Power Management ICs for Automotive Body Control

LED Drivers for Automotive Light

BD8372HFP-M,BD8372EFJ-M

No.11039EAT13

●Description

BD8372HFP-M and BD8372EFJ-M are a LED source driver with the capability of withstanding high input voltage (50V MAX). The fixed current output can change in the H/L current, and it is the best for automotive LED drive. It is built into LED open/short protection, external resistance open/short protection and overvoltage overheating protection and high reliability can be achieved. When driving two or more LED by using two or more IC, it can be done to control LED all together turning off even if LED causes short/open in a certain row.

●Features

1) Input voltage range 5.5～40V
2) Changeable type fixed current source driver(200 mA max), Current accuracy ±3%(VIN=13 V, Ta=25℃)
3) H/L Current setting switch control
4) Built-in LED open/short protection circuit
5) Built-in ISET open/short protection circuit
6) Built-in overvoltage overheating protection and temperature protection circuit
7) Error state output detection function (PBUS)
8) HRP7/HTSOP-J8 package

●Applications

For automotive (Lear lamp, Interior light, etc.)

●Absolute maximum ratings (Ta=25℃)

Parameter	Symbol	Ratings	Unit
Power supply voltage	V_{VIN}	50	V
STOP, IOUT, PBUS terminal	V_{STOP}, V_{IOUT}, V_{PBUS}	50	V
ISETH, ISETL terminal	V_{ISETH}, V_{ISETL}	7	V
Power Consumption	Pd	2.3(HRP7) *1	W
		1.1(HTSOP-J8) *2	
Operating temperature range	Topr	-40～125	℃
Storage temperature range	Tstg	-55～150	℃
Joint part temperature	Tjmax	150	℃
IOUT output maximum current	I_{IOUT}	200	mA

*1 HRP7
IC mounted on glass epoxy 2 layer board, area 15mmx15mm of the back copper foil, measuring 70mm×70mm×1.6mm less than copper foil share 3%, power dissipated at a rate of 18.4mw/℃ at temperatures above 25℃.

*2 HTSOP-J8
IC mounted on glass epoxy 2 layer board, area 15mmx15mm of the back copper foil, measuring 70mm×70mm×1.6mm less than copper foil share 3%, power dissipated at a rate of 88mw/℃ at temperatures above 25℃.

●Operating conditions (Ta=-40～+125℃)

〔Please set after considering power consumption for the power-supply voltage.〕

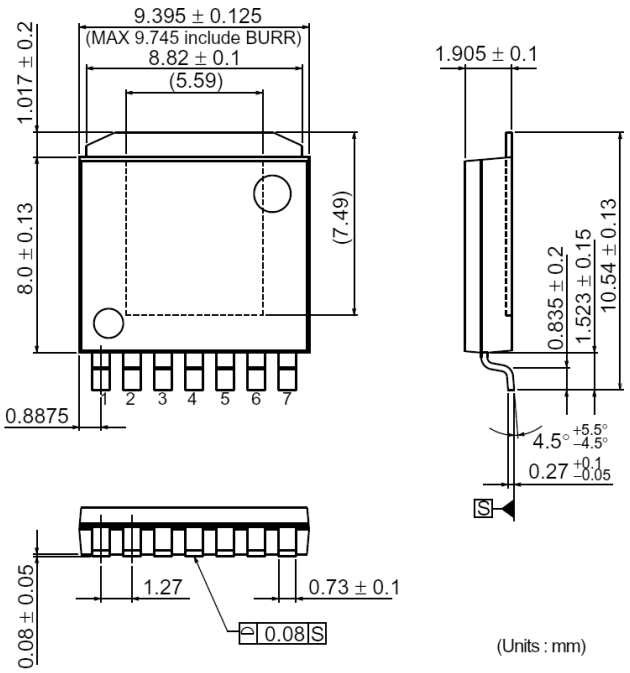
Parameter	Symbol	Ratings			Unit	Conditions
		Min.	Typ.	Max.		
Power supply voltage	VIN	5.5	13	40	V	-
Current setting resistance	R_{ISETH}	10k	-	100k	Ω	STOP=H
	R_{ISETL}	10k	-	100k	Ω	STOP=L

●Electrical characteristics (unless otherwise specified, Ta=-40～125℃, VIN=13V, R_{ISETL}=R_{ISETH}=40kΩ, PBUS=10kΩ)

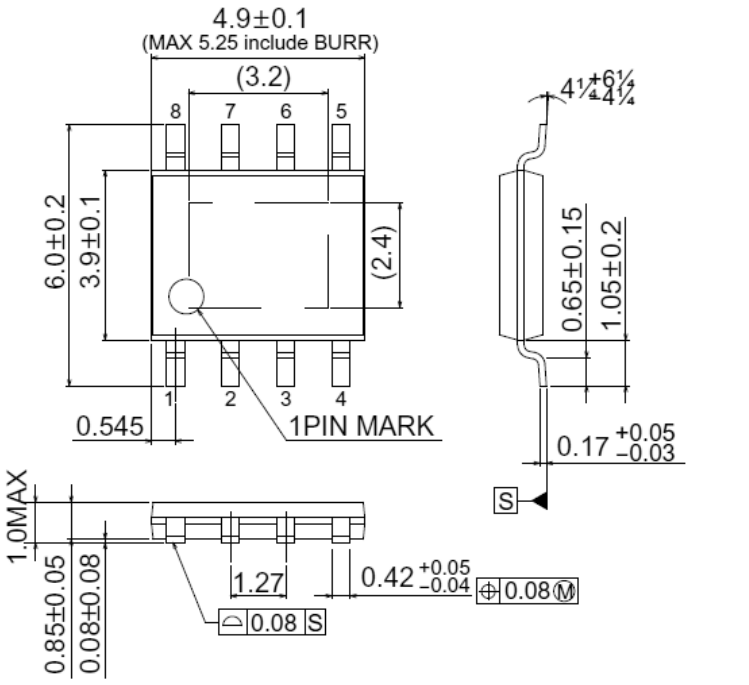
Parameter	Symbol	Limits			Unit	Conditions
		Min.	Typ.	Max.		
Circuit current	IVIN	-	2.9	5	mA	
IOUT output current different width H	IOUT_H	48.5	50	51.5	mA	50mA setting (ISET=40kΩ) STOP=High, Ta=25℃
		46	50	54	mA	50mA setting (ISET=40kΩ) STOP=High, Ta=-40～125℃
IOUT output current different width L	IOUT_L	4.85	5	5.15	mA	5mA setting (ISET=40kΩ) STOP=Low, Ta=25℃
		4.6	5	5.4	mA	5mA setting (ISET=40kΩ) STOP=Low, Ta=-40～125℃
IOUT drop voltage H	VDRH_IOUT	-	0.7	1.2	V	200mA setting(ISET=10kΩ) STOP=High
IOUT drop voltage L	VDRL_IOUT	-	0.5	0.7	V	20mA setting(ISET=10kΩ) STOP=Low
IOUT OFF current	IIOUT_OFF	-	-	1	μA	VIOUT=2V, PBUS=L, Ta=25℃
IOUT current at GND short	IIOUT_SHORT	-	-	40	μA	VIOUT=0V
ISET current	IISET	-	0.8	-	μA	ISETH, ISETL
ISET short detection	VISET_SHORT	-	5.1k	7.5k	V	ISETH, ISETL
ISET open detection	VISET_OPEN	125k	400k	-	V	ISETH, ISETL
IOUT LED OPEN detection	VIOUT_OPEN	VIN-0.3	VIN-0.2	VIN-0.1	V	
IOUT LED short detection	VIOUT_SHORT	0.2	0.6	1.0	V	
STOP input voltage H	VIH_STOP	4.0	-	VIN+0.2	V	
STOP input voltage L	VIL_STOP	GND	-	1.0	V	
STOP input current	VIN_STOP	-	40	100	μA	STOP=13V
PBUS input voltage H	VIH_PBUS	4.0	-	VIN+0.2	V	
PBUS input voltage L	VIL_PBUS	GND	-	2.0	V	
PBUS Low voltage	VOL_PBUS	-	-	1.5	V	IPBUS=20mA
PBUS input current	IIN_PBUS	-	38	100	μA	PBUS=13V
VIN Reduce voltage open mask	VUVLO_IOPEN	7.5	8.0	8.5	V	
VIN Over voltage mute current	VIN_OVPMUTE	16	19	24	V	200mA setting (ISET=10kΩ) STOP=High

※This product is not designed for use in radioactive environments.

●Package outline

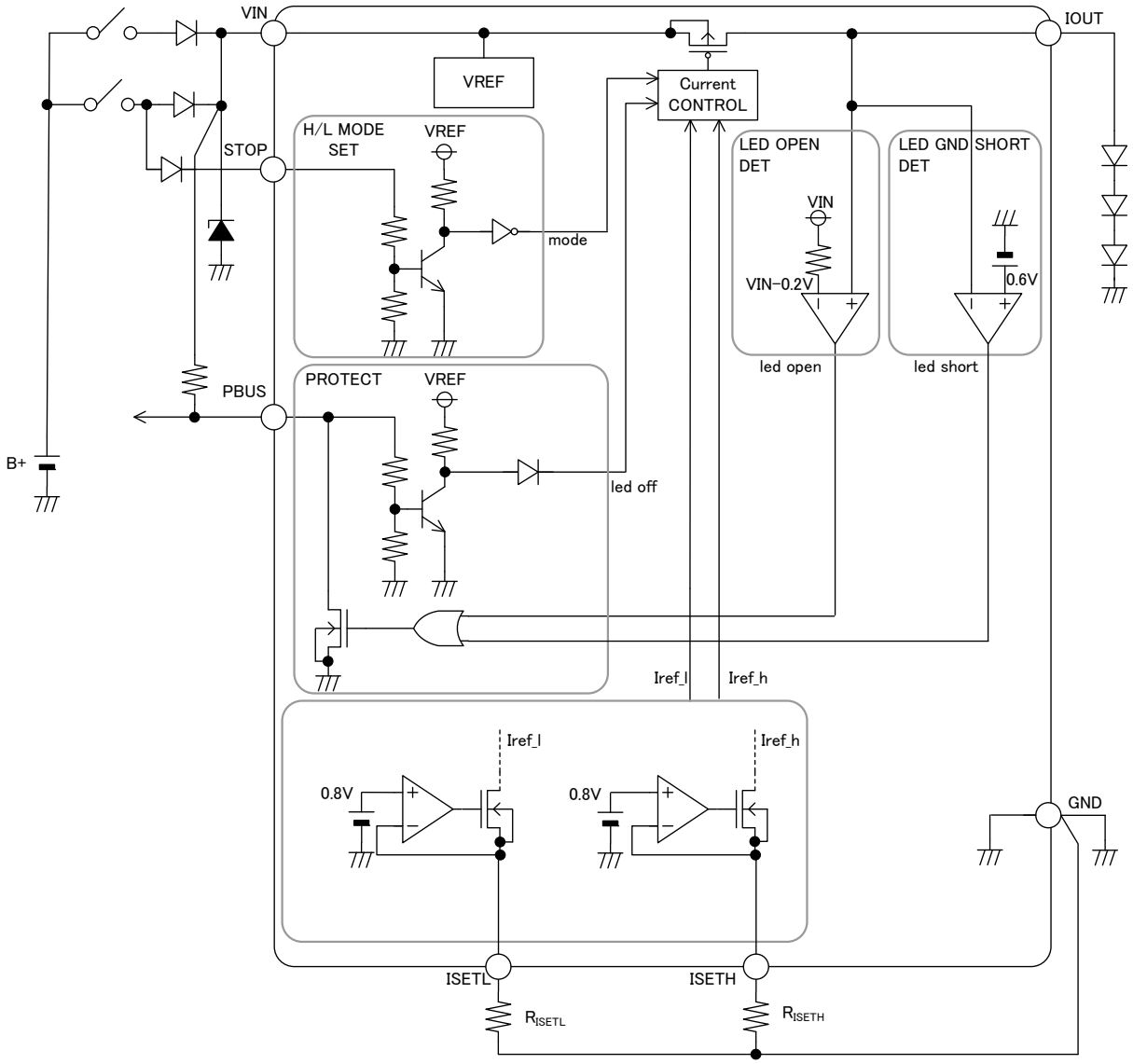


HRP7(Unit : mm)



HTSOP-J8(Unit : mm)

●Block diagram



●Pin description

HRP7

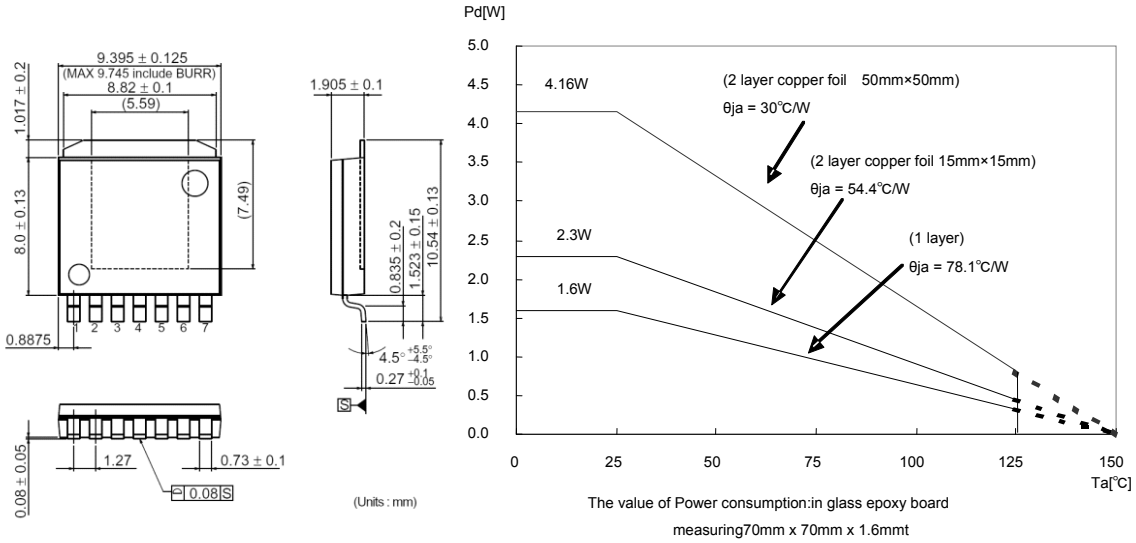
No.	Symbol	Description
1	STOP	Brake light input terminal
2	PBUS	Error detection I/O terminal
3	ISETL	Current setting terminal(L mode)
4	GND	GND
5	ISETH	Current setting terminal(H mode)
6	VIN	Lighting signal
7	IOUT	Current output terminal

HTSOP-J8

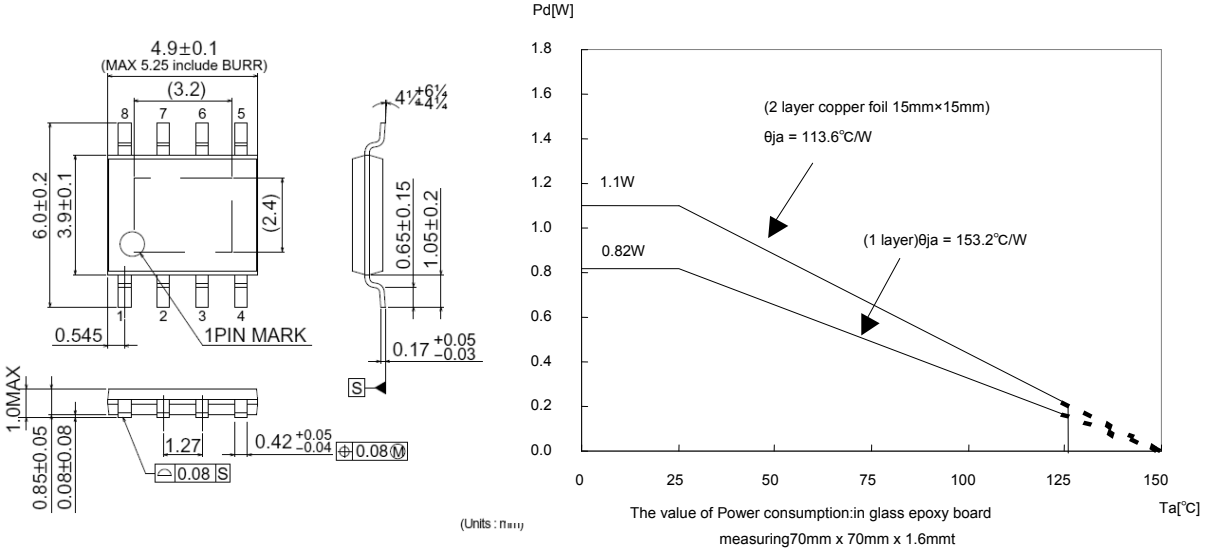
No.	Symbol	Description
1	VIN	Lighting signal
2	IOUT	Current output terminal
3	GND	GND
4	GND	GND
5	STOP	Brake light input terminal
6	PBUS	Error detection I/O terminal
7	ISETL	Current setting terminal(L mode)
8	ISETH	Current setting terminal(H mode)

●Electrical characteristic curves

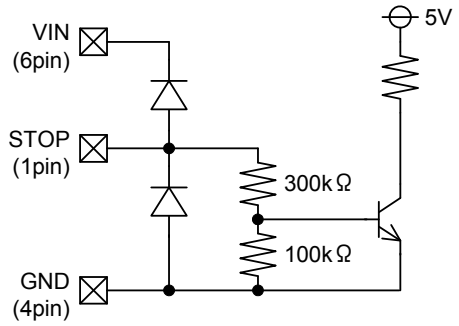
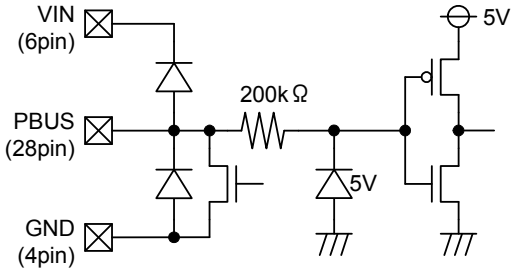
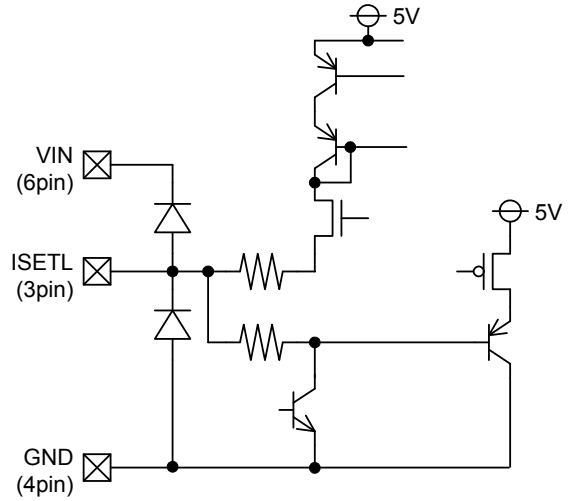
HRP7

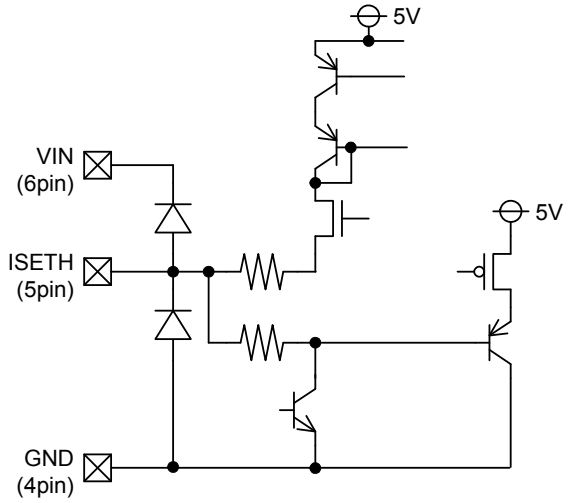
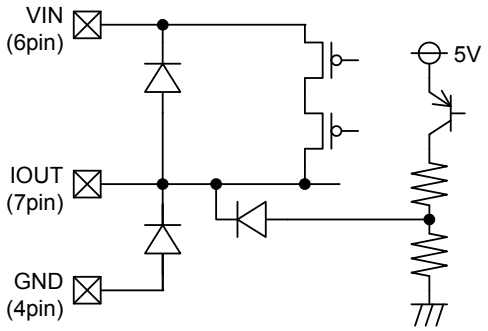


HTSOP-J8



●Equivalent-circuit diagram of the terminals

Pin No.	Pin name	Equivalent-circuit diagram of the terminals
1	STOP	
2	PBUS	
3	ISETL	
4	GND	-

Pin No.	Pin name	Equivalent-circuit diagram of the terminals
5	ISETH	
6	VIN	-
7	IOUT	

●Function description

(Unless otherwise specified, VIN=13V, R_{ISETL}=R_{ISETH}=40kΩ, The numerical value in the table has described the TYP value.)

Table for operation

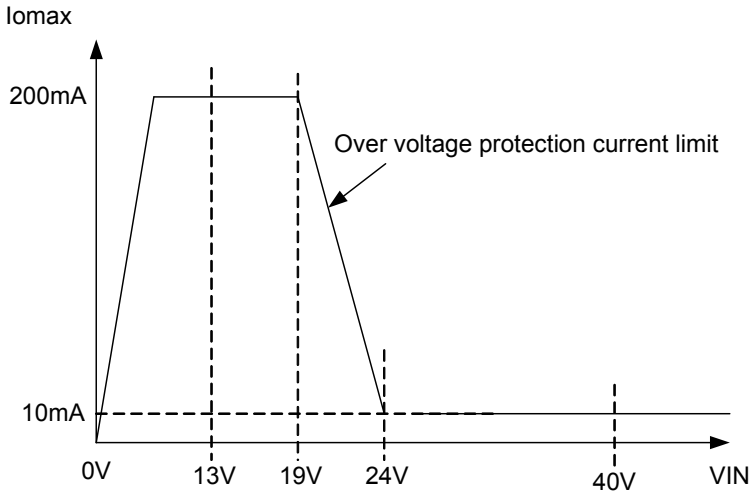
STIOP	VIOUT	RISETL	RISETH	MODE	IOUT_	PBUS
L	2.V<VIOUT<12.3V	10kΩ≦RISETL ≦100kΩ	-	L mode normal operation	2mA～20mA	Hi-Z
H	2V<VIOUT<11.8V	-	10kΩ≦RISETH ≦100kΩ	H mode normal operation	20mA～200mA	Hi-Z
L/H	VIOUT≦0.6V	-	-	Output short	40μA(max)	LOW output
L/H	12.8V≦VIOUT	-	-	Output open	1μA(max)	LOW output
L	-	RISETL<7.5kΩ/ 125kΩ<RISETL	-	ISETL short / ISETL open	1μA(max)	LOW output
H	-	-	RISETH<7.5Ω/ 125kΩ<RISETH	ISETH short / ISETH open	1μA(max)	LOW output
L	2.V<VIOUT<12.3V	10kΩ≦RISETL ≦100kΩ	-	PBUS control OFF	1μA(max)	LOW input
H	2.V<VIOUT<11.8V	-	10kΩ≦RISETH ≦100kΩ	PBUS control OFF	1μA(max)	LOW input

Protection mode operation voltage

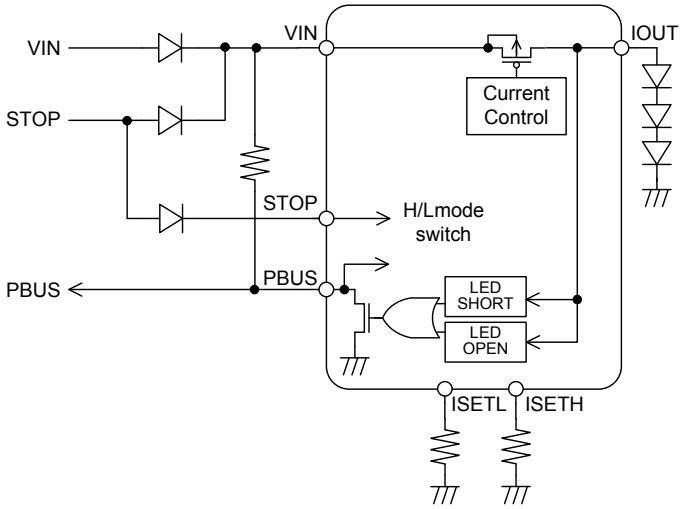
VIN	LED open	LED short	ISET open	ISET short	PBUS	Overvoltage protection
5.5V<VIN≦8V	×	○	○	○	○	×
8V≦VIN	○	○	○	○	○	×
19V≦VIN	○	○	○	○	○	○

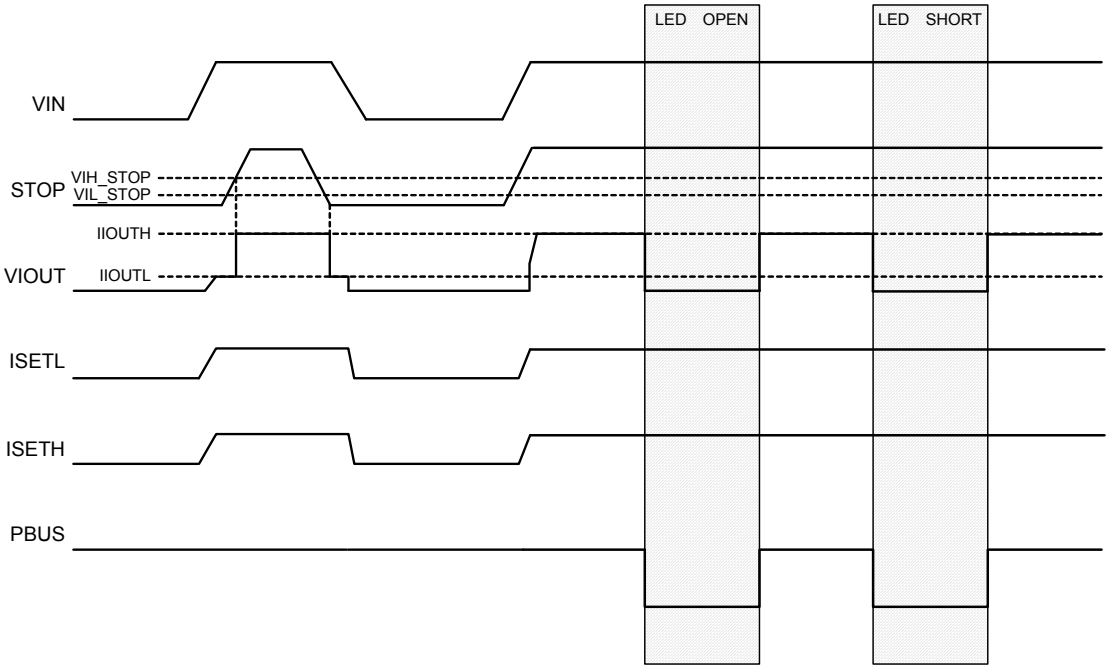
○ : Protection mode effective
× : Protection mode invalidity

The LED open function is masked with VIN≦8V. For the over voltage protection to operate in 18V≦VIN, and the output current is derating to suppress the generation of heat rise of IC.



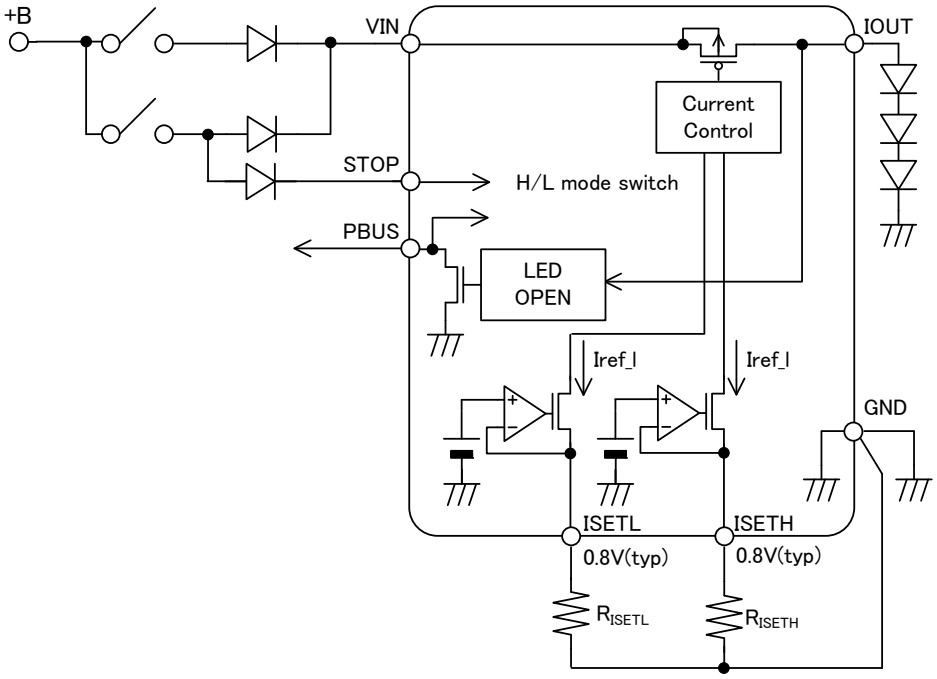
●Timing chart

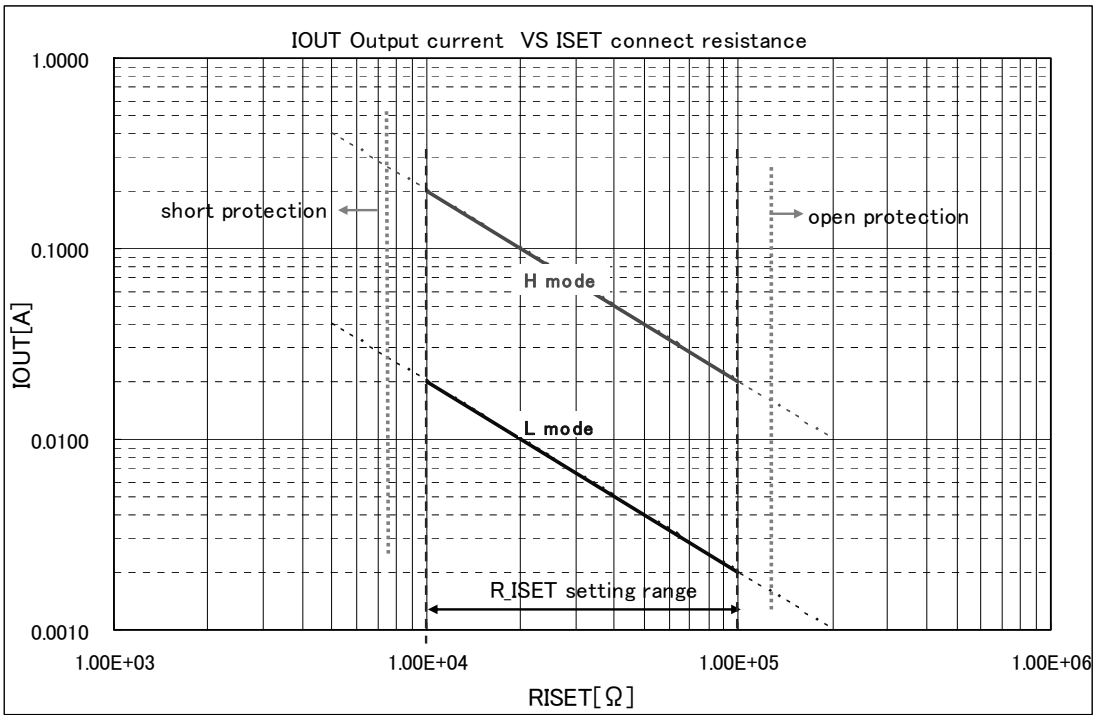




●Method of setting current

ISETL/ISETH generates a standard Voltage respectively in IC (0.8V typ). A standard current is generated by connecting resistance with ISET terminal, and the current is converted internally and it outputs.





・L mode(STOP=Low)

$$I_{IOUT} = \frac{0.8V}{R_{ISETL}} * 250[A]$$

exp） R_{ISETL} =1.6kΩ $I_{IOUT} = \frac{0.8V}{40k\,\Omega} \times 250 = 5[mA]$

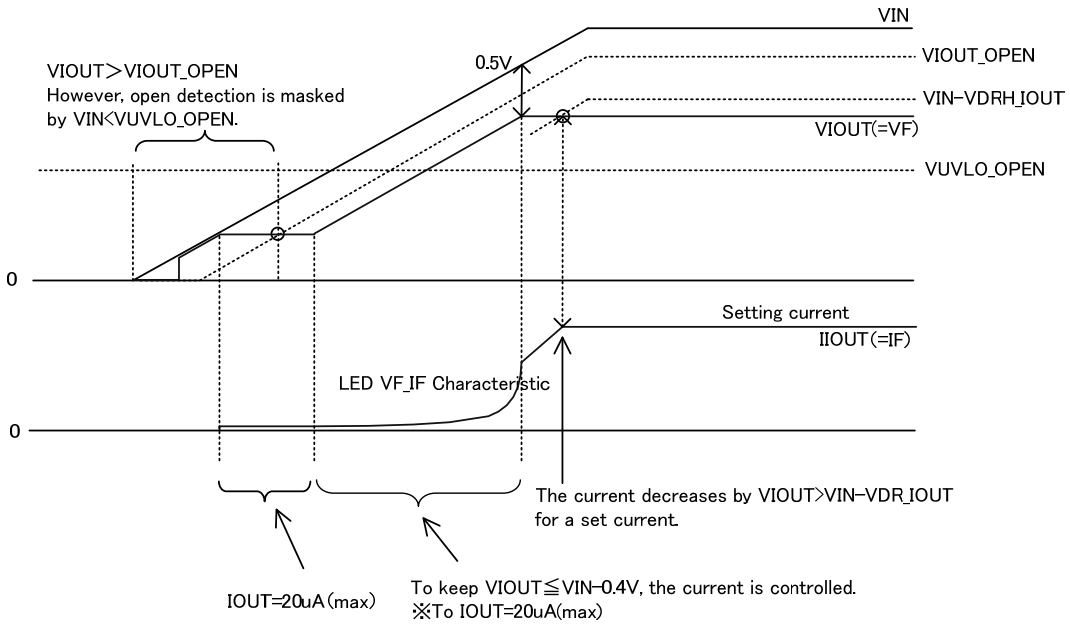
・H mode(STOP=High)

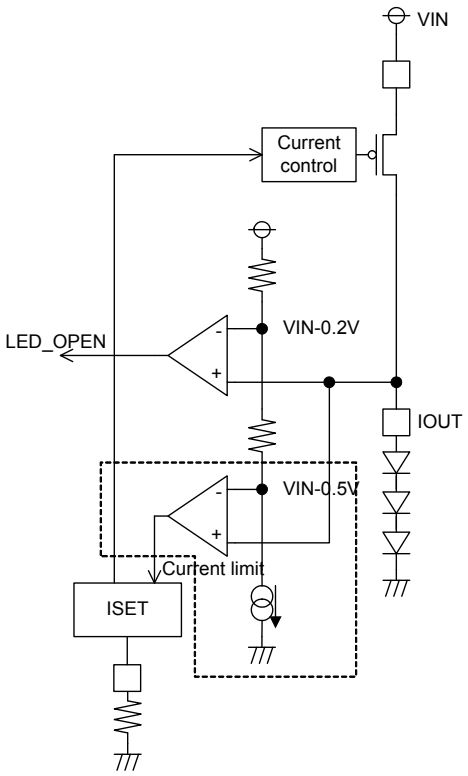
$$I_{IOUT} = \frac{0.8V}{R_{ISETH}} \times 2500[A]$$

exp） R_{ISETH} = 40kΩ $I_{IOUT} = \frac{0.8V}{40k\,\Omega} \times 2500 = 50\,[mA]$

●**Current control at output saturation**

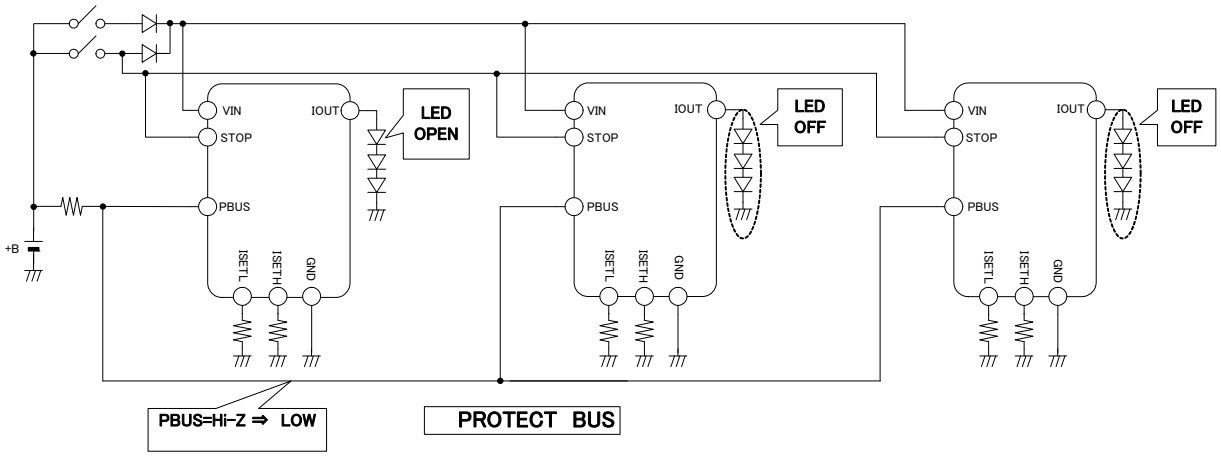
When VIOUT(=VF) exceeds VIN-0.4V, the current is decreased for a set current. Therefore, because VF decreases due to IF decrease of LED, Threshold VOUT=VIN-0.2V of open detection can be prevented keeping the relation of VIOUT≦VIN-0.4V, and being exceeded. The current control must become IOUT<20μA and IF must select LED for VF not to exceed VUVLO_OPEN by 20μA.



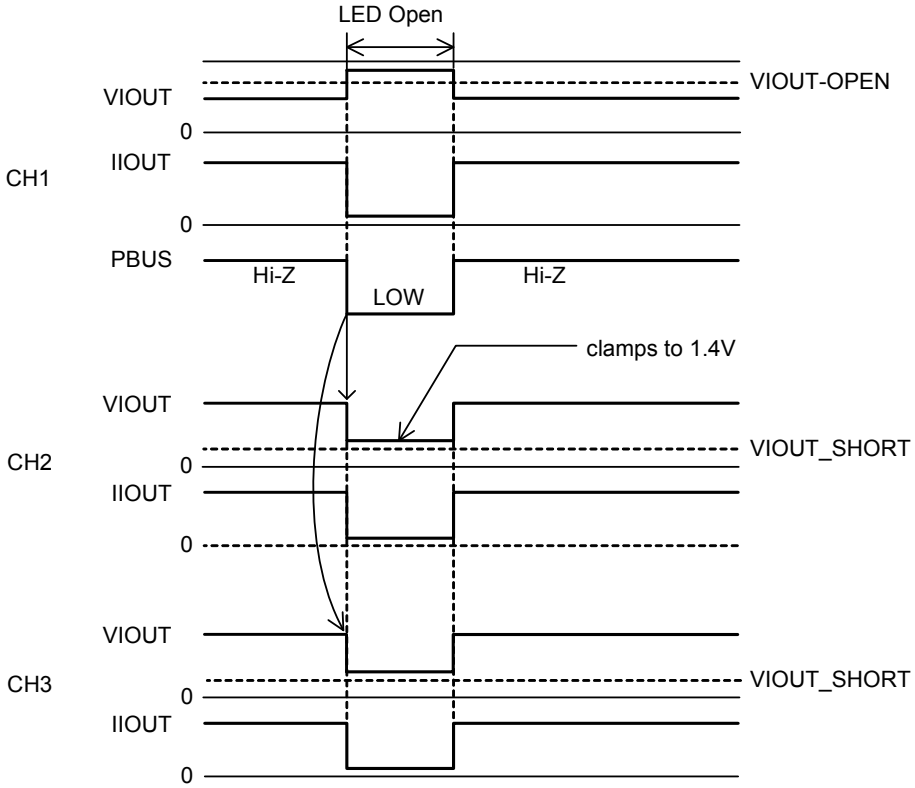


●PROTECT BUS (PBUS)

PUBS is an I/O terminal that outputs error and the terminal that detects error. When error occurs because of open/short of external parts etc. , Low is output from Hi(Hi-Z) with PBUS terminal, and it is possible to detect error from the outside. The output current can be turned off by controlling. PUBS to Hi→Low from outside. LED of all rows can control turning off even if open/short circuit of LED occurs because it connects the terminal PUBS of each CH as shown in following figure when driving two or mode LED by useing two or mode this IC.



・Example of operating protection by LED open



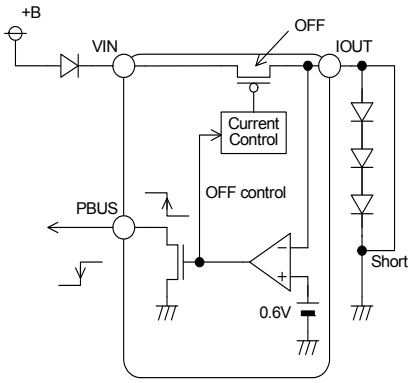
PBUS becomes LOW from Hi-Z because of the LED open. Turning off the LED driver of another CH detects error and LED is controlled by PUBS becomes Low. VIOUT clamps to 1.4V and prevents GND short detection in the matrix at turning off.

●Protection function

As for this IC, short/open protection of external parts is built into, and it is possible to detect error with the terminal PUBS.

①LED open detecting function

When LED connected with the terminal IOUT is opened, open detection is done by the terminal IOUT becomes an overvoltage.
The terminal PBUS is made Low and it informs of error.

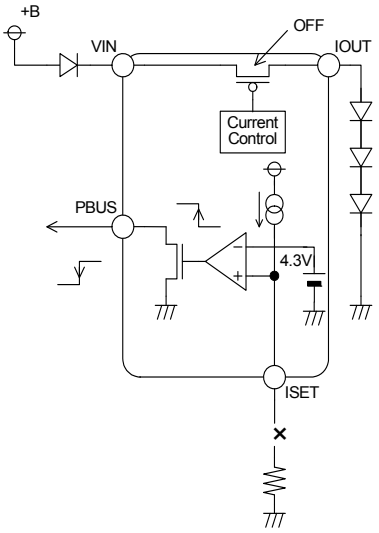


②LED short detecting function

When LED connected with the terminal IOUT becomes short, it detects short by the terminal IOUT becomes a low voltage.
The output current is turned off, the heat destruction of IC is prevented, the terminal PBUS is made Low, and it informs of error.

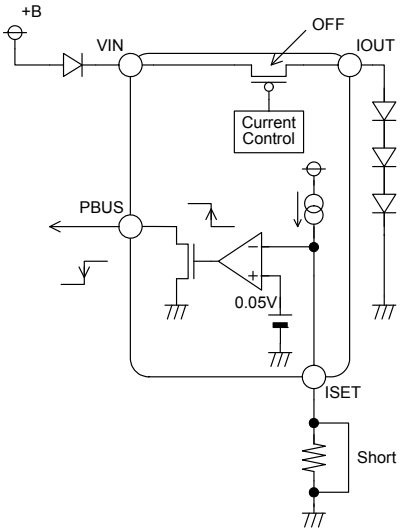
③ISET(H/L) open detecting function

When the external resistance connected with the terminal ISET is opened, open detection is done
The output current is turned off, PBUS is made Low, and it informs of error. When it doesn't depend on the mode and either terminal is opened, the terminal ISET is detected for H mode and for L mode though it exists by two terminals.



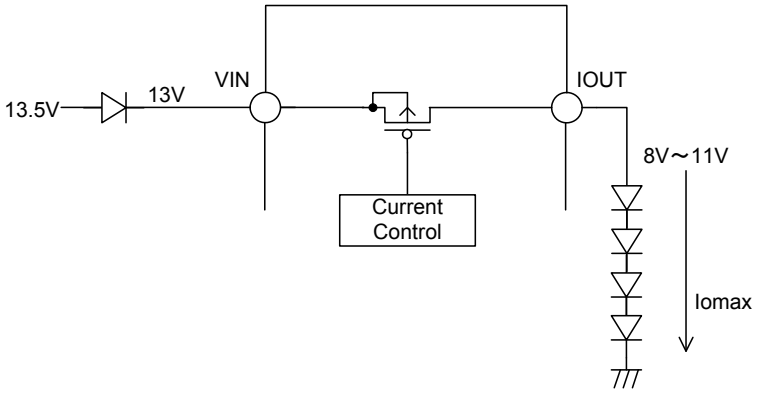
④ISET(H/L) short detecting function

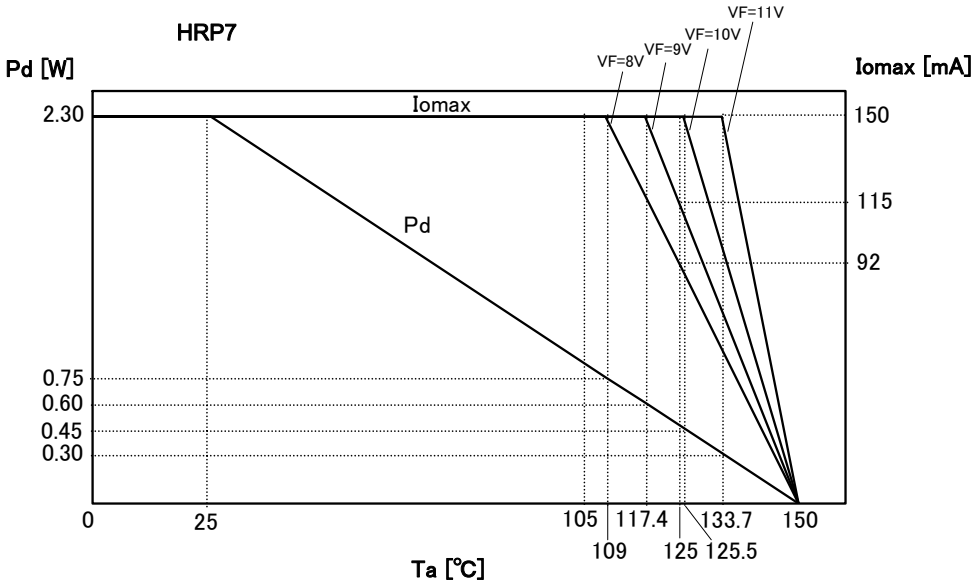
When the external resistance connected with the terminal ISET becomes short, it detects short
The output is turned off, the overcurrent is prevented,PBUS is made Low, and it informs of error.
When it doesn't depend on the mode and either terminal becomes short, the terminal ISET is detected for H mode and for L mode though it exists by two terminals.

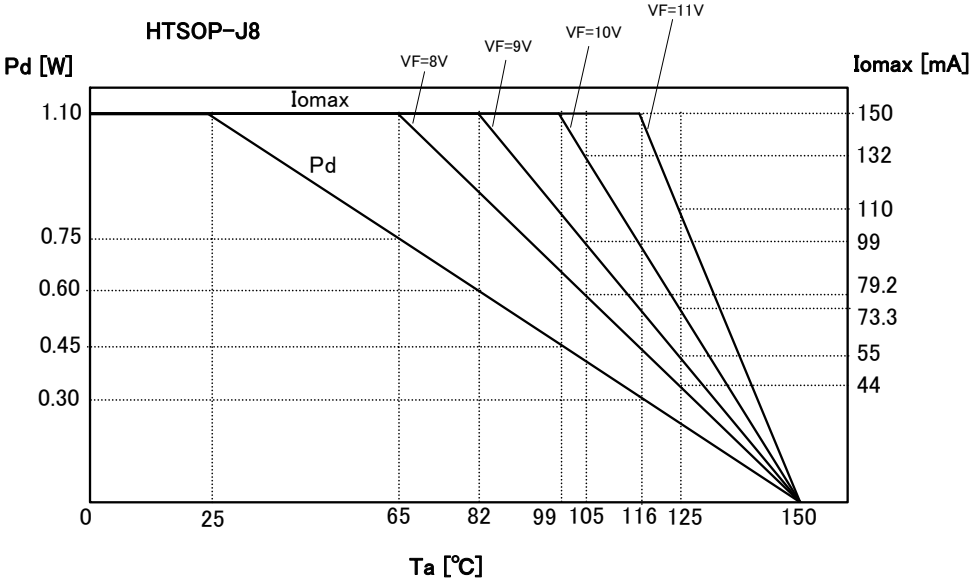


●Pd(Power dissipation) and Iomax (Permissible current)

The relation between Pd and Iomax by VF of LED connected with IOUT is shown.







●Notes for use

1. Absolute maximum ratings
   We are careful enough for quality control about this IC. So, there is no problem under normal operation, excluding that it exceeds the absolute maximum ratings. However, this IC might be destroyed when the absolute maximum ratings, such as impressed voltages or the operating temperature range (Topr), is exceeded, and whether the destruction is short circuit mode or open circuit mode cannot be specified. Please take into consideration the physical countermeasures for safety, such as fusing, if a particular mode that exceeds the absolute maximum rating is assumed.

2. Reverse polarity connection
   Connecting the power line to the IC in reverse polarity (from that recommended) will damage the part. Please utilize the direction protection device as a diode in the supply line.

3. Power supply line
   Please design the power supply line where a large current is thrown to reduce the resistance of the wiring for the power supply pattern so that there is a possibility of usually influencing operation.

4. GND line
   The ground line is where the lowest potential and transient voltages are connected to the IC.
   Please confirm whether there is actually terminal that is the voltage of GND or less including transients.

5. Thermal design
   Do not exceed the power dissipation (Pd) of the package specification rating under actual operation, and please design enough temperature margins. This product has exposed the frame to the back side of the package, but please note that it is assumed to use heat radiation efficiency by the heat radiation for this part. Please take the heat radiation pattern on not only the surface of the substrate but also the back of the substrate widely.

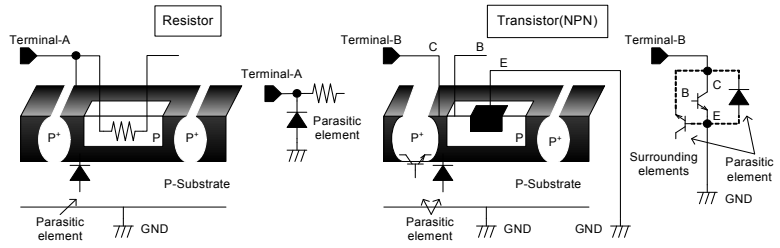
6. Short circuit mode between terminals and wrong mounting
   Do not mount the IC in the wrong direction and displacement, and be careful about the reverse-connection of the power connector. Moreover, this IC might be destroyed when the dust short the terminals between them or GND.
   (The outputs of CH1(pin2,3) have NO protection circuit. So please especially be careful about them.)

7. Radiation
   Strong electromagnetic radiation can cause operation failures.

8. TSD (Thermal Shut-Down)
   The TSD is activated when the junction temperature (Tj) exceeds Tjmax, and the output terminal is switched to OPEN.
   The guarantee and protection of set are not purpose. Therefore, please do not use this IC after TSD circuit operates, nor use it for assumption that operates the TSD circuit.

9. Inspection by the set circuit board
   The stress might hang to IC by connecting the capacitor to the terminal with low impedance. Then, please discharge electricity in each and all process. Moreover, when attaching or detaching from jig in the inspection process, please turn off the power before mounting the IC, and turn on after mounting the IC, and vice versa. In addition, please take into consideration the countermeasures for electrostatic damage, such as giving the earth in assembly process, transportation or preservation.

10. Input terminal
    This IC is a monolithic IC, and has P^+ isolation and P substrate for the element separation. Therefore, a parasitic PN junction is firmed in this P-layer and N-layer of each element. For instance, the resistor or the transistor is connected to the terminal as shown in the figure below. When the GND voltage potential is greater than the voltage potential at Terminals A on the resistor, at Terminal B on the transistor, the PN junction operates as a parasitic diode. In addition, the parasitic NPN transistor is formed in said parasitic diode and the N layer of surrounding elements close to said parasitic diode. These parasitic elements are formed in the IC because of the voltage relation. The parasitic element operating causes the interference of circuit operation, then the wrong operation and destruction. Therefore, please be careful so as not to operate the parasitic elements by impressing to input terminals lower voltage than GND (P substrate). Please do not apply the voltage to the input terminal when the power-supply voltage is not impressed. Moreover, please impress each input terminal lower than the power-supply voltage or equal to the specified range in the guaranteed voltage when the power-supply voltage is impressing.



Example of IC of simple structure

11. About a steep change of the Vcc voltage
    There is a possibility of generating a large current because MOS is used for the output transistor when the input voltage change is steep. Please select external parts after it verifies it enough by a real application including the transition change.

●Ordering part number

B	D	8	3	7	2	H	F	P	-	M	T	R

Part No.

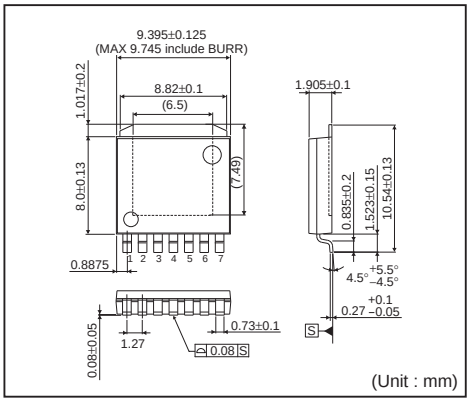
Part No.
8372

Package
HFP : HRP7
EFJ : HTSOP-J8

for
Automotive

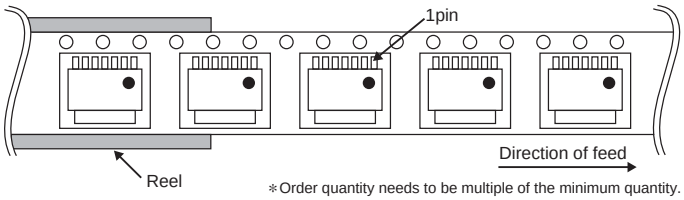
Packaging and forming specification
TR: Embossed tape and reel
(HRP7)
E2: Embossed tape and reel
(HTSOP-J8)

HRP7



<Tape and Reel information>

Tape	Embossed carrier tape
Quantity	2000pcs
Direction of feed	TR (The direction is the 1pin of product is at the upper right when you hold reel on the left hand and you pull out the tape on the right hand)



∗Order quantity needs to be multiple of the minimum quantity.

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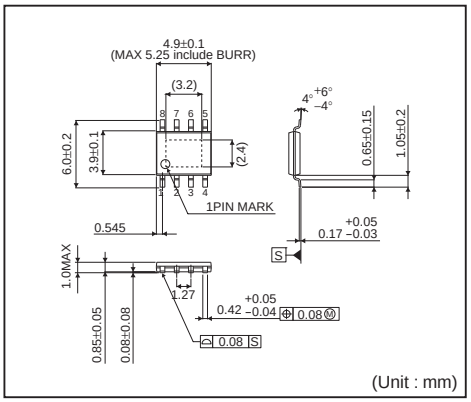
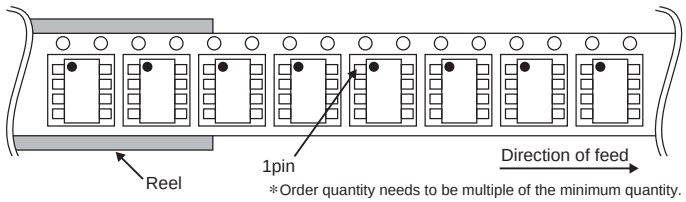


<Tape and Reel information>

Tape	Embossed carrier tape
Quantity	2500pcs
Direction of feed	E2 (The direction is the 1pin of product is at the upper left when you hold reel on the left hand and you pull out the tape on the right hand)



∗Order quantity needs to be multiple of the minimum quantity.

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