

Toshiba Intelligent Power Device Silicon Monolithic Power MOS Integrated Circuit

TPD1030F

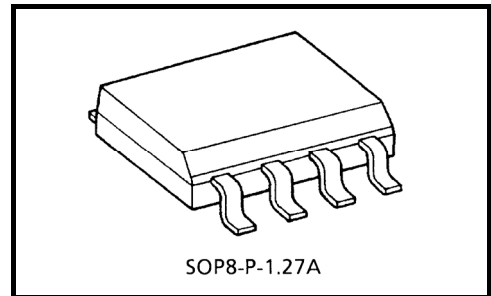
2-IN-1 Low-Side Switch for Motor, Solenoid and Lamp Drive

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.

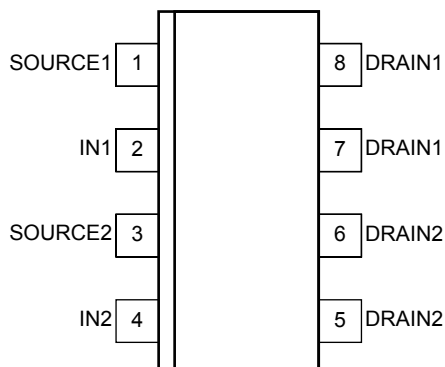
Features

- 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) (@ $V_{IN} = 5 V$, $I_D = 0.5 A$, $T_{ch} = 25^\circ C$)
- 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 packing.

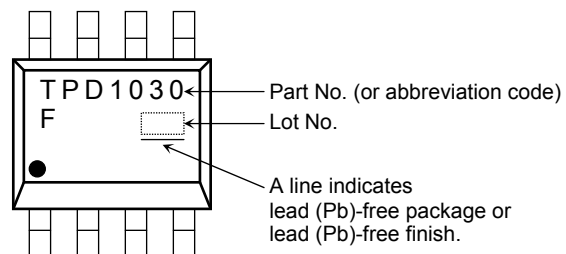


Weight: 0.08 g (typ.)

Pin Assignment (top view)

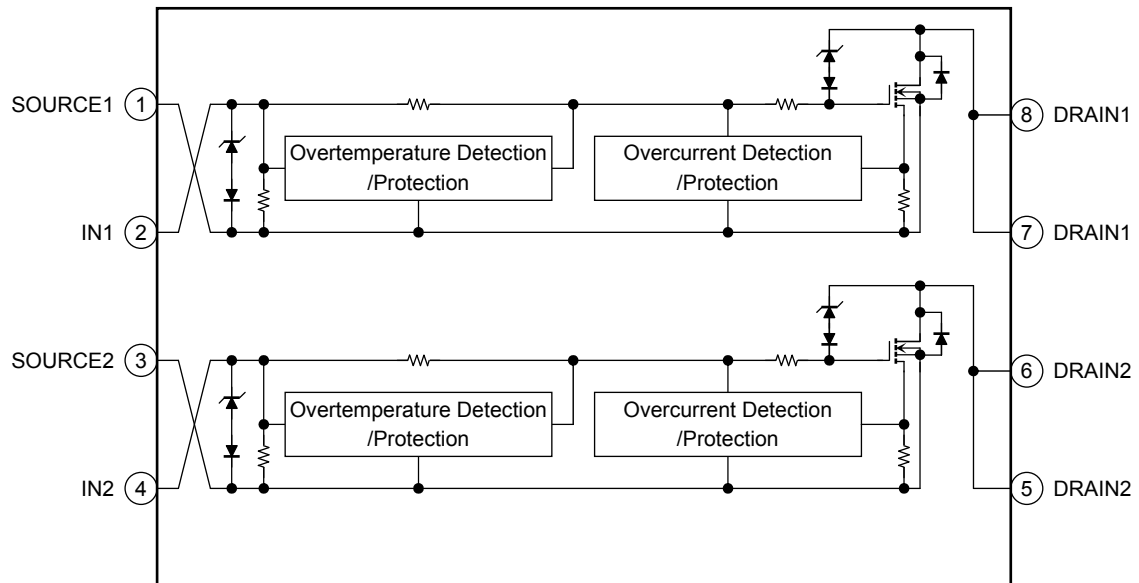


Marking



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

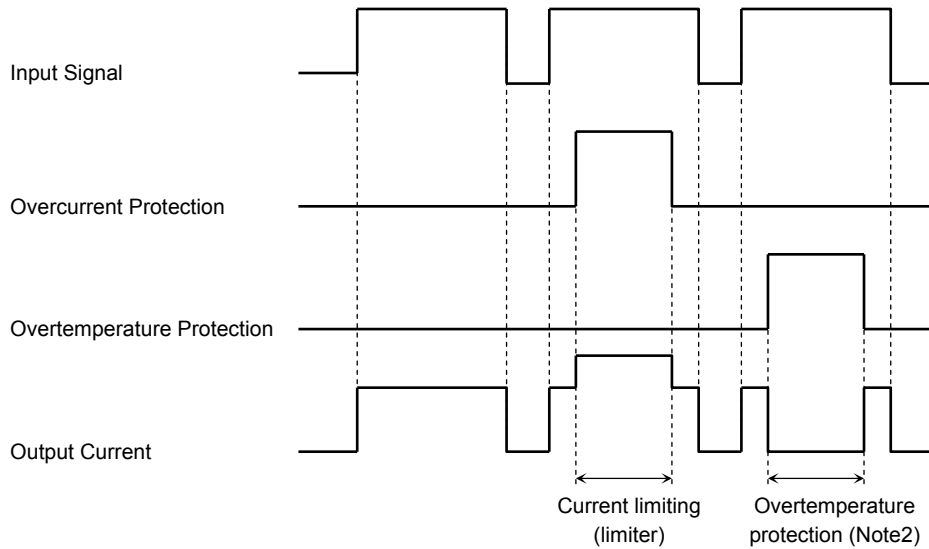
Block Diagram



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 × 25.4mm × 0.8mm] (with the two devices operating)

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

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

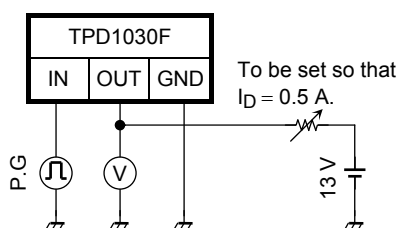
Electrical Characteristics

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

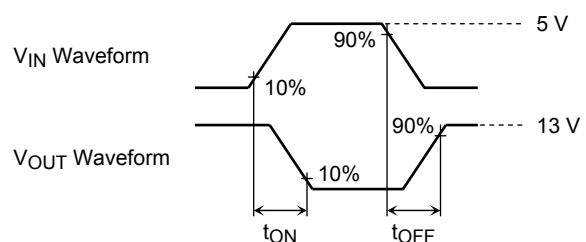
Test Circuit 1

Switching time measuring circuit

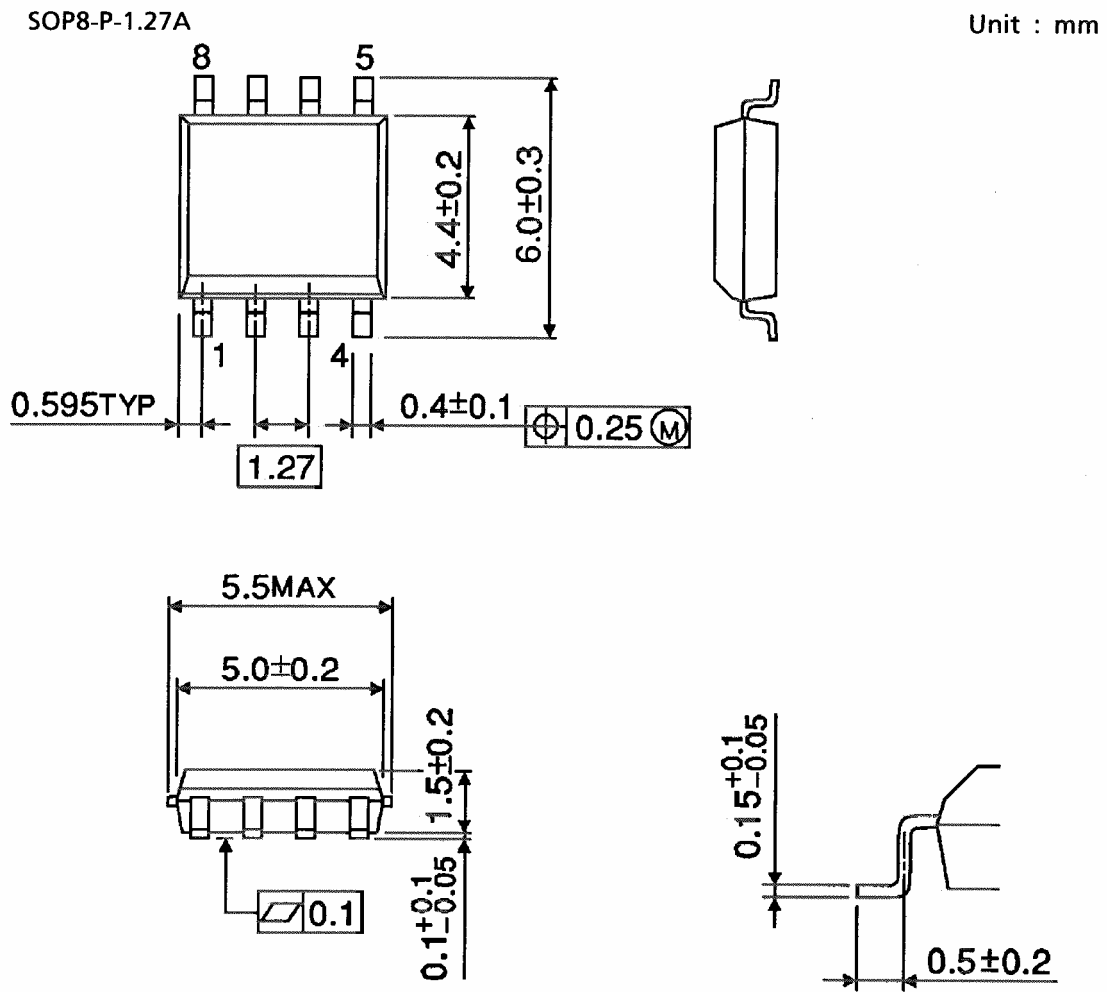
Test Circuit



Measured Waveforms



Package Dimensions



Weight: 0.08 g (typ.)

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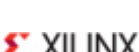
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