

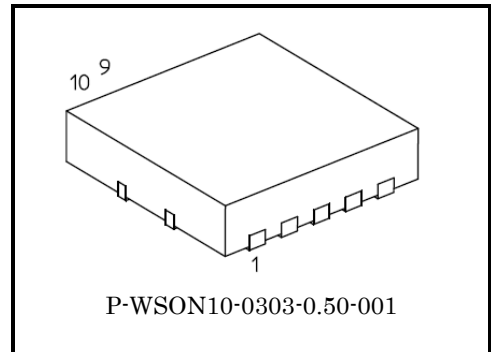
TPD1058FA

Low-Side Switch for Solenoid, Motor and Lamp Drive

The TPD1058FA is a monolithic power IC for low-side switches. The IC has a MOSFET (DMOS) output which can be directly driven from a CMOS or TTL logic circuit (e.g., an MPU). The IC is equipped with intelligent self-protective functions and diagnostic functions.

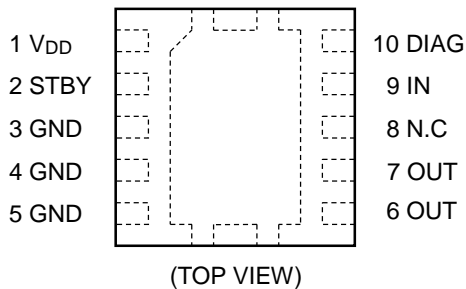
Features

- A monolithic power IC with a new structure combining a control block and a power MOSFET (DMOS) on single chip.
- Can directly drive a power load from CMOS or TTL logic.
- Built-in protection against overvoltage (active clamp), over temperature (thermal shutdown), and over current.
- Incorporates a diagnosis function that allows diagnosis output to be read externally at load short-circuiting, opening, or over temperature
- Low Drain-Source ON-resistance:
 $R_{DS(ON)} = 0.1 \Omega$ (Max) @ $V_{DD} = 5V, V_{STBY} = V_{IN} = 5V, I_O = 2A, T_{ch} = 25^\circ C$
- Low Standby Current:
 $I_{DD} = 10\mu A$ (Max) @ $V_{STBY} = V_{IN} = 0V, V_{DD} = 5V, T_{ch} = -40$ to $125^\circ C$
- WSON10 package with embossed-tape packing.

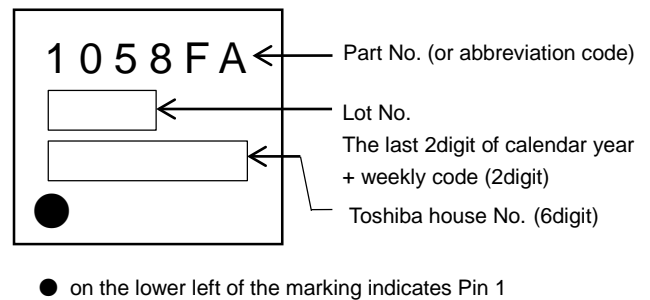


Weight: 0.02 g (typ.)

Pin Assignment (top view)



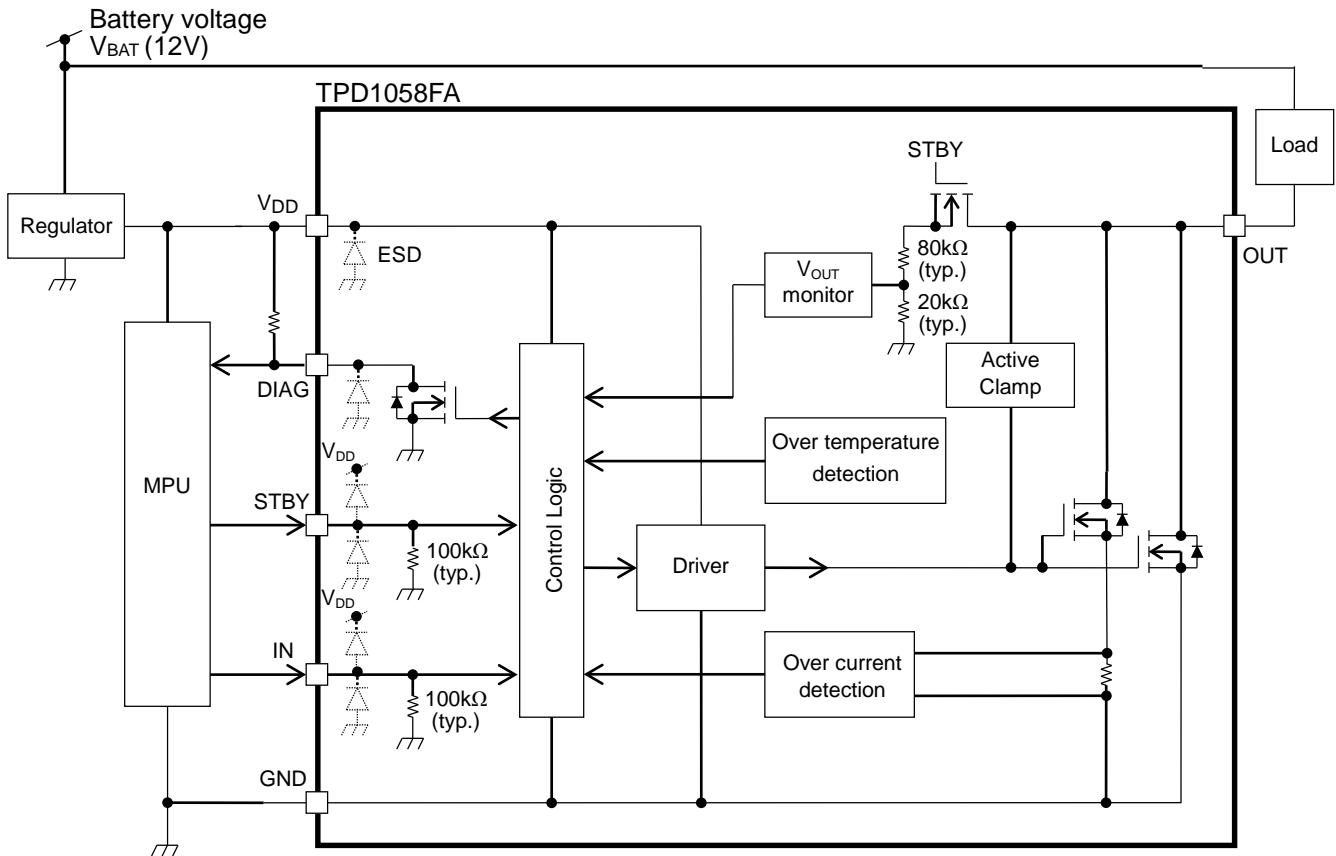
Marking



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

Start of commercial production
2015-4

Block Diagram / Application Circuit

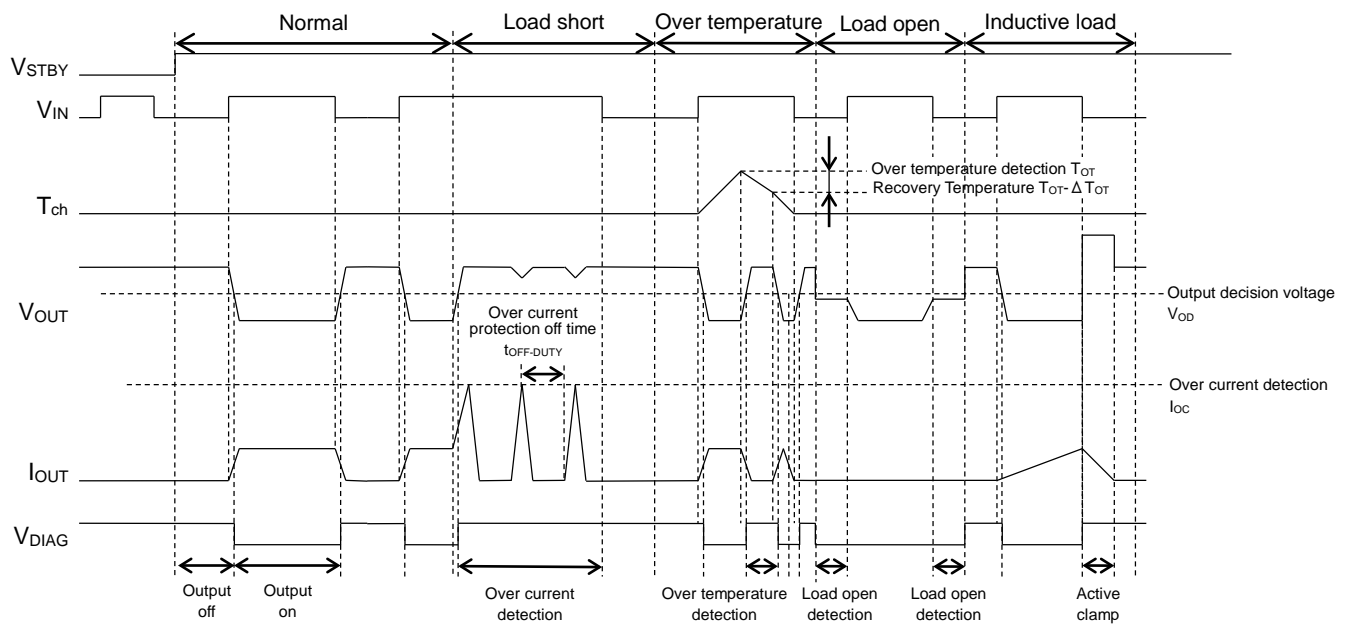


Note1: The value in block diagram is a standard value in T_{ch} = 25°C.

Pin Description

Pin No.	Symbol	Pin Description
1	V _{DD}	Power supply pin.
2	STBY	Standby pin. This pin has an internal pull-down resistor (100kΩ (typ.)). In the case of open state, it becomes standby mode same as V _{STBY} =V _{IL} . V _{STBY} =V _{IL} : I _{DD} ≤10μA (Standby mode) V _{STBY} =V _{IH} : Active control
3,4,5	GND	Ground pin.
6,7	OUT	Output pin. When a load short-circuit causes an overcurrent (6A min) to flow into a device, output current is limited in order to protect the IC.
8	N.C	No-Connect pin. (not connected to the chip.)
9	IN	Input pin. The IN pin has an internal pull-down resistor (100kΩ (typ.)). Even if the IN pin is open, the output will not accidentally turn on.
10	DIAG	Self-diagnosis output pin. N-channel open drain.

Timing chart



Truth table

STBY	IN	OUT	DIAG	Output DMOS	Operating state
L	L	H	H	OFF	Standby mode
	H	H	H	OFF	
H	L	H	H	OFF	Normal operation
	H	L	L	ON	
	L	H	H	OFF	Over current (VDD short / GND short)
	H	H(*1)	H	ON/OFF	
	L	H	H	OFF	Over temperature
	H	H(*1)	H	OFF	
	L	L(*2)	L	OFF	Load open (Disconnection)
	H	L	L	ON	

*1: Case of STBY=H and IN=H, the output voltage conditions to output a diagnosis are more than V_{OD} . ($V_{OUT} > V_{OD}$)

*2: Case of STBY=H and IN=L, the output voltage conditions to output a diagnosis are less than V_{OD} . ($V_{OUT} < V_{OD}$)

Absolute Maximum Ratings (Ta = 25°C)

Characteristics	Symbol	PIN	Rating	Unit	Note
Supply voltage	V _{DD}	V _{DD}	-0.3 to 6	V	-
Input voltage	V _{IN} , V _{STBY}	IN,STBY	-0.3 to 6	V	-
DIAG output voltage	V _{DIAG}	DIAG	-0.3 to 6	V	-
DIAG output current	I _{DIAG}	DIAG	5	mA	-
Output voltage	V _{OUT}	OUT	-0.3 to 40	V	N channel DMOS (V _{DSS} =60V)
Output current	I _{OUT}	OUT	Internally limited	A	-
Power dissipation (Note 2)	P _D	-	1.84	W	Note 2
Single pulse active clamp capability (Note 3)	E _{AS}	-	95	mJ	-
Active clamp current	I _{AR}	OUT	6	A	-
Operating temperature	T _{opr}	-	-40 to 125	°C	-
Channel temperature	T _{ch}	-	150	°C	-
Storage temperature	T _{stg}	-	-40 to 150	°C	-

Note1: 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

Characteristics	Symbol	Rating	Unit
Thermal resistance, channel to ambient	R _{th (ch-a)}	67.6	°C / W

Note 2: Glass epoxy board
 Material: FR-4(4 layer)
 Board size: 76.2mm×114.3mm×1.6mm
 Via: φ0.3mm(2 point)

Note 3: Active clamp capability (single pulse) test condition
 V_{DD}=12V, T_{ch}=25°C(initial), L=3.9 mH, I_{AR}=6 A

Electrical Characteristics

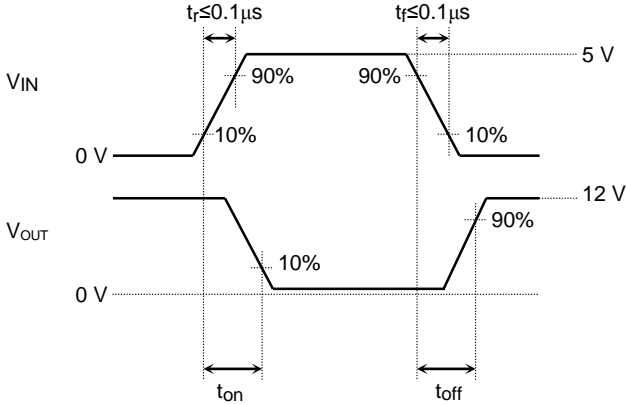
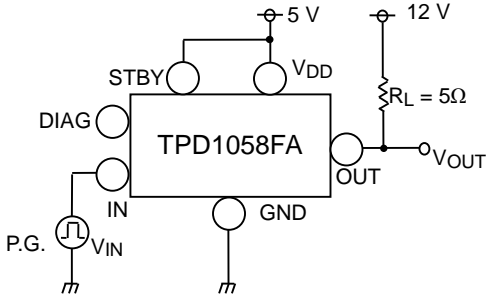
(Unless otherwise specified T_{ch} = -40 to 125°C, V_{DD} = 4.5 to 5.5V)

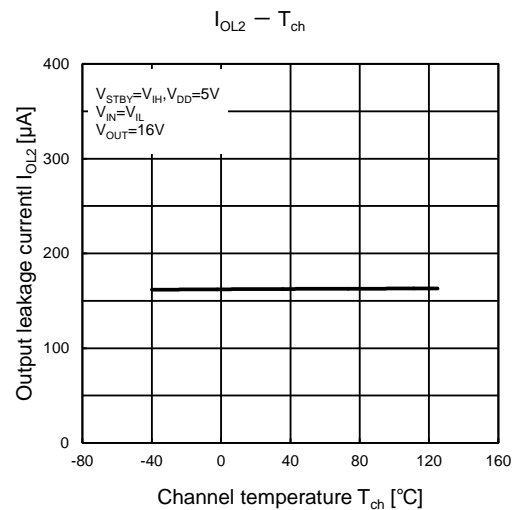
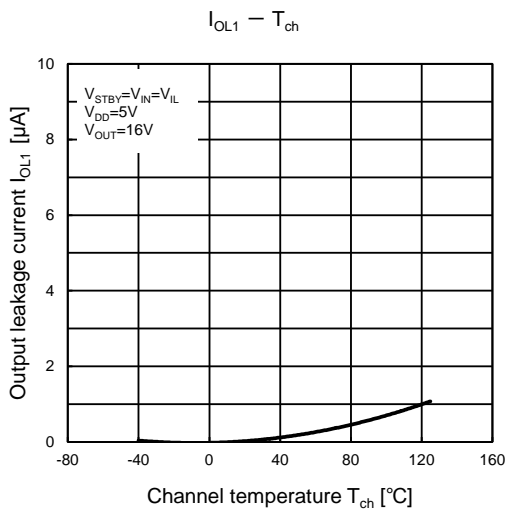
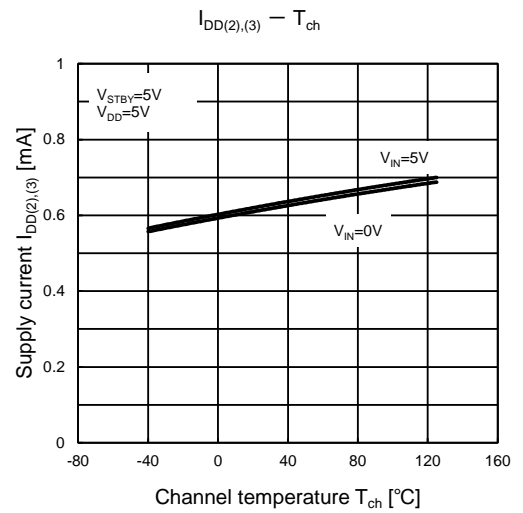
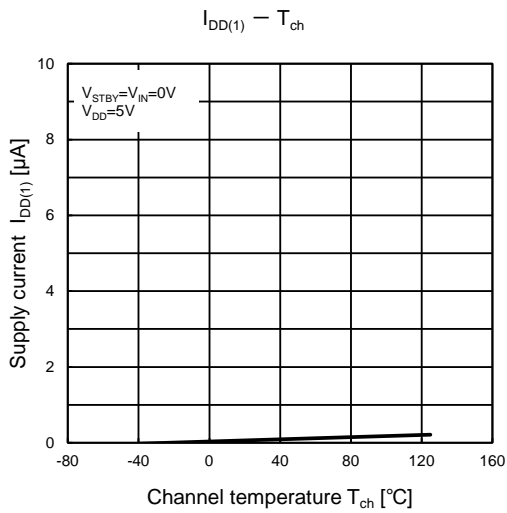
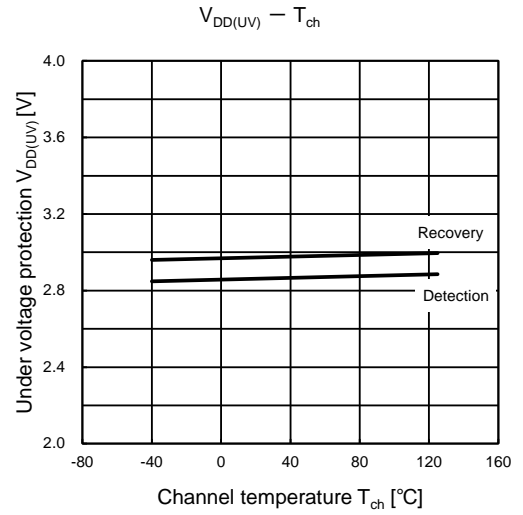
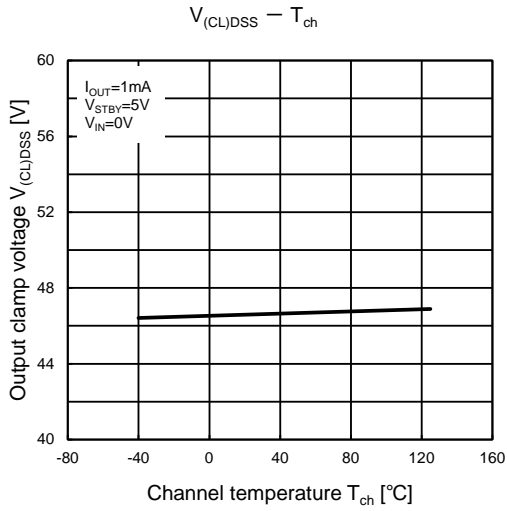
Characteristics	Symbol	Pin	Test condition	Min	Typ.	Max	Unit
Output clamp voltage	V _{(CL)DSS}	OUT	I _{OUT} =1mA, V _{STBY} =5V, V _{IN} =0V	40	46	60	V
Operating supply voltage	V _{DD(opr)}	V _{DD}	-	4.5	5	5.5	V
Under voltage protection	V _{DD(UV)}	V _{DD}	-	2.5	2.9	3.5	V
Supply current	I _{DD1}	V _{DD}	V _{STBY} =0V, V _{IN} =0V, V _{DD} =5V,	-	0	10	μA
	I _{DD2}	V _{DD}	V _{STBY} =5V, V _{IN} =0V, V _{DD} =5V	-	0.61	2	mA
	I _{DD3}	V _{DD}	V _{STBY} =5V, V _{IN} =5V, V _{DD} =5V	-	0.62	5	mA
Output leakage current	I _{OL1}	OUT	V _{STBY} =V _{IL} , V _{IN} =V _{IL} , V _{OUT} =8 to 16V	-	-	10	μA
	I _{OL2}	OUT	V _{STBY} =V _{IH} , V _{IN} =V _{IL} , V _{OUT} =8 to 16V	-	160	300	μA
High level input voltage	V _{IH}	IN,STBY	-	2.0	-	-	V
Low level input voltage	V _{IL}	IN,STBY	-	-	-	0.8	V
High level input current	I _{IH}	IN,STBY	V _{IN} (V _{STBY})=5V, V _{DD} =5V	-	50	200	μA
Low level input current	I _{IL}	IN,STBY	V _{IN} (V _{STBY})=0V, V _{DD} =5V	-1	-	1	μA
DIAG leakage current	I _{DH}	DIAG	V _{DIAG} =5V	-	-	3	μA
DIAG output voltage	V _{DL}	DIAG	I _{DIAG} =+1mA	-	0.01	0.2	V
Output resistance (output DMOS on)	R _{DS(ON)1}	OUT	I _{OUT} =+2A, T _{ch} =25°C, V _{DD} =5V, V _{STBY} =V _{IH} , V _{IN} =V _{IH}	-	0.07	0.10	Ω
	R _{DS(ON)2}	OUT	I _{OUT} =+2A, T _{ch} =-40 to 125°C, V _{DD} =5V, V _{STBY} =V _{IH} , V _{IN} =V _{IH}	-	-	0.16	Ω
Over temperature detection	T _{OT}	-	V _{STBY} =V _{IH} , V _{IN} =V _{IH}	150	172	200	°C
	ΔT _{OT}	-		-	12	-	
Over current detection	I _{OC}	OUT	V _{STBY} =V _{IH} , V _{IN} =V _{IH} , V _{DD} =5V	6	13	-	A
Over current protection off time	t _{OFF-DUTY}	OUT	V _{BAT} =12V, R _L =0.1Ω, V _{DD} =5V, V _{STBY} =V _{IH} , V _{IN} =V _{IH}	3	7	12	ms
Load open detection resistance	R _{op}	OUT	V _{STBY} =V _{IH} , V _{IN} =V _{IL} , V _{OUT} =8 to 16V	10	300	1000	kΩ
	ΔR _{op}	OUT	V _{STBY} =V _{IH} , V _{IN} =V _{IL} , V _{OUT} =8 to 16V	-	40	-	kΩ
Output detection voltage	V _{OD}	OUT	V _{STBY} =V _{IH} , V _{OUT} =L→H	2	3	4	V
	ΔV _{OD}	OUT	V _{STBY} =V _{IH}	-	0.3	-	V
Output resistance (output DMOS off)	R _{OUT1}	OUT	V _{STBY} =V _{IH} , V _{IN} =V _{IL} , V _{DD} =4.5 to 5.5V T _{ch} =25°C	75	100	125	kΩ
	R _{OUT2}	OUT	V _{STBY} =V _{IH} , V _{IN} =V _{IL} , V _{DD} =4.5 to 5.5V T _{ch} =-40 to 125°C	60	100	140	kΩ
Switching time	Δt _f	OUT	V _{STBY} =V _{IH} , V _{DD} =5V, T _{ch} =25°C, V _{BAT} =12V, R _L =5Ω, Slew rate : V _{OUT} 10% to 90%	7	16.4	-	V/μs
	t _{on}	OUT		-	0.8	5	μs
	Δt _r	OUT		7	15.5	-	V/μs
	t _{off}	OUT		-	2.1	5	μs

*The condition of the typical value is T_{ch}=25°C, V_{DD}=5V.

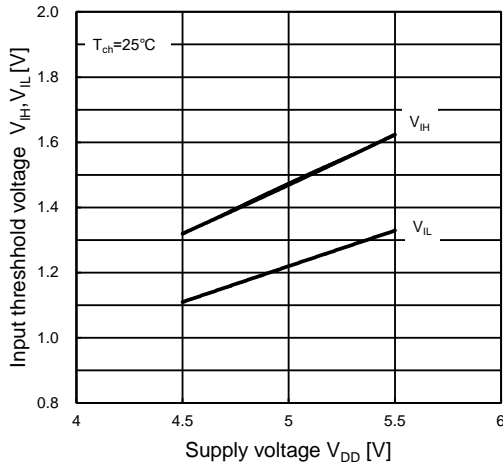
Test Circuit

Switching time t_{on} , t_{off}

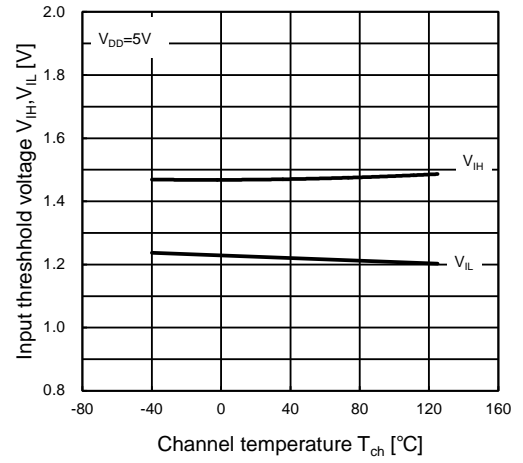




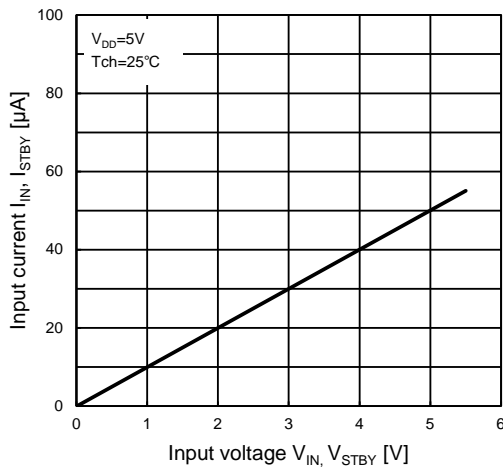
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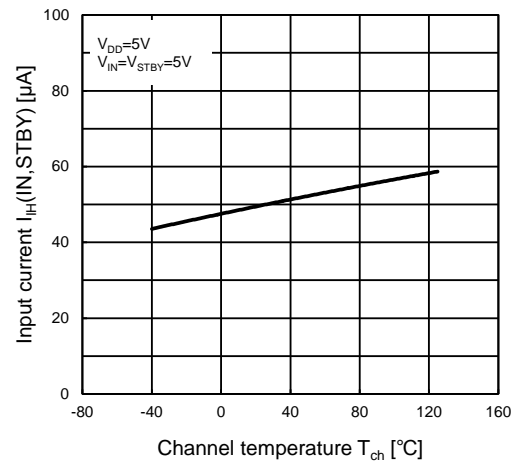
$V_{IH}, V_{IL} - T_{ch}$



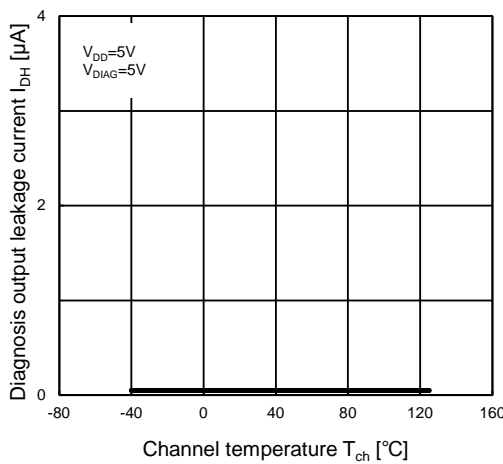
$I_{IN} - V_{IN}$



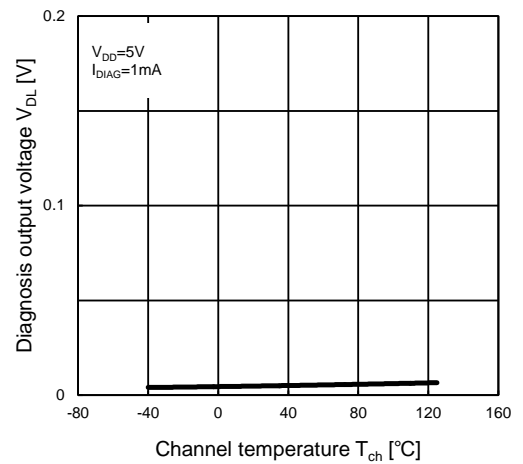
$I_{IH} - T_{ch}$

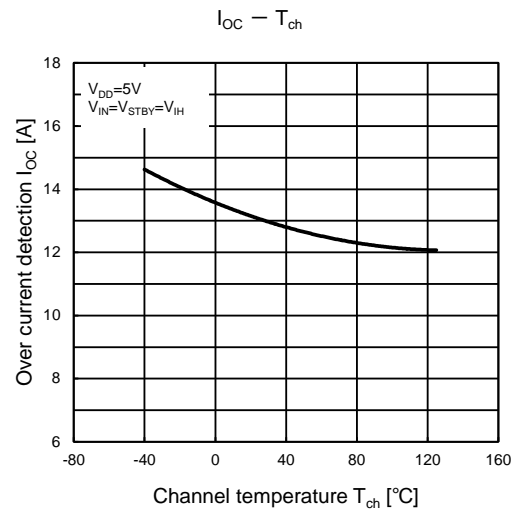
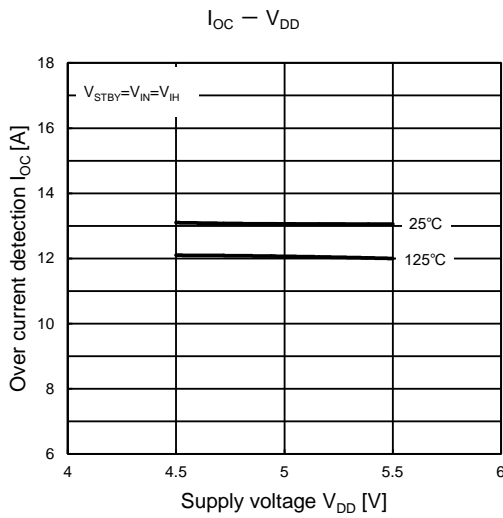
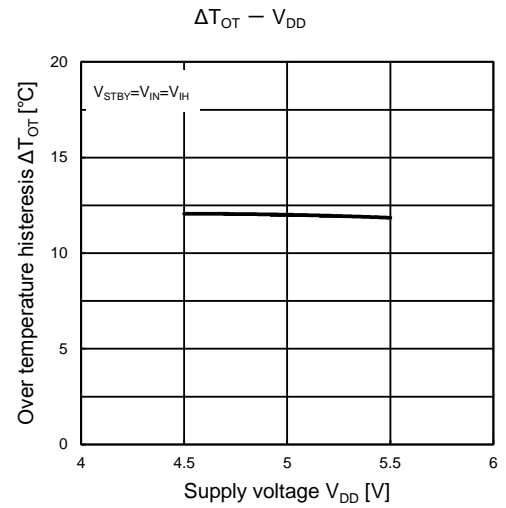
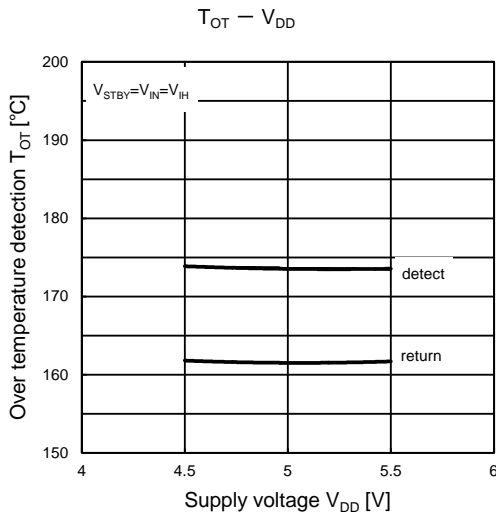
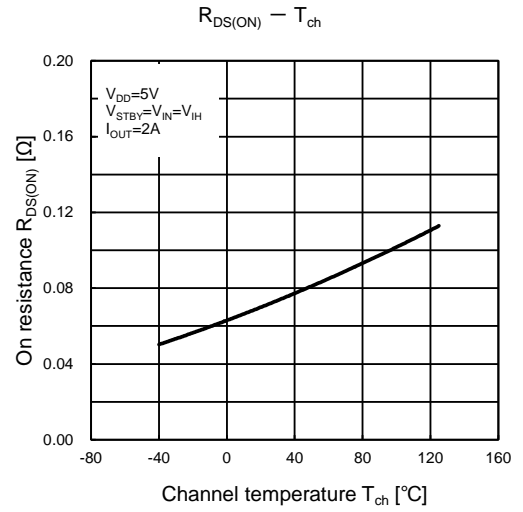
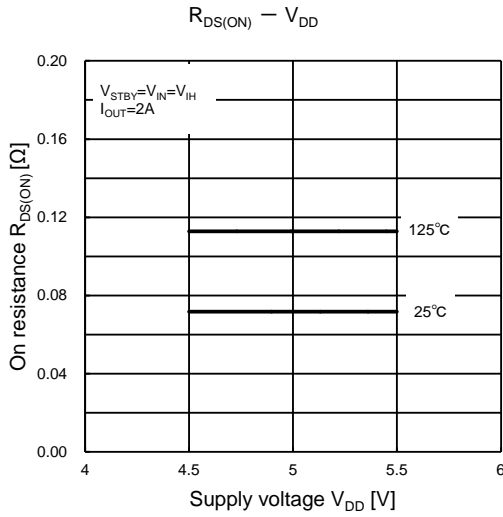


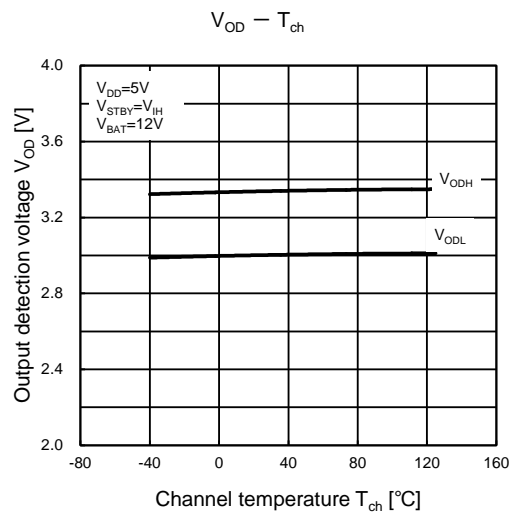
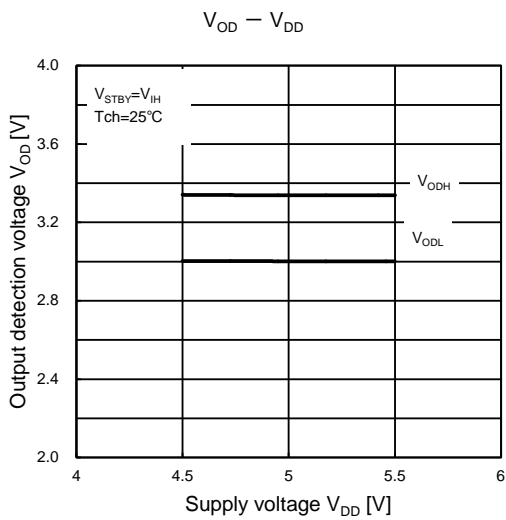
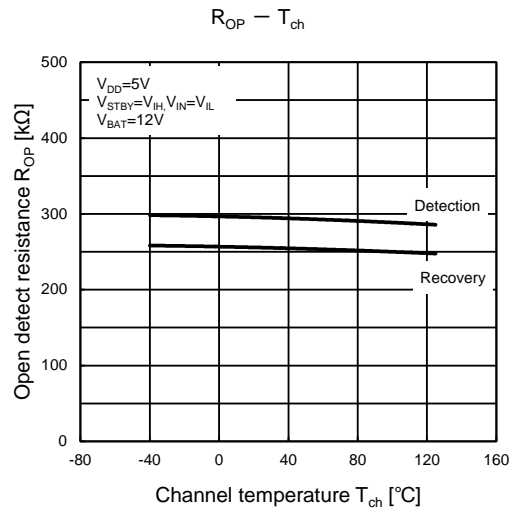
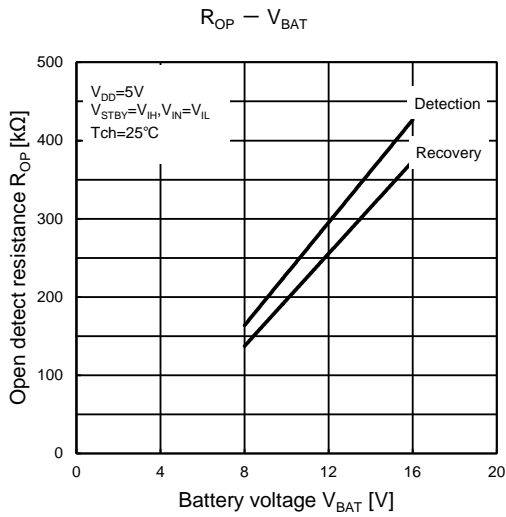
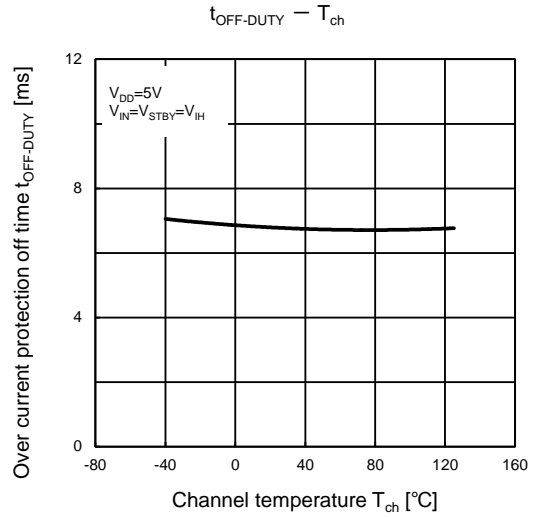
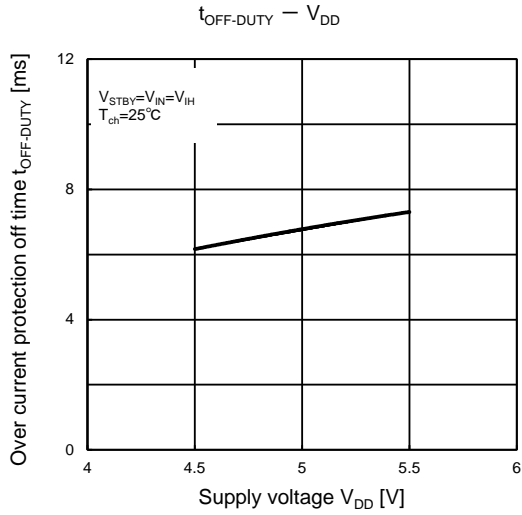
$I_{DH} - T_{ch}$

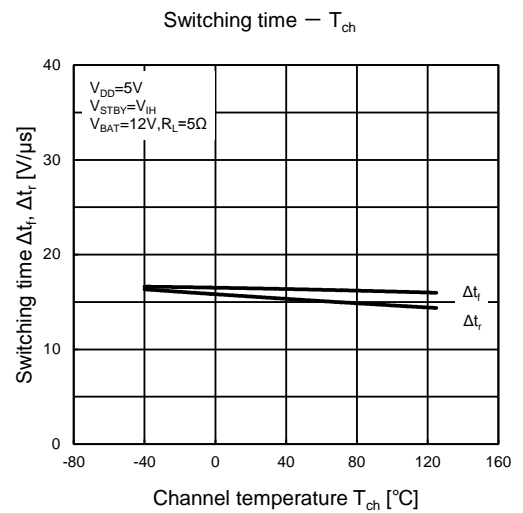
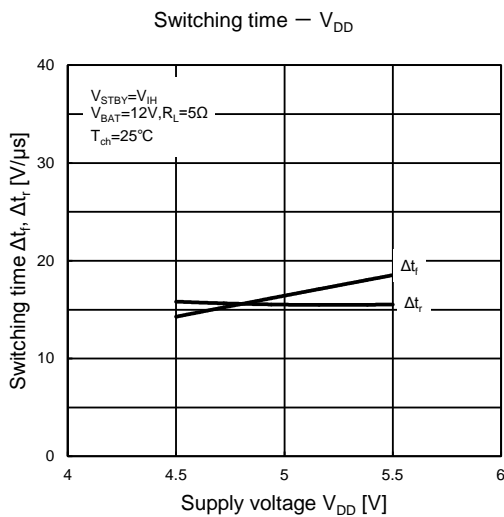
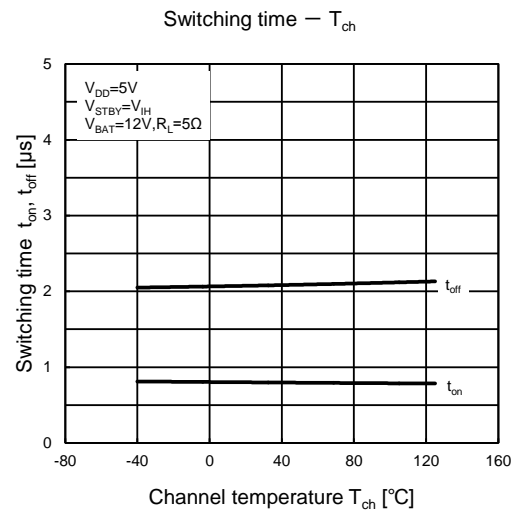
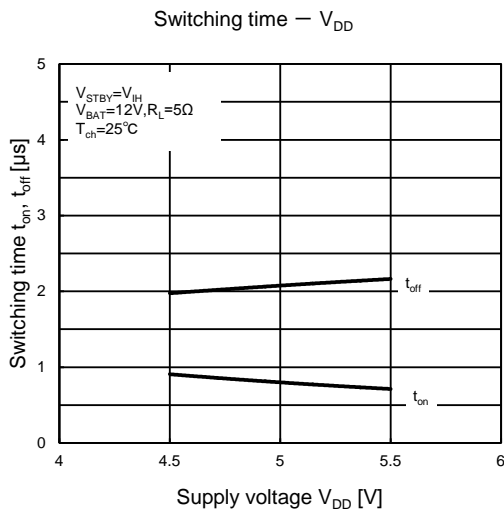
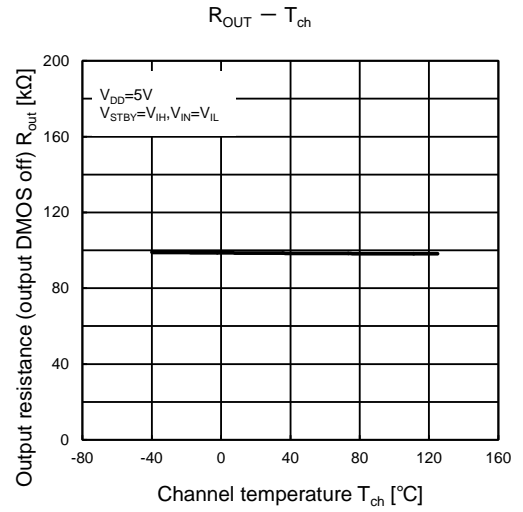
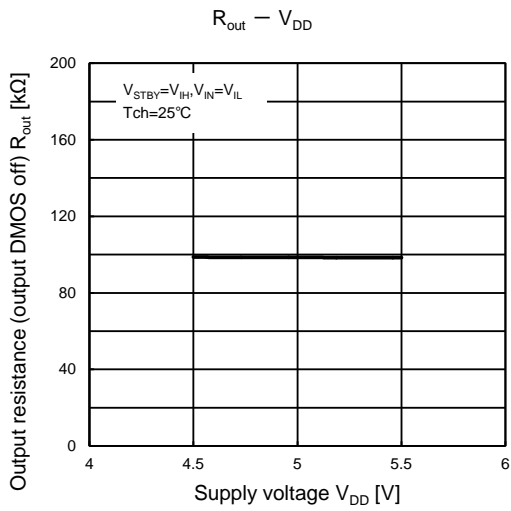


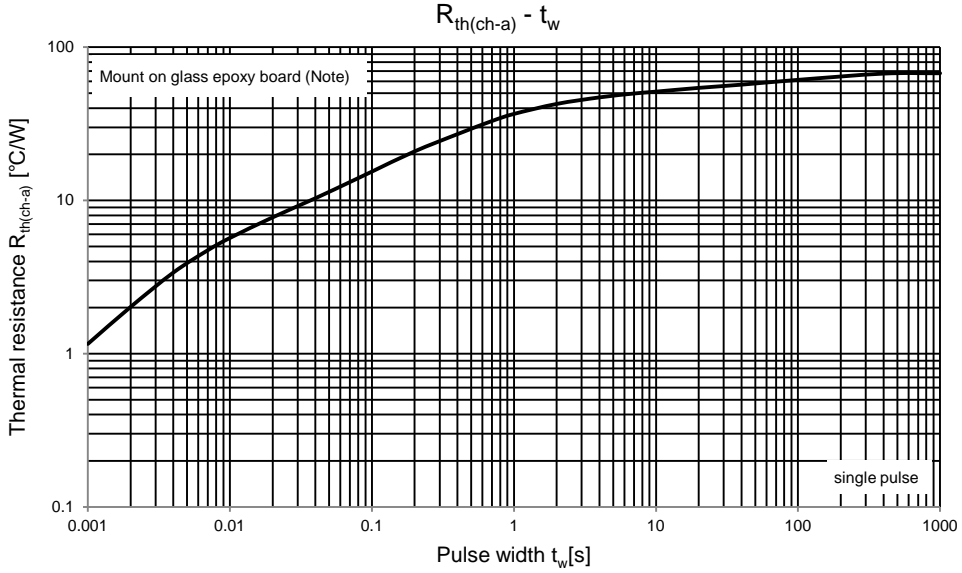
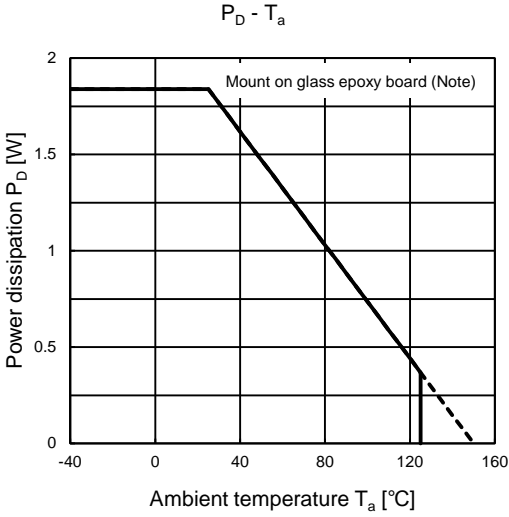
$V_{DL} - T_{ch}$









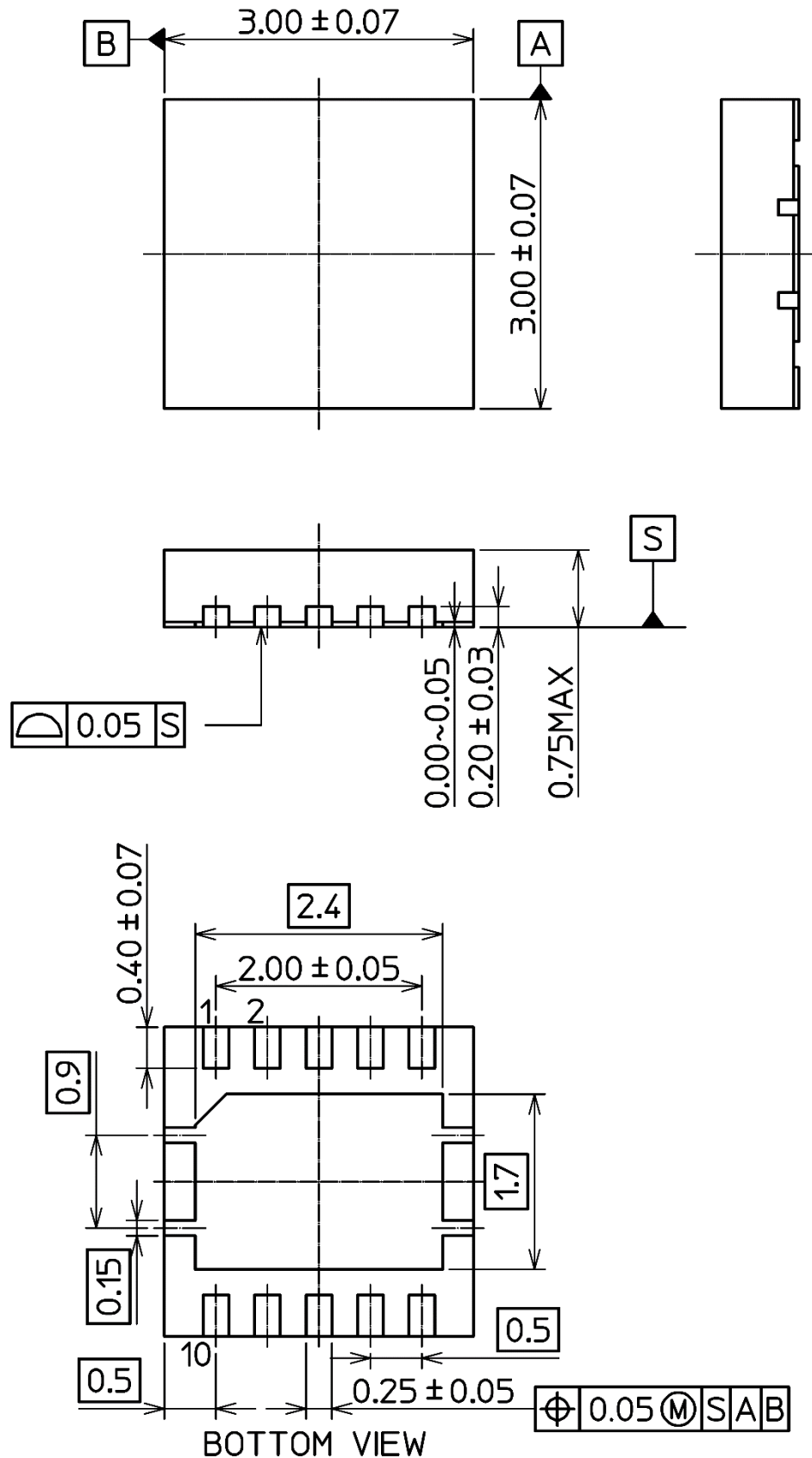


Note: Glass epoxy board
Material: FR-4 (4 layer)
Board size: 76.2mm×114.3mm×1.6mm
Via: ϕ 0.3mm (2 point)

Package Dimensions

P-WSON10-0303-0.50-001

Unit: mm



Weight: 0.02 g (Typ.)

Note: Please connect exposed pad to electrical open or GND.

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