

TPC8228-H

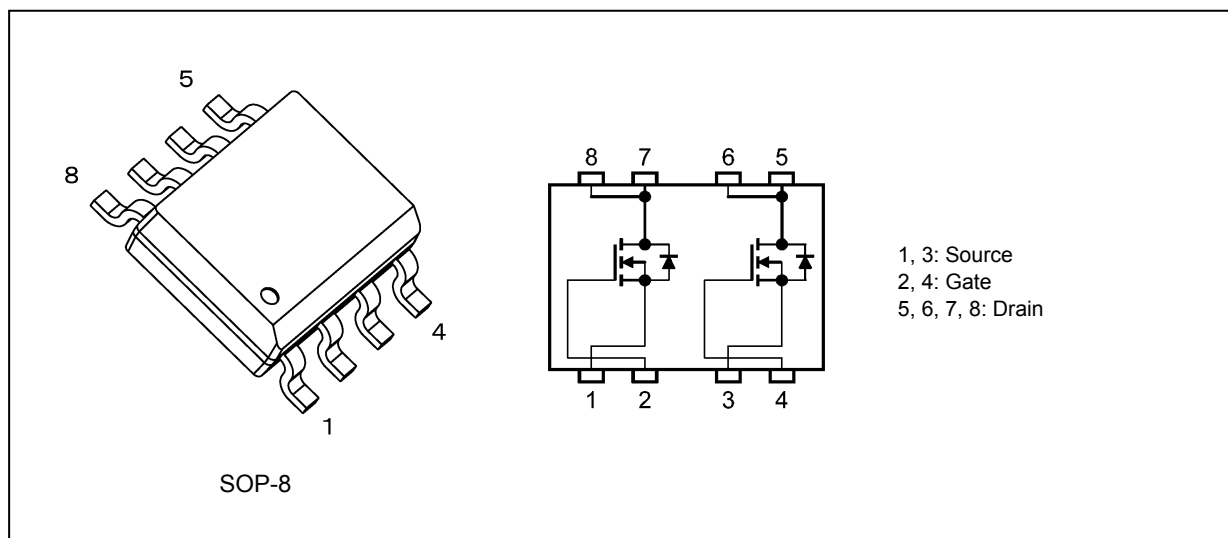
1. Applications

- DC-DC Converters
- CCFL Inverters

2. Features

- (1) Small, thin package
- (2) High-speed switching
- (3) Small gate charge: $Q_{SW} = 2.6 \text{ nC}$ (typ.)
- (4) Low drain-source on-resistance: $R_{DS(ON)} = 38 \text{ m}\Omega$ (typ.)
- (5) Low leakage current: $I_{DSS} = 10 \text{ }\mu\text{A}$ (max) ($V_{DS} = 60 \text{ V}$)
- (6) Enhancement mode: $V_{th} = 1.3 \text{ to } 2.3 \text{ V}$ ($V_{DS} = 10 \text{ V}$, $I_D = 0.1 \text{ mA}$)

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}	3.8	A
Drain current (pulsed) (Note 1)	I_{DP}	15.2	
Power dissipation (single operation) (t = 10 s) (Note 2), (Note 4)	$P_{\text{D}(1)}$	1.5	W
Power dissipation (per device for dual operation) (t = 10 s) (Note 2), (Note 5)	$P_{\text{D}(2)}$	1.1	
Power dissipation (single operation) (t = 10 s) (Note 3), (Note 4)	$P_{\text{D}(1)}$	0.75	
Power dissipation (per device for dual operation) (t = 10 s) (Note 3), (Note 5)	$P_{\text{D}(2)}$	0.45	
Single-pulse avalanche energy (Note 6)	E_{AS}	10	mJ
Avalanche current	I_{AR}	3.8	A
Channel temperature	T_{ch}	150	$^\circ\text{C}$
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-ambient thermal resistance (single operation) (t = 10 s) (Note 2), (Note 4)	$R_{\text{th(ch-a)}(1)}$	83.3	$^\circ\text{C/W}$
Channel-to-ambient thermal resistance (per device for dual operation) (t = 10 s) (Note 2), (Note 5)	$R_{\text{th(ch-a)}(2)}$	113	
Channel-to-ambient thermal resistance (single operation) (t = 10 s) (Note 3), (Note 4)	$R_{\text{th(ch-a)}(1)}$	166	
Channel-to-ambient thermal resistance (per device for dual operation) (t = 10 s) (Note 3), (Note 5)	$R_{\text{th(ch-a)}(2)}$	277	

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: Power dissipation and thermal resistance values per device with the other device being off (During single operation, power is supplied to only one of the two devices.)

Note 5: Power dissipation and thermal resistance values per device for dual operation (During dual operation, power is evenly supplied to both devices.)

Note 6: $V_{\text{DD}} = 24\text{ V}$, $T_{\text{ch}} = 25^\circ\text{C}$ (initial), $L = 1.0\text{ mH}$, $I_{\text{AR}} = 3.8\text{ A}$

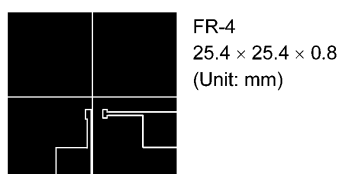


Fig. 5.1 Device Mounted on a Glass-Epoxy Board (a)

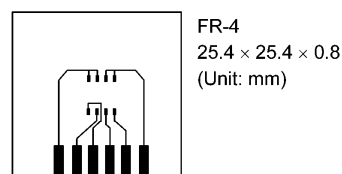


Fig. 5.2 Device Mounted on a Glass-Epoxy Board (b)

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

6. Electrical Characteristics

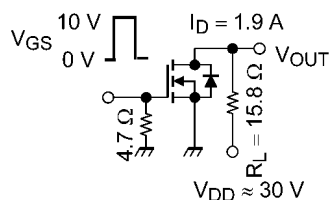
6.1. Static Characteristics ($T_a = 25^\circ\text{C}$ unless otherwise specified)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Gate leakage current	I_{GSS}	$V_{GS} = \pm 20\text{ V}$, $V_{DS} = 0\text{ V}$	—	—	± 0.1	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 (Note 7)	$V_{(BR)DSX}$	$I_D = 10\text{ mA}$, $V_{GS} = -20\text{ V}$	43	—	—	
Gate threshold voltage	V_{th}	$V_{DS} = 10\text{ V}$, $I_D = 0.1\text{ mA}$	1.3	—	2.3	
Drain-source on-resistance	$R_{DS(ON)}$	$V_{GS} = 4.5\text{ V}$, $I_D = 1.9\text{ A}$	—	43	64	$\text{m}\Omega$
		$V_{GS} = 10\text{ V}$, $I_D = 1.9\text{ A}$	—	38	57	

Note 7: 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 ($T_a = 25^\circ\text{C}$ unless otherwise specified)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Input capacitance	C_{iss}	$V_{DS} = 10\text{ V}$, $V_{GS} = 0\text{ V}$, $f = 1\text{ MHz}$	—	640	—	pF
Reverse transfer capacitance	C_{rss}		—	25	—	
Output capacitance	C_{oss}		—	90	—	
Gate resistance	r_g	$V_{DS} = 10\text{ V}$, $V_{GS} = 0\text{ V}$, $f = 5\text{ MHz}$	—	3.2	4.6	Ω
Switching time (rise time)	t_r	See Figure 6.2.1.	—	1.8	—	ns
Switching time (turn-on time)	t_{on}		—	6.7	—	
Switching time (fall time)	t_f		—	1.8	—	
Switching time (turn-off time)	t_{off}		—	18	—	



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	$V_{DD} \approx 48\text{ V}$, $V_{GS} = 10\text{ V}$, $I_D = 3.8\text{ A}$	—	11	—	nC
		$V_{DD} \approx 48\text{ V}$, $V_{GS} = 5\text{ V}$, $I_D = 3.8\text{ A}$	—	5.7	—	
Gate-source charge 1	Q_{gs1}	$V_{DD} \approx 48\text{ V}$, $V_{GS} = 10\text{ V}$, $I_D = 3.8\text{ A}$	—	2.1	—	
Gate-drain charge	Q_{gd}		—	1.8	—	
Gate switch charge	Q_{SW}		—	2.6	—	

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 8)	I_{DRP}	—	—	—	15.2	A
Diode forward voltage	V_{DSF}	$I_{DR} = 3.8\text{ A}$, $V_{GS} = 0\text{ V}$	—	—	-1.2	V

Note 8: Ensure that the channel temperature does not exceed 150°C .

7. Marking (Note)

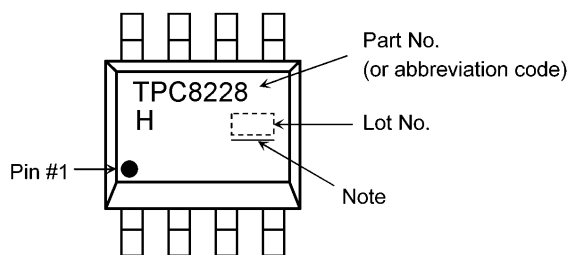


Fig. 7.1 Marking

Note: A line under a Lot No. identifies the indication of product Labels.

Not underlined: [[Pb]]/INCLUDES > MCV

Underlined: [[G]]/RoHS COMPATIBLE or [[G]]/RoHS [[Pb]]

Please contact your TOSHIBA sales representative for details as to environmental matters such as the RoHS compatibility of Product.

The RoHS is the Directive 2011/65/EU of the European Parliament and of the Council of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment.

8. Characteristics Curves (Note)

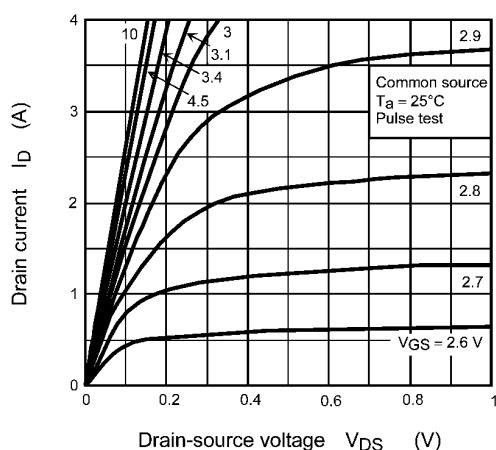


Fig. 8.1 $I_D - V_{DS}$

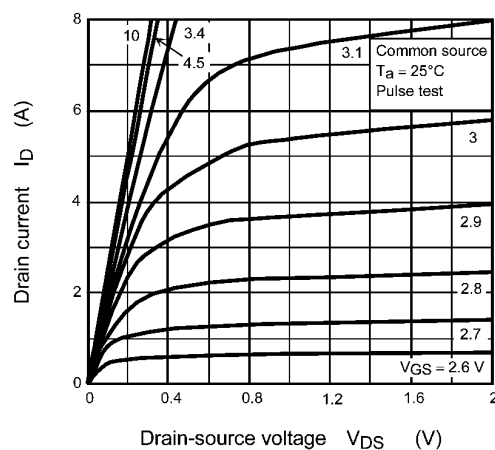


Fig. 8.2 $I_D - V_{DS}$

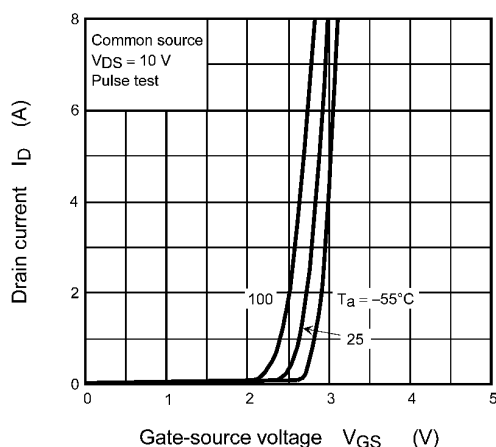


Fig. 8.3 $I_D - V_{GS}$

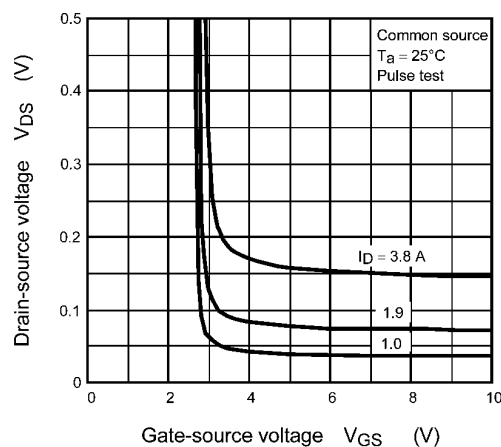


Fig. 8.4 $V_{DS} - V_{GS}$

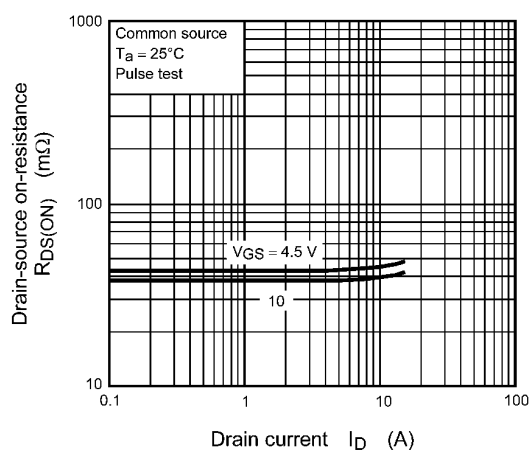


Fig. 8.5 $R_{DS(ON)} - I_D$

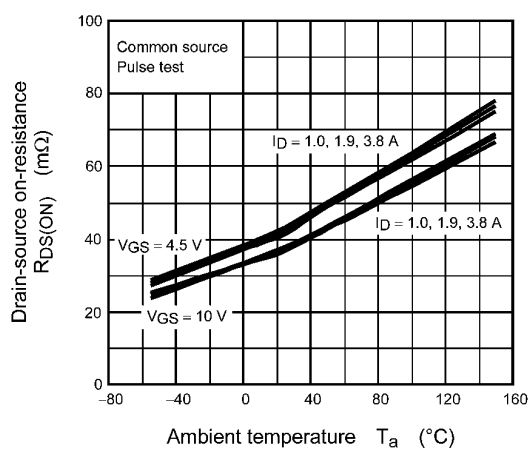


Fig. 8.6 $R_{DS(ON)} - T_a$

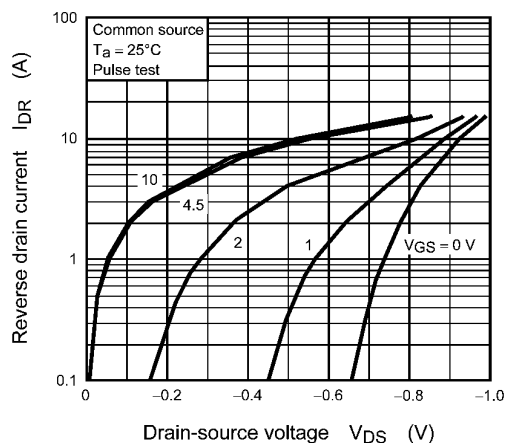


Fig. 8.7 $I_{DR} - V_{DS}$

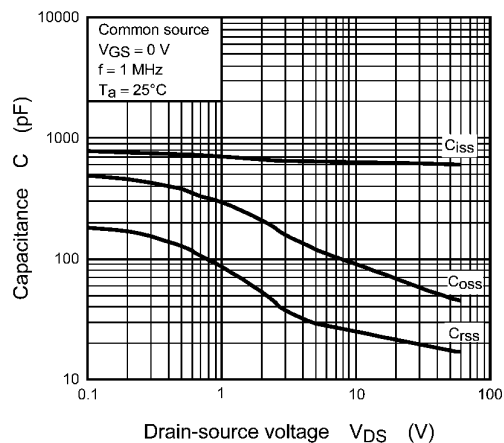


Fig. 8.8 Capacitance - V_{DS}

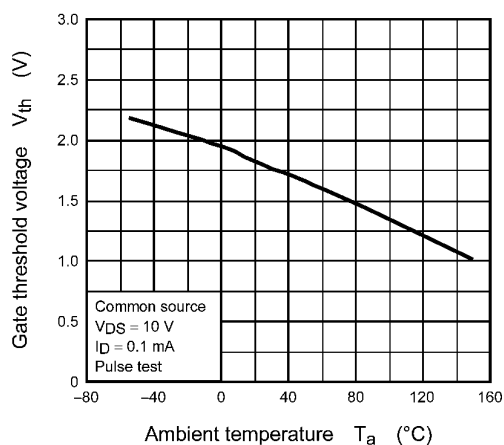


Fig. 8.9 $V_{th} - T_a$

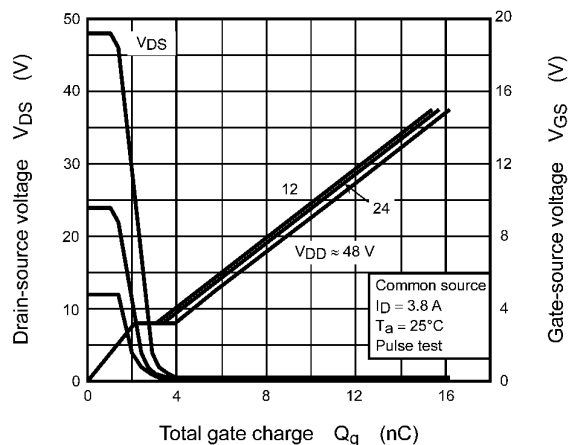
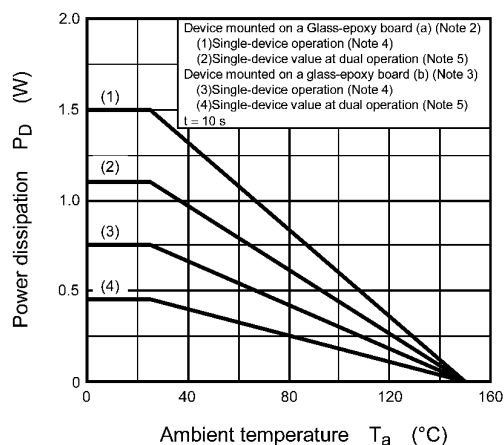


Fig. 8.10 Dynamic Input/Output Characteristics



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

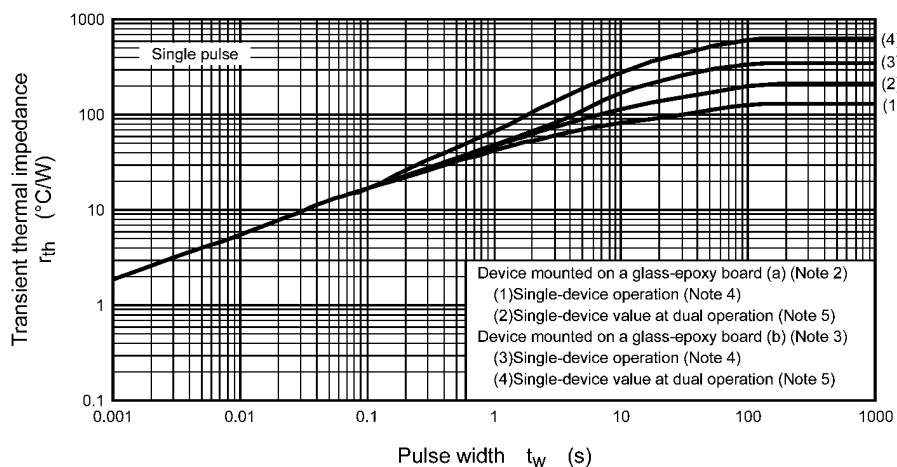


Fig. 8.12 $r_{th} - t_w$
(Guaranteed Maximum)

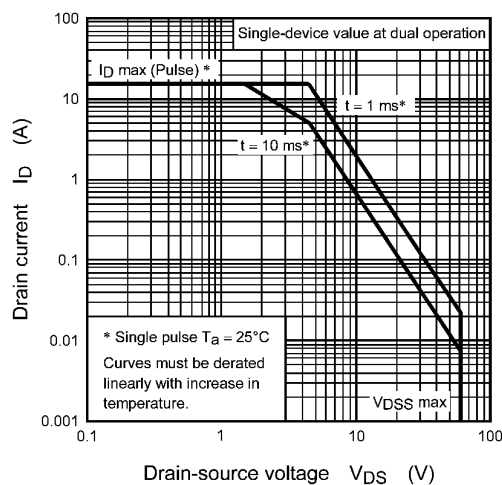
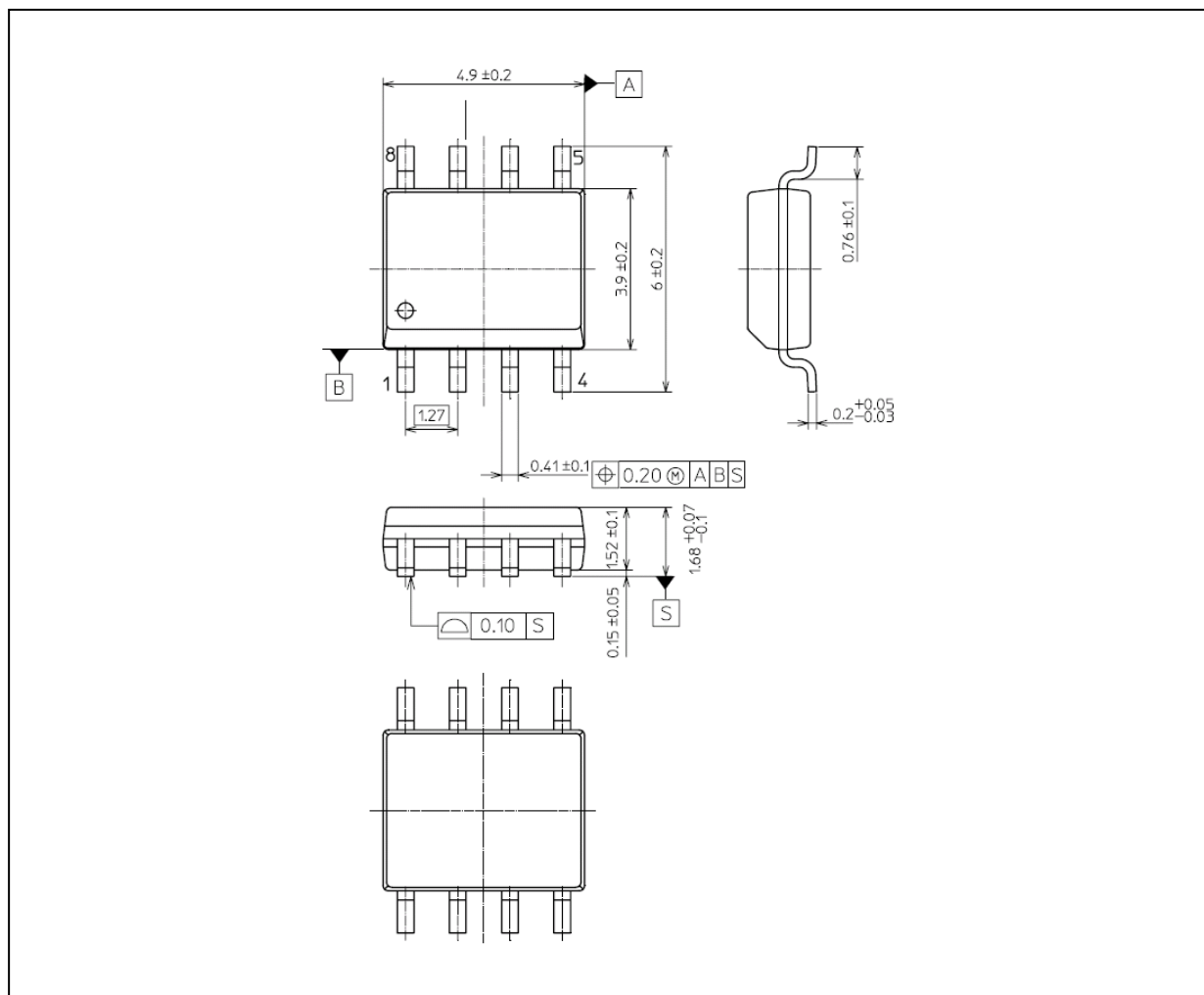


Fig. 8.13 Safe Operating Area
(Guaranteed Maximum)

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

Package Dimensions

Unit: mm



Weight: 0.085 g (typ.)

Package Name(s)
TOSHIBA: 2-5R1S
Nickname: SOP-8

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