

Toshiba Intelligent Power Device Silicon Monolithic Power MOS Integrated Circuit

# TPD1030F

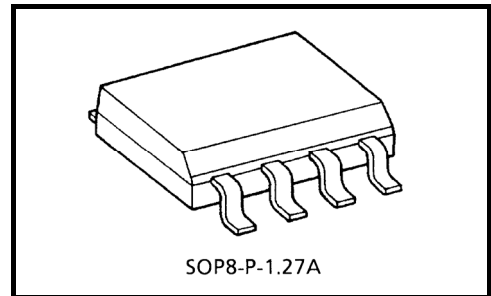
## 2-IN-1 Low-Side Switch for Motor, Solenoid and Lamp Drive

The TPD1030F 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.

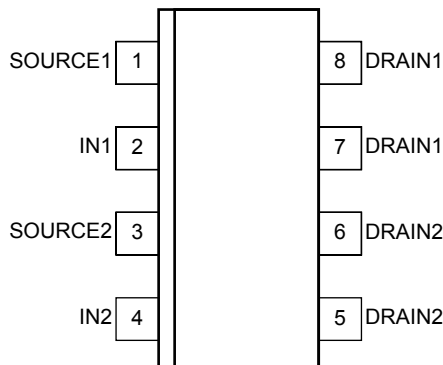
### Features

- Two built-in power IC chips with a new structure combining a control block and a vertical power MOSFET ( $L^2$ - $\pi$ -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:  $R_{DS(ON)} = 0.6 \Omega$  (max) (@ $V_{IN} = 5 V$ ,  $I_D = 0.5 A$ ,  $T_{ch} = 25^\circ C$ )
- Low Leakage Current:  $I_{DSS} = 10 \mu A$  (max) (@ $V_{IN} = 0 V$ ,  $V_{DS} = 30 V$ ,  $T_{ch} = 25^\circ C$ )
- Low Input Current:  $I_{IN} = 300 \mu A$  (max) (@ $V_{IN} = 5 V$ ,  $T_{ch} = 25^\circ C$ )
- 8-pin SOP package with embossed-tape packaging.

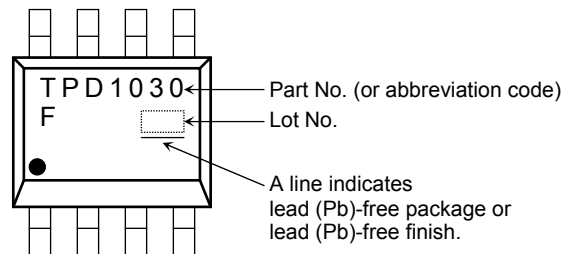


Weight: 0.08 g (typ.)

### Pin Assignment (top view)

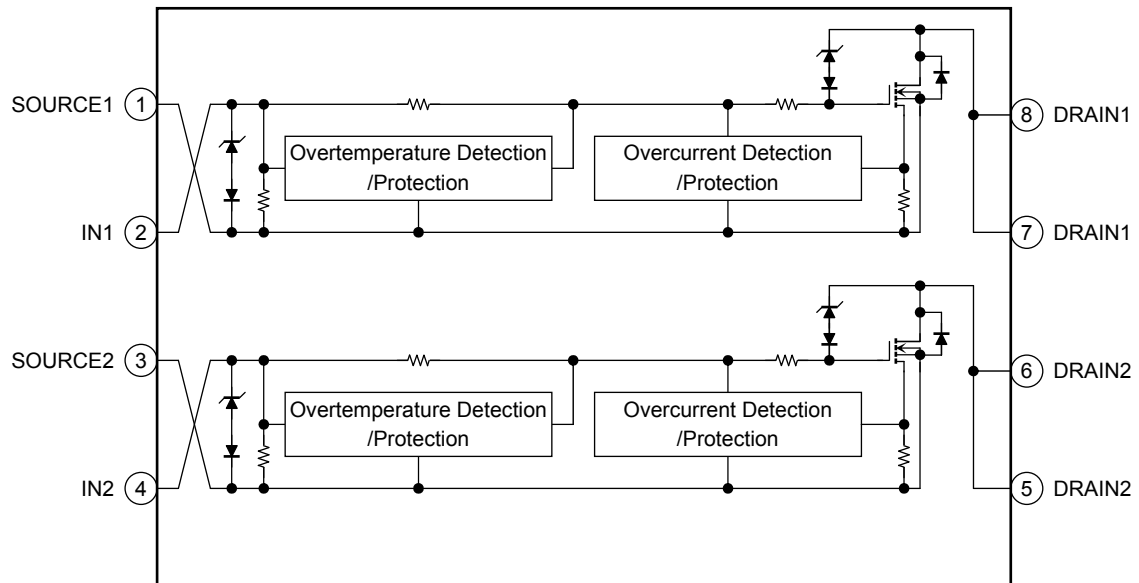


### Marking



Note1: Due to its MOS structure, this product is sensitive to static electricity.

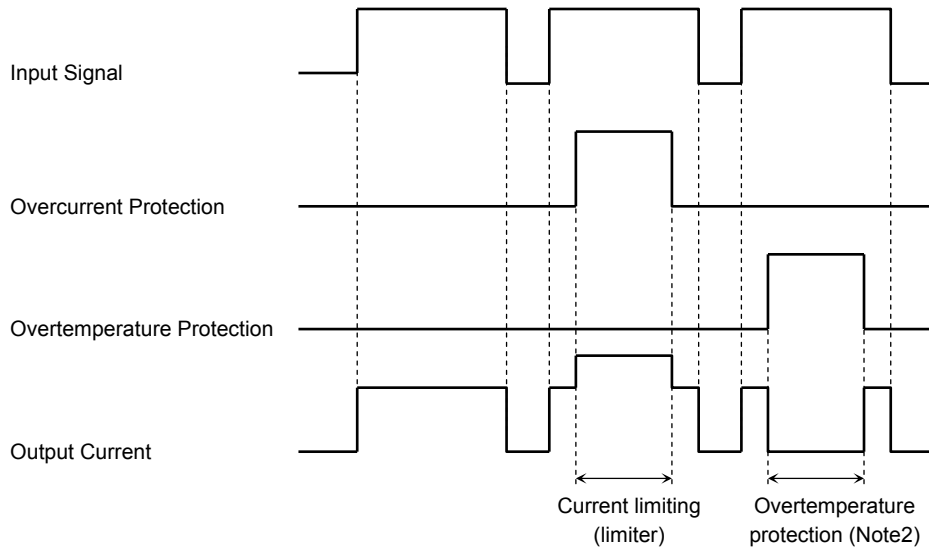
**Block Diagram**



**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 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**



Note2: The overheating detector circuits feature hysteresis. After overheating is detected, normal operation is restored only when the channel temperature falls by the hysteresis amount (5°C typ.) in relation to the overheating detection temperature.

**Truth Table**

IN	V <sub>OUT</sub>	Mode
L	H	Normal
H	L	
L	H	Overcurrent
H	H	
L	H	Overtemperature
H	H	

**Absolute Maximum Ratings (Ta = 25°C)**

Characteristics	Symbol	Rating	Unit
Drain-source voltage	V <sub>DS</sub> (DC)	40	V
Drain current	I <sub>D</sub>	Internally Limited	A
Input voltage	V <sub>IN</sub>	-0.3 to 7	V
Power dissipation (t = 10 s)	P <sub>D</sub>	2.0 (Note 3)	W
Single pulse active clamp capability (Note 4)	E <sub>AS</sub>	10	mJ
Active clamp current	I <sub>AR</sub>	1	A
Repetitive active clamp capability (Note 5)	E <sub>AR</sub>	0.2	mJ
Operating temperature	T <sub>opr</sub>	-40 to 110	°C
Channel temperature	T <sub>ch</sub>	150	°C
Storage temperature	T <sub>stg</sub>	-55 to 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 Characteristics

Characteristics	Symbol	Max	Unit
Thermal resistance, channel to ambient (t = 10 s) (Note3)	$R_{th} (ch-a)$	62.5	°C/W

Note 3: Drive operation: Mounted on glass epoxy board [25.4mm × 25.4mm × 0.8mm] (with the two devices operating)

Note 4: Active clamp capability (single pulse) test condition  
 $V_{DD} = 25 V$ , Starting  $T_{ch} = 25^{\circ}C$ ,  $L = 10 mH$ ,  $I_{AR} = 1 A$ ,  $R_G = 25 \Omega$

Note 5: Repetitive rating, pulse width limited by maximum channel temperature.

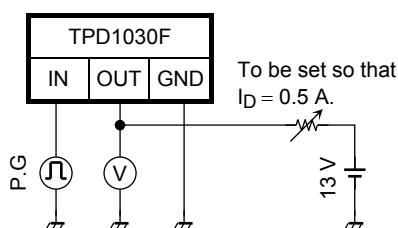
## Electrical Characteristics

Characteristics	Symbol	Test Circuit	Test Condition	Min	Typ.	Max	Unit	
Drain-source clamp voltage	$V_{(CL) DSS}$	—	$T_{ch} = -40 \sim 110^{\circ}C$ $V_{IN} = 0 V$ , $I_D = 1 mA$	40	—	60	V	
Input threshold voltage	$V_{th}$	—	$T_{ch} = 25^{\circ}C$	1.0	—	2.8	V	
			$T_{ch} = -40 \sim 110^{\circ}C$					0.9
Protective circuit operation input voltage range	$V_{IN (opr)}$	—	$T_{ch} = 25^{\circ}C$	—	—	7	V	
			$T_{ch} = -40 \sim 110^{\circ}C$	—	—	7		
Drain cut-off current	$I_{DSS}$	—	$T_{ch} = 25^{\circ}C$	$V_{IN} = 0 V$ , $V_{DS} = 30V$	—	—	10	$\mu A$
			$T_{ch} = -40 \sim 110^{\circ}C$		—	—	100	
Input current	$I_{IN (1)}$	—	$T_{ch} = 25^{\circ}C$	$V_{IN} = 5 V$ , at normal operation	—	—	300	$\mu A$
	$I_{IN (2)}$	—	$T_{ch} = -40 \sim 110^{\circ}C$	$V_{IN} = 5 V$ , when overcurrent protective circuit is actuated	—	—	350	
Drain-source on resistance	$R_{DS (ON)}$	—	$T_{ch} = 25^{\circ}C$	$V_{IN} = 5 V$ , $I_D = 0.5 A$	—	0.44	0.6	$\Omega$
			$T_{ch} = -40 \sim 110^{\circ}C$		—	—	0.9	
Overtemperature protection	$T_S$	—	—	$V_{IN} = 5 V$	150	160	—	°C
Overcurrent protection	$I_S$	—	$T_{ch} = 25^{\circ}C$	$V_{IN} = 5 V$	1	1.8	—	A
			$T_{ch} = -40 \sim 110^{\circ}C$		0.7	—	—	
Switching time	$t_{ON}$	1	$T_{ch} = 25^{\circ}C$	$V_{DD} = 13 V$ , $V_{IN} = 0V/5 V$ , $I_D = 0.5 A$	—	—	30	$\mu s$
			$T_{ch} = -40 \sim 110^{\circ}C$		—	—	60	
	$T_{ch} = 25^{\circ}C$		—		—	60		
	$T_{ch} = -40 \sim 110^{\circ}C$		—		—	90		
Source-drain diode forward voltage	$V_{DSF}$	—	$T_{ch} = 25^{\circ}C$	$I_F = 1 A$ , $V_{IN} = 0 V$	—	—	1.7	V

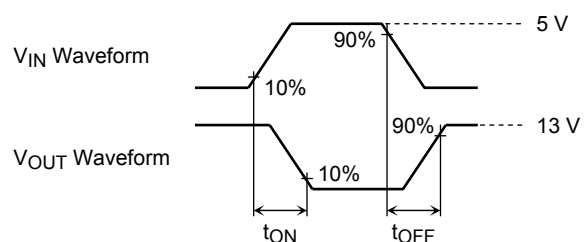
## Test Circuit 1

Switching time measuring circuit

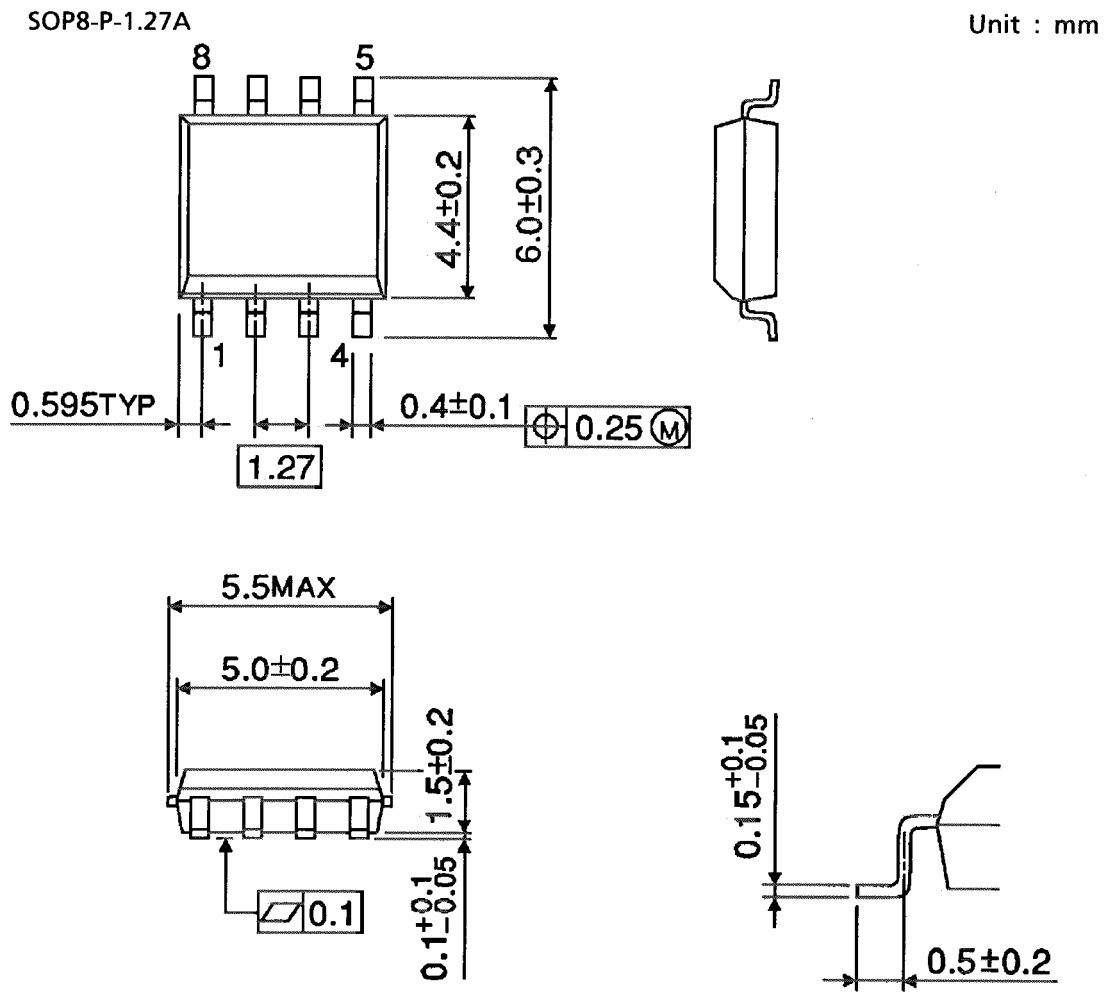
### Test Circuit



### Measured Waveforms



## Package Dimensions



Weight: 0.08 g (typ.)

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