

# TK35A65W

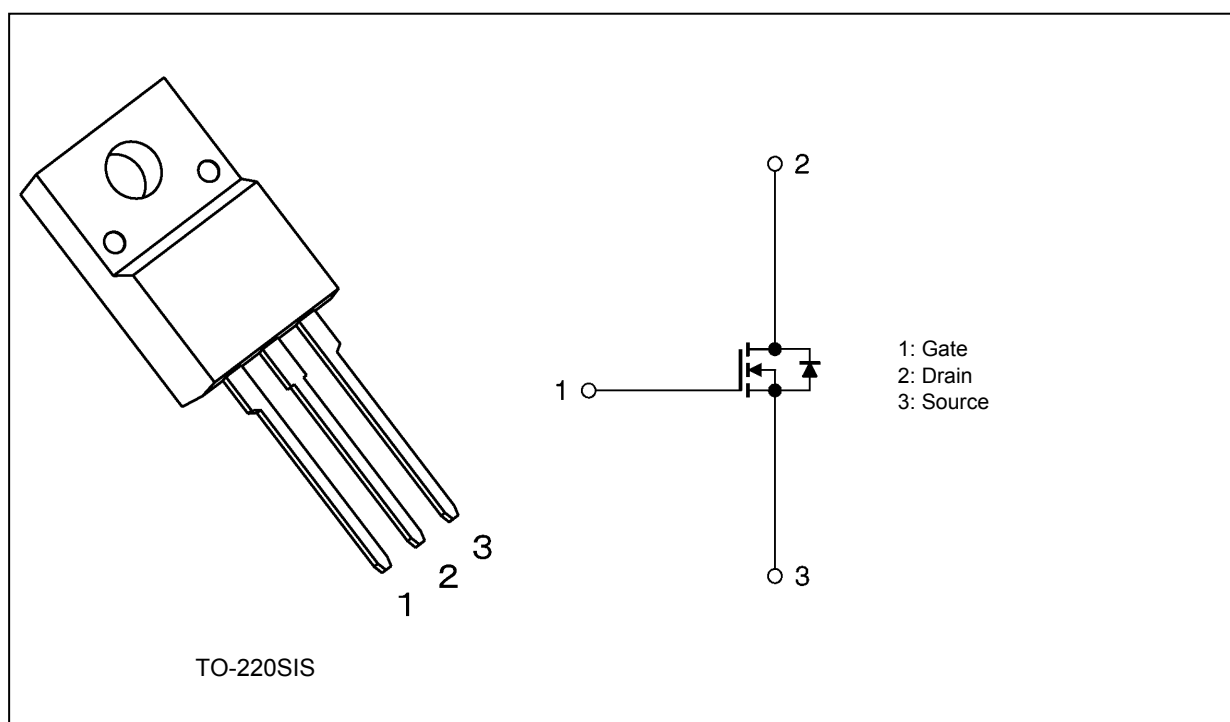
## 1. Applications

- Switching Voltage Regulators

## 2. Features

- (1) Low drain-source on-resistance:  $R_{DS(ON)} = 0.068 \Omega$  (typ.)  
by using Super Junction Structure : DTMOS
- (2) Easy to control Gate switching
- (3) Enhancement mode:  $V_{th} = 2.5$  to  $3.5$  V ( $V_{DS} = 10$  V,  $I_D = 2.1$  mA)

## 3. Packaging and Internal Circuit



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

| Characteristics                                | Symbol                | Rating     | Unit             |
|------------------------------------------------|-----------------------|------------|------------------|
| Drain-source voltage                           | $V_{\text{DSS}}$      | 650        | V                |
| Gate-source voltage                            | $V_{\text{GSS}}$      | $\pm 30$   |                  |
| Drain current (DC) (Note 1)                    | $I_{\text{D}}$        | 35         | A                |
| Drain current (pulsed) (Note 1)                | $I_{\text{DP}}$       | 140        |                  |
| Power dissipation ( $T_c = 25^\circ\text{C}$ ) | $P_{\text{D}}$        | 50         | W                |
| Single-pulse avalanche energy (Note 2)         | $E_{\text{AS}}$       | 614        | mJ               |
| Avalanche current                              | $I_{\text{AR}}$       | 8.8        | A                |
| Reverse drain current (DC) (Note 1)            | $I_{\text{DR}}$       | 35         |                  |
| Reverse drain current (pulsed) (Note 1)        | $I_{\text{DRP}}$      | 140        |                  |
| Channel temperature                            | $T_{\text{ch}}$       | 150        | $^\circ\text{C}$ |
| Storage temperature                            | $T_{\text{stg}}$      | -55 to 150 |                  |
| Isolation voltage (RMS)                        | $V_{\text{ISO(RMS)}}$ | 2000       | V                |
| Mounting torque                                | TOR                   | 0.6        | N · m            |

Note: Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) are within the absolute maximum ratings.

Please design the appropriate reliability upon reviewing the Toshiba Semiconductor Reliability Handbook ("Handling Precautions"/"Derating Concept and Methods") and individual reliability data (i.e. reliability test report and estimated failure rate, etc.).

#### 5. Thermal Characteristics

| Characteristics                       | Symbol                | Max  | Unit               |
|---------------------------------------|-----------------------|------|--------------------|
| Channel-to-case thermal resistance    | $R_{\text{th(ch-c)}}$ | 2.5  | $^\circ\text{C/W}$ |
| Channel-to-ambient thermal resistance | $R_{\text{th(ch-a)}}$ | 62.5 |                    |

Note 1: Ensure that the channel temperature does not exceed  $150^\circ\text{C}$ .

Note 2:  $V_{\text{DD}} = 90\text{ V}$ ,  $T_{\text{ch}} = 25^\circ\text{C}$  (initial),  $L = 14\text{ mH}$ ,  $R_{\text{G}} = 25\ \Omega$ ,  $I_{\text{AR}} = 8.8\text{ A}$

Note: This transistor is sensitive to electrostatic discharge and should be handled with care.

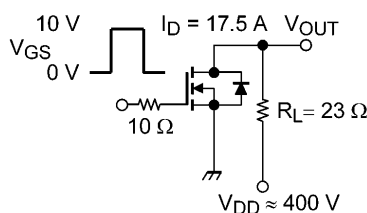
## 6. Electrical Characteristics

### 6.1. Static Characteristics ( $T_a = 25^\circ\text{C}$ unless otherwise specified)

| Characteristics                | Symbol        | Test Condition                                     | Min | Typ.  | Max     | Unit          |
|--------------------------------|---------------|----------------------------------------------------|-----|-------|---------|---------------|
| Gate leakage current           | $I_{GSS}$     | $V_{GS} = \pm 30\text{ V}$ , $V_{DS} = 0\text{ V}$ | —   | —     | $\pm 1$ | $\mu\text{A}$ |
| Drain cut-off current          | $I_{DSS}$     | $V_{DS} = 650\text{ V}$ , $V_{GS} = 0\text{ V}$    | —   | —     | 10      |               |
| Drain-source breakdown voltage | $V_{(BR)DSS}$ | $I_D = 10\text{ mA}$ , $V_{GS} = 0\text{ V}$       | 650 | —     | —       | V             |
| Gate threshold voltage         | $V_{th}$      | $V_{DS} = 10\text{ V}$ , $I_D = 2.1\text{ mA}$     | 2.5 | —     | 3.5     |               |
| Drain-source on-resistance     | $R_{DS(ON)}$  | $V_{GS} = 10\text{ V}$ , $I_D = 17.5\text{ A}$     | —   | 0.068 | 0.08    | $\Omega$      |

### 6.2. Dynamic Characteristics ( $T_a = 25^\circ\text{C}$ unless otherwise specified)

| Characteristics                | Symbol      | Test Condition                                                         | Min | Typ. | Max | Unit     |
|--------------------------------|-------------|------------------------------------------------------------------------|-----|------|-----|----------|
| Input capacitance              | $C_{iss}$   | $V_{DS} = 300\text{ V}$ , $V_{GS} = 0\text{ V}$ , $f = 100\text{ kHz}$ | —   | 4100 | —   | pF       |
| Reverse transfer capacitance   | $C_{rss}$   |                                                                        | —   | 9    | —   |          |
| Output capacitance             | $C_{oss}$   |                                                                        | —   | 90   | —   |          |
| Effective output capacitance   | $C_{o(er)}$ | $V_{DS} = 0\text{ to }400\text{ V}$ , $V_{GS} = 0\text{ V}$            | —   | 130  | —   |          |
| Gate resistance                | $r_g$       | $V_{DS} = \text{OPEN}$ , $f = 1\text{ MHz}$                            | —   | 2    | —   | $\Omega$ |
| Switching time (rise time)     | $t_r$       | See Figure 6.2.1                                                       | —   | 30   | —   | ns       |
| Switching time (turn-on time)  | $t_{on}$    |                                                                        | —   | 70   | —   |          |
| Switching time (fall time)     | $t_f$       |                                                                        | —   | 8    | —   |          |
| Switching time (turn-off time) | $t_{off}$   |                                                                        | —   | 150  | —   |          |
| MOSFET dv/dt ruggedness        | dv/dt       | $V_{DD} = 0\text{ to }400\text{ V}$ , $I_D = 17.5\text{ A}$            | 50  | —    | —   | V/ns     |



Duty  $\leq 1\%$ ,  $t_w = 10\text{ }\mu\text{s}$

Fig. 6.2.1 Switching Time Test Circuit

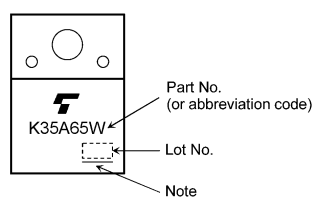
### 6.3. Gate Charge Characteristics ( $T_a = 25^\circ\text{C}$ unless otherwise specified)

| Characteristics                                 | Symbol    | Test Condition                                                               | Min | Typ. | Max | Unit |
|-------------------------------------------------|-----------|------------------------------------------------------------------------------|-----|------|-----|------|
| Total gate charge (gate-source plus gate-drain) | $Q_g$     | $V_{DD} \approx 400\text{ V}$ , $V_{GS} = 10\text{ V}$ , $I_D = 35\text{ A}$ | —   | 100  | —   | nC   |
| Gate-source charge 1                            | $Q_{gs1}$ |                                                                              | —   | 25   | —   |      |
| Gate-drain charge                               | $Q_{gd}$  |                                                                              | —   | 35   | —   |      |

### 6.4. Source-Drain Characteristics ( $T_a = 25^\circ\text{C}$ unless otherwise specified)

| Characteristics               | Symbol    | Test Condition                                                                              | Min | Typ. | Max  | Unit          |
|-------------------------------|-----------|---------------------------------------------------------------------------------------------|-----|------|------|---------------|
| Diode forward voltage         | $V_{DSF}$ | $I_{DR} = 35\text{ A}$ , $V_{GS} = 0\text{ V}$                                              | —   | —    | -1.7 | V             |
| Reverse recovery time         | $t_{rr}$  | $I_{DR} = 17.5\text{ A}$ , $V_{GS} = 0\text{ V}$<br>$-dI_{DR}/dt = 50\text{ A}/\mu\text{s}$ | —   | 430  | —    | ns            |
| Reverse recovery charge       | $Q_{rr}$  |                                                                                             | —   | 4.2  | —    | $\mu\text{C}$ |
| Peak reverse recovery current | $I_{rr}$  |                                                                                             | —   | 21   | —    | A             |
| Diode dv/dt ruggedness        | dv/dt     | $I_{DR} = 17.5\text{ A}$ , $V_{GS} = 0\text{ V}$ , $V_{DD} = 400\text{ V}$                  | 15  | —    | —    | V/ns          |

## 7. Marking (Note)



**Fig. 7.1 Marking**

Note: A line under a Lot No. identifies the indication of product Labels.

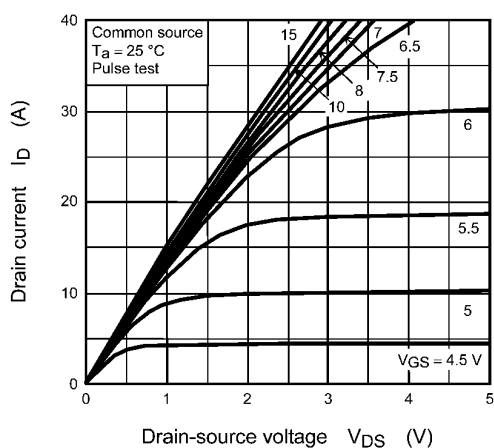
Not underlined: [[Pb]]/INCLUDES > MCV

Underlined: [[G]]/RoHS COMPATIBLE or [[G]]/RoHS [[Pb]]

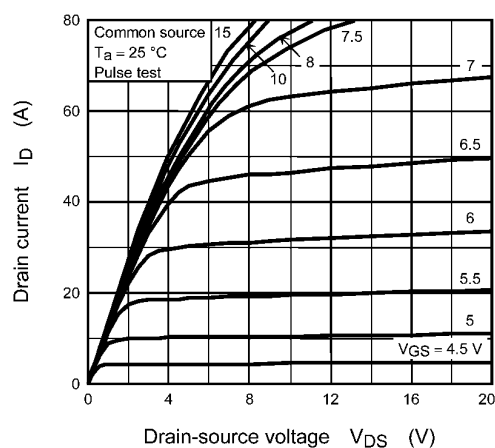
Please contact your TOSHIBA sales representative for details as to environmental matters such as the RoHS compatibility of Product.

The RoHS is the Directive 2011/65/EU of the European Parliament and of the Council of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment.

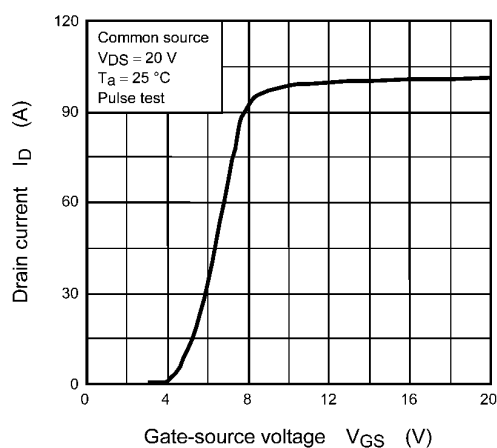
# 8. Characteristics Curves (Note)



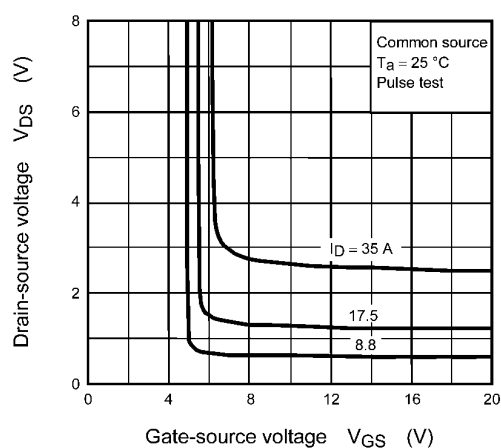
**Fig. 8.1**  $I_D - V_{DS}$



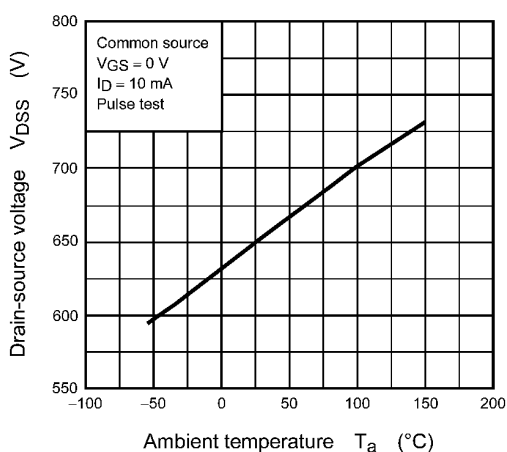
**Fig. 8.2**  $I_D - V_{DS}$



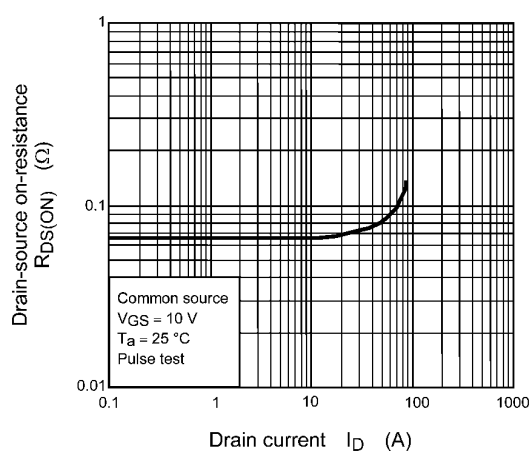
**Fig. 8.3**  $I_D - V_{GS}$



**Fig. 8.4**  $V_{DS} - V_{GS}$



**Fig. 8.5**  $V_{DS} - T_a$



**Fig. 8.6**  $R_{DS(ON)} - I_D$

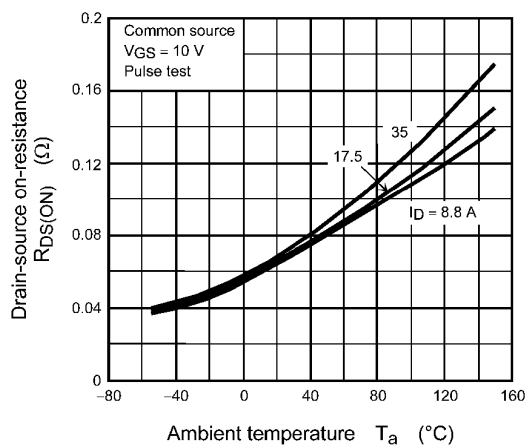


Fig. 8.7  $R_{DS(ON)} - T_a$

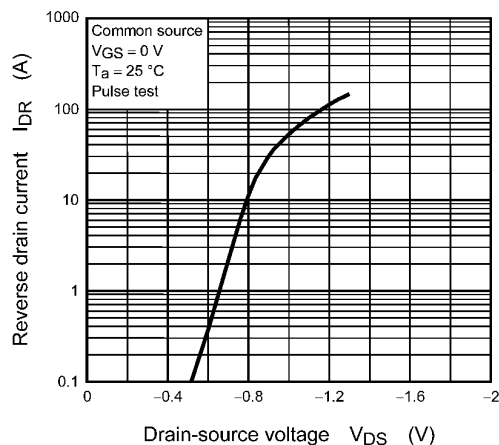


Fig. 8.8  $I_{DR} - V_{DS}$

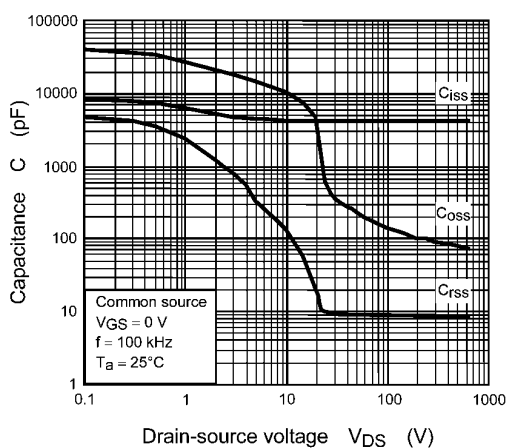


Fig. 8.9  $C - V_{DS}$

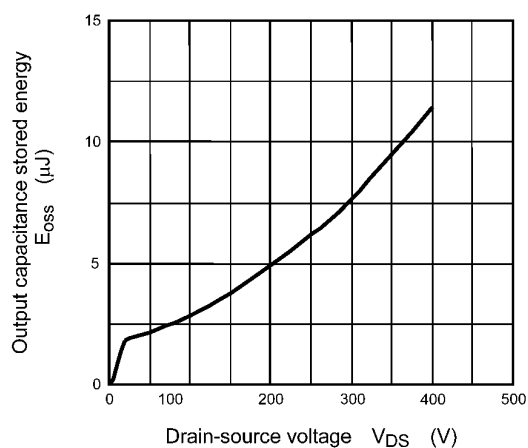


Fig. 8.10  $E_{OSS} - V_{DS}$

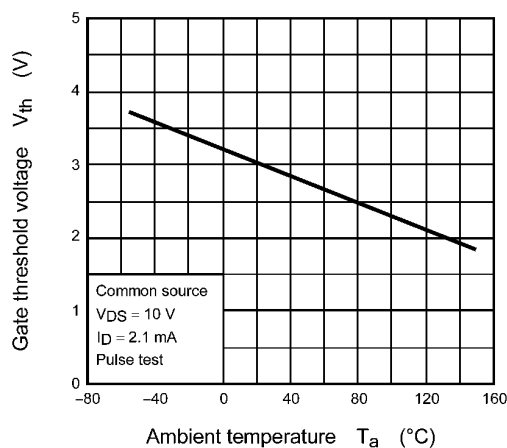


Fig. 8.11  $V_{th} - T_a$

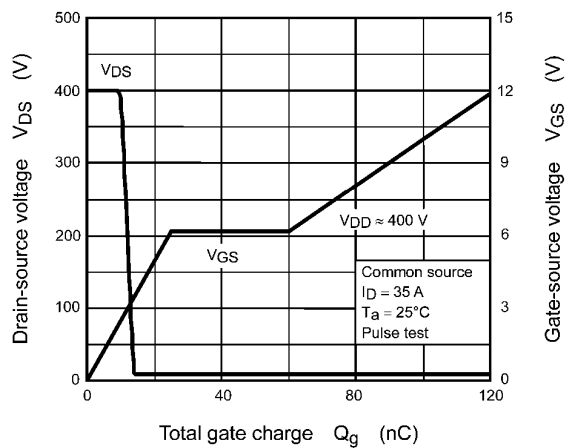
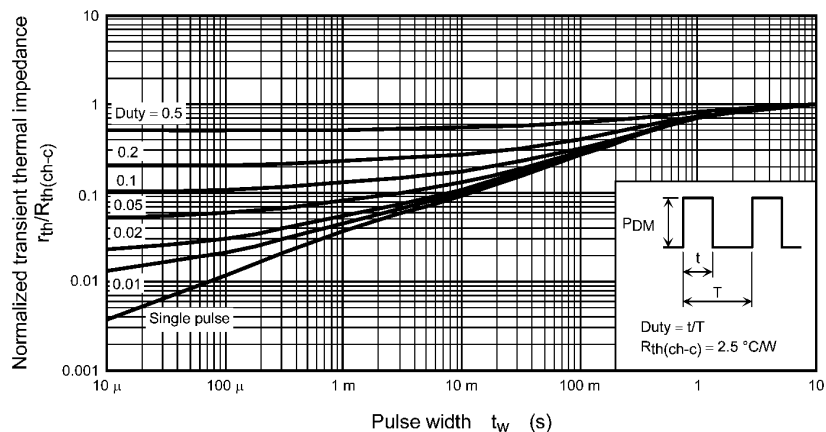
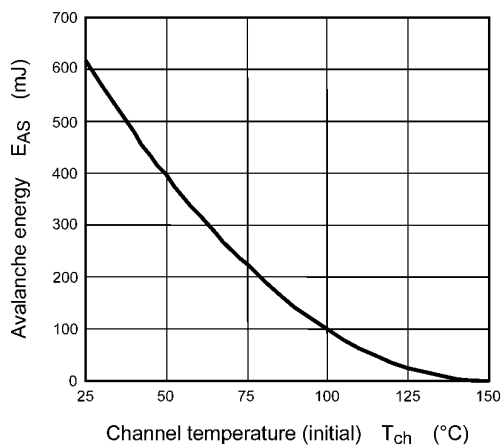


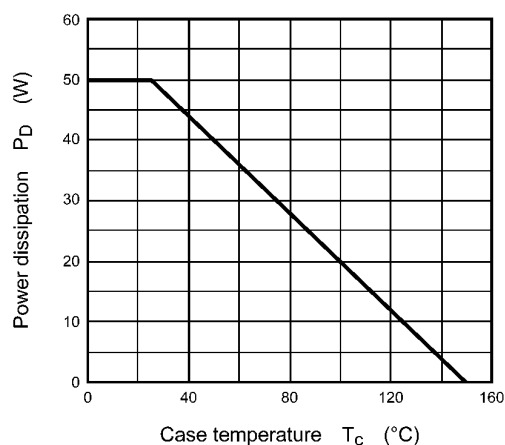
Fig. 8.12 Dynamic Input/Output Characteristics



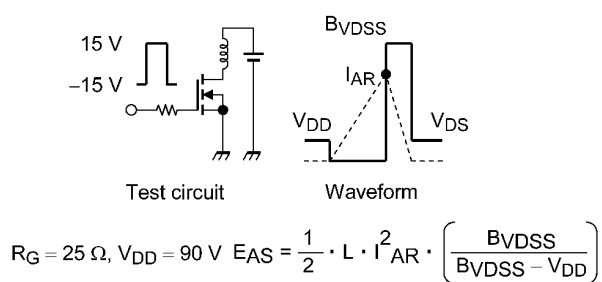
**Fig. 8.13  $r_{th} - t_w$**   
(Guaranteed Maximum)



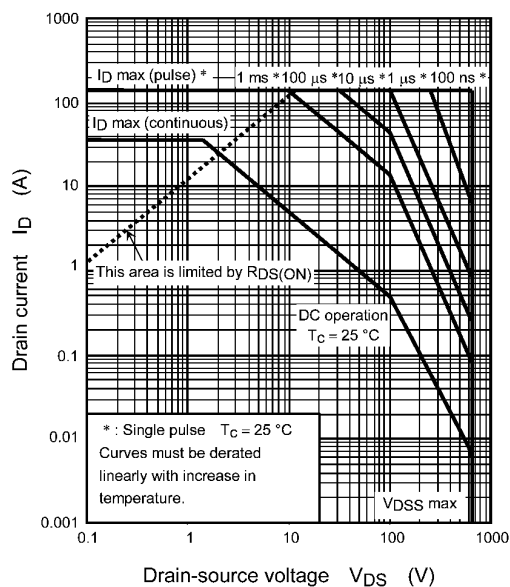
**Fig. 8.14  $E_{AS} - T_{ch}$**   
(Guaranteed Maximum)



**Fig. 8.15  $P_D - T_c$**   
(Guaranteed Maximum)



**Fig. 8.16 Test Circuit/Waveform**



**Fig. 8.17 Safe Operating Area  
(Guaranteed Maximum)**

Note: The above characteristics curves are presented for reference only and not guaranteed by production test, unless otherwise noted.

## Package Dimensions

Unit: mm



Weight: 1.7 g (typ.)

| Package Name(s)     |
|---------------------|
| JEITA: SC-67        |
| TOSHIBA: 2-10U1S    |
| Nickname: TO-220SIS |

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