

TPCP8013

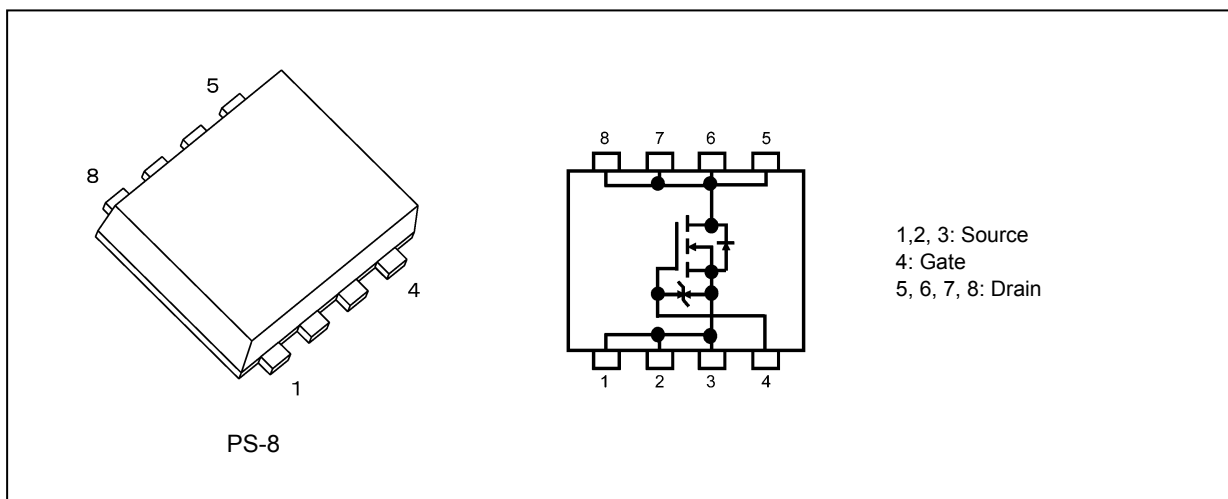
1. Applications

- Motor Drivers
- Mobile Equipment

2. Features

- (1) AEC-Q101 qualified
- (2) Small, thin package
- (3) Small gate charge : $Q_{SW} = 4.5 \text{ nC (typ.)}$
- (4) Low drain-source on-resistance: $R_{DS(ON)} = 41.5 \text{ m}\Omega \text{ (typ.)}$ ($V_{GS} = 10 \text{ V}$)
- (5) Low leakage current: $I_{DSS} = 10 \text{ }\mu\text{A (max)}$ ($V_{DS} = 60 \text{ V}$)
- (6) Enhancement mode: $V_{th} = 2 \text{ to } 3 \text{ V}$ ($V_{DS} = 10 \text{ V}$, $I_D = 1 \text{ mA}$)

3. Packaging and Internal Circuit



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

Characteristics	Symbol	Rating	Unit
Drain-source voltage	V_{DSS}	60	V
Gate-source voltage	V_{GSS}	± 20	
Drain current (DC) (Note 1)	I_{D}	4	A
Drain current (pulsed) (Note 1)	I_{DP}	16	
Power dissipation ($t = 5$ s) (Note 2)	P_{D}	1.96	W
Power dissipation ($t = 5$ s) (Note 3)	P_{D}	0.94	W
Single-pulse avalanche energy (Note 4)	E_{AS}	29.2	mJ
Avalanche current	I_{AR}	4	A
Channel temperature (Note 5)	T_{ch}	175	$^\circ\text{C}$
Storage temperature (Note 5)	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-ambient thermal resistance ($t = 5$ s) (Note 2)	$R_{\text{th(ch-a)}}$	76.5	$^\circ\text{C/W}$
Channel-to-ambient thermal resistance ($t = 5$ s) (Note 3)	$R_{\text{th(ch-a)}}$	159.5	$^\circ\text{C/W}$

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: $V_{\text{DD}} = 25$ V, $T_{\text{ch}} = 25^\circ\text{C}$ (initial), $L = 2.48$ mH, $R_{\text{G}} = 1$ Ω , $I_{\text{AR}} = 4$ A

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

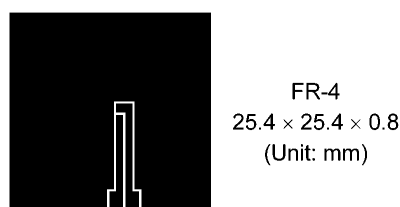


Fig. 5.1 Device Mounted on a Glass-Epoxy Board (a)

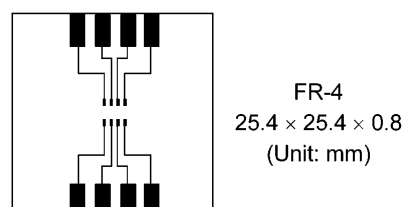


Fig. 5.2 Device Mounted on a Glass-Epoxy Board (b)

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

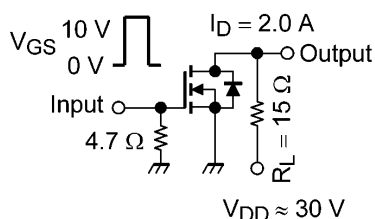
6. Electrical Characteristics

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}	$V_{GS} = \pm 16\text{ V}$, $V_{DS} = 0\text{ V}$	—	—	± 10	μA
Drain cut-off current	I_{DSS}	$V_{DS} = 60\text{ V}$, $V_{GS} = 0\text{ V}$	—	—	10	
Drain-source breakdown voltage	$V_{(BR)DSS}$	$I_D = 10\text{ mA}$, $V_{GS} = 0\text{ V}$	60	—	—	V
Drain-source breakdown voltage	$V_{(BR)DSX}$	$I_D = 10\text{ mA}$, $V_{GS} = -20\text{ V}$	40	—	—	
Gate threshold voltage	V_{th}	$V_{DS} = 10\text{ V}$, $I_D = 1\text{ mA}$	2	2.5	3	
Drain-source on-resistance	$R_{DS(ON)}$	$V_{GS} = 6\text{ V}$, $I_D = 2\text{ A}$	—	48.7	77.9	$\text{m}\Omega$
		$V_{GS} = 10\text{ V}$, $I_D = 2\text{ A}$	—	41.5	51.8	

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}	$V_{DS} = 10\text{ V}$, $V_{GS} = 0\text{ V}$, $f = 1\text{ MHz}$	—	515	—	pF
Reverse transfer capacitance	C_{rss}		—	48	—	
Output capacitance	C_{oss}		—	86	—	
Switching time (rise time)	t_r	See Figure 6.2.1	—	4.9	—	ns
Switching time (turn-on time)	t_{on}		—	11.5	—	
Switching time (fall time)	t_f		—	4.3	—	
Switching time (turn-off time)	t_{off}		—	18.5	—	



Duty $\leq 1\%$, $t_w = 10\text{ }\mu\text{s}$

Fig. 6.2.1 Switching Time Test Circuit

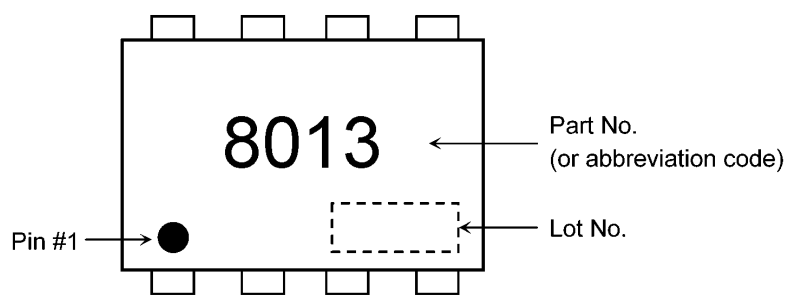
6.3. Gate Charge Characteristics ($T_a = 25^\circ\text{C}$ unless otherwise specified)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Total gate charge (gate-source plus gate-drain)	Q_g	$V_{DD} \approx 48\text{ V}$, $V_{GS} = 10\text{ V}$, $I_D = 4\text{ A}$	—	12	—	nC
Gate-source charge 1	Q_{gs1}		—	1.9	—	
Gate-drain charge	Q_{gd}		—	4.0	—	
Gate switch charge	Q_{sw}		—	4.5	—	

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}	—	—	—	16	A
Diode forward voltage	V_{DSF}	$I_{DR} = 4\text{ A}$, $V_{GS} = 0\text{ V}$	—	—	-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)

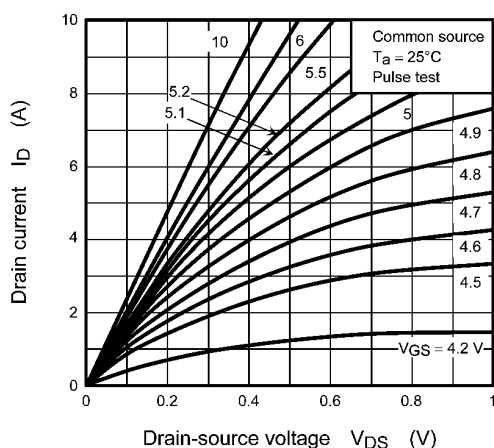


Fig. 8.1 $I_D - V_{DS}$

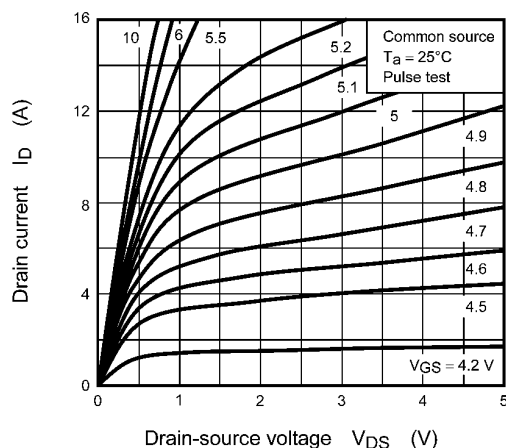


Fig. 8.2 $I_D - V_{DS}$

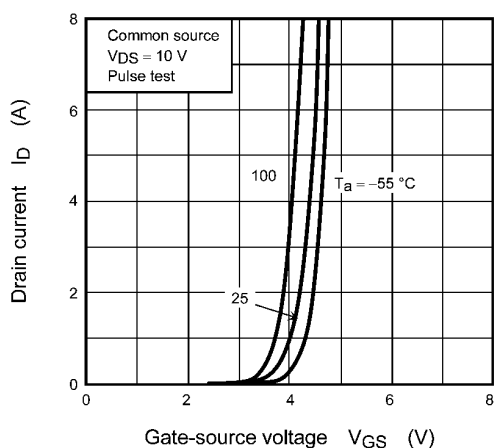


Fig. 8.3 $I_D - V_{GS}$

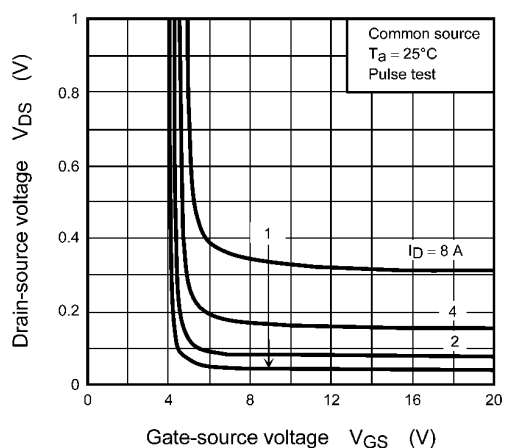


Fig. 8.4 $V_{DS} - V_{GS}$

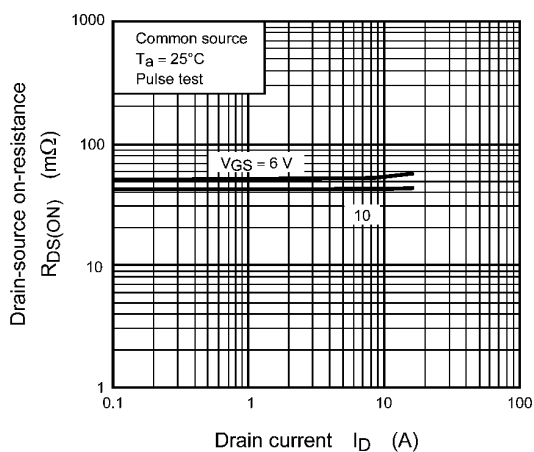


Fig. 8.5 $R_{DS(ON)} - I_D$

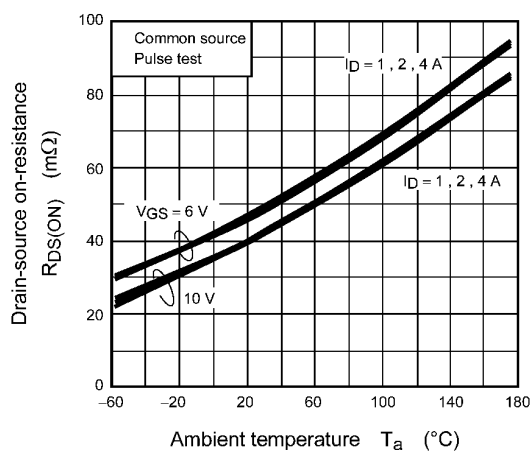


Fig. 8.6 $R_{DS(ON)} - T_a$ (Note 7)

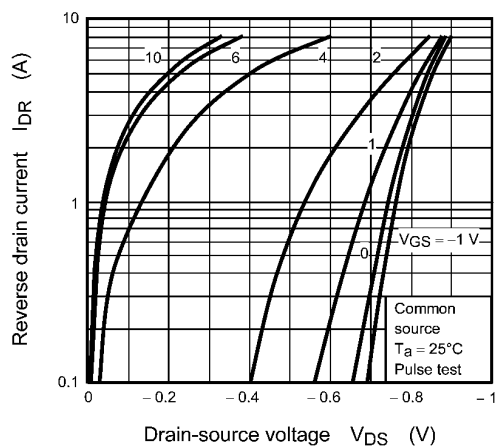


Fig. 8.7 $I_{DR} - V_{DS}$

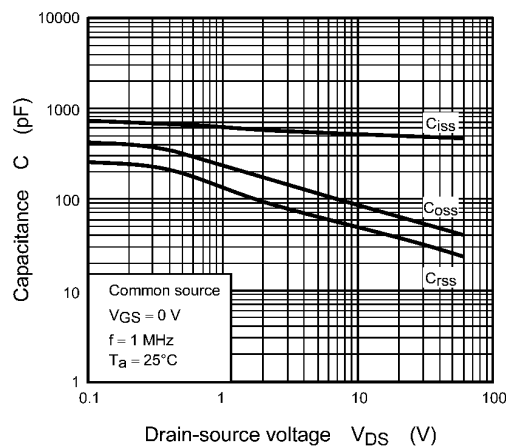


Fig. 8.8 Capacitance - V_{DS}

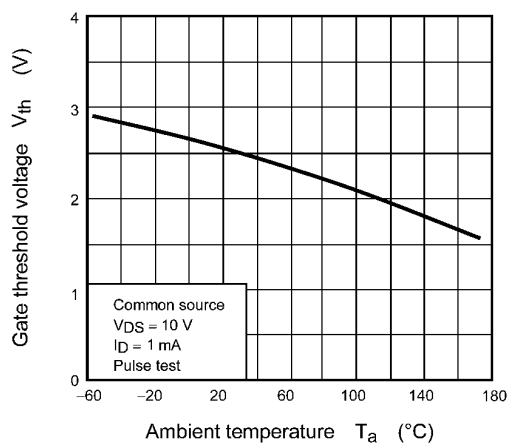


Fig. 8.9 $V_{th} - T_a$ (Note 7)

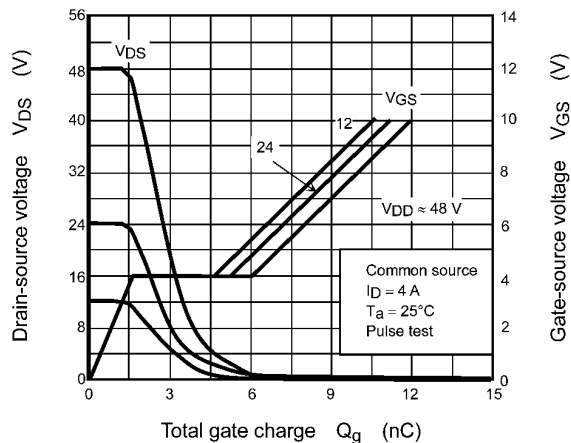
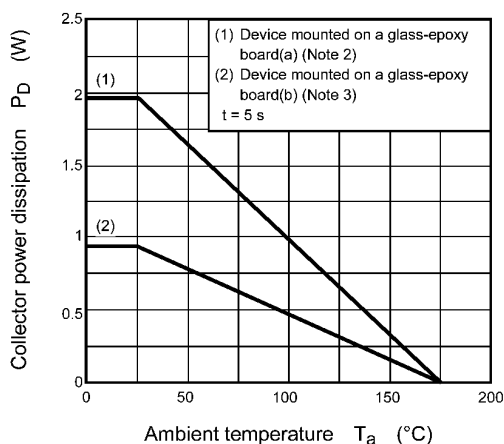


Fig. 8.10 Dynamic Input/Output Characteristics



**Fig. 8.11 $P_D - T_a$ (Note 7)
(Guaranteed Maximum)**

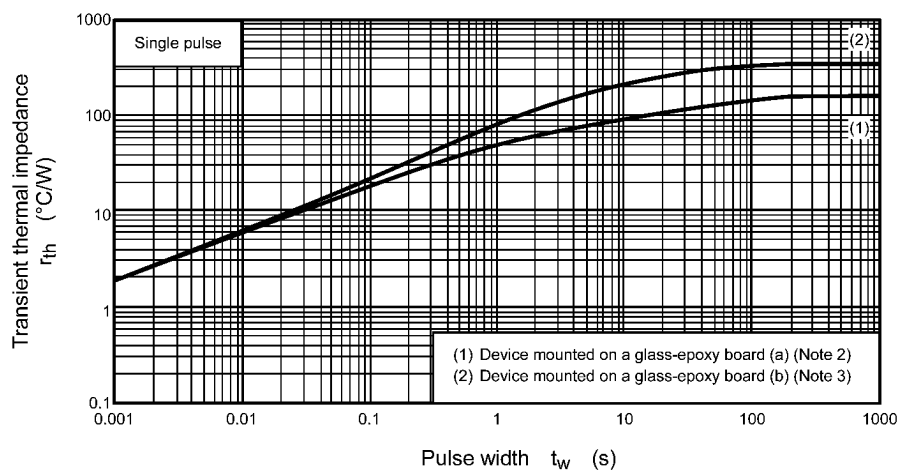


Fig. 8.12 $r_{th} - t_w$
(Guaranteed Maximum)

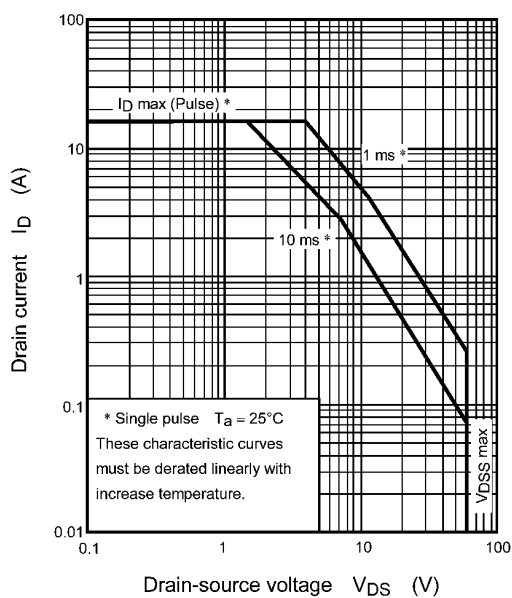
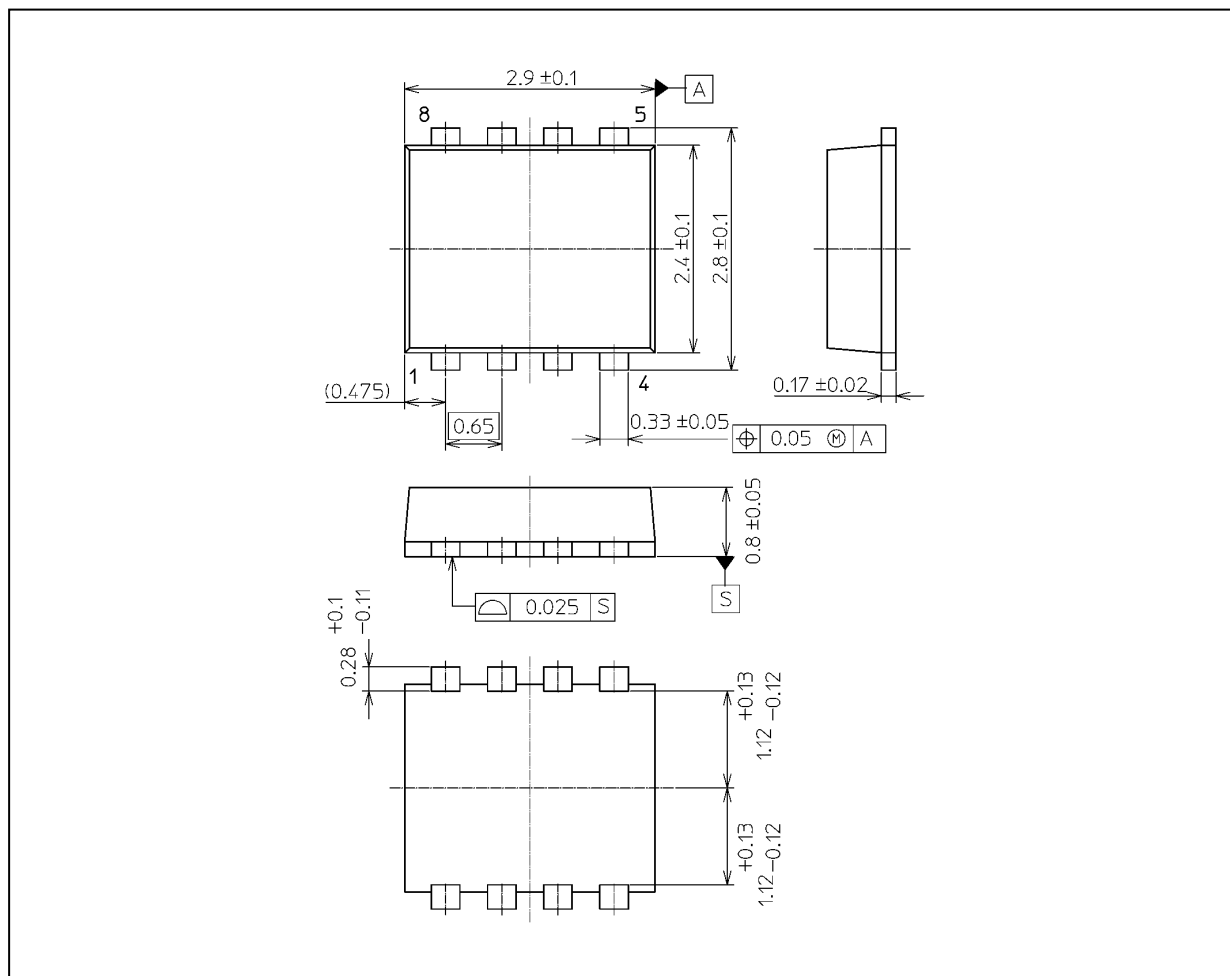


Fig. 8.13 Safe Operating Area
(Guaranteed Maximum)

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

Note 7: The definitions of the absolute maximum channel and storage temperatures are qualified per AEC-Q101.

Unit: mm



Weight: 0.017 g (typ.)

Package Name(s)
TOSHIBA: 2-3V1S
Nickname: PS-8

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