ROHM SEMICONDUCTOR

Datasheet

Constant Current LED Drivers

50V 200mA
1ch Source Driver for Automotive

BD8372HFP-M BD8372EFJ-M

General Description

BD8372HFP-M and BD8372EFJ-M are LED source drivers capable of withstanding high input voltage (50V MAX). The constant current output is set by either of two external resistors. It has built-in LED open/short protection, external resistance open/short protection and overvoltage protection that can achieve high reliability. It is possible to control all LEDs together and turn OFF even if LED causes short/open in a certain row when driving two or more LEDs by using multiple ICs.

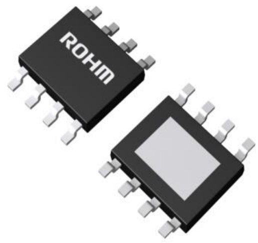
Key Specifications

- Input Voltage Range: 5.5V to 40V
- Max Output Current: 200mA(MAX)
- Output Current Accuracy: ±8%(Max)
- Operating Temperature Range: -40°C to +125°C

Packages

Packages	W (Typ) x D (Typ) x H (Max)
HRP7	9.395mm x 10.540mm x 2.005mm
HTSOP-J8	4.90mm x 6.00mm x 1.00mm

HRP7



HTSOP-J8

Features

- Variable form Constant- Current Source
- H/L Current Setting Switch Control
- LED Open/Short Protection Circuit Integrated
- ISET Open/Short Protection Circuit Integrated
- Overvoltage Mute and Temperature Protection Function Integrated
- Abnormal Output Detection and Output Functions (PBUS)

Applications

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

Basic Application Circuit

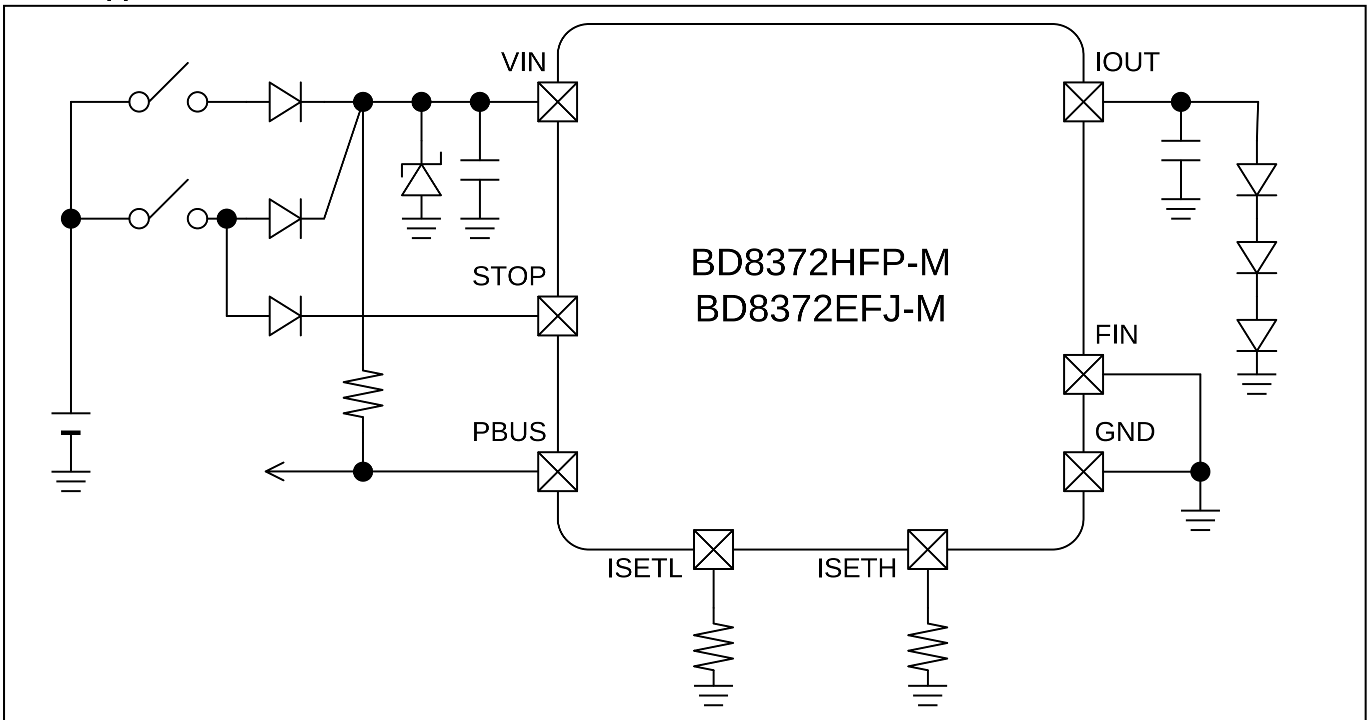


Figure 1. Typical Application Circuit

○Product structure：Silicon monolithic integrated circuit ○This product has no designed protection against radioactive rays

Pin Configurations

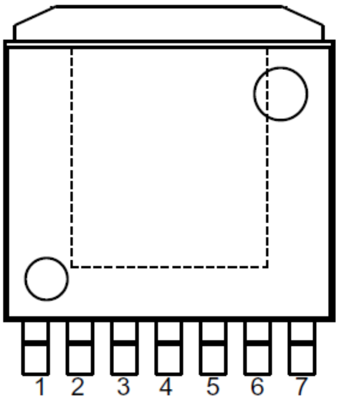


Figure 2. HRP7 Package Pin Configuration

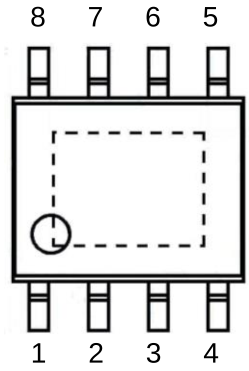


Figure 3. HTSOP-J8 Package Pin Configuration

Pin Descriptions

HRP7

Pin No.	Pin Name	Description
1	STOP	Input terminal for Brake lamp
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	Power supply input
7	IOUT	Current output terminal

HTSOP-J8

Pin No.	Pin Name	Description
1	VIN	Power supply input
2	IOUT	Current output terminal
3	GND	GND
4	GND	GND
5	STOP	Input terminal for Brake lamp
6	PBUS	Error detection I/O terminal
7	ISETL	Current setting terminal (L mode)
8	ISETH	Current setting terminal (H mode)

Block Diagram

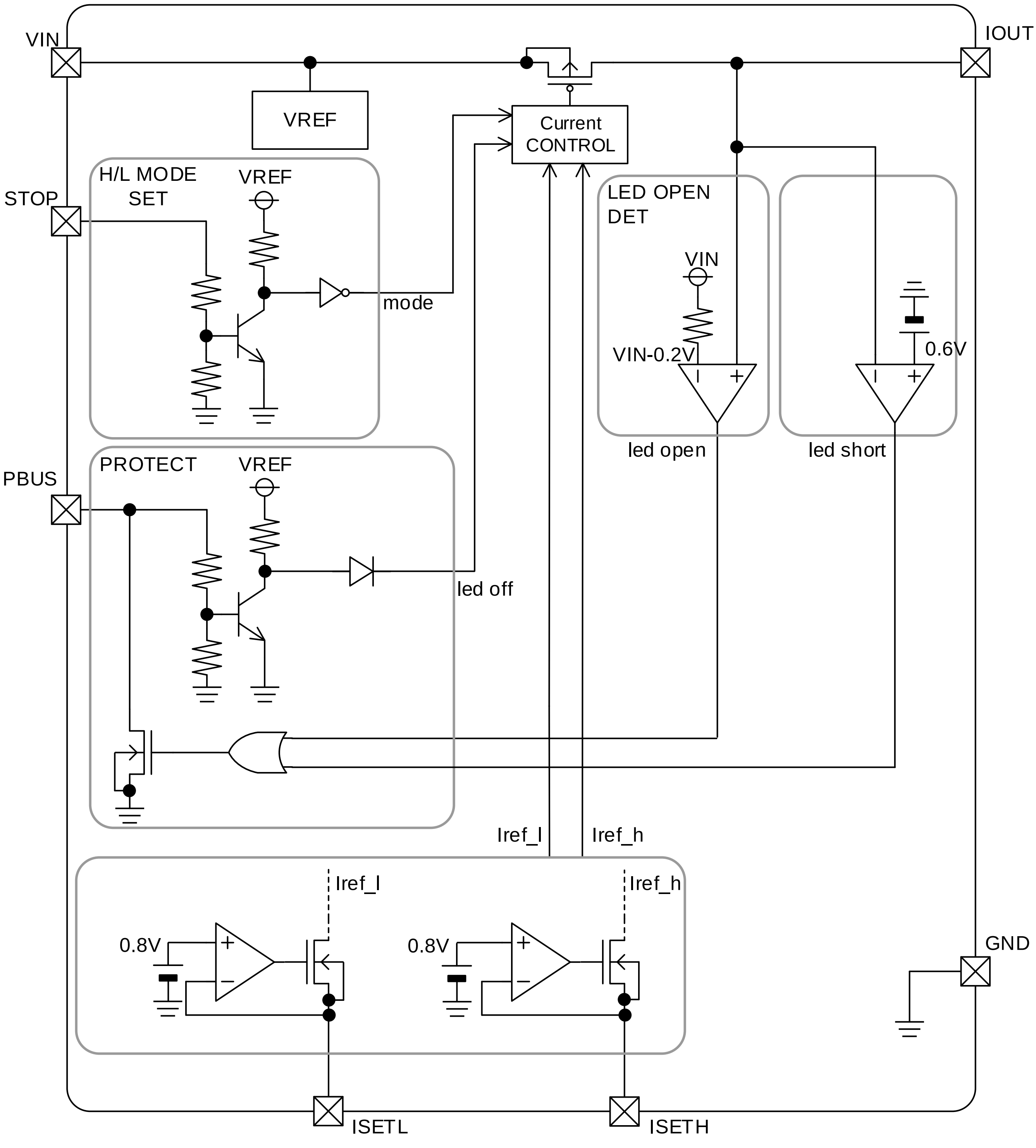


Figure 4. Block Diagram

Absolute Maximum Ratings (Ta=25°C)

Parameter	Symbol		Rating	Unit
Power Supply Voltage	V_{IN}		-0.3 to +50	V
STOP, IOUT, PBUS Terminal	V_{STOP}, V_{IOUT}, V_{PBUS}		-0.3 to V_{IN}+0.3	V
ISETH, ISETL Terminal	V_{ISETH}, V_{ISETL}		-0.3 to +7	V
Power Consumption	Pd	HRP7	2.3 (Note 1)	W
		HTSOP-J8	1.1 (Note 2)	
Operating Temperature Range	Topr		-40 to +125	°C
Storage Temperature Range	Tstg		-55 to +150	°C
Junction Temperature	Tjmax		150	°C
IOUT Output Maximum Current	I_{IOUT}		200	mA

(Note 1) HRP7
IC mounted on glass epoxy 2-layer board area 15mmx15mm of the back copper foil, measuring 70mmx70mmx1.6mm.
Pd decreased at 18.4mw/°C for temperatures above Ta=25°C.

(Note 2) HTSOP-J8
IC mounted on glass epoxy 2-layer board area 15mmx15mm of the back copper foil, measuring 70mmx70mmx1.6mm.
Pd decreased at 8.8mW/°C for temperatures above Ta=25°C.

Caution: Operating the IC over the absolute maximum ratings may damage the IC. The damage can either be a short circuit between pins or an open circuit between pins and the internal circuitry. Therefore, it is important to consider circuit protection measures, such as adding a fuse, in case the IC is operated over the absolute maximum ratings.

Recommended Operating Conditions (Ta=-40°C to +125°C)

(Please set after considering power consumption for the power-supply voltage.)

Parameter	Symbol	Rating			Unit	Conditions
		Min	Typ	Max		
Power Supply Voltage	V_{IN}	5.5	13	40	V	-
Current Setting Resistor	R_{ISETH}	10	-	100	kΩ	STOP=H
	R_{ISETL}	10	-	100	kΩ	STOP=L
Minimum Capacitor connecting IOUT terminal	C_{IOUT}	0.1	-	-	μF	

Electrical Characteristics

(Unless otherwise specified, Ta=-40°C to 125°C, V_{IN}=13V, R_{ISETL}=R_{ISETH}=40kΩ, R_{PBUS}=10kΩ)

Parameter	Symbol	Limit			Unit	Conditions
		Min	Typ	Max		
Circuit Current	I_{VIN}	-	2.9	5	mA	
IOUT Output Current H	I_{OUT_H}	48.5	50	51.5	mA	50mA setting (I_{SET}=40kΩ) STOP=High, Ta=25°C
		46	50	54	mA	50mA setting (I_{SET}=40kΩ) STOP=High, Ta=-40°C to +125°C
IOUT Output Current L	I_{OUT_L}	4.85	5	5.15	mA	5mA setting (I_{SET}=40kΩ) STOP=Low, Ta=25°C
		4.6	5	5.4	mA	5mA setting (I_{SET}=40kΩ) STOP=Low, Ta=-40°C to +125°C
IOUT Drop Voltage H	V_{DRH_IOUT}	-	0.7	1.2	V	200mA setting(I_{SET}=10kΩ) STOP=High
IOUT Drop Voltage L	V_{DRL_IOUT}	-	0.5	0.7	V	20mA setting(I_{SET}=10kΩ) STOP=Low
IOUT OFF Current	I_{IOUT_OFF}	-	-	1	µA	V_{IOUT}=2V, PBUS=L, Ta=25°C
IOUT Current at GND Short	I_{IOUT_SHORT}	-	-	40	µA	V_{IOUT}=0V
ISET Terminal Voltage	V_{ISET}	-	0.8	-	V	At ISETL or ISETH pins
ISET Short Detection Resistor	R_{ISET_SHORT}	-	5.1k	7.5k	Ω	At ISETL or ISETH pins
ISET Open Detection Resistor	R_{ISET_OPEN}	125k	400k	-	Ω	At ISETL or ISETH pins
IOUT LED OPEN Detection	V_{IOUT_OPEN}	V_{IN}-0.3	V_{IN}-0.2	V_{IN}-0.1	V	
IOUT LED Short Detection	V_{IOUT_SHORT}	0.2	0.6	1.0	V	
STOP Input Voltage H	V_{IH_STOP}	4.0	-	V_{IN}+0.2	V	
STOP Input Voltage L	V_{IL_STOP}	GND	-	1.0	V	
STOP Input Current	I_{IN_STOP}	-	40	100	µA	V_{STOP}=13V
PBUS Input Voltage H	V_{IH_PBUS}	4.0	-	V_{IN}+0.2	V	
PBUS Input Voltage L	V_{IL_PBUS}	GND	-	2.0	V	
PBUS Low Voltage	V_{OL_PBUS}	-	-	1.5	V	I_{PBUS}=20mA
PBUS Input Current	I_{IN_PBUS}	-	38	100	µA	V_{PBUS}=13V
IN Under Voltage Open Detection Mask Voltage	V_{UVLO_IOPEN}	7.5	8.0	8.5	V	
Over Voltage Mute Voltage	$V_{IN\_OVPMUTE}$	16	19	24	V	200mA setting (I_{SET}=10kΩ) STOP=High

Typical Performance Curves (Reference Data)

(Unless otherwise specified Ta=25°C, V_{IN}=13V)

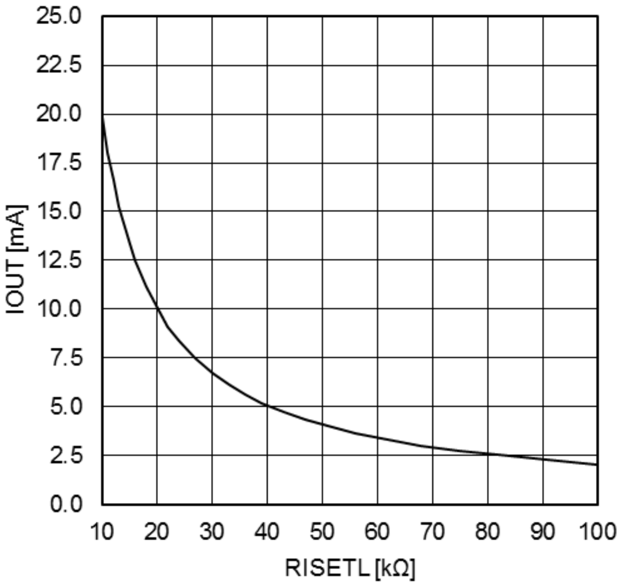


Figure 5. I_{OUT} vs R_{ISETL}
(STOP=Low)

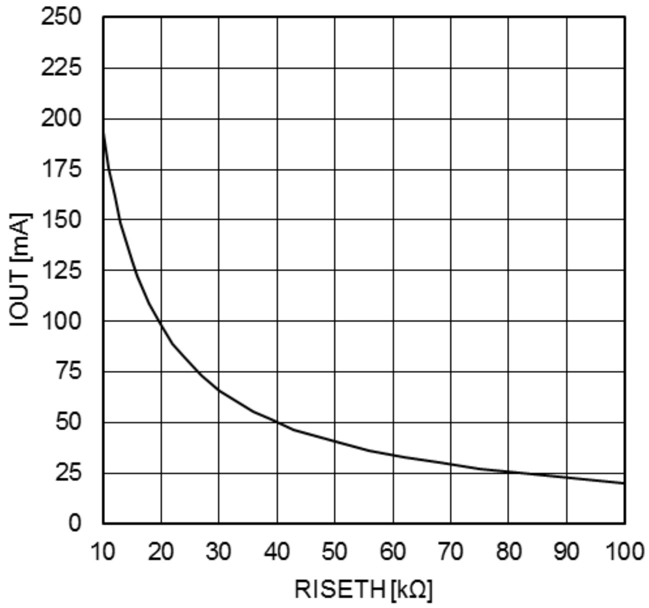


Figure 6. I_{OUT} vs R_{ISETH}
(STOP=High)

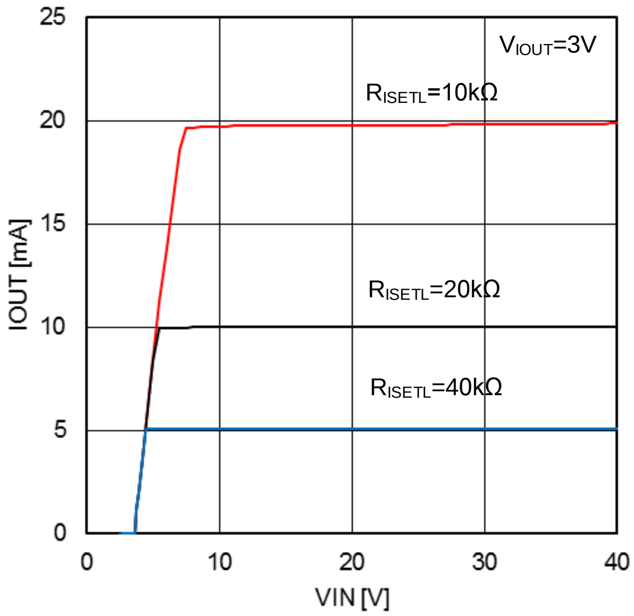


Figure 7. I_{OUT} vs V_{IN}
(STOP=Low)

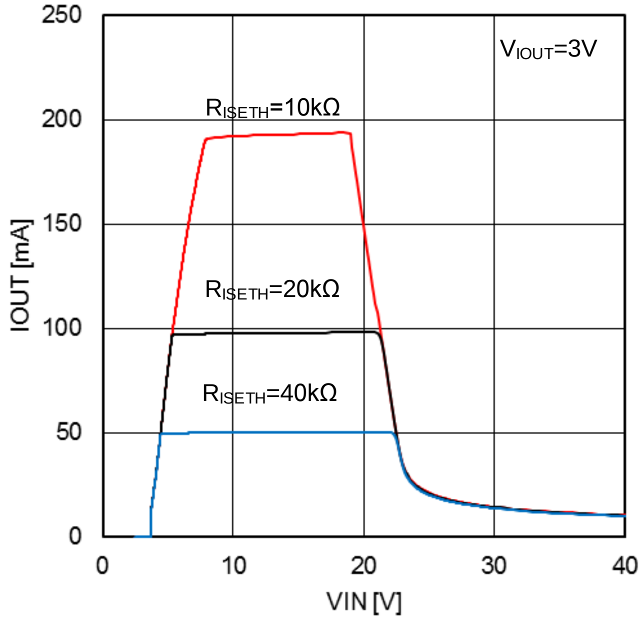


Figure 8. I_{OUT} vs V_{IN}
(STOP=High)

Typical Performance Curves (Reference Data) - continued

(Unless otherwise specified Ta=25°C, V_{IN}=13V)

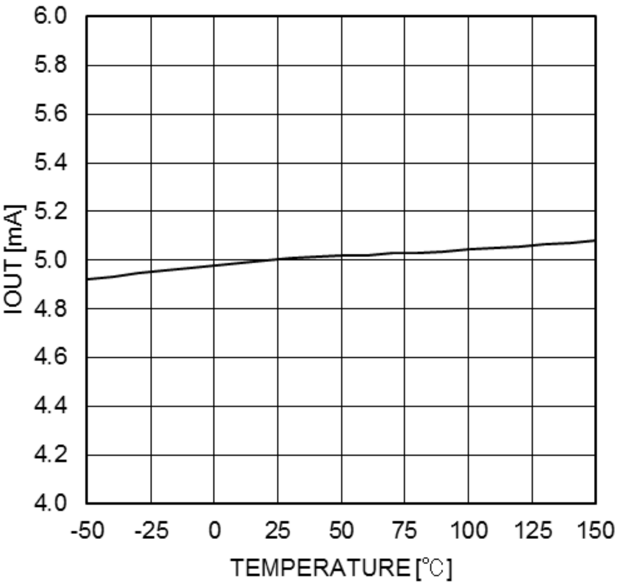


Figure 9. I_{OUT} vs Ta
(STOP=Low)

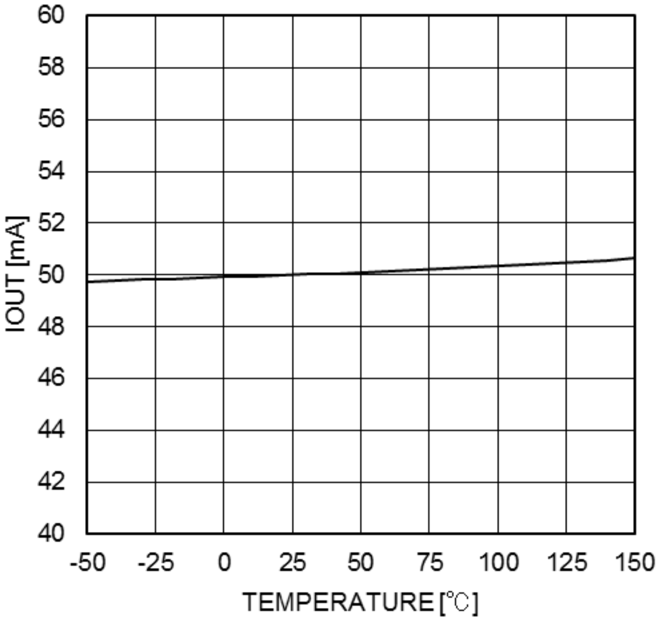


Figure 10. I_{OUT} vs Ta
(STOP=High)

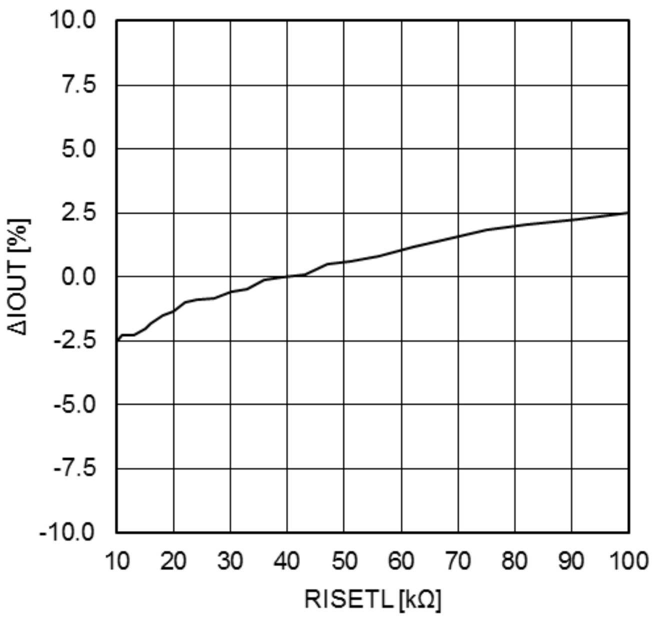


Figure 11. ΔI_{OUT} vs R_{ISETL}
(STOP=Low)

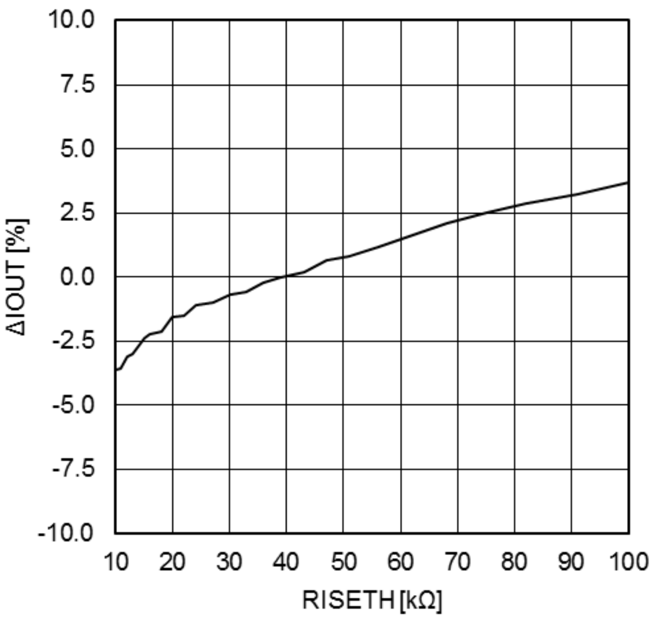
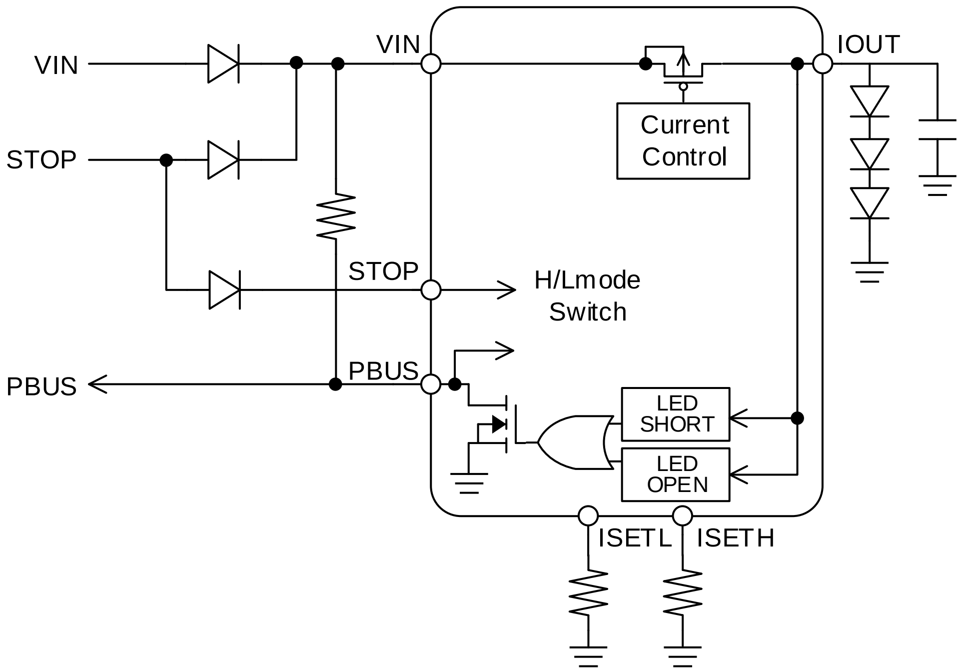


Figure 12. ΔI_{OUT} vs R_{ISETH}
(STOP=High)

Timing Chart



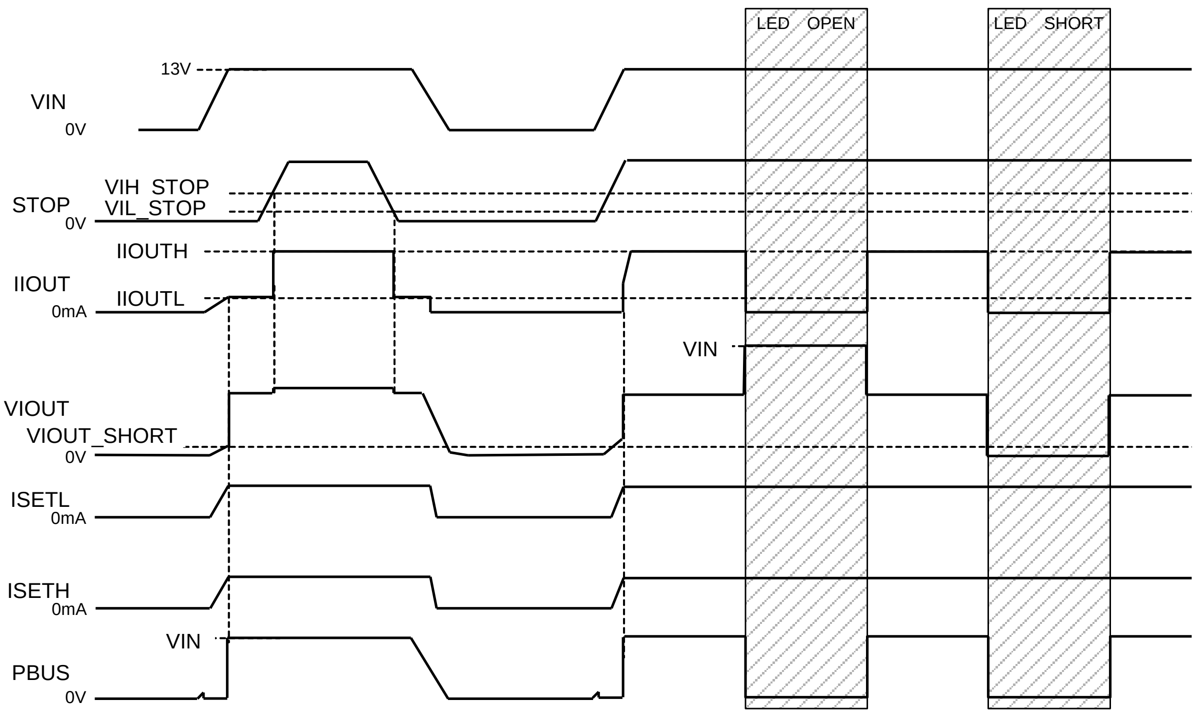


Figure 13. Timing Chart

Function Description

(Unless otherwise specified, Ta=25°C, V_{IN}=13V, R_{ISETL}=R_{ISETH}=40kΩ, the numerical value in the table are TYP values.)

1. Table for Operation

STOP	V_{IOUT}	R_{ISETL}	R_{ISETH}	MODE	I_{OUT}	PBUS
L	2V<V_{IOUT} <V_{IN}-0.7V(Max)	10kΩ≤R_{ISETL} ≤100kΩ	-	L mode normal operation	2mA to 20mA	Hi-Z
H	2V<V_{IOUT} <V_{IN}-1.2V(Max)	-	10kΩ≤R_{ISETH} ≤100kΩ	H mode normal operation	20mA to 200mA	Hi-Z
L/H	V_{IOUT}≤0.6V(Typ)	-	-	Output short	40µA(Max)	LOW output
L/H	V_{IOUT}≥ V_{IN}-0.2V(Typ)	-	-	Output open	1µA(Max)	LOW output
L	-	R_{ISETL}<7.5kΩ(Max)	-	I_{SETL} short	1µA(Max)	LOW output
L	-	R_{ISETL}>125kΩ(Min)	-	I_{SETL} open	1µA(Max)	LOW output
H	-	-	R_{ISETH}<7.5kΩ(Max)	I_{SETH} short	1µA(Max)	LOW output
H	-	-	R_{ISETH}>125kΩ(Min)	I_{SETH} open	1µA(Max)	LOW output
L	2V<V_{IOUT} <V_{IN}-0.7V(Max)	10kΩ≤R_{ISETL} ≤100kΩ	-	PBUS control OFF	1µA(Max)	LOW input
H	2V<V_{IOUT} <V_{IN}-1.2V(Max)	-	10kΩ≤R_{ISETH} ≤100kΩ	PBUS control OFF	1µA(Max)	LOW input

Protection Mode Operation Voltage(The numerical value are typical)

V_{IN}	LED open	LED short	ISET open	ISET short	PBUS	Overvoltage protection
5.5V<V_{IN}≤8V	×	○	○	○	○	×
8V≤V_{IN}≤19V	○	○	○	○	○	×
19V≤V_{IN}	○	○	○	○	○	○

○ : Protection mode ON
× : Protection mode OFF

The LED open function is masked with V_{IN}≤8V.

2. **Method of Setting Current**

The IC regulates the voltage at ISETL/ISETH to V_{ISET} (0.8V typ) across the external resistor to set I_{OUT}. Then I_{OUT} is set by setting STOP High or Low.

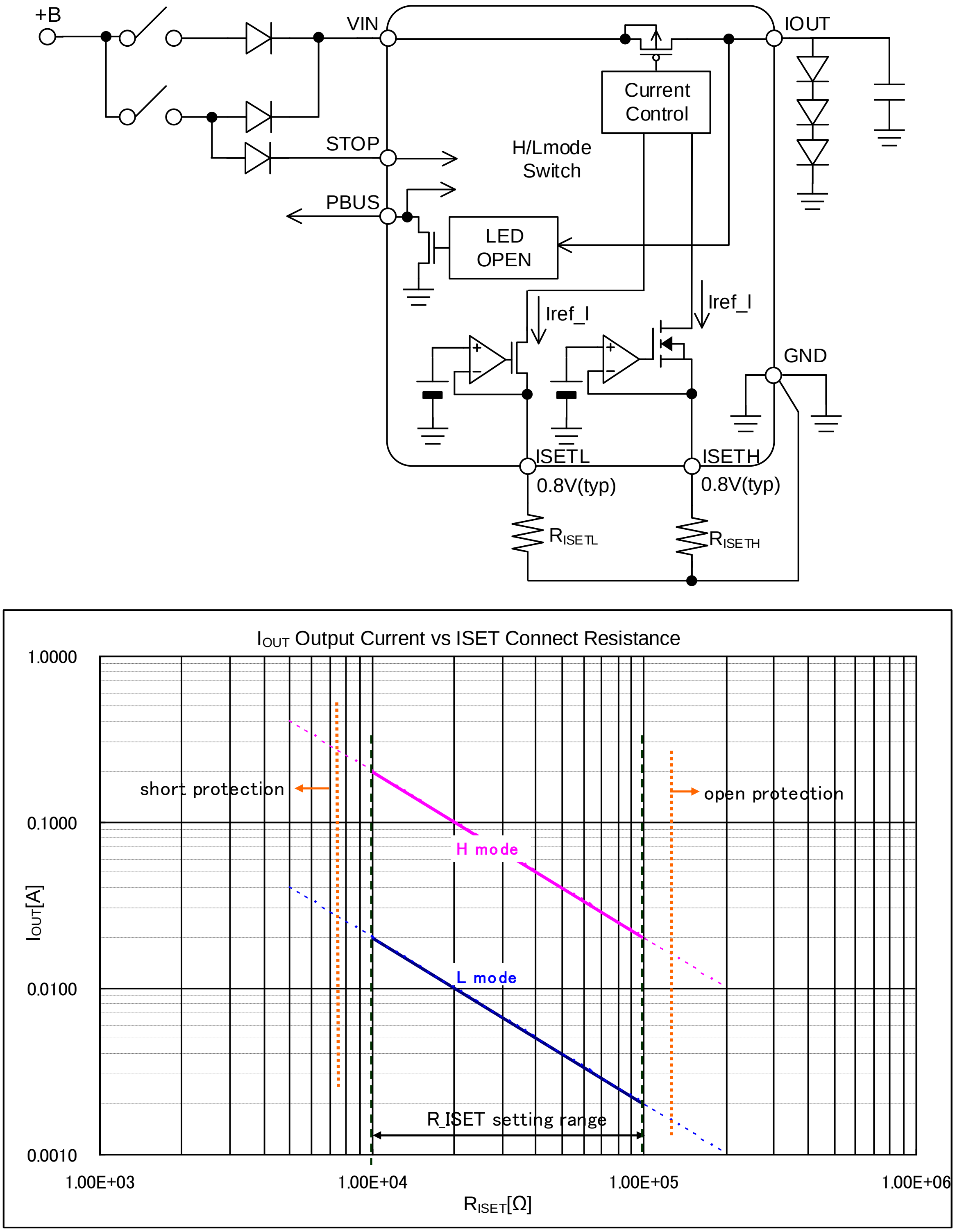


Figure 14. Current setting method

- L mode (STOP=Low)

$$I_{IOUT} = \frac{0.8V}{R_{ISETL}} \times 250A$$

exp) $R_{ISETL} = 40k\Omega \quad I_{IOUT} = \frac{0.8V}{40k\Omega} \times 250 = 5mA$

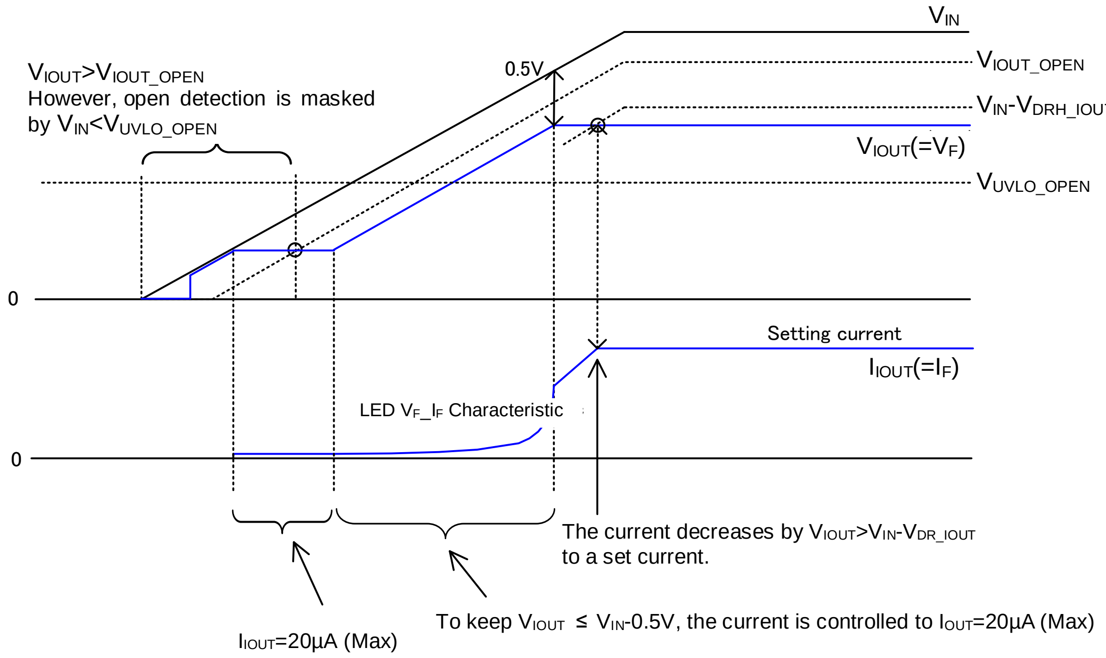
- H mode (STOP=High)

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

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

3. Current Control at Output Saturation

When V_{IOUT} (=V_F) - V_{IN} > 0.5V (TYP), the LED current I_F is decreased to a set current 20µA (TYP). Therefore, V_F decreases due to the decrease in the current. Open detection can be prevented by keeping $V_{IOUT} \leq V_{IN}$-0.5V. The current controlled to I_{OUT}<20µA and the LED current I_F must be set so that V_F does not exceed V_{UVLO_OPEN} by 20µA.
If V_{IN} < V_{UVLO_OPEN} this function is not active.



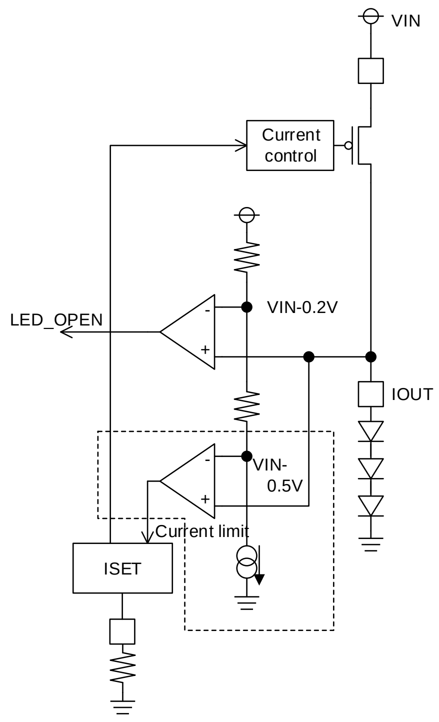


Figure 15. Current Control at Output Saturation

4. PROTECT BUS (PBUS)

PBUS is an I/O terminal that outputs any detected error by switching PBUS from Hi-Z (Note 1) to Low. The output current can also be turned OFF by pulling the PBUS Low. When driving multiple LEDs through multiple ICs, as shown in the figure below, all the rows of LEDs can be turned OFF by any fault by connecting PBUS terminal to each IC.

(Note1) PBUS terminal is an open drain terminal. Even when used separately, please be pulled up(10kΩ) to power supply voltage.

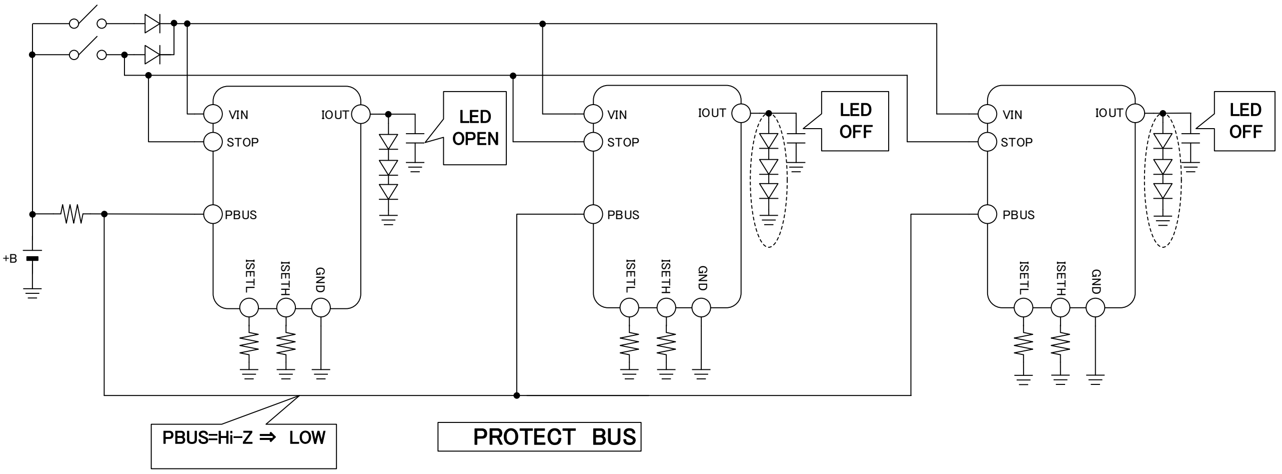


Figure 16. PBUS Function

- Example of operating protection for an LED open condition

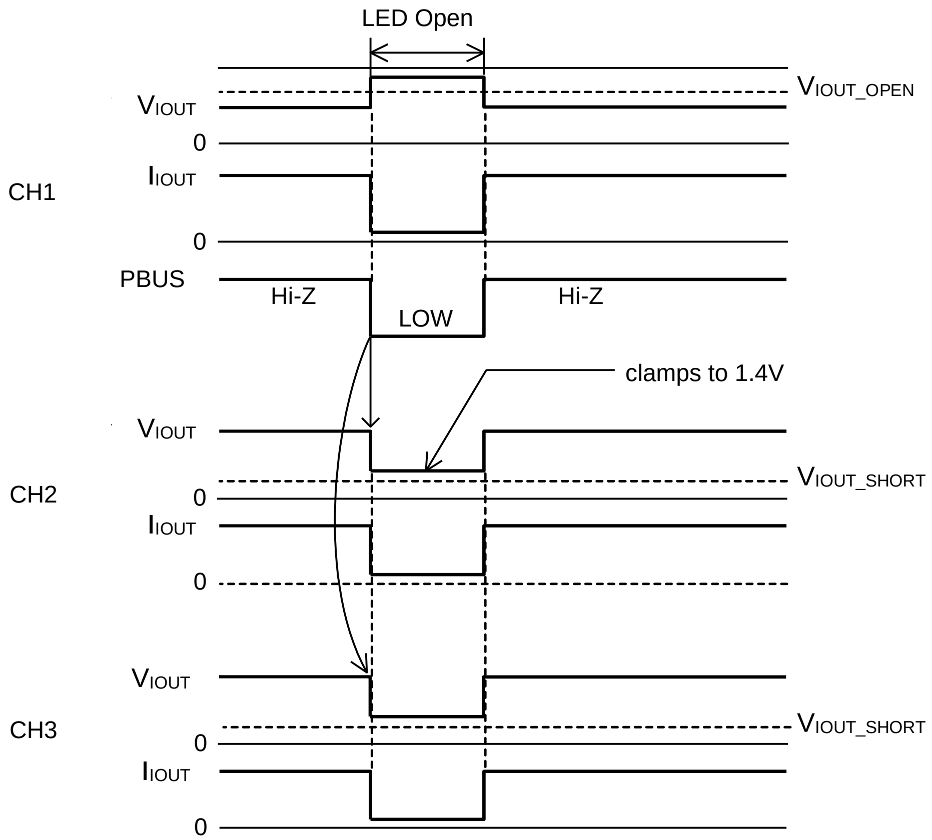


Figure 17. Example of protective Operation

When LED becomes open on the first IC, PBUS of IC1 is switched from Hi-Z to Low. As PBUS becomes Low, the other ICs detect the error and turns OFF their own LEDs. V_{IOUT} clamps to 1.4V during the OFF period in order to prevent ground short protection.

5. Protection Function

This IC has built-in short/open protection function for the external components. Any error detected will pull the PBUS terminal low.

(1) LED Open Detecting Function

When any LED connected at the IOUT becomes open, V_{IOUT} will go HIGH. When an error is detected at $V_{IOUT} < V_{IOUT\_OPEN}$ the PBUS is pulled LOW.

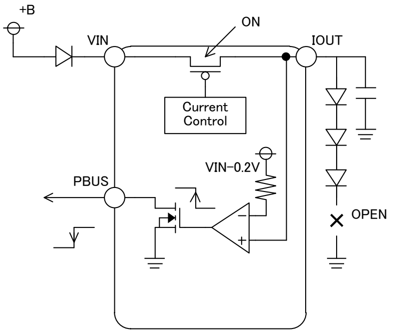


Figure 18. LED Open detection function

(2) LED Short Detecting Function

When the LEDs connected at the IOUT terminal are shorted to ground, V_{IOUT} will go LOW. When an error is detected at $V_{IOUT} < V_{IOUT\_SHORT}$ 0.6V (TYP) the output current is turned OFF to prevent IC heating and the PBUS is pulled LOW.

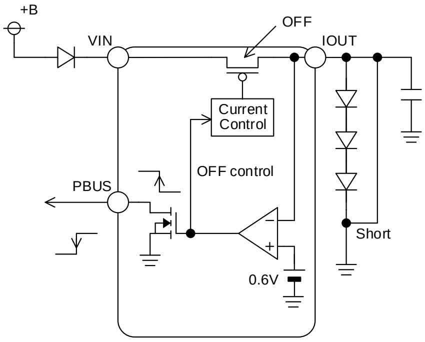


Figure 19. LED Short detection function

(3) ISET(H/L) Open Detection Function

When the external resistance connected to ISET(H/L) terminal is open, ISET(H/L) open detection will be activated by decreasing the ISET(H/L) terminal current. At L mode, ISETL open detection is activated nevertheless state of the ISETH terminal. Also at H mode, ISETH open detection is activated nevertheless state of the ISETL terminal. The output current is turned off While detecting open and it can be notify the abnormally by changing the PBUS terminal output to low.

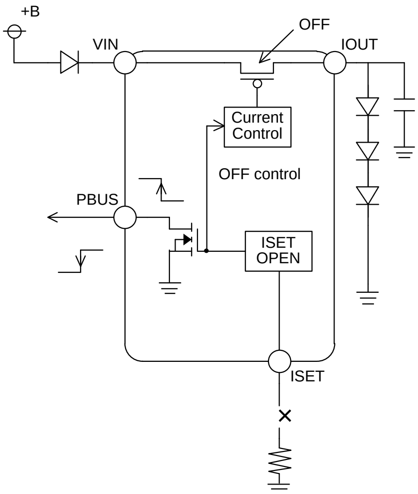


Figure 20. ISET Pin open detection function

(4) ISET(H/L) Short Detection Function

When the external resistance connected to ISET(H/L) terminal is short to GND, ISET(H/L) short detection will be activated by increasing the ISET(H/L) terminal current. At L mode, ISETL short detection is activated nevertheless state of the ISETH terminal. Also at H mode, ISETH short detection is activated nevertheless state of the ISETL terminal. The output current is turned off While detecting short to GND and it can be notify the abnormally by changing the PBUS terminal output to low.

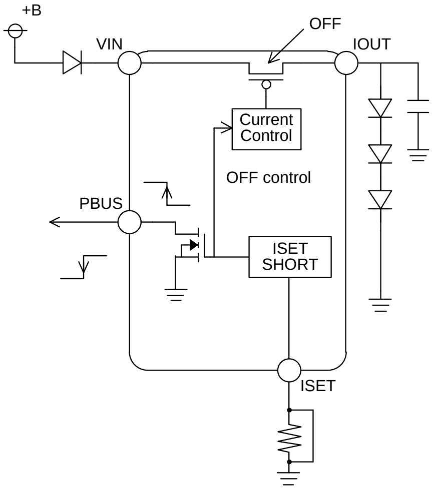


Figure 21. ISET Pin short detection function

6. Over Voltage Protection

Overvoltage protection works in (R_{ISETH}=40kΩ), 18V (TYP) ≤ V_{IN} at I_{OUT}=200mA setting and limits output current to suppress the upswing in heat generation of LSI.
The overvoltage mute protection is effective only for (STOP=High) at H mode time.

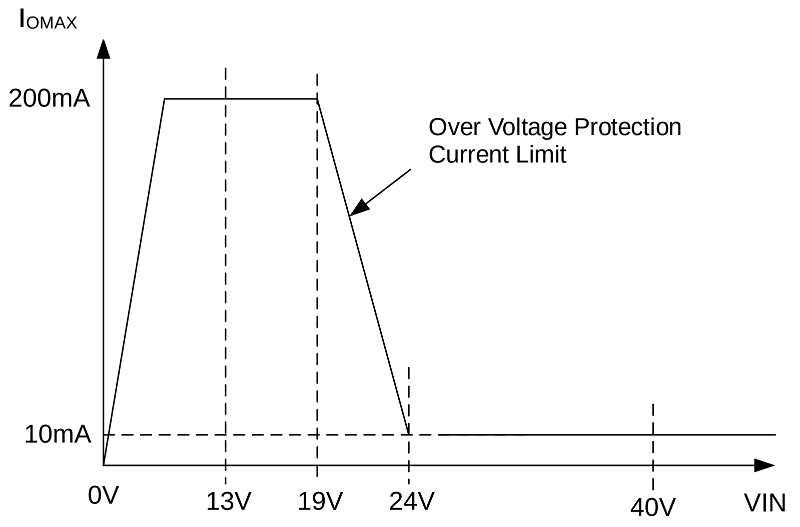


Figure 22. Overvoltage mute function

Recommended application circuit

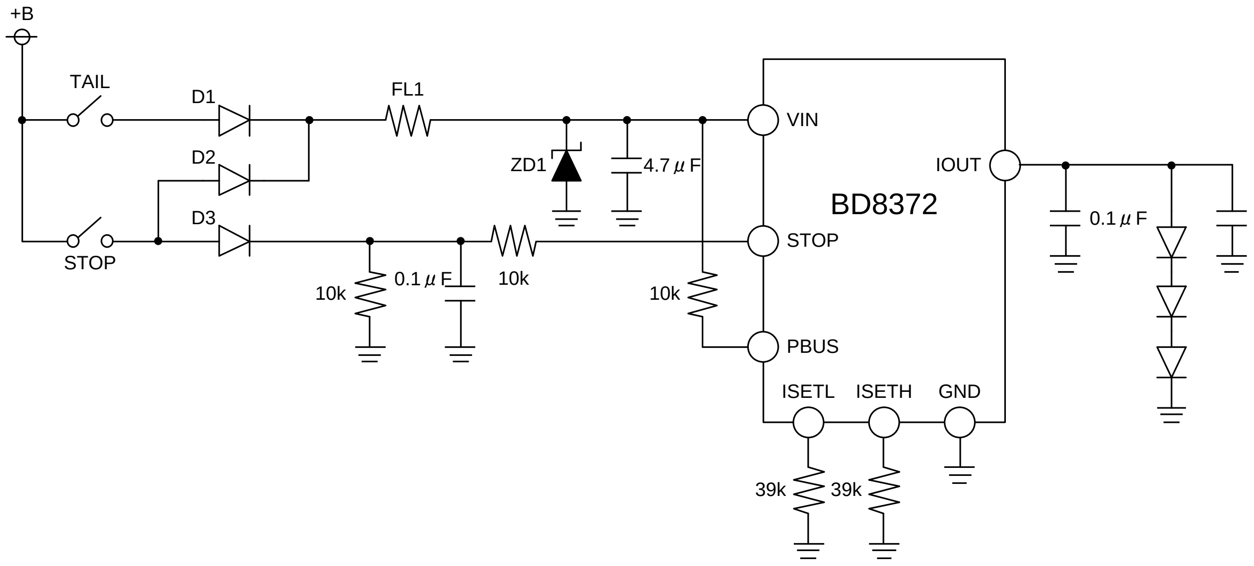


Figure 23. Recommended application circuit

(Note) EMC
ISO 11452-2 (ALSE)
ISO 11452-4 (BCI)
ISO 7637-2

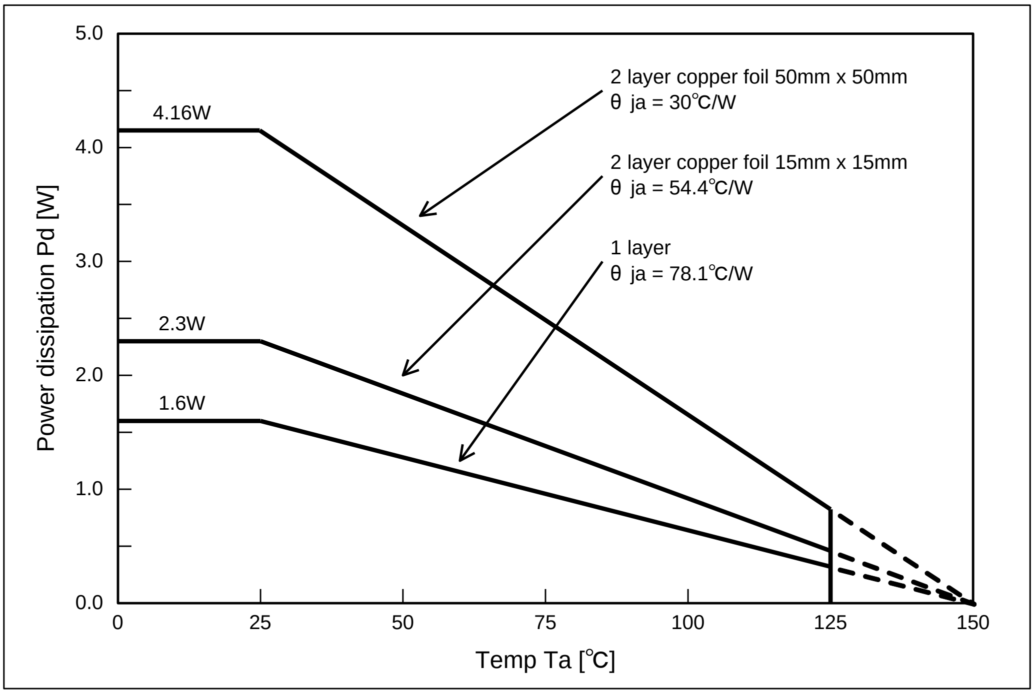
- pulse1
- Pulse2a,2b (level4)
- Pulse3a,3b (level4)

No.	Component Name	Component Value	Product Name	Company
1	D1	-	RF201L2S	ROHM
2	D2	-	RF201L2S	ROHM
3	D3	-	RF201L2S	ROHM
4	Z_{D1}	-	TNR12H-220K	NIPPON CHEMICON
5	FL1	-	MMZ2012R102A	TDK
6	C_{VIN}	4.7µF	GCM32ER71H475KA40	murata
7	C_{IOUT}	0.1µF	GCM188R11H104KA42	murata
8	C_{STOP}	0.1µF	GCM188R11H104KA42	murata
9	RISETL	39kΩ	MCR03 Series	ROHM
10	RISETH	39kΩ	MCR03 Series	ROHM
11	R_{PBUS}	10kΩ	MCR03 Series	ROHM
12	R1	10kΩ	MCR03 Series	ROHM
13	R2	10kΩ	MCR03 Series	ROHM

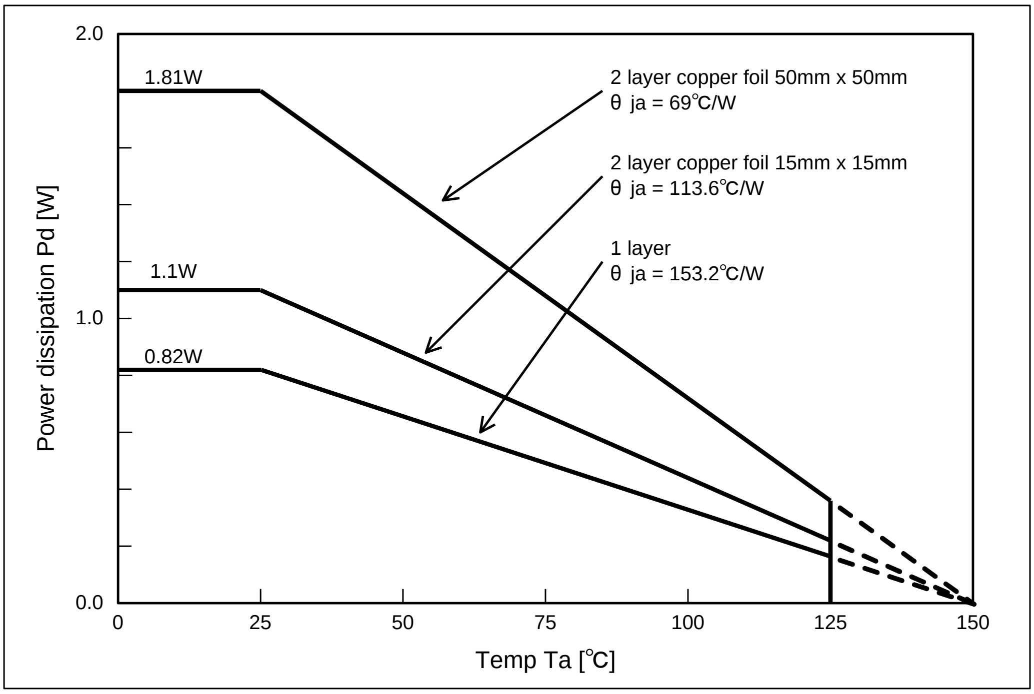
Table 1. BOM List

Power Dissipation

HRP7 Package



HTSOP-J8 Package

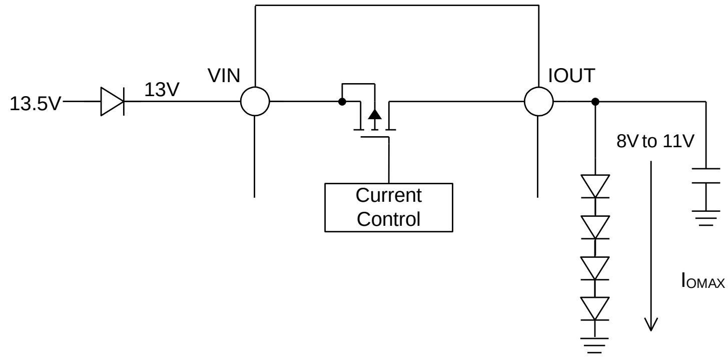


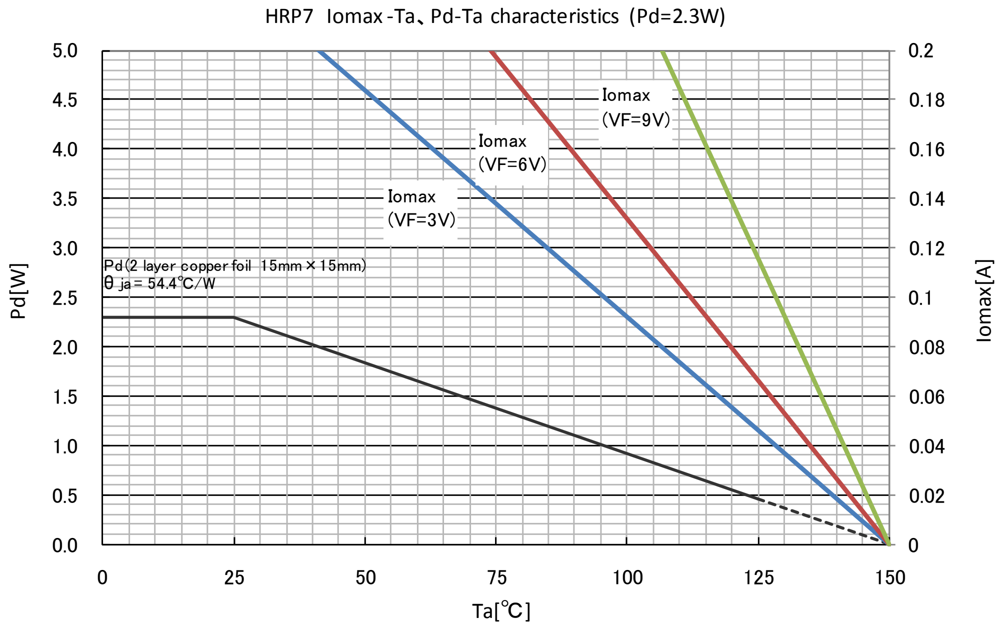
(Caution1) When mounted with 70.0mm x 70.0mm x 1.6mm glass epoxy substrate.
(Caution2) Abobe copper foil area indicates backside copper foil area.
(Caution3) Value changes according to number of substrate layers and copper foil area.Note that this value is a measured value. Not a guaranteed value.

Figure 24. Thermal Dissipation Curve

Pd (Power dissipation) and I_{OMAX} (Permissible current)

The relation between Pd and I_{OMAX} by V_F of LED connected with IOUT is shown.





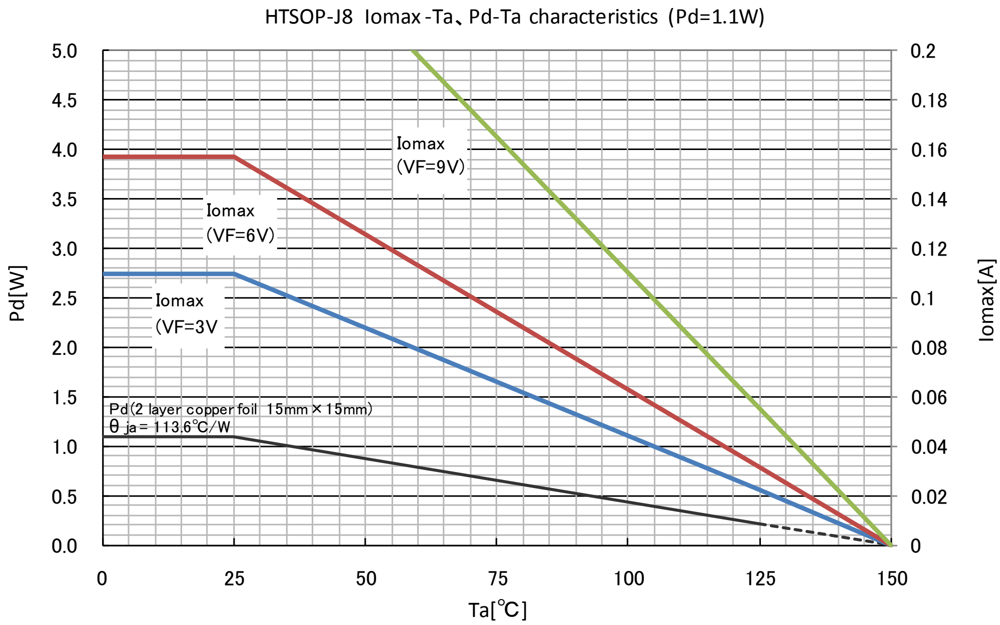
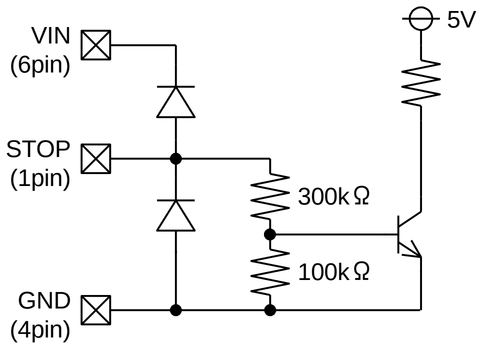
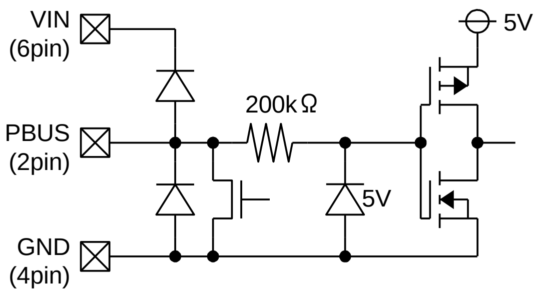
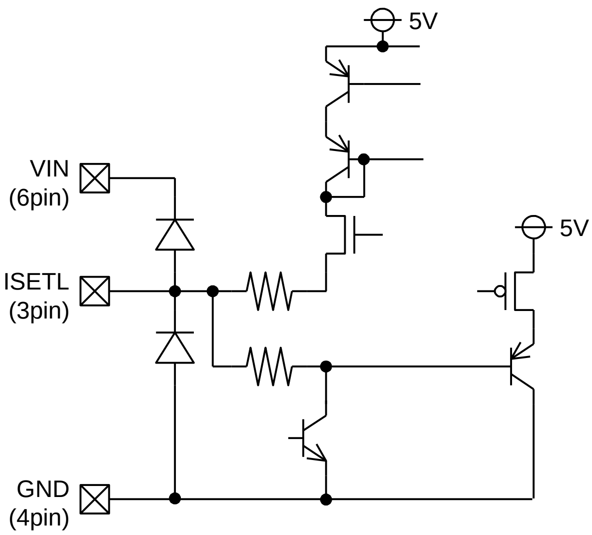
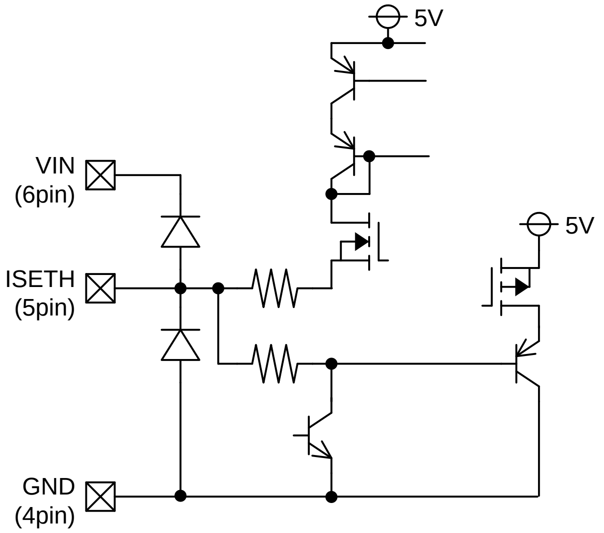
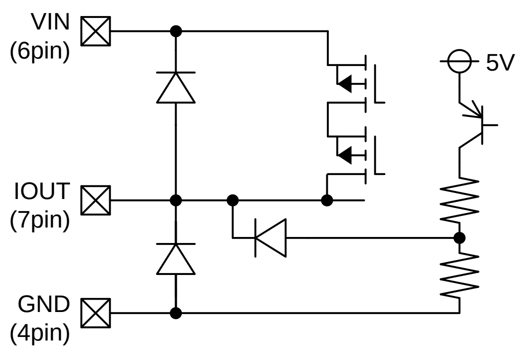


Figure 25. Heat reduction curve

I/O Equivalent Circuit (HRP7 Package)

Pin No.	Pin Name	I/O Equivalent Circuit
1	STOP	
2	PBUS	
3	ISETL	
4	GND	-

I/O Equivalent Circuit (HRP7 Package)– continued

Pin No.	Pin Name	I/O Equivalent Circuit
5	ISETH	
6	VIN	-
7	IOUT	

Operational Notes

1. **Reverse Connection of Power Supply**
   Connecting the power supply in reverse polarity can damage the IC. Take precautions against reverse polarity when connecting the power supply, such as mounting an external diode between the power supply and the IC's power supply pins.

2. **Power Supply Lines**
   Design the PCB layout pattern to provide low impedance supply lines. Separate the ground and supply lines of the digital and analog blocks to prevent noise in the ground and supply lines of the digital block from affecting the analog block. Furthermore, connect a capacitor to ground at all power supply pins. Consider the effect of temperature and aging on the capacitance value when using electrolytic capacitors.

3. **Ground Voltage**
   Ensure that no pins are at a voltage below that of the ground pin at any time, even during transient condition.

4. **Ground Wiring Pattern**
   When using both small-signal and large-current ground traces, the two ground traces should be routed separately but connected to a single ground at the reference point of the application board to avoid fluctuations in the small-signal ground caused by large currents. Also ensure that the ground traces of external components do not cause variations on the ground voltage. The ground lines must be as short and thick as possible to reduce line impedance.

5. **Thermal Consideration**
   Should by any chance the power dissipation rating be exceeded the rise in temperature of the chip may result in deterioration of the properties of the chip. In case of exceeding this absolute maximum rating, increase the board size and copper area to prevent exceeding the Pd rating.

6. **Recommended Operating Conditions**
   These conditions represent a range within which the expected characteristics of the IC can be approximately obtained. The electrical characteristics are guaranteed under the conditions of each parameter.

7. **Inrush Current**
   When power is first supplied to the IC, it is possible that the internal logic may be unstable and inrush current may flow instantaneously due to the internal powering sequence and delays, especially if the IC has more than one power supply. Therefore, give special consideration to power coupling capacitance, power wiring, width of ground wiring, and routing of connections.

8. **Operation Under Strong Electromagnetic Field**
   Operating the IC in the presence of a strong electromagnetic field may cause the IC to malfunction.

9. **Testing on Application Boards**
   When testing the IC on an application board, connecting a capacitor directly to a low-impedance output pin may subject the IC to stress. Always discharge capacitors completely after each process or step. The IC's power supply should always be turned off completely before connecting or removing it from the test setup during the inspection process. To prevent damage from static discharge, ground the IC during assembly and use similar precautions during transport and storage.

10. **Inter-pin Short and Mounting Errors**
    Ensure that the direction and position are correct when mounting the IC on the PCB. Incorrect mounting may result in damaging the IC. Avoid nearby pins being shorted to each other especially to ground, power supply and output pin. Inter-pin shorts could be due to many reasons such as metal particles, water droplets (in very humid environment) and unintentional solder bridge deposited in between pins during assembly to name a few.

Operational Notes – continued

11. **Unused Input Pins**
Input pins of an IC are often connected to the gate of a MOS transistor. The gate has extremely high impedance and extremely low capacitance. If left unconnected, the electric field from the outside can easily charge it. The small charge acquired in this way is enough to produce a significant effect on the conduction through the transistor and cause unexpected operation of the IC. So unless otherwise specified, unused input pins should be connected to the power supply or ground line.

12. **Regarding the Input Pin of the IC**
This monolithic IC contains P+ isolation and P substrate layers between adjacent elements in order to keep them isolated. P-N junctions are formed at the intersection of the P layers with the N layers of other elements, creating a parasitic diode or transistor. For example (refer to figure below):

When GND > Pin A and GND > Pin B, the P-N junction operates as a parasitic diode.
When GND > Pin B, the P-N junction operates as a parasitic transistor.

Parasitic diodes inevitably occur in the structure of the IC. The operation of parasitic diodes can result in mutual interference among circuits, operational faults, or physical damage. Therefore, conditions that cause these diodes to operate, such as applying a voltage lower than the GND voltage to an input pin (and thus to the P substrate) should be avoided.

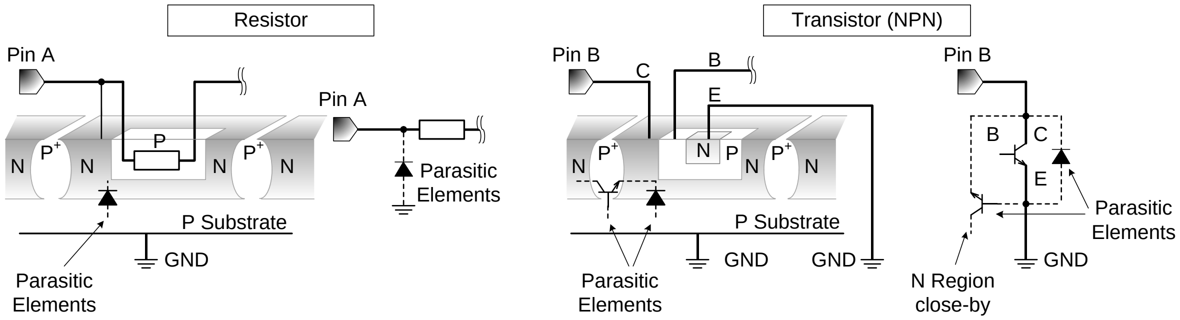


Figure 26. Example of monolithic IC structure

13. **Thermal Shutdown Circuit(TSD)**
This IC has a built-in thermal shutdown circuit that prevents heat damage to the IC. Normal operation should always be within the IC's power dissipation rating. If however the rating is exceeded for a continued period, the junction temperature (Tj) will rise which will activate the TSD circuit that will turn OFF all output pins. When the Tj falls below the TSD threshold, the circuits are automatically restored to normal operation.
Note that the TSD circuit operates in a situation that exceeds the absolute maximum ratings and therefore, under no circumstances, should the TSD circuit be used in a set design or for any purpose other than protecting the IC from heat damage.

14. **Sudden Voltage Surge on VIN**
Because MOSFETs are used in the output, a very steep change in the VCC voltage may cause the transistors to conduct large current. Take this condition into account when selecting the value of external circuit constants for a certain application.

Ordering Information

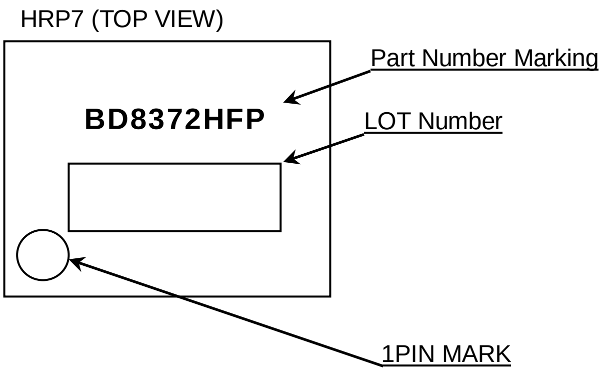
B D 8 3 7 2 H F P - M T R

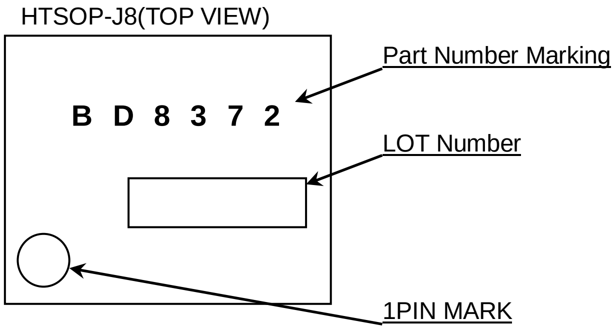
- Form name
- Package
  HFP : HRP7
- Packaging and forming specification
  TR: Embossed tape and reel
  (HRP7)

B D 8 3 7 2 E F J - M E 2

- Form name
- Package
  EFJ : HTSOP-J8
- Packaging and forming specification
  E2: Embossed tape and reel
  (HTSOP-J8)

Marking Diagrams

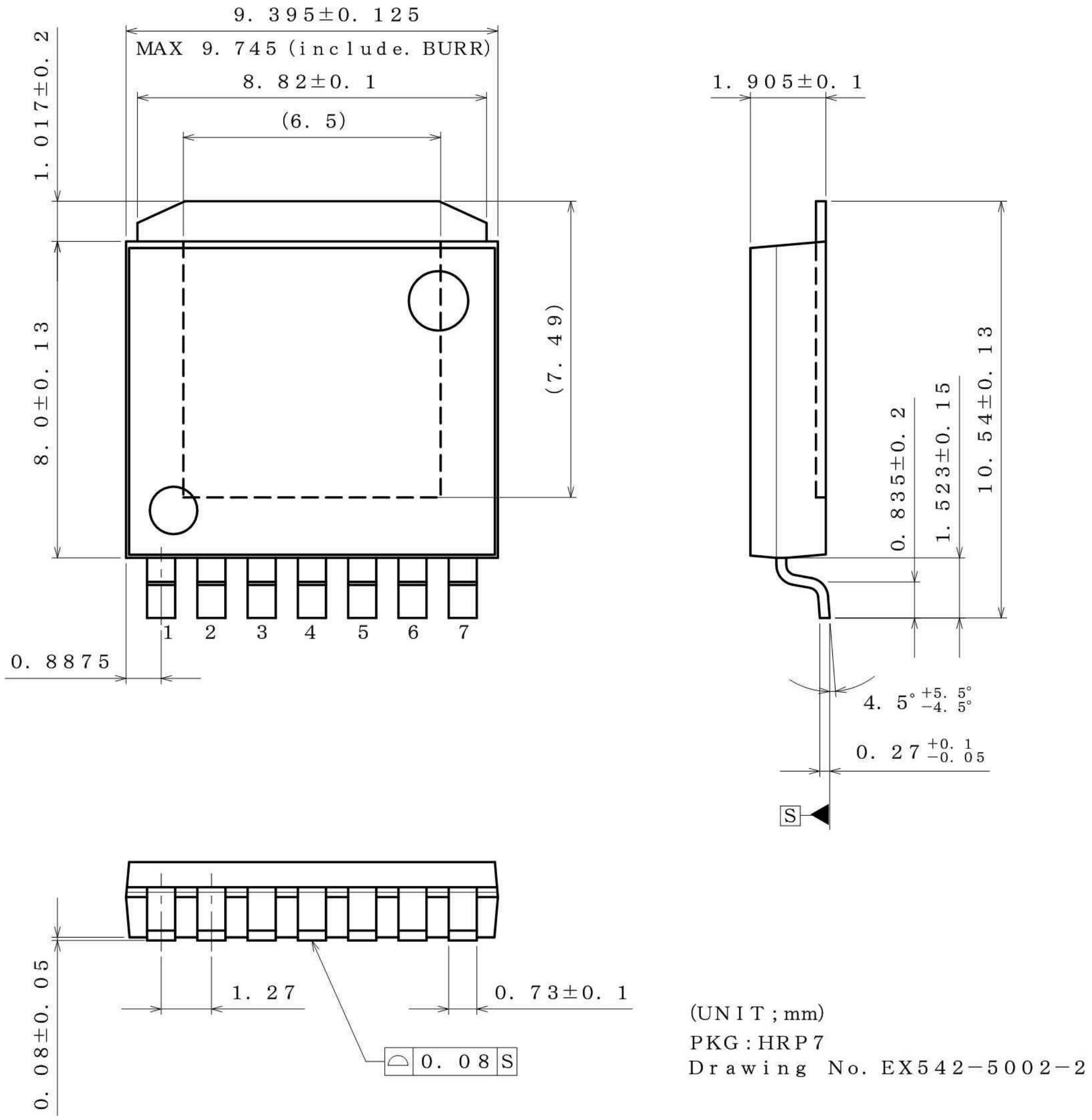




Part Number Marking	Package		Part Number
BD8372HFP	HRP7	Reel of 2000	BD8372HFP-MTR
BD8372	HTSOP-J8	Reel of 2500	BD8372EFJ-ME2

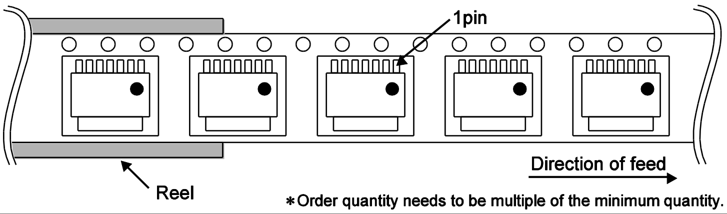
Physical Dimension, Tape and Reel Information

Package Name	HRP7



<Tape and Reel information>

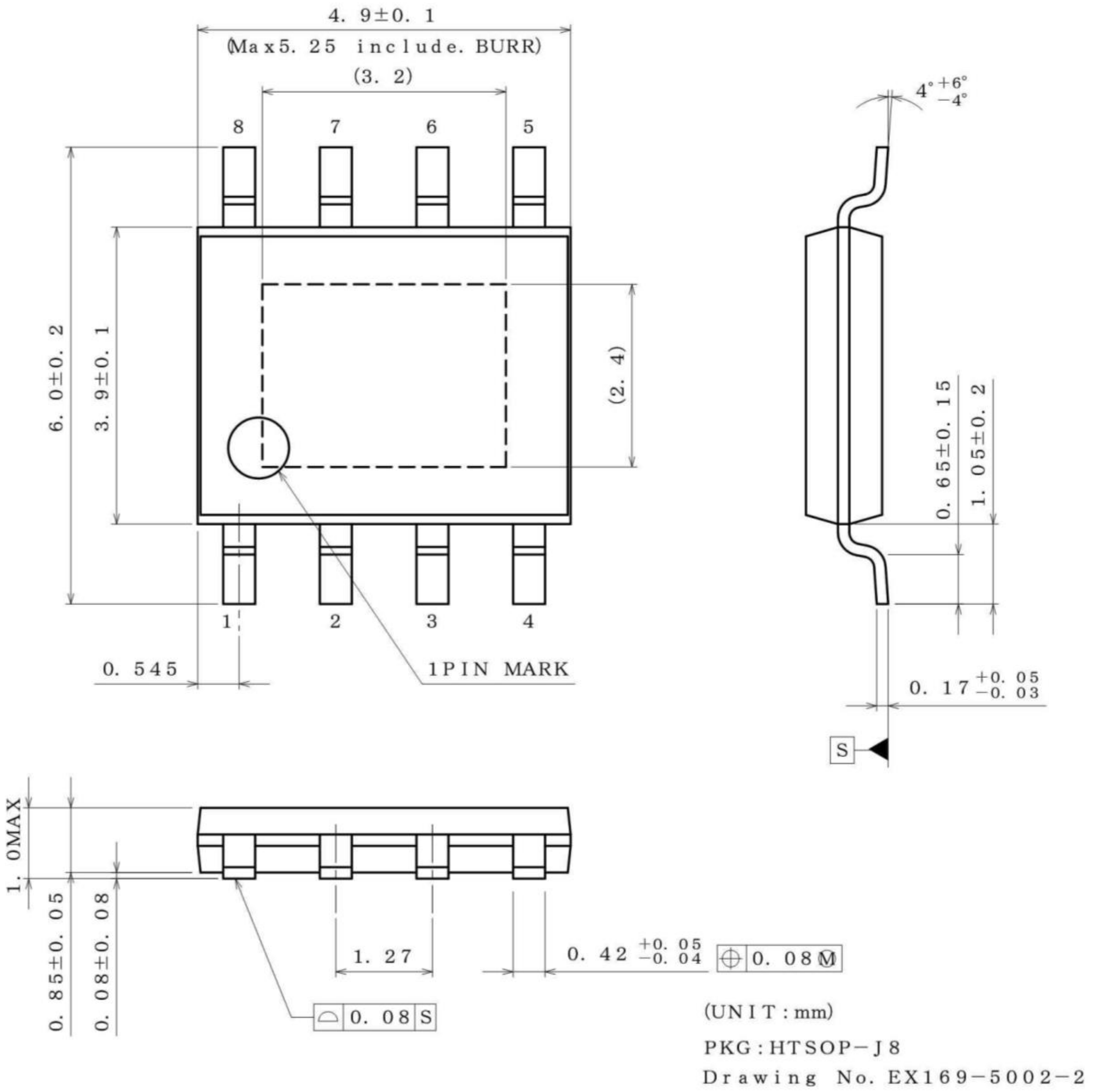
Tape	Embossed carrier tape
Quantity	2000pcs
Direction of feed	TR (The direction is the 1pin of product is at the upper right when you hold reel on the left hand and you pull out the tape on the right hand)



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

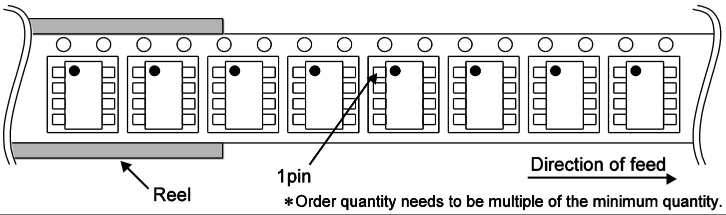
Physical Dimension, Tape and Reel Information – continued

Package Name	HTSOP-J8



<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.

Revision History

Date	Revision	Changes
06.Nov.2015	001	New Release
09.Oct.2018	002	Page. 5 Circuit Current　Symbol　I_{IN} ⇒ I_{VIN} STOP Input Current　Symbol　V_{IN_STOP} ⇒ I_{IN_STOP} IN Over Voltage Current ⇒ Over Voltage Mute Voltage Page. 8 Figure 13. Timming chart　modify Page. 10 exp) $R_{ISETL} = 16k\Omega$ ⇒ exp) $R_{ISETL} = 40k\Omega$ Page. 11 Figure 15.　V_{ULOO_OPEN} ⇒ V_{UVLO_OPEN} V_{DRH_IOUT} ⇒ V_{DRH_IOUT} Page.13 Figure 18. 20. 21.　modify 5. Protection Function　PUBS ⇒ PBUS (3)ISET(H/L) Open Detection Function　change words (4)ISET(H/L) Short Detection Function　change words Page.15 Figure 23.　2.5kΩ@100MHz　delete comment Table 1. BOM List　5 FL1　HMZ2012R102A ⇒ MMZ2012R102A Page.18 I/O Equivalent Circuit　add word　(HRP7 Package) 2 PBUS　(28pin) ⇒ (2pin)

Notice

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1. If you intend to use our Products in devices requiring extremely high reliability (such as medical equipment (Note 1), aircraft/spacecraft, nuclear power controllers, etc.) and whose malfunction or failure may cause loss of human life, bodily injury or serious damage to property ("Specific Applications"), please consult with the ROHM sales representative in advance. Unless otherwise agreed in writing by ROHM in advance, ROHM shall not be in any way responsible or liable for any damages, expenses or losses incurred by you or third parties arising from the use of any ROHM's Products for Specific Applications.

(Note1) Medical Equipment Classification of the Specific Applications

JAPAN	USA	EU	CHINA
CLASSⅢ	CLASSⅢ	CLASSⅡb	CLASSⅢ
CLASSⅣ		CLASSⅢ	

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   [b] Installation of redundant circuits to reduce the impact of single or multiple circuit failure

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   [b] Use of our Products outdoors or in places where the Products are exposed to direct sunlight or dust
   [c] Use of our Products in places where the Products are exposed to sea wind or corrosive gases, including Cl_2, H_2S, NH_3, SO_2, and NO_2
   [d] Use of our Products in places where the Products are exposed to static electricity or electromagnetic waves
   [e] Use of our Products in proximity to heat-producing components, plastic cords, or other flammable items
   [f] Sealing or coating our Products with resin or other coating materials
   [g] Use of our Products without cleaning residue of flux (even if you use no-clean type fluxes, cleaning residue of flux is recommended); or Washing our Products by using water or water-soluble cleaning agents for cleaning residue after soldering
   [h] Use of the Products in places subject to dew condensation

4. The Products are not subject to radiation-proof design.

5. Please verify and confirm characteristics of the final or mounted products in using the Products.

6. In particular, if a transient load (a large amount of load applied in a short period of time, such as pulse. is applied, confirmation of performance characteristics after on-board mounting is strongly recommended. Avoid applying power exceeding normal rated power; exceeding the power rating under steady-state loading condition may negatively affect product performance and reliability.

7. De-rate Power Dissipation depending on ambient temperature. When used in sealed area, confirm that it is the use in the range that does not exceed the maximum junction temperature.

8. Confirm that operation temperature is within the specified range described in the product specification.

9. ROHM shall not be in any way responsible or liable for failure induced under deviant condition from what is defined in this document.

Precaution for Mounting / Circuit board design

1. When a highly active halogenous (chlorine, bromine, etc.) flux is used, the residue of flux may negatively affect product performance and reliability.

2. In principle, the reflow soldering method must be used on a surface-mount products, the flow soldering method must be used on a through hole mount products. If the flow soldering method is preferred on a surface-mount products, please consult with the ROHM representative in advance.

For details, please refer to ROHM Mounting specification

Precautions Regarding Application Examples and External Circuits

1. If change is made to the constant of an external circuit, please allow a sufficient margin considering variations of the characteristics of the Products and external components, including transient characteristics, as well as static characteristics.

2. You agree that application notes, reference designs, and associated data and information contained in this document are presented only as guidance for Products use. Therefore, in case you use such information, you are solely responsible for it and you must exercise your own independent verification and judgment in the use of such information contained in this document. ROHM shall not be in any way responsible or liable for any damages, expenses or losses incurred by you or third parties arising from the use of such information.

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This Product is electrostatic sensitive product, which may be damaged due to electrostatic discharge. Please take proper caution in your manufacturing process and storage so that voltage exceeding the Products maximum rating will not be applied to Products. Please take special care under dry condition (e.g. Grounding of human body / equipment / solder iron, isolation from charged objects, setting of Ionizer, friction prevention and temperature / humidity control).

Precaution for Storage / Transportation

1. Product performance and soldered connections may deteriorate if the Products are stored in the places where:
   - [a] the Products are exposed to sea winds or corrosive gases, including Cl2, H2S, NH3, SO2, and NO2
   - [b] the temperature or humidity exceeds those recommended by ROHM
   - [c] the Products are exposed to direct sunshine or condensation
   - [d] the Products are exposed to high Electrostatic

2. Even under ROHM recommended storage condition, solderability of products out of recommended storage time period may be degraded. It is strongly recommended to confirm solderability before using Products of which storage time is exceeding the recommended storage time period.

3. Store / transport cartons in the correct direction, which is indicated on a carton with a symbol. Otherwise bent leads may occur due to excessive stress applied when dropping of a carton.

4. Use Products within the specified time after opening a humidity barrier bag. Baking is required before using Products of which storage time is exceeding the recommended storage time period.

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