GaN Amplifier 50 V, 25 W
30 - 2700 MHz

MACOM PURE CARBIDE

MAPC-A1000-BD
Rev. V1

Features

- *MACOM PURE CARBIDE*® Amplifier Series
- Suitable for Linear & Saturated Applications
- CW & Pulsed Operation: 25 W Output Power
- Internally Pre-matched
- 50 V Operation
- Compatible with MACOM Power Management Bias Controller/Sequencer MABC-11040

6.5 x 7.0 mm DFN

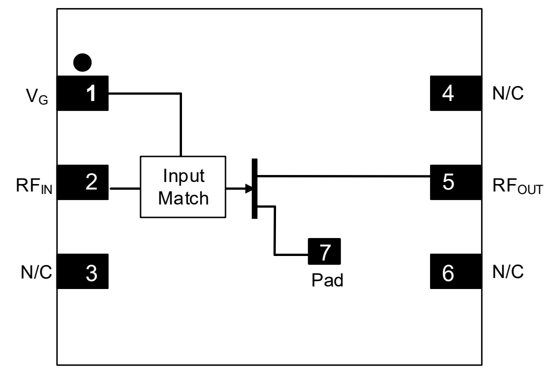
Applications

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

Description

The MAPC-A1000-BD is a high power GaN on Silicon Carbide HEMT D-mode amplifier suitable for 0.3 - 2.7 GHz frequency operation. The device supports both CW and pulsed operation with output levels of at least 25 W (44 dBm) in a 6.5 x 7.0 mm plastic package.

Functional Schematic



Typical Performance:

Measured in Evaluation Test Fixture:
P_{IN} = 32.7 dBm, V_{DS} = 50 V, I_{DQ} = 40 mA, T_C = 25°C,
100 µs Pulse Width, 10% Duty Cycle

Frequency (GHz)	Output Power (dBm)	Gain (dB)	η_D (%)
0.5	44.8	12.1	58.6
0.9	45.8	13.1	72.2
1.4	45.7	13.0	58.7
2.0	45.6	12.9	63.6
2.7	46.1	13.5	59.5

Pin Configuration

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

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

Ordering Information

Part Number	Package
MAPC-A1000-BD000	Bulk Quantity
MAPC-A1000-BDTR1	Tape and Reel
MAPC-A1000-BDSB1	Sample Board

DC-0039128

RF Electrical Characteristics: T_C = 25°C, V_{DS} = 50 V, I_{DQ} = 40 mA
Note: Performance in MACOM Evaluation Test Fixture, 50 Ω system

Parameter	Test Conditions	Symbol	Min.	Typ.	Max.	Units
Small Signal Gain	Pulsed[2], 2.7 GHz	G_{SS}	-	15.5	-	dB
Power Gain	Pulsed[2], 2.7 GHz, 2.5 dB Gain Compression	G_{SAT}	-	13.5	-	dB
Drain Efficiency	Pulsed[2], 2.7 GHz, 2.5 dB Gain Compression	η_{SAT}	-	59.5	-	%
Output Power	Pulsed[2], 2.7 GHz, 2.5 dB Gain Compression	P_{SAT}	-	46.1	-	dBm
Power Gain	Pulsed[2], 2.7 GHz, P_{IN} = 32.7 dBm	G_P	-	13.5	-	dB
Drain Efficiency	Pulsed[2], 2.7 GHz, P_{IN} = 32.7 dBm	η	-	59.5	-	%
Input Return Loss	Pulsed[2], 2.7 GHz, P_{IN} = 32.7 dBm	IRL	-	46.1	-	dB
Gain Variation (-40°C to +85°C)	Pulsed[2], 2.7 GHz	ΔG	-	0.015	-	dB/°C
Power Variation (-40°C to +85°C)	Pulsed[2], 2.7 GHz	ΔPdB	-	0.001	-	dBm/°C
Ruggedness: Output Mismatch	All phase angles	Ψ	VSWR = 10:1, No Damage			

RF Electrical Specifications: T_A = 25°C, V_{DS} = 50 V, I_{DQ} = 40 mA
Note: Performance in MACOM Production Test Fixture, 50 Ω system

Parameter	Test Conditions	Symbol	Min.	Typ.	Max.	Units
Output Power	Pulsed[2], 2.7 GHz, P_{IN} = 33.6 dBm	P_{OUT}	44.6	45.4	-	dB
Power Gain	Pulsed[2], 2.7 GHz, P_{IN} = 33.6 dBm	G_P	11.0	11.9	-	dB
Drain Efficiency	Pulsed[2], 2.7 GHz, P_{IN} = 33.6 dBm	η	55	62	-	%

2. Pulse details: 100 μs pulse width, 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} = 150 V	I_{DLK}	-	-	3.6	mA
Gate-Source Leakage Current	V_{GS} = -8 V, V_{DS} = 0 V	I_{GLK}	-	-	3.6	mA
Gate Threshold Voltage	V_{DS} = 50 V, I_D = 3.6 mA	V_T	-	-2.5	-	V
Gate Quiescent Voltage	V_{DS} = 50 V, I_D = 40 mA	V_{GSQ}	-2.75	-2.45	-2.00	V

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

Parameter	Absolute Maximum
Drain Source Voltage, V_{DS}	150 V
Gate Source Voltage, V_{GS}	-10 to 2 V
Gate Current, I_G	3.6 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 +225°C
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 V_{DS} < 55 V will ensure MTTF > 1 x 10^6 hours.
6. Operating at nominal conditions with $T_{CH} \leq 225°C$ will ensure MTTF > 2.5 x 10^6 hours.

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)	6.7	°C/W

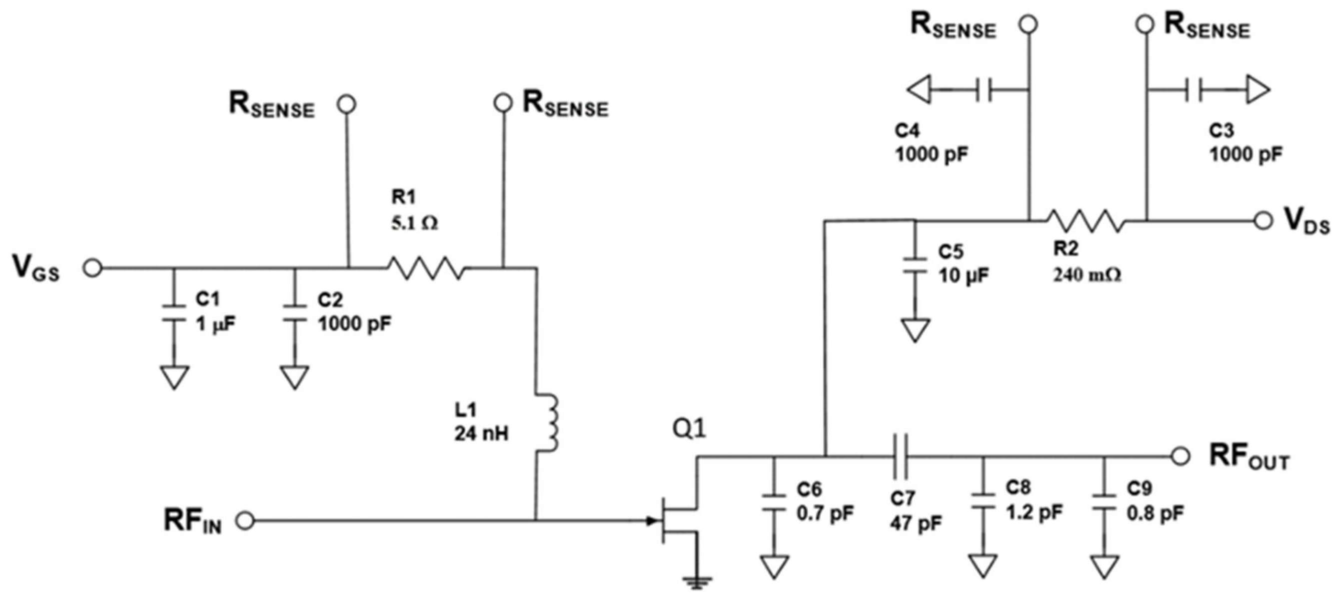
Handling Procedures

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.

Evaluation Test Fixture and Recommended Tuning Solution 0.5 - 2.7 GHz



Description

Parts measured on evaluation 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

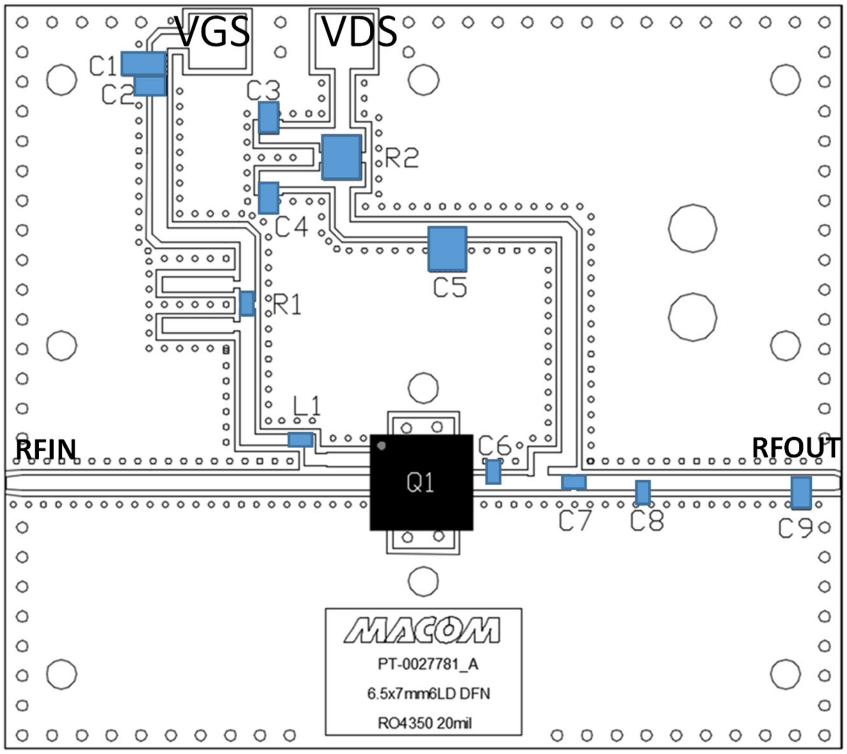
Turning the device ON

1. Set 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}.

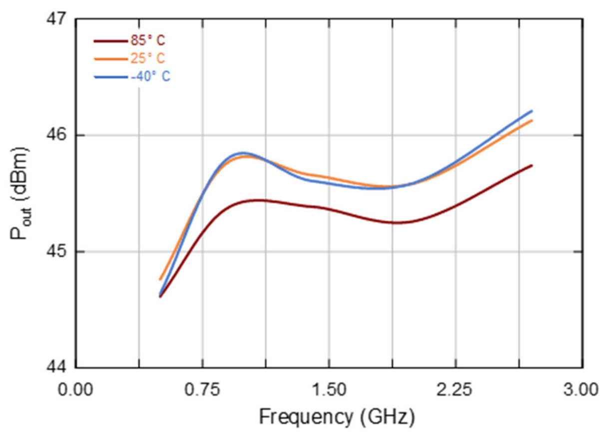
Evaluation Test Fixture and Recommended Tuning Solution 0.5 - 2.7 GHz



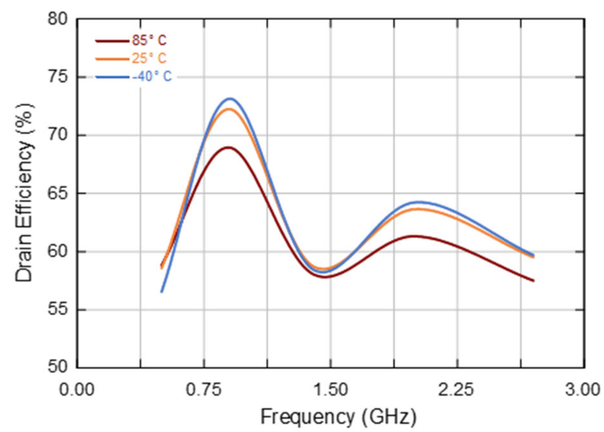
Reference Designator	Value	Tolerance	Manufacturer	Part Number
C1	1 µF	+/- 10 %	Murata	GRM31CR72A105KA01L
C2, C3, C4	1000 pF	+/- 5 %	Murata	GRM219R72A102JA01D
C5	10 µF	+/- 10 %	Murata	GRM32EC72A106KE05L
C6	0.7 pF	+/- 0.1 pF	PPI	0603N0R7BL250
C7	47 pF	+/- 5 %	PPI	0603N470JL250
C8	1.2 pF	+/- 0.1 pF	PPI	0603N1R2BL250
C9	0.8 pF	+/- 0.1 pF	PPI	0805N0R8BW251X
R1	5.1 Ω	+/- 1 %	YAGEO	RC0603JR-07SR1L
R2	240 mΩ	+/- 1 %	Vishay Dale	RCWE1210R240FKEA
L1	24 nH	+/- 2 %	CoilCraft	0603HP-24NXGEW
Q1	MACOM GaN Power Amplifier			MAPC-A1000
PCB	RO4350B, 20 mil, 0.5 oz Cu, SnPb Finish			

Typical Performance Curves as Measured in the 0.5 - 2.7 GHz Application Fixture: 2.7 GHz, Pulsed (100 µs/10%), V_{DS} = 50 V, I_{DQ} = 40 mA, P_{IN} = 32.7 dBm, T_C = 25°C

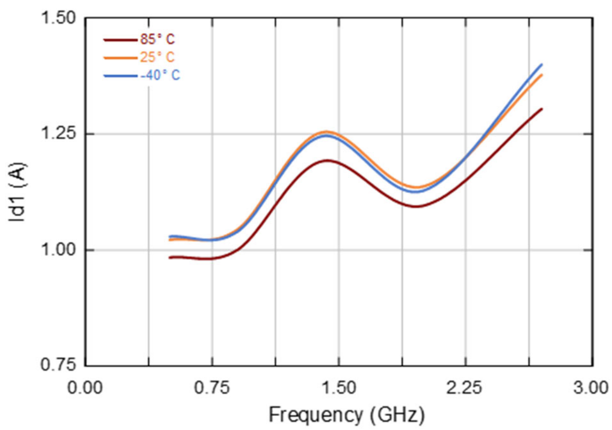
Output Power vs. Frequency over Temperature



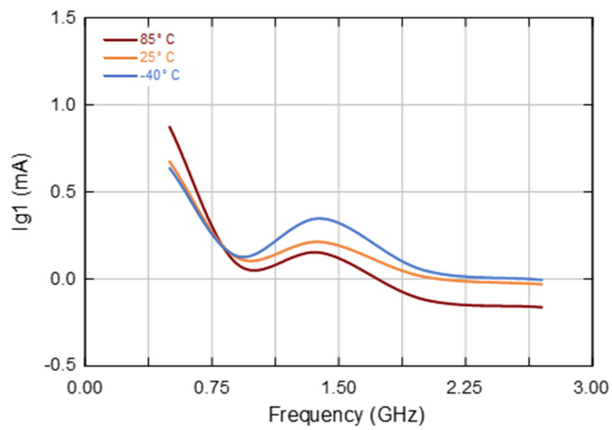
Drain Efficiency vs. Frequency over Temperature



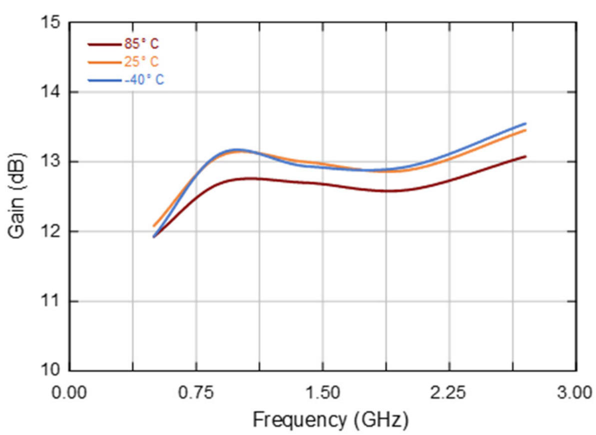
Drain Current vs. Frequency over Temperature



Gate Current vs. Frequency over Temperature



Large Signal Gain vs. Frequency over Temperature



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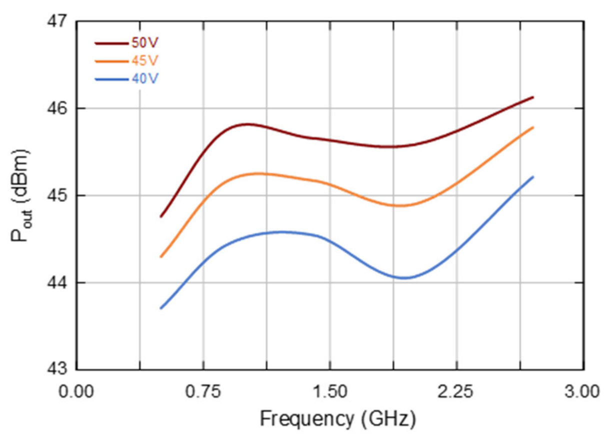
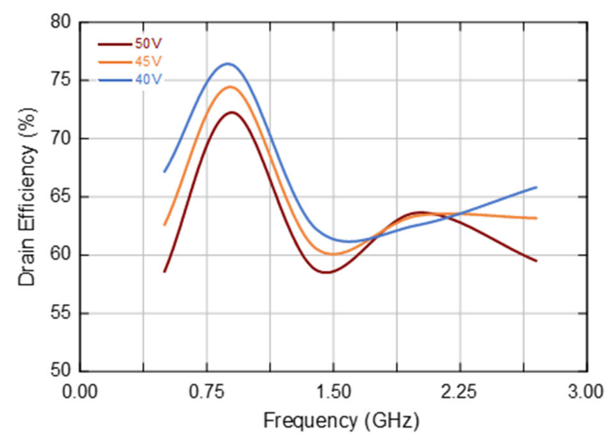
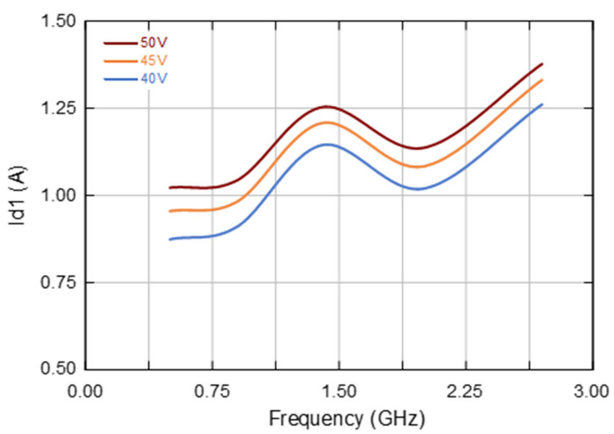
Output Power vs. Frequency over Voltage



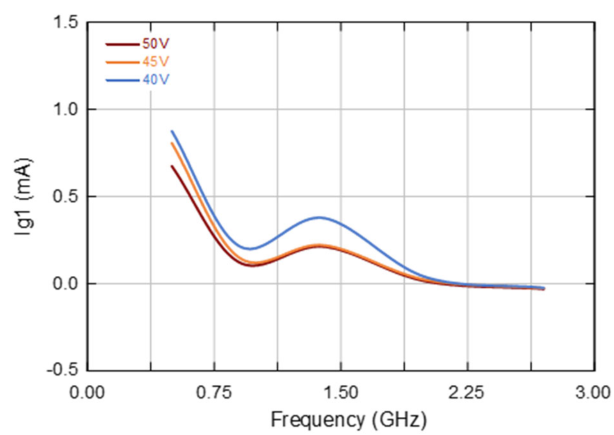
Drain Efficiency vs. Frequency over Voltage



Drain Current vs. Frequency over Voltage



Gate Current vs. Frequency over Voltage



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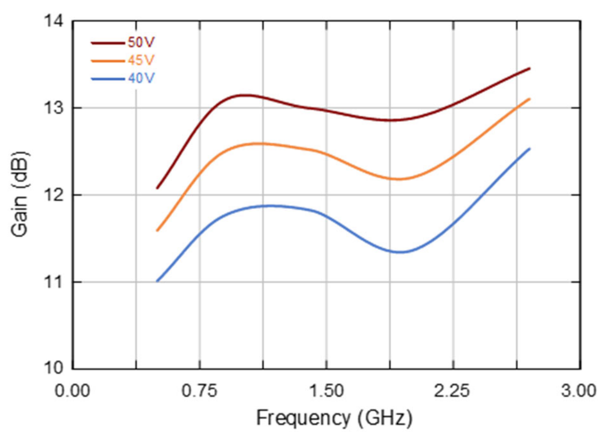

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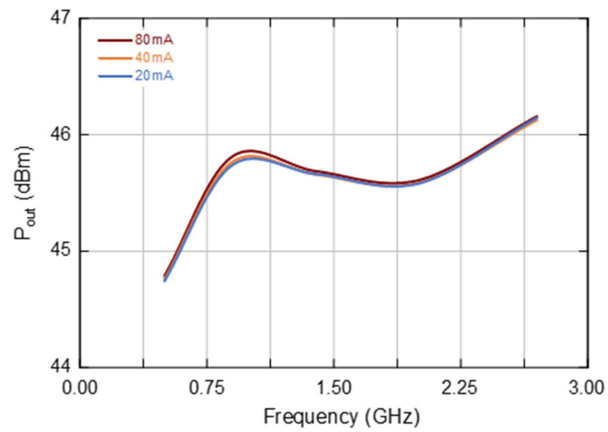
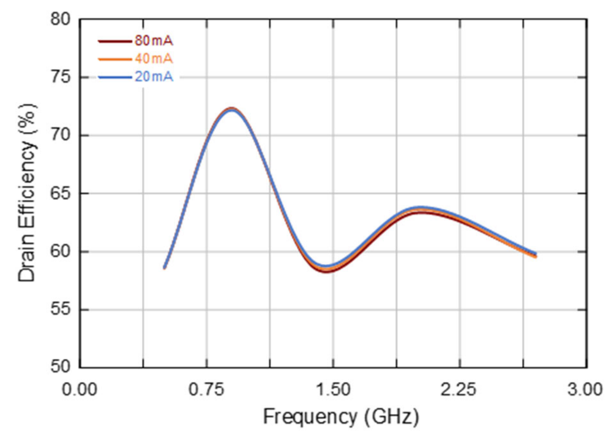
Output Power vs. Frequency over Current



Drain Efficiency vs. Frequency over Current



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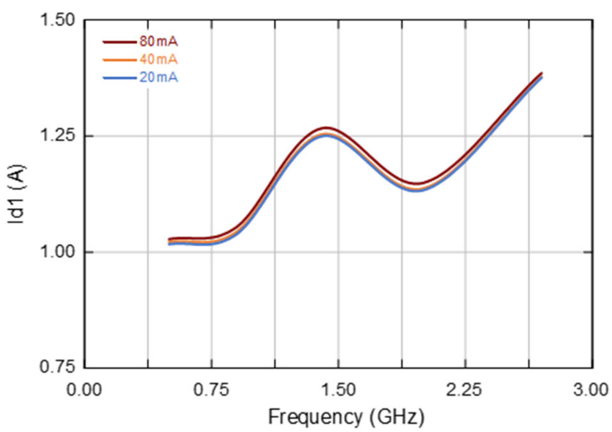
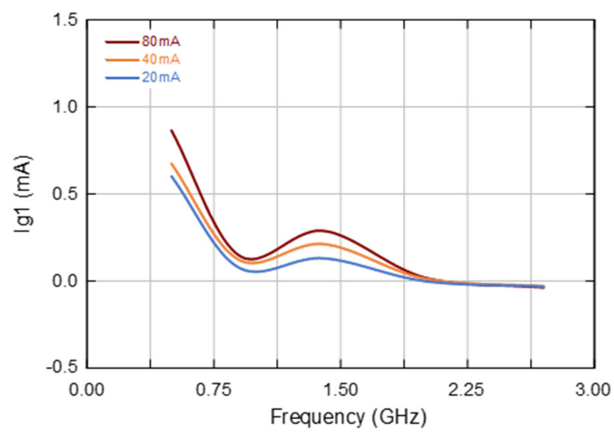


Gate Current vs. Frequency over Current



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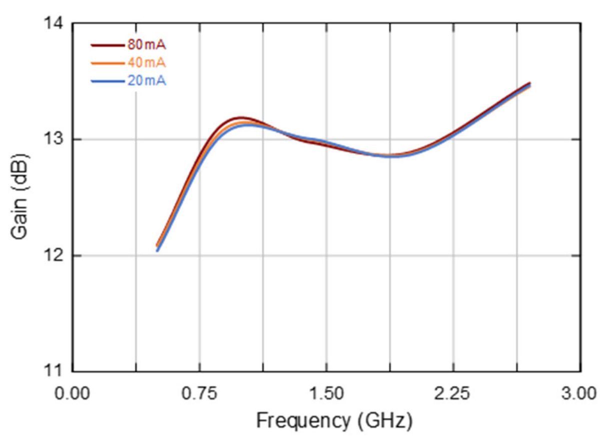

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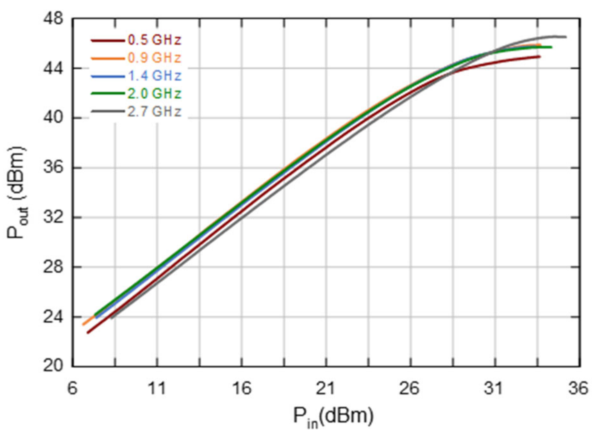
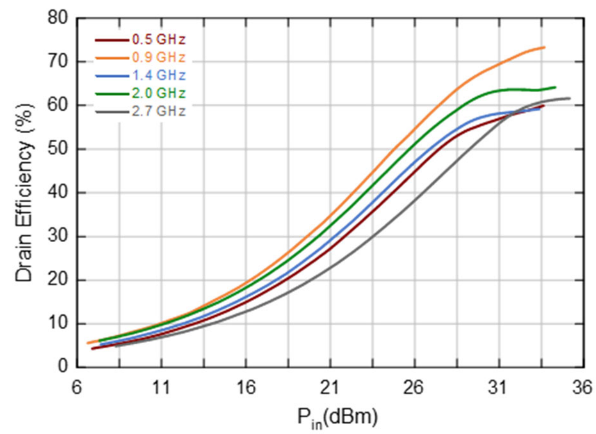
Output Power vs. Input Power over Frequency



Drain Efficiency vs. Input Power over Frequency



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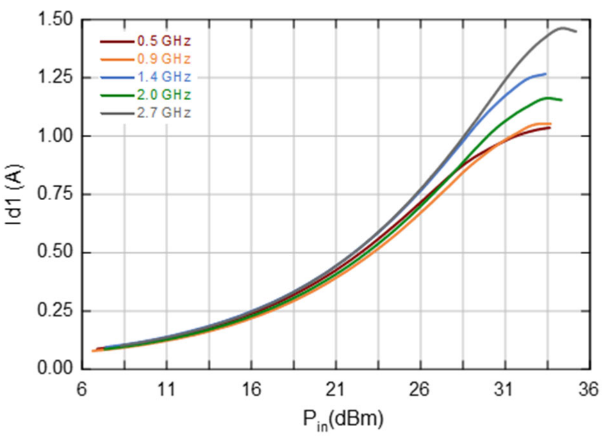

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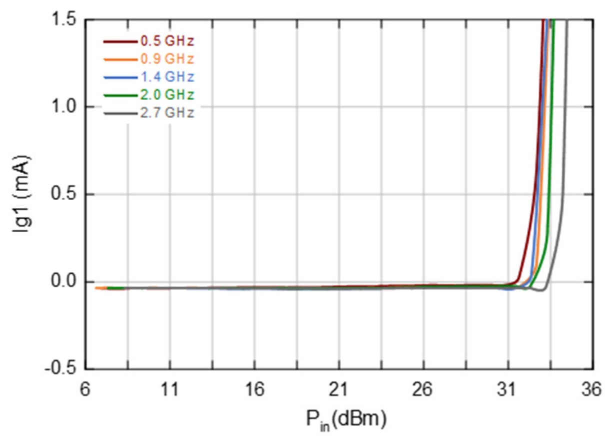

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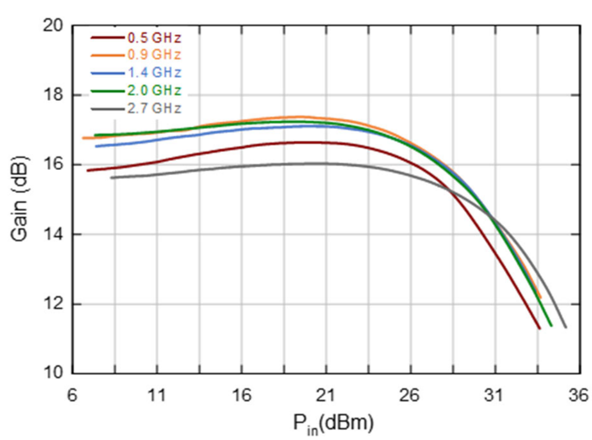

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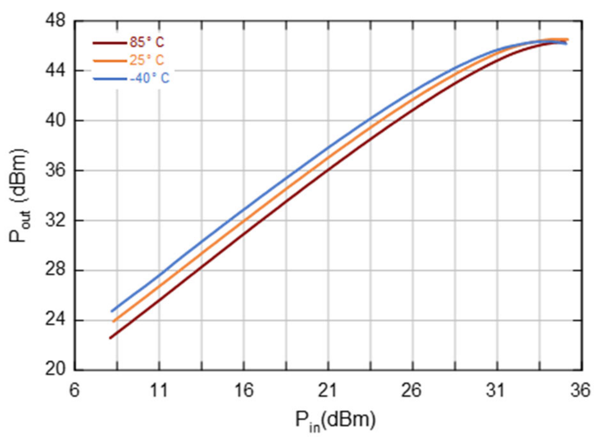
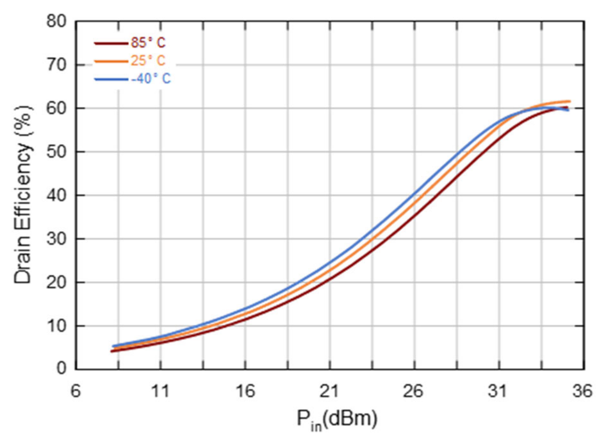


Drain Efficiency vs. Input Power over Temperature



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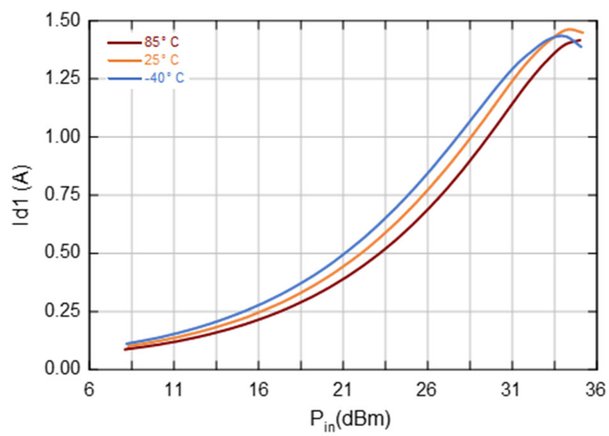

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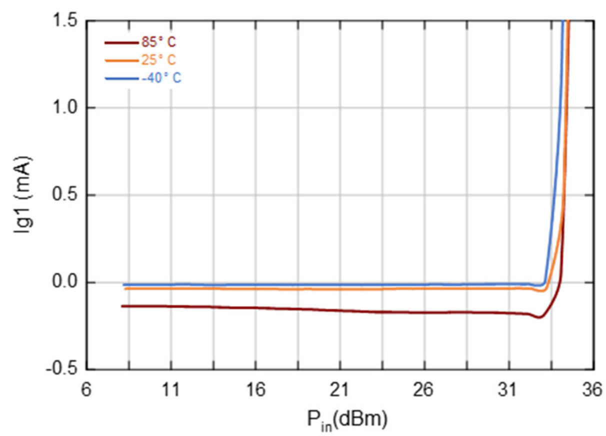

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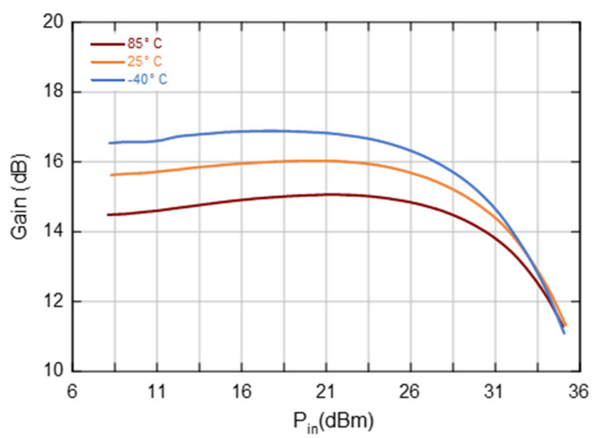

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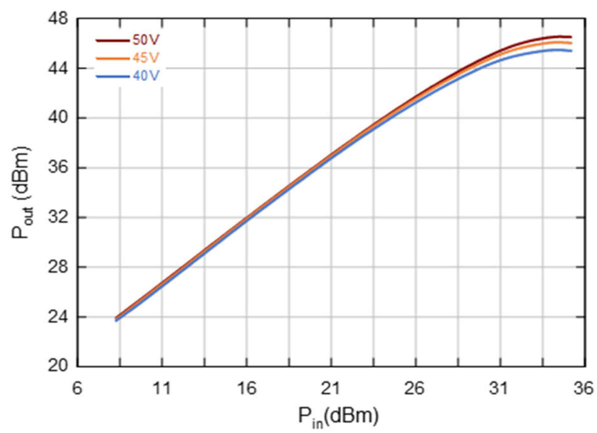
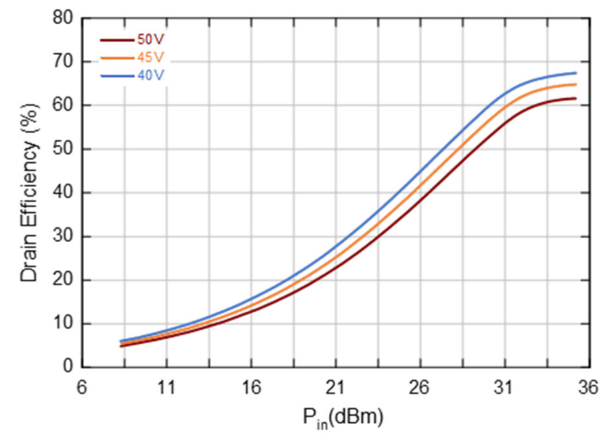
Output Power vs. Input Power over Voltage



Drain Efficiency vs. Input Power over Voltage



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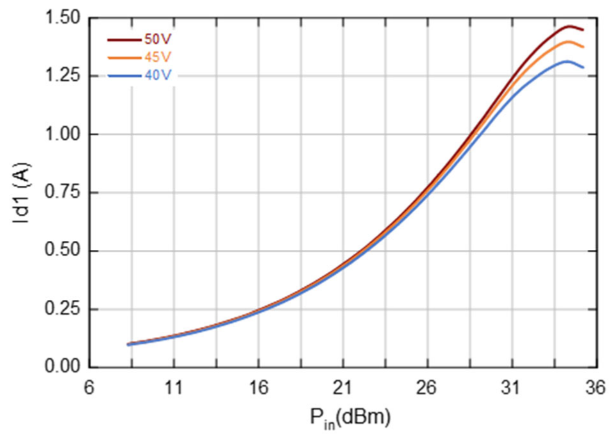
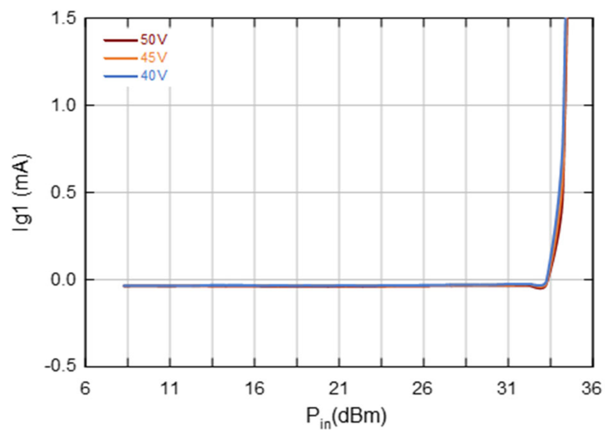


Gate Current vs. Input Power over Voltage



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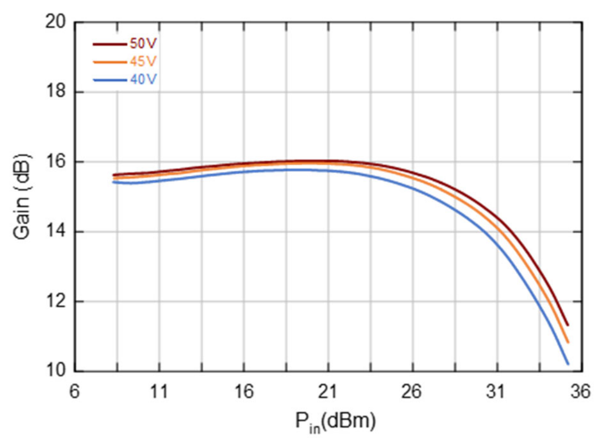

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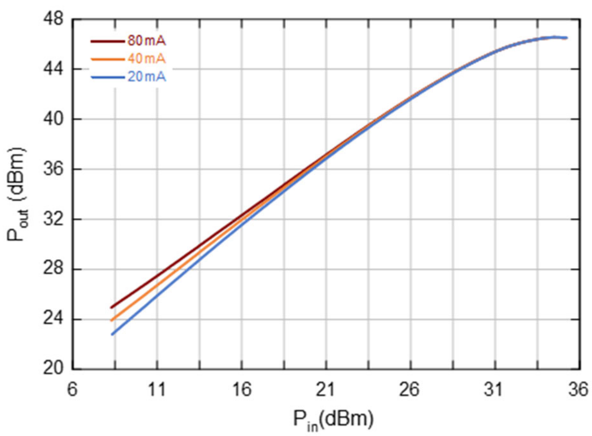
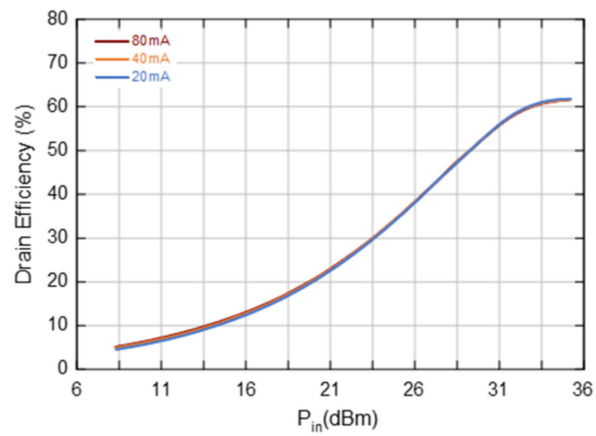
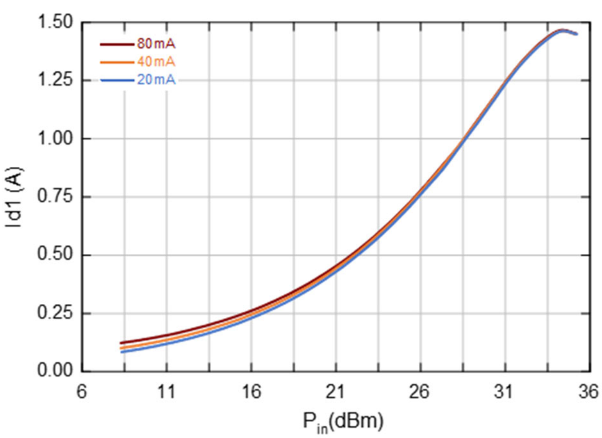
Output Power vs. Input Power over Current



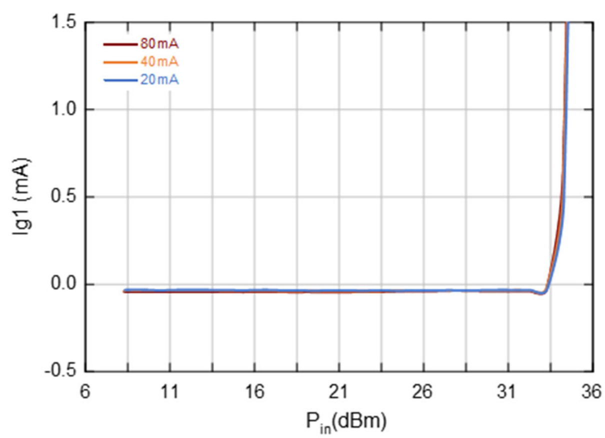
Drain Efficiency vs. Input Power over Current



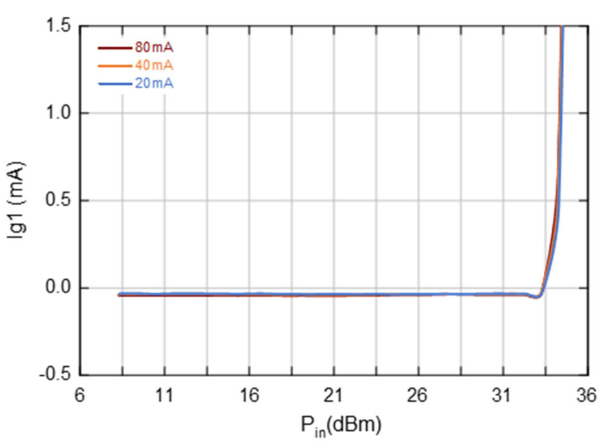
Drain Current vs. Input Power over Current



Gate Current vs. Input Power over Current



Large Signal Gain vs. Input Power over Current



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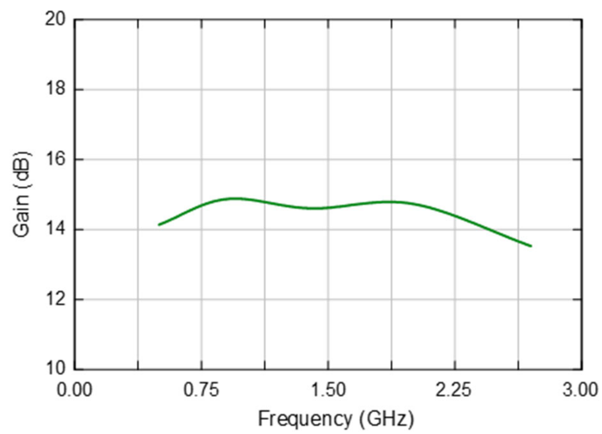
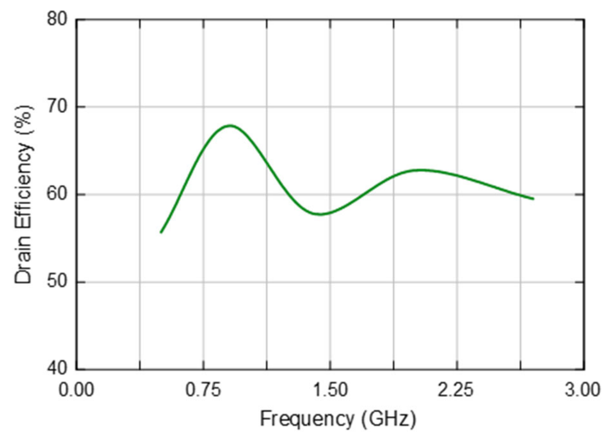
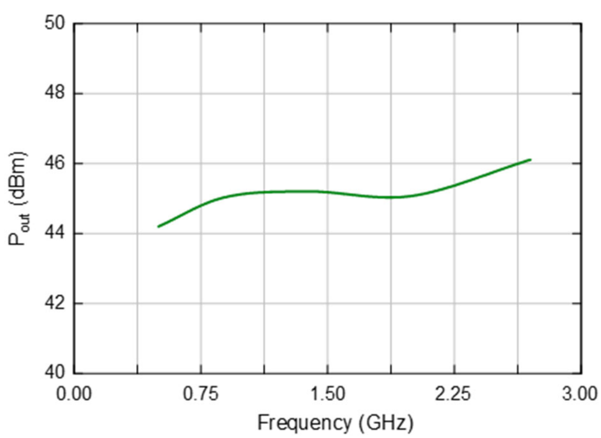
Gain vs. Frequency, 2.5 dB Compression



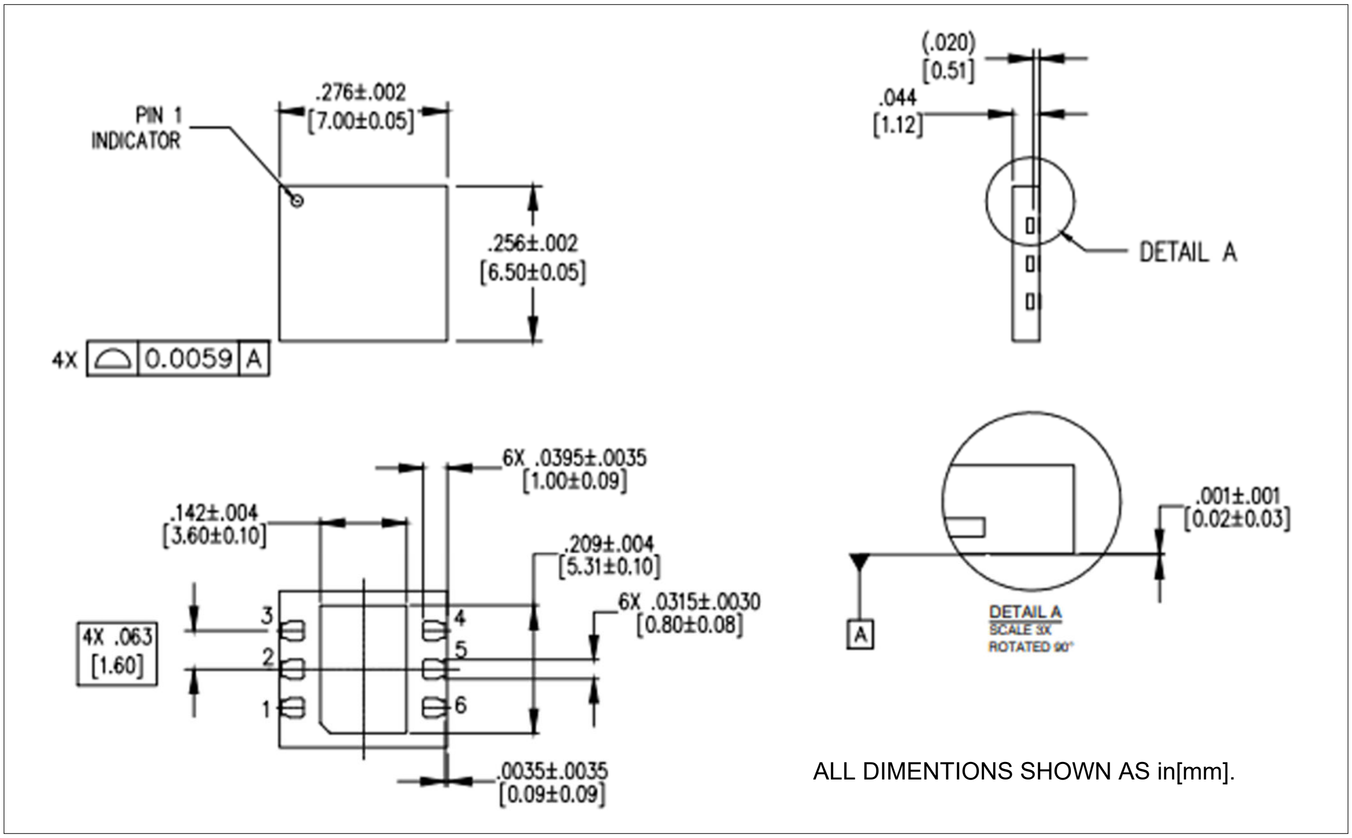
Drain Efficiency vs. Frequency, 2.5 dB Compression



Output Power vs. Frequency, 2.5 dB Compression



Lead-Free 6.5 x 7.0 mm 6-Lead Package Dimensions†



† Reference Application Note S2083 for lead-free solder reflow recommendations.
Meets JEDEC moisture sensitivity level (MSL) 3 requirements.
Plating is NiPdAu.