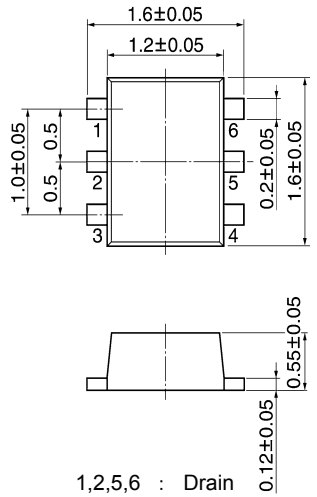
TOSHIBA Field-Effect Transistor Silicon P-Channel MOS Type (U-MOSⅥ)

SSM6J212FE

○ Power Management Switch Applications

- 1.5-V drive
- Low ON-resistance: $R_{DS(ON)}$ = 94.0 mΩ (max) (@V_{GS} = -1.5 V)
  $R_{DS(ON)}$ = 65.4 mΩ (max) (@V_{GS} = -1.8 V)
  $R_{DS(ON)}$ = 49.0 mΩ (max) (@V_{GS} = -2.5 V)
  $R_{DS(ON)}$ = 40.7 mΩ (max) (@V_{GS} = -4.5 V)

Unit: mm



JEDEC	―
JEITA	―
TOSHIBA	2-2N1J

Weight : 3mg (typ.)

Absolute Maximum Ratings (Ta = 25°C)

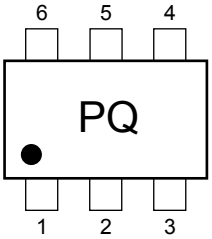
Characteristic		Symbol	Rating	Unit
Drain-source voltage		V_{DSS}	-20	V
Gate-source voltage		V_{GSS}	± 8	V
Drain current	DC	I_D (Note 1)	-4.0	A
	Pulse	I_{DP} (Note 1)	-8.0	
Drain power dissipation		P_D (Note 2)	500	mW
		t = 10s	700	
Channel temperature		T_{ch}	150	°C
Storage temperature range		T_{stg}	−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).

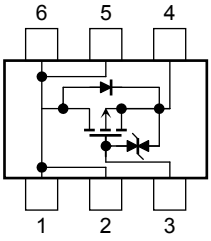
Note 1: The channel temperature should not exceed 150°C during use.

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

Marking (Top View)



Equivalent Circuit



Electrical Characteristics (Ta = 25°C)

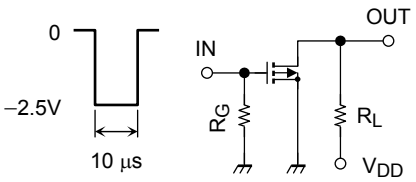
Characteristic		Symbol	Test Conditions		Min	Typ.	Max	Unit
Drain-source breakdown voltage		$V_{(BR)\ DSS}$	I_D = -1 mA, V_{GS} = 0 V		-20	—	—	V
		$V_{(BR)\ DSX}$	I_D = -1 mA, V_{GS} = 5 V	(Note 4)	-15	—	—	V
Drain cut-off current		I_{DSS}	V_{DS} = -20 V, V_{GS} = 0 V		—	—	-1	μA
Gate leakage current		I_{GSS}	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)	4.7	9.4	—	S
Drain–source ON-resistance		$R_{DS\ (ON)}$	I_D = -3.0 A, V_{GS} = -4.5 V	(Note 3)	—	35.3	40.7	mΩ
			I_D = -2.0 A, V_{GS} = -2.5 V	(Note 3)	—	41.3	49.0	
			I_D = -1.0 A, V_{GS} = -1.8 V	(Note 3)	—	48.6	65.4	
			I_D = -0.5 A, V_{GS} = -1.5 V	(Note 3)	—	56.7	94.0	
Input capacitance		C_{iss}	V_{DS} = -10 V, V_{GS} = 0 V f = 1 MHz		—	970	—	pF
Output capacitance		C_{oss}			—	127	—	
Reverse transfer capacitance		C_{rss}			—	109	—	
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		—	47	—	ns
	Turn-off time	t_{off}			—	143	—	
Total gate charge		Q_g	V_{DD} = -10 V, I_{DD} = -4.0 A, V_{GS} = -4.5 V		—	14.1	—	nC
Gate-source charge		Q_{gs1}			—	1.7	—	
Gate-drain charge		Q_{gd}			—	2.4	—	
Drain-source forward voltage		V_{DSF}	I_D = 4.0 A, V_{GS} = 0 V	(Note 3)	—	0.87	1.2	V

Note3: Pulse test

Note4: V_{DSX} mode (the application of a plus voltage between gate and source) may cause decrease in maximun rating of drain-source voltage

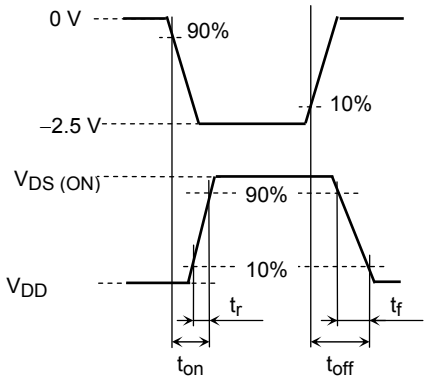
Switching Time Test Circuit

(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} and (c) V_{OUT}



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: $V_{GS\ (off)} < V_{th} < V_{GS\ (on)}$.)

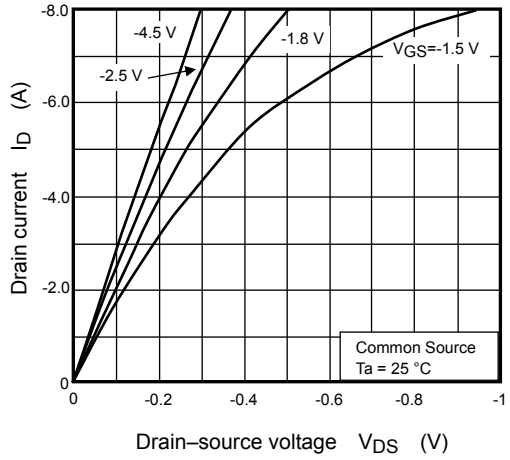
Take this into consideration when using the device.

Handling Precaution

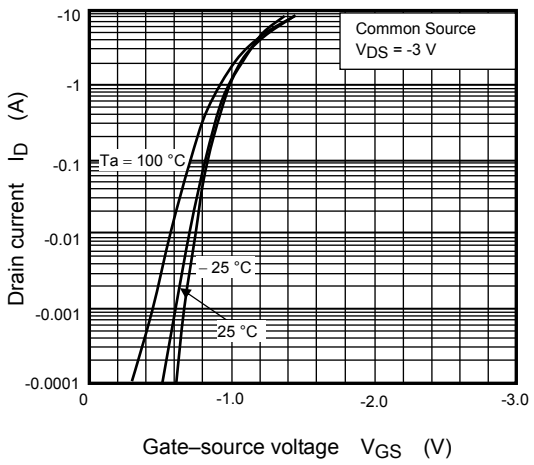
When handling individual devices that are not yet mounted on a circuit board, make sure that the environment is protected against electrostatic discharge. Operators should wear antistatic clothing, and containers and other objects that come into direct contact with devices should be made of antistatic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

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

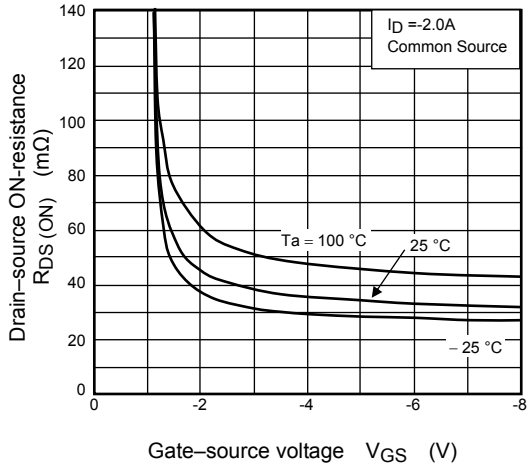
$I_D - V_{DS}$



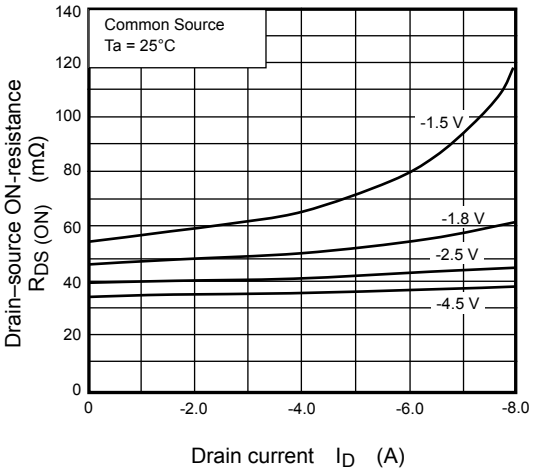
$I_D - V_{GS}$



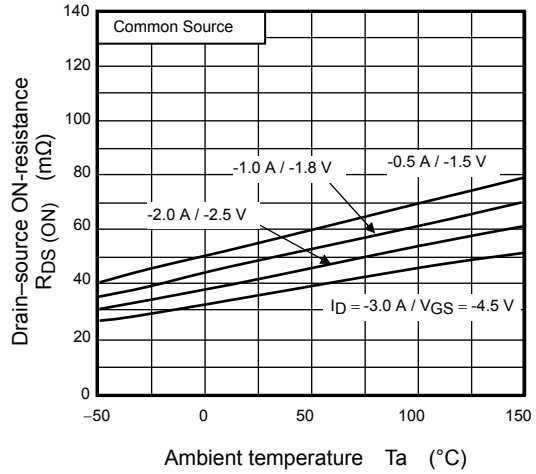
$R_{DS\ (ON)} - V_{GS}$



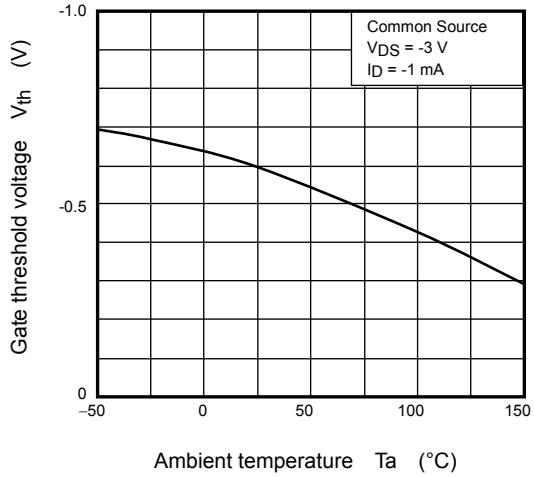
$R_{DS\ (ON)} - I_D$

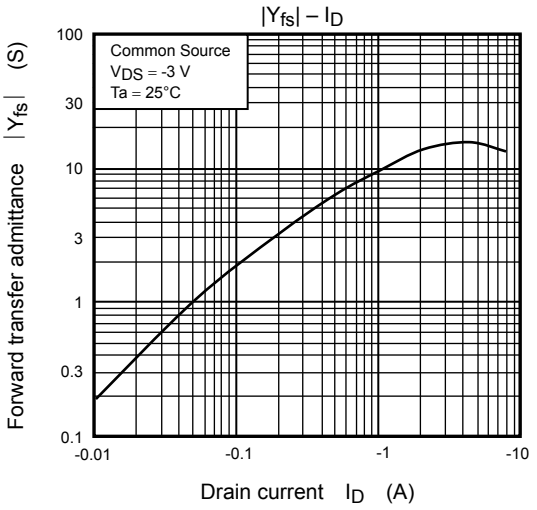


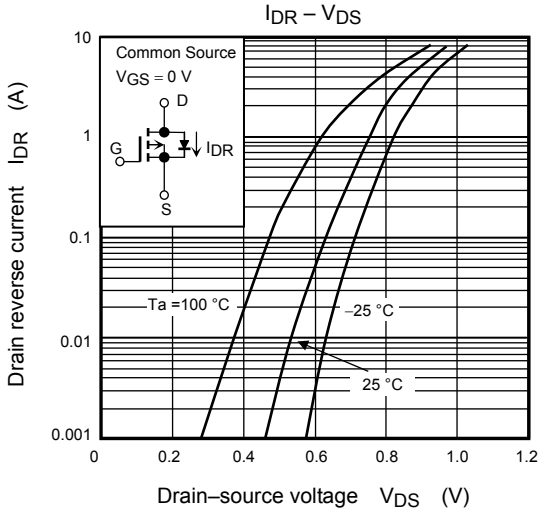
$R_{DS\ (ON)} - Ta$

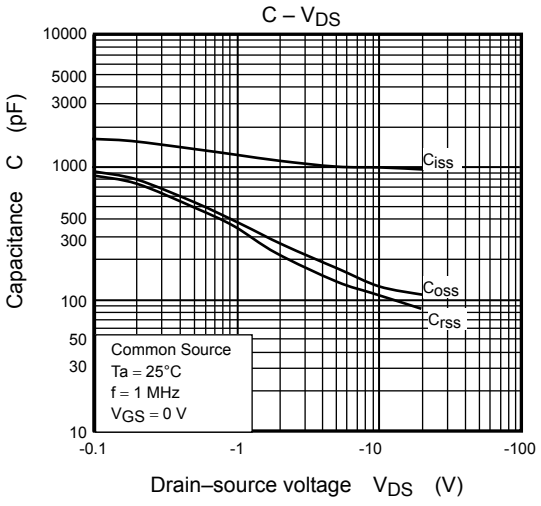


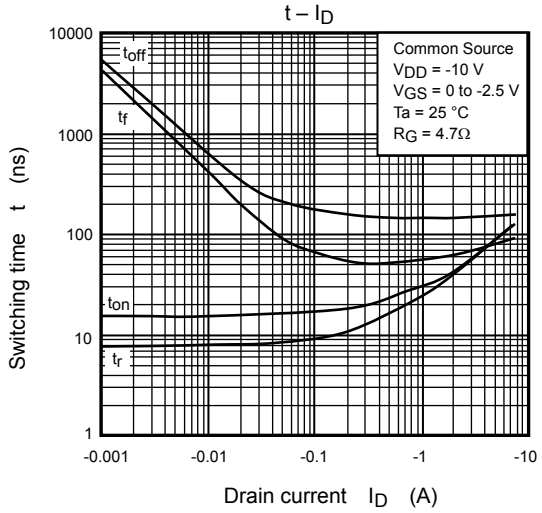
$V_{th} - Ta$

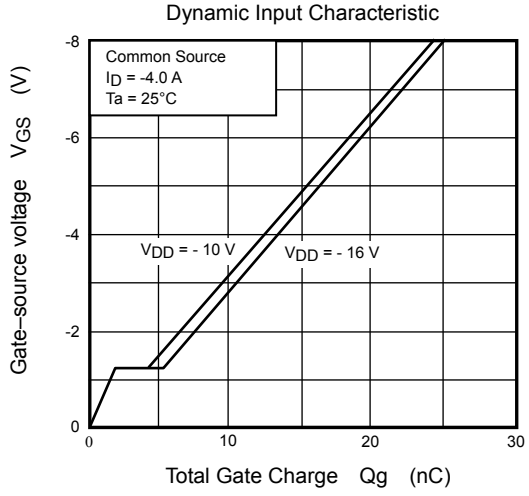



|Yfs| – ID
Common Source
VDS = -3 V
Ta = 25°C
Forward transfer admittance |Yfs| (S)
Drain current ID (A)
100
30
10
3
1
0.3
0.1
-0.01
-0.1
-1
-10

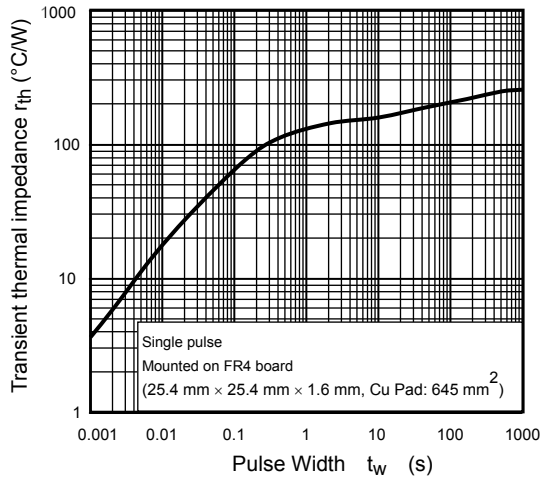

IDR – VDS
Common Source
VGS = 0 V
D
G
S
IDR
Ta =100 °C
25 °C
–25 °C
Drain reverse current IDR (A)
Drain–source voltage VDS (V)
10
1
0.1
0.01
0.001
0
0.2
0.4
0.6
0.8
1.0
1.2


C – VDS
Ciss
Coss
Crss
Common Source
Ta = 25°C
f = 1 MHz
VGS = 0 V
Capacitance C (pF)
Drain–source voltage VDS (V)
10000
5000
3000
1000
500
300
100
50
30
10
-0.1
-1
-10
-100

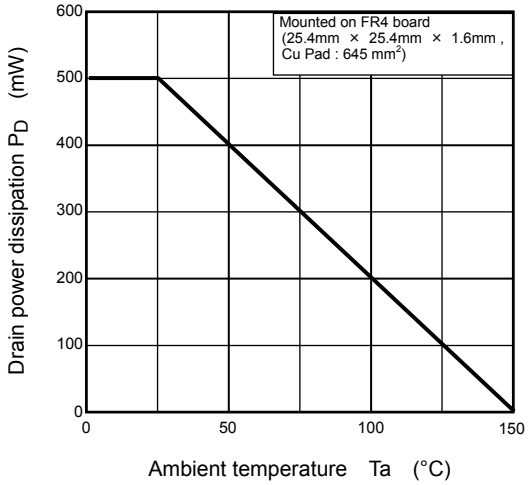

t – ID
toff
tf
ton
tr
Common Source
VDD = -10 V
VGS = 0 to -2.5 V
Ta = 25 °C
RG = 4.7Ω
Switching time t (ns)
Drain current ID (A)
10000
1000
100
10
1
-0.001
-0.01
-0.1
-1
-10


Dynamic Input Characteristic
Common Source
ID = -4.0 A
Ta = 25°C
VDD = - 10 V
VDD = - 16 V
Gate–source voltage VGS (V)
Total Gate Charge Qg (nC)
-8
-6
-4
-2
0
0
10
20
30

$r_{th} - t_w$


Transient thermal impedance r_{th} (°C/W)
1000
100
10
1
0.001
0.01
0.1
1
10
100
1000
Pulse Width t_w (s)
Single pulse
Mounted on FR4 board
(25.4 mm × 25.4 mm × 1.6 mm, Cu Pad: 645 mm^2)

$P_D - Ta$


Drain power dissipation P_D (mW)
600
500
400
300
200
100
0
0
50
100
150
Ambient temperature Ta (°C)
Mounted on FR4 board
(25.4mm × 25.4mm × 1.6mm ,
Cu Pad : 645 mm^2)

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