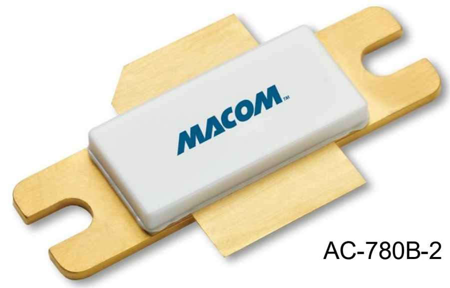
Features

- Suitable for Linear and Saturated Applications
- Pulsed Operation: 500 W Output Power
- Internally Pre-Matched
- 260°C Reflow Compatible
- 50 V Operation
- 100% RF Tested
- RoHS* Compliant



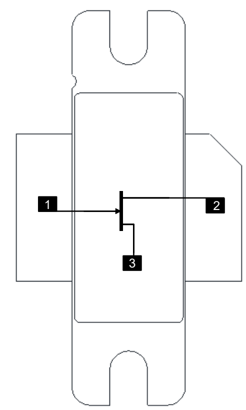
AC-780B-2

Description

The MAGX-101214-500L00 is a high power GaN on Si HEMT D-mode amplifier designed for 500 W peak power and optimized for 1.2 - 1.4 GHz frequency operation. This device supports pulsed and linear operation with peak output power levels of 500 W (57 dBm) in an air cavity ceramic package.

The MAGX-101214-500L00 is ideally suited for long pulse applications as a highly efficient, precise heat and power source. The wide range of applications includes solid state cooking, RF plasma generation, material drying, industrial heating, automotive ignition, lighting and medical.

Functional Schematic



Typical Performance:

- V_{DS} = 50 V, I_{DQ} = 150 mA, T_C = 25°C. Measured under load-pull at 2.5 dB Compression, 100 µs pulse width, 10% duty cycle.

Frequency (GHz)	Output Power[1] (dBm)	Gain[2] (dB)	η_D[2] (%)
1.2	58.6	17.9	71.3
1.3	58.4	17.4	73.2
1.4	58.3	16.8	73.5

1. Load impedance tuned for maximum output power.
2. Load impedance tuned for maximum drain efficiency.

Pin Configuration

Pin #	Pin Name	Function
1	RF_{IN} / V_G	RF Input / Gate
2	RF_{OUT} / V_D	RF Output / Drain
3	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
MAGX-101214-500L00	Bulk Quantity
MAGX-101214-500LT0	Tape and Reel
MAGX-1P1214-500L00	Sample Board

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

RF Electrical Characteristics: T_C = 25°C, V_{DS} = 50 V, I_{DQ} = 150 mA
Note: Performance in MACOM Evaluation Test Fixture, 50 Ω system

Parameter	Test Conditions	Symbol	Min.	Typ.	Max.	Units
Small Signal Gain	Pulsed[4], 1.4 GHz	G_{SS}	-	17.8	-	dB
Power Gain	Pulsed[4], 1.4 GHz, 2.5 dB Gain Compression	G_{SAT}	-	15.3	-	dB
Saturated Drain Efficiency	Pulsed[4], 1.4 GHz, 2.5 dB Gain Compression	η_{SAT}	-	73.5	-	%
Saturated Output Power	Pulsed[4], 1.4 GHz, 2.5 dB Gain Compression	P_{SAT}	-	57.3	-	dBm
Gain Variation	Pulsed[4], 1.4 GHz, -40°C to +85°C	ΔG	-	0.013	-	dB/°C
Power Variation	Pulsed[4], 1.4 GHz, -40°C to +85°C	ΔP2.5dB	-	0.005	-	dB/°C
Power Gain	Pulsed[4], 1.4 GHz, P_{IN} = 40.6 dBm	G_P	-	16.4	-	dB
Drain Efficiency	Pulsed[4], 1.4 GHz, P_{IN} = 40.6 dBm	η	-	71.8	-	%
Input Return Loss	Pulsed[4], 1.4 GHz, P_{IM} = 40.6 dBm	IRL	-	-8.4	-	dB
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} = 150 mA
Note: Performance in MACOM Production Test Fixture, 50 Ω system

Parameter	Test Conditions	Symbol	Min.	Typ.	Max.	Units
Power Gain	Pulsed[4], 1.4 GHz, 2.5 dB Gain Compression	G_{SAT}	13.1	13.9	-	dB
Saturated Drain Efficiency	Pulsed[4], 1.4 GHz, 2.5 dB Gain Compression	η_{SAT}	64.5	68.5	-	%
Saturated Output Power	Pulsed[4], 1.4 GHz, 2.5 dB Gain Compression	P_{SAT}	56.6	57.2	-	dBm
Gain	Pulsed[4], 1.4 GHz, P_{IN} = 41.3 dBm	G_P	14.7	15.5	-	dB
Drain Efficiency	Pulsed[4], 1.4 GHz, P_{IN} = 41.3 dBm	η	60	65.6	-	%
Input Return Loss	Pulsed[4], 1.4 GHz, P_{IN} = 41.3 dBm	IRL	-	-7.6	-5	dB

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}	-	-	82	mA
Gate-Source Leakage Current	V_{GS} = -8 V, V_{DS} = 0 V	I_{GLK}	-	-	82	mA
Gate Threshold Voltage	V_{DS} = 50 V, I_D = 82 mA	V_T	-2.6	-2.35	-	V
Gate Quiescent Voltage	V_{DS} = 50 V, I_D = 150 mA	V_{GSQ}	-2.4	-2.15	-1.4	V
On Resistance	V_{GS} = 2 V, I_D = 608 mA	R_{ON}	-	0.09	-	Ω
Maximum Drain Current	V_{DS} = 7 V, pulse width 300 µs	$I_{D, MAX}$	-	47.2	-	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	82 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 > 1 x 10^7 hours.
8. Operating at nominal conditions with $T_{CH} \leq 225°C$ will ensure MTTF > 1 x 10^7 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* = 3.686, *B* = -35.00, and *C* = 25,416.

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)	0.57	°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)	0.46	°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

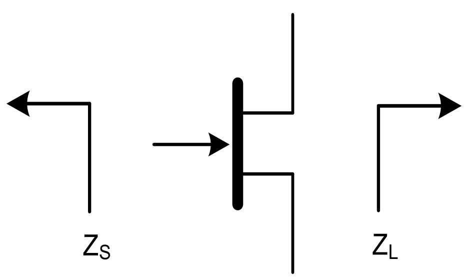
Gallium Nitride Circuits are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. Proper ESD control techniques should be used when handling these HBM Class 2, CDM Class C3 devices.

Pulsed[4] Load-Pull Performance
Reference Plane at Device Leads

Frequency (GHz)	Z_{SOURCE} (Ω)	Maximum Output Power V_{DS} = 50 V, I_{DQ} = 150 mA, T_C = 25°C, P2.5 dB					
		Z_{LOAD}[11] (Ω)	Gain (dB)	P_{OUT} (dBm)	P_{OUT} (W)	η_D (%)	AM/PM (°)
1.2	0.3 - j1.9	0.65 + j0.15	16.7	58.6	724.4	61.8	53.8
1.3	0.4 - j2.2	0.65 + j0.25	16.1	58.4	691.8	61.3	47.4
1.4	0.7 - j2.8	0.65 + j0.27	15.8	58.3	676.1	62	35.2

Frequency (GHz)	Z_{SOURCE} (Ω)	Maximum Drain Efficiency V_{DS} = 50 V, I_{DQ} = 150 mA, T_C = 25°C, P2.5 dB					
		Z_{LOAD}[12] (Ω)	Gain (dB)	P_{OUT} (dBm)	P_{OUT} (W)	η_D (%)	AM/PM (°)
1.2	0.4 - j2.0	0.87 + j0.57	17.9	56.5	446.7	71.3	33.7
1.3	0.5 - j2.5	0.78 + j0.57	17.4	55.9	389	73.2	25.1
1.4	1.0 - j3.1	0.75 + j0.42	16.8	56.1	407.4	73.5	13.9

Impedance Reference

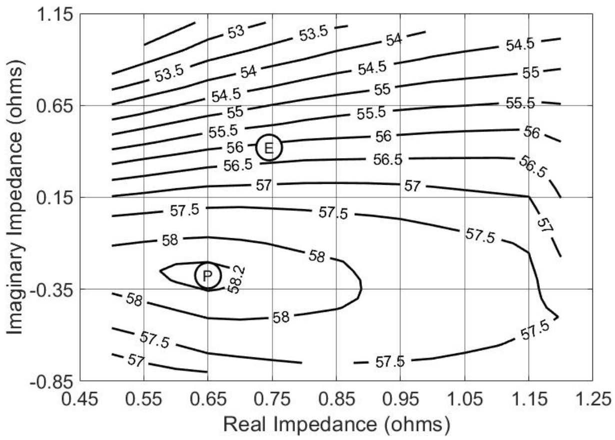


Z_{SOURCE} = Measured impedance presented to the input of the device at package reference plane.
Z_{LOAD} = Measured impedance presented to the output of the device at package reference plane.

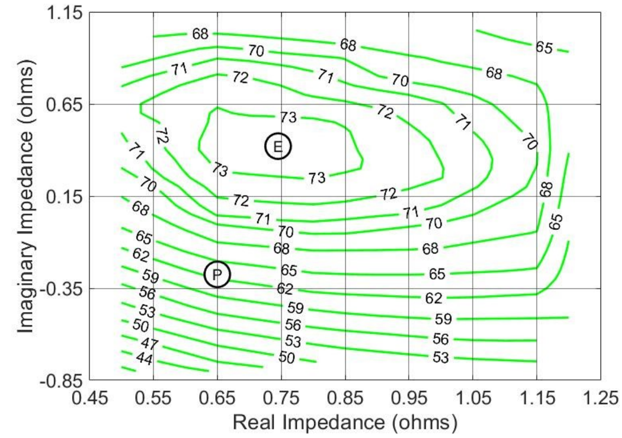
11. Load Impedance for optimum output power.
12. Load Impedance for optimum efficiency.

Pulsed[4] Load-Pull Performance @ 1.4 GHz

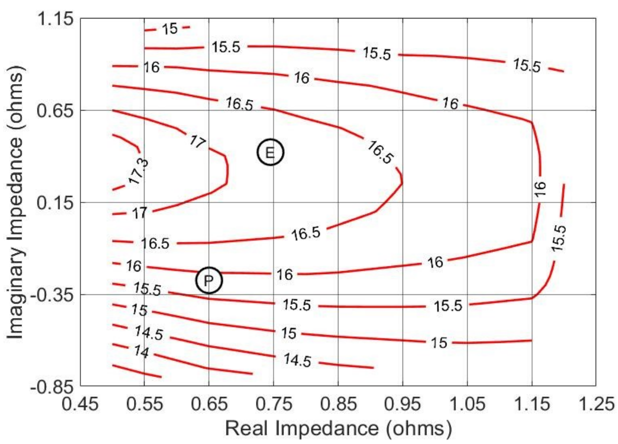
P2.5dB Loadpull Output Power Contours (dBm)



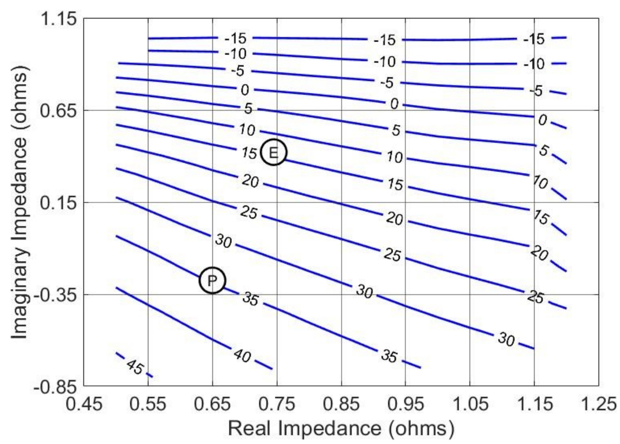
P2.5dB Loadpull Drain Efficiency Contours (%)



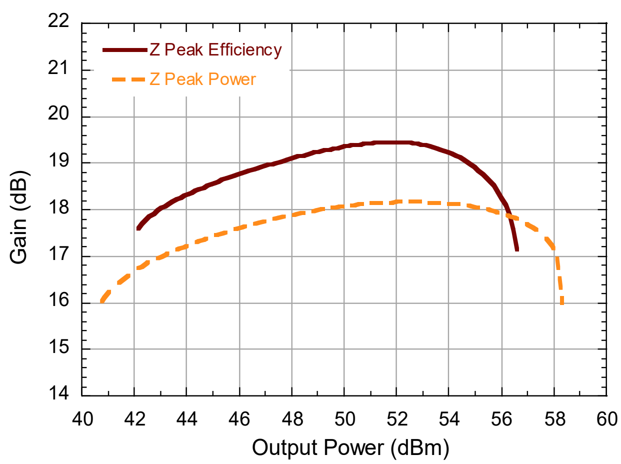
P2.5dB Loadpull Gain Contours (dB)



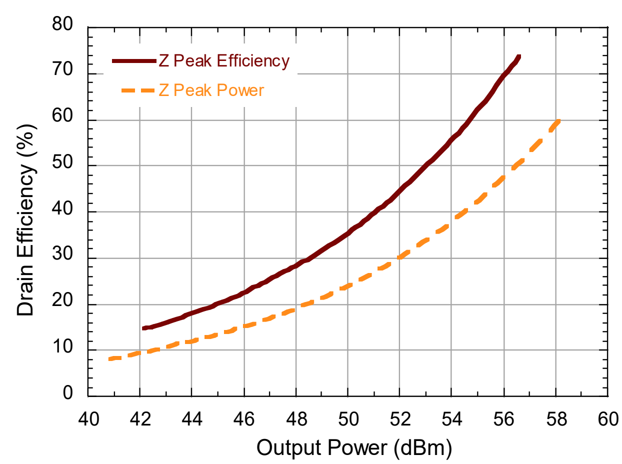
P2.5dB Loadpull AM/PM Contours (°)



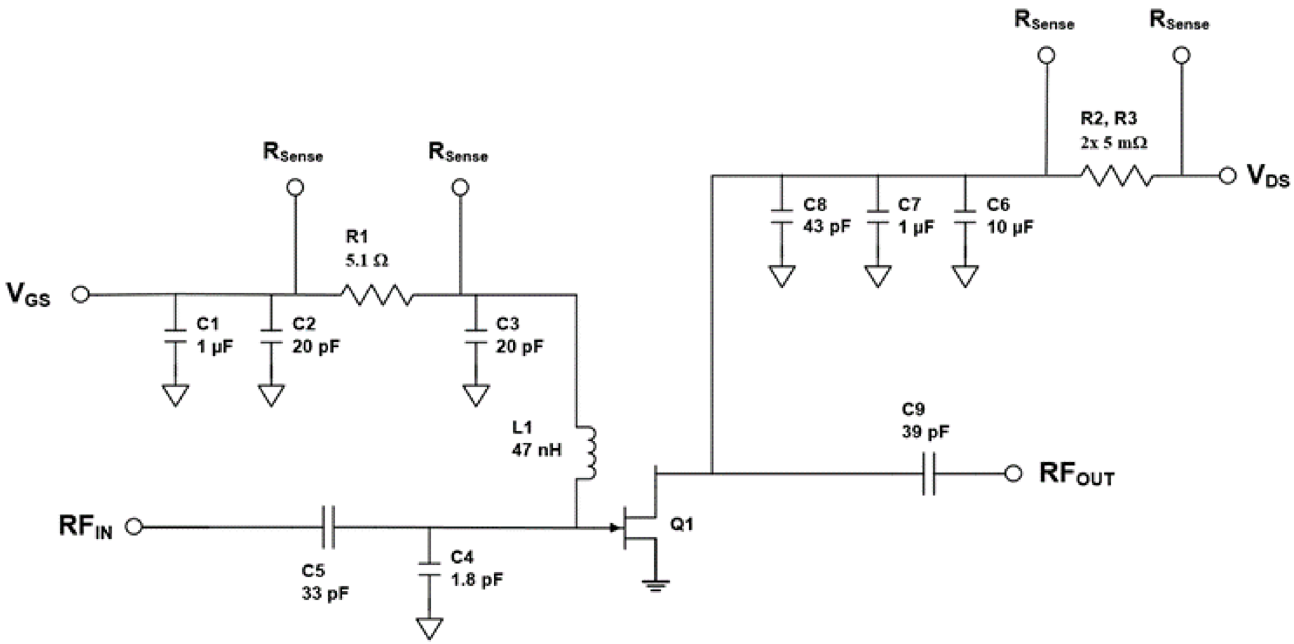
Gain vs. Output Power



Drain Efficiency vs. Output Power



Evaluation Test Fixture and Recommended Tuning Solution 1.2 - 1.4 GHz



Description

Parts measured on evaluation board (25-mil thick RO6010). 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

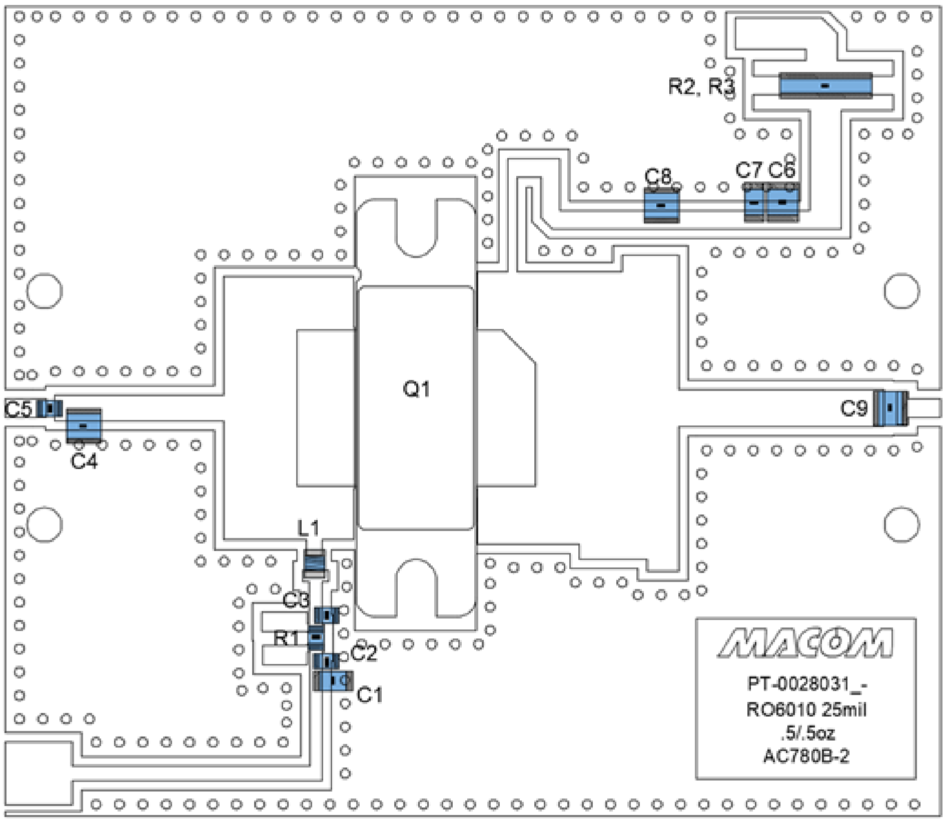
Turning the device ON

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}.

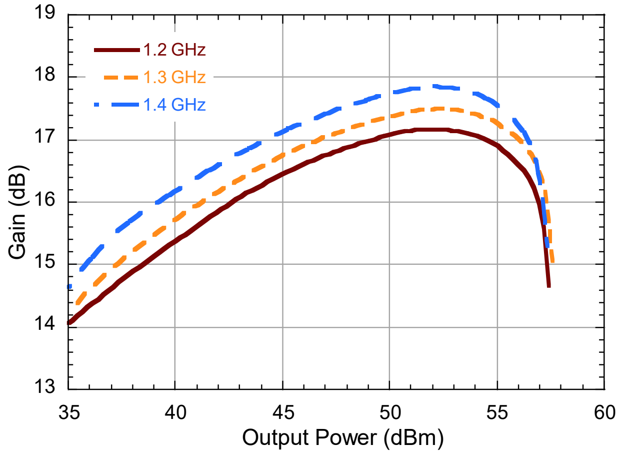
Evaluation Test Fixture and Recommended Tuning Solution 1.2 - 1.4 GHz



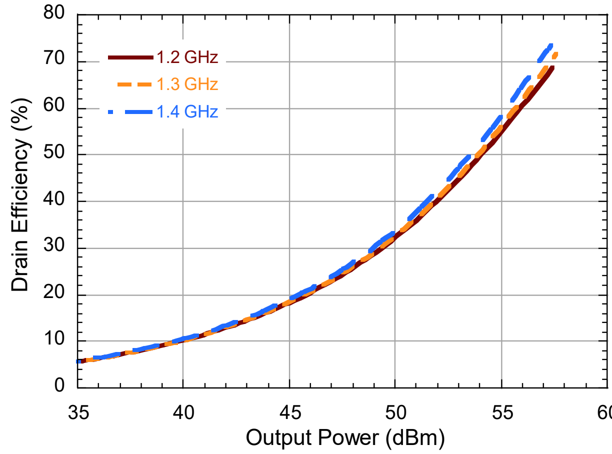
Reference Designator	Value	Tolerance	Manufacturer	Part Number
C1, C7	1 µF	+/- 10 %	Murata	GRM31CR72A105KA01L
C2, C3	20 pF	+/- 5 %	PPI	0805N200JW251X
C4	1.8 pF	+/- 0.1 pF	PPI	1111N1R8BW501XT
C5	33 pF	+/- 5 %	PPI	0805N330JW251X
C6	10 µF	+/- 10 %	Murata	GRM32EC72A106KE05L
C8	43 pF	+/- 5 %	PPI	1111N430JW501XT
C9	39 pF	+/- 5 %	PPI	1111N390JW501XT
R1	5.1 Ω	+/- 1 %	Vishay	CRCW08055R10FKEA
R2, R3	5 mΩ	+/- 1 %	Susumu	RL7520WT-R005-F
L1	47 nH	+/- 5 %	Coilcraft	0805CS-470XJE
Q1	MACOM GaN Power Amplifier			MAGX-101214-500L0S
PCB	RO6010, 25 mil, 0.5 oz. Cu, SnPb Finish			

Typical Performance Curves as Measured in the 1.2 - 1.4 GHz Evaluation Test Fixture:
Pulsed[4] 1.4 GHz, V_{DS} = 50 V, I_{DQ} = 150 mA, T_C = 25°C (Unless Otherwise Noted)

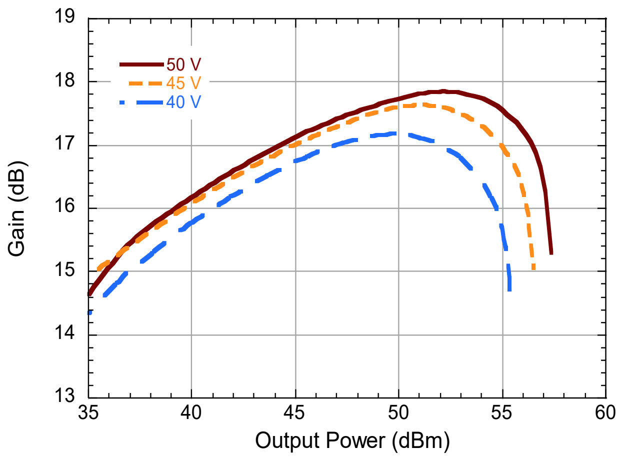
Gain vs. Output Power and Frequency



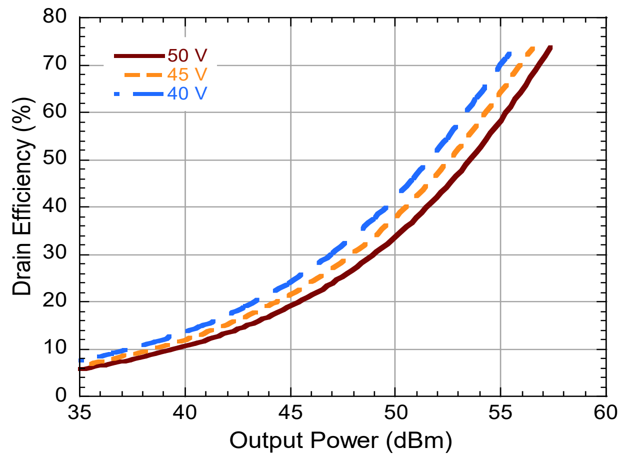
Drain Efficiency vs. Output Power and Frequency



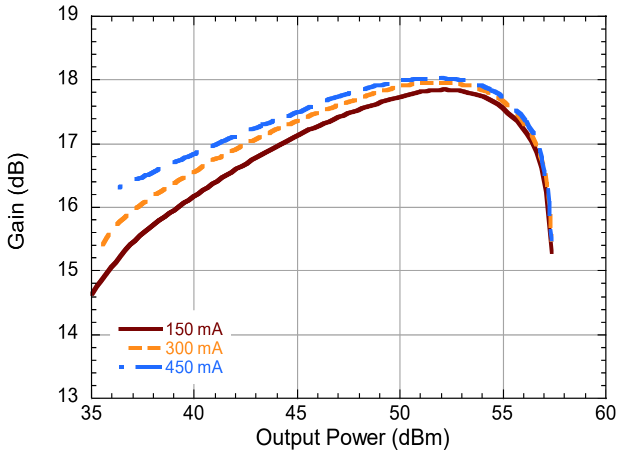
Gain vs. Output Power and V_{DS}



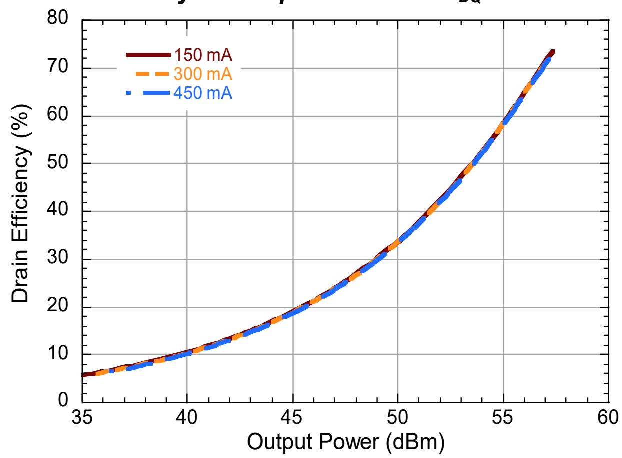
Drain Efficiency vs. Output Power and V_{DS}



Gain vs. Output Power and I_{DQ}



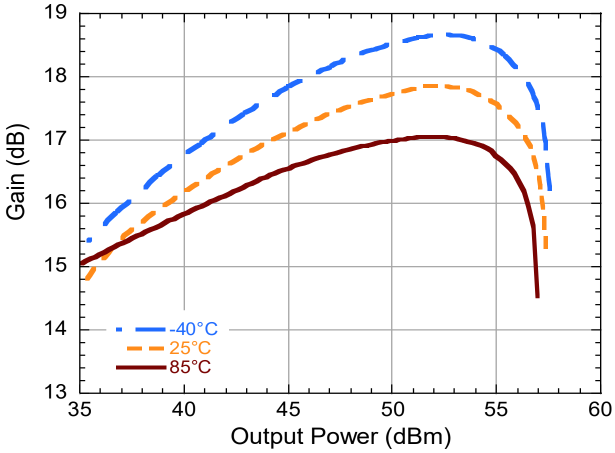
Drain Efficiency vs. Output Power and I_{DQ}



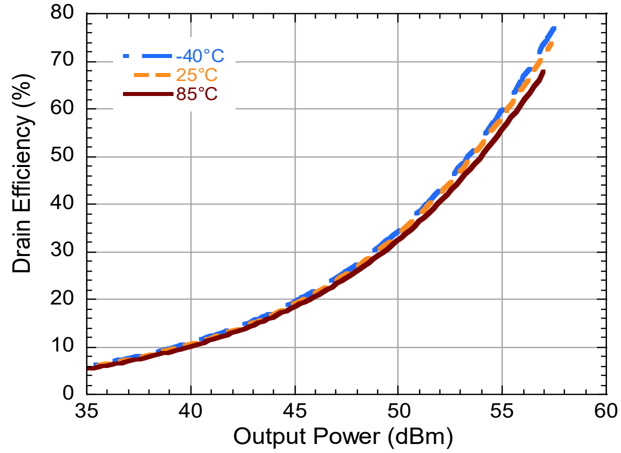
Typical Performance Curves as Measured in the 1.2 - 1.4 GHz Evaluation Test Fixture:

Pulsed[4] 1.4 GHz, V_{DS} = 50 V, I_{DQ} = 150 mA, T_C = 25°C (Unless Otherwise Noted)

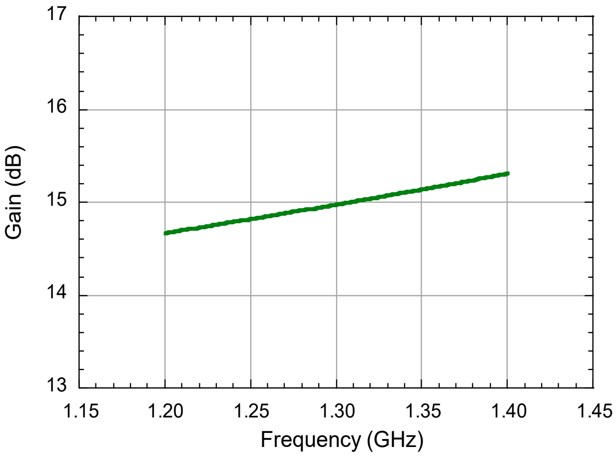
Gain vs. Output Power and T_C



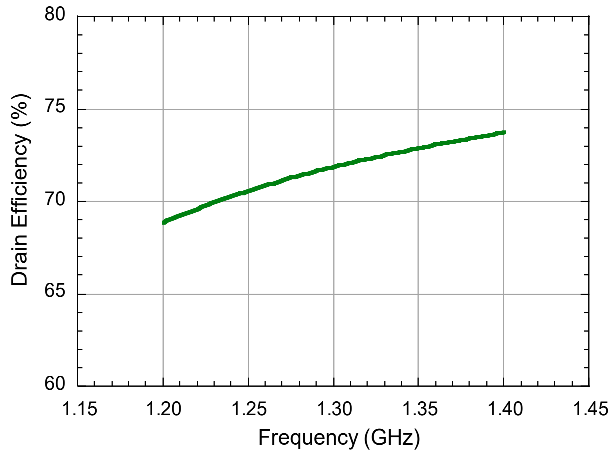
Drain Efficiency vs. Output Power and T_C



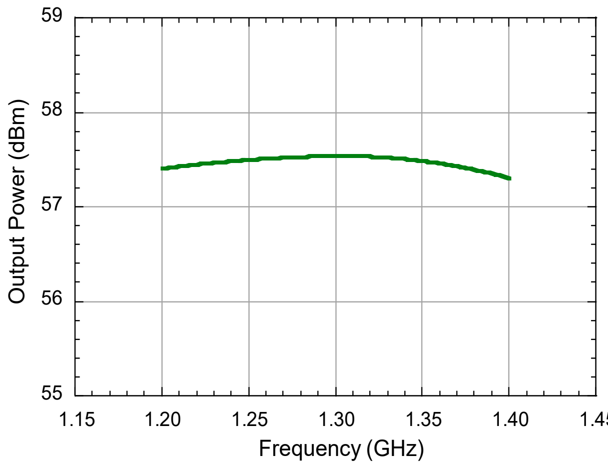
Gain vs. Frequency, 2.5dB Gain Compression



Drain Efficiency vs. Frequency, 2.5dB Gain Compression



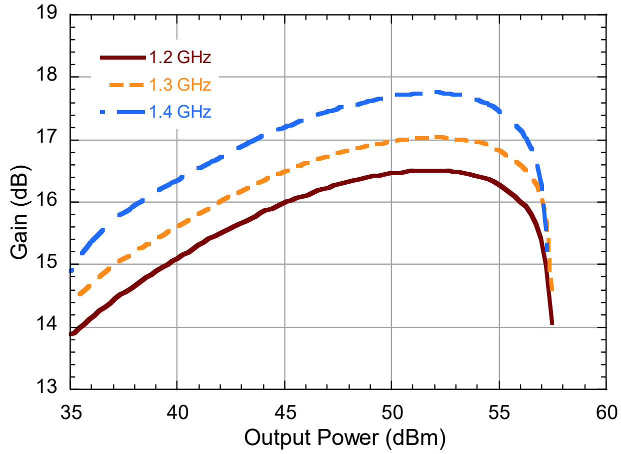
Output Power vs. Frequency, 2.5dB Gain Compression



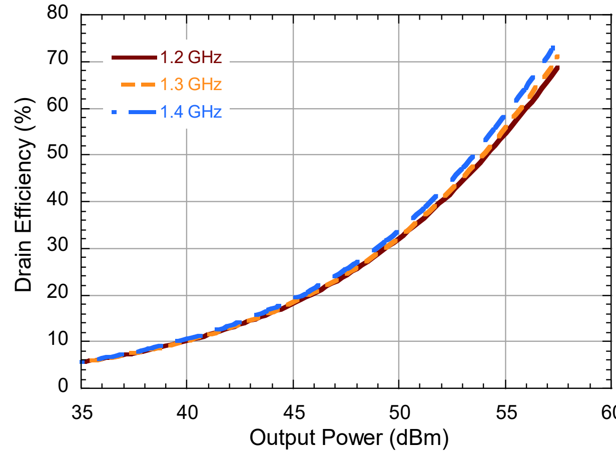
Typical Performance Curves as Measured in the 1.2 - 1.4 GHz Evaluation Test Fixture:

Pulsed 1.4 GHz, V_{DS} = 50 V, I_{DQ} = 150 mA, T_C = 25°C, Pulse Width = 1.5 ms, Duty Cycle = 15 % (Unless Otherwise Noted)

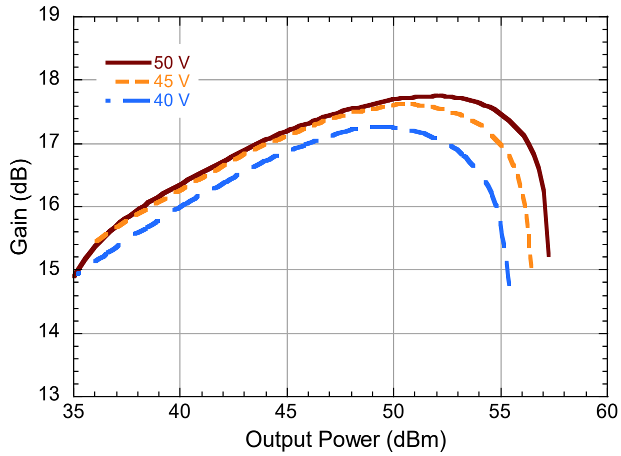
Gain vs. Output Power and Frequency



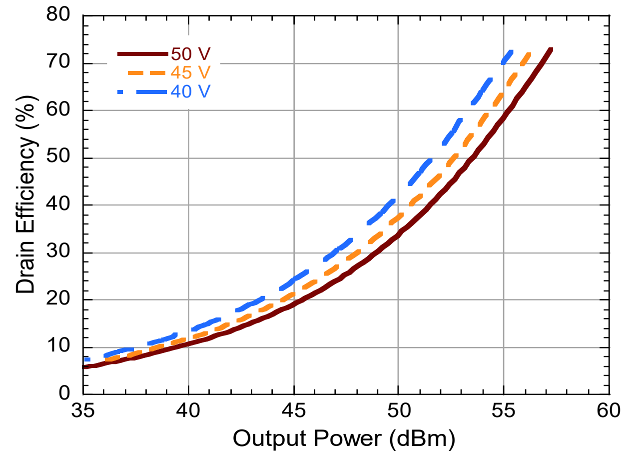
Drain Efficiency vs. Output Power and Frequency



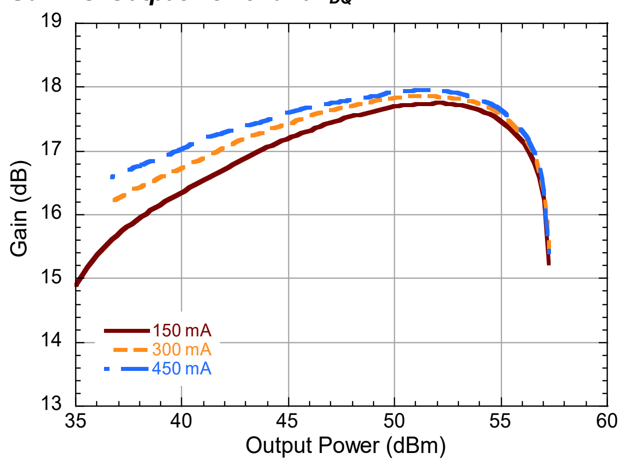
Gain vs. Output Power and V_{DS}



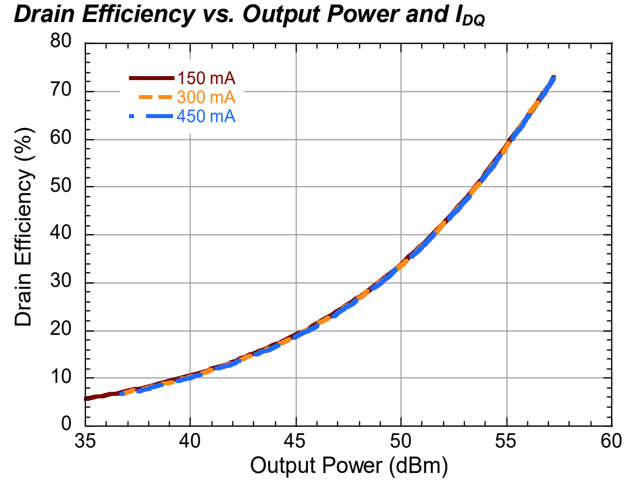
Drain Efficiency vs. Output Power and V_{DS}



Gain vs. Output Power and I_{DQ}



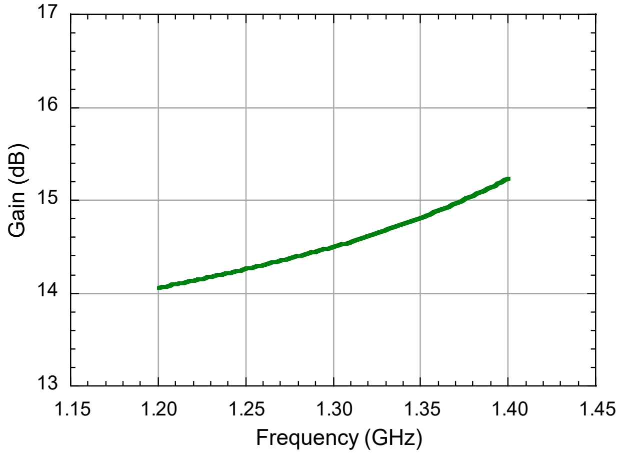
Drain Efficiency vs. Output Power and I_{DQ}



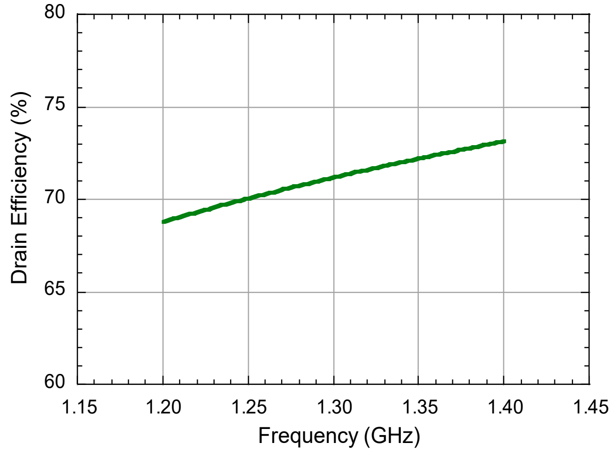
Typical Performance Curves as Measured in the 1.2 - 1.4 GHz Evaluation Test Fixture:

Pulsed 1.4 GHz, V_{DS} = 50 V, I_{DQ} = 150 mA, T_C = 25°C, Pulse Width = 1.5 ms, Duty Cycle = 15 % (Unless Otherwise Noted)

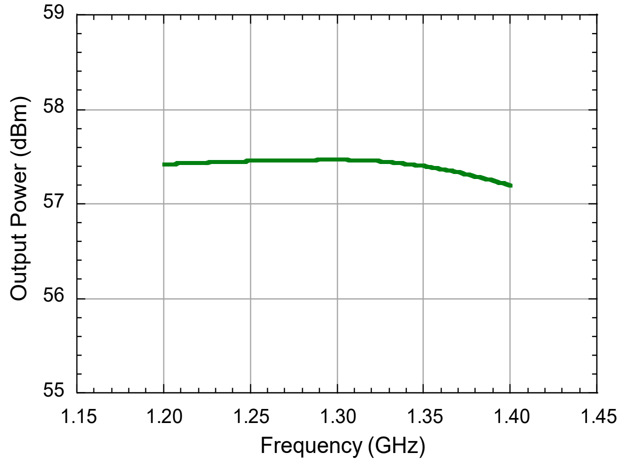
Gain vs. Frequency, 2.5dB Gain Compression



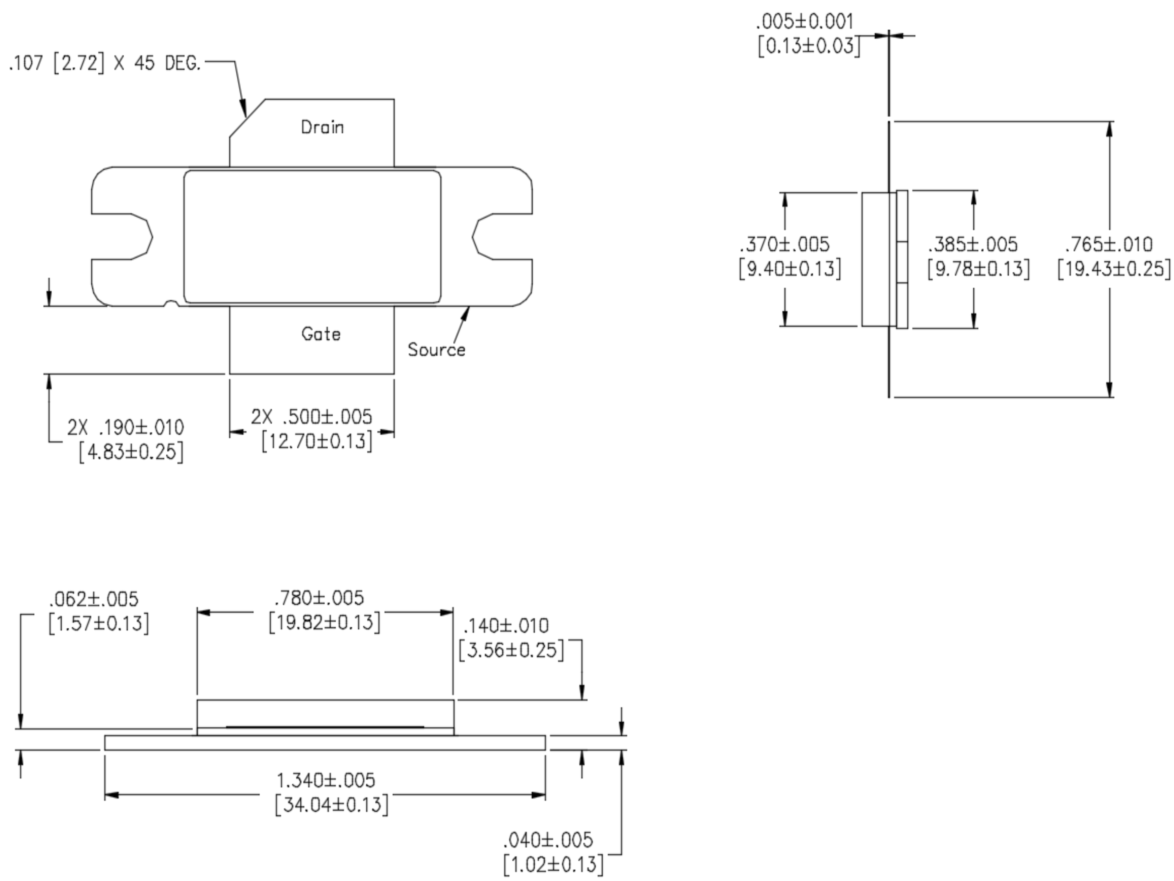
Drain Efficiency vs. Frequency, 2.5dB Gain Compression



Output Power vs. Frequency, 2.5dB Gain Compression



Lead-Free AC-780B-2 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.