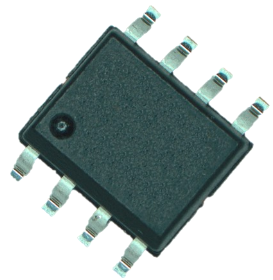
GaN Transistor, 5 W, 28 V DC - 6 GHz

Features

- *MACOM PURE CARBIDE®* Amplifier Series
- Saturated Output Power: 8 W @ 2.5 GHz
- Drain Efficiency: 65 % @ 2.5 GHz
- Small Signal Gain: 18.5 dB @ 2.5 GHz
- Compatible with MACOM Power Management Bias Controller/Sequencer MABC-11040B
- RoHS* Compliant



SOIC-8L

Applications

- Defense Communications
- Land Mobile Radio
- Avionics
- Wireless Infrastructure
- ISM
- VHF/UHF/L/S-Band Radar

Description

The MAPC-A3033 is a 5 W packaged, unmatched transistor utilizing a high performance GaN on SiC production process. This transistor supports both defense and commercial related applications.

Offered in an industry standard surface mount plastic package, the MAPC-A3033 provides superior performance under CW operation allowing customers to improve SWaP-C benchmarks in their next generation systems.

Typical RF Performance:

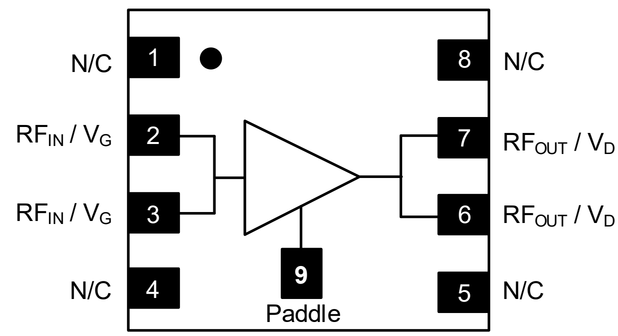
Measured in evaluation board at CW conditions,
P_{IN} = 26 dBm, V_{DS} = 28 V, I_{DQ} = 50 mA, T_C = 25°C

Frequency (GHz)	Output Power (dBm)	Gain (dB)	η_D (%)
2.5	39	13.0	65

Ordering Information

Part Number	MOQ Increment
MAPC-A3033-AP000	Bulk Quantity: Plastic
MAPC-A3033-APTR1	Tape and Reel: Plastic
MAPC-A3033-APSB1	Sample Board: Plastic

Functional Schematic



Pin Configuration

Pin #	Pin Name	Function
1, 4, 5, 8	N/C	No Connection
2, 3	RF_{IN} / V_G	RF Input / Gate
6, 7	RF_{OUT} / V_D	RF Output / Drain
9	Paddle[1]	Ground / Source

1. The exposed pad centered on the package bottom must be connected to RF and DC ground. This path must also provide a low thermal resistance heat path.

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

RF Electrical Specifications: T_C = 25°C, V_{DS} = 28 V, I_{DQ} = 50 mA

Parameter	Test Conditions	Symbol	Min.	Typ.	Max.	Units
Small Signal Gain	CW, 2.5 GHz	G_{SS}	-	16.7	-	dB
Saturated Output Power	CW, 2.5 GHz	P_{SAT}	-	39	-	dBm
Drain Efficiency at Saturation	CW, 2.5 GHz	η_{SAT}	-	65	-	%
Power Gain	2.5 GHz, P_{OUT} = 4W	G_P	12.8	14.9	-	dB
Drain Efficiency	2.5 GHz, P_{OUT} = 4W	η	45	57	-	%
Ruggedness: Output Mismatch	All phase angles	Ψ	VSWR = 15:1, No Device Damage			

Note: Final testing and screening for all transistor sales is performed using the MAPC-A3033-AHB1 at 2.5 GHz.

DC Electrical Characteristics: T_C = 25°C

Parameter	Test Conditions	Symbol	Min.	Typ.	Max.	Units
Drain-Source Leakage Current	V_{GS} = -8 V, V_{DS} = 120 V	I_{DLK}	-	-	2.2	mA
Gate-Source Leakage Current	V_{GS} = -8 V, V_{DS} = 120 V	I_{GLK}	-0.5	-	-	mA
Gate Threshold Voltage	V_{DS} = 10 V, I_D = 2.16 mA	V_T	-3.0	-	-2.0	V
Gate Quiescent Voltage	V_{DS} = 28 V, I_D = 50 mA	V_{GSQ}	-	-2.4	-	V

Absolute Maximum Ratings[2,3,4,5,6]

Parameter	Absolute Maximum
Drain Source Voltage, V_{DS}	120 V
Gate Source Voltage, V_{GS}	-10 to 2 V
Gate Current, I_G	2.16 mA
DC Drain Current, I_D	1.0 A
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	+225 °C

2. Exceeding any one or combination of these limits may cause permanent damage to this device.
3. MACOM does not recommend sustained operation above maximum operating conditions.
4. Operating at drain source voltage V_{DS} < 110 V will ensure MTTF > 1 x 10^6 hours.
5. Operating at nominal conditions with T_{CH} ≤ 200°C will ensure MTTF > 1 x 10^6 hours.
6. 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* = TBD, *B* = TBD, and *C* =TBD.

Thermal Characteristics[7]:

Parameter	Test Conditions	Symbol	Typical
Thermal Resistance using Finite Element Analysis	V_{DS} = 28 V, T_C = 85°C, T_{CH} = 225°C	R_{θ}(FEA)	TBD °C/W

7. 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

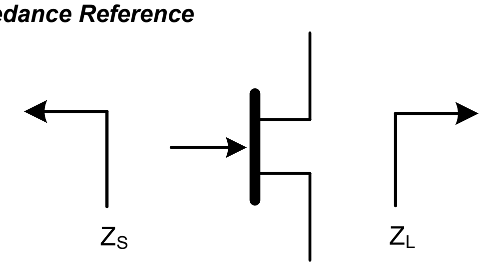
Gallium Nitride Circuits are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. Proper ESD control techniques should be used when handling.

28 V CW Simulated Load-Pull Performance (Per Each Side of Symmetric Device)
Reference Plane at Device Leads

Frequency (MHz)	Z_{SOURCE} (Ω)	Maximum Output Power V_{DS} = 28 V, I_{DQ} = 50 mA, T_C = 25°C, P3.0dB				
		Z_{LOAD}[8] (Ω)	Gain (dB)	P_{OUT} (dBm)	P_{OUT} (W)	η_D (%)
900	15+j*22	34.6+j*2.4	21.0	39.6	9.1	60
2200	3.0-j*4.6	31.5-j*0.8	16.5	39.8	9.5	62
2700	2.8-j*11.2	29.1-j*2.7	14.8	39.8	9.5	62
5800	7-j*60.8	26.8-j*38.3	11.9	39.2	8.3	57

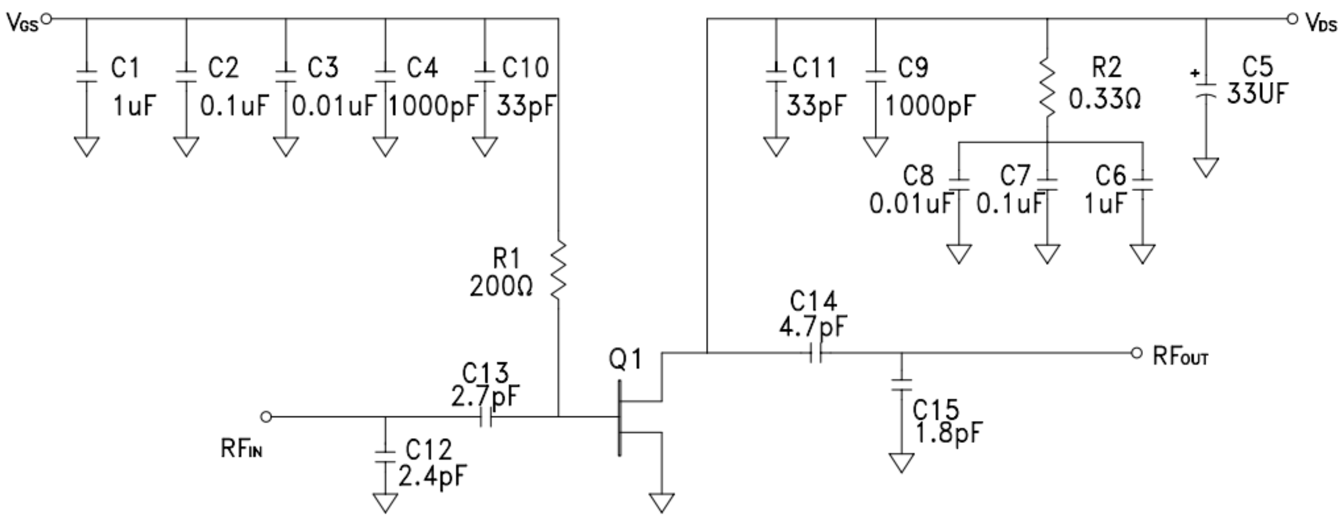
Frequency (MHz)	Z_{SOURCE} (Ω)	Maximum Drain Efficiency V_{DS} = 28 V, I_{DQ} = 50 mA, T_C = 25°C, P3.0dB				
		Z_{LOAD}[9] (Ω)	Gain (dB)	P_{OUT} (dBm)	P_{OUT} (W)	η_D (%)
900	15+j*22	60.8+j*27.9	22.2	38.0	6.3	68
2200	3.0-j*4.6	31.4+j*16.4	17.7	38.3	6.8	68
2700	2.8-j*11.2	26.0+j*11.5	15.8	38.7	7.4	67
5800	7-j*60.8	16.1-j*31.6	12,5	38.3	6.8	63

Impedance Reference



Z_{SOURCE} = Measured impedance presented to the input of the device at package reference plane.
Z_{LOAD} = Measured impedance presented to the output of the device at package reference plane.
8. Load Impedance for optimum output power.
9. Load Impedance for optimum efficiency.

2.5 GHz Evaluation Test Fixture and Recommended Tuning Solution



Description

Parts measured on evaluation board (20 mil thick RO4350B). 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

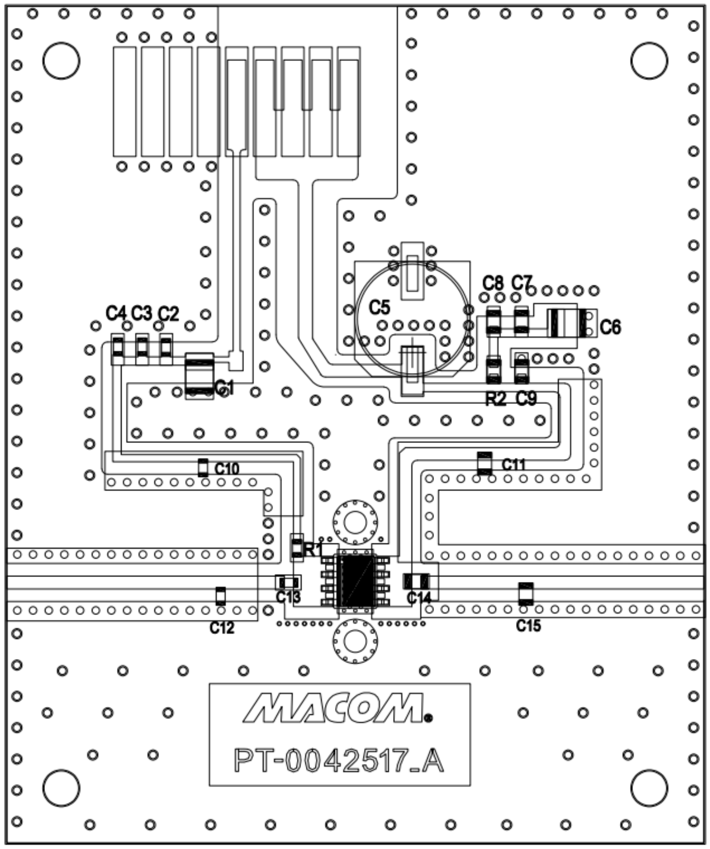
1. Set V_{GS} to pinch-off (V_P).
2. Turn on V_{DS} to nominal voltage (50 V).
3. Increase V_{GS} until I_{DS} current is reached.
4. Apply RF power to desired level.

Bias 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}.

* For an integrated power management solution please contact MACOM support regarding the MABC-11040.

Evaluation Test Fixture and Recommended Tuning Solution 2.5 GHz



Reference Designator	Value	Tolerance	Manufacturer	Part number
C1, C6	1 µF	10%	Kyocera/AVX	12101C105KAT2A
C2, C7	0.1 µF	10%	Murata	GRM188R72A104KA35D
C3, C8	0.01 µF	10%	Kyocera/AVX	06031C103KAT2A
C4, C9	1000 pF	10%	Kyocera/AVX	06031C102KAT2A
C5	33 µF	20%	Panasonic	EEE-2AA330P
C10,C11	33 pF	5%	Kyocera/AVX	ATC600F330JT
C12	2.4 pF	5%	Kyocera/AVX	ATC600F2R4JT
C13	2.7 pF	5%	Kyocera/AVX	ATC600F2R7JT
C14	4.7 pF	5%	Kyocera/AVX	ATC600F4R7JT
C15	1.8 pF	5%	Kyocera/AVX	ATC600F1R8JT
R1	200 Ohm	5%	Panasonic	ERJ-2GEJ201X
R2	0.33 Ohm	1%	Susumu	RL1220S-R33-F
Q1	MACOM GaN Transistor			MAPC-A3033-AP
PCB	RO4350B, 20 mil, 1 oz Cu, ENIG Finish			

Typical Performance Curves as Measured in the 2.5 GHz Evaluation Test Fixture

CW, P_{IN} = 26 dBm, V_{DS} = 28 V, I_{DQ} = 50 mA, Freq = 2.5 GHz, T_C = 25°C (Unless Otherwise Noted)
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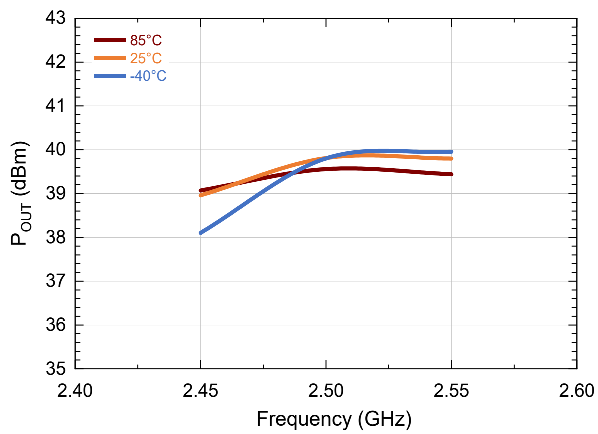
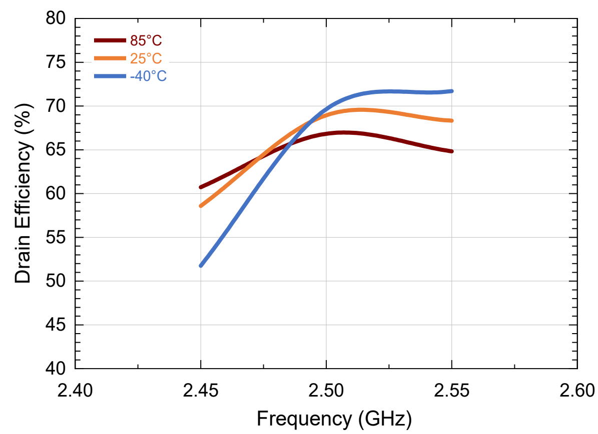
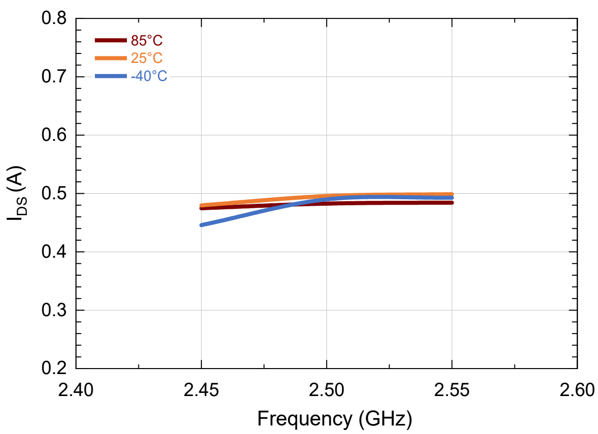
Output Power vs. Frequency and Temperature



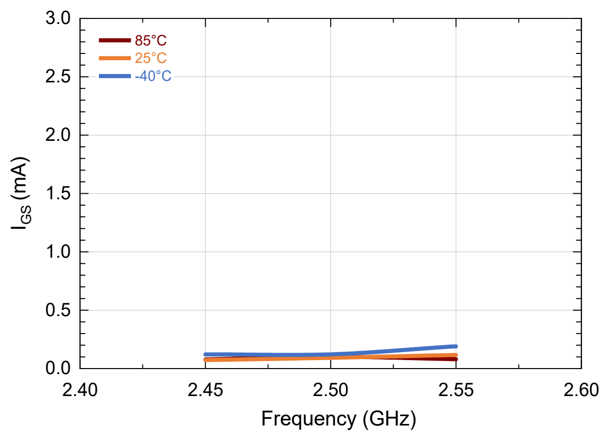
Drain Efficiency vs. Frequency and Temperature



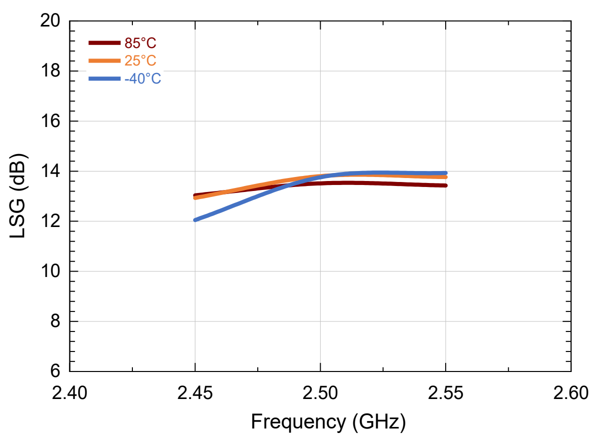
Drain Current vs. Frequency and Temperature



Gate Current vs. Frequency and Temperature



Large Signal Gain vs. Frequency and Temperature



Typical Performance Curves as Measured in the 2.5 GHz Evaluation Test Fixture

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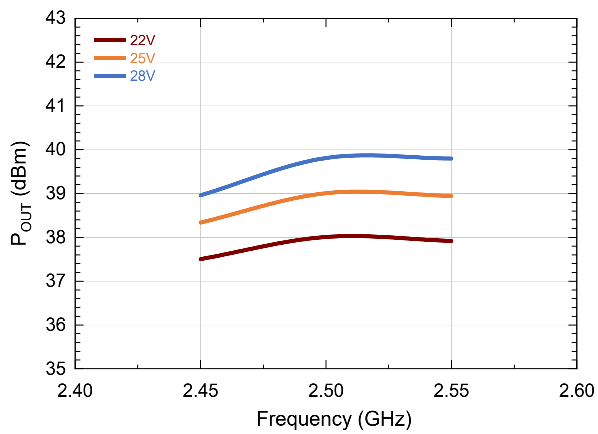
Output Power vs. Frequency and V_{DS}



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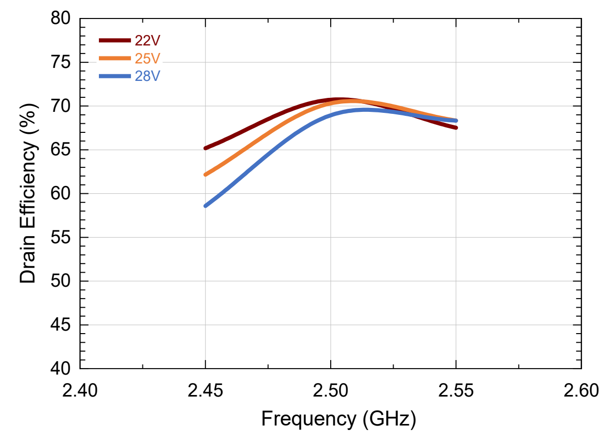

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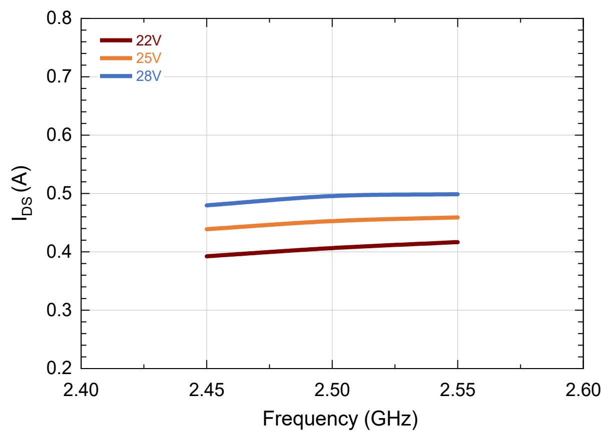
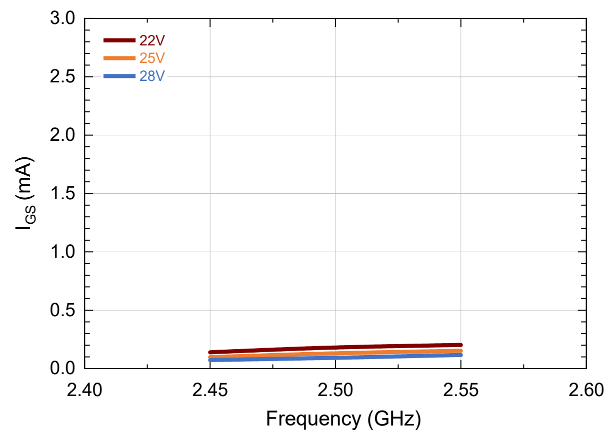


Gate Current vs. Frequency and V_{DS}



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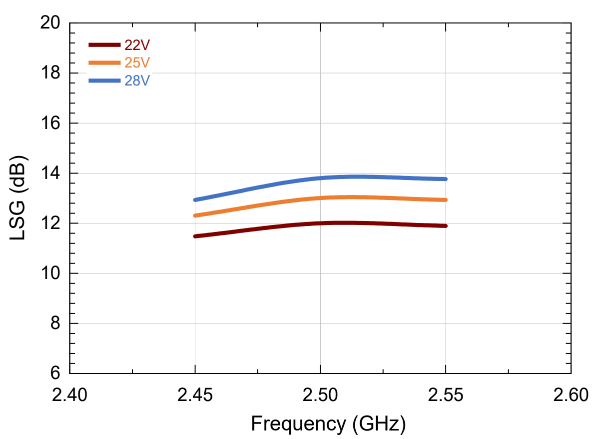

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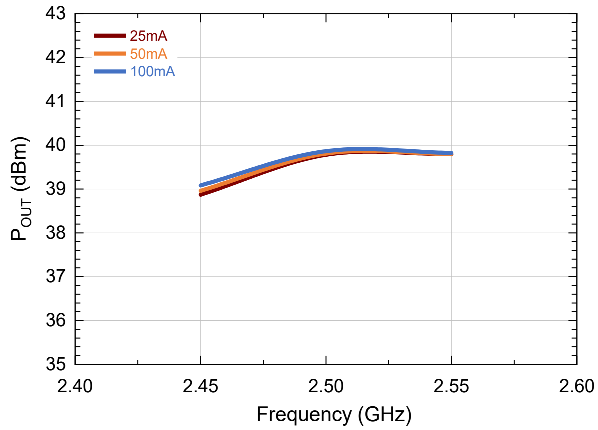
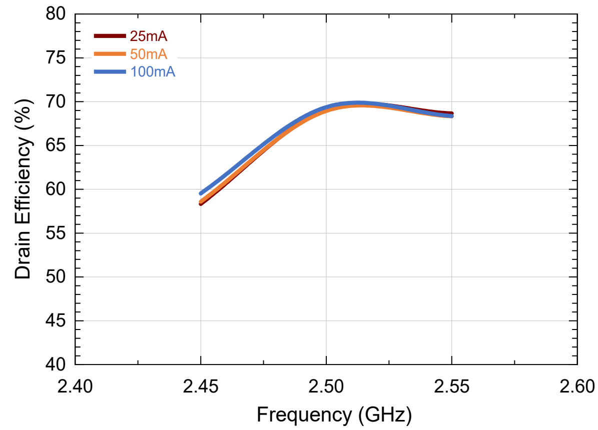
Output Power vs. Frequency and I_{DQ}



Drain Efficiency vs. Frequency and I_{DQ}



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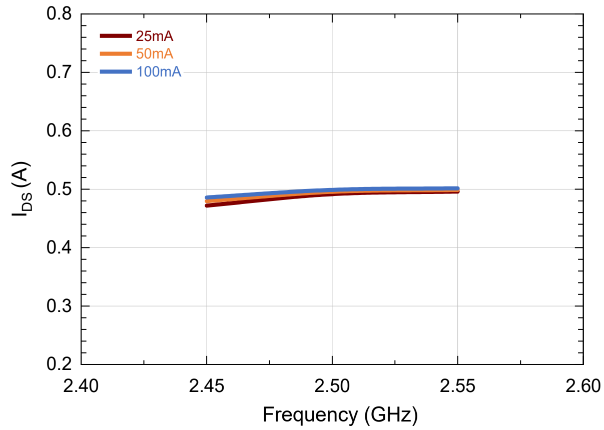
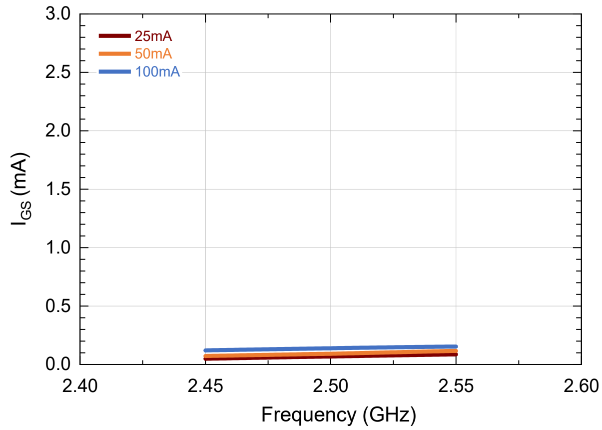


Gate Current vs. Frequency and I_{DQ}



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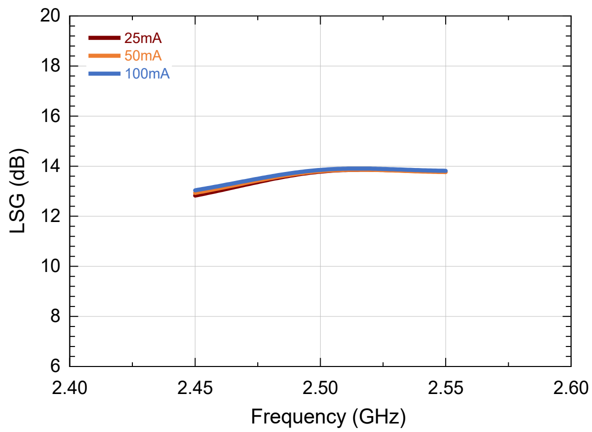

Typical Performance Curves as Measured in the 2.5 GHz Evaluation Test Fixture

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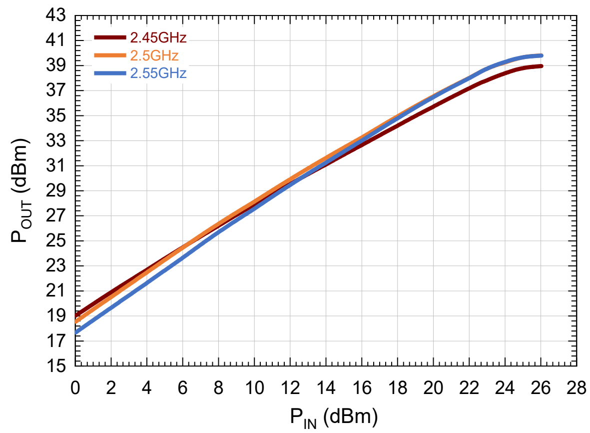
Output Power vs. P_{IN} and Frequency



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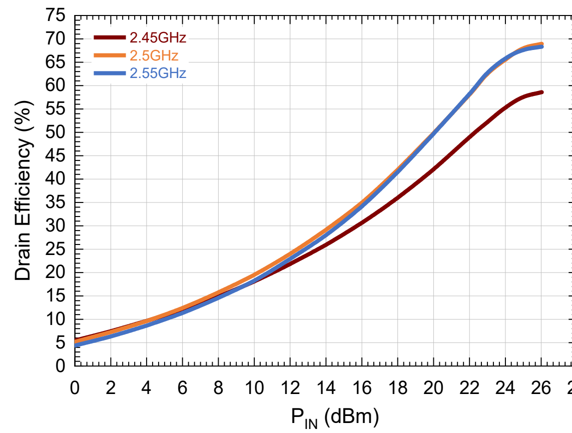

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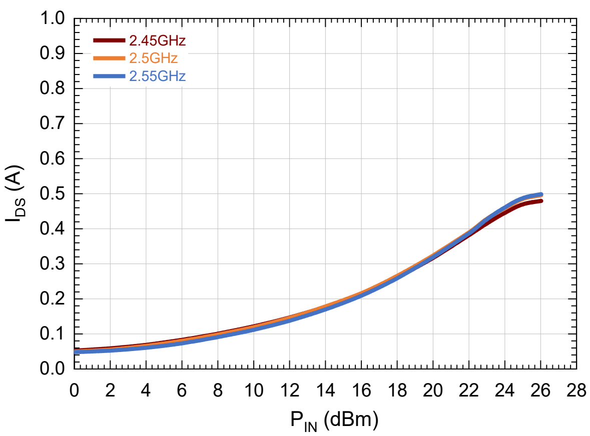

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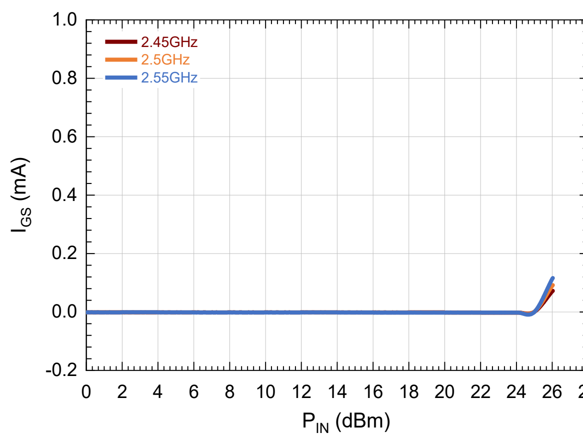

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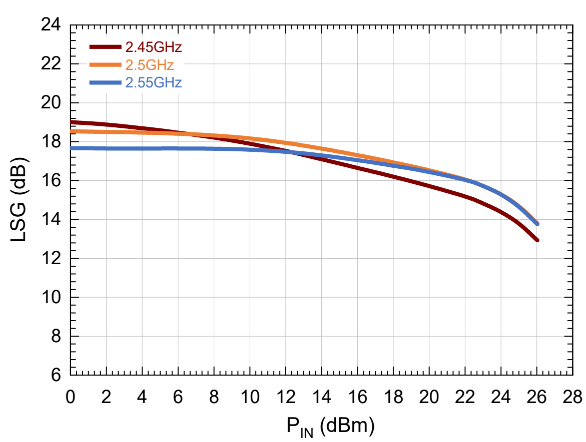

Typical Performance Curves as Measured in the 2.5 GHz Evaluation Test Fixture

CW, P_{IN} = 26 dBm, V_{DS} = 28 V, I_{DQ} = 50 mA, Freq = 2.5 GHz, T_C = 25°C (Unless Otherwise Noted)
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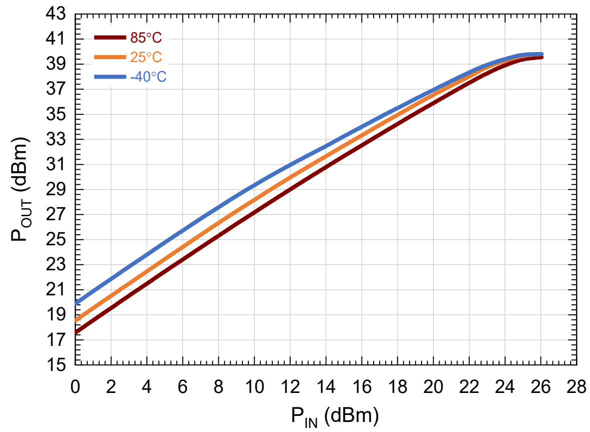
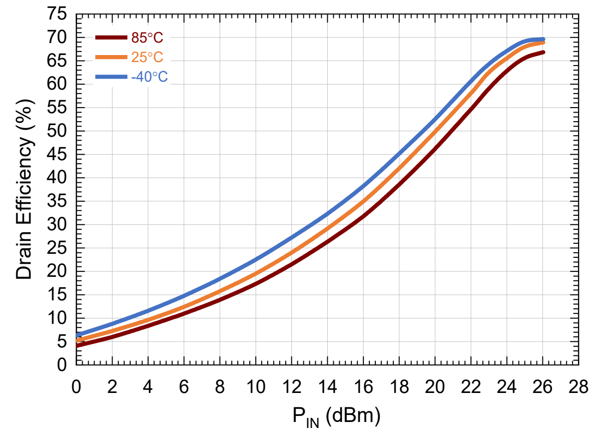
Output Power vs. P_{IN} and Temperature



Drain Efficiency vs. P_{IN} and Temperature



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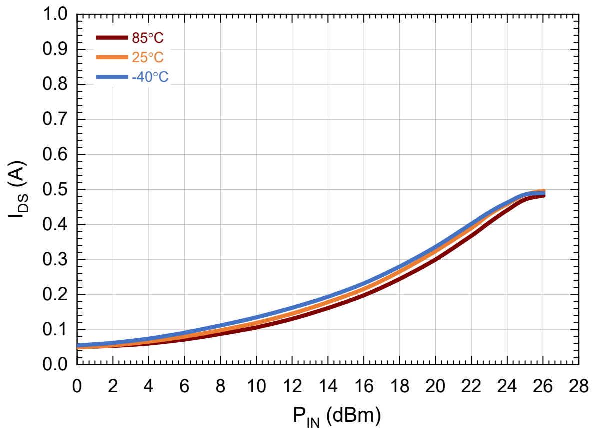

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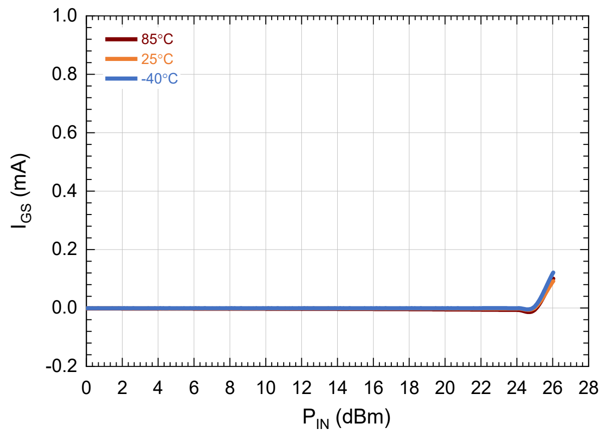

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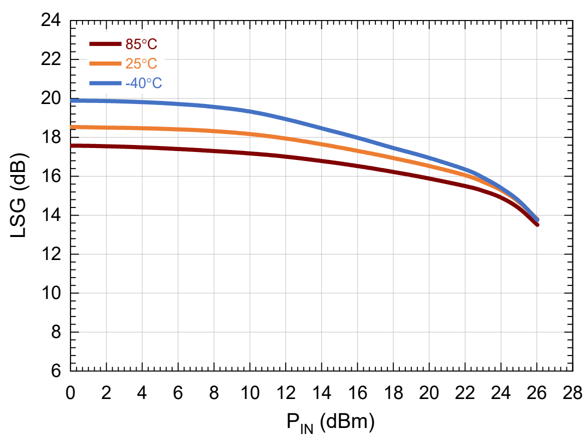

Typical Performance Curves as Measured in the 2.5 GHz Evaluation Test Fixture

CW, P_{IN} = 26 dBm, V_{DS} = 28 V, I_{DQ} = 50 mA, Freq = 2.5 GHz, T_C = 25°C (Unless Otherwise Noted)

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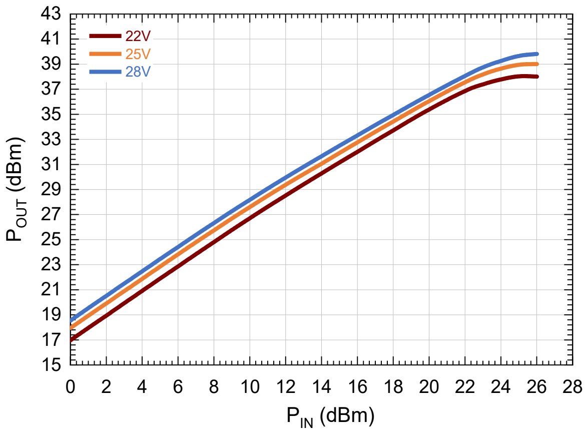
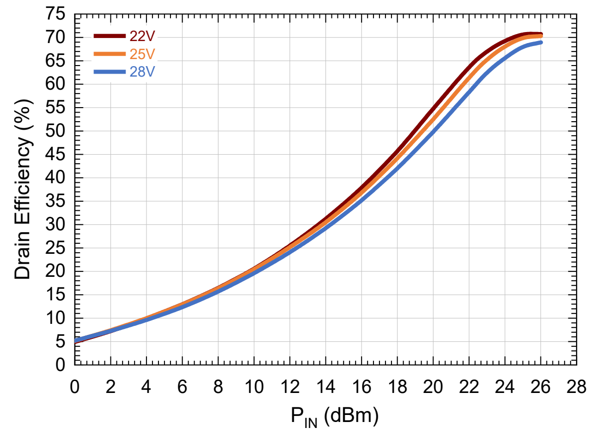
Output Power vs. P_{IN} and V_{DS}



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



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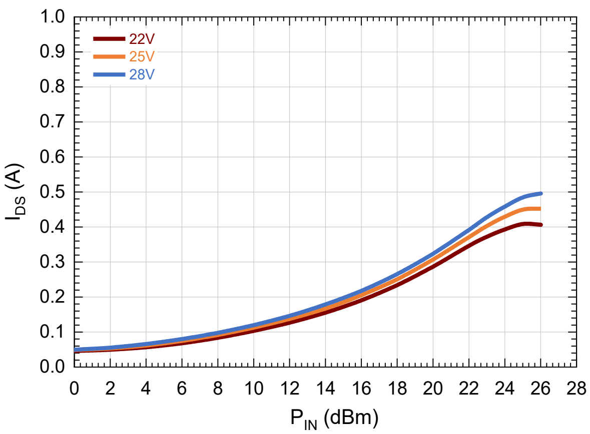

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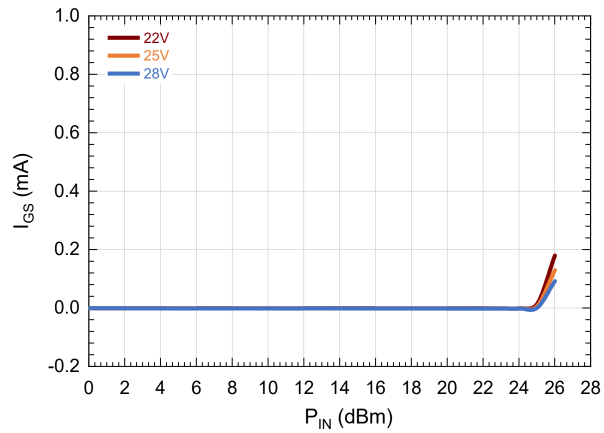

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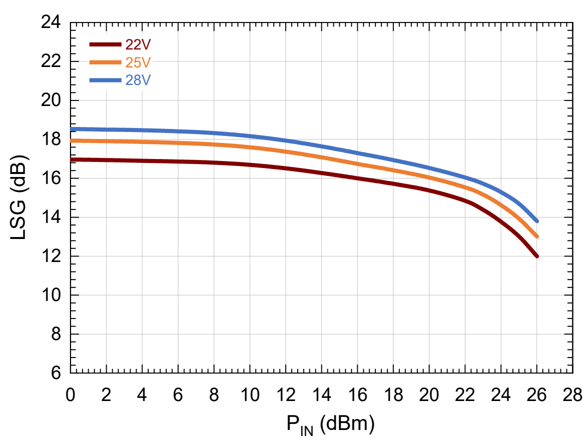

Typical Performance Curves as Measured in the 2.5 GHz Evaluation Test Fixture

CW, P_{IN} = 26 dBm, V_{DS} = 28 V, I_{DQ} = 50 mA, Freq = 2.5 GHz, T_C = 25°C (Unless Otherwise Noted)
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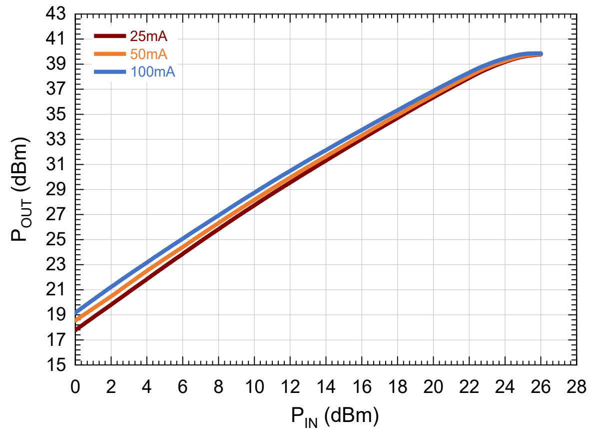
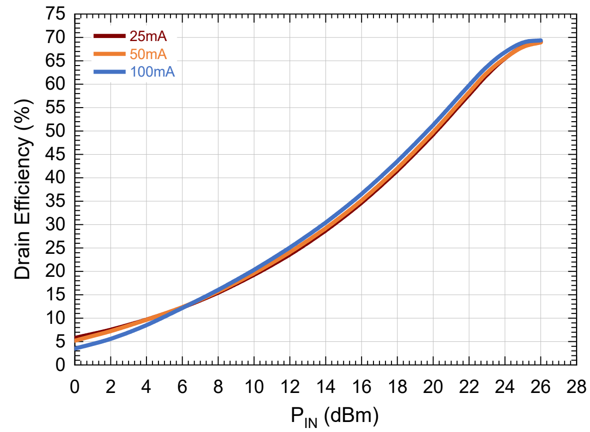
Output Power vs. P_{IN} and I_{DQ}



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



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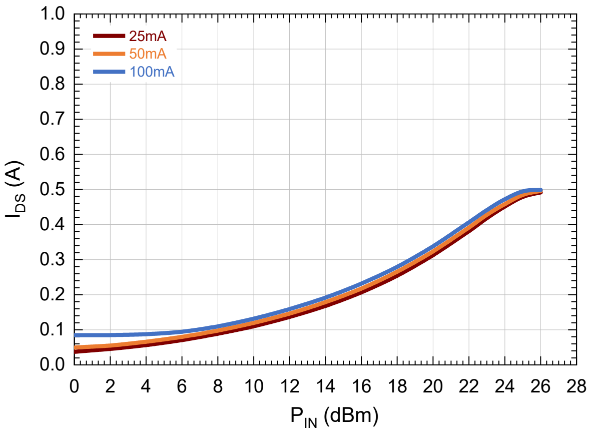
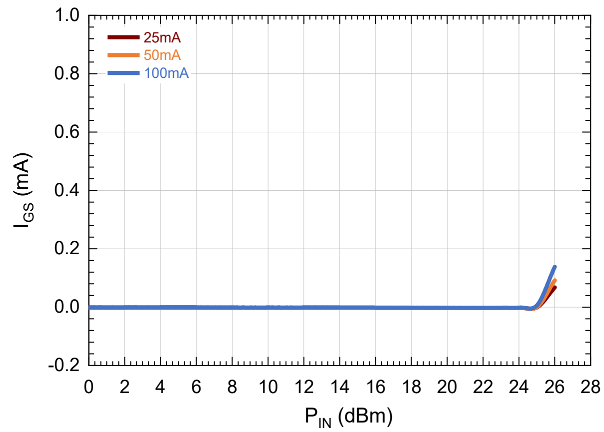
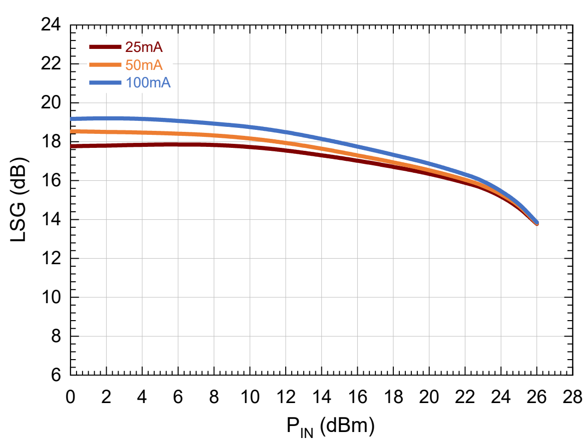


Gate Current vs. P_{IN} and I_{DQ}



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

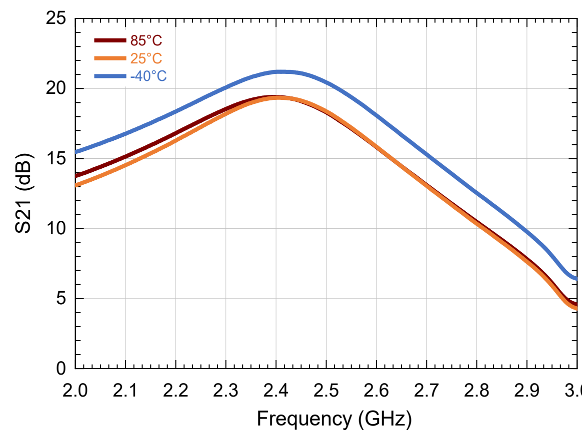


Typical Performance Curves as Measured in the 2.5 GHz Evaluation Test Fixture:

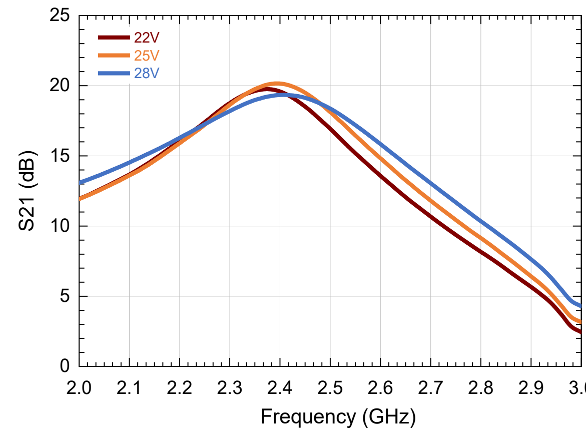
CW, V_{DS} = 28 V, I_{DQ} = 50 mA, Pin = -20 dBm, T_C = 25°C (Unless Otherwise Noted)

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

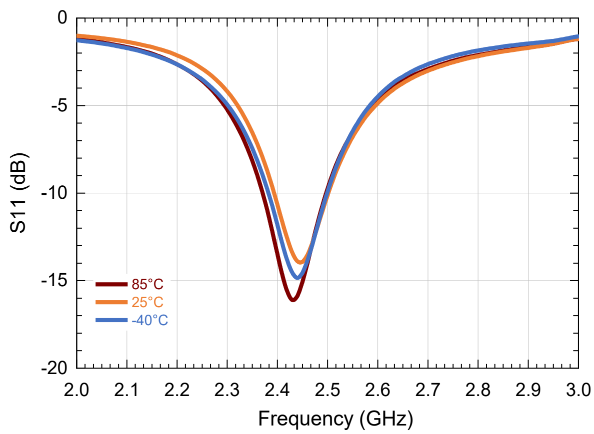
S21 vs Frequency and Temperature



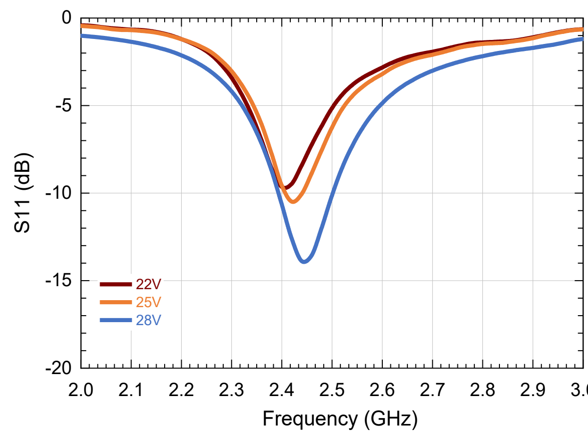
S21 vs Frequency and V_{DS}



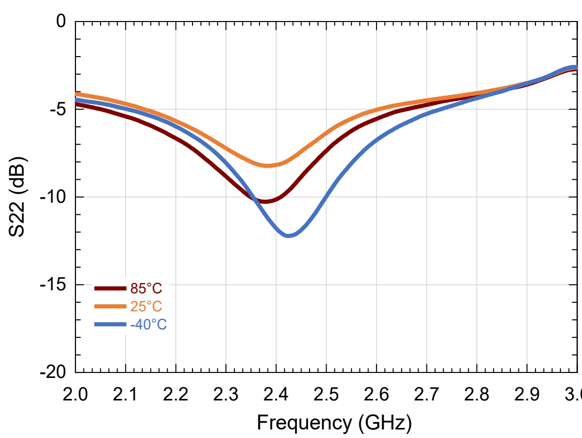
S11 vs Frequency and Temperature



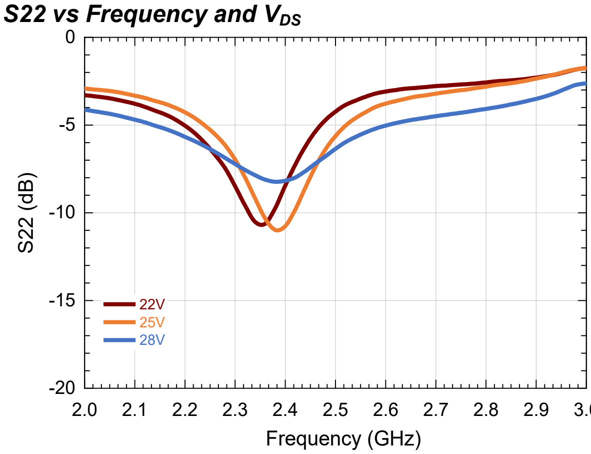
S11 vs Frequency and V_{DS}



S22 vs Frequency and Temperature



S22 vs Frequency and V_{DS}

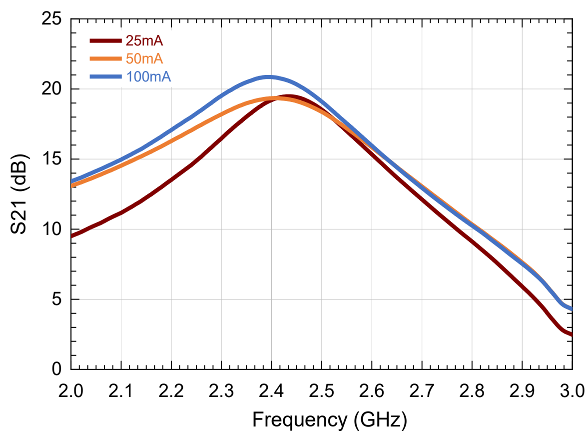


Typical Performance Curves as Measured in the 2.5 GHz Evaluation Test Fixture:

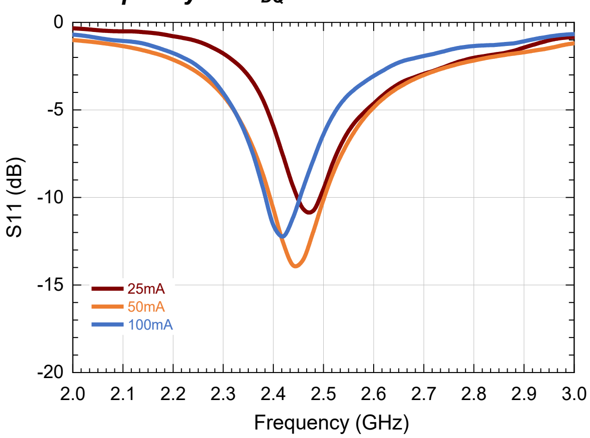
CW, V_{DS} = 28 V, I_{DQ} = 50 mA, Pin = -20 dBm (Unless Otherwise Noted)

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

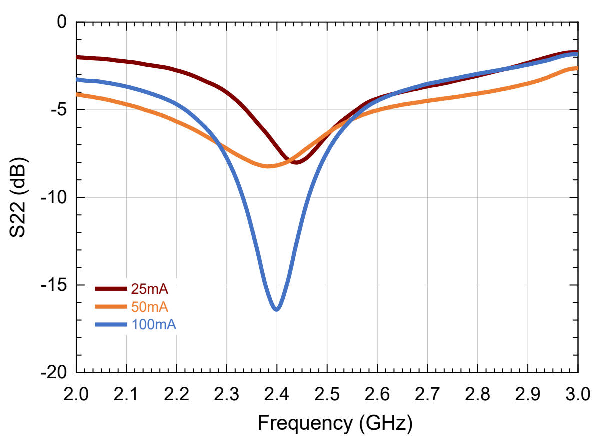
S21 vs Frequency and I_{DQ}



S11 vs Frequency and I_{DQ}



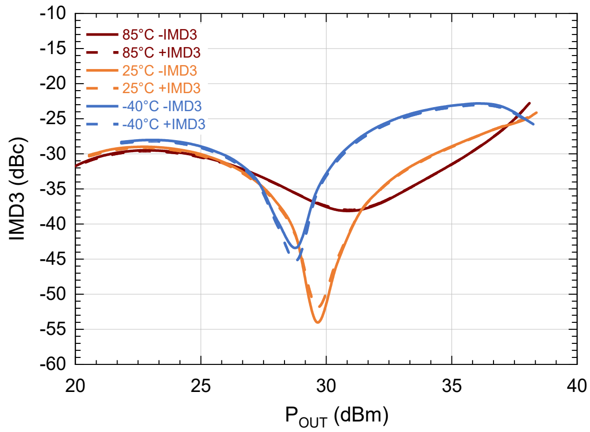
S22 vs Frequency and I_{DQ}



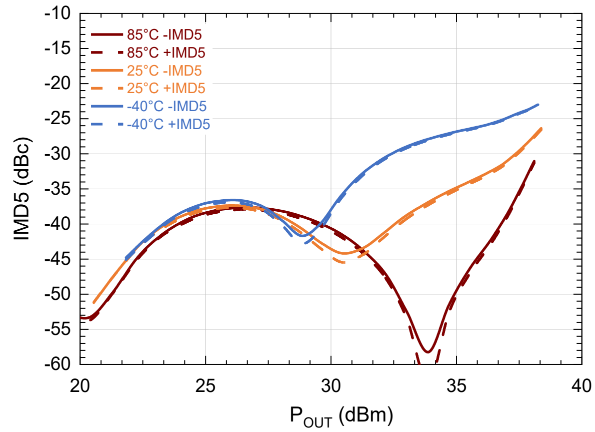
Typical Performance Curves as Measured in the 2.5 GHz Evaluation Test Fixture:

CW, Two Tone, ΔF = 1 MHz, V_{DS} = 28 V, I_{DQ} = 50 mA, Freq = 2.5 GHz, T_C = 25°C (Unless Otherwise Noted)
For Engineering Evaluation Only - This data does not Modify MACOM's Datasheet Limits.

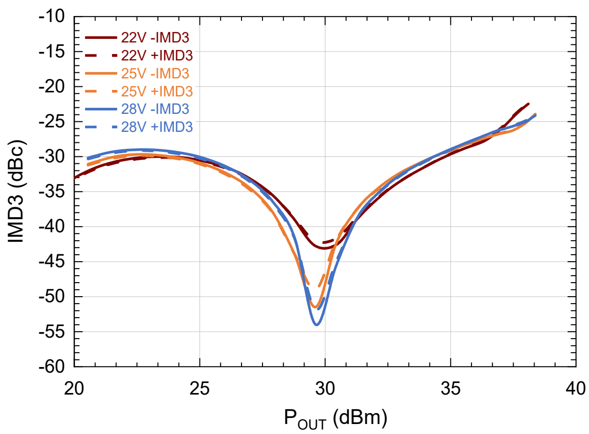
IMD3 vs. Output Power and Temperature



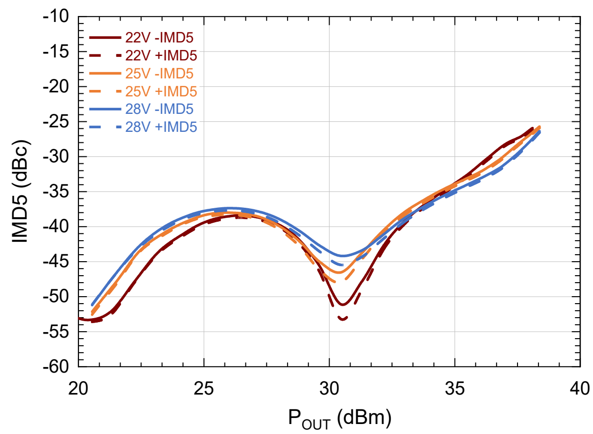
IMD5 vs. Output Power and Temperature



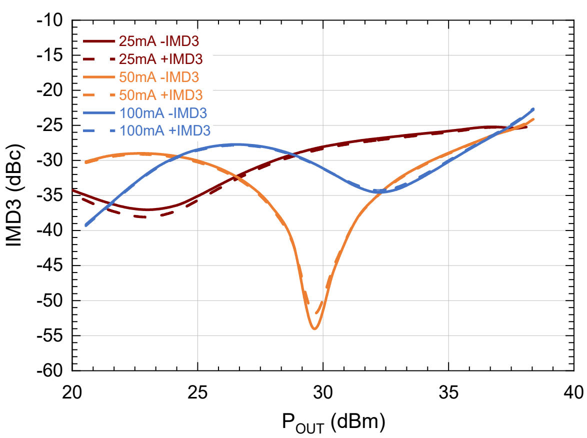
IMD3 vs. Output Power and V_{DS}



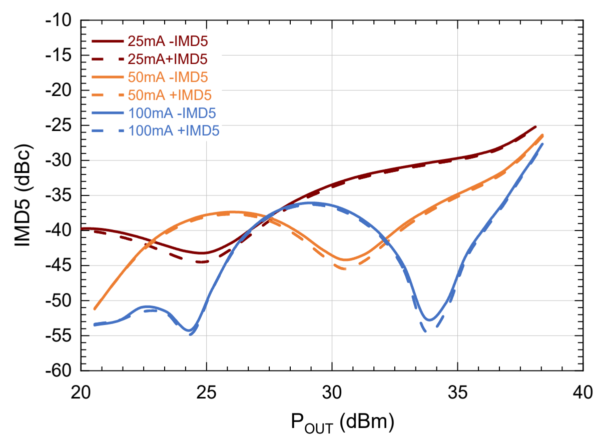
IMD5 vs. Output Power and V_{DS}



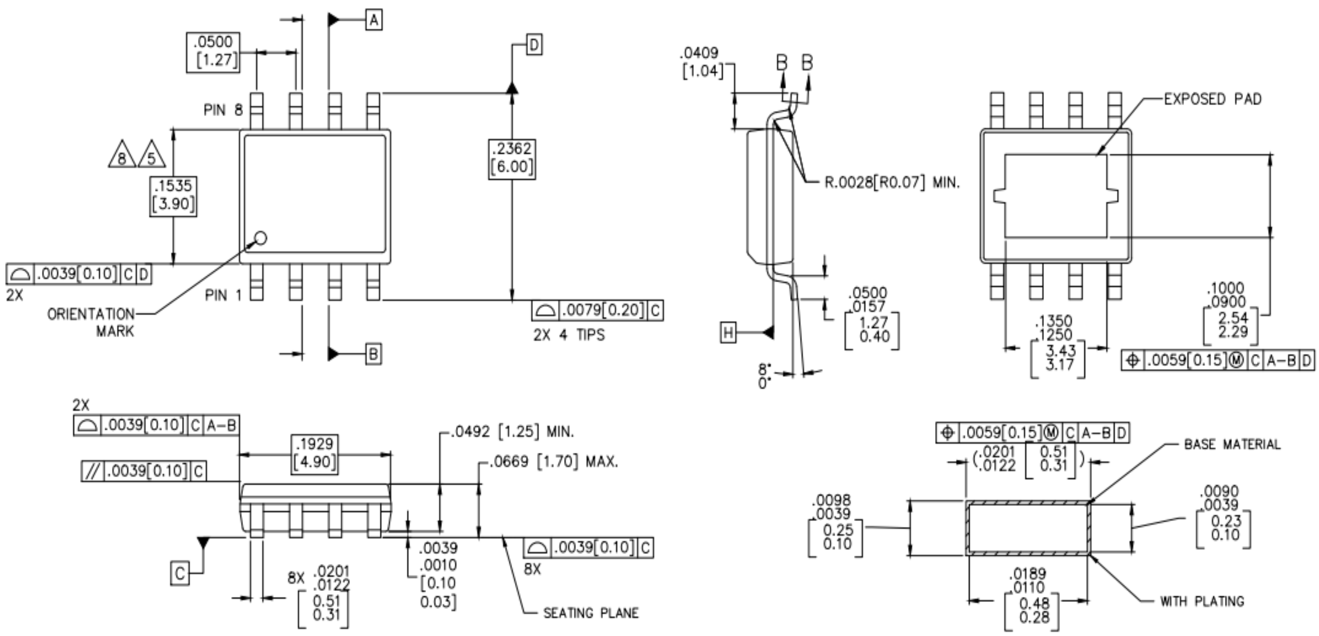
IMD3 vs. Output Power and I_{DQ}



IMD5 vs. Output Power and I_{DQ}



SOIC 8-Lead Plastic Package†



NOTES:

1. PACKAGE
   A. ALL DIMENSIONS PER JEDEC NO. MS–012–BA, ISSUE F. ALL DIMENSIONS SHOWN AS in[mm].
      CONTROLING DIMENSIONS ARE IN mm AND CONVERTED in DIMENSIONS ARE NOT NECESSARILY EXACT.
   B. LEAD FINISH: 100% MATTE TIN FOLLOWED BY A POST PLATE ANNEALING OPERATION

† Meets JEDEC moisture sensitivity level 3 requirements.
Plating is Matte Sn.