

TOSHIBA Intelligent Power Device Silicon Monolithic Power MOS Integrated Circuit

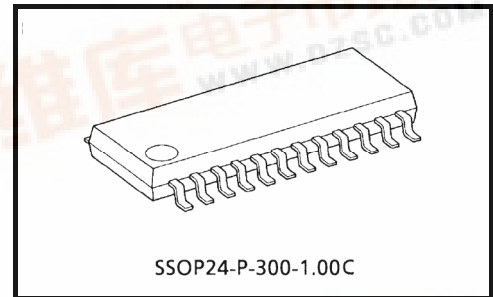
TPD2007F

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.

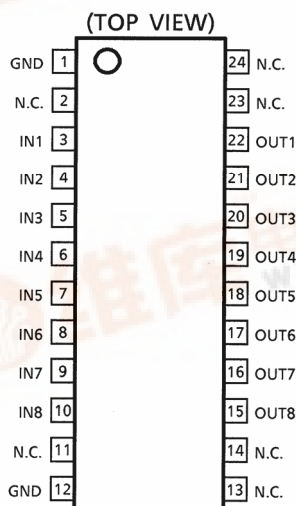
Features

- 8-channel low-side switch array incorporating an N-channel power MOSFET ($1.4\ \Omega$ 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: $1.4\ \Omega$ max @ $V_{IN} = 5\text{ V}$, $I_D = 0.5\text{ A}$ (per channel)
- Supports parallel operation.
- Built-in active clamp circuit
- Supplied in an SSOP-24 package (300 mil) in embossed taping.

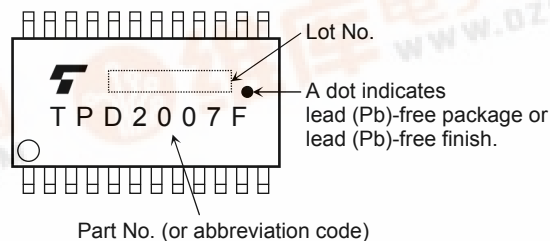


Weight: 0.29 g (typ.)

Pin Assignment

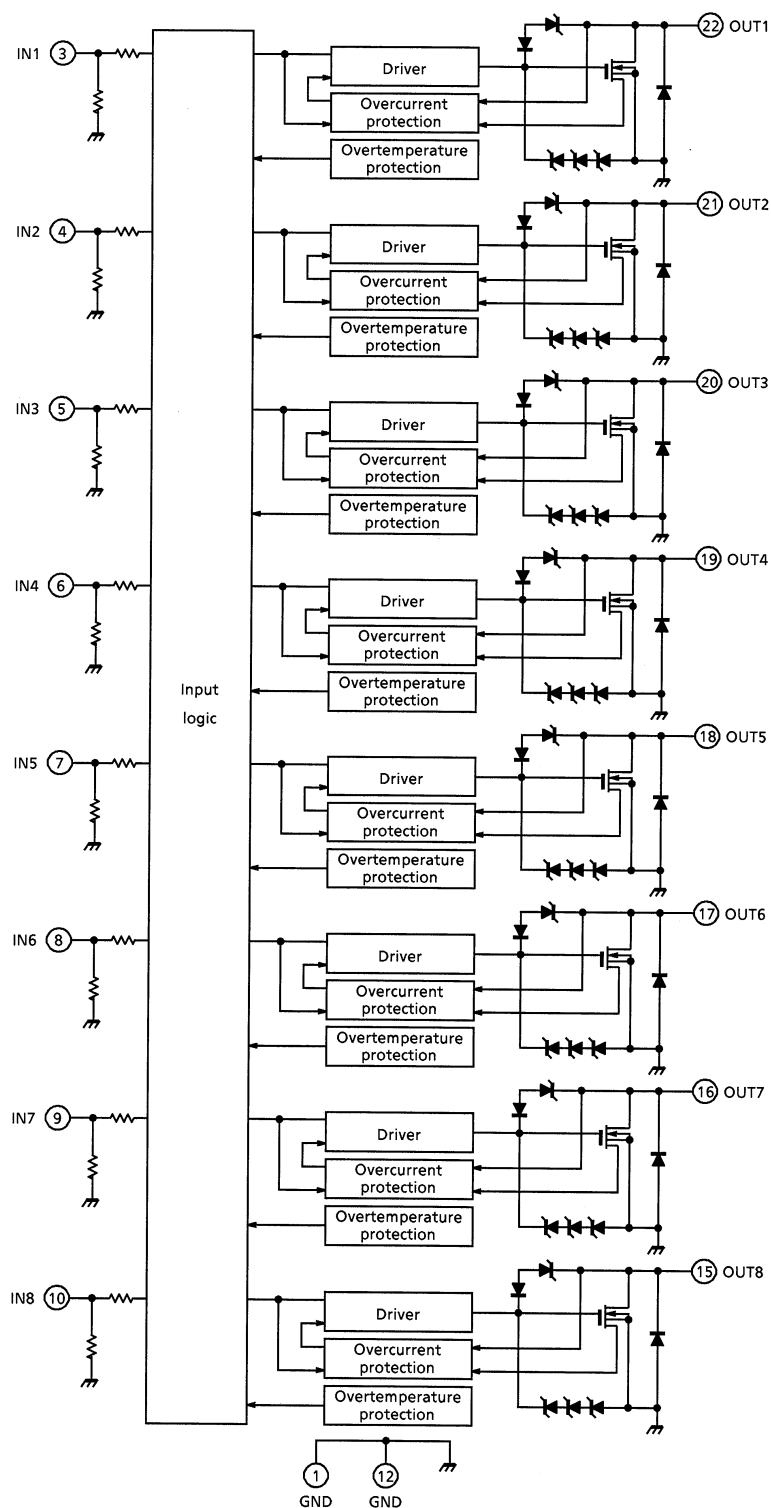


Marking



Note: 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.

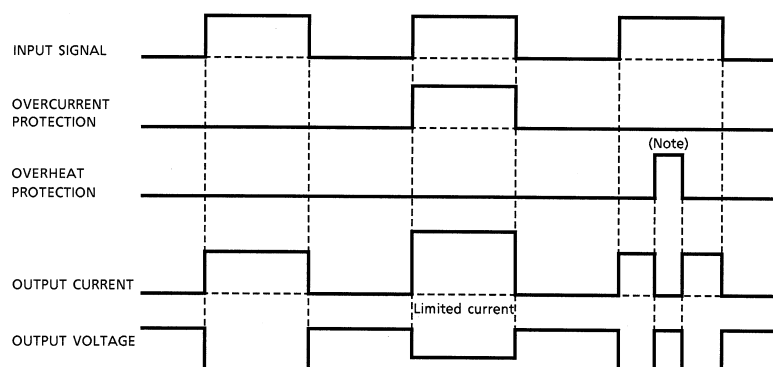
Block Diagram



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)	ΣR _{th} (j-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, $T_j = 25^\circ\text{C}$)

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

Description of Protector Circuit

(1) Overtemperature Protection

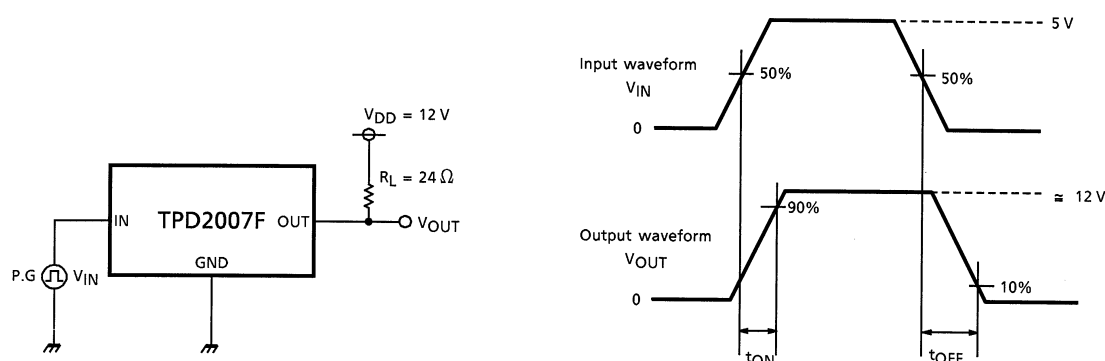
- The overheating detector circuits feature hysteresis. After overheating is detected, normal operation is restored only when the junction temperature falls by the hysteresis amount (10°C typ.) in relation to the overheating detection temperature.

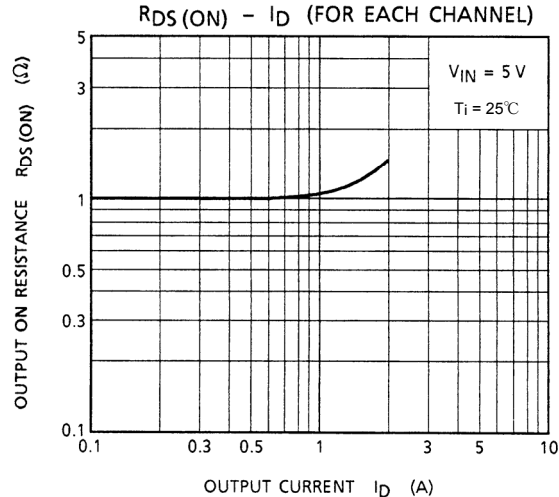
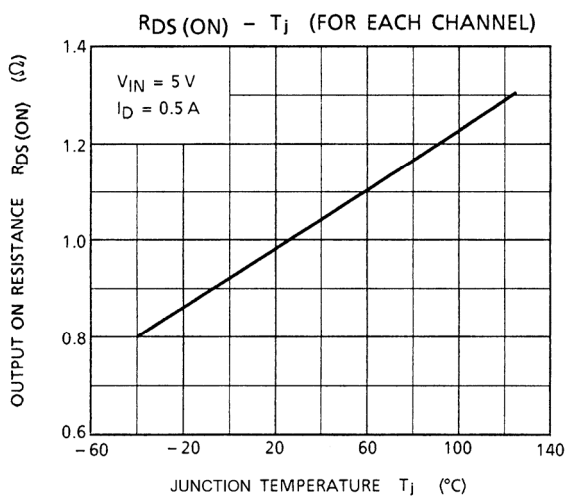
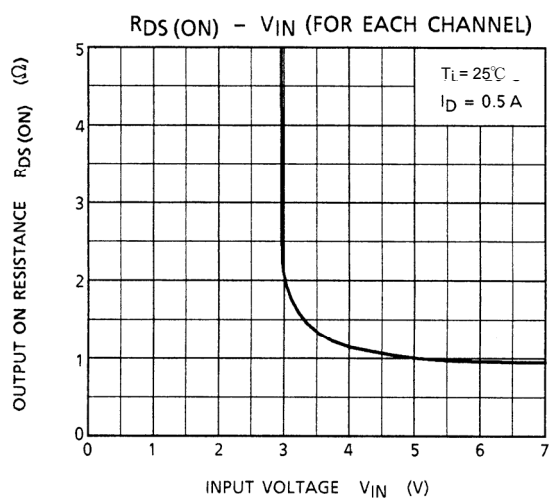
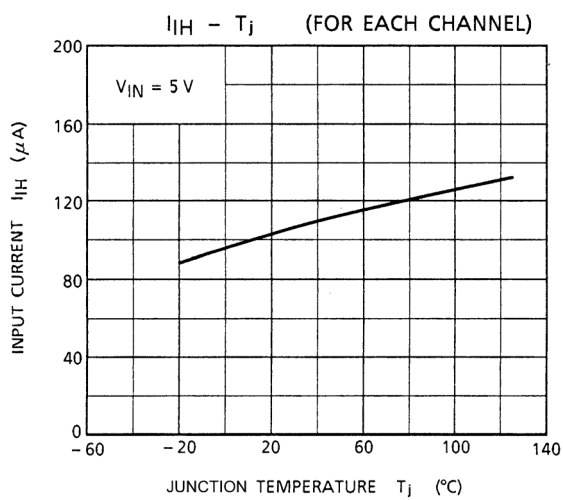
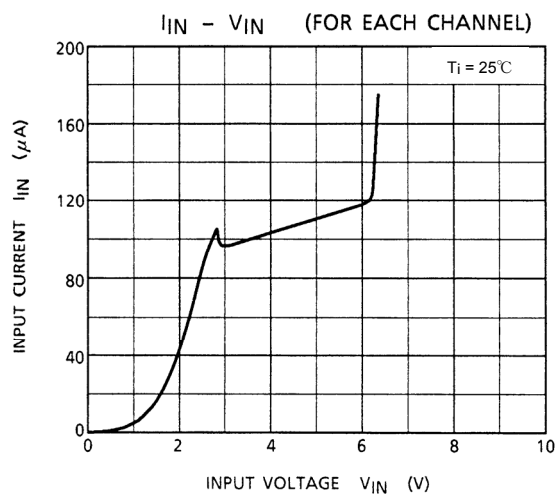
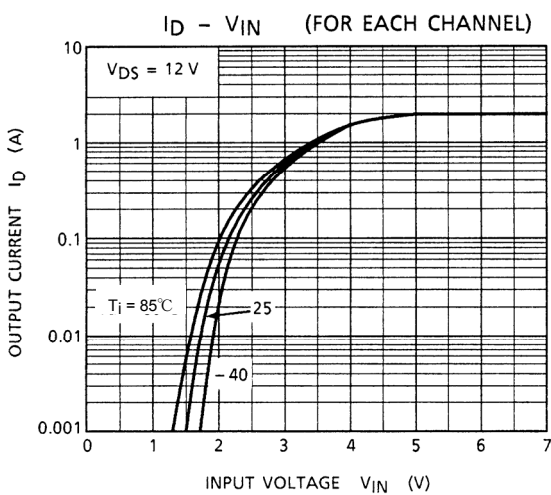
(2) Overcurrent Protection

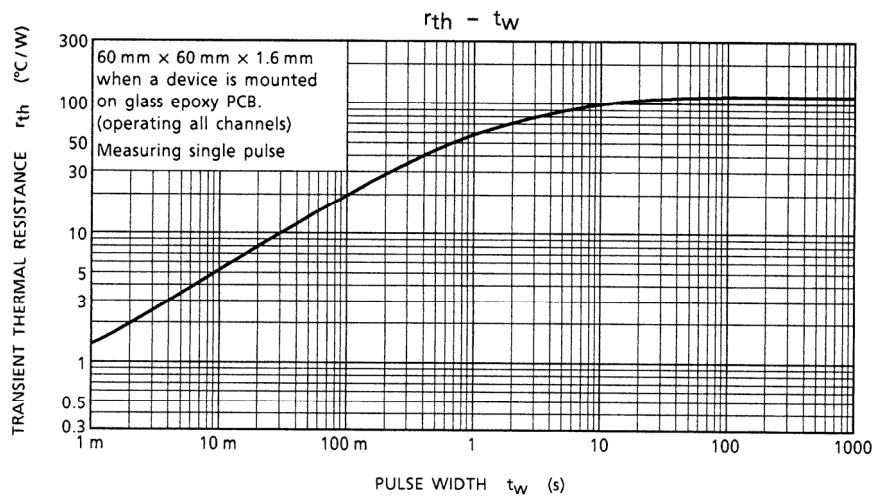
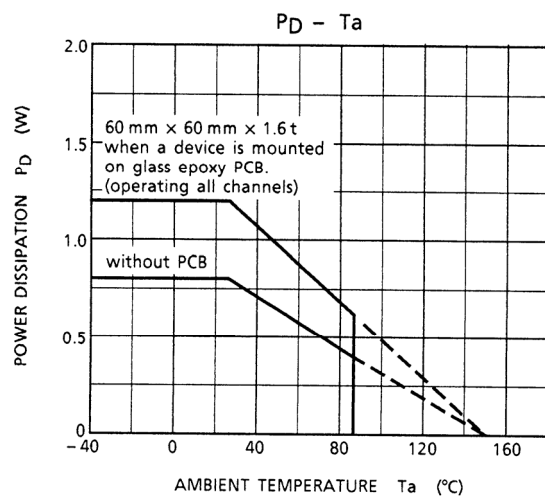
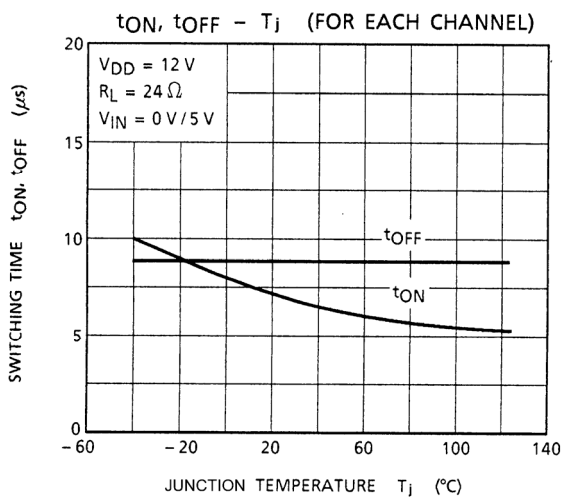
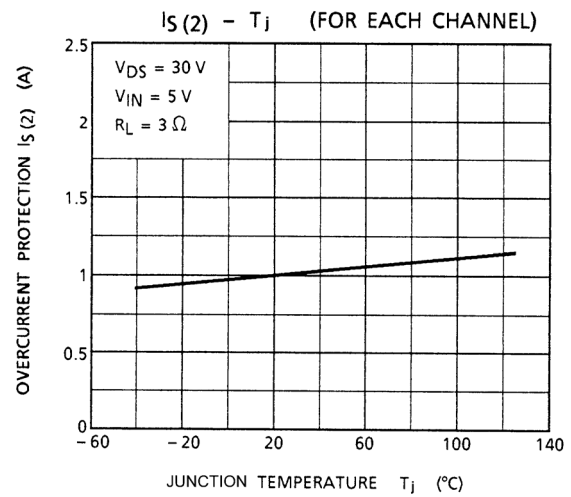
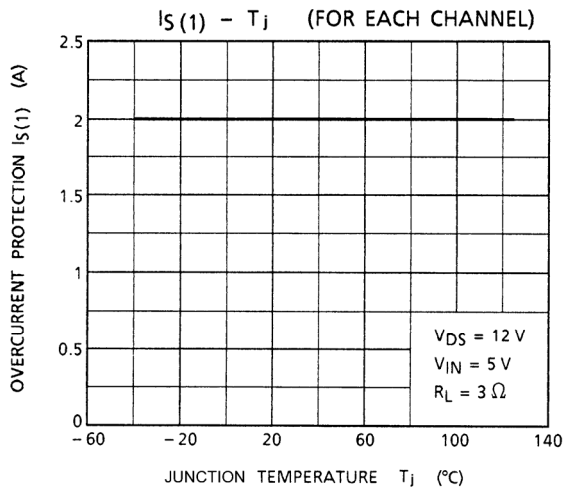
- When overcurrent is detected, the overcurrent limiter function limits the output current. Normal operation is restored when the load current drops below the overcurrent detection value.

Test Circuit

Switching Time







Moisture-Proof Packing

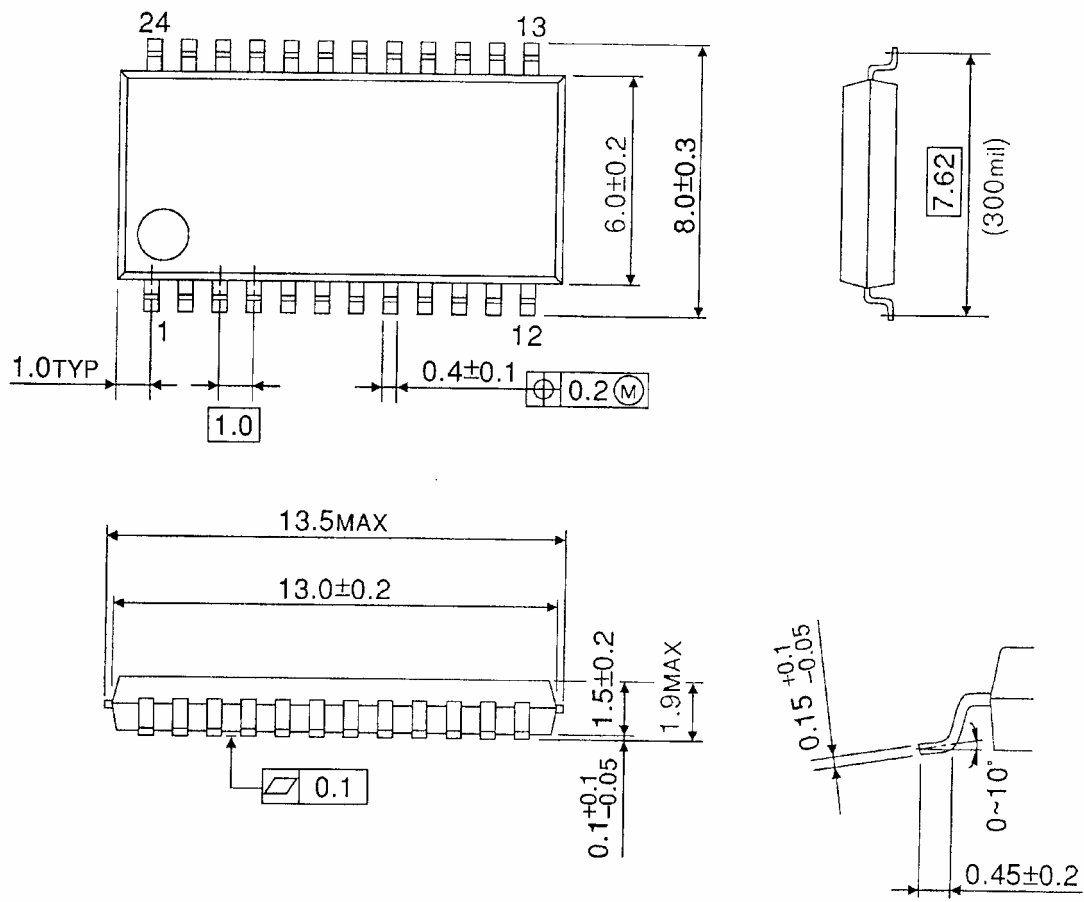
After the pack is opened, the devices should be used within 48 hours and in a 30°C, 60% RH environment. Embossed-tape packing cannot be baked. Devices so packed must be within their allowable time limits after unpacking, as specified on the packing.

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

Package Dimensions

SSOP24-P-300-1.00C

Unit : mm



Weight: 0.29 g (typ.)

RESTRICTIONS ON PRODUCT USE

20070701-EN

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