

## Preliminary

Toshiba Intelligent Power Device Silicon Monolithic Power MOS Integrated Circuit

# TPD1035F

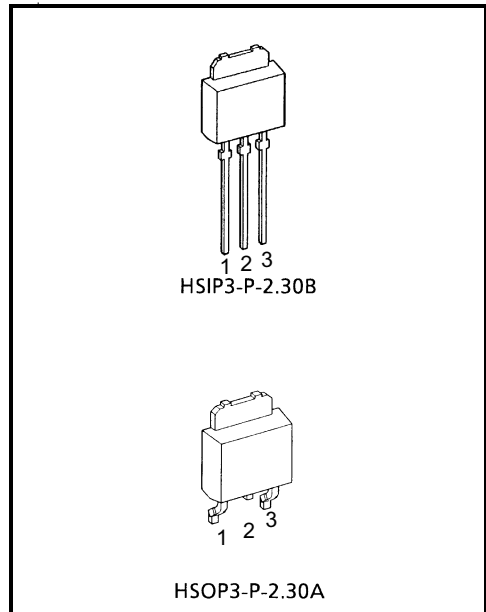
Low-Side Power Switch for Motor, Solenoid and Lamp Drivers

TPD1035F is a 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 offers intelligent self-protection functions.

## Features

- A monolithic power IC with a new structure combining a control block and a vertical power MOSFET ( $L^2$ - $\pi$ -MOS) on a single 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)  
(@ $V_{IN} = 0 \text{ V}$ ,  $V_{DS} = 30 \text{ V}$ ,  $T_{ch} = 25^\circ\text{C}$ )
- Low Input Current:  $I_{IN} = 300 \mu\text{A}$  (max)  
(@ $V_{IN} = 5 \text{ V}$ ,  $T_{ch} = 25^\circ\text{C}$ )
- 3-pin package for surface mounting can be packed in tape.

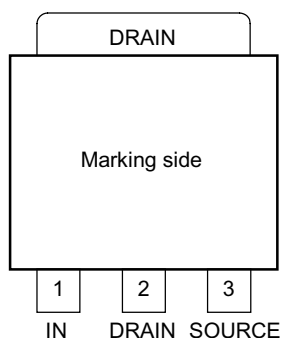


Weight

HSIP3-P-2.30B: 0.36 g (typ.)

HSOP3-P-2.30A: 0.28 g (typ.)

## Pin Assignment (top view)



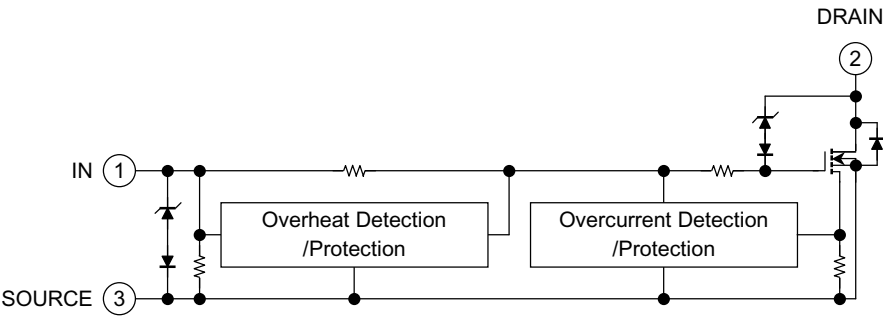
Note1: That because of its MOS structure, this product is sensitive to static electricity.

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Block Diagram

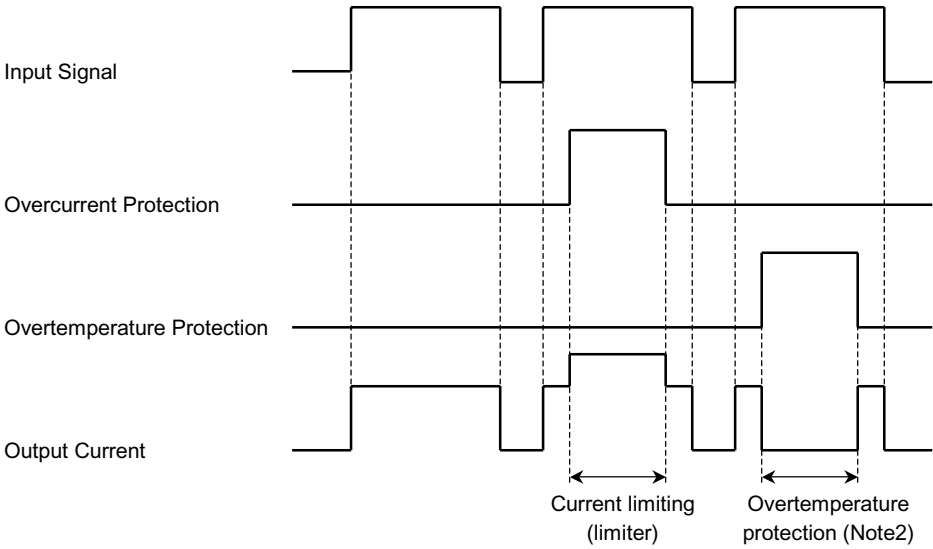


Pin Description

| Pin No. | Symbol | Pin Description   |
|---------|--------|---|
| 1       | IN     | Input pin<br>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. |
| 2       | DRAIN  | Drain pin<br>Drain current is limited (by current limiter) if it exceeds 3 A (min) in order to protect the IC.  |
| 3       | SOURCE | Source pin  |

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**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                |                 |

**Maximum Ratings (Ta = 25°C)**

| Characteristics       |                       | Symbol               | Rating             | Unit |
|-----------------------|-----------------------|----------------------|--------------------|------|
| Drain-source voltage  |                       | V <sub>DS</sub> (DC) | 20                 | V    |
| Drain current         |                       | I <sub>D</sub>       | Internally Limited | A    |
| Input voltage         |                       | V <sub>IN</sub>      | −0.3 to 7          | V    |
| Power dissipation     | T <sub>c</sub> = 25°C | P <sub>D</sub>       | 10                 | W    |
|                       | T <sub>a</sub> = 25°C |                      | 1                  |      |
| 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   |

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### Thermal Characteristics

| Characteristics                        | Symbol         | Max  | Unit |
|--|----------------|------|------|
| Thermal resistance, channel to case    | $R_{th(ch-c)}$ | 12.5 | °C/W |
| Thermal resistance, channel to ambient | $R_{th(ch-a)}$ | 125  | °C/W |

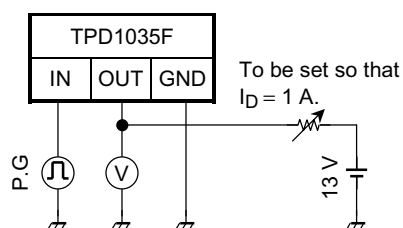
### Electrical Characteristics ( $T_{ch} = 25^{\circ}\text{C}$ )

| Characteristics                                  | Symbol        | Test Circuit | Test Condition   | Min | Typ. | Max | Unit          |
|--|---------------|--------------|--|-----|------|-----|---------------|
| Drain-source clamp voltage                       | $V_{(CL)DSS}$ | —            | $V_{IN} = 0\text{ V}$ , $I_D = 1\text{ mA}$                            | 40  | —    | 60  | V             |
| Input threshold voltage                          | $V_{th}$      | —            | $V_{DS} = 13\text{ V}$ , $I_D = 10\text{ mA}$                          | 1.0 | —    | 2.8 | V             |
| Protective circuit operation input voltage range | $V_{IN(opr)}$ | —            | —  | 3   | —    | 7   | V             |
| Drain cut-off current                            | $I_{DSS}$     | —            | $V_{IN} = 0\text{ V}$ , $V_{DS} = 30\text{ V}$                         | —   | —    | 10  | $\mu\text{A}$ |
| Input current                                    | $I_{IN(1)}$   | —            | $V_{IN} = 5\text{ V}$ , at normal operation                            | —   | —    | 300 | $\mu\text{A}$ |
|  | $I_{IN(2)}$   | —            | $V_{IN} = 5\text{ V}$ , when protective circuit is actuated            | —   | —    | 390 |               |
| Drain-source on resistance                       | $R_{DS(ON)}$  | —            | $V_{IN} = 5\text{ V}$ , $I_D = 1\text{ A}$                             | —   | 0.25 | 0.4 | $\Omega$      |
| Overtemperature protection                       | $T_S$         | —            | $V_{IN} = 5\text{ V}$  | 150 | 160  | —   | °C            |
| Overcurrent protection                           | $I_S$         | —            | $V_{IN} = 5\text{ V}$  | 3   | —    | —   | A             |
| Switching time                                   | $t_{ON}$      | 1            | $V_{DD} = 13\text{ V}$ , $V_{IN} = 5\text{ V}$ ,<br>$I_D = 1\text{ A}$ | —   | —    | 30  | $\mu\text{s}$ |
|  | $t_{OFF}$     | 1            |  | —   | —    | 60  |               |
| Source-drain diode forward voltage               | $V_{DSF}$     | —            | $I_F = 3\text{ A}$ , $V_{IN} = 0\text{ V}$                             | —   | —    | 1.7 | V             |

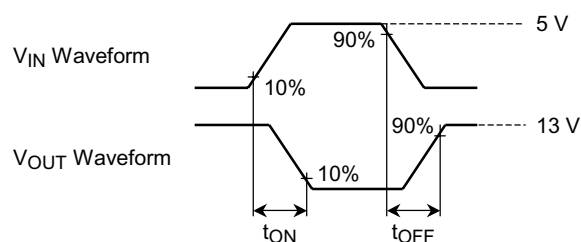
### Test Circuit 1

Switching time measuring circuit

#### Test Circuit



#### Measured Waveforms

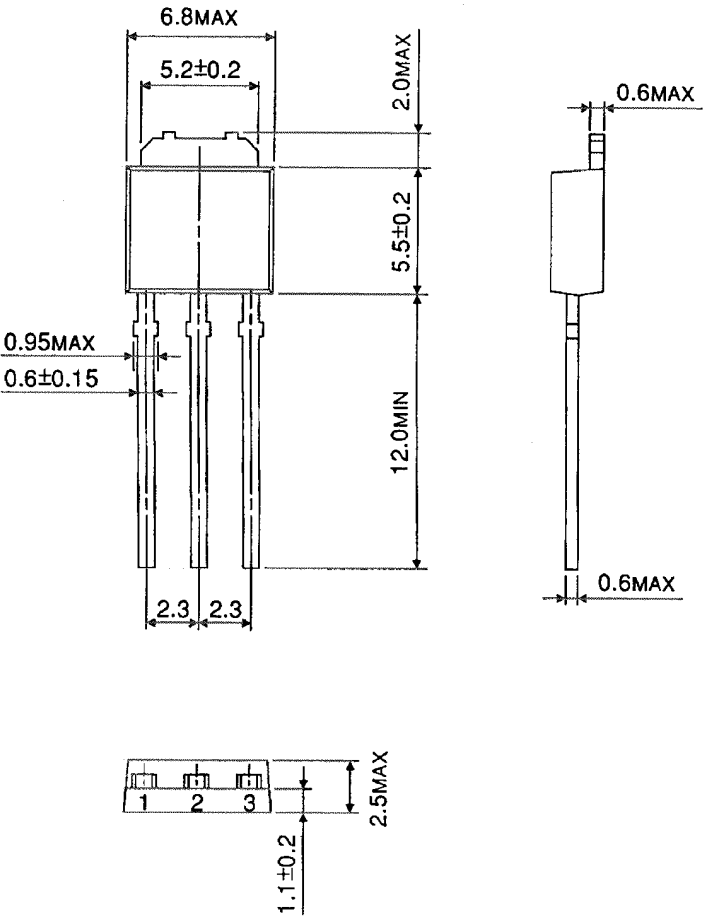


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Package Dimensions

HSIP3-P-2.30B

Unit : mm

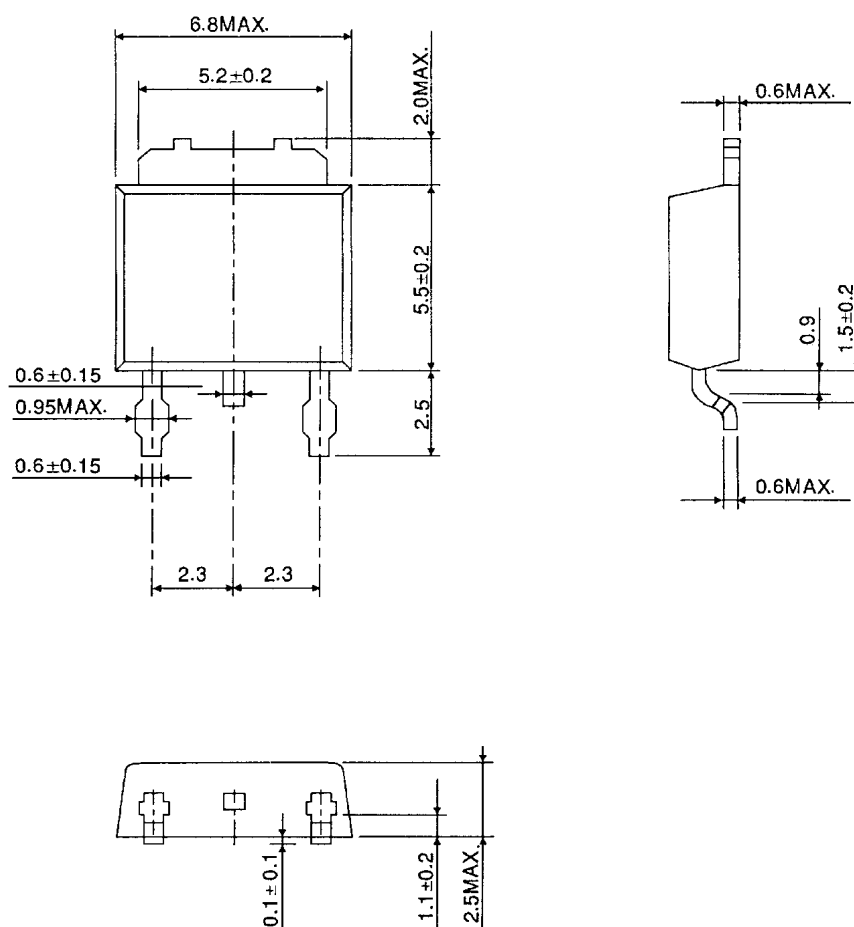


Weight: 0.36 g (typ.)

**Package Dimensions**

HSOP3-P-2.30A

Unit : mm



Weight: 0.28 g (typ.)