

TK4P60DB

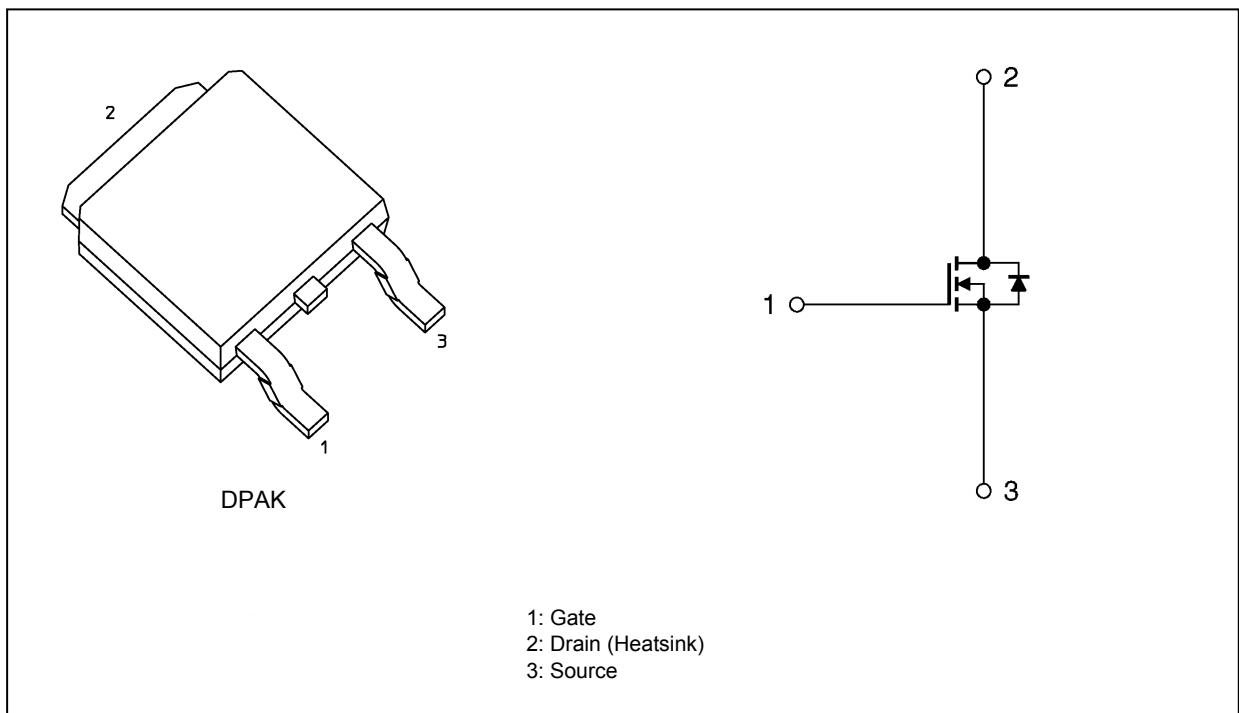
1. Applications

- Switching Voltage Regulators

2. Features

- (1) Low drain-source on-resistance : $R_{DS(ON)} = 1.6 \Omega$ (typ.)
- (2) High forward transfer admittance : $|Y_{fs}| = 2.2 \text{ S}$ (typ.)
- (3) Low leakage current : $I_{DSS} = 10 \mu\text{A}$ (max) ($V_{DS} = 600 \text{ V}$)
- (4) Enhancement mode : $V_{th} = 2.4 \text{ to } 4.4 \text{ V}$ ($V_{DS} = 10 \text{ V}$, $I_D = 1 \text{ mA}$)

3. Packaging and Internal Circuit



Start of commercial production

2009-12

2015-03-05

Rev.1.0

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

| Characteristics | Symbol | Rating | Unit |
|--|-----------|------------|------------------|
| Drain-source voltage | V_{DSS} | 600 | V |
| Gate-source voltage | V_{GSS} | ± 30 | |
| Drain current (DC) (Note 1) | I_D | 3.7 | A |
| Drain current (pulsed) (Note 1) | I_{DP} | 14.8 | |
| Power dissipation ($T_c = 25\text{ }^\circ\text{C}$) | P_D | 80 | W |
| Single-pulse avalanche energy (Note 2) | E_{AS} | 147 | mJ |
| Avalanche current (Note 3) | I_{AR} | 3.7 | A |
| Repetitive avalanche energy (Note 3) | E_{AR} | 8 | mJ |
| Reverse drain current (DC) (Note 1) | I_{DR} | 3.7 | A |
| Reverse drain current (pulsed) (Note 1) | I_{DRP} | 14.8 | |
| Channel temperature | T_{ch} | 150 | $^\circ\text{C}$ |
| 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 | $R_{th(ch-c)}$ | 1.56 | $^\circ\text{C}/\text{W}$ |
| Channel-to-ambient thermal resistance | $R_{th(ch-a)}$ | 125 | |

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

Note 2: $V_{DD} = 90\text{ V}$, $T_{ch} = 25\text{ }^\circ\text{C}$ (initial), $L = 18.7\text{ mH}$, $R_G = 25\text{ }\Omega$, $I_{AR} = 3.7\text{ A}$

Note 3: Repetitive rating; pulse width limited by maximum channel temperature.

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

6. Electrical Characteristics

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

| Characteristics | Symbol | Test Condition | Min | Typ. | Max | Unit |
|--------------------------------|---------------|---|-----|------|---------|---------------|
| Gate leakage current | I_{GSS} | $V_{GS} = \pm 30\text{ V}, V_{DS} = 0\text{ V}$ | — | — | ± 1 | μA |
| Drain cut-off current | I_{DSS} | $V_{DS} = 600\text{ V}, V_{GS} = 0\text{ V}$ | — | — | 10 | |
| Drain-source breakdown voltage | $V_{(BR)DSS}$ | $I_D = 10\text{ mA}, V_{GS} = 0\text{ V}$ | 600 | — | — | V |
| Gate threshold voltage | V_{th} | $V_{DS} = 10\text{ V}, I_D = 1\text{ mA}$ | 2.4 | — | 4.4 | |
| Drain-source on-resistance | $R_{DS(ON)}$ | $V_{GS} = 10\text{ V}, I_D = 1.9\text{ A}$ | — | 1.6 | 2 | Ω |
| Forward transfer admittance | $ Y_{fs} $ | $V_{DS} = 10\text{ V}, I_D = 1.9\text{ A}$ | 0.6 | 2.2 | — | S |

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

| Characteristics | Symbol | Test Condition | Min | Typ. | Max | Unit |
|--------------------------------|-----------|--|-----|------|-----|---------------|
| Input capacitance | C_{iss} | $V_{DS} = 25\text{ V}, V_{GS} = 0\text{ V},$ $f = 1\text{ MHz}$ | — | 540 | — | μF |
| Reverse transfer capacitance | C_{rss} | | — | 3 | — | |
| Output capacitance | C_{oss} | | — | 60 | — | |
| Switching time (rise time) | t_r | See Fig.6.2.1 | — | 18 | — | ns |
| Switching time (turn-on time) | t_{on} | | — | 40 | — | |
| Switching time (fall time) | t_f | | — | 8 | — | |
| Switching time (turn-off time) | t_{off} | | — | 55 | — | |

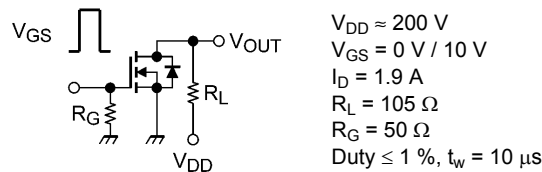


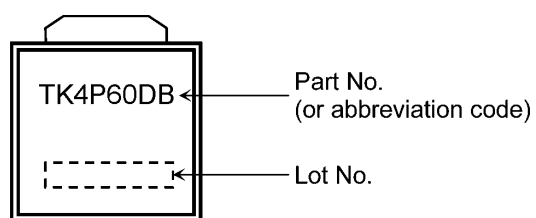
Fig. 6.2.1 Switching Time Test Circuit

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

| Characteristics | Symbol | Test Condition | Min | Typ. | Max | Unit |
|---|----------|--|-----|------|-----|------|
| Total gate charge (gate-source plus gate-drain) | Q_g | $V_{DD} \approx 400\text{ V}, V_{GS} = 10\text{ V},$ $I_D = 3.7\text{ A}$ | — | 11 | — | nC |
| Gate-source charge | Q_{gs} | | — | 6 | — | |
| Gate-drain charge | Q_{gd} | | — | 5 | — | |

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

| Characteristics | Symbol | Test Condition | Min | Typ. | Max | Unit |
|-------------------------|-----------|--|-----|------|------|---------------|
| Diode forward voltage | V_{DSF} | $I_{DR} = 3.7\text{ A}, V_{GS} = 0\text{ V}$ | — | — | -1.7 | V |
| Reverse recovery time | t_{rr} | $I_{DR} = 3.7\text{ A}, V_{GS} = 0\text{ V},$ $-di/dt = 100\text{ A}/\mu\text{s}$ | — | 1000 | — | ns |
| Reverse recovery charge | Q_{rr} | | — | 5.5 | — | μC |

7. Marking**Fig. 7.1 Marking**

8. Characteristics Curves (Note)

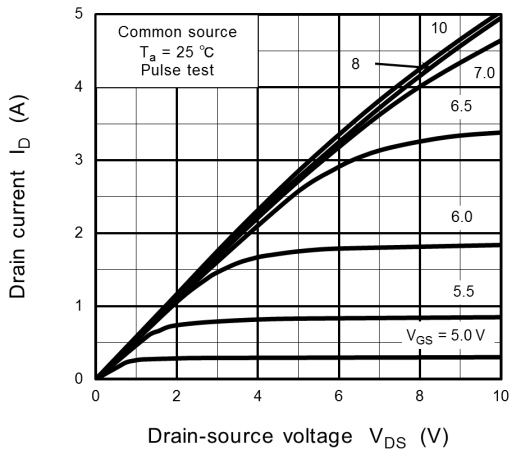


Fig. 8.1 $I_D - V_{DS}$

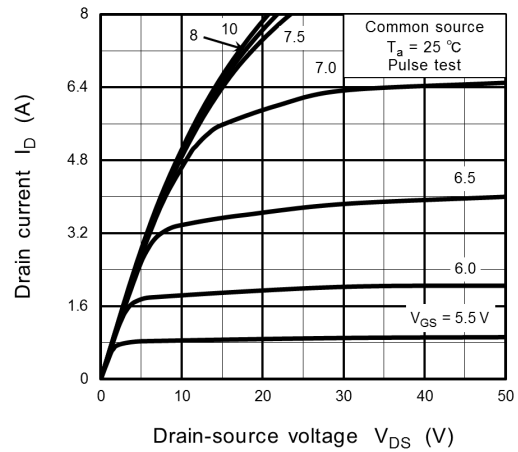


Fig. 8.2 $I_D - V_{DS}$

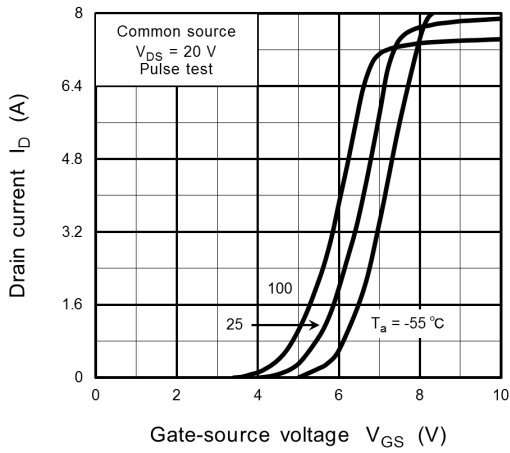


Fig. 8.3 $I_D - V_{GS}$

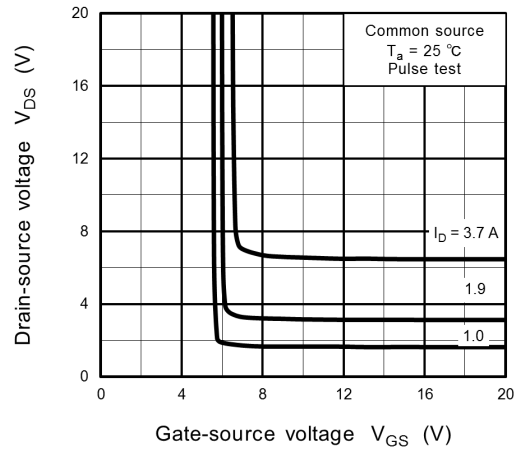


Fig. 8.4 $V_{DS} - V_{GS}$

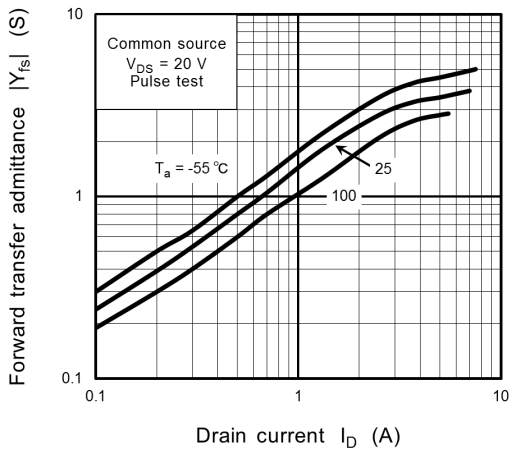


Fig. 8.5 $|Y_{fs}| - I_D$

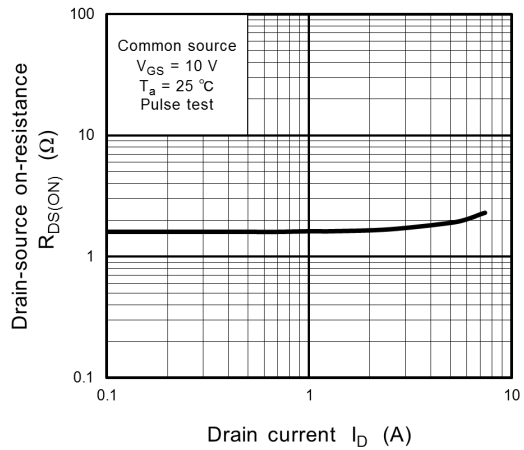


Fig. 8.6 $R_{DS(ON)} - I_D$

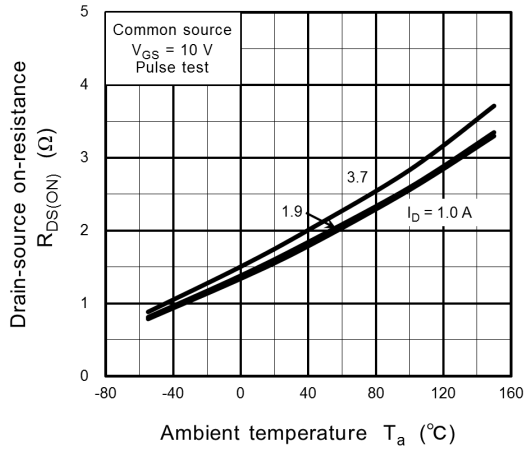


Fig. 8.7 $R_{DS(ON)} - T_a$

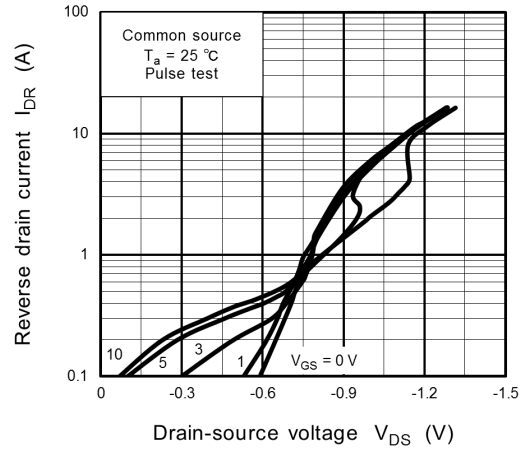


Fig. 8.8 $I_{DR} - V_{DS}$

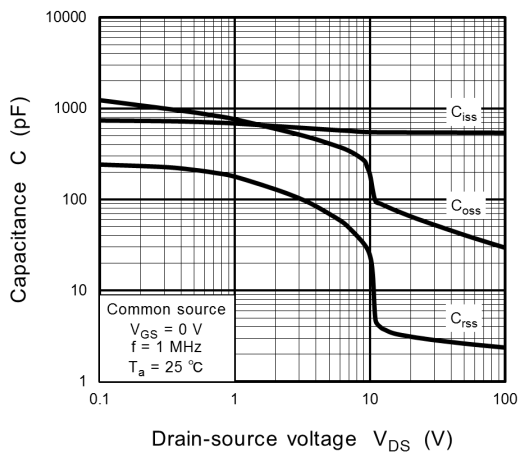


Fig. 8.9 $C - V_{DS}$

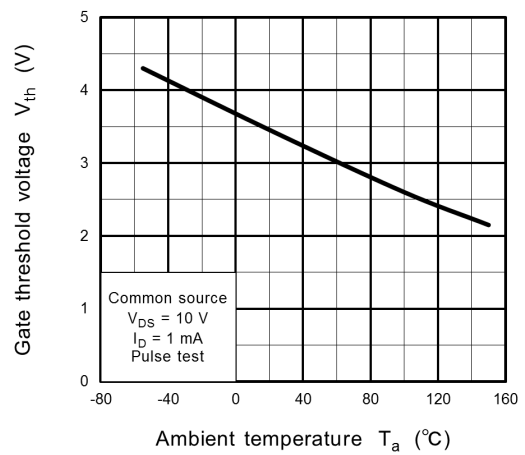


Fig. 8.10 $V_{th} - T_a$

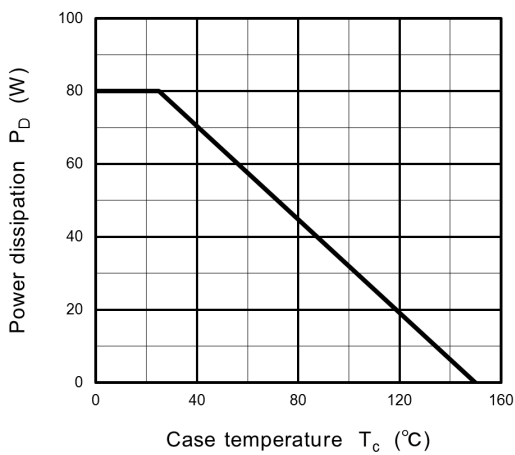


Fig. 8.11 $P_D - T_c$
(Guaranteed Maximum)

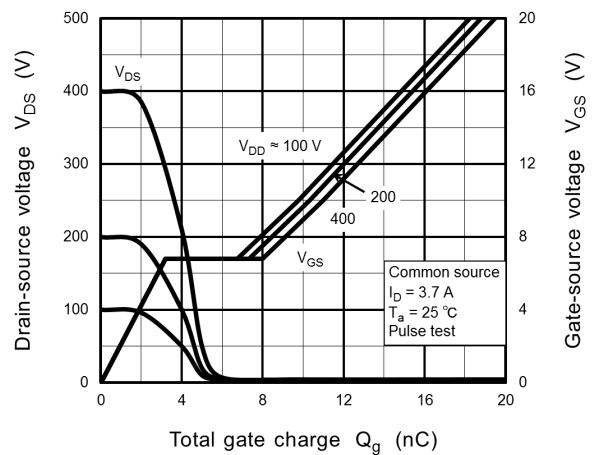


Fig. 8.12 Dynamic Input/Output Characteristics

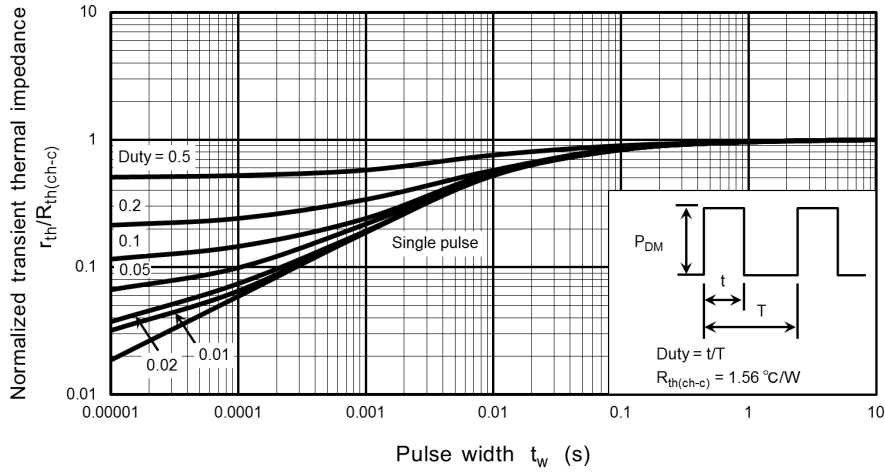


Fig. 8.13 $r_{th}/R_{th(ch-c)} - t_w$
(Guaranteed Maximum)

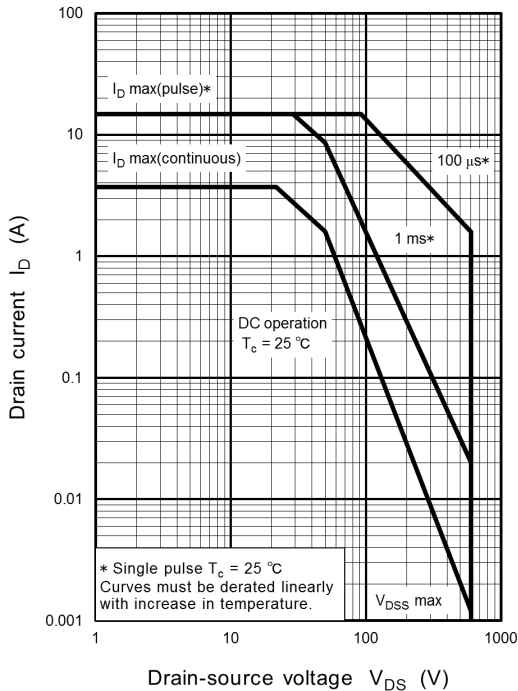


Fig. 8.14 Safe Operating Area
(Guaranteed Maximum)

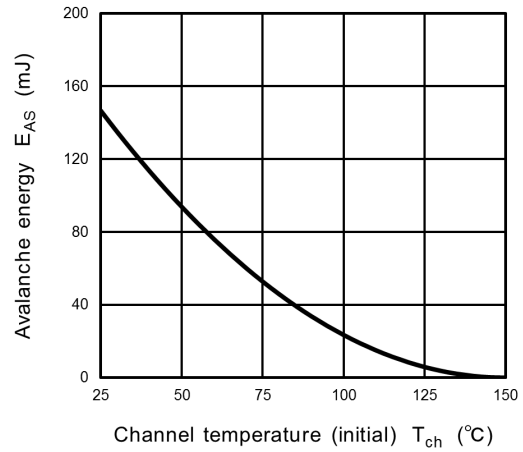
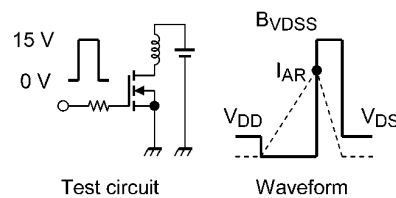


Fig. 8.15 $E_{AS} - T_{ch}$
(Guaranteed Maximum)



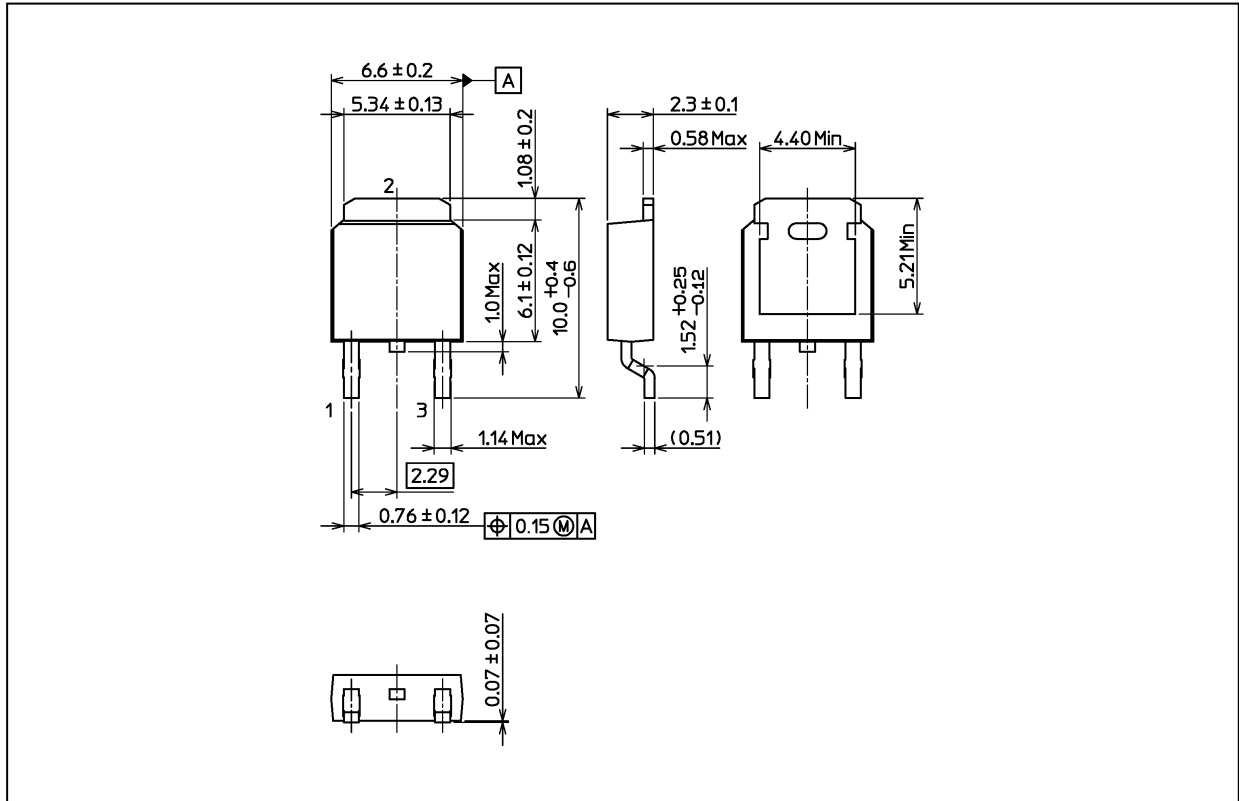
$$R_G = 25 \Omega, V_{DD} = 90 \text{ V} \quad E_{AS} = \frac{1}{2} \cdot L \cdot I_{AR}^2 \cdot \left(\frac{B_{VDSS}}{B_{VDSS} - V_{DD}} \right)$$

Fig. 8.16 Test Circuit/Waveform

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

Package Dimensions

Unit: mm



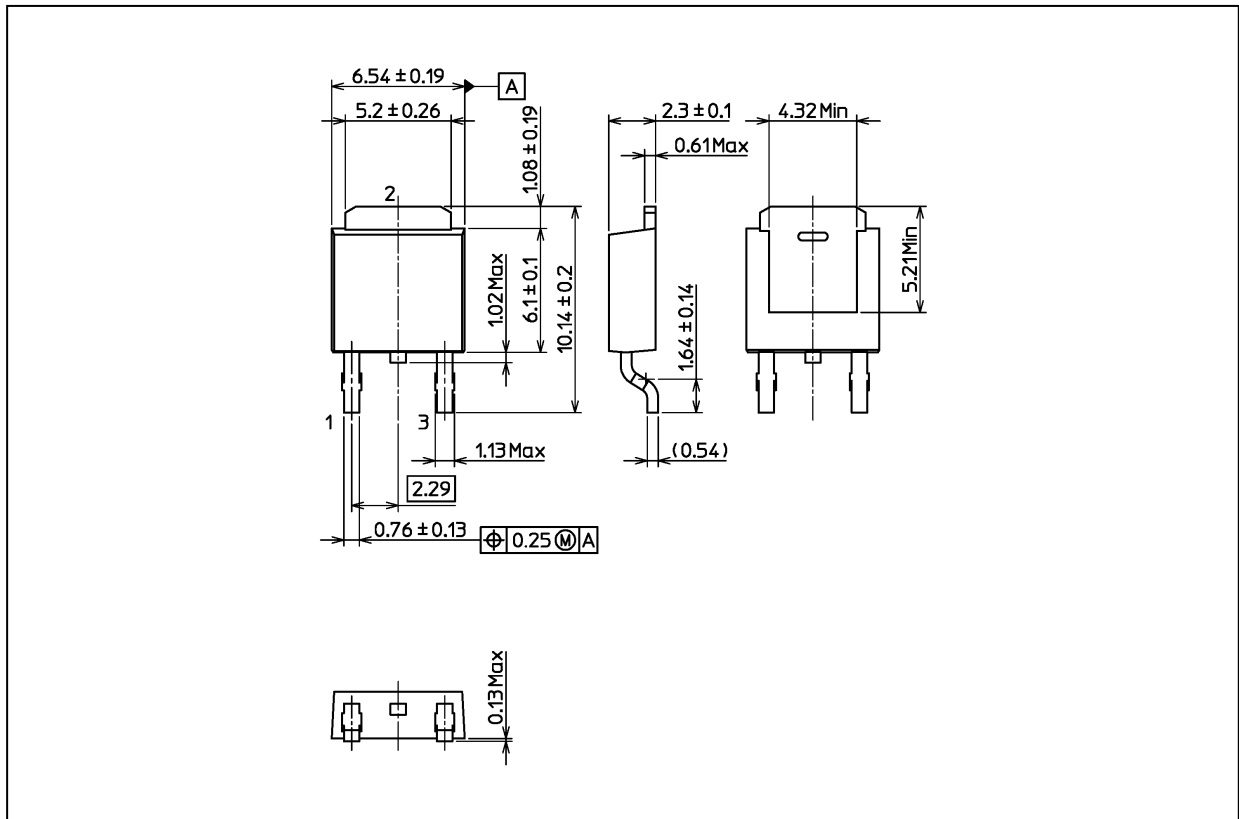
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Weight: 0.36 g (typ.)

| Package Name(s) |
|-----------------|
| JEDEC: TO-252 |
| TOSHIBA: 2-7K1S |
| Nickname: DPAK |

Package Dimensions

Unit: mm



Both products are compliant with the JEDEC: TO-252 Package specification. Please contact the Toshiba sales representative for further details.

Weight: 0.389 g (typ.)



| Package Name(s) |
|-----------------|
| JEDEC: TO-252 |
| TOSHIBA: 2-7N1S |
| Nickname: DPAK |

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