NPT1010

Gallium Nitride 28V, 100W RF Power Transistor

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

FEATURES

- Optimized for broadband operation from DC – 2000MHz
- 100W P_{3dB} CW power at 900MHz
- 60-95 W P_{SAT} CW power from 500-1000MHz in broadband application design
- High efficiency from 14 - 28V
- 1.4 °C/W R_{TH} with maximum T_J rating of 200°C
- Robust up to 10:1 VSWR mismatch at all phase angles with no damage to the device
- Subject to EAR99 export control

DC – 2000 MHz
14 – 28 Volt
GaN HEMT

RoHS

RF Specifications (CW, 900MHz): V_{DS} = 28V, I_{DQ} = 700mA, T_A = 25°C, Measured in Nitronex Test Fixture

Symbol	Parameter	Min	Typ	Max	Units
P_{3dB}	Average Output Power at 3dB Gain Compression	49.0	50.0	-	dBm
P_{1dB}	Average Output Power at 1dB Gain Compression	-	49.0	-	dBm
G_{SS}	Small Signal Gain	18.7	19.7	-	dB
η	Drain Efficiency at 3dB Gain Compression	57	64	-	%
VSWR	10:1 VSWR at all phase angles	No damage to the device			

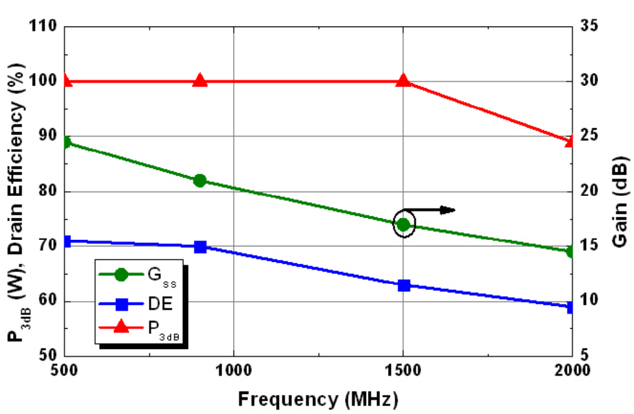


Figure 1 - Typical CW Performance in Load-Pull, V_{DS} = 28V, I_{DQ} = 700mA

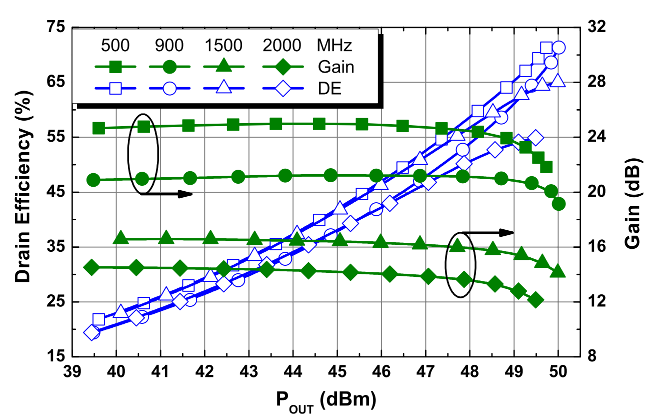


Figure 2 - Typical CW Performance in Load-Pull, V_{DS} = 28V, I_{DQ} = 700mA

DC Specifications: T_A = 25°C

Symbol	Parameter	Min	Typ	Max	Units
Off Characteristics					
V_{BDS}	Drain-Source Breakdown Voltage (V_{GS} = -8V, I_D = 36mA)	100	-	-	V
I_{DLK}	Drain-Source Leakage Current (V_{GS} = -8V, V_{DS} = 60V)	-	9	18	mA
On Characteristics					
V_T	Gate Threshold Voltage (V_{DS} = 28V, I_D = 36mA)	-2.3	-1.8	-1.3	V
V_{GSQ}	Gate Quiescent Voltage (V_{DS} = 28V, I_D = 700mA)	-2.0	-1.5	-1.0	V
R_{ON}	On Resistance (V_{GS} = 2V, I_D = 270mA)	-	0.13	0.14	Ω
$I_{D,MAX}$	Drain Current (V_{DS} = 7V pulsed, 300µs pulse width, 0.2% duty cycle)	19.0	21.0	-	A

Thermal Resistance Specification

Symbol	Parameter	Min	Typ	Max	Units
θ_{JC}	Thermal Resistance (Junction-to-Case), T_J = 180 °C	-	1.4	-	°C/W

Absolute Maximum Ratings: Not simultaneous, T_C = 25°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	180	mA
P_T	Total Device Power Dissipation (Derated above 25°C)	125	W
T_{STG}	Storage Temperature Range	-65 to 150	°C
T_J	Operating Junction Temperature	200	°C
HBM	Human Body Model ESD Rating (per JESD22-A114)	1B (>500V)	
MM	Machine Model ESD Rating (per JESD22-A115)	Class A (≤200V)	
CDM	Charge Device Model ESD Rating (per JESD22-C101)	IV (>1000V)	

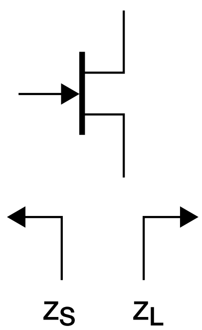
NPT1010

Load-Pull Data, Reference Plane at Device Leads

V_{DS}=28V, I_{DQ}=700mA, T_A=25°C unless otherwise noted

Table 1: Optimum Source and Load Impedances for CW Gain, Drain Efficiency, and Output Power Performance

Frequency (MHz)	Z_S (Ω)	Z_L (Ω)	P_{SAT} (W)	G_{SS} (dB)	Drain Efficiency @ P_{SAT} (%)
500	2.8 + j2.2	2.7 + j2.0	100	24.5	71%
900	1.1 - j0.5	1.9 + j0.6	100	21.0	70%
1500	1.1 - j3.6	2.0 - j1.2	100	17.0	63%
2000	1.1 - j4.9	1.9 - j3.8	89	14.5	59%



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

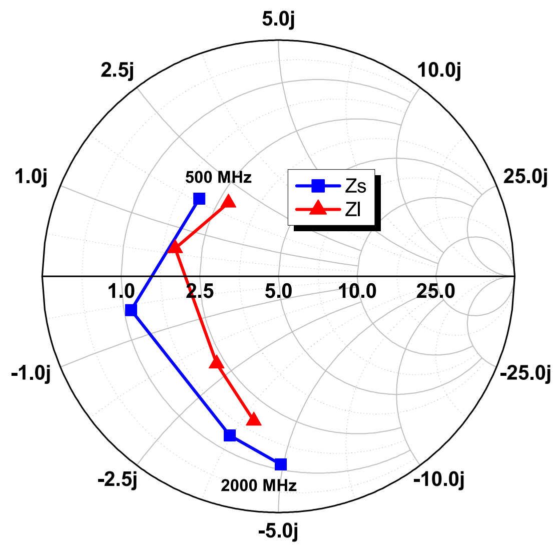


Figure 3 - Optimum Impedances for CW Performance. Z_0 = 5 Ω

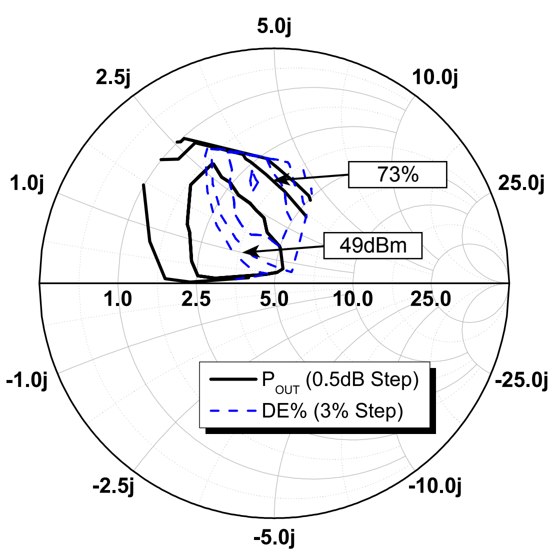


Figure 4 - Load-Pull Contours, 500MHz, P_{IN} = 27dBm, Z_S = 2.8 + j2.2 Ω

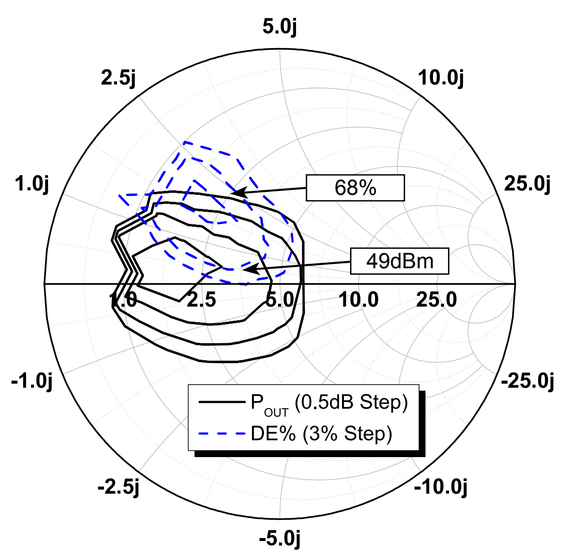


Figure 5 - Load-Pull Contours, 900MHz, P_{IN} = 32.5dBm, Z_S = 1.1 - j0.5 Ω

Load-Pull Data, Reference Plane at Device Leads

V_{DS}=28V, I_{DQ}=700mA, T_A=25°C unless otherwise noted.

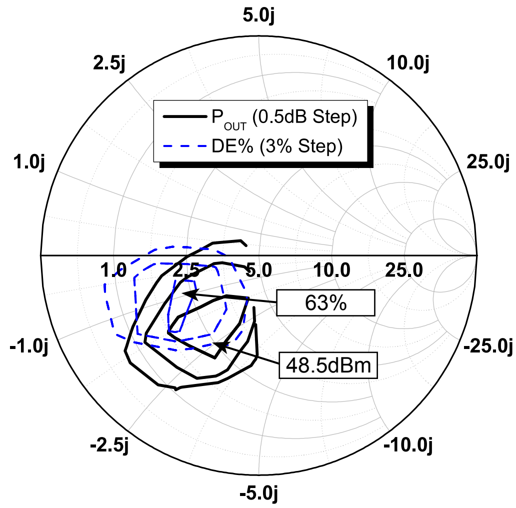


Figure 6 - Load-Pull Contours, 1500MHz, P_{IN} = 29dBm, Z_S = 1.1 - j3.6 Ω

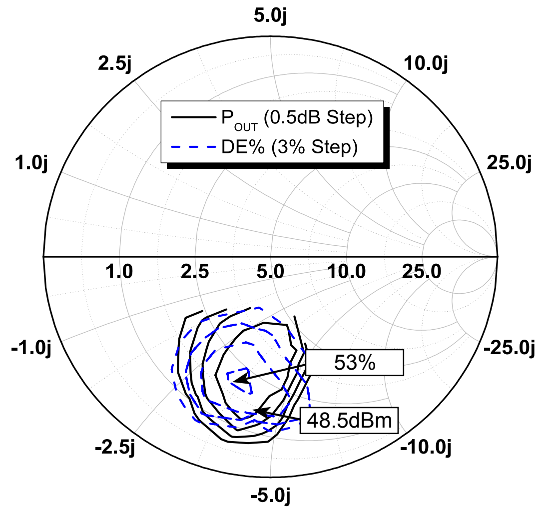


Figure 7 - Load-Pull Contours, 2000MHz, P_{IN} = 36dBm, Z_S = 1.1 - j4.9 Ω

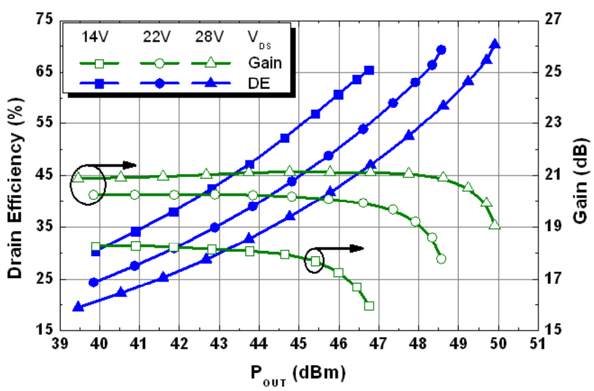


Figure 8 - Typical CW Performance Over Voltage in Load-Pull, 900MHz

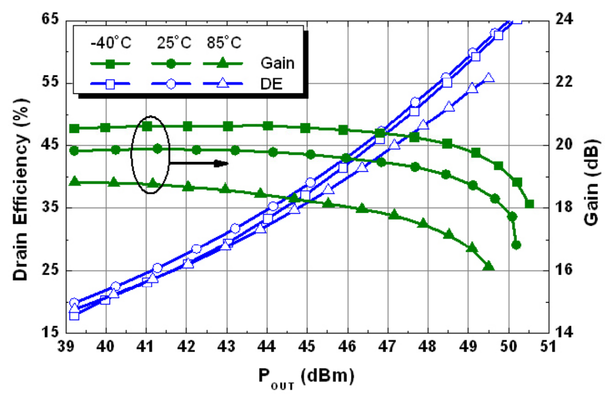


Figure 9 - Typical CW Performance Over Temperature in Nitronex Test Fixture, 900MHz

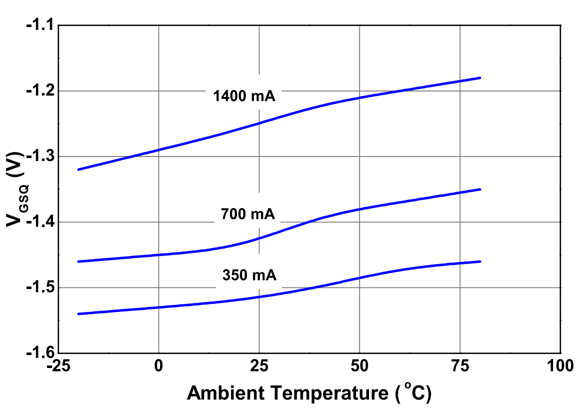


Figure 10 - Quiescent Gate Voltage (V_{GSQ}) Required to Reach I_{DQ} as a Function of Ambient Temperature, V_{DS} = 28V

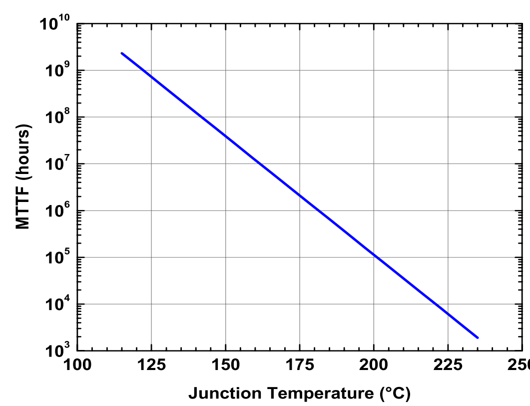


Figure 11 - MTTF of NRF1 Devices as a Function of Junction Temperature

RF Performance in 500-1000MHz Broadband Application Circuit

V_{DS}=28V, I_{DQ}=700mA, T_A=25°C unless otherwise noted

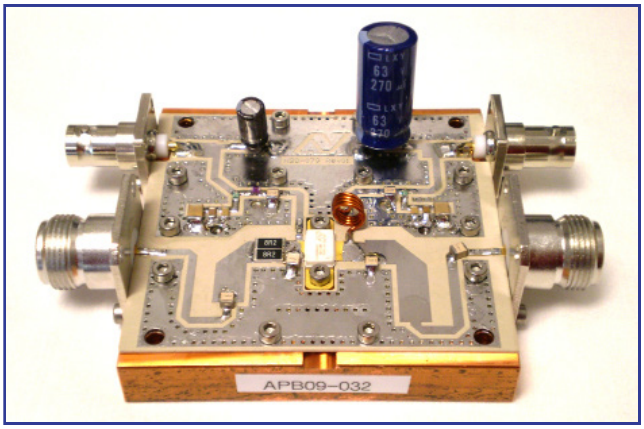


Figure 12 - Photograph of 500-1000MHz broadband application circuit for NPT1010

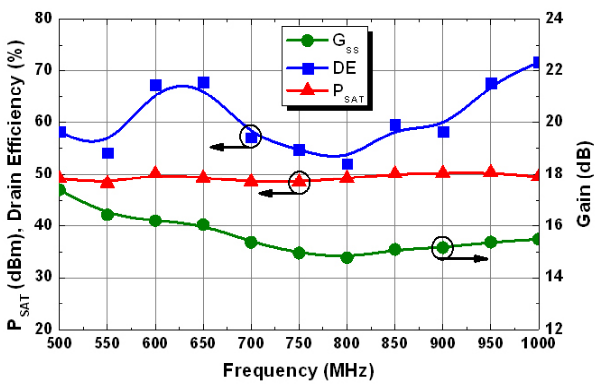


Figure 13 - CW Performance in broadband circuit. Measurements (symbols) are connected by a smoothing function (25 °C)

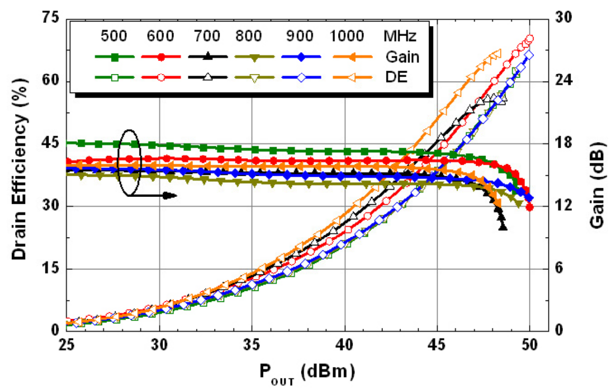


Figure 14 - CW drive up curves in broadband circuit.

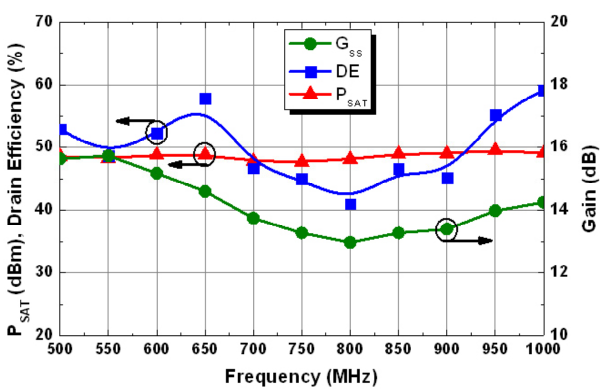


Figure 15 - CW Performance in broadband circuit. Measurements (symbols) are connected by a smoothing function (100 °C)

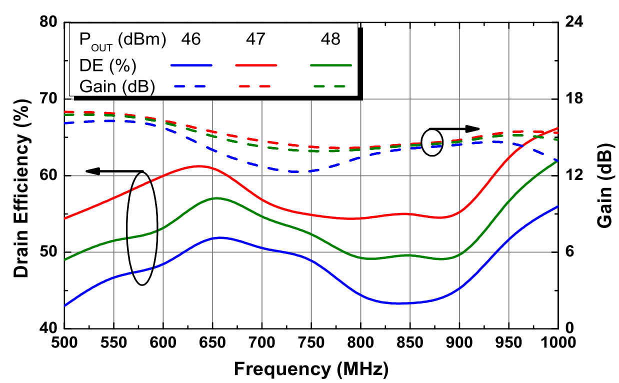


Figure 16 - CW Performance in broadband circuit at different output powers connected by a smoothing function

RF Performance in 500-1000MHz Broadband Application Circuit

V_{DS}=28V, I_{DQ}=700mA, T_A=25°C unless otherwise noted

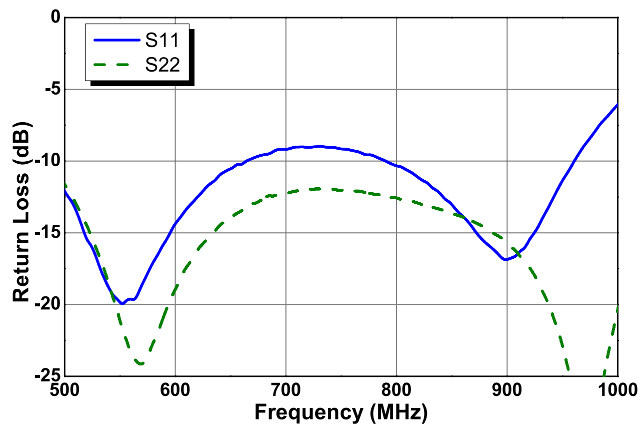


Figure 17 - Input and output return loss of the 500-1000MHz broadband application circuit, P_{IN} = -5dBm

Table 2: Power, gain, efficiency and temperature rise across frequency in the 500-1000MHz application circiut

Frequency (MHz)	P_{SAT} (dBm)	P_{SAT} (W)	Drain Efficiency @ P_{SAT} (%)	G_{SS} (dB)	$T_{J,RISE}$ (°C)[1]
500	48.9	77.8	60	18.1	76
550	49.3	84.9	65	17.4	66
600	49.8	94.8	69	16.6	63
650	48.3	68.2	63	16.1	59
700	48.1	63.8	56	15.5	73
750	48.0	63.1	55	15.1	76
800	49.4	86.9	63	15.1	76
850	49.7	92.5	66	15.4	71
900	50.0	98.9	66	15.7	74
950	49.0	79.4	69	16.0	53
1000	48.3	67.1	67	16.0	49

Note 1: Temperature rise is from junction to case and is calculated from the dissipated power using an R_{TH} value of 1.4°C/W

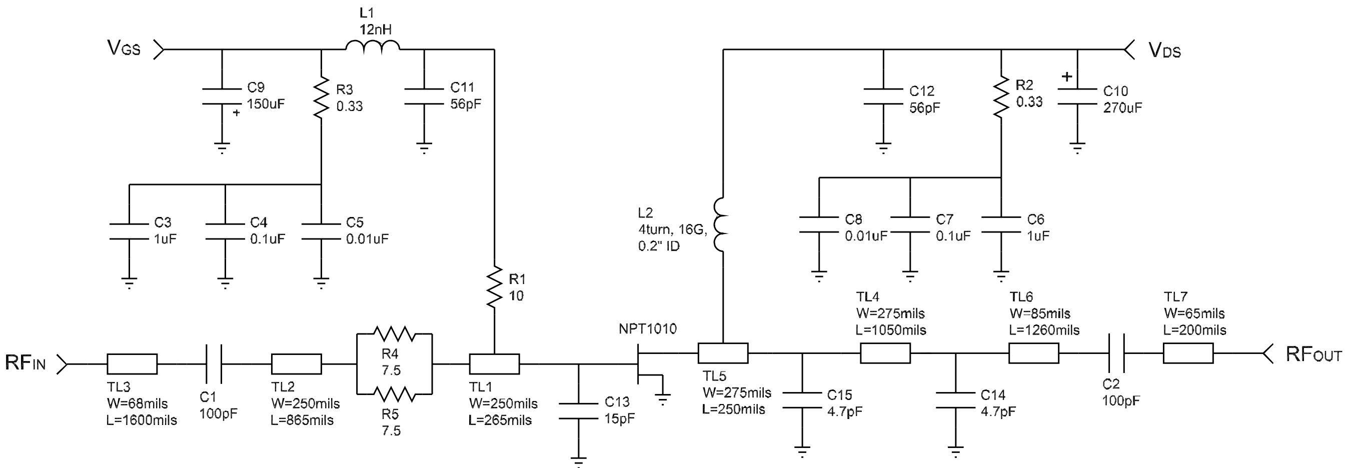


Figure 18 - Schematic of 500-1000MHz application board for NPT1010

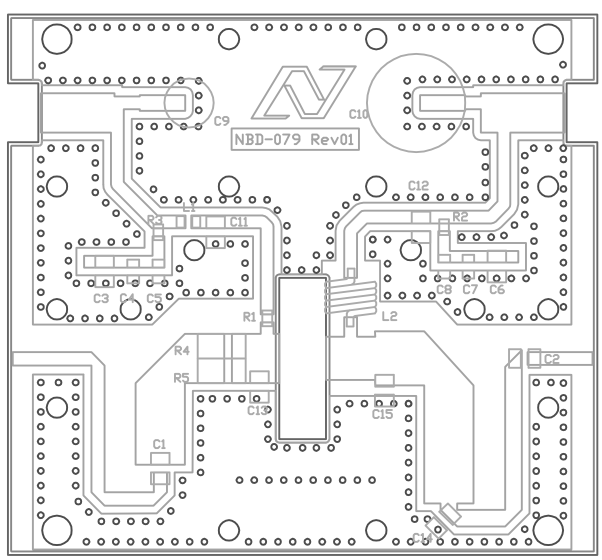


Figure 19 - Layout of 500-1000MHz application board for NPT1010

Table 3: NPT1010 500-1000MHz Application Board Build of Materials

Name	Value	Tolerance	Size	Vendor	Vendor Number
C1	100pF	5%	.11"X.11"	ATC	ATC100B101J
C2	100pF	5%	.11"X.11"	ATC	ATC100B101J
C3, C6	1.0uF	10%	1812	AVX Corp	18121C105KAT2A
C4, C7	0.1uF	10%	1206	Kemet	C1206C104K1RACTU
C5, C8	0.01uF	1%	1206	AVX Corp	12061C103KAT2A
C9	150uF	20%	3216(EIA)	Nichicon	UPW1C151MED
C10	270uF	20%	10mm(dia)	United Chmi-Con	ELXY 630ELL271MK25S
C11, C12	56pF	1%	.11"X.11"	ATC	ATC100B560J
C14, C15	4.7pF	1%	.11"X.11"	ATC	ATC100B4R7J
C13	15pF	1%	.11"X.11"	ATC	ATC100B150J
R1	10 ohms	5%	805	Panasonic	ERJ-6ENF10R0V
R2, R3	0.33 ohms	1%	805	Panasonic	ERJ-6RQFR33V
R4, R5	7.5 ohms	1%	2512	Stackpole Electron-	RHC 2512 10 1% R
L1	12nH	5%	805	Coilcraft	0805CS-120XJB
L2	4 Turn, 16G, 0.2"ID Copper Wire				
N Connector				Amphenol	172195
nbd-079_Rev1				Rogers	Rogers 6010LM 25mil, 1oz, ε_r = 10.2
Copper Heatsink					
BNC Connectors				Tyco Electronics	1052566-1
Metric 18-8 SS Socket head Cap Screw M2.5 Thread, 8mm Length, 0.45mm Pitch				McMaster Carr	91292A012

Ordering Information[1]

Part Number	Description
NPT1010B	NPT1010 in AC360B-2 Metal-Ceramic Bolt-Down Package

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

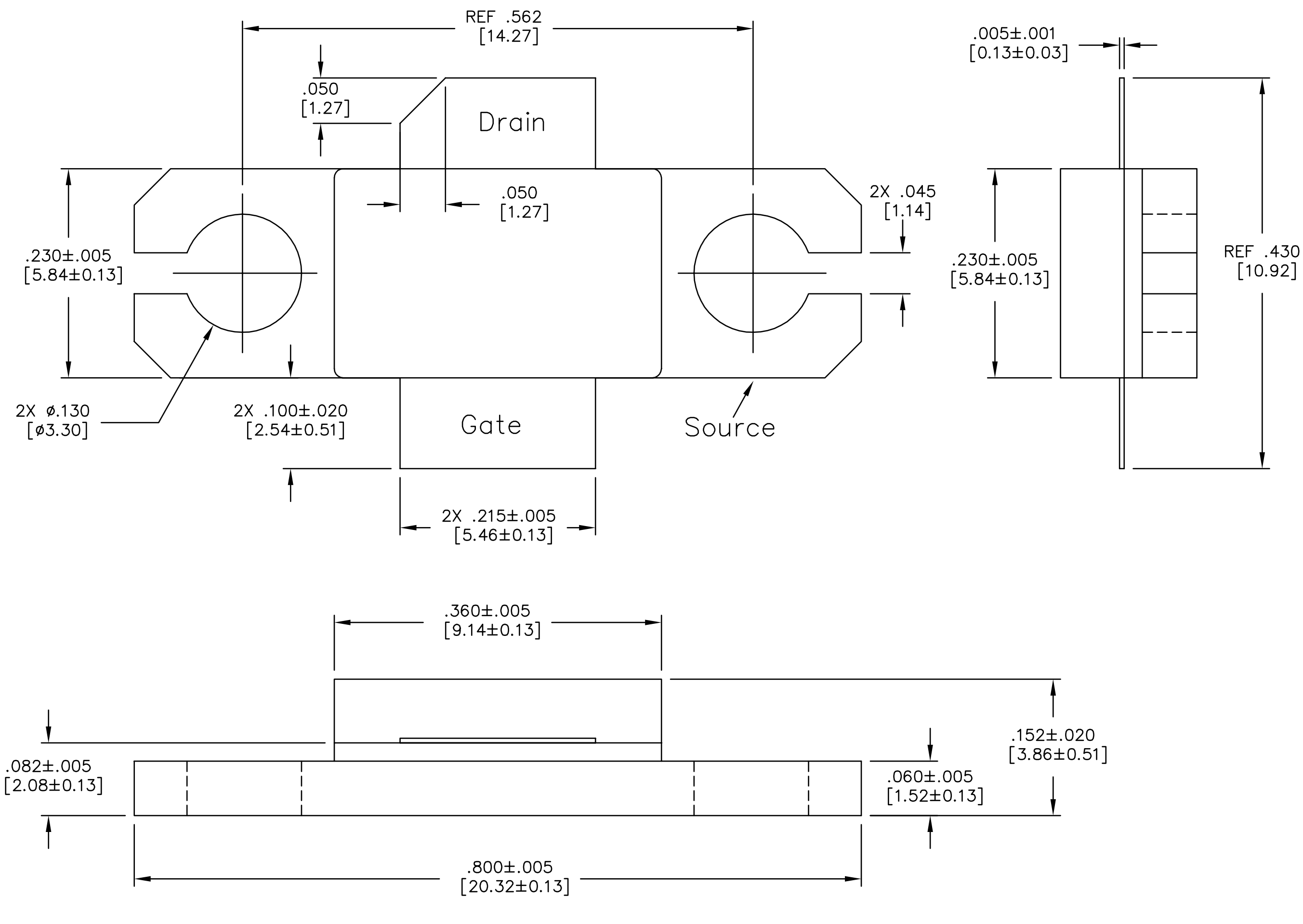


Figure 20 - AC360B-2 Metal-Ceramic Package Dimensions and Pinout (all dimensions are in inches [mm])

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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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