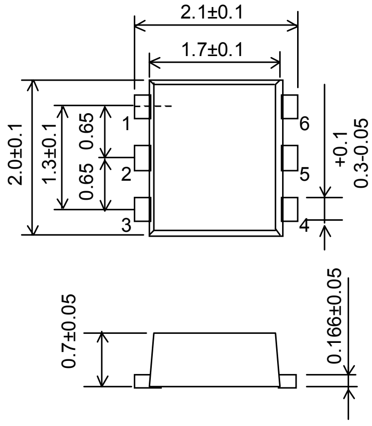
TOSHIBA Field-Effect Transistor Silicon P Channel MOS Type

SSM6P39TU

○ Power Management Switch Applications
○ High-Speed Switching Applications

- 1.8 V drive
- P-ch 2-in-1
- Low ON-resistance: R_{on} = 430mΩ (max) (@V_{GS} = –1.8 V)
  R_{on} = 294mΩ (max) (@V_{GS} = –2.5 V)
  R_{on} = 213mΩ (max) (@V_{GS} = –4.0 V)

Unit: mm



1.Source1 4.Source2
2.Gate1 5.Gate2
3.Drain2 6.Drain1

UF6

JEDEC	―
JEITA	―
TOSHIBA	2-2T1B

Weight: 7.0mg (typ.)

Absolute Maximum Ratings (Ta = 25 °C) (Q1,Q2 Common) (Note)

Characteristic		Symbol	Rating	Unit
Drain-source voltage		V_{DSS}	-20	V
Gate-source voltage		V_{GSS}	± 8	V
Drain current	DC	I_D	-1.5	A
	Pulse	I_{DP}	-3	
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).

Note1: Mounted on an FR4 board. (total dissipation)
(25.4 mm × 25.4 mm × 1.6 mm, Cu Pad : 645 mm^2)

Start of commercial production
2008-01

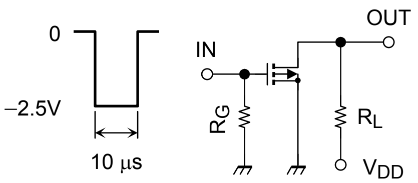
Electrical Characteristics (Ta = 25°C) (Q1,Q2 Common)

Characteristics		Symbol	Test Conditions	Min	Typ.	Max	Unit
Drain-source breakdown voltage		$V_{(BR)\ DSS}$	I_D = -1 mA, V_{GS} = 0 V	-20	—	—	V
		$V_{(BR)\ DSX}$	I_D = -1 mA, V_{GS} = +8 V	-12	—	—	
Drain cutoff current		I_{DSS}	V_{DS} = -20 V, V_{GS} = 0 V	—	—	-10	μA
Gate leakage current		I_{GSS}	V_{GS} = ±8 V, V_{DS} = 0 V	—	—	±1	μA
Gate threshold voltage		V_{th}	V_{DS} = -3 V, I_D = -1 mA	-0.3	—	-1.0	V
Forward transfer admittance		$\|Y_{fs}\|$	V_{DS} = -3 V, I_D = -1 A (Note 2)	1.6	3.2	—	S
Drain-source ON-resistance		$R_{DS\ (ON)}$	I_D = -1.0 A, V_{GS} = -4 V (Note 2)	—	160	213	mΩ
			I_D = -0.8 A, V_{GS} = -2.5 V (Note 2)	—	210	294	
			I_D = -0.1 A, V_{GS} = -1.8 V (Note 2)	—	280	430	
Input capacitance		C_{iss}	V_{DS} = -10 V, V_{GS} = 0 V, f = 1 MHz	—	250	—	pF
Output capacitance		C_{oss}		—	43	—	
Reverse transfer capacitance		C_{rss}		—	35	—	
Total Gate Charge		Q_g	V_{DS} = -10 V, I_D= -1.5 A, V_{GS} = -4 V	—	6.4	—	nC
Gate–Source Charge		Q_{gs}		—	4.5	—	
Gate–Drain Charge		Q_{gd}		—	1.9	—	
Switching time	Turn-on time	t_{on}	V_{DD} = -10 V, I_D = -1 A, V_{GS} = 0 to -2.5 V, R_G = 4.7 Ω	—	12	—	ns
	Turn-off time	t_{off}		—	11.2	—	
Drain-source forward voltage		V_{DSF}	I_D = 1.5 A, V_{GS} = 0 V (Note 2)	—	0.88	1.2	V

Note 2: Pulse test

Switching Time Test Circuit

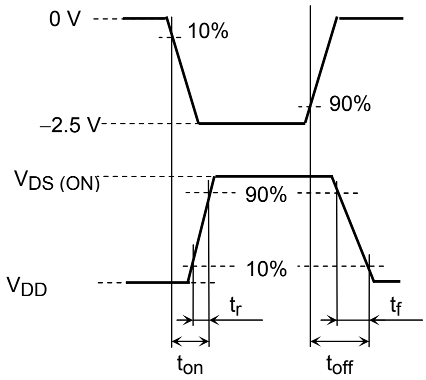
(a) Test Circuit



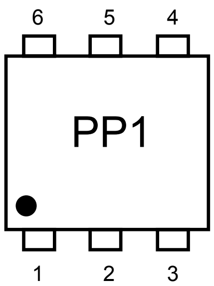
V_{DD} = − 10 V
R_G = 4.7 Ω
Duty ≤ 1%
V_{IN}: t_r, t_f < 5 ns
Common Source
Ta = 25°C

(b) V_{IN}

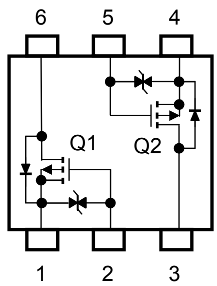
(c) V_{OUT}



Marking



Equivalent Circuit (top view)



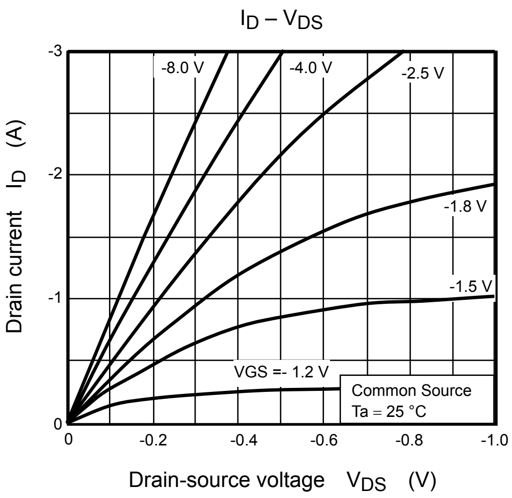
Notice on Usage

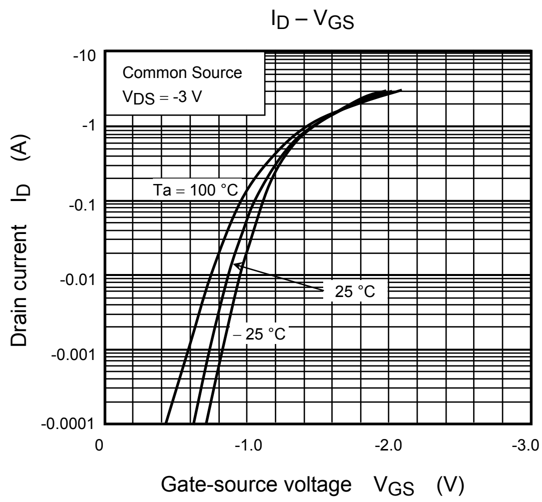
V_{th} can be expressed as the voltage between gate and source when the low operating current value is I_D = -1 mA for this product. For normal switching operation, $V_{GS\ (on)}$ requires a higher voltage than V_{th} and $V_{GS\ (off)}$ requires a lower voltage than V_{th}. (The relationship can be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

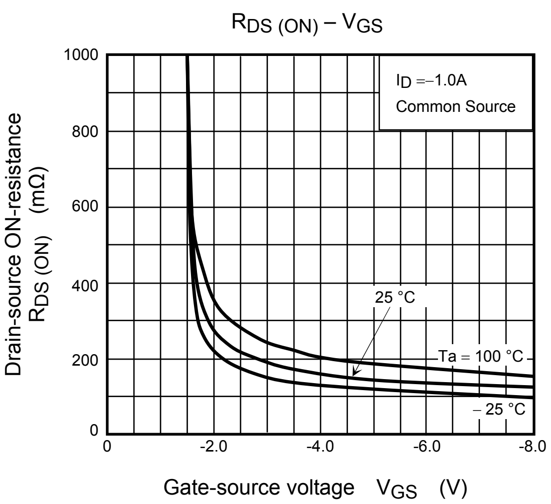
Take this into consideration when using the device.

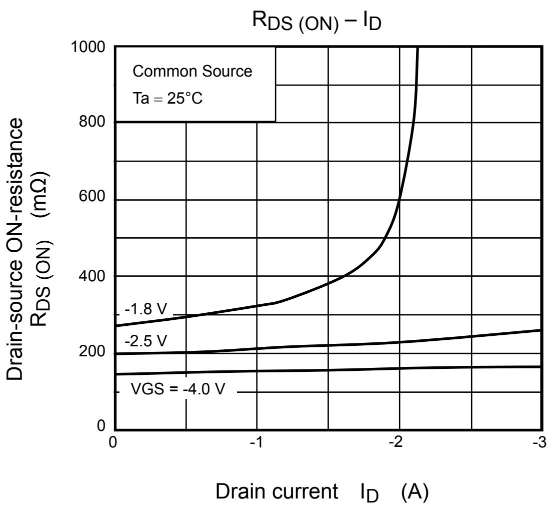
Handling Precaution

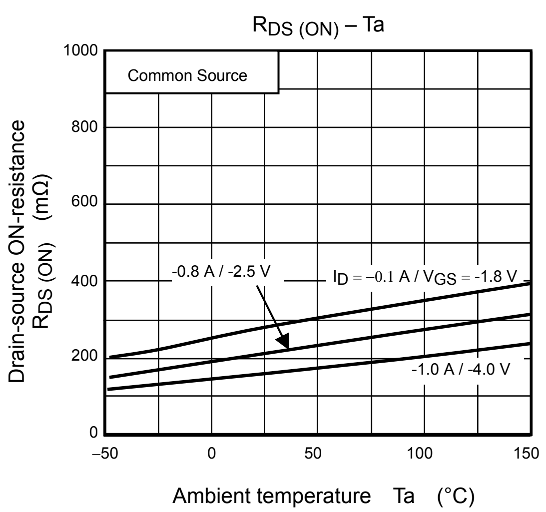
When handling individual devices that are not yet mounted on a circuit board, make sure that the environment is protected against electrostatic discharge. Operators should wear antistatic clothing, and containers and other objects that come into direct contact with devices should be made of antistatic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

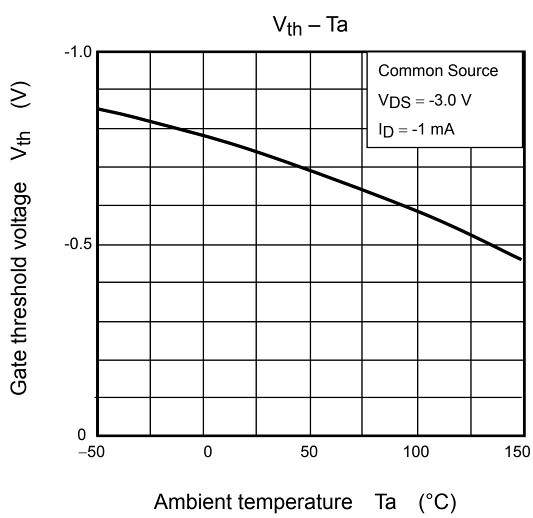

ID – VDS
-8.0 V
-4.0 V
-2.5 V
-1.8 V
-1.5 V
VGS =- 1.2 V
Common Source
Ta = 25 °C
Drain current ID (A)
Drain-source voltage VDS (V)
-3
-2
-1
0
0
-0.2
-0.4
-0.6
-0.8
-1.0


ID – VGS
Common Source
VDS = -3 V
Ta = 100 °C
25 °C
– 25 °C
Drain current ID (A)
Gate-source voltage VGS (V)
-10
-1
-0.1
-0.01
-0.001
-0.0001
0
-1.0
-2.0
-3.0

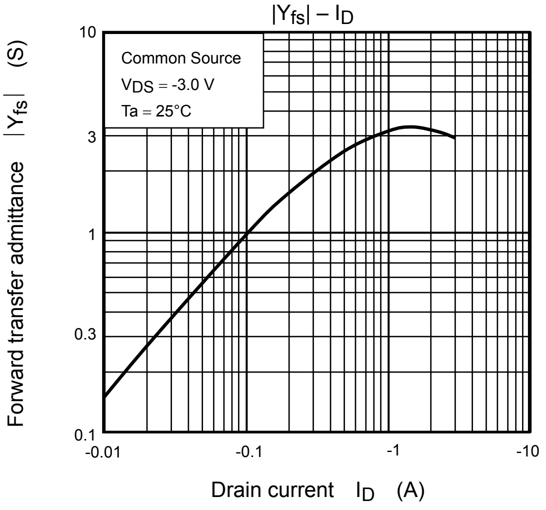

RDS (ON) – VGS
ID =–1.0A
Common Source
25 °C
Ta = 100 °C
– 25 °C
Drain-source ON-resistance RDS (ON) (mΩ)
Gate-source voltage VGS (V)
1000
800
600
400
200
0
0
-2.0
-4.0
-6.0
-8.0


RDS (ON) – ID
Common Source
Ta = 25°C
-1.8 V
-2.5 V
VGS = -4.0 V
Drain-source ON-resistance RDS (ON) (mΩ)
Drain current ID (A)
1000
800
600
400
200
0
0
-1
-2
-3

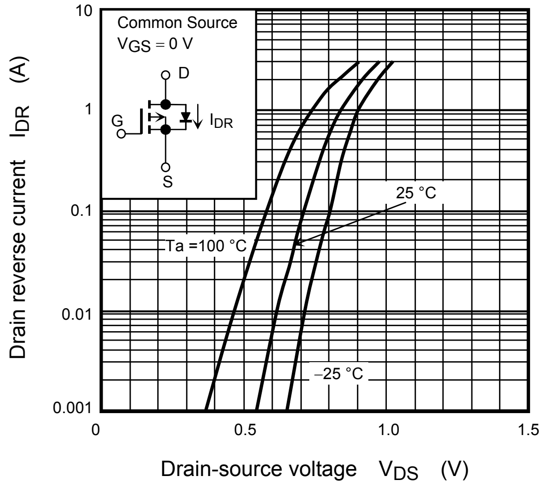

RDS (ON) – Ta
Common Source
-0.8 A / -2.5 V
ID = -0.1 A / VGS = -1.8 V
-1.0 A / -4.0 V
Drain-source ON-resistance RDS (ON) (mΩ)
Ambient temperature Ta (°C)
1000
800
600
400
200
0
–50
0
50
100
150


Vth – Ta
Common Source
VDS = -3.0 V
ID = -1 mA
Gate threshold voltage Vth (V)
Ambient temperature Ta (°C)
-1.0
-0.5
0
–50
0
50
100
150

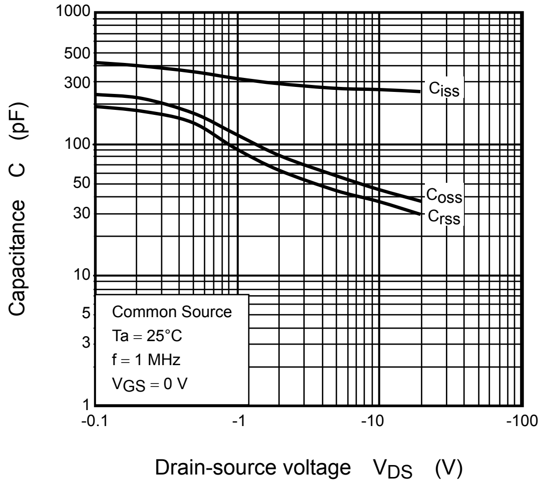
$|Y_{fs}| – I_D$



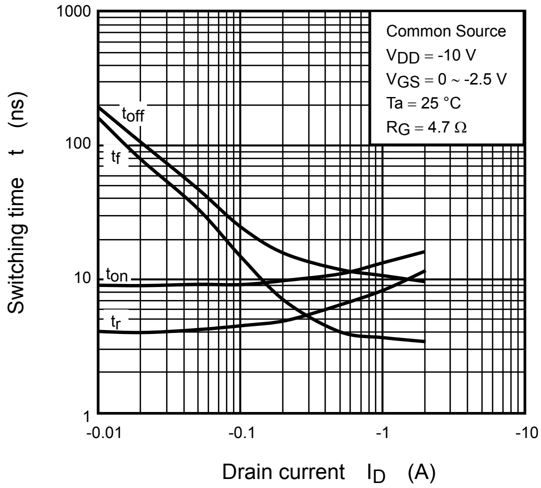
$I_{DR} – V_{DS}$



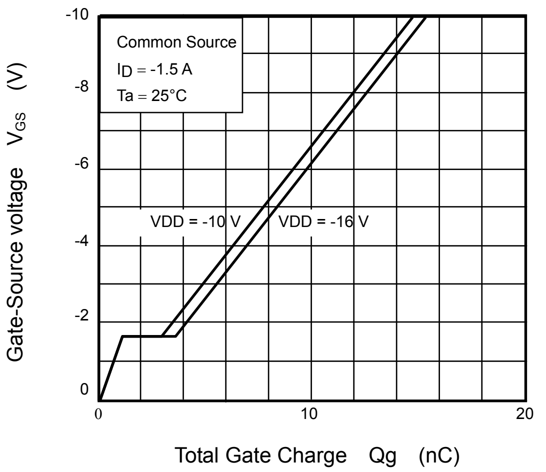
$C – V_{DS}$



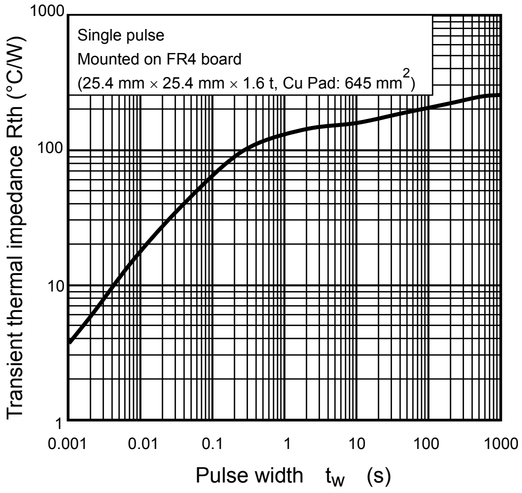
$t – I_D$



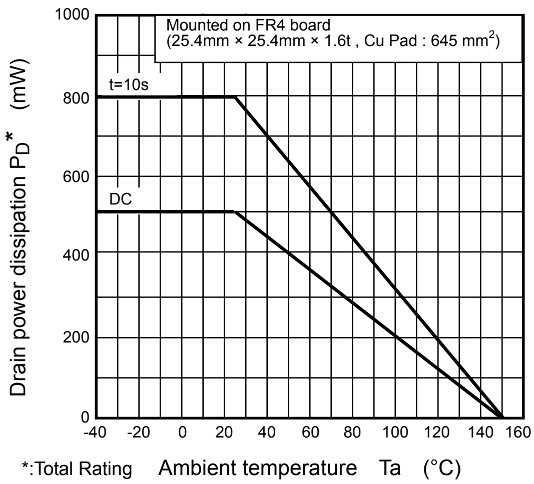
Dynamic Input Characteristic



$r_{th} - t_w$


Single pulse
Mounted on FR4 board
(25.4 mm × 25.4 mm × 1.6 t, Cu Pad: 645 mm2)
Transient thermal impedance Rth (°C/W)
1000
100
10
1
0.001
0.01
0.1
1
10
100
1000
Pulse width tw (s)

$P_D - T_a$


Mounted on FR4 board
(25.4mm × 25.4mm × 1.6t , Cu Pad : 645 mm2)
t=10s
DC
Drain power dissipation PD* (mW)
1000
800
600
400
200
0
-40
-20
0
20
40
60
80
100
120
140
160
*:Total Rating
Ambient temperature Ta (°C)

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