GaN Amplifier 50 V, 50 W
DC - 2700 MHz

Features

- Optimized for a Multitude of Applications
- CW and Pulsed Operation: 50 W Output Power
- Internally Pre-matched
- 260°C Reflow Compatible
- 50 V Operation
- 100% RF Tested
- RoHS* Compliant

TO-272S-2

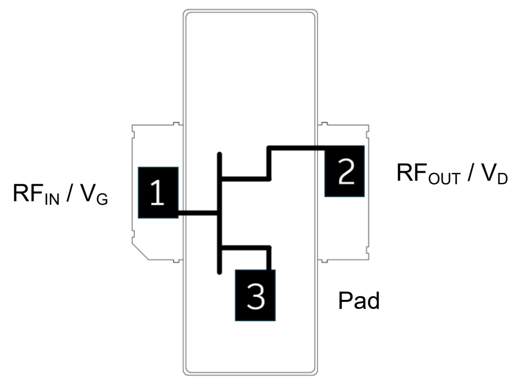
Applications

- military radio communications, digital cellular infrastructure, RF energy, avionics, test instrumentation and RADAR

Description

The MAPC-A1110-AP is a high power GaN on Silicon HEMT D-mode amplifier optimized for DC - 2700 MHz frequency operation. The device supports both CW and pulsed operation with peak output power levels to 50 W (47 dBm) in a plastic package.

Functional Schematic



Typical Performance:

Measured in Evaluation Test Fixture: P_{IN} = 32 dBm, 100 µs pulse width, 10% duty cycle

- V_{DS} = 50 V, I_{DQ} = 100 mA, T_C = 25°C

Frequency (MHz)	Output Power (dBm)	Gain (dB)	η_D (%)
2400	48.57	16.56	69
2450	48.63	16.63	72
2500	48.22	16.22	66

Pin Configuration

Pin #	Pin Name	Function
1	RF_{IN} / V_G	RF Input / Gate
2	RF_{OUT} / V_D	RF Output / Drain
3	Pad[1]	Ground / Source

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

Ordering Information

Part Number	Package
MAPC-A1110-AP000	Bulk Quantity
MAPC-A1110-APTR1	Tape and Reel
MAPC-A1110-APSB1	Sample Board

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

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RF Electrical Characteristics: T_C = 25°C, V_{DS} = 50 V, I_{DQ} = 100 mA
Note: Performance in MACOM Application Fixture (2400 - 2500 MHz), 50 Ω system

Parameter	Test Conditions	Symbol	Min.	Typ.	Max.	Units
Small Signal Gain	CW, 2500 MHz	G_{SS}	-	18.8	-	dB
Power Gain	CW_2, 2500 MHz, 2 dB Gain Compression	G_{SAT}	-	16.6	-	dB
Saturated Drain Efficiency	CW_2, 2500 MHz, 2 dB Gain Compression	η_{SAT}	-	65	-	%
Saturated Output Power	CW_2, 2500 MHz, 2 dB Gain Compression	P_{SAT}	-	48.1	-	dBm
Gain Variation (-40°C to +85°C)	Pulsed[2], 2500 MHz	ΔG	-	0.005	-	dB/°C
Power Variation (-40°C to +85°C)	Pulsed[2], 2500 MHz	ΔP2dB	-	0.005	-	dB/°C
Gain	CW_2, 2500 MHz, P_{IN} = 32 dBm	G_P	-	16.2	-	dB
Drain Efficiency	CW_2, 2500 MHz, P_{IN} = 32 dBm	η	-	66	-	%
Ruggedness: Output Mismatch	All phase angles	Ψ	VSWR = 10:1, No Device Damage			

RF Electrical Specifications: T_A = 25°C, V_{DS} = 50 V, I_{DQ} = 100 mA
Note: Performance in MACOM Production Test Fixture, 50 Ω system

Parameter	Test Conditions	Symbol	Min.	Typ.	Max.	Units
Power Gain	CW_2, 2500 MHz, 2 dB Gain Compression	G_{SAT}	14.5	15.8	-	dB
Saturated Drain Efficiency	CW_2, 2500 MHz, 2 dB Gain Compression	η_{SAT}	67	71	-	%
Saturated Output Power	CW_2, 2500 MHz, 2 dB Gain Compression	P_{SAT}	49	49.8	-	dBm
Gain	CW, 2500 MHz, P_{IN} = 33 dBm	G_P	15.5	16.4	-	dB
Drain Efficiency	CW, 2500 MHz, P_{IN} = 33 dBm	η	63	69	-	%

2. Pulse details: 100 µs pulse width, 1 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}	-	-	10.8	mA
Gate-Source Leakage Current	V_{GS} = -8 V, V_{DS} = 0 V	I_{GLK}	-	-	10.8	mA
Gate Threshold Voltage	V_{DS} = 50 V, I_D = 10.8 mA	V_T	-2.6	-2.0	-1.6	V
Gate Quiescent Voltage	V_{DS} = 50 V, I_D = 250 mA	V_{GSQ}	-2.4	-1.8	-1.4	V

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

Parameter	Absolute Maximum
Drain Source Voltage, V_{DS}	130 V
Gate Source Voltage, V_{GS}	-10 to 3 V
Gate Current, I_G	10 mA
Storage Temperature Range	-65°C to +150°C
Case Operating Temperature Range	-40°C to +120°C
Channel Operating Temperature Range, T_{CH}	-40°C to +225°C
Absolute Maximum Channel Temperature	+250°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 V_{DS} < 55 V will ensure MTTF > 2.5 x 10^6 hours.
6. Operating at nominal conditions with T_{CH} ≤ 225°C will ensure MTTF > 2.5 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* = 0.0355, *B* = -9.89, and *C* = 13,925.

Thermal Characteristics[8]

Parameter	Test Conditions	Symbol	Typical	Units
Thermal Resistance using Finite Element Analysis	V_{DS} = 50 V, P_D = 30 W, T_C = 85°C, T_{CH} = 225°C	R_θ(FEA)	3.14	°C/W

8. Case temperature measured using thermocouple embedded in heat-sink. Contact local applications support team for more details on this measurement.

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.

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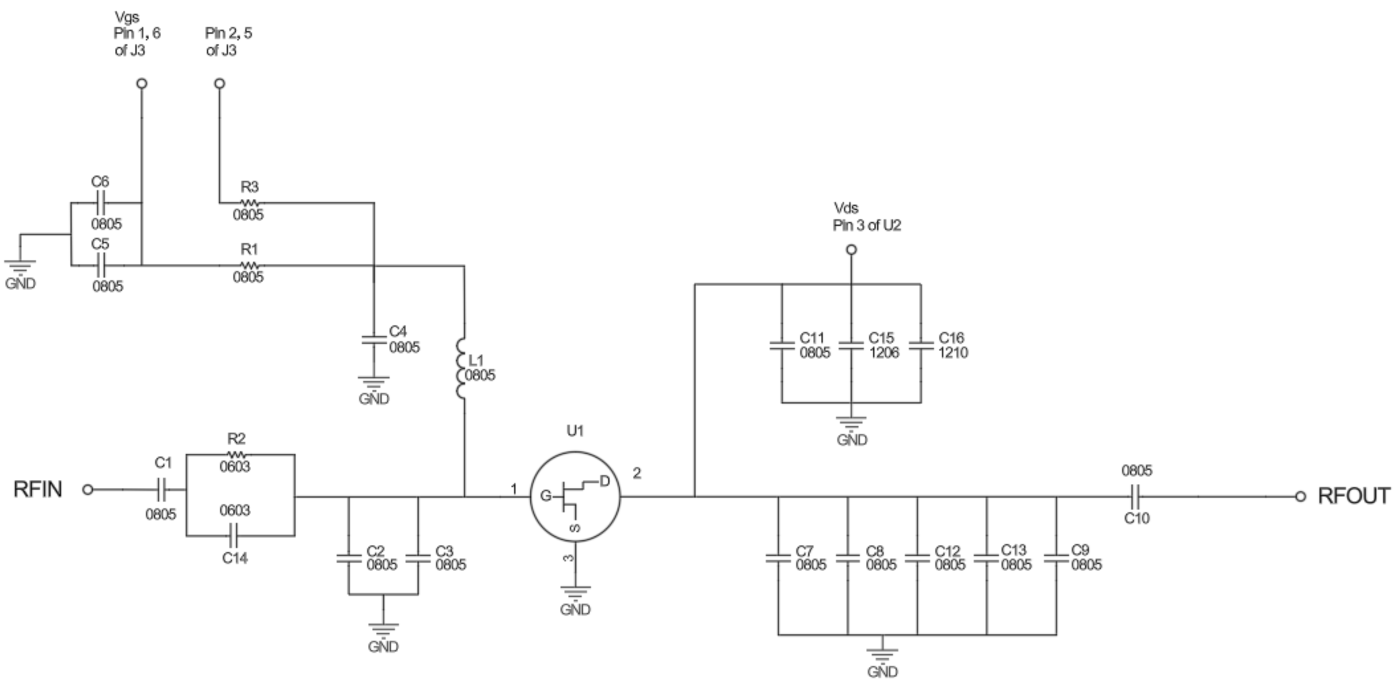
DC-0037983

Application Fixture 2400 - 2500 MHz



Description
Parts measured on application board (20-mil thick RF35A2). 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 V_{GS} to pinch-off (V_P).
2. Turn on V_{DS} to nominal voltage (50 V).
3. Increase V_{GS} until I_{DS} current is reached.
4. Apply RF power to desired level.

Turning the device OFF
1. Turn the RF power off.
2. Decrease V_{GS} down to V_P pinch-off.
3. Decrease V_{DS} down to 0 V.
4. Turn off V_{GS}.

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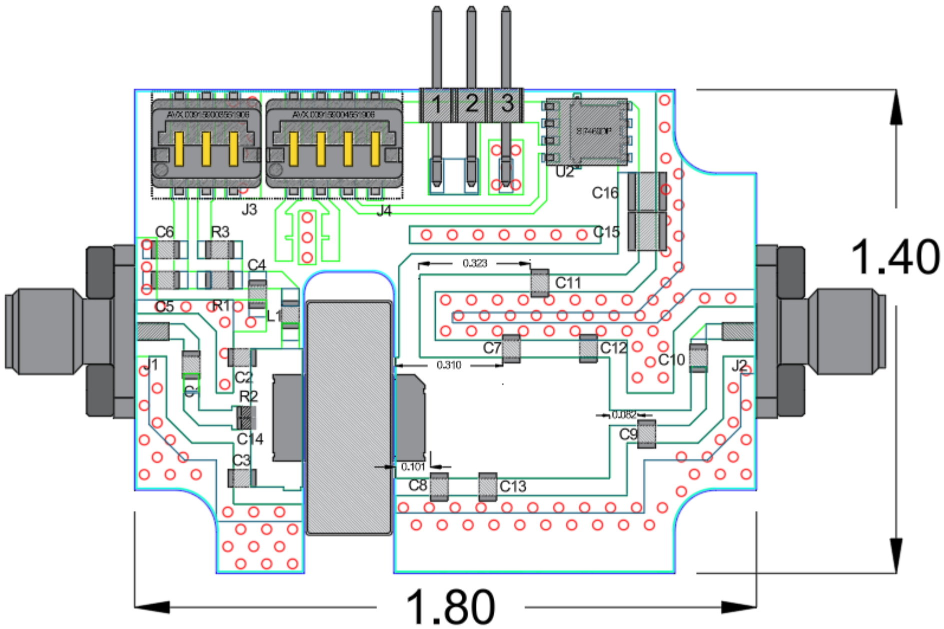

Parts List

Reference Designator	Value	Tolerance	Manufacturer	Part Number
C1	22 pF	5%	Kyocera AVX	600F220JT250XT
C10	10 pF	5%	Kyocera AVX	600F100JT250XT
C11, C13	3 pF	0.1pF	Kyocera AVX	600F3R0BT250XT
C14	6.8 pF	0.1pF	Kyocera AVX	600S6R8BT250XT
C15	1 µF	10%	Murata	GRM32ER72A105KA01
C16	10 µF	10%	Murata	GRM32ER61H106KA12
C2, C3	1.1 pF	0.1pF	Kyocera AVX	600F1R1BT250XT
C4	4.7 pF	0.1pF	Kyocera AVX	600F4R7BT250XT
C5	0.01 µF	0.01uF	Murata	GRM21BR72E103KW03
C6	1 µF	10%	Murata	GCM21BC72A105KE36
C7, C8, C9, C12	1.8 pF	0.1pF	Kyocera AVX	600F1R8BT250XT
L1	12 nH	2%	Coilcraft	0805HP-12NXGRC
R1	5.1 Ω	1%	Yageo	RC0805FR-075R1L
R2	5.6 Ω	1%	Yageo	AC0603FR-075R6L
R3	1 kΩ	5%	VIKING	CR-050FLF——1K
U2	80-V	-	MACOM	Si7469DP
Q1	50 W	-	MACOM	MAPC-A1110-AP
PCB	Taconic RF35A2, 20 mil, 1 oz. Cu, Au Finish			

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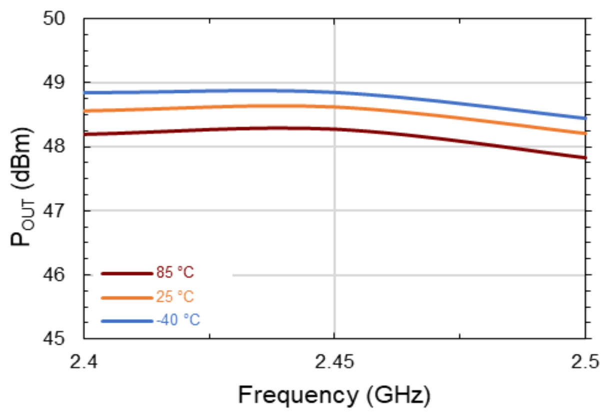
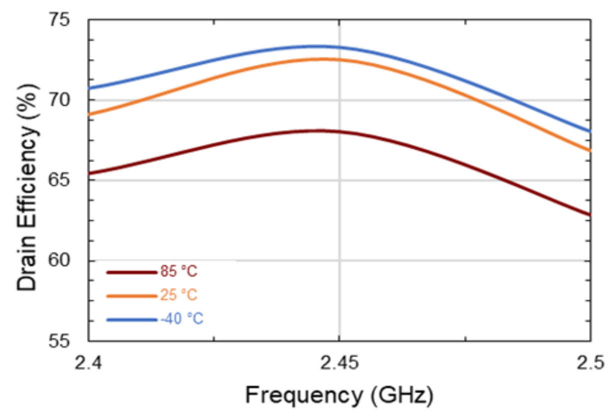
Unless Otherwise Noted

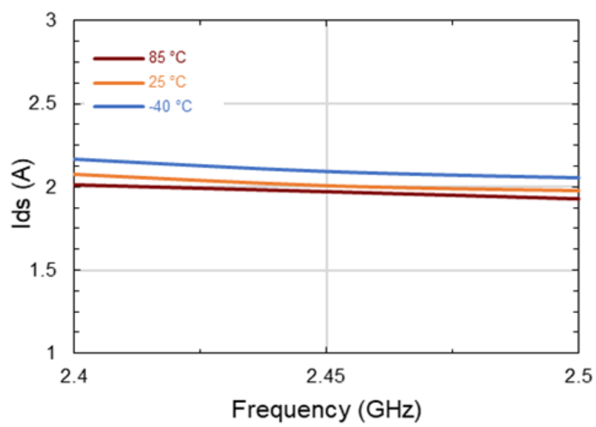
Output Power vs. Temperature and Frequency



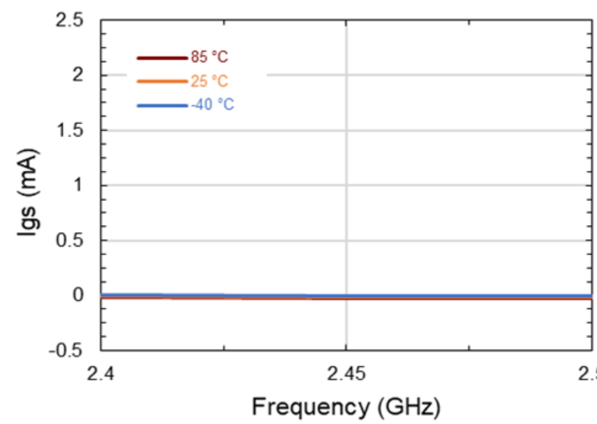
Drain Efficiency vs Temperature and Frequency



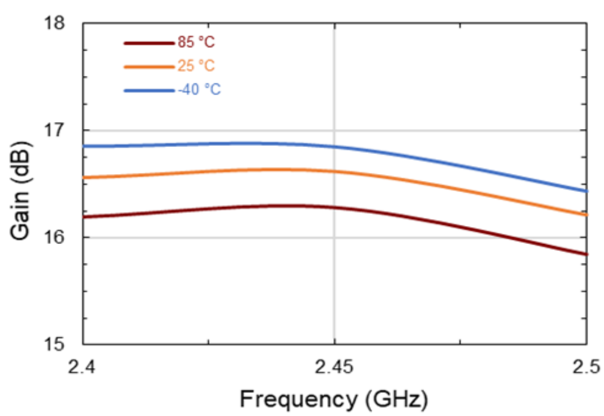
Drain Current vs. Temperature and Frequency



Gate Current vs. Temperature and Frequency



Large Signal Gain vs. Temperature and Frequency



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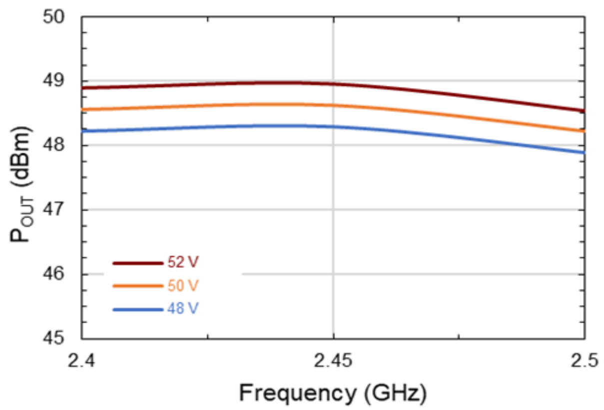
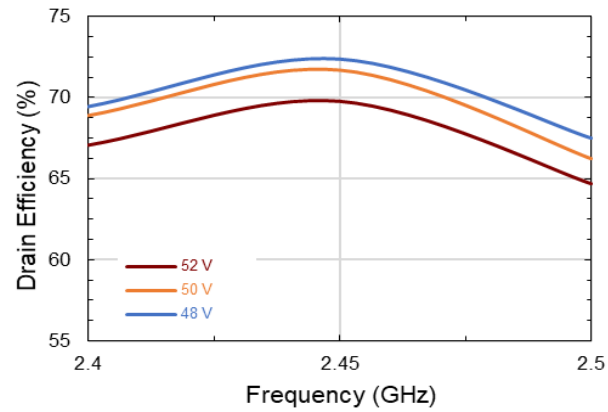
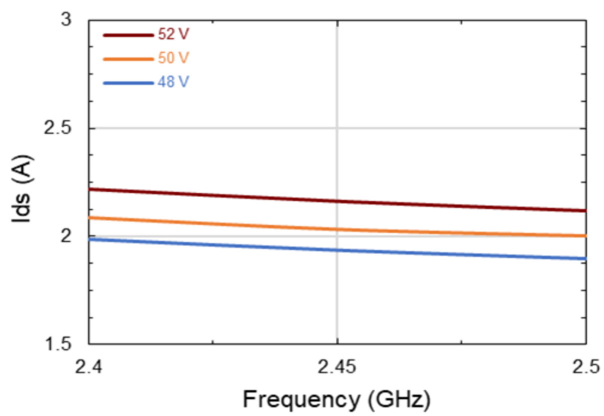
Output Power vs. V_{DS} and Frequency



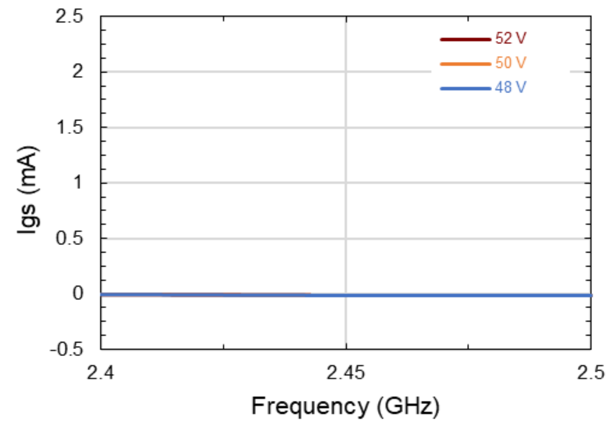
Drain Efficiency vs. V_{DS} and Frequency



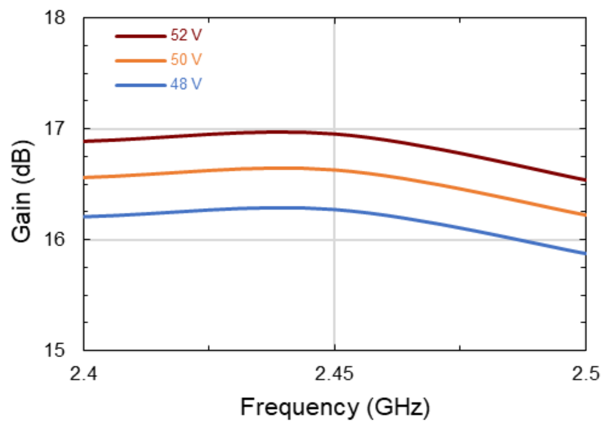
Drain Current vs. V_{DS} and Frequency



Gate Current vs. V_{DS} and Frequency



Large Signal Gain vs. V_{DS} and Frequency



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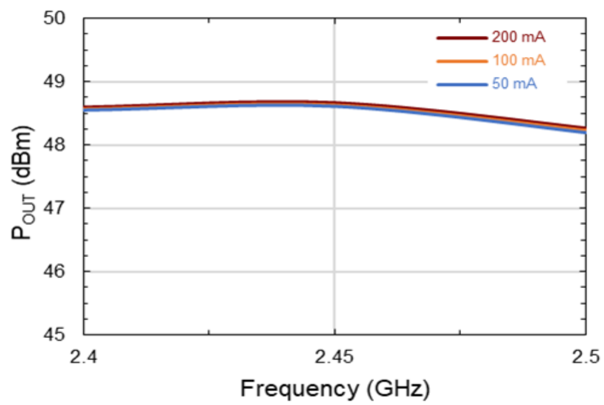
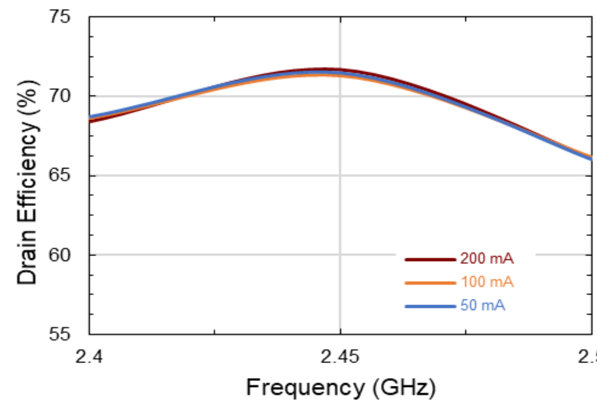
Output Power vs. I_{DQ} and Frequency



Drain Efficiency vs. I_{DQ} and Frequency



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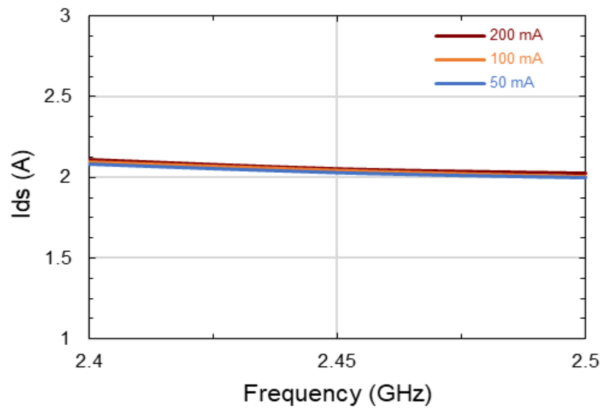

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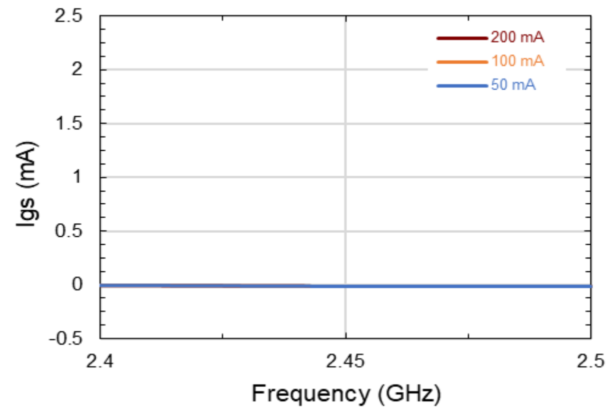
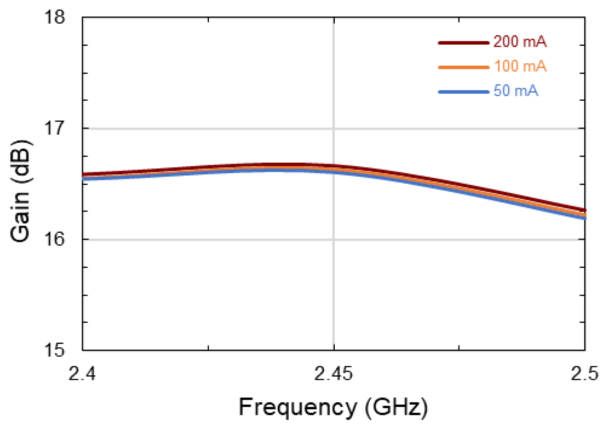


Large Signal Gain vs. I_{DQ} and Frequency



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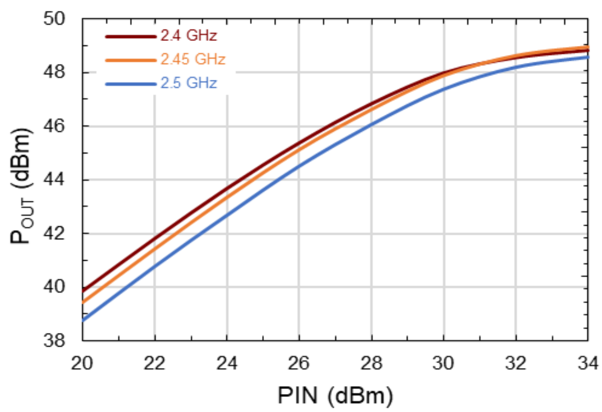
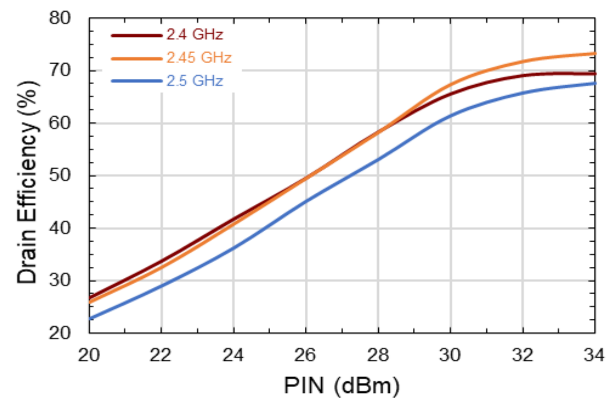
Output Power vs. Frequency and P_{IN}



Drain Efficiency vs. Frequency and P_{IN}



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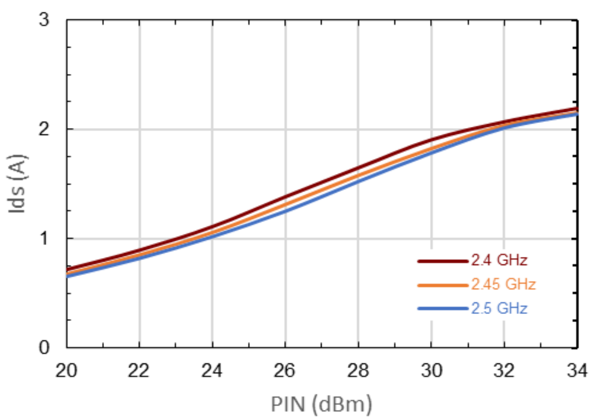
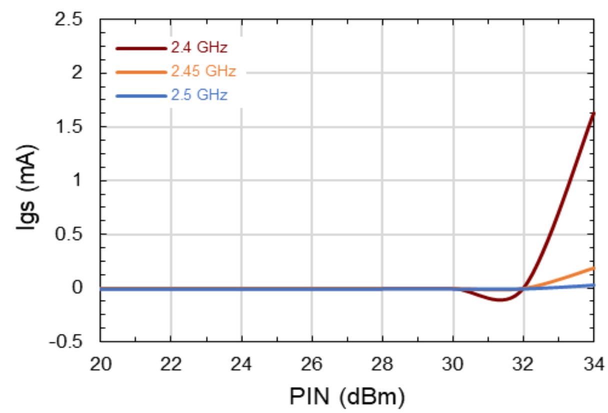
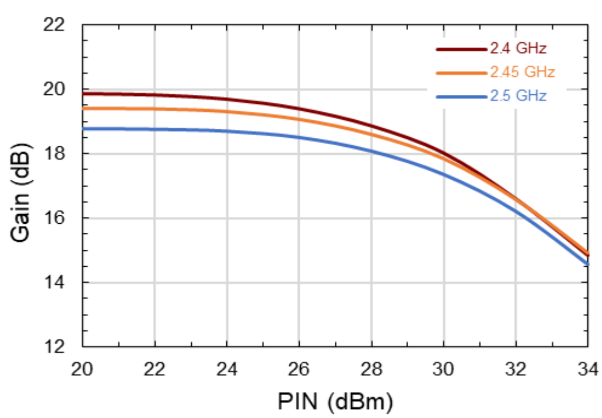


Gate Current vs. Frequency and P_{IN}



Large Signal Gain vs. Frequency and P_{IN}



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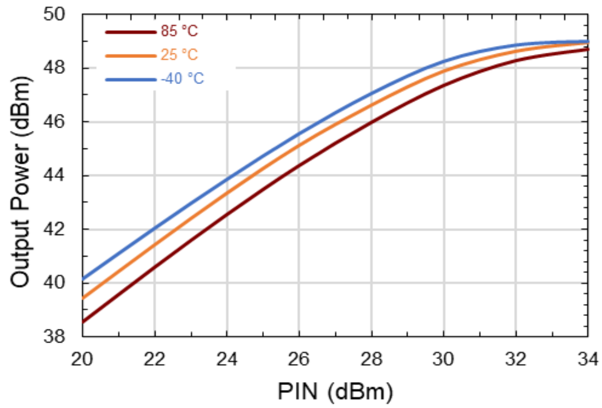
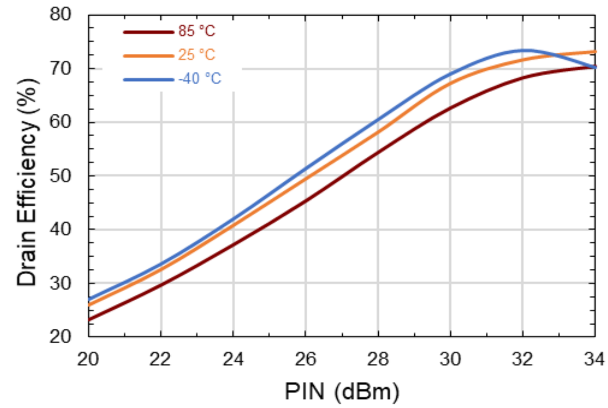
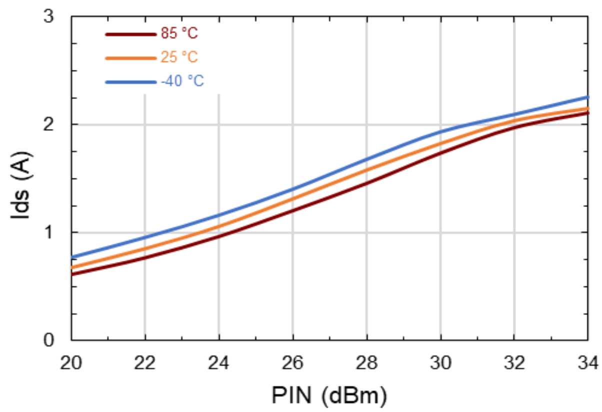
Output Power vs. Temperature and P_{IN}



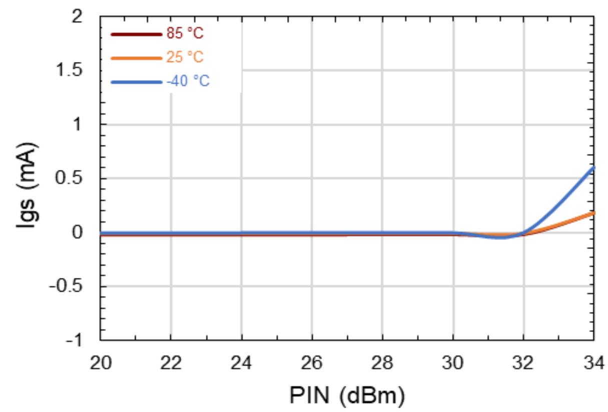
Drain Efficiency vs. Temperature and P_{IN}



Drain Current vs. Temperature and P_{IN}



Gate Current vs. Temperature and P_{IN}



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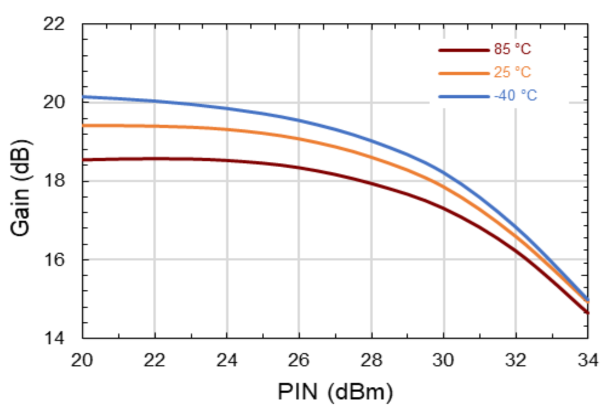

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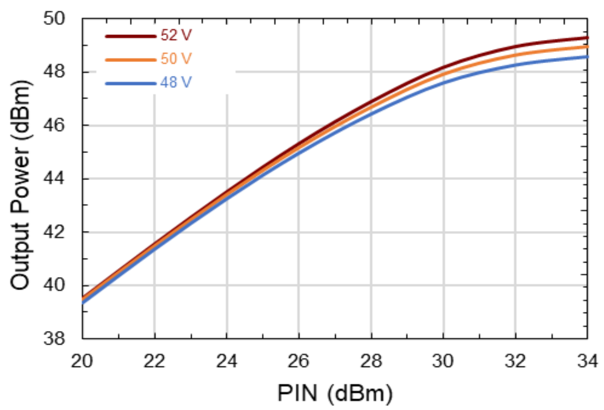
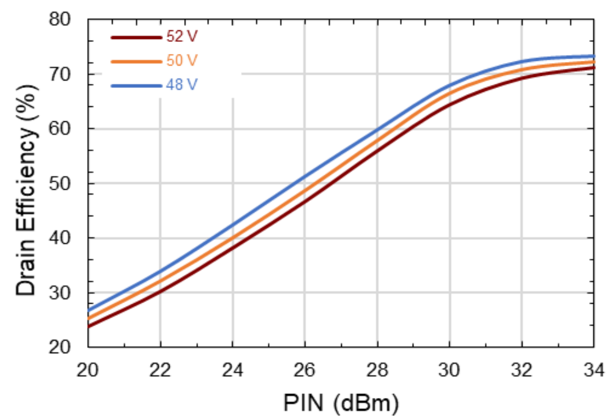
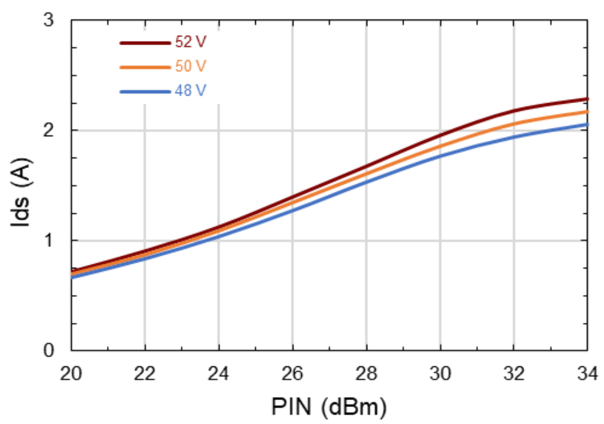


Drain Efficiency vs. V_{DS} and P_{IN}



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



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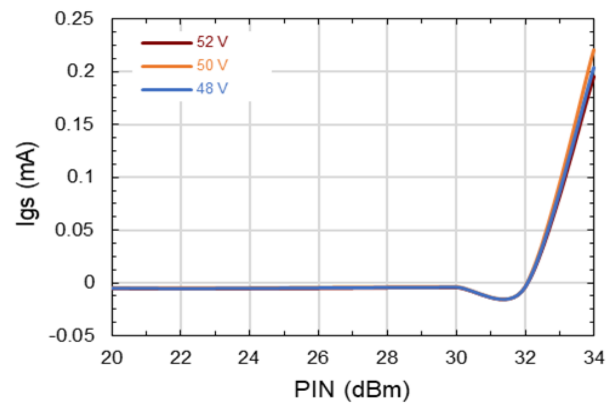
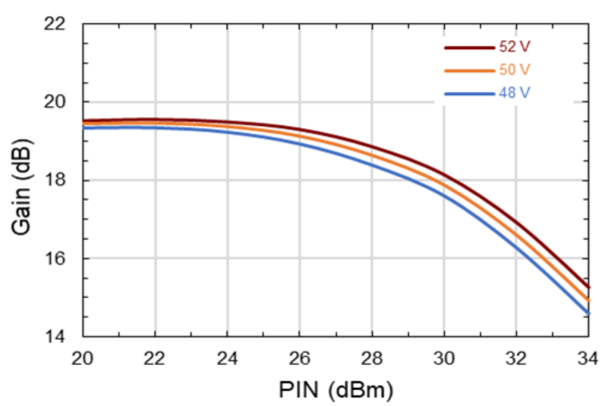


Large Signal Gain vs. V_{DS} and P_{IN}



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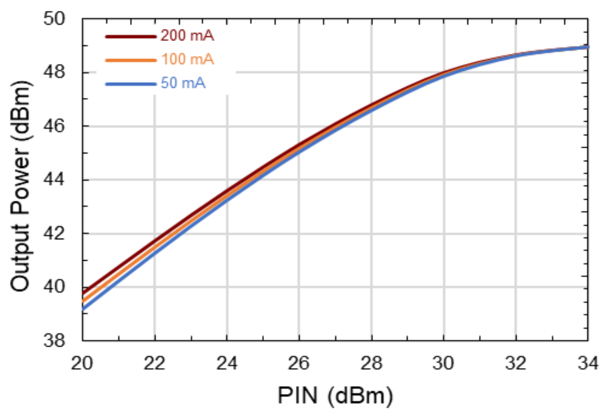
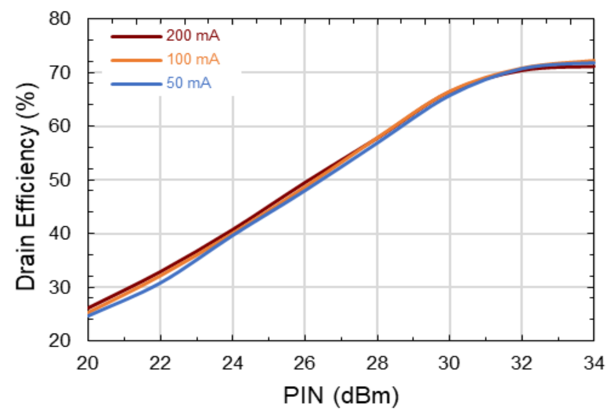
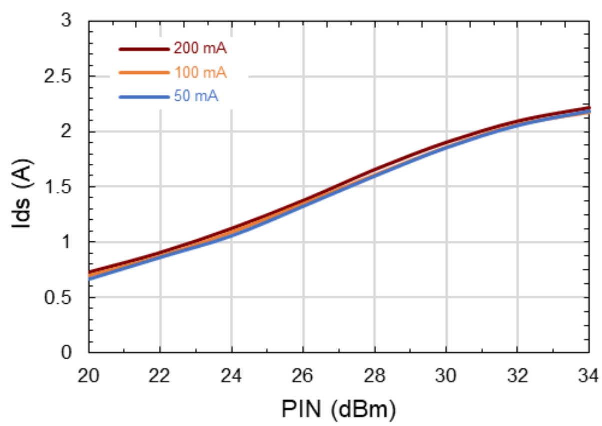


Drain Efficiency vs. I_{DQ} and P_{IN}



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



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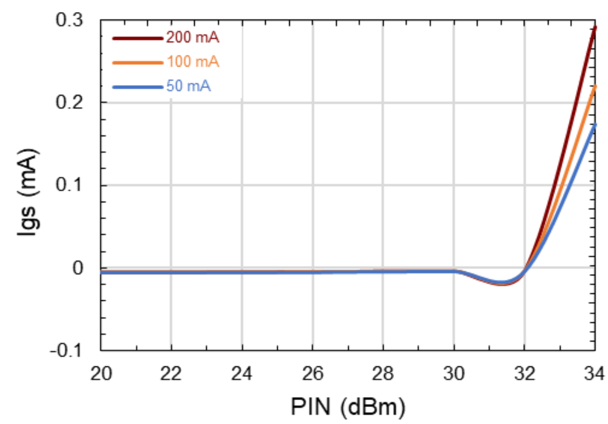
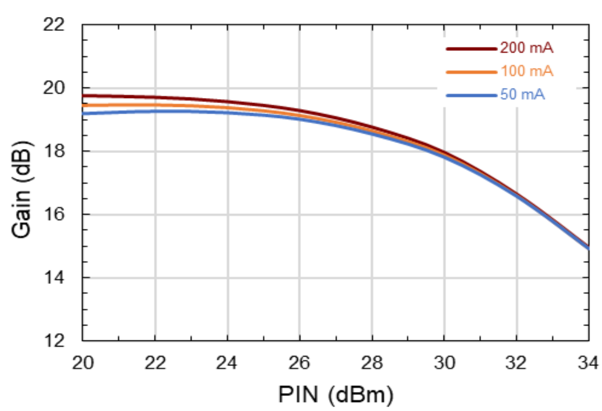


Large Signal Gain vs. I_{DQ} and P_{IN}



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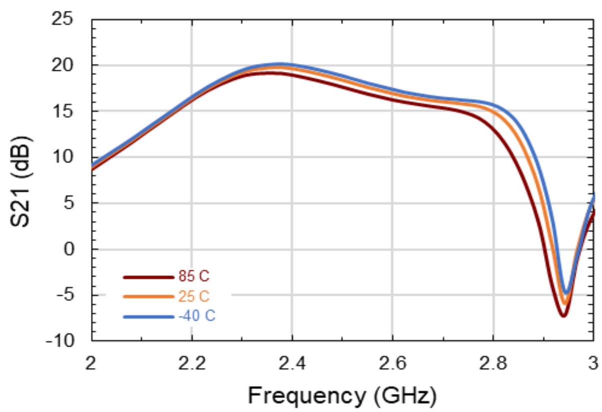
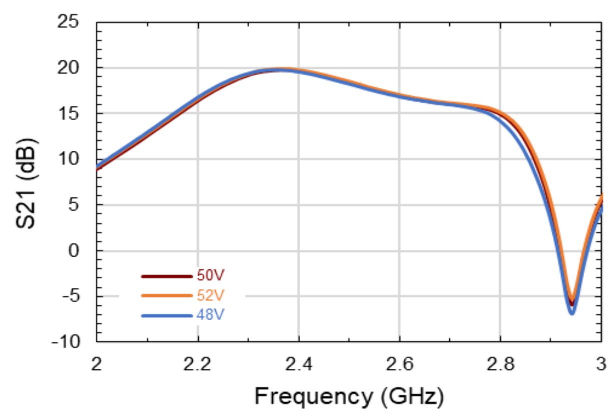
Typical Performance Curves as Measured in the 2400 - 2500 MHz Application Fixture:

CW, 2.45 GHz, V_{DS} = 50 V, I_{DQ} = 100 mA, T_C = 25°C
Unless Otherwise Noted

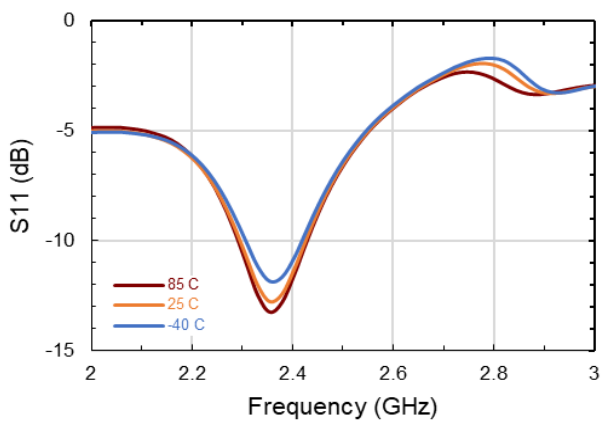
S21 vs Frequency and Temperature



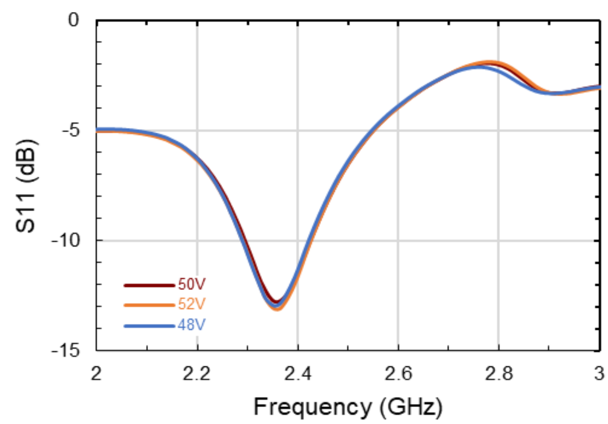
S21 vs Frequency and V_{DS}



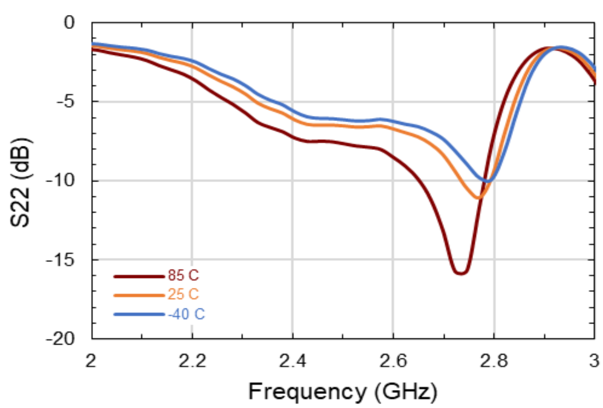
S11 vs Frequency and Temperature



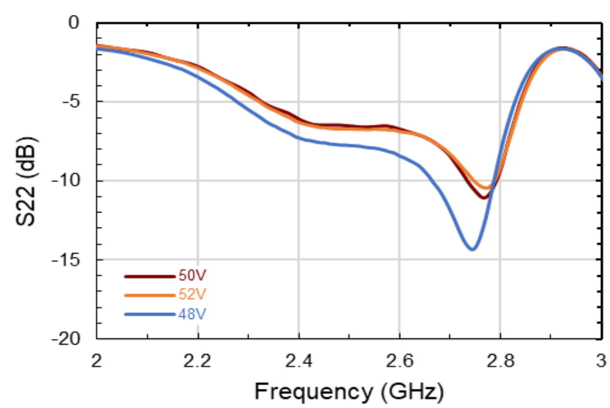
S11 vs Frequency and V_{DS}



S22 vs Frequency and Temperature



S22 vs Frequency and V_{DS}



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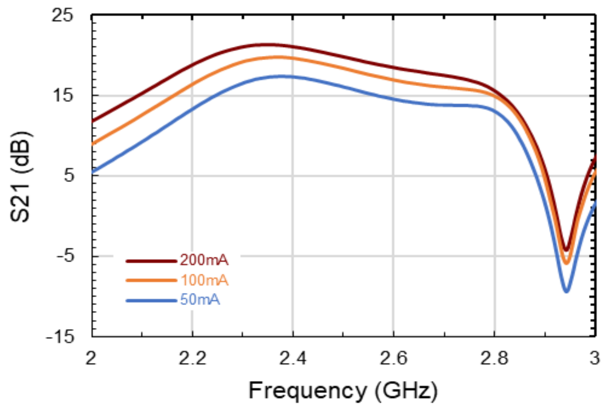
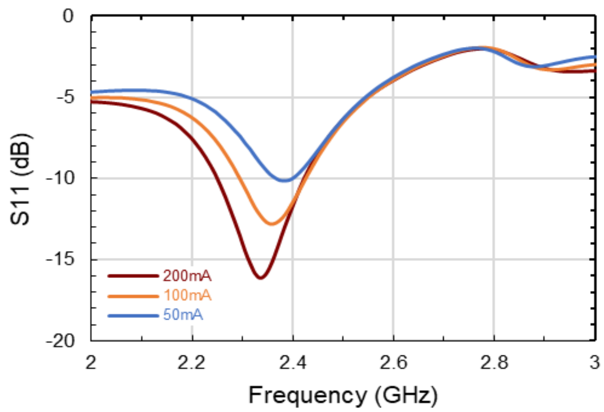
Typical Performance Curves as Measured in the 2400 - 2500 MHz Application Fixture:
CW, 2.45 GHz, V_{DS} = 50 V, I_{DQ} = 100 mA, T_C = 25°C
Unless Otherwise Noted

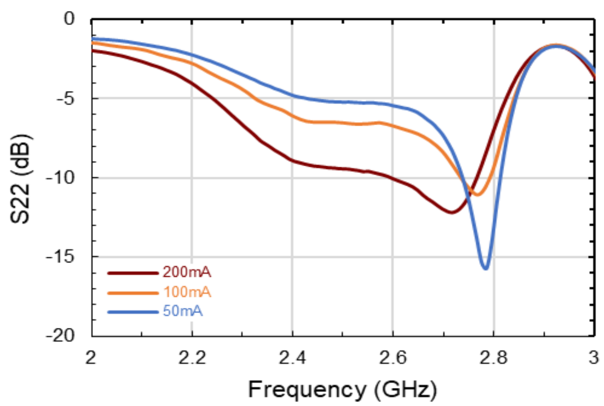
S21 vs Frequency and I_{DQ}



S11 vs Frequency and I_{DQ}



S22 vs Frequency and I_{DQ}



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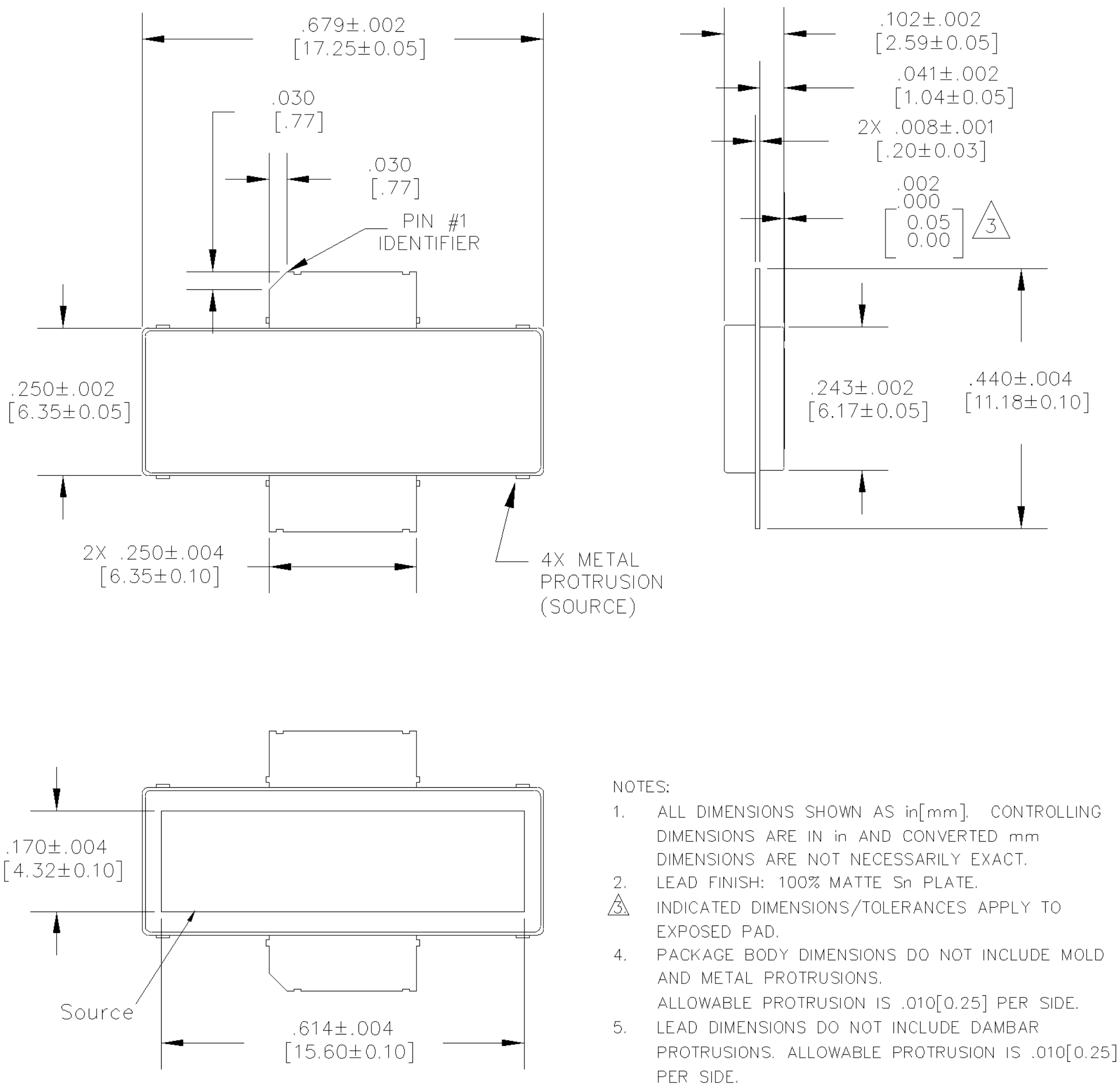
Lead-Free TO-272S-2 Package Dimensions†



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

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