

TOSHIBA INTELLIGENT POWER DEVICE  
SILICON MONOLITHIC POWER MOS INTEGRATED CIRCUIT

# TPD1033F

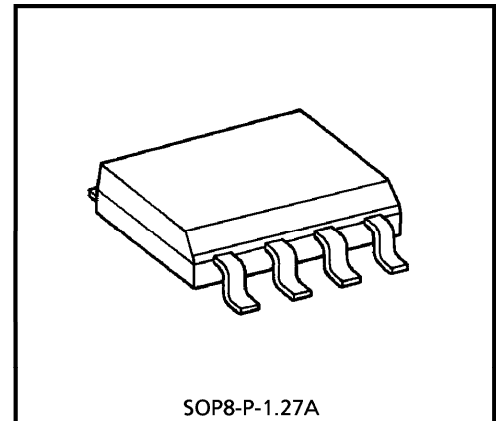
## HIGH-SIDE POWER SWITCH for MOTORS, SOLENOIDS, and LAMP DRIVERS

TPD1033F is a monolithic power IC for high-side switches. The IC has a vertical MOS FET output which can be directly driven from a CMOS or TTL logic circuit (eg, an MPU). The device offers 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 overheating and load short circuiting.
- Incorporates a diagnosis function that allows diagnosis output to be read externally at load short circuiting, opening, or overheating.
- Up to  $-10V$  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.), at  $V_{DD} = 12 \text{ V}$ ,  $V_{IN} = 0$
- 8-pin SOP package for surface mounting can be packed in tape.

(Note) : That because of its MOS structure, this product is sensitive to static electricity.

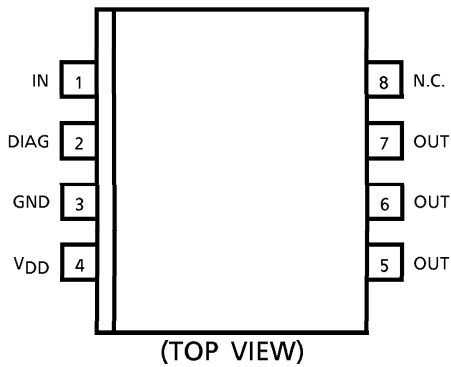


Weight : 0.08 g (Typ.)

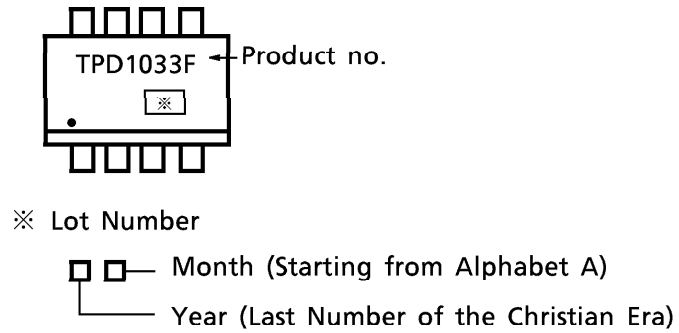
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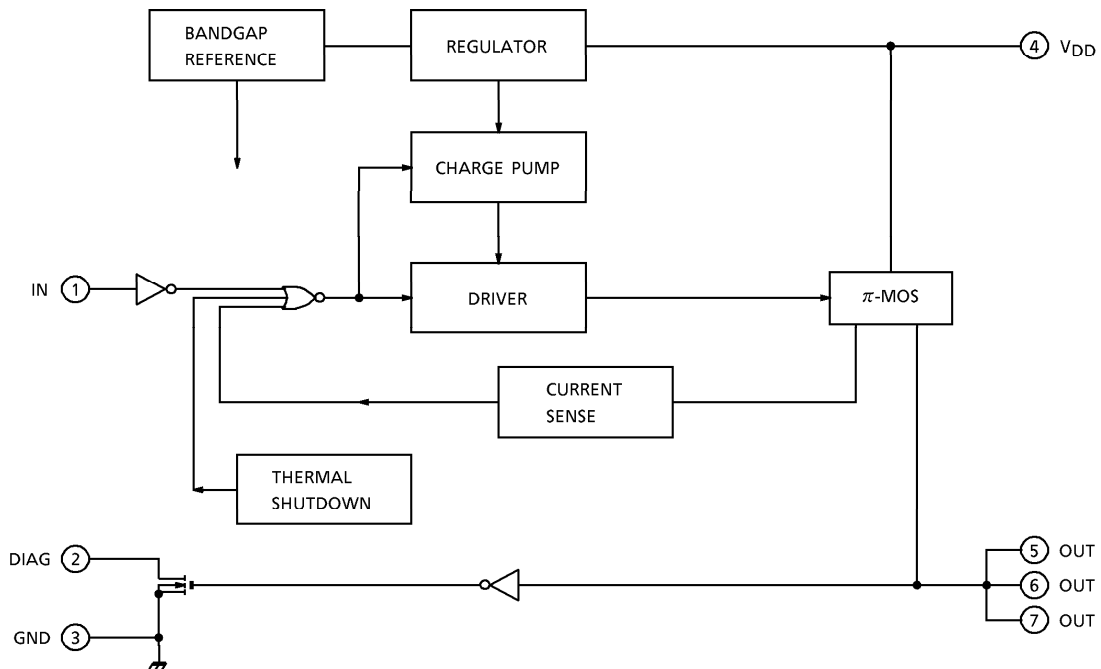
**PIN ASSIGNMENT**



**MARKING**



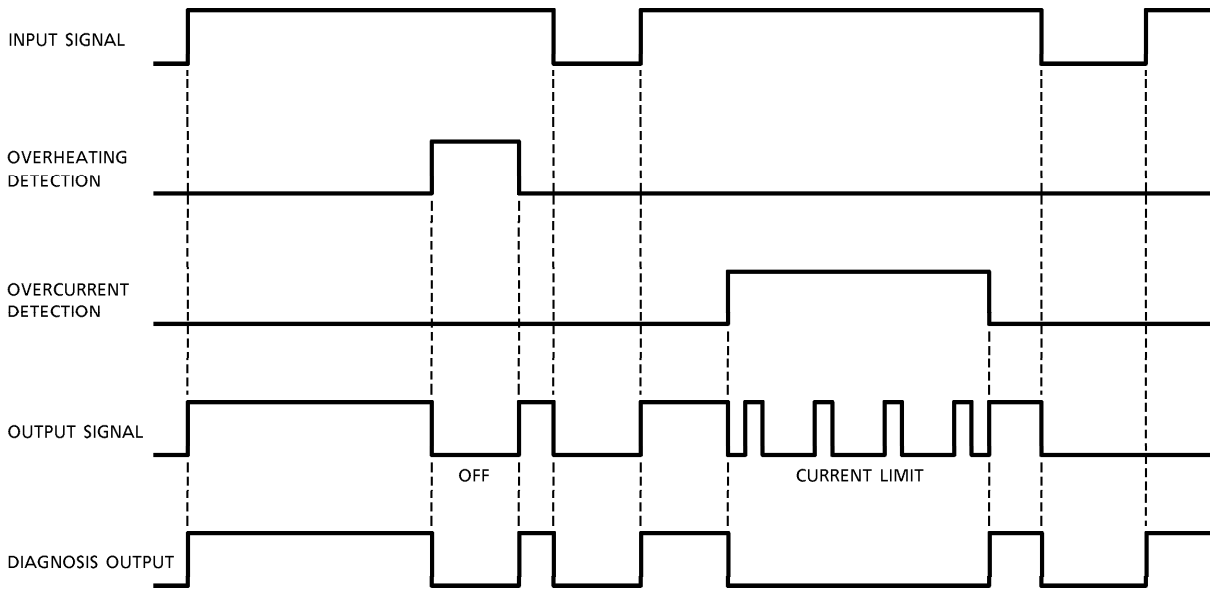
**BLOCK DIAGRAM**



**PIN DESCRIPTION**

PIN No.	SYMBOL	FUNCTION
1	IN	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	VDD	Power pin.
5, 6, 7	OUT	Output pin. When the load is short circuited and current in excess of the detection current (8A 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	Overheating
L	L	L	

## 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
	Pulse	V <sub>DD</sub> (2)	60 (Rs = 1 Ω, τ = 250 ms)
Input Voltage	DC	V <sub>IN</sub> (1)	-0.5~12
	Pulse	V <sub>IN</sub> (2)	V <sub>DD</sub> (1) + 1.5 (t = 100 ms)
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
Junction Temperature	T <sub>j</sub>	150	°C
Storage Temperature	T <sub>stg</sub>	-55~150	°C
Lead Temperature / time	T <sub>SOL</sub>	275 (5 s), 260 (10 s)	°C

## THERMAL RESISTANCE

CHARACTERISTIC	SYMBOL	TEST CONDITION	UNIT
Thermal Resistance	R <sub>th (j-a)</sub>	89.3 (Note 1)	°C/W
		52.1 (Note 2)	

(Note 1) : Mounted on glass epoxy board (1 inch<sup>2</sup> × 0.8 t) (DC)

(Note 2) : Mounted on glass epoxy board (1 inch<sup>2</sup> × 0.8 t) (t<sub>w</sub> ≤ 10 s)

**ELECTRICAL CHARACTERISTICS** (Unless otherwise specified, Tc = -40~110°C, VDD = 8~18 V)

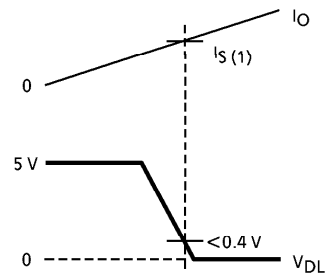
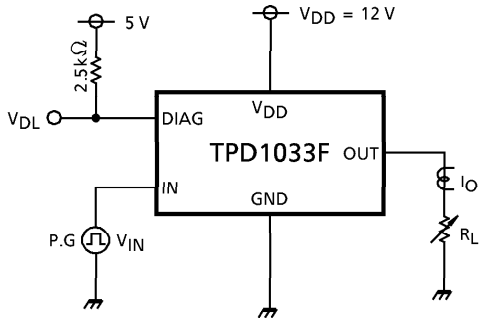
CHARACTERISTIC		SYMBOL	TEST CIR-CUIT	TEST CONDITION	MIN	TYP.	MAX	UNIT
Operating Supply Voltage		VDD (OPR)	—	—	5	12	18	V
Current Dissipation		IDD	—	VDD = 12 V, VIN = 0	—	1	5	mA
Input Voltage		VIH	—	VDD = 12 V, IO = 2 A	3.5	—	—	V
		VIL	—	VDD = 12 V, IO = 1.2 mA	—	—	1.5	V
Input Current		IIN (1)	—	VDD = 12 V, VIN = 5 V	—	50	200	μA
		IIN (2)	—	VDD = 12 V, VIN = 0	-0.2	—	0.2	μA
On Voltage		VDS (ON)	—	VDD = 12 V, IO = 2 A, Tc = 25°C	—	—	0.44	V
On Resistance		RDS (ON)	—	VDD = 12 V, IO = 2 A, Tc = 25°C	—	—	0.22	Ω
Output Leakage Current		IOL	—	VDD = 18 V, VIN = 0	—	—	1.2	mA
Diagnosis Output Voltage	"L" Level	VDL	—	VDD = 12 V, IDL = 2 mA	—	—	0.4	V
Diagnosis Output Current	"H" Level	IDH	—	VDD = 18 V, VDH = 18 V	—	—	10	μA
Overcurrent Detection		IS (1) (Note 3)	1	VDD = 12 V, Tc = 25°C	4	6	8	A
		IS (2) (Note 4)	2		4	8	12	A
Overheating Detection	Temperature	Ts	—	—	150	160	200	°C
	Hysteresis	ΔTs	—		—	10	—	°C
Open Detection Resistance		Rops	—	VDD = 8 V	1	20	100	kΩ
Switching Time		tON	3	VDD = 12 V, RL = 5 Ω, Tc = 25°C	10	100	—	μs
		tOFF	3		10	30	—	μs

(Note 3) : Overcurrent detection value when load is short circuited and VIN = "L" → "H"

(Note 4) : Overcurrent detection value when load current is increased while VIN = "H"

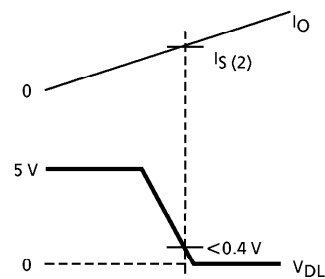
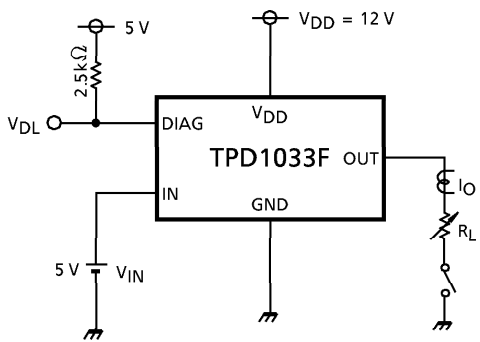
TEST CIRCUIT 1

Over-voltage detection



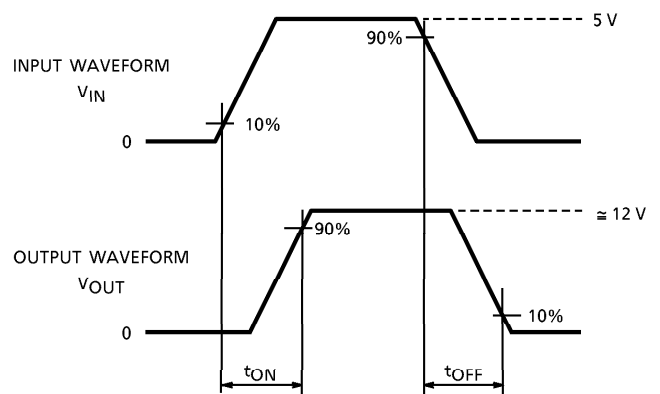
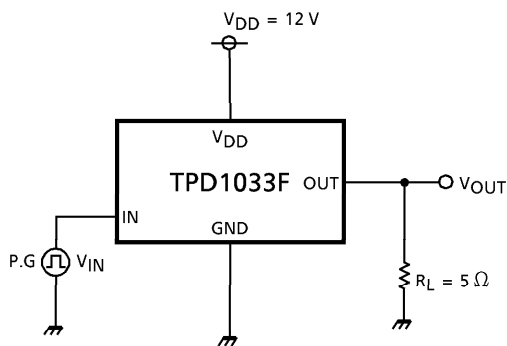
TEST CIRCUIT 2

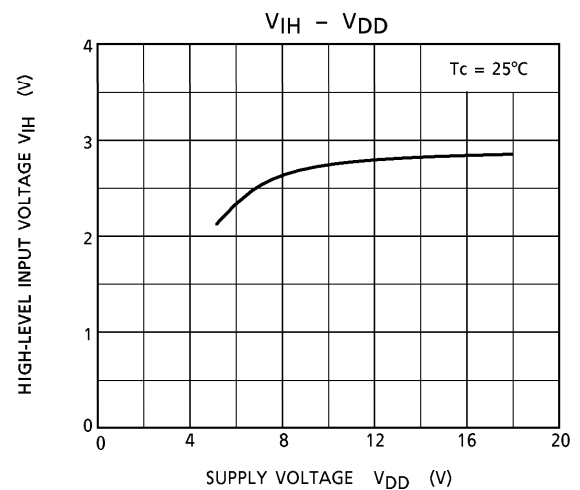
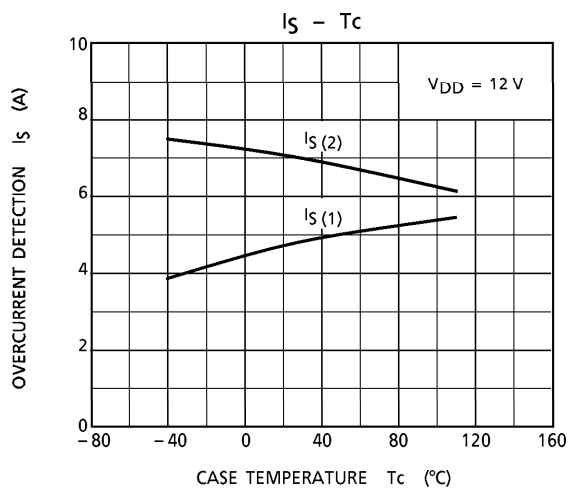
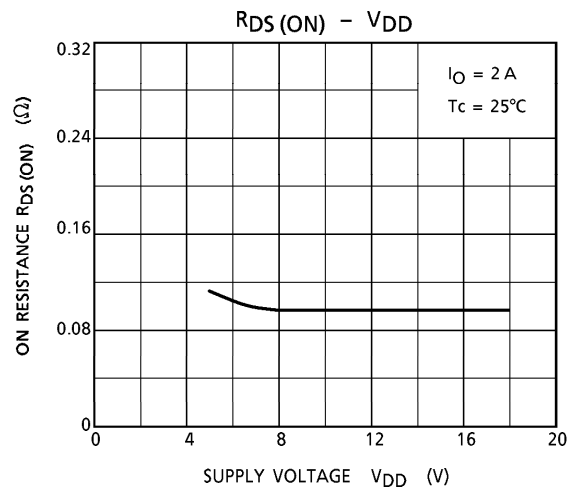
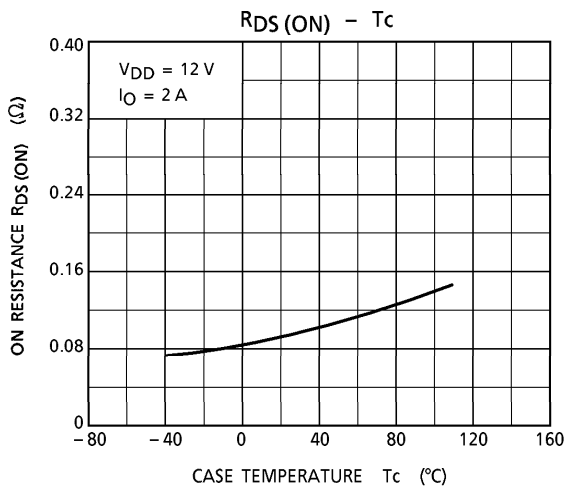
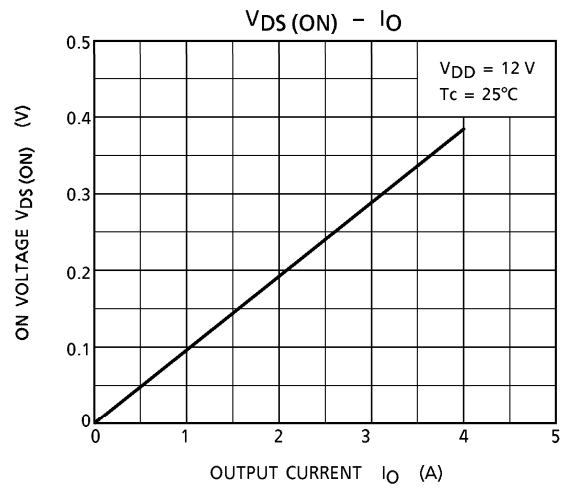
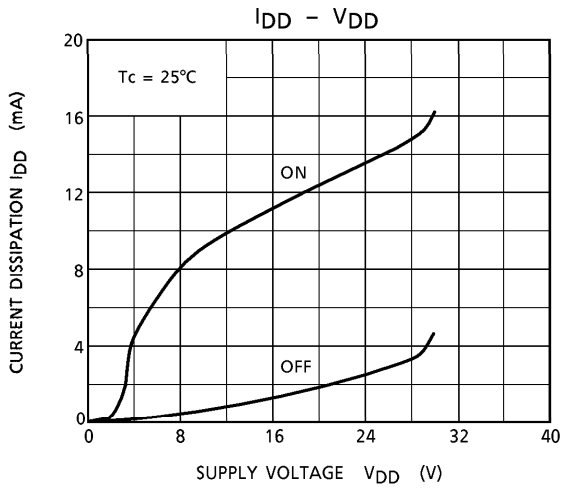
Over-voltage detection

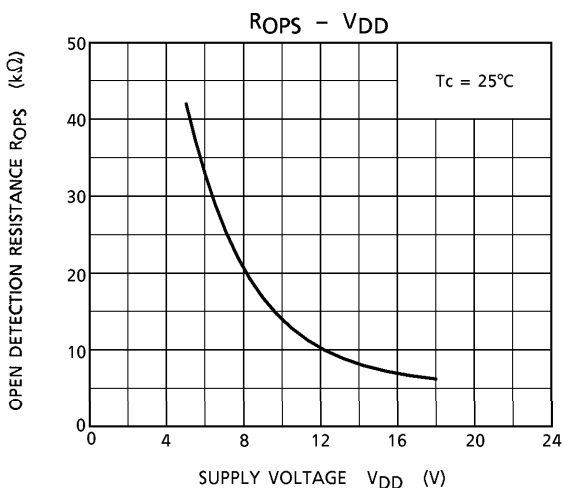
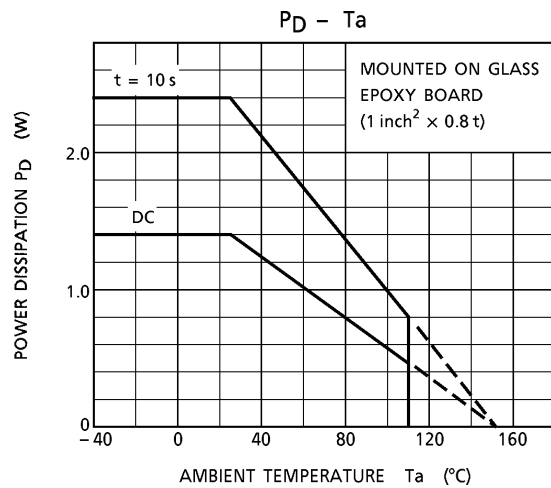
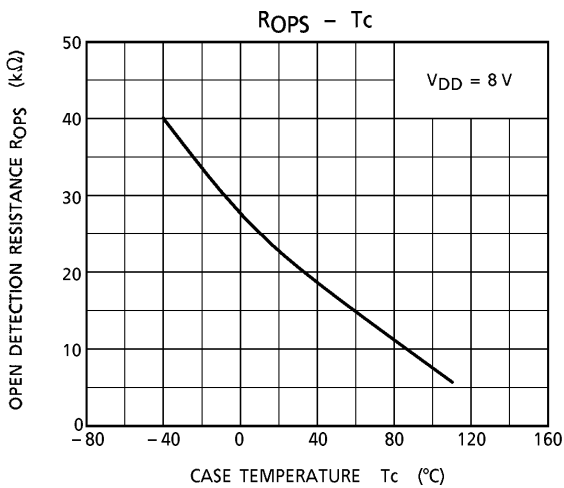
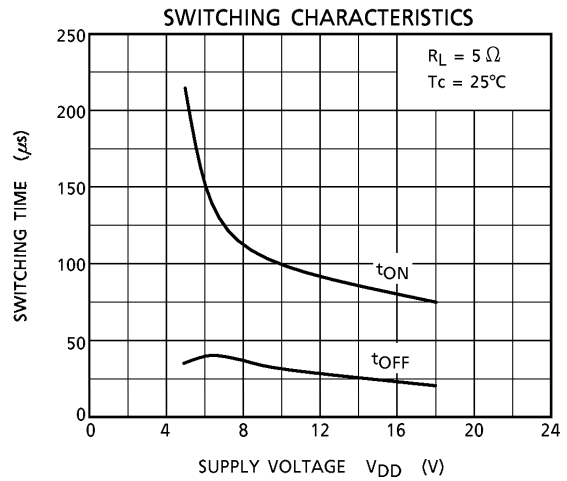
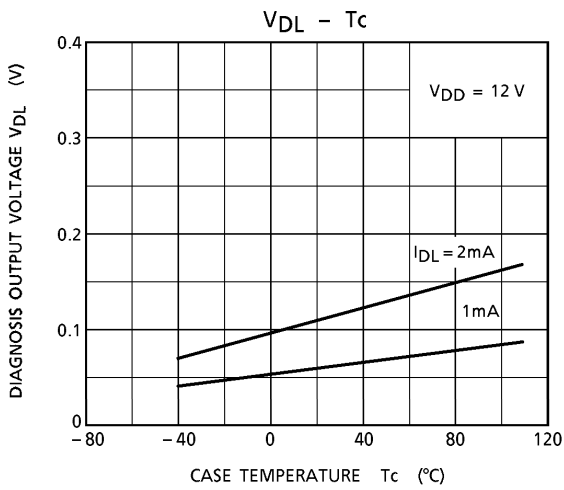


TEST CIRCUIT 3

Switching time



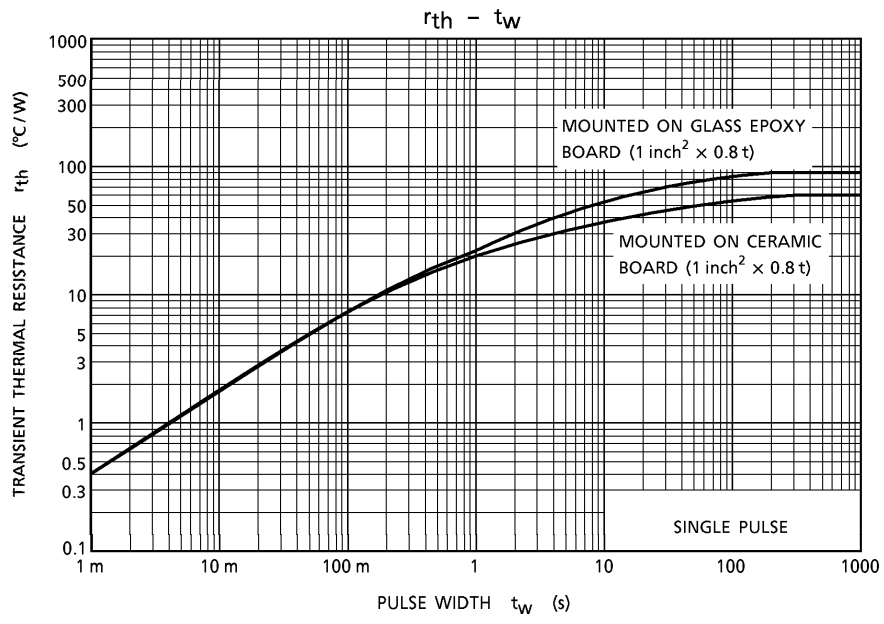




**PRECAUTION :**

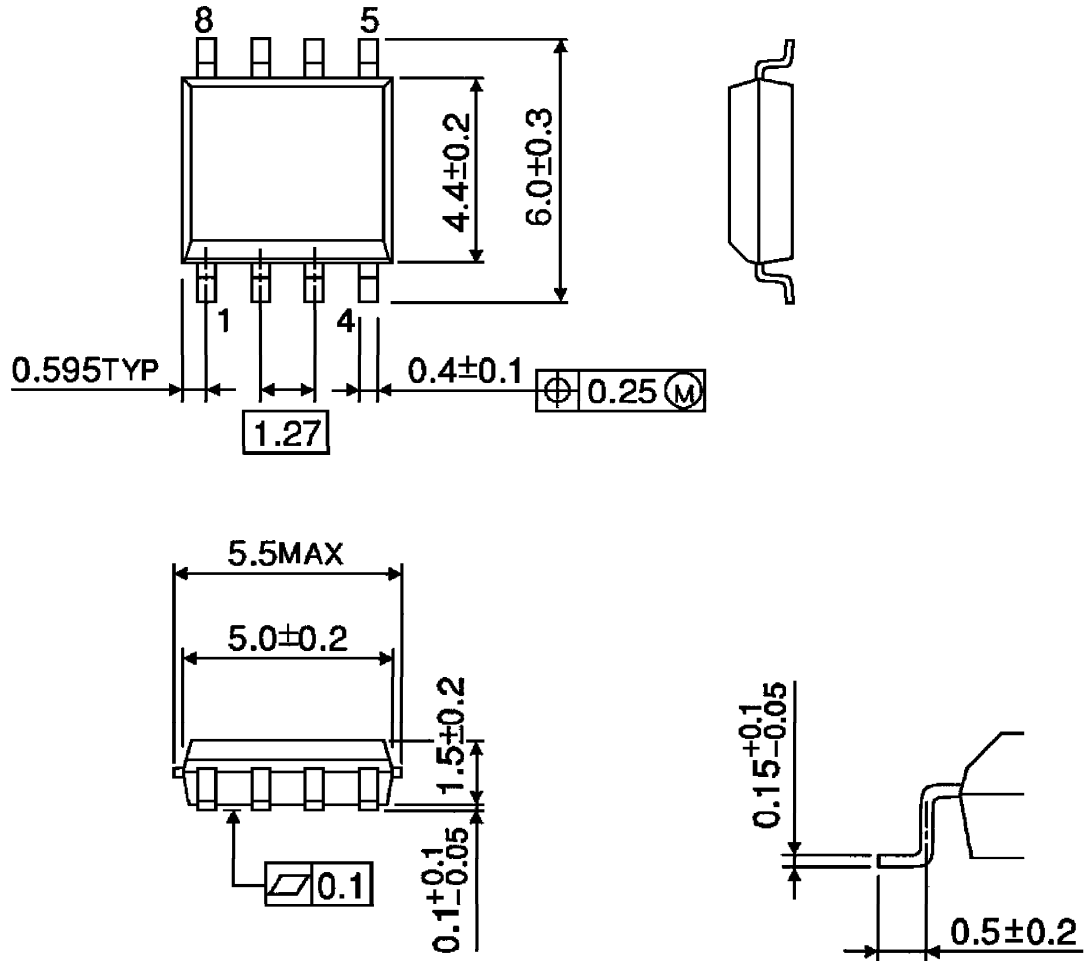
1. Since protection for, for example, reverse connection of the battery is not provided, provide protection using external circuits.





PACKAGE DIMENSIONS  
SOP8-P1.27A

Unit : mm



Weight : 0.08 g (Typ.)