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

TPH2R408QM

1. Applications

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

2. Features

(1) High-speed switching

(2) Small gate charge: Q_{SW} = 28 nC (typ.)

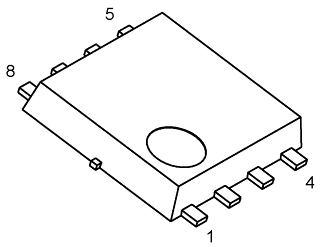
(3) Small output charge: Q_{oss} = 90 nC (typ.)

(4) Low drain-source on-resistance: $R_{DS(ON)}$ = 1.9 mΩ (typ.) (V_{GS} = 10 V)

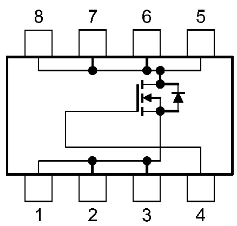
(5) Low leakage current: I_{DSS} = 10 μA (max) (V_{DS} = 80 V)

(6) Enhancement mode: V_{th} = 2.5 to 3.5 V (V_{DS} = 10 V, I_D = 1.0 mA)

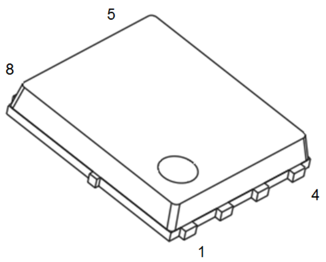
3. Packaging and Internal Circuit



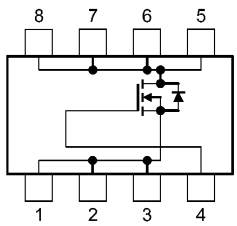
SOP Advance



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
2019-09

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

Characteristics			Symbol	Rating	Unit
Drain-source voltage			V_{DSS}	80	V
Gate-source voltage			V_{GSS}	±20	
Drain current (DC)	(T_c = 25 °C)	(Note 1)	I_D	120	A
Drain current (DC)	(Silicon limit)	(Note 1), (Note 2)	I_D	200	
Drain current (pulsed)	(t = 100 μs)	(Note 1)	I_{DP}	500	
Power dissipation	(T_c = 25 °C)		P_D	210	W
Power dissipation		(Note 3)	P_D	3	
Power dissipation		(Note 4)	P_D	0.96	
Single-pulse avalanche energy		(Note 5)	E_{AS}	144	mJ
Single-pulse avalanche current		(Note 5)	I_{AS}	120	A
Channel temperature			T_{ch}	175	°C
Storage temperature			T_{stg}	-55 to 175	

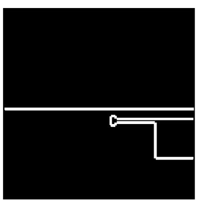
Note: Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.)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

Note: This product is not designed for radiation resistance or cosmic ray resistance, and these natural environmental factors may affect reliability.
In addition, radiation from the constituent materials of the product also becomes a natural environmental factor, which may affect reliability.

5. Thermal Characteristics

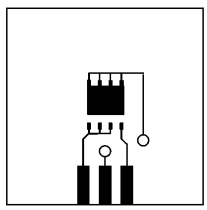
Characteristics			Symbol	Max	Unit
Channel-to-case thermal resistance	(T_c = 25 °C)		$R_{th(ch-c)}$	0.71	°C/W
Channel-to-ambient thermal resistance	(T_a = 25 °C)	(Note 3)	$R_{th(ch-a)}$	50	
Channel-to-ambient thermal resistance	(T_a = 25 °C)	(Note 4)	$R_{th(ch-a)}$	156	

Note 1: Ensure that the channel temperature does not exceed 175 °C.
Note 2: Limited by silicon chip capability.
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} = 60 V, T_{ch} = 25 °C (initial), L = 8.5 μH, I_{AS} = 120 A



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

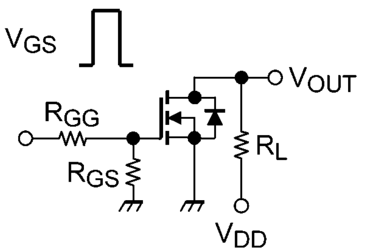
6.1. Static Characteristics (T_a = 25 °C unless otherwise specified)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Gate leakage current	I_{GSS}	V_{GS} = ±20 V, V_{DS} = 0 V	—	—	±0.1	µA
Drain cut-off current	I_{DSS}	V_{DS} = 80 V, V_{GS} = 0 V	—	—	10	
Drain-source breakdown voltage	$V_{(BR)DSS}$	I_D = 10 mA, V_{GS} = 0 V	80	—	—	V
Drain-source breakdown voltage (Note 6)	$V_{(BR)DSX}$	I_D = 10 mA, V_{GS} = -20 V	60	—	—	
Gate threshold voltage	V_{th}	V_{DS} = 10 V, I_D = 1.0 mA	2.5	—	3.5	
Drain-source on-resistance	$R_{DS(ON)}$	V_{GS} = 6 V, I_D = 50 A	—	2.5	3.5	mΩ
		V_{GS} = 10 V, I_D = 50 A	—	1.9	2.43	

Note 6: If a reverse bias is applied between gate and source, this device enters $V_{(BR)DSX}$ mode. Note that the drain-source breakdown voltage is lowered in this mode.

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} = 40 V, V_{GS} = 0 V, f = 1 MHz	—	5870	8300	pF
Reverse transfer capacitance	C_{rss}		—	60	—	
Output capacitance	C_{oss}		—	1340	—	
Gate resistance	r_g	—	—	1.9	2.9	Ω
Switching time (rise time)	t_r	See Figure 6.2.1	—	18.4	—	ns
Switching time (turn-on time)	t_{on}		—	38	—	
Switching time (fall time)	t_f		—	34	—	
Switching time (turn-off time)	t_{off}		—	138	—	



V_{DD} ≈ 40 V
V_{GS} = 0 V/ 10 V
I_D = 50 A
R_L = 0.8 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} ≈ 40 V, V_{GS} = 10 V, I_D = 50 A	—	87	—	nC
		V_{DD} ≈ 40 V, V_{GS} = 6 V, I_D = 50 A	—	55	—	
Gate-source charge 1	Q_{gs1}	V_{DD} ≈ 40 V, V_{GS} = 10 V, I_D = 50 A	—	23	—	
Gate-drain charge	Q_{gd}		—	19	—	
Gate switch charge	Q_{SW}		—	28	—	
Output charge	Q_{oss}	V_{DS} = 40 V, V_{GS} = 0 V, f = 1 MHz	—	90	—	

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 7)	I_{DRP}	(t = 100 μs)	—	—	500	A
Diode forward voltage	V_{DSF}	I_{DR} = 120 A, V_{GS} = 0 V	—	—	-1.2	V
Reverse recovery time	t_{rr}	I_{DR} = 30 A, V_{GS} = 0 V, $-dI_{DR}/dt$ = 100 A/μs	—	57	—	ns
Reverse recovery charge	Q_{rr}		—	74	—	nC

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

7. Marking

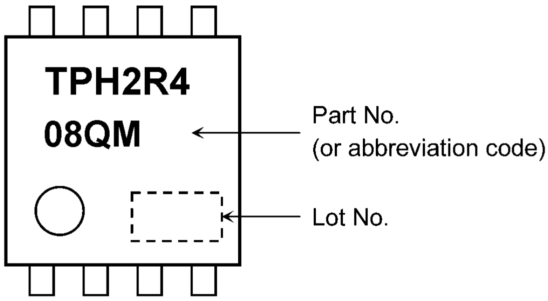


Fig. 7.1 Marking

8. Characteristics Curves (Note)

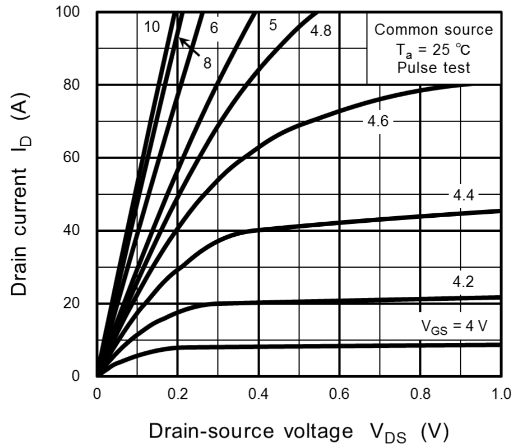


Fig. 8.1 I_D - V_{DS}

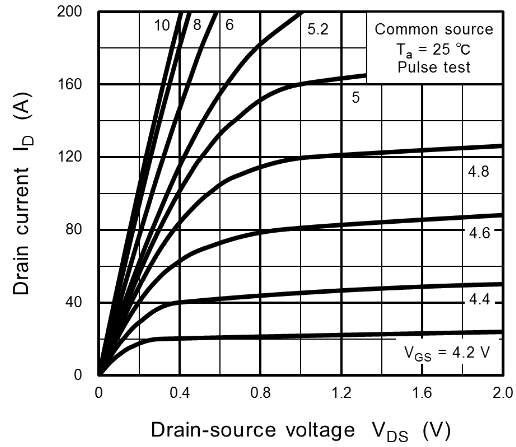


Fig. 8.2 I_D - V_{DS}

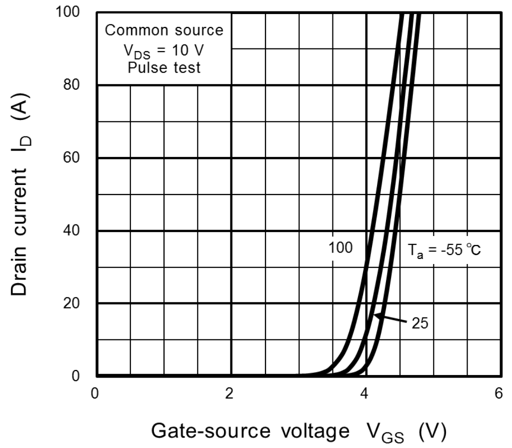


Fig. 8.3 I_D - V_{GS}

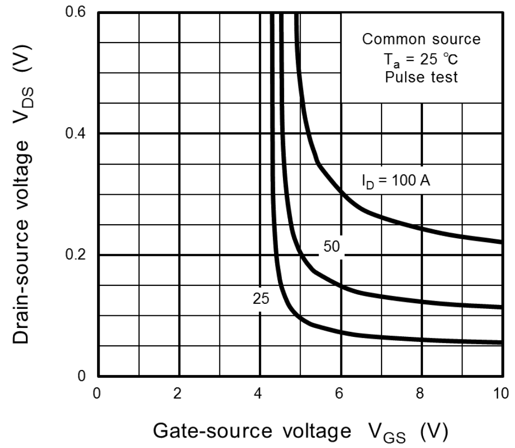


Fig. 8.4 V_{DS} - V_{GS}

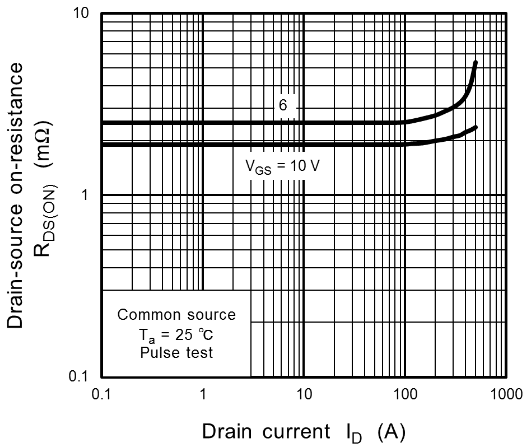


Fig. 8.5 $R_{DS(ON)}$ - I_D

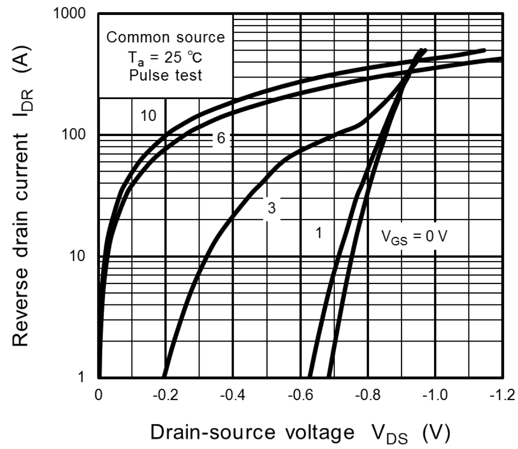


Fig. 8.6 I_{DR} - V_{DS}

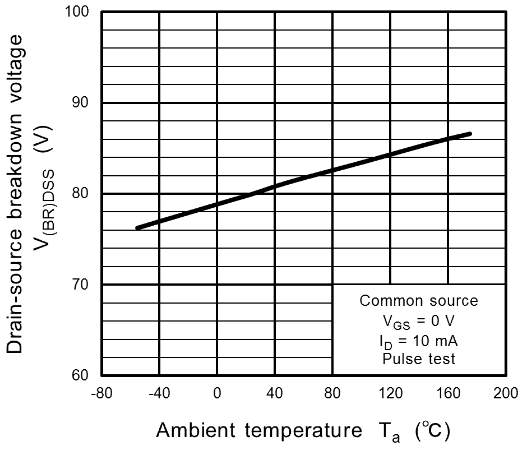


Fig. 8.7 $V_{(BR)DSS}$ - T_a

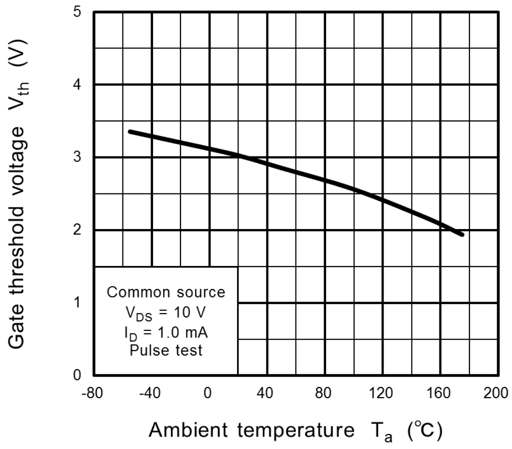


Fig. 8.8 V_{th} - T_a

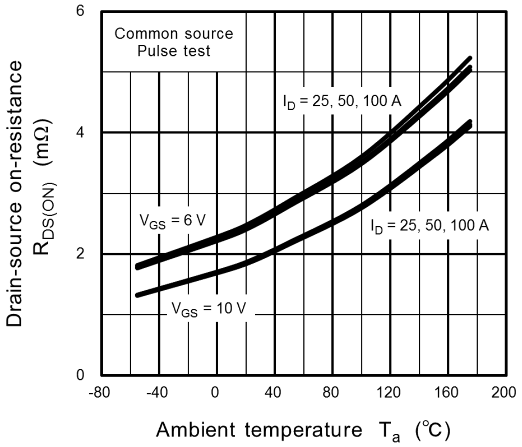


Fig. 8.9 $R_{DS(ON)}$ - T_a

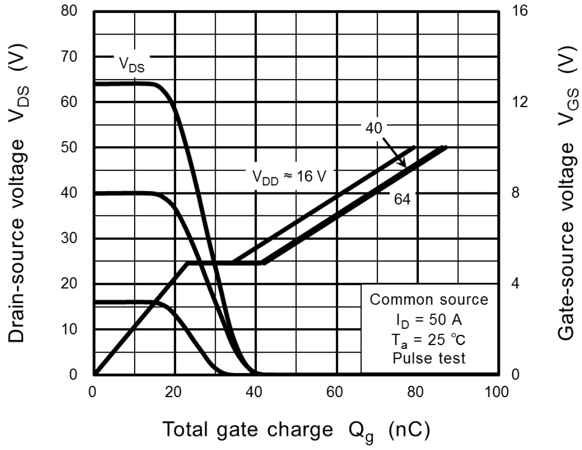


Fig. 8.10 Dynamic Input/Output Characteristics

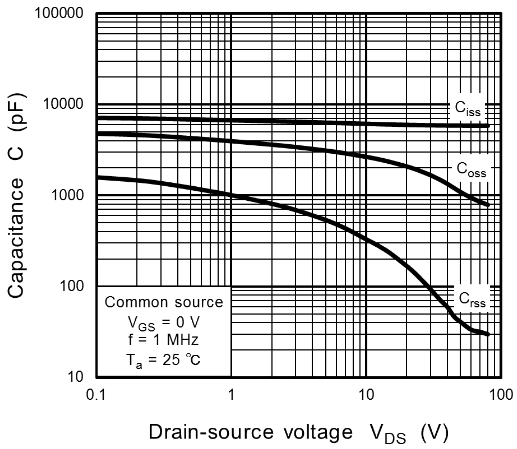


Fig. 8.11 Capacitance - V_{DS}

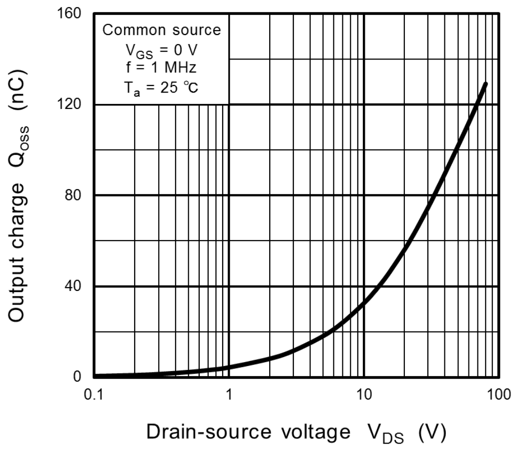


Fig. 8.12 Q_{oss} - V_{DS}

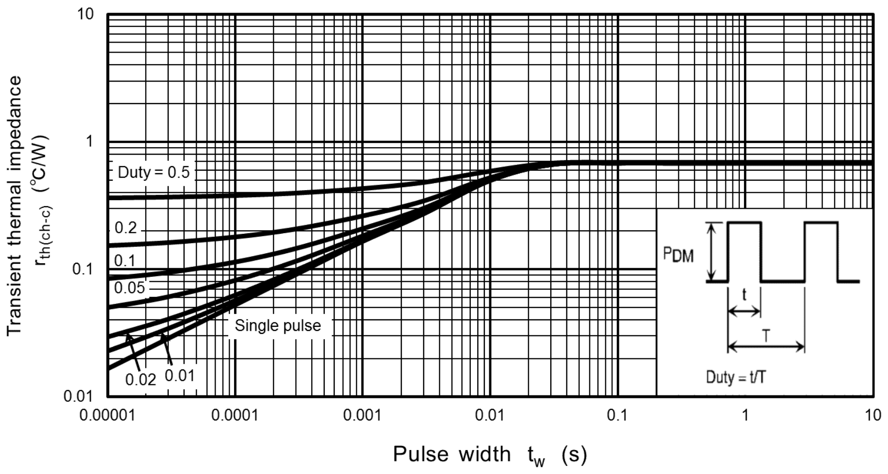


Fig. 8.13 r_{th} - t_w
(Guaranteed Maximum)

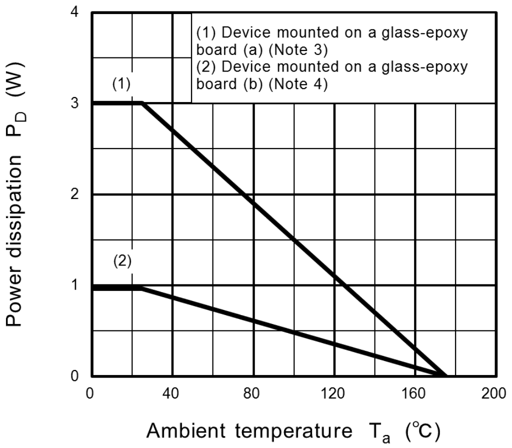


Fig. 8.14 P_D - T_a
(Guaranteed Maximum)

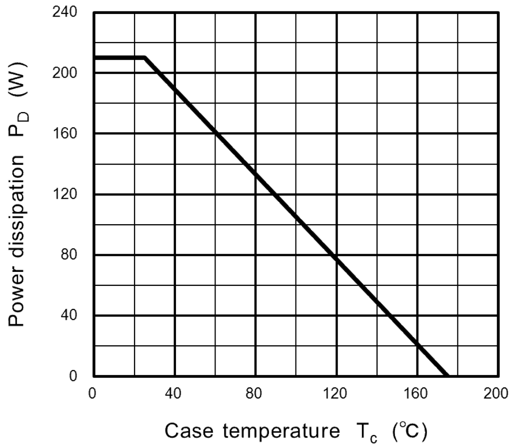


Fig. 8.15 P_D - T_c
(Guaranteed Maximum)

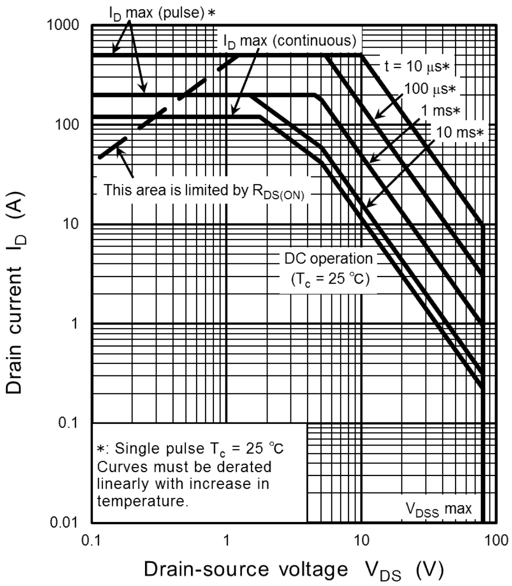
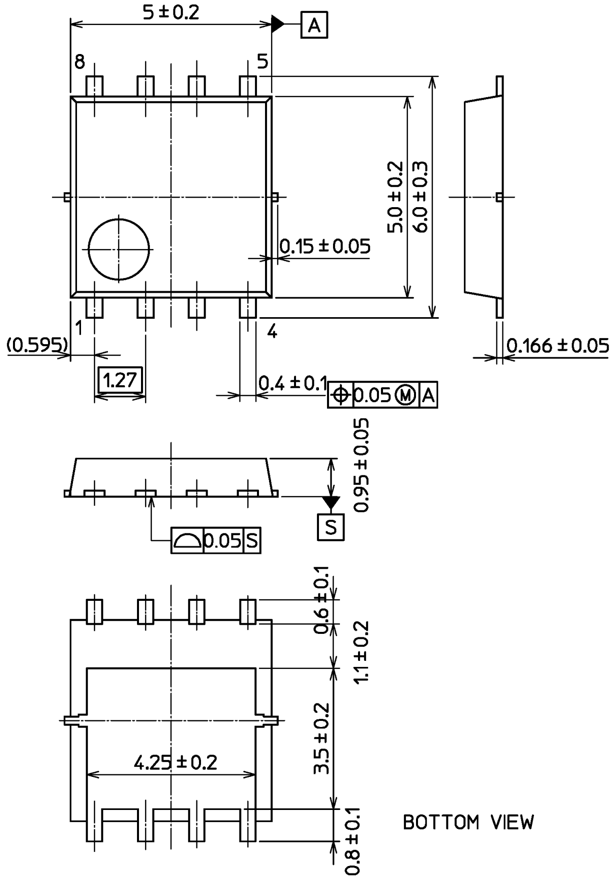


Fig. 8.16 Safe Operating Area
(Guaranteed Maximum)

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

Package Dimensions

Unit: mm



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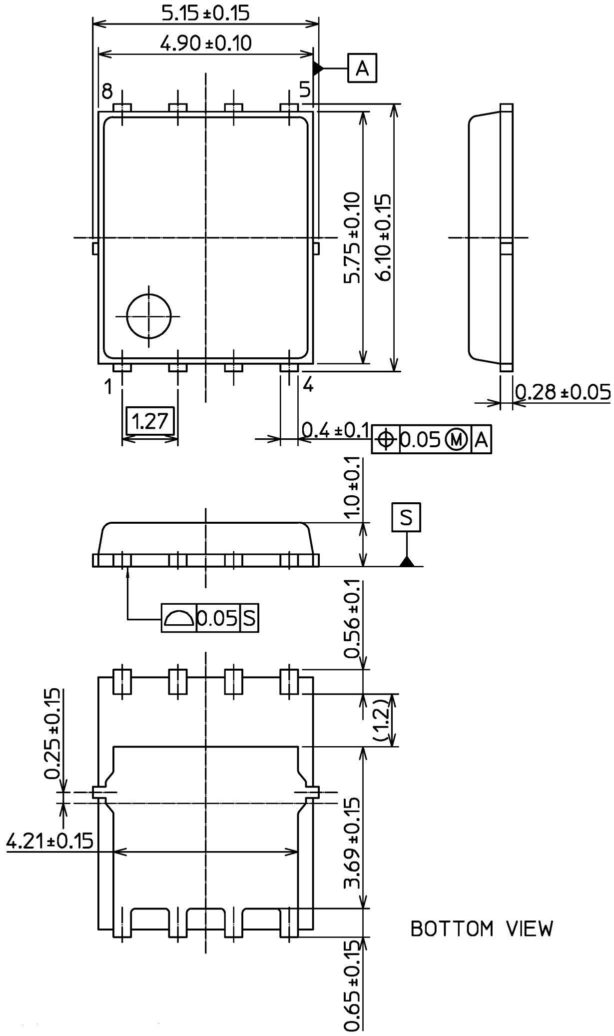
Weight: 0.087 g (typ.)

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: 0.111 g (typ.)

Package Name(s)
TOSHIBA: 2-5W1A
Nickname: SOP Advance(N)

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