

TOSHIBA Field Effect Transistor Silicon N-Channel MOS Type (π -MOS V)

2SK4002

Chopper Regulator, DC-DC Converter and Motor Drive Applications

- Low drain-source ON-resistance: $R_{DS(ON)} = 4.2 \Omega$ (typ.)
- High forward transfer admittance: $|Y_{fs}| = 1.7 S$ (typ.)
- Low leakage current: $I_{DSS} = 100 \mu A$ (max) ($V_{DS} = 600 V$)
- Enhancement mode: $V_{th} = 2.0$ to $4.0 V$ ($V_{DS} = 10 V, I_D = 1 mA$)

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

| Characteristic | Symbol | Rating | Unit |
|--|------------------------------------|------------|------------|
| Drain-source voltage | V_{DSS} | 600 | V |
| Drain-gate voltage ($R_{GS} = 20 k\Omega$) | V_{DGR} | 600 | V |
| Gate-source voltage | V_{GSS} | ± 30 | V |
| Drain current | DC (Note 1) | I_D | 2 A |
| | Pulse ($t = 1 ms$) (Note 1) | I_{DP} | 5 A |
| | Pulse ($t = 100 \mu s$) (Note 1) | I_{DP} | 8 A |
| Drain power dissipation ($T_c = 25^\circ C$) | P_D | 20 | W |
| Single-pulse avalanche energy (Note 2) | E_{AS} | 93 | mJ |
| Avalanche current | I_{AR} | 2 | A |
| Repetitive avalanche energy (Note 3) | E_{AR} | 2 | 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

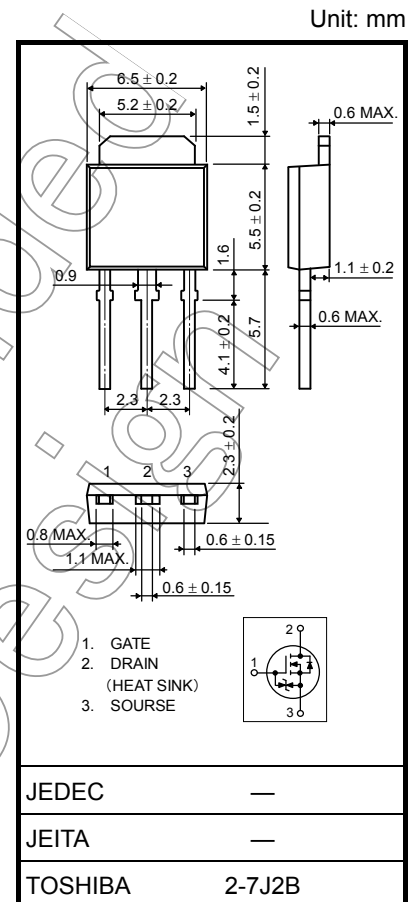
| Characteristic | Symbol | Max | Unit |
|--|----------------|------|----------------|
| Thermal resistance, channel to case | $R_{th(ch-c)}$ | 6.25 | $^\circ C / W$ |
| Thermal resistance, channel to ambient | $R_{th(ch-a)}$ | 125 | $^\circ C / W$ |

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), $L = 41 mH, R_G = 25 \Omega, I_{AR} = 2 A$

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.)

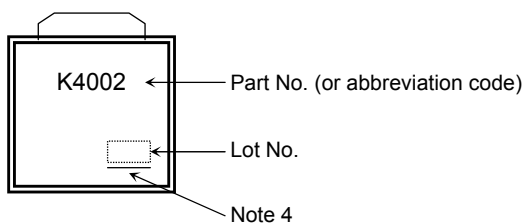
Electrical Characteristics (Ta = 25°C)

| Characteristic | | Symbol | Test Condition | Min | Typ. | Max | Unit |
|---|---------------|---------------|--|----------|------|----------|---------------|
| Gate leakage current | | I_{GSS} | $V_{GS} = \pm 25\text{ V}, V_{DS} = 0\text{ V}$ | — | — | ± 10 | μA |
| Gate-source breakdown voltage | | $V_{(BR)GSS}$ | $I_G = \pm 10\ \mu\text{A}, V_{DS} = 0\text{ V}$ | ± 30 | — | — | V |
| Drain cutoff current | | I_{DSS} | $V_{DS} = 600\text{ V}, V_{GS} = 0\text{ V}$ | — | — | 100 | μA |
| Drain-source breakdown voltage | | $V_{(BR)DSS}$ | $I_D = 10\text{ mA}, V_{GS} = 0\text{ V}$ | 600 | — | — | V |
| Gate threshold voltage | | V_{th} | $V_{DS} = 10\text{ V}, I_D = 1\text{ mA}$ | 2.0 | — | 4.0 | V |
| Drain-source ON-resistance | | $R_{DS(ON)}$ | $V_{GS} = 10\text{ V}, I_D = 1\text{ A}$ | — | 4.2 | 5.0 | Ω |
| Forward transfer admittance | | $ Y_{fs} $ | $V_{DS} = 10\text{ V}, I_D = 1\text{ A}$ | 0.8 | 1.7 | — | S |
| Input capacitance | | C_{iss} | $V_{DS} = 10\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$ | — | 380 | — | pF |
| Reverse transfer capacitance | | C_{rss} | | — | 40 | — | |
| Output capacitance | | C_{oss} | | — | 120 | — | |
| Switching time | Rise time | t_r | <p>$I_D = 1\text{ A}$ $V_{GS} = 10\text{ V}$ $V_{GS} = 0\text{ V}$ $50\ \Omega$ $R_L = 200\ \Omega$ V_{OUT} $V_{DD} \approx 200\text{ V}$ Duty $\leq 1\%$, $t_w = 10\ \mu\text{s}$</p> | — | 15 | — | ns |
| | Turn-on time | t_{on} | | — | 25 | — | |
| | Fall time | t_f | | — | 20 | — | |
| | Turn-off time | t_{off} | | — | 80 | — | |
| Total gate charge (gate-source plus gate-drain) | | Q_g | $V_{DD} \approx 480\text{ V}, V_{GS} = 10\text{ V}, I_D = 2\text{ A}$ | — | 9 | — | nC |
| Gate-source charge | | Q_{gs} | | — | 5 | — | |
| Gate-drain ("Miller") charge | | Q_{gd} | | — | 4 | — | |

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

| Characteristic | Symbol | Test Condition | Min | Typ. | Max | Unit |
|---|-----------|--|-----|------|------|---------------|
| Continuous drain reverse current (Note 1) | I_{DR} | — | — | — | 2 | A |
| Pulse drain reverse current (Note 1) | I_{DRP} | $t = 1\text{ ms}$ | — | — | 5 | A |
| | I_{DRP} | $t = 100\ \mu\text{s}$ | — | — | 8 | A |
| Forward voltage (diode) | V_{DSF} | $I_{DR} = 2\text{ A}, V_{GS} = 0\text{ V}$ | — | — | -1.5 | V |
| Reverse recovery time | t_{rr} | $I_{DR} = 2\text{ A}, V_{GS} = 0\text{ V}$ | — | 1000 | — | ns |
| Reverse recovery charge | Q_{rr} | $dI_{DR}/dt = 100\text{ A}/\mu\text{s}$ | — | 3.5 | — | μC |

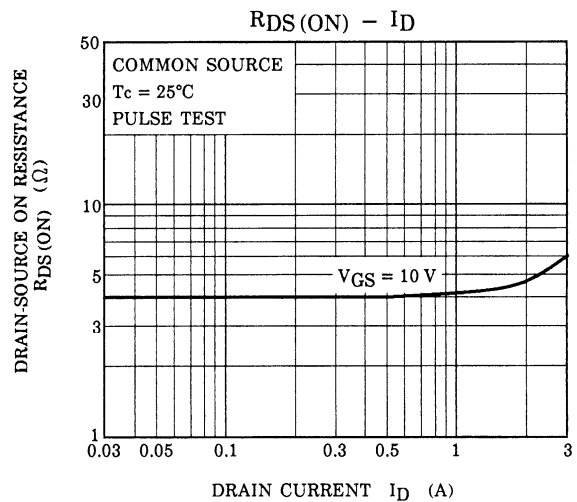
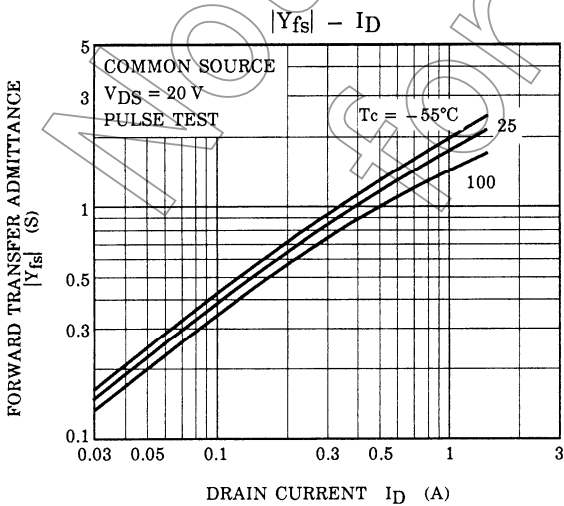
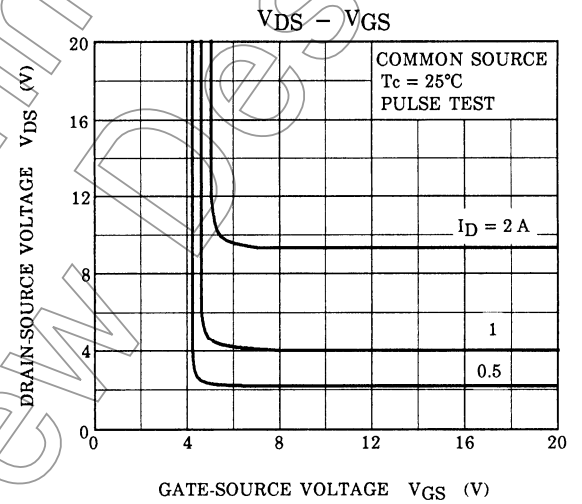
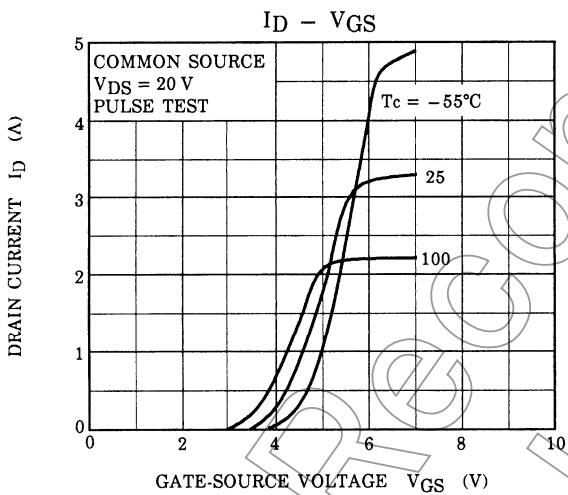
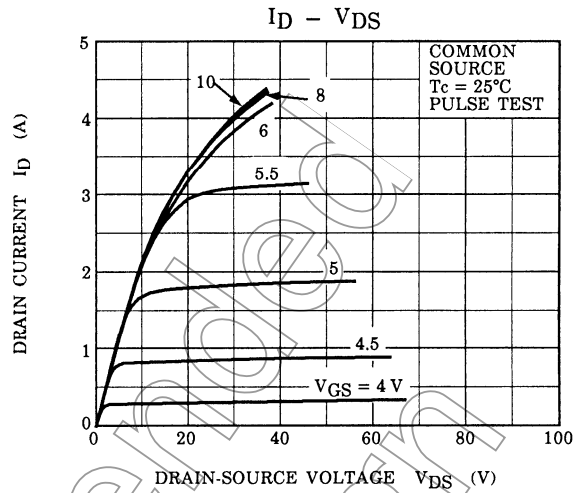
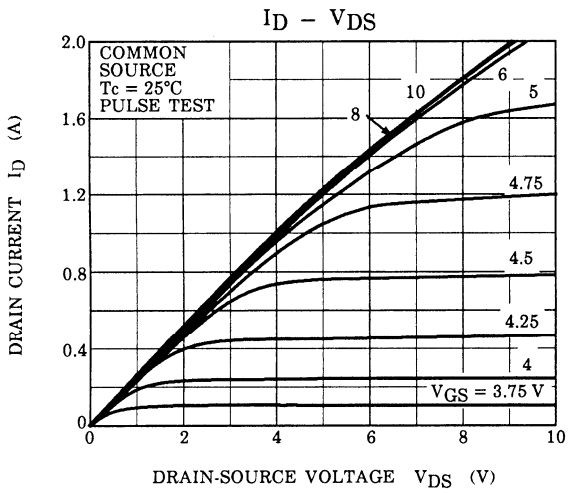
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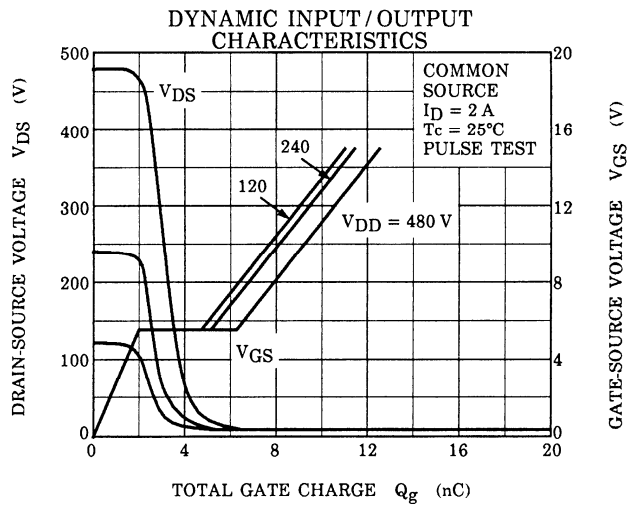
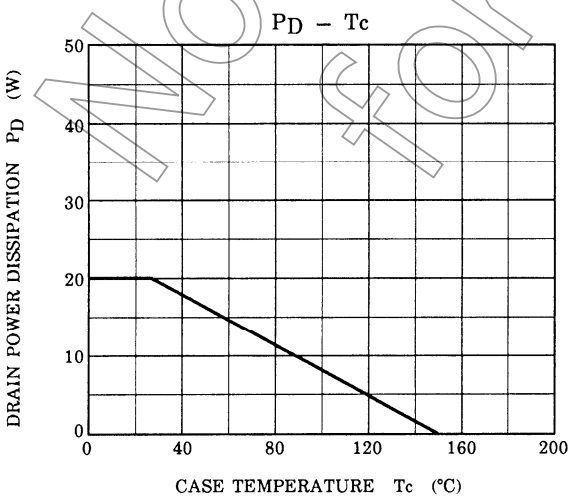
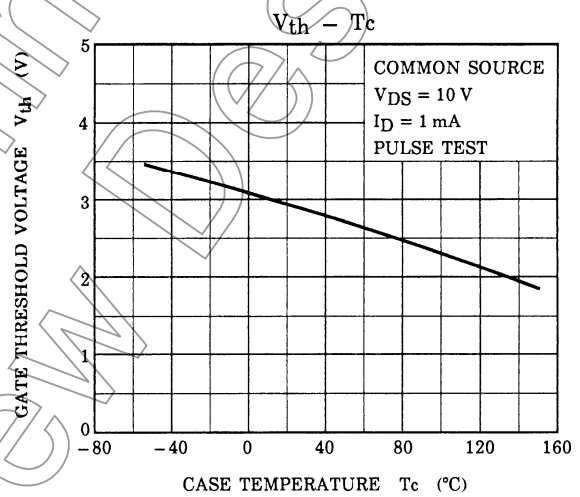
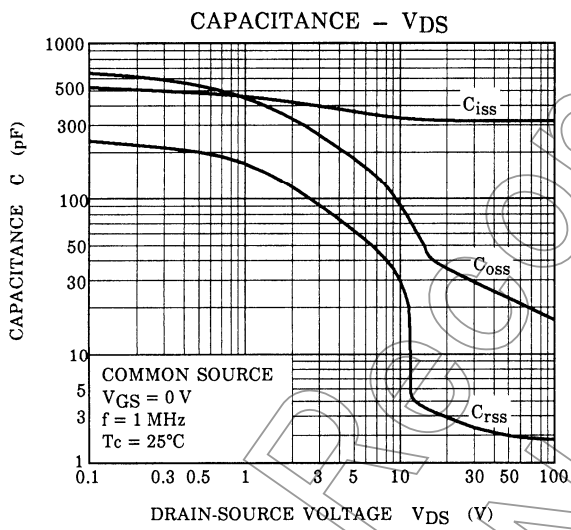
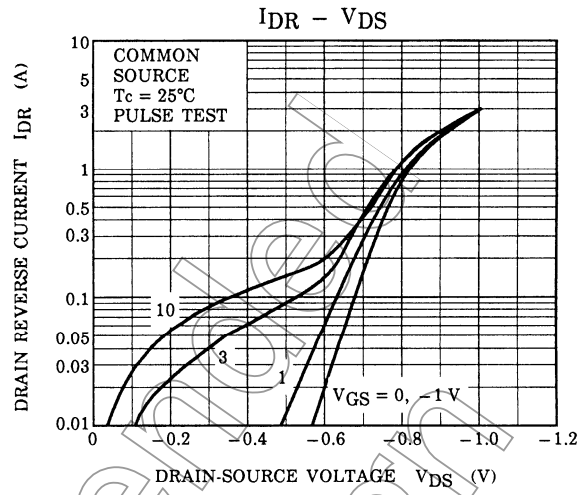
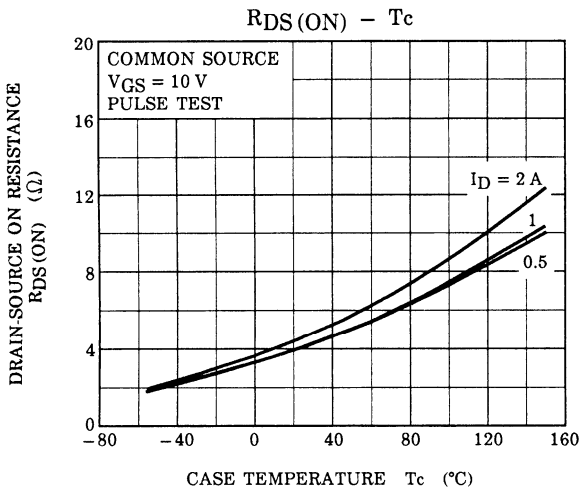


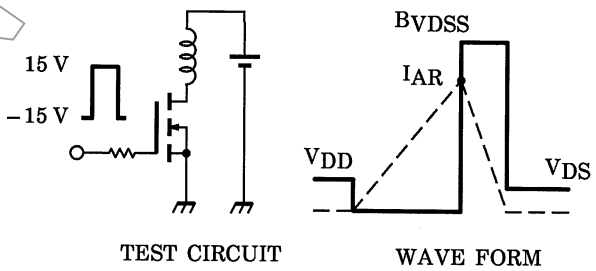
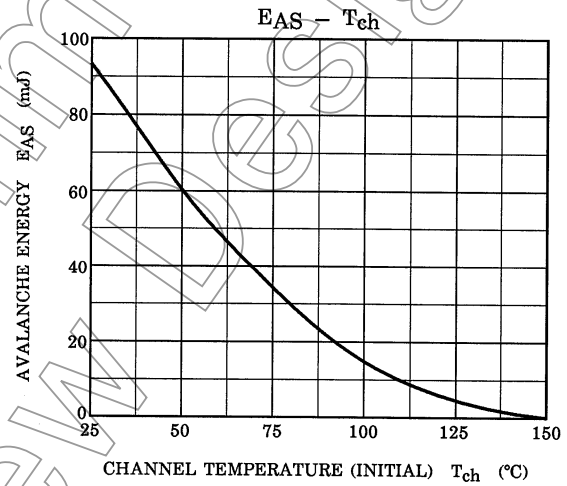
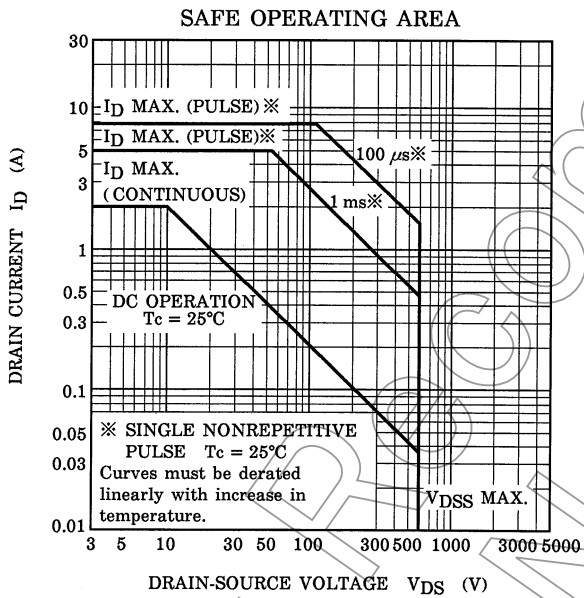
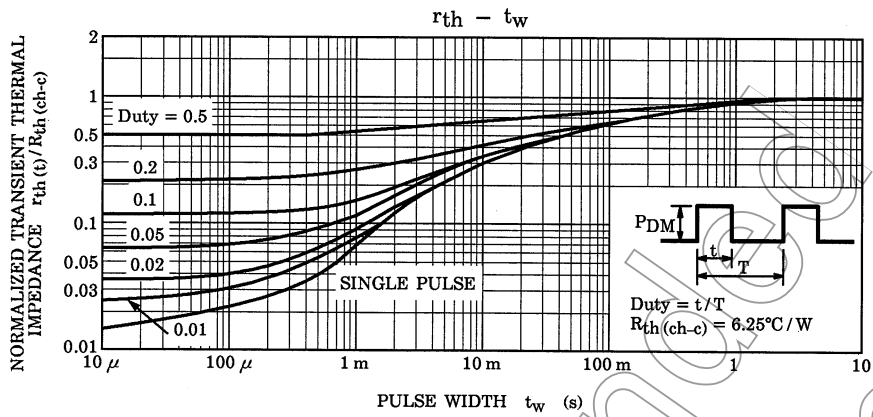
Note 4: A line under a Lot No. identifies the indication of product Labels.

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

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$R_G = 25 \Omega$
 $V_{DD} = 90 \text{ V}, L = 41 \text{ mH}$

$$EAS = \frac{1}{2} \cdot L \cdot I^2 \cdot \left(\frac{BVDSS}{BVDSS - VDD} \right)$$

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