

TOSHIBA Intelligent Power Device Silicon Monolithic Power MOS Integrated Circuit

TPD1009S

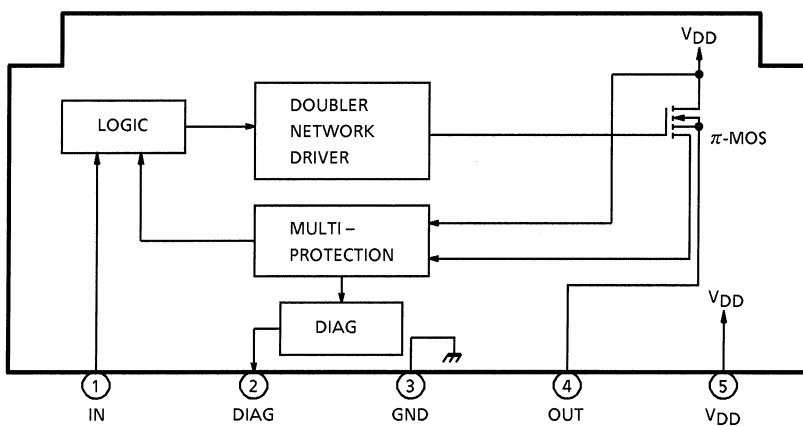
High-side Power Switch for Motors, Solenoids, and Lamp Drivers.

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

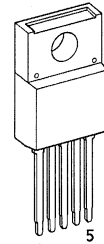
- A monolithic power IC with a new structure combining a control block (Bi-CMOS) and a vertical power MOS FET (π -MOS) on a single chip.
- One side of load can be grounded to a high-side switch.
- Can directly drive a power load from a microprocessor.
- Built-in protection against thermal shutdown and load short circuiting.
- Incorporates a diagnosis function that allows diagnosis output to be read externally at load short circuiting, opening, or overtemperature.
- 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.) (@ $V_{DD} = 12V$, $V_{IN} = 0V$)
- 5-pin TO-220 insulated package.
- Three standard lead configurations.

Pin Assignment



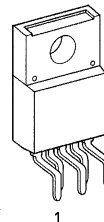
Note: That because of its MOS structure, this product is sensitive to static electricity.

STL



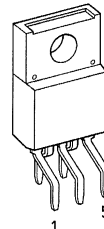
SSIP5-P-1.70C

LBF



ZIP5-P-1.70L

LBS



ZIP5-P-1.70K

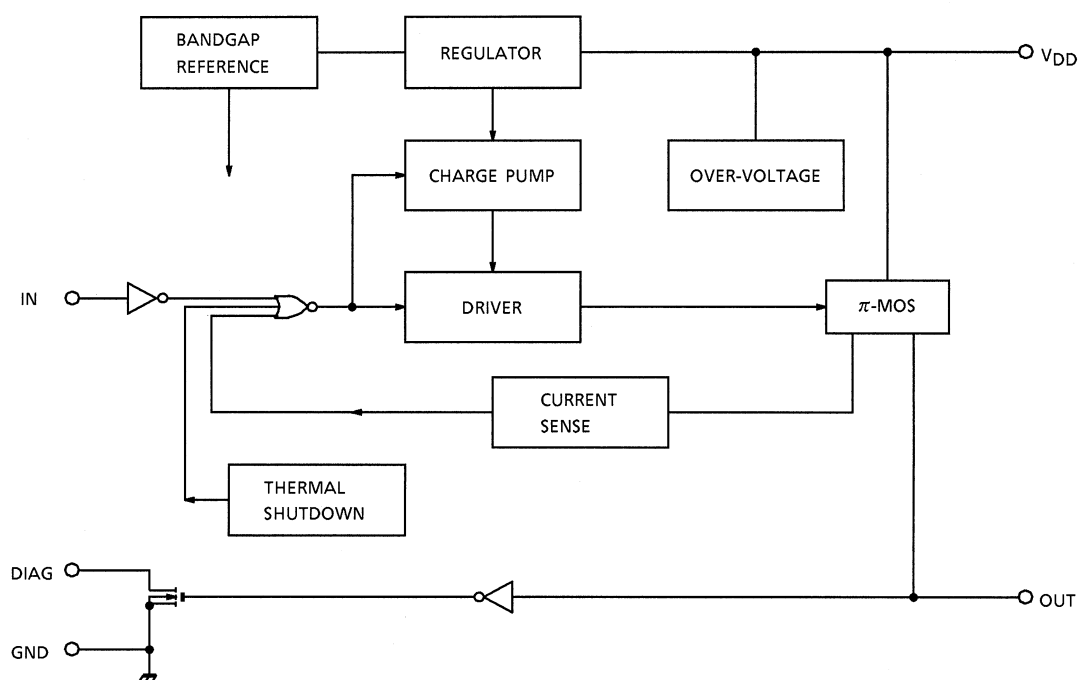
Weight

SSIP5-P-1.70C : 2.1g (typ.)

ZIP5-P-1.70L : 2.1g (typ.)

ZIP5-P-1.70K : 2.1g (typ.)

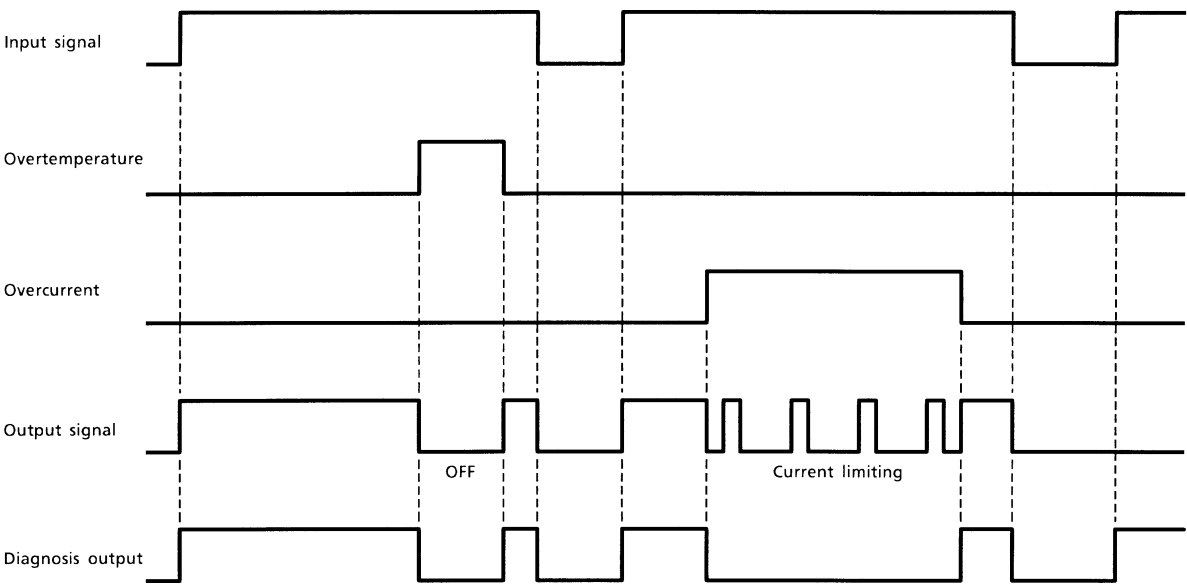
Block Diagram



Pin Description

Pin No.	Symbol	Function
1	IN	Input pin. 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	Overcurrent
L	L	L	
H	H	H	Load open
L	H	H	
H	L	L	Overtemperature
L	L	L	

Maximum Ratings (Ta = 25°C)

Characteristics		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		T _j	150	°C
Storage Temperature		T _{stg}	-55~150	°C
Lead Temperature/time		T _{SOL}	275 (5s), 260 (10s)	°C

Electrical Characteristics (Tj = -40~110°C, V_{DD} = 8~18V)

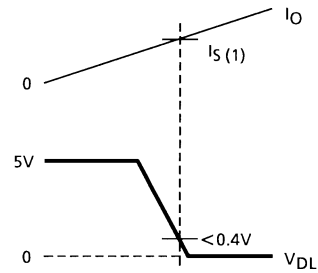
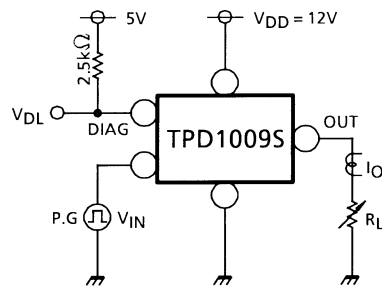
Characteristics		Symbol	Test Circuit	Test Condition	Min	Typ.	Max	Unit
Operating Supply Voltage		V _{DD} (opr)	—	—	5	12	18	V
Supply Current		I _{DD}	—	V _{DD} = 12V, V _{IN} = 0V	—	1	5	mA
Input Voltage		V _{IH}	—	V _{DD} = 12V, I _O = 8A	3.5	—	—	V
		V _{IL}	—	V _{DD} = 12V, I _O = 1.2mA	—	—	1.5	V
Input Current		I _{IN} (1)	—	V _{DD} = 12V, V _{IN} = 5V	—	50	200	μA
		I _{IN} (2)	—	V _{DD} = 12V, V _{IN} = 0V	-0.2	—	0.2	μA
On Voltage		V _{DS} (ON)	—	V _{DD} = 12V, I _O = 8A, Tj = 25°C	—	—	0.48	V
On Resistance		R _{DS} (ON)	—	V _{DD} = 12V, I _O = 8A, Tj = 25°C	—	—	0.06	Ω
Output Leakage Current		I _{OL}	—	V _{DD} = 18V, V _{IN} = 0V	—	—	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 Protection		I _S (1) (Note 1)	1	V _{DD} = 12V, Tj = 25°C	8	12	—	A
		I _S (2) (Note 2)	2		15	24	—	A
Thermal Shutdown	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, Tj = 25°C	10	200	—	μs
		t _{OFF}	3		10	30	—	μs

Note 1: I_S (1) Overcurrent detection value when load is short circuited and V_{IN} = “L” → “H”

Note 2: I_S (2) Overcurrent detection value when load current is increased while V_{IN} = “H”

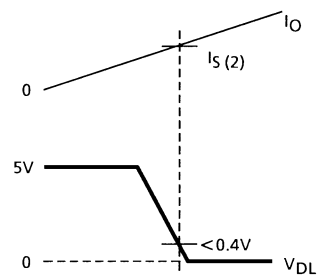
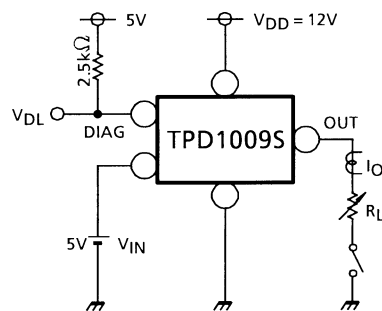
Test Circuit 1

Over-voltage detection



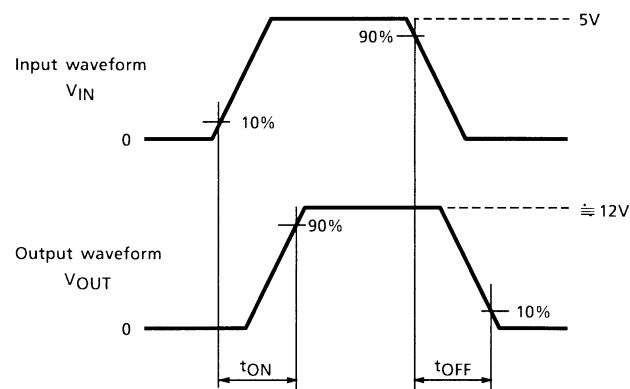
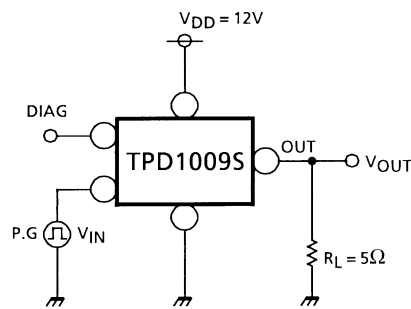
Test Circuit 2

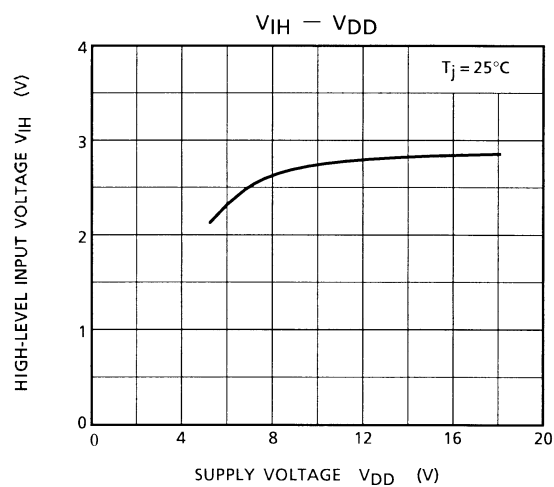
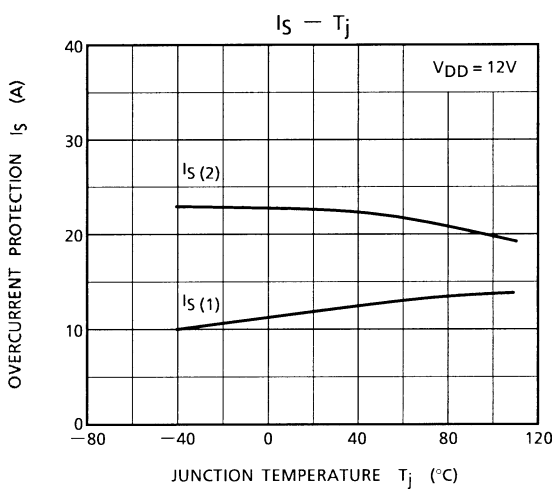
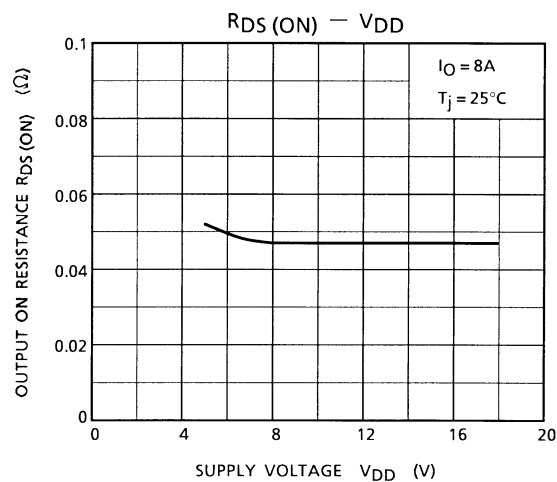
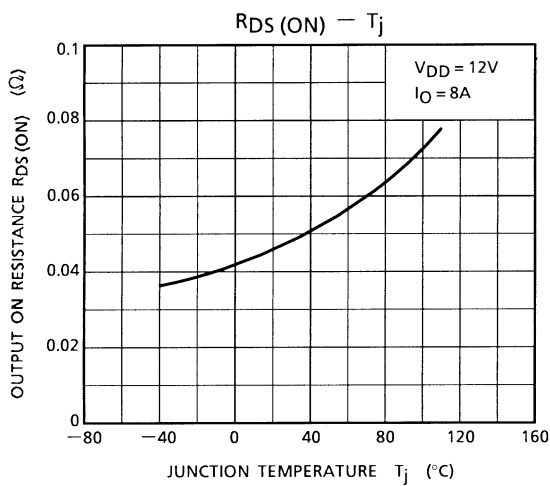
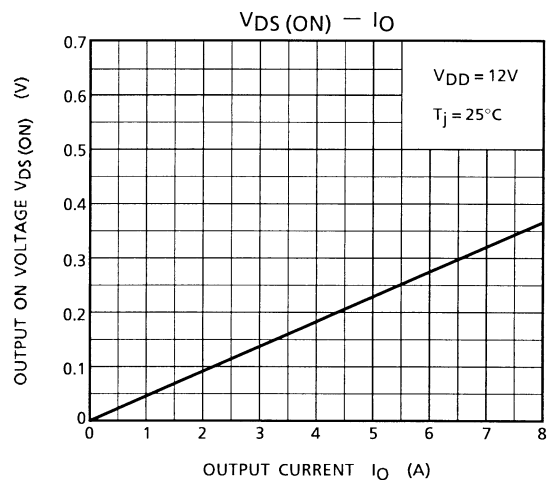
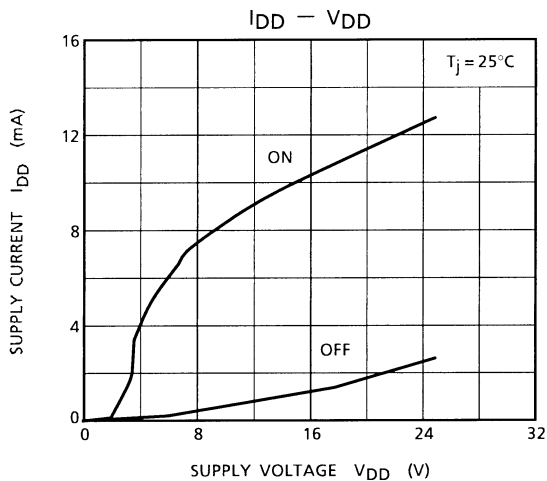
Over-voltage detection

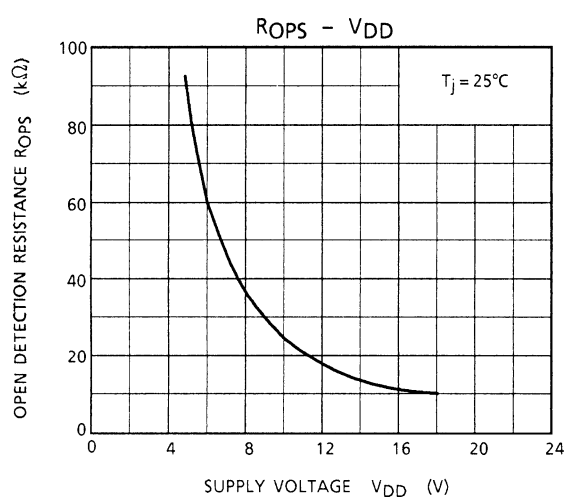
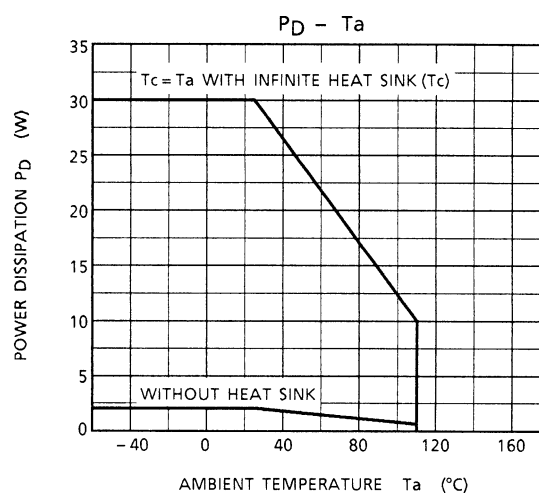
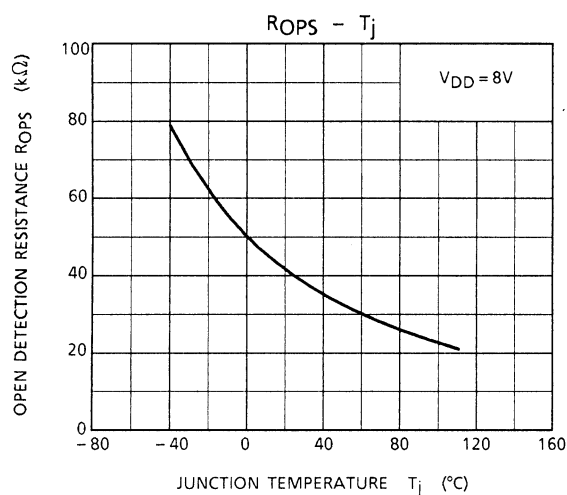
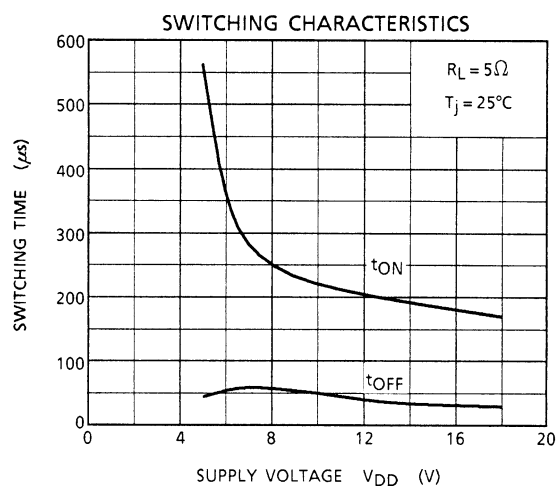
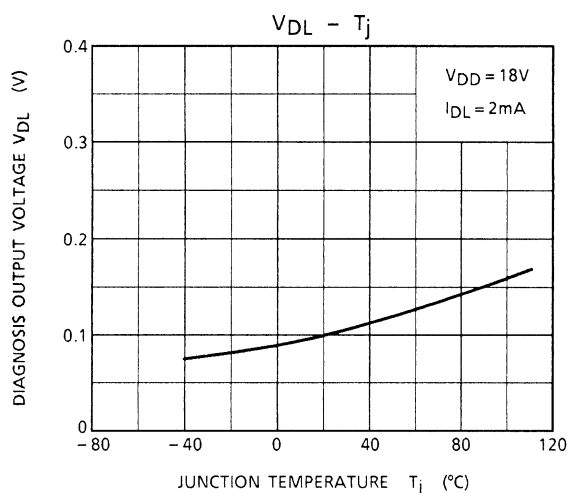


Test Circuit 3

Switching time







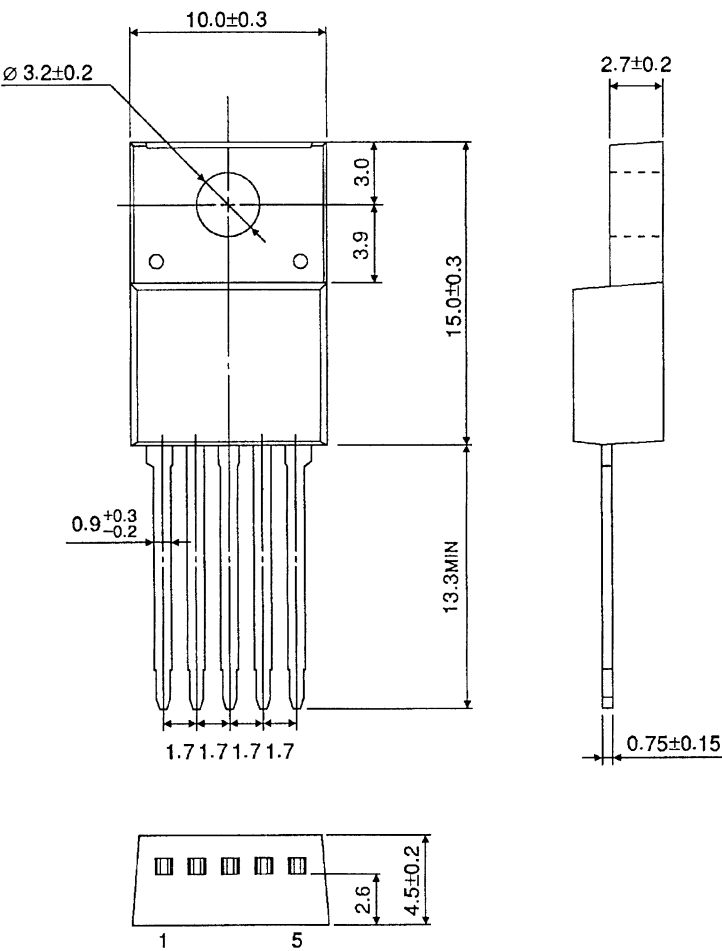
Precaution:

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

Package Dimensions

SSIP5-P-1.70C (STL)

Unit : mm

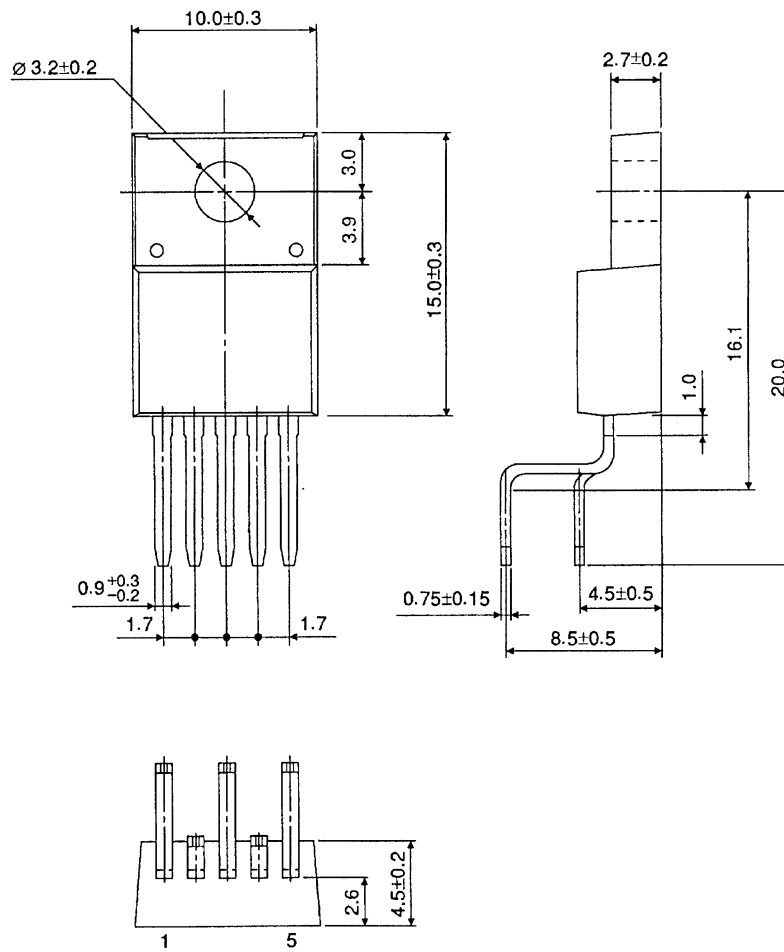


Weight: 2.1g (typ.)

Package Dimensions

ZIP5-P-1.70L (LBF)

Unit : mm

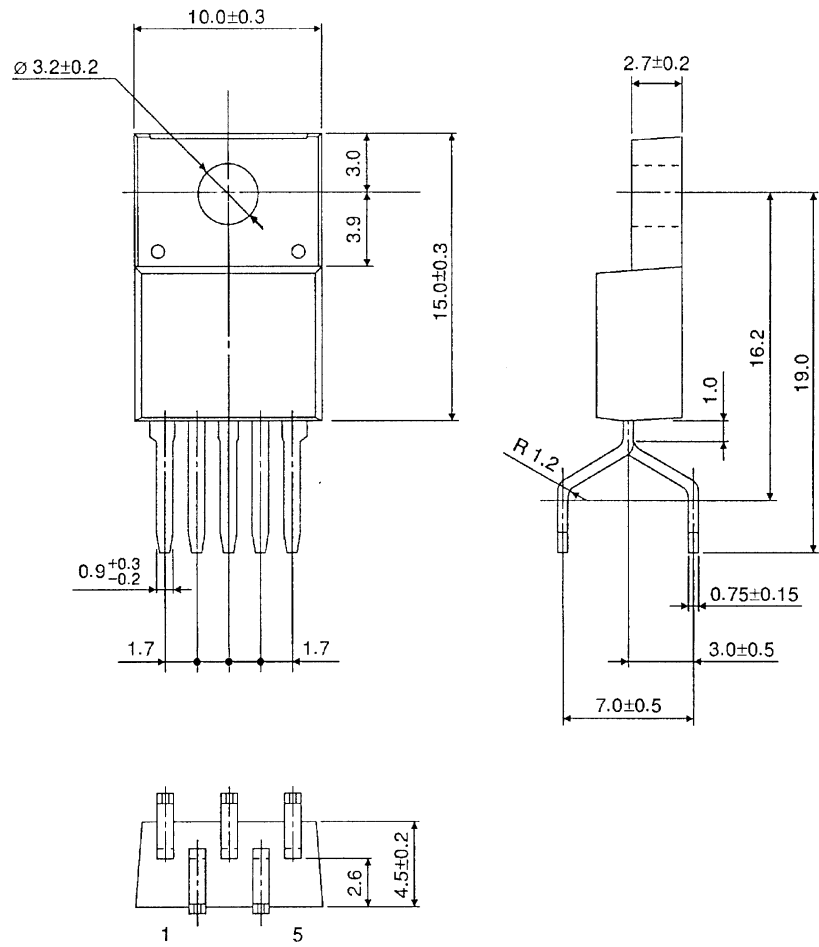


Weight: 2.1g (typ.)

Package Dimensions

ZIP5-P-1.70K (LBS)

Unit : mm



Weight: 2.1g (typ.)

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