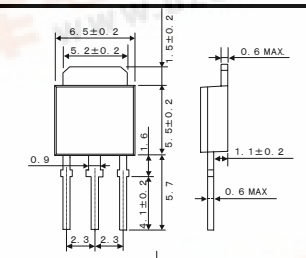
TOSHIBA Field Effect Transistor Silicon P Channel MOS Type (U−MOSIII)

# 2SJ681

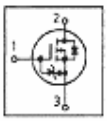
## Relay Drive, DC−DC Converter and Motor Drive Applications

- 4-V gate drive
- Low drain−source ON resistance: $R_{DS\ (ON)}$ = 0.12 Ω (typ.)
- High forward transfer admittance: $|Y_{fs}|$ = 5.0 S (typ.)
- Low leakage current: $I_{DSS}$ = −100 μA (max) ($V_{DS}$ = −60 V)
- Enhancement mode: $V_{th}$ = −0.8 to −2.0 V
  ($V_{DS}$ = −10 V, $I_D$ = −1 mA)

Unit: mm




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



| | |
|---|---|
| JEDEC | — |
| JEITA | — |
| TOSHIBA | 2-7J2B |

Weight: 0.36 g (typ.)

## Maximum Ratings (Ta = 25°C)

| Characteristics | | 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 (Note 1) | $I_D$ | −5 | A |
| | Pulse(Note 1) | $I_{DP}$ | −20 | A |
| Drain power dissipation | | $P_D$ | 20 | W |
| Single pulse avalanche energy (Note 2) | | $E_{AS}$ | 40.5 | mJ |
| Avalanche current | | $I_{AR}$ | −5 | A |
| Repetitive avalenche energy (Note 3) | | $E_{AR}$ | 2 | mJ |
| 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 | $R_{th\ (ch-c)}$ | 6.25 | °C / W |
| Thermal resistance, channel to ambient | $R_{th\ (ch-a)}$ | 125 | °C / W |

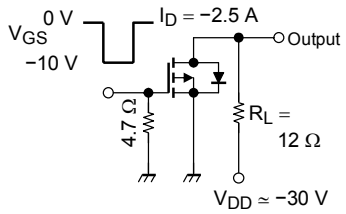
Note 1: Ensure that the channel temperature does not exceed 150°C.

Note 2: $V_{DD}$ = −25 V, $T_{ch}$ = 25°C (initial), L = 2.2 mH,
$R_G$ = 25 Ω, $I_{AR}$ = −5 A

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

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

## Electrical Characteristics (Ta = 25°C)

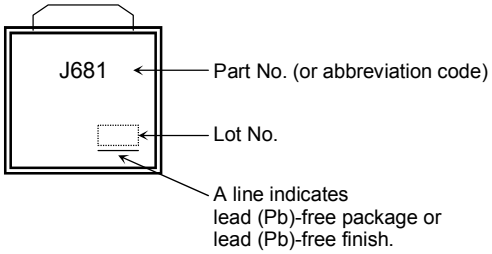
| Characteristics | | Symbol | Test Condition | Min | Typ. | Max | Unit |
|---|---|---|---|---|---|---|---|
| Gate leakage current | | $I_{GSS}$ | $V_{GS}$ = ±16 V, $V_{DS}$ = 0 V | — | — | ±10 | μA |
| Drain cut−off current | | $I_{DSS}$ | $V_{DS}$ = −60 V, $V_{GS}$ = 0 V | — | — | −100 | μA |
| Drain−source breakdown voltage | | $V_{(BR)\ DSS}$ | $I_D$ = −10 mA, $V_{GS}$ = 0 V | −60 | — | — | V |
| | | $V_{(BR)\ DSX}$ | $I_D$ = −10 mA, $V_{GS}$ = 20 V | −35 | — | — | 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, $I_D$ = −2.5 A | — | 0.16 | 0.25 | Ω |
| | | | $V_{GS}$ = −10 V, $I_D$ = −2.5 A | — | 0.12 | 0.17 | |
| Forward transfer admittance | | $\|Y_{fs}\|$ | $V_{DS}$ = −10 V, $I_D$ = −2.5 A | 2.5 | 5.0 | — | S |
| Input capacitance | | $C_{iss}$ | $V_{DS}$ = −10 V, $V_{GS}$ = 0 V, f = 1 MHz | — | 700 | — | pF |
| Reverse transfer capacitance | | $C_{rss}$ | | — | 60 | — | |
| Output capacitance | | $C_{oss}$ | | — | 90 | — | |
| Switching time | Rise time | $t_r$ |  | — | 14 | — | ns |
| | Turn−on time | $t_{on}$ | | — | 24 | — | |
| | Fall time | $t_f$ | | — | 14 | — | |
| | Turn−off time | $t_{off}$ | | — | 95 | — | |
| Total gate charge (Gate−source plus gate−drain) | | $Q_g$ | $V_{DD}$ ≈ −48 V, $V_{GS}$ = −10 V, $I_D$ = −5 A | — | 15 | — | nC |
| Gate−source charge | | $Q_{gs}$ | | — | 11 | — | |
| Gate−drain (“miller”) charge | | $Q_{gd}$ | | — | 4 | — | |



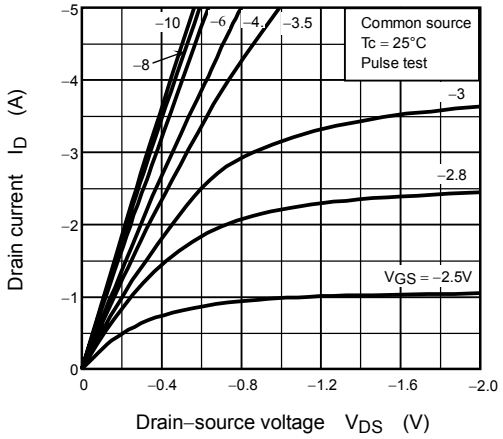
## Source-Drain Ratings and Characteristics (Ta = 25°C)

| Characteristics | Symbol | Test Condition | Min | Typ. | Max | Unit |
|---|---|---|---|---|---|---|
| Continuous drain reverse current (Note 1) | $I_{DR}$ | — | — | — | −5 | A |
| Pulse drain reverse current (Note 1) | $I_{DRP}$ | — | — | — | −20 | A |
| Forward voltage (diode) | $V_{DSF}$ | $I_{DR}$ = −5 A, $V_{GS}$ = 0 V | — | — | 1.7 | V |
| Reverse recovery time | $t_{rr}$ | $I_{DR}$ = −5 A, $V_{GS}$ = 0 V<br>$dI_{DR}$ / dt = 50 A / μS | — | 40 | — | ns |
| Reverse recovery charge | Qrr | | — | 32 | — | nC |

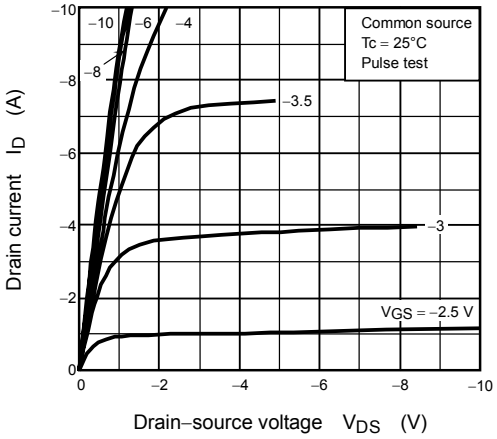
## Marking



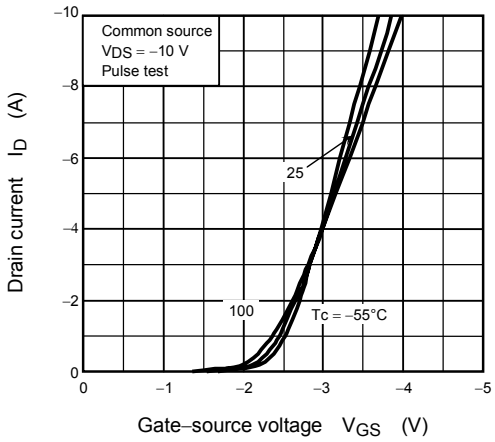
$I_D - V_{DS}$



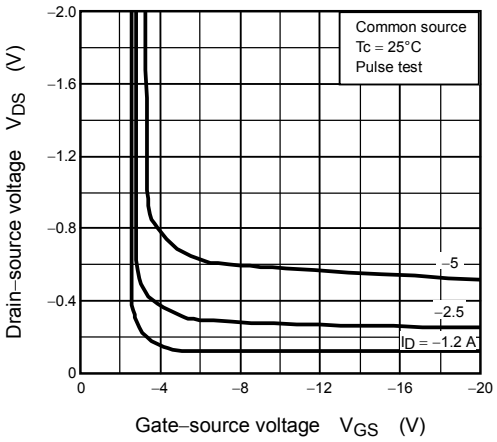

$I_D - V_{DS}$



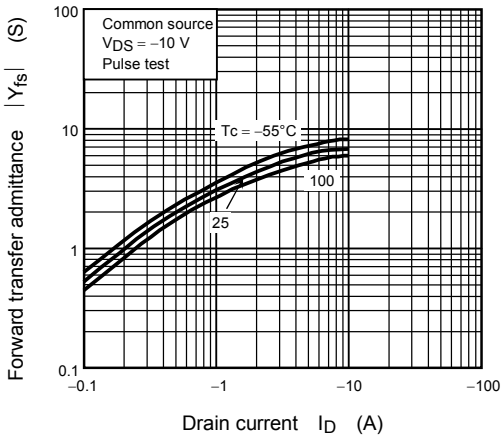

$I_D - V_{GS}$



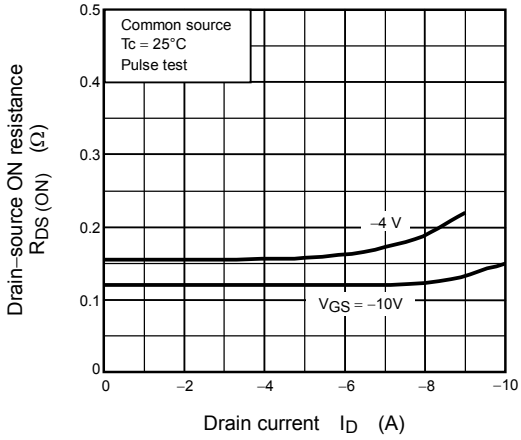

$V_{DS} - V_{GS}$



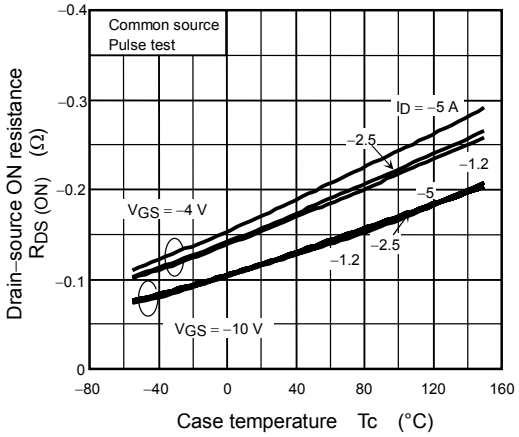

$|Y_{fs}| - I_D$



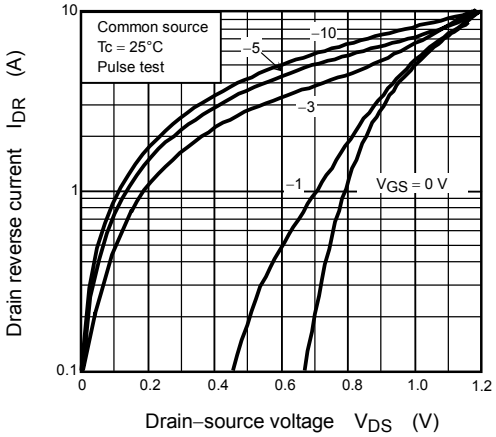

$R_{DS\ (ON)} - I_D$



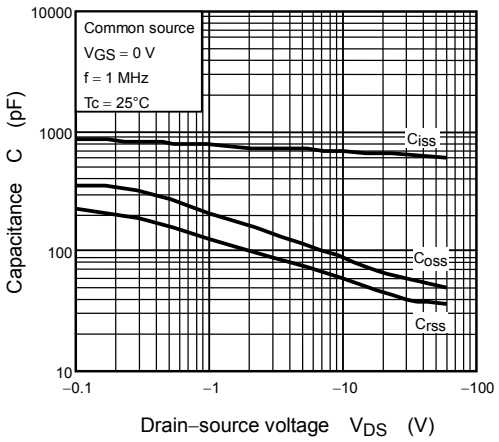
$R_{DS\ (ON)}$ – Tc



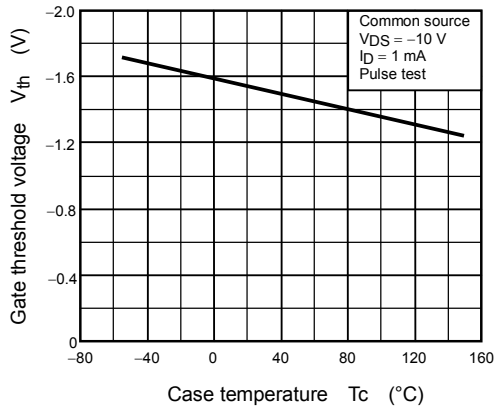

$I_{DR}$ – $V_{DS}$



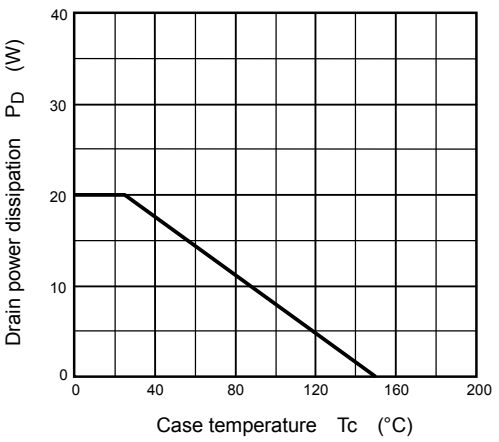

Capacitance – $V_{DS}$



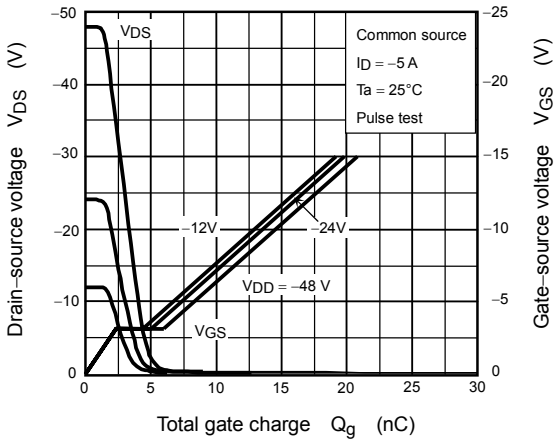

$V_{th}$ – Tc



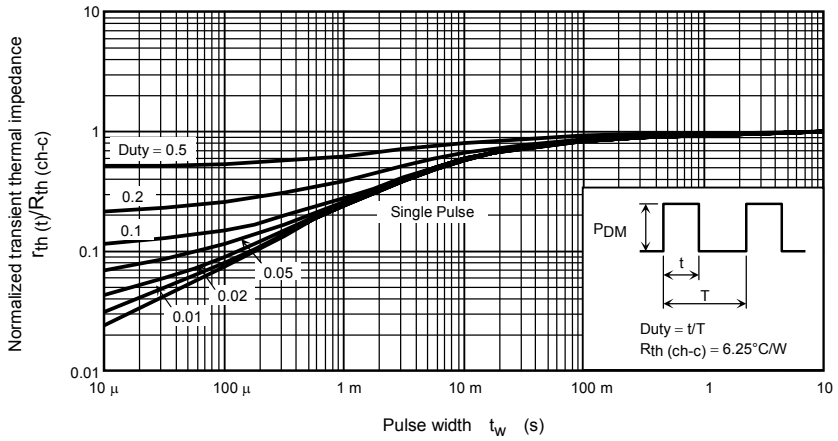

$P_D$ – Tc



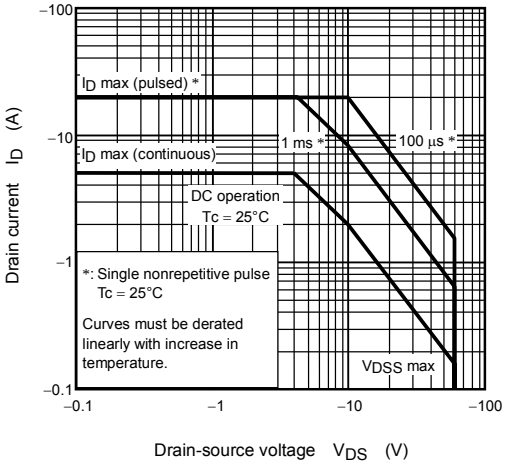

Dynamic input/output characteristics



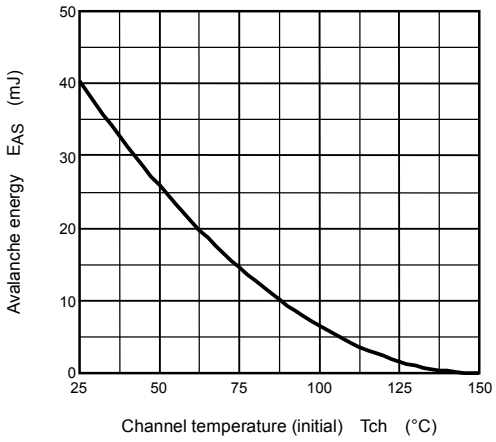
$r_{th} - t_w$

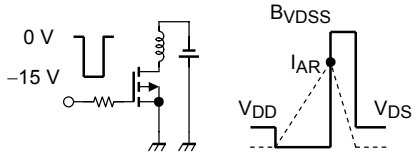



Safe operating area




$E_{AS} - T_{ch}$




Test circuit Wave form

$R_G = 25\ \Omega$
$V_{DD} = -25$ V, L = 2.2 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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