

TOSHIBA Intelligent Power Device Silicon Monolithic Power MOS Integrated Circuit

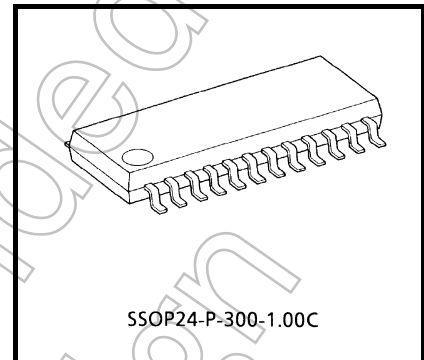
# TPD2005F

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

The TPD2005F is an 8-channel high-side switch array for vertical power MOSFET output. A monolithic power IC, it can directly drive a power load from a CMOS or TTL logic circuit (such as an MPU). It offers overcurrent and overtemperature protection functions.

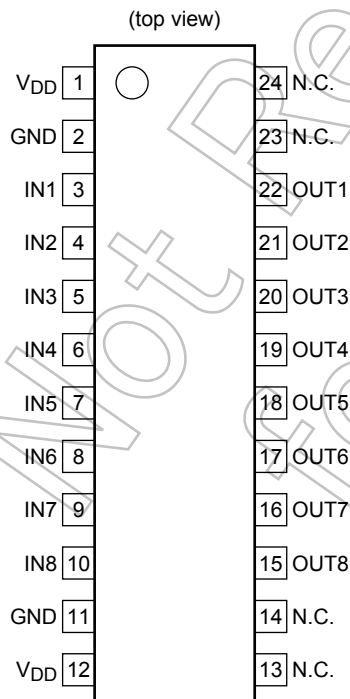
## Features

- A high-side switch array incorporating an N-channel power MOSFET (1.2 Ωmax.) and an 8-channel charge pump
- Can directly drive a power load from a microprocessor.
- Built-in protection against overtemperature protection and overcurrent protection
- 8-channel access enables space-saving design
- High operating supply voltage : 40 V
- Low on resistance : 1.2 Ω max. (@VDD = 12 V, IO = 0.5 A (per channel))
- Supports parallel operation.
- Low supply current : 5 mA max. (@VDD = 40 V, VIN = 0 V)
- Supplied in an SSOP-24 package (300 mil) in embossed taping.

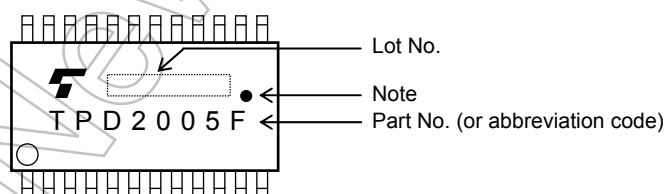


Weight: 0.29g (typ.)

## Pin Assignment



## Marking



Note : A dot marking for identifies the indication of product Labels.

Without a dot: [[Pb]]/INCLUDES > MCV

With a dot: [[G]]/RoHS COMPATIBLE or [[G]]/RoHS [[Pb]]

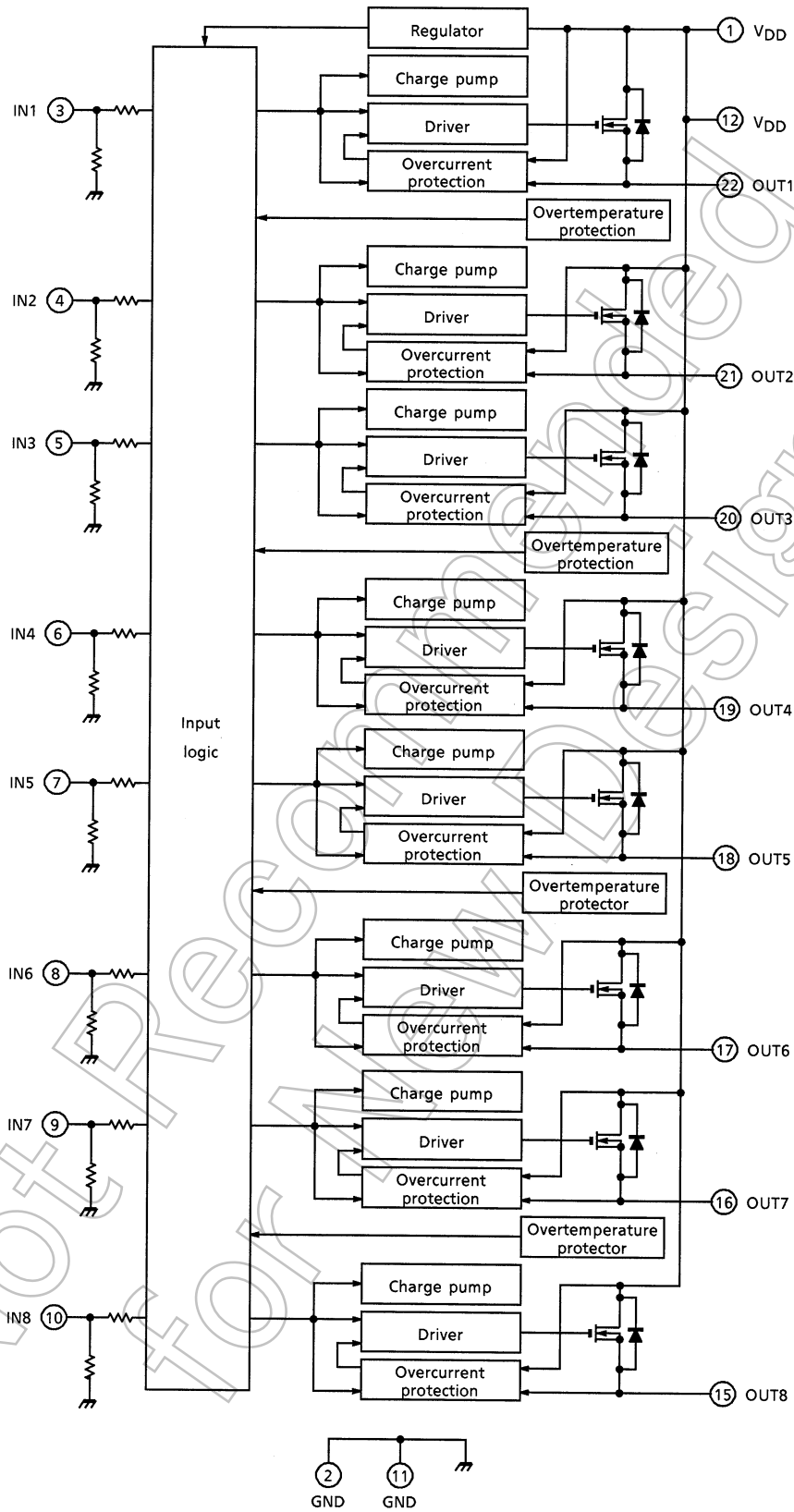
Please contact your TOSHIBA sales representative for details as to environmental matters such as the RoHS compatibility of Product.

The RoHS is the 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.

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

Start of commercial production  
1999-05

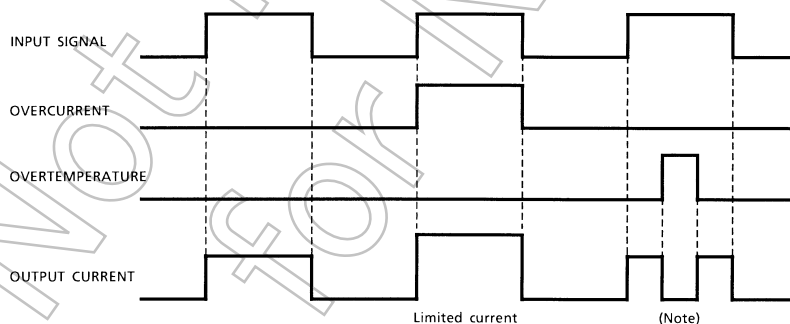
## Block Diagram



## Pin Description

Pin No.	Symbol	Description
1	V <sub>DD</sub>	Power supply pin; in common with the pin No.12 internally.
2	GND	GND pin; in common with the pin No.11 internally.
3	IN1	Control input pin for channel 1 and built-in pull-down resistor (100 kΩ typ.)
4	IN2	Control input pin for channel 2 and built-in pull-down resistor (100 kΩ typ.)
5	IN3	Control input pin for channel 3 and built-in pull-down resistor (100 kΩ typ.)
6	IN4	Control input pin for channel 4 and built-in pull-down resistor (100 kΩ typ.)
7	IN5	Control input pin for channel 5 and built-in pull-down resistor (100 kΩ typ.)
8	IN6	Control input pin for channel 6 and built-in pull-down resistor (100 kΩ typ.)
9	IN7	Control input pin for channel 7 and built-in pull-down resistor (100 kΩ typ.)
10	IN8	Control input pin for channel 8 and built-in pull-down resistor (100 kΩ typ.)
11	GND	GND pin; in common with the pin No.2 internally.
12	V <sub>DD</sub>	Power supply 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 overtemperature detector circuits feature hysteresis. After overtemperature is detected, normal operation is restored only when the junction temperature falls by the hysteresis amount (10°C typ.) in relation to the overtemperature detection temperature.

## Truth Table

Input Signal	Output Signal	State
L	L	Normal
H	H	
L	L	Overcurrent
H	Internally limited	
L	L	Overtemperature
H	L	

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

Characteristic	Symbol	Rating	Unit
Supply voltage	V <sub>DD</sub>	45	V
Input voltage	V <sub>IN</sub>	- 0.5 to 7	V
Drain-source voltage	V <sub>DS</sub>	60	V
Output current	I <sub>O</sub>	Internally limited	A
Power dissipation (operating all channels, Ta = 25°C)	P <sub>T</sub>	0.8	W
		1.2 (Note 1)	
Single pulse avalanche energy	E <sub>AS</sub>	10	mJ
Operating temperature	T <sub>opr</sub>	- 40 to 85	°C
Junction temperature	T <sub>J</sub>	150	°C
Storage temperature	T <sub>stg</sub>	- 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

Characteristic	Symbol	Rating	Unit
Thermal resistance junction to ambient (Operating all channels, Ta = 25°C)	ΣR <sub>th(j-a)</sub>	156.3	°C / W
		104.2 (Note 1)	

Note 1: 60 mm × 60 mm × 1.6 mm when a device is mounted on a glass epoxy PCB (DC).

## Electrical Characteristics

(Unless otherwise specified,  $V_{DD} = 8$  to  $40V$ ,  $T_j = 25^\circ C$ )

Characteristic	Symbol	Test Circuit	Test Condition	Min	Typ.	Max	Unit
Operating supply voltage	$V_{DD(opr)}$	—	—	8	—	40	V
Supply current	$I_{DD}$	—	$V_{DD} = 40 V, V_{IN} = 0 V$	—	—	5	mA
Input voltage	"L" level	$V_{IL}$	—	—	—	1.5	V
	"H" level	$V_{IH}$	—	3.5	—	—	
Input current	$I_{IL}$	—	$V_{DD} = 24 V, V_{IN} = 0 V$	-10	—	10	$\mu A$
	$I_{IH}$	—	$V_{DD} = 24 V, V_{IN} = 5 V$	—	50	200	
On resistance	$R_{DS(ON)}$	—	$V_{DD} = 12 V, I_O = 0.5 A$	—	0.9	1.2	$\Omega$
Output leakage current	$I_{OL}$	—	$V_{DD} = 40 V, V_{IN} = 0 V$	—	—	100	$\mu A$
Overcurrent protection	$I_S$	—	—	1	—	3	A
Overtemperature detection	Temperature	$T_{SD}$	—	—	160	—	$^\circ C$
	Hysteresis	$\Delta T_{SD}$	—	—	10	—	
Switching time	$t_{ON}$	1	$V_{DD} = 12 V, R_L = 24 \Omega$	—	11	200	$\mu s$
	$t_{OFF}$			—	4	50	

## Description of Protector Circuit

### (1) Overtemperature Protection

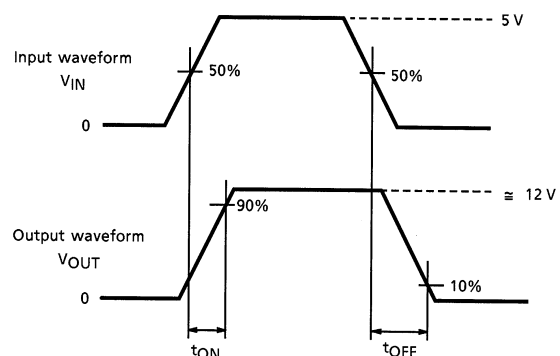
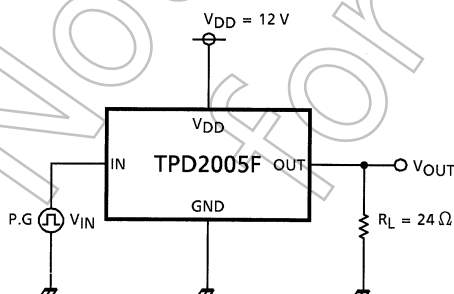
- There are four built-in overtemperature detector circuits, one each for channels 1 and 2; channels 3 and 4; channels 5 and 6; and channels 7 and 8, respectively. The circuit logic is such that, when any of the four detectors detects overtemperature, the circuit turns off the output of both its channels (for example, both channels 1 and 2).
- The overtemperature detector circuits feature hysteresis. After overtemperature is detected, normal operation is restored only when the junction temperature falls by the hysteresis amount ( $10^\circ C$  typ.) in relation to the overtemperature detection temperature.

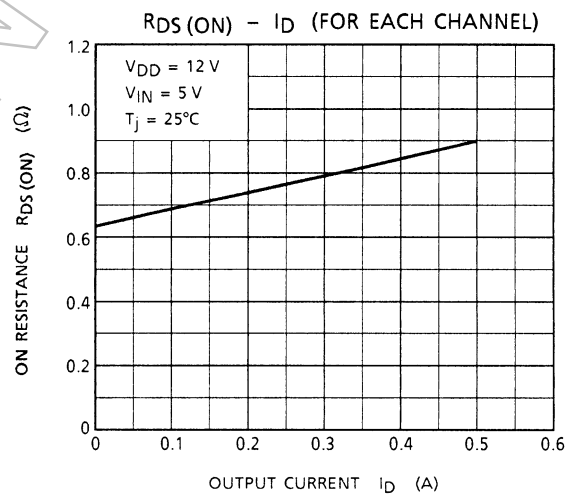
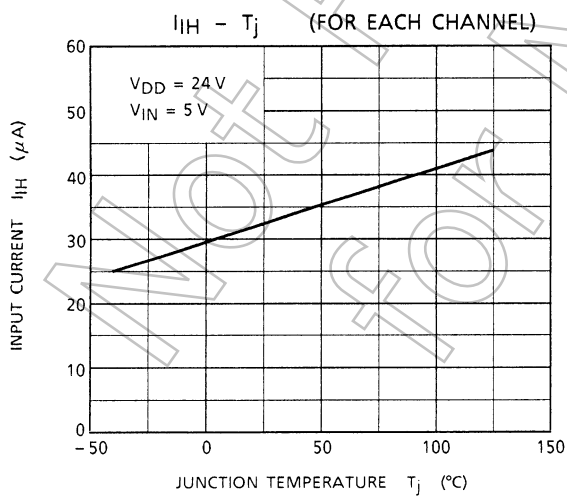
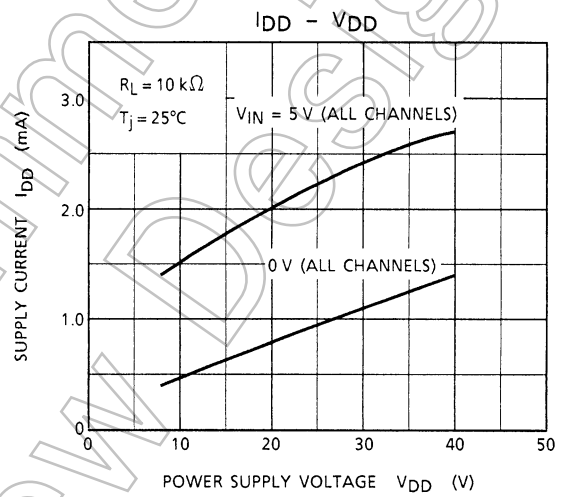
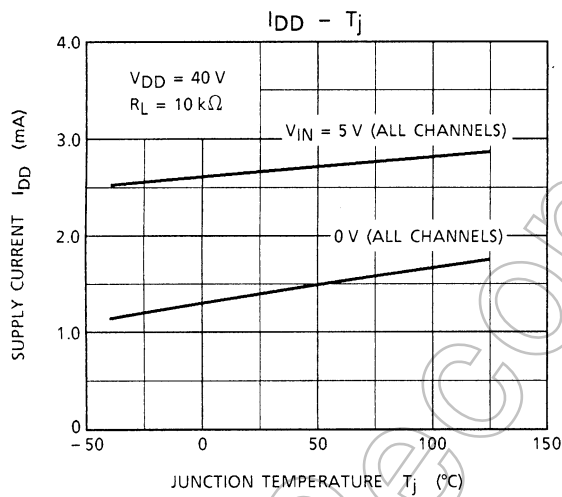
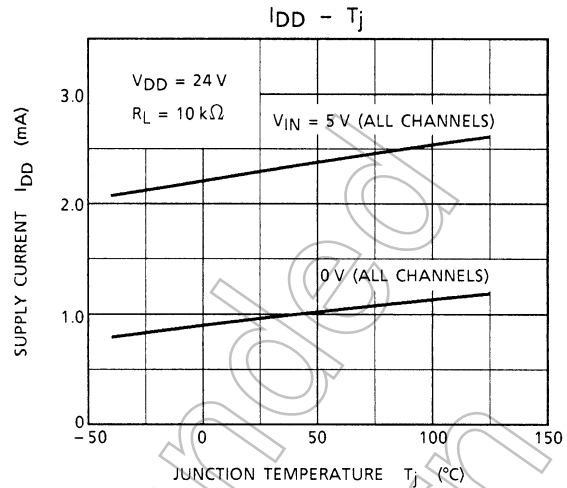
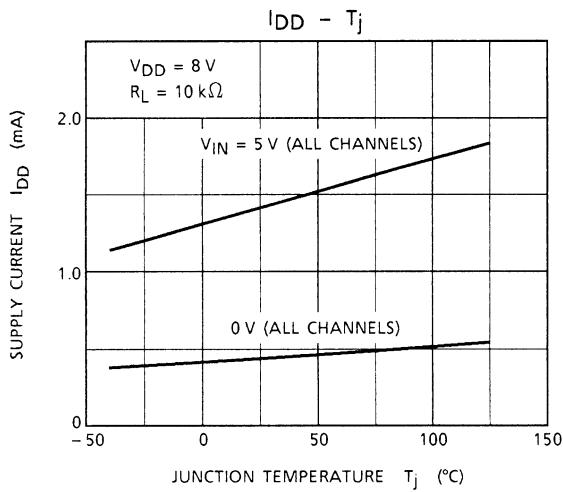
### (2) Overcurrent Protection

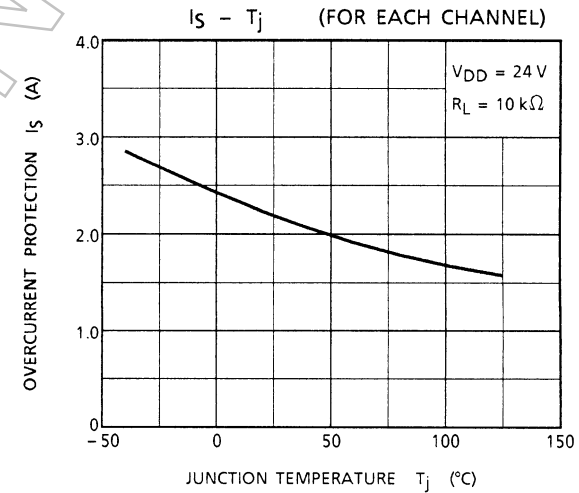
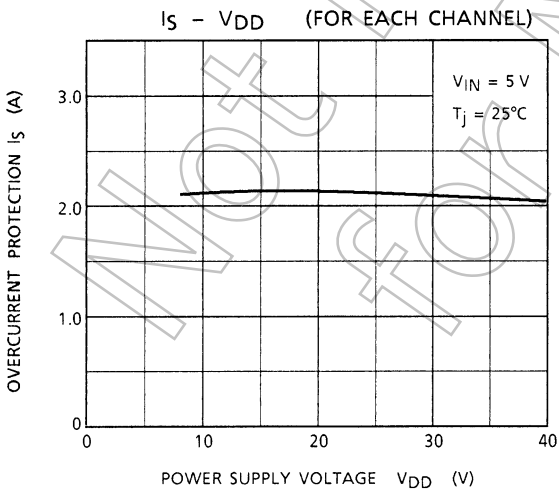
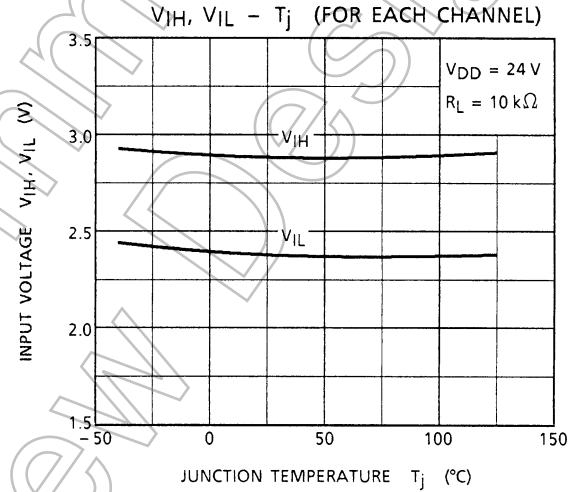
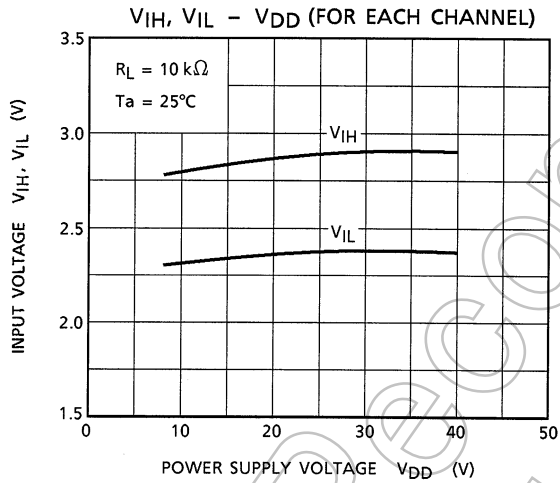
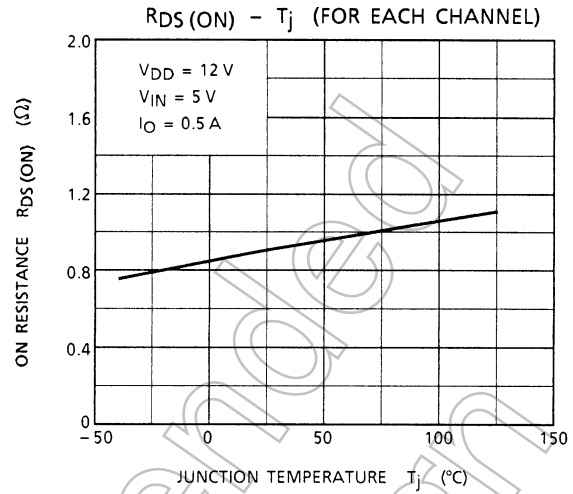
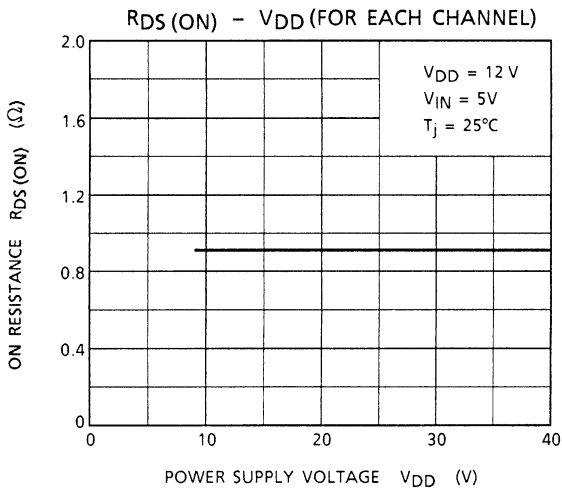
- When overcurrent is detected, the overcurrent limiter function limits the output current. Normal operation is restored when the load current drops below the overcurrent detection value.

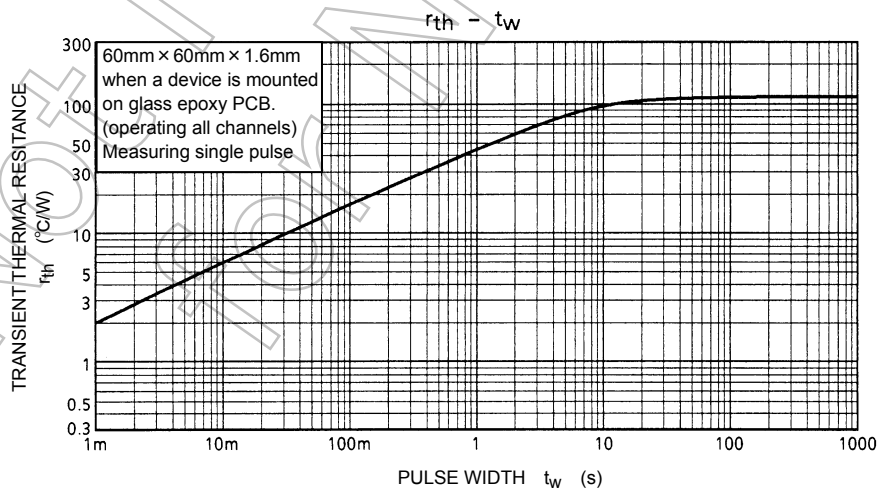
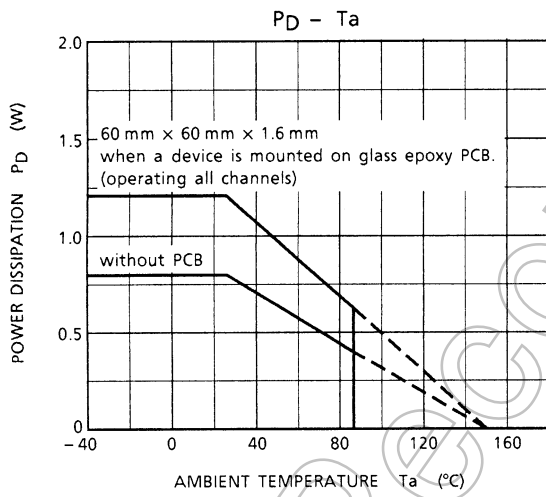
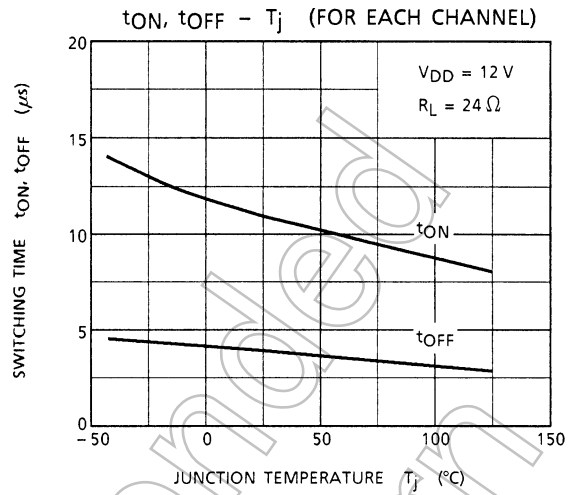
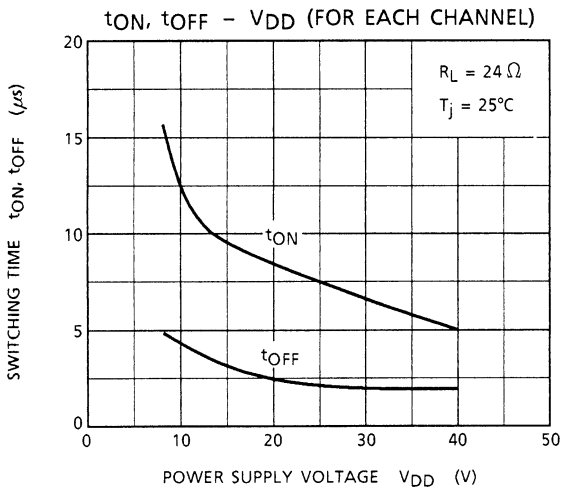
## Test Circuit

### Switching Time











**Caution on Usage**

1. As protection against reverse connection of batteries is not provided, take protective measures using external circuits.
2. As a negative bias protector circuit is not built into the output pins, if negative bias is applied to the output pins, be sure to connect a freewheel diode between OUT and GND.

**Moisture-Proof Packing**

After the pack is opened, use the devices in a 30°C, 60% RH environment, and within 48 hours. Embossed-tape packing cannot be baked. Devices so packed must be within their allowable time limits after unpacking, as specified on the packing.

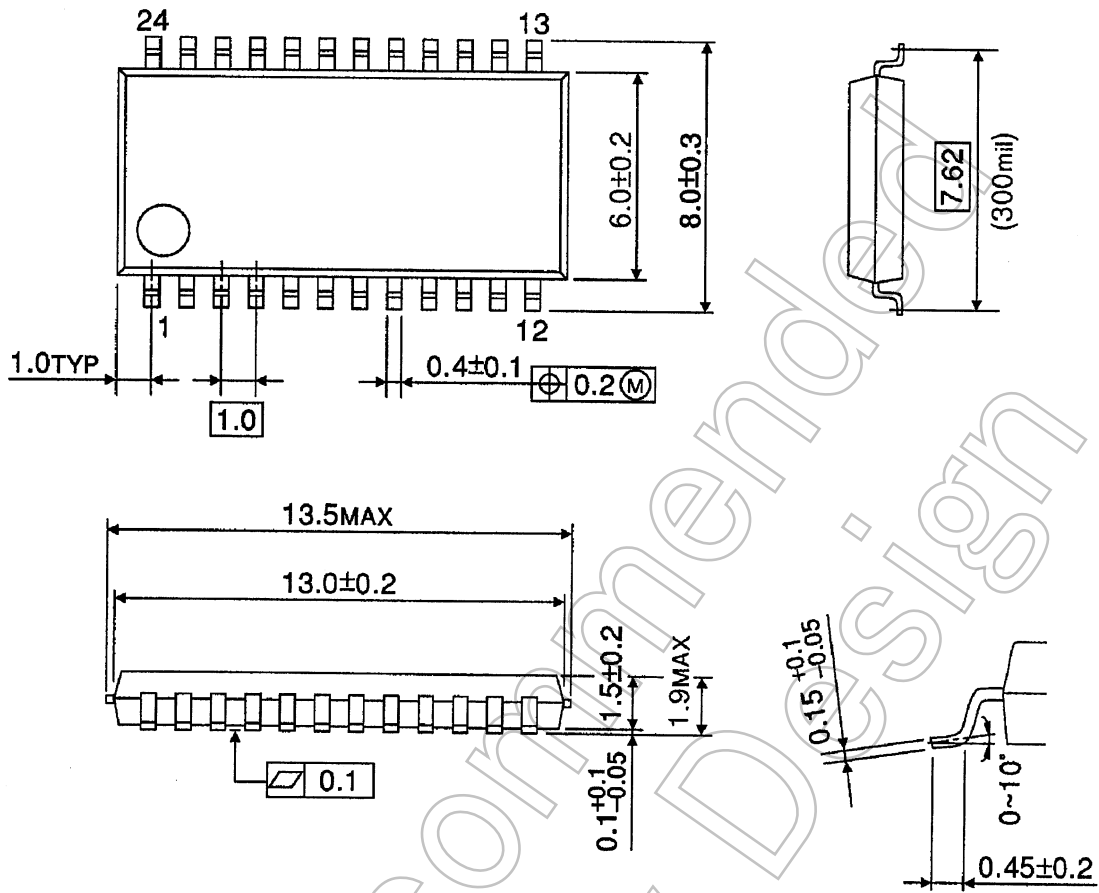
Standard tape packing quantity: 2000 devices / reel (EL1)

Not Recommended  
for New Design

**Package Dimensions**

SSOP24-P-300-1.00C

Unit: mm



Weight: 0.29g (typ.)

Not Recommended for New Design

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