

MOSFETs Silicon N-channel MOS (U-MOSIX-H)

XPH1R104PS

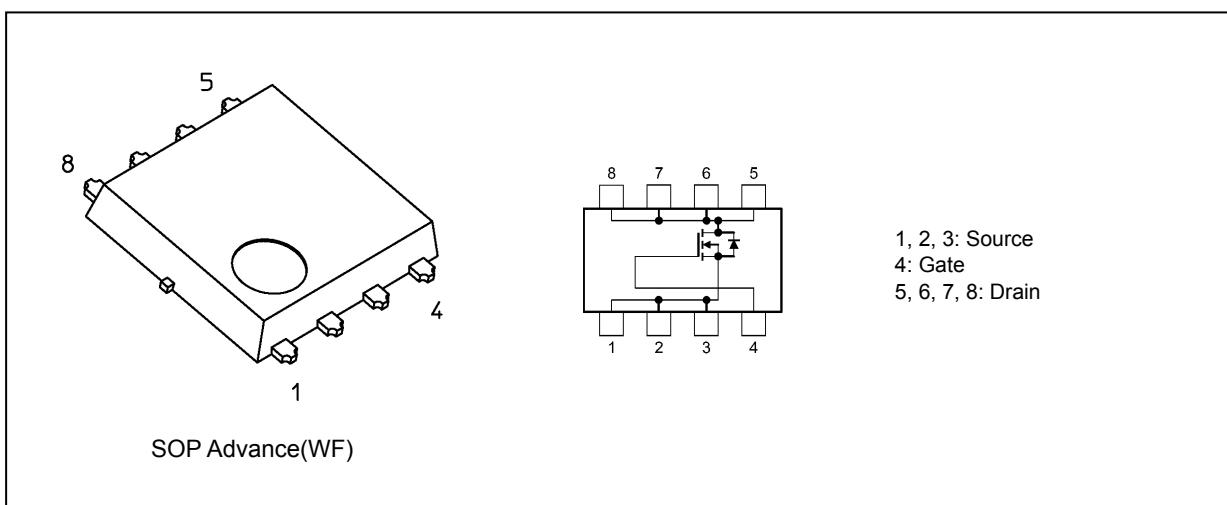
1. Applications

- Automotive
- Motor Drivers
- Switching Voltage Regulators

2. Features

- (1) AEC-Q101 qualified
- (2) Small, thin package
- (3) Low drain-source on-resistance: $R_{DS(ON)} = 0.95 \text{ m}\Omega$ (typ.) ($V_{GS} = 10 \text{ V}$)
- (4) Low leakage current: $I_{DSS} = 10 \mu\text{A}$ (max) ($V_{DS} = 40 \text{ V}$)
- (5) Enhancement mode: $V_{th} = 2.0$ to 3.0 V ($V_{DS} = 10 \text{ V}$, $I_D = 0.5 \text{ mA}$)

3. Packaging and Internal Circuit



Start of commercial production
2021-10

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

Characteristics	Symbol	Rating	Unit
Drain-source voltage	V_{DSS}	40	V
Gate-source voltage	V_{GSS}	± 20	
Drain current (DC)	I_D	120	A
Drain current (pulsed)	I_{DP}	360	
Power dissipation ($T_c = 25^\circ\text{C}$)	P_D	132	W
Power dissipation ($t = 10\text{ s}$)		3.0	
Power dissipation ($t = 10\text{ s}$)		0.96	
Single-pulse avalanche energy	E_{AS}	140	mJ
Single-pulse avalanche current	I_{AS}	120	A
Channel temperature	T_{ch}	175	$^\circ\text{C}$
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 impedance ($T_c = 25^\circ\text{C}$)	$Z_{th(ch-c)}$	1.13	$^\circ\text{C/W}$
Channel-to-ambient thermal impedance ($t = 10\text{ s}$)	$Z_{th(ch-a)}$	50	
Channel-to-ambient thermal impedance ($t = 10\text{ s}$)	$Z_{th(ch-a)}$	156	

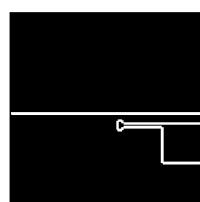
Note 1: Ensure that the channel temperature does not exceed 175°C .

Note 2: Device mounted on a glass-epoxy board (a), Figure 5.1

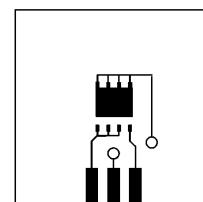
Note 3: Device mounted on a glass-epoxy board (b), Figure 5.2

Note 4: $V_{DD} = 32\text{ V}$, $T_{ch} = 25^\circ\text{C}$ (initial), $L = 7.47\text{ }\mu\text{H}$, $R_G = 25\text{ }\Omega$, $I_{AS} = 120\text{ A}$

Note 5: The definitions of the absolute maximum channel and storage temperatures are qualified per AEC-Q101.



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



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

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

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

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Gate leakage current	I_{GSS}	$V_{GS} = \pm 20\text{ V}$, $V_{DS} = 0\text{ V}$	—	—	± 1	μA
Drain cut-off current	I_{DSS}	$V_{DS} = 40\text{ V}$, $V_{GS} = 0\text{ V}$	—	—	10	
Drain-source breakdown voltage	$V_{(BR)DSS}$	$I_D = 10\text{ mA}$, $V_{GS} = 0\text{ V}$	40	—	—	V
	$V_{(BR)DSX}$	$I_D = 10\text{ mA}$, $V_{GS} = -20\text{ V}$	20	—	—	
Gate threshold voltage	V_{th}	$V_{DS} = 10\text{ V}$, $I_D = 0.5\text{ mA}$	2.0	—	3.0	
Drain-source on-resistance	$R_{DS(\text{ON})}$	$V_{GS} = 6\text{ V}$, $I_D = 60\text{ A}$	—	1.30	1.96	$\text{m}\Omega$
		$V_{GS} = 10\text{ V}$, $I_D = 60\text{ A}$	—	0.95	1.14	

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}	$V_{DS} = 10\text{ V}$, $V_{GS} = 0\text{ V}$, $f = 300\text{ kHz}$	—	4560	—	pF
Reverse transfer capacitance	C_{rss}		—	320	—	
Output capacitance	C_{oss}		—	2940	—	
Gate resistance	r_g		—	2.9	—	Ω
Switching time (rise time)	t_r	See Fig. 6.2.1	—	8	—	ns
Switching time (turn-on time)	t_{on}		—	22	—	
Switching time (fall time)	t_f		—	23	—	
Switching time (turn-off time)	t_{off}		—	71	—	

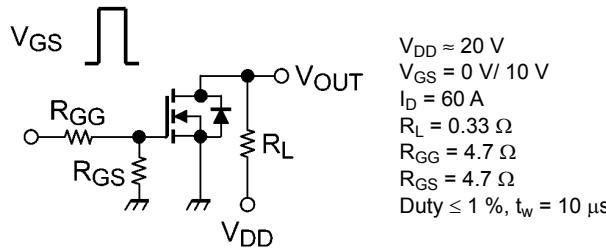


Fig. 6.2.1 Switching Time Test Circuit

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	$V_{DD} \approx 32\text{ V}$, $V_{GS} = 10\text{ V}$, $I_D = 120\text{ A}$	—	55	—	nC
Gate-source charge 1	Q_{gs1}		—	20	—	
Gate-drain charge	Q_{gd}		—	13	—	

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 (pulsed) (Note 6)	I_{DRP}	—	—	—	360	A
Diode forward voltage	V_{DSF}	$I_{DR} = 120\text{ A}$, $V_{GS} = 0\text{ V}$	—	—	-1.2	V

Note 6: Ensure that the channel temperature does not exceed 175°C .

7. Marking

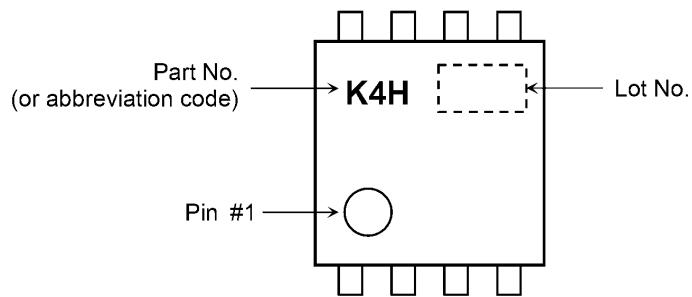
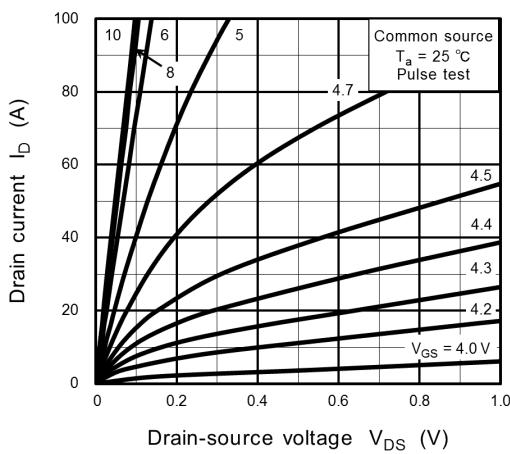
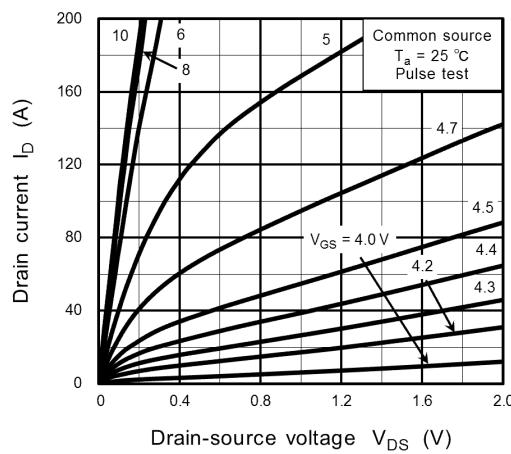
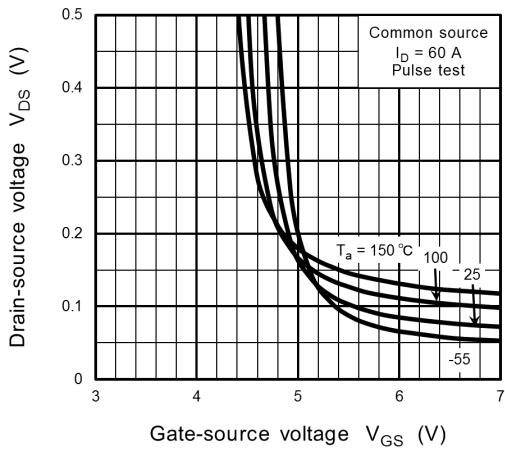
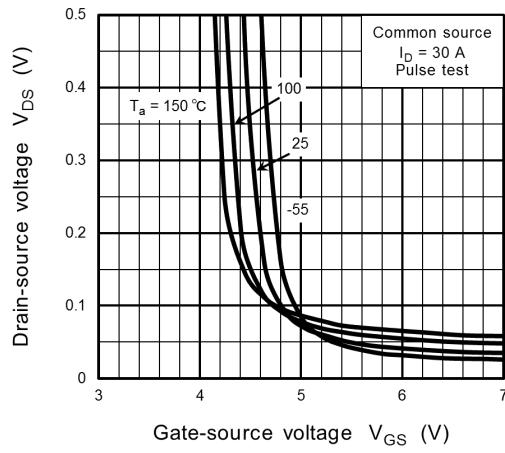
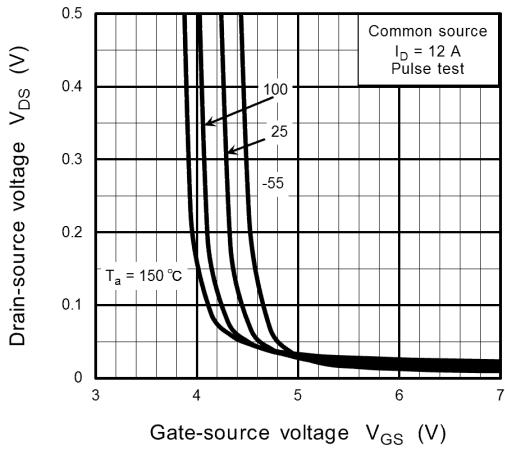
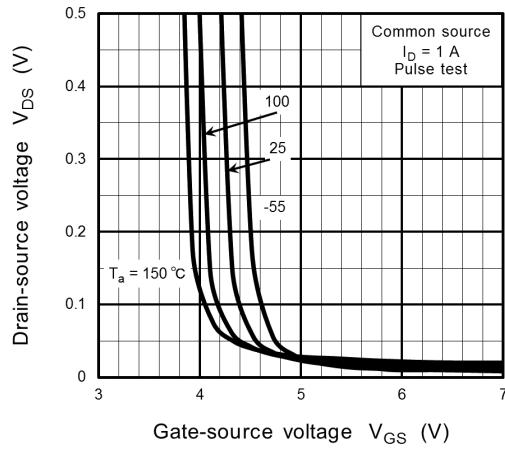


Fig. 7.1 Marking

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}

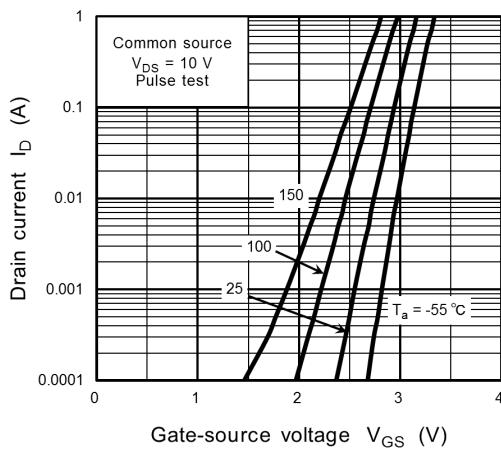


Fig. 8.7 I_D - V_{GS}

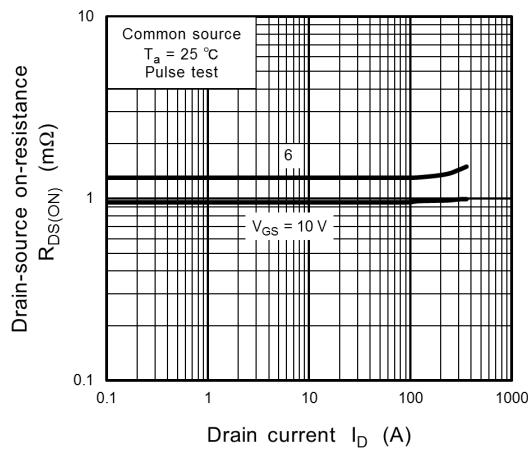


Fig. 8.8 $R_{DS(ON)}$ - I_D

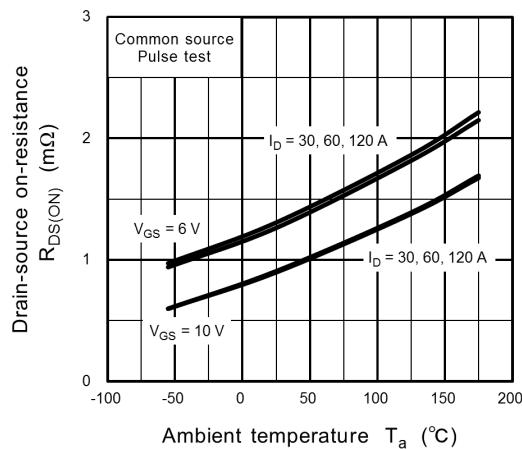


Fig. 8.9 $R_{DS(ON)}$ - T_a

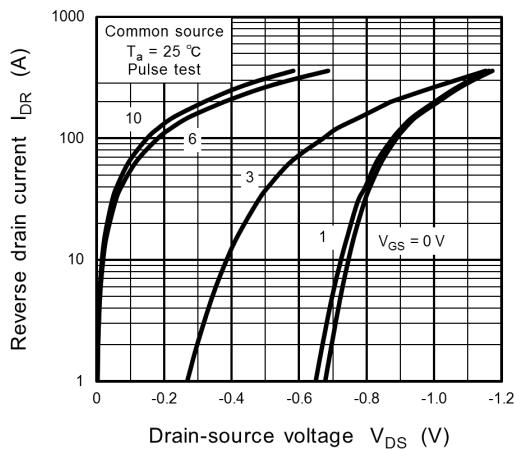


Fig. 8.10 I_{DR} - V_{DS}

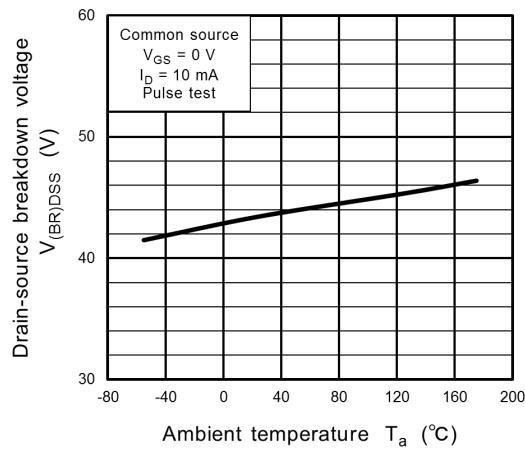


Fig. 8.11 $V_{(BR)DSS}$ - T_a

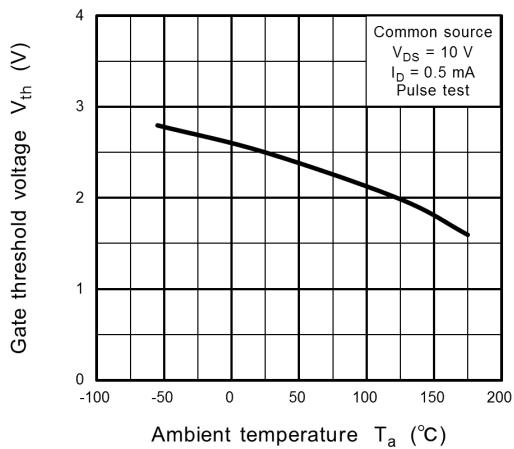


Fig. 8.12 V_{th} - T_a

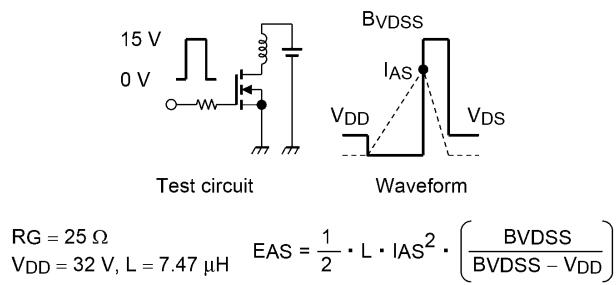
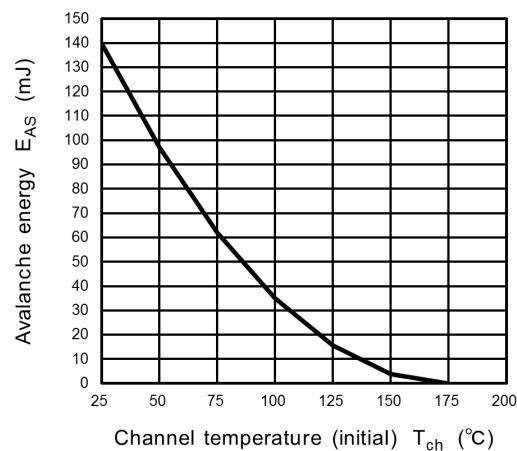
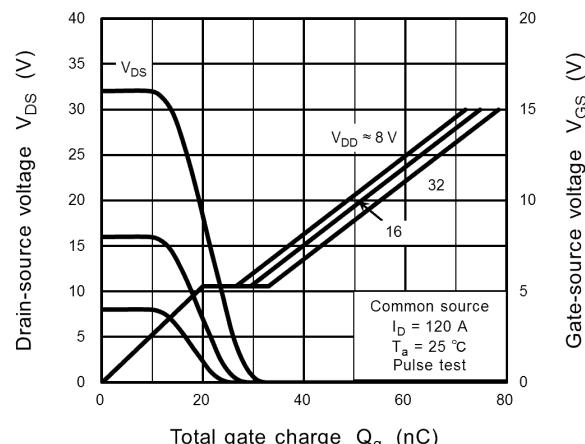
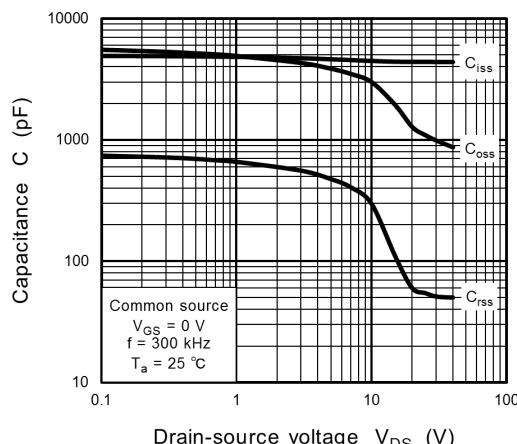
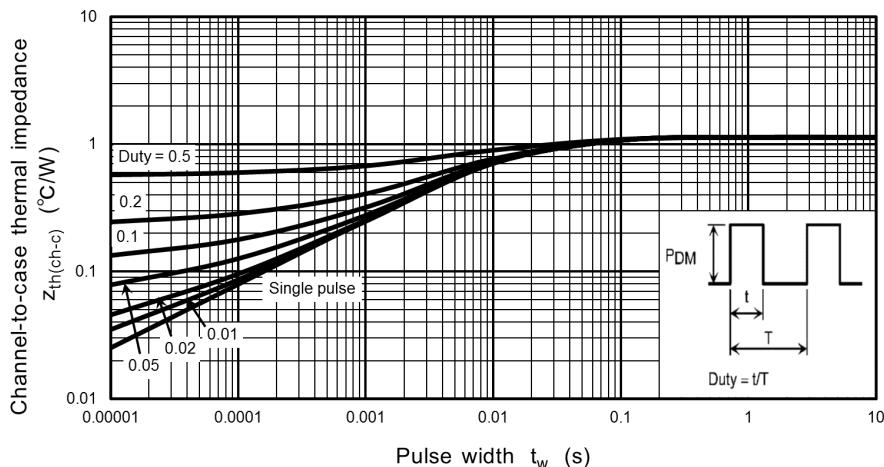
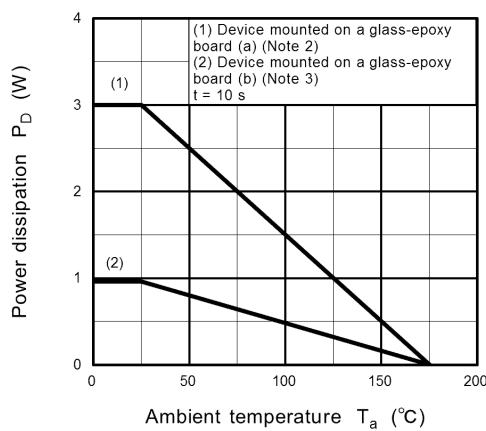


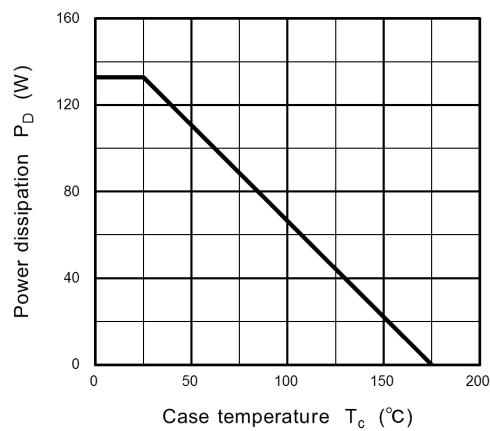
Fig. 8.16 Test Circuit/Waveform



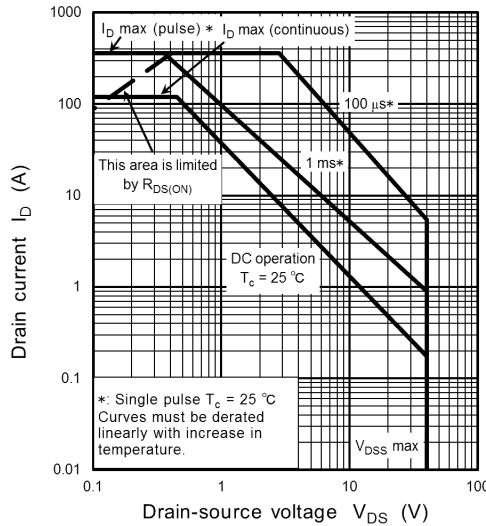
**Fig. 8.17 $Z_{th(ch-c)} - t_w$
(Guaranteed Maximum)**



**Fig. 8.18 $P_D - T_a$
(Guaranteed Maximum)**



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

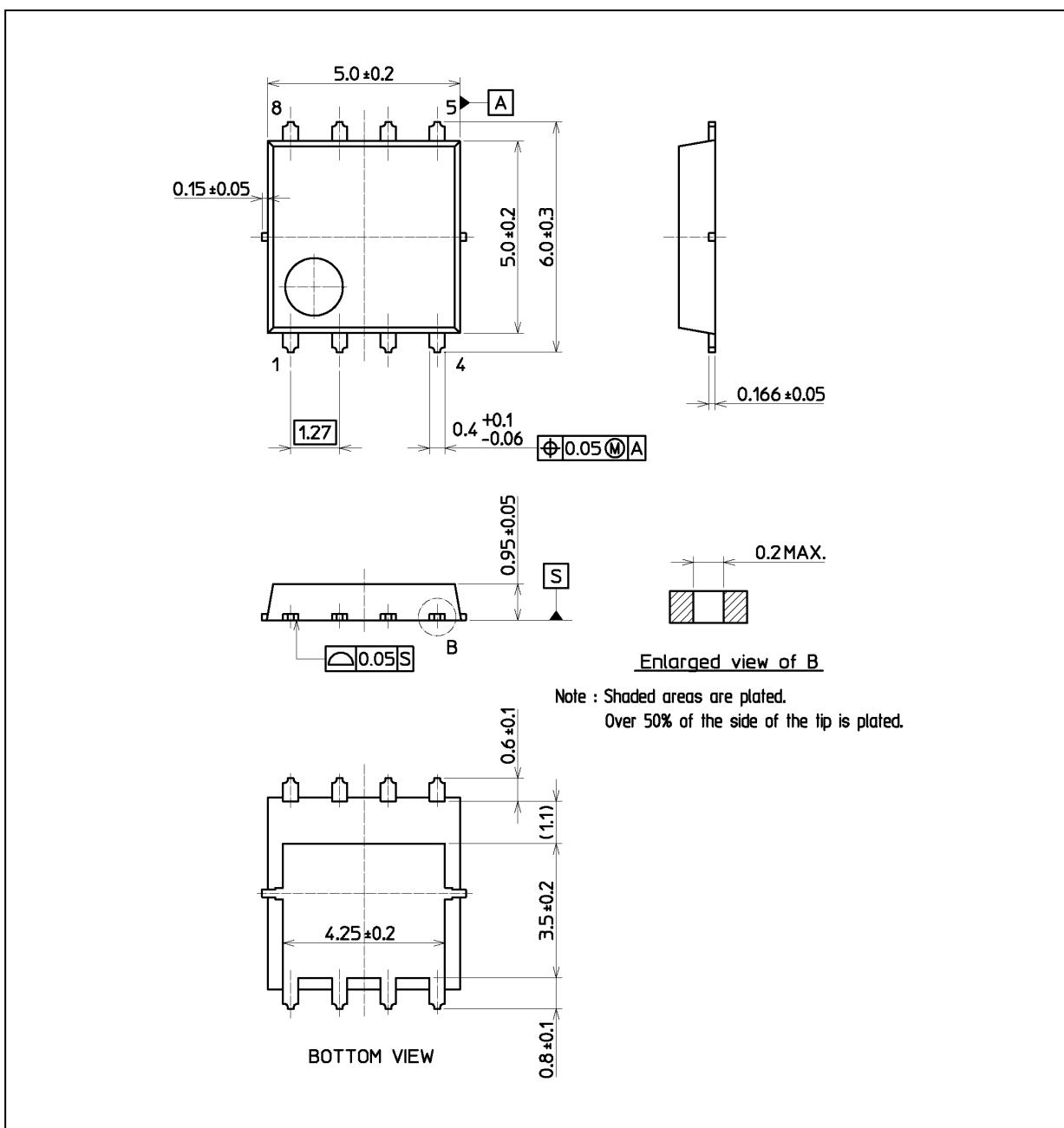


**Fig. 8.20 Safe Operating Area
(Guaranteed Maximum)**

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

Package Dimensions

Unit: mm



Weight: 0.080 g (typ.)

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

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