

Toshiba Intelligent Power Device Silicon Monolithic Power MOS Integrated circuit

TPD1038F

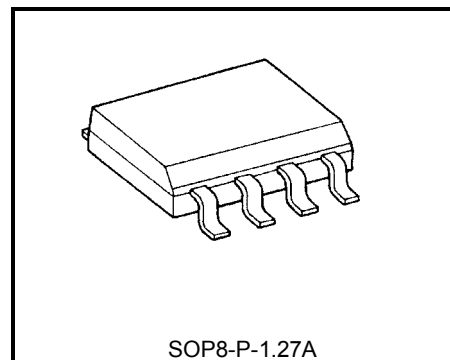
Motor, Solenoid, Lamp Drivers

High Side Power Switch

TPD1038F is a monolithic power IC for high-side switches. The IC has a vertical MOS FET output which can be directly driven from a CMOS or TTL logic circuit (eg, an MPU). The device offers intelligent self-protection and diagnostic functions.

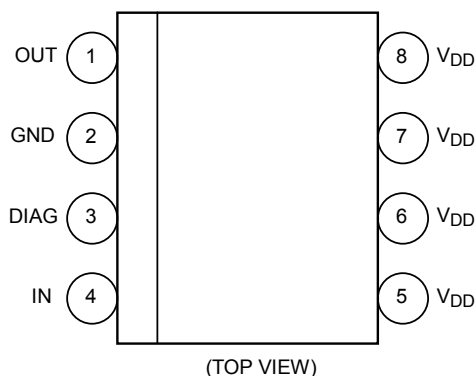
Features

- A monolithic power IC with a structure combining a control block (Bi-CMOS) and a vertical power MOS FET on a single chip.
- One side of load can be grounded to a high-side switch.
- Can directly drive a power load from a microprocessor.
- Built-in protection against overheating and load short circuiting.
- Incorporates a diagnosis function that allows diagnosis output to be read externally at load short-circuiting, opening, or overheating.
- Up to $-(50-V_{DD}) \sim -(60-V_{DD})$ of counterelectromotive force from an L load can be applied.
- Low on Resistance : $R_{DS(ON)} = 120m\Omega$ (max) (@ $V_{DD} = 12V$, $T_a = 25^\circ C$, $I_o = 2A$)
- 8-pin SOP package for surface mounting can be packed in tape.

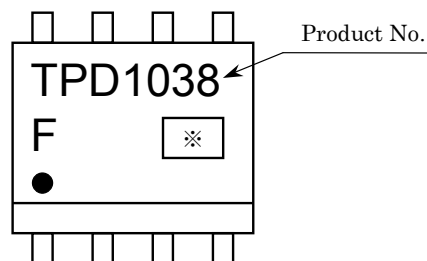


Weight : 0.08g(typ.)

Pin Assignment



Marking



(●) on lower left of the marking indicates Pin1.

※Lot Number

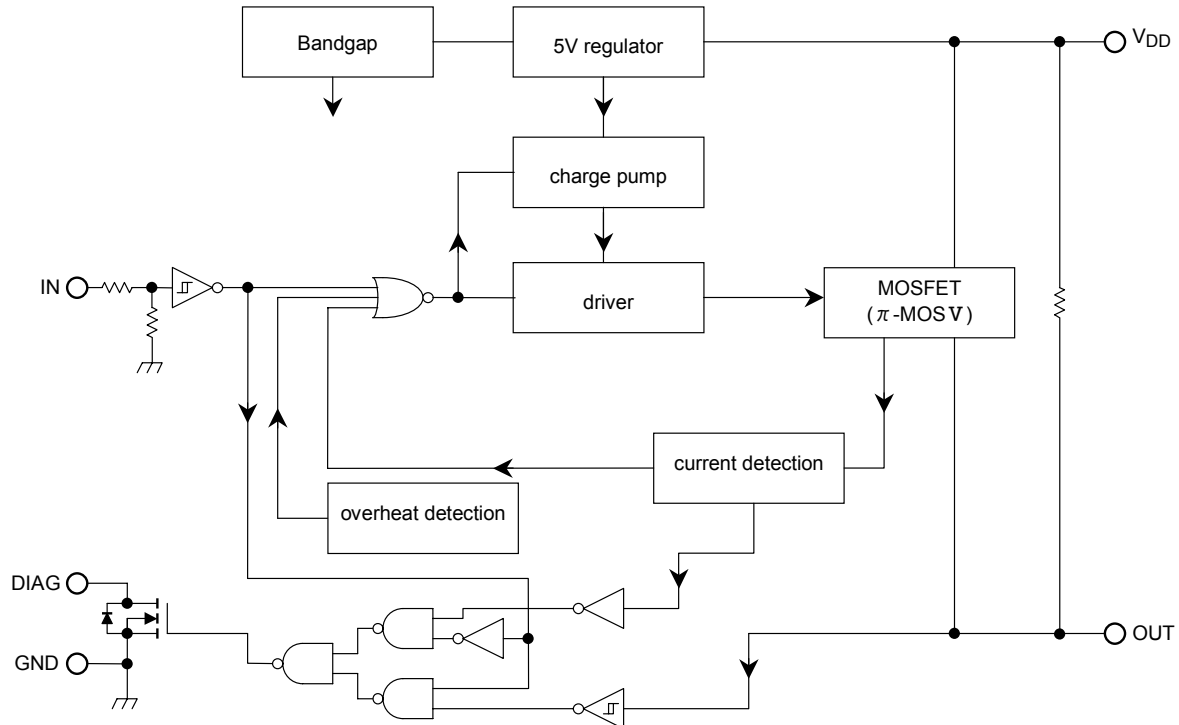
Weekly code : (Three digits)



Week of manufacture
(01 for first of year, continues up to 52 or 53)
Year of manufacture
(One low-order digits of calendar year)

That because of its MOS structure, this product is sensitive to static electrocity.

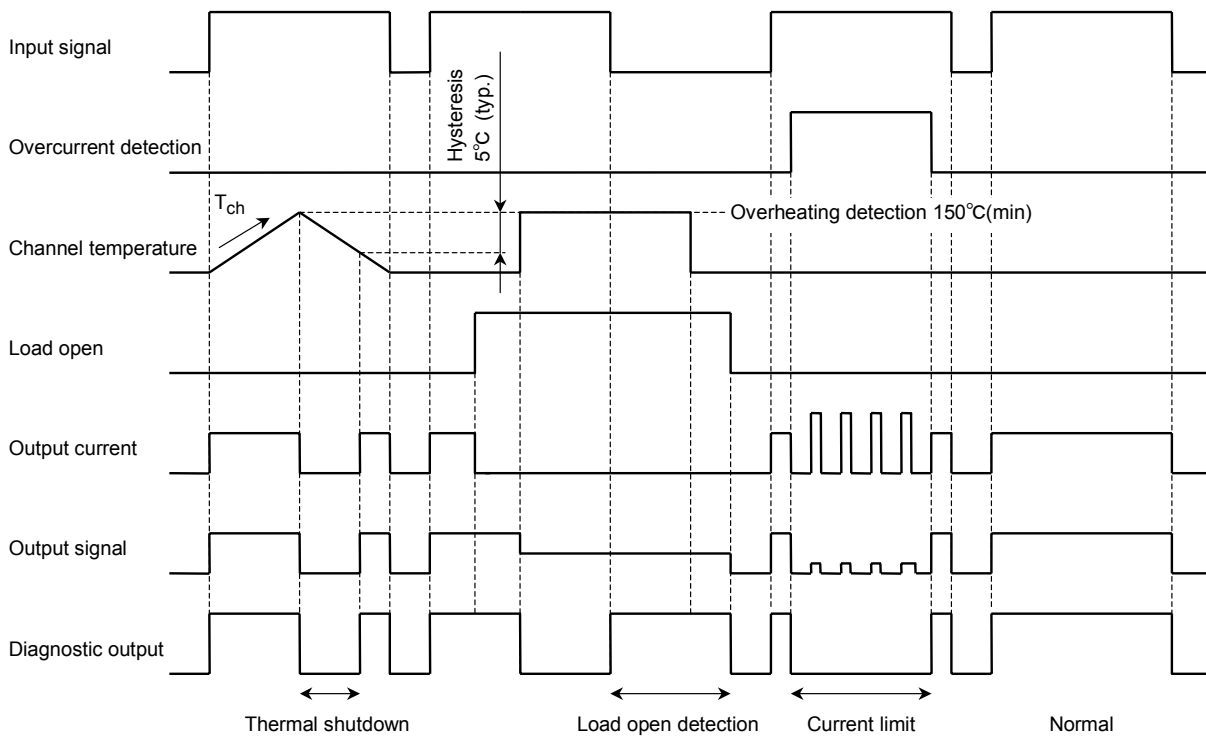
Block Diagram



Pin Description

Pin No.	Symbol	Function
1	OUT	Output pin. When the load is short circuited and current in excess of the detection current (3A min) flows to the output pin, the output automatically turns on or off.
2	GND	Ground pin.
3	DIAG	Self-diagnosis detection pin. Goes low when overheating is detected or when output is short circuit with input on (high). N-channel open drain.
4	IN	Input pin. Input is CMOS compatible, with pull down resistor connected. Even if the input is open, output will not accidentally turn on.
5,6,7,8	V _{DD}	Power pin.

Timing Chart



Truth Table

Input signal	Diagnosis output	Output signal	Output state	Operating state
H	H	H	on	Normal
L	L	L	off	
H	L	L	current limit (switching)	Load Short
L	L	L	off	
H	L	L	off	Overheating
L	L	L	off	
H	H	H	on	Load open
L	H	H	off	
H	L	L	off	Overheating and load open
L	H	H	off	

Maximum Ratings (Ta = 25°C)

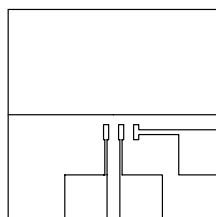
Characteristics		Symbol	Rating	Unit
Drain-Source Voltage		V_{DS}	60	V
Supply Voltage	DC	$V_{DD(1)}$	25	V
	Pulse	$V_{DD(2)}$	60($R_S=1\Omega$, $\tau=250\text{ms}$)	V
Input Voltage	DC	$V_{IN(1)}$	-0.5~12	V
	Pulse	$V_{IN(2)}$	$V_{DD(1)}+1.5(t=100\text{ms})$	V
Diagnosis Output Voltage		V_{DIAG}	-0.5~25	V
Output Current		I_O	Internally Limited	A
Input current		I_{IN}	± 10	mA
Diagnosis current		I_{DIAG}	5	mA
Power Dissipation (Note 1-a)		$P_{D(1)}$	1.1	W
Power Dissipation (Note 1-b)		$P_{D(2)}$	0.425	W
Operating temperature		T_{opr}	-40~110	°C
Channel temperature		T_{ch}	150	°C
Storage temperature		T_{stg}	-55~150	°C

Thermal Resistance

Characteristic	Symbol	Rating	Unit
Thermal Resistance	$R_{th(ch-a)}$	113.5 (Note1-a)	°C /W
		294.0 (Note1-b)	

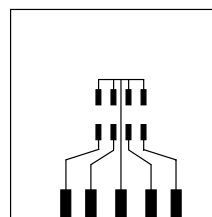
Note 1:

1-a : Mounted on glass epoxy board (a)



FR-4
25.4 × 25.4 × 0.8
(Unit : mm)

1-b : Mounted on glass epoxy board (b)



FR-4
25.4 × 25.4 × 0.8
(Unit : mm)

Electrical characteristics (T_a=25°C)

Characteristics	Symbol	Test circuit	Test condition	min	typ.	max	Unit
Operating supply voltage	V _{DD(OPR)}	—	—	6	12	18	V
Current dissipation	I _{DD}	—	V _{DD} =12V, V _{IN} =0V, R _L =10Ω	—	—	3	mA
H-level input voltage	V _{IH}	—	V _{DD} =12V	3.5	—	—	V
L-level input voltage	V _{IL}	—	V _{DD} =12V	—	—	1.5	V
H-level input current	I _{IH}	—	V _{DD} =12V, V _{IN} =5V	—	—	200	μA
On resistance	R _{DS(ON)}	—	V _{DD} =12V, I _O =2A	—	—	0.12	Ω
Output leakage current	I _{OL}	—	V _{DD} =12V	—	—	1	mA
Diagnosis output voltage	V _{DL}	—	V _{DD} =12V, V _{IN} =0V, I _{DL} =1mA, R _L =10Ω	—	—	0.4	V
Diagnosis output current	I _{DH}	—	V _{DD} =12V, V _{IN} =5V, R _L =10Ω, V _{DH} =12V	—	—	10	μA
Over current detection	I _{OC(1)} (Note2)	1, 2	V _{DD} =12V	3	—	9	A
	I _{OC(2)} (Note3)	3	V _{DD} =12V, R _L =0.1Ω	—	—	10	A
Overheating detection	T _{OT}	—	V _{DD} =12V	150	—	200	°C
Load open detection (Note4)	R _{op}	—	V _{DD} =12V, V _{IN} =0V	5	17	—	kΩ
Switching time	t _{on}	4	V _{DD} =12V, R _L =10Ω	—	—	100	μs
	t _{off}			—	—	40	μs
Diagnosis delay time	t _{DLH}	5	V _{DD} =12V, R _L =10Ω	—	70	—	μs
	t _{DHL}			—	22	—	μs
Output clamp voltage	V _{clamp}	—	V _{DD} =12V, V _{IN} =0V, I _O =1A, L=10mH	-(60-V _{DD})	—	-(50-V _{DD})	V

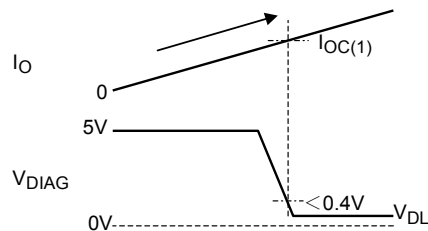
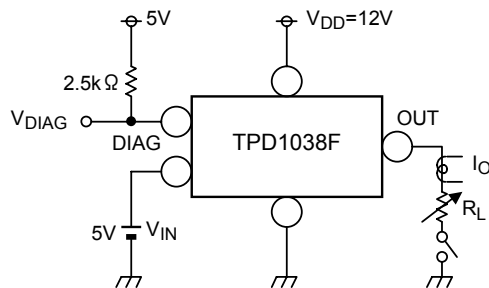
(Note 2) Over current detection

(Note 3) Peak current @ current limit function

(Note 4) Load open detection function : V_{DD} = 8 ~ 18V

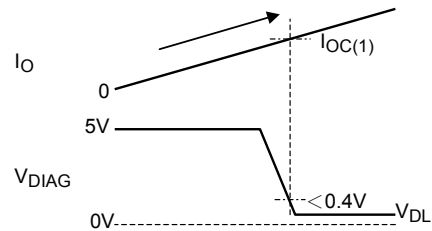
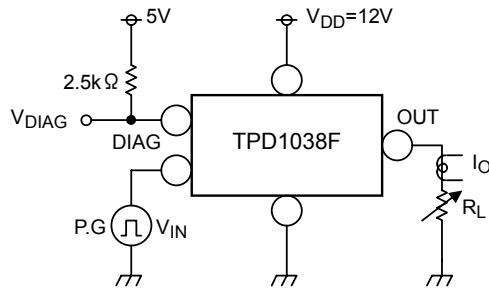
Test circuit 1

Over current detection I_{OC(1)} : Over current detection when load current is increased while V_{IN} = "H"



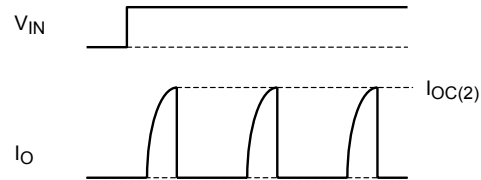
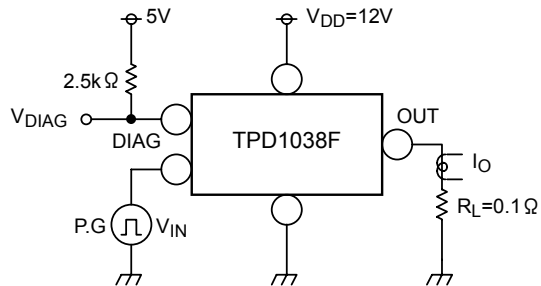
Test circuit 2

Over current detection $I_{OC(1)}$: Over current detection when load is short circuit and $V_{IN} = "L" \rightarrow "H"$



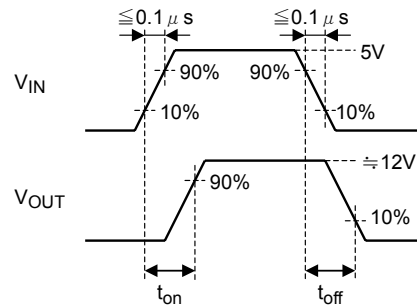
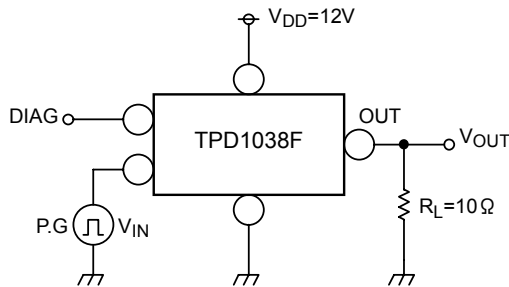
Test circuit 3

Over current detection $I_{OC(2)}$



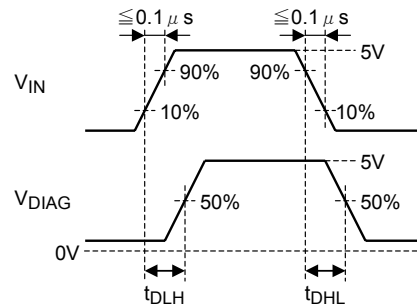
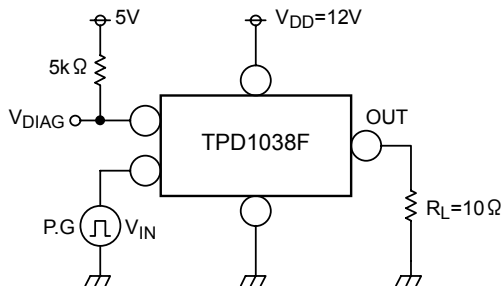
Test circuit 4

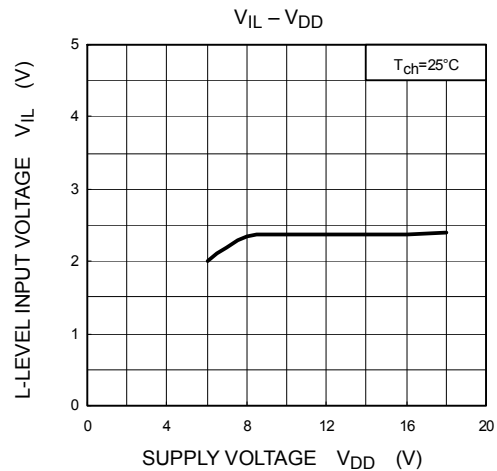
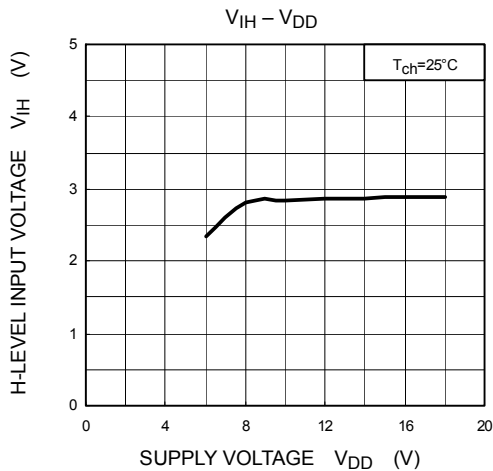
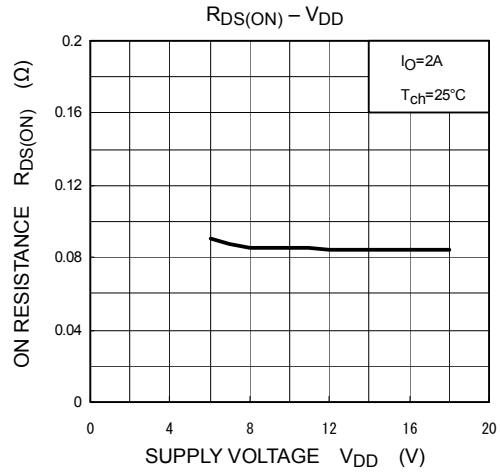
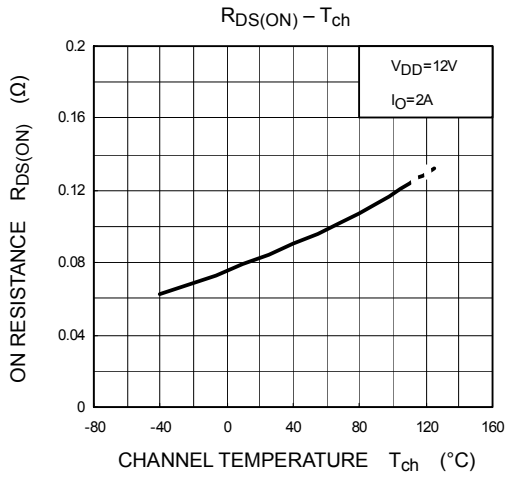
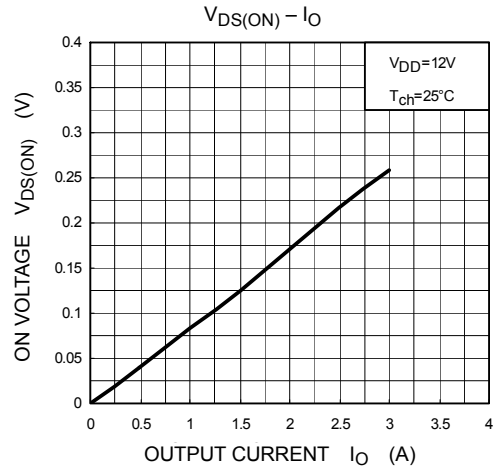
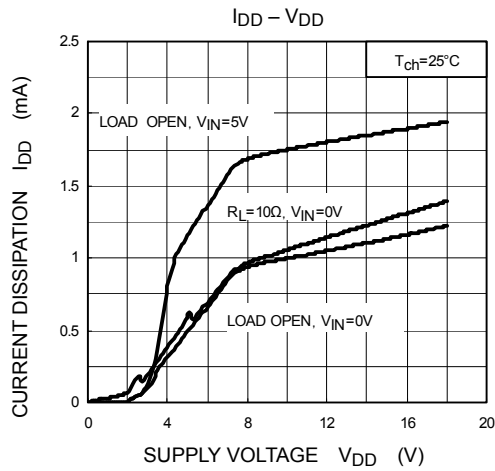
Switching time t_{on} , t_{off}

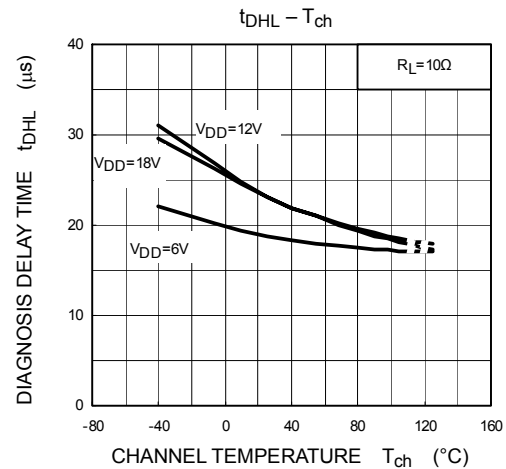
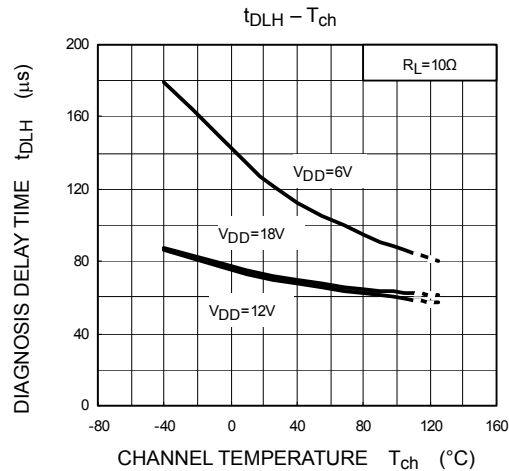
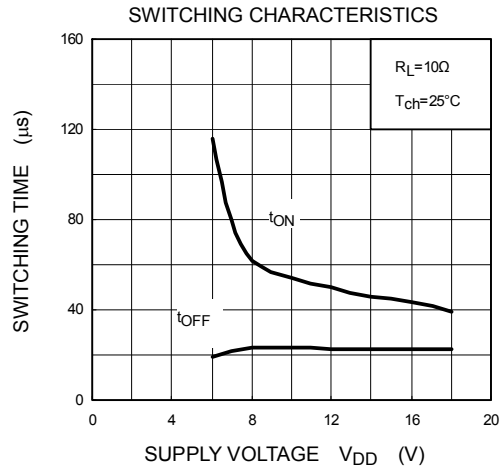
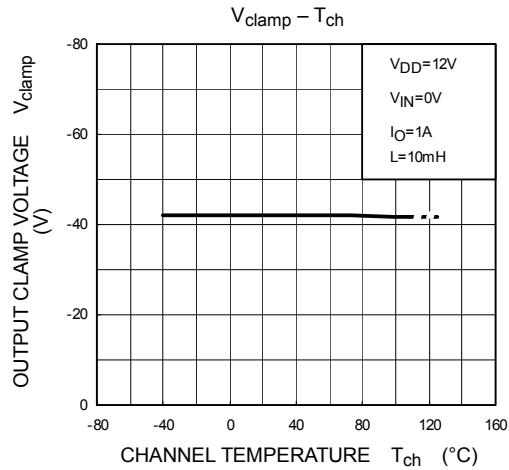
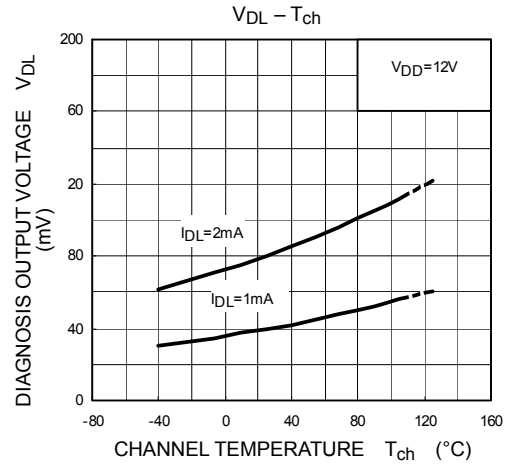
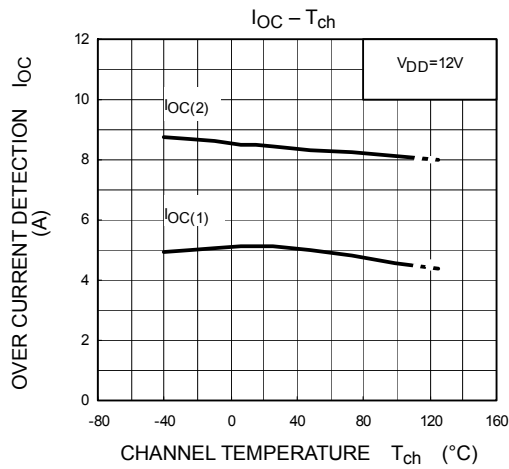


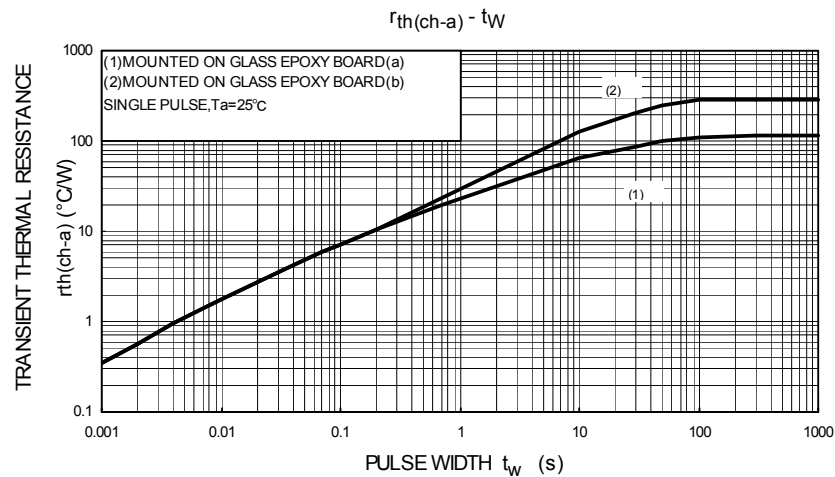
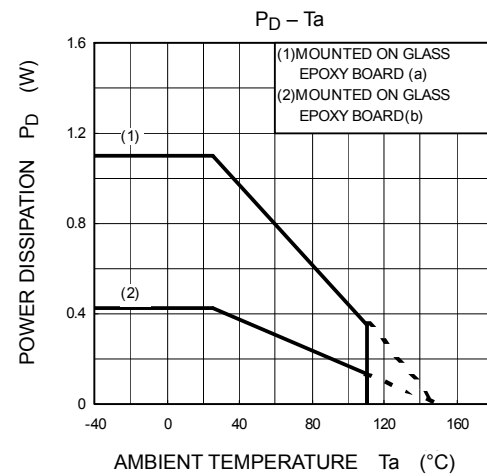
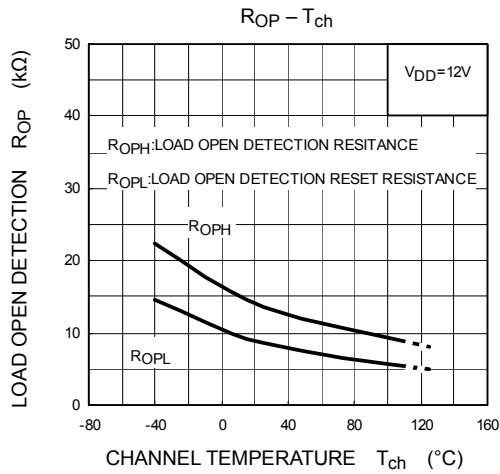
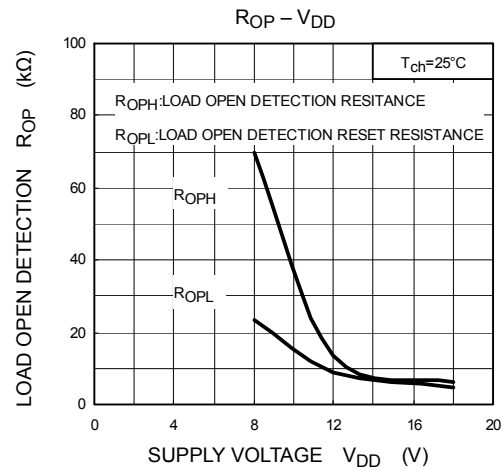
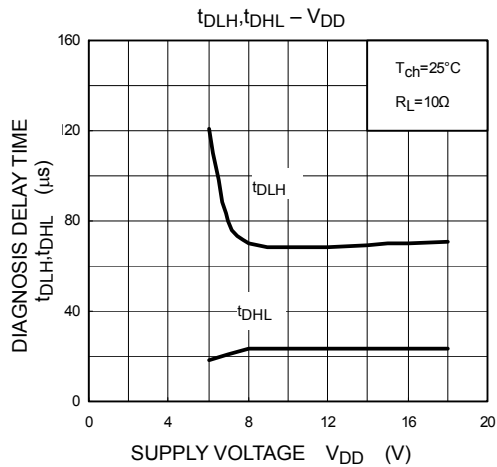
Test circuit 5

Diagnosis delay time t_{DLH} , t_{DHL}

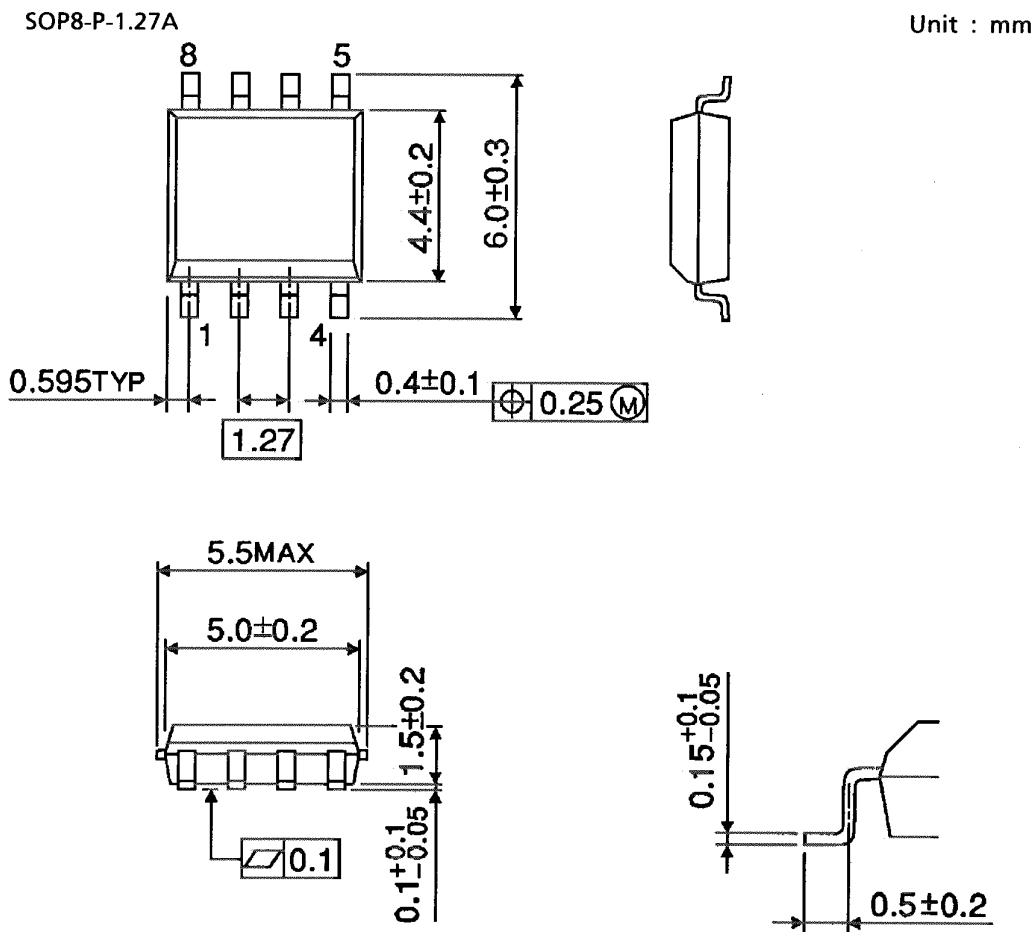








Package dimensions



Weight : 0.08g (typ.)

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