# PHD9NQ20T-VB Datasheet
# N-Channel 200 V (D-S) MOSFET

| PRODUCT SUMMARY | | |
|---|---|---|
| $V_{DS}$ (V) | $R_{DS(on)}$ (Ω) | $I_D$ (A) |
| 200 | 0.245 at $V_{GS}$ = 10 V | 10 |

## FEATURES

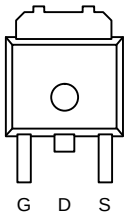
- Trench Power MOSFET
- 175 °C Junction Temperature
- PWM Optimized
- 100 % $R_g$ Tested
- Compliant to RoHS Directive 2002/95/EC

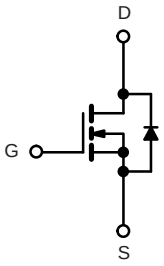
RoHS COMPLIANT

## APPLICATIONS

- Primary Side Switch

TO-252




N-Channel MOSFET

| ABSOLUTE MAXIMUM RATINGS ($T_A$ = 25 °C, unless otherwise noted) | | | | |
|---|---|---|---|---|
| **Parameter** | | **Symbol** | **Limit** | **Unit** |
| Drain-Source Voltage | | $V_{DS}$ | 200 | V |
| Gate-Source Voltage | | $V_{GS}$ | ± 20 | |
| Continuous Drain Current ($T_J$ = 175 °C)[b] | $T_C$ = 25 °C | $I_D$ | 10 | A |
| | $T_C$ = 125 °C | | 7 | |
| Pulsed Drain Current | | $I_{DM}$ | 12 | |
| Continuous Source Current (Diode Conduction) | | $I_S$ | 6 | |
| Avalanche Current | | $I_{AS}$ | 6 | |
| Single Pulse Avalanche Energy | L = 0.1 mH | $E_{AS}$ | 18 | mJ |
| Maximum Power Dissipation | $T_C$ = 25 °C | $P_D$ | 96[b] | W |
| | $T_A$ = 25 °C | | 3[a] | |
| Operating Junction and Storage Temperature Range | | $T_J$, $T_{stg}$ | - 55 to 175 | °C |

| THERMAL RESISTANCE RATINGS | | | | | |
|---|---|---|---|---|---|
| **Parameter** | | **Symbol** | **Typical** | **Maximum** | **Unit** |
| Junction-to-Ambient[a] | t ≤ 10 s | $R_{thJA}$ | 15 | 18 | °C/W |
| | Steady State | | 40 | 50 | |
| Junction-to-Case (Drain) | | $R_{thJC}$ | 0.85 | 1.1 | |

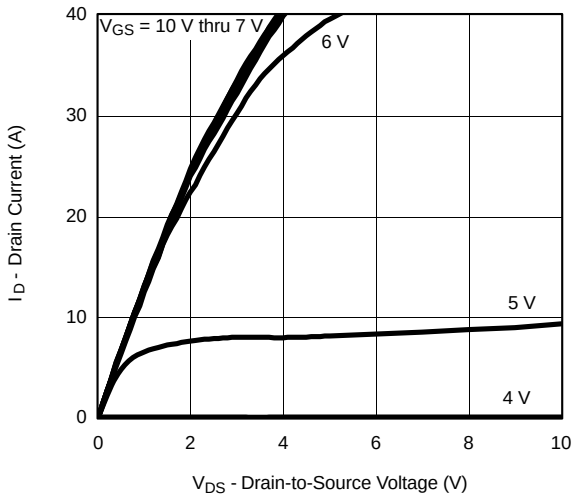
Notes:
a. Surface mounted on 1" x 1" FR4 board.
b. See SOA curve for voltage derating.

| **SPECIFICATIONS** ($T_J$ = 25 °C, unless otherwise noted) | | | | | | |
|---|---|---|---|---|---|---|
| **Parameter** | **Symbol** | **Test Conditions** | **Min.** | **Typ.[a]** | **Max.** | **Unit** |
| **Static** | | | | | | |
| Drain-Source Breakdown Voltage | $V_{DS}$ | $V_{GS}$ = 0 V, $I_D$ = 250 µA | 200 | | | V |
| Gate Threshold Voltage | $V_{GS(th)}$ | $V_{DS}$ = $V_{GS}$, $I_D$ = 250 µA | 2 | | 4 | |
| Gate-Body Leakage | $I_{GSS}$ | $V_{DS}$ = 0 V, $V_{GS}$ = ± 20 V | | | ± 100 | nA |
| Zero Gate Voltage Drain Current | $I_{DSS}$ | $V_{DS}$ = 200 V, $V_{GS}$ = 0 V | | | 1 | µA |
| | | $V_{DS}$ = 200 V, $V_{GS}$ = 0 V, $T_J$ = 125 °C | | | 50 | |
| | | $V_{DS}$ = 200 V, $V_{GS}$ = 0 V, $T_J$ = 175 °C | | | 250 | |
| On-State Drain Current[b] | $I_{D(on)}$ | $V_{DS}$ = 5 V, $V_{GS}$ = 10 V | 40 | | | A |
| Drain-Source On-State Resistance[b] | $R_{DS(on)}$ | $V_{GS}$ = 10 V, $I_D$ = 3 A | | 0.245 | | Ω |
| | | $V_{GS}$ = 10 V, $I_D$ = 3 A, $T_J$ = 125 °C | | 0.290 | | |
| | | $V_{GS}$ = 10 V, $I_D$ = 3 A, $T_J$ = 175 °C | | 0.320 | | |
| | | $V_{GS}$ = 6 V, $I_D$ = 3 A | | 0.270 | | |
| Forward Transconductance[b] | $g_{fs}$ | $V_{DS}$ = 15 V, $I_D$ = 3 A | | 35 | | S |
| **Dynamic[a]** | | | | | | |
| Input Capacitance | $C_{iss}$ | $V_{GS}$ = 0 V, $V_{DS}$ = 25 V, F = 1 MHz | | 1800 | | pF |
| Output Capacitance | $C_{oss}$ | | | 180 | | |
| Reverse Transfer Capacitance | $C_{rss}$ | | | 80 | | |
| Total Gate Charge[c] | $Q_g$ | $V_{DS}$ = 100 V, $V_{GS}$ = 10 V, $I_D$ = 3 A | | 34 | 51 | nC |
| Gate-Source Charge[c] | $Q_{gs}$ | | | 8 | | |
| Gate-Drain Charge[c] | $Q_{gd}$ | | | 12 | | |
| Gate Resistance | $R_g$ | | 0.5 | | 2.9 | Ω |
| Turn-On Delay Time[c] | $t_{d(on)}$ | $V_{DD}$ = 100 V, $R_L$ = 5.2 Ω<br>$I_D$ ≅ 3 A, $V_{GEN}$ = 10 V, $R_g$ = 2.5 Ω | | 15 | 25 | ns |
| Rise Time[c] | $t_r$ | | | 50 | 75 | |
| Turn-Off Delay Time[c] | $t_{d(off)}$ | | | 30 | 45 | |
| Fall Time[c] | $t_f$ | | | 60 | 90 | |
| **Source-Drain Diode Ratings and Characteristics** ($T_C$ = 25 °C) | | | | | | |
| Pulsed Current | $I_{SM}$ | | | | 5 | A |
| Diode Forward Voltage[b] | $V_{SD}$ | $I_F$ = 3 A, $V_{GS}$ = 0 V | | 0.9 | 1.5 | V |
| Source-Drain Reverse Recovery Time | $t_{rr}$ | $I_F$ = 3 A, dI/dt = 100 A/µs | | 180 | 250 | ns |

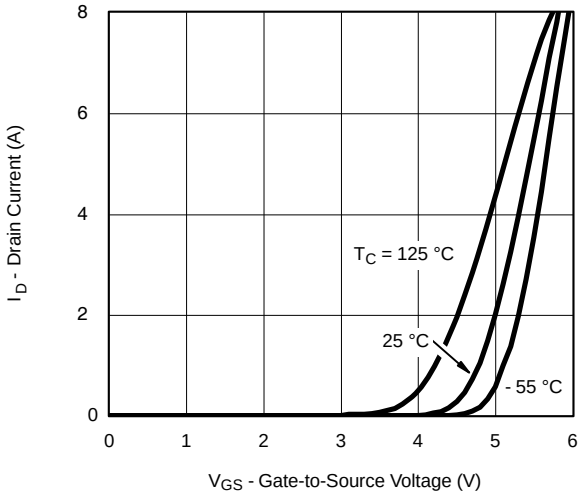
Notes:
a. Guaranteed by design, not subject to production testing.
b. Pulse test; pulse width ≤ 300 µs, duty cycle ≤ 2 %.
c. Independent of operating temperature.

*Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.*

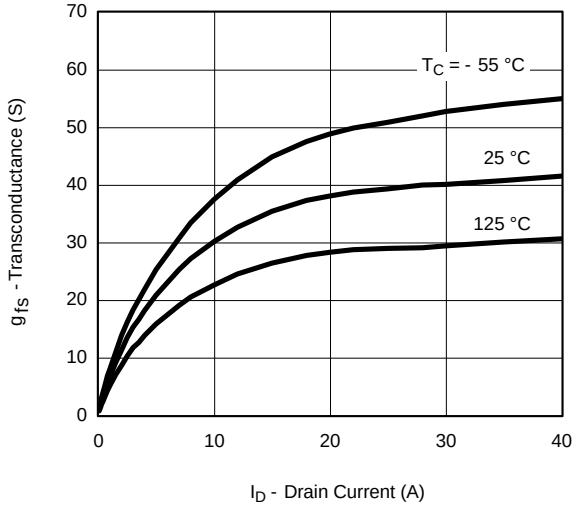
## TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



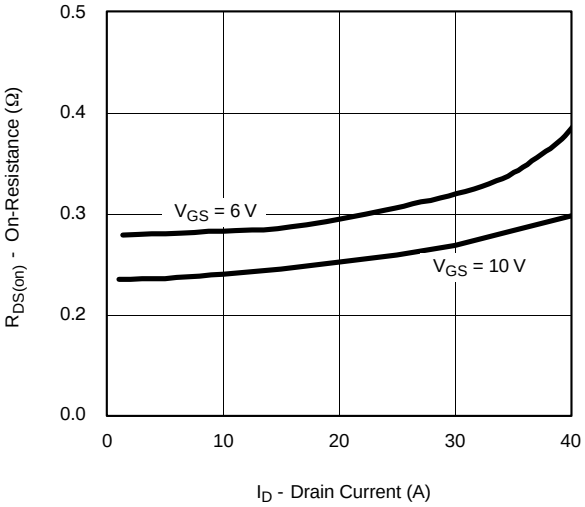

**Output Characteristics**



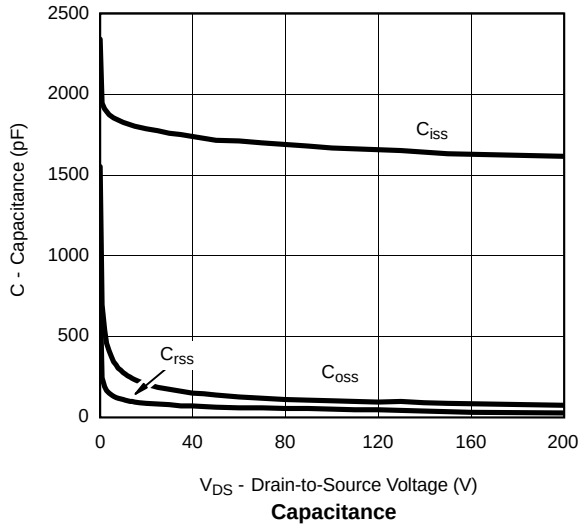

**Transfer Characteristics**



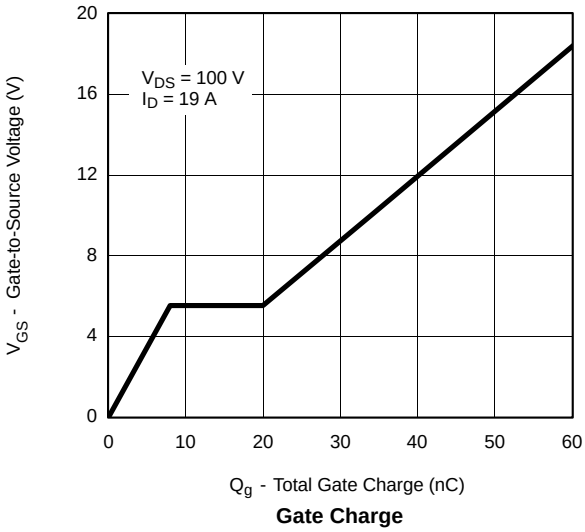

**Transconductance**




**On-Resistance vs. Drain Current**

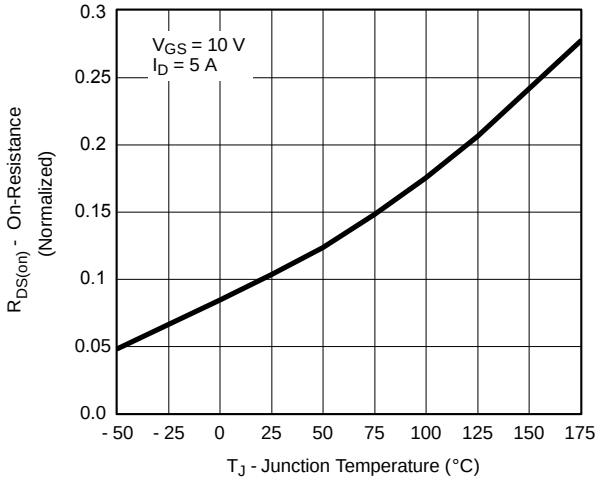



**Capacitance**

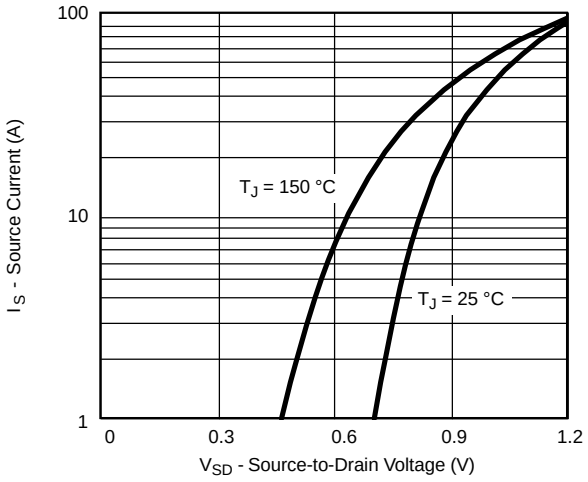



**Gate Charge**

## TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)

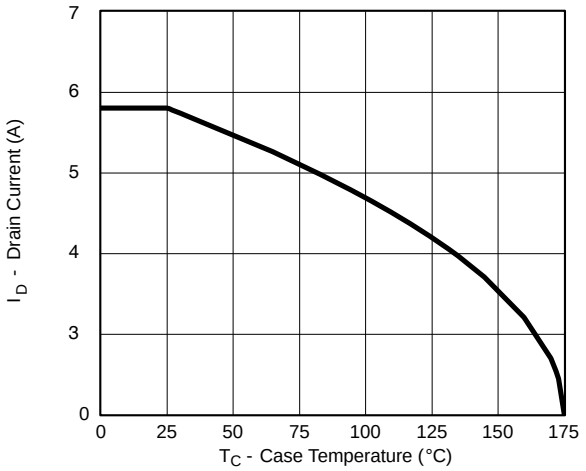



**On-Resistance vs. Junction Temperature**

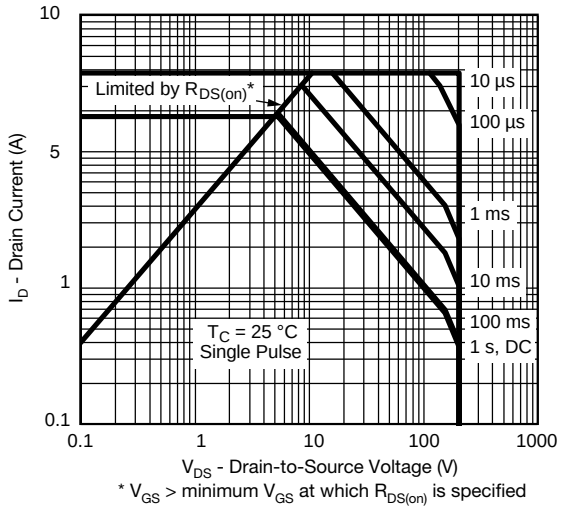



**Source-Drain Diode Forward Voltage**

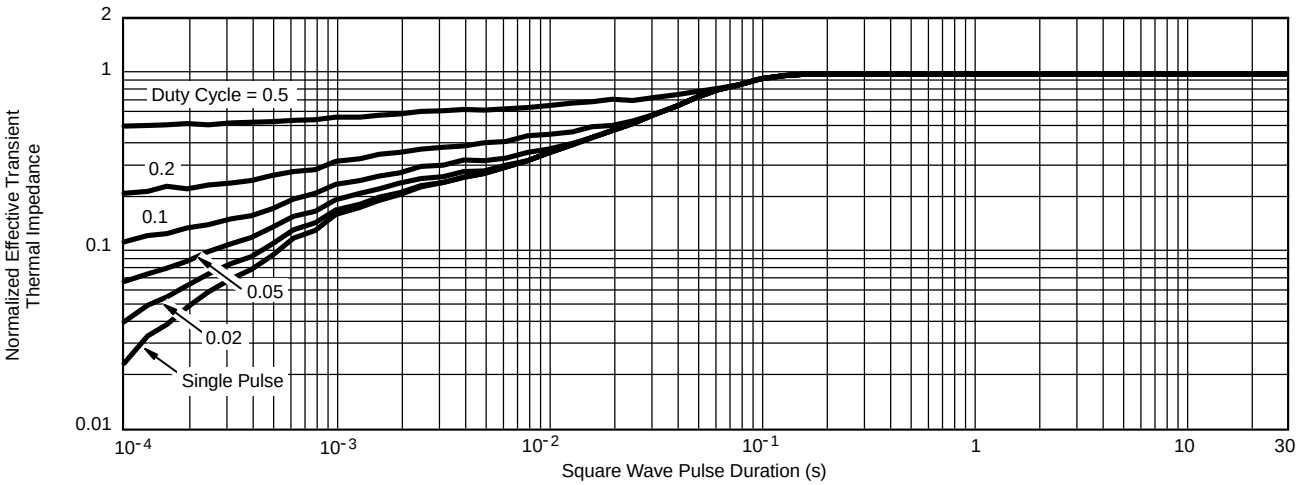
## THERMAL RATINGS




**Maximum Avalanche Drain Current vs. Case Temperature**

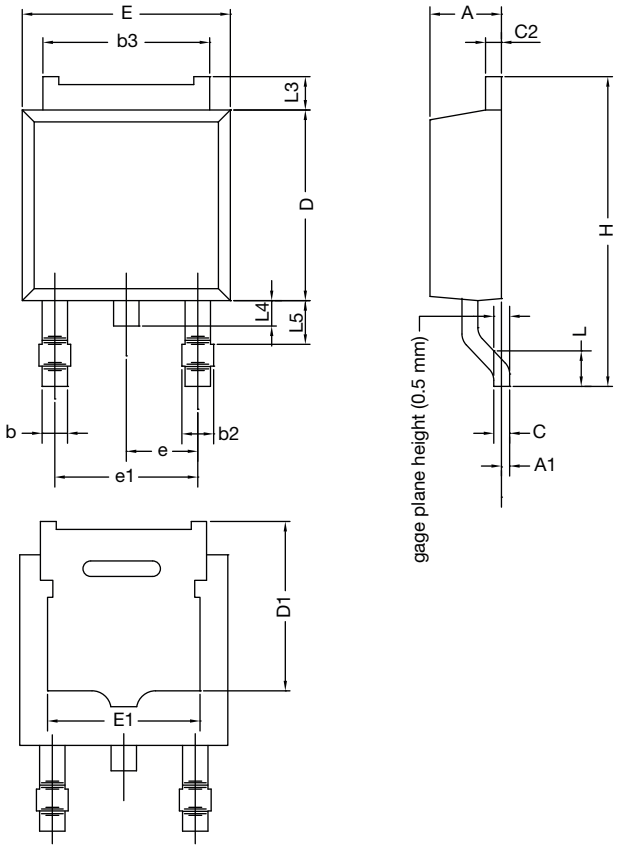



**Safe Operating Area**




**Normalized Thermal Transient Impedance, Junction-to-Case**

# TO-252AA CASE OUTLINE

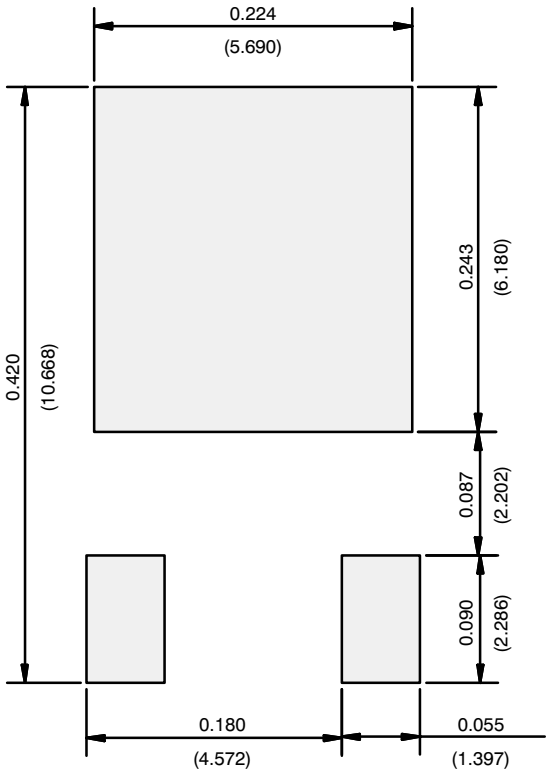



| | MILLIMETERS | | INCHES | |
|---|---|---|---|---|
| **DIM.** | **MIN.** | **MAX.** | **MIN.** | **MAX.** |
| A | 2.18 | 2.38 | 0.086 | 0.094 |
| A1 | - | 0.127 | - | 0.005 |
| b | 0.64 | 0.88 | 0.025 | 0.035 |
| b2 | 0.76 | 1.14 | 0.030 | 0.045 |
| b3 | 4.95 | 5.46 | 0.195 | 0.215 |
| C | 0.46 | 0.61 | 0.018 | 0.024 |
| C2 | 0.46 | 0.89 | 0.018 | 0.035 |
| D | 5.97 | 6.22 | 0.235 | 0.245 |
| D1 | 5.21 | - | 0.205 | - |
| E | 6.35 | 6.73 | 0.250 | 0.265 |
| E1 | 4.32 | - | 0.170 | - |
| H | 9.40 | 10.41 | 0.370 | 0.410 |
| e | 2.28 BSC | | 0.090 BSC | |
| e1 | 4.56 BSC | | 0.180 BSC | |
| L | 1.40 | 1.78 | 0.055 | 0.070 |
| L3 | 0.89 | 1.27 | 0.035 | 0.050 |
| L4 | - | 1.02 | - | 0.040 |
| L5 | 1.14 | 1.52 | 0.045 | 0.060 |
| ECN: X12-0247-Rev. M, 24-Dec-12<br>DWG: 5347 | | | | |

**Note**

- Dimension L3 is for reference only.

## RECOMMENDED MINIMUM PADS FOR DPAK (TO-252)




Recommended Minimum Pads
Dimensions in Inches/(mm)

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