## 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

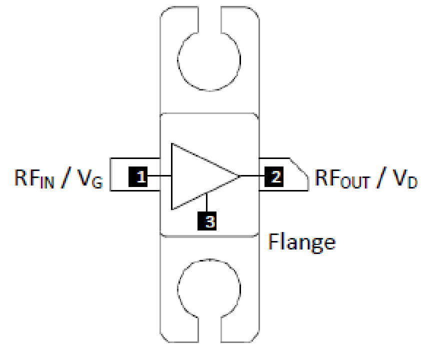
## Description

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 air cavity ceramic package.

## Ordering Information

| Part Number | Package |
|---|---|
| NPTB00025B | 30 slot tray |

## Functional Schematic




## Pin Configuration

| Pin # | Pin Name | Function |
|---|---|---|
| 1 | $RF_{IN}$ / $V_G$ | RF Input / Gate |
| 2 | $RF_{OUT}$ / $V_D$ | RF Output / Drain |
| 3 | Flange[1] | 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°C

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

## DC Electrical Characteristics: $T_C$ = 25°C

| Parameter | Test Conditions | Symbol | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|
| **Off Characteristics** | | | | | | |
| 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 |
| **On Characteristics** | | | | | | |
| 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 | Ω |
| Drain Current | $V_{DS}$ = 7 V pulsed, pulse width 300 µs<br>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[2,3,4]

| 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 $T_J \leq 200°C$ will ensure MTTF > 1 x $10^6$ hours.

## Thermal Characteristics[5]

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

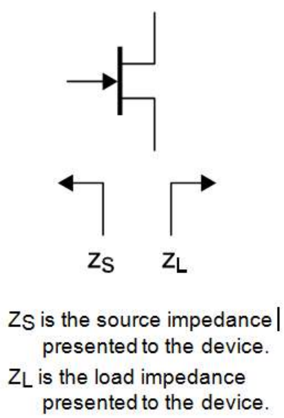
5. Junction temperature ($T_J$) measured using IR Microscopy. Case temperature measured using thermocouple embedded in heat-sink.

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

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

| Frequency (MHz) | $Z_S$ (Ω) | $Z_L$ (Ω) |
|---|---|---|
| 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*




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

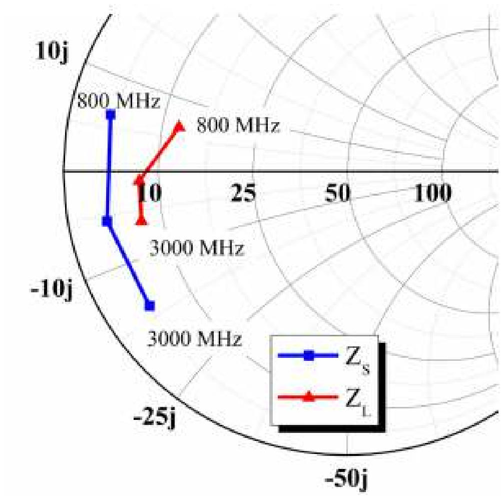



**Figure 1 -** Optimum Impedance Characteristics for CW Performance, $V_{DS}$ = 28 V, $I_{DQ}$ = 225 mA

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

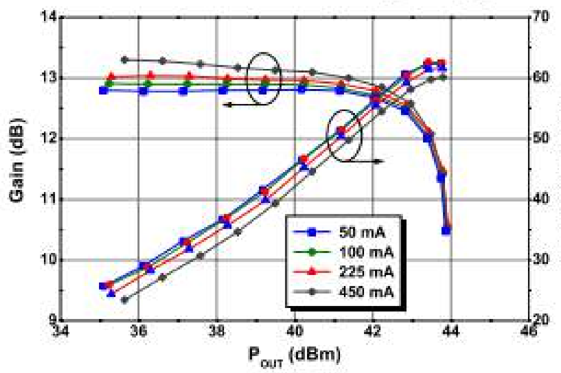



**Figure 2 -** Typical CW Performance,
Over Current, Frequency = 3000 MHz

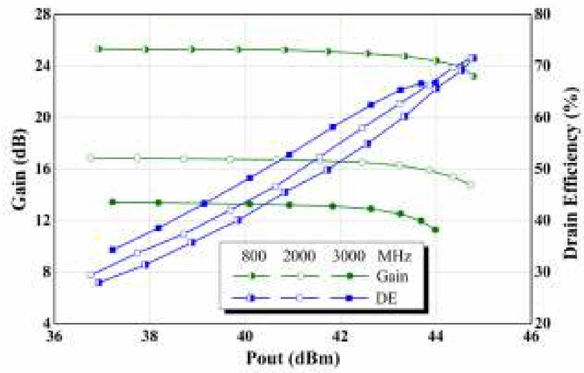



**Figure 3 -** Typical CW Performance,
Over Frequency

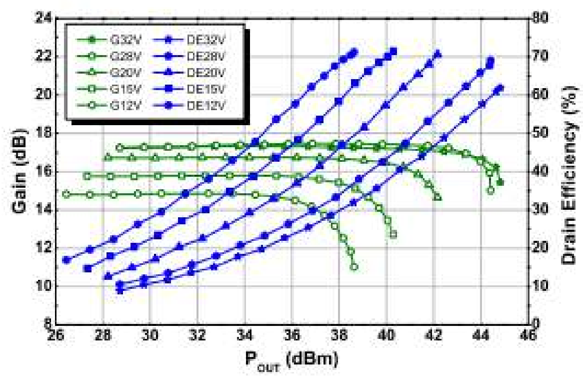



**Figure 4 -** Typical CW Performance Over Voltage,
Impedances Held Constant, Frequency = 1800 MHz

## Typical Device Characteristics: $V_{DS}$ = 28 V, $I_{DQ}$ = 225 mA, $T_A$ = 25°C

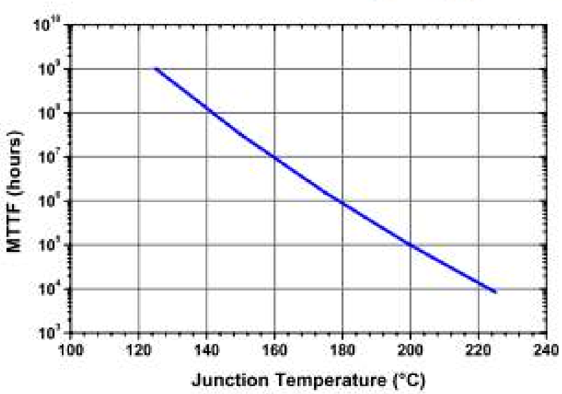



**Figure 5 -** MTTF of NRF1 Devices as a Function of
Junction Temperature

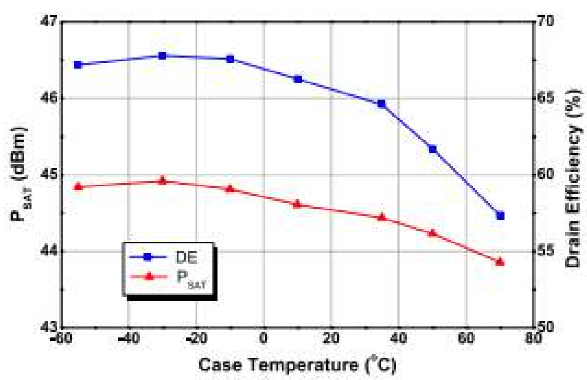



**Figure 6 -** Typical CW Performance in test fixture,
Frequency = 3000 MHz

## NPTB00025 3000 MHz, CW Production Test Fixture

**$V_{DS}$ = 28 V, $I_{DQ}$ = 225 mA, $T_A$ = 25°C**

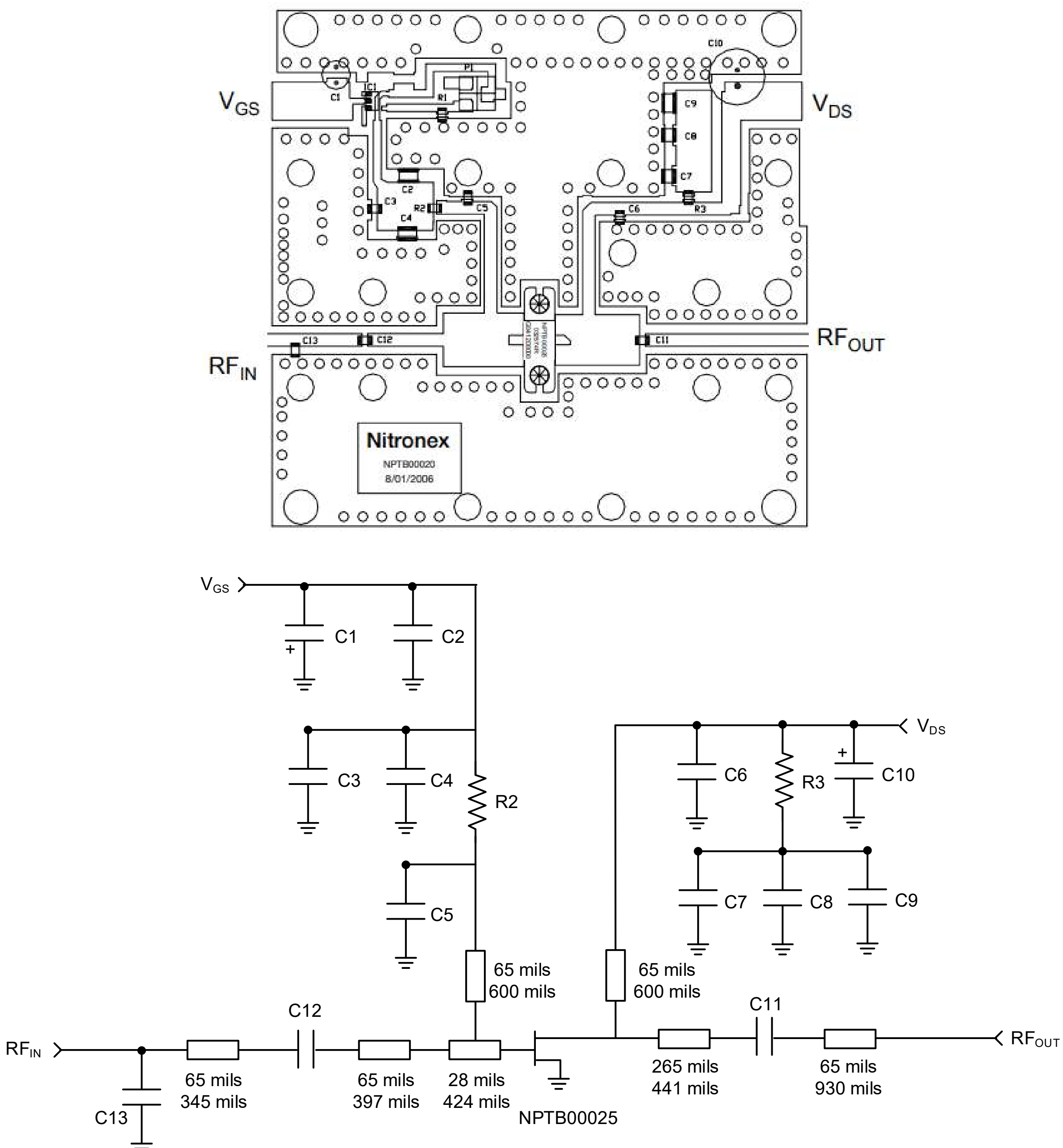



**Figure 7 - NPTB00025 3000 MHz Test Fixture and Schematic**

## Parts list

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

## Outline Drawing

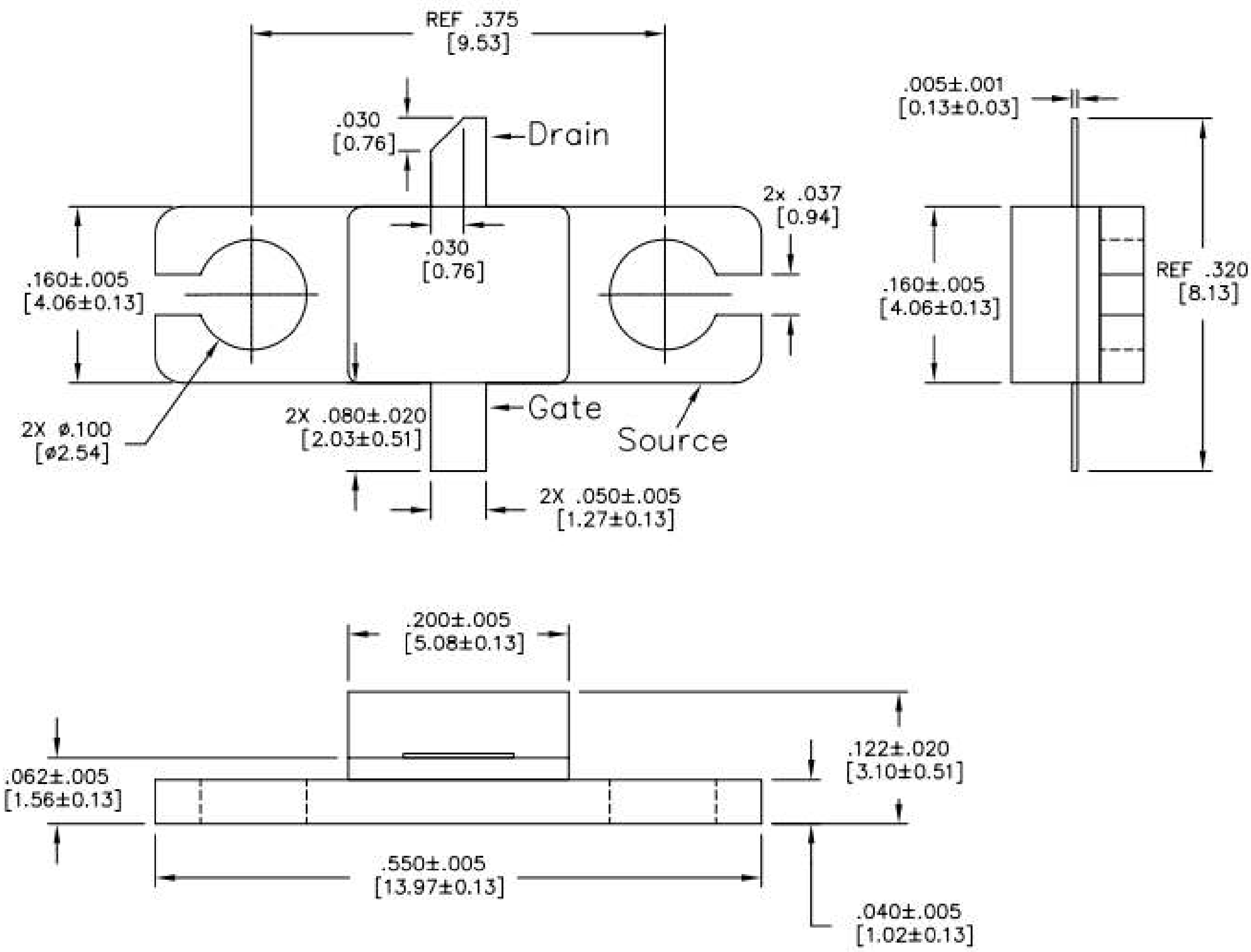



**Figure 8 - AC200B-2**
**Metal –Ceramic Package Dimensions & Pinout (all dimensions are in inches [mm])**