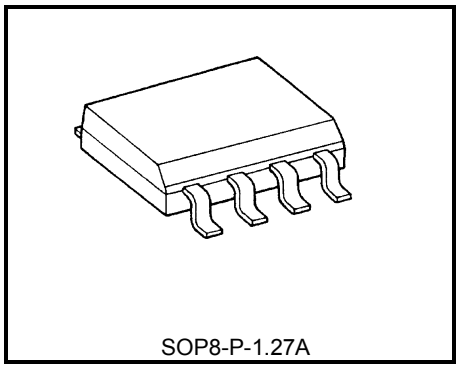
Toshiba Intelligent Power Device Silicon Monolithic Power MOS Integrated Circuit

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.

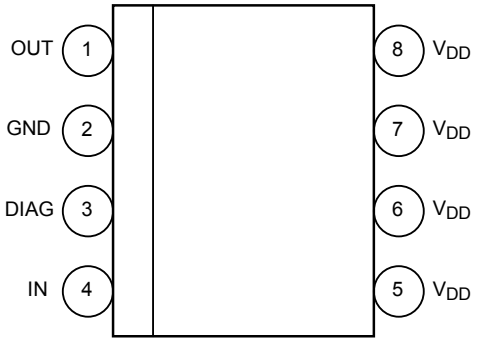


Weight : 0.08g(typ.)

Features

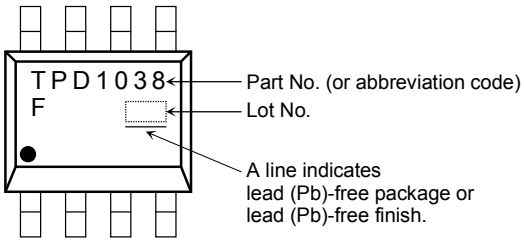
- A monolithic power IC with a structure combining a control block (Bi-CMOS) and a vertical power MOS FET on a single chip.
- One side of load can be grounded to a high-side switch.
- Can directly drive a power load from a microprocessor.
- Built-in protection against overheating and load short-circuiting.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

Pin Assignment



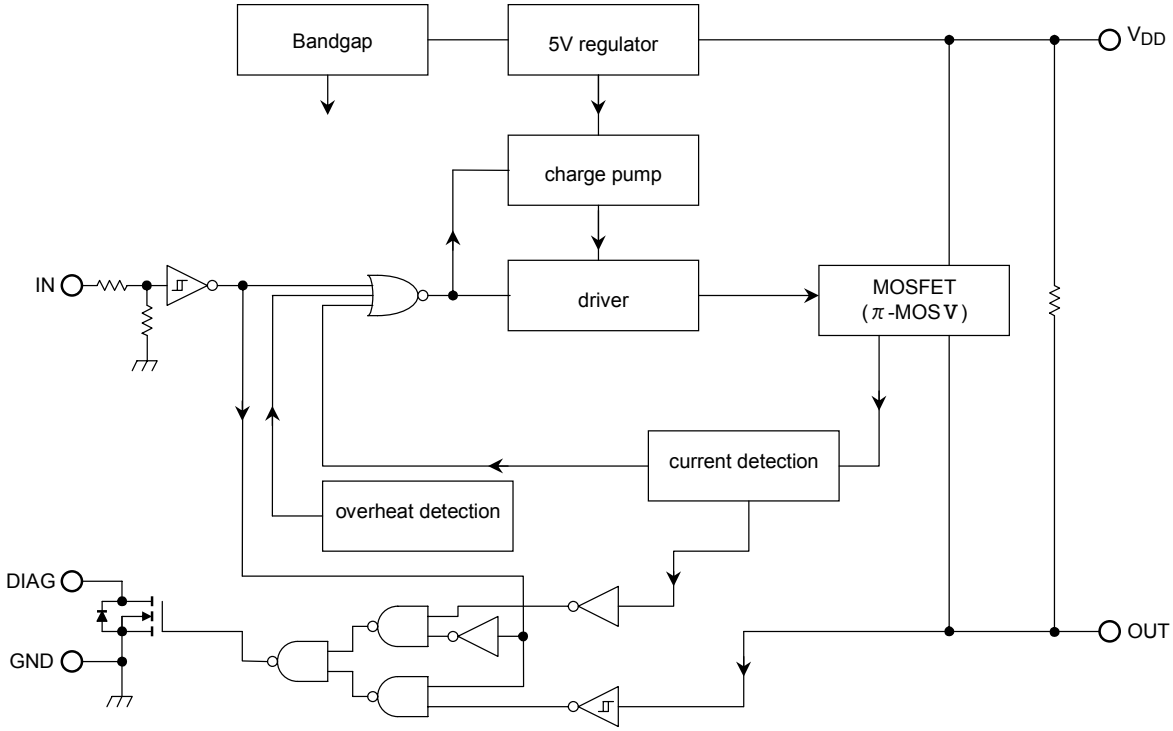
(TOP VIEW)

Marking



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

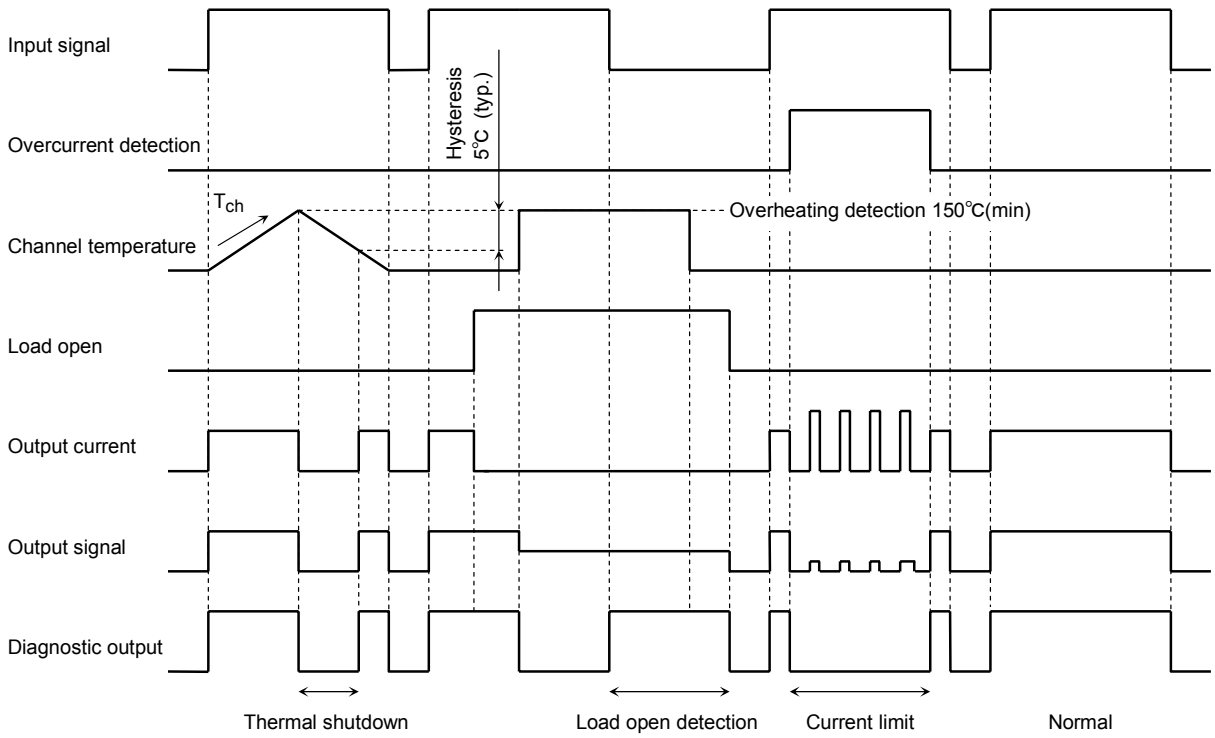
Block Diagram



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	V
	Pulse	$V_{DD(2)}$	60(R_S=1Ω, τ =250ms)	V
Input voltage	DC	$V_{IN(1)}$	−0.5～12	V
	Pulse	$V_{IN(2)}$	$V_{DD(1)}$+1.5(t=100ms)	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		Topr	−40～110	°C
Channel temperature		T_{ch}	150	°C
Storage temperature		T_{stg}	−55～150	°C

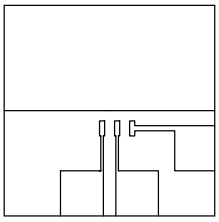
Note: Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) 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)	

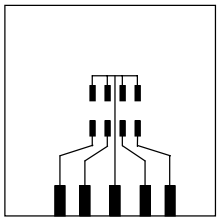
Note 1:

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	℃
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

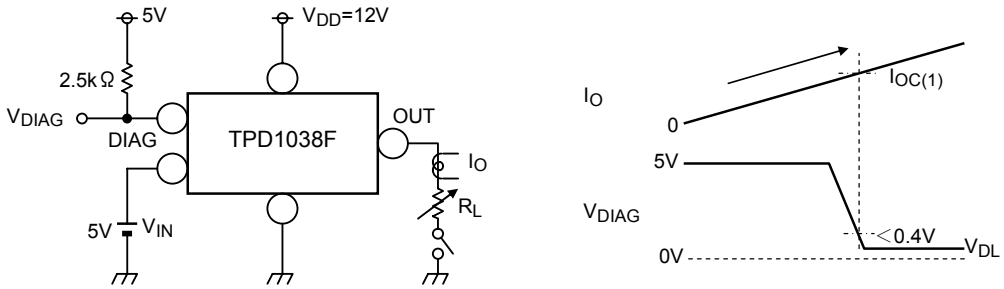
(Note 2) Over-current detection

(Note 3) Peak current @ current limit function

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

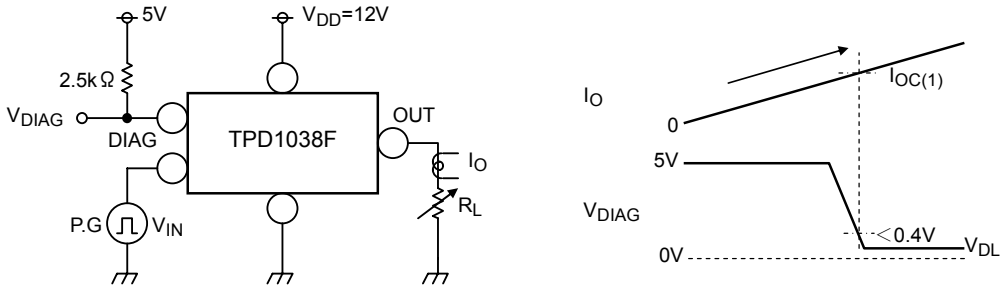
Test Circuit 1

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



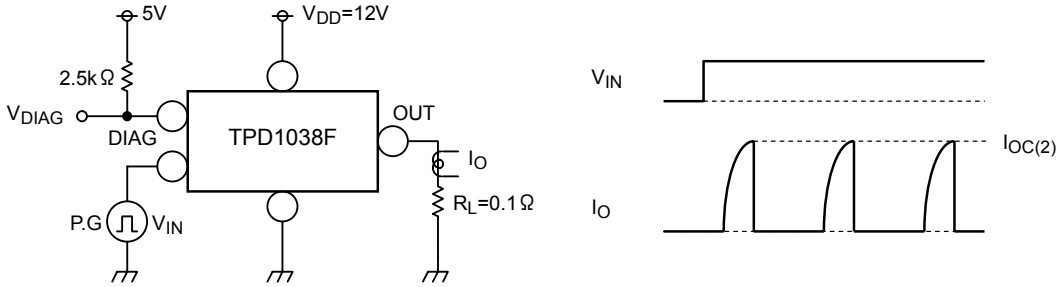
Test Circuit 2

Over current detection $I_{OC(1)}$: Over current detection when load is short circuit and VIN = "L" → "H"



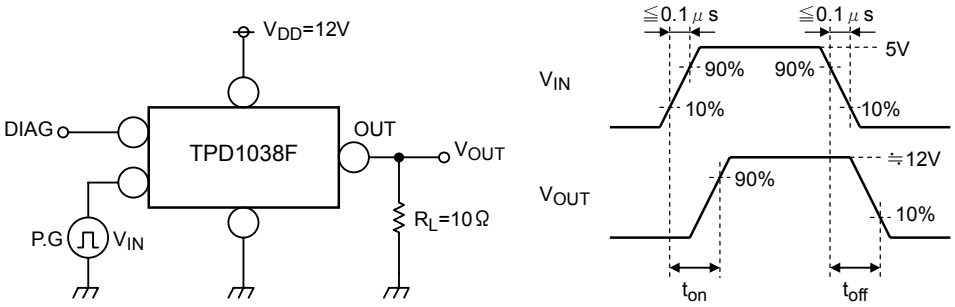
Test Circuit 3

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



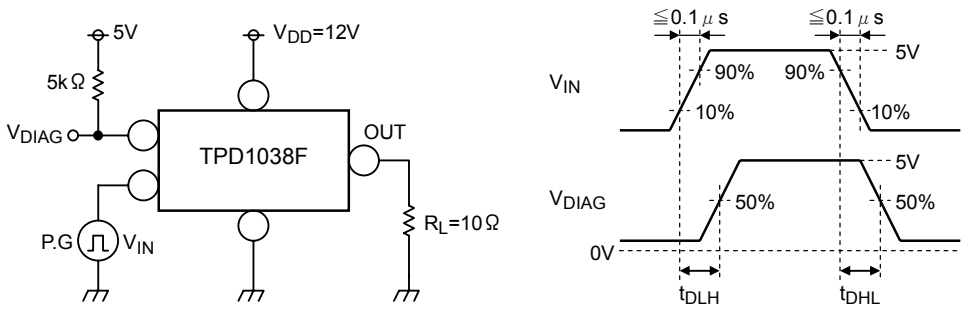
Test Circuit 4

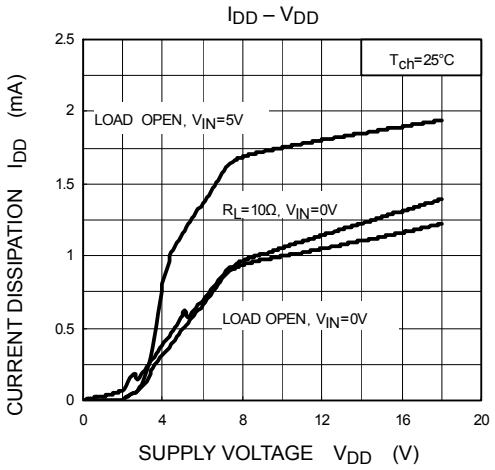
Switching time t_{on}, t_{off}

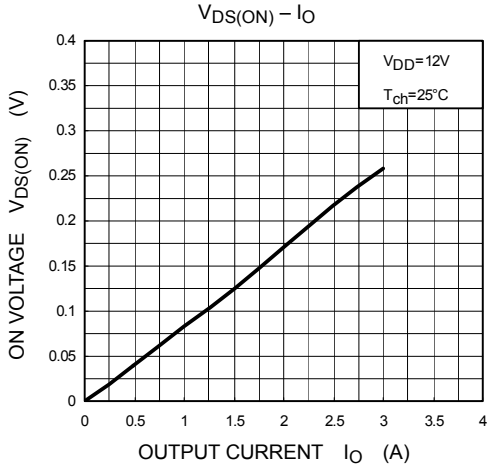


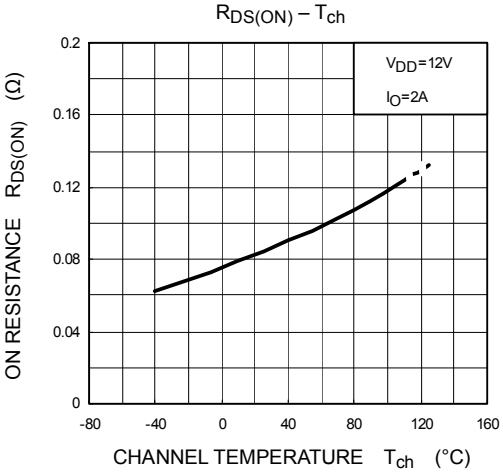
Test Circuit 5

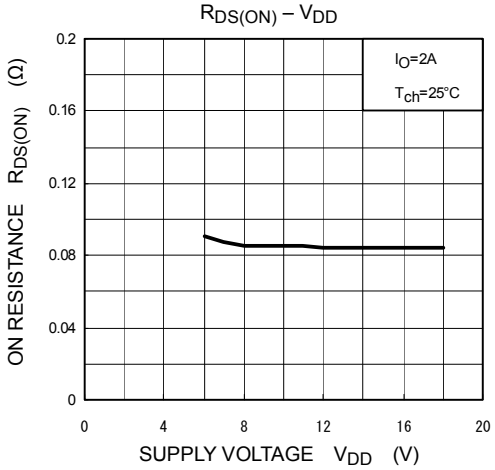
Diagnosis delay time t_{DLH}, t_{DHL}

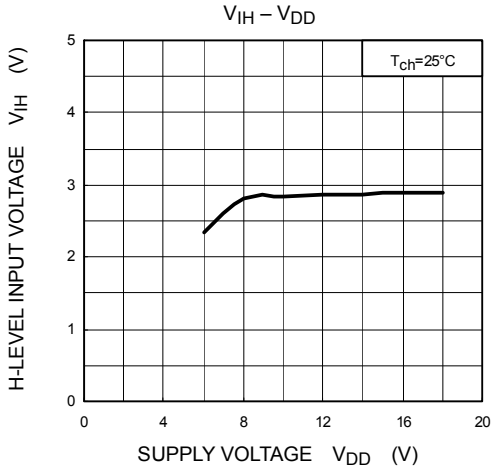


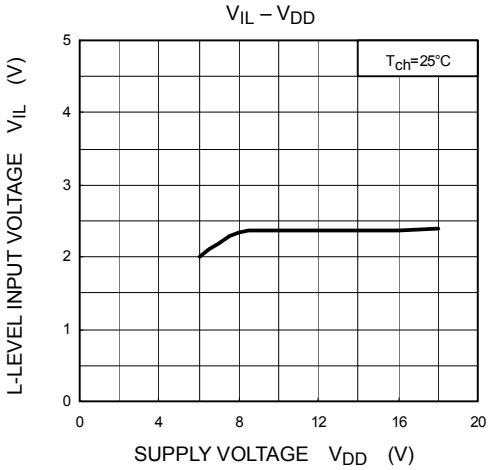

IDD – VDD
Tch=25°C
LOAD OPEN, VIN=5V
RL=10Ω, VIN=0V
LOAD OPEN, VIN=0V
CURRENT DISSIPATION IDD (mA)
SUPPLY VOLTAGE VDD (V)
0
0.5
1
1.5
2
2.5
0
4
8
12
16
20

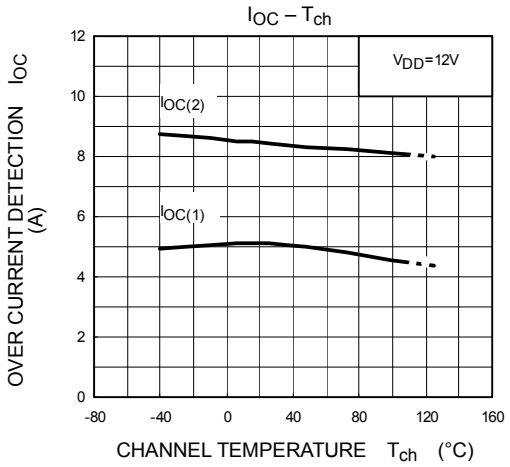

VDS(ON) – IO
VDD=12V
Tch=25°C
ON VOLTAGE VDS(ON) (V)
OUTPUT CURRENT IO (A)
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0
0.5
1
1.5
2
2.5
3
3.5
4

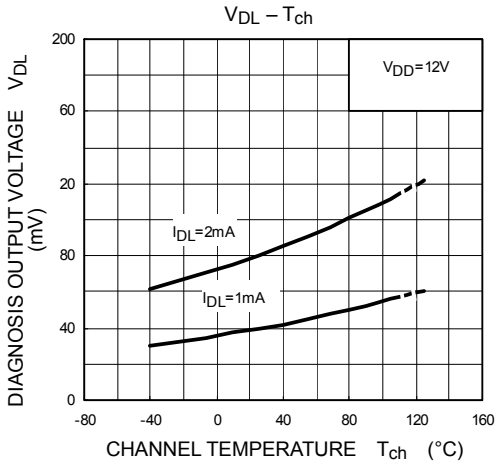

RDS(ON) – Tch
VDD=12V
IO=2A
ON RESISTANCE RDS(ON) (Ω)
CHANNEL TEMPERATURE Tch (°C)
0
0.04
0.08
0.12
0.16
0.2
-80
-40
0
40
80
120
160

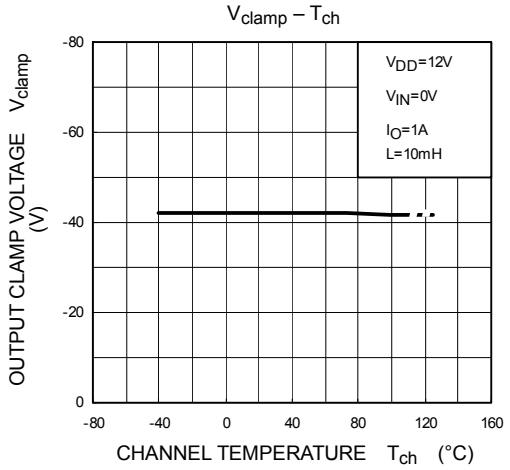

RDS(ON) – VDD
IO=2A
Tch=25°C
ON RESISTANCE RDS(ON) (Ω)
SUPPLY VOLTAGE VDD (V)
0
0.04
0.08
0.12
0.16
0.2
0
4
8
12
16
20

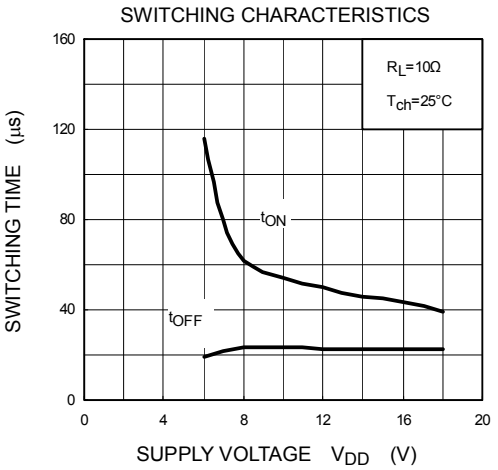

VIH – VDD
Tch=25°C
H-LEVEL INPUT VOLTAGE VIH (V)
SUPPLY VOLTAGE VDD (V)
0
1
2
3
4
5
0
4
8
12
16
20

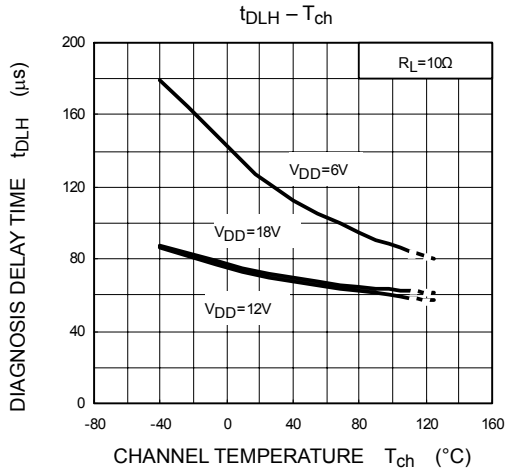

VIL – VDD
Tch=25°C
L-LEVEL INPUT VOLTAGE VIL (V)
SUPPLY VOLTAGE VDD (V)
0
1
2
3
4
5
0
4
8
12
16
20

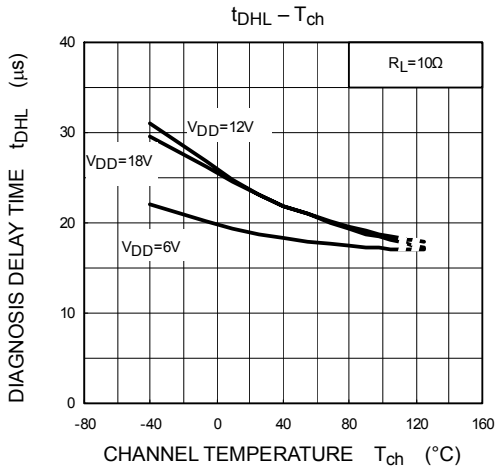

IOC – Tch
VDD=12V
IOC(2)
IOC(1)
OVER CURRENT DETECTION IOC (A)
CHANNEL TEMPERATURE Tch (°C)

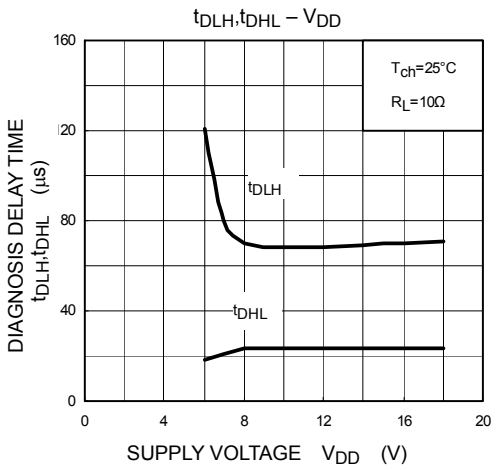

VDL – Tch
VDD=12V
IDL=2mA
IDL=1mA
DIAGNOSIS OUTPUT VOLTAGE VDL (mV)
CHANNEL TEMPERATURE Tch (°C)

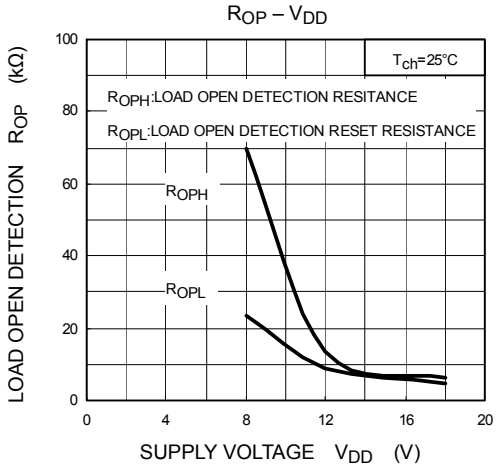

Vclamp – Tch
VDD=12V
VIN=0V
IO=1A
L=10mH
OUTPUT CLAMP VOLTAGE Vclamp (V)
CHANNEL TEMPERATURE Tch (°C)

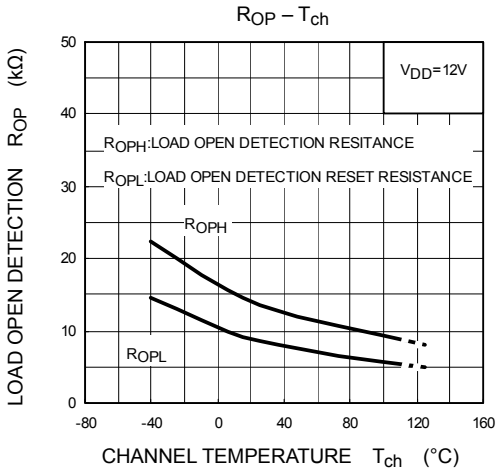

SWITCHING CHARACTERISTICS
RL=10Ω
Tch=25°C
tON
tOFF
SWITCHING TIME (μs)
SUPPLY VOLTAGE VDD (V)

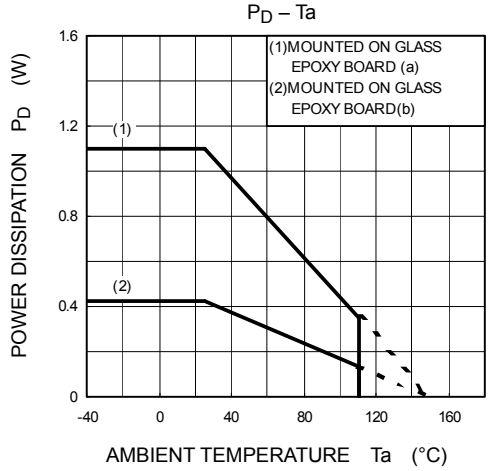

tDLH – Tch
RL=10Ω
VDD=6V
VDD=18V
VDD=12V
DIAGNOSIS DELAY TIME tDLH (μs)
CHANNEL TEMPERATURE Tch (°C)

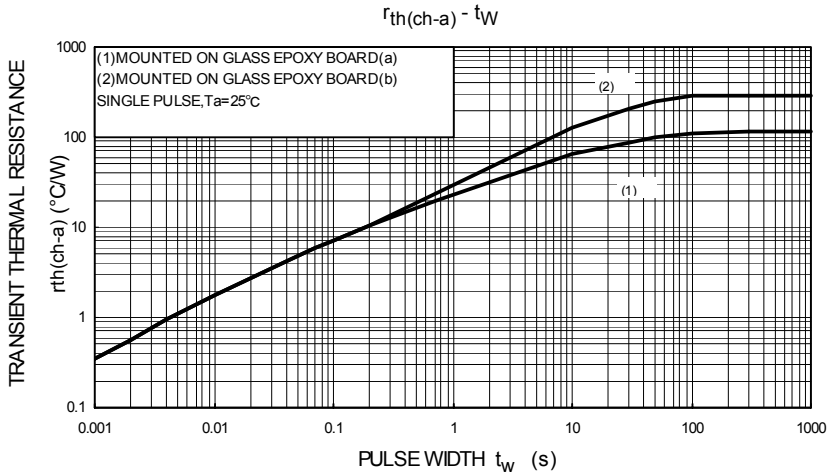

tDHL – Tch
RL=10Ω
VDD=12V
VDD=18V
VDD=6V
DIAGNOSIS DELAY TIME tDHL (μs)
CHANNEL TEMPERATURE Tch (°C)


tDLH,tDHL – VDD
Tch=25°C
RL=10Ω
tDLH
tDHL
DIAGNOSIS DELAY TIME tDLH,tDHL (μs)
SUPPLY VOLTAGE VDD (V)

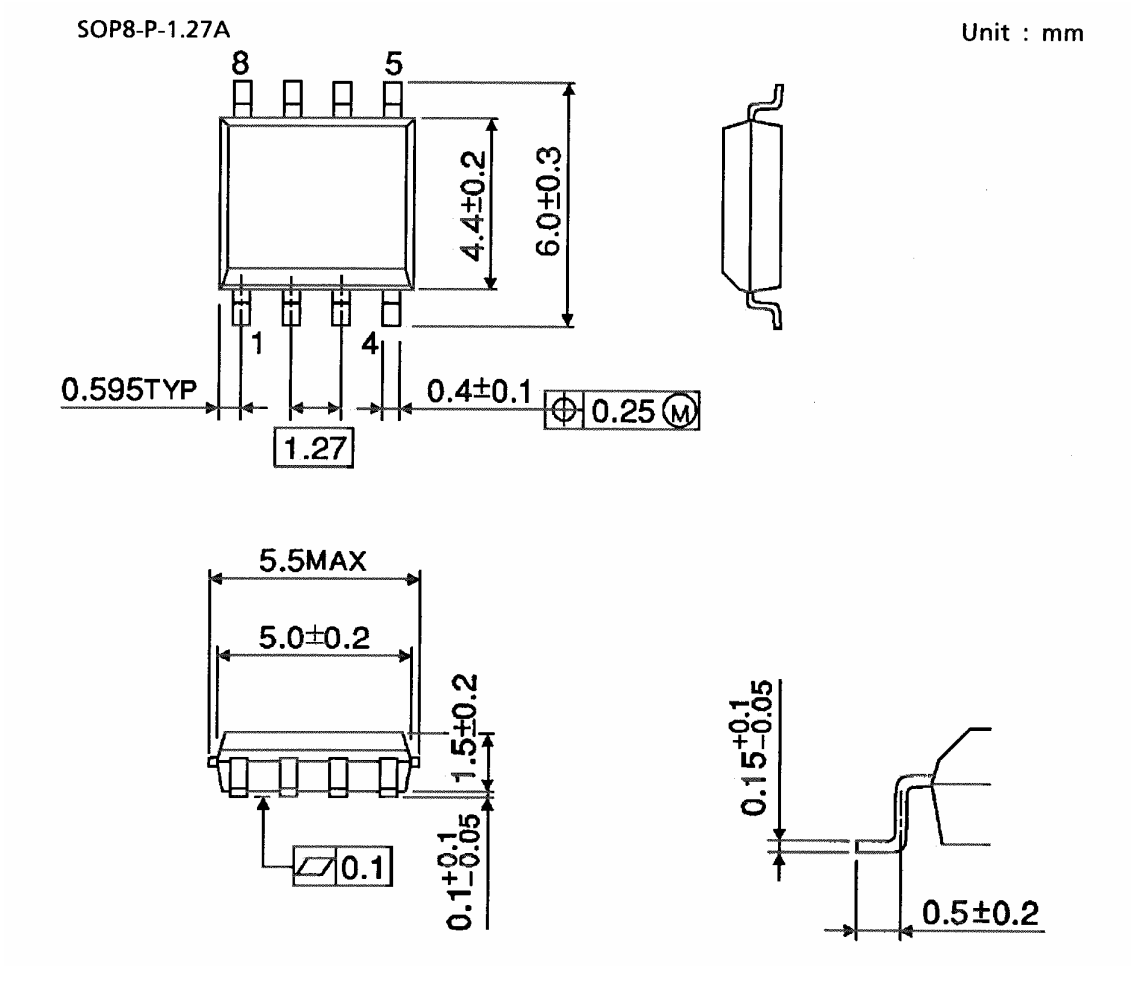

ROP – VDD
Tch=25°C
ROPH:LOAD OPEN DETECTION RESITANCE
ROPL:LOAD OPEN DETECTION RESET RESISTANCE
ROPH
ROPL
LOAD OPEN DETECTION ROP (kΩ)
SUPPLY VOLTAGE VDD (V)


ROP – Tch
VDD=12V
ROPH:LOAD OPEN DETECTION RESITANCE
ROPL:LOAD OPEN DETECTION RESET RESISTANCE
ROPH
ROPL
LOAD OPEN DETECTION ROP (kΩ)
CHANNEL TEMPERATURE Tch (°C)


PD – Ta
(1)MOUNTED ON GLASS EPOXY BOARD (a)
(2)MOUNTED ON GLASS EPOXY BOARD(b)
(1)
(2)
POWER DISSIPATION PD (W)
AMBIENT TEMPERATURE Ta (°C)


rth(ch-a) - tW
(1)MOUNTED ON GLASS EPOXY BOARD(a)
(2)MOUNTED ON GLASS EPOXY BOARD(b)
SINGLE PULSE,Ta=25°C
(2)
(1)
TRANSIENT THERMAL RESISTANCE rth(ch-a) (°C/W)
PULSE WIDTH tW (s)

Package Dimensions



Weight: 0.08g (typ.)

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- The TOSHIBA products listed in this document are intended for usage in general electronics applications (computer, personal equipment, office equipment, measuring equipment, industrial robotics, domestic appliances, etc.). These TOSHIBA products are neither intended nor warranted for usage in equipment that requires extraordinarily high quality and/or reliability or a malfunction or failure of which may cause loss of human life or bodily injury (“Unintended Usage”). Unintended Usage include atomic energy control instruments, airplane or spaceship instruments, transportation instruments, traffic signal instruments, combustion control instruments, medical instruments, all types of safety devices, etc.. Unintended Usage of TOSHIBA products listed in this document shall be made at the customer’s own risk.
- The products described in this document are subject to the foreign exchange and foreign trade laws.

Компания «ЭлектроПласт» предлагает заключение долгосрочных отношений при поставках импортных электронных компонентов на взаимовыгодных условиях!

Наши преимущества:

- Оперативные поставки широкого спектра электронных компонентов отечественного и импортного производства напрямую от производителей и с крупнейших мировых складов;
- Поставка более 17-ти миллионов наименований электронных компонентов;
- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- Лицензия ФСБ на осуществление работ с использованием сведений, составляющих государственную тайну;
- Поставка специализированных компонентов (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Aeroflex, Peregrine, Syfer, Eurofarad, Texas Instrument, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits,General Dynamics и др.);

Помимо этого, одним из направлений компании «ЭлектроПласт» является направление «Источники питания». Мы предлагаем Вам помощь Конструкторского отдела:

- Подбор оптимального решения, техническое обоснование при выборе компонента;
- Подбор аналогов;
- Консультации по применению компонента;
- Поставка образцов и прототипов;
- Техническая поддержка проекта;
- Защита от снятия компонента с производства.

Как с нами связаться

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