

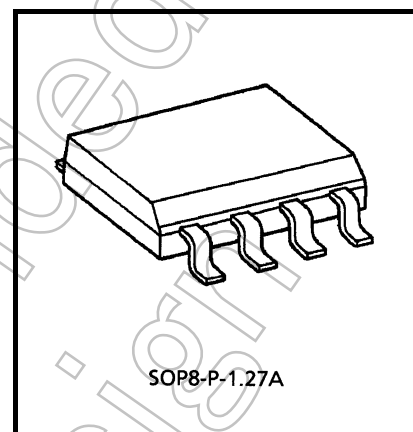
# TPD1033F

## High-side Power Switch for Motors, Solenoids, and Lamp Drivers

The TPD1033F is a monolithic power IC for high-side switches. The IC has a vertical MOS FET output that can be directly driven from a CMOS or TTL logic circuit (e.g., an MPU). The device is equipped with intelligent self-protection and diagnostic functions.

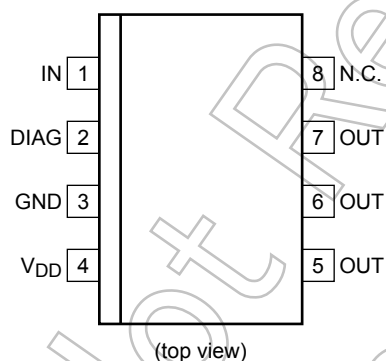
### Features

- A monolithic power IC with a new structure combining a control block (Bi-CMOS) and a vertical power MOS FET ( $\pi$ -MOS) on a single chip
- One side of load can be grounded to a high-side switch
- Can directly drive a power load from a microprocessor.
- Built-in protection against thermal shutdown and load short-circuiting.
- Incorporates a diagnosis function that allows diagnosis output to be read externally in the event of load short-circuiting, opening, or overheating.
- Up to -10 V of counterelectromotive force from an L load can be applied.
- Low on-resistance :  $R_{ON} = 220 \text{ m}\Omega$  (max)
- Low operating current :  $I_{DD} = 1 \text{ mA}$  (typ.), (@ $V_{DD} = 12 \text{ V}$ ,  $V_{IN} = 0 \text{ V}$ )
- 8-pin SOP package for surface mounting can be packed in tape.

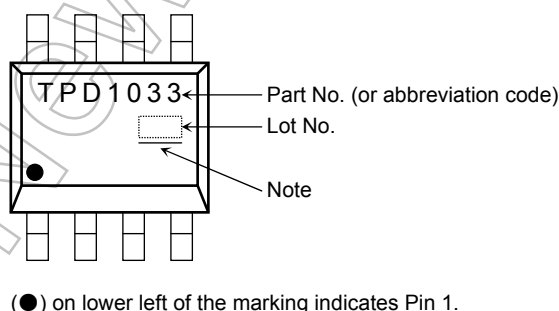


Weight: 0.08 g (typ.)

### Pin Assignment



### Marking



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

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

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

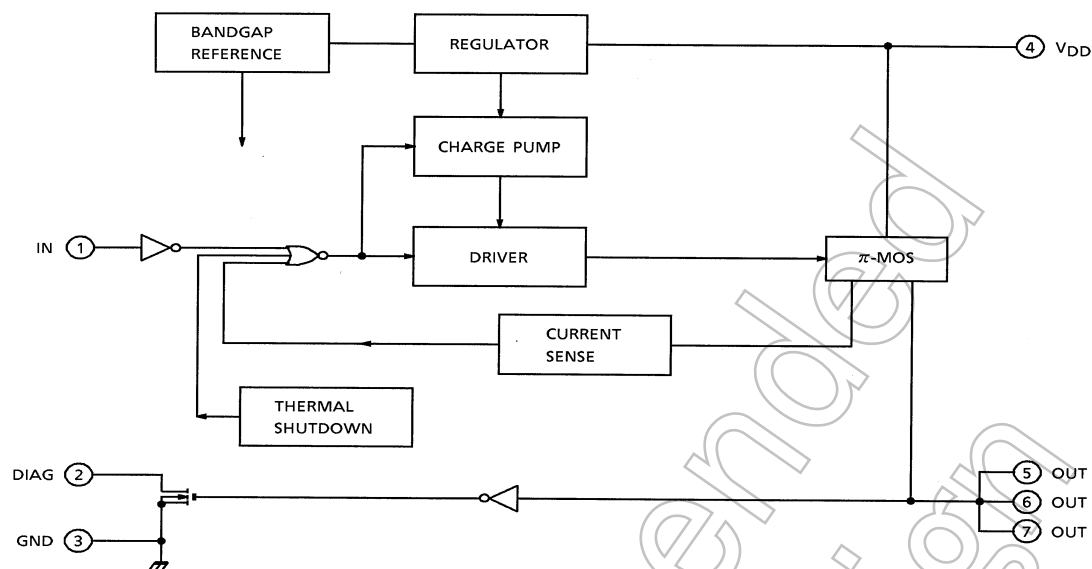
Please contact your TOSHIBA sales representative for details as to environmental matters such as the RoHS compatibility of Product.

The RoHS is 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.

Due to its MOS structure, this product is sensitive to static electricity.

Start of commercial production  
2000-02

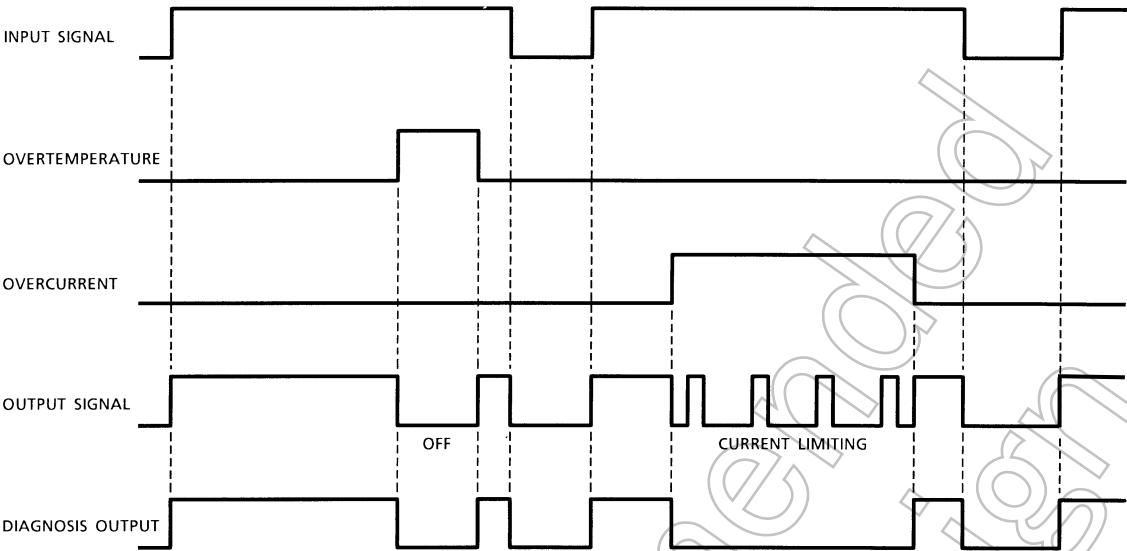
**Block Diagram**



**Pin Description**

Pin No.	Symbol	Function
1	IN	Input pin. Input is CMOS-compatible, with pull-down resistor connected. Even if the input is open, output will not accidentally turn on.
2	DIAG	Self-diagnosis detection pin. Goes low when overheating is detected or when output is short-circuited with input on (high). n-channel open drain.
3	GND	Ground pin.
4	V <sub>DD</sub>	Power pin.
5, 6, 7	OUT	Output pin. When the load is short-circuited and current in excess of the detection current (8 A typ.) flows to the output pin, the output automatically turns on or off.

Timing Chart



Truth Table

Input Signal	Output Signal	Diagnosis Output	State
H	H	H	Normal
L	L	L	
H	L	L	Load short-circuited
L	L	L	
H	H	H	Load open
L	H	H	
H	L	L	Overtemperature
L	L	L	

**Absolute Maximum Ratings (Ta = 25°C)**

Characteristic		Symbol	Rating	Unit
Drain-source voltage		V <sub>DS</sub>	60	V
Supply voltage	DC	V <sub>DD</sub> (1)	25	V
	Pulse	V <sub>DD</sub> (2)	60 (Rs = 1Ω, T = 250 ms)	V
Input voltage	DC	V <sub>IN</sub> (1)	-0.5 ~ 12	V
	Pulse	V <sub>IN</sub> (2)	V <sub>DD</sub> (1) + 1.5 (t = 100 ms)	V
Diagnosis output voltage		V <sub>DIAG</sub>	-0.5 ~ 25	V
Output current		I <sub>O</sub>	Internally limited	A
Input current		I <sub>IN</sub>	± 10	mA
Diagnosis output current		I <sub>DIAG</sub>	5	mA
Power dissipation (Ta = 25°C)		P <sub>D</sub>	1.4 Note 1	W
			2.4 Note 2	
Operating temperature		T <sub>opr</sub>	- 40 ~ 110	°C
Channel temperature		T <sub>ch</sub>	150	°C
Storage temperature		T <sub>stg</sub>	- 55 ~ 150	°C

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 and the operating ranges.

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).

**Thermal Resistance**

Characteristic	Symbol	Test Condition	Unit
Thermal resistance	R <sub>th (ch-a)</sub>	89.3 (Note 1)	°C/W
		52.1 (Note 2)	

Note 1: Mounted on glass epoxy board (25.4 mm × 25.4 mm × 0.8 mm) (DC)

Note 2: Mounted on glass epoxy board (25.4 mm × 25.4 mm × 0.8 mm) (t<sub>W</sub> ≤ 10 s)

**Electrical Characteristics**

 (Unless otherwise specified,  $T_{ch} = -40$  to  $110^{\circ}\text{C}$ ,  $V_{DD} = 8\sim 18\text{ V}$ )

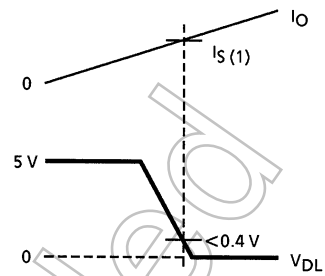
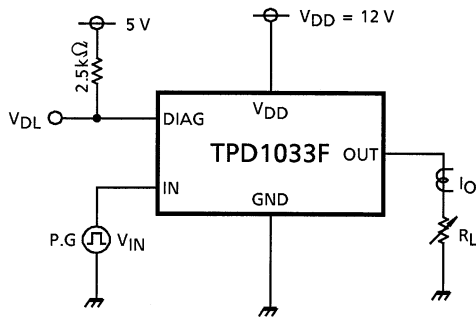
Characteristic		Symbol	Test Circuit	Test Condition	Min	Typ.	Max	Unit
Operating supply voltage		$V_{DD}(\text{opr})$	—	—	5	12	18	V
Supply current		$I_{DD}$	—	$V_{DD} = 12\text{ V}$ , $V_{IN} = 0\text{ V}$	—	1	5	mA
Input voltage		$V_{IH}$	—	$V_{DD} = 12\text{ V}$ , $I_O = 2\text{ A}$	3.5	—	—	V
		$V_{IL}$	—	$V_{DD} = 12\text{ V}$ , $I_O = 1.2\text{ mA}$	—	—	1.5	V
Input current		$I_{IN}(1)$	—	$V_{DD} = 12\text{ V}$ , $V_{IN} = 5\text{ V}$	—	50	200	$\mu\text{A}$
		$I_{IN}(2)$	—	$V_{DD} = 12\text{ V}$ , $V_{IN} = 0\text{ V}$	-0.2	—	0.2	$\mu\text{A}$
On-voltage		$V_{DS}(\text{ON})$	—	$V_{DD} = 12\text{ V}$ , $I_O = 2\text{ A}$ , $T_{ch} = 25^{\circ}\text{C}$	—	—	0.44	V
On-resistance		$R_{DS}(\text{ON})$	—	$V_{DD} = 12\text{ V}$ , $I_O = 2\text{ A}$ , $T_{ch} = 25^{\circ}\text{C}$	—	—	0.22	$\Omega$
Output leakage current		$I_{OL}$	—	$V_{DD} = 18\text{ V}$ , $V_{IN} = 0\text{ V}$	—	—	1.2	mA
Diagnosis output voltage	"L" Level	$V_{DL}$	—	$V_{DD} = 12\text{ V}$ , $I_{DL} = 2\text{ mA}$	—	—	0.4	V
Diagnosis output current	"H" Level	$I_{DH}$	—	$V_{DD} = 18\text{ V}$ , $V_{DH} = 18\text{ V}$	—	—	10	$\mu\text{A}$
Overcurrent protection		$I_S(1)$ Note 3	1	$V_{DD} = 12\text{ V}$ , $T_{ch} = 25^{\circ}\text{C}$	4	6	8	A
		$I_S(2)$ Note 4	2		4	8	12	A
Thermal shutdown	Temperature	$T_S$	—	—	150	160	200	$^{\circ}\text{C}$
	Hysteresis	$\Delta T_S$	—		—	10	—	$^{\circ}\text{C}$
Open detection resistance		$R_{ops}$	—	$V_{DD} = 8\text{ V}$	1	20	100	k $\Omega$
Switching time		$t_{ON}$	3	$V_{DD} = 12\text{ V}$ , $R_L = 5\Omega$ , $T_{ch} = 25^{\circ}\text{C}$	10	100	—	$\mu\text{s}$
		$t_{OFF}$	3		10	30	—	$\mu\text{s}$

 Note 3: Overcurrent detection value when load is short circuited and  $V_{IN} = \text{"L"} \rightarrow \text{"H"}$ 

 Note 4: Overcurrent detection value when load current is increased while  $V_{IN} = \text{"H"}$

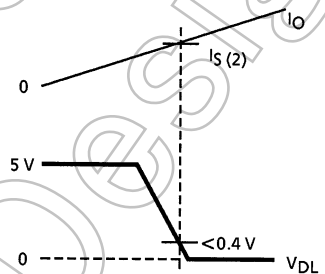
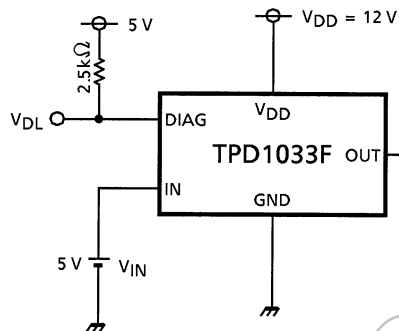
## Test Circuit 1

### Over-current detection



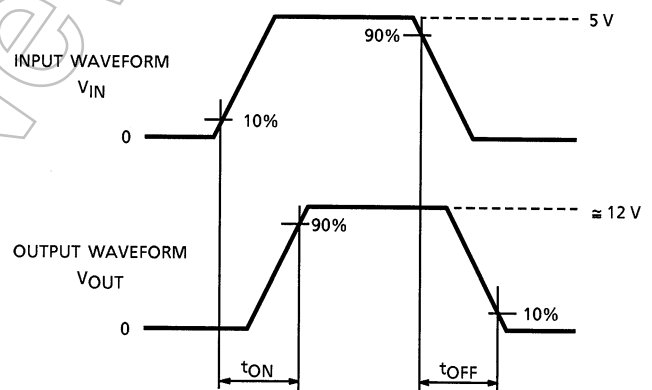
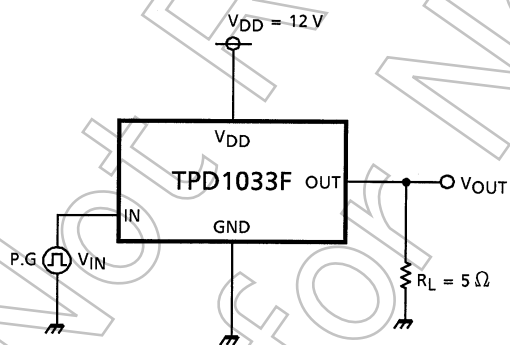
## Test Circuit 2

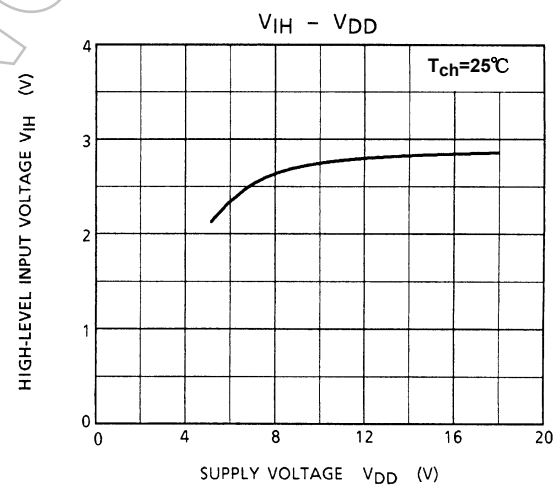
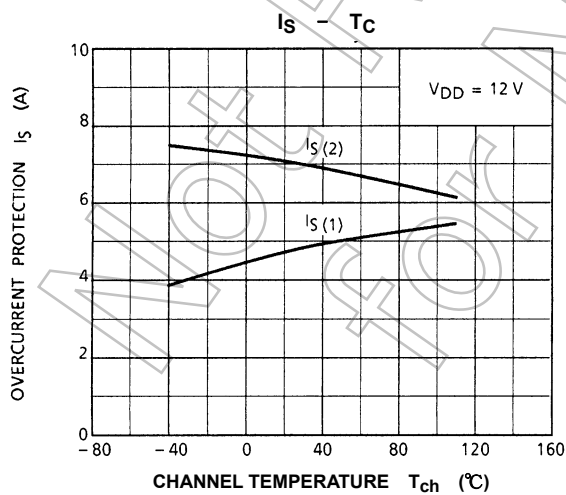
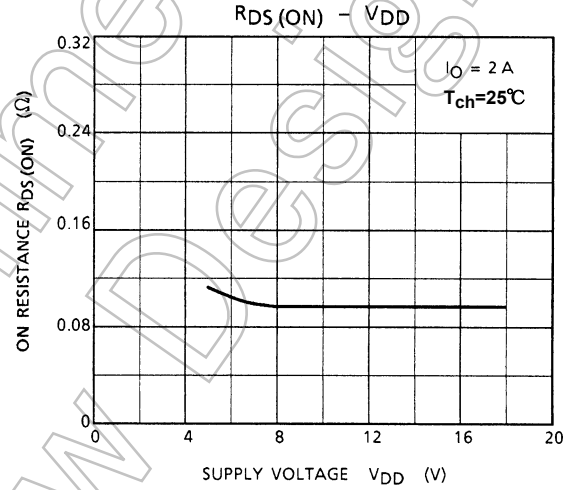
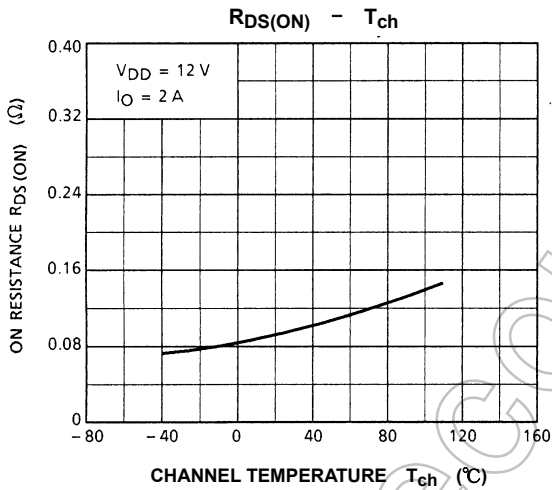
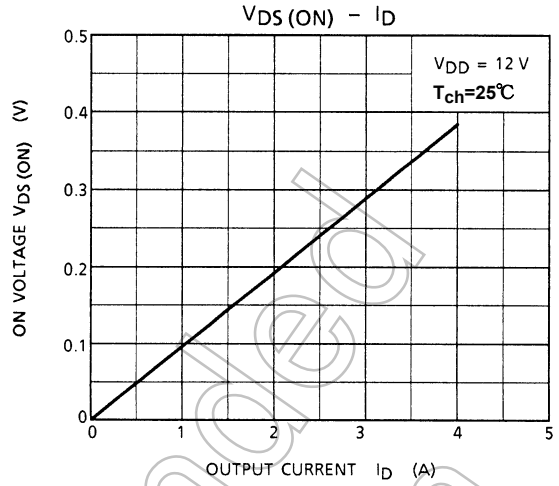
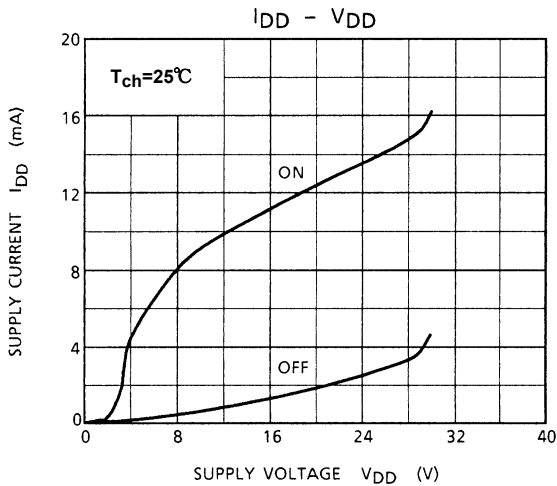
### Over-current detection

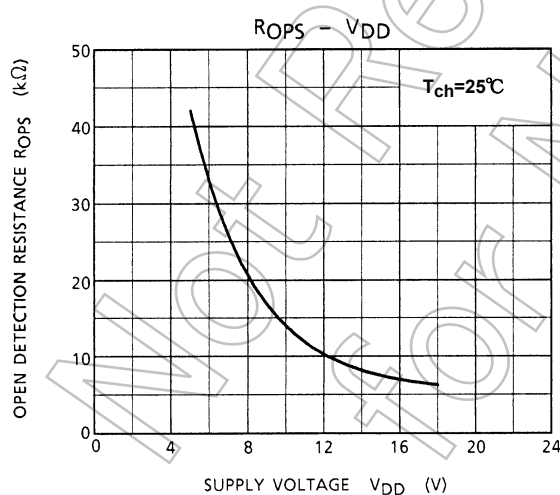
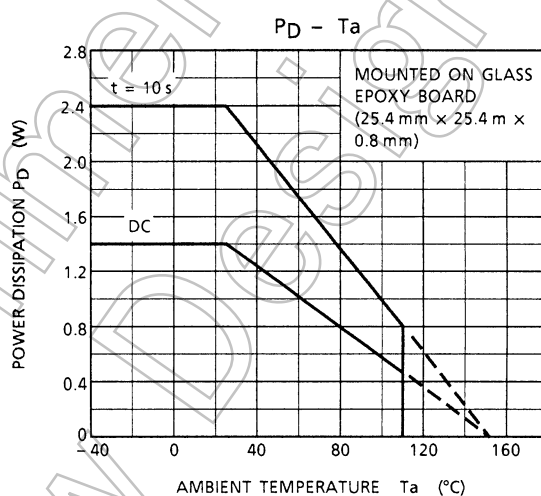
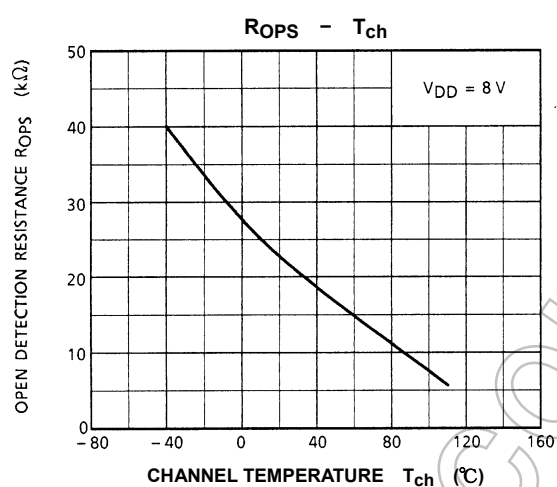
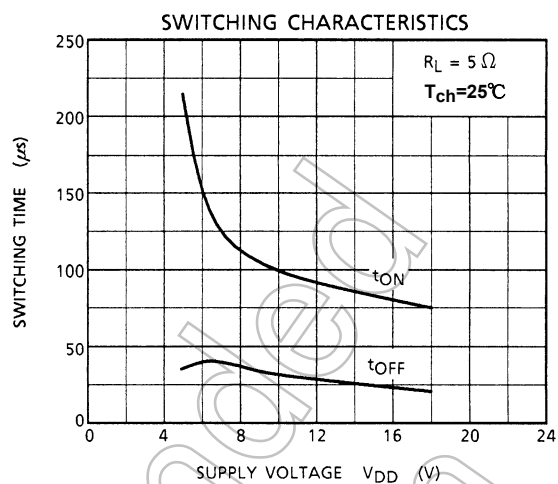
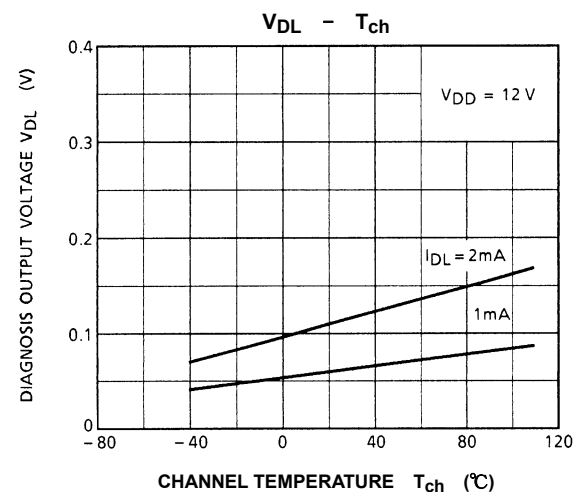


## Test Circuit 3

### Switching time



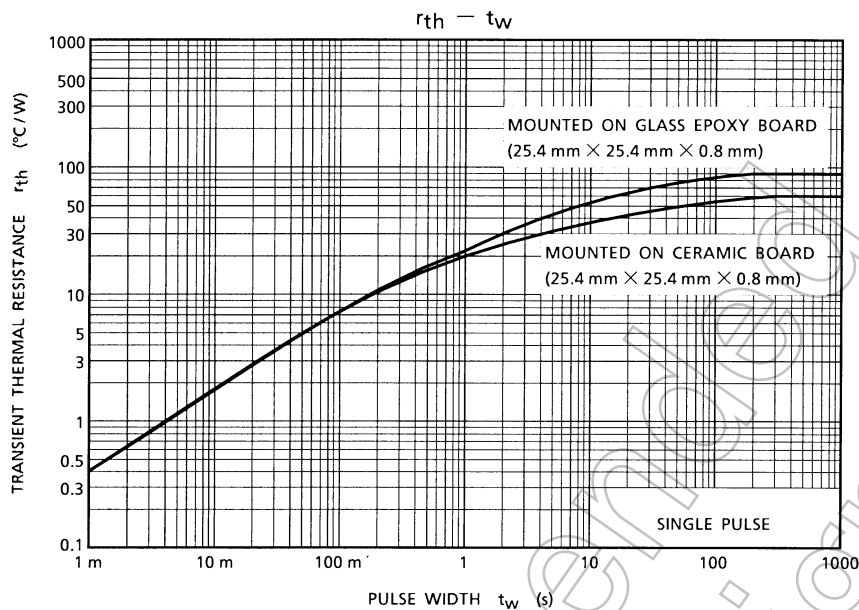




## Precaution:

1. Since there is no built-in protection against reverse connection of batteries, etc., provide such protection using external circuits.

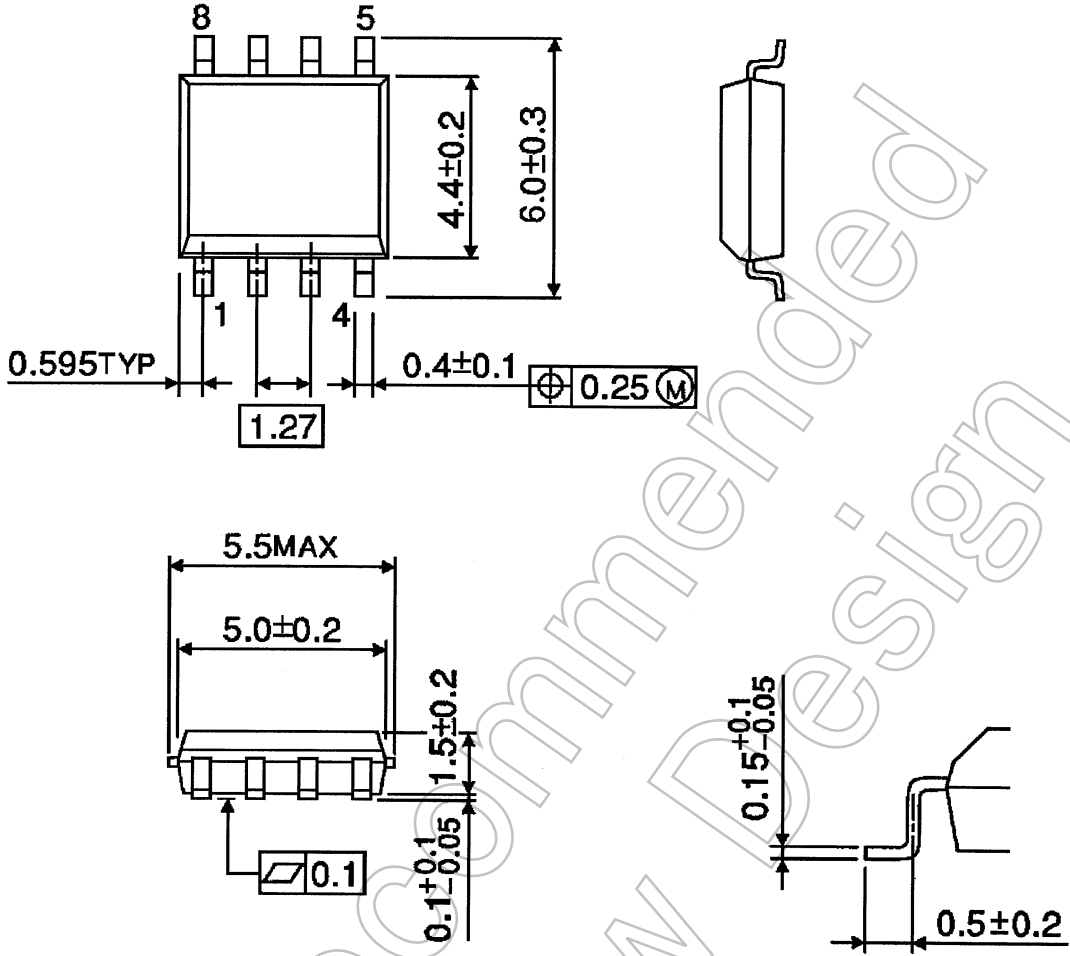




Package Dimensions

SOP8-P1.27A

Unit : mm



Weight: 0.08 g (typ.)

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