

## Reversible Motor Drivers for Brush Motors

# 0.5A or Less Reversible Motor Drivers (Single Moter)



BH6578FVM,BD7931F

No.11008EBT05

**●Description**

The BH6578FVM and BD7931F are reversible motor drivers with a wide output dynamic range, with power MOS used for the output transistor. The motor drivers can set the output mode to four modes of normal rotation, reverse rotation, stop (idling), and braking in accordance with input logic (2 inputs).

**●Features**

- 1) Wide dynamic range loading driver with MOS output,  $R_{on} = 1.0\Omega$  (Top+Bottom)
- 2) With loading driver voltage setting terminal
- 3) Built-in thermal shutdown circuit (TSD)
- 4) MSOP8 package (BH6578FVM)
- 5) SOP8 package (BD7931F)

**●Applications**

Tray loading of CD/DVD, applications using DC motors

**●Absolute maximum ratings (Ta=25°C)**

Parameter	Symbol	Ratings		Unit
		BH6578FVM	BD7931F	
Supply Voltage	Vcc	7	15	V
Power dissipation	Pd	0.55 *	0.69**	W
Operating temperature	Topr	-35~+85	-40~85	°C
Storage temperature	Tstg	-55~+150		°C
Output current	Iout	500		mA
Junction temperature	Tjmax	150		°C

\* When 70 mmx70 mmx1.6 mm thick glass epoxy substrate with less than 3% copper foil occupancy ratio is mounted. When used at Ta=25°C or higher, derated at 4.4 mW/°C.

\*\* When 70 mmx70 mmx1.6 mm thick glass epoxy substrate with less than 3% copper foil occupancy ratio is mounted. When used at Ta=25°C or higher, derated at 5.5 mW/°C.

**●Recommended operating range**

Parameter	Symbol	Range		Unit
		BH6578FVM	BD7931F	
Supply voltage	Vcc	4.5~5.5	4.5~14	V

**●Truth table**

BH6578FVM,BD7931F

INPUT		OUTPUT		Function
INFWD	INREV	OUT+	OUT-	
L	L	Hi Z	Hi Z	High Impedance
L	H	L	H	REV mode
H	L	H	L	FWD mode
H	H	L	L	Brake mode

Hiz : Hi-impedance

## ●Electrical characteristics

BH6578FVM(Unless otherwise specified, Ta=25°C, Vcc=5V)

Parameter	Symbol	Limits.			Unit	Conditions
		Min.	Typ.	Max.		
Standby current	ICC1	-	0.4	0.8	mA	No load
<b>(Loading Driver)</b>						
Output offset voltage	VOFSL	-15	0	+15	mV	Brake mode
Input threshold voltage H	VIH	2.0	—	Vcc	V	
Input threshold voltage L	VIL	GND	—	0.5	V	
ON resistance	RON	—	1.0	1.8	Ω	Io=500mA, Top+Bottom
Voltage gain (Loading)	GVLD	4.5	6.0	7.5	dB	*1
Voltage gain difference (Loading)	ΔGVLD	-2.0	0	2.0	dB	
Input bias current	IINL	—	86	120	μA	FIN=5V, RIN=5V
LDCONT bias current	ILDC	—	—	300	nA	CONT=2V

\* No radiation-resistant design is adopted for the present product.

\*1. Let V01 denote output-to-output voltage when CONT=1V and V02 denote output-to-output voltage when CONT=3.5V, voltage gain can be expressed by the following equation:  $GVLD=20\log[(V02-V01)/2.5]$ 

BD7931F(Unless otherwise specified, Ta=25°C, Vcc=8V)

Parameter	Symbol	Limits.			Unit	Conditions
		Min.	Typ.	Max.		
Standby current	ICC1	-	0	5	μA	
Supply current 1	ICC2	-	1.1	2.2	mA	FIN=5V, RIN=0V
Supply current 2	ICC3	-	0.8	1.6	mA	FIN=RIN=5V
<b>(Loading Driver)</b>						
Output offset voltage	VOFSL	-35	0	+35	mV	Brake mode
Input threshold voltage H	VIH	2.0	—	Vcc	V	
Input threshold voltage L	VIL	GND	—	0.5	V	
ON resistance	RON	—	1.0	1.8	Ω	Io=500mA, Top+Bottom
Voltage gain (Loading)	GVLD	4.0	6.0	8.0	dB	*2
Voltage gain difference (Loading)	ΔGVLD	-2.0	0	2.0	dB	
Input bias current	IINL	—	165	250	μA	FIN=5V, RIN=5V
LDCONT bias current	ILDC	—	—	300	nA	CONT=5V

\* No radiation-resistant design is adopted for the present product.

\*1. Let V01 denote output-to-output voltage when CONT=1V and V02 denote output-to-output voltage when CONT=3.5V, voltage gain can be expressed by the following equation:  $GVLD=20\log[(V02-V01)/2.5]$

●Reference data

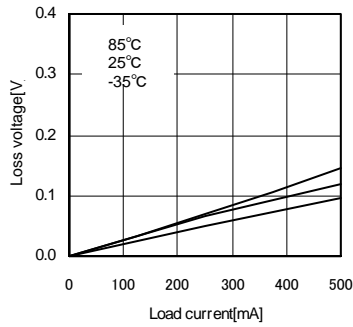


Fig.1 Output loss voltage L (BH6578FVM)  
V<sub>cc</sub>=5V, CONT=OPEN  
FWD mode

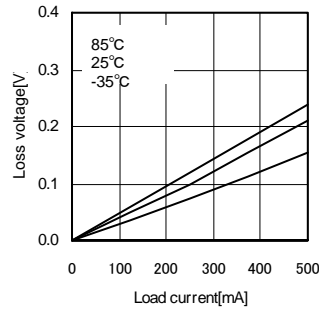


Fig.2 Output loss voltage L (BH6578FVM)  
V<sub>cc</sub>=5V, CONT=OPEN  
REV mode

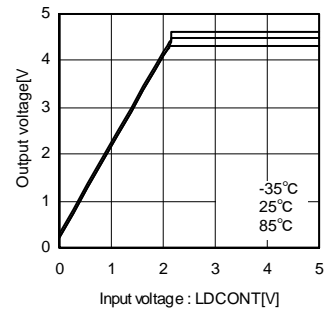


Fig.3 Voltage gain (BH6578FVM)  
V<sub>cc</sub>=5V, CONT=SWEEP  
R<sub>L</sub>=8Ω +47μH

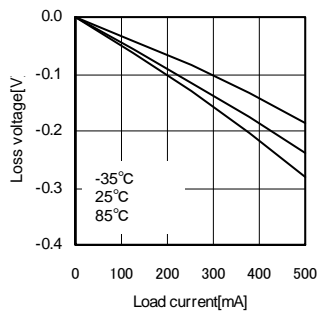


Fig.4 Output loss voltage H (BH6578FVM)  
V<sub>cc</sub>=5V, CONT=OPEN  
FWD mode

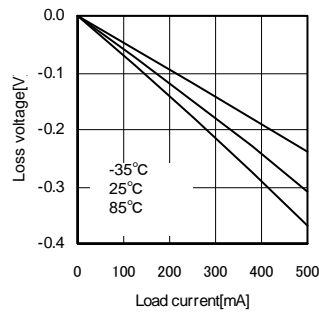


Fig.5 Output loss voltage H (BH6578FVM)  
V<sub>cc</sub>=5V, CONT=OPEN  
REV mode

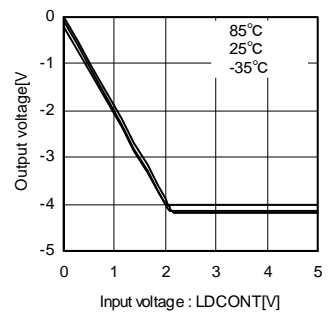


Fig.6 Voltage gain (BH6578FVM)  
V<sub>cc</sub>=5V, CONT=SWEEP  
R<sub>L</sub>=8Ω +47μH

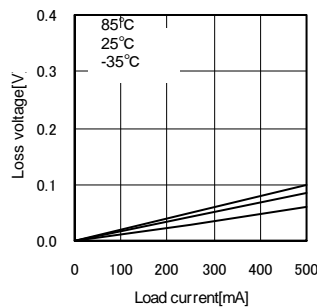


Fig.7 Output loss voltage L (BD7931F)  
V<sub>cc</sub>=8V, CONT=OPEN  
FWD mode

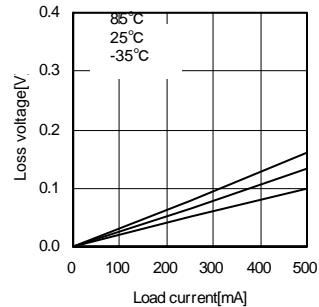


Fig.8 Output loss voltage L (BD7931F)  
V<sub>cc</sub>=8V, CONT=OPEN  
REV mode

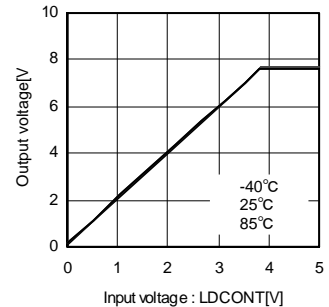


Fig.9 Voltage gain (BD7931F)  
V<sub>cc</sub>=8V, CONT=SWEEP  
R<sub>L</sub>=20Ω +47μH

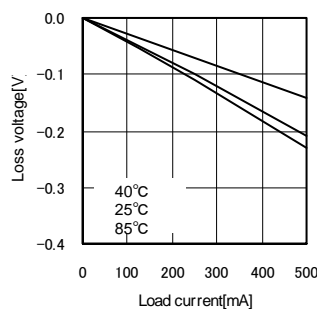


Fig.10 Output loss voltage H (BD7931F)  
V<sub>cc</sub>=8V, CONT=OPEN  
FWD mode

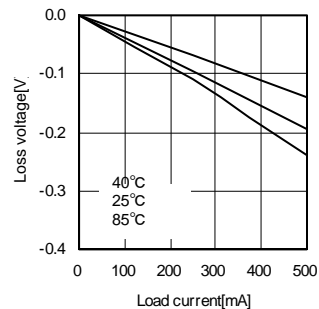


Fig.11 Output loss voltage H (BD7931F)  
V<sub>cc</sub>=8V, CONT=OPEN  
REV mode

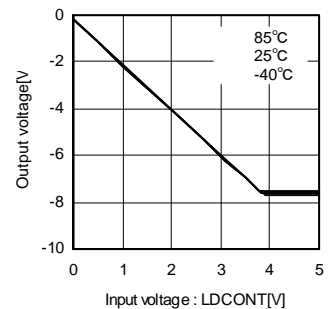
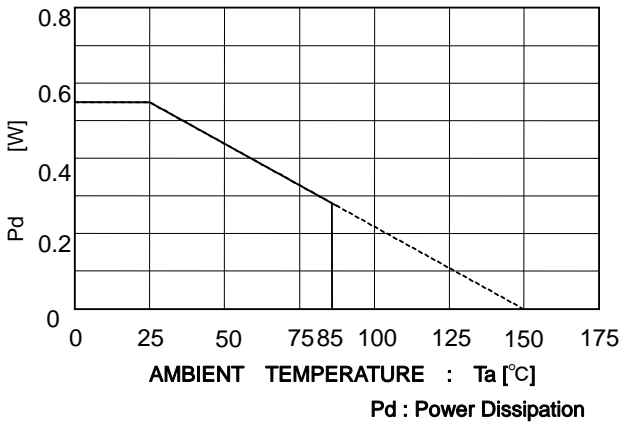


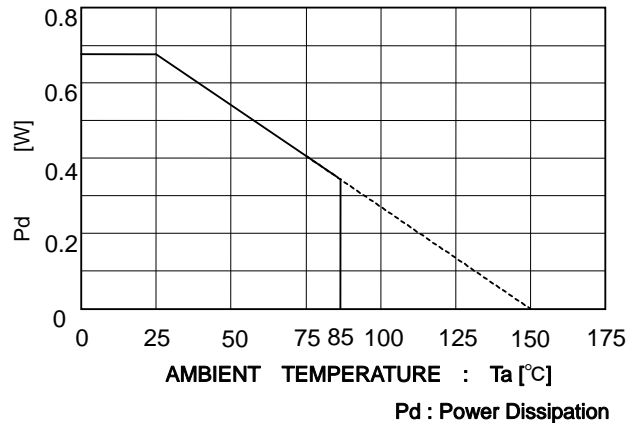
Fig.12 Voltage gain (BD7931F)  
V<sub>cc</sub>=8V, CONT=SWEEP  
R<sub>L</sub>=20Ω +47μH

● Thermal derating curves

BH6578FVM



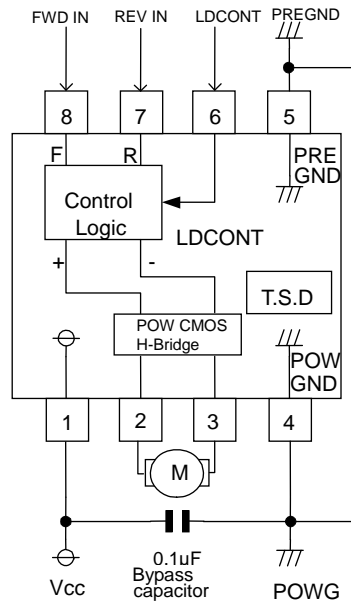
BD7931F



\*when 70 mmx70 mmx1.6 mm thick glass epoxy substrate with less than 3% copper foil occupancy ratio is mounted.

● Block diagram, applied circuit diagram example

BH6578FVM, BD7931F (in common)



T.S.D: Thermal shutdown

Fig.13

● Pin descriptions

Pin No.	Pin Name	Function	Pin No.	PinName	Function
1	Vcc	Supply voltage	5	GND_S	Signal ground
2	OUT+	FWD output	6	LDCONT	Loading driver voltage setting pin
3	OUT-	REV output	7	INREV	REV input
4	GND	Power ground	8	INFWD	FWD input

● Interfaces

BH6578FVM

LDCONT

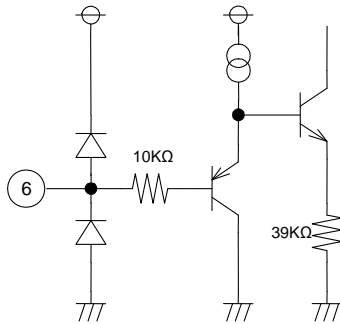


Fig.14

BD7931F

LDCONT

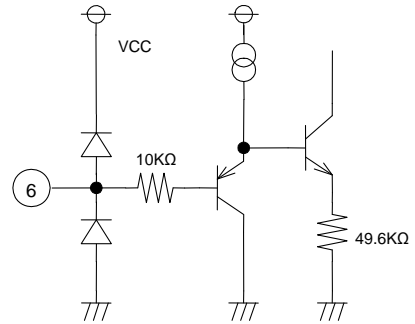


Fig.17

OUT+/OUT-

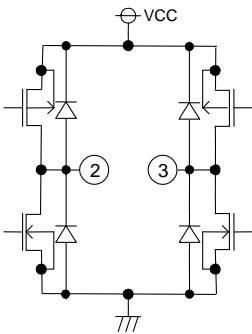


Fig.15

INFWD/INREV

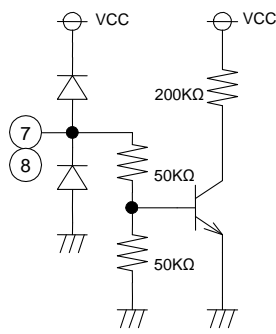


Fig.16

OUT+/OUT-

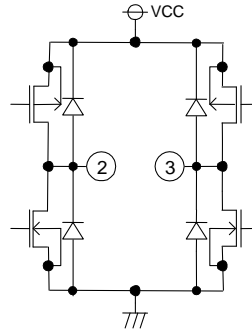


Fig.18

FIN/RIN

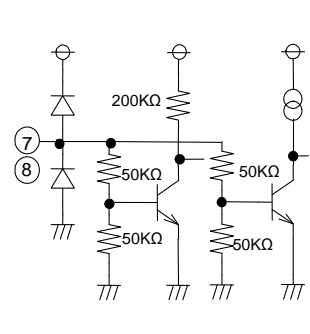


Fig.19

● Operations

(1) CONTROL LOGIC

Operation of each mode is carried out as follows:

When INFWD is "H" and INREV is "L," the normal rotation mode is achieved and current flows from OUT<sup>+</sup> to OUT<sup>-</sup>. When both INFWD and INREV are "H," the brake mode is achieved. Operation in such event is described as follows: the top-side transistor turns OFF to stop supplying motor drive current, the bottom-side transistor turns ON to absorb reverse EMF of motor and applies brake to motor. When both INFWD and INREV are "L," OUT<sup>+</sup> and OUT<sup>-</sup> potentials become open and the motor stops.

(2) LOADING CONT

Controlling the output voltage can vary voltage applied to the motor and can control the motor speed. By the voltage entered to the CONT terminal, the output H voltage can be controlled (gain 6dB Typ.). Even if the voltage entered is increased more than necessary (Vcc Max), the output voltage never exceeds the power supply voltage.

## ●Notes for use

- (1) Absolute maximum ratings  
In the event that applied voltage (VCC, VM), working temperature range (Topr), and other absolute maximum rating are exceeded, the IC may be destroyed. Because it is unable to identify the short-circuit mode, open mode, etc., if any special mode is assumed, which exceeds the absolute maximum rating, physical safety measures are requested to be taken, such as fuses, etc.
- (2) Reverse connection of power supply connector  
Reverse connection of power supply connector may destroy the IC. Take necessary measures to protect the IC from reverse connection breakage such as externally inserting diodes across power supply and IC power supply terminal as well as across power supply and motor coil.
- (3) Power supply line  
Because return of current regenerated by reverse EMF of a motor occurs, take necessary measures such as inserting capacitors across the power supply and GND as a path for regenerated current, and determine the capacity value after thoroughly confirming that there would be no problems in various characteristics such as capacitance drop at low temperature which may occur with electrolytic capacitors.
- (4) Ground potential  
Keep the GND terminal potential to the minimum potential under any operating condition. In addition, check if there is actually any terminal which provides voltage below GND including transient phenomena.
- (5) Thermal design  
Consider permissible dissipation (Pd) under actual working condition and carry out thermal design with sufficient margin provided.
- (6) Terminal-to-terminal short-circuit and erroneous mounting  
When the present IC is mounted to a printed circuit board, take utmost care to direction of IC and displacement. In the event that the IC is mounted erroneously, IC may be destroyed. In the event of short-circuit caused by foreign matter that enters in a clearance between outputs or output and power-GND, the IC may be destroyed.
- (7) Operation in strong electromagnetic field  
The use of the present IC in the strong electromagnetic field may result in maloperation, to which care must be taken.
- (8) ASO  
When IC is used, design in such a manner that the output transistor to a motor does not exceed absolute maximum ratings and ASO.
- (9) Thermal shutdown circuit (TSD) (common)  
When junction temperature (Tj) becomes thermal shutdown ON temperature 175°C, the thermal shutdown circuit (TSD circuit) is activated and driver output current is shorted. There is 25°C temperature hysteresis. The thermal shutdown protection circuit is first and foremost intended for interrupt IC from thermal runaway, and is not intended to protect and warrant the IC. Consequently, never attempt to continuously use the IC after this circuit is activated or to use the circuit with the activation of the circuit premised.
- (10) Capacitor across output and GND  
In the event a large capacitor is connected across output and GND, when Vcc and VIN are short-circuited with 0V or GND for some kind of reasons, current charged in the capacitor flows into the output and may destroy the IC. Use a capacitor smaller than 0.1 μF between output and GND.
- (11) Inspection by set substrate  
In the event a capacitor is connected to a pin with low impedance at the time of inspection with a set substrate, there is a fear of applying stress to the IC. Therefore, be sure to discharge electricity for every process. Furthermore, when the set substrate is connected to a jig in the inspection process, be sure to turn OFF power supply to connect the jig and be sure to turn OFF power supply to remove the jig. As electrostatic measures, provide grounding in the assembly process, and take utmost care in transportation and storage.

## (12) IC terminal input

The present IC is a monolithic IC and has P<sup>+</sup> isolation and a P substrate between elements to separate elements. With this P layer and N layer of each element, PN junction is formed, and various parasitic elements are formed. For example, when resistors and transistors are connected to terminals as is the case of Fig.20, where in the case of resistor, the potential difference satisfies the relation of GND > (terminal A), and in the case of transistor (NPN), the potential difference satisfies the relation of GND > (terminal B), PN junction works as a diode.

Furthermore, in the case of transistor (NPN), a parasitic NPN transistor operates by the N-layer of other elements adjacent to the parasitic diode. The parasitic element is inevitably formed because of the IC construction. The operation of the parasitic element gives rise to mutual interference between circuits and results in malfunction, and eventually, breakdown. Consequently, take utmost care not to use the IC to operate the parasitic element such as applying voltage lower than GND (P substrate) to the input terminal.

In addition, when the power supply voltage is not applied to IC, do not apply voltage to the input terminal, either. Similarly, when the power supply voltage is applied, each input terminals shall be the voltage below the power supply voltage or within the guaranteed values of electrical properties.

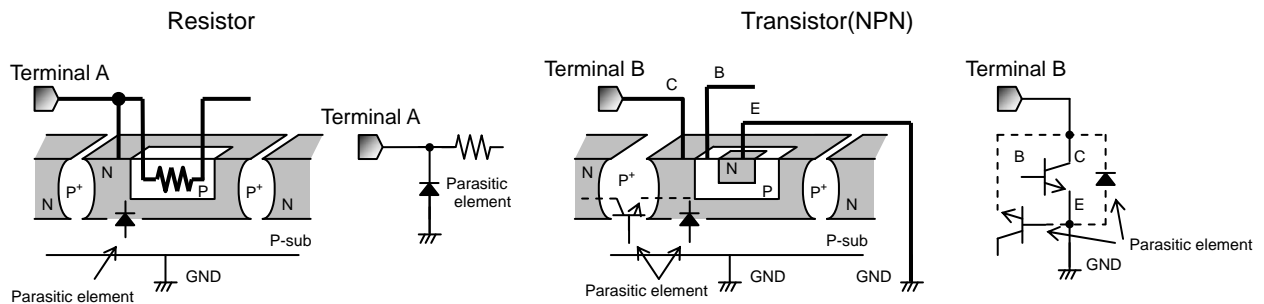


Fig.20 Example of the basic structure of a bipolar IC

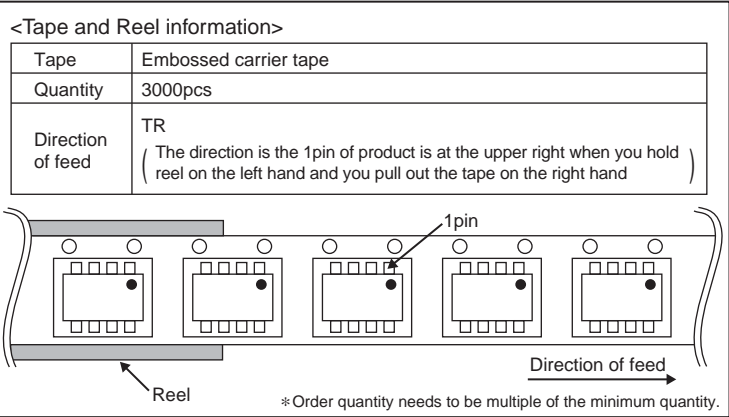
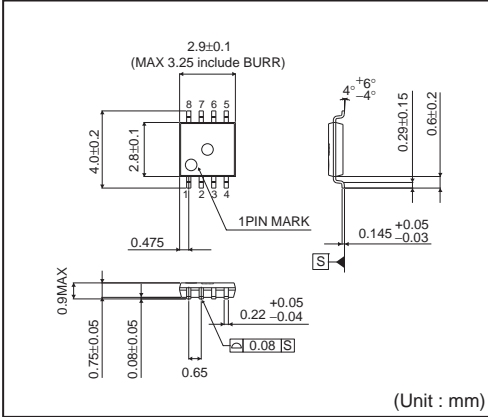
## (13) GND wiring pattern

If there are a small signal GND and a high current GND, it is recommended to separate the patterns for the high current GND and the small signal GND and provide a proper grounding to the reference point of the set not to affect the voltage at the small signal GND with the change in voltage due to resistance component of pattern wiring and high current. Also for GND wiring pattern of the component externally connected, pay special attention not to cause undesirable change to it.

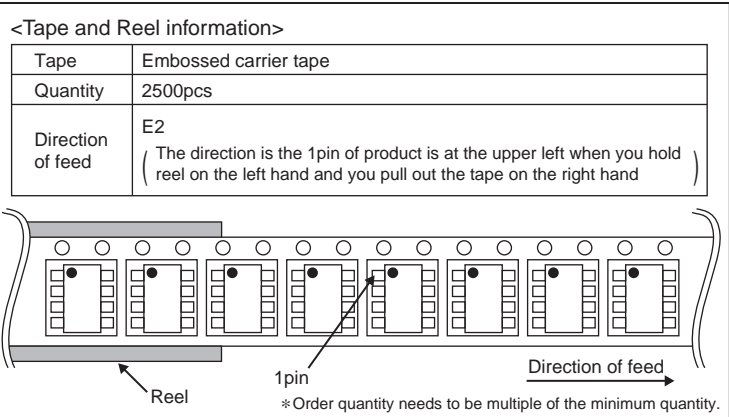
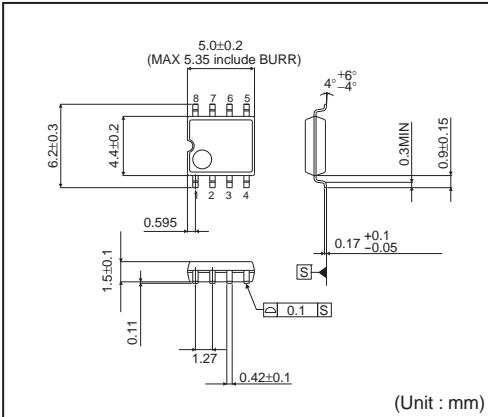
●Operating part number

B	H		6	5	7	8		F	V	M	-	T	R
Part No BH BD		Part No 6578 7931					Package FVM : MSOP8 F : SOP8			Packaging and forming specification E2: Embossed tape and reel (SOP8) TR: Embossed tape and reel (MSOP8)			

MSOP8



SOP8





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CLASS III	CLASS III	CLASS II b	CLASS III
CLASS IV		CLASS III	

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  - Use of our Products in places where the Products are exposed to sea wind or corrosive gases, including Cl<sub>2</sub>, H<sub>2</sub>S, NH<sub>3</sub>, SO<sub>2</sub>, and NO<sub>2</sub>
  - Use of our Products in places where the Products are exposed to static electricity or electromagnetic waves
  - Use of our Products in proximity to heat-producing components, plastic cords, or other flammable items
  - Sealing or coating our Products with resin or other coating materials
  - 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
  - Use of the Products in places subject to dew condensation
- The Products are not subject to radiation-proof design.
- Please verify and confirm characteristics of the final or mounted products in using the Products.
- 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.
- De-rate Power Dissipation (Pd) depending on Ambient temperature (Ta). When used in sealed area, confirm the actual ambient temperature.
- Confirm that operation temperature is within the specified range described in the product specification.
- 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

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

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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.
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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 Cl<sub>2</sub>, H<sub>2</sub>S, NH<sub>3</sub>, SO<sub>2</sub>, and NO<sub>2</sub>
  - [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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