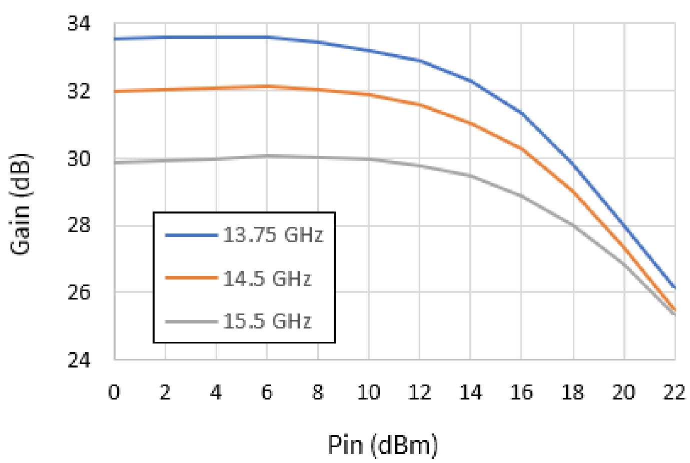
Drain Current vs. Input Power



Gate Current vs. Input Power



Gain vs. Input Power



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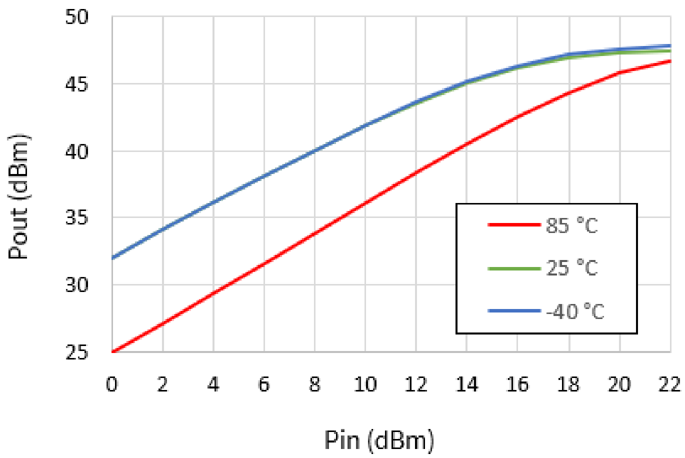
DC-0031256

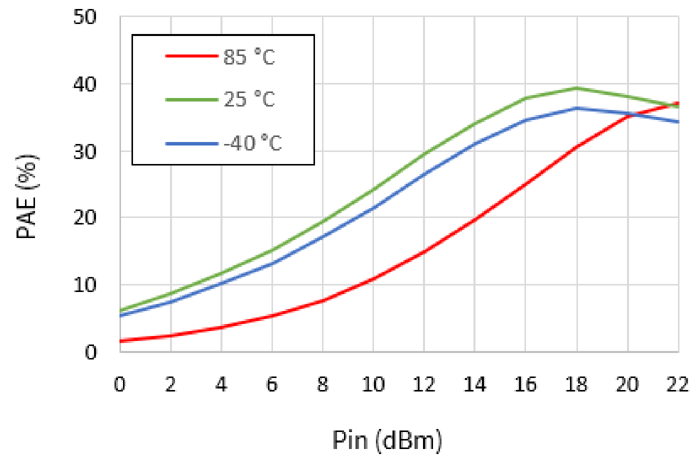
Typical Performance Curves - Drive-Up over Temperature:

V_D = 28 V, I_{DQ} = 650 mA, CW, Frequency: 14.5GHz

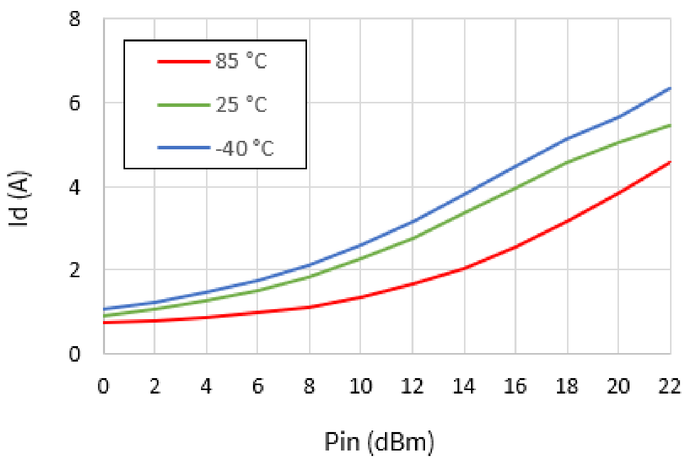
Output Power vs. Input Power



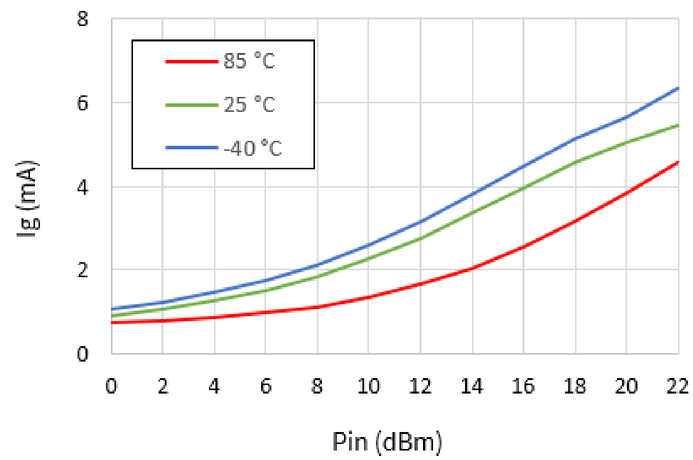
Power-Added Efficiency vs. Input Power



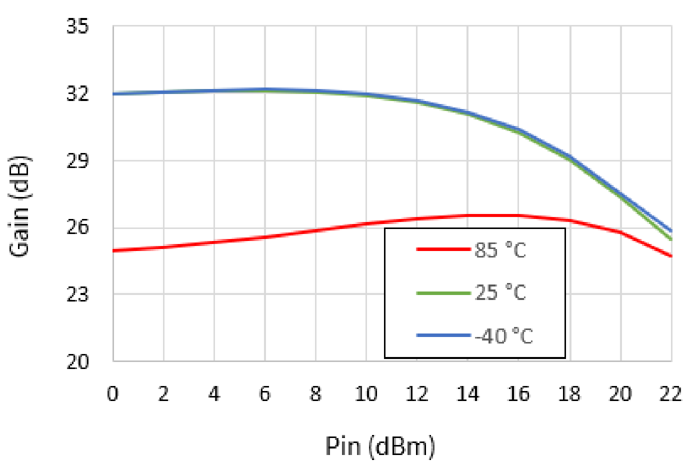
Drain Current vs. Input Power



Gate Current vs. Input Power



Gain vs. Input Power



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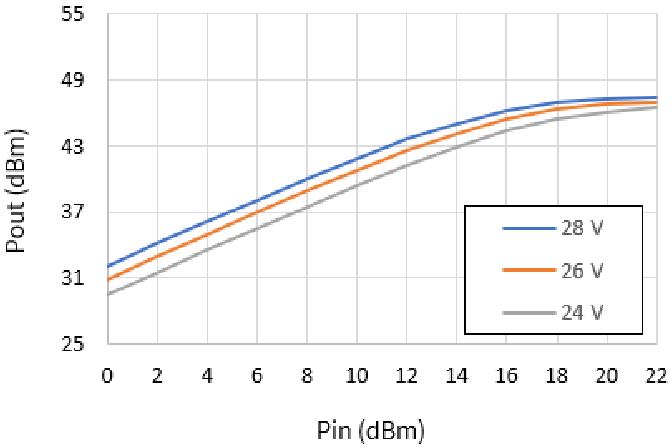
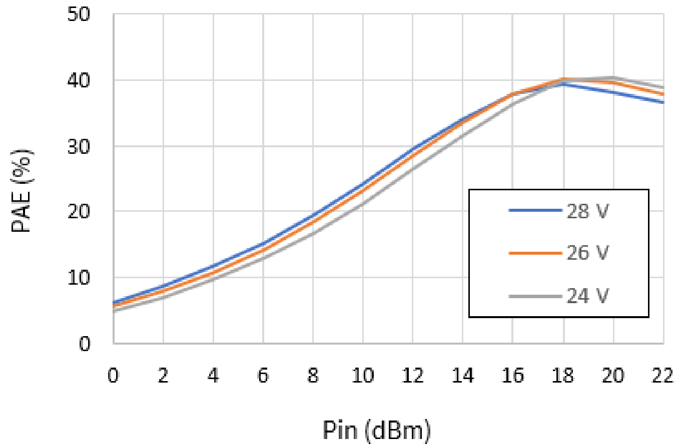
Typical Performance Curves - Drive-Up over V_D:

I_{DQ} = 650 mA, CW, T_C = 25°C, Frequency: 14.5GHz

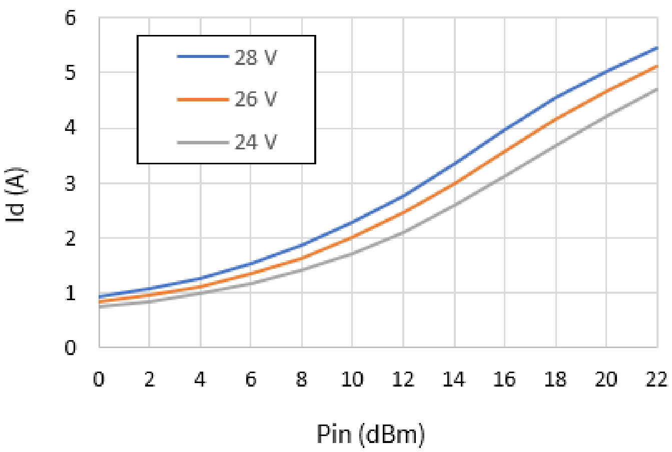
Output Power vs. Input Power



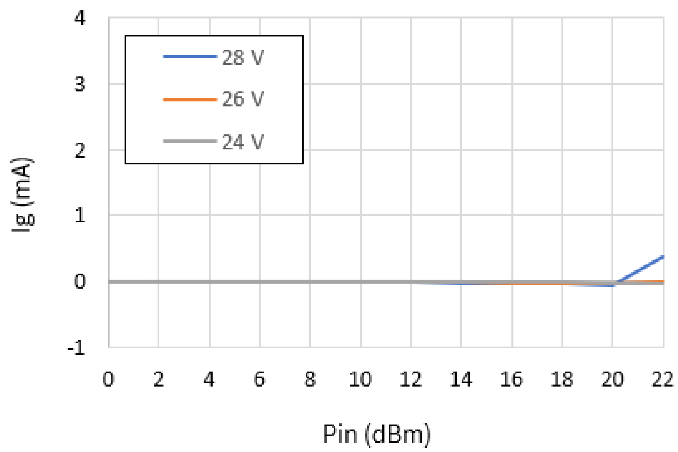
Power-Added Efficiency vs. Input Power



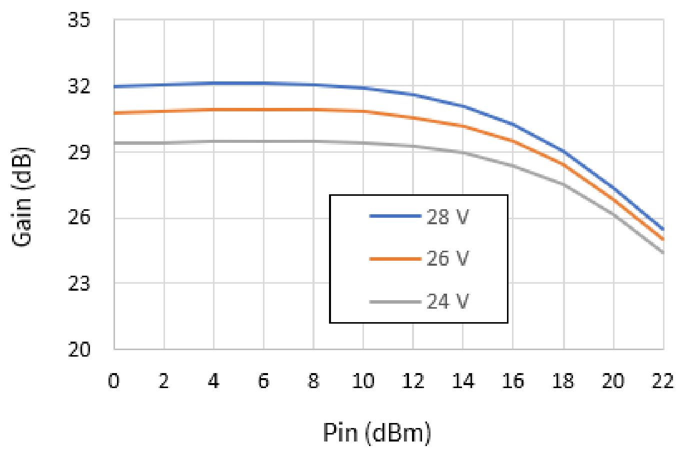
Drain Current vs. Input Power



Gate Current vs. Input Power



Gain vs. Input Power



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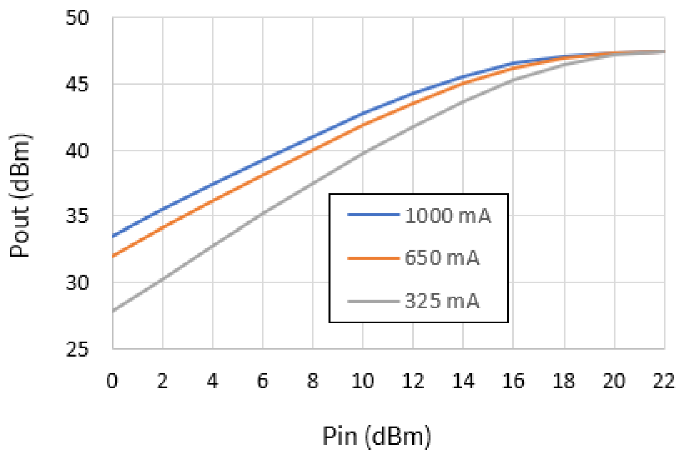
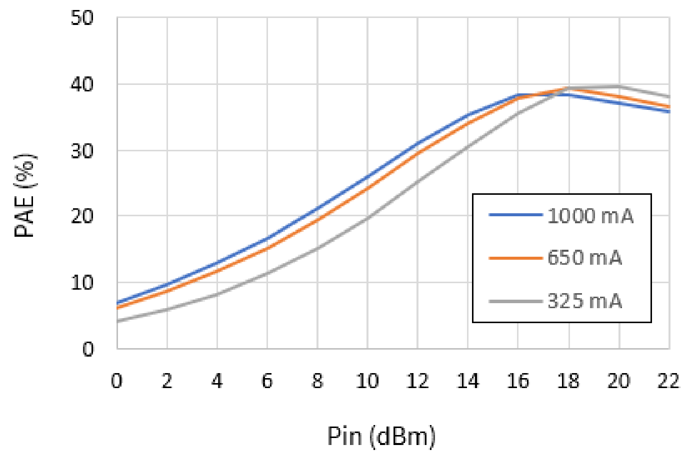
Typical Performance Curves - Drive-Up over I_{DQ}:

V_D = 28 V, CW, T_C = 25°C, Frequency: 14.5GHz

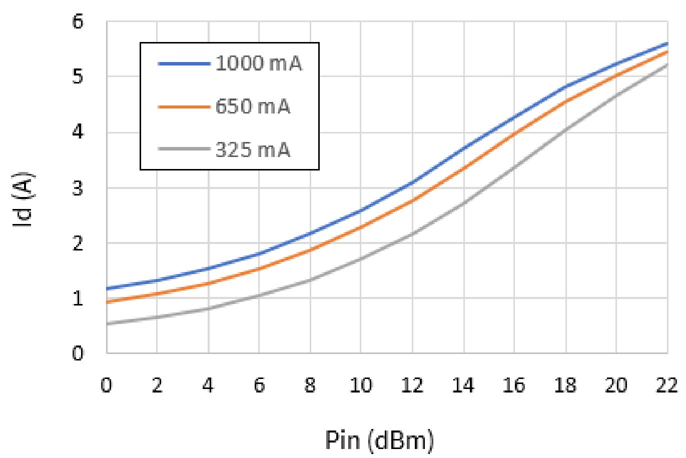
Output Power vs. Input Power



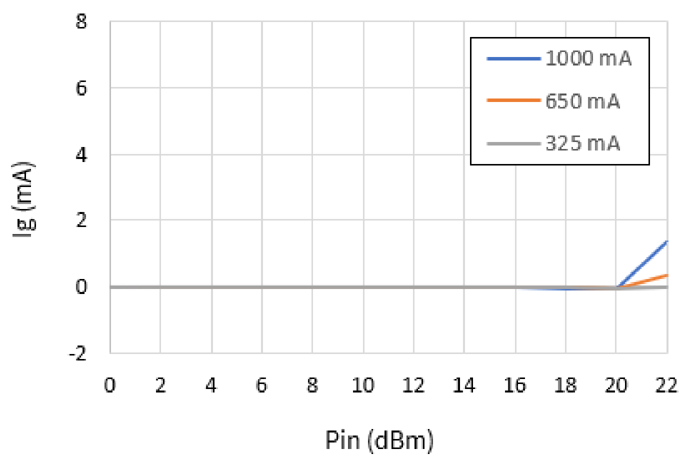
Power-Added Efficiency vs. Input Power



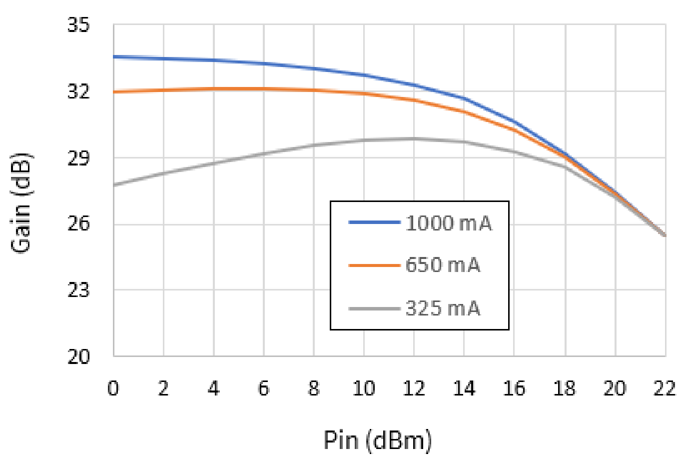
Drain Current vs. Input Power



Gate Current vs. Input Power



Gain vs. Input Power



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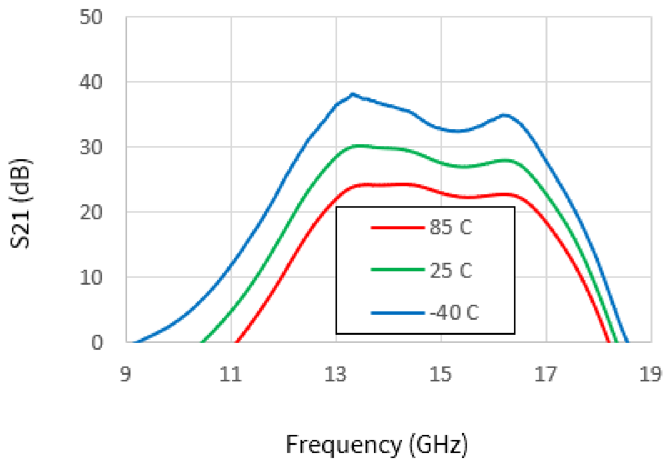
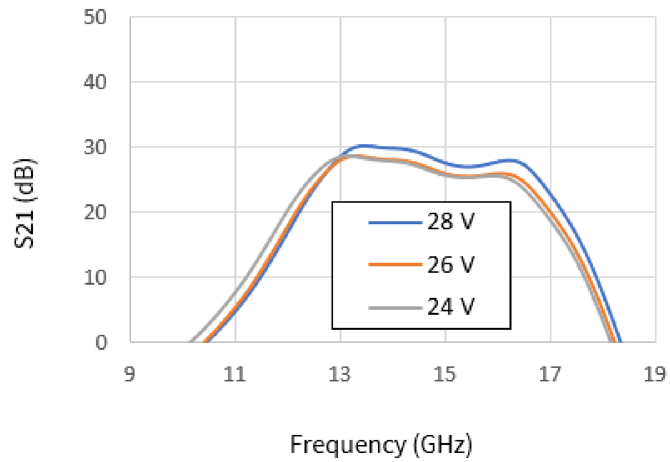
Typical Performance Curves - Small Signal over Temperature and V_D:

I_{DQ} = 650 mA, CW, P_{IN} = -20 dBm

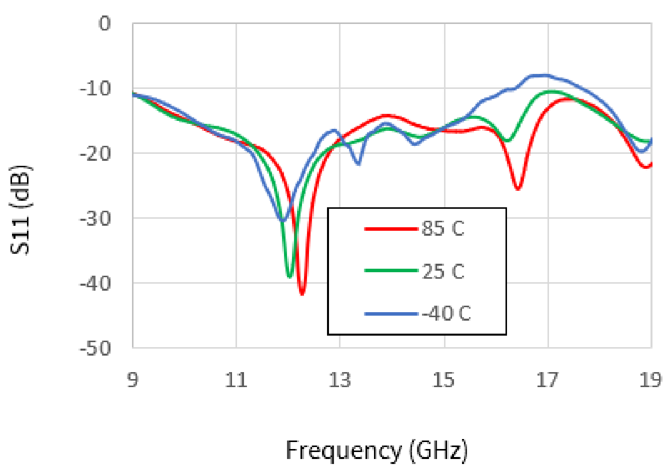
S21 vs. Frequency over Temperature @ V_D = 28 V



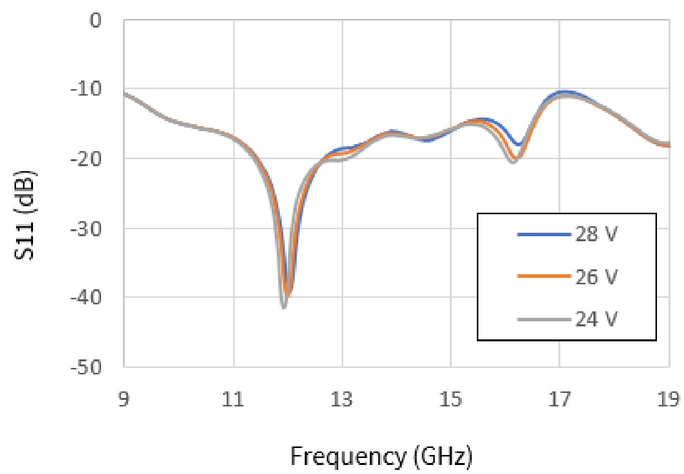
S21 vs. Frequency over V_D @ 25°C



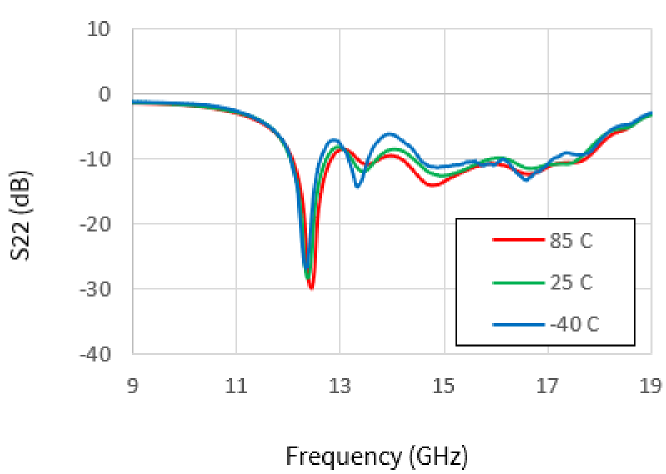
S11 vs. Frequency over Temperature @ V_D = 28 V



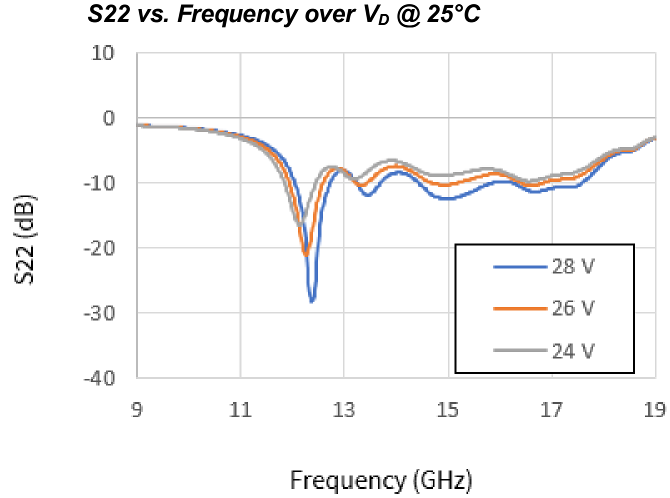
S11 vs. Frequency over V_D @ 25°C



S22 vs. Frequency over Temperature @ V_D = 28 V



S22 vs. Frequency over V_D @ 25°C



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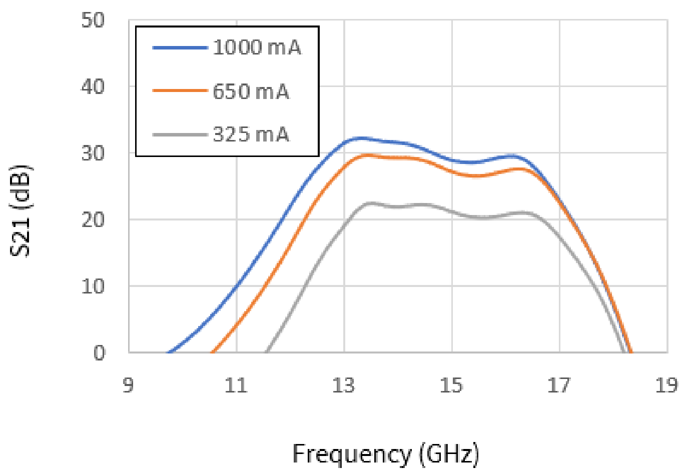
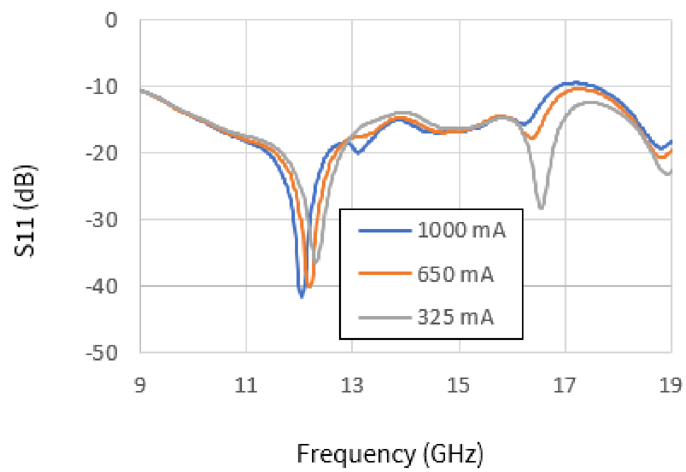
Typical Performance Curves - Small Signal over I_{DQ}:

V_D = 28 V, CW, P_{IN} = 22 dBm, T_C = 25°C

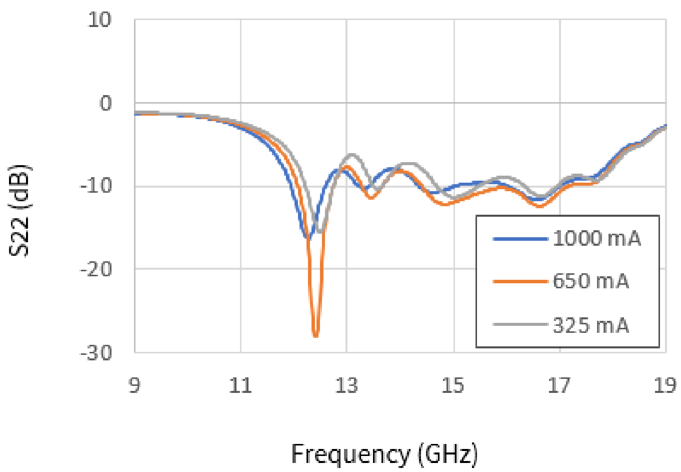
S21 vs. Frequency over I_{DQ}



S11 vs. Frequency over I_{DQ}



S22 vs. Frequency over I_{DQ}



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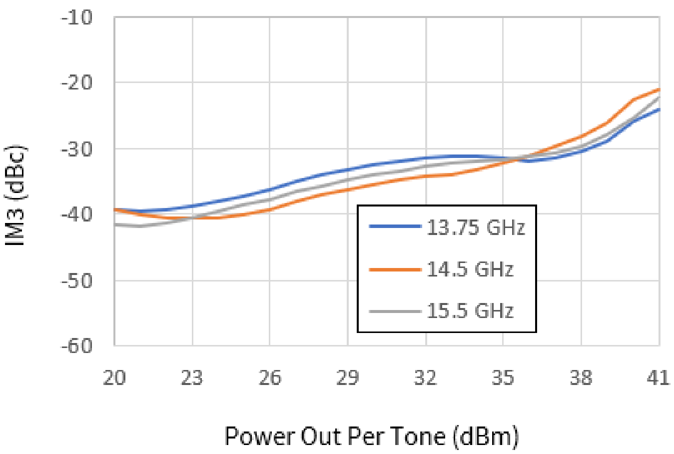
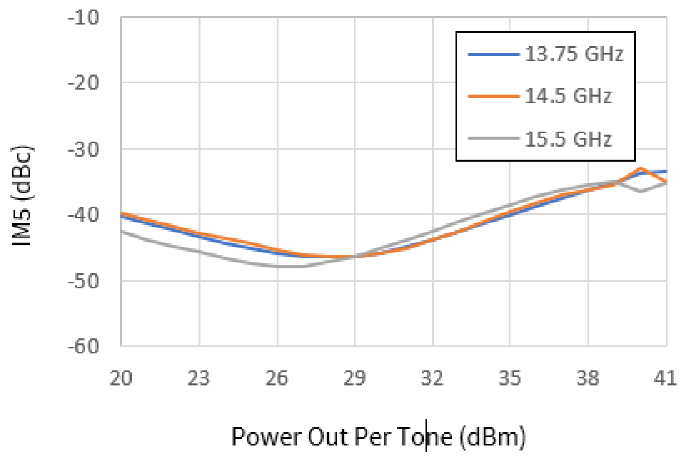
Typical Performance Curves - Linearity (IM3 and IM5)

V_D = 28 V, I_{DQ} = 650 mA, CW, P_{OUT} = 43 dBm, Frequency = 14.5 GHz, Tone Spacing = 10MHz, T_C = 25°C

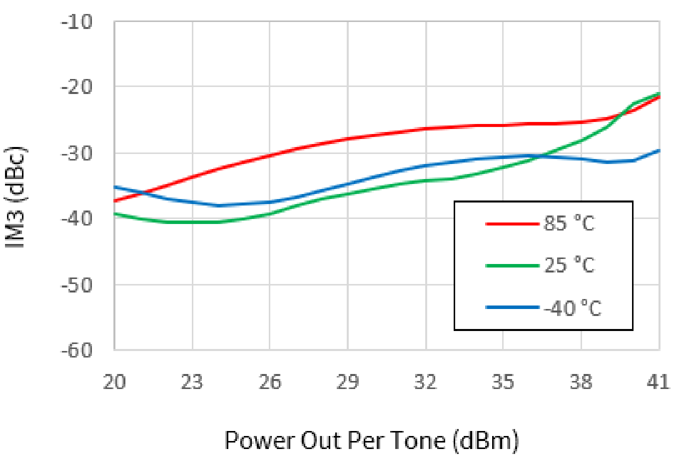
IM3 vs. Pout/tone over Frequency



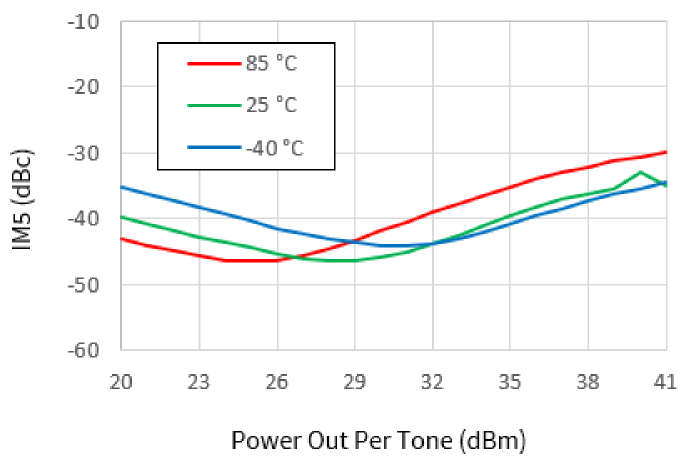
IM5 vs. Pout/tone over Frequency



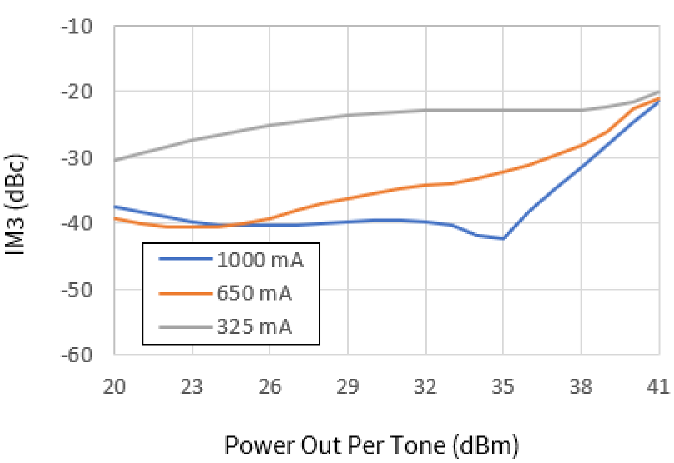
IM3 vs. Pout/tone over Temperature



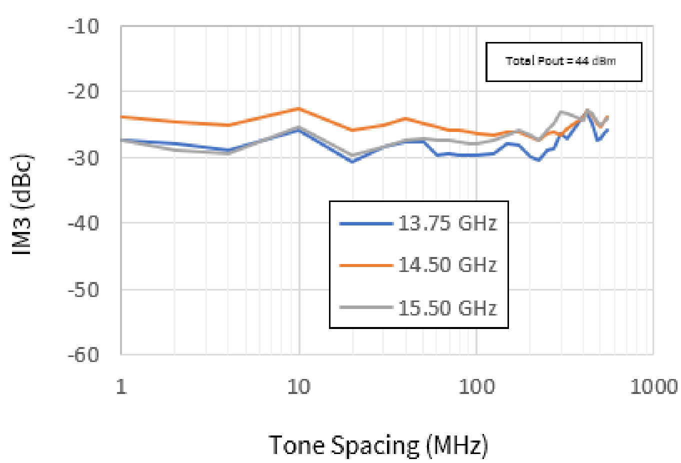
IM5 vs. Pout/tone over Temperature



IM3 vs. Pout/tone over Idq



IM3 vs. Tone Spacing over Frequency



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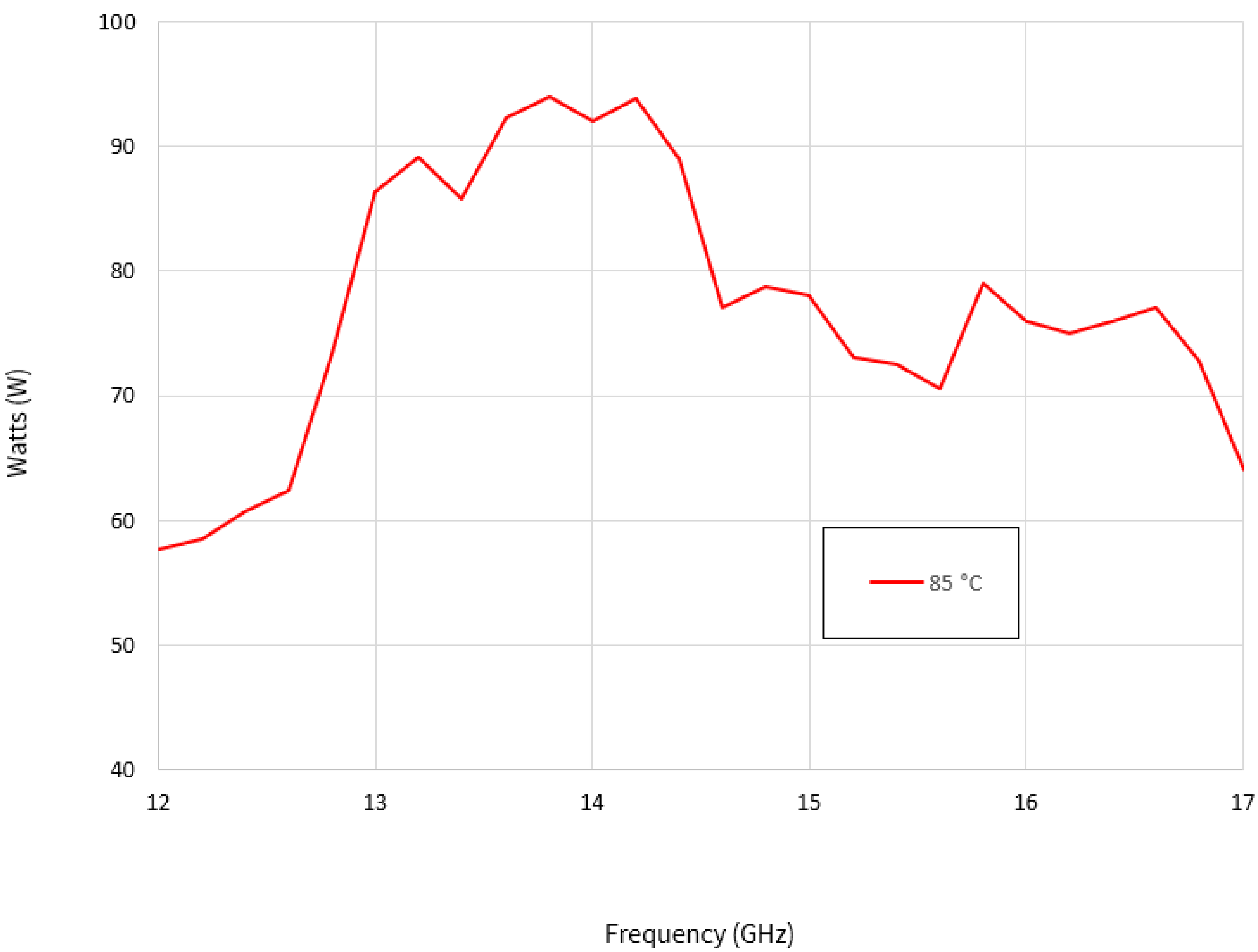
Thermal Characteristics

Parameter	Operating Conditions	Value
Operating Junction Temperature (T_J)	Freq = 2.5 GHz, V_D = 50 V, I_{DQ} = 500 mA, I_{DRIVE} = 1.8 A, P_{IN} = 32 dBm, P_{OUT} = 45.67 dBm, P_{DISS} = 55.5 W, T_C = 85°C, CW	206.4ºC
Thermal Resistance, Junction to Case ($R_{θJC}$)		2.187

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



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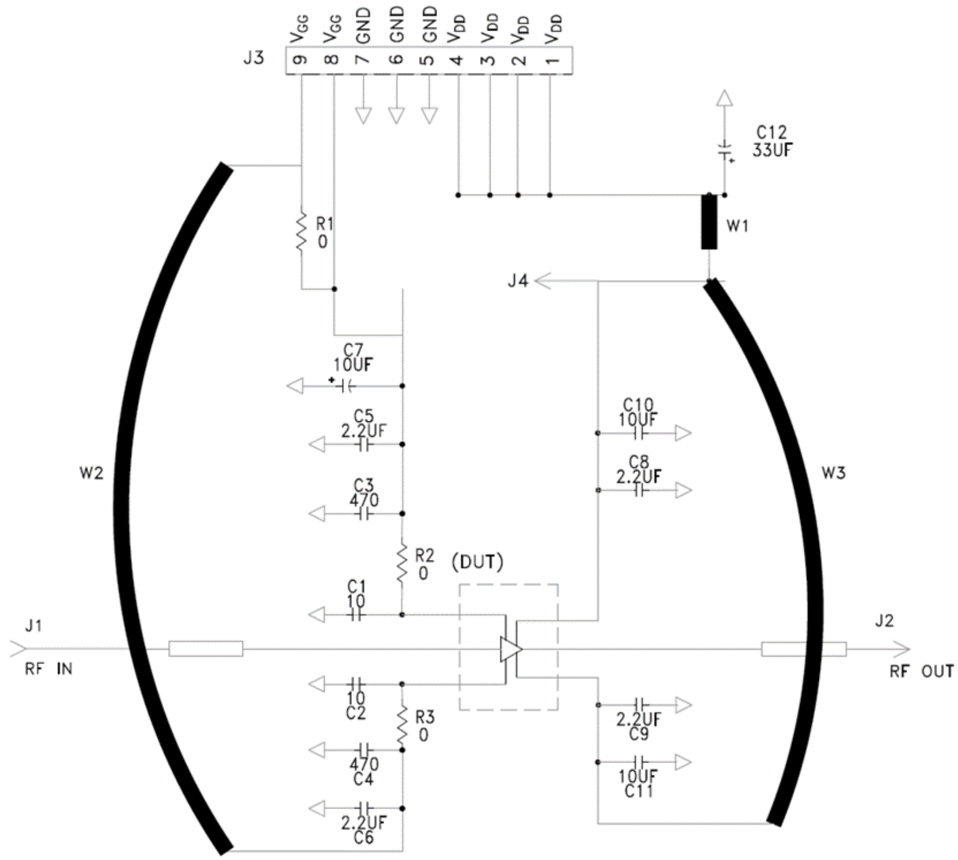
Evaluation Board Schematic (CMPA1E1F060F-AMP)



Parts List

Part	Value	Qty.
R1, R2, R3	RES 0 Ohm, 0603	3
C1,C2	CAP, 10PF, +/-5%, ATC600S	2
C3,C4	CAP, 470PF, 5%, 100V, 0603	2
C5,C6,C8,C9	CAP, 2.2UF	4
C7	CAP 10UF 16V TANTALUM, 2312	1
C10,C11	CAP, 10UF	2
C12	CAPACITOR, 33UF, 100V, Electrolytic	1
-	PCB, RO3003, .010 THK, HPHF Package	1
-	BASEPLATE 3.0x1.5x0.25 Cu	1
J1, J2	Connector 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	WIRE, BLACK, 30 AWG	1
W2, W3	WIRE, BLACK, 22 AWG	2
U1	CMPA1E1F060F	1

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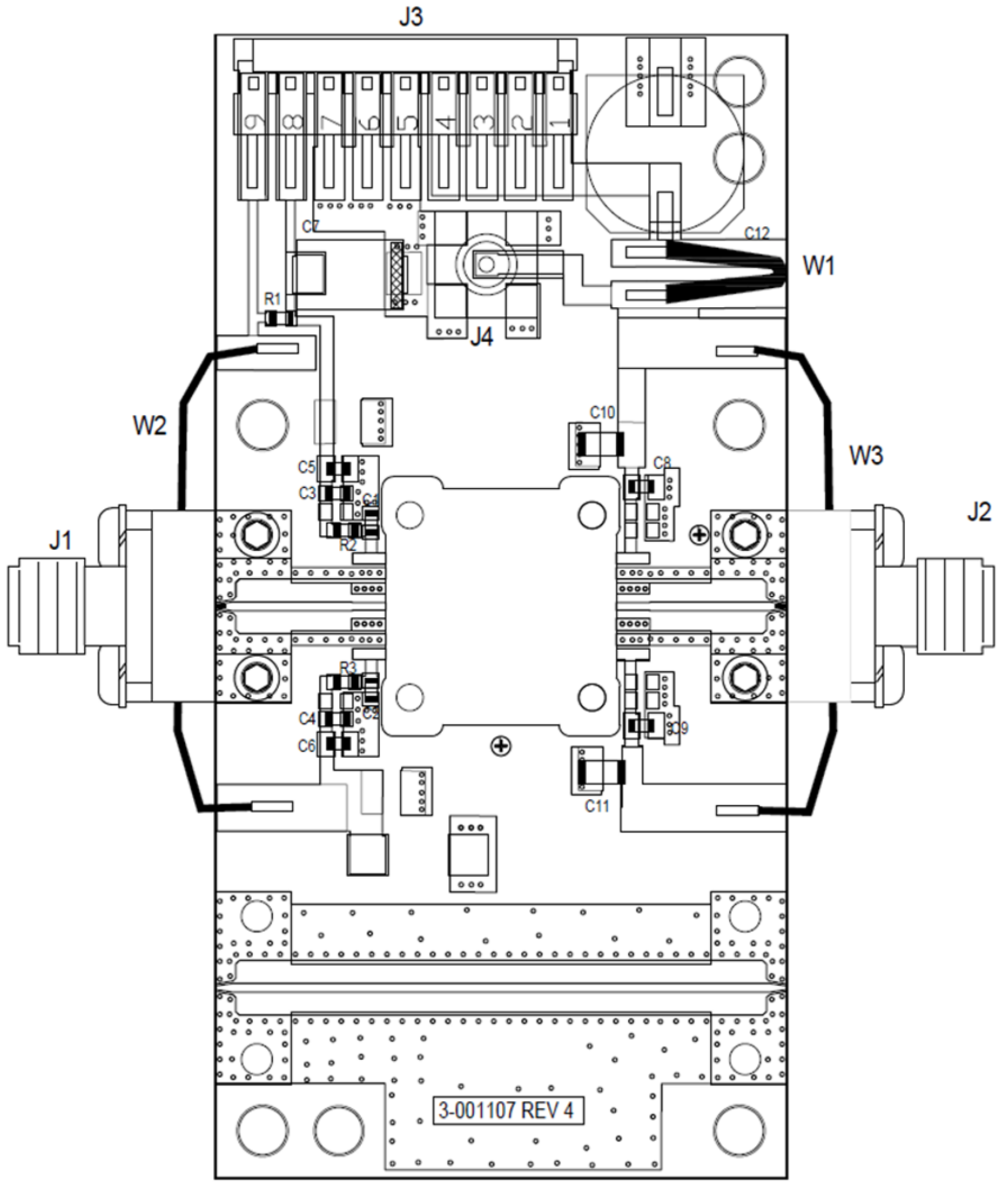
Evaluation Board Assembly Drawing (CMPA1E1F060F-AMP)



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)

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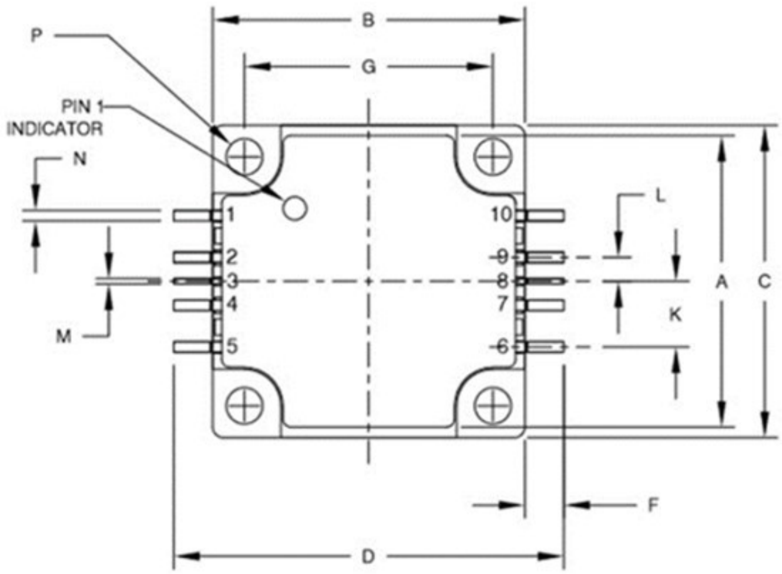
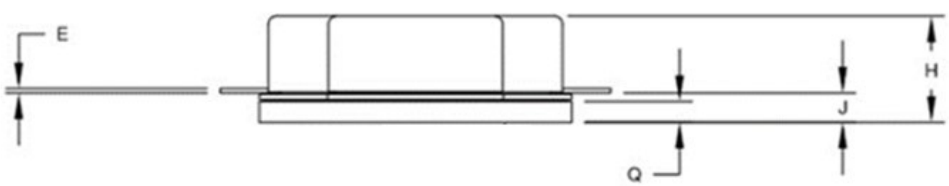
Mechanical Information





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

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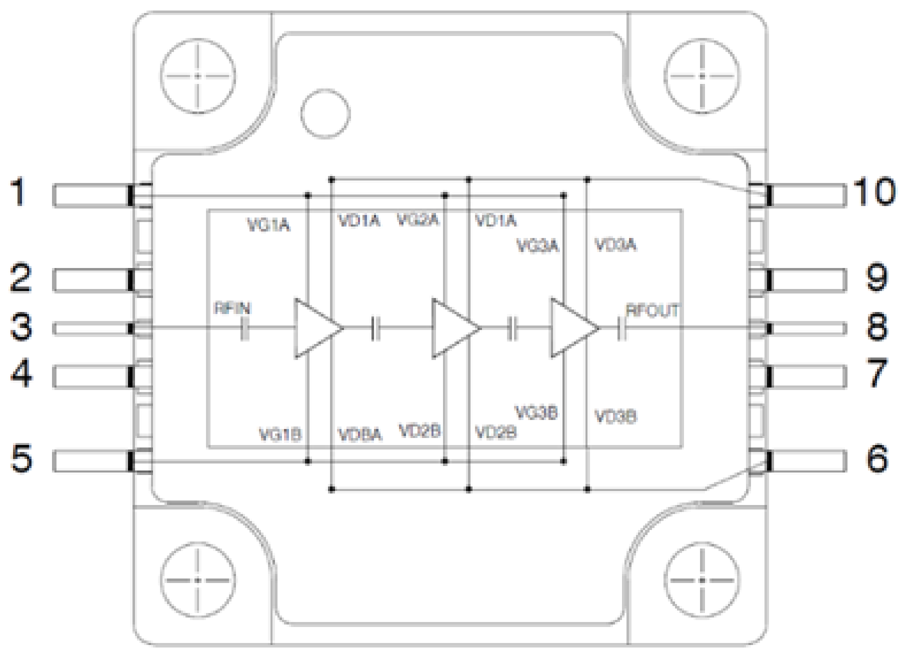
Pin Description

Pin #	Name	Description
1	VG	Pins 1 and 5 must be electrically connected to the gate bias voltage.
2	GND	RF and DC ground
3	RF Input	RF Input. 50-ohm matched. Internally DC blocked.
4	GND	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	GND	RF and DC ground
8	RF Output	RF Output. 50-ohm matched. Internally DC blocked.
9	GND	RF and DC ground
10	VD	Pins 6 and 10 must be electrically connected to the drain bias voltage.
Paddle	GND	RF and DC ground



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Revision History

Rev	Date	Change Description
V1P	09/17/2024	Initial preliminary release.
V1	09/29/2025	Production release.

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