

Toshiba Intelligent Power Device Silicon Monolithic Power MOS Integrated Circuit

# TPD1032F

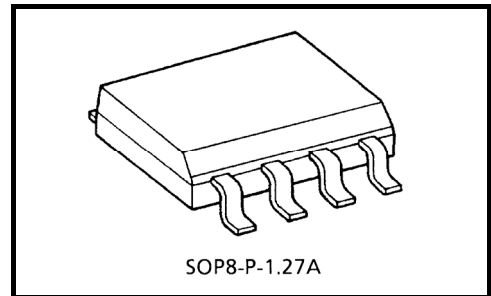
## 2-IN-1 Low-Side Power Switch for Motor, Solenoid and Lamp Drive

The TPD1032F 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.

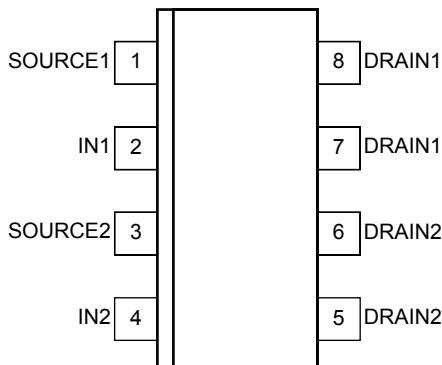
### Features

- Two built-in power IC chips with a new structure combining a control block and a vertical power MOSFET (L<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:  $R_{DS(ON)} = 0.4 \Omega$  (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) (@ $V_{IN} = 0 \text{ V}$ ,  $V_{DS} = 20 \text{ V}$ ,  $T_{ch} = 25^\circ\text{C}$ )
- Low Input Current:  $I_{IN} = 300 \mu\text{A}$  (max) (@ $V_{IN} = 5 \text{ V}$ ,  $T_{ch} = -40 \sim 110^\circ\text{C}$ )
- 8-pin SOP package for surface with embossed-tape packing.



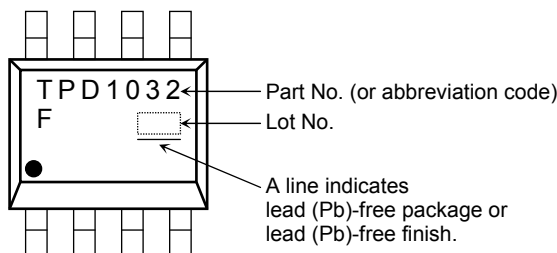
Weight: 0.08 g (typ.)

### Pin Assignment (top view)

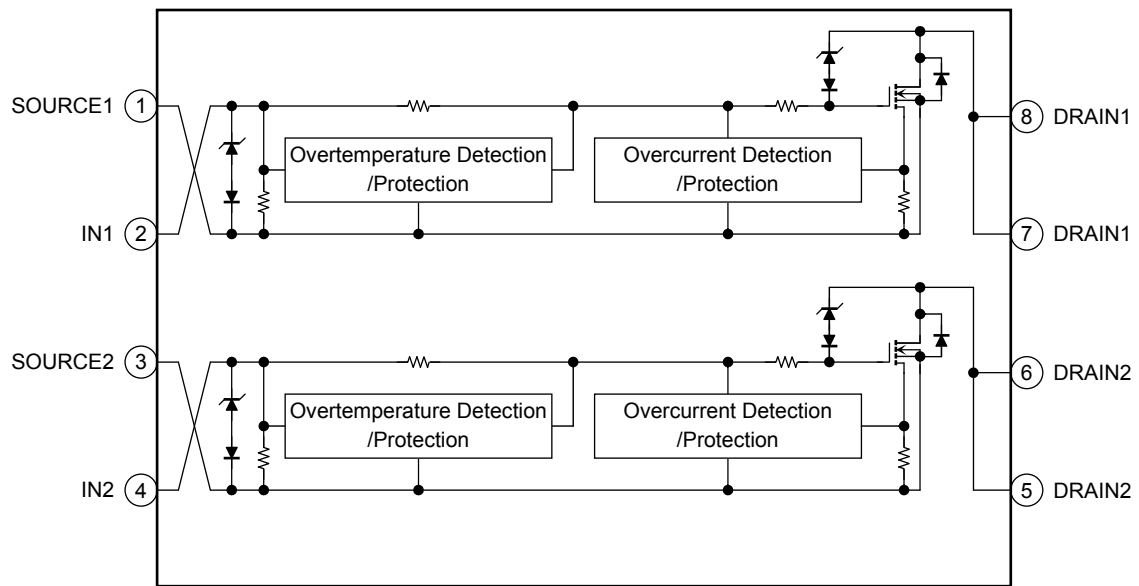


Note1: Due to its MOS structure, this product is sensitive to static electricity.

### Marking



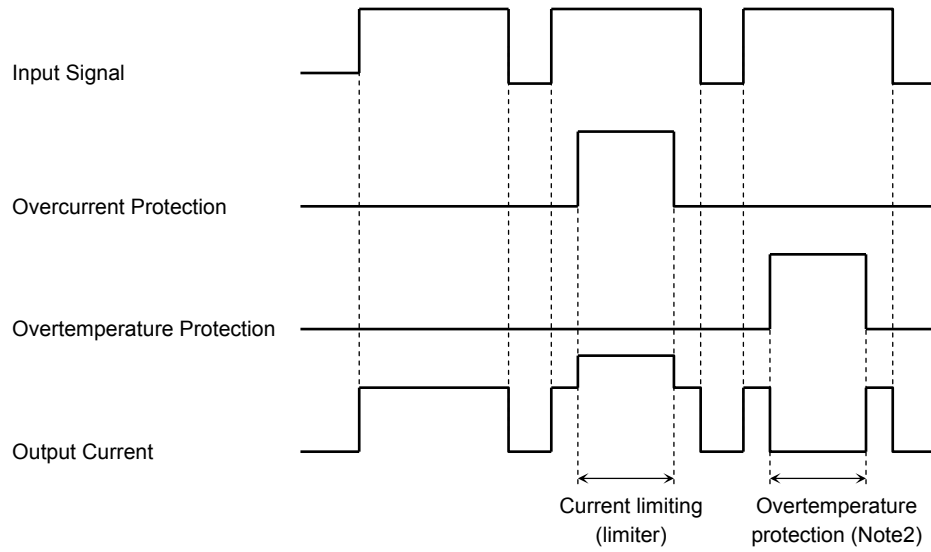
**Block Diagram**



**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



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	DC	V <sub>DS</sub>	20	V
	Pulse		40	
Drain current		I <sub>D</sub>	Internally limited	A
Input voltage		V <sub>IN</sub>	-0.3 to 7	V
Power dissipation (Ta=25°C)(Note 3a)	Single-device operation (Note4a)	P <sub>D(1)</sub>	0.95	W
	Single-device value at dual operation (Note4b)	P <sub>D(2)</sub>	0.54	
Power dissipation (Ta=25°C)(Note 3b)	Single-device operation (Note4a)	P <sub>D(3)</sub>	0.38	
	Single-device value at dual operation (Note4b)	P <sub>D(4)</sub>	0.20	
Single pulse active clamp capability (Note 5)		E <sub>AS</sub>	90	mJ
Active clamp current		I <sub>AR</sub>	3	A
Repetitive active clamp capability (Note 6)		E <sub>AR</sub>	54	μJ
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

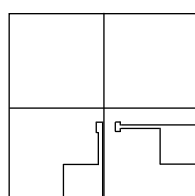
Note: Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) 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 (Note3a)	Single-device operation (Note 4a)	R <sub>th (ch-a)(1)</sub>	132	°C/W
	Single-device value at dual operation (Note 4b)	R <sub>th (ch-a)(2)</sub>	231	
Thermal resistance, channel to ambient (Note3b)	Single-device operation (Note 4a)	R <sub>th (ch-a)(1)</sub>	330	°C/W
	Single-device value at dual operation (Note 4b)	R <sub>th (ch-a)(2)</sub>	625	

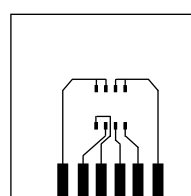
Note 3:



(a)

a) Device mounted on a glass-epoxy board (a)

FR-4  
25.4 × 25.4 × 0.8  
(Unit: mm)



(b)

b) Device mounted on a glass-epoxy board (b)

FR-4  
25.4 × 25.4 × 0.8  
(Unit: mm)

Note 4:

- a) The power dissipation and thermal resistance values are shown for a single device.  
(During single-device operation, power is only applied to one device.)
- b) The power dissipation and thermal resistance values are shown for a single device.  
(During dual operation, power is evenly applied to both device.)

Note 5: Active clamp capability (single pulse) test condition

$V_{DD} = 25\text{ V}$ , Starting  $T_{ch} = 25^\circ\text{C}$ ,  $L = 10\text{ mH}$ ,  $I_{AR} = 3\text{ A}$ ,  $R_G = 25\ \Omega$

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

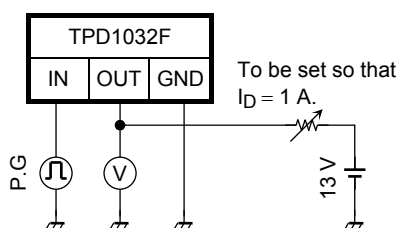
## Electrical Characteristics

Characteristics	Symbol	Test Circuit	Test Condition	Min	Typ.	Max	Unit
Drain-source clamp voltage	$V_{(CL)DSS}$	—	$T_{ch} = -40 \sim 110^\circ\text{C}$ $V_{IN} = 0\text{ V}$ , $I_D = 1\text{ mA}$	40	—	60	V
Input threshold voltage	$V_{th}$	—	$T_{ch} = 25^\circ\text{C}$	1.0	—	2.8	V
			$T_{ch} = -40 \sim 110^\circ\text{C}$				
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	$I_{DSS}$	—	$T_{ch} = 25^\circ\text{C}$	—	—	10	$\mu\text{A}$
			$T_{ch} = -40 \sim 110^\circ\text{C}$			100	
Input current	$I_{IN(1)}$	—	$T_{ch} = 25^\circ\text{C}$	—	—	300	$\mu\text{A}$
	$I_{IN(2)}$	—	$T_{ch} = -40 \sim 110^\circ\text{C}$	—	—	350	
Drain-source on resistance	$R_{DS(ON)}$	—	$T_{ch} = 25^\circ\text{C}$	—	0.25	0.4	$\Omega$
			$T_{ch} = -40 \sim 110^\circ\text{C}$			0.6	
Overtemperature protection	$T_S$	—	—	150	160	—	$^\circ\text{C}$
Overcurrent protection	$I_S$	—	$T_{ch} = 25^\circ\text{C}$	3	3.7	—	A
			$T_{ch} = -40 \sim 110^\circ\text{C}$			2	
Switching time	$t_{ON}$	1	$T_{ch} = 25^\circ\text{C}$	—	—	30	$\mu\text{s}$
			$T_{ch} = -40 \sim 110^\circ\text{C}$			60	
	$T_{ch} = 25^\circ\text{C}$		60				
	$T_{ch} = -40 \sim 110^\circ\text{C}$		90				
Source-drain diode forward voltage	$V_{DSF}$	—	$T_{ch} = 25^\circ\text{C}$	—	—	1.7	V

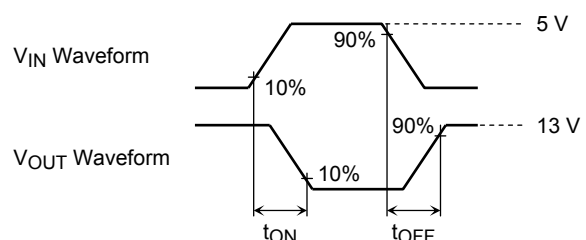
## Test Circuit 1

Switching time measuring circuit

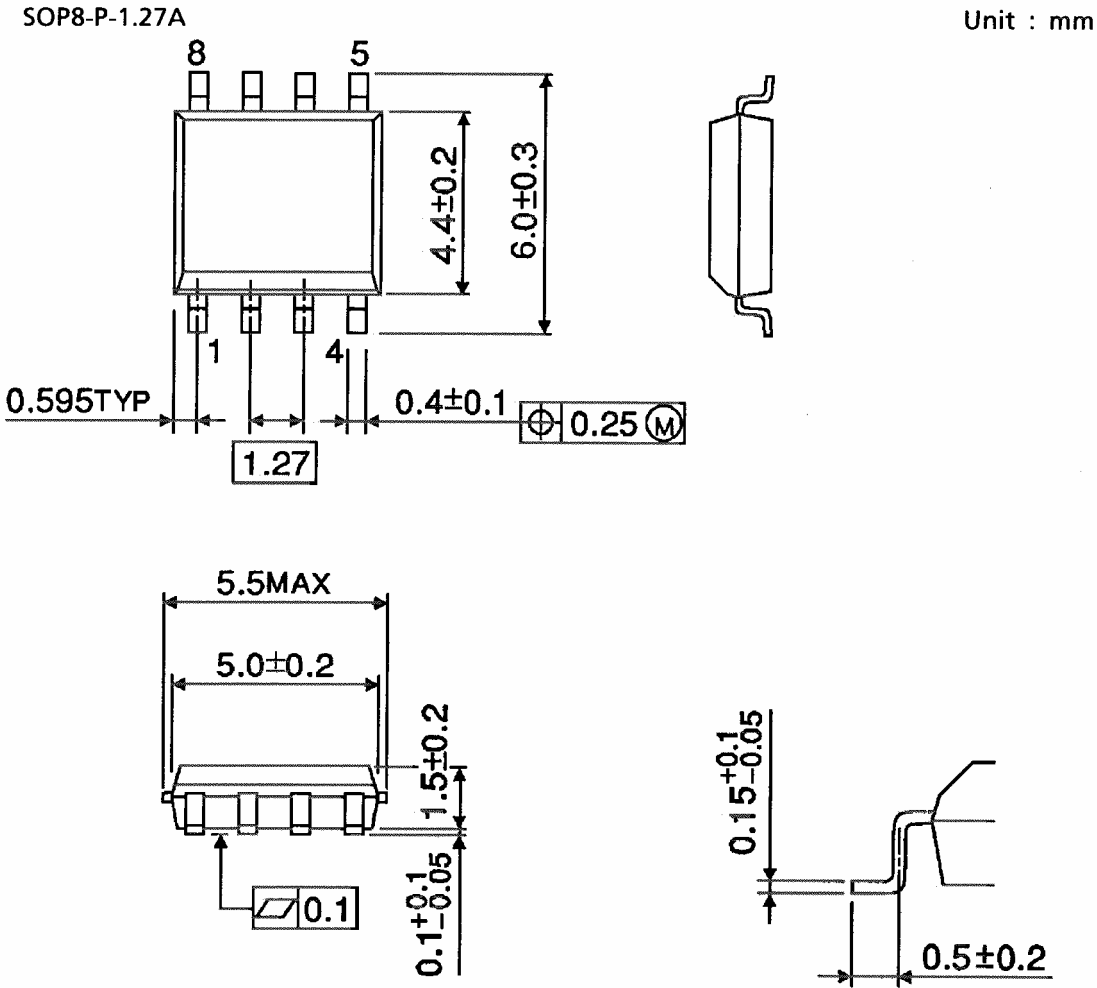
### Test Circuit



### Measured Waveforms



Package Dimensions



Weight: 0.08 g (typ.)

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