30V N-Channel MOSFETs

# PDP3904

## General Description

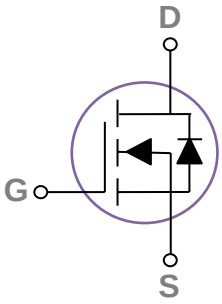
*These N-Channel enhancement mode power field effect transistors are using trench DMOS technology. This advanced technology has been especially tailored to minimize on-state resistance, provide superior switching performance, and withstand high energy pulse in the avalanche and commutation mode. These devices are well suited for high efficiency fast switching applications.*

| BVDSS | RDSON | ID |
|---|---|---|
| 30V | 4mΩ | 140A |

## Features

- *30V, 140A, RDS(ON) =4mΩ@VGS = 10V*
- *Improved dv/dt capability*
- *Fast switching*
- *100% EAS Guaranteed*
- *Green Device Available*

## TO220 Pin Configuration


## Applications

- *MB / VGA / Vcore*
- *POL Applications*
- *SMPS 2nd SR*

## Absolute Maximum Ratings Tc=25℃ unless otherwise noted

| Symbol | Parameter | Rating | Units |
|---|---|---|---|
| $V_{DS}$ | Drain-Source Voltage | 30 | V |
| $V_{GS}$ | Gate-Source Voltage | ±20 | V |
| $I_D$ | Drain Current – Continuous ($T_C$=25˚C) | 140 | A |
| | Drain Current – Continuous ($T_C$=100˚C) | 89 | A |
| $I_{DM}$ | Drain Current – Pulsed[1] | 560 | A |
| EAS | Single Pulse Avalanche Energy[2] | 125 | mJ |
| IAS | Single Pulse Avalanche Current[2] | 50 | A |
| $P_D$ | Power Dissipation ($T_C$=25˚C) | 125 | W |
| | Power Dissipation – Derate above 25˚C | 1 | W/˚C |
| $T_{STG}$ | Storage Temperature Range | -55 to 175 | ˚C |
| $T_J$ | Operating Junction Temperature Range | -55 to 175 | ˚C |

## Thermal Characteristics

| Symbol | Parameter | Typ. | Max. | Unit |
|---|---|---|---|---|
| $R_{\theta JA}$ | Thermal Resistance Junction to ambient | --- | 62 | ˚C/W |
| $R_{\theta JC}$ | Thermal Resistance Junction to Case | --- | 1 | ˚C/W |

## Electrical Characteristics ($T_J$=25 ℃, unless otherwise noted)

### Static State Characteristics

| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $BV_{DSS}$ | Drain-Source Breakdown Voltage | $V_{GS}$=0V , $I_D$=250uA | 30 | --- | --- | V |
| $\triangle BV_{DSS}/\triangle T_J$ | $BV_{DSS}$ Temperature Coefficient | Reference to 25℃ , $I_D$=1mA | --- | 0.03 | --- | V/℃ |
| $I_{DSS}$ | Drain-Source Leakage Current | $V_{DS}$=30V , $V_{GS}$=0V , $T_J$=25℃ | --- | --- | 1 | uA |
| | | $V_{DS}$=24V , $V_{GS}$=0V , $T_J$=125℃ | --- | --- | 10 | uA |
| $I_{GSS}$ | Gate-Source Leakage Current | $V_{GS}$=±20V , $V_{DS}$=0V | --- | --- | ±100 | nA |
| $R_{DS(ON)}$ | Static Drain-Source On-Resistance[3] | $V_{GS}$=10V , $I_D$=24A | --- | 3.5 | 4 | mΩ |
| | | $V_{GS}$=4.5V , $I_D$=12A | --- | 5.1 | 6 | mΩ |
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{GS}$=$V_{DS}$ , $I_D$ =250uA | 1.2 | 1.6 | 2.5 | V |
| $\triangle V_{GS(th)}$ | $V_{GS(th)}$ Temperature Coefficient | | --- | -5 | --- | mV/℃ |
| gfs | Forward Transconductance | $V_{DS}$=10V , $I_D$=10A | --- | 16 | --- | S |

### Dynamic Characteristics

| | | | | | | |
|---|---|---|---|---|---|---|
| $Q_g$ | Total Gate Charge[3,4] | $V_{DS}$=15V , $V_{GS}$=4.5V , $I_D$=24A | --- | 24 | 36 | nC |
| $Q_{gs}$ | Gate-Source Charge[3,4] | | --- | 4.2 | 8 | |
| $Q_{gd}$ | Gate-Drain Charge[3,4] | | --- | 13 | 20 | |
| $T_{d(on)}$ | Turn-On Delay Time[3,4] | $V_{DD}$=15V , $V_{GS}$=10V , $R_G$=3.3Ω $I_D$=15A | --- | 12.6 | 24 | ns |
| $T_r$ | Rise Time[3,4] | | --- | 19.5 | 37 | |
| $T_{d(off)}$ | Turn-Off Delay Time[3,4] | | --- | 42.8 | 81 | |
| $T_f$ | Fall Time[3,4] | | --- | 13.2 | 25 | |
| $C_{iss}$ | Input Capacitance | $V_{DS}$=25V , $V_{GS}$=0V , F=1MHz | --- | 2200 | 3300 | pF |
| $C_{oss}$ | Output Capacitance | | --- | 280 | 410 | |
| $C_{rss}$ | Reverse Transfer Capacitance | | --- | 177 | 260 | |
| $R_g$ | Gate resistance | $V_{GS}$=0V, $V_{DS}$=0V, F=1MHz | --- | 2 | 4 | Ω |

### Guaranteed Avalanche Energy

| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| EAS | Single Pulse Avalanche Energy | $V_{DD}$=25V, L=0.1mH, IAS=24A | 31 | --- | --- | mJ |

### Drain-Source Diode Characteristics

| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $I_S$ | Continuous Source Current | $V_G$=$V_D$=0V , Force Current | --- | --- | 140 | A |
| $I_{SM}$ | Pulsed Source Current[3] | | --- | --- | 560 | A |
| $V_{SD}$ | Diode Forward Voltage[3] | $V_{GS}$=0V , $I_S$=1A , $T_J$=25℃ | --- | --- | 1 | V |
| $t_{rr}$ | Reverse Recovery Time | $V_{DS}$=30V,$I_S$=24A , di/dt=100A/μs $T_J$=25℃ | --- | 19.1 | --- | ns |
| $Q_{rr}$ | Reverse Recovery Charge | | --- | 9.5 | --- | nC |

Note :
1. Repetitive Rating : Pulsed width limited by maximum junction temperature.
2. $V_{DD}$=25V,$V_{GS}$=10V,L=0.1mH,$I_{AS}$=50A.,$R_G$=25Ω, Starting $T_J$=25℃.
3. The data tested by pulsed , pulse width ≦ 300us , duty cycle ≦ 2%.
4. Essentially independent of operating temperature.

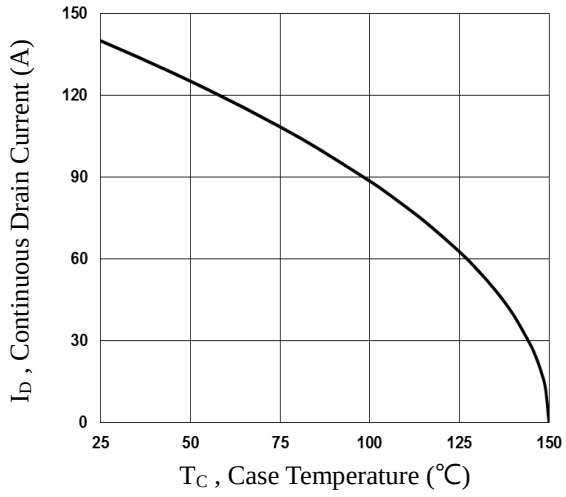



**Fig.1 Continuous Drain Current vs. $T_C$**

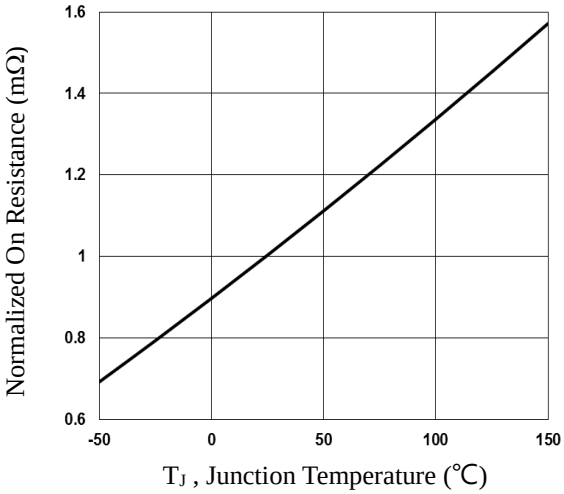



**Fig.2 Normalized RDSON vs. $T_J$**

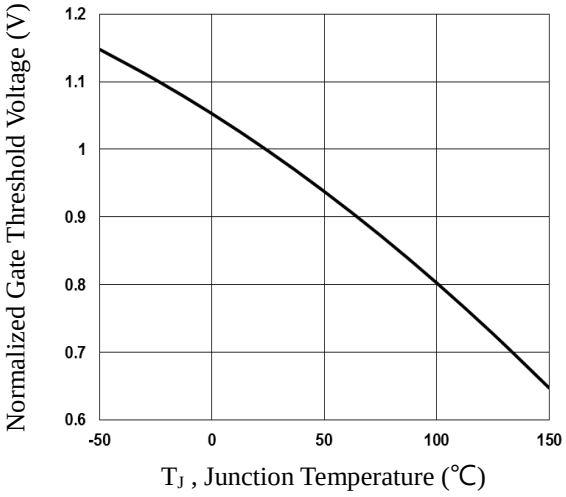



**Fig.3 Normalized $V_{th}$ vs. $T_J$**

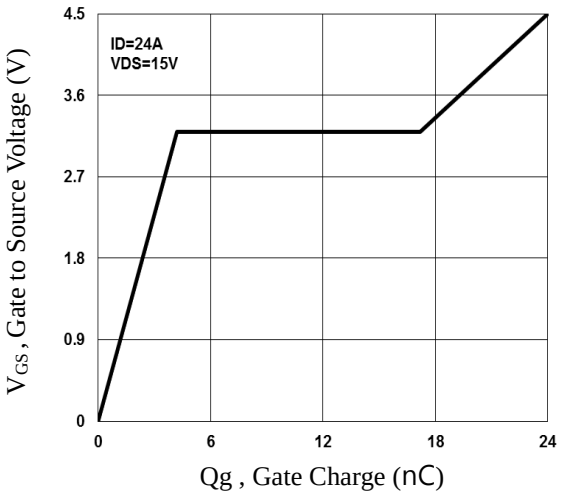



**Fig.4 Gate Charge Waveform**

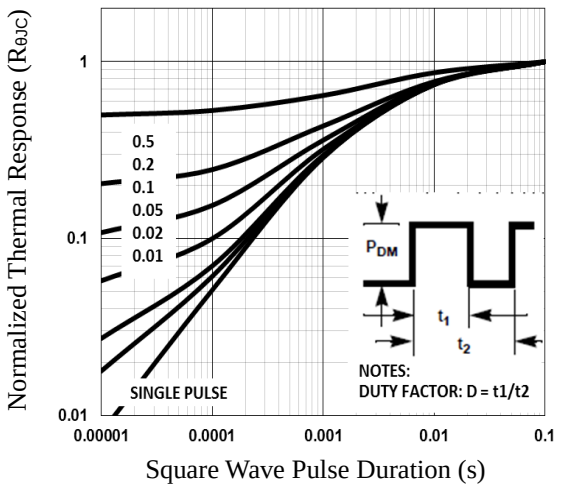



**Fig.5 Normalized Transient Impedance**

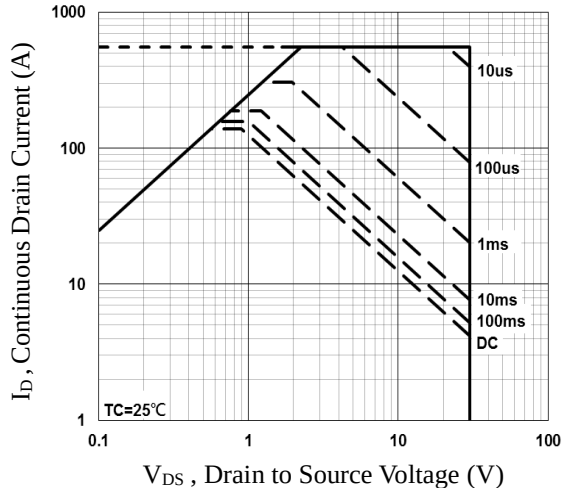



**Fig.6 Maximum Safe Operation Area**

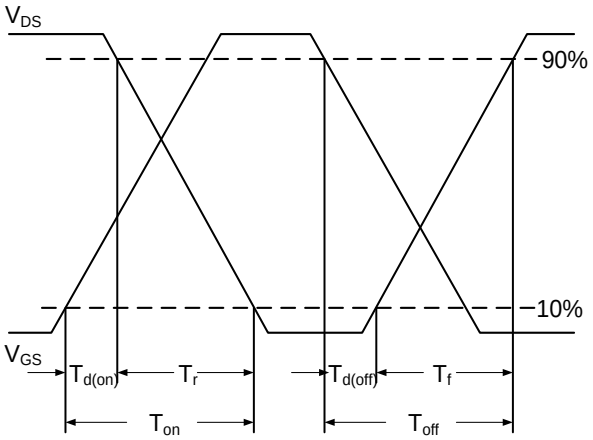



**Fig.7 Switching Time Waveform**

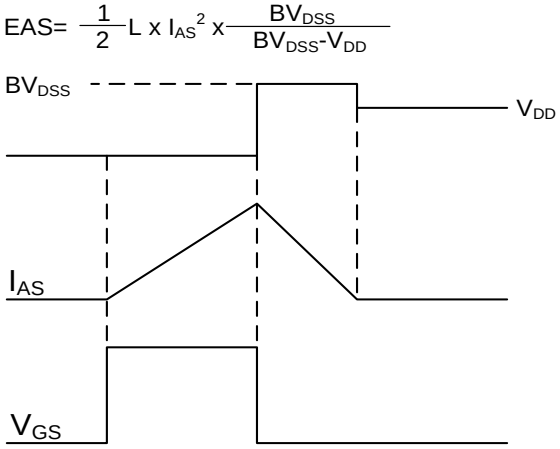
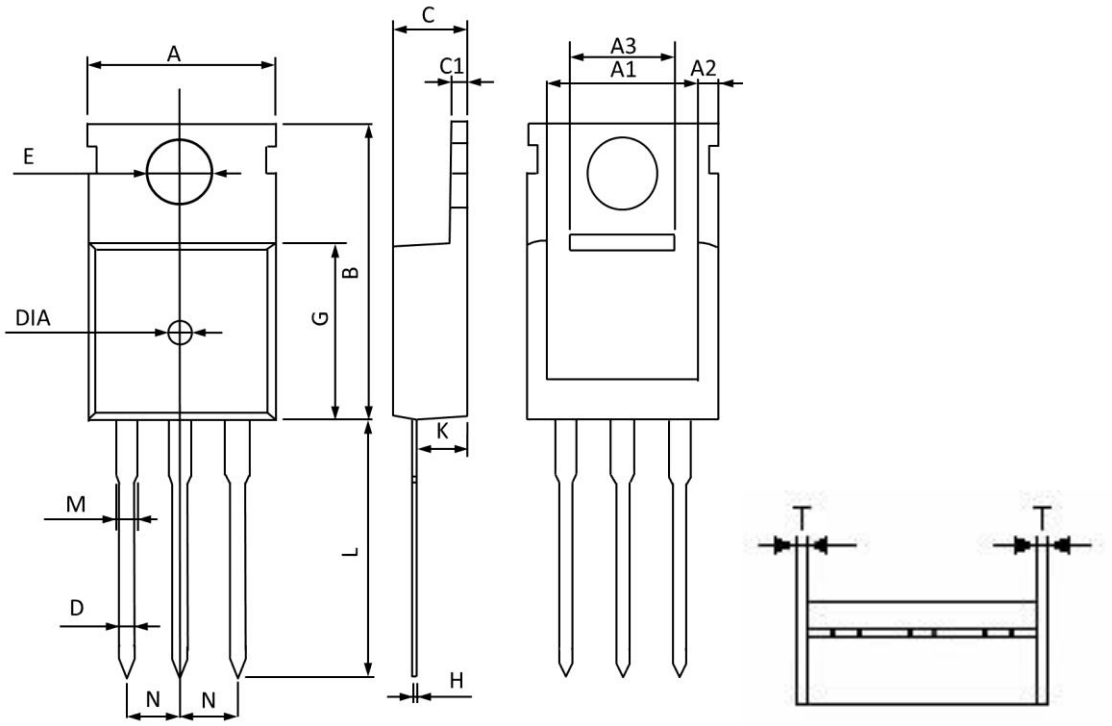



**Fig.8 EAS Waveform**

# TO220 PACKAGE INFORMATION




| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|---|---|---|---|---|
| | Min | Max | Min | Max |
| A | 9.70 | 10.30 | 0.382 | 0.405 |
| A1 | 8.44 | 8.84 | 0.333 | 0.348 |
| A2 | 1.05 | 1.25 | 0.042 | 0.049 |
| A3 | 5.10 | 5.30 | 0.201 | 0.208 |
| B | 15.40 | 16.20 | 0.607 | 0.637 |
| C | 4.28 | 4.68 | 0.169 | 0.184 |
| C1 | 1.10 | 1.50 | 0.044 | 0.059 |
| D | 0.60 | 1.00 | 0.024 | 0.039 |
| E | 3.40 | 3.80 | 0.134 | 0.149 |
| G | 8.70 | 9.30 | 0.343 | 0.366 |
| H | 0.40 | 0.60 | 0.016 | 0.023 |
| K | 2.10 | 2.70 | 0.083 | 0.106 |
| L | 12.80 | 13.60 | 0.504 | 0.535 |
| M | 1.10 | 1.50 | 0.044 | 0.059 |
| N | 2.49 | 2.59 | 0.099 | 0.101 |
| T | 0.345 | 0.355 | 0.014 | 0.014 |
| DIA | 1.45 | 1.55 | 0.058 | 0.061 |