MOSFETs Silicon P-Channel MOS (U-MOSⅥ)

TPN4R712MD

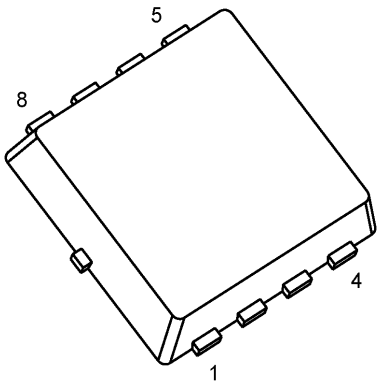
1. Applications

- Lithium-Ion Secondary Batteries
- Power Management Switches

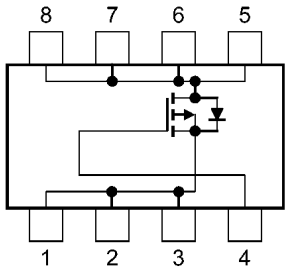
2. Features

(1) Low drain-source on-resistance: $R_{DS(ON)}$ = 3.8 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



TSON Advance



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

Start of commercial production
2014-12

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

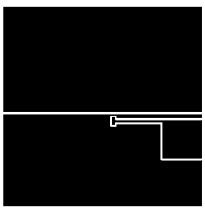
Characteristics			Symbol	Rating	Unit
Drain-source voltage			V_{DSS}	-20	V
Gate-source voltage			V_{GSS}	±12	
Drain current (DC)	(T_c = 25 °C)	(Note 1)	I_D	-36	A
Drain current (pulsed)	(t = 1 ms)	(Note 1)	I_{DP}	-180	
Power dissipation	(T_c = 25 °C)		P_D	42	W
Power dissipation	(t = 10 s)	(Note 2)		1.9	
Power dissipation	(t = 10 s)	(Note 3)		0.7	
Single-pulse avalanche energy		(Note 4)	E_{AS}	320	mJ
Single-pulse avalanche current			I_{AS}	-36	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).

5. Thermal Characteristics

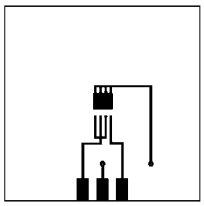
Characteristics			Symbol	Max	Unit
Channel-to-case thermal resistance	(T_c = 25 °C)		$R_{th(ch-c)}$	2.97	°C/W
Channel-to-ambient thermal resistance	(t = 10 s)	(Note 2)	$R_{th(ch-a)}$	65.7	
Channel-to-ambient thermal resistance	(t = 10 s)	(Note 3)	$R_{th(ch-a)}$	178	

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 = 190 μH, I_{AS} = -36 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.

6. Electrical Characteristics

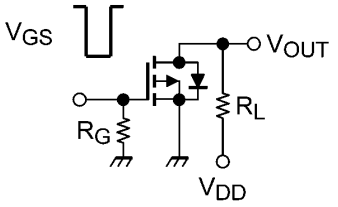
6.1. Static Characteristics (T_a = 25 °C unless otherwise specified)

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 = -16 A	—	6.0	8.1	mΩ
		V_{GS} = -4.5 V, I_D = -18 A	—	3.8	4.7	

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	—	4300	—	pF
Reverse transfer capacitance	C_{rss}		—	640	—	
Output capacitance	C_{oss}		—	700	—	
Switching time (rise time)	t_r	See Fig. 6.2.1.	—	11	—	ns
Switching time (turn-on time)	t_{on}		—	18	—	
Switching time (fall time)	t_f		—	145	—	
Switching time (turn-off time)	t_{off}		—	443	—	



V_{DD} ≈ -10 V
V_{GS} = -5.0 V / 0 V
I_D = -18 A
R_L = 0.56 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 = -36 A	—	65	—	nC
Gate-source charge 1	Q_{gs1}		—	7.5	—	
Gate-drain charge	Q_{gd}		—	20	—	

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}	—	—	—	-180	A
Diode forward voltage	V_{DSF}	I_{DR} = -36 A, V_{GS} = 0 V	—	—	1.2	V

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

7. Marking

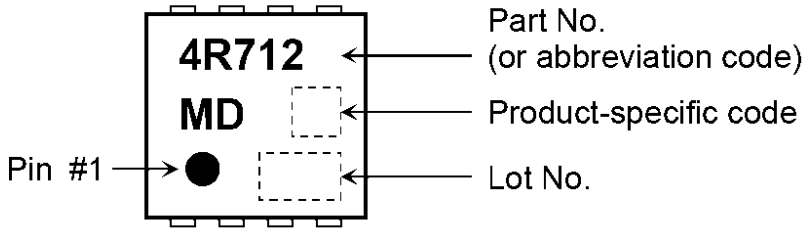


Fig. 7.1 Marking

8. Characteristics Curves (Note)

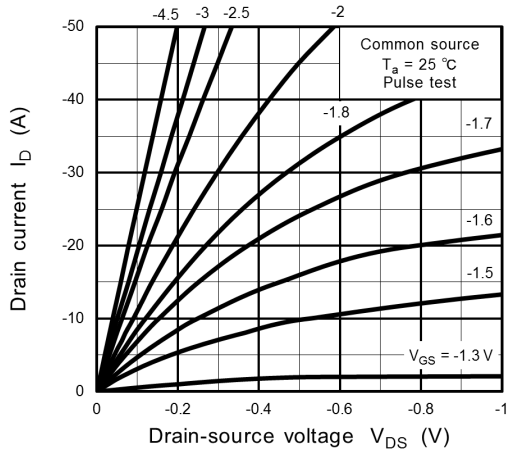


Fig. 8.1 I_D - V_{DS}

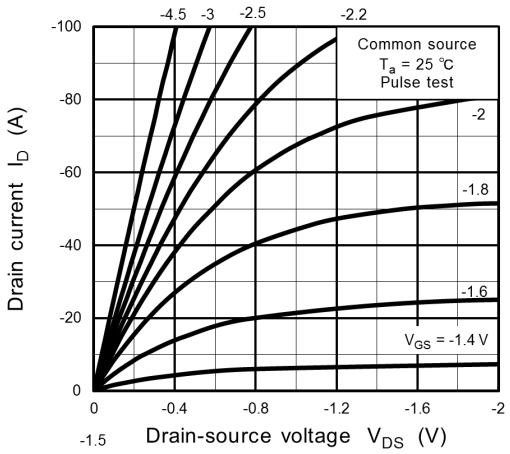


Fig. 8.2 I_D - V_{DS}

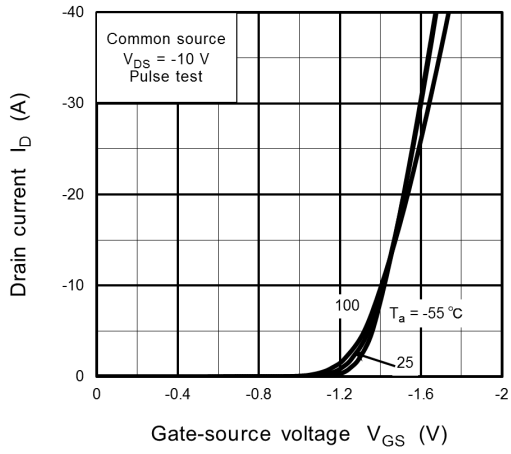


Fig. 8.3 I_D - V_{GS}

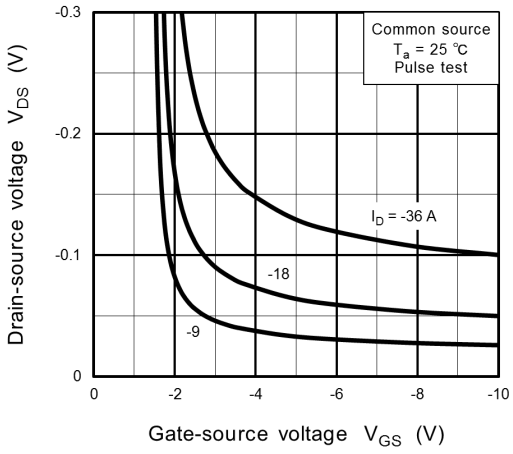


Fig. 8.4 V_{DS} - V_{GS}

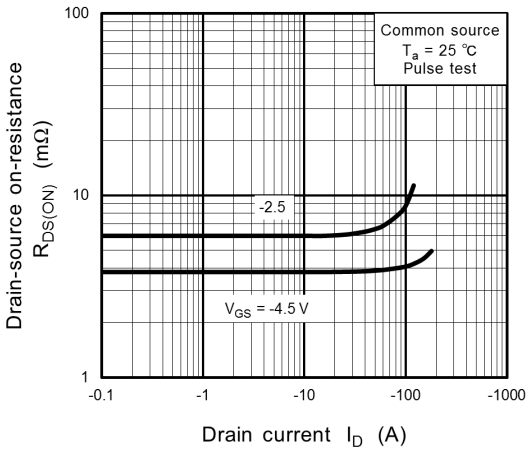


Fig. 8.5 $R_{DS(ON)}$ - I_D

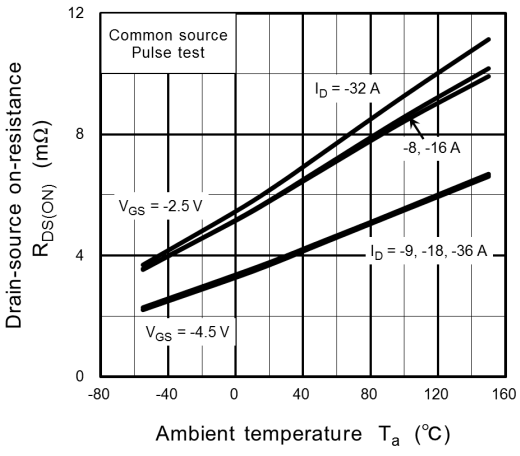


Fig. 8.6 $R_{DS(ON)}$ - T_a

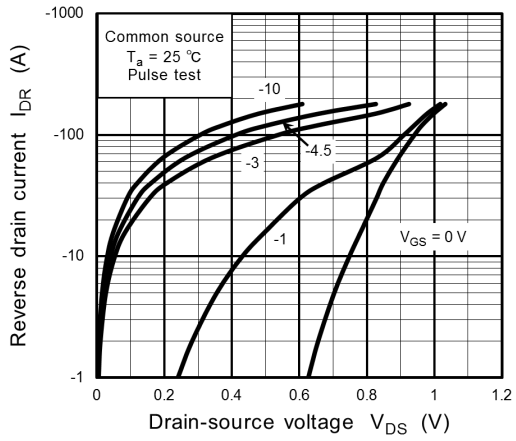


Fig. 8.7 I_{DR} - V_{DS}

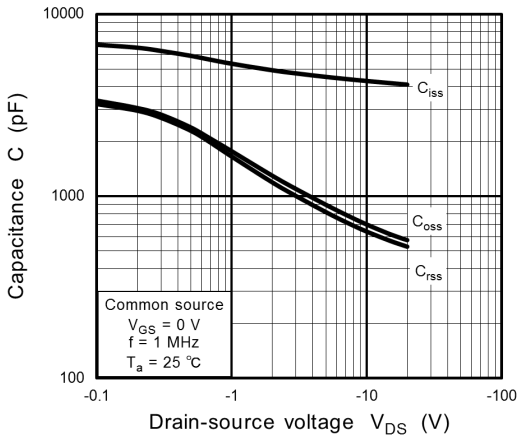


Fig. 8.8 Capacitance - V_{DS}

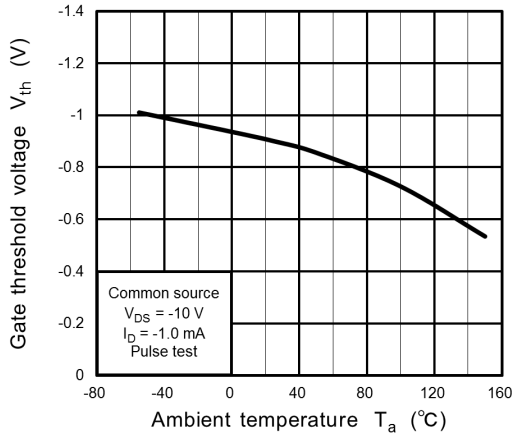


Fig. 8.9 V_{th} - T_a

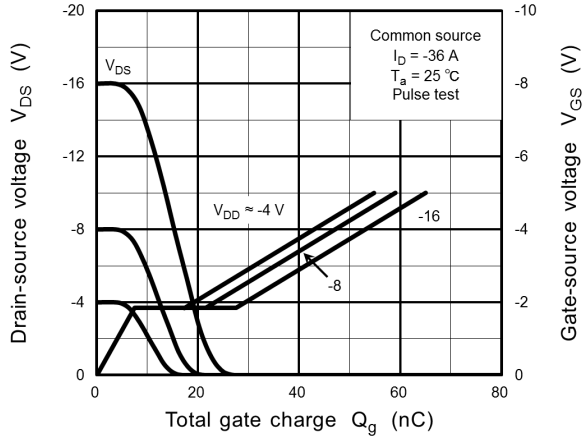


Fig. 8.10 Dynamic Input/Output Characteristics

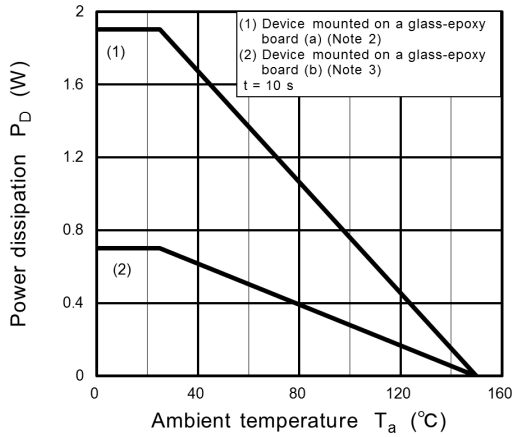


Fig. 8.11 P_D - T_a
(Guaranteed Maximum)

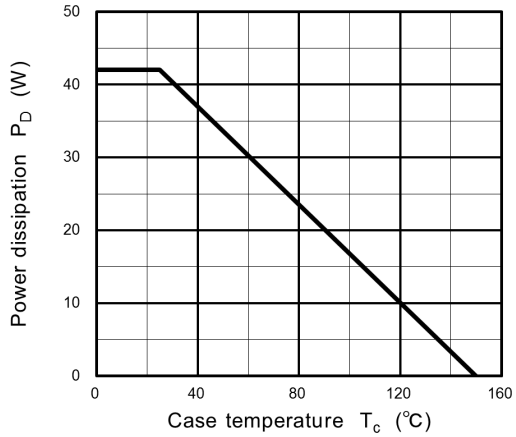


Fig. 8.12 P_D - T_c
(Guaranteed Maximum)

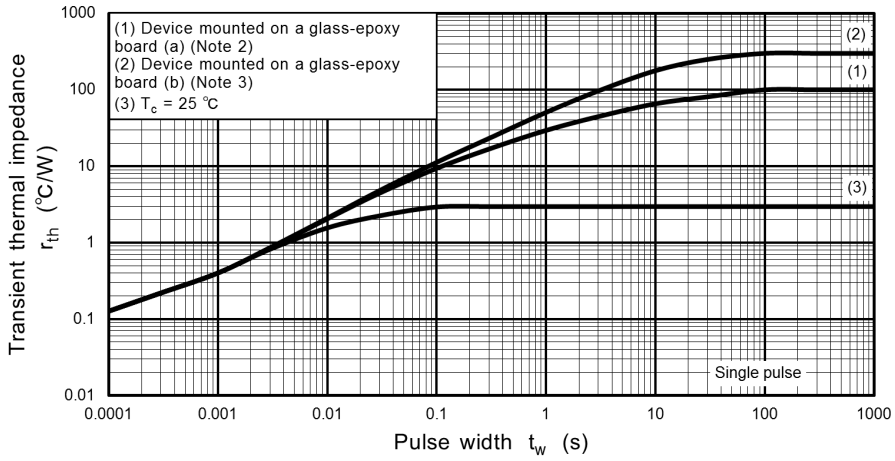


Fig. 8.13 r_{th} - t_w (Guaranteed Maximum)

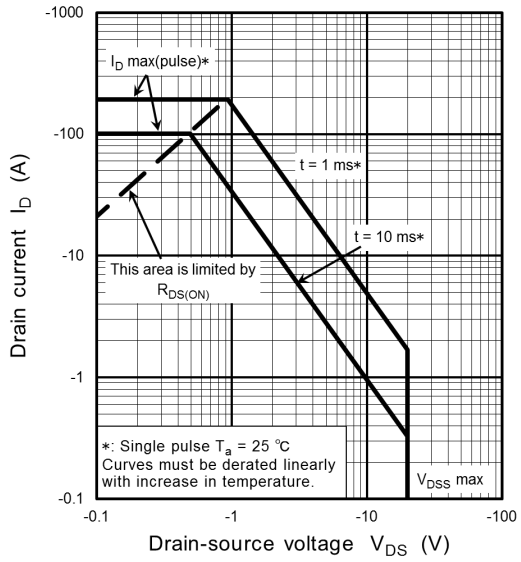
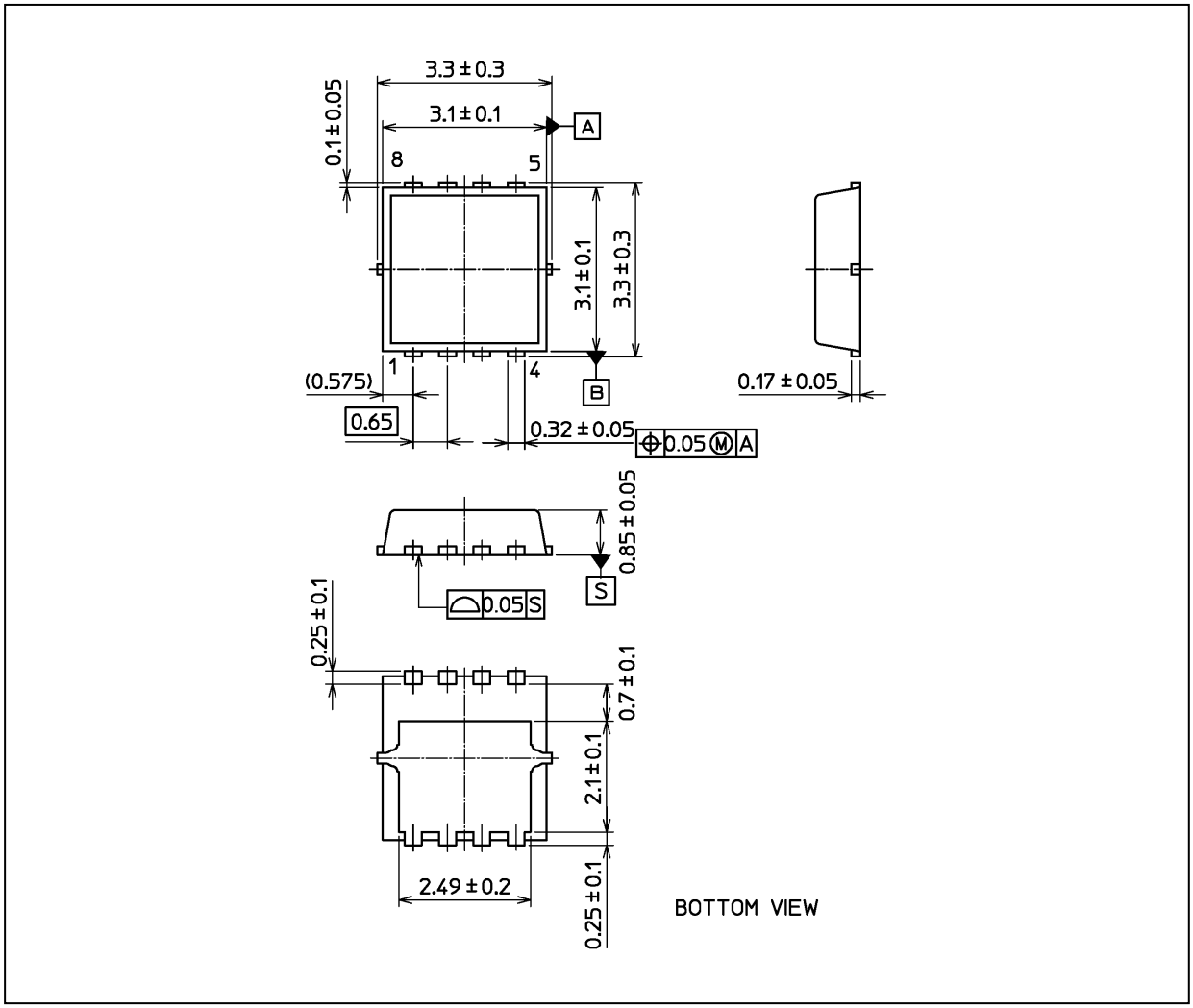


Fig. 8.14 Safe Operating Area (Guaranteed Maximum)

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

Package Dimensions

Unit: mm



Weight: 0.029 g (typ.)

Package Name(s)
TOSHIBA: 2-3X1S
Nickname: TSON Advance

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