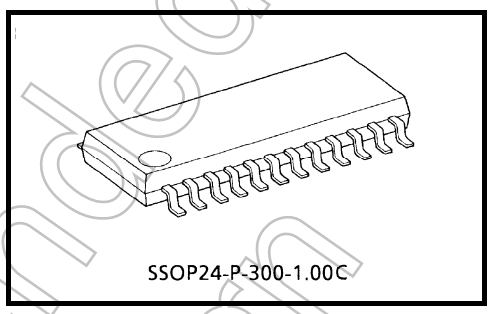
TOSHIBA Intelligent Power Device Silicon Monolithic Power MOS Integrated Circuit

# TPD2007F

## Low-Side Power Switch Array (8 Channels) for Motors, Solenoids, and Lamp Drivers

The TPD2007F is an 8-channel low-side switch array. The IC has a vertical MOSFET output which can be directly driven from a CMOS or TTL logic circuit (e.g., an MPU). It offers overcurrent and overtemperature protection functions.

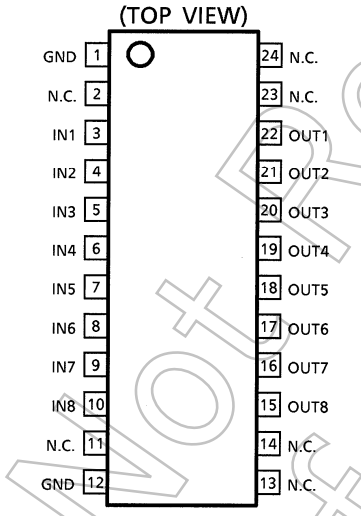



Weight: 0.29 g (typ.)

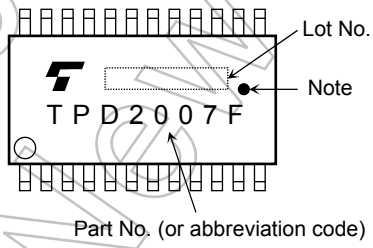
### Features

- 8-channel low-side switch array incorporating an N-channel power MOSFET (1.4Ω max)
- Can directly drive a power load from a microprocessor.
- Built-in protection against overtemperature and overcurrent
- 8-channel access enables space-saving design.
- High operating voltage: 40 V
- Low on-resistance: 1.4 Ω max @$V_{IN}$ = 5 V, $I_D$ = 0.5 A (per channel)
- Supports parallel operation.
- Built-in active clamp circuit
- Supplied in an SSOP-24 package (300 mil) in embossed taping.

### Pin Assignment




### Marking



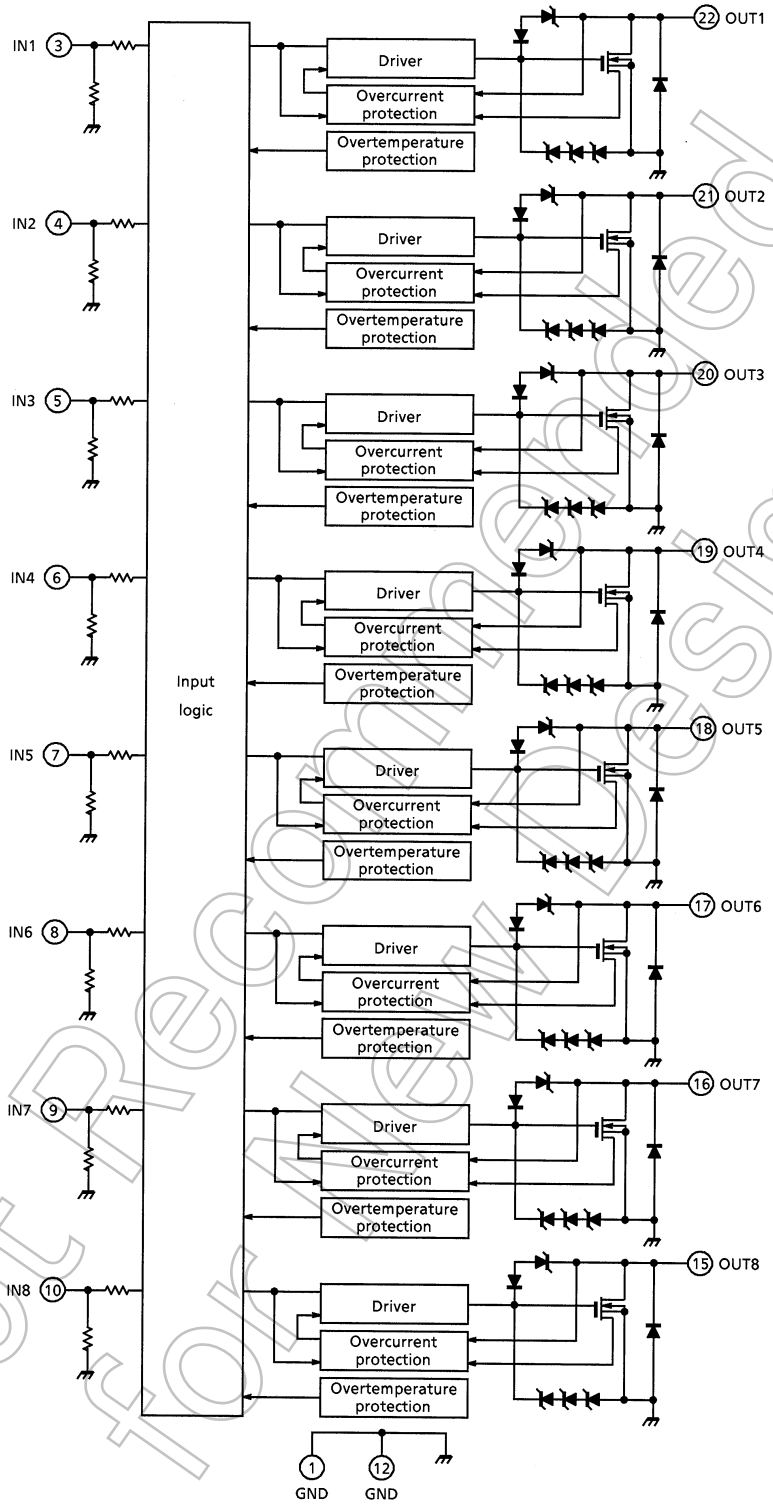

Note：A dot marking for identifying the indication of product Labels.
Not underlined: [[Pb]]/INCLUDES > MCV
Underlined: [[G]]/RoHS COMPATIBLE or [[G]]/RoHS [[Pb]]

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.

This product has a MOS structure and is sensitive to electrostatic discharge. When handling this product, ensure that the environment is protected against electrostatic discharge.

Start of commercial production
1999-05

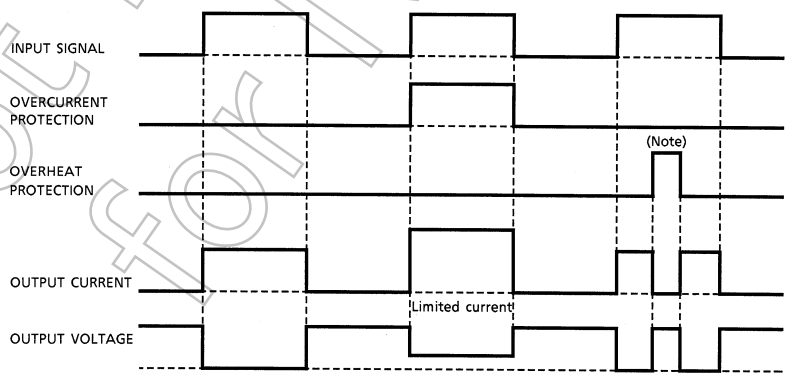
## Block Diagram



## Pin Description

| Pin No. | Symbol | Description |
|---|---|---|
| 1 | GND | GND pin; in common with the pin no.12 internally. |
| 2 | N.C. | — |
| 3 | IN1 | Control input pin for channel 1 and built-in pull-down resistor (300 kΩ typ.) |
| 4 | IN2 | Control input pin for channel 2 and built-in pull-down resistor (300 kΩ typ.) |
| 5 | IN3 | Control input pin for channel 3 and built-in pull-down resistor (300 kΩ typ.) |
| 6 | IN4 | Control input pin for channel 4 and built-in pull-down resistor (300 kΩ typ.) |
| 7 | IN5 | Control input pin for channel 5 and built-in pull-down resistor (300 kΩ typ.) |
| 8 | IN6 | Control input pin for channel 6 and built-in pull-down resistor (300 kΩ typ.) |
| 9 | IN7 | Control input pin for channel 7 and built-in pull-down resistor (300 kΩ typ.) |
| 10 | IN8 | Control input pin for channel 8 and built-in pull-down resistor (300 kΩ typ.) |
| 11 | N.C. | — |
| 12 | GND | GND pin; in common with the pin no.1 internally. |
| 13 | N.C. | — |
| 14 | N.C. | — |
| 15 | OUT8 | Output pin for channel 8 |
| 16 | OUT7 | Output pin for channel 7 |
| 17 | OUT6 | Output pin for channel 6 |
| 18 | OUT5 | Output pin for channel 5 |
| 19 | OUT4 | Output pin for channel 4 |
| 20 | OUT3 | Output pin for channel 3 |
| 21 | OUT2 | Output pin for channel 2 |
| 22 | OUT1 | Output pin for channel 1 |
| 23 | N.C. | — |
| 24 | N.C. | — |

## Timing Chart




Note: The overheating detector circuits feature hysteresis. After overheating is detected, normal operation is restored only when the junction temperature falls by the hysteresis amount (10°C typ.) in relation to the overheating detection temperature.

## Truth Table

| Input Signal | Output Signal | State |
|---|---|---|
| L | H | Normal |
| H | L | |
| L | H | Overcurrent protection |
| H | Internally limited | |
| L | H | Overtemperature protection |
| H | H | |

## Absolute Maximum Ratings (Ta = 25°C)

| Characteristic | Symbol | Rating | Unit |
|---|---|---|---|
| Drain-source voltage | $V_{DSS}$ | 40 | V |
| Input voltage | $V_{IN}$ | −0.5 ~ 7 | V |
| Output current | $I_D$ | Internally Limited | A |
| Power dissipation (operating all channels, ta = 25°C) | $P_T$ | 0.8 | W |
| | | 1.2 (Note) | |
| Single pulse avalanche energy | $E_{AS}$ | 10 | mJ |
| Operating temperature | $T_{opr}$ | −40 ~ 85 | °C |
| Junction temperature | $T_j$ | 150 | °C |
| Storage temperature | $T_{stg}$ | −55 ~ 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

| Characteristic | Symbol | Rating | Unit |
|---|---|---|---|
| Thermal resistance junction to ambient (operating all channels, ta = 25°c) | $\Sigma R_{th\ (j\text{-}a)}$ | 156.3 | °C / W |
| | | 104.2 (Note) | |

Note: 60 mm × 60 mm × 1.6 mm when mounted on a glass epoxy PCB (DC)

## Electrical Characteristics
**(Unless otherwise specified, $T_j$ = 25°C)**

| Characteristic | | Symbol | Test Circuit | Test Condition | Min | Typ. | Max | Unit |
|---|---|---|---|---|---|---|---|---|
| Drain-source clamp voltage | | $V_{(BR)\ DSS}$ | — | $I_D$ = 10 mA, $V_{IN}$ = 0 V | 40 | — | — | V |
| Input voltage | | $V_{th}$ | — | $V_{DS}$ = 24 V, $I_{DS}$ = 1 mA | 0.8 | — | 2.0 | V |
| Input current | | $I_{IL}$ | — | $V_{IN}$ = 0 V | −10 | — | 10 | μA |
| | | $I_{IH}$ | — | $V_{IN}$ = 5 V | — | 140 | 300 | |
| On resistance | | $R_{DS(ON)}$ | — | $V_{IN}$ = 5 V, $I_O$ = 0.5 A | — | 1.0 | 1.4 | Ω |
| Off current | | $I_{DSS}$ | — | $V_{DS}$ = 40V | — | — | 100 | μA |
| Overcurrent protection | | $I_{S(1)}$ | — | $V_{DS}$ = 12 V, $V_{IN}$ = 5 V, $R_L$ = 3Ω | 1 | 2 | 3 | A |
| | | $I_{S(2)}$ | — | $V_{DS}$ = 30 V, $V_{IN}$ = 5 V, $R_L$ = 3Ω | 0.7 | — | 2 | |
| Overtemperature Protection | Temperature | TSD | — | $V_{IN}$ = 5 V | — | 160 | — | °C |
| | Hysteresis | ΔTSD | — | — | — | 10 | — | |
| Switching time | | $t_{ON}$ | 1 | $V_{DD}$ = 12 V, $R_L$ = 24Ω, $V_{IN}$ = 0 V / 5 V | — | 10 | 50 | μs |
| | | $t_{OFF}$ | 1 | | — | 10 | 50 | |
| Operating input voltage protection circuit | | $V_{IN(P)}$ | — | — | 3.9 | — | 6.0 | V |
| Drain-source diode forward voltage | | $V_{DSF}$ | — | IF = 1 A, $V_{IN}$ = 0 V | — | — | 1.6 | V |

## Description of Protector Circuit

### (1) Overtemperature Protection

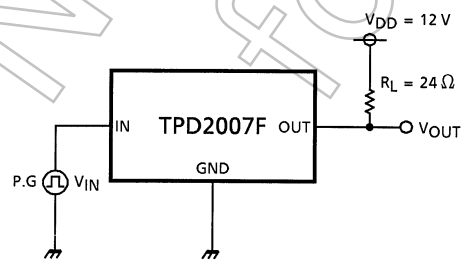
- The overheating detector circuits feature hysteresis. After overheating is detected, normal operation is restored only when the junction temperature falls by the hysteresis amount (10°C typ.) in relation to the overheating detection temperature.

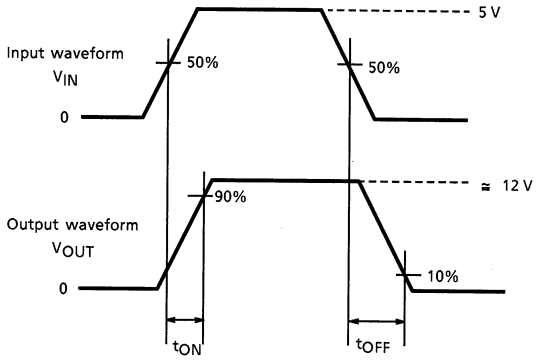
### (2) Overcurrent Protection

- When overcurrent is detected, the overcurrent limiter function limits the output current. Normal operation is restored when the load current drops below the overcurrent detection value.

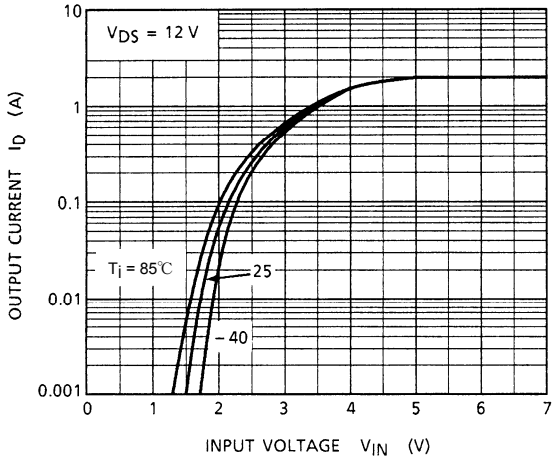
## Test Circuit

### Switching Time

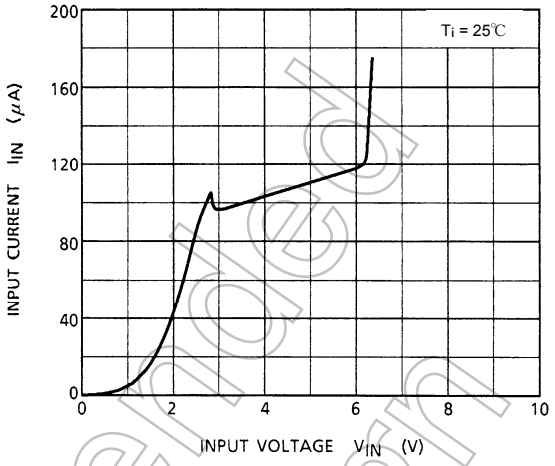


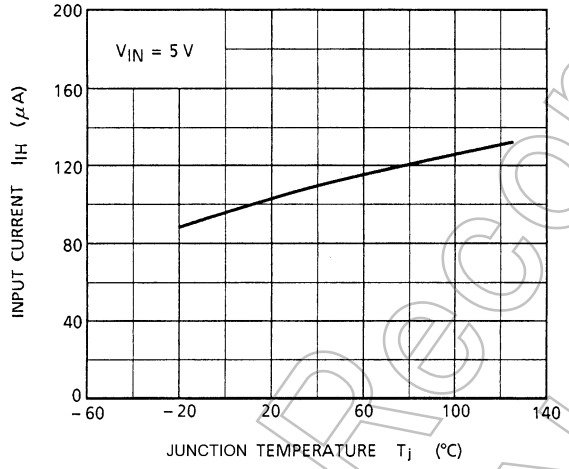
$I_D$ – $V_{IN}$ (FOR EACH CHANNEL)



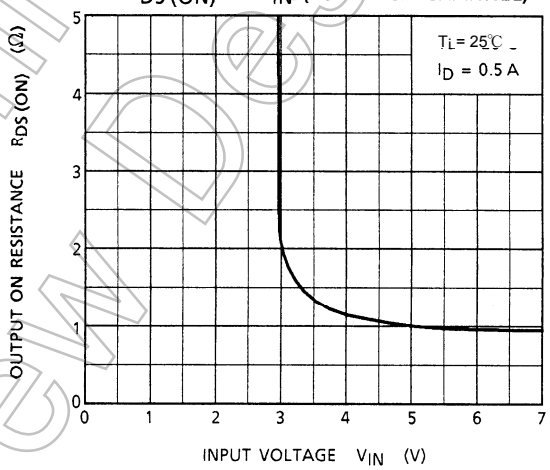

$I_{IN}$ – $V_{IN}$ (FOR EACH CHANNEL)



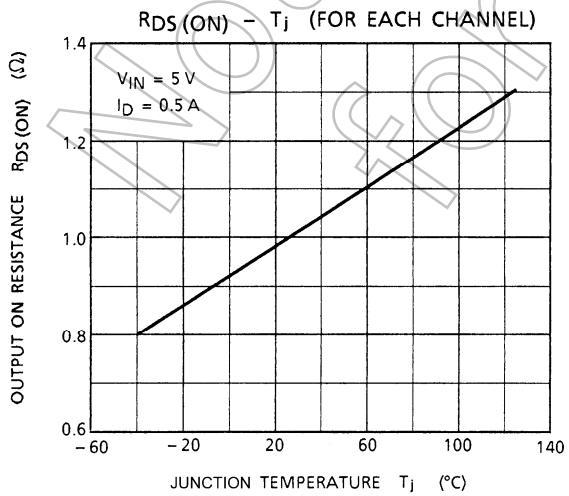

$I_{IH}$ – $T_j$ (FOR EACH CHANNEL)



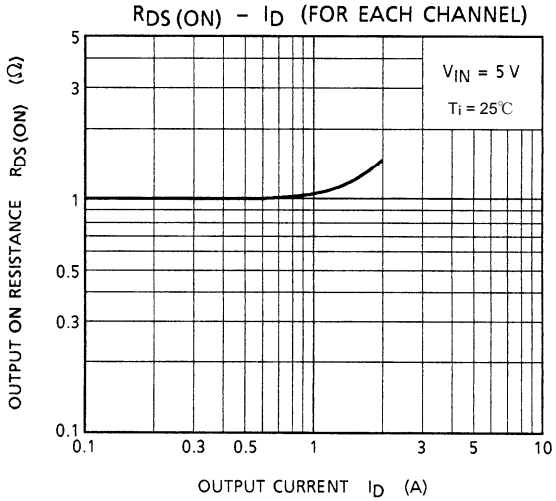

$R_{DS\,(ON)}$ – $V_{IN}$ (FOR EACH CHANNEL)



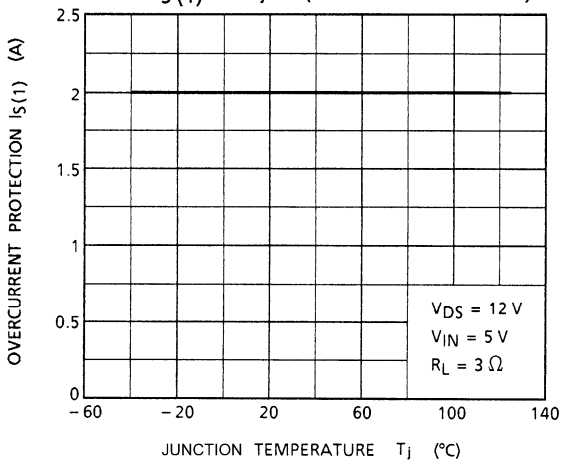

$R_{DS\,(ON)}$ – $T_j$ (FOR EACH CHANNEL)



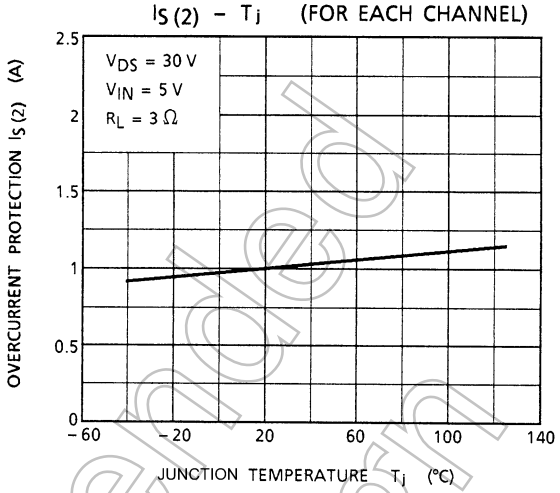

$R_{DS\,(ON)}$ – $I_D$ (FOR EACH CHANNEL)



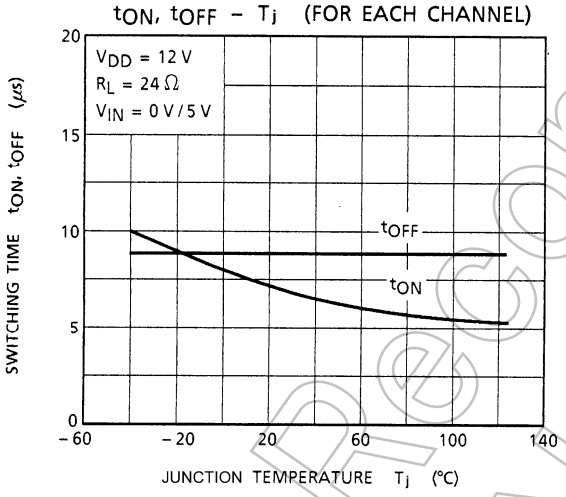
$I_{S(1)}$ – $T_j$ (FOR EACH CHANNEL)



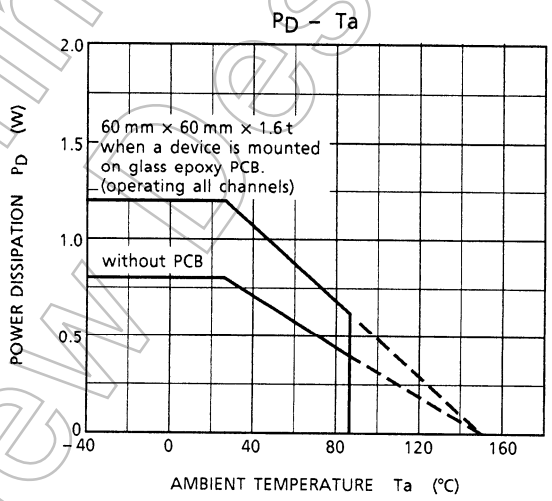

$I_{S(2)}$ – $T_j$ (FOR EACH CHANNEL)



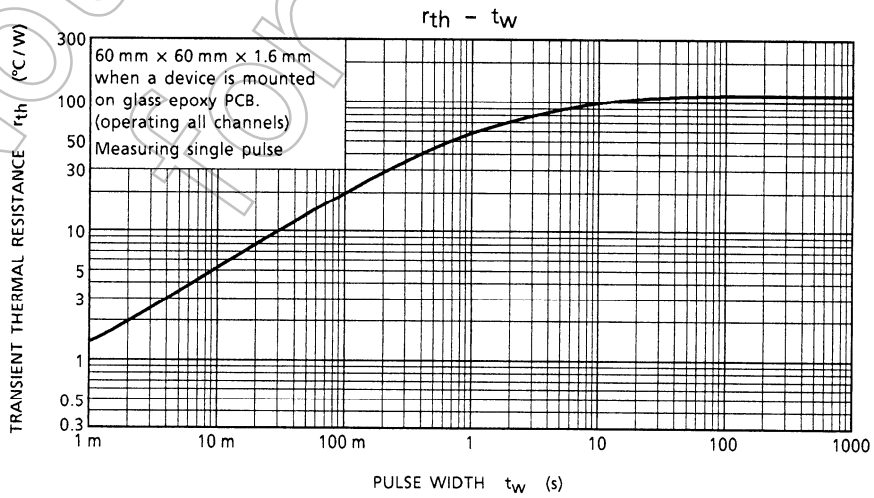

$t_{ON}$, $t_{OFF}$ – $T_j$ (FOR EACH CHANNEL)




$P_D$ – Ta




$r_{th}$ – $t_w$



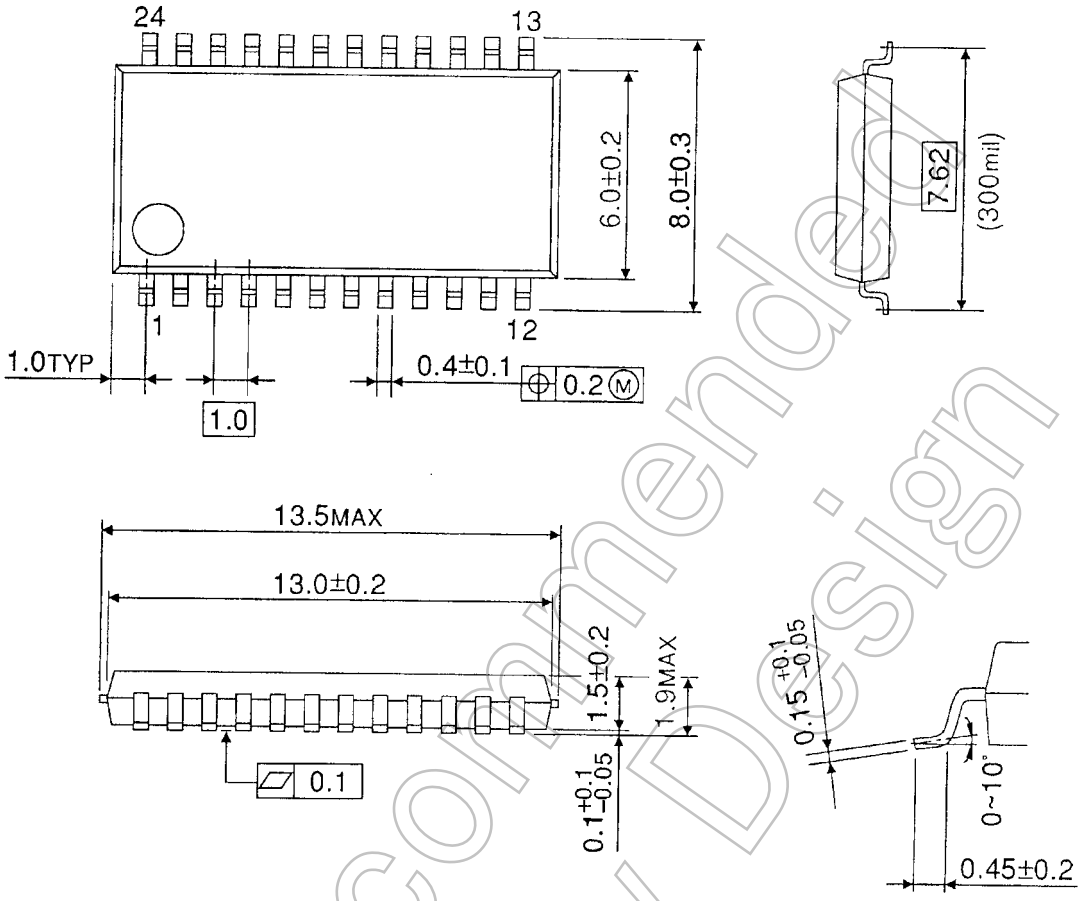
## Moisture-Proof Packing

After the pack is opened, the devices should be used within 48 hours and in a 30°C, 60% RH environment. Embossed-tape packing cannot be baked. Devices so packed must be within their allowable time limits after unpacking, as specified on the packing.
Standard tape packing quantity: 2000 devices / reel (EL1)

## Package Dimensions

SSOP24-P-300-1.00C

Unit : mm




Weight: 0.29 g (typ.)

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