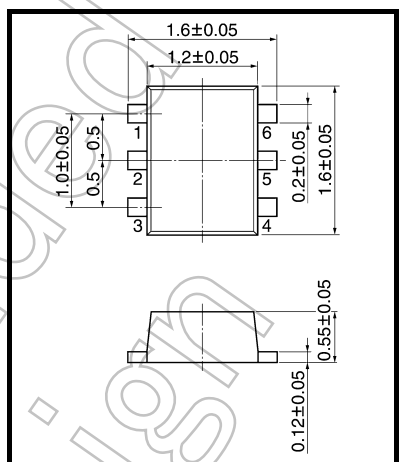
TOSHIBA Field Effect Transistor Silicon N Channel MOS Type

# SSM6K31FE

○ High speed switching

○ DC-DC Converter

単位: mm




1,2,5,6: Drain
3: Gate
4: Source

ES6

| | |
|---|---|
| JEDEC | — |
| JEITA | — |
| TOSHIBA | 2-2N1J |

Weight: 3 mg (typ.)

- 4-V drive
- Low $R_{DS\ (ON)}$: $R_{DS\ (ON)}$ = 320 mΩ (max) (@$V_{GS}$ = 10 V)
  : $R_{DS\ (ON)}$ = 540 mΩ (max) (@$V_{GS}$ = 4 V)

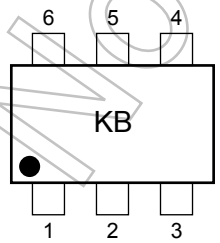
## Absolute Maximum Ratings (Ta = 25°C)

| Characteristics | | Symbol | Rating | Unit |
|---|---|---|---|---|
| Drain-Source voltage | | $V_{DS}$ | 20 | V |
| Gate-Source voltage | | $V_{GSS}$ | ±20 | V |
| Drain current | DC | $I_D$ | 1.2 | A |
| | Pulse | $I_{DP}$ | 2.4 | |
| Drain power dissipation | | $P_D$(Note 1) | 500 | mW |
| Channel temperature | | $T_{ch}$ | 150 | °C |
| Storage temperature range | | $T_{stg}$ | −55 to 150 | °C |

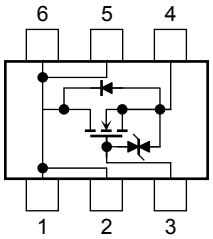
Note: Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) 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).

Note 1: Mounted on FR4 board
(25.4 mm × 25.4 mm × 1.6 mm (t), Cu pad: 645 $mm^2$)

## Marking




## Equivalent Circuit (top view)




## Handling Precaution

When handling individual devices (which are not yet mounted on a circuit board), ensure that the environment is protected against static electricity. Operators should wear anti-static clothing, and containers and other objects that come into direct contact with devices should be made of anti-static materials.

Start of commercial production
2004-04

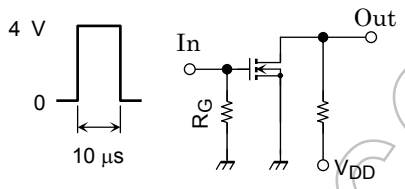
## Electrical Characteristics (Ta = 25°C)

| Characteristics | | Symbol | Test Condition | Min | Typ. | Max | Unit |
|---|---|---|---|---|---|---|---|
| Gate leakage current | | $I_{GSS}$ | $V_{GS}$ = ±16 V, $V_{DS}$ = 0 V | — | — | ±1 | μA |
| Drain-Source breakdown voltage | | $V_{(BR)\ DSS}$ | $I_D$ = 1 mA, $V_{GS}$ = 0 V | 20 | — | — | V |
| Drain cut-off current | | $I_{DSS}$ | $V_{DS}$ = 20 V, $V_{GS}$ = 0 V | — | — | 1 | μA |
| Gate threshold voltage | | $V_{th}$ | $V_{DS}$ = 5 V, $I_D$ = 0.1 mA | 1.1 | — | 2.3 | V |
| Forward transfer admittance | | $\|Y_{fs}\|$ | $V_{DS}$ = 5 V, $I_D$ = 0.6 A (Note 2) | 0.58 | 1.16 | — | S |
| Drain-Source on-resistance | | $R_{DS\ (ON)}$ | $I_D$ = 0.6 A, $V_{GS}$ = 10 V (Note 2) | — | 240 | 320 | mΩ |
| | | | $I_D$ = 0.6 A, $V_{GS}$ = 4 V (Note 2) | — | 400 | 540 | |
| Input capacitance | | $C_{iss}$ | $V_{DS}$ = 10 V, $V_{GS}$ = 0 V, f = 1 MHz | — | 36 | — | pF |
| Reverse transfer capacitance | | $C_{rss}$ | $V_{DS}$ = 10 V, $V_{GS}$ = 0 V, f = 1 MHz | — | 10 | — | pF |
| Output capacitance | | $C_{oss}$ | $V_{DS}$ = 10 V, $V_{GS}$ = 0 V, f = 1 MHz | — | 30 | — | pF |
| Switching time | Turn-on time | $t_{on}$ | $V_{DD}$ = 10 V, $I_D$ = 0.6 A, | — | 21 | — | ns |
| | Turn-off time | $t_{off}$ | $V_{GS}$ = 0 to 4 V, $R_G$ = 10 Ω | — | 8 | — | |

Note 2: Pulse measurement

## Switching Time Test Circuit

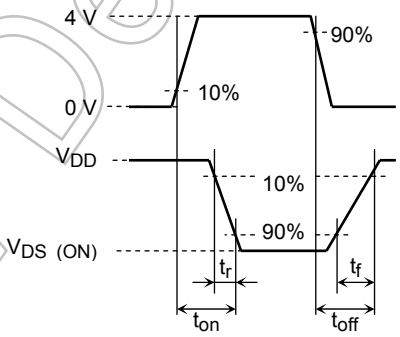
### (a) Test circuit




$V_{DD}$ = 10 V
$R_G$ = 10 Ω
Duty ≤ 1%
$V_{IN}$: $t_r$, $t_f$ < 5 ns
Common source
Ta = 25°C

### (b) $V_{IN}$

### (c) $V_{OUT}$

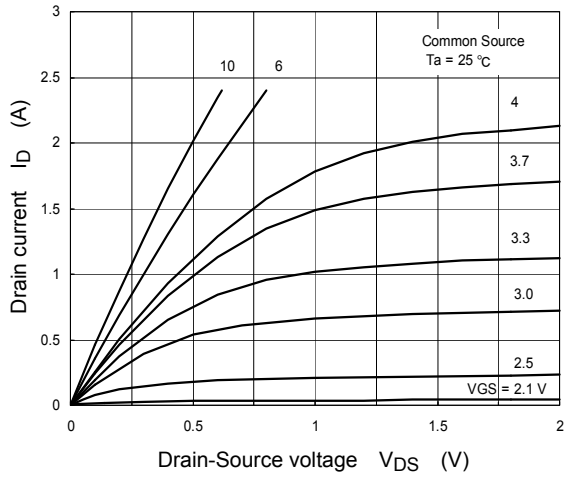



## Precaution

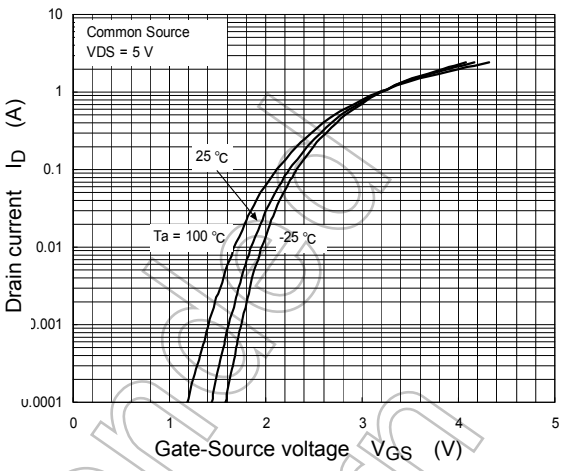
$V_{th}$ can be expressed as the voltage between the gate and source when the low operating current value is $I_D$ = 0.1 mA for this product. For normal switching operation, $V_{GS\ (on)}$ requires a higher voltage than $V_{th}$ and $V_{GS\ (off)}$ requires a lower voltage than $V_{th}$. The relationship can be established as follows:
$V_{GS\ (off)} < V_{th} < V_{GS\ (on)}$.

Be sure to take this into consideration when using the device.

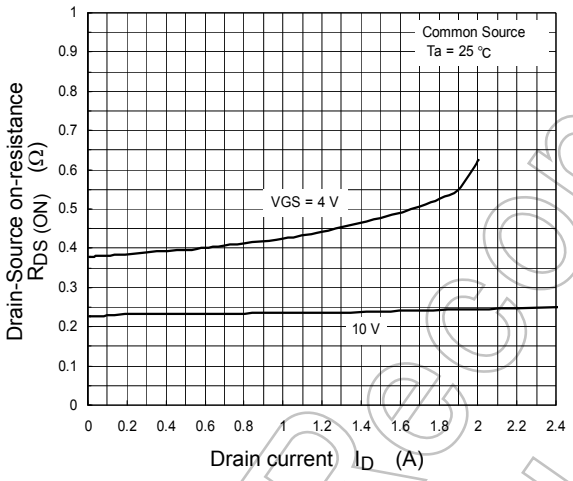
$I_D - V_{DS}$



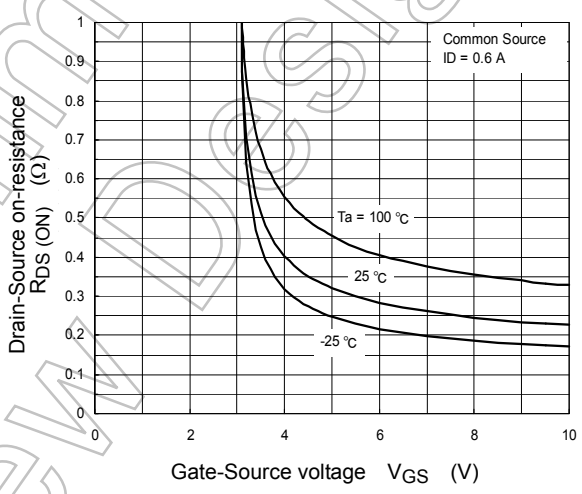

$I_D - V_{GS}$



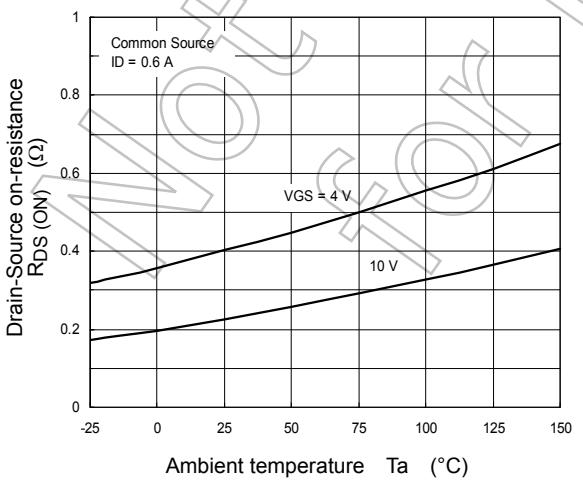

$R_{DS(ON)} - I_D$



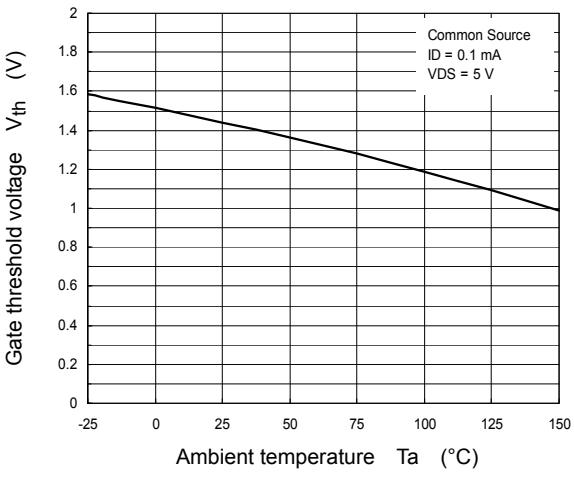

$R_{DS(ON)} - V_{GS}$



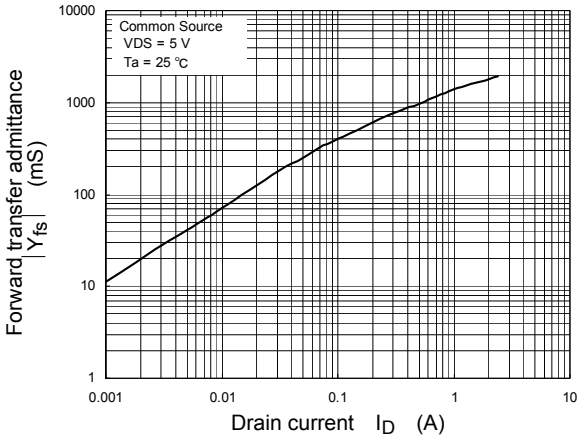

$R_{DS(ON)} - Ta$



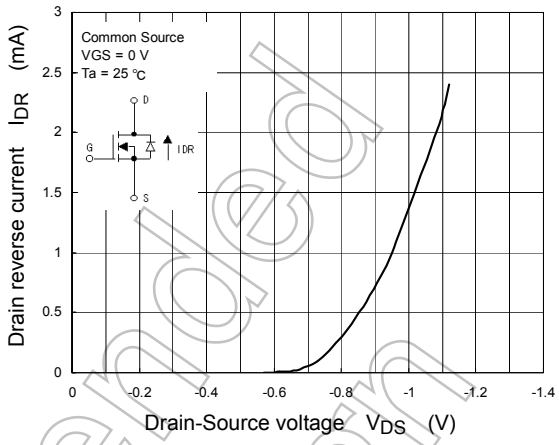

$V_{th} - Ta$



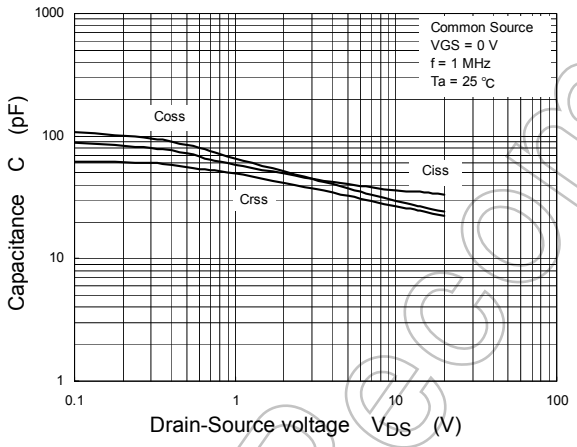
$|Y_{fs}| - I_D$



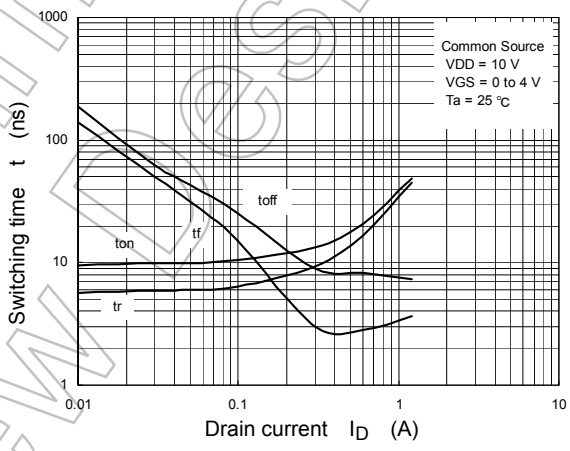

$I_{DR} - V_{DS}$



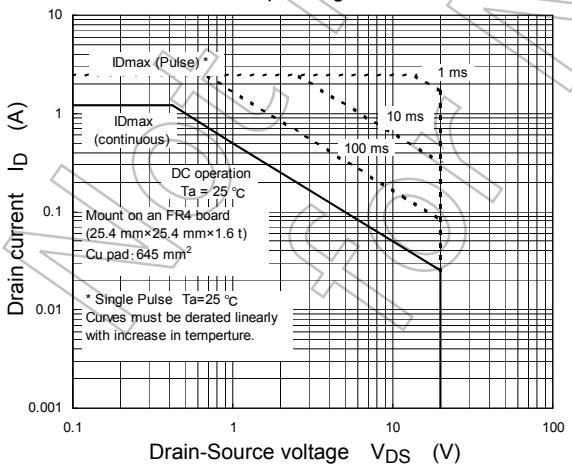

$C - V_{DS}$



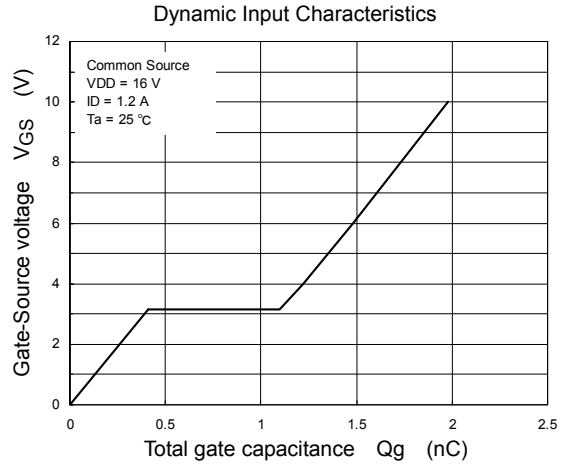

$t - I_D$



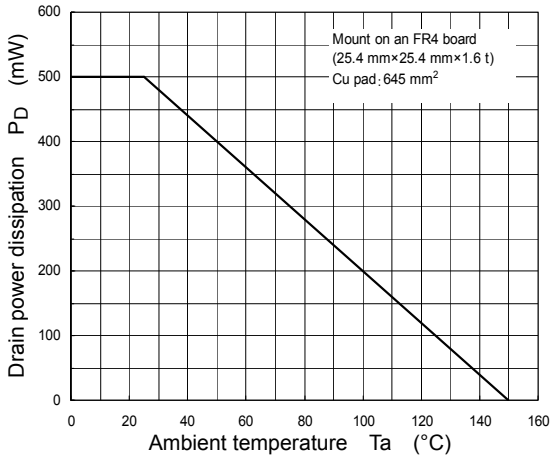

Safe operating area



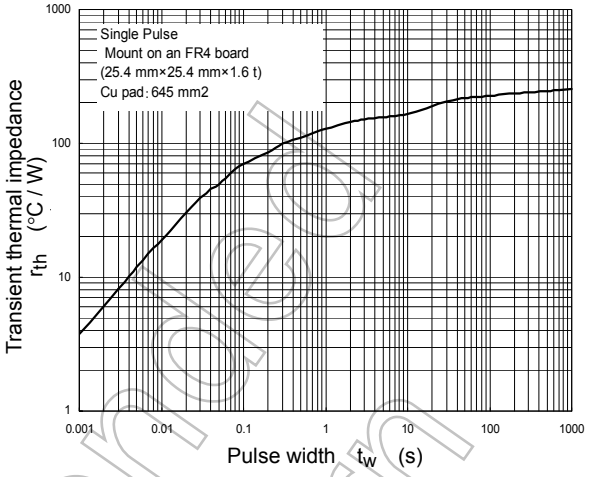

Dynamic Input Characteristics



$P_D$ – Ta




$r_{th}$ – $t_w$



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