

Toshiba Intelligent Power Device Silicon Monolithic Power MOS Integrated Circuit

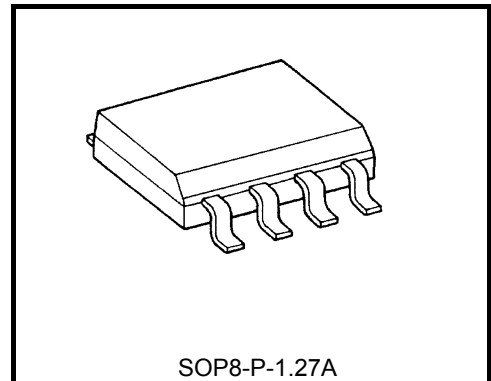
TPD1038F

Motor, Solenoid, Lamp Drivers
High-side Power Switch

The 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 (e.g., an MPU). The device offers intelligent self-protection and diagnostic functions.

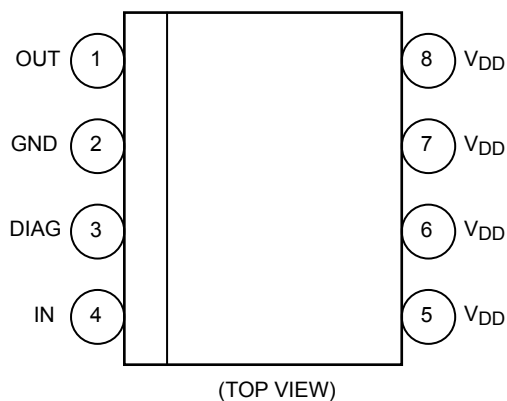
Features

- 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 : $R_{DS(ON)}=120m\Omega(\text{max})$ (@ $V_{DD} = 12\text{ V}$, $T_a = 25^\circ\text{C}$, $I_o = 2\text{ A}$)
- 8-pin SOP package for surface mounting that can be packed in tape

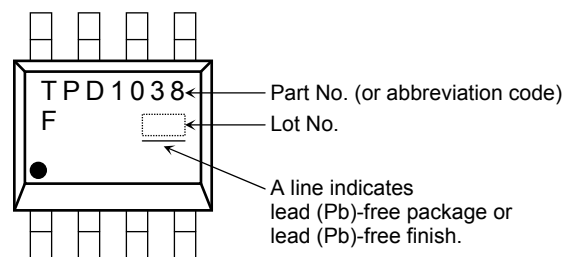


Weight : 0.08g(typ.)

Pin Assignment

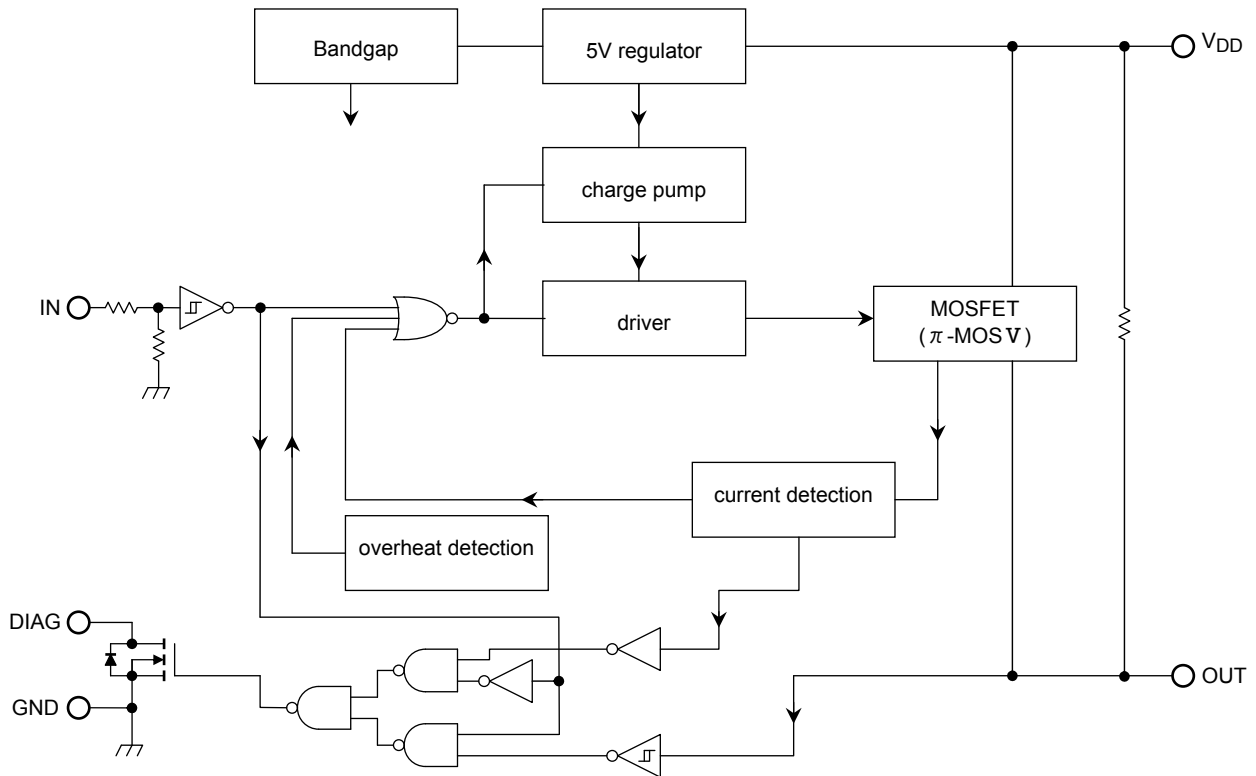


Marking



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

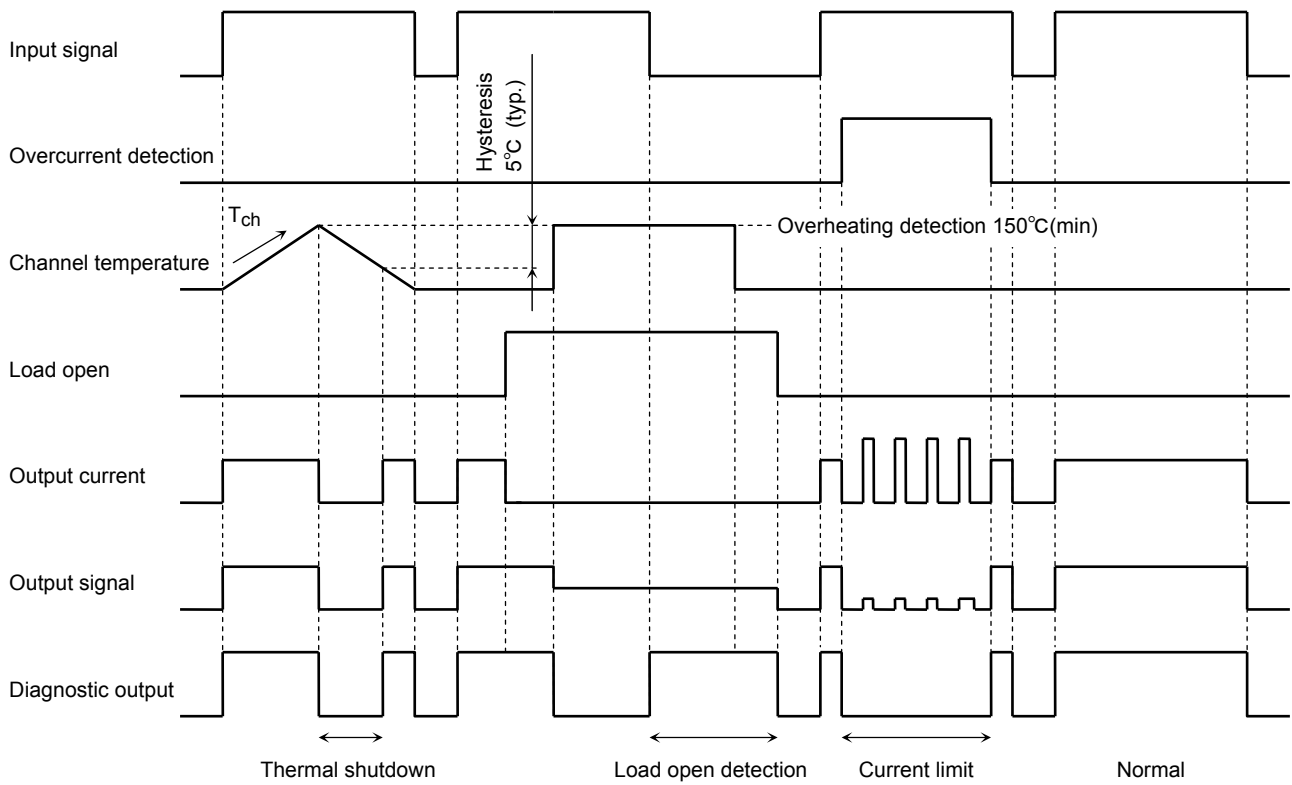
Block Diagram



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	

Absolute Maximum Ratings (Ta = 25°C)

Characteristics	Symbol	Rating	Unit
Drain-source voltage	V _{DS}	60	V
Supply voltage	DC	V _{DD(1)}	25
	Pulse	V _{DD(2)}	60(R _S =1Ω, τ=250ms)
Input voltage	DC	V _{IN(1)}	-0.5~12
	Pulse	V _{IN(2)}	V _{DD(1)} +1.5(t=100ms)
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

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.

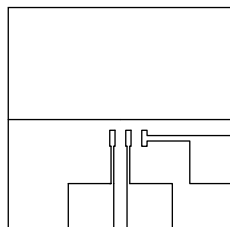
Please design the appropriate reliability upon reviewing the Toshiba Semiconductor Reliability Handbook ("Handling Precautions"/Derating Concept and Methods) and individual reliability data (i.e. reliability test report and estimated failure rate, etc).

Thermal Resistance

Characteristic	Symbol	Rating	Unit
Thermal resistance	R _{th(ch-a)}	113.5 (Note1-a)	°C /W
		294.0 (Note1-b)	

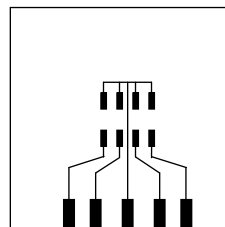
Note 1:

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	"L"-level	V _{DL}	—	V _{DD} =12V, V _{IN} =0V, I _{DL} =1mA, R _L =10Ω	—	—	0.4	V
Diagnosis output current	"H"-level	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

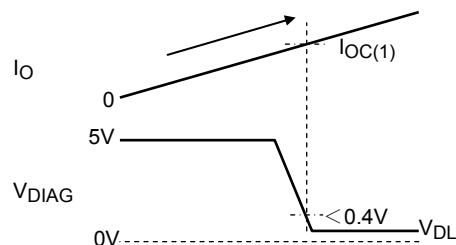
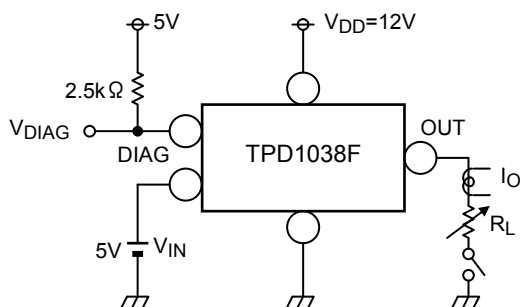
(Note 2) Over-current detection

(Note 3) Peak current @ current limit function

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

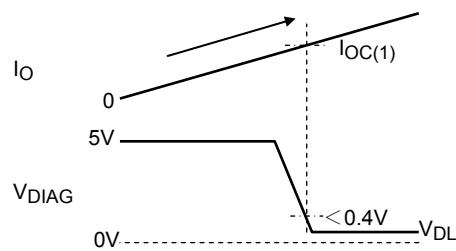
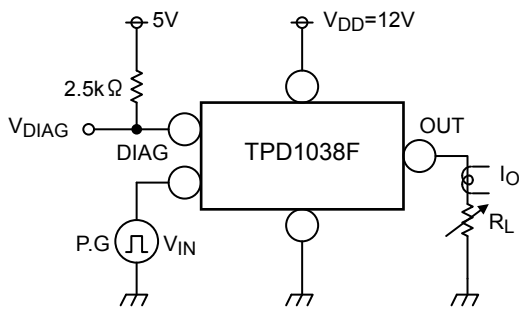
Test Circuit 1

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



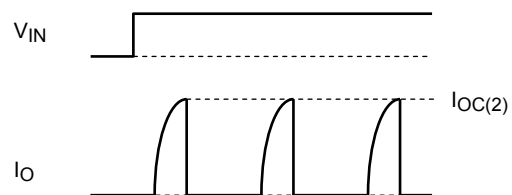
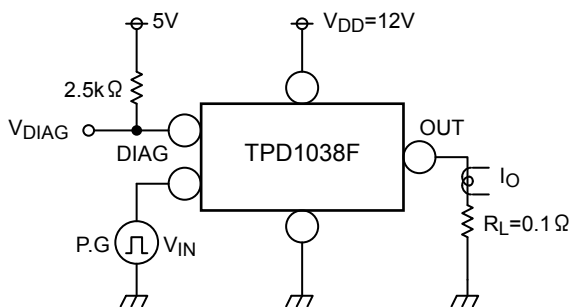
Test Circuit 2

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



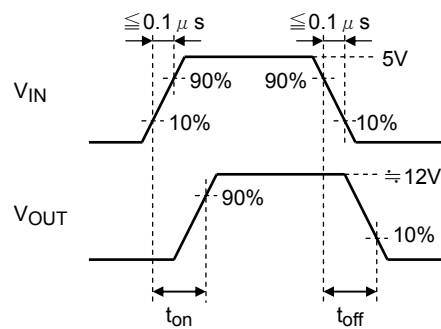
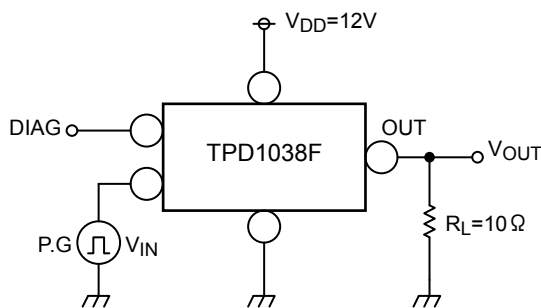
Test Circuit 3

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



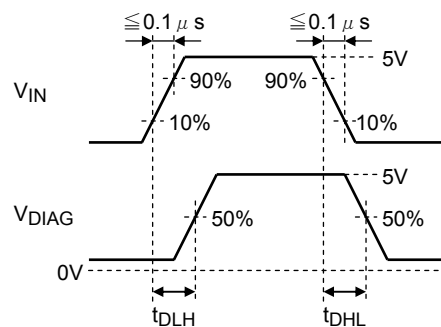
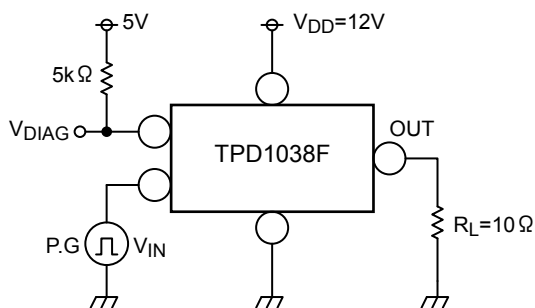
Test Circuit 4

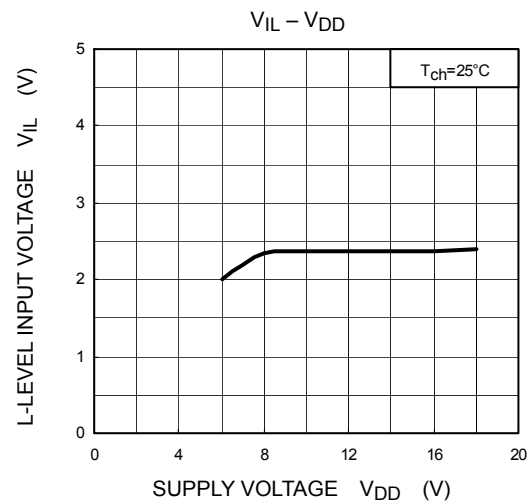
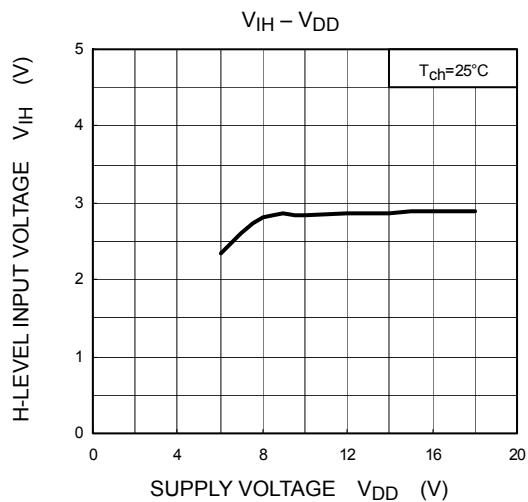
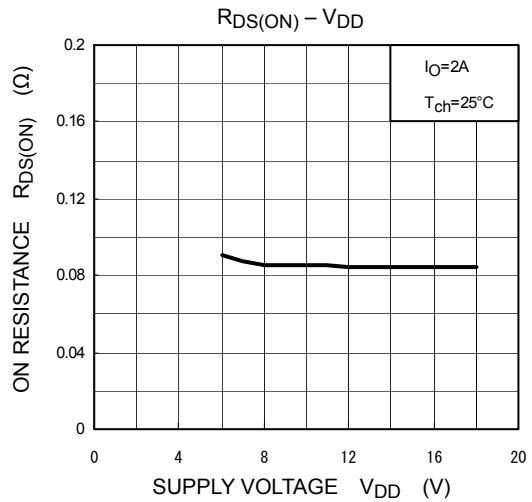
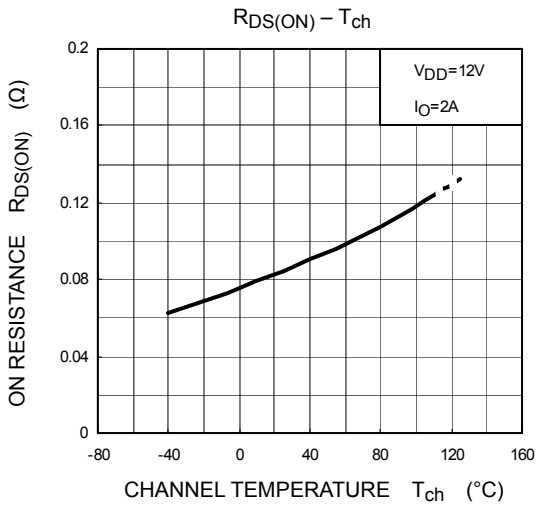
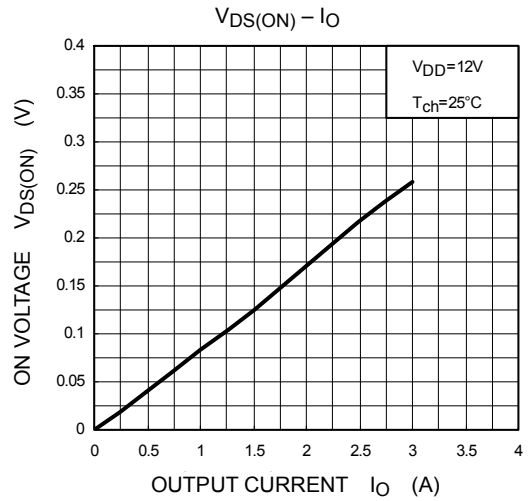
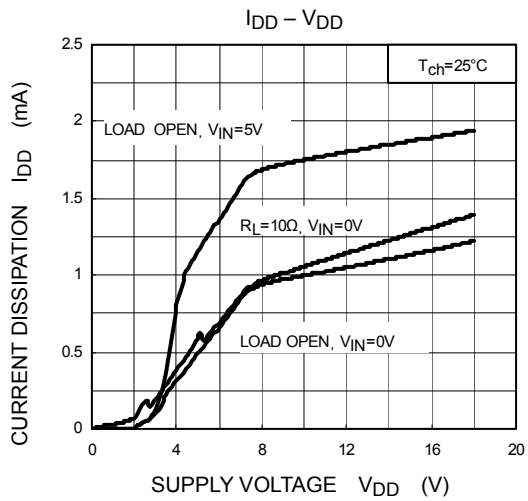
Switching time t_{on} , t_{off}

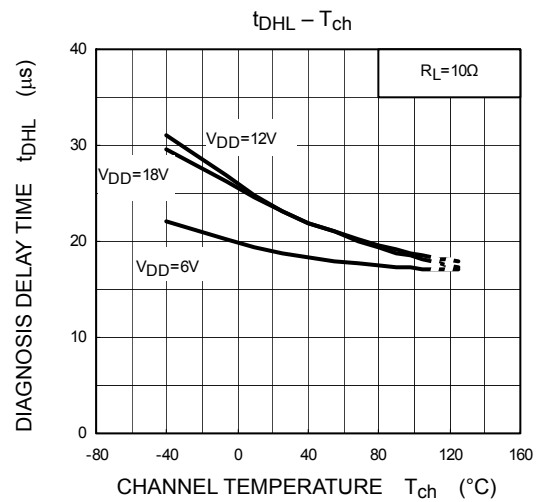
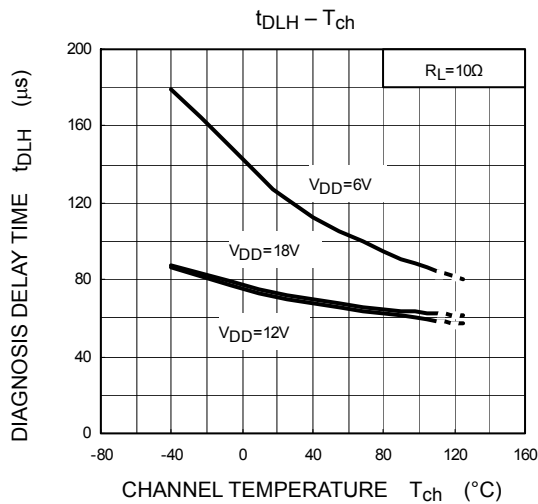
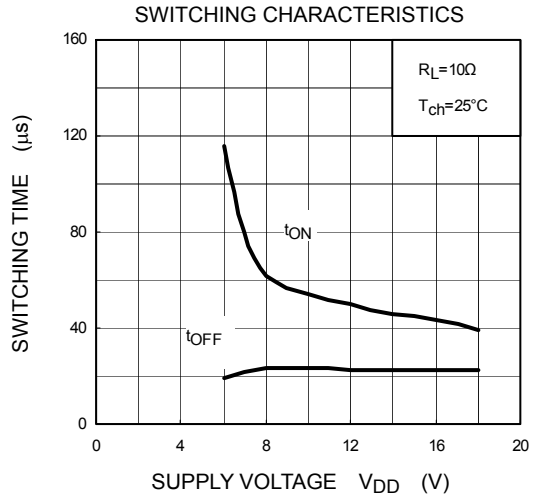
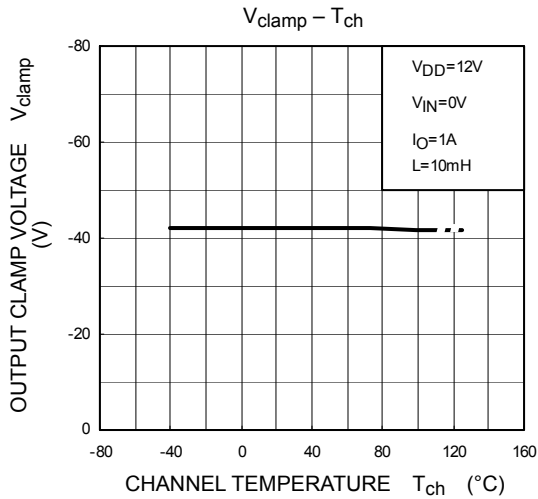
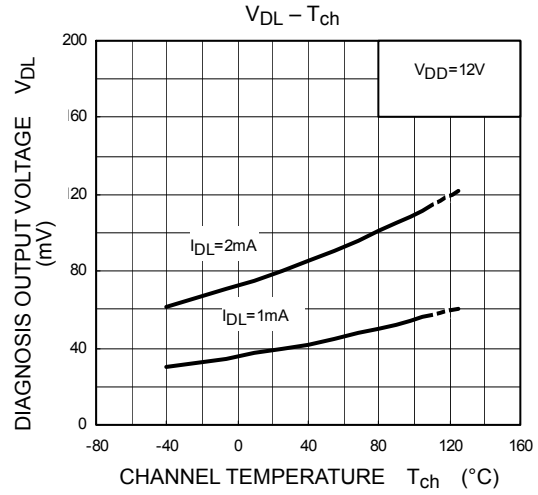
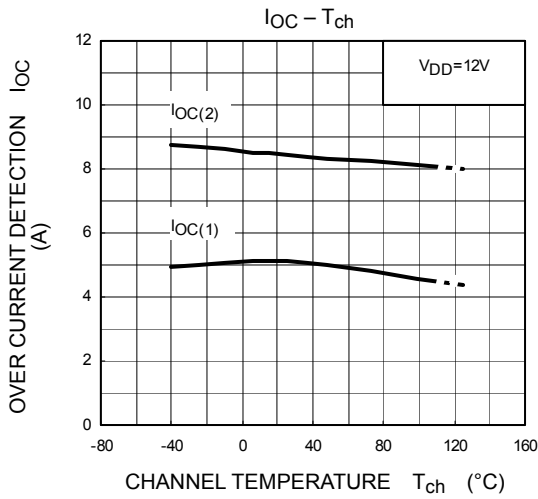


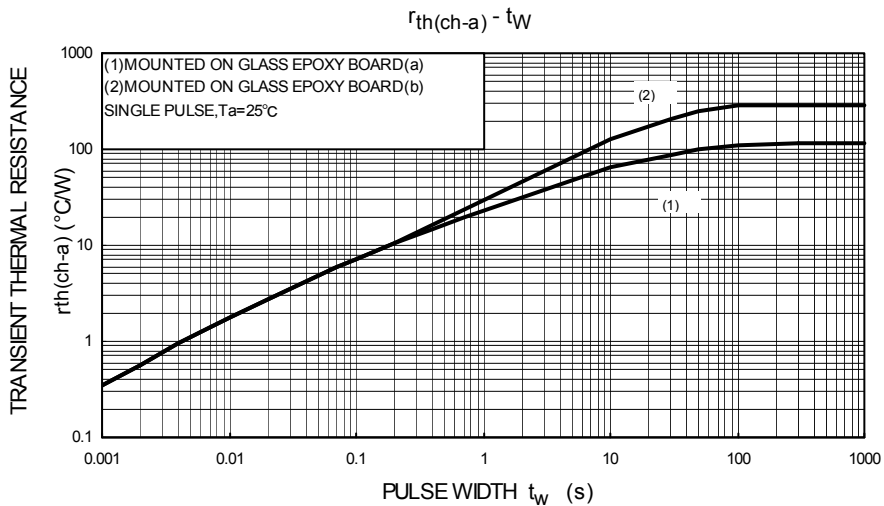
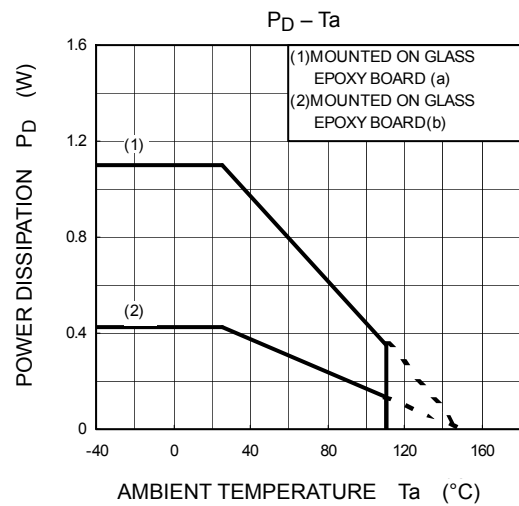
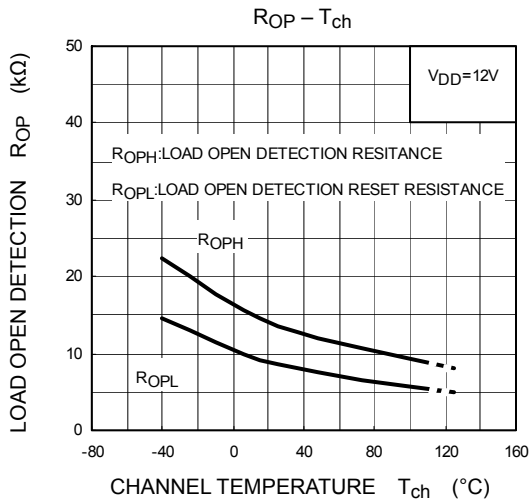
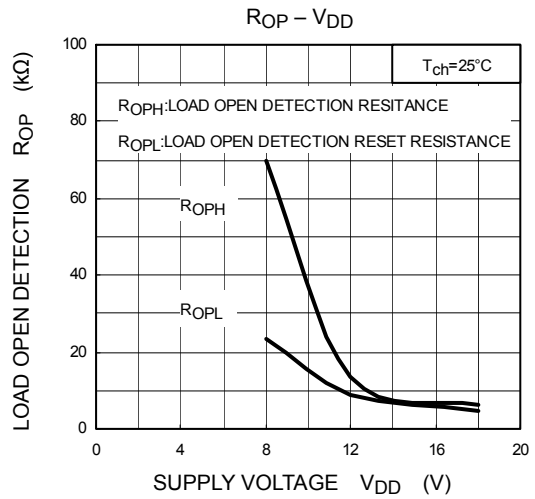
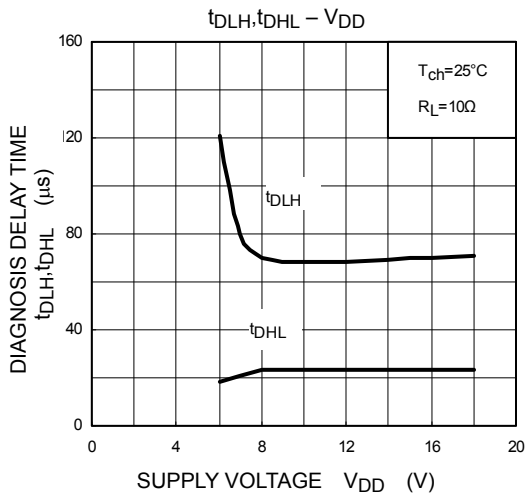
Test Circuit 5

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

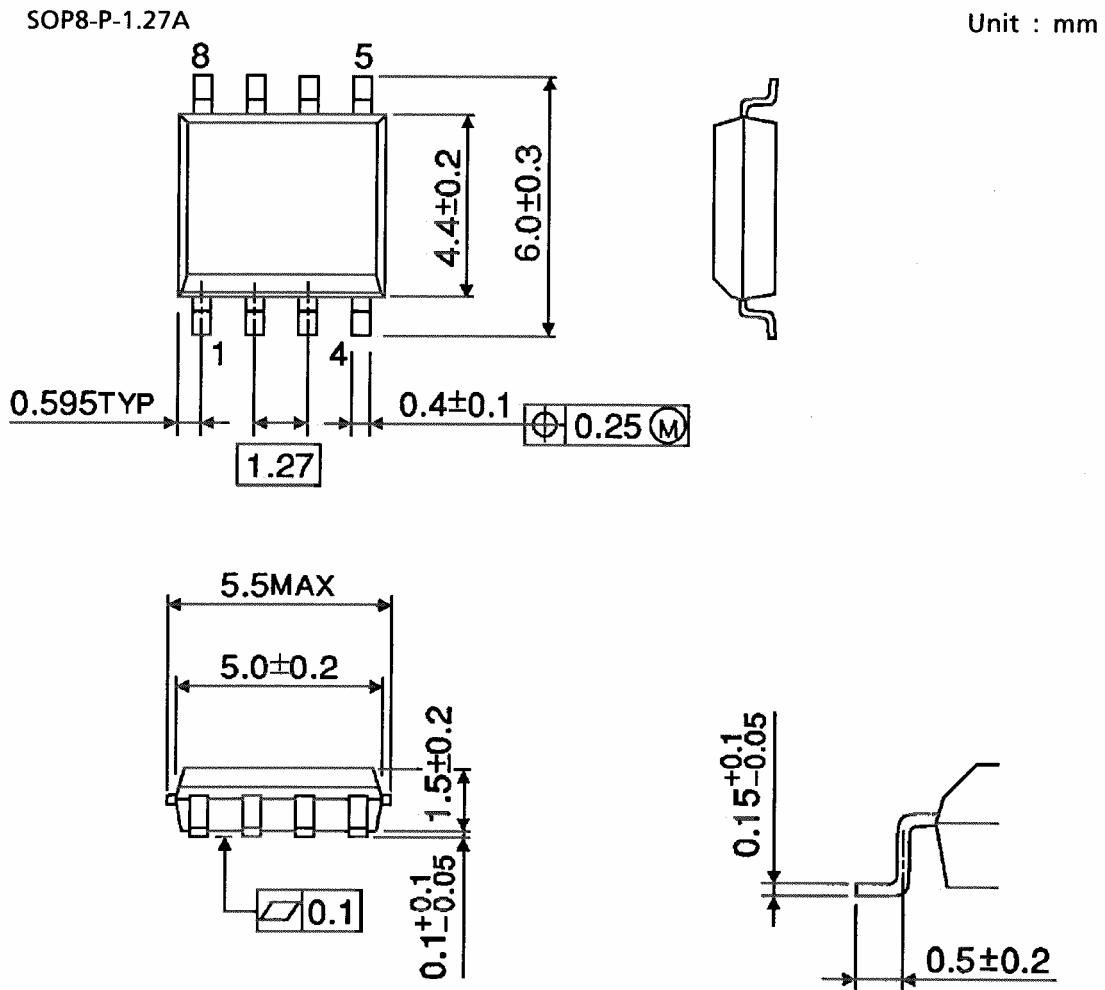








Package Dimensions



Weight: 0.08g (typ.)

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20070701-EN

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