TOSHIBA Field Effect Transistor Silicon N-Channel MOS Type

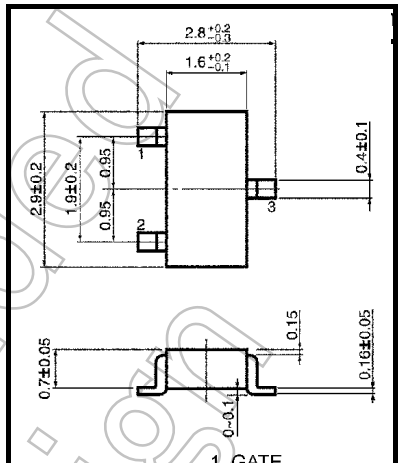
# SSM3K301T

Power Management Switch Applications

High-Speed Switching Applications

- 1.8 V drive
- Low ON-resistance: $R_{on}$ = 110 mΩ (max) (@$V_{GS}$ = 1.8 V)
  $R_{on}$ = 74 mΩ (max) (@$V_{GS}$ = 2.5 V)
  $R_{on}$ = 56 mΩ (max) (@$V_{GS}$ = 4.0 V)

Unit: mm




| | |
|---|---|
| TSM | |
| JEDEC | — |
| JEITA | — |
| TOSHIBA | 2-3S1A |

Weight: 10 mg (typ.)

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

| Characteristics | | Symbol | Rating | Unit |
|---|---|---|---|---|
| Drain-Source voltage | | $V_{DS}$ | 20 | V |
| Gate-Source voltage | | $V_{GSS}$ | ± 12 | V |
| Drain current | DC | $I_D$ | 3.5 | A |
| | Pulse | $I_{DP}$ | 7.0 | |
| Drain power dissipation | | $P_{D\ (Note\ 1)}$ | 700 | 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 an FR4 board.
(25.4 mm × 25.4 mm × 1.6 t, Cu Pad: 645 $mm^2$ )

## Electrical Characteristics (Ta = 25°C)

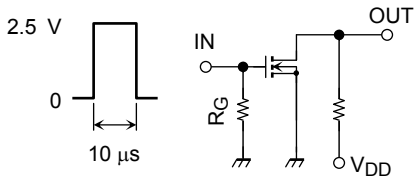
| Characteristics | | Symbol | Test Condition | | Min | Typ. | Max | Unit |
|---|---|---|---|---|---|---|---|---|
| Drain-Source breakdown voltage | | $V_{(BR)\ DSS}$ | $I_D$ = 1 mA, $V_{GS}$ = 0 | | 20 | — | — | V |
| | | $V_{(BR)\ DSX}$ | $I_D$ = 1 mA, $V_{GS}$ = −12 V | | 12 | — | — | |
| Drain cutoff current | | $I_{DSS}$ | $V_{DS}$ = 20 V, $V_{GS}$ = 0 | | — | — | 1 | μA |
| Gate leakage current | | $I_{GSS}$ | $V_{GS}$ = ±12 V, $V_{DS}$ = 0 | | — | — | ±1 | μA |
| Gate threshold voltage | | $V_{th}$ | $V_{DS}$ = 3 V, $I_D$ = 1 mA | | 0.4 | — | 1.0 | V |
| Forward transfer admittance | | $\|Y_{fs}\|$ | $V_{DS}$ = 3 V, $I_D$ = 2.0 A | (Note 2) | 6 | 10 | — | S |
| Drain-Source ON-resistance | | $R_{DS\ (ON)}$ | $I_D$ = 2.0 A, $V_{GS}$ = 4.0 V | (Note 2) | — | 44 | 56 | mΩ |
| | | | $I_D$ = 1.0 A, $V_{GS}$ = 2.5 V | (Note 2) | — | 53 | 74 | |
| | | | $I_D$ = 0.5 A, $V_{GS}$ = 1.8 V | (Note 2) | — | 70 | 110 | |
| Input capacitance | | $C_{iss}$ | $V_{DS}$ = 10 V, $V_{GS}$ = 0, f = 1 MHz | | — | 320 | — | pF |
| Output capacitance | | $C_{oss}$ | | | — | 62 | — | |
| Reverse transfer capacitance | | $C_{rss}$ | | | — | 51 | — | |
| Total Gate Charge | | $Q_g$ | $V_{DS}$ = 10 V, $I_{DS}$= 3.5 A, $V_{GS}$ = 4 V | | — | 4.8 | — | nC |
| Gate-Source Charge | | $Q_{gs}$ | | | — | 3.3 | — | |
| Gate-Drain Charge | | $Q_{gd}$ | | | — | 1.5 | — | |
| Switching time | Turn-on time | $t_{on}$ | $V_{DD}$ = 10 V, $I_D$ = 2 A, $V_{GS}$ = 0 to 2.5 V, $R_G$ = 4.7 Ω | | — | 18 | — | ns |
| | Turn-off time | $t_{off}$ | | | — | 14 | — | |
| Drain-Source forward voltage | | $V_{DSF}$ | $I_D$ = −3.5 A, $V_{GS}$ = 0 V | (Note 2) | — | −0.85 | −1.2 | V |

Note 2: Pulse test

Start of commercial production
2006-09

## Switching Time Test Circuit

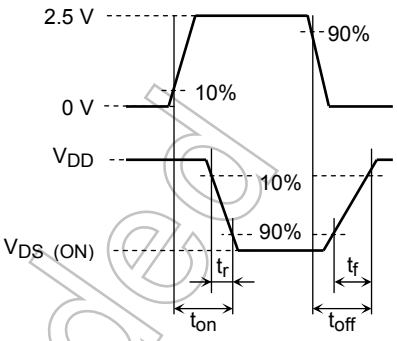
### (a) Test Circuit



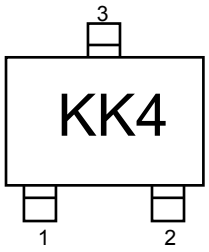

$V_{DD}$ = 10 V
$R_G$ = 4.7 Ω
Duty ≤ 1%
$V_{IN}$: $t_r$, $t_f$ < 5 ns
Common Source
Ta = 25°C

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

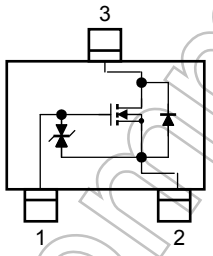
### (c) $V_{OUT}$




## Marking




## Equivalent Circuit (top view)



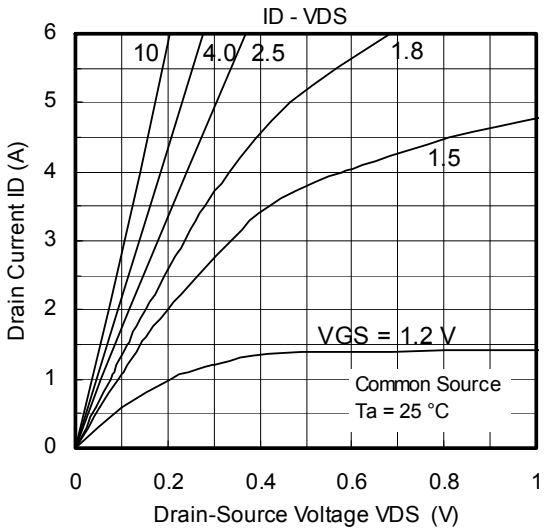

## Notice on Usage

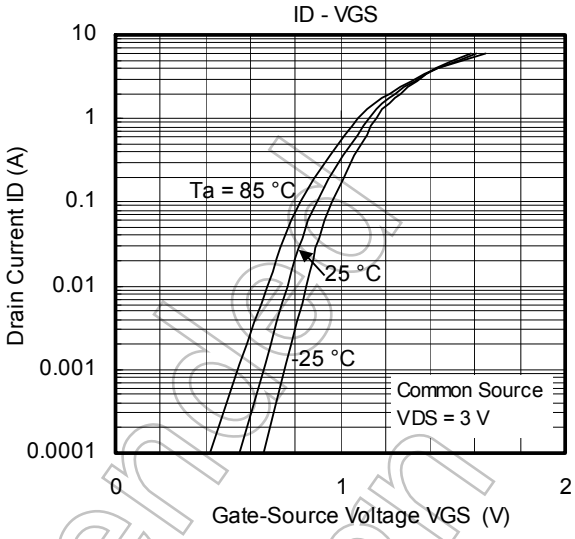
$V_{th}$ can be expressed as the voltage between gate and source when the low operating current value is $I_D$ = 1 mA for this product. For normal switching operation, $V_{GS\ (on)}$ requires a higher voltage than $V_{th}$, and $V_{GS\ (off)}$ requires a lower voltage than $V_{th}$. (The relationship can be established as follows: $V_{GS\ (off)} < V_{th} < V_{GS\ (on)}$.)

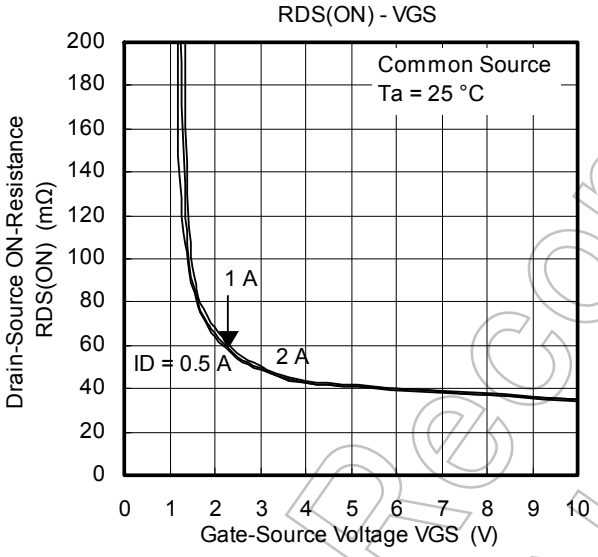
Take this into consideration when using the device.

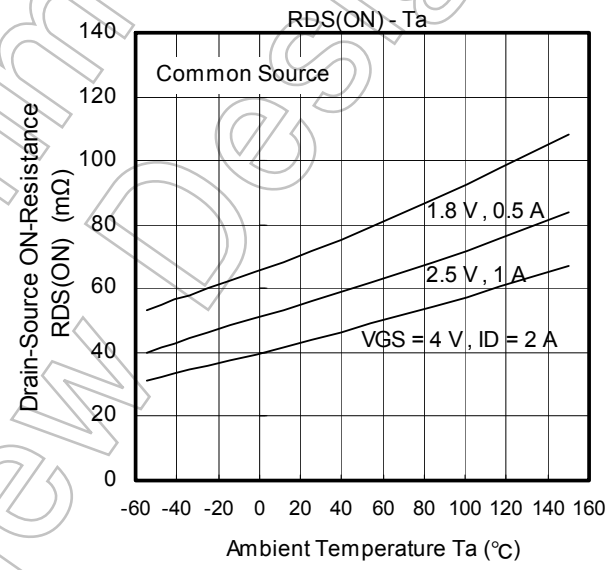
## Handling Precaution

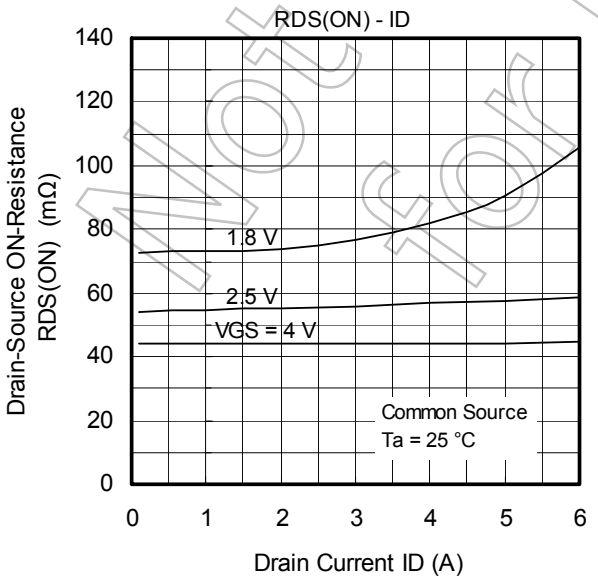
When handling individual devices that are not yet mounted on a circuit board, make sure that the environment is protected against electrostatic discharge. Operators should wear antistatic clothing, and containers and other objects that come into direct contact with devices should be made of antistatic materials.

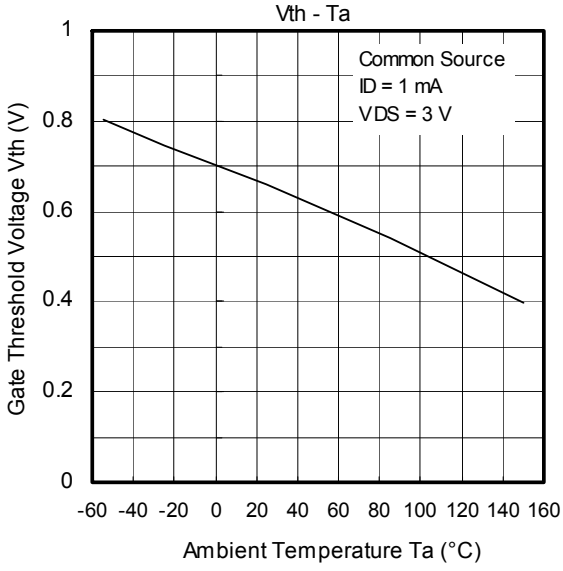


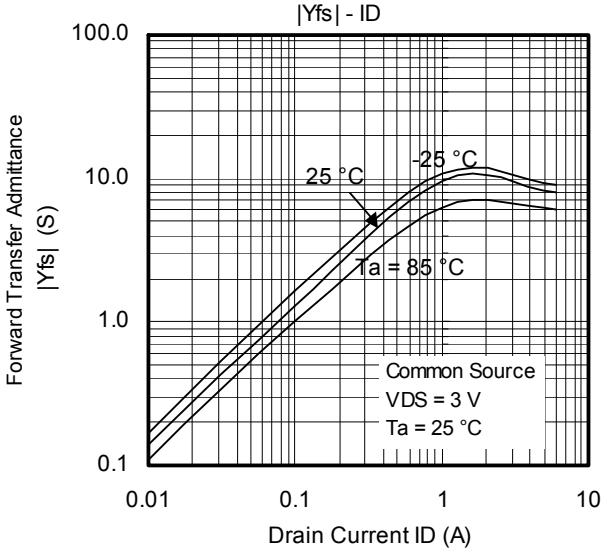



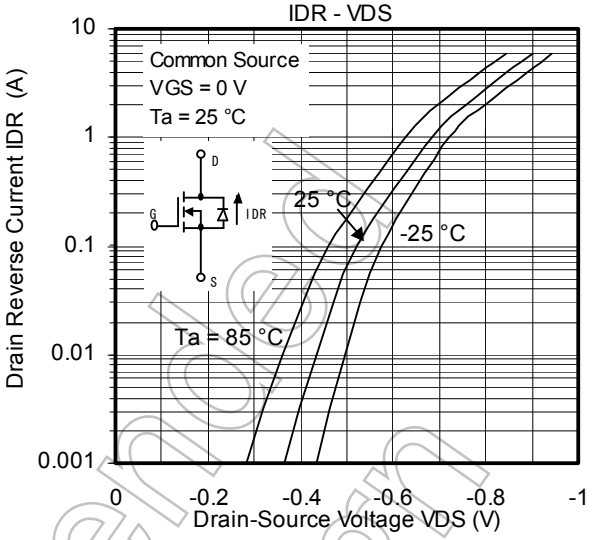



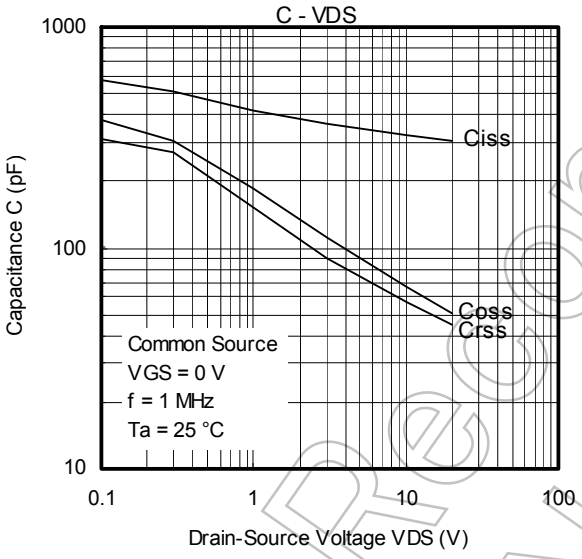
|Yfs| - ID



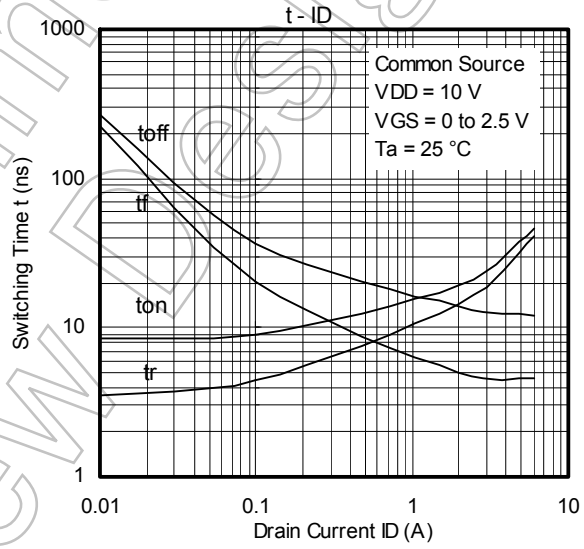

IDR - VDS



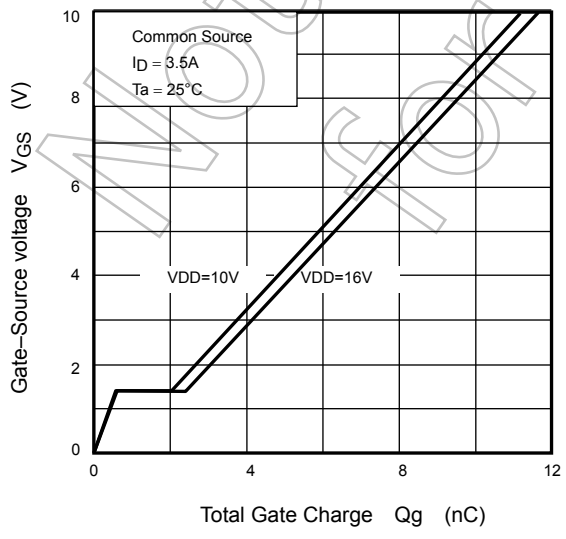

C - VDS



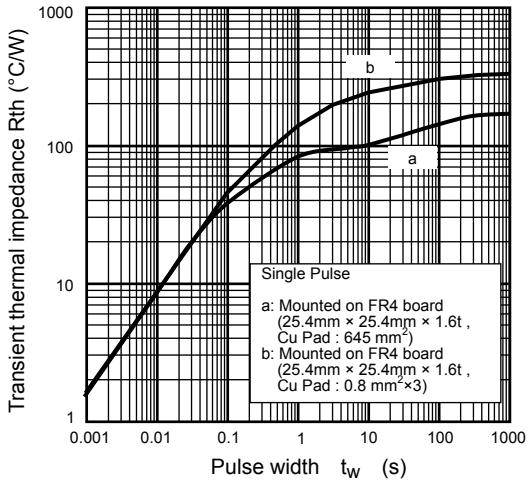

t - ID



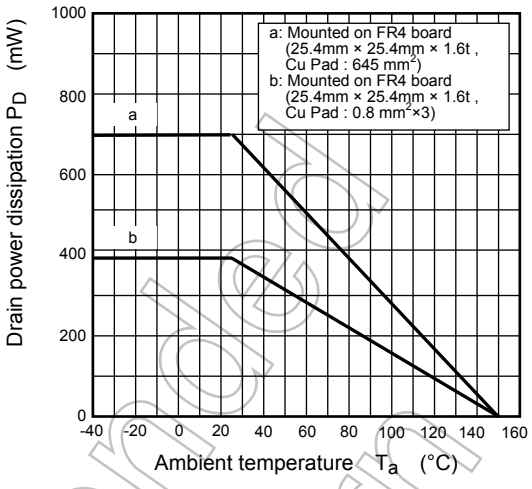

Dynamic Input Characteristic



$r_{th} - t_w$




$P_D - T_a$



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