TOSHIBA FIELD EFFECT TRANSISTOR SILICON N CHANNEL MOS TYPE ($L^2$-$\pi$-MOSV)

# 2SK2376

HIGH SPEED, HIGH CURRENT SWITCHING APPLICATIONS

CHOPPER REGULATOR, DC-DC CONVERTER AND MOTOR DRIVE APPLICATIONS

INDUSTRIAL APPLICATIONS

- 4 V Gate Drive
- Low Drain-Source ON Resistance : $R_{DS\,(ON)}$ = 13 mΩ (Typ.)
- High Forward Transfer Admittance : $|Y_{fs}|$ = 40 S (Typ.)
- Low Leakage Current : $I_{DSS}$ = 100 μA (Max.) ($V_{DS}$ = 60 V)
- Enhancement-Mode : $V_{th}$ = 0.8~2.0 V ($V_{DS}$ = 10 V, $I_D$ = 1 mA)

MAXIMUM RATINGS (Ta = 25°C)

| CHARACTERISTIC | | SYMBOL | RATING | UNIT |
|---|---|---|---|---|
| Drain-Source Voltage | | $V_{DSS}$ | 60 | V |
| Drain-Gate Voltage ($R_{GS}$ = 20 kΩ) | | $V_{DGR}$ | 60 | V |
| Gate-Source Voltage | | $V_{GSS}$ | ±20 | V |
| Drain Current | DC | $I_D$ | 45 | A |
| | Pulse | $I_{DP}$ | 180 | A |
| Drain Power Dissipation (Tc = 25°C) | | $P_D$ | 100 | W |
| Single Pulse Avalanche Energy** | | $E_{AS}$ | 701 | mJ |
| Avalanche Current | | $I_{AR}$ | 45 | A |
| Repetitive Avalanche Energy* | | $E_{AR}$ | 10 | mJ |
| Channel Temperature | | $T_{ch}$ | 150 | °C |
| Storage Temperature Range | | $T_{stg}$ | −55~150 | °C |

THERMAL CHARACTERISTICS

| CHARACTERISTIC | SYMBOL | MAX. | UNIT |
|---|---|---|---|
| Thermal Resistance, Channel To Case | $R_{th\,(ch\text{-}c)}$ | 1.25 | °C / W |
| Thermal Resistance, Channel To Ambient | $R_{th\,(ch\text{-}a)}$ | 83.3 | °C / W |

Note ;

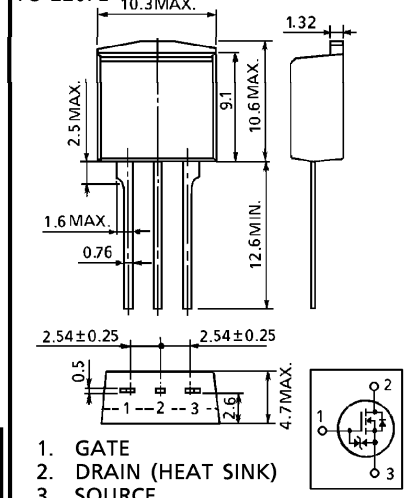
* Repetitive rating ; Pulse Width Limited by Max. junction temperature.

** $V_{DD}$ = 25 V, $T_{ch}$ = 25°C (initial), L = 471 μH, $R_G$ = 25 Ω, $I_{AR}$ = 45 A

**This transistor is an electrostatic sensitive device. Please handle with caution.**

Unit in mm

TO-220FL

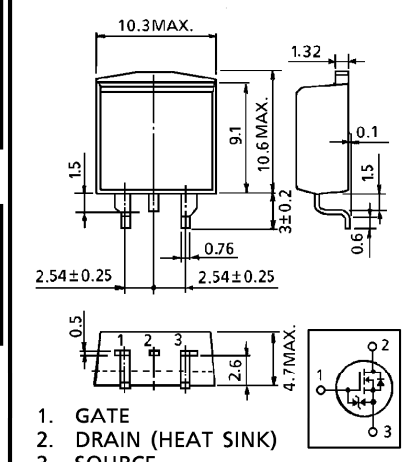



1. GATE
2. DRAIN (HEAT SINK)
3. SOURCE

| | |
|---|---|
| JEDEC | — |
| EIAJ | — |
| TOSHIBA | 2-10S1B |

Unit in mm

TO-220SM



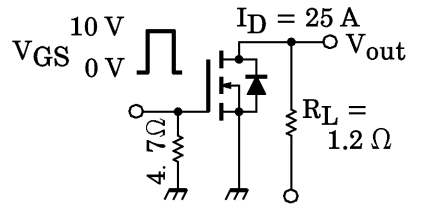

1. GATE
2. DRAIN (HEAT SINK)
3. SOURCE

| | |
|---|---|
| JEDEC | — |
| EIAJ | — |
| TOSHIBA | 2-10S2B |

Weight : 1.5 g

961001EAA2

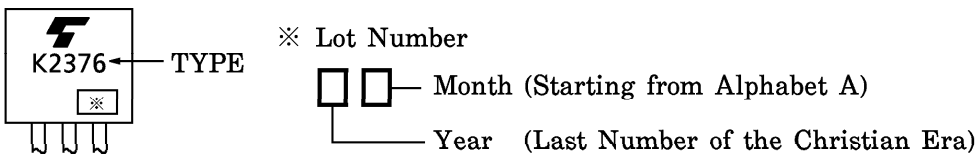
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

| CHARACTERISTIC | | SYMBOL | TEST CONDITION | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|---|
| Gate Leakage Current | | $I_{GSS}$ | $V_{GS}$ = ±16 V, $V_{DS}$ = 0 V | — | — | ±10 | μA |
| Drain Cut-off Current | | $I_{DSS}$ | $V_{DS}$ = 60 V, $V_{GS}$ = 0 V | — | — | 100 | μA |
| Drain-Source Breakdown Voltage | | $V_{(BR)\,DSS}$ | $I_D$ = 10 mA, $V_{GS}$ = 0 V | 60 | — | — | V |
| Gate Threshold Voltage | | $V_{th}$ | $V_{DS}$ = 10 V, $I_D$ = 1 mA | 0.8 | — | 2.0 | V |
| Drain-Source ON Resistance | | $R_{DS\,(ON)}$ | $V_{GS}$ = 4 V, $I_D$ = 25 A | — | 19 | 25 | mΩ |
| | | | $V_{GS}$ = 10 V, $I_D$ = 25 A | — | 13 | 17 | |
| Forward Transfer Admittance | | $\|Y_{fs}\|$ | $V_{DS}$ = 10 V, $I_D$ = 25 A | 28 | 40 | — | S |
| Input Capacitance | | $C_{iss}$ | $V_{DS}$ = 10 V, $V_{GS}$ = 0 V<br>f = 1 MHz | — | 3350 | — | pF |
| Reverse Transfer Capacitance | | $C_{rss}$ | | — | 550 | — | |
| Output Capacitance | | $C_{oss}$ | | — | 1600 | — | |
| Switching Time | Rise Time | $t_r$ |  | — | 25 | — | ns |
| | Turn-on Time | $t_{on}$ | | — | 55 | — | |
| | Fall Time | $t_f$ | | — | 60 | — | |
| | Turn-off Time | $t_{off}$ | $V_{IN}$ : $t_r$, $t_f$ < 5 ns,<br>Duty ≦ 1%, $t_w$ = 10 μs | — | 180 | — | |
| Total Gate Charge (Gate-Source Plus Gate-Drain) | | $Q_g$ | $V_{DD}$ ≒ 48 V, $V_{GS}$ = 10 V<br>$I_D$ = 45 A | — | 110 | — | nC |
| Gate-Source Charge | | $Q_{gs}$ | | — | 70 | — | |
| Gate-Drain ("Miller") Charge | | $Q_{gd}$ | | — | 40 | — | |

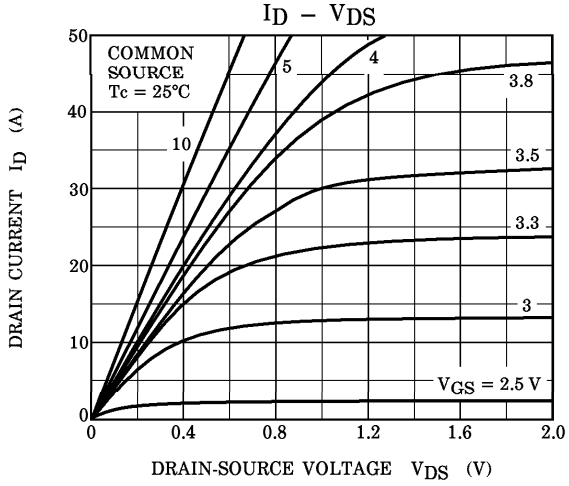
SOURCE-DRAIN DIODE RATINGS AND CHARACTERISTICS (Ta = 25°C)

| CHARACTERISTIC | SYMBOL | TEST CONDITION | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| Continuous Drain Reverse Current | $I_{DR}$ | — | — | — | 45 | A |
| Pulse Drain Reverse Current | $I_{DRP}$ | — | — | — | 180 | A |
| Diode Forward Voltage | $V_{DSF}$ | $I_{DR}$ = 45 A, $V_{GS}$ = 0 V | — | — | −1.7 | V |
| Reverse Recovery Time | $t_{rr}$ | $I_{DR}$ = 45 A, $V_{GS}$ = 0 V<br>$dI_{DR}$ / dt = 50 A / μs | — | 120 | — | ns |
| Reverse Recovery Charge | $Q_{rr}$ | | — | 0.2 | — | μC |

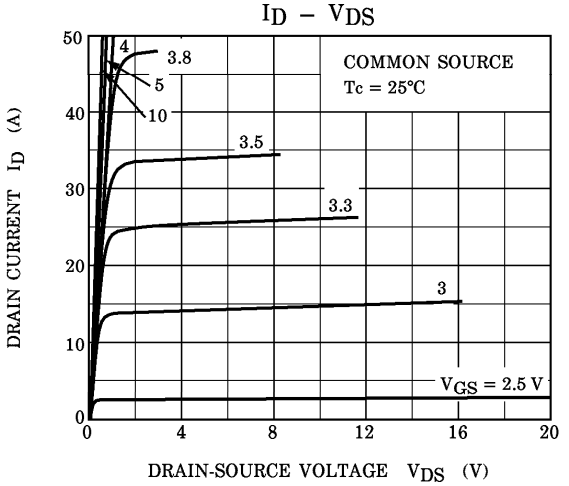
MARKING



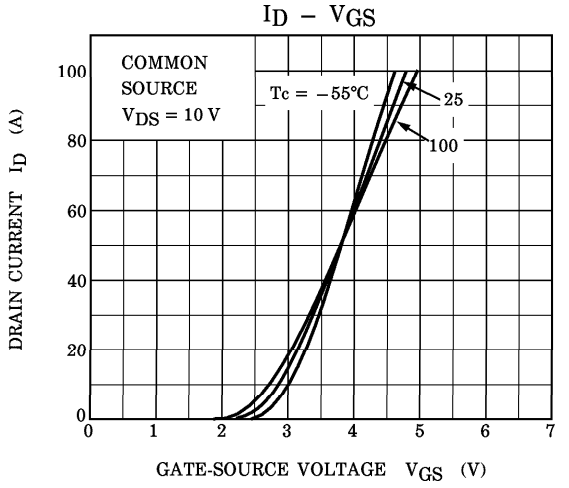
$I_D - V_{DS}$



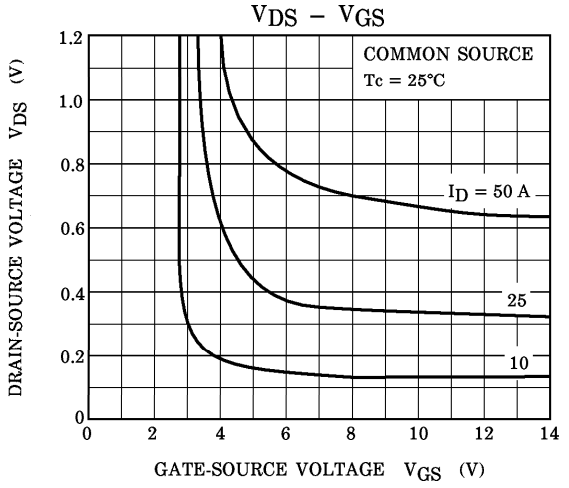

$I_D - V_{DS}$



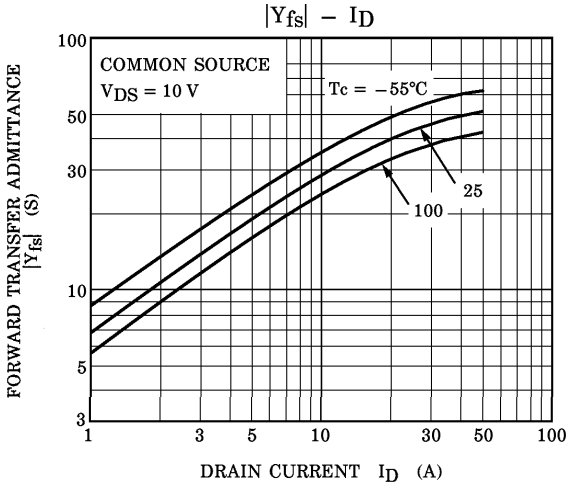

$I_D - V_{GS}$



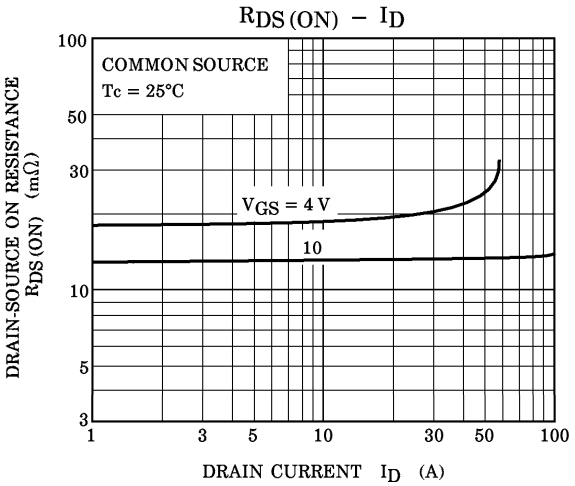

$V_{DS} - V_{GS}$



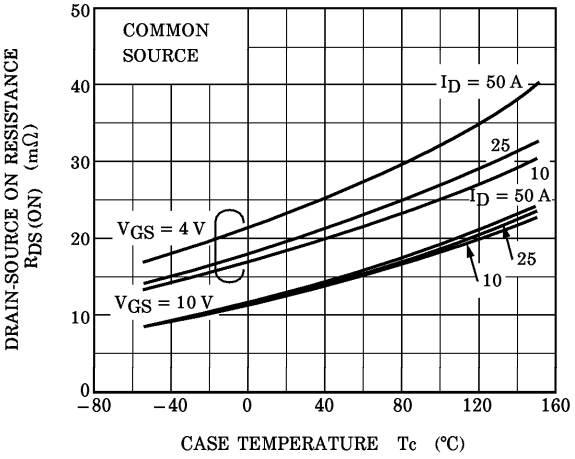

$|Y_{fs}| - I_D$



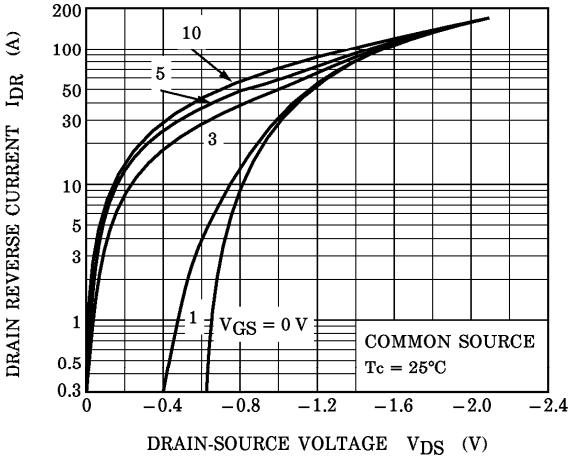

$R_{DS\,(ON)} - I_D$



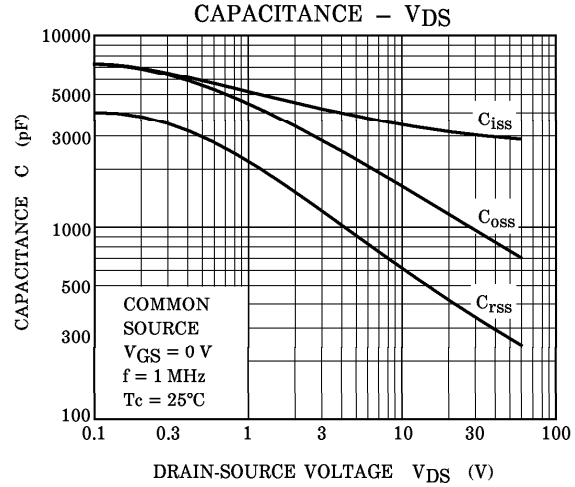
$R_{DS\,(ON)}$ – Tc



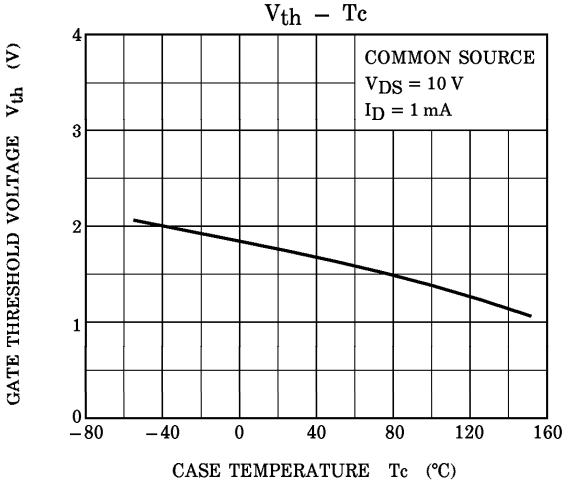

$I_{DR}$ – $V_{DS}$



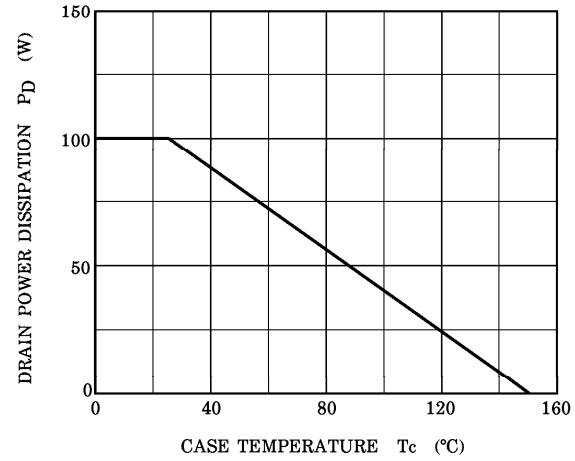

CAPACITANCE – $V_{DS}$



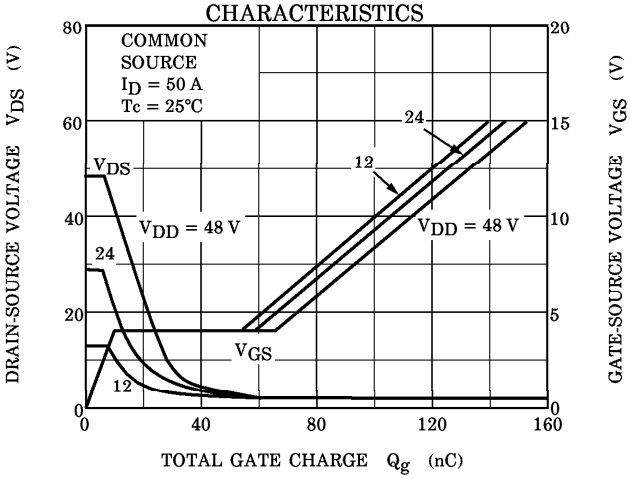

$V_{th}$ – Tc



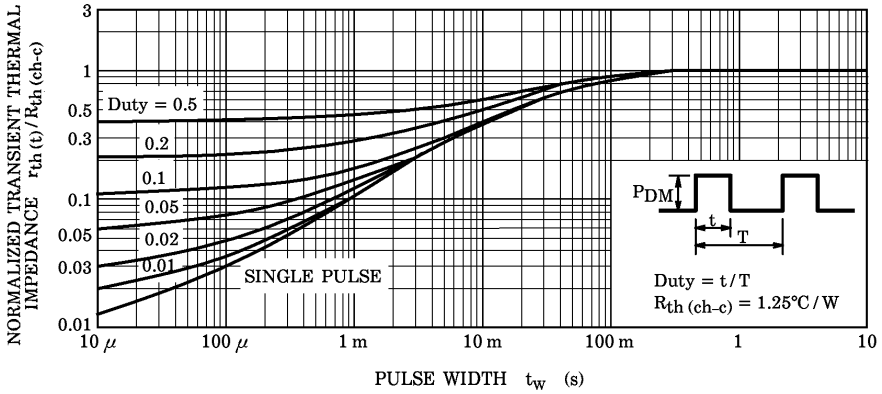

$P_D$ – Tc



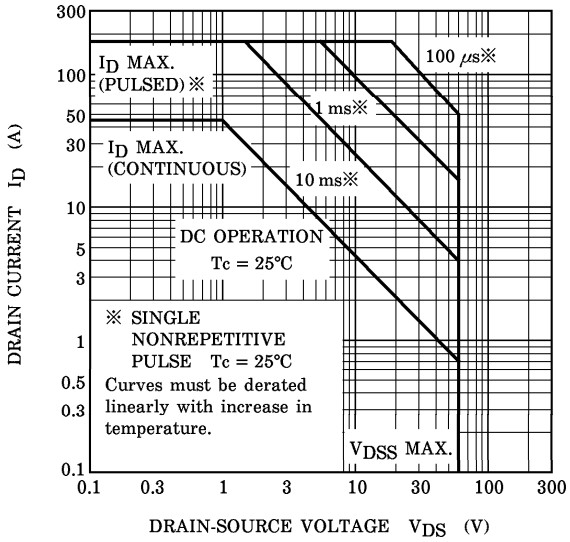

DYNAMIC INPUT / OUTPUT CHARACTERISTICS



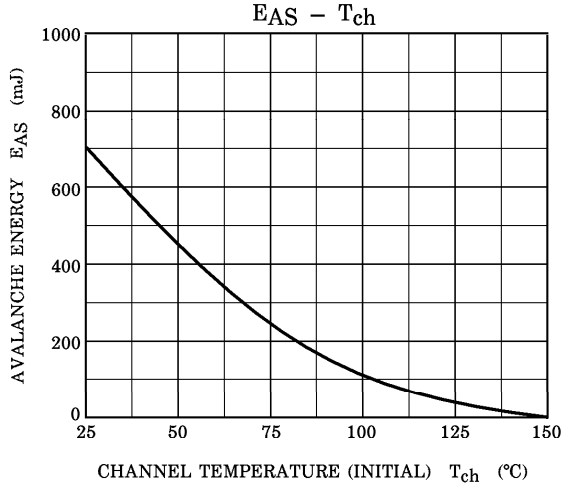
$r_{th} - t_w$

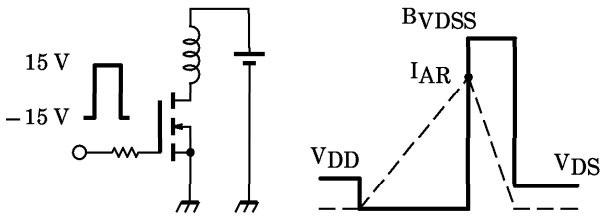



SAFE OPERATING AREA




$E_{AS} - T_{ch}$




TEST CIRCUIT WAVE FORM

Peak $I_{AR}$ = 45 A, $R_G$ = 25 Ω
$V_{DD}$ = 25 V, L = 471 μH

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