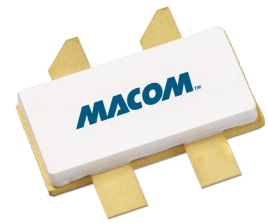
Features

- *MACOM PURE CARBIDE*® Amplifier Series
- Optimized for Modulated Signal Applications
- Optimized for Asymmetrical Doherty Application
- High Terminal Impedances for Broadband Performance
- 50 V Operation
- 100% RF Tested
- RoHS* Compliant

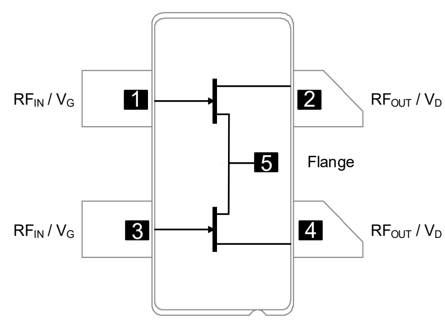


AC-780S-4

Description

The MAPC-A2519 is a high power GaN on silicon carbide HEMT D-mode amplifier suitable for asymmetrical Doherty applications with 85 W average power and optimized for 2.3 - 2.4 GHz modulated signal operation. The device supports pulsed, and linear operation with peak output power levels to 600 W (57.8 dBm) in an air cavity ceramic package.

Functional Schematic



Typical Doherty Performance:

- WCDMA 3GPP TM1, 10 dB PAR @ 0.01% CCDF. V_{DS} = 50 V, I_{DQCAR} = 430 mA, V_{GSPK} = -4.9 V, T_C = 25°C, P_{OUT} = 49.5 dBm

Frequency (GHz)	GP (dB)	η_D (%)	Output PAR (dB)	ACPR (dBc)
2.30	17.0	48.8	8.1	-31.6
2.35	16.6	50.1	8.3	-32.8
2.40	16.1	49.3	8.0	-29.0

Pin Configuration

Pin #	Pin Name	Function
1	RF_{IN} / V_G	RF Input / Gate (Carrier)
2	RF_{OUT} / V_D	RF Output / Drain (Carrier)
3	RF_{IN} / V_G	RF Input / Gate (Peaking)
4	RF_{OUT} / V_D	RF Output / Drain (Peaking)
5	Flange[1]	Ground / Source

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

Ordering Information

Part Number	Package
MAPC-A2519-AS000	Bulk Quantity
MAPC-A2519-ASTR1	Tape and Reel
MAPC-A2519-ASSB1	Sample Board

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

RF Electrical Specifications: T_C = 25°C, V_{DS} = 50 V, I_{DQCAR} = 430 mA, V_{GSPK} = -4.9 V
Note: Performance in MACOM Doherty Evaluation Test Fixture, 50 Ω system.

Parameter	Test Conditions	Symbol	Min.	Typ.	Max.	Units
Small Signal Gain	Pulsed[2], 2.35 GHz	G_{SS}	-	17.8	-	dB
Saturated Output Power	Pulsed[2], 2.35 GHz	P_{SAT}	-	57.8	-	dBm
Drain Efficiency at Saturation	Pulsed[2], 2.35 GHz	η_{SAT}	-	60.0	-	%
AM/PM	Pulsed[2], 2.35 GHz	Φ	-	5	-	°
Modulated Peak Power	WCDMA[3], 2.35 GHz	$P_{-2.5dB}$[4]	-	57.6	-	dBm
Gain Flatness in 100 MHz	WCDMA[3], P_{OUT} = 49.5 dBm	G_F	-	1.0	-	dB
Gain Variation (-25°C to +105°C)	WCDMA[3], 2.35 GHz, P_{OUT} = 49.5 dBm	ΔG	-	0.014	-	dB/°C
Power Variation (-25°C to +105°C)	Pulsed[2], 2.35 GHz	ΔP_{-1dB}	-	0.002	-	dB/°C
Power Gain	WCDMA[3], 2.35 GHz, P_{OUT} = 49.5 dBm	G_P	-	16.5	-	dB
Drain Efficiency	WCDMA[3], 2.35 GHz, P_{OUT} = 49.5 dBm	η	-	50.1	-	%
Output PAR @ 0.01% CCDF	WCDMA[3], 2.35 GHz, P_{OUT} = 49.5 dBm	PAR	-	8.3	-	dB
Adjacent Channel Power Ratio	WCDMA[3], 2.35 GHz, P_{OUT} = 49.5 dBm	ACPR	-	-32.8	-	dBc
Input Return Loss	WCDMA[3], 2.35 GHz, P_{OUT} = 49.5 dBm	IRL	-	-10	-	dB
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_{DQCAR} = 300 mA, V_{GSPK} = -4.8 V
Note: Performance in MACOM Doherty Production Test Fixture, 50 Ω system

Parameter	Test Conditions	Symbol	Min.	Typ.	Max.	Units
Power Gain	WCDMA[3], 2.35 GHz, P_{OUT} = 49.5 dBm	G_P	14.6	15.8	-	dB
Drain Efficiency	WCDMA[3], 2.35 GHz, P_{OUT} = 49.5 dBm	η	41.7	46.1	-	%
Output PAR @ 0.01% CCDF	WCDMA[3], 2.35 GHz, P_{OUT} = 49.5 dBm	PAR	7.4	8.0	-	dB
Input Return Loss	WCDMA[3], 2.35 GHz, P_{OUT} = 49.5 dBm	IRL	-	-19	-6	dB

2. Pulse details: 100 µs pulse width, 10% Duty Cycle.
3. Modulated Signal: 3.84 MHz, WCMDA 3 GPP TM1 64 DPCH, 9.9 dB PAR @ 0.01% CCDF.
4. P2.5dB = P_{OUT} + 7.5 dB where P_{OUT} is the average output power measured using a modulated signal[3] where the output PAR is compressed to 7.5 dB @ 0.01% probability CCDF.

DC Electrical Characteristics T_A = 25°C

Parameter	Test Conditions	Symbol	Min.	Typ.	Max.	Units
Carrier Amplifier						
Drain-Source Leakage Current (Carrier)	V_{GS} = -8 V, V_{DS} = 130 V	I_{DLK}	-	-	26.9	mA
Gate-Source Leakage Current (Carrier)	V_{GS} = -8 V, V_{DS} = 0 V	I_{GLK}	-	-	26.9	mA
Gate Threshold Voltage	V_{DS} = 50 V, I_D = 26.9 mA	V_T	-4.0	-3.1	-	V
Gate Quiescent Voltage	V_{DS} = 50 V, I_D = 300 mA	V_{GSQ}	-3.1	-2.8	-2.1	V
Maximum Drain Current	V_{DS} = 7 V pulsed, pulse width 300 µs	$I_{D,\ MAX}$	-	22.9	-	A
Peaking Amplifier						
Drain-Source Leakage Current (Peaking)	V_{GS} = -8 V, V_{DS} = 130 V	I_{DLK}	-	-	36.4	mA
Gate-Source Leakage Current (Peaking)	V_{GS} = -8 V, V_{DS} = 0 V	I_{GLK}	-	-	36.4	mA
Gate Threshold Voltage	V_{DS} = 50 V, I_D = 36.4 mA	V_T	-4.0	-3.1	-	V
Gate Quiescent Voltage	V_{DS} = 50 V, I_D = 450 mA	V_{GSQ}	-3.1	-2.8	-2.1	V
Maximum Drain Current	V_{DS} = 7 V pulsed, pulse width 300 µs	$I_{D,\ MAX}$	-	30.9	-	A

Absolute Maximum Ratings[5,6,7,8.9]

Parameter	Absolute Maximum
Drain Source Voltage, V_{DS}	130 V
Gate Source Voltage, V_{GS}	-10 to 3 V
Gate Current (Carrier), I_G	26.9 mA
Gate Current (Peaking), I_G	36.4 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

5. Exceeding any one or combination of these limits may cause permanent damage to this device.
6. MACOM does not recommend sustained operation above maximum operating conditions.
7. Operating at drain source voltage V_{DS} < 55 V will ensure MTTF > 2.51×10^6 hours.
8. Operating at nominal conditions with $T_{CH} \leq 225°C$ will ensure MTTF > 2.51×10^6 hours.
9. 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 = 1.93, B = -45.31, and C = 29,585.

Thermal Characteristics[10]

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)	1.02	°C/W
Thermal Resistance using Infrared Measurement of Die Surface Temperature	V_{DS} = 50 V T_C = 85°C, T_{CH} = 225°C	R_θ(IR)	0.82	°C/W

10. 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 devices.

Pulsed[2] Load-Pull Performance: Reference Plane at Device Leads

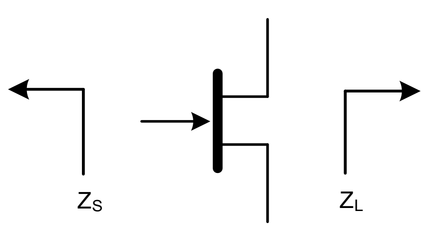
Frequency (GHz)	Z_{SOURCE} (Ω)	Carrier Amplifier: Maximum Output Power V_{DS} = 50 V, I_{DQ} = 360 mA, T_C = 25°C, P2.5dB					
		Z_{LOAD}[11] (Ω)	Gain (dB)	P_{OUT} (dBm)	P_{OUT} (W)	η_D (%)	AM/PM (°)
2.3	5.5 - j8.2	5.5 - j4.1	18.9	54.2	263	62.3	2.7
2.35	7.3 - j6.8	5.9 - j3.8	18.8	54.1	257	61.4	5.3
2.4	8.7 - j5.2	6.2 - j3.7	18.9	54.1	257	62.2	7.5

Frequency (GHz)	Z_{SOURCE} (Ω)	Carrier Amplifier: Maximum Drain Efficiency V_{DS} = 50 V, I_{DQ} = 360 mA, T_C = 25°C, P2.5dB					
		Z_{LOAD}[12] (Ω)	Gain (dB)	P_{OUT} (dBm)	P_{OUT} (W)	η_D (%)	AM/PM (°)
2.3	5.5 - j8.2	2.6 - j4.9	20.6	52.7	186	72.7	4.1
2.35	7.3 - j6.8	2.8 - j5.1	20.6	52.8	191	72.7	6.3
2.4	8.7 - j5.2	3.0 - j5.3	20.6	52.7	186	73.4	8.2

Frequency (GHz)	Z_{SOURCE} (Ω)	Peaking Amplifier: Maximum Output Power V_{DS} = 50 V, I_{DQ} = 450 mA, T_C = 25°C, P2.5dB					
		Z_{LOAD}[11] (Ω)	Gain (dB)	P_{OUT} (dBm)	P_{OUT} (W)	η_D (%)	AM/PM (°)
2.3	8.1 - j2.5	5.1 - j6.9	17.8	55.6	363	59.1	3.4
2.35	6.8 - j0.0	5.6 - j7.1	17.3	55.6	363	59.4	10.6
2.4	5.3 - j0.4	5.9 - j7.0	17.4	55.6	363	60.1	3.9

Frequency (GHz)	Z_{SOURCE} (Ω)	Peaking Amplifier: Maximum Drain Efficiency V_{DS} = 50 V, I_{DQ} = 450 mA, T_C = 25°C, P2.5dB					
		Z_{LOAD}[12] (Ω)	Gain (dB)	P_{OUT} (dBm)	P_{OUT} (W)	η_D (%)	AM/PM (°)
2.3	6.7 + j0.2	2.4 - j6.9	19.1	54.3	269	68.6	2.7
2.35	4.4 + j1.1	2.6 - j6.6	18.8	54.4	275	69.3	2.4
2.4	3.0 - j0.2	2.8 - j6.9	17.4	54.2	263	68.4	2.9

Impedance Reference

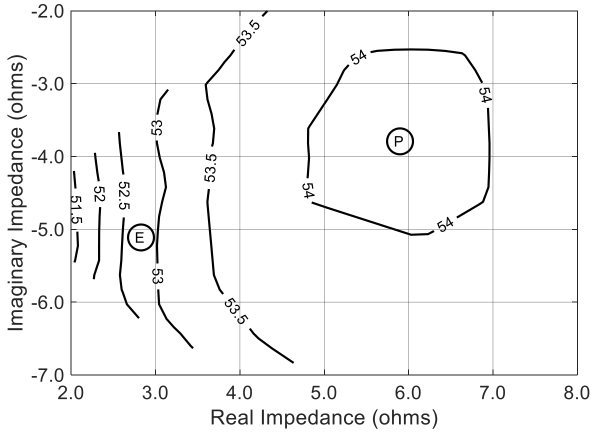


Z_{SOURCE} = Measured impedance presented to the input of the device at package reference plane.
Z_{LOAD} = Measured impedance presented to the output of the device at package reference plane.

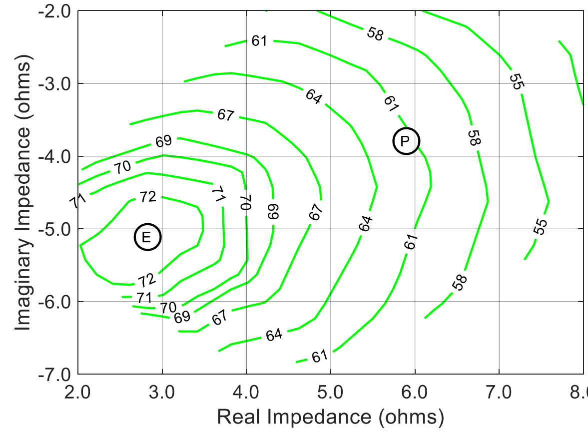
11. Load Impedance for optimum output power.
12. Load Impedance for optimum efficiency.

Pulsed² Load-Pull Performance: Carrier Amplifier 2.35 GHz

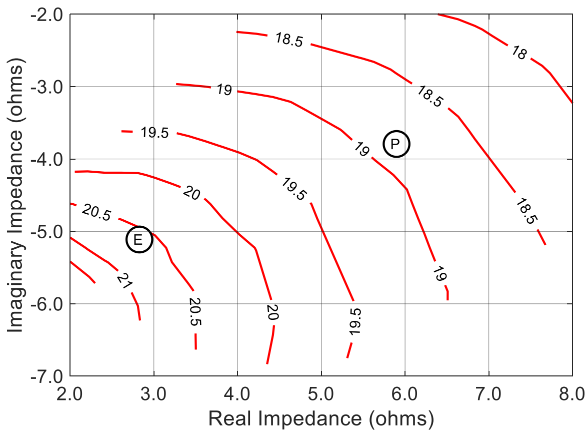
P2.5dB Loadpull Output Power Contours (dBm)



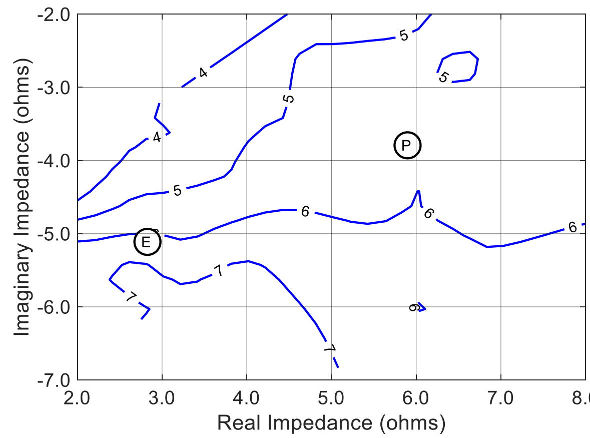
P2.5dB Loadpull Drain Efficiency Contours (%)



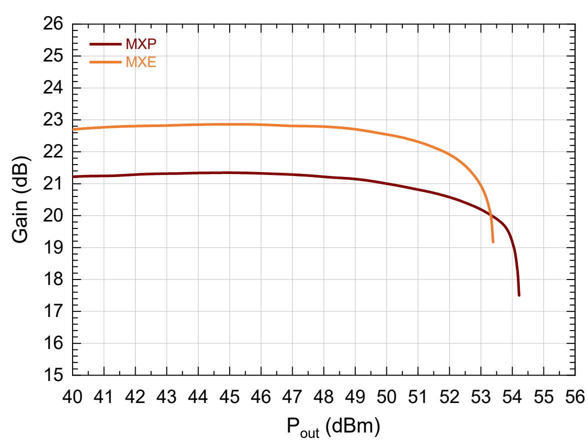
P2.5dB Loadpull Gain Contours (dB)



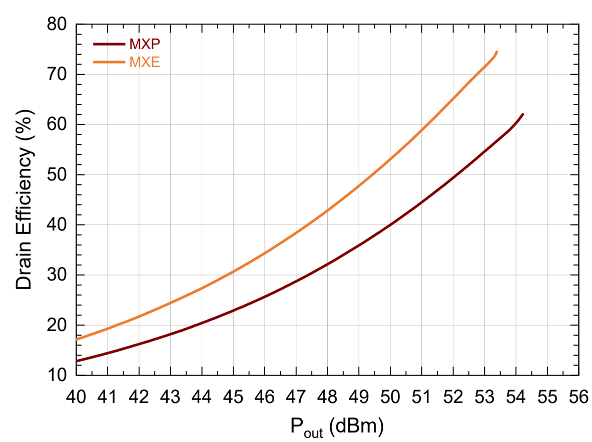
P2.5dB Loadpull AM/PM Contours (°)



Gain vs. Output Power

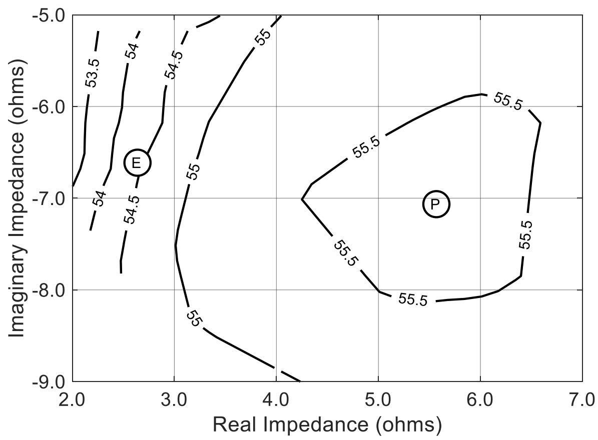


Drain Efficiency vs. Output Power

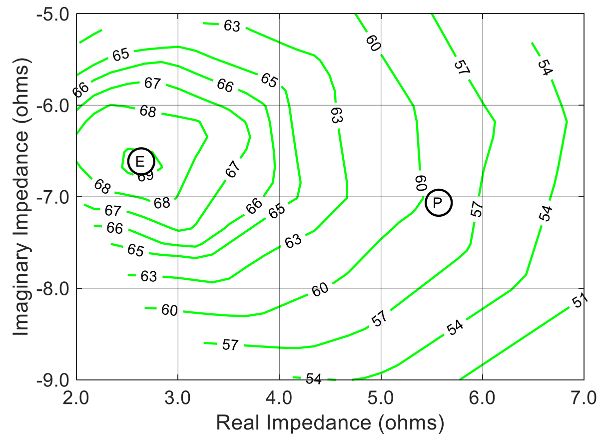


Pulsed[2] Load-Pull Performance: Peaking Amplifier 2.35 GHz

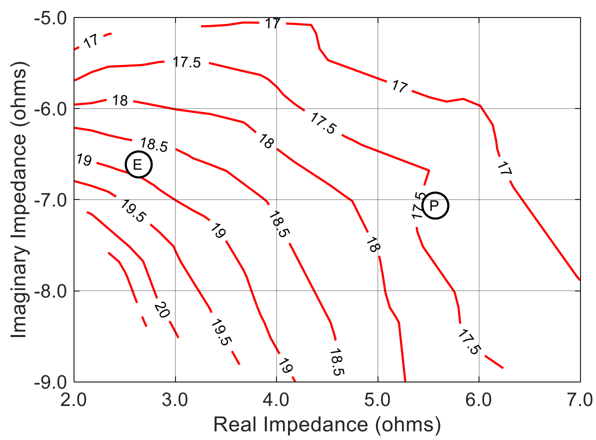
P2.5dB Loadpull Output Power Contours (dBm)



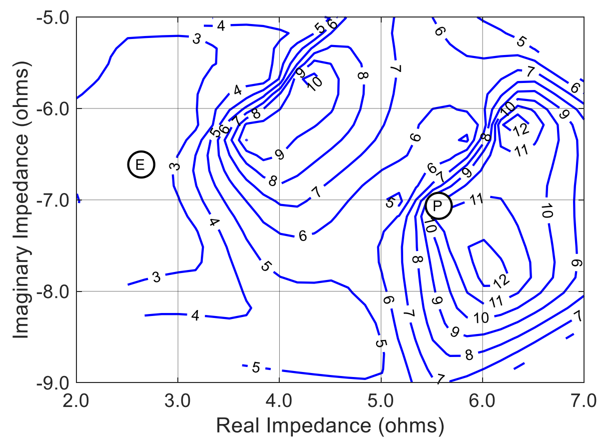
P2.5dB Loadpull Drain Efficiency Contours (%)



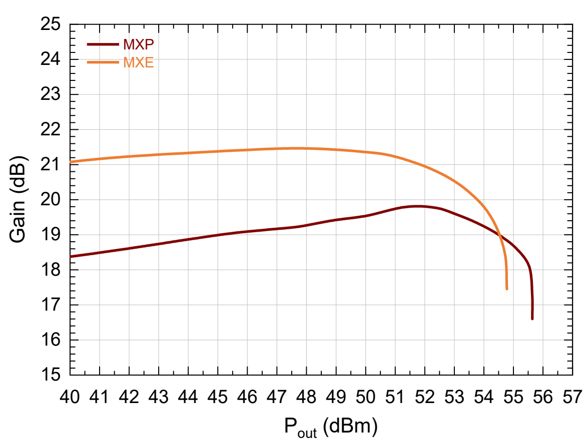
P2.5dB Loadpull Gain Contours (dB)



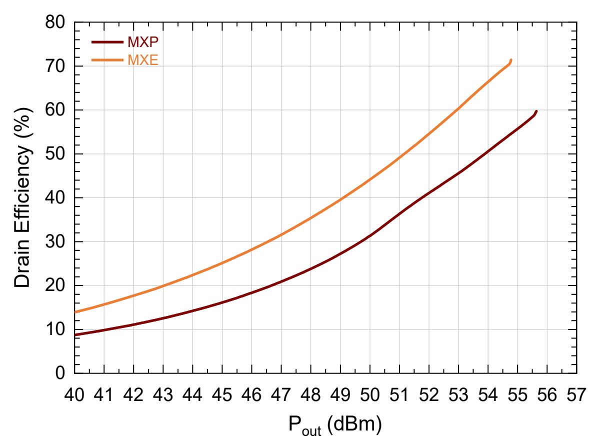
P2.5dB Loadpull AM/PM Contours (°)



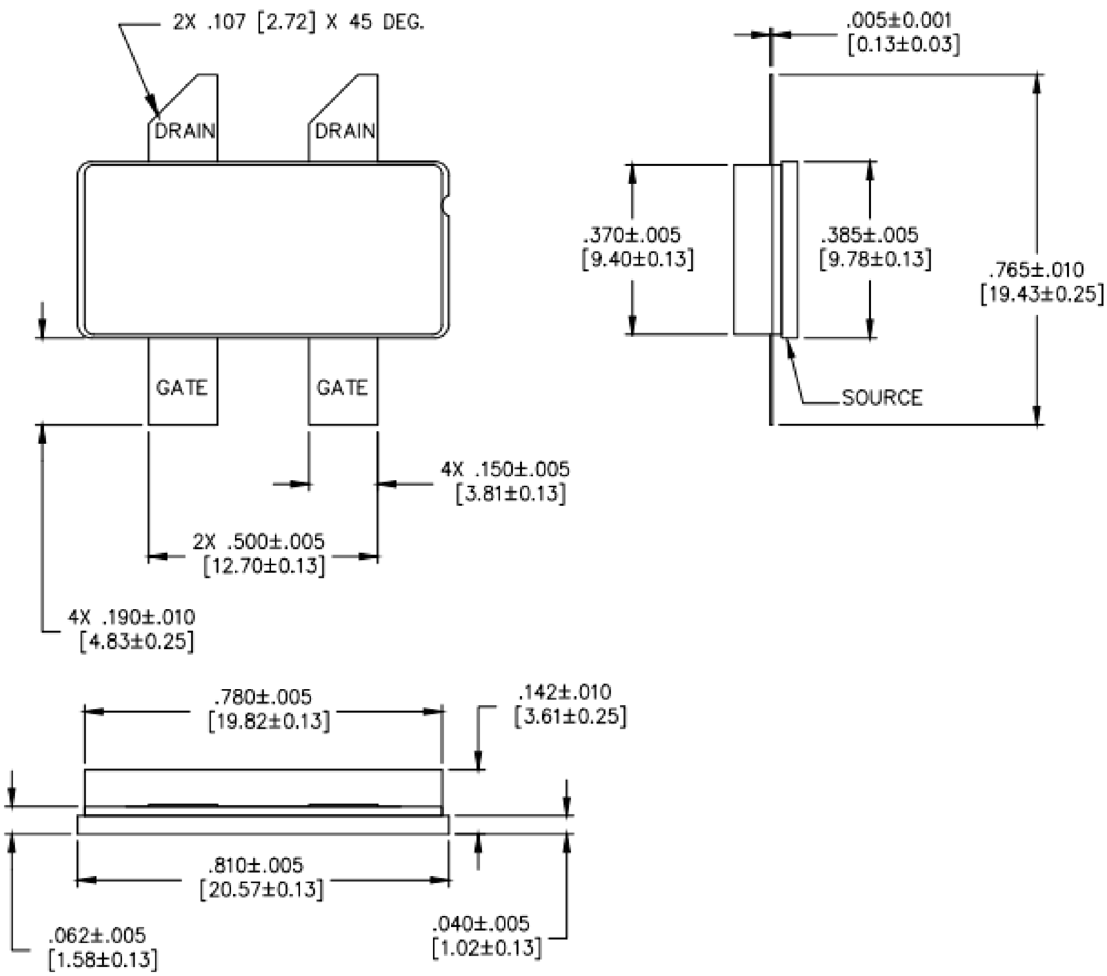
Gain vs. Output Power



Drain Efficiency vs. Output Power



Lead-Free AC-780S-4 Package Dimensions†



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 AN0004363 for lead-free solder reflow recommendations.
Meets JEDEC moisture sensitivity level 3 requirements.
Plating is Au.