

Gallium Nitride 48V, 100W, DC-2 GHz HEMT

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

Features

- Suitable for linear and saturated applications
- Tunable from DC-2 GHz
- 48V Operation
- Industry Standard Plastic Package
- High Drain Efficiency (>60%)



Applications

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

DC-2 GHz
100W
GaN HEMT



Product Description

The NPT2022 GaN HEMT is a wideband transistor optimized for DC-2 GHz operation. This device has been designed for saturated and linear operation with output power levels to 100W (50 dBm) in an industry standard plastic package with a bolt down flange.

RF Specifications (CW, 900 MHz): $V_{DS} = 48V$, $I_{DQ} = 600mA$, $T_C = 25^{\circ}C$

Symbol	Parameter	Min	Typ	Max	Units
G_{SS}	Small-signal Gain	-	19	-	dB
P_{SAT}	Saturated Output Power	-	50.5	-	dBm
η_{SAT}	Efficiency at Saturated Output Power	-	64	-	%
G_P	Gain at $P_{OUT} = 100W$	-	17	-	dB
η	Drain Efficiency at $P_{OUT} = 100W$	-	60	-	%
V_{DS}	Drain Voltage	-	48	-	V
Ψ	Ruggedness: Output Mismatch, all phase angles	VSWR = 10:1, No Device Damage			

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

Symbol	Parameter	Min	Typ	Max	Units
Off Characteristics					
I_{DLK}	Drain-Source Leakage Current ($V_{GS}=-8\text{V}$, $V_{DS}=160\text{V}$)	-	-	24	mA
I_{GLK}	Gate-Source Leakage Current ($V_{GS}=-8\text{V}$, $V_{DS}=0\text{V}$)	-	-	12	mA
On Characteristics					
V_T	Gate Threshold Voltage ($V_{DS}=48\text{V}$, $I_D=24\text{mA}$)	-2.5	-1.5	-0.5	V
V_{GSQ}	Gate Quiescent Voltage ($V_{DS}=48\text{V}$, $I_D=600\text{mA}$)	-2.1	-1.2	-0.3	V
R_{ON}	On Resistance ($V_{DS}=2\text{V}$, $I_D=180\text{mA}$)	-	0.2	-	Ω
$I_{D, MAX}$	Maximum Drain Current ($V_{DS}=7\text{V}$ pulsed, 300 μs pulse width, 0.2% Duty Cycle)	-	14	-	A

Thermal Resistance Specification:

Symbol	Parameter	Typ	Units
$R_{\theta JC}$	Thermal Resistance (Junction-to-Case), $T_J = 200^\circ\text{C}$	1.3	$^\circ\text{C/W}$

Junction Temperature (T_J) measured using IR Microscopy, Case Temperature (T_C) measured using a thermocouple embedded in heatsink.

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

Symbol	Parameter	Max	Units
V_{DS}	Drain-Source Voltage	160	V
V_{GS}	Gate-Source Voltage	-10 to 3	V
I_G	Gate Current	48	mA
P_T	Total Device Power Dissipation (Derated above 25°C)	134	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)	Class 1B	
MSL	Moisture sensitivity level (per IPC/JEDEC J-STD-020)	MSL-3	

Load-Pull Data, Reference Plane at Device Leads

$V_{DS}=48V$, $I_{DQ}=600mA$, $T_C=25^\circ C$ unless otherwise noted

Optimum Source and Load Impedances:

(CW Drain Efficiency and Output Power Tradeoff Impedance)

Frequency (MHz)	$Z_S (\Omega)$	$Z_L (\Omega)$	$P_{SAT} (W)$	$G_{SS} (dB)$	Drain Efficiency @ P_{SAT} (%)
500	$1.3 + j0.2$	$5.8 + j2.0$	152	26	71
900	$1.1 - j2.2$	$5.0 + j1.9$	139	22	70
1800	$1.3 - j6.9$	$3.2 - j2.5$	133	17	66
2000	$1.4 - j7.6$	$2.3 - j3.5$	119	16	66

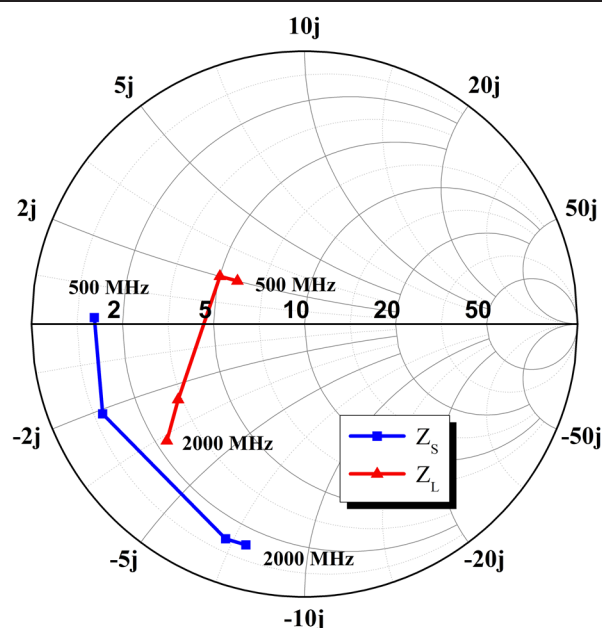
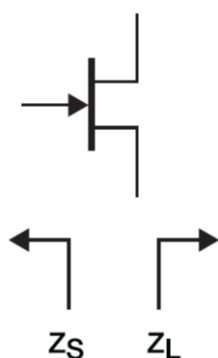


Figure 1: CW Power/Drain Efficiency Tradeoff Impedances, $Z_0=10\Omega$

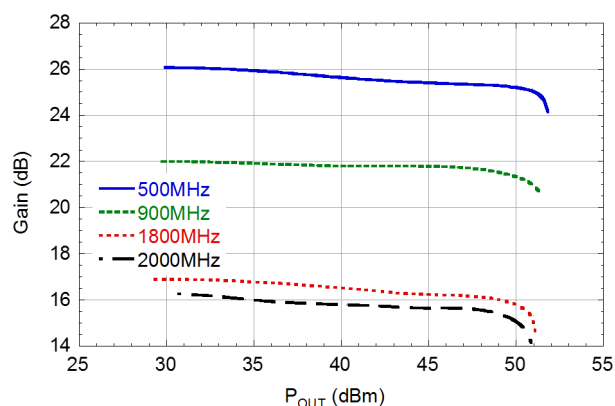


Figure 2: Gain vs. P_{OUT}

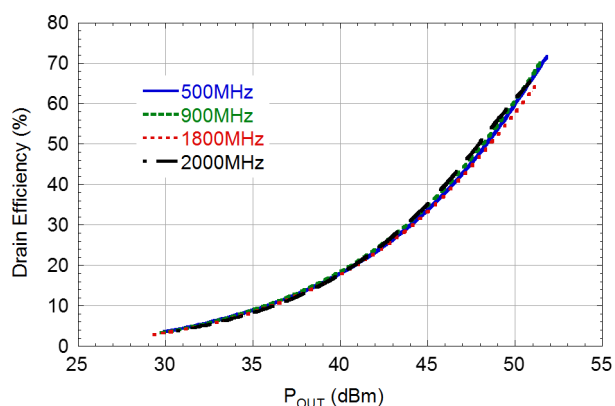


Figure 3: Efficiency vs. P_{OUT}

900 MHz Narrowband Circuit

(CW, $V_{DS}=48V$, $I_{DQ}=600mA$, $T_C=25^{\circ}C$, unless otherwise noted)

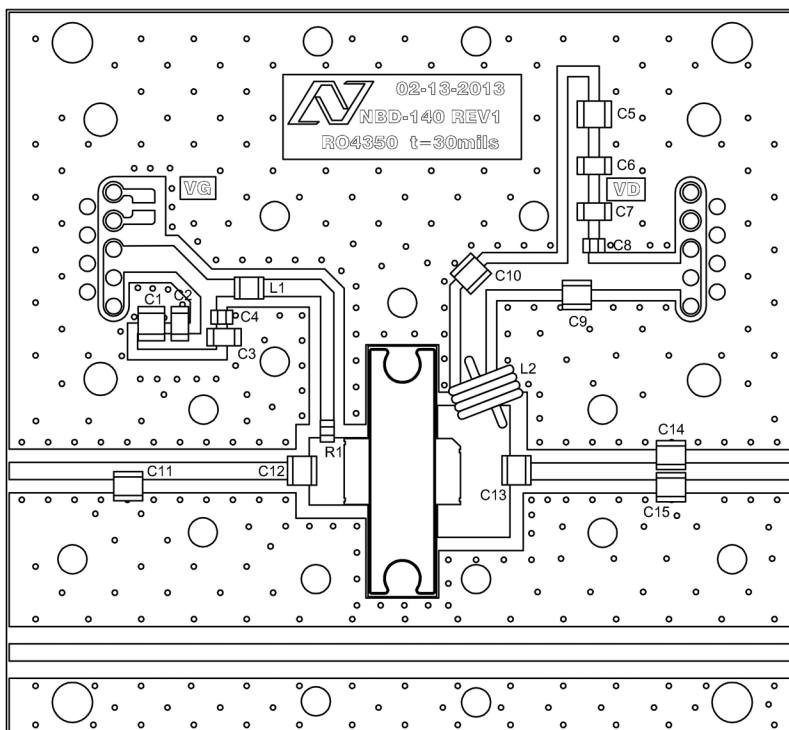


Figure 4: Component Placement of 900 MHz Narrowband Circuit for NPT2022

Reference	Value	Manufacturer	Part Number
C1, C5	1 μ F	AVX	1210C105KAT2A
C2, C6	0.1 μ F	Kemet	C1206C104K1RACTU
C3, C7	0.01 μ F	AVX	12061C103KAT2A
C4, C8	1000pF	Kemet	C0805C102K1RACTU
C9	10pF	ATC	ATC800B100B
C10	33pF	ATC	ATC800B330B
C11	15pF	ATC	ATC800B150B
C12	6.8pF	ATC	ATC800B6R8B
C13	18pF	ATC	ATC800B180B
C14	0.8pF	ATC	ATC800B0R8B
C15	8.2pF	ATC	ATC800B8R2B
R1	10 Ω	Panasonic	ERJ-2RKF10R0X
L1	19.4nH	Coilcraft	0806SQ-19NJL
L2	~44nH	20 AWG Cu Wire	4 turn, 5mm ID
PCB	RO4350, $\epsilon_r=3.5$, 0.030"	Rogers	Nitronex NBD-140r2

Typical Performance in 900 MHz Narrowband Circuit

(CW, $V_{DS}=48V$, $I_{DQ}=600mA$, $f=900MHz$, $T_C=25^\circ C$, unless otherwise noted)

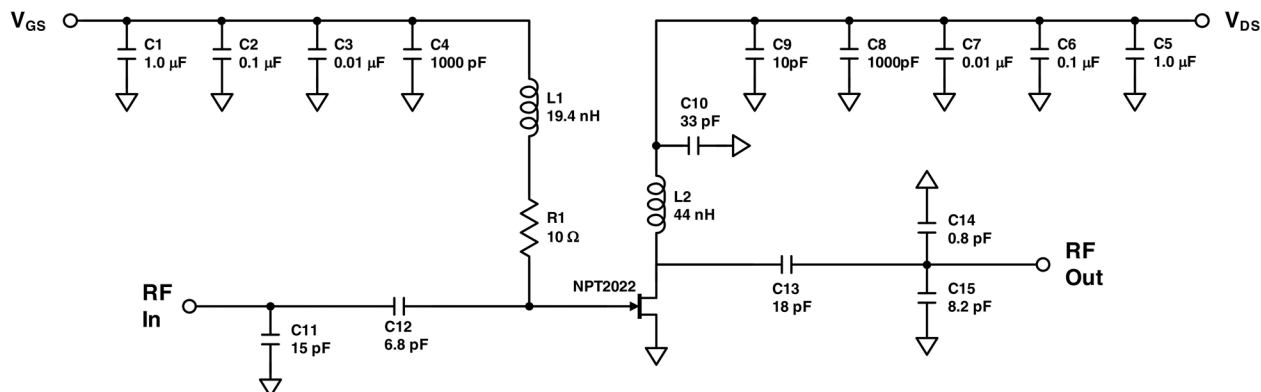


Figure 5. Electrical Schematic of 900 MHz Narrowband Circuit for NPT2022

(For RF Tuning details see Component Placement Diagram Figure 4)

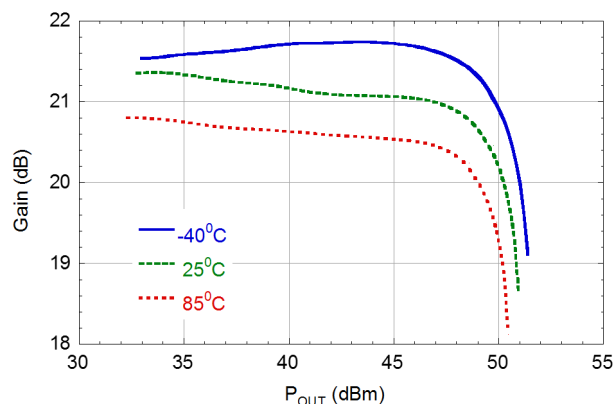


Figure 6: Gain vs. P_{OUT}

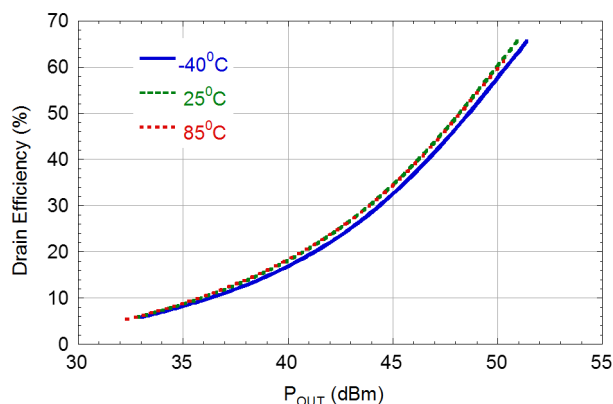


Figure 7: Drain Efficiency vs. P_{OUT}

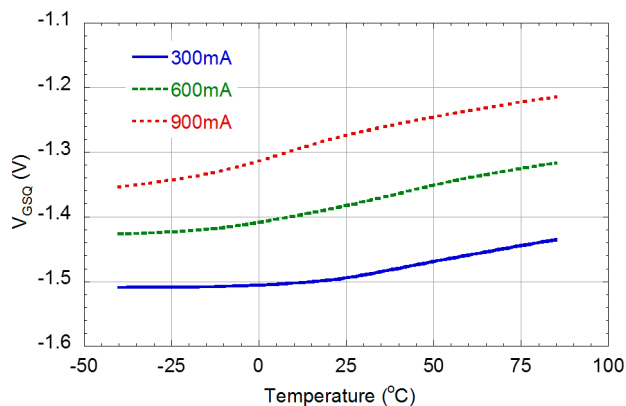


Figure 8: Quiescent V_{GS} vs. Temperature

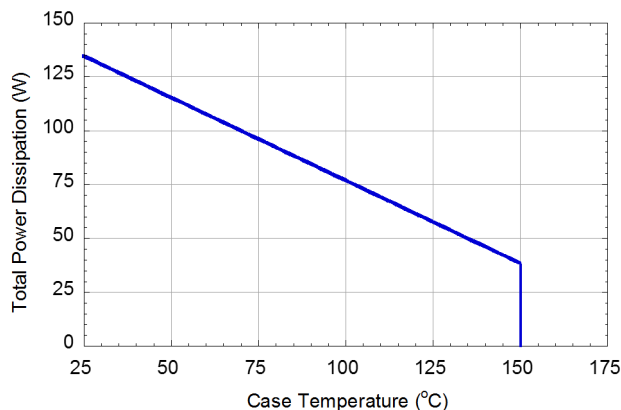


Figure 9: Power De-rating Curve
($T_J = 200^\circ C$, $T_C > 25^\circ C$)

Typical Performance in 900 MHz Narrowband Circuit

(CW, $V_{DS}=48V$, $I_{DQ}=600mA$, $f=900MHz$, $T_C=25^\circ C$, unless otherwise noted)

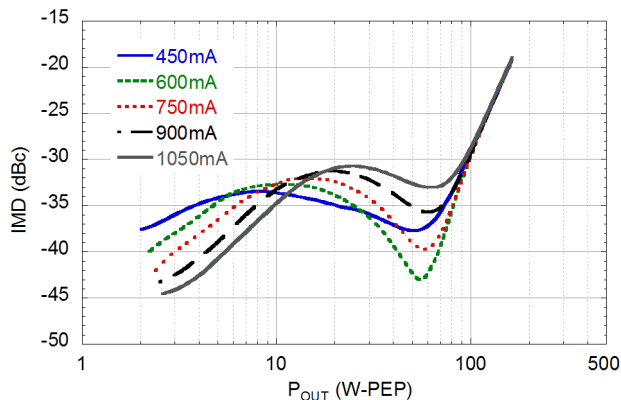


Figure 10: 2-Tone IMD3 vs. P_{OUT} vs. I_{DQ}
(1MHz Tone Spacing)

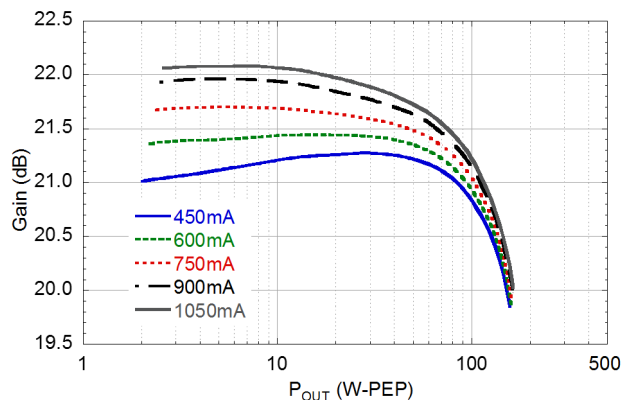


Figure 11: 2-Tone Gain vs. P_{OUT} vs. I_{DQ}
(1MHz Tone Spacing)

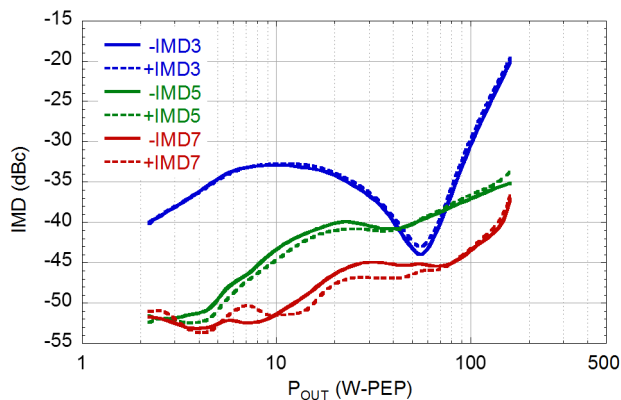


Figure 12: 2-Tone IMD vs. P_{OUT}
(1MHz Tone Spacing)

130-940 MHz Broadband Circuit

(CW, $V_{DS}=48V$, $I_{DQ}=600mA$, $T_C=25^{\circ}C$, unless otherwise noted)

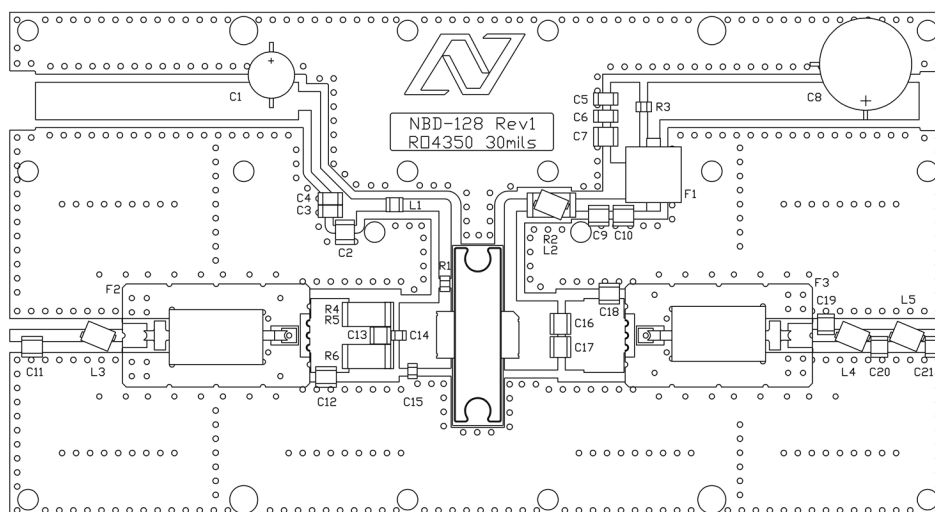


Figure 13: Component Placement of 130-940 MHz Broadband Circuit for NPT2022

Reference	Value	Manufacturer	Part Number
C1	150 μ F	Nichicon	UPW1C151MED
C2, C7	1 μ F	AVX	1210C105KAT2A
C3, C6	0.1 μ F	Kemet	C1206C104K1RACTU
C4, C5	0.01 μ F	AVX	12061C103KAT2A
C8	270 μ F	United Chemi-Con	ELXY 630ELL271MK25S
C9	18pF	ATC	ATC100B180
C10	1000pF	ATC	ATC100B102
C11	1.5pF	ATC	ATC100B1R5
C12	5.6pF	ATC	ATC100B5R6
C13	15pF	ATC	ATC100B150
C14	220pF	ATC	600F221FT
C15	12pF	ATC	600F120FT
C16, C17	82pF	ATC	ATC100B820
C18	4.7pF	ATC	ATC100B4R7
C19	2.4pF	ATC	ATC100B2R4
C20	3.9pF	ATC	ATC100B3R9
C21	1.0pF	ATC	ATC100B1R0
R1	49.9 Ω	Panasonic	ERJ-6ENF49R9V
R2	470 Ω	Panasonic	ERJ-1TNF4700U
R3	0.33 Ω	Panasonic	ERJ-6RQFR33V
R4, R5, R6	24.9 Ω	Panasonic	ERJ-1TNF24R9U
F1	Material 73	Fair-Rite	2673000801
F2, F3	4:1 Transformer	Anaren	XMT031B5012
L1	25nH	Coilcraft	0908SQ-25NJL
L2, L4	8nH	Coilcraft	A03TJL
L3, L5	5nH	Coilcraft	A02TJL
PCB	RO4350, $\epsilon_r=3.5$, 0.020"	Rogers	Nitronex NBD-128r1

Typical Performance in 130-940 MHz Broadband Circuit

(CW, $V_{DS}=48V$, $I_{DQ}=600mA$, $T_C=25^\circ C$, unless otherwise noted)

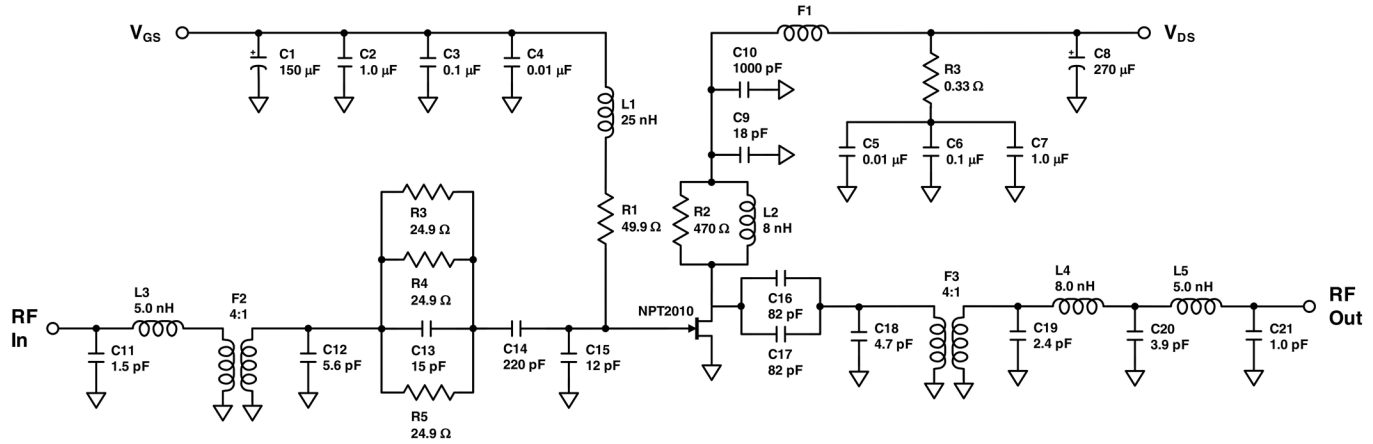


Figure 14. Electrical Schematic of 130-940 MHz Broadband Circuit for NPT2022
(For RF Tuning details see Component Placement Diagram Figure 13)

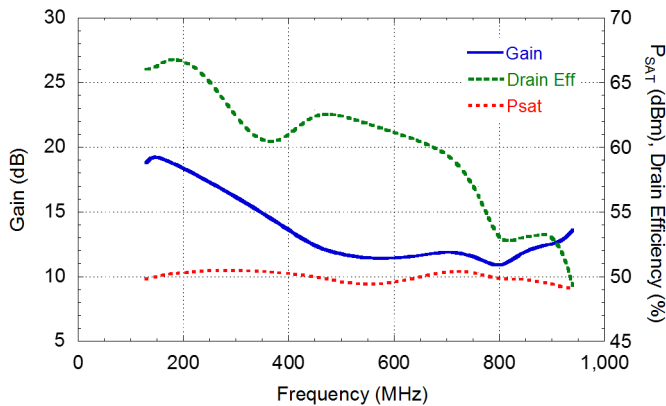


Figure 15: Performance vs. Frequency at
($P_{OUT} = P_{SAT}$)

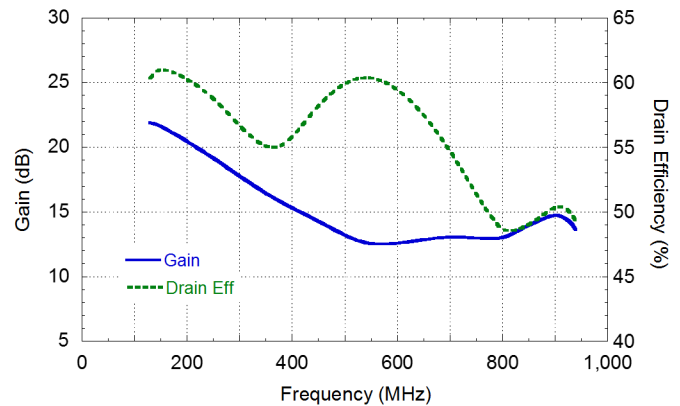


Figure 16: Performance vs. Frequency
($P_{OUT} = 49\text{dBm}$)

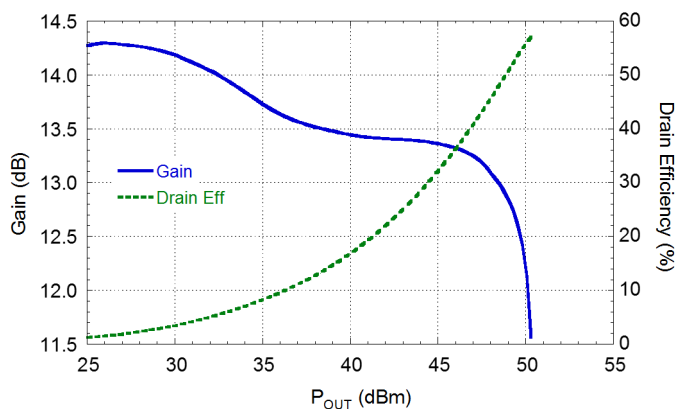


Figure 17: Performance vs. P_{OUT}
($f = 760\text{MHz}$)

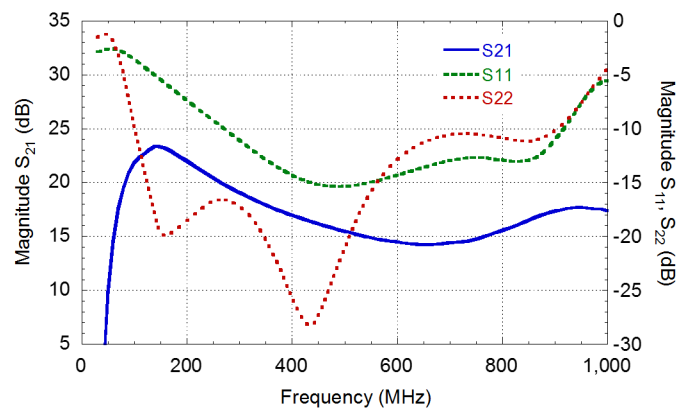


Figure 18: Small Signal s-parameters vs. Frequency

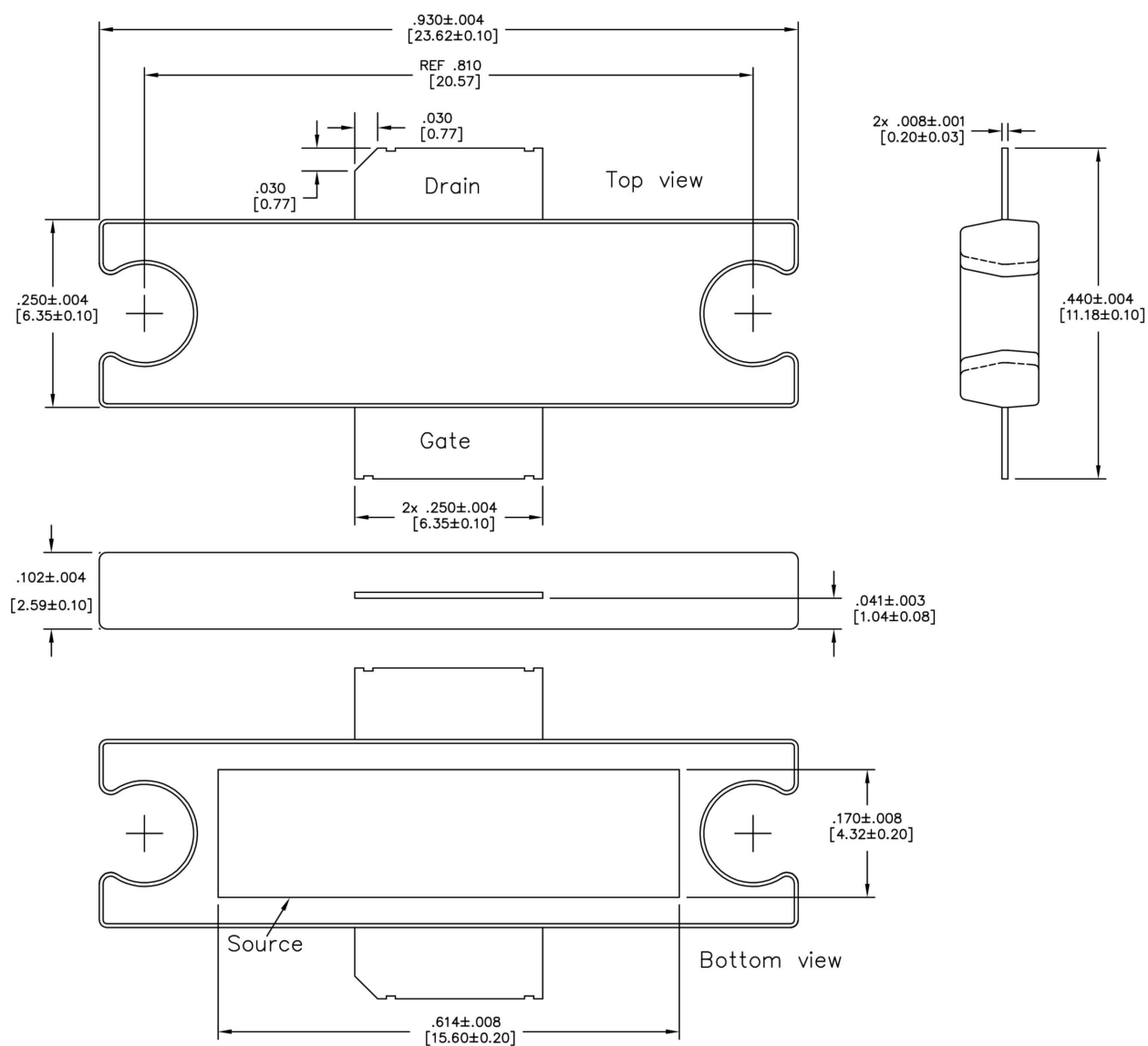


Figure 19 - TO272-2 Bolt-Down Plastic Package Dimensions (all dimensions in inches [millimeters])

Function
Gate — RF Input
Drain — RF Output (Cut lead)
Source — Ground (Flange)

Nitronex, LLC

2305 Presidential Drive
Durham, NC 27703 USA
+1.919.807.9100 (telephone)
+1.919.807.9200 (fax)
info@nitronex.com
www.nitronex.com

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).**

Important Notice

Nitronex, LLC reserves the right to make corrections, modifications, enhancements, improvements and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to Nitronex terms and conditions of sale supplied at the time of order acknowledgment. The latest information from Nitronex can be found either by calling Nitronex at 1-919-807-9100 or visiting our website at www.nitronex.com.

Nitronex warrants performance of its packaged semiconductor or die to the specifications applicable at the time of sale in accordance with Nitronex standard warranty. Testing and other quality control techniques are used to the extent Nitronex deems necessary to support the warranty. Except where mandated by government requirements, testing of all parameters of each product is not necessarily performed.

Nitronex assumes no liability for applications assistance or customer product design. Customers are responsible for their product and applications using Nitronex semiconductor products or services. To minimize the risks associated with customer products and applications, customers should provide adequate design and operating safeguards.

Nitronex does not warrant or represent that any license, either express or implied, is granted under any Nitronex patent right, copyright, mask work right, or other Nitronex intellectual property right relating to any combination, machine or process in which Nitronex products or services are used.

Reproduction of information in Nitronex data sheets is permitted if and only if said reproduction does not alter any of the information and is accompanied by all associated warranties, conditions, limitations and notices. Any alteration of the contained information invalidates all warranties and Nitronex is not responsible or liable for any such statements.

Nitronex products are not intended or authorized for use in life support systems, including but not limited to surgical implants into the body or any other application intended to support or sustain life. Should Buyer purchase or use Nitronex, LLC products for any such unintended or unauthorized application, Buyer shall indemnify and hold Nitronex, LLC, its officers, employees, subsidiaries, affiliates, distributors, and its successors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, notwithstanding if such claim alleges that Nitronex was negligent regarding the design or manufacture of said products.

Nitronex and the Nitronex logo are registered trademarks of Nitronex, LLC.

All other product or service names are the property of their respective owners.

©Nitronex, LLC 2013 All rights reserved.