60V N-Channel MOSFETs

# PDEN2N7002S

## 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 |
|---|---|---|
| 60V | 3Ω | 0.2A |

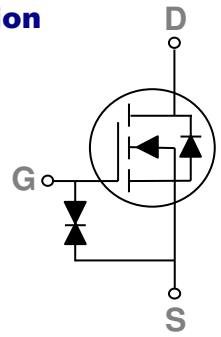
## Features

- *60V,0.2A, RDS(ON) =3Ω@VGS=10V*
- *Improved dv/dt capability*
- *Fast switching*
- *100% EAS Guaranteed*
- *Green Device Available*
- *G-S ESD Protection Diode Embedded*
- *ESD protected up to 2KV*

## Applications

- *Motor Drive*
- *Power Tools*
- *LED Lighting*

## SOT23-3S Pin Configuration


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

| Symbol | Parameter | Rating | Units |
|---|---|---|---|
| $V_{DS}$ | Drain-Source Voltage | 60 | V |
| $V_{GS}$ | Gate-Source Voltage | ±20 | V |
| $I_D$ | Drain Current – Continuous ($T_C$=25℃) | 0.2 | A |
| | Drain Current – Continuous ($T_C$=100℃) | 0.1 | A |
| $I_{DM}$ | Drain Current – Pulsed[1] | 0.8 | A |
| $P_D$ | Power Dissipation ($T_C$=25℃) | 0.35 | W |
| | Power Dissipation – Derate above 25℃ | 0.003 | W/℃ |
| $T_{STG}$ | Storage Temperature Range | -50 to 150 | ℃ |
| $T_J$ | Operating Junction Temperature Range | -50 to 150 | ℃ |

## Thermal Characteristics

| Symbol | Parameter | Typ. | Max. | Unit |
|---|---|---|---|---|
| $R_{\theta JA}$ | Thermal Resistance Junction to ambient | --- | 357 | ℃/W |

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

### Off Characteristics

| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $BV_{DSS}$ | Drain-Source Breakdown Voltage | $V_{GS}$=0V , $I_D$=250uA | 60 | --- | --- | V |
| $I_{DSS}$ | Drain-Source Leakage Current | $V_{DS}$=60V , $V_{GS}$=0V , $T_J$=25℃ | --- | --- | 1 | uA |
| | | $V_{DS}$=48V , $V_{GS}$=0V , $T_J$=125℃ | --- | --- | 10 | uA |
| $I_{GSS}$ | Gate-Source Leakage Current | $V_{GS}$=±20V , $V_{DS}$=0V | --- | --- | ±20 | uA |

### On Characteristics

| | | | | | | |
|---|---|---|---|---|---|---|
| $R_{DS(ON)}$ | Static Drain-Source On-Resistance | $V_{GS}$=10V , $I_D$=0.3A | --- | 1.3 | 3 | Ω |
| | | $V_{GS}$=4.5V , $I_D$=0.2A | --- | 1.5 | 4 | Ω |
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{GS}$=$V_{DS}$ , $I_D$ =250uA | 1 | 1.8 | 2.5 | V |
| gfs | Forward Transconductance | $V_{DS}$=10V , $I_D$=0.3A | --- | 0.5 | --- | S |

### Dynamic and switching Characteristics

| | | | | | | |
|---|---|---|---|---|---|---|
| $Q_g$ | Total Gate Charge[2,3] | $V_{DS}$=30V , $V_{GS}$=10V , $I_D$=1A | --- | 3.7 | 5.6 | nC |
| $Q_{gs}$ | Gate-Source Charge[2,3] | | --- | 0.9 | 1.4 | |
| $Q_{gd}$ | Gate-Drain Charge[2,3] | | --- | 0.4 | 0.6 | |
| $T_{d(on)}$ | Turn-On Delay Time[2,3] | $V_{DD}$=30V , $V_{GS}$=10V , $R_G$=6Ω , $I_D$=0.2A | --- | 3 | 6 | ns |
| $T_r$ | Rise Time[2,3] | | --- | 5 | 10 | |
| $T_{d(off)}$ | Turn-Off Delay Time[2,3] | | --- | 14 | 27 | |
| $T_f$ | Fall Time[2,3] | | --- | 9 | 17 | |
| $C_{iss}$ | Input Capacitance | $V_{DS}$=30V , $V_{GS}$=0V , F=1MHz | --- | 25.5 | 38 | pF |
| $C_{oss}$ | Output Capacitance | | --- | 17 | 26 | |
| $C_{rss}$ | Reverse Transfer Capacitance | | --- | 7.8 | 12 | |

### Drain-Source Diode Characteristics and Maximum Ratings

| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $I_S$ | Continuous Source Current | $V_G$=$V_D$=0V , Force Current | --- | --- | 0.3 | A |
| $I_{SM}$ | Pulsed Source Current | | --- | --- | 1.2 | A |
| $V_{SD}$ | Diode Forward Voltage | $V_{GS}$=0V , $I_S$=1A , $T_J$=25℃ | --- | --- | 1 | V |
| $t_{rr}$ | Reverse Recovery Time | $V_{GS}$=50V, $I_S$=1A , dI/dt=100A/μs , $T_J$=25℃ | --- | 3.4 | --- | ns |
| $Q_{rr}$ | Reverse Recovery Charge | | --- | 0.7 | --- | nC |

Note :
1. Repetitive Rating : Pulsed width limited by maximum junction temperature.
2. The data tested by pulsed , pulse width ≦ 300us , duty cycle ≦ 2%.
3. Essentially independent of operating temperature.

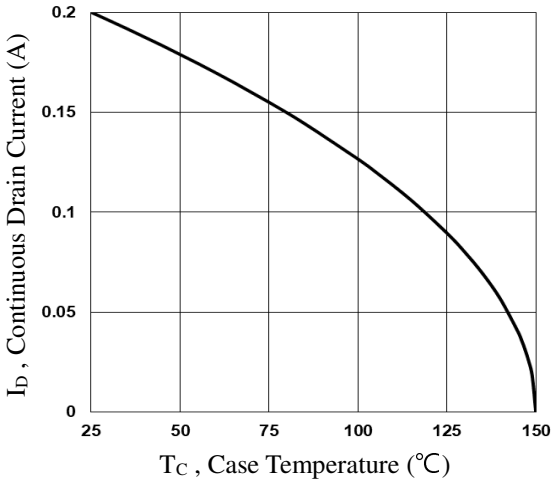



**Fig.1 Continuous Drain Current vs. $T_C$**

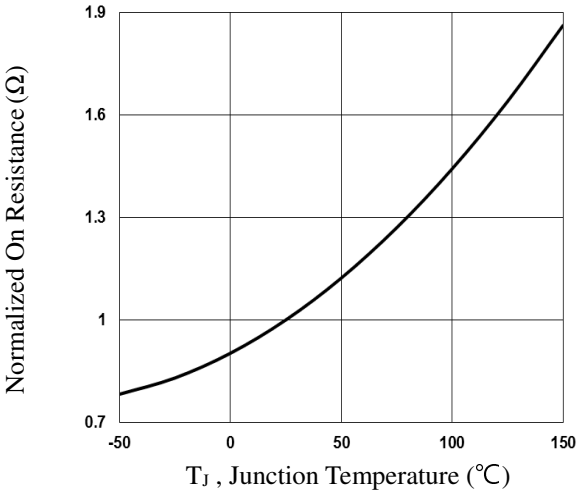



**Fig.2 Normalized RDSON vs. $T_J$**

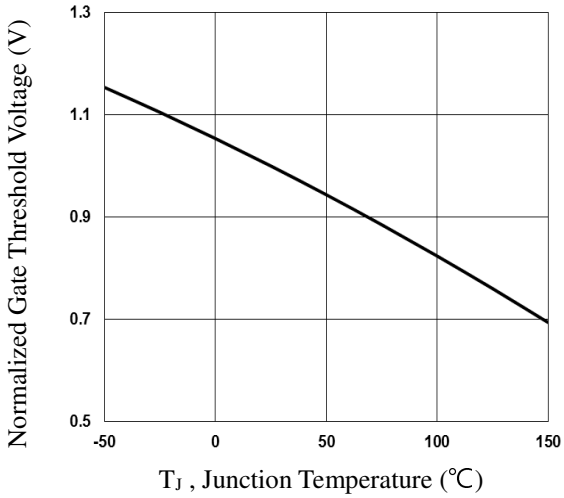



**Fig.3 Normalized $V_{th}$ vs. $T_J$**

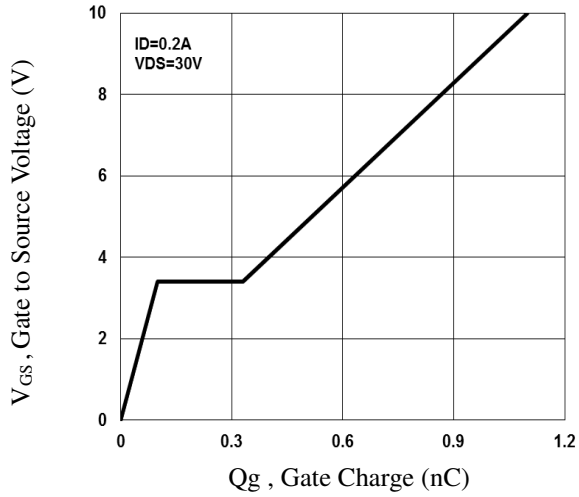



**Fig.4 Gate Charge Waveform**

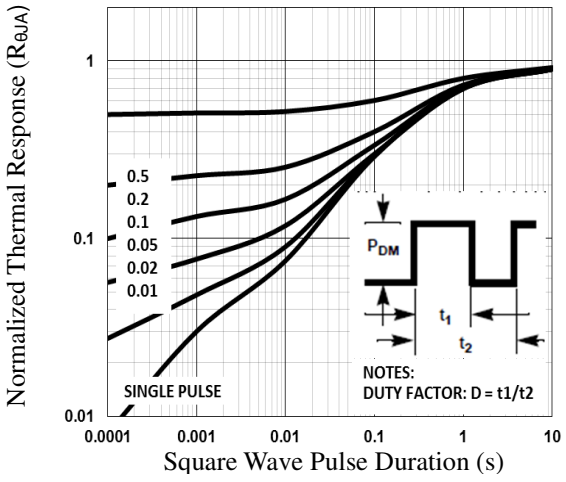



**Fig.5 Normalized Transient Impedance**

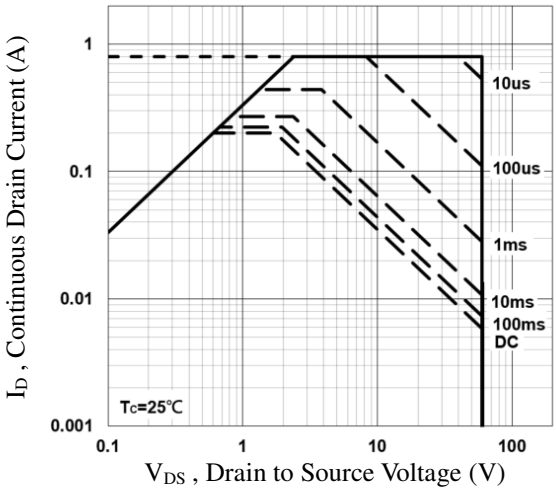



**Fig.6 Maximum Safe Operation Area**

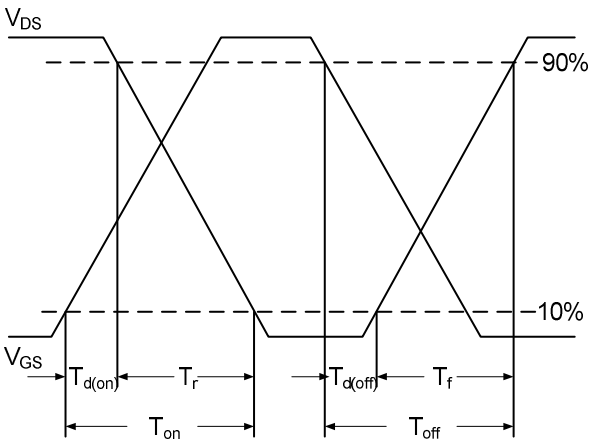



**Fig.7 Switching Time Waveform**

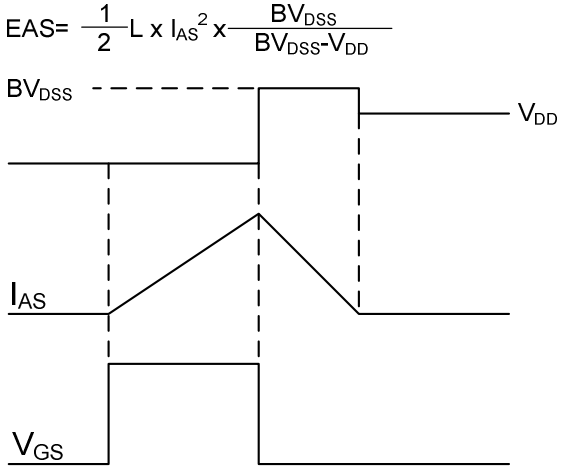
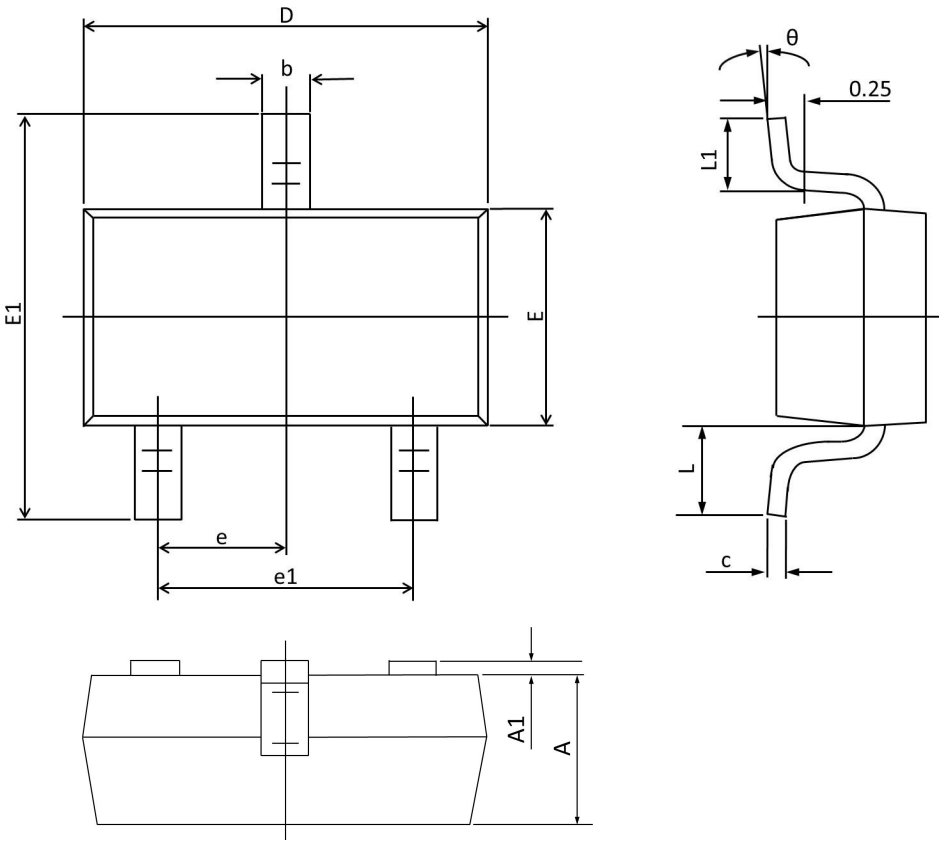



**Fig.8 EAS Waveform**

# SOT23-3S PACKAGE INFORMATION




| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|---|---|---|---|---|
| | Min | Max | Min | Max |
| A | 0.900 | 1.000 | 0.035 | 0.039 |
| A1 | 0.000 | 0.100 | 0.000 | 0.004 |
| b | 0.300 | 0.500 | 0.012 | 0.020 |
| c | 0.090 | 0.110 | 0.003 | 0.004 |
| D | 2.800 | 3.000 | 0.110 | 0.118 |
| E | 1.200 | 1.400 | 0.047 | 0.055 |
| E1 | 2.250 | 2.550 | 0.089 | 0.100 |
| e | 0.950 TYP. | | 0.037 TYP. | |
| e1 | 1.800 | 2.000 | 0.071 | 0.079 |
| L | 0.550 REF. | | 0.022 REF. | |
| L1 | 0.300 | 0.500 | 0.012 | 0.020 |
| $\theta$ | 1° | 7° | 1° | 7° |