

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

## SSM6J213FE

### ○ Power Management Switch Applications

- 1.5-V drive
- Low ON-resistance:  $R_{DS(ON)} = 250 \text{ m}\Omega$  (max) (@ $V_{GS} = -1.5 \text{ V}$ )  
 $R_{DS(ON)} = 178 \text{ m}\Omega$  (max) (@ $V_{GS} = -1.8 \text{ V}$ )  
 $R_{DS(ON)} = 133 \text{ m}\Omega$  (max) (@ $V_{GS} = -2.5 \text{ V}$ )  
 $R_{DS(ON)} = 103 \text{ m}\Omega$  (max) (@ $V_{GS} = -4.5 \text{ V}$ )

### Absolute Maximum Ratings ( $T_a = 25^\circ\text{C}$ )

Characteristic	Symbol	Rating	Unit
Drain-source voltage	$V_{DS}$	-20	V
Gate-source voltage	$V_{GS}$	$\pm 8$	V
Drain current	DC	$I_D$ (Note 1)	A
	Pulse	$I_{DP}$ (Note 1)	
Power dissipation	$P_D$ (Note 2)	500	mW
	$t = 10\text{s}$	700	
Channel temperature	$T_{ch}$	150	$^\circ\text{C}$
Storage temperature range	$T_{stg}$	-55 to 150	$^\circ\text{C}$

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.

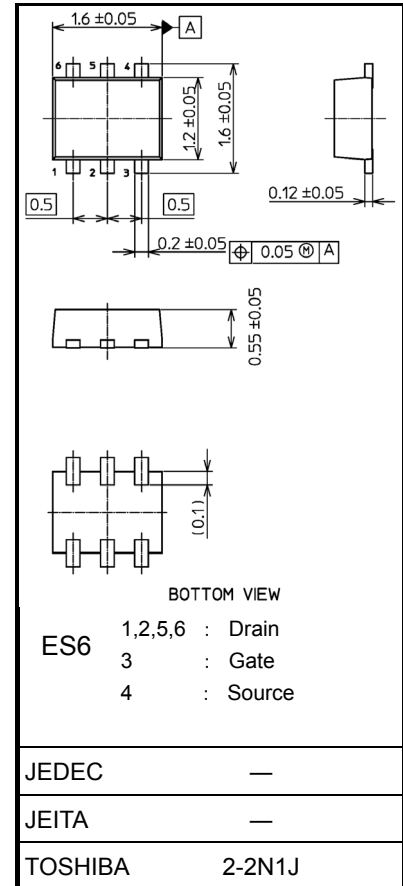
Please design the appropriate reliability upon reviewing the Toshiba Semiconductor Reliability Handbook ("Handling Precautions"/"Derating Concept and Methods") and individual reliability data (i.e. reliability test report and estimated failure rate, etc.).

Note 1: The channel temperature should not exceed  $150^\circ\text{C}$  during use.

Note 2: Mounted on a FR4 board.

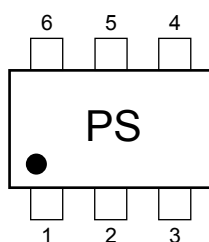
( $25.4 \text{ mm} \times 25.4 \text{ mm} \times 1.6 \text{ mm}$ , Cu Pad:  $645 \text{ mm}^2$ )

Unit: mm

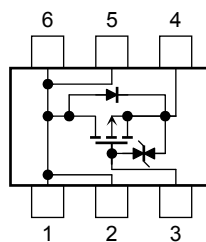


Weight: 3mg (typ.)

### Marking (Top View)



### Equivalent Circuit



Start of commercial production  
2011-01

## Electrical Characteristics (Ta = 25°C)

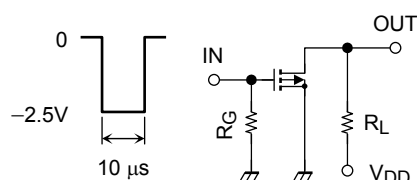
Characteristic	Symbol	Test Conditions	Min	Typ.	Max	Unit
Drain-source breakdown voltage	$V_{(BR)DSS}$	$I_D = -1 \text{ mA}$ , $V_{GS} = 0 \text{ V}$	-20	—	—	V
	$V_{(BR)DSX}$	$I_D = -1 \text{ mA}$ , $V_{GS} = 5 \text{ V}$ (Note 4)	-15	—	—	V
Drain cut-off current	$I_{DSS}$	$V_{DS} = -20 \text{ V}$ , $V_{GS} = 0 \text{ V}$	—	—	-1	$\mu\text{A}$
Gate leakage current	$I_{GSS}$	$V_{GS} = \pm 8 \text{ V}$ , $V_{DS} = 0 \text{ V}$	—	—	$\pm 1$	$\mu\text{A}$
Gate threshold voltage	$V_{th}$	$V_{DS} = -3 \text{ V}$ , $I_D = -1 \text{ mA}$	-0.3	—	-1.0	V
Forward transfer admittance	$ Y_{fs} $	$V_{DS} = -3 \text{ V}$ , $I_D = -1.0 \text{ A}$ (Note 3)	2.8	5.6	—	S
Drain-source ON-resistance	$R_{DS(ON)}$	$I_D = -1.5 \text{ A}$ , $V_{GS} = -4.5 \text{ V}$ (Note 3)	—	88.5	103	$\text{m}\Omega$
		$I_D = -1.0 \text{ A}$ , $V_{GS} = -2.5 \text{ V}$ (Note 3)	—	107.5	133	
		$I_D = -0.5 \text{ A}$ , $V_{GS} = -1.8 \text{ V}$ (Note 3)	—	130	178	
		$I_D = -0.25 \text{ A}$ , $V_{GS} = -1.5 \text{ V}$ (Note 3)	—	151	250	
Input capacitance	$C_{iss}$	$V_{DS} = -10 \text{ V}$ , $V_{GS} = 0 \text{ V}$ $f = 1 \text{ MHz}$	—	290	—	$\text{pF}$
Output capacitance	$C_{oss}$		—	44	—	
Reverse transfer capacitance	$C_{rss}$		—	32	—	
Switching time	Turn-on time	$V_{DD} = -10 \text{ V}$ , $I_D = -0.5 \text{ A}$	—	12.0	—	ns
	Turn-off time	$V_{GS} = 0 \text{ to } -2.5 \text{ V}$ , $R_G = 4.7 \Omega$	—	46.2	—	
Total gate charge	$Q_g$	$V_{DD} = -10 \text{ V}$ , $I_D = -2.0 \text{ A}$ , $V_{GS} = -4.5 \text{ V}$	—	4.7	—	nC
Gate-source charge	$Q_{gs1}$		—	0.4	—	
Gate-drain charge	$Q_{gd}$		—	1.0	—	
Drain-source forward voltage	$V_{DSF}$	$I_D = 2.6 \text{ A}$ , $V_{GS} = 0 \text{ V}$ (Note 3)	—	0.89	1.2	V

Note3: Pulse test

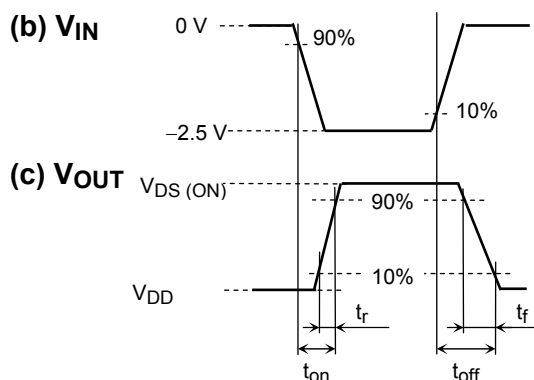
Note4: If a forward bias is applied between gate and source, this device enters  $V_{(BR)DSX}$  mode. Note that the drain-source breakdown voltage is lowered in this mode.

## Switching Time Test Circuit

### (a) Test Circuit



$V_{DD} = -10 \text{ V}$   
 $R_G = 4.7 \Omega$   
 Duty  $\leq 1\%$   
 $V_{IN}$ :  $t_r, t_f < 5 \text{ ns}$   
 Common Source  
 $T_a = 25^\circ\text{C}$



## Notice on Usage

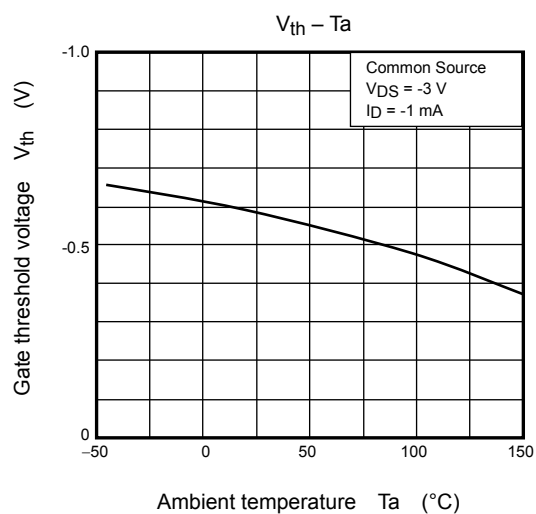
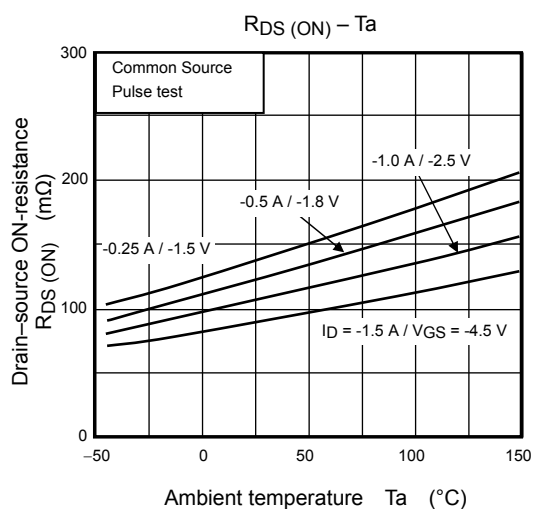
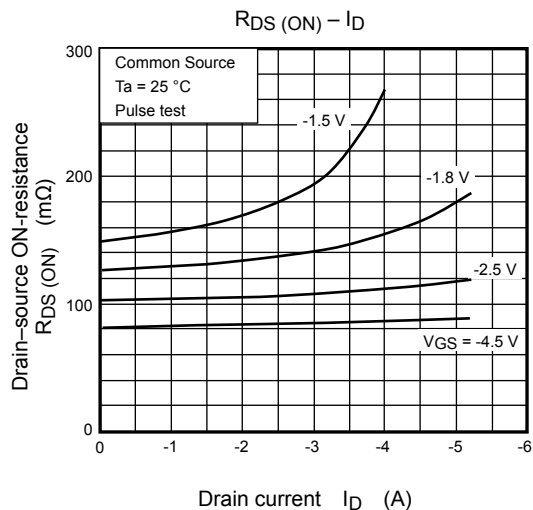
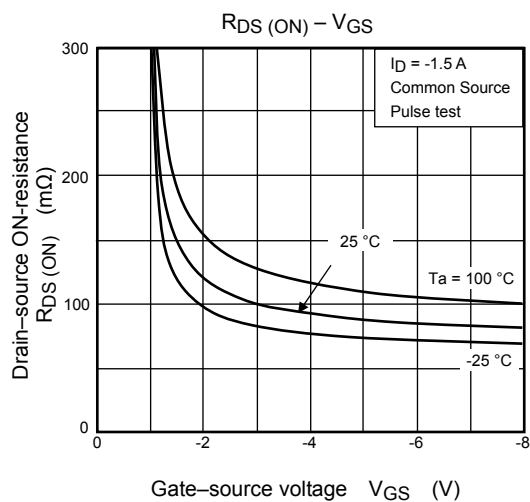
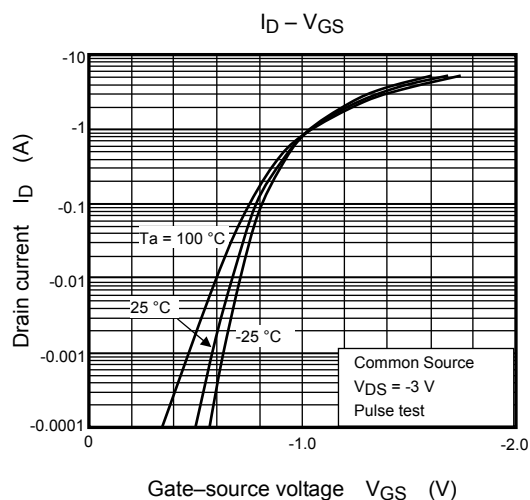
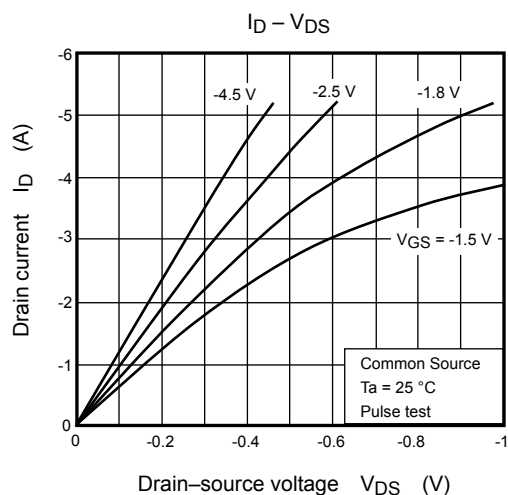
$V_{th}$  can be expressed as the voltage between gate and source when the low operating current value is  $I_D = -1 \text{ mA}$  for this product. For normal switching operation,  $V_{GS(ON)}$  requires a higher voltage than  $V_{th}$  and  $V_{GS(OFF)}$  requires a lower voltage than  $V_{th}$ . (The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

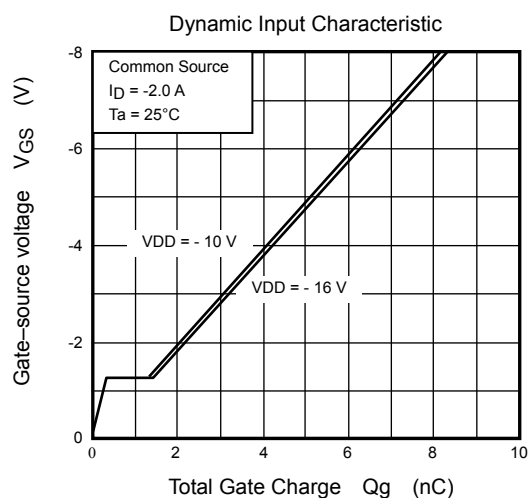
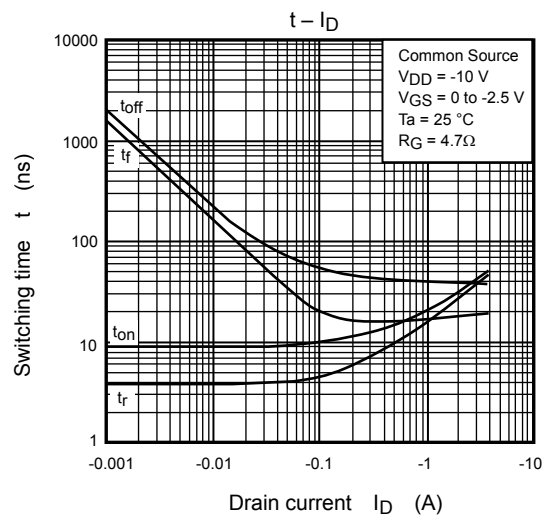
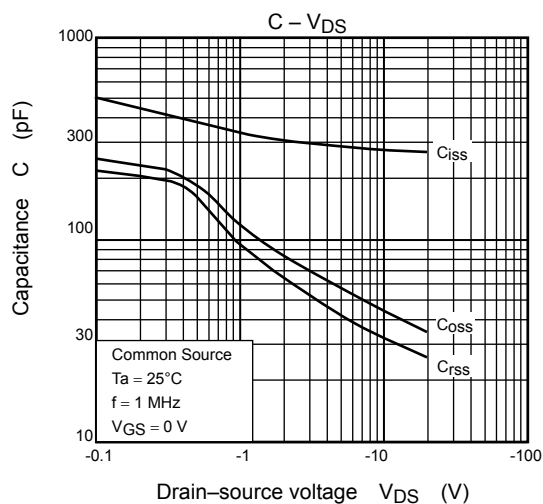
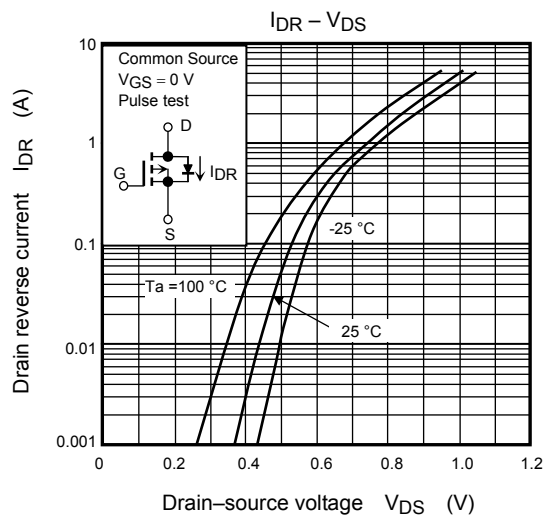
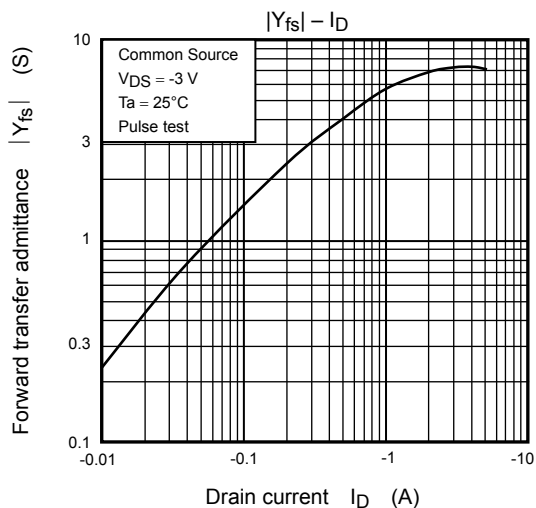
Take this into consideration when using the device.

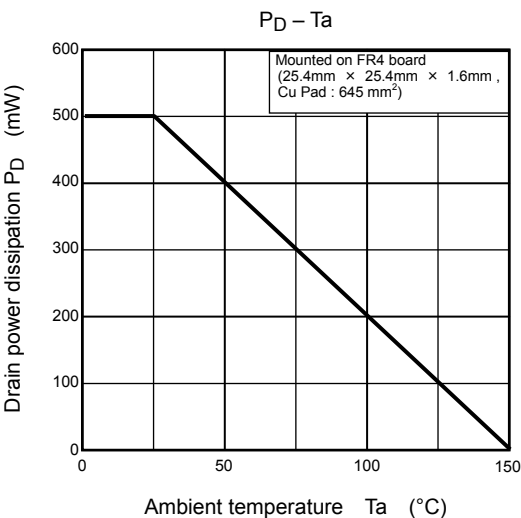
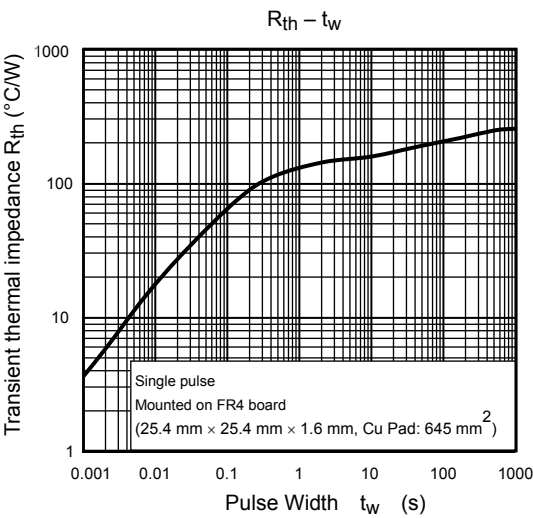
## Handling Precaution

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.

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







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