

Features

- GaN on Si HEMT D-Mode Transistor
- Suitable for linear and saturated applications
- Tunable from DC 2 GHz
- 48 V Operation
- 20 dB Gain @ 900 MHz
- 60 % Drain Efficiency @ 900 MHz
- 100 % RF Tested
- Standard plastic package with bolt down flange
- RoHS* Compliant and 260°C reflow compatible

Description

The NPT2022 GaN HEMT is a wideband transistor optimized for DC - 2 GHz operation. This device supports CW, pulsed, and linear operation with output power levels to 100 W (50 dBm) in an industry standard plastic package.

The NPT2022 is ideally suited for defense communications, land mobile radio, avionics, wireless infrastructure, ISM applications and VHF/ UHF/L/S-band radar.

Built using the SIGANTIC® process - a proprietary GaN-on-Silicon technology.



Functional Schematic



Pin Configuration

Pin No.	Pin Name	Function
1	RF_IN / V_G	RF Input / Gate
2	RF_{OUT} / V_{D}	RF Output / Drain
3	Pad ¹	Ground / Source

1. The exposed pad centered on the package bottom must be connected to RF and DC ground. This path must also provide a low thermal resistance heat path.

Part Number

Ordering Information

NPT2022	Bulk Quantity		
NPT2022-SMBPPR	Sample Board		

* Restrictions on Hazardous Substances, European Union Directive 2011/65/EU.

Package

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RF Electrical Specifications: $T_c = 25^{\circ}C$, $V_{DS} = 48 V$, $I_{DQ} = 600 mA$

Parameter Test Conditions S		Symbol	Min.	Тур.	Max.	Units
Small Signal Gain	CW, 900 MHz	G _{SS}	-	21	-	dB
Saturated Output Power	CW, 900 MHz	P _{SAT}	-	50.5	-	dBm
Drain Efficiency at Saturation	CW, 900 MHz	η_{SAT}	-	62	-	%
Power Gain	900 MHz, P _{OUT} = 100 W	G _P	19	20	-	dB
Drain Efficiency	900 MHz, P _{OUT} = 100 W	η	56	58	-	%
Ruggedness: Output Mismatch	All phase angles	Ψ	VSWR	= 10:1, No	Device D	amage

DC Electrical Characteristics: T_c = 25°C

Parameter	Test Conditions	Symbol	Min.	Тур.	Max.	Units
Drain-Source Leakage Current	V_{GS} = -8 V, V_{DS} = 160 V	I _{DLK}	-	-	24	mA
Gate-Source Leakage Current	V_{GS} = -8 V, V_{DS} = 0 V	I _{GLK}	-	-	12	mA
Gate Threshold Voltage	V _{DS} = 48 V, I _D = 24 mA	VT	-2.5	-1.6	-0.5	V
Gate Quiescent Voltage	V _{DS} = 48 V, I _D = 600 mA	V_{GSQ}	-2.1	-1.4	-0.3	V
On Resistance	V_{DS} = 2 V, I_{D} = 180 mA	R _{ON}	-	0.2	-	Ω
Maximum Drain Current	V_{DS} = 7 V pulsed, pulse width 300 μs	I _{D,MAX}	-	14	-	А

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Absolute Maximum Ratings^{2,3,4}

Parameter	Absolute Maximum		
Drain Source Voltage, V_{DS}	160 V		
Gate Source Voltage, V_{GS}	-10 to 3 V		
Gate Current, I _G	48 mA		
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 $T_J \le 200^{\circ}C$ will ensure MTTF > 1 x 10^{6} hours.

Thermal Characteristics⁵

Parameter	Test Conditions	Symbol	Typical	Units
Thermal Resistance	V _{DS} = 48 V, T _J = 200°C	$R_{ ext{ heta}JC}$	1.3	°C/W

 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 HBM Class 1B devices.

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GaN Wideband Transistor 48 V, 100 W DC - 2 GHz

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Load-Pull Performance: V_{DS} = 48 V, I_{DQ} = 600 mA, T_{C} = 25°C

Reference Plane at Device Leads, CW Drain Efficiency and Output Power Tradeoff Impedance

Frequency (MHz)	Z _s (Ω)	Z _L (Ω)	P _{SAT} (W)	G _{ss} (dB)	Drain Efficiency @ P _{SAT} (%)
500	1.3 + j0.8	5.8 + j2.5	152	26	71
900	1.1 - j1.3	5.0 + j2.8	139	22	70
1800	1.3 - j5.7	3.2 - j1.4	133	17	66
2000	1.4 - j6.3	2.3 - j2.3	119	16	66

Impedance Reference



Z_s and Z_L vs. Frequency





45

50

55



Drain Efficiency vs. Output Power



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Output Power (dBm)

25





Evaluation Board and Recommended Tuning Solution

900 MHz Narrowband Circuit



Description

Parts measured on evaluation board (30-mil thick RO4350). Matching is provided using a combination of lumped elements and transmission lines as shown in the simplified schematic above. Recommended tuning solution component placement, transmission lines, and details are shown on the next page.

Bias Sequencing

Turning the device ON

- 1. Set V_{GS} to the pinch-off (V_P), typically -5 V.
- 2. Turn on V_{DS} to nominal voltage (48 V).
- 3. Increase V_{GS} until the I_{DS} current is reached.
- 4. Apply RF power to desired level.

Turning the device OFF

- 1. Turn the RF power off.
- 2. Decrease V_{GS} down to $V_{P.}$
- 3. Decrease V_{DS} down to 0 V.
- 4. Turn off V_{GS} .

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Evaluation Board and Recommended Tuning Solution 900 MHz Narrowband Circuit



Parts list

Reference	Value	Tolerance	Manufacturer	Part Number
C1, C5	1.0 µF	10%	AVX	12101C105KAT2A
C2, C6	0.1 µF	10%	Kemet	C1206C104K1RACTU
C3, C7	0.01 µF	10%	AVX	12061C103KAT2A
C4, C8	1000 pF	10%	Kemet	C0805C102K1RACTU
C9	10 pF	5%	ATC	ATC800B100J
C10	33 pF	10%	ATC	ATC800B330K
C11	15 pF	10%	ATC	ATC800B150K
C12	6.8 pF	0.1 pF	ATC	ATC800B6R8B
C13	18 pF	10%	ATC	ATC800B180K
C14	0.8 pF	0.1 pF	ATC	ATC800B0R8B
C15	8.2 pF	0.1 pF	ATC	ATC800B8R2B
R1	10 Ω	1%	Panasonic	ERJ-2RKF10R0X
L1	19.4 nH	5%	Coilcraft	0806SQ-19NJLB
L2	~44 nH	10%	20 AWG Cu Wire	4 turn, 5mm ID
РСВ	Rogers RO4350, ε _r =3.5, 30 mil			

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GaN Wideband Transistor 48 V, 100 W DC - 2 GHz

Typical performance as measured in the 900 MHz evaluation board: CW, V_{DS} = 48 V, I_{DQ} = 600 mA (unless noted)





Quiescent V_{GS} vs. Temperature



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Typical 2-Tone performance as measured in the 900 MHz evaluation board: 1 MHz Tone Spacing, V_{DS} = 48 V, I_{DQ} = 600 mA, T_{C} = 25°C (unless noted)





2-Tone Gain vs. Output Power vs. Quiescent Current





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Evaluation Board and Recommended Tuning Solution

130 - 940 MHz Broadband Circuit



Parts list

Reference	Value	Tolerance	Manufacturer	Part Number	
C1	150 µF	20%	Nichicon	UPW1C151MED	
C2, C7	1.0 µF	10%	AVX	1210C105KAT2A	
C3, C6	0.1 µF	10%	Kemet	C1206C104K1RACTU	
C4, C5	0.01 µF	10%	AVX	12061C103KAT2A	
C8	270 µF	20%	United Chemi-Con	ELXY 630ELL271MK25S	
C9	18 pF	5%	ATC	ATC100B180J	
C10	1000 pF	5%	ATC	ATC100B102J	
C11	1.5 pF	0.1 pF	ATC	ATC100B1R5B	
C12	5.6 pF	0.1 pF	ATC	ATC100B5R6B	
C13	15 pF	5%	ATC	ATC100B150J	
C14	220 pF	5%	ATC	ATC600F221J	
C15	12 pF	2%	ATC	ATC600F120F	
C16, C17	82 pF	10%	ATC	ATC100B820K	
C18	4.7 pF	0.1 pF	ATC	ATC100B4R7B	
C19	2.4 pF	0.1 pF	ATC	ATC100B2R4B	
C20	3.9 pF	0.1 pF	ATC	ATC100B3R9B	
C21	1.0 pF	0.1 pF	ATC	ATC100B1R0B	
R1	49.9 Ω	1%	Panasonic	ERJ-6ENF49R9V	
R2	470 Ω	1%	Panasonic	ERJ-1TNF4700U	
R3	0.33 Ω	1%	Panasonic	ERJ-6RQFR33V	
R4, R5	24.9 Ω	1%	Panasonic	ERJ-1TNF24R9U	
F1	Material 73	-	Fair-Rite	2673000801	
F2, F3	4:1 Transformer	-	Anaren	XMT031B5012	
L1	25 nH	5%	Coilcraft	0908SQ-25NJL	
L2, L4	8.0 nH	5%	Coilcraft	A03TJL	
L3, L5	5.0 nH	5%	Coilcraft	A02TJL	
PCB		Rogers RO4350, ε _r =3.5, 30 mil			

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Evaluation Board and Recommended Tuning Solution

130 - 940 MHz Broadband Circuit



Performance vs. Frequency at POUT = PSAT







Performance vs. Frequency at Pour = 49 dBm



Small Signal s-parameters vs. Frequency



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¹⁰

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GaN Wideband Transistor 48 V, 100 W DC - 2 GHz

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TO272-2 Plastic Package[†]



[†] Meets JEDEC moisture sensitivity level 3 requirements. Plating is Matte Sn.

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