

## Features

- Optimized for Broadband Operation (DC - 4 GHz)
- 25 W P3dB CW Narrowband Power
- 10 W P3dB CW Broadband Power (0.05 - 1 GHz)
- Characterized for Operation up to 32 V
- 100% RF Tested
- Thermally-Enhanced Surface Mount Package
- High Reliability Gold Metallization Process
- Subject to EAR99 Export Control
- RoHS\* Compliant

## Applications

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

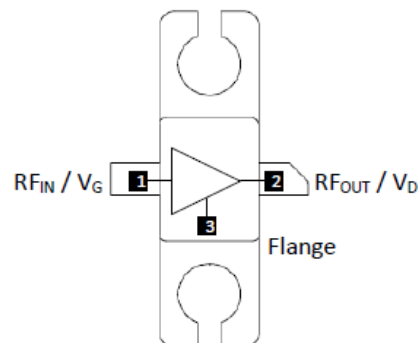
## Description

The NPTB00025 GaN HEMT is a power transistor optimized for DC - 4 GHz operation. This device supports CW, pulsed, and linear operation with output power levels to 25 W. This transistor is assembled in an industry standard surface mount plastic package.

## Ordering Information

Part Number	Package
NPTB00025B	30 slot tray

## Functional Schematic



## Pin Configuration

Pin #	Pin Name	Function
1	RF <sub>IN</sub> / V <sub>G</sub>	RF Input / Gate
2	RF <sub>OUT</sub> / V <sub>D</sub>	RF Output / Drain
3	Flange <sup>1</sup>	Ground / Source

1. The Flange must be connected to RF and DC ground. This path must also provide a low thermal resistance heat path.

\* Restrictions on Hazardous Substances, compliant to current RoHS EU directive.

**Typical CW RF Specifications: (measured in a test fixture)**

**Freq. = 3 GHz,  $V_{DS} = 28$  V,  $I_{DQ} = 225$  mA,  $T_C = 25^\circ\text{C}$**

Parameter	Test Conditions	Symbol	Min.	Typ.	Max.	Units
Average Output Power	3 dB Compression 1 dB Compression	$P_{3dB}$ $P_{1dB}$	22 18	25 21	—	W
Small Signal Gain	—	$G_{SS}$	12.5	13.5	—	dB
Drain Efficiency	3 dB Compression	$\eta$	60	65	—	%
Output Mismatch Stress	VSWR = 10:1. all phase angles, $P_{OUT} = P_{SAT}$	$\psi$	No performance degradation after test			

**DC Electrical Characteristics:  $T_C = 25^\circ\text{C}$**

Parameter	Test Conditions	Symbol	Min.	Typ.	Max.	Units
<b>Off Characteristics</b>						
Drain-Source Breakdown Voltage	$V_{GS} = -8$ V, $I_D = 8$ mA	$V_{BDS}$	100	—	—	V
Drain-Source Leakage Current	$V_{GS} = -8$ V, $V_{DS} = 60$ V	$I_{DLK}$	—	1	5	mA
<b>On Characteristics</b>						
Gate Threshold Voltage	$V_{DS} = 28$ V, $I_D = 8$ mA	$V_T$	-2.3	-1.8	-1.3	V
Gate Quiescent Voltage	$V_{DS} = 28$ V, $I_D = 225$ mA	$V_{GSQ}$	-2.0	-1.5	-1.0	V
On Resistance	$V_{GS} = 2$ V, $I_D = 60$ mA	$R_{ON}$	—	0.44	0.55	$\Omega$
Drain Current	$V_{DS} = 7$ V pulsed, pulse width 300 $\mu\text{s}$ 0.2% Duty Cycle, $V_{GS} = 2$ V	$I_D$	4.9	5.4	—	A

**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 1A devices.

**Absolute Maximum Ratings<sup>2,3,4</sup>**

Parameter	Absolute Maximum
Drain Source Voltage, $V_{DS}$	100 V
Gate Source Voltage, $V_{GS}$	-10 to 3 V
Gate Current, $I_G$	40 mA
Total Device Power Dissipation (derated above +25°C)	33 W
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  $T_J \leq 200^\circ\text{C}$  will ensure  $\text{MTTF} > 1 \times 10^6$  hours.

**Thermal Characteristics<sup>5</sup>**

Parameter	Test Conditions	Symbol	Typical	Units
Thermal Resistance	$V_{DS} = 28 \text{ V}, T_J = 200^\circ\text{C}$	$R_{\theta JC}$	5.25	°C/W

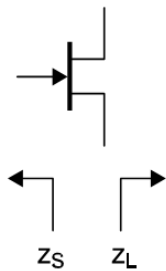
5. Junction temperature ( $T_J$ ) measured using IR Microscopy. Case temperature measured using thermocouple embedded in heat-sink.

Load-Pull Data, Reference Plane at Device Leads:  $V_{DS} = 28\text{ V}$ ,  $I_{DQ} = 225\text{ mA}$ ,  $T_C = 25^\circ\text{C}$

**Table 1: Optimum Impedance Characteristics for CW Gain, Drain Efficiency, and Output Power Performance**

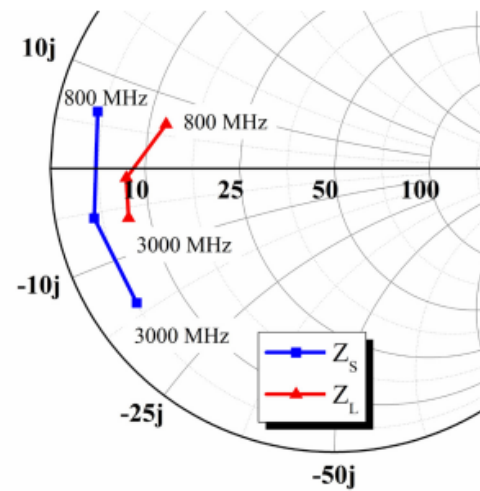
Frequency (MHz)	$Z_S$ ( $\Omega$ )	$Z_L$ ( $\Omega$ )
800	$3.9 + j5.9$	$12.2 + j6.1$
2000	$3.7 - j5.1$	$7.7 + j1.1$
3000	$4.7 - j15.3$	$7.4 - j5.8$

**Impedance Reference**



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

**$Z_S$  and  $Z_L$  vs. Frequency**



**Figure 1 - Optimum Impedance Characteristics for CW Performance,  $V_{DS} = 28\text{ V}$ ,  $I_{DQ} = 225\text{ mA}$**

Load-Pull Data, Reference Plane at Device Leads:  $V_{DS} = 28\text{ V}$ ,  $I_{DQ} = 225\text{ mA}$ ,  $T_A = 25^\circ\text{C}$

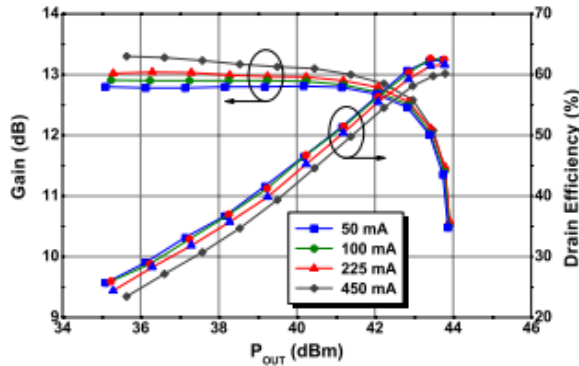


Figure 2 - Typical CW Performance, Over Current, Frequency = 3000 MHz

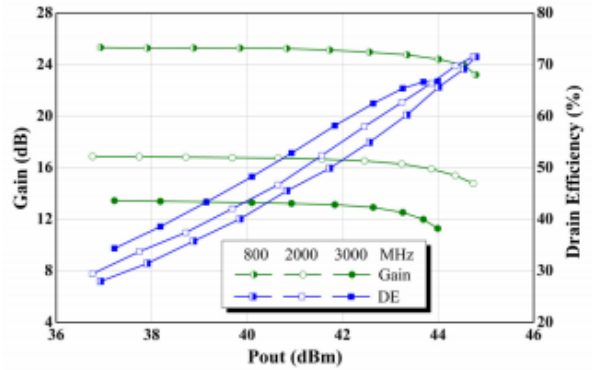


Figure 3 - Typical CW Performance, Over Frequency

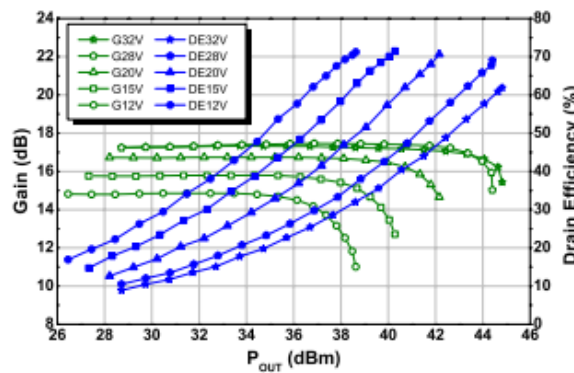


Figure 4 - Typical CW Performance Over Voltage, Impedances Held Constant, Frequency = 1800 MHz

Typical Device Characteristics:  $V_{DS} = 28\text{ V}$ ,  $I_{DQ} = 225\text{ mA}$ ,  $T_A = 25^\circ\text{C}$

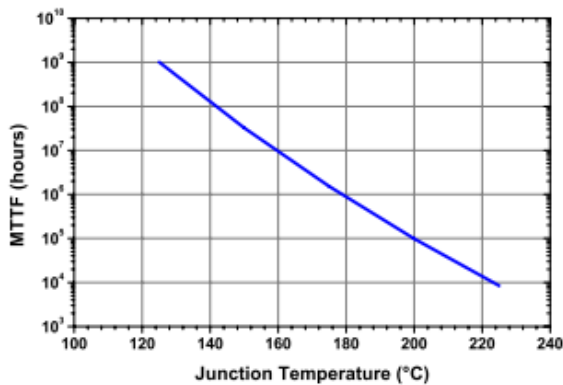


Figure 5 - MTTF of NRF1 Devices as a Function of Junction Temperature

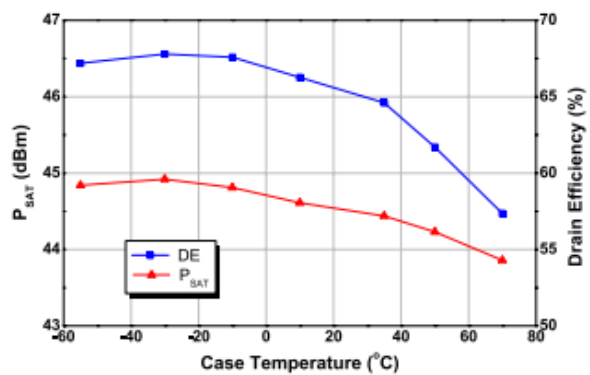
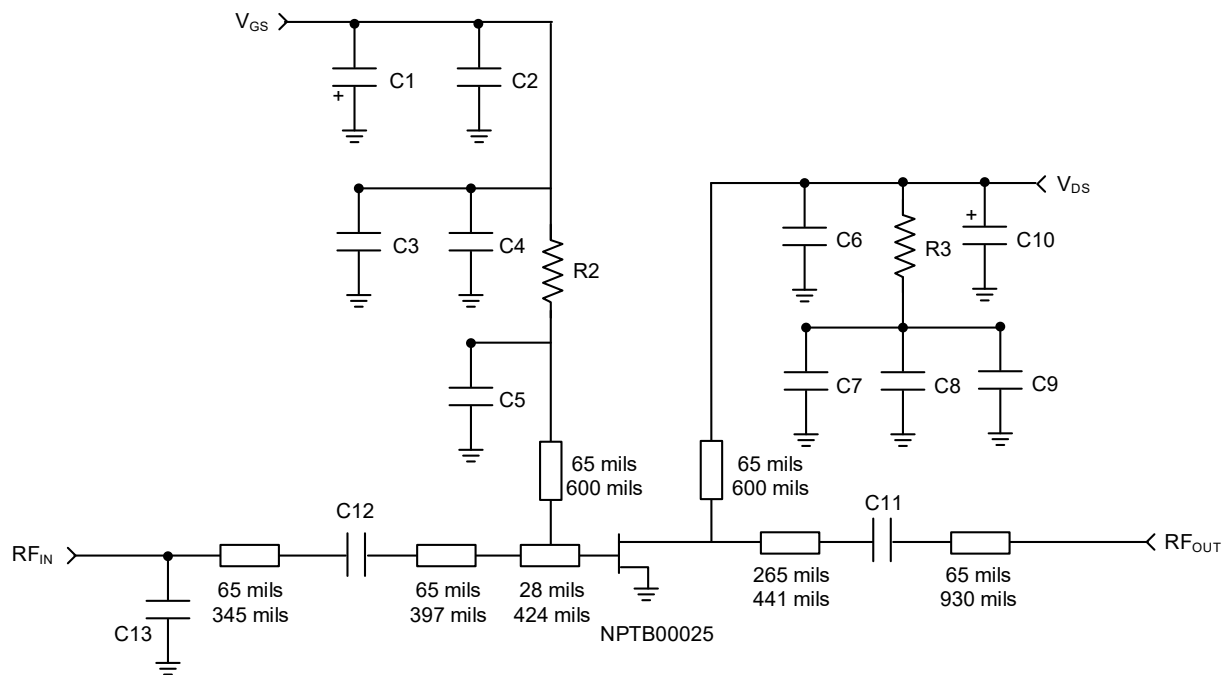
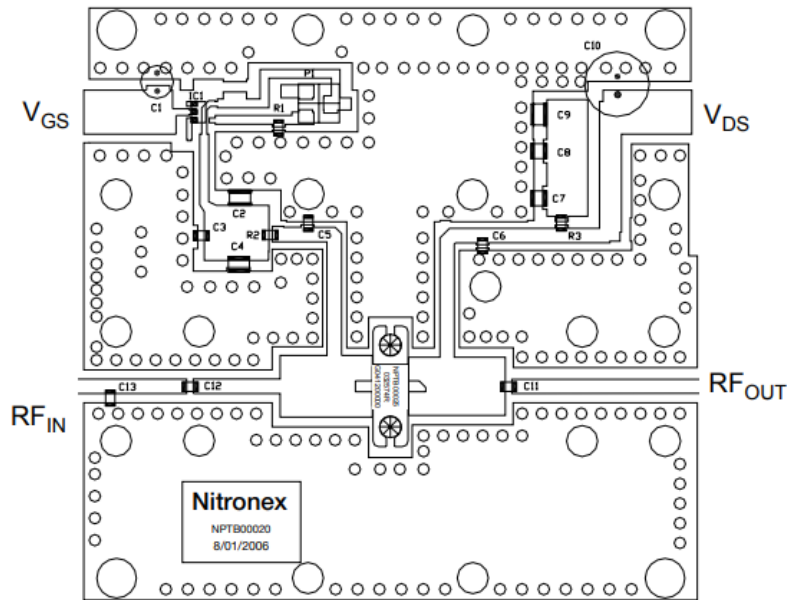


Figure 6 - Typical CW Performance in test fixture, Frequency = 3000 MHz

**NPTB00025 3000 MHz, CW Production Test Fixture**

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



**Figure 7 - NPTB00025 3000 MHz Test Fixture and Schematic**

# GaN Power Transistor, 28 V, 25 W DC - 4 GHz



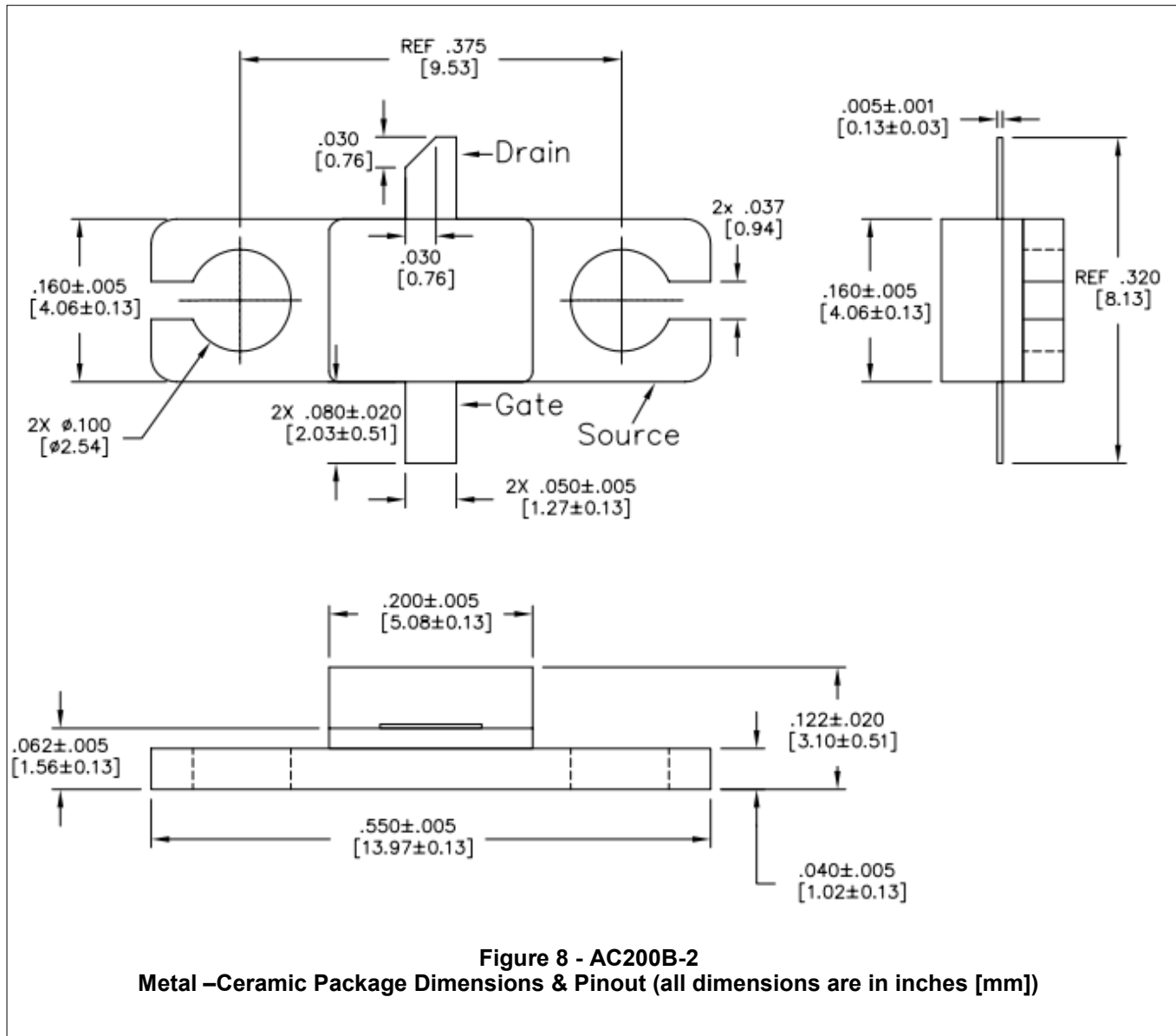
NPTB00025

Rev. V1

## Parts list

Reference	Value	Tolerance	Manufacturer	Part Number
C1	150 $\mu$ F	20%	Nichicon	UPW1C151MED
C10	270 $\mu$ F	20%	United Chemi-Con	ELXY630ELL271MK25S
C2, C8	0.1 $\mu$ F	10%	Kemet	C1206C104K1RACTU
C3, C7	0.01 $\mu$ F	10%	AVX	12061C103KAT2A
C4, C9	1 $\mu$ F	10%	Panasonic	ECJ-5YB2A105M
C5, C6, C11, C12	5.6 pF	$\pm$ 0.1 pF	ATC	ATC600F5R6B
C13	1.2 pF	$\pm$ 0.1 pF	ATC	ATC600F1R2AT
R2	49.9 $\Omega$	1%	Panasonic	ERJ-6ENF49R9V
R3	0.33 $\Omega$	1%	Panasonic	ERJ-6RQFR33V
PCB	Taconic, RF35, $\epsilon_r=3.5$ , t = 30 mils			

Outline Drawing



**Figure 8 - AC200B-2  
Metal -Ceramic Package Dimensions & Pinout (all dimensions are in inches [mm])**



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