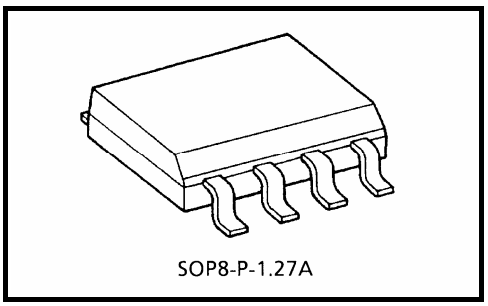
Toshiba Intelligent Power Device Silicon Monolithic Power MOS Integrated Circuit

TPD1036F

2-IN-1 Low-Side Power Switch for Motor, Solenoid and Lamp Drivers

The TPD1036F is a 2-IN-1 low-side switch.
The output has a vertical MOSFET, and the input can be directly driven from CMOS or TTL logic (e.g., an MPU). The IC provides intelligent protection functions.

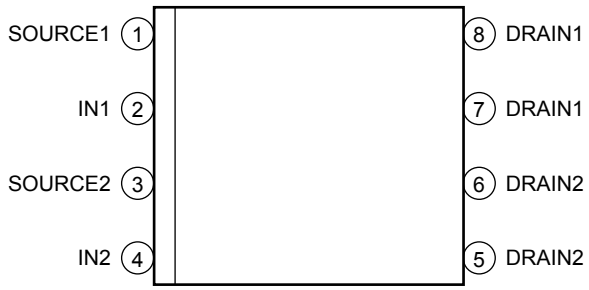


Weight: 0.08 g (typ.)

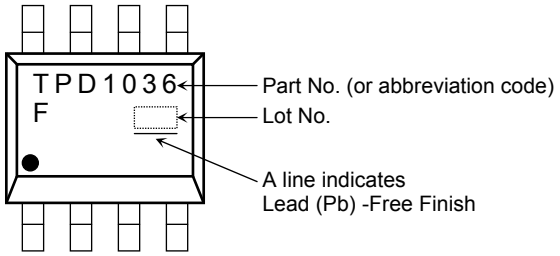
Features

- Two built-in power IC chips with a structure that incorporates a control block and a vertical power MOSFET on each chip.
- Can be directly driven from a microprocessor, a CMOS logic IC, etc.
- Overvoltage (active clamp), overtemperature (thermal shutdown), and overcurrent (current limiter) protections are built in.
- Low ON-resistance: $R_{DS\ (ON)}$ = 0.5 Ω (max) (@V_{IN} = 5 V, I_D = 0.7 A, T_{ch} = 25°C)
- Low drain cut-off current: I_{DSS} = 10 μA (max) (@V_{IN} = 0 V, V_{DS} = 30 V, T_{ch} = 25°C)
- Low input current: I_{IN} = 300 μA (max) (@V_{IN} = 5 V, T_{ch} = -40 to 110°C)
- Housed in the 8-pin SOP package and supplied in embossed carrier tape.

Pin Assignment (top view)

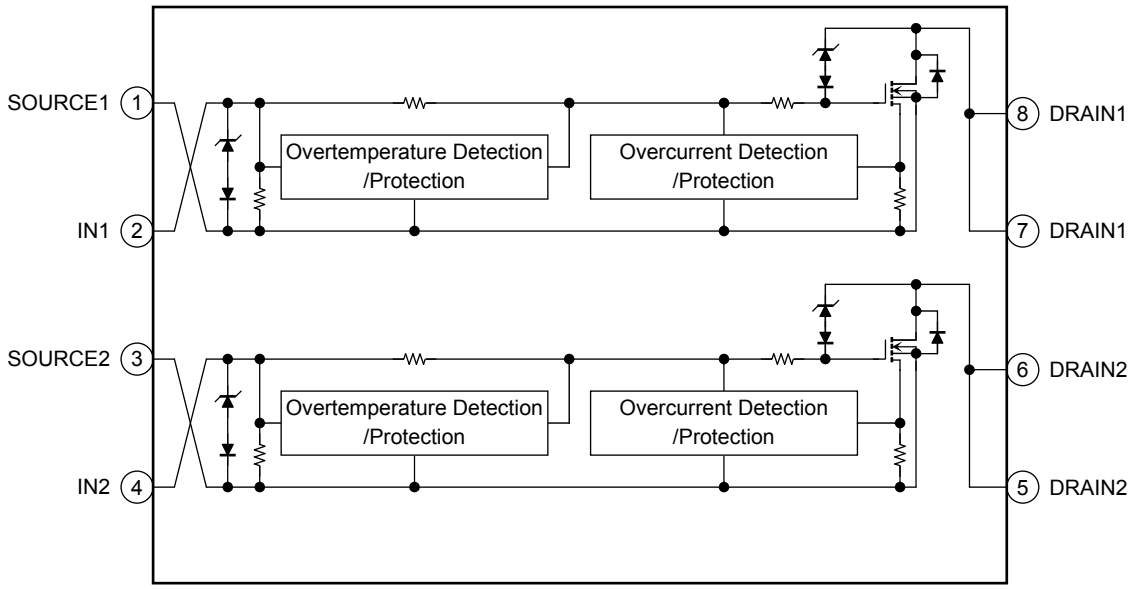


Marking



Note: This product has a MOS structure and is sensitive to electrostatic discharge.

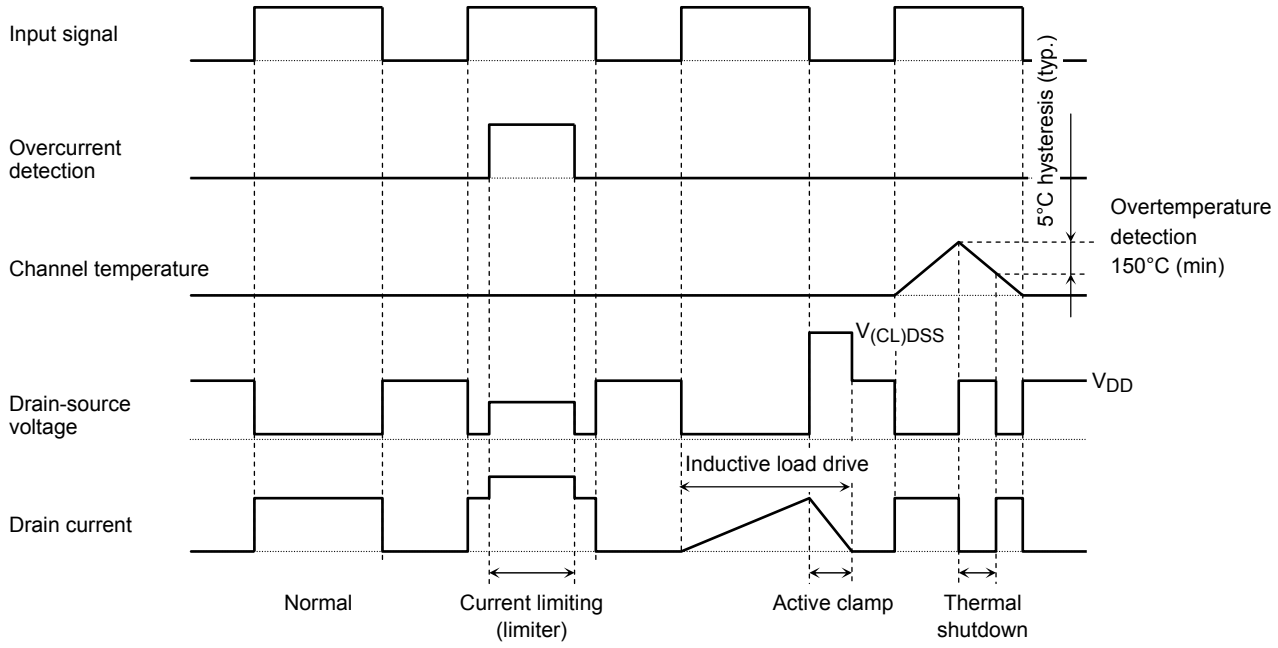
Block Diagram



Pin Description

Pin No.	Symbol	Pin Description
1	SOURCE1	Source pin 1.
2	IN1	Input pin 1. This pin is connected to a pull-down resistor internally, so that even if the input is open-circuited, output never turns on inadvertently.
3	SOURCE2	Source pin 2.
4	IN2	Input pin 2. This pin is connected to a pull-down resistor internally, so that even if the input is open-circuited, output never turns on inadvertently.
5, 6	DRAIN2	Drain pin 2. Drain current is limited (by current limiter) if it exceeds 1 A (min) in order to protect the IC.
7, 8	DRAIN1	Drain pin 1. Drain current is limited (by current limiter) if it exceeds 1 A (min) in order to protect the IC.

Timing Chart



Truth Table

V_{IN}	V_{DS}	Output State	Operating State
L	H	Off	Normal
H	L	On	
L	H	Off	Load short-circuited
H	H	Current limiting (limiter)	
L	H	Off	Overtemperature
H	H	Off	

Absolute Maximum Ratings (Ta = 25°C)

Characteristics		Symbol	Rating	Unit
Drain-source voltage	DC	V_{DS}	30	V
Drain current		I_D	Internally limited	A
Input voltage		V_{IN}	−0.3 to 6	V
Power dissipation (t = 10 s) (Note 2)		P_D	2.0	W
Single pulse active clamp capability (Note 3)		E_{AS}	23	mJ
Active clamp current		I_{AR}	1.5	A
Repetitive active clamp capability (Note 4)		E_{AR}	0.2	mJ
Operating temperature		T_{opr}	−40 to 110	°C
Channel temperature		T_{ch}	150	°C
Storage temperature		T_{stg}	−55 to 150	°C

Note 1: 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 Characteristics

Characteristics	Symbol	Max	Unit
Thermal resistance, channel to ambient (Note 2)	$R_{th\ (ch\text{-}a)}$	62.5	°C/W

Note 2: Mount on glass epoxy boad [25.4 × 25.4 × 0.8mm] (with the two devices driving)(t =10 s)

Note 3: Single pulse active clamp capability test condition
V_{DD} = 25 V, T_{ch} = 25°C (initial), L = 10 mH, I_{AR} = 1.5 A, R_G = 25Ω

Note 4: Repetitive rating: Pulse width limited by maximum channel temperature

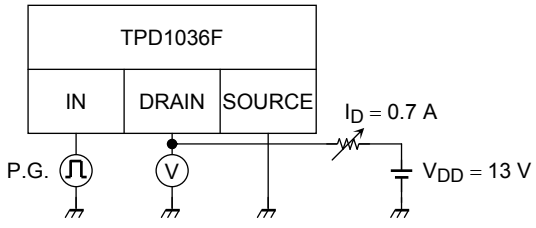
Electrical Characteristics

Characteristics	Symbol	Test Circuit	Test Condition		Min	Typ.	Max	Unit
Drain-source clamp voltage	$V_{(CL)\ DSS}$	—	T_{ch} = -40 to 110℃	V_{IN} = 0 V, I_D=1mA	40	—	60	V
Input threshold voltage	V_{th}	—	T_{ch} = 25℃	V_{DS} = 13 V, I_D = 10mA	1.0	—	2.8	V
			T_{ch} = -40 to 110℃		0.9	—	3.0	
Protective circuit operation input voltage range	$V_{IN\ (opr)}$	—	T_{ch} = 25℃	—	3	—	6	V
			T_{ch} = -40 to 110℃	—	3.5	—	6	
Drain cut-off current	I_{DSS}	—	T_{ch} = 25℃	V_{IN} = 0 V, V_{DS} = 30V	—	—	10	μA
			T_{ch} = -40 to 110℃		—	—	100	
Input current	$I_{IN\ (1)}$	—	T_{ch} = -40 to 110℃	V_{IN} = 5 V, at normal operation	—	—	300	μA
	$I_{IN\ (2)}$	—	T_{ch} = -40 to 110℃	V_{IN} = 5 V, when overcurrent protective circuit is actuated	—	—	350	
Drain-source ON-resistance	$R_{DS\ (ON)}$	—	T_{ch} = 25℃	V_{IN} = 5 V, I_D = 0.7 A	—	0.3	0.5	Ω
			T_{ch} = -40 to 110℃		—	—	0.75	
Overtemperature detection	T_S	—	—	V_{IN} = 5 V	150	160	—	°C
Overcurrent detection	I_S	2	T_{ch} = 25℃	V_{IN} = 5 V	1.5	2.5	—	A
			T_{ch} = -40 to 110℃		1	—	—	
Switching times	t_{ON}	1	T_{ch} = 25℃	V_{DD} = 13 V, V_{IN} = 0 V/5 V, I_D = 0.7 A	—	—	30	μs
			T_{ch} = -40 to 110℃		—	—	60	
	t_{OFF}		T_{ch} = 25℃		—	—	60	
			T_{ch} = -40 to 110℃		—	—	90	
Drain-source diode forward voltage	V_{DSF}	—	T_{ch} = 25℃	V_{IN} = 0 V, I_F = 1.5 A	—	—	1.7	V

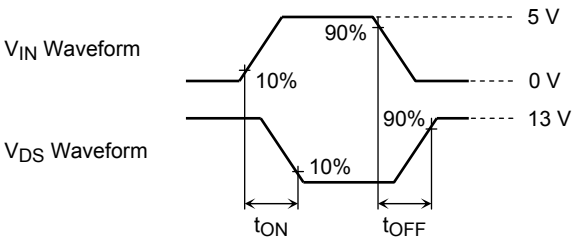
Test Circuit 1

Switching times measuring circuit

Test Circuit



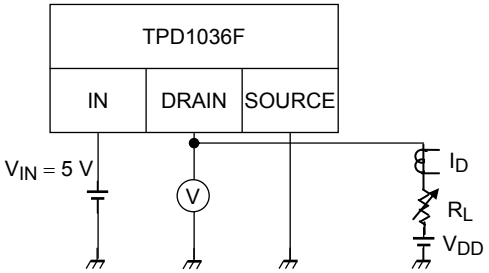
Measured Waveforms

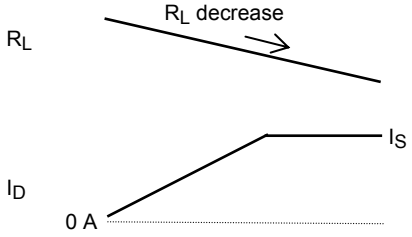


Test Circuit 2

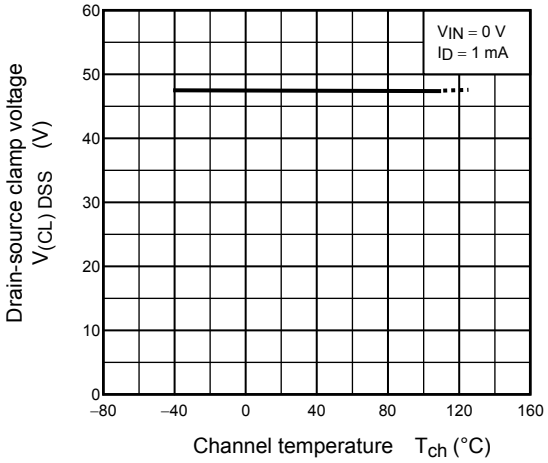
Overcurrent detection measuring circuit

Test Circuit

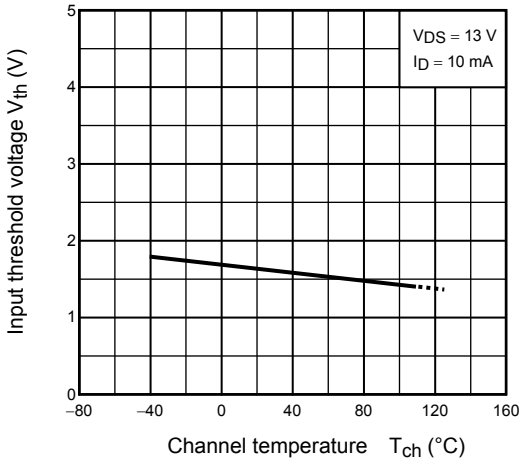




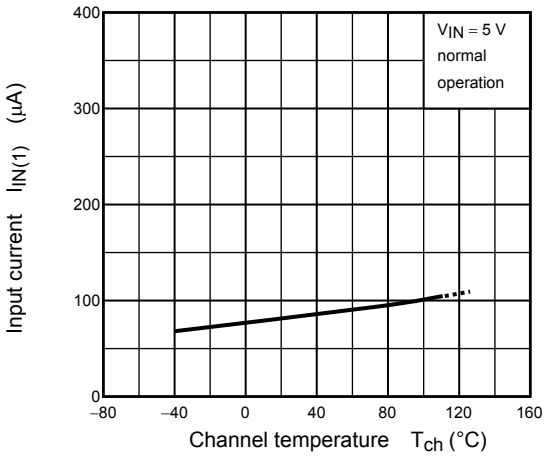
$V_{(CL)\ DSS} - T_{ch}$



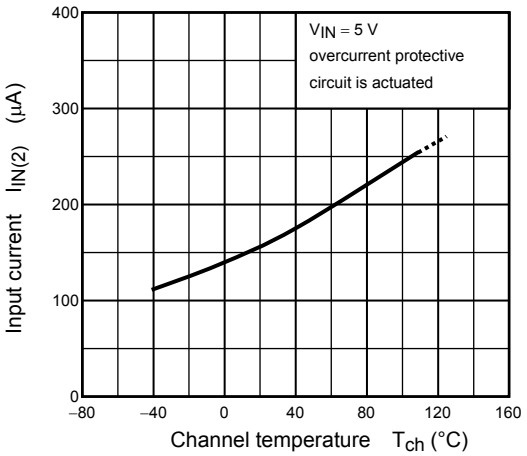
$V_{th} - T_{ch}$



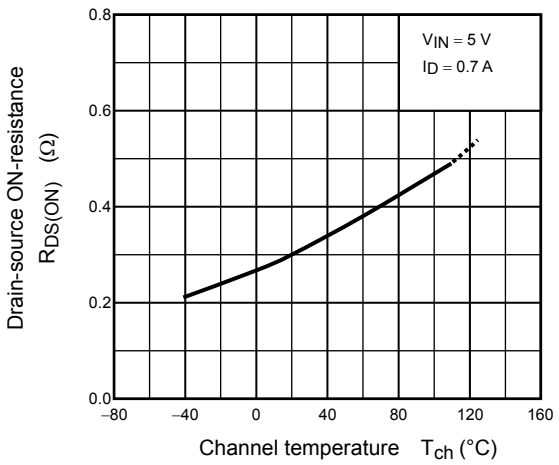
$I_{IN\ (1)} - T_{ch}$



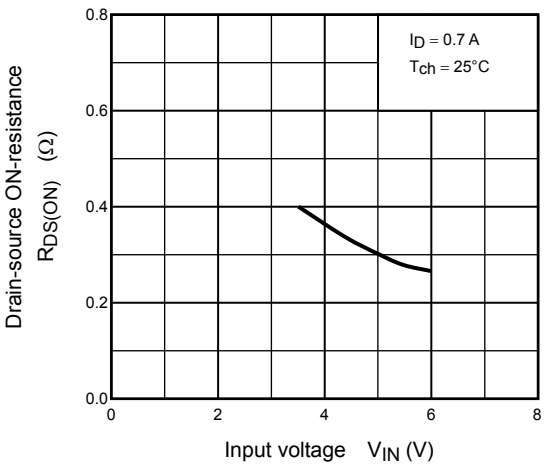
$I_{IN\ (2)} - T_{ch}$



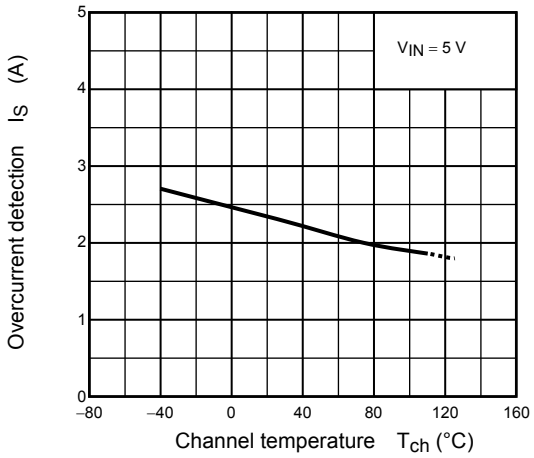
$R_{DS\ (ON)} - T_{ch}$



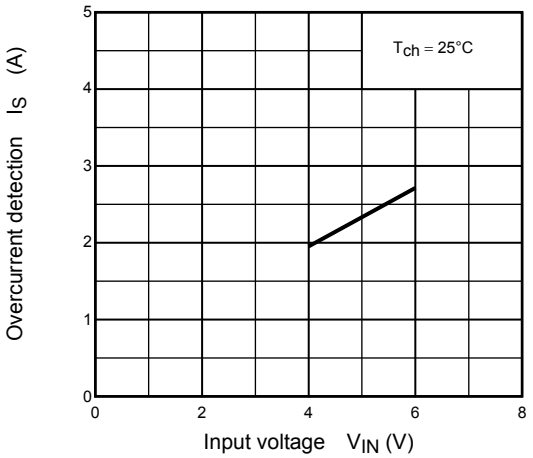
$R_{DS\ (ON)} - V_{IN}$



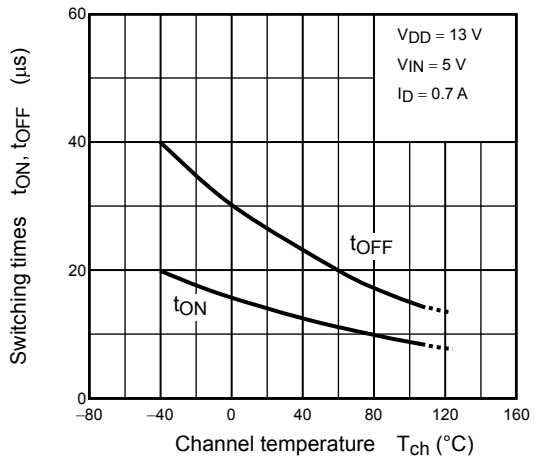
$I_S - T_{ch}$



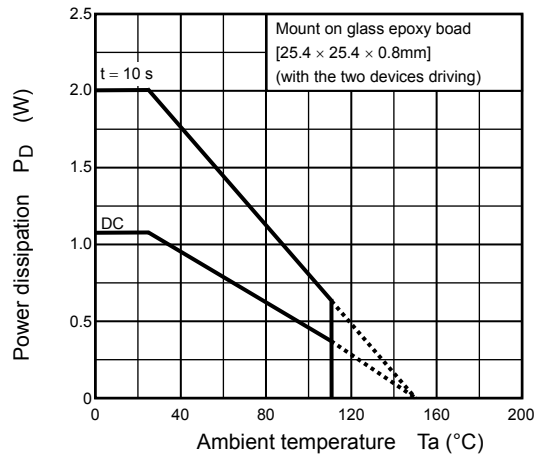
$I_S - V_{IN}$



$t_{ON}, t_{OFF} - T_{ch}$

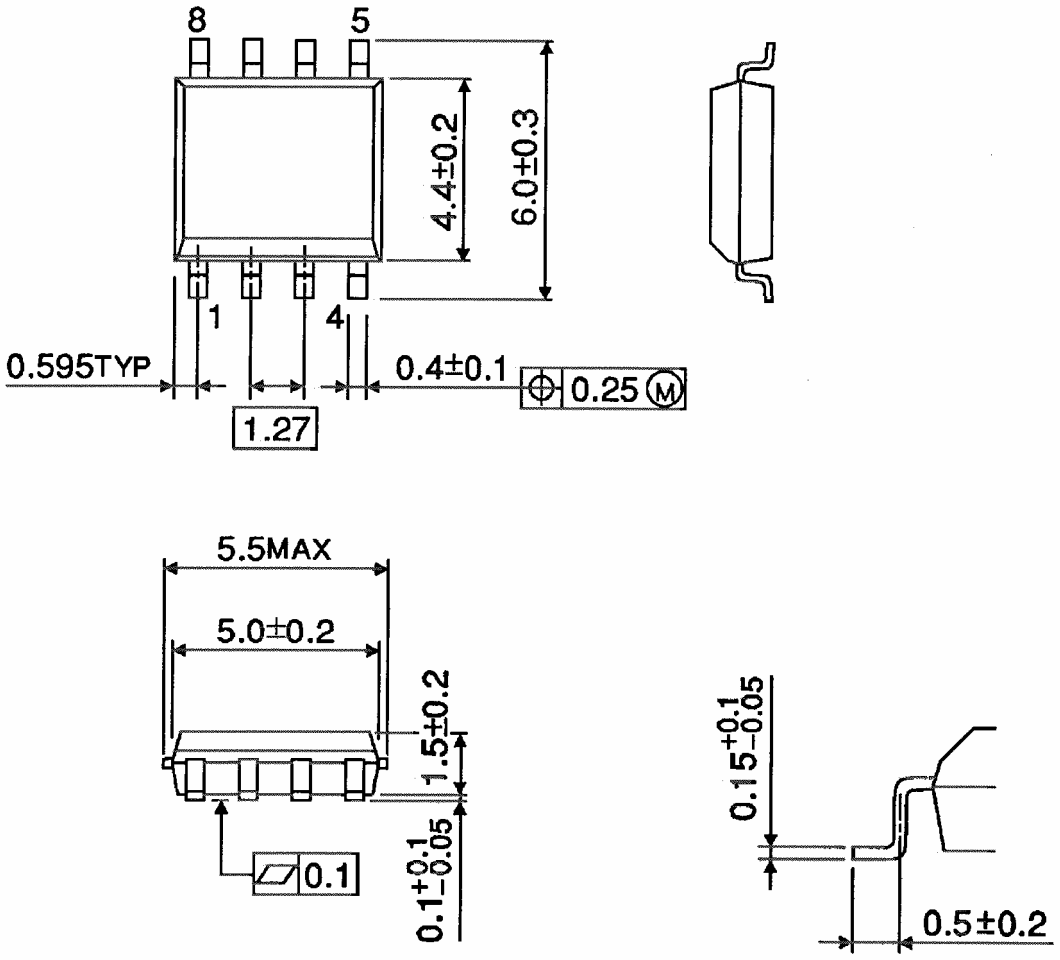


$P_D - Ta$



Package Dimensions

SOP8-P-1.27A Unit : mm



Weight: 0.08 g (typ.)

RESTRICTIONS ON PRODUCT USE

20070701-EN GENERAL

- The information contained herein is subject to change without notice.
- TOSHIBA is continually working to improve the quality and reliability of its products. Nevertheless, semiconductor devices in general can malfunction or fail due to their inherent electrical sensitivity and vulnerability to physical stress. It is the responsibility of the buyer, when utilizing TOSHIBA products, to comply with the standards of safety in making a safe design for the entire system, and to avoid situations in which a malfunction or failure of such TOSHIBA products could cause loss of human life, bodily injury or damage to property.
  In developing your designs, please ensure that TOSHIBA products are used within specified operating ranges as set forth in the most recent TOSHIBA products specifications. Also, please keep in mind the precautions and conditions set forth in the “Handling Guide for Semiconductor Devices,” or “TOSHIBA Semiconductor Reliability Handbook” etc.
- The TOSHIBA products listed in this document are intended for usage in general electronics applications (computer, personal equipment, office equipment, measuring equipment, industrial robotics, domestic appliances, etc.).These TOSHIBA products are neither intended nor warranted for usage in equipment that requires extraordinarily high quality and/or reliability or a malfunction or failure of which may cause loss of human life or bodily injury (“Unintended Usage”). Unintended Usage include atomic energy control instruments, airplane or spaceship instruments, transportation instruments, traffic signal instruments, combustion control instruments, medical instruments, all types of safety devices, etc.. Unintended Usage of TOSHIBA products listed in his document shall be made at the customer’s own risk.
- The products described in this document shall not be used or embedded to any downstream products of which manufacture, use and/or sale are prohibited under any applicable laws and regulations.
- Please contact your sales representative for product-by-product details in this document regarding RoHS compatibility. Please use these products in this document in compliance with all applicable laws and regulations that regulate the inclusion or use of controlled substances. Toshiba assumes no liability for damage or losses occurring as a result of noncompliance with applicable laws and regulations.