

# TPD1044F

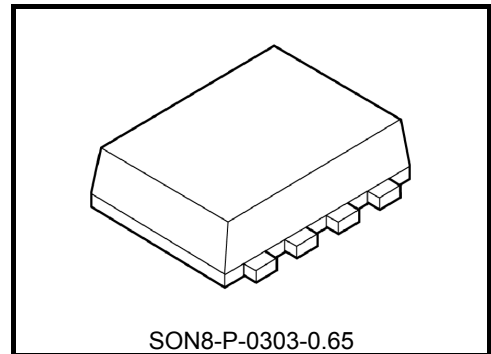
## Low-Side Switch for Motor, Solenoid and Lamp Drive

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.

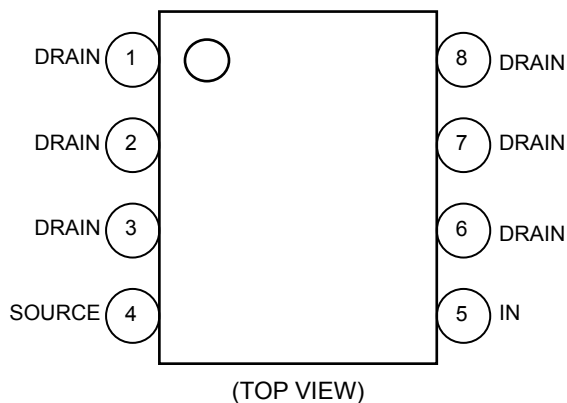
### Features

- A monolithic power IC with a new structure combining a control block and a vertical power MOSFET (L<sup>2</sup>-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.

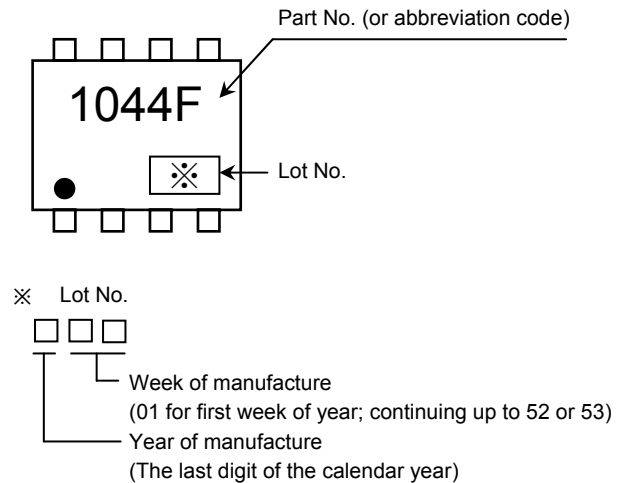


Weight: 0.017 g (typ.)

### Pin Assignment (top view)

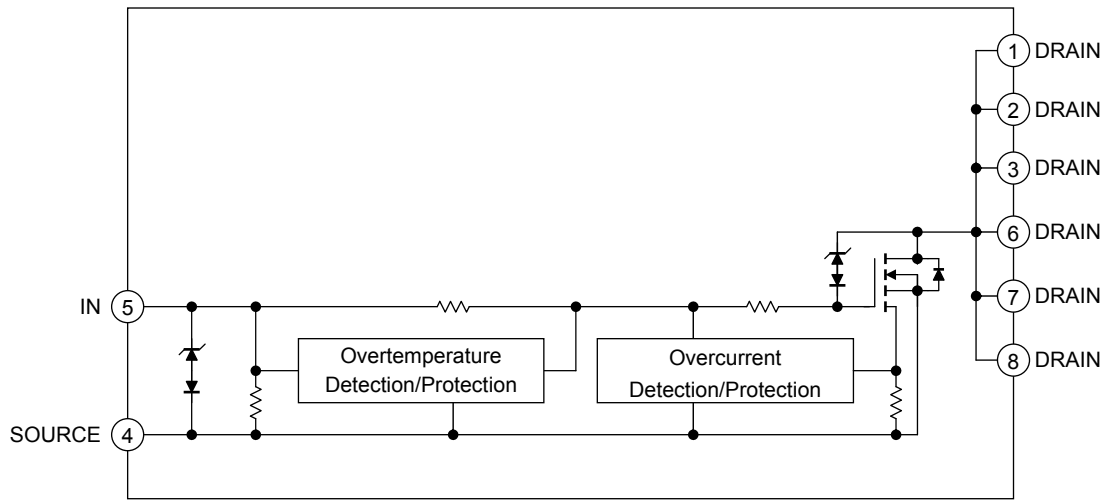


### Marking



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

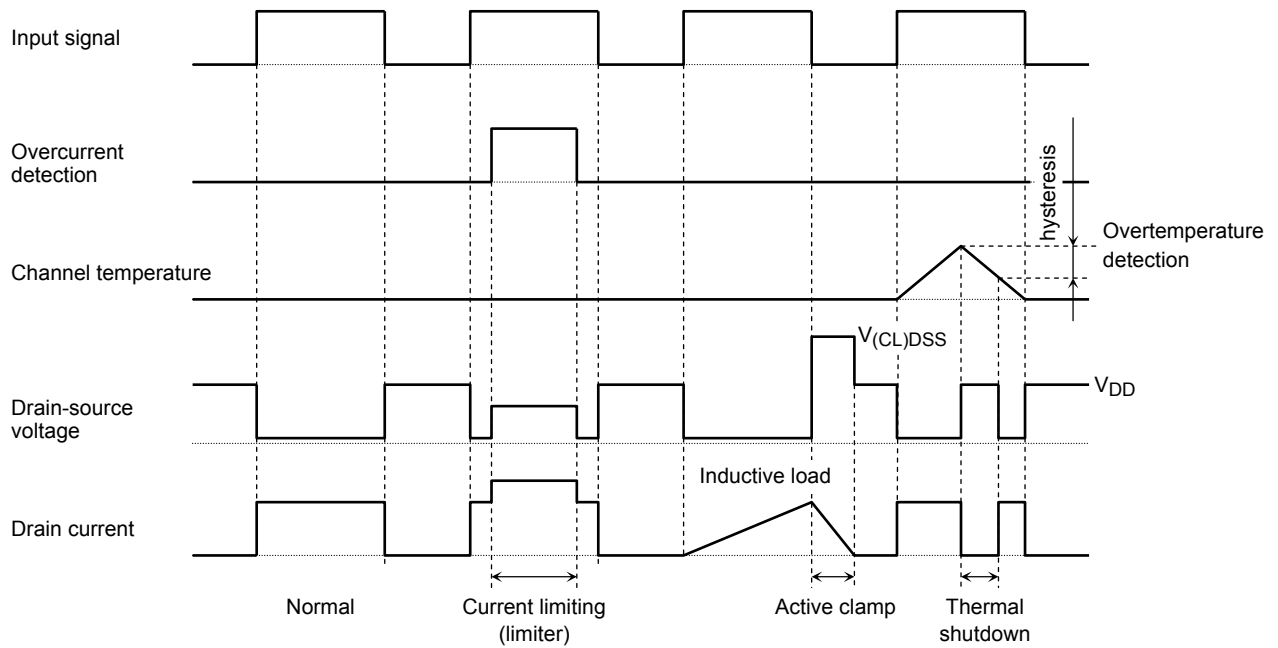
**Block Diagram**



**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 <sub>DS</sub>	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),  $L = 50\text{ mH}$ ,  $I_{AR} = 1\text{ A}$ ,  $R_G = 25\ \Omega$

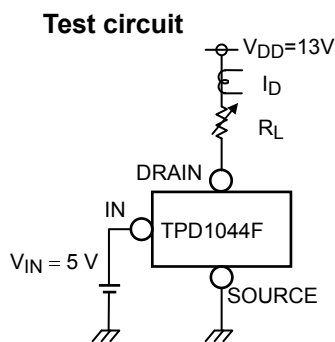
Note 5: Repetitive rating, pulse width limited by maximum channel temperature.

## Electrical Characteristics(Ta = 25°C)

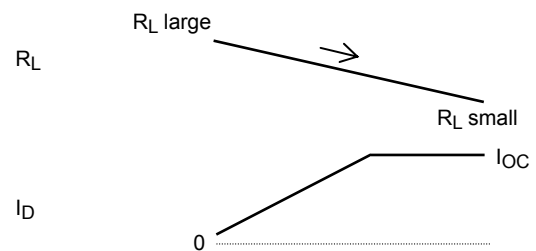
Characteristics	Symbol	Test circuit	Test condition	Min	Typ.	Max	Unit
Drain-source clamp voltage	$V_{(CL) DSS}$	-	$V_{IN} = 0 V, I_D = 1 mA$	41	-	60	V
Input threshold voltage	$V_{th}$	-	$V_{DS} = 13 V, I_D = 10 mA$	1.0	-	2.8	V
Protective circuit operation input voltage range	$V_{IN (opr)}$	-	-	3	-	6	V
Drain cut-off current	$I_{DSS}$	-	$V_{IN} = 0 V, V_{DS} = 30 V$	-	-	10	$\mu A$
Input current	$I_{IH (1)}$	-	$V_{IN} = 5 V$ , at normal operation	-	-	300	$\mu A$
	$I_{IH (2)}$	-	$V_{IN} = 5 V$ , 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	$\Omega$
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	-	$\mu s$
	$t_{off}$			-	15	-	

### Test circuit 1

#### Overcurrent measuring circuit



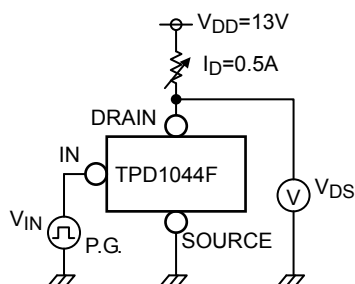
#### Measured waveforms



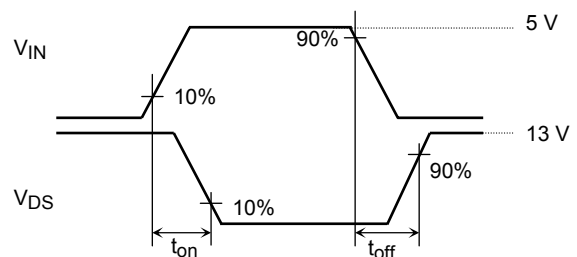
### Test circuit 2

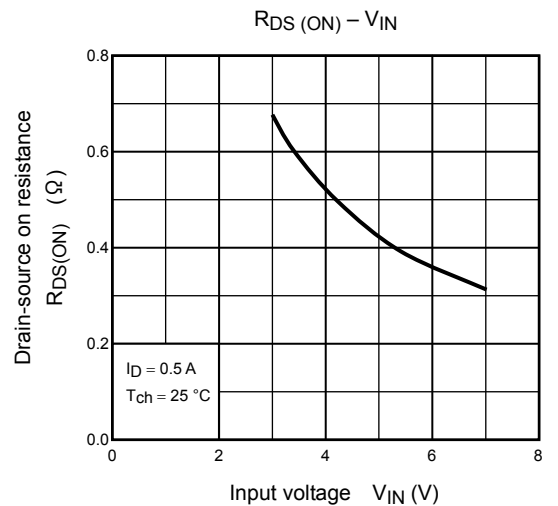
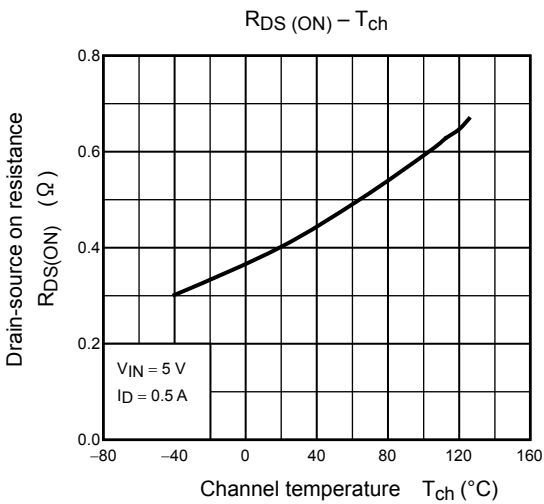
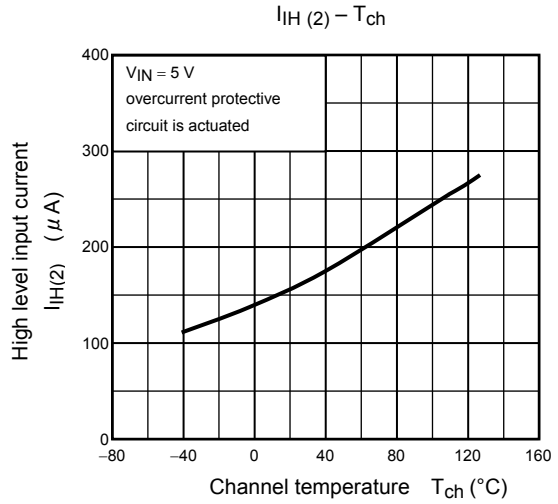
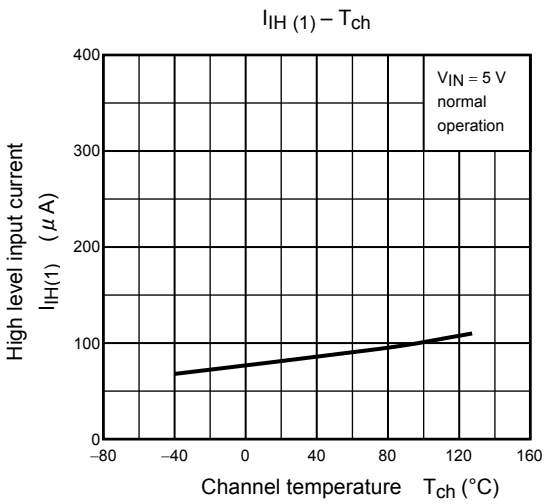
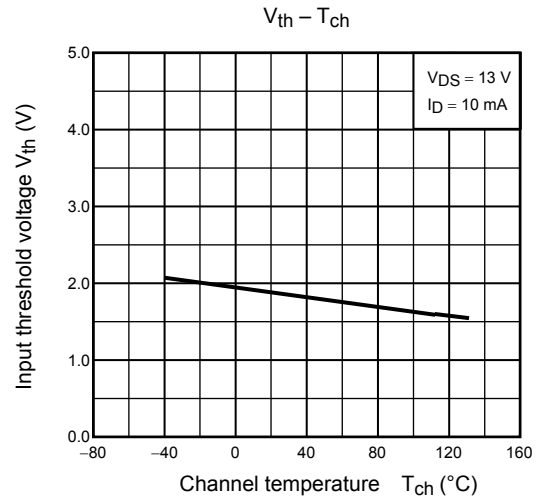
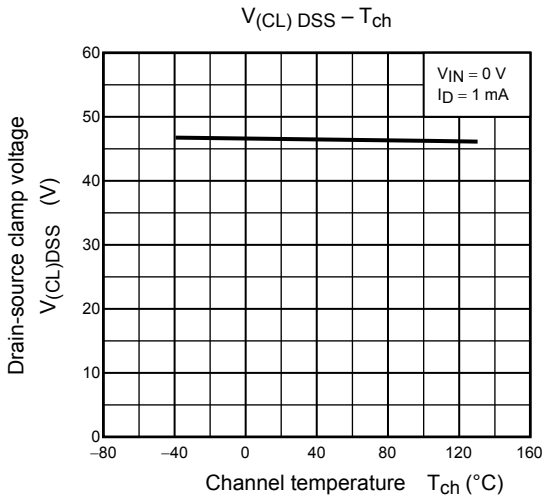
#### Switching time measuring circuit

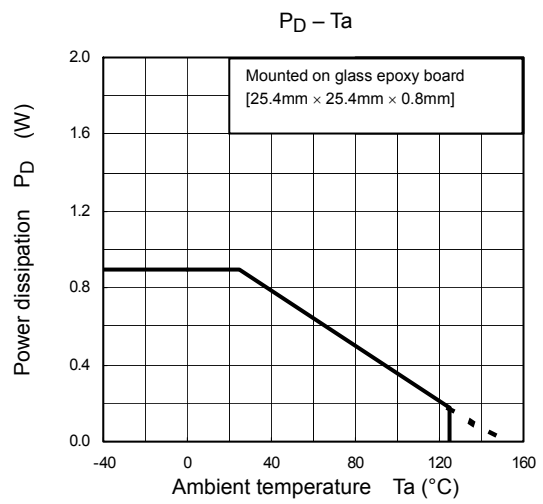
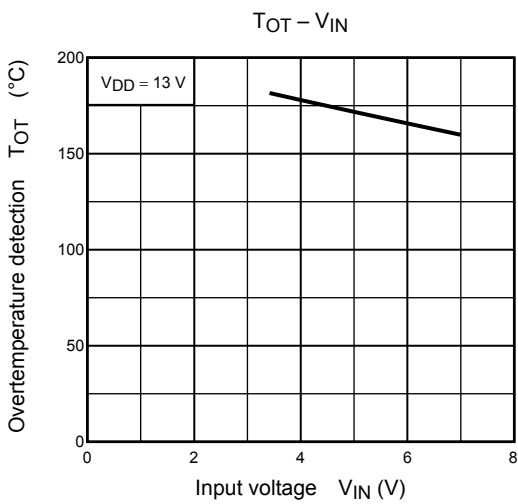
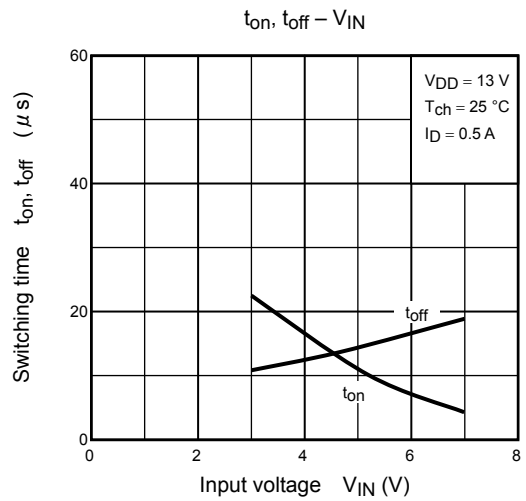
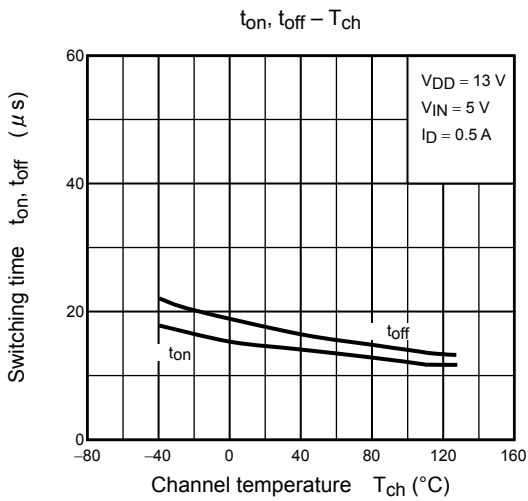
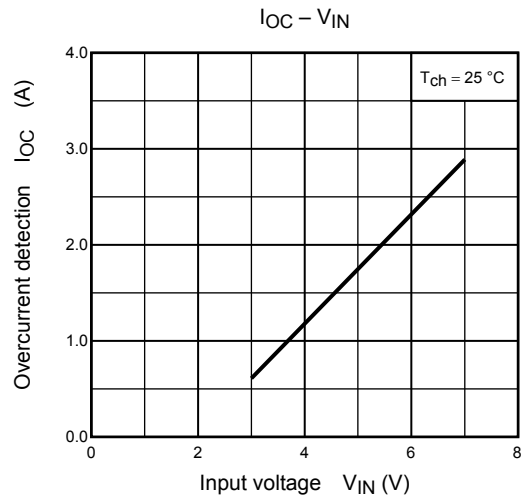
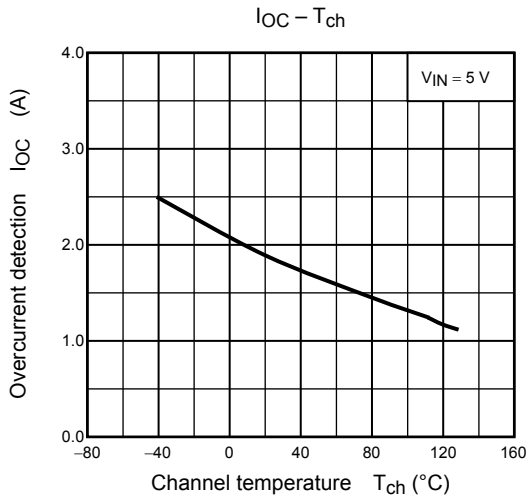
#### Test circuit

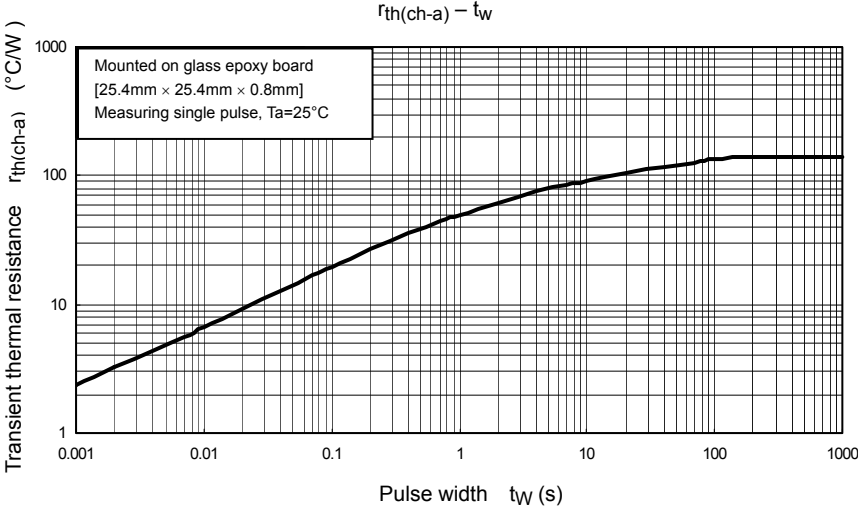


#### Measured waveforms







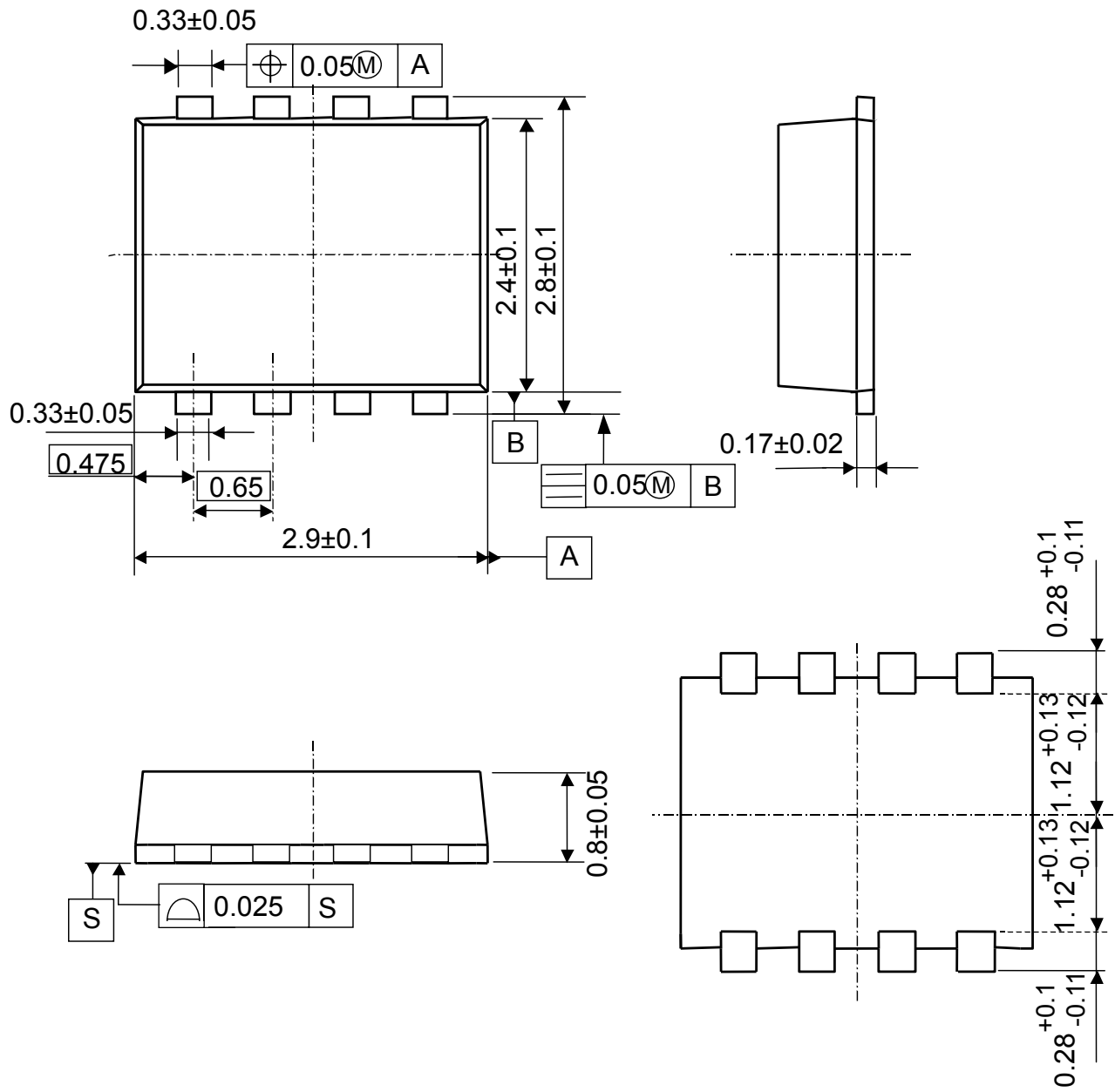




## Package Dimensions

SON8-P-0303-0.65

Unit : mm



Weight: 0.017 g (Typ.)

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20070701-EN GENERAL

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