D/A Converter Series for Electronic Adjustments

Standard 8bit 8ch Type D/A Converters

BH2226FV,BH2226F

No.09052EBT05

●Description

The BH2226FV,BH2226F is an 8bit R-2R-type D/A converter with 8 channels. The D/A converter output and serial / parallel conversion function can be switched with one command, and a built-in RESET function ensures that the output voltage at all channels is Low during power up. A broad power supply voltage range (2.7V-5.5V) is available, providing design flexibility.

●Features

1) Integrated expansion port function
2) Built-in RESET function
3) High speed output response characteristics
4) 3-line-type serial interface
5) Broad power supply voltage range: 2.7V-5.5V

●Applications

DVCs, DSCs, DVDs, CD-Rs, CD-RWs

●Line up matrix

Parameter	BH2226FV	BH2226F
Power source voltage range	2.7~5.5V	2.7~5.5V
Number of channels	8ch	8ch
Current consumption	1.3 mA	1.3 mA
Differential non linearity error	±1.0LSB	±1.0LSB
Integral non linearity error	±1.5LSB	±1.5LSB
Output current performance	±1.0mA	±1.0mA
Settling time	100µs	100µs
Data transfer frequency	10MHz	10MHz
Input format	CMOS	CMOS
Data latch method	CSB method	CSB method
Package	SSOP-B16	SOP16

●Absolute Maximum Ratings

(Ta=25℃)

Parameter	Symbol	Limits	Unit	Remarks
Power source voltage	VCC	-0.3~7.0	V	-
Terminal voltage	VIN	-0.3~VCC	V	-
Storage temperature range	TSTG	-55~125	℃	-
Power dissipation	PD	450*1	mW	BH2226FV
		500*2	mW	BH2226F

*1 Derated at 4.5mW/ ℃ at Ta>25℃

*2 Derated at 5.0mW/ ℃ at Ta>25℃

*3 Please note that this product is not robust against radiation.

●Recommended Operating Conditions

(Ta=25℃)

Parameter	Symbol	Limits			Unit	Remarks
		MIN.	TYP.	MAX.		
VCC power source voltage	VCC	2.7	-	5.5	V	-
Terminal input voltage range	VIN	0	-	VCC	V	-
Analog output current	IO	-1.0	-	1.0	mA	-
Operating temperature range	TOPR	-20	-	85	℃	-
Serial clock frequency	FCLK	-	1.0	10.0	MHz	-
D/A output limit load capacity	CL	-	-	0.1	μF	-

●Electrical Characteristics

(Unless otherwise specified, VCC=3.0V, RL=OPEN, CL=0pF, Ta=25℃)

Parameter	Symbol	Limits			Unit	Conditions
		MIN.	TYP.	MAX.		
<Current consumption>						
VCC system	ICC	-	1.1	2.5	mA	CLK=1MHz, 80H setting
	ICCPD	-	5	20	μA	At power down setting
<Logic interface>						
L input voltage	VIL	GND	-	0.6	V	VCC=5V
H input voltage	VIH	2.4	-	VCC	V	VCC=5V
Input current	IIN	-10	-	10	μA	
L output voltage	VOL	-	-	0.4	V	IOH=2.5mA
H output voltage	VOH	VCC-0.4	-	-	V	IOL=0.4mA
<Buffer amplifier>						
Output zero scale voltage	ZS1	GND	-	0.1	V	00H setting, at no load
	ZS3	GND	-	0.3	V	00H setting, IOH=1.0mA
Output full scale voltage	FS1	VCC-0.1	-	VCC	V	FFH setting, at no load
	FS3	VCC-0.3	-	VCC	V	FFH setting, IOL=1.0mA
<D/A converter precision>						
Differential non linearity error	DNL	-1.0	-	1.0	LSB	Input code 02H~FDH
Integral non linearity error	INL	-1.5	-	1.5	LSB	Input code 02H~FDH
VCC power source voltage rise time	trVCC	100	-	-	μs	VCC=0→2.7V
Power on reset release voltage	VPOR	-	1.9	-	V	

●Timing Chart

（Unless otherwise specified, VCC=3.0V, RL=OPEN, CL=0pF, Ta=25℃）

Parameter	Symbol	Limits			Unit	Conditions
		MIN.	TYP.	MAX.		
CLK L level time	tCLKL	50	-	-	ns	
CLK H level time	tCLKH	50	-	-	ns	
DI setup time	tsDI	20	-	-	ns	
DI hold time	thDI	40	-	-	ns	
Parallel input setup time	tsPI	20	-	-	ns	
Parallel input hold time	thPI	40	-	-	ns	
CSB setup time	tsCSB	50	-	-	ns	
CSB hold time	thCSB	50	-	-	ns	
CSB H level time	tCSBH	50	-	-	ns	
D/A output settling time	tOUT	-	-	100	µs	CL=50pF,RL=10kΩ
Parallel output delay time	tpOUT	-	-	600	ns	CL=50pF,RL=10kΩ
Serial output delay time	tsOUT	-	-	350	ns	CL=50pF,RL=10kΩ

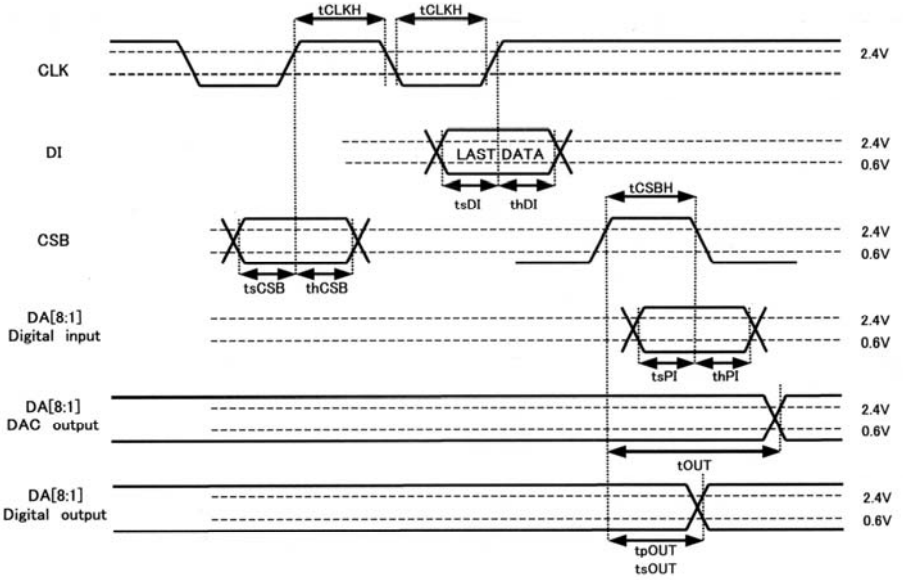


Fig.1

●Terminal Description / Block Diagrams

(BH2226FV,BH2226F)

No.	Terminal name	Function
1	DA1	Analog output terminal / I/O input output terminal
2	DA2	
3	DA3	
4	DA4	
5	DA5	
6	DA6	
7	DA7	
8	DA8	
9	VCC	Power source terminal
10	RESETB	Reset terminal
11	TEST	Test terminal (normal connected to GND)
12	CSB	Chip select signal input terminal
13	CLK	Serial clock input terminal
14	DI	Serial data input terminal
15	SO	Serial data output terminal
16	GND	Ground terminal

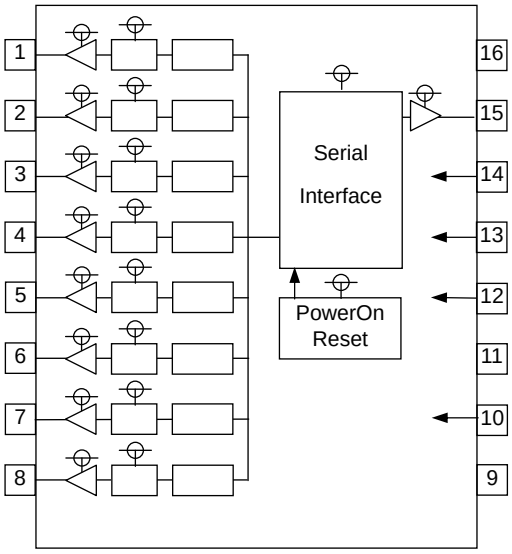


Fig.2

●Input-Output equivalence circuits

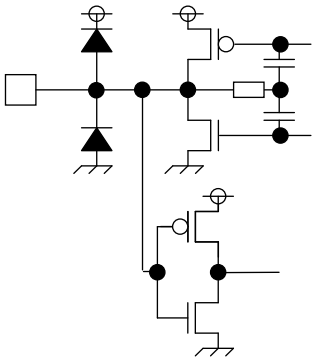
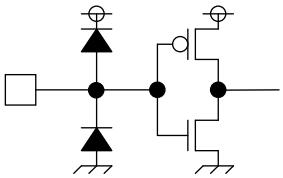
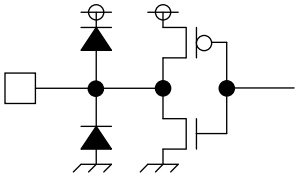
Terminal	Equivalence Circuit	Terminal	Equivalence Circuit
DA1 DA2 DA3 DA4 DA5 DA6 DA7 DA8		DI CLK CSB TEST RESETB	
		SO	

Fig.3 Input-Output equivalence circuits

●Operation Description

・Command Transmission

The Control command consists of 3 lines of 12bit serial input data (MSB first).

DI data is read at the rising edge of the CLK, and becomes valid in the CSB Low area (before the CSB rise for 12bit data).

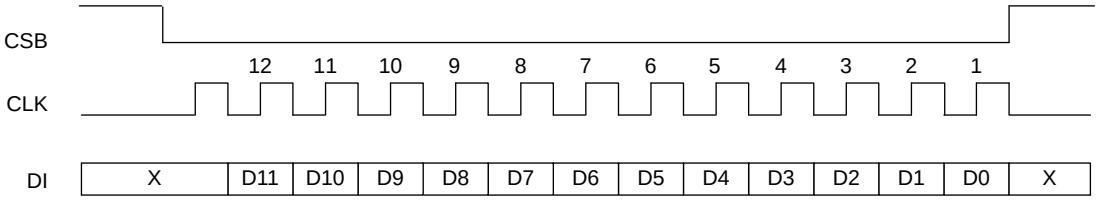


Fig.4

Data Settings

D0	D1	D2	D3	D4	D5	D6	D7	Setting
0	0	0	0	0	0	0	0	At D/A setting：GND
1	0	0	0	0	0	0	0	At D/A setting：(VCC-GND)/256x1
0	1	0	0	0	0	0	0	At D/A setting：(VCC-GND)/256 x 2
1	1	0	0	0	0	0	0	At D/A setting：(VCC-GND)/256 x 3
0	0	1	0	0	0	0	0	At D/A setting：(VCC-GND)/256 x 4
~								~
0	1	1	1	1	1	1	1	At D/A setting：(VCC-GND)/256 x 254
1	1	1	1	1	1	1	1	At D/A setting：(VCC-GND)/256 x 255

(Note) Default D[7:0]=00h

Channel Settings

D8	D9	D10	D11	Setting
0	0	0	0	Power down setting (default)
0	0	0	1	DA1
0	0	1	0	DA2
0	0	1	1	DA3
0	1	0	0	DA4
0	1	0	1	DA5
0	1	1	0	DA6
0	1	1	1	DA7
1	0	0	0	DA8
1	0	0	1	Power down release
1	0	1	0	Inconsequential
1	0	1	1	Inconsequential
1	1	0	0	I/O D/A select
1	1	0	1	I/O serial⇒Parallel
1	1	1	0	I/O parallel⇒Serial
1	1	1	1	I/O status setting

Input / Output D/A Selection settings ：Each channel can be set for either I/O port or D/A converter output.

0: I/O mode (When I/O mode is selected, set the status as well.)

1: D/A mode (Set the I/O status to output mode.)

D0	D1	D2	D3	D4	D5	D6	D7	Description
DA1	DA2	DA3	DA4	DA5	DA6	DA7	DA8	Corresponding terminals for I/O or D/A selection

I/O Status Setting : Set the status of the I/O input output terminal by D0 ~ D7.

0: input mode (High-Z status)

1: output mode

D0	D1	D2	D3	D4	D5	D6	D7	Description
DA1	DA2	DA3	DA4	DA5	DA6	DA7	DA8	Corresponding terminals for status setting

・Command Transmission Procedures

Carry out the following after power on and just after external reset:

(1) Power Down Release (2) I/O D/A Select (3) I/O Status Set

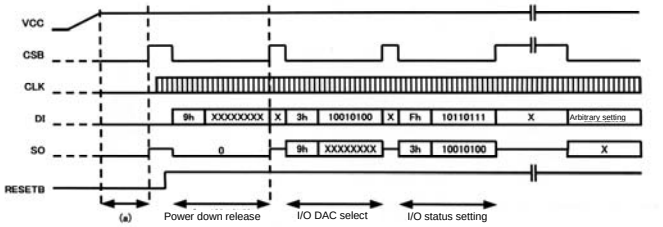


Fig.5

Note: When power is started, the power on reset is activated and the internal register initialized. However, as shown in the figure above, in area (a), if CSB cannot be made High and noise is introduced in the control line an error may occur when setting during the rising CSB signal.

In such a case, set the external RESETB terminal to Low and reset when CSB = High.

・Parallel - Serial Conversion

Parallel data {DA[8:1]} is taken in at the first CSB falling edge after setting the parallel serial command.

The data is then outputted in synch with the falling edge of the CLK in the next CSB = Low area, and output from 4CLK.

However, please note that the SCLK falling edge that occurs from CSB fall to the first SCLK rising edge is not counted.

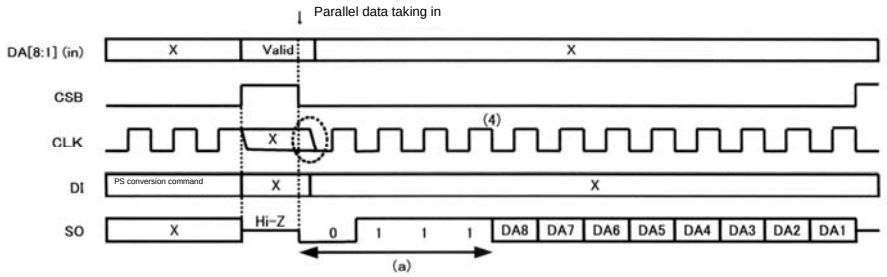


Fig.6

・Serial - Parallel Conversion

DI serial data is taken in at the rising edge of the CLK.

The data is then output from the DA[8:1] terminal just after the CSB rising edge.

During that time the SO terminal output becomes undetermined (just previous address setting + data output).

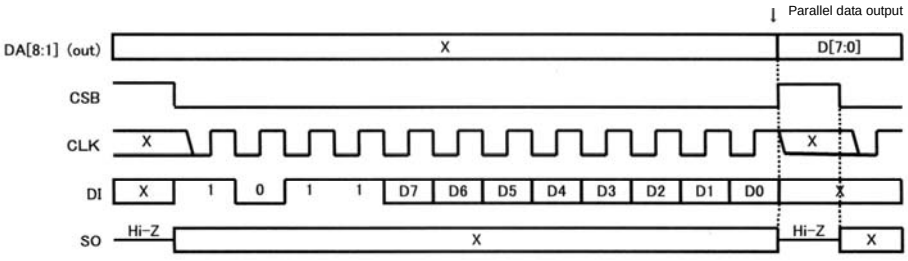


Fig.7

・D/A Converter Output Setting (Fig. 7)

DI serial data is taken in at the rising edge of the clock.

The D/A converter output is output from the DA[8:1] terminal just after the rising edge of the CSB.

During that time, the SO terminal output becomes undetermined (just previous address setting + data output).

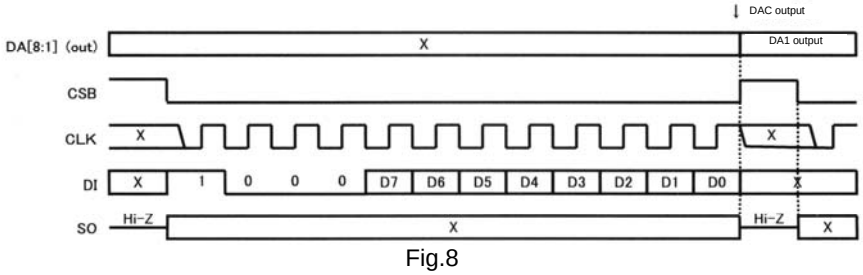


Fig.8

●Electrical Characteristics Curves

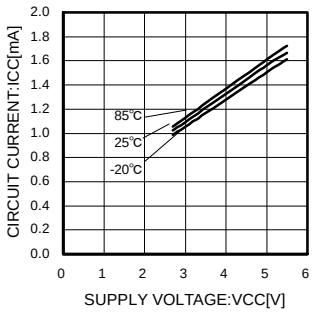


Fig.9 Action current consumption

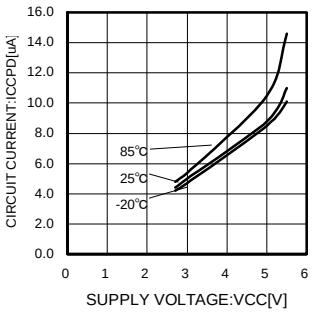


Fig.10 Consumption current at power down

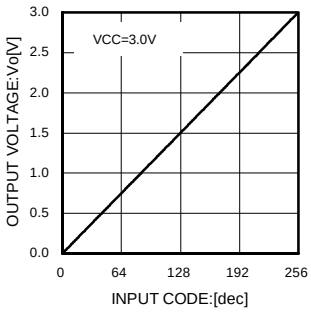


Fig.11 Output voltage characteristic

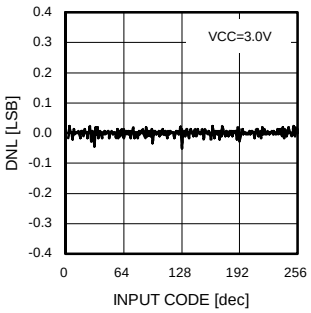


Fig.12 Differential non linearity error

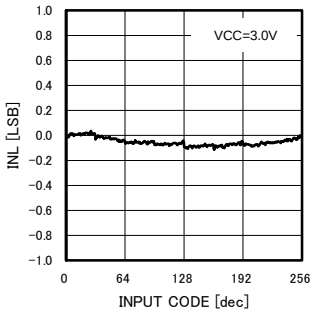


Fig.13 Integral non linearity error

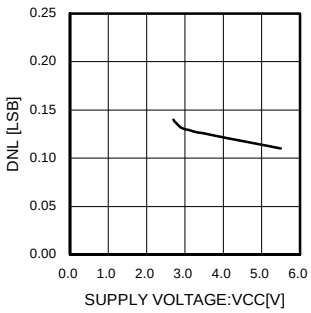


Fig.14 Power source voltage vs. differential non linearity error

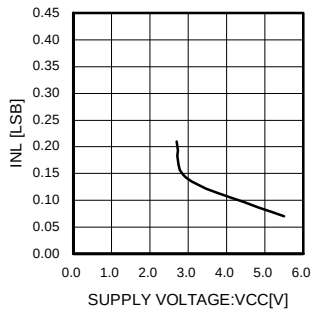


Fig.15 Power source voltage vs. integral non linearity error

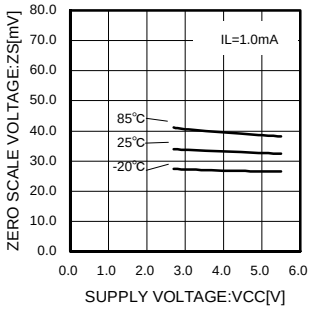


Fig.16 Output zero scale voltage

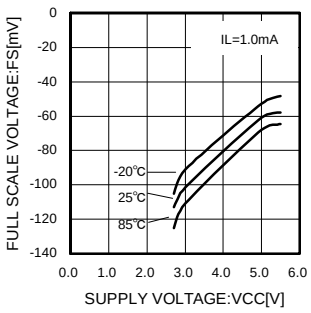


Fig.17 Output full scale voltage

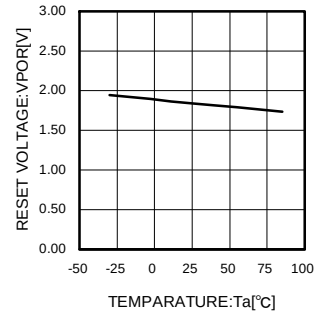


Fig.18 Reset release voltage

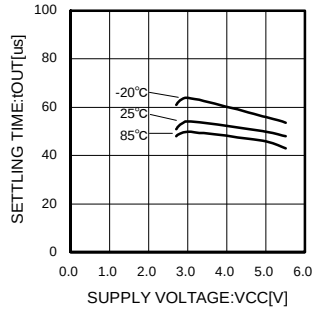


Fig.19 Settling time

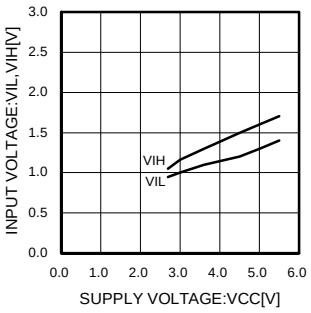


Fig.20 Input voltage

●Operation Notes

(1) Numbers and data in entries are representative design values and are not guaranteed values of the items.

(2) Although we are confident in recommending the sample application circuits, carefully check their characteristics further when using them. When modifying externally attached component constants before use, determine them so that they have sufficient margins by taking into account variations in externally attached components and the Rohm LSI, not only for static characteristics but also including transient characteristics.

(3) Absolute Maximum Ratings
Operating or testing the device over the maximum specifications may damage the part itself as well as peripheral components. Therefore, please ensure that the specifications are not exceeded.

(4) GND potential
Ensure that the GND terminal is at the lowest potential under all operating conditions.

(5) Thermal design
Use a thermal design that allows for a sufficient margin regarding power dissipation (Pd) under actual operating conditions.

(6) Terminal shorts and mis-mounting
Incorrect orientation or misalignment of the IC when mounting to the PCB may damage part. Short-circuits caused by the introduction of foreign matter between the output terminals or across the output and power supply or GND may also result in destruction.

(7) Operation in a strong magnetic field
Operation in a strong electromagnetic field may cause malfunction.

(8) Reset Function
The power on reset circuit, which initializes internal settings, may malfunction during abrupt power ons. Therefore, set the time constant so as to satisfy the power source rise time.

(9) After power on and after the external reset is in power down status, DA1 ~ DA8 will be in input mode (all terminals at High-Z).

(10) In the case of condition changes in the DA1 ~ DA8 terminals (i.e. changes from D/A mode to serial-parallel mode, from serial-parallel mode to parallel-serial mode, excluding D/A data and I/O data updates), change both analog and digital settings of High-Z.

(11) Connect the RESETB terminal to VCC and set it to High, making sure that it becomes Low only at reset.

(12) Initialization of the serial interface shift register is carried out only by power on reset, or external reset, and is not reset by CSB = High. Therefore, when a specified clock number (12CLK) is not attained during command setting, interrupting processing, transfer regular data once again.

(13) The power down function restricts the consumption current in the internal analog circuit. Set it by command. At power down, for channels set to D/A mode, "I/O D/A selection" is changed from "D/A mode" to "I/O mode". Therefore, when the "I/O status setting" of the channel is in input mode, the terminal is in High-Z status and the input becomes unstable and unnecessary current flows. Set the I/O status setting of channel to be in output mode, or set the terminal using resistance.

(14) When shifting from PIO use status to D/A use status, a wait time in order to ensure D/A output stability is necessary. Therefore wait for a maximum of 1ms after the "I/O D/A select" command is input.
If wait time is problematic, set the D/A setting code to 80hex and change it to the specified code setting.

●Ordering part number

B	H	2	2	2	6	F	V	-	E	2

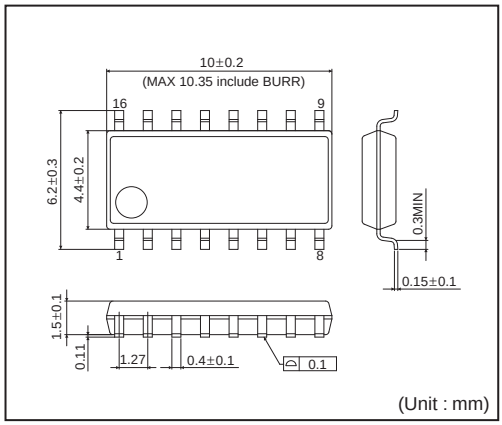
Part No. (BH)

Part No. (2226)

Package
FV: SSOP-B16
F: SOP16

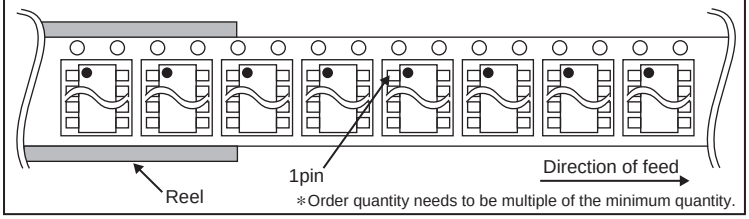
Packaging and forming specification
E2: Embossed tape and reel
(SSOP-B16/SOP16)

SOP16



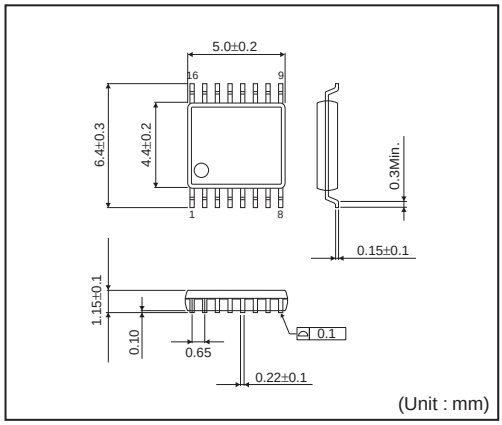
<Tape and Reel information>

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.

SSOP-B16



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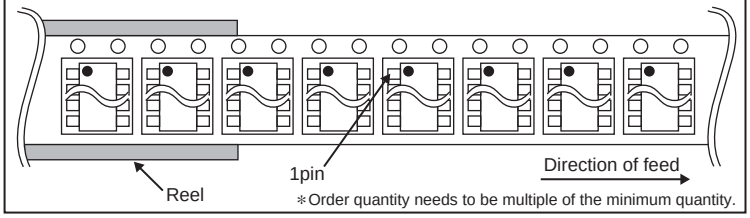

∗Order quantity needs to be multiple of the minimum quantity.

Notice

Precaution on using ROHM Products

1. Our Products are designed and manufactured for application in ordinary electronic equipments (such as AV equipment, OA equipment, telecommunication equipment, home electronic appliances, amusement equipment, etc.). If you intend to use our Products in devices requiring extremely high reliability (such as medical equipment (Note 1), transport equipment, traffic equipment, aircraft/spacecraft, nuclear power controllers, fuel controllers, car equipment including car accessories, safety devices, 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 designed and manufactured for use under standard conditions and not 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

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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.

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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.

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