MOSFETs Silicon N-Channel MOS (DTMOSⅥ)

# TK200U65Z5

## 1. Applications

- Switching Voltage Regulators

## 2. Features

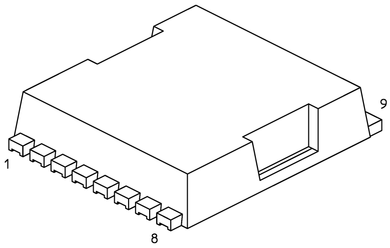
(1) Fast reverse recovery time: $t_{rr}$ = 95 ns (typ.)

(2) Low drain-source on-resistance: $R_{DS(ON)}$ = 0.154 Ω (typ.)

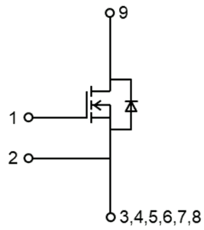
(3) High-speed switching properties with the lower capacitance.

(4) Enhancement mode: $V_{th}$ = 3.5 to 4.5 V ($V_{DS}$ = 10 V, $I_D$ = 0.61 mA)

## 3. Packaging and Internal Circuit




TOLL




1: Gate
2: Source 2
3, 4, 5, 6, 7, 8: Source 1
9: Drain (heatsink)

Notice: Only use source 2 pin for gate input signal return. Please make sure that the main current flows into the source 1 pins.

## 4. Absolute Maximum Ratings (Note) ($T_a$ = 25 °C unless otherwise specified)

| Characteristics | | Symbol | Rating | Unit |
|---|---|---|---|---|
| Drain-source voltage | | $V_{DSS}$ | 650 | V |
| Gate-source voltage | | $V_{GSS}$ | ±30 | |
| Drain current (DC) | (Note 1) | $I_D$ | 15 | A |
| Drain current (pulsed) | (Note 1) | $I_{DP}$ | 60 | |
| Power dissipation | ($T_c$ = 25 °C) | $P_D$ | 130 | W |
| Single-pulse avalanche energy | (Note 2) | $E_{AS}$ | 204 | mJ |
| Single-pulse avalanche current | | $I_{AS}$ | 3 | A |
| Reverse drain current (DC) | (Note 1) | $I_{DR}$ | 15 | |
| Reverse drain current (pulsed) | (Note 1) | $I_{DRP}$ | 60 | |
| Channel temperature | | $T_{ch}$ | 150 | °C |
| Storage temperature | | $T_{stg}$ | -55 to 150 | |

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).

Start of commercial production
2025-02

## 5. Thermal Characteristics

| Characteristics | Symbol | Max | Unit |
|---|---|---|---|
| Channel-to-case thermal resistance | $R_{th(ch\text{-}c)}$ | 0.961 | °C/W |

Note 1: Ensure that the channel temperature does not exceed 150 °C.
Note 2: $V_{DD}$ = 90 V, $T_{ch}$ = 25 °C (initial), L = 40.2 mH, $I_{AS}$ = 3 A

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

## 6. Electrical Characteristics

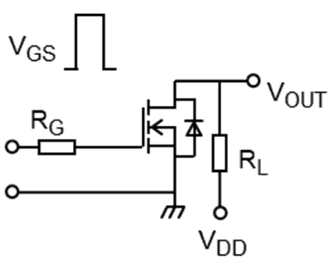
### 6.1. Static Characteristics ($T_a$ = 25 °C unless otherwise specified)

| Characteristics | Symbol | Test Condition | Min | Typ. | Max | Unit |
|---|---|---|---|---|---|---|
| Gate leakage current | $I_{GSS}$ | $V_{GS}$ = ±30 V, $V_{DS}$ = 0 V | — | — | ±1 | μA |
| Drain cut-off current | $I_{DSS}$ | $V_{DS}$ = 650 V, $V_{GS}$ = 0 V | — | — | 100 | |
| Drain-source breakdown voltage | $V_{(BR)DSS}$ | $I_D$ = 10 mA, $V_{GS}$ = 0 V | 650 | — | — | V |
| Gate threshold voltage | $V_{th}$ | $V_{DS}$ = 10 V, $I_D$ = 0.61 mA | 3.5 | — | 4.5 | |
| Drain-source on-resistance | $R_{DS(ON)}$ | $V_{GS}$ = 10 V, $I_D$ = 7.5 A | — | 0.154 | 0.200 | Ω |

### 6.2. Dynamic Characteristics ($T_a$ = 25 °C unless otherwise specified)

| Characteristics | Symbol | Test Condition | Min | Typ. | Max | Unit |
|---|---|---|---|---|---|---|
| Input capacitance | $C_{iss}$ | $V_{DS}$ = 300 V, $V_{GS}$ = 0 V, f = 100 kHz | — | 1400 | — | pF |
| Reverse transfer capacitance | $C_{rss}$ | | — | 1.2 | — | |
| Output capacitance | $C_{oss}$ | | — | 38 | — | |
| Effective output capacitance (Note 3) (energy related) | $C_{o(er)}$ | $V_{DS}$ = 0 to 400 V, $V_{GS}$ = 0 V | — | 58 | — | |
| Effective output capacitance (Note 4) (time related) | $C_{o(tr)}$ | | — | 375 | — | |
| Gate resistance | $r_g$ | $V_{DS}$ = OPEN , f = 1 MHz | — | 2.8 | — | Ω |
| Switching time (rise time) | $t_r$ | See Fig. 6.2.1 | — | 10 | — | ns |
| Switching time (turn-on time) | $t_{on}$ | | — | 35 | — | |
| Switching time (fall time) | $t_f$ | | — | 4.4 | — | |
| Switching time (turn-off time) | $t_{off}$ | | — | 60 | — | |
| MOSFET dv/dt ruggedness | dv/dt | $V_{DS} \leq V_{DSS}$, $I_D \leq$ 7.5 A | 90 | — | — | V/ns |

Note 3: $C_{O(er)}$ is a fixed capacitance that gives the same stored energy as $C_{OSS}$ while $V_{DS}$ is rising from 0 V to 400 V.
Note 4: $C_{O(tr)}$ is a fixed capacitance that gives the same charging time as $C_{OSS}$ while $V_{DS}$ is rising from 0 V to 400 V.




$V_{DD} \approx$ 400 V
$V_{GS}$ = 10 V/0 V
$I_D$ = 7.5 A
$R_L$ = 53 Ω
$R_G$ = 10 Ω
Duty ≤ 1 %, $t_w$ = 10 μs

**Fig. 6.2.1 Switching Time Test Circuit**

### 6.3. Gate Charge Characteristics ($T_a$ = 25 °C unless otherwise specified)

| Characteristics | Symbol | Test Condition | Min | Typ. | Max | Unit |
|---|---|---|---|---|---|---|
| Total gate charge (gate-source plus gate-drain) | $Q_g$ | $V_{DD}$ ≈ 400 V, $V_{GS}$ = 10 V, $I_D$ = 15 A | — | 26 | — | nC |
| Gate-source charge 1 | $Q_{gs1}$ | | — | 8.8 | — | |
| Gate-drain charge | $Q_{gd}$ | | — | 8.8 | — | |

### 6.4. Source-Drain Characteristics ($T_a$ = 25 °C unless otherwise specified)

| Characteristics | Symbol | Test Condition | Min | Typ. | Max | Unit |
|---|---|---|---|---|---|---|
| Diode forward voltage | $V_{DSF}$ | $I_{DR}$ = 15 A, $V_{GS}$ = 0 V | — | — | -1.7 | V |
| Reverse recovery time (Note 5) | $t_{rr}$ | $V_{DD}$ = 400 V, $I_{DR}$ = 7.5 A, $V_{GS}$ = 0 V, $-dI_{DR}/dt$ = 100 A/µs | — | 95 | 152 | ns |
| Reverse recovery charge | $Q_{rr}$ | | — | 0.4 | — | µC |
| Peak reverse recovery current | $I_{rr}$ | | — | 8.4 | — | A |
| Diode dv/dt ruggedness | dv/dt | $V_{DD}$ ≤ 400 V, $I_{DR}$ ≤ 7.5 A, $V_{GS}$ = 0 V | 70 | — | — | V/ns |

Note 5: Defined by design.

## 7. Marking (Note)

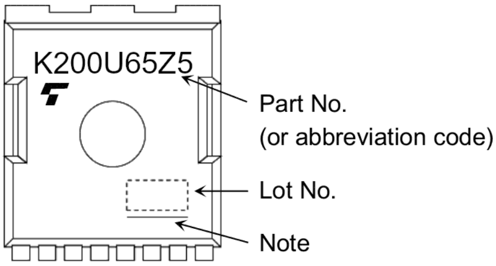



**Fig. 7.1 Marking**

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)

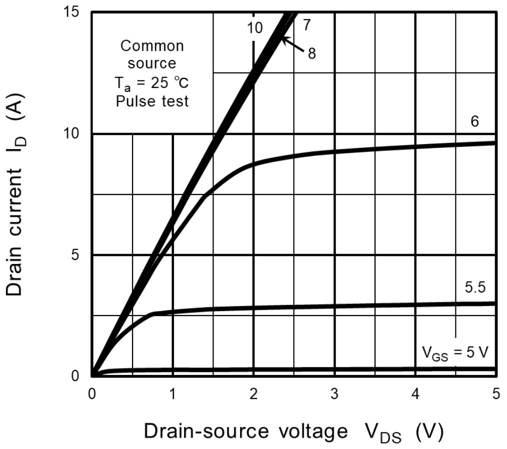



**Fig. 8.1 $I_D$ - $V_{DS}$**

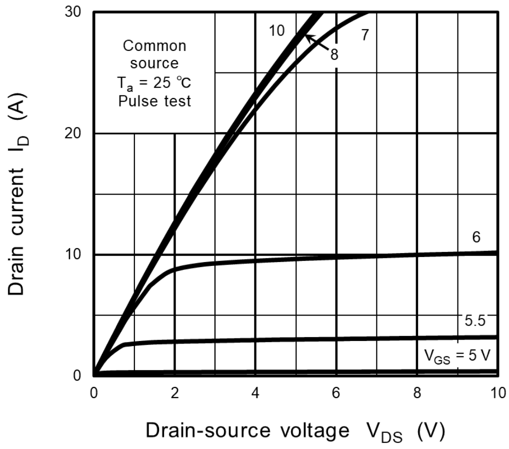



**Fig. 8.2 $I_D$ - $V_{DS}$**

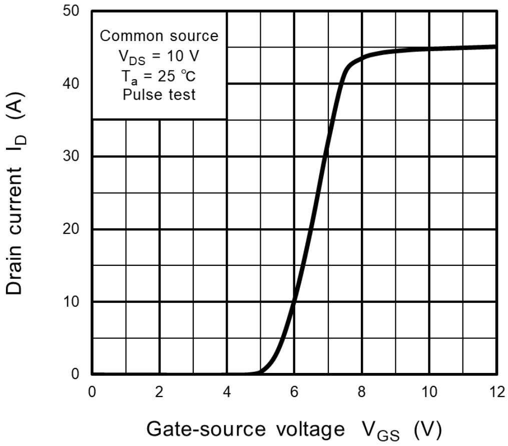



**Fig. 8.3 $I_D$ - $V_{GS}$**

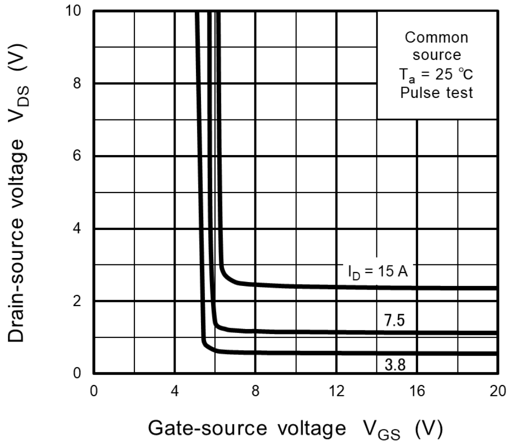



**Fig. 8.4 $V_{DS}$ - $V_{GS}$**

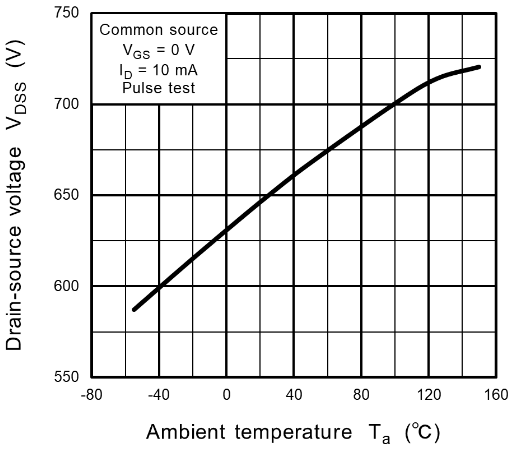



**Fig. 8.5 $V_{DSS}$ - $T_a$**

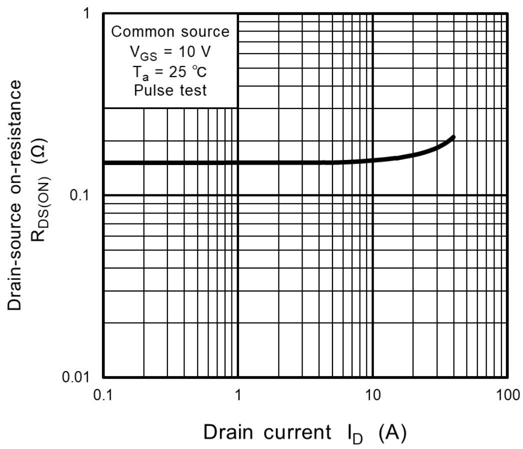



**Fig. 8.6 $R_{DS(ON)}$ - $I_D$**

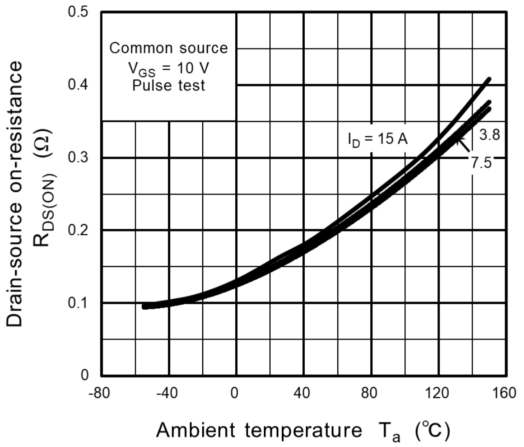



**Fig. 8.7 $R_{DS(ON)}$ - $T_a$**

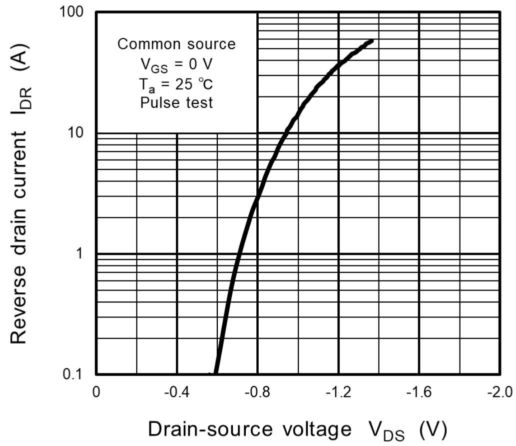



**Fig. 8.8 $I_{DR}$ - $V_{DS}$**

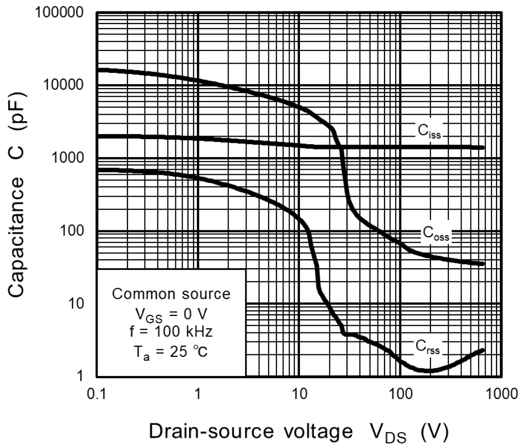



**Fig. 8.9 C - $V_{DS}$**

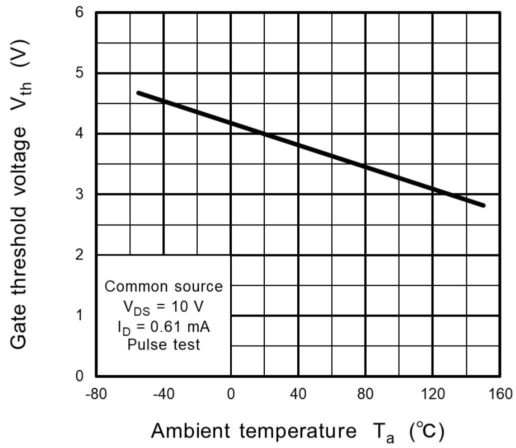



**Fig. 8.10 $V_{th}$ - $T_a$**

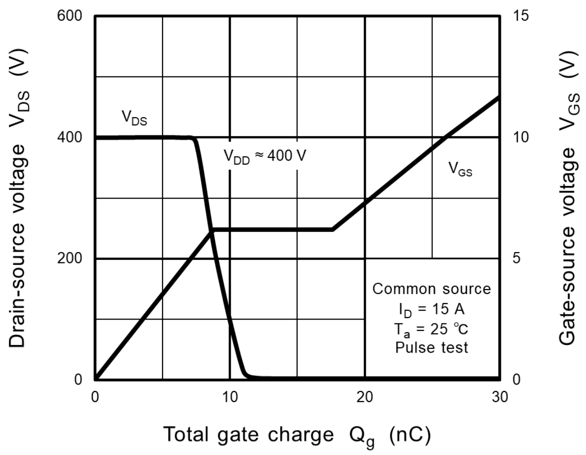



**Fig. 8.11 Dynamic Input/Output Characteristics**

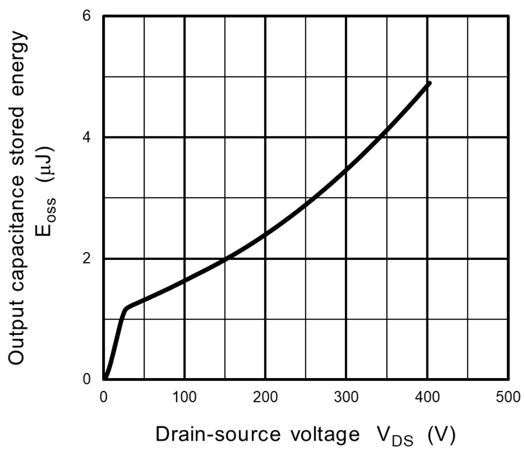



**Fig. 8.12 $E_{OSS}$ - $V_{DS}$**

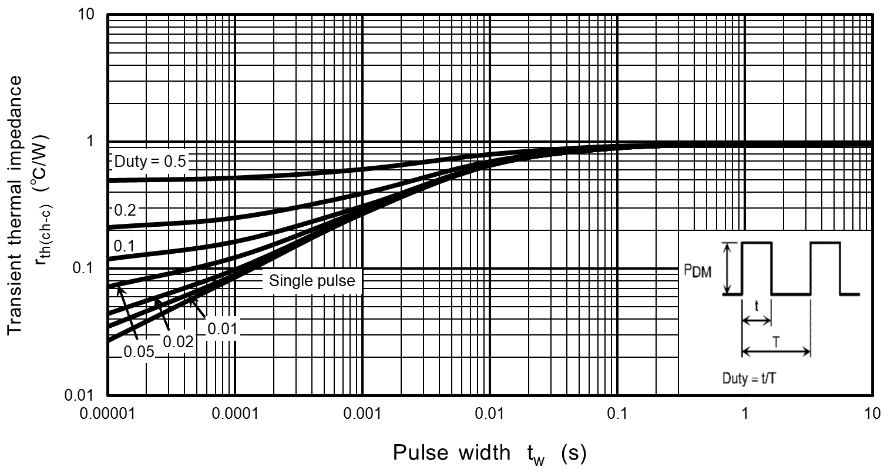



**Fig. 8.13 $r_{th}$ - $t_w$**
**(Guaranteed Maximum)**

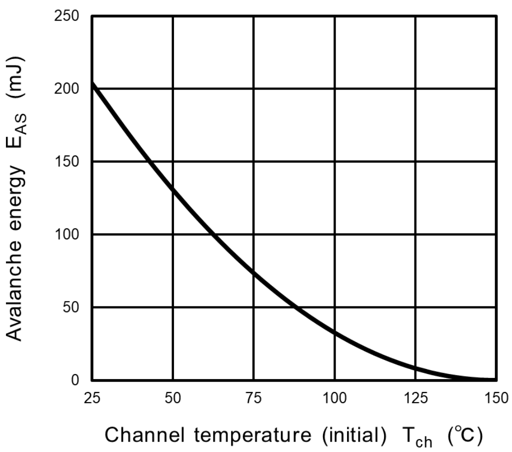



**Fig. 8.14 $E_{AS}$ - $T_{ch}$**
**(Guaranteed Maximum)**

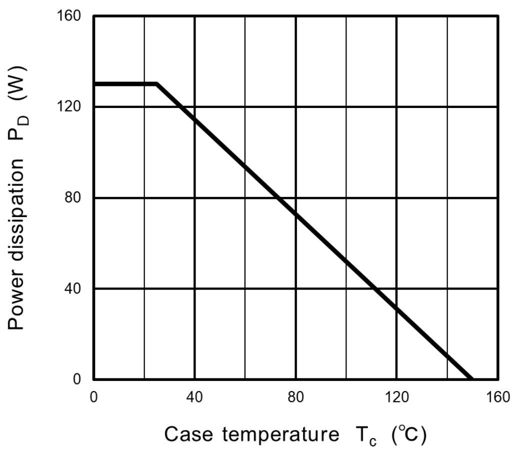
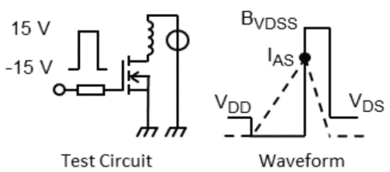



**Fig. 8.15 $P_D$ - $T_c$**
**(Guaranteed Maximum)**




$V_{DD}$ = 90 V, L = 40.2 mH $E_{AS} = \frac{1}{2} \cdot L \cdot I_{AS}^2 \cdot \left( \frac{B_{VDSS}}{B_{VDSS} - V_{DD}} \right)$

**Fig. 8.16 Test Circuit/Waveform**

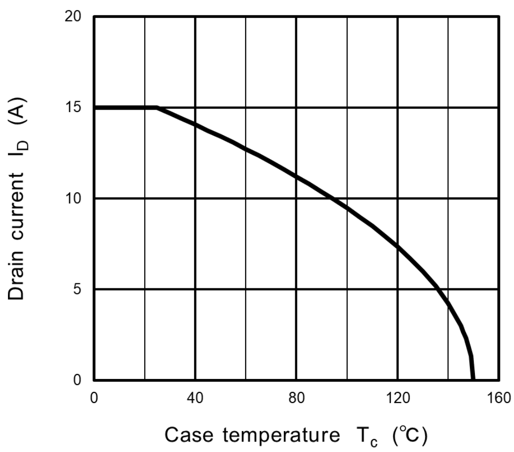



**Fig. 8.17 $I_D$ - $T_c$**
**(Guaranteed Maximum)**

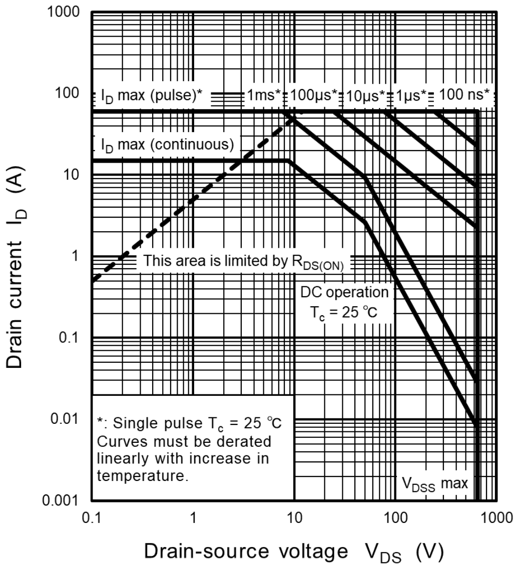
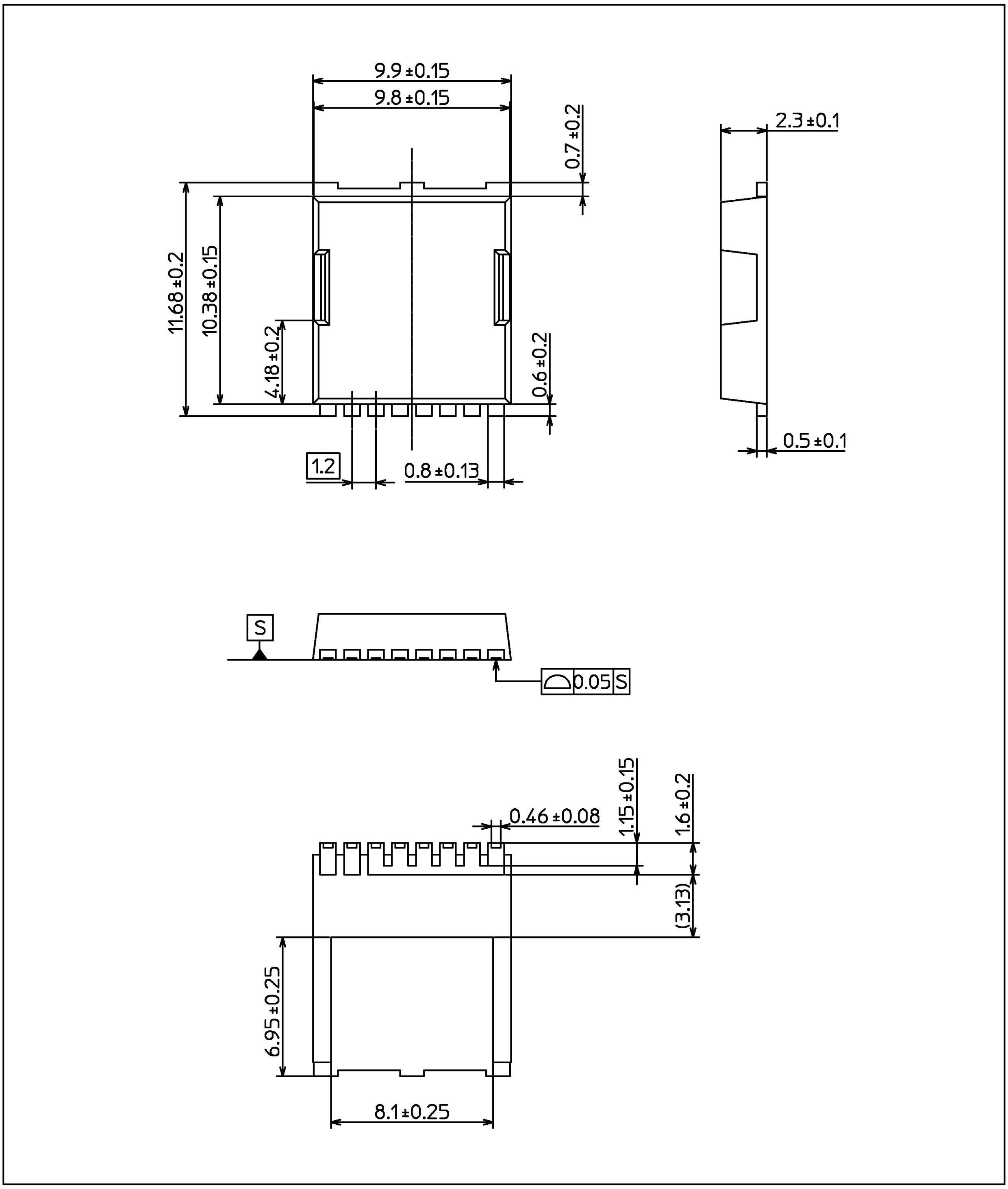



**Fig. 8.18 Safe Operating Area (Guaranteed Maximum)**

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

## Package Dimensions

Unit: mm




Weight: 0.75 g (typ.)

| Package Name(s) |
| --- |
| TOSHIBA: 2-10AF1A |
| Nickname: TOLL |

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