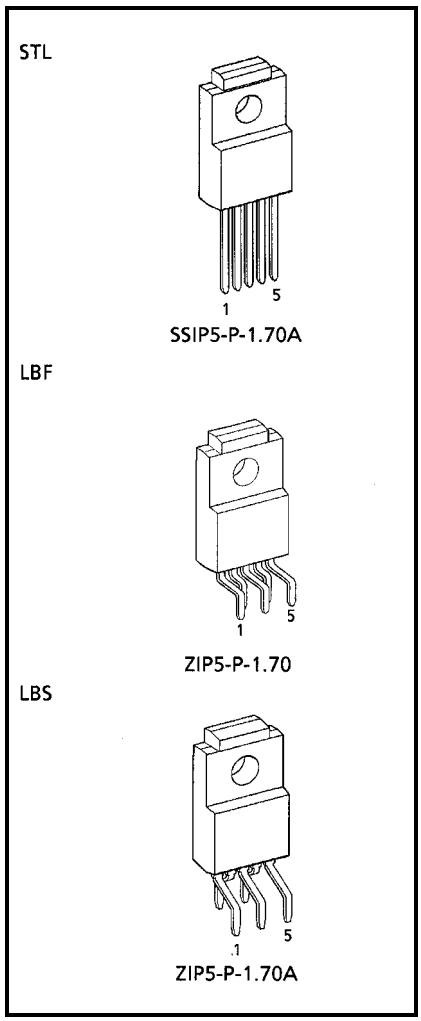
TOSHIBA Intelligent Power Device Silicon Monolithic Power MOS Integrated Circuit

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.

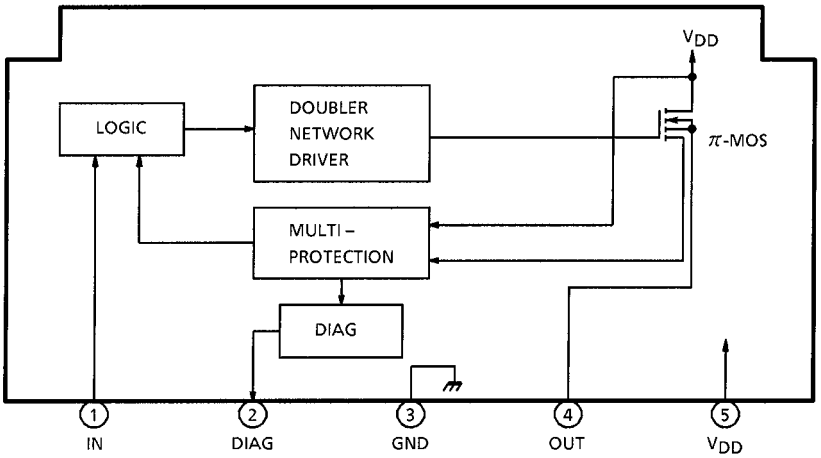


Weight
SSIP5−P−1.70A : 2.2g (typ.)
ZIP5−P−1.70 : 2.2g (typ.)
ZIP5−P−1.70A : 2.2g (typ.)

Features

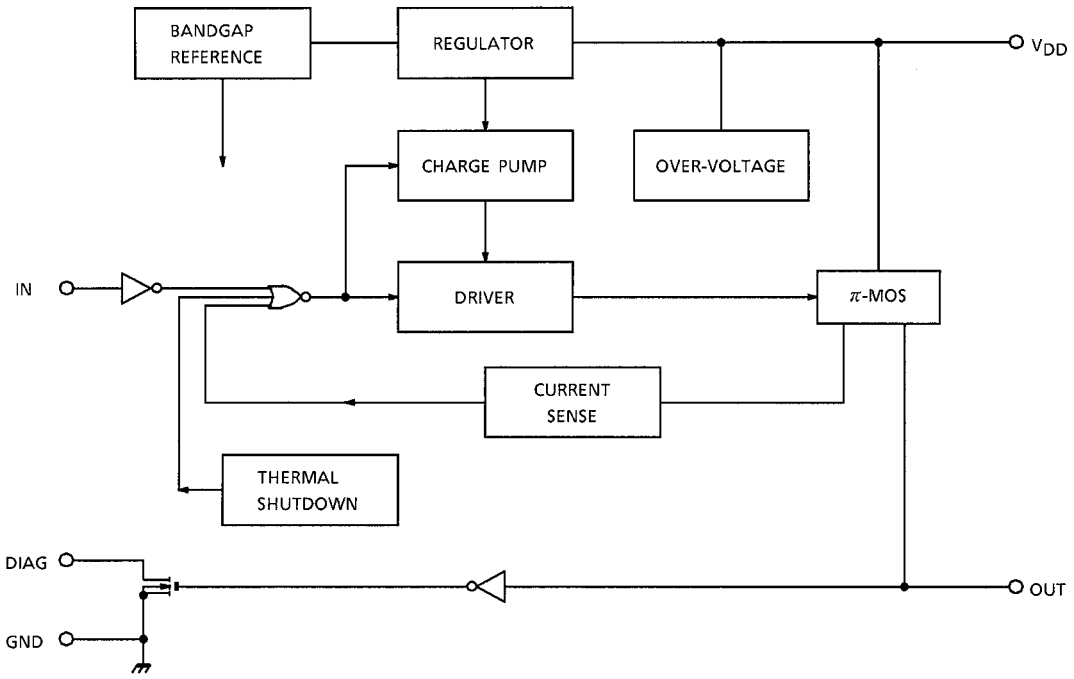
- A monolithic power IC with a new structure combining a control block (Bi−CMOS) and a vertical power MOS FET (π−MOS) on a single chip.
- One side of load can be grounded to a high−side switch.
- Can directly drive a power load from a microprocessor.
- Built−in protection against thermal shutdown and load short circuiting. Also 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} = 60mΩ (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.

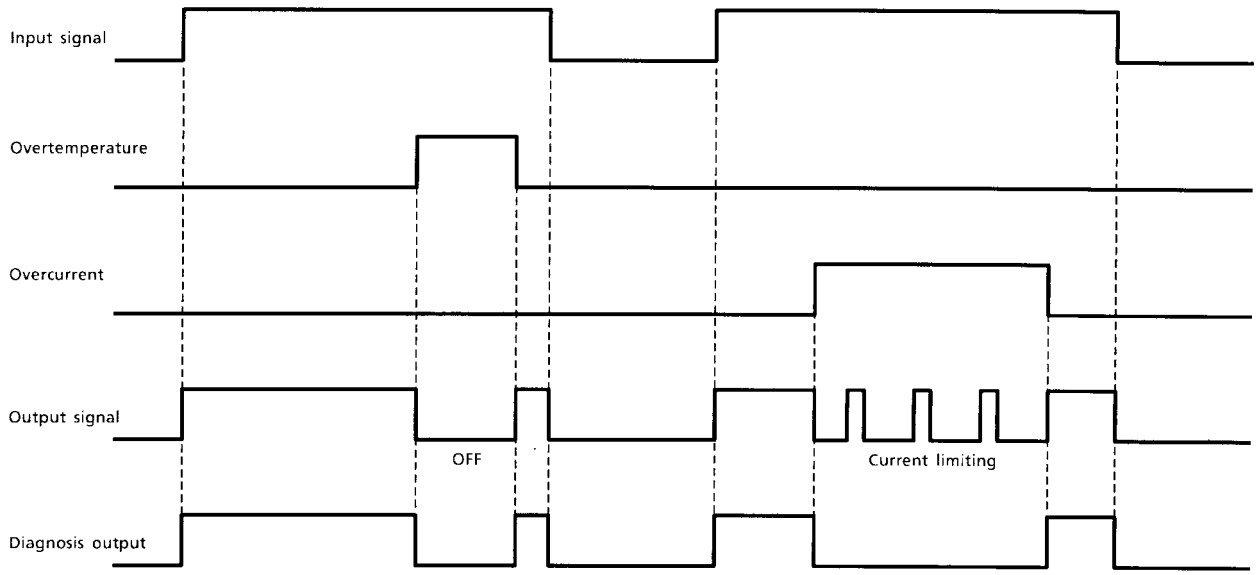
Block Diagram



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 overtemperature 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}	−40~85	°C
Junction Temperature		T_j	150	°C
Storage Temperature		T_{stg}	−55~150	°C
Lead Temperature/time		T_{SOL}	275 (5s), 260 (10s)	°C

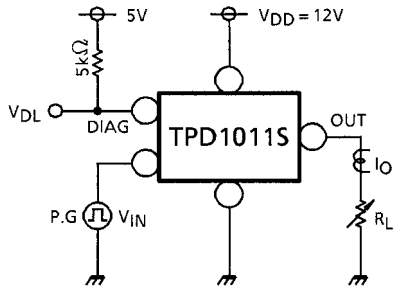
Electrical Characteristics (T_j = −40~85°C, V_{DD} = 8~18V)

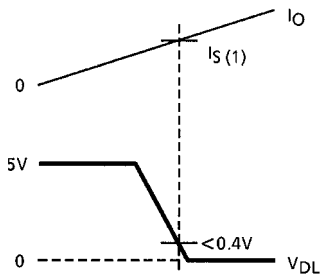
Characteristics		Symbol	Test Circuit	Test Condition	Min	Typ.	Max	Unit
Operating Supply Voltage		$V_{DD\ (opr)}$	—	—	5	12	18	V
Supply Current		I_{DD}	—	V_{DD} = 12V, V_{IN} = 0V	—	1	5	mA
Input Voltage		V_{IH}	—	V_{DD} = 12V, I_O = 8A	3.5	—	—	V
		V_{IL}	—	V_{DD} = 12V, I_O = 1.2mA	—	—	1.5	V
Input Current		$I_{IN\ (1)}$	—	V_{DD} = 12V, I_{IN} = 5V	—	50	200	μA
		$I_{IN\ (2)}$		V_{DD} = 12V, I_{IN} = 0V	−0.2	—	0.2	μA
On Voltage		$V_{DS\ (ON)}$	—	V_{DD} = 12V, I_O = 8A, T_j = 25°C	—	—	0.48	V
On Resistance		$R_{DS\ (ON)}$	—	V_{DD} = 12V, I_O = 8A, T_j = 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} = 1mA	—	—	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, T_j = 25°C	15	40	—	A
		$I_{S\ (2)}$ (Note 2)	2		30	50	—	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, T_j = 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

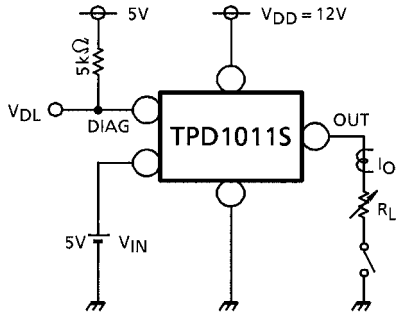
Overcurrent detection

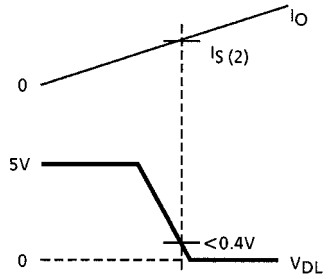




Test Circuit 2

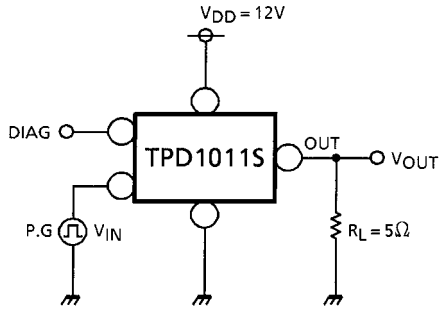
Over−current detection

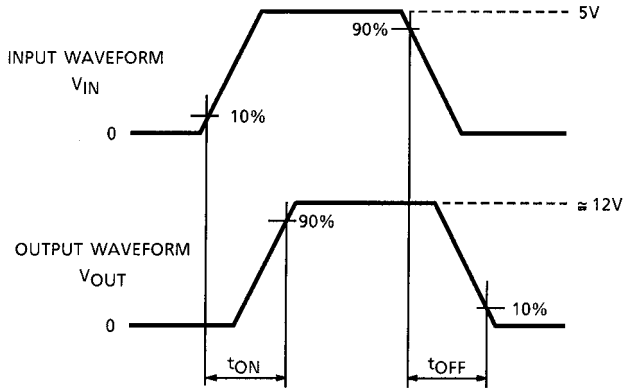




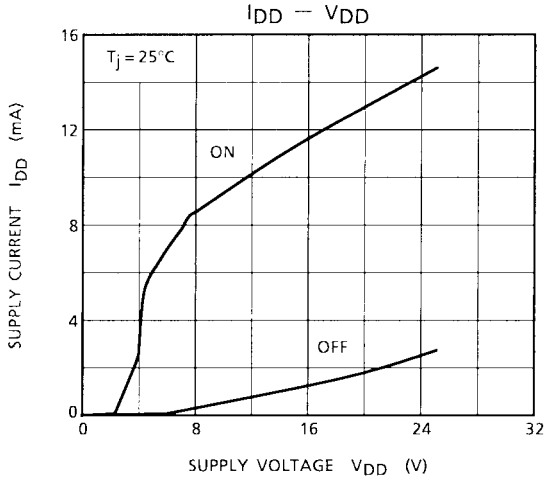
Test Circuit 3

Switching time

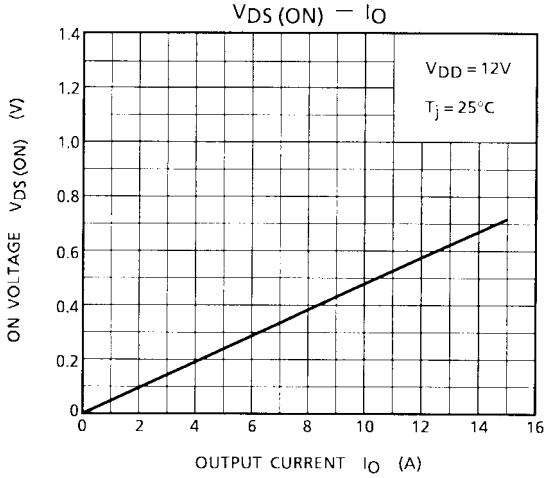




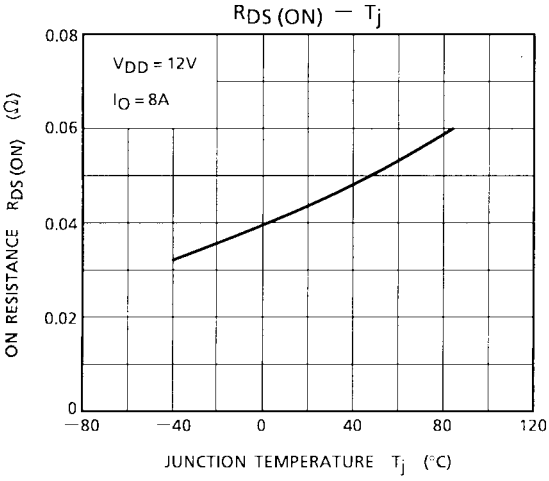
I_{DD} – V_{DD}



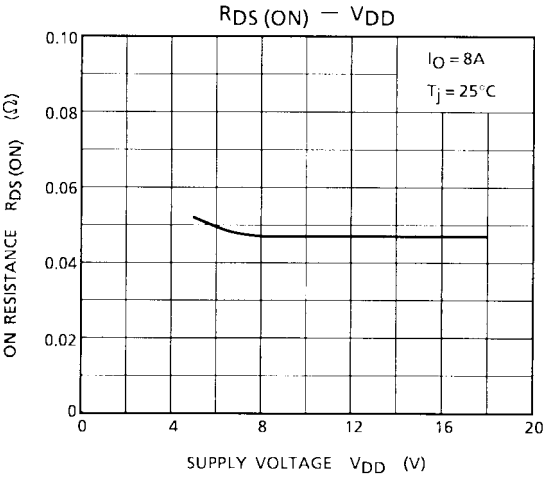
$V_{DS\ (ON)}$ – I_O



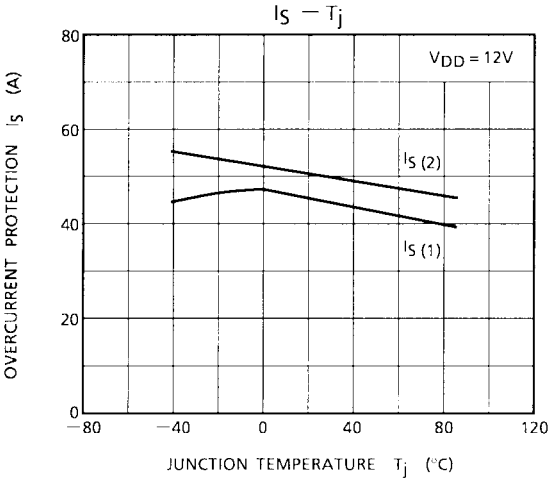
$R_{DS\ (ON)}$ – T_j



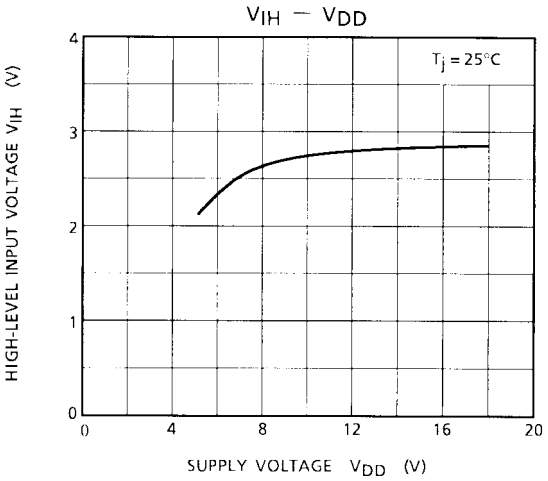
$R_{DS\ (ON)}$ – V_{DD}

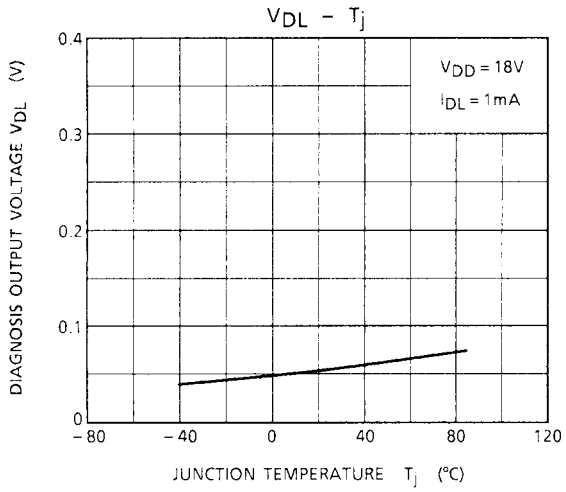


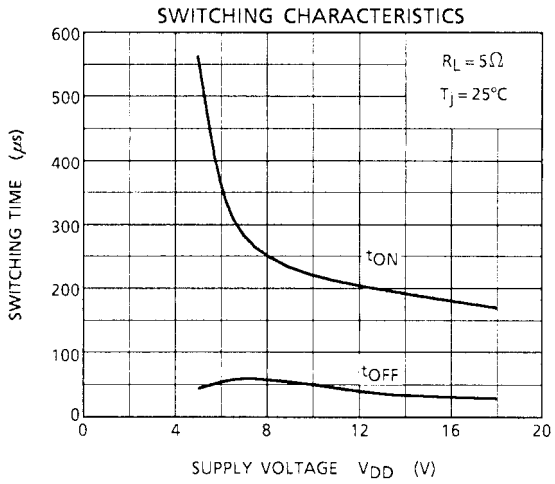
I_S – T_j

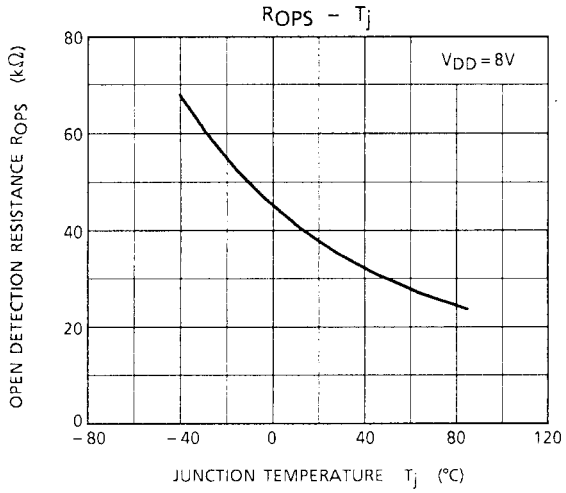


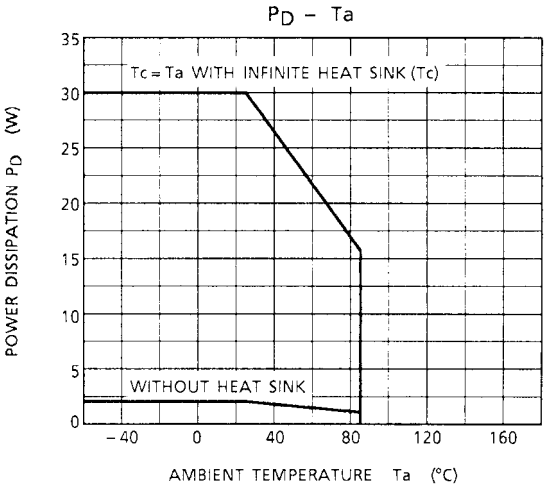
V_{IH} – V_{DD}

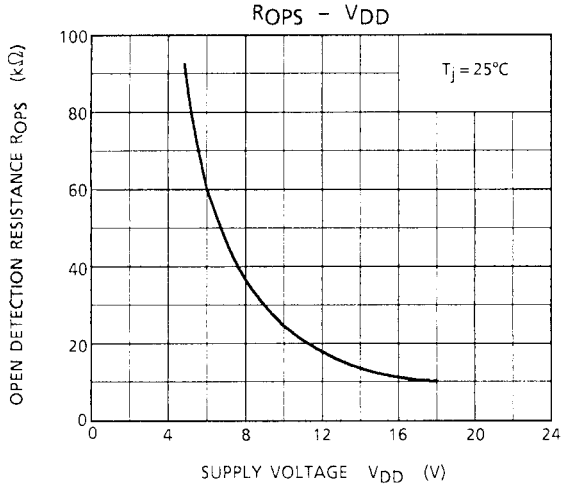










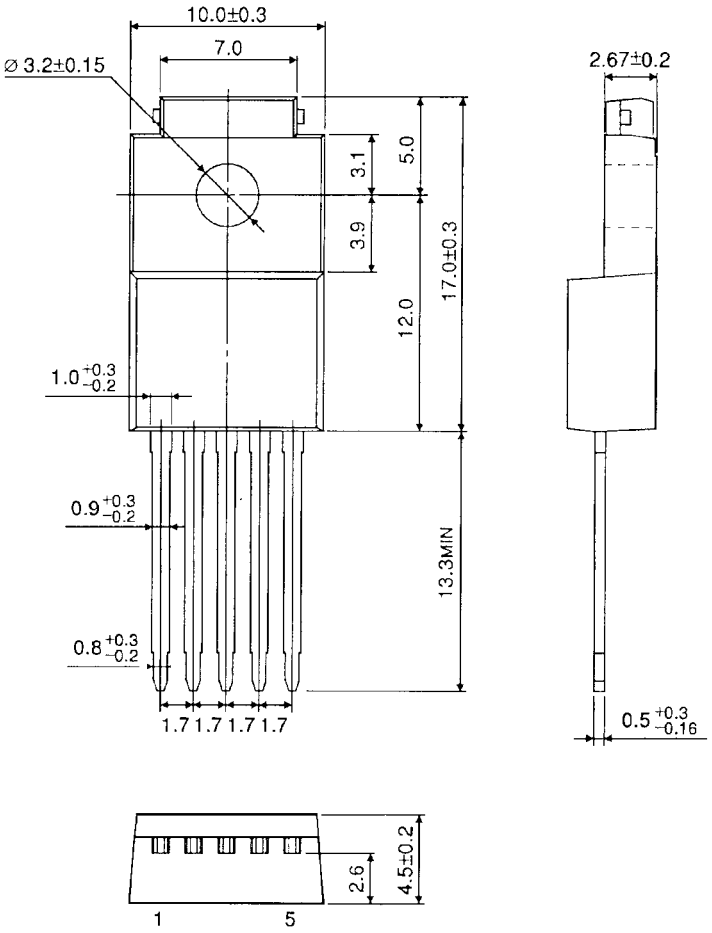


Precaution:

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

Package Dimensions

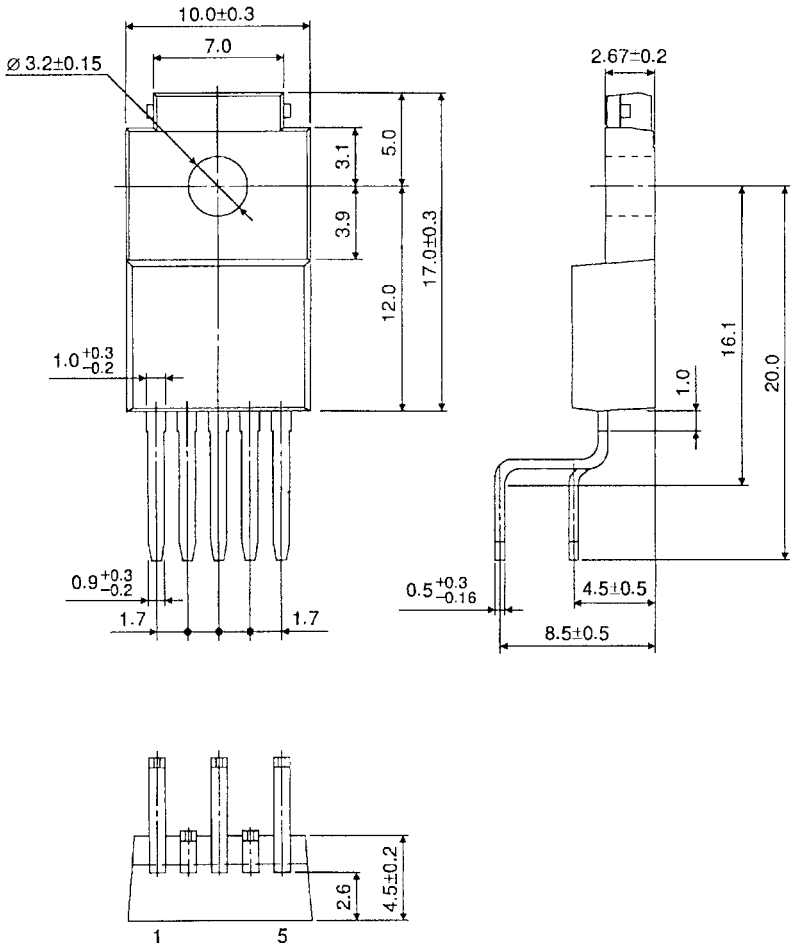
SSIP5-P-1.70A (STL) Unit : mm



Weight: 2.2g (typ.)

Package Dimensions

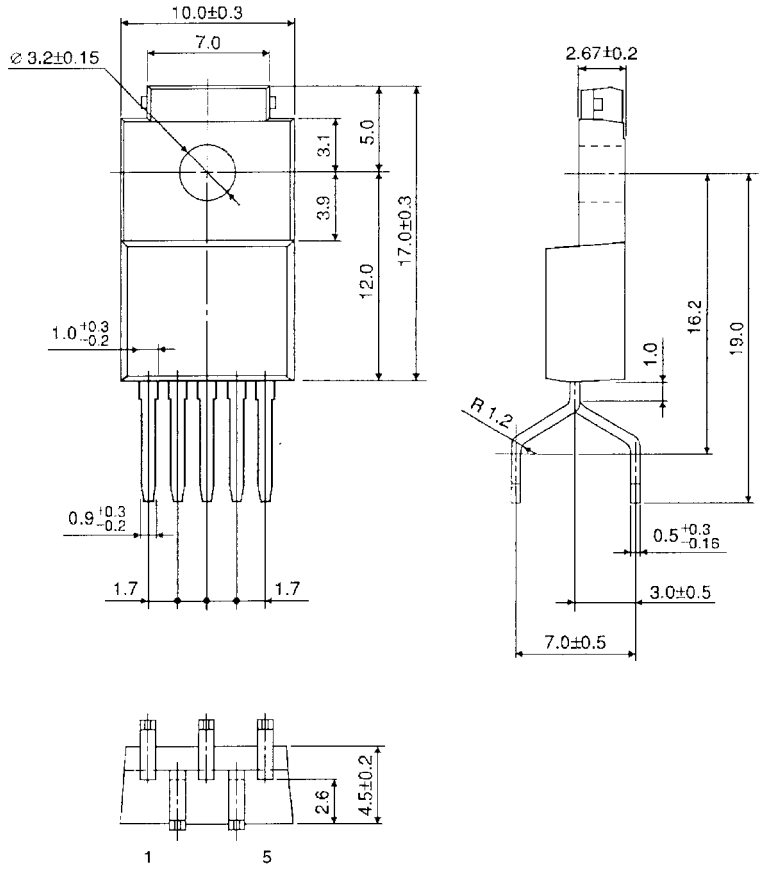
ZIP5-P-1.70 (LBF) Unit : mm



Weight: 2.2g (typ.)

Package Dimensions

ZIP5-P-1.70A (LBS) Unit : mm



Weight: 2.2g (typ.)

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