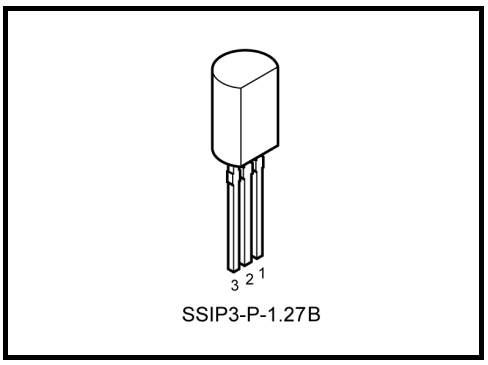
TOSHIBA Intelligent Power Device Silicon Monolithic Power MOS IC

TPD1039S

Low-Side Switch for Motor, Solenoid and Lamp Drive

TPD1039S is a monolithic power IC for low-side switch.
The IC has a vertical MOSFET output which can be directly driven from a CMOS or TTL logic circuit (e.g., an MPU). The IC offers intelligent self-protection functions.

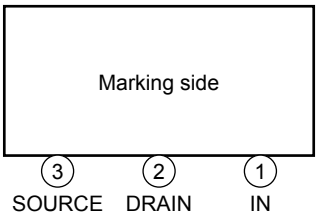


Weight: 0.36 g (typ.)

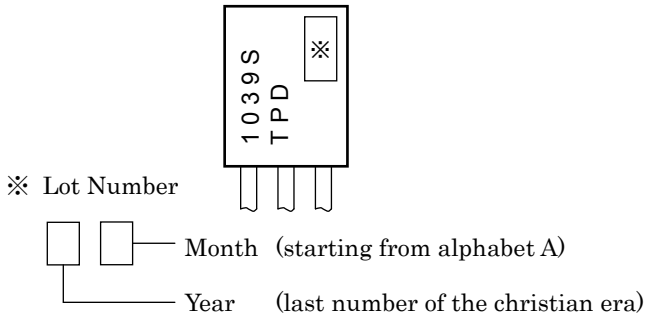
Features

- A monolithic power IC with a new structure combining a control block and a vertical power MOSFET (π-MOS) on a single chip.
- Can directly drive a power load from a CMOS or TTL logic.
- Built-in protection circuits against overvoltage, overheat, and overcurrent.
- Low ON-resistance: $R_{DS\ (ON)}$ = 0.25 Ω (max) (@V_{IN} = 5 V, T_{ch} = 25°C)
- Package TO-92 (MOD) can be packed in tape.

Pin Assignment

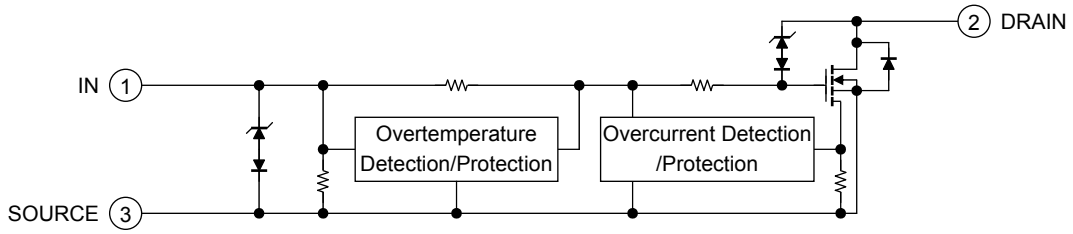


Marking



That because of its MOS structure, this product is sensitive to static electricity.

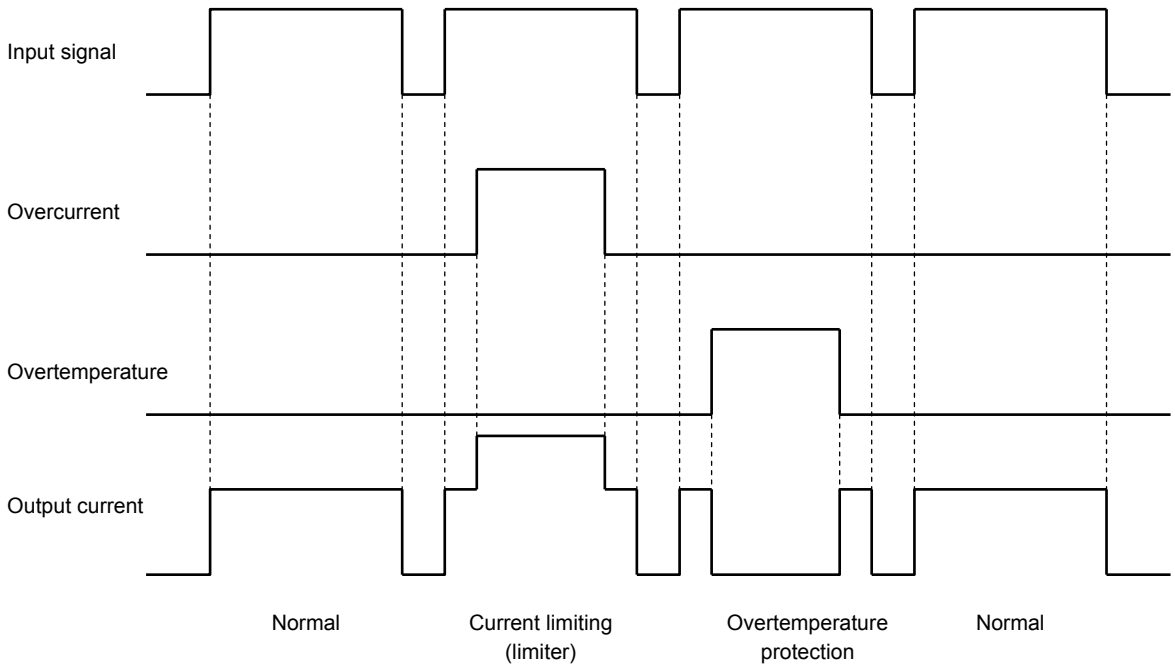
Block Diagram



Pin Description

Pin No.	Symbol	Pin Description
1	IN	Input pin. This pin is connected to a pull-down resistor internally, so that even when input wiring is open-circuited, output can never be turned on inadvertently.
2	DRAIN	Output pin. The current limit for output current is 5 A (typ.) when excessive current flow into a device because of in-rush current and short load of a lamp.
3	SOURCE	Ground pin.

Timing Chart



Truth Table

V_{IN}	V_{DRAIN}	State
L	H	Normal
H	L	
L	H	Overcurrent
H	L	
L	H	Overtemperature
H	H	

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}	−0.5~6	V
Power dissipation (Ta = 25°C)	P_D	0.9	W
Single pulse active clamp capability (Note 1)	E_{AS}	20	mJ
Active clamp current	I_{AR}	1.5	A
Repetitive active clamp capability (Note 2)	E_{AR}	0.09	mJ
Operating temperature	T_{opr}	−40~85	°C
Channel temperature	T_{ch}	150 (Note 3)	°C
Storage temperature range	T_{stg}	−55~150	°C

Note 1: Active clamp capability (single pulse) test condition
V_{DD} = 25 V, Starting T_{ch} = 25°C, L = 10 mH, I_{AR} = 1.5 A, R_G = 25 Ω

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

Note 3: Overtemperature protection will work when the channel temperature exceeds 125°C.
Be sure to operate the device in such a way that the channel temperature does not exceed 125°C.

Note4: 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 ambient	$R_{th\ (ch-a)}$	139	°C/W

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

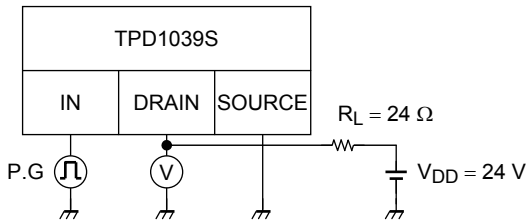
Characteristics	Symbol	Test Circuit	Test Condition	Min	Typ.	Max	Unit
Drain-source clamp voltage	$V_{(CL)\ DSS}$	—	V_{IN} = 0 V, I_D = 1 mA	45	—	—	V
High level input voltage	V_{IH}	—	V_{DS} = 10~40 V, $I_D \geqq$ 1 A	3.5	—	6	V
Low level input voltage	V_{IL}	—	V_{DS} = 10~40 V, $I_D \leqq$ 10 μA	—	—	0.8	V
Draint cut-off current	I_{DSS}	—	V_{IN} = 0 V, V_{DS} = 40 V	—	—	10	μA
Input current	I_{IN}	—	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
Thermal shutdown (Note 4)	T_S	—	V_{IN} = 5 V	125	—	—	°C
Overcurrent protection	I_S	—	V_{IN} = 5 V	—	5	—	A
Switching time	t_{ON}	1	V_{DD} = 24 V, V_{IN} = 5 V, R_L = 24 Ω	—	15	—	μs
	t_{OFF}			—	45	—	
Source-drain diode forward voltage	V_{DSF}	—	I_F = 1.5 A	—	0.9	1.8	V

Note 4: Overtemperature protection will work when the channel temperature exceeds 125°C.
Be sure to operate the device in such a way that the channel temperature does not exceed 125°C.
The overtemperature protection function protects a device from destruction.
Once started, however, this function will operate continuously; device reliability is not guaranteed while the function is in operation.

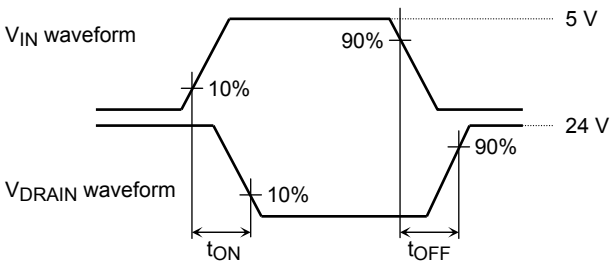
Test Circuit 1

Switching time measuring circuit

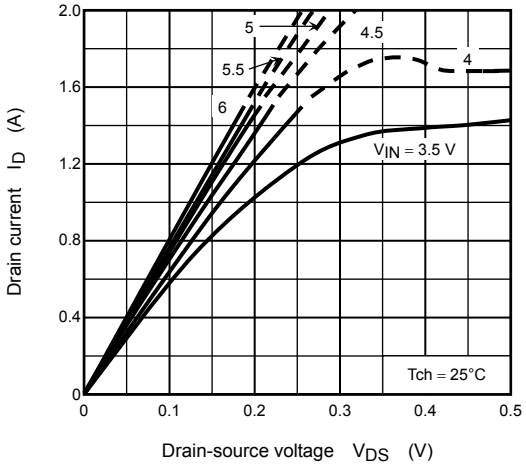
Test circuit



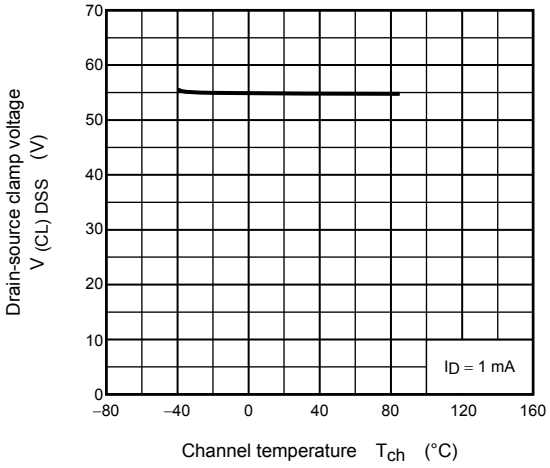
Measured waveforms



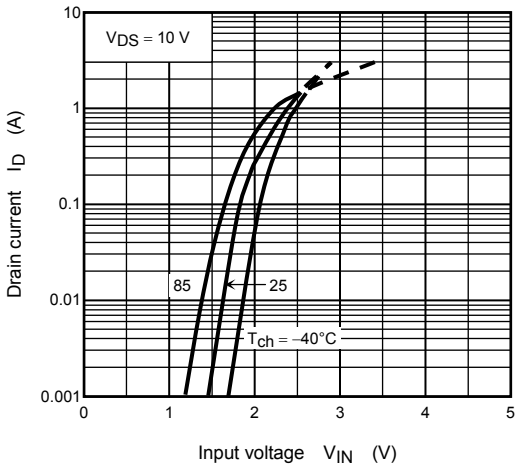
$I_D - V_{DS}$



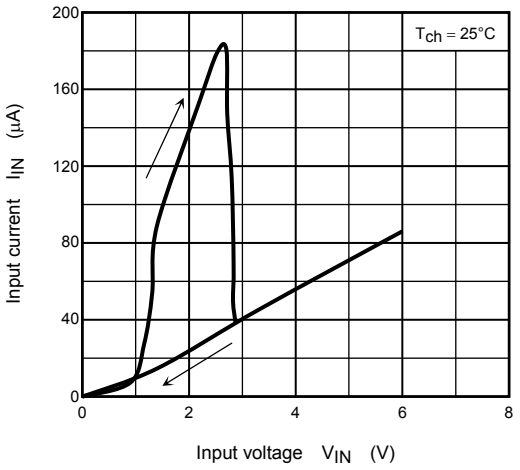
$V_{(CL)\ DSS} - T_{ch}$



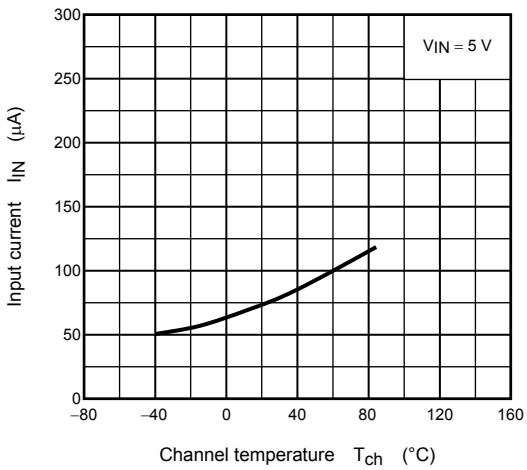
$I_D - V_{IN}$



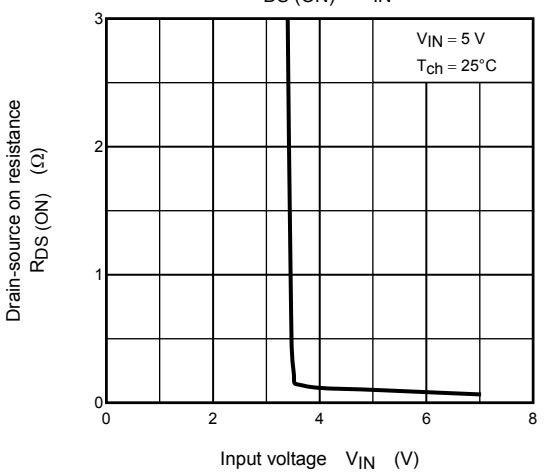
$I_{IN} - V_{IN}$



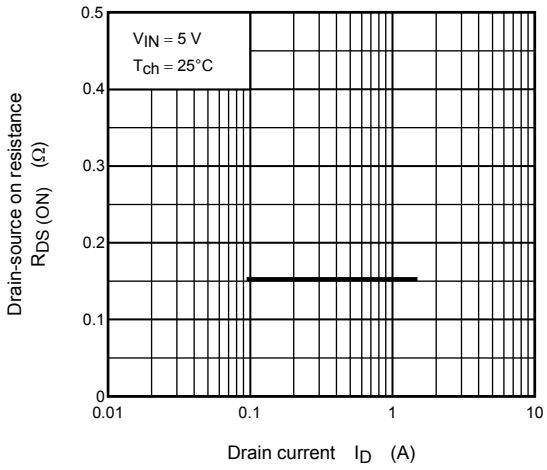
$I_{IN} - T_{ch}$



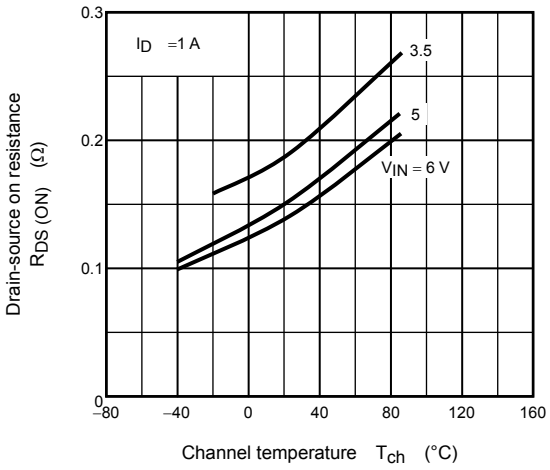
$R_{DS\ (ON)} - V_{IN}$



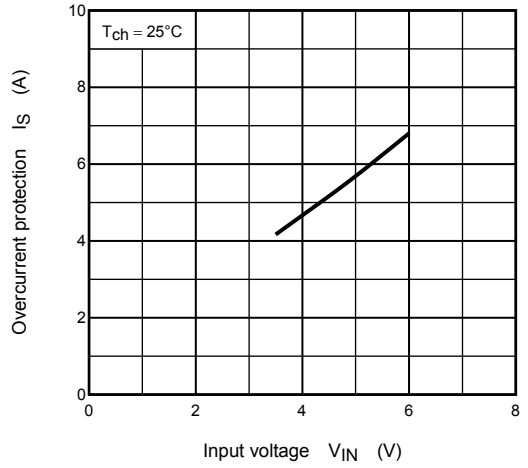
$R_{DS\ (ON)} - I_D$



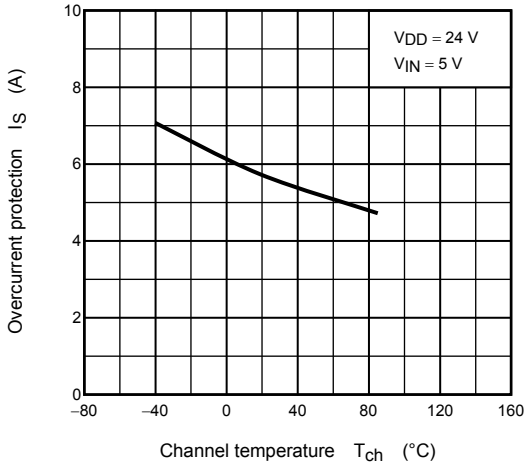
$R_{DS\ (ON)} - T_{ch}$



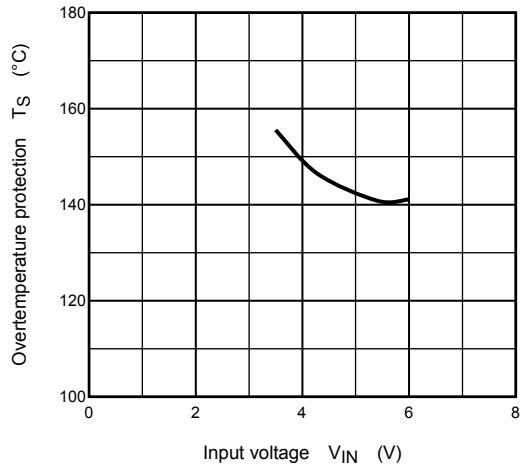
$I_S - V_{IN}$



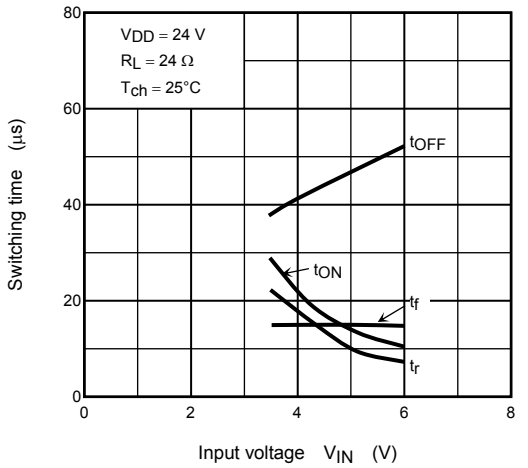
$I_S - Tch$



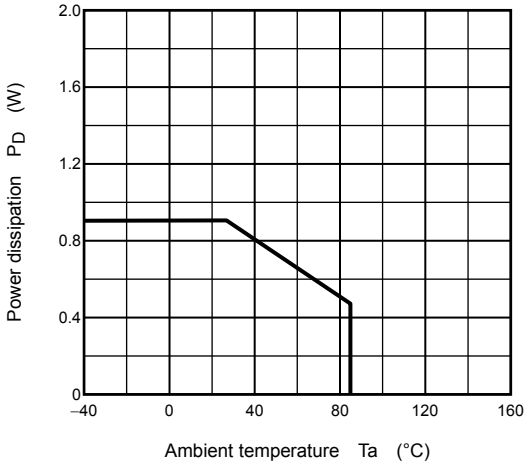
$T_S - V_{IN}$



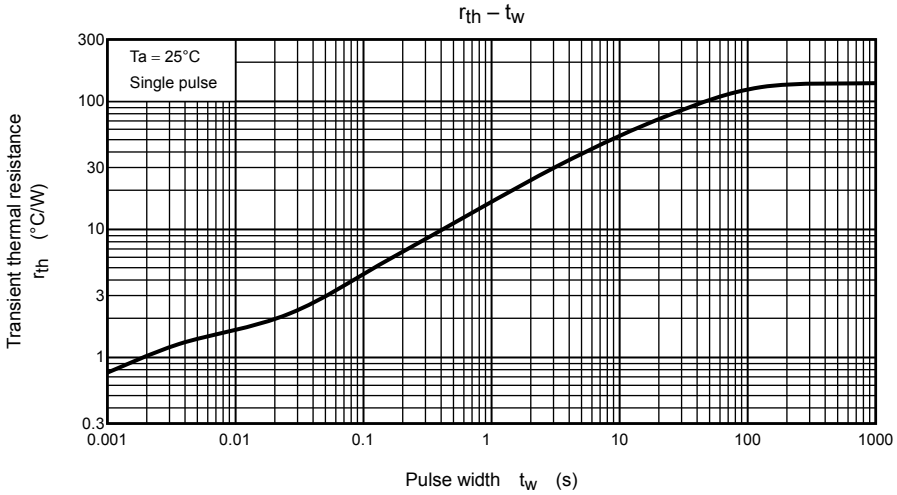
Switching time – V_{IN}



P_D – Ta


2.0
1.6
1.2
0.8
0.4
0
Power dissipation P_D (W)
–40
0
40
80
120
160
Ambient temperature Ta (°C)

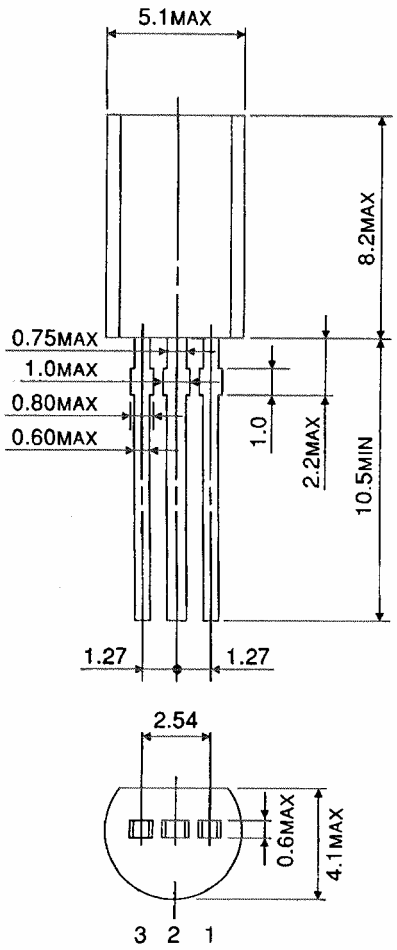
r_{th} – t_w


Ta = 25°C
Single pulse
300
100
30
10
3
1
0.3
Transient thermal resistance r_{th} (°C/W)
0.001
0.01
0.1
1
10
100
1000
Pulse width t_w (s)

Package Dimensions

SSIP3-P-1.27B

Unit : mm



Weight: 0.36 g (typ.)

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20070701-EN

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