GaN Amplifier 65 V, 500 W
3.5 - 3.7 GHz

MACOM PURE CARBIDE

MAPC-A4031
Rev. V1

Features
- Output Power: 500 W
- Large Signal Gain: 12 dB
- Drain Efficiency: 55%
- Internally Matched: 50 Ω
- High Temperature Operation
- RoHS* Compliant

Applications
- Civil & Military Pulsed Radar Amplifiers

AC-587BH-2

Description
The MAPC-A4031 is a Gallium nitride (GaN) amplifier designed specifically with high efficiency and high power for the 3.5 - 3.7 GHz S-Band radar band.

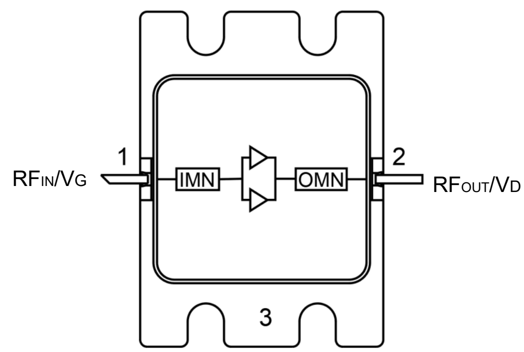
The amplifier is matched to 50 Ω on the input and 50 Ω on the output. At the core of MAPC-A4031 is the high power density 65 V GaN-on-silicon carbide (SiC) manufacturing process. The amplifier is supplied in a ceramic/metal flange package of type AC-587BH-2

Typical RF Performance:
Measured in Evaluation Test Fixture at P_{IN} = 46 dBm, 100 µs pulse width and 10% Duty Cycle.

- V_{DS} = 65 V, I_{DQ} = 1000 mA, T_C = 25°C

Frequency (GHz)	Output Power (dBm)	Power Gain (dB)	η_D[1] (%)
3.5	58.8	12.8	53.3
3.6	58.6	12.6	54.1
3.7	58.3	12.3	55.1

Functional Schematic



Pin Configuration

Pin #	Pin Name	Function
1	RF_{IN} / V_G	RF Input / Gate
2	RF_{OUT} / V_D	RF Output / Drain
3	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
MAPC-A4031-AB000	Bulk
MAPC-A4031-ABSB1	Sample Board

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

DC-0035547

RF Electrical Characteristics: Freq. = 3.5 - 3.7 GHz, T_C = 25°C, V_{DS} = 65 V, I_{DQ} = 1000 mA, Pulse Width = 100 µs, Duty Cycle = 10%

Performance in MACOM Evaluation Test Fixture, 50 Ω system

Parameter	Test Conditions	Symbol	Min.	Typ.	Max.	Units
Output Power	Pulsed, P_{IN} = 46 dBm	P_{OUT}	—	58.6	—	dBm
Drain Efficiency	Pulsed, P_{IN} = 46 dBm	DE	—	54.0	—	%
Large Signal Gain	Pulsed, P_{IN} = 46 dBm	G_P	—	12.6	—	dB
Small Signal Gain	CW, P_{IN} = -20 dBm	S21	—	14.5	—	dB
Input Return Loss	CW, P_{IN} = -20 dBm	S11	—	-16	—	dB
Output Return Loss	CW, P_{IN} = -20 dBm	S22	—	-8	—	dB
Output Mismatch Stress	V_{DD} = 65 V, I_{DQ} = 1000 mA, P_{IN} = 46 dBm	ψ	VSWR =10:1, No Device Damage			

RF Electrical Specifications[2]: P_{IN} = 46 dBm, T_A = +25°C, V_{DS} = 65 V, I_{DQ} = 500 mA, Pulse Width 100 µs, 10% Duty Cycle

Parameter	Conditions	Units	Min.	Typ.	Max.
Output Power	3.5 GHz 3.7 GHz	W	500 500	759 678	—
Power Gain	3.5 GHz 3.7 GHz	dB	11.0 11.0	12.8 12.3	—
Drain Efficiency	3.5 GHz 3.7 GHz	%	50 50	53.3 55.1	—

2. Final testing and screening for all amplifier sales is performed using the MAPC-A4031 production test fixture.

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}	—	—	11.62	mA
Gate-Source Leakage Current	V_{GS} = -8 V, V_{DS} = 10 V	I_{GLK}	-11.62	—	—	mA
Gate Threshold Voltage	V_{DS} = 10 V, I_D = 83.6 mA	V_T	-3.8	-3.1	-2.3	V
Gate Quiescent Voltage	V_{DS} = 65 V, I_D = 1000 mA	V_{GSQ}	—	-2.75	—	V

Absolute Maximum Ratings[3,4]

Parameter	Absolute Maximum
Pulse Width	100 µsec
Duty Cycle	10%
Drain-Source Voltage	195 V
Gate Voltage	-10, +2 V
DC Drain Current	14 A
Gate Current	80 mA
Input Power	48 dBm
Storage Temperature	-65°C to +150°C
Mounting Temperature	+245°C for 30 seconds
Junction Temperature[5]	+225°C
Operating Temperature	-40°C to +125°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.

Thermal Characteristics

Parameter	Symbol	Test Conditions	Units	Rating
Operating Junction Temperature	T_J	Pulse Width = 100 µs , Duty Cycle = 10%, P_{DISS} = 660 W T_C = 85°C	°C	165
Thermal Resistance, Junction to Case	$R_{\theta JC}$		°C/W	0.12

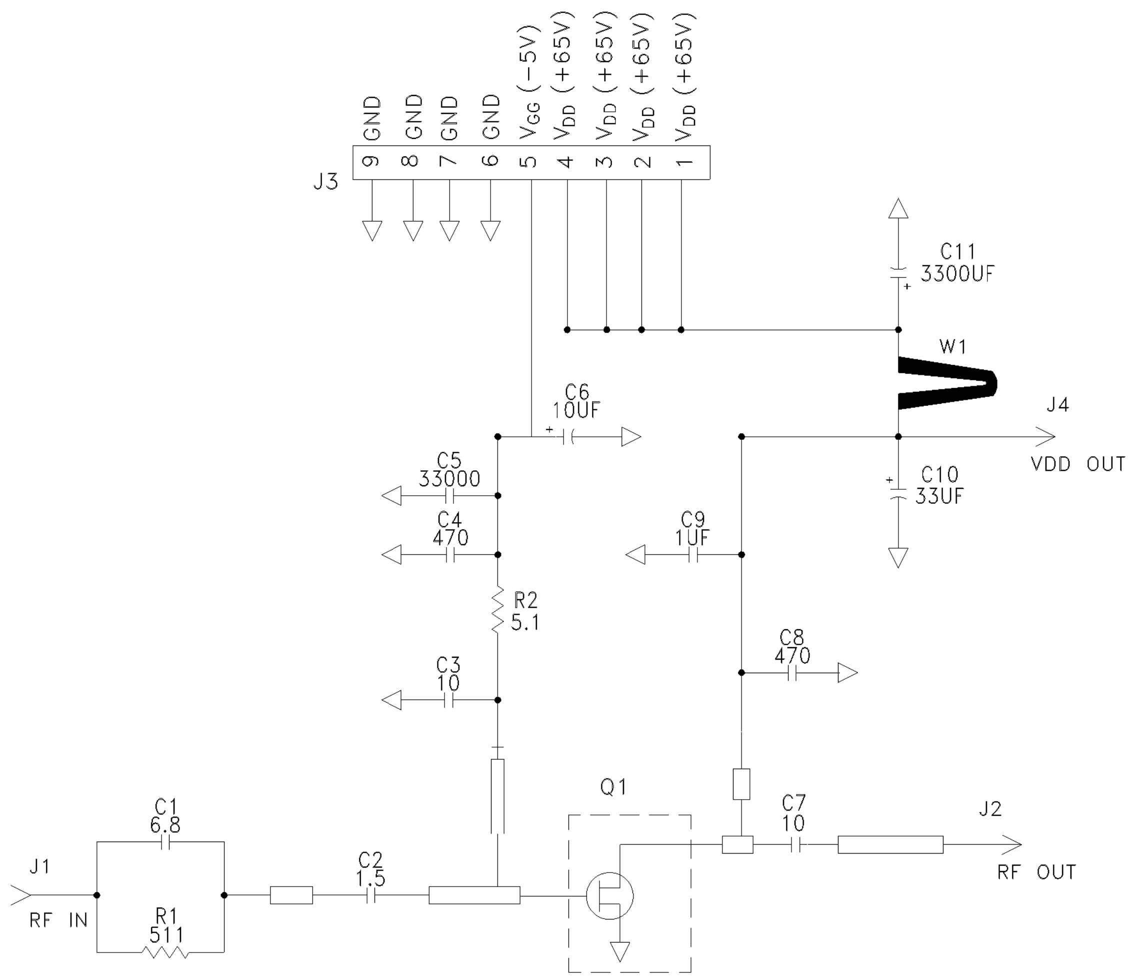
Handling Procedures

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 3A and CDM Class C3 devices.

Application Circuit Schematic



Description

Parts measured on evaluation board (30-mil thick TACONIC RF-35P, 2oz Copper). 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

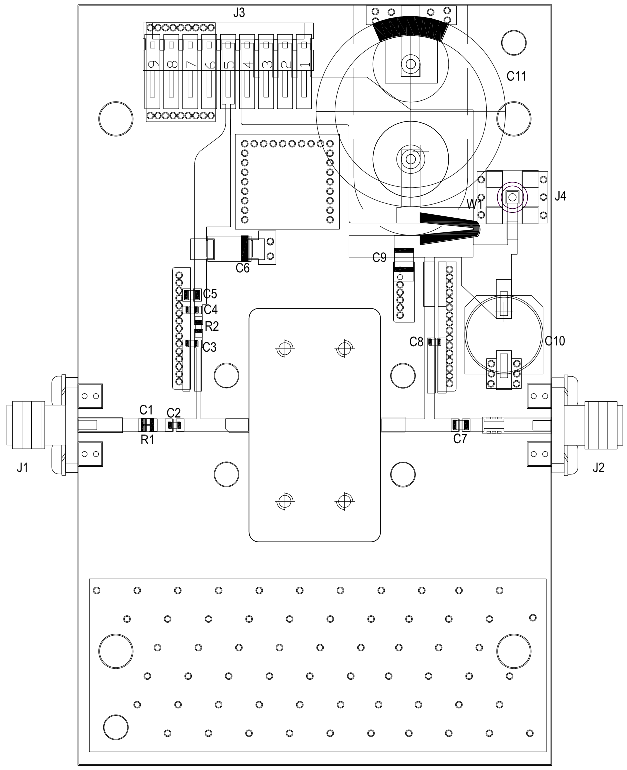
Bias ON

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

Assembly Drawing



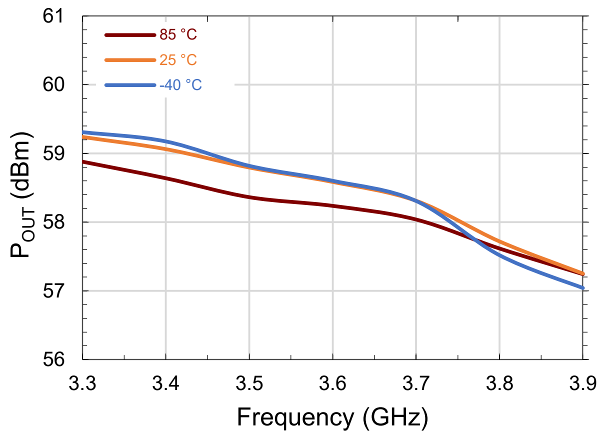
Assembly Parts List

Reference Designator	Description	Manufacturer	Part Number
C1	CAP, 6.8pF, +/- 0.25 pF, 0603, ATC	AVX	600S6R8BT250XT
C2	CAP, 1.5 pF, +/-0.1pF, 250V, 0805, ATC600F	AVX	600F1R5BT250XT
C3	CAP, 10.0pF, +/-5%, 0603, ATC	AVX	600S100GT250XT
C4,C8	CAP, 470PF, 5%,100V, 0603	Murata	GCM1885C2A471JA16
C5	CAP,33000PF, 0805,100V, X7R	Murata	GRM21BR72A333KA01
C6	CAP 10UF 16V TANTALUM, 2312	AVX	TAJC106M016RNJ
C7	CAP, 10pF, +/- 1%, 250V, 0805, ATC600F	AVX	600F100JT250XT
C9	CAP, 1.0UF, 100V, +/-10%, X7R, 1210	Murata	GCJ31CR72A105KA01
C10	CAP, 33 UF, 20%, G CASE	Panasonic	EEE-FK2A330P
C11	CAP, 3300 UF, +/-20%, 100V, ELECTROLYTIC, VR, RADIAL	Nichicon	UKW2A332MRD
R1	RES,1/16W,0603,1%,511 OHMS	Susumu	RR0816P-5110-D-69A
R2	RES, 1/16W, 0603, 1%, 5.1 Ohms	Vishay	CRCW06035R10FKEA
PCB	PCB FOR TEST FIXTURE, APPS CIRCUIT, 65V, CGHV37400F1-TB		
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
W1	WIRE ASSEMBLY, 4.2", 18 AWG, TEST FIXTURE	Remington	MIL-W-16878
Q1	MACOM GaN Power Amplifier		MAPC-A4031-AB

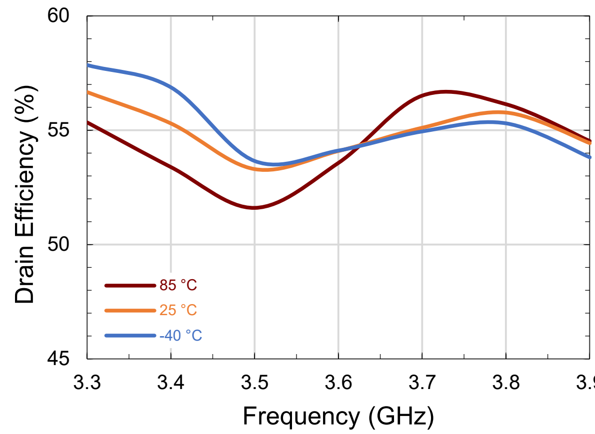
Typical Performance Curves as Measured in the 3.5 – 3.7 GHz Evaluation Test Fixture

Pulsed 100 µs 10%, P_{IN} = 46 dBm, V_{DS} = 65 V, I_{DQ} = 1000 mA, Frequency = 3.6 GHz (Unless otherwise noted)
For Engineering Evaluation Only – This data does not Modify MACOM’s Datasheet Limits.

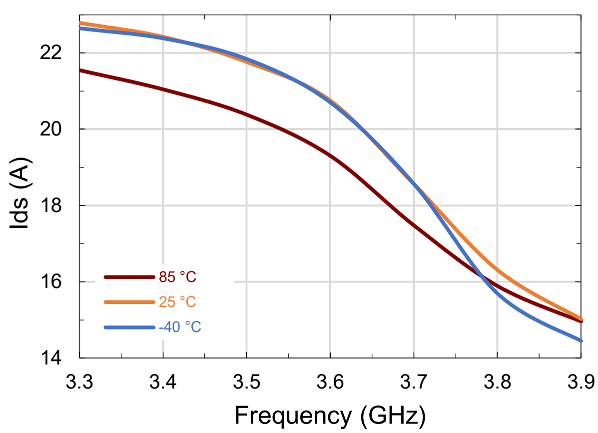
Output Power vs. Temperature and Frequency



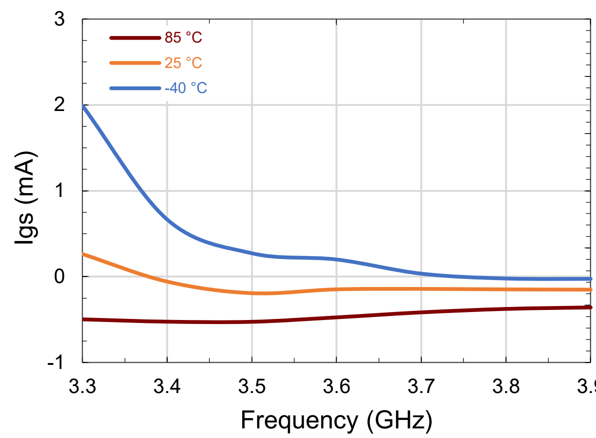
Drain Efficiency vs. Temperature and Frequency



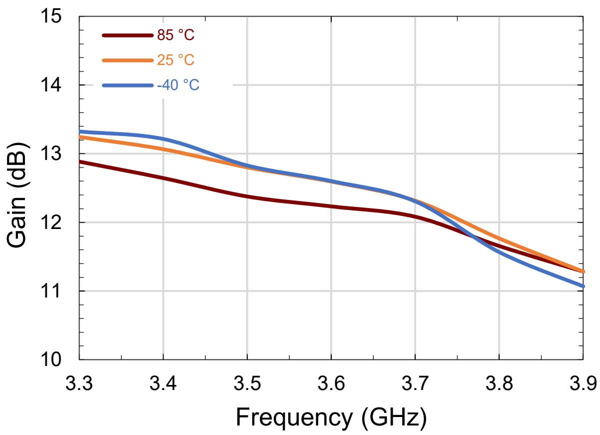
Drain Current vs. Temperature and Frequency



Gate Current vs. Temperature and Frequency



Large Signal Gain vs. Temperature and Frequency



Typical Performance Curves as Measured in the 3.5 – 3.7 GHz Evaluation Test Fixture

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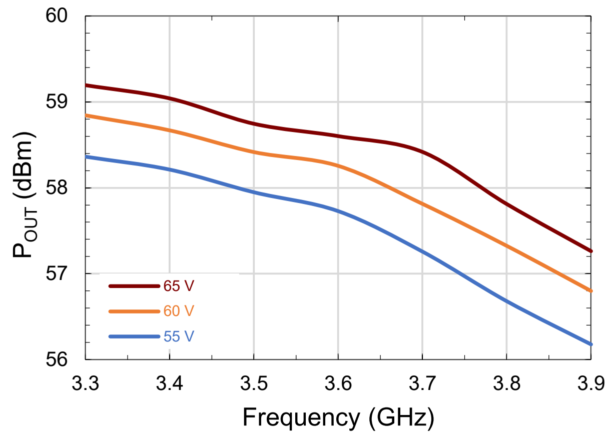
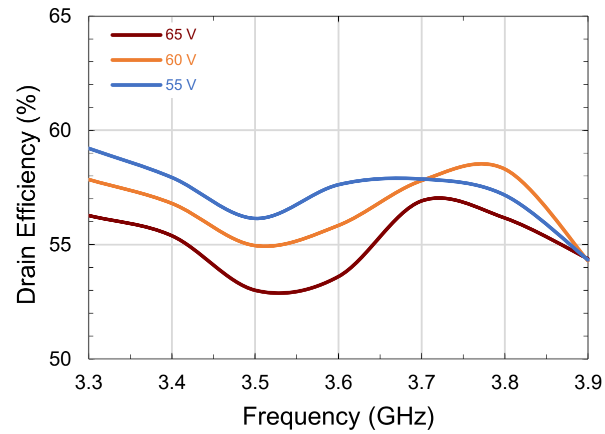
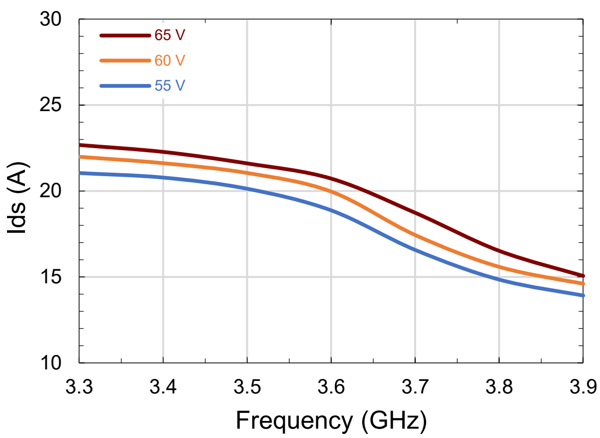
Output Power vs. V_{DS} and Frequency



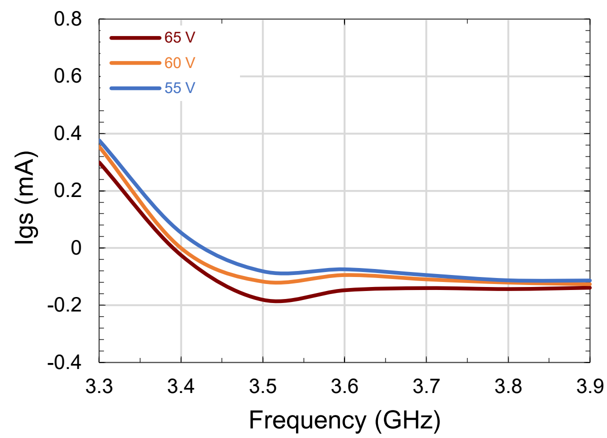
Drain Efficiency vs. V_{DS} and Frequency



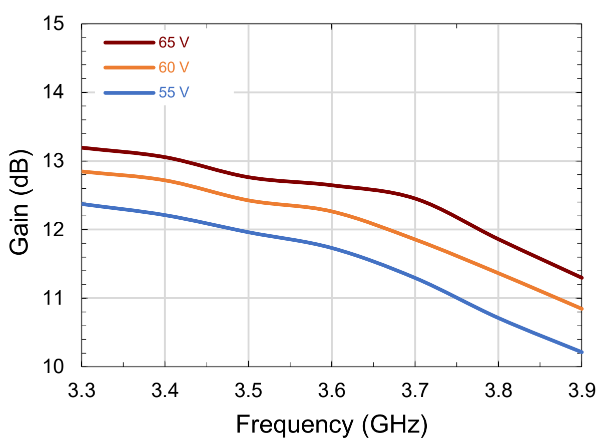
Drain Current vs. V_{DS} and Frequency



Gate Current vs. V_{DS} and Frequency



Large Signal Gain vs. V_{DS} and Frequency



Typical Performance Curves as Measured in the 3.5 – 3.7 GHz Evaluation Test Fixture

Pulsed 100 µs 10%, P_{IN} = 46 dBm, V_{DS} = 65 V, I_{DQ} = 1000 mA, Frequency = 3.6 GHz (Unless otherwise noted)
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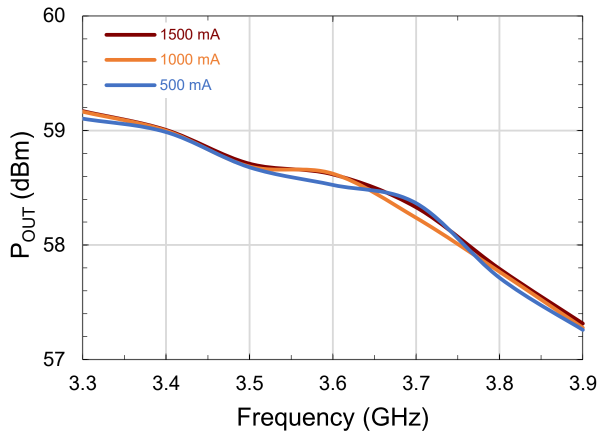
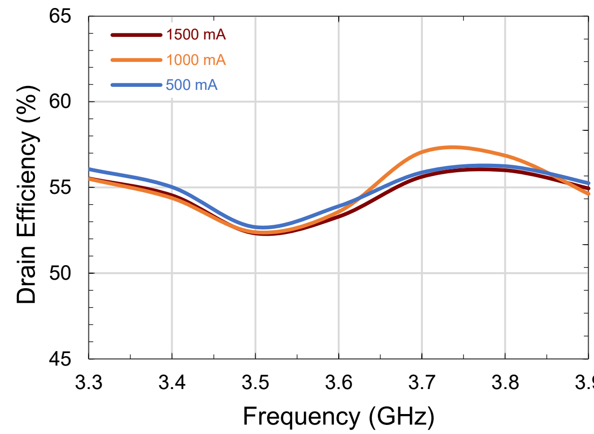
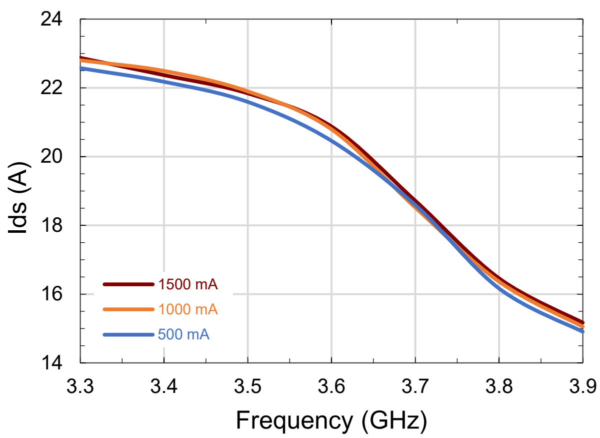
Output Power vs. I_{DQ} and Frequency



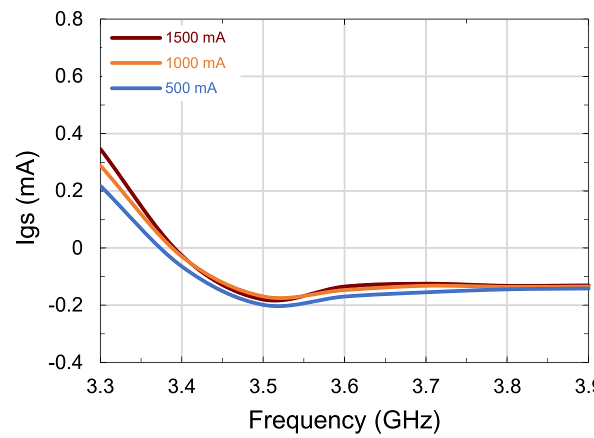
Drain Efficiency vs. I_{DQ} and Frequency



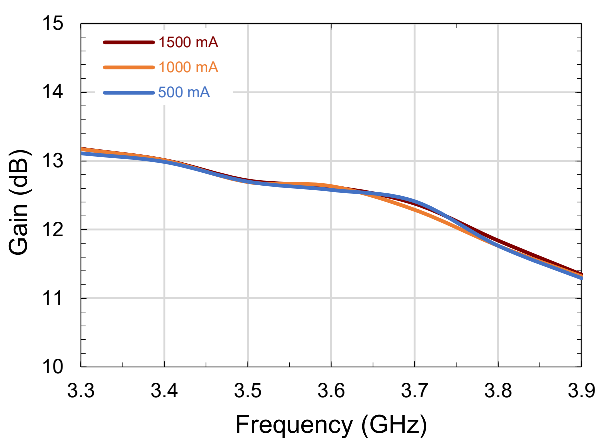
Drain Current vs. I_{DQ} and Frequency



Gate Current vs. I_{DQ} and Frequency



Large Signal Gain vs. I_{DQ} and Frequency



Typical Performance Curves as Measured in the 3.5 – 3.7 GHz Evaluation Test Fixture

Pulsed 100 µs 10%, P_{IN} = 46 dBm, V_{DS} = 65 V, I_{DQ} = 1000 mA, Frequency = 3.6 GHz (Unless otherwise noted)
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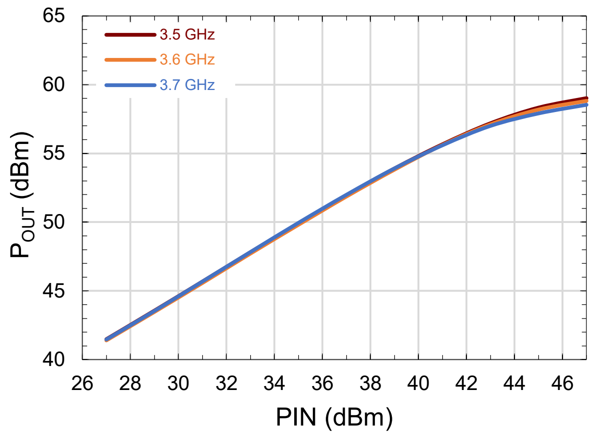
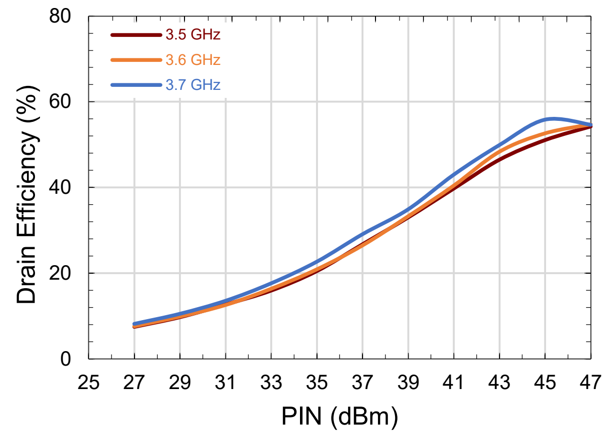
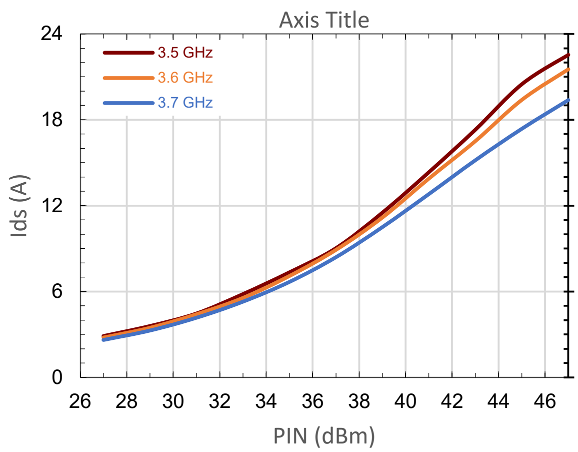
Output Power vs. Frequency and P_{IN}



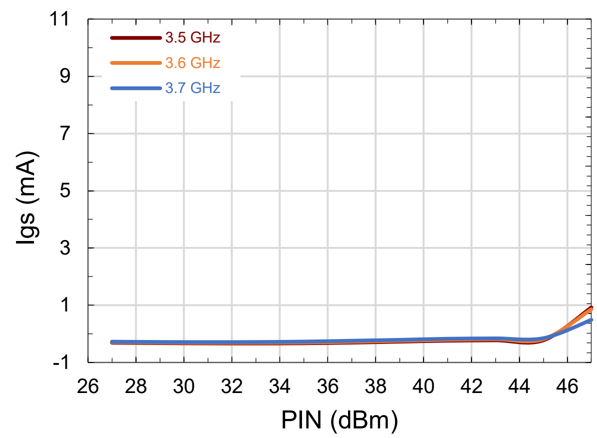
Drain Efficiency vs. Frequency and P_{IN}



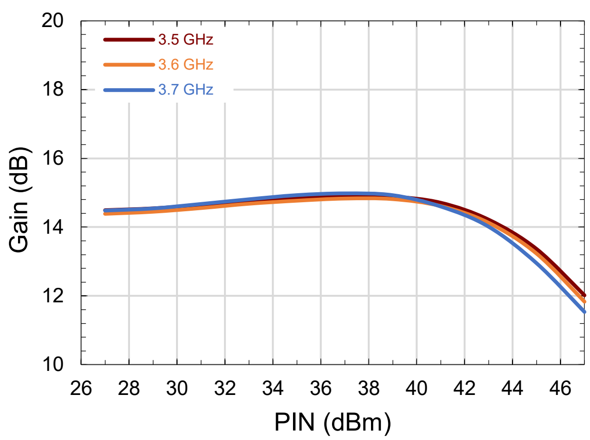
Drain Current vs. Frequency and P_{IN}



Gate Current vs. Frequency and P_{IN}



Large Signal Gain vs. Frequency and P_{IN}



Typical Performance Curves as Measured in the 3.5 – 3.7 GHz Evaluation Test Fixture

Pulsed 100 µs 10%, P_{IN} = 46 dBm, V_{DS} = 65 V, I_{DQ} = 1000 mA, Frequency = 3.6 GHz (Unless otherwise noted)
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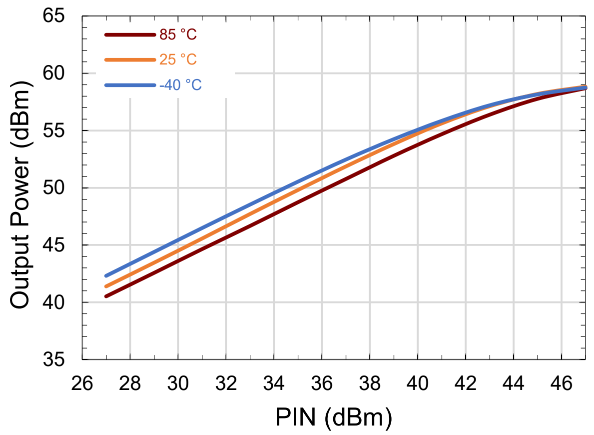
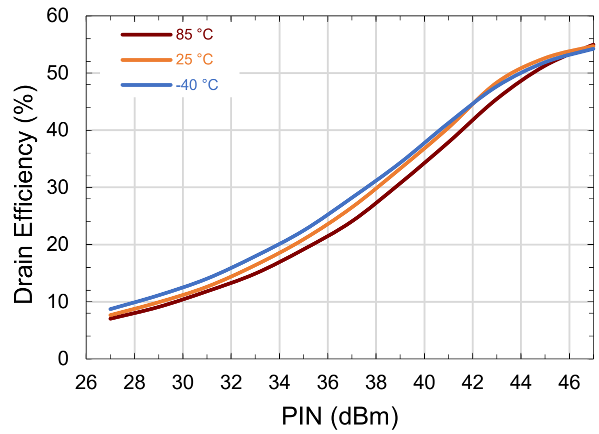
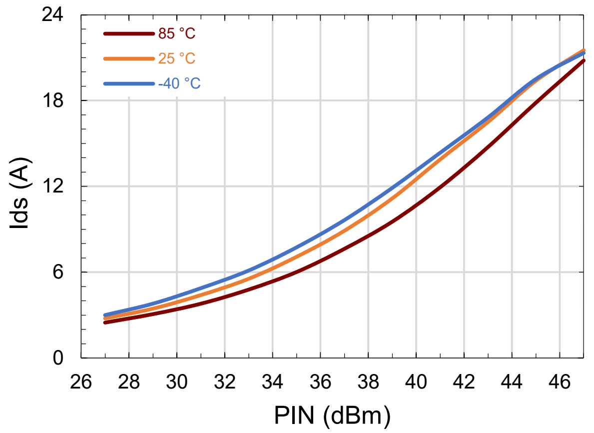
Output Power vs. Temperature and P_{IN}



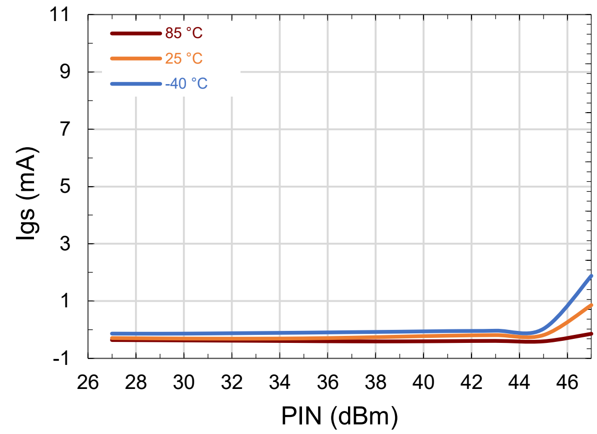
Drain Efficiency vs. Temperature and P_{IN}



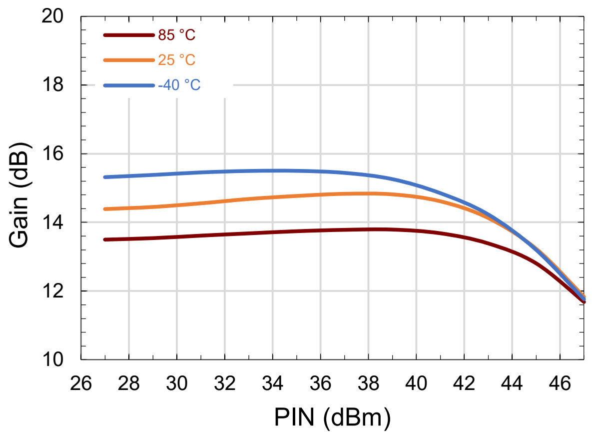
Drain Current vs. Temperature and P_{IN}



Gate Current vs. Temperature and P_{IN}



Large Signal Gain vs. Temperature and P_{IN}



Typical Performance Curves as Measured in the 3.5 – 3.7 GHz Evaluation Test Fixture

Pulsed 100 µs 10%, P_{IN} = 46 dBm, V_{DS} = 65 V, I_{DQ} = 1000 mA, Frequency = 3.6 GHz (Unless otherwise noted)
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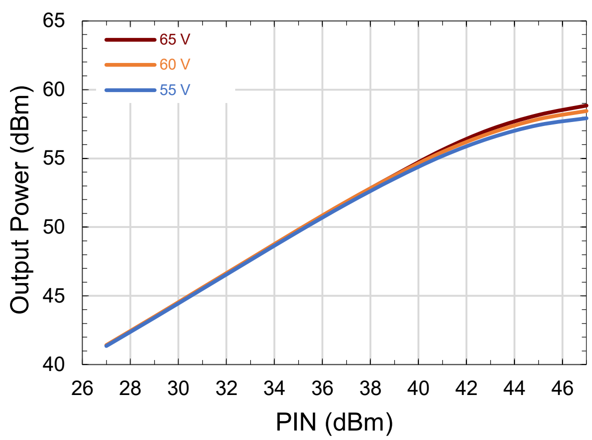
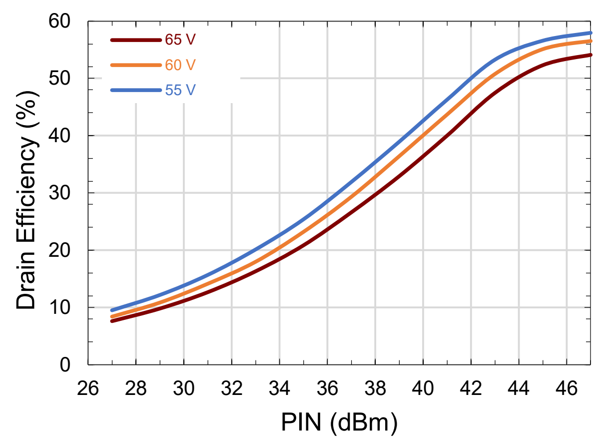
Output Power vs. V_{DS} and P_{IN}



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



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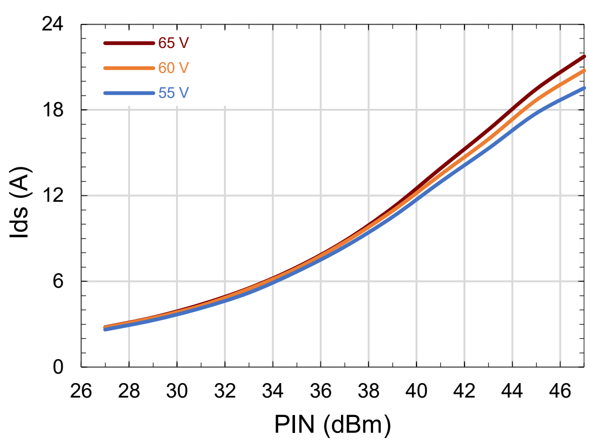
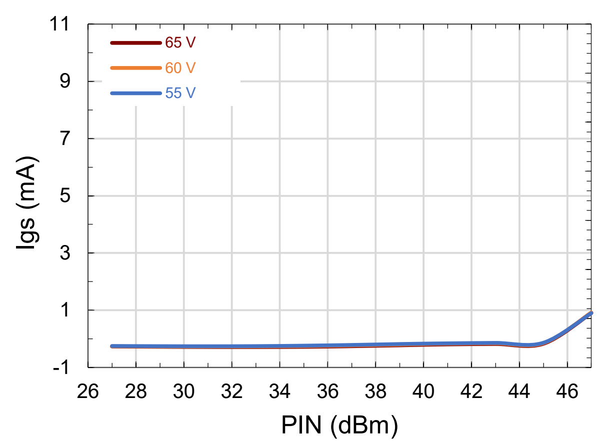
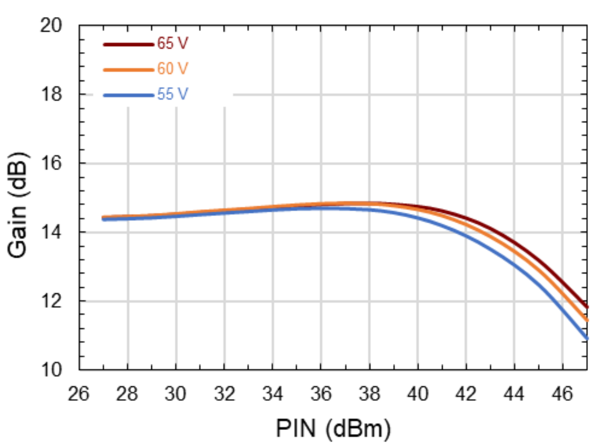


Gate Current vs. V_{DS} and P_{IN}



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



Typical Performance Curves as Measured in the 3.5 – 3.7 GHz Evaluation Test Fixture

Pulsed 100 μs 10%, P_{IN} = 46 dBm, V_{DS} = 65 V, I_{DQ} = 1000 mA, Frequency = 3.6 GHz (Unless otherwise noted)
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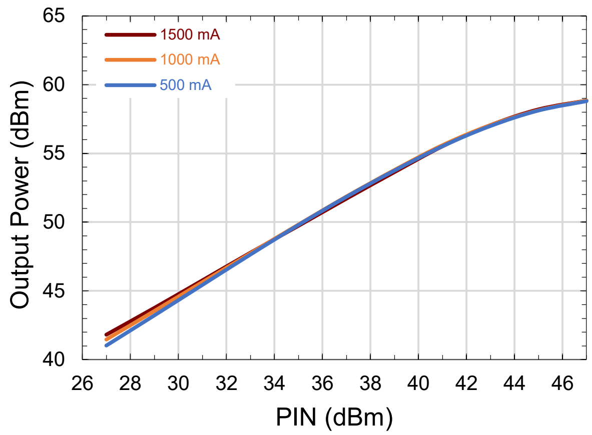
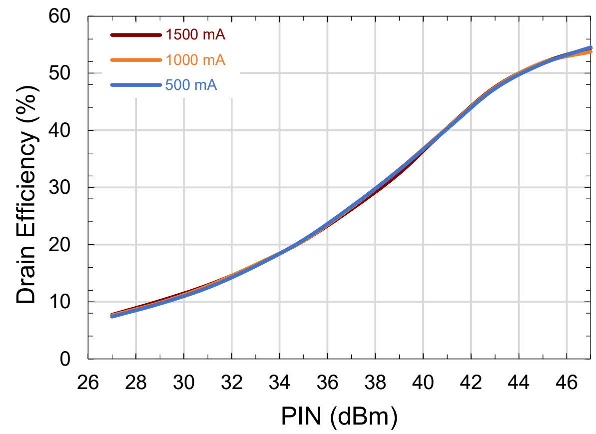
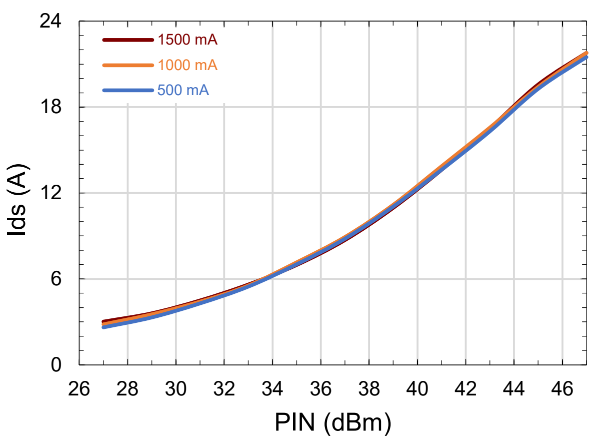
Output Power vs. I_{DQ} and P_{IN}



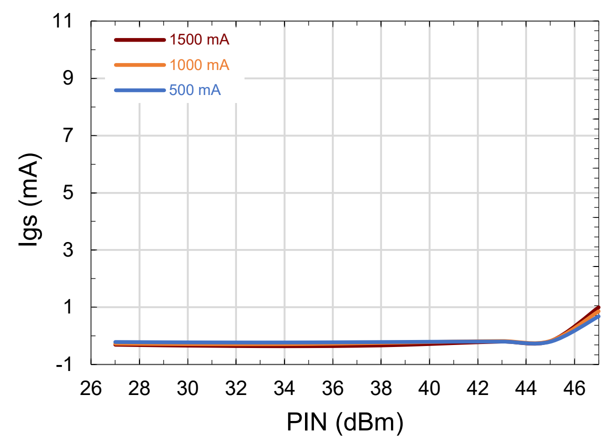
Drain Efficiency vs. I_{DQ} and P_{IN}



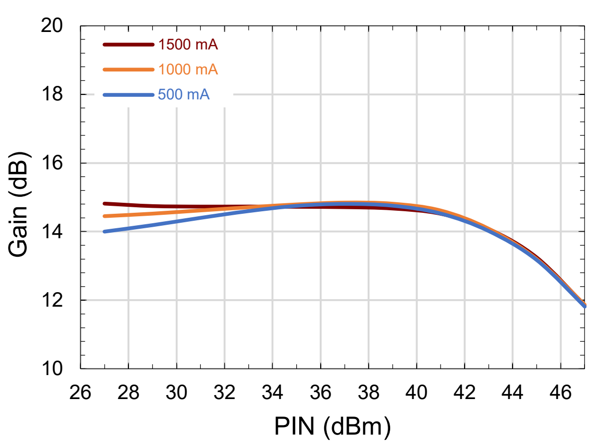
Drain Current vs. I_{DQ} and P_{IN}



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



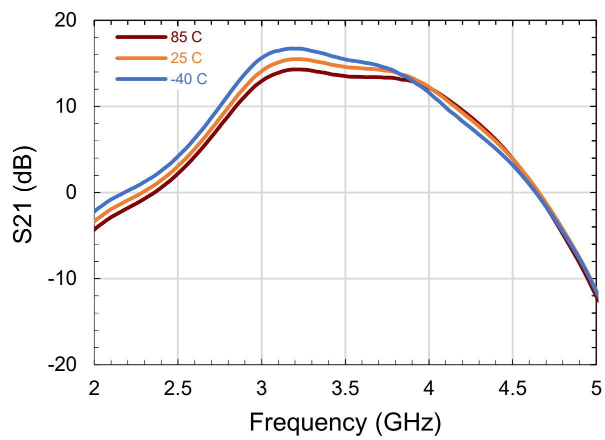
Large Signal Gain vs. I_{DQ} and P_{IN}



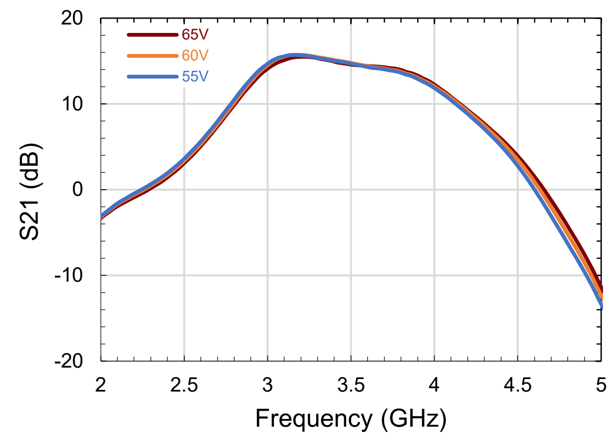
Typical Performance Curves as Measured in the 3.5 – 3.7 GHz Evaluation Test Fixture:

CW, V_{DS} = 65 V, I_{DQ} = 1000 mA, P_{IN} = -20 dBm (Unless Otherwise Noted)
For Engineering Evaluation Only—This data does not Modify MACOM's Datasheet Limits.

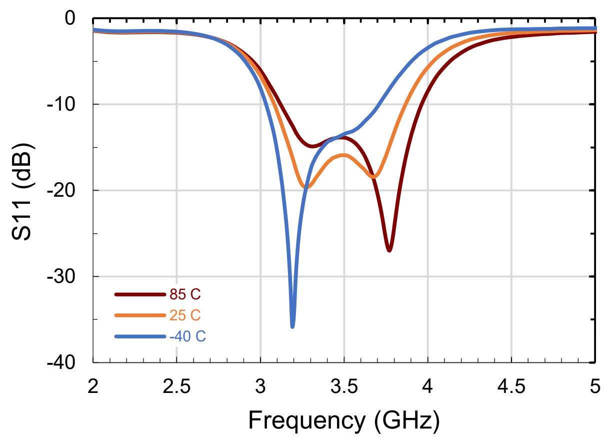
S21 vs Frequency and Temperature



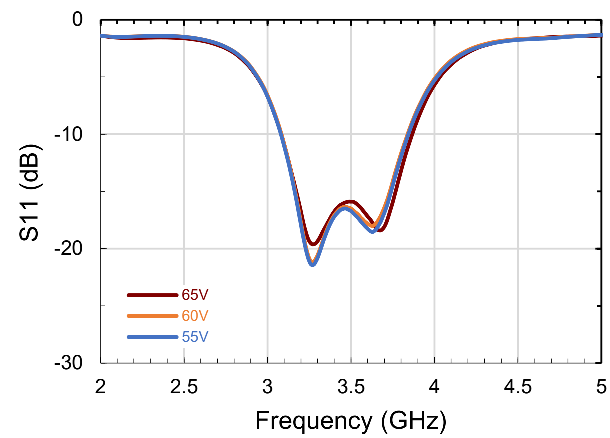
S21 vs Frequency and V_{DS}



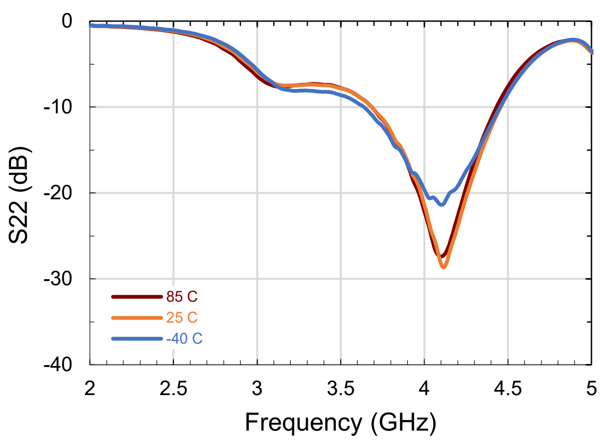
S11 vs Frequency and Temperature



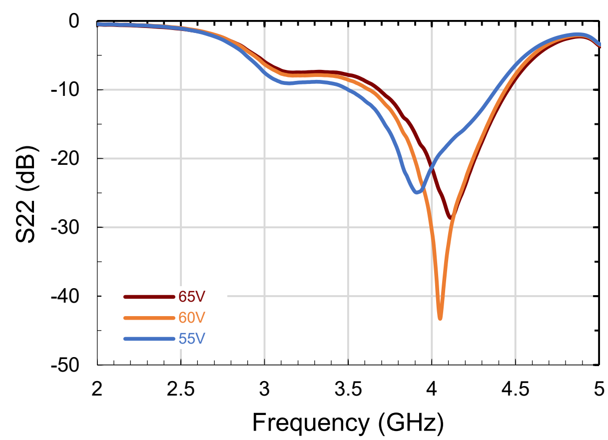
S11 vs Frequency and V_{DS}



S22 vs Frequency and Temperature



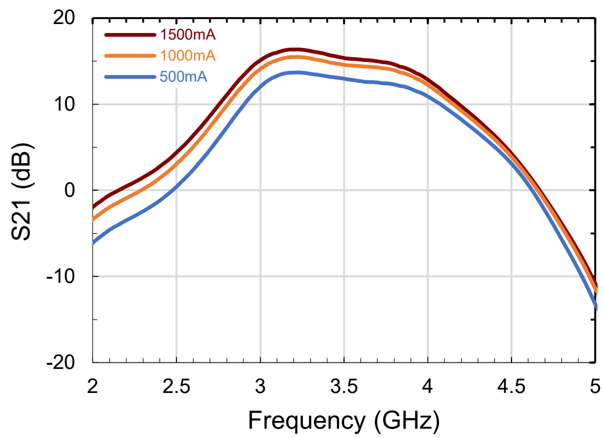
S22 vs Frequency and V_{DS}



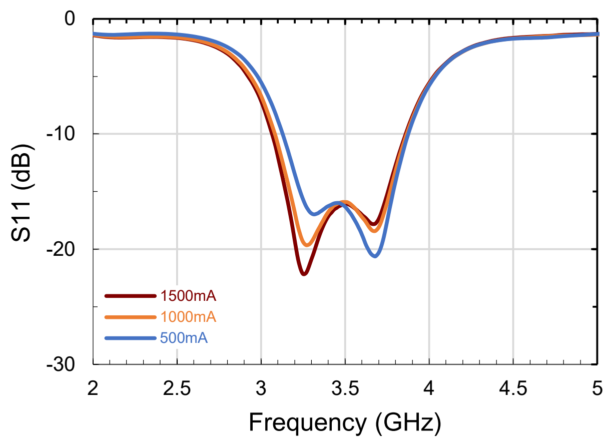
Typical Performance Curves as Measured in the 3.5– 3.7 GHz Evaluation Test Fixture:

CW, V_{DS} = 65 V, I_{DQ} = 1000 mA, P_{IN} = -20 dBm (Unless Otherwise Noted)
For Engineering Evaluation Only—This data does not Modify MACOM's Datasheet Limits.

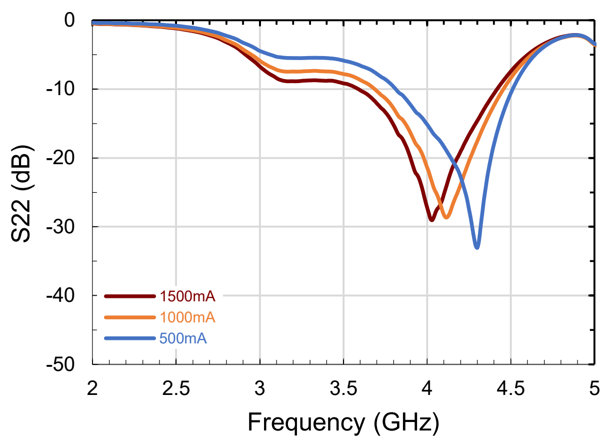
S21 vs Frequency and I_{DQ}



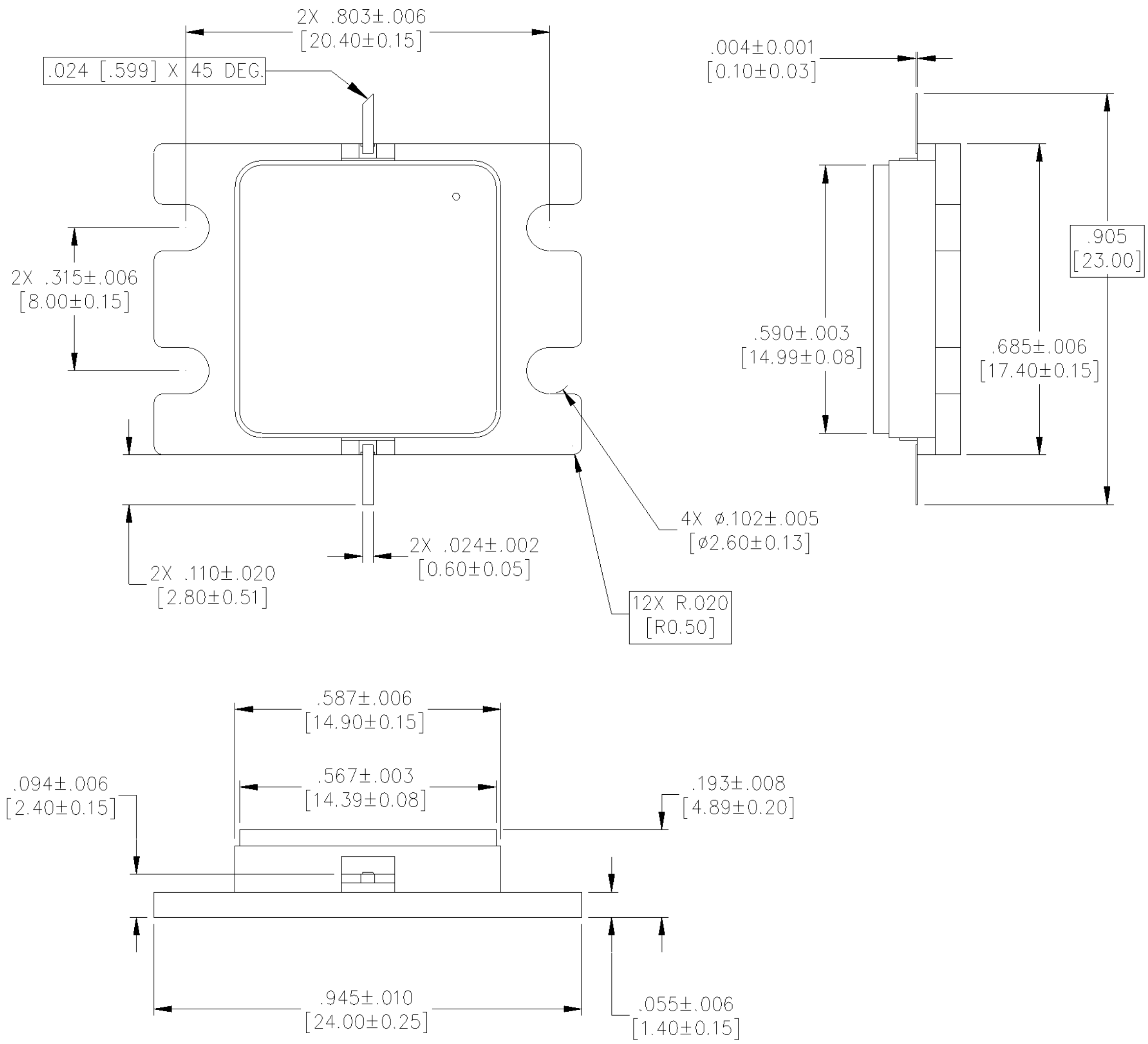
S11 vs Frequency and I_{DQ}



S22 vs Frequency and I_{DQ}



Product Dimensions (Package Type AC–587BH-2)



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
   LID MATERIAL: CERAMIC
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