

TOSHIBA INTELLIGENT POWER DEVICE SILICON MONOLITHIC POWER MOS INTEGRATED CIRCUIT

TPD1011S

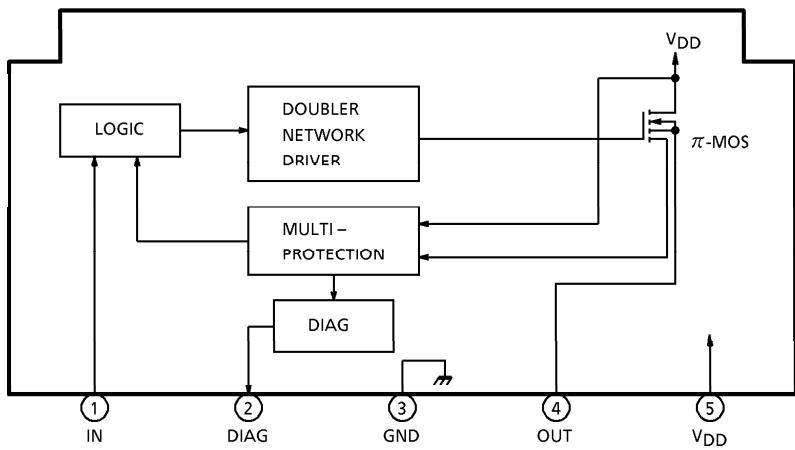
HIGH-SIDE POWER SWITCH for MOTORS, SOLENOIDS, and LAMP
DRIVERS

TPD1011S 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. Also 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.

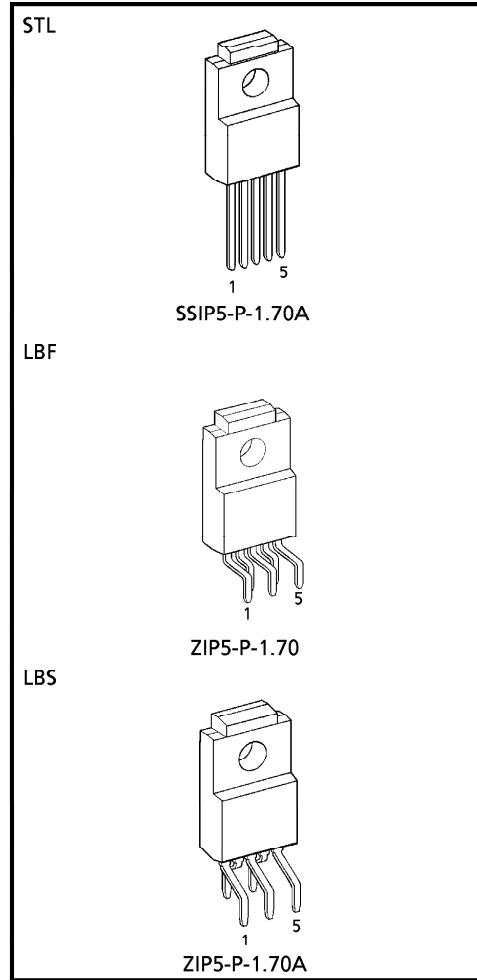
PIN ASSIGNMENT



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

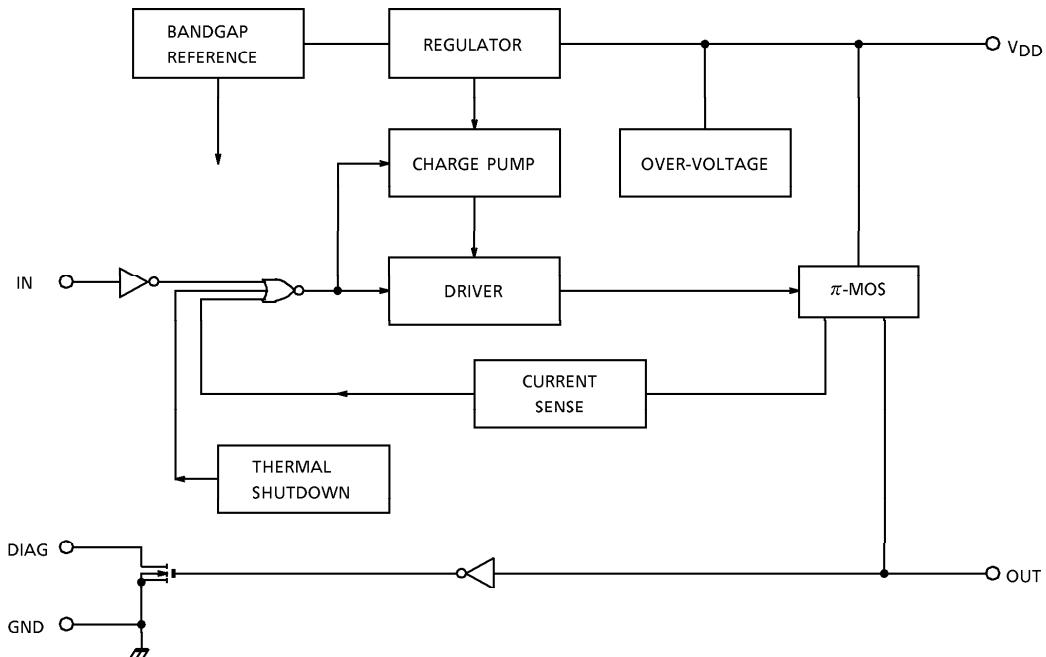
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Weight
 SSIP5-P-1.70A : 2.2g (Typ.)
 ZIP5-P-1.70 : 2.2g (Typ.)
 ZIP5-P-1.70A : 2.2g (Typ.)

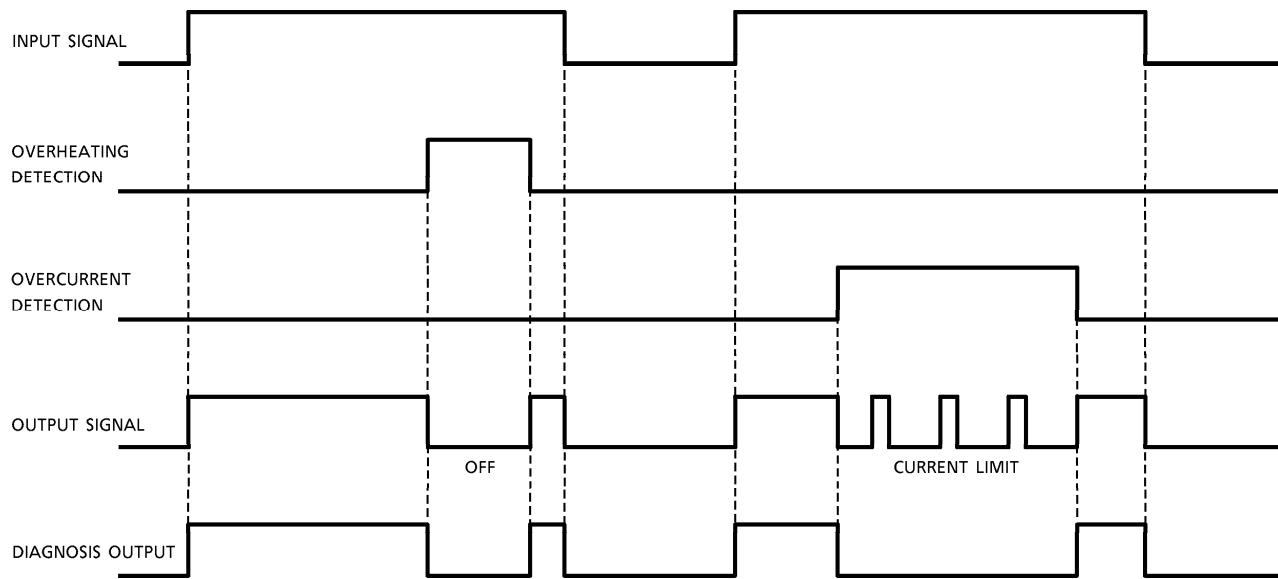
BLOCK DIAGRAM



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	
L	L	L	Overheating

MAXIMUM RATINGS ($T_a = 25^\circ\text{C}$)

CHARACTERISTIC		SYMBOL	RATING	UNIT
Drain-source Voltage		V_{DS}	60	V
Supply Voltage	DC	V_{DD} (1)	25	V
	Pulse	V_{DD} (2)	60 ($R_s = 1\Omega$, $\tau = 250\text{ms}$)	V
Input Voltage	DC	V_{IN} (1)	-0.5~12	V
	Pulse	V_{IN} (2)	V_{DD} (1) + 1.5 ($t = 100\text{ms}$)	V
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	$T_c = 25^\circ\text{C}$	P_D (1)	30	W
	$T_a = 25^\circ\text{C}$	P_D (2)	2	W
Operating Temperature		T_{opr}	-40~85	$^\circ\text{C}$
Junction Temperature		T_j	150	$^\circ\text{C}$
Storage Temperature		T_{stg}	-55~150	$^\circ\text{C}$
Lead Temperature / time		T_{SOL}	275 (5s), 260 (10s)	$^\circ\text{C}$

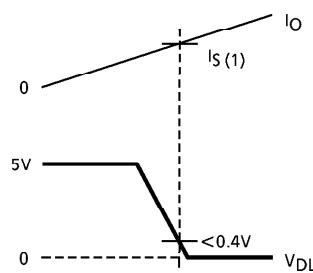
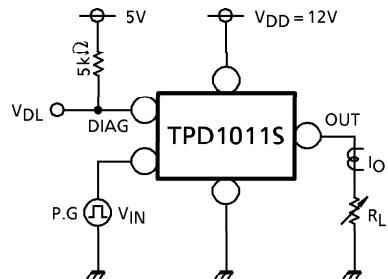
ELECTRICAL CHARACTERISTICS ($T_c = -40\sim 85^\circ\text{C}$, $V_{DD} = 8\sim 18\text{V}$)

CHARACTERISTIC		SYMBOL	TEST CIR-CUIT	TEST CONDITION	MIN	TYP.	MAX	UNIT
Operating Supply Voltag		V_{DD} (OPR)	—	—	5	12	18	V
Current Dissipation		I_{DD}	—	$V_{DD} = 12\text{V}$, $V_{IN} = 0$	—	1	5	mA
Input Voltage		V_{IH}	—	$V_{DD} = 12\text{V}$, $I_O = 8\text{A}$	3.5	—	—	V
		V_{IL}	—	$V_{DD} = 12\text{V}$, $I_O = 1.2\text{mA}$	—	—	1.5	V
Input Current		I_{IN} (1)	—	$V_{DD} = 12\text{V}$, $I_{IN} = 5\text{V}$	—	50	200	μA
		I_{IN} (2)	—	$V_{DD} = 12\text{V}$, $I_{IN} = 0$	-0.2	—	0.2	μA
On Voltage		V_{DS} (ON)	—	$V_{DD} = 12\text{V}$, $I_O = 8\text{A}$, $T_c = 25^\circ\text{C}$	—	—	0.48	V
On Resistance		R_{DS} (ON)	—	$V_{DD} = 12\text{V}$, $I_O = 8\text{A}$, $T_c = 25^\circ\text{C}$	—	—	0.06	Ω
Output Leakage Current		I_{OL}	—	$V_{DD} = 18\text{V}$, $V_{IN} = 0$	—	—	1.2	mA
Diagnosis Output Voltage	"L" Level	V_{DL}	—	$V_{DD} = 12\text{V}$, $I_{DL} = 1\text{mA}$	—	—	0.4	V
Diagnosis Output Current	"H" Level	I_{DH}	—	$V_{DD} = 18\text{V}$, $V_{DH} = 18\text{V}$	—	—	10	μA
Overcurrent Detection		I_S (1) *1	1	$V_{DD} = 12\text{V}$, $T_c = 25^\circ\text{C}$	15	40	—	A
		I_S (2) *2	2		30	50	—	A
Overheating Detection	Temperature	T_S	—	—	150	160	200	$^\circ\text{C}$
	Hysteresis	ΔT_S	—	—	—	10	—	$^\circ\text{C}$
Open Detection Resistance		R_{ops}	—	$V_{DD} = 8\text{V}$	1	50	100	$\text{k}\Omega$
Switching Time		t_{ON}	3	$V_{DD} = 12\text{V}$, $R_L = 5\Omega$ $T_c = 25^\circ\text{C}$	10	200	—	μs
		t_{OFF}	3		10	30	—	μs

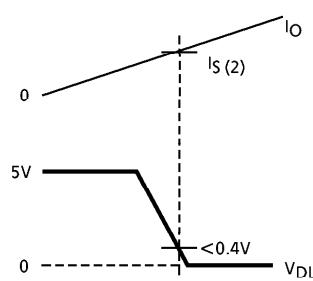
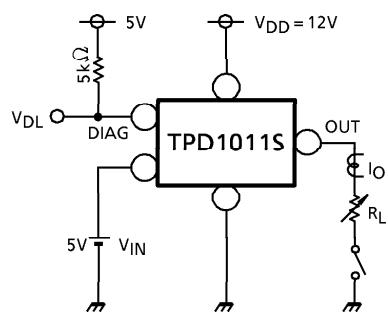
*1 I_S (1) Overcurrent detection value when load is short circuited and $V_{IN} = "L" \rightarrow "H"$ *2 I_S (2) Overcurrent detection value when load current is increased while $V_{IN} = "H"$

TEST CIRCUIT 1

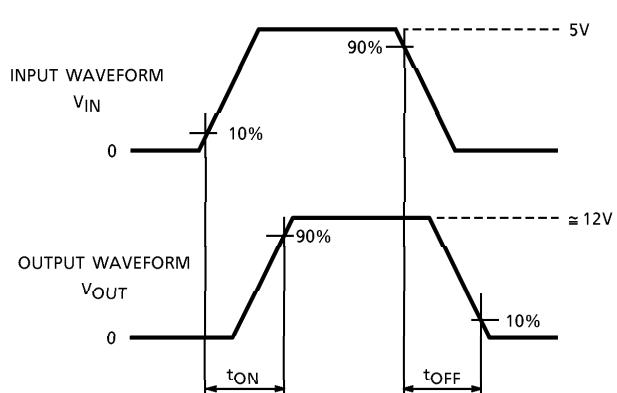
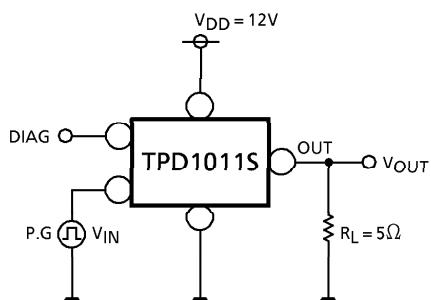
Overcurrent detection

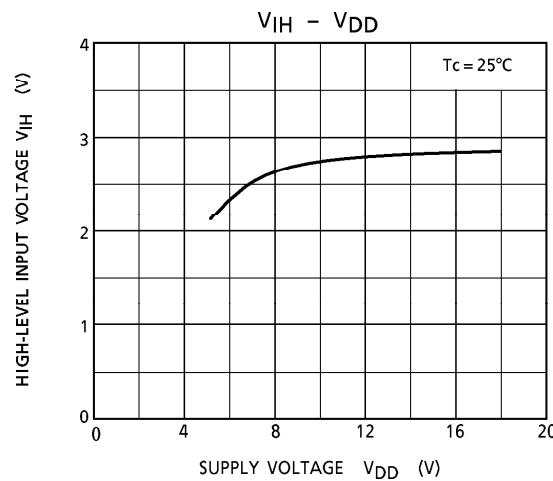
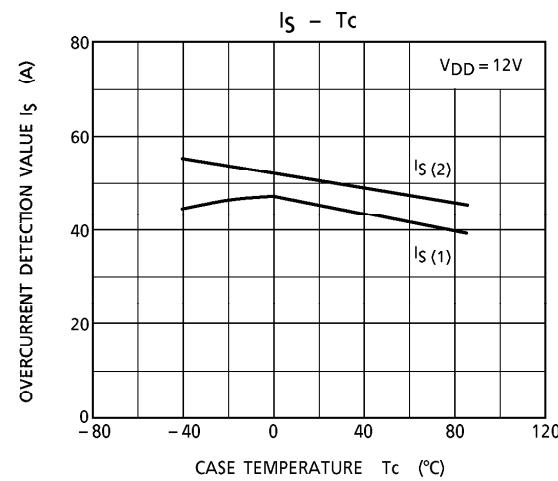
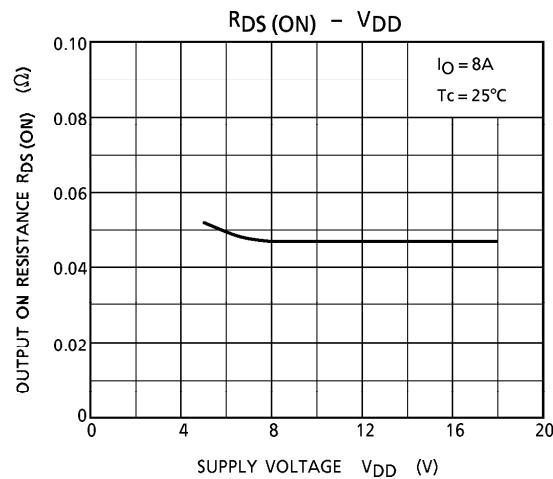
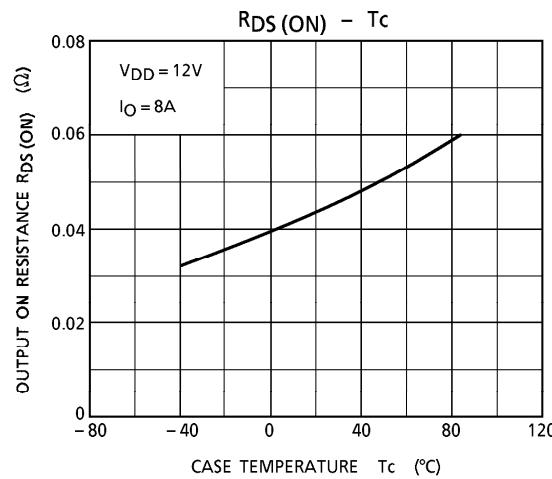
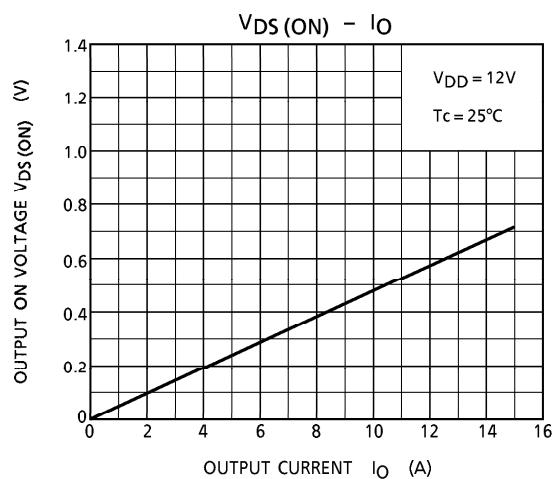
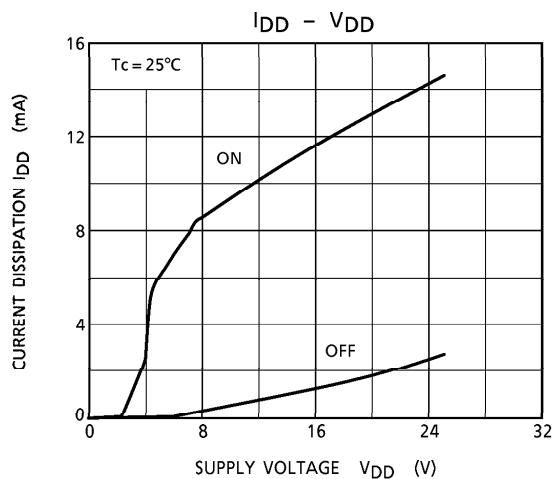
**TEST CIRCUIT 2**

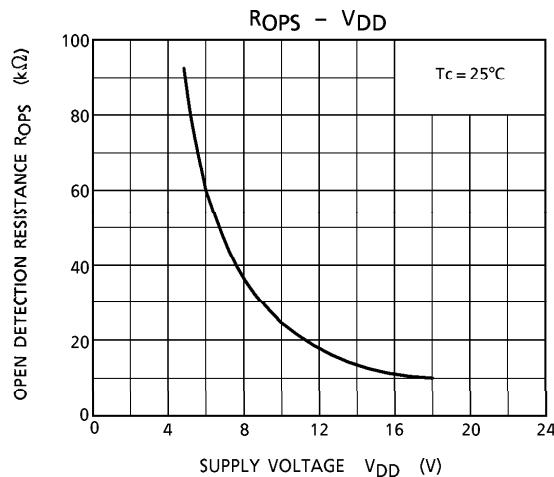
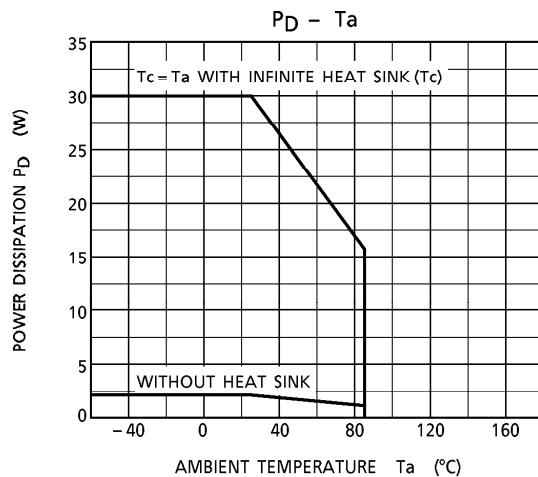
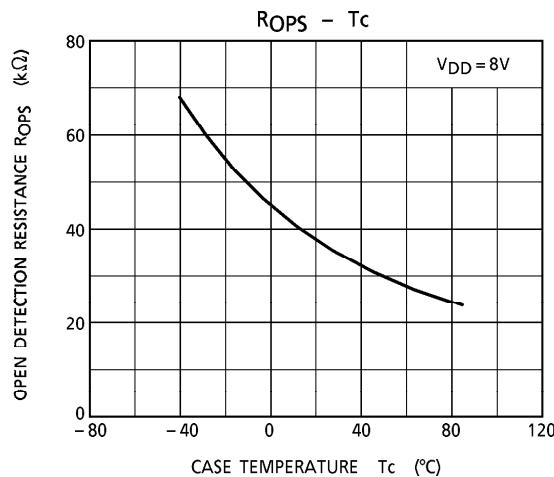
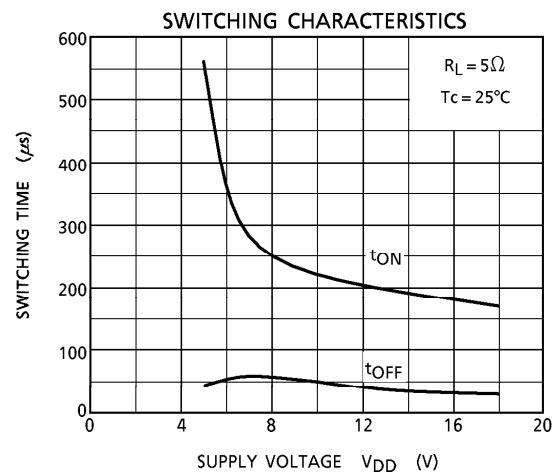
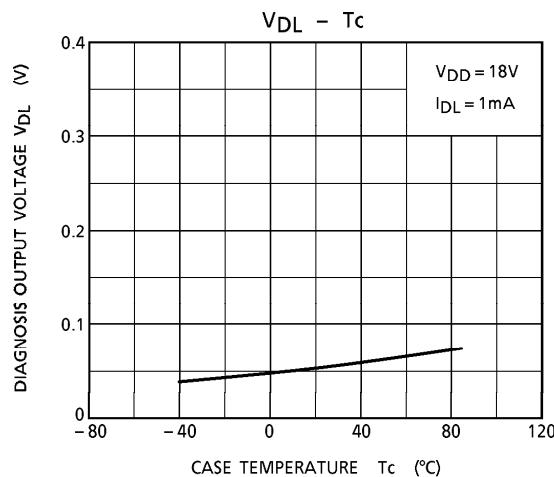
Over-current detection

**TEST CIRCUIT 3**

Switching time



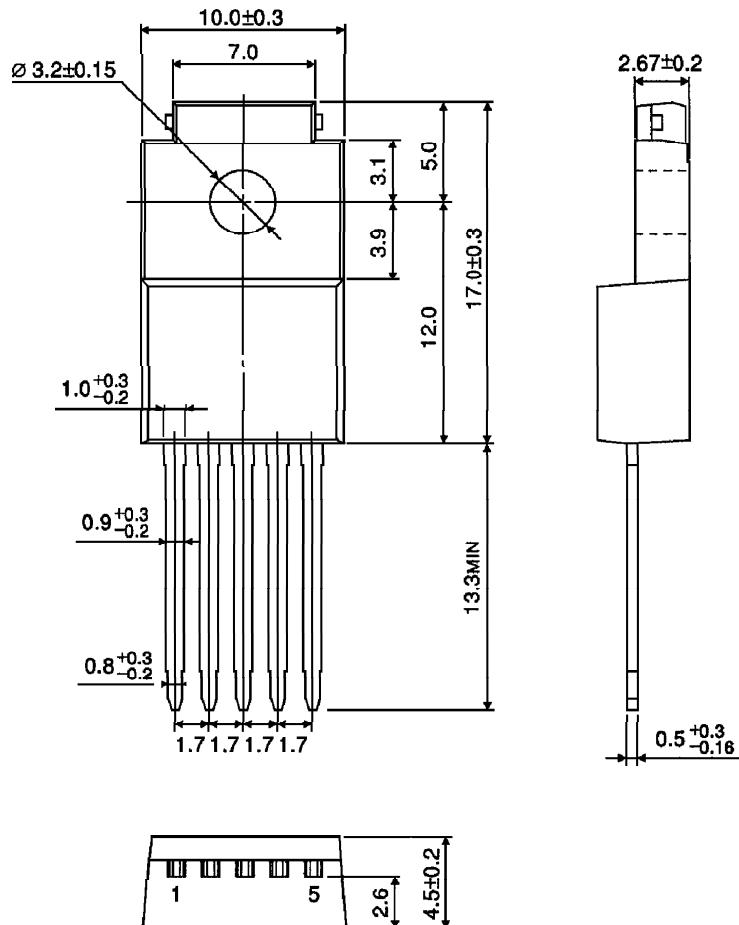


**PRECAUTION:**

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

OUTLINE DRAWING
SSIP5-P-1.70A (STL)

Unit : mm

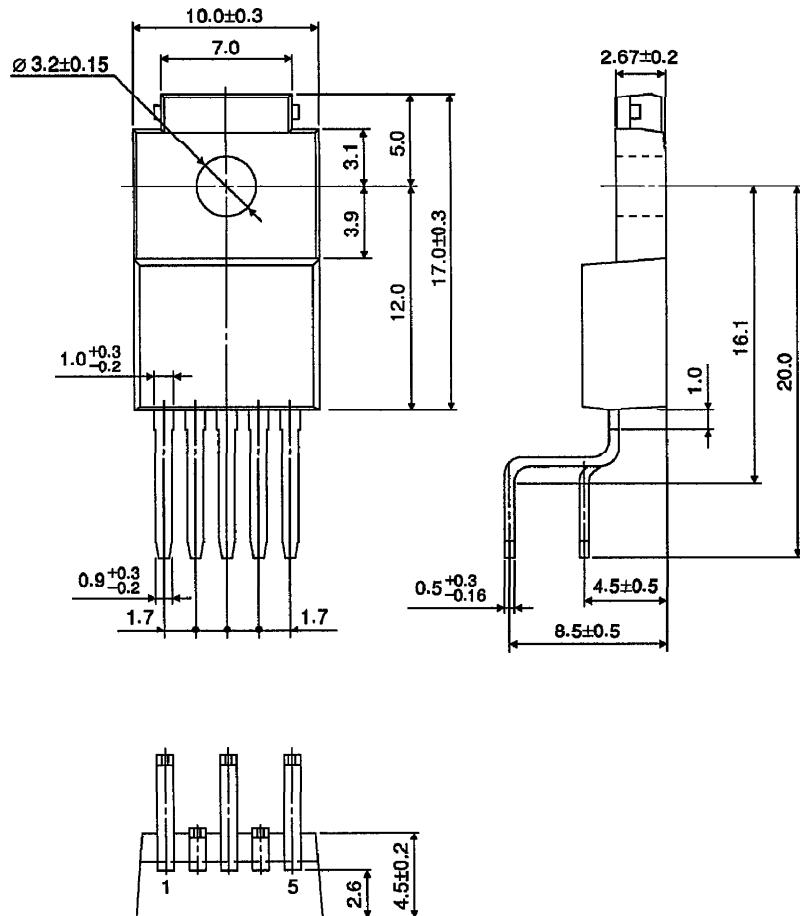


Weight : 2.2g (Typ.)

OUTLINE DRAWING

ZIP5-P-1.70 (LBF)

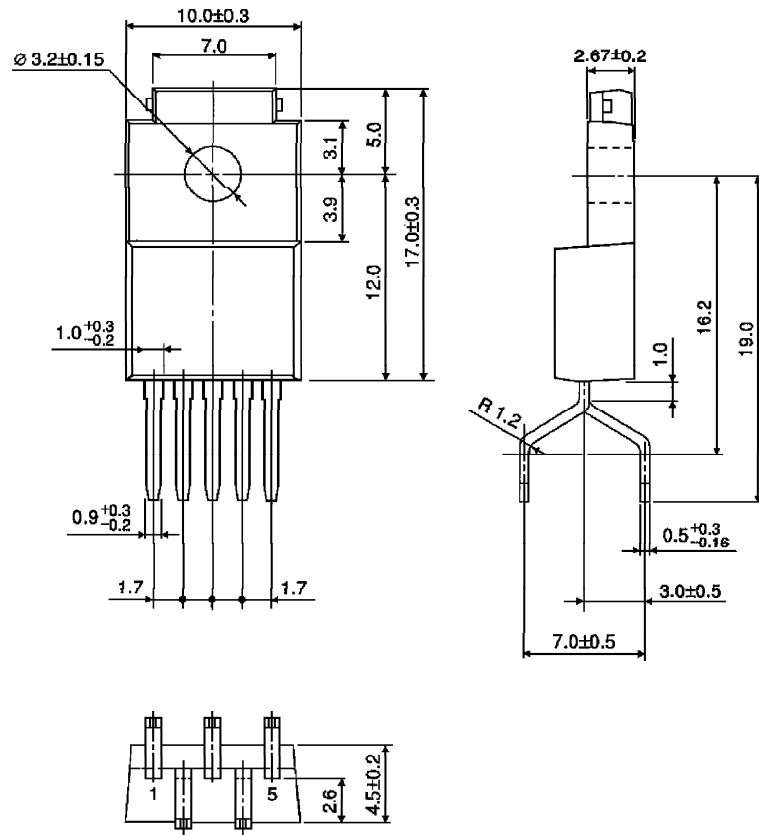
Unit : mm



Weight : 2.2g (Typ.)

OUTLINE DRAWING
ZIP5-P-1.70A (LBS)

Unit : mm



Weight : 2.2g (Typ.)