450 W, 50 Ω Input/Output Matched, GaN HEMT Amplifier
2.75 - 3.75 GHz

MACOM PURE CARBIDE™

CGHV38375F
Rev. V1

Features

- Full S-Band Radar Coverage
- Saturated Power: 450 W
- Large Signal Gain: >10 dB
- Drain Efficiency: 55%
- Internally Matched: 50 Ω
- Pulsed and CW Operation

Applications

- Civil & Military, Pulsed and CW S-Band Radar

Description

The CGHV38375F is a packaged, 450 W HPA matched to 50 ohms at both input and output ports. The CGHV38375F operates from 2.75 - 3.75 GHz providing coverage over the entire S-Band radar band. This high-power amplifier provides >10 dB of large signal gain and 40% power-added efficiency and is ideally suited as a high-power building block supporting both pulsed and CW radar applications.

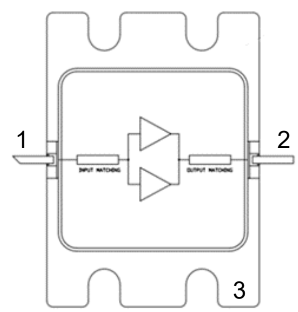
Typical RF Performance:

Measured at fixed input power of +46 dBm, 100 µs pulse width, 10% duty cycle.

- V_{DS} = 50 V, I_{DQ} = 500 mA, T_C = 25°C

Frequency (GHz)	Output Power (dBm)	Gain (dB)	η_D (%)
2.75	55.9	9.9	50
2.9	57.4	11.4	67
3.3	57.5	11.5	62
3.5	57.7	11.7	60
3.75	56.8	10.8	60

Functional Schematic



Pin Configuration

Pin #	Description
1	Gate / RF Input
2	Drain / RF Output
3	Source / Flange

Ordering Information

Part Number	Package
CGHV38375F	bulk
CGHV38375F-AMP	Sample Board

* Restrictions on Hazardous Substances, compliant to current RoHS EU directive.

RF Electrical Specifications: Freq. = 2.75 - 3.75 GHz, T_A = +25C, V_{DD} = 50 V, I_{DQ} = 500 mA

Parameter	Test Conditions	Units	Min.	Typ.	Max.
Output Power	P_{IN} = 46 dBm, Pulse Width = 100 µs, Duty Cycle = 10% 2.75 GHz 2.9 GHz 3.3 GHz 3.5 GHz 3.75 GHz	dBm	54.0 56.5 56.5 56.0 55.75	55.8 57.5 57.8 57.5 56.9	—
Drain Efficiency	P_{IN} = 46 dBm, Pulse Width = 100 µs, Duty Cycle = 10% 2.75 GHz 2.9 GHz 3.3 GHz 3.5 GHz 3.75 GHz	%	31.0 53.5 52.0 47.0 52.0	42.8 60.5 63.2 58.6 61.9	—
Small Signal Gain	P_{IN} = -10 dBm 2.75 GHz 2.9 GHz 3.3 GHz 3.5 GHz 3.75 GHz	dB	6.5 10.0 9.0 9.0 9.5	9.4 12.9 13.5 13.3 13.1	—
Input Return Loss	P_{IN} = -10 dBm	dB	—	6	—
Output Return Loss	P_{IN} = -10 dBm	dB	—	6	—
Output Mismatch Stress (VSWR)	No damage at all phase angles	Ψ	—	5:1	—

Note: Final testing and screening for all amplifier sales is performed using the CGHV38375F-AMP at 2.75-3.75 GHz.

DC Electrical Specifications: Freq. = 2.75 - 3.75 GHz, T_A = +25C

Parameter	Test Conditions	Units	Min.	Typ.	Max.
Gate Threshold Voltage	V_{DS} = 10 V, I_D = 83.6 mA	V	-3.8	-3.0	-2.3
Gate Quiescent Voltage	V_{DD} = 28 V, I_{DQ} = 500 mA	VDC	—	-2.7	—
Saturated Drain Current	V_{DS} = 6.0 V, V_{GS} = 2.0 V	A	54.4	77.7	—
Drain Source Breakdown Voltage	V_{GS} = -8 V, I_D = 83.6 mA	V	125	—	—

Absolute Maximum Ratings[1,2]

Parameter	Absolute Maximum
Drain-Source Voltage	150 V
Gate Voltage	-10, +2 V
Drain Current	24 A
Gate Current	102 mA
Input Power	48 dBm
Storage Temperature	-55C to +150°C
Mounting Temperature	+320°C
Junction Temperature[3,4,5]	+225°C
Operating Temperature	-40°C to +85°C

1. Exceeding any one or combination of these limits may cause permanent damage to this device.
2. MACOM does not recommend sustained operation near these survivability limits.
3. Operating at nominal conditions with $T_J \leq +275$ C will ensure MTTF > 1 x 10^6 hours.
4. Junction Temperature (T_J) = T_C + Θjc * (V * I)
   Typical thermal resistance (Θjc) = 0.22 °C/W for 100 µs/10%.
   a) For T_C = +25°C,
      T_J = 121C @ P_{DISS} = 437 W
   b) For T_C = +85°C,
      T_J = 179 °C @ P_{DISS} = 427 W
5. Junction Temperature (T_J) = T_C + ϴjc * (V * I)
   Typical thermal resistance (ϴjc) = 0.5 °C/W for CW.
   a) For T_C = +85°C,
      T_J = 185 °C @ P_{DISS} = 200 W

Handling Procedures

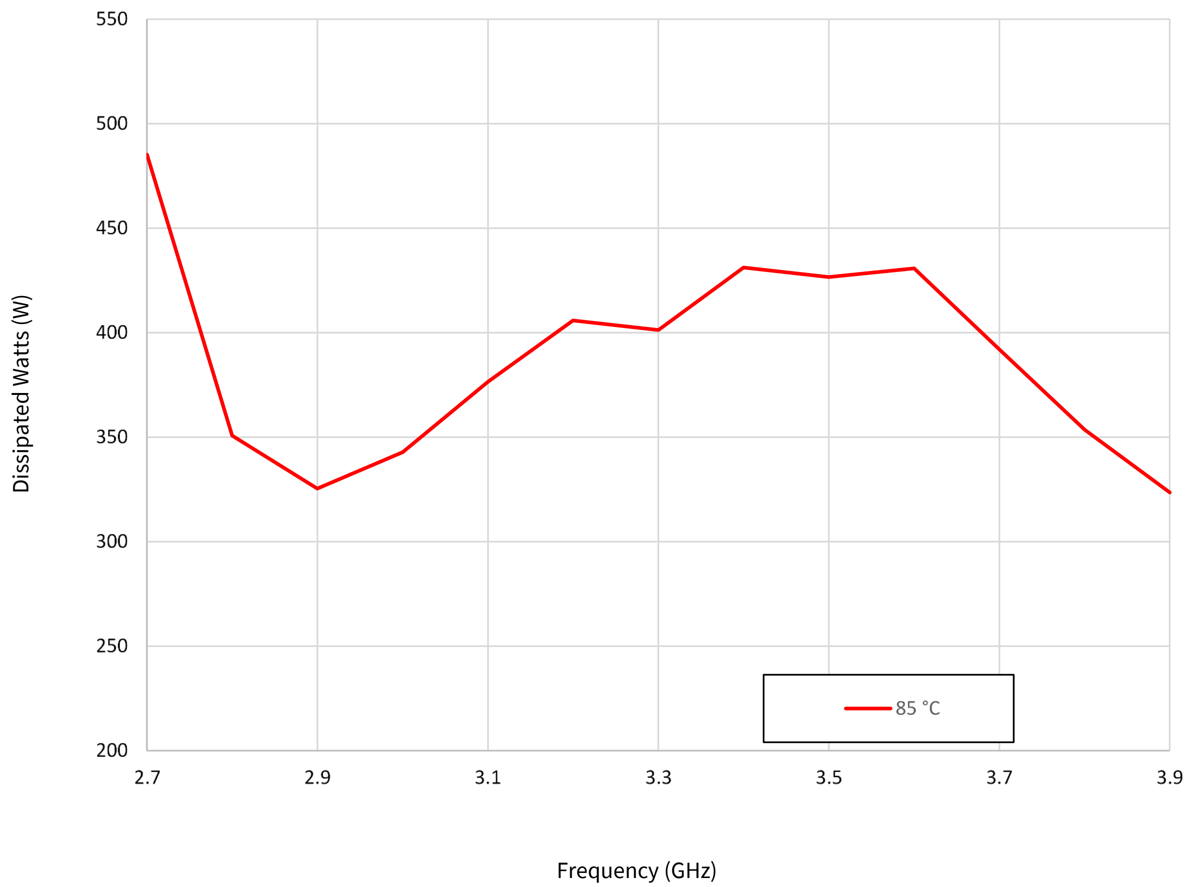
Please observe the following precautions to avoid damage:

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.

Thermal Characteristics

Parameter	Operating Conditions	Value
Operating Junction Temperature (T_J)	Freq = 3.5 GHz, V_D = 50 V, I_{DQ} = 500 mA, I_{DRIVE} = 18.59 A, P_{IN} = 46 dBm, P_{OUT} = 57.3 dBm, P_{DISS} = 426.5 W, T_C = 85°C, PW = 100 µs, DC = 10%	179ºC
Thermal Resistance, Junction to Case ($R_{θJC}$)		0.22ºC/W



For Engineering Evaluation Only – This data does not Modify MACOM's Datasheet Limits.

Typical Performance Curves:

V_D = 50 V, I_{DQ} = 500 mA, Pulse Width = 100 µs, Duty Cycle = 10%, P_{IN} = 46 dBm, T_B = +25°C.
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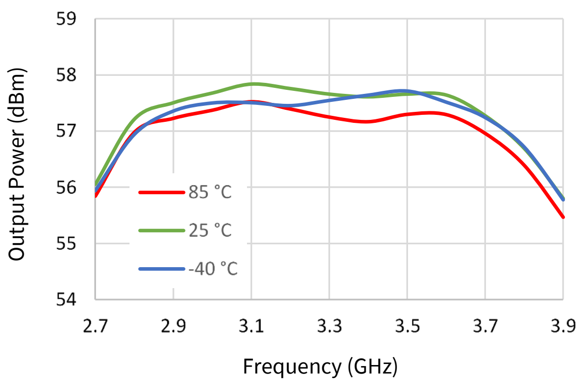
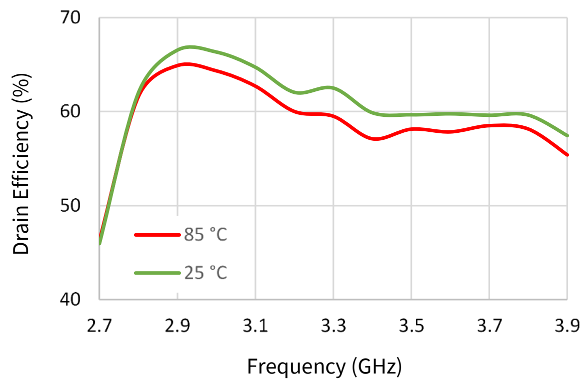
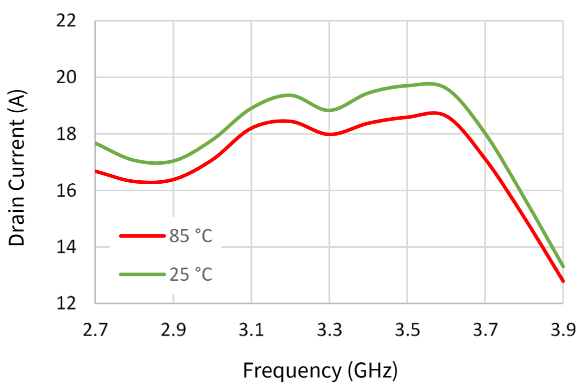
Output Power vs. Frequency vs. Temperature



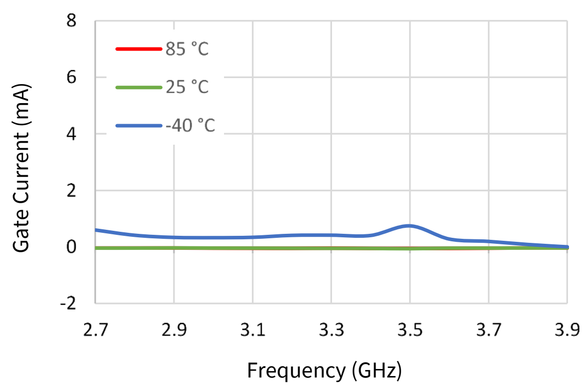
Drain Efficiency vs. Frequency vs. Temperature



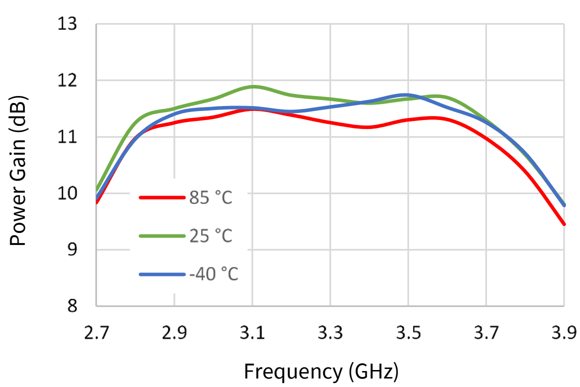
Drain Current vs. Frequency vs. Temperature



Gate Current vs. Frequency vs. Temperature



Power Gain vs. Frequency vs. Temperature



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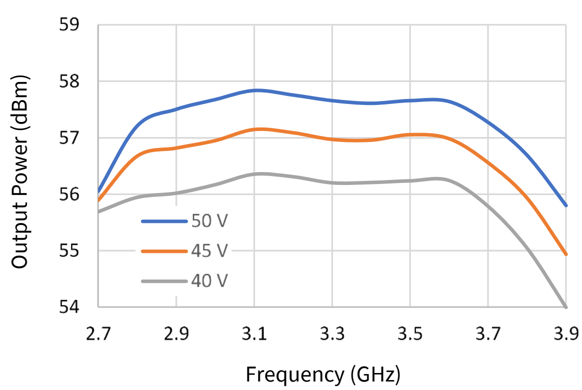
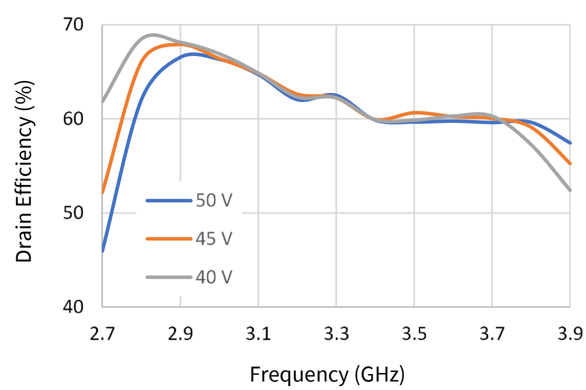
Output Power vs. Frequency vs. V_{DS}



Drain Efficiency vs. Frequency vs. V_{DS}



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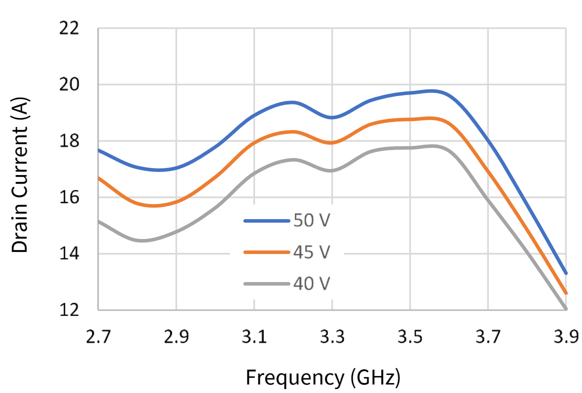
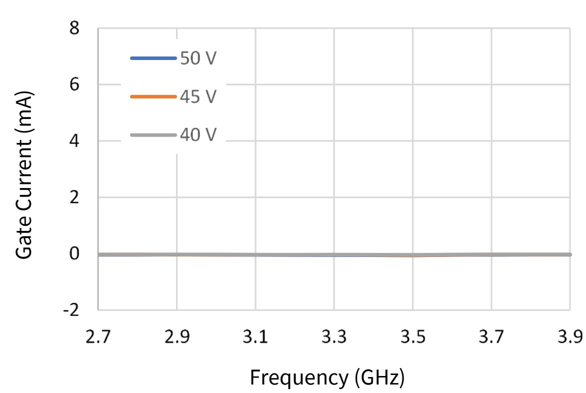


Gate Current vs. Frequency vs. V_{DS}



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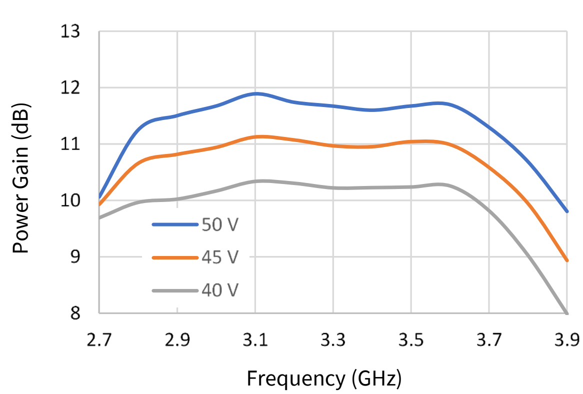

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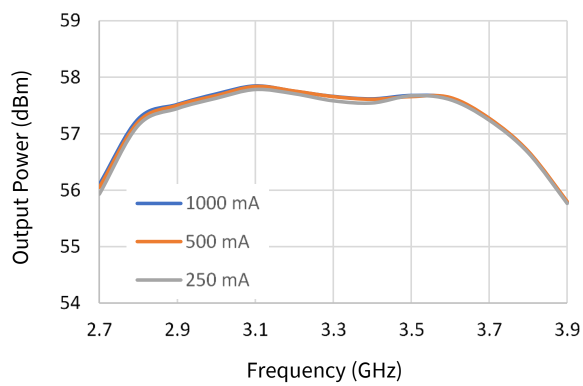
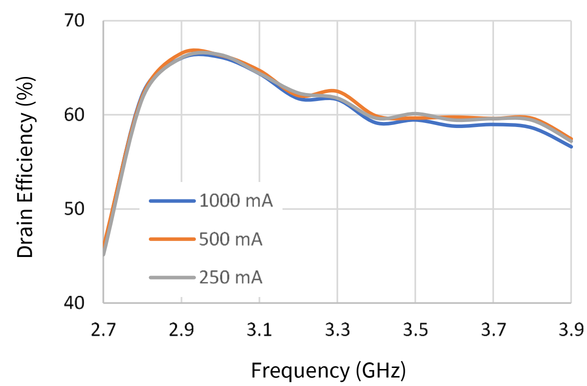
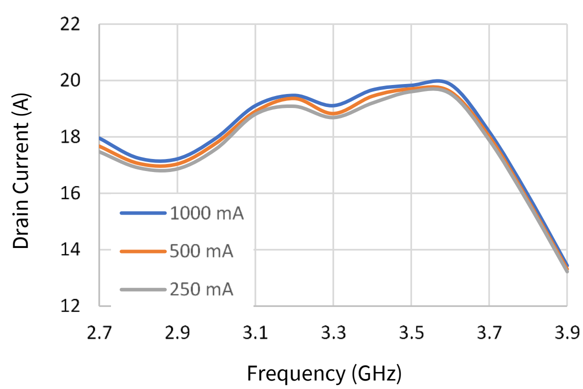
Output Power vs. Frequency vs. I_{DQ}



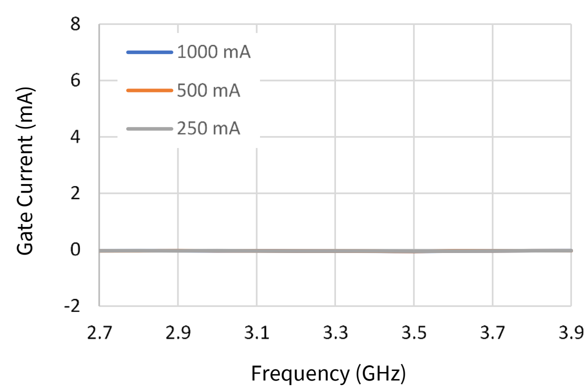
Drain Efficiency vs. Frequency vs. I_{DQ}



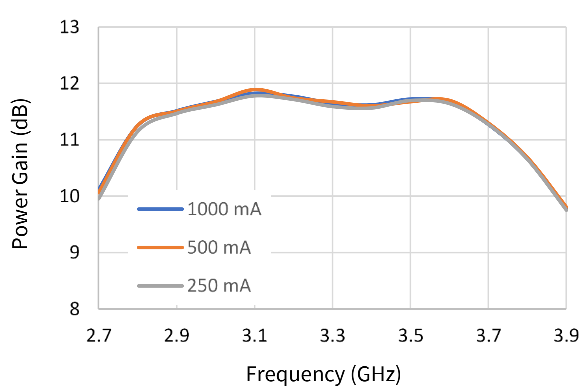
Drain Current vs. Frequency vs. I_{DQ}



Gate Current vs. Frequency vs. I_{DQ}



Power Gain vs. Frequency vs. I_{DQ}



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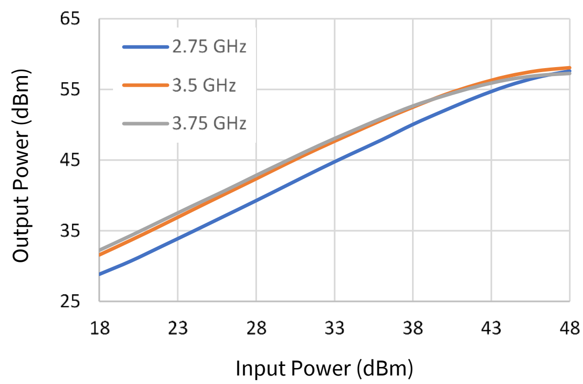
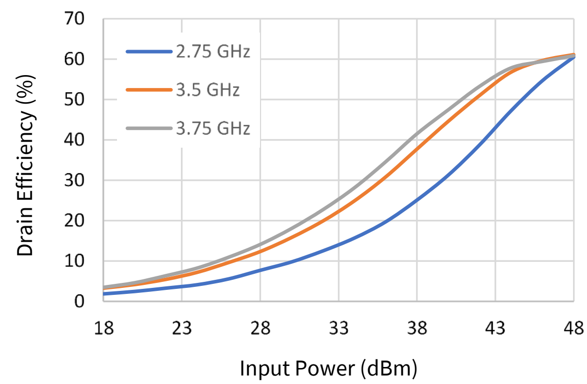
Output Power vs. Input Power vs. Frequency



Drain Efficiency vs. Input Power vs. Frequency



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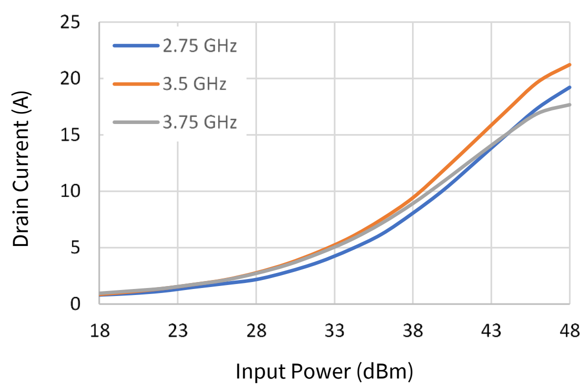

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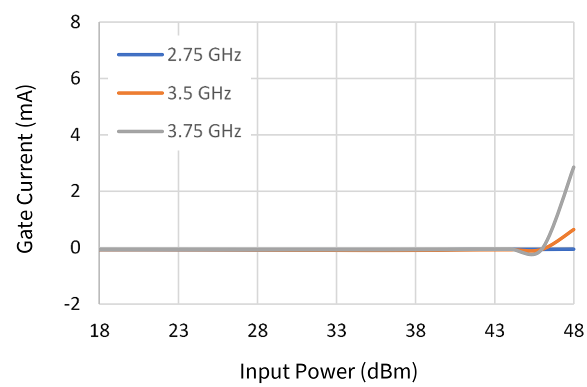

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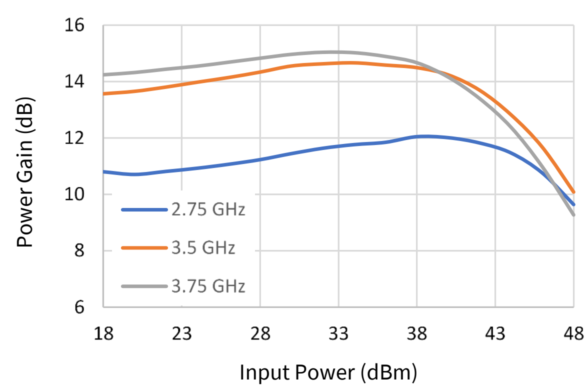

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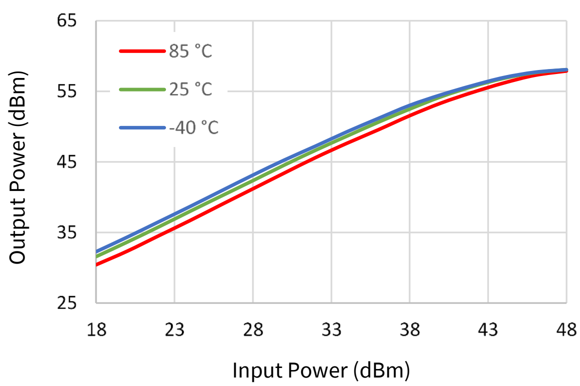
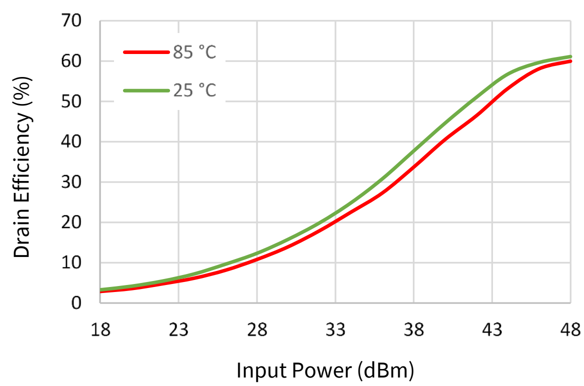
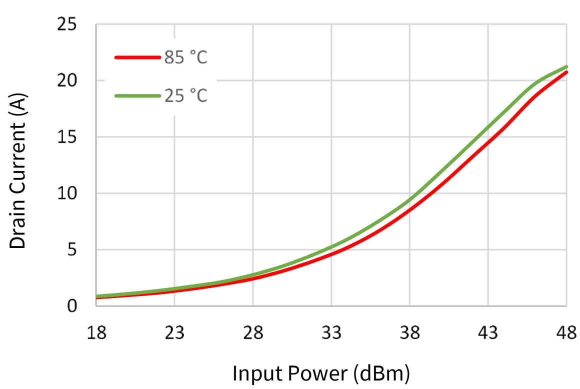
Output Power vs. Input Power vs. Temperature



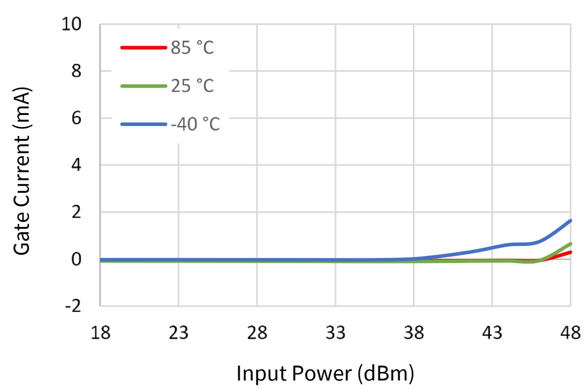
Drain Efficiency vs. Input Power vs. Temperature



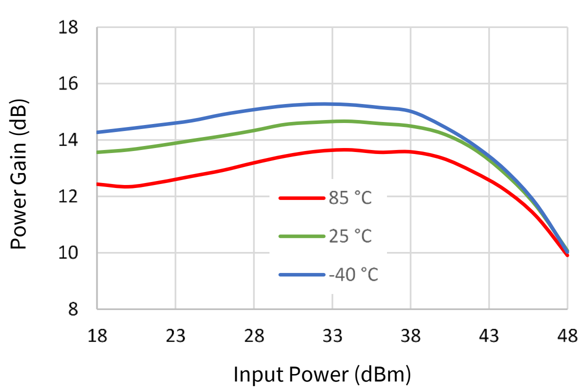
Drain Current vs. Input Power vs. Temperature



Gate Current vs. Input Power vs. Temperature



Power Gain vs. Input Power vs. Temperature



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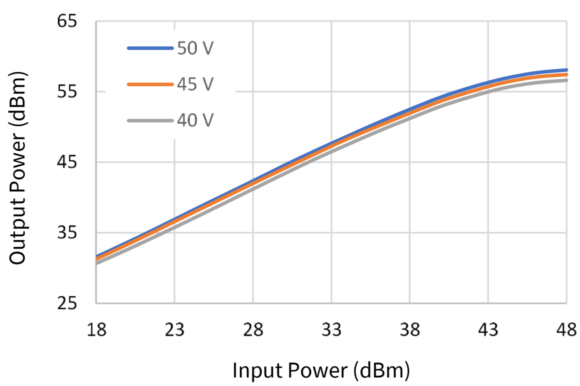
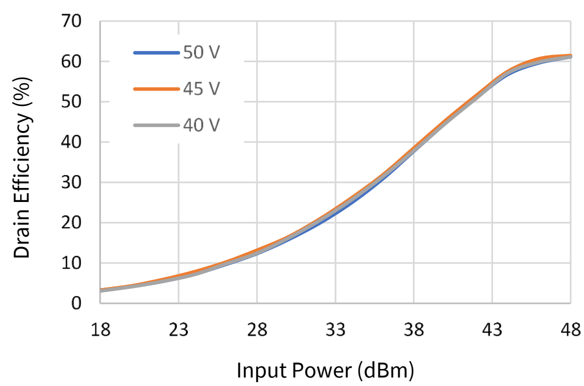
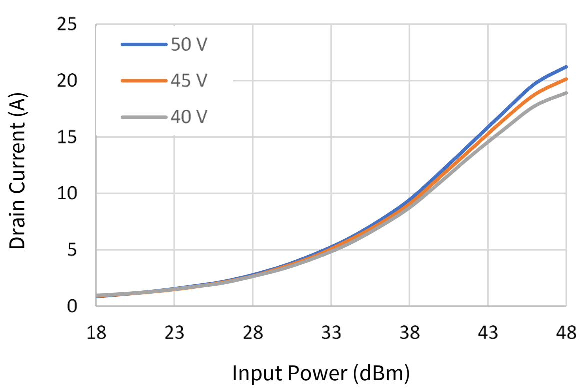
Output Power vs. Input Power vs. V_{DS}



Drain Efficiency vs. Input Power vs. V_{DS}



Drain Current vs. Input Power vs. V_{DS}



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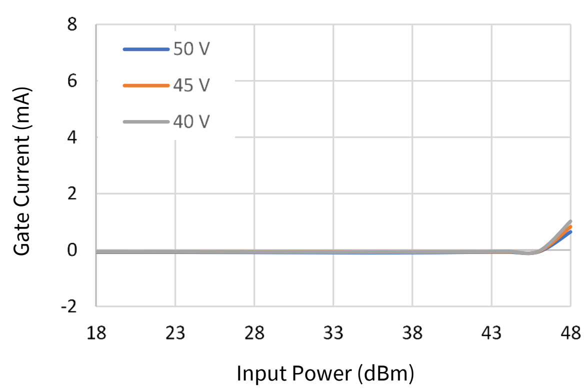
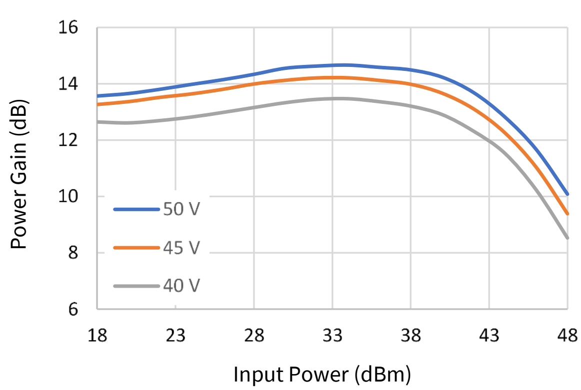


Power Gain vs. Input Power vs. V_{DS}



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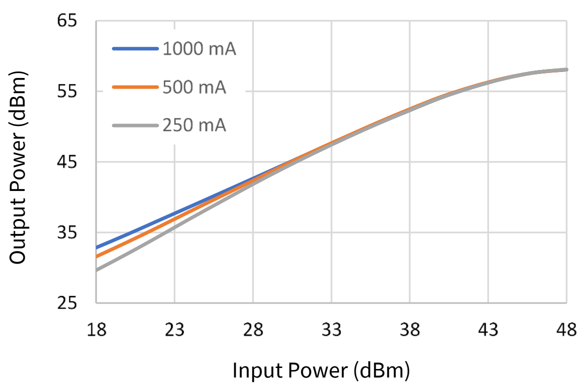
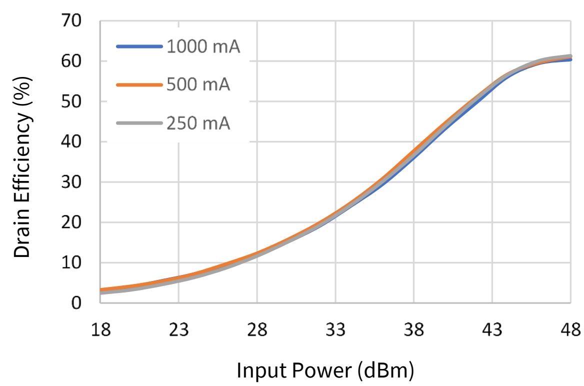
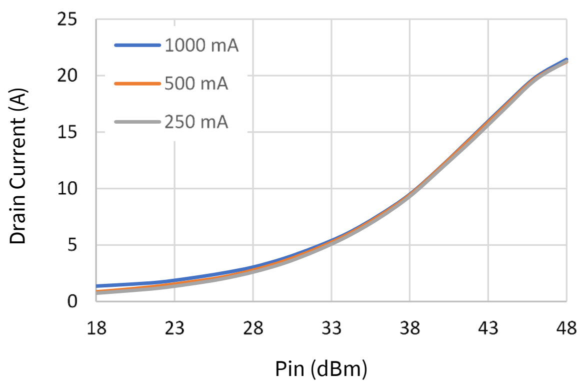


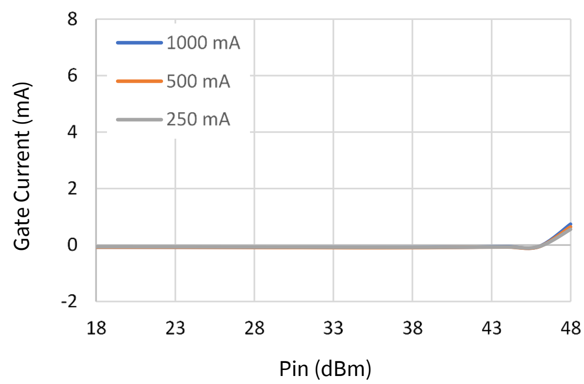
Drain Efficiency vs. Input Power vs. I_{DQ}



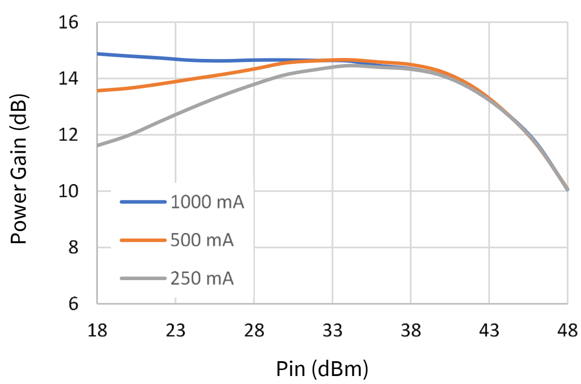
Drain Current vs. Input Power vs. I_{DQ}



Gate Current vs. Input Power vs. I_{DQ}



Power Gain vs. Input Power vs. I_{DQ}



Typical Performance Curves:

V_D = 50 V, I_{DQ} = 500 mA, CW, P_{IN} = 43 dBm, T_B = +25°C.
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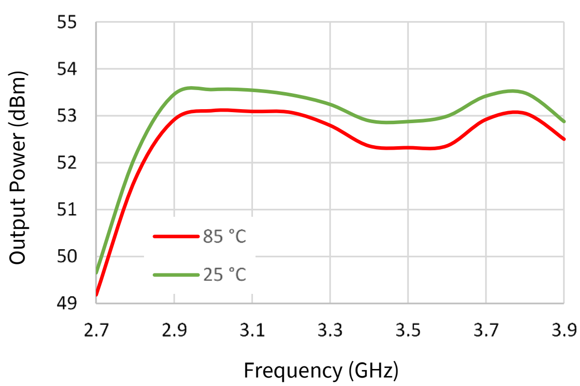
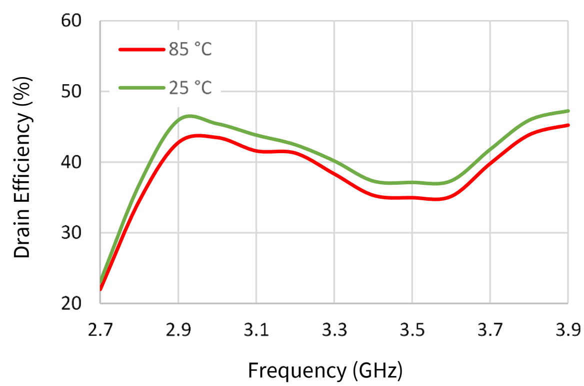
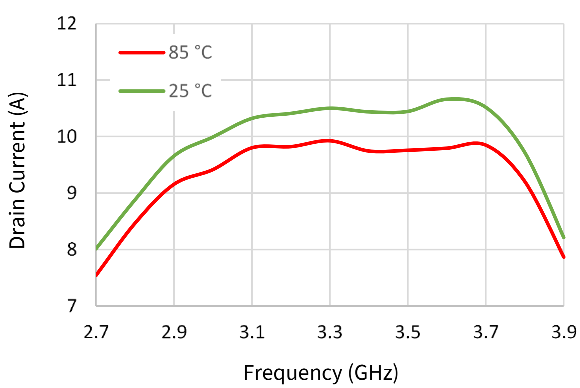
Output Power vs. Frequency vs. Temperature



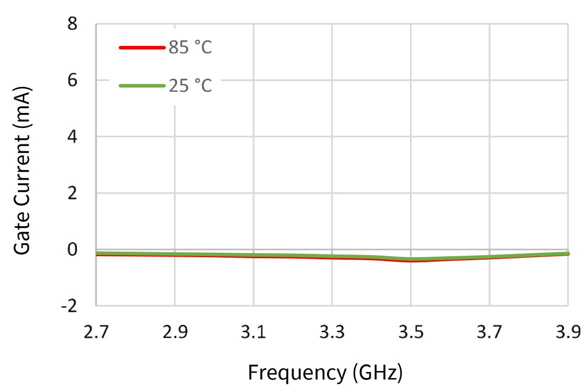
Drain Efficiency vs. Frequency vs. Temperature



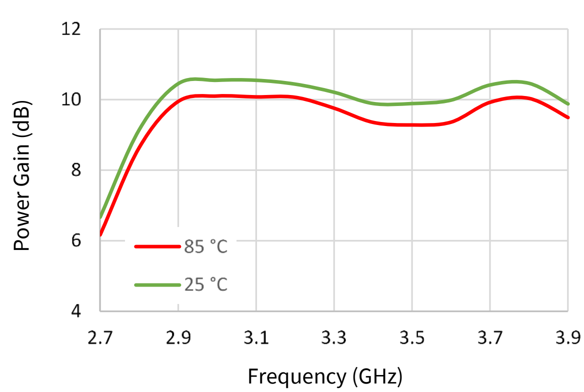
Drain Current vs. Frequency vs. Temperature



Gate Current vs. Frequency vs. Temperature



Power Gain vs. Frequency vs. Temperature



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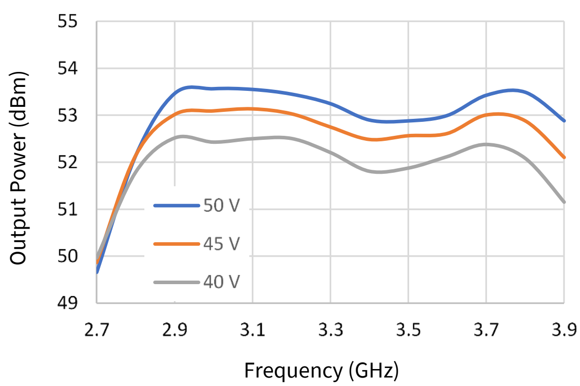
Output Power vs. Frequency vs. V_{DS}



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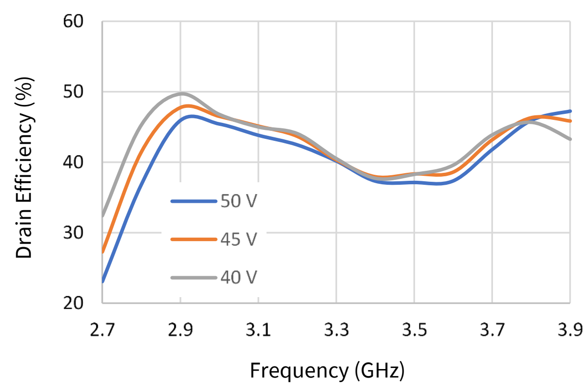
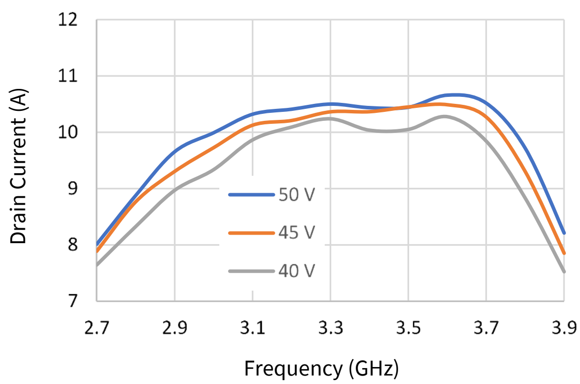


Drain Current vs. Frequency vs. V_{DS}



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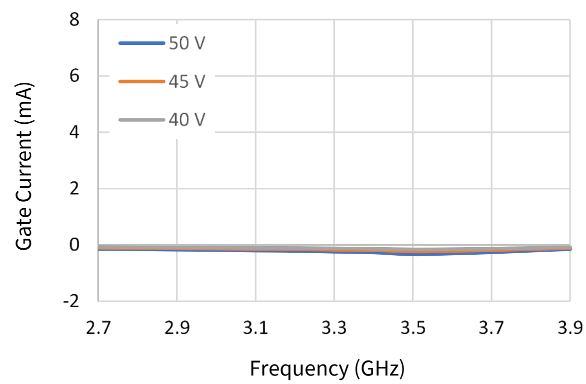
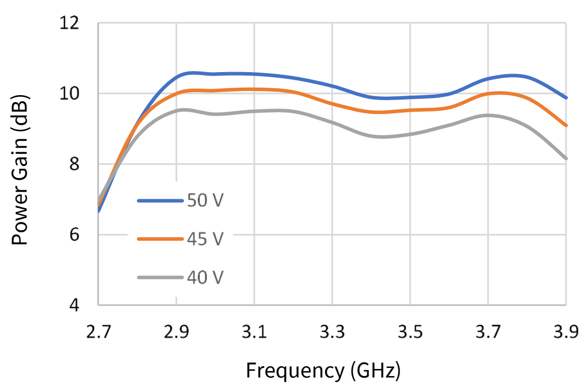


Power Gain vs. Frequency vs. V_{DS}



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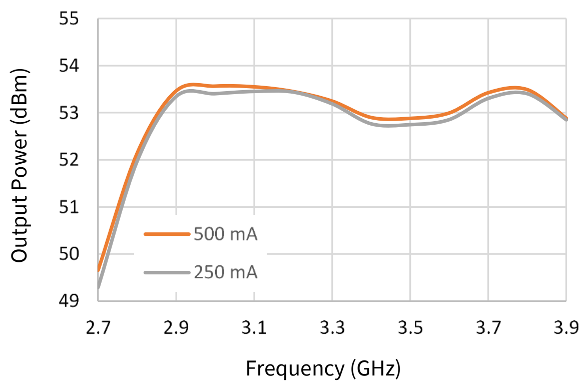

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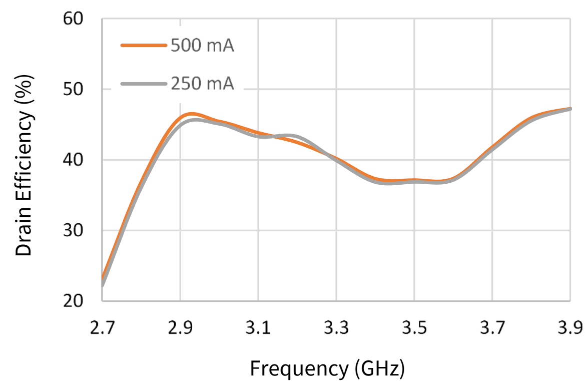
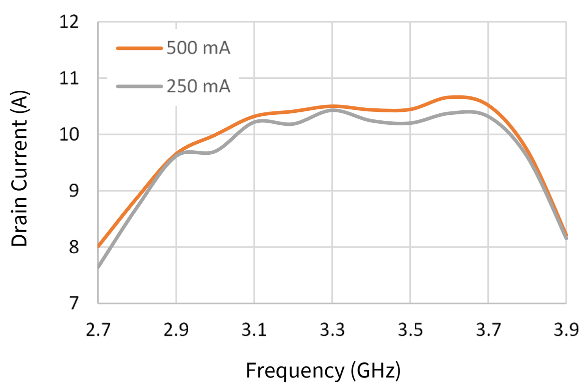
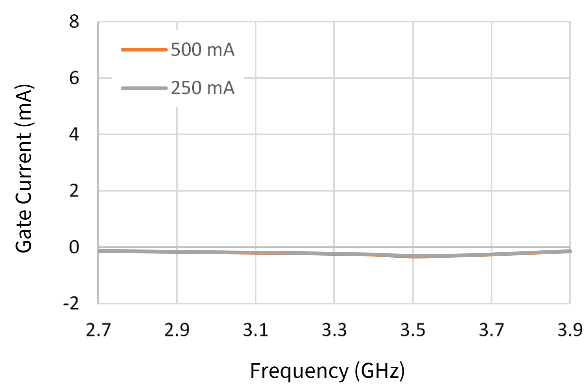


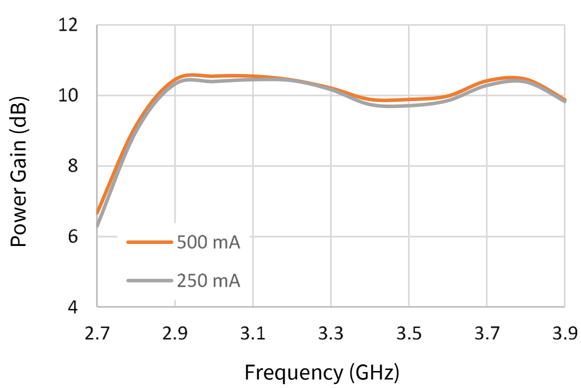
Drain Current vs. Frequency vs. I_{DQ}



Gate Current vs. Frequency vs. I_{DQ}



Power Gain vs. Frequency vs. I_{DQ}

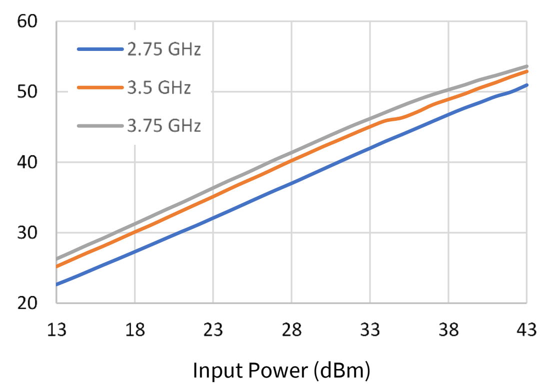


Typical Performance Curves:

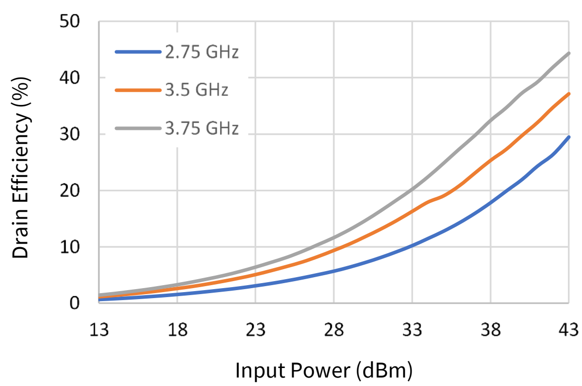
V_D = 50 V, I_{DQ} = 500 mA, CW, T_B = +25°C.

For Engineering Evaluation Only – This data does not Modify MACOM's Datasheet Limits.

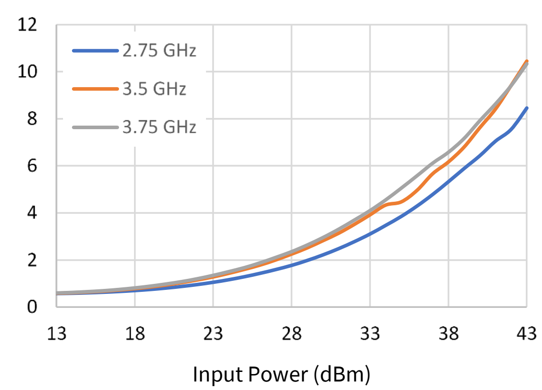
Output Power vs. Input Power vs. Frequency



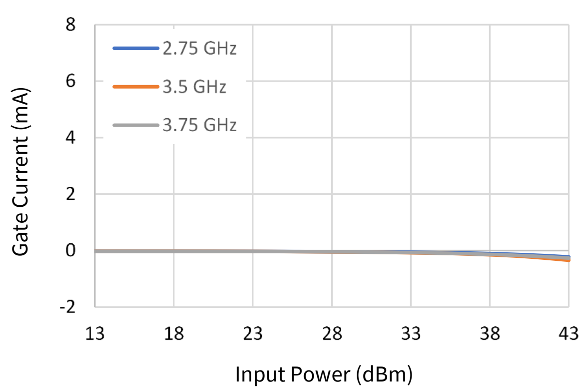
Drain Efficiency vs. Input Power vs. Frequency



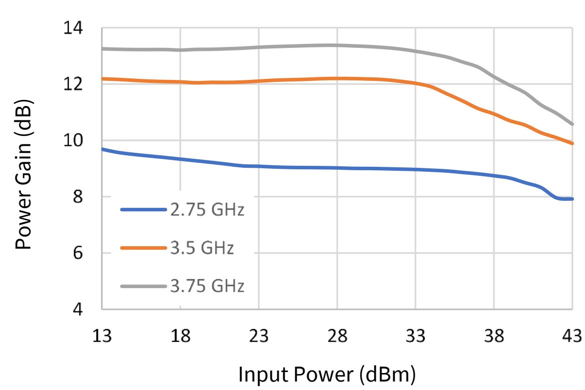
Drain Current vs. Input Power vs. Frequency



Gate Current vs. Input Power vs. Frequency



Power Gain vs. Input Power vs. Frequency



Typical Performance Curves:

V_D = 50 V, I_{DQ} = 500 mA, CW, T_B = +25°C.

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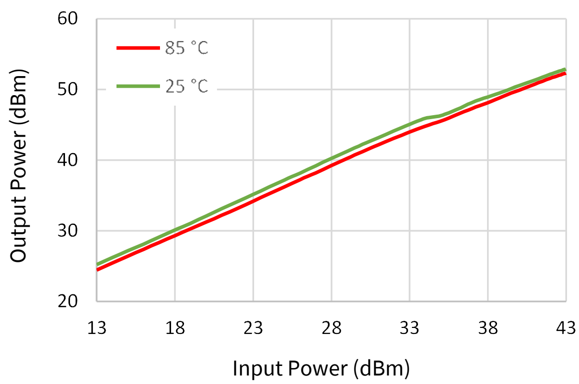
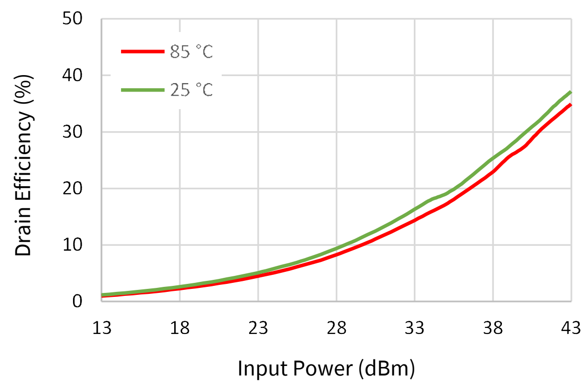
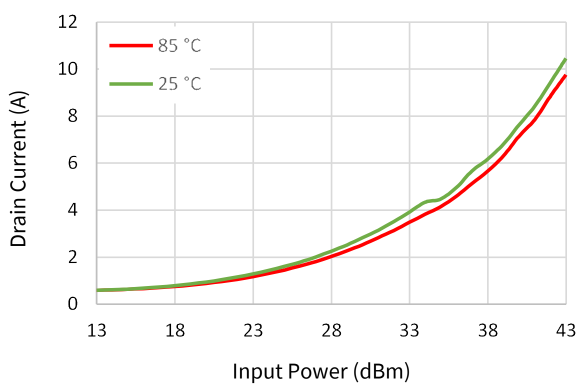
Output Power vs. Input Power vs. Temperature



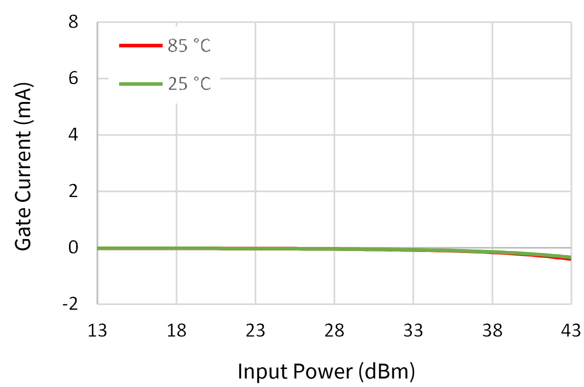
Drain Efficiency vs. Input Power vs. Temperature



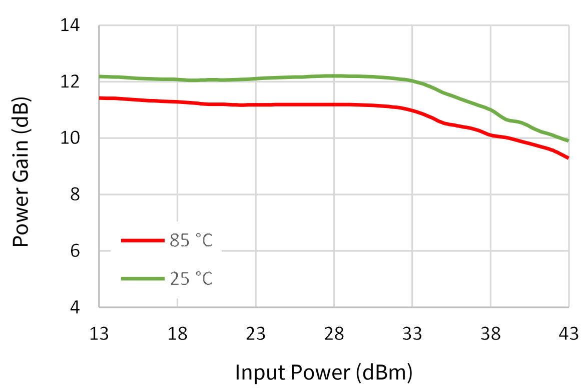
Drain Current vs. Input Power vs. Temperature



Gate Current vs. Input Power vs. Temperature



Power Gain vs. Input Power vs. Temperature

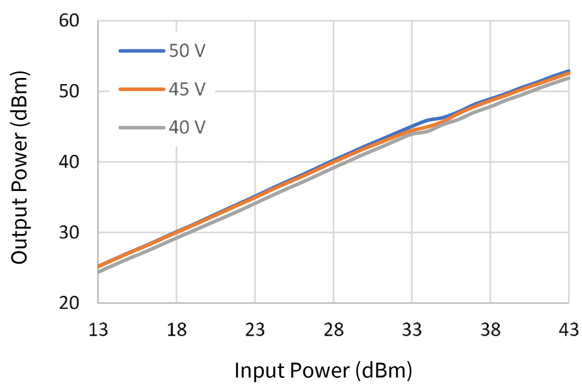


Typical Performance Curves:

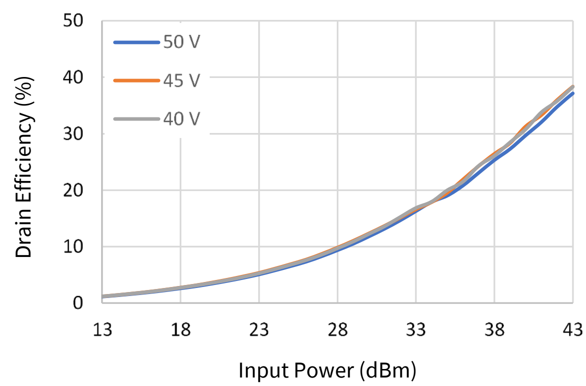
V_D = 50 V, I_{DQ} = 500 mA, CW, T_B = +25°C.

For Engineering Evaluation Only – This data does not Modify MACOM's Datasheet Limits.

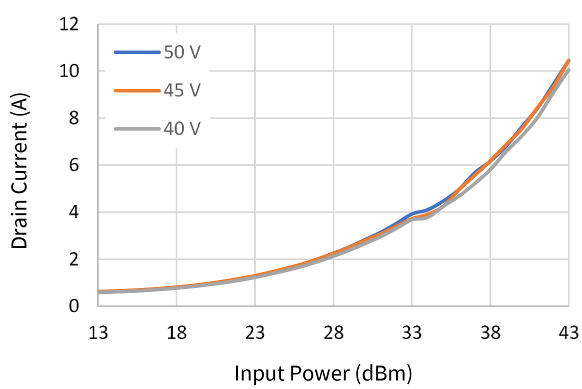
Output Power vs. Input Power vs. V_{DS}



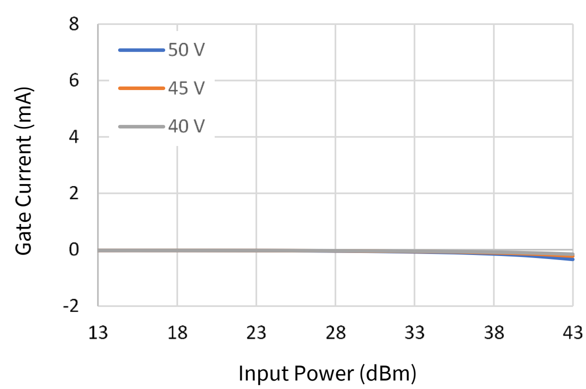
Drain Efficiency vs. Input Power vs. V_{DS}



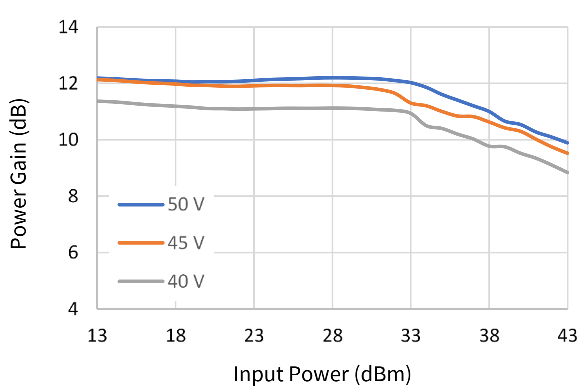
Drain Current vs. Input Power vs. V_{DS}



Gate Current vs. Input Power vs. V_{DS}



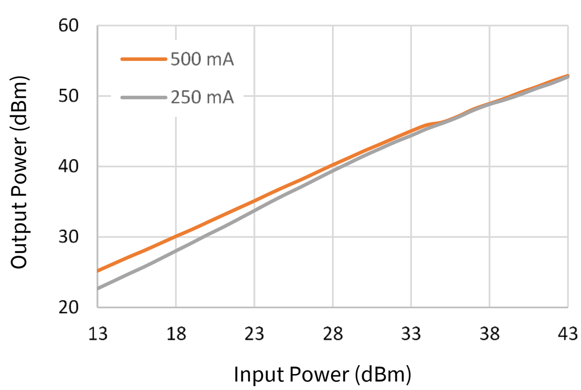
Power Gain vs. Input Power vs. V_{DS}



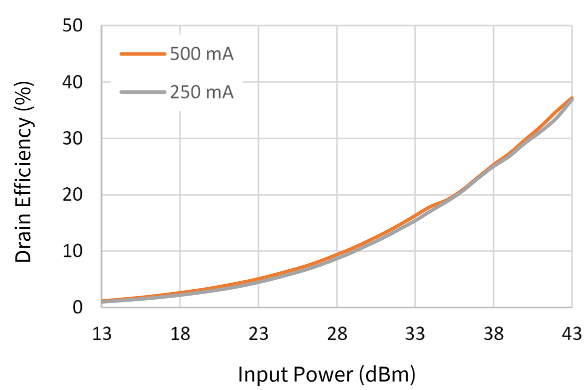
Typical Performance Curves:

V_D = 50 V, I_{DQ} = 500 mA, CW, T_B = +25°C.
For Engineering Evaluation Only – This data does not Modify MACOM's Datasheet Limits.

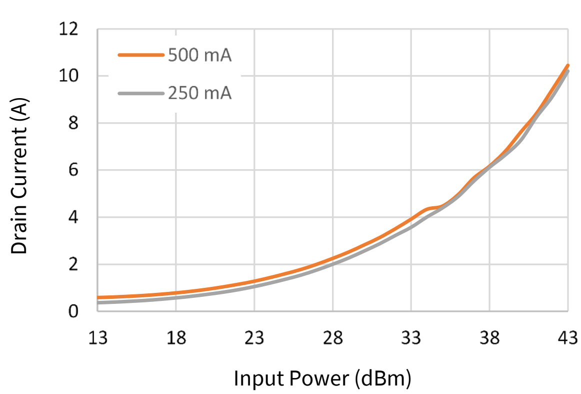
Output Power vs. Input Power vs. I_{DQ}



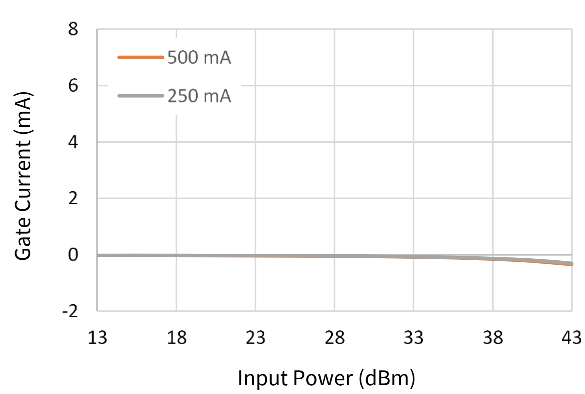
Drain Efficiency vs. Input Power vs. I_{DQ}



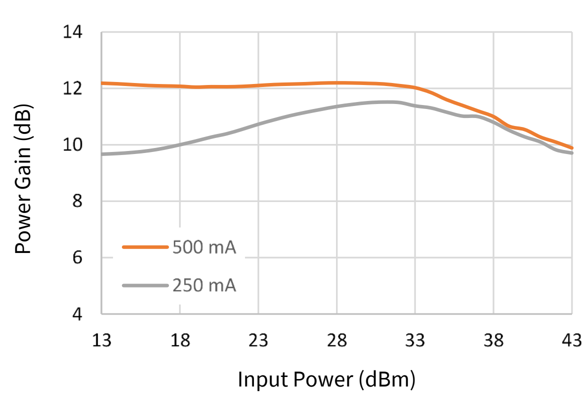
Drain Current vs. Input Power vs. I_{DQ}



Gate Current vs. Input Power vs. I_{DQ}



Power Gain vs. Input Power vs. I_{DQ}

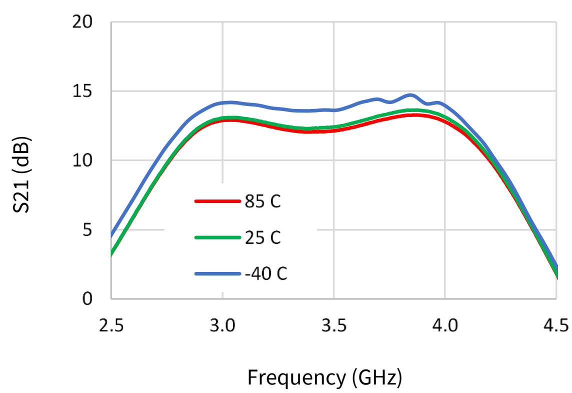


Typical Performance Curves:

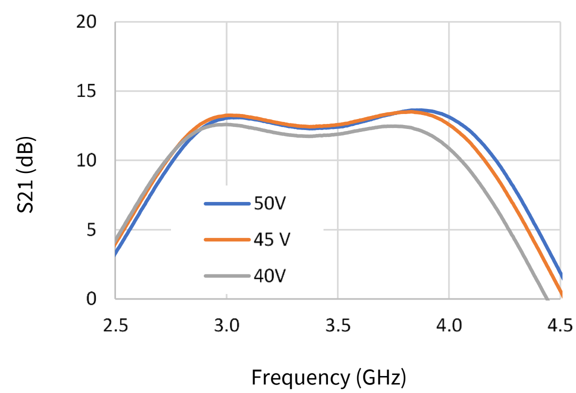
V_D = 50 V, I_{DQ} = 500 mA, P_{IN} = -20 dBm, T_B = +25°C.

For Engineering Evaluation Only – This data does not Modify MACOM's Datasheet Limits.

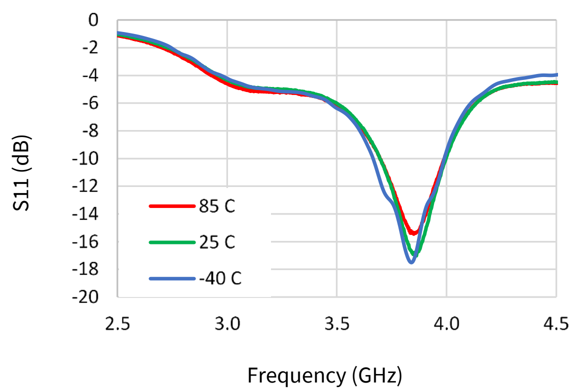
S21 vs. Frequency vs. Temperature



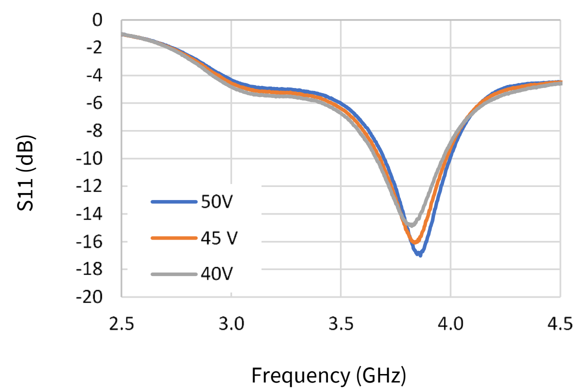
S21 vs. Frequency vs. V_{DS}



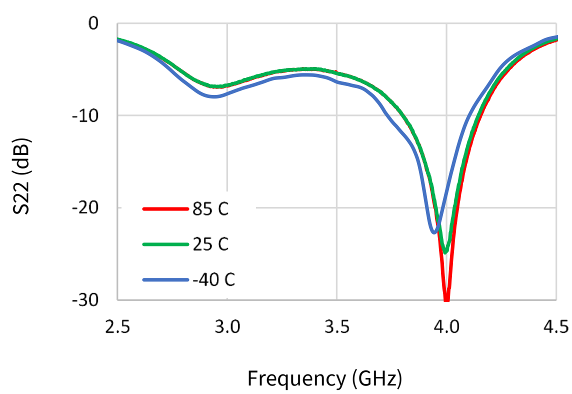
S11 vs. Frequency vs. Temperature



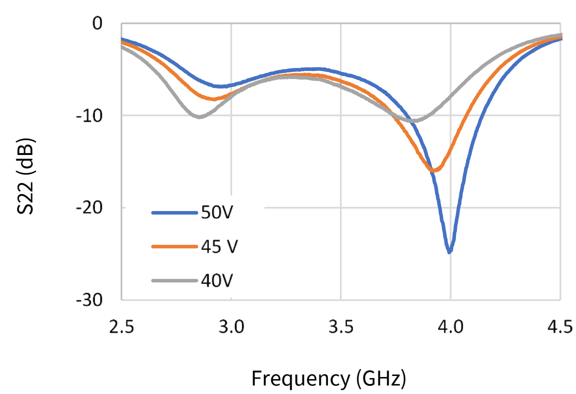
S11 vs. Frequency vs. V_{DS}



S22 vs. Frequency vs. Temperature



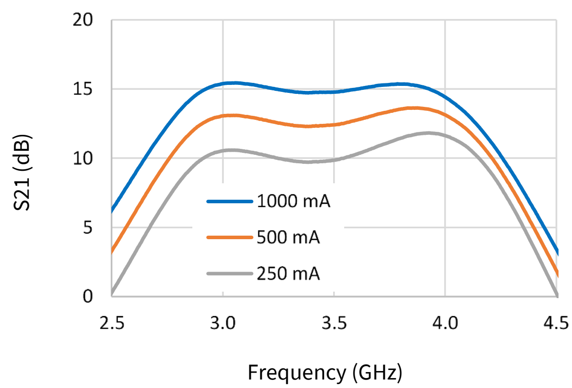
S22 vs. Frequency vs. V_{DS}



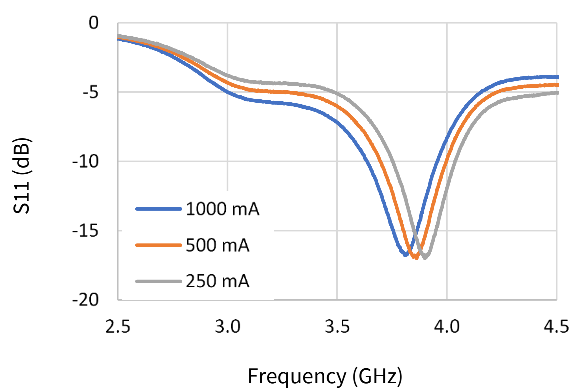
Typical Performance Curves:

V_D = 50 V, I_{DQ} = 500 mA, P_{IN} = -20 dBm, T_B = +25°C.
For Engineering Evaluation Only – This data does not Modify MACOM's Datasheet Limits.

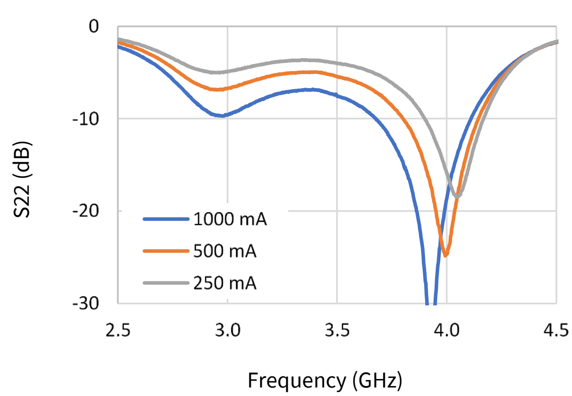
S21 vs. Frequency vs. I_{DQ}



S11 vs. Frequency vs. I_{DQ}



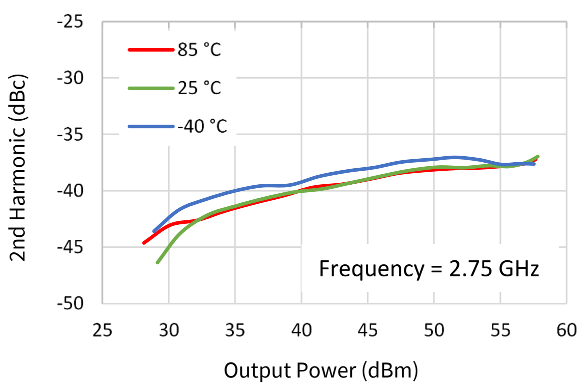
S22 vs. Frequency vs. I_{DQ}



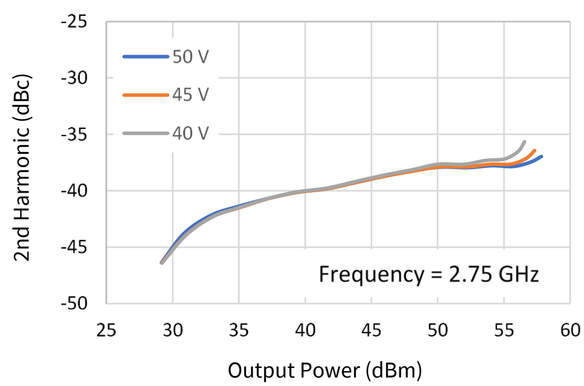
Typical Performance Curves:

V_D = 50 V, I_{DQ} = 500 mA, Pulse Width = 100 μs, Duty Cycle = 10%, P_{IN} = 46 dBm, T_B = +25°C.
For Engineering Evaluation Only – This data does not Modify MACOM's Datasheet Limits.

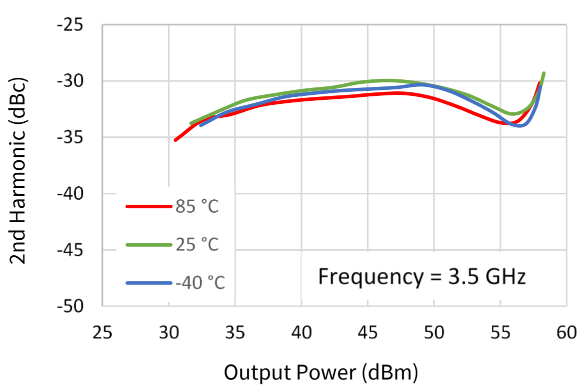
2nd Harmonic vs. Output Power vs. Temperature



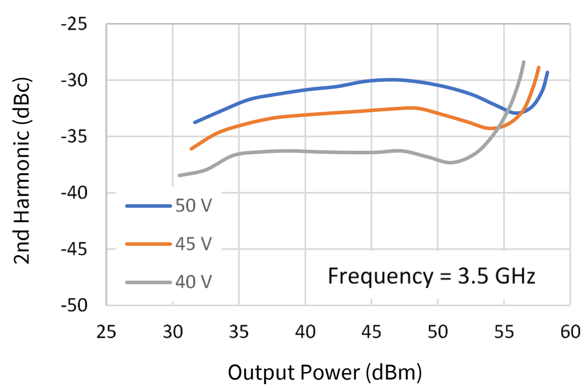
2nd Harmonic vs. Output Power vs. V_{DS}



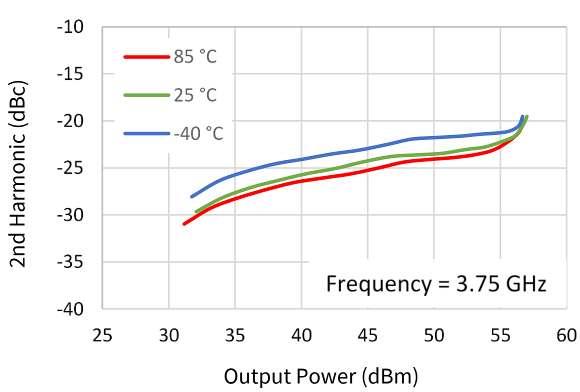
2nd Harmonic vs. Output Power vs. Temperature



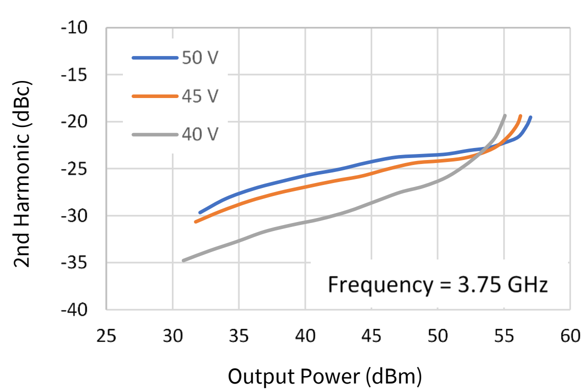
2nd Harmonic vs. Output Power vs. V_{DS}



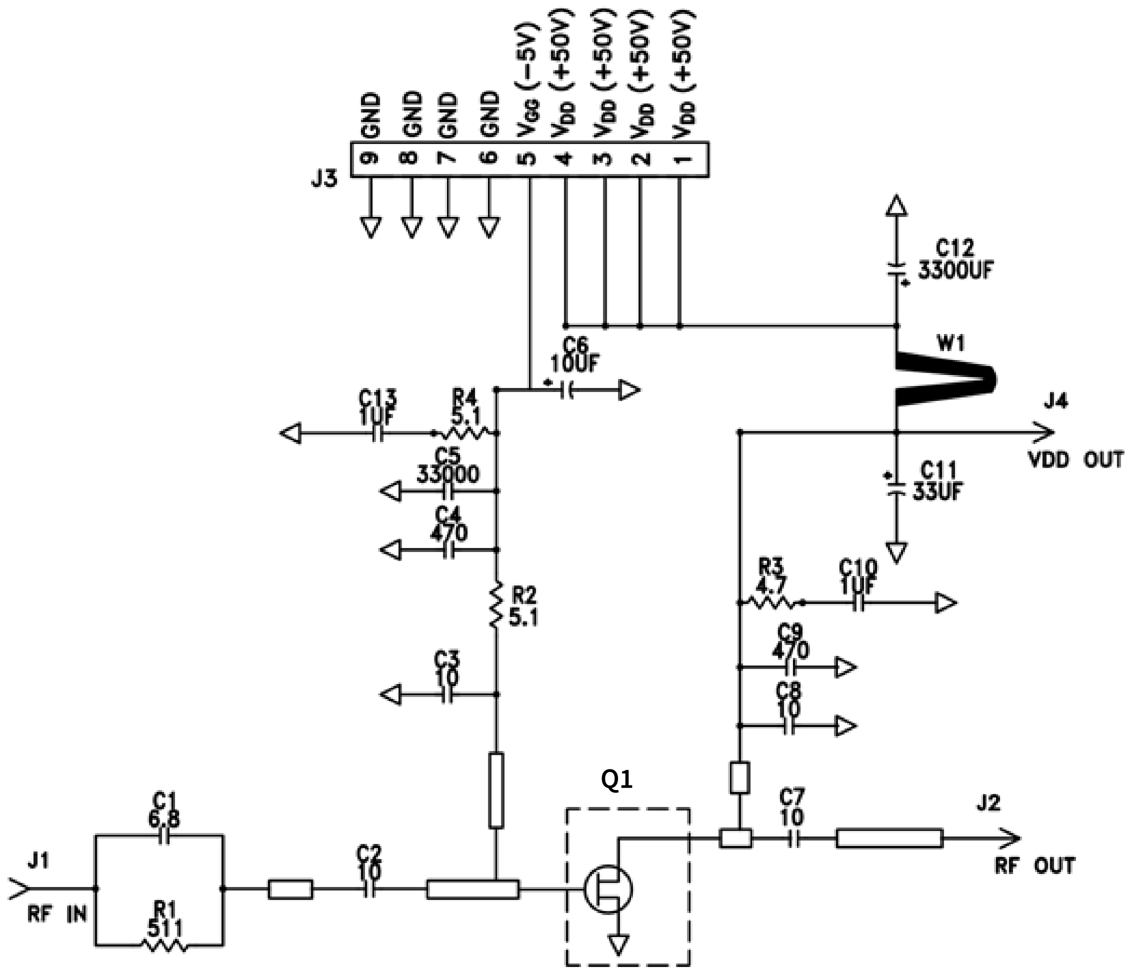
2nd Harmonic vs. Output Power vs. Temperature



2nd Harmonic vs. Output Power vs. V_{DS}



Evaluation Test Fixture 2.75 - 3.75 GHz



Bias Sequencing

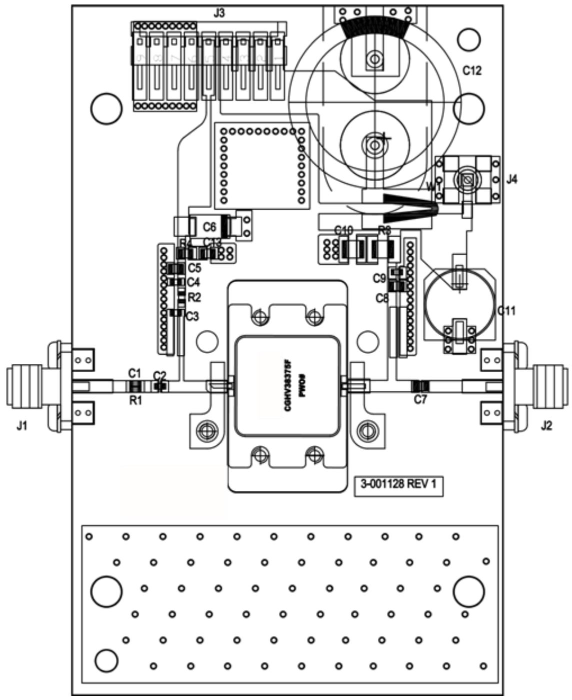
Turning the device ON

1. Set V_{GS} to pinch-off (V_P).
2. Turn on V_{DS} to nominal voltage (50 V).
3. Increase V_{GS} until I_{DS} current is reached.
4. Apply RF power to desired level.

Turning the device OFF

1. Turn the RF power OFF.
2. Decrease V_{GS} down to V_P pinch-off.
3. Decrease V_{DS} down to 0 V.
4. Turn off V_{GS}.

Evaluation Test Fixture 2.75 - 3.75 GHz

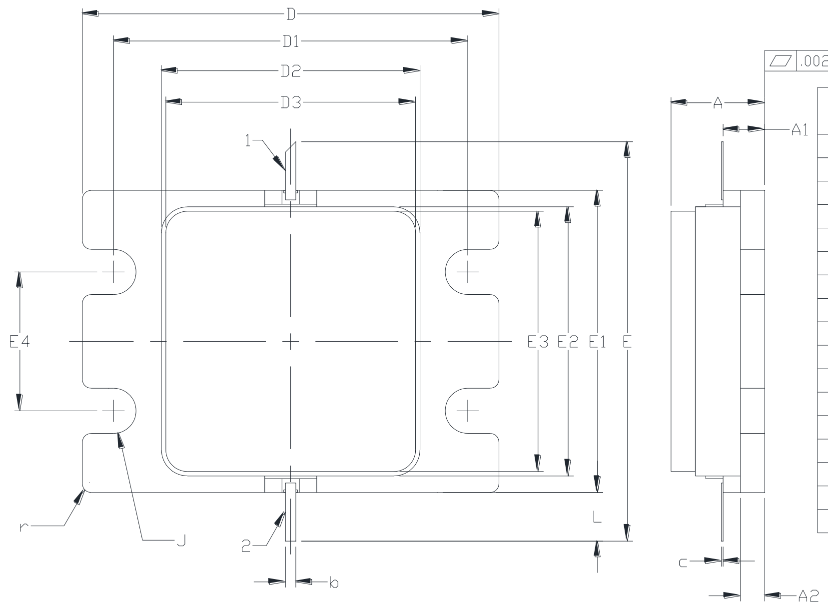


Parts List

Reference Designator	Description	Qty
R1	RES, 511 OHM, +/- 1%, 1/16W,0603	1
R2, R4	RES, 5.1 OHM, +/- 1%, 1/16W,0603	2
R3	RES, 4.7 OHM, 1%, 1/4W, 1206	1
C1	CAP, 6.8 pF, +/- 0.25pF, 250V, 0603	1
C2,C7,C8	CAP, 10 pF, +/- 1%, 250V, 0805	3
C3	CAP, 10 pF, +/-5%,250V, 0603,	1
C4,C9	CAP, 470 pF, 5%, 100V, 0603, X	2
C5	CAP, 33000 pF, 0805, 100V, X7R	1
C6	CAP, 10 µF, 16V, TANTALUM	1
C10	CAP, 1 µF, 100V, 10%, X7R, 1210	1
C11	CAP, 33 µF, 20%, G CASE	1
C12	CAP, 3300 µF, +/-20%, 100V, ELECTROLYTIC	1
C13	CAP, 1 µF, 0805, 100V, X7S	1
J1,J2	CONN, SMA, PANEL MOUNT JACK, FL	2
J3	HEADER RT>PLZ .1CEN LK 9POS	1
J4	CONNECTOR ; SMB, Straight, JACK, SMD	1
W1	CABLE, 18 AWG, 4.2	1
Q1	Transistor CGHV38375F	1
PCB	PCB, RF35-TC, 2.5 X 4.0 X 0.030	1

Product Dimensions (Package Type 440226)

NOTES: (UNLESS OTHERWISE SPECIFIED)
1. INTERPRET DRAWING IN ACCORDANCE WITH ANSI Y14.5M-2009
2. ADHESIVE FROM LID MAY EXTEND A MAXIMUM OF .020 BEYOND EDGE OF LID
3. LID MAY BE MISALIGNED TO THE BODY OF PACKAGE BY A MAXIMUM OF .008 IN ANY DIRECTION
4. ALL PLATED SURFACES ARE GOLD OVER NICKEL



1. GATE
2. DRAIN

DIM	INCHES MIN	INCHES MAX	MILLIMETERS MIN	MILLIMETERS MAX	NOTES
A	0.205	0.221	5.21	5.61	
A1	0.088	0.100	2.24	2.54	2x
A2	0.049	0.061	1.24	1.55	
b	0.022	0.026	0.56	0.66	2x
c	0.003	0.006	0.08	0.15	
D	0.935	0.955	23.75	24.26	
D1	0.797	0.809	20.24	20.55	2x
D2	0.581	0.593	14.76	15.06	
D3	0.565	0.571	14.35	14.50	
E	0.906		23.01		REF
E1	0.679	0.691	17.25	17.55	
E2	0.604	0.616	15.34	15.65	
E3	0.588	0.594	14.93	15.09	
E4	0.309	0.321	7.85	8.15	2x
J	ø0.097	ø0.107	ø2.46	ø2.72	4x
L	0.090	0.130	2.29	3.30	2x
r	0.02 TYP		0.51 TYP		12x