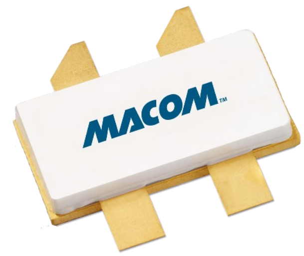
Features

- *MACOM PURE CARBIDE™* Amplifier Series
- Suitable for Linear & Saturated Applications
- CW Operation: 400 W Output Power
- 260°C Reflow Compatible
- 45 V Operation
- 100% RF Tested
- RoHS* Compliant



AC-780S-4

Description

The MAPC-A1524 is a GaN on Silicon Carbide HEMT D-mode amplifier suitable for 1.7 - 2.2 GHz frequency operation. The device supports both pulsed and CW operation with minimum output power levels of 400 W (56 dBm) in an air cavity ceramic package.

Typical RF Performance:

Measured under load-pull at 3 dB compression, 100 µs pulse width, 10% duty cycle.

- V_{DS} = 45 V, I_{DQ} = 550 mA, T_C = 25°C

Frequency (GHz)	Output Power[1] (dBm)	Gain[2] (dB)	η_D[2] (%)
1.7	56.7	16.9	73.4
1.8	56.2	17.6	70.2
1.9	56.7	18.1	70.7
2.0	56.5	18.4	72.6
2.1	56.5	18.2	74.3
2.2	56.3	17.6	73.4

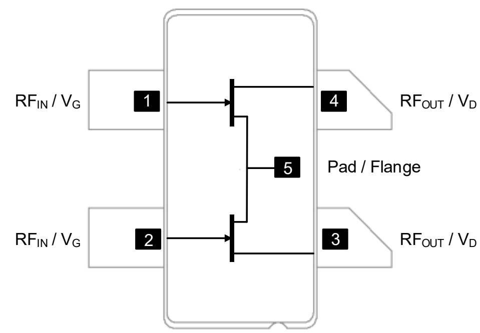
1. Load impedance tuned for maximum drain efficiency. Power is twice single side performance.
2. Load impedance tuned for maximum drain efficiency.

Measured on evaluation board at 3 dB compression, CW excitation.

- V_{DS} = 45 V, I_{DQ} = 100 mA, T_C = 25°C

Frequency (GHz)	Output Power (dBm)	Gain (dB)	η_D (%)
2.0	56.9	15.7	70.0
2.1	56.8	15.7	67.9
2.2	56.2	15.8	67.7

Functional Schematic



Pin Configuration

Pin #	Pin Name	Function
1	RF_{IN} / V_{G1}	RF Input / Gate
2	RF_{OUT} / V_{D1}	RF Output / Drain
3	RF_{IN} / V_{G2}	RF Input / Gate
4	RF_{OUT} / V_{D2}	RF Output / Drain
5	Flange[3]	Ground / Source

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

Ordering Information

Part Number	Package
MAPC-A1524-AS000	Bulk Quantity
MAPC-A1524-ASTR1	Tape and Reel
MAPC-A1524-ASSB1	Sample Board

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

RF Electrical Characteristics: T_C = 25°C, V_{DS} = 45 V, I_{DQ} = 100 mA
Note: Performance in MACOM Evaluation Test Fixture, 50 Ω system

Parameter	Test Conditions	Symbol	Min.	Typ.	Max.	Units
Power Gain	CW, 2.1 GHz, 3 dB Gain Compression	G_{SAT}	-	15.7	-	dB
Saturated Drain Efficiency	CW, 2.1 GHz, 3 dB Gain Compression	η_{SAT}	-	67.9	-	%
Saturated Output Power	CW, 2.1 GHz, 3dB Gain Compression	P_{SAT}	-	56.8	-	dBm
Gain Variation (-40°C to +85°C)	CW, 2.1 GHz	ΔG	-	-0.02	-	dB/°C
Power Variation (-40°C to +85°C)	CW, 2.1 GHz	ΔP3dB	-	-0.005	-	dB/°C
Ruggedness: Output Mismatch	Pulsed[4], All phase angles	Ψ	VSWR = 10:1, No Damage			

RF Electrical Specifications: T_A = 25°C, V_{DS} = 45 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	Pulsed[4], 2.1 GHz, 3 dB Gain Compression	G_{SAT}	14.8	15.6	-	dB
Saturated Drain Efficiency	Pulsed[4], 2.1 GHz, 3 dB Gain Compression	η_{SAT}	61.0	65.0	-	%
Saturated Output Power	Pulsed[4], 2.1 GHz, 3 dB Gain Compression	P_{SAT}	55.4	56.2	-	dBm

4. 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} = 130 V	I_{DLK}	-	-	72.8	mA
Gate-Source Leakage Current	V_{GS} = -8 V, V_{DS} = 0 V	I_{GLK}	-	-	72.8	mA
Gate Threshold Voltage	V_{DS} = 50 V, I_D = 72.8 mA	V_T	-	-3.1	-	V
Gate Quiescent Voltage	V_{DS} = 50 V, I_D = 100 mA	V_{GSQ}	-	-2.7	-	V
Maximum Drain Current	V_{DS} = 7 V, pulse width 300 μs	$I_{D, MAX}$	-	61.9	-	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, I_G	72.8 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
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 x 10^6 hours.
8. Operating at nominal conditions with $T_{CH} \leq 200°C$ will ensure MTTF > 2 x 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, B = -38.215, and C = 26,343.

Thermal Characteristics[10]

Parameter	Test Conditions	Symbol	Typical	Units
Thermal Resistance using Finite Element Analysis	V_{DS} = 45 V, T_C = 85°C, T_{CH} = 225°C	R_θ (FEA)	0.527	°C/W
Thermal Resistance using Infrared Measurement of Die Surface Temperature	V_{DS} = 45 V, T_C = 85°C, T_{CH} = 225°C	R_θ (IR)	0.474	°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

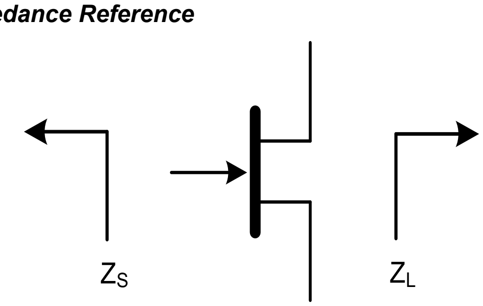
Gallium Nitride Circuits are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. Proper ESD control techniques should be used when handling.

Pulsed[4] Load-Pull Performance at 45 V - Per Side
Reference Plane at Device Leads

Frequency (GHz)	Z_{SOURCE} (Ω)	Maximum Output Power V_{DS} = 45 V, I_{DQ} = 550 mA, T_C = 25°C, P3dB					
		Z_{LOAD}[11] (Ω)	Gain (dB)	P_{OUT} (dBm)	P_{OUT} (W)	η_D (%)	AM/PM (°)
1.7	3 - j6.5	6.3 - j4.5	15.5	55.1	324	59.8	-12.1
1.8	3 - j8	7.3 - j4.4	15.8	54.8	302	58.7	-24.2
1.9	4 - j10	8.5 - j4.1	16.4	54.8	302	59.6	-36.8
2.0	7 - j11	9.3 - j2.4	17.0	54.9	309	61.4	-62.1
2.1	18 - j6	8.9 + j0.3	16.7	55.0	316	62.8	-109.2
2.2	9 + j5	6.8 + j2.1	16.3	54.9	309	62.4	188.2

Frequency (GHz)	Z_{SOURCE} (Ω)	Maximum Drain Efficiency V_{DS} = 45 V, I_{DQ} = 550 mA, T_C = 25°C, P3dB					
		Z_{LOAD}[12] (Ω)	Gain (dB)	P_{OUT} (dBm)	P_{OUT} (W)	η_D (%)	AM/PM (°)
1.7	3 - j6.5	2.5 - j3.7	16.9	53.7	234	73.4	-7.7
1.8	3 - j8	2.9 - j4.5	17.6	53.2	209	70.2	-16.4
1.9	4 - j10	4.0 - j5.1	18.1	53.7	234	70.7	-28.6
2.0	7 - j11	4.6 - j5.6	18.4	53.5	224	72.6	-51.6
2.1	18 - j6	6.2 - j5.6	18.2	53.5	224	74.3	-103.2
2.2	9 + j5	8.2 - j4.5	17.6	53.3	213	73.4	193.6

Impedance Reference

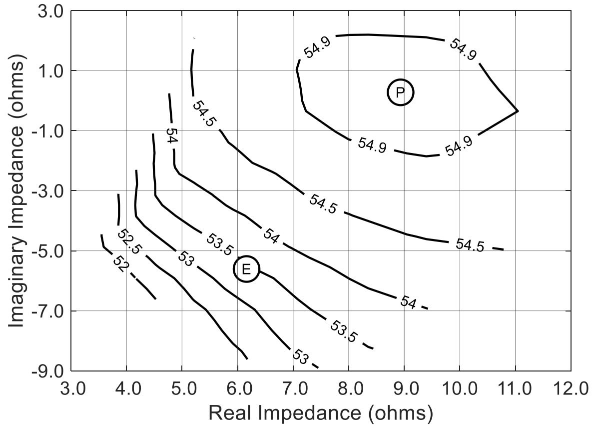


Z_{SOURCE} = Measured impedance presented to the input of the device at package reference plane.
Z_{LOAD} = Measured impedance presented to the output of the device at package reference plane.

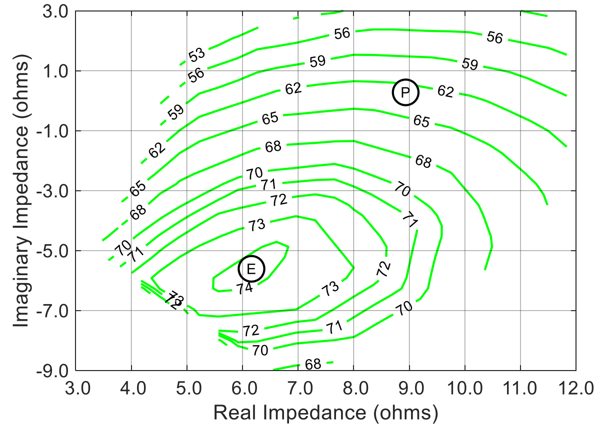
11. Load Impedance for optimum output power.
12. Load Impedance for optimum efficiency.

Pulsed[4] 45 V Load-Pull Performance @ 2.1 GHz - Per Side

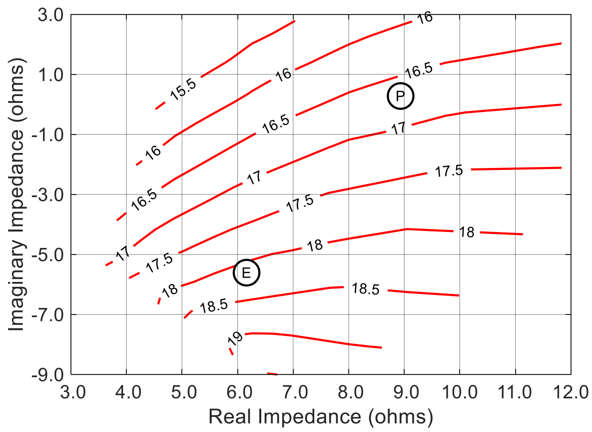
P3dB Loadpull Output Power Contours (dBm)



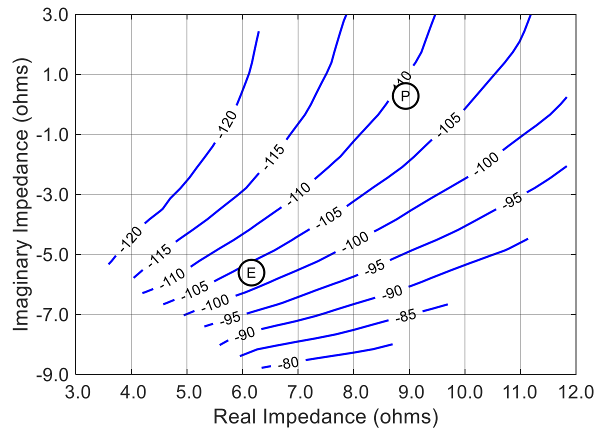
P3dB Loadpull Drain Efficiency Contours (%)



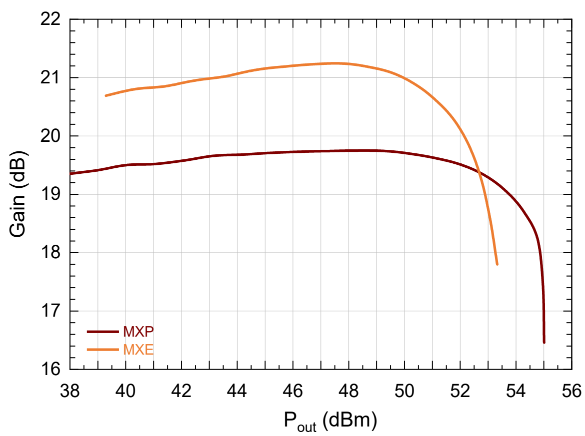
P3dB Loadpull Gain Contours (dB)



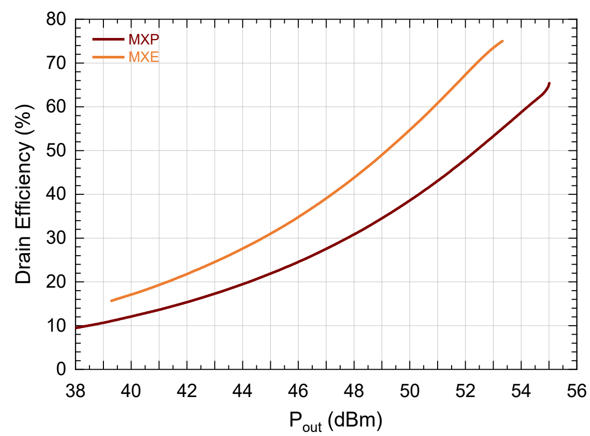
P3dB Loadpull AM/PM Contours (°)



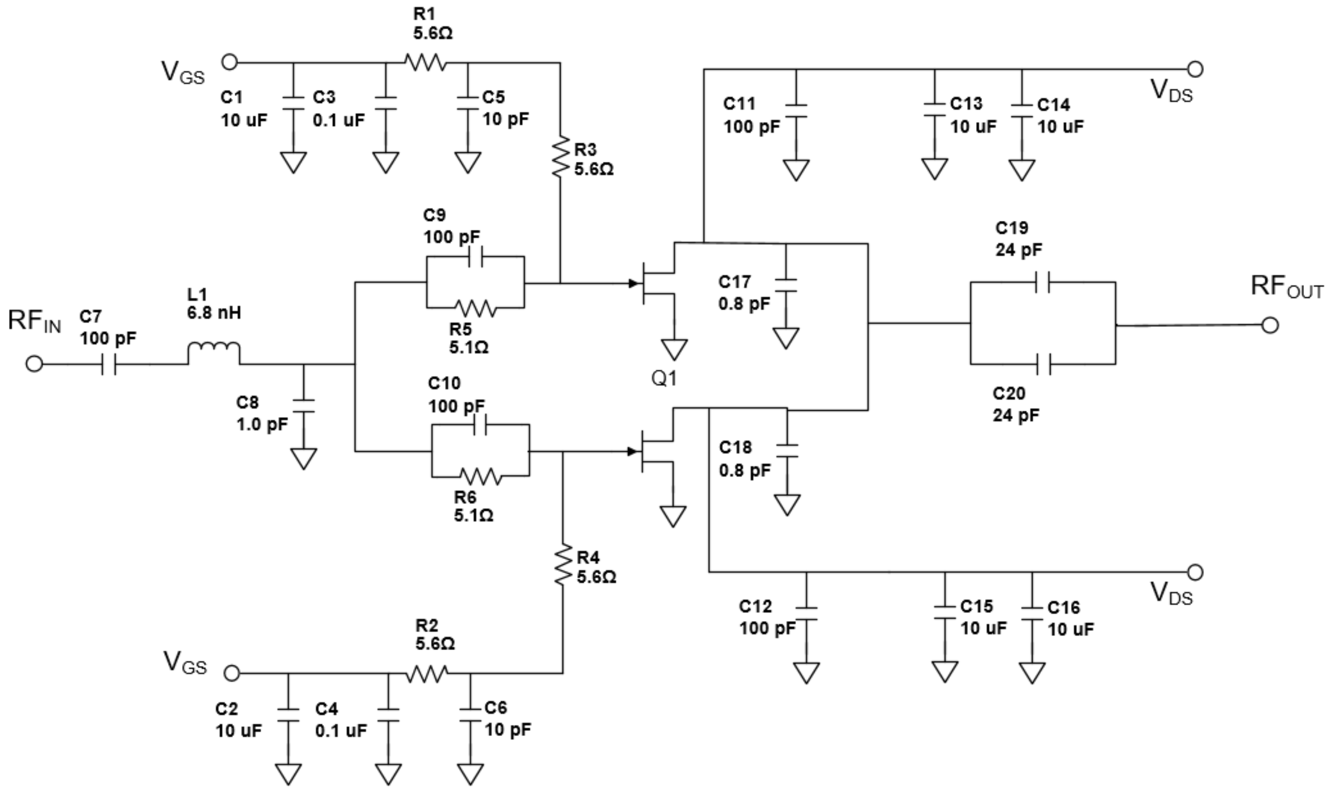
Gain vs. Output Power



Drain Efficiency vs. Output Power



Evaluation Test Fixture and Recommended Tuning Solution 2.0 - 2.2 GHz



Description

Parts measured on evaluation board (20-mil thick RT6035HTC). 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

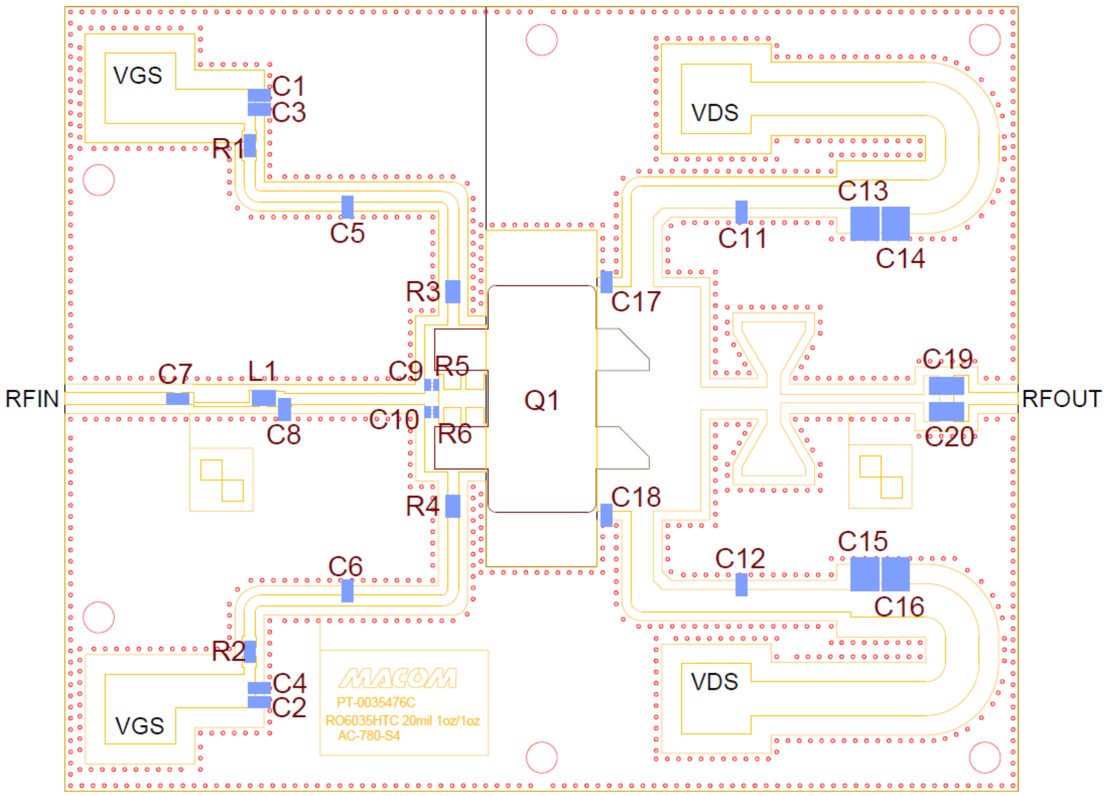
Turning the device ON

1. Set V_{GS} to pinch-off (-4 V).
2. Turn on V_{DS} to nominal voltage (45 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 –4V .
3. Decrease V_{DS} down to 0 V.
4. Turn off V_{GS}.

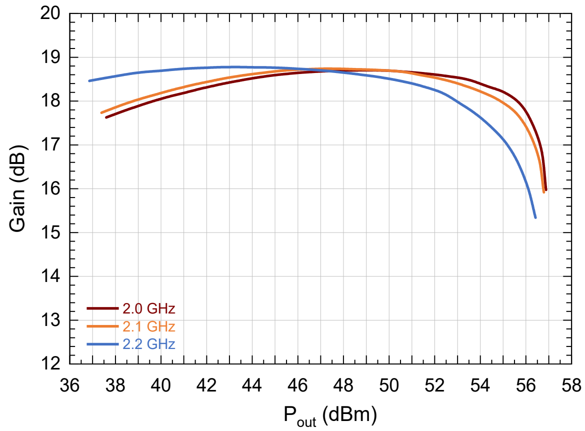
Evaluation Test Fixture and Recommended Tuning Solution 2.0 - 2.2 GHz



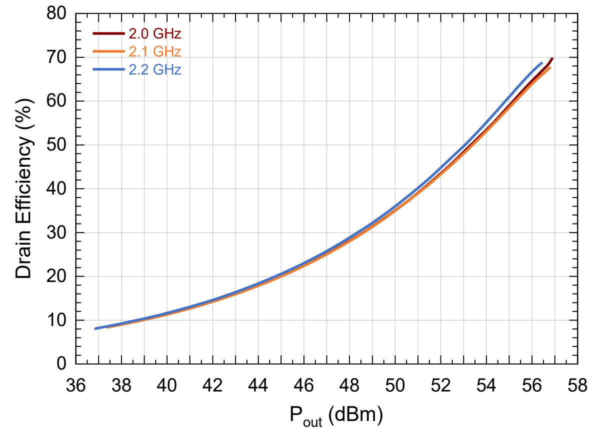
Reference Designator	Value	Tolerance	Manufacturer	Part Number
C1, C2	10 µF	+/- 10 %	Murata	GRM21BR6YA106KE43L
C3, C4	0.1 µF	+/- 10 %	Murata	GRM21BR72A104KAC4L
C5, C6	10 pF	+/- 2 %	Murata	GQM2195C2E100GB12D
C7, C11, C12	100 pF	+/- 5 %	Kyocera/AVX	600F101JT250X
C8	1 pF	+/- 0.1 pF	Kyocera/AVX	600F1R0BT250X
C9, C10	100 pF	+/- 5 %	Murata	GRM1555C1H101JA01D
C13, C14, C15, C16	10 µF	+/- 10 %	Murata	GRM32EC72A106KE05L
C17, C18	0.8 pF	+/- 0.1 pF	Kyocera/AVX	600F0R8BT250X
C19, C20	24 pF	+/- 5 %	Vishay	VJ1111D240JEQJHT
R1, R2, R3, R4	5.6 Ω	+/- 0.5 %	Yageo	RT0805DRE075R6L
R5, R6	5.1 Ω	+/- 0.5 %	Yageo	RT0402DRE075R1L
L1	6.8 nH	+/- 5 %	Coilcraft	0805CS-060XJR
Q1	MACOM GaN Power Amplifier			MAPC-A1524
PCB	RO6035HTC, 20 mil, 1.0 oz. Cu, Au Finish			

Typical Performance Curves as Measured in the 2.0 - 2.2 GHz Evaluation Test Fixture:
CW 2.1 GHz, V_{DS} = 45 V, I_{DQ} = 100 mA, T_C = 25°C (Unless Otherwise Noted)

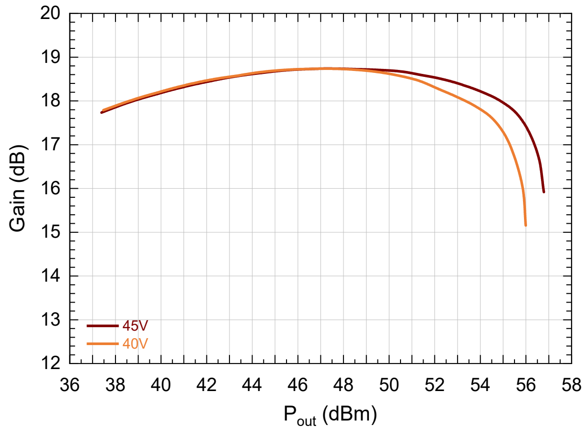
Gain vs. Output Power and Frequency



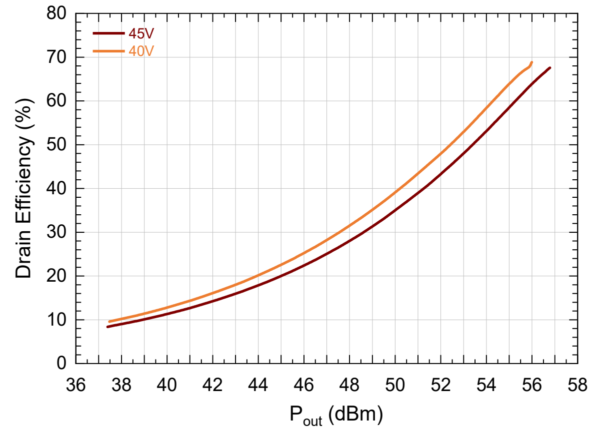
Drain Efficiency vs. Output Power and Frequency



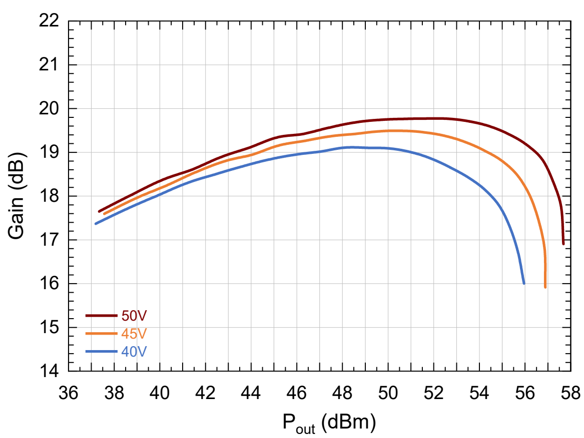
Gain vs. Output Power and V_{DS}



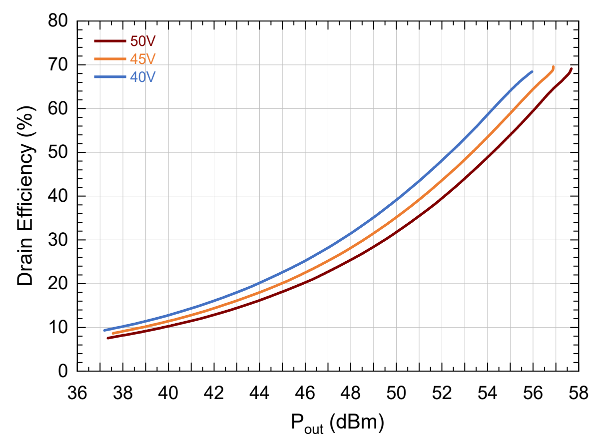
Drain Efficiency vs. Output Power and V_{DS}



Pulsed[4] Gain vs. Output Power and V_{DS}



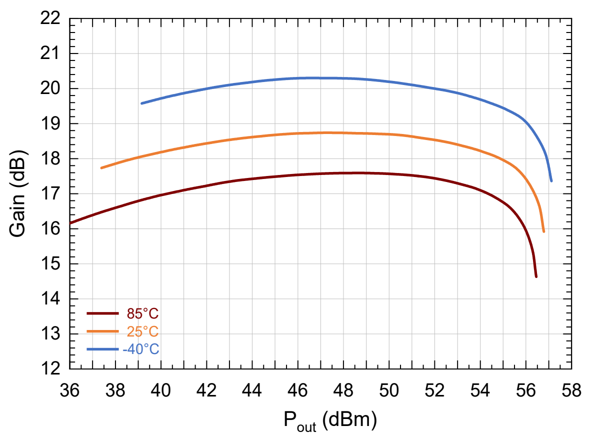
Pulsed[4] Drain Efficiency vs. Output Power and V_{DS}



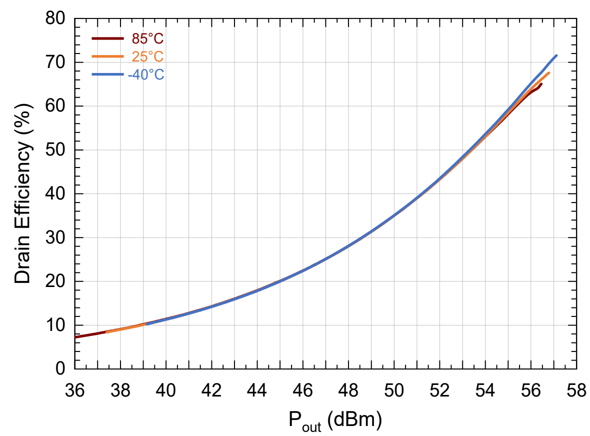
Typical Performance Curves as Measured in the 2.0 - 2.2 GHz Evaluation Test Fixture:

CW 2.1 GHz, V_{DS} = 45 V, I_{DQ} = 100 mA, T_C = 25°C (Unless Otherwise Noted)

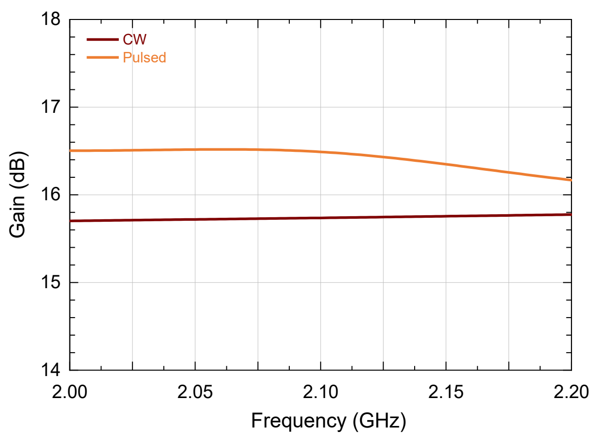
Gain vs. Output Power and Temperature



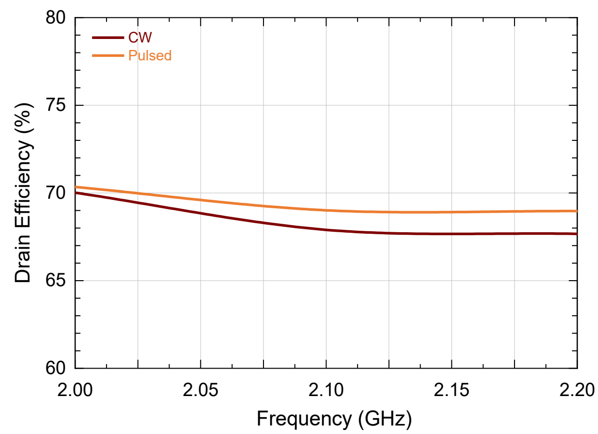
Drain Efficiency vs. Output Power and Temperature



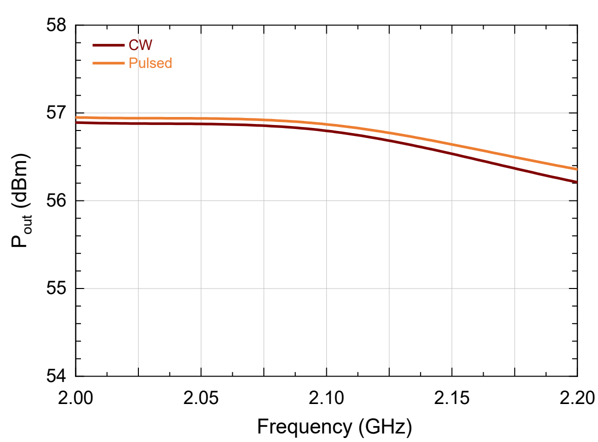
Gain vs. Frequency, 3dB Compression



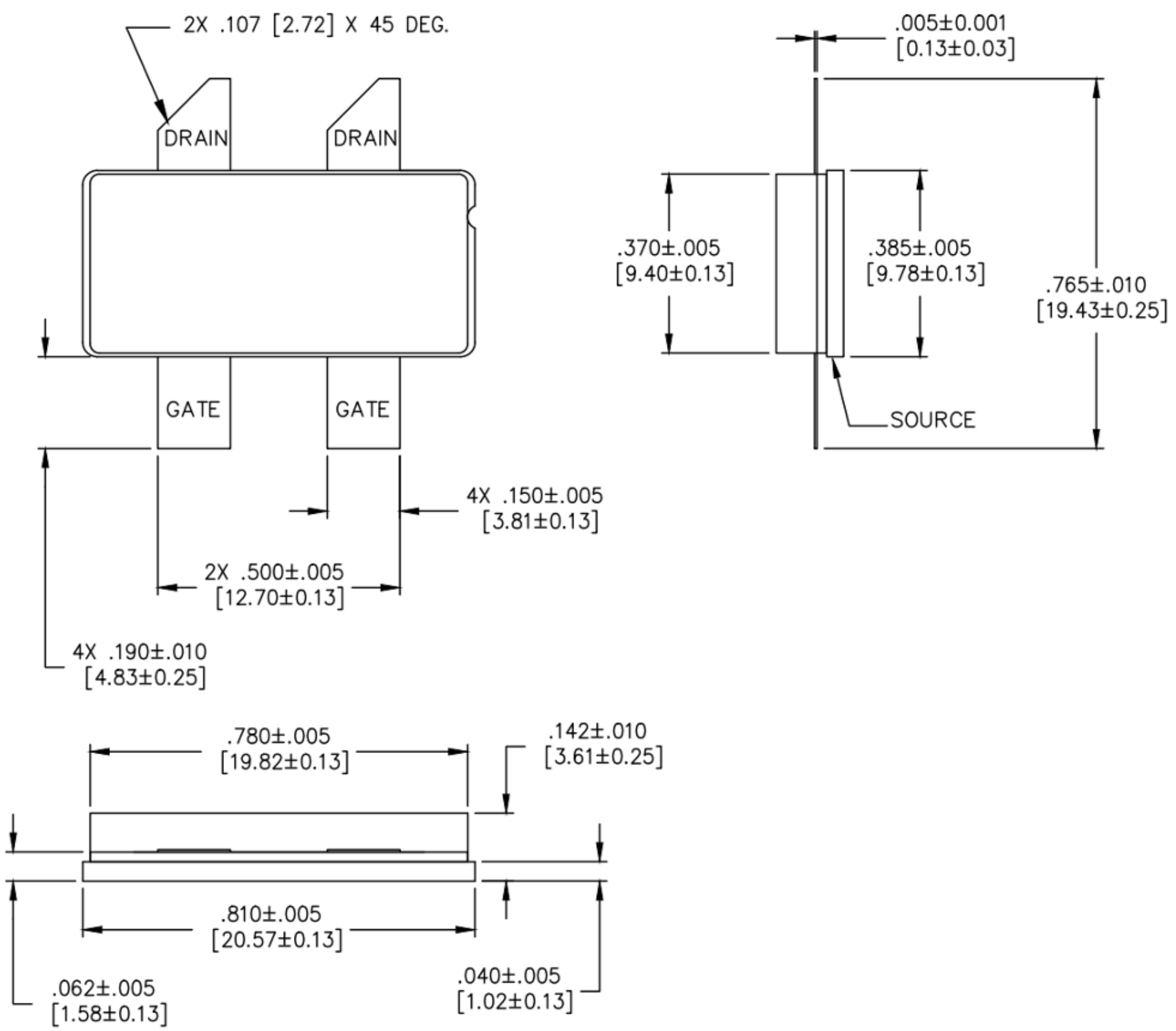
Drain Efficiency vs. Frequency, 3dB Compression



Output Power vs. Frequency, 3dB Compression



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 mounting recommendations.
Meets JEDEC moisture sensitivity level 3 requirements.
Plating is Au.