Features

- Optimized for Broadband Operation (DC - 4 GHz)
- 25 W P3dB CW Power @ 3000 MHz
- 16 - 20 W P3dB CW Power from 1.0 - 2.5 GHz in application board with >45% Drain Efficiency
- 10 - 20 W P3dB CW Power from 0.03 - 1.0 GHz in application board with >50% Drain Efficiency
- High Efficiency from 14 to 28 V
- 4°C/W R_{TH} with T_J <200°C
- Robust up to 10:1 VSWR Mismatch at All Angles with No Device Damage at 90°C Flange
- Subject to EAR99 Export Control
- RoHS* Compliant

Applications

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

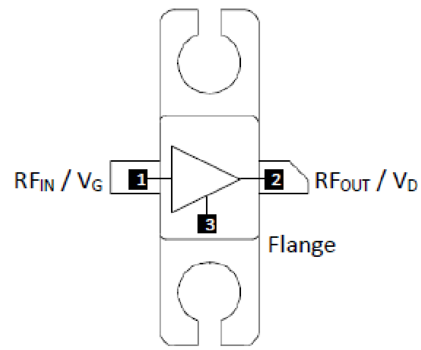
Description

The NPT1012B GaN HEMT is a power transistor optimized for DC - 4 GHz operation. This device supports CW, pulsed, and linear operation with output power levels to 25 W. This transistor is assembled in an industry standard surface mount plastic package.

Ordering Information

Part Number	Package
NPT1012B	30 slot tray

Functional Schematic



Pin Configuration

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

1. The flange 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.

Typical CW RF Specifications: (measured in a test fixture)
Freq. = 3 GHz, V_{DS} = 28 V, I_{DQ} = 225 mA, T_C = 25°C

Parameter	Test Conditions	Symbol	Min.	Typ.	Max.	Units
Average Output Power	3 dB Compression 1 dB Compression	P_{3dB} P_{1dB}	43 —	44 43	—	W
Small Signal Gain	—	G_{SS}	12	13	—	dB
Drain Efficiency	3 dB Compression	η	57	65	—	%
Output Mismatch Stress	VSWR = 10:1. all phase angles, P_{OUT} = P_{SAT}	Ψ	No performance degradation after test			

DC Electrical Characteristics: T_C = 25°C

Parameter	Test Conditions	Symbol	Min.	Typ.	Max.	Units
Off Characteristics						
Drain-Source Breakdown Voltage	V_{GS} = -8 V, I_D = 8 mA	V_{BDS}	100	—	—	V
Drain-Source Leakage Current	V_{GS} = -8 V, V_{DS} = 60 V	I_{DLK}	—	—	4	mA
On Characteristics						
Gate Threshold Voltage	V_{DS} = 28 V, I_D = 8 mA	V_T	-2.3	-1.8	-1.3	V
Gate Quiescent Voltage	V_{DS} = 28 V, I_D = 225 mA	V_{GSQ}	-2.0	-1.5	-1.0	V
On Resistance	V_{GS} = 2 V, I_D = 60 mA	R_{ON}	—	0.44	0.55	Ω
Drain Current	V_{DS} = 7 V pulsed, pulse width 300 μs 0.2% Duty Cycle, V_{GS} = 2 V	I_D	—	5.4	—	A

Absolute Maximum Ratings[2,3,4]

Parameter	Absolute Maximum
Drain Source Voltage, V_{DS}	100 V
Gate Source Voltage, V_{GS}	-10 to 3 V
Gate Current, I_G	40 mA
Total Device Power Dissipation (derated above +25°C)	44 W
Junction Temperature, T_J	+200°C
Operating Temperature	-40°C to +85°C
Storage Temperature	-65°C to +150°C

2. Exceeding any one or combination of these limits may cause permanent damage to this device.
3. MACOM does not recommend sustained operation near these survivability limits.
4. Operating at nominal conditions with $T_J \leq 200°C$ will ensure MTTF > 1×10^6 hours.

Thermal Characteristics[5]

Parameter	Test Conditions	Symbol	Typical	Units
Thermal Resistance	V_{DS} = 28 V, T_J = 180°C	$R_{\theta JC}$	4.0	°C/W

5. Junction temperature (T_J) measured using IR Microscopy. Case temperature measured using thermocouple embedded in heat-sink.

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 MM Class A, CDM Class IV, HBM Class 1B devices.

Load-Pull Data, Reference Plane at Device Leads: V_{DS} = 28 V, I_{DQ} = 225 mA, T_A = 25°C

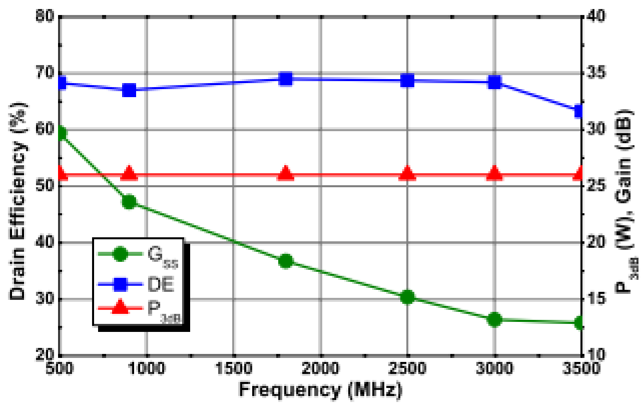


Figure 1 - Typical CW Performance in Load-Pull, V_{DS} = 28V, I_{DQ} = 225mA

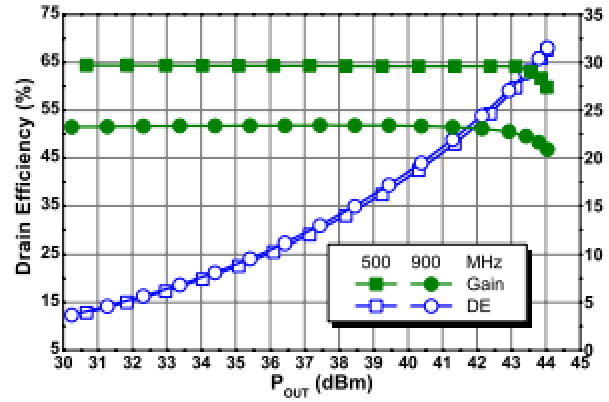


Figure 2 - Typical CW Performance[1] in Load-Pull, V_{DS} = 28V, I_{DQ} = 225mA

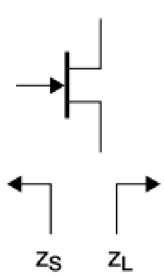
Load-Pull Data, Reference Plane at Device Leads: V_{DS} = 28 V, I_{DQ} = 225 mA, T_C = 25°C

Table 1: Optimum Impedance Characteristics for CW Gain, Drain Efficiency, and Output Power Performance

Frequency (MHz)	V_{DS} (V)	Z_S (Ω)	Z_L (Ω)	P_{SAT} (W)	GSS (dB)	Drain Efficiency @ P_{SAT} (%)
500[6]	14	7.0 + j8.2	8.6 + j7.4	12	27.8	76
500[6]	22	7.0 + j8.2	9.7 + j11.3	21	29.2	74
500[6]	28	7.0 + j8.2	9.7 + j14.1	26	29.7	68
900[6]	14	5.8 + j3.1	6.8 + j4.7	12	22.4	74
900[6]	22	5.8 + j3.1	9.6 + j5.3	24	23.3	74
900[6]	28	5.8 + j3.1	9.8 + j7.8	26	23.6	67
1800	28	3.5 - j3.6	6.9 + j2.0	26	18.4	69
2500	14	3.9 - j7.5	6.2 - j8.0	13	13.7	70
2500	22	4.8 - j7.0	5.5 - j4.1	19	14.9	69
2500	28	4.8 - j7.0	5.5 - j4.1	26	15.2	69
3000	28	5.3 - j8.8	5.3 - j6.4	26	13.2	66
3500	28	5.0 - j14.5	7.0 - j9.5	26	12.9	63

6. 500 MHz and 900 MHz Load-Pull data collected using a 4.7 Ω resistor in the RF path added for stability.

Impedance Reference



Z_S is the source impedance presented to the device.
Z_L is the load impedance presented to the device.

Z_S and Z_L vs. Frequency

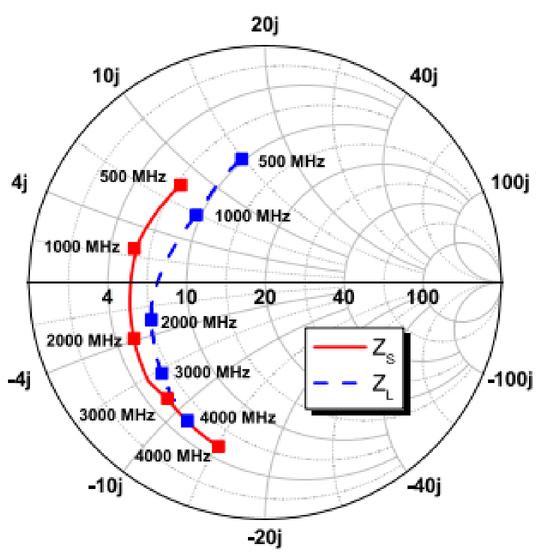


Figure 3 - Optimum Impedances for CW Performance, V_{DS} = 28V

Load-Pull Data, Reference Plane at Device Leads: V_{DS} = 28 V, I_{DQ} = 225 mA, T_A = 25°C

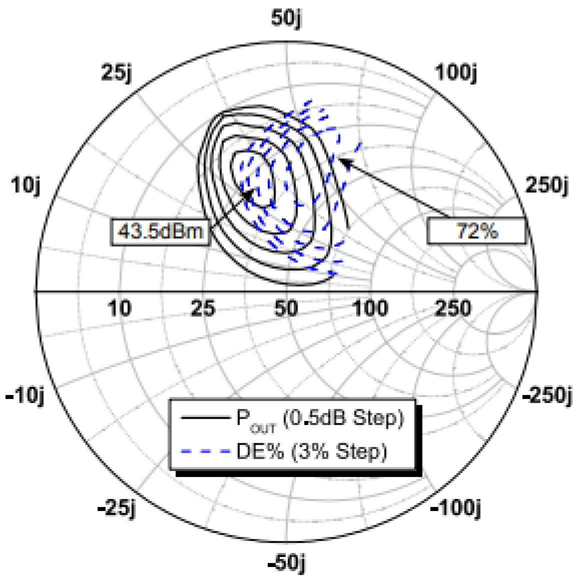


Figure 4 - Load-Pull Contours[1], 500MHz, P_{IN} = 14.5dBm, Z_S = 7.0 + j8.2 Ω

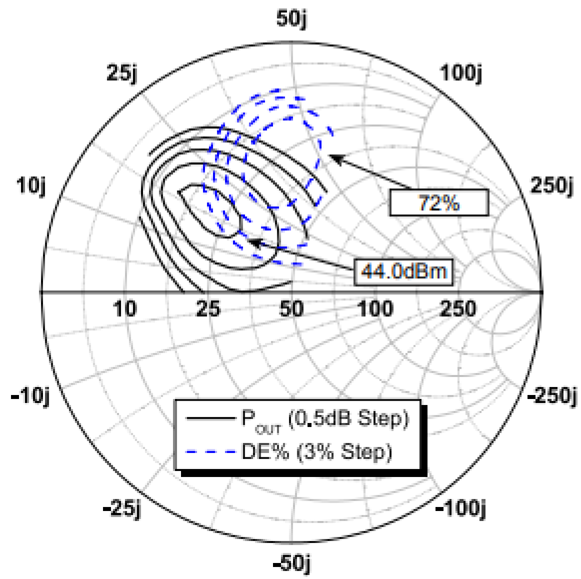


Figure 5 - Load-Pull Contours[1], 900MHz, P_{IN} = 21.0dBm, Z_S = 5.8 + j3.1 Ω

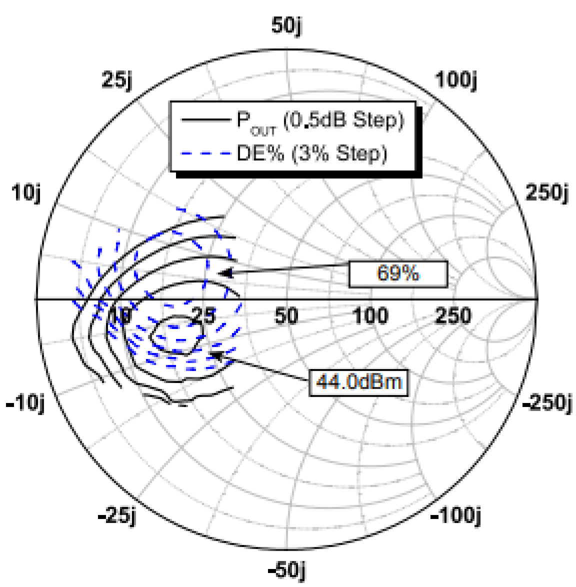


Figure 6 - Load-Pull Contours, 1800MHz, P_{IN} = 26.5dBm, Z_S = 3.5 - j3.6 Ω

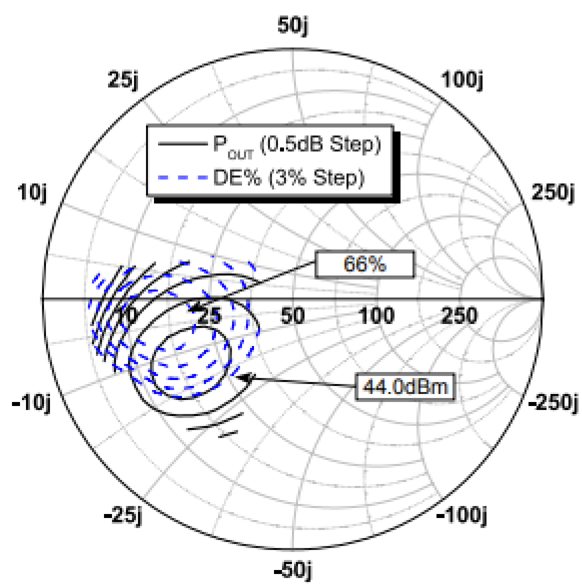


Figure 7 - Load-Pull Contours, 2500MHz, P_{IN} = 29.4dBm, Z_S = 4.8 - j7.0 Ω

Load-Pull Data, Reference Plane at Device Leads: V_{DS} = 28 V, I_{DQ} = 225 mA, T_A = 25°C

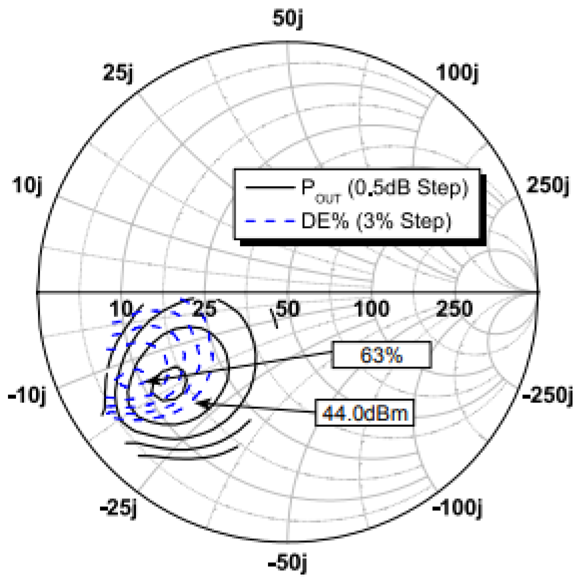


Figure 8 - Load-Pull Contours, 3000MHz, P_{IN} = 31.7dBm, Z_S = 5.3 - j8.8 Ω

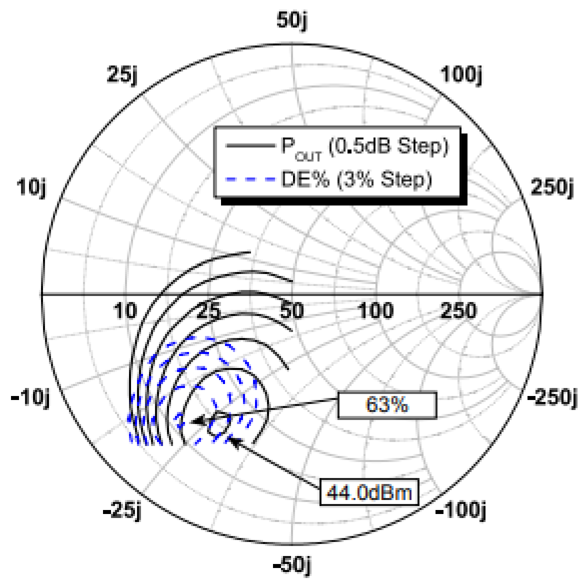


Figure 9 - Load-Pull Contours, 3500MHz, P_{IN} = 33.5dBm, Z_S = 5.0 - j14.5 Ω

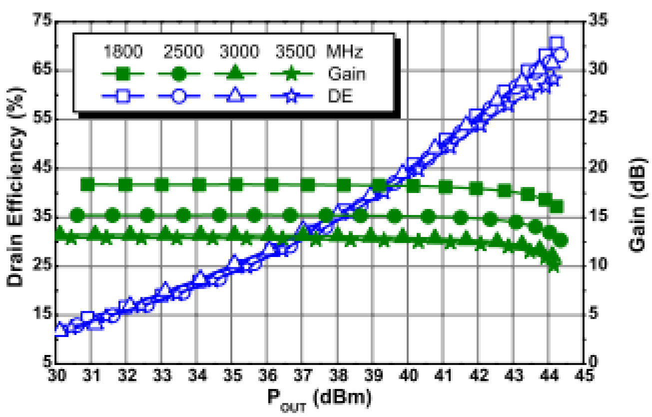


Figure 10 - Typical CW Performance in Load-Pull

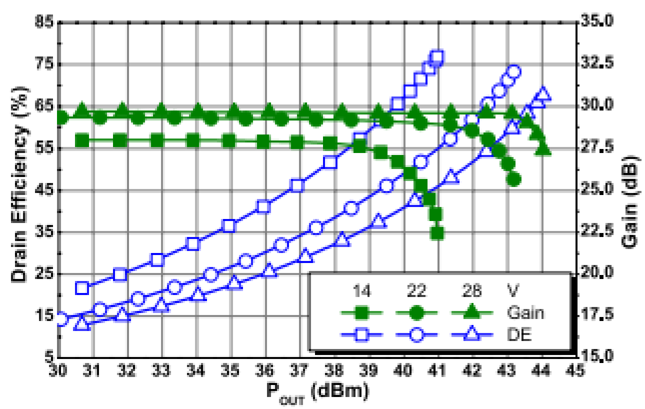


Figure 11 - Typical CW Performance[1] Over Voltage in Load-Pull, 500MHz

Load-Pull Data, Reference Plane at Device Leads: V_{DS} = 28 V, I_{DQ} = 225 mA, T_A = 25°C

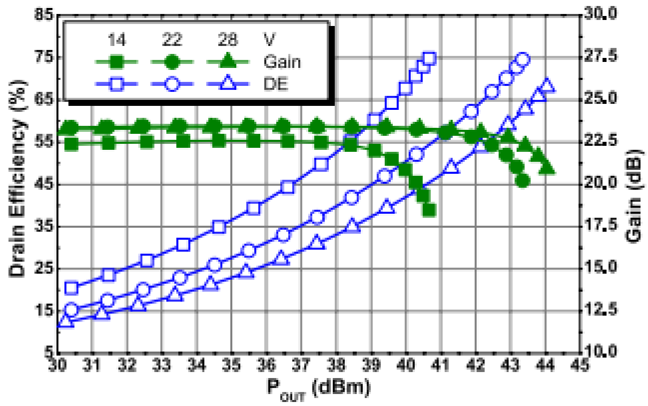


Figure 12 - Typical CW Performance[1] Over Voltage in Load-Pull, 900MHz

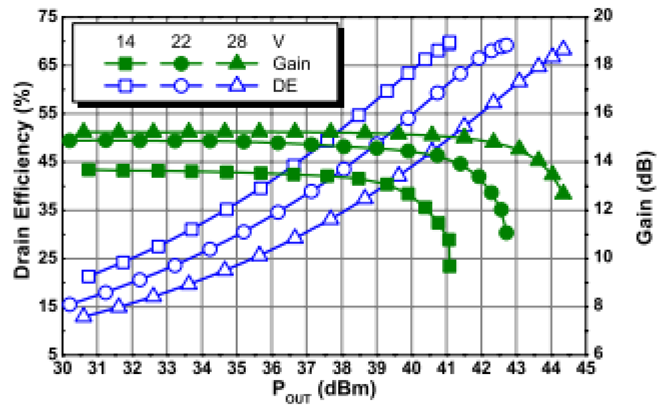


Figure 13 - Typical CW Performance Over Voltage in Load-Pull, 2500MHz

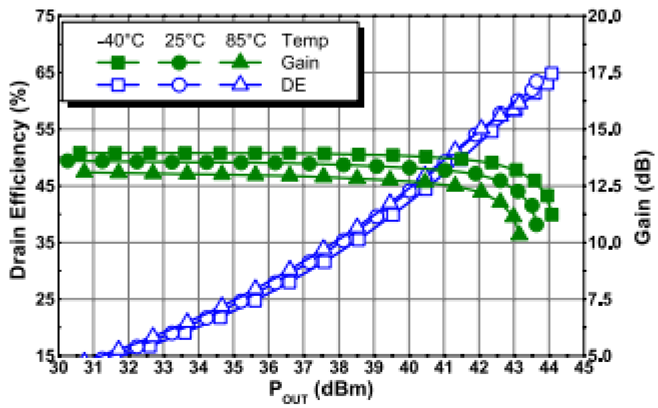


Figure 14 - Typical CW Performance Over Temperature in Nitronex Test Fixture, 3000MHz

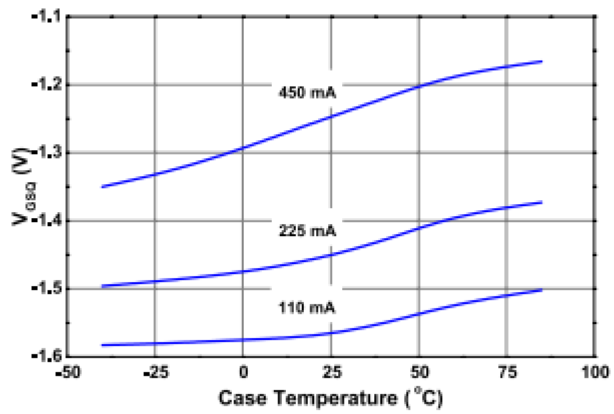


Figure 15 - Quiescent Gate Voltage (V_{GSQ}) Required to Reach I_{DQ} as a Function of Case Temperature, V_{DS} = 28V

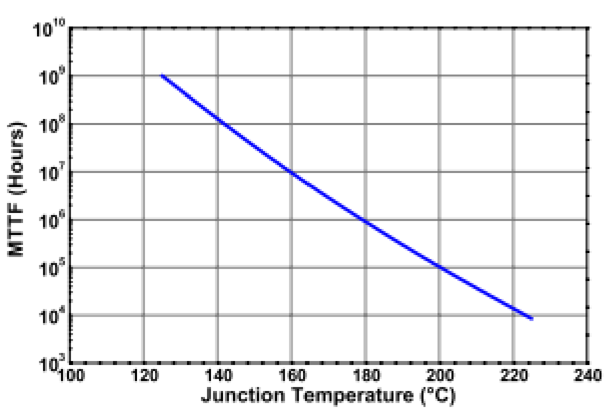


Figure 16 - MTTF of NRF1 Devices as a Function of Junction Temperature

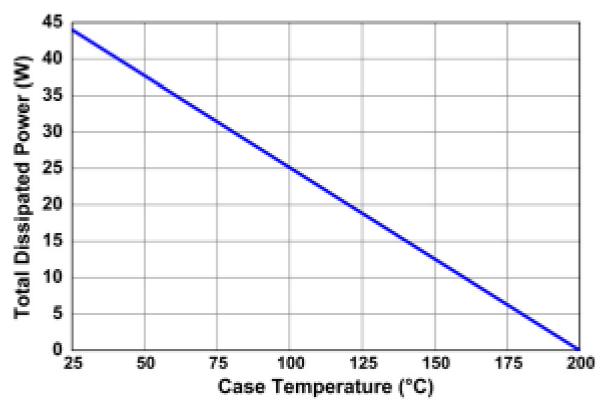


Figure 17 - Power Derating Curve

Outline Drawing

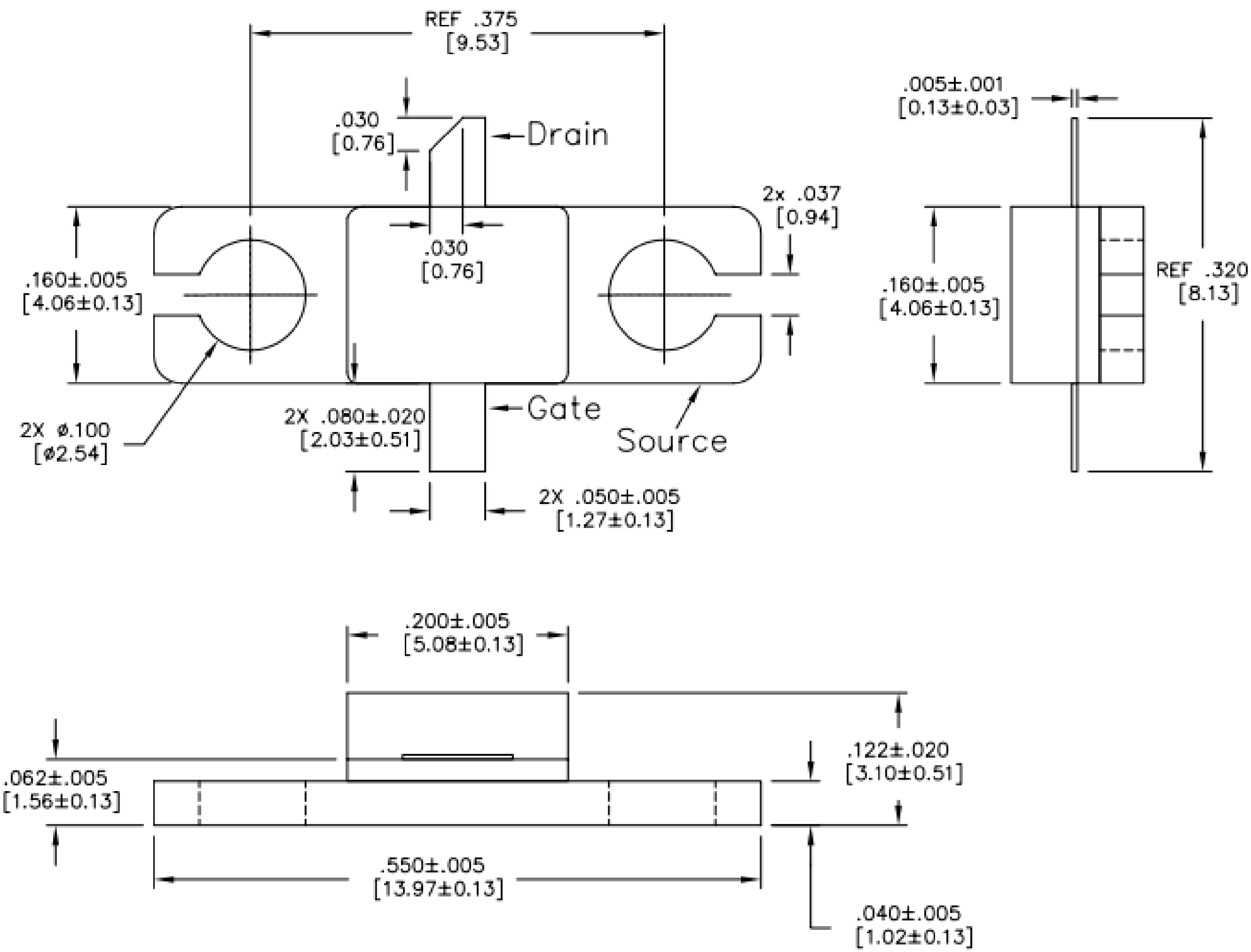


Figure 18 - AC200B-2
Metal-Ceramic Package Dimensions & Pinout (all dimensions are in inches [mm])