

TOSHIBA Intelligent Power Device Silicon Monolithic Power MOS Integrated Circuit

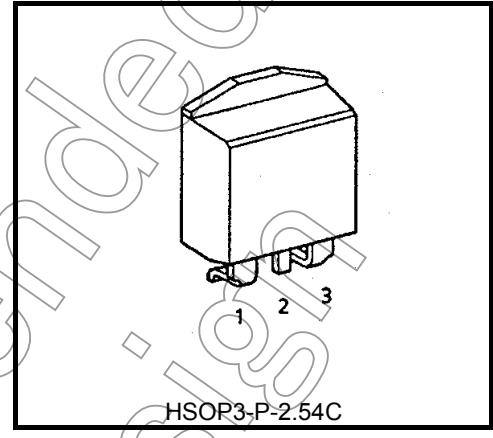
TPD1031AF

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

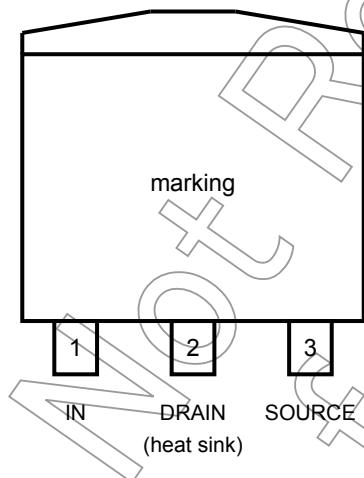
The TPD1031AF is a monolithic power IC intended for low-side load switching applications. The output has a vertical MOSFET, and the input can be directly driven from CMOS or TTL logic (e.g., an MPU). The TPD1031AF provides intelligent protection functions.

Features

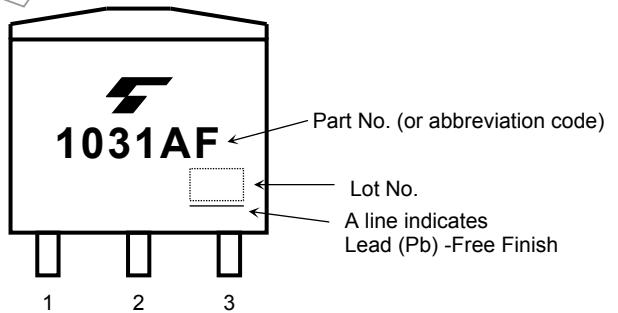
- A structure that incorporates control circuitry and a vertical power MOSFET on a single chip.
- Can be directly driven from a microprocessor, a CMOS logic IC, etc.
- Overvoltage, overtemperature and overcurrent protections
- Low ON-resistance: $R_{DS(ON)} = 65\text{m}\Omega$ (max) (@ $V_{IN} = 5\text{ V}$, $I_D = 4\text{ A}$, $T_{ch} = 25^\circ\text{C}$)
- Low leakage current: $I_{DSS} = 100\text{ }\mu\text{A}$ (max) (@ $V_{IN} = 0\text{ V}$, $V_{DS} = 40\text{ V}$, $T_{ch} = 25^\circ\text{C}$)
- Housed in "TO-220SM" package and supplied in embossed carrier tape.



Pin Assignment

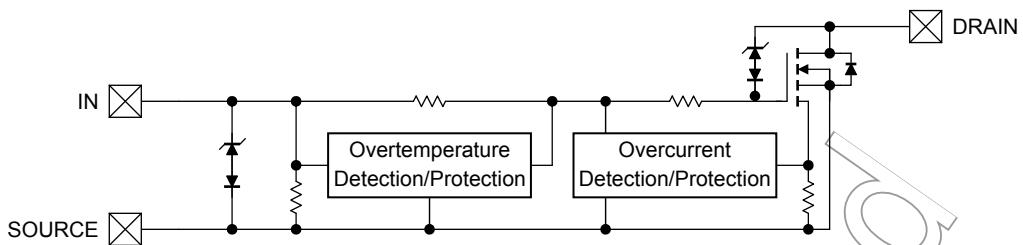


Marking



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

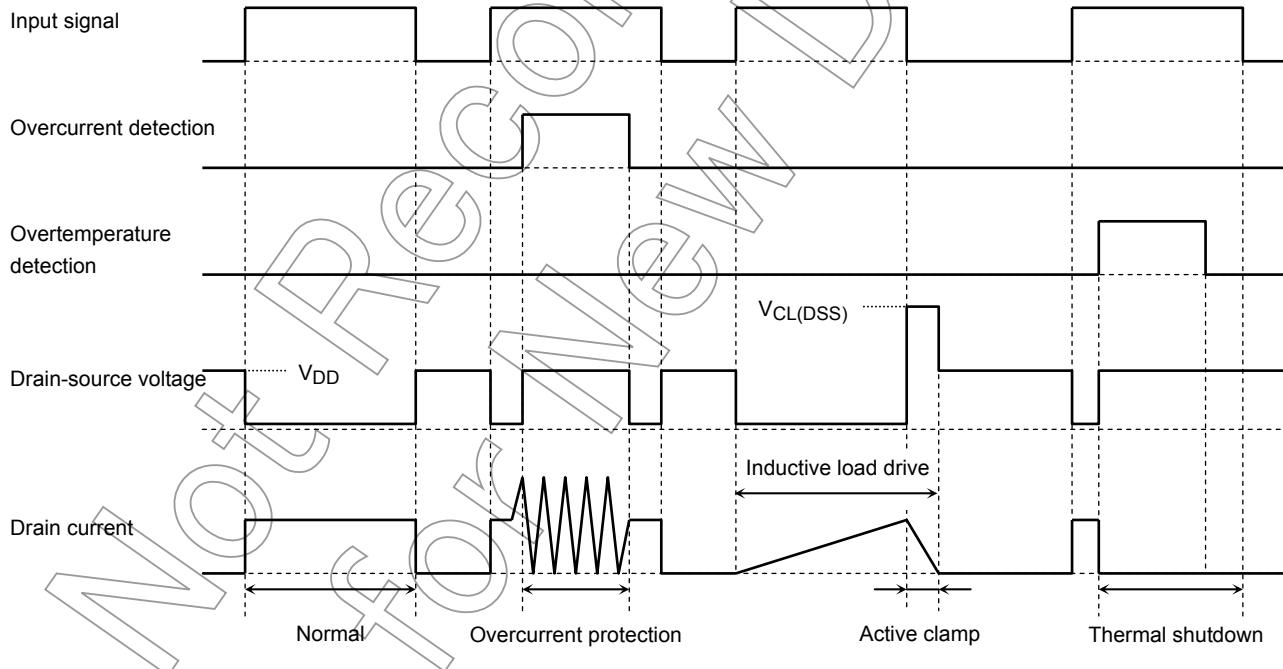
Block Diagram



Pin Description

Pin No.	Symbol	Pin Description
1	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.
2	DRAIN	Drain pin. When a load short-circuit causes an overcurrent (8 A min) to flow into a device, the output automatically turns on and off repeatedly.
3	SOURCE	Source (ground) pin.

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 (switching)	
L	H	Off	Overtemperature
H	H	Off	

Absolute Maximum Ratings (Ta = 25°C)

Characteristics		Symbol	Rating	Unit
Drain-source voltage		V _{DS}	50	V
Drain current		I _D	Internally limited	A
Input voltage		V _{IN}	-0.3 to 7	V
Power dissipation	T _c = 25°C	P _{D(1)}	50	W
	T _a = 25°C	P _{D(2)}	1.5	
Single pulse active clamp capability (Note 1)		E _{AS}	1110	mJ
Active clamp current		I _{AR}	8	A
Repetitive active clamp capability (Note 2)		E _{AR}	5	mJ
Operating temperature		T _{opr}	-40 to 110	°C
Channel temperature		T _{ch}	150	°C
Storage temperature		T _{stg}	-55 to 150	°C

Note 1: Active clamp capability (single pulse) test condition

V_{DD} = 25 V, T_{ch} = 25°C (initial), L = 20 mH, I_{AR} = 8 A, R_G = 25 Ω

Note 2: Repetitive rating. Pulse width limited by maximum channel temperature

Note 3: 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	max	Unit
Thermal resistance, channel to case	R _{th(ch-c)}	2.5	°C/W
Thermal resistance, channel to ambient	R _{th(ch-a)}	83.3	°C/W

Electrical Characteristics ($T_{ch} = 25^\circ\text{C}$)

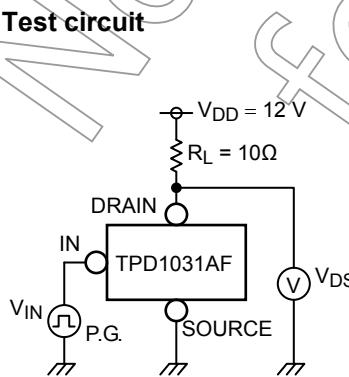
Characteristics	Symbol	Test circuit	Test condition	Min	Typ.	Max	Unit
Operating supply voltage range	$V_{DD(\text{opr})}$	-	-	-	-	18	V
High-level input current	I_{IH}	-	$V_{IN} = 5\text{ V}, V_{DS} = 0\text{ V}$	-	-	500	μA
Drain cut-off current	I_{DSS}	-	$V_{DS} = 40\text{ V}, V_{IN} = 0\text{ V}$	-	-	100	μA
Drain-source clamp voltage	$V_{(\text{CL})DSS}$	-	$I_D = 10\text{ mA}, V_{IN} = 0\text{ V}$	50	-	-	V
Drain-source ON-resistance	$R_{DS(\text{ON})}$	-	$V_{IN} = 5\text{ V}, I_D = 4\text{ A}$	-	0.045	0.065	Ω
Switching times	Rise time	t_r	1 $V_{IN} = +5\text{ V}/0\text{ V}$ $V_{DD} = 12\text{ V}$ $R_L = 10\Omega$	-	70	-	μs
	Turn on time	t_{on}		-	100	250	
	Fall time	t_f		-	120	-	
	Turn off time	t_{off}		-	300	450	
Input threshold voltage	V_{th}	-	$V_{DS} = 12\text{ V}, I_D = 1\text{ mA}$	2	3	3.5	V
Protective circuit operation input voltage range	$V_{IN(\text{P})}$	-	-	4	-	-	V
Overcurrent detection	I_{OC}	-	$V_{IN} = 5\text{ V}$	8	15	-	A
Overtemperature detection	T_{OT}	-	$V_{IN} = 5\text{ V}$	-	160	-	$^\circ\text{C}$
Drain-source diode forward voltage	V_{DSF}	-	$I_{DR} = 8\text{ A}, V_{IN} = 0\text{ V}$	-	-	1.8	V

Electrical Characteristics ($T_{ch} = -40$ to 110°C)

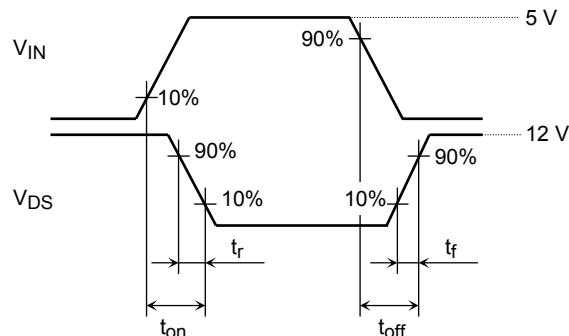
Characteristics	Symbol	Test circuit	Test condition	Min	Typ.	Max	Unit
Operating supply voltage range	$V_{DD(\text{opr})}$	-	-	-	-	18	V
High-level input current	I_{IH}	-	$V_{IN} = 5\text{ V}, V_{DS} = 0\text{ V}$	-	-	750	μA
Drain cut-off current	I_{DSS}	-	$V_{DS} = 40\text{ V}, V_{IN} = 0\text{ V}$	-	-	100	μA
Drain-source clamp voltage	$V_{(\text{CL})DSS}$	-	$I_D = 10\text{ mA}, V_{IN} = 0\text{ V}$	48	-	-	V
Drain-source ON-resistance	$R_{DS(\text{ON})}$	-	$V_{IN} = 5\text{ V}, I_D = 4\text{ A}$	-	0.045	0.095	Ω
Switching times	Rise time	t_r	1 $V_{IN} = +5\text{ V}/0\text{ V}$ $V_{DD} = 12\text{ V}$ $R_L = 10\Omega$	-	70	-	μs
	Turn on time	t_{on}		-	100	400	
	Fall time	t_f		-	120	-	
	Turn off time	t_{off}		-	300	700	
Input threshold voltage	V_{th}	-	$V_{DS} = 12\text{ V}, I_D = 1\text{ mA}$	1.5	3	4	V
Protective circuit operation input voltage range	$V_{IN(\text{P})}$	-	-	4	-	-	V
Overcurrent detection	I_{OC}	-	$V_{IN} = 5\text{ V}$	8	15	-	A
Overtemperature detection	T_{OT}	-	$V_{IN} = 5\text{ V}$	-	160	-	$^\circ\text{C}$

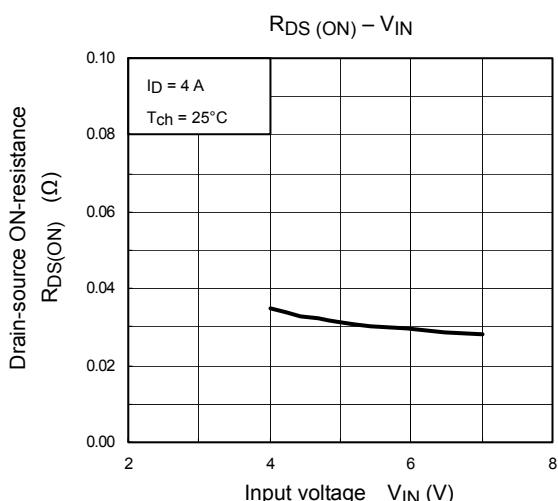
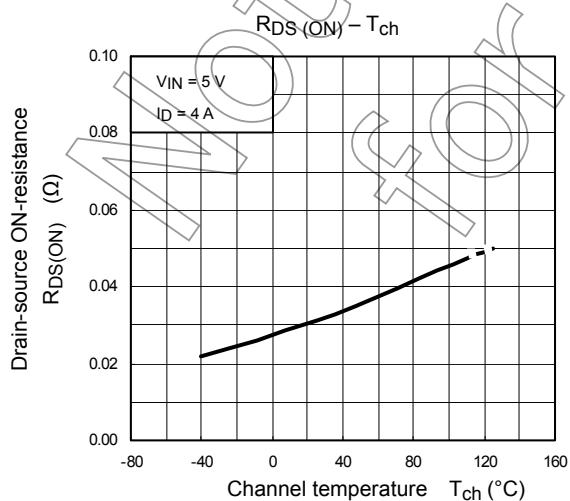
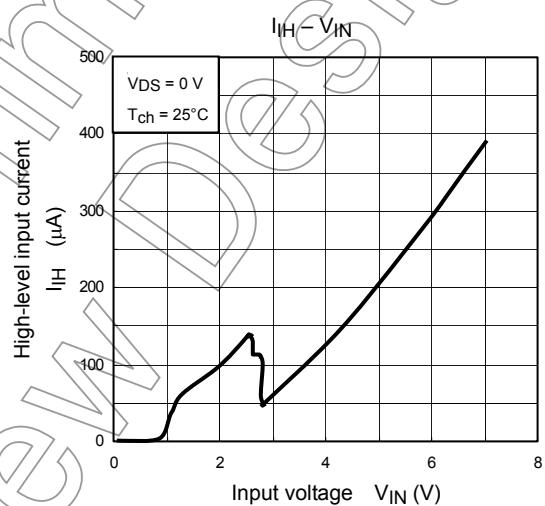
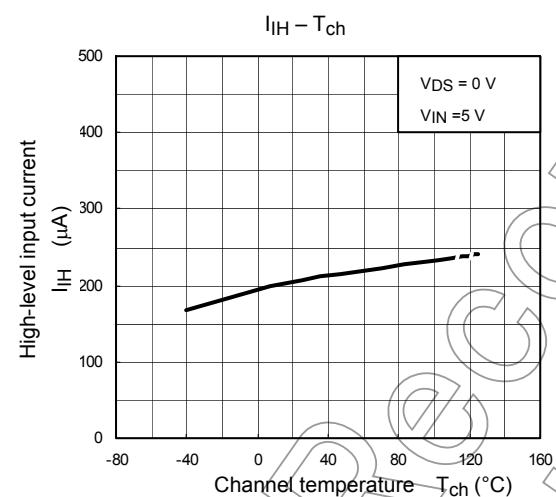
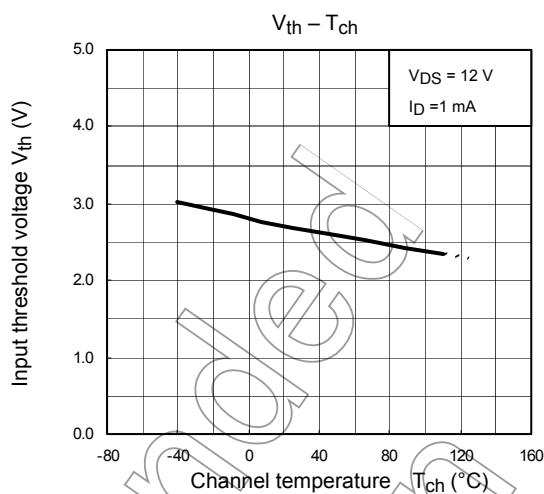
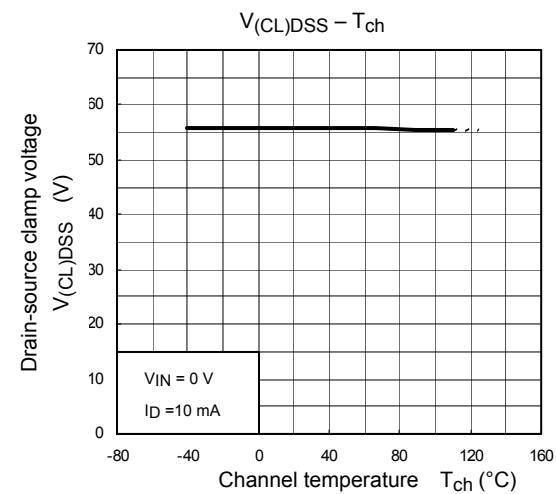
Test Circuit 1

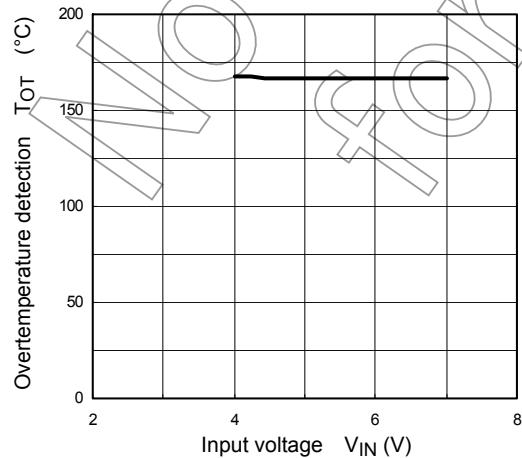
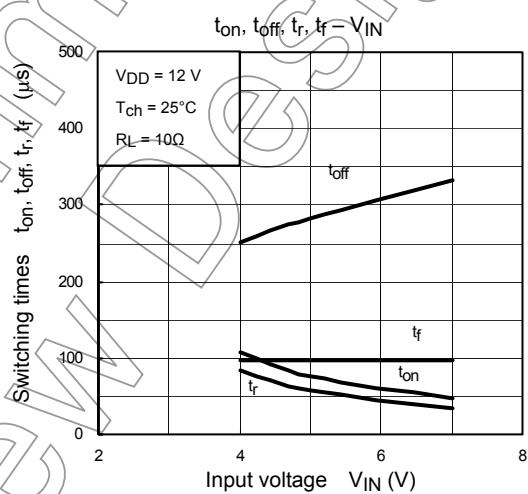
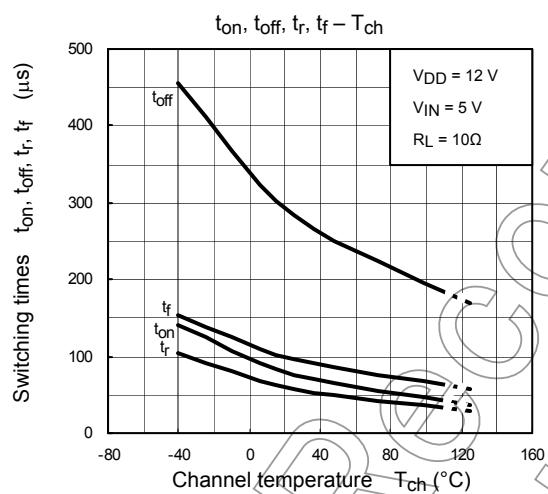
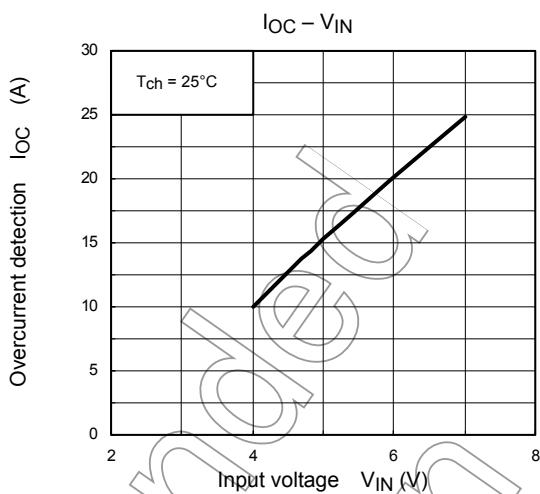
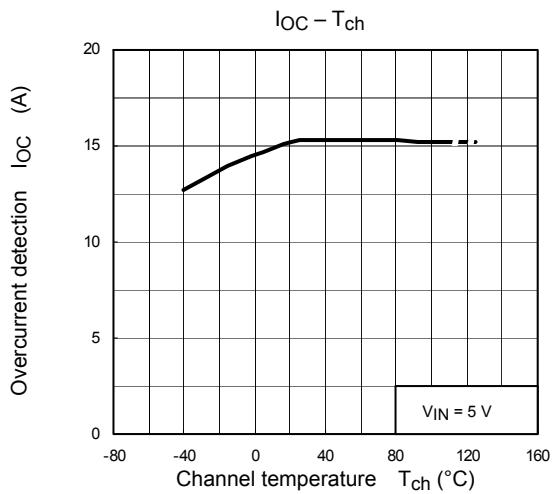
Switching times measuring circuit

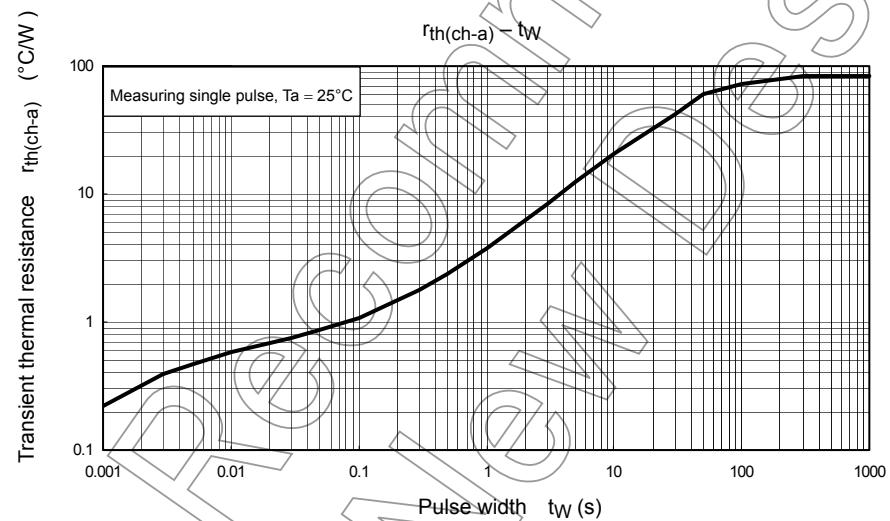
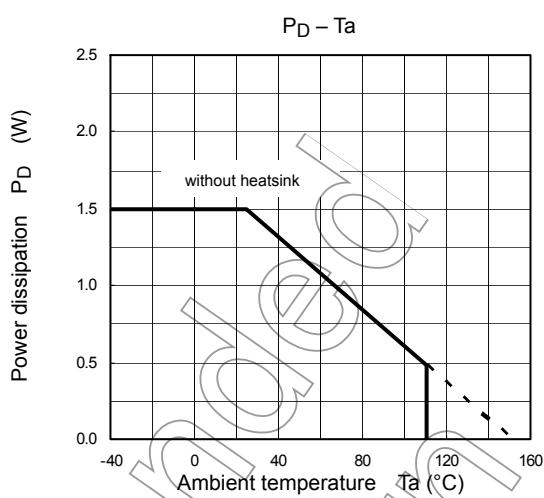
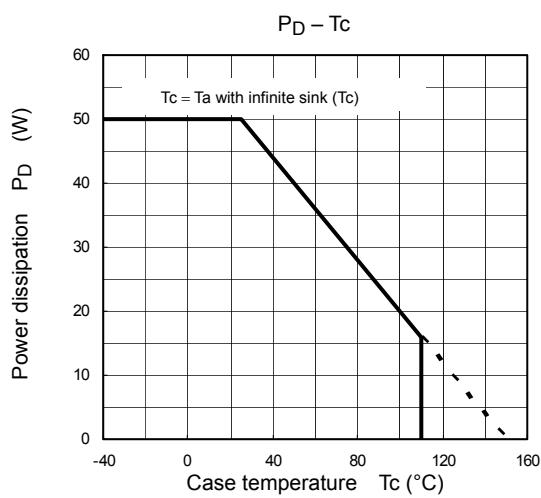


Measured waveforms





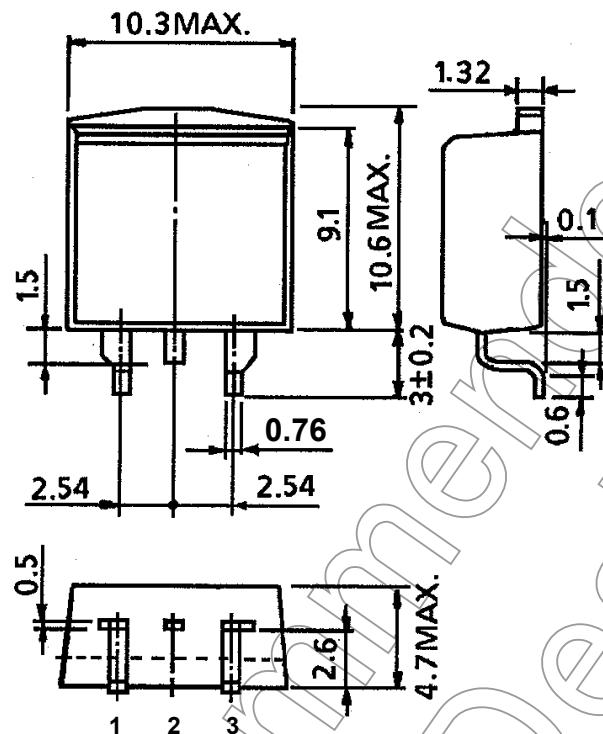




Package Dimensions

HSOP3-P-2.54C

Unit: mm



Weight: 1.5 g (typ.)

recommended design

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20070701-EN GENERAL

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