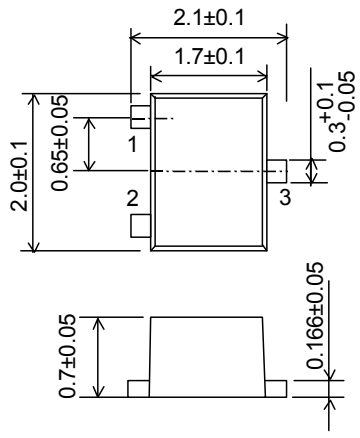
TOSHIBA Field Effect Transistor Silicon N Channel MOS Type

# SSM3K116TU

High Speed Switching Applications

- 2.5V drive
- Low on-resistance: $R_{on}$ = 135mΩ (max) (@$V_{GS}$ = 2.5 V)
  $R_{on}$ = 100mΩ (max) (@$V_{GS}$ = 4.5 V)

Unit: mm




1: Gate
2: Source
3: Drain

| | |
|---|---|
| UFM | |
| JEDEC | — |
| JEITA | — |
| TOSHIBA | 2-2U1A |

Weight: 6.6 mg (typ.)

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

| Characteristic | | Symbol | Rating | Unit |
|---|---|---|---|---|
| Drain-Source voltage | | $V_{DS}$ | 30 | V |
| Gate-Source voltage | | $V_{GSS}$ | ± 12 | V |
| Drain current | DC | $I_D$ | 2.2 | A |
| | Pulse | $I_{DP}$ | 4.4 | |
| Drain power dissipation | | $P_{D\ (Note\ 1)}$ | 800 | mW |
| | | $P_{D\ (Note\ 2)}$ | 500 | |
| 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 ceramic board.
(25.4 mm × 25.4 mm × 0.8 mm, Cu Pad: 645 $mm^2$ )

Note 2: Mounted on FR4 board.
(25.4 mm × 25.4 mm × 1.6 mm, Cu Pad: 645 $mm^2$ )

## Electrical Characteristics (Ta = 25°C)

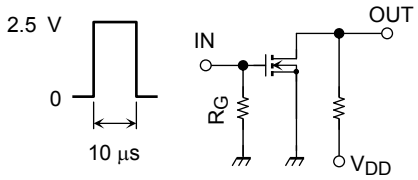
| Characteristic | | Symbol | Test Conditions | Min | Typ. | Max | Unit |
|---|---|---|---|---|---|---|---|
| Drain-Source breakdown voltage | | $V_{(BR)\ DSS}$ | $I_D$ = 1 mA, $V_{GS}$ = 0 | 30 | — | — | V |
| | | $V_{(BR)\ DSX}$ | $I_D$ = 1 mA, $V_{GS}$ = −12 V | 18 | — | — | |
| Drain cut-off current | | $I_{DSS}$ | $V_{DS}$ = 30 V, $V_{GS}$ = 0 | — | — | 1 | μA |
| Gate leakage current | | $I_{GSS}$ | $V_{GS}$ = ±12V, $V_{DS}$ = 0 | — | — | ±1 | μA |
| Gate threshold voltage | | $V_{th}$ | $V_{DS}$ = 3 V, $I_D$ = 0.1 mA | 0.5 | — | 1.1 | V |
| Forward transfer admittance | | $\|Y_{fs}\|$ | $V_{DS}$ = 3 V, $I_D$ = 0.25 A (Note3) | 1 | 2 | — | S |
| Drain-Source on-resistance | | $R_{DS\ (ON)}$ | $I_D$ = 0.5 A, $V_{GS}$ = 4.5 V (Note3) | — | 75 | 100 | mΩ |
| | | | $I_D$ = 0.25 A, $V_{GS}$ = 2.5 V (Note3) | — | 95 | 135 | |
| Input capacitance | | $C_{iss}$ | $V_{DS}$ = 10 V, $V_{GS}$ = 0, f = 1 MHz | — | 245 | — | pF |
| Output capacitance | | $C_{oss}$ | $V_{DS}$ = 10 V, $V_{GS}$ = 0, f = 1 MHz | — | 41 | — | pF |
| Reverse transfer capacitance | | $C_{rss}$ | $V_{DS}$ = 10 V, $V_{GS}$ = 0, f = 1 MHz | — | 33 | — | pF |
| Switching time | Turn-on time | $t_{on}$ | $V_{DD}$ = 10 V, $I_D$ = 0.25 A, | — | 9 | — | ns |
| | Turn-off time | $t_{off}$ | $V_{GS}$ = 0 to 2.5 V, $R_G$ = 4.7 Ω | — | 15 | — | |
| Drain-Source forward voltage | | $V_{DSF}$ | $I_D$ = −2.2A, $V_{GS}$ = 0 V (Note3) | — | −0.83 | -1.2 | V |

Note3: Pulse test

Start of commercial production
2005-06

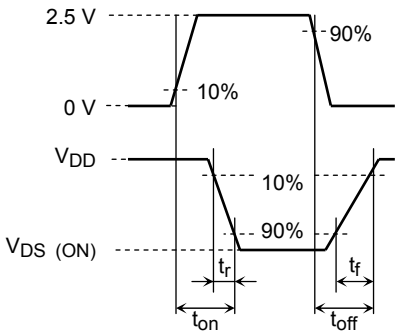
## Switching Time Test Circuit

### (a) Test Circuit



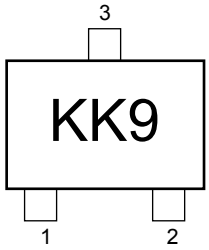

$V_{DD}$ = 10 V
$R_G$ = 4.7 Ω
Duty ≤ 1%
$V_{IN}$: $t_r$, $t_f$ < 5 ns
Common Source
Ta = 25°C

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

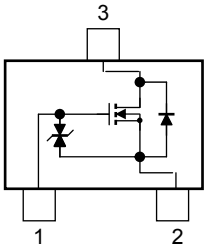



### (c) $V_{OUT}$

## Marking




## Equivalent Circuit (top view)

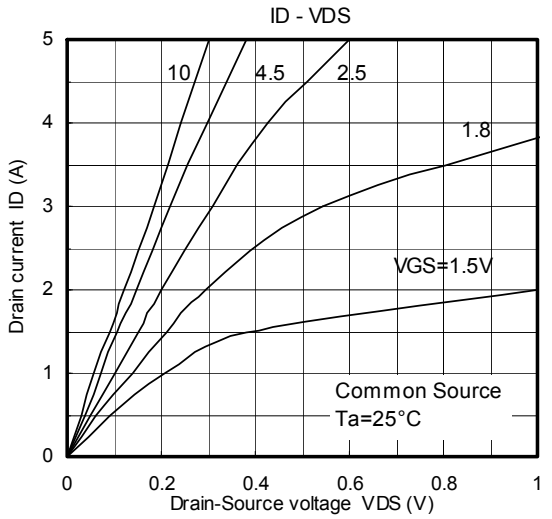


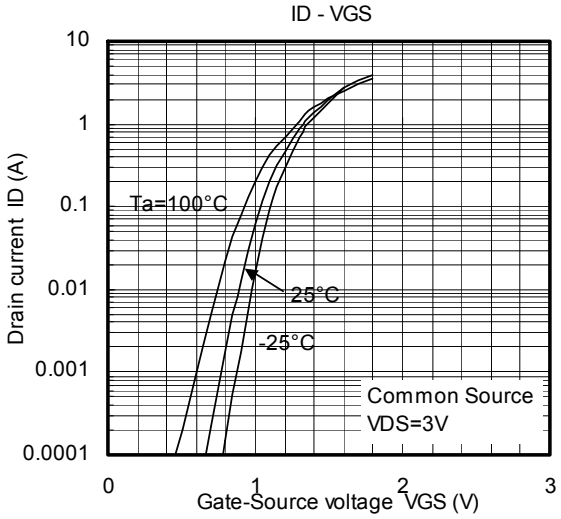

## Precaution

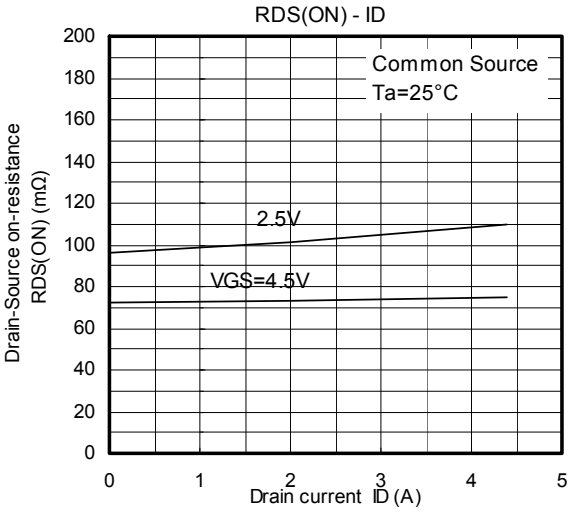
$V_{th}$ can be expressed as the voltage between gate and source when the low operating current value is $I_D$=0.1mA for this product. For normal switching operation, $V_{GS\ (on)}$ requires a higher voltage than $V_{th}$, and $V_{GS\ (off)}$ requires a lower voltage than $V_{th}$.
(The relationship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

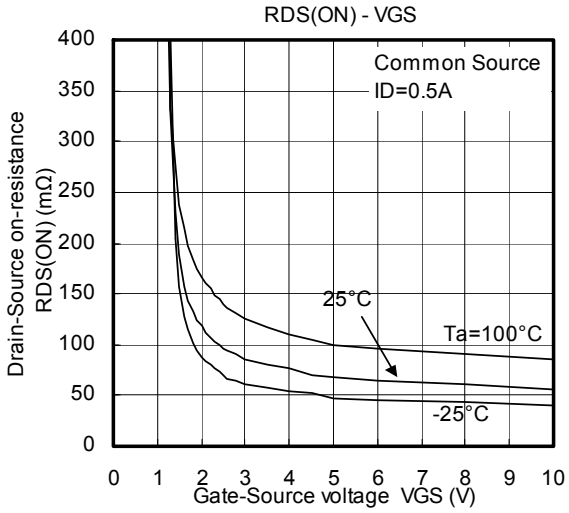
## Handling Precaution

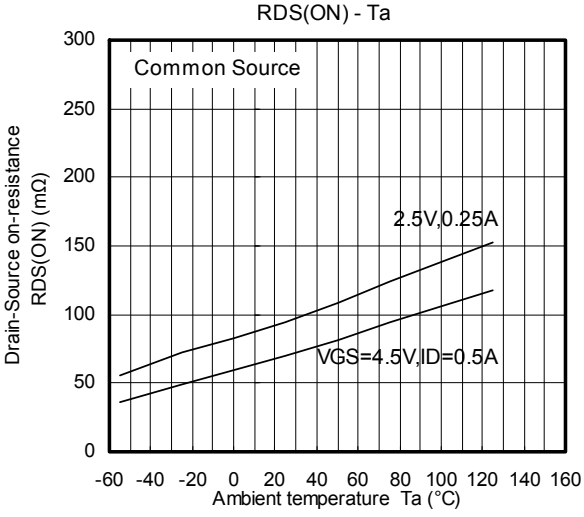
When handling individual devices which are not yet mounted on a circuit board, be sure that the environment is protected against electrostatic discharge. Operators should wear anti-static clothing, and containers and other objects that come into direct contact with devices should be made of anti-static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

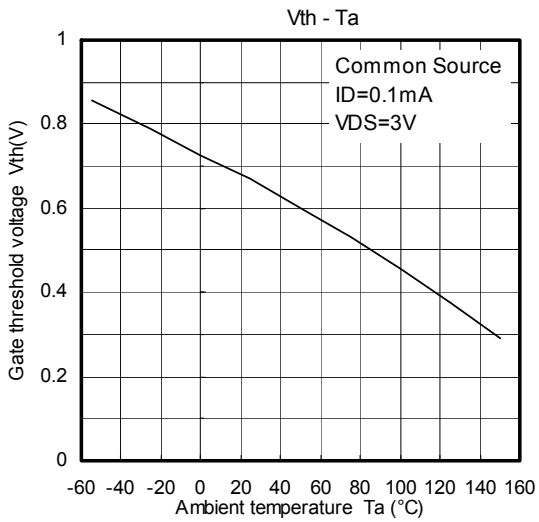

ID - VDS
Drain current ID (A)
Drain-Source voltage VDS (V)
10
4.5
2.5
1.8
VGS=1.5V
Common Source
Ta=25°C

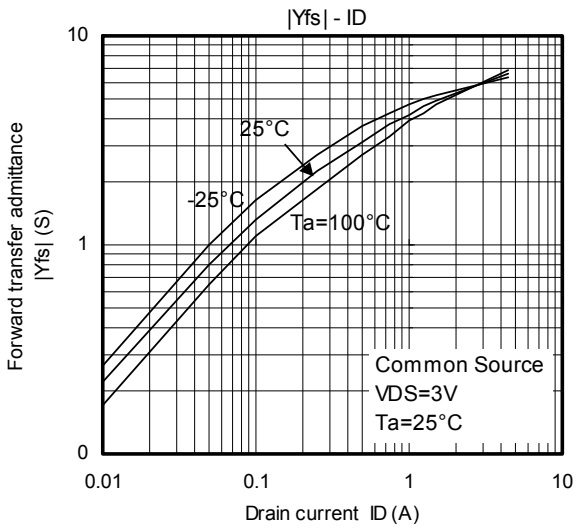

ID - VGS
Drain current ID (A)
Gate-Source voltage VGS (V)
Ta=100°C
25°C
-25°C
Common Source
VDS=3V

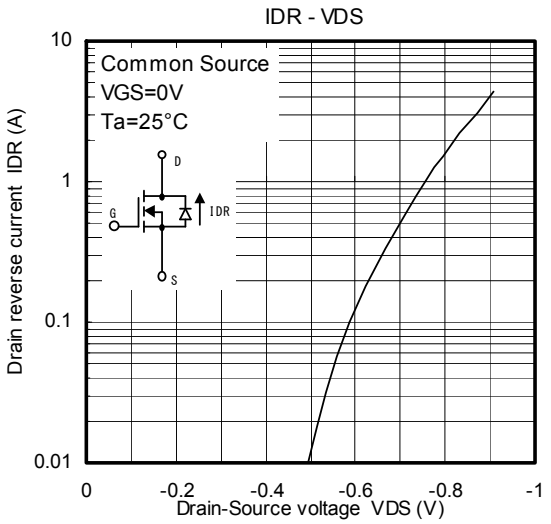

RDS(ON) - ID
Drain-Source on-resistance RDS(ON) (mΩ)
Drain current ID (A)
Common Source
Ta=25°C
2.5V
VGS=4.5V

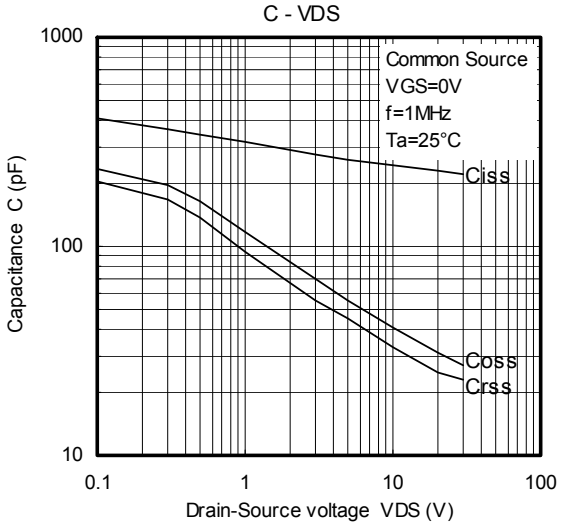

RDS(ON) - VGS
Drain-Source on-resistance RDS(ON) (mΩ)
Gate-Source voltage VGS (V)
Common Source
ID=0.5A
25°C
Ta=100°C
-25°C

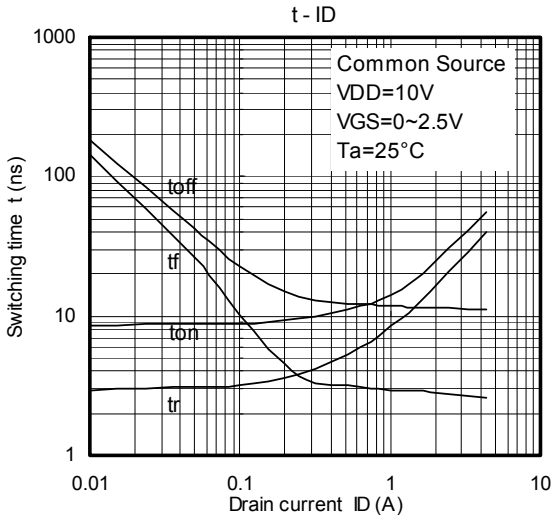

RDS(ON) - Ta
Drain-Source on-resistance RDS(ON) (mΩ)
Ambient temperature Ta (°C)
Common Source
2.5V,0.25A
VGS=4.5V,ID=0.5A

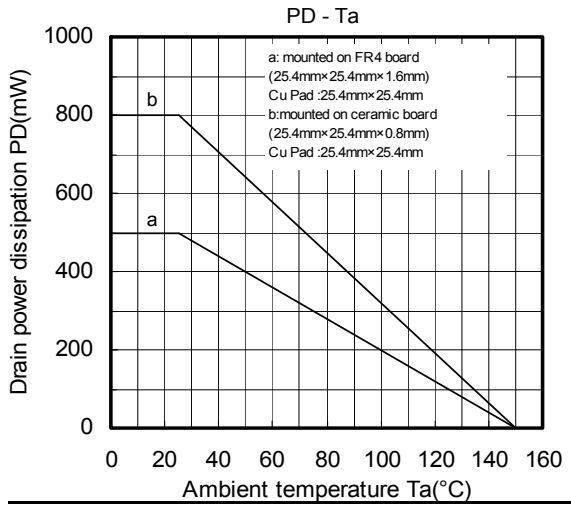

Vth - Ta
Gate threshold voltage Vth(V)
Ambient temperature Ta (°C)
Common Source
ID=0.1mA
VDS=3V

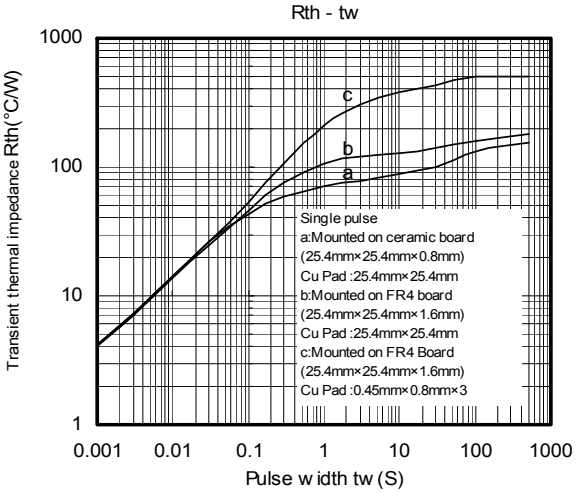

|Yfs| - ID
Forward transfer admittance |Yfs| (S)
Drain current ID (A)
25°C
-25°C
Ta=100°C
Common Source
VDS=3V
Ta=25°C
10
1
0
0.01
0.1
1
10


IDR - VDS
Drain reverse current IDR (A)
Drain-Source voltage VDS (V)
Common Source
VGS=0V
Ta=25°C
D
G
S
IDR
10
1
0.1
0.01
0
-0.2
-0.4
-0.6
-0.8
-1


C - VDS
Capacitance C (pF)
Drain-Source voltage VDS (V)
Common Source
VGS=0V
f=1MHz
Ta=25°C
Ciss
Coss
Crss
1000
100
10
0.1
1
10
100


t - ID
Switching time t (ns)
Drain current ID (A)
Common Source
VDD=10V
VGS=0~2.5V
Ta=25°C
toff
tf
ton
tr
1000
100
10
1
0.01
0.1
1
10


PD - Ta
Drain power dissipation PD(mW)
Ambient temperature Ta(°C)
a: mounted on FR4 board
(25.4mm×25.4mm×1.6mm)
Cu Pad :25.4mm×25.4mm
b:mounted on ceramic board
(25.4mm×25.4mm×0.8mm)
Cu Pad :25.4mm×25.4mm
b
a
1000
800
600
400
200
0
0
20
40
60
80
100
120
140
160


Rth - tw
Transient thermal impedance Rth(°C/W)
Pulse width tw (S)
Single pulse
a:Mounted on ceramic board
(25.4mm×25.4mm×0.8mm)
Cu Pad :25.4mm×25.4mm
b:Mounted on FR4 board
(25.4mm×25.4mm×1.6mm)
Cu Pad :25.4mm×25.4mm
c:Mounted on FR4 Board
(25.4mm×25.4mm×1.6mm)
Cu Pad :0.45mm×0.8mm×3
c
b
a
1000
100
10
1
0.001
0.01
0.1
1
10
100
1000

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