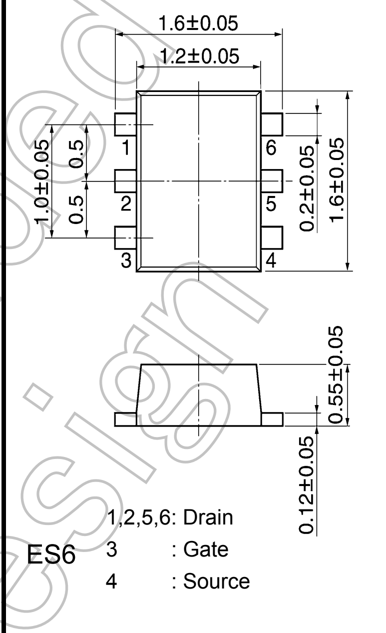
TOSHIBA Field-Effect Transistor Silicon N-Channel MOS Type

SSM6K208FE

○ High-Speed Switching Applications

○ Power Management Switch Applications

Unit: mm



JEDEC	―
JEITA	―
TOSHIBA	2-2N1A

Weight: 3mg (typ.)

- 1.8V drive
- Low ON-resistance: R_{on} = 296 mΩ (max) (@V_{GS} = 1.8 V)
  R_{on} = 177 mΩ (max) (@V_{GS} = 2.5 V)
  R_{on} = 133 mΩ (max) (@V_{GS} = 4.0 V)

Absolute Maximum Ratings (Ta = 25°C)

Characteristic		Symbol	Rating	Unit
Drain-Source voltage		V_{DSS}	30	V
Gate-Source voltage		V_{GSS}	± 12	V
Drain current	DC	I_D	1.9	A
	Pulse	I_{DP}	3.8	
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).

Note 1: Mounted on FR4 board.
(25.4 mm × 25.4 mm × 1.6mm, Cu Pad: 645 mm^2)

Start of commercial production
2008-01

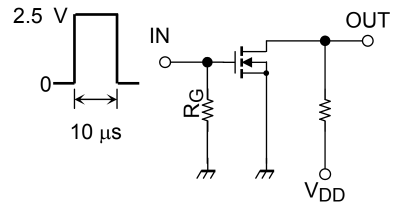
Electrical Characteristics (Ta = 25°C)

Characteristic		Symbol	Test Conditions	Min	Typ.	Max	Unit
Drain-Source breakdown voltage		$V_{(BR)DSS}$	I_D = 1 mA, V_{GS} = 0 V	30	—	—	V
		$V_{(BR)DSX}$	I_D = 1 mA, V_{GS} = −12 V	18	—	—	
Drain cut-off current		I_{DSS}	V_{DS} = 30 V, V_{GS} = 0 V	—	—	1	μA
Gate leakage current		I_{GSS}	V_{GS} = ±12 V, V_{DS} = 0 V	—	—	±1	μA
Gate threshold voltage		V_{th}	V_{DS} = 3 V, I_D = 1 mA	0.4	—	1.0	V
Forward transfer admittance		$\|Y_{fs}\|$	V_{DS} = 3 V, I_D = 1.0 A (Note 2)	2	3.9	—	S
Drain–source ON-resistance		$R_{DS(ON)}$	I_D = 1.0 A, V_{GS} = 4 V (Note 2)	—	103	133	mΩ
			I_D = 0.8 A, V_{GS} = 2.5 V (Note 2)	—	125	177	
			I_D = 0.5 A, V_{GS} = 1.8 V (Note 2)	—	165	296	
Input capacitance		C_{iss}	V_{DS} = 15 V, V_{GS} = 0 V, f = 1 MHz	—	123	—	pF
Output capacitance		C_{oss}		—	43	—	
Reverse transfer capacitance		C_{rss}		—	18	—	
Total Gate Charge		Q_g	V_{DS} = 15V, I_D = 1.9 A, V_{GS} = 4 V	—	1.9	—	nC
Gate-Source Charge		Q_{gs}		—	1.1	—	
Gate-Drain Charge		Q_{gd}		—	0.8	—	
Switching time	Turn-on time	t_{on}	V_{DD} = 15 V, I_D = 1.0 A, V_{GS} = 0 to 2.5 V, R_G = 4.7 Ω	—	9.2	—	ns
	Turn-off time	t_{off}		—	6.4	—	
Drain-Source forward voltage		V_{DSF}	I_D = −1.9 A, V_{GS} = 0 V (Note 2)	—	−0.83	−1.2	V

Note 2: Pulse test

Switching Time Test Circuit

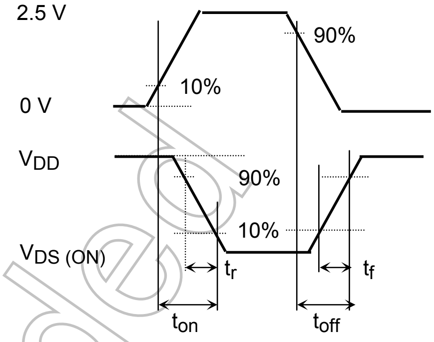
(a) Test Circuit



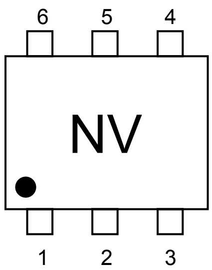
V_{DD} = 15 V
R_G = 4.7 Ω
Duty ≤ 1%
V_{IN}: t_r, t_f < 5 ns
Common Source
Ta = 25°C

(b) V_{IN}

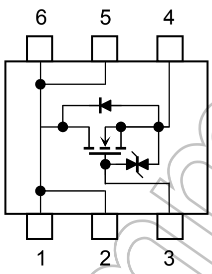
(c) V_{OUT}



Marking



Equivalent Circuit (top view)



Usage Considerations

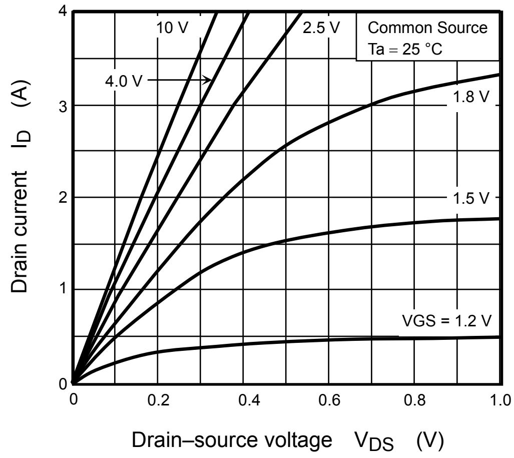
Let V_{th} be the voltage applied between gate and source that causes the drain current (I_D) to below (1 mA for the SSM6K208FE). Then, for normal switching operation, $V_{GS(on)}$ must be higher than V_{th}, and $V_{GS(off)}$ must be lower than V_{th}. This relationship can be expressed as: $V_{GS(off)} < V_{th} < V_{GS(on)}$.

Take this into consideration when using the device.

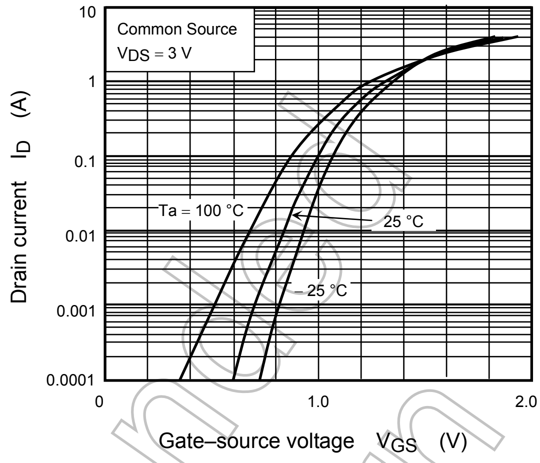
Handling Precaution

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.

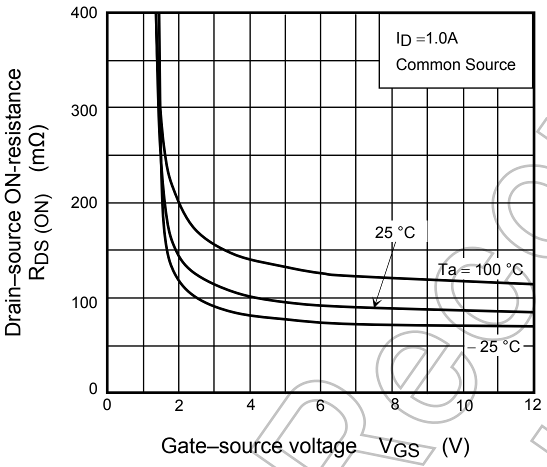
I_D – V_{DS}



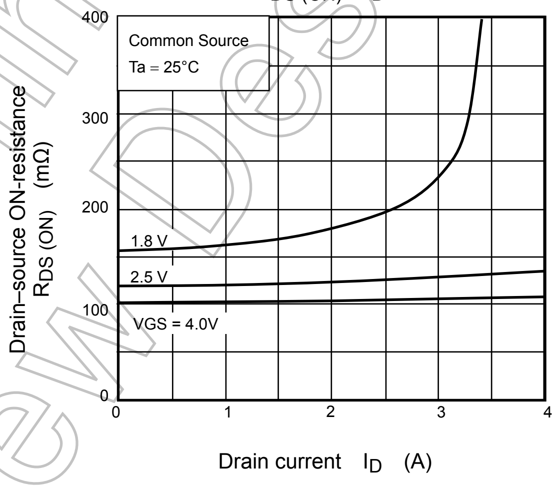
I_D – V_{GS}



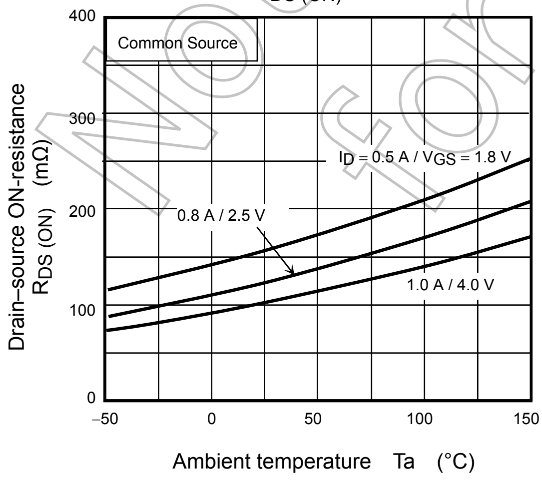
$R_{DS\ (ON)}$ – V_{GS}



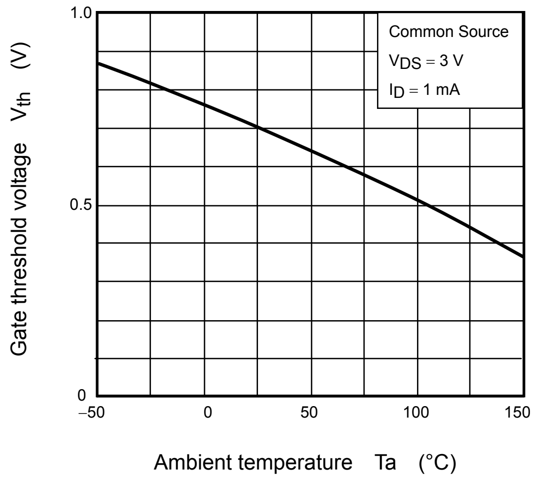
$R_{DS\ (ON)}$ – I_D

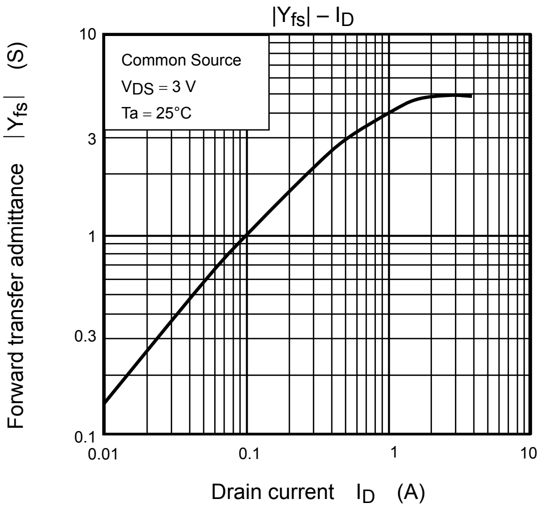


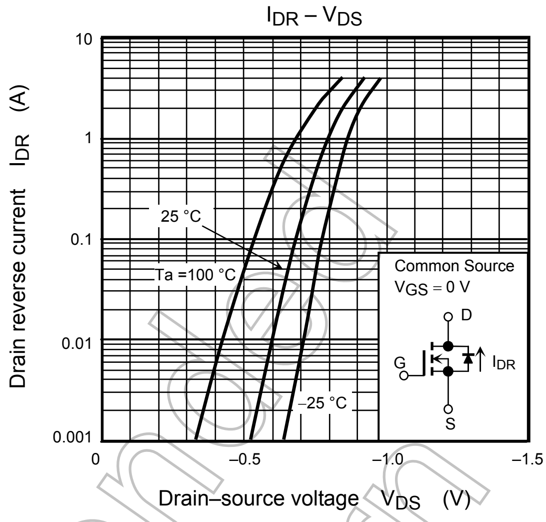
$R_{DS\ (ON)}$ – Ta

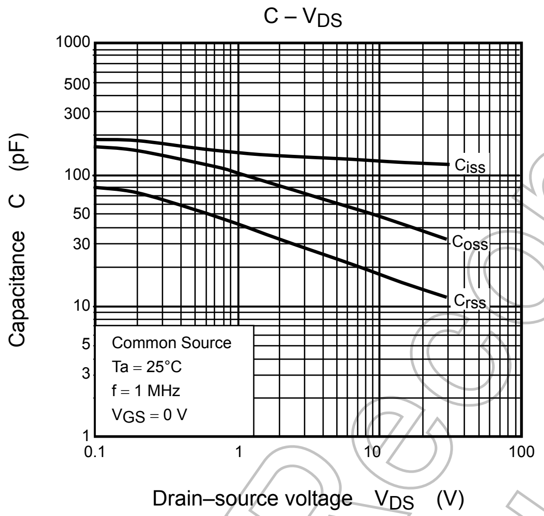


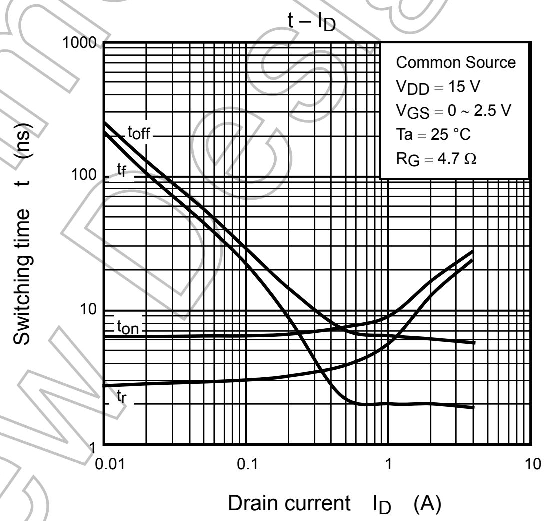
V_{th} – Ta

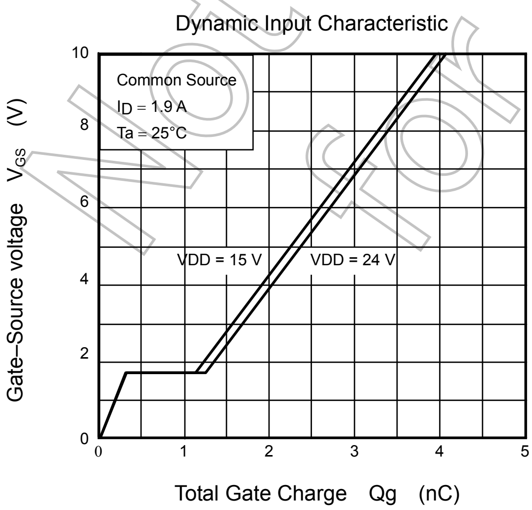


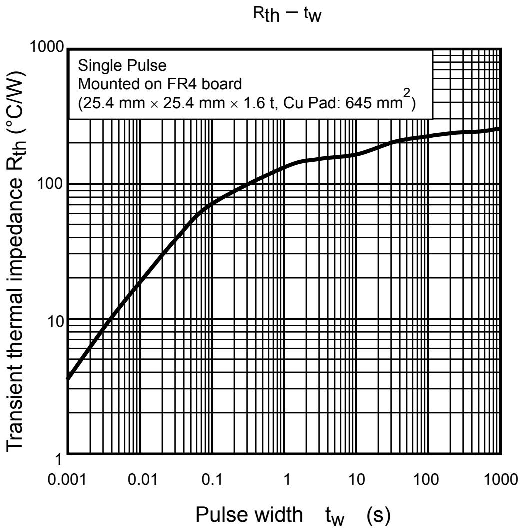

|Yfs| – ID
Common Source
VDS = 3 V
Ta = 25°C
Forward transfer admittance |Yfs| (S)
Drain current ID (A)
10
3
1
0.3
0.1
0.01
0.1
1
10

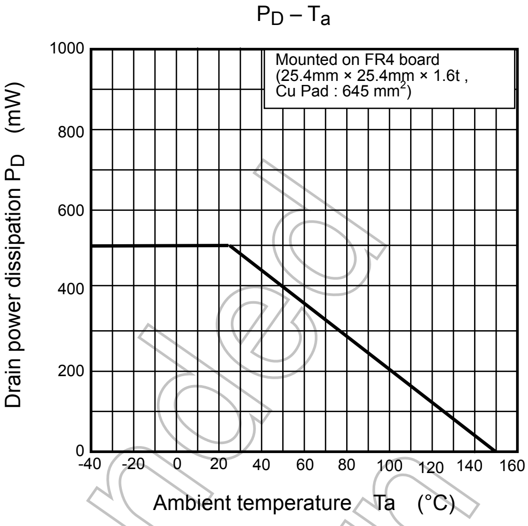

IDR – VDS
Common Source
VGS = 0 V
D
G
S
IDR
25 °C
Ta =100 °C
−25 °C
Drain reverse current IDR (A)
Drain–source voltage VDS (V)
10
1
0.1
0.01
0.001
0
−0.5
−1.0
−1.5


C – VDS
Ciss
Coss
Crss
Common Source
Ta = 25°C
f = 1 MHz
VGS = 0 V
Capacitance C (pF)
Drain–source voltage VDS (V)
1000
500
300
100
50
30
10
5
3
1
0.1
1
10
100


t – ID
Common Source
VDD = 15 V
VGS = 0 ~ 2.5 V
Ta = 25 °C
RG = 4.7 Ω
toff
tf
ton
tr
Switching time t (ns)
Drain current ID (A)
1000
100
10
1
0.01
0.1
1
10


Dynamic Input Characteristic
Common Source
ID = 1.9 A
Ta = 25°C
VDD = 15 V
VDD = 24 V
Gate–Source voltage VGS (V)
Total Gate Charge Qg (nC)
10
8
6
4
2
0
0
1
2
3
4
5


Rth – tw
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)


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

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