

## 60V Dual N-Channel MOSFET

### Description:

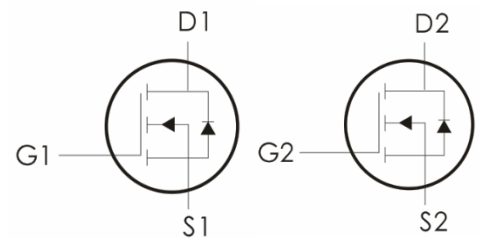
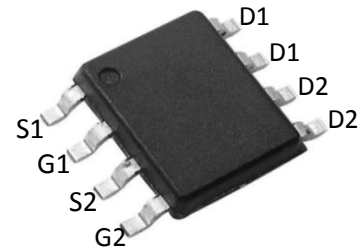
This Dual N-Channel MOSFET uses advanced trench technology and design to provide excellent  $R_{DS(on)}$  with low gate charge.

It can be used in a wide variety of applications.

### Features:

- 1)  $V_{DS}=60V, I_D=5A, R_{DS(on)} < 36m\Omega @ V_{GS}=10V$
- 2) Low gate charge.
- 3) Green device available.
- 4) Advanced high cell density trench technology for ultra low  $R_{DS(on)}$ .
- 5) Excellent package for good heat dissipation.

SOP-8



### Absolute Maximum Ratings: ( $T_a=25^\circ\text{C}$ unless otherwise noted)

| Symbol         | Parameter                                           | Ratings     | Units            |
|----------------|-----------------------------------------------------|-------------|------------------|
| $V_{DS}$       | Drain-Source Voltage                                | 60          | V                |
| $V_{GS}$       | Gate-Source Voltage                                 | $\pm 20$    | V                |
| $I_D$          | Continuous Drain Current - $T_A=25^\circ\text{C}^1$ | 5           | A                |
|                | Continuous Drain Current - $T_A=70^\circ\text{C}^1$ | 3.5         |                  |
| $I_{DM}$       | Drain Current-Pulsed <sup>2</sup>                   | 18          | A                |
| $E_{AS}$       | Single Pulse Avalanche Energy <sup>3</sup>          | 22          | mJ               |
| $I_{AS}$       | Avalanche Current                                   | 21          | A                |
| $P_D$          | Power Dissipation <sup>4</sup>                      | 1.5         | W                |
| $T_J, T_{STG}$ | Operating and Storage Junction Temperature Range    | -55 to +150 | $^\circ\text{C}$ |

### Thermal Characteristics:

| Symbol          | Parameter                                            | Max | Units                     |
|-----------------|------------------------------------------------------|-----|---------------------------|
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient <sup>1</sup> | 85  | $^\circ\text{C}/\text{W}$ |
| $R_{\theta JC}$ | Thermal Resistance Junction-Case <sup>1</sup>        | 25  | $^\circ\text{C}/\text{W}$ |

## Electrical Characteristics: ( $T_C=25^{\circ}\text{C}$ unless otherwise noted)

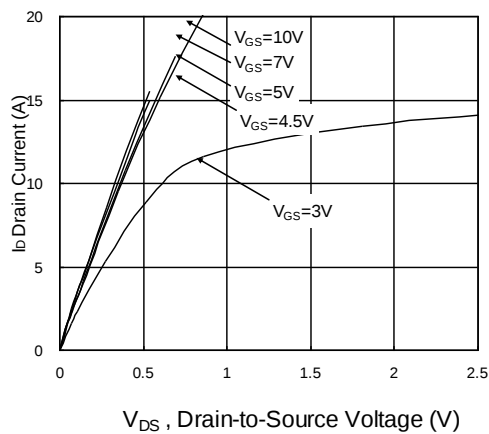
| Symbol                    | Parameter                        | Conditions                                                                                    | Min | Typ  | Max   | Units |
|---------------------------|----------------------------------|-----------------------------------------------------------------------------------------------|-----|------|-------|-------|
| Off Characteristics       |                                  |                                                                                               |     |      |       |       |
| BV <sub>DSS</sub>         | Drain-Sourctce Breakdown Voltage | V <sub>GS</sub> =0V, I <sub>D</sub> =250 μ A                                                  | 60  | ---  | ---   | V     |
| I <sub>DSS</sub>          | Zero Gate Voltage Drain Current  | V <sub>GS</sub> =0V, V <sub>DS</sub> =48V, T <sub>J</sub> =25 °C                              | --- | ---  | 1     | μ A   |
|                           |                                  | V <sub>GS</sub> =0V, V <sub>DS</sub> =48V, T <sub>J</sub> =55 °C                              | --- | ---  | 5     | μ A   |
| I <sub>GSS</sub>          | Gate-Source Leakage Current      | V <sub>GS</sub> = ± 20V, V <sub>DS</sub> =0A                                                  | --- | ---  | ± 100 | nA    |
| On Characteristics        |                                  |                                                                                               |     |      |       |       |
| V <sub>GS(th)</sub>       | GATE-Source Threshold Voltage    | V <sub>GS</sub> =V <sub>DS</sub> , I <sub>D</sub> =250 μ A                                    | 1   | ---  | 2.5   | V     |
| R <sub>DS(ON)</sub>       | Drain-Source On Resistance       | V <sub>GS</sub> =10V, I <sub>D</sub> =4A                                                      | --- | 30   | 36    | m Ω   |
|                           |                                  | V <sub>GS</sub> =4.5V, I <sub>D</sub> =3A                                                     | --- | 34   | 45    |       |
| G <sub>FS</sub>           | Forward Transconductance         | V <sub>DS</sub> =5V, I <sub>D</sub> =4A                                                       | --- | 28.3 | ---   | S     |
| Dynamic Characteristics   |                                  |                                                                                               |     |      |       |       |
| C <sub>iss</sub>          | Input Capacitance                | V <sub>DS</sub> =15V, V <sub>GS</sub> =0V, f=1MHz                                             | --- | 1020 | ---   | pF    |
| C <sub>oss</sub>          | Output Capacitance               |                                                                                               | --- | 60   | ---   |       |
| C <sub>rss</sub>          | Reverse Transfer Capacitance     |                                                                                               | --- | 45   | ---   |       |
| Switching Characteristics |                                  |                                                                                               |     |      |       |       |
| t <sub>d(on)</sub>        | Turn-On Delay Time               | V <sub>DD</sub> =30V, I <sub>D</sub> =4A<br><br>R <sub>G</sub> =3.3 Ω . V <sub>GS</sub> =10V, | --- | 3    | ---   | ns    |
| t <sub>r</sub>            | Rise Time                        |                                                                                               | --- | 34   | ---   | ns    |
| t <sub>d(off)</sub>       | Turn-Off Delay Time              |                                                                                               | --- | 23   | ---   | ns    |
| t <sub>f</sub>            | Fall Time                        |                                                                                               | --- | 6    | ---   | ns    |
| Q <sub>g</sub>            | Total Gate Charge                | V <sub>GS</sub> =10V, V <sub>DS</sub> =48V, I <sub>D</sub>                                    | --- | 19   | ---   | nC    |
| Q <sub>gs</sub>           | Gate-Source Charge               | =4A                                                                                           | --- | 2.6  | ---   | nC    |

|                                           |                                                 |                                                               |     |      |     |    |
|-------------------------------------------|-------------------------------------------------|---------------------------------------------------------------|-----|------|-----|----|
| <b>Q<sub>gd</sub></b>                     | Gate-Drain "Miller" Charge                      |                                                               | --- | 4.1  | --- | nC |
| <b>R<sub>G</sub></b>                      | Gate Resistance                                 | V <sub>DS</sub> =0V, V <sub>GS</sub> =0V, f=1MHz              | --- | 2.5  | --- | Ω  |
| <b>Drain-Source Diode Characteristics</b> |                                                 |                                                               |     |      |     |    |
| <b>V<sub>SD</sub></b>                     | Source-Drain Diode Forward Voltage <sup>2</sup> | V <sub>GS</sub> =0V, I <sub>S</sub> =1A, T <sub>J</sub> =25°C | --- | ---  | 1.2 | V  |
| <b>I<sub>S</sub></b>                      | Continuous Source Current <sup>1,5</sup>        | V <sub>G</sub> =V <sub>D</sub> =0V, Force Current             | --- | ---  | 4.5 | A  |
| <b>I<sub>SM</sub></b>                     | Pulsed Source Current <sup>2,5</sup>            |                                                               | --- | ---  | 18  | A  |
| <b>T<sub>rr</sub></b>                     | Reverse Recovery Time                           | I <sub>F</sub> =4A, dI/dt=100A/μs, T <sub>J</sub> =25°C       | --- | 12.1 | --- | ns |
| <b>Q<sub>rr</sub></b>                     | Reverse Recovery Charge                         |                                                               | --- | 6.7  | --- | nC |

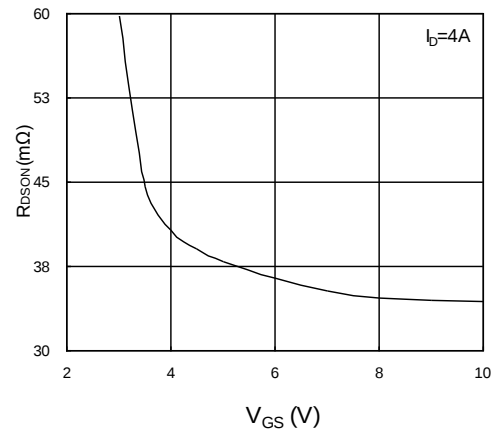
## Notes:

1. The data tested by surface mounted on a 1 inch<sup>2</sup> FR-4 board with 2OZ copper.
2. The data tested by pulsed, pulse width ≤ 300us, duty cycle ≤ 2%
3. The EAS data shows Max. rating. The test condition is V<sub>DD</sub>=25V, V<sub>GS</sub>=10V, L=0.1mH, I<sub>AS</sub>=21A
4. The power dissipation is limited by 150°C junction temperature
5. The data is theoretically the same as I<sub>D</sub> and I<sub>DM</sub>, in real applications, should be limited by total power dissipation.

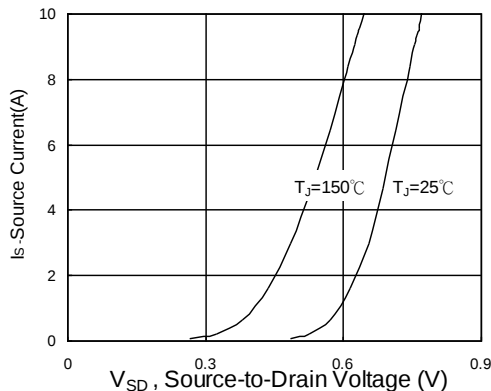
## Typical Characteristics: (T<sub>C</sub>=25°C unless otherwise noted)



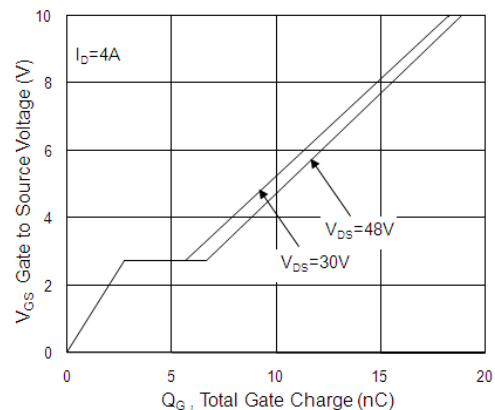
**Fig.1 Typical Output Characteristics**



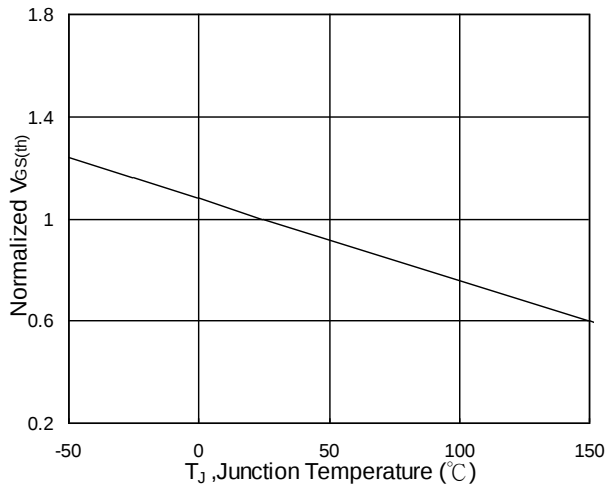
**Fig.2 On Resistance vs. Gate-Source**



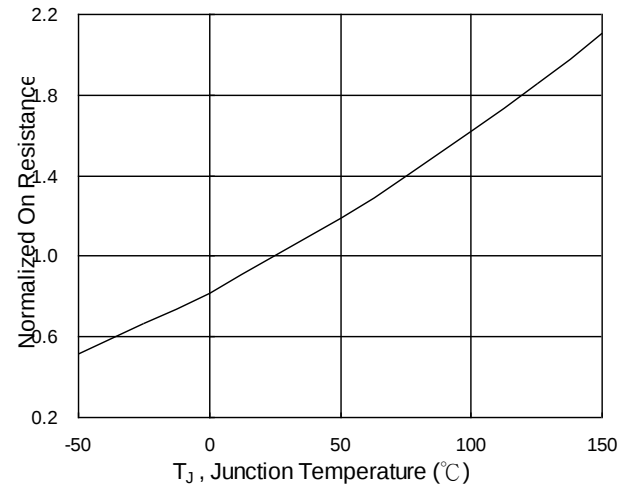
**Fig.3 Forward Characteristics Of Reverse**



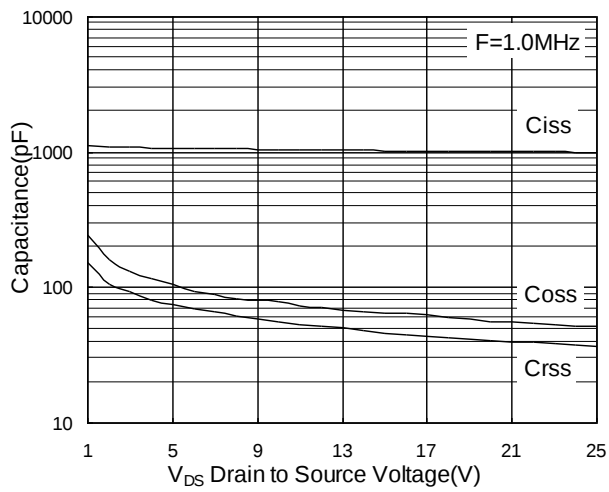
**Fig.4 Gate-Charge Characteristics**



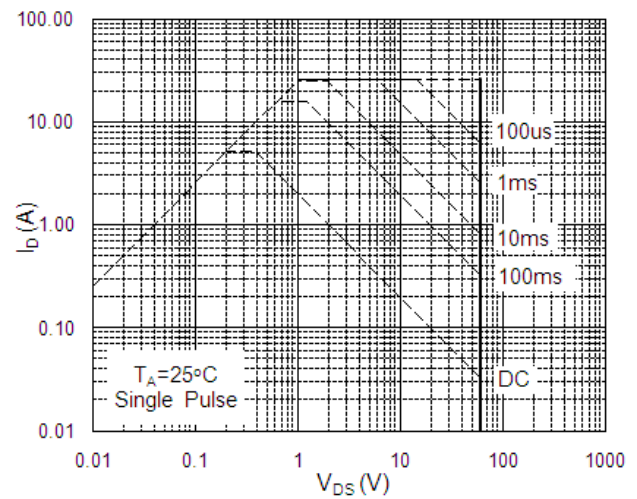
**Fig.5 Normalized  $V_{GS(th)}$  vs.  $T_J$**



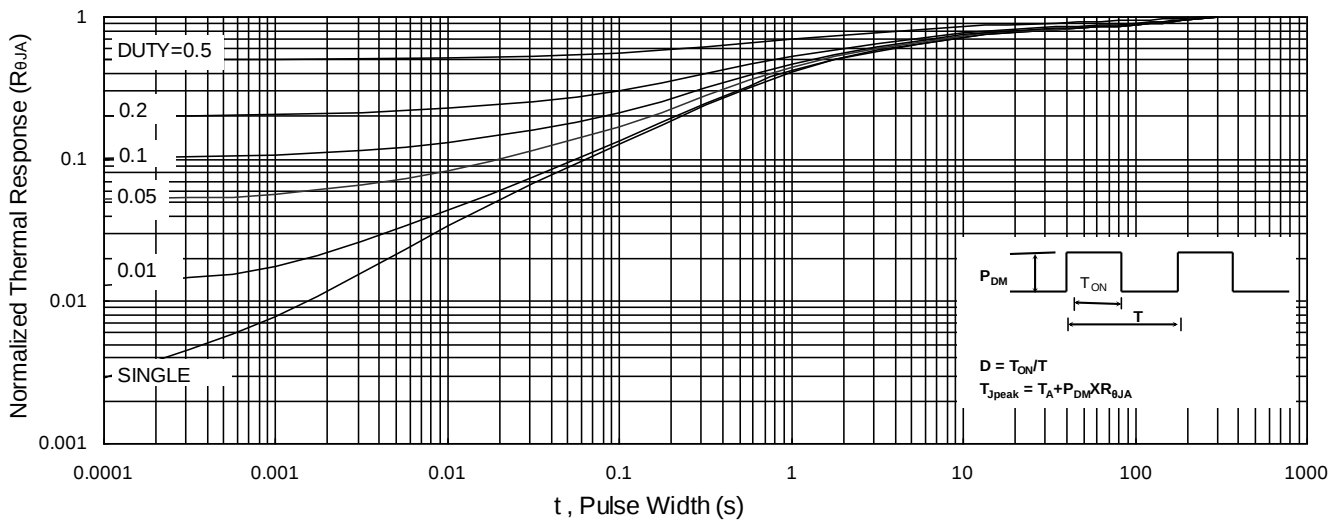
**Fig.6 Normalized  $R_{DS(on)}$  vs.  $T_J$**



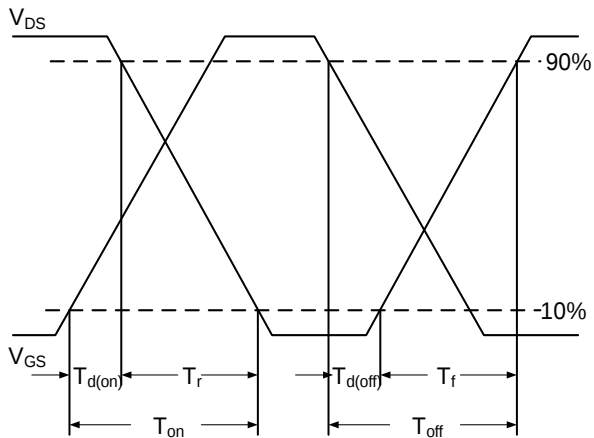
**Fig.7 Capacitance**



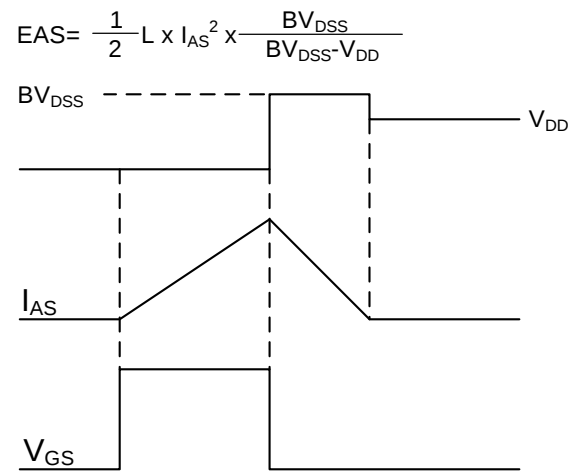
**Fig.8 Safe Operating Area**



**Fig.9 Normalized Maximum Transient Thermal Impedance**

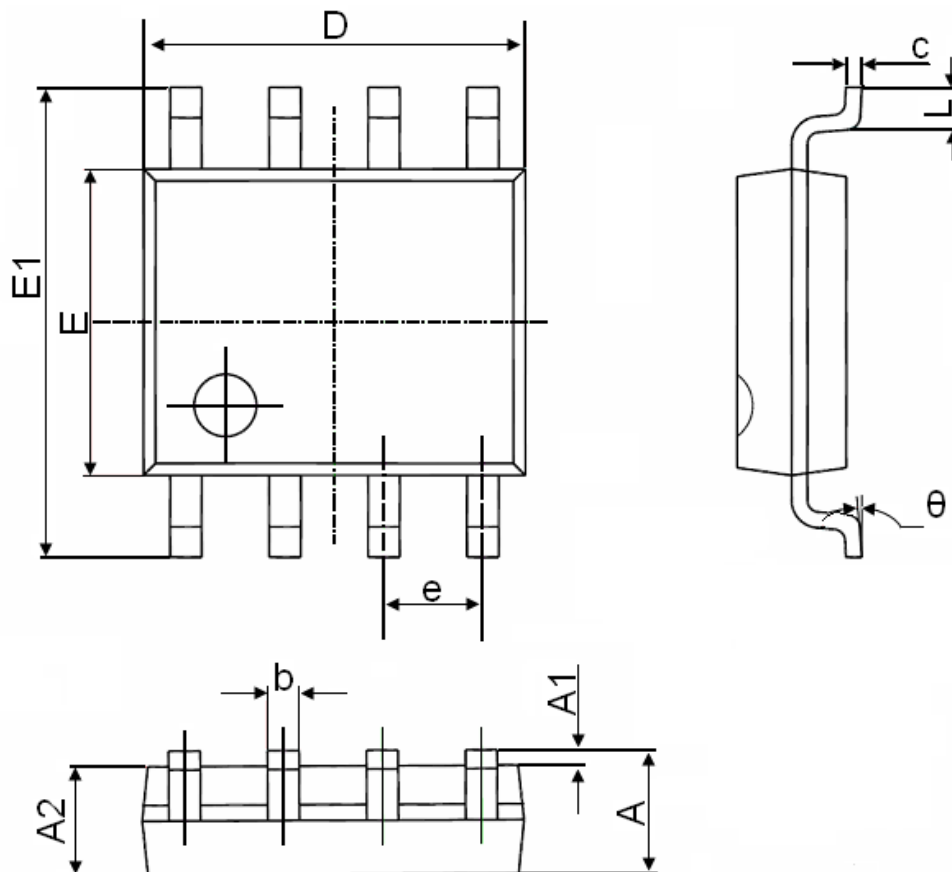


**Fig.10 Switching Time Waveform**



**Fig.11 Unclamped Inductive Switching Waveform**

## SOP-8 Package Information



| Symbol   | Dimensions In Millimeters |       | Dimensions In Inches |       |
|----------|---------------------------|-------|----------------------|-------|
|          | Min.                      | Max.  | Min.                 | Max.  |
| A        | 1.350                     | 1.750 | 0.053                | 0.069 |
| A1       | 0.100                     | 0.250 | 0.004                | 0.010 |
| A2       | 1.350                     | 1.550 | 0.053                | 0.061 |
| b        | 0.330                     | 0.510 | 0.013                | 0.020 |
| c        | 0.170                     | 0.250 | 0.006                | 0.010 |
| D        | 4.700                     | 5.100 | 0.185                | 0.200 |
| E        | 3.800                     | 4.000 | 0.150                | 0.157 |
| E1       | 5.800                     | 6.200 | 0.228                | 0.244 |
| e        | 1.270(BSC)                |       | 0.050(BSC)           |       |
| L        | 0.400                     | 1.270 | 0.016                | 0.050 |
| $\theta$ | 0°                        | 8°    | 0°                   | 8°    |