CMOS LDO Regulators for Portable Equipments

1ch 150mA CMOS LDO Regulators

BH□□NB1WHFV series

No.11020EBT04

●Description

The BH□□NB1WHFV series is a line of 150 mA output, high-performance CMOS regulators that deliver a high ripple rejection ratio of 80 dB (Typ., 1 kHz). They are ideal for use in high-performance, analog applications and offer improved line regulation, load regulation, and noise characteristics. Using the ultra-small HVSOF5 package, which features a built-in heat sink, contributes to space-saving application designs.

●Features

1) High accuracy output voltage: ± 1%
2) High ripple rejection ratio: 80 dB (Typ., 1 kHz)
3) Stable with ceramic capacitors
4) Low bias current: 60 µA
5) Output voltage on/off control
6) Built-in overcurrent and thermal shutdown circuits
7) Ultra-small HVSOF5 power package

●Applications

Battery-driven portable devices, etc.

●Product line

■150 mA BH□□NB1WHFV Series

Product name	2.5	2.8	2.85	2.9	3.0	3.1	3.3	Package
BH□□NB1WHFV	√	√	√	√	√	√	√	HVSOF5

Model name: BH□□NB1W□
(a: □□, b: □)

Symbol	Description			
a	Output voltage specification			
	□□	Output voltage (V)	□□	Output voltage (V)
	25	2.5 V (Typ.)	30	3.0 V (Typ.)
	28	2.8 V (Typ.)	31	3.1 V (Typ.)
	2J	2.85 V (Typ.)	33	3.3 V (Typ.)
	29	2.9 V (Typ.)		
b	Package HFV: HVSOF5			

●Absolute maximum ratings

Parameter	Symbol	Ratings	Unit
Applied power supply voltage	VMAX	−0.3 to +6.0	V
Power dissipation	Pd	410 *1	mW
Operating temperature range	Topr	−40 to +85	°C
Storage temperature range	Tstg	−55 to +125	°C

*1: Reduce by 4.1 mW/°C over 25°C, when mounted on a glass epoxy PCB (70 mm × 70 mm × 1.6 mm).

●Recommended operating ranges (not to exceed Pd)

Parameter	Symbol	Ratings	Unit
Power supply voltage	V_{IN}	2.5 to 5.5	V
Output current	I_{OUT}	0 to 150	mA

●Recommended operating conditions

Parameter	Symbol	Ratings			Unit	Conditions
		Min.	Typ.	Max.		
Input capacitor	C_{IN}	0.1 *2	—	—	µF	The use of ceramic capacitors is recommended.
Output capacitor	C_O	2.2 *2	—	—	µF	The use of ceramic capacitors is recommended.

*2 Make sure that the output capacitor value is not kept lower than this specified level across a variety of temperature, DC bias characteristic. And also make sure that the capacitor value cannot change as time progresses.

●Electrical characteristics

(Unless otherwise specified, Ta = 25°C, V_{IN} = V_{OUT} + 1.0 V, STBY = 1.5 V, C_{IN} = 0.1 µF, C_O = 2.2 µF)

Parameter		Symbol	Limits			Unit	Conditions
			Min.	Typ.	Max.		
Output voltage		V_{OUT}	V_{OUT}×0.99	V_{OUT}	V_{OUT}×1.01	V	I_{OUT} = 1 mA
Circuit current		IGND	—	60	100	µA	I_{OUT} = 50 mA
Circuit current (STBY)		ISTBY	—	—	1.0	µA	STBY = 0 V
Ripple rejection ratio		RR	—	80	—	dB	VRR = −20 dBv, fRR = 1 kz, I_{OUT} = 10 mA
Load response 1		LTV1	—	25	—	mV	I_{OUT} = 1 mA to 30 mA
Load response 2		LTV2	—	25	—	mV	I_{OUT} = 30 mA to 1 mA
Dropout voltage 1		VSAT1	—	80	150	mV	V_{IN} = 0.98 × V_{OUT}, I_{OUT} = 30 mA
Dropout voltage 2		VSAT2	—	250	450	mV	V_{IN} = 0.98 × V_{OUT}, I_{OUT} = 100 mA
Line regulation		VDL1	—	1	20	mV	V_{IN} = V_{OUT} + 0.5 V to 5.5 V, I_{OUT} = 50 mA
Load regulation 1		VDLO1	—	6	30	mV	I_{OUT} = 1 mA to 100 mA
Load regulation 2		VDLO2	—	9	90	mV	I_{OUT} = 1 mA to 150 mA
Overcurrent protection limit current		ILMAX	—	250	—	mA	V_O = V_{OUT} × 0.98
Short current		ISHORT	—	50	—	mA	V_O = 0 V
STBY pull-down resistance		RSTB	275	550	1100	kΩ	
STBY control voltage	ON	VSTBH	1.5	—	V_{IN}	V	
	OFF	VSTBL	−0.3	—	0.3	V	

* This IC is not designed to be radiation-resistant.

●Reference data

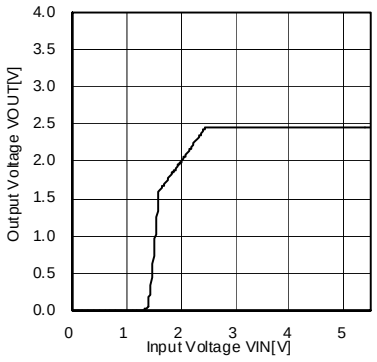


Fig.1 Output Voltage vs Input Voltage (BH25NB1WHFV)

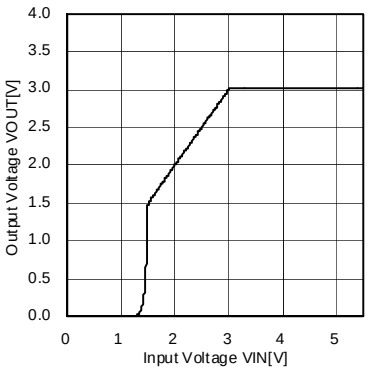


Fig.2 Output Voltage vs Input Voltage (BH30NB1WHFV)

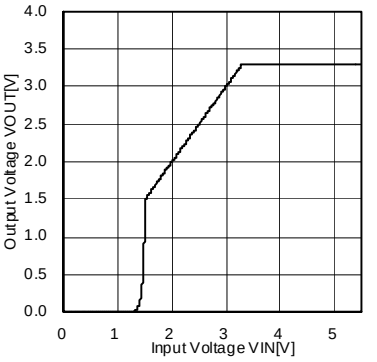


Fig.3 Output Voltage vs Input Voltage (BH33NB1WHFV)

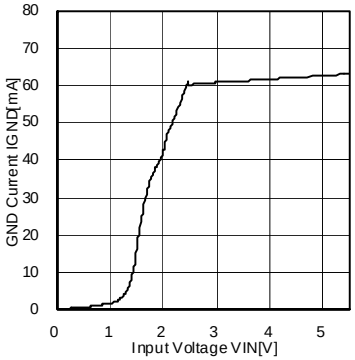


Fig.4 GND Current vs Input Voltage (BH25NB1WHFV)

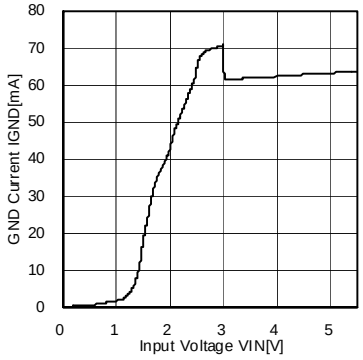


Fig.5 GND Current vs Input Voltage (BH30NB1WHFV)

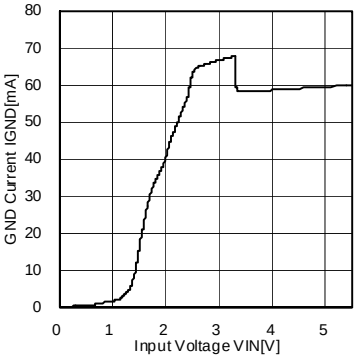


Fig.6 GND Current vs Input Voltage (BH33NB1WHFV)

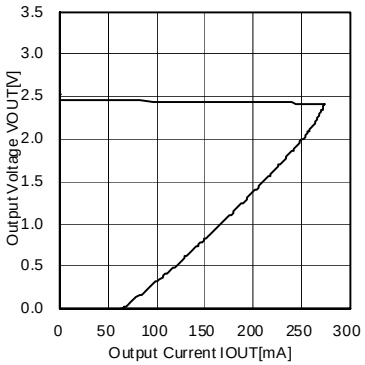


Fig.7 Output Voltage vs Output Current (BH25NB1WHFV)

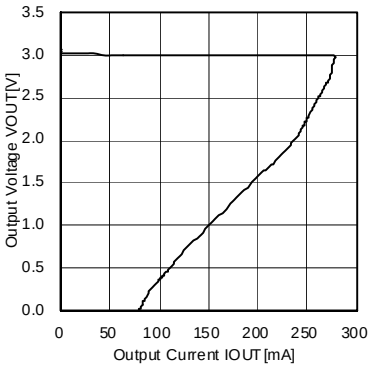


Fig.8 Output Voltage vs Output Current (BH30NB1WHFV)

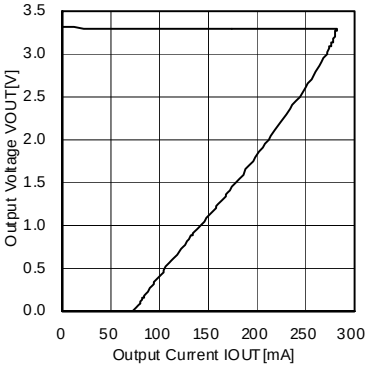


Fig.9 Output Voltage vs Output Current (BH33NB1WHFV)

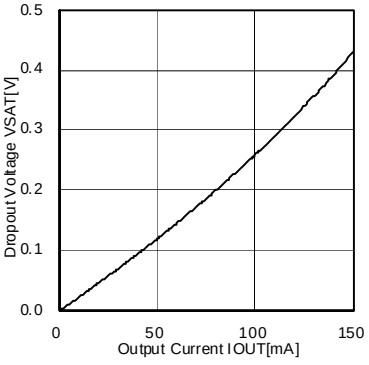


Fig.10 Dropout voltage vs Output Current (BH25NB1WHFV)

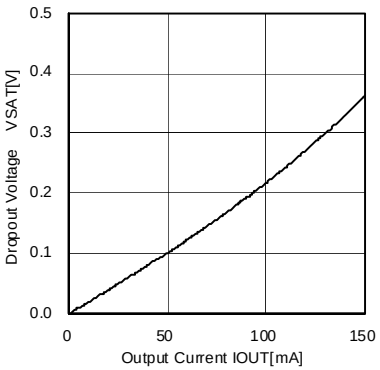


Fig.11 Dropout voltage vs Output Current (BH30NB1WHFV)

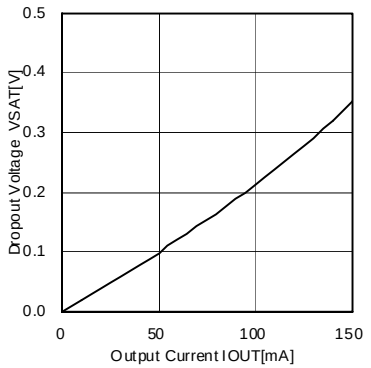


Fig.12 Dropout voltage vs Output Current (BH33NB1WHFV)

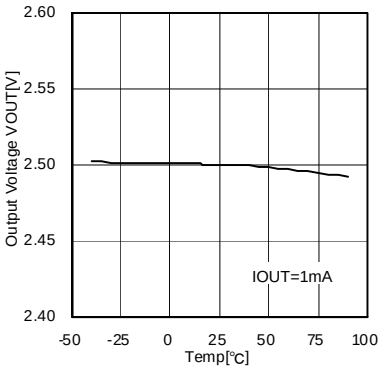


Fig.13 Output Voltage vs Temperature (BH25NB1WHFV)

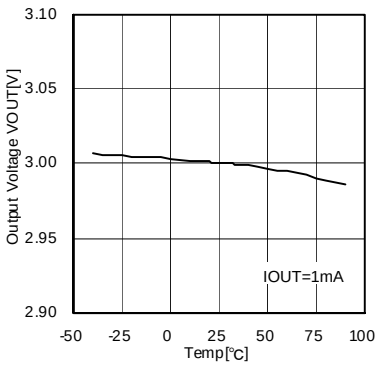


Fig.14 Output Voltage vs Temperature (BH30NB1WHFV)

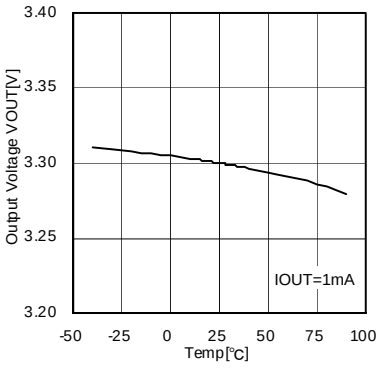


Fig.15 Output Voltage vs Temperature (BH33NB1WHFV)

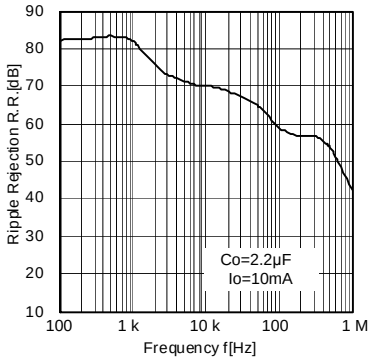


Fig.16 Ripple Rejection (BH25NB1WHFV)

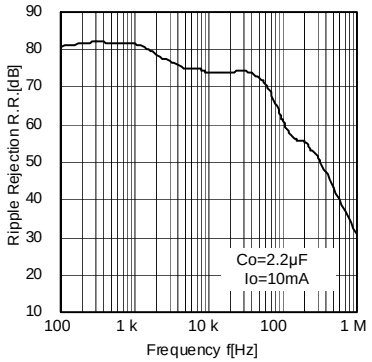


Fig.17 Ripple Rejection (BH30NB1WHFV)

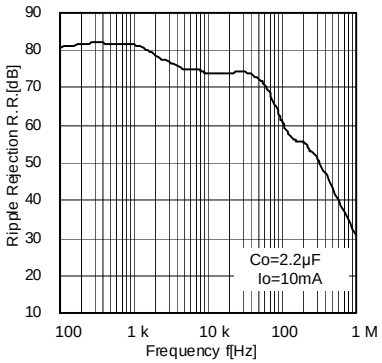


Fig.18 Ripple Rejection (BH33NB1WHFV)

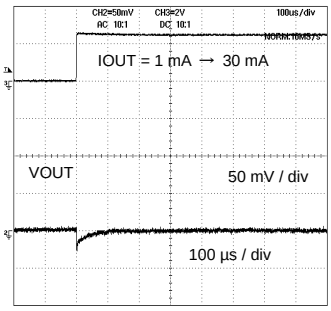


Fig.19 Load Response (Co = 2.2 µF) (BH25NB1WHFV)

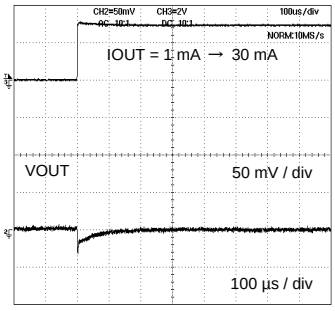


Fig.20 Load Response (Co = 2.2 µF) (BH30NB1WHFV)

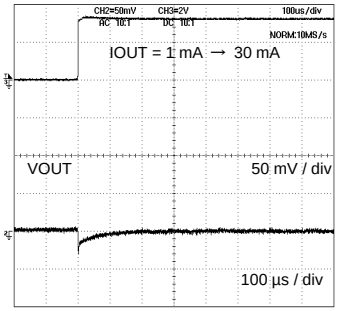


Fig.21 Load Response (Co = 2.2 µF) (BH33NB1WHFV)

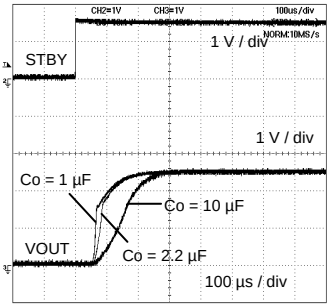


Fig.22 Output Voltage Rise Time (BH25NB1WHFV)

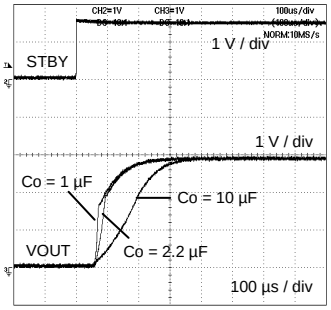


Fig.23 Output Voltage Rise Time (BH30NB1WHFV)

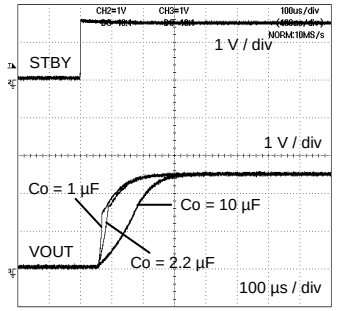
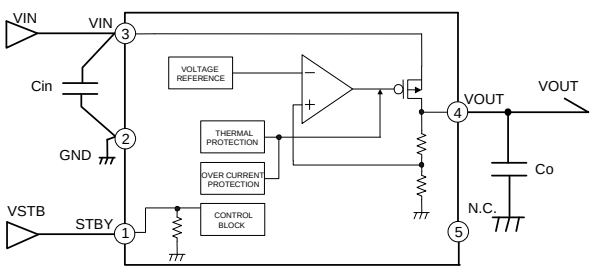
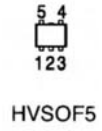


Fig.24 Output Voltage Rise Time (BH33NB1WHFV)

●Block diagram, recommended circuit diagram, and pin assignment diagram

BH□□NB1WHFV





Pin No.	Symbol	Function
1	STBY	Output voltage on/off control (High: ON, Low: OFF)
2	GND	Ground
3	VIN	Power supply input
4	VOUT	Voltage output
5	N.C.	NO CONNECT

Cin · · · 0.1μF
Co · · · 2.2μF

Fig.25

●Power dissipation (Pd)

1. Power dissipation (Pd)

Power dissipation calculations include estimates of power dissipation characteristics and internal IC power consumption, and should be treated as guidelines. In the event that the IC is used in an environment where this power dissipation is exceeded, the attendant rise in the junction temperature will trigger the thermal shutdown circuit, reducing the current capacity and otherwise degrading the IC's design performance. Allow for sufficient margins so that this power dissipation is not exceeded during IC operation.

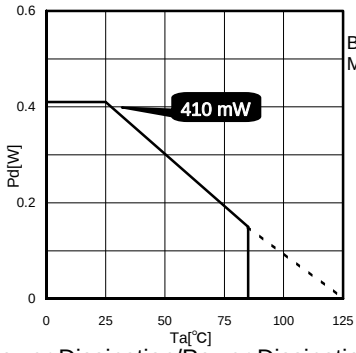
Calculating the maximum internal IC power consumption (P_{MAX})

$$P_{MAX} = (V_{IN} - V_{OUT}) \times I_{OUT\ (MAX.)}$$

V_{IN} : Input voltage
V_{OUT} : Output voltage
I_{OUT} (MAX): Max. output current

2. Power dissipation/power dissipation reduction (Pd)

HVSOF5



Board: 70 mm × 70 mm × 1.6 mm
Material: Glass epoxy PCB

Fig. 26 HVSOF5 Power Dissipation/Power Dissipation Reduction (Example)

*Circuit design should allow a sufficient margin for the temperature range so that PMAX < Pd.

●Input Output capacitors

It is recommended to insert bypass capacitors between input and GND pins, positioning them as close to the pins as possible. These capacitors will be used when the power supply impedance increases or when long wiring paths are used, so they should be checked once the IC has been mounted.
Ceramic capacitors generally have temperature and DC bias characteristics. When selecting ceramic capacitors, use X5R or X7R, or better models that offer good temperature and DC bias characteristics and high tolerant voltages.

Typical ceramic capacitor characteristics

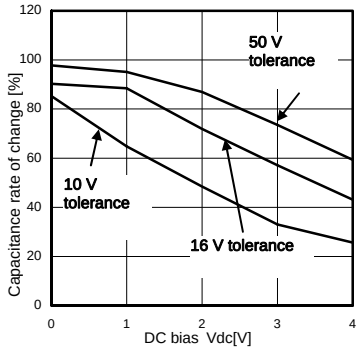


Fig.27 Capacitance vs Bias (Y5V)

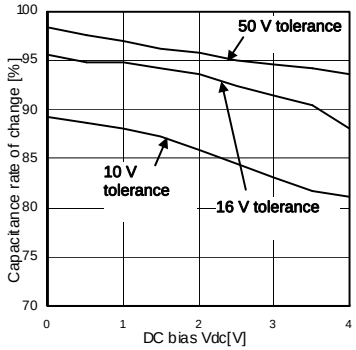


Fig.28 Capacitance vs Bias (X5R, X7R)

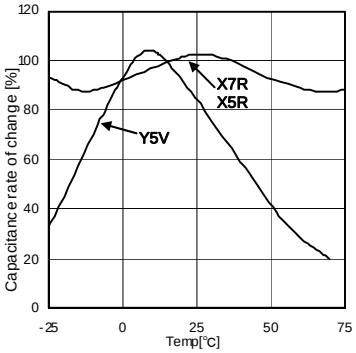


Fig.29 Capacitance vs Temperature (X5R, X7R, Y5V)

●Output capacitors

Mounting input capacitor between input pin and GND(as close to pin as possible), and also output capacitor between output pin and GND(as close to pin as possible) is recommended. The input capacitor reduces the output impedance of the voltage supply source connected to the VCC. The higher value the output capacitor goes, the more stable the whole operation becomes. This leads to high load transient response. Please confirm the whole operation on actual application board. Generally, ceramic capacitor has wide range of tolerance, temperature coefficient, and DC bias characteristic. And also its value goes lower as time progresses. Please choose ceramic capacitors after obtaining more detailed data by asking capacitor makers.

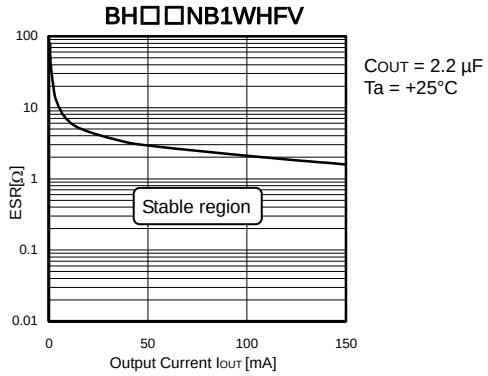


Fig.30 Stable Operation Region (Example)

●Operation Notes

1. Absolute maximum ratings
   An excess in the absolute maximum ratings, such as supply voltage, temperature range of operating conditions, etc., can break down the devices, thus making impossible to identify breaking mode, such as a short circuit or an open circuit. If any over rated values will expect to exceed the absolute maximum ratings, consider adding circuit protection devices, such as fuses.

2. Thermal design
   Use a thermal design that allows for a sufficient margin in light of the power dissipation (Pd) in actual operating conditions.

3. Inter-pin shorts and mounting errors
   Use caution when positioning the IC for mounting on printed circuit boards. The IC may be damaged if there is any connection error or if pins are shorted together.

4. Thermal shutdown circuit (TSD)
   The IC incorporates a built-in thermal shutdown circuit (TSD circuit). The thermal shutdown circuit is designed only to shut the IC off to prevent runaway thermal operation. It is not designed to protect the IC or guarantee its operation. Do not continue to use the IC after operating this circuit or use the IC in an environment where the operation of this circuit is assumed.

5. Overcurrent protection circuit
   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. These protection circuits are 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 capability has negative characteristics to temperatures.

6. Action in strong electromagnetic field
   Use caution when using the IC in the presence of a strong electromagnetic field as doing so may cause the IC to malfunction.

7. Ground wiring pattern
   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 ground potential of application 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 components, either.

8. GND voltage
The potential of GND pin must be minimum potential in all operating conditions.

9. Back Current
In applications where the IC may be exposed to back current flow, it is recommended to create a path to dissipate this current by inserting a bypass diode between the VIN and VOUT pins.

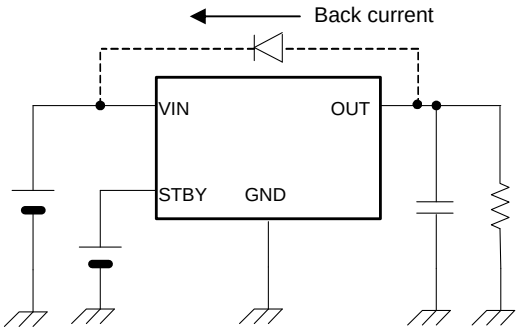


Fig. 31 Example Bypass Diode Connection

10. 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. Use similar precaution when transporting or storing the IC.

11. Regarding 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 these P layers with the N layers of other elements, creating a parasitic diode or transistor. For example, the relation between each potential is as follows:
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 can occur inevitable in the structure of the IC. The operation of parasitic diodes can result in mutual interference among circuits, operational faults, or physical damage. Accordingly, methods by which parasitic diodes operate, such as applying a voltage that is lower than the GND (P substrate) voltage to an input pin, should not be used.

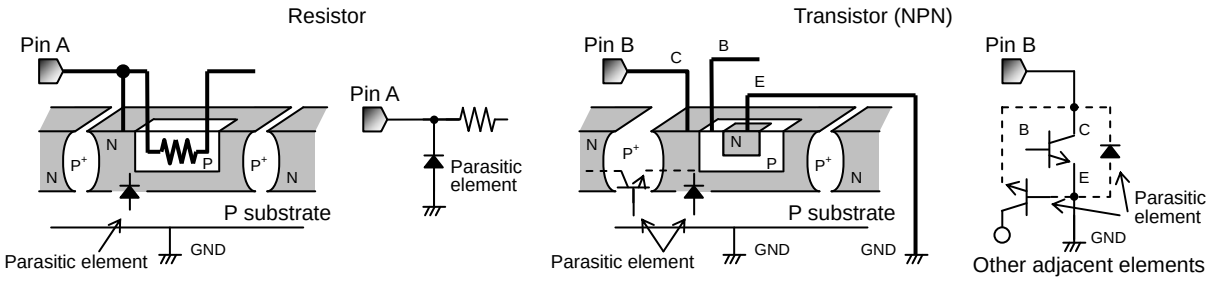


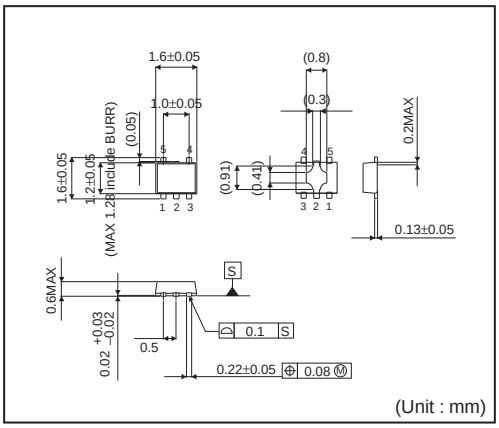
Fig.32 Example of IC structure

●Ordering part number

B	H	2	5	N	B	1	W	H	F	V	-	T	R

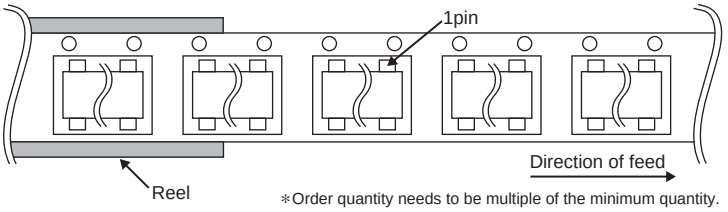
- Part No.
- Output voltage
  25:2.5 V
  28:2.8 V
  2J:2.85 V
  29:2.9 V
  30:3.0 V
  31:3.1 V
  33:3.3 V
- Series
  NB1 : High ripple rejection
- Shutdown switch
  W : Includes switch
- Package
  HFV : HVSOF5
- Packaging and forming specification
  TR: Embossed tape and reel

HVSOF5



<Tape and Reel information>

Tape	Embossed carrier tape
Quantity	3000pcs
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.

Notes

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