

## 60V N-Channel MOSFETs

### General Description

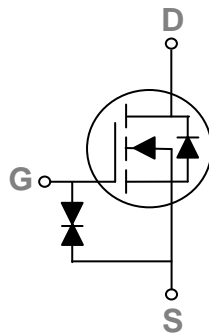
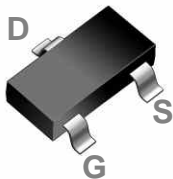
These N-Channel enhancement mode power field effect transistors are using trench DMOS technology. This advanced technology has been especially tailored to minimize on-state resistance, provide superior switching performance, and withstand high energy pulse in the avalanche and commutation mode. These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

|            |                  |       |
|------------|------------------|-------|
| $BV_{DSS}$ | $R_{DS(ON)Max.}$ | $I_D$ |
| 60V        | 1.2Ω             | 0.3A  |

### Features

- 60V, 0.3A,  $R_{DS(ON)Max.} = 1.2\Omega @ V_{GS}=10V$
- Improved  $dv/dt$  capability
- Fast switching
- Green Device Available
- G-S ESD Protection Diode Embedded

### SOT-23 Pin Configuration



### Applications

- Motor Drive
- Power Tools
- LED Lighting

### Absolute Maximum Ratings $T_c=25^\circ\text{C}$ unless otherwise noted

| Symbol    | Parameter  | Rating     | Units               |
|-----------|--|------------|---------------------|
| $V_{DS}$  | Drain-Source Voltage                                   | 60         | V                   |
| $V_{GS}$  | Gate-Source Voltage                                    | $\pm 20$   | V                   |
| $I_D$     | Drain Current – Continuous ( $T_c=25^\circ\text{C}$ )  | 0.3        | A                   |
|           | Drain Current – Continuous ( $T_c=100^\circ\text{C}$ ) | 0.2        | A                   |
| $I_{DM}$  | Drain Current – Pulsed <sup>1</sup>                    | 1.4        | A                   |
| $P_D$     | Power Dissipation ( $T_c=25^\circ\text{C}$ )           | 0.35       | W                   |
|           | Power Dissipation – Derate above $25^\circ\text{C}$    | 0.003      | W/ $^\circ\text{C}$ |
| ESD       | Human Body Model                                       | 2000       | V                   |
| $T_{STG}$ | Storage Temperature Range                              | -50 to 150 | $^\circ\text{C}$    |
| $T_J$     | Operating Junction Temperature Range                   | -50 to 150 | $^\circ\text{C}$    |

Note F: Exceed these limits to damage to the device.

Note G: Exposure to absolute maximum rating conditions may affect device reliability.

### Thermal Characteristics

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

**Electrical Characteristics (T<sub>J</sub>=25 °C, unless otherwise noted)**
**Off Characteristics**

| Symbol                              | Parameter                                 | Conditions   | Min. | Typ. | Max. | Unit |
|-------------------------------------|---|--|------|------|------|------|
| BV <sub>DSS</sub>                   | Drain-Source Breakdown Voltage            | V <sub>GS</sub> =0V, I <sub>D</sub> =250uA                       | 60   |      |      | V    |
| ΔBV <sub>DSS</sub> /ΔT <sub>J</sub> | BV <sub>DSS</sub> Temperature Coefficient | Reference to 25°C, I <sub>D</sub> =1mA                           |      | 0.04 |      | V/°C |
| I <sub>DSS</sub>                    | Drain-Source Leakage Current              | V <sub>DS</sub> =60V, V <sub>GS</sub> =0V, T <sub>J</sub> =25°C  |      |      | 1    | uA   |
|                                     |   | V <sub>DS</sub> =48V, V <sub>GS</sub> =0V, T <sub>J</sub> =125°C |      |      | 100  | uA   |
| I <sub>GSS</sub>                    | Gate-Source Leakage Current               | V <sub>GS</sub> =±20V, V <sub>DS</sub> =0V                       |      |      | ±10  | uA   |

**On Characteristics**

|                      |   |  |   |      |     |       |
|----------------------|---|--|---|------|-----|-------|
| R <sub>DS(ON)</sub>  | Static Drain-Source On-Resistance           | V <sub>GS</sub> =10V, I <sub>D</sub> =0.5A               |   | 0.9  | 1.2 | Ω     |
|                      |   | V <sub>GS</sub> =4.5V, I <sub>D</sub> =0.2A              |   | 1.1  | 2   | Ω     |
| V <sub>GS(th)</sub>  | Gate Threshold Voltage                      | V <sub>GS</sub> =V <sub>DS</sub> , I <sub>D</sub> =250uA | 1 | 1.6  | 2.5 | V     |
| ΔV <sub>GS(th)</sub> | V <sub>GS(th)</sub> Temperature Coefficient |  |   | -4   |     | mV/°C |
| g <sub>fs</sub>      | Forward Transconductance                    | V <sub>DS</sub> =10V, I <sub>D</sub> =0.1A               |   | 0.40 |     | S     |

**Dynamic and switching Characteristics**

|                     |                                    |  |  |      |  |    |
|---------------------|------------------------------------|--|--|------|--|----|
| Q <sub>g</sub>      | Total Gate Charge <sup>2,3</sup>   | V <sub>DS</sub> =30V, V <sub>GS</sub> =10V, I <sub>D</sub> =0.2A                       |  | 1.1  |  | nC |
| Q <sub>gs</sub>     | Gate-Source Charge <sup>2,3</sup>  |  |  | 0.1  |  |    |
| Q <sub>gd</sub>     | Gate-Drain Charge <sup>2,3</sup>   |  |  | 0.23 |  |    |
| T <sub>d(on)</sub>  | Turn-On Delay Time <sup>2,3</sup>  | V <sub>DD</sub> =30V, V <sub>GS</sub> =10V, R <sub>G</sub> =6Ω<br>I <sub>D</sub> =0.2A |  | 3    |  | ns |
| T <sub>r</sub>      | Rise Time <sup>2,3</sup>           |  |  | 5    |  |    |
| T <sub>d(off)</sub> | Turn-Off Delay Time <sup>2,3</sup> |  |  | 14   |  |    |
| T <sub>f</sub>      | Fall Time <sup>2,3</sup>           |  |  | 9    |  |    |
| C <sub>iss</sub>    | Input Capacitance                  | V <sub>DS</sub> =10V, V <sub>GS</sub> =0V, F=1MHz                                      |  | 30.6 |  | pF |
| C <sub>oss</sub>    | Output Capacitance                 |  |  | 5.5  |  |    |
| C <sub>rss</sub>    | Reverse Transfer Capacitance       |  |  | 4    |  |    |

**Drain-Source Diode Characteristics and Maximum Ratings**

| Symbol          | Parameter                 | Conditions  | Min. | Typ. | Max. | Unit |
|-----------------|---------------------------|---|------|------|------|------|
| I <sub>S</sub>  | Continuous Source Current | V <sub>G</sub> =V <sub>D</sub> =0V, Force Current             |      |      | 0.3  | A    |
| I <sub>SM</sub> | Pulsed Source Current     |   |      |      | 1.2  | A    |
| V <sub>SD</sub> | Diode Forward Voltage     | V <sub>GS</sub> =0V, I <sub>S</sub> =1A, T <sub>J</sub> =25°C |      |      | 1    | V    |

Note :

1. Repetitive Rating : Pulsed width limited by maximum junction temperature.
2. V<sub>DD</sub>=25V, V<sub>GS</sub>=10V, L=1mH, I<sub>AS</sub>=7A., R<sub>G</sub>=25Ω, Starting T<sub>J</sub>=25°C
3. The data tested by pulsed, pulse width ≤ 300us, duty cycle ≤ 2%.
4. Essentially independent of operating temperature.

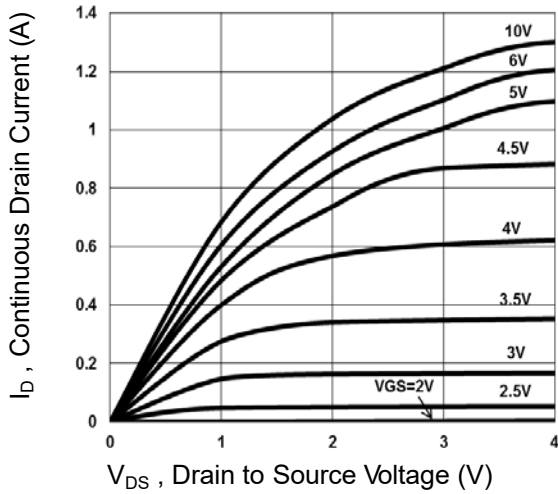


Fig.1 Output Characteristics

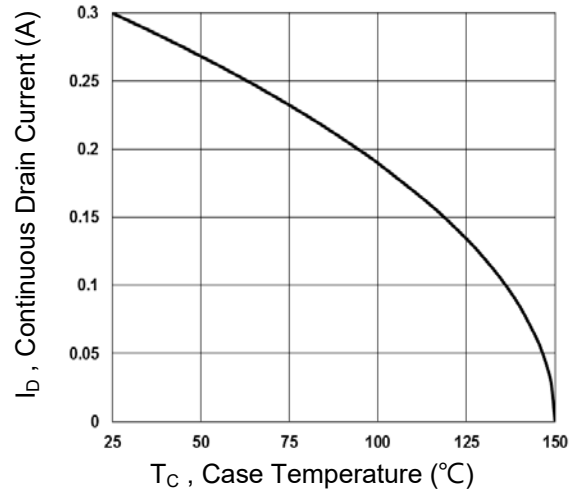


Fig.2 Continuous Drain Current vs.  $T_C$

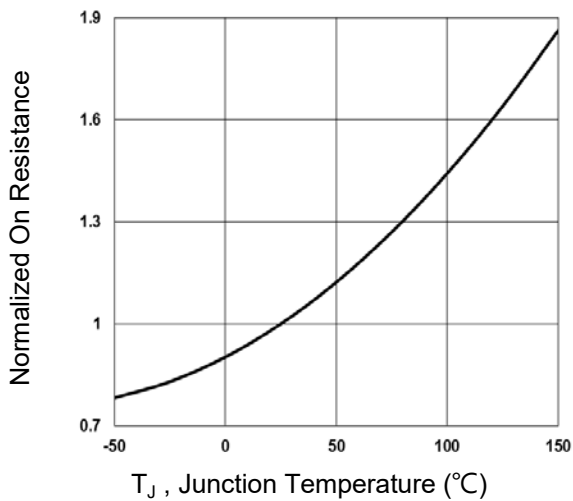


Fig.3 Normalized  $R_{DS(on)}$  vs.  $T_J$

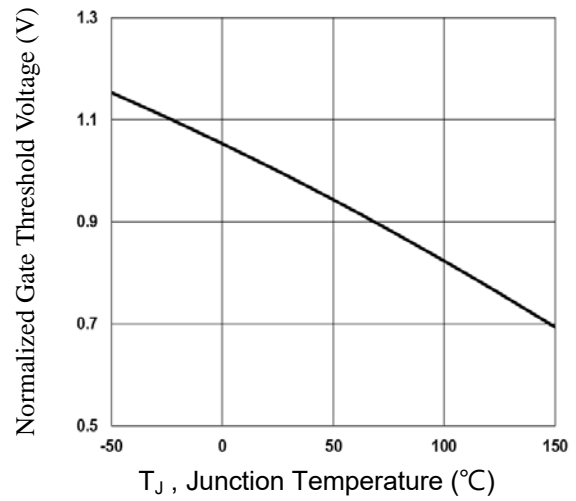


Fig.4 Normalized  $V_{th}$  vs.  $T_J$

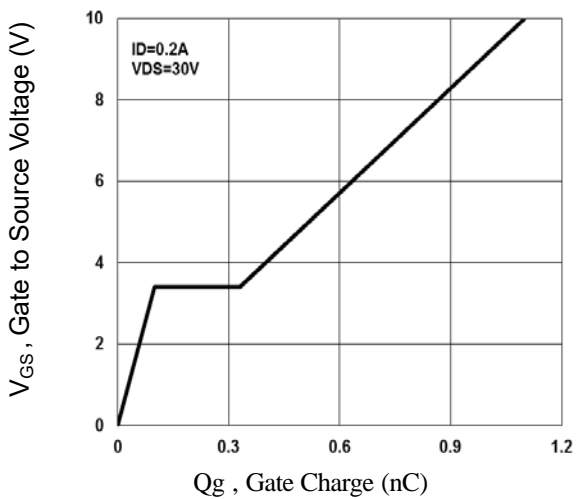


Fig.5 Gate Charge Waveform

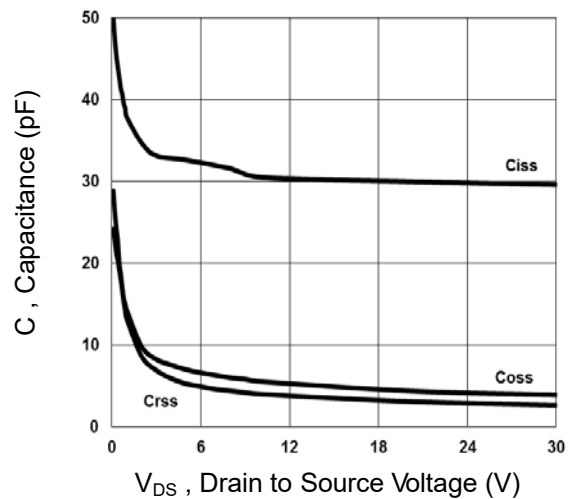


Fig.6 Capacitance Characteristics

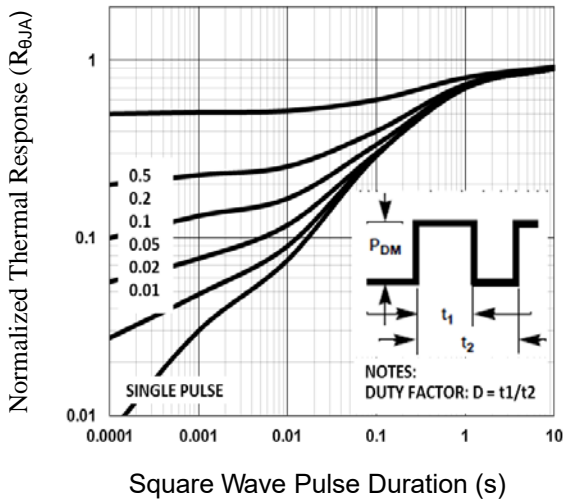


Fig.7 Normalized Transient Impedance

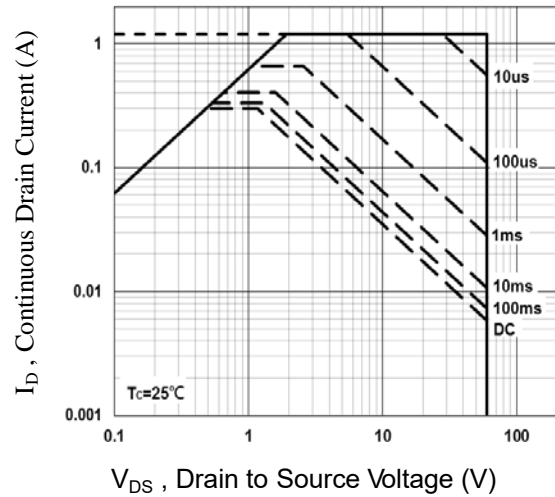


Fig.8 Maximum Safe Operation Area

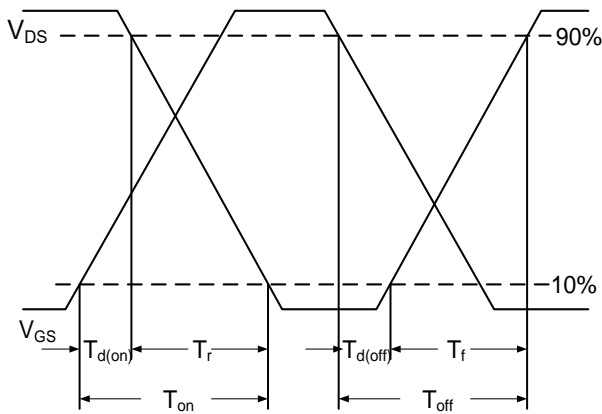


Fig.9 Switching Time Waveform

$$EAS = \frac{1}{2} L \times I_{AS}^2 \times \frac{BV_{DSS}}{BV_{DSS} - V_{DD}}$$

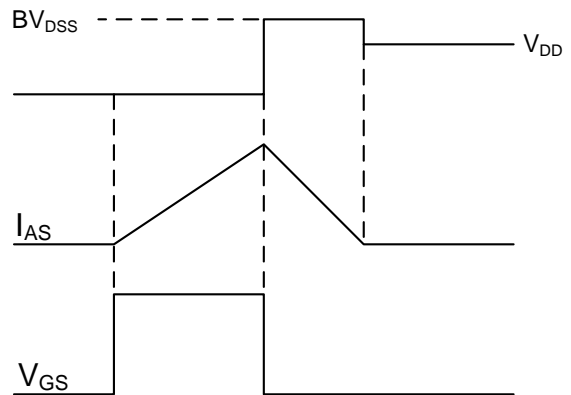
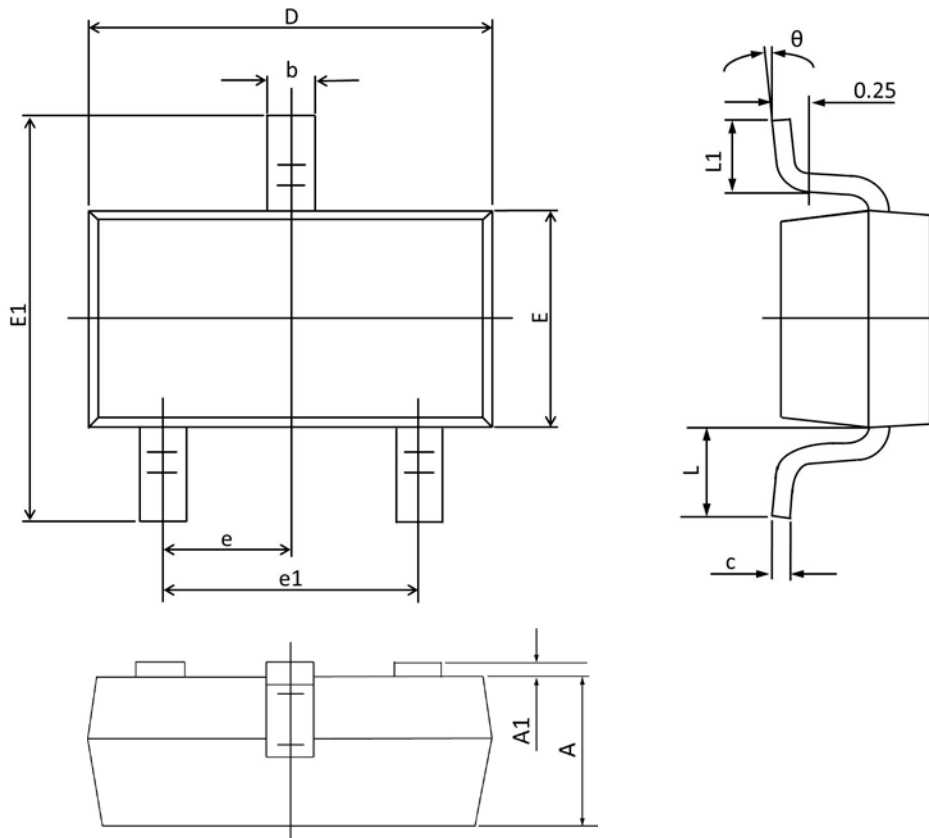


Fig.10 EAS Waveform

## SOT-23 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°    |