

Toshiba Intelligent Power Device Silicon Monolithic Power MOS Integrated Circuit

TPD1060F

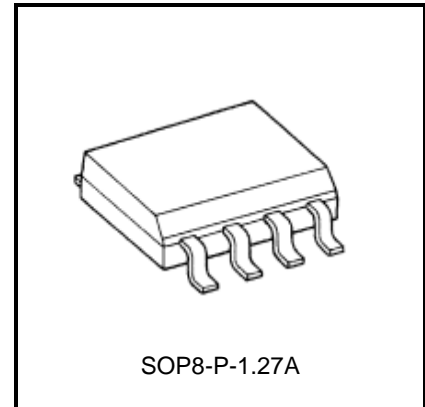
High-Side Switch for Motor, Solenoid and Lamp Drive

The TPD1060F is a monolithic power IC for high-side switches.

The IC has a P channel MOSFET (D-MOS) 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.

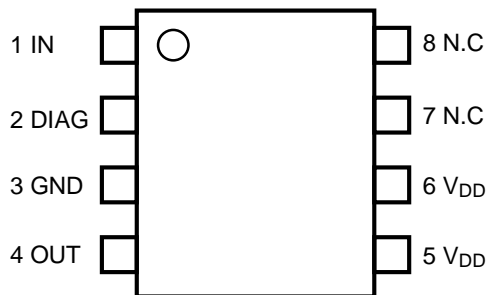
Features

- A monolithic power IC with a new structure combining a control block (Bi-CMOS) and a power MOSFET (D-MOS) on a single chip.
- One side of load can be grounded to a high-side switch.
- Can directly drive a power load from a CMOS or TTL logic.
- Built-in protection circuits against load short-circuiting, over temperature (thermal shutdown).
- Incorporates a diagnosis function that allows diagnosis output to be read externally at load short-circuiting, opening, or over temperature.
- The counter electromotive force due to the inductance load to the output terminal can be applied to $V_{OUT} \geq V_{DD}-40\text{ V}$.
- Low Supply voltage: $V_{DD(opr)} = 4\text{ V (Min)}$
- Low Drain-Source ON-resistance:
 $R_{DS(ON)} = 0.12\ \Omega\ (\text{Max})\ (@V_{DD}=8\text{ to }18\text{ V}, T_j = 25^\circ\text{C}, I_O = -1\text{A}, V_{IN} = 5\text{ V})$
- "SOP-8" package with embossed-tape packing.



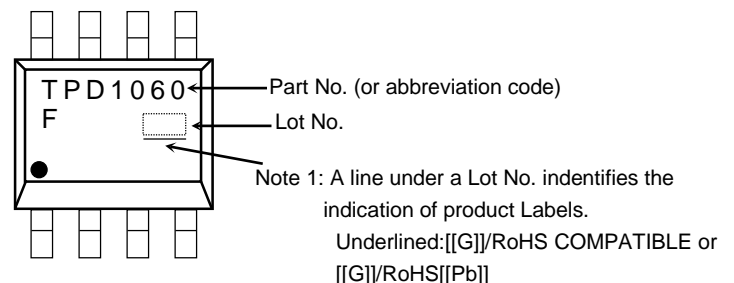
Weight: 0.08 g (Typ.)

Pin Assignment (top view)



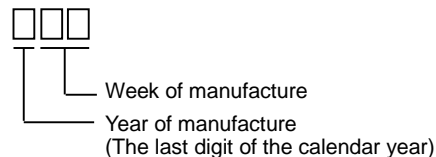
Due to its MOS structure, this product is sensitive to static electricity.

Marking



● on the lower left of the marking indicates Pin 1

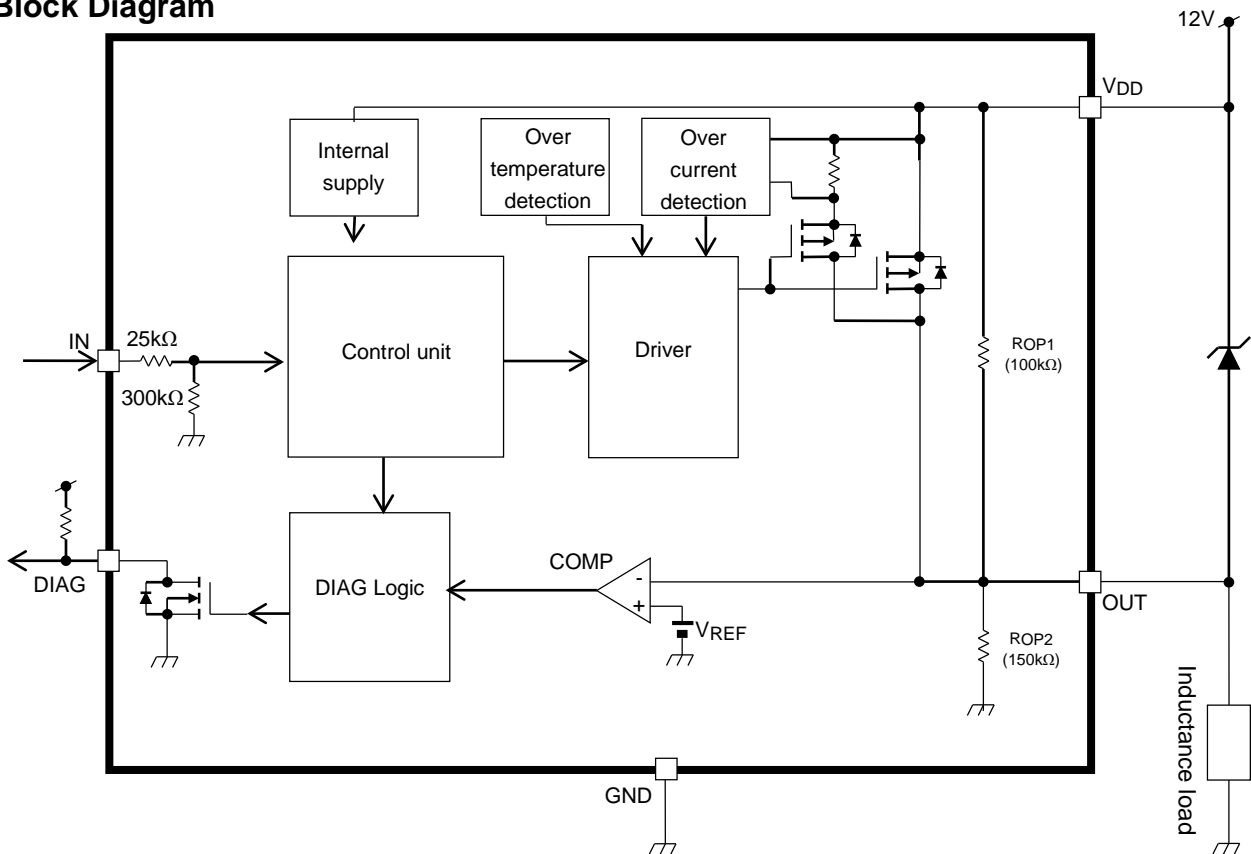
*Lot No. : (Three digits)



Note 1: Please contact your TOSHIBA sales representative for details as to environmental matters such as the RoHS compatibility of Product. The RoHS is the Directive 2011/65/EU of the European Parliament and of the Council of 8 June 2011 on the restriction of the use of certain Hazardous substances in electrical and electronic equipment.

Start of commercial production
2016-3

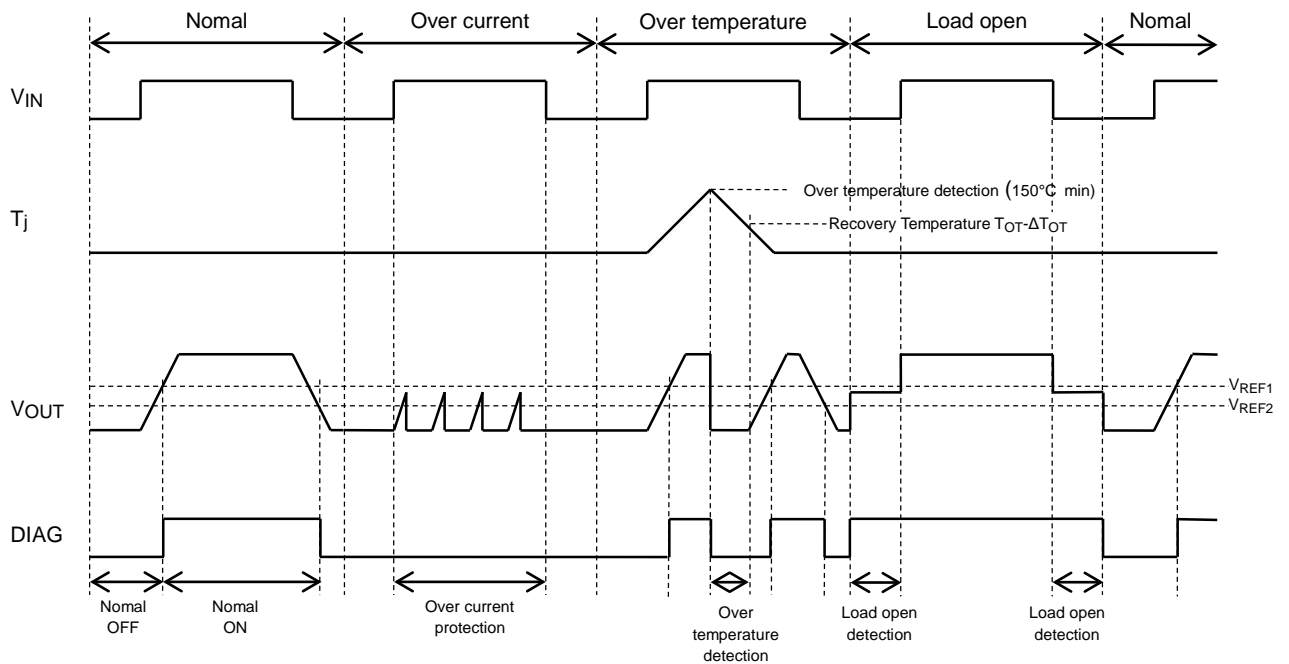
Block Diagram



Pin Description

Pin No.	Symbol	Pin Description
1	IN	Input pin. The IN pin has an internal pull-down resistor. Even if the IN pin is open, the output will not accidentally turn on.
2	DIAG	Self-diagnosis detection pin. Load open, overcurrent and overheating are diagnosed. Circuit configuration is the N channel open Drain.
3	GND	Ground pin.
4	OUT	Output pin. When a load short-circuit causes an overcurrent 3.0 A (Min) to flow into a device, output current is limited in order to protect the IC.
5,6	V _{DD}	Power supply pin.
7,8	N.C	No-Connect pin. (not connected to the chip.)

Timing chart



Truth table

IN	VOUT	Output state	DIAG	Operating state
L	L	OFF	L	Normal
H	H	ON	H	
L	H(Note 2)	OFF	H	Load open
H	H	ON	H	
L	L	OFF	L	Overcurrent
H	L	Current limit (Switching)	L	
L	L	OFF	L	Over temperature
H	L	OFF	L	

Note 2: Voltage determined with product internal resistance (R_{OP1} and R_{OP2}) and the external resistance between OUT –GND pin.

Absolute Maximum Ratings (Ta = 25°C)

Characteristics	Symbol	Rating	Unit	Remarks
Drain-source voltage	V _{DS}	40	V	P channel MOSFET
Supply voltage	DC	V _{DD(1)}	-0.3 to 25	V
	Pulse	V _{DD(2)}	40	V
Input voltage	DC	V _{IN(1)}	-0.3 to 6	V
Diagnosis output voltage	V _{DIAG}	-0.3 to 6	V	
Output voltage	V _{OUT}	(V _{DD} -40) to (V _{DD} +0.3)	V	
Output current	DC	I _{O(1)}	-3	A
	Pulse	I _{O(2)}	internally limited	A
Diagnosis output current	I _{DIAG}	5	mA	
Power dissipation	P _{D(1)}	0.9	W	(Note 3-a)
	P _{D(2)}	0.523	W	(Note 3-b)
Operating temperature	T _{opr}	-40 to 125	°C	
Junction temperature	T _j	150	°C	
Storage temperature	T _{stg}	-55 to 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.

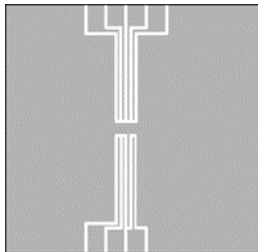
Please design the appropriate reliability upon reviewing the Toshiba Semiconductor Reliability Handbook ("Handling Precautions"/"Derating Concept and Methods") and individual reliability data (i.e. reliability test report and estimated failure rate, etc).

Thermal Resistance

Characteristics	Symbol	Rating	unit
Thermal resistance, junction to ambient	R _{th(j-a)}	138.0 (Note 3-a)	°C / W
		239.0 (Note 3-b)	

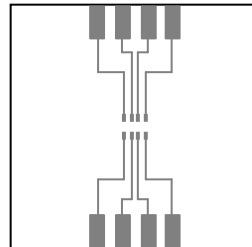
Note 3:

(Note 3-a) Glass epoxy board



Glass epoxy board
Material: FR-4
25.4mm×25.4mm×0.8mm

(Note 3-b) Glass epoxy board



Glass epoxy board
Material: FR-4
25.4mm×25.4mm×0.8mm

Electrical Characteristics (Unless otherwise specified, $T_j = -40$ to 125°C , $V_{DD} = 5$ to 18V)

Characteristics		Symbol	Test Circuit	Test Condition	Min	Typ.	Max	Unit	
Operating supply voltage		$V_{DD(\text{opr})}$	-	-	4.0	-	18.0	V	
Output negative voltage		$V_{\text{OUT}(\text{neg})}$	-	$V_{\text{IN}} = V_{\text{IL}}$	$V_{DD}-40$	-	-	V	
High-level Input voltage		V_{IH}	-	$V_{DD}=4$ to 18V	3.5	-	-	V	
Low-level Input voltage		V_{IL}	-	$V_{DD}=4$ to 18V	-	-	1.5	V	
Supply current		$I_{DD(\text{off})}$	-	$V_{\text{IN}} = V_{\text{IL}}$, OUT open	-	1.1	2.5	mA	
		$I_{DD(\text{on})}$	-	$V_{\text{IN}} = V_{\text{IH}}$, OUT open	-	1.2	3.0	mA	
Input current		$I_{\text{IN}(1)}$	-	$V_{\text{IN}}=5\text{V}$	-	18	50	μA	
		$I_{\text{IN}(2)}$	-	$V_{\text{IN}}=0\text{V}$	-1	-	1	μA	
Drain-source ON-resistance		$R_{\text{DS(ON)}}$	-	$V_{DD}=8$ to 18V , $I_{\text{O}}=-1\text{A}$, $T_j=25^\circ\text{C}$, $V_{\text{IN}}=V_{\text{IH}}$	-	0.07	0.12	Ω	
			-	$V_{DD}=8$ to 18V , $I_{\text{O}}=-1\text{A}$, $T_j=125^\circ\text{C}$, $V_{\text{IN}}=V_{\text{IH}}$	-	-	0.19	Ω	
Output leakage current		I_{OL}	-	$V_{\text{IN}}=V_{\text{IL}}$, $V_{\text{OUT}}=0\text{V}$	-500	-180	-	μA	
Diagnosis output voltage	“ L ” revel	V_{DL}	-	$I_{\text{DIAG}}=1\text{mA}$	-	0.27	0.40	V	
Diagnosis output leakage current	“ H ” revel	I_{DH}	-	$V_{\text{DIAG}}=5\text{V}$	-	-	10	μA	
Over current detection		I_{OC}	-	$V_{\text{IN}}=V_{\text{IH}}$, $V_{DD}=5$ to 18V	-9.0	-5.4	-3.0	A	
			-	$V_{\text{IN}}=V_{\text{IH}}$, $V_{DD}=4$ to 5V	-	-5.3	-	A	
Over current protection off time		Short- T_{off}	-	$V_{DD}=12\text{V}$, $R_{\text{L}}=0.1\Omega$, $T_j=25^\circ\text{C}$	3.3	8.0	15.0	ms	
Over temperature detection		Temperature	T_{OT}	-	$V_{\text{IN}}=V_{\text{IH}}$, $V_{DD}=5$ to 18V	150	170	200	$^\circ\text{C}$
				-	$V_{\text{IN}}=V_{\text{IH}}$, $V_{DD}=4$ to 5V	-	170	-	$^\circ\text{C}$
		Hysteresis	ΔT_{OT}	-	$V_{\text{IN}}=V_{\text{IH}}$, $V_{DD}=4$ to 18V	-	5	-	$^\circ\text{C}$
Load open threshold resistance		R_{OP}	-	$V_{\text{IN}}=V_{\text{IL}}$, $V_{DD}=5$ to 18V	0.5	12.4	100.0	$\text{k}\Omega$	
			-	$V_{\text{IN}}=V_{\text{IL}}$, $V_{DD}=4$ to 5V	-	120	-	$\text{k}\Omega$	
Switching time		t_{ON}	1	$V_{DD}=12\text{V}$, $R_{\text{L}}=10\Omega$, $T_j=25^\circ\text{C}$	-	20	50	μs	
		t_{OFF}			-	20	50	μs	
		t_{ON}		$V_{DD}=4\text{V}$, $R_{\text{L}}=10\Omega$, $T_j=25^\circ\text{C}$	-	20	-	μs	
		t_{OFF}			-	20	-	μs	

Note: Typical characteristic conditions are $V_{DD}=12\text{V}$, $T_j=25^\circ\text{C}$.

Typical characteristic conditions ($V_{DD}=4$ to 5V) are $V_{DD}=4\text{V}$, $T_j=25^\circ\text{C}$.

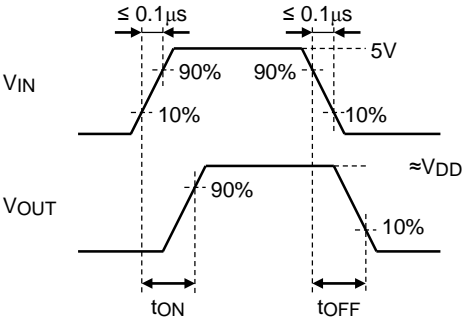
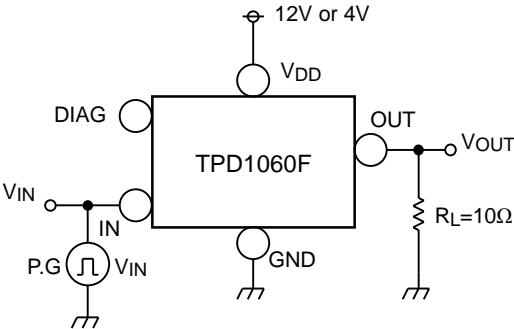
Note: Polarity of the current "-" is the current from the product to the outside.

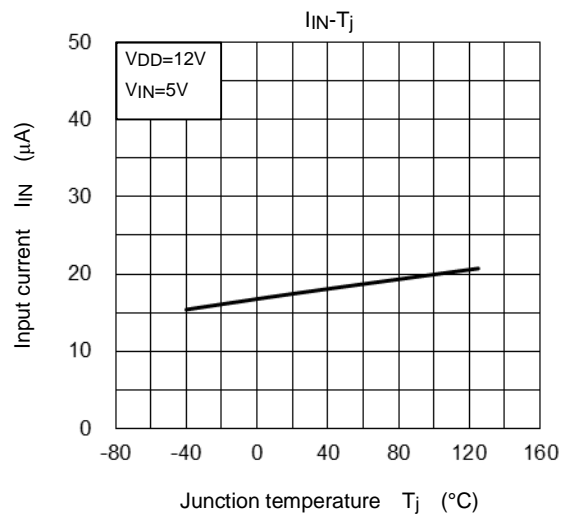
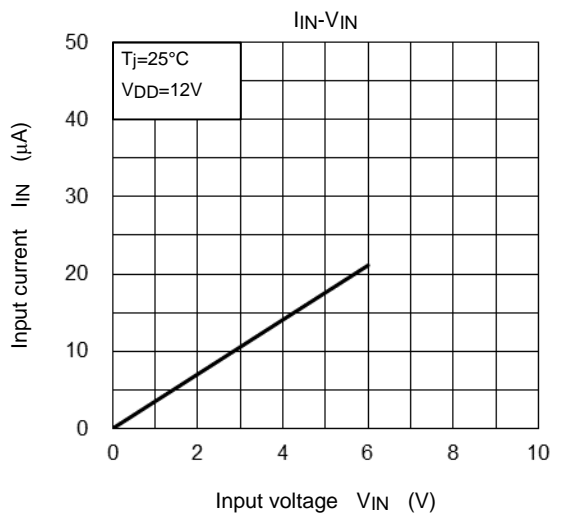
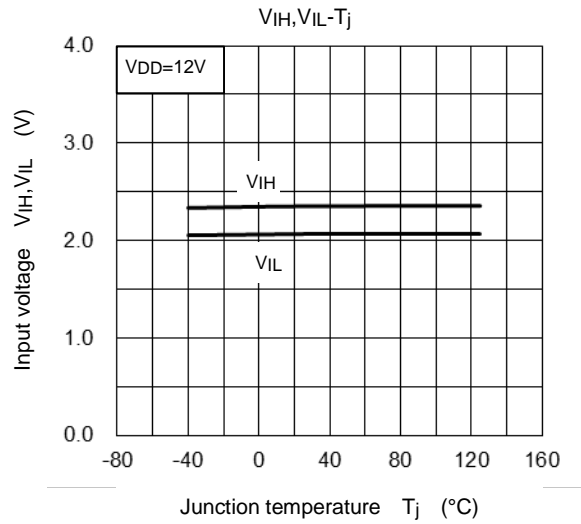
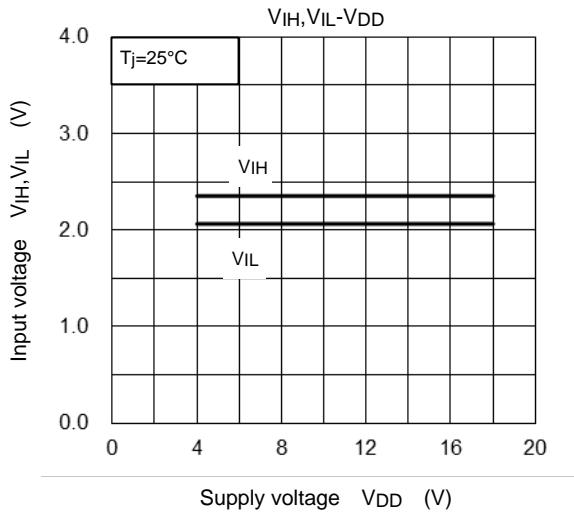
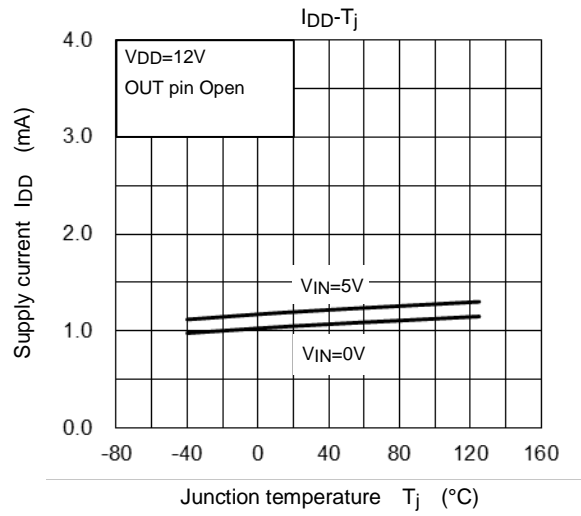
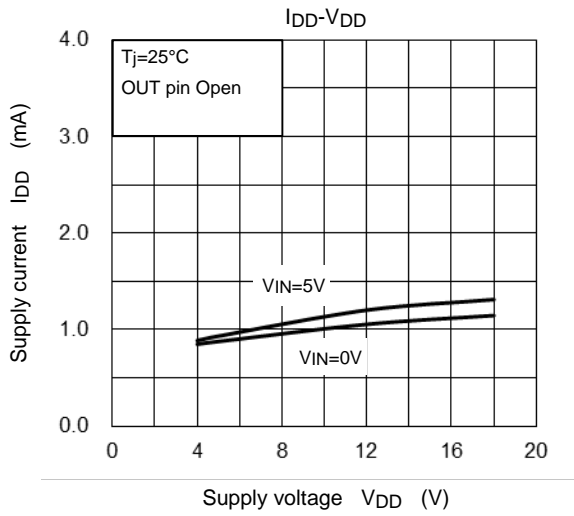
Precautions for use:

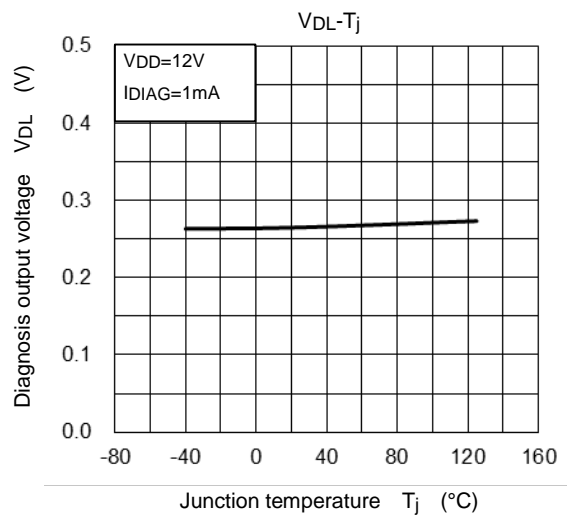
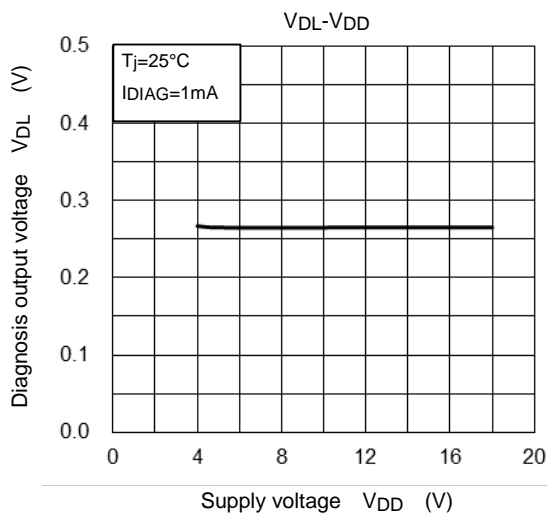
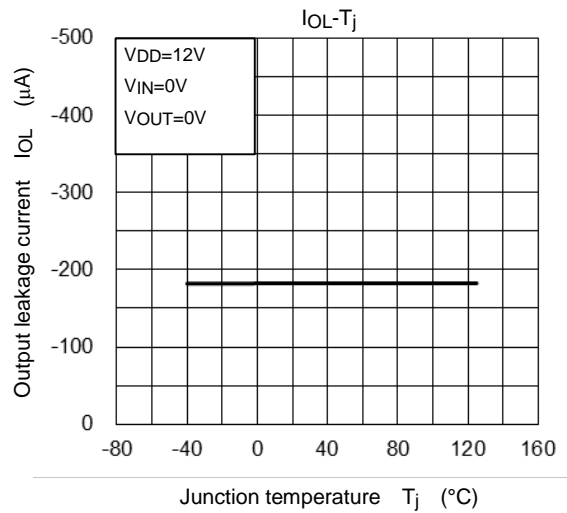
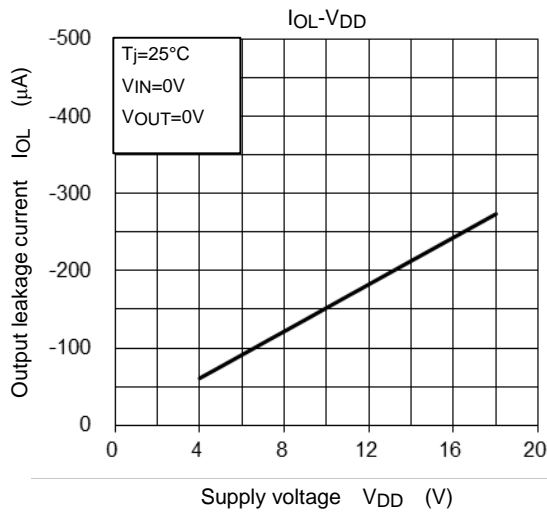
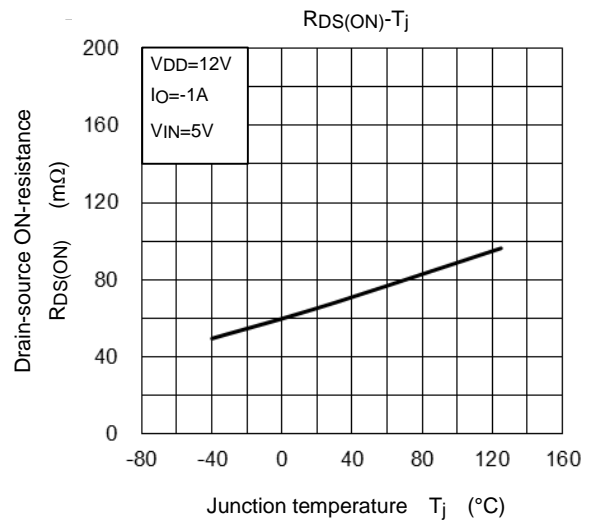
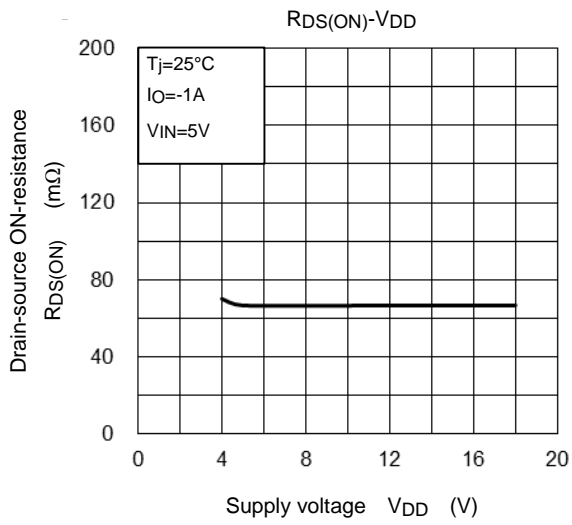
Although this product contains the negative voltage bias protection circuit of an Output pin, don't build in the inductive load energy absorption circuit. Please connect a regeneration element (diode) outside at any cost at the time of inductive load use, such as a solenoid operated valve.

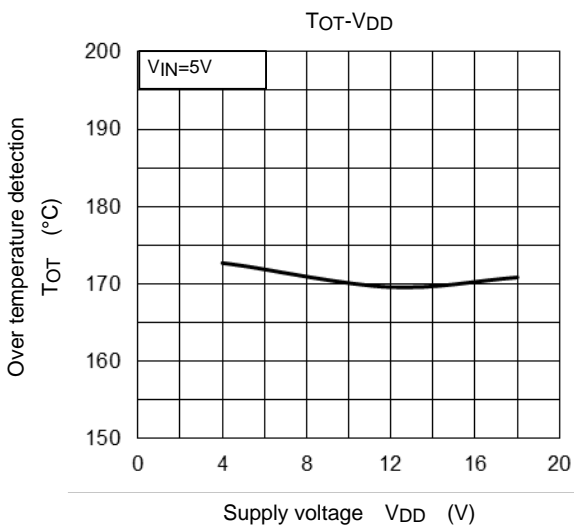
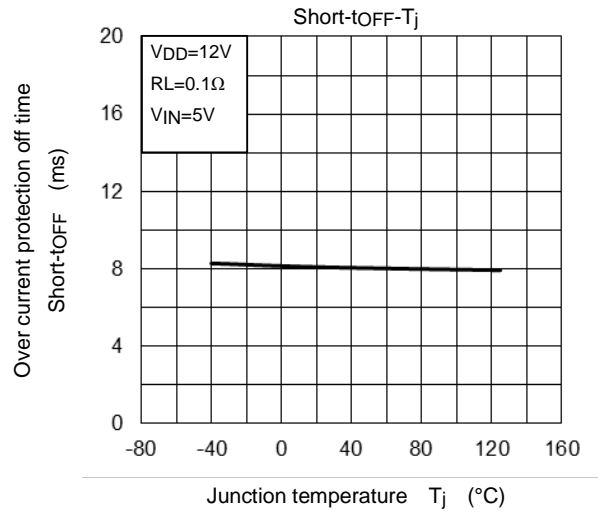
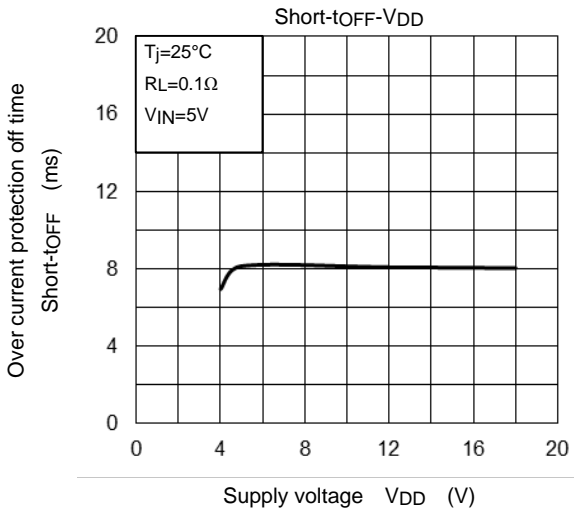
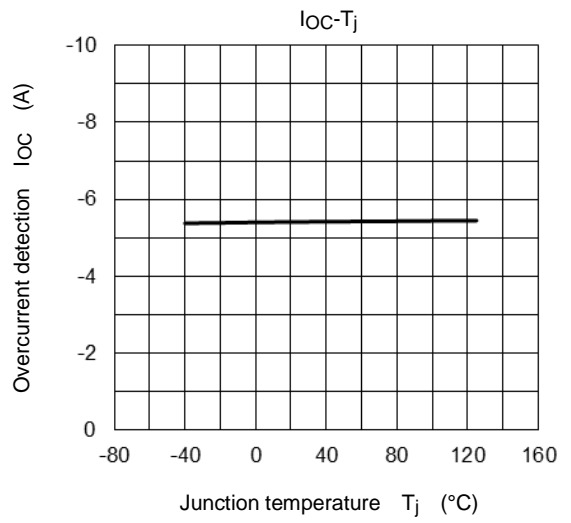
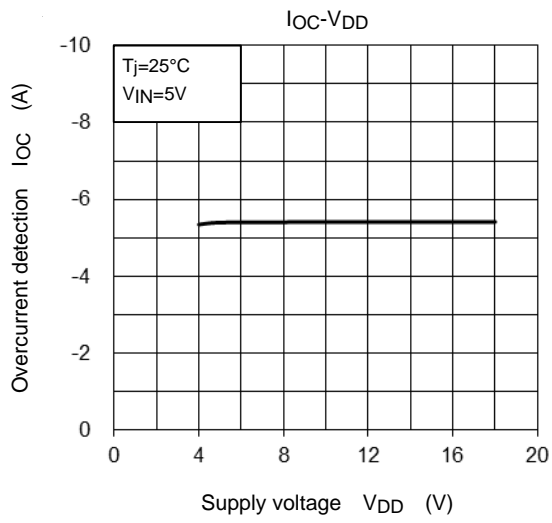
Test Circuit 1

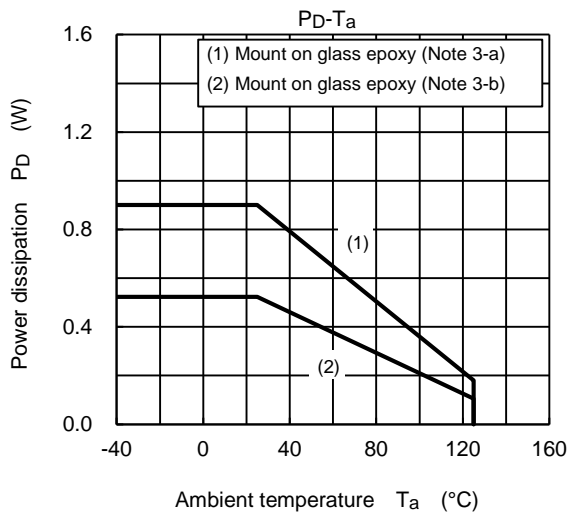
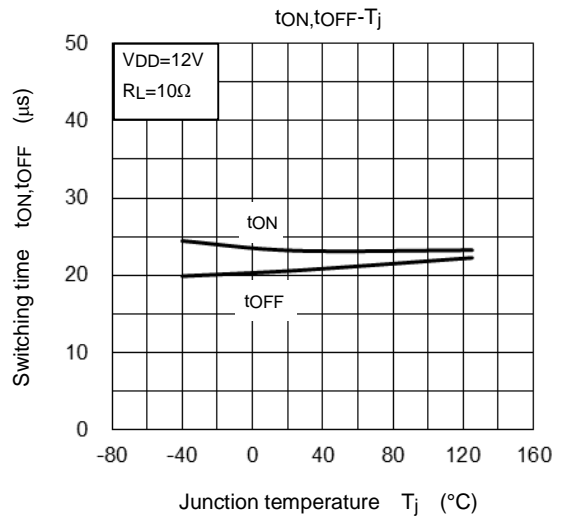
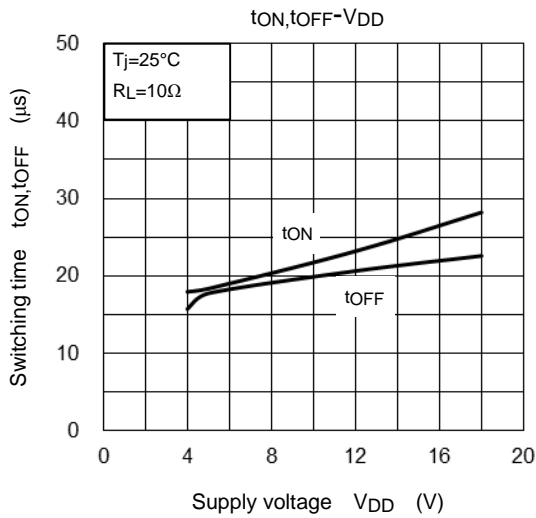
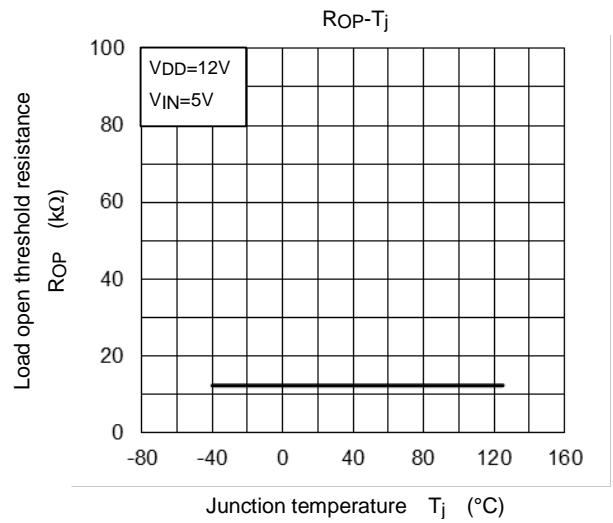
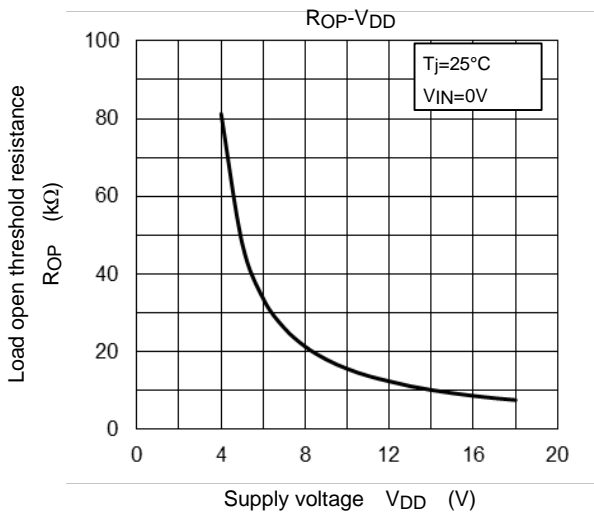
Switching time t_{ON} , t_{OFF}

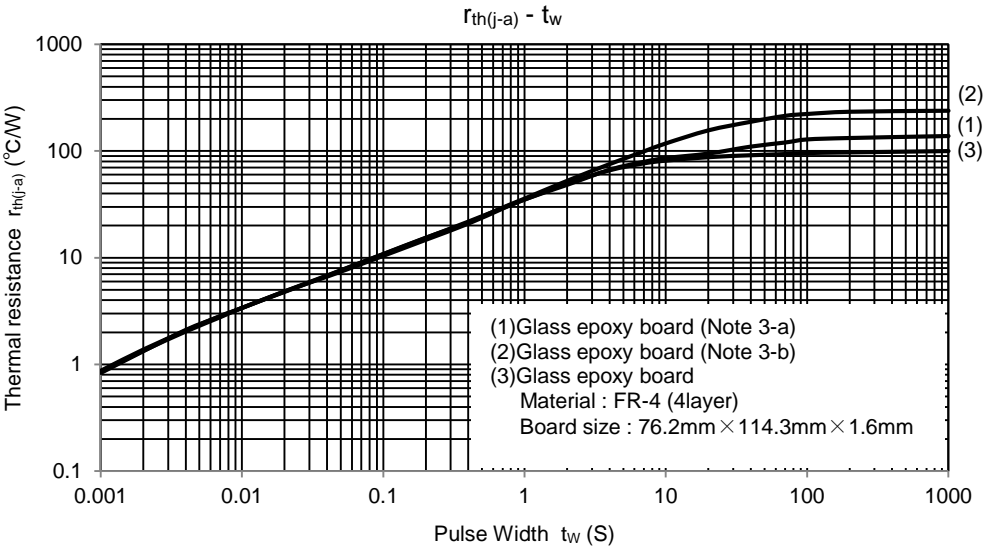




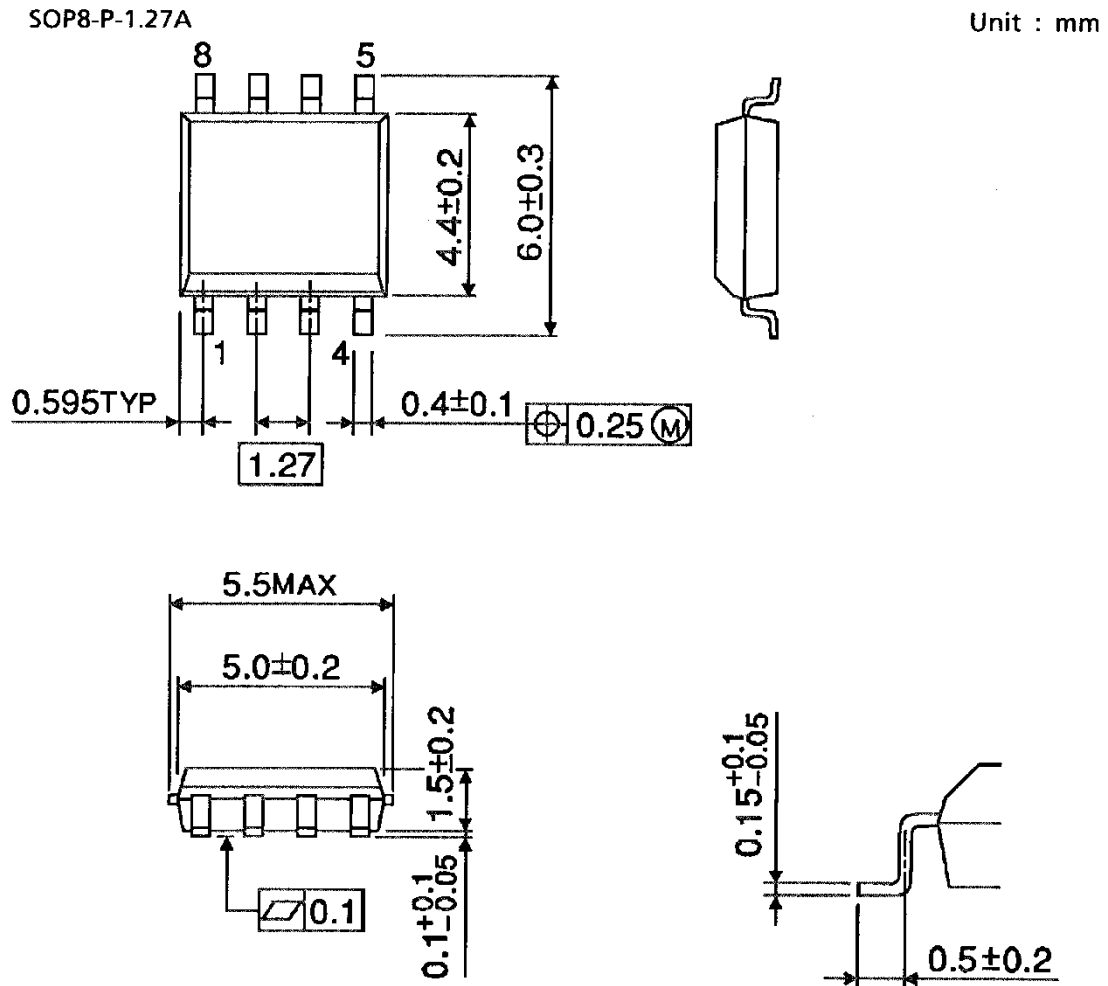








Package Dimensions



Weight: 0.08 g (Typ.)

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