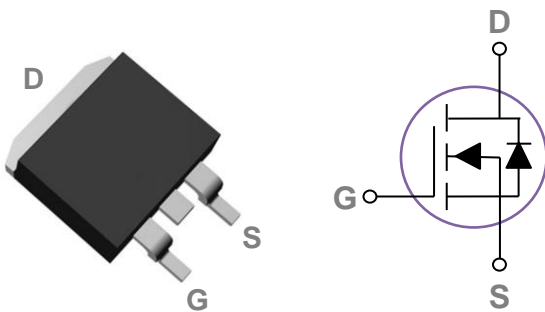


### General Description

These N-Channel enhancement mode power field effect transistors are using super junction MOS 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.

### TO263 Pin Configuration



|       |       |     |
|-------|-------|-----|
| BVDSS | RDSON | ID  |
| 650V  | 320mΩ | 14A |

### Features

- 650V, 14A,  $R_{DS(ON)} = 320m\Omega @ V_{GS} = 10V$
- Improved  $dv/dt$  capability
- Fast switching
- 100% EAS Guaranteed
- Green Device Available

### Applications

- PFC Power Supply Stages
- Motor Control
- DC-DC Converters
- Adapter

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

| Symbol    | Parameter  | Rating     | Units               |
|-----------|--|------------|---------------------|
| $V_{DS}$  | Drain-Source Voltage                                   | 650        | V                   |
| $V_{GS}$  | Gate-Source Voltage                                    | $\pm 30$   | V                   |
| $I_D$     | Drain Current – Continuous ( $T_c=25^\circ\text{C}$ )  | 14         | A                   |
|           | Drain Current – Continuous ( $T_c=100^\circ\text{C}$ ) | 8.8        | A                   |
| $I_{DM}$  | Drain Current – Pulsed <sup>1</sup>                    | 56         | A                   |
| EAS       | Single Pulse Avalanche Energy <sup>2</sup>             | 290        | mJ                  |
| $P_D$     | Power Dissipation ( $T_c=25^\circ\text{C}$ )           | 114        | W                   |
|           | Power Dissipation – Derate above $25^\circ\text{C}$    | 0.91       | W/ $^\circ\text{C}$ |
| $T_{STG}$ | Storage Temperature Range                              | -55 to 150 | $^\circ\text{C}$    |
| $T_J$     | Operating Junction Temperature Range                   | -55 to 150 | $^\circ\text{C}$    |

### Thermal Characteristics

| Symbol          | Parameter                              | Typ. | Max. | Unit                      |
|-----------------|--|------|------|---------------------------|
| $R_{\theta JA}$ | Thermal Resistance Junction to ambient | ---  | 62   | $^\circ\text{C}/\text{W}$ |
| $R_{\theta JC}$ | Thermal Resistance Junction to Case    | ---  | 1.1  | $^\circ\text{C}/\text{W}$ |

**Electrical Characteristics ( $T_J=25^\circ\text{C}$ , unless otherwise noted)**
**Off Characteristics**

| Symbol    | Parameter                      | Conditions                                      | Min. | Typ. | Max.      | Unit          |
|-----------|--------------------------------|---|------|------|-----------|---------------|
| $BV_{DS}$ | Drain-Source Breakdown Voltage | $V_{GS}=0V, I_D=1mA$                            | 650  | ---  | ---       | V             |
| $I_{DSS}$ | Drain-Source Leakage Current   | $V_{DS}=650V, V_{GS}=0V, T_J=25^\circ\text{C}$  | ---  | ---  | 1         | $\mu\text{A}$ |
|           |                                | $V_{DS}=520V, V_{GS}=0V, T_J=100^\circ\text{C}$ | ---  | ---  | 10        | $\mu\text{A}$ |
| $I_{GSS}$ | Gate-Source Leakage Current    | $V_{GS}=\pm 30V, V_{DS}=0V$                     | ---  | ---  | $\pm 100$ | nA            |

**On Characteristics**

| Symbol       | Parameter                         | Conditions                          | Min. | Typ. | Max. | Unit             |
|--------------|-----------------------------------|-------------------------------------|------|------|------|------------------|
| $R_{DS(ON)}$ | Static Drain-Source On-Resistance | $V_{GS}=10V, I_D=6A$                | ---  | 270  | 320  | $\text{m}\Omega$ |
| $V_{GS(th)}$ | Gate Threshold Voltage            | $V_{GS}=V_{DS}, I_D=250\mu\text{A}$ | 2    | 3    | 4    | V                |

**Dynamic and switching Characteristics**

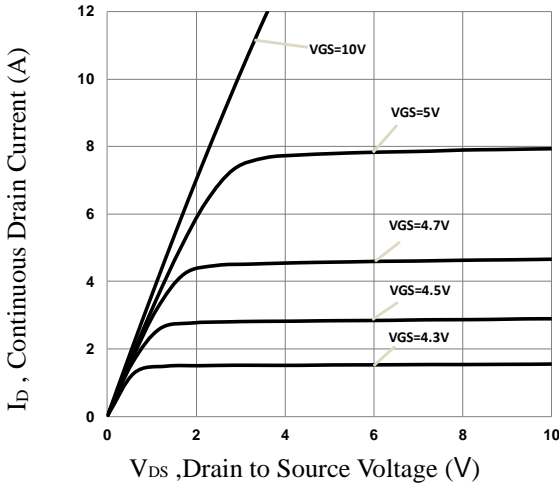
| Symbol       | Parameter                           | Conditions                                       | Min. | Typ. | Max. | Unit     |
|--------------|-------------------------------------|--|------|------|------|----------|
| $Q_g$        | Total Gate Charge <sup>3, 4</sup>   | $V_{DS}=350V, V_{GS}=10V, I_D=14A$               | ---  | 26   | 40   | nC       |
| $Q_{gs}$     | Gate-Source Charge <sup>3, 4</sup>  |  | ---  | 5    | 8    |          |
| $Q_{gd}$     | Gate-Drain Charge <sup>3, 4</sup>   |  | ---  | 18   | 26   |          |
| $T_{d(on)}$  | Turn-On Delay Time <sup>3, 4</sup>  | $V_{DS}=350V, V_{GS}=10V, R_G=25\Omega, I_D=14A$ | ---  | 20   | 30   | ns       |
| $T_r$        | Rise Time <sup>3, 4</sup>           |  | ---  | 43   | 65   |          |
| $T_{d(off)}$ | Turn-Off Delay Time <sup>3, 4</sup> |  | ---  | 91   | 137  |          |
| $T_f$        | Fall Time <sup>3, 4</sup>           |  | ---  | 42   | 63   |          |
| $C_{iss}$    | Input Capacitance                   | $V_{DS}=350V, V_{GS}=0V, F=1\text{MHz}$          | ---  | 910  | 1360 | pF       |
| $C_{oss}$    | Output Capacitance                  |  | ---  | 28   | 45   |          |
| $C_{rss}$    | Reverse Transfer Capacitance        |  | ---  | 2.4  | 5    |          |
| $R_g$        | Gate resistance                     | $V_{GS}=0V, V_{DS}=0V, F=1\text{MHz}$            | ---  | 7    | ---  | $\Omega$ |

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

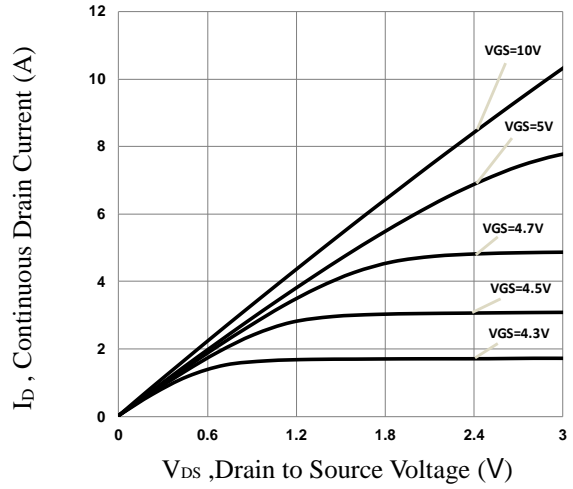
| Symbol   | Parameter                 | Conditions                                     | Min. | Typ. | Max. | Unit          |
|----------|---------------------------|--|------|------|------|---------------|
| $I_S$    | Continuous Source Current | $V_G=V_D=0V, \text{Force Current}$             | ---  | ---  | 14   | A             |
| $I_{SM}$ | Pulsed Source Current     |  | ---  | ---  | 28   | A             |
| $V_{SD}$ | Diode Forward Voltage     | $V_{GS}=0V, I_S=1A, T_J=25^\circ\text{C}$      | ---  | ---  | 1.2  | V             |
| $t_{rr}$ | Reverse Recovery Time     | $V_R=400V, I_S=10A$                            | ---  | 330  | ---  | ns            |
| $Q_{rr}$ | Reverse Recovery Charge   | $di/dt=100A/\mu\text{s}, T_J=25^\circ\text{C}$ | ---  | 4.1  | ---  | $\mu\text{C}$ |

Note :

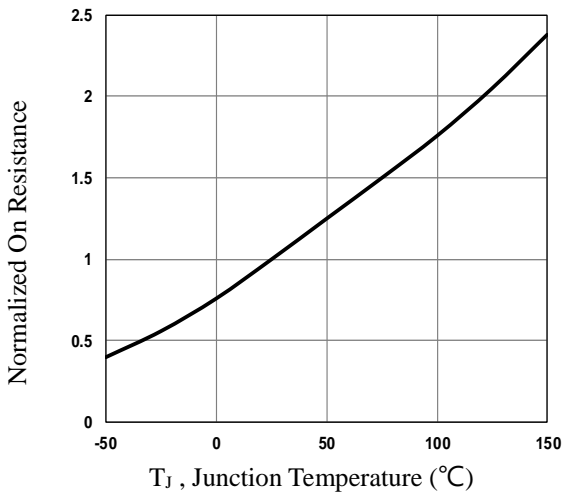
1. Repetitive Rating : Pulsed width limited by maximum junction temperature.
2. The data tested by pulsed , pulse width  $\leq 300\mu\text{s}$  , duty cycle  $\leq 2\%$ .
3. Essentially independent of operating temperature.



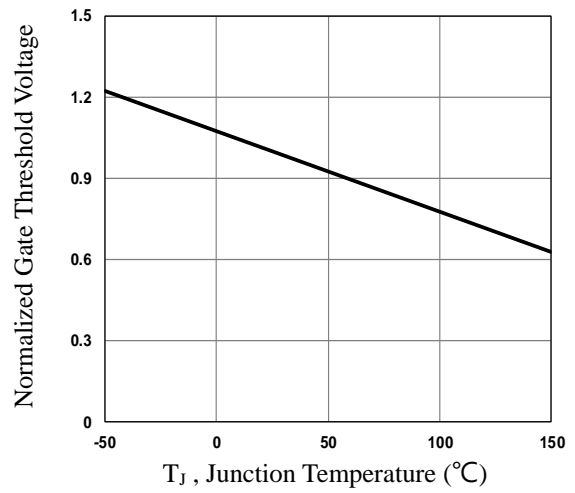
**Fig.1 Typical Output Characteristics**



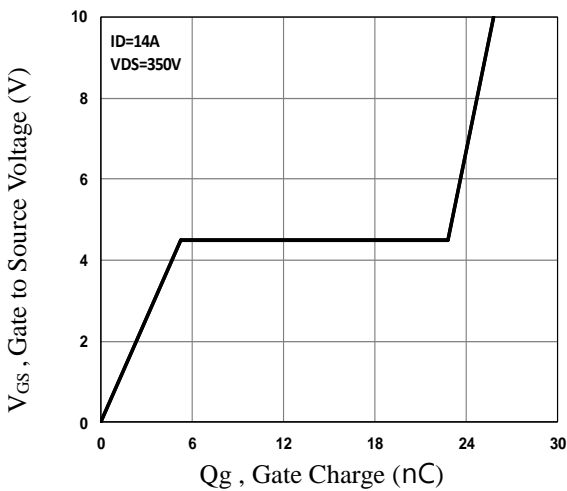
**Fig.2 Typical Output Characteristics**



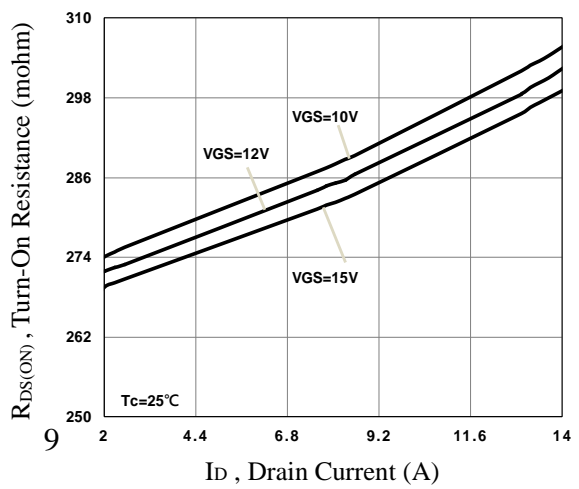
**Fig.3 Normalized  $R_{DS(on)}$  vs.  $T_J$**



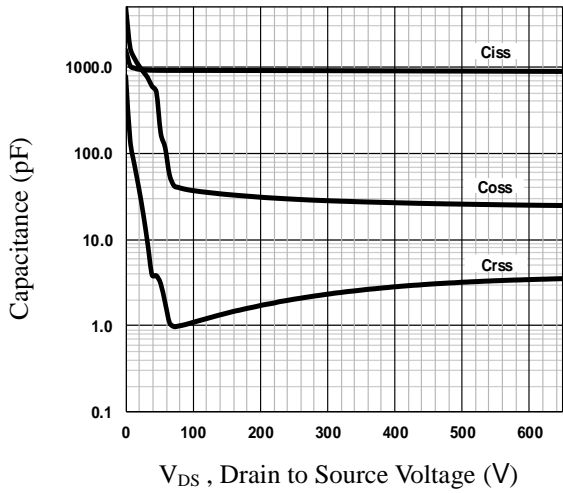
**Fig.4 Normalized  $V_{th}$  vs.  $T_J$**



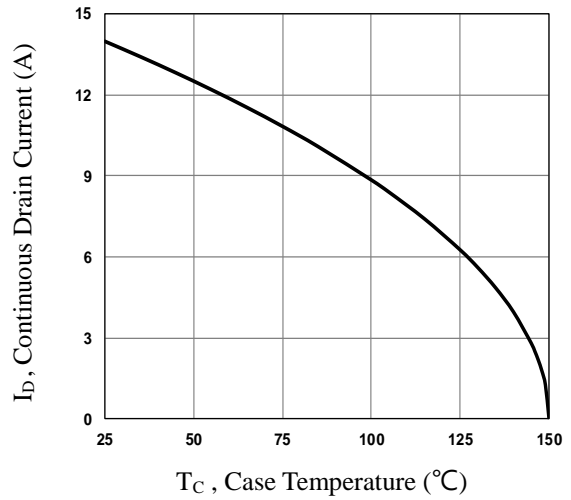
**Fig.5 Gate Charge Characteristics**



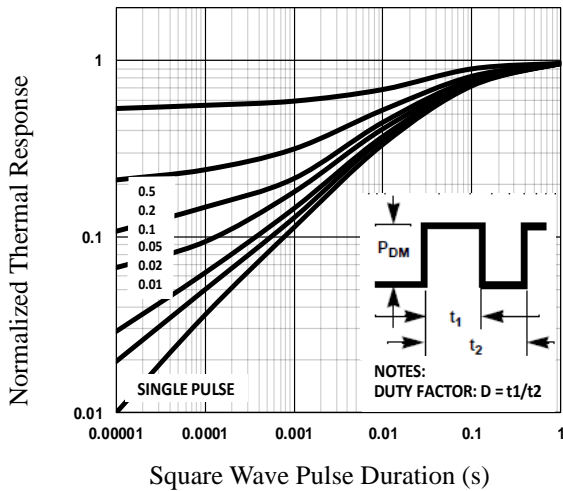
**Fig.6 Turn-On Resistance vs.  $I_D$**



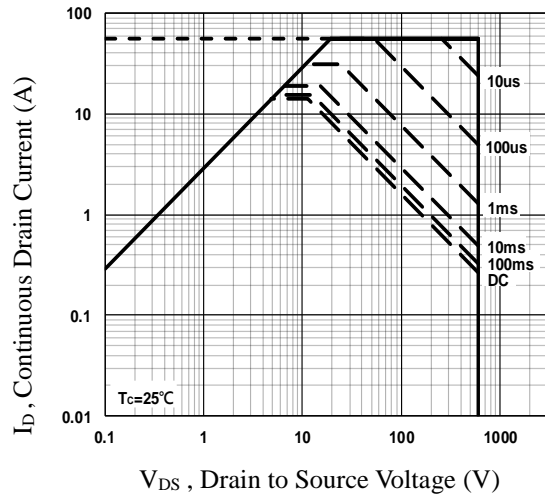
**Fig.7 Capacitance Characteristics**



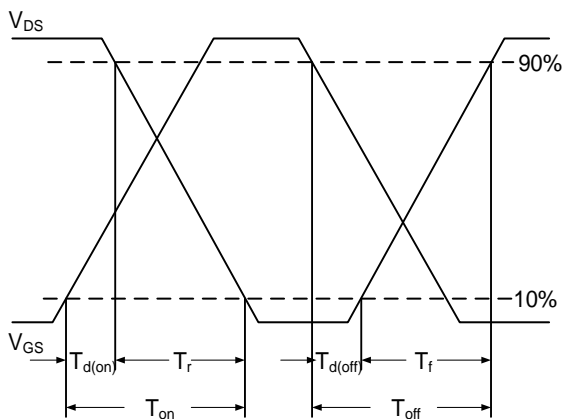
**Fig.8 Continuous Drain Current vs. T<sub>c</sub>**



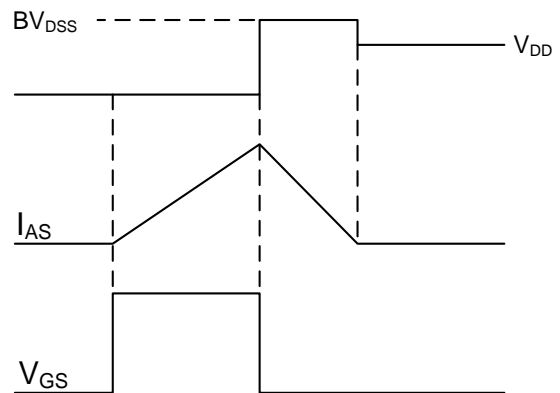
**Fig.9 Normalized Transient Impedance**



**Fig.10 Maximum Safe Operation Area**

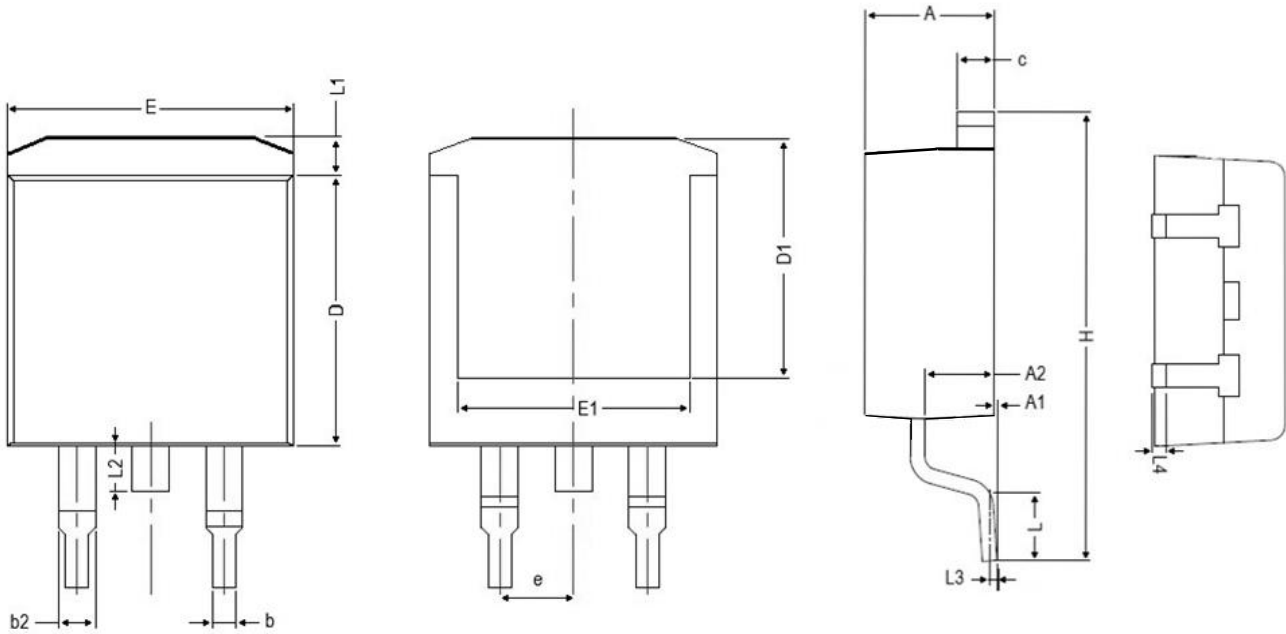


**Fig.11 Switching Time Waveform**



**Fig.12 EAS Waveform**

**TO263 PACKAGE INFORMATION**



| Symbol | Dimensions In Millimeters |        | Dimensions In Inches |       |
|--------|---------------------------|--------|----------------------|-------|
|        | MAX                       | MIN    | MAX                  | MIN   |
| A      | 4.850                     | 4.200  | 0.191                | 0.165 |
| A1     | 0.300                     | 0.000  | 0.012                | 0.000 |
| A2     | 2.900                     | 2.200  | 0.114                | 0.087 |
| b      | 0.950                     | 0.700  | 0.037                | 0.028 |
| b2     | 1.700                     | 1.000  | 0.067                | 0.039 |
| c      | 1.450                     | 1.150  | 0.057                | 0.045 |
| D      | 9.500                     | 8.350  | 0.374                | 0.329 |
| D1     | 9.150                     | 6.400  | 0.360                | 0.252 |
| E      | 10.500                    | 9.600  | 0.413                | 0.378 |
| E1     | 8.900                     | 6.850  | 0.350                | 0.270 |
| e      | 2.540 BSC                 |        | 0.100 BSC            |       |
| H      | 15.900                    | 14.600 | 0.626                | 0.575 |
| L      | 2.800                     | 1.700  | 0.110                | 0.067 |
| L1     | 1.700                     | 1.050  | 0.067                | 0.041 |
| L2     | 2.100                     | 1.300  | 0.083                | 0.051 |
| L3     | 0.250 BSC                 |        | 0.010 BSC            |       |
| L4     | 0.750                     | 0.200  | 0.030                | 0.008 |