TOSHIBA INTELLIGENT POWER DEVICE SILICON MONOLITHIC POWER MOS INTEGRATED CIRCUIT

TPD1009S

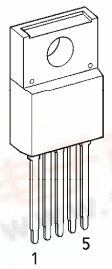
HIGH-SIDE POWER SWITCH for MOTORS, SOLENOIDS, and LAMP DRIVERS.

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

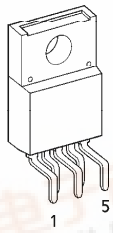
- A monolithic power IC with a new structure combining a control block (Bi-CMOS) and a vertical power MOS FET (π-MOS) on a single chip.
- One side of load can be grounded to a high-side switch.
- Can directly drive a power load from a microprocessor.
- Built-in protection against overheating and load 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: $I_{DD} = 1$mA (Typ.), at $V_{DD} = 12$V, $V_{IN} = 0$
- 5-pin TO-220 insulated package.
- Three standard lead configurations.

STL



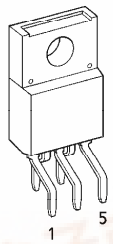
SSIP5-P-1.70C

LBF



ZIP5-P-1.70L

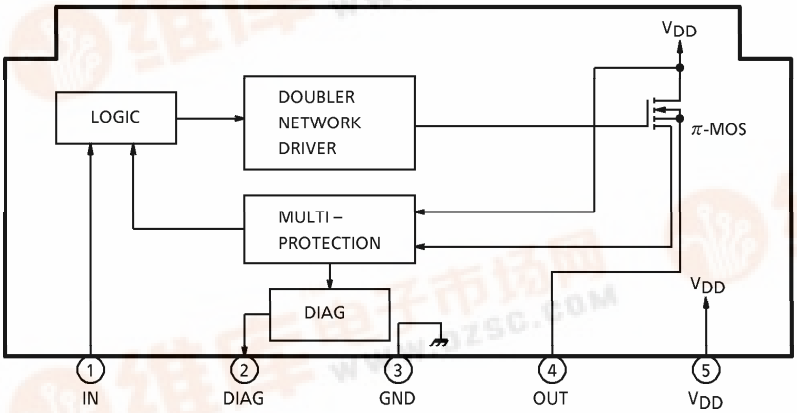
LBS



ZIP5-P-1.70K

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

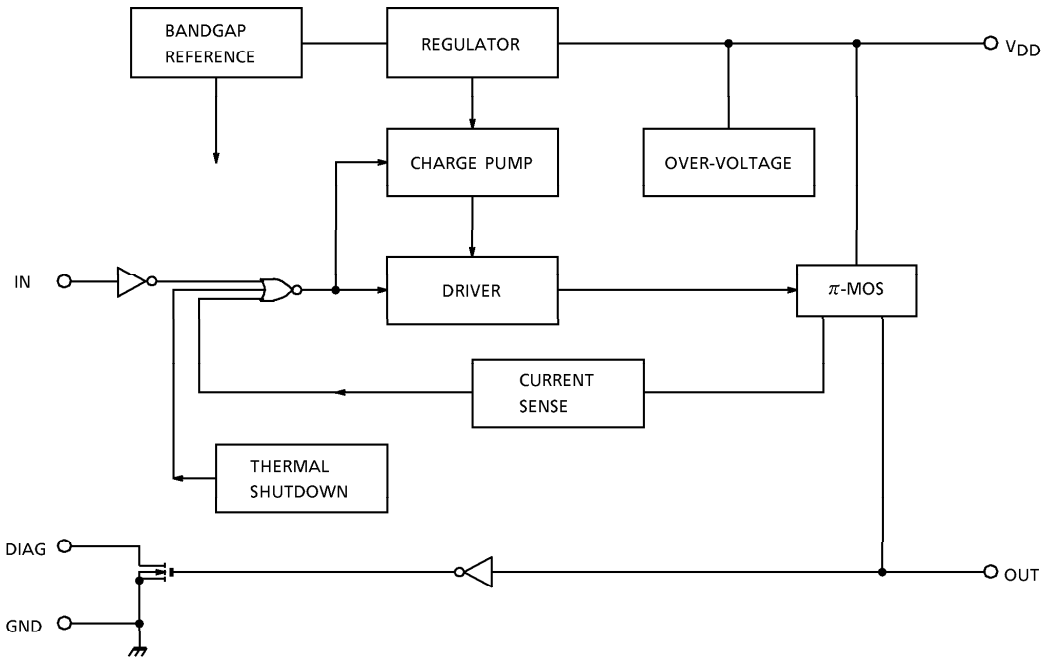
PIN ASSIGNMENT



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

961001EBA2

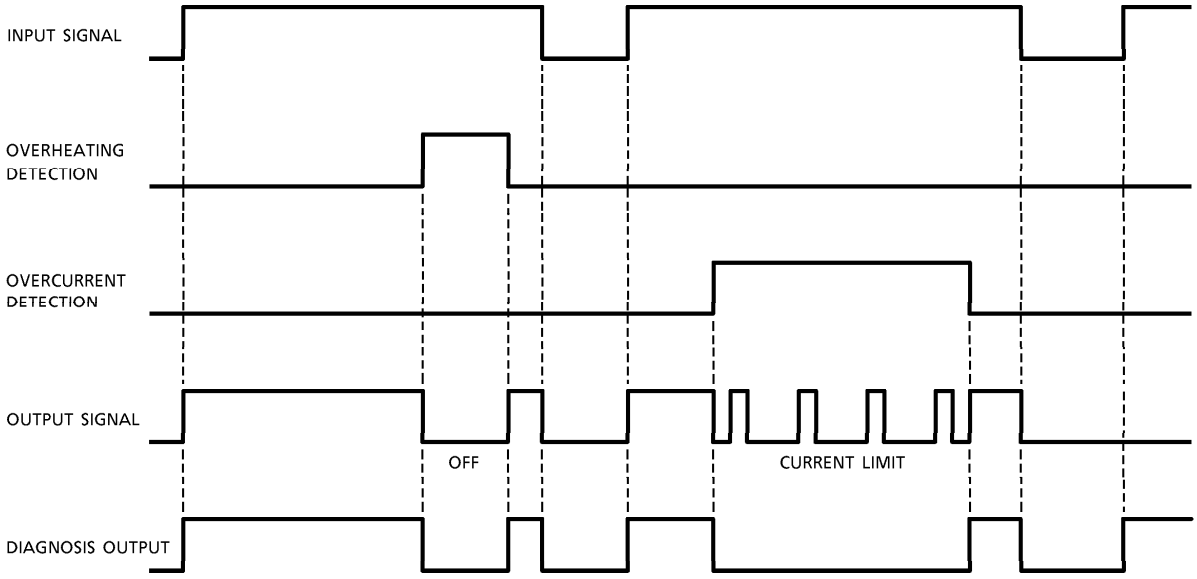
BLOCK DIAGRAM



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	V
	Pulse	V_{DD} (2)	60 (Rs = 1Ω, τ = 250ms)	V
Input Voltage	DC	V_{IN} (1)	−0.5~12	V
	Pulse	V_{IN} (2)	V_{DD} (1) + 1.5 (t = 100ms)	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	Tc = 25°C	P_D (1)	30	W
	Ta = 25°C	P_D (2)	2	W
Operating Temperature		T_{opr}	−40~110	°C
Junction Temperature		Tj	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)

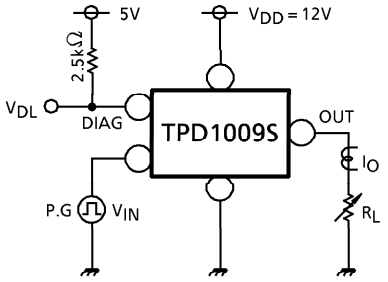
CHARACTERISTIC		SYMBOL	TEST CIR-CUIT	TEST CONDITION	MIN	TYP.	MAX	UNIT
Operating Supply Voltag		V_{DD} (OPR)	—	—	5	12	18	V
Current Dissipation		I_{DD}	—	V_{DD} = 12V, V_{IN} = 0	—	1	5	mA
Input Voltage		V_{IH}	—	V_{DD} = 12V, I_O = 8A	3.5	—	—	V
		V_{IL}	—	V_{DD} = 12V, I_O = 1.2mA	—	—	1.5	V
Input Current		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	Ts	—	—	150	160	200	°C
	Hysteresis	ΔTs	—		—	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

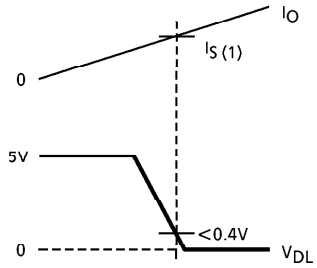
*1 I_S (1) Overcurrent detection value when load is short circuited and V_{IN} = "L"→"H"

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

TEST CIRCUIT 1

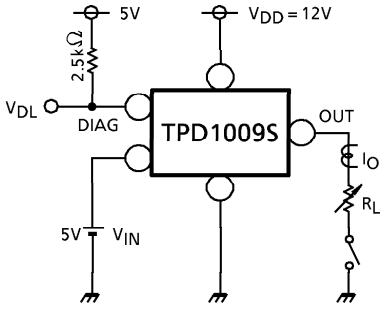
Over-voltage detection

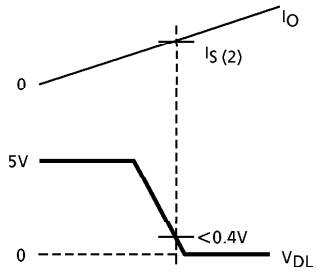




TEST CIRCUIT 2

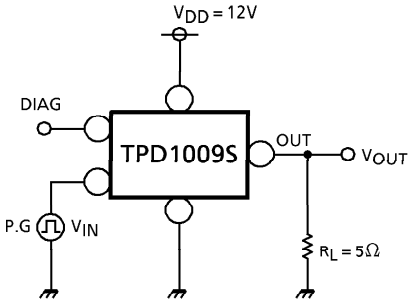
Over-voltage detection

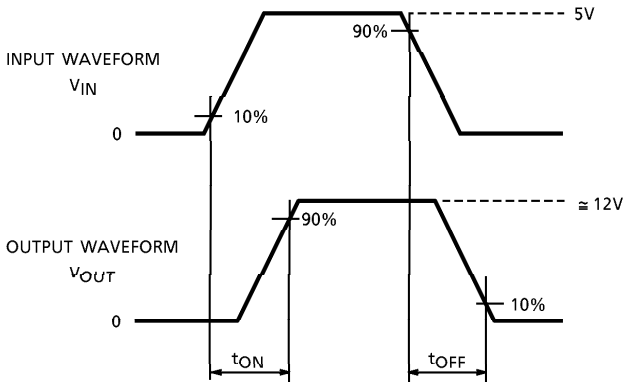




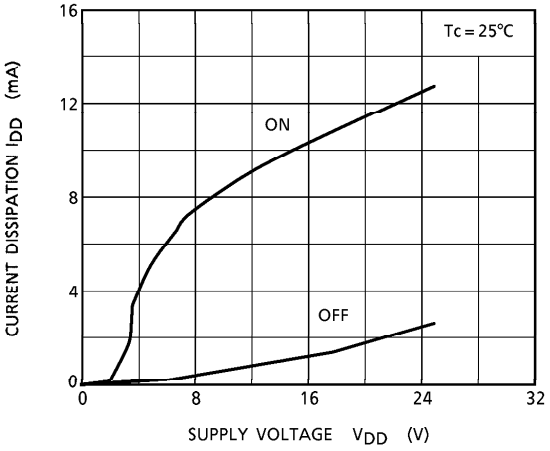
TEST CIRCUIT 3

Switching time

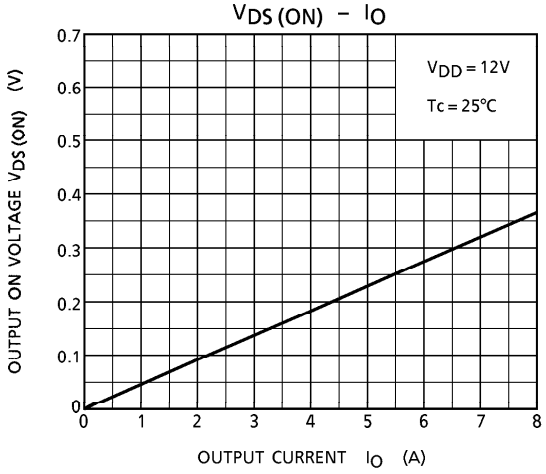




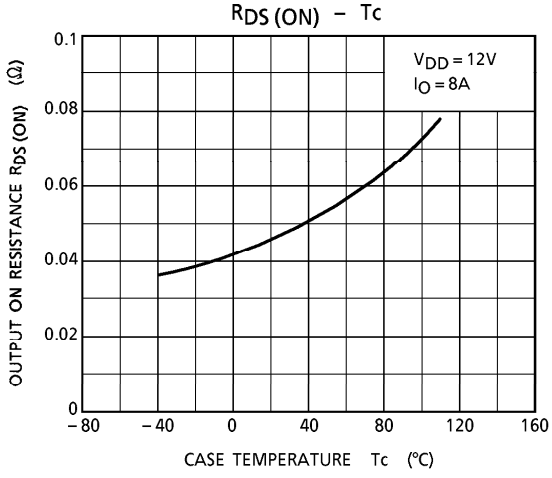
I_{DD} – V_{DD}



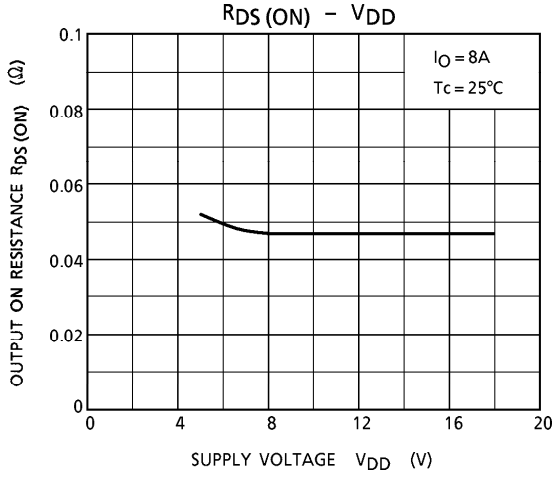
$V_{DS\,(ON)}$ – I_O



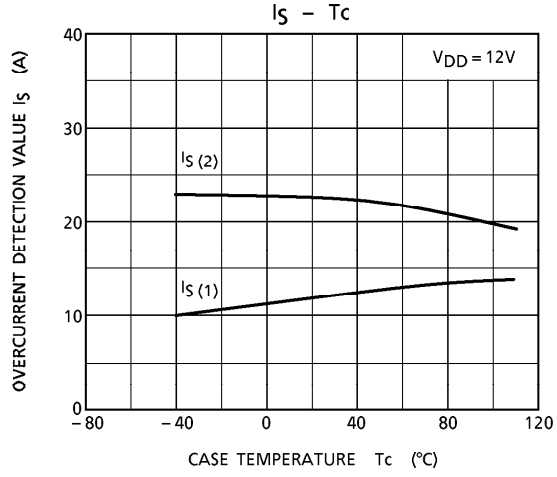
$R_{DS\,(ON)}$ – Tc



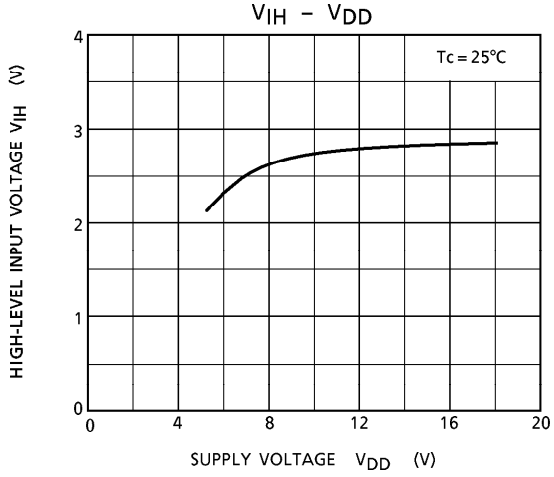
$R_{DS\,(ON)}$ – V_{DD}



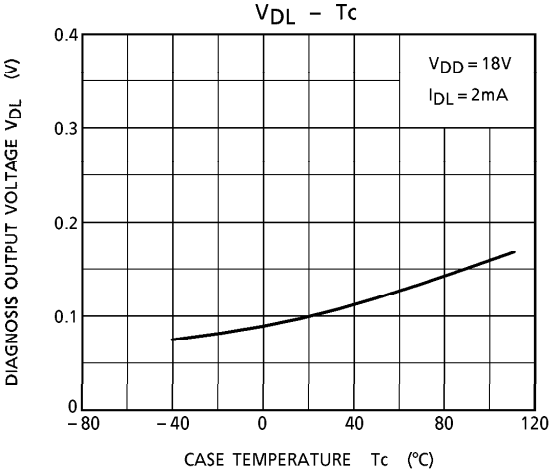
I_S – Tc



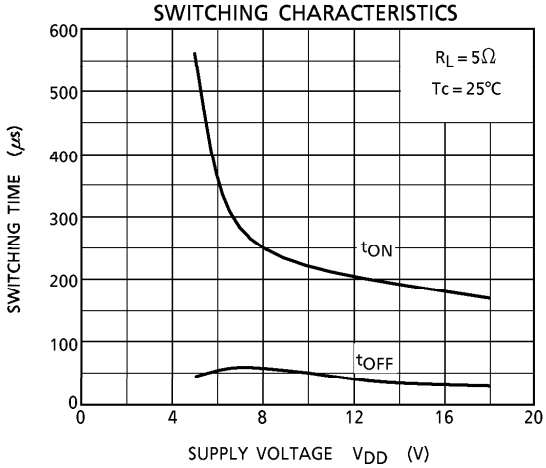
V_{IH} – V_{DD}



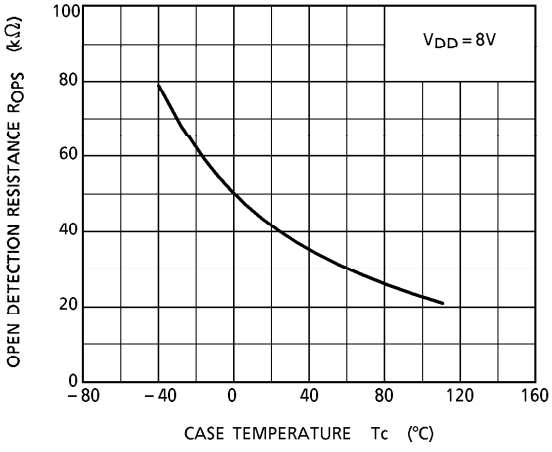
V_{DL} – Tc



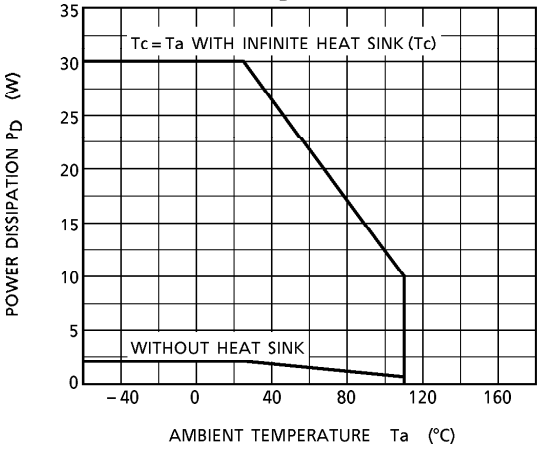
SWITCHING CHARACTERISTICS



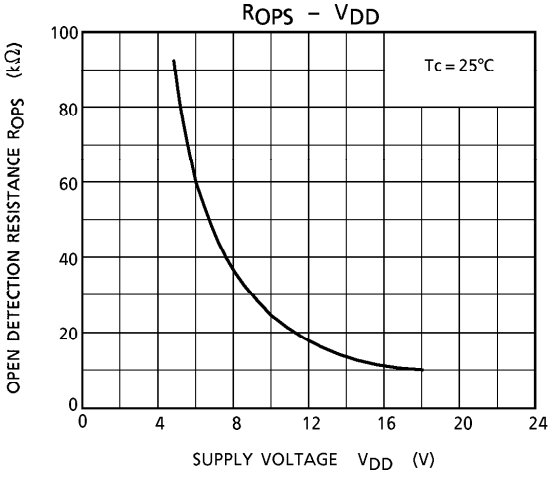
R_{OPS} – Tc



P_D – Ta



R_{OPS} – V_{DD}



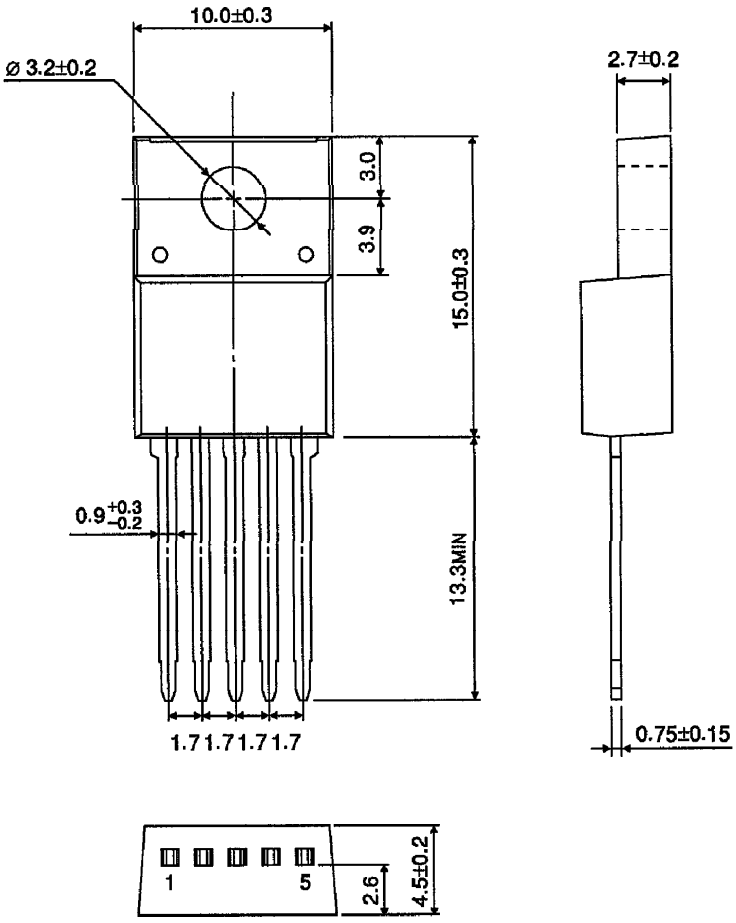
PRECAUTION:

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

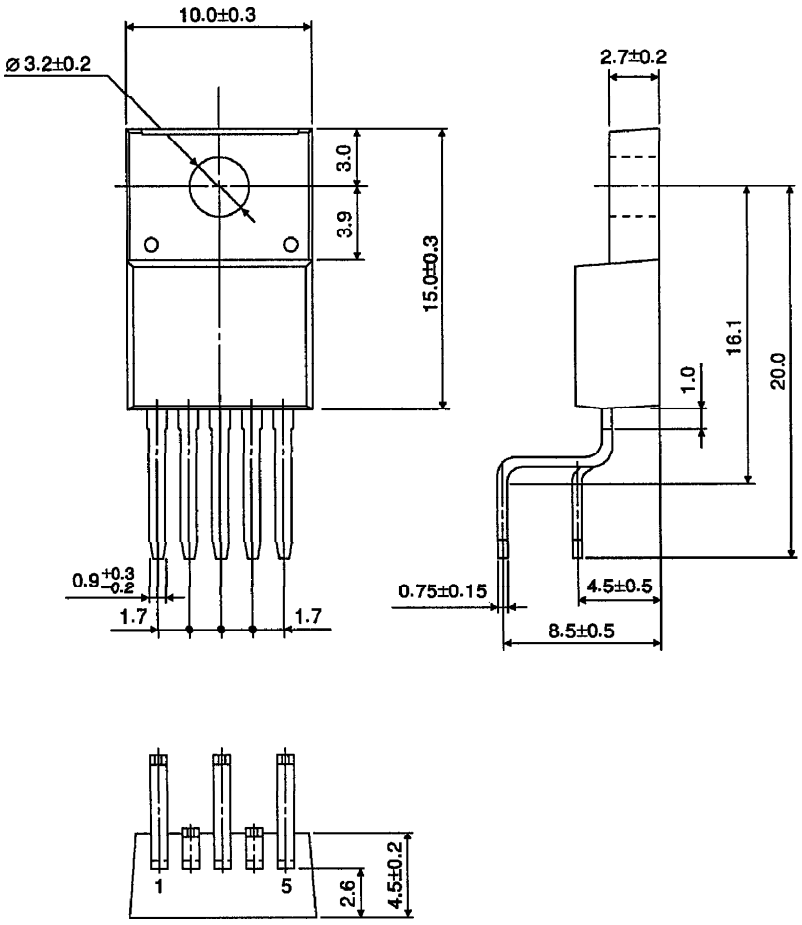


Weight : 2.1g (Typ.)

OUTLINE DRAWING

ZIP5-P-1.70L (LBF)

Unit : mm

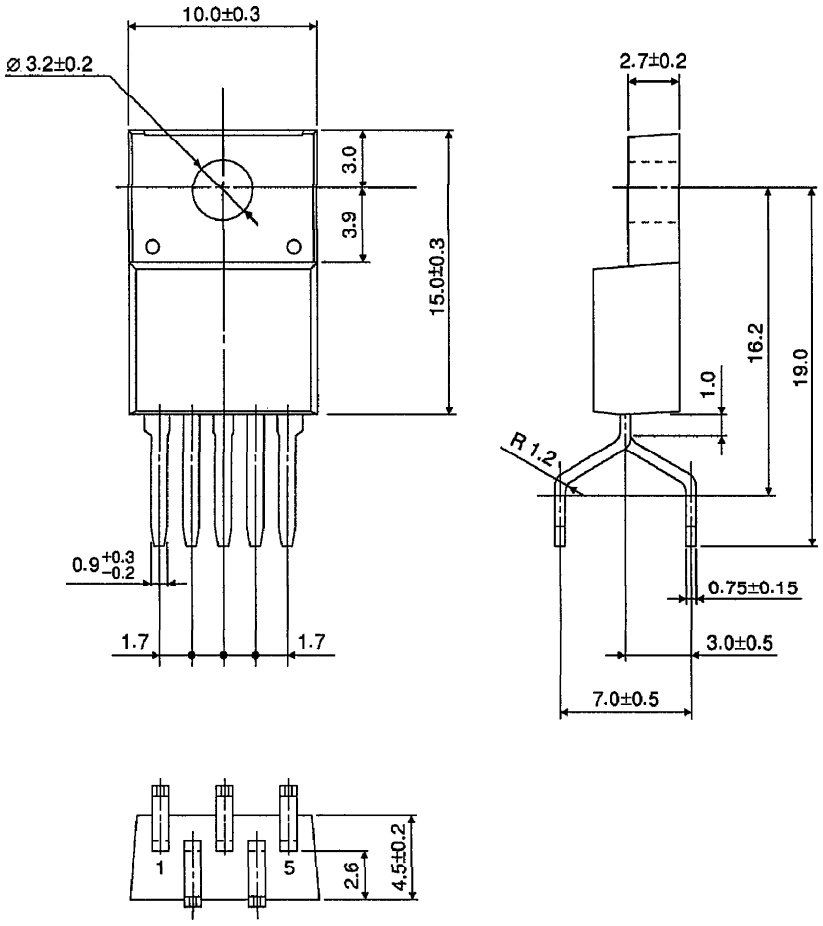


Weight : 2.1g (Typ.)

OUTLINE DRAWING

ZIP5-P-1.70K (LBS)

Unit : mm



Weight : 2.1g (Typ.)