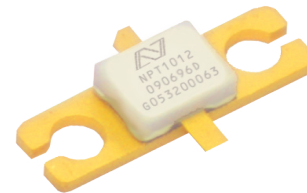


## Gallium Nitride 28V, 25W RF Power Transistor

Built using the SIGANTIC® NRF1 process - A proprietary GaN-on-Silicon technology

### FEATURES

- Optimized for broadband operation from DC-4000MHz
- 25W P<sub>3dB</sub> CW power at 3000MHz
- 16-20W P<sub>3dB</sub> CW power from 1000-2500MHz in application board with >45% drain efficiency
- 10-20W P<sub>3dB</sub> CW power from 30-1000MHz in application board with >50% drain efficiency
- High efficiency from 14 - 28V
- 4.0 °C/W R<sub>TH</sub> with maximum T<sub>J</sub> rating of 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

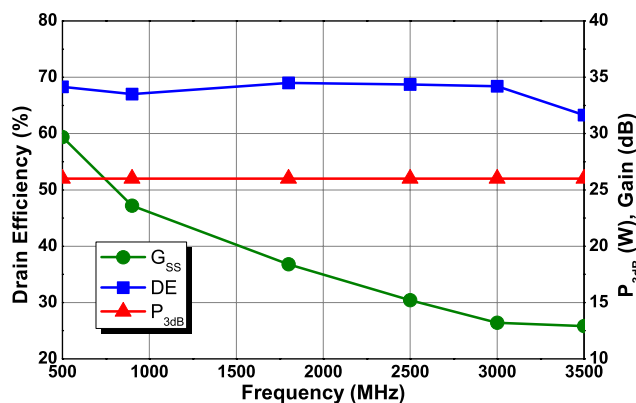


**DC – 4000 MHz  
25 Watt, 28 Volt  
GaN HEMT**

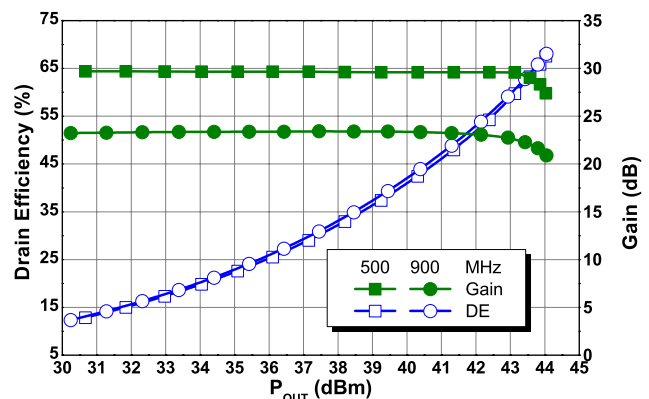


**RF Specifications (CW, 3000MHz):** V<sub>DS</sub> = 28V, I<sub>DQ</sub> = 225mA, T<sub>C</sub> = 25°C, Measured in Nitronex Test Fixture

Symbol	Parameter	Min	Typ	Max	Units
P <sub>3dB</sub>	Average Output Power at 3dB Gain Compression	43	44	-	dBm
P <sub>1dB</sub>	Average Output Power at 1dB Gain Compression	-	43	-	dBm
G <sub>SS</sub>	Small Signal Gain	12	13	-	dB
η	Drain Efficiency at 3dB Gain Compression	57	65	-	%
VSWR	10:1 VSWR at all phase angles	No damage to the device			



**Figure 1** - Typical CW Performance in Load-Pull, V<sub>DS</sub> = 28V, I<sub>DQ</sub> = 225mA



**Figure 2** - Typical CW Performance<sup>1</sup> in Load-Pull, V<sub>DS</sub> = 28V, I<sub>DQ</sub> = 225mA

Note 1: 500MHz and 900MHz Load-Pull data collected using a 4.7 Ω resistor in the RF path added for stability

## DC Specifications: $T_C = 25^\circ\text{C}$

Symbol	Parameter	Min	Typ	Max	Units
<b>Off Characteristics</b>					
$V_{BDS}$	Drain-Source Breakdown Voltage ( $V_{GS} = -8\text{V}$ , $I_D = 8\text{mA}$ )	100	-	-	V
$I_{DLK}$	Drain-Source Leakage Current ( $V_{GS} = -8\text{V}$ , $V_{DS} = 60\text{V}$ )	-	-	4	mA
<b>On Characteristics</b>					
$V_T$	Gate Threshold Voltage ( $V_{DS} = 28\text{V}$ , $I_D = 8\text{mA}$ )	-2.3	-1.8	-1.3	V
$V_{GSQ}$	Gate Quiescent Voltage ( $V_{DS} = 28\text{V}$ , $I_D = 225\text{mA}$ )	-2.0	-1.5	-1.0	V
$R_{ON}$	On Resistance ( $V_{GS} = 2\text{V}$ , $I_D = 60\text{mA}$ )	-	0.44	0.55	$\Omega$
$I_{D,MAX}$	Drain Current ( $V_{DS} = 7\text{V}$ pulsed, 300 $\mu\text{s}$ pulse width, 0.2% duty cycle, $V_{GS} = 2.0\text{V}$ )	-	5.4	-	A

## Thermal Resistance Specification

Symbol	Parameter	Min	Typ	Max	Units
$\theta_{JC}$	Thermal Resistance (Junction-to-Case), $T_J = 180^\circ\text{C}$	-	4.0	-	$^\circ\text{C}/\text{W}$

## Absolute Maximum Ratings: Not simultaneous, $T_C = 25^\circ\text{C}$ unless otherwise noted

Symbol	Parameter	Max	Units
$V_{DS}$	Drain-Source Voltage	100	V
$V_{GS}$	Gate-Source Voltage	-10 to 3	V
$I_G$	Gate Current	40	mA
$P_T$	Total Device Power Dissipation (Derated above $25^\circ\text{C}$ )	44	W
$T_{STG}$	Storage Temperature Range	-65 to 150	$^\circ\text{C}$
$T_J$	Operating Junction Temperature	200	$^\circ\text{C}$
HBM	Human Body Model ESD Rating (per JESD22-A114)	1B (+/-500V)	
MM	Machine Model ESD Rating (per JESD22-A115)	A (>100V)	
CDM	Charge Device Model ESD Rating (per JESD22-C101)	IV (>1000V)	

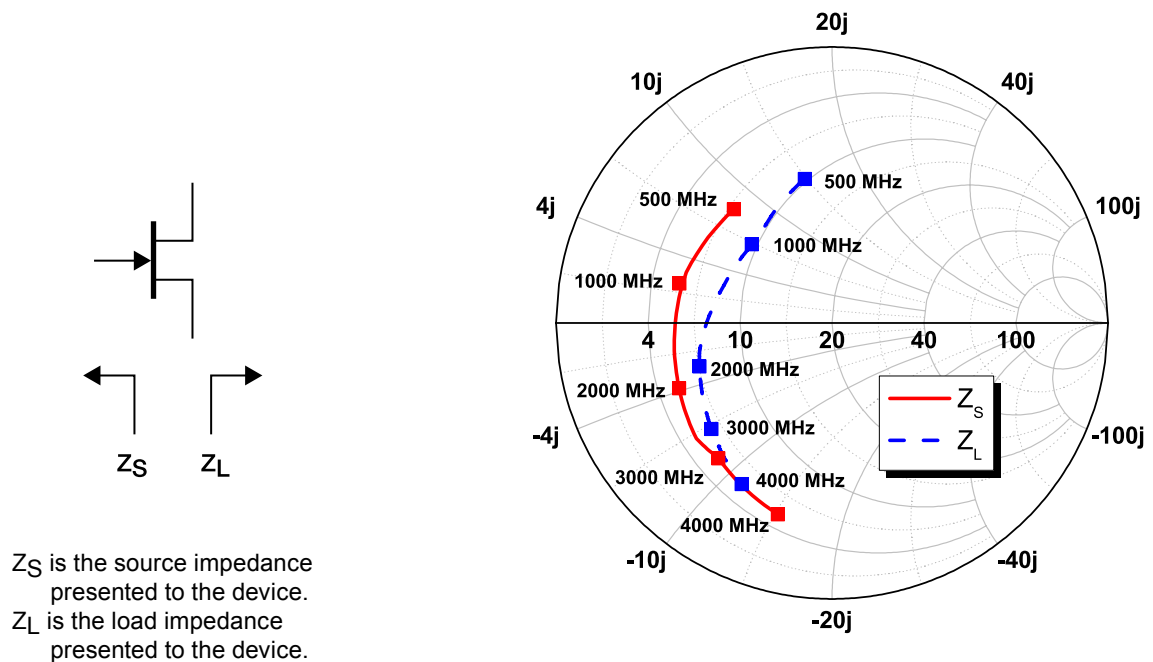
## Load-Pull Data, Reference Plane at Device Leads

$V_{DS}=28V$ ,  $I_{DQ}=225mA$ ,  $T_A=25^\circ C$  unless otherwise noted

**Table 1:** Optimum Source and Load Impedances<sup>1</sup> for CW Gain, Drain Efficiency, and Output Power Performance

Frequency (MHz)	$V_{DS}$ (V)	$Z_S$ ( $\Omega$ )	$Z_L$ ( $\Omega$ )	$P_{SAT}$ (W)	$G_{SS}$ (dB)	Drain Efficiency @ $P_{SAT}$ (%)
500	14	$7.0 + j8.2$	$8.6 + j7.4$	12	27.8	76
500	22	$7.0 + j8.2$	$9.7 + j11.3$	21	29.2	74
500	28	$7.0 + j8.2$	$9.7 + j14.1$	26	29.7	68
900	14	$5.8 + j3.1$	$6.8 + j4.7$	12	22.4	74
900	22	$5.8 + j3.1$	$9.6 + j5.3$	24	23.3	74
900	28	$5.8 + j3.1$	$9.8 + j 7.8$	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

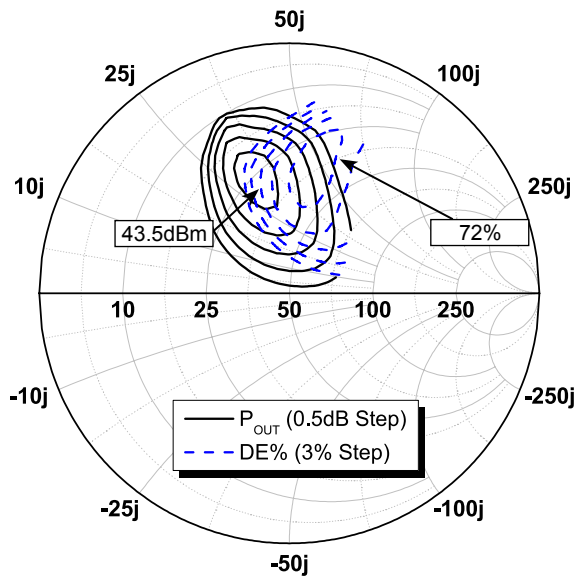
Note 1: 500MHz and 900MHz Load-Pull data collected using a 4.7  $\Omega$  resistor in the RF path added for stability



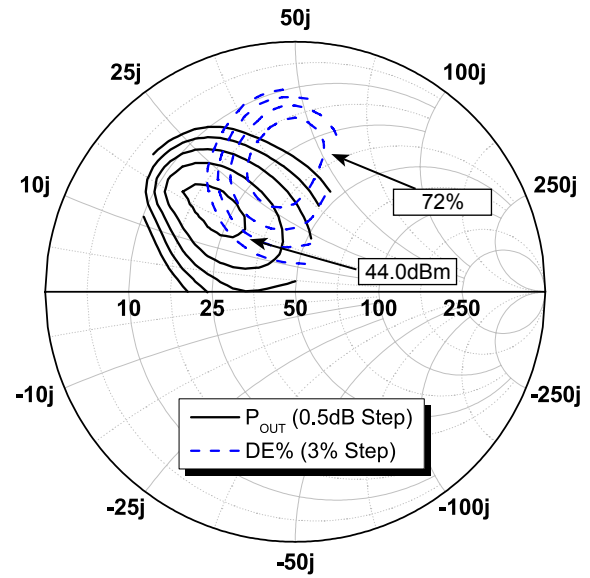
**Figure 3 -** Optimum Impedances for CW Performance,  $V_{DS} = 28V$

## Load-Pull Data, Reference Plane at Device Leads

$V_{DS}=28V, I_{DQ}=225mA, T_A=25^{\circ}C$  unless otherwise noted

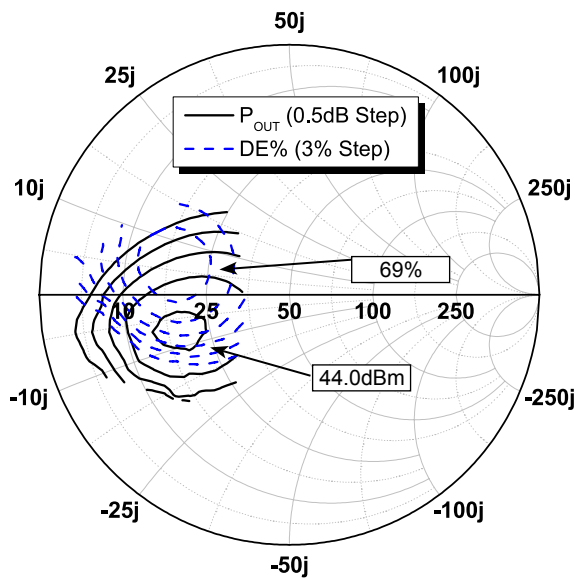


**Figure 4** - Load-Pull Contours<sup>1</sup>, 500MHz,  
 $P_{IN} = 14.5dBm, Z_S = 7.0 + j8.2 \Omega$

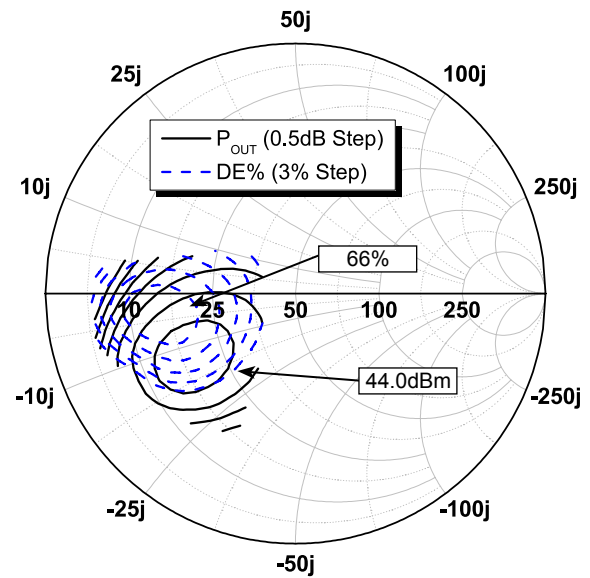


**Figure 5** - Load-Pull Contours<sup>1</sup>, 900MHz,  
 $P_{IN} = 21.0dBm, Z_S = 5.8 + j3.1 \Omega$

Note 1: 500MHz and 900MHz Load-Pull data collected using a 4.7  $\Omega$  resistor in the RF path added for stability



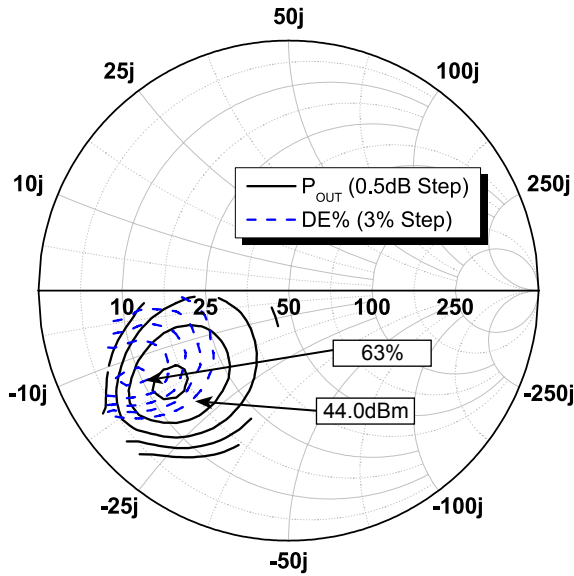
**Figure 6** - Load-Pull Contours, 1800MHz,  
 $P_{IN} = 26.5dBm, Z_S = 3.5 - j3.6 \Omega$



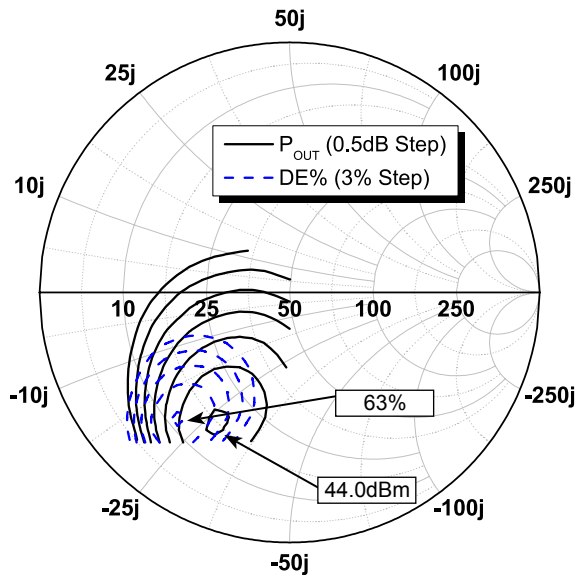
**Figure 7** - Load-Pull Contours, 2500MHz,  
 $P_{IN} = 29.4dBm, Z_S = 4.8 - j7.0 \Omega$

## Load-Pull Data, Reference Plane at Device Leads

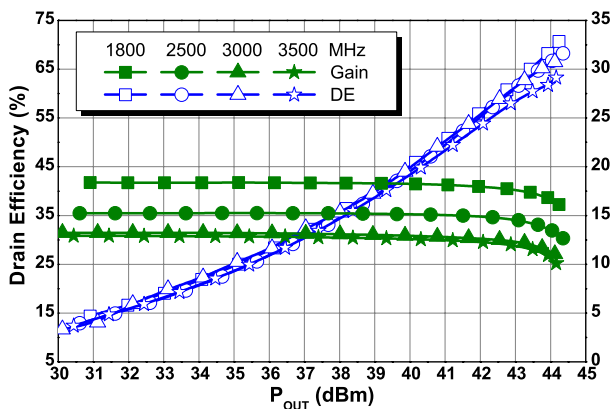
$V_{DS}=28V$ ,  $I_{DQ}=225mA$ ,  $T_A=25^\circ C$  unless otherwise noted



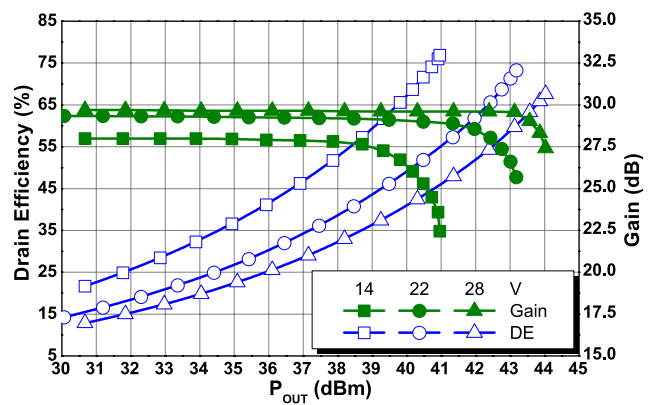
**Figure 8** - Load-Pull Contours, 3000MHz,  
 $P_{IN} = 31.7dBm$ ,  $Z_S = 5.3 - j8.8 \Omega$



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



**Figure 10** - Typical CW Performance in Load-Pull

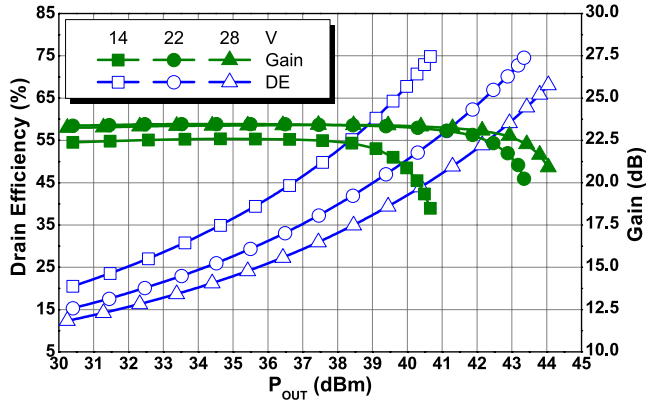


**Figure 11** - Typical CW Performance<sup>1</sup> Over Voltage in Load-Pull, 500MHz

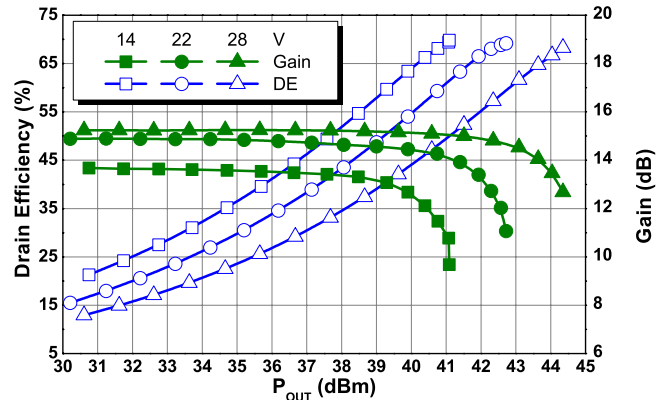
Note 1: 500MHz and 900MHz Load-Pull data collected using a 4.7  $\Omega$  resistor in the RF path added for stability

## Load-Pull Data, Reference Plane at Device Leads

$V_{DS}=28V, I_{DQ}=225mA, T_A=25^\circ C$  unless otherwise noted

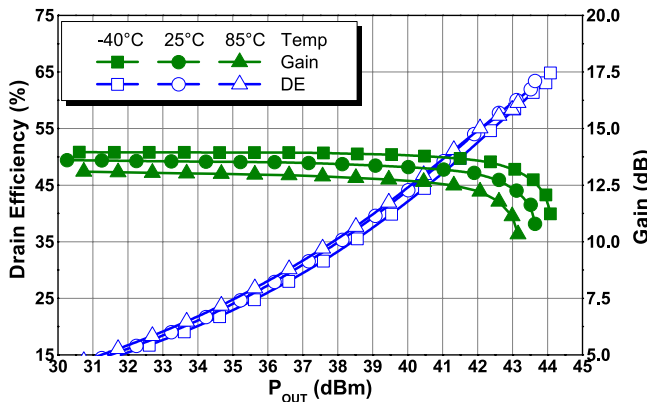


**Figure 12 - Typical CW Performance<sup>1</sup> Over Voltage in Load-Pull, 900MHz**

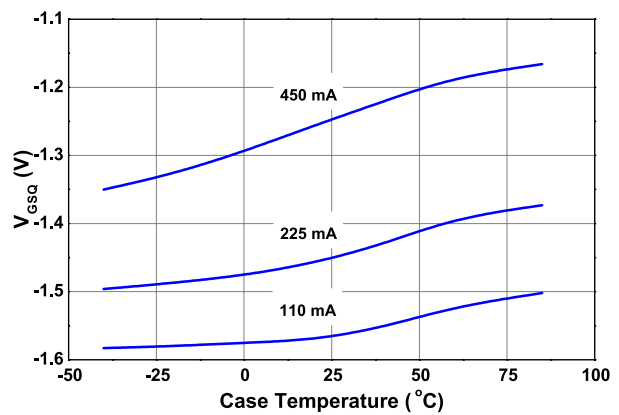


**Figure 13 - Typical CW Performance Over Voltage in Load-Pull, 2500MHz**

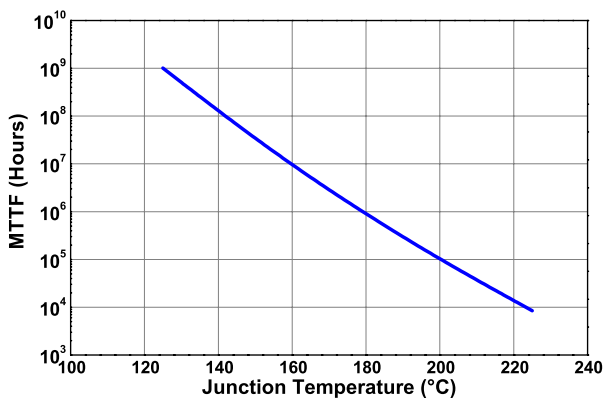
Note 1: 500MHz and 900MHz Load-Pull data collected using a 4.7  $\Omega$  resistor in the RF path added for stability



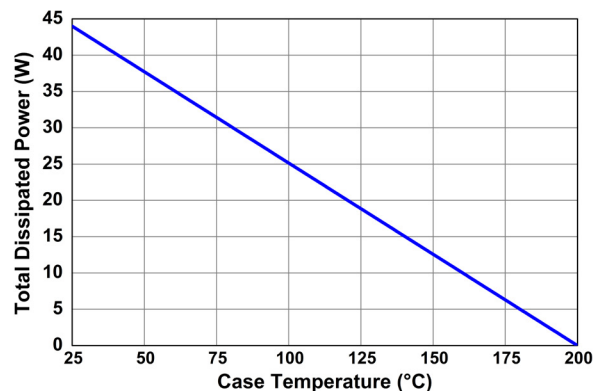
**Figure 14 - Typical CW Performance Over Temperature in Nitronex Test Fixture, 3000MHz**



**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**

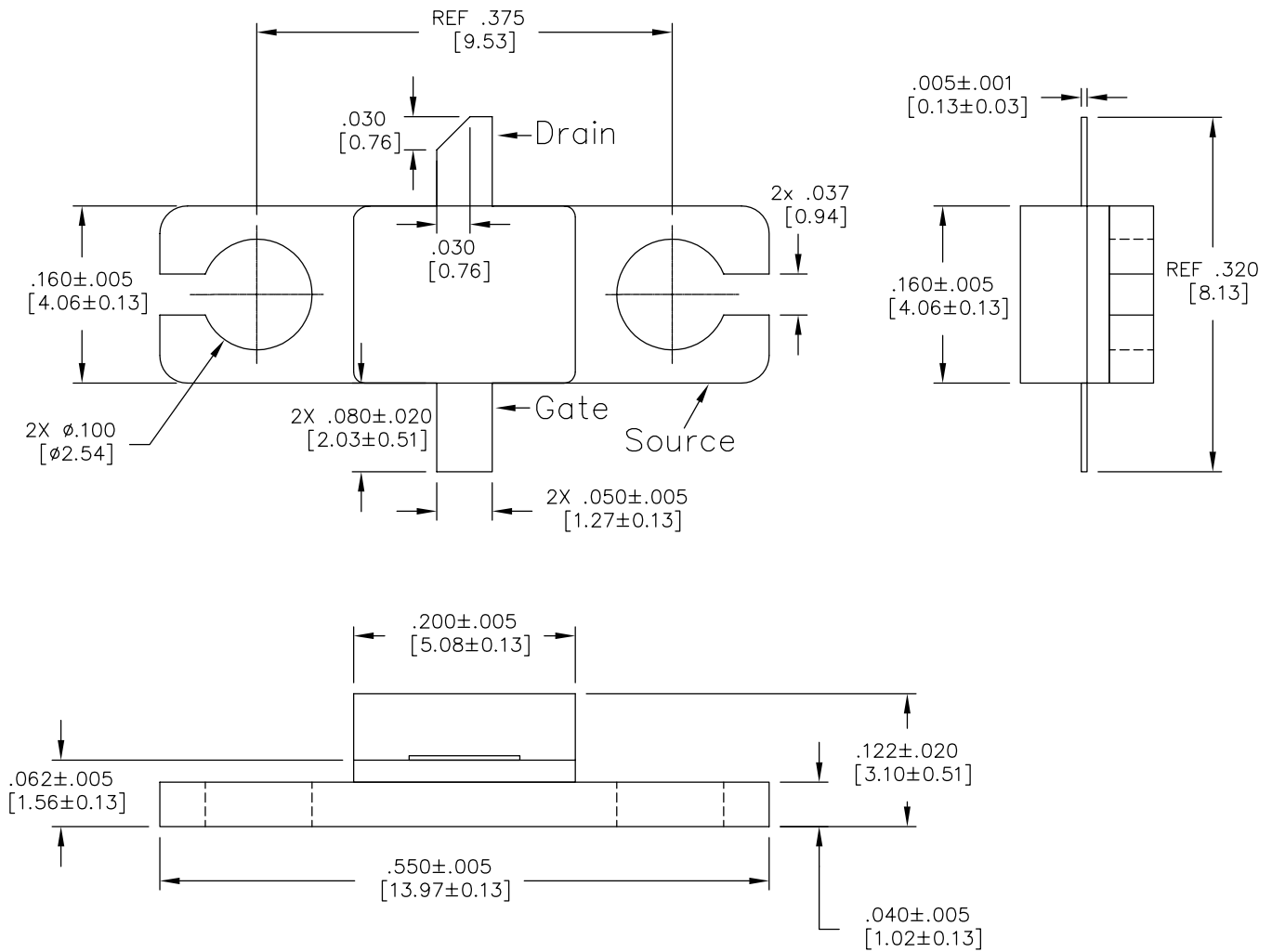
# NPT1012



## Ordering Information<sup>1</sup>

Part Number	Description
NPT1012B	NPT1012 in AC200B-2 Metal-Ceramic Bolt-Down Package

1: To find a Nitronex contact in your area, visit our website at <http://www.nitronex.com>



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

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## Additional Information

**This part is lead-free and is compliant with the RoHS directive (Restrictions on the Use of Certain Hazardous Substances in Electrical and Electronic Equipment).**

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