MOSFETs Silicon P-Channel MOS (U-MOSⅥ)

# TJ10S04M3L

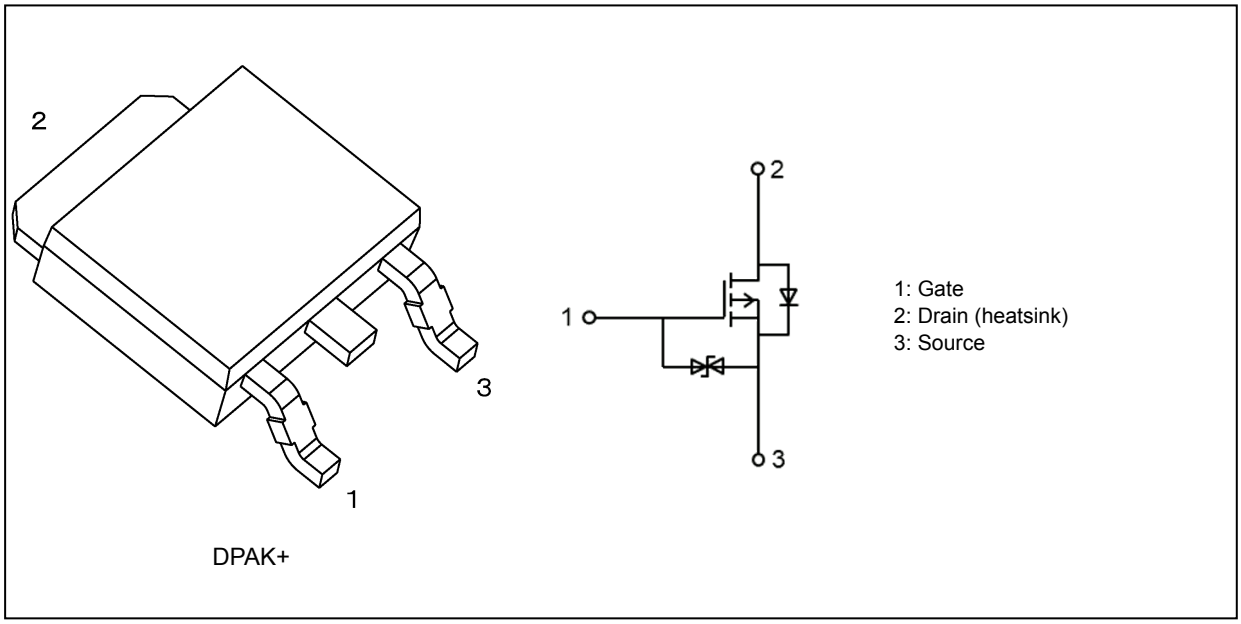
## 1. Applications

- Automotive
- Motor Drivers
- DC-DC Converters
- Switching Voltage Regulators

## 2. Features

(1) AEC-Q101 qualified
(2) Low drain-source on-resistance: $R_{DS(ON)}$ = 33.8 mΩ (typ.) ($V_{GS}$ = -10 V)
(3) Low leakage current: $I_{DSS}$ = -10 μA (max) ($V_{DS}$ = -40 V)
(4) Enhancement mode: $V_{th}$ = -2.0 to -3.0 V ($V_{DS}$ = -10 V, $I_D$ = -1 mA)

## 3. Packaging and Internal Circuit




Start of commercial production
2011-03

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

| Characteristics | | Symbol | Rating | Unit |
|---|---|---|---|---|
| Drain-source voltage | | $V_{DSS}$ | -40 | V |
| Gate-source voltage | | $V_{GSS}$ | -20/+10 | |
| Drain current (DC) | (Note 1) | $I_D$ | -10 | A |
| Drain current (pulsed) | (Note 1) | $I_{DP}$ | -20 | |
| Power dissipation | ($T_c$ = 25°C) | $P_D$ | 27 | W |
| Single-pulse avalanche energy | (Note 2) | $E_{AS}$ | 23 | mJ |
| Avalanche current | | $I_{AR}$ | -10 | A |
| Channel temperature | (Note 3) | $T_{ch}$ | 175 | °C |
| Storage temperature | (Note 3) | $T_{stg}$ | -55 to 175 | |

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 | $R_{th(ch-c)}$ | 5.4 | °C/W |

Note 1: Ensure that the channel temperature does not exceed 175°C.
Note 2: $V_{DD}$ = -25 V, $T_{ch}$ = 25°C (initial), L = 243 μH, $R_G$ = 25 Ω, $I_{AR}$ = -10 A
Note 3: The definitions of the absolute maximum channel and storage temperatures are qualified per AEC-Q101.

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

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# 6. Electrical Characteristics

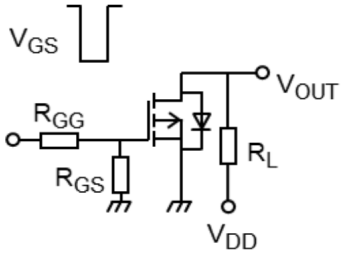
## 6.1. Static Characteristics ($T_a$ = 25°C unless otherwise specified)

| 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 | $I_{DSS}$ | $V_{DS}$ = -40 V, $V_{GS}$ = 0 V | — | — | -10 | |
| Drain-source breakdown voltage | $V_{(BR)DSS}$ | $I_D$ = -10 mA, $V_{GS}$ = 0 V | -40 | — | — | V |
| Drain-source breakdown voltage (Note 4) | $V_{(BR)DSX}$ | $I_D$ = -10 mA, $V_{GS}$ = 10 V | -30 | — | — | |
| Gate threshold voltage | $V_{th}$ | $V_{DS}$ = -10 V, $I_D$ = -1 mA | -2.0 | — | -3.0 | |
| Drain-source on-resistance | $R_{DS(ON)}$ | $V_{GS}$ = -6 V, $I_D$ = -5 A | — | 42 | 62 | mΩ |
| | | $V_{GS}$ = -10 V, $I_D$ = -5 A | — | 33.8 | 44 | |

Note 4: If a forward 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 | — | 930 | — | pF |
| Reverse transfer capacitance | $C_{rss}$ | | — | 90 | — | |
| Output capacitance | $C_{oss}$ | | — | 140 | — | |
| Switching time (rise time) | $t_r$ | See Figure 6.2.1. | — | 7 | — | ns |
| Switching time (turn-on time) | $t_{on}$ | | — | 15 | — | |
| Switching time (fall time) | $t_f$ | | — | 40 | — | |
| Switching time (turn-off time) | $t_{off}$ | | — | 145 | — | |




$V_{DD}$ ≈ -20 V
$V_{GS}$ = 0 V/-10 V
$I_D$ = -5 A
$R_L$ = 4 Ω
$R_{GG}$ = $R_{GS}$ = 4.7 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) | $Q_g$ | $V_{DD}$ ≈ -32 V, $V_{GS}$ = -10 V, $I_D$ = -10 A | — | 19 | — | nC |
| Gate-source charge | $Q_{gs}$ | | — | 13.5 | — | |
| Gate-drain charge | $Q_{gd}$ | | — | 5.5 | — | |

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

| Characteristics | Symbol | Test Condition | Min | Typ. | Max | Unit |
|---|---|---|---|---|---|---|
| Reverse drain current (DC) (Note 5) | $I_{DR}$ | — | — | — | -10 | A |
| Reverse drain current (pulsed) (Note 5) | $I_{DRP}$ | — | — | — | -20 | |
| Diode forward voltage | $V_{DSF}$ | $I_{DR}$ = -10 A, $V_{GS}$ = 0 V | — | — | 1.2 | V |
| Reverse recovery time | $t_{rr}$ | $I_{DR}$ = -10 A, $V_{GS}$ = 0 V<br>$dI_{DR}/dt$ = 50 A/μs | — | 28 | — | ns |
| Reverse recovery charge | $Q_{rr}$ | | — | 11 | — | nC |

Note 5: Ensure that the channel temperature does not exceed 175°C.

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## 7. Marking (Note)

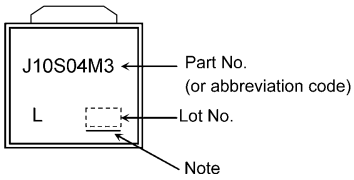



**Fig. 7.1 Marking**

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.

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## 8. Characteristics Curves (Note)

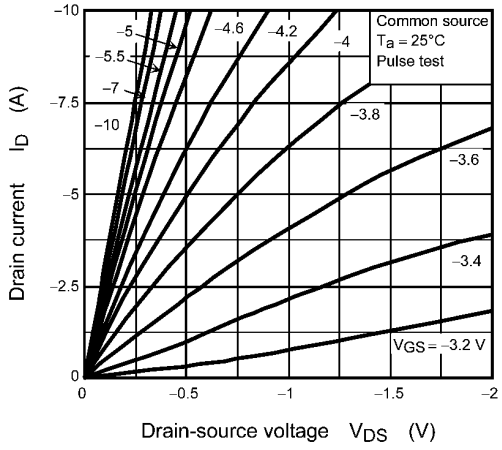



Fig. 8.1 $I_D$ - $V_{DS}$

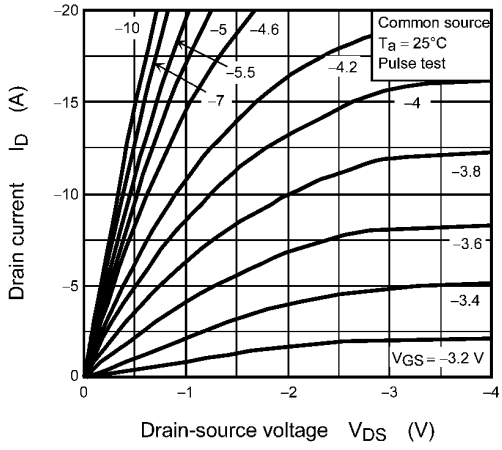



Fig. 8.2 $I_D$ - $V_{DS}$

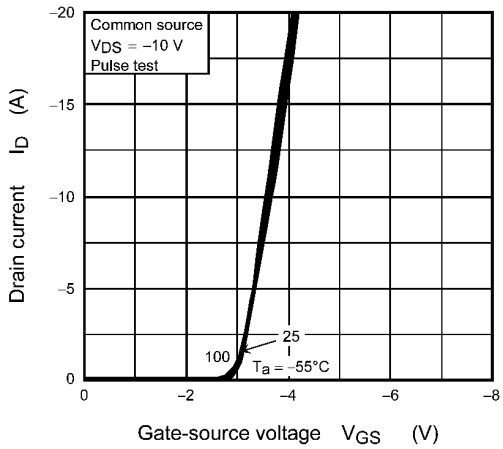



Fig. 8.3 $I_D$ - $V_{GS}$

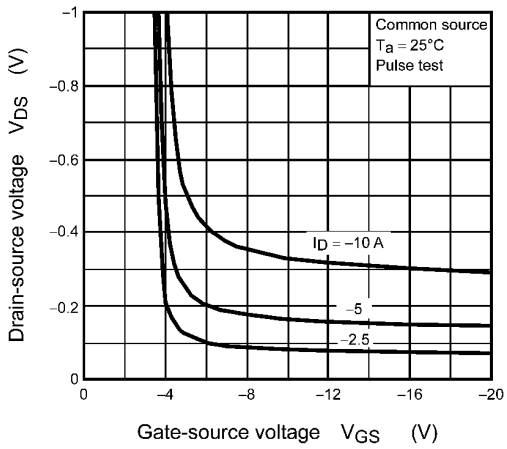



Fig. 8.4 $V_{DS}$ - $V_{GS}$

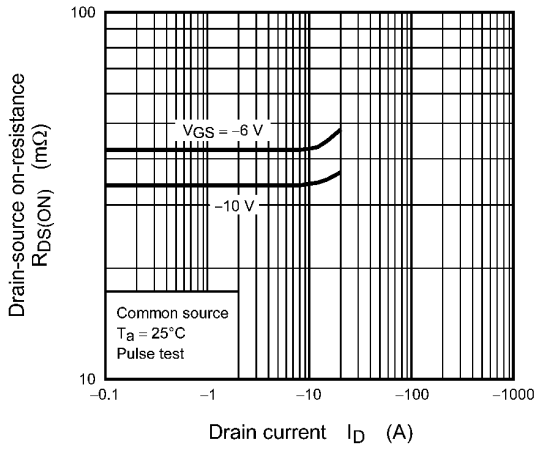



Fig. 8.5 $R_{DS(ON)}$ - $I_D$

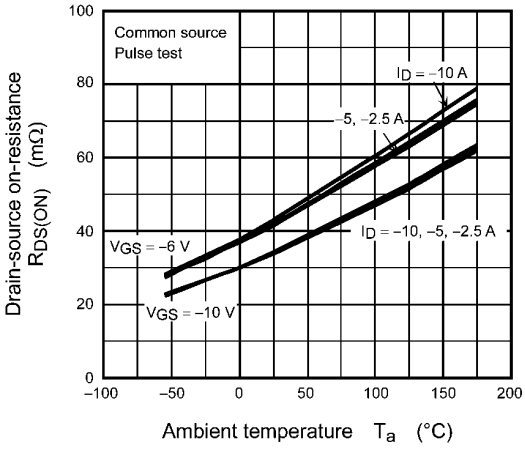



Fig. 8.6 $R_{DS(ON)}$ - $T_a$

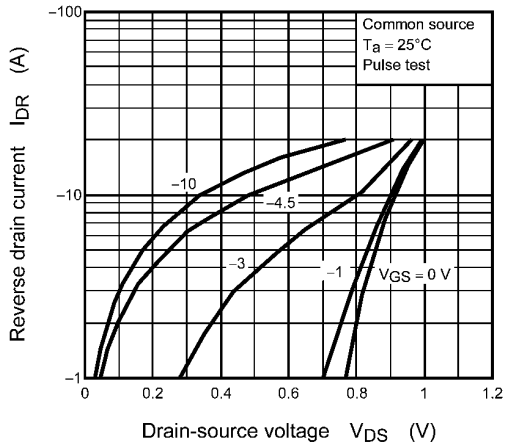



Fig. 8.7 $I_{DR}$ - $V_{DS}$

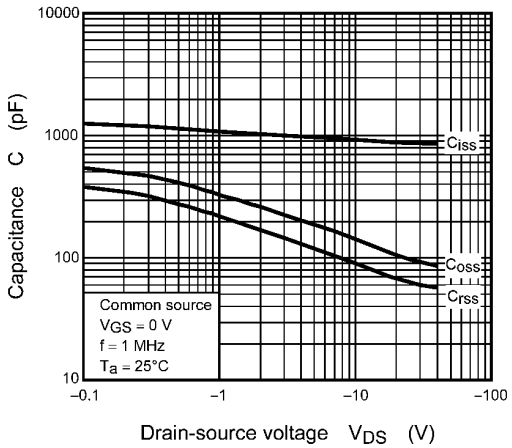



Fig. 8.8 Capacitance - $V_{DS}$

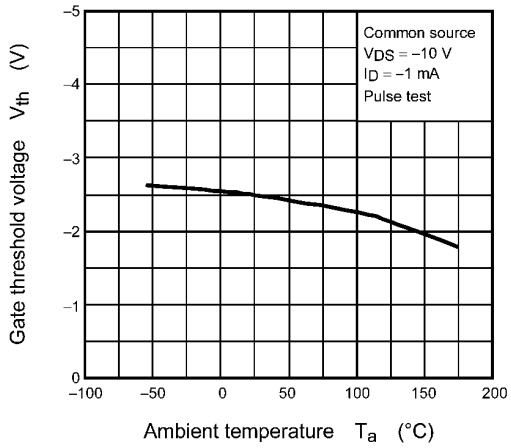



Fig. 8.9 $V_{th}$ - $T_a$

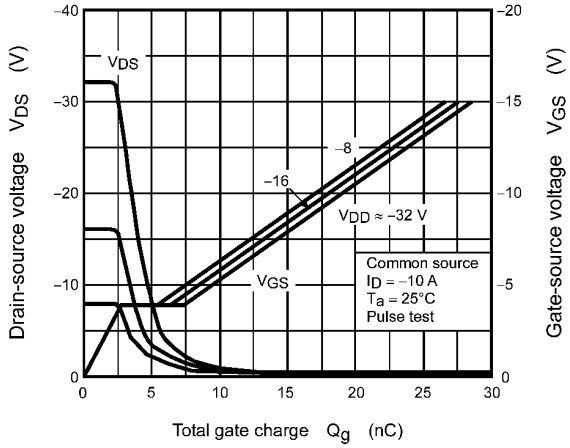



Fig. 8.10 Dynamic Input/Output Characteristics

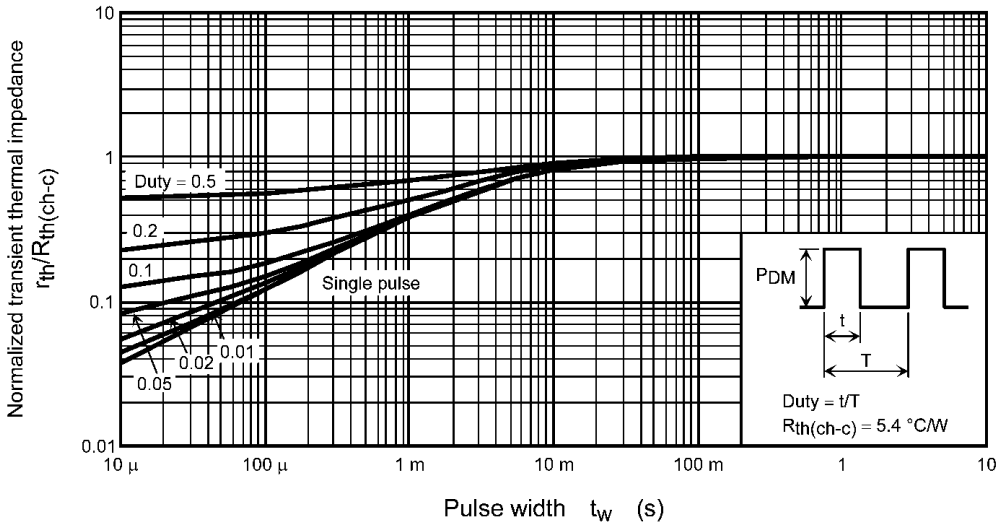



**Fig. 8.11 $r_{th}/R_{th(ch-c)}$ - $t_w$ (Guaranteed Maximum)**

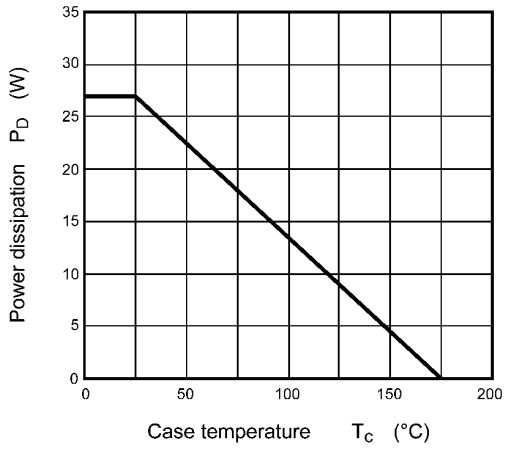



**Fig. 8.12 $P_D$ - $T_c$ (Guaranteed Maximum)**

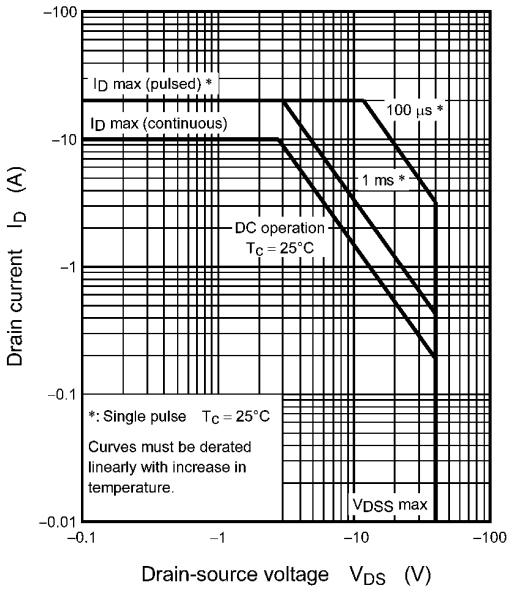
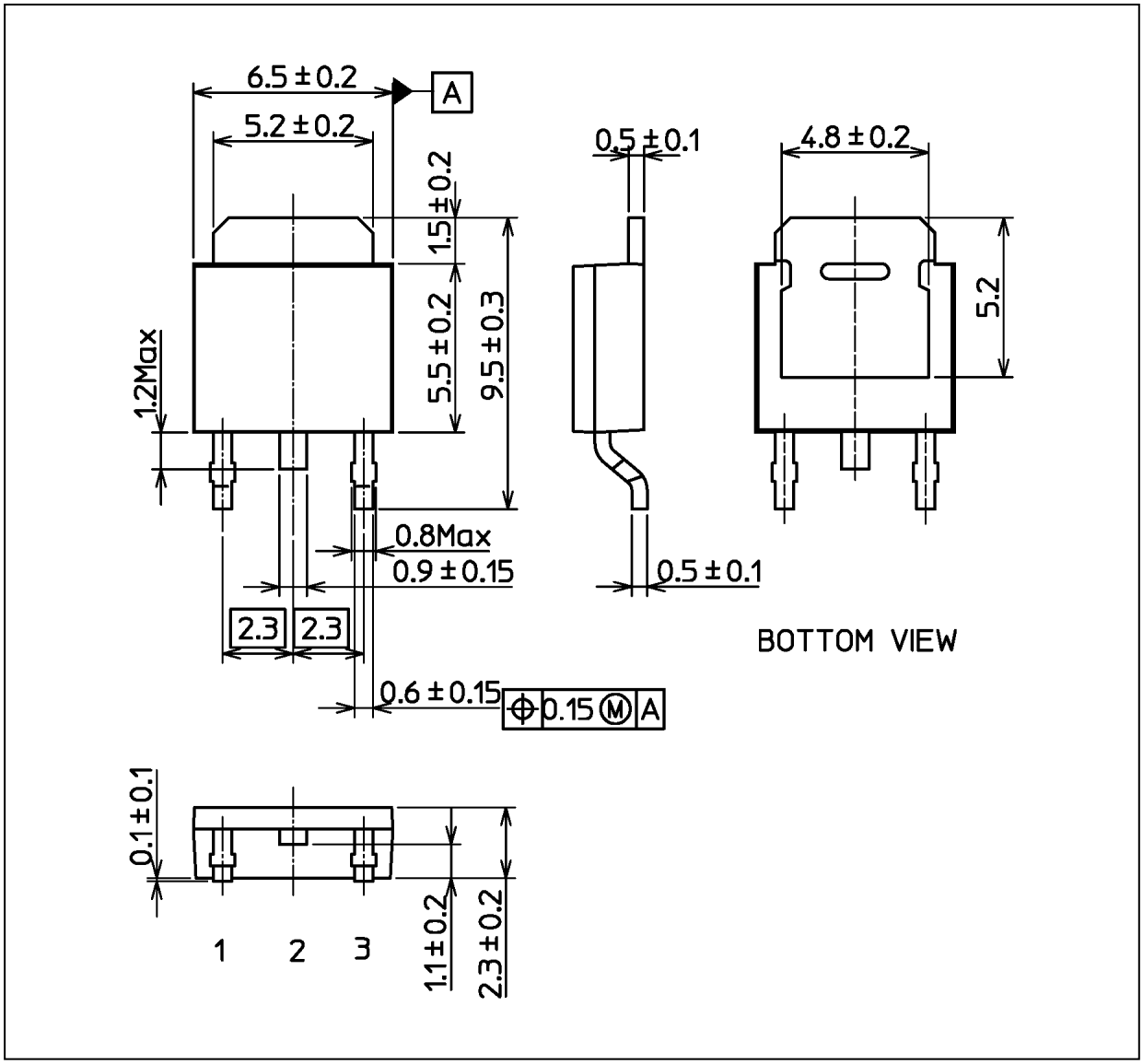



**Fig. 8.13 Safe Operating Area (Guaranteed Maximum)**

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

## Package Dimensions

Unit: mm




Weight: 0.36 g (typ.)

| Package Name(s) |
|---|
| TOSHIBA: 2-7M1A |
| Nickname: DPAK+ |

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