

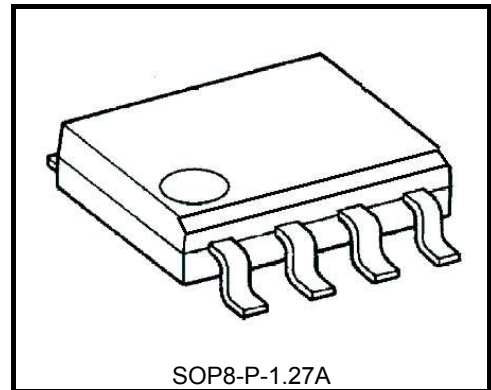
TPD1039F

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.

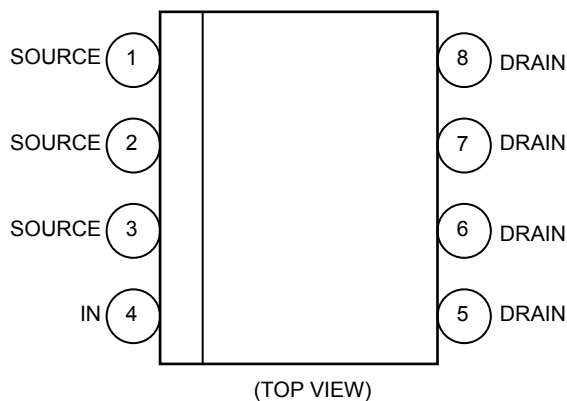
Features

- 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: $R_{DS(ON)} = 0.25 \Omega$ (max) (@ $V_{IN} = 5 V, I_D = 1 A, T_{ch} = 25^\circ C$)
- Housed in the 8-pin SOP package and supplied in embossed carrier tape.

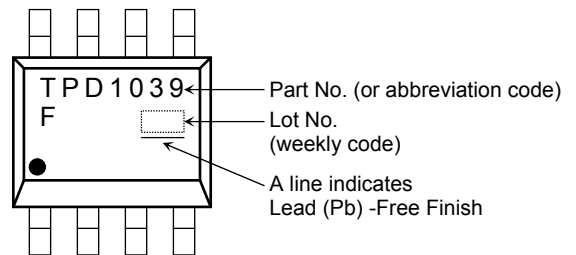


Weight: 0.08 g (typ.)

Pin Assignment (top view)

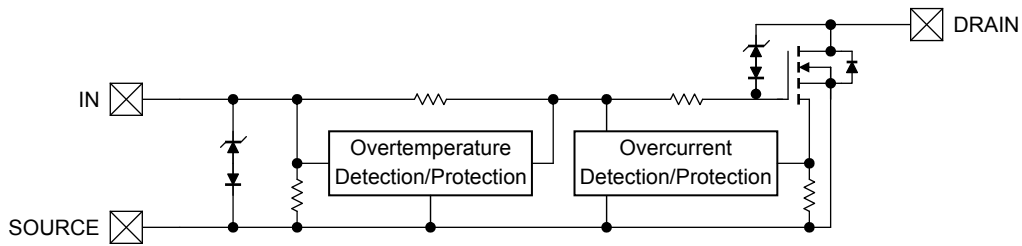


Marking



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

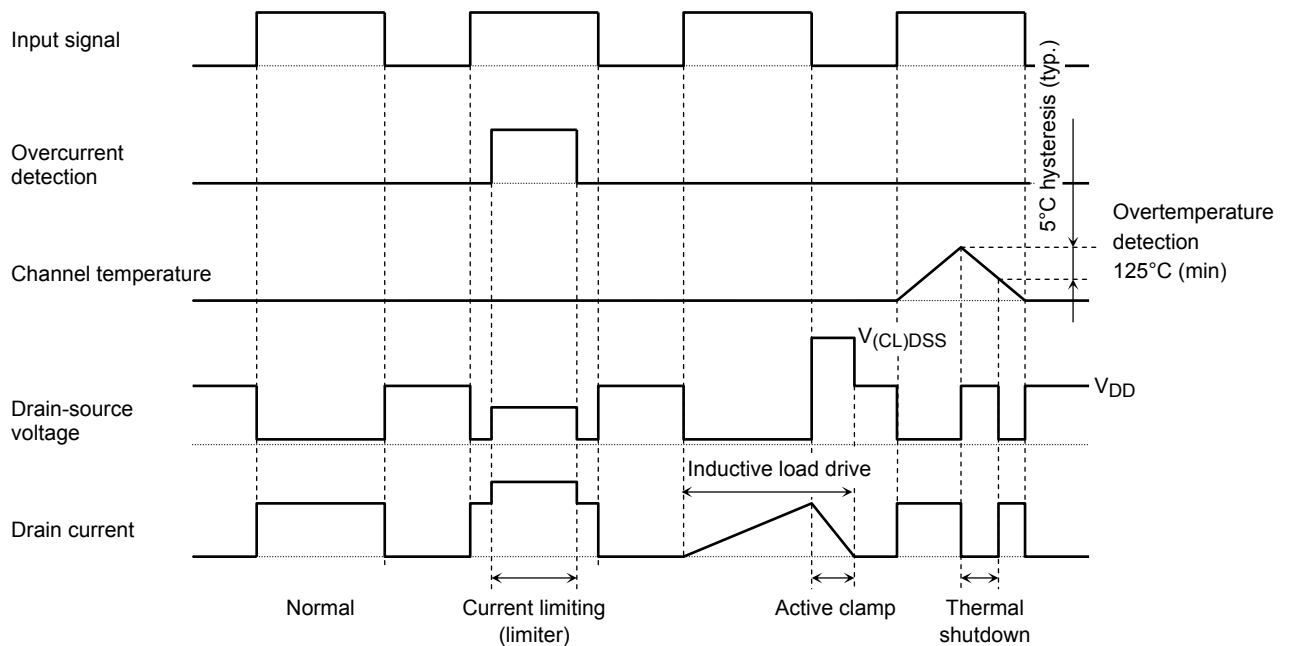
Block Diagram



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.

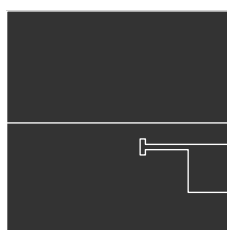
Please design the appropriate reliability upon reviewing the Toshiba Semiconductor Reliability Handbook (“Handling Precautions”/“Derating Concept and Methods”) and individual reliability data (i.e. reliability test report and estimated failure rate, etc).

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)	

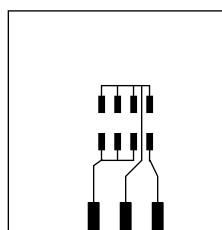
Note 2:

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, T_{ch}, 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 ≥ 1 A	3.5	-	6	V
Low-level input voltage	V _{IL}	1	V _{DS} = 10 to 40 V, I _D ≤ 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.

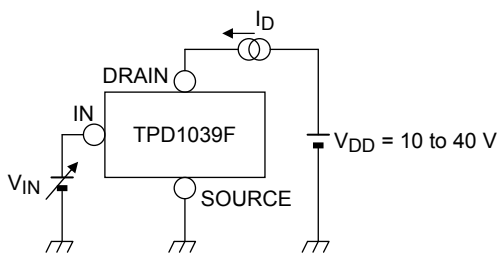
Ensure that the channel temperature, T_{ch}, does not exceed 125°C under the worst-case conditions.

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.

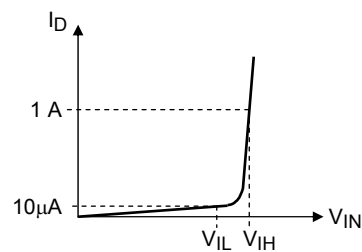
Test Circuit 1

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

Test circuit



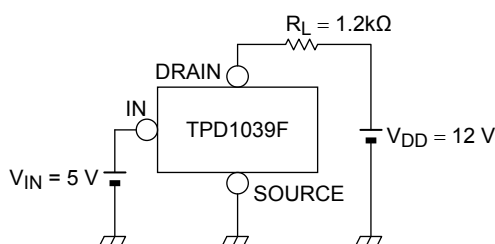
Measured waveforms



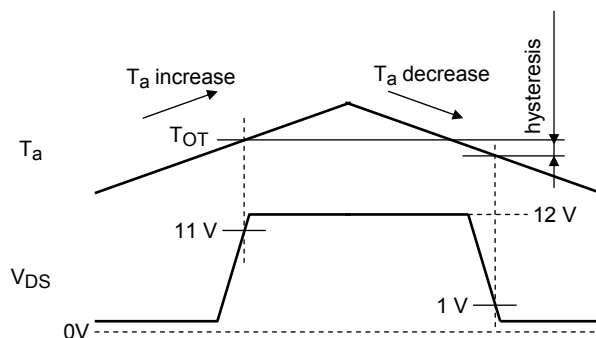
Test Circuit 2

Overtemperature detection measuring circuit

Test circuit



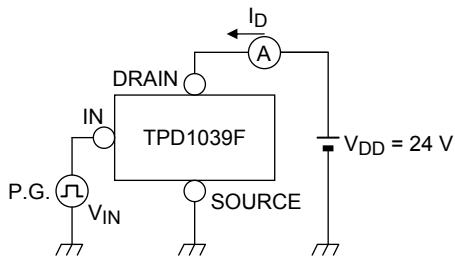
Measured waveforms



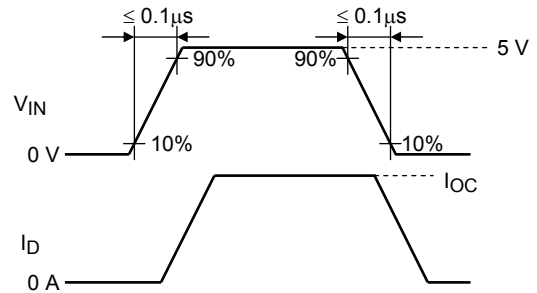
Test Circuit 3

Overcurrent detection circuit

Test circuit



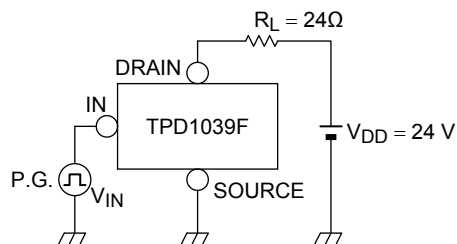
Measured waveforms



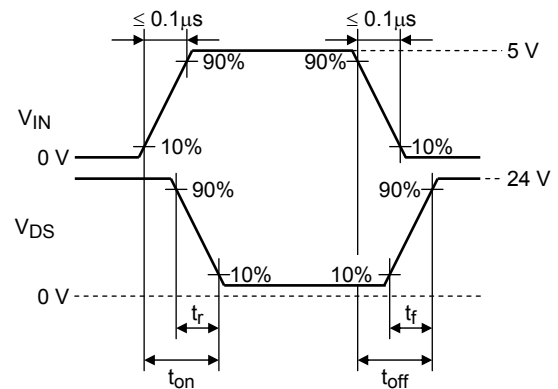
Test Circuit 4

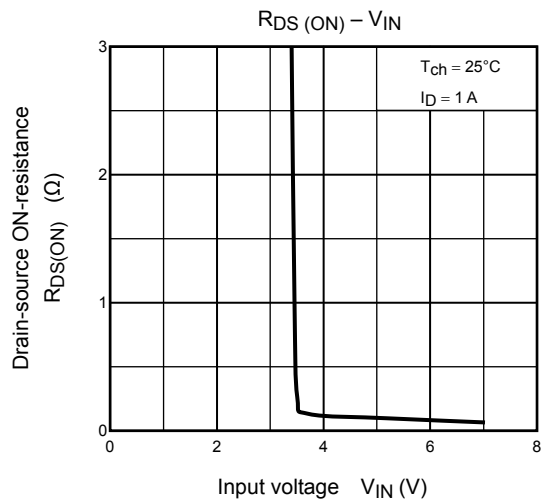
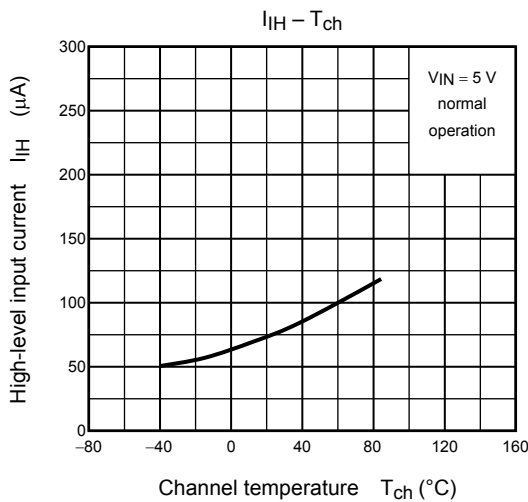
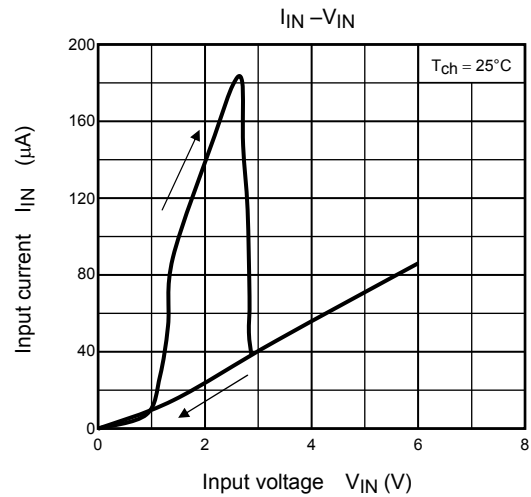
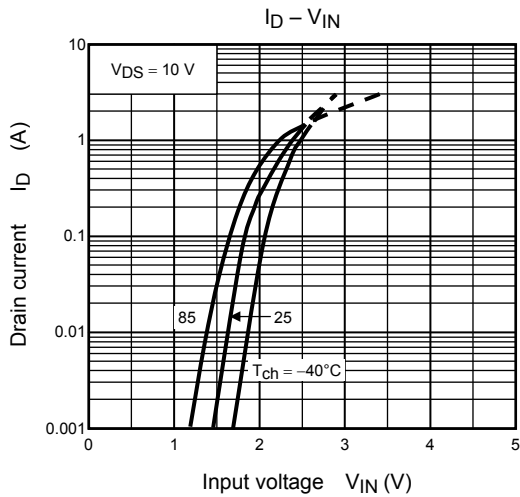
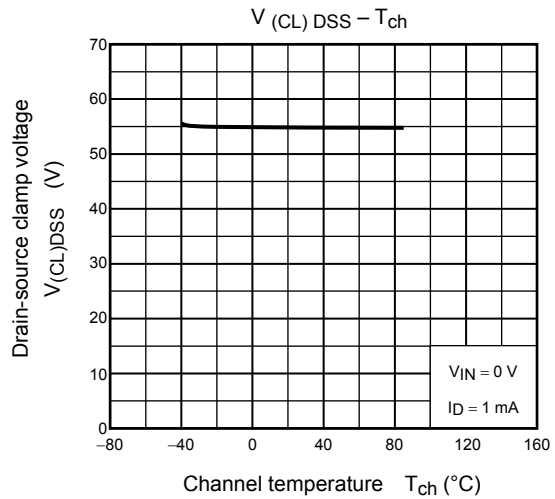
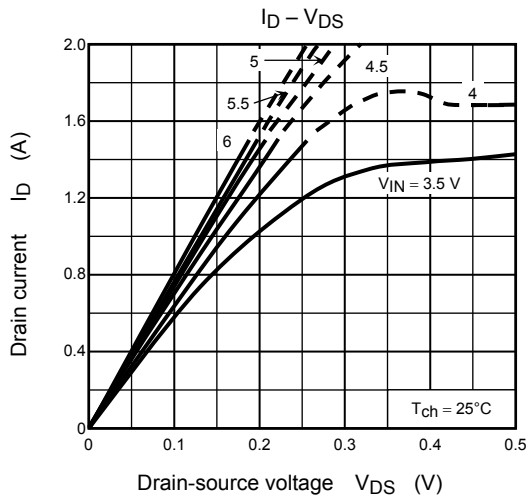
Switching time measuring circuit

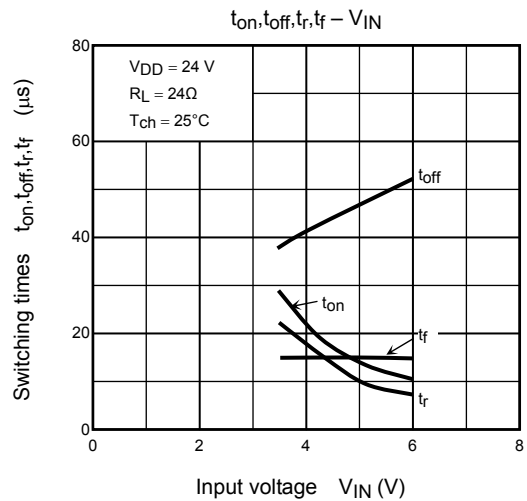
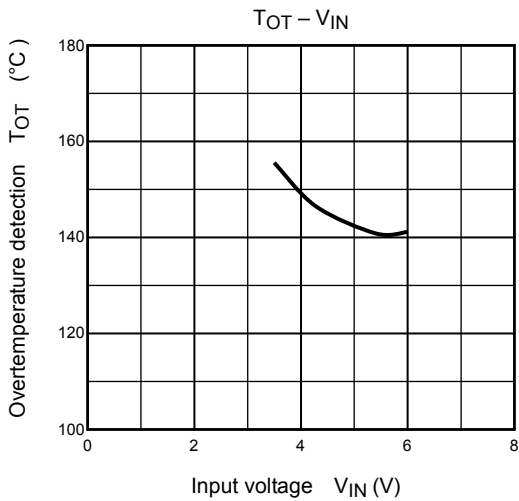
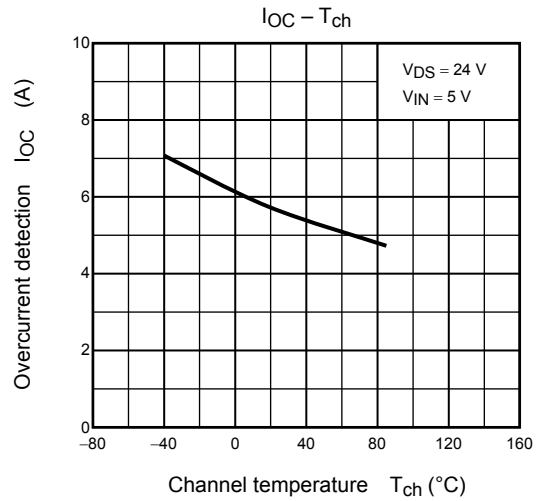
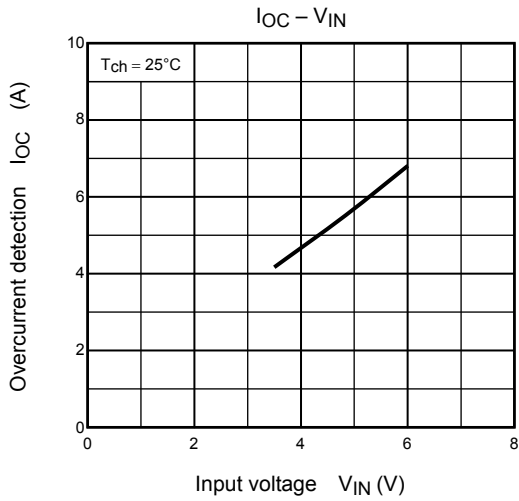
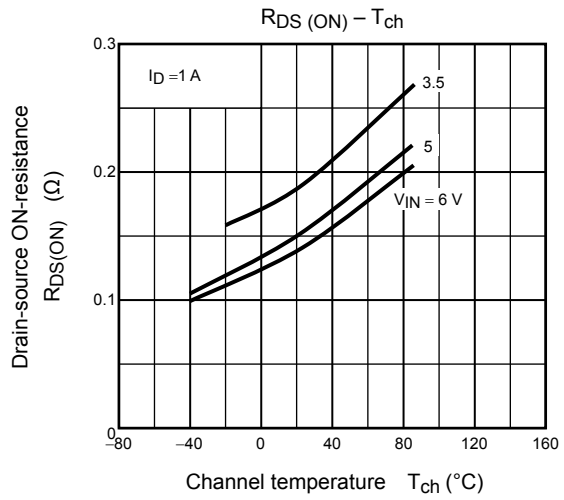
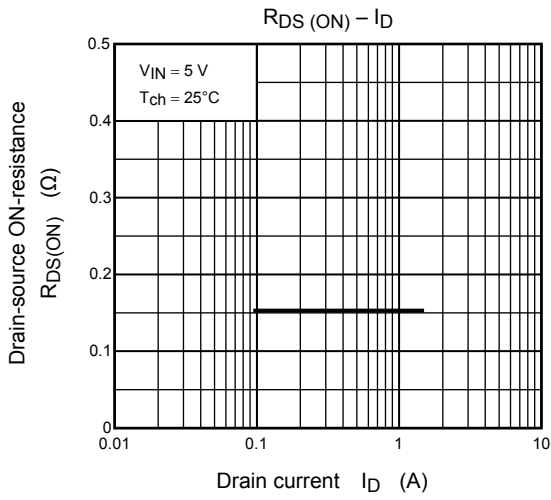
Test circuit

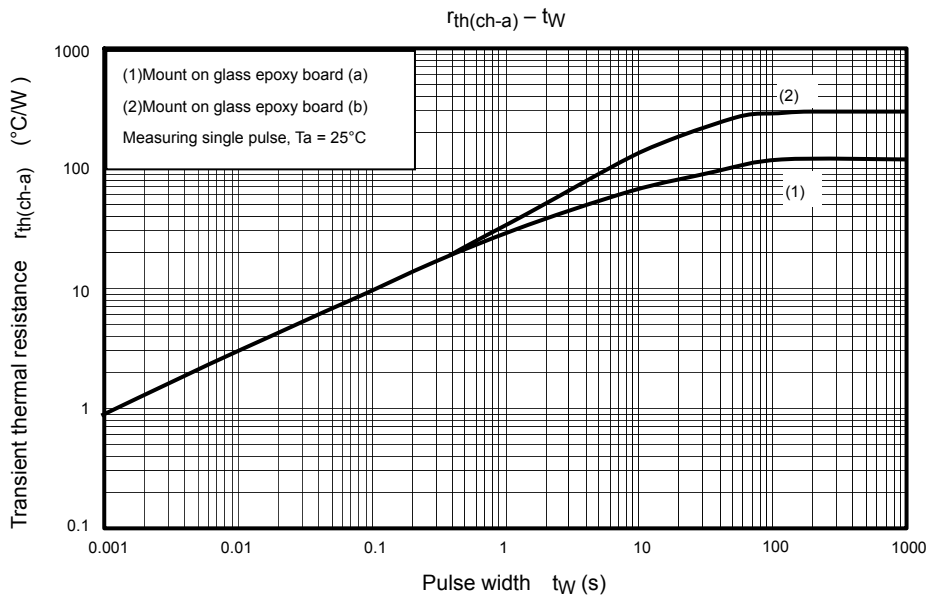
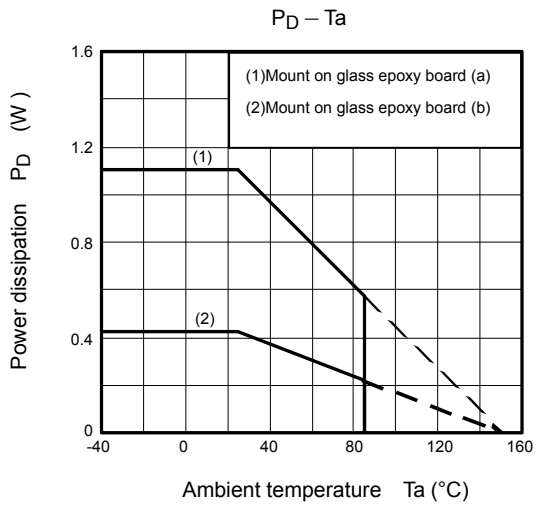


Measured waveforms

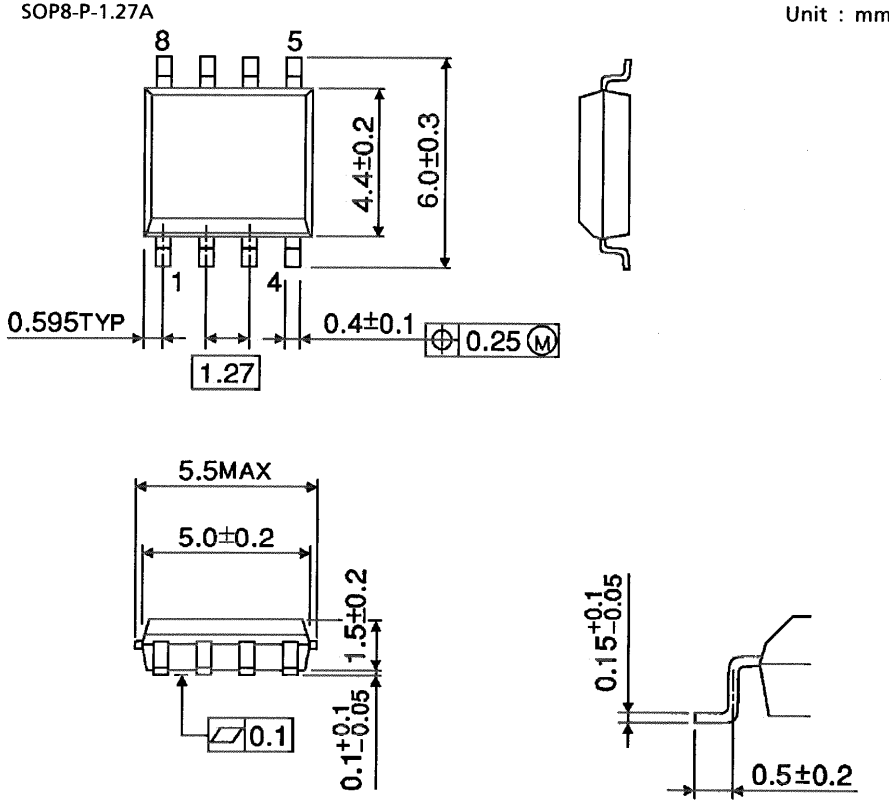








Package Dimensions



Weight: 0.08 g (typ.)

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20070701-EN GENERAL

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