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

TPH1R204PL

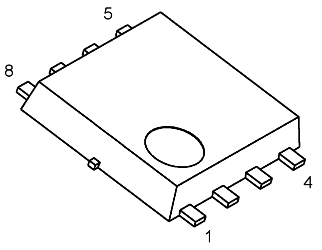
1. Applications

- High-Efficiency DC-DC Converters
- Switching Voltage Regulators

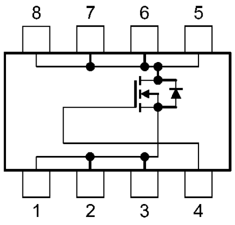
2. Features

(1) High-speed switching
(2) Small gate charge: Q_{SW} = 17 nC (typ.)
(3) Small output charge: Q_{oss} = 56 nC (typ.)
(4) Low drain-source on-resistance: $R_{DS(ON)}$ = 1.0 mΩ (typ.) (V_{GS} = 10 V)
(5) Low leakage current: I_{DSS} = 10 μA (max) (V_{DS} = 40 V)
(6) Enhancement mode: V_{th} = 1.4 to 2.4 V (V_{DS} = 10 V, I_D = 0.5 mA)

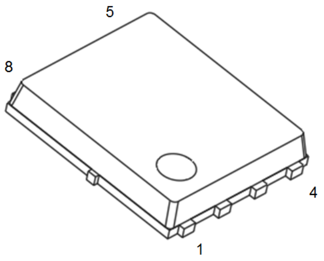
3. Packaging and Internal Circuit



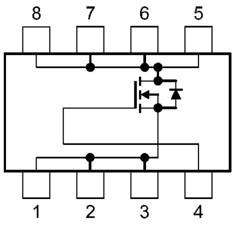
SOP Advance



1, 2, 3: Source
4: Gate
5, 6, 7, 8: Drain



SOP Advance(N)



1, 2, 3: Source
4: Gate
5, 6, 7, 8: Drain

The package can be selected according to your preference. For details, please contact your TOSHIBA sales representative.

Start of commercial production
2015-09

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

Characteristics			Symbol	Rating	Unit
Drain-source voltage			V_{DSS}	40	V
Gate-source voltage			V_{GSS}	±20	
Drain current (DC)	(T_c = 25 °C)	(Note 1), (Note 2)	I_D	150	A
Drain current (DC)	(Silicon limit)	(Note 1), (Note 2)	I_D	246	A
Drain current (pulsed)	(t = 100 μs)	(Note 1)	I_{DP}	500	A
Power dissipation	(T_c = 25 °C)		P_D	132	W
Power dissipation		(Note 3)	P_D	3	W
Power dissipation		(Note 4)	P_D	0.96	W
Single-pulse avalanche energy		(Note 5)	E_{AS}	127	mJ
Single-pulse avalanche current		(Note 5)	I_{AS}	120	A
Channel temperature			T_{ch}	175	°C
Storage temperature			T_{stg}	-55 to 175	°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).

5. Thermal Characteristics

Characteristics			Symbol	Max	Unit
Channel-to-case thermal resistance	(T_c = 25 °C)		$R_{th(ch-c)}$	1.13	°C/W
Channel-to-ambient thermal resistance	(T_a = 25 °C)	(Note 3)	$R_{th(ch-a)}$	50	
Channel-to-ambient thermal resistance	(T_a = 25 °C)	(Note 4)	$R_{th(ch-a)}$	156	

Note 1: Ensure that the channel temperature does not exceed 175 °C.
Note 2: Limited by package limit. Silicon chip capability is 246 A. (T_c = 25 °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} = 32 V, T_{ch} = 25 °C (initial), L = 0.0068 mH, I_{AS} = 120 A

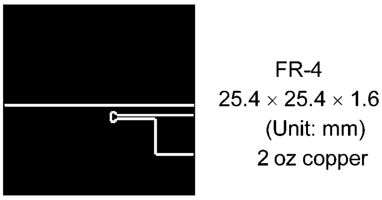


Fig. 5.1 Device Mounted on a Glass-Epoxy Board (a)

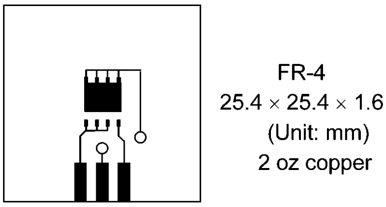


Fig. 5.2 Device Mounted on a Glass-Epoxy Board (b)

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

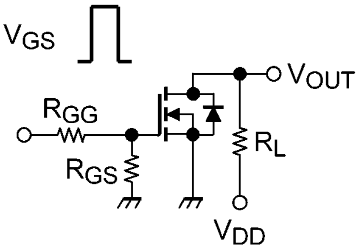
6. Electrical Characteristics

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

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Gate leakage current	I_{GSS}	V_{GS} = ±20 V, V_{DS} = 0 V	—	—	±0.1	µA
Drain cut-off current	I_{DSS}	V_{DS} = 40 V, V_{GS} = 0 V	—	—	10	
Drain-source breakdown voltage	$V_{(BR)DSS}$	I_D = 10 mA, V_{GS} = 0 V	40	—	—	V
	$V_{(BR)DSX}$	I_D = 10 mA, V_{GS} = -20 V	25	—	—	
Gate threshold voltage	V_{th}	V_{DS} = 10 V, I_D = 0.5 mA	1.4	—	2.4	
Drain-source on-resistance	$R_{DS(ON)}$	V_{GS} = 4.5 V, I_D = 50 A	—	1.5	2.1	mΩ
		V_{GS} = 10 V, I_D = 50 A	—	1.0	1.24	

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} = 20 V, V_{GS} = 0 V, f = 1 MHz	—	5500	7200	pF
Reverse transfer capacitance	C_{rss}		—	93	—	
Output capacitance	C_{oss}		—	1300	—	
Gate resistance	r_g	—	—	0.6	1.1	Ω
Switching time (rise time)	t_r	See Fig. 6.2.1	—	13	—	ns
Switching time (turn-on time)	t_{on}		—	33	—	
Switching time (fall time)	t_f		—	10	—	
Switching time (turn-off time)	t_{off}		—	58	—	



V_{DD} ≈ 20 V
V_{GS} = 0 V/ 10 V
I_D = 50 A
R_L = 0.4 Ω
R_{GG} = 4.7 Ω
R_{GS} = 4.7 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} ≈ 20 V, V_{GS} = 10 V, I_D = 50 A	—	74	—	nC
		V_{DD} ≈ 20 V, V_{GS} = 4.5 V, I_D = 50 A	—	34	—	
Gate-source charge 1	Q_{gs1}	V_{DD} ≈ 20 V, V_{GS} = 10 V, I_D = 50 A	—	16	—	
Gate-drain charge	Q_{gd}		—	17	—	
Gate switch charge	Q_{SW}		—	17	—	
Output charge	Q_{oss}	V_{DS} = 20 V, V_{GS} = 0 V	—	56	—	

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

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Reverse drain current (pulsed) (Note 6)	I_{DRP} (t = 100 μs)	—	—	—	500	A
Diode forward voltage	V_{DSF}	I_{DR} = 150 A, V_{GS} = 0 V	—	—	-1.2	V
Reverse recovery time	t_{rr}	V_R = 20 V, I_{DR} = 37.5 A, V_{GS} = 0 V, $-dI_{DR}/dt$ = 100 A/μs	—	46	—	ns
Reverse recovery charge	Q_{rr}	V_R = 20 V, I_{DR} = 37.5 A, V_{GS} = 0 V, $-dI_{DR}/dt$ = 100 A/μs	—	46	—	nC

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

7. Marking

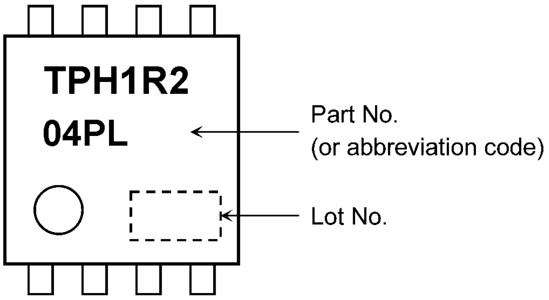


Fig. 7.1 Marking

8. Characteristics Curves (Note)

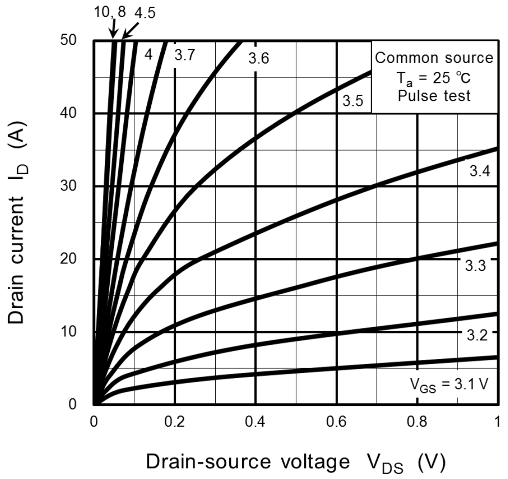


Fig. 8.1 I_D - V_{DS}

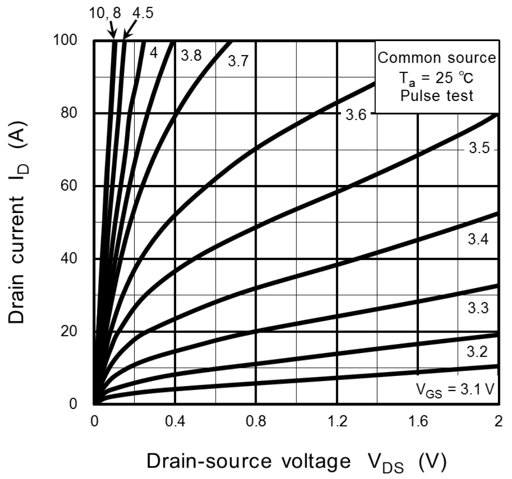


Fig. 8.2 I_D - V_{DS}

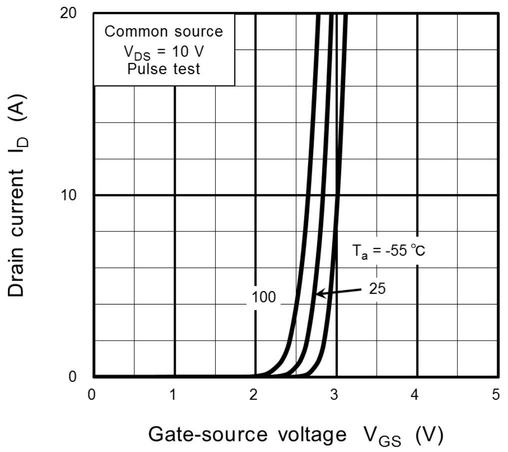


Fig. 8.3 I_D - V_{GS}

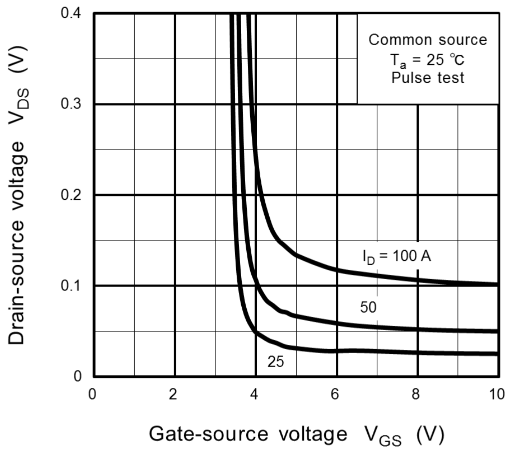


Fig. 8.4 V_{DS} - V_{GS}

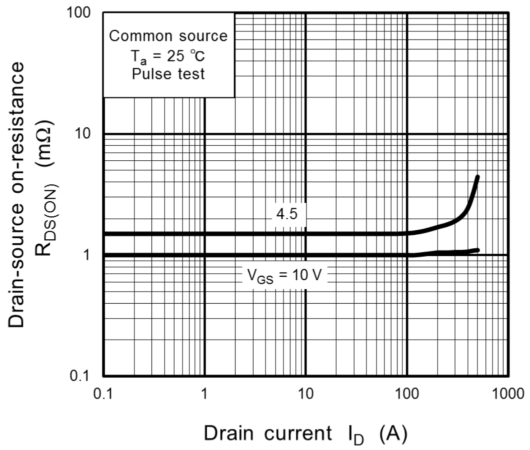


Fig. 8.5 $R_{DS(ON)}$ - I_D

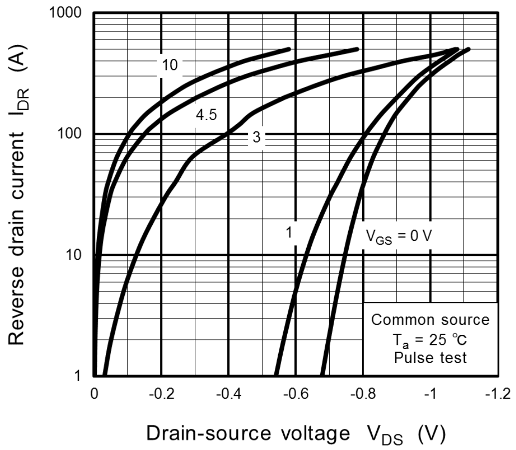


Fig. 8.6 I_{DR} - V_{DS}

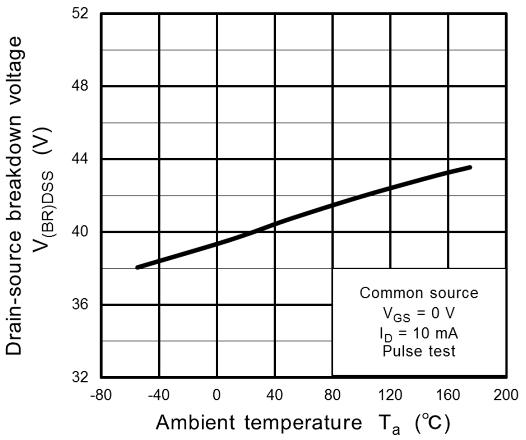


Fig. 8.7 $V_{(BR)DSS}$ - T_a

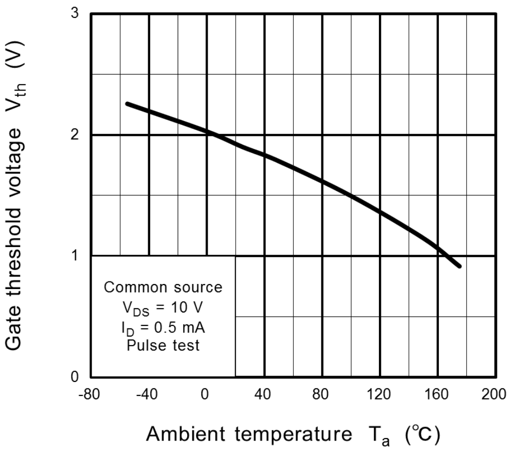


Fig. 8.8 V_{th} - T_a

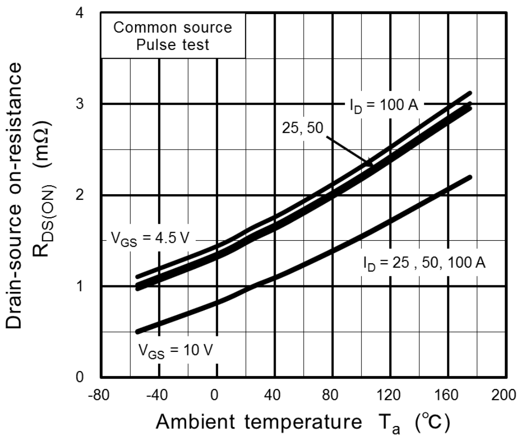


Fig. 8.9 $R_{DS(ON)}$ - T_a

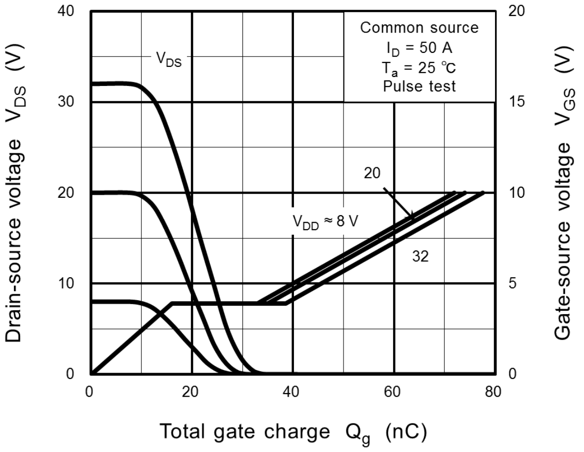


Fig. 8.10 Dynamic Input/Output Characteristics

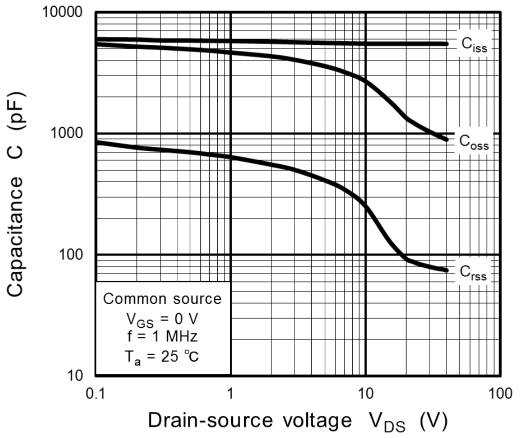


Fig. 8.11 Capacitance - V_{DS}

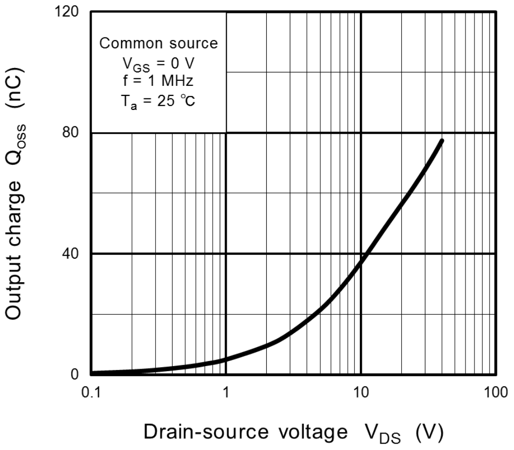


Fig. 8.12 Q_{oss} - V_{DS}

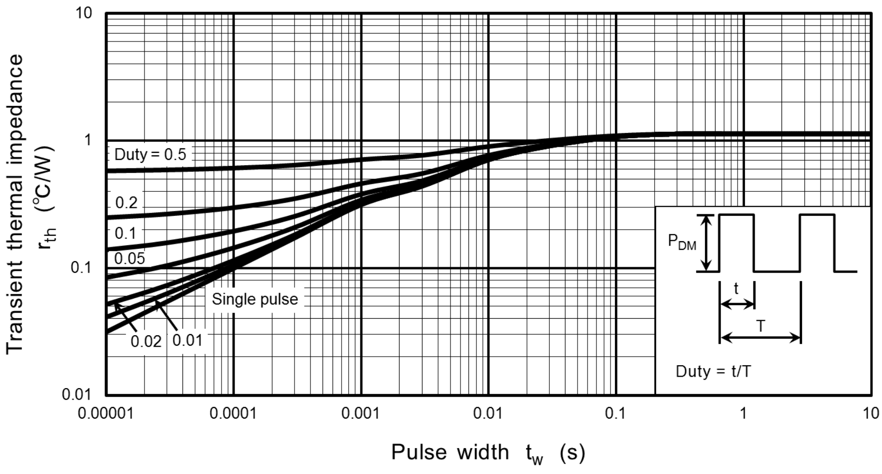


Fig. 8.13 r_{th} - t_w
(Guaranteed Maximum)

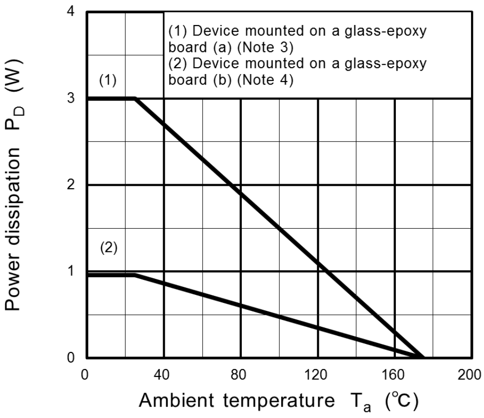


Fig. 8.14 P_D - T_a
(Guaranteed Maximum)

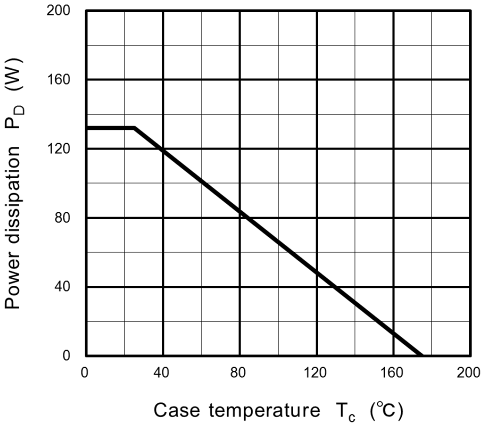


Fig. 8.15 P_D - T_c
(Guaranteed Maximum)

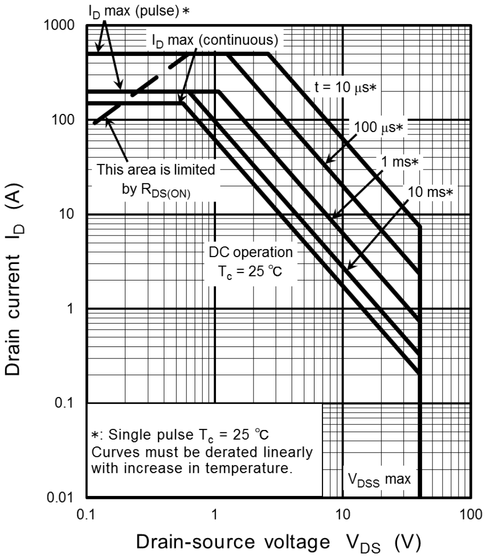
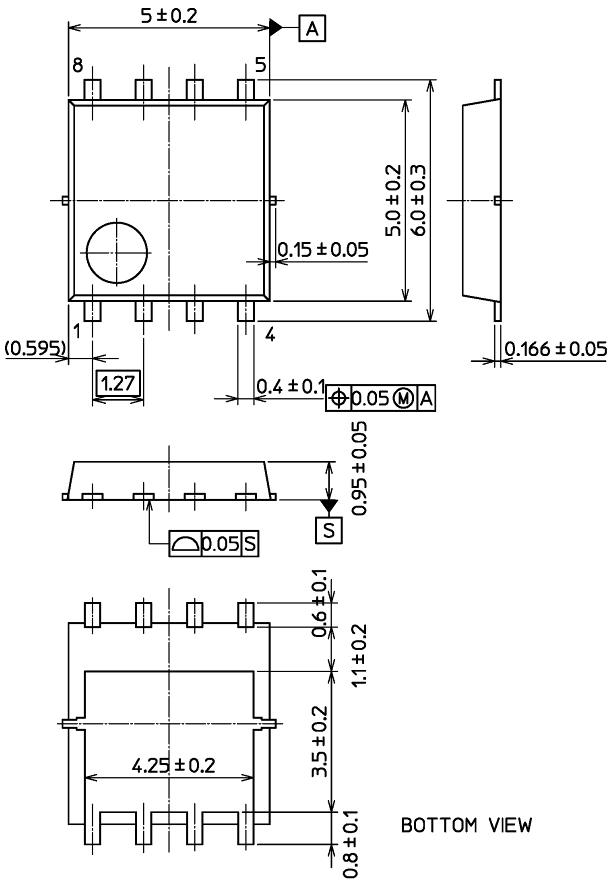


Fig. 8.16 Safe Operating Area
(Guaranteed Maximum)

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

Package Dimensions

Unit: mm



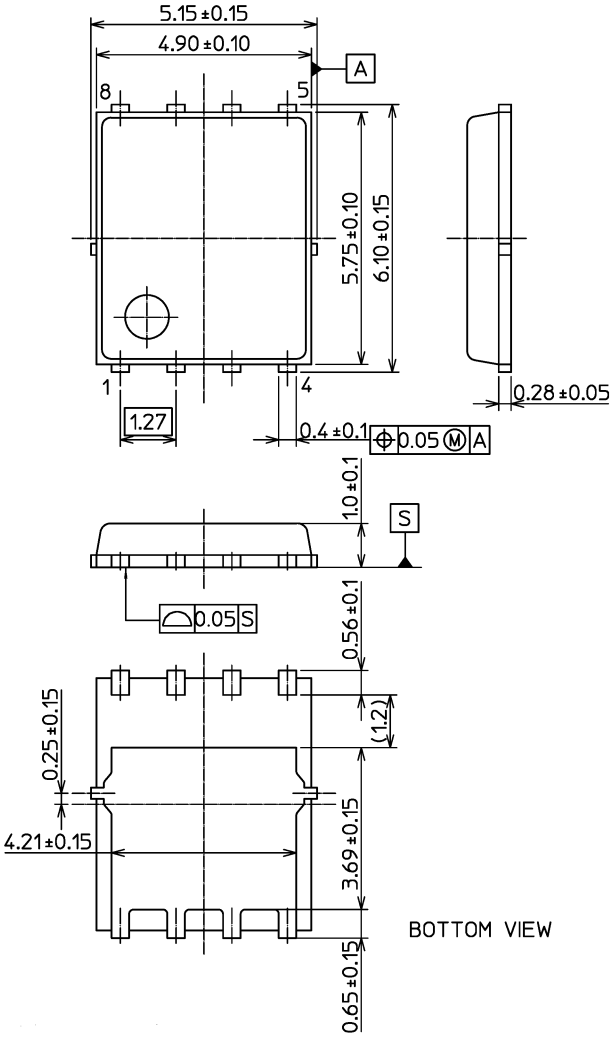
The package can be selected according to your preference. For details, please contact your TOSHIBA sales representative.

Weight: 0.079 g (typ.)

Package Name(s)
TOSHIBA: 2-5Q1S
Nickname: SOP Advance

Package Dimensions

Unit: mm



The package can be selected according to your preference. For details, please contact your TOSHIBA sales representative.

Weight: 0.105 g (typ.)

Package Name(s)
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Nickname: SOP Advance(N)