

## Gallium Nitride 28V, 5W RF Power Transistor

Built using the SIGANTIC<sup>®</sup> NRF1 process - A proprietary GaN-on-Silicon technology

### FEATURES

- Optimized for CW, pulsed, WiMAX, W-CDMA, LTE, and other applications from DC to 6GHz
- 100% RF Tested at 2500MHz
- 5W P3dB CW Power
- 15.5dB Power Gain
- Low cost, surface mount SOIC package
- High reliability gold metallization process
- Lead-free and RoHS compliant
- Subject to EAR99 Export Control



**DC - 6000MHz  
5 Watt, 28 Volt  
GaN HEMT**



**2-Tone Specifications:**  $V_{DS} = 28V$ ,  $I_{DQ} = 50mA$ , Frequency = 2500MHz, Tone spacing = 1MHz,  $T_C = 25^\circ C$   
Measured in Nitronex Test Fixture

Symbol	Parameter	Min	Typ	Max	Units
$P_{1dB,PEP}$	Peak Envelope Power at 1dB Compression	5.0	7.5	-	W
$G_{SS}$	Small Signal Gain	14.5	15.5	-	dB
$P_{IMD3}$	Peak Envelope Power at -35dBc IMD3	-	2.5	-	W
$\eta$	Drain Efficiency at 3dB Compression	55	60	-	%

**RF Performance (CW):**  $V_{DS} = 28V$ ,  $I_{DQ} = 50mA$ , Frequency = 2500MHz,  $T_C = 25^\circ C$ , Measured in Nitronex Test Fixture

Symbol	Parameter	Typ	Units
$P_{3dB}$	Average Output Power at 3dB Compression	5.1	W
$P_{1dB}$	Average Output Power at 1dB Compression	2.9	W
$\eta$	Drain Efficiency at 3dB Compression	56	%

**OFDM Performance:**  $V_{DS} = 28V$ ,  $I_{DQ} = 100mA$ , Single carrier OFDM waveform 64-QAM 3/4, 8 burst, continuous frame data, 3.5 MHz channel bandwidth. Peak/Avg. = 10.3dB @ 0.01% probability on CCDF. Frequency = 3500MHz,  $P_{OUT,AVG} = 24dBm$ ,  $T_C = 25^\circ C$ . Measured in Load Pull System

Symbol	Parameter	Typ	Units
$G_p$	Power Gain	11.2	dB
$\eta$	Drain Efficiency	9	%
EVM	Error Vector Magnitude	1.0	%

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

Symbol	Parameter	Min	Typ	Max	Units
<b>Off Characteristics</b>					
$V_{BDS}$	Drain-Source Breakdown Voltage ( $V_{GS} = -8\text{V}$ , $I_D = 2\text{mA}$ )	100	-	-	V
$I_{DLK}$	Drain-Source Leakage Current ( $V_{GS} = -8\text{V}$ , $V_{DS} = 60\text{V}$ )	-	0.5	2	mA
<b>On Characteristics</b>					
$V_T$	Gate Threshold Voltage ( $V_{DS} = 28\text{V}$ , $I_D = 2\text{mA}$ )	-2.0	-1.5	-1.0	V
$V_{GSQ}$	Gate Quiescent Voltage ( $V_{DS} = 28\text{V}$ , $I_D = 50\text{mA}$ )	-1.8	-1.3	-0.8	V
$R_{ON}$	On Resistance ( $V_{GS} = 2\text{V}$ , $I_D = 15\text{mA}$ )	-	2.0	2.2	$\Omega$
$I_D$	Drain Current ( $V_{DS} = 7\text{V}$ pulsed, 300 $\mu\text{s}$ pulse width, 0.2% duty cycle, $V_{GS} = 2\text{V}$ )	1.1	1.3	-	A

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

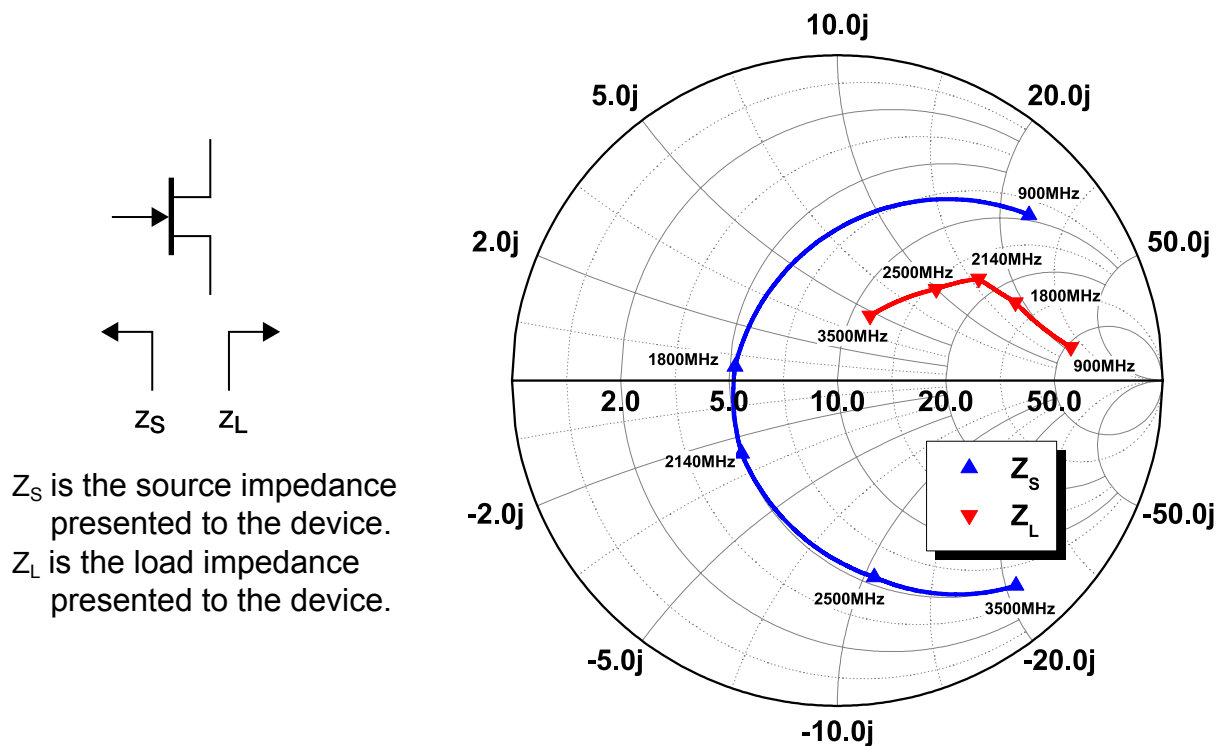
Symbol	Parameter	Max	Units
$V_{DS}$	Drain-Source Voltage	100	V
$V_{GS}$	Gate-Source Voltage	-10 to 3	V
$P_T$	Total Device Power Dissipation (Derated above $25^\circ\text{C}$ )	7.6	W
$\theta_{JC}$	Thermal Resistance (Junction-to-Case)	23	$^\circ\text{C}/\text{W}$
$T_{STG}$	Storage Temperature Range	-65 to 150	$^\circ\text{C}$
$T_J$	Operating Junction Temperature	200	$^\circ\text{C}$
HBM	Human Body Model ESD Rating (per JESD22-A114)	1A (>250V)	
MM	Machine Model ESD Rating (per JESD22-A115)	M1(>50V)	
MSL	Moisture Sensitivity Level (per IPC/JEDEC J-STD-020): Rating of 3 at $260^\circ\text{C}$ Package Peak Temperature		

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

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

**Table 1:** Optimum Source and Load Impedances ( $V_{DS} = 28V$ )

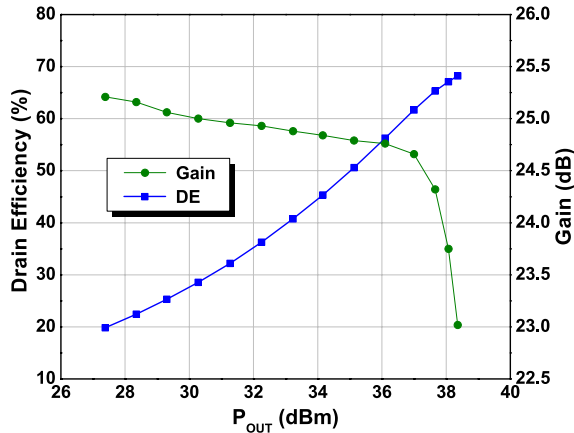
Frequency	$Z_S (\Omega)$	$Z_L (\Omega)$	$I_{DQ} (mA)$	Optimized Tuning Condition
900	$9.2 + j23.8$	$52.6 + j22.8$	50	CW Power and Efficiency
1800	$5.2 + j0.5$	$24.5 + j18.3$	50	CW Power and Efficiency
2140	$5.0 - j2.6$	$17.1 + j15.0$	50	CW Power and Efficiency
2500	$5.4 - j10.5$	$14.7 + j10.0$	50	CW Power and Efficiency
3500	$5.0 - j21.0$	$11.2 + j4.7$	50	CW Power and Efficiency
900	$21.9 + j43.4$	$59.5 + j33.7$	100	W-CDMA, $P_{OUT}$ , Efficiency, -45dBc ACPR
1800	$13.1 + j24.3$	$34.5 + j48.8$	100	W-CDMA, $P_{OUT}$ , Efficiency, -45dBc ACPR
2140	$5.4 + j17.3$	$25.4 + j36.4$	100	W-CDMA, $P_{OUT}$ , Efficiency, -45dBc ACPR
2600	$4.0 + j6.8$	$12.2 + j25.8$	100	LTE, $P_{OUT}$ , Efficiency, -45dBc ACPR
2500	$5.0 + j16.2$	$13.2 + j20.4$	100	OFDM, Maximum $P_{OUT}$ , 1.5% EVM
3500	$4.1 - j0.6$	$6.6 + j10.5$	100	OFDM, Maximum $P_{OUT}$ , 1.5% EVM
5100	$17.8 - j16.4$	$10.7 - j4.9$	100	OFDM, Maximum $P_{OUT}$ , 1.5% EVM
5200	$21.5 - j29.0$	$11.9 - j4.8$	100	OFDM, Maximum $P_{OUT}$ , 1.5% EVM
5700	$10.2 - j13.2$	$11.3 - j17.0$	100	OFDM, Maximum $P_{OUT}$ , 1.5% EVM
5800	$11.0 - j16.3$	$12.1 - j15.3$	100	OFDM, Maximum $P_{OUT}$ , 1.5% EVM



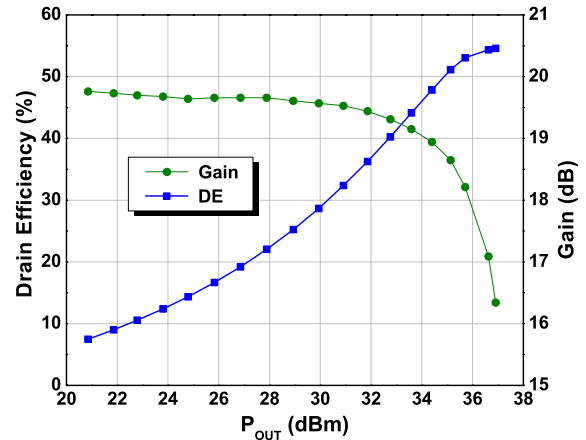
**Figure 1 - Impedances for Optimum CW Power,  $V_{DS} = 28V, I_{DQ} = 50mA$**

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

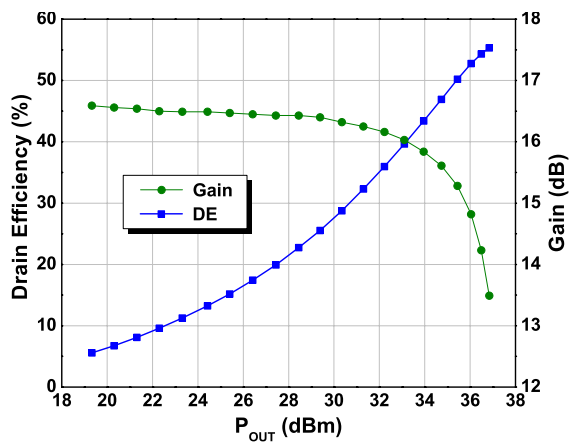
$V_{DS}=28V, I_{DQ}=50mA, T_A=25^\circ C$  unless otherwise noted.



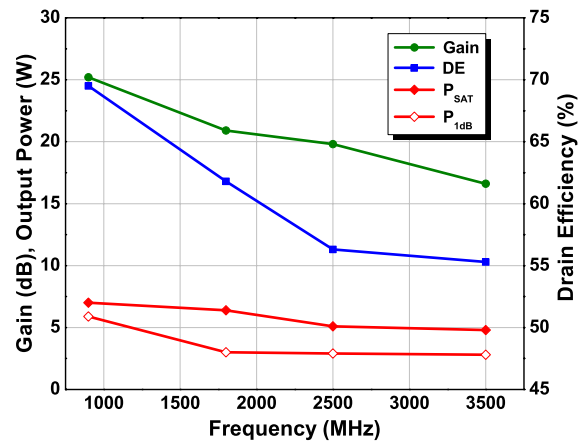
**Figure 2 - Typical CW Performance**  
Frequency = 900MHz



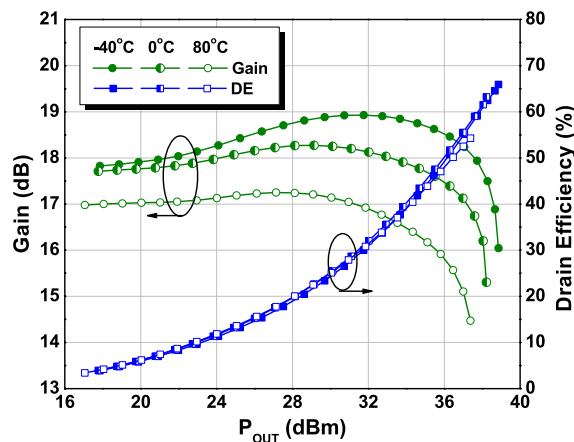
**Figure 3 - Typical CW Performance**  
Frequency = 2500MHz



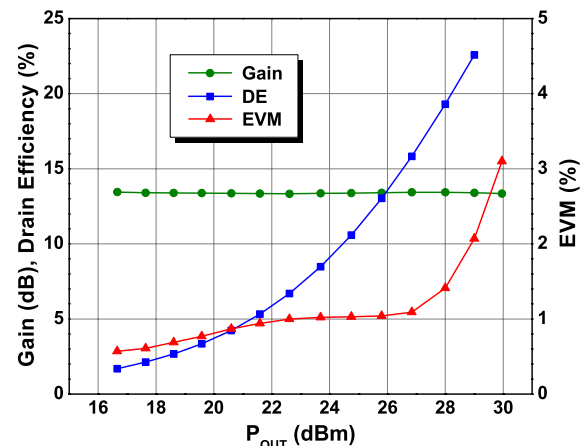
**Figure 4 - Typical CW Performance**  
Frequency = 3500MHz



**Figure 5 - Typical CW Performance**  
Frequency = 900 to 3500MHz



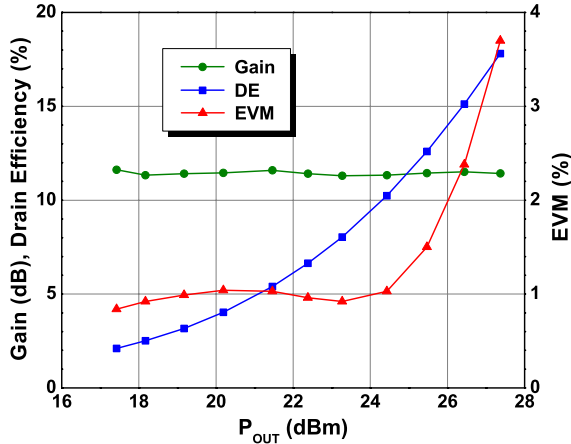
**Figure 6 - Typical CW Performance**  
Over Temperature, Frequency = 2500MHz



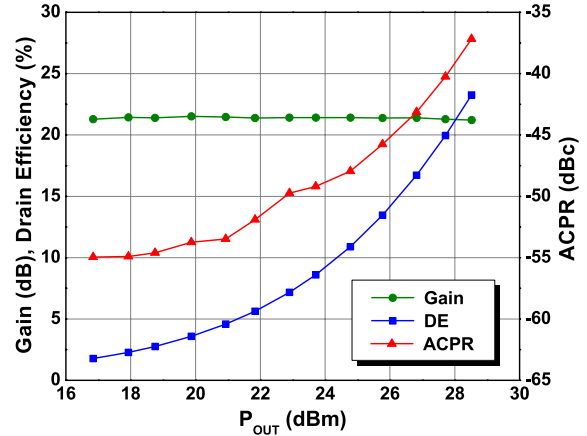
**Figure 7 - Typical OFDM Performance**  
 $I_{DQ} = 100mA$ , Frequency = 2500MHz

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

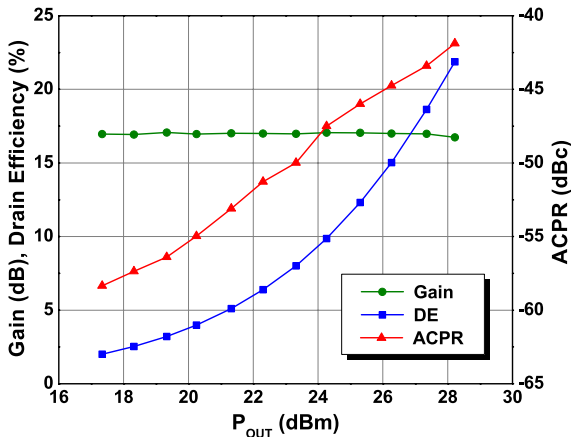
$V_{DS}=28V$ ,  $I_{DQ}=50mA$ ,  $T_A=25^{\circ}C$  unless otherwise noted.



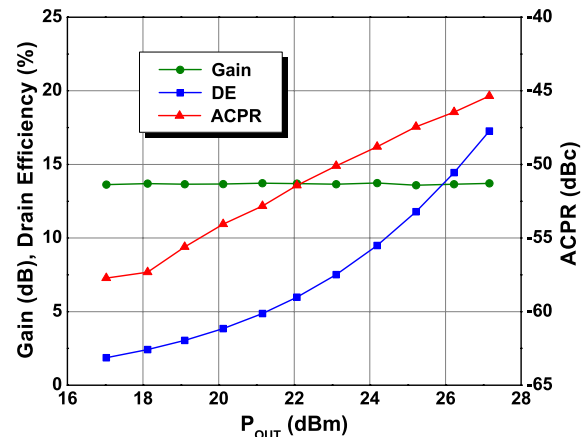
**Figure 8 - Typical OFDM Performance**  
 $I_{DQ} = 100mA$ , Frequency = 3500MHz



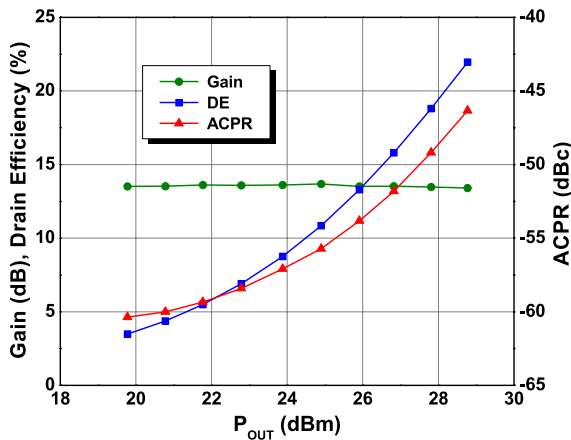
**Figure 9 - Typical W-CDMA Performance**  
 $I_{DQ} = 100mA$ , Frequency = 900MHz



**Figure 10 - Typical W-CDMA Performance**  
 $I_{DQ} = 100mA$ , Frequency = 1800MHz



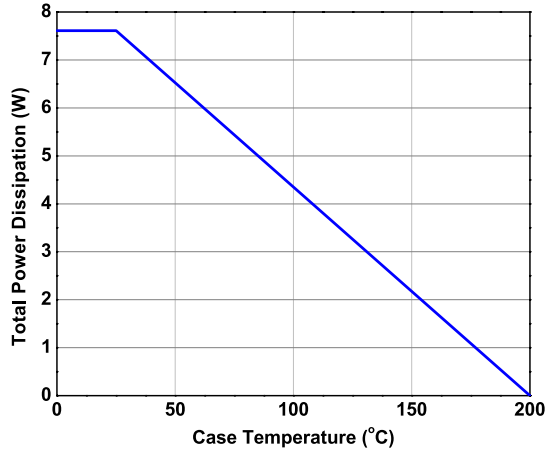
**Figure 11 - Typical W-CDMA Performance**  
 $I_{DQ} = 100mA$ , Frequency = 2140MHz



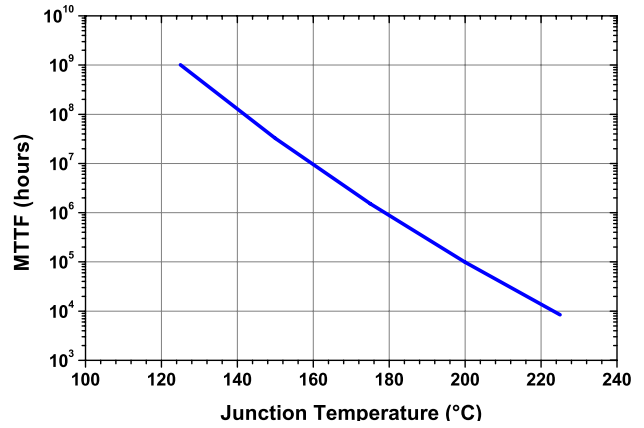
**Figure 12 - Typical LTE Performance**  
 $I_{DQ} = 100mA$ , Frequency = 2600MHz

## Typical Device Characteristics

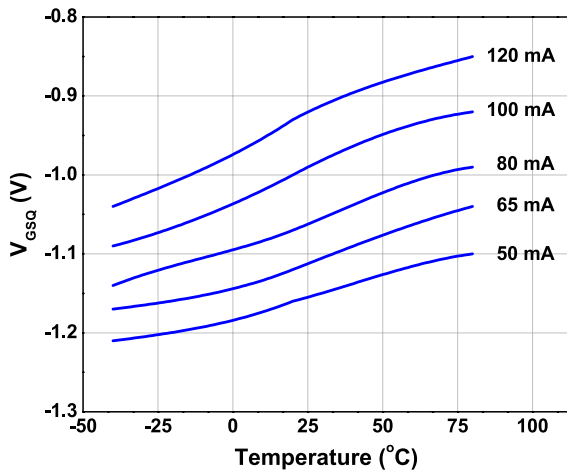
$V_{DS}=28V$ ,  $I_{DQ}=50mA$ ,  $T_A=25^{\circ}C$  unless otherwise noted.



**Figure 13 - Power Derating Curve**



**Figure 14 - MTTF of NRF1 Devices as a Function of Junction Temperature**



**Figure 15 - Quiescent Gate Voltage ( $V_{GSQ}$ ) Required to Reach  $I_{DQ} = 50mA$  as a Function of Ambient Temperature**

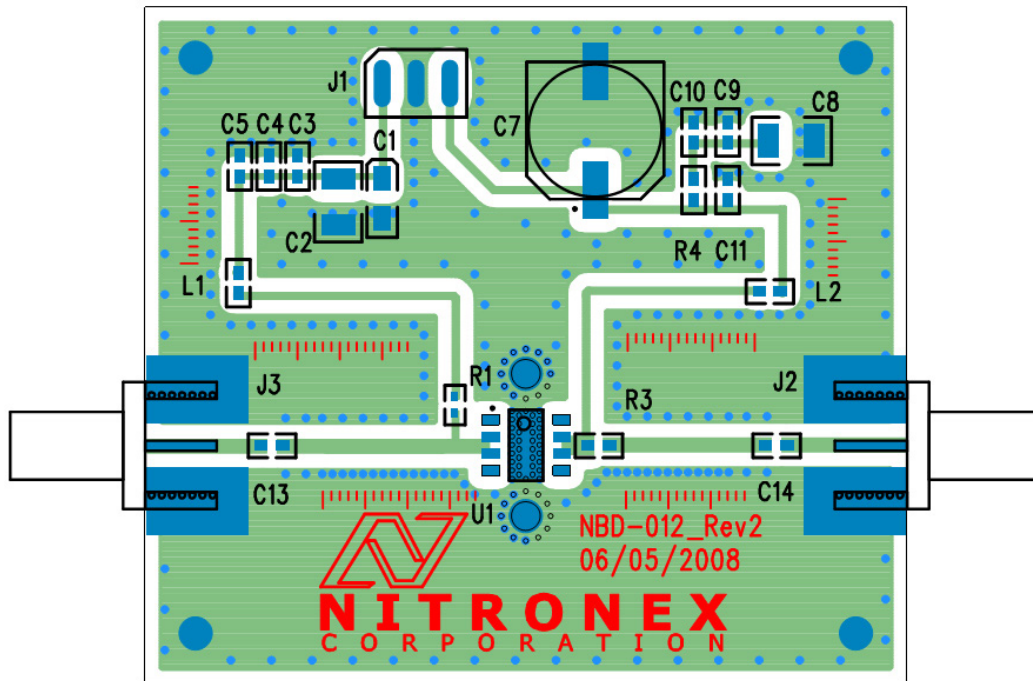


Figure 16 - APP-NPTB00004-25 2500MHz Demonstration Board

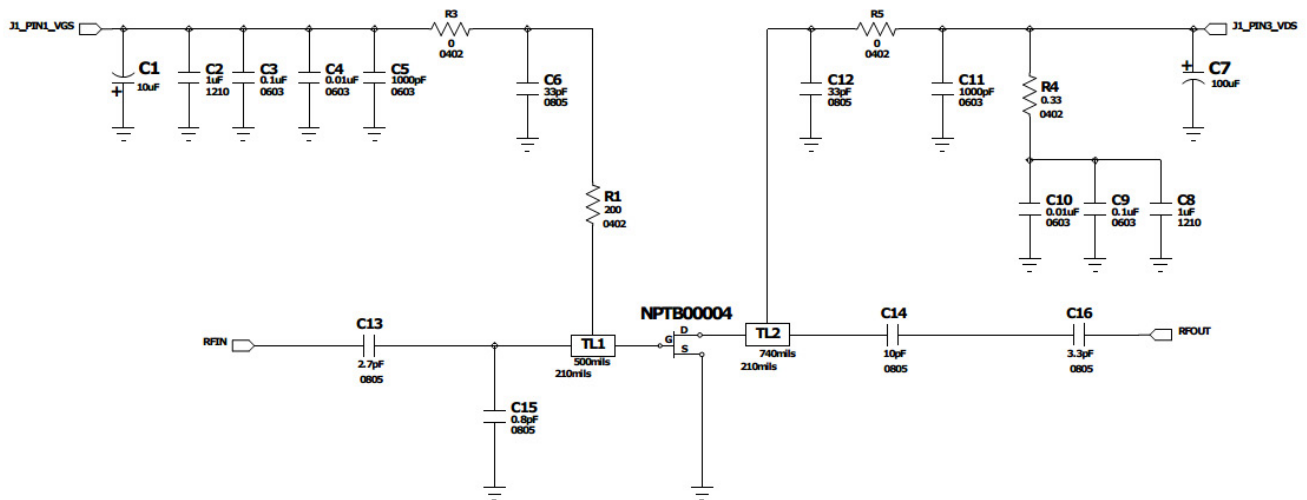


Figure 17 - APP-NPTB00004-25 2500MHz Demonstration Board Equivalent Circuit

**Table 2:** APP-NPTB00004-25 2500MHz Demonstration Board Bill of Materials

Name	Value	Tolerance	Vendor	Vendor Number
C1	10uF	20%	AVX	TAJA106M016R
C2	1uF	10%	AVX	12101C105KAT2A
C3	0.1uF	10%	Murata	GRM188R72A104KA35D
C4	0.01uF	10%	AVX	06031C103KAT2A
C5	0.001uF	10%	AVX	06031C102KAT2A
C6	33pF	5%	ATC	ATC600F330B
C7	100uF	20%	Panasonic	ECE-V1JA101P
C8	1uF	10%	AVX	12101C105KAT2A
C9	0.1uF	10%	Murata	GRM188R72A104KA35D
C10	0.01uF	10%	AVX	06031C103KAT2A
C11	0.001uF	10%	AVX	06031C102KAT2A
C12	33pF	5%	ATC	ATC600F330B
C13	2.7pF	+/- 0.1pF	ATC	ATC600F2R7B
C14	10pF	1%	ATC	ATC600F100B
C15	0.8pF	+/-0.1pF	ATC	ATC600F0R8B
C16	3.3pF	+/-0.1pF	ATC	ATC600F3R3B
R1	200 ohm	1%	Panasonic	ERJ-2GEJ201X
R3, R5	0 ohm	--	Panasonic	ERJ-2GE0R00X
R4	0.033 ohm	1%	Panasonic	ERJ-6BWJR033W
NBD-012_Rev1	--	--	Alberta Printed Circuits	NBD-012_Rev1
Substrate			Rogers	R04350, t = 30mil $\epsilon_r = 3.5$

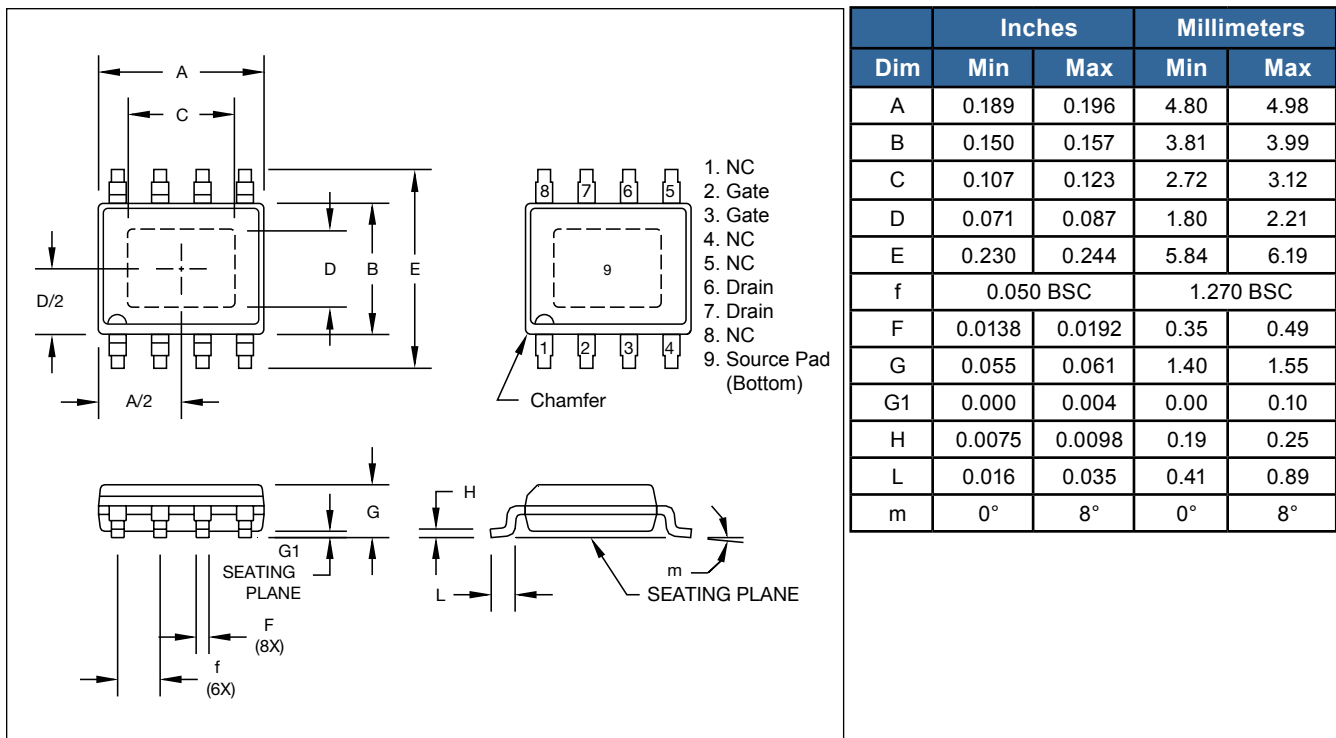


## Ordering Information<sup>1</sup>

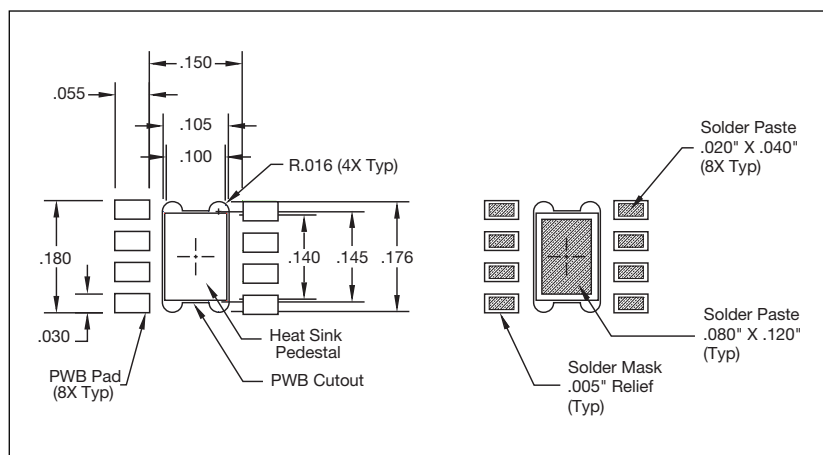
Part Number	Order Multiple	Description
NPTB00004DT	97	Tube; NPTB00004 in D (PSOP2) Package
NPTB00004DR	1500	Tape and Reel; NPTB00004 in D (PSOP2) Package

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

## D Package Dimensions and Pinout



## Mounting Footprints



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info@nitronex.com  
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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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