

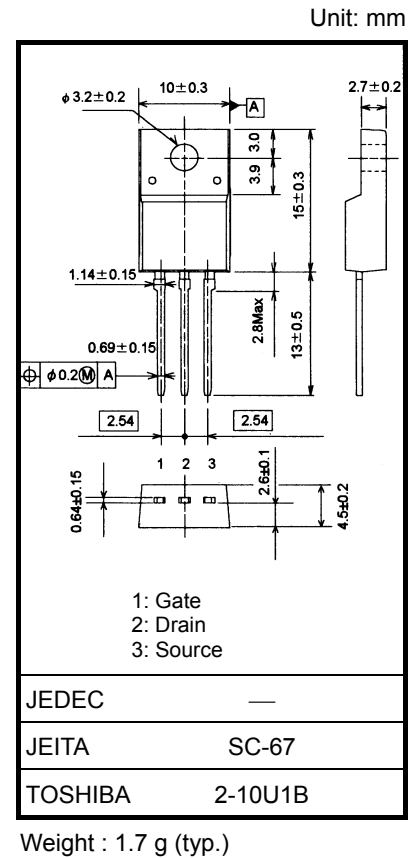
## TK4A60D

### Switching Regulator Applications

- Low drain-source ON-resistance:  $R_{DS(ON)} = 1.4 \Omega$  (typ.)
- High forward transfer admittance:  $|Y_{fs}| = 2.5 S$  (typ.)
- Low leakage current:  $I_{DSS} = 10 \mu A$  (max) ( $V_{DS} = 600 V$ )
- 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                           |                | $V_{DSS}$ | 600        | V          |
| Gate-source voltage                            |                | $V_{GSS}$ | $\pm 30$   | V          |
| Drain current                                  | DC (Note 1)    | $I_D$     | 4          | A          |
|                                                | Pulse (Note 1) | $I_{DP}$  | 16         |            |
| Drain power dissipation ( $T_c = 25^\circ C$ ) |                | $P_D$     | 35         | W          |
| Single pulse avalanche energy (Note 2)         |                | $E_{AS}$  | 187        | mJ         |
| Avalanche current                              |                | $I_{AR}$  | 4          | A          |
| Repetitive avalanche energy (Note 3)           |                | $E_{AR}$  | 3.5        | 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    | $R_{th(ch-c)}$ | 3.57 | $^\circ C/W$ |
| Thermal resistance, channel to ambient | $R_{th(ch-a)}$ | 62.5 | $^\circ C/W$ |

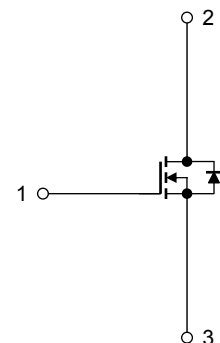
Note 1: Ensure that the channel temperature does not exceed  $150^\circ C$ .

Note 2:  $V_{DD} = 90 V$ ,  $T_{ch} = 25^\circ C$  (initial),  $L = 20.5 mH$ ,  $R_G = 25 \Omega$ ,  $I_{AR} = 4 A$

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

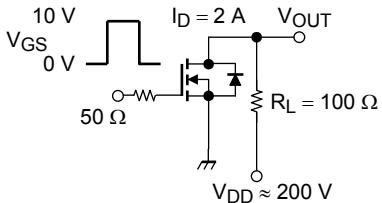
This transistor is an electrostatic-sensitive device. Handle with care.

### Internal Connection



Start of commercial production  
2008-10

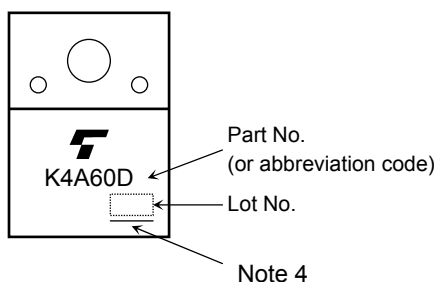
## Electrical Characteristics (Ta = 25°C)

| 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          |               | $I_{DSS}$     | $V_{DS} = 600 \text{ V}, V_{GS} = 0 \text{ V}$                                     | —   | —    | 10      | $\mu\text{A}$ |
| Drain-source breakdown voltage |               | $V_{(BR)DSS}$ | $I_D = 10 \text{ mA}, V_{GS} = 0 \text{ V}$                                        | 600 | —    | —       | 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     |               | $R_{DS(ON)}$  | $V_{GS} = 10 \text{ V}, I_D = 2 \text{ A}$                                         | —   | 1.4  | 1.7     | $\Omega$      |
| Forward transfer admittance    |               | $ Y_{fs} $    | $V_{DS} = 10 \text{ V}, I_D = 2 \text{ A}$                                         | 0.7 | 2.5  | —       | S             |
| Input capacitance              |               | $C_{iss}$     | $V_{DS} = 25 \text{ V}, V_{GS} = 0 \text{ V}, f = 1 \text{ MHz}$                   | —   | 600  | —       | pF            |
| Reverse transfer capacitance   |               | $C_{rss}$     |                                                                                    | —   | 4    | —       |               |
| Output capacitance             |               | $C_{oss}$     |                                                                                    | —   | 70   | —       |               |
| 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              |               | $Q_g$         | $V_{DD} \approx 400 \text{ V}, V_{GS} = 10 \text{ V}, I_D = 4 \text{ A}$           | —   | 12   | —       | nC            |
| Gate-source charge             |               | $Q_{gs}$      |                                                                                    | —   | 7    | —       |               |
| Gate-drain charge              |               | $Q_{gd}$      |                                                                                    | —   | 5    | —       |               |

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

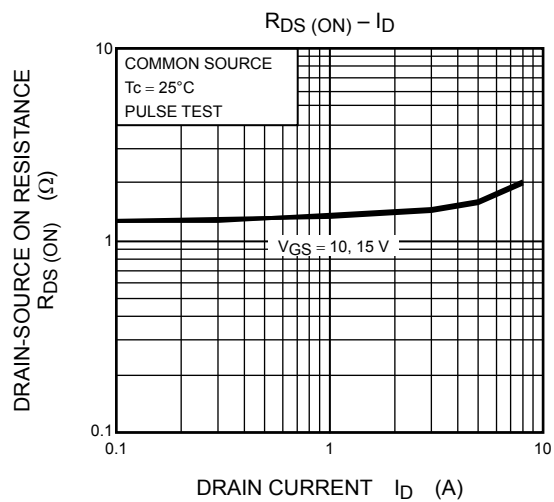
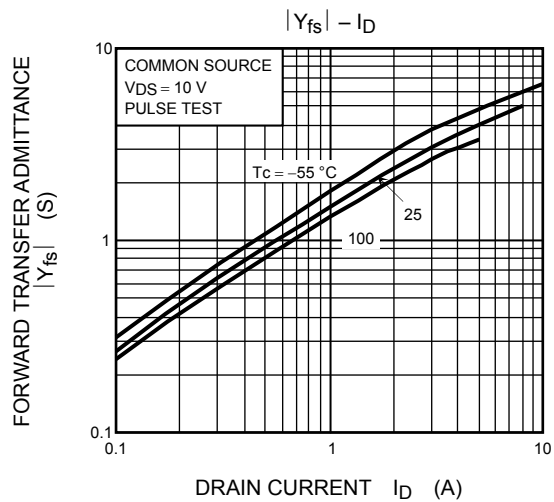
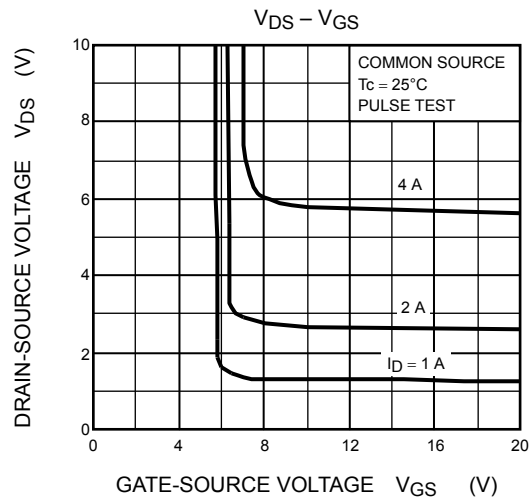
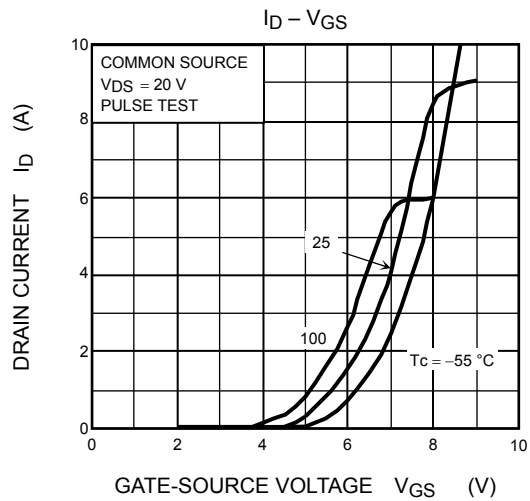
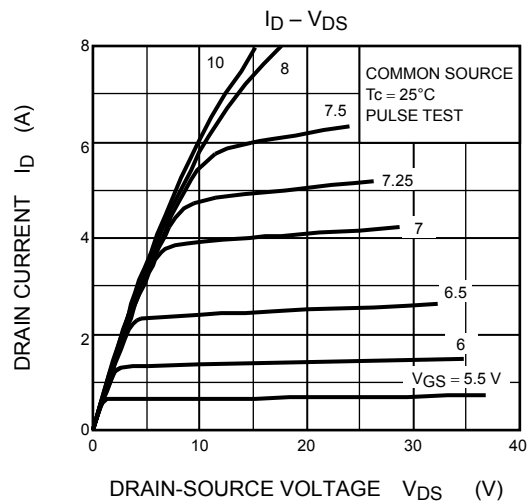
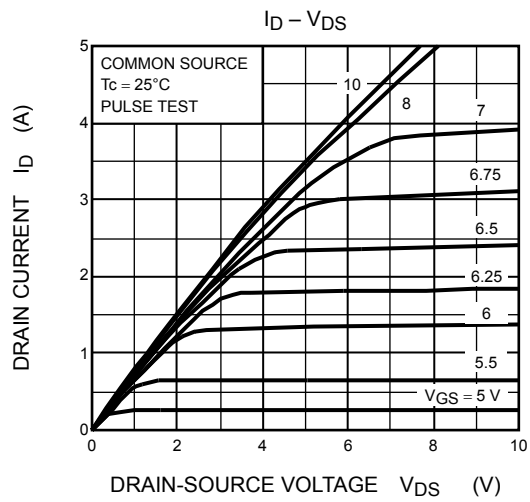
| Characteristics                              | Symbol    | Test Condition                                | Min | Typ. | Max  | Unit          |
|----------------------------------------------|-----------|-----------------------------------------------|-----|------|------|---------------|
| Continuous drain reverse current<br>(Note 1) | $I_{DR}$  | —                                             | —   | —    | 4    | A             |
| Pulse drain reverse current<br>(Note 1)      | $I_{DRP}$ | —                                             | —   | —    | 16   | A             |
| Forward voltage (diode)                      | $V_{DSF}$ | $I_{DR} = 4 \text{ A}, V_{GS} = 0 \text{ V}$  | —   | —    | -1.7 | V             |
| Reverse recovery time                        | $t_{rr}$  | $I_{DR} = 4 \text{ A}, V_{GS} = 0 \text{ V},$ | —   | 1200 | —    | ns            |
| Reverse recovery charge                      | $Q_{rr}$  | $dI_{DR}/dt = 100 \text{ A}/\mu\text{s}$      | —   | 7    | —    | $\mu\text{C}$ |

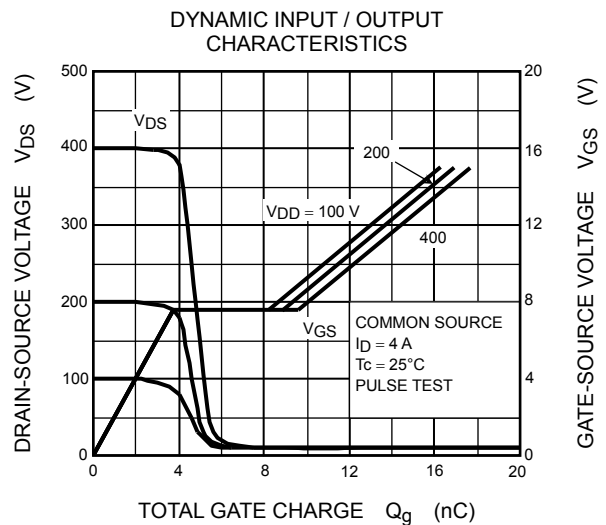
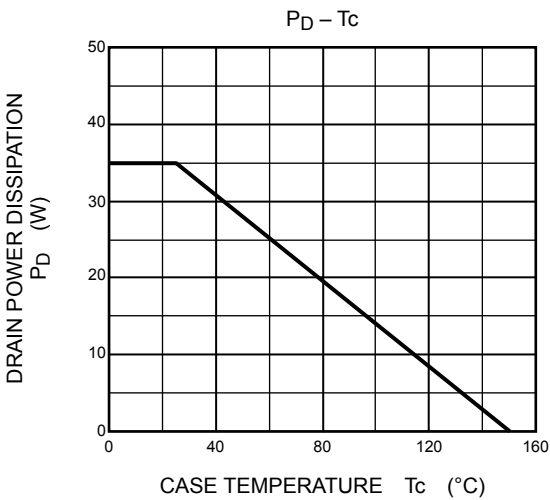
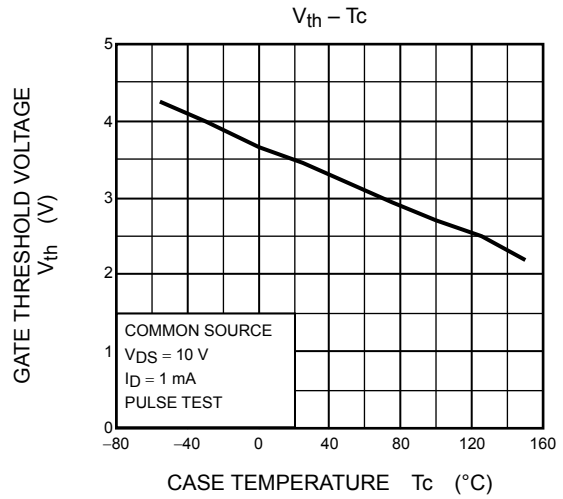
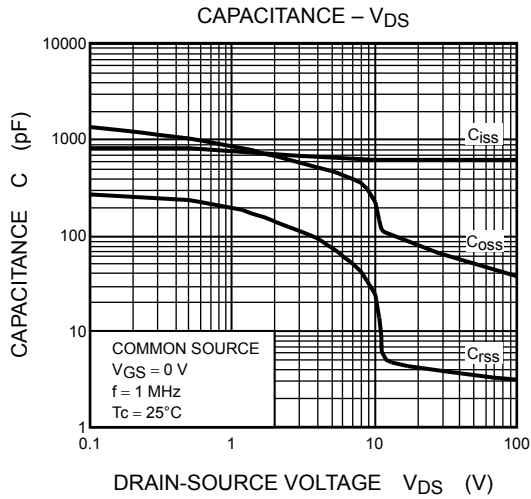
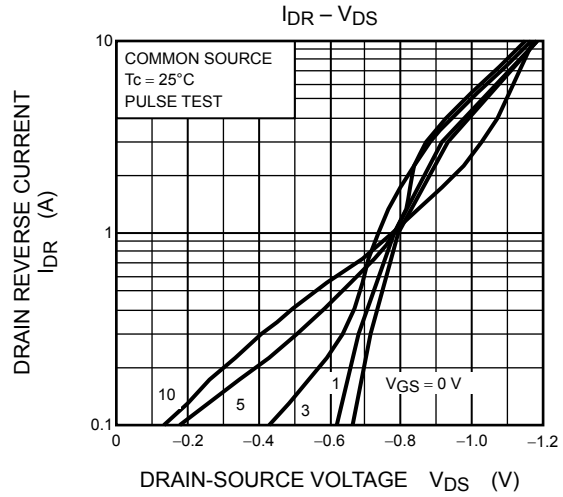
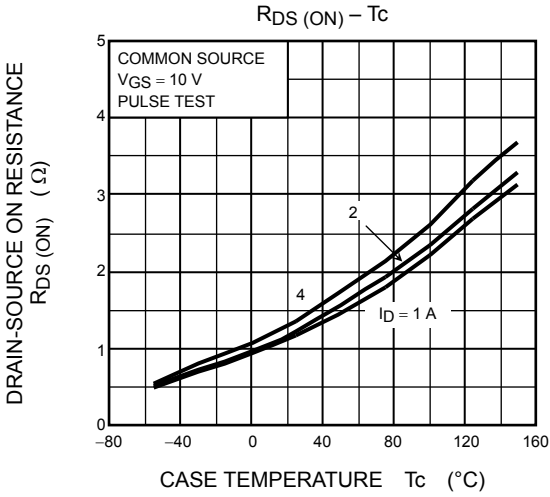
## Marking

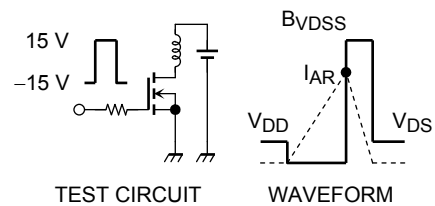
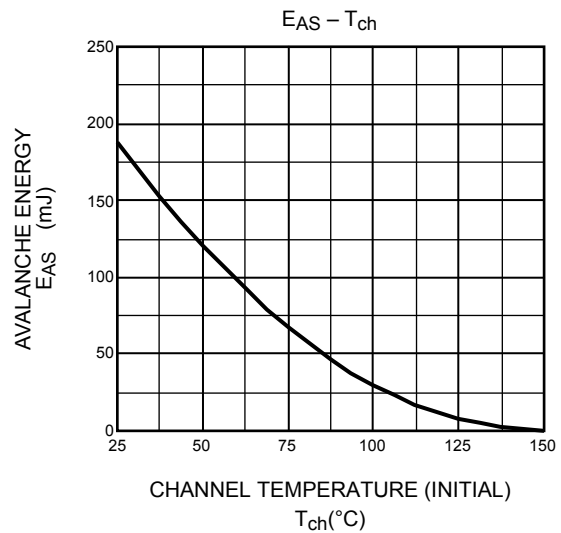
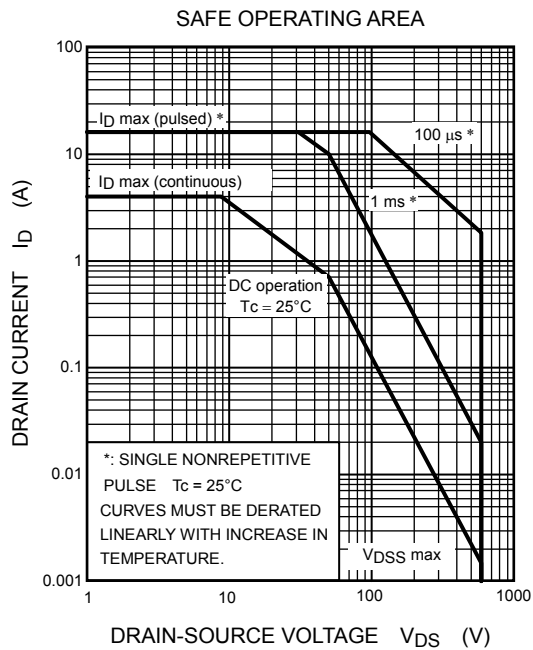
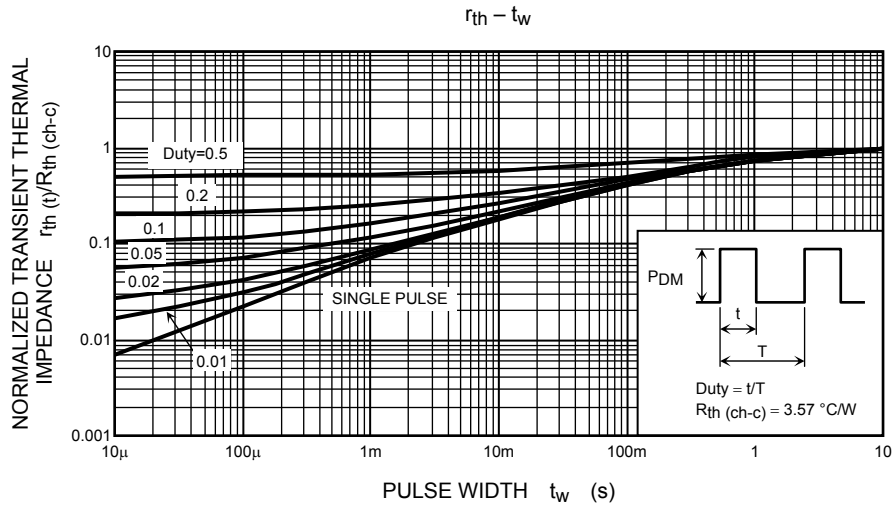


Note 4: A line under a Lot No. identifies the indication of product Labels.  
[[G]]/RoHS COMPATIBLE or [[G]]/RoHS [[Pb]]

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.







$$R_G = 25 \, \Omega$$

$$V_{DD} = 90 \, V, L = 20.5 \, mH$$

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

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