

Toshiba Intelligent Power Device Silicon Monolithic Power MOS Integrated Circuit

TPD1030F

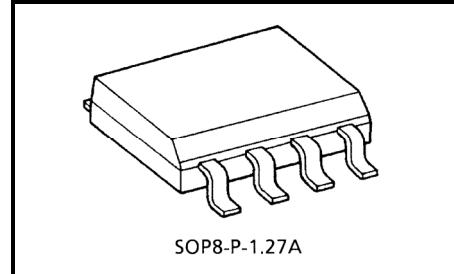
2-IN-1 Low-Side Switch for Motor, Solenoid and Lamp Drive

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.

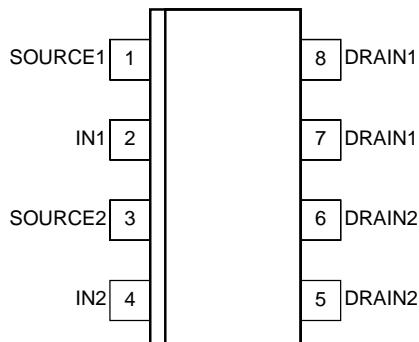
Features

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

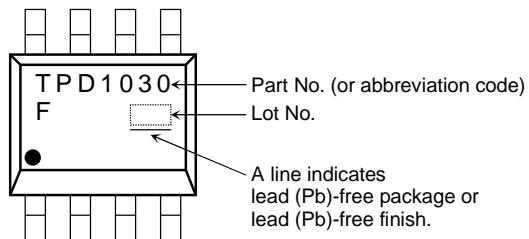


Weight: 0.08 g (typ.)

Pin Assignment (top view)

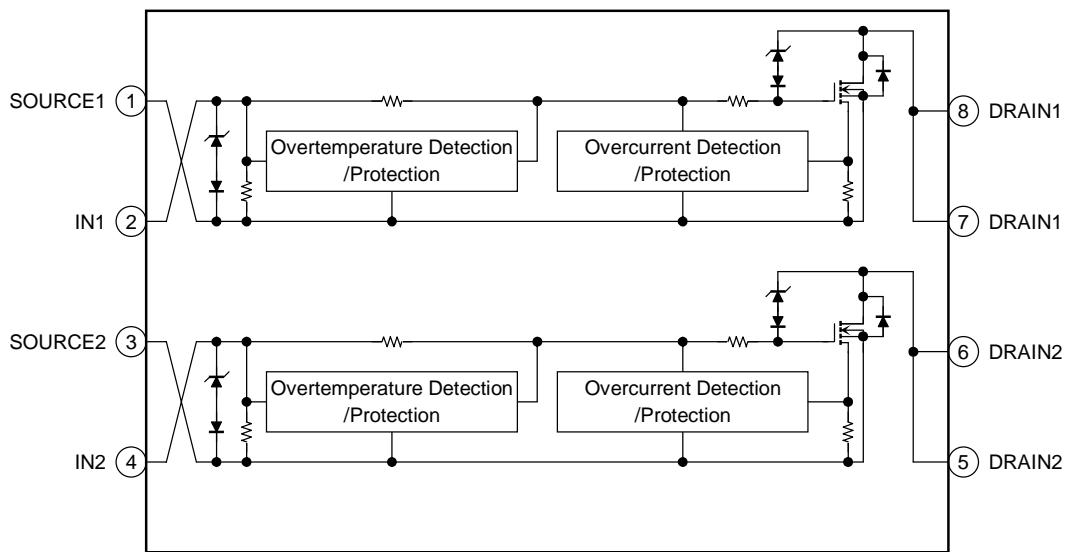


Marking



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

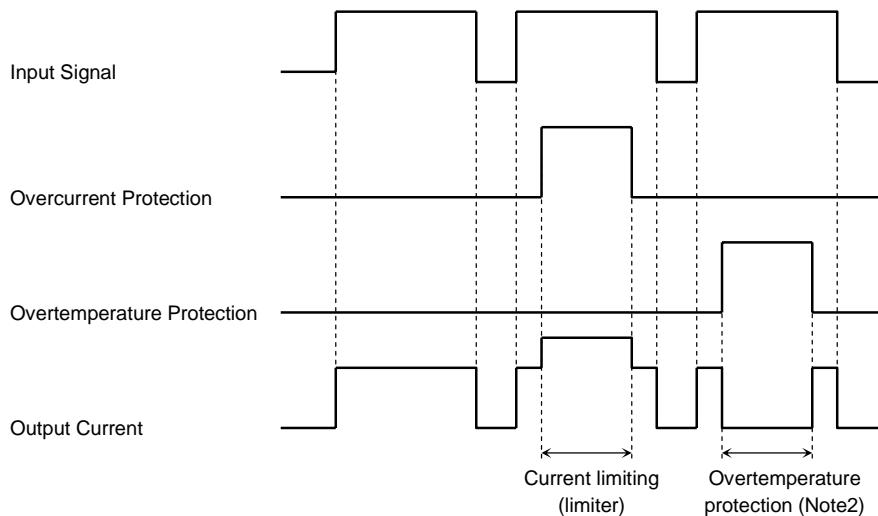
Block Diagram



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 _{OUT}	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 _{DS} (DC)	40	V
Drain current	I _D	Internally Limited	A
Input voltage	V _{IN}	-0.3 to 7	V
Power dissipation (t = 10 s)	P _D	2.0 (Note 3)	W
Single pulse active clamp capability (Note 4)	E _{AS}	10	mJ
Active clamp current	I _{AR}	1	A
Repetitive active clamp capability (Note 5)	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: 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 \times 25.4mm \times 0.8mm]
(with the two devices operating)

Note 4: Active clamp capability (single pulse) test condition

$V_{DD} = 25$ V, Starting $T_{ch} = 25^\circ\text{C}$, $L = 10$ mH, $I_{AR} = 1$ A, $R_G = 25 \Omega$

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

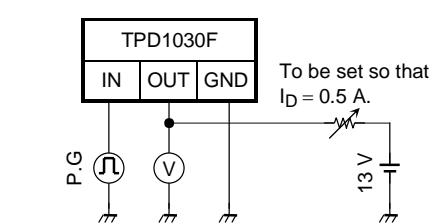
Electrical Characteristics

Characteristics	Symbol	Test Circuit	Test Condition		Min	Typ.	Max	Unit
Drain-source clamp voltage	$V_{(CL) DSS}$	—	$T_{ch} = -40 \sim 110^\circ\text{C}$	$V_{IN} = 0$ V, $I_D = 1$ mA	40	—	60	V
Input threshold voltage	V_{th}	—	$T_{ch} = 25^\circ\text{C}$	$V_{DS} = 13$ V, $I_D = 10$ mA	1.0	—	2.8	V
			$T_{ch} = -40 \sim 110^\circ\text{C}$		0.9	—	3.0	
Protective circuit operation input voltage range	V_{IN} (opr)	—	$T_{ch} = 25^\circ\text{C}$	—	3	—	7	V
			$T_{ch} = -40 \sim 110^\circ\text{C}$	—	3.5	—	7	
Drain cut-off current	I_{DSS}	—	$T_{ch} = 25^\circ\text{C}$	$V_{IN} = 0$ V, $V_{DS} = 30$ V	—	—	10	μA
			$T_{ch} = -40 \sim 110^\circ\text{C}$		—	—	100	
Input current	I_{IN} (1)	—	$T_{ch} = 25^\circ\text{C}$	$V_{IN} = 5$ V, at normal operation	—	—	300	μA
	I_{IN} (2)	—	$T_{ch} = -40 \sim 110^\circ\text{C}$	$V_{IN} = 5$ V, when overcurrent protective circuit is actuated	—	—	350	
Drain-source on resistance	R_{DS} (ON)	—	$T_{ch} = 25^\circ\text{C}$	$V_{IN} = 5$ V, $I_D = 0.5$ A	—	0.44	0.6	Ω
			$T_{ch} = -40 \sim 110^\circ\text{C}$		—	—	0.9	
Overtemperature protection	T_S	—	—	$V_{IN} = 5$ V	150	160	—	$^\circ\text{C}$
Overcurrent protection	I_S	—	$T_{ch} = 25^\circ\text{C}$	$V_{IN} = 5$ V	1	1.8	—	A
			$T_{ch} = -40 \sim 110^\circ\text{C}$		0.7	—	—	
Switching time	t_{ON}	1	$T_{ch} = 25^\circ\text{C}$	$V_{DD} = 13$ V, $V_{IN} = 0V/5$ V, $I_D = 0.5$ A	—	—	30	μs
	t_{OFF}		$T_{ch} = -40 \sim 110^\circ\text{C}$		—	—	60	
			$T_{ch} = 25^\circ\text{C}$		—	—	60	
			$T_{ch} = -40 \sim 110^\circ\text{C}$		—	—	90	
Source-drain diode forward voltage	V_{DSF}	—	$T_{ch} = 25^\circ\text{C}$	$I_F = 1$ A, $V_{IN} = 0$ V	—	—	1.7	V

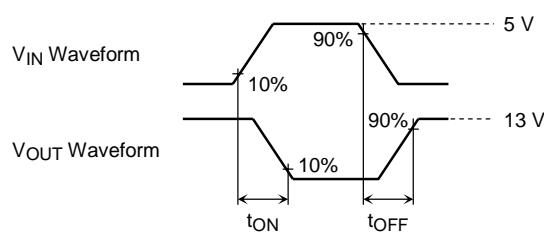
Test Circuit 1

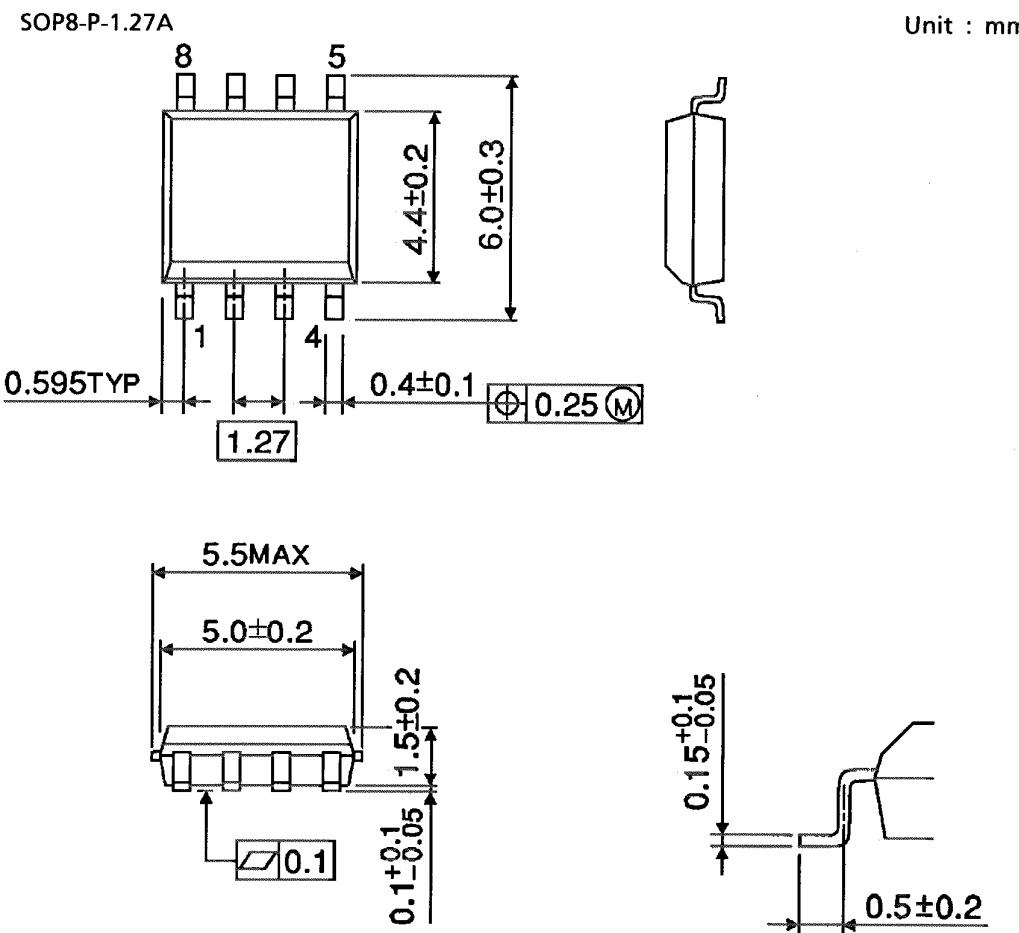
Switching time measuring circuit

Test Circuit



Measured Waveforms



Package Dimensions

Weight: 0.08 g (typ.)

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