

Silicon P-Channel MOS Type / Silicon Epitaxial Schottky Barrier Diode

# SSM5G06FE

## DC-DC Converter Applications

- Combined a P-channel MOSFET and a Schottky barrier diode in one package.
- Optimum for high-density mounting in small packages

### Absolute Maximum Ratings (Ta = 25°C) MOSFET

Characteristics		Symbol	Rating	Unit
Drain-Source voltage		$V_{DSS}$	-20	V
Gate-Source voltage		$V_{GSS}$	$\pm 10$	V
Drain current	DC	$I_D$	-100	mA
	Pulse	$I_{DP}$ (Note 2)	-200	
Power dissipation		$P_D$ (Note 1)	150	mW
Channel temperature		$T_{ch}$	150	°C

### Absolute Maximum Ratings (Ta = 25°C) SBD

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 (10ms)		$I_{FSM}$	1 (50 Hz)	A
Junction temperature		$T_j$	125	°C

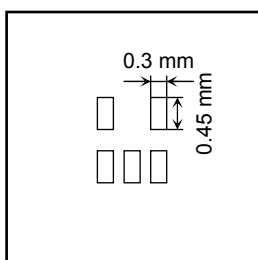
### Absolute Maximum Ratings (Ta = 25°C) MOSFET, SBD COMMON

Characteristics		Symbol	Rating	Unit
Storage temperature range		$T_{stg}$	-55 to 125	°C
Operating temperature range		$T_{opr}$ (Note3)	-40 to 100	°C

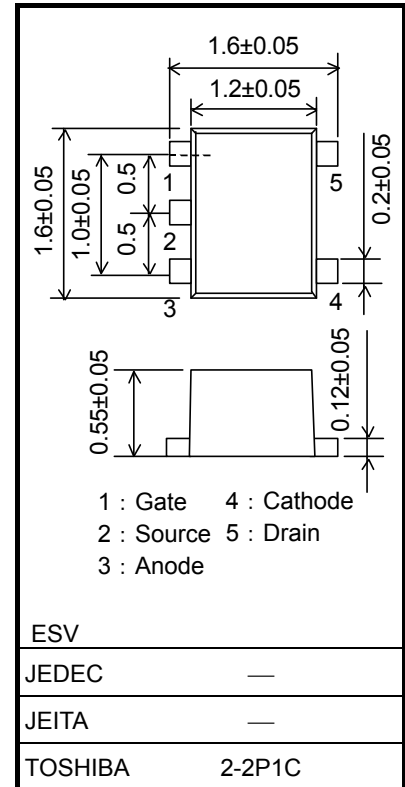
Note: Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.)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

Note1: Total rating. Mounted on an FR4 board. (25.4 mm × 25.4 mm × 1.6 mm, Cu Pad: 0.135 mm<sup>2</sup> × 5)



Unit: mm



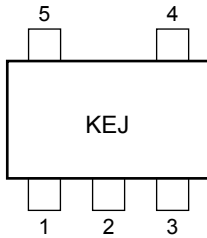
Weight: 3 mg (Typ.)

Start of commercial production  
2002-08

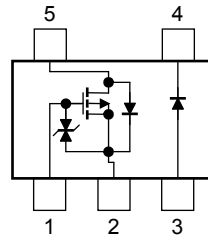
Note 2: The pulse width limited by max channel temperature.

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

### Marking



### Equivalent Circuit



### Handling Precaution

When handling individual devices (which are not yet mounted on a circuit board), ensure that the environment is protected against static discharge. Operators should wear anti-static clothing and use containers and other objects that are made of anti-static materials.

## MOSFET

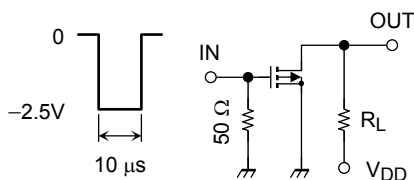
### Electrical Characteristics (Ta = 25°C)

Characteristic	Symbol	Test Condition	Min	Typ.	Max	Unit
Gate leakage current	$I_{GSS}$	$V_{GS} = \pm 10\text{ V}, V_{DS} = 0\text{ V}$	—	—	$\pm 1$	$\mu\text{A}$
Drain-Source breakdown voltage	$V_{(BR)DSS}$	$I_D = -0.1\text{ mA}, V_{GS} = 0\text{ V}$	-20	—	—	V
Drain Cut-off current	$I_{DSS}$	$V_{DS} = -20\text{ V}, V_{GS} = 0\text{ V}$	—	—	-1	$\mu\text{A}$
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} $	$V_{DS} = -3\text{ V}, I_D = -10\text{ mA}$ (Note 4)	25	—	—	mS
Drain-Source on-resistance	$R_{DS(ON)}$	$I_D = -10\text{ mA}, V_{GS} = -4\text{ V}$ (Note 4)	—	6	8	$\Omega$
		$I_D = -10\text{ mA}, V_{GS} = -2.5\text{ V}$ (Note 4)	—	8	12	
		$I_D = -1\text{ mA}, V_{GS} = -1.5\text{ V}$ (Note 4)	—	18	45	
Input capacitance	$C_{iss}$	$V_{DS} = -3\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$	—	11	—	pF
Reverse transfer capacitance	$C_{rss}$	$V_{DS} = -3\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$	—	3.7	—	pF
Output capacitance	$C_{oss}$	$V_{DS} = -3\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$	—	10	—	pF
Switching time	Turn-on time	$t_{on}$	—	130	—	ns
	Turn-off time	$t_{off}$				

Note 4: Pulse test

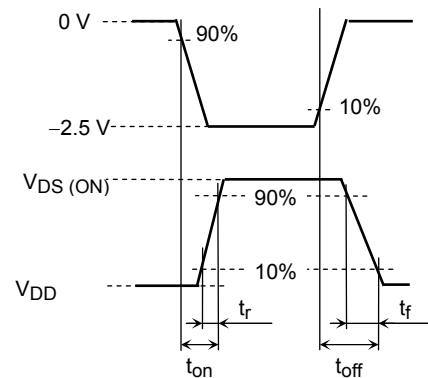
### Switching Time Test Circuit

#### (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 low operating current value is  $I_D = -100\ \mu\text{A}$  for this product. For normal switching operation,  $V_{GS(ON)}$  requires higher voltage than  $V_{th}$  and  $V_{GS(OFF)}$  requires lower voltage than  $V_{th}$ .

(Relationship can be established as follows:  $V_{GS(OFF)} < V_{th} < V_{GS(ON)}$ )

Please take this into consideration for using the device.

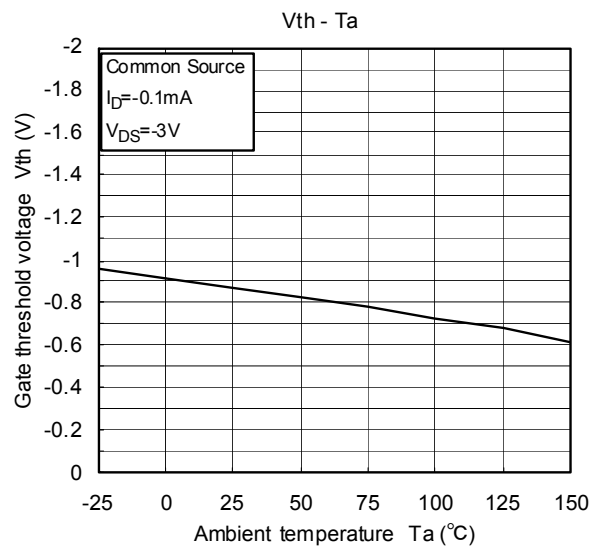
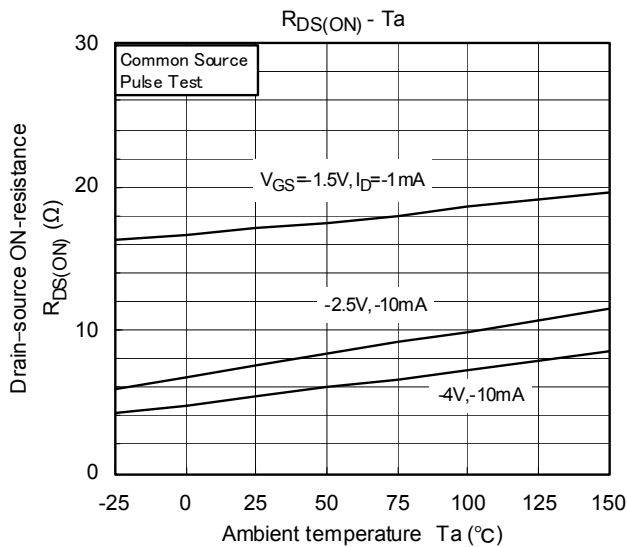
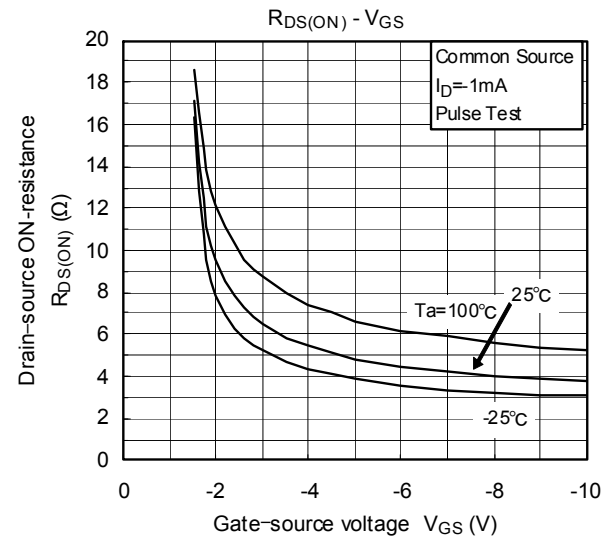
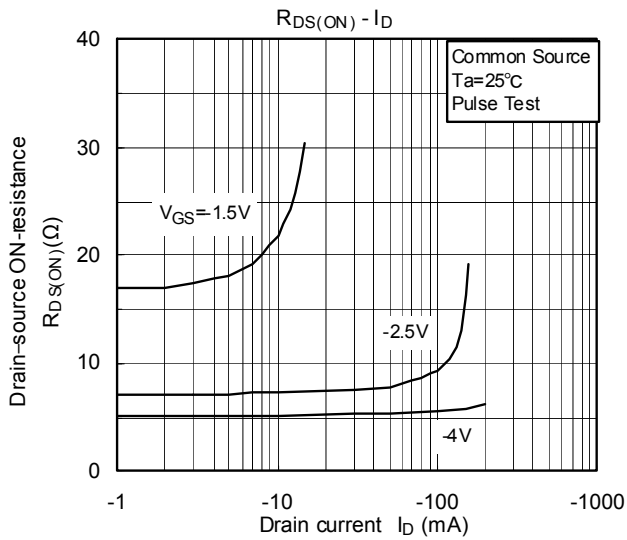
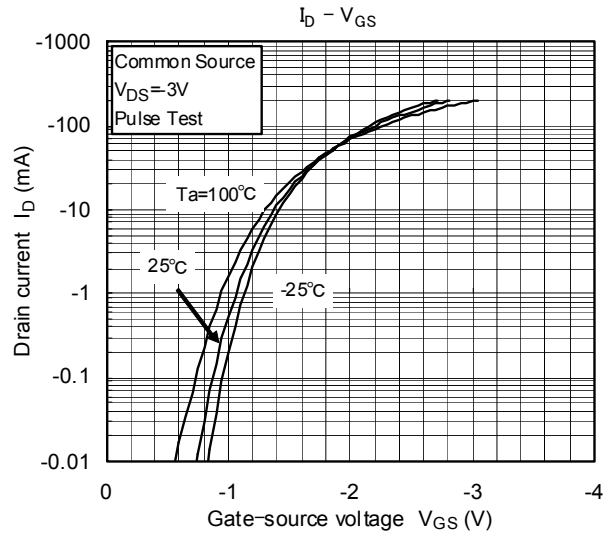
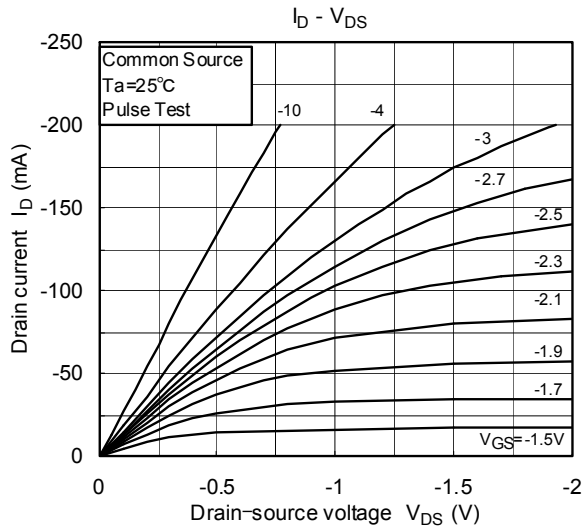
**SBD****Electrical Characteristics (Ta = 25°C)**

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	$\mu\text{A}$
Total capacitance	$C_T$	$V_R = 0 \text{ V}, f = 1 \text{ MHz}$	—	20	40	pF

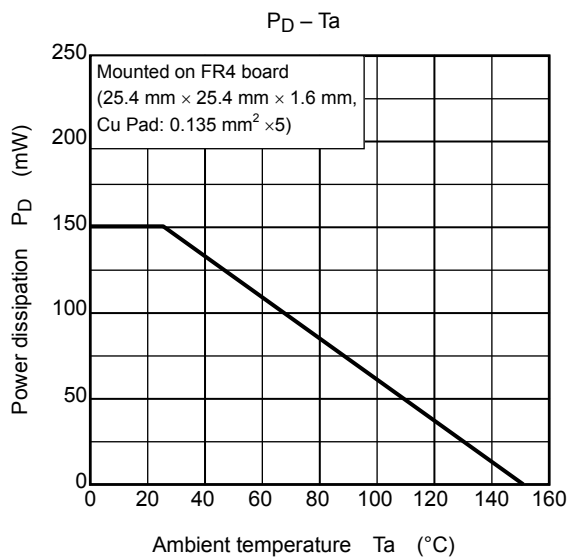
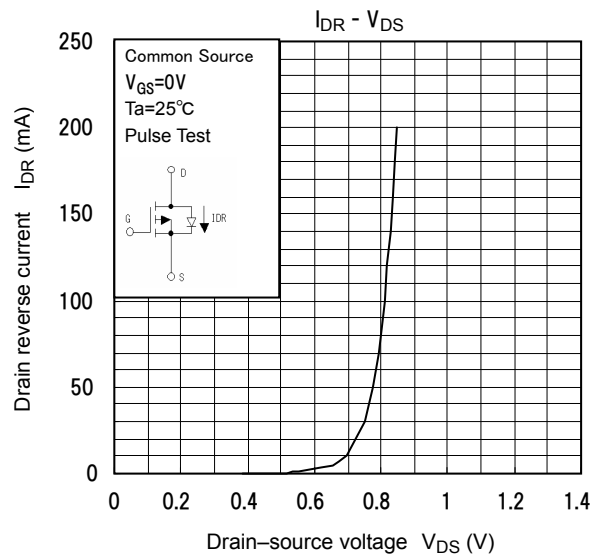
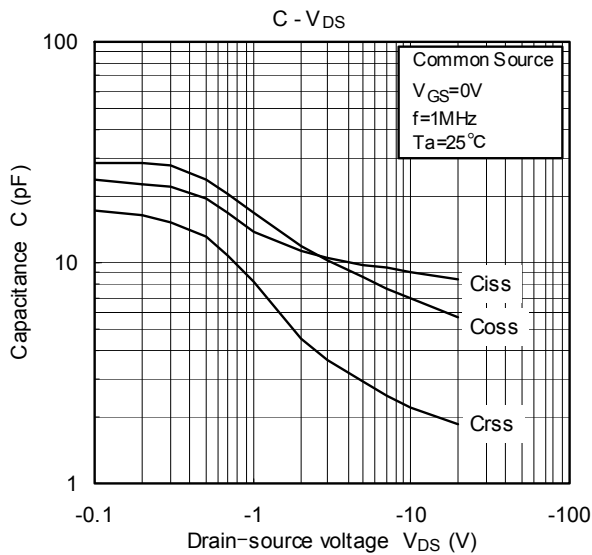
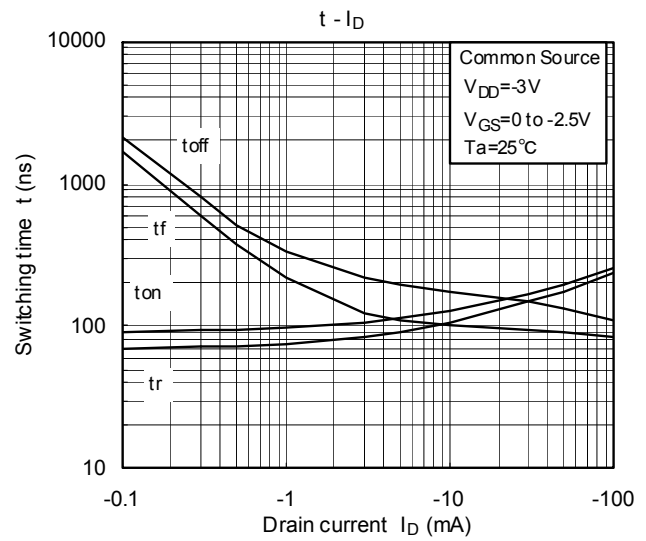
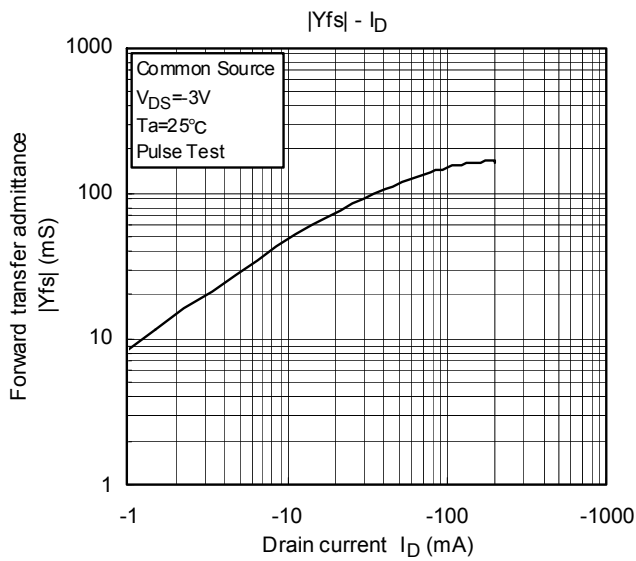
**Precaution**

The Schottky barrier diode in this device has large reverse current leakage compared to typical switching diodes. Thus, excessive operating temperature or voltage may cause thermal runaway. To avoid this problem, be sure to take both forward and reverse loss into consideration.

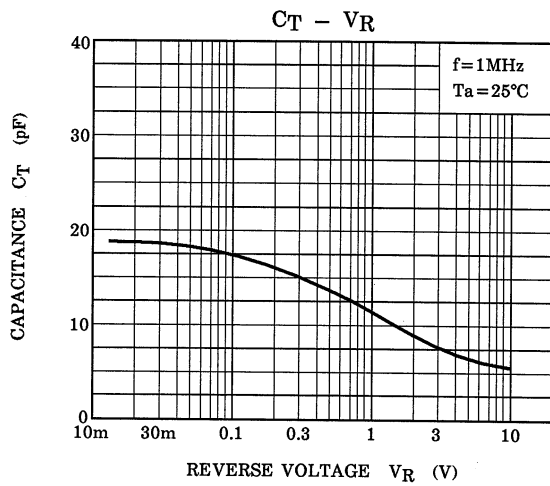
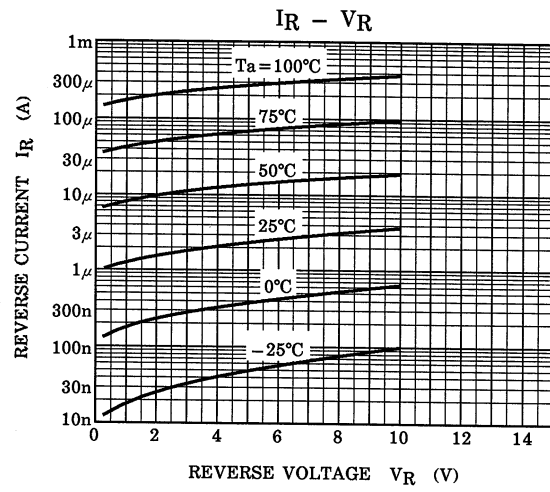
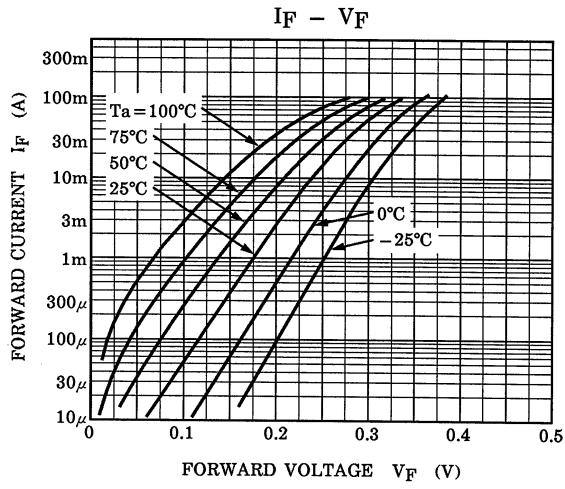
## MOSFET



## MOSFET



## SBD



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