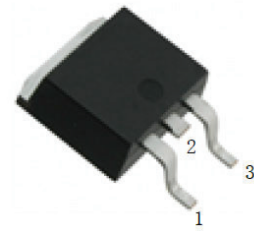
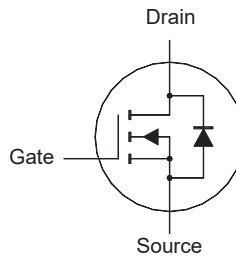


### Features

- Low  $R_{DS(ON)}$
- Surface-mounted package
- Low Gate-Source Threshold Voltage
- Halogen and Antimony Free(HAF), RoHS compliant



1. Gate 2. Drain 3. Source  
TO-252 Plastic Package

### Application

- Load Switch
- DC-DC converters

### Key Parameters

| Parameter        | Value                         | Unit       |
|------------------|-------------------------------|------------|
| $BV_{DSS}$       | 40                            | V          |
| $R_{DS(ON)}$ Max | 2.8 @ $V_{GS} = 10\text{ V}$  | m $\Omega$ |
|                  | 3.7 @ $V_{GS} = 4.5\text{ V}$ |            |
| $V_{GS(th)}$ typ | 1.4                           | V          |
| $Q_g$ typ        | 46 @ $V_{GS} = 10\text{ V}$   | nC         |

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

| Parameter                                        | Symbol         | Value                                                 | Unit             |
|--------------------------------------------------|----------------|-------------------------------------------------------|------------------|
| Drain-Source Voltage                             | $V_{DS}$       | 40                                                    | V                |
| Gate-Source Voltage                              | $V_{GS}$       | $\pm 20$                                              | V                |
| Continuous Drain Current                         | $I_D$          | 117                                                   | A                |
|                                                  |                | 73                                                    |                  |
|                                                  |                | $T_c = 25^\circ\text{C}$<br>$T_c = 100^\circ\text{C}$ |                  |
| Peak Drain Current, Pulsed <sup>1)</sup>         | $I_{DM}$       | 400                                                   | A                |
| Avalanche Current                                | $I_{AS}$       | 49                                                    | A                |
| Single Pulse Avalanche Energy <sup>2)</sup>      | $E_{AS}$       | 120                                                   | mJ               |
| Power Dissipation                                | $P_D$          | 61.3                                                  | W                |
|                                                  |                | $T_c = 25^\circ\text{C}$                              |                  |
| Operating Junction and Storage Temperature Range | $T_J, T_{stg}$ | - 55 to + 150                                         | $^\circ\text{C}$ |

### Thermal Characteristics

| Parameter                                                 | Symbol          | Max. | Unit               |
|-----------------------------------------------------------|-----------------|------|--------------------|
| Thermal Resistance from Junction to Case                  | $R_{\theta JC}$ | 2    | $^\circ\text{C/W}$ |
| Thermal Resistance from Junction to Ambient <sup>3)</sup> | $R_{\theta JA}$ | 35   | $^\circ\text{C/W}$ |

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

<sup>2)</sup> Limited by  $T_{J(MAX)}$ , starting  $T_J = 25^\circ\text{C}$ ,  $L = 0.1\text{ mH}$ ,  $R_g = 25\text{ }\Omega$ ,  $I_{AS} = 49\text{ A}$ ,  $V_{GS} = 10\text{ V}$ .

<sup>3)</sup> Device mounted on FR-4 substrate PC board, 2oz copper, with 1-inch square copper plate in 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 $I_D = 250\ \mu\text{A}$                                                                                                                    | $BV_{DSS}$   | 40     | -        | -          | V             |
| Drain-Source Leakage Current<br>at $V_{DS} = 32\ \text{V}$                                                                                                                       | $I_{DSS}$    | -      | -        | 1          | $\mu\text{A}$ |
| Gate Leakage Current<br>at $V_{GS} = \pm 20\ \text{V}$                                                                                                                           | $I_{GSS}$    | -      | -        | $\pm 100$  | nA            |
| Gate-Source Threshold Voltage<br>at $V_{DS} = V_{GS}$ , $I_D = 250\ \mu\text{A}$                                                                                                 | $V_{GS(th)}$ | 1.2    | -        | 2.5        | V             |
| Drain-Source On-State Resistance<br>at $V_{GS} = 10\ \text{V}$ , $I_D = 23\ \text{A}$<br>at $V_{GS} = 4.5\ \text{V}$ , $I_D = 18\ \text{A}$                                      | $R_{DS(on)}$ | -<br>- | 2.2<br>- | 2.8<br>3.7 | m $\Omega$    |
| <b>DYNAMIC PARAMETERS</b>                                                                                                                                                        |              |        |          |            |               |
| Forward Transconductance<br>at $V_{DS} = 5\ \text{V}$ , $I_D = 5\ \text{A}$                                                                                                      | $g_{fs}$     | -      | 20       | -          | S             |
| Gate resistance<br>at $V_{GS} = 0\ \text{V}$ , $V_{DS} = 0\ \text{V}$ , $f = 1\ \text{MHz}$                                                                                      | $R_g$        | -      | 0.8      | -          | $\Omega$      |
| Input Capacitance<br>at $V_{GS} = 0\ \text{V}$ , $V_{DS} = 25\ \text{V}$ , $f = 1\ \text{MHz}$                                                                                   | $C_{iss}$    | -      | 2936     | -          | pF            |
| Output Capacitance<br>at $V_{GS} = 0\ \text{V}$ , $V_{DS} = 25\ \text{V}$ , $f = 1\ \text{MHz}$                                                                                  | $C_{oss}$    | -      | 564      | -          | pF            |
| Reverse Transfer Capacitance<br>at $V_{GS} = 0\ \text{V}$ , $V_{DS} = 25\ \text{V}$ , $f = 1\ \text{MHz}$                                                                        | $C_{rss}$    | -      | 34       | -          | pF            |
| Gate charge total<br>at $V_{DS} = 25\ \text{V}$ , $I_D = 23\ \text{A}$ , $V_{GS} = 10\ \text{V}$<br>at $V_{DS} = 25\ \text{V}$ , $I_D = 23\ \text{A}$ , $V_{GS} = 4.5\ \text{V}$ | $Q_g$        | -<br>- | 46<br>21 | -<br>-     | nC            |
| Gate to Source Charge<br>at $V_{DS} = 25\ \text{V}$ , $I_D = 23\ \text{A}$ , $V_{GS} = 10\ \text{V}$                                                                             | $Q_{gs}$     | -      | 9.5      | -          | nC            |
| Gate to Drain Charge<br>at $V_{DS} = 25\ \text{V}$ , $I_D = 23\ \text{A}$ , $V_{GS} = 10\ \text{V}$                                                                              | $Q_{gd}$     | -      | 6.6      | -          | nC            |
| Turn-On Delay Time<br>at $V_{DS} = 25\ \text{V}$ , $I_D = 23\ \text{A}$ , $V_{GS} = 10\ \text{V}$ , $R_g = 3.3\ \Omega$                                                          | $t_{d(on)}$  | -      | 19       | -          | ns            |
| Turn-On Rise Time<br>at $V_{DS} = 25\ \text{V}$ , $I_D = 23\ \text{A}$ , $V_{GS} = 10\ \text{V}$ , $R_g = 3.3\ \Omega$                                                           | $t_r$        | -      | 41       | -          | ns            |
| Turn-Off Delay Time<br>at $V_{DS} = 25\ \text{V}$ , $I_D = 23\ \text{A}$ , $V_{GS} = 10\ \text{V}$ , $R_g = 3.3\ \Omega$                                                         | $t_{d(off)}$ | -      | 17       | -          | ns            |
| Turn-Off Fall Time<br>at $V_{DS} = 25\ \text{V}$ , $I_D = 23\ \text{A}$ , $V_{GS} = 10\ \text{V}$ , $R_g = 3.3\ \Omega$                                                          | $t_f$        | -      | 8        | -          | ns            |
| <b>Body-Diode PARAMETERS</b>                                                                                                                                                     |              |        |          |            |               |
| Drain-Source Diode Forward Voltage<br>at $I_S = 1\ \text{A}$ , $V_{GS} = 0\ \text{V}$                                                                                            | $V_{SD}$     | -      | -        | 1.3        | V             |
| Body-Diode Continuous Current                                                                                                                                                    | $I_S$        | -      | -        | 117        | A             |
| Body-Diode Continuous Current, Pulsed                                                                                                                                            | $I_{SM}$     | -      | -        | 400        | A             |
| Body Diode Reverse Recovery Time<br>at $I_S = 23\ \text{A}$ , $di/dt = 100\ \text{A} / \mu\text{s}$                                                                              | $t_{rr}$     | -      | 25.5     | -          | ns            |
| Body Diode Reverse Recovery Charge<br>at $I_S = 23\ \text{A}$ , $di/dt = 100\ \text{A} / \mu\text{s}$                                                                            | $Q_{rr}$     | -      | 17       | -          | nC            |

## Electrical Characteristics Curves

Fig. 1 Typical Output Characteristics

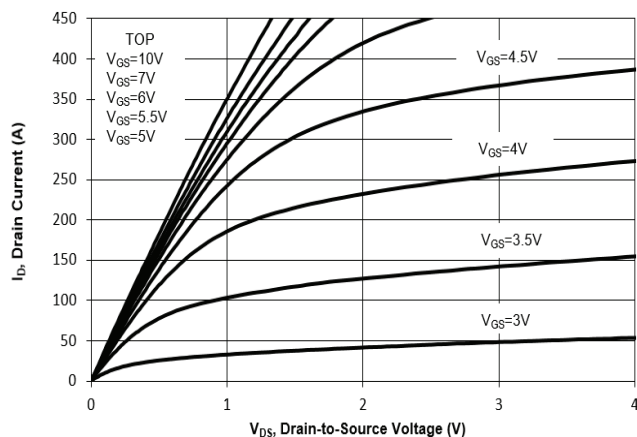


Fig. 2 Typical Transfer Characteristics

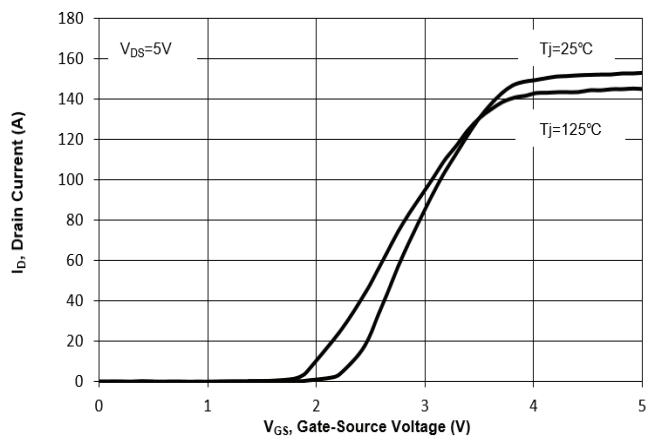


Fig. 3 On-Resistance vs. Drain Current

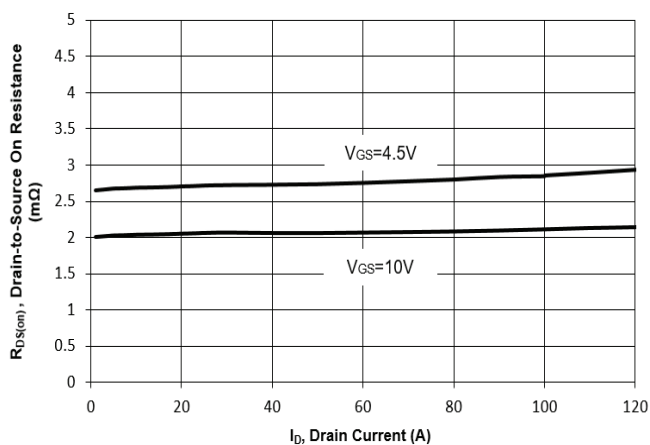


Fig. 4 On-Resistance vs. Gate to Source Voltage

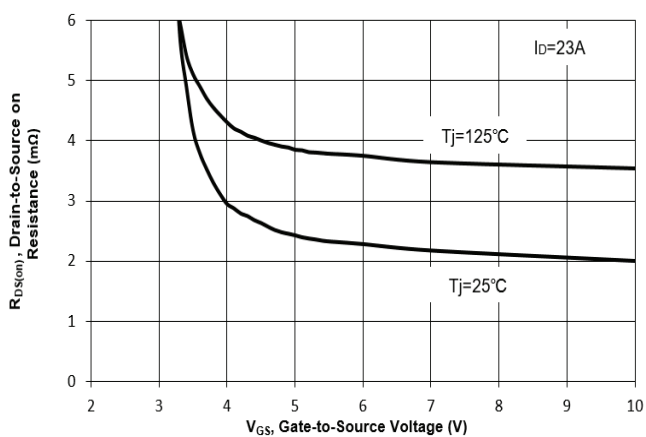


Fig. 5 On-Resistance vs.  $T_j$

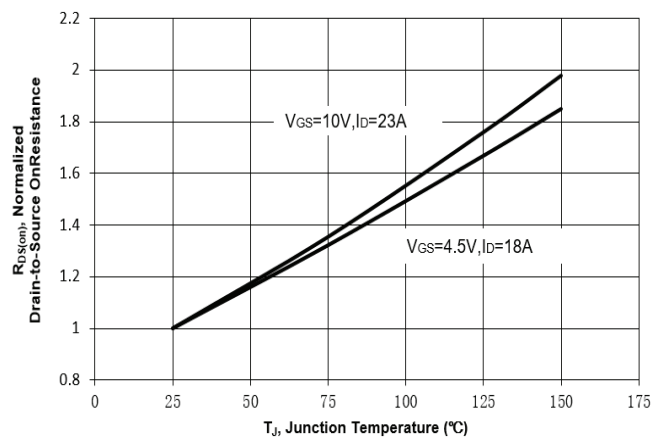
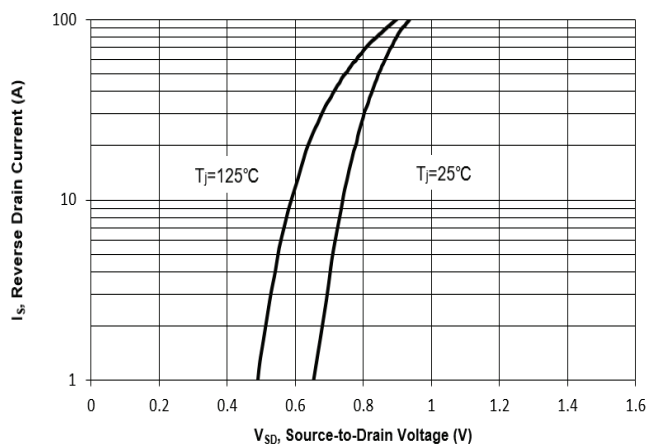


Fig. 6 Typical Body-Diode Forward Characteristics



## Electrical Characteristics Curves

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

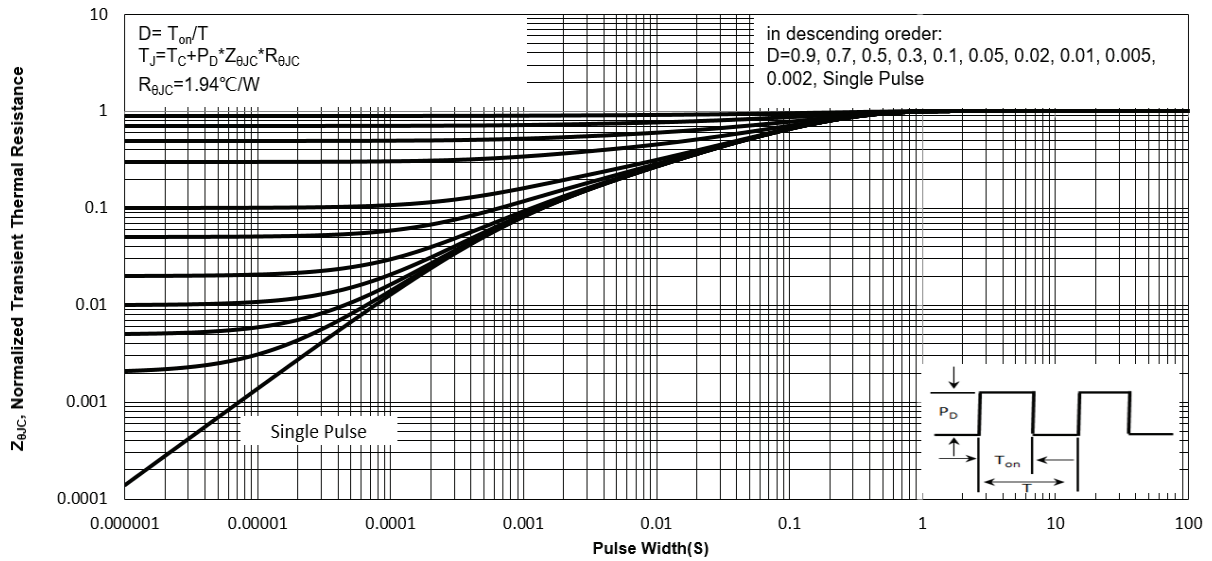


Fig. 14 Normalized Maximum Transient Thermal Impedance( $z_{\theta JA}$ )

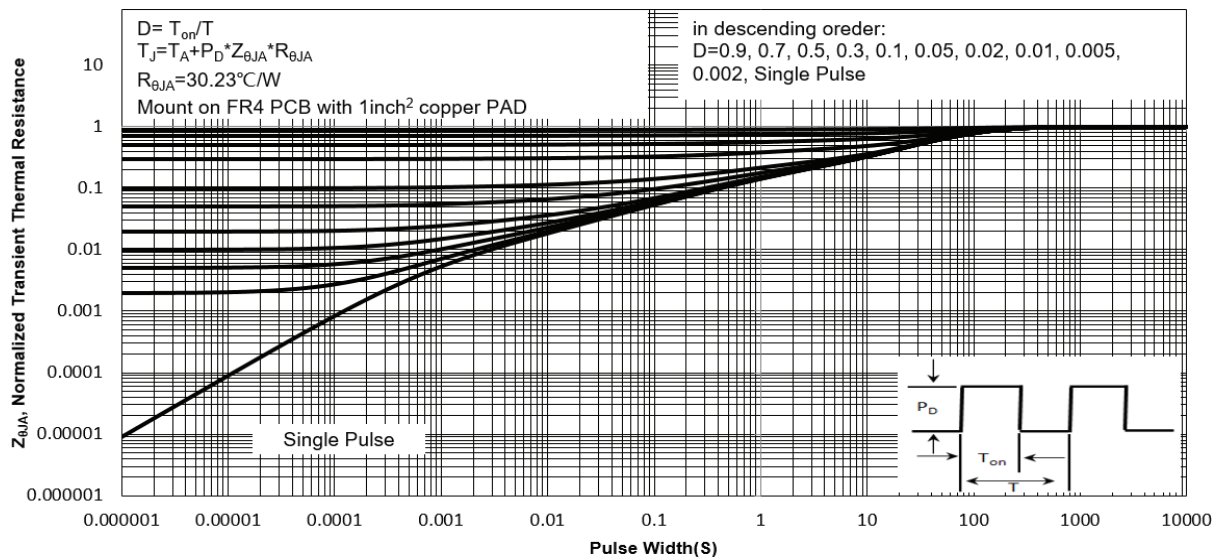


Fig. 7 Typical Junction Capacitance

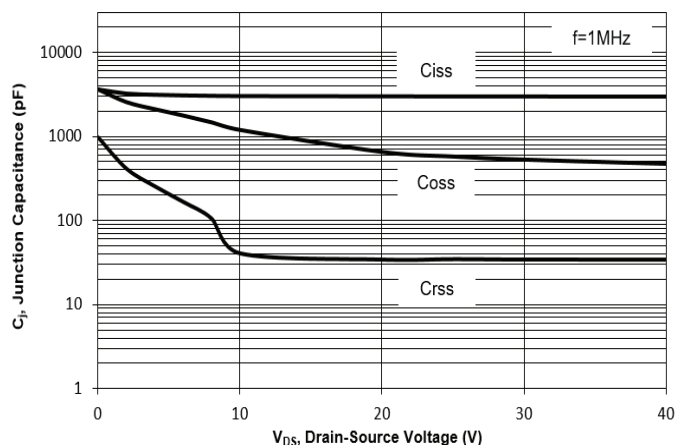


Fig. 8 Drain-Source Leakage Current vs.  $T_j$

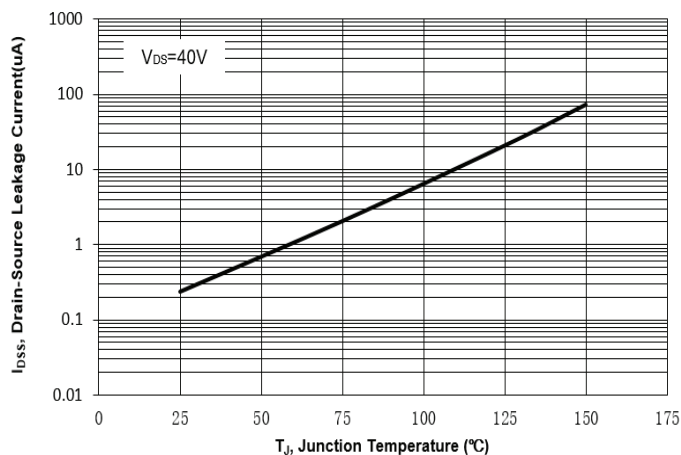


Fig. 9  $V_{(BR)DSS}$  vs. Junction Temperature

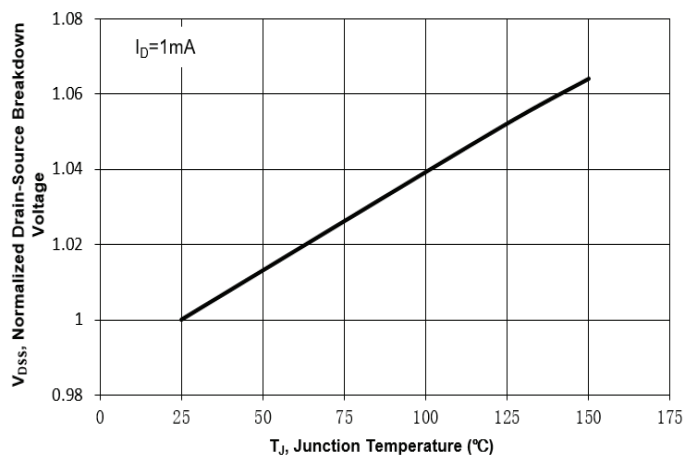


Fig. 10 Gate Threshold Variation vs.  $T_j$

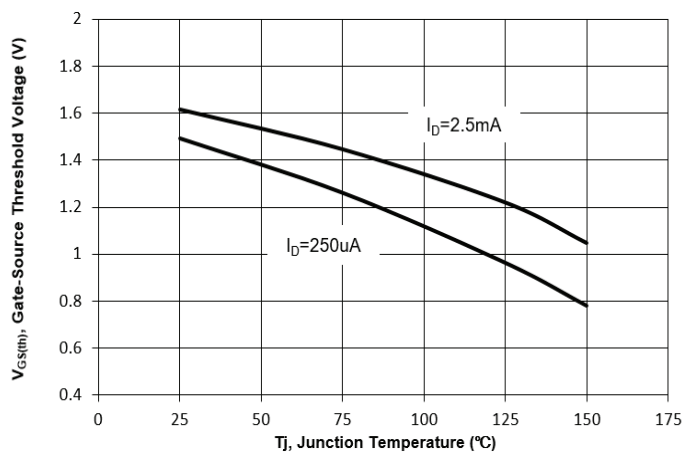


Fig. 11 Gate Charge

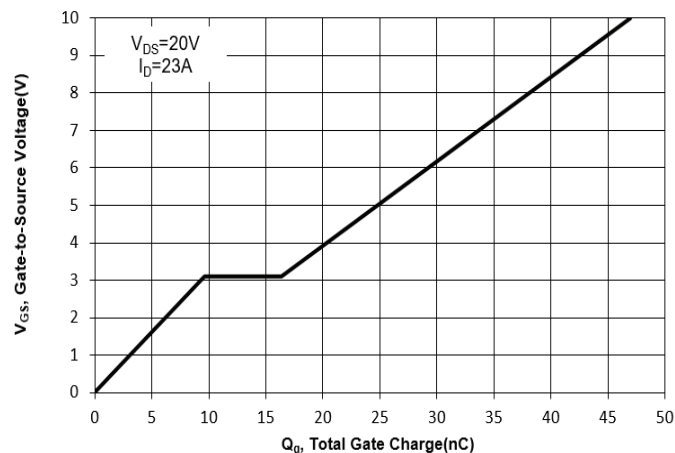
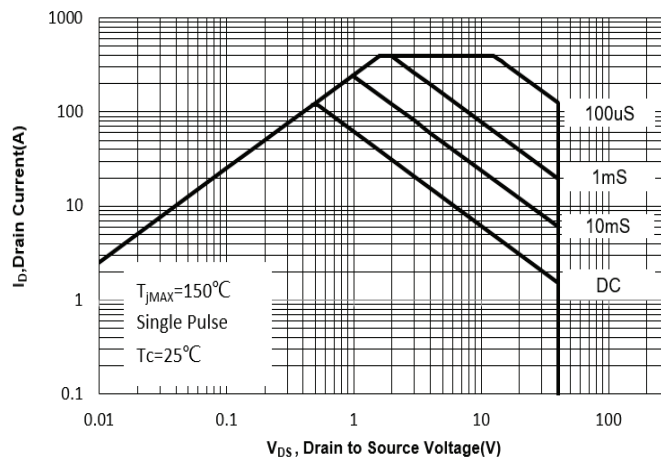


Fig. 12 Safe Operation Area



## Test Circuits

Fig.1-1 Switching times test circuit

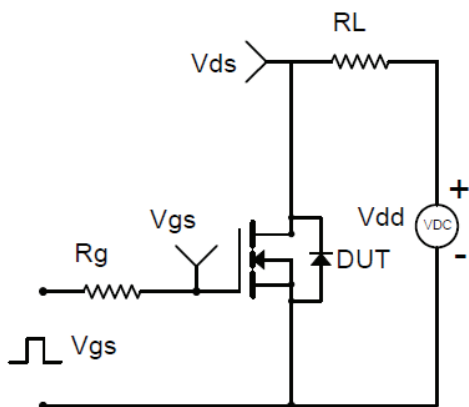


Fig.1-2 Switching Waveform

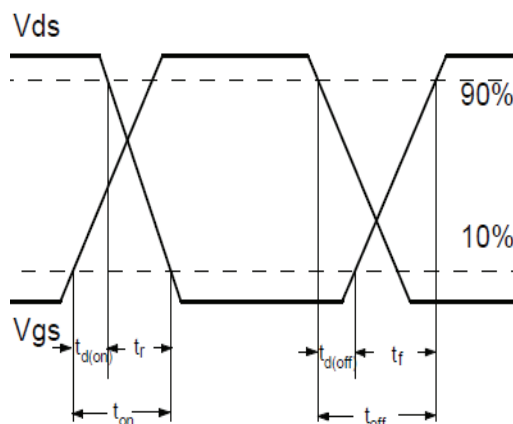


Fig.2-1 Gate charge test circuit

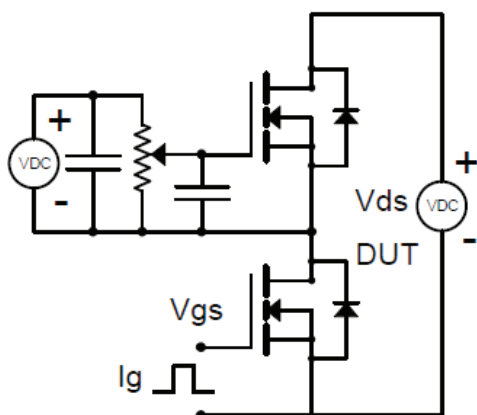


Fig.2-2 Gate charge waveform

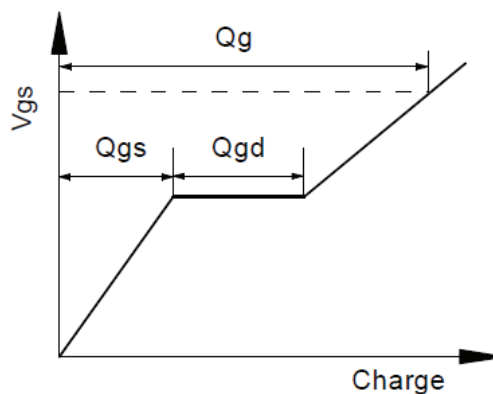


Fig.3-1 Avalanche test circuit

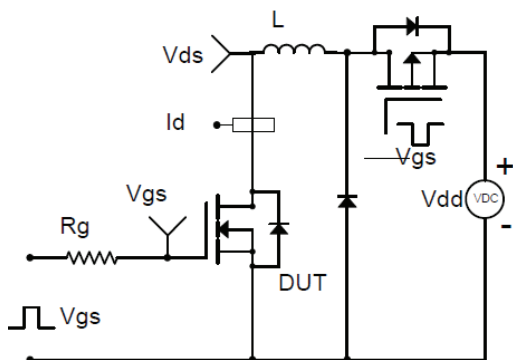
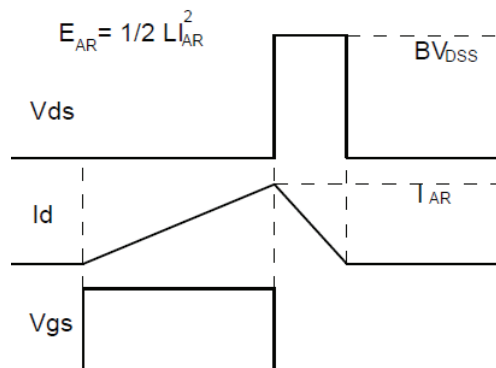
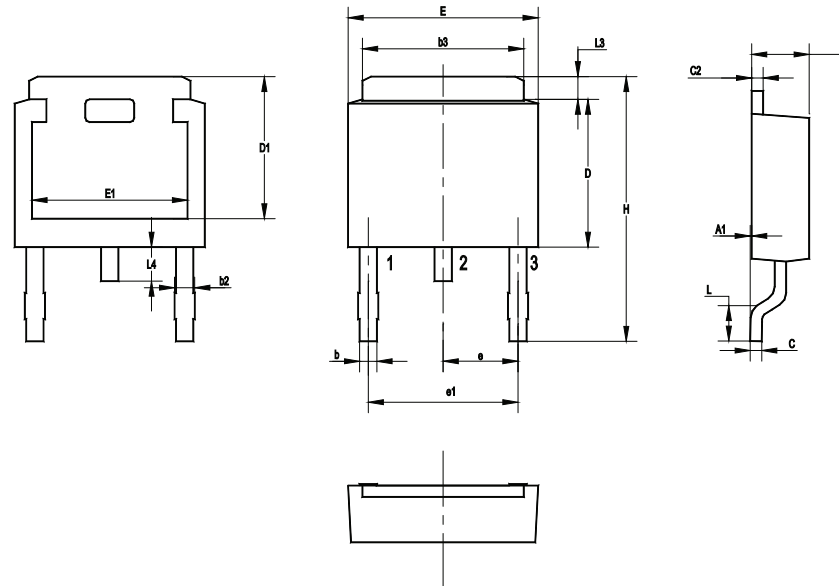


Fig.3-2 Avalanche waveform



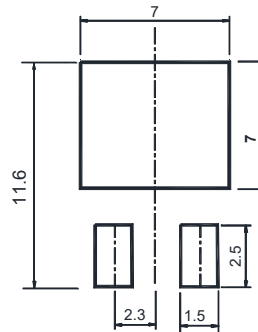
Package Outline Dimensions (Units: mm)

TO-252



| UNIT | A   | A1   | b   | b2   | b3  | C    | C2   | D   | D1  | E   | E1  | e    | e1   | H    | L    | L3   | L4   |
|------|-----|------|-----|------|-----|------|------|-----|-----|-----|-----|------|------|------|------|------|------|
| mm   | 2.5 | 0.15 | 1.0 | 1.15 | 5.5 | 0.65 | 0.65 | 6.2 | 5.4 | 6.7 | 5.0 | 2.30 | 4.60 | 10.7 | 1.78 | 1.20 | 1.10 |
|      | 2.1 | 0    | 0.5 | 0.65 | 4.9 | 0.4  | 0.4  | 5.6 | 5.0 | 6.1 | 4.6 | TYP. | TYP. | 9    | 1.40 | 0.85 | 0.51 |

Recommended Soldering Footprint



Packing information

| Package | Tape Width (mm) | Pitch   |               | Reel Size |      | Per Reel Packing Quantity |
|---------|-----------------|---------|---------------|-----------|------|---------------------------|
|         |                 | mm      | inch          | mm        | inch |                           |
| TO-252  | 16              | 8 ± 0.1 | 0.315 ± 0.004 | 330       | 13   | 2,500                     |

Marking information

" DR04N019LS " = Part No.

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

Font type: Arial



Disclaimer: Our company reserve the right to make modifications, enhancements, improvements, corrections or other changes to improve product design, functions and reliability, anytime without notice.