

TOSHIBA Field Effect Transistor Silicon N-Channel MOS Type ( $\pi$ -MOSVI)

## 2SK3947

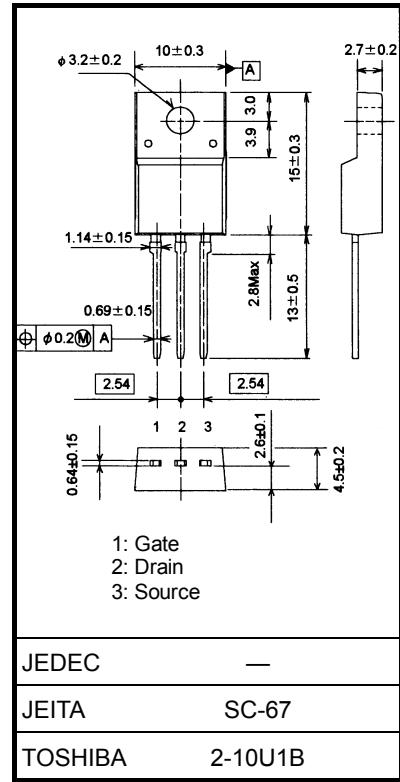
## Switching Regulator Applications

Unit: mm

- Low drain-source ON-resistance:  $R_{DS(ON)} = 1.1 \Omega$  (typ.)
- High forward transfer admittance:  $|Y_{fs}| = 5.0 \text{ S}$  (typ.)
- Low leakage current:  $I_{DSS} = 100 \mu\text{A}$  ( $V_{DS} = 600 \text{ V}$ )
- Enhancement mode:  $V_{th} = 2.0$  to  $4.0 \text{ V}$  ( $V_{DS} = 10 \text{ V}$ ,  $I_D = 1 \text{ mA}$ )

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

| Characteristic                                       | Symbol                                | Rating     | Unit             |
|--|---------------------------------------|------------|------------------|
| Drain-source voltage                                 | $V_{DSS}$                             | 600        | V                |
| Drain-gate voltage ( $R_{GS} = 20 \text{ k}\Omega$ ) | $V_{DGR}$                             | 600        | V                |
| Gate-source voltage                                  | $V_{GSS}$                             | $\pm 30$   | V                |
| Drain current  | DC (Note 1)                           | $I_D$      | 6                |
|  | Pulse ( $t = 1 \text{ ms}$ ) (Note 1) | $I_{DP}$   | 24               |
| Drain power dissipation ( $T_c = 25^\circ\text{C}$ ) | $P_D$                                 | 40         | W                |
| Single-pulse avalanche energy (Note 2)               | $E_{AS}$                              | 345        | mJ               |
| Avalanche current                                    | $I_{AR}$                              | 6          | A                |
| Repetitive avalanche energy (Note 3)                 | $E_{AR}$                              | 4          | 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

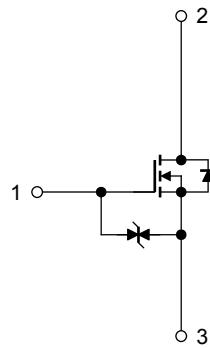
| Characteristic                         | Symbol                | Max   | Unit               |
|--|-----------------------|-------|--------------------|
| Thermal resistance, channel to case    | $R_{th}(\text{ch-c})$ | 3.125 | $^\circ\text{C/W}$ |
| Thermal resistance, channel to ambient | $R_{th}(\text{ch-a})$ | 62.5  | $^\circ\text{C/W}$ |

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

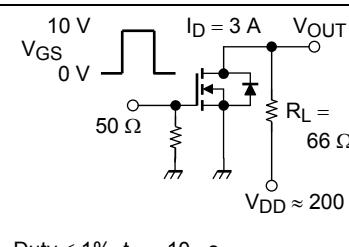
Note 2:  $V_{DD} = 90 \text{ V}$ ,  $T_{ch} = 25^\circ\text{C}$  (initial),  $L = 16.8 \text{ mH}$ ,  $I_{AR} = 6 \text{ A}$ ,  $R_G = 25 \Omega$

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

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



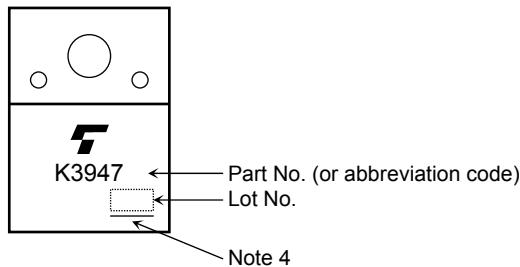
## Electrical Characteristics (Ta = 25°C)

| Characteristic                 | Symbol                | Test Condition  | Min   | Typ. | Max | Unit |    |
|--------------------------------|-----------------------|---|---|------|-----|------|----|
| Gate leakage current           | I <sub>GSS</sub>      | V <sub>GS</sub> = ±25 V, V <sub>DS</sub> = 0 V                        | —   | —    | ±10 | μA   |    |
| Gate-source breakdown voltage  | V <sub>(BR) GSS</sub> | I <sub>G</sub> = ±10 μA, V <sub>DS</sub> = 0 V                        | ±30   | —    | —   | V    |    |
| Drain cutoff current           | I <sub>DSS</sub>      | V <sub>DS</sub> = 600 V, V <sub>GS</sub> = 0 V                        | —   | —    | 100 | μA   |    |
| Drain-source breakdown voltage | V <sub>(BR) DSS</sub> | I <sub>D</sub> = 10 mA, V <sub>GS</sub> = 0 V                         | 600   | —    | —   | V    |    |
| Gate threshold voltage         | V <sub>th</sub>       | V <sub>DS</sub> = 10 V, I <sub>D</sub> = 1 mA                         | 2.0   | —    | 4.0 | V    |    |
| Drain-source ON-resistance     | R <sub>DS</sub> (ON)  | V <sub>GS</sub> = 10 V, I <sub>D</sub> = 3 A                          | —   | 1.1  | 1.4 | Ω    |    |
| Forward transfer admittance    | Y <sub>fs</sub>       | V <sub>DS</sub> = 10 V, I <sub>D</sub> = 3 A                          | 1.5   | 5.0  | —   | S    |    |
| Input capacitance              | C <sub>iss</sub>      | V <sub>DS</sub> = 25 V, V <sub>GS</sub> = 0 V, f = 1 MHz              | —   | 1050 | —   | pF   |    |
| Reverse transfer capacitance   | C <sub>rss</sub>      |   | —   | 10   | —   |      |    |
| Output capacitance             | C <sub>oss</sub>      |   | —   | 110  | —   |      |    |
| Switching time                 | Rise time             | t <sub>r</sub>  | <br>Duty ≤ 1%, t <sub>W</sub> = 10 μs | —    | 20  | —    | ns |
|                                | Turn-on time          | t <sub>on</sub>   |   | —    | 40  | —    |    |
|                                | Fall time             | t <sub>f</sub>  |   | —    | 35  | —    |    |
|                                | Turn-off time         | t <sub>off</sub>  |   | —    | 130 | —    |    |
| Total gate charge              | Q <sub>g</sub>        | V <sub>DD</sub> ≈ 400 V, V <sub>GS</sub> = 10 V, I <sub>D</sub> = 6 A | —   | 28   | —   | nC   |    |
| Gate-source charge             | Q <sub>gs</sub>       |   | —   | 16   | —   |      |    |
| Gate-drain charge              | Q <sub>gd</sub>       |   | —   | 12   | —   |      |    |

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

| Characteristic                            | Symbol           | Test Condition   | Min | Typ. | Max  | Unit |
|---|------------------|--|-----|------|------|------|
| Continuous drain reverse current (Note 1) | I <sub>DR</sub>  | —  | —   | —    | 6    | A    |
| Pulse drain reverse current (Note 1)      | I <sub>DRP</sub> | —  | —   | —    | 24   | A    |
| Forward voltage (diode)                   | V <sub>DSF</sub> | I <sub>DR</sub> = 6 A, V <sub>GS</sub> = 0 V                                     | —   | —    | -1.7 | V    |
| Reverse recovery time                     | t <sub>rr</sub>  | I <sub>DR</sub> = 6 A, V <sub>GS</sub> = 0 V,<br>dI <sub>DR</sub> /dt = 100 A/μs | —   | 140  | —    | ns   |
| Reverse recovery charge                   | Q <sub>rr</sub>  |  | —   | 0.3  | —    | μC   |

## Marking

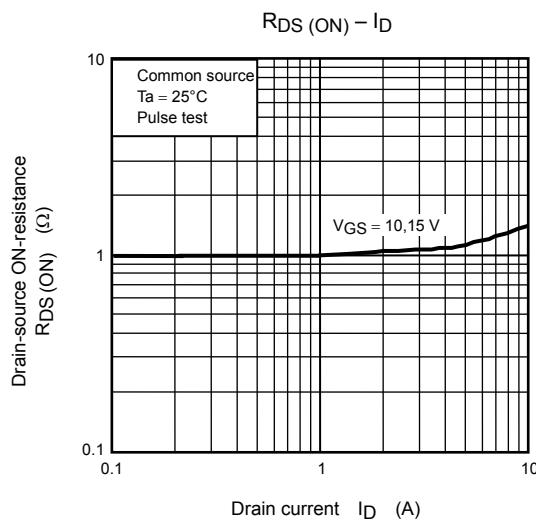
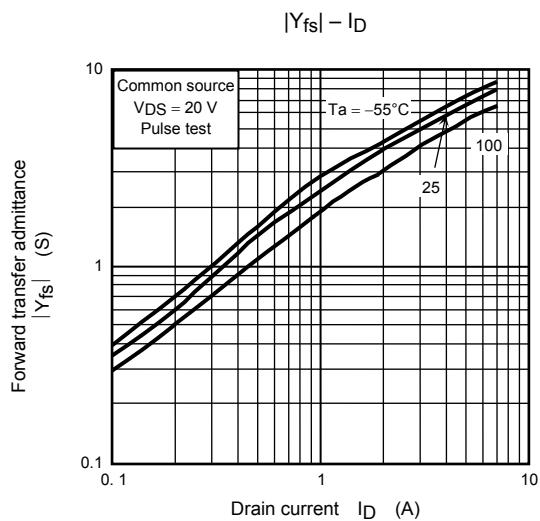
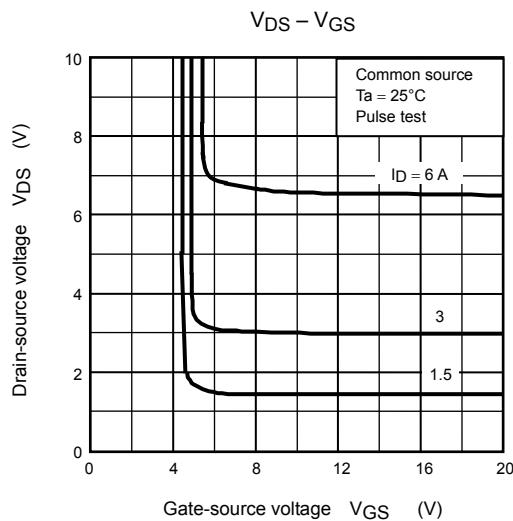
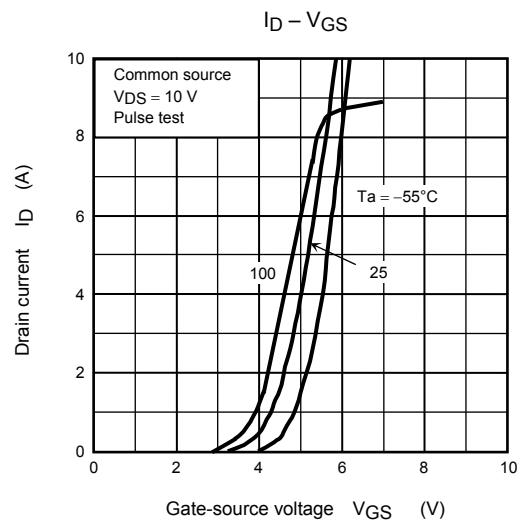
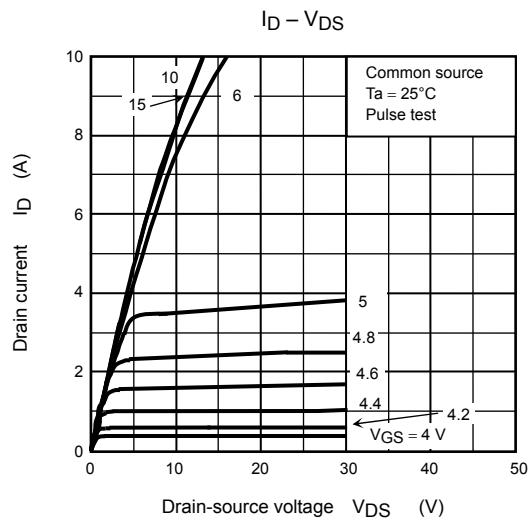
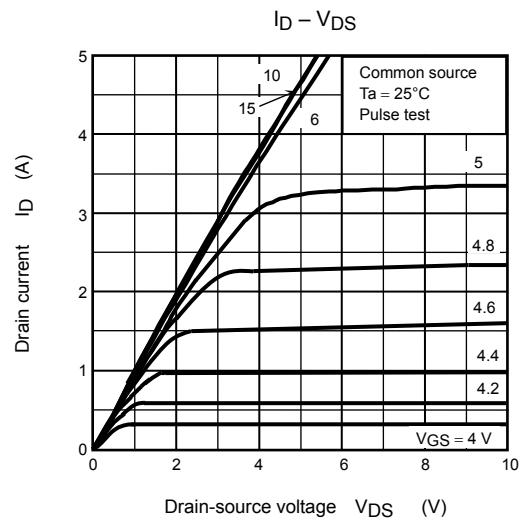


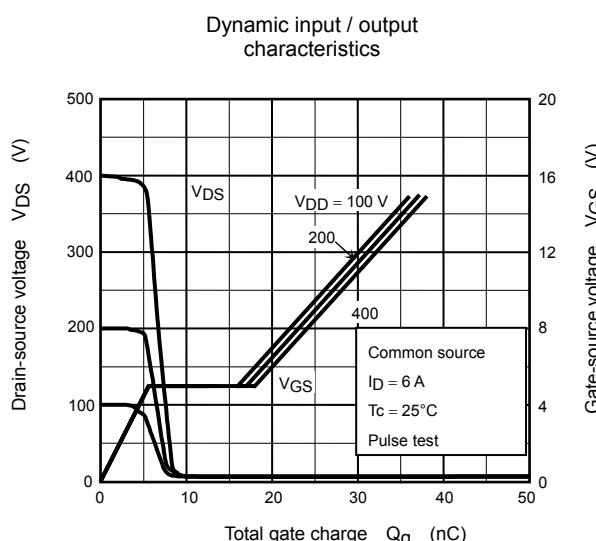
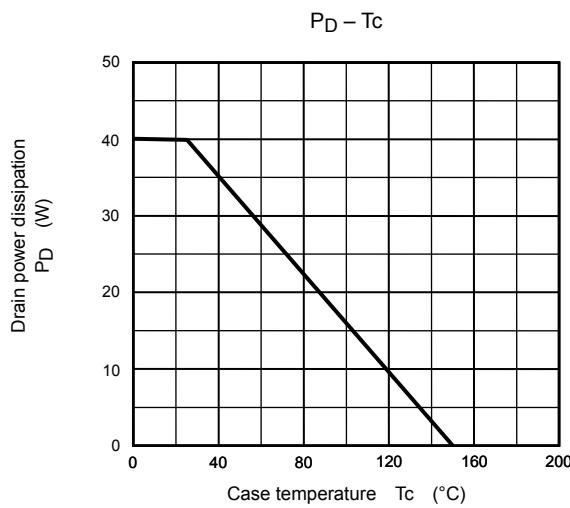
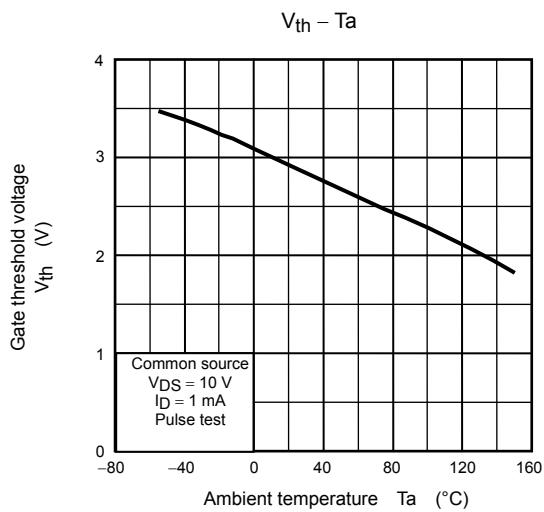
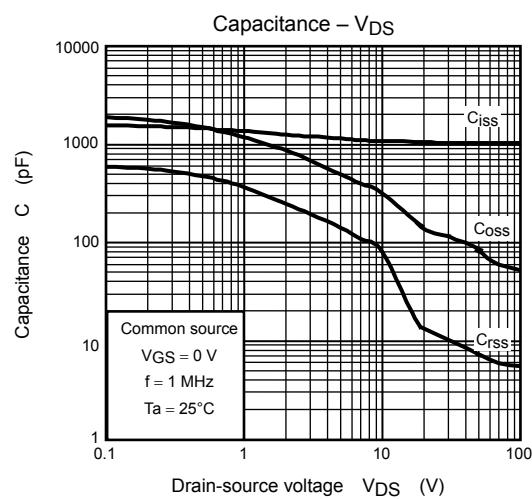
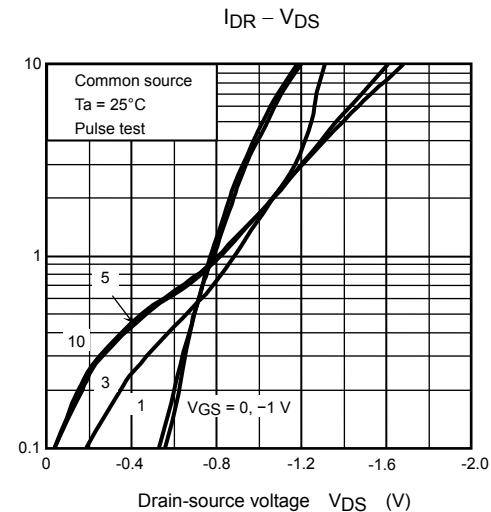
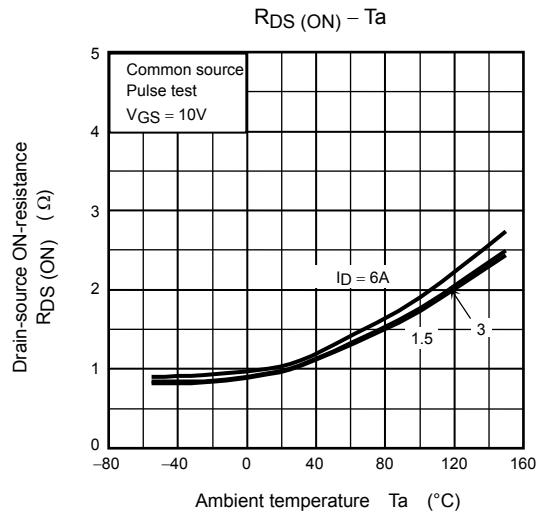
Note 4: A line under a Lot No. identifies the indication of product Labels.

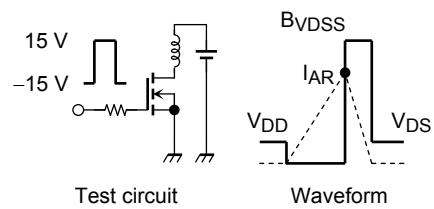
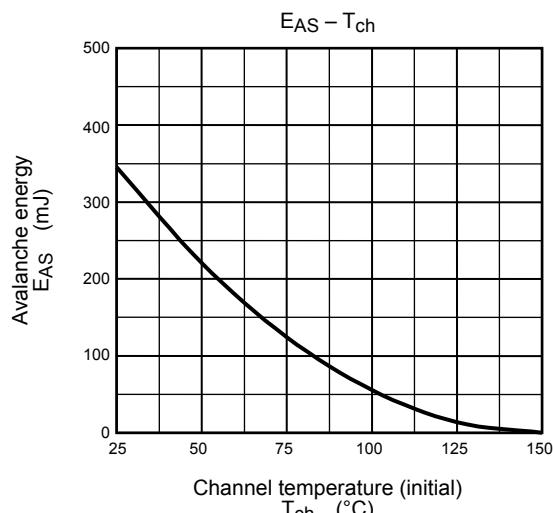
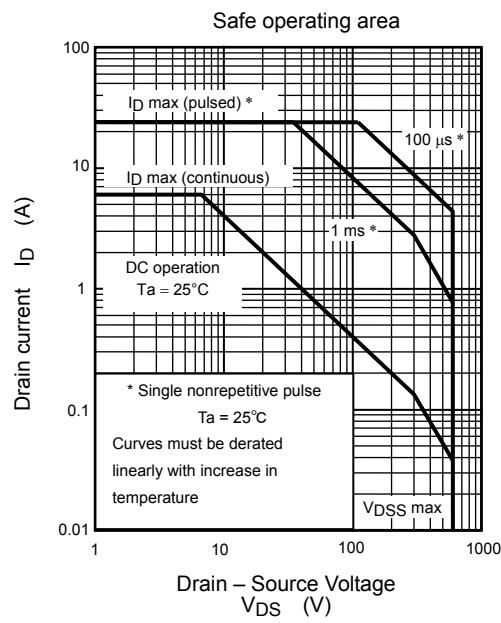
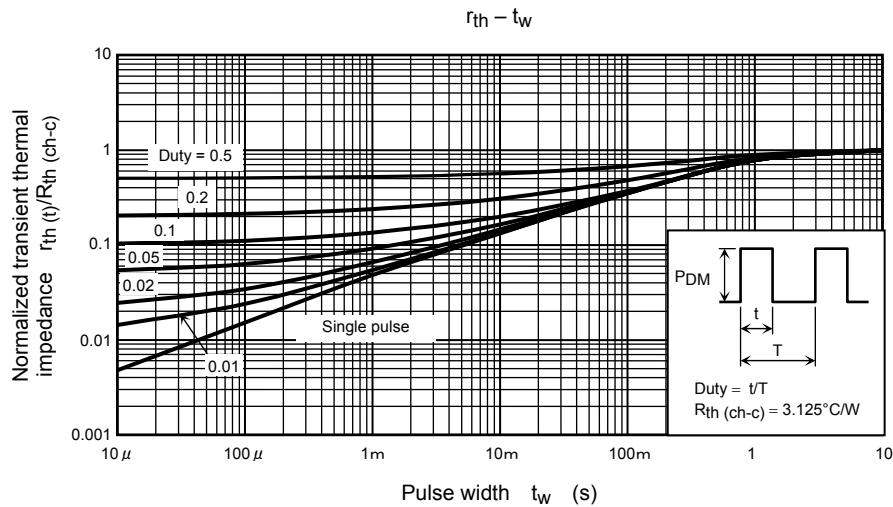
Not underlined: [[Pb]]/INCLUDES > MCV

Underlined: [[G]]/RoHS COMPATIBLE or [[G]]/RoHS [[Pb]]

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$$R_G = 25 \Omega$$

$$V_{DD} = 90 \text{ V}, L = 16.8 \text{ mH}$$

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

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