MOSFETs Silicon P-Channel MOS (U-MOSⅥ)

XPH8R316MC

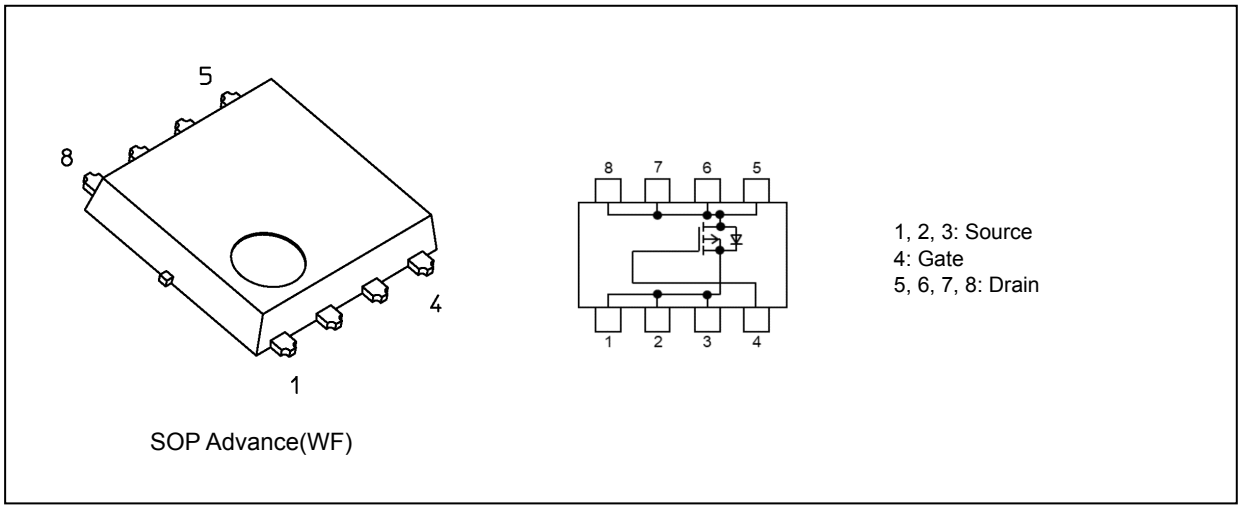
1. Applications

- Automotive
- Switching Voltage Regulators
- DC-DC Converters
- Motor Drivers

2. Features

(1) AEC-Q101 qualified
(2) Small, thin package
(3) Low drain-source on-resistance: $R_{DS(ON)}$ = 6.4 mΩ (typ.) (V_{GS} = -10 V)
(4) Low leakage current: I_{DSS} = -10 μA (max) (V_{DS} = -60 V)
(5) Enhancement mode: V_{th} = -1.0 to -2.1 V (V_{DS} = -10 V, I_D = -1 mA)

3. Packaging and Internal Circuit



SOP Advance(WF)

Start of commercial production
2023-05

4. Absolute Maximum Ratings (Note) (T_a = 25 °C unless otherwise specified)

Characteristics			Symbol	Rating	Unit
Drain-source voltage			V_{DSS}	-60	V
Gate-source voltage		(Note 1)	V_{GSS}	+10/-20	
Drain current (DC)		(Note 2)	I_D	-90	A
Drain current (pulsed)		(Note 2)	I_{DP}	-180	
Power dissipation	(T_c = 25 °C)		P_D	170	W
Power dissipation	(t = 10 s)	(Note 3)		3	
Power dissipation	(t = 10 s)	(Note 4)		0.96	
Single-pulse avalanche energy		(Note 5)	E_{AS}	126	mJ
Single-pulse avalanche current			I_{AS}	-90	A
Channel temperature		(Note 6)	T_{ch}	175	°C
Storage temperature		(Note 6)	T_{stg}	-55 to 175	

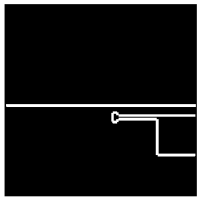
Note: Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.)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

Note 1: AEC-Q101 qualification is performed at V_{GS} = 8/-20 V, Ta=175°C

5. Thermal Characteristics

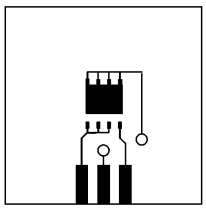
Characteristics			Symbol	Max	Unit
Channel-to-case thermal impedance	(T_c = 25 °C)		$z_{th(ch-c)}$	0.88	°C/W
Channel-to-ambient thermal impedance	(t = 10 s)	(Note 3)	$z_{th(ch-a)}$	50	
Channel-to-ambient thermal impedance	(t = 10 s)	(Note 4)	$z_{th(ch-a)}$	156	

Note 2: Ensure that the channel temperature does not exceed 175 °C.
Note 3: Device mounted on a glass-epoxy board (a), Figure 5.1
Note 4: Device mounted on a glass-epoxy board (b), Figure 5.2
Note 5: V_{DD} = -48 V, T_{ch} = 25 °C (initial), L = 12 μH, R_G = 25 Ω, I_{AS} = -90 A, V_{GS} = 0/-15 V
Note 6: The definitions of the absolute maximum channel and storage temperatures are qualified per AEC-Q101.



FR-4
25.4 × 25.4 × 1.6
(Unit: mm)
2 oz copper

Fig. 5.1 Device Mounted on a Glass-Epoxy Board (a)



FR-4
25.4 × 25.4 × 1.6
(Unit: mm)
2 oz copper

Fig. 5.2 Device Mounted on a Glass-Epoxy Board (b)

Note: This transistor is sensitive to electrostatic discharge and should be handled with care.

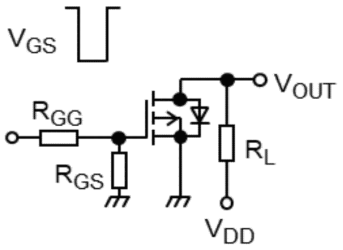
6. Electrical Characteristics

6.1. Static Characteristics (T_a = 25 °C unless otherwise specified)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Gate leakage current	I_{GSS}	V_{GS} = +10/-20 V, V_{DS} = 0 V	—	—	±1	μA
Drain cut-off current	I_{DSS}	V_{DS} = -60 V, V_{GS} = 0 V	—	—	-10	
Drain-source breakdown voltage	$V_{(BR)DSS}$	I_D = -10 mA, V_{GS} = 0 V	-60	—	—	V
	$V_{(BR)DSX}$	I_D = -10 mA, V_{GS} = 10 V	-50	—	—	
Gate threshold voltage	V_{th}	V_{DS} = -10 V, I_D = -1 mA	-1.0	—	-2.1	
Drain-source on-resistance	$R_{DS(ON)}$	V_{GS} = -4.5 V, I_D = -45 A	—	6.8	10.2	mΩ
		V_{GS} = -10 V, I_D = -45 A	—	6.4	8.3	

6.2. Dynamic Characteristics (T_a = 25 °C unless otherwise specified)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Input capacitance	C_{iss}	V_{DS} = -10 V, V_{GS} = 0 V, f = 300 kHz	—	10500	14700	pF
Reverse transfer capacitance	C_{rss}		—	740	1036	
Output capacitance	C_{oss}		—	860	—	
Gate resistance	r_g		—	13	26	Ω
Switching time (rise time)	t_r	See Fig. 6.2.1	—	115	—	ns
Switching time (turn-on time)	t_{on}		—	125	—	
Switching time (fall time)	t_f		—	436	—	
Switching time (turn-off time)	t_{off}		—	1890	—	



V_{DD} ≈ -30 V
V_{GS} = 0 V/ -10 V
I_D = -45 A
R_L = 0.67 Ω
R_{GG} = R_{GS} = 50 Ω
Duty ≤ 1 %, t_w = 10 μs

Fig. 6.2.1 Switching Time Test Circuit

6.3. Gate Charge Characteristics (T_a = 25 °C unless otherwise specified)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Total gate charge (gate-source plus gate-drain)	Q_g	V_{DD} ≈ -48 V, V_{GS} = -10 V, I_D = -90 A	—	222	—	nC
Gate-source charge 1	Q_{gs1}		—	19	—	
Gate-drain charge	Q_{gd}		—	47	—	

6.4. Source-Drain Characteristics (T_a = 25 °C unless otherwise specified)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Reverse drain current (DC) (Note 7)	I_{DR}	—	—	—	-90	A
Reverse drain current (pulsed) (Note 7)	I_{DRP}	—	—	—	-180	A
Diode forward voltage	V_{DSF}	I_{DR} = -90 A, V_{GS} = 0 V	—	—	1.2	V
Reverse recovery time	t_{rr}	I_{DR} = -90 A, V_{GS} = 0 V $-dI_{DR}/dt$ = -50 A/μs	—	113	—	ns
Reverse recovery charge	Q_{rr}		—	90	—	nC

Note 7: Ensure that the channel temperature does not exceed 175 °C.

7. Marking

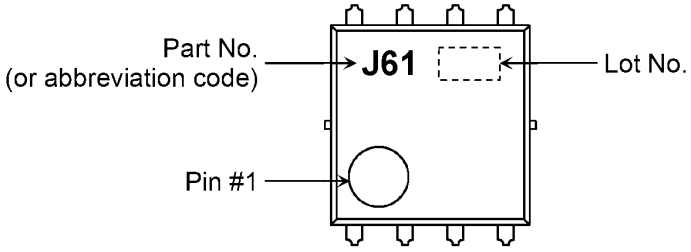


Fig. 7.1 Marking

8. Characteristics Curves (Note)

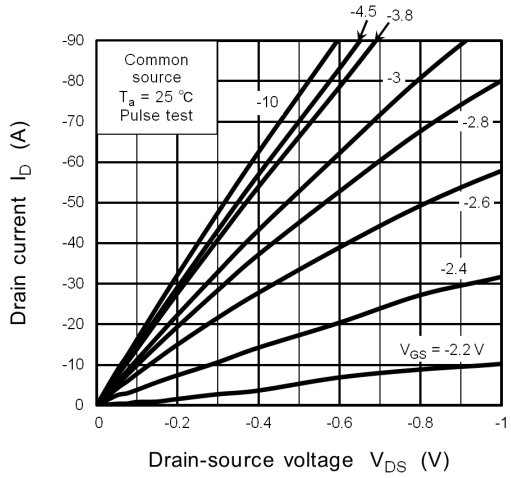


Fig. 8.1 I_D - V_{DS}

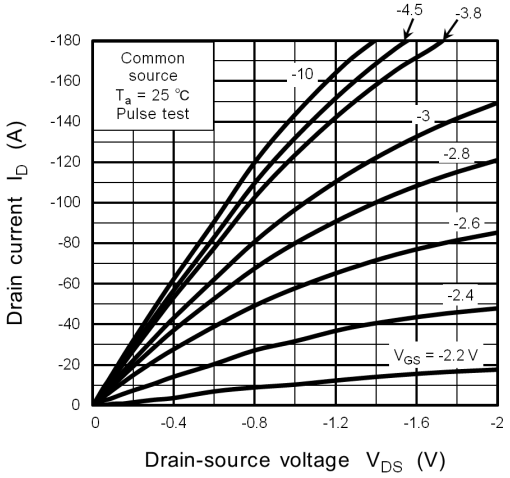


Fig. 8.2 I_D - V_{DS}

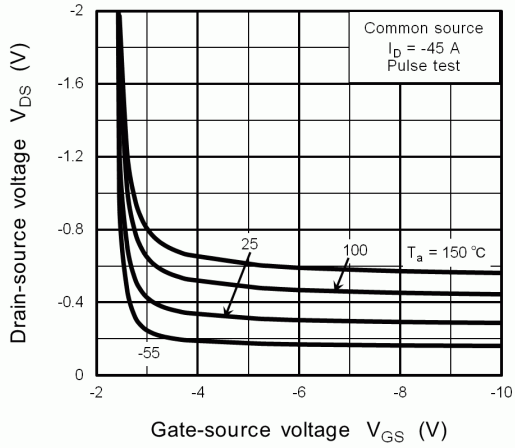


Fig. 8.3 V_{DS} - V_{GS}

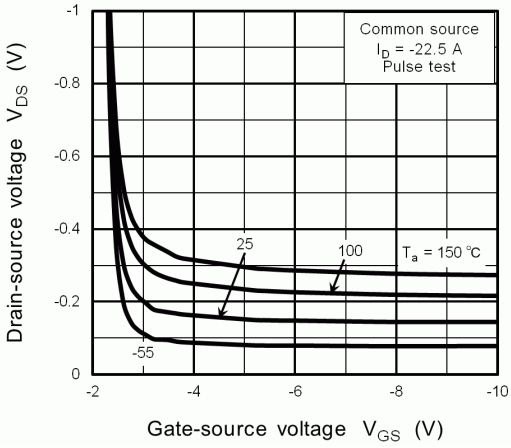


Fig. 8.4 V_{DS} - V_{GS}

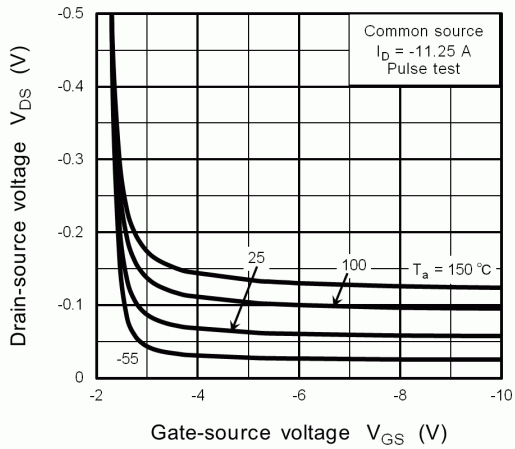


Fig. 8.5 V_{DS} - V_{GS}

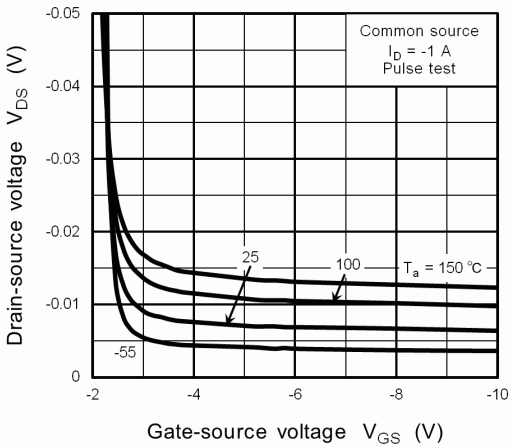


Fig. 8.6 V_{DS} - V_{GS}

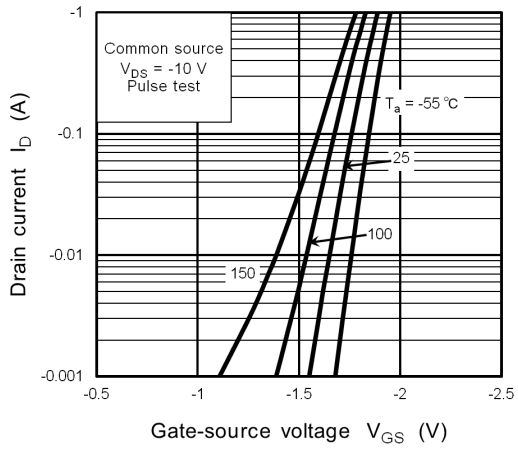


Fig. 8.7 I_D - V_{GS}

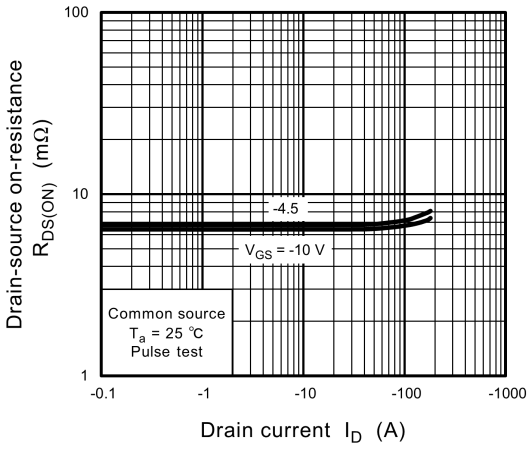


Fig. 8.8 $R_{DS(ON)}$ - I_D

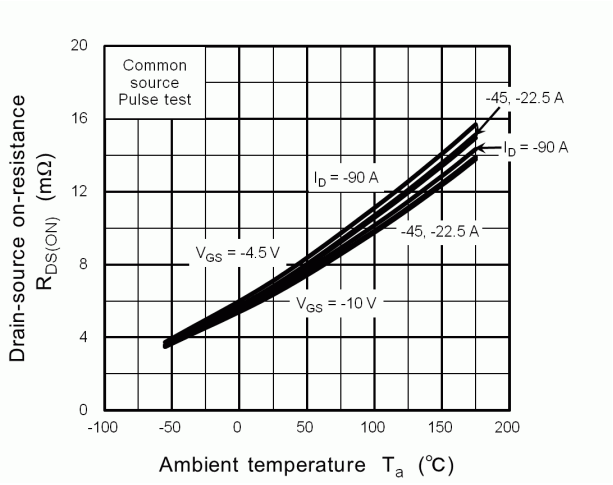


Fig. 8.9 $R_{DS(ON)}$ - T_a

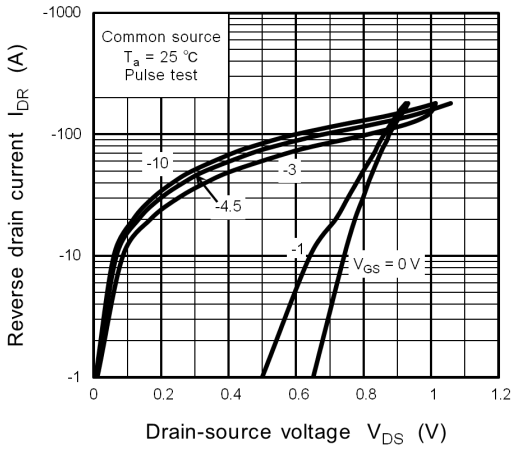


Fig. 8.10 I_{DR} - V_{DS}

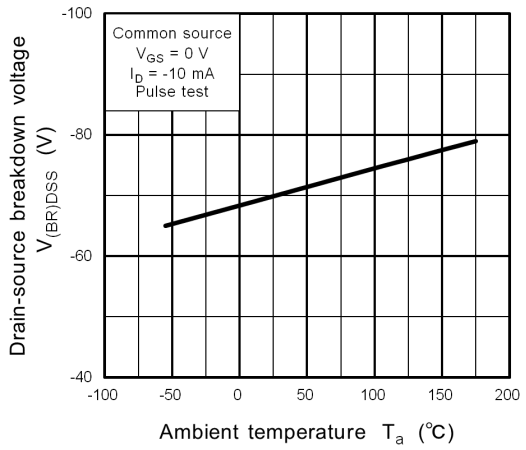


Fig. 8.11 $V_{(BR)DSS}$ - T_a

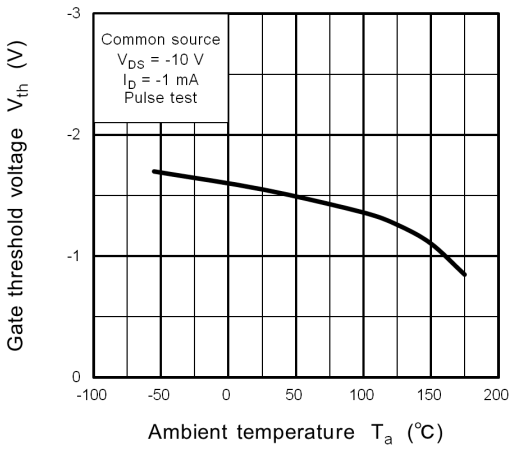


Fig. 8.12 V_{th} - T_a

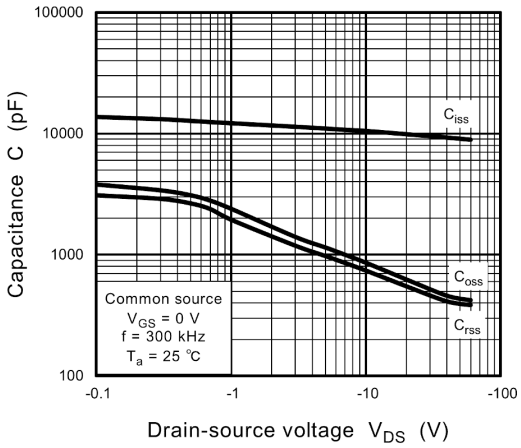


Fig. 8.13 Capacitance - V_{DS}

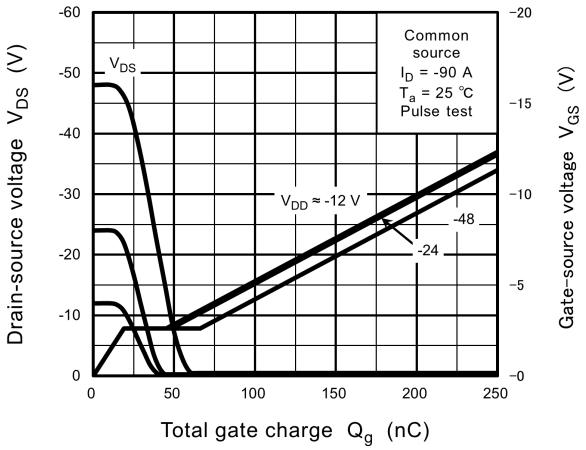


Fig. 8.14 Dynamic Input/Output Characteristics

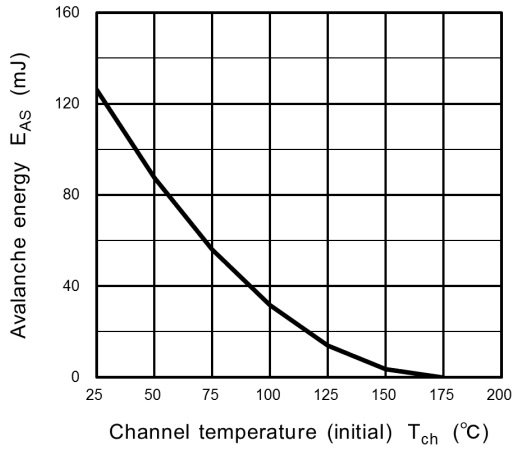


Fig. 8.15 E_{AS} - T_{ch} (Guaranteed Maximum)

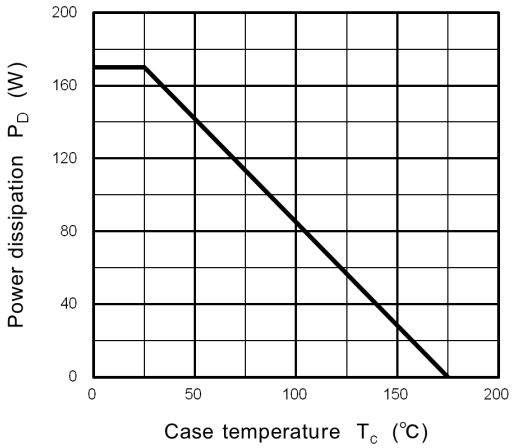
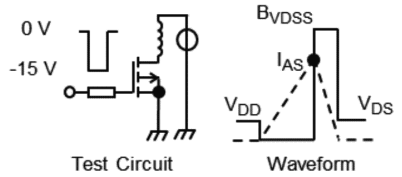


Fig. 8.16 P_D - T_c (Guaranteed Maximum)



R_G = 25 Ω
V_{DD} = -48 V, L = 12 μH

$$E_{AS} = \frac{1}{2} \cdot L \cdot I_{AS}^2 \cdot \left(\frac{B_{VDSS}}{B_{VDSS} - V_{DD}} \right)$$

Fig. 8.17 Test Circuit/Waveform

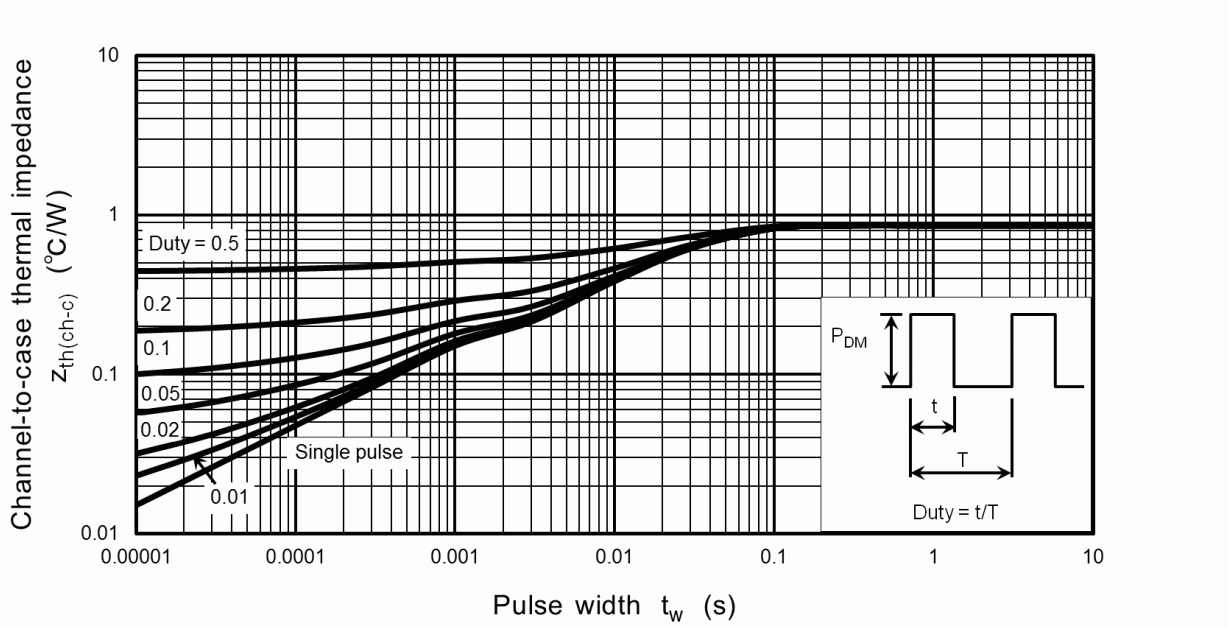


Fig. 8.18 $z_{th(ch-c)}$ - t_w (Guaranteed Maximum)

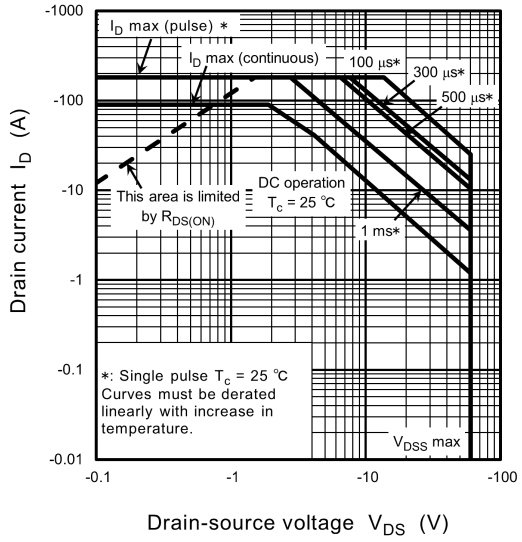
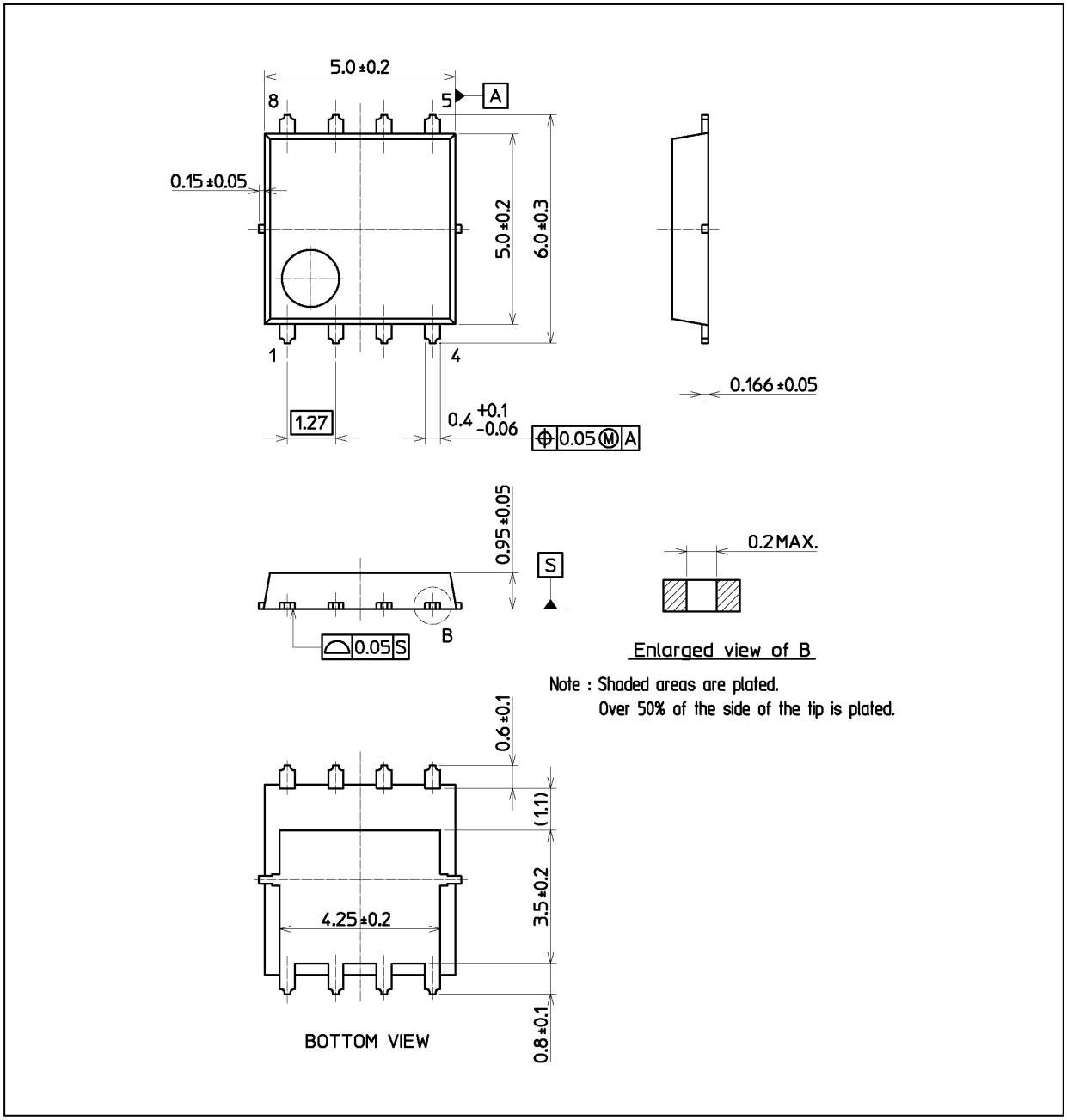


Fig. 8.19 Safe Operating Area (Guaranteed Maximum)

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

Package Dimensions

Unit: mm



Weight: 0.083 g (typ.)

Package Name(s)
TOSHIBA: 2-5Q4A
Nickname: SOP Advance(WF)

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