

TOSHIBA Field Effect Transistor Silicon N Channel MOS Type ( $\pi$ -MOS $\text{VII}$ )

# TK4A53D

## Switching Regulator Applications

- Low drain-source ON-resistance:  $R_{DS(ON)} = 1.3 \Omega$  (typ.)
- High forward transfer admittance:  $|Y_{fs}| = 3.0 \text{ S}$  (typ.)
- Low leakage current:  $I_{DSS} = 10 \mu\text{A}$  (max) ( $V_{DS} = 525 \text{ V}$ )
- Enhancement mode:  $V_{th} = 2.4$  to  $4.4 \text{ V}$  ( $V_{DS} = 10 \text{ V}$ ,  $I_D = 1 \text{ mA}$ )

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

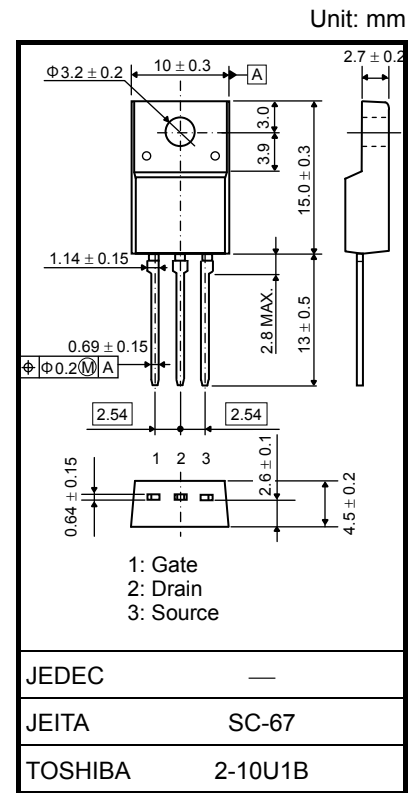
| Characteristics                                      |                | Symbol    | Rating     | Unit             |
|--|----------------|-----------|------------|------------------|
| Drain-source voltage                                 |                | $V_{DSS}$ | 525        | V                |
| 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 ( $T_c = 25^\circ\text{C}$ ) |                | $P_D$     | 35         | W                |
| Single pulse avalanche energy (Note 2)               |                | $E_{AS}$  | 252        | mJ               |
| Avalanche current                                    |                | $I_{AR}$  | 4          | A                |
| Repetitive avalanche energy (Note 3)                 |                | $E_{AR}$  | 3.5        | mJ               |
| Channel temperature                                  |                | $T_{ch}$  | 150        | $^\circ\text{C}$ |
| Storage temperature range                            |                | $T_{stg}$ | -55 to 150 | $^\circ\text{C}$ |

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.).

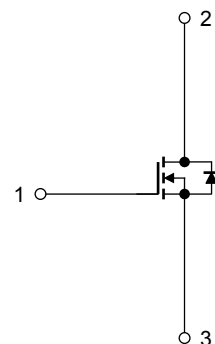
## Thermal Characteristics

| Characteristics                        | Symbol         | Max  | Unit               |
|--|----------------|------|--------------------|
| Thermal resistance, channel to case    | $R_{th(ch-c)}$ | 3.57 | $^\circ\text{C/W}$ |
| Thermal resistance, channel to ambient | $R_{th(ch-a)}$ | 62.5 | $^\circ\text{C/W}$ |

- Note 1: Ensure that the channel temperature does not exceed  $150^\circ\text{C}$ .
- Note 2:  $V_{DD} = 90 \text{ V}$ ,  $T_{ch} = 25^\circ\text{C}$ (initial),  $L = 27 \text{ mH}$ ,  $R_G = 25 \Omega$ ,  $I_{AR} = 4 \text{ A}$
- Note 3: Repetitive rating: pulse width limited by maximum channel temperature
- This transistor is an electrostatic-sensitive device. Handle with care.



Weight: 1.7 g (typ.)



Start of commercial production  
2009-04

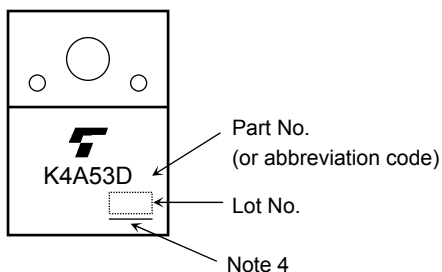
## Electrical Characteristics (Ta = 25°C)

| 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          |               | $I_{DSS}$     | $V_{DS} = 525\text{ V}, V_{GS} = 0\text{ V}$                          | —   | —    | 10      | $\mu\text{A}$ |
| Drain-source breakdown voltage |               | $V_{(BR)DSS}$ | $I_D = 10\text{ mA}, V_{GS} = 0\text{ V}$                             | 525 | —    | —       | 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     |               | $R_{DS(ON)}$  | $V_{GS} = 10\text{ V}, I_D = 2\text{ A}$                              | —   | 1.3  | 1.7     | $\Omega$      |
| Forward transfer admittance    |               | $ Y_{fs} $    | $V_{DS} = 10\text{ V}, I_D = 2\text{ A}$                              | 0.6 | 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              |               | $Q_g$         | $V_{DD} \approx 400\text{ V}, V_{GS} = 10\text{ V}, I_D = 4\text{ A}$ | —   | 11   | —       | nC            |
| Gate-source charge             |               | $Q_{gs}$      |   | —   | 6    | —       |               |
| Gate-drain charge              |               | $Q_{gd}$      |   | —   | 5    | —       |               |

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

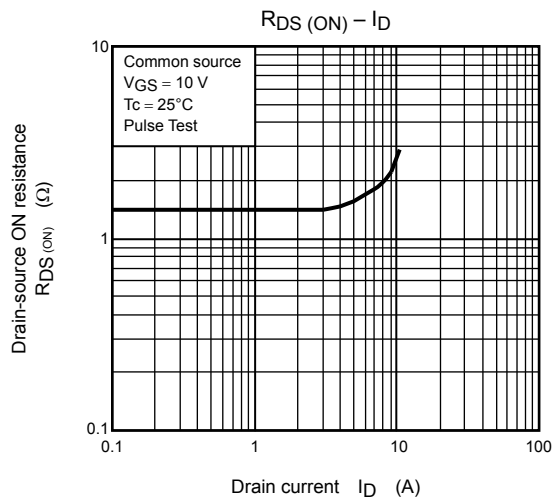
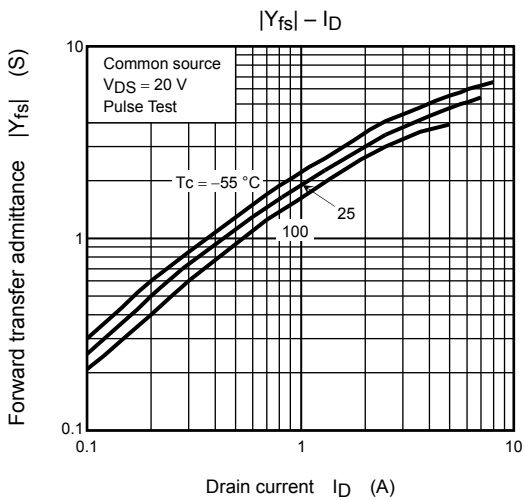
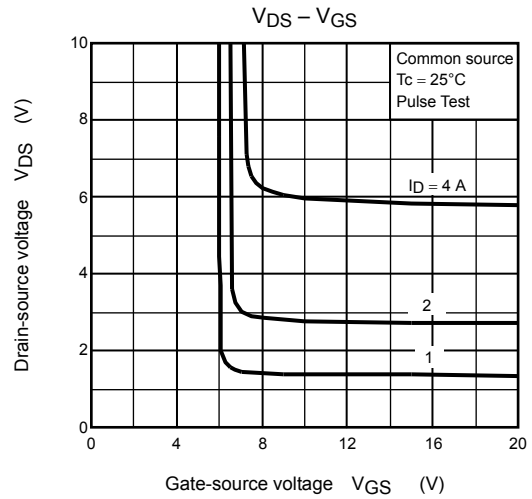
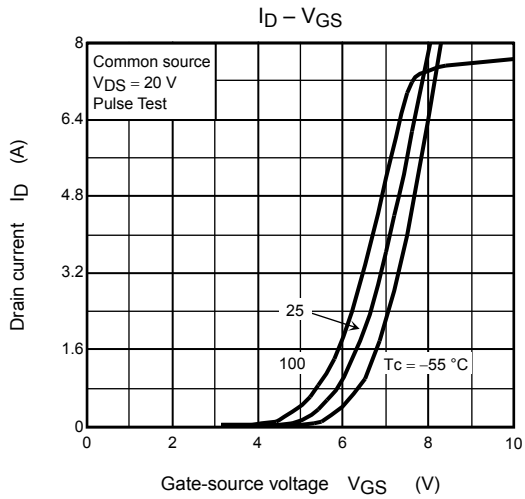
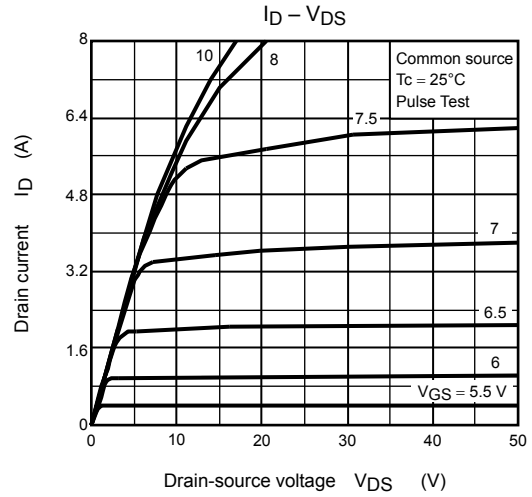
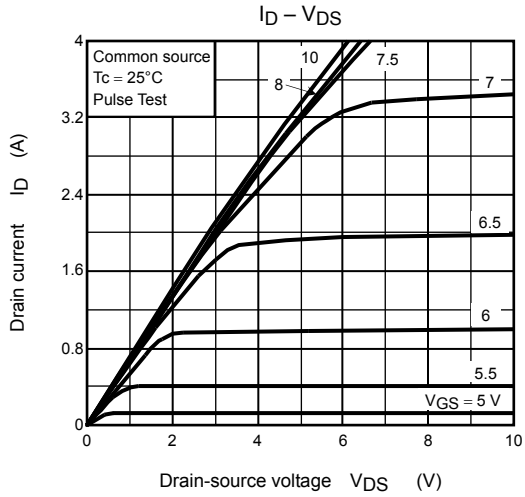
| Characteristics                              |  | Symbol    | Test Condition                              | Min | Typ. | Max  | Unit          |
|--|--|-----------|---|-----|------|------|---------------|
| Continuous drain reverse current<br>(Note 1) |  | $I_{DR}$  | —   | —   | —    | 4    | A             |
| 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                        |  | $t_{rr}$  | $I_{DR} = 4\text{ A}, V_{GS} = 0\text{ V},$ | —   | 1000 | —    | ns            |
| Reverse recovery charge                      |  | $Q_{rr}$  | $dI_{DR}/dt = 100\text{ A}/\mu\text{s}$     | —   | 5.4  | —    | $\mu\text{C}$ |

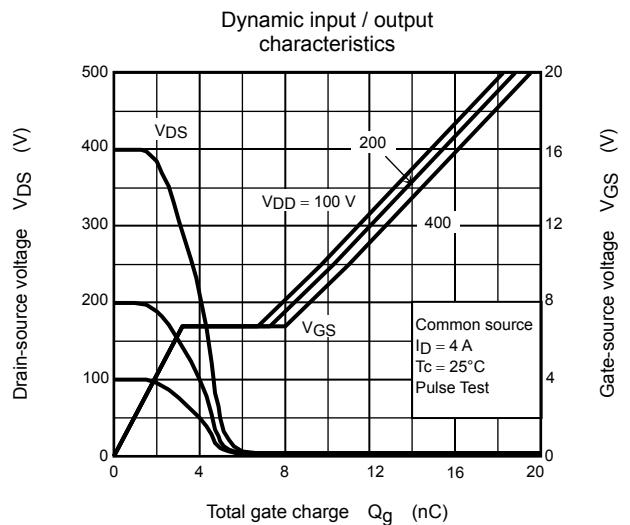
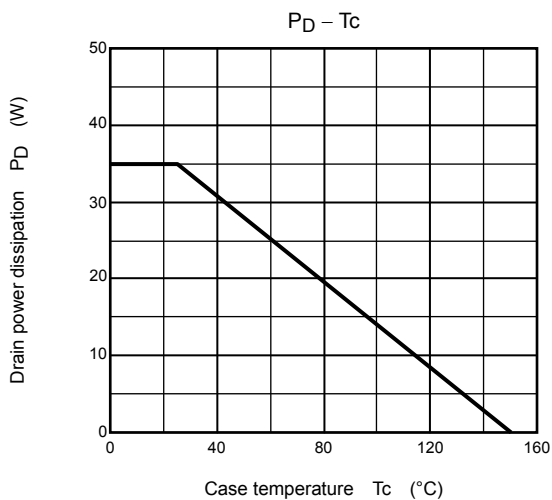
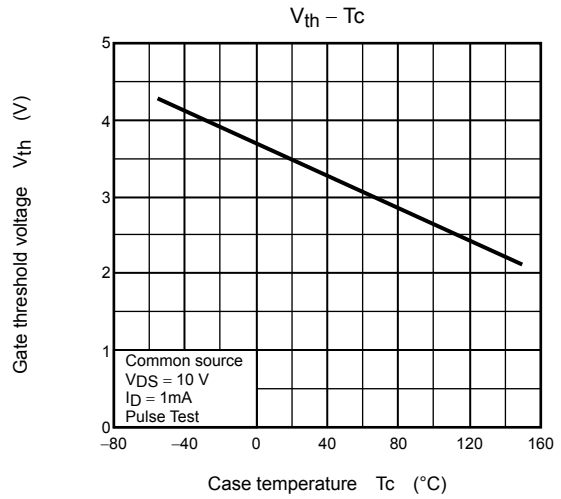
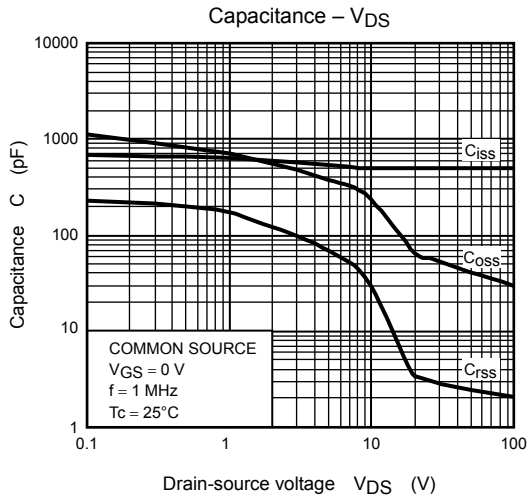
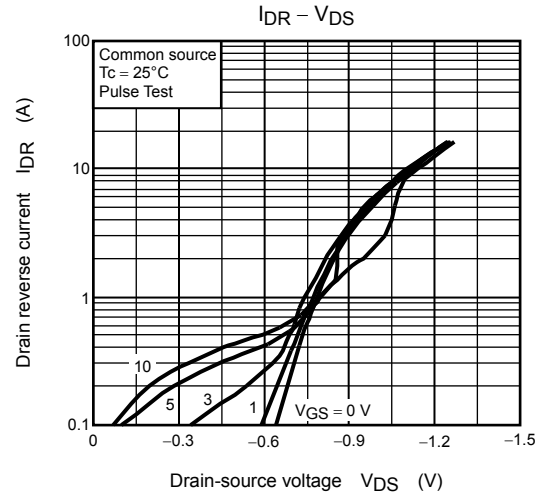
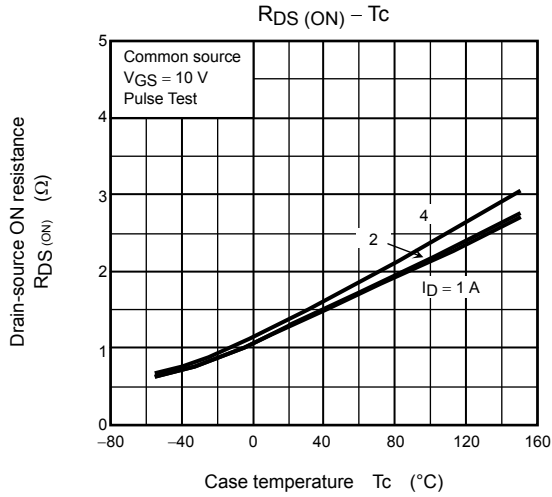
## Marking

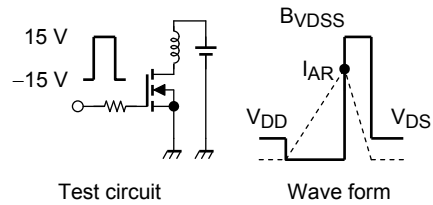
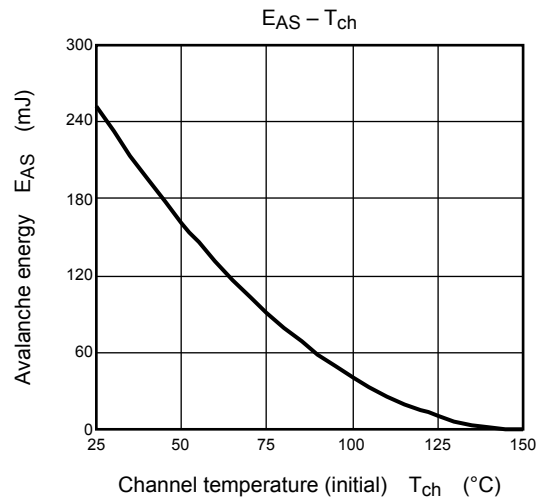
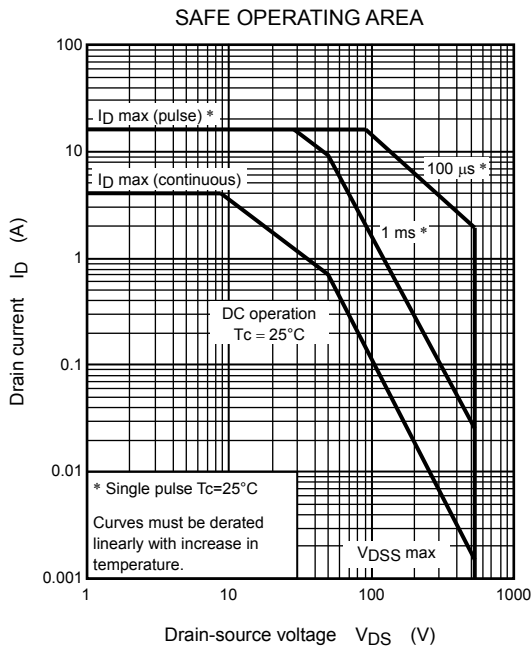
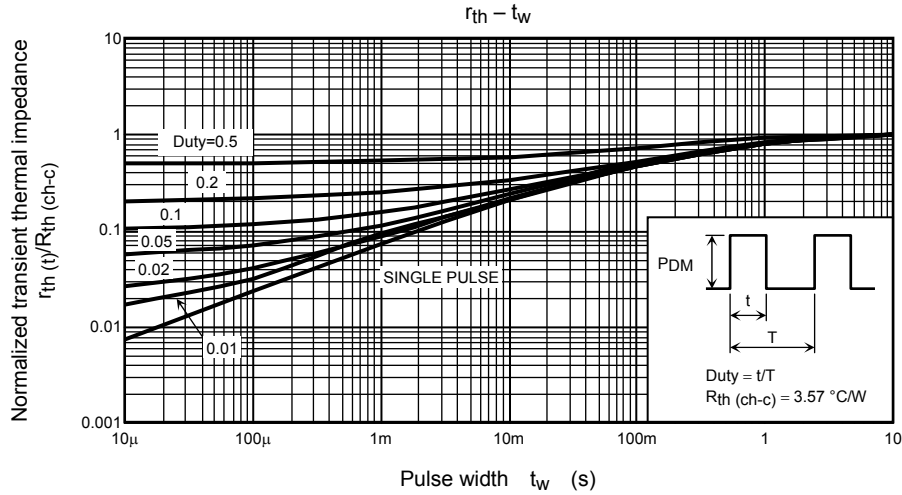


Note 4: A line under a Lot No. identifies the indication of product Labels [[G]]/RoHS COMPATIBLE or [[G]]/RoHS [[Pb]]

Please contact your TOSHIBA sales representative for details as to environmental matters such as the RoHS compatibility of Product. The RoHS is 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.







$R_G = 25 \Omega$   
 $V_{DD} = 90 V, L = 27 mH$

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

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