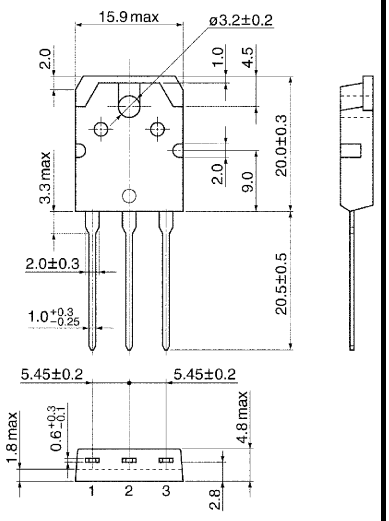
TOSHIBA Field Effect Transistor Silicon N Channel MOS Type ($L^2$−π−MOSIII)

# 2SK1381

Relay Drive, Motor Drive and DC−DC Converter Applications

- 4-V gate drive
- Low drain−source ON resistance : $R_{DS\ (ON)}$ = 25 mΩ (typ.)
- High forward transfer admittance : $|Y_{fs}|$ = 33 S (typ.)
- Low leakage current : $I_{DSS}$ = 100 μA (max) ($V_{DS}$ = 100 V)
- Enhancement mode : $V_{th}$ = 0.8~2.0 V ($V_{DS}$ = 10 V, $I_D$ = 1 mA)

Unit: mm




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

| | |
|---|---|
| JEDEC | — |
| JEITA | — |
| TOSHIBA | 2-16C1B |

Weight: 4.6 g (typ.)

## Maximum Ratings (Ta = 25°C)

| Characteristics | | Symbol | Rating | Unit |
|---|---|---|---|---|
| Drain−source voltage | | $V_{DSS}$ | 100 | V |
| Drain−gate voltage ($R_{GS}$ = 20 kΩ) | | $V_{DGR}$ | 100 | V |
| Gate−source voltage | | $V_{GSS}$ | ±20 | V |
| Drain current | DC (Note 1) | $I_D$ | 50 | A |
| | Pulse (Note 1) | $I_{DP}$ | 200 | |
| Drain power dissipation (Tc = 25°C) | | $P_D$ | 150 | W |
| Channel temperature | | $T_{ch}$ | 150 | °C |
| Storage temperature range | | $T_{stg}$ | −55~150 | °C |

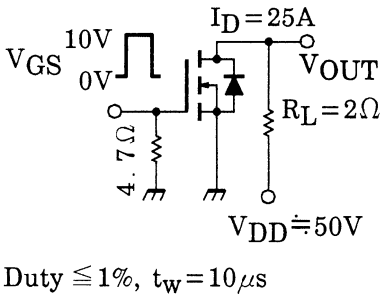
## Thermal Characteristics

| Characteristics | Symbol | Max | Unit |
|---|---|---|---|
| Thermal resistance, channel to case | $R_{th\ (ch-c)}$ | 0.833 | °C / W |
| Thermal resistance, channel to ambient | $R_{th\ (ch-a)}$ | 50 | °C / W |

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

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

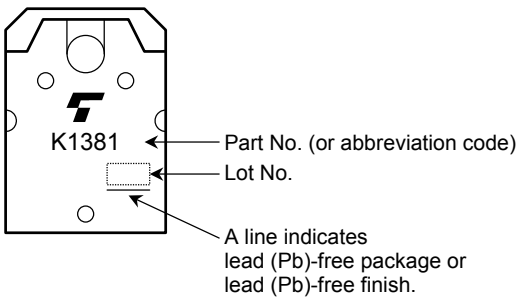
## Electrical Characteristics (Ta = 25°C)

| Characteristics | | Symbol | Test Condition | Min | Typ. | Max | Unit |
|---|---|---|---|---|---|---|---|
| Gate leakage current | | $I_{GSS}$ | $V_{GS}$ = ±20 V, $V_{DS}$ = 0 V | — | — | ±50 | nA |
| Drain cut−off current | | $I_{DSS}$ | $V_{DS}$ = 100 V, $V_{GS}$ = 0 V | — | — | 100 | μA |
| Drain−source breakdown voltage | | $V_{(BR)\ DSS}$ | $I_D$ = 10 mA, $V_{GS}$ = 0 V | 100 | — | — | 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 | — | 31 | 46 | mΩ |
| | | | $V_{GS}$ = 10 V, $I_D$ = 25 A | — | 25 | 32 | |
| Forward transfer admittance | | $\|Y_{fs}\|$ | $V_{DS}$ = 10 V, $I_D$ = 25 A | 20 | 33 | — | S |
| Input capacitance | | $C_{iss}$ | $V_{DS}$ = 10 V, $V_{GS}$ = 0 V, f = 1 MHz | — | 3700 | — | pF |
| Reverse transfer capacitance | | $C_{rss}$ | | — | 580 | — | |
| Output capacitance | | $C_{oss}$ | | — | 1500 | — | |
| Switching time | Rise time | $t_r$ |   | — | 16 | — | ns |
| | Turn−on time | $t_{on}$ | | — | 46 | — | |
| | Fall time | $t_f$ | | — | 60 | — | |
| | Turn−off time | $t_{off}$ | | — | 185 | — | |
| Total gate charge (Gate−source plus gate−drain) | | $Q_g$ | $V_{DD}$ ≈ 80 V, $V_{GS}$ = 10 V, $I_D$ = 50 A | — | 88 | — | nC |
| Gate−source charge | | $Q_{gs}$ | | — | 62 | — | |
| Gate−drain (“miller”) charge | | $Q_{gd}$ | | — | 26 | — | |

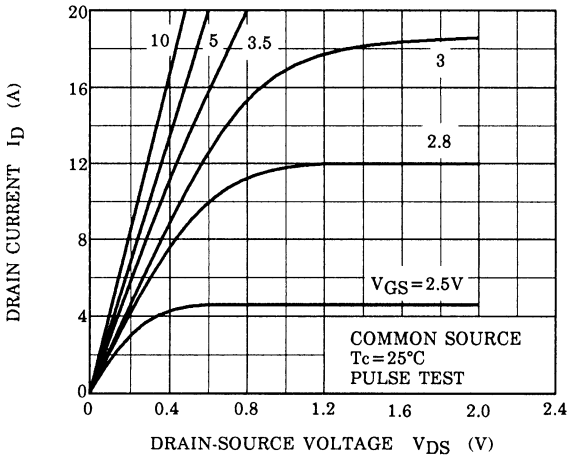
## Source−Drain Ratings and Characteristics (Ta = 25°C)

| Characteristics | Symbol | Test Condition | Min | Typ. | Max | Unit |
|---|---|---|---|---|---|---|
| Continuous drain reverse current (Note 1) | $I_{DR}$ | — | — | — | 50 | A |
| Pulse drain reverse current (Note 1) | $I_{DRP}$ | — | — | — | 200 | A |
| Forward voltage (diode) | $V_{DSF}$ | $I_{DR}$ = 50 A, $V_{GS}$ = 0 V | — | — | −1.6 | V |
| Reverse recovery time | $t_{rr}$ | $I_{DR}$ = 50 A, $V_{GS}$ = 0 V<br>$dI_{DR}$ / dt = 50 A / μs | — | 280 | — | ns |
| Reverse recovered charge | $Q_{rr}$ | | — | 0.56 | — | μC |

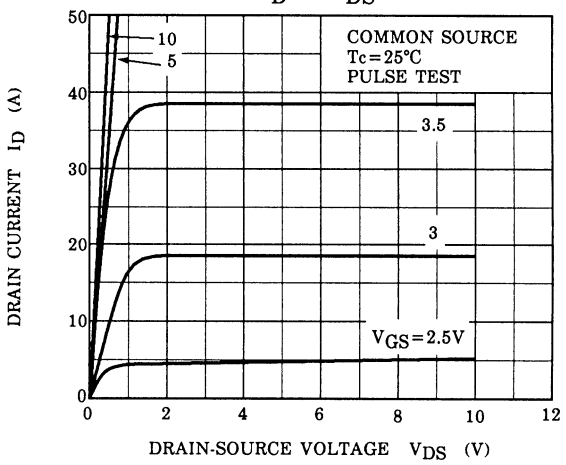
## Marking



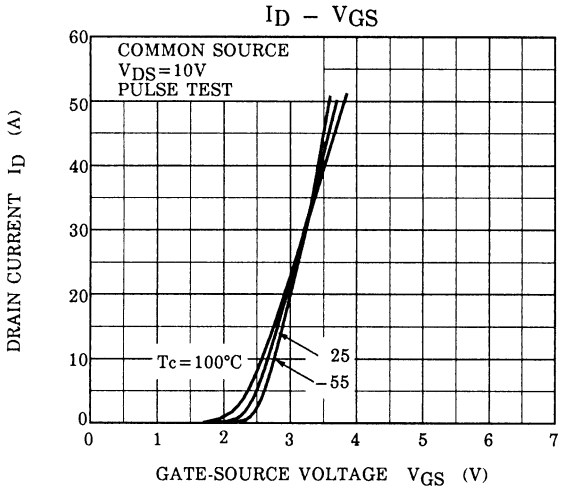
$I_D - V_{DS}$



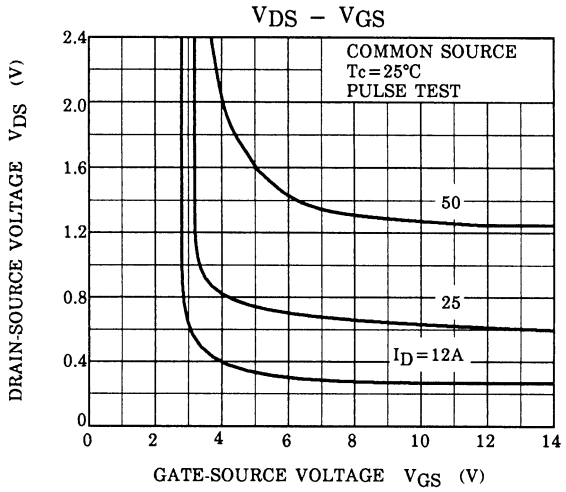

$I_D - V_{DS}$



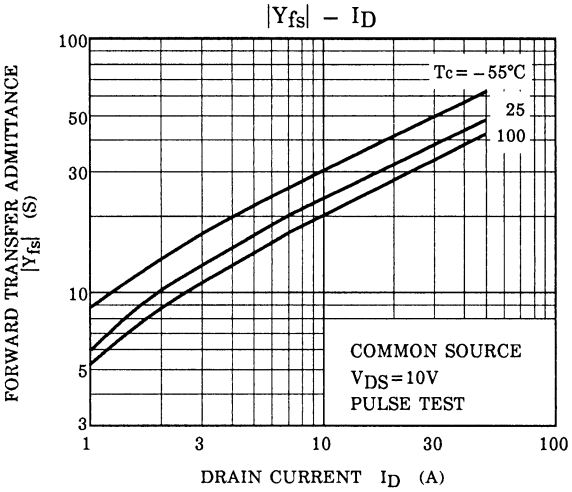

$I_D - V_{GS}$



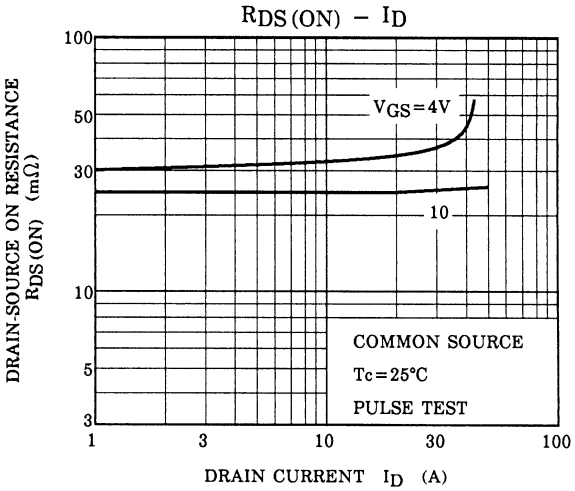

$V_{DS} - V_{GS}$



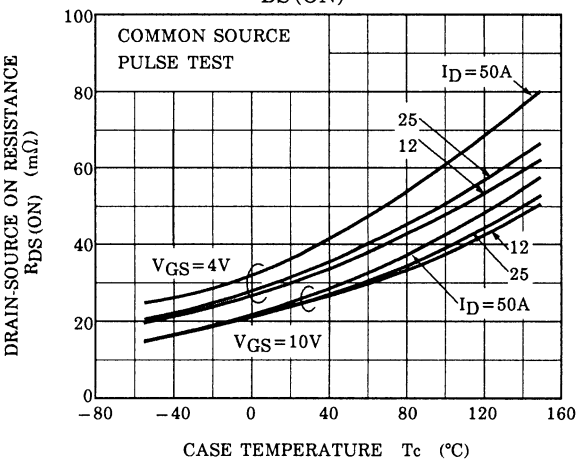

$|Y_{fs}| - I_D$



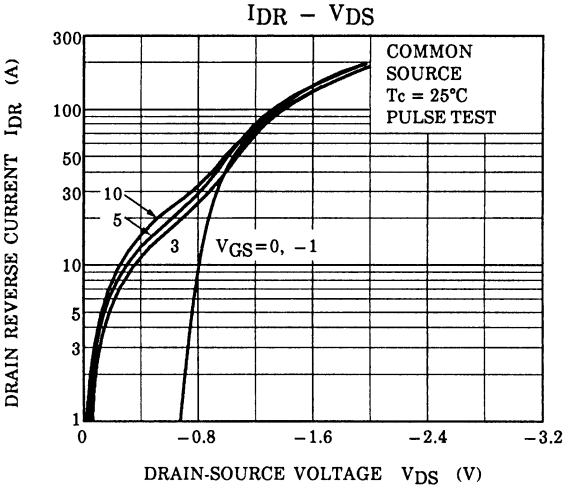

$R_{DS(ON)} - I_D$



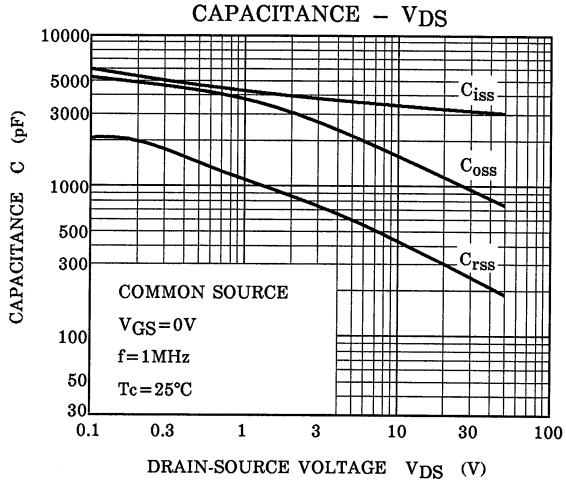
$R_{DS(ON)}$ – Tc



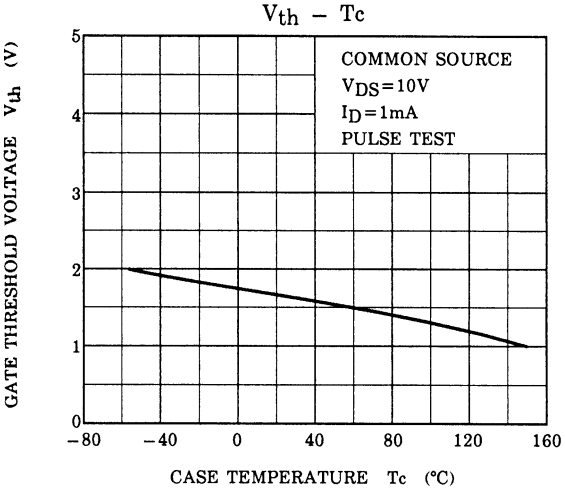

$I_{DR}$ – $V_{DS}$



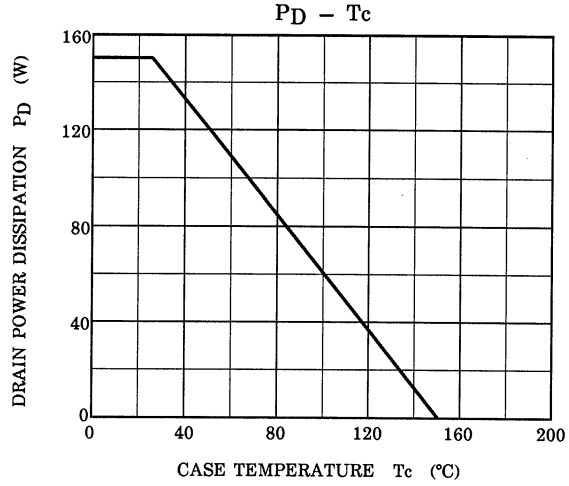

CAPACITANCE – $V_{DS}$



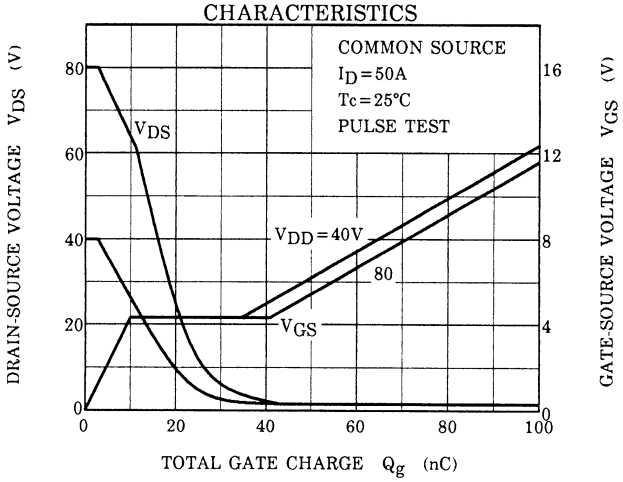

$V_{th}$ – Tc

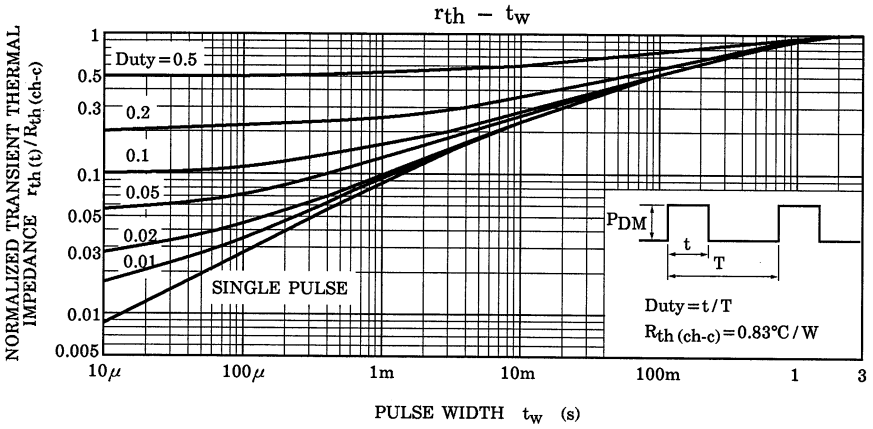


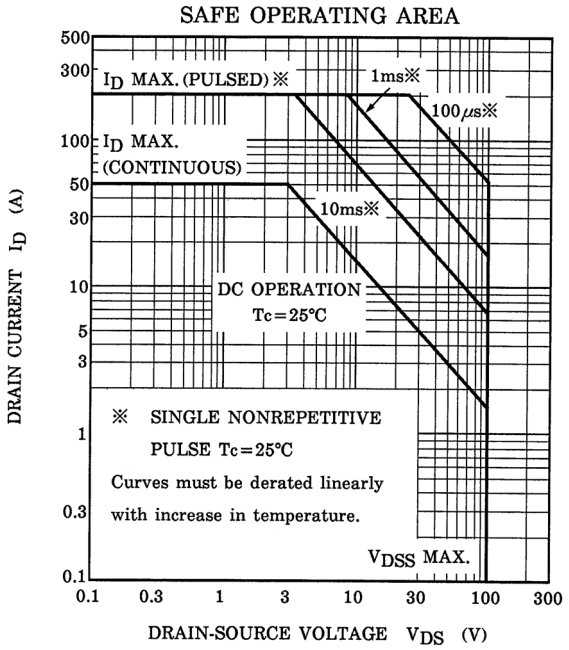

$P_D$ – Tc




DYNAMIC INPUT / OUTPUT CHARACTERISTICS




$r_{th}$ – $t_w$
NORMALIZED TRANSIENT THERMAL IMPEDANCE $r_{th}$ (t) / $R_{th}$ (ch-c)
1
0.5
0.3
0.1
0.05
0.03
0.01
0.005
Duty = 0.5
0.2
0.1
0.05
0.02
0.01
SINGLE PULSE
$P_{DM}$
t
T
Duty = t / T
$R_{th}$ (ch-c) = 0.83°C / W
10μ
100μ
1m
10m
100m
1
3
PULSE WIDTH $t_w$ (s)


SAFE OPERATING AREA
DRAIN CURRENT $I_D$ (A)
500
300
100
50
30
10
5
3
1
0.3
0.1
$I_D$ MAX. (PULSED) ※
1ms※
100μs※
$I_D$ MAX. (CONTINUOUS)
10ms※
DC OPERATION
Tc = 25°C
※ SINGLE NONREPETITIVE PULSE Tc = 25°C
Curves must be derated linearly with increase in temperature.
$V_{DSS}$ MAX.
0.1
0.3
1
3
10
30
100
300
DRAIN-SOURCE VOLTAGE $V_{DS}$ (V)

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