

# TK5P50D

## Switching Regulator Applications

- Low drain-source ON-resistance:  $R_{DS(ON)} = 1.3 \Omega$  (typ.)
- High forward transfer admittance:  $|Y_{fs}| = 3.0 S$  (typ.)
- Low leakage current:  $I_{DSS} = 10 \mu A$  (max) ( $V_{DS} = 500 V$ )
- Enhancement-mode:  $V_{th} = 2.4$  to  $4.4 V$  ( $V_{DS} = 10 V$ ,  $I_D = 1 mA$ )

## Absolute Maximum Ratings ( $T_a = 25^\circ C$ )

| Characteristics                                |                               | Symbol    | Rating         | Unit       |
|------------------------------------------------|-------------------------------|-----------|----------------|------------|
| Drain-source voltage                           |                               | $V_{DSS}$ | 500            | V          |
| Gate-source voltage                            |                               | $V_{GSS}$ | $\pm 30$       | V          |
| Drain current                                  | DC (Note 1)                   | $I_D$     | 5              | A          |
|                                                | Pulse ( $t = 1 ms$ ) (Note 1) | $I_{DP}$  | 20             |            |
| Drain power dissipation ( $T_c = 25^\circ C$ ) |                               | $P_D$     | 80             | W          |
| Single pulse avalanche energy (Note 2)         |                               | $E_{AS}$  | 128            | mJ         |
| Avalanche current                              |                               | $I_{AR}$  | 5              | A          |
| Repetitive avalanche energy (Note 3)           |                               | $E_{AR}$  | 8              | mJ         |
| Channel temperature                            |                               | $T_{ch}$  | 150            | $^\circ C$ |
| Storage temperature range                      |                               | $T_{stg}$ | $-55$ to $150$ | $^\circ C$ |

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).

## Thermal Characteristics

| Characteristics                        | Symbol         | Max  | Unit         |
|----------------------------------------|----------------|------|--------------|
| Thermal resistance, channel to case    | $R_{th(ch-c)}$ | 1.56 | $^\circ C/W$ |
| Thermal resistance, channel to ambient | $R_{th(ch-a)}$ | 125  | $^\circ C/W$ |

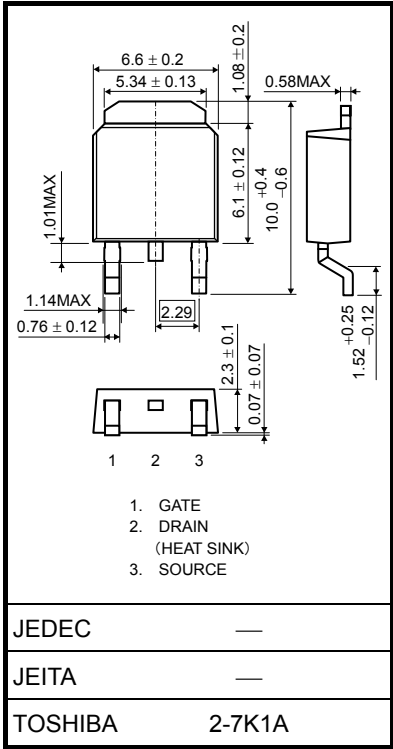
Note 1: Please use devices on conditions that the channel temperature is below  $150^\circ C$ .

Note 2:  $V_{DD} = 90 V$ ,  $T_{ch} = 25^\circ C$  (initial),  $L = 8.67 mH$ ,  $R_G = 25 \Omega$ ,  $I_{AR} = 5 A$

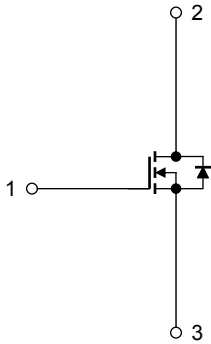
Note 3: Repetitive rating: pulse width limited by maximum channel temperature

This transistor is an electrostatic sensitive device. Please handle with caution.

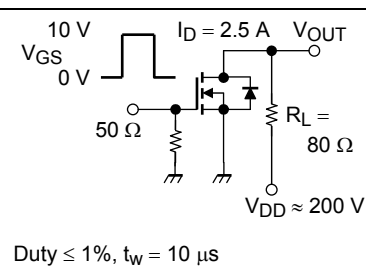
Unit: mm



Weight : 0.36 g (typ.)



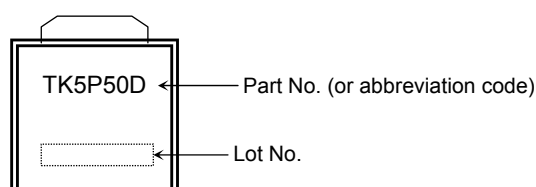
## Electrical Characteristics (Ta = 25°C)

| Characteristics                |               | Symbol        | Test Condition                                                                     | Min | Typ. | Max     | Unit          |
|--------------------------------|---------------|---------------|------------------------------------------------------------------------------------|-----|------|---------|---------------|
| Gate leakage current           |               | $I_{GSS}$     | $V_{GS} = \pm 30 \text{ V}, V_{DS} = 0 \text{ V}$                                  | —   | —    | $\pm 1$ | $\mu\text{A}$ |
| Drain cut-off current          |               | $I_{DSS}$     | $V_{DS} = 500 \text{ V}, V_{GS} = 0 \text{ V}$                                     | —   | —    | 10      | $\mu\text{A}$ |
| Drain-source breakdown voltage |               | $V_{(BR)DSS}$ | $I_D = 10 \text{ mA}, V_{GS} = 0 \text{ V}$                                        | 500 | —    | —       | V             |
| Gate threshold voltage         |               | $V_{th}$      | $V_{DS} = 10 \text{ V}, I_D = 1 \text{ mA}$                                        | 2.4 | —    | 4.4     | V             |
| Drain-source ON-resistance     |               | $R_{DS(ON)}$  | $V_{GS} = 10 \text{ V}, I_D = 2.5 \text{ A}$                                       | —   | 1.3  | 1.5     | $\Omega$      |
| Forward transfer admittance    |               | $ Y_{fs} $    | $V_{DS} = 10 \text{ V}, I_D = 2.5 \text{ A}$                                       | 0.8 | 3.0  | —       | S             |
| Input capacitance              |               | $C_{iss}$     | $V_{DS} = 25 \text{ V}, V_{GS} = 0 \text{ V}, f = 1 \text{ MHz}$                   | —   | 490  | —       | pF            |
| Reverse transfer capacitance   |               | $C_{rss}$     |                                                                                    | —   | 3    | —       |               |
| Output capacitance             |               | $C_{oss}$     |                                                                                    | —   | 55   | —       |               |
| Switching time                 | Rise time     | $t_r$         |  | —   | 18   | —       | ns            |
|                                | Turn-on time  | $t_{on}$      |                                                                                    | —   | 40   | —       |               |
|                                | Fall time     | $t_f$         |                                                                                    | —   | 8    | —       |               |
|                                | Turn-off time | $t_{off}$     |                                                                                    | —   | 55   | —       |               |
| Total gate charge              |               | $Q_g$         | $V_{DD} \approx 400 \text{ V}, V_{GS} = 10 \text{ V}, I_D = 5 \text{ A}$           | —   | 11   | —       | nC            |
| Gate-source charge             |               | $Q_{gs}$      |                                                                                    | —   | 6    | —       |               |
| Gate-drain charge              |               | $Q_{gd}$      |                                                                                    | —   | 5    | —       |               |

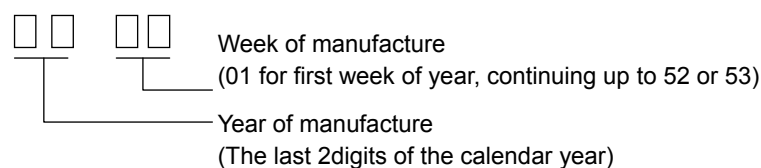
## Source-Drain Ratings and Characteristics (Ta = 25°C)

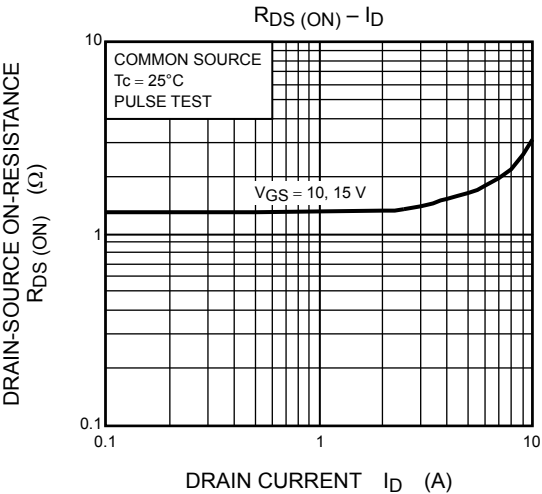
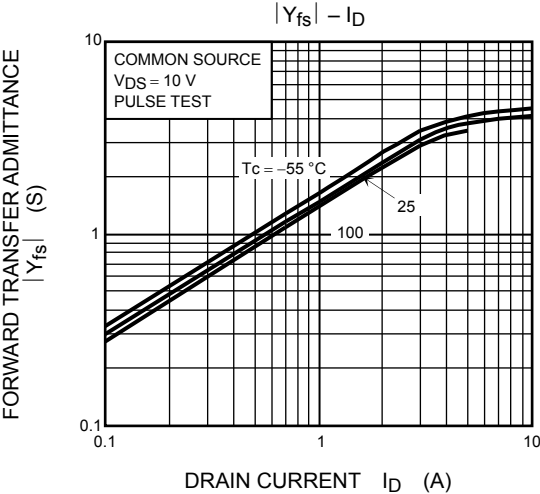
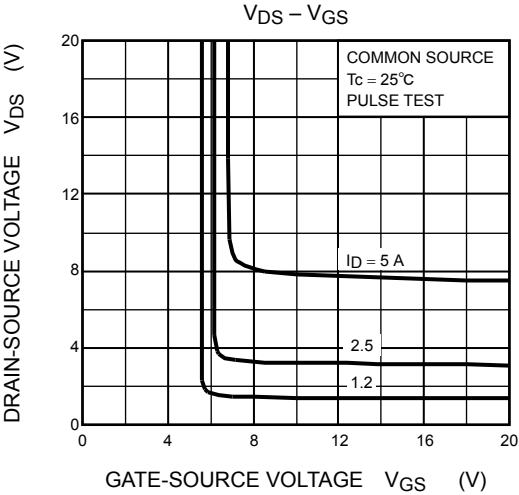
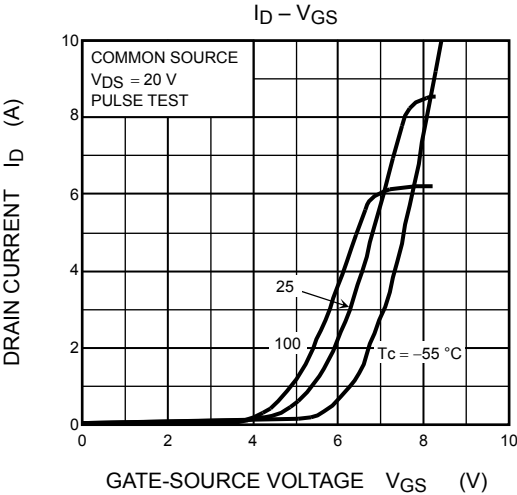
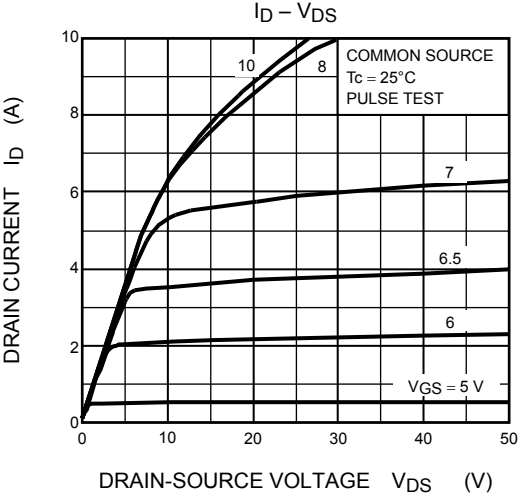
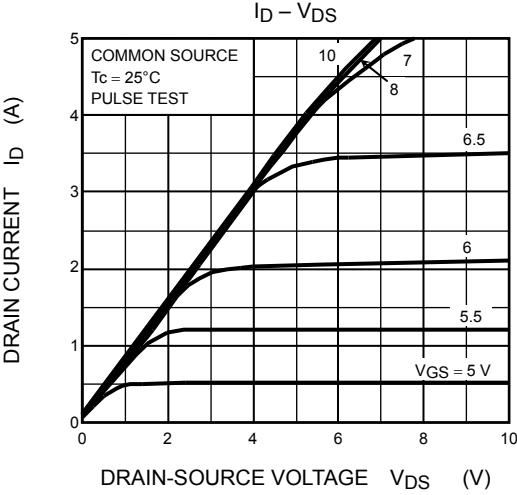
| Characteristics                              | Symbol    | Test Condition                                | Min | Typ. | Max  | Unit          |
|----------------------------------------------|-----------|-----------------------------------------------|-----|------|------|---------------|
| Continuous drain reverse current<br>(Note 1) | $I_{DR}$  | —                                             | —   | —    | 5    | A             |
| Pulse drain reverse current<br>(Note 1)      | $I_{DRP}$ | —                                             | —   | —    | 20   | A             |
| Forward voltage (diode)                      | $V_{DSF}$ | $I_{DR} = 5 \text{ A}, V_{GS} = 0 \text{ V}$  | —   | —    | -1.7 | V             |
| Reverse recovery time                        | $t_{rr}$  | $I_{DR} = 5 \text{ A}, V_{GS} = 0 \text{ V},$ | —   | 1000 | —    | ns            |
| Reverse recovery charge                      | $Q_{rr}$  | $dI_{DR}/dt = 100 \text{ A}/\mu\text{s}$      | —   | 5.0  | —    | $\mu\text{C}$ |

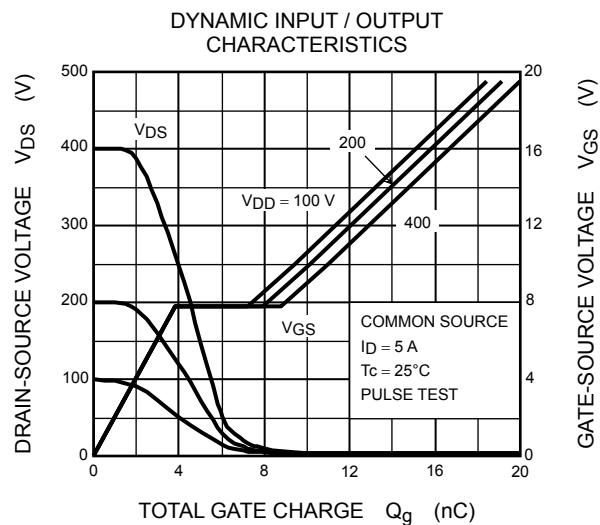
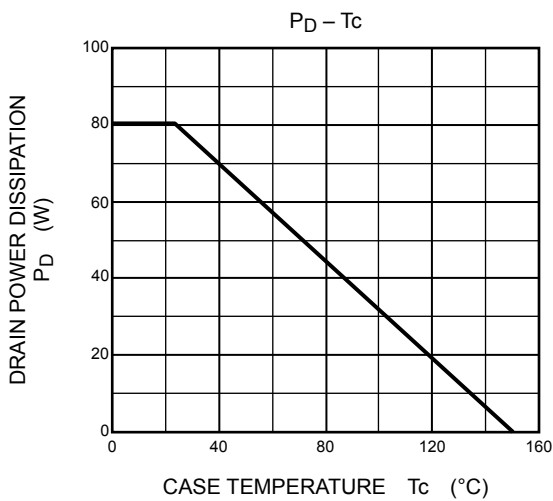
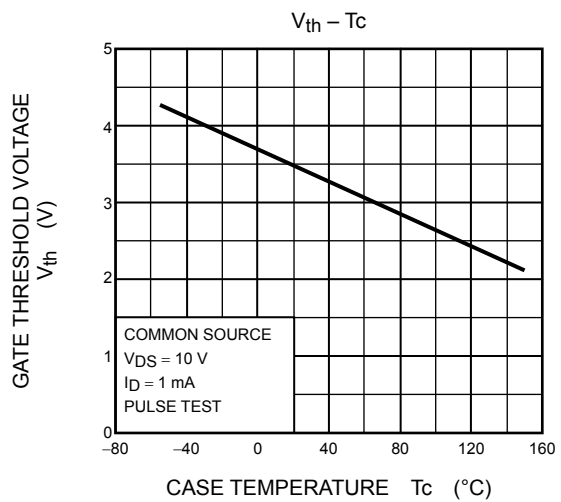
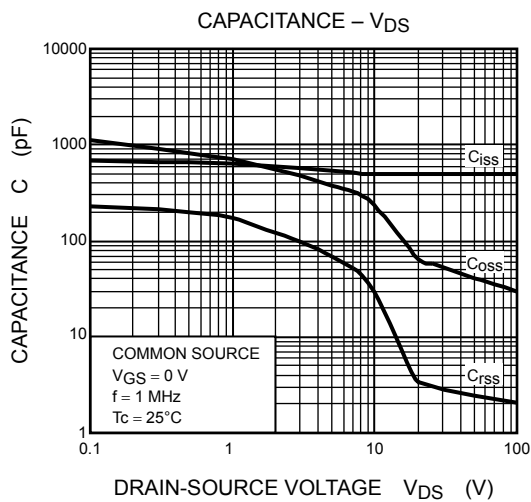
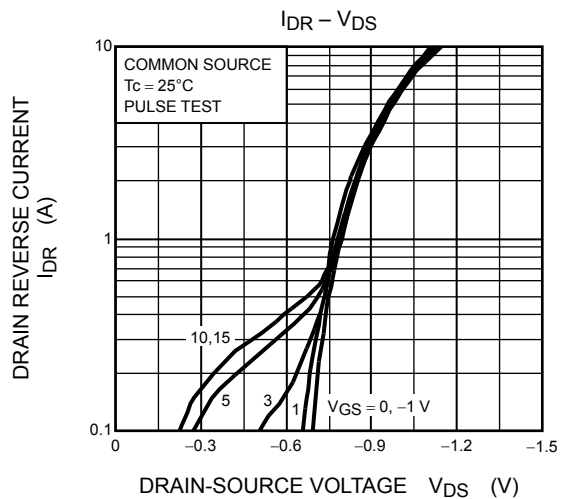
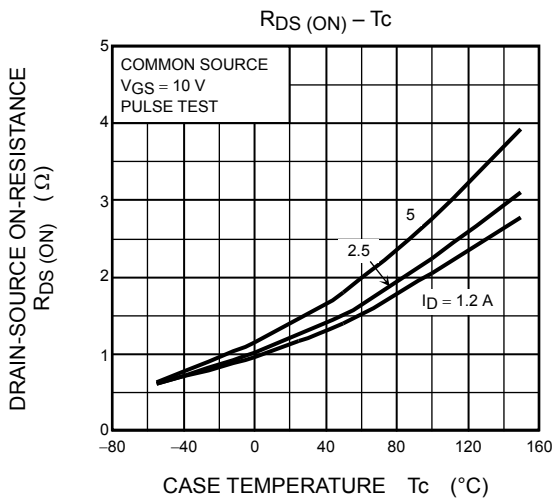
## Marking (Note 4)

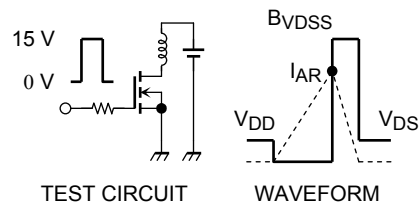
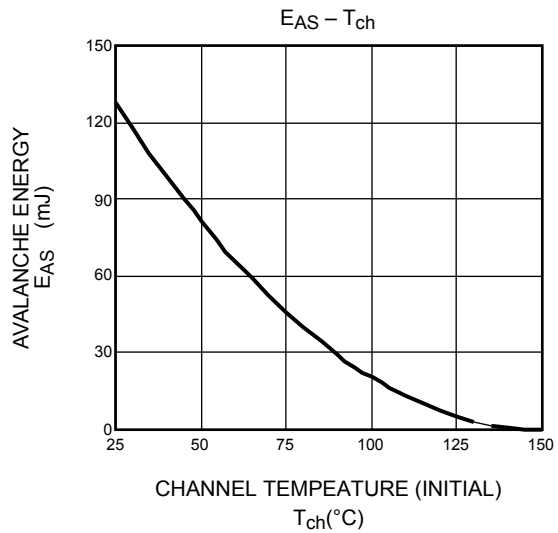
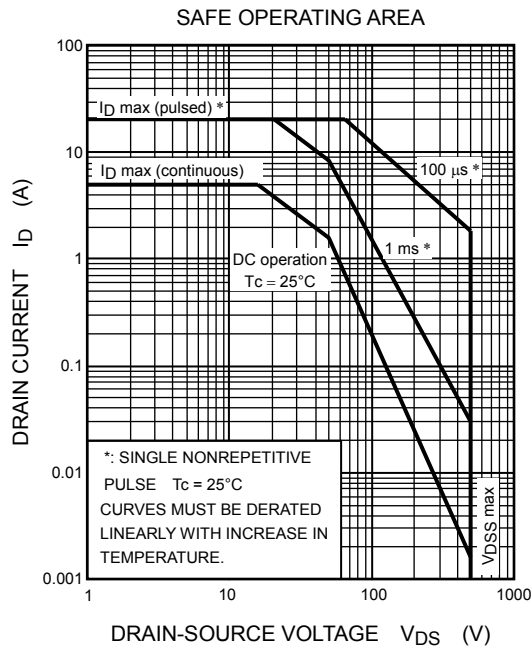
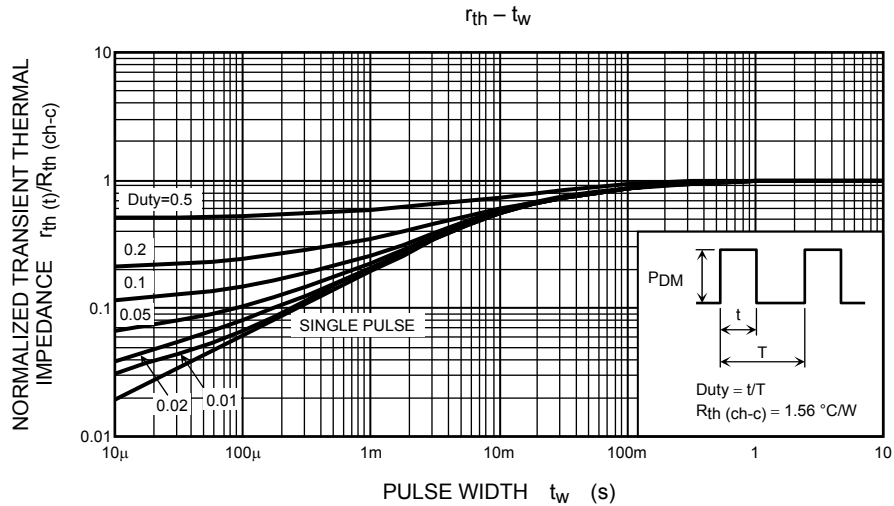


Note 4: \* Weekly code: (Four digits)









$R_G = 25 \, \Omega$   
 $V_{DD} = 90 \, V, L = 8.67 \, mH$

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

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