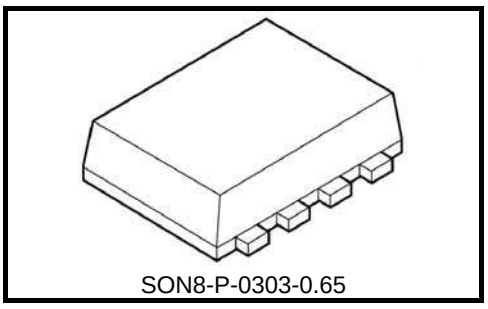
Toshiba Intelligent Power Device Silicon Monolithic Power MOS Integrated Circuit

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.



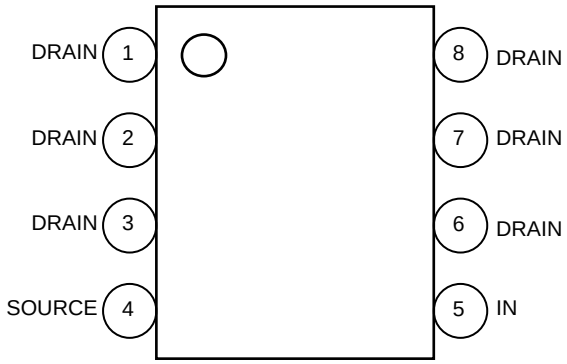
SON8-P-0303-0.65

Weight: 0.017 g (typ.)

Features

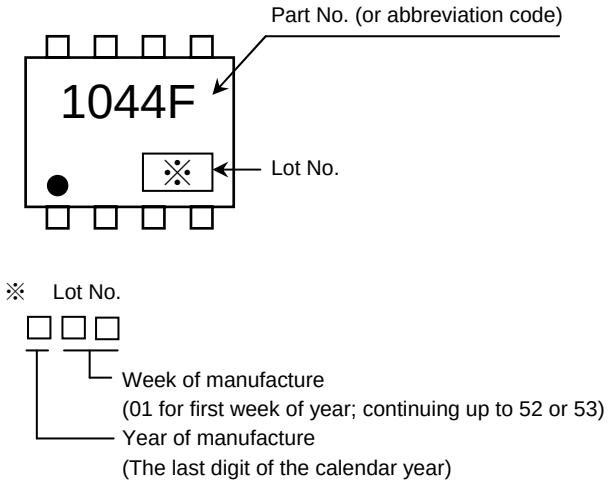
- A monolithic power IC with a new structure combining a control block and a vertical power MOSFET (L^2-π-MOSV) on single chip.
- Can directly drive a power load from a CMOS or TTL logic.
- Built-in protection circuits against overvoltage (active clamp), overtemperature (thermal shutdown), and overcurrent (current limiter).
- Low Drain-Source ON-resistance: $R_{DS\ (ON)}$ = 0.6 Ω (max) (@V_{IN} = 5 V, I_D = 0.5 A, T_{ch} = 25°C)
- Low Leakage Current: I_{DSS} = 10 μA (max) (@V_{IN} = 0 V, V_{DS} = 30 V, T_{ch} = 25°C)
- Low Input Current: I_{IN} = 300 μA (max) (@V_{IN} = 5 V, T_{ch} = 25°C)
- "PS-8" package with embossed-tape packing.

Pin Assignment (top view)



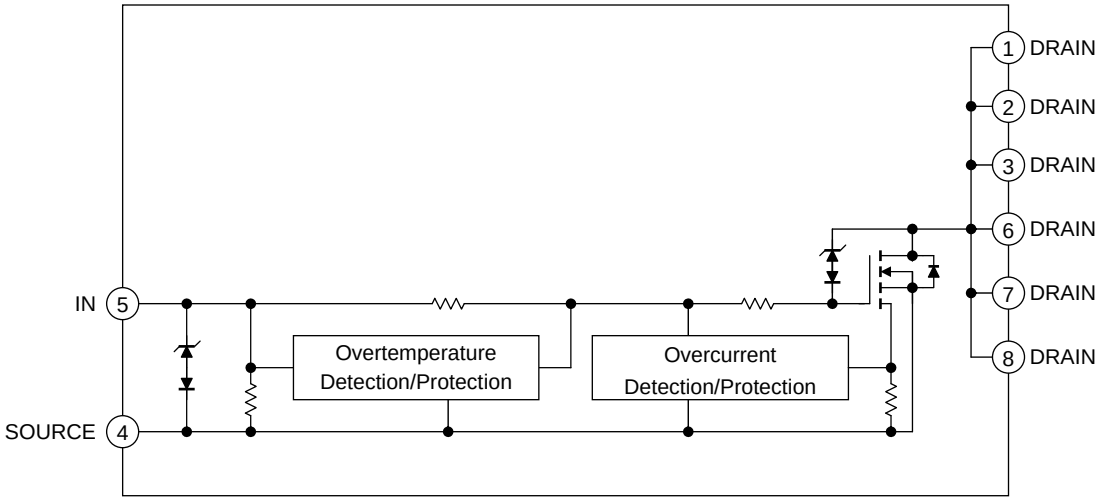
(TOP VIEW)

Marking



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

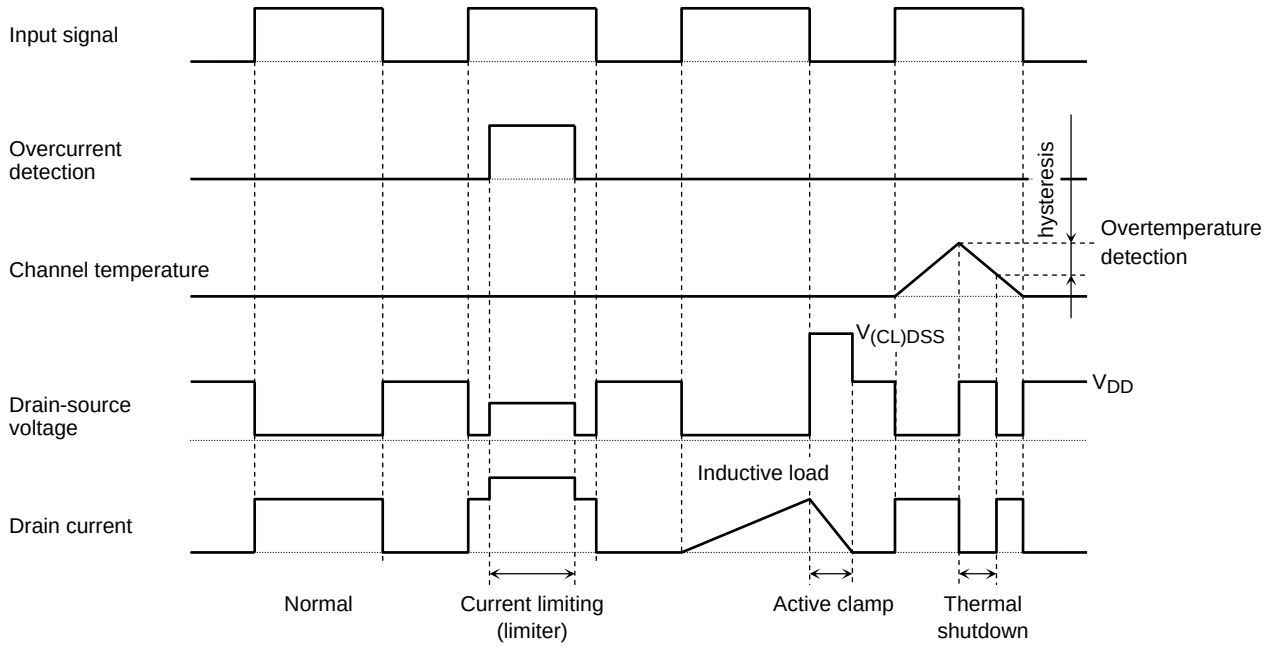
Block Diagram



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℃ 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℃)

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	℃
Channel temperature	T_{ch}	150	℃
Storage temperature	T_{stg}	−55~150	℃

Thermal Characteristics

Characteristics	Symbol	Max	Unit
Thermal resistance, channel to ambient (Note 3)	$R_{th\ (ch-a)}$	138.9	℃/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 V, T_{ch} = 25℃(initial), L = 50 mH, I_{AR} = 1 A, R_G = 25 Ω

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

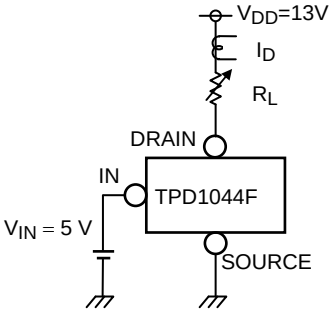
Electrical Characteristics(Ta = 25°C)

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	-	°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	-	

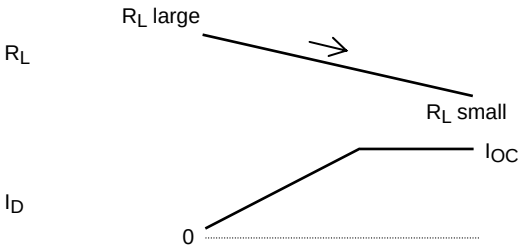
Test circuit 1

Overcurrent measuring circuit

Test circuit



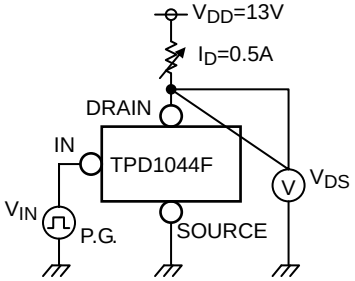
Measured waveforms



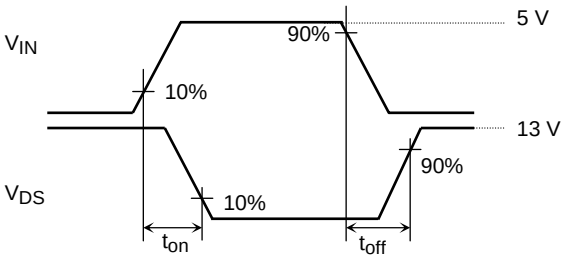
Test circuit 2

Switching time measuring circuit

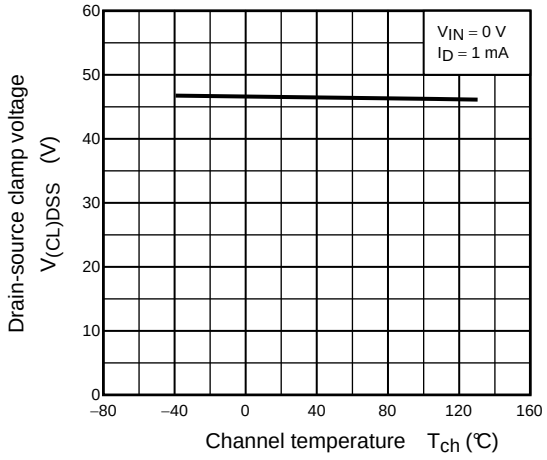
Test circuit



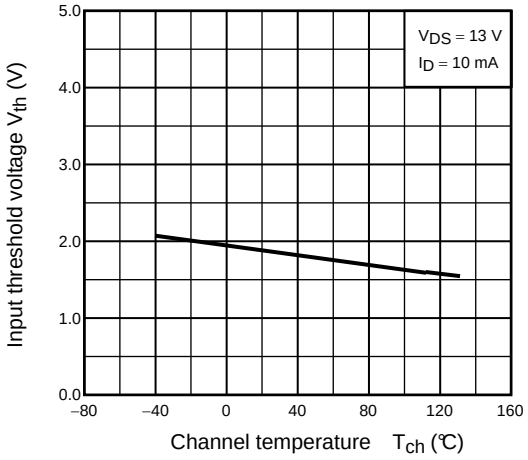
Measured waveforms



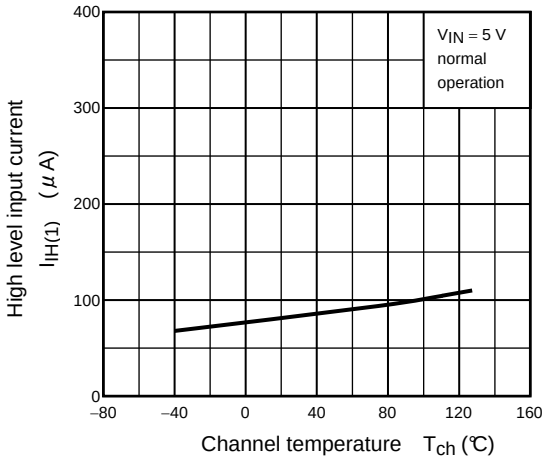
$V_{(CL)\ DSS} - T_{ch}$



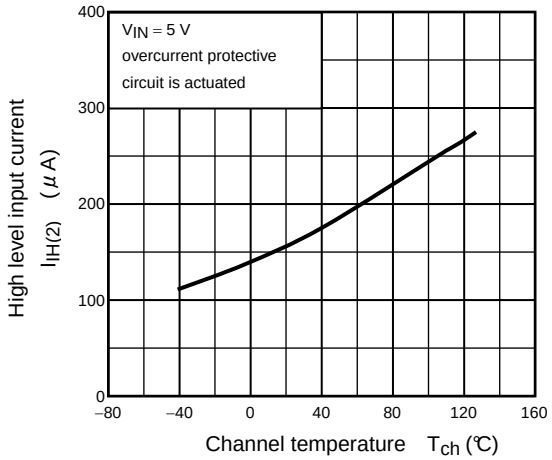
$V_{th} - T_{ch}$



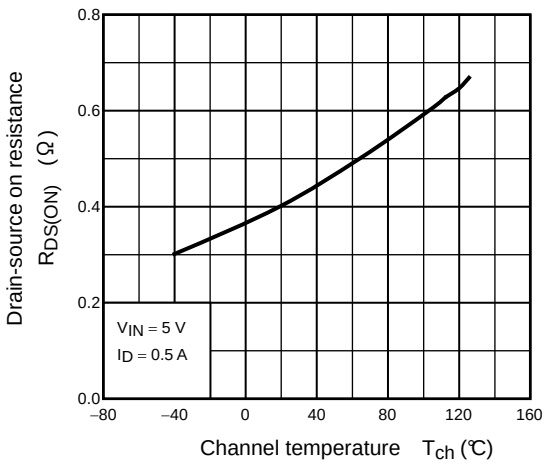
$I_{IH\ (1)} - T_{ch}$



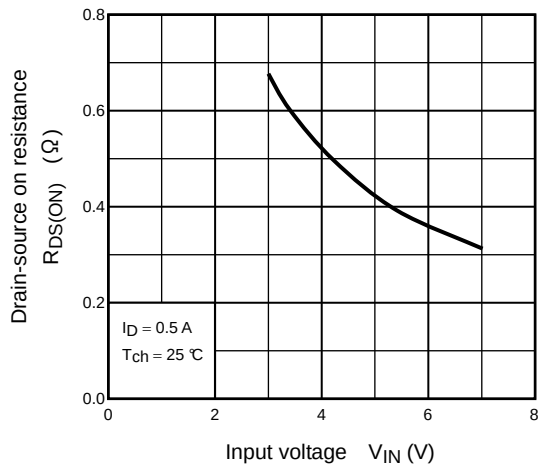
$I_{IH\ (2)} - T_{ch}$



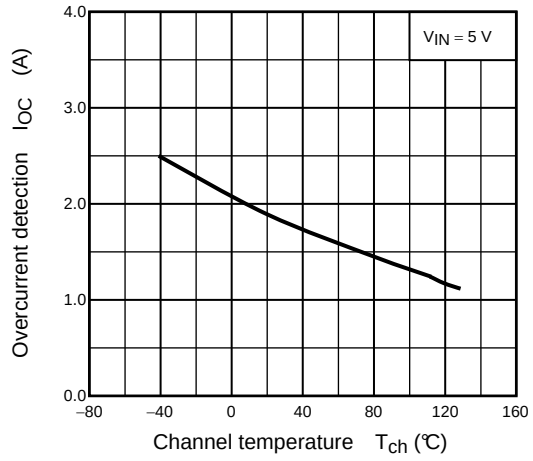
$R_{DS\ (ON)} - T_{ch}$



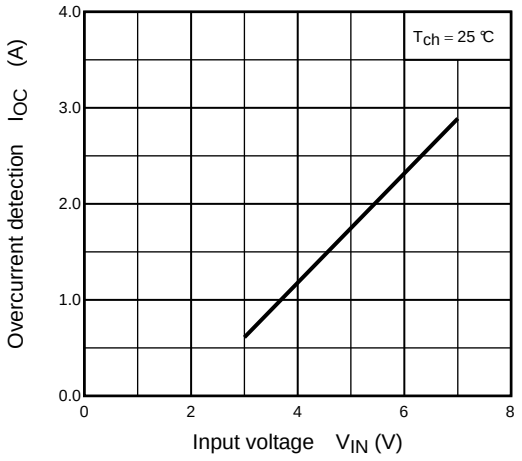
$R_{DS\ (ON)} - V_{IN}$



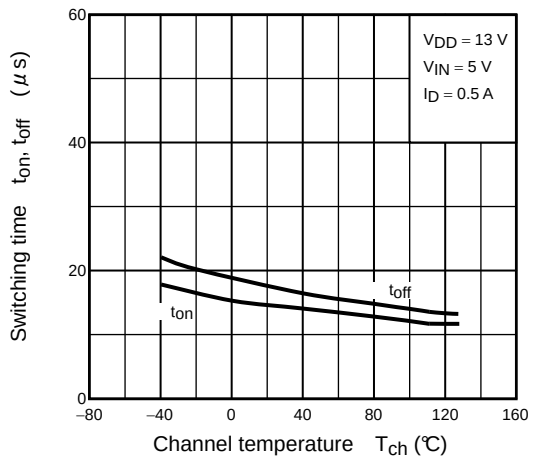
$I_{OC} - T_{ch}$



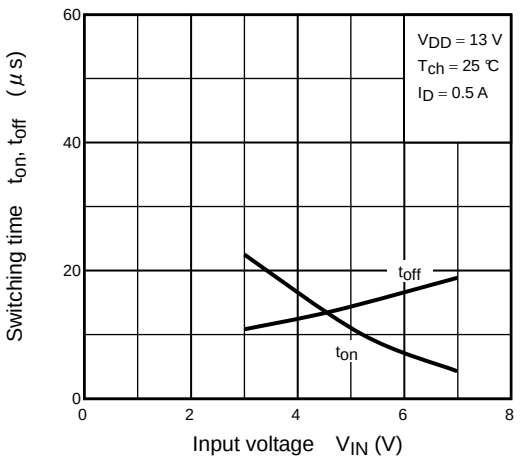
$I_{OC} - V_{IN}$



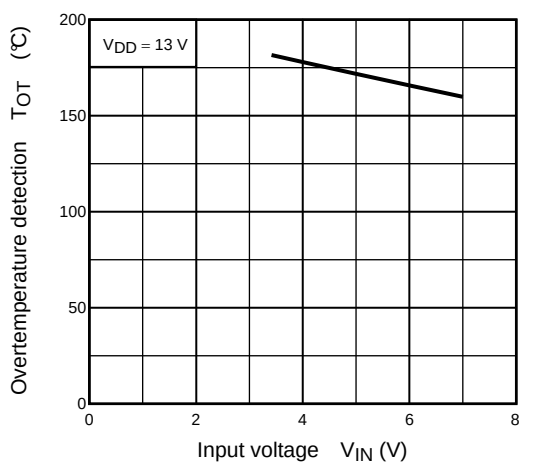
$t_{on}, t_{off} - T_{ch}$



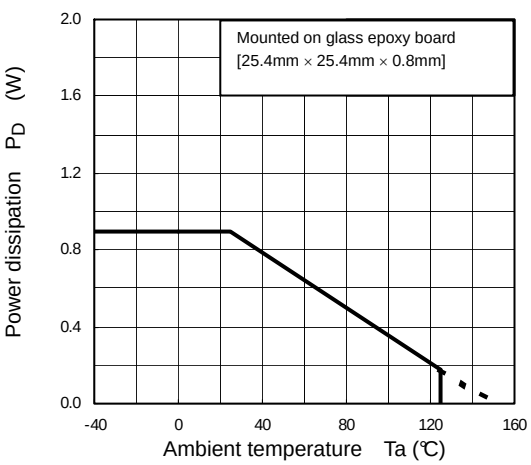
$t_{on}, t_{off} - V_{IN}$

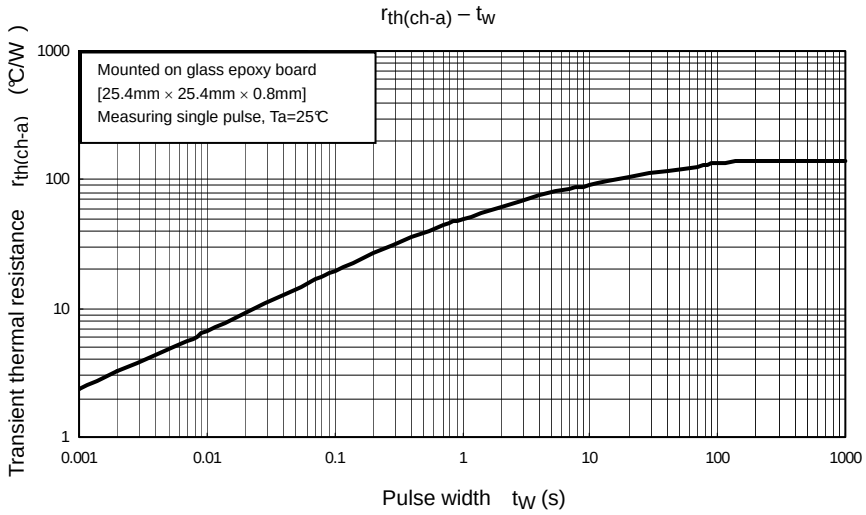


$T_{OT} - V_{IN}$



$P_D - Ta$

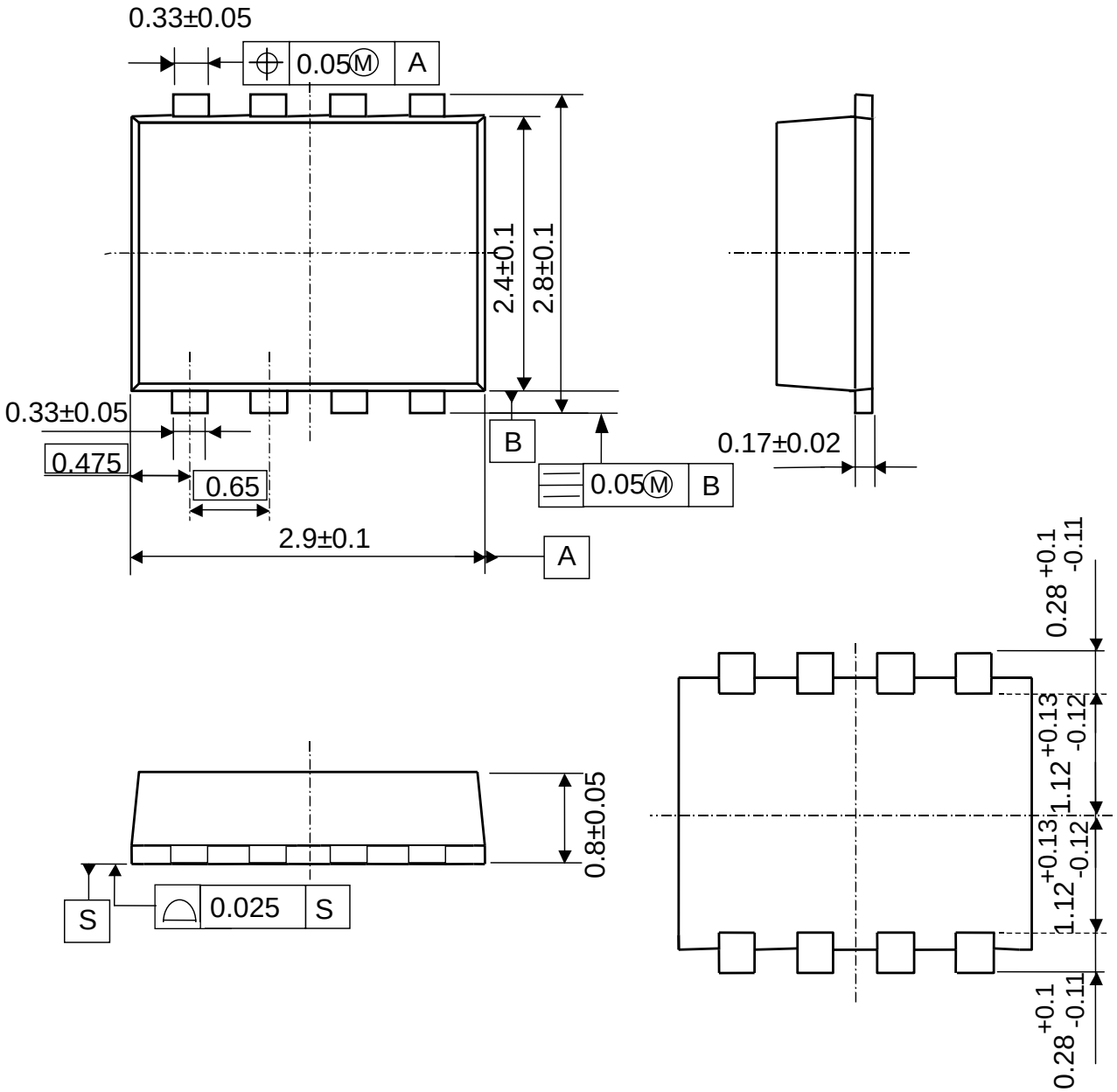



$r_{th(ch-a)} - t_w$
Mounted on glass epoxy board
[25.4mm × 25.4mm × 0.8mm]
Measuring single pulse, Ta=25℃
Transient thermal resistance $r_{th(ch-a)}$ (℃/W)
1000
100
10
1
0.001
0.01
0.1
1
10
100
1000
Pulse width t_W (s)

Package Dimensions

SON8-P-0303-0.65

Unit : mm



Weight: 0.017 g (Typ.)

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