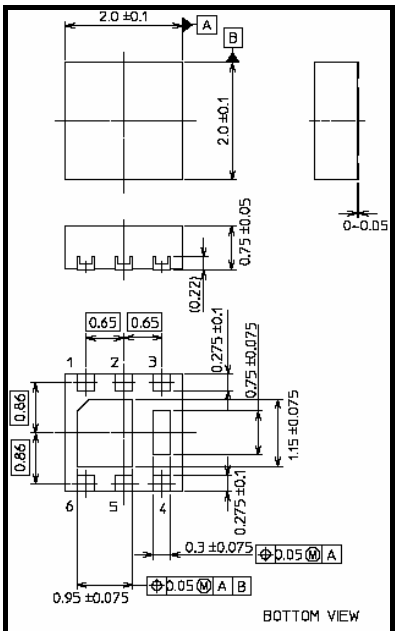
TOSHIBA Field-Effect Transistor Silicon P-Channel MOS Type (U-MOSⅥ)

SSM6J503NU

Power Management Switch Applications

- 1.5V drive
- Low ON-resistance: $R_{DS(ON)}$= 89.6 mΩ (max) (@V_{GS} = -1.5 V)
  $R_{DS(ON)}$ = 57.9 mΩ (max) (@V_{GS} = -1.8 V)
  $R_{DS(ON)}$ = 41.7 mΩ (max) (@V_{GS} = -2.5 V)
  $R_{DS(ON)}$ = 32.4 mΩ (max) (@V_{GS} = -4.5 V)

Unit: mm



UDFN6B	
JEITA	—
TOSHIBA	2-2AA1A

Weight: 8.5 mg (typ.)

Absolute Maximum Ratings (Ta = 25°C)

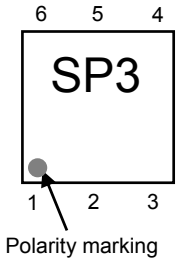
Characteristics		Symbol	Rating	Unit
Drain-Source voltage		V_{DSS}	−20	V
Gate-Source voltage		V_{GSS}	±8	V
Drain current	DC	I_D	−6.0	A
	Pulse	I_{DP} (Note 1)	-24.0	
Power Dissipation		P_D (Note 2)	1	W
		t ≦10s	2	
Channel temperature		T_{ch}	150	°C
Storage temperature		T_{stg}	−55 to 150	°C

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).

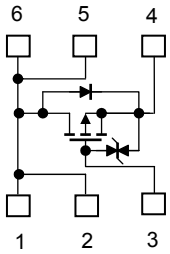
Note 1: The pulse width limited by max channel temperature.

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

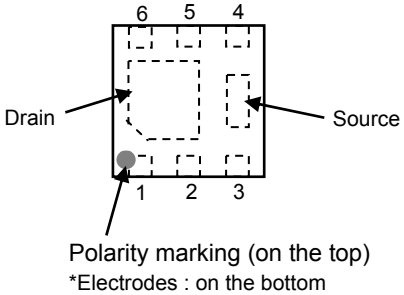
Marking(Top View)



Equivalent Circuit(Top View)



Pin Condition(Top View)



Start of commercial production
2010-11

Electrical Characteristics (Ta = 25°C)

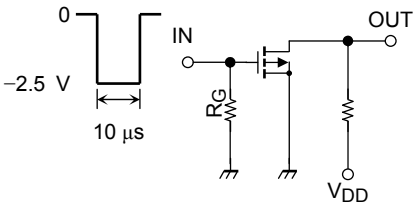
Characteristic		Symbol	Test Conditions	Min	Typ.	Max	Unit
Drain-Source breakdown voltage		$V_{(BR)\ DSS}$	I_D = -1 mA, V_{GS} = 0 V	-20	—	—	V
		$V_{(BR)\ DSX}$	I_D = -1 mA, V_{GS} = 5 V (Note 4)	-15	—	—	
Drain cut-off current		I_{DSS}	V_{DS} = -20 V, V_{GS} = 0 V	—	—	-1	μA
Gate leakage current		I_{GSS}	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 = -1.0 A (Note 3)	4.5	9.1	—	S
Drain–source ON-resistance		$R_{DS\ (ON)}$	I_D = -3.0 A, V_{GS} = -4.5 V (Note 3)	—	27.7	32.4	mΩ
			I_D = -2.5 A, V_{GS} = -2.5 V (Note 3)	—	33.1	41.7	
			I_D = -1.5 A, V_{GS} = -1.8 V (Note 3)	—	40.6	57.9	
			I_D = -0.5 A, V_{GS} = -1.5 V (Note 3)	—	48.6	89.6	
Input capacitance		C_{iss}	V_{DS} = -10 V, V_{GS} = 0 V, f = 1 MHz	—	840	—	pF
Output capacitance		C_{oss}		—	118	—	
Reverse transfer capacitance		C_{rss}		—	99	—	
Total Gate Charge		Q_g	V_{DD} = −10 V, I_D = −4.0 A, V_{GS} = −4.5 V	—	12.8	—	nC
Gate-Source Charge		Q_{gs1}		—	1.4	—	
Gate-Drain Charge		Q_{gd}		—	3.0	—	
Switching time	Turn-on time	t_{on}	V_{DD} = -10 V, I_D = -2.0 A, V_{GS} = 0 to -2.5 V, R_G = 4.7 Ω	—	32	—	ns
	Turn-off time	t_{off}		—	107	—	
Drain-Source forward voltage		V_{DSF}	I_D = 4.0 A, V_{GS} = 0 V (Note 3)	—	0.78	1.2	V

Note 3: Pulse test

Note 4: If a forward bias is applied between gate and source, this device enters V(BR)DSX mode. Note that the drain-source breakdown voltage is lowered in this mode

Switching Time Test Circuit

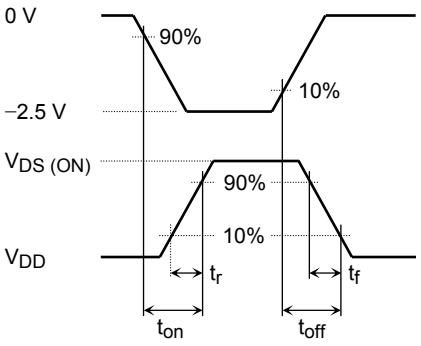
(a) Test circuit



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}



Precaution

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

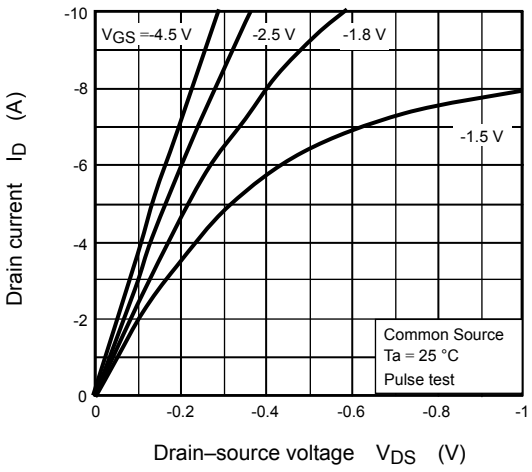
Please take this into consideration for using the device.

Handling Precaution

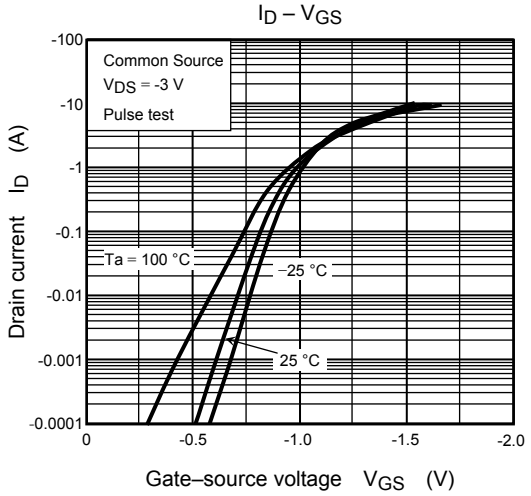
When handling individual devices that are not yet mounted on a circuit board, make sure that the environment is protected against electrostatic discharge. Operators should wear antistatic clothing, and containers and other objects that come into direct contact with devices should be made of antistatic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

Thermal resistance $R_{th\ (ch\text{-}a)}$ and power dissipation P_D vary depending on board material, board area, board thickness and pad area. When using this device, please take heat dissipation into consideration

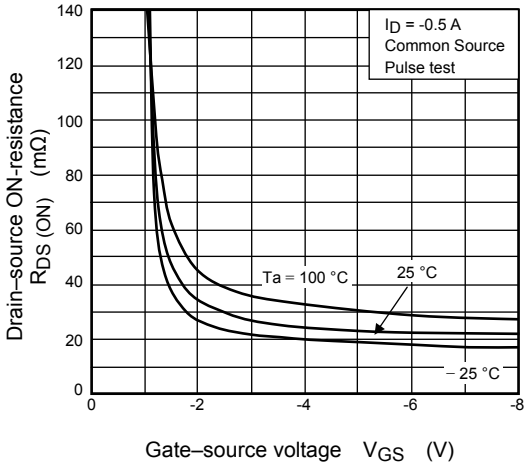
$I_D - V_{DS}$



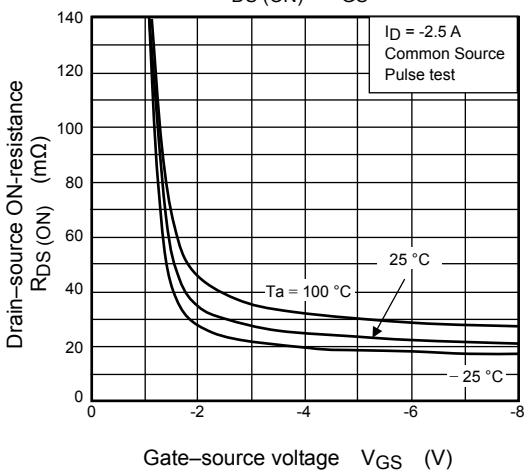
$I_D - V_{GS}$



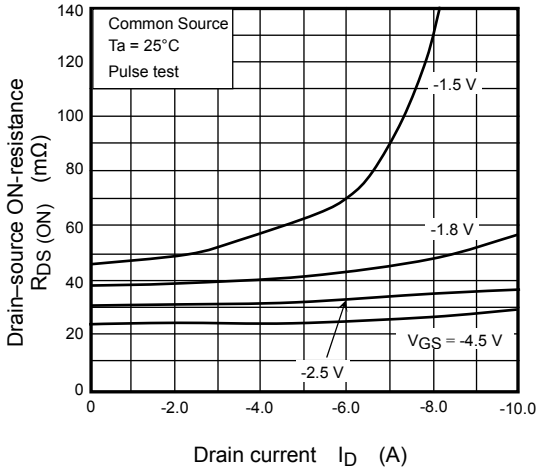
$R_{DS\ (ON)} - V_{GS}$



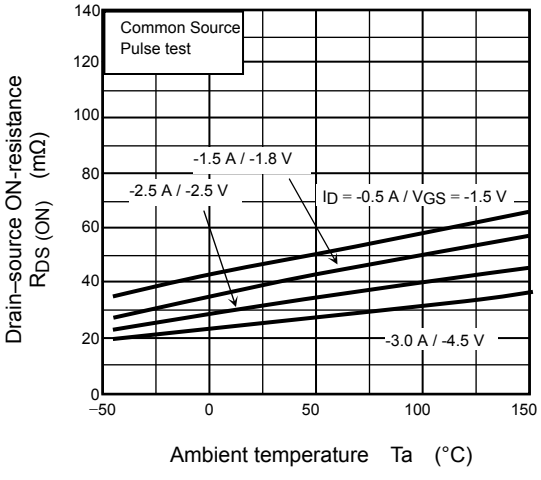
$R_{DS\ (ON)} - V_{GS}$



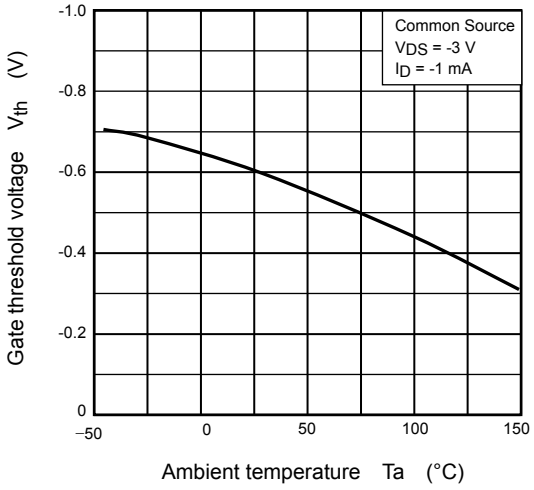
$R_{DS\ (ON)} - I_D$



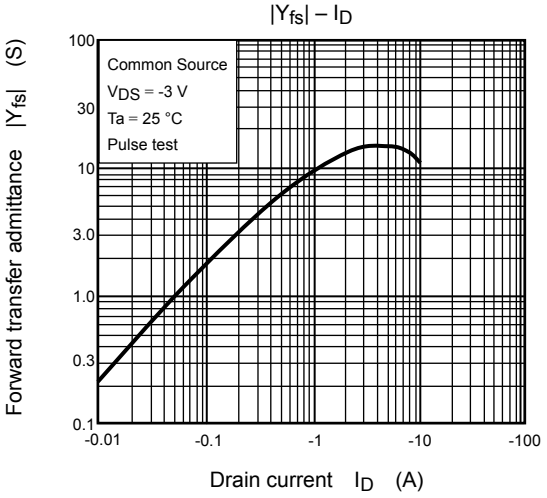
$R_{DS\ (ON)} - Ta$



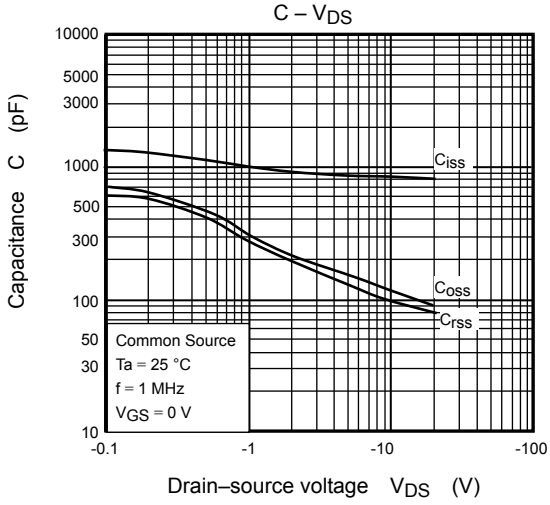
V_{th} – Ta



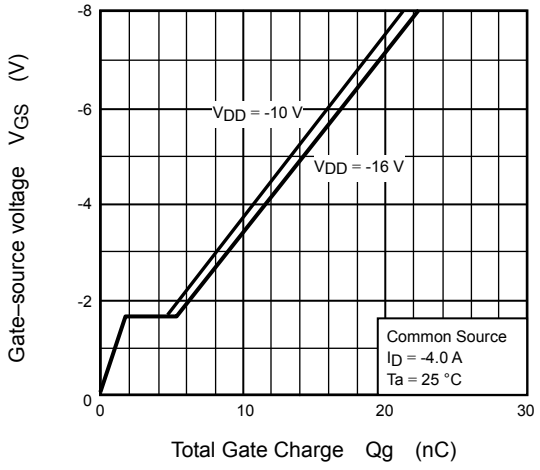
$|Y_{fs}|$ – I_D



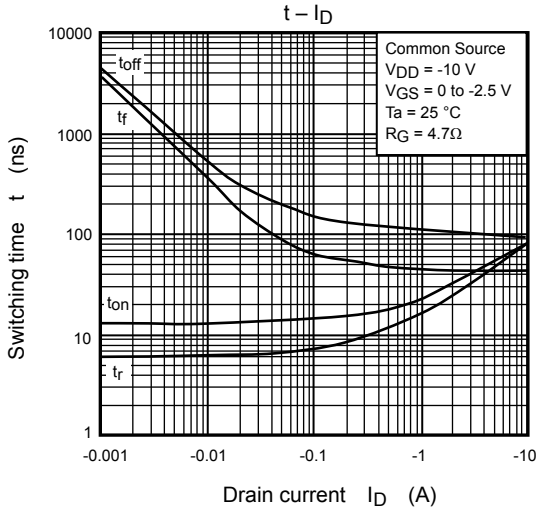
C – V_{DS}



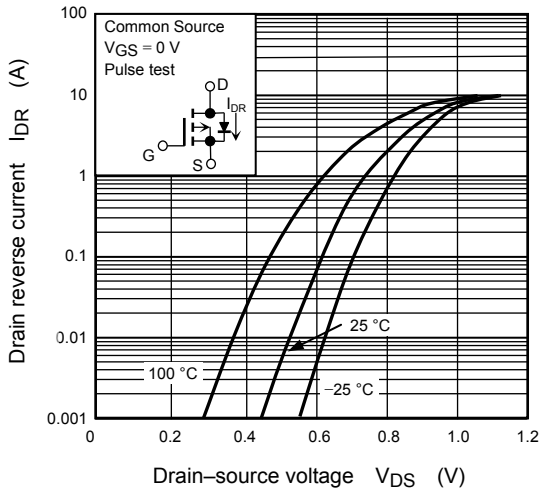
Dynamic Input Characteristic



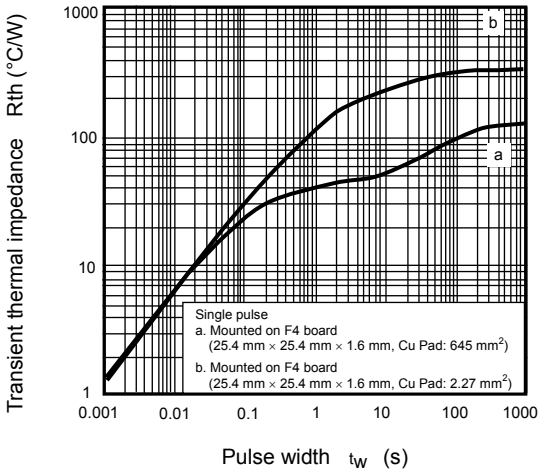
t – I_D



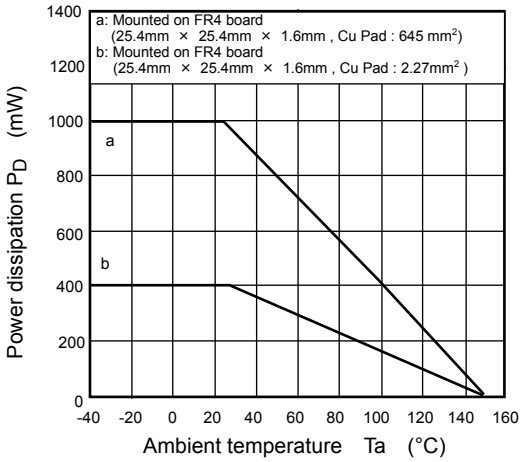
I_{DR} – V_{DS}



R_{th} – t_w


Transient thermal impedance Rth (°C/W)
1000
100
10
1
0.001
0.01
0.1
1
10
100
1000
Pulse width tw (s)
b
a
Single pulse
a. Mounted on F4 board
(25.4 mm × 25.4 mm × 1.6 mm, Cu Pad: 645 mm²)
b. Mounted on F4 board
(25.4 mm × 25.4 mm × 1.6 mm, Cu Pad: 2.27 mm²)

P_D – Ta


Power dissipation PD (mW)
1400
1200
1000
800
600
400
200
0
-40
-20
0
20
40
60
80
100
120
140
160
Ambient temperature Ta (°C)
a: Mounted on FR4 board
(25.4mm × 25.4mm × 1.6mm , Cu Pad : 645 mm²)
b: Mounted on FR4 board
(25.4mm × 25.4mm × 1.6mm , Cu Pad : 2.27mm²)
a
b

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