

GaN Amplifier 65 V, 700 W

3.1 - 3.5 GHz



MACOM PURE CARBIDE

MAPC-A4030

Rev. V1

Features

- 700 W Output Power
- Large Signal Gain: 11.5 dB
- Drain Efficiency: 57%
- Internally Matched: 50 Ω
- High Temperature Operation
- RoHS* Compliant

Applications

- Civil & Military Pulsed Radar Amplifiers

Description

The MAPC-A4030 is a Gallium nitride (GaN) amplifier designed specifically with high efficiency and high power for the 3.1 - 3.5 GHz S-Band radar band.

The amplifier is matched to 50-Ohms on the input and 50-Ohms on the output. At the core of MAPC-A4030 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 $P_{IN} = 47$ dBm, 100 μ s pulse width and 10% Duty Cycle.

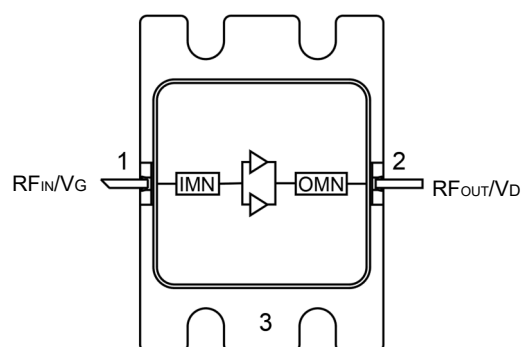
- $V_{DS} = 65$ V, $I_{DQ} = 500$ mA, $T_C = 25^\circ\text{C}$

Frequency (GHz)	Output Power (dBm)	Power Gain (dB)	η_D^1 (%)
3.1	58.8	11.8	60.3
3.3	58.7	11.7	59.2
3.5	58.4	11.4	56.2



AC-587BH-2

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-A4030-AB000	Bulk
MAPC-A4030-ABSB1	Sample Board

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

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RF Electrical Characteristics: Freq. = 3.1 - 3.5 GHz, $T_C = 25^\circ\text{C}$, $V_{DS} = 65\text{ V}$, $I_{DQ} = 500\text{ mA}$, 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, $P_{IN} = 47\text{ dBm}$	P_{OUT}	—	58.7	—	dBm
Drain Efficiency	Pulsed, $P_{IN} = 47\text{ dBm}$	DE	—	59.2	—	%
Large Signal Gain	Pulsed, $P_{IN} = 47\text{ dBm}$	G_P	—	11.7	—	dB
Small Signal Gain	CW, $P_{IN} = -20\text{ dBm}$	S21	—	15.2	—	dB
Input Return Loss	CW, $P_{IN} = -20\text{ dBm}$	S11	—	-19	—	dB
Output Return Loss	CW, $P_{IN} = -20\text{ dBm}$	S22	—	-8	—	dB
Output Mismatch Stress	$V_{DD} = 65\text{ V}$, $I_{DQ} = 500\text{ mA}$, $P_{IN} = 47\text{ dBm}$	ψ	VSWR = 3:1, No Device Damage			

RF Electrical Specifications²: $P_{IN} = 47\text{ dBm}$, $T_A = +25^\circ\text{C}$, $V_{DS} = 65\text{ V}$, $I_{DQ} = 500\text{ mA}$, Pulse Width 100 μs , 10% Duty Cycle

Parameter	Conditions	Units	Min.	Typ.	Max.
Output Power	3.1 GHz 3.3 GHz 3.5 GHz	W	700 700 700	790 810 780	—
Power Gain	3.1 GHz 3.3 GHz 3.5 GHz	dB	11.5 11.5 11.3	12.0 12.0 11.9	—
Drain Efficiency	3.1 GHz 3.3 GHz 3.5 GHz	%	60 59 55	64 63 61	—

2. Final testing and screening for all amplifier sales is performed using the MAPC-A4030 production test fixture.

DC Electrical Characteristics $T_A = 25^\circ\text{C}$

Parameter	Test Conditions	Symbol	Min.	Typ.	Max.	Units
Drain-Source Leakage Current	$V_{GS} = -8\text{ V}$, $V_{DS} = 10\text{ V}$	I_{DLK}	—	—	11.62	mA
Gate-Source Leakage Current	$V_{GS} = -8\text{ V}$, $V_{DS} = 10\text{ V}$	I_{GLK}	-11.62	—	—	mA
Gate Threshold Voltage	$V_{DS} = 10\text{ V}$, $I_D = 83.6\text{ mA}$	V_T	-3.8	-3.1	-2.3	V
Gate Quiescent Voltage	$V_{DS} = 565\text{ V}$, $I_D = 500\text{ mA}$	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.

Thermal Characteristics

Parameter	Symbol	Test Conditions	Units	Rating
Operating Junction Temperature	T _J	Pulse Width = 100 µs , Duty Cycle = 10%, P _{DISS} = 574 W T _C = 85°C	°C	154
Thermal Resistance, Junction to Case	R _{θJC}		°C/W	0.12

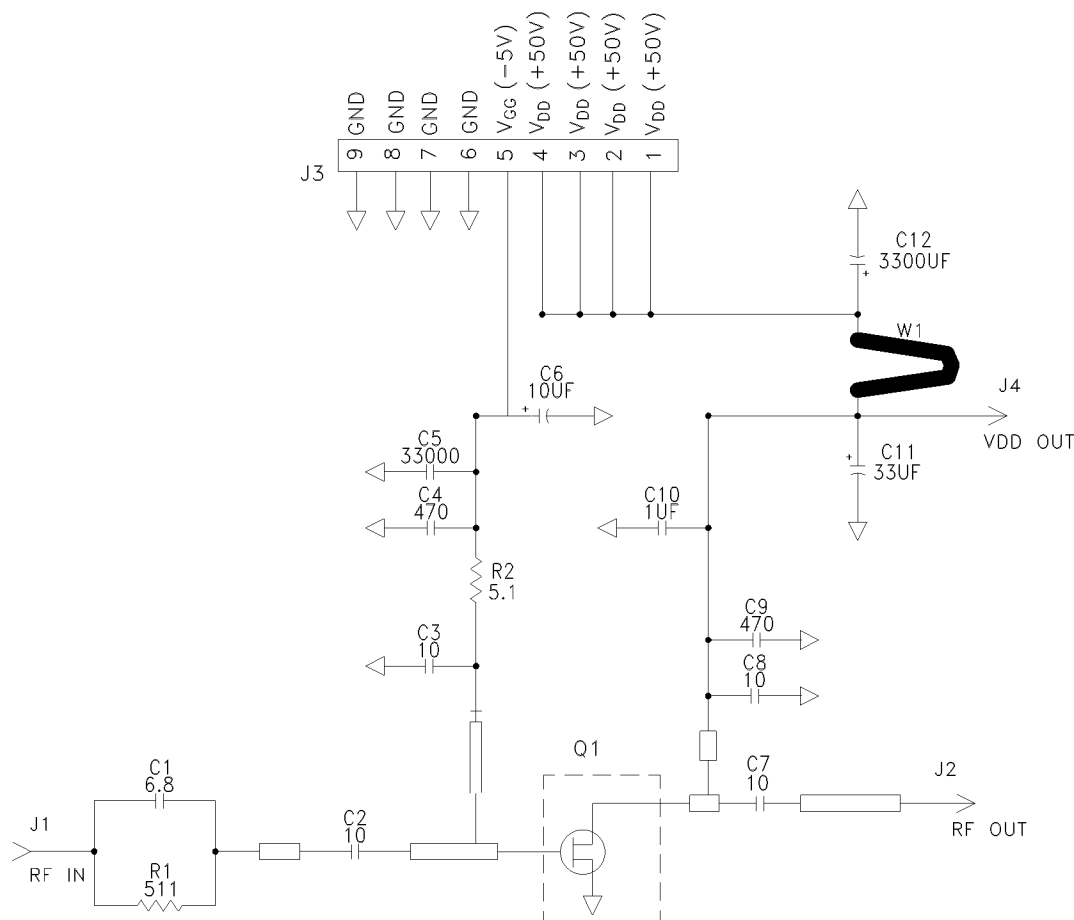
Handling Procedures

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

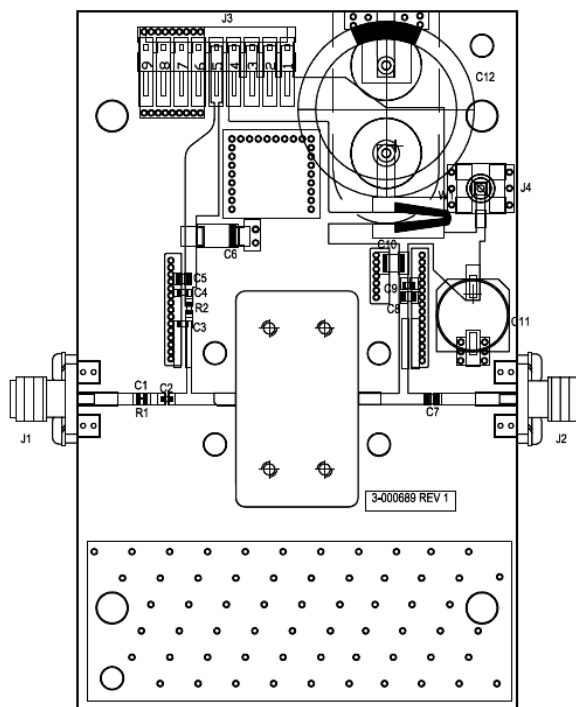
Bias ON

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



Parts List

Reference Designator	Description	Manufacturer	Part Number
C1	CAP, 6.8pF, +/- 0.25 pF, 0603, ATC	AVX	600S6R8BT250XT
C2,C7,C8	CAP, 10pF, +/- 1%, 250V, 0805, ATC600F	AVX	600F100JT250XT
C3	CAP, 10.0pF, +/-5%, 0603, ATC	AVX	600S100GT250XT
C4,C9	CAP, 470PF, 5%,100V, 0603	Murata	GCM1885C2A471JA16
C5	CAP,33000PF, 0805,100V, X7R	Murata	GRM21BR72A333KA01
C6	CAP 10UF 16V TANTALUM, 2312	AVX	TAJC106M016RNJ
C10	CAP, 1.0UF, 100V, +/-10%, X7R, 1210	Murata	GCJ31CR72A105KA01
C11	CAP, 33 UF, 20%, G CASE	Panasonic	EEE-FK2A330P
C12	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, RF35P, 30 MIL THK, SBAND CIRCUIT 440217		
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		
Q1	MACOM GaN Power Amplifier		MAPC-A4030-AB

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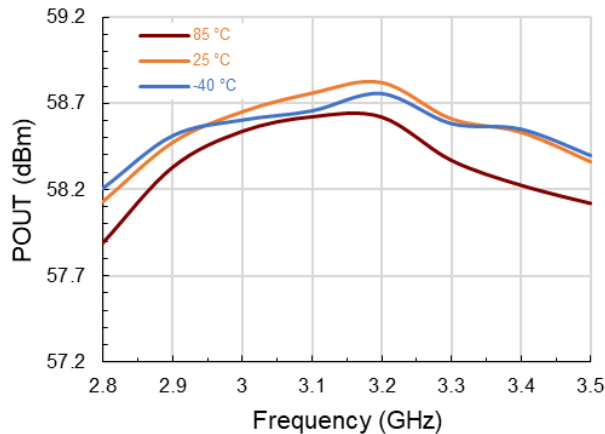
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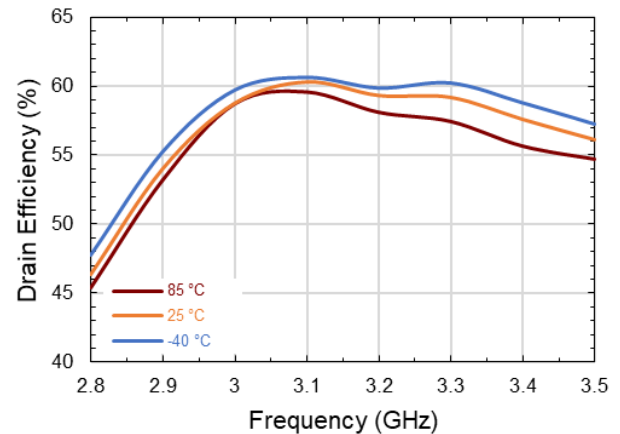
Rev. V1

Typical Performance Curves as Measured in the 3.1 – 3.5 GHz Evaluation Test Fixture
Pulsed 100 μ s 10%, $P_{IN} = 47$ dBm, $V_{DS} = 65$ V, $I_{DQ} = 500$ mA, Frequency = 3.3 GHz (Unless otherwise noted)
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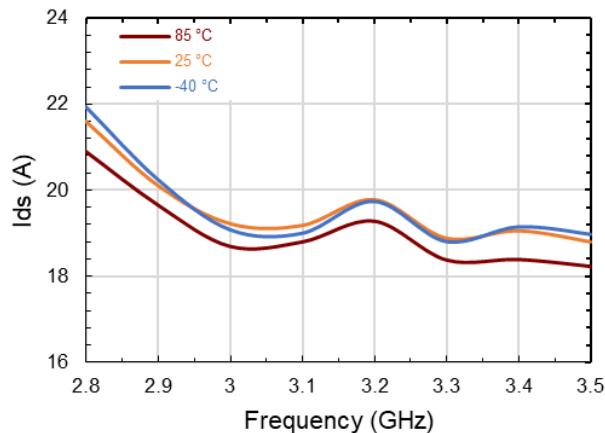
Output Power vs. Temperature and Frequency



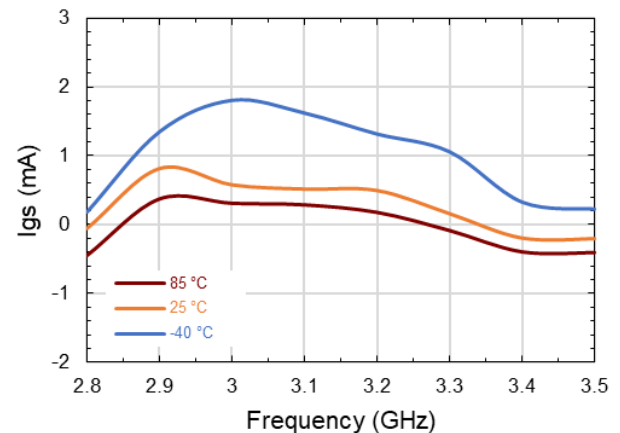
Drain Efficiency vs. Temperature and Frequency



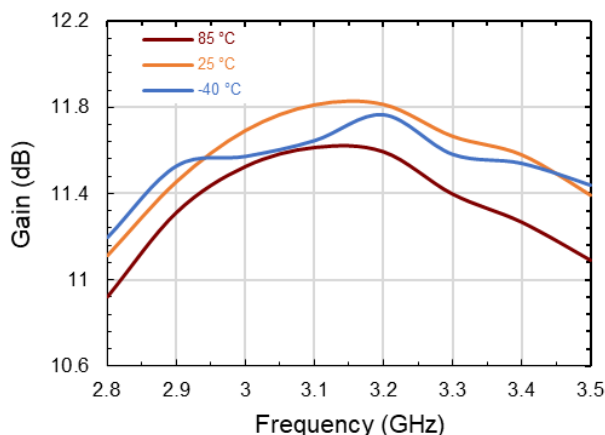
Drain Current vs. Temperature and Frequency



Gate Current vs. Temperature and Frequency



Large Signal Gain vs. Temperature and Frequency



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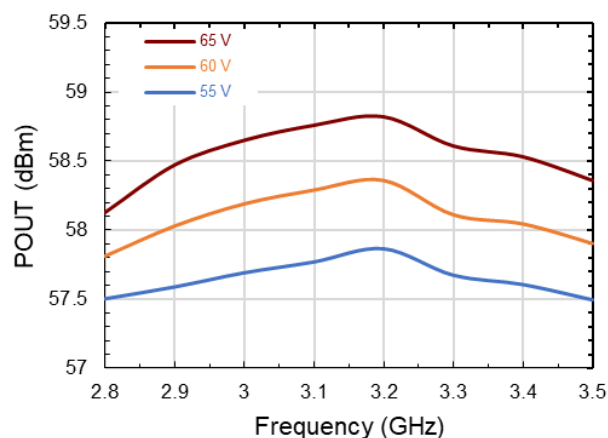
MAPC-A4030

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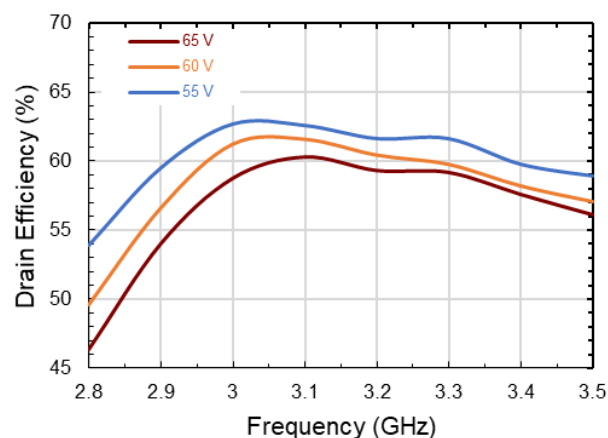
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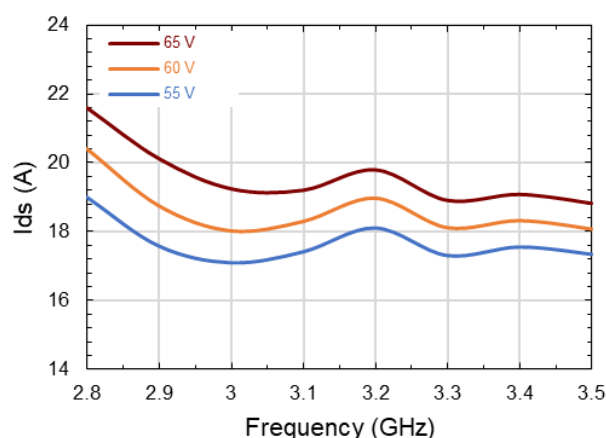
Output Power vs. V_{DS} and Frequency



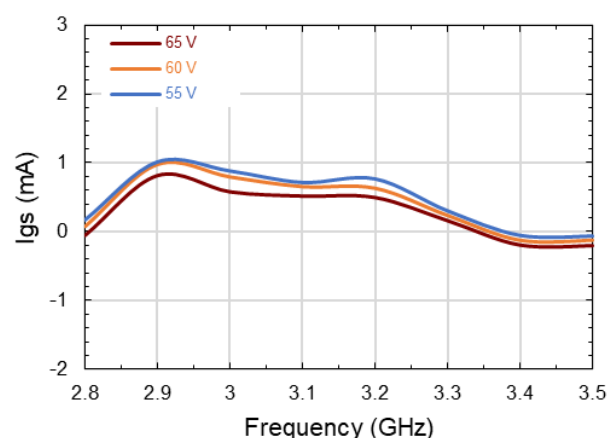
Drain Efficiency vs. V_{DS} and Frequency



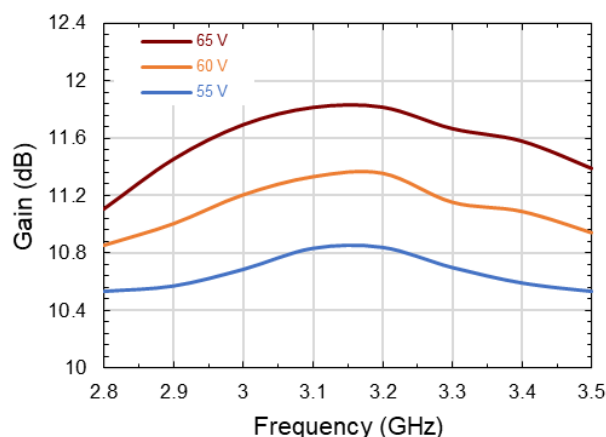
Drain Current vs. V_{DS} and Frequency



Gate Current vs. V_{DS} and Frequency



Large Signal Gain vs. V_{DS} and Frequency



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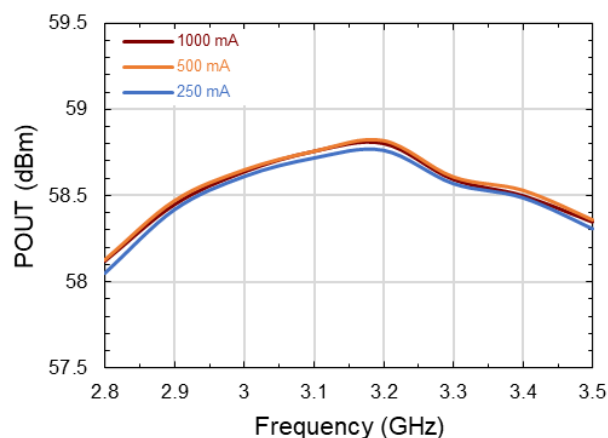
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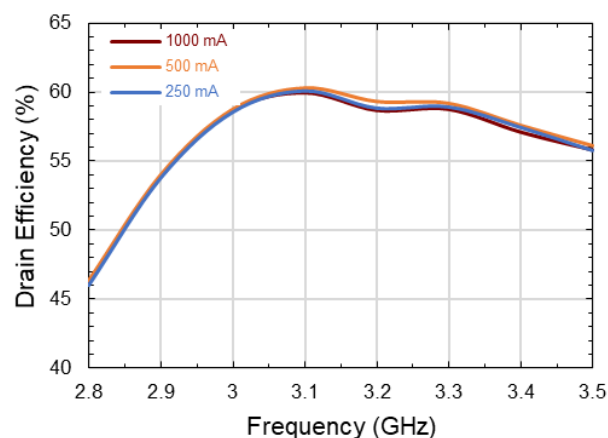
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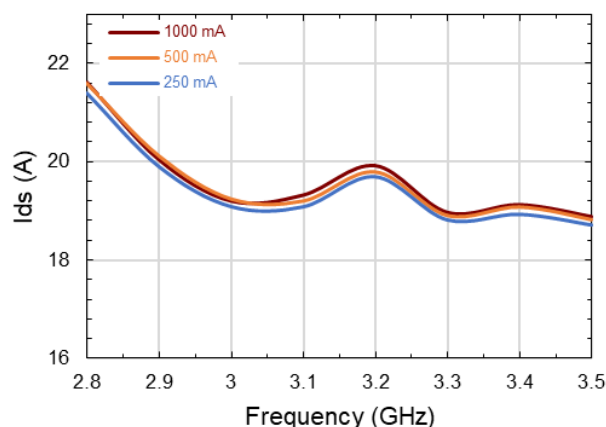
Output Power vs. I_{DQ} and Frequency



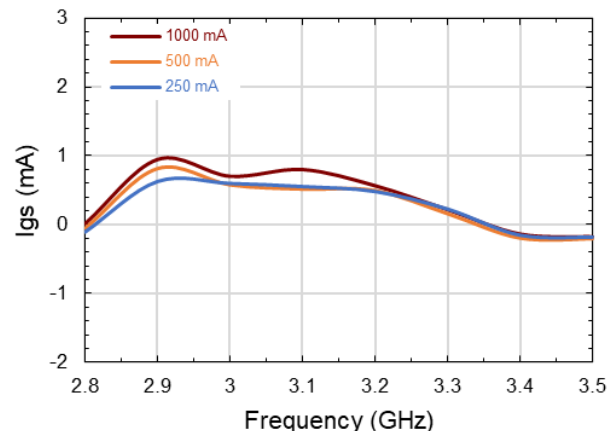
Drain Efficiency vs. I_{DQ} and Frequency



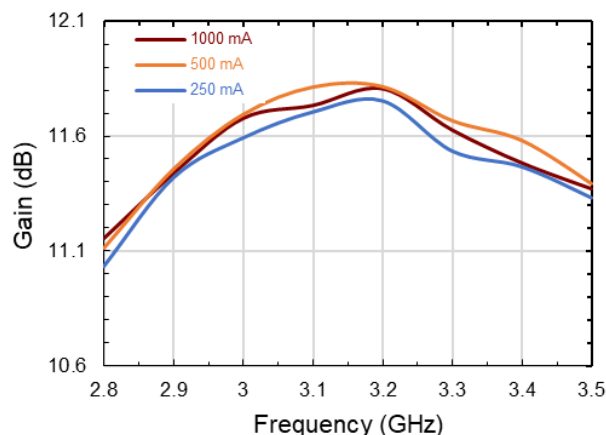
Drain Current vs. I_{DQ} and Frequency



Gate Current vs. I_{DQ} and Frequency



Large Signal Gain vs. I_{DQ} and Frequency

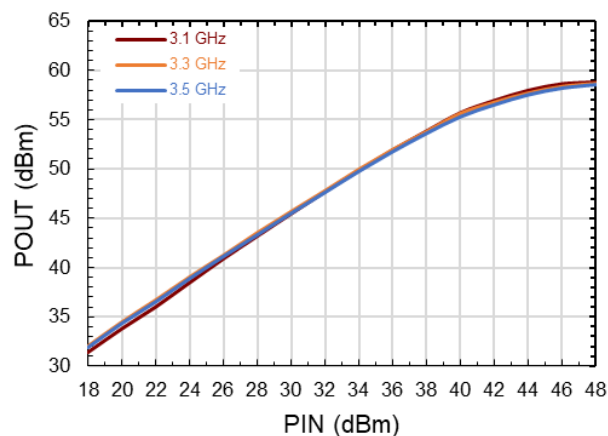


Typical Performance Curves as Measured in the 3.1 – 3.5 GHz Evaluation Test Fixture

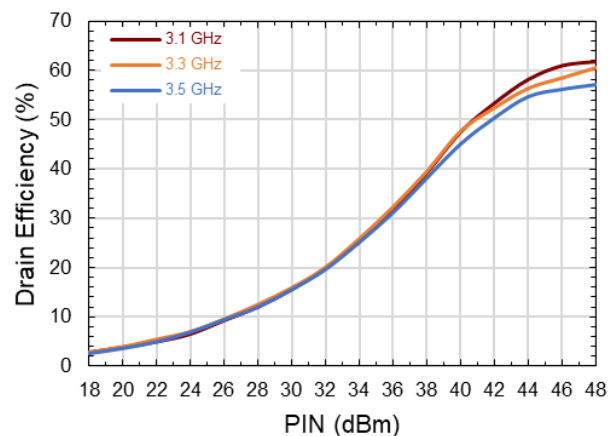
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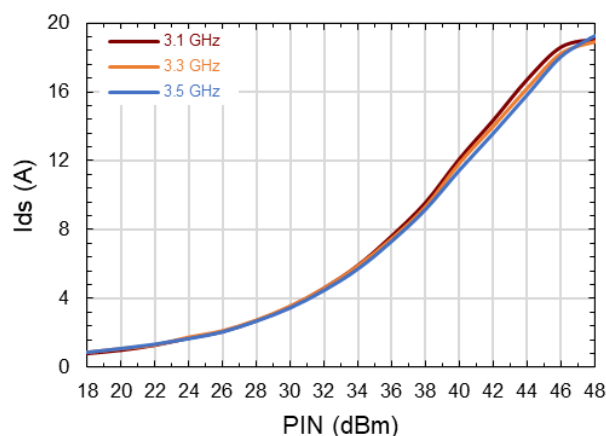
Output Power vs. Frequency and P_{IN}



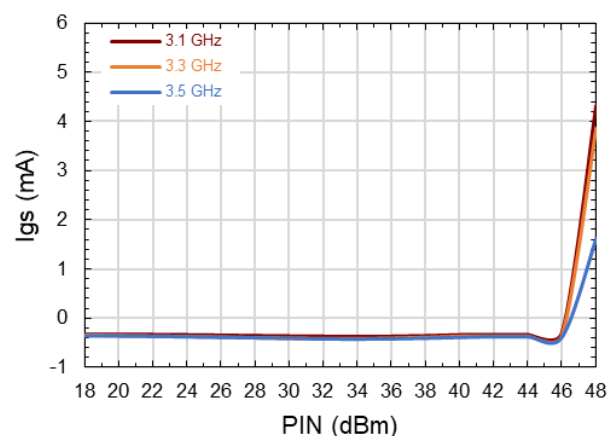
Drain Efficiency vs. Frequency and P_{IN}



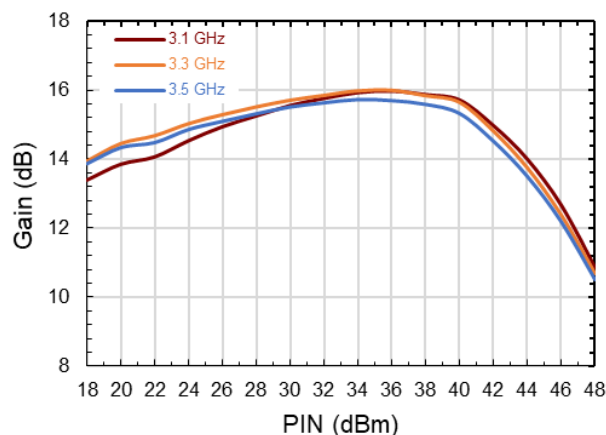
Drain Current vs. Frequency and P_{IN}



Gate Current vs. Frequency and P_{IN}



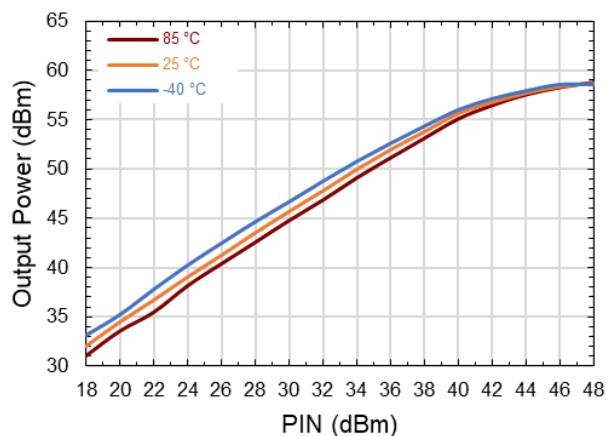
Large Signal Gain vs. Frequency and P_{IN}



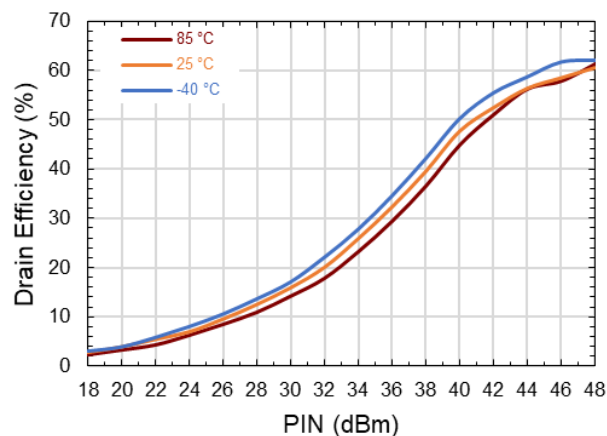
Typical Performance Curves as Measured in the 3.1 – 3.5 GHz Evaluation Test Fixture

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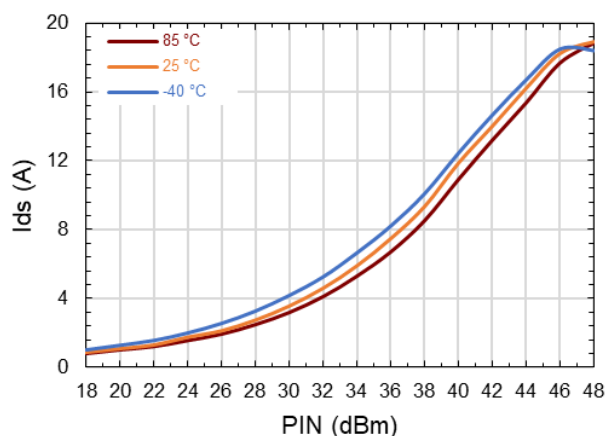
Output Power vs. Temperature and P_{IN}



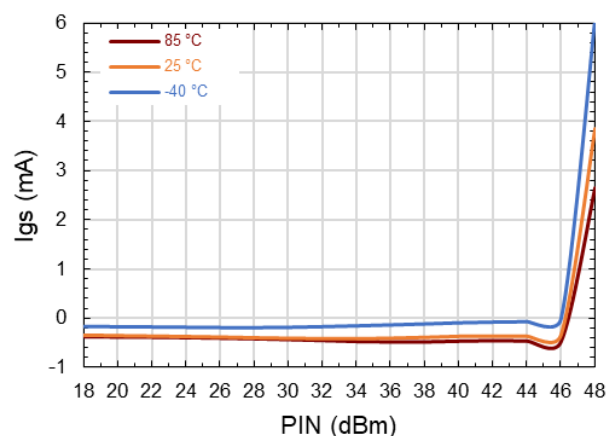
Drain Efficiency vs. Temperature and P_{IN}



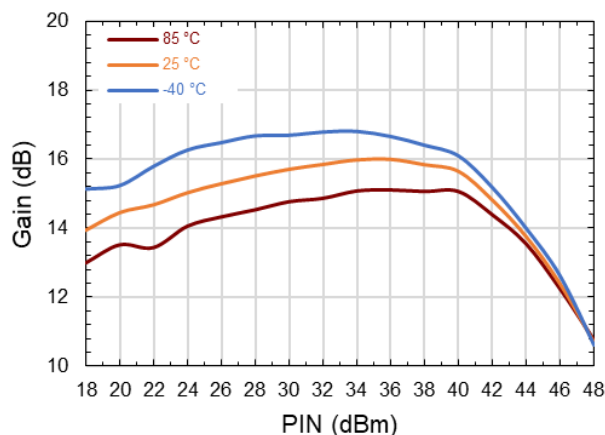
Drain Current vs. Temperature and P_{IN}



Gate Current vs. Temperature and P_{IN}



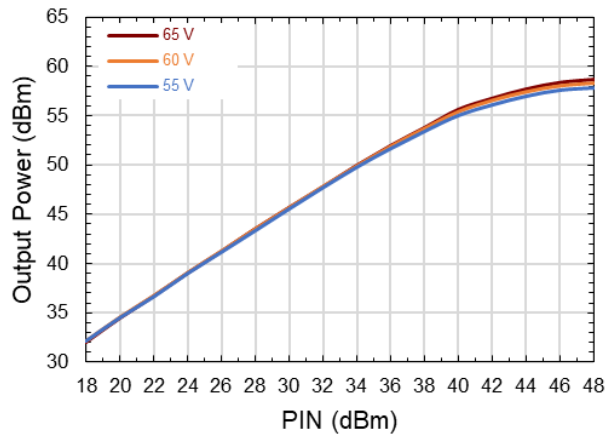
Large Signal Gain vs. Temperature and P_{IN}



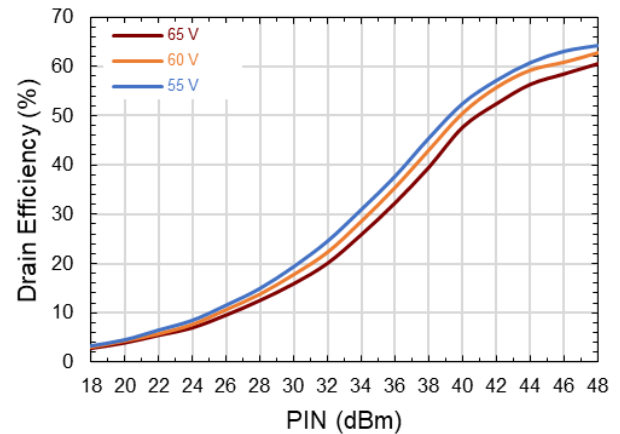
Typical Performance Curves as Measured in the 3.1 – 3.5 GHz Evaluation Test Fixture

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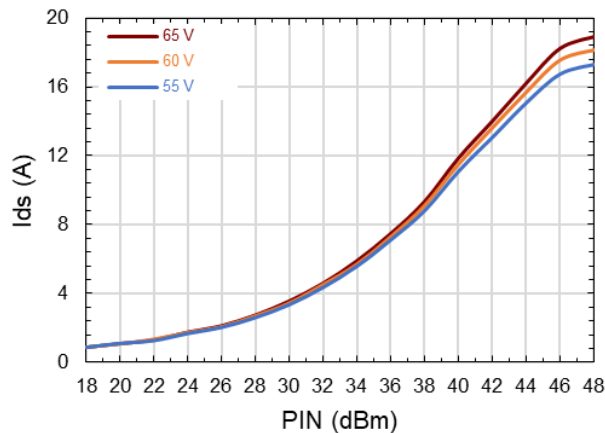
Output Power vs. V_{DS} and P_{IN}



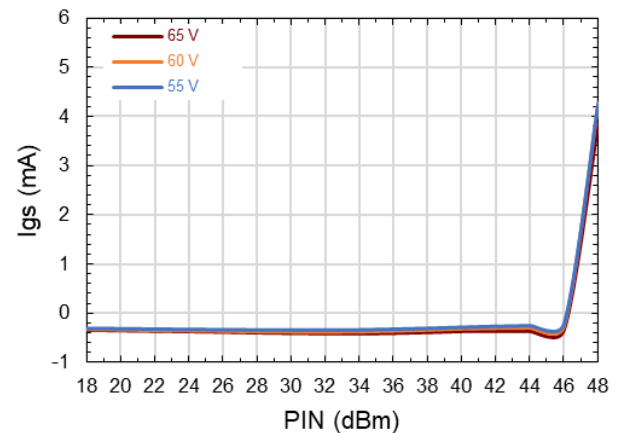
Drain Efficiency vs. V_{DS} and P_{IN}



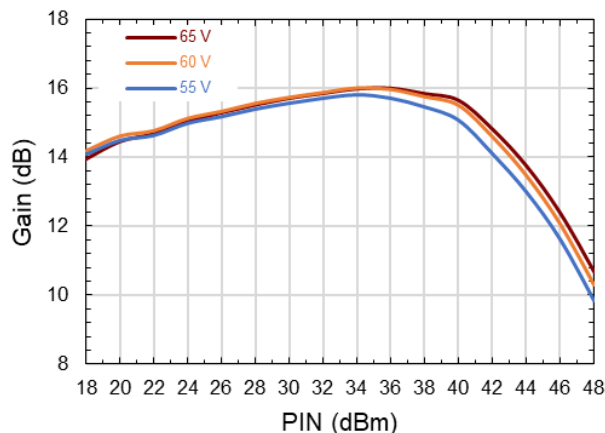
Drain Current vs. V_{DS} and P_{IN}



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



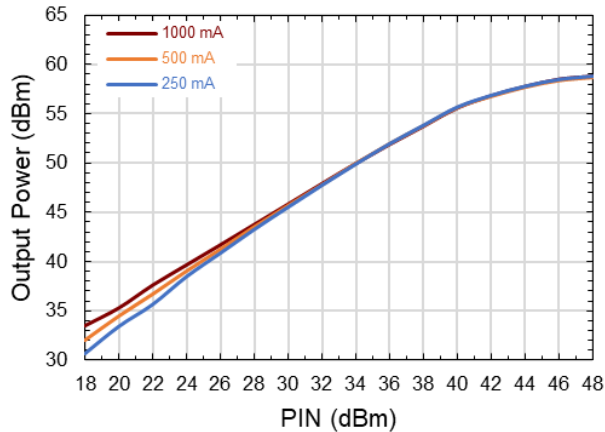
Large Signal Gain vs. V_{DS} and P_{IN}



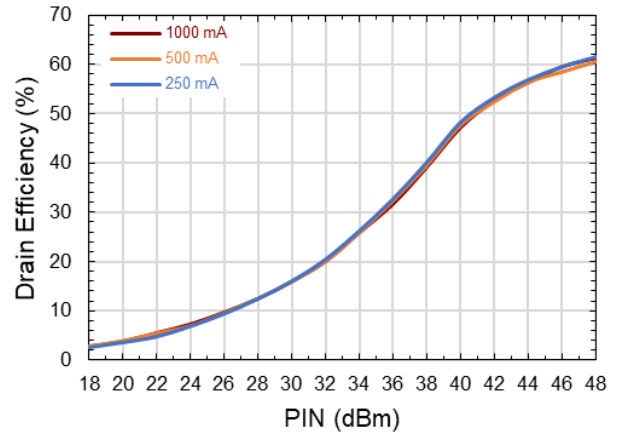
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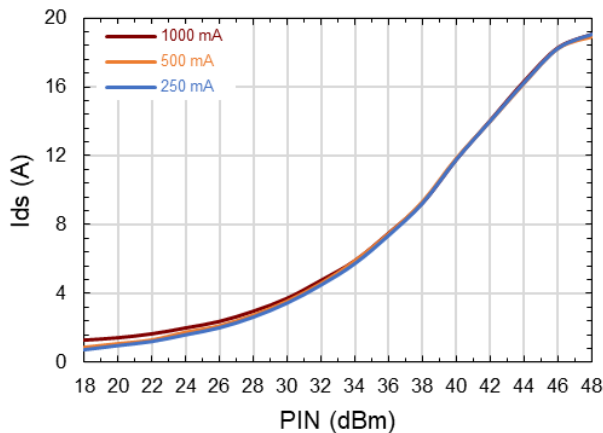
Output Power vs. I_{DQ} and P_{IN}



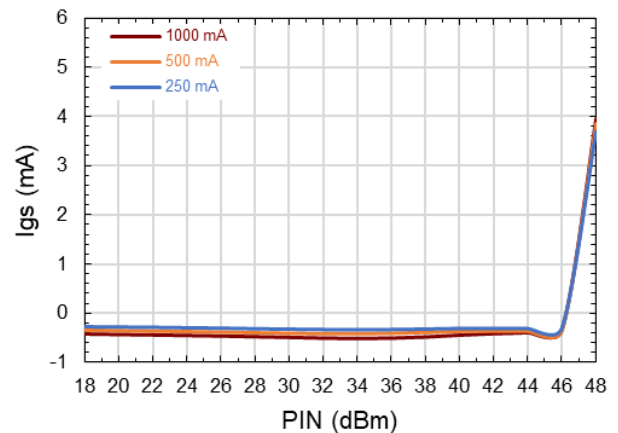
Drain Efficiency vs. I_{DQ} and P_{IN}



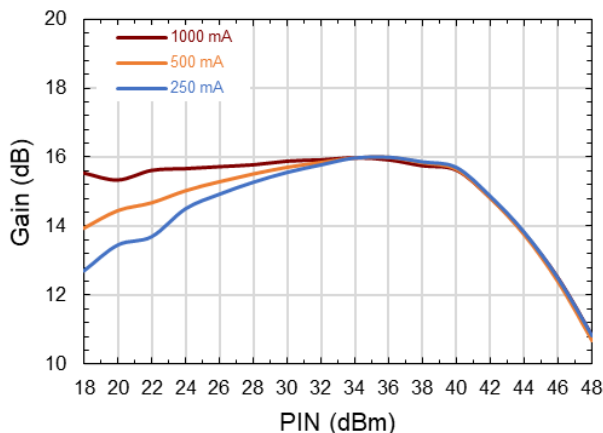
Drain Current vs. I_{DQ} and P_{IN}



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



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

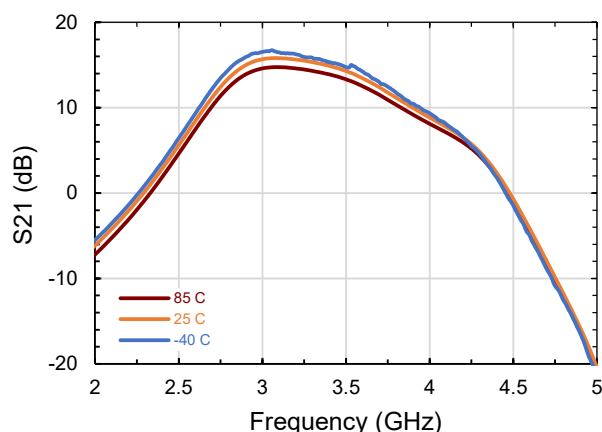


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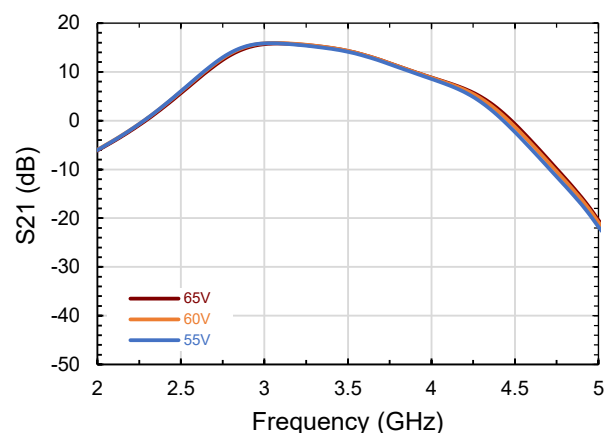
CW, $V_{DS} = 65$ V, $I_{DQ} = 500$ mA, $P_{IN} = -20$ dBm (Unless Otherwise Noted)

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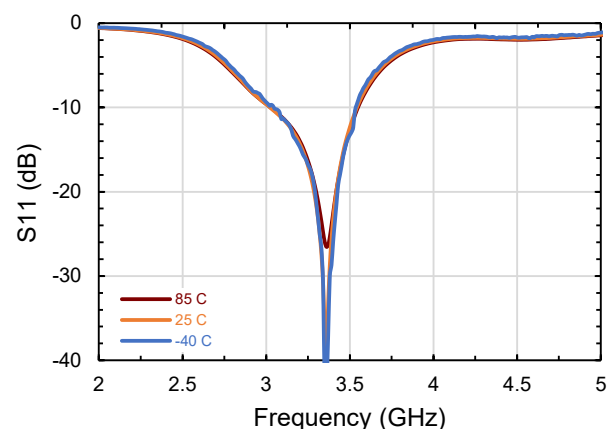
S21 vs Frequency and Temperature



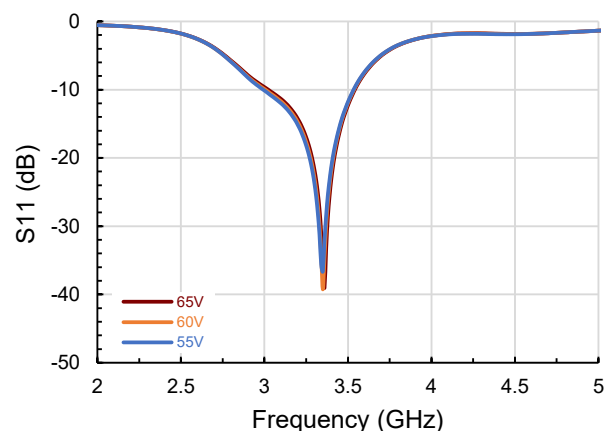
S21 vs Frequency and V_{DS}



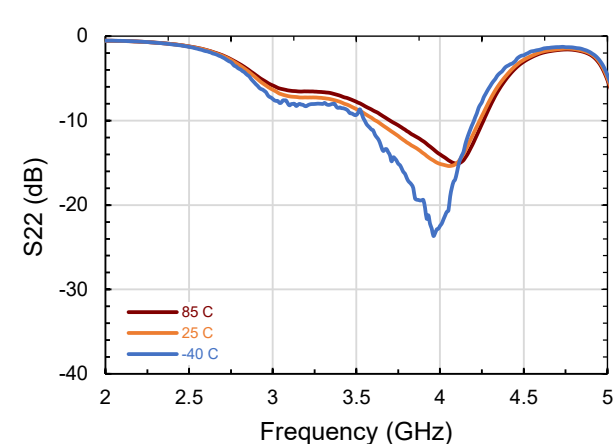
S11 vs Frequency and Temperature



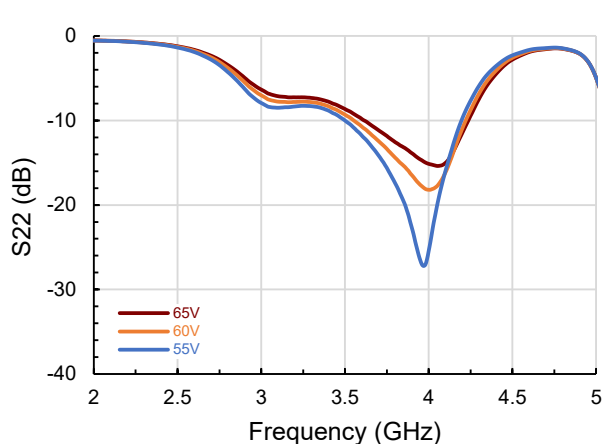
S11 vs Frequency and V_{DS}



S22 vs Frequency and Temperature



S22 vs Frequency and V_{DS}

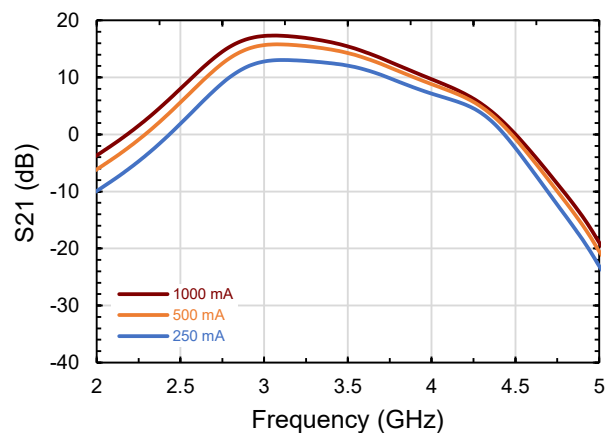


Typical Performance Curves as Measured in the 3.1– 3.5 GHz Evaluation Test Fixture:

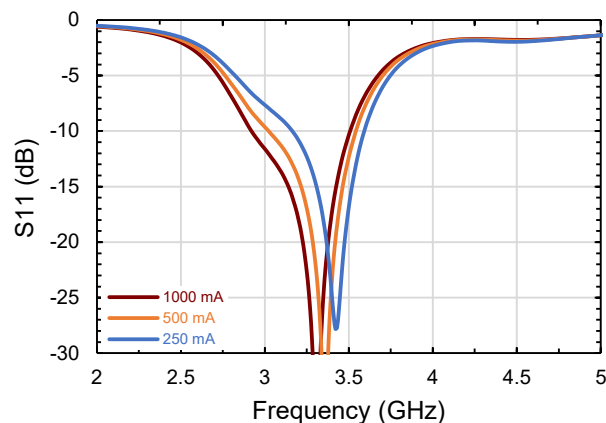
CW, $V_{DS} = 65$ V, $I_{DQ} = 500$ mA, $P_{IN} = -20$ dBm (Unless Otherwise Noted)

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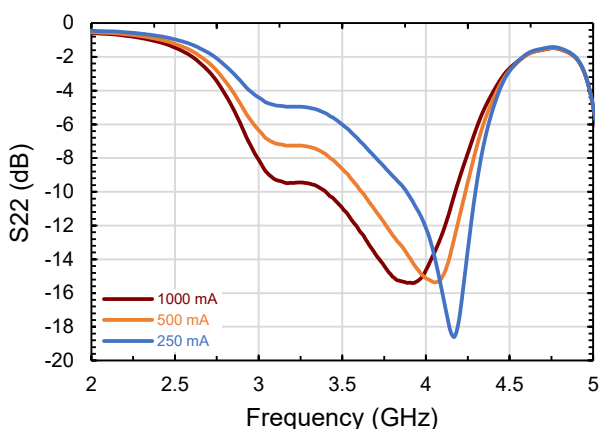
S₂₁ vs Frequency and I_{DQ}



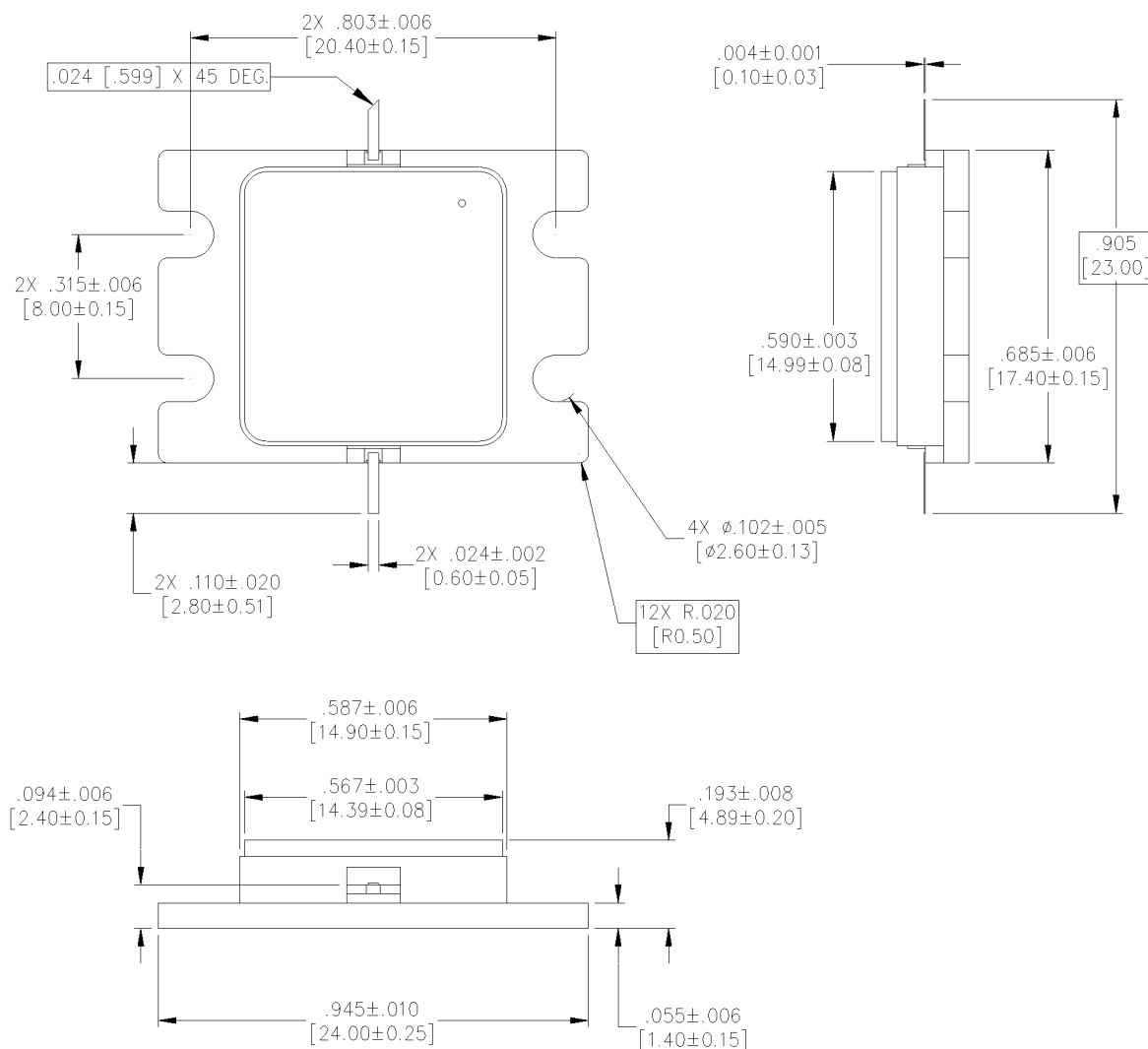
S₁₁ vs Frequency and I_{DQ}



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 $\pm .005$ [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

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