

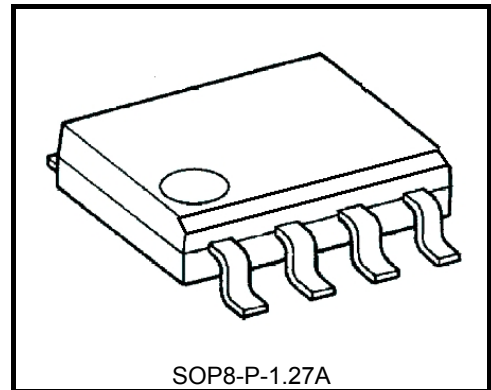
TPD1039F

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

The TPD1039F is a monolithic power IC intended for low-side load switching applications. The output has a vertical MOSFET, and the input can be directly driven from CMOS or TTL logic (e.g., an MPU). The TPD1039F provides intelligent protection functions.

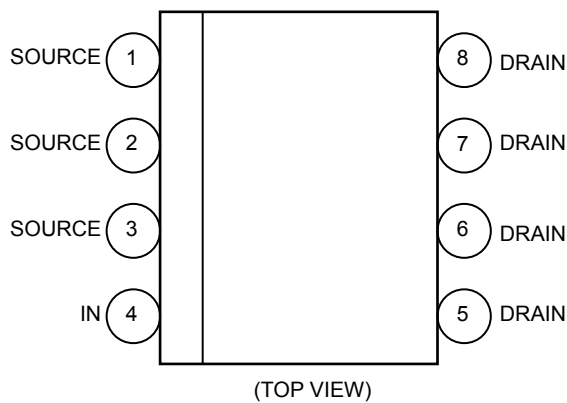
Features

- A structure that incorporates control circuitry and a vertical power MOSFET on a single chip.
- Can be directly driven from a microprocessor, a CMOS logic IC, etc.
- Overvoltage, overtemperature and overcurrent protections
- Low ON-resistance: $R_{DS(ON)} = 0.25 \Omega$ (max) (@ $V_{IN} = 5 V$, $I_D = 1 A$, $T_{ch} = 25^\circ C$)
- Housed in the 8-pin SOP package and supplied in embossed carrier tape.

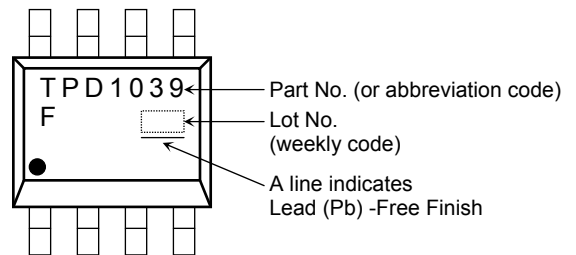


Weight: 0.08 g (typ.)

Pin Assignment (top view)

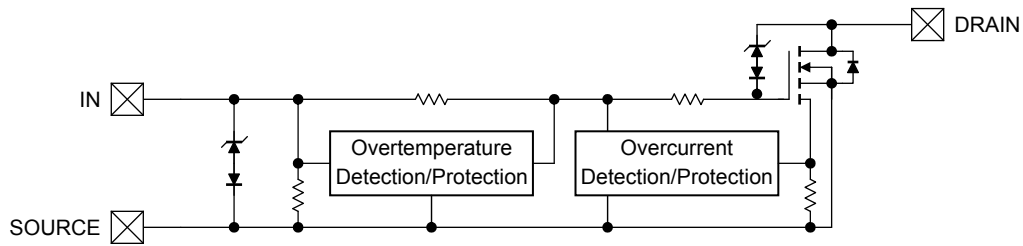


Marking



Note: This product has a MOS structure and is sensitive to electrostatic discharge.

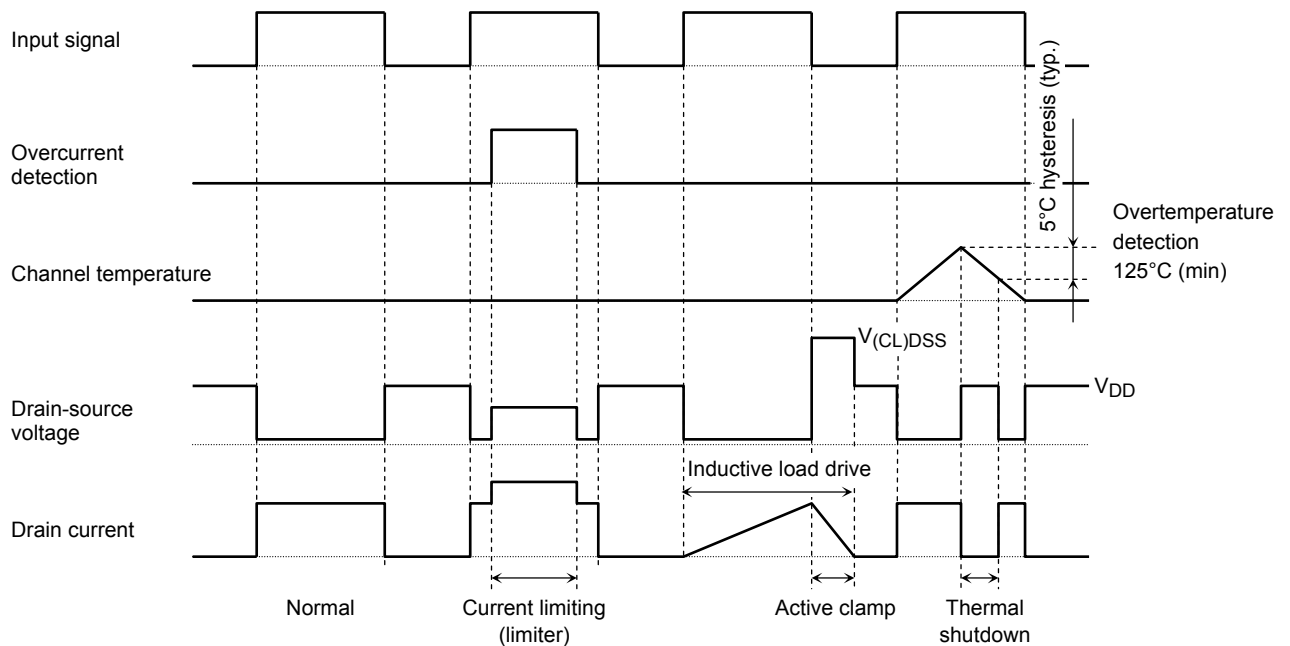
Block Diagram



Pin Description

| Pin No. | Symbol | Pin Description |
|------------|--------|--|
| 1, 2, 3 | SOURCE | Source (ground) pins. |
| 4 | IN | Input pin. This pin is connected to a pull-down resistor internally, so that even if the input is open-circuited, the output never turns on inadvertently. |
| 5, 6, 7, 8 | DRAIN | Drain pins. The output current is limited to 5 A (typ.) even if an excessive current flows into a device due to an in-rush current of a lamp or load short-circuit. |

Timing Chart



Truth Table

| V_{IN} | V_{DS} | Output State | Operating State |
|----------|----------|---------------------------|----------------------|
| L | H | Off | Normal |
| H | L | On | |
| L | H | Off | Load short-circuited |
| H | H | Current limiting(limiter) | |
| L | H | Off | Overtemperature |
| H | H | Off | |

Absolute Maximum Ratings (Ta = 25°C)

| Characteristics | Symbol | Rating | Unit |
|--|---------------|--------------|------|
| Drain-source voltage | V_{DS} (DC) | 45 | V |
| Drain current | I_D (DC) | 1.5 | A |
| Input voltage | V_{IN} | -0.5 to 6 | V |
| Power dissipation (Note 2-a) | $P_{D(1)}$ | 1.1 | W |
| Power dissipation (Note 2-b) | $P_{D(2)}$ | 0.425 | W |
| Single pulse active clamp capability (Note 3) | E_{AS} | 20 | mJ |
| Active clamp current | I_{AR} | 1.5 | A |
| Repetitive active clamp capability (Note 2-a) (Note 4) | E_{AR} | 0.11 | mJ |
| Operating temperature | T_{opr} | -40 to 85 | °C |
| Channel temperature | T_{ch} | 150 (Note 5) | °C |
| Storage temperature | T_{stg} | -55 to 150 | °C |

Note 1: 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.

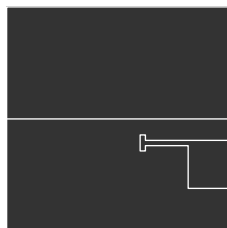
Please design the appropriate reliability upon reviewing the Toshiba Semiconductor Reliability Handbook (“Handling Precautions”/“Derating Concept and Methods”) and individual reliability data (i.e. reliability test report and estimated failure rate, etc).

Thermal Characteristics

| Characteristics | Symbol | Rating | Unit |
|--|----------------|------------------|-------|
| Thermal resistance, channel to ambient | $R_{th(ch-a)}$ | 113.5 (Note 2-a) | °C /W |
| | | 294.0 (Note 2-b) | |

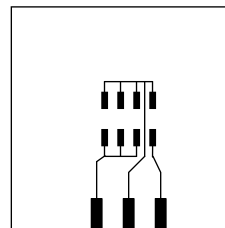
Note 2:

2-a: glass epoxy board (a)



FR-4
25.4 × 25.4 × 0.8
(unit: mm)

2-b: glass epoxy board (b)



FR-4
25.4 × 25.4 × 0.8
(unit: mm)

Note 3: Active clamp capability (single pulse) test condition

$$V_{DD} = 25 \text{ V}, T_{ch} = 25^\circ\text{C} \text{ (initial)}, L = 10 \text{ mH}, I_{AR} = 1.5 \text{ A}, R_G = 25 \Omega$$

Note 4: Repetitive rating: Pulse width limited by maximum channel temperature

Note 5: Overtemperature protection is tripped at a channel temperature of 125°C.

Ensure that the channel temperature, T_{ch} , does not exceed 125°C under the worst-case conditions.

Electrical Characteristics (T_{ch} = 25°C)

| Characteristics | Symbol | Test Circuit | Test Condition | Min | Typ. | Max | Unit |
|--|----------------------|--------------|---|-----|------|------|------|
| Drain-source clamp voltage | V _{(CL)DSS} | - | V _{IN} = 0 V, I _D = 1 mA | 45 | - | - | V |
| High-level input voltage | V _{IH} | 1 | V _{DS} = 10 to 40 V, I _D ≥ 1 A | 3.5 | - | 6 | V |
| Low-level input voltage | V _{IL} | 1 | V _{DS} = 10 to 40 V, I _D ≤ 10μA | - | - | 0.8 | |
| Drain cut-off current | I _{DSS} | - | V _{IN} = 0 V, V _{DS} = 40 V | - | - | 10 | μA |
| High-level input current | I _{IH} | - | V _{IN} = 5 V, at normal operation | - | - | 400 | μA |
| Drain-source ON-resistance | R _{DS(ON)} | - | V _{IN} = 5 V, I _D = 1 A | - | - | 0.25 | Ω |
| Protective circuit operation input Voltage range | V _{IN(opr)} | - | - | 3.5 | - | 6 | V |
| Overtemperature detection (Note 6) | T _{OT} | 2 | V _{IN} = 5 V, V _{DD} = 12 V | 125 | - | - | °C |
| Overcurrent detection | I _{OC} | 3 | V _{IN} = 5 V, V _{DS} = 24 V | - | 5 | - | A |
| Switching times | t _{on} | 4 | V _{DD} = 24 V, V _{IN} = 0 V/5 V, R _L = 24Ω | - | 15 | - | μs |
| | t _{off} | | | - | 45 | - | |
| Drain-source diode forward Voltage | V _{DSF} | - | V _{IN} = 0 V, I _{DR} = 1.5 A | - | 0.9 | 1.8 | V |

Note 6: Overtemperature protection is tripped at a channel temperature of 125°C.

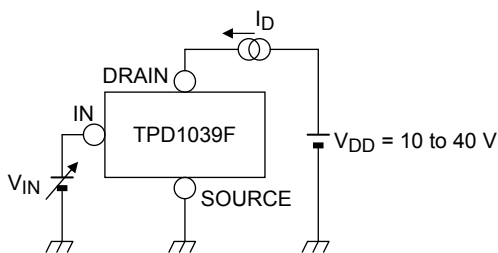
Ensure that the channel temperature, T_{ch}, does not exceed 125°C under the worst-case conditions.

This feature is intended to protect the device against damage. The device reliability is not guaranteed if the device persists to remain overtemperature protection mode.

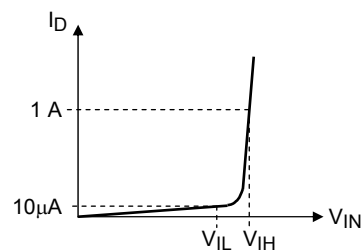
Test Circuit 1

H-level input voltage, L-level input voltage measuring circuit

Test circuit



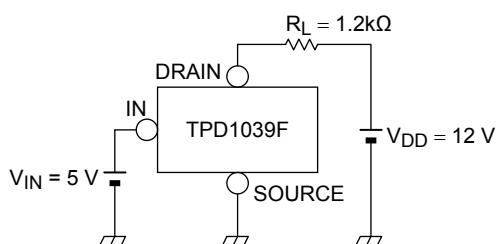
Measured waveforms



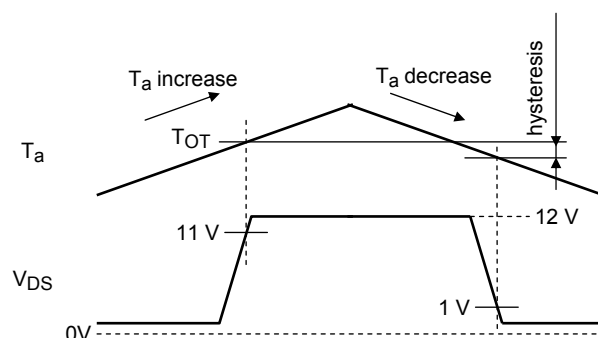
Test Circuit 2

Overtemperature detection measuring circuit

Test circuit



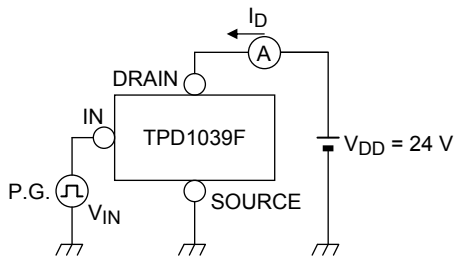
Measured waveforms



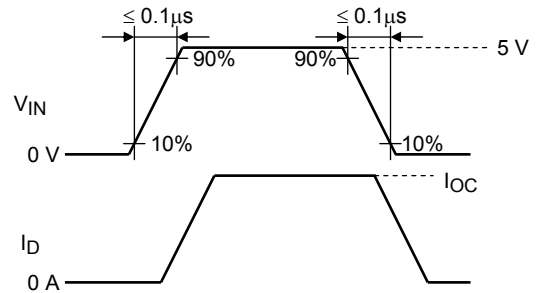
Test Circuit 3

Overcurrent detection circuit

Test circuit



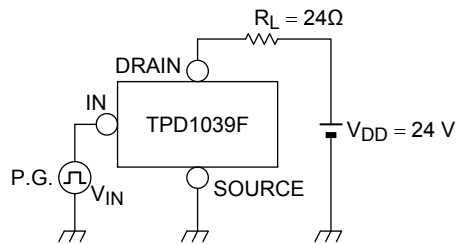
Measured waveforms



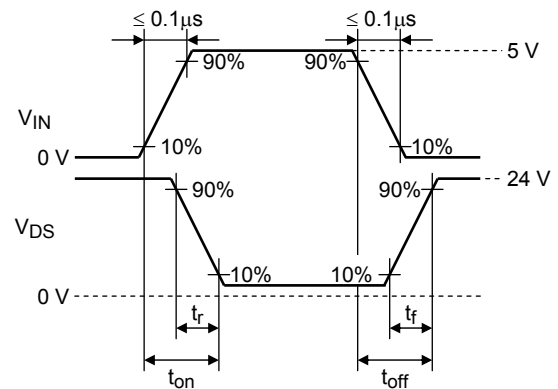
Test Circuit 4

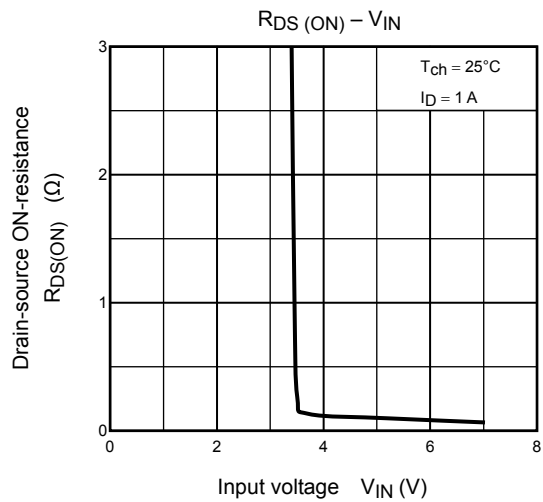
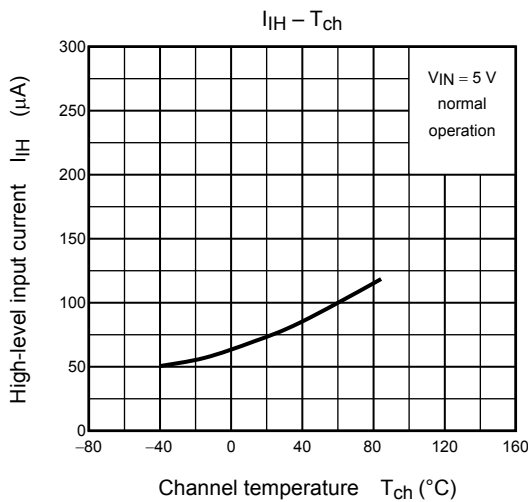
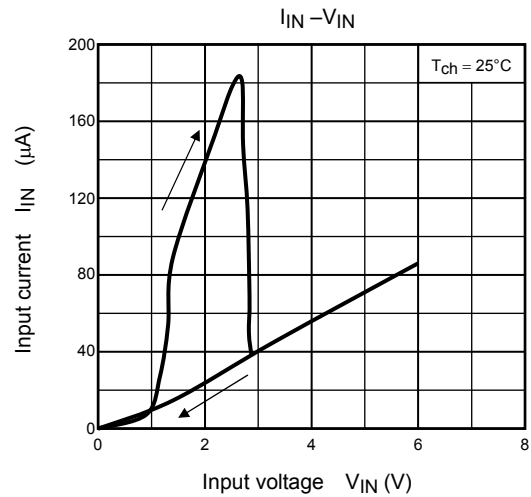
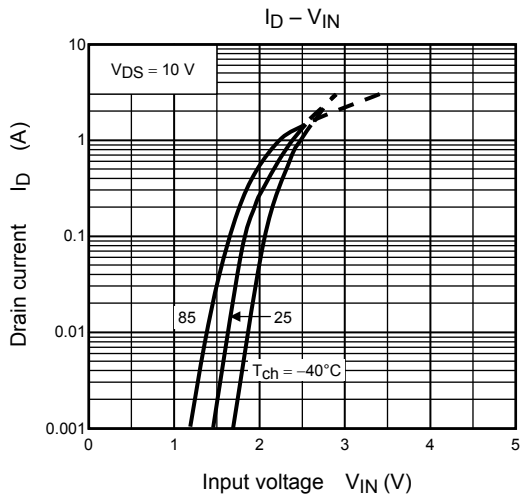
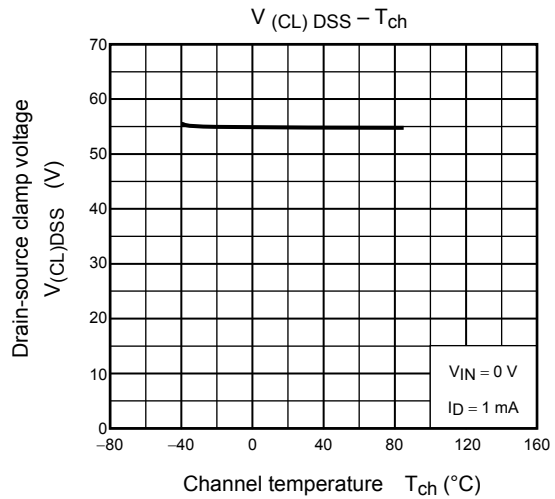
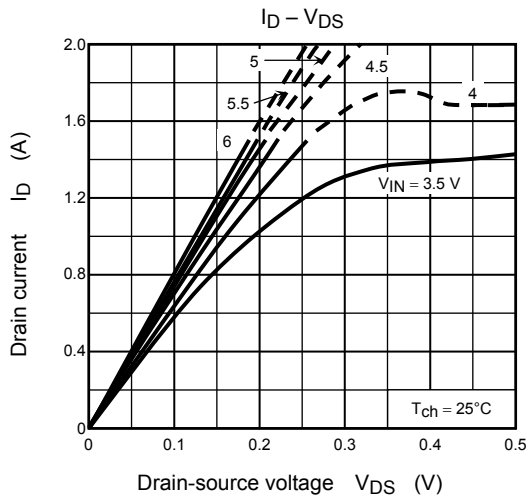
Switching time measuring circuit

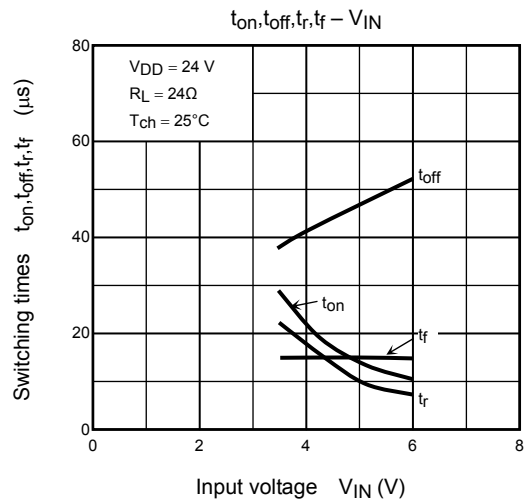
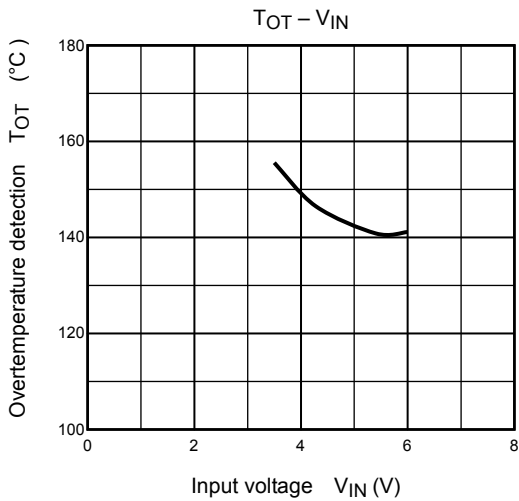
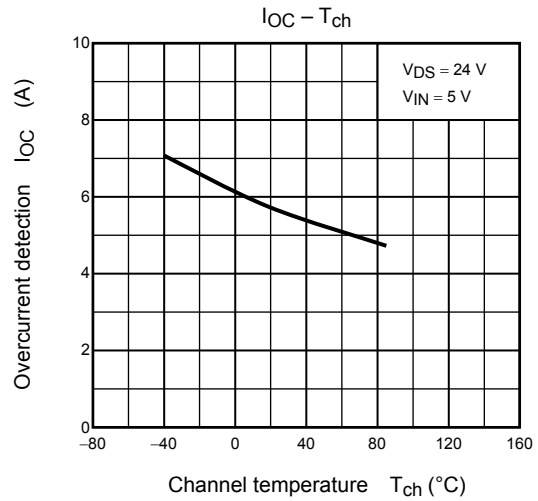
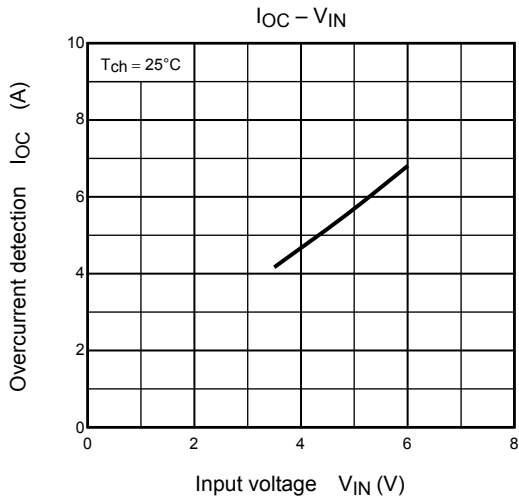
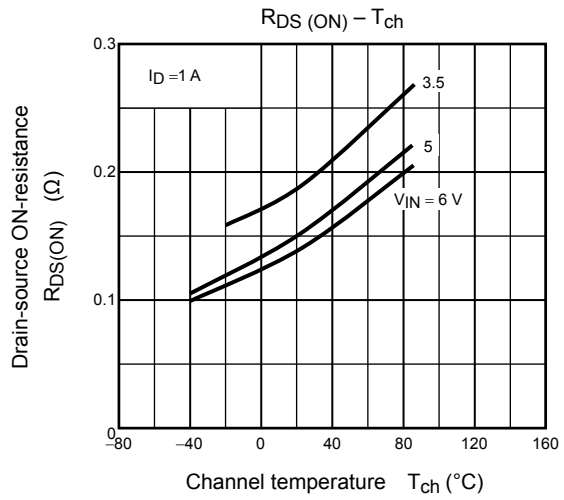
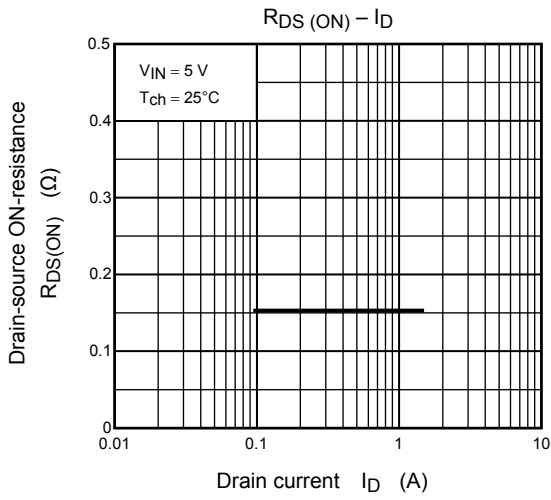
Test circuit

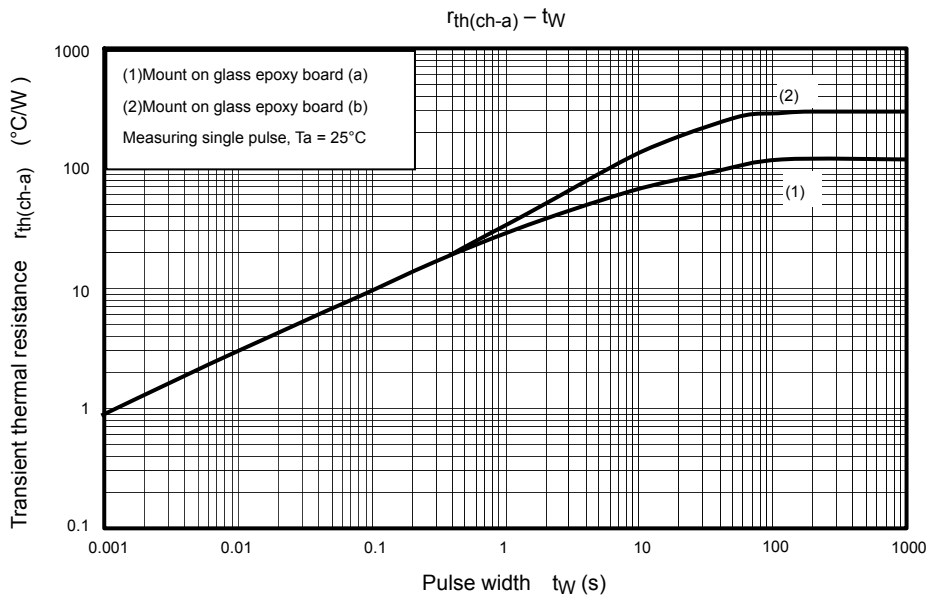
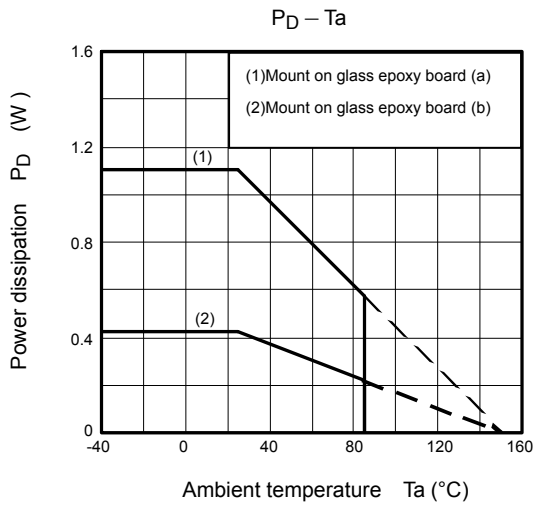


Measured waveforms

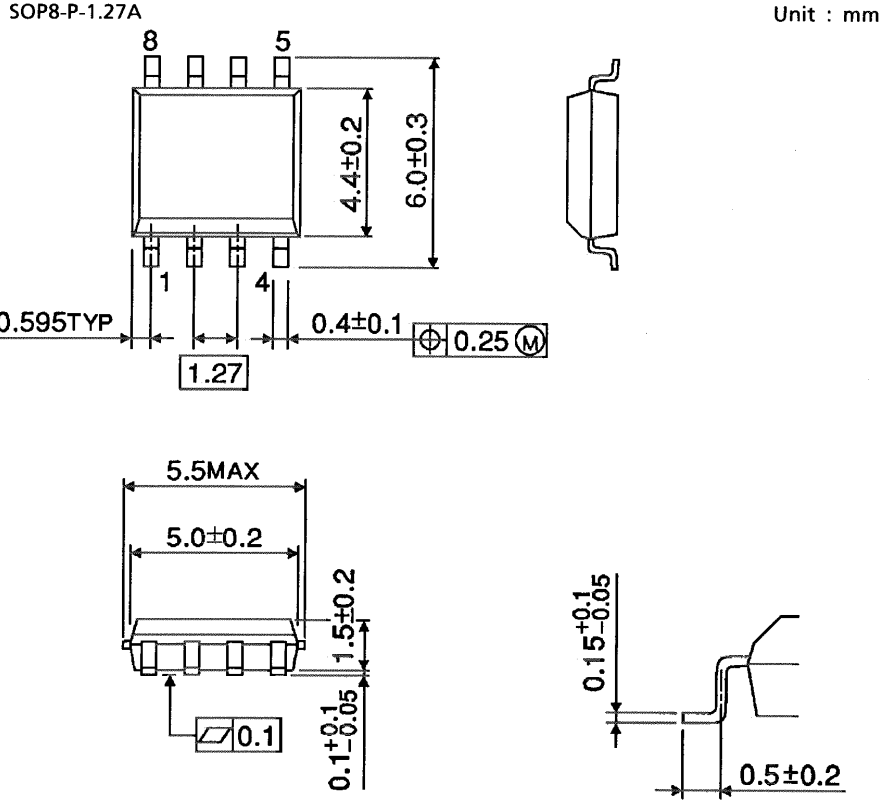








Package Dimensions



Weight: 0.08 g (typ.)

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20070701-EN GENERAL

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