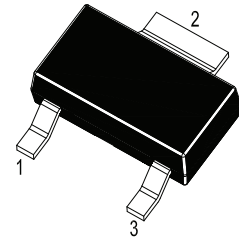
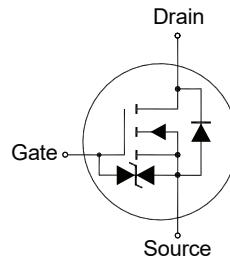


## N-Channel Enhancement Mode MOSFET

### Features

- Low Gate Charge
- Built-in G-S Protection Diode
- Surface-mounted package
- Halogen and Antimony Free(HAF), RoHS compliant
- Typical ESD Protection HBM Class 3A

| Classification | Voltage Range(V) |
|----------------|------------------|
| 0A             | < 125            |
| 0B             | 125 to < 250     |
| 1A             | 250 to < 500     |
| 1B             | 500 to < 1000    |
| 1C             | 1000 to < 2000   |
| 2              | 2000 to < 4000   |
| 3A             | 4000 to < 8000   |
| 3B             | ≥ 8000           |



1.Gate 2.Drain 3.Source  
SOT-223-2 Plastic Package

### Key Parameters

| Parameter                | Value                         | Unit |
|--------------------------|-------------------------------|------|
| $B_{V_{DS}}$             | 600                           | V    |
| $R_{DS(ON)} \text{ Max}$ | 600 @ $V_{GS} = 10 \text{ V}$ | mΩ   |
| $V_{GS(th)} \text{ typ}$ | 4.1                           | V    |
| $Q_g \text{ typ}$        | 12 @ $V_{GS} = 10 \text{ V}$  | nC   |

### Application

- Lighting
- Motor drive

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

| Parameter                                                              | Symbol         | Value         | Unit |
|------------------------------------------------------------------------|----------------|---------------|------|
| Drain-Source Voltage                                                   | $V_{DS}$       | 600           | V    |
| Gate-Source Voltage                                                    | $V_{GS}$       | ± 30          | V    |
| Drain Current<br>$T_c = 25^\circ\text{C}$<br>$T_c = 100^\circ\text{C}$ | $I_D$          | 4<br>2.5      | A    |
| Peak Drain Current, Pulsed <sup>1)</sup>                               | $I_{DM}$       | 15            | A    |
| Avalanche Current                                                      | $I_{AS}$       | 1.75          | A    |
| Single-Pulsed Avalanche Energy <sup>2)</sup>                           | $E_{AS}$       | 120.9         | mJ   |
| Total Power Dissipation<br>$T_c = 25^\circ\text{C}$                    | $P_{tot}$      | 19.2          | W    |
| Operating Junction and Storage Temperature Range                       | $T_J, T_{stg}$ | - 55 to + 150 | °C   |

### Thermal Characteristics

| Parameter                                                 | Symbol          | Max. | Unit |
|-----------------------------------------------------------|-----------------|------|------|
| Thermal Resistance from Junction to Case                  | $R_{\theta JC}$ | 6.5  | °C/W |
| Thermal Resistance from Junction to Ambient <sup>3)</sup> | $R_{\theta JA}$ | 62.5 | °C/W |

<sup>1)</sup> Pulse Test: Pulse Width ≤ 100 μs, Duty Cycle ≤ 2%, Repetitive rating, pulse width limited by junction temperature  $T_{J(MAX)} = 150^\circ\text{C}$ .

<sup>2)</sup> Limited by  $T_{J(MAX)}$ , starting  $T_J = 25^\circ\text{C}$ ,  $L = 79 \text{ mH}$ ,  $R_g = 25 \Omega$ ,  $I_{AS} = 1.75 \text{ A}$ ,  $V_{GS} = 10 \text{ V}$ .

<sup>3)</sup> Device Surface Mounted on FR-4 substrate PC board, 2oz copper, with 1-inch square copper plate, in a still air.

**Characteristics at  $T_a = 25^\circ\text{C}$  unless otherwise specified**

| Parameter                                                                                                                    | Symbol       | Min. | Typ. | Max.     | Unit             |
|------------------------------------------------------------------------------------------------------------------------------|--------------|------|------|----------|------------------|
| <b>STATIC PARAMETERS</b>                                                                                                     |              |      |      |          |                  |
| Drain-Source Breakdown Voltage<br>at $I_D = 1\text{ mA}$                                                                     | $BV_{DSS}$   | 600  | -    | -        | V                |
| Drain-Source On-State Current<br>at $V_{DS} = 600\text{ V}$                                                                  | $I_{DSS}$    | -    | -    | 1        | $\mu\text{A}$    |
| Gate-Source Leakage Current<br>at $V_{GS} = \pm 30\text{ V}$                                                                 | $I_{GSS}$    | -    | -    | $\pm 10$ | $\mu\text{A}$    |
| Gate-Source Threshold Voltage<br>at $V_{DS} = V_{GS}$ , $I_D = 250\text{ }\mu\text{A}$                                       | $V_{GS(th)}$ | 3.5  | -    | 4.5      | V                |
| Drain-Source On-State Resistance<br>at $V_{GS} = 10\text{ V}$ , $I_D = 2.5\text{ A}$                                         | $R_{DS(ON)}$ | -    | 507  | 600      | $\text{m}\Omega$ |
| <b>DYNAMIC PARAMETERS</b>                                                                                                    |              |      |      |          |                  |
| Forward Transconductance<br>at $V_{DS} = 10\text{ V}$ , $I_D = 2.5\text{ A}$                                                 | $g_{fs}$     | -    | 4.3  | -        | S                |
| Gate Resistance<br>at $V_{GS} = 0\text{ V}$ , $V_{DS} = 0\text{ V}$ , $f = 1\text{ MHz}$                                     | $R_g$        | -    | 14   | -        | $\Omega$         |
| Input Capacitance<br>at $V_{GS} = 0\text{ V}$ , $V_{DS} = 300\text{ V}$ , $f = 1\text{ MHz}$                                 | $C_{iss}$    | -    | 528  | -        | pF               |
| Output Capacitance<br>at $V_{GS} = 0\text{ V}$ , $V_{DS} = 300\text{ V}$ , $f = 1\text{ MHz}$                                | $C_{oss}$    | -    | 18   | -        | pF               |
| Reverse Transfer Capacitance<br>at $V_{GS} = 0\text{ V}$ , $V_{DS} = 300\text{ V}$ , $f = 1\text{ MHz}$                      | $C_{rss}$    | -    | 5    | -        | pF               |
| Total Gate Charge<br>at $V_{DS} = 300\text{ V}$ , $V_{GS} = 10\text{ V}$ , $I_D = 2.5\text{ A}$                              | $Q_g$        | -    | 12   | -        | nC               |
| Gate-Source Charge<br>at $V_{DS} = 300\text{ V}$ , $V_{GS} = 10\text{ V}$ , $I_D = 2.5\text{ A}$                             | $Q_{gs}$     | -    | 4    | -        | nC               |
| Gate-Drain Charge<br>at $V_{DS} = 300\text{ V}$ , $V_{GS} = 10\text{ V}$ , $I_D = 2.5\text{ A}$                              | $Q_{gd}$     | -    | 4    | -        | nC               |
| Turn-On Delay Time<br>at $V_{DS} = 300\text{ V}$ , $V_{GS} = 10\text{ V}$ , $I_D = 2.5\text{ A}$ , $R_g = 10\text{ }\Omega$  | $t_{d(on)}$  | -    | 36   | -        | ns               |
| Turn-On Rise Time<br>at $V_{DS} = 300\text{ V}$ , $V_{GS} = 10\text{ V}$ , $I_D = 2.5\text{ A}$ , $R_g = 10\text{ }\Omega$   | $t_r$        | -    | 14   | -        | ns               |
| Turn-Off Delay Time<br>at $V_{DS} = 300\text{ V}$ , $V_{GS} = 10\text{ V}$ , $I_D = 2.5\text{ A}$ , $R_g = 10\text{ }\Omega$ | $t_{d(off)}$ | -    | 31   | -        | ns               |
| Turn-Off Fall Time<br>at $V_{DS} = 300\text{ V}$ , $V_{GS} = 10\text{ V}$ , $I_D = 2.5\text{ A}$ , $R_g = 10\text{ }\Omega$  | $t_f$        | -    | 64.4 | -        | ns               |
| <b>Body-Diode PARAMETERS</b>                                                                                                 |              |      |      |          |                  |
| Drain-Source Diode Forward Voltage<br>at $I_S = 1\text{ A}$ , $V_{GS} = 0\text{ V}$                                          | $V_{SD}$     | -    | -    | 1.2      | V                |
| Body-Diode Continuous Current                                                                                                | $I_S$        | -    | -    | 4        | A                |
| Body-Diode Continuous Current, Pulsed                                                                                        | $I_{SM}$     | -    | -    | 15       | A                |
| Body Diode Reverse Recovery Time<br>at $I_S = 2.5\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$                             | $t_{rr}$     | -    | 80   | -        | ns               |
| Body Diode Reverse Recovery Charge<br>at $I_S = 2.5\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$                           | $Q_{rr}$     | -    | 304  | -        | nC               |

## Electrical Characteristics Curves

Fig. 1 Typical Output Characteristics

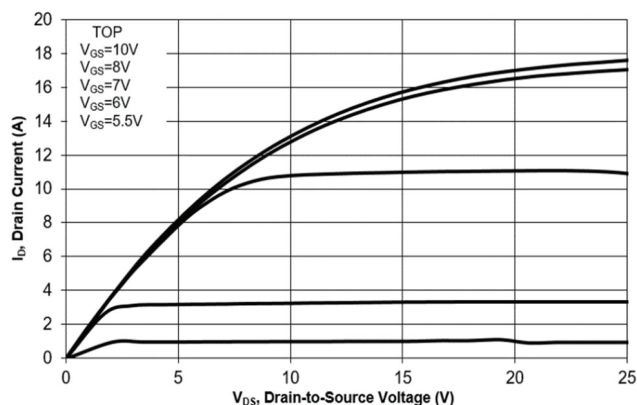


Fig. 2 Typical Transfer Characteristics

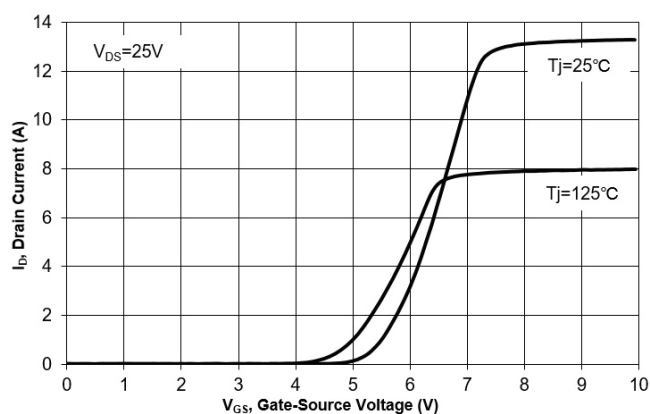


Fig. 3 On-Resistance vs. Drain Current

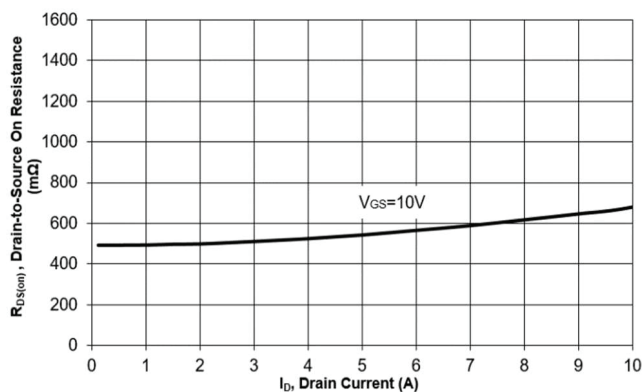


Fig. 4 On-Resistance vs. Gate to Source Voltage

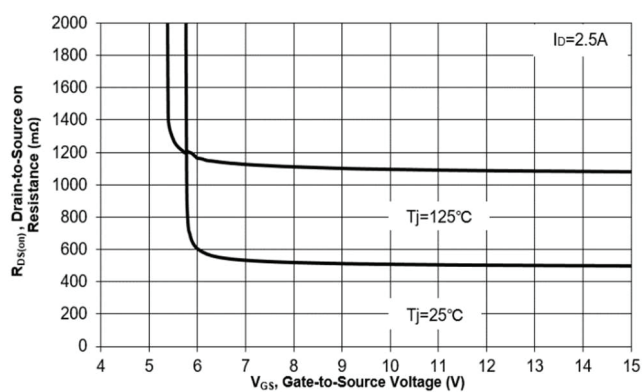


Fig. 5 On-Resistance vs.  $T_J$

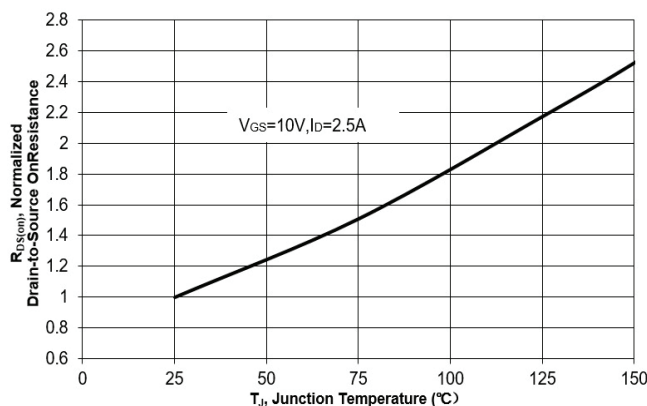
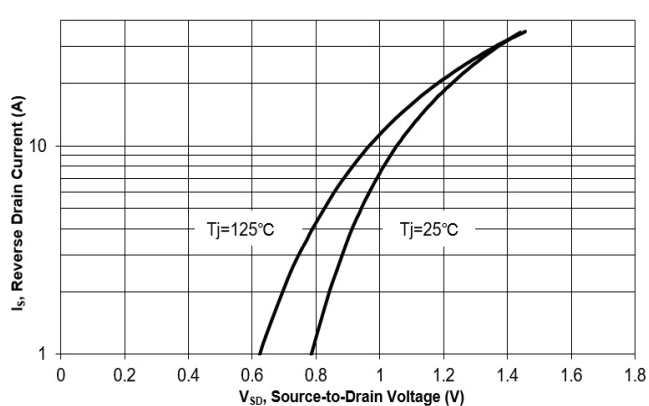


Fig. 6 Typical Body-Diode Forward Characteristics



## Electrical Characteristics Curves

Fig. 7 Typical Junction Capacitance

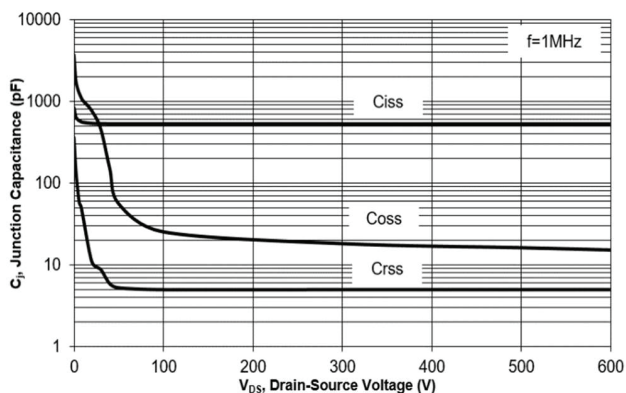


Fig. 8 Drain-Source Leakage Current vs.  $T_j$

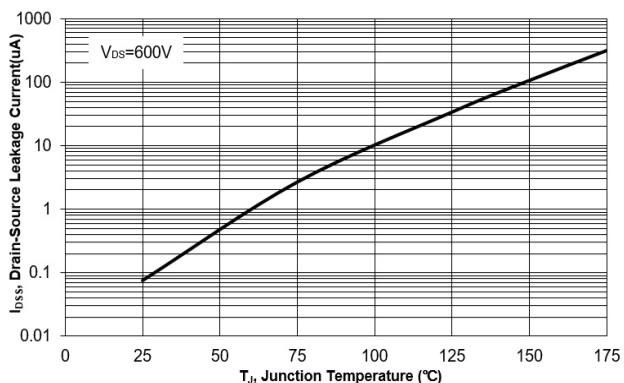


Fig. 9  $V_{(BR)DSS}$  vs. Junction Temperature

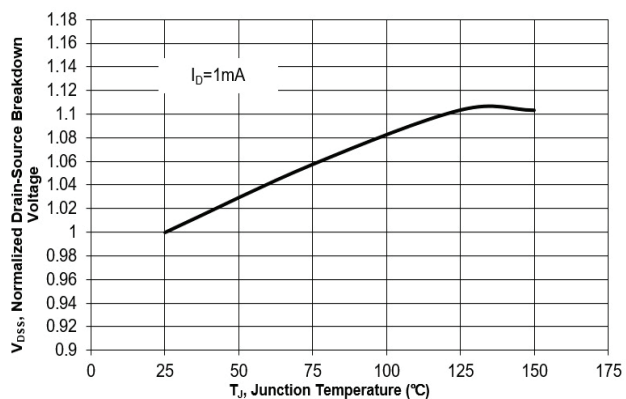


Fig. 10 Gate Threshold Variation vs.  $T_j$

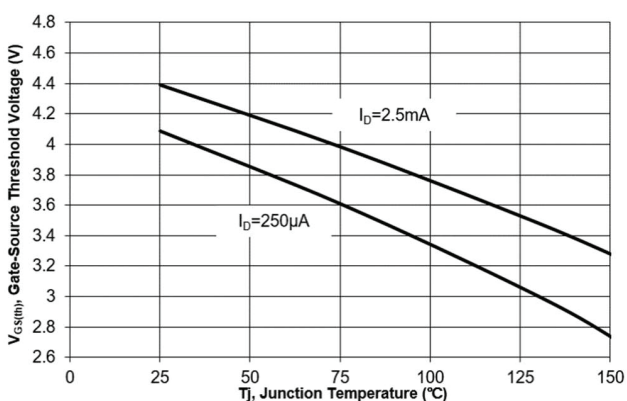


Fig. 11 Gate Charge

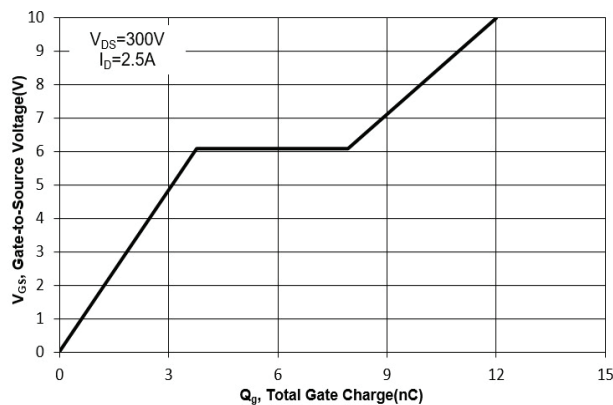


Fig. 12 Safe Operation Area

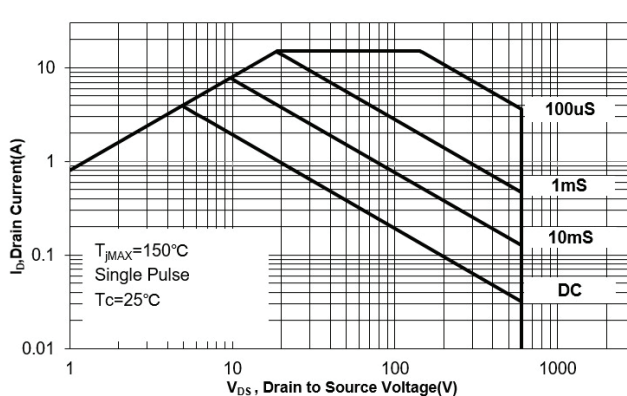


Fig. 13 Normalized Maximum Transient Thermal Impedance( $Z_{\theta JC}$ )

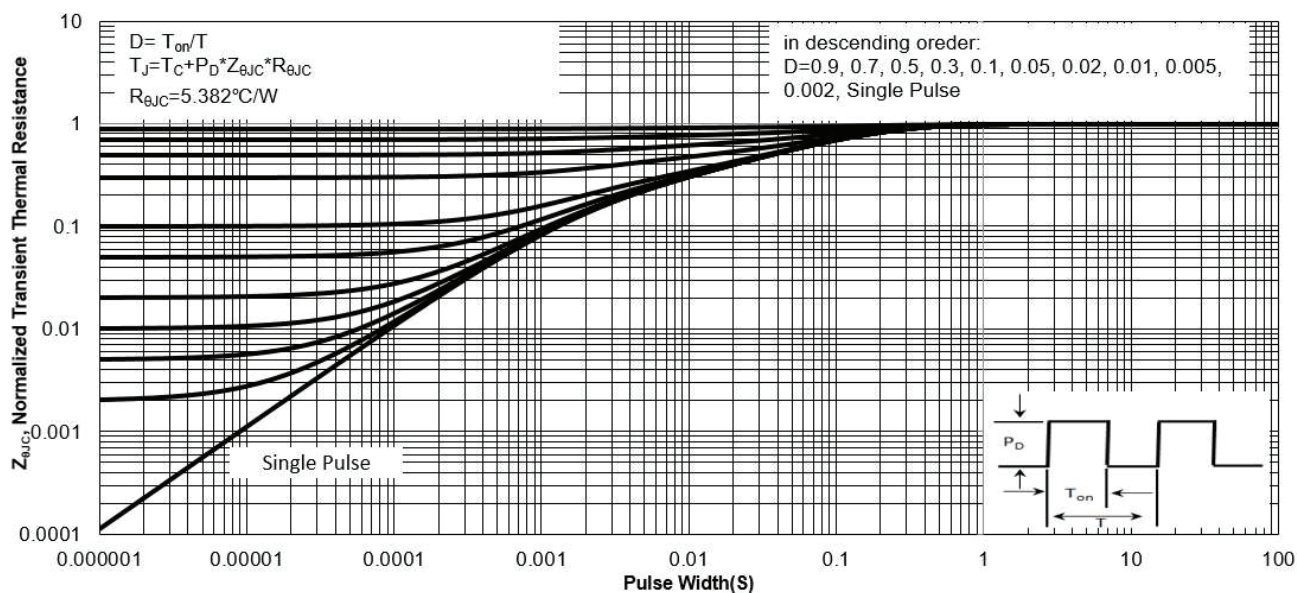
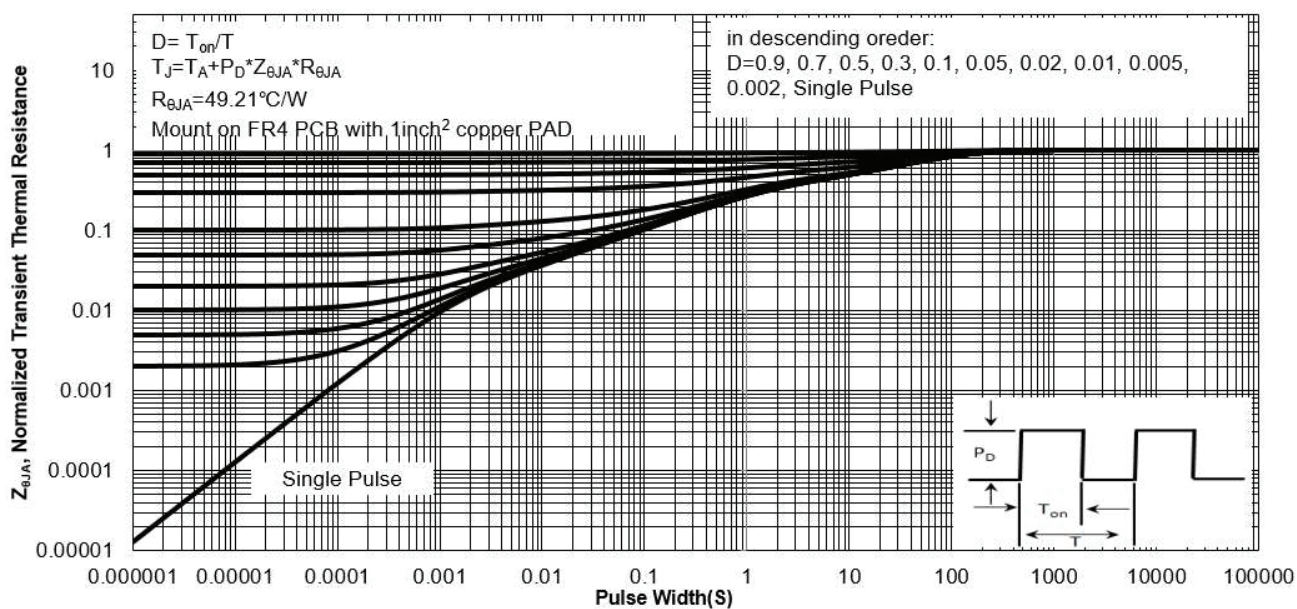
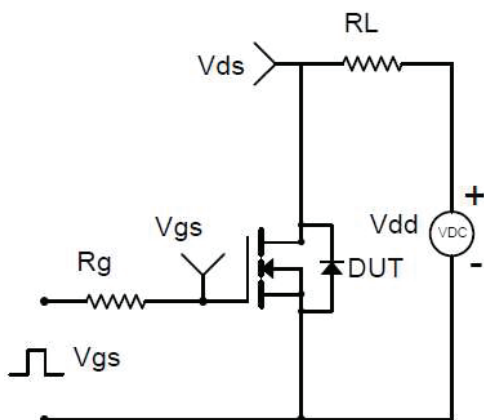
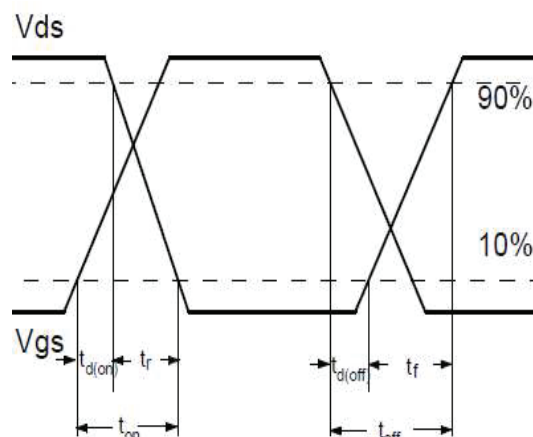
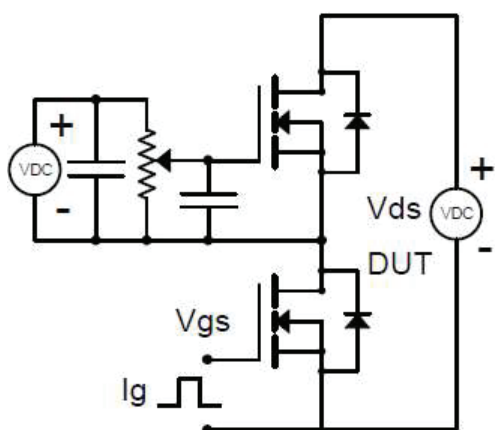
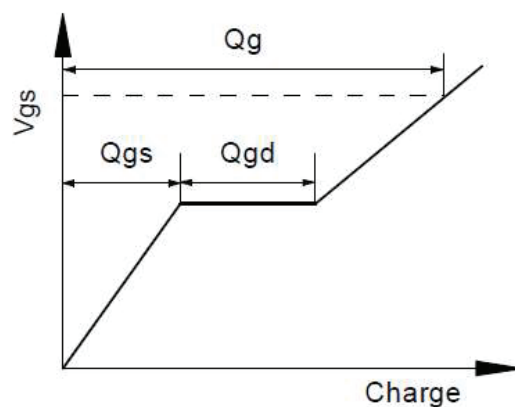
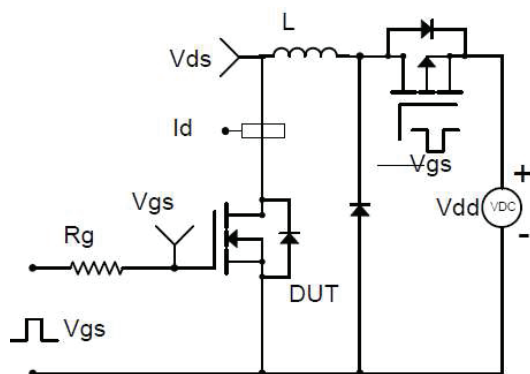
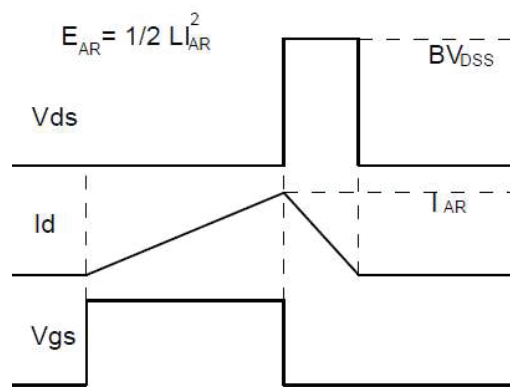
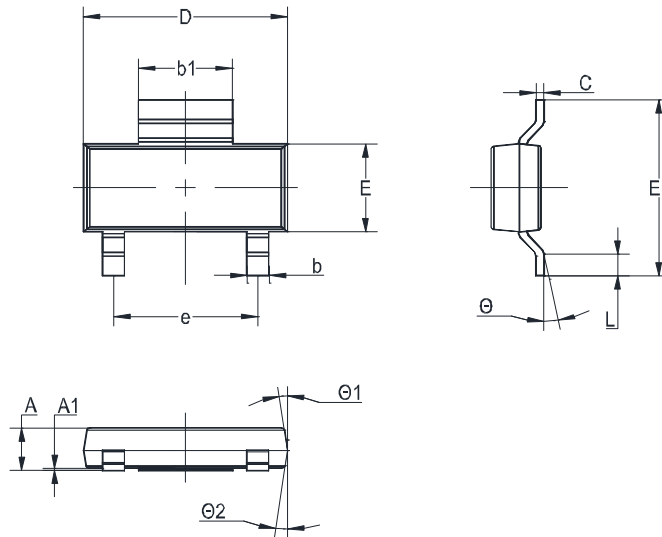


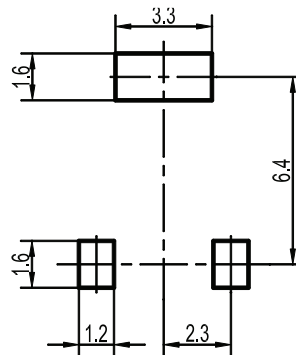
Fig. 14 Normalized Maximum Transient Thermal Impedance( $Z_{\theta JA}$ )



**Test Circuits**
**Fig.1-1 Switching times test circuit**

**Fig.1-2 Switching Waveform**

**Fig.2-1 Gate charge test circuit**

**Fig.2-2 Gate charge waveform**

**Fig.3-1 Avalanche test circuit**

**Fig.3-2 Avalanche waveform**


**PACKAGE OUTLINE (Dimensions in mm)**
**SOT-223-2**


| Unit | A          | A1         | b          | b1         | C            | D          | E          | E1         | e          | L          | Θ         | Θ1       | Θ2       |
|------|------------|------------|------------|------------|--------------|------------|------------|------------|------------|------------|-----------|----------|----------|
| mm   | 1.8<br>1.5 | 0.1<br>MAX | 0.8<br>0.6 | 3.1<br>2.9 | 0.32<br>0.22 | 6.7<br>6.3 | 3.7<br>3.3 | 7.3<br>6.7 | 4.6<br>TYP | 1.1<br>0.7 | 10°<br>0° | 7°<br>0° | 7°<br>0° |

**Recommended Soldering Footprint**

**Packing information**

| Package   | Tape Width<br>(mm) | Pitch   |               | Reel Size |      | Per Reel Packing Quantity |
|-----------|--------------------|---------|---------------|-----------|------|---------------------------|
|           |                    | mm      | inch          | mm        | inch |                           |
| SOT-223-2 | 12                 | 8 ± 0.1 | 0.315 ± 0.004 | 330       | 13   | 3,000                     |

**Marking information**

" PDQ60N600KR " = Part No

" \*\*\*\*\* " = Date Code Marking

Font type: Arial

