

MOSFETs Silicon Carbide N-Channel MOS

TW054V65C

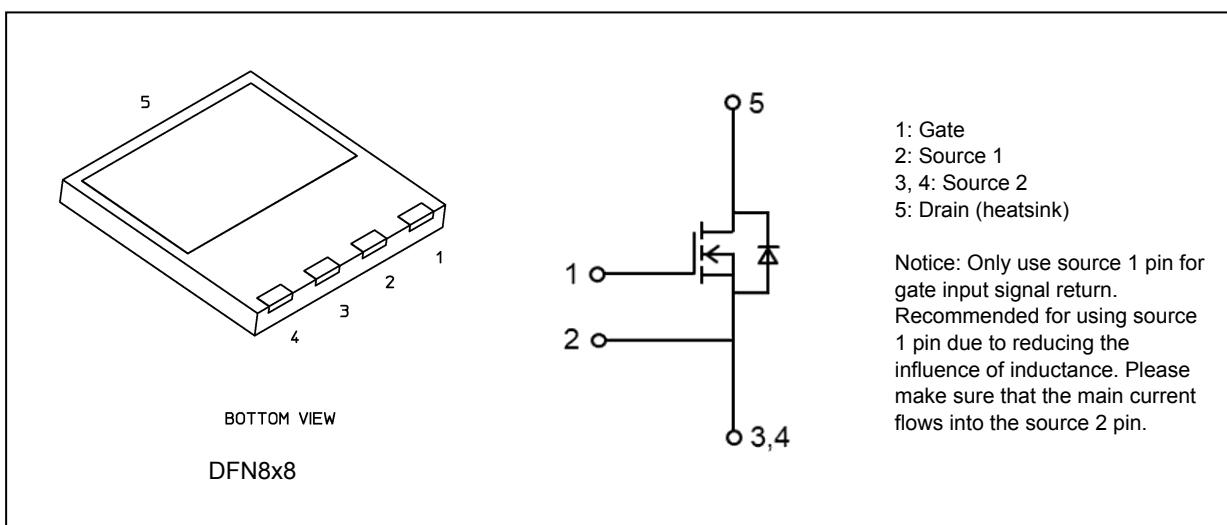
1. Applications

- Switching Voltage Regulators

2. Features

- (1) Chip design of 3rd generation (Built-in SiC schottky barrier diode)
- (2) Low diode forward voltage: $V_{DSF} = -1.35$ V (typ.)
- (3) High voltage: $V_{DSS} = 650$ V
- (4) Low drain-source on-resistance: $R_{DS(ON)} = 54$ m Ω (typ.)
- (5) Less susceptible to malfunction due to high threshold voltage: $V_{th} = 3.0$ to 5.0 V ($V_{DS} = 10$ V, $I_D = 1.6$ mA)
- (6) Recommended gate - source drive voltage: $V_{GS_on} = 18$ V, $V_{GS_off} = 0$ V
- (7) Enhancement mode.

3. Packaging and Internal Circuit



4. Absolute Maximum Ratings (Note) ($T_a = 25^\circ\text{C}$ unless otherwise specified)

Characteristics	Symbol	Rating	Unit
Drain-source voltage	V_{DSS}	650	V
Gate-source voltage	V_{GSS}	+25/-10	
Drain current (DC) ($T_c = 25^\circ\text{C}$) (Note 1)	I_D	36	A
Drain current (DC) ($T_c = 100^\circ\text{C}$) (Note 1)	I_D	25	
Drain current (pulsed) ($T_c = 25^\circ\text{C}$) (Note 1)	I_{DP}	99	
Drain current (pulsed) ($T_c = 100^\circ\text{C}$) (Note 1)	I_{DP}	76	
Power dissipation ($T_c = 25^\circ\text{C}$)	P_D	132	W
Channel temperature	T_{ch}	175	°C
Storage temperature	T_{stg}	-55 to 175	

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.).

5. Thermal Characteristics

Characteristics	Symbol	Max	Unit
Channel-to-case thermal resistance	$R_{th(ch-c)}$	1.133	°C/W

Note 1: Ensure that the channel temperature does not exceed 175 °C.

Note: This transistor is sensitive to electrostatic discharge and should be handled with care.
It should be used for switching applications.

6. Electrical Characteristics

6.1. Static Characteristics ($T_a = 25^\circ\text{C}$ unless otherwise specified)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Gate leakage current	I_{GSS}	$V_{GS} = +25/-10\text{ V}, V_{DS} = 0\text{ V}$	—	—	± 0.1	μA
Drain cut-off current	I_{DSS}	$V_{DS} = 650\text{ V}, V_{GS} = 0\text{ V}$	—	3.0	58	
		$T_a = 150^\circ\text{C}, V_{DS} = 650\text{ V}, V_{GS} = 0\text{ V}$	—	17	—	
Drain-source breakdown voltage	$V_{(BR)DSS}$	$I_D = 4\text{ mA}, V_{GS} = 0\text{ V}$	650	—	—	V
Gate threshold voltage (Note 2)	V_{th}	$V_{DS} = 10\text{ V}, I_D = 1.6\text{ mA}$	3.0	—	5.0	
Drain-source on-resistance	$R_{DS(\text{ON})}$	$V_{GS} = 18\text{ V}, I_D = 20\text{ A}$	—	54	81	$\text{m}\Omega$
		$T_a = 150^\circ\text{C}, V_{GS} = 18\text{ V}, I_D = 20\text{ A}$	—	58	—	

Note 2: Please be sure to apply I_{GSS} ($V_{GS} = 25\text{ V}$) before the V_{th} test.

6.2. Dynamic Characteristics ($T_a = 25^\circ\text{C}$ unless otherwise specified)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Input capacitance	C_{iss}	$V_{DS} = 400 \text{ V}, V_{GS} = 0 \text{ V}, f = 100 \text{ kHz}$	—	1362	—	pF
Reverse transfer capacitance	C_{rss}		—	4.4	—	
Output capacitance	C_{oss}		—	156	—	
Effective output capacitance (energy related)	$C_{o(er)}$		—	175	—	
Effective output capacitance (time related)	$C_{o(tr)}$		—	258	—	
Output charge	Q_{oss}		—	103	—	nC
C_{oss} stored energy	E_{oss}		—	14	—	μJ
Gate resistance	r_g	$V_{DS} = \text{OPEN}, f = 1 \text{ MHz}$	—	3.6	—	Ω
Turn-on delay time	$t_{d(on)}$	See Fig. 6.2.1	—	30	—	ns
Switching time (rise time)	t_r		—	14	—	
Turn-off delay time	$t_{d(off)}$		—	41	—	
Switching time (fall time)	t_f		—	16	—	
Turn-on switching loss	E_{on}		—	122	—	μJ
Turn-off switching loss	E_{off}		—	58	—	

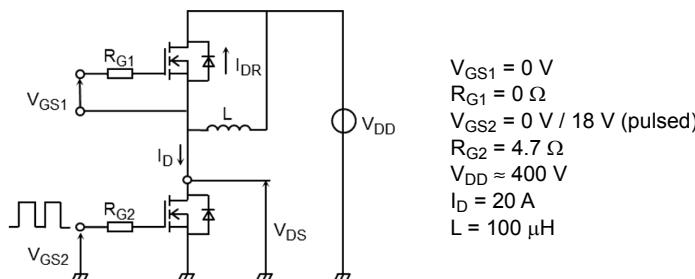


Fig. 6.2.1 Switching Time Test Circuit

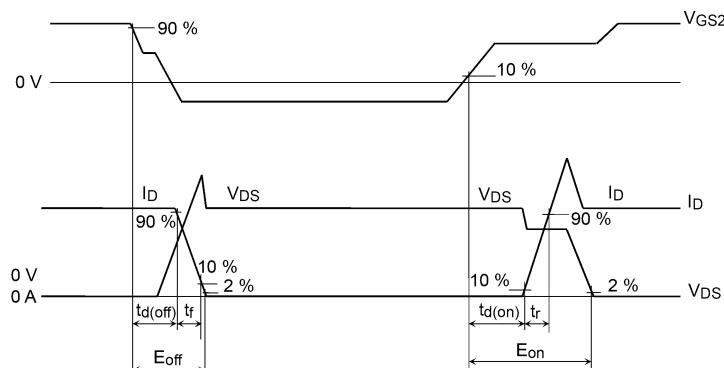


Fig. 6.2.2 Timing Diagrams

6.3. Gate Charge Characteristics ($T_a = 25^\circ\text{C}$ unless otherwise specified)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Total gate charge (gate-source plus gate-drain)	Q_g	$V_{DD} \approx 400 \text{ V}, V_{GS} = 18 \text{ V}, I_D = 20 \text{ A}$	—	41	—	nC
Gate-source charge 1	Q_{gs1}		—	17	—	
Gate-drain charge	Q_{gd}		—	6.2	—	

6.4. Source · Drain Characteristics ($T_a = 25^\circ\text{C}$ unless otherwise specified)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Reverse drain current (DC) (Note 3)	I_{DR}	$T_c = 25^\circ\text{C}, V_{GS} = -5 \text{ V}$	—	—	35	A
		$T_c = 100^\circ\text{C}, V_{GS} = -5 \text{ V}$	—	—	23	
		$T_c = 25^\circ\text{C}, V_{GS} = 18 \text{ V}$	—	—	36	
		$T_c = 100^\circ\text{C}, V_{GS} = 18 \text{ V}$	—	—	25	
Reverse drain current (pulsed)	I_{DRP}	$T_c = 25^\circ\text{C}, V_{GS} = -5 \text{ V}$	—	—	99	
		$T_c = 100^\circ\text{C}, V_{GS} = -5 \text{ V}$	—	—	41	
		$T_c = 25^\circ\text{C}, V_{GS} = 18 \text{ V}$	—	—	99	
		$T_c = 100^\circ\text{C}, V_{GS} = 18 \text{ V}$	—	—	76	
Diode forward voltage	V_{DSF}	$I_{DR} = 12 \text{ A}, V_{GS} = -5 \text{ V}$	—	-1.35	-1.80	V
		$T_a = 150^\circ\text{C}, I_{DR} = 12 \text{ A}, V_{GS} = -5 \text{ V}$	—	-1.60	—	
Reverse recovery time	t_{rr}	$I_{DR} = 13 \text{ A}, V_{GS} = 0 \text{ V}, V_{DD} = 400 \text{ V}, -dI_{DR}/dt = 1000 \text{ A}/\mu\text{s}$	—	50	—	ns
Reverse recovery charge	Q_{rr}		—	250	—	nC
Peak reverse recovery current	I_{rr}		—	10	—	A

Note 3: Ensure that the channel temperature does not exceed 175°C .

7. Marking

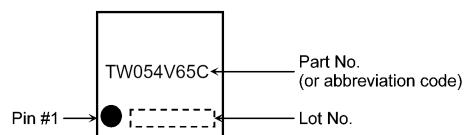
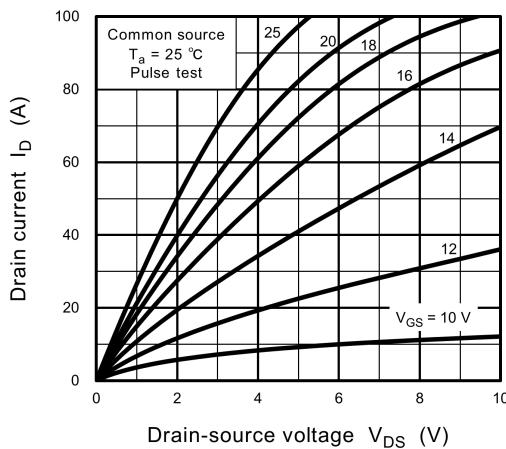
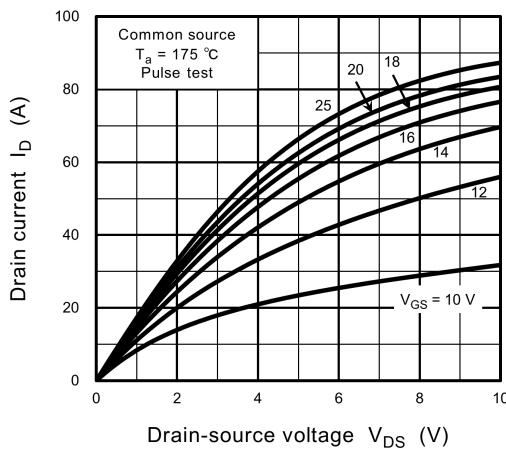
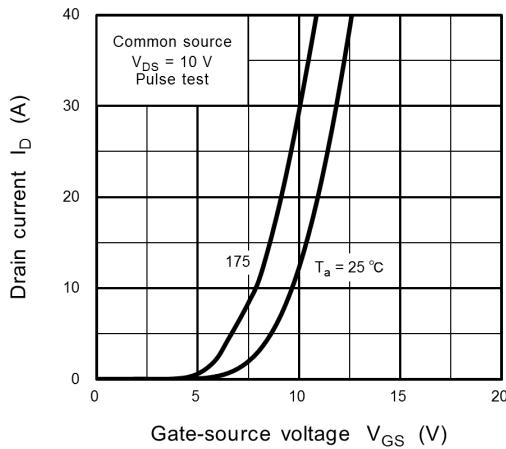
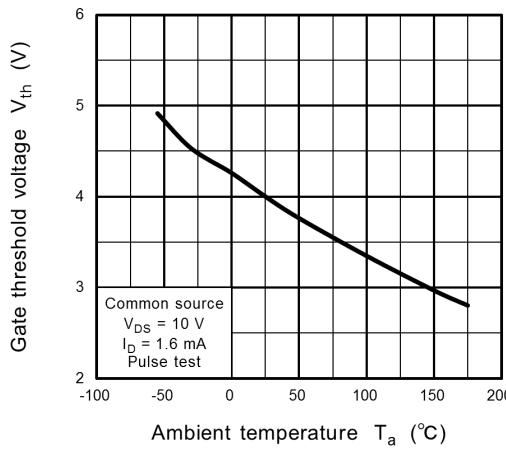
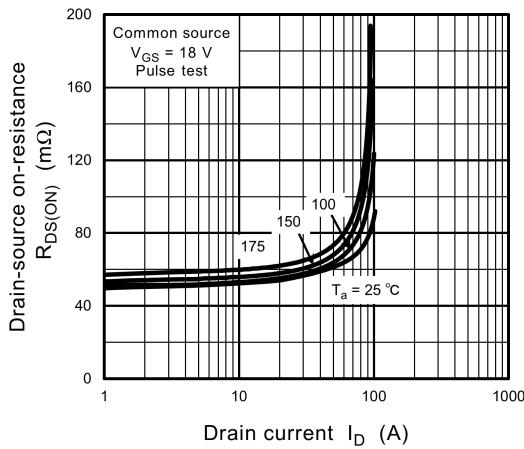
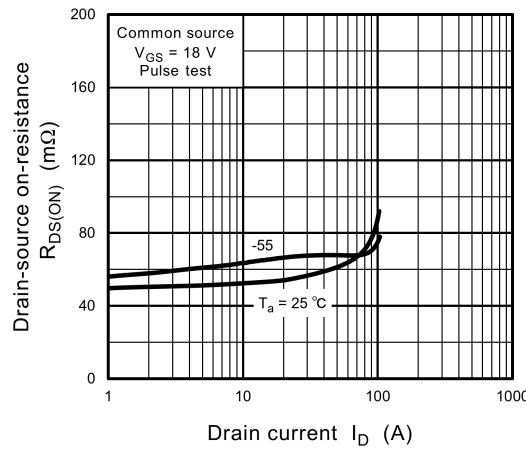
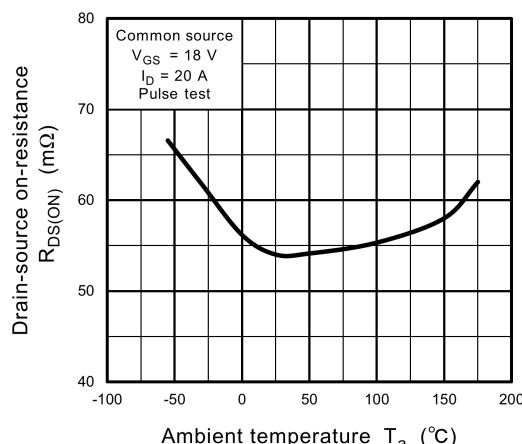
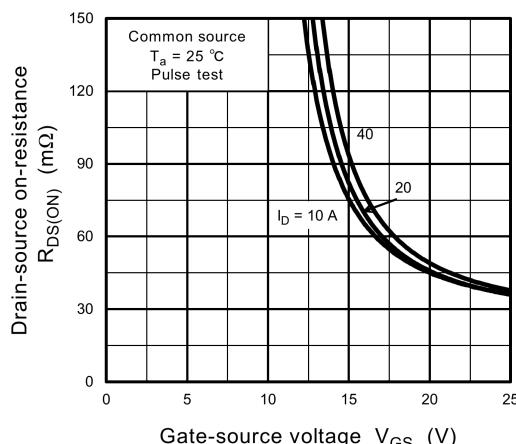
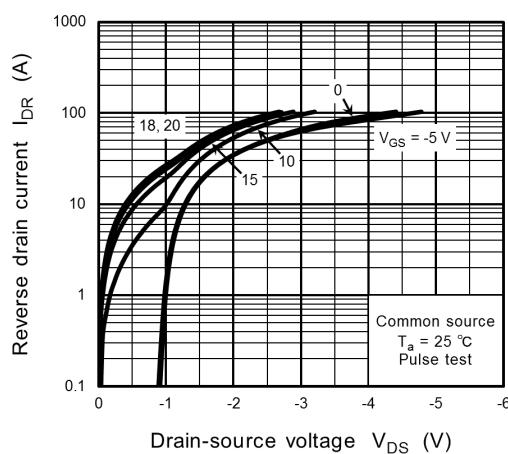
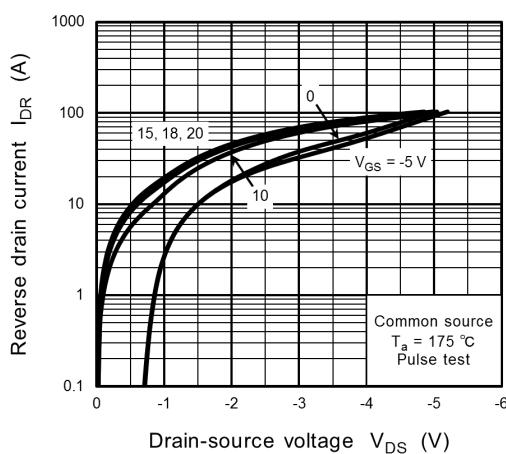
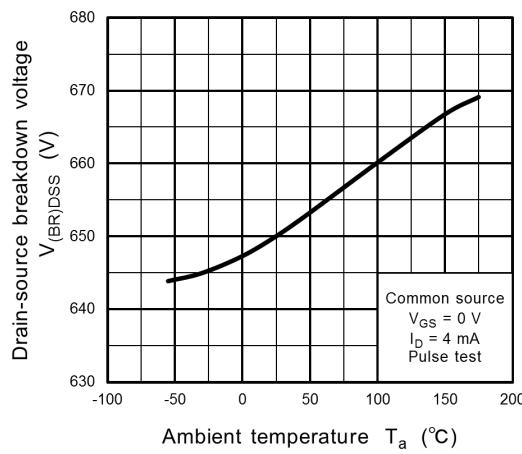
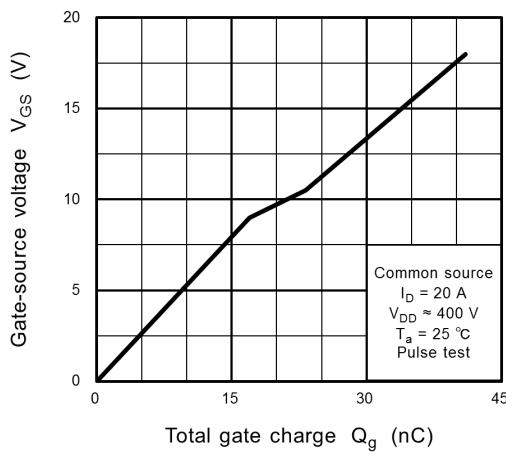
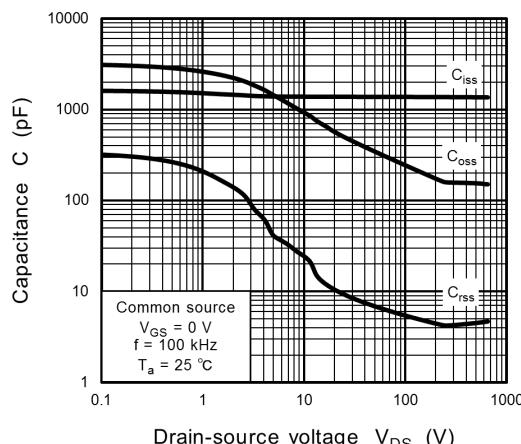
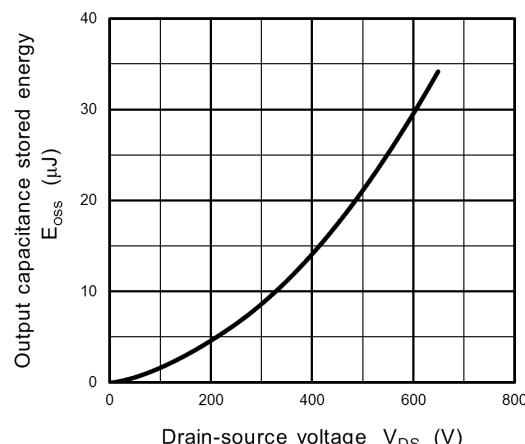
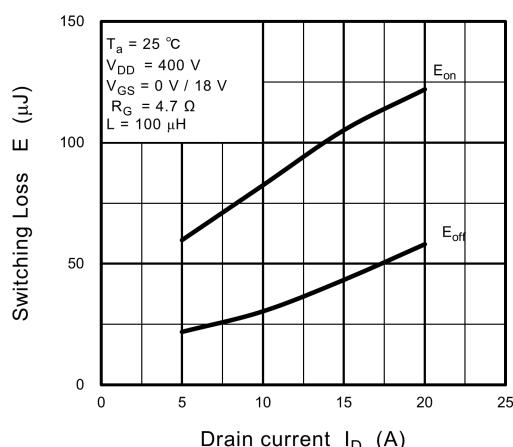
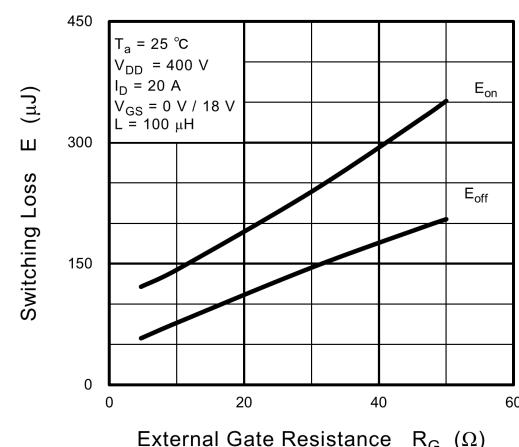
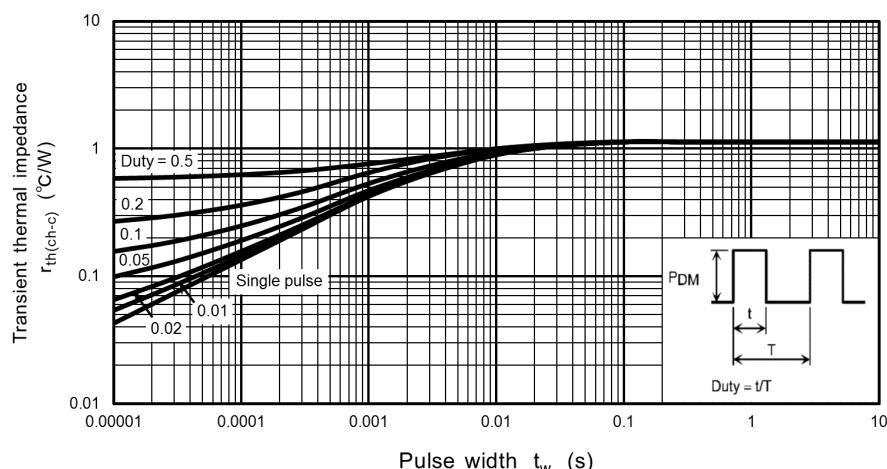


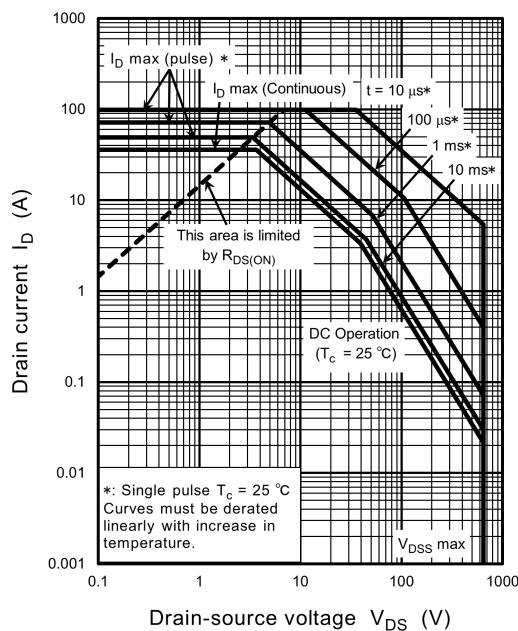
Fig. 7.1 Marking

8. Characteristics Curves (Note)

Fig. 8.1 I_D - V_{DS} Fig. 8.2 I_D - V_{DS} Fig. 8.3 I_D - V_{GS} Fig. 8.4 V_{th} - T_a Fig. 8.5 $R_{DS(ON)}$ - I_D Fig. 8.6 $R_{DS(ON)}$ - I_D

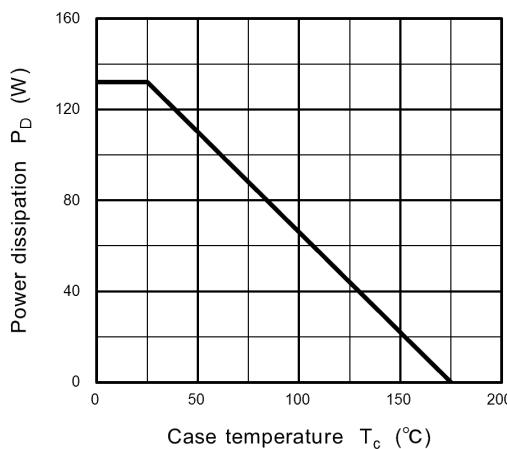

Fig. 8.7 $R_{DS(ON)} - T_a$

Fig. 8.8 $R_{DS(ON)} - V_{GS}$

Fig. 8.9 $I_{DR} - V_{DS}$

Fig. 8.10 $I_{DR} - V_{DS}$

Fig. 8.11 $V_{(BR)DSS} - T_a$

Fig. 8.12 Dynamic Input Characteristics


Fig. 8.13 C - V_{DS}

Fig. 8.14 E_{oss} - V_{DS}

Fig. 8.15 E - I_D

Fig. 8.16 E - R_G

**Fig. 8.17 $r_{th(\text{ch-c})}$ - t_w
(Guaranteed Maximum)**



**Fig. 8.18 Safe Operating Area
(Guaranteed Maximum)**

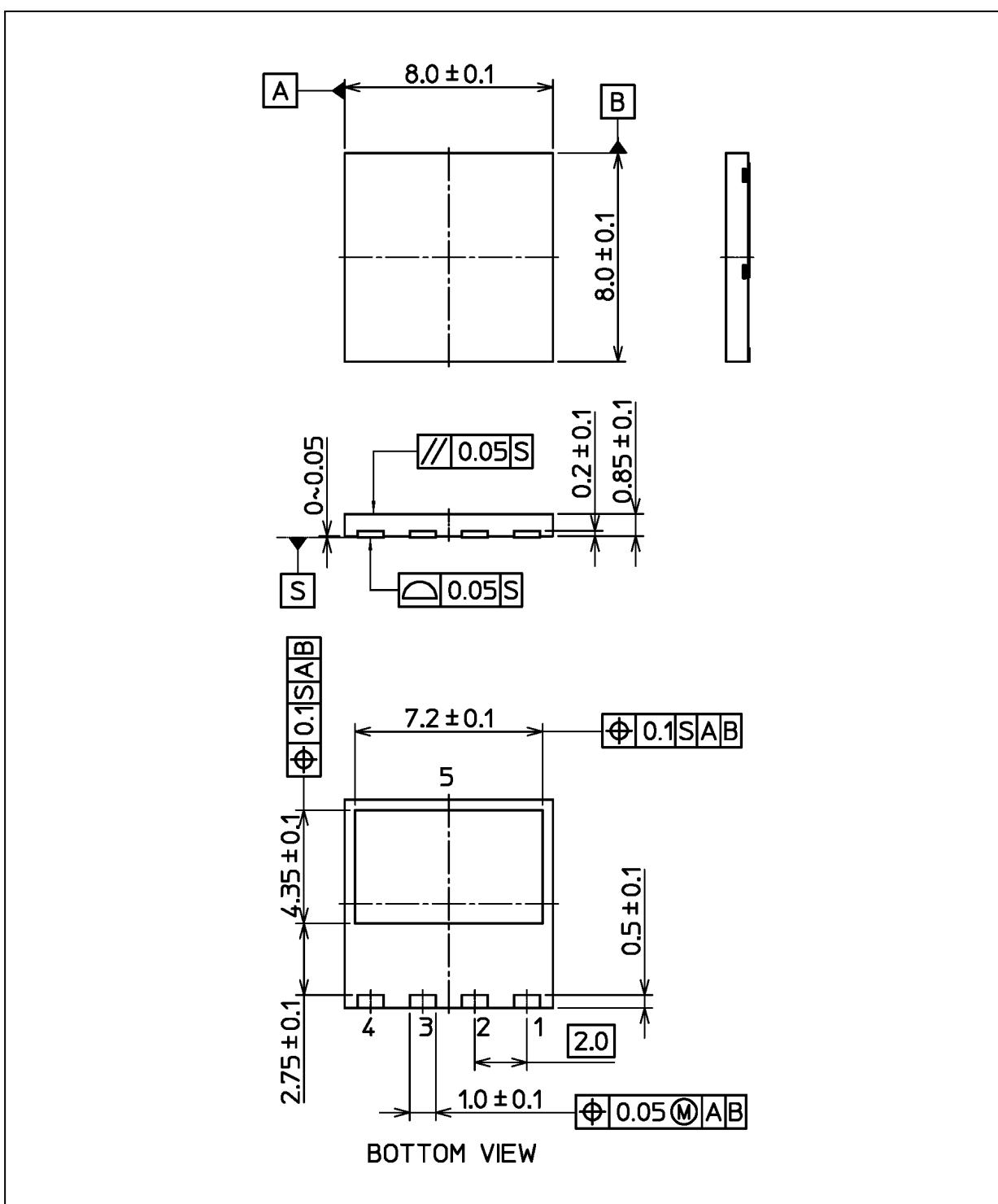
Note: The above characteristics curves are presented for reference only and not guaranteed by production test, unless otherwise noted.



**Fig. 8.19 $P_D - T_c$
(Guaranteed Maximum)**

Package Dimensions

Unit: mm



Weight: 0.175 g (typ.)

Package Name(s)
TOSHIBA: 2-8T1A
Nickname: DFN8x8

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