

TOSHIBA Field Effect Transistor Silicon N-Channel MOS Type (L<sup>2</sup>-π-MOSV)

# 2SK2201

Chopper Regulator, DC/DC Converter and Motor Drive Applications

- 4 V gate drive
- Low drain-source ON-resistance :  $R_{DS(ON)} = 0.28 \Omega$  (typ.)
- High forward transfer admittance :  $|Y_{fs}| = 3.5 \text{ S}$  (typ.)
- Low leakage current :  $I_{DSS} = 100 \mu\text{A}$  (max) ( $V_{DS} = 100 \text{ V}$ )
- Enhancement mode :  $V_{th} = 0.8 \text{ to } 2.0 \text{ V}$  ( $V_{DS} = 10 \text{ V}$ ,  $I_D = 1 \text{ mA}$ )

## Absolute Maximum Ratings (Ta = 25°C)

| Characteristic                                       |                | Symbol    | Rating     | Unit |
|--|----------------|-----------|------------|------|
| Drain-source voltage                                 |                | $V_{DSS}$ | 100        | V    |
| Drain-gate voltage ( $R_{GS} = 20 \text{ k}\Omega$ ) |                | $V_{DGR}$ | 100        | V    |
| Gate-source voltage                                  |                | $V_{GSS}$ | $\pm 20$   | V    |
| Drain current  | DC (Note 1)    | $I_D$     | 3          | A    |
|  | Pulse (Note 1) | $I_{DP}$  | 12         | A    |
| Drain power dissipation ( $T_c = 25^\circ\text{C}$ ) |                | $P_D$     | 20         | W    |
| Single-pulse avalanche energy (Note 2)               |                | $E_{AS}$  | 140        | mJ   |
| Avalanche current                                    |                | $I_{AR}$  | 3          | A    |
| Repetitive avalanche energy (Note 3)                 |                | $E_{AR}$  | 2          | mJ   |
| Channel temperature                                  |                | $T_{ch}$  | 150        | °C   |
| Storage temperature range                            |                | $T_{stg}$ | -55 to 150 | °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

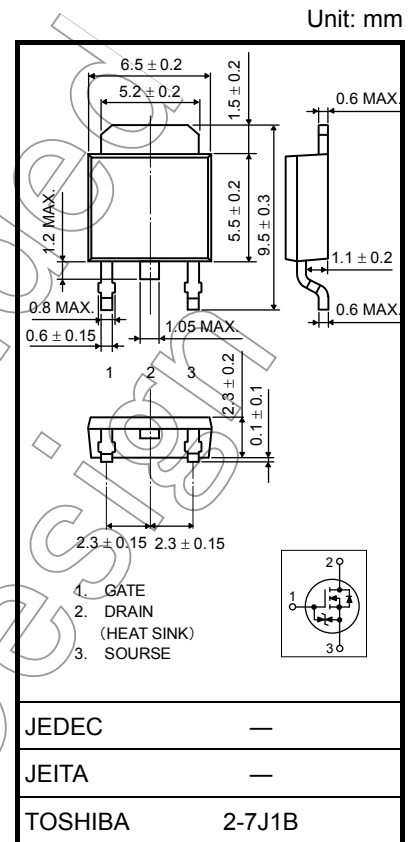
| Characteristic                         | Symbol         | Max  | Unit   |
|--|----------------|------|--------|
| Thermal resistance, channel to case    | $R_{th(ch-c)}$ | 6.25 | °C / W |
| Thermal resistance, channel to ambient | $R_{th(ch-a)}$ | 125  | °C / W |

Note 1: Ensure that the channel temperature does not exceed 150°C.

Note 2:  $V_{DD} = 50 \text{ V}$ ,  $T_{ch} = 25^\circ\text{C}$  (initial),  $L = 25 \text{ mH}$ ,  $R_G = 25 \Omega$ ,  $I_{AR} = 3 \text{ A}$

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

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



Weight: 0.36 g (typ.)

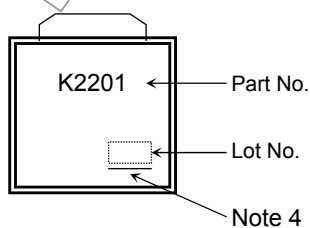
## Electrical Characteristics (Ta = 25°C)

| Characteristic                                  |               | Symbol        | Test Condition   | Min | Typ. | Max      | Unit          |
|---|---------------|---------------|--|-----|------|----------|---------------|
| Gate leakage current                            |               | $I_{GSS}$     | $V_{GS} = \pm 16\text{ V}, V_{DS} = 0\text{ V}$                      | —   | —    | $\pm 10$ | $\mu\text{A}$ |
| Drain cutoff current                            |               | $I_{DSS}$     | $V_{DS} = 100\text{ V}, V_{GS} = 0\text{ V}$                         | —   | —    | 100      | $\mu\text{A}$ |
| Drain-source breakdown voltage                  |               | $V_{(BR)DSS}$ | $I_D = 10\text{ mA}, V_{GS} = 0\text{ V}$                            | 100 | —    | —        | V             |
| Gate threshold voltage                          |               | $V_{th}$      | $V_{DS} = 10\text{ V}, I_D = 1\text{ mA}$                            | 0.8 | —    | 2.0      | V             |
| Drain-source ON-resistance                      |               | $R_{DS(ON)}$  | $V_{GS} = 4\text{ V}, I_D = 2\text{ A}$                              | —   | 0.36 | 0.45     | $\Omega$      |
|   |               |               | $V_{GS} = 10\text{ V}, I_D = 2\text{ A}$                             | —   | 0.28 | 0.35     |               |
| Forward transfer admittance                     |               | $ Y_{fs} $    | $V_{DS} = 10\text{ V}, I_D = 2\text{ A}$                             | 1.5 | 3.5  | —        | S             |
| Input capacitance                               |               | $C_{iss}$     | $V_{DS} = 10\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$        | —   | 280  | —        | pF            |
| Reverse transfer capacitance                    |               | $C_{rss}$     |  | —   | 50   | —        |               |
| Output capacitance                              |               | $C_{oss}$     |  | —   | 105  | —        |               |
| Switching time                                  | Rise time     | $t_r$         |  | —   | 20   | —        | ns            |
|   | Turn-on time  | $t_{on}$      |  | —   | 50   | —        |               |
|   | Fall time     | $t_f$         |  | —   | 40   | —        |               |
|   | Turn-off time | $t_{off}$     |  | —   | 170  | —        |               |
| Total gate charge (gate-source plus gate-drain) |               | $Q_g$         | $V_{DD} \approx 80\text{ V}, V_{GS} = 10\text{ V}, I_D = 3\text{ A}$ | —   | 13.5 | —        | nC            |
| Gate-source charge                              |               | $Q_{gs}$      |  | —   | 8.5  | —        |               |
| Gate-drain ("Miller") charge                    |               | $Q_{gd}$      |  | —   | 5    | —        |               |

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

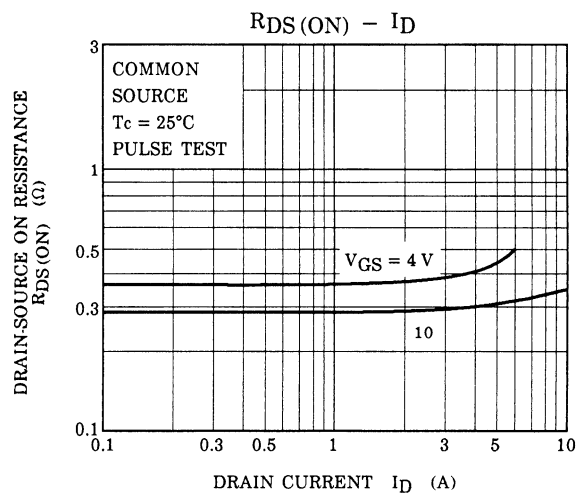
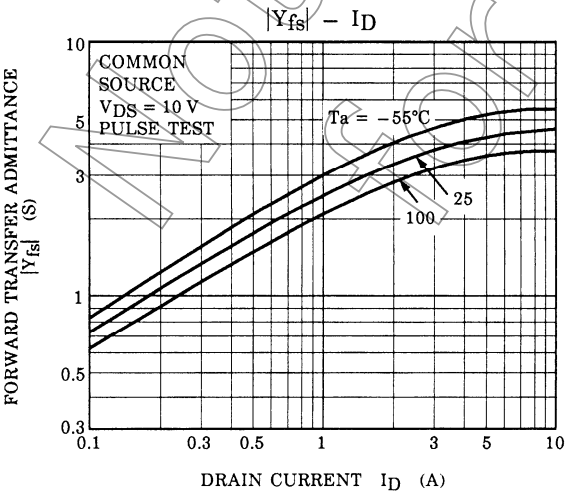
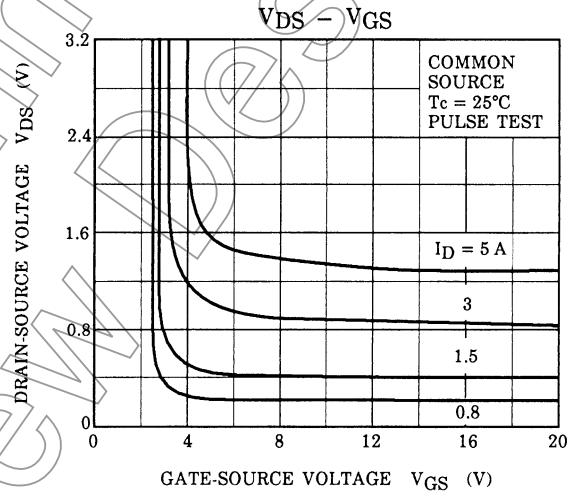
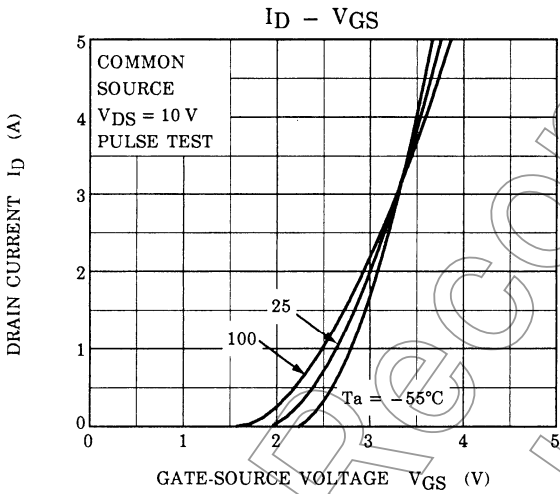
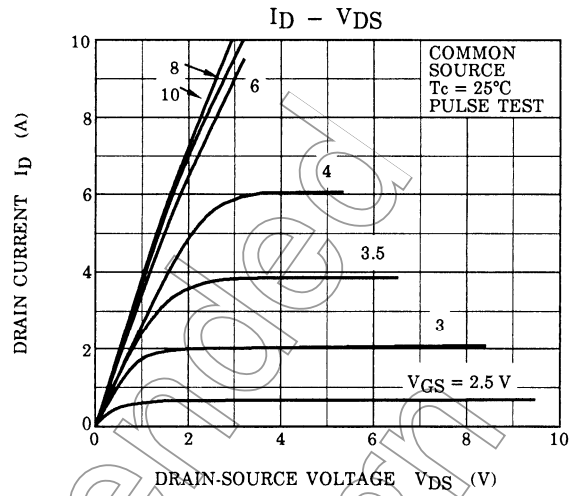
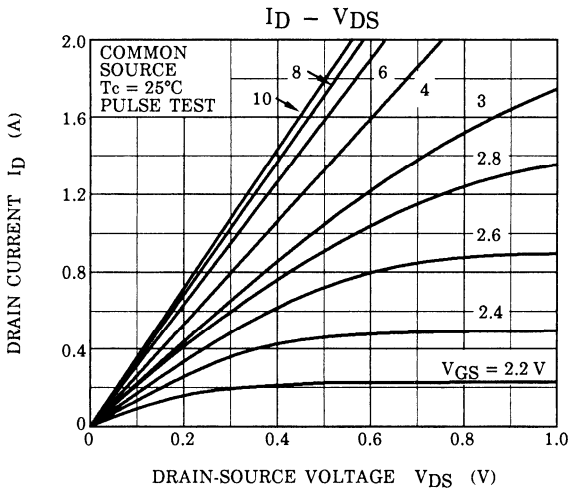
| Characteristic                            | Symbol    | Test Condition   | Min | Typ. | Max  | Unit          |
|---|-----------|--|-----|------|------|---------------|
| Continuous drain reverse current (Note 1) | $I_{DR}$  | —  | —   | —    | 3    | A             |
| Pulse drain reverse current (Note 1)      | $I_{DRP}$ | —  | —   | —    | 12   | A             |
| Forward voltage (diode)                   | $V_{DSF}$ | $I_{DR} = 3\text{ A}, V_{GS} = 0\text{ V}$   | —   | —    | -1.5 | V             |
| Reverse recovery time                     | $t_{rr}$  | $I_{DR} = 3\text{ A}, V_{GS} = 0\text{ V}, dI_{DR} / dt = 50\text{ A} / \mu\text{s}$ | —   | 100  | —    | ns            |
| Reverse recovery charge                   | $Q_{rr}$  |  | —   | 0.2  | —    | $\mu\text{C}$ |

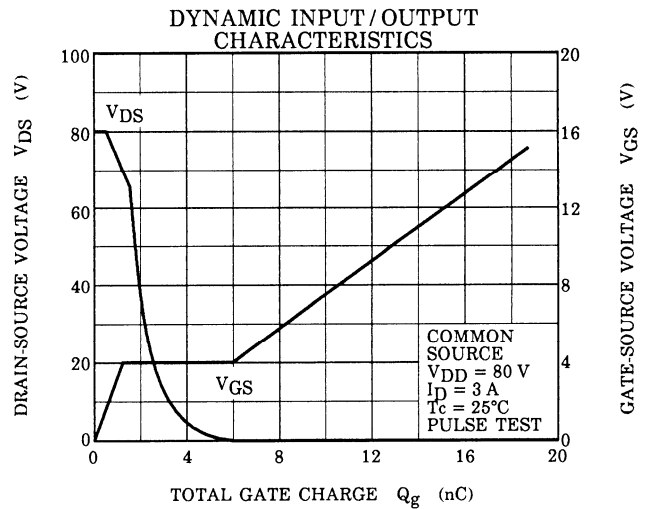
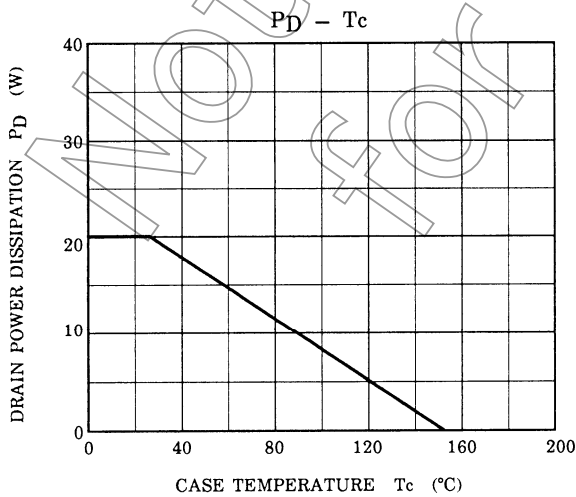
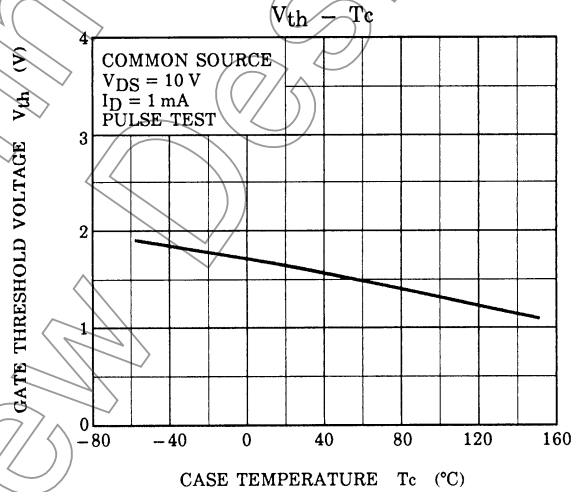
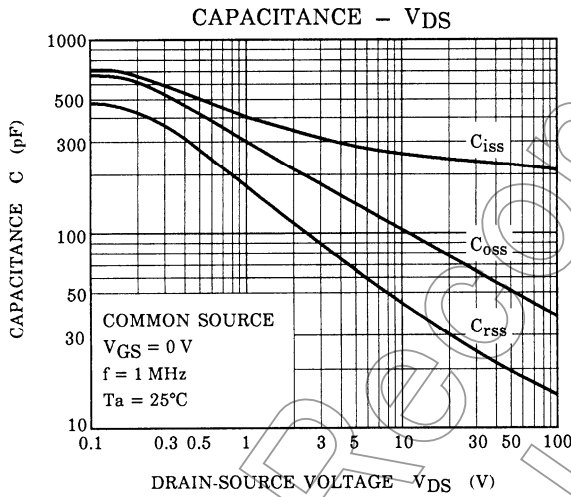
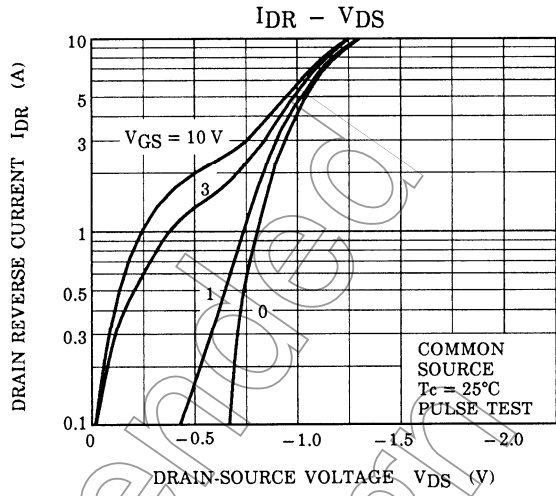
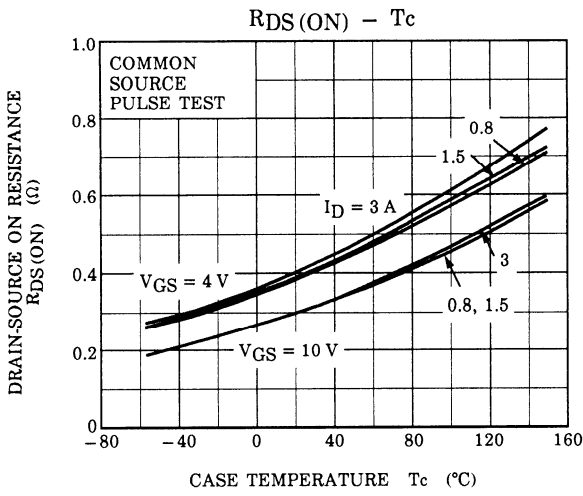
## Marking

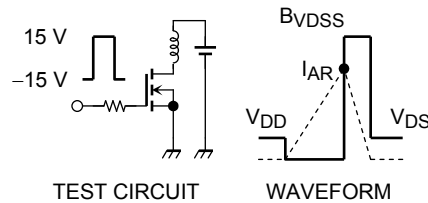
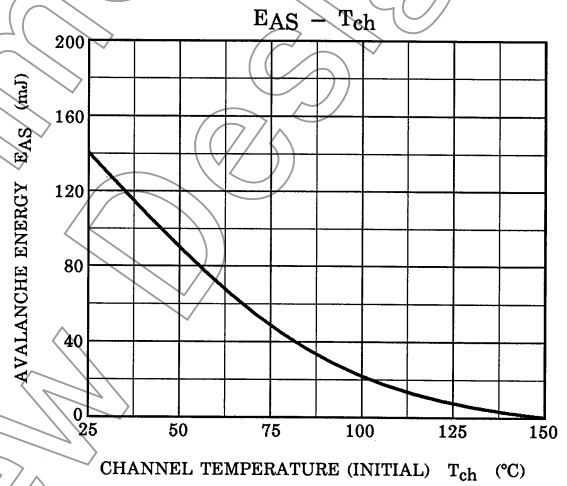
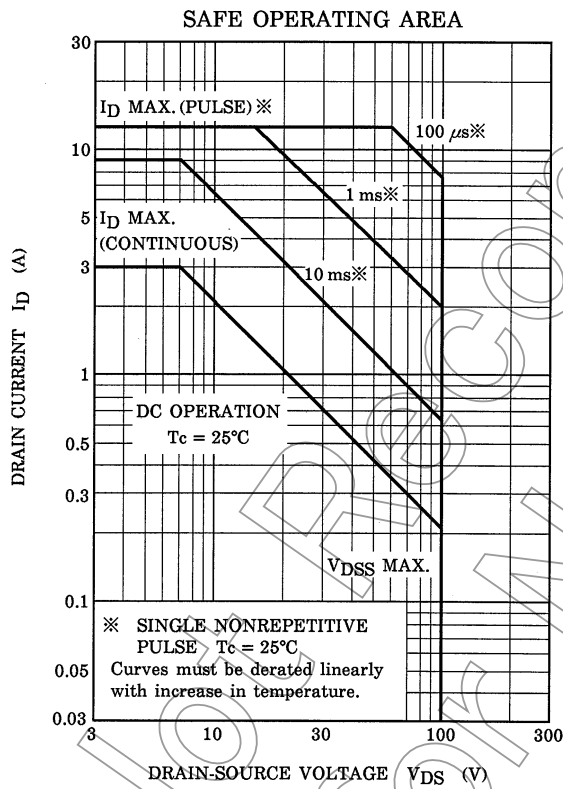
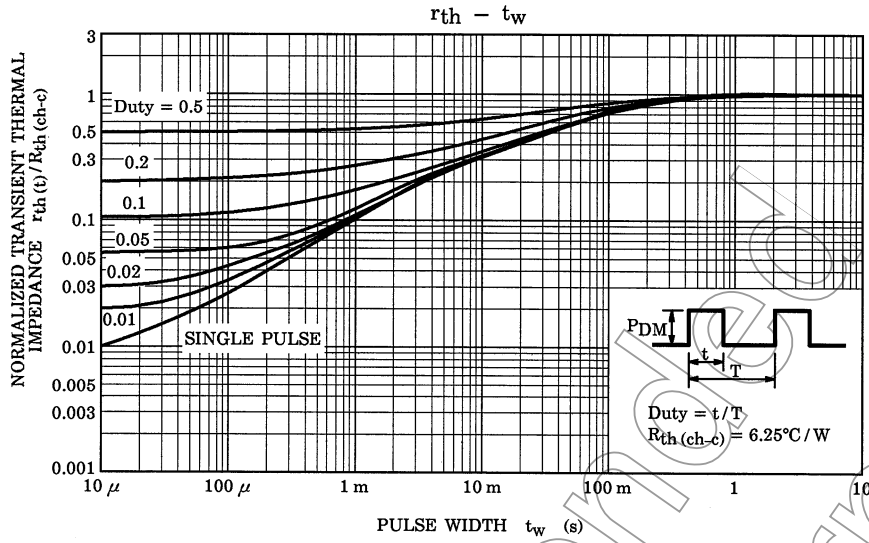


Note 4: A line under a Lot No. identifies the indication of product Labels [[G]]/RoHS COMPATIBLE or [[G]]/RoHS [[Pb]]

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$R_G = 25 \Omega$   
 $V_{DD} = 50 \text{ V}, L = 25 \text{ mH}$

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

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