

TOSHIBA INTELLIGENT POWER DEVICE SILICON MONOLITHIC POWER MOS INTEGRATED CIRCUIT

TPD1009S

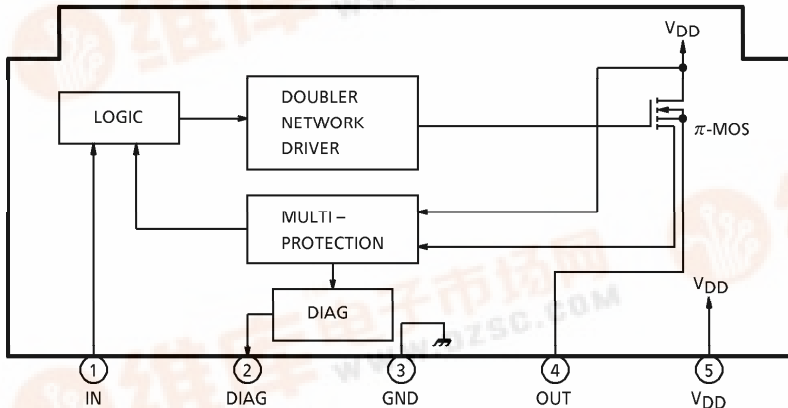
HIGH-SIDE POWER SWITCH for MOTORS, SOLENOIDS, and LAMP DRIVERS.

TPD1009S 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 (eg, an MPU). The device offers intelligent self-protection and diagnostic functions.

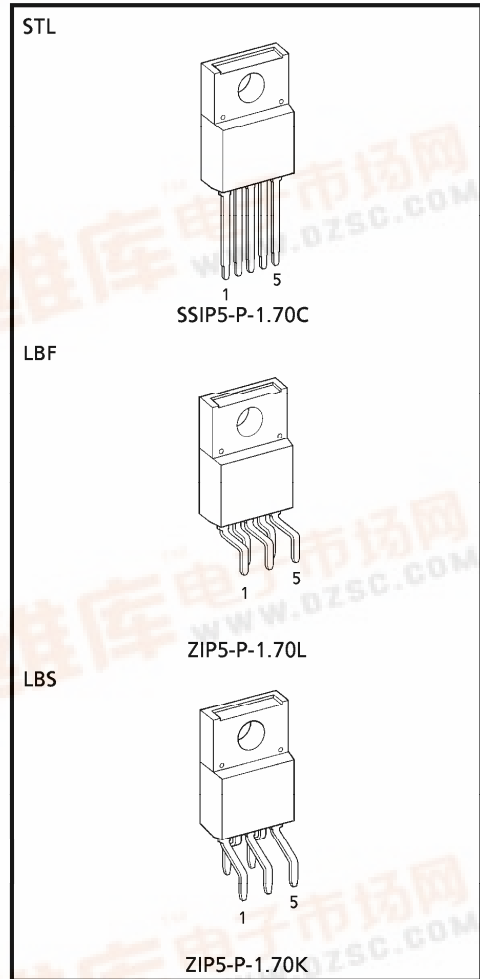
FEATURES

- A monolithic power IC with a new structure combining a control block (Bi-CMOS) and a vertical power MOS FET (π -MOS) 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 -10V of counterelectromotive force from an L load can be applied.
- Low on resistance : $R_{ON} = 60m\Omega$ (Max)
- Low operating current: $I_{DD} = 1mA$ (Typ.), at $V_{DD} = 12V$, $V_{IN} = 0$
- 5-pin TO-220 insulated package.
- Three standard lead configurations.

PIN ASSIGNMENT



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



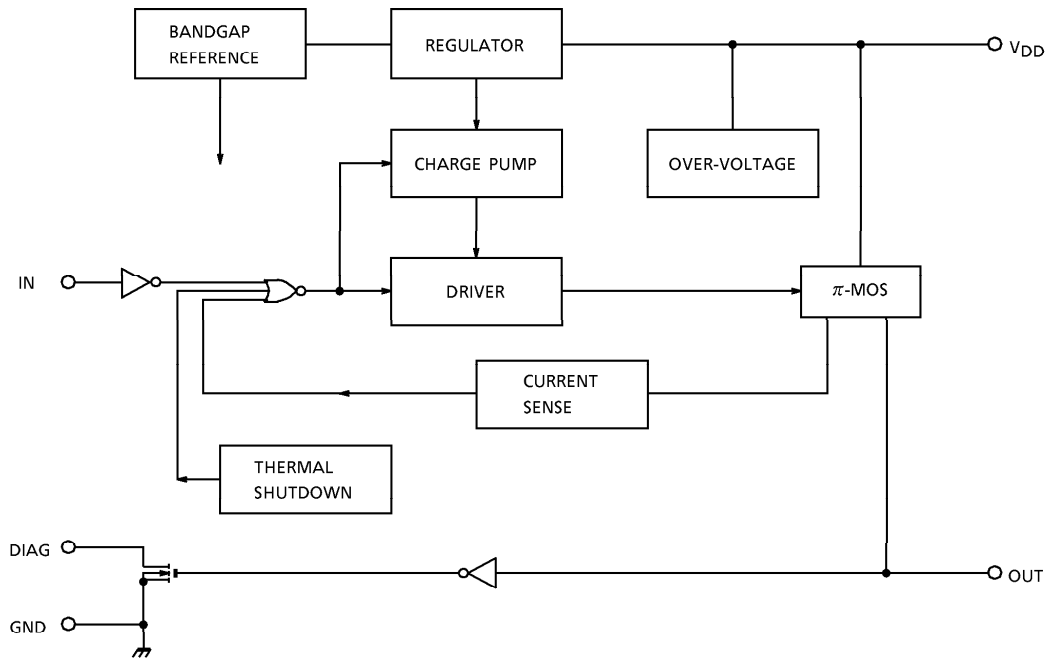
Weight
 SSIP5-P-1.70C : 2.1g (Typ.)
 ZIP5-P-1.70L : 2.1g (Typ.)
 ZIP5-P-1.70K : 2.1g (Typ.)

961001EBA2

- TOSHIBA is continually working to improve the quality and the reliability of its products. Nevertheless, semiconductor devices in general can malfunction or fail due to their inherent electrical sensitivity and vulnerability to physical stress. It is the responsibility of the buyer, when utilizing TOSHIBA products, to observe standards of safety, and to avoid situations in which a malfunction or failure of a TOSHIBA product could cause loss of human life, bodily injury or damage to property. In developing your designs, please ensure that TOSHIBA products are used within specified operating ranges as set forth in the most recent products specifications. Also, please keep in mind the precautions and conditions set forth in the TOSHIBA Semiconductor Reliability Handbook.
- The products described in this document are subject to foreign exchange and foreign trade control laws.
- The information contained herein is presented only as a guide for the applications of our products. No responsibility is assumed by TOSHIBA CORPORATION for any infringements of intellectual property or other rights of the third parties which may result from its use. No license is granted by implication or otherwise under any intellectual property or other rights of TOSHIBA CORPORATION or others.
- The information contained herein is subject to change without notice.



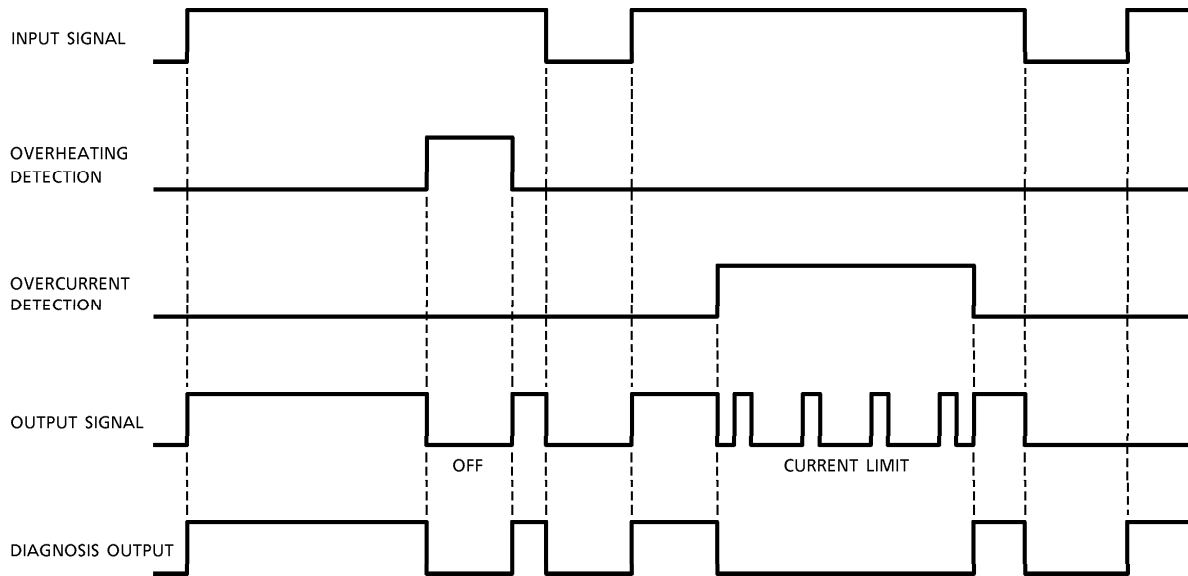
BLOCK DIAGRAM



PIN DESCRIPTION

PIN No.	SYMBOL	FUNCTION
1	IN	Input is CMOS-compatible, with pull-down resistor connected. Even if the input is open, output will not accidentally turn on.
2	DIAG	Self-diagnosis detection pin. Goes low when overheating is detected or when output is short circuited with input on (high). N-channel open drain.
3	GND	Ground pin.
4	OUT	Output pin. When the load is short circuited and current in excess of the detection current flows to the output pin, the output automatically turns on or off.
5	V _{DD}	Power pin.

TIMING CHART



TRUTH TABLE

INPUT SIGNAL	OUTPUT SIGNAL	DIAGNOSIS OUTPUT	STATE
H	H	H	Normal
L	L	L	
H	L	L	Load short circuited
L	L	L	
H	H	H	Load open
L	H	H	
H	L	L	Overheating
L	L	L	

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Drain-source Voltage	V _{DS}	60	V
Supply Voltage	DC	V _{DD} (1)	25
	Pulse	V _{DD} (2)	60 (Rs = 1Ω, τ = 250ms)
Input Voltage	DC	V _{IN} (1)	- 0.5~12
	Pulse	V _{IN} (2)	V _{DD} (1) + 1.5 (t = 100ms)
Diagnosis Output Voltage	V _{DIAG}	- 0.5~25	V
Output Current	I _O	Internally Limited	A
Input Current	I _{IN}	± 10	mA
Diagnosis Output Current	I _{DIAG}	5	mA
Power Dissipation	Tc = 25°C	P _D (1)	30
	Ta = 25°C	P _D (2)	2
Operating Temperature	T _{opr}	- 40~110	°C
Junction Temperature	T _j	150	°C
Storage Temperature	T _{stg}	- 55~150	°C
Lead Temperature / time	T _{SOL}	275 (5 s), 260 (10 s)	°C

ELECTRICAL CHARACTERISTICS (Tc = -40~110°C, V_{DD} = 8~18V)

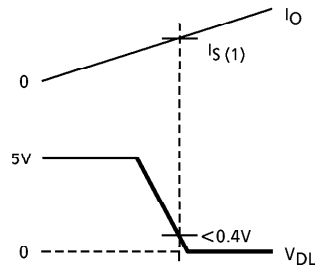
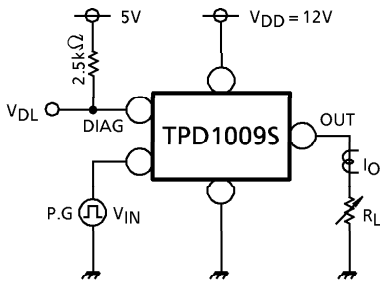
CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	TEST CONDITION	MIN	TYP.	MAX	UNIT
Operating Supply Voltage	V _{DD} (OPR)	—	—	5	12	18	V
Current Dissipation	I _{DD}	—	V _{DD} = 12V, V _{IN} = 0	—	1	5	mA
Input Voltage	V _{IH}	—	V _{DD} = 12V, I _O = 8A	3.5	—	—	V
	V _{IL}	—	V _{DD} = 12V, I _O = 1.2mA	—	—	1.5	V
Input Current	I _{IN} (1)	—	V _{DD} = 12V, V _{IN} = 5V	—	50	200	μA
	I _{IN} (2)	—	V _{DD} = 12V, V _{IN} = 0	- 0.2	—	0.2	μA
On Voltage	V _{DS} (ON)	—	V _{DD} = 12V, I _O = 8A, Tc = 25°C	—	—	0.48	V
On Resistance	R _{DS} (ON)	—	V _{DD} = 12V, I _O = 8A, Tc = 25°C	—	—	0.06	Ω
Output Leakage Current	I _{OL}	—	V _{DD} = 18V, V _{IN} = 0	—	—	1.2	mA
Diagnosis Output Voltage	"L" Level	V _{DL}	V _{DD} = 12V, I _{DL} = 2mA	—	—	0.4	V
Diagnosis Output Current	"H" Level	I _{DH}	V _{DD} = 18V, V _{DH} = 18V	—	—	10	μA
Overcurrent Detection	I _S (1) *1	1	V _{DD} = 12V, Tc = 25°C	8	12	—	A
	I _S (2) *2	2		15	24	—	A
Overheating Detection	Temperature	T _s	—	150	160	200	°C
	Hysteresis	ΔT _s		—	10	—	°C
Open Detection Resistance	R _{ops}	—	V _{DD} = 8V	1	50	100	kΩ
Switching Time	t _{ON}	3	V _{DD} = 12V, R _L = 5Ω, Tc = 25°C	10	200	—	μs
	t _{OFF}	3		10	30	—	μs

*1 I_S (1) Overcurrent detection value when load is short circuited and V_{IN} = "L" → "H"

*2 I_S (2) Overcurrent detection value when load current is increased while V_{IN} = "H"

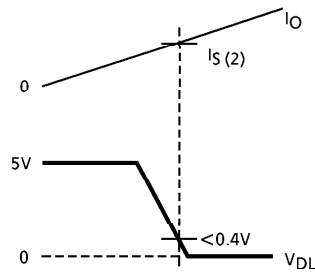
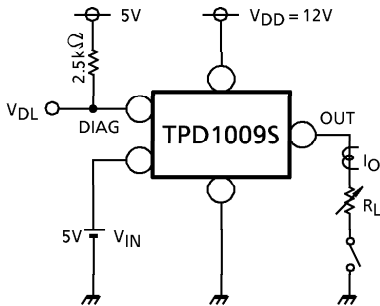
TEST CIRCUIT 1

Over-voltage detection



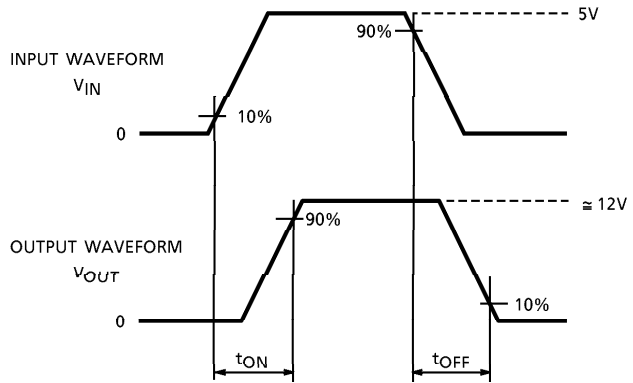
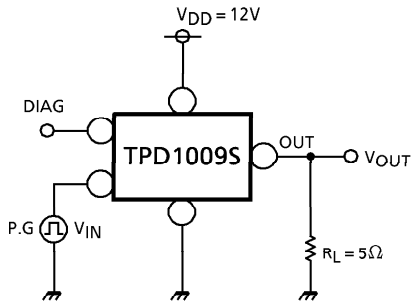
TEST CIRCUIT 2

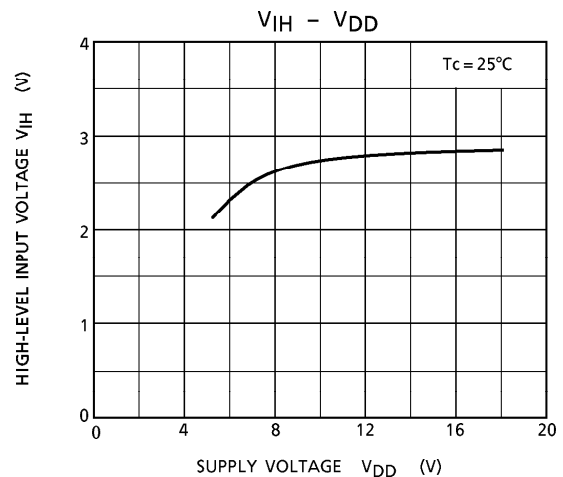
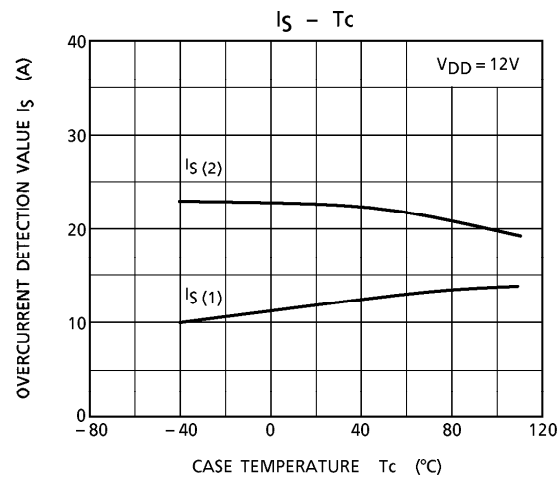
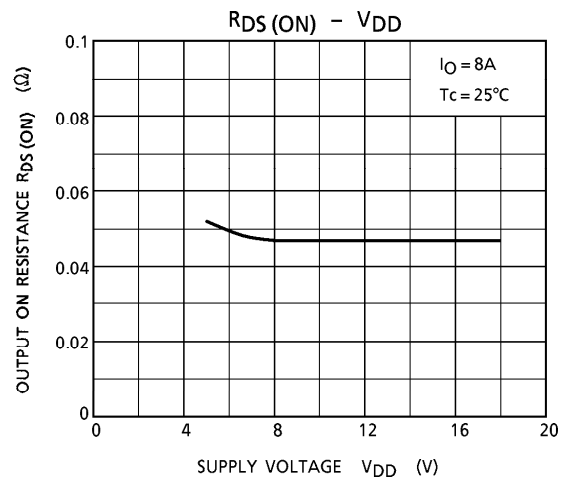
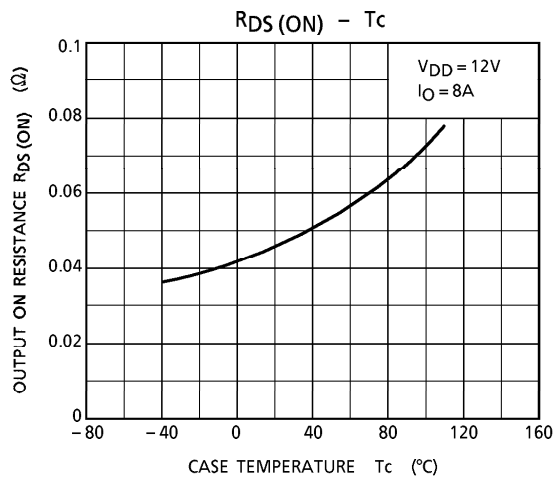
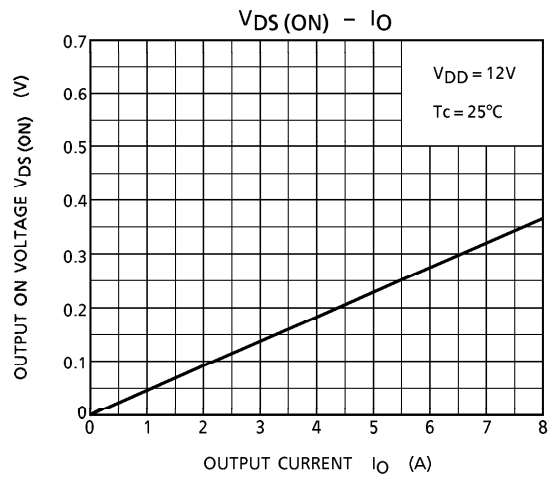
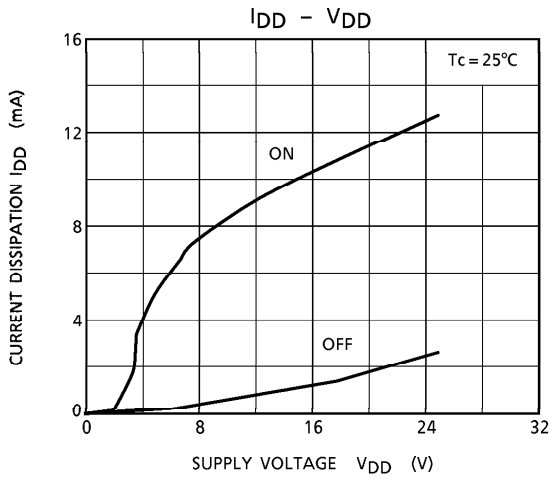
Over-voltage detection

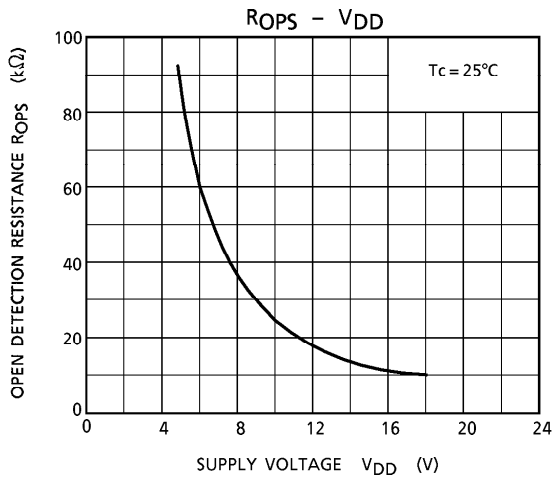
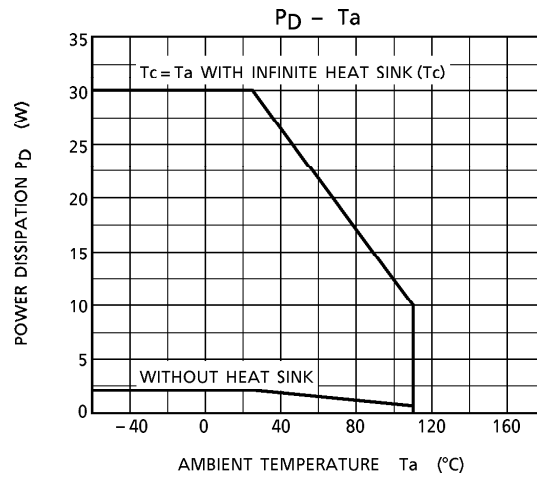
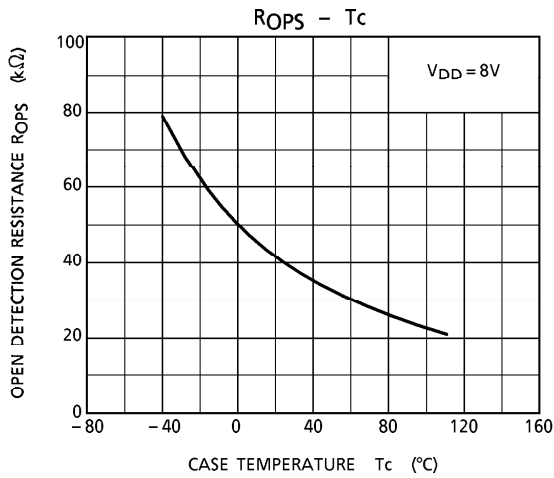
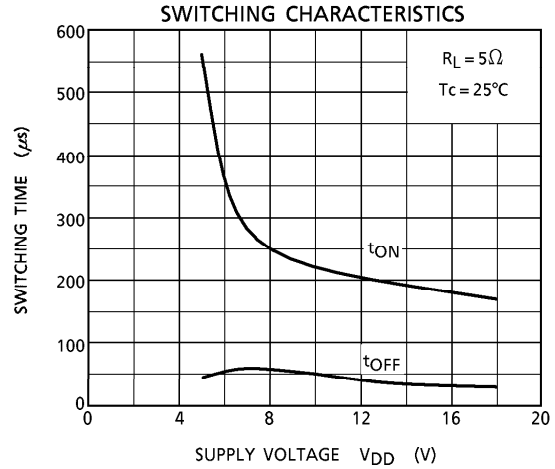
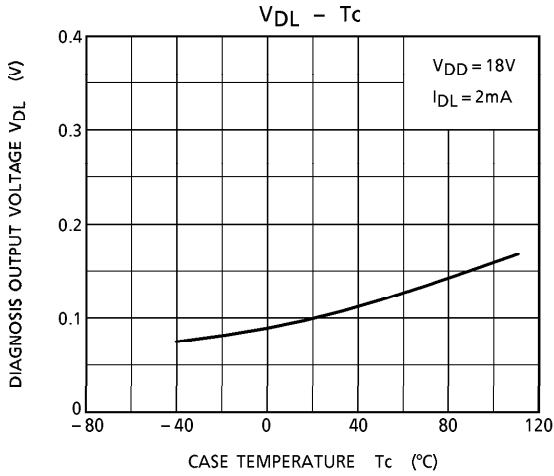


TEST CIRCUIT 3

Switching time





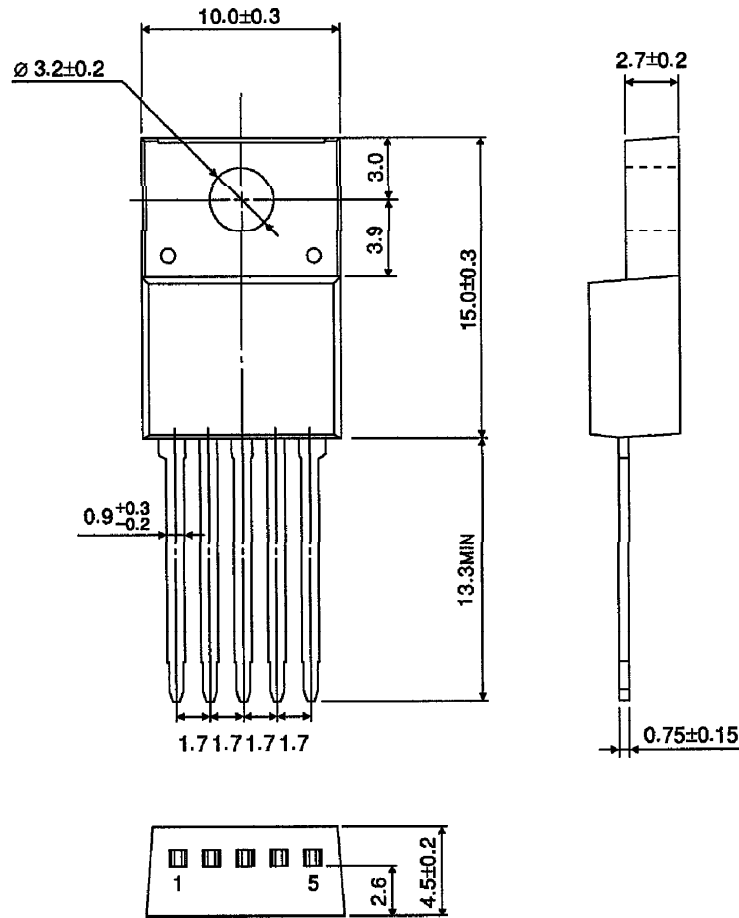


PRECAUTION:

1. Since protection for, for example, reverse connection of the battery is not provided, provide protection using external circuits.

OUTLINE DRAWING
SSIP5-P-1.70C (STL)

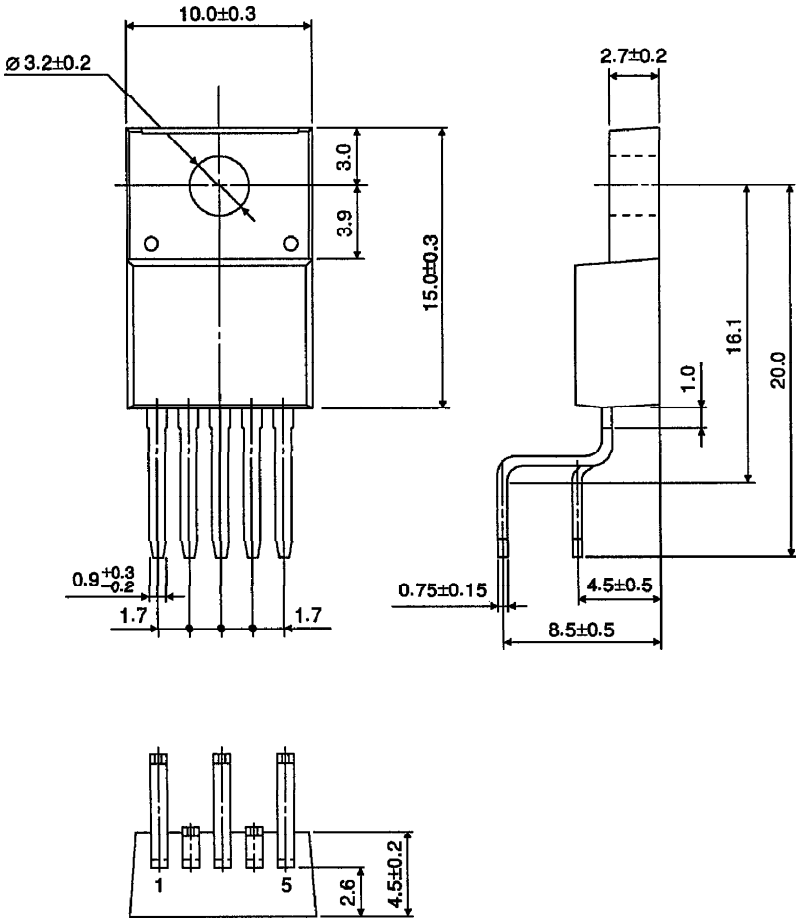
Unit : mm



Weight : 2.1g (Typ.)

OUTLINE DRAWING
ZIP5-P-1.70L (LBF)

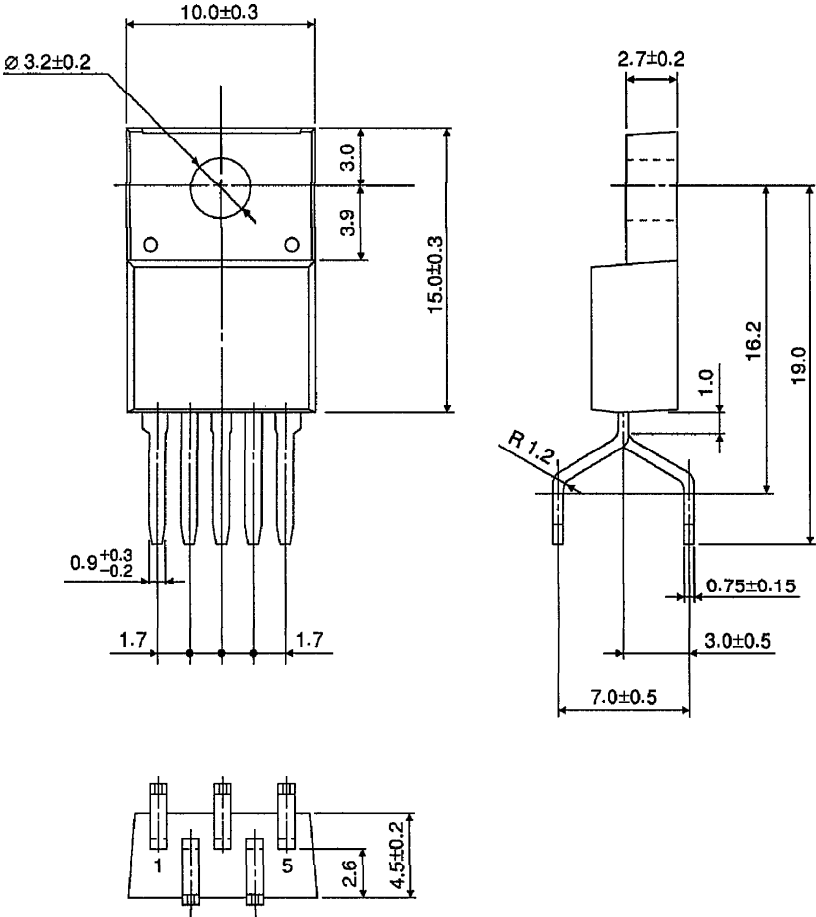
Unit : mm



Weight : 2.1g (Typ.)

OUTLINE DRAWING
ZIP5-P-1.70K (LBS)

Unit : mm



Weight : 2.1g (Typ.)