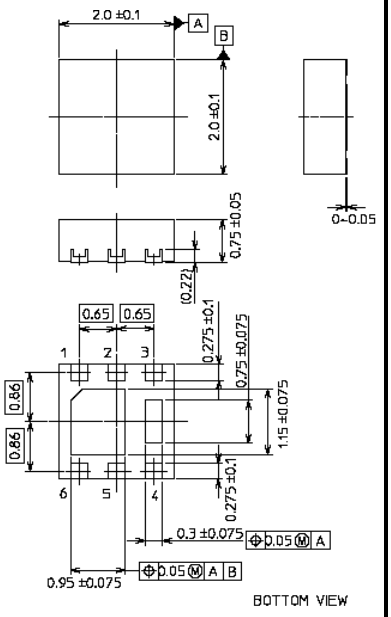
TOSHIBA Field Effect Transistor Silicon N Channel MOS Type(U-MOSⅨ-H)

SSM6K513NU

Power Management Switch Applications

- 4.5V drive
- Low ON-resistance: $R_{DS(ON)}$ = 8.0 mΩ (typ.) (@V_{GS} = 4.5V)
  $R_{DS(ON)}$ = 6.5 mΩ (typ.) (@V_{GS} = 10 V)

Unit: mm



1,2,5,6: Drain
3: Gate
4: Source

UDFN6B	
JEDEC	―
JEITA	―
TOSHIBA	2-2AA1A

Weight: 8.5 mg (typ.)

Absolute Maximum Ratings (Ta = 25°C)

Characteristics		Symbol	Rating	Unit
Drain-Source voltage		V_{DSS}	30	V
Gate-Source voltage		V_{GSS}	±20	V
Drain current	DC	I_D	15	A
	Pulse	I_{DP} (Note 2)	50	
Power dissipation		P_D(Note 3)	1.25	W
		t≦10s	2.5	
Single-pulse avalanche energy		E_{AS} (Note 4)	17.9	mJ
Avalanche current		I_{AR}	15	A
Channel temperature		T_{ch}	150	°C
Storage temperature		T_{stg}	−55 to 150	°C

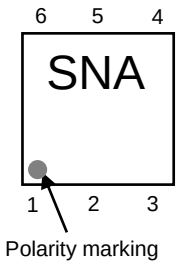
Note: Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) 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 2: PW≦10us,Duty≦1%

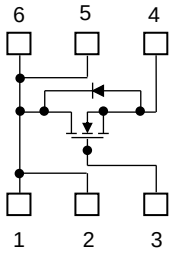
Note 3: Mounted on a FR4 board.
(25.4 mm × 25.4 mm × 1.6 mm, Cu Pad: 645 mm^2)

Note 4: VDD = 24 V, Tch = 25°C (Initial state), L = 50 μH, RG = 25Ω,

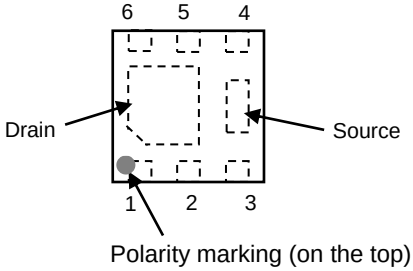
Marking(Top View)



Equivalent Circuit(Top View)



Pin Condition(Top View)



Electrical Characteristics (Ta = 25°C)

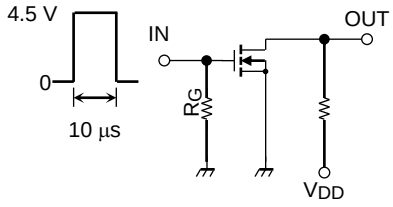
Characteristic		Symbol	Test Conditions	Min	Typ.	Max	Unit
Drain-Source breakdown voltage		$V_{(BR)\ DSS}$	I_D = 10 mA, V_{GS} = 0 V	30	—	—	V
		$V_{(BR)\ DSX}$	I_D = 10 mA, V_{GS} = -20 V (Note 5)	27	—	—	
Drain cut-off current		I_{DSS}	V_{DS} = 30 V, V_{GS} = 0 V	—	—	1	μA
Gate leakage current		I_{GSS}	V_{GS} = ±20 V, V_{DS} = 0 V	—	—	±100	nA
Gate threshold voltage		V_{th}	V_{DS} = 10 V, I_D = 0.1 mA	1.1	—	2.1	V
Forward transfer admittance		$\|Y_{fs}\|$	V_{DS} = 10 V, I_D = 2.0 A (Note 6)	—	6.8	—	S
Drain–source ON-resistance		$R_{DS\ (ON)}$	I_D = 4 A, V_{GS} = 10 V (Note 6)	—	6.5	8.9	mΩ
			I_D = 4 A, V_{GS} = 4.5 V (Note 6)	—	8.0	12	
Input capacitance		C_{iss}	V_{DS} = 15 V, V_{GS} = 0 V, f = 1 MHz	—	1130	—	pF
Output capacitance		C_{oss}		—	350	—	
Reverse transfer capacitance		C_{rss}		—	52	—	
Total Gate Charge		Q_g	V_{DD} = 15 V, I_D = 15 A, V_{GS} = 4.5 V	—	7.5	—	nC
Gate-Source Charge1		Q_{gs1}		—	3.0	—	
Gate-Drain Charge		Q_{gd}		—	2.2	—	
Switching time	Turn-on time	t_{on}	V_{DD} = 15 V, I_D = 1.0 A, V_{GS} = 0 to 4.5 V, R_G = 30 Ω	—	28	—	ns
	Turn-off time	t_{off}		—	33	—	
Drain-Source forward voltage		V_{DSF}	I_D = −4.0 A, V_{GS} = 0 V (Note 3)	—	-0.76	-1.2	V

Note 5: If a reverse 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

Note 6: Pulse test

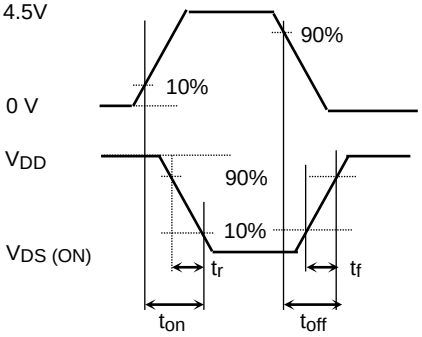
Switching Time Test Circuit

(a)



V_{DD} = 15V
R_G = 30Ω
Duty ≤ 1%
V_{IN}: t_r, t_f < 5 ns
Common Source
Ta = 25°C

(b)



(c)

Precaution

Let V_{th} be the voltage applied between gate and source that causes the drain current (I_D) to be low (0.1 mA for the SSM6K513NU). Then, for normal switching operation, $V_{GS(on)}$ must be higher than V_{th}, and $V_{GS(off)}$ must be lower than V_{th}. This relationship can be expressed as: $V_{GS(off)} < V_{th} < V_{GS(on)}$.

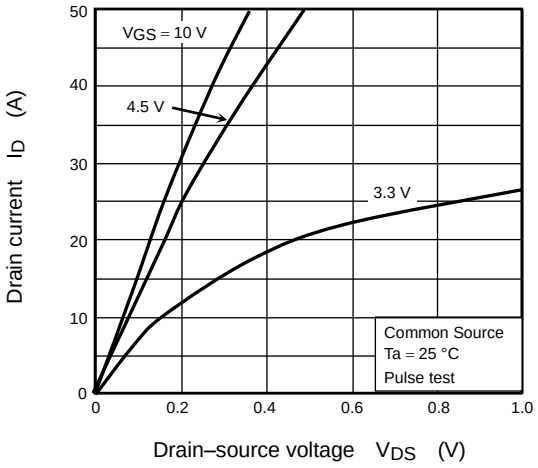
Take this into consideration when using the device.

Handling Precaution

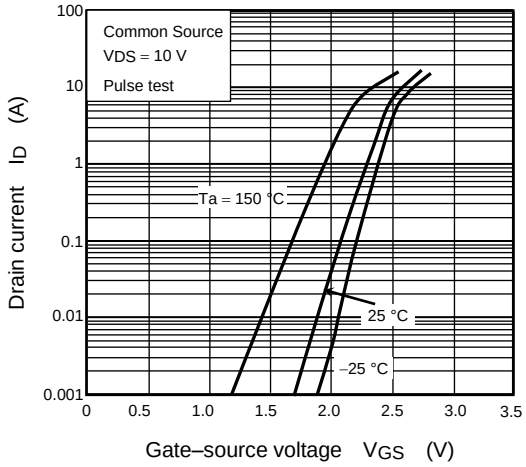
When handling individual devices that are not yet mounted on a circuit board, make sure that the environment is protected against electrostatic discharge. Operators should wear antistatic clothing, and containers and other objects that come into direct contact with devices should be made of antistatic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

Thermal resistance $R_{th\ (ch-a)}$ 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

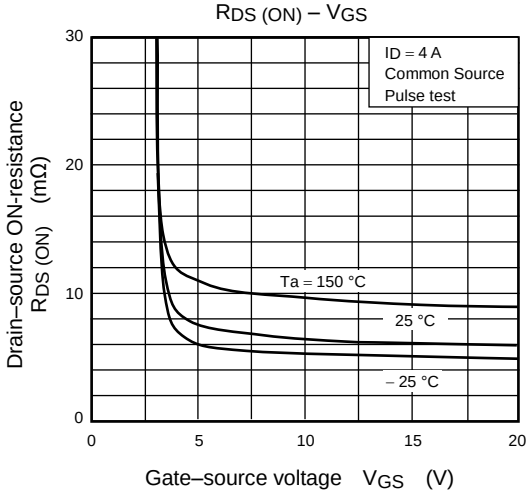
I_D – V_{DS}



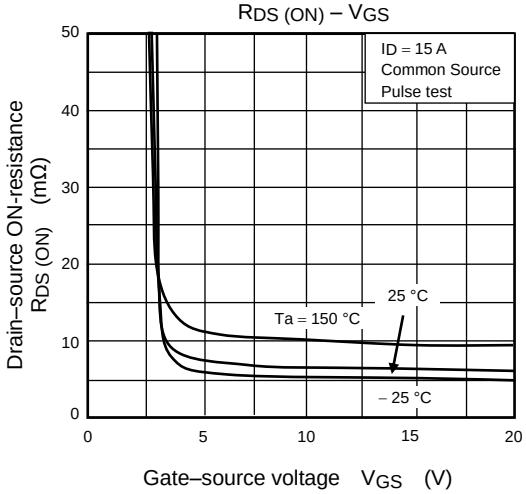
I_D – V_{GS}



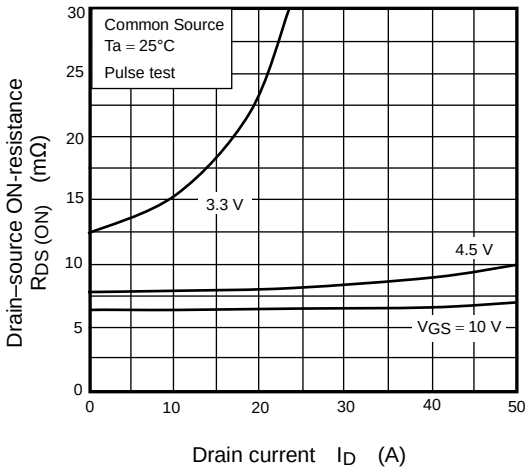
$R_{DS\ (ON)}$ – V_{GS}



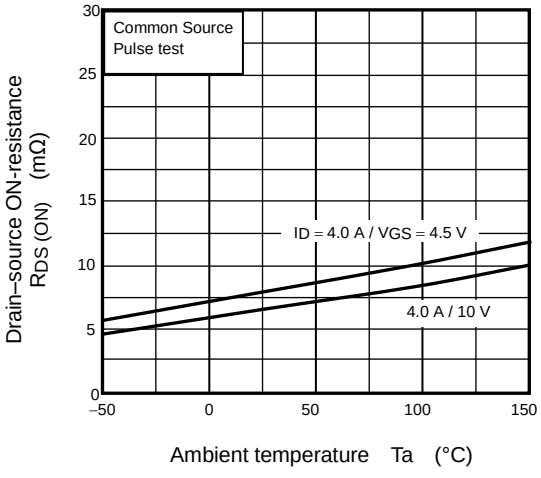
$R_{DS\ (ON)}$ – V_{GS}



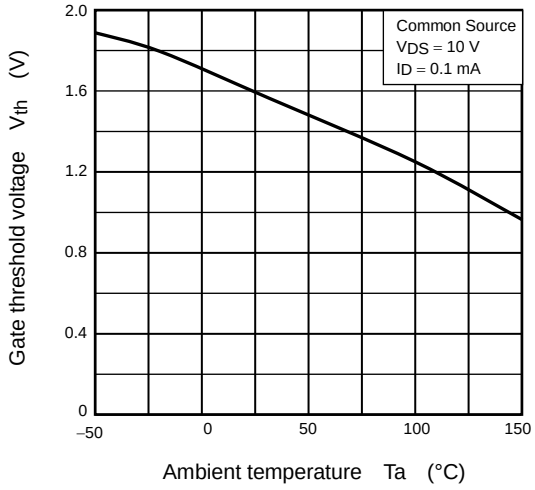
$R_{DS\ (ON)}$ – I_D



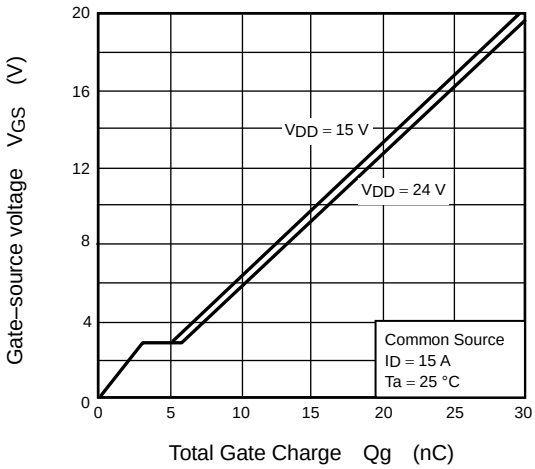
$R_{DS\ (ON)}$ – Ta



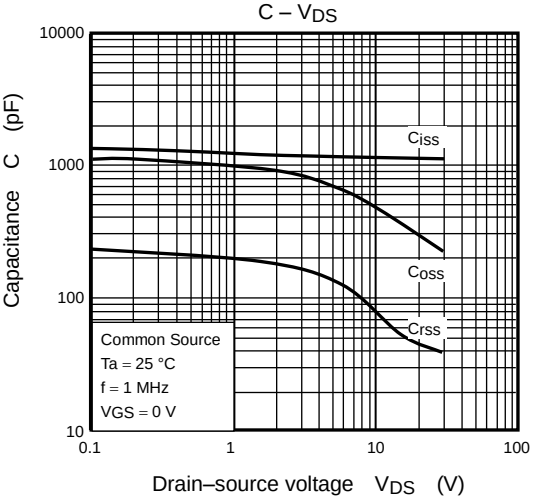
V_{th} – Ta



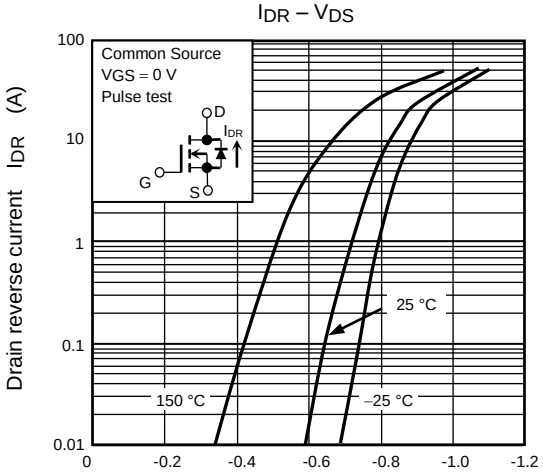
Dynamic Input Characteristic



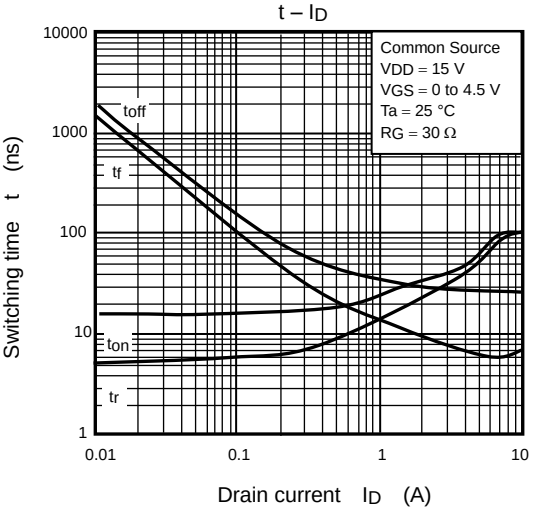
C – V_{DS}



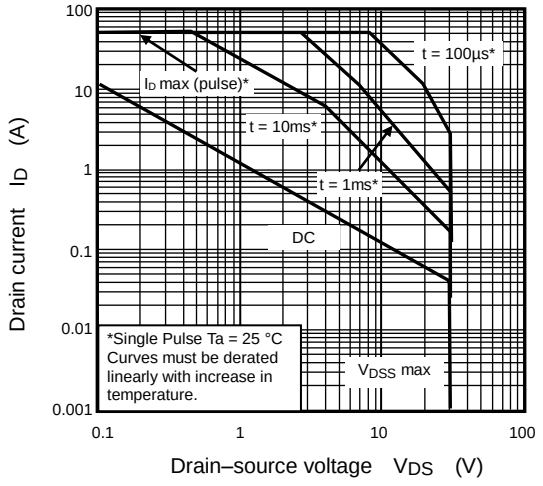
I_{DR} – V_{DS}



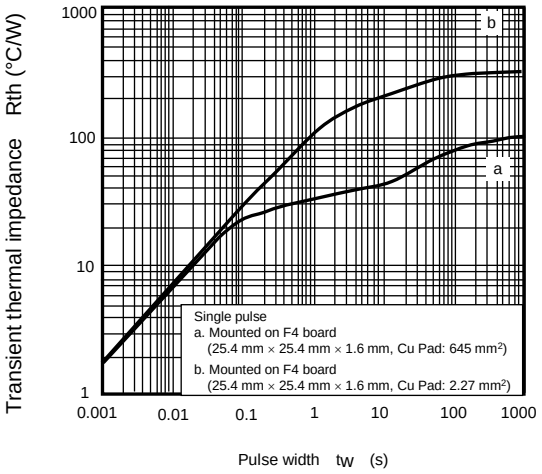
t – I_D



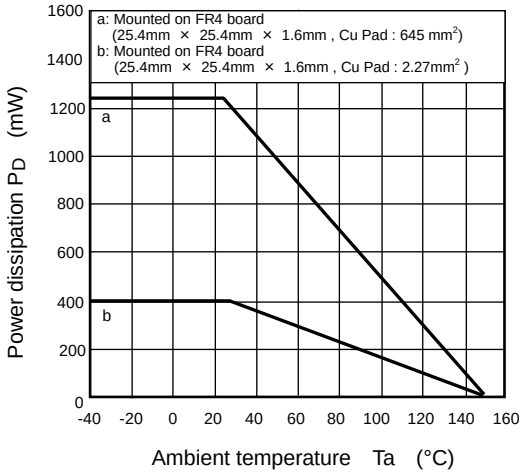
Safe Operating Area



r_{th} – t_w


Transient thermal impedance Rth (°C/W)
1000
100
10
1
0.001
0.01
0.1
1
10
100
1000
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)
Pulse width tw (s)

P_D – Ta


Power dissipation PD (mW)
1600
1400
1200
1000
800
600
400
200
0
-40
-20
0
20
40
60
80
100
120
140
160
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
Ambient temperature Ta (°C)

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