MOSFETs Silicon P-Channel MOS (U-MOSⅥ)

# TPCA8135

## 1. Applications

- DC-DC Converters

## 2. Features

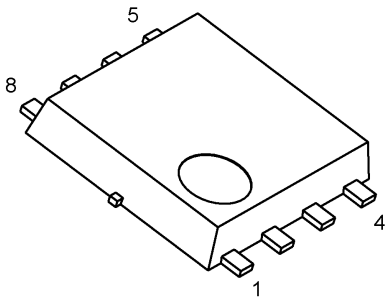
(1) Small, thin package

(2) Low drain-source on-resistance: $R_{DS(ON)}$ = 96 mΩ (typ.) ($V_{GS}$ = -10 V)

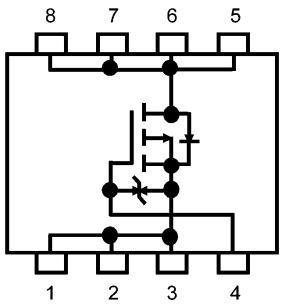
(3) Low leakage current: $I_{DSS}$ = -10 μA (max) ($V_{DS}$ = -60 V)

(4) Enhancement mode: $V_{th}$ = -2.0 to -3.0 V ($V_{DS}$ = -10 V, $I_D$ = -1.0 mA)

## 3. Packaging and Internal Circuit




SOP Advance




1, 2, 3: Source 4: Gate
5, 6, 7, 8: Drain

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

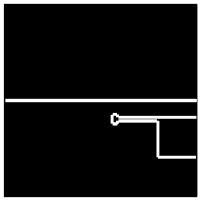
| Characteristics | | | Symbol | Rating | Unit |
|---|---|---|---|---|---|
| Drain-source voltage | | | $V_{DSS}$ | -60 | V |
| Gate-source voltage | | | $V_{GSS}$ | -20/+10 | |
| Drain current (DC) | | (Note 1) | $I_D$ | -5 | A |
| Drain current (pulsed) | | (Note 1) | $I_{DP}$ | -15 | |
| Power dissipation | ($T_c$ = 25°C) | | $P_D$ | 20.4 | W |
| Power dissipation | (t = 10 s) | (Note 2) | $P_D$ | 3.3 | W |
| Power dissipation | (t = 10 s) | (Note 3) | $P_D$ | 1.9 | W |
| Single-pulse avalanche energy | | (Note 4) | $E_{AS}$ | 34 | mJ |
| Avalanche current | | | $I_{AR}$ | -5 | A |
| Channel temperature | | (Note 5) | $T_{ch}$ | 175 | °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).

## 5. Thermal Characteristics

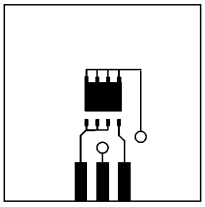
| Characteristics | | | Symbol | Max | Unit |
|---|---|---|---|---|---|
| Channel-to-case thermal resistance | ($T_c$ = 25°C) | | $R_{th(ch-c)}$ | 7.35 | °C/W |
| Channel-to-ambient thermal resistance | (t = 10 s) | (Note 2) | $R_{th(ch-a)}$ | 44.6 | °C/W |
| Channel-to-ambient thermal resistance | (t = 10 s) | (Note 3) | $R_{th(ch-a)}$ | 78.1 | °C/W |

Note 1: Ensure that the channel temperature does not exceed 175°C.
Note 2: Device mounted on a glass-epoxy board (a), Figure 5.1
Note 3: Device mounted on a glass-epoxy board (b), Figure 5.2
Note 4: $V_{DD}$ = -25 V, $T_{ch}$ = 25°C (initial), L = 1900 μH, $R_G$ = 25 Ω, $I_{AR}$ = -5 A
Note 5: Merely Channel temperature is guaranteed 175°C.
Storage temperature range is guaranteed as usual (-55 to 150°C).



FR-4
25.4 × 25.4 × 0.8
(Unit: mm)

**Fig. 5.1 Device Mounted on a Glass-Epoxy Board (a)**



FR-4
25.4 × 25.4 × 0.8
(Unit: mm)

**Fig. 5.2 Device Mounted on a Glass-Epoxy Board (b)**

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

# 6. Electrical Characteristics

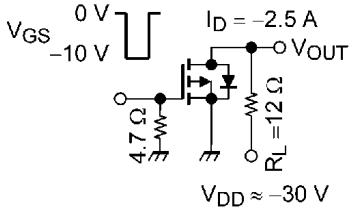
## 6.1. Static Characteristics ($T_a$ = 25°C unless otherwise specified)

| Characteristics | Symbol | Test Condition | Min | Typ. | Max | Unit |
|---|---|---|---|---|---|---|
| Gate leakage current | $I_{GSS}$ | $V_{GS}$ = -16/+10 V, $V_{DS}$ = 0 V | — | — | ±10 | μA |
| Drain cut-off current | $I_{DSS}$ | $V_{DS}$ = -60 V, $V_{GS}$ = 0 V | — | — | -10 | |
| Drain-source breakdown voltage | $V_{(BR)DSS}$ | $I_D$ = -10 mA, $V_{GS}$ = 0 V | -60 | — | — | V |
| Drain-source breakdown voltage (Note 6) | $V_{(BR)DSX}$ | $I_D$ = -10 mA, $V_{GS}$ = 10 V | -50 | — | — | |
| Gate threshold voltage | $V_{th}$ | $V_{DS}$ = -10 V, $I_D$ = -1.0 mA | -2.0 | — | -3.0 | |
| Drain-source on-resistance | $R_{DS(ON)}$ | $V_{GS}$ = -6 V, $I_D$ = -2.5 A | — | 101 | 162 | mΩ |
| | | $V_{GS}$ = -10 V, $I_D$ = -2.5 A | — | 96 | 125 | |

Note 6: If a reverse bias is applied between gate and source, this device enters $V_{(BR)DSX}$ mode. Note that the drain-source breakdown voltage is lowered in this mode.

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

| Characteristics | Symbol | Test Condition | Min | Typ. | Max | Unit |
|---|---|---|---|---|---|---|
| Input capacitance | $C_{iss}$ | $V_{DS}$ = -10 V, $V_{GS}$ = 0 V, f = 1 MHz | — | 820 | — | pF |
| Reverse transfer capacitance | $C_{rss}$ | | — | 62 | — | |
| Output capacitance | $C_{oss}$ | | — | 90 | — | |
| Switching time (rise time) | $t_r$ | See Figure 6.2.1. | — | 5 | — | ns |
| Switching time (turn-on time) | $t_{on}$ | | — | 12 | — | |
| Switching time (fall time) | $t_f$ | | — | 29 | — | |
| Switching time (turn-off time) | $t_{off}$ | | — | 120 | — | |




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) | $Q_g$ | $V_{DD}$ ≈ -48 V, $V_{GS}$ = -10 V, $I_D$ = -5 A | — | 19 | — | nC |
| Gate-source charge 1 | $Q_{gs1}$ | | — | 2.4 | — | |
| Gate-drain charge | $Q_{gd}$ | | — | 5.4 | — | |

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

| Characteristics | Symbol | Test Condition | Min | Typ. | Max | Unit |
|---|---|---|---|---|---|---|
| Reverse drain current (pulsed) (Note 7) | $I_{DRP}$ | — | — | — | -15 | A |
| Diode forward voltage | $V_{DSF}$ | $I_{DR}$ = -5 A, $V_{GS}$ = 0 V | — | — | 1.2 | V |

Note 7: Ensure that the channel temperature does not exceed 175°C.

## 7. Marking

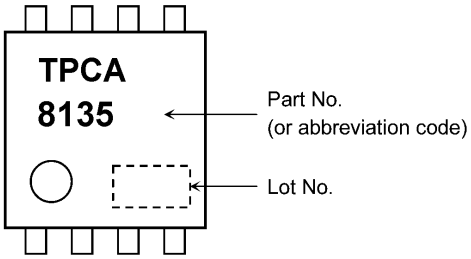



Fig. 7.1 Marking

## 8. Characteristics Curves (Note)

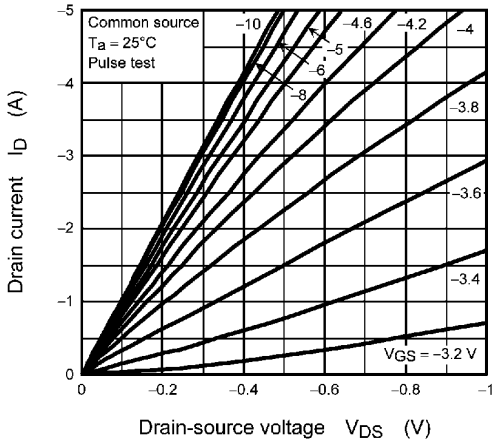



Fig. 8.1 $I_D$ - $V_{DS}$

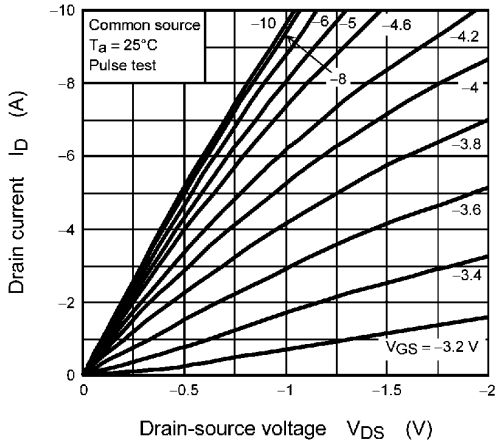



Fig. 8.2 $I_D$ - $V_{DS}$

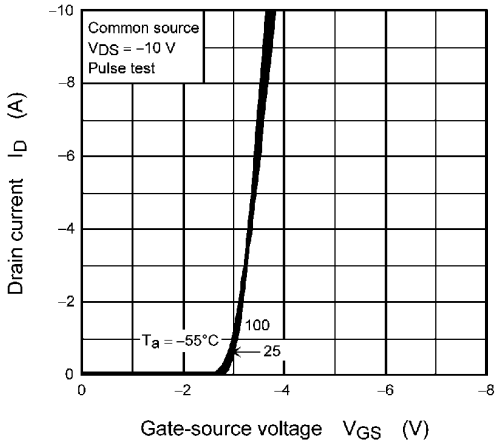



Fig. 8.3 $I_D$ - $V_{GS}$

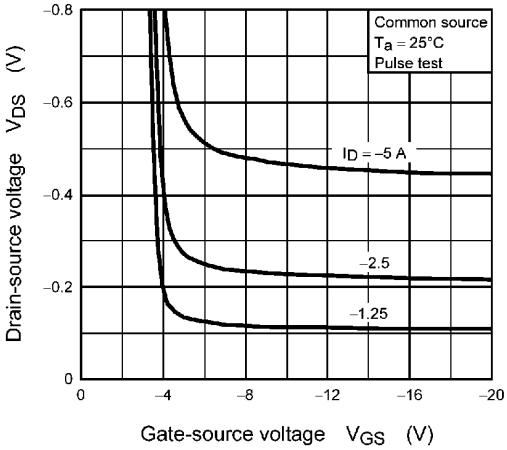



Fig. 8.4 $V_{DS}$ - $V_{GS}$

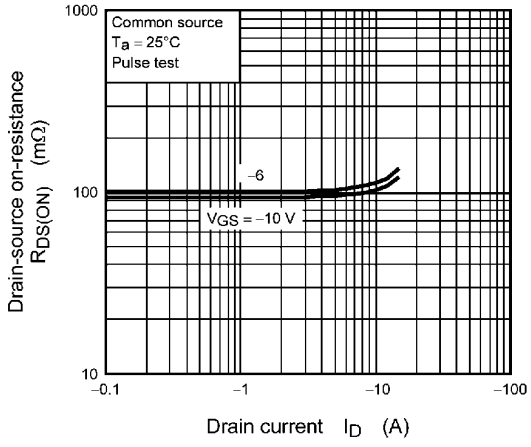



Fig. 8.5 $R_{DS(ON)}$ - $I_D$

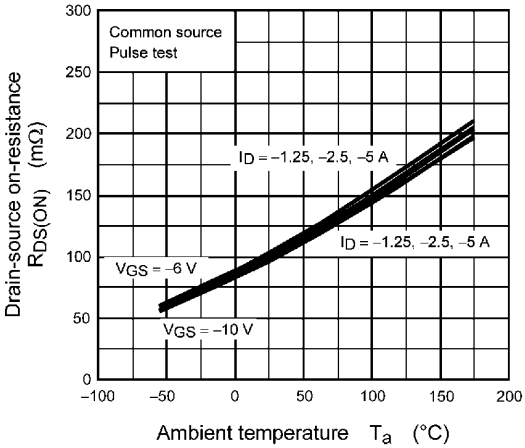



Fig. 8.6 $R_{DS(ON)}$ - $T_a$ (Note 8)

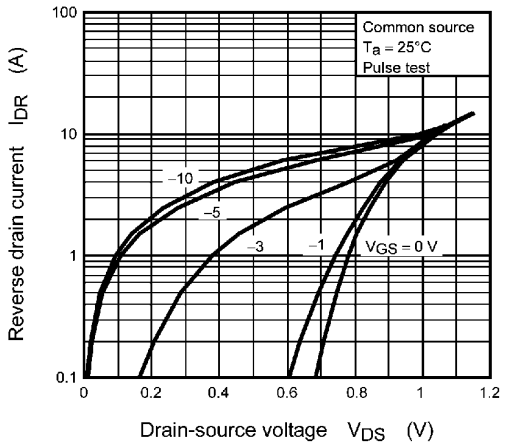



Fig. 8.7 $I_{DR}$ - $V_{DS}$

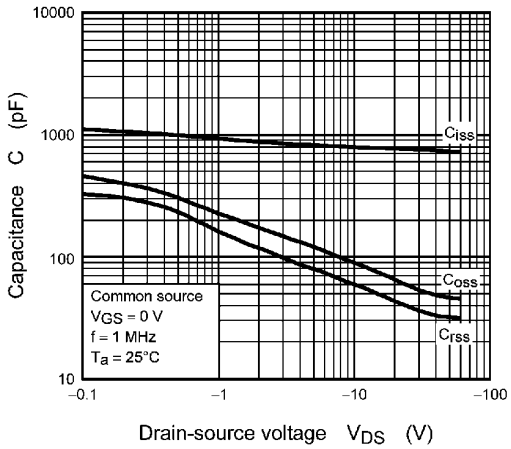



Fig. 8.8 Capacitance - $V_{DS}$

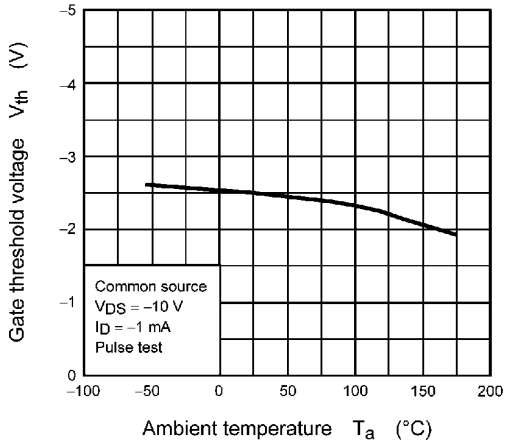



Fig. 8.9 $V_{th}$ - $T_a$ (Note 8)

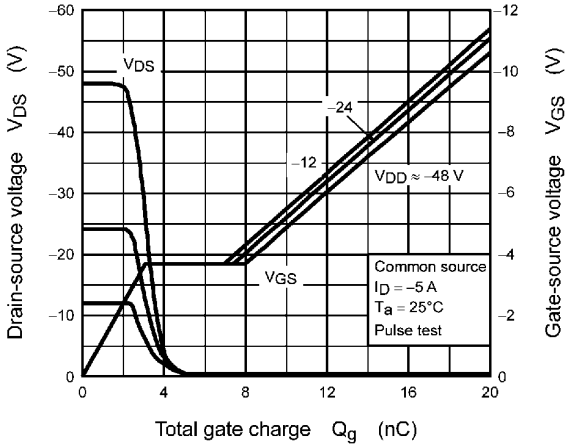



Fig. 8.10 Dynamic Input/Output Characteristics

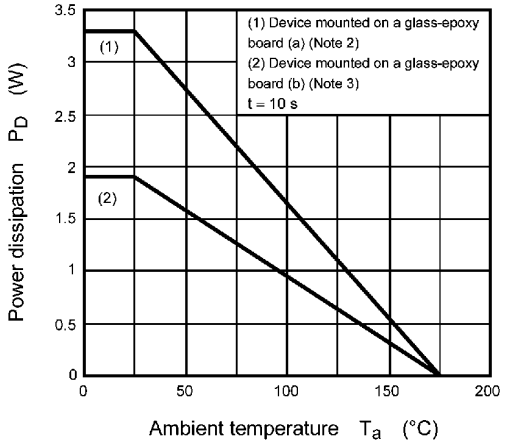



Fig. 8.11 $P_D$ - $T_a$ (Note 8)
(Guaranteed Maximum)

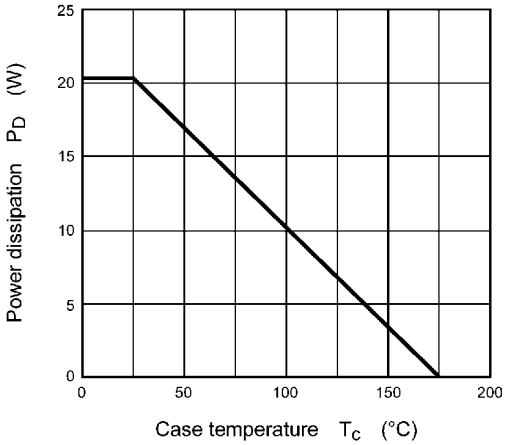



Fig. 8.12 $P_D$ - $T_c$ (Note 8)
(Guaranteed Maximum)

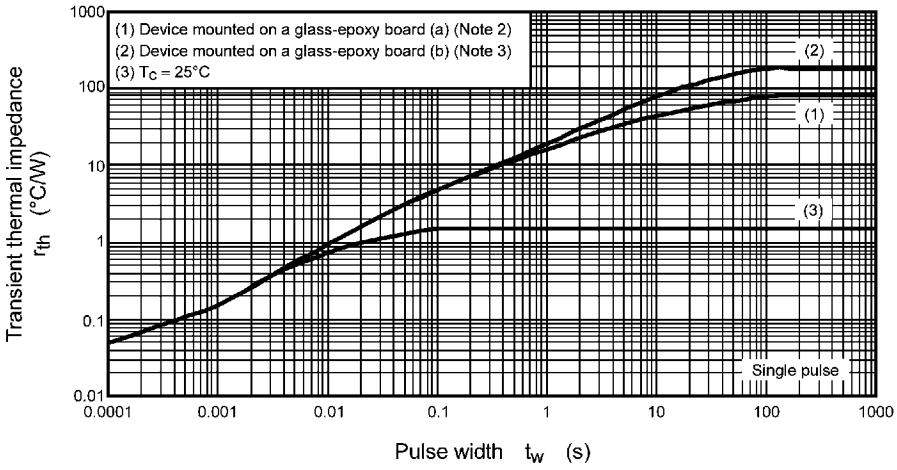



**Fig. 8.13 $r_{th}$ - $t_w$**
**(Guaranteed Maximum)**

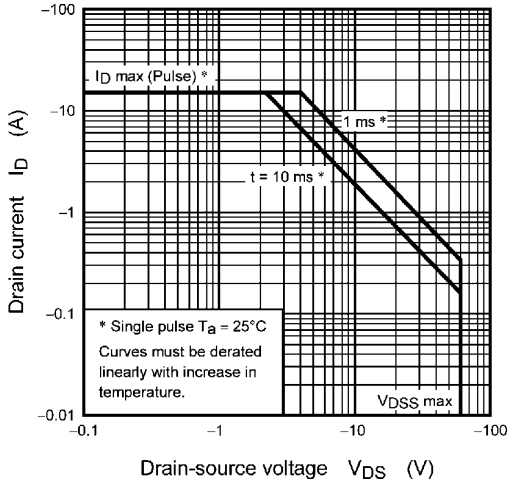


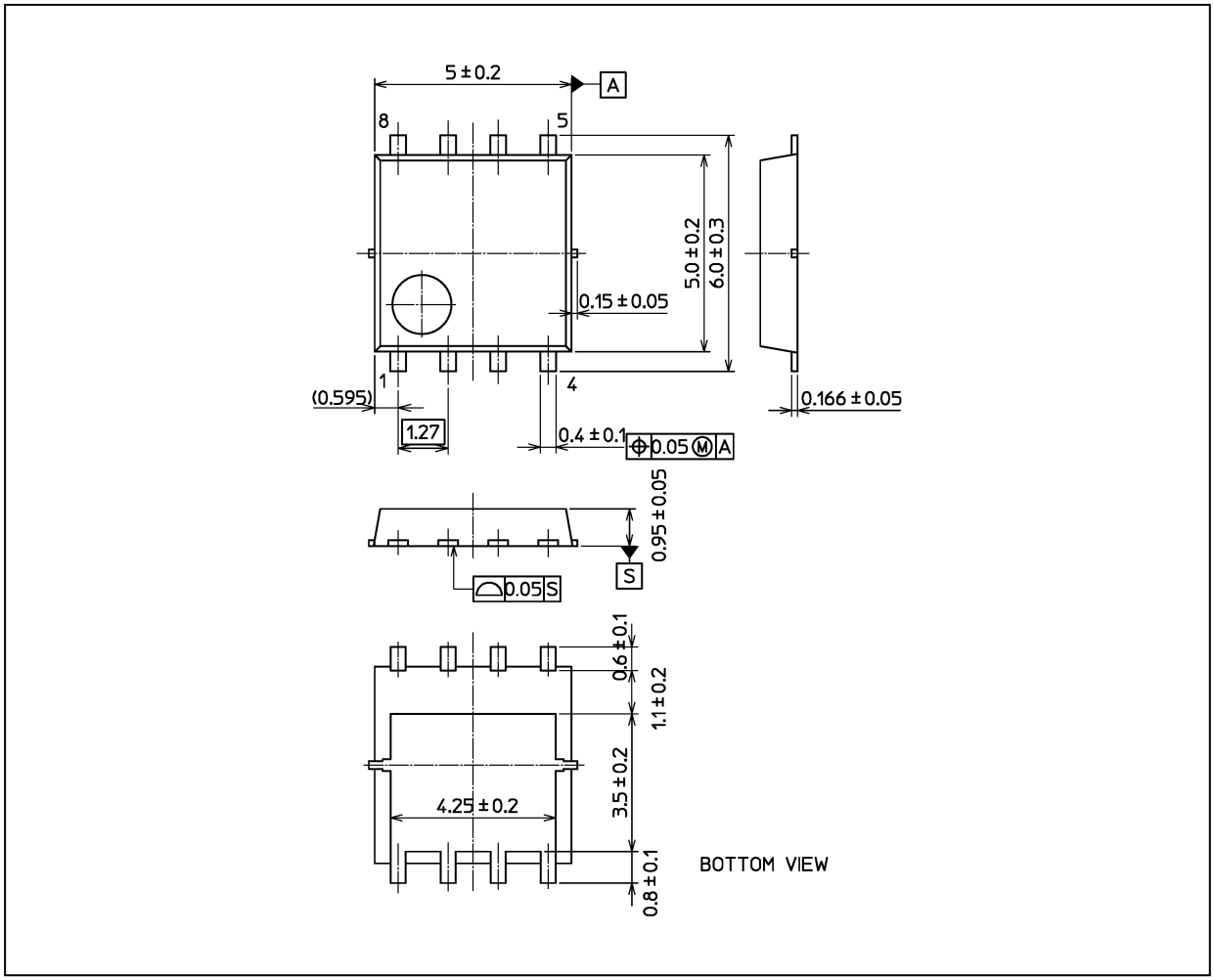

**Fig. 8.14 Safe Operating Area**
**(Guaranteed Maximum)**

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

Note 8: Although several performance curves are shown up to a $T_a$ or $T_c$ of 175°C, the device is not guaranteed at storage temperatures up to 175°C. The storage temperature ($T_{stg}$) range is rated at -55°C to 150°C.

## Package Dimensions

Unit: mm




Weight: 0.069 g (typ.)

| Package Name(s) |
|---|
| TOSHIBA: 2-5Q1S |
| Nickname: SOP Advance |

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