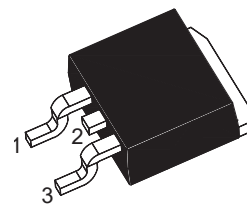
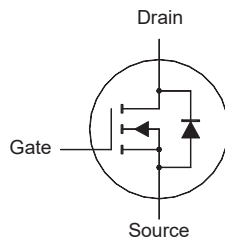


## N-Channel Enhancement Mode MOSFET

### Features

- Surface-mounted package
- Low Gate-Source Threshold Voltage
- Halogen and Antimony Free(HAF),  
RoHS compliant



1.Gate 2.Drain 3.Source  
TO-263 Plastic Package

### Key Parameters

| Parameter        | Value                        | Unit       |
|------------------|------------------------------|------------|
| $BV_{DSS}$       | 40                           | V          |
| $R_{DS(ON)}$ Max | 4 @ $V_{GS} = 10\text{ V}$   | m $\Omega$ |
|                  | 5 @ $V_{GS} = 4.5\text{ V}$  |            |
| $V_{GS(th)}$ typ | 1.5                          | V          |
| $Q_g$ typ        | 143 @ $V_{GS} = 10\text{ V}$ | 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                |
| Drain Current                                    | $I_D$          | 105           | A                |
| $T_c = 25^\circ\text{C}$                         |                | 73            |                  |
| $T_c = 100^\circ\text{C}$                        |                |               |                  |
| Peak Drain Current, Pulsed <sup>1)</sup>         | $I_{DM}$       | 500           | A                |
| Avalanche Current                                | $I_{AS}$       | 58.8          | A                |
| Single Pulse Avalanche Energy <sup>2)</sup>      | $E_{AS}$       | 172.8         | mJ               |
| Power Dissipation                                | $P_D$          | 83.3          | W                |
| $T_c = 25^\circ\text{C}$                         |                |               |                  |
| Operating Junction and Storage Temperature Range | $T_J, T_{stg}$ | - 55 to + 175 | $^\circ\text{C}$ |

### Thermal Characteristics

| Parameter                                                 | Symbol          | Max. | Unit               |
|-----------------------------------------------------------|-----------------|------|--------------------|
| Thermal Resistance from Junction to Case                  | $R_{\theta JC}$ | 1.8  | $^\circ\text{C/W}$ |
| Thermal Resistance from Junction to Ambient <sup>3)</sup> | $R_{\theta JA}$ | 30   | $^\circ\text{C/W}$ |

<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  $T_{J(MAX)} = 175^\circ\text{C}$ .

<sup>2)</sup> Limited by  $T_{J(MAX)}$ , starting  $T_J = 25^\circ\text{C}$ ,  $L = 0.1\text{ mH}$ ,  $R_g = 25\text{ }\Omega$ ,  $I_{AS} = 58.8\text{ A}$ ,  $V_{GS} = 10\text{ V}$ .

<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 $V_{GS} = \pm 16\ \text{V}$                                                                                                                           | $I_{GSS}$    | -      | -         | $\pm 100$ | nA            |
| Gate-Source Threshold Voltage<br>at $V_{DS} = V_{GS}$ , $I_D = 250\ \mu\text{A}$                                                                                                 | $V_{GS(th)}$ | 1      | -         | 2.5       | V             |
| Drain-Source On-State Resistance<br>at $V_{GS} = 10\ \text{V}$ , $I_D = 30\ \text{A}$<br>at $V_{GS} = 4.5\ \text{V}$ , $I_D = 20\ \text{A}$                                      | $R_{DS(on)}$ | -<br>- | 3.4<br>-  | 4<br>5    | m $\Omega$    |
| <b>DYNAMIC PARAMETERS</b>                                                                                                                                                        |              |        |           |           |               |
| Forward Transconductance<br>at $V_{DS} = 5\ \text{V}$ , $I_D = 20\ \text{A}$                                                                                                     | $g_{fs}$     | -      | 55.8      | -         | S             |
| Gate Resistance<br>at $V_{GS} = 0\ \text{V}$ , $V_{DS} = 0\ \text{V}$ , $f = 1\ \text{MHz}$                                                                                      | $R_g$        | -      | 0.5       | -         | $\Omega$      |
| Input Capacitance<br>at $V_{GS} = 0\ \text{V}$ , $V_{DS} = 20\ \text{V}$ , $f = 1\ \text{MHz}$                                                                                   | $C_{iss}$    | -      | 7007      | -         | pF            |
| Output Capacitance<br>at $V_{GS} = 0\ \text{V}$ , $V_{DS} = 20\ \text{V}$ , $f = 1\ \text{MHz}$                                                                                  | $C_{oss}$    | -      | 549       | -         | pF            |
| Reverse Transfer Capacitance<br>at $V_{GS} = 0\ \text{V}$ , $V_{DS} = 20\ \text{V}$ , $f = 1\ \text{MHz}$                                                                        | $C_{rss}$    | -      | 404       | -         | pF            |
| Gate charge total<br>at $V_{DS} = 20\ \text{V}$ , $V_{GS} = 10\ \text{V}$ , $I_D = 30\ \text{A}$<br>at $V_{DS} = 20\ \text{V}$ , $V_{GS} = 4.5\ \text{V}$ , $I_D = 30\ \text{A}$ | $Q_g$        | -<br>- | 143<br>68 | -<br>-    | nC            |
| Gate to Source Charge<br>at $V_{DS} = 20\ \text{V}$ , $V_{GS} = 10\ \text{V}$ , $I_D = 30\ \text{A}$                                                                             | $Q_{gs}$     | -      | 22        | -         | nC            |
| Gate to Drain Charge<br>at $V_{DS} = 20\ \text{V}$ , $V_{GS} = 10\ \text{V}$ , $I_D = 30\ \text{A}$                                                                              | $Q_{gd}$     | -      | 28        | -         | nC            |
| Turn-On Delay Time<br>at $V_{DS} = 20\ \text{V}$ , $V_{GS} = 10\ \text{V}$ , $I_D = 30\ \text{A}$ , $R_g = 3.3\ \Omega$                                                          | $t_{d(on)}$  | -      | 40        | -         | ns            |
| Turn-On Rise Time<br>at $V_{DS} = 20\ \text{V}$ , $V_{GS} = 10\ \text{V}$ , $I_D = 30\ \text{A}$ , $R_g = 3.3\ \Omega$                                                           | $t_r$        | -      | 63        | -         | ns            |
| Turn-Off Delay Time<br>at $V_{DS} = 20\ \text{V}$ , $V_{GS} = 10\ \text{V}$ , $I_D = 30\ \text{A}$ , $R_g = 3.3\ \Omega$                                                         | $t_{d(off)}$ | -      | 37        | -         | ns            |
| Turn-Off Fall Time<br>at $V_{DS} = 20\ \text{V}$ , $V_{GS} = 10\ \text{V}$ , $I_D = 30\ \text{A}$ , $R_g = 3.3\ \Omega$                                                          | $t_f$        | -      | 9         | -         | 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                                                                                                                                                    | $I_S$        | -      | -         | 105       | A             |
| Body-Diode Continuous Current, Pulsed                                                                                                                                            | $I_{SM}$     | -      | -         | 500       | A             |
| Body Diode Reverse Recovery Time<br>at $I_S = 30\ \text{A}$ , $di/dt = 100\ \text{A} / \mu\text{s}$                                                                              | $t_{rr}$     | -      | 21        | -         | ns            |
| Body Diode Reverse Recovery Charge<br>at $I_S = 30\ \text{A}$ , $di/dt = 100\ \text{A} / \mu\text{s}$                                                                            | $Q_{rr}$     | -      | 13        | -         | nC            |

## Electrical Characteristics Curves

Fig. 1 Typical Output Characteristics

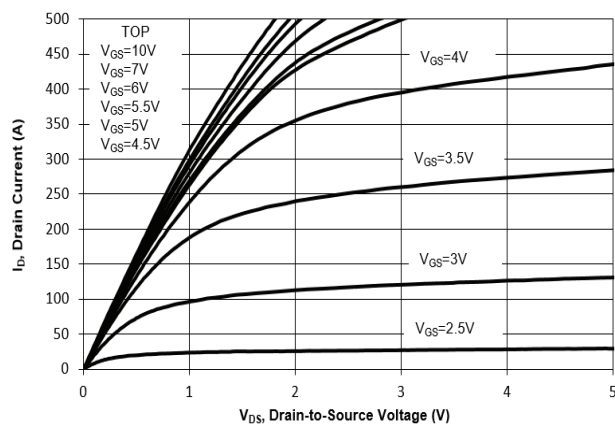


Fig. 2 Typical Transfer Characteristics

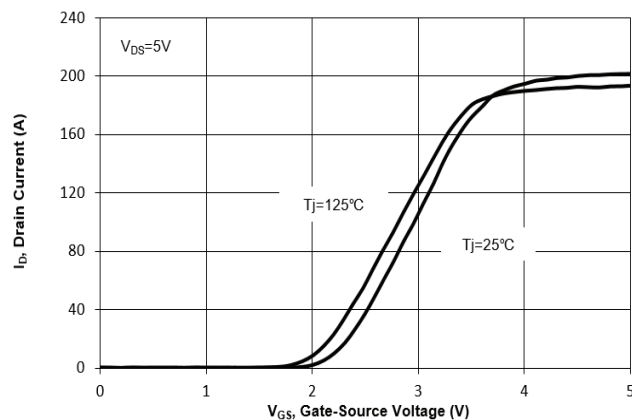


Fig. 3 On-Resistance vs. Drain Current

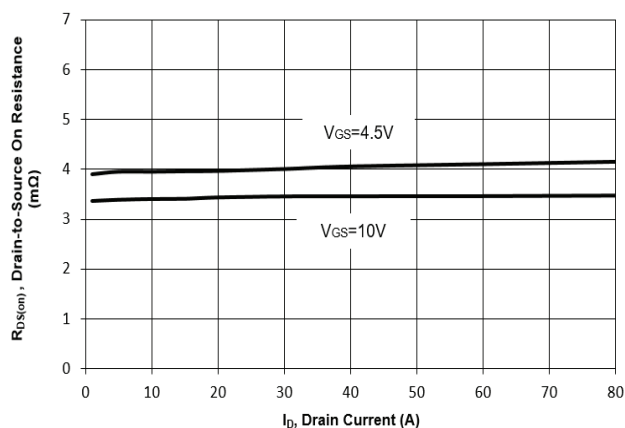


Fig. 4 On-Resistance vs. Gate to Source Voltage

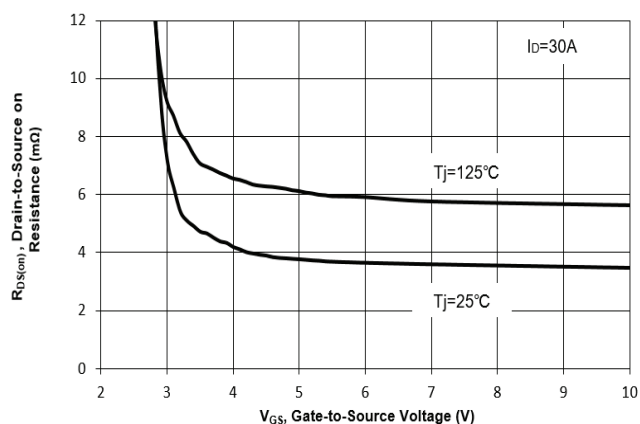


Fig. 5 On-Resistance vs.  $T_J$

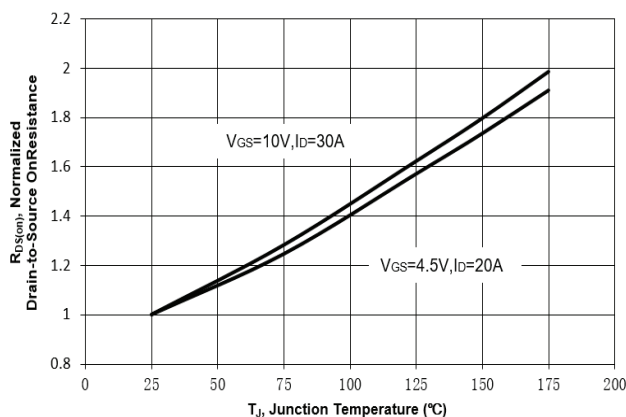
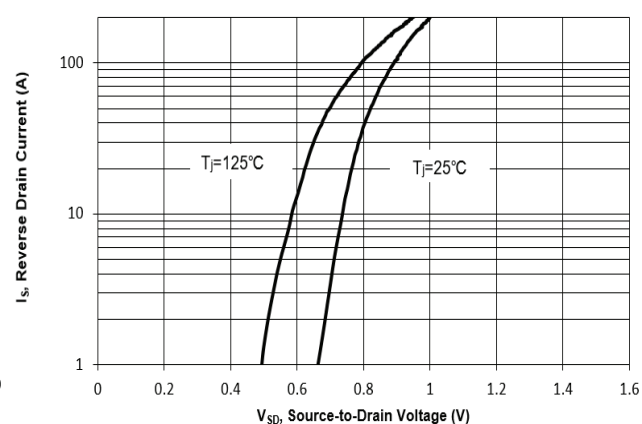


Fig. 6 Typical Body-Diode Forward Characteristics



## Electrical Characteristics Curves

Fig. 7 Typical Junction Capacitance

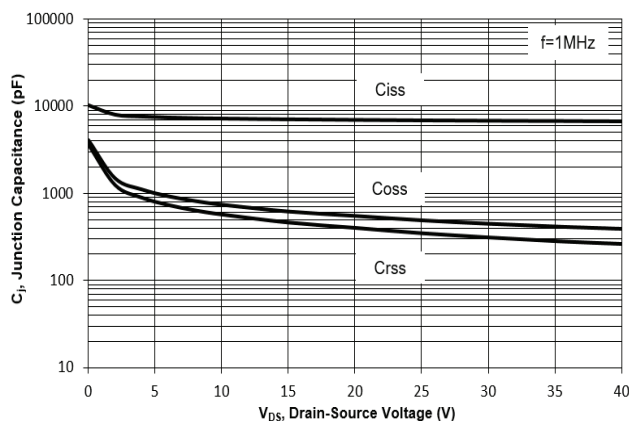


Fig. 8 Drain-Source Leakage Current vs.  $T_j$

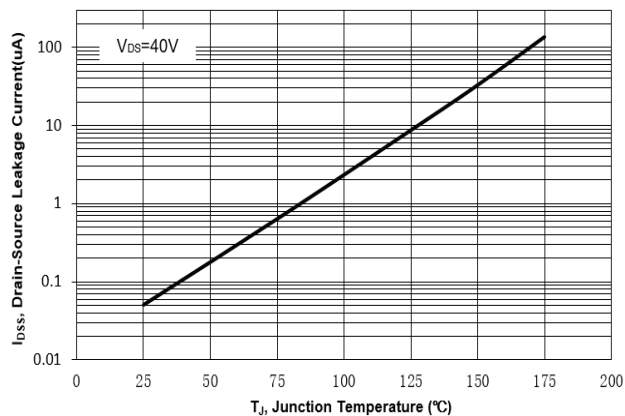


Fig. 9  $V_{(BR)DSS}$  vs. Junction Temperature

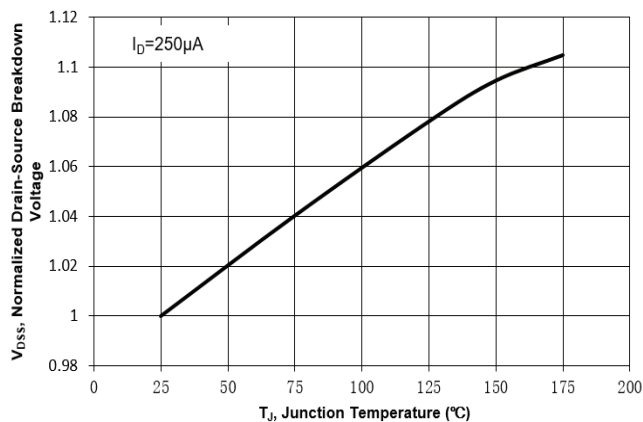


Fig. 10 Gate Threshold Variation vs.  $T_j$

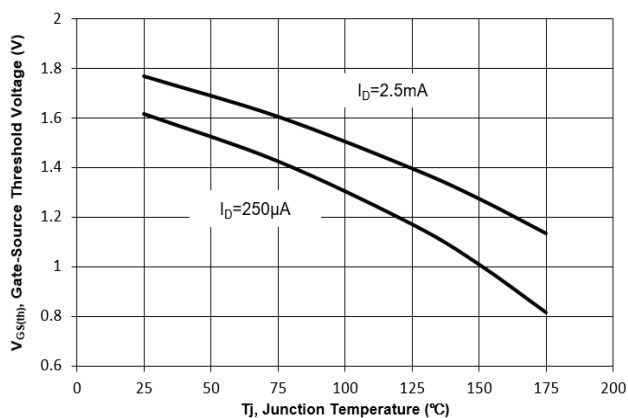


Fig. 11 Gate Charge

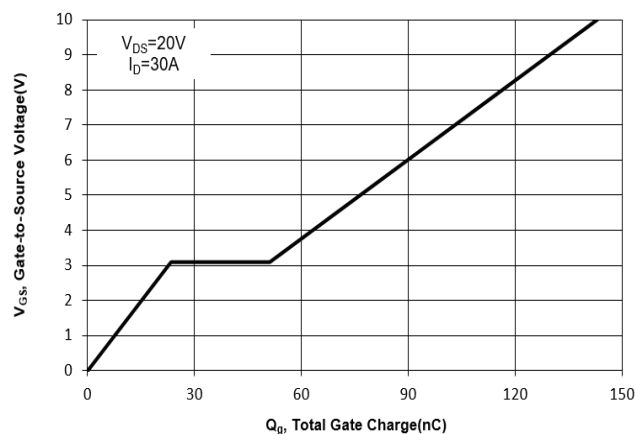
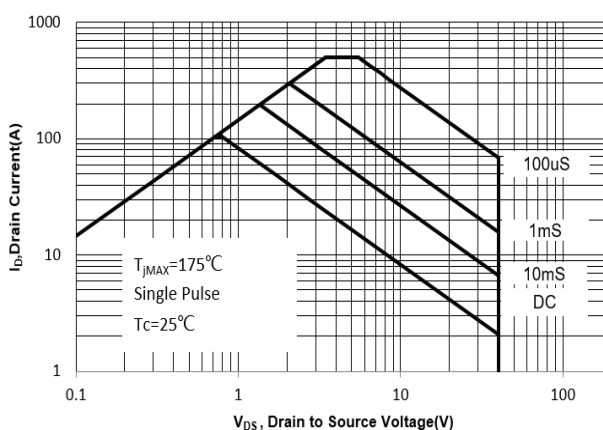


Fig. 12 Safe Operation Area



## Electrical Characteristics Curves

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

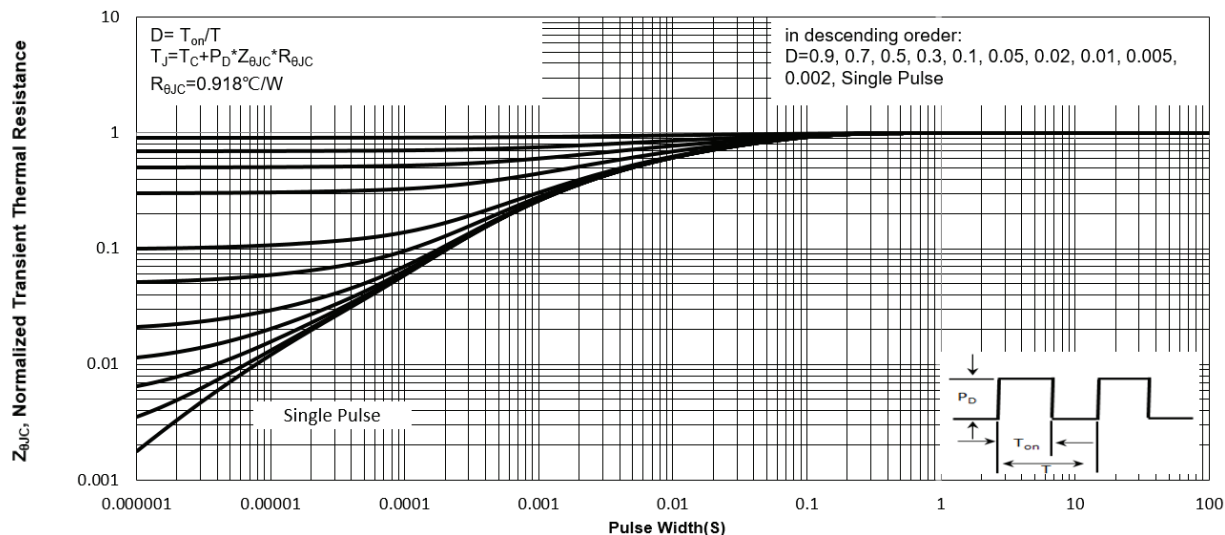
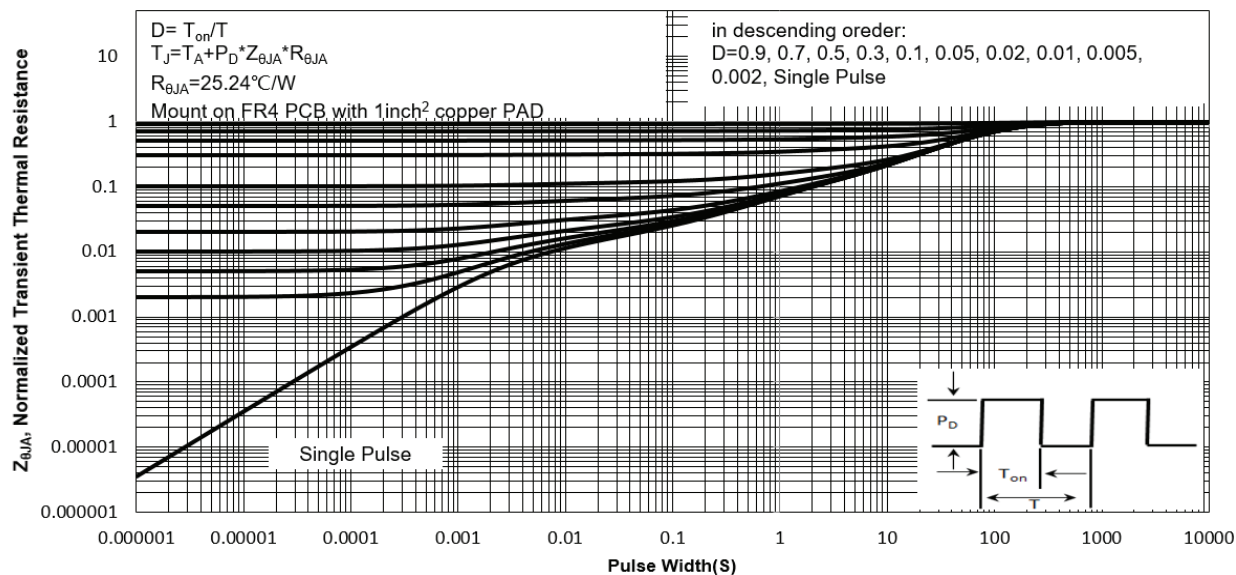


Fig. 14 Normalized Maximum Transient Thermal Impedance( $Z_{\theta JA}$ )



## Test Circuits

Fig.1-1 Switching times test circuit

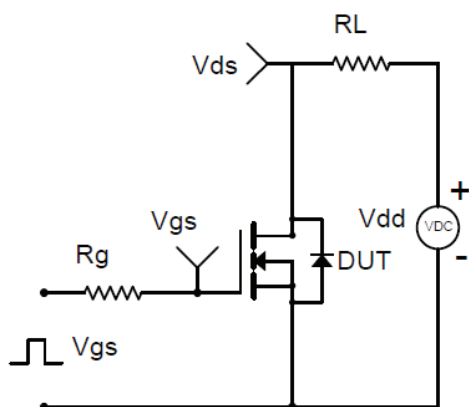


Fig.1-2 Switching Waveform

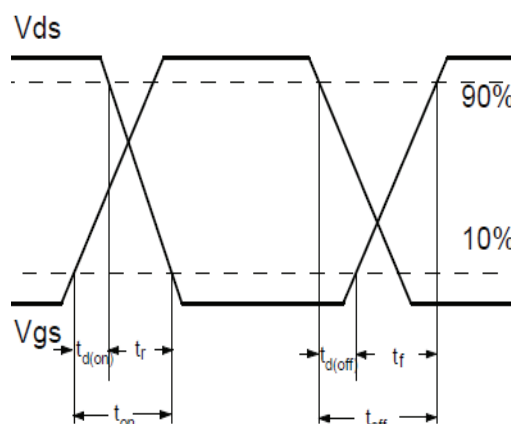


Fig.2-1 Gate charge test circuit

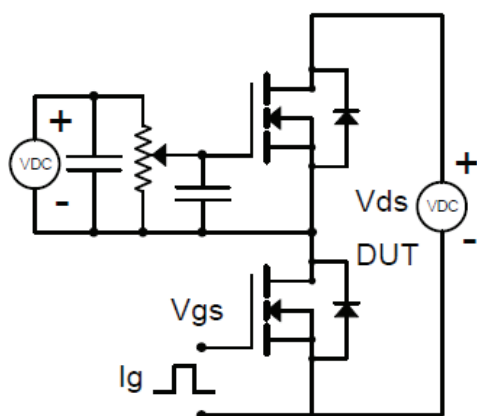


Fig.2-2 Gate charge waveform

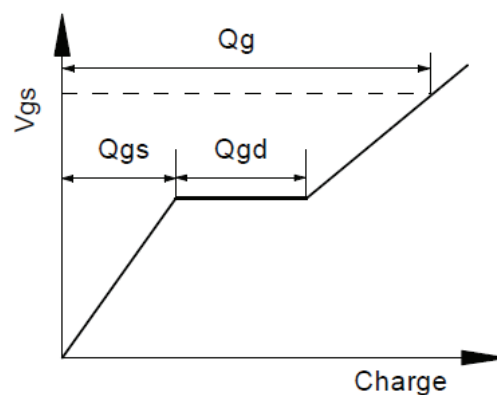


Fig.3-1 Avalanche test circuit

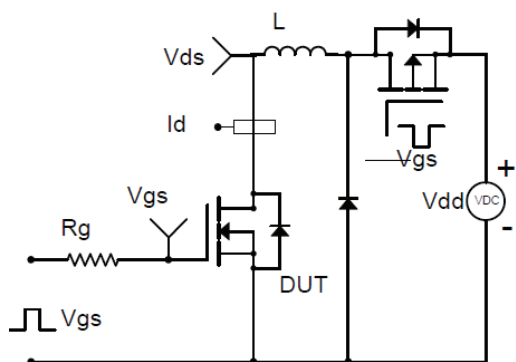
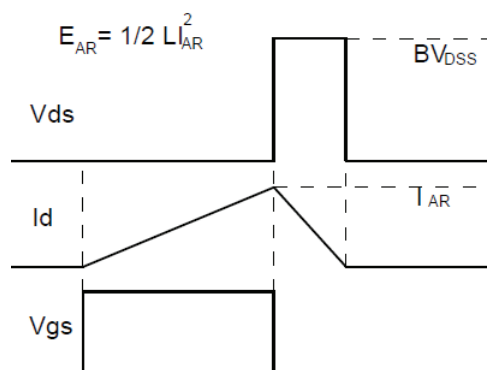
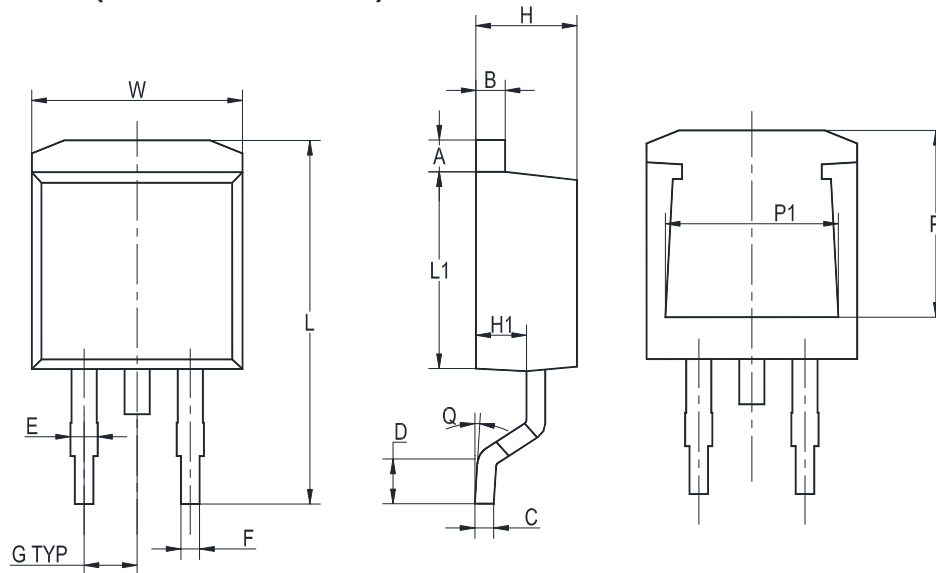
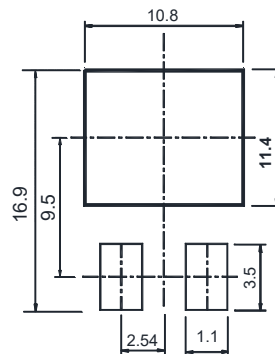


Fig.3-2 Avalanche waveform



**Package Outline (Dimensions in mm)**
**TO-263**


| UNIT | A   | B   | C   | D    | E   | F    | G    | W    | H   | H1  | L    | L1  | Q   | P   | P1  |
|------|-----|-----|-----|------|-----|------|------|------|-----|-----|------|-----|-----|-----|-----|
| mm   | 1.5 | 1.5 | 0.5 | 2.60 | 1.6 | 0.94 | 2.54 | 10.5 | 4.8 | 2.9 | 16.5 | 8.7 | 8°  | 7.6 | 8.2 |
|      | 1.1 | 1.1 | 0.3 | 2.15 | 1.1 | 0.68 | TYP  | 9.6  | 4.4 | 2.5 | 14.5 | 8.2 | MAX | 7.1 | 7.4 |

**Recommended Soldering Footprint**

**Packing information**

| Package | Reel Quantity | Box Quantity | Carton Quantity | Delivery Mode |
|---------|---------------|--------------|-----------------|---------------|
| TO-263  | 0.8 K / Reel  | 0.8 K / Box  | 4K pcs / Carton | Reel          |

**Marking information**

" TV04N040LS " = Part No.

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

Font type: Arial



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