GaN on SiC Amplifier, 2500 W, 65 V 0.96 - 1.4 GHz

Features

- Saturated Power: 2500 W
- Drain Efficiency: 60%
- Small Signal Gain: 18 dB
- Lead-Free Air Cavity Ceramic Package
- RoHS* Compliant

Applications

- Avionics - TACAN, DME, IFF
- L-band Radar
- General Amplification

Description

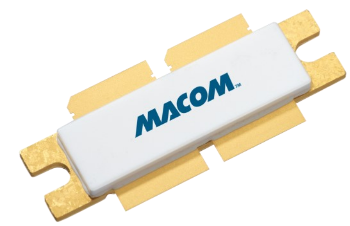
CGHV1420KF is a 2500W package, partially-matched amplifier utilizing high performance, GaN on SiC production process. The CGHV1420KF operates up to 1.4 GHz and supports both defense and commercial-related avionics applications. The CGHV1420KF typically achieves 2500 W of saturated output power with 17 dB of large signal gain and 60% drain efficiency via a 1030 MHz reference design.

Packaged in a thermally-enhanced, flange package, the CGHV1420KF provides superior performance allowing customers to improve SWaP-C benchmarks in their next-generation systems.

Typical RF Performance:

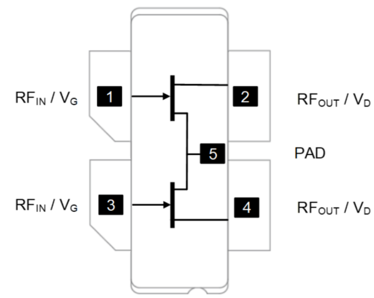
- Pulsed measurement, P_{IN} = 47 dBm, V_{DS} = 65 V, I_{DQ} = 2000 mA, T_C = 25°C, Pulse width = 32 µs, Duty cycle = 4%,

Frequency (MHz)	Output Power (dBm)	Gain (dB)	η_D
1030	64.4	17.4	63



AC-1230B-4

Functional Schematic



Pin Configuration

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[1]	Ground / Source

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

Ordering Information

Part Number	MOQ Increment
CGHV1420KF	Bulk Quantity: Bolt-down
CGHV1420KF-AMP	Sample Board: Bolt-down

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

RF Electrical Characteristics[2]: Freq. = 1.03 GHz, T_A = 25°C, V_{DS} = 65 V, I_{DQ} = 2000 mA

Parameter	Test Conditions	Symbol	Min.	Typ.	Max.	Units
Output Power	Pulsed[3], P_{IN} = 47 dBm	P_{OUT}	—	64.4	—	dBm
Drain Efficiency	Pulsed[3], P_{IN} = 47 dBm	DE	—	63	—	%
Large Signal Gain	Pulsed[3], P_{IN} = 47 dBm	G_P	—	17.4	—	dB
Small Signal Gain	CW, P_{IN} = -20 dBm	S21	—	18.4	—	dB
Input Return Loss	CW, P_{IN} = -20 dBm	S11	—	-9	—	dB
Output Return Loss	CW, P_{IN} = -20 dBm	S22	—	-4	—	dB
Output Mismatch Stress[2]	P_{IN} = 47 dBm, All Phase Angles	ψ	VSWR = 6:1, No Device Damage			

2. Performance in MACOM Evaluation Fixture, 50 Ω System
3. Pulse Width = 32 µs, 4 % Duty Cycle

RF Electrical Specifications[4] : Freq. = 1.03 GHz, T_A = +25°C, V_{DS} = 65 V, I_{DQ} = 2000 mA Pulse Width 32 µs, 10% Duty Cycle, P_{IN} = 47 dBm

Parameter	Conditions	Symbol	Min.	Typ.	Max.	Units
Output Power	1.03 GHz	P_{OUT}	64	64.4	—	dBm
Drain Efficiency	1.03 GHz	η	58	62	—	%
Power Gain	1.03 GHz	G_P	17	17.4	—	dB

4. Final testing and screening for all amplifier sales is performed using the CGHV1420KF production test fixture at 1.03 GHz.

DC Electrical Characteristics T_A = 25°C

Parameter	Test Conditions	Symbol	Min.	Typ.	Max.	Units
Drain-Source Leakage Current	V_{GS} = -8 V, V_{DS} = 10 V	I_{DLK}	—	—	36.92	mA
Gate-Source Leakage Current	V_{GS} = -8 V, V_{DS} = 10 V	I_{GLK}	-36.92	—	—	mA
Gate Threshold Voltage	V_{DS} = 10 V, I_D = 265.6 mA	V_T	-3.8	-3.1	-2.3	V
Gate Quiescent Voltage	V_{DS} = 65 V, I_D = 2000 mA	V_{GSQ}	—	-3.1	—	V

Thermal Characteristics

Parameter	Symbol	Test Conditions	Units	Rating
Operating Junction Temperature	T_J	Pulse Width = 32 µs , Duty Cycle = 4 %, P_{DISS} = 1663 W, T_C = 85.0°C	°C	201
Thermal Resistance, Junction to Case	$R_{\theta JC}$		°C/W	0.07

Absolute Maximum Ratings[5,6,7]

Parameter	Absolute Maximum
Drain-Source Voltage	195 V
Gate Voltage	-10 V, +2 V
Drain Current	96 A
Gate Current	334 mA
Input Power	50 dBm
Dissipated Power[8]	2000 W
Pulse Width/Duty Cycle	100 µs / 10%
Junction Temperature	+225°C
Operating Temperature	-40°C to +85°C
Storage Temperature	-65°C to +150°C
Mounting Temperature	+260°C

5. Exceeding any one or combination of these limits may cause permanent damage to this device.
6. MACOM does not recommend sustained operation near these survivability limits.
7. Operating at nominal conditions with $T_J \leq$ +225 °C will ensure MTTF > 1 x 10^6 hours.
2. 85 °C, Pulse Width = 32 µs, 4 % Duty Cycle

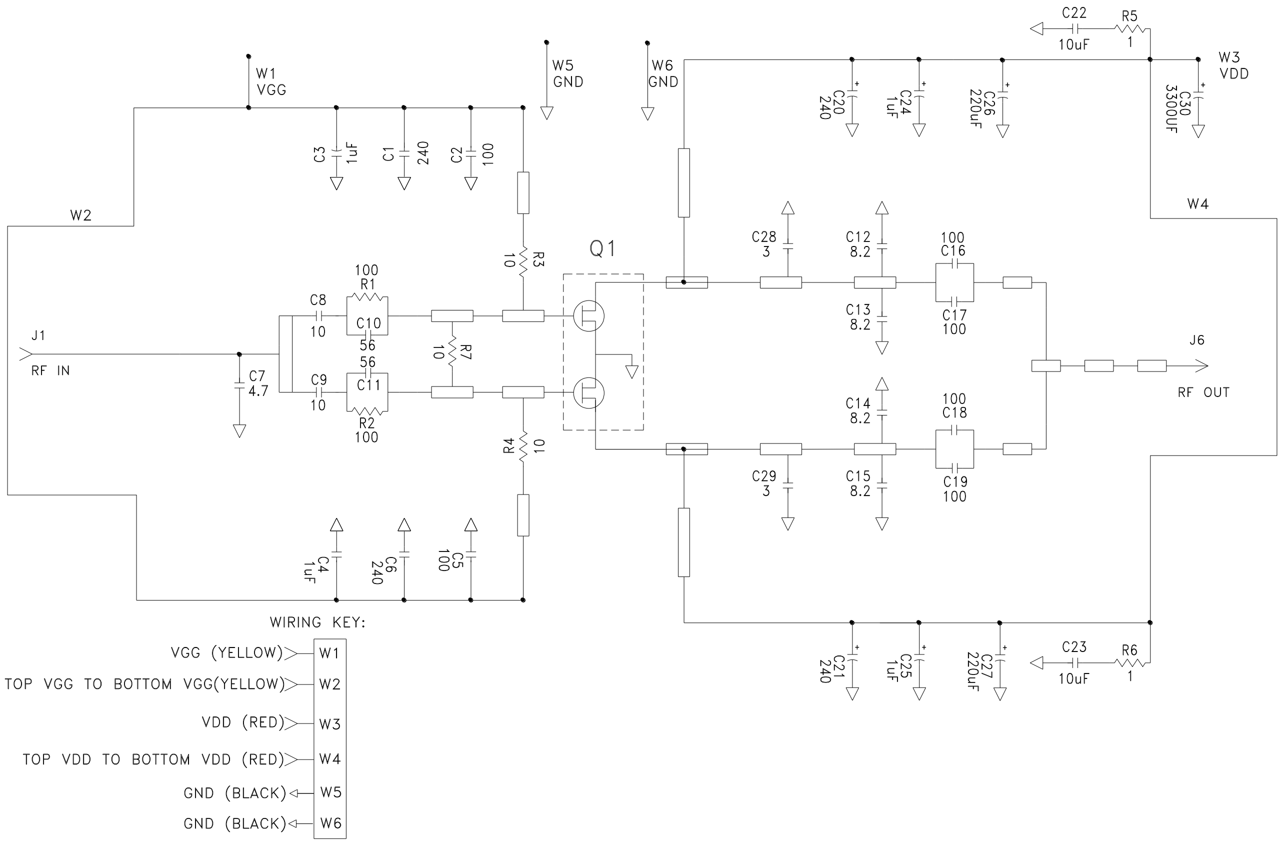
Handling Procedures

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.

Evaluation Test Fixture and Recommended Tuning Solution, 1.03 GHz



Description

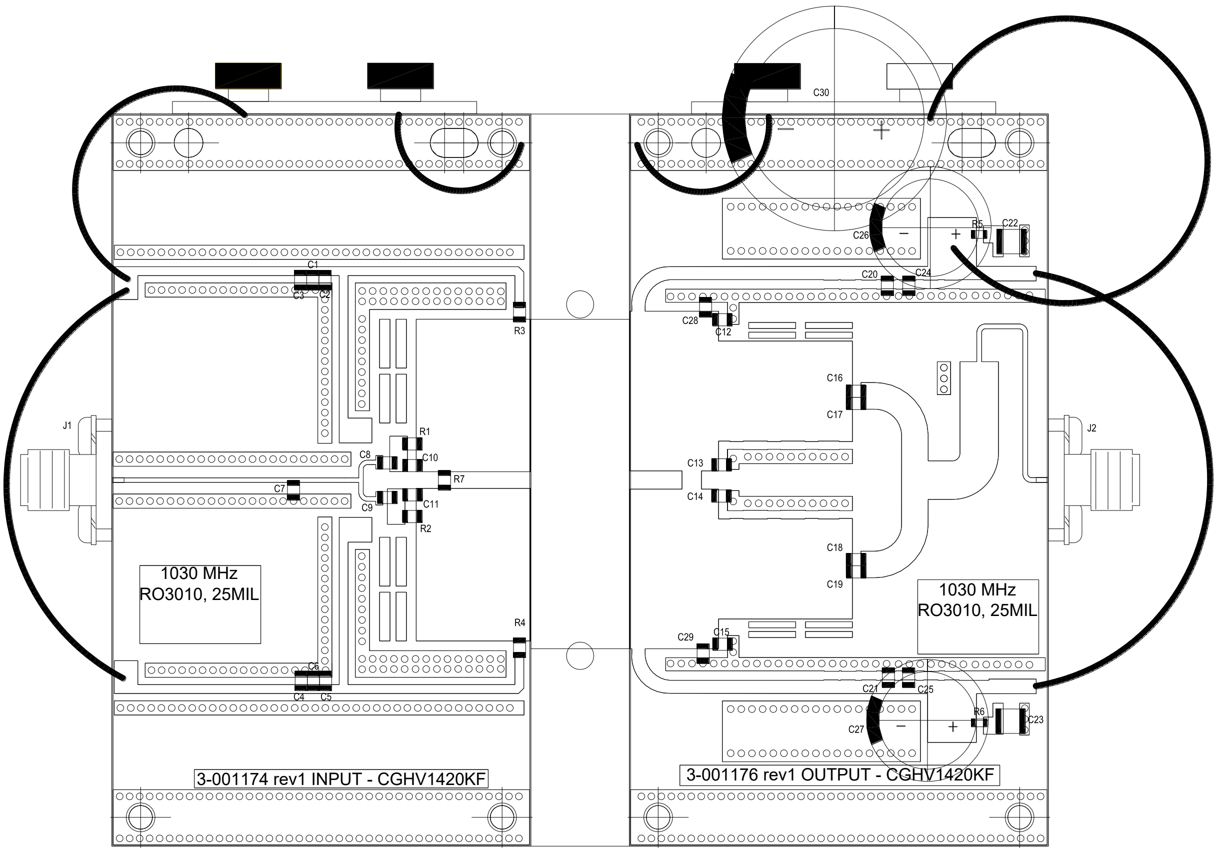
Parts measured on evaluation board (25-mil thick RO3010). Matching is provided using a combination of lumped elements and transmission lines as shown in the simplified schematic above. Recommended tuning solution component placement, transmission lines, and details are shown on the next page.

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 Test Fixture and Recommended Tuning Solution, 1.03 GHz



Assembly Parts List

Reference Designator	Description	Manufacturer	Part Number
C1, C6, C20, C21	CAP, 240 PF +/-5%, 0805, 600F	AVX	600F241JT250XT
C2, C5, C16, C17, C18, C19	CAP, 100 PF +/- 5%, 250V, 0805, 600F	AVX	600F101JT250XT
C3, C4, C24, C25	CAP, 1UF, 0805, 100V, X7S	TDK	C2012X7S2A105K125AB
C7	CAP, 4.7pF, +/-0.1pF, 250V, 0805, 600F	AVX	600F4R7BT250XT
C8, C9	CAP, 10pF, +/- 5%, 250V, 0805, 600F	AVX	600F100JT250XT
C10, C11	CAP, 56PF +/-5%, 250V, 0805, 600F	AVX	600F560JT250XT
C12, C13, C14, C15	CAP, 8.2pF, +/-0.1pF, 250V, 0805, 600F	AVX	600F8R2BT250XT
C22, C23	CAP, 10 UF, 10%, 100V, 1210, X7S	Murata	GRM32EC72A106KE05
C26, C27	CAP, 220uF, +/-20%, 100V, ALUM ELEC	Panasonic	EEU-FS2A221B
C28, C29	CAP, 3.0pF, +/-0.1pF, 250V, 0805, 600F	AVX	600F3R0BT250XT
C30	CAP, 3300 UF, +/-20%, 100V, ELECTROLYTIC, VR, RADIAL	Nichicon	UKW2A332MRD
R1, R2	RES, 100 OHM, 0805, HIGH POWER SMT	IMS	ND3-0805EW100G
R5, R6	RES, 1 OHMS, 1%, 1/4 w, 1206	Yageo	RC1206FR-071RL
R3, R4, R7	RES, 10 OHM, 5%, 1/8W, 0805	Yageo	RC0805FR-0710RL
J1,J2	CONN, SMA, PANEL MOUNT JACK, FLANGE, 4-HOLE, BLUNT POST	Amphenol	132150
J3	HEADER RT>PLZ .1CEN LK 9POS	AMP	640457-9
J4	CONN, SMB, STRAIGHT JACK RECEPTACLE, SMT, 50 OHM, Au PLATED	Cinch	131-3711-201
PCB	ROGERS 3010, 25mil, 3 oz Cu		
Q1	MACOM GaN Power Amplifier		CGHV1420KF

Typical Performance Curves as Measured in the 1.03 GHz Evaluation Test Fixture

Pulsed 32 µs 4%, P_{IN} = 47 dBm, V_{DS} = 65 V, I_{DQ} = 2000 mA, Frequency = 1.03 GHz (unless otherwise noted)
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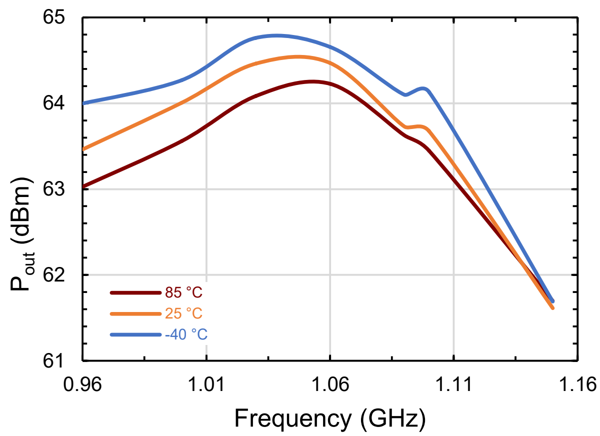
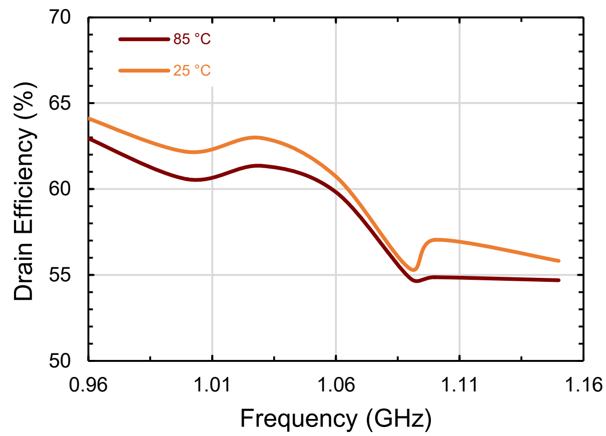
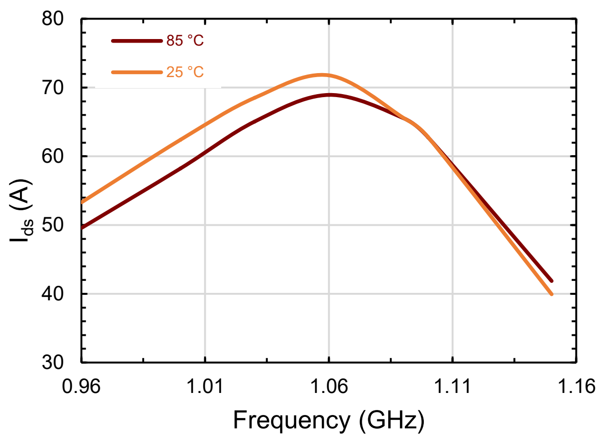
Output Power vs. Temperature and Frequency



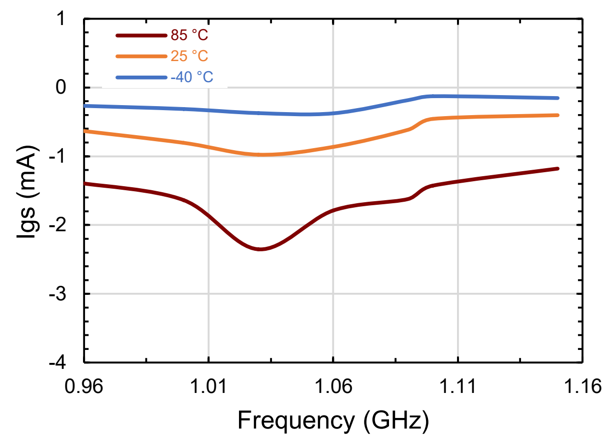
Drain Efficiency vs. Temperature and Frequency



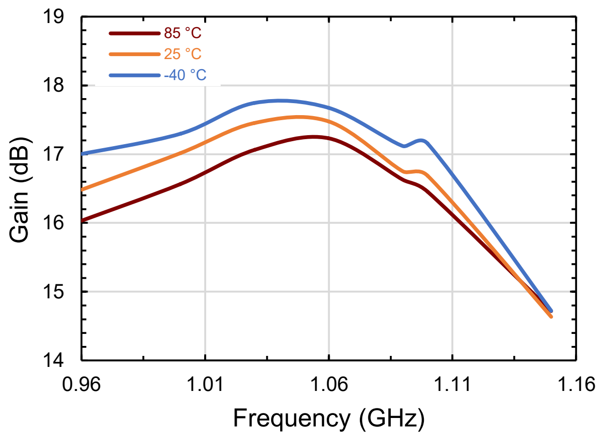
Drain Current vs. Temperature and Frequency



Gate Current vs. Temperature and Frequency



Large Signal Gain vs. Temperature and Frequency



Typical Performance Curves as Measured in the 1.03 GHz Evaluation Test Fixture

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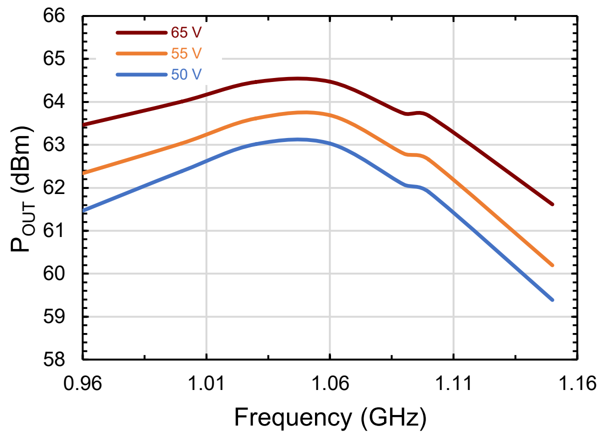
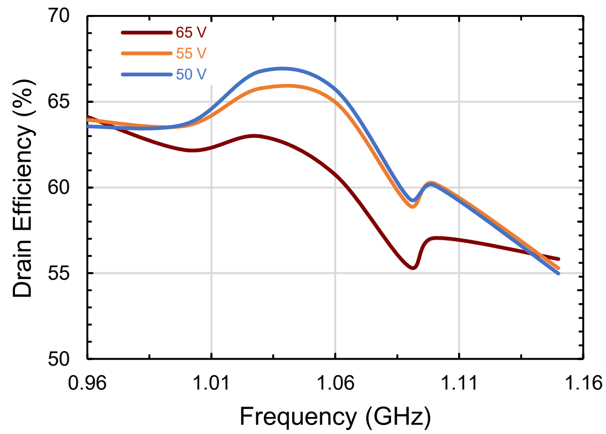
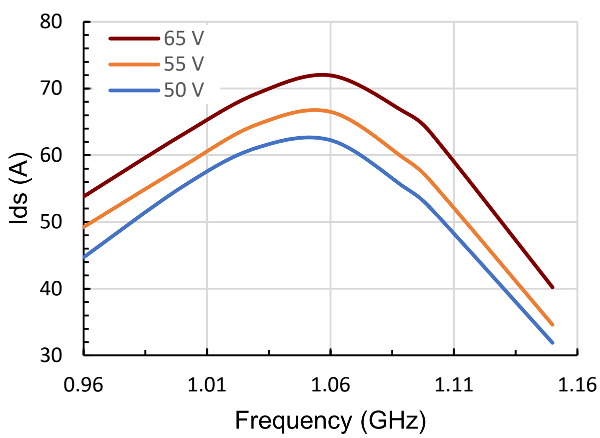
Output Power vs. V_{DS} and Frequency



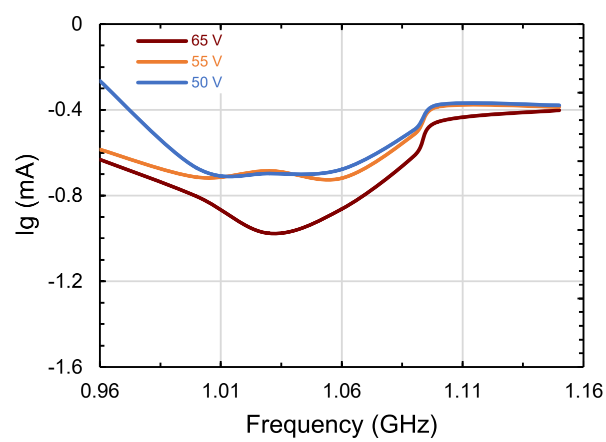
Drain Efficiency vs. V_{DS} and Frequency



Drain Current vs. V_{DS} and Frequency



Gate Current vs. V_{DS} and Frequency



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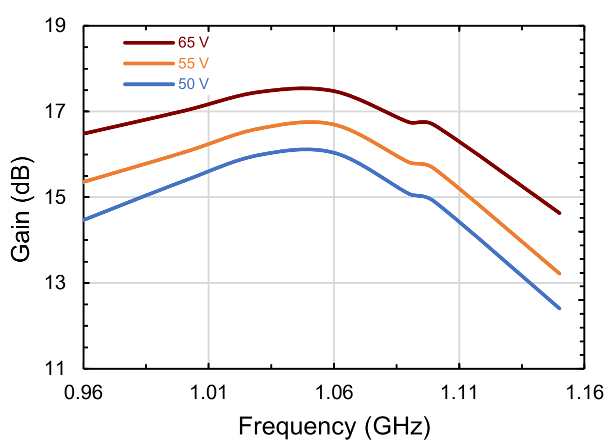

Typical Performance Curves as Measured in the 1.03 GHz Evaluation Test Fixture

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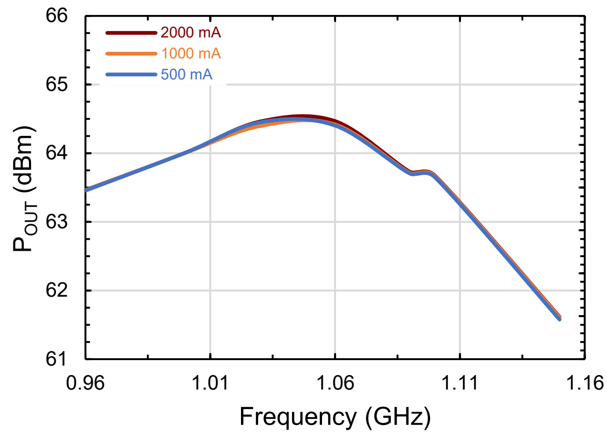
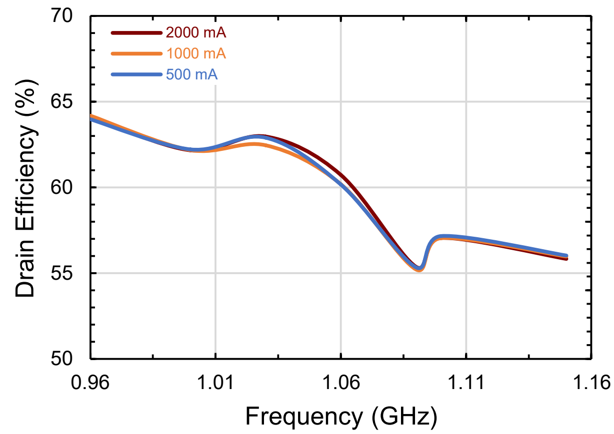
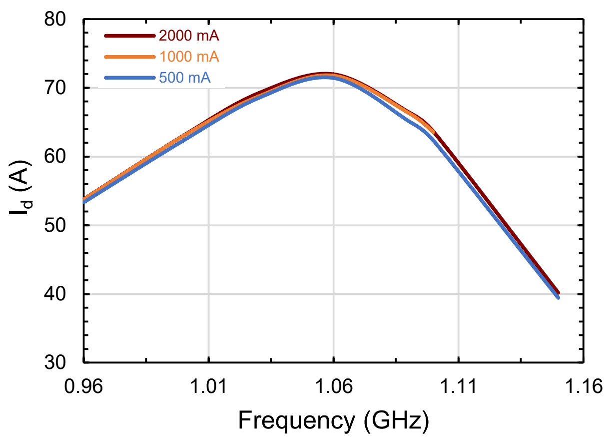
Output Power vs. I_{DQ} and Frequency



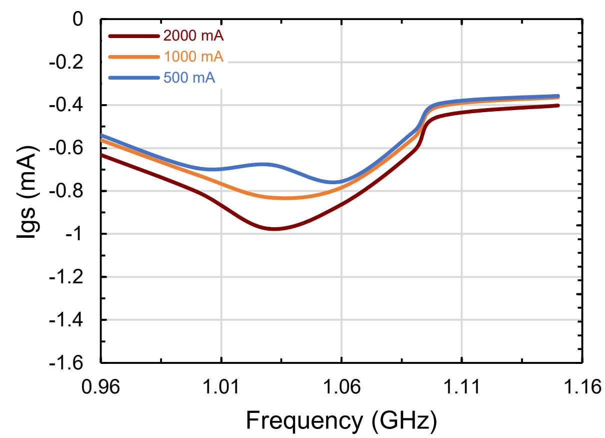
Drain Efficiency vs. I_{DQ} and Frequency



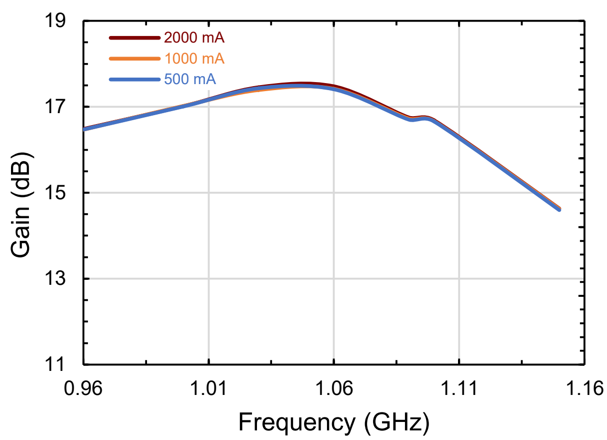
Drain Current vs. I_{DQ} and Frequency



Gate Current vs. I_{DQ} and Frequency



Large Signal Gain vs. I_{DQ} and Frequency



Typical Performance Curves as Measured in the 1.03 GHz Evaluation Test Fixture

Pulsed 32 µs 4%, P_{IN} = 47 dBm, V_{DS} = 65 V, I_{DQ} = 2000 mA, Frequency = 1.03 GHz (unless otherwise noted)
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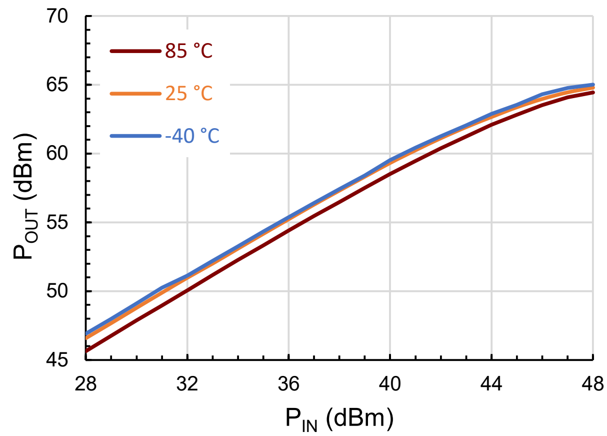
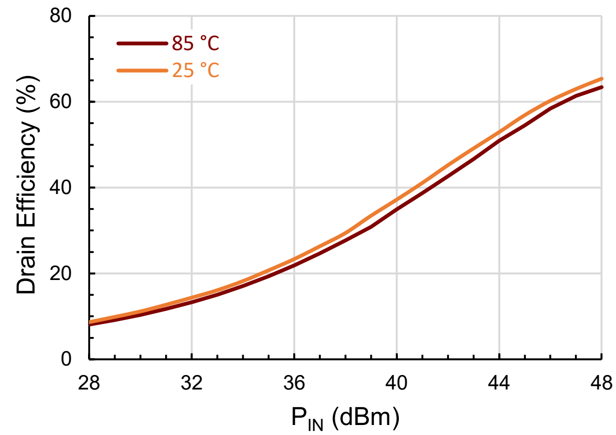
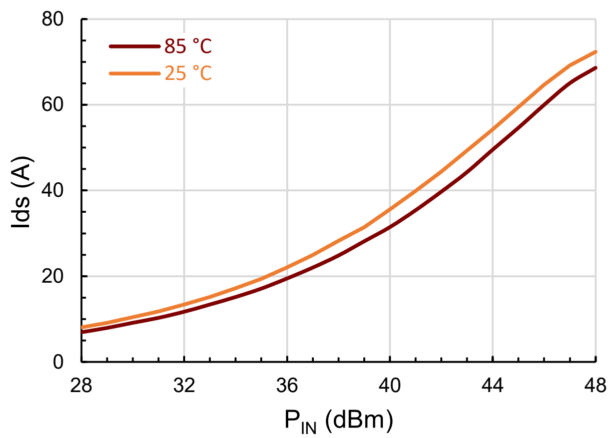
Output Power vs. Temperature and P_{IN}



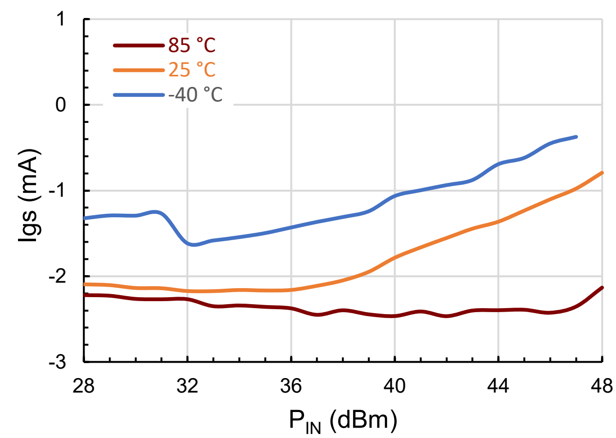
Drain Efficiency vs. Temperature and P_{IN}



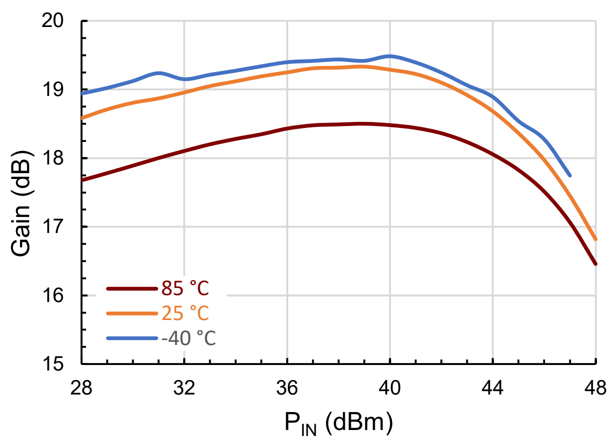
Drain Current vs. Temperature and P_{IN}



Gate Current vs. Temperature and P_{IN}



Large Signal Gain vs. Temperature and P_{IN}



Typical Performance Curves as Measured in the 1.03 GHz Evaluation Test Fixture

Pulsed 32 µs 4%, P_{IN} = 47 dBm, V_{DS} = 65 V, I_{DQ} = 2000 mA, Frequency = 1.03 GHz (unless otherwise noted)
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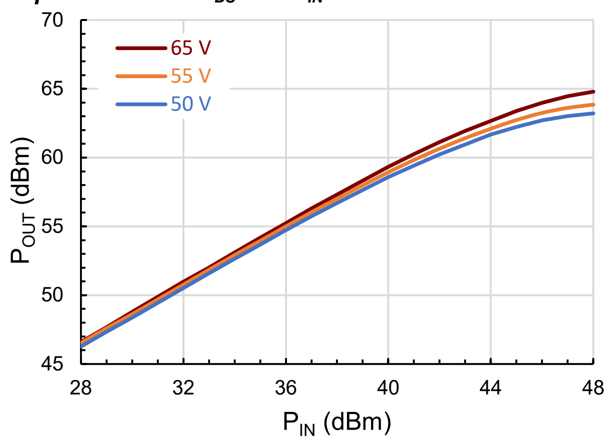
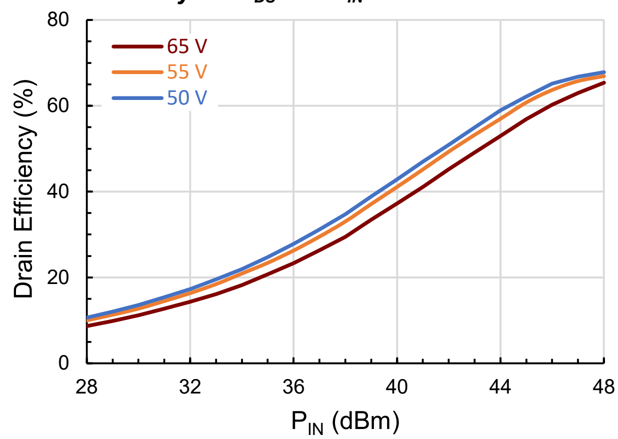
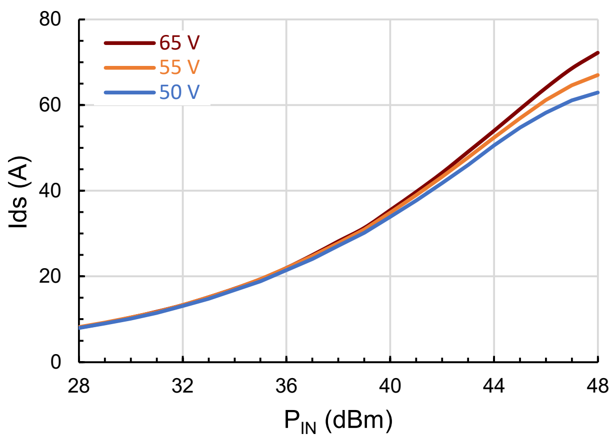
Output Power vs. V_{DS} and P_{IN}



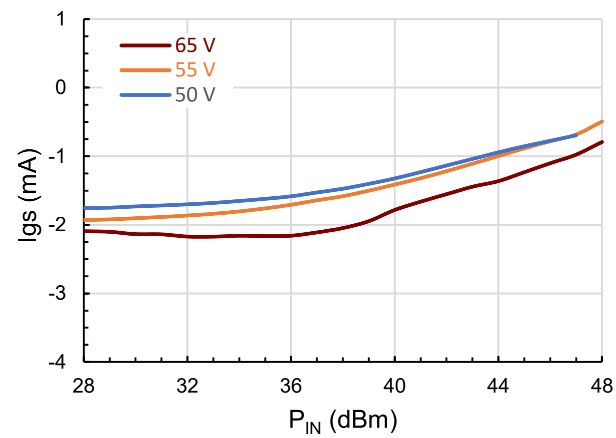
Drain Efficiency vs. V_{DS} and P_{IN}



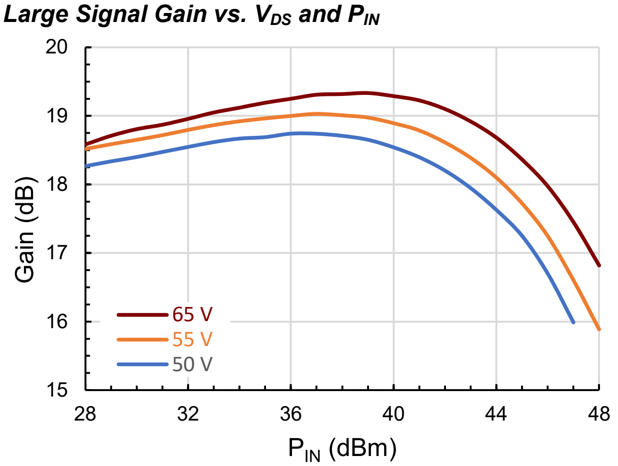
Drain Current vs. V_{DS} and P_{IN}



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



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



Typical Performance Curves as Measured in the 1.03 GHz Evaluation Test Fixture

Pulsed 32 µs 4%, P_{IN} = 47 dBm, V_{DS} = 65 V, I_{DQ} = 2000 mA, Frequency = 1.03 GHz (unless otherwise noted)
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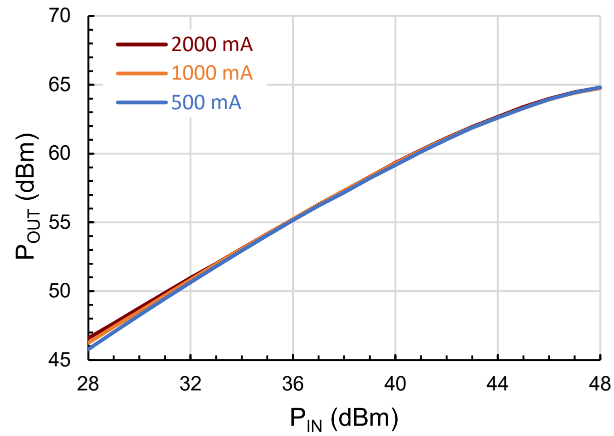
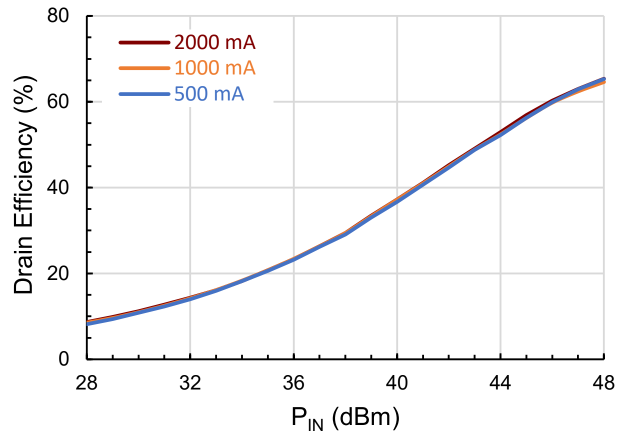
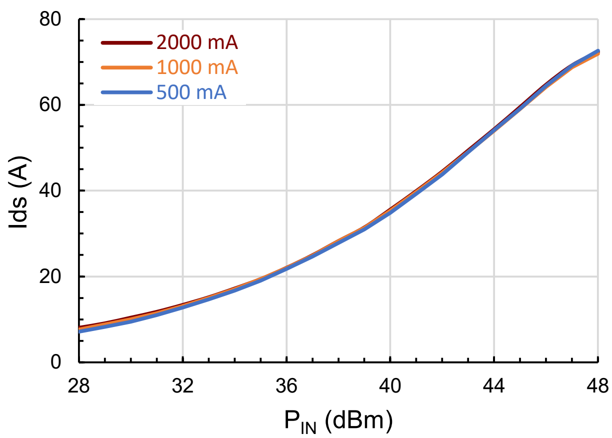
Output Power vs. I_{DQ} and P_{IN}



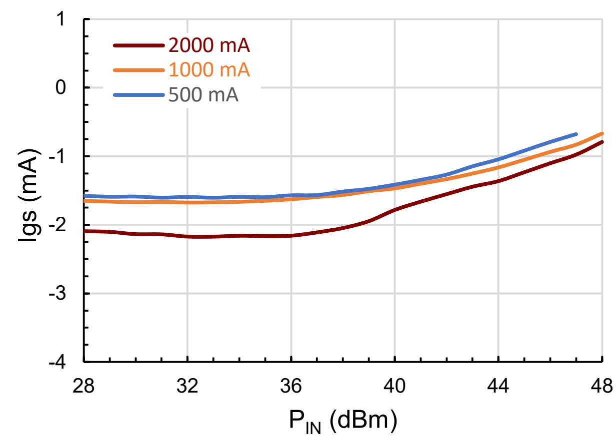
Drain Efficiency vs. I_{DQ} and P_{IN}



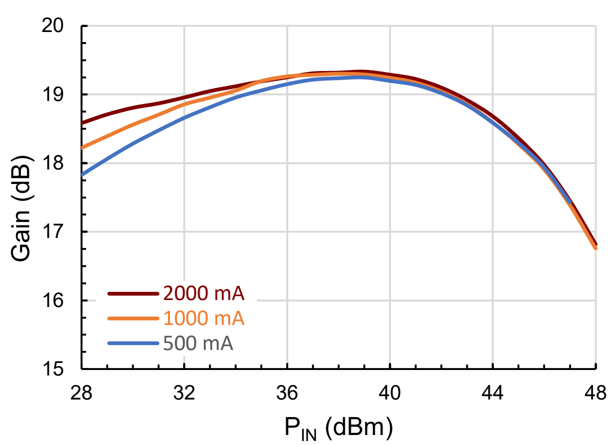
Drain Current vs. I_{DQ} and P_{IN}



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



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



Typical Performance Curves as Measured in the 1.03 GHz Evaluation Test Fixture:

CW, V_{DS} = 65 V, I_{DQ} = 2000 mA, P_{IN} = -20 dBm (unless Otherwise Noted)
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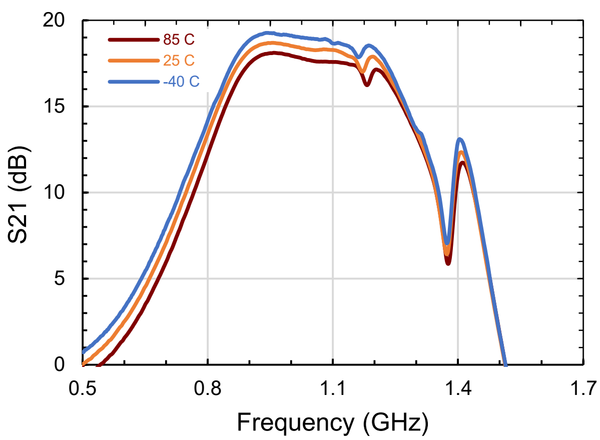
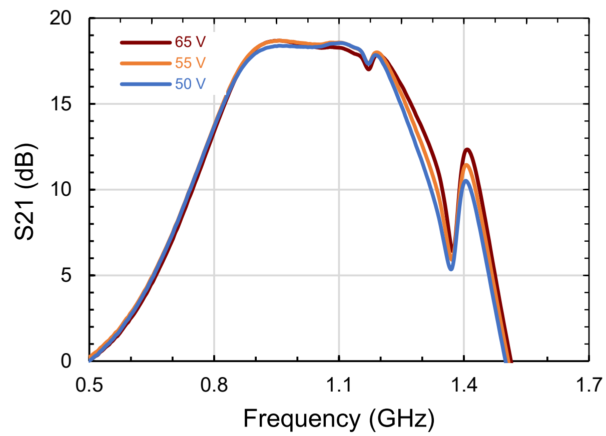
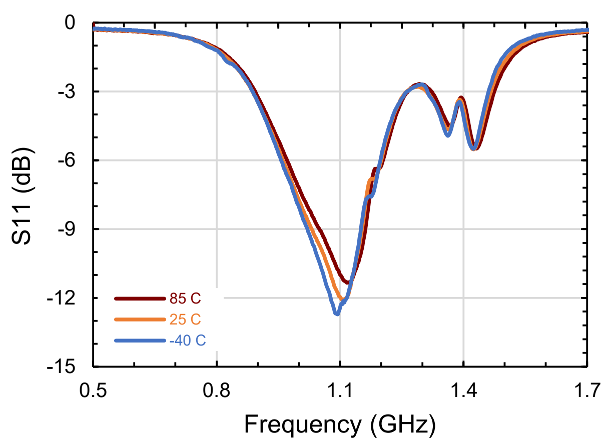
S21 vs Frequency and Temperature



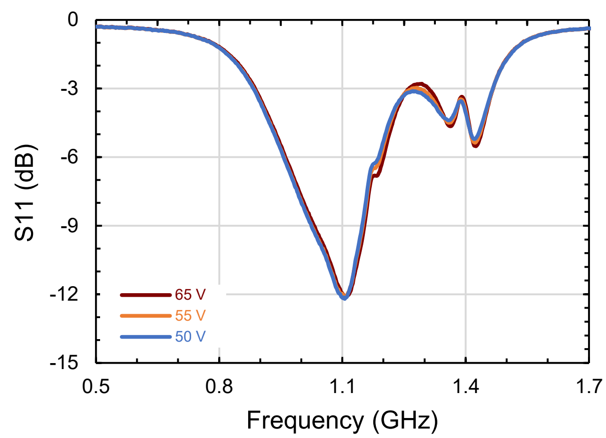
S21 vs Frequency and V_{DS}



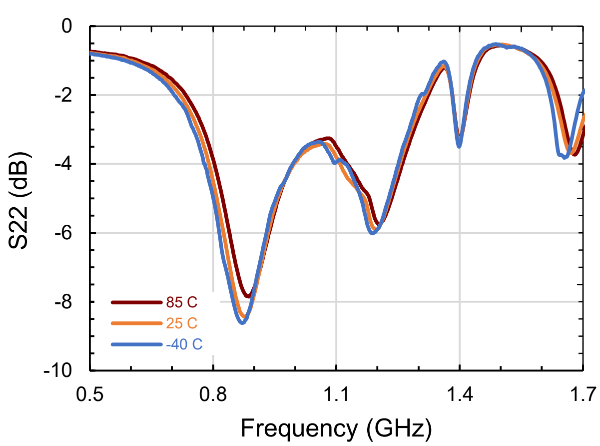
S11 vs Frequency and Temperature



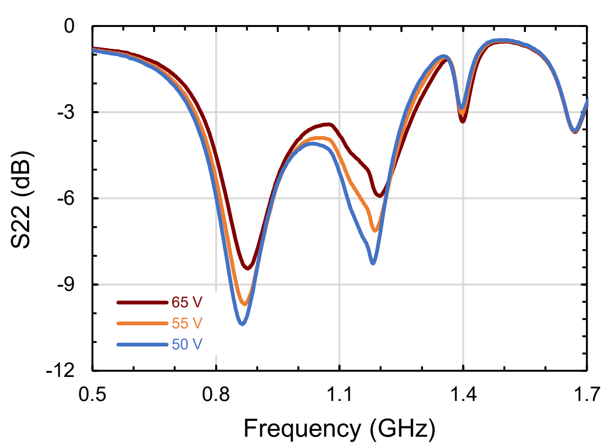
S11 vs Frequency and V_{DS}



S22 vs Frequency and Temperature



S22 vs Frequency and V_{DS}

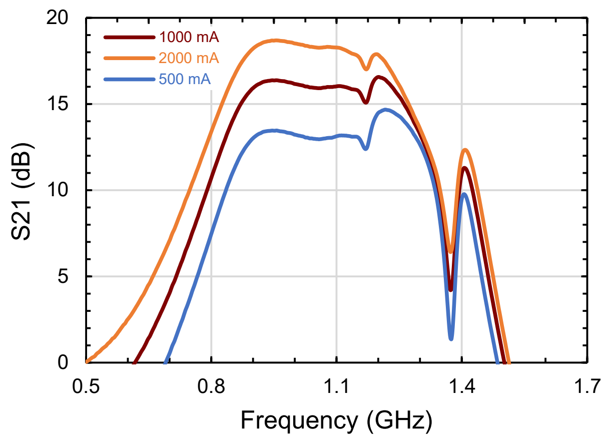


Typical Performance Curves as Measured in the 1.03 GHz Evaluation Test Fixture:

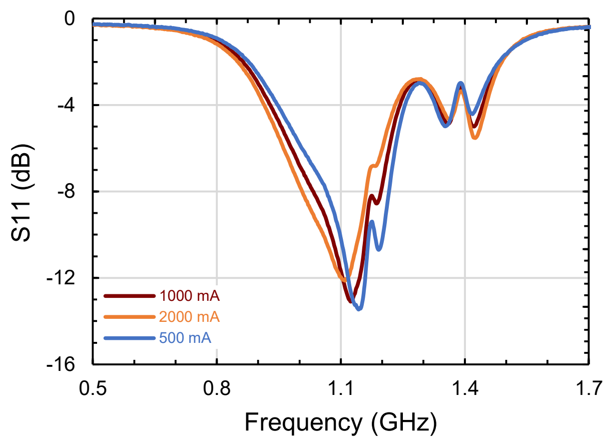
CW, V_{DS} = 65 V, I_{DQ} = 2000 mA, P_{IN} = -20 dBm (unless Otherwise Noted)

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

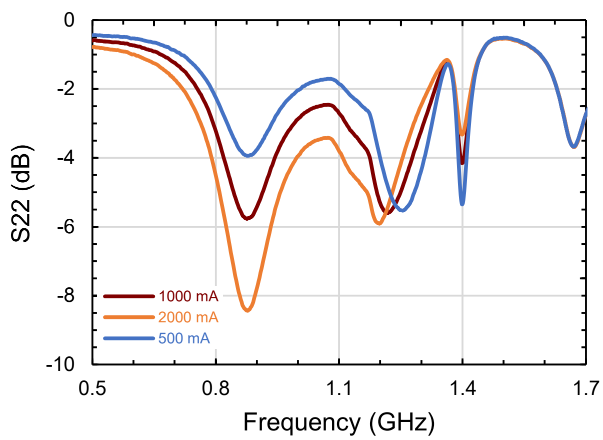
S21 vs Frequency and I_{DQ}



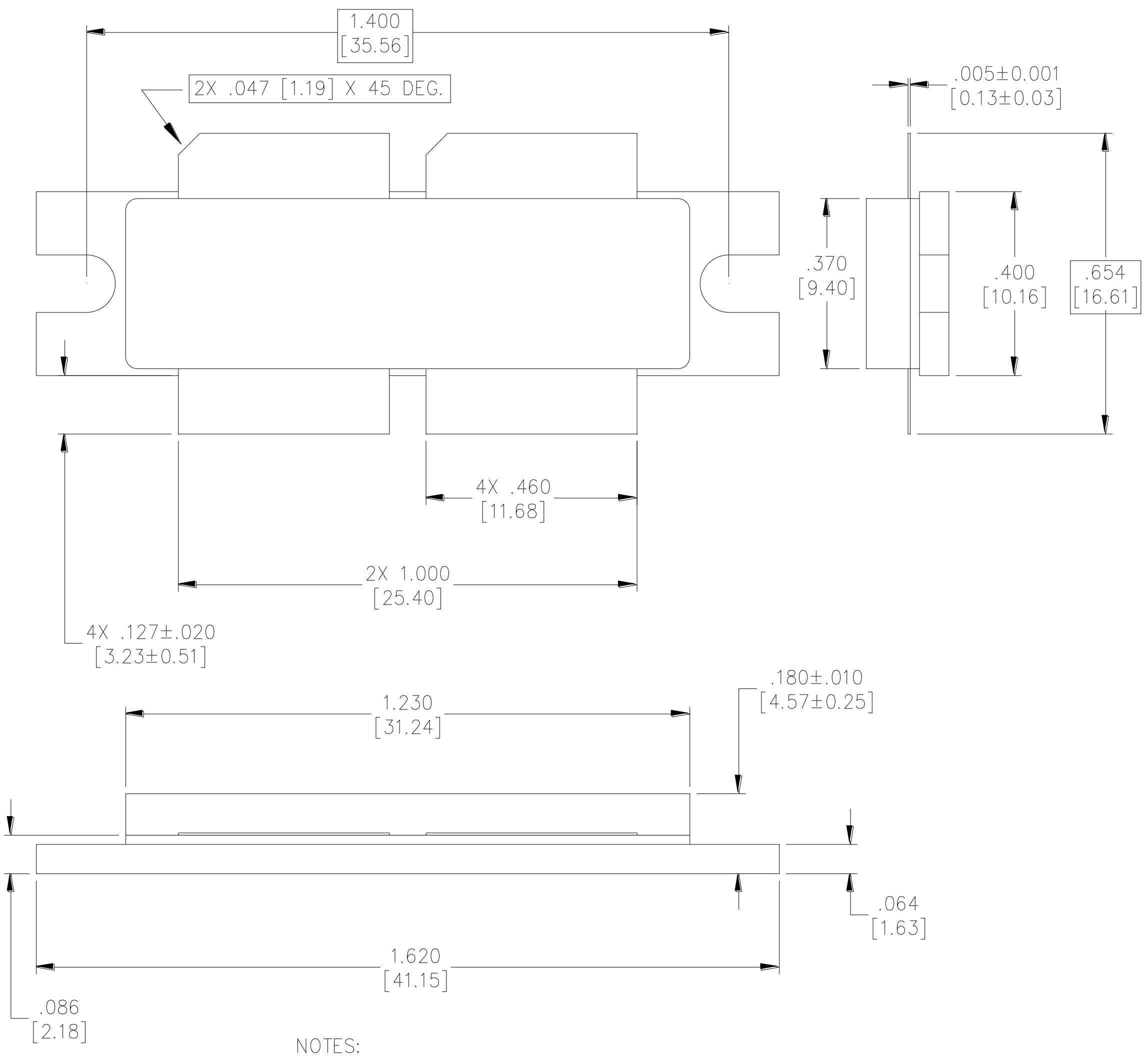
S11 vs Frequency and I_{DQ}



S22 vs Frequency and I_{DQ}



AC-1230B-4 Package Dimensions



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 ±.005 [0.13] UNLESS OTHERWISE NOTED
3. LEAD FINISH: AU
   FLANGE FINISH: AU
4. LID SEAL EPOXY MAY FLOW OUT A MAXIMUM OF .020 [0.51] FROM EDGE OF LID
5. LID MAY BE MIS-ALIGNED UP TO .010 [0.25] FROM PACKAGE IN ANY DIRECTION