GaN on SiC Amplifier, 50 V, 600 W
2.4 - 2.5 GHz

Features

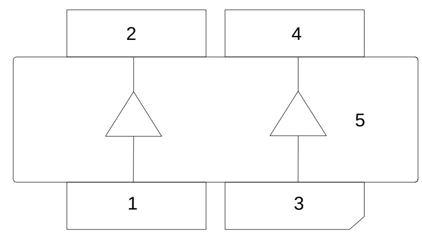
- MACOM PURE CARBIDE® Amplifier Series
- Suitable for Linear & Saturated Applications
- CW Operation: 600 W Output Power
- Internally Pre-Matched
- 50 V Operation
- 100% RF Tested
- RoHS* Compliant

Description

The MAPC-A1539 is a GaN on Silicon Carbide HEMT D-mode amplifier suitable for 2.4 - 2.5 GHz frequency operation. The device supports both pulsed and CW operation with minimum output power levels of greater than 600 W in a plastic package.

The MAPC-A1539 is ideally suited for CW applications as a highly efficient precise heat and power source. The wide range of applications includes solid state cooking, RF plasma generation, material drying, industrial heating, automotive ignition, lighting and medical.

Functional Schematic



Typical RF Performance:

- V_{DS} = 50 V, Vg = -4.5 V, T_C = 25°C, P_{IN} = 44 dBm, CW

Frequency (GHz)	Output Power (dBm)	Gain (dB)	η_D (%)
2.40	59.1	15.1	64.8
2.45	58.6	14.6	69.7
2.50	57.5	13.5	69.1

Pin Configuration[1]

Pin #	Pin Name	Function
1	RF_{IN} / V_{G1}	RF Input / Gate
2	RF_{OUT} / V_{D1}	RF Output / Drain
3	RF_{IN} / V_{G2}	RF Input / Gate
4	RF_{OUT} / V_{D2}	RF Output / Drain
5	Flange[3]	Ground / Source

1. The flange on the package bottom must be connected to RF, DC and thermal ground.

Ordering Information

Part Number	Package
MAPC-A1539-AS000	Bulk
MAPC-A1539-ASSB1	Sample Board

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

Electrical Specifications[2]: Freq. = 2.45 GHz, T_A = 25°C, V_D = +50 V, V_G = -4 V, Z_0 = 50 Ω, Pulse Width = 100 µs, Duty Cycle = 10%

Parameter	Test Conditions	Units	Min.	Typ.	Max.
Output Power	Pulsed, P_{IN} = 43 dBm	dBm	57.9	58.4	—
Drain Efficiency	Pulsed, P_{IN} = 43 dBm	%	64.0	70.2	—
Large Signal Gain	Pulsed, P_{IN} = 43 dBm	dB	14.9	15.3	—

2. Final testing and screening for all transistor sales is performed using the MAPC-A1539-AS production fixture at 2.45 GHz.

Absolute Maximum Ratings[3,4]

Parameter	Absolute Maximum
Vdss	150 V
Vgs	-8, +2 V
Gate Current	102 mA
Junction Temperature[5,6]	+225°C
Operating Temperature	-40°C to +85°C
Storage Temperature	-65C to +150°C

3. Exceeding any one or combination of these limits may cause permanent damage to this device.
4. MACOM does not recommend sustained operation near these survivability limits.
5. Operating at nominal conditions with $T_J \leq$ +225 C will ensure MTTF > 1 x 10^6 hours.
6. Junction Temperature (T_J) = T_C + ϴjc * (V * I)
   Typical thermal resistance (ϴjc) = 0.32 °C/W.
   a) For T_C = +25°C,
      T_J = 137 °C @ P_{DISS} = 350 W
   b) For T_C = +85°C,
      T_J = 197 °C @ P_{DISS} = 350 W

Handling Procedures

Please observe the following precautions to avoid damage:

Static Sensitivity

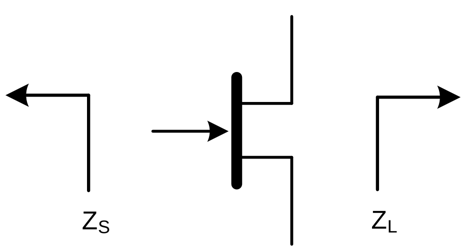
These electronic devices are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. Proper ESD control techniques should be used when handling these HBM Class 0B and CDM Class C2A devices.

Measured Pulsed Load-Pull Performance (10 µsec / 0.1%)
Reference plane at Device Bond Pads

Frequency (GHz)		Maximum Output Power					
		V_{DS} = 50 V, V_g = -4 V, T_c = 25 C, P_{3dB}					
	Z_{SOURCE}	Z_{LOAD}	2nd Harmonic Z_{LOAD}, 10 (Ω)	Gain	Pout	Pout	η_D
	(Ω)	(Ω)	(Mag/ Phase)	(dB)	(dBm)	(W)	(%)
2.4	2 - j5	1.15 - j1.95	0.8 / 100 deg	15.1	57.35	543	70.5
2.5	2 - j5	1.10 - j2.00	0.8 / 100 deg	14.7	57.05	507	70.5

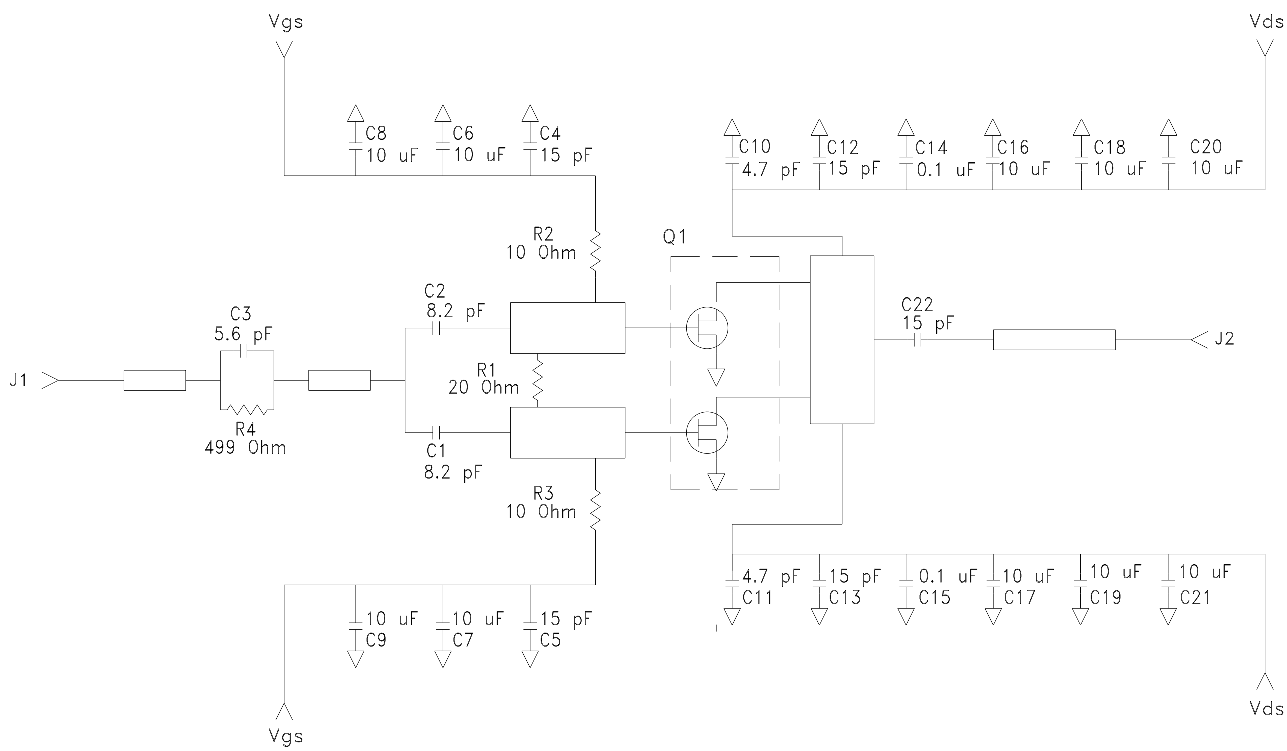
Frequency (GHz)		Maximum Drain Efficiency					
		V_{DS} = 50 V, V_g = -4 V, T_c = 25 C, P_{3dB}					
	Z_{SOURCE}	Z_{LOAD}	2nd Harmonic Z_{LOAD}, 10 (Ω)	Gain	Pout	Pout	η_D
	(Ω)	(Ω)	(Mag/ Phase)	(dB)	(dBm)	(W)	(%)
2.4	2 - j5	0.88 - j1.11	0.8 / 100 deg	16.2	55.52	356.5	81.5
2.5	2 - j5	0.86 - j1.32	0.8 / 100 deg	15.5	55.59	362.2	79.6

Impedance Reference



Z_{SOURCE} = Measured impedance presented to the input of the device at bond pad reference plane.
Z_{LOAD} = Measured impedance presented to the output of the device at bond pad reference plane.

Evaluation Board and Recommended Tuning Solution, 2.4 - 2.5 GHz



Description

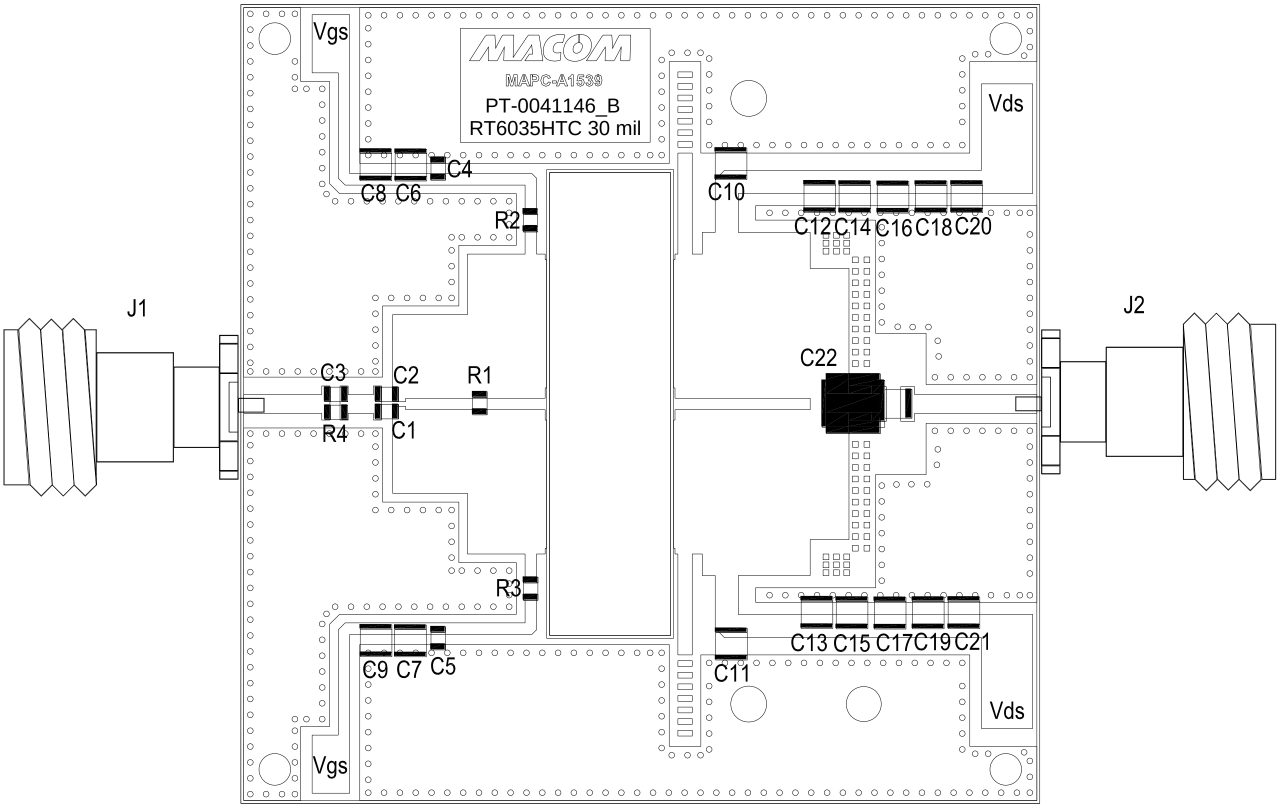
Parts measured on evaluation board (30-mil thick RT/duroid 6035HTC). Matching is provided using a combination of lumped elements and transmission lines as shown in the simplified schematic above. Recommended tuning solution component placement, transmission lines, and details are shown on the next page.

Biasing Sequence

Bias ON
1. Ensure RF is turned off
2. Apply pinch-off voltage of -5 V to the gate
3. Apply nominal drain voltage
4. Bias gate to desired quiescent drain current
5. Apply RF

Bias OFF
1. Turn RF off
2. Apply pinch-off voltage of -5 V to the gate
3. Turn-off drain voltage
4. Turn-off gate voltage

Evaluation Board and Recommended Tuning Solution, 2.4 - 2.5 GHz



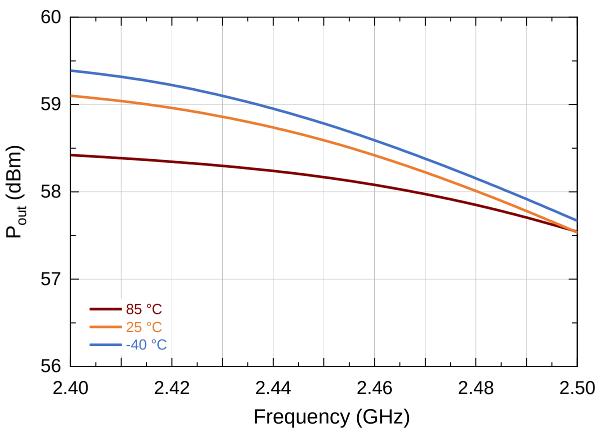
Assembly Parts List

Reference Designator	Description	Manufacturer	Manufacturer PN
C1, C2	CAP, CER, 8.2pF, +/-5%, 250V,NP0, 0805	Kyocera AVX	600F8R2JT250XT
C3	CAP, CER, 5.6pF, +/-0.1pF, 250V,NP0, 0805	Kyocera AVX	600F5R6BT250XT
C4, C5	CAP, CER, 15pF, +/-5%, 250V,NP0, 0805	Kyocera AVX	600F150JT250XT
C6, C7, C8, C9, C16, C17, C18, C19, C20, C21	CAP, CER, 10uF, +/-10%, 100V, X7S, 1210	Murata	GRM32EC72A106KE05L
C10, C11	CAP, CER, 4.7pF, +/-0.25pF, 500V, C0G/NP0, 1111	Vishay Vitramon	VJ1111D4R7CXEQJHT
C12, C13	CAP, CER, 15pF, +/-5%, 500V, C0G/NP0, 1111	Vishay Vitramon	VJ1111D150JXEQJHT
C14, C15	CAP, CER, 0.1uF, +/-10%, 100V, X7R, 1210	Murata	GRM32NR72A104KA01L
C22	CAP, MICA, 15pF, +/-5%, 300V, SMD	Cornell Dubilier Knowles	MIN02-002CC150J-F
R1	RES, 20 Ohm, 5%, 1/4W, 0805	KOA Speer	RK73B2ATTD200J
R2, R3	RES, 10 Ohm, 5%, 1/4W, 0805	KOA Speer	RK73B2ATTD100J
R4	RES, 499 Ohm, +/- 1%, 1/4W, 0805	KOA Speer	RK73H2ATTD4990F
J1, J2	N-Type Connector, 50 ohm, Panel Mount	Amphenol	172190
Q1	MACOM, 600W, 2.4-2.5GHz Amplifier		MAPC-A1539
PCB	Rogers, RT/duroid 6035HTC, 30mil		

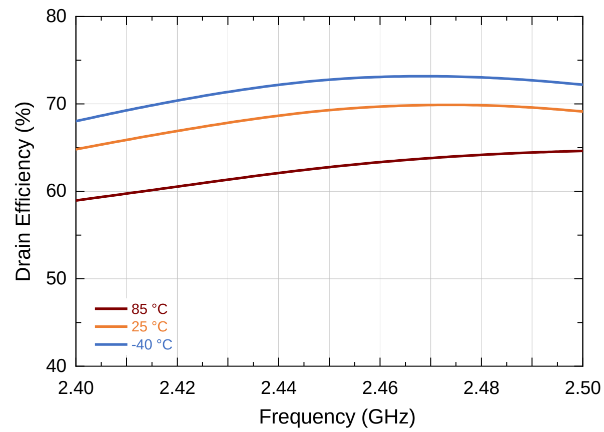
Typical Performance Curves as Measured in the 2.4 – 2.5 GHz Evaluation Test Fixture

V_{DS} = 50 V, Vg = -4.5 V, T_C = 25°C, Pin = 44 dBm, CW, Freq = 2.45 GHz **(Unless otherwise noted)**
For Engineering Evaluation Only – This data does not Modify MACOM's Datasheet Limits.

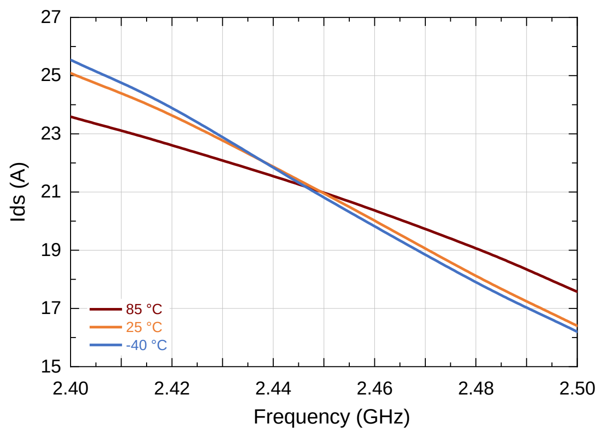
Output Power vs. Temperature and Frequency



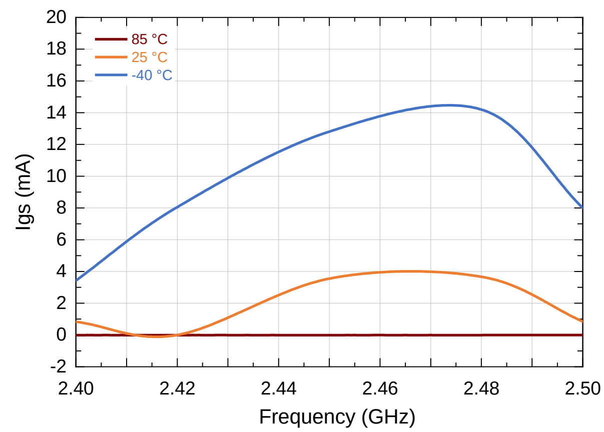
Drain Efficiency vs. Temperature and Frequency



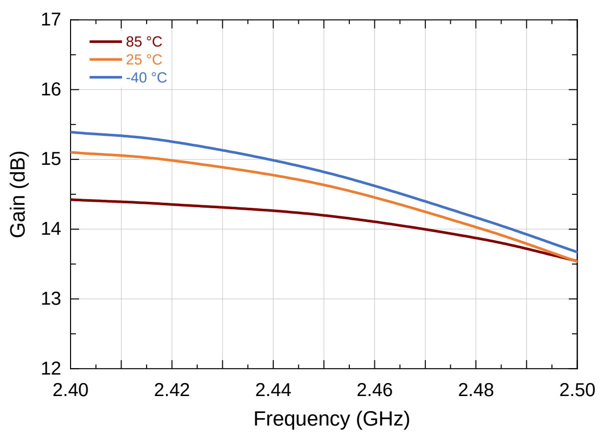
Drain Current vs. Temperature and Frequency



Gate Current vs. Temperature and Frequency



Large Signal Gain vs. Temperature and Frequency



Typical Performance Curves as Measured in the 2.4 – 2.5 GHz Evaluation Test Fixture

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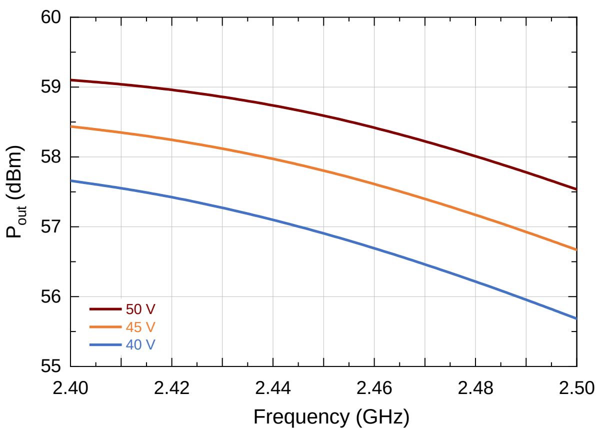
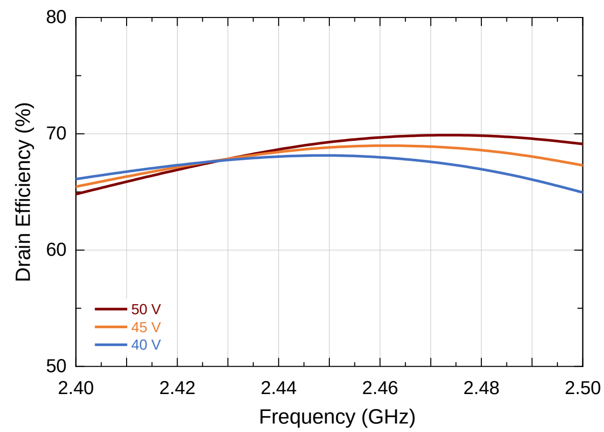
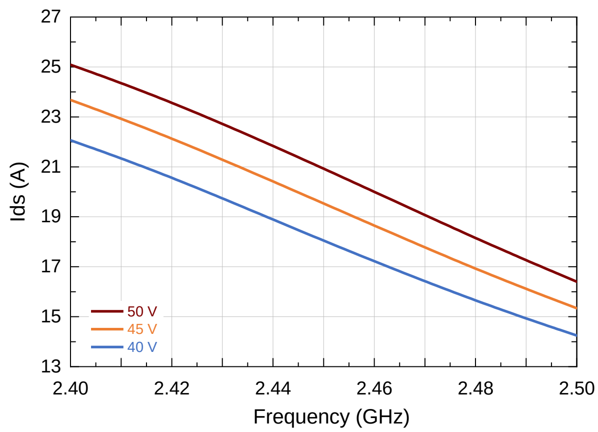
Output Power vs. V_{DS} and Frequency



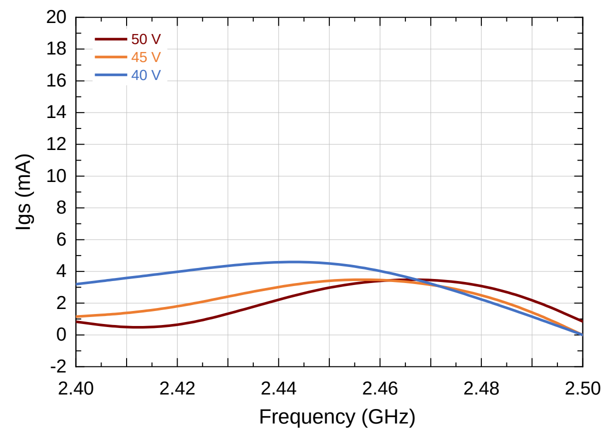
Drain Efficiency vs. V_{DS} and Frequency



Drain Current vs. V_{DS} and Frequency



Gate Current vs. V_{DS} and Frequency



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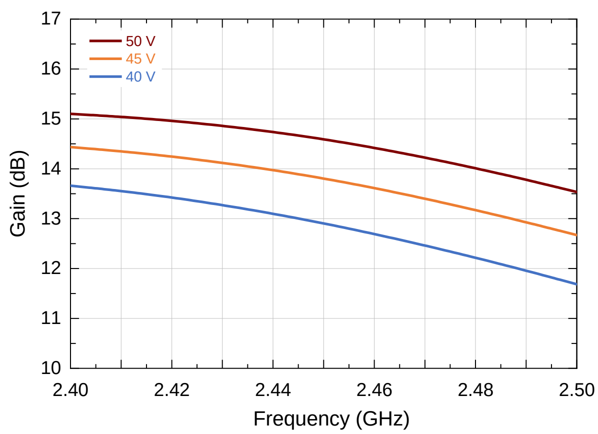

Typical Performance Curves as Measured in the 2.4 – 2.5 GHz Evaluation Test Fixture

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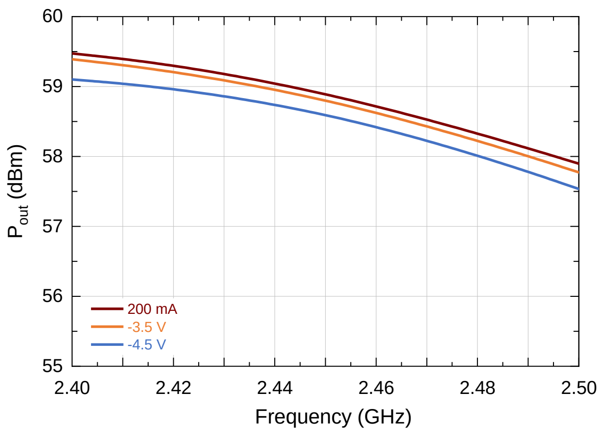
Output Power vs. I_{DQ} and Frequency



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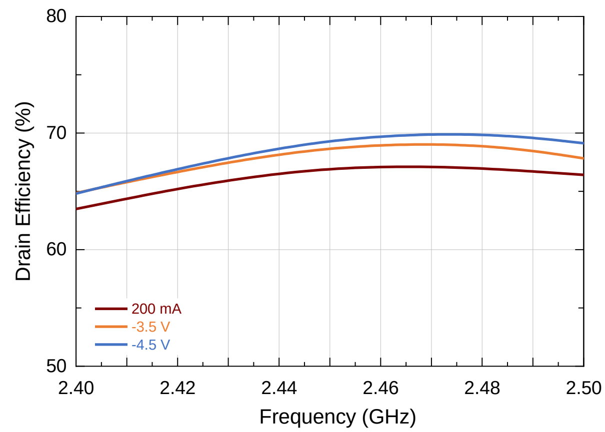

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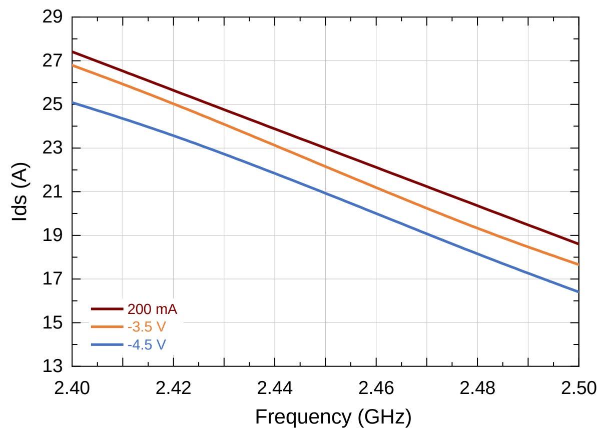

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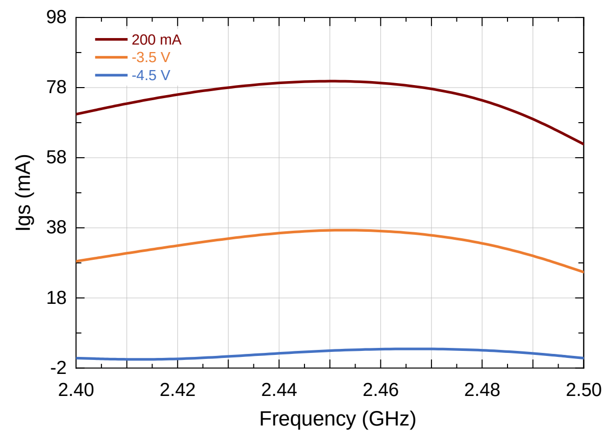

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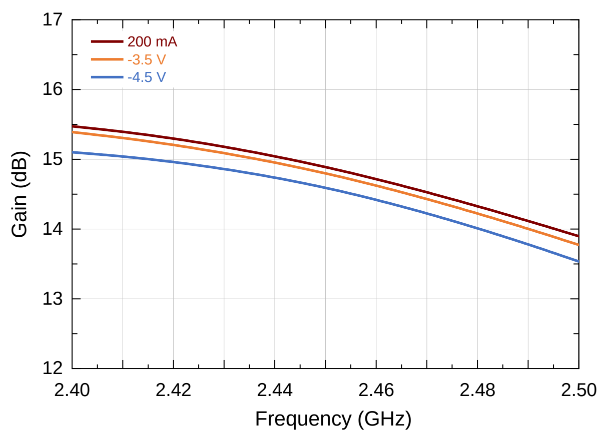

Typical Performance Curves as Measured in the 2.4 – 2.5 GHz Evaluation Test Fixture

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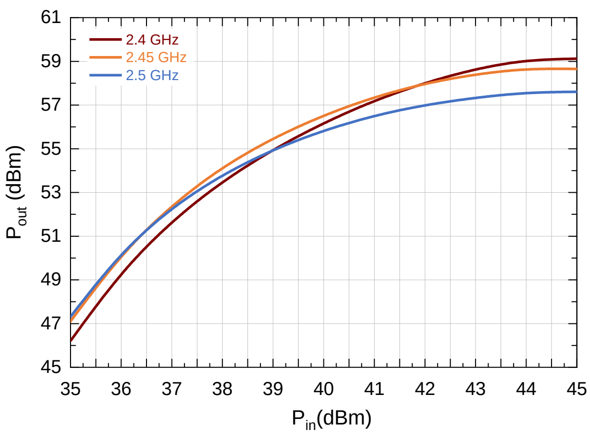
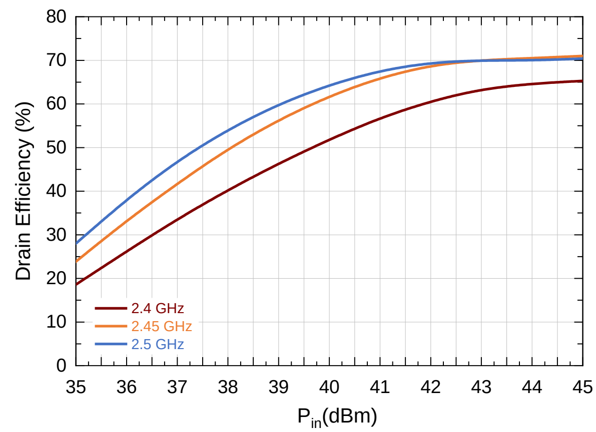
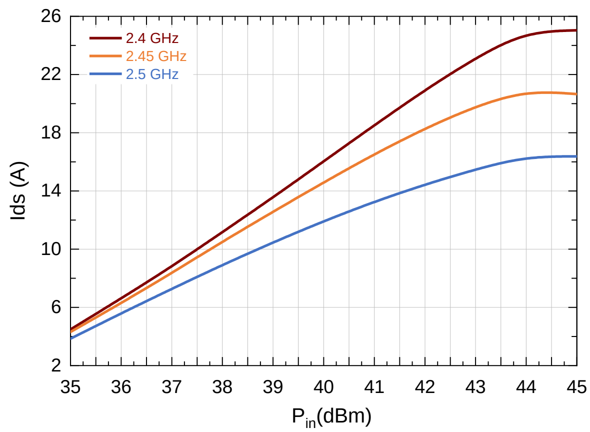
Output Power vs. Frequency and P_{IN}



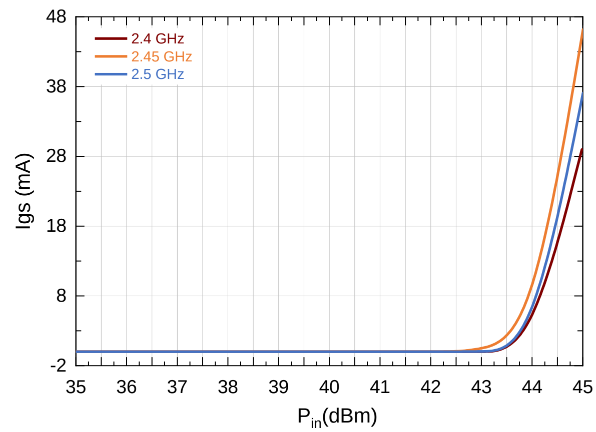
Drain Efficiency vs. Frequency and P_{IN}



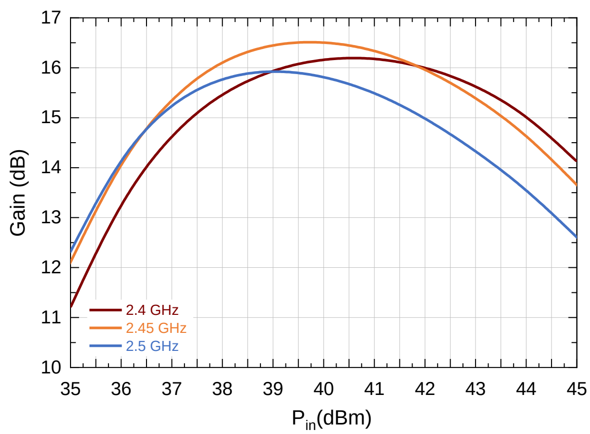
Drain Current vs. Frequency and P_{IN}



Gate Current vs. Frequency and P_{IN}



Large Signal Gain vs. Frequency and P_{IN}



Typical Performance Curves as Measured in the 2.4 – 2.5 GHz Evaluation Test Fixture

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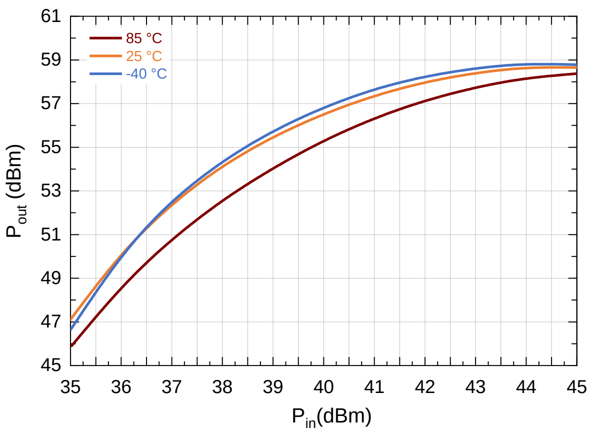
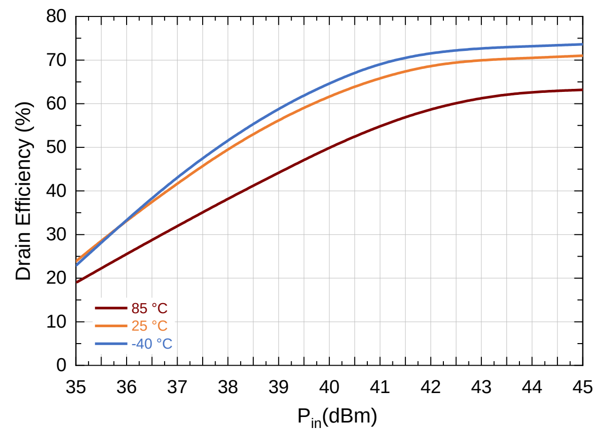
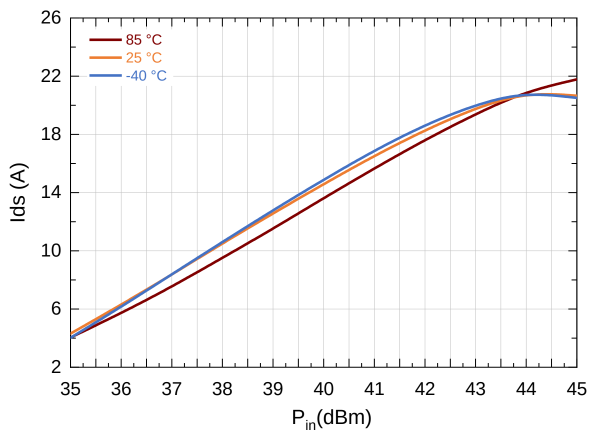
Output Power vs. Temperature and P_{IN}



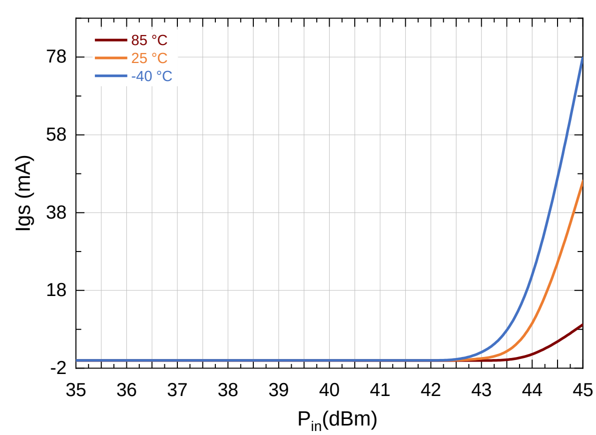
Drain Efficiency vs. Temperature and P_{IN}



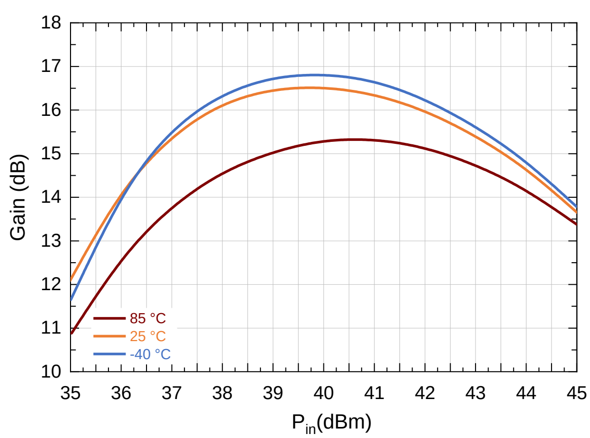
Drain Current vs. Temperature and P_{IN}



Gate Current vs. Temperature and P_{IN}



Large Signal Gain vs. Temperature and P_{IN}



Typical Performance Curves as Measured in the 2.4 – 2.5 GHz Evaluation Test Fixture

V_{DS} = 50 V, Vg = -4.5 V, T_C = 25°C, Pin = 44 dBm, CW, Freq = 2.45 GHz **(Unless otherwise noted)**
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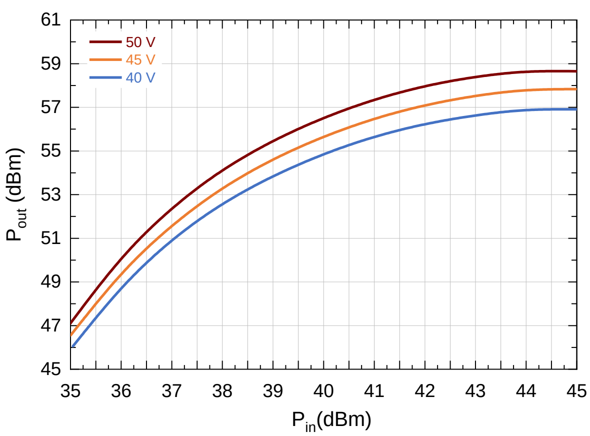
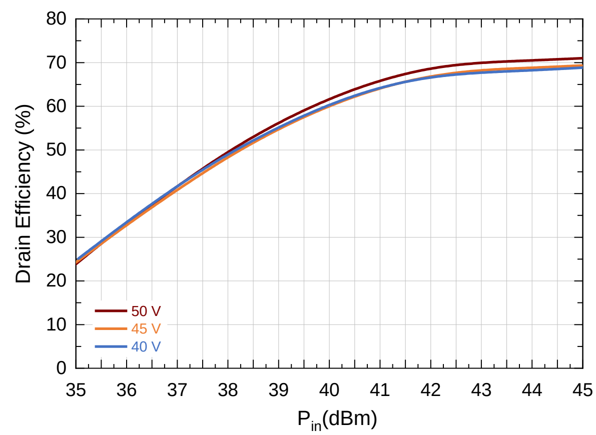
Output Power vs. V_{DS} and P_{IN}



Drain Efficiency vs. V_{DS} and P_{IN}



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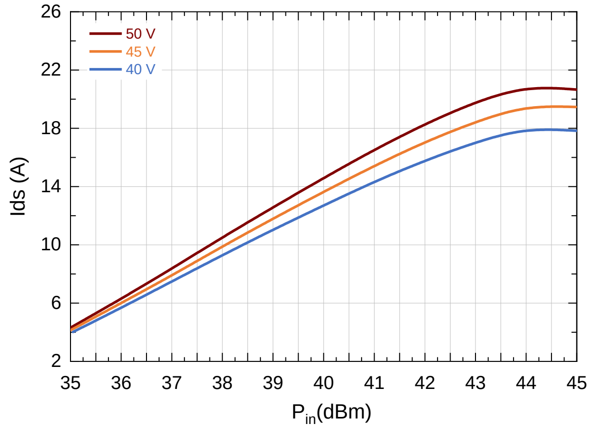
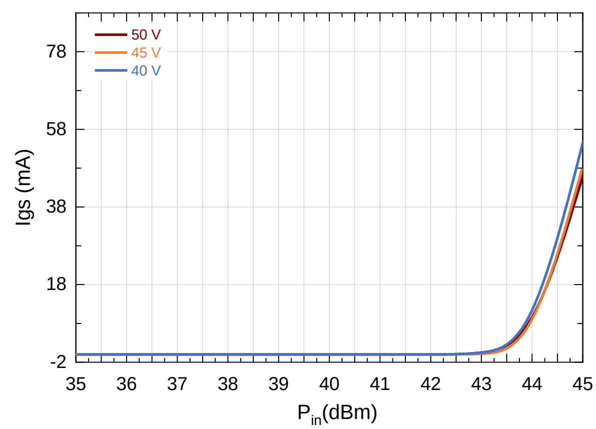
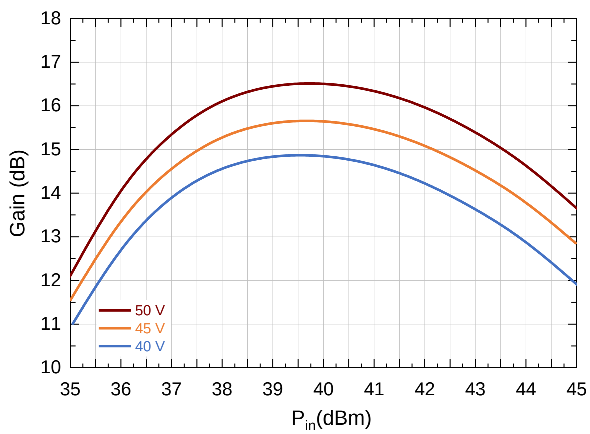


Gate Current vs. V_{DS} and P_{IN}



Large Signal Gain vs. V_{DS} and P_{IN}



Typical Performance Curves as Measured in the 2.4 – 2.5 GHz Evaluation Test Fixture

V_{DS} = 50 V, Vg = -4.5 V, T_C = 25°C, Pin = 44 dBm, CW, Freq = 2.45 GHz **(Unless otherwise noted)**
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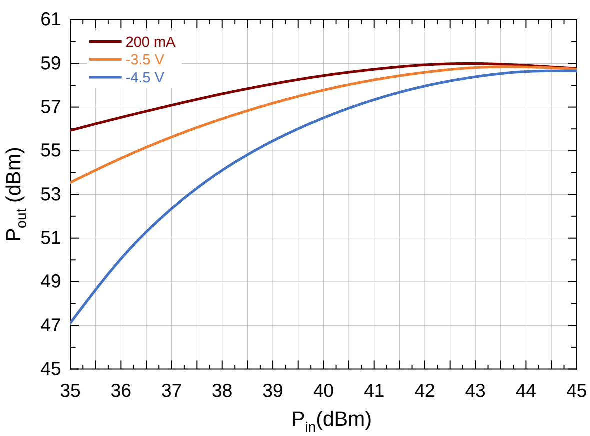
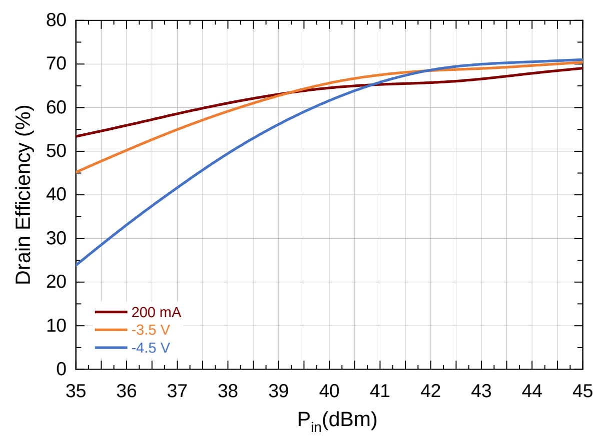
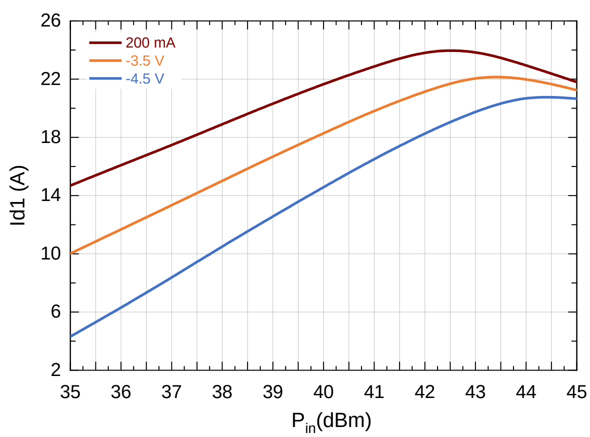
Output Power vs. I_{DQ} and P_{IN}



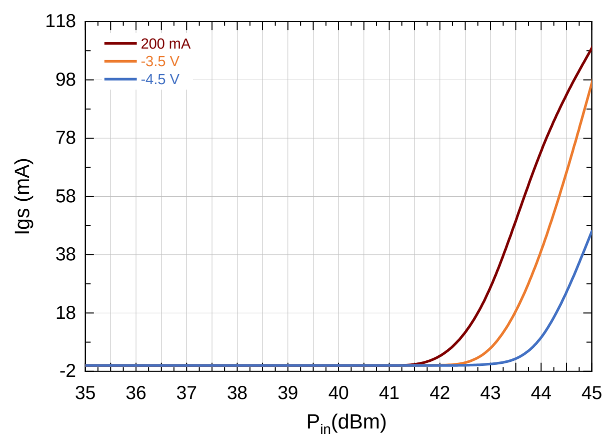
Drain Efficiency vs. I_{DQ} and P_{IN}



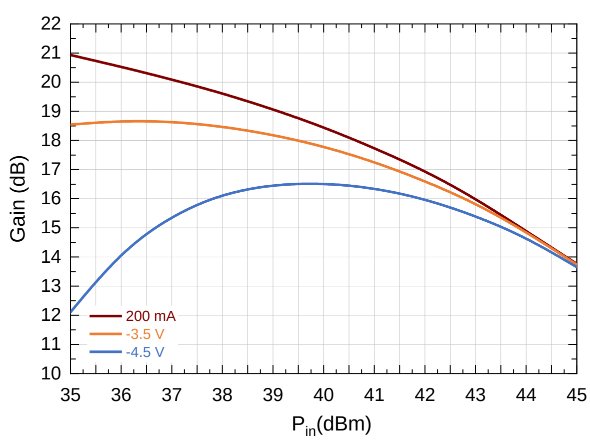
Drain Current vs. I_{DQ} and P_{IN}



Gate Current vs. I_{DQ} and P_{IN}



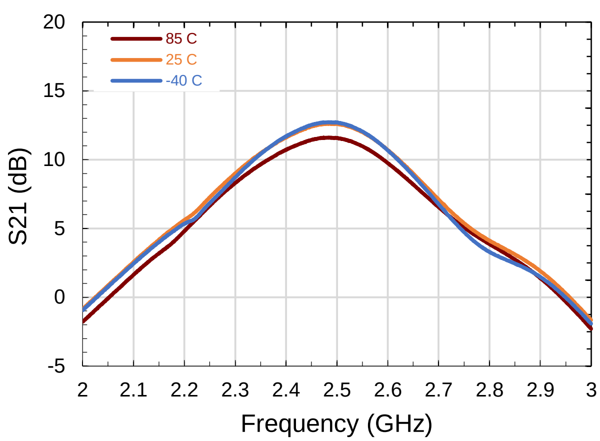
Large Signal Gain vs. I_{DQ} and P_{IN}



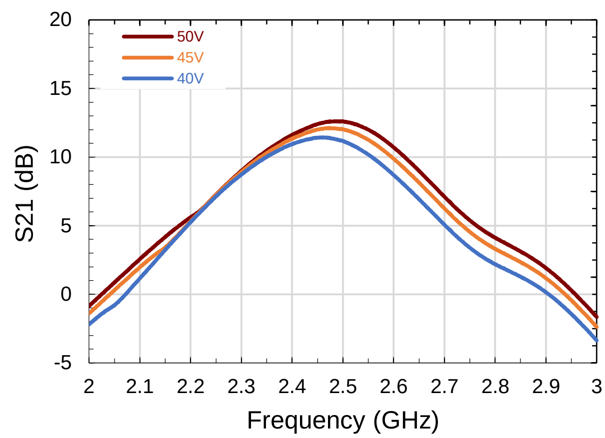
Typical Performance Curves as Measured in the 2.4– 2.5 GHz Evaluation Test Fixture:

CW, V_{DS} = 50 V, I_{DQ} = 200 mA, Pin=-20dBm (Unless Otherwise Noted)
For Engineering Evaluation Only—This data does not Modify MACOM's Datasheet Limits.

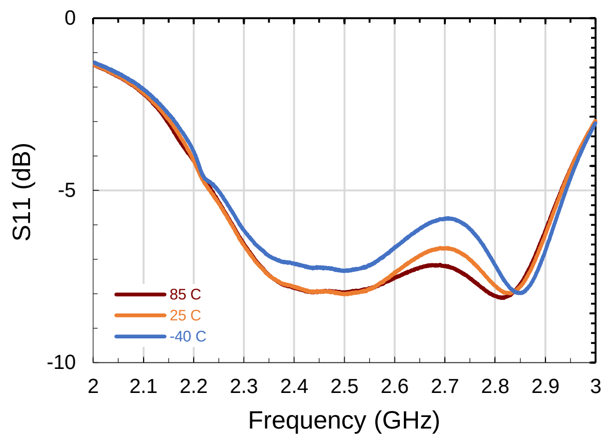
S21 vs Frequency and Temperature



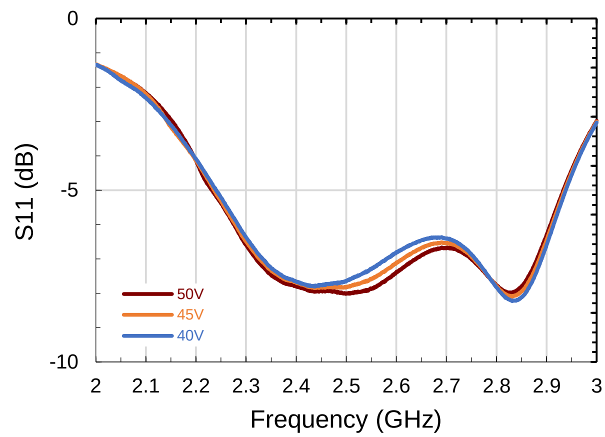
S21 vs Frequency and V_{DS}



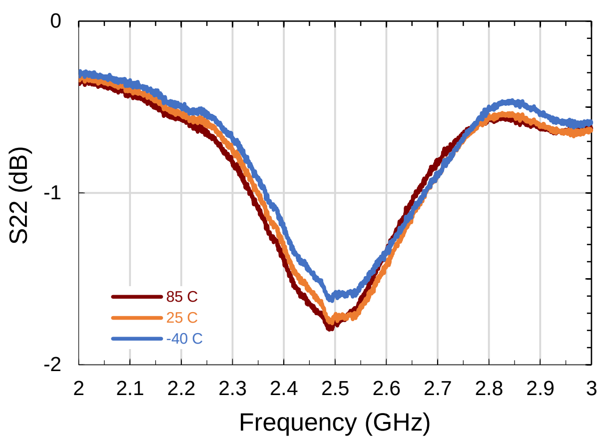
S11 vs Frequency and Temperature



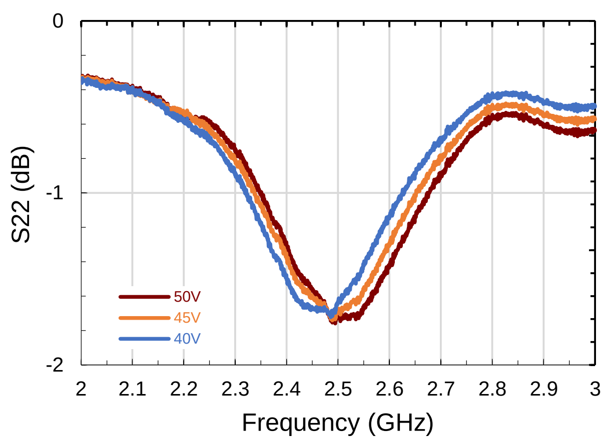
S11 vs Frequency and V_{DS}



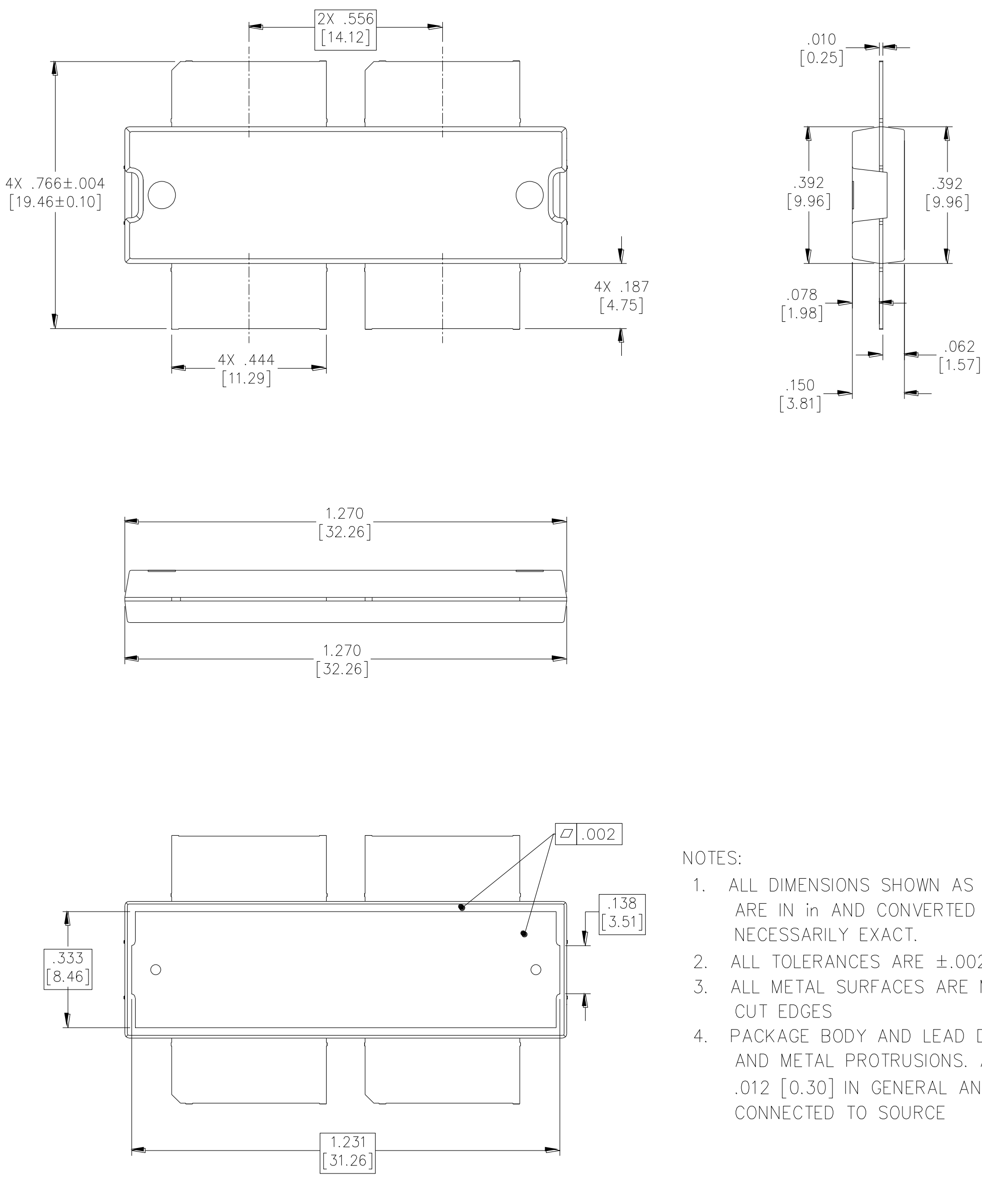
S22 vs Frequency and Temperature



S22 vs Frequency and V_{DS}



Product Outline Specifications



NOTES:
1. ALL DIMENSIONS SHOWN AS in[mm]. CONTROLLING DIMENSIONS ARE IN in AND CONVERTED mm DIMENSIONS ARE NOT NECESSARILY EXACT.
2. ALL TOLERANCES ARE ±.002 [0.05] UNLESS OTHERWISE NOTED
3. ALL METAL SURFACES ARE MATTE Sn PLATED EXCEPT FOR CUT EDGES
4. PACKAGE BODY AND LEAD DIMENSIONS DO NOT INCLUDE MOLD AND METAL PROTRUSIONS. ALLOWABLE PROTRUSION IS .012 [0.30] IN GENERAL AND .004 [0.10] FOR PROTRUSIONS CONNECTED TO SOURCE