Automotive Body Power Management LSI

Voltage Tracker

BD3925FP-C,BD3925HFP-C

No.11039EBT06

●Description

BD3925FP-C and BD3925HFP-C are voltage trackers for automotive use which feature high withstand-voltage to 50V. They offer the output current loading to 500mA while limiting the quiescent current to 45µA (typ.), so that they suit to apply for systems which are permanently connected to the car battery and requiring low-current-consumption. The offset is ±15mV (for 5V output. 6V < Vcc < 36V, 5mA < Io < 200mA). They integrate folded–type of over-current protection to minimize heat dissipation while accidentally shorted, thus lead to most robust power-supply design under the harsh automotive environment.

●Features

1) Ultra-low quiescent current: 45µA (TYP.)
2) Low-saturation voltage type P-channel DMOS output transistors
3) Low offset voltage: ± 15mV(for 5V output, 6V< Vcc <36V, 5mA<Io<200mA)
4) Vcc power supply voltage = 50 V
5) Integrated over-current protection circuit and thermal shutdown circuit
6) TO252-5/HRP5 Package

●Applications

Onboard vehicle devices (body-control, car stereos, satellite navigation systems, etc.)

●Product line

Part No.	Package
BD3925FP-C	TO252-5
BD3925HFP-C	HRP5

●Absolute maximum ratings (Ta=25°C)

Parameter	Symbol	Limit	Unit
Supply Voltage	Vcc	50 ※1	V
Switch Supply Voltage	Vsw	50	V
VADJ Terminal Supply Voltage	VADJ	28	V
Vo Terminal Voltage	Vout	28	V
Output Current	Io	500	mA
Power Dissipation	Pd	1.3 (TO252-5) ※2	W
		1.6 (HRP5) ※3	
Operating Temperature Range	Topr	-40 ~ +125	℃
Storage Temperature Range	Tstg	-55 ~ +150	℃
Maximum Junction Temperature	Tjmax	150	℃

※1 Not to exceed Pd and ASO.
※2 TO252-5: Reduced by 10.4 mW/°C over 25 °C, when mount on a glass epoxy board : 70 mm × 70 mm × 1.6 mm.
※3 HRP5: Reduced by 12.8 mW/°C over 25 °C, when mount on a glass epoxy board : 70 mm × 70 mm × 1.6 mm).
NOTE: This product is not designed for protection against radioactive rays.

●**Operating Conditions**

Parameter	Symbol	Min.	Max.	Unit
Supply Voltage	Vcc	4.5 ※4	36.0	V
Input Voltage ※5	VADJ	2.5	14	V
Output Current	Io	−	500	mA

※4 Please consider that the Output voltage would be dropped (Dropout voltage) according to the output current.
※5 Not to exceed Vcc - 0.5V.
NOTE: This product is not designed for protection against radioactive rays.

●**Electrical Characteristics** (Unless otherwise specified, Ta=-40 ~ 125°C, VCC=13.2 V, SW=3V, ADJ=5V)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Shut Down Current	Ishut	−	−	10	μA	SW=GND
Bias Current	Ib	−	45	90	μA	Io=0mA
Offset Voltage	△Vo	-15	−	15	mV	6V<Vcc<36V, 5mA<IO<200mA
Output Current	Io	0.5	−	−	A	
Dropout Voltage	△Vd	−	0.25	0.48	V	Vcc=5V, VADJ=5V, Io=200mA
Ripple Rejection	R.R.	45	55	−	dB	f=120Hz, ein=1Vrms, Io=100mA
Switch Threshold Voltage H	SWH	2.0	−	−	V	ACTIVE MODE
Switch Threshold Voltage L	SWL	−	−	0.5	V	OFF MODE
Switch Bias Current	SWI	−	22	60	μA	SW=5V
ADJ Bias Voltage	ADJI	−	5	12	μA	ADJ=5V

●**Reference Data (BD3925FP-C)**

Unless otherwise specified, Vcc=13.2V, ADJ=5V, SW=3V, Ta=25°C

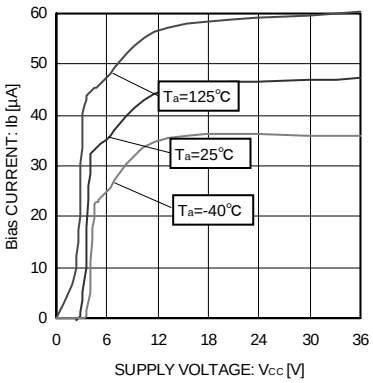


Fig.1 Bias current

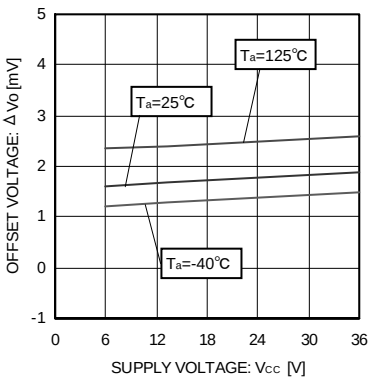


Fig.2 Output voltage vs power supply voltage 1 (Io=5mA)

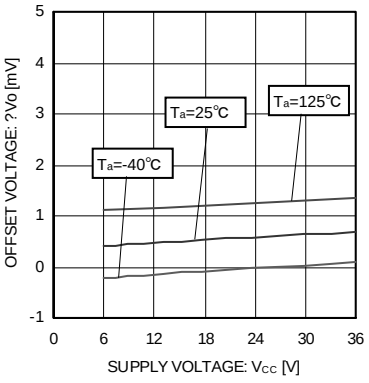


Fig.3 Output voltage vs power supply voltage 2 (Io=200mA)

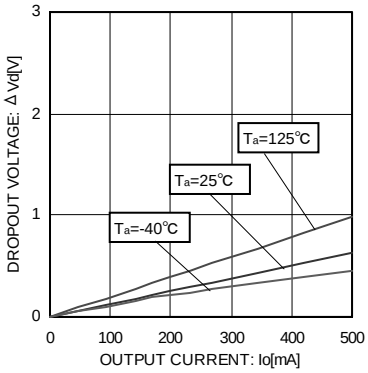


Fig.4 Dropout voltage

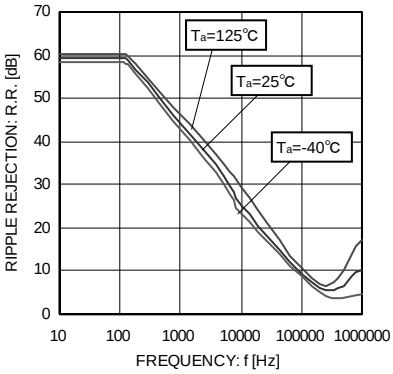


Fig.5 Ripple rejection

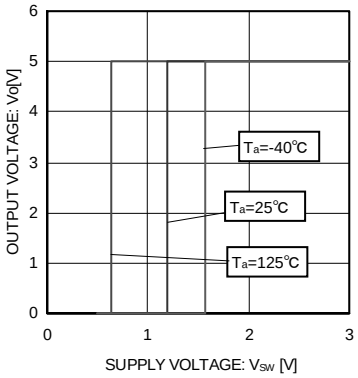


Fig.6 Output voltage vs SW input voltage

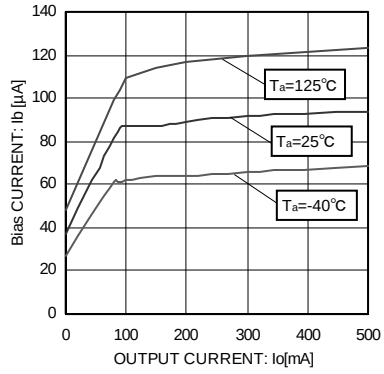


Fig.7 Bias current classified by load

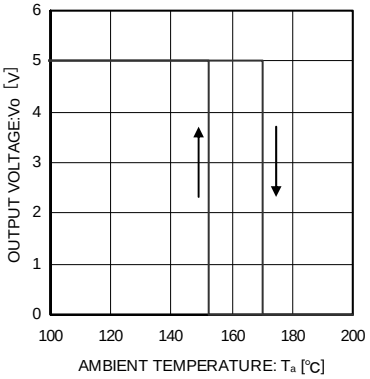


Fig.8. Thermal shutdown circuit

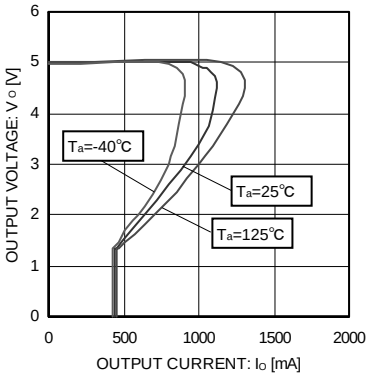


Fig.9 Output voltage vs load

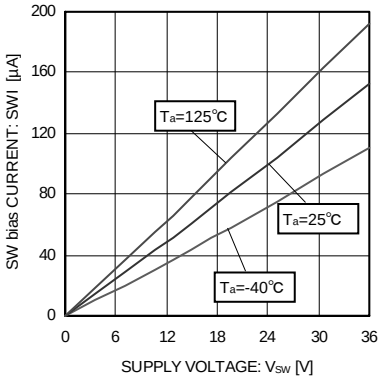


Fig.10 SW bias current

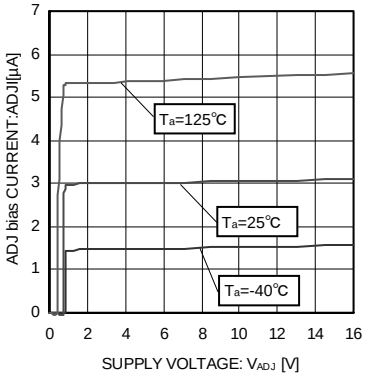


Fig.11 ADJ bias current

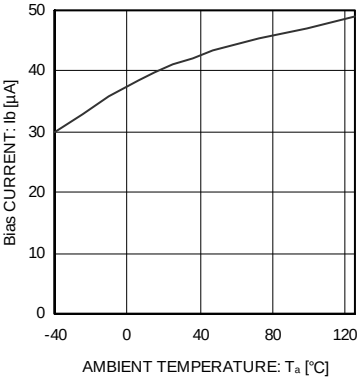


Fig.12 Bias current vs temperature

●**Block Diagram**

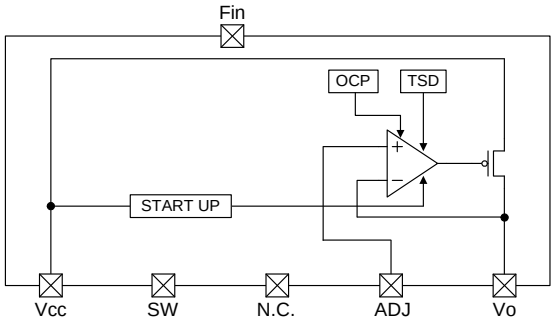


Fig.13 (FP)

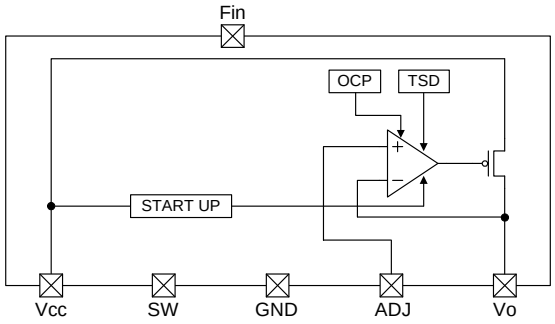


Fig.14 (HFP)

TO252-5

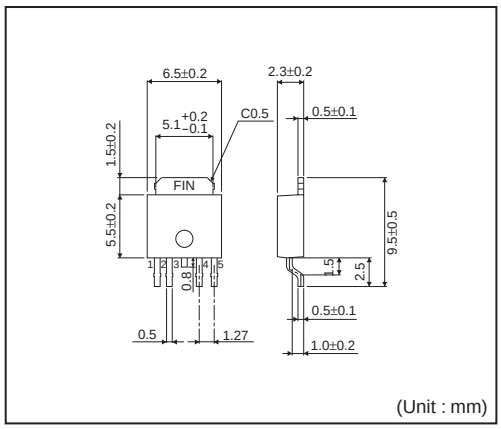
Pin No.	Pin Name	Function
1	Vcc	Power supply pin
2	SW	Vo on/off function pin
3	N.C.	No Connection
4	ADJ	Input voltage
5	Vo	Output Voltage
Fin	GND	Grand

HRP5

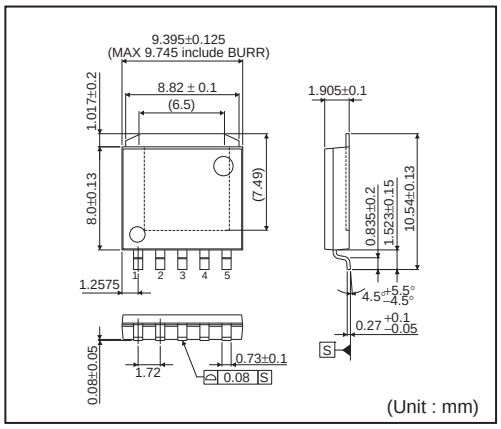
Pin No.	Pin Name	Function
1	Vcc	Power supply pin
2	SW	Vo on/off function pin
3	GND	Grand
4	ADJ	Input voltage
5	Vo	Output Voltage
Fin	GND	Grand

●**Top View** (Package dimension)

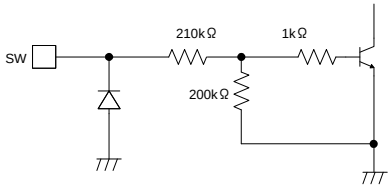
TO252-5



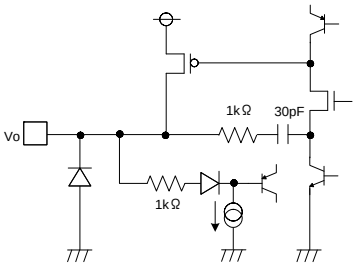
HRP5



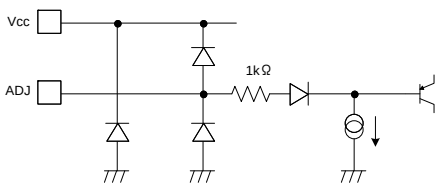
●**I/O equivalence circuit** (All resistance values are typical.)



2PIN[SW]



5PIN[Vo]



1.4PIN[Vcc、ADJ]

●Thermal Dissipation Curve

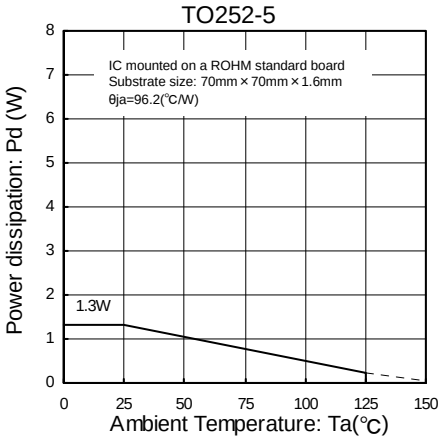


Fig.15

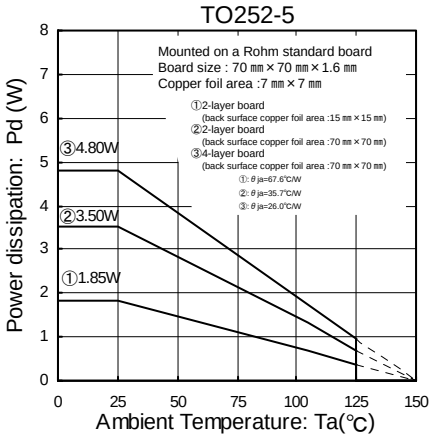


Fig.16

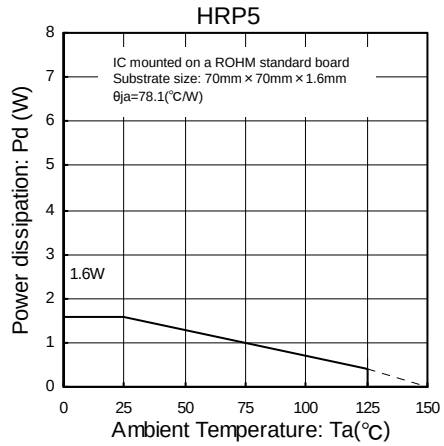


Fig.17

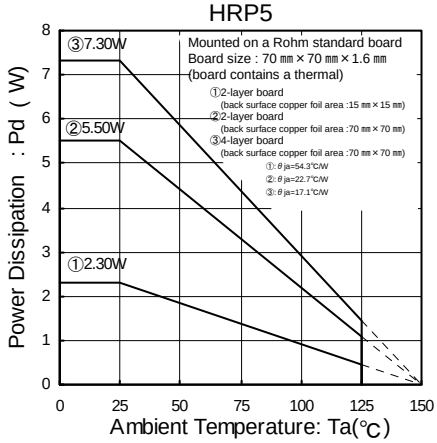


Fig.18

Refer to the heat mitigation characteristics illustrated in Figs. 15 ~ 18 when using the IC in an environment where Ta≧25°C. The characteristics of the IC are greatly influenced by the operating temperature. If the temperature is in excess of the maximum junction temperature Tjmax, the elements of the IC may be deteriorated or damaged. It is necessary to give sufficient consideration to the heat of the IC in view of two points, i.e., the protection of the IC from instantaneous damage and the maintenance of the reliability of the IC in long-time operation.
In order to protect the IC from thermal destruction, it is necessary to operate the IC not in excess of the maximum junction temperature Tjmax. Fig. 15,16 illustrates the power dissipation/heat mitigation characteristics for the TO252 package. Operate the IC within the power dissipation Pd. The following method is used to calculate the power consumption Pc (W).

$Pc=(Vcc-Vo)\times Io+Vcc\times Ib$

Power dissipation $Pd \geqq Pc$

Vcc : Input voltage
Vo : Output voltage
Io : Load current
Ib : Total supply current

The load current IO is obtained to operate the IC within the power dissipation.

$$Io \leqq \frac{Pd - Vcc \times Ib}{Vcc - Vo}$$

(Please refer to Fig.7 and Fig.12 for Ib.)

The maximum load current IOMAX for the applied voltage Vcc can be calculated during the thermal design process.

Example)BD3925FP-C Vcc = 12V and Vo=5V(ADJ=5)at Ta = 85°C

$$Io \leqq \frac{0.624 - 12 \times Ib}{12 - 5}$$

(θja=96.2℃/W→-10.4mAW/℃
25℃=1.3W→85℃=0.624W)

Io≦89mA (Ib=100μA)

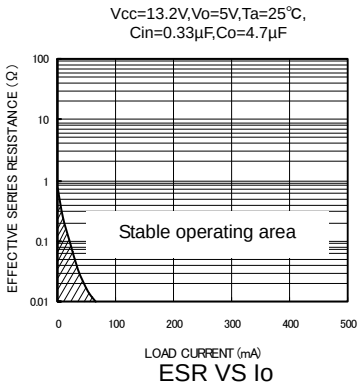
Make a thermal calculation in consideration of the above so that the whole operating temperature range will be within the power dissipation.
The power consumption Pc of the IC in the event of shorting (i.e., if the Vo and GND pins are shorted) will be obtained from the following equation.

$Pc=Vcc\times(Icc+Ishort)$ Ishort = Short current (Please refer to Fig.9 for Ishort.)

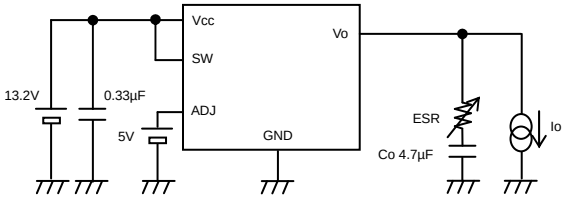
●Pin Settings / Precautions

1. Vcc pins
   Insert capacitors with a capacitance of 0.33µF to 1000µF between the Vcc and GND pins.
   The capacitance varies with the application. Be sure to design the capacitance with a sufficient margin.

2. Output pin
   It is necessary to place capacitors between each output pin and GND to prevent oscillation on the output. Usable capacitance values range from 4.7µF to 1000µF. Ceramic capacitors can be used as long as their ESR value is low enough to prevent oscillation. Abrupt fluctuations in input voltage and load conditions may affect the output voltage. Output capacitance values should be determined only through sufficient testing of the actual application.



ESR VS Io



※Pin Settings / Precautions 2 Measurement circuit

●Notes for use

1. Absolute maximum ratings
   Use of the IC in excess of absolute maximum ratings such as the applied voltage or operating temperature range may result in IC damage. Assumptions should not be made regarding the state of the IC (short mode or open mode) when such damage is suffered. A physical safety measure such as a fuse should be implemented when use of the IC in a special mode where the absolute maximum ratings may be exceeded is anticipated.

2. GND potential
   Ensure a minimum GND pin potential in all operating conditions.

3. Thermal design
   The Power dissipation indicated on this specification is the value without heat sink. Use a thermal design that allows for a sufficient margin by attaching with heat sink in light of the power dissipation (Pd) in actual operating conditions.

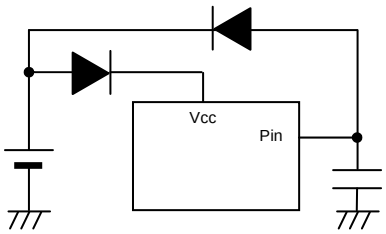
4. Pin short and mistake mounting
   Use caution when orienting and positioning the IC for mounting on printed circuit boards. Improper mounting may result in damage to the IC. Shorts between output pins and the power supply and GND pins caused by the presence of a foreign object may result in damage to the IC. Ensure a minimum GND pin potential in all operating conditions.

5. Actions in strong magnetic field
   Keep in mind that the IC may malfunction in strong magnetic fields

6. Testing on application boards
   When testing the IC on an application board, connecting a capacitor to a pin with low impedance subjects the IC to stress. Always discharge capacitors after each process or step. Always turn the IC's power supply off before connecting it to or removing it from a jig or fixture during the inspection process. Ground the IC during assembly steps as an antistatic measure, and use similar caution when transporting or storing the IC

7. Ground patterns
   When using both small signal and large current GND patterns, it is recommended to isolate the two ground patterns, placing a single ground point at the application's reference point so that the pattern wiring resistance and voltage variations caused by large currents do not cause variations in the small signal ground voltage. Be careful not to change the GND wiring pattern of any external parts, either.

8. Applications or inspection processes where the potentials of the Vcc pin and other pins may be reversed from their normal states may cause damage to the IC's internal circuitry or elements. Use an output pin capacitance of 470µF or lower in case Vcc is shorted with the GND pin while the external capacitor is charged. It is recommended to insert a diode for preventing back current flow in series with Vcc or bypass diodes between Vcc and each pin.

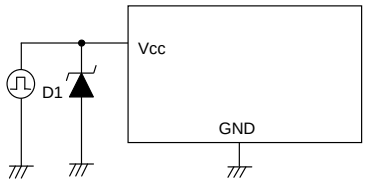


9. SW Pin, ADJ Pin
   Do not apply the voltage to SW pin and ADJ pin when the Vcc is not applied.
   And when the Vcc is applied, the voltage of SW pin and ADJ pin must not exceed Vcc.

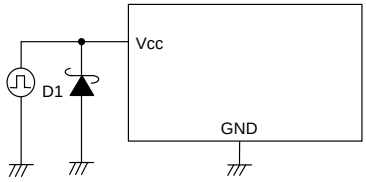
10. Thermal shutdown circuit (TSD)
    This IC incorporates a built-in TSD circuit for the protection from thermal destruction. The IC should be used within the specified power dissipation range. However, in the event that the IC continues to be operated in excess of its power dissipation limits, the attendant rise in the junction temperature (Tj) will trigger the TSD circuit to turn off all output power elements(175℃:Typ). The circuit automatically resets once the junction temperature (Tj) drops (150℃:Typ). Operation of the TSD circuit presumes that the IC's absolute maximum ratings have been exceeded. Application designs should never make use of the TSD circuit.

11. Overcurrent protection circuit (OCP)
    The IC incorporates a built-in overcurrent protection circuit that operates according to the output current capacity.
    This circuit serves to protect the IC from damage when the load is shorted. The protection circuit is designed to limit current flow by not latching in the event of a large and instantaneous current flow originating from a large capacitor or other component. This protection circuits is effective in preventing damage due to sudden and unexpected accidents.
    However, the IC should not be used in applications characterized by the continuous operation or transitioning of the protection circuits. At the time of thermal designing, keep in mind that the current capacity has negative characteristics to temperatures.

12. About positive surge voltage
To protect against a surge voltage that exceeds 50V between Vcc and GND please insert a power zener diode between Vcc terminal and GND.

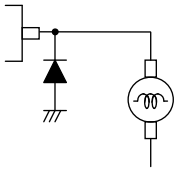


13. About negative surge voltage
To protect against a negative surge voltage, please insert a Schottky diode between the Vcc terminal and GND.



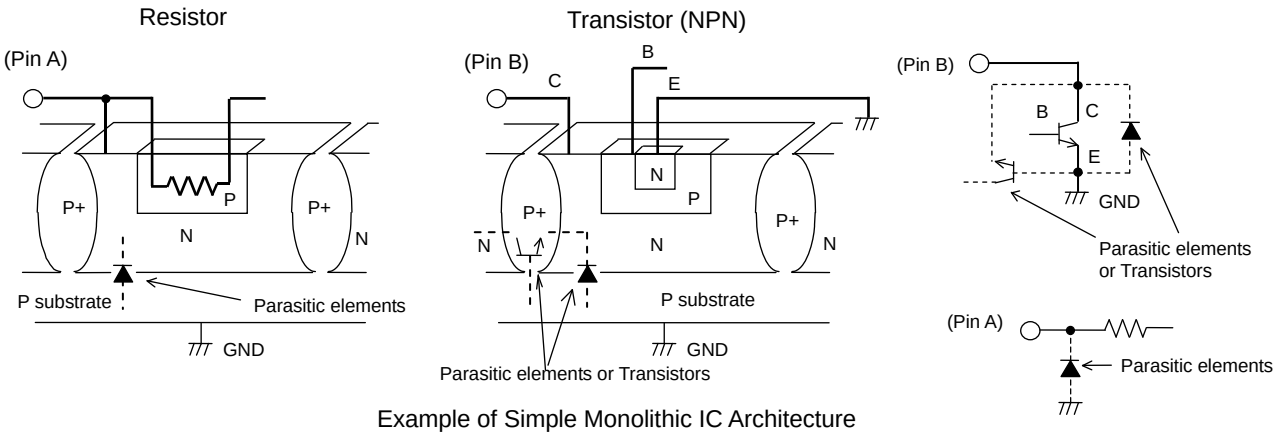
14. For an infinitesimal fluctuations of output voltage
At the use of the application that infinitesimal fluctuations of output voltage caused by some factors (e.g. disturbance noise, input voltage fluctuations, load fluctuations, etc.), please take enough measures to avoid some influence (e.g. insert the filter, etc.).

15. We recommend using Diode for protection purpose when the temperature so output voltage is off.
This is to prevent against large loads of impedance or reverse current during initial stages or output off stage



16. 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 these P layers with the N layers of other elements to create a variety of parasitic elements. For example, when the resistors and transistors are connected to the pins as shown in the following figure,
- ○The P/N junction functions as a parasitic diode when GND > Pin A for the resistor or GND > Pin B for the transistor (NPN).
- ○Similarly, when GND > Pin B for the transistor (NPN), the parasitic diode described above combines with the N layer of other adjacent elements to operate as a parasitic NPN transistor.

The formation of parasitic elements as a result of the relationships of the potentials of different pins is an inevitable result of the IC's architecture. The operation of parasitic elements can cause interference with circuit operation as well as IC malfunction and damage. For these reasons, it is necessary to use caution so that the IC is not used in a way that will trigger the operation of parasitic elements, such as by the application of voltages lower than the GND (P substrate) voltage to input pins. Keep in mind that the IC may malfunction in strong magnetic fields.,



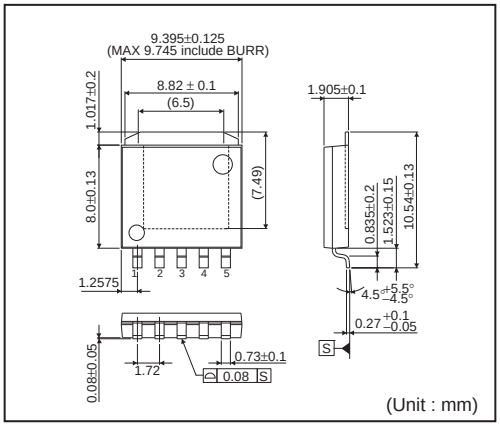
Example of Simple Monolithic IC Architecture

●Part Number Selection

B	D	3	9	2	5	H	F	P	-	C	T	R

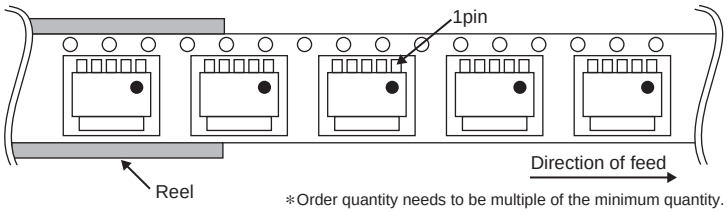
- Part No.
- Part No.
- Package
  HFP :HRP5
  FP :TO252-5
- Packaging and forming specification
  TR: Embossed tape and reel (HRP5)
  E2: Embossed tape and reel (TO252-5)

HRP5



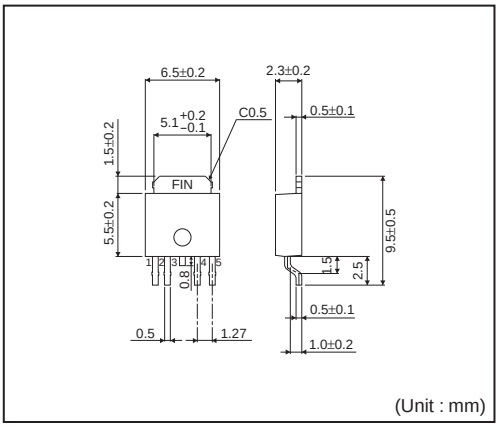
<Tape and Reel information>

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)



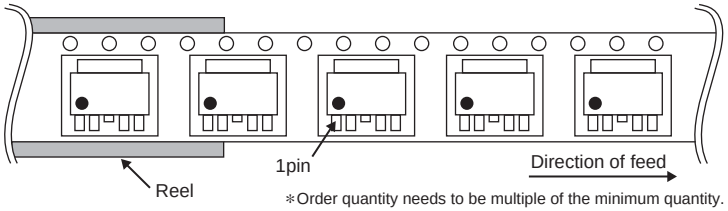
∗Order quantity needs to be multiple of the minimum quantity.

TO252-5



<Tape and Reel information>

Tape	Embossed carrier tape
Quantity	2000pcs
Direction of feed	E2 (The direction is the 1pin of product is at the lower 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.

Notice

Precaution on using ROHM Products

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	

2. ROHM designs and manufactures its Products subject to strict quality control system. However, semiconductor products can fail or malfunction at a certain rate. Please be sure to implement, at your own responsibilities, adequate safety measures including but not limited to fail-safe design against the physical injury, damage to any property, which a failure or malfunction of our Products may cause. The following are examples of safety measures:
   [a] Installation of protection circuits or other protective devices to improve system safety
   [b] Installation of redundant circuits to reduce the impact of single or multiple circuit failure

3. Our Products are not designed under any special or extraordinary environments or conditions, as exemplified below. Accordingly, ROHM shall not be in any way responsible or liable for any damages, expenses or losses arising from the use of any ROHM's Products under any special or extraordinary environments or conditions. If you intend to use our Products under any special or extraordinary environments or conditions (as exemplified below), your independent verification and confirmation of product performance, reliability, etc, prior to use, must be necessary:
   [a] Use of our Products in any types of liquid, including water, oils, chemicals, and organic solvents
   [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 (Pd) depending on Ambient temperature (Ta). When used in sealed area, confirm the actual ambient 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; if flow soldering method is preferred, 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.

Precaution for Electrostatic

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.

Precaution for Product Label

QR code printed on ROHM Products label is for ROHM's internal use only.

Precaution for Disposition

When disposing Products please dispose them properly using an authorized industry waste company.

Precaution for Foreign Exchange and Foreign Trade act

Since our Products might fall under controlled goods prescribed by the applicable foreign exchange and foreign trade act, please consult with ROHM representative in case of export.

Precaution Regarding Intellectual Property Rights

1. All information and data including but not limited to application example contained in this document is for reference only. ROHM does not warrant that foregoing information or data will not infringe any intellectual property rights or any other rights of any third party regarding such information or data. ROHM shall not be in any way responsible or liable for infringement of any intellectual property rights or other damages arising from use of such information or data.:

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Other Precaution

1. This document may not be reprinted or reproduced, in whole or in part, without prior written consent of ROHM.

2. The Products may not be disassembled, converted, modified, reproduced or otherwise changed without prior written consent of ROHM.

3. In no event shall you use in any way whatsoever the Products and the related technical information contained in the Products or this document for any military purposes, including but not limited to, the development of mass-destruction weapons.

4. The proper names of companies or products described in this document are trademarks or registered trademarks of ROHM, its affiliated companies or third parties.

General Precaution

1. Before you use our Products, you are requested to carefully read this document and fully understand its contents. ROHM shall not be in any way responsible or liable for failure, malfunction or accident arising from the use of any ROHM's Products against warning, caution or note contained in this document.

2. All information contained in this document is current as of the issuing date and subject to change without any prior notice. Before purchasing or using ROHM's Products, please confirm the latest information with a ROHM sales representative.

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