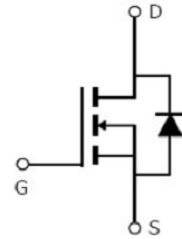


**Main Product Characteristics:**

|              |                   |
|--------------|-------------------|
| $V_{DS}$     | 40V               |
| $R_{DS(on)}$ | 3mohm(typ.)       |
| $I_D$        | 180A <sup>⑥</sup> |


**TO220**

**Marking and pin  
Assignment**

**Schematic diagram**
**Features and Benefits:**

- Advanced MOSFET process technology
- Special designed for PWM, load switching and general purpose applications
- Ultra low on-resistance with low gate charge
- Fast switching and reverse body recovery
- 175°C operating temperature


**Description:**

It utilizes the latest processing techniques to achieve the high cell density and reduces the on-resistance with high repetitive avalanche rating. These features combine to make this design an extremely efficient and reliable device for use in power switching application and a wide variety of other applications.

**Absolute max Rating:**

| Symbol             | Parameter                                             | Max.             | Units |
|--------------------|-------------------------------------------------------|------------------|-------|
| $I_D$ @ TC = 25°C  | Continuous Drain Current, $V_{GS}$ @ 10V <sup>①</sup> | 180 <sup>⑥</sup> | A     |
| $I_D$ @ TC = 100°C | Continuous Drain Current, $V_{GS}$ @ 10V <sup>①</sup> | 120 <sup>⑥</sup> |       |
| $I_{DM}$           | Pulsed Drain Current <sup>②</sup>                     | 720              |       |
| $P_D$ @TC = 25°C   | Power Dissipation <sup>③</sup>                        | 200              | W     |
|                    | Linear Derating Factor                                | 1.3              | W/°C  |
| $V_{DS}$           | Drain-Source Voltage                                  | 40               | V     |
| $V_{GS}$           | Gate-to-Source Voltage                                | ± 20             | V     |
| $E_{AS}$           | Single Pulse Avalanche Energy @ L=0.11mH              | 550              | mJ    |
| $I_{AS}$           | Avalanche Current @ L=0.11mH                          | 100              | A     |
| $T_J$ $T_{STG}$    | Operating Junction and Storage Temperature Range      | -55 to + 175     | °C    |

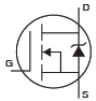
## Thermal Resistance

| Symbol          | Characterizes                                                | Typ. | Max. | Units |
|-----------------|--------------------------------------------------------------|------|------|-------|
| $R_{\theta JC}$ | Junction-to-case <sup>③</sup>                                | —    | 0.75 | °C/W  |
| $R_{\theta JA}$ | Junction-to-ambient ( $t \leq 10s$ ) <sup>④</sup>            | —    | 62   | °C/W  |
|                 | Junction-to-Ambient (PCB mounted, steady-state) <sup>④</sup> | —    | 40   | °C/W  |

## Electrical Characterizes @ $T_A=25^\circ\text{C}$ unless otherwise specified

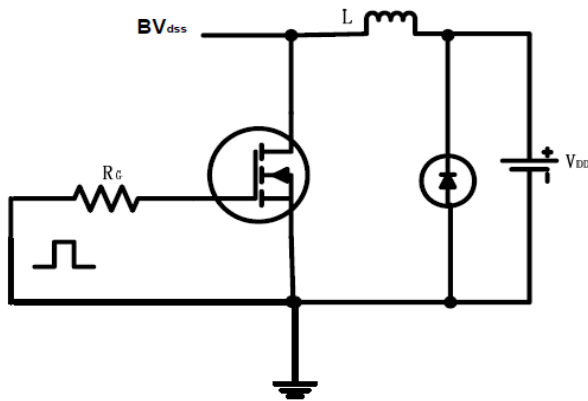
| Symbol        | Parameter                            | Min. | Typ.  | Max. | Units | Conditions                                                                              |
|---------------|--------------------------------------|------|-------|------|-------|-----------------------------------------------------------------------------------------|
| $V_{(BR)DSS}$ | Drain-to-Source breakdown voltage    | 40   | —     | —    | V     | $V_{GS} = 0V, I_D = 250\mu A$                                                           |
| $R_{DS(on)}$  | Static Drain-to-Source on-resistance | —    | 3     | 4    | mΩ    | $V_{GS}=10V, I_D = 75A$                                                                 |
|               |                                      | —    | 4.8   | —    |       | $T_J = 125^\circ\text{C}$                                                               |
| $V_{GS(th)}$  | Gate threshold voltage               | 2    | —     | 4    | V     | $V_{DS} = V_{GS}, I_D = 250\mu A$                                                       |
|               |                                      | —    | 2.2   | —    |       | $T_J = 125^\circ\text{C}$                                                               |
| $I_{DSS}$     | Drain-to-Source leakage current      | —    | —     | 1    | μA    | $V_{DS} = 40V, V_{GS} = 0V$                                                             |
|               |                                      | —    | —     | 50   |       | $T_J = 125^\circ\text{C}$                                                               |
| $I_{GSS}$     | Gate-to-Source forward leakage       | —    | —     | 100  | nA    | $V_{GS} = 20V$                                                                          |
|               |                                      | —    | —     | -100 |       | $V_{GS} = -20V$                                                                         |
| $Q_g$         | Total gate charge                    | —    | 124.4 | —    | nC    | $I_D = 75A,$<br>$V_{DS}=32V,$<br>$V_{GS} = 10V$                                         |
| $Q_{gs}$      | Gate-to-Source charge                | —    | 32.5  | —    |       |                                                                                         |
| $Q_{gd}$      | Gate-to-Drain("Miller") charge       | —    | 50.7  | —    |       |                                                                                         |
| $t_{d(on)}$   | Turn-on delay time                   | —    | 24.1  | —    | ns    | $V_{GS}=10V, V_{DS} = 16.5V,$<br>$R_L=0.22\Omega,$<br>$R_{GEN}=3\Omega,$<br>$I_D = 75A$ |
| $t_r$         | Rise time                            | —    | 107.7 | —    |       |                                                                                         |
| $t_{d(off)}$  | Turn-Off delay time                  | —    | 43.9  | —    |       |                                                                                         |
| $t_f$         | Fall time                            | —    | 26.6  | —    |       |                                                                                         |
| $C_{iss}$     | Input capacitance                    | —    | 6940  | —    | pF    | $V_{GS} = 0V,$<br>$V_{DS} = 25V,$<br>$f = 1\text{MHz}$                                  |
| $C_{oss}$     | Output capacitance                   | —    | 808   | —    |       |                                                                                         |
| $C_{rss}$     | Reverse transfer capacitance         | —    | 649   | —    |       |                                                                                         |

## Source-Drain Ratings and Characteristics

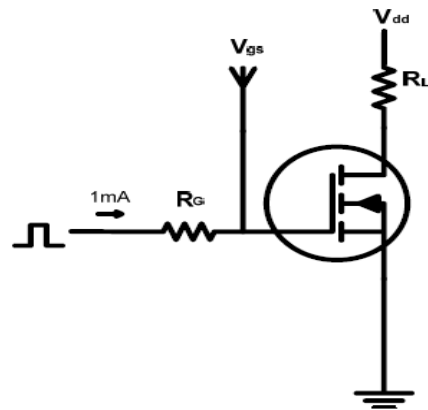
| Symbol   | Parameter                              | Min. | Typ. | Max.             | Units | Conditions                                                                                                                                           |
|----------|----------------------------------------|------|------|------------------|-------|------------------------------------------------------------------------------------------------------------------------------------------------------|
| $I_S$    | Continuous Source Current (Body Diode) | —    | —    | 180 <sup>⑥</sup> | A     | MOSFET symbol showing the integral reverse p-n junction diode.  |
| $I_{SM}$ | Pulsed Source Current (Body Diode)     | —    | —    | 720              | A     |                                                                                                                                                      |
| $V_{SD}$ | Diode Forward Voltage                  | —    | 0.92 | 1.3              | V     | $I_S=75A, V_{GS}=0V$                                                                                                                                 |
| $t_{rr}$ | Reverse Recovery Time                  | —    | 39.7 | —                | ns    | $T_J = 25^\circ\text{C}, I_F = 75A,$<br>$di/dt = 100A/\mu s$                                                                                         |
| $Q_{rr}$ | Reverse Recovery Charge                | —    | 37.3 | —                | nC    |                                                                                                                                                      |

## Test circuits and Waveforms

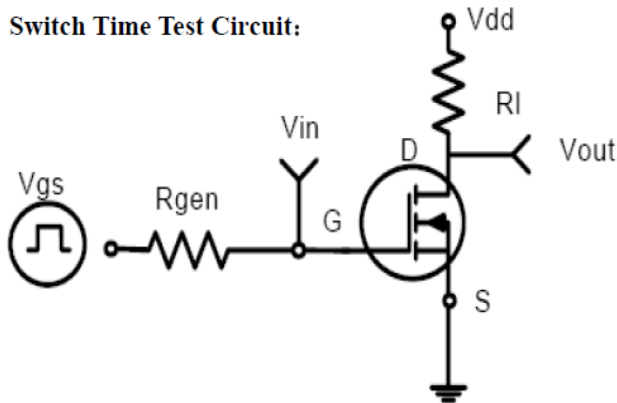
**EAS test circuits:**



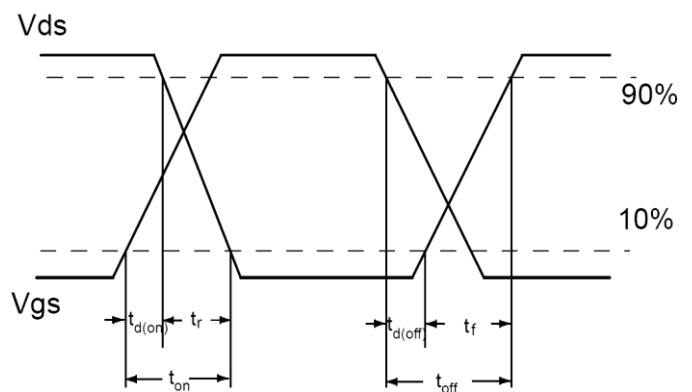
**Gate charge test circuit:**



**Switch Time Test Circuit:**



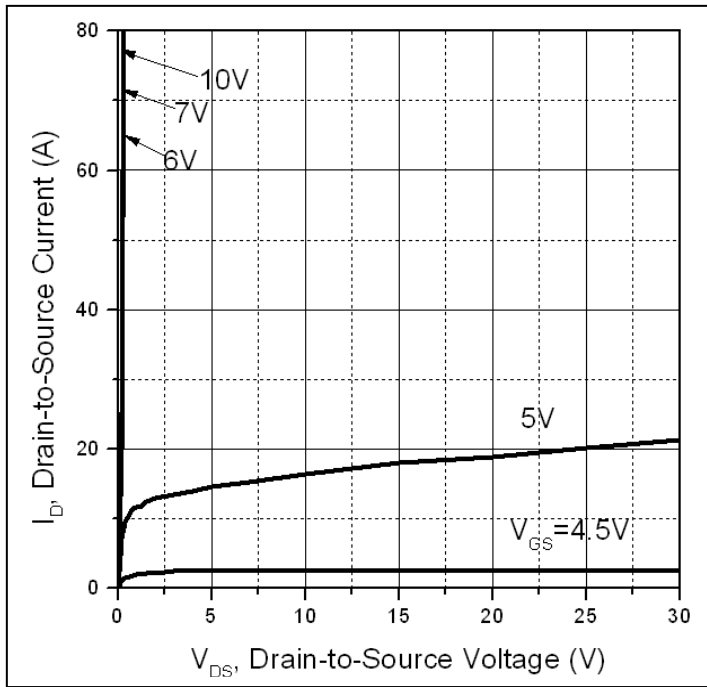
**Switch Waveforms:**



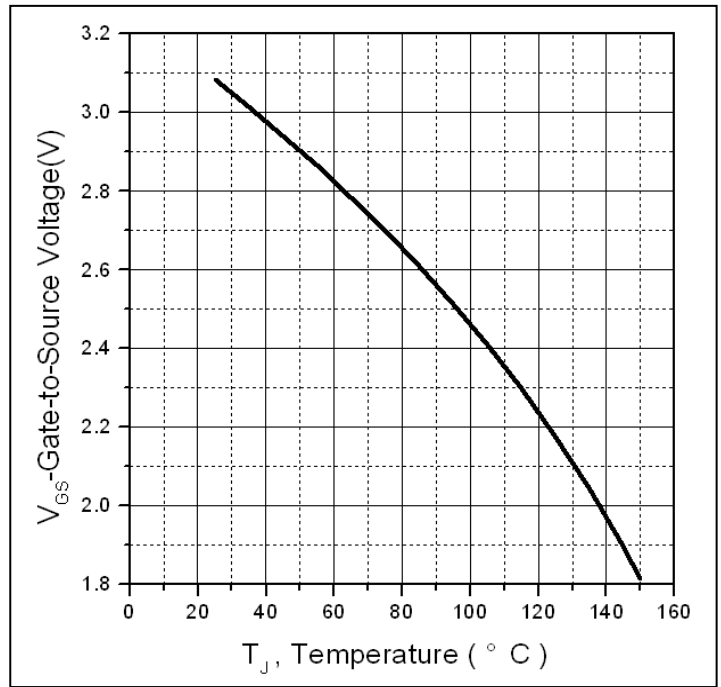
## Notes:

- ① Calculated continuous current based on maximum allowable junction temperature.
- ② Repetitive rating; pulse width limited by max. junction temperature.
- ③ The power dissipation PD is based on max. junction temperature, using junction-to-case thermal resistance.
- ④ The value of  $R_{\theta JA}$  is measured with the device mounted on 1 in 2 FR-4 board with 2oz. Copper, in a still air environment with  $T_A = 25^\circ\text{C}$

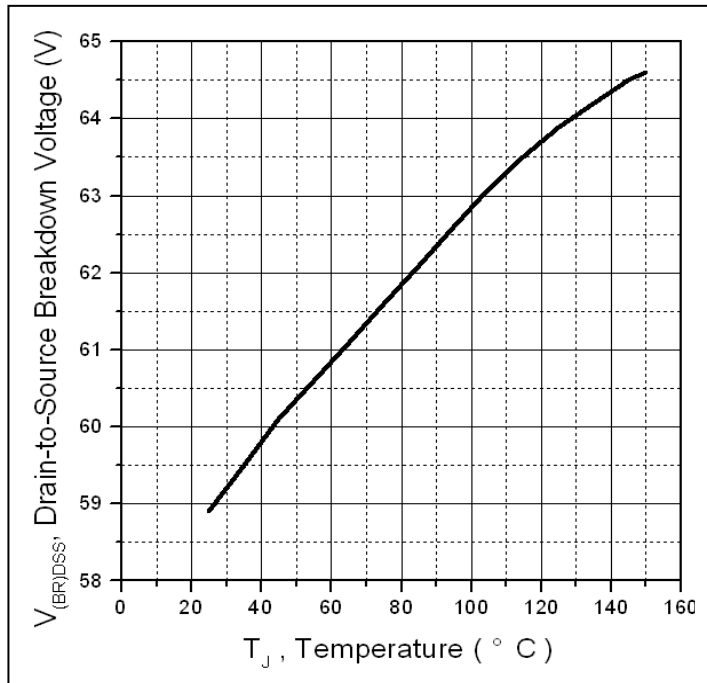
## Typical electrical and thermal characteristics



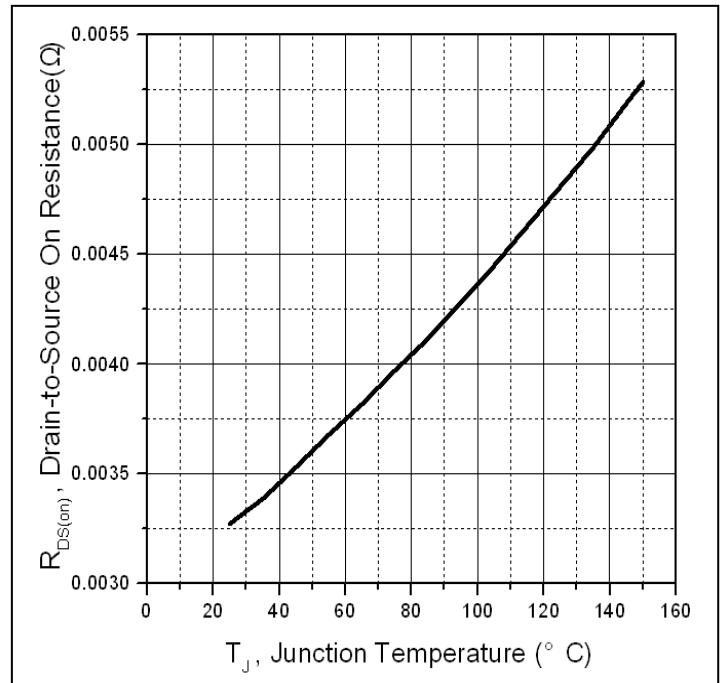
**Figure 1: Typical Output Characteristics**



**Figure 2: Gate to source cut-off voltage**

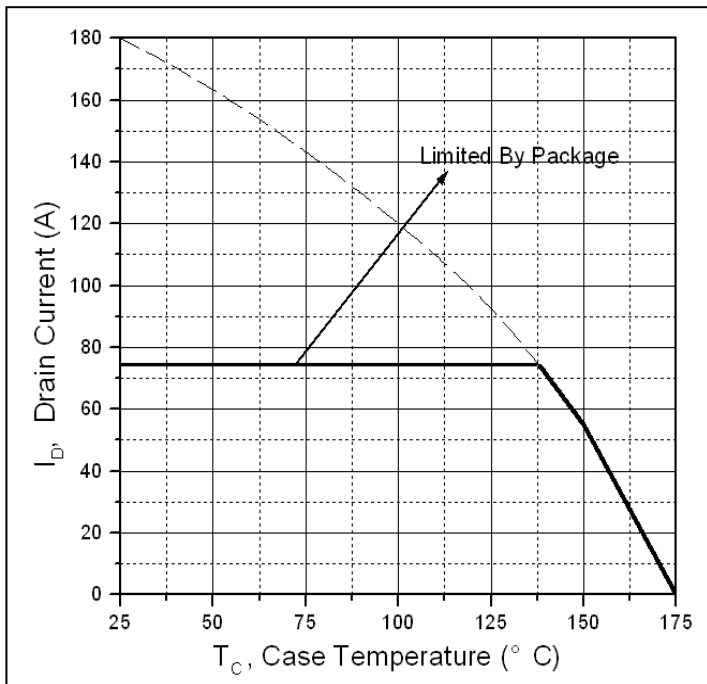


**Figure 3: Drain-to-Source Breakdown Voltage vs. Temperature**

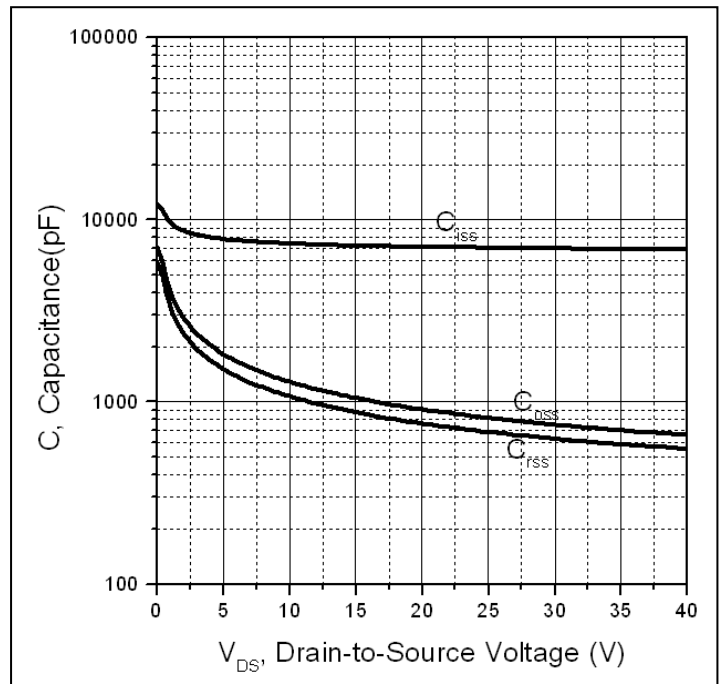


**Figure 4: Normalized On-Resistance Vs. Case Temperature**

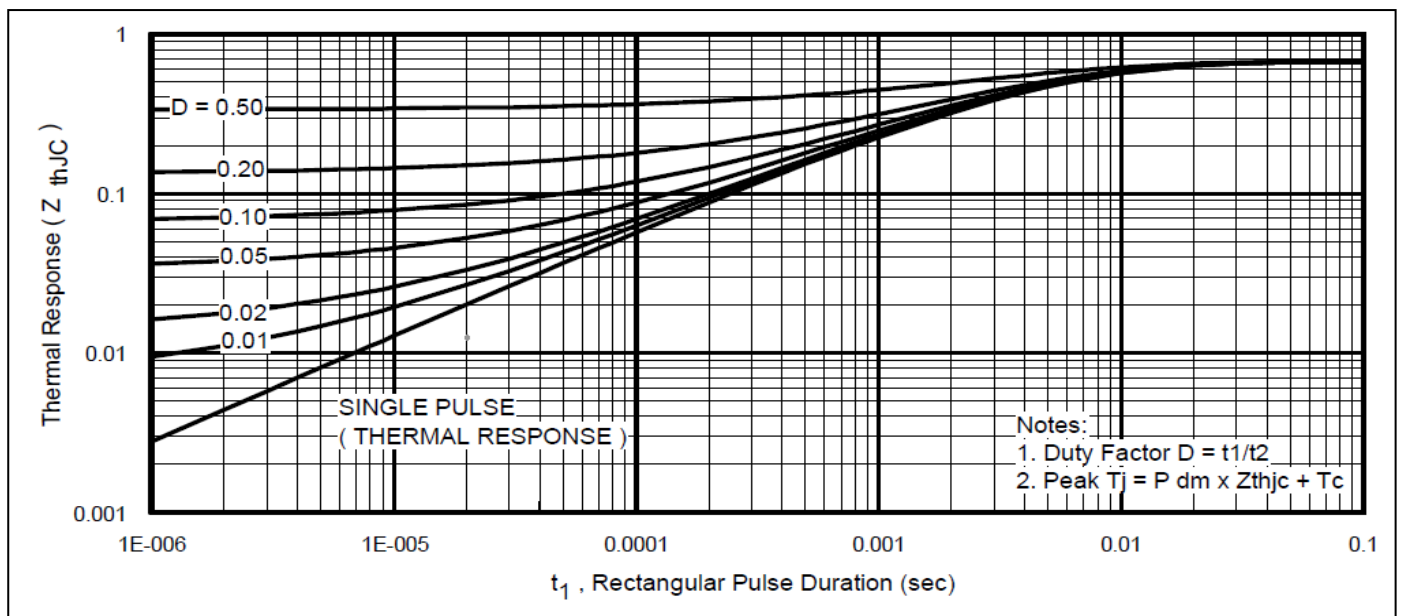
## Typical electrical and thermal characteristics



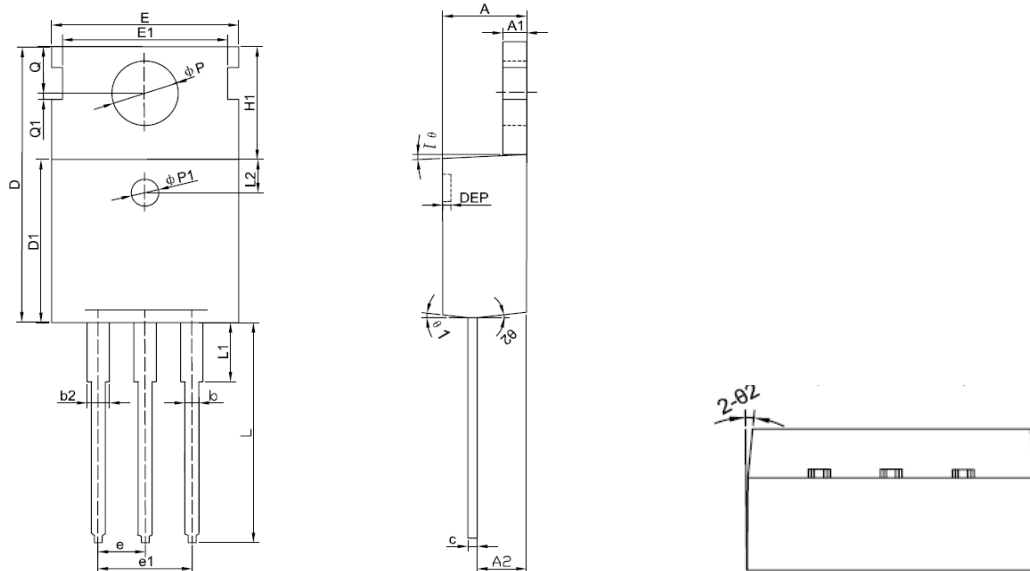
**Figure 5. Maximum Drain Current Vs. Case Temperature**



**Figure 6. Typical Capacitance Vs. Drain-to-Source Voltage**



**Figure7. Maximum Effective Transient Thermal Impedance, Junction-to-Case**

**Mechanical Data:**
**TO220 PACKAGE OUTLINE DIMENSION**


| Symbol | Dimension In Millimeters |        |        | Dimension In Inches |       |       |
|--------|--------------------------|--------|--------|---------------------|-------|-------|
|        | Min                      | Nom    | Max    | Min                 | Nom   | Max   |
| A      | 4.400                    | 4.550  | 4.700  | 0.173               | 0.179 | 0.185 |
| A1     | 1.270                    | 1.300  | 1.330  | 0.050               | 0.051 | 0.052 |
| A2     | 2.590                    | 2.690  | 2.790  | 0.102               | 0.106 | 0.110 |
| b      | 0.770                    | -      | 0.900  | 0.030               | -     | 0.035 |
| b2     | 1.230                    | -      | 1.360  | 0.048               | -     | 0.054 |
| c      | 0.480                    | 0.500  | 0.520  | 0.019               | 0.020 | 0.020 |
| D      | 15.100                   | 15.400 | 15.700 | -                   | 0.606 | -     |
| D1     | 9.000                    | 9.100  | 9.200  | 0.354               | 0.358 | 0.362 |
| DEP    | 0.050                    | 0.285  | 0.520  | 0.002               | 0.011 | 0.020 |
| E      | 10.060                   | 10.160 | 10.260 | 0.396               | 0.400 | 0.404 |
| E1     | -                        | 8.700  | -      | -                   | 0.343 | -     |
| ΦP1    | 1.400                    | 1.500  | 1.600  | 0.055               | 0.059 | 0.063 |
| e      | 2.54BSC                  |        |        | 0.1BSC              |       |       |
| e1     | 5.08BSC                  |        |        | 0.2BSC              |       |       |
| H1     | 6.100                    | 6.300  | 6.500  | 0.240               | 0.248 | 0.256 |
| L      | 12.750                   | 12.960 | 13.170 | 0.502               | 0.510 | 0.519 |
| L1     | -                        | -      | 3.950  | -                   | -     | 0.156 |
| L2     | 1.85REF                  |        |        | 0.073REF            |       |       |
| ΦP     | 3.570                    | 3.600  | 3.630  | 0.141               | 0.142 | 0.143 |
| Q      | 2.730                    | 2.800  | 2.870  | 0.107               | 0.110 | 0.113 |
| Q1     | -                        | 0.200  | -      | -                   | 0.008 | -     |
| θ1     | 5°                       | 7°     | 9°     | 5°                  | 7°    | 9°    |
| θ2     | 1°                       | 3°     | 5°     | 1°                  | 3°    | 5°    |

**Ordering and Marking Information****Device Marking: SSF4203****Package (Available)****TO220****Operating Temperature Range****C : -55 to 175 °C****Devices per Unit**

| <b>Package Type</b> | <b>Units/Tube</b> | <b>Tubes/Inner Box</b> | <b>Units/Inner Box</b> | <b>Inner Boxes/Carton Box</b> | <b>Units/Carton Box</b> |
|---------------------|-------------------|------------------------|------------------------|-------------------------------|-------------------------|
| <b>TO220</b>        | <b>50</b>         | <b>20</b>              | <b>1000</b>            | <b>6</b>                      | <b>6000</b>             |

**Reliability Test Program**

| <b>Test Item</b>                           | <b>Conditions</b>                                                                              | <b>Duration</b>                               | <b>Sample Size</b>         |
|--------------------------------------------|------------------------------------------------------------------------------------------------|-----------------------------------------------|----------------------------|
| <b>High Temperature Reverse Bias(HTRB)</b> | <b>T<sub>j</sub>=125°C to 175°C @ 80% of Max V<sub>DSS</sub>/V<sub>CES</sub>/V<sub>R</sub></b> | <b>168 hours<br/>500 hours<br/>1000 hours</b> | <b>3 lots x 77 devices</b> |
| <b>High Temperature Gate Bias(HTGB)</b>    | <b>T<sub>j</sub>=150°C or 175°C @ 100% of Max V<sub>GSS</sub></b>                              | <b>168 hours<br/>500 hours<br/>1000 hours</b> | <b>3 lots x 77 devices</b> |

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