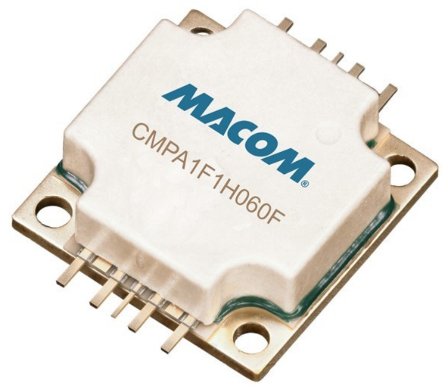
GaN High Power Amplifier, 60 W
15.4 - 17.7 GHz

CMPA1F1H060F
Rev. V1

Features

- Saturated Power: 60 W
- Power Added Efficiency: 35%
- Large Signal Gain: 25 dB
- Small Signal Gain: 23 dB
- Input Return Loss: -20 dB
- Output Return Loss: -10 dB
- Pulsed operation



Applications

- Defense and Commercial Ku-Band Radar

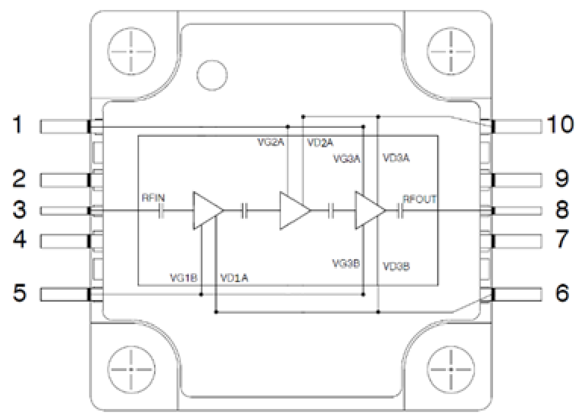
Description

MACOM's CMPA1F1H060F is an 60 W package MMIC HPA utilizing MACOM's high performance, 0.15μm GaN-on-SiC production process. The CMPA1F1H060F operates from 15.4 - 17.7 GHz and supports both defense and commercial-related radar applications. The CMPA1F1H060F achieves 60 W of saturated output power with 25 dB of large signal gain and typically 35% power-added efficiency under pulsed operation.

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

Packaged in a 15 mm bolt-down, flange package, the CMPA1F1H060F provides superior RF performance and thermal management allowing customers to improve SWaP-C benchmarks in their next-generation systems.

Functional Schematic



Ordering Information

Part Number	Package (MOQ/ Mult)
CMPA1F1H060F	Tray (10/10)
CMPA1F1H060F-AMP	Sample Board (1/1)

Pin Configuration[1]

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

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

RF Electrical Specifications: V_D = 28 V, I_{DQ} = 430 mA, T_C = 25°C, Z_0 = 50 Ω

Parameter	Test Conditions	Frequency (GHz)	Units	Min.	Typ.	Max.
Output Power	P_{IN} = 23 dBm Pulse: 150 µs, 20%	15.4 16.4 17.7	dBm	46.5 47.0 47.0	47.5 48.0 48.0	—
Power Added Efficiency		15.4 16.4 17.7	%	28 30 28	35 37 33	—
Large Signal Gain		15.4 16.4 17.7	dB	—	24.5 25 25	—
Small Signal Gain	P_{IN} = -20 dBm CW	15.4 16.4 17.7	dB	—	23 23 22	—
Input Return Loss		15.4-17.7	dB	—	-20	—
Output Return Loss		15.4-17.7	dB	—	-10	—

DC Electrical Specifications:

Parameter	Units	Min.	Typ.	Max.
Drain Voltage	V	—	28	—
Gate Voltage	V	—	-1.9	—
Quiescent Drain Current	mA	—	430	—
Saturated Drain Current	A	—	6.5	—

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	—	430	—
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 Breakdown Voltage	BV_{DS}	V	—	84
Drain Voltage	V_D	V	—	28
Gate Voltage	V_G	V	-8	+2
Drain Current	I_D	A	—	9
Gate Current	I_G	mA	—	21
Dissipated Power @ +85°	P_{DISS}	W	—	150
VSWR	—	Ratio	—	7:1
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:

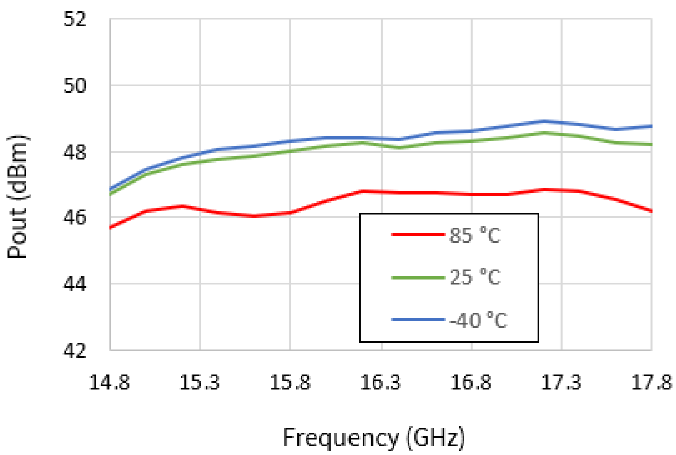
Static Sensitivity

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.

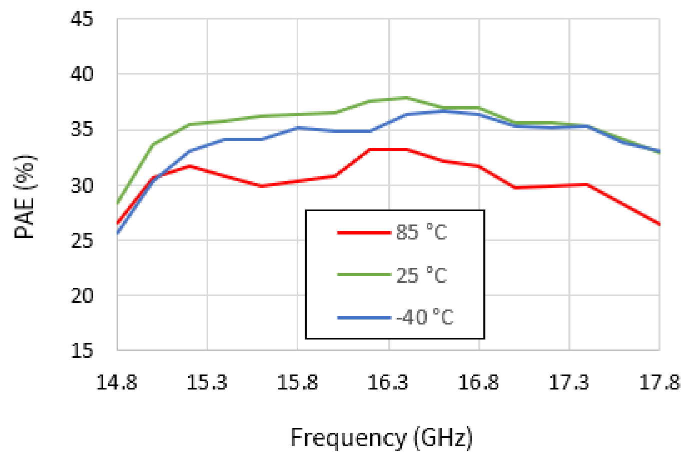
Typical Performance Curves - Large Signal over Temperature

V_D = 28 V, I_{DQ} = 430 mA, PW = 150µS, DC = 20%, P_{IN} = 23 dBm

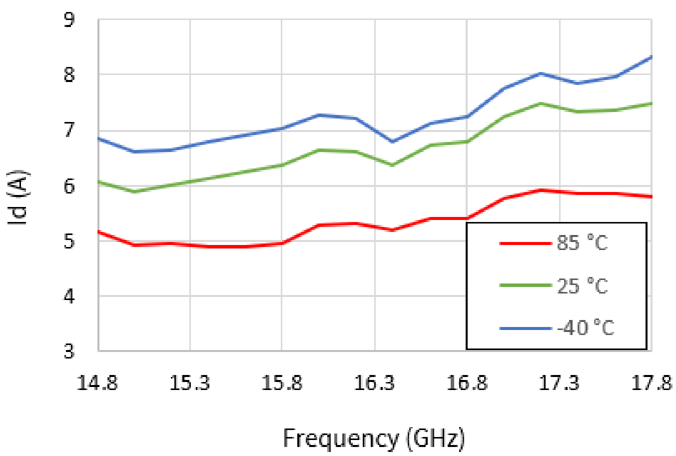
Output Power vs. Frequency



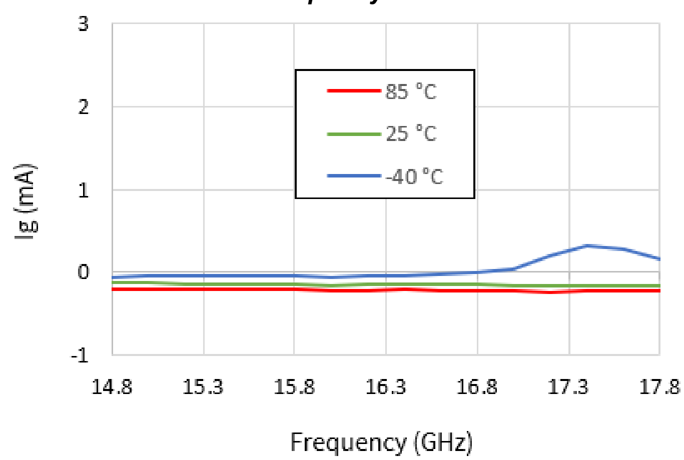
Power Added Efficiency vs. Frequency



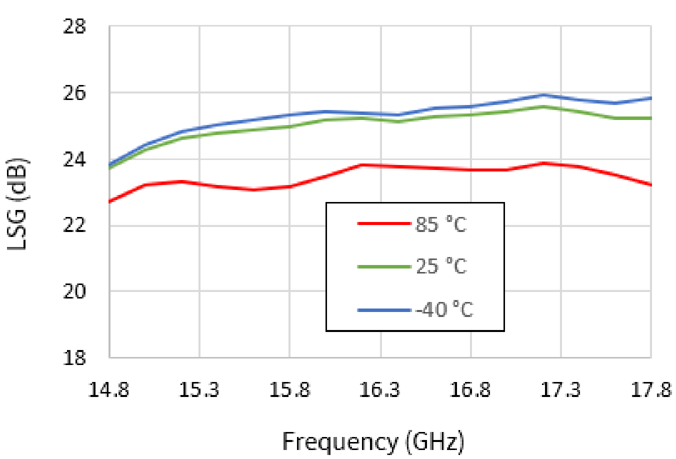
Drain Current vs. Frequency



Gate Current vs. Frequency



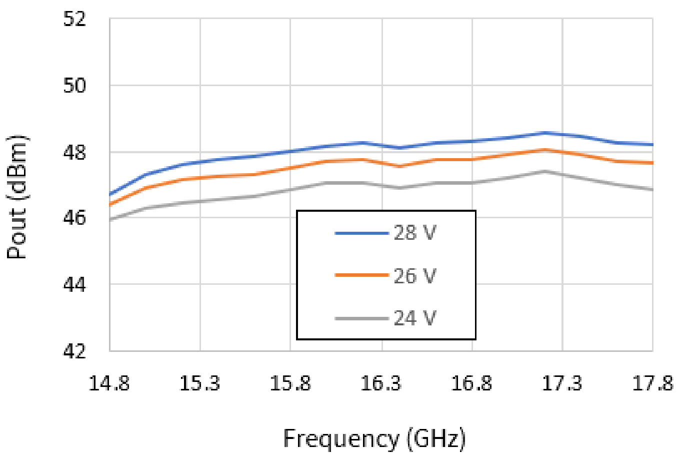
Large Signal Gain vs. Frequency



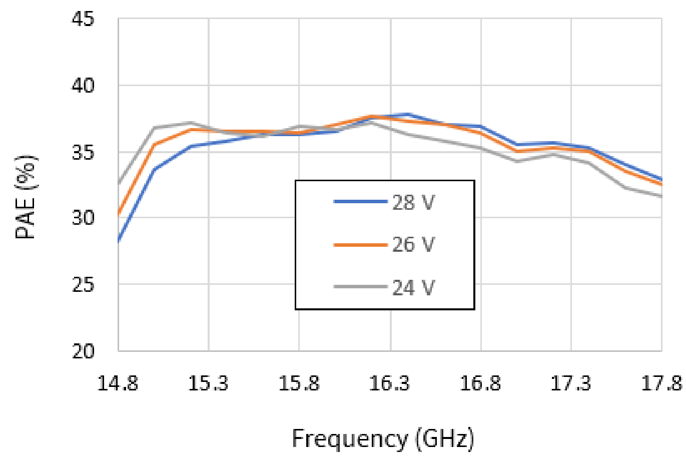
Typical Performance Curves - Large Signal over V_D

I_{DQ} = 430 mA, PW = 150µS, DC = 20%, P_{IN} = 23 dBm, T_C = 25°C

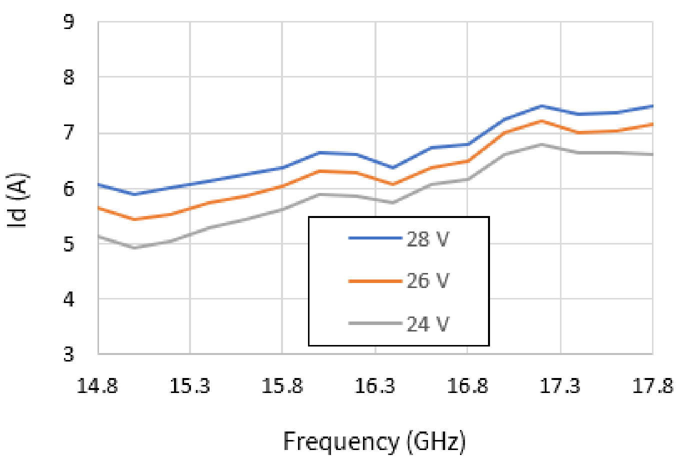
Output Power vs. Frequency



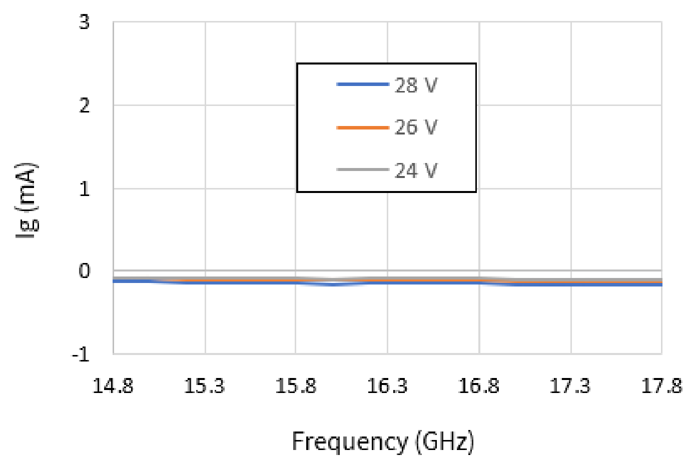
Power Added Efficiency vs. Frequency



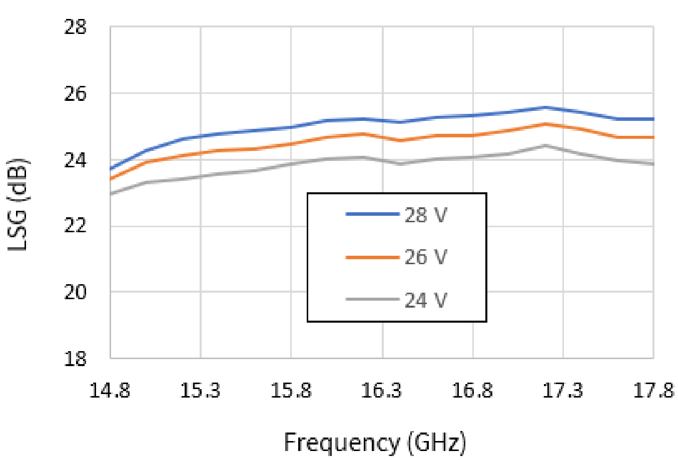
Drain Current vs. Frequency



Gate Current vs. Frequency



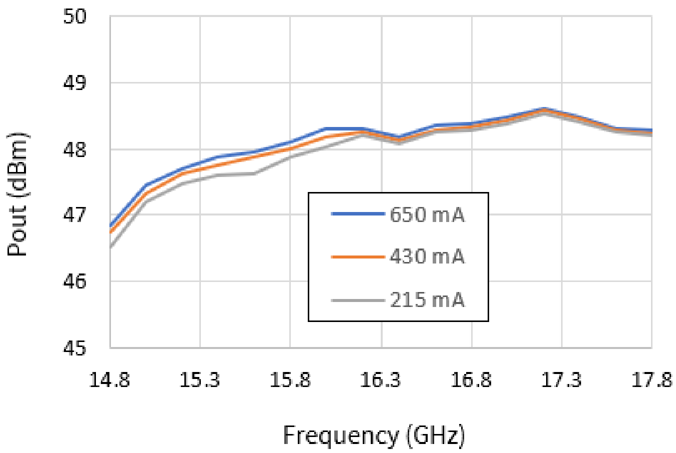
Large Signal Gain vs. Frequency



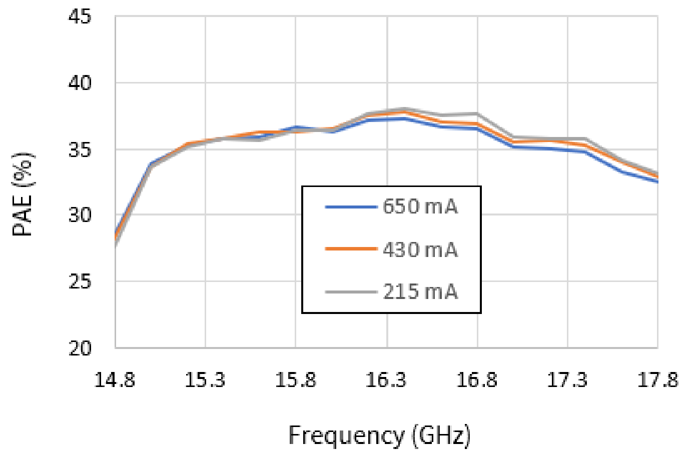
Typical Performance Curves - Large Signal over I_{DQ}

V_D = 28 V, PW = 150µS, DC = 20%, P_{IN} = 23 dBm, T_C = 25°C

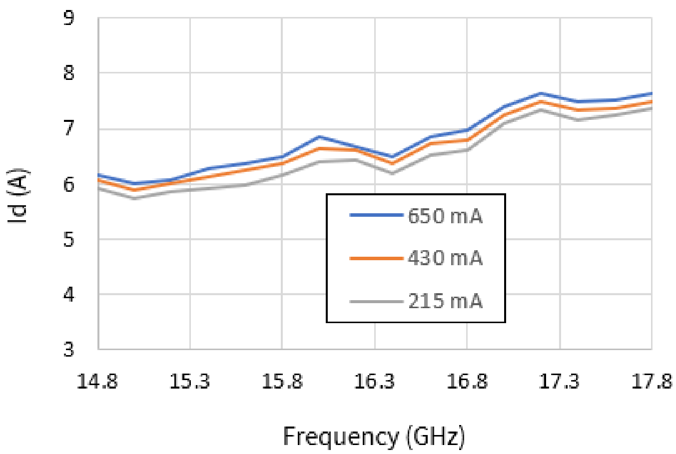
Output Power vs. Frequency



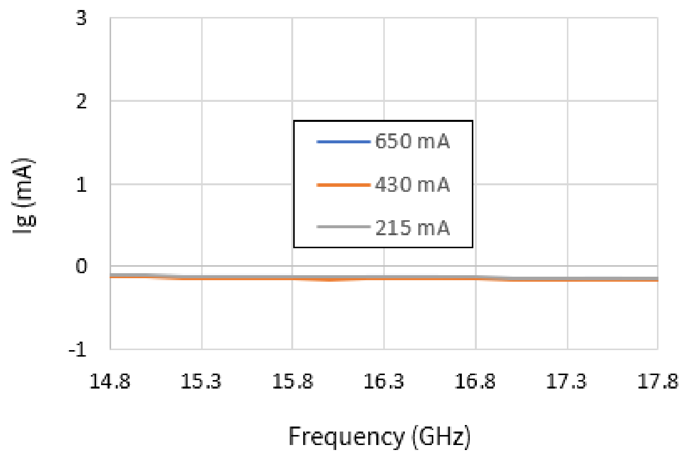
Power Added Efficiency vs. Frequency



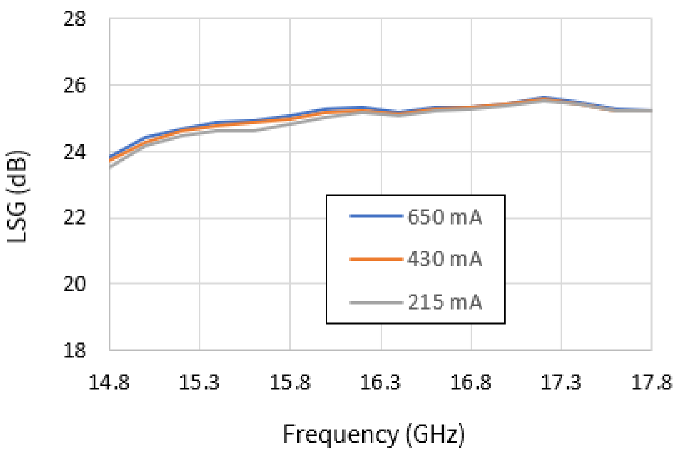
Drain Current vs. Frequency



Gate Current vs. Frequency



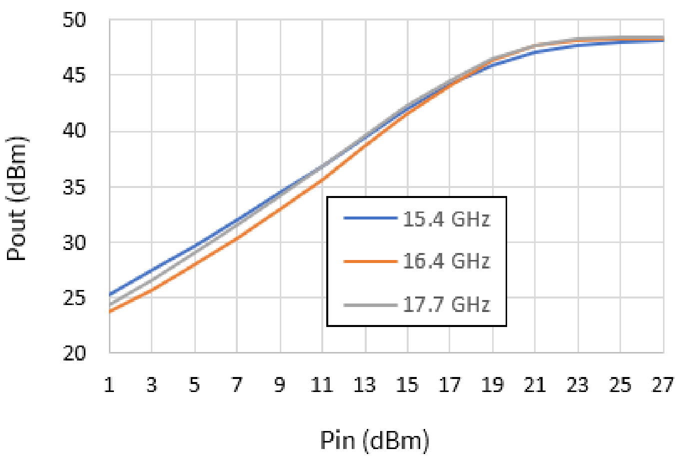
Large Signal Gain vs. Frequency



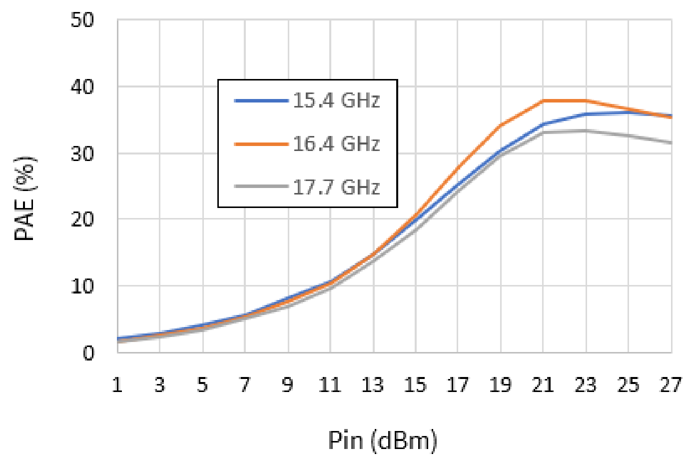
Typical Performance Curves - Drive-Up over Frequency

V_D = 28 V, I_{DQ} = 430 mA, PW = 150µS, DC = 20%, T_C = 25°C

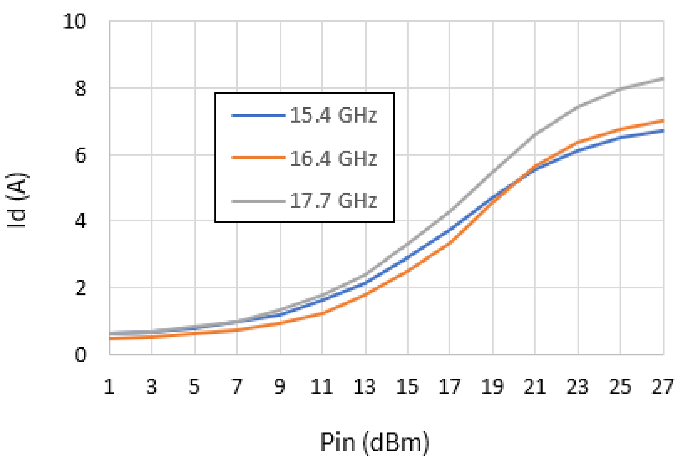
Output Power vs. Input Power



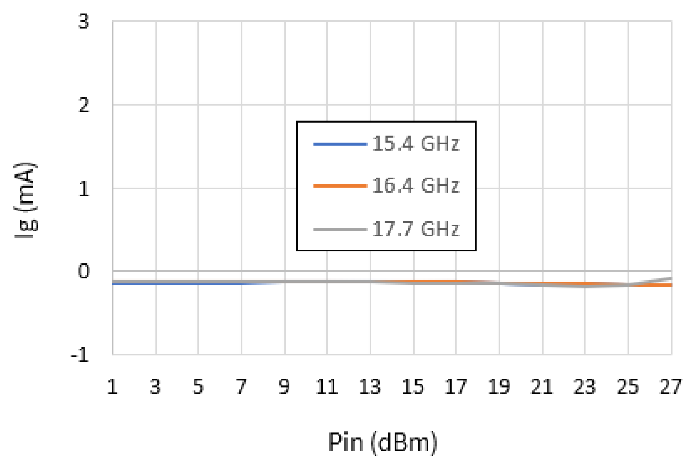
Power Added Efficiency vs. Input Power



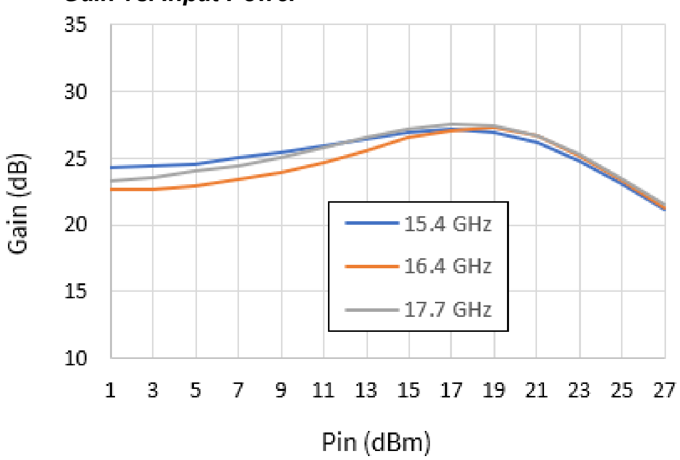
Drain Current vs. Input Power



Gate Current vs. Input Power



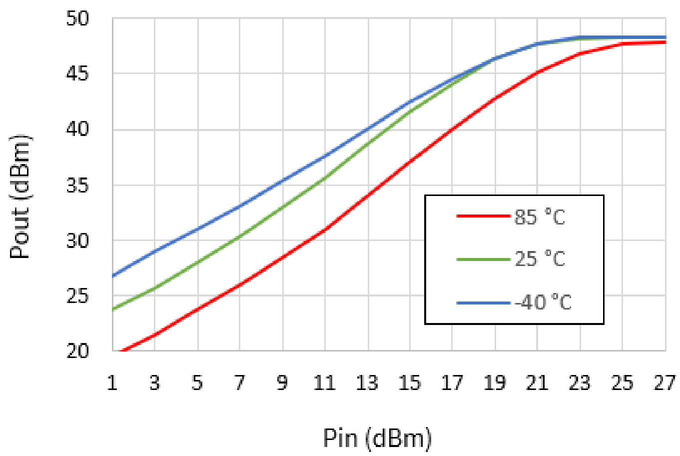
Gain vs. Input Power



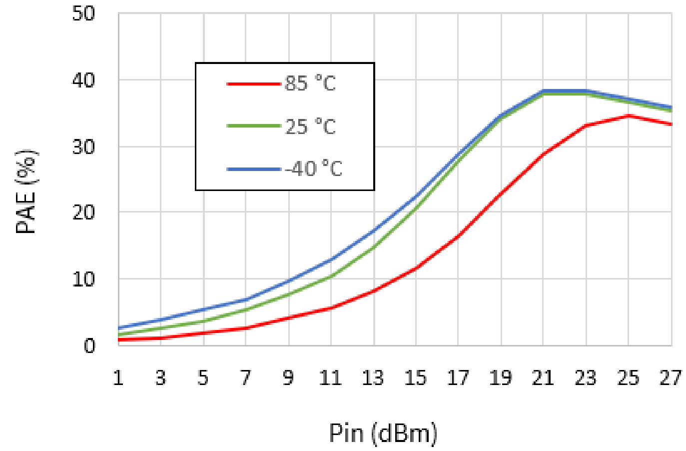
Typical Performance Curves - Drive-Up over Temperature

V_D = 28 V, I_{DQ} = 430 mA, PW = 150µS, DC = 20%, Frequency = 16.4 GHz

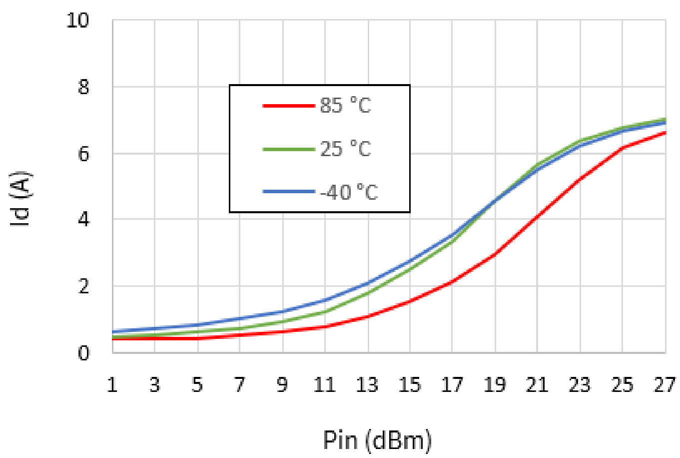
Output Power vs. Input Power



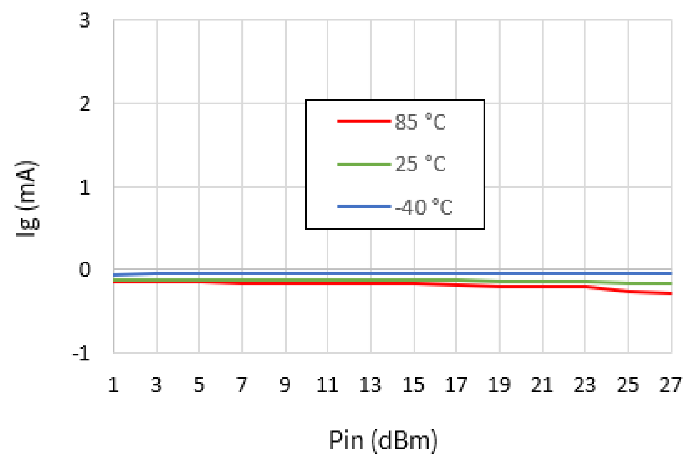
Power Added Efficiency vs. Input Power



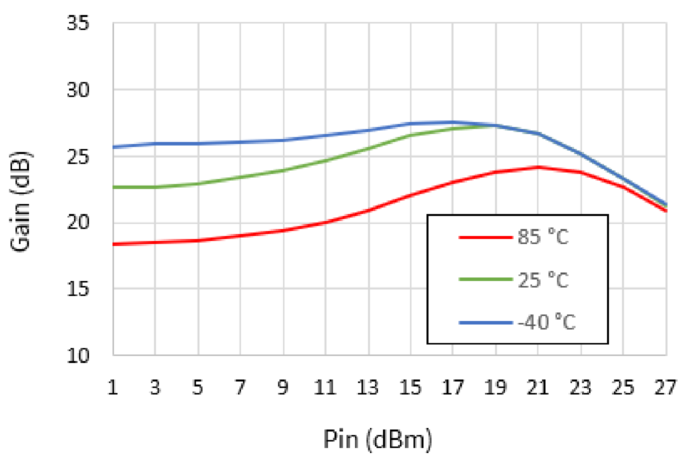
Drain Current vs. Input Power



Gate Current vs. Input Power



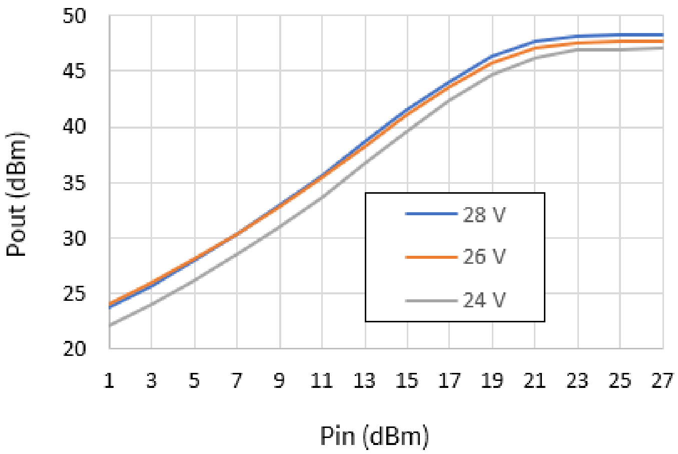
Gain vs. Input Power



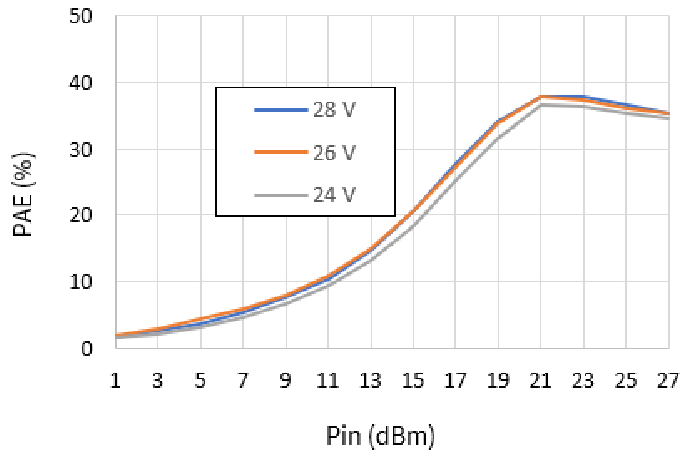
Typical Performance Curves - Drive-Up over V_D

I_{DQ} = 430 mA, PW = 150µS, DC = 20%, Frequency = 16.4 GHz, T_C = 25°C

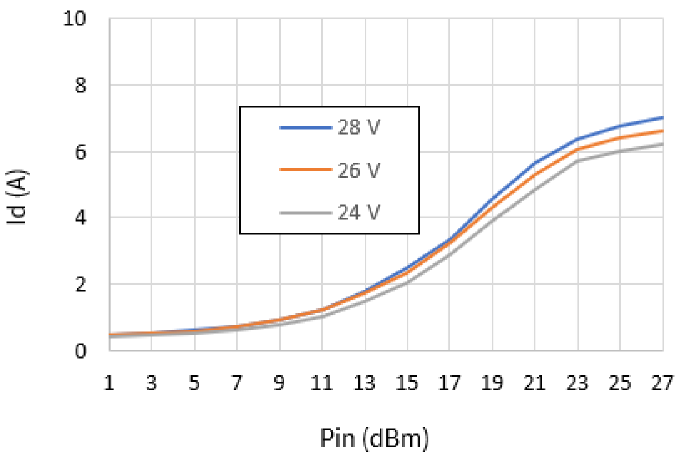
Output Power vs. Input Power



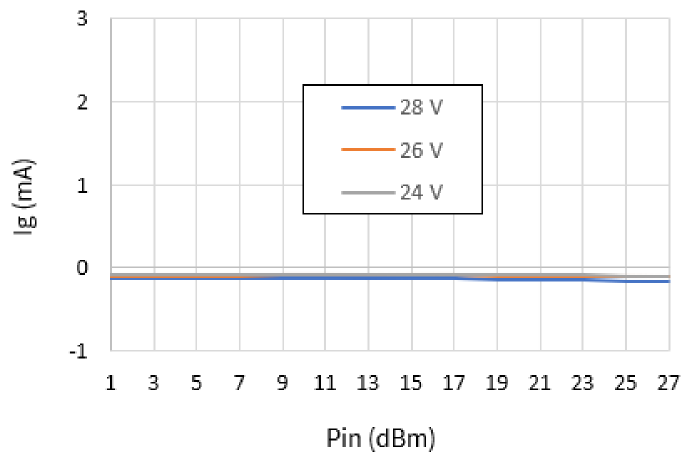
Power Added Efficiency vs. Input Power



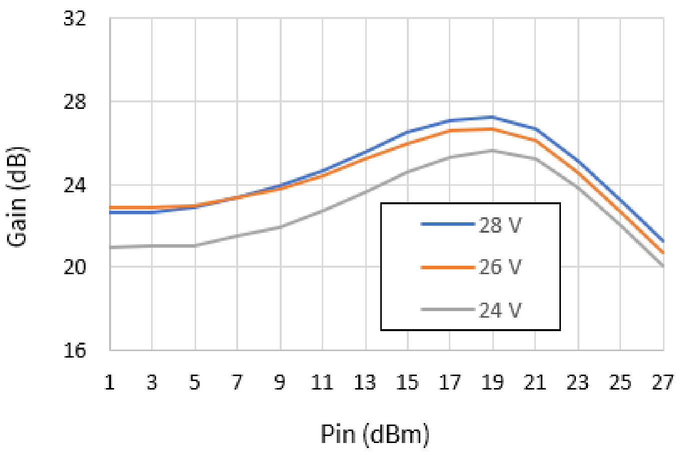
Drain Current vs. Input Power



Gate Current vs. Input Power



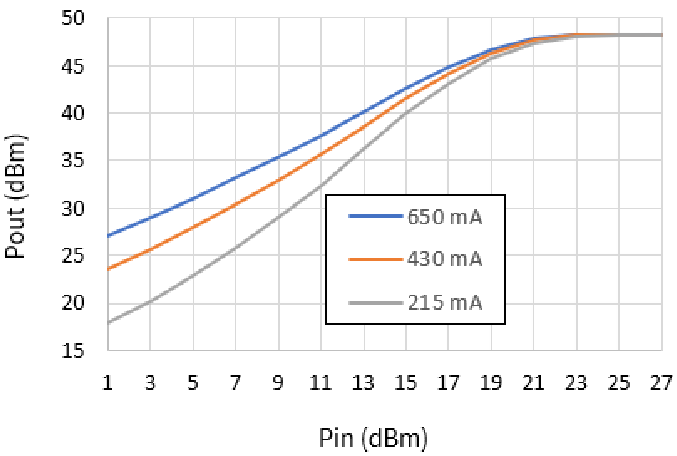
Gain vs. Input Power



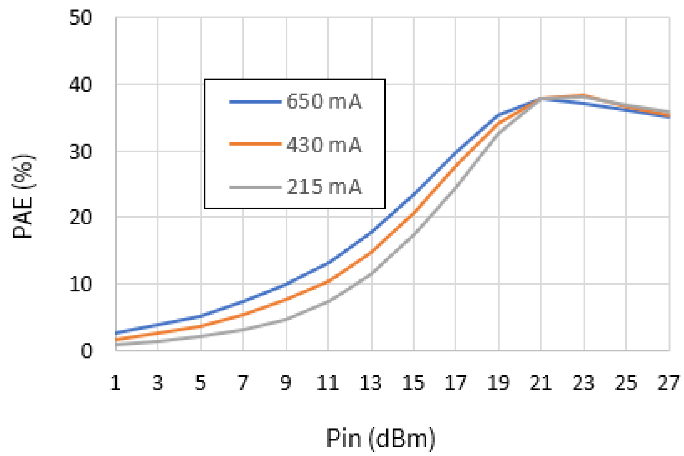
Typical Performance Curves - Drive-Up over I_{DQ}

V_D = 28 V, PW = 150µS, DC = 20%, Frequency = 16.4 GHz, T_C = 25°C

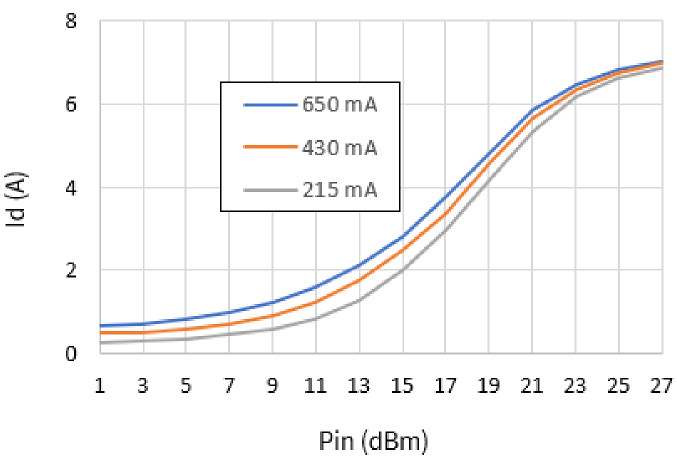
Output Power vs. Input Power



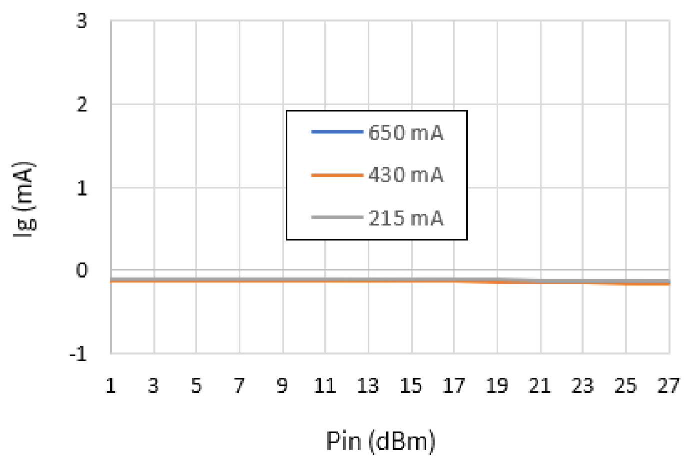
Power Added Efficiency vs. Input Power



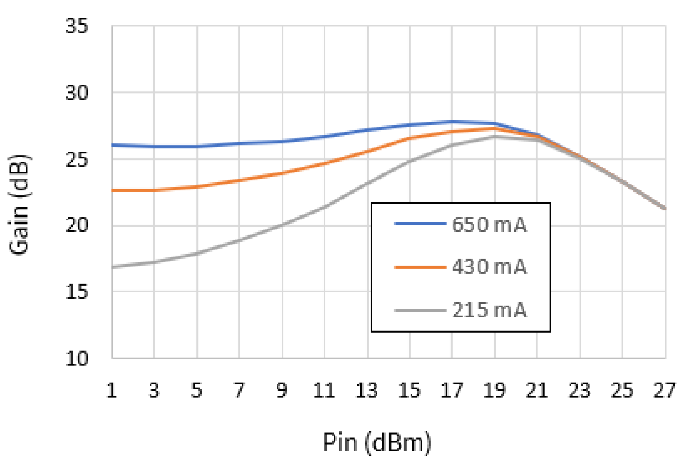
Drain Current vs. Input Power



Gate Current vs. Input Power



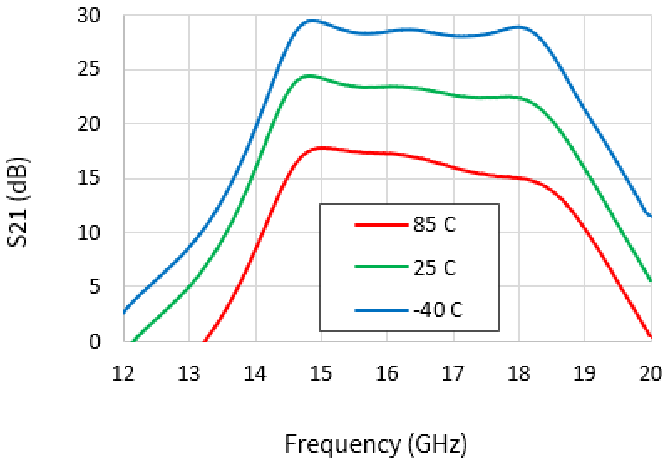
Large Signal Gain vs. Input Power



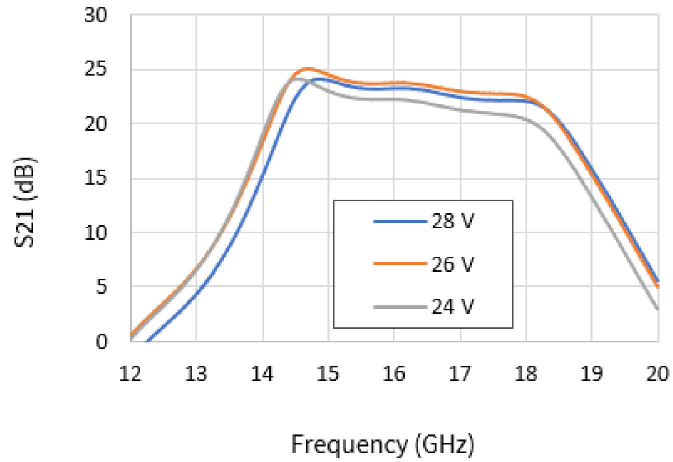
Typical Performance Curves - Small Signal over Temperature and V_D

I_{DQ} = 430 mA, CW, P_{IN} = -20 dBm

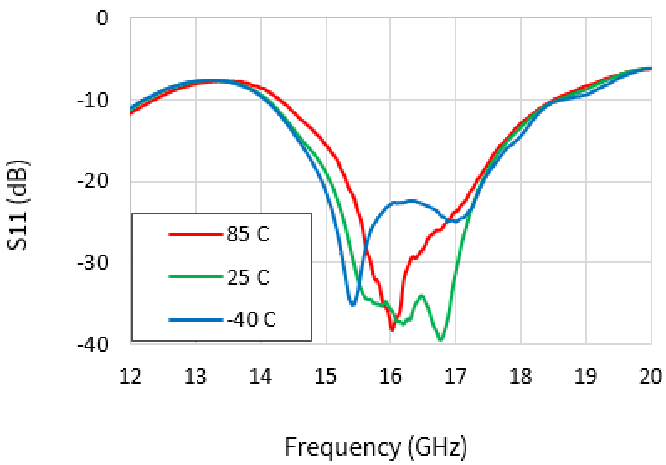
S21 vs. Frequency over Temperature @ V_D = 28 V



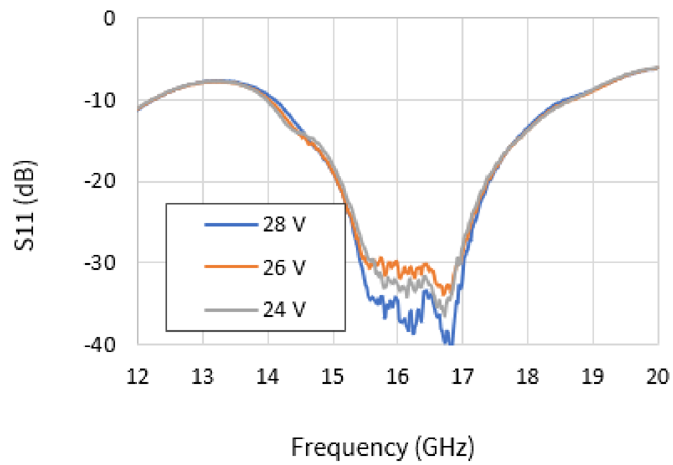
S21 vs. Frequency over V_D @ 25°C



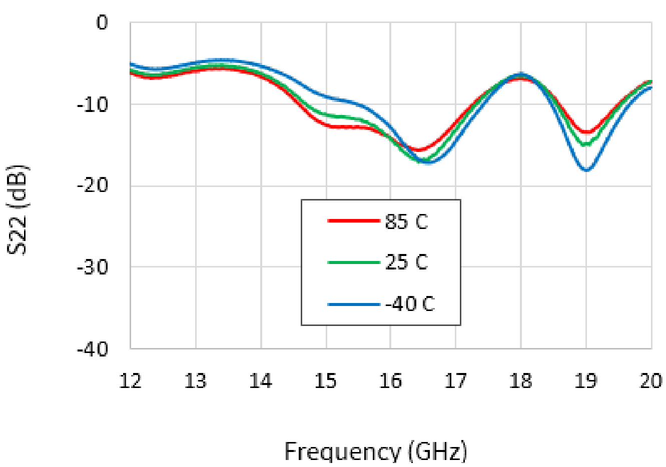
S11 vs. Frequency over Temperature @ V_D = 28 V



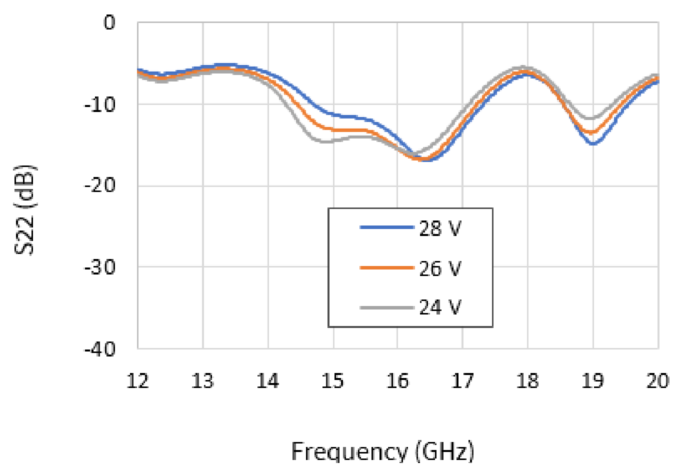
S11 vs. Frequency over V_D @ 25°C



S22 vs. Frequency over Temperature @ V_D = 28 V



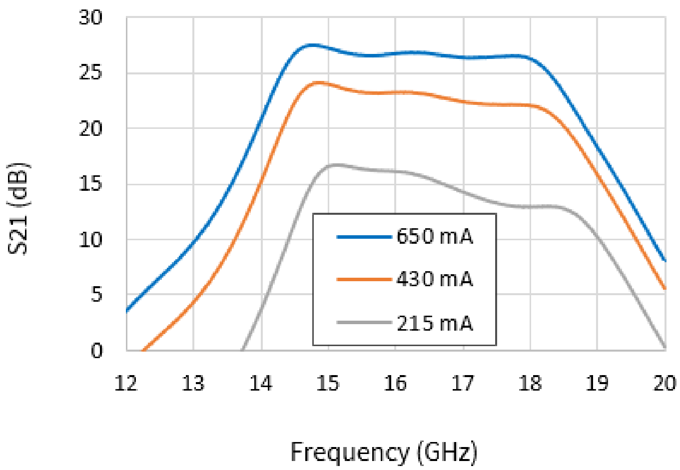
S22 vs. Frequency over V_D @ 25°C



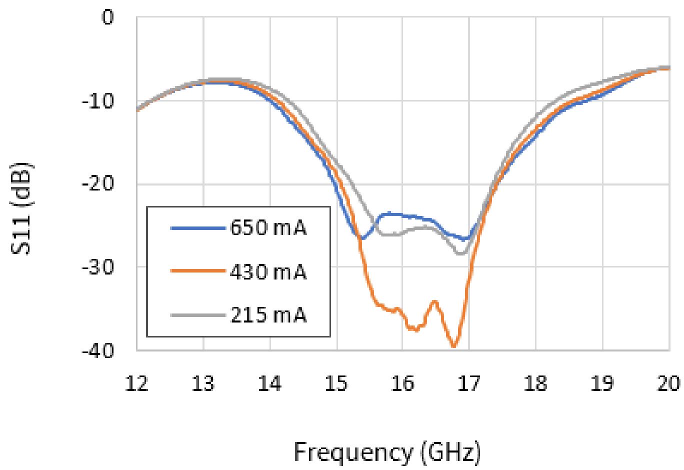
Typical Performance Curves - Small Signal over I_{DQ}

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

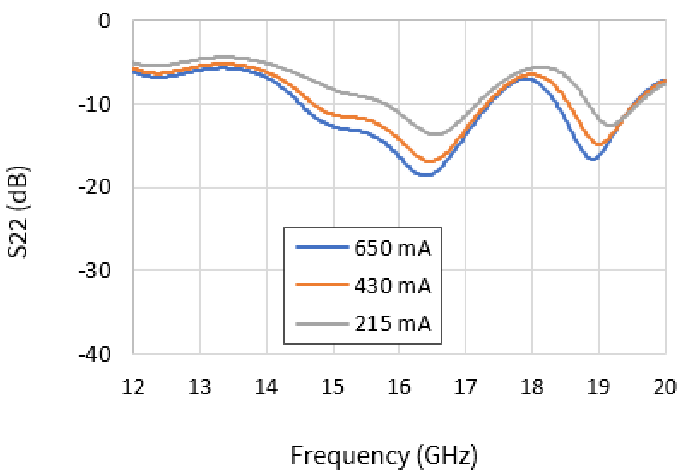
S21 vs. Frequency over I_{DQ}



S11 vs. Frequency over I_{DQ}



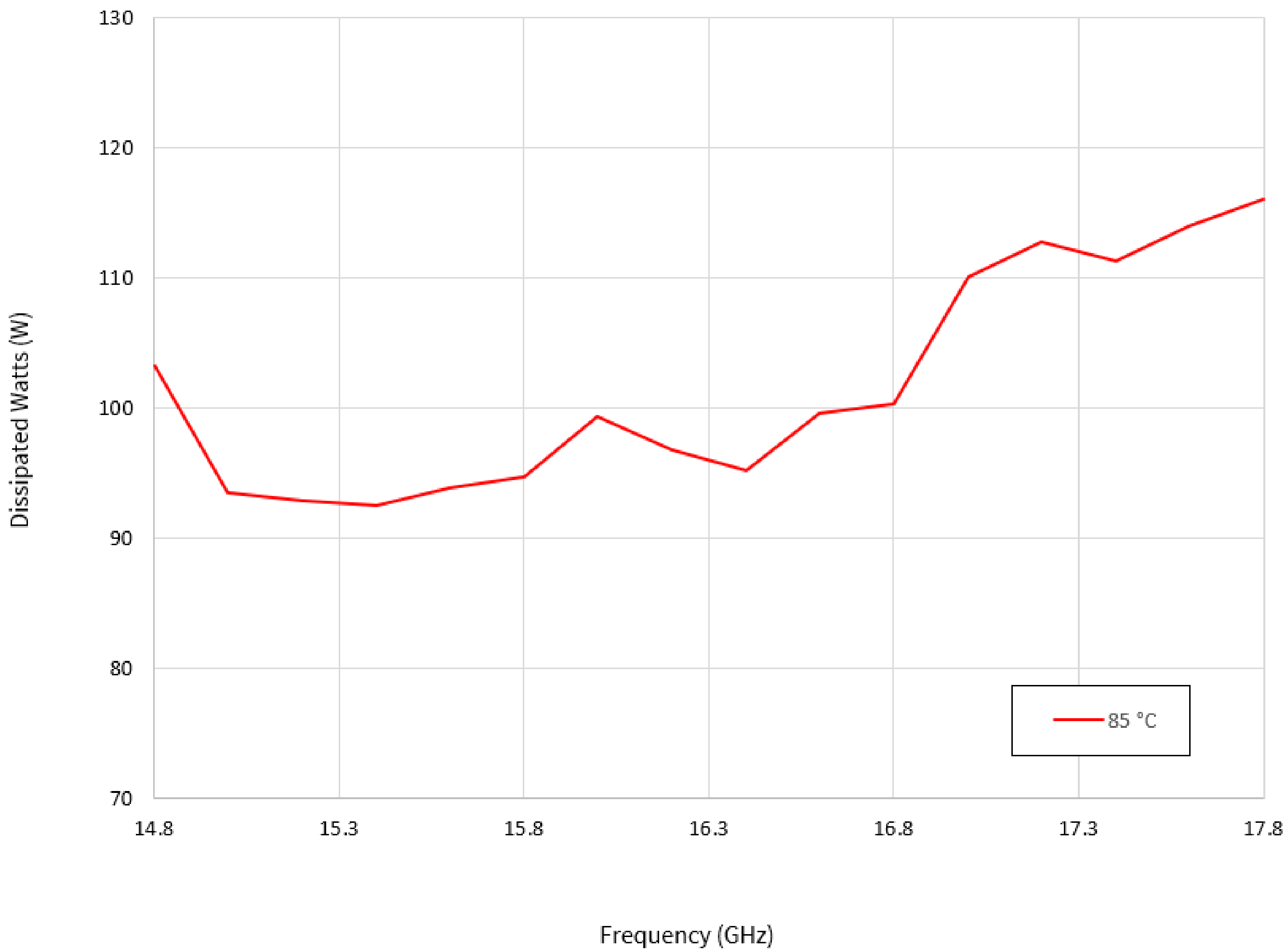
S22 vs. Frequency over I_{DQ}



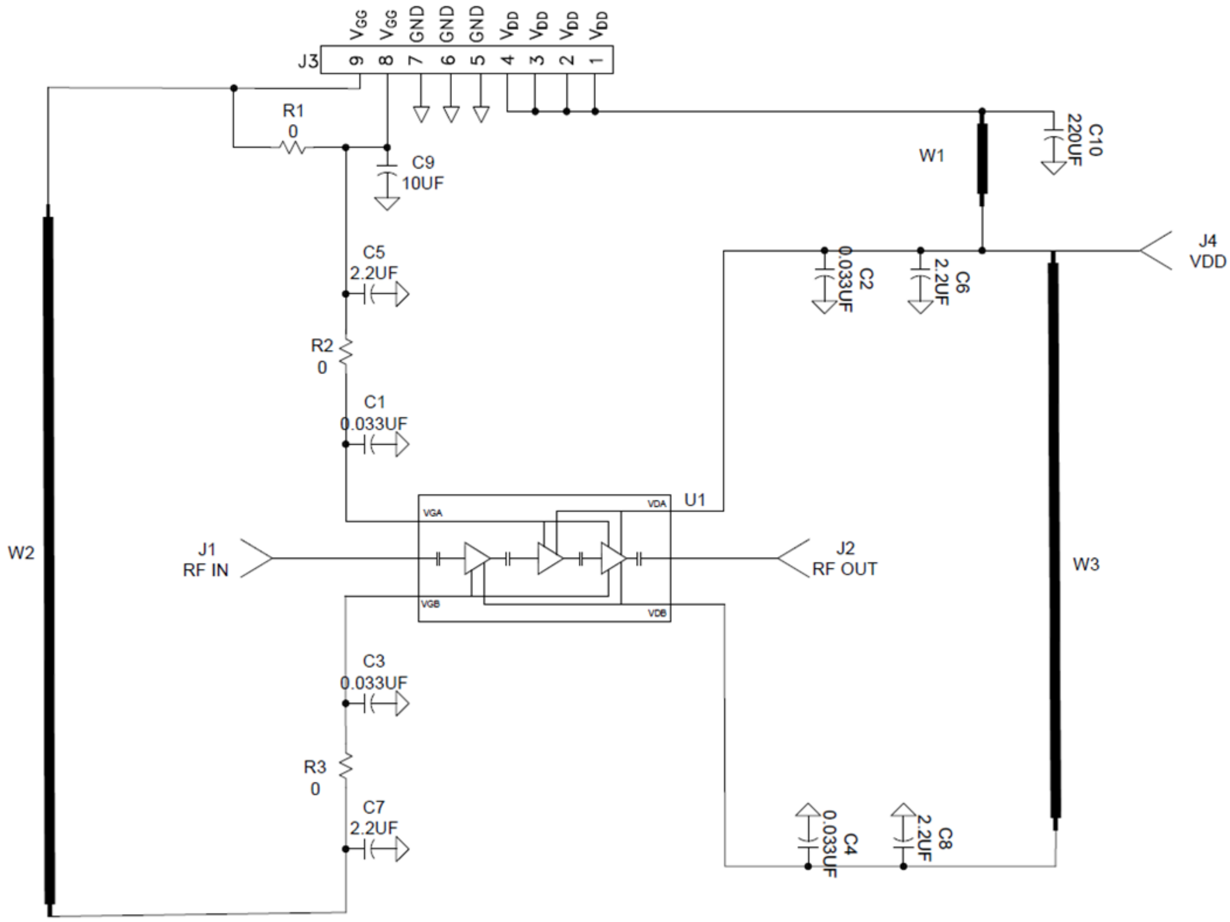
Thermal Characteristics

Parameter	Operating Conditions	Value
Operating Junction Temperature (T_J)	Freq = 16.4 GHz, V_D = 28 V, I_{DQ} = 430 mA, I_{DRIVE} = 5.2 A , P_{IN} = 23 dBm, P_{OUT} = 47.5 dBm, P_{DISS} = 95 W, T_{CASE} = 85°C, PW = 150 µS, DC = 20%	172ºC
Thermal Resistance, Junction to Case ($R_{\theta JC}$)		0.92ºC/W

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



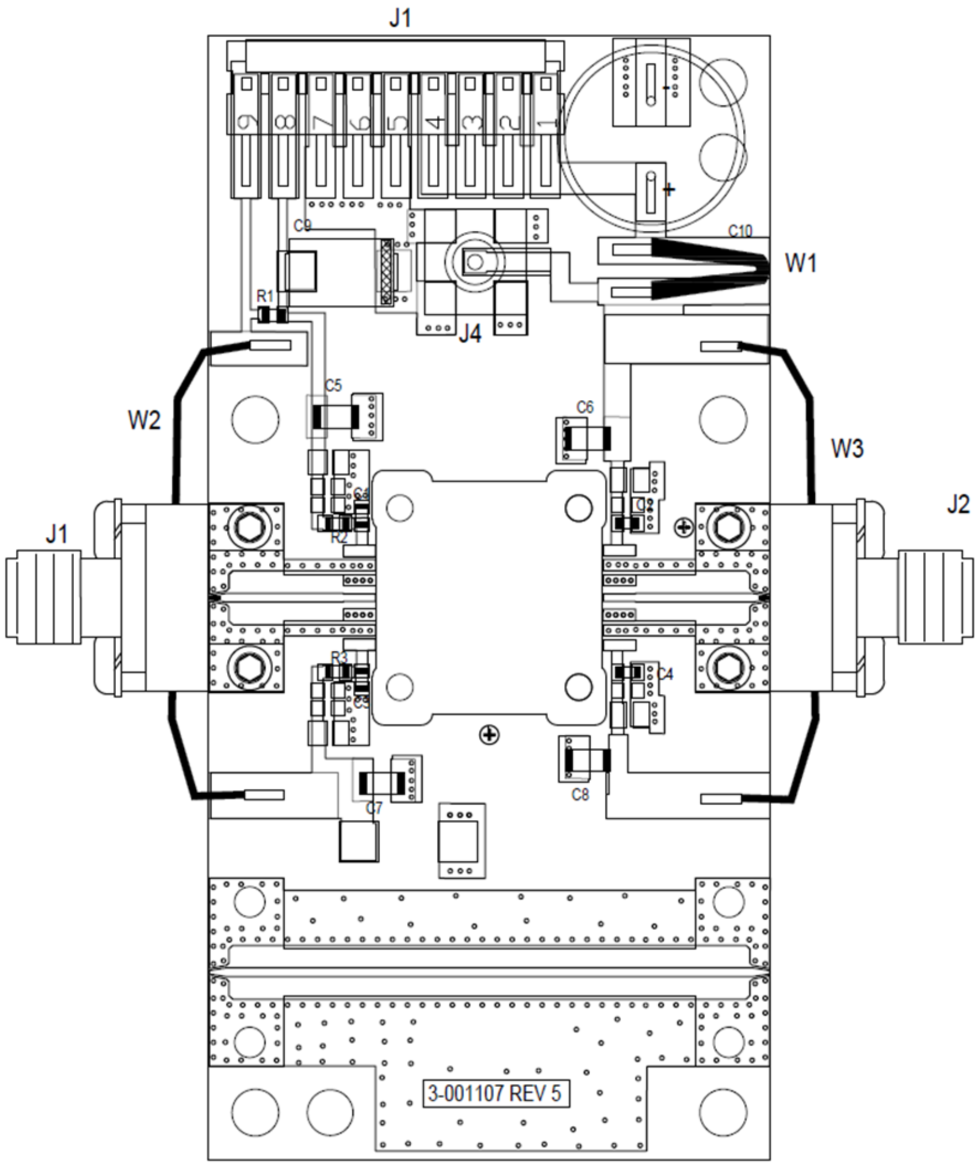
Evaluation Board Schematic (CMPA1F1H060F-AMP)



Parts List

Part	Value	Qty.
R1, R2, R3	RES 0 Ohm, 0603	3
C1,C2,C3,C4	CAP, 33000pF, +/-20%, 0603, AVX	4
C5,C6,C7,C8	CAP, 2.2UF	4
C9	CAP 10UF 16V TANTALUM, 2312	1
C10	CAPACITOR, 220UF, 100V, Electrolytic capacitor, Radial Leaded	1
-	PCB, R3003, .010 THK, CMPA1F1H060F	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	CMPA1F1H060F	1

Evaluation Board Assembly Drawing (CMPA1F1H060F-AMP)



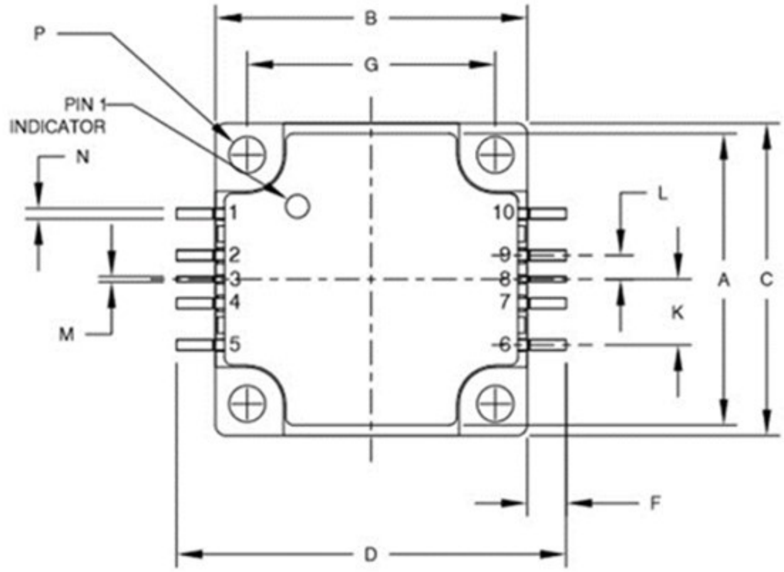
Bias On Sequence

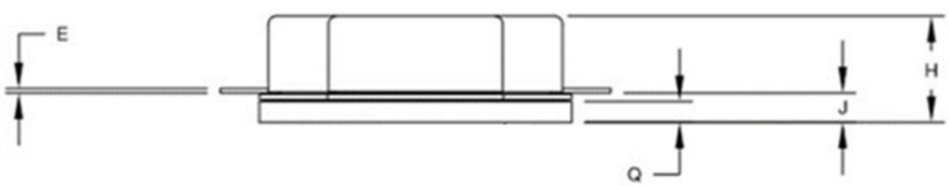
1. Ensure RF is turned-off
2. Apply pinch-off voltage of -5 V to the gate (V_G)
3. Apply nominal drain voltage (V_D)
4. Adjust Vg to obtain desired quiescent drain current (I_{DQ})
5. Apply RF

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

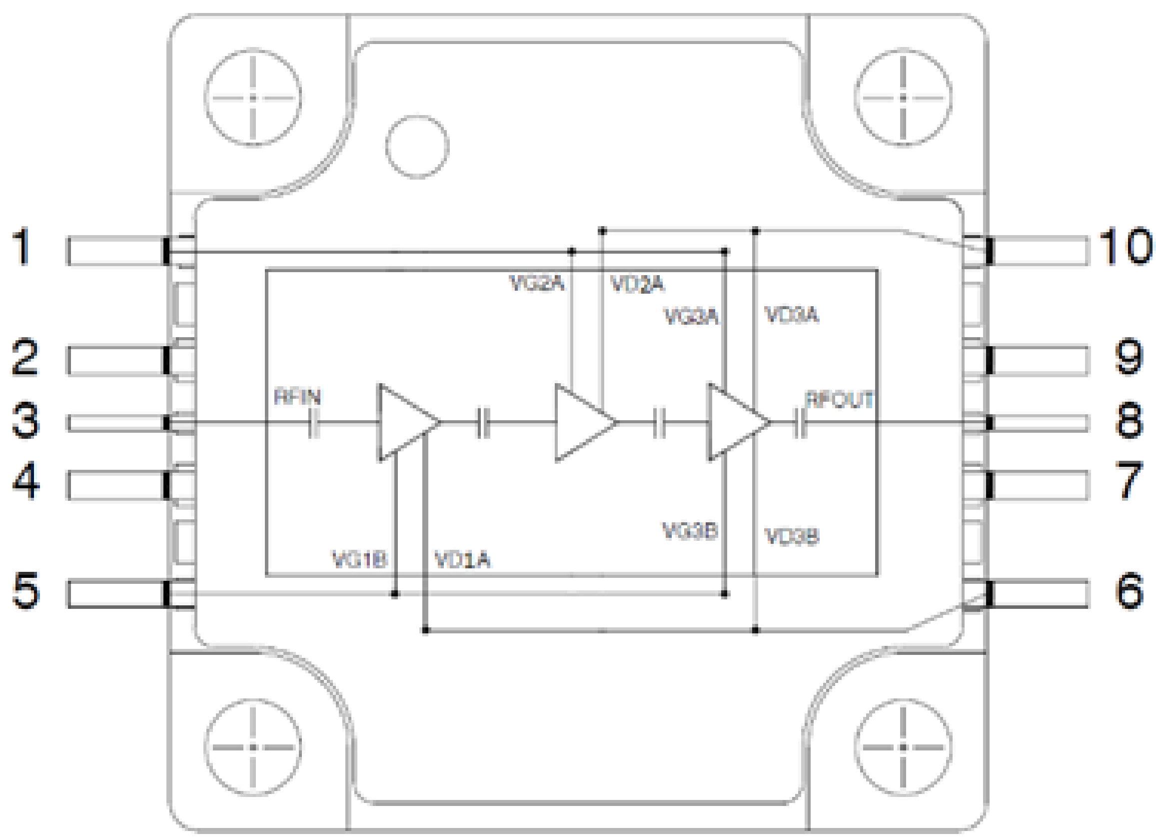




DIM	INCHES			MILLIMETERS		
	MIN	TYP	MAX	MIN	TYP	MAX
A	.555	.560	.565	14.10	14.22	14.35
B	.595	.600	.605	15.11	15.24	15.37
C	.595	.600	.605	15.11	15.24	15.37
D	-	(.750)	-	-	(19.05)	-
E	.006	.008	.010	0.15	0.20	0.25
F	.065	.075	.085	1.66	1.91	2.16
G	.473	.478	.483	12.01	12.14	12.27
H	.191	.203	.215	4.86	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	RF_{IN}	RF Input. 50-ohm matched. Internally DC blocked.
8	RF_{OUT}	RF Output. 50-ohm matched. Internally DC blocked.
Base	GND	RF and DC ground



Revision History

Rev	Date	Change Description
V1P	11/27/2024	Preliminary release.
V1	09/29/2025	Production release.