GaN Amplifier 50 V, 65 W
DC – 3.5 GHz

MACOM PURE CARBIDE

MAPC-A1100
Rev. V10

Features

- *MACOM PURE CARBIDE*® Amplifier Series
- Suitable for Linear and Saturated Applications
- CW and Pulsed Operation: 65 W Output Power
- Internally Pre-matched
- 50 V Operation
- Compatible with MACOM Power Management Bias Controller/Sequencer MABC-11040

Applications

- Military Radio Communications, radar, Avionics, Digital Cellular Infrastructure, RF Energy, and Test Instrumentation

Description

The MAPC-A1100 is a high power GaN on Silicon Carbide HEMT D-mode amplifier suitable for DC – 3.5 GHz frequency operation. The device supports both CW and pulsed operation with output levels of at least 65 W (48.1 dBm) in an air cavity ceramic package.

Typical Performance:

Measured in Evaluation Test Fixture:

P_{IN} = 30.5 dBm, 100 µs pulse width, 10% duty cycle
VDS = 50 V, IDQ = 110 mA, TC = 25°C

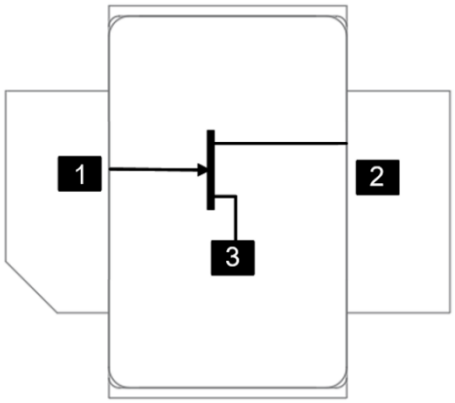
Frequency (GHz)	Output Power (dBm)	Gain (dB)	η_D (%)
3.45	47.5	17.1	75
3.50	47.4	16.9	75
3.55	47.2	16.7	75

Ordering Information

Part Number	Package
MAPC-A1100-BS000	Bulk Quantity
MAPC-A1100-BSTR1	Tape and Reel
MAPC-A1100-BSSB1	Sample Board

AC-360S-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	Ground / Source

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

RF Electrical Characteristics: T_C = 25°C, V_{DS} = 50V, I_{DQ} = 110 mA
Note: Performance in MACOM Application Fixture (3.45 – 3.55 GHz), 50 Ω system

Parameter	Test Conditions	Symbol	Min.	Typ.	Max.	Units
Small Signal Gain	Pulsed[2], 3.5 GHz	G_{SS}	-	21.2	-	dB
Power Gain	Pulsed[2], 3.5 GHz, 2.5 dB Gain Compression	G_{SAT}	-	18.2	-	dB
Drain Efficiency	Pulsed[2], 3.5 GHz, 2.5 dB Gain Compression	η_{SAT}	-	74	-	%
Output Power	Pulsed[2], 3.5 GHz, 2.5 dB Gain Compression	P_{SAT}	-	47.2	-	dBm
Power Gain	Pulsed[2], 3.5 GHz, P_{IN} = 30.5 dB	G_P	-	16.9	-	dB
Drain Efficiency	Pulsed[2], 3.5 GHz, P_{IN} = 30.5 dB	η_P	-	75	-	%
Output Power	Pulsed[2], 3.5 GHz, P_{IN} = 30.5 dB	P_P	-	47.4	-	dBm
Gain Variation (-40°C to +85°C)	Pulsed[2], 3.5 GHz	ΔG	-	0.005	-	dB/°C
Power Variation (-40°C to +85°C)	Pulsed[2], 3.5 GHz	ΔPdB	-	0.005	-	dB/°C
Ruggedness: Output Mismatch	All phase angles	Ψ	VSWR = 10:1, No Device Damage			

RF Electrical Characteristics: T_C = 25°C, V_{DS} = 50 V, I_{DQ} = 110 mA
Note: Performance in MACOM Production Test Fixture, 50 Ω system

Parameter	Test Conditions	Symbol	Min.	Typ.	Max.	Units
Power Gain	Pulsed[2], 3.5 GHz, 2.5 dB Gain Compression	G_{SAT}	15.4	16.8	-	dB
Saturated Drain Efficiency	Pulsed[2], 3.5 GHz, 2.5 dB Gain Compression	η_{SAT}	68	74	-	%
Saturated Output Power	Pulsed[2], 3.5 GHz, 2.5 dB Gain Compression	P_{SAT}	47.6	48.5	-	dBm

2. Pulse Details: 100µs pulse width, 10 ms period, 10% Duty Cycle.

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} = 130 V	I_{DLK}	-	-	6.48	mA
Gate-Source Leakage Current	V_{GS} = -8 V, V_{DS} = 0 V	I_{GLK}	-	-	6.48	mA
Gate Threshold Voltage	V_{DS} = 50 V, I_D = 6.48 mA	V_T	-	-2.9	-	V
Gate Quiescent Voltage	V_{DS} = 50 V, I_D = 110 mA	V_{GSQ}	-3.5	-2.5	-2.0	V

Absolute Maximum Ratings[3,4,5,6,7]

Parameter	Absolute Maximum
Drain Source Voltage, V_{DS}	150 V
Gate Source Voltage, V_{GS}	-8 to +2 V
Gate Current, I_G	6.5 mA
Storage Temperature Range	-65°C to +150°C
Case Operating Temperature Range	-40°C to +85°C
Channel Operating Temperature Range, T_{CH}	-40°C to +85°C
Absolute Maximum Channel Temperature	+275°C

3. Exceeding any one or combination of these limits may cause permanent damage to this device.
4. MACOM does not recommend sustained operation above maximum operating conditions.
5. Operating at drain source voltage VDS < 55 V will ensure MTTF > 2.15 x 10^6 hours.
6. Operating at nominal conditions with TCH ≤ 275°C will ensure MTTF > 2.15 x 10^6 hours.
7. MTTF may be estimated by the expression MTTF (hours) = A e [B + C/(T+273)] where T is the channel temperature in degrees Celsius, A = 1.537, B = -24.8111, and C = 21,352.

Thermal Characteristics

Parameter	Test Conditions	Symbol	Typical	Units
Thermal Resistance using Finite Element Analysis	V_{DS} = 50 V, T_C = 85°C, T_{CH} = 225°C	R_{Θ}(FEA)	4.63	°C/W

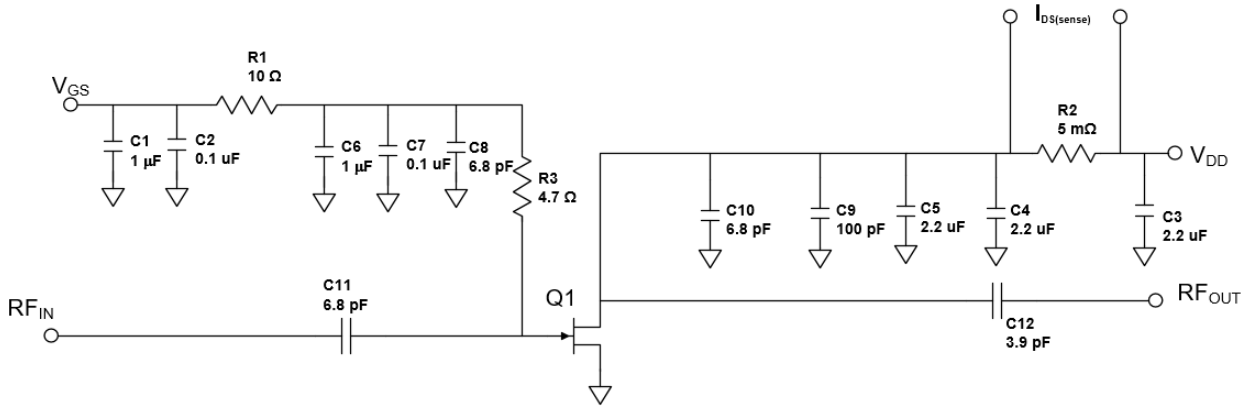
Handling Procedures

Please observe the following precautions to avoid damage:

Static Sensitivity

Gallium Nitride Circuits 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 1B, CDM Class C3 devices.

Application Fixture 3.45 – 3.55 GHz



Description

Parts measured on application board (20-mil thick RO4350). 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.

Bias Sequencing

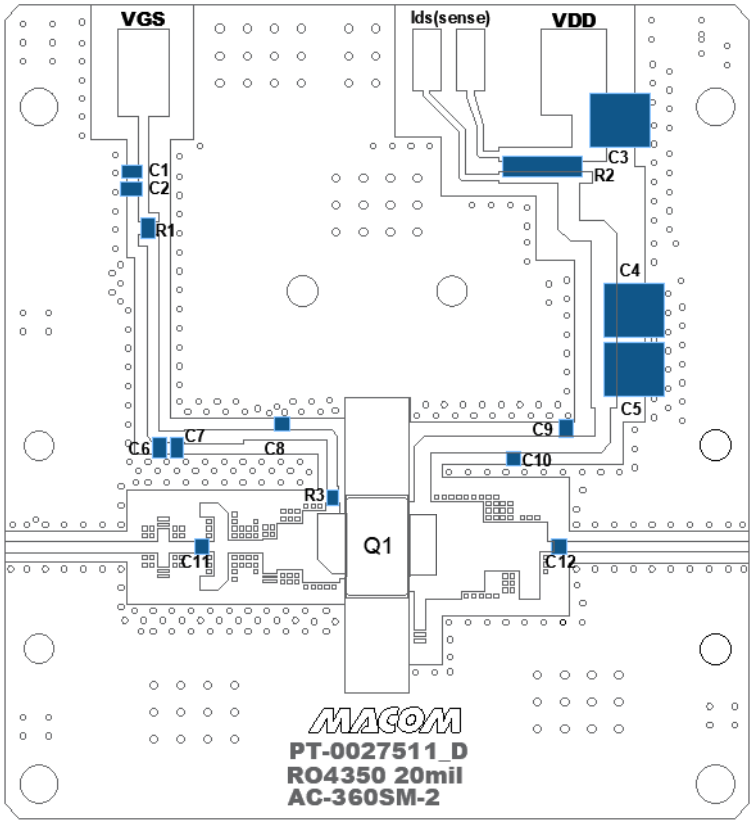
Turning the device ON

1. Set VGS to pinch-off (VP).
2. Turn on VDS to nominal voltage (50 V).
3. Increase VGS until IDS current is reached.
4. Apply RF power to desired level.

Turning the device OFF

1. Turn the RF power off.
2. Decrease VGS down to VP pinch-off.
3. Decrease VDS down to 0 V.
4. Turn off VGS.

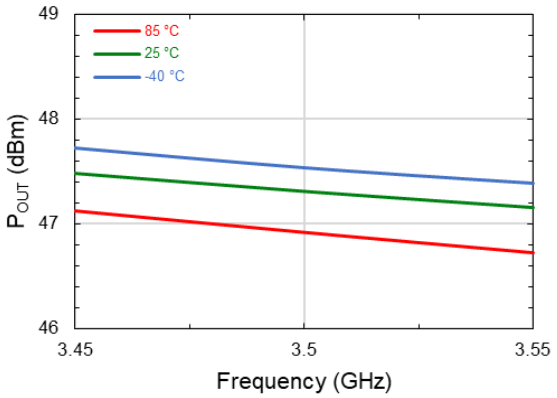
Application Test Fixture and Recommended Tuning Solution 3.45 - 3.55 GHz



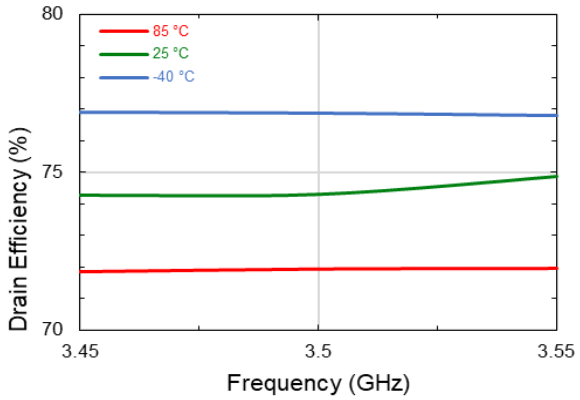
Reference Designator	Value	Tolerance	Manufacturer	Part Number
C1, C6	1 µF	+/- 10%	Murata	GRM21BC72A105KE01L
C2, C7	0.1 µF	+/- 10%	Murata	GCD21BR72A104KA01L
C3, C4, C5	2.2 µF	+/- 20%	Murata	KRM55TR72E225MH01L
C8, C10, C11	6.8 µF	+/- 0.1pF	PPI	0603N6R8BW251
C9	100 pF	+/- 5%	Murata	GQM2195C2E101JB12
C12	3.9 pF	+/- 0.25pF	PPI	0505C3R9CW151X
R1	10 Ω	+/- 1%	Vishay Dale	CRCW080510R0FKTA
R2	5 mΩ	+/- 1%	Susumu	RL7520WT-R005-F
R3	4.7 Ω	+/- 0.1%	Stackpole Electronics Inc	RNCF0603BKE4R70
Q1	MACOM GaN Power Amplifier			MAPC-A1100
PCB	RO4350LM, 20 mil, 1 oz Cu, Au Finish			

Typical Performance Curves as Measured in the 3.45 - 3.55 GHz Application Fixture: 3.5 GHz, V_{DS} = 50 V, I_{DQ} = 110 mA, P_{IN} = 30 dBm, T_C = 25°C (Unless Otherwise Noted)

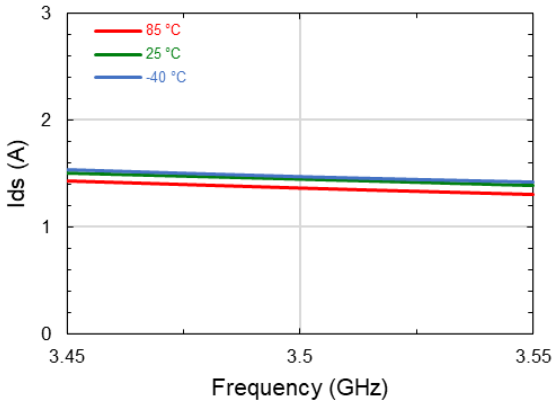
Output Power vs. Temperature and Frequency



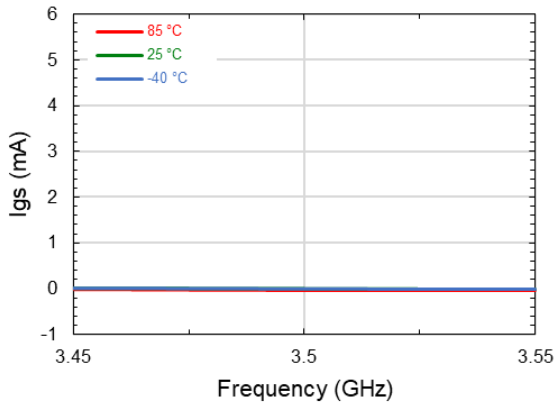
Drain Efficiency vs. Temperature and Frequency



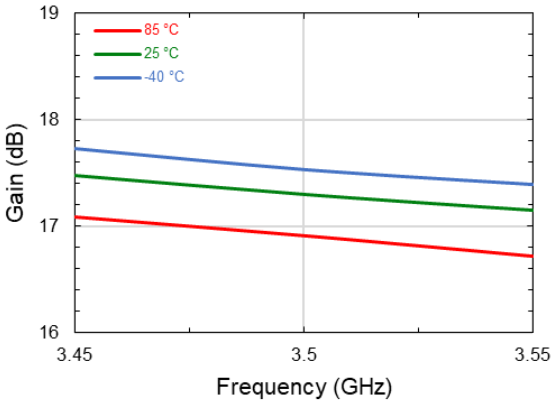
Drain Current vs. Temperature and Frequency



Gate Current vs. Temperature and Frequency

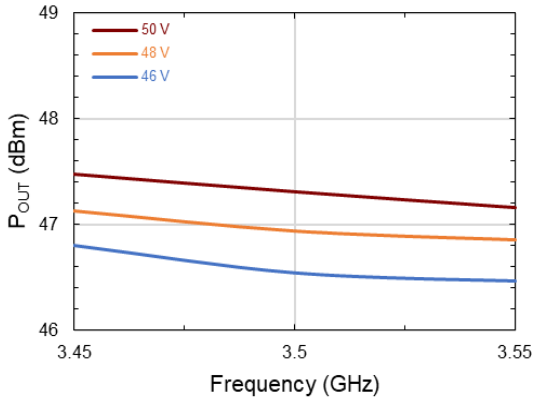


Large Signal Gain vs. Temperature and Frequency

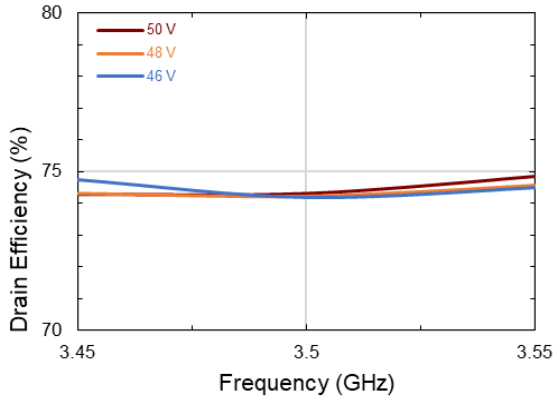


Typical Performance Curves as Measured in the 3.45 - 3.55 GHz Application Fixture: 3.5 GHz, V_{DS} = 50 V, I_{DQ} = 110 mA, T_C = 25°C (Unless Otherwise Noted)

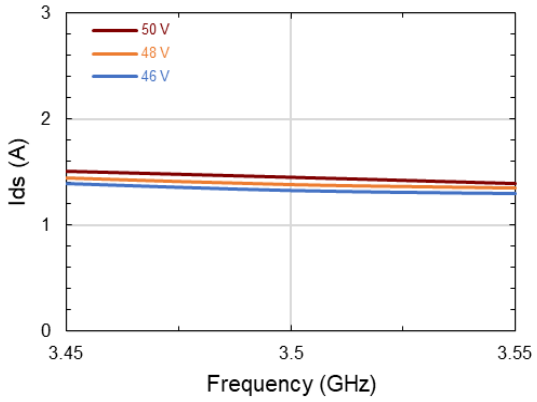
Output Power vs. V_{DS} and Frequency



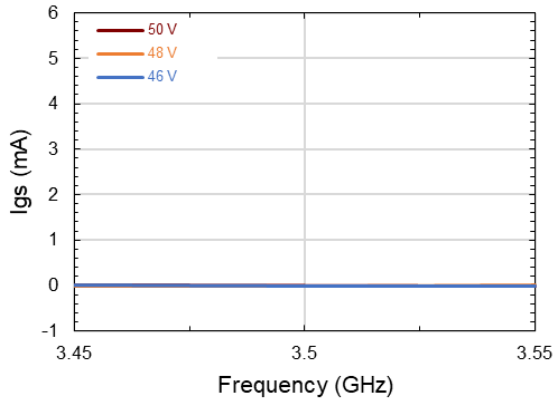
Drain Efficiency vs. V_{DS} and Frequency



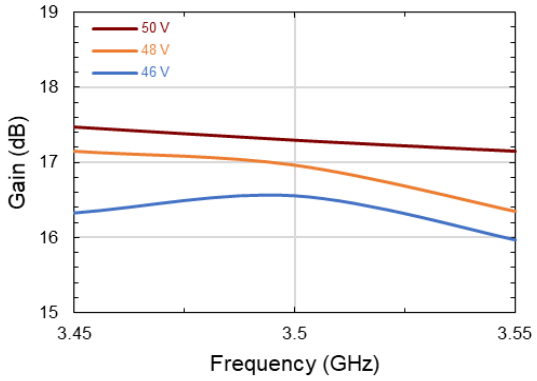
Drain Current vs. V_{DS} and Frequency



Gate Current vs. V_{DS} and Frequency

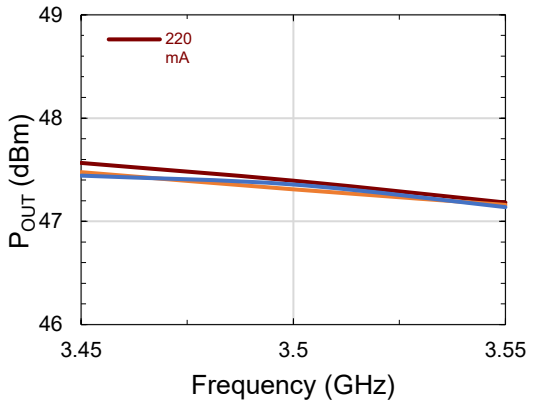


Large Signal Gain vs. V_{DS} and Frequency

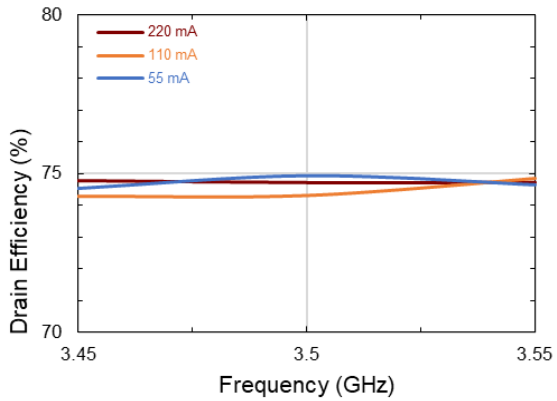


Typical Performance Curves as Measured in the 3.45 - 3.55 GHz Application Fixture: 3.5 GHz, V_{DS} = 50 V, I_{DQ} = 110 mA, T_C = 25°C (Unless Otherwise Noted)

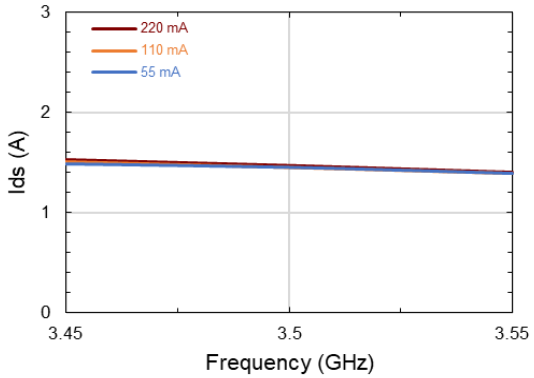
Output Power vs. I_{DQ} and Frequency



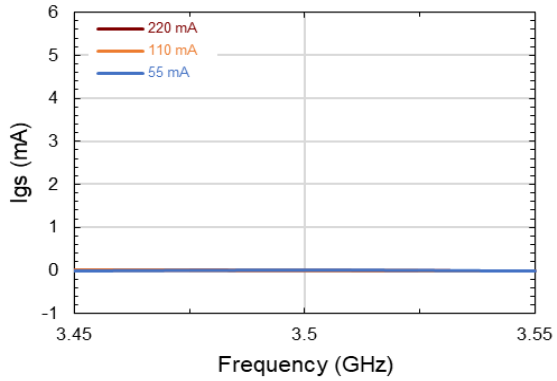
Drain Efficiency vs. I_{DQ} and Frequency



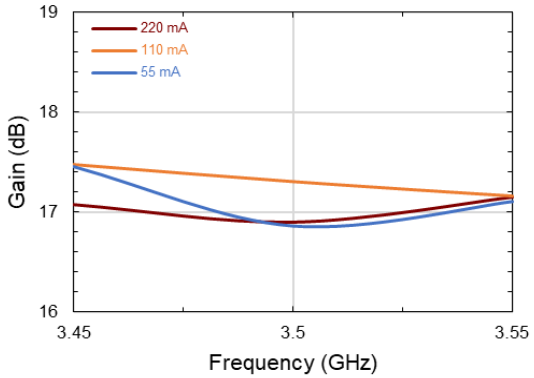
Drain Current vs. I_{DQ} and Frequency



Gate Current vs. I_{DQ} and Frequency

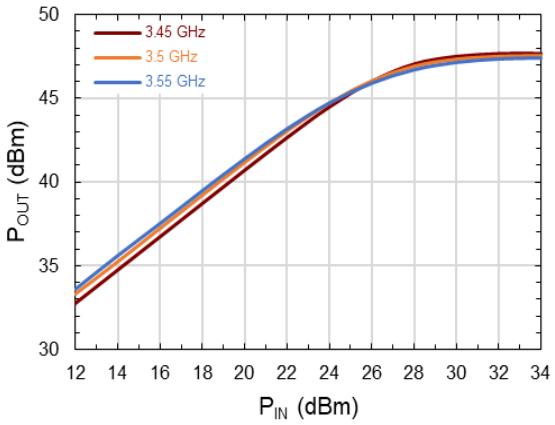


Large Signal Gain vs. I_{DQ} and Frequency

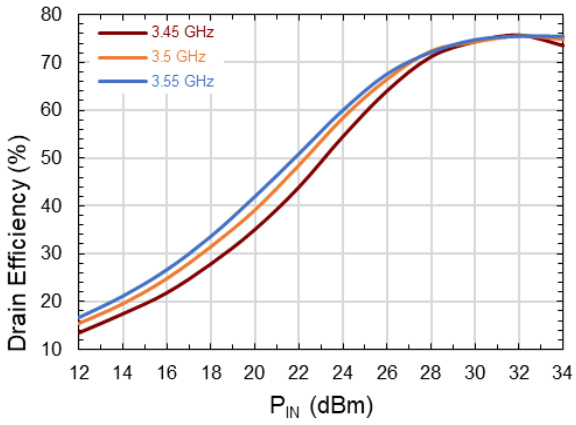


Typical Performance Curves as Measured in the 3.45 - 3.55 GHz Application Fixture: 3.5 GHz, V_{DS} = 50 V, I_{DQ} = 110 mA, T_C = 25°C (Unless Otherwise Noted)

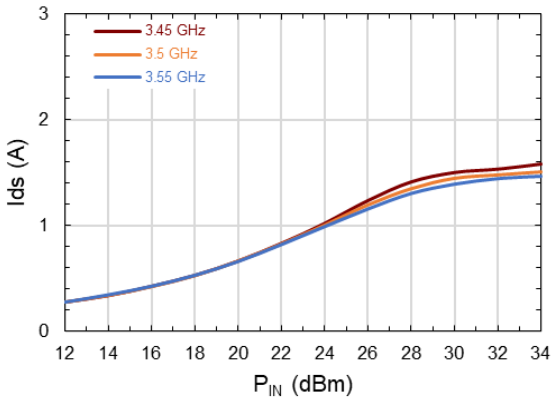
Output Power vs. Frequency and P_{IN}



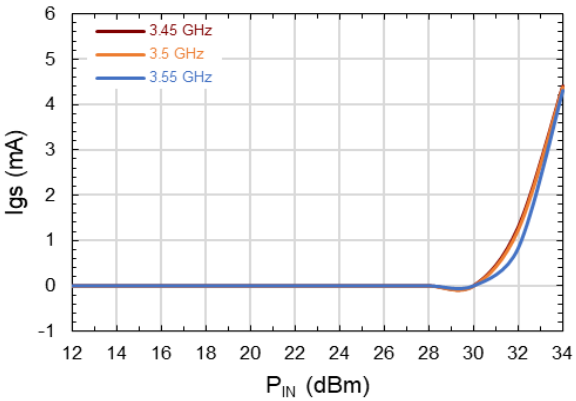
Drain Efficiency vs. Frequency and P_{IN}



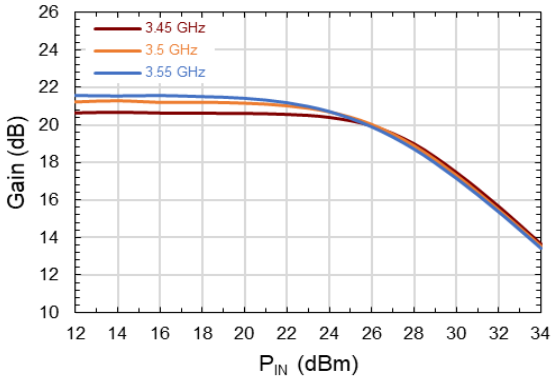
Drain Current vs. Frequency and P_{IN}



Gate Current vs. Frequency and P_{IN}

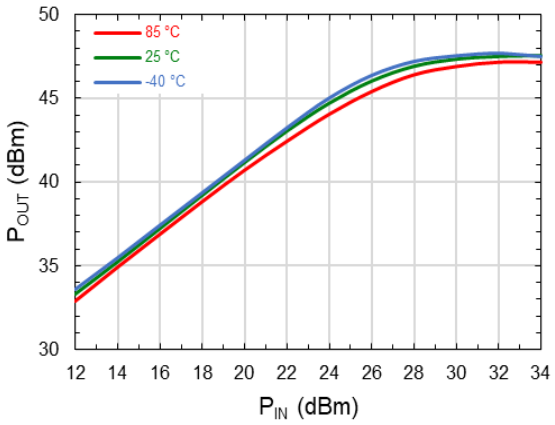


Large Signal Gain vs. Frequency and P_{IN}

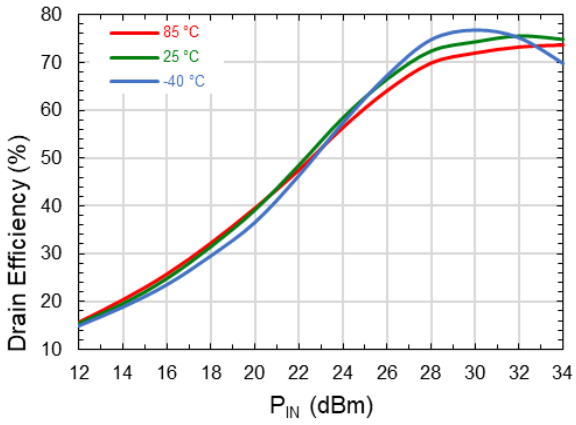


Typical Performance Curves as Measured in the 3.45 - 3.55 GHz Application Fixture: 3.5 GHz, V_{DS} = 50 V, I_{DQ} = 110 mA, T_C = 25°C (Unless Otherwise Noted)

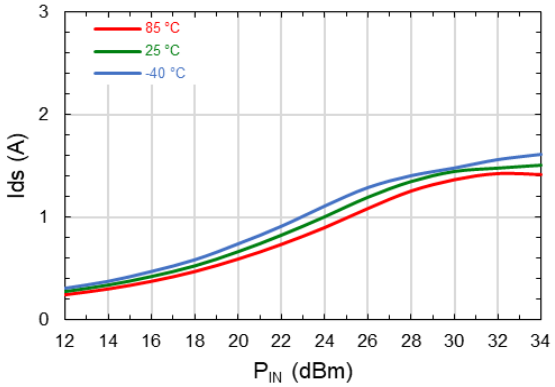
Output Power vs. Temperature and P_{IN}



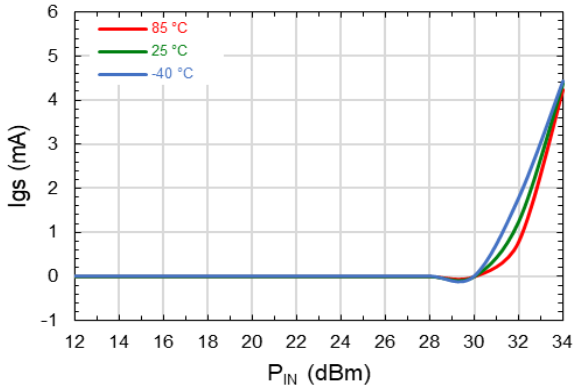
Drain Efficiency vs. Temperature and P_{IN}



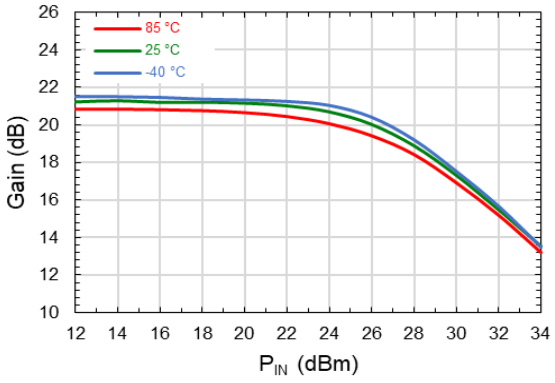
Drain Current vs. Temperature and P_{IN}



Gate Current vs. Temperature and P_{IN}

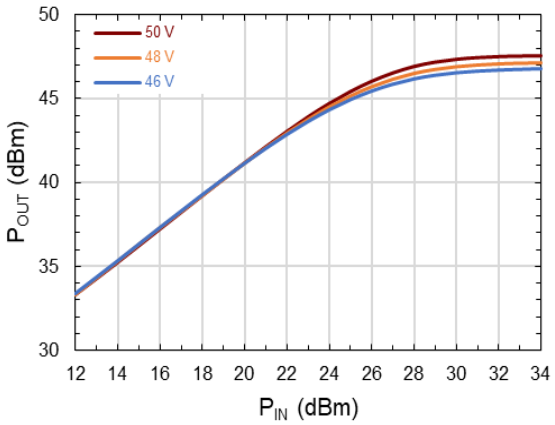


Large Signal Gain vs. Temperature and P_{IN}

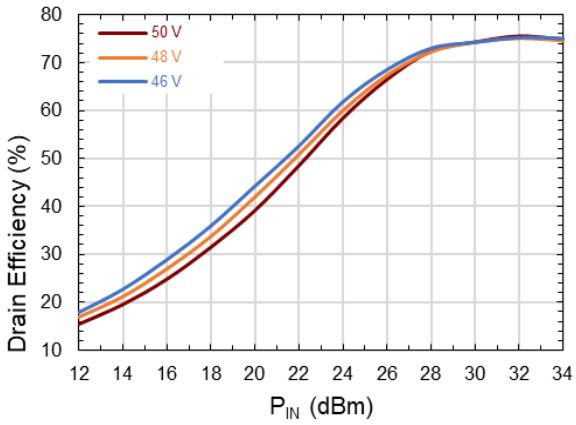


Typical Performance Curves as Measured in the 3.45 – 3.55 GHz Application Fixture: 3.5 GHz, V_{DS} = 50 V, I_{DQ} = 110 mA, T_C = 25°C (Unless Otherwise Noted)

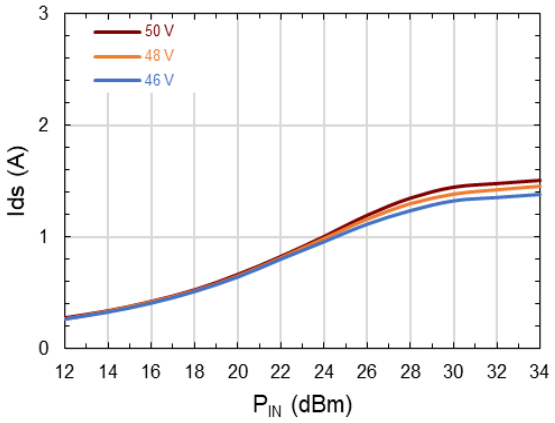
Output Power vs. V_{DS} and P_{IN}



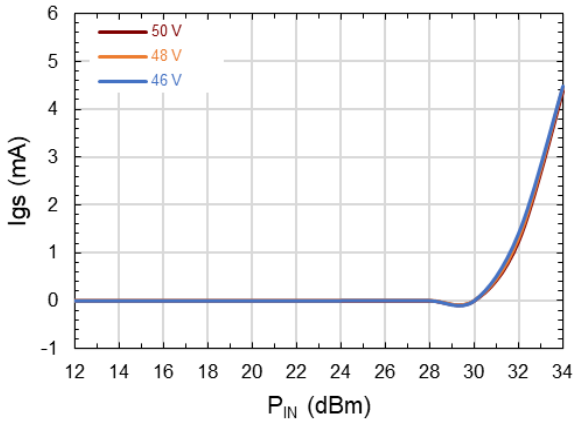
Drain Efficiency vs. V_{DS} and P_{IN}



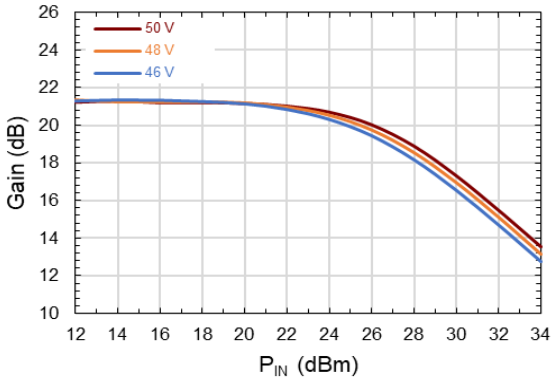
Drain Current vs. V_{DS} and P_{IN}



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

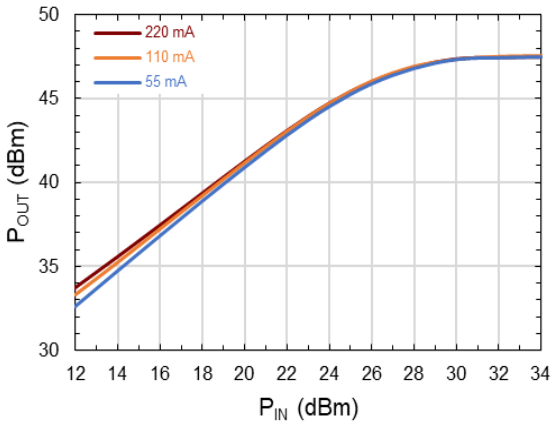


Large Signal Gain vs. V_{DS} and P_{IN}

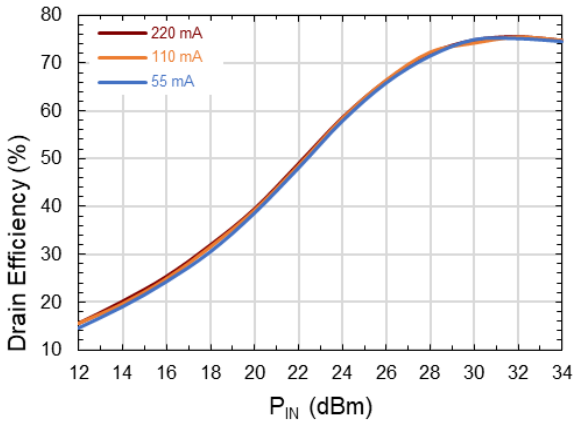


Typical Performance Curves as Measured in the 3.45 - 3.55 GHz Application Fixture: 3.5 GHz, V_{DS} = 50 V, I_{DQ} = 110 mA, T_C = 25°C (Unless Otherwise Noted)

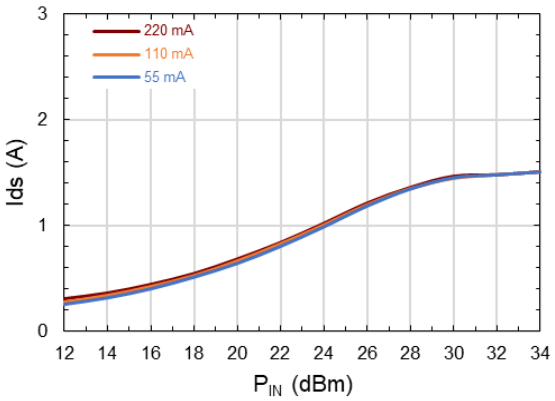
Output Power vs. I_{DQ} and P_{IN}



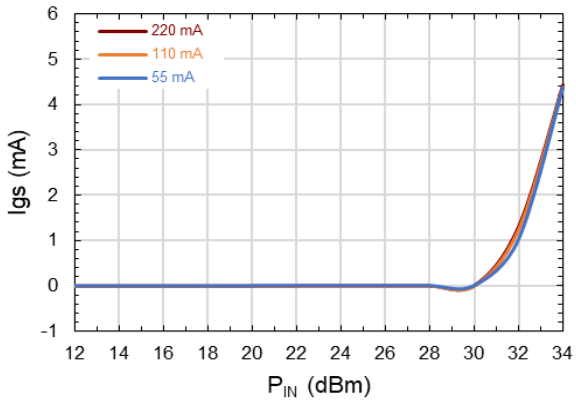
Drain Efficiency vs. I_{DQ} and P_{IN}



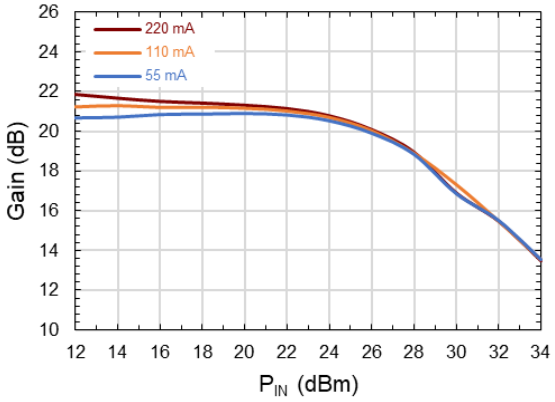
Drain Current vs. I_{DQ} and P_{IN}



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

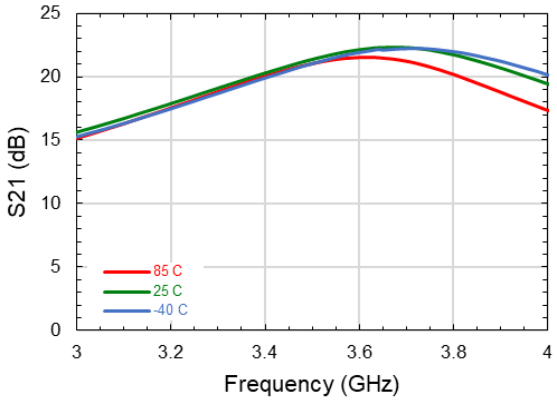


Large Signal Gain vs. I_{DQ} and P_{IN}

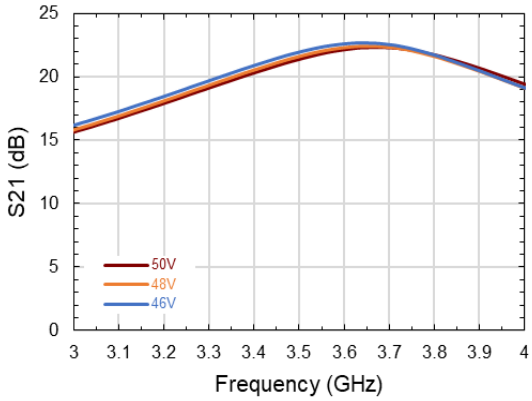


Typical Performance Curves as Measured in the 3.45 - 3.55 GHz Application Fixture: 3.5 GHz, V_{DS} = 50 V, I_{DQ} = 110 mA, T_C = 25°C (Unless Otherwise Noted)

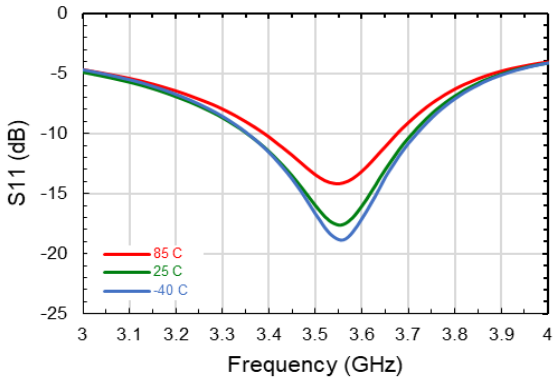
S21 vs. Frequency and Temperature



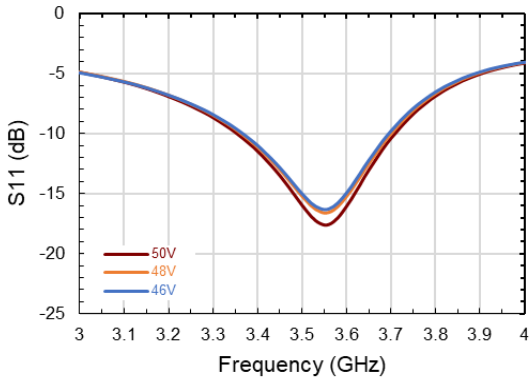
S21 vs. Frequency and V_{DS}



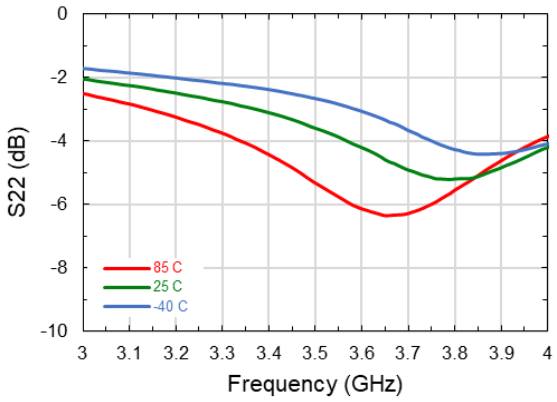
S11 vs. Frequency and Temperature



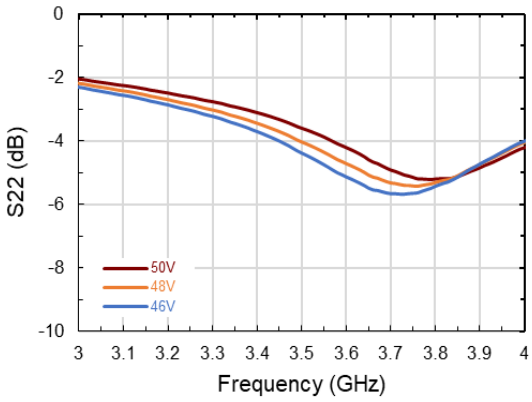
S11 vs. Frequency and V_{DS}



S22 vs. Frequency and Temperature

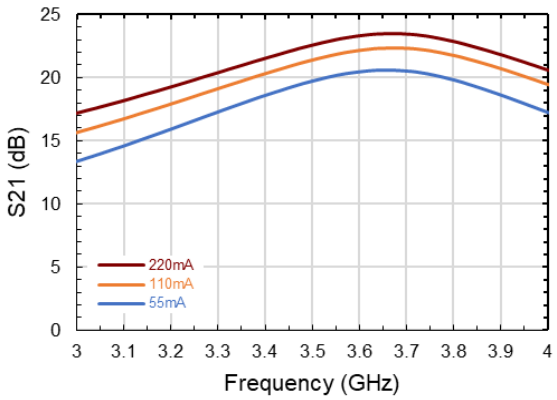


S22 vs. Frequency and V_{DS}

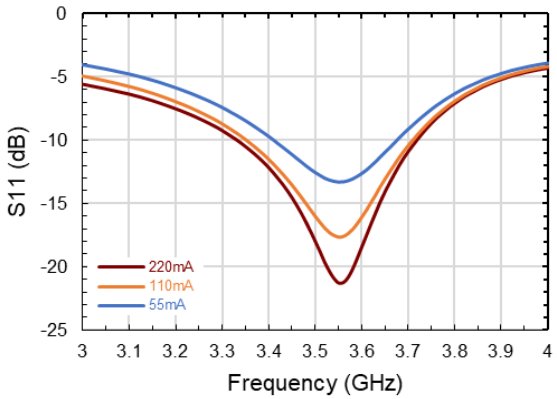


Typical Performance Curves as Measured in the 3.45 - 3.55 GHz Application Fixture: 3.5 GHz, V_{DS} = 50 V, I_{DQ} = 110 mA, T_C = 25°C (Unless Otherwise Noted

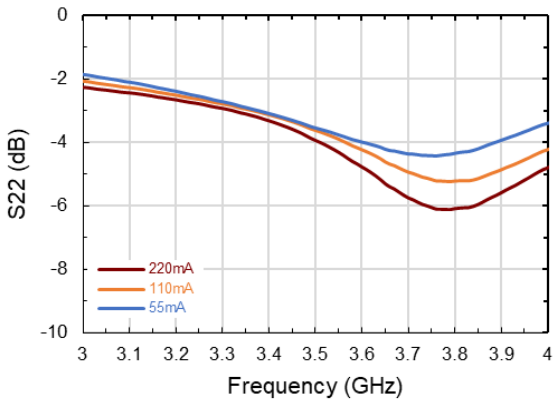
S21 vs. Frequency and I_{DQ}



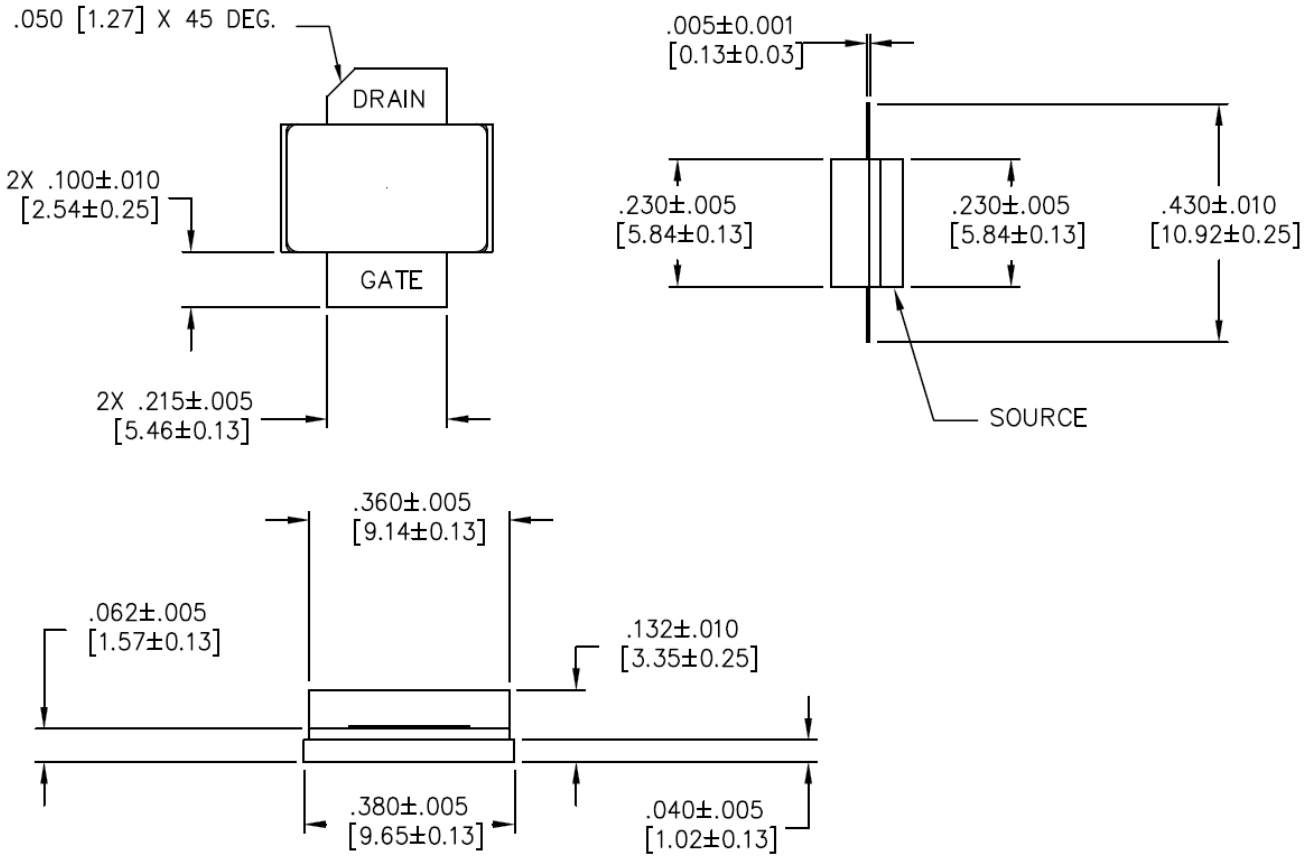
S11 vs. Frequency and I_{DQ}



S22 vs. Frequency and I_{DQ}



Package Dimensions (AC-360S-2) †



NOTES:
1. ALL DIMENSIONS SHOWN AS in[mm]. CONTROLLING DIMENSIONS ARE IN In AND CONVERTED mm DIMENSIONS ARE NOT NECESSARILY EXACT.
2. LEAD FINISH: AU
   FLANGE FINISH: AU
3. LID SEAL EPOXY MAY FLOW OUT A MAXIMUM OF .018 [0.46] FROM EDGE OF LID
4. LID MAY BE MIS-ALIGNED UP TO .008 [0.20] FROM PACKAGE IN ANY DIRECTION

† Reference Application Note AN0004125 for lead-free solder reflow recommendations.
Meets JEDEC moisture sensitivity level 3 requirements.
Plating is Matte Sn.