

## D/A Converter Series for Electronic Adjustments

# Standard 8bit 10ch 12ch Type D/A Converters


**BH2223FV, BH2221FV**

No.09052EAT06

**●Description**

BH2223FV and BH2221FV are high performance 8bit R-2R-type D/A converters with 10 and 12 channels outputs, respectively. A built-in RESET function ensures that the output voltage at all channels is Low during power up. And a broad power supply voltage range (2.7V - 5.5V) provides design flexibility.

**●Features**

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

**●Applications**

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

**●Lineup**

| Parameter                        | BH2223FV    | BH2221FV    |
|----------------------------------|-------------|-------------|
| Power source voltage range       | 2.7 to 5.5V | 2.7 to 5.5V |
| Number of channels               | 10ch        | 12ch        |
| Current consumption              | 1.6mA       | 1.8mA       |
| 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 method                     | CMOS        | CMOS        |
| Data latch method                | LD method   | LD method   |
| Package                          | SSOP-B16    | SSOP-B20    |

**●Absolute Maximum Ratings (Ta=25°C)**

| Parameter                 | Symbol | Limits      | Unit | Remarks  |
|---------------------------|--------|-------------|------|----------|
| Power source voltage      | VCC    | -0.3 to 7.0 | V    |          |
| Terminal voltage          | VIN    | -0.3 to VCC | V    |          |
| Storage temperature range | TSTG   | -55 to 125  | °C   |          |
| Power dissipation         | PD     | 650*1       | mW   | BH2221FV |
|                           |        | 450*2       | mW   | BH2223FV |

\*1 Derated at 6.5mW/°C at Ta>25°C

\*2 Derated at 4.5mW/°C at Ta>25°C

\*3 These products are not robust against radiation

**●Recommended Operating Conditions (Ta=25°C)**

| Parameter                    | Symbol | Limits |      |      | Unit | Remarks |
|------------------------------|--------|--------|------|------|------|---------|
|                              |        | MIN.   | TYP. | MAX. |      |         |
| VCC power source voltage     | VCC    | 2.7    | -    | 5.5  | V    | -       |
| VDD power source voltage     | VDD    | 2.7    | -    | VCC  | V    | -       |
| Terminal input voltage range | VIN    | 0      | -    | VCC  | V    | -       |
| Analog output current        | IO     | -1.0   | 0    | 1.0  | mA   | -       |
| Action temperature range     | TOPR   | -20    | -    | 85   | °C   | -       |
| Serial clock frequency       | FSCLK  | -      | 1.0  | 10.0 | MHz  | -       |
| Limit load capacity          | CL     | -      | -    | 0.1  | μF   | -       |

●Electrical Characteristics (Unless otherwise specified, VCC=3.0V, VDD=3.0V, RL=OPEN, CL=0pF, Ta=25°C)

| Parameter                          | Symbol | Limits  |      |        | Unit | Conditions              |
|------------------------------------|--------|---------|------|--------|------|-------------------------|
|                                    |        | MIN.    | TYP. | MAX.   |      |                         |
| <Current consumption>              |        |         |      |        |      |                         |
| VCC system                         | ICC    | -       | 0.6  | 1.5    | mA   | CLK=1MHz, 80H setting   |
| VDD system                         | IDD    | -       | 1.0  | 2.0    | mA   |                         |
| <Logic interface>                  |        |         |      |        |      |                         |
| L input voltage                    | VIL    | GND     | -    | 0.2VCC | V    |                         |
| H input voltage                    | VIH    | 0.8VCC  | -    | VCC    | V    |                         |
| Input current                      | IIN    | -10     | -    | 10     | μA   |                         |
| <Buffer amplifier>                 |        |         |      |        |      |                         |
| Output zero scale voltage          | ZS1    | GND     | -    | 0.1    | V    | 00H setting, at no load |
|                                    | ZS2    | GND     | -    | 0.3    | V    | 00H setting, IOH=1.0mA  |
| Output full scale voltage          | FS1    | VCC-0.1 | -    | VCC    | V    | FFH setting, at no load |
|                                    | FS2    | 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 to FDH   |
| Integral non linearity error       | INL    | -1.5    | -    | 1.5    | LSB  | Input code 02H to 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 (VCC = 3.0V, VDD = 3.0V, RL = OPEN, CL = 0pF, Ta = 25°C, unless otherwise specified.)

| Parameter            | Symbol | Limits |      |      | Unit | Conditions       |
|----------------------|--------|--------|------|------|------|------------------|
|                      |        | MIN.   | TYP. | MAX. |      |                  |
| CLK L level time     | tCLKL  | 50     | -    | -    | ns   |                  |
| CLK H level time     | tCLKH  | 50     | 0    | 0    | ns   |                  |
| DI setup time        | tsDI   | 20     | -    | -    | ns   |                  |
| DI hold time         | thDI   | 40     | -    | -    | ns   |                  |
| LD setup time        | tsLD   | 50     | -    | -    | ns   |                  |
| LD hold time         | thLD   | 50     | -    | -    | ns   |                  |
| LD H level time      | tLDH   | 50     | -    | -    | ns   |                  |
| Output settling time | tOUT   | -      | -    | 100  | μs   | CL=50pF, RL=10kΩ |

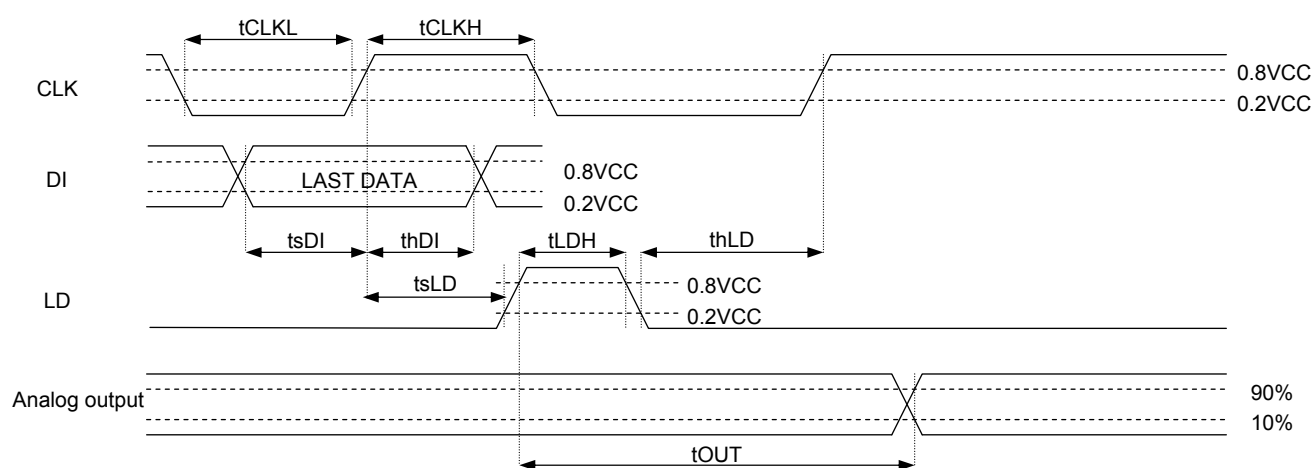


Fig.1

## ● Pin Description / Block Diagrams

(BH2223FV)

| Terminal | Terminal name | Function                        |
|----------|---------------|---------------------------------|
| 1        | AO2           | Analog output terminal          |
| 2        | AO3           |                                 |
| 3        | AO4           |                                 |
| 4        | AO5           |                                 |
| 5        | AO6           |                                 |
| 6        | AO7           |                                 |
| 7        | AO8           |                                 |
| 8        | AO9           |                                 |
| 9        | VCC           | Power source terminal           |
| 10       | AO10          | Analog output terminal          |
| 11       | NC            | Not connected yet               |
| 12       | LD            | Serial data load input terminal |
| 13       | CLK           | Serial clock input terminal     |
| 14       | DI            | Serial data input terminal      |
| 15       | AO1           | Analog output terminal          |
| 16       | GND           | Ground terminal                 |

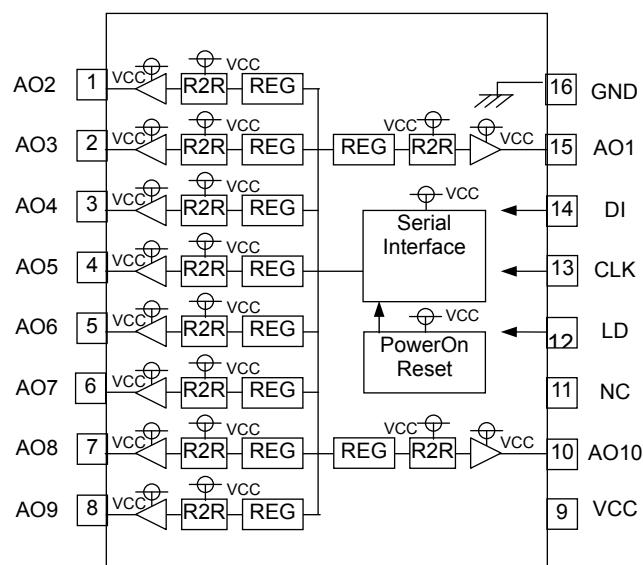


Fig.2

(BH2221FV)

| Terminal | Terminal name | Function                                     |
|----------|---------------|----------------------------------------------|
| 1        | NC            | Not connected yet                            |
| 2        | AO3           | Analog output terminal                       |
| 3        | AO4           |                                              |
| 4        | AO5           |                                              |
| 5        | AO6           |                                              |
| 6        | AO7           |                                              |
| 7        | AO8           |                                              |
| 8        | AO9           |                                              |
| 9        | AO10          |                                              |
| 10       | VDD           | D/A converter standard power source terminal |
| 11       | VCC           | Power source terminal                        |
| 12       | AO11          | Analog output terminal                       |
| 13       | AO12          |                                              |
| 14       | NC            | Not connected yet                            |
| 15       | LD            | Serial data                                  |
| 16       | CLK           | Serial clock input terminal                  |
| 17       | DI            | Serial data input terminal                   |
| 18       | AO1           | Analog output terminal                       |
| 19       | AO2           |                                              |
| 20       | GND           | Ground terminal                              |

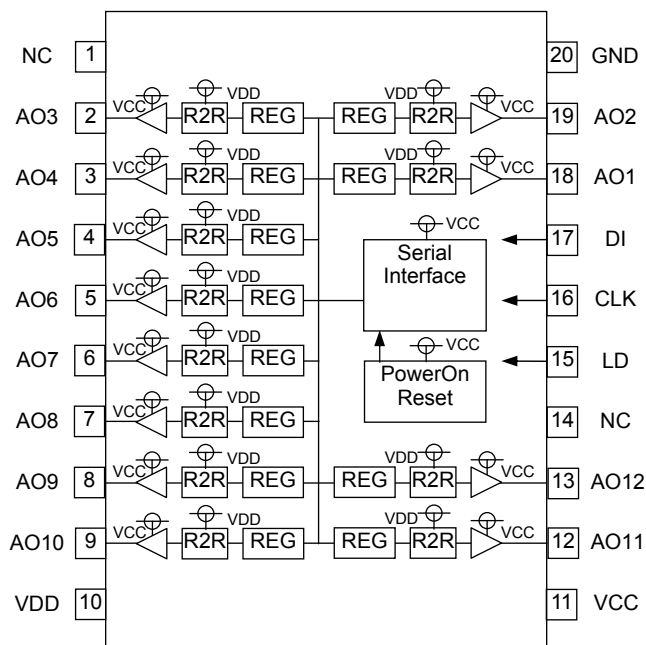


Fig.3

## ●Equivalent Circuit

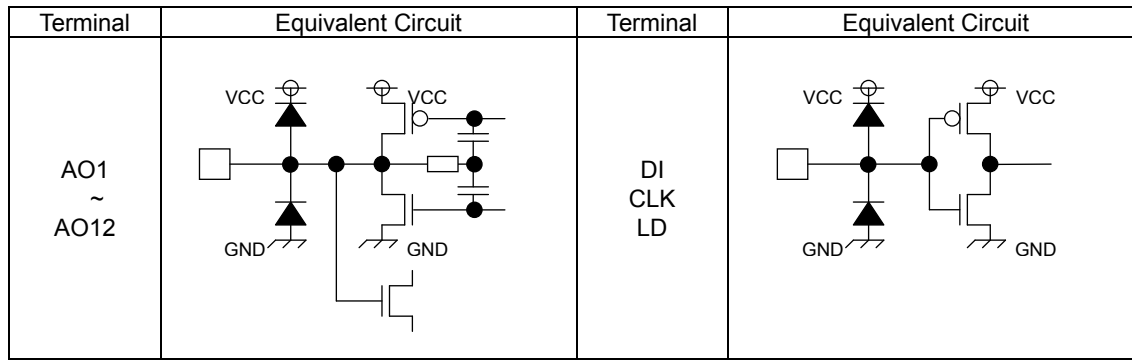


Fig.4 Equivalent Circuit

## ●Operation Description

## Command Transmission

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

Data is read at the rising edge of the CLK, and output data is determined in LD High area and held in the LD Low area.

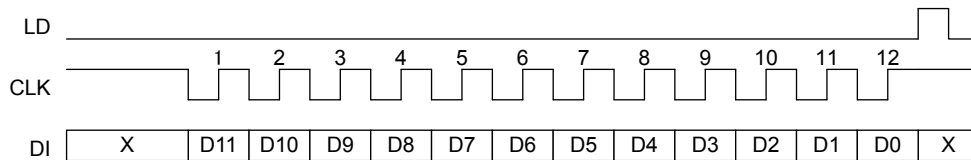


Fig.5

## Data Settings

| D0 | D1 | D3 | D3 | D4 | D5 | D6 | D7 | Setting                   |
|----|----|----|----|----|----|----|----|---------------------------|
| 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | GND                       |
| 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | (VCC or VDD-GND)/256x1    |
| 0  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | (VCC or VDD-GND)/256x2    |
| 1  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | (VCC or VDD -GND)/256x3   |
| 0  | 0  | 1  | 0  | 0  | 0  | 0  | 0  | (VCC or VDD -GND)/256x4   |
| ~  |    |    |    |    |    |    |    | ~                         |
| 0  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | (VCC or VDD -GND)/256x254 |
| 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | (VCC or VDD -GND)/256x255 |

## Channel Settings

| D8 | D9 | D10 | D11 | BH2223FV        | BH2221FV        |
|----|----|-----|-----|-----------------|-----------------|
| 0  | 0  | 0   | 0   | Inconsequential | Inconsequential |
| 0  | 0  | 0   | 1   | AO1             | AO1             |
| 0  | 0  | 1   | 0   | AO2             | AO2             |
| 0  | 0  | 1   | 1   | AO3             | AO3             |
| 0  | 1  | 0   | 0   | AO4             | AO4             |
| 0  | 1  | 0   | 1   | AO5             | AO5             |
| 0  | 1  | 1   | 0   | AO6             | AO6             |
| 0  | 1  | 1   | 1   | AO7             | AO7             |
| 1  | 0  | 0   | 0   | AO8             | AO8             |
| 1  | 0  | 0   | 1   | AO9             | AO9             |
| 1  | 0  | 1   | 0   | AO10            | AO10            |
| 1  | 0  | 1   | 1   | Inconsequential | AO11            |
| 1  | 1  | 0   | 0   | Inconsequential | AO12            |
| 1  | 1  | 0   | 1   | Inconsequential | Inconsequential |
| 1  | 1  | 1   | 0   | Inconsequential | Inconsequential |
| 1  | 1  | 1   | 1   | Inconsequential | Inconsequential |

## ●Electrical Characteristics Curves

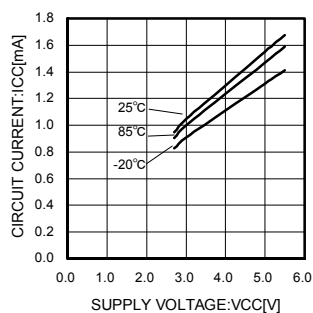


Fig.6 VCC system current consumption

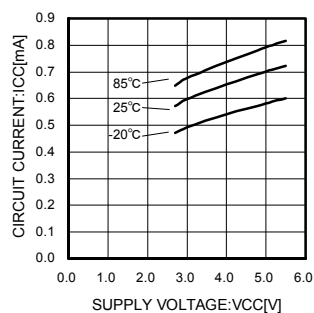


Fig.7 VDD system current consumption

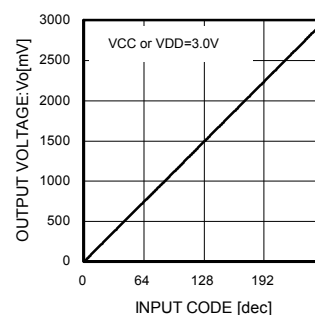


Fig.8 Output voltage characteristic

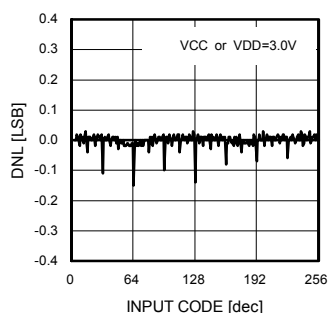


Fig.9 Differential non linearity error

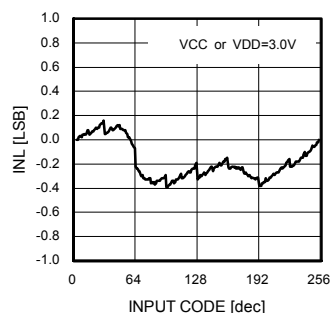


Fig.10 Integral non linearity error

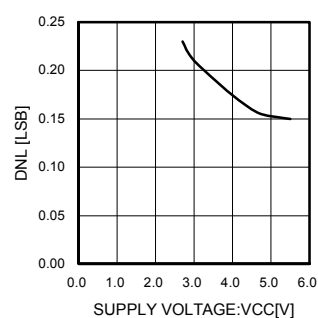


Fig.11 Power source voltage to differential non linearity error

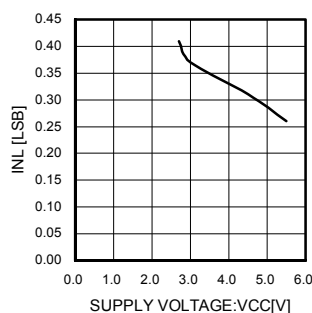


Fig.12 Power source voltage to integral non linearity error

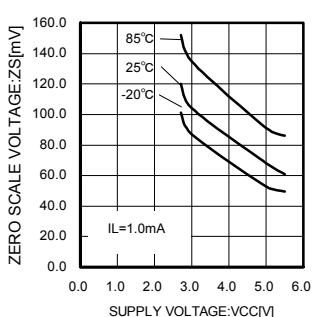


Fig.13 Output zero scale voltage

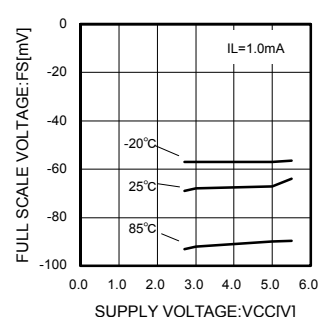


Fig.14 Output full scale voltage

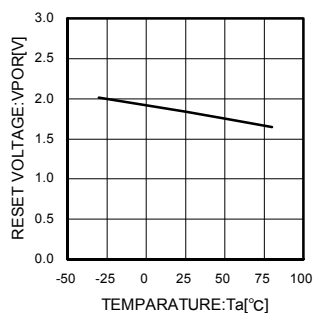


Fig.15 Reset release voltage

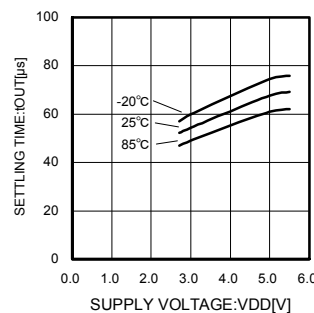


Fig.16 Settling time

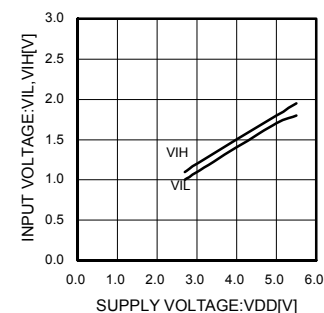


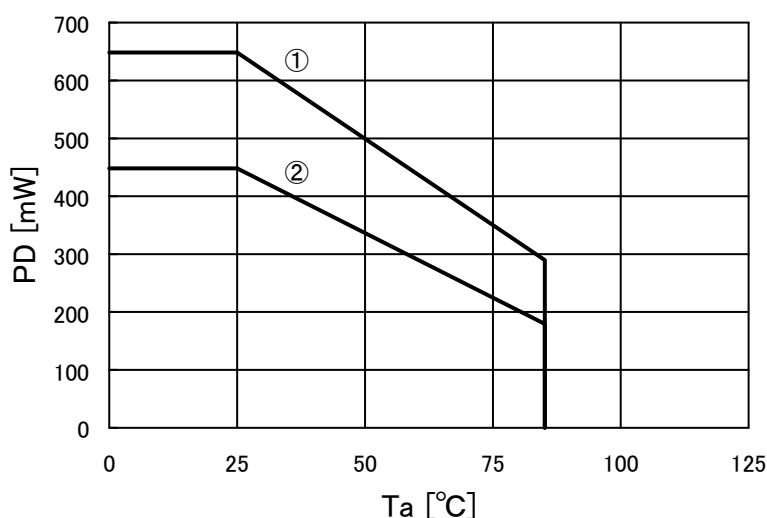
Fig.17 Input voltage

### ● 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) Power source voltage  
Set the power source voltage so that  $VCC \geq VDD$ .
- (9) 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.

### ● Thermal Derating Curve

- ① SSOP-B20(BH2221FV)
- ② SSOP-B16(BH2223FV)



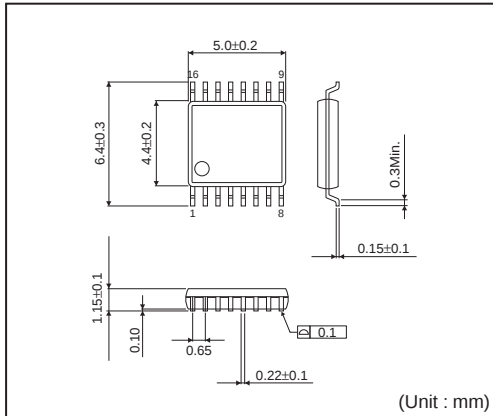
Mounted on a 70x70x1.6mm FR4 glass epoxy board (copper foil area 3% or below)

Fig.18

## ●Ordering part number

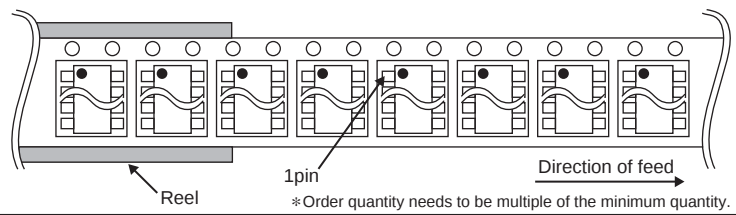
|          |                          |                                         |                                                                   |
|----------|--------------------------|-----------------------------------------|-------------------------------------------------------------------|
| B H      | 2 2 2 3                  | F V                                     | - E 2                                                             |
| Part No. | Part No.<br>2223<br>2221 | Package<br>FV: SSOP-B16<br>FV: SSOP-B20 | Packaging and forming specification<br>E2: Embossed tape and reel |

## SSOP-B16

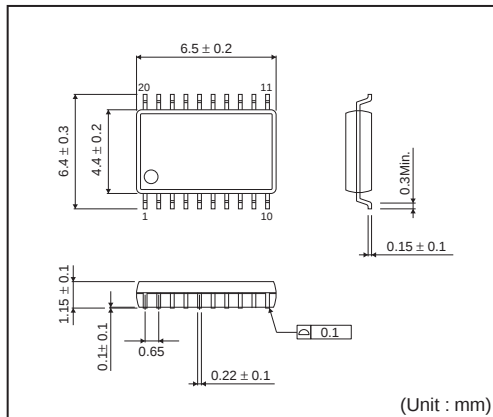


## &lt;Tape and Reel information&gt;

|                   |                                                                                                                                                   |
|-------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|
| Tape              | Embossed carrier tape                                                                                                                             |
| Quantity          | 2500pcs                                                                                                                                           |
| Direction of feed | E2<br>(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) |

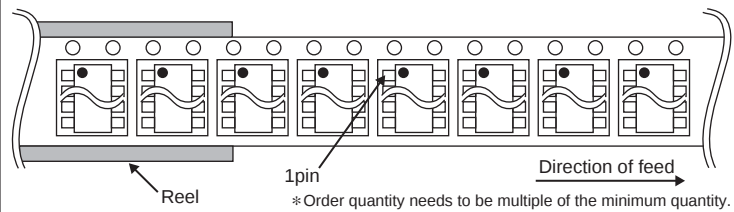


## SSOP-B20



## &lt;Tape and Reel information&gt;

|                   |                                                                                                                                                   |
|-------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|
| Tape              | Embossed carrier tape                                                                                                                             |
| Quantity          | 2500pcs                                                                                                                                           |
| Direction of feed | E2<br>(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) |



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