

Silicon N Channel MOS Type / Silicon Epitaxial Schottky Barrier Diode

SSM5H06FE

DC-DC Converter

- Combined Nch MOSFET and Schottky Diode in one Package.
- Small package

Absolute Maximum Ratings (Ta = 25°C) MOSFET

Characteristics		Symbol	Rating	Unit
Drain-Source voltage		V _{DS}	20	V
Gate-Source voltage		V _{GSS}	±10	V
Drain current	DC	I _D	100	mA
	Pulse	I _{DP} (Note 2)	200	
Drain power dissipation		P _D (Note 1)	150	mW
Channel temperature		T _{ch}	150	°C

Absolute Maximum Ratings (Ta = 25°C) SCHOTTKY DIODE

Characteristics		Symbol	Rating	Unit
Maximum (peak) reverse voltage		V _{RM}	15	V
Reverse voltage		V _R	12	V
Average forward current		I _O	100	mA
Peak one cycle surge forward current (non-repetitive)		I _{FSM}	1 (50 Hz)	A
Junction temperature		T _j	125	°C

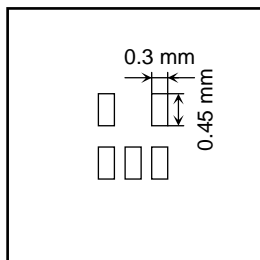
Absolute Maximum Ratings (Ta = 25°C) MOSFET, DIODE COMMON

Characteristics		Symbol	Rating	Unit
Storage temperature		T _{stg}	-55~125	°C
Operating temperature		T _{opr} (Note 3)	-40~100	°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).

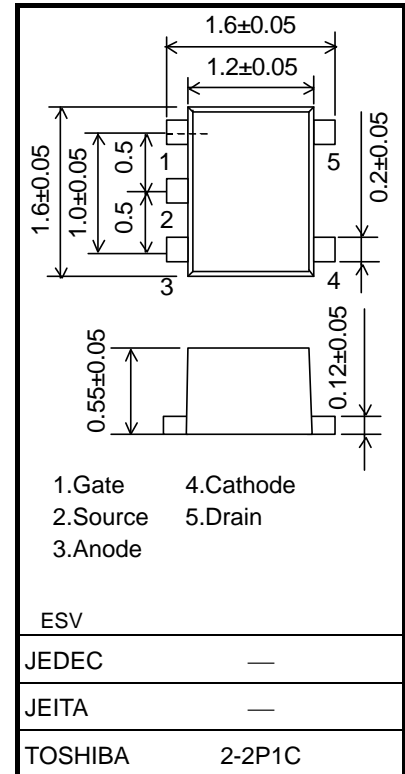
Note 1: Mounted on FR4 board
(25.4 mm × 25.4 mm × 1.6 t, Cu Pad: 0.135 mm² × 5)



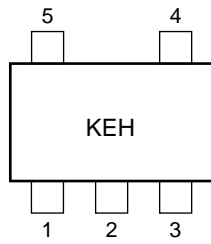
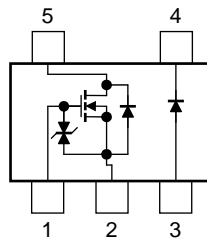
Note 2: The pulse width limited by max channel temperature.

Note 3: Operating temperature limited by max channel temperature and max junction temperature.

Unit: mm



Weight: 3 mg (typ.)

Marking**Equivalent Circuit****Handling Precaution**

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

The Channel-to-Ambient thermal resistance $R_{th(ch-a)}$ and the drain power dissipation P_D vary according to the board material, board area, board thickness and pad area. When using this device, please take heat dissipation fully into account.

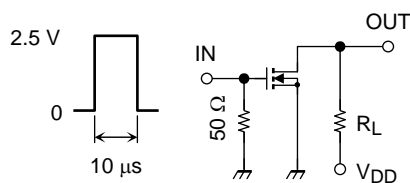
MOSFET

Electrical Characteristics (Ta = 25°C)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Gate leakage current	I_{GSS}	$V_{GS} = \pm 10\text{ V}, V_{DS} = 0$	—	—	± 1	μA
Drain-Source breakdown voltage	$V_{(BR)DSS}$	$I_D = 0.1\text{ mA}, V_{GS} = 0$	20	—	—	V
Drain cut-off current	I_{DSS}	$V_{DS} = 20\text{ V}, V_{GS} = 0$	—	—	1	μA
Gate threshold voltage	V_{th}	$V_{DS} = 3\text{ V}, I_D = 0.1\text{ mA}$	0.6	—	1.1	V
Forward transfer admittance	$ Y_{fs} $	$V_{DS} = 3\text{ V}, I_D = 10\text{ mA}$	40	—	—	mS
Drain-Source on-resistance	$R_{DS(ON)}$	$I_D = 10\text{ mA}, V_{GS} = 4\text{ V}$	—	1.5	3.0	Ω
		$I_D = 10\text{ mA}, V_{GS} = 2.5\text{ V}$	—	2.2	4.0	
		$I_D = 1\text{ mA}, V_{GS} = 1.5\text{ V}$	—	5.2	15	
Input capacitance	C_{iss}	$V_{DS} = 3\text{ V}, V_{GS} = 0, f = 1\text{ MHz}$	—	9.3	—	pF
Reverse transfer capacitance	C_{rss}	$V_{DS} = 3\text{ V}, V_{GS} = 0, f = 1\text{ MHz}$	—	4.5	—	pF
Output capacitance	C_{oss}	$V_{DS} = 3\text{ V}, V_{GS} = 0, f = 1\text{ MHz}$	—	9.8	—	pF
Switching time	Turn-on time	t_{on}	—	70	—	ns
	Turn-off time	t_{off}		125		

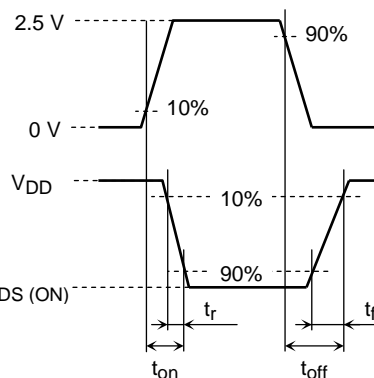
Switching Time Test Circuit

(a) Test circuit

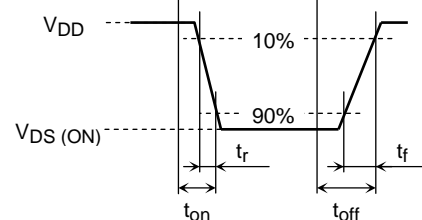


$V_{DD} = 3\text{ V}$
 Duty $\leq 1\%$
 V_{IN} : $t_r, t_f < 5\text{ ns}$
 $(Z_{out} = 50\ \Omega)$
 Common Source
 $T_a = 25^\circ\text{C}$

(b) V_{IN}



(c) V_{OUT}



Precaution

V_{th} can be expressed as voltage between gate and source when the low operating current value is $I_D = 100\ \mu\text{A}$ 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: $V_{GS(off)} < V_{th} < V_{GS(on)}$)

Please take this into consideration when using the device.

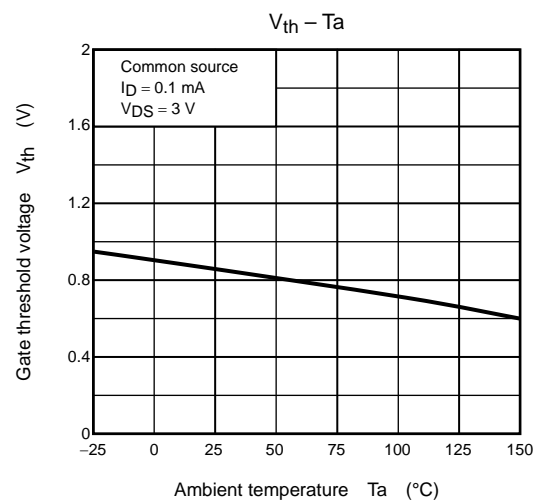
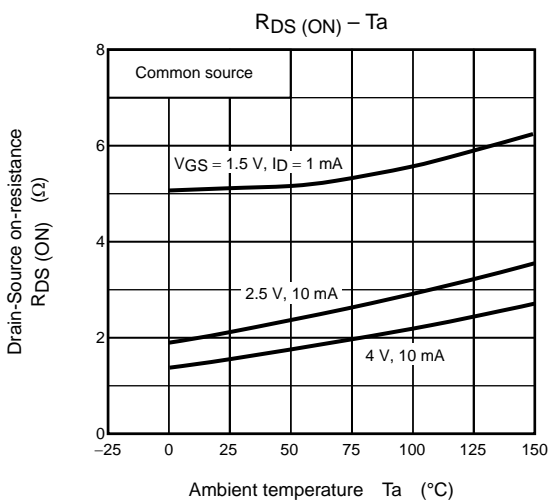
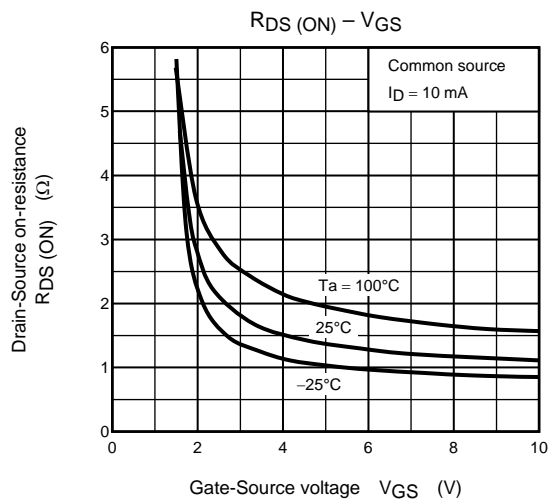
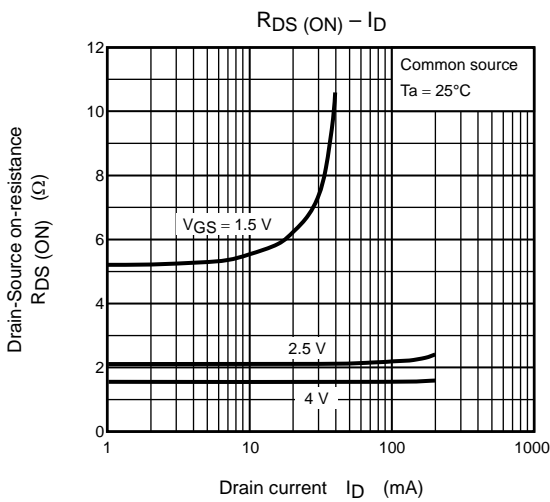
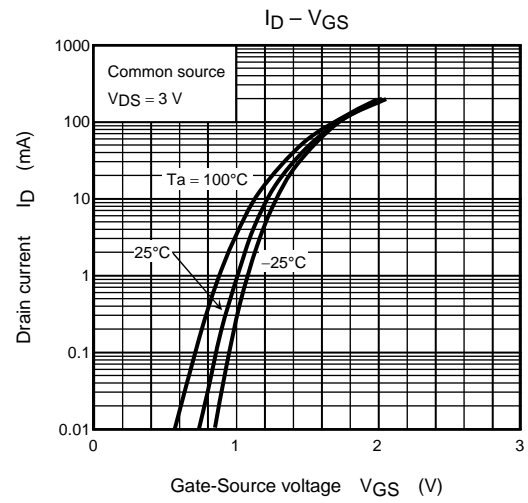
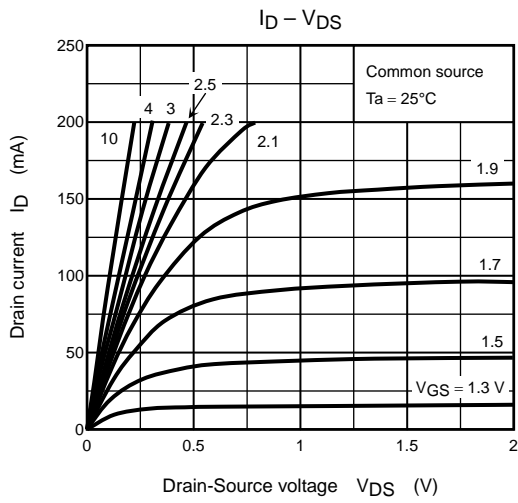
Schottky Diode**Electrical Characteristics (Ta = 25°C)**

Characteristic	Symbol	Test Condition	Min	Typ.	Max	Unit
Forward voltage	$V_F (1)$	$I_F = 1\text{mA}$	—	0.18	—	V
	$V_F (2)$	$I_F = 5\text{mA}$	—	0.23	0.30	V
	$V_F (3)$	$I_F = 100\text{mA}$	—	0.35	0.50	V
Reverse current	I_R	$V_R = 12\text{ V}$	—	—	22	μA
Total capacitance	C_T	$V_R = 0\text{ V}, f = 1\text{ MHz}$	—	20	40	pF

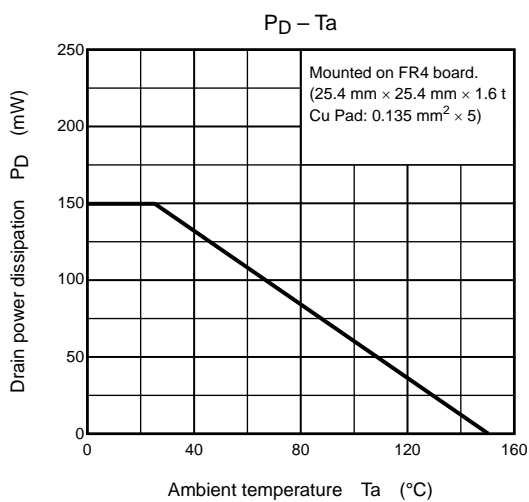
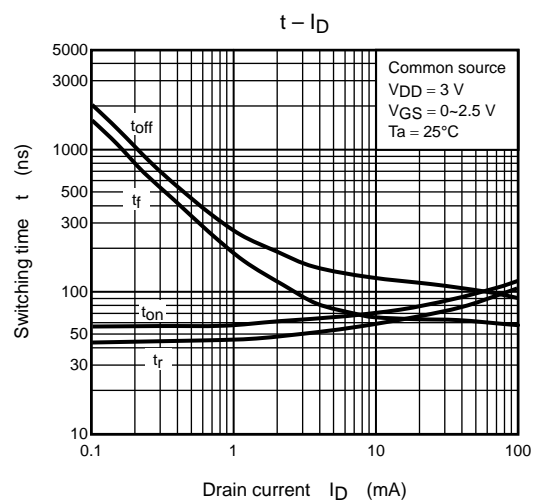
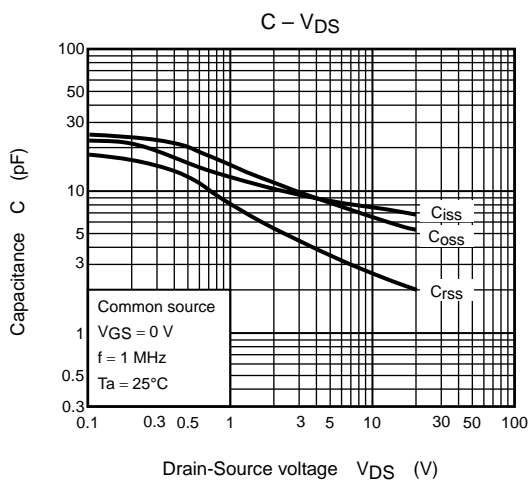
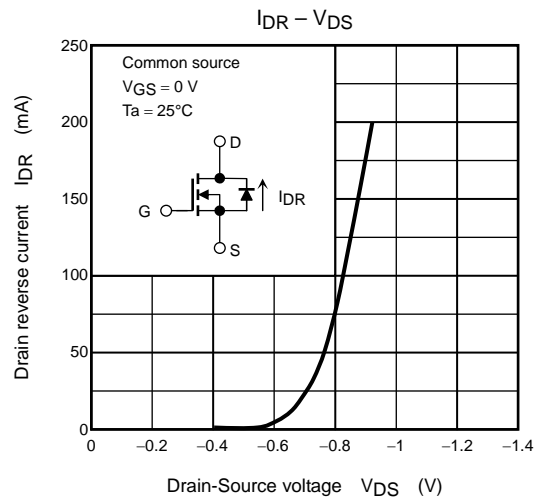
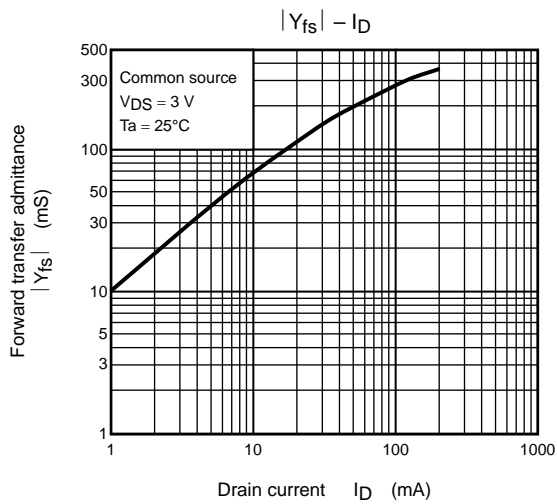
Precaution

The schottky barrier diodes of this product have large-reverse-current-leakage characteristics compared to other switching diodes. This current leakage and improper operating temperature or voltage may cause thermal runaway resulting in breakdown. Take forward and reverse loss into consideration in radiation design and safety design.

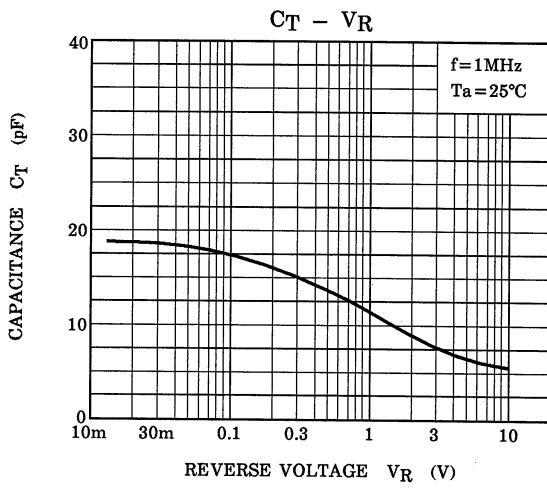
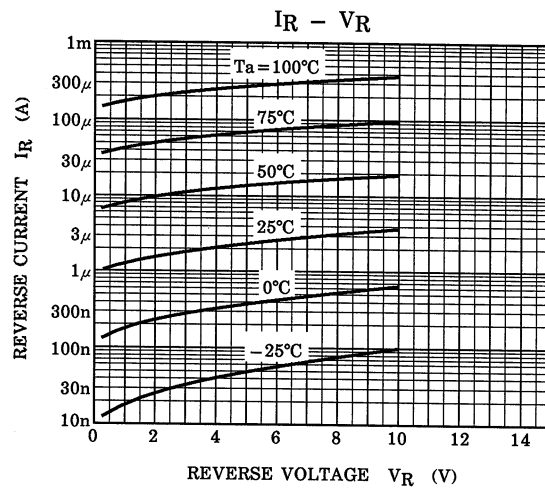
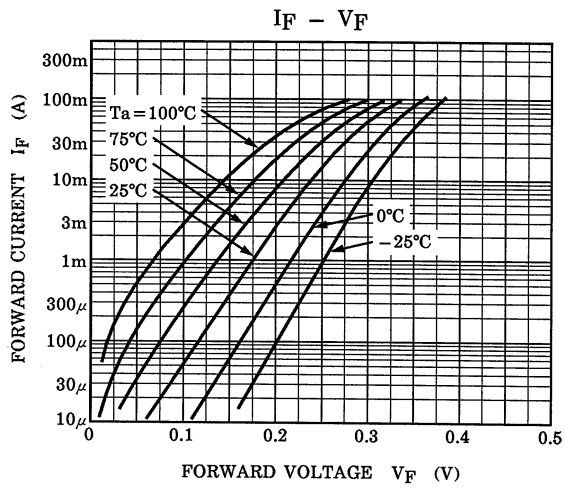
MOSFET Electrical Characteristics Graph



MOSFET Electrical Characteristics Graph



SBD Electrical Characteristics Graph



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