

TOSHIBA Intelligent Power Device Silicon Monolithic Power MOS Integrated Circuit

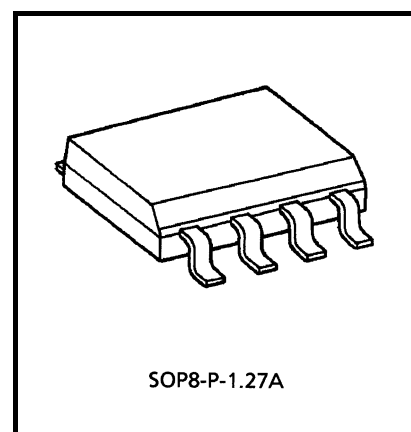
TPD1033F

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.

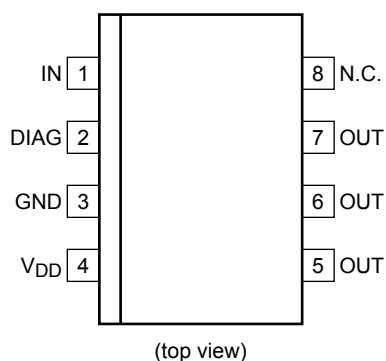
Features

- 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.

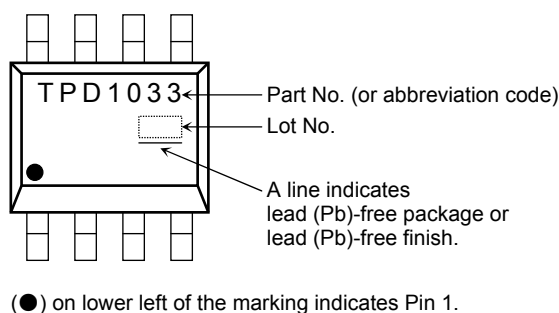


Weight: 0.08 g (typ.)

Pin Assignment



Marking



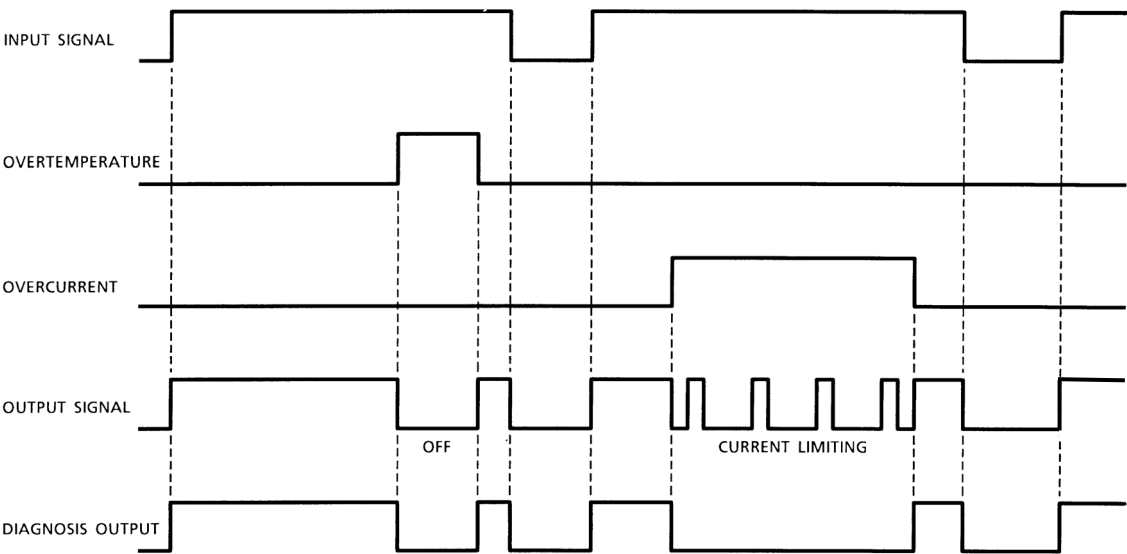
Note: Due to its MOS structure, this product is sensitive to static electricity.

The block diagram illustrates the internal architecture of the 78L05 voltage regulator. Key components and their interconnections are as follows:

- Inputs:** IN (1), DIAG (2), and GND (3).
- Core Blocks:** BANDGAP REFERENCE, REGULATOR, CHARGE PUMP, DRIVER, CURRENT SENSE, THERMAL SHUTDOWN, and π -MOS.
- Connections:**
 - The **BANDGAP REFERENCE** provides a reference voltage to the **REGULATOR** and the **CHARGE PUMP**.
 - The **REGULATOR** is connected to **VDD (4)** and the **CHARGE PUMP**.
 - The **CHARGE PUMP** outputs to the **DRIVER**.
 - The **DRIVER** controls the **π -MOS** transistor.
 - The **CURRENT SENSE** block monitors the current through the **π -MOS** and provides feedback to the **DRIVER** and the **THERMAL SHUTDOWN** logic.
 - The **THERMAL SHUTDOWN** block provides a shutdown signal to the **DRIVER** and the **CHARGE PUMP**.
 - The **π -MOS** transistor's source is connected to **GND (3)** and its drain provides the output **OUT (5, 6, 7)**.
 - The **DIAG (2)** input is connected to the **π -MOS** and the **THERMAL SHUTDOWN** block.

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	V
	Pulse	$V_{DD(2)}$	60 ($R_s = 1\Omega, T = 250\text{ ms}$)	V
Input voltage	DC	$V_{IN(1)}$	-0.5 ~ 12	V
	Pulse	$V_{IN(2)}$	$V_{DD(1)} + 1.5$ ($t = 100\text{ ms}$)	V
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 , $V_{DD} = 8\sim 18\text{ V}$)

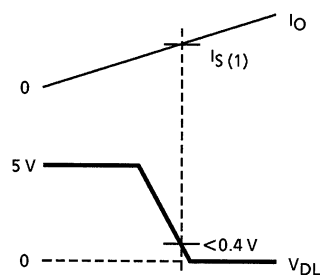
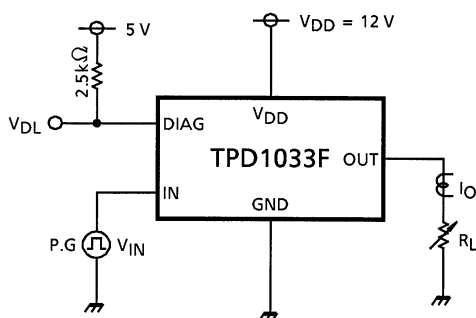
Characteristic		Symbol	Test Circuit	Test Condition	Min	Typ.	Max	Unit
Operating supply voltage		$V_{DD}(\text{opr})$	—	—	5	12	18	V
Supply current		I_{DD}	—	$V_{DD} = 12\text{ V}$, $V_{IN} = 0\text{ V}$	—	1	5	mA
Input voltage		V_{IH}	—	$V_{DD} = 12\text{ V}$, $I_O = 2\text{ A}$	3.5	—	—	V
		V_{IL}	—	$V_{DD} = 12\text{ V}$, $I_O = 1.2\text{ mA}$	—	—	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 $V_{IN} = \text{"H"}$

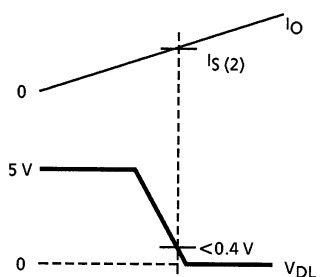
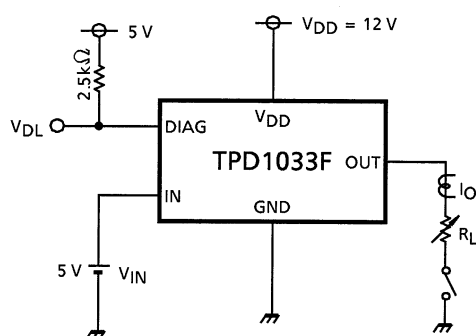
Test Circuit 1

Over-current detection



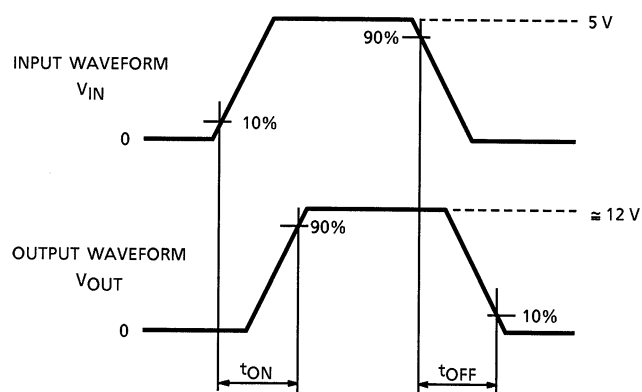
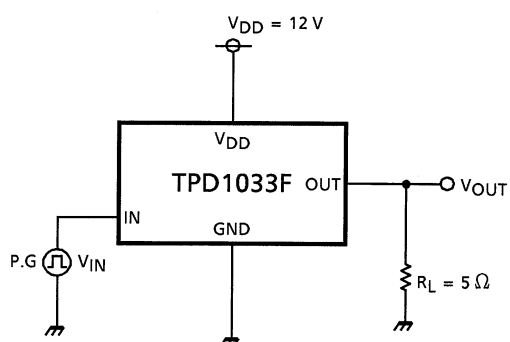
Test Circuit 2

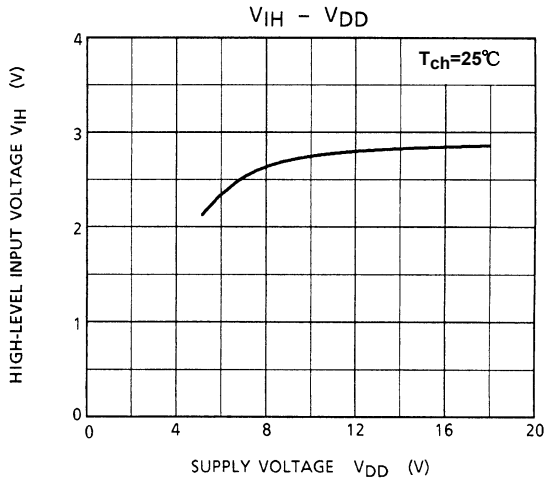
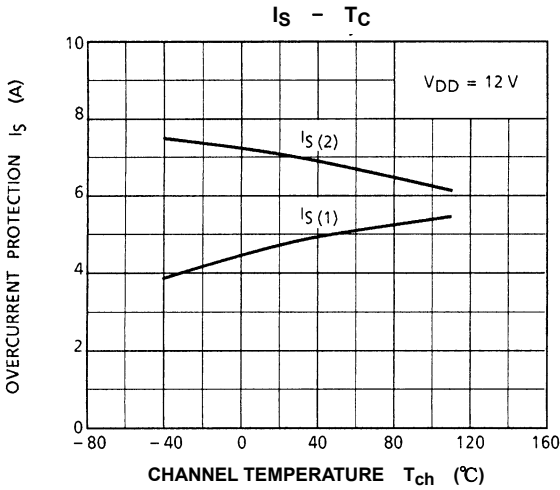
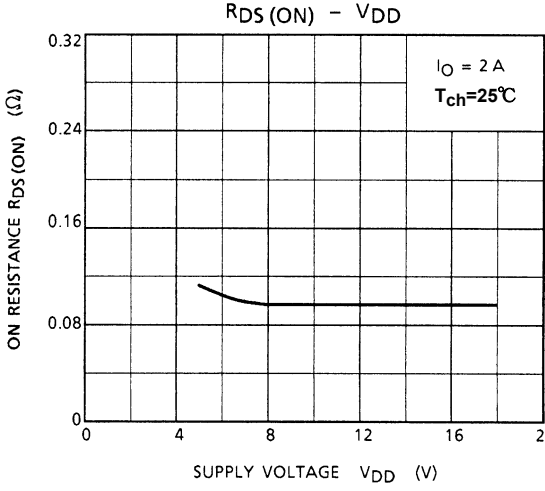
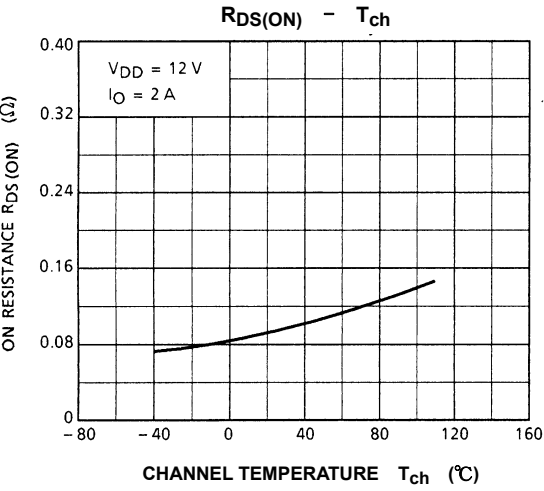
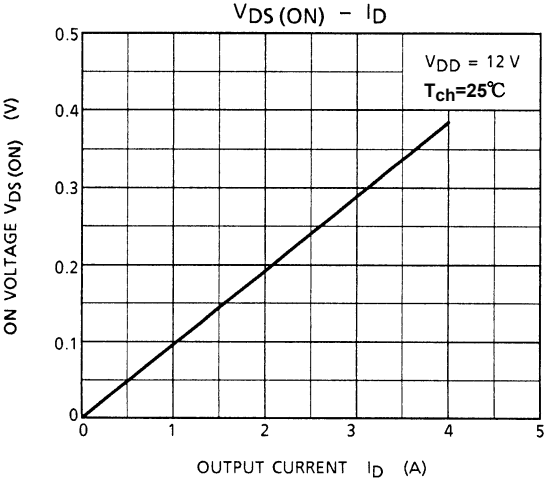
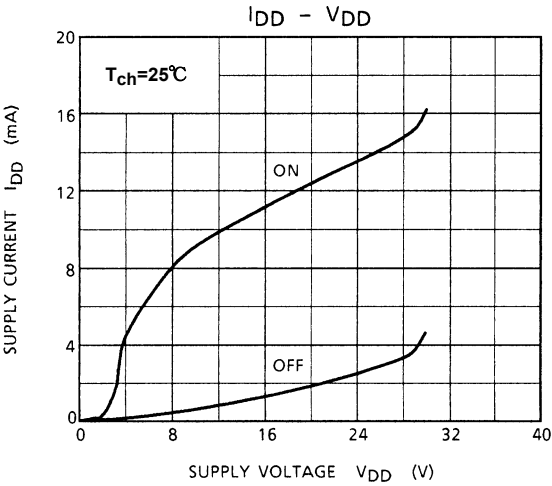
Over-current detection

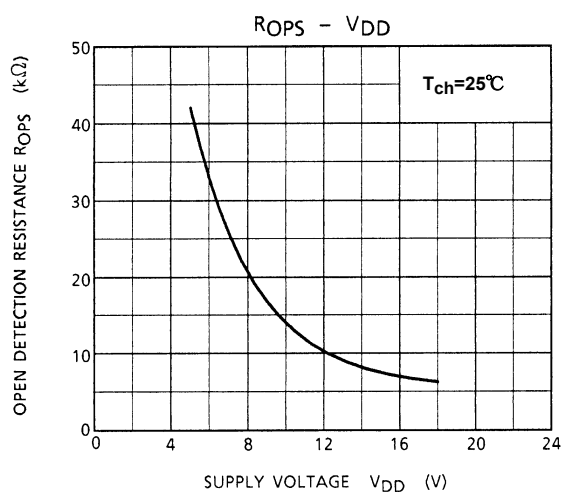
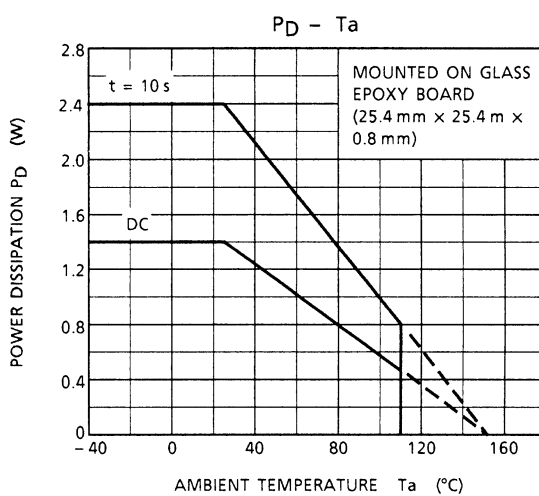
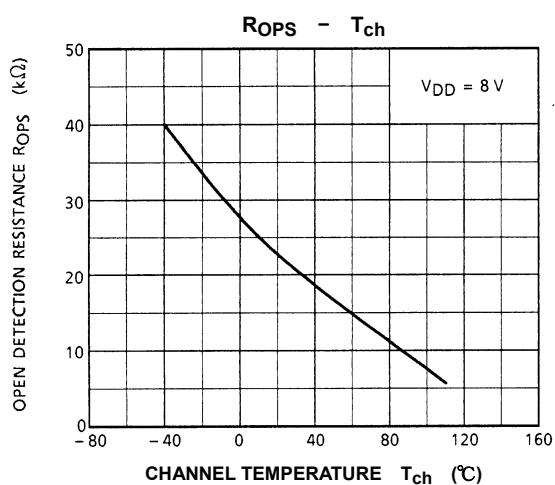
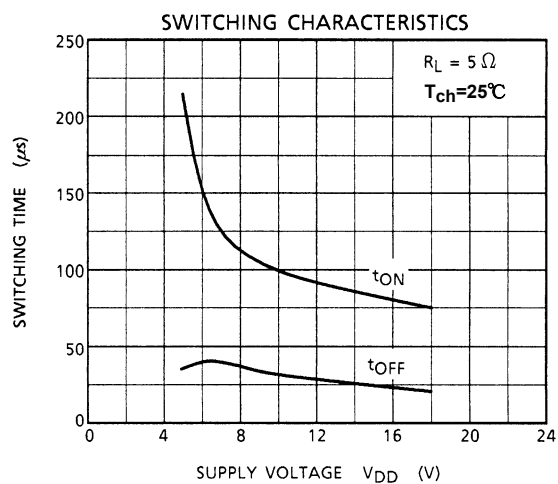
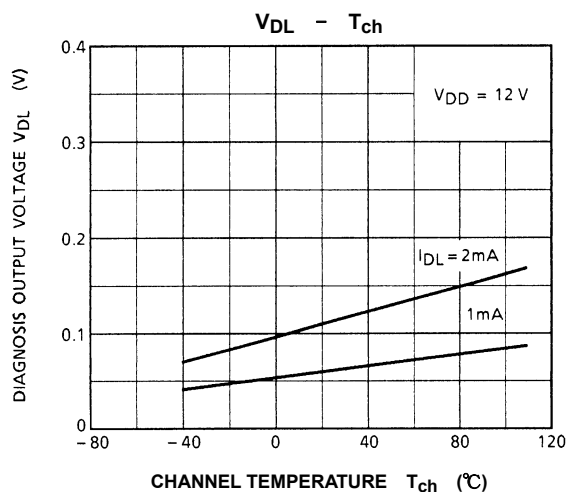


Test Circuit 3

Switching time

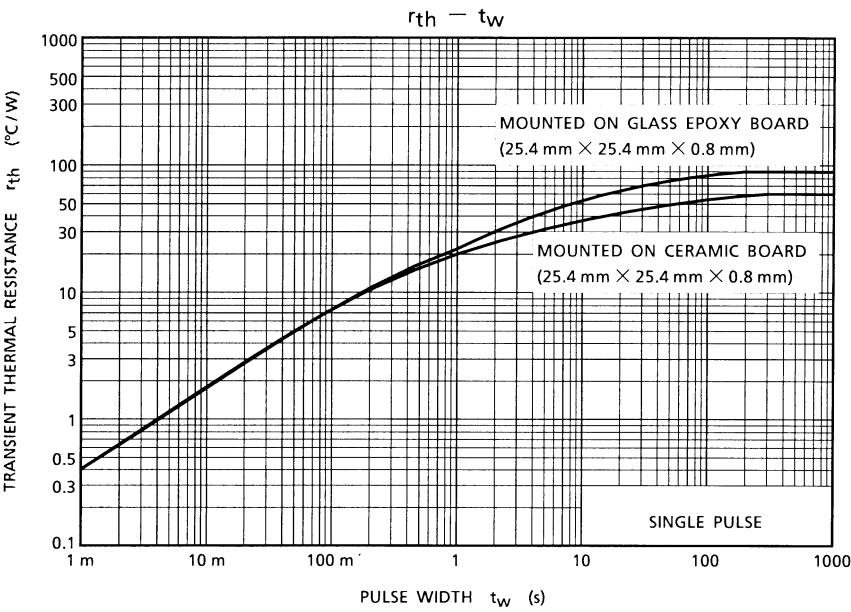






Precaution:

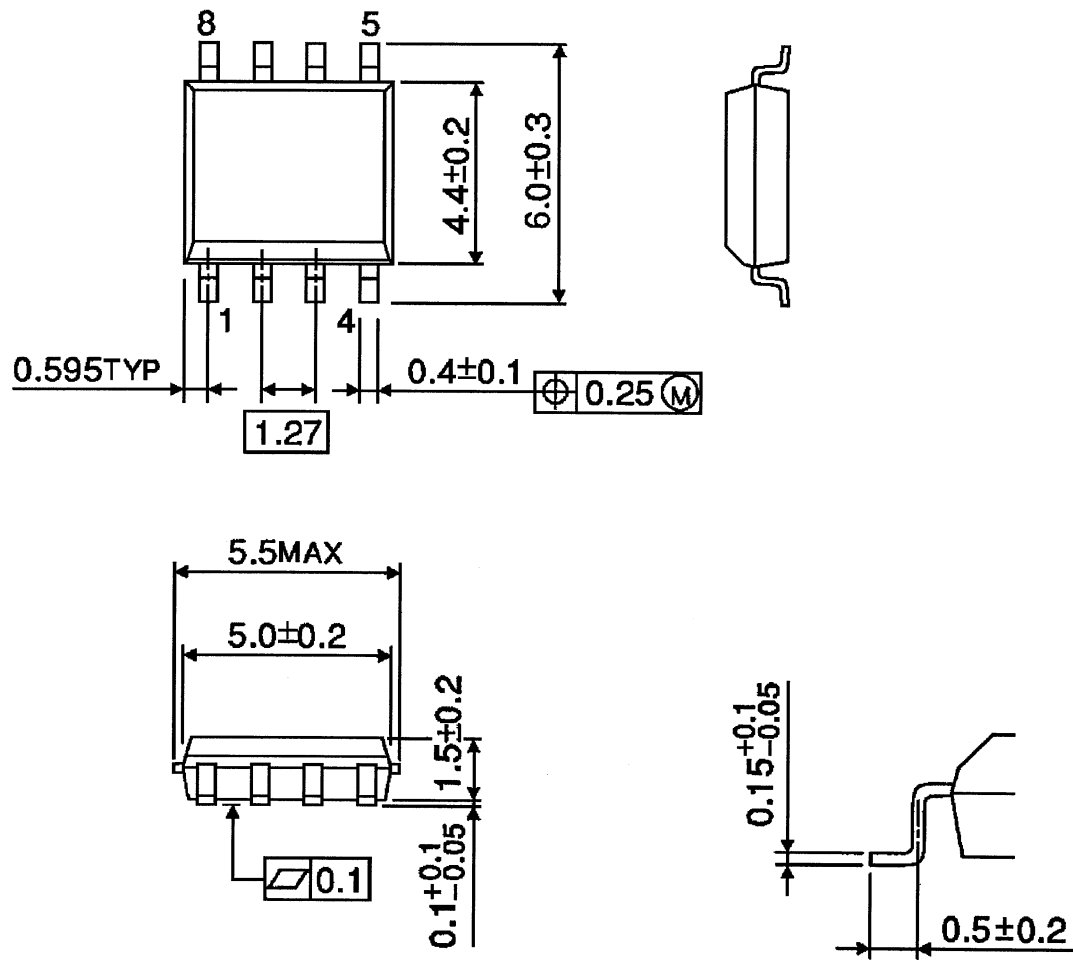
1. Since there is no built-in protection against reverse connection of batteries, etc., provide such protection using external circuits.



Package Dimensions

SOP8-P1.27A

Unit : mm



Weight: 0.08 g (typ.)

RESTRICTIONS ON PRODUCT USE

20070701-EN

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- Подбор аналогов;
- Консультации по применению компонента;
- Поставка образцов и прототипов;
- Техническая поддержка проекта;
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Как с нами связаться

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