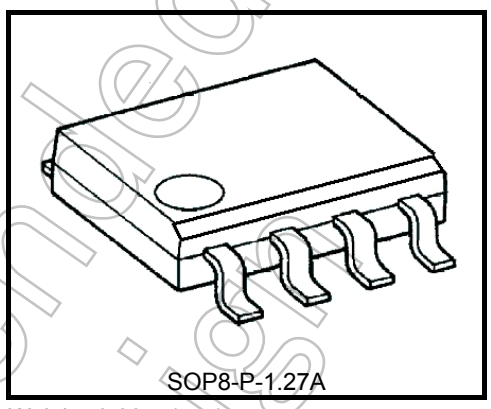
Toshiba Intelligent Power Device Silicon Monolithic Power MOS Integrated Circuit

TPD1039F

Low-Side Power Switch for Motor, Solenoid and Lamp Drivers

The TPD1039F is a monolithic power IC intended for low-side load switching applications. The output has a vertical MOSFET, and the input can be directly driven from CMOS or TTL logic (e.g., an MPU). The TPD1039F provides intelligent protection functions.



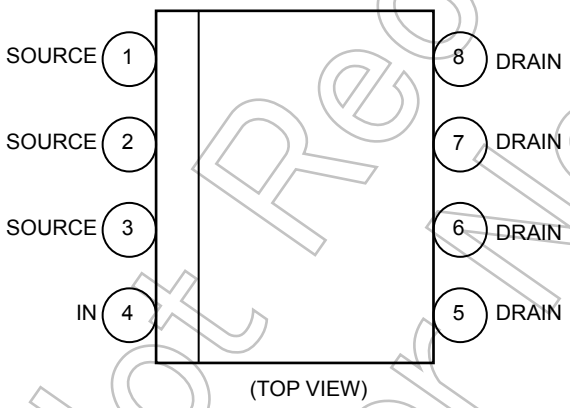
SOP8-P-1.27A

Weight: 0.08 g (typ.)

Features

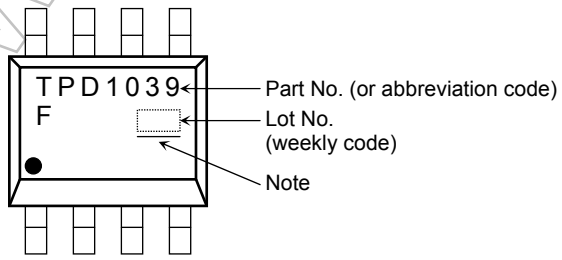
- A structure that incorporates control circuitry and a vertical power MOSFET on a single chip.
- Can be directly driven from a microprocessor, a CMOS logic IC, etc.
- Overvoltage, overtemperature and overcurrent protections
- Low ON-resistance: $R_{DS\ (ON)}$ = 0.25 Ω (max) (@V_{IN} = 5 V, I_D = 1 A, T_{ch} = 25°C)
- Housed in the 8-pin SOP package and supplied in embossed carrier tape.

Pin Assignment (top view)



(TOP VIEW)

Marking



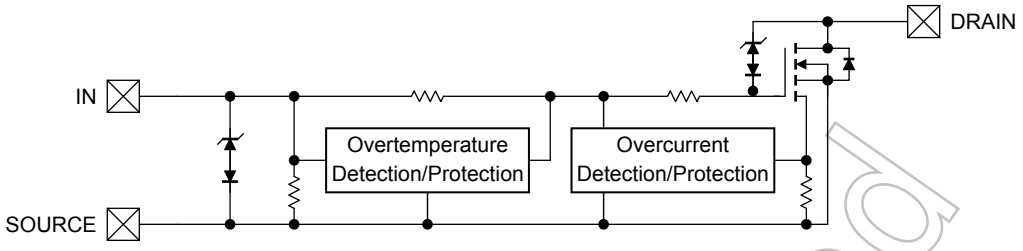
Note: A line under a Lot No. identifies the indication of product Labels
Not underlined: [[Pb]]/INCLUDES > MCV
Underlined: [[G]]/RoHS COMPATIBLE or [[G]]/RoHS [[Pb]]

Please contact your TOSHIBA sales representative for details as to environmental matters such as the RoHS compatibility of Product.
The RoHS is 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.

This product has a MOS structure and is sensitive to electrostatic discharge.

Start of commercial production
2001-09

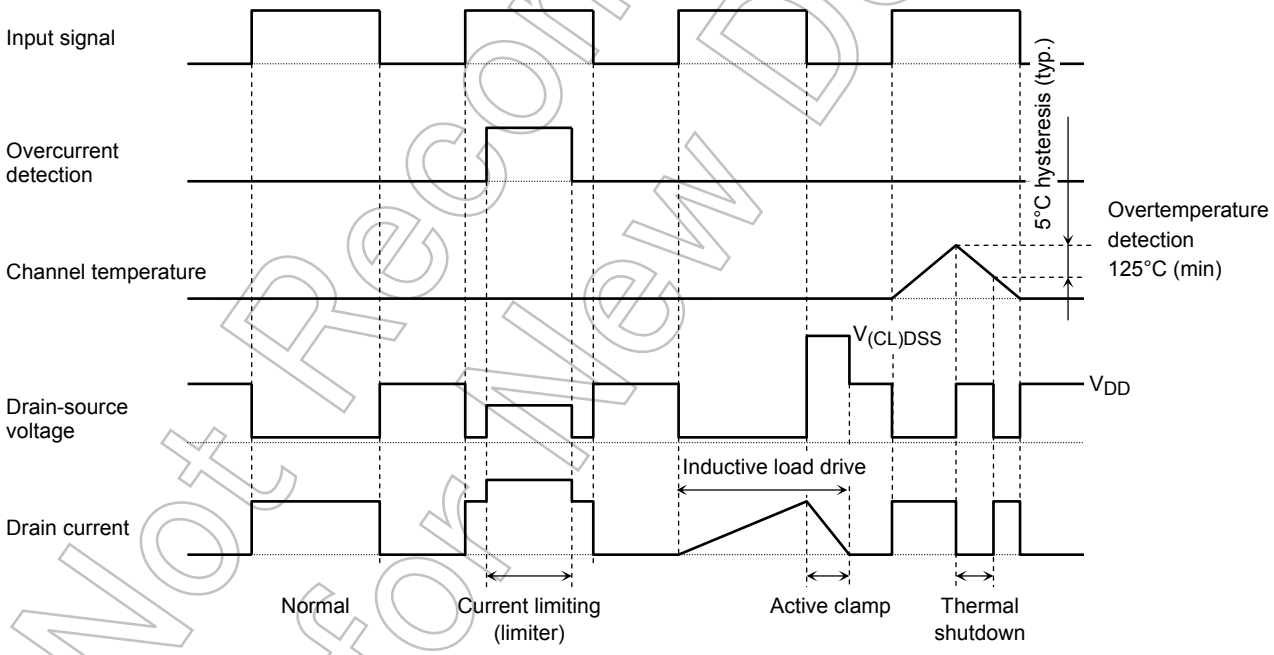
Block Diagram



Pin Description

Pin No.	Symbol	Pin Description
1, 2, 3	SOURCE	Source (ground) pins.
4	IN	Input pin. This pin is connected to a pull-down resistor internally, so that even if the input is open-circuited, the output never turns on inadvertently.
5 ,6, 7, 8	DRAIN	Drain pins. The output current is limited to 5 A (typ.) even if an excessive current flows into a device due to an in-rush current of a lamp or load short-circuit.

Timing Chart



Truth Table

V_{IN}	V_{DS}	Output State	Operating State
L	H	Off	Normal
H	L	On	
L	H	Off	Load short-circuited
H	H	Current limiting(limiter)	
L	H	Off	Overtemperature
H	H	Off	

Absolute Maximum Ratings (Ta = 25°C)

Characteristics	Symbol	Rating	Unit
Drain-source voltage	$V_{DS\ (DC)}$	45	V
Drain current	$I_{D\ (DC)}$	1.5	A
Input voltage	V_{IN}	−0.5 to 6	V
Power dissipation (Note 2-a)	$P_{D(1)}$	1.1	W
Power dissipation (Note 2-b)	$P_{D(2)}$	0.425	W
Single pulse active clamp capability (Note 3)	E_{AS}	20	mJ
Active clamp current	I_{AR}	1.5	A
Repetitive active clamp capability (Note 2-a) (Note 4)	E_{AR}	0.11	mJ
Operating temperature	T_{opr}	−40 to 85	°C
Channel temperature	T_{ch}	150 (Note 5)	°C
Storage temperature	T_{stg}	−55 to 150	°C

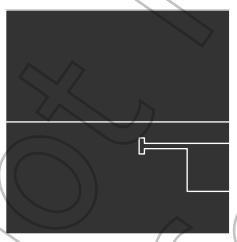
Note 1: Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) 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	$R_{th(ch-a)}$	113.5 (Note 2-a)	°C /W
		294.0 (Note 2-b)	

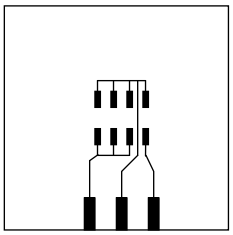
Note 2:

2-a: glass epoxy board (a)



FR-4
25.4 × 25.4 × 0.8
(unit: mm)

2-b: glass epoxy board (b)



FR-4
25.4 × 25.4 × 0.8
(unit: mm)

Note 3: Active clamp capability (single pulse) test condition
V_{DD} = 25 V, T_{ch} = 25°C (initial), L = 10 mH, I_{AR} = 1.5 A, R_G = 25 Ω

Note 4: Repetitive rating: Pulse width limited by maximum channel temperature

Note 5: Overtemperature protection is tripped at a channel temperature of 125°C.
Ensure that the channel temperature, Tch, does not exceed 125°C under the worst-case conditions.

Electrical Characteristics (T_{ch} = 25°C)

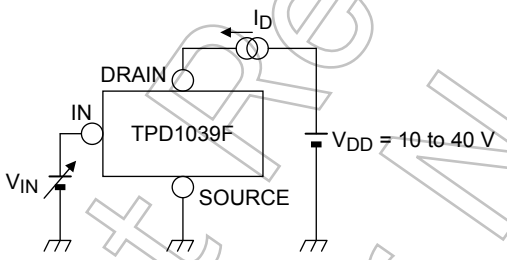
Characteristics	Symbol	Test Circuit	Test Condition	Min	Typ.	Max	Unit
Drain-source clamp voltage	$V_{(CL)DSS}$	-	V_{IN} = 0 V, I_D = 1 mA	45	-	-	V
High-level input voltage	V_{IH}	1	V_{DS} = 10 to 40 V, $I_D \geq$ 1 A	3.5	-	6	V
Low-level input voltage	V_{IL}	1	V_{DS} = 10 to 40 V, $I_D \leq$ 10μA	-	-	0.8	
Drain cut-off current	I_{DSS}	-	V_{IN} = 0 V, V_{DS} = 40 V	-	-	10	μA
High-level input current	I_{IH}	-	V_{IN} = 5 V, at normal operation		-	400	μA
Drain-source ON-resistance	$R_{DS(ON)}$	-	V_{IN} = 5 V, I_D = 1 A	-	-	0.25	Ω
Protective circuit operation input Voltage range	$V_{IN(opr)}$	-	-	3.5	-	6	V
Overtemperature detection (Note 6)	T_{OT}	2	V_{IN} = 5 V, V_{DD} = 12 V	125	-	-	°C
Overcurrent detection	I_{OC}	3	V_{IN} = 5 V, V_{DS} = 24 V	-	5	-	A
Switching times	t_{on}	4	V_{DD} = 24 V, V_{IN} = 0 V/5 V, R_L = 24Ω	-	15	-	μs
	t_{off}			-	45	-	
Drain-source diode forward Voltage	V_{DSF}	-	V_{IN} = 0 V, I_{DR} = 1.5 A	-	0.9	1.8	V

Note 6: Overtemperature protection is tripped at a channel temperature of 125°C.
Ensure that the channel temperature, Tch, does not exceed 125°C under the worst-case conditions.
This feature is intended to protect the device against damage. The device reliability is not guaranteed if the device persists to remain overtemperature protection mode.

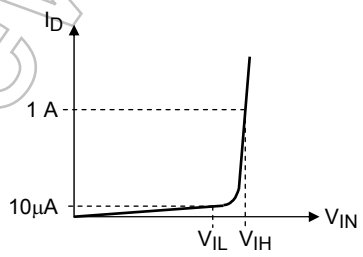
Test Circuit 1

H-level input voltage, L-level input voltage measuring circuit

Test circuit



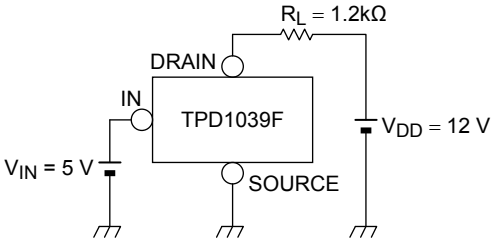
Measured waveforms



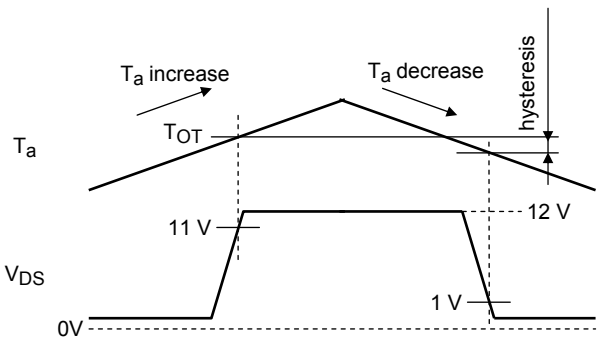
Test Circuit 2

Overtemperature detection measuring circuit

Test circuit



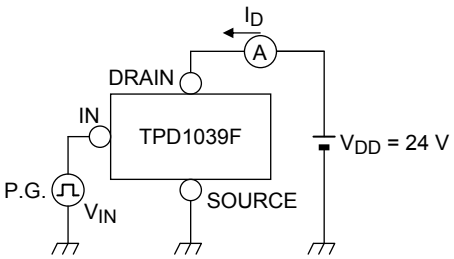
Measured waveforms



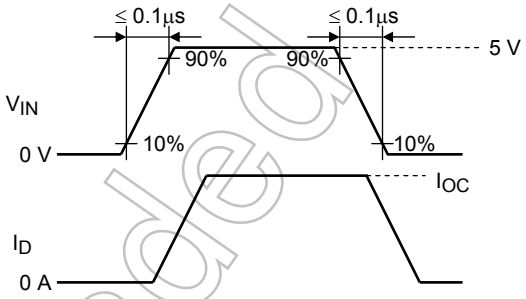
Test Circuit 3

Overcurrent detection circuit

Test circuit



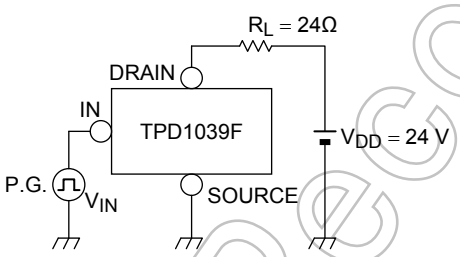
Measured waveforms



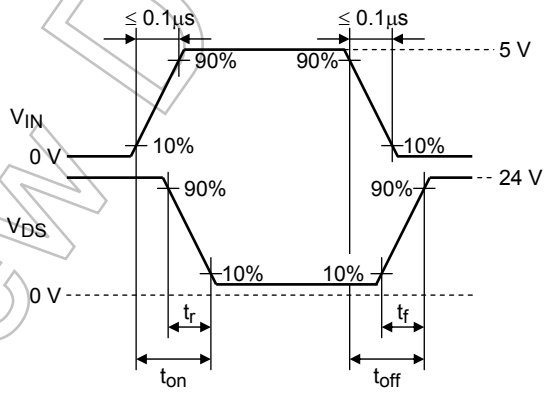
Test Circuit 4

Switching time measuring circuit

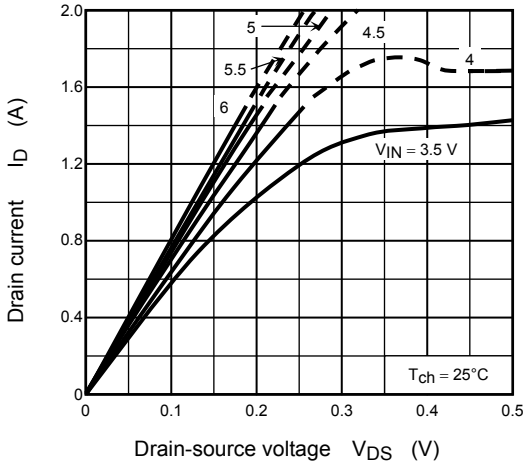
Test circuit



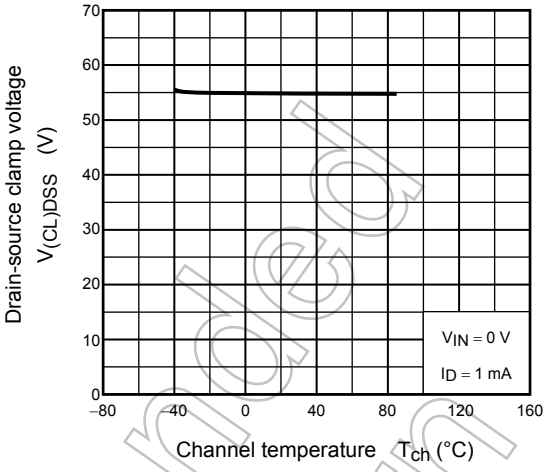
Measured waveforms



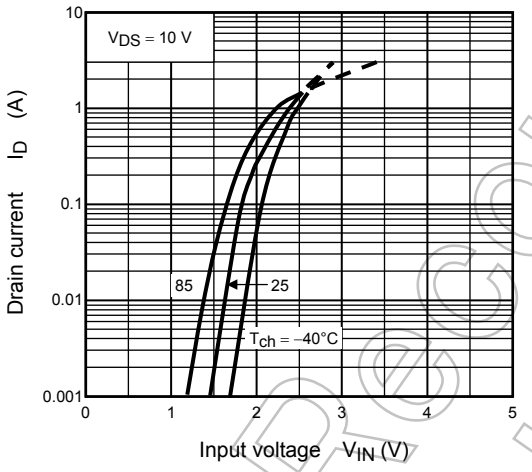
$I_D - V_{DS}$



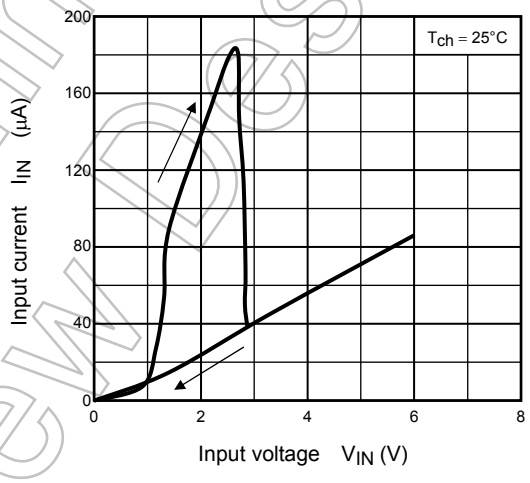
$V_{(CL)\,DSS} - T_{ch}$



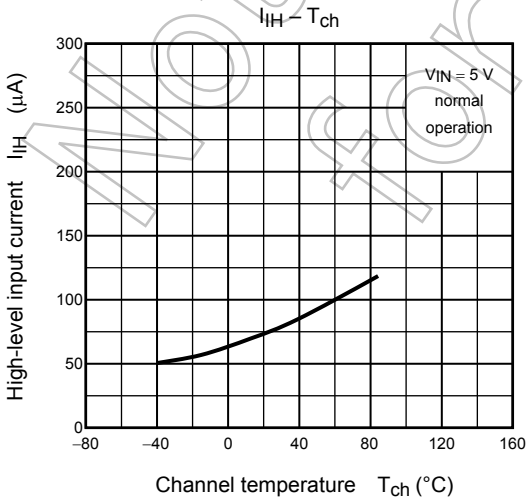
$I_D - V_{IN}$



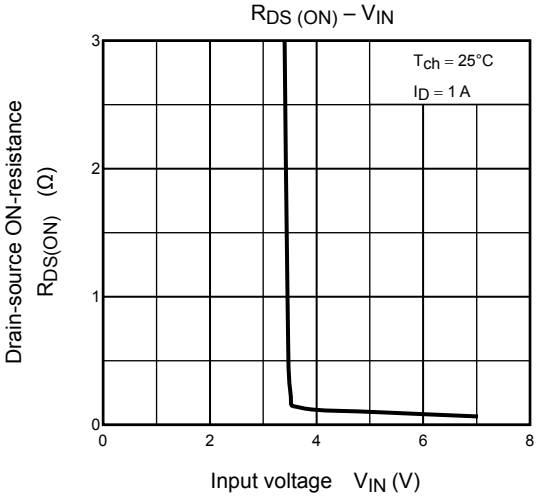
$I_{IN} - V_{IN}$



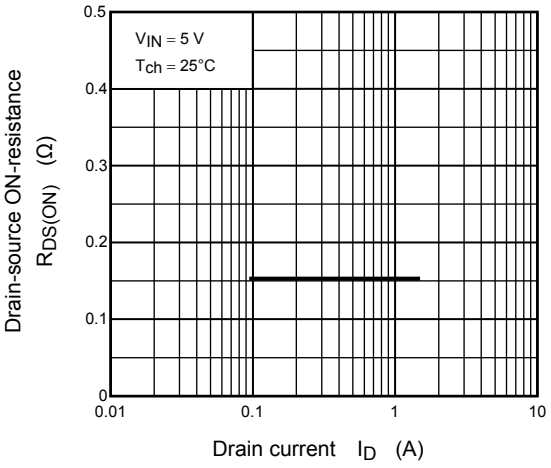
$I_{IH} - T_{ch}$



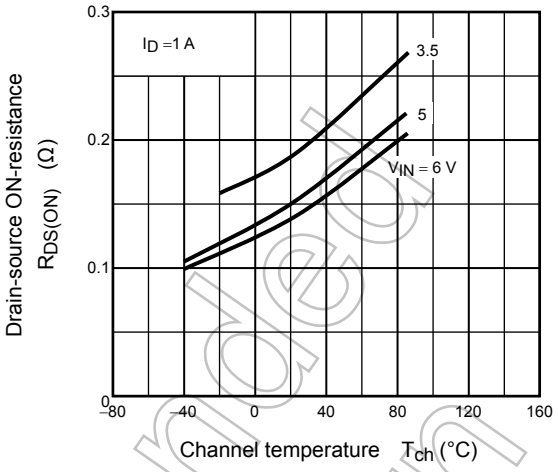
$R_{DS\,(ON)} - V_{IN}$



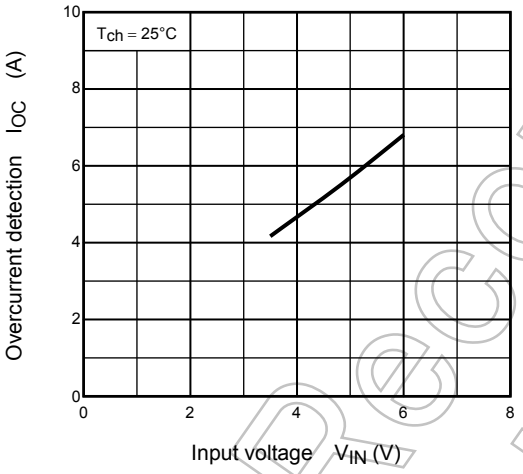
$R_{DS\ (ON)} - I_D$



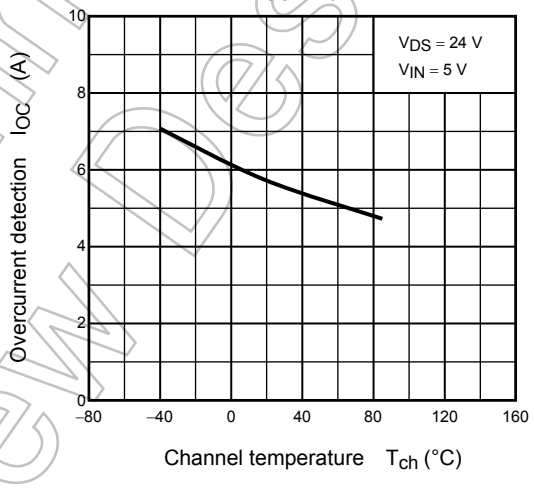
$R_{DS\ (ON)} - T_{ch}$



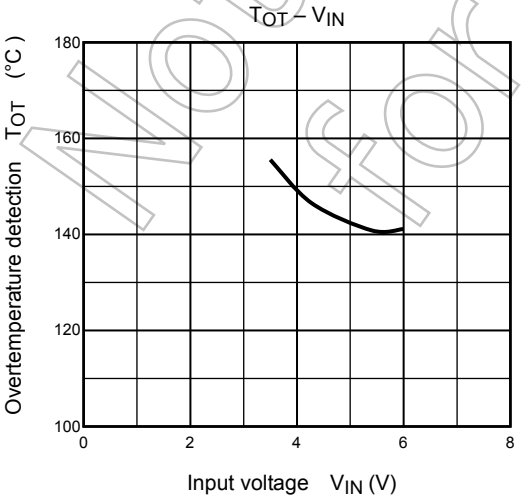
$I_{OC} - V_{IN}$



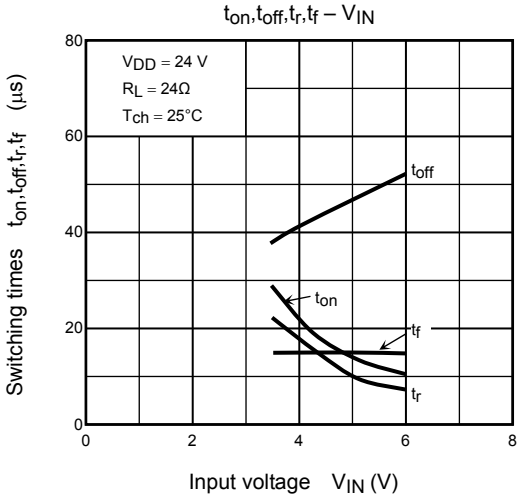
$I_{OC} - T_{ch}$



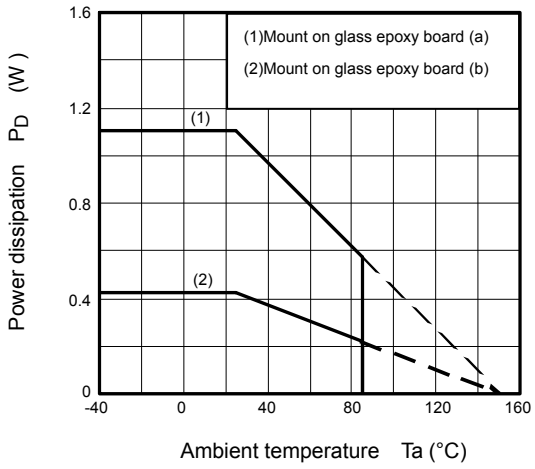
$T_{OT} - V_{IN}$



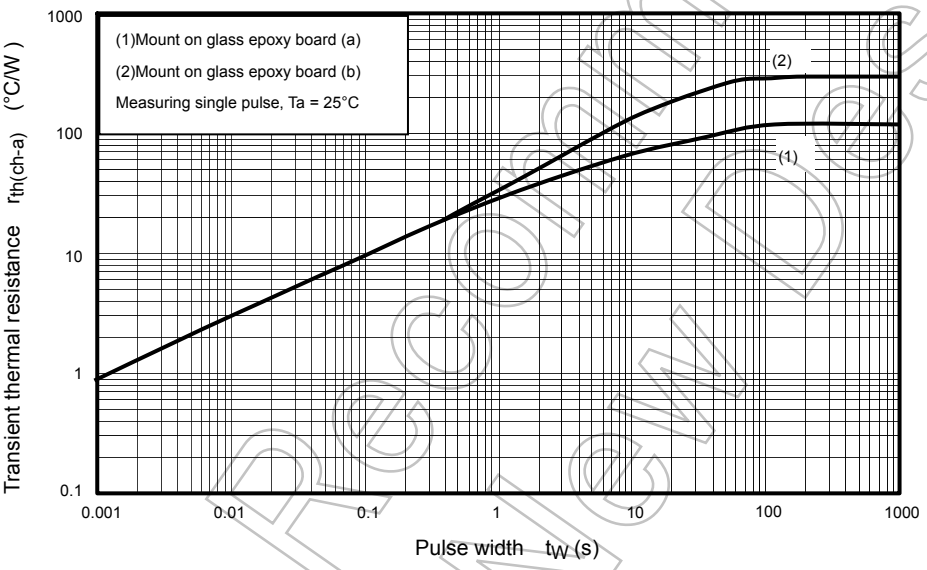
$t_{on}, t_{off}, t_r, t_f - V_{IN}$



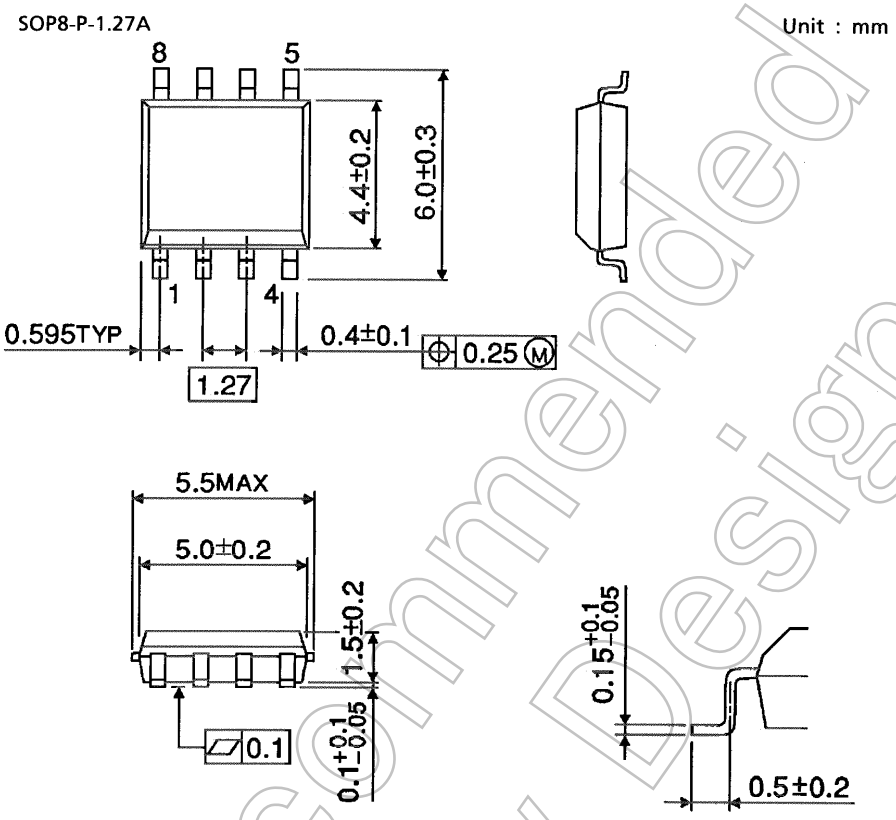
$P_D - Ta$



$r_{th(ch-a)} - t_W$



Package Dimensions



Weight: 0.08 g (typ.)

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