TOSHIBA Field Effect Transistor Silicon N-Channel MOS Type

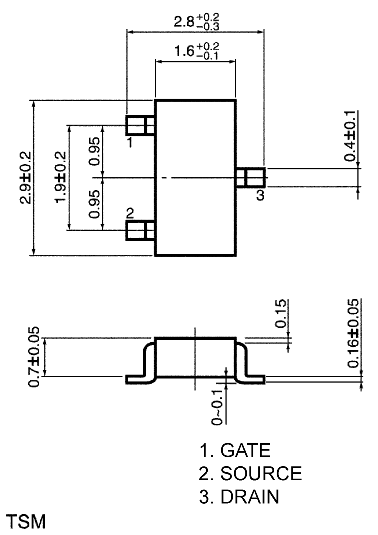
SSM3K301T

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



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)

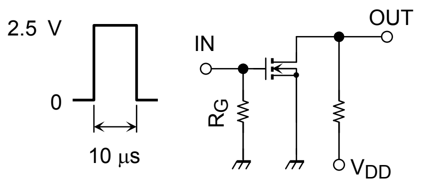
Characteristics		Symbol	Test Condition	Min	Typ.	Max	Unit
Drain-Source breakdown voltage		$V_{(BR)DSS}$	I_D = 1 mA, V_{GS} = 0	20	―	―	V
		$V_{(BR)DSX}$	I_D = 1 mA, V_{GS} = −12 V	12	―	―	
Drain cutoff current		I_{DSS}	V_{DS} = 20 V, V_{GS} = 0	―	―	1	μA
Gate leakage current		I_{GSS}	V_{GS} = ±12 V, V_{DS} = 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

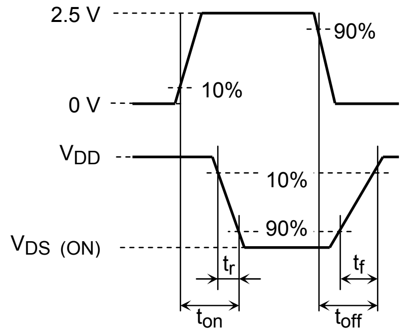
(a) Test Circuit



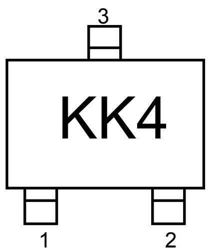
V_{DD} = 10 V
R_G = 4.7 Ω
Duty ≤ 1%
V_{IN}: t_r, t_f < 5 ns
Common Source
Ta = 25°C

(b) V_{IN}

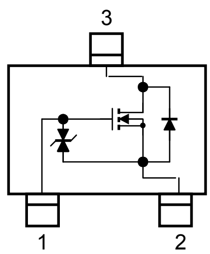
(c) V_{OUT}



Marking



Equivalent Circuit (top view)



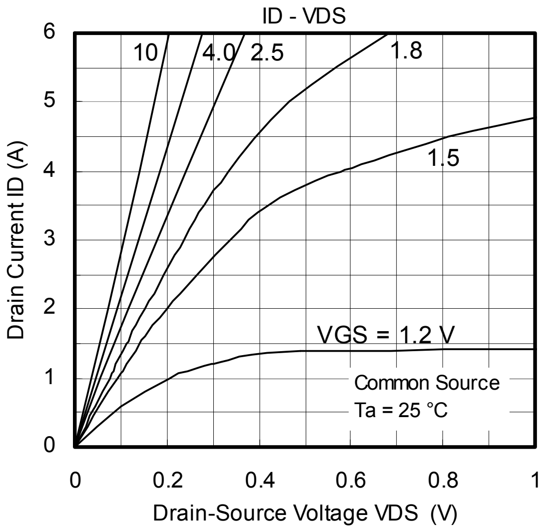
Notice on Usage

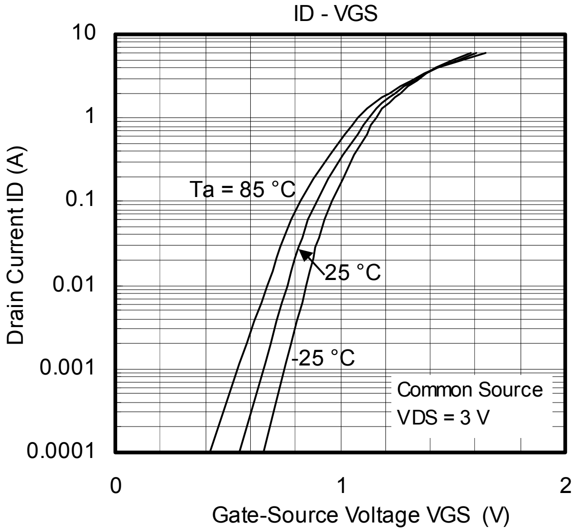
V_{th} can be expressed as the voltage between gate and source when the low operating current value is I_D = 1 mA for this product. For normal switching operation, $V_{GS\ (on)}$ requires a higher voltage than V_{th}, and $V_{GS\ (off)}$ requires a lower voltage than V_{th}. (The relationship can be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

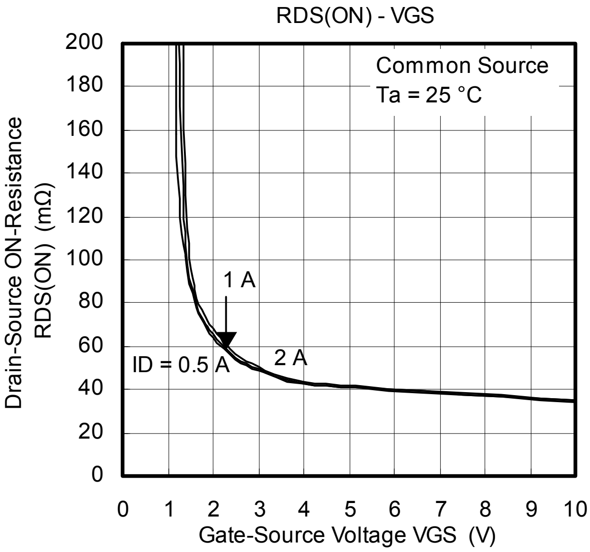
Take this into consideration when using the device.

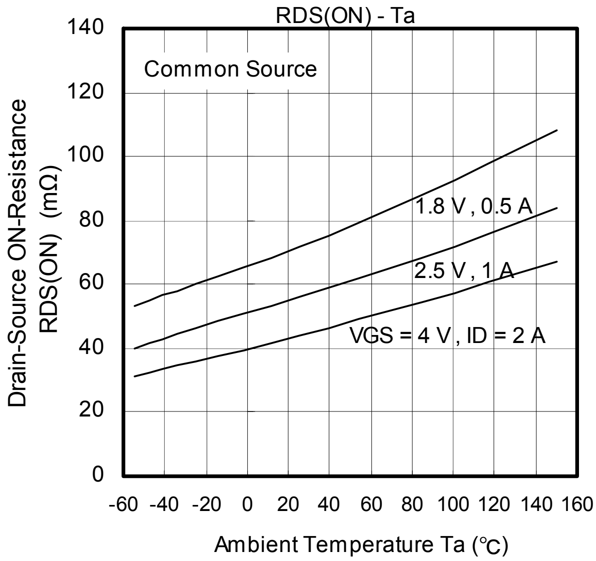
Handling Precaution

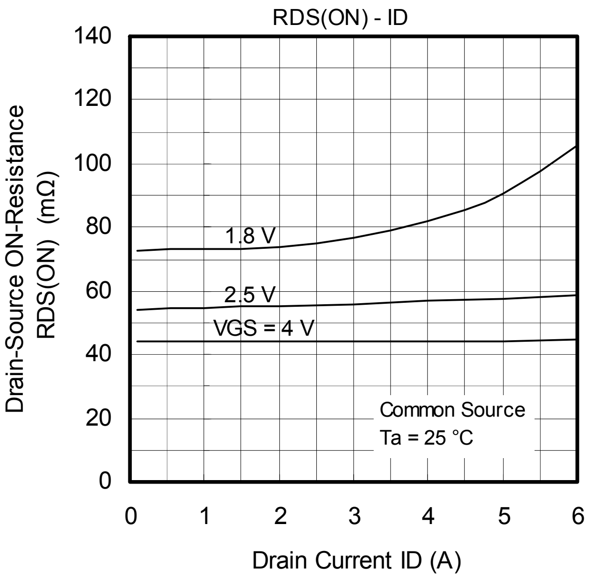
When handling individual devices that are not yet mounted on a circuit board, make sure that the environment is protected against electrostatic discharge. Operators should wear antistatic clothing, and containers and other objects that come into direct contact with devices should be made of antistatic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

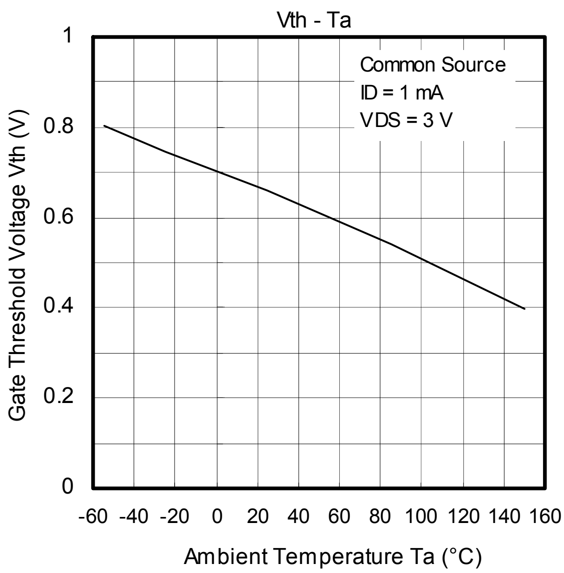

ID - VDS
Drain Current ID (A)
Drain-Source Voltage VDS (V)
10
4.0
2.5
1.8
1.5
VGS = 1.2 V
Common Source
Ta = 25 °C

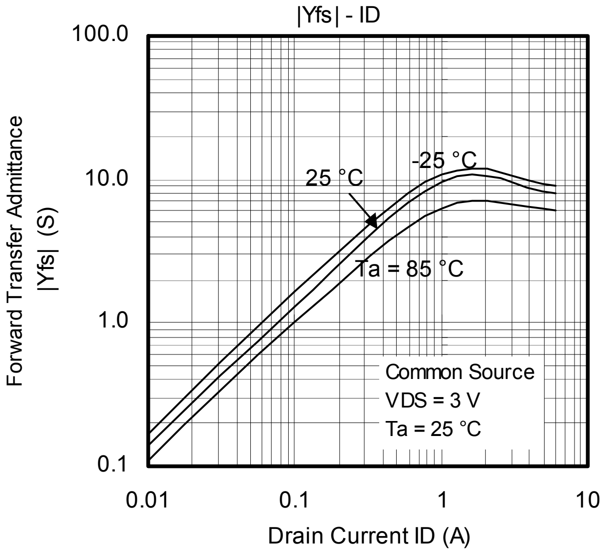

ID - VGS
Drain Current ID (A)
Gate-Source Voltage VGS (V)
Ta = 85 °C
25 °C
-25 °C
Common Source
VDS = 3 V

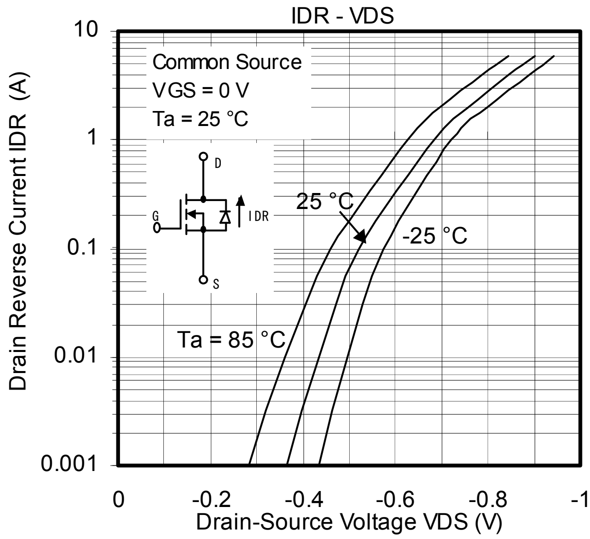

RDS(ON) - VGS
Drain-Source ON-Resistance RDS(ON) (mΩ)
Gate-Source Voltage VGS (V)
Common Source
Ta = 25 °C
1 A
ID = 0.5 A
2 A

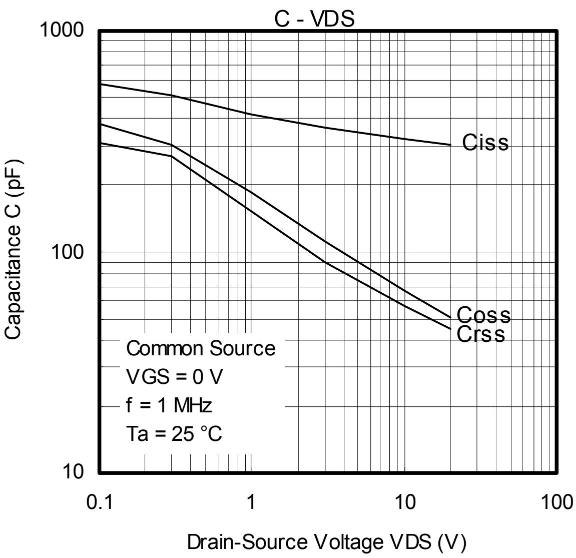

RDS(ON) - Ta
Drain-Source ON-Resistance RDS(ON) (mΩ)
Ambient Temperature Ta (°C)
Common Source
1.8 V , 0.5 A
2.5 V , 1 A
VGS = 4 V , ID = 2 A

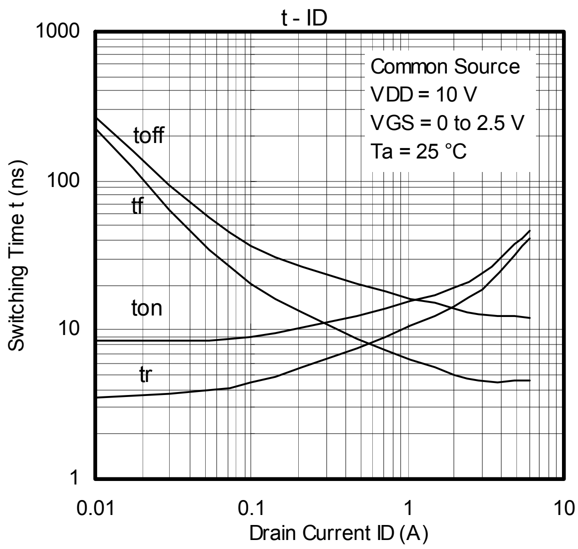

RDS(ON) - ID
Drain-Source ON-Resistance RDS(ON) (mΩ)
Drain Current ID (A)
1.8 V
2.5 V
VGS = 4 V
Common Source
Ta = 25 °C

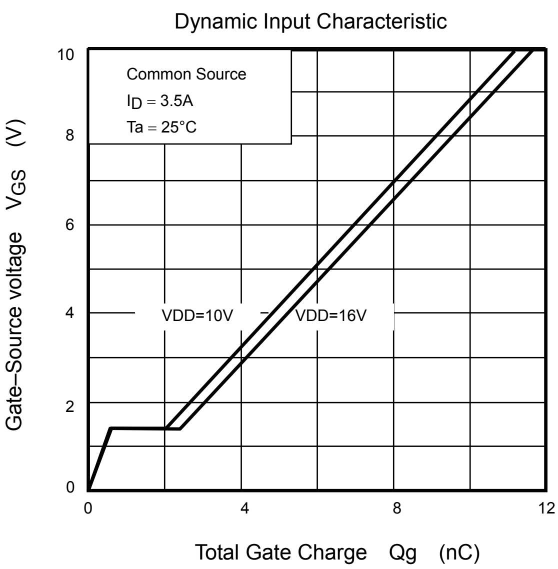

Vth - Ta
Gate Threshold Voltage Vth (V)
Ambient Temperature Ta (°C)
Common Source
ID = 1 mA
VDS = 3 V

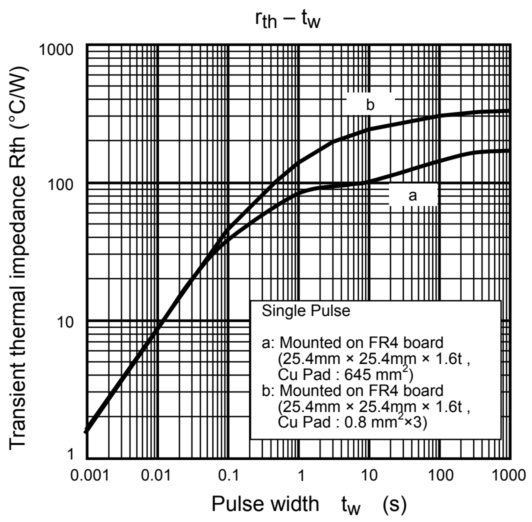

|Yfs| - ID
Forward Transfer Admittance |Yfs| (S)
Drain Current ID (A)
25 °C
-25 °C
Ta = 85 °C
Common Source
VDS = 3 V
Ta = 25 °C
100.0
10.0
1.0
0.1
0.01
0.1
1
10


IDR - VDS
Drain Reverse Current IDR (A)
Drain-Source Voltage VDS (V)
Common Source
VGS = 0 V
Ta = 25 °C
D
G
S
IDR
25 °C
-25 °C
Ta = 85 °C
10
1
0.1
0.01
0.001
0
-0.2
-0.4
-0.6
-0.8
-1

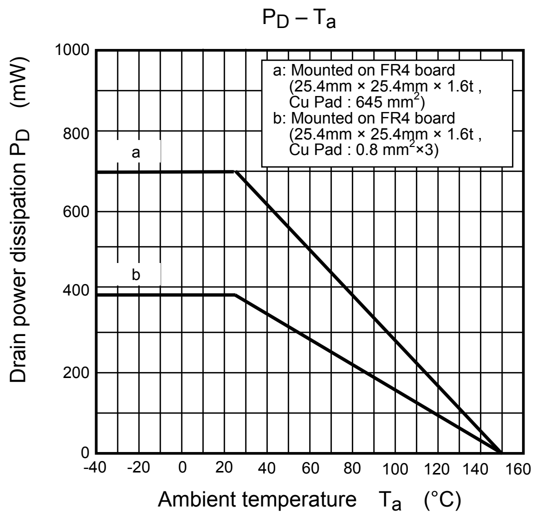

C - VDS
Capacitance C (pF)
Drain-Source Voltage VDS (V)
Ciss
Coss
Crss
Common Source
VGS = 0 V
f = 1 MHz
Ta = 25 °C
1000
100
10
0.1
1
10
100


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


Dynamic Input Characteristic
Gate–Source voltage VGS (V)
Total Gate Charge Qg (nC)
Common Source
ID = 3.5A
Ta = 25°C
VDD=10V
VDD=16V
10
8
6
4
2
0
0
4
8
12



r_{th} – t_w
Transient thermal impedance Rth (°C/W)
Pulse width t_w (s)
1000
100
10
1
0.001
0.01
0.1
1
10
100
1000
a
b
Single Pulse
a: Mounted on FR4 board
(25.4mm × 25.4mm × 1.6t ,
Cu Pad : 645 mm²)
b: Mounted on FR4 board
(25.4mm × 25.4mm × 1.6t ,
Cu Pad : 0.8 mm²×3)



P_D – T_a
Drain power dissipation P_D (mW)
Ambient temperature T_a (°C)
1000
800
600
400
200
0
-40
-20
0
20
40
60
80
100
120
140
160
a
b
a: Mounted on FR4 board
(25.4mm × 25.4mm × 1.6t ,
Cu Pad : 645 mm²)
b: Mounted on FR4 board
(25.4mm × 25.4mm × 1.6t ,
Cu Pad : 0.8 mm²×3)

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