

TK80S04K3L

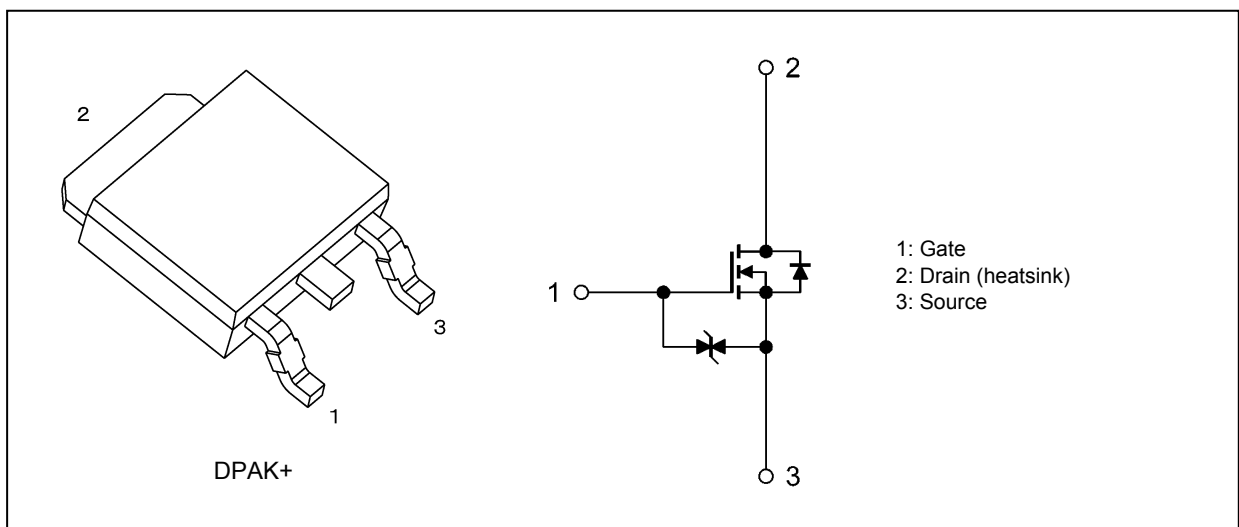
1. Applications

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

2. Features

- (1) AEC-Q101 qualified
- (2) Low drain-source on-resistance: $R_{DS(ON)} = 2.4 \text{ m}\Omega$ (typ.) ($V_{GS} = 10 \text{ V}$)
- (3) Low leakage current: $I_{DSS} = 10 \text{ }\mu\text{A}$ (max) ($V_{DS} = 40 \text{ V}$)
- (4) Enhancement mode: $V_{th} = 2.0 \text{ to } 3.0 \text{ V}$ ($V_{DS} = 10 \text{ V}$, $I_D = 1 \text{ mA}$)

3. Packaging and Internal Circuit



Start of commercial production

2011-04

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

| Characteristics | Symbol | Rating | Unit |
|--|-----------|------------|------------------|
| Drain-source voltage | V_{DSS} | 40 | V |
| Gate-source voltage | V_{GSS} | ± 20 | |
| Drain current (DC) (Note 1) | I_D | 80 | A |
| Drain current (pulsed) (Note 1) | I_{DP} | 160 | |
| Power dissipation ($T_c = 25^\circ\text{C}$) | P_D | 100 | W |
| Single-pulse avalanche energy (Note 2) | E_{AS} | 135 | mJ |
| Avalanche current | I_{AR} | 80 | A |
| Channel temperature (Note 3) | T_{ch} | 175 | $^\circ\text{C}$ |
| 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 | $R_{th(ch-c)}$ | 1.5 | $^\circ\text{C}/\text{W}$ |

Note 1: Ensure that the channel temperature does not exceed 175°C .

Note 2: $V_{DD} = 25\text{ V}$, $T_{ch} = 25^\circ\text{C}$ (initial), $L = 22\ \mu\text{H}$, $R_G = 1\ \Omega$, $I_{AR} = 80\text{ A}$

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.

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} | $V_{GS} = \pm 16\text{ V}, V_{DS} = 0\text{ V}$ | — | — | ± 10 | μA |
| Drain cut-off current | I_{DSS} | $V_{DS} = 40\text{ V}, V_{GS} = 0\text{ V}$ | — | — | 10 | |
| Drain-source breakdown voltage | $V_{(BR)DSS}$ | $I_D = 10\text{ mA}, V_{GS} = 0\text{ V}$ | 40 | — | — | V |
| | $V_{(BR)DSX}$ | $I_D = 10\text{ mA}, V_{GS} = -20\text{ V}$ | 20 | — | — | |
| Gate threshold voltage | V_{th} | $V_{DS} = 10\text{ V}, I_D = 1\text{ mA}$ | 2.0 | — | 3.0 | |
| Drain-source on-resistance | $R_{DS(ON)}$ | $V_{GS} = 6\text{ V}, I_D = 40\text{ A}$ | — | 3.0 | 4.8 | $\text{m}\Omega$ |
| | | $V_{GS} = 10\text{ V}, I_D = 40\text{ A}$ | — | 2.4 | 3.1 | |

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} | $V_{DS} = 10\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$ | — | 4340 | — | pF |
| Reverse transfer capacitance | C_{rss} | | — | 570 | — | |
| Output capacitance | C_{oss} | | — | 910 | — | |
| Switching time (rise time) | t_r | See Figure 6.2.1. | — | 13 | — | ns |
| Switching time (turn-on time) | t_{on} | | — | 28 | — | |
| Switching time (fall time) | t_f | | — | 20 | — | |
| Switching time (turn-off time) | t_{off} | | — | 80 | — | |

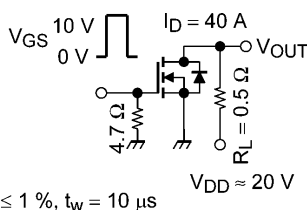


Fig. 6.2.1 Switching Time Test Circuit

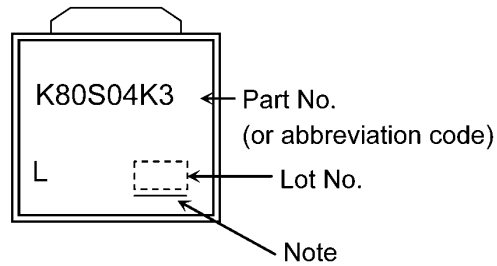
6.3. Gate Charge Characteristics ($T_a = 25^\circ\text{C}$ unless otherwise specified)

| Characteristics | Symbol | Test Condition | Min | Typ. | Max | Unit |
|---|----------|---|-----|------|-----|------|
| Total gate charge (gate-source plus gate-drain) | Q_g | $V_{DD} \approx 32\text{ V}, V_{GS} = 10\text{ V}, I_D = 80\text{ A}$ | — | 87 | — | nC |
| Gate-source charge | Q_{gs} | | — | 57 | — | |
| Gate-drain charge | Q_{gd} | | — | 30 | — | |

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

| Characteristics | Symbol | Test Condition | Min | Typ. | Max | Unit |
|---|-----------|--|-----|------|------|------|
| Reverse drain current (DC) (Note 4) | I_{DR} | — | — | — | 80 | A |
| Reverse drain current (pulsed) (Note 4) | I_{DRP} | — | — | — | 160 | |
| Diode forward voltage | V_{DSF} | $I_{DR} = 80\text{ A}, V_{GS} = 0\text{ V}$ | — | — | -1.2 | V |
| Reverse recovery time | t_{rr} | $I_{DR} = 80\text{ A}, V_{GS} = 0\text{ V}$ $-di_{DR}/dt = 50\text{ A}/\mu\text{s}$ | — | 57 | — | ns |
| Reverse recovery charge | Q_{rr} | | — | 45 | — | nC |

Note 4: Ensure that the channel temperature does not exceed 175°C .

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)

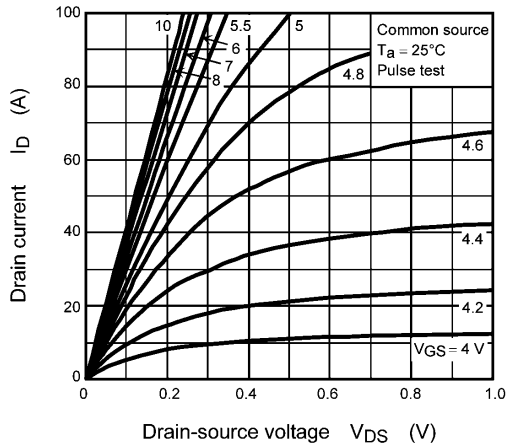


Fig. 8.1 $I_D - V_{DS}$

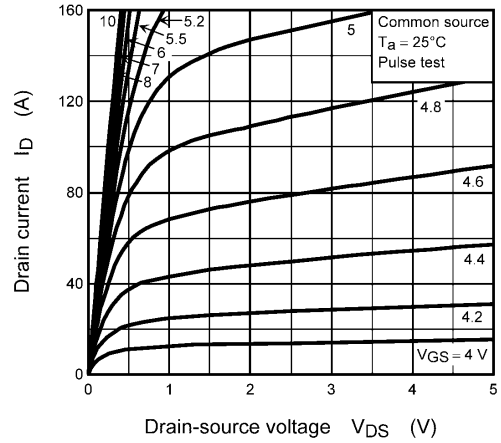


Fig. 8.2 $I_D - V_{DS}$

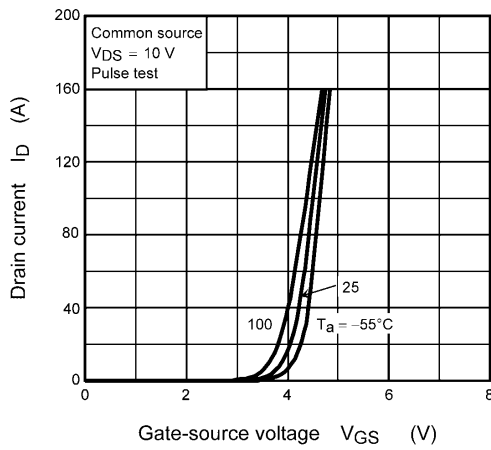


Fig. 8.3 $I_D - V_{GS}$

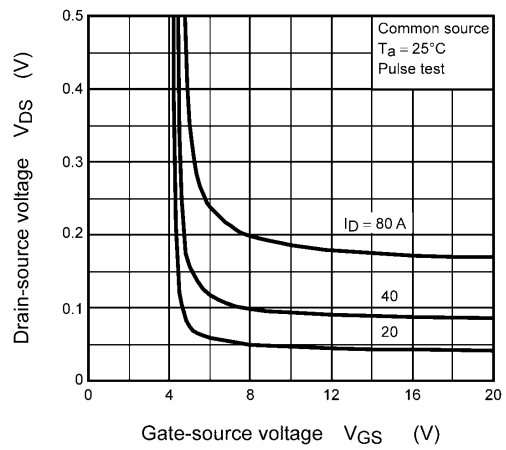


Fig. 8.4 $V_{DS} - V_{GS}$

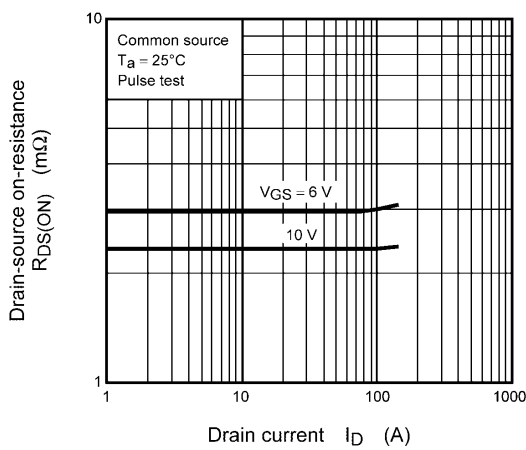


Fig. 8.5 $R_{DS(ON)} - I_D$

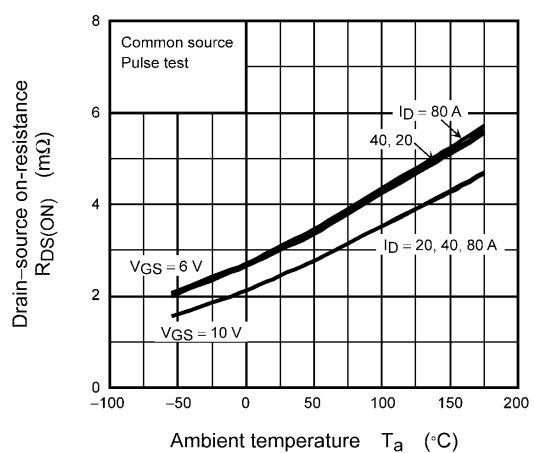


Fig. 8.6 $R_{DS(ON)} - T_a$

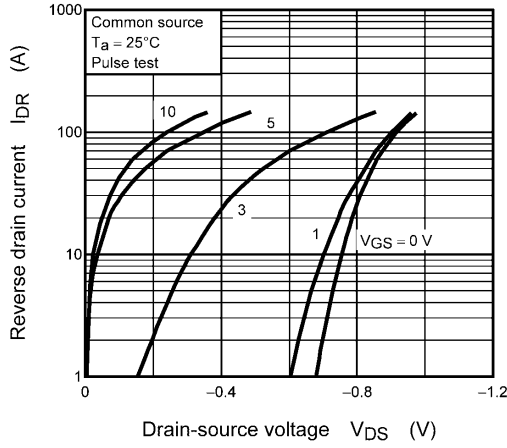


Fig. 8.7 $I_{DR} - V_{DS}$

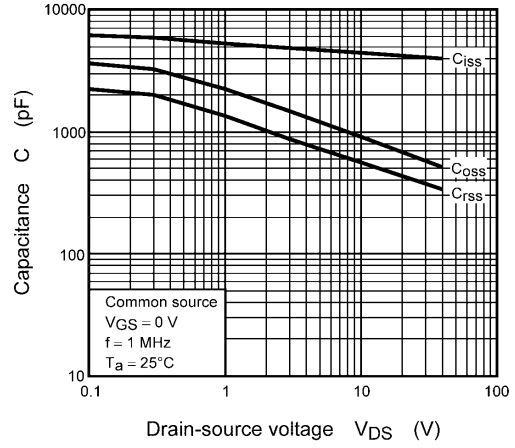


Fig. 8.8 Capacitance - V_{DS}

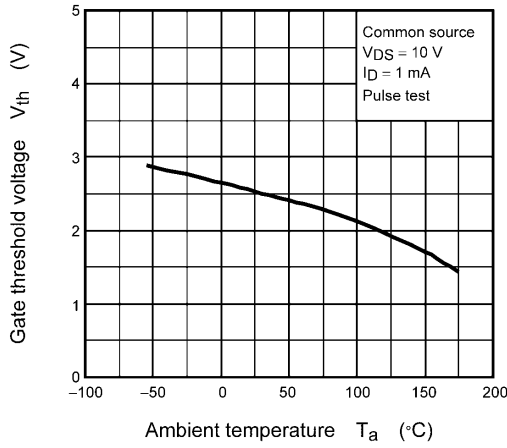


Fig. 8.9 $V_{th} - T_a$

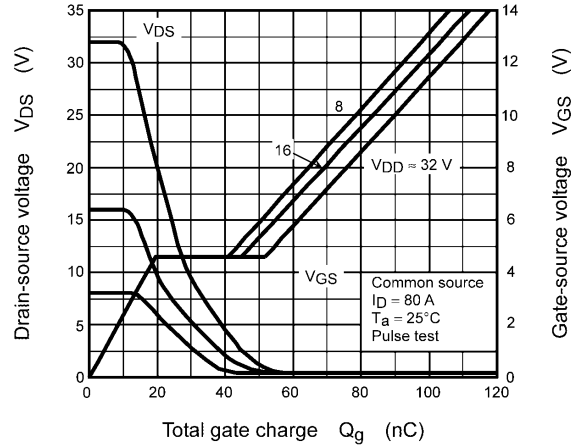
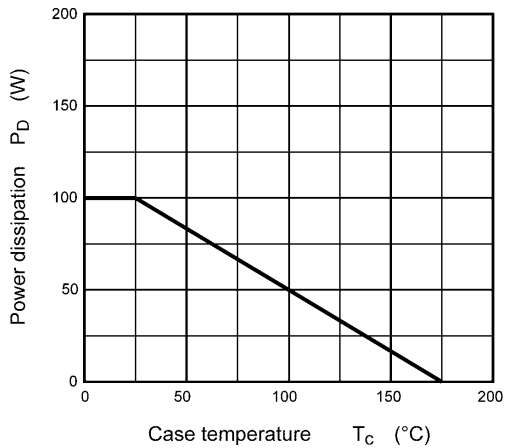


Fig. 8.10 Dynamic Input/Output Characteristics



**Fig. 8.11 $P_D - T_c$
(Guaranteed Maximum)**

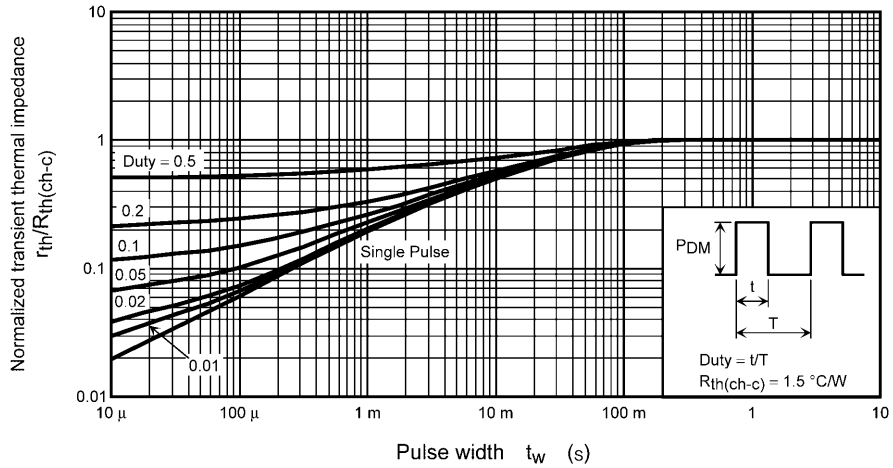


Fig. 8.12 $r_{th}/R_{th(ch-c)} - t_w$
(Guaranteed Maximum)

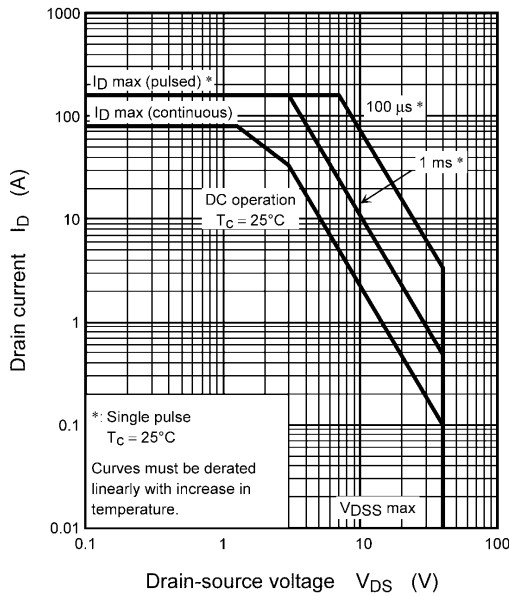


Fig. 8.13 Safe Operating Area
(Guaranteed Maximum)

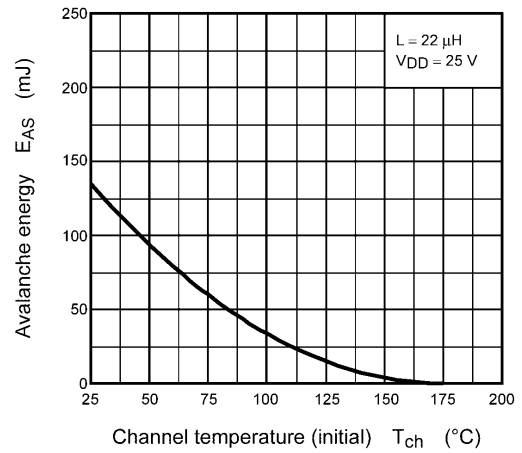


Fig. 8.14 $E_{AS} - T_{ch}$
(Guaranteed Maximum)

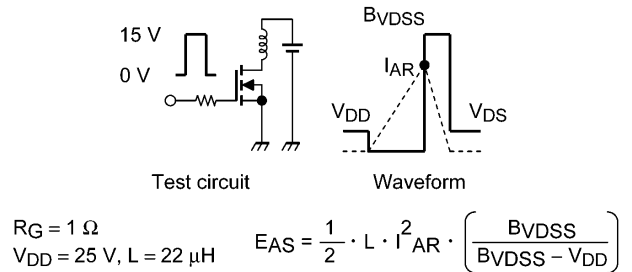


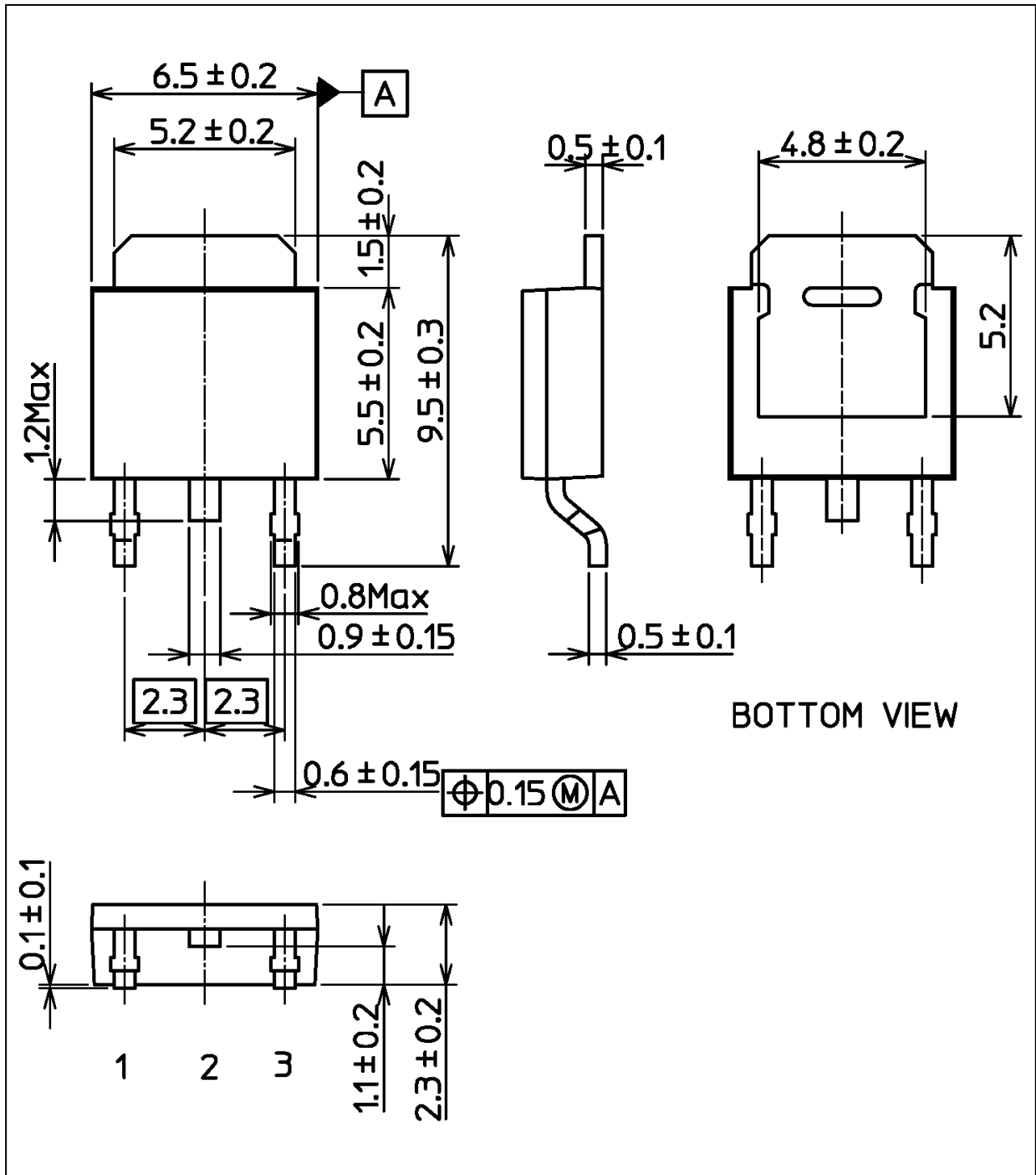
Fig. 8.15 Test Circuit/Waveform

$$E_{AS} = \frac{1}{2} \cdot L \cdot I_{AR}^2 \cdot \left(\frac{B_{VDSS}}{B_{VDSS} - V_{DD}} \right)$$

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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