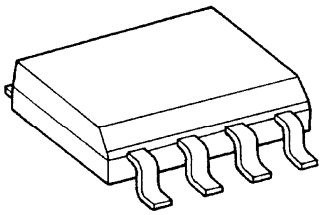
Toshiba Intelligent Power Device Silicon Monolithic Power MOS Integrated Circuit

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.

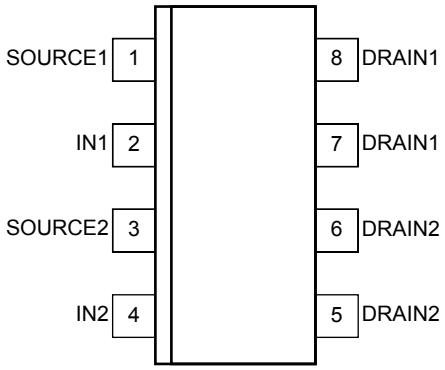


Weight: 0.08 g (typ.)

Features

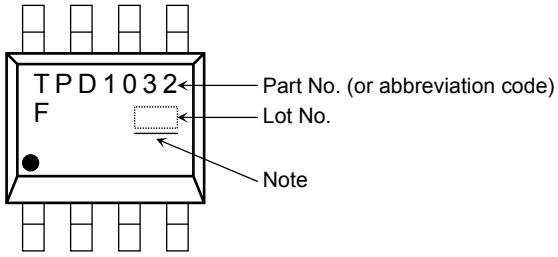
- Two built-in power IC chips with a new structure combining a control block and a vertical power MOSFET (L^2-π-MOS) on each chip.
- Can directly drive a power load from a CMOS or TTL logic.
- Built-in protection circuits against overvoltage (active clamp), overtemperature (thermal shutdown), and overcurrent (current limiter).
- Low Drain-Source ON-resistance: $R_{DS\ (ON)}$ = 0.4 Ω (max) ($@V_{IN}$ = 5 V, I_D = 1 A, T_{ch} = 25°C)
- Low Leakage Current: I_{DSS} = 10 μA (max) ($@V_{IN}$ = 0 V, V_{DS} = 20 V, T_{ch} = 25°C)
- Low Input Current: I_{IN} = 300 μA (max) ($@V_{IN}$ = 5 V, T_{ch} = -40～110°C)
- 8-pin SOP package for surface with embossed-tape packing.

Pin Assignment (top view)



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

Marking

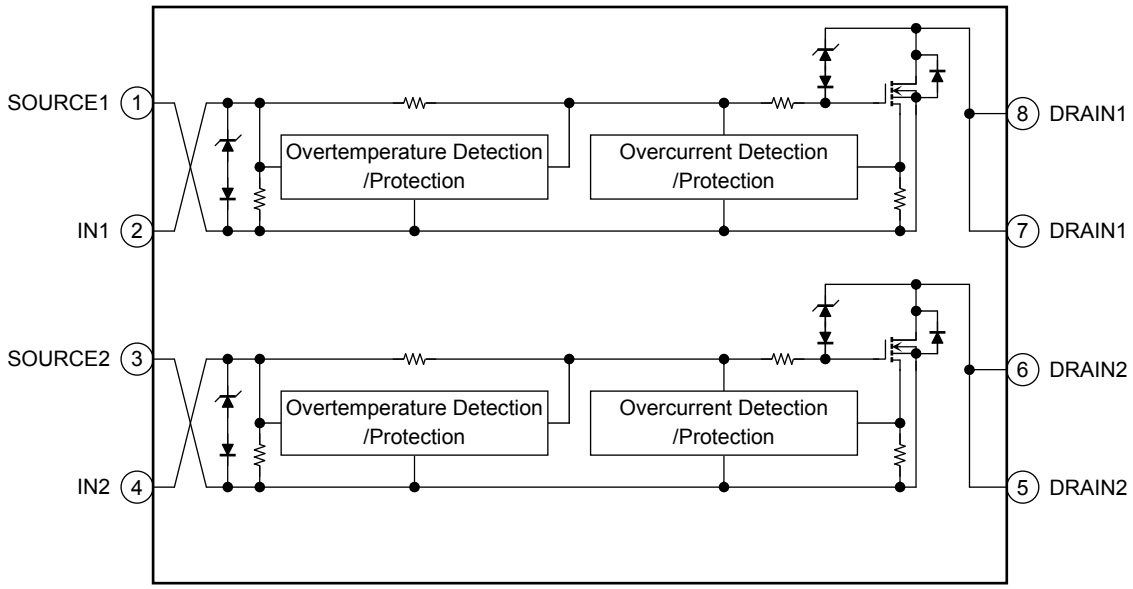


Note: A line under a Lot No. identifies the indication of product Labels.
Not underlined: [[Pb]]/INCLUDES > MCV
Underlined: [[G]]/RoHS COMPATIBLE or [[G]]/RoHS [[Pb]]

Please contact your TOSHIBA sales representative for details as to environmental matters such as the RoHS compatibility of Product. The RoHS is Directive 2011/65/EU of the European Parliament and of the Council of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment.

Start of commercial production
1999-10

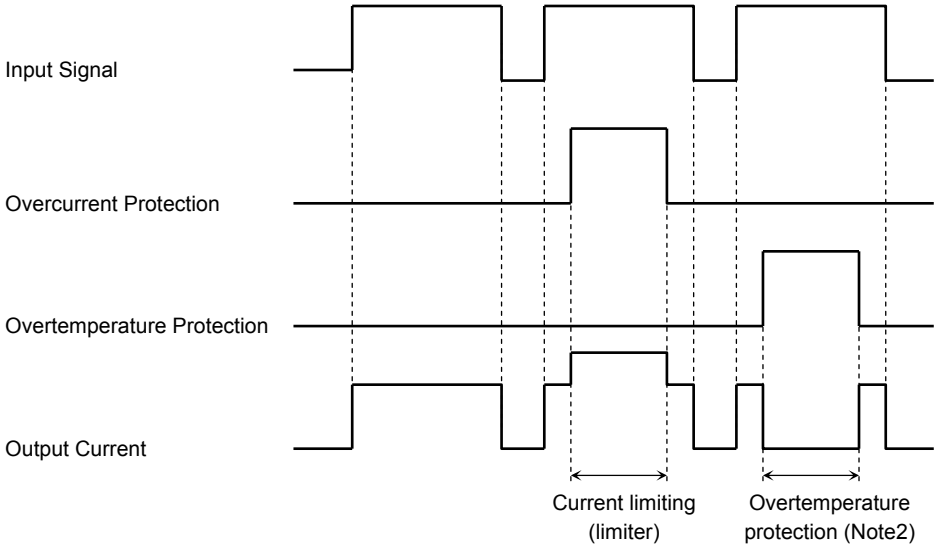
Block Diagram



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_{OUT}	Mode
L	H	Normal
H	L	
L	H	Overcurrent
H	H	
L	H	Overtemperature
H	H	

Absolute Maximum Ratings (Ta = 25°C)

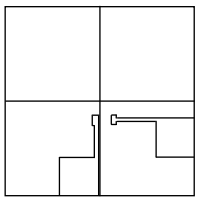
Characteristics		Symbol	Rating	Unit
Drain-source voltage	DC	V_{DS}	20	V
	Pulse		40	
Drain current		I_D	Internally limited	A
Input voltage		V_{IN}	−0.3 to 7	V
Power dissipation (Ta=25°C)(Note 3a)	Single-device operation (Note4a)	$P_{D(1)}$	0.95	W
	Single-device value at dual operation (Note4b)	$P_{D(2)}$	0.54	
Power dissipation (Ta=25°C)(Note 3b)	Single-device operation (Note4a)	$P_{D(3)}$	0.38	
	Single-device value at dual operation (Note4b)	$P_{D(4)}$	0.20	
Single pulse active clamp capability (Note 5)		E_{AS}	90	mJ
Active clamp current		I_{AR}	3	A
Repetitive active clamp capability (Note 6)		E_{AR}	54	μJ
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 (Note3a)	Single-device operation (Note 4a)	$R_{th\ (ch\text{-}a)(1)}$	132	°C/W
	Single-device value at dual operation (Note 4b)	$R_{th\ (ch\text{-}a)(2)}$	231	
Thermal resistance, channel to ambient (Note3b)	Single-device operation (Note 4a)	$R_{th\ (ch\text{-}a)(1)}$	330	°C/W
	Single-device value at dual operation (Note 4b)	$R_{th\ (ch\text{-}a)(2)}$	625	

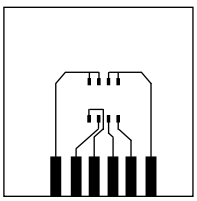
Note 3:



FR-4
25.4 × 25.4 × 0.8
(Unit: mm)

(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)

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 V, Starting T_{ch} = 25°C, L = 10 mH, I_{AR} = 3 A, R_G = 25 Ω

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

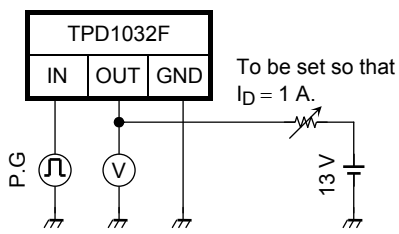
Electrical Characteristics

Characteristics	Symbol	Test Circuit	Test Condition		Min	Typ.	Max	Unit
Drain-source clamp voltage	$V_{(CL)\ DSS}$	—	T_{ch}=-40～110℃	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}=-40～110℃		0.9	—	3.0	
Protective circuit operation input voltage range	$V_{IN\ (opr)}$	—	T_{ch}=25℃	—	3	—	7	V
			T_{ch}=-40～110℃	—	3.5	—	7	
Drain cut-off current	I_{DSS}	—	T_{ch}=25℃	V_{IN} = 0 V, V_{DS}=20V	—	—	10	μA
			T_{ch}=-40～110℃		—	—	100	
Input current	$I_{IN\ (1)}$	—	T_{ch}=25℃	V_{IN} = 5 V, at normal operation	—	—	300	μA
	$I_{IN\ (2)}$	—	T_{ch}=-40～110℃	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 = 1 A	—	0.25	0.4	Ω
			T_{ch}=-40～110℃		—	—	0.6	
Overtemperature protection	T_S	—	—	V_{IN} = 5 V	150	160	—	°C
Overcurrent protection	I_S	—	T_{ch}=25℃	V_{IN} = 5 V	3	3.7	—	A
			T_{ch}=-40～110℃		2	—	—	
Switching time	t_{ON}	1	T_{ch}=25℃	V_{DD} = 13 V, V_{IN} = 0V/5 V, I_D = 1 A	—	—	30	μs
			T_{ch}=-40～110℃		—	—	60	
	t_{OFF}		T_{ch}=25℃		—	—	60	
			T_{ch}=-40～110℃		—	—	90	
Source-drain diode forward voltage	V_{DSF}	—	T_{ch}=25℃	I_F = 3 A, V_{IN} = 0 V	—	—	1.7	V

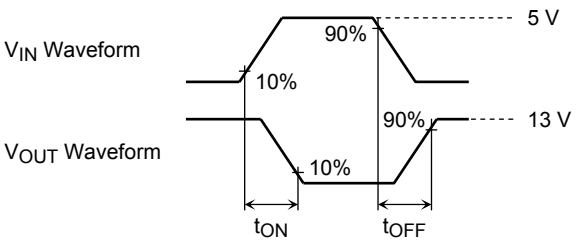
Test Circuit 1

Switching time measuring circuit

Test Circuit

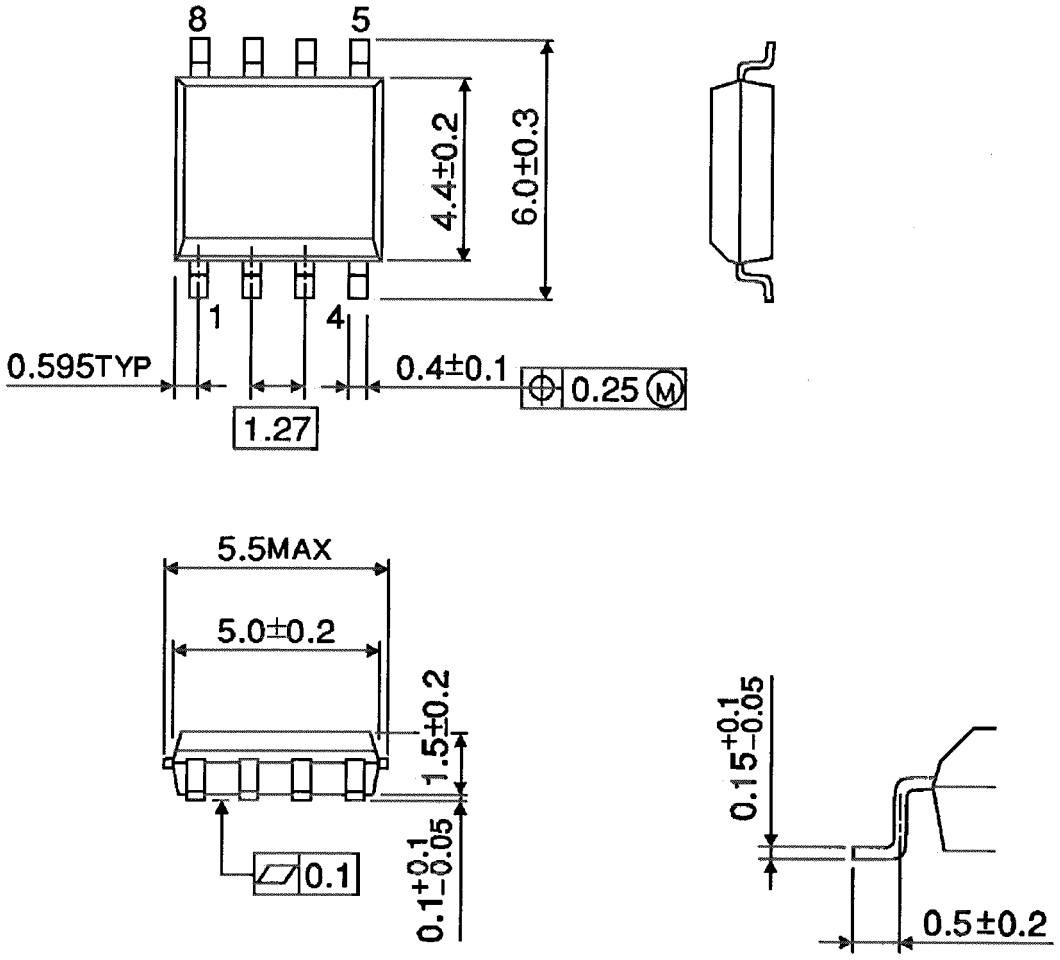


Measured Waveforms



Package Dimensions

SOP8-P-1.27A Unit : mm



Weight: 0.08 g (typ.)

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