MOSFETs Silicon P-Channel MOS (U-MOSⅥ)

TPH1R712MD

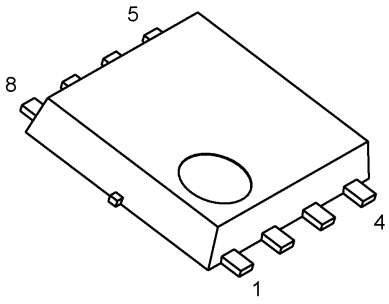
1. Applications

- Lithium-Ion Secondary Batteries
- Power Management Switches

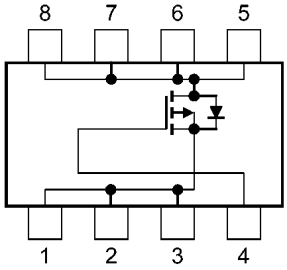
2. Features

(1) Low drain-source on-resistance: $R_{DS(ON)}$ = 1.35 mΩ (typ.) (V_{GS} = -4.5 V)
(2) Low leakage current: I_{DSS} = -10 μA (max) (V_{DS} = -20 V)
(3) Enhancement mode: V_{th} = -0.5 to -1.2 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

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

Characteristics			Symbol	Rating	Unit
Drain-source voltage			V_{DSS}	-20	V
Gate-source voltage			V_{GSS}	±12	
Drain current (DC)	(T_c = 25 °C)	(Note 1)	I_D	-60	A
Drain current (pulsed)	(t = 1 ms)	(Note 1)	I_{DP}	-200	
Power dissipation	(T_c = 25 °C)		P_D	78	W
Power dissipation	(t = 10 s)	(Note 2)	P_D	2.8	
Power dissipation	(t = 10 s)	(Note 3)	P_D	1.6	
Single-pulse avalanche energy		(Note 4)	E_{AS}	468	mJ
Single-pulse avalanche current			I_{AS}	-60	A
Channel temperature			T_{ch}	150	°C
Storage temperature			T_{stg}	-55 to 150	

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).

Start of commercial production
2014-03

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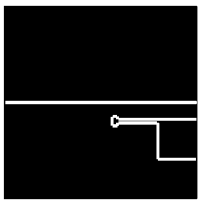
5. Thermal Characteristics

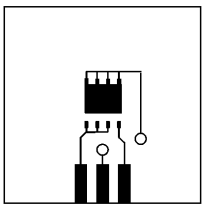
Characteristics			Symbol	Max	Unit
Channel-to-case thermal resistance	(T_c = 25 °C)		$R_{th(ch-c)}$	1.60	°C/W
Channel-to-ambient thermal resistance	(t = 10 s)	(Note 2)	$R_{th(ch-a)}$	44.6	
Channel-to-ambient thermal resistance	(t = 10 s)	(Note 3)	$R_{th(ch-a)}$	78.1	

Note 1: Ensure that the channel temperature does not exceed 150 °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} = -16 V, T_{ch} = 25 °C (initial), L = 100 μH, I_{AS} = -60 A



FR-4
25.4 × 25.4 × 0.8
(Unit: mm)

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



FR-4
25.4 × 25.4 × 0.8
(Unit: mm)

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.

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6. Electrical Characteristics

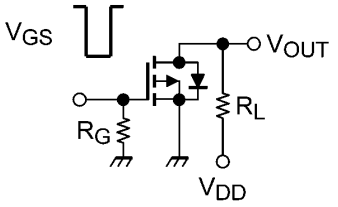
6.1. Static Characteristics (T_a = 25 °C unless otherwise specified)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Gate leakage current	I_{GSS}	V_{GS} = ±12 V, V_{DS} = 0 V	—	—	±0.1	μA
Drain cut-off current	I_{DSS}	V_{DS} = -20 V, V_{GS} = 0 V	—	—	-10	
Drain-source breakdown voltage	$V_{(BR)DSS}$	I_D = -10 mA, V_{GS} = 0 V	-20	—	—	V
Drain-source breakdown voltage (Note 5)	$V_{(BR)DSX}$	I_D = -10 mA, V_{GS} = 8.0 V	-12	—	—	
Gate threshold voltage	V_{th}	V_{DS} = -10 V, I_D = -1.0 mA	-0.5	—	-1.2	
Drain-source on-resistance	$R_{DS(ON)}$	V_{GS} = -2.5 V, I_D = -30 A	—	2.0	2.7	mΩ
		V_{GS} = -4.5 V, I_D = -30 A	—	1.35	1.7	

Note 5: 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} = -10 V, V_{GS} = 0 V, f = 1 MHz	—	10900	—	pF
Reverse transfer capacitance	C_{rss}		—	1550	—	
Output capacitance	C_{oss}		—	2010	—	
Switching time (rise time)	t_r	See Fig. 6.2.1.	—	14	—	ns
Switching time (turn-on time)	t_{on}		—	27	—	
Switching time (fall time)	t_f		—	512	—	
Switching time (turn-off time)	t_{off}		—	1620	—	



V_{DD} ≈ -10 V
V_{GS} = -5.0 V
I_D = -30 A
R_L = 0.33 Ω
R_G = 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} ≈ -16 V, V_{GS} = -5.0 V, I_D = -60 A	—	182	—	nC
Gate-source charge 1	Q_{gs1}		—	23	—	
Gate-drain charge	Q_{gd}		—	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) (Note6)	I_{DRP}	—	—	—	-200	A
Diode forward voltage	V_{DSF}	I_{DR} = -60 A, V_{GS} = 0 V	—	—	1.2	V

Note6: Ensure that the channel temperature does not exceed 150°C.

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7. Marking

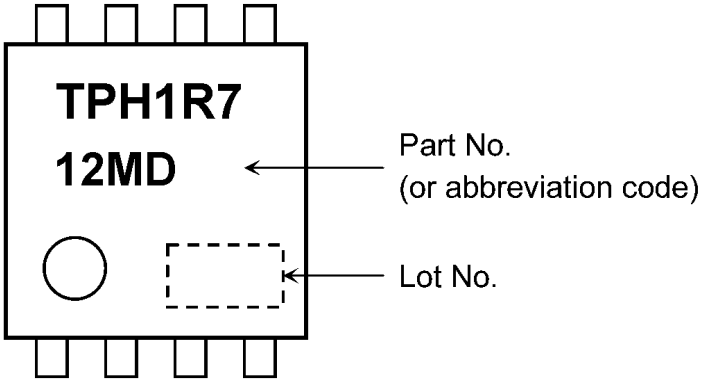

Fig. 7.1 Marking

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8. Characteristics Curves (Note)

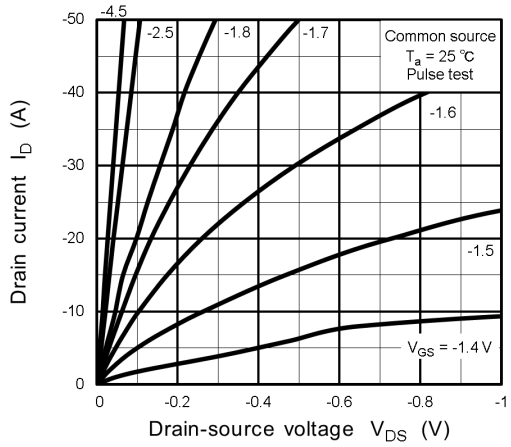

Fig. 8.1 I_D - V_{DS}

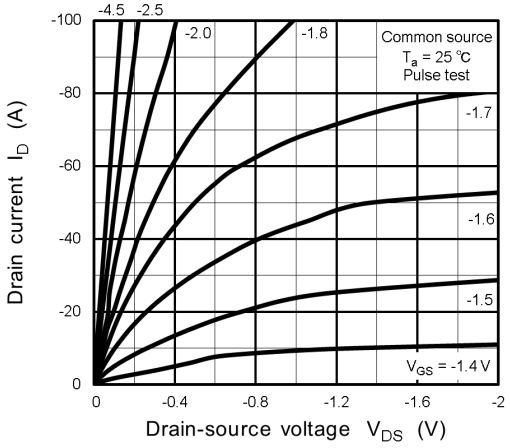

Fig. 8.2 I_D - V_{DS}

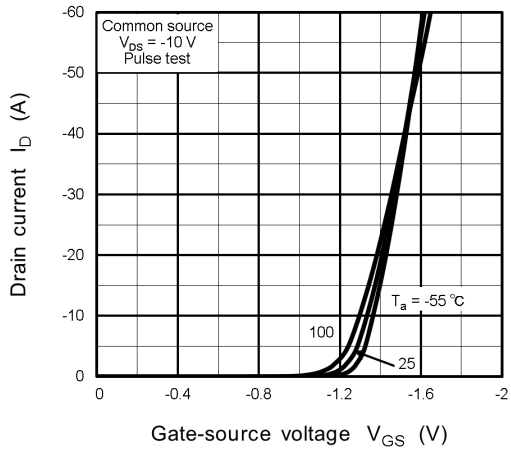

Fig. 8.3 I_D - V_{GS}

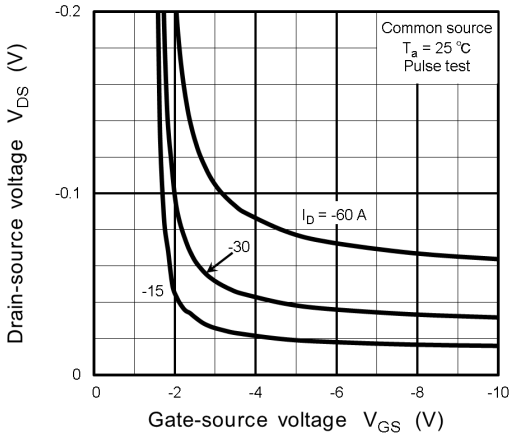

Fig. 8.4 V_{DS} - V_{GS}

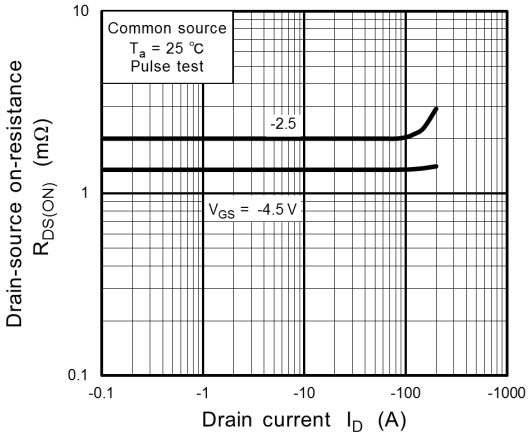

Fig. 8.5 $R_{DS(ON)}$ - I_D

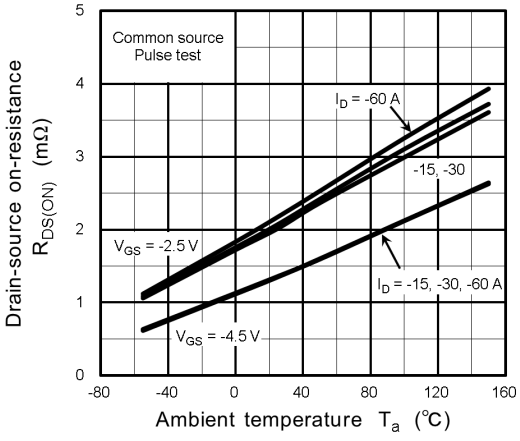

Fig. 8.6 $R_{DS(ON)}$ - T_a

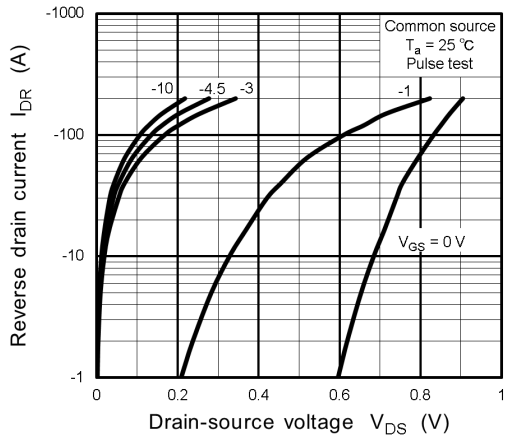

Fig. 8.7 I_{DR} - V_{DS}

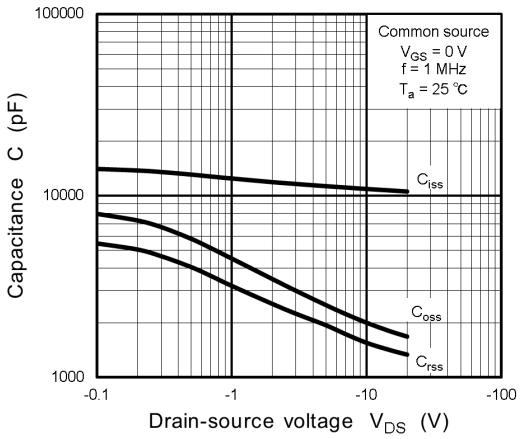

Fig. 8.8 Capacitance - V_{DS}

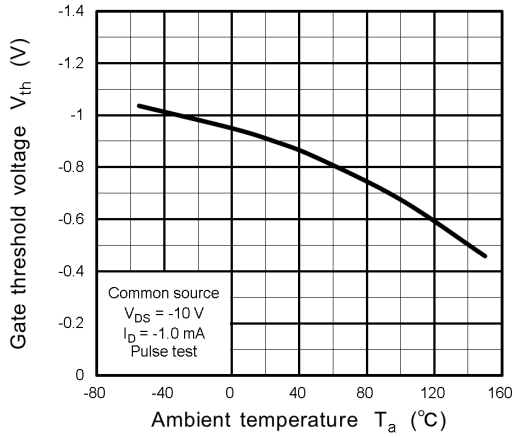

Fig. 8.9 V_{th} - T_a

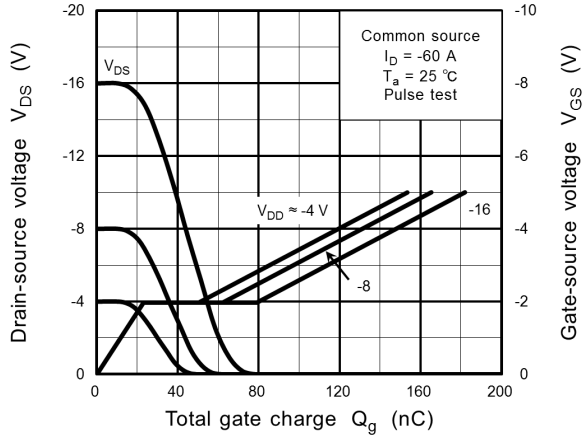

Fig. 8.10 Dynamic Input/Output Characteristics

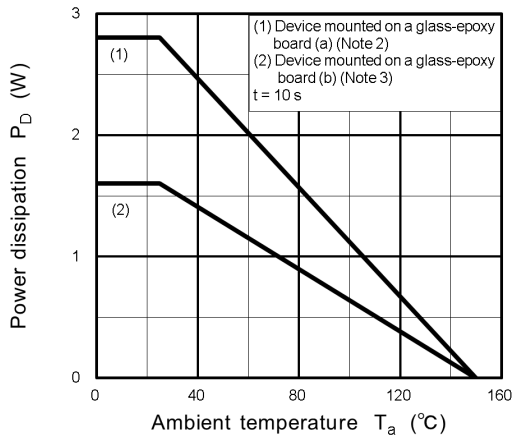

Fig. 8.11 P_D - T_a
(Guaranteed Maximum)

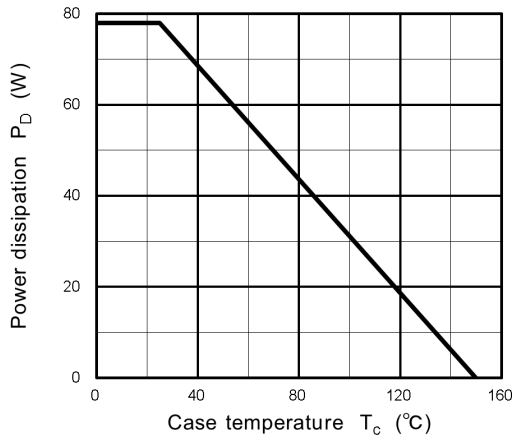

Fig. 8.12 P_D - T_c
(Guaranteed Maximum)

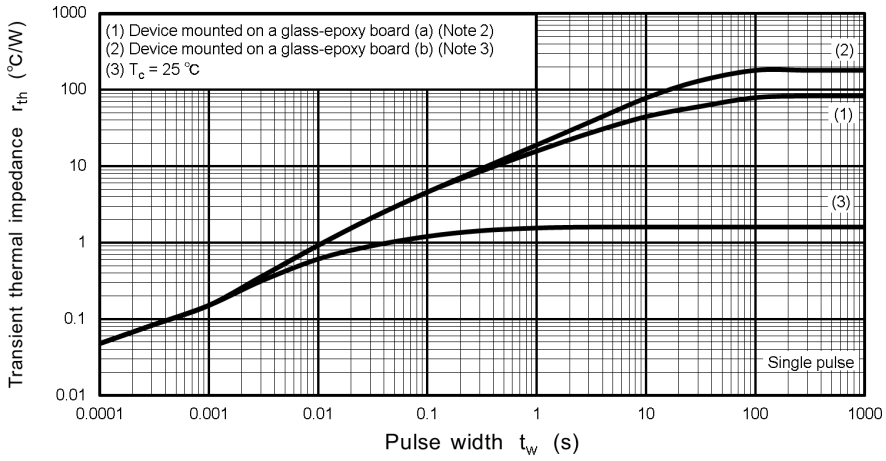

Fig. 8.13 r_{th} - t_w (Guaranteed Maximum)

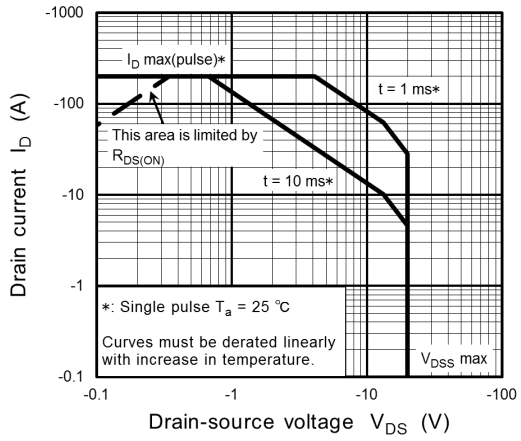

Fig. 8.14 Safe Operating Area (Guaranteed Maximum)

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

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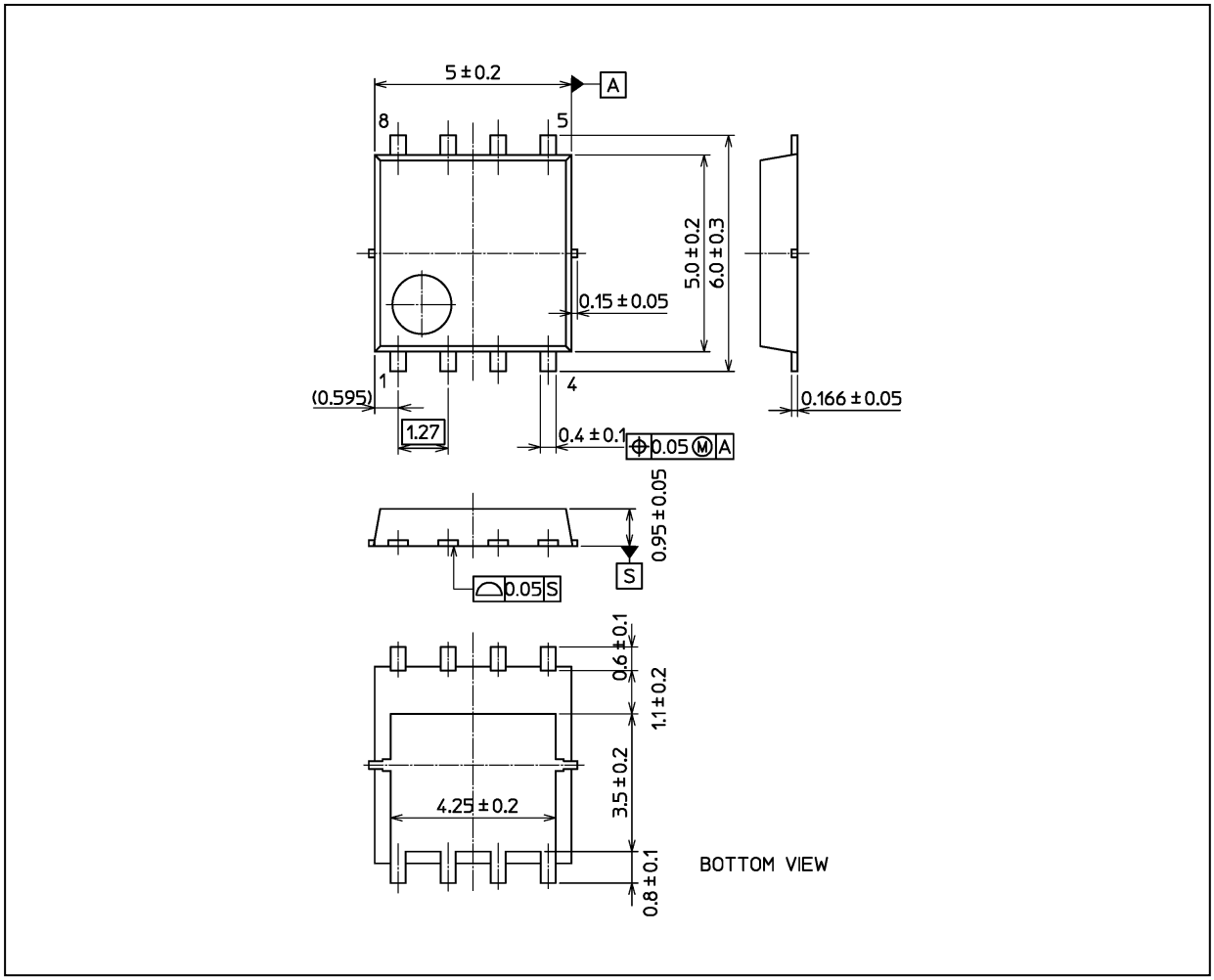
Package Dimensions

Unit: mm



Weight: 0.087 g (typ.)

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

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