# NPT25015

## Gallium Nitride 28V, 23W RF Power Transistor

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

### FEATURES

- Optimized for CW, pulsed, WiMAX, and other applications from DC - 3000 MHz
- 23W $P_{3dB}$ peak envelope power (PEP)
- 1.5W linear power @ 2% EVM for single carrier OFDM, 10.3dB peak/average, 3.5MHz channel bandwidth, 14dB gain, 23.5% efficiency, 2500-2700MHz
- 100% RF tested
- Thermally-enhanced industry standard package
- High reliability gold metallization process
- Lead-free and RoHS compliant
- Subject to EAR99 export control


**DC - 3000 MHz**
**23 Watt, 28 Volt**
**GaN HEMT**

RoHS

**Typical 2-Tone Performance:** $V_{DS}$ = 28V, $I_{DQ}$ = 200mA, Frequency = 2500MHz, Tone Spacing = 1.0MHz, $T_C$ = 25°C
Measured in Nitronex Test Fixture

| Symbol | Parameter | Min | Typ | Max | Units |
|---|---|---|---|---|---|
| $P_{3dB,PEP}$ | Peak Envelope Power at 3dB Compression | 20 | 25 | - | W |
| $P_{1dB,PEP}$ | Peak Envelope Power at 1dB Compression | - | 15 | - | W |
| $G_{SS}$ | Small Signal Gain | 13.0 | 14.0 | 15.0 | dB |
| $\eta$ | Drain Efficiency at 3dB Compression | 53 | 58 | - | % |

**Typical OFDM Performance:** $V_{DS}$ = 28V, $I_{DQ}$ = 200mA, Single carrier OFDM waveform 64-QAM 3/4, 8 burst, continuous frame data, 10 MHz channel bandwidth. Peak/Avg = 10.3dB @ 0.01% probability on CCDF. Frequency = 2500 - 2700MHz. $P_{OUT,AVG}$ = 1.5W, $T_C$ = 25°C. Measured in Load Pull System (Refer to Table 1 and Figure 1)

| Symbol | Parameter | Typ | Units |
|---|---|---|---|
| $G_P$ | Power Gain | 14.0 | dB |
| $\eta$ | Drain Efficiency | 23.5 | % |
| EVM | Error Vector Magnitude | 2.0 | % |

## DC Specifications: $T_C$ = 25°C

| Symbol | Parameter | Min | Typ | Max | Units |
|---|---|---|---|---|---|
| **Off Characteristics** | | | | | |
| $V_{BDS}$ | Drain-Source Breakdown Voltage ($V_{GS}$ = -8V, $I_D$ = 8mA) | 100 | - | - | V |
| $I_{DLK}$ | Drain-Source Leakage Current ($V_{GS}$ = -8V, $V_{DS}$ = 60V) | - | - | 4 | mA |
| **On Characteristics** | | | | | |
| $V_T$ | Gate Threshold Voltage ($V_{DS}$ = 28V, $I_D$ = 8mA) | -2.3 | -1.8 | -1.3 | V |
| $V_{GSQ}$ | Gate Quiescent Voltage ($V_{DS}$ = 28V, $I_D$ = 200mA) | -2.0 | -1.5 | -1.0 | V |
| $R_{ON}$ | On Resistance ($V_{GS}$ = 2V, $I_D$ = 60mA) | - | 0.45 | 0.50 | Ω |
| $I_{D,MAX}$ | Drain Current ($V_{DS}$ = 7V pulsed, 300ms pulse width, 0.2% duty cycle) | - | 5.0 | - | A |

## 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 |
| $P_T$ | Total Device Power Dissipation (Derated above 25°C) | 28 | W |
| $\theta_{JC}$ | Thermal Resistance (Junction-to-Case) | 6.25 | °C/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) | 1A (>250V) | |
| MM | Machine Model ESD Rating (per JESD22-A115) | M1 (>50V) | |
| MSL | Moisture Sensitivity Level (Per IPC/JEDEC J-STD-20) @ 260°C Peak Package Temperature | 3 | |

## Load-Pull Data, Reference Plane at Device Leads

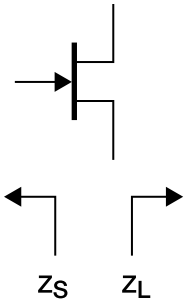
$V_{DS}$=28V, $I_{DQ}$=200mA, $T_A$=25°C unless otherwise noted

**Table 1:** Optimum Impedance Characteristics for Linear OFDM Tuning, single carrier OFDM waveform 64-QAM 3/4, 8 burst, continuous frame data, 10 MHz channel bandwidth. Peak/Avg = 10.3dB @ 0.01% probability on CCDF

| Frequency (MHz) | $Z_S$ (Ω) | $Z_L$ (Ω) | $P_{OUT}$ (W) | Gain (dB) | Drain Efficiency (%) |
|---|---|---|---|---|---|
| 2500 | 5.2 - j 1.6 | 3.3 + j 1.7 | 1.5 | 14.5 | 25 |
| 2600 | 4.6 - j 1.9 | 3.1 + j 2.7 | 1.5 | 14.5 | 25 |
| 2700 | 4.0 - j 2.2 | 2.9 + j 4.3 | 1.5 | 14.4 | 24 |

**Table 2:** Optimum Impedance Characteristics for CW $P_{SAT}$, Efficiency, and Gain

| Frequency (MHz) | $Z_S$ (Ω) | $Z_L$ (Ω) | $P_{SAT}$ (W) | $G_{SS}$ (dB) | Drain Efficiency (%) |
|---|---|---|---|---|---|
| 2500 | 3.7 - j 4.7 | 6.9 - j 1.2 | 23 | 14.5 | 60 |




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

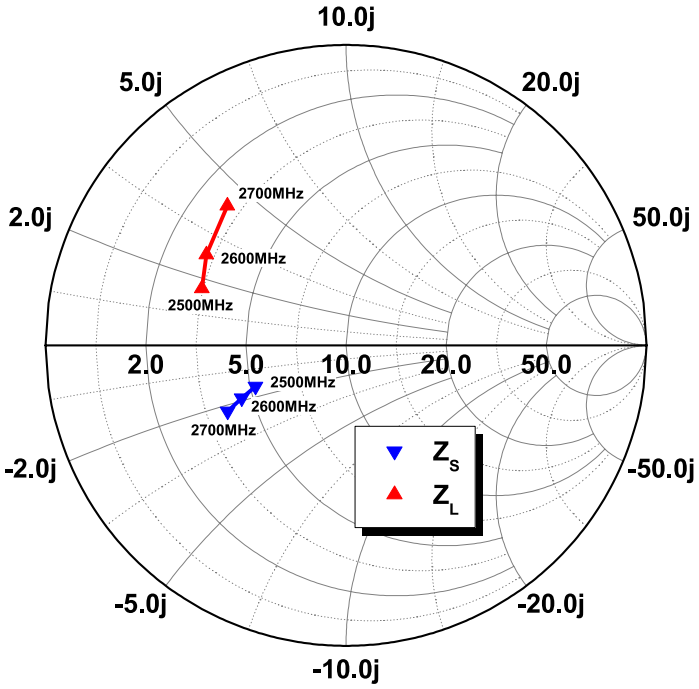



**Figure 1 -** Optimum Impedance Characteristics for OFDM Tuning, $V_{DS}$ = 28V, $I_{DQ}$ = 200mA

## Load-Pull Data, Reference Plane at Device Leads

$V_{DS}$=28V, $I_{DQ}$=200mA, $T_A$=25°C unless otherwise noted

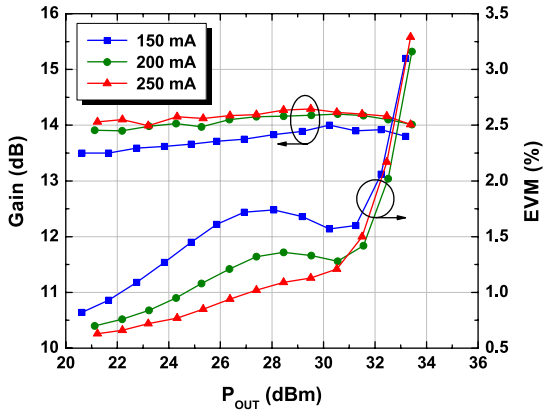



**Figure 2 -** Typical OFDM Performance at 2500MHz and 28V versus $I_{DQ}$

## Typical Device Characteristics

$V_{DS}$=28V, $I_{DQ}$=200mA, $T_A$=25°C unless otherwise noted

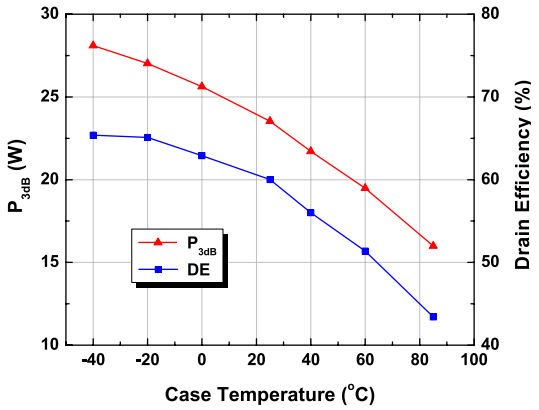



**Figure 3 -** $P_{3dB,PEP}$ and Drain Efficiency versus Temperature at 2500MHz, Application Board

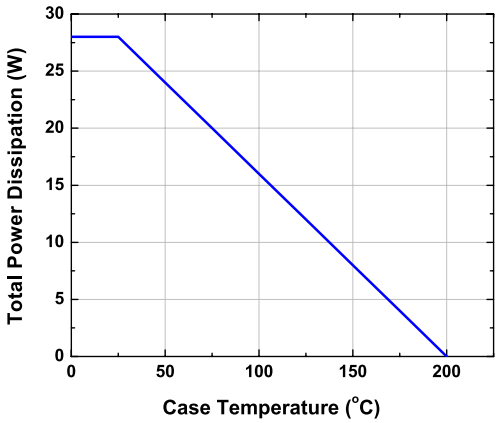



**Figure 4 -** Power Derating Curve

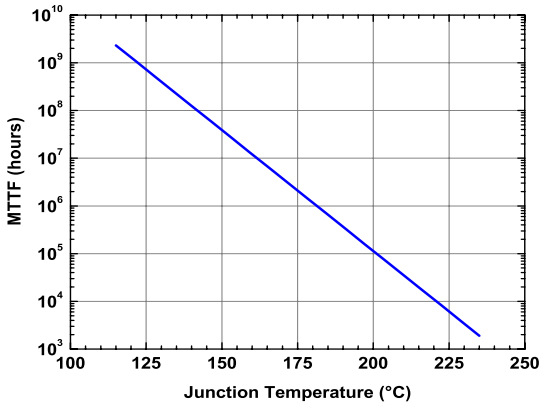



**Figure 5 -** MTTF of NRF1 devices as a function of junction temperature

# APP-NPT25015-25, 2500-2700MHz Linear WiMAX Application Board

802.16e Single Carrier OFDM, 64-QAM 3/4, 8-burst, 20ms frame 75% filled, 10MHz channel bandwidth, PAR=10.3dB @ 0.01% CCDF

Detailed design information and data available at www.nitronex.com

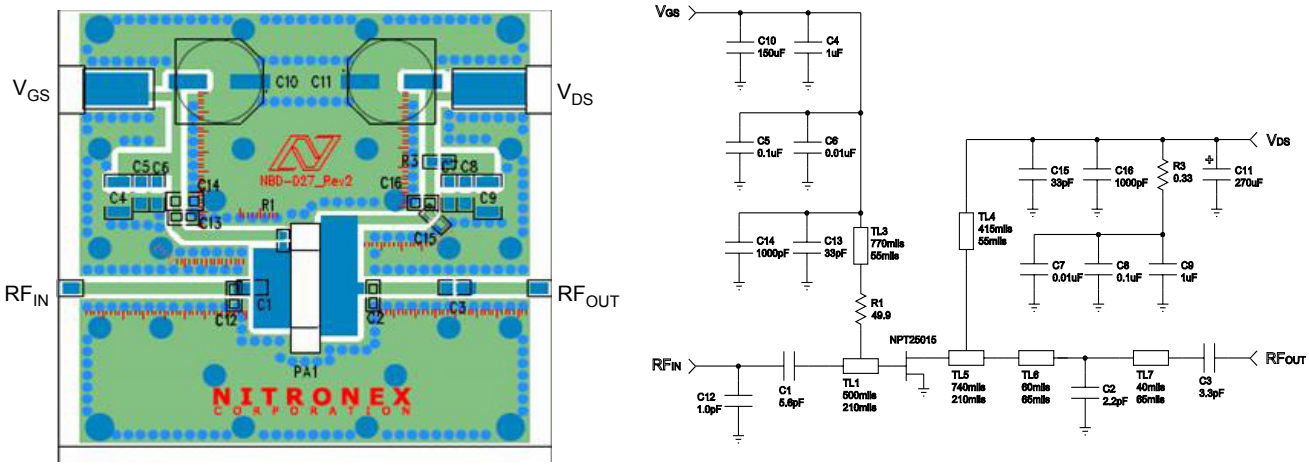



**Figure 6 -** APP-NPT25015-25 Demonstration Board and Schematic

**Table 2:** APP-NPT25015-25 Demonstration Board Bill of Materials

| Name | Value | Tolerance | Vendor | Vendor Number |
|---|---|---|---|---|
| C1 | 5.6pF | +/- 0.1pF | ATC | ATC600F5R6B |
| C2 | 2.2pF | +/- 0.1pF | ATC | ATC600F2R2B |
| C3 | 3.3pF | +/- 0.1pF | ATC | ATC600F3R3B |
| C4, C9 | 1.0uF | 10% | Panasonic | ECJ-5YB2A105M |
| C5, C8 | 0.1uF | 10% | Kemet | C1206C104K1RACTU |
| C6, C7 | 0.01uF | 10% | AVX | 12061C103KAT2A |
| C10 | 150uF | 20% | Nichicon | UPW1C151MED |
| C11 | 270uF | 20% | United Chemi-Con | ELXY630ELL271MK25S |
| C12 | 1.0pF | +/- 0.1pF | ATC | ATC600F1R0B |
| C13, C15 | 33pF | 5% | ATC | ATC600F330B |
| C14, C16 | 1000pF | 10% | Kemet | C0805C102K1RACTU |
| PA1 | -- | -- | -- | NPT25015D |
| R1 | 49.9 ohm | 1% | Panasonic | ERJ-2RKF49R9X |
| R3 | 0.33 ohm | 1% | Panasonic | ERJ-6RQFR33V |
| -- | -- | -- | -- | Coin to mount PA1 |
| Substrate | | | Rogers | R04350, t = 30mil $\varepsilon_r$ = 3.5 |

# APP-NPT25015-25, 2500-2700MHz Linear WiMAX Application Board

802.16e Single Carrier OFDM, 64-QAM 3/4, 8-burst, continuous frame data, 10MHz channel bandwidth, PAR=10.3dB @ 0.01% CCDF
Detailed design information and data available at www.nitronex.com

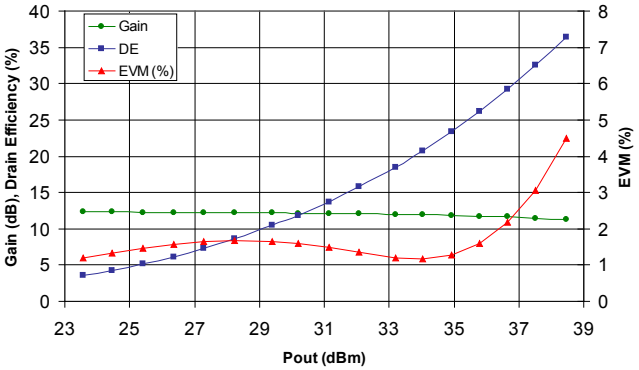



**Figure 7 -** Gain, Efficiency, EVM at 2500MHz

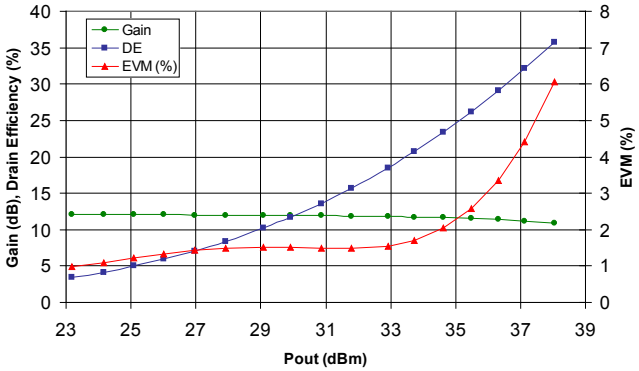



**Figure 8 -** Gain, Efficiency, EVM at 2600MHz

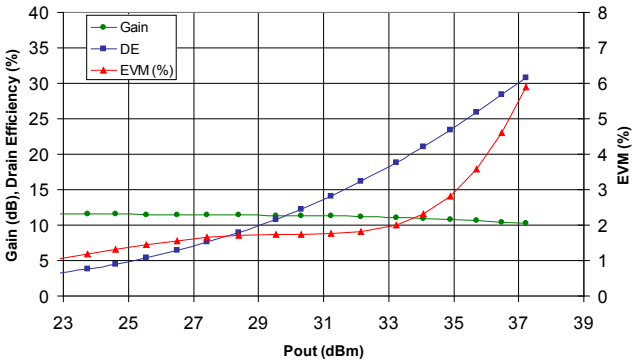


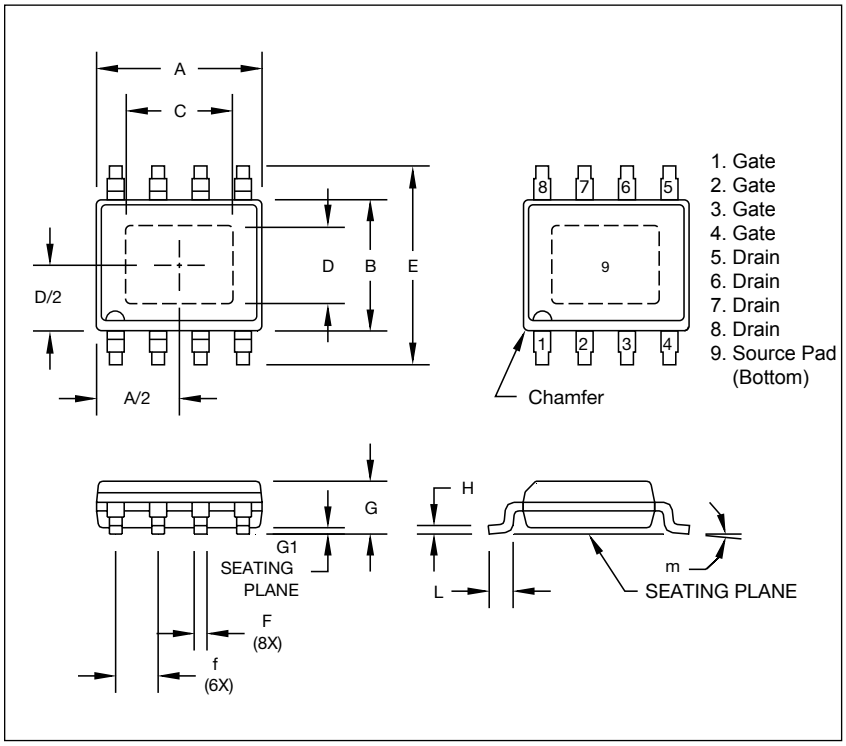

**Figure 9 -** Gain, Efficiency, EVM at 2700MHz

## Ordering Information

| Part Number | Order Multiple | Description |
|---|---|---|
| NPT25015DT | 97 | Tube; NPT25015 in D (PSOP2) Package |
| NPT25015DR | 1500 | Tape and Reel; NPT25015 in D (PSOP2) Package |

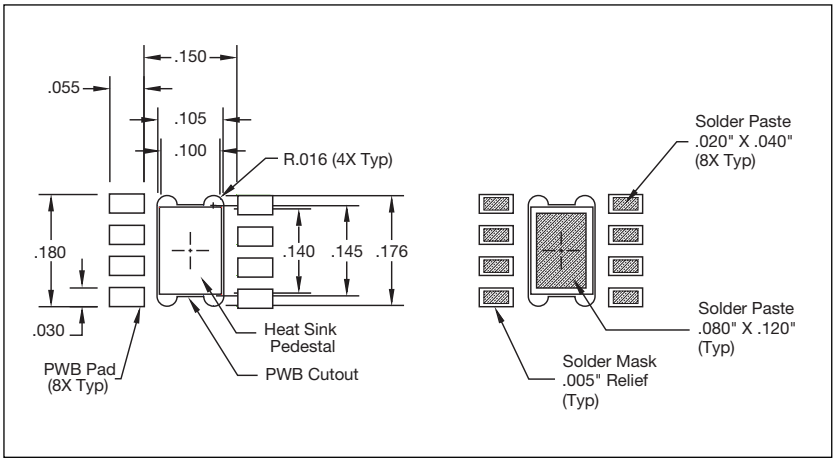
1: To find a Nitronex contact in your area, visit our website at http://www.nitronex.com

**Figure 10 -** D Package Dimensions and Pinout




| | Inches | | Millimeters | |
|---|---|---|---|---|
| Dim | Min | Max | Min | Max |
| A | 0.189 | 0.196 | 4.80 | 4.98 |
| B | 0.150 | 0.157 | 3.81 | 3.99 |
| C | 0.107 | 0.123 | 2.72 | 3.12 |
| D | 0.071 | 0.870 | 1.80 | 22.1 |
| E | 0.230 | 0.244 | 5.84 | 6.19 |
| f | 0.050 BSC | | 1.270 BSC | |
| F | 0.0138 | 0.0192 | 0.35 | 0.49 |
| G | 0.055 | 0.061 | 1.40 | 1.55 |
| G1 | 0.000 | 0.004 | 0.00 | 0.10 |
| H | 0.075 | 0.098 | 1.91 | 2.50 |
| L | 0.016 | 0.035 | 0.41 | 0.89 |
| m | 0° | 8° | 0° | 8° |

**Figure 11 -** Mounting Footprint



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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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