

# TPD1046F

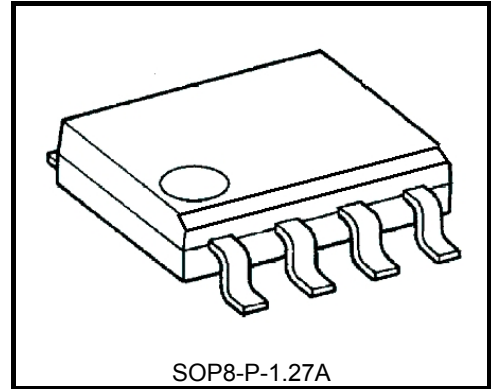
## 2-IN-1 Low-Side Power Switch for Motor, Solenoid and Lamp Drive

The TPD1046F is a 2-IN-1 low-side switch.

The IC has a vertical MOSFET output which can be directly driven from a CMOS or TTL logic circuit (e.g., an MPU). The IC is equipped with intelligent self-protection functions.

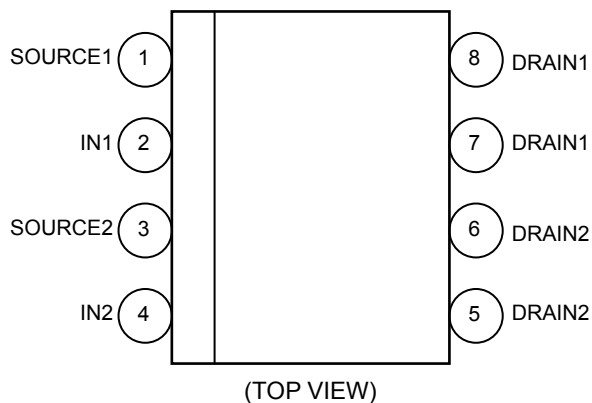
### Features

- Two built-in power IC chips with a structure combining a control block and a vertical power MOSFET (L<sup>2</sup>-π-MOS) on each chip.
- Can directly drive a power load from a CMOS or TTL logic.
- Built-in protection circuits against overvoltage (active clamp), overtemperature (thermal shutdown), and overcurrent (current limiter).
- Low Drain-Source ON-resistance:  $R_{DS(ON)} = 0.2 \Omega$  (max) (@ $V_{IN} = 5 \text{ V}$ ,  $I_D = 1 \text{ A}$ ,  $T_{ch} = 25^\circ\text{C}$ )
- Low Leakage Current:  $I_{DSS} = 10 \mu\text{A}$  (max) (@ $V_{IN} = 0 \text{ V}$ ,  $V_{DS} = 30 \text{ V}$ ,  $T_{ch} = 25^\circ\text{C}$ )
- Low Input Current:  $I_{IN} = 600 \mu\text{A}$  (max) (@ $V_{IN} = 5 \text{ V}$ ,  $T_{ch} = -40\sim 125^\circ\text{C}$ )
- 8-pin SOP package with embossed-tape packing.

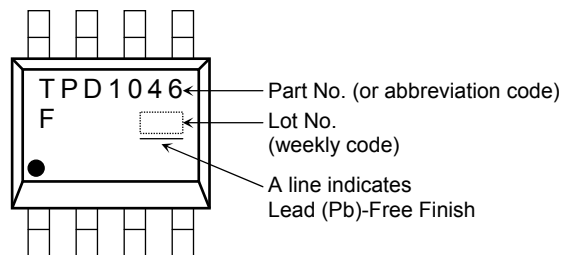


Weight: 0.08 g (typ.)

### Pin Assignment (top view)

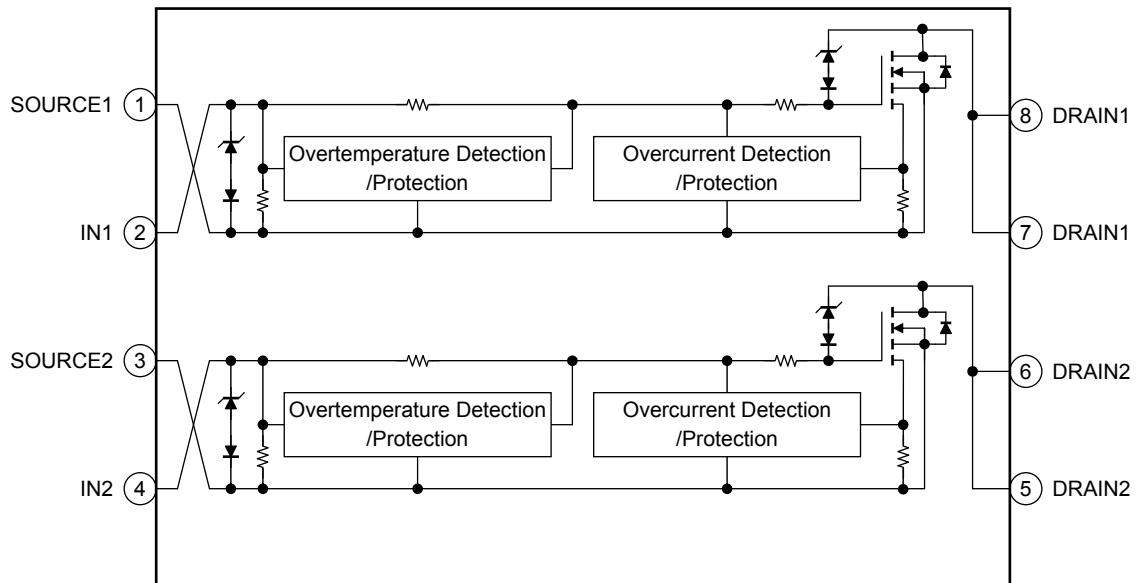


### Marking



Note 1: Due to its MOS structure, this product is sensitive to static electricity.

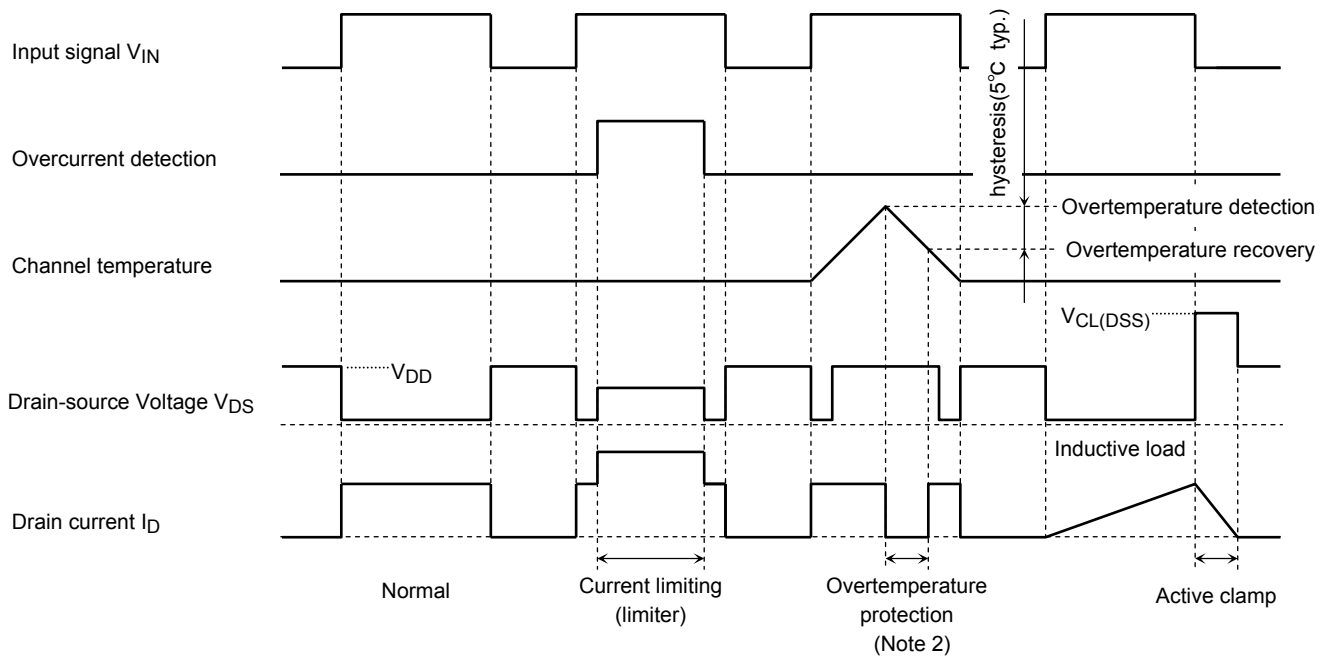
**Block Diagram**



**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 when input wiring is open-circuited, output can never be turned 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 when input wiring is open-circuited, output can never be turned on inadvertently.
5, 6	DRAIN2	Drain pin 2 Drain current is limited (by current limiter) if it exceeds 3 A (min) in order to protect the IC.
7, 8	DRAIN1	Drain pin 1 Drain current is limited (by current limiter) if it exceeds 3 A (min) in order to protect the IC.

**Timing Chart**



Note 2: The overtemperature detector circuits feature hysteresis. After overtemperature is detected, normal operation is restored only when the channel temperature falls by the hysteresis amount (5°C typ.) in relation to the overtemperature detection temperature.

**Truth Table**

$V_{IN}$	$V_{DS}$	Output State	Operating State
L	H	OFF	Normal
H	L	ON	
L	H	OFF	Overcurrent
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		$V_{DS(DC)}$	40	V
Drain current		$I_D$	Internally Limited	A
Input voltage		$V_{IN}$	-0.3~7	V
Power dissipation (Ta = 25°C) (Note 3-a)	1device operation (Note 4a)	$P_{D(1)}$	0.95	W
	2 devices operation per device (Note 4b)	$P_{D(2)}$	0.54	W
Power dissipation (Ta = 25°C) (Note 3-b)	1device operation (Note 4a)	$P_{D(1)}$	0.38	W
	2 devices operation per device (Note 4b)	$P_{D(2)}$	0.20	W
Single pulse active clamp tolerance (Note 5)		$E_{AS}$	97	mJ
Active clamp current		$I_{AR}$	3	A
Repetitive active clamp tolerance (Note 3-a) (Note 6)		$E_{AR}$	54	$\mu J$
Operating temperature		$T_{opr}$	-40~125	°C
Channel temperature		$T_{ch}$	150	°C
Storage temperature		$T_{stg}$	-55~150	°C

## Thermal Characteristics

Characteristics		Symbol	max	Unit
Thermal resistance, channel to ambient (Note 3-a)	1device operation (Note 4a)	$R_{th(ch-a)(1)}$	132	°C/W
	2 devices operation per device (Note 4b)	$R_{th(ch-a)(2)}$	231	
Thermal resistance, channel to ambient (Note 3-b)	1device operation (Note 4a)	$R_{th(ch-a)(1)}$	330	°C/W
	2 devices operation per device (Note 4b)	$R_{th(ch-a)(2)}$	625	

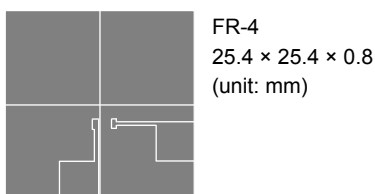
Note: Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) 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).

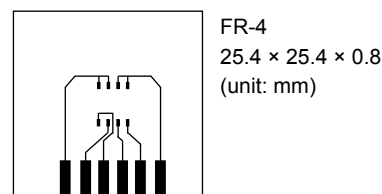
Note 3:

3-a : glass epoxy board (a)

3-b : glass epoxy board (b)



(a)



(b)

Note 4:

- a) 1 device operation : power dissipation value or thermal resistance of one side device.
- b) 2 devices operation per device : power dissipation value or thermal resistance per device when power is impressed evenly.

Note 5:  $V_{DD} = 25\text{ V}$ ,  $T_{ch} = 25^{\circ}\text{C}(\text{initial})$ ,  $L = 10.8\text{ mH}$ ,  $I_{AR} = 3\text{ A}$ ,  $R_G = 25\ \Omega$

Note 6: Repetitive rating : Pulse width limited by maximum channel temperature.

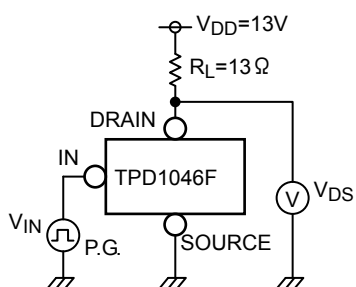
## Electrical Characteristics

Characteristics		Symbol	Test Circuit	Test Condition	Min	Typ.	Max	Unit	
Drain-source clamp voltage	$V_{(CL) DSS}$	-	-	$T_{ch} = 25^{\circ}C$	40	49	60	V	
				$T_{ch} = -40 \sim 125^{\circ}C$					$V_{IN} = 0 V,$ $I_D = 1 mA$
Input threshold voltage	$V_{th}$	-	-	$T_{ch} = 25^{\circ}C$	1.0	1.6	2.8	V	
				$T_{ch} = -40 \sim 125^{\circ}C$					$V_{DS} = 13 V,$ $I_D = 10 mA$
Protective circuit operation input voltage range	$V_{IN (opr)}$	-	-	$T_{ch} = -40 \sim 125^{\circ}C$	4	-	7	V	
Drain cut-off current	$I_{DSS}$	-	-	$T_{ch} = 25^{\circ}C$	-	-	10	$\mu A$	
				$T_{ch} = -40 \sim 125^{\circ}C$			$V_{IN} = 0 V,$ $V_{DS} = 12 V$		30
High level input current	$I_{IH (1)}$	-	-	$T_{ch} = 25^{\circ}C$	-	130	600	$\mu A$	
				$T_{ch} = -40 \sim 125^{\circ}C$			$V_{IN} = 5 V,$ at normal operation		600
High level input current	$I_{IH (2)}$	-	-	$T_{ch} = -40 \sim 125^{\circ}C$	-	-	2000	$\mu A$	
				$V_{IN} = 5 V,$ when protective circuit is actuated					
Drain-source on resistance	$R_{DS (ON)}$	-	-	$T_{ch} = 25^{\circ}C$	-	0.14	0.2	$\Omega$	
				$T_{ch} = -40 \sim 125^{\circ}C$			$V_{IN} = 5 V,$ $I_D = 1 A$		0.3
Load-short tolerance	$V_{DS}$	-	-	$T_{ch} = -40 \sim 125^{\circ}C$	20	-	-	V	
Overtemperature detection	temperature detection	$T_{OT(1)}$	-	-	-	-	-	150	$^{\circ}C$
	temperature recovery	$T_{OT(2)}$	-					125	
Overcurrent detection	$I_{OC}$	-	-	$T_{ch} = 25^{\circ}C$	-	3.7	-	A	
				$T_{ch} = -40 \sim 125^{\circ}C$			$V_{IN} = 5 V$		2.0
Switching time	$t_{on}$	1	-	$T_{ch} = 25^{\circ}C$	-	15	100	$\mu s$	
				$T_{ch} = -40 \sim 125^{\circ}C$			$V_{DD} = 13 V,$ $V_{IN} = 0 V/5 V,$ $R_L = 13 \Omega$		100
	$T_{ch} = 25^{\circ}C$			30			100		
	$T_{ch} = -40 \sim 125^{\circ}C$			-			-		100
Drain-source diode forward voltage	$V_{DSF}$	-	-	$T_{ch} = 25^{\circ}C$	-	-	1.7	V	

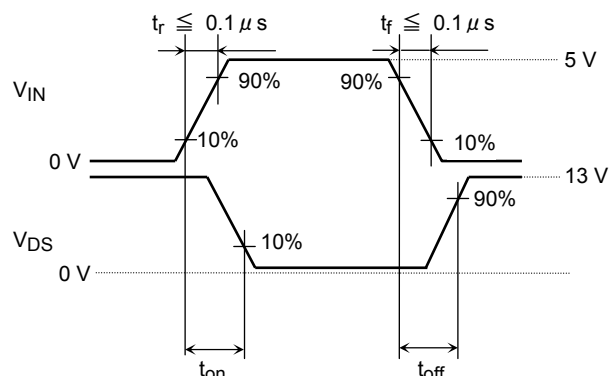
### Test Circuit 1

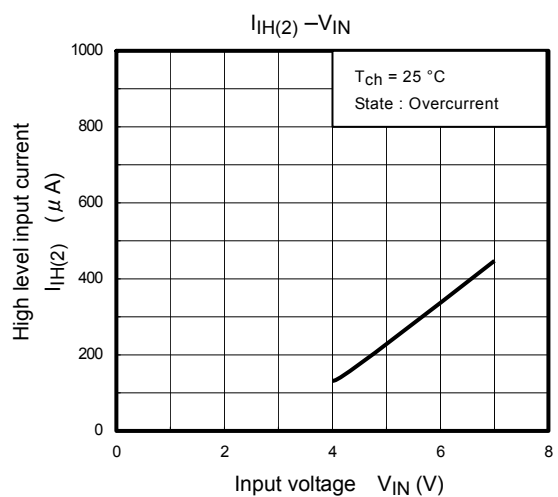
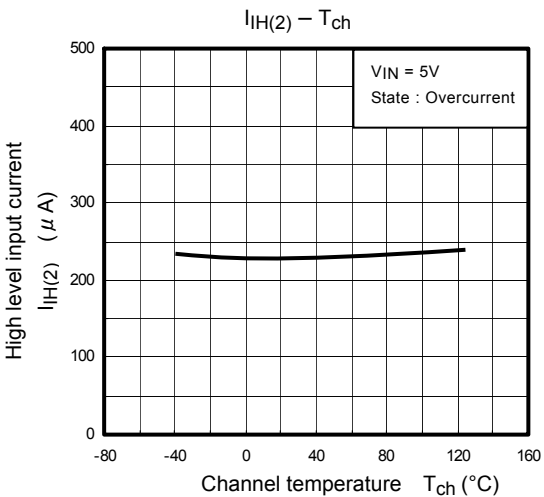
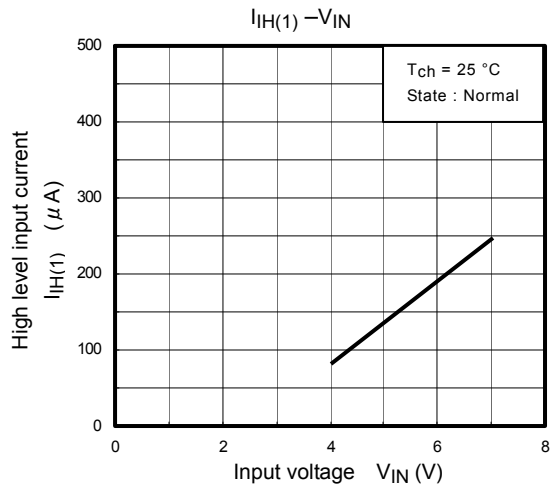
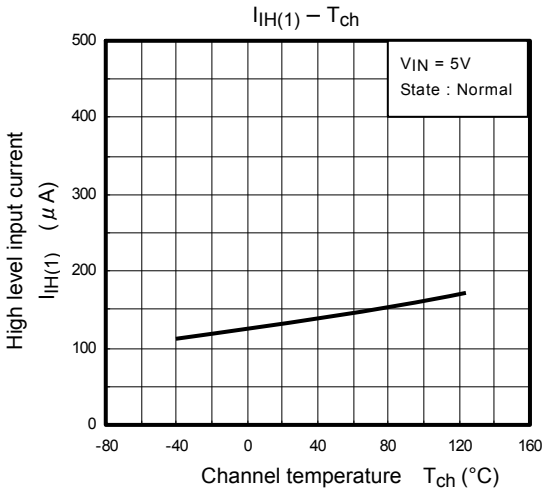
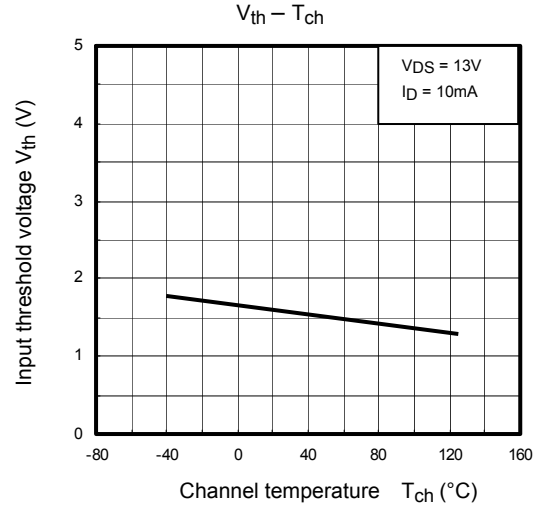
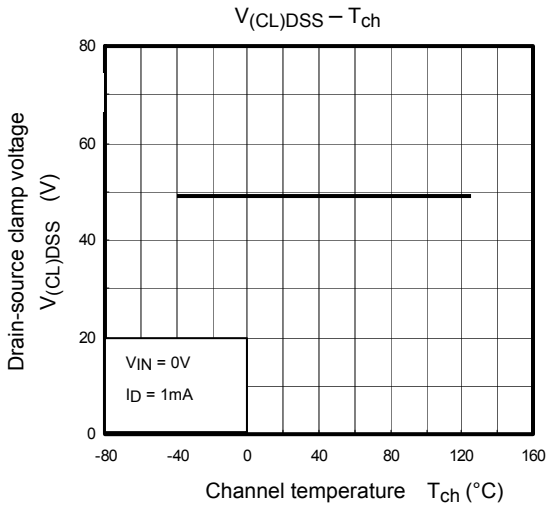
#### Switching time measuring circuit

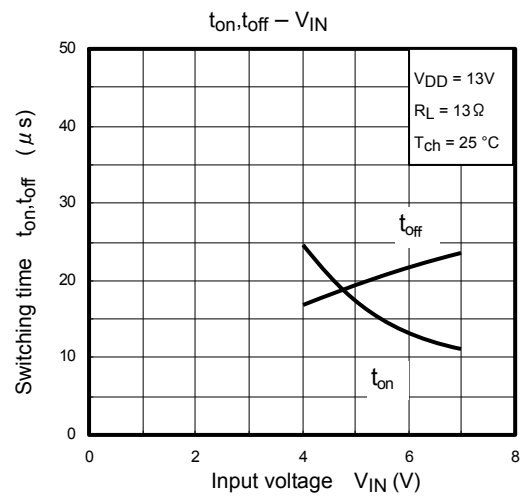
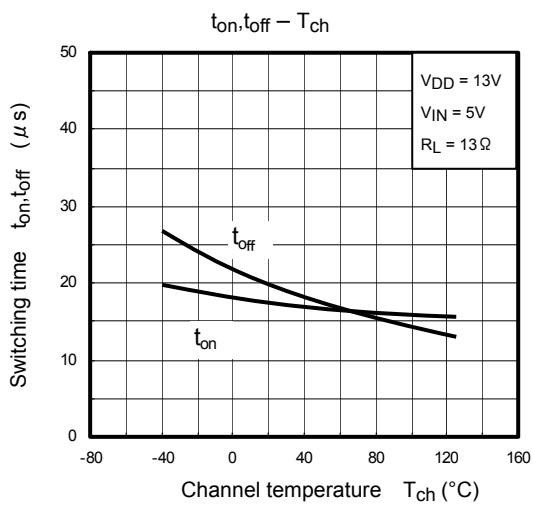
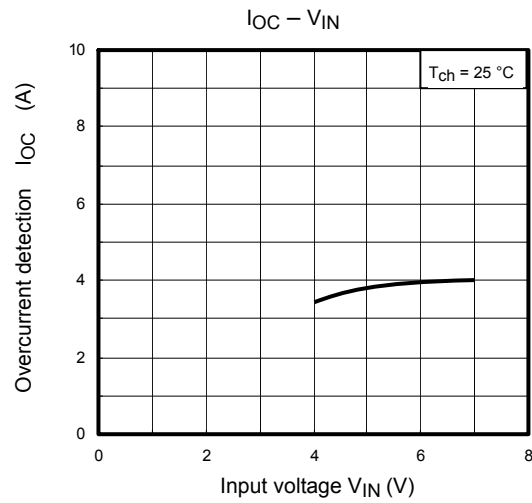
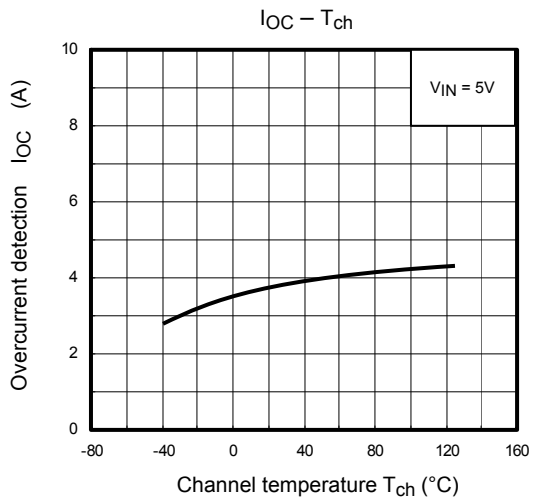
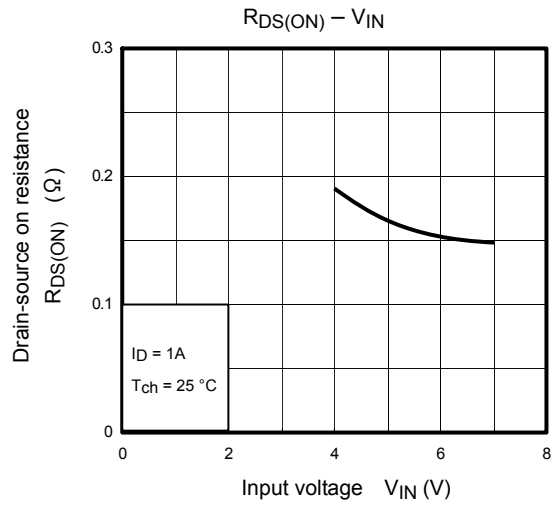
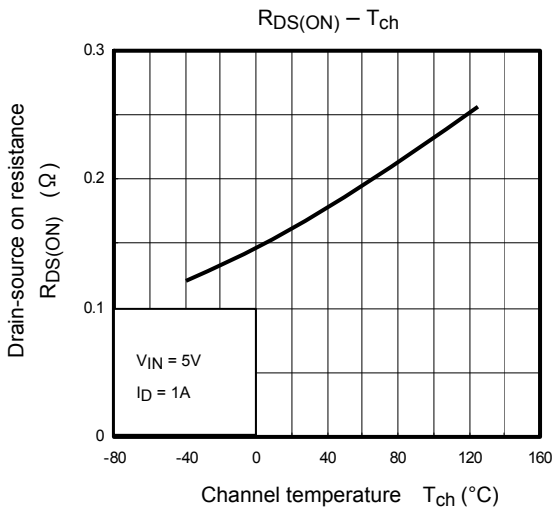
Test circuit



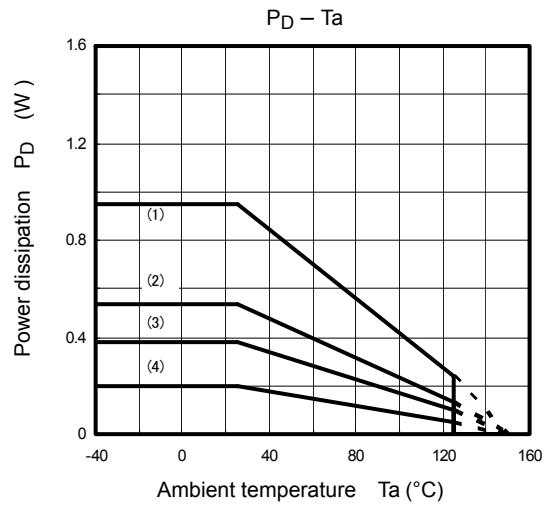
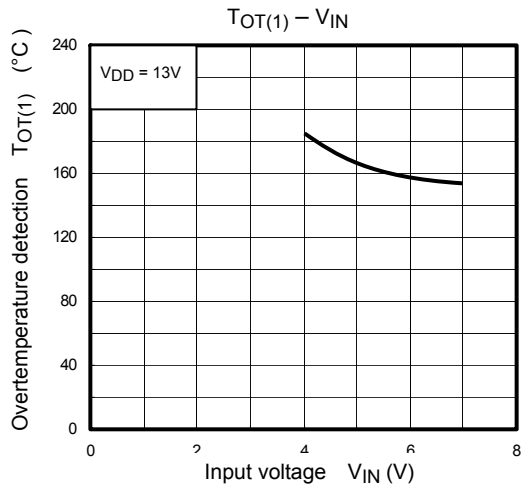
Measured waveforms



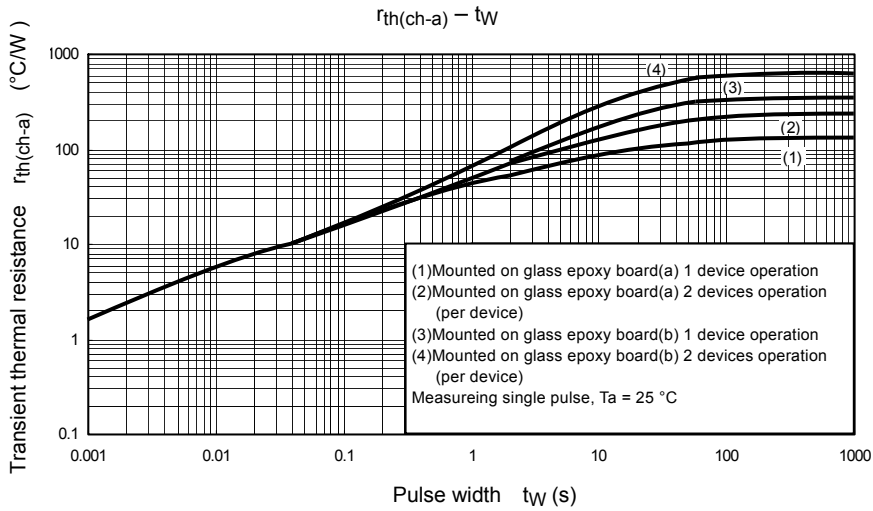




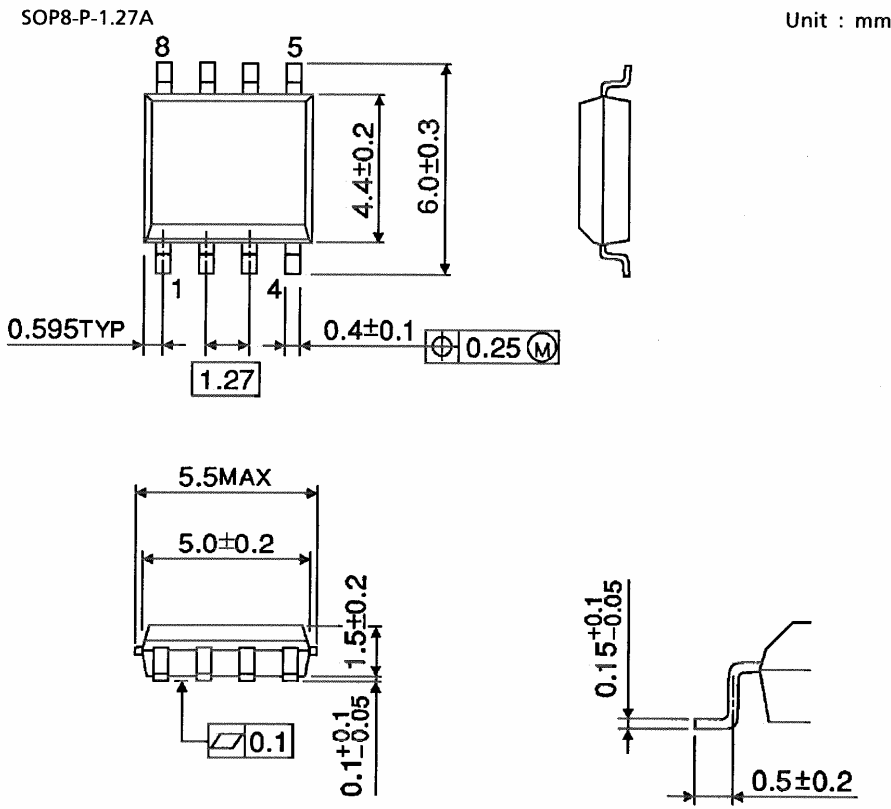




- (1) Mounted on glass epoxy board(a) 1 device operation
- (2) Mounted on glass epoxy board(a) 2 devices operation (per device)
- (3) Mounted on glass epoxy board(b) 1 device operation
- (4) Mounted on glass epoxy board(b) 2 devices operation (per device)



Package Dimensions



Weight: 0.08 g (typ.)

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20070701-EN GENERAL

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