

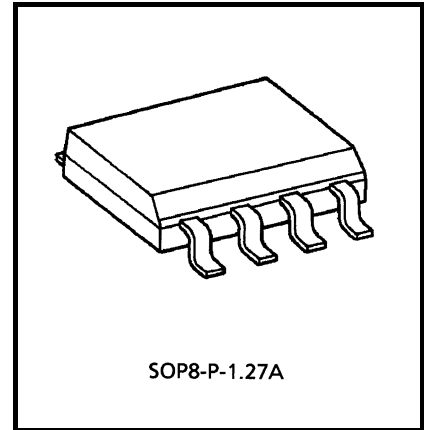
TPD1033F

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.

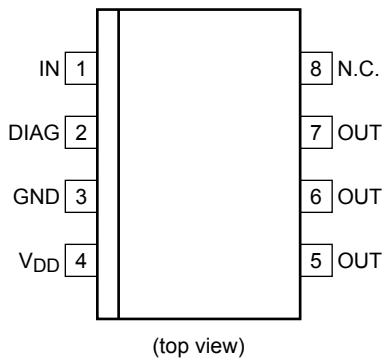
Features

- A monolithic power IC with a new structure combining a control block (Bi-CMOS) and a vertical power MOS FET (π -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.

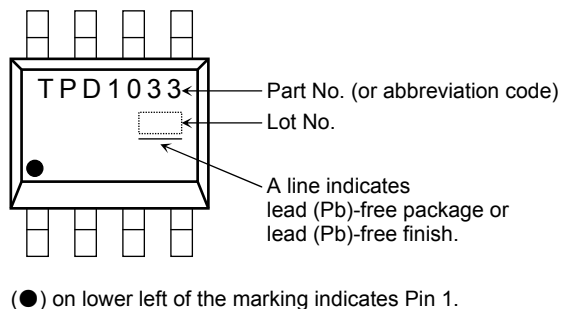


Weight: 0.08 g (typ.)

Pin Assignment

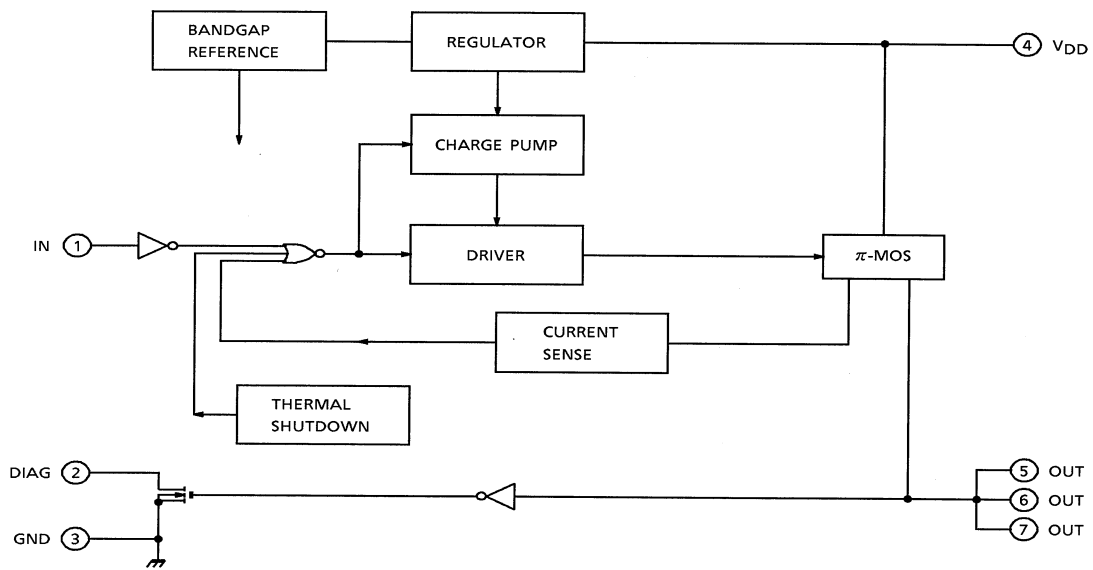


Marking



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

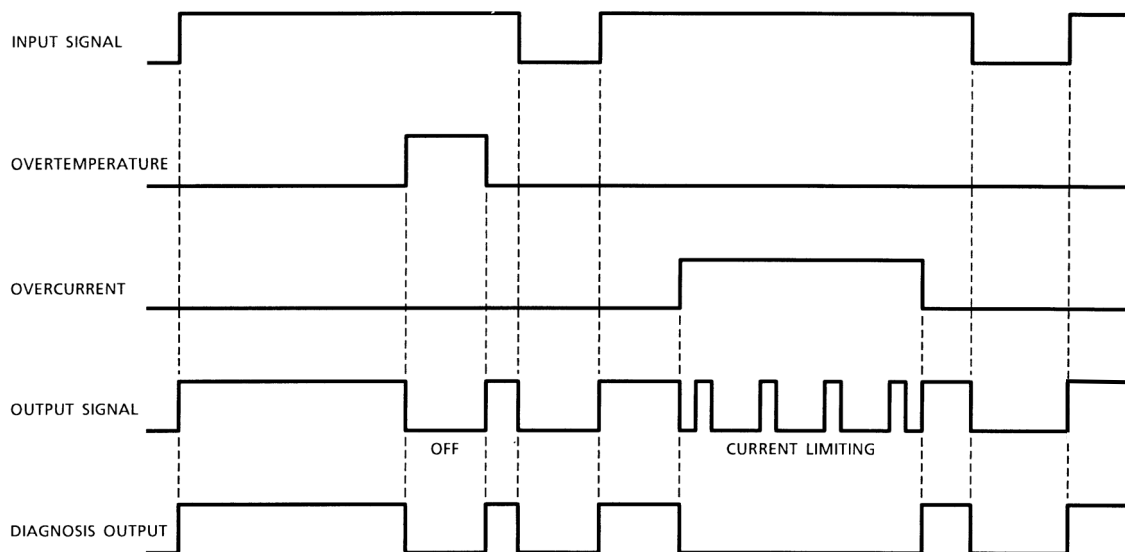
Block Diagram



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 _{DD}	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_{DS}	60	V
Supply voltage	DC	$V_{DD(1)}$	25
	Pulse	$V_{DD(2)}$	60 ($R_s = 1\Omega, T = 250\text{ ms}$)
Input voltage	DC	$V_{IN(1)}$	-0.5 ~ 12
	Pulse	$V_{IN(2)}$	$V_{DD(1)} + 1.5$ ($t = 100\text{ ms}$)
Diagnosis output voltage	V_{DIAG}	-0.5 ~ 25	V
Output current	I_O	Internally limited	A
Input current	I_{IN}	± 10	mA
Diagnosis output current	I_{DIAG}	5	mA
Power dissipation (Ta = 25°C)	P_D	1.4 Note 1	W
		2.4 Note 2	
Operating temperature	T_{opr}	- 40 ~ 110	°C
Channel temperature	T_{ch}	150	°C
Storage temperature	T_{stg}	- 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	$R_{th(ch-a)}$	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) ($t_W \leq 10\text{ s}$)

Electrical Characteristics

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

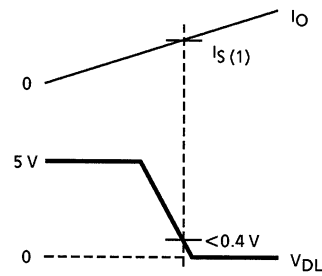
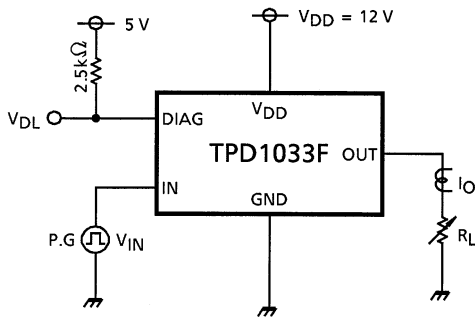
Characteristic		Symbol	Test Circuit	Test Condition	Min	Typ.	Max	Unit
Operating supply voltage		$V_{DD}(\text{opr})$	—	—	5	12	18	V
Supply current		I_{DD}	—	$V_{DD} = 12\text{ V}$, $V_{IN} = 0\text{ V}$	—	1	5	mA
Input voltage		V_{IH}	—	$V_{DD} = 12\text{ V}$, $I_O = 2\text{ A}$	3.5	—	—	V
		V_{IL}	—	$V_{DD} = 12\text{ V}$, $I_O = 1.2\text{ mA}$	—	—	1.5	V
Input current		$I_{IN}(1)$	—	$V_{DD} = 12\text{ V}$, $V_{IN} = 5\text{ V}$	—	50	200	μA
		$I_{IN}(2)$	—	$V_{DD} = 12\text{ V}$, $V_{IN} = 0\text{ V}$	-0.2	—	0.2	μA
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	Ω
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	μA
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	ΔT_s		—	10	—	$^{\circ}\text{C}$
Open detection resistance		R_{Ops}	—	$V_{DD} = 8\text{ V}$	1	20	100	$\text{k}\Omega$
Switching time		t_{ON}	3	$V_{DD} = 12\text{ V}$, $R_L = 5\Omega$, $T_{ch} = 25^{\circ}\text{C}$	10	100	—	μs
		t_{OFF}	3		10	30	—	μs

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 $V_{IN} = \text{“H”}$

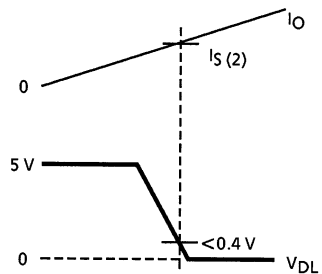
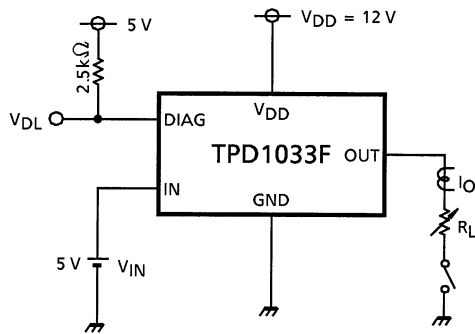
Test Circuit 1

Over-current detection



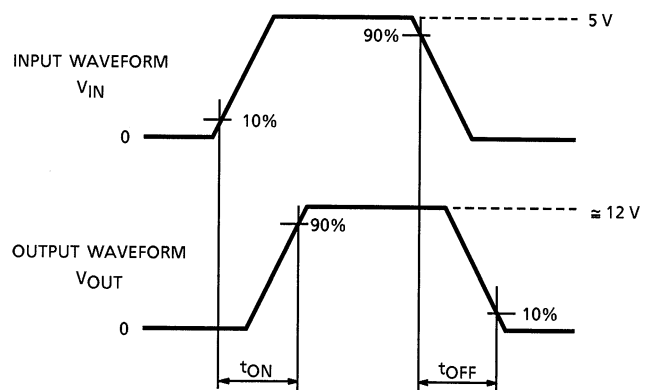
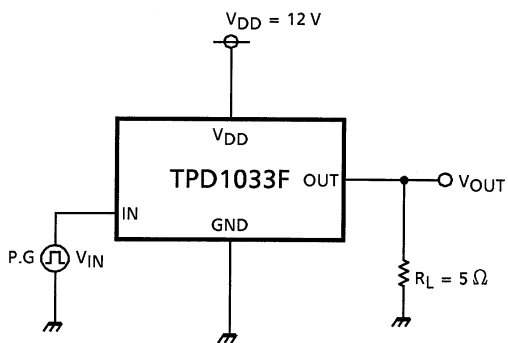
Test Circuit 2

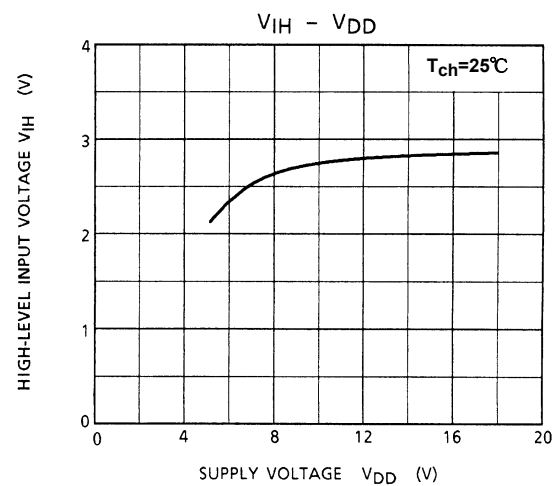
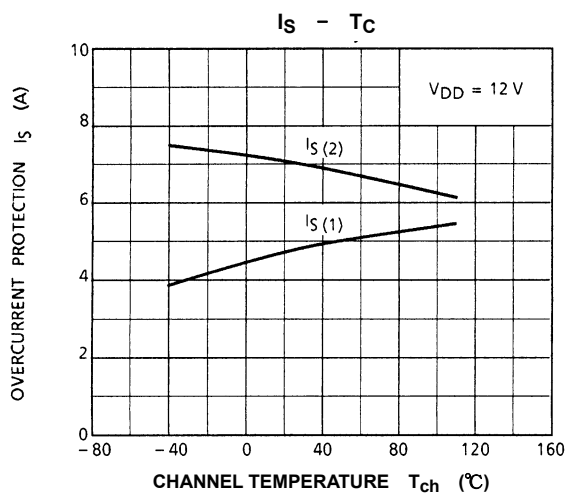
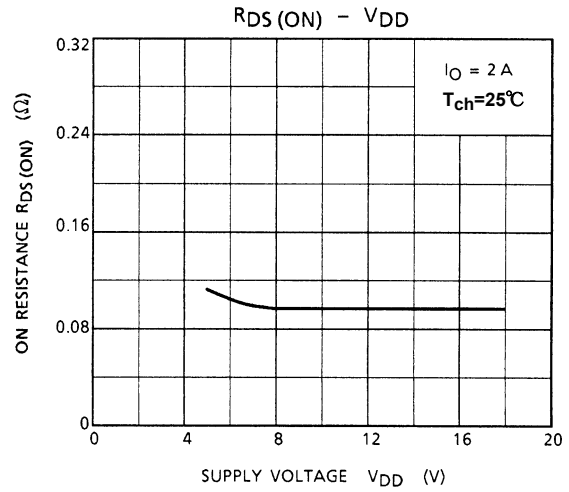
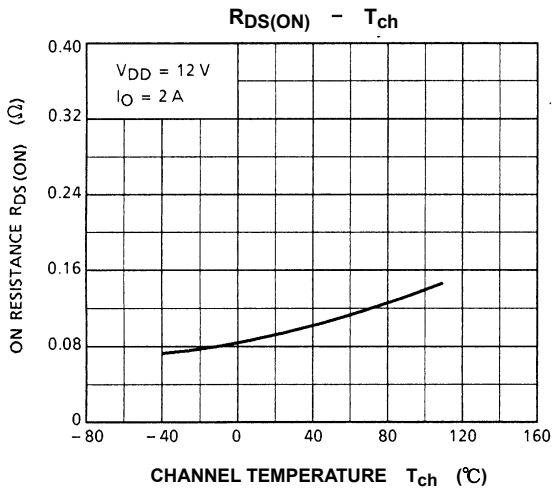
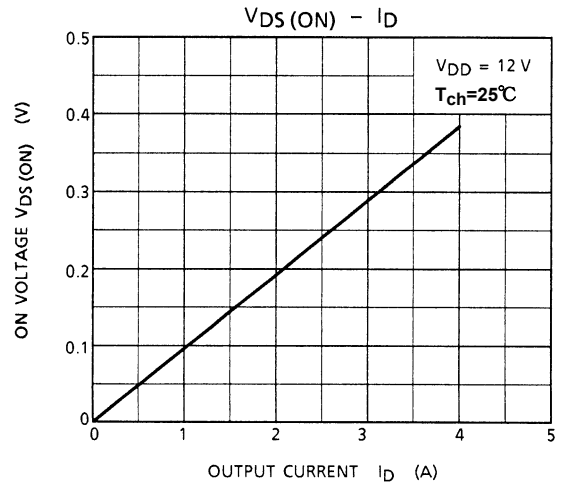
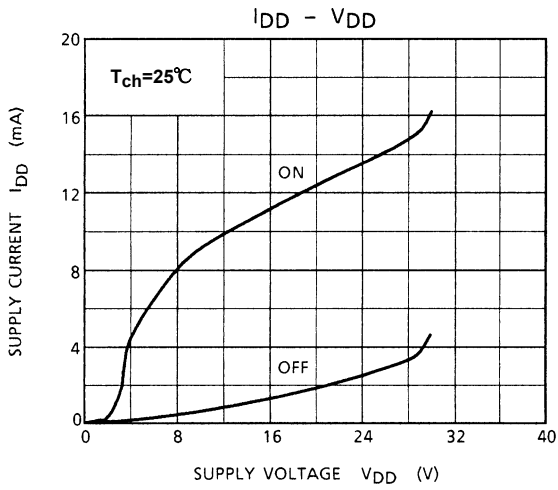
Over-current detection

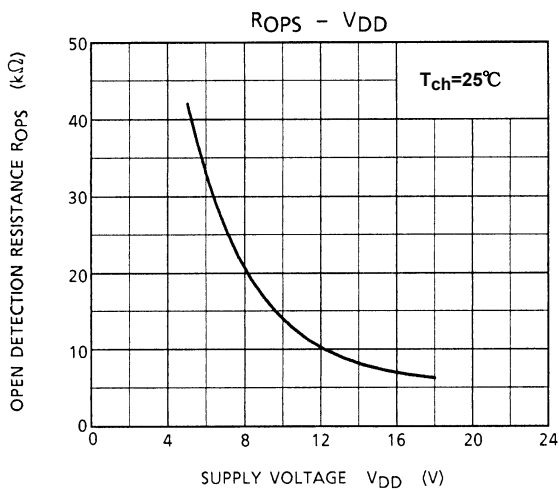
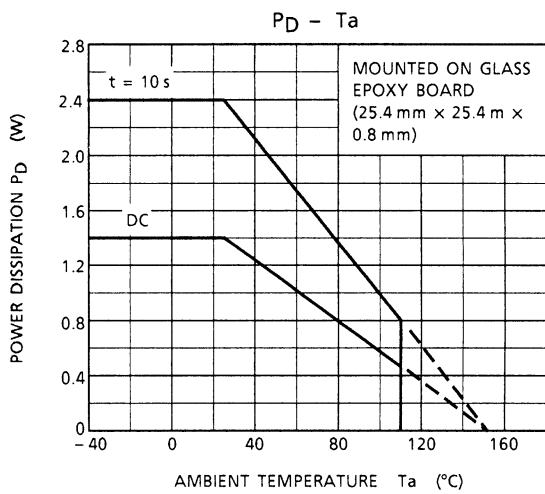
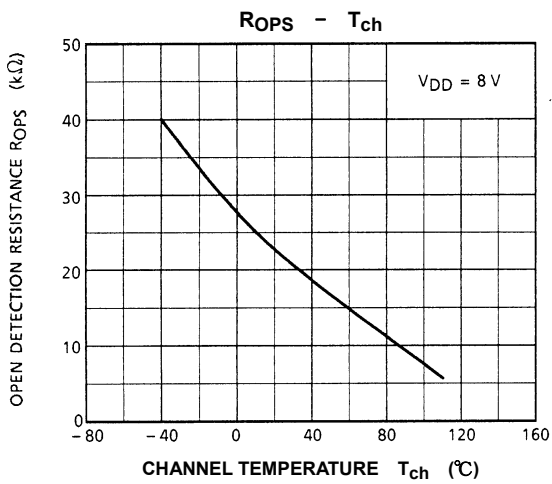
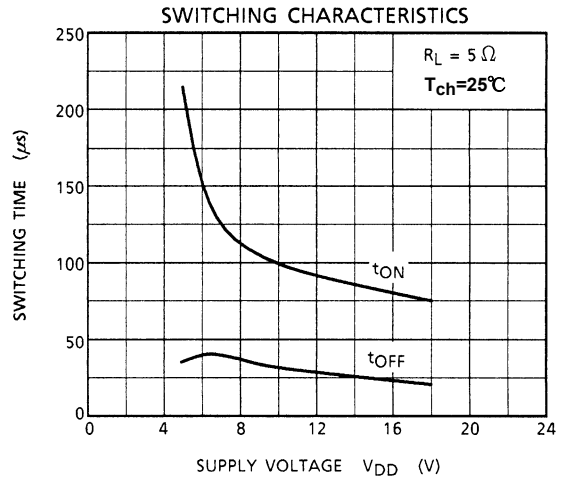
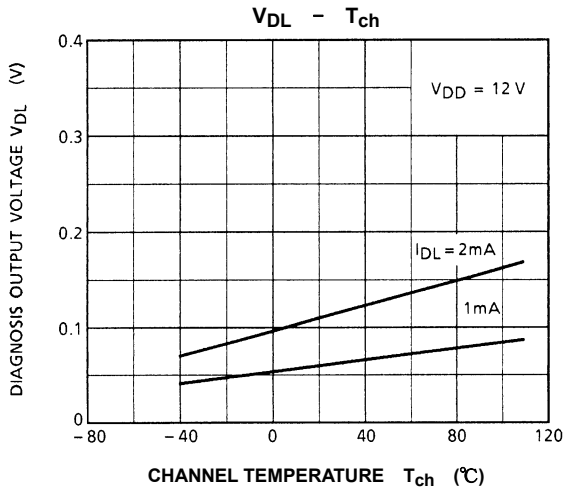


Test Circuit 3

Switching time

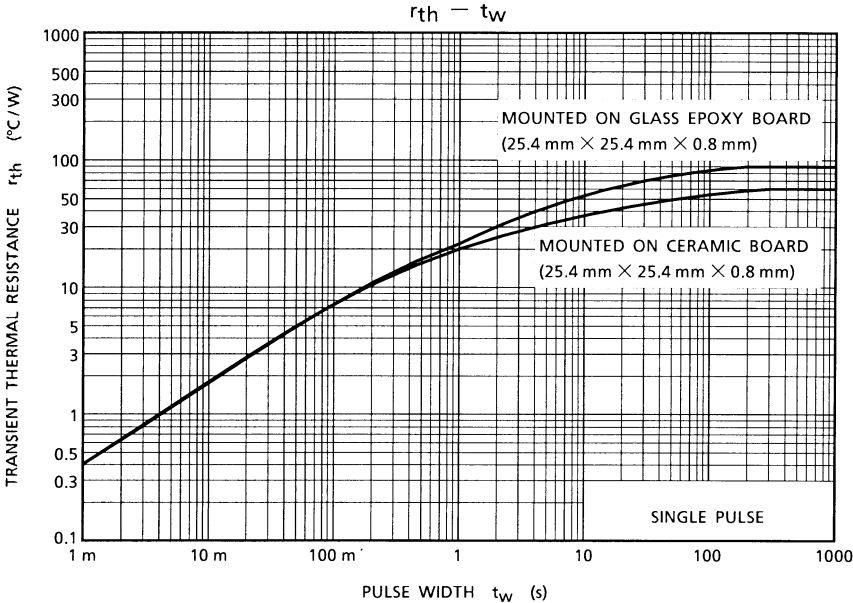






Precaution:

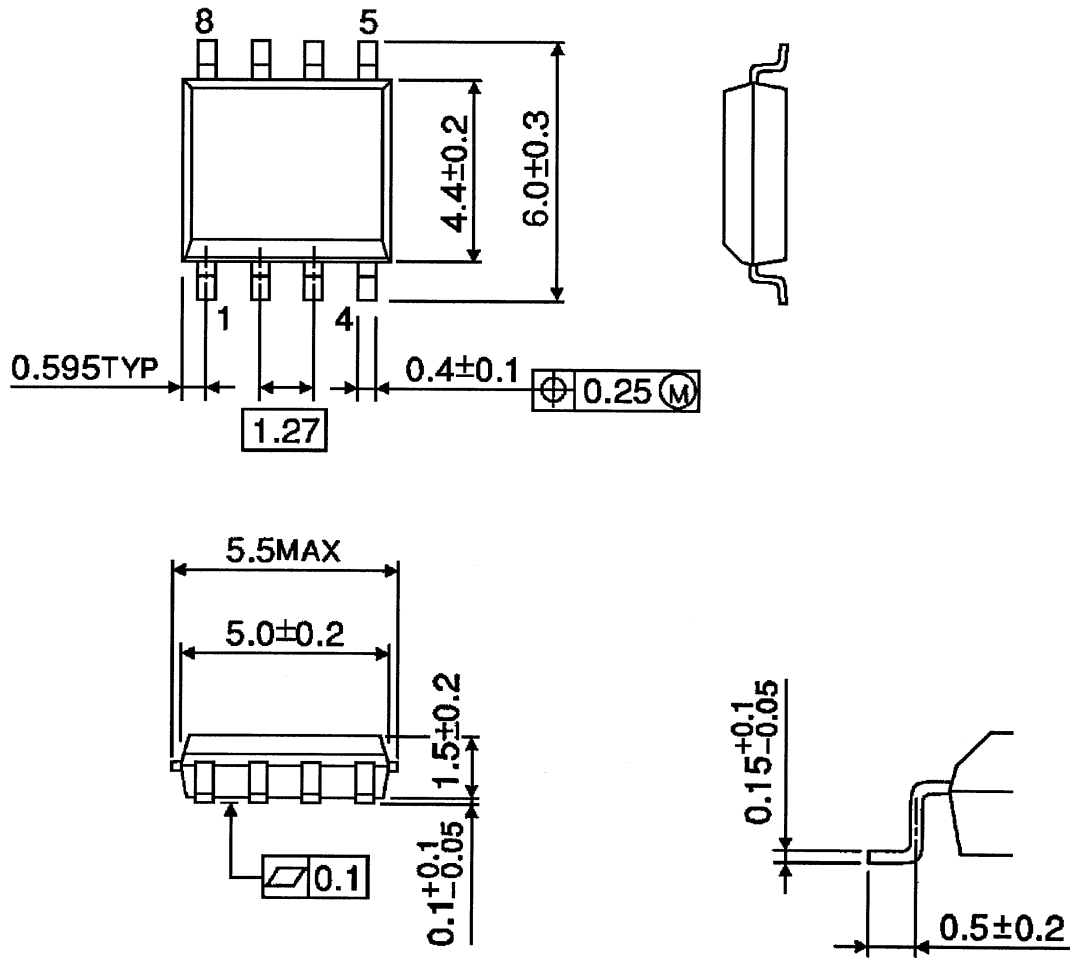
1. Since there is no built-in protection against reverse connection of batteries, etc., provide such protection using external circuits.



Package Dimensions

SOP8-P1.27A

Unit : mm



Weight: 0.08 g (typ.)

RESTRICTIONS ON PRODUCT USE

20070701-EN

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