

Toshiba Intelligent Power Device Silicon Monolithic Power MOS Integrated Circuit

TPD1044F

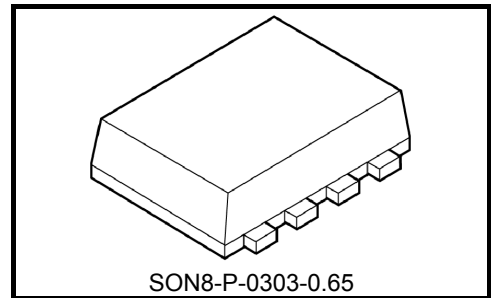
Low-Side Switch for Motor, Solenoid and Lamp Drive

The TPD1044F 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 is equipped with intelligent self-protection functions.

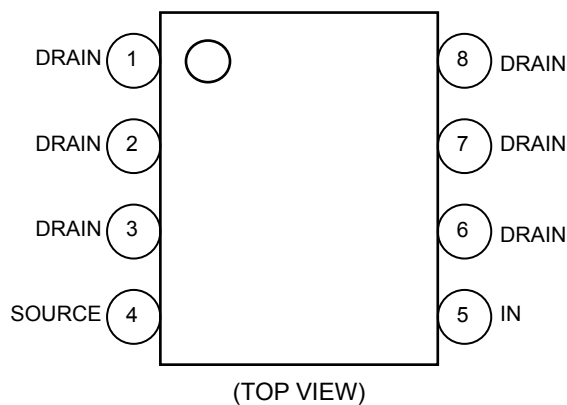
Features

- A monolithic power IC with a new structure combining a control block and a vertical power MOSFET (L²-π-MOSV) on 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: $R_{DS(ON)} = 0.6 \Omega$ (max) (@ $V_{IN} = 5 \text{ V}$, $I_D = 0.5 \text{ A}$, $T_{ch} = 25^\circ\text{C}$)
- 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) (@ $V_{IN} = 5 \text{ V}$, $T_{ch} = 25^\circ\text{C}$)
- “PS-8” package with embossed-tape packing.

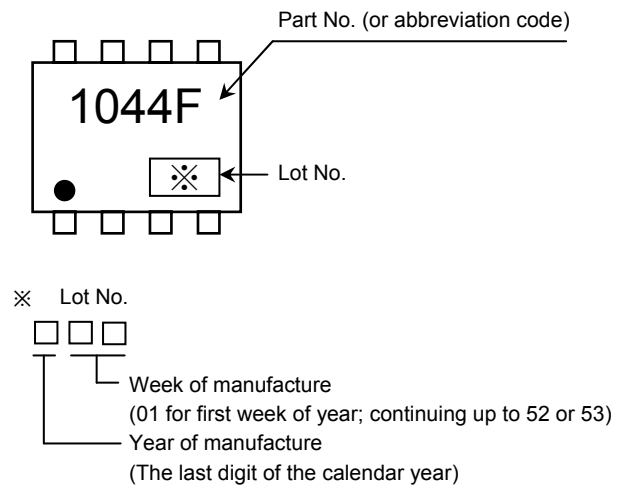


Weight: 0.017 g (typ.)

Pin Assignment (top view)



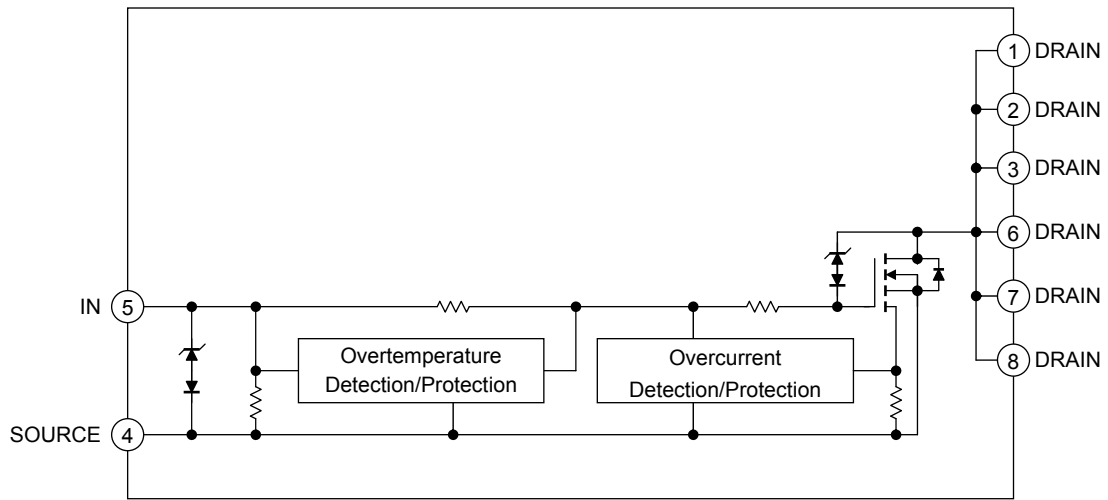
Marking



Note 1: Due to its MOS structure, this product is sensitive to static electricity.

Start of commercial production
2003-09

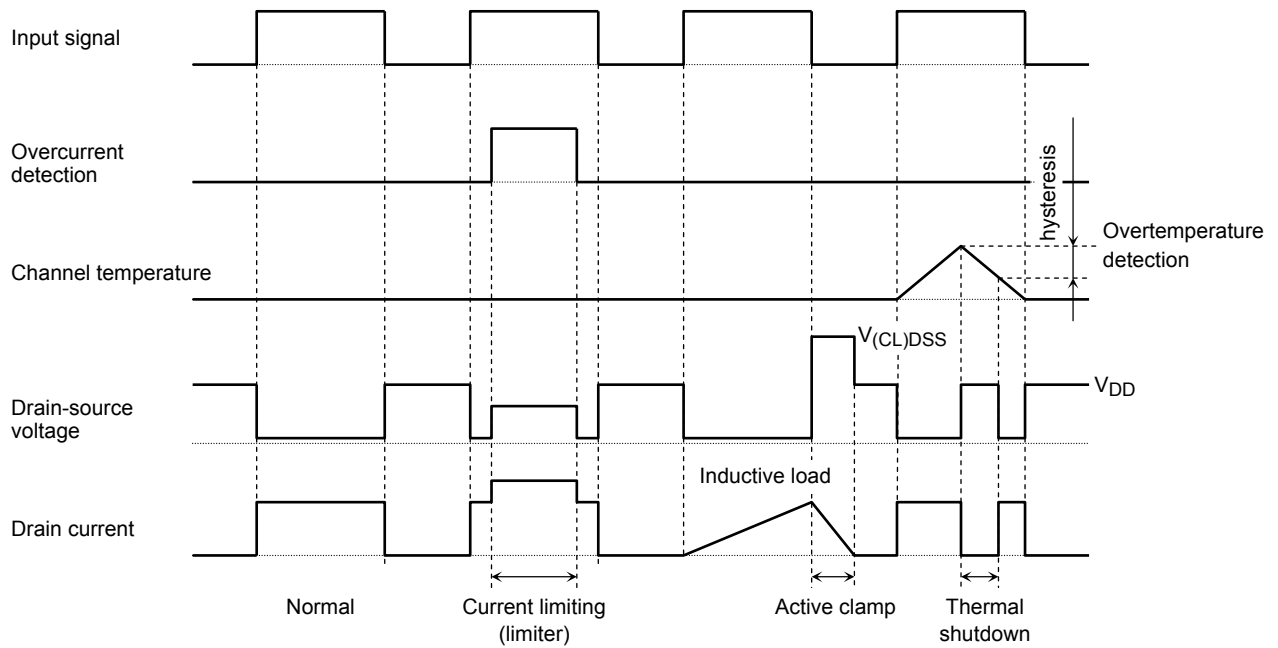
Block Diagram



Pin Description

| Pin No. | Symbol | Pin Description |
|-------------|--------|--|
| 1,2,3,6,7,8 | DRAIN | Drain current is limited (by current limiter) if it exceeds 1 A (min) in order to protect the IC. |
| 4 | SOURCE | Source pin. |
| 5 | IN | Input pin. 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. |

Timing chart



Note 2: The overtemperature detector circuits feature hysteresis. After overtemperature is detected, normal operation is restored only when the channel temperature falls by the hysteresis amount (5°C typ.) in relation to the overtemperature detection temperature.

Truth table

| IN | V _{DS} | Output state | Operating state |
|----|-----------------|---------------------------|-----------------------------|
| L | H | OFF | Normal |
| H | L | ON | |
| L | H | OFF | Overcurrent (load short) |
| 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 | $V_{DS(DC)}$ | 41 | V |
| Drain current | I_D | Internally Limited | A |
| Input voltage | V_{IN} | -0.3~7 | V |
| Power dissipation (Note 3) | P_D | 0.9 | W |
| Single pulse active clamp capability (Note 4) | E_{AS} | 125 | mJ |
| Active clamp current | I_{AR} | 1 | A |
| Repetitive active clamp capability (Note 5) | E_{AR} | 0.09 | mJ |
| Operating temperature | T_{opr} | -40~125 | °C |
| Channel temperature | T_{ch} | 150 | °C |
| Storage temperature | T_{stg} | -55~150 | °C |

Thermal Characteristics

| Characteristics | Symbol | Max | Unit |
|---|----------------|-------|------|
| Thermal resistance, channel to ambient (Note 3) | $R_{th(ch-a)}$ | 138.9 | °C/W |

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).

Note 3:

Drive operation: Mounted on glass epoxy board [25.4mm × 25.4mm × 0.8mm]



Note 4: Active clamp capability (single pulse) test condition

$V_{DD} = 40\text{ V}$, $T_{ch} = 25^\circ\text{C}$ (initial), $L = 50\text{ mH}$, $I_{AR} = 1\text{ A}$, $R_G = 25\ \Omega$

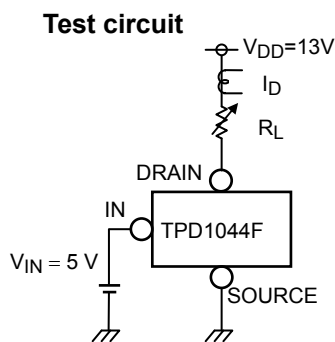
Note 5: Repetitive rating, pulse width limited by maximum channel temperature.

Electrical Characteristics(Ta = 25°C)

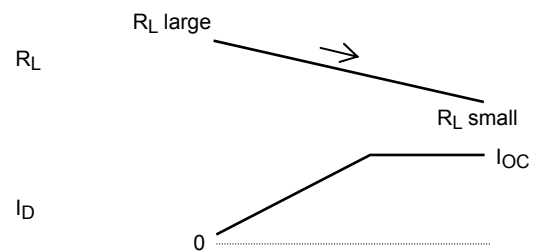
| Characteristics | Symbol | Test circuit | Test condition | Min | Typ. | Max | Unit |
|--|----------------|--------------|--|-----|------|-----|-------------|
| Drain-source clamp voltage | $V_{(CL) DSS}$ | - | $V_{IN} = 0 V, I_D = 1 mA$ | 41 | - | 60 | V |
| Input threshold voltage | V_{th} | - | $V_{DS} = 13 V, I_D = 10 mA$ | 1.0 | - | 2.8 | V |
| Protective circuit operation input voltage range | $V_{IN (opr)}$ | - | - | 3 | - | 6 | V |
| Drain cut-off current | I_{DSS} | - | $V_{IN} = 0 V, V_{DS} = 30 V$ | - | - | 10 | μA |
| Input current | $I_{IH (1)}$ | - | $V_{IN} = 5 V$, at normal operation | - | - | 300 | μA |
| | $I_{IH (2)}$ | - | $V_{IN} = 5 V$, when overcurrent protective circuit is actuated | - | - | 350 | |
| Drain-source on resistance | $R_{DS (ON)}$ | - | $V_{IN} = 5 V, I_D = 0.5 A$ | - | 0.44 | 0.6 | Ω |
| Overtemperature detection | T_{OT} | - | $V_{IN} = 5 V$ | 150 | 160 | - | $^{\circ}C$ |
| Overcurrent detection | I_{OC} | 1 | $V_{IN} = 5 V$ | 1.0 | 1.8 | - | A |
| Switching time | t_{on} | 2 | $V_{DD} = 13 V, V_{IN} = 0 V/5 V, I_D = 0.5 A$ | - | 10 | - | μs |
| | t_{off} | | | - | 15 | - | |

Test circuit 1

Overcurrent measuring circuit



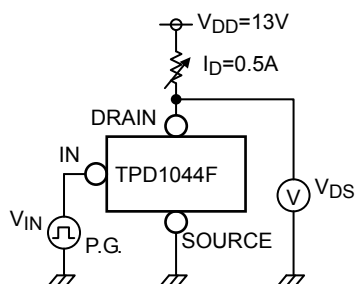
Measured waveforms



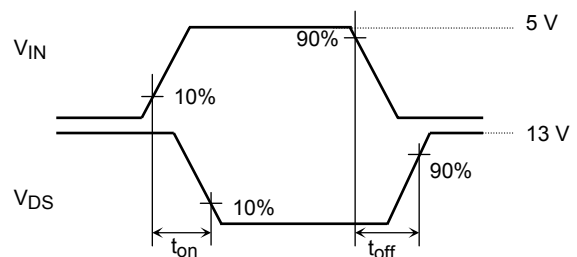
Test circuit 2

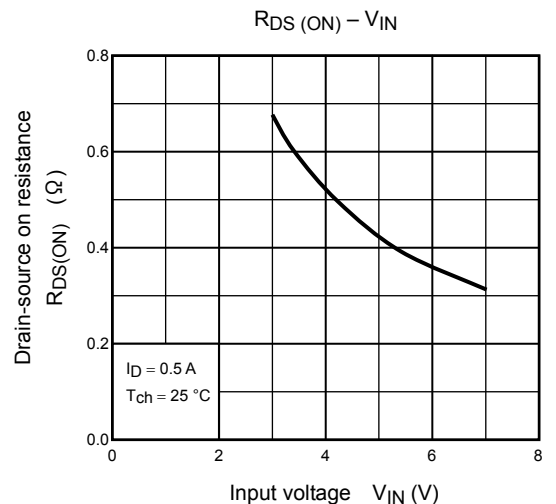
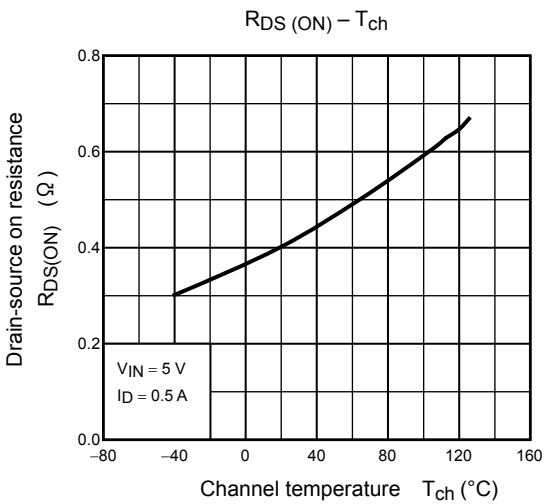
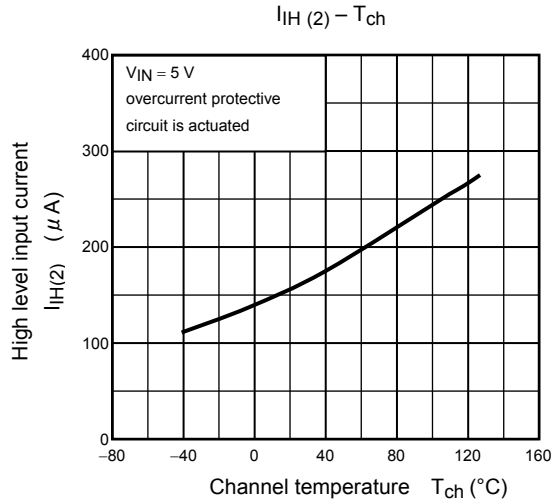
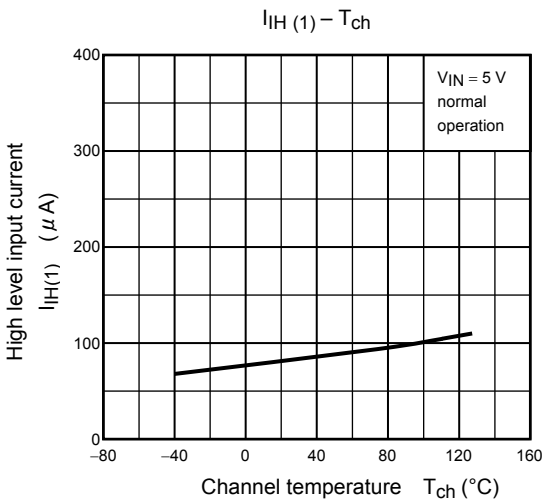
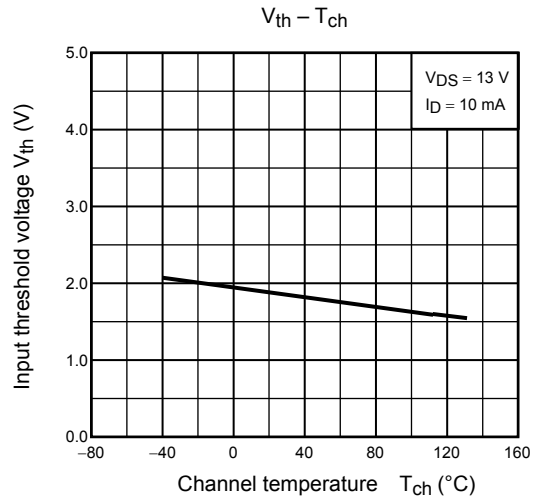
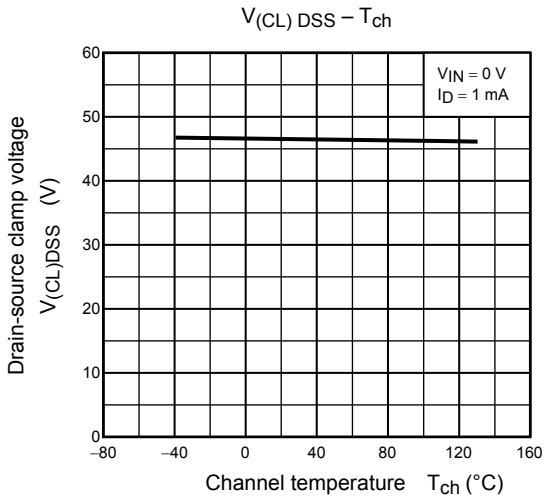
Switching time measuring circuit

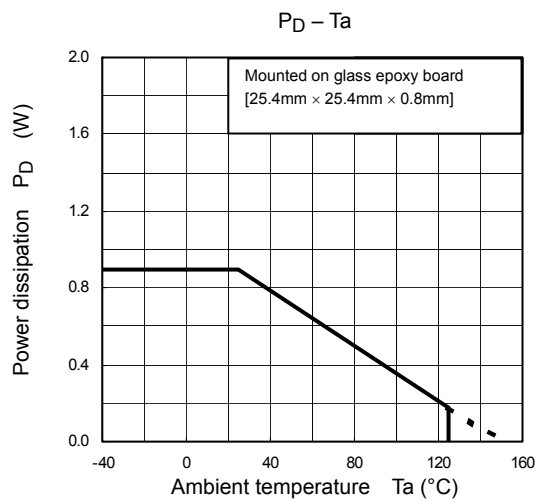
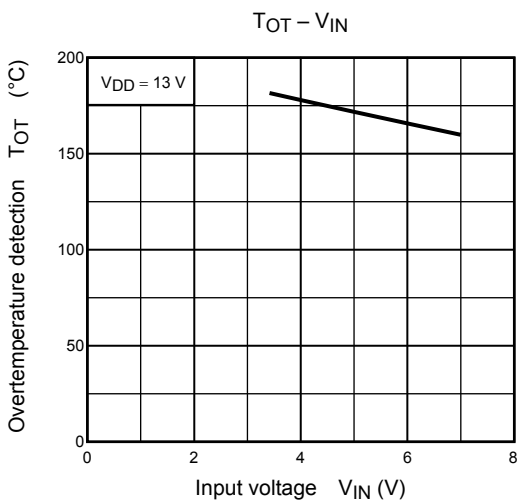
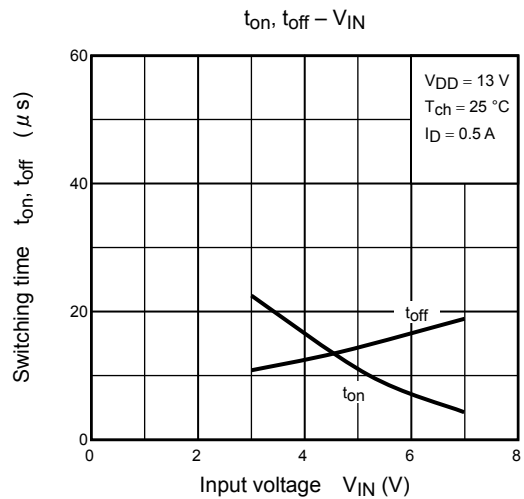
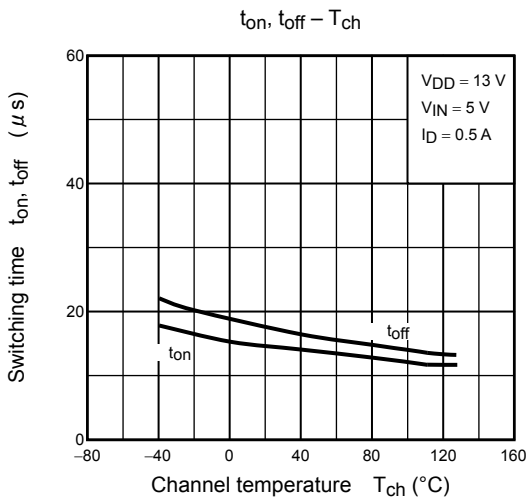
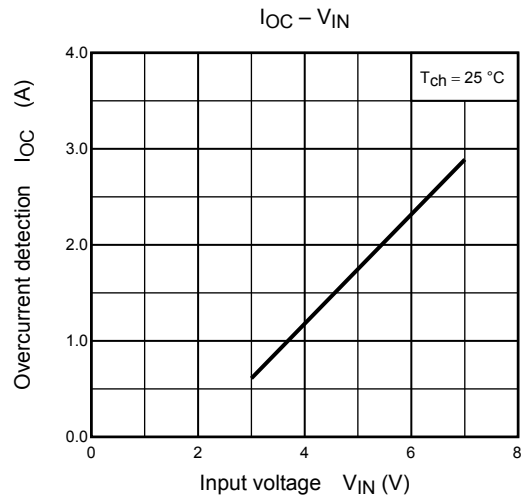
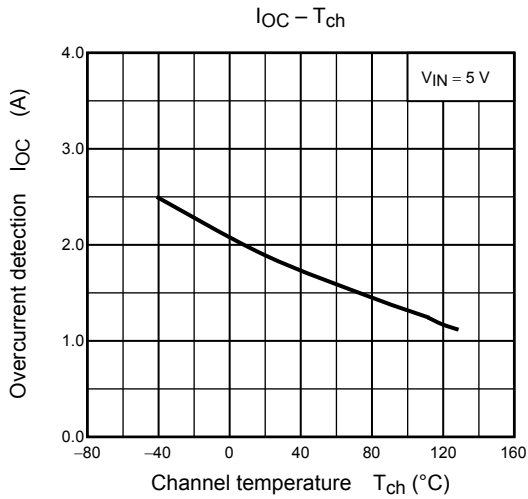
Test circuit

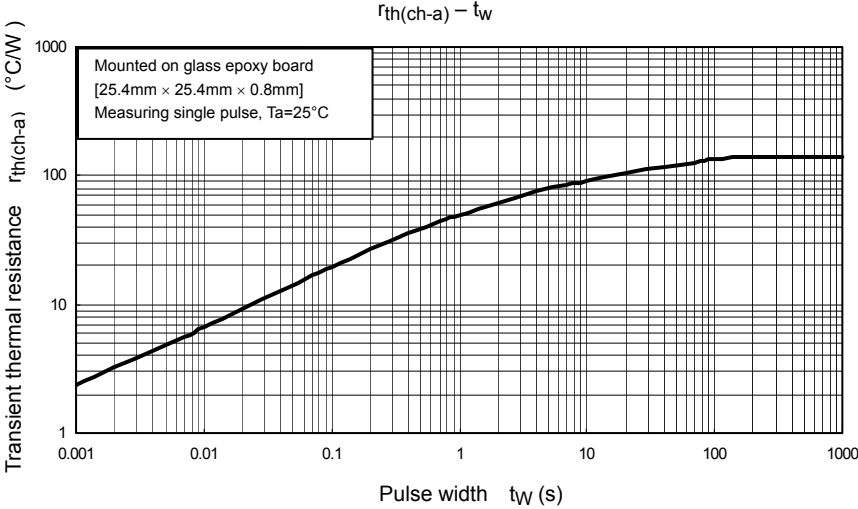


Measured waveforms





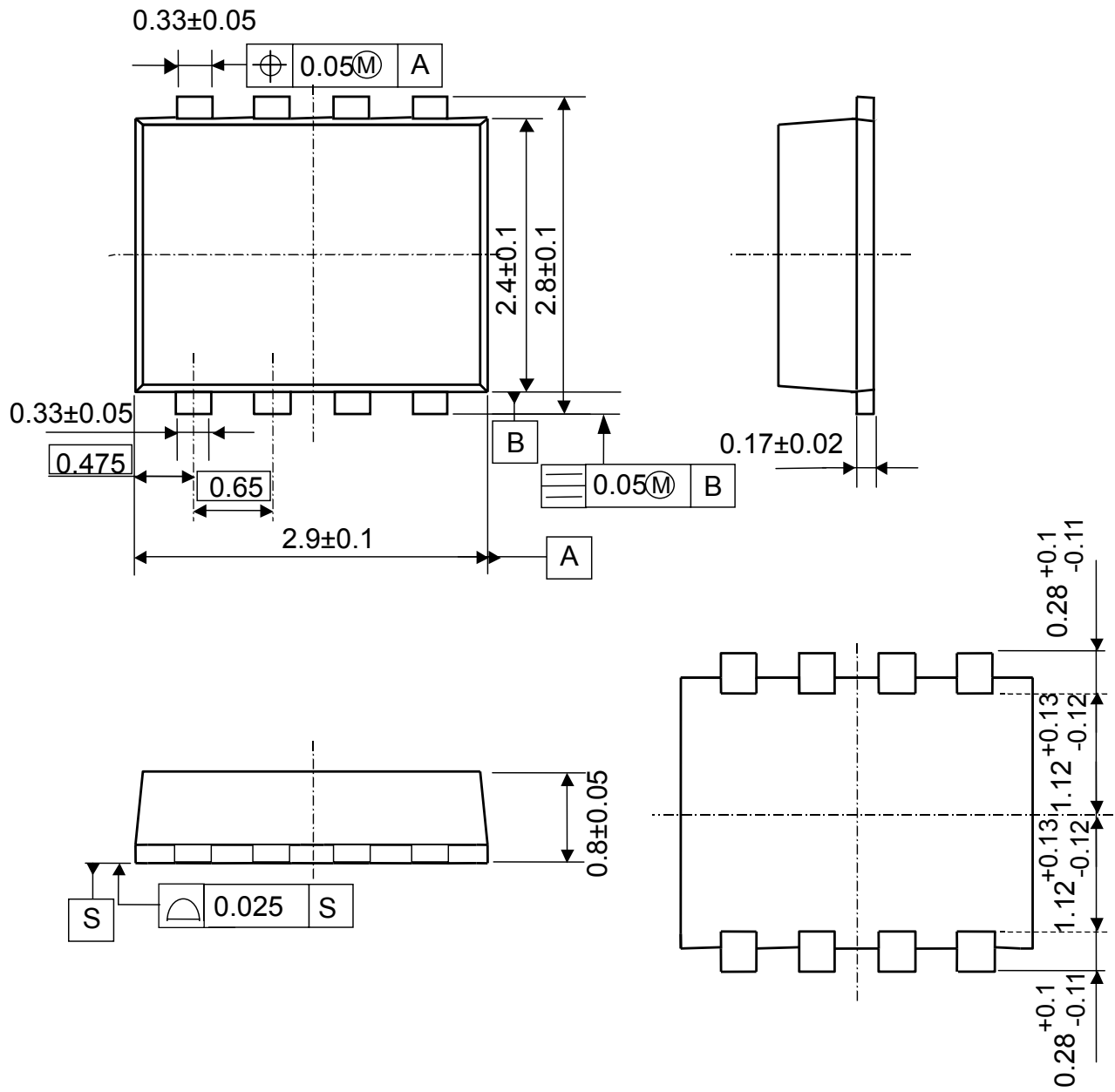




Package Dimensions

SON8-P-0303-0.65

Unit : mm



Weight: 0.017 g (Typ.)

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