

# Ambient Light Sensor IC Series

# Analog Current Output Type Ambient Light Sensor IC



**BH1621FVC**

No.09046EBT02

## ●Descriptions

BH1621FVC is an analog current output ambient light sensor. This IC is the most suitable to obtain the ambient light data for adjusting LCD and Keypad backlight of Mobile phone for power saving and better visibility

## ●Features

- 1) Compact surface mount package 1.6 × 1.6 mm
- 2) Spectral sensitivity close to human eyes sensitivity.
- 3) Output current in proportion to brightness.
- 4) Supply voltage operates from 2.4V to 5.5V
- 5) Built-in shutdown function
- 6) 2 steps controllable output current gain.
- 7) 1.8V logic input interface
- 8) Low sensitivity variation (+/-15%)

## ●Applications

Mobile phone, LCD TV, PDP TV, Laptop PC, Portable game console, Digital camera, Digital video camera, Car navigation, PDA, LCD display

## ●Absolute Maximum Ratings

| Parameter             | Symbol  | Limits  | Units |
|-----------------------|---------|---------|-------|
| Supply Voltage        | Vmax    | 7       | V     |
| Operating Temperature | Topr    | -40~85  | °C    |
| Storage Temperature   | Tstg    | -40~100 | °C    |
| Iout Current          | Ioutmax | 7.5     | mA    |
| Power Dissipation     | Pd      | 165※    | mW    |

※ 70mm × 70mm × 1.6mm glass epoxy board. Derating at 2.2 mW/°C for operating above Ta=25°C.

## ●Operating Conditions

| Parameter   | Symbol | Min. | Typ. | Max. | Units |
|-------------|--------|------|------|------|-------|
| VCC Voltage | Vcc    | 2.4  | 3.0  | 5.5  | V     |

●Electrical Characteristics ( VCC = 3.0V, Ta = 25°C, unless otherwise noted )

| Parameter                                       | Symbol            | Min. | Typ. | Max.            | Units | Conditions                                           |
|-------------------------------------------------|-------------------|------|------|-----------------|-------|------------------------------------------------------|
| Supply Current1 ( Operate )                     | Icc1              | 51   | 74   | 97              | μA    | Ev=100 lx ( H-Gain Mode ) ※                          |
| Supply Current2 ( 0 lx )                        | Icc2              | 4.5  | 9    | 13.5            | μA    | Ev=0 lx ( H-Gain Mode )                              |
| Supply Current3 ( Shutdown )                    | Icc3sd            | -    | 0.2  | 0.4             | μA    | V <sub>GC1</sub> =V <sub>GC2</sub> =0 No Input Light |
| IOOUT Output Current1<br>( Dark Current )       | Iout1             | -    | -    | 0.2             | μA    | Ev=0 lx                                              |
| IOOUT Output Current2                           | Iout2             | 51   | 60   | 69              | μA    | Ev=100 lx ( H-Gain Mode ) ※                          |
| Peak Wave Length                                | λp                | -    | 560  | -               | nm    |                                                      |
| Incandescent/Fluorescent<br>Light Current Ratio | rIF               | -    | 1.0  | -               | times | Ev=100 lx                                            |
| Saturated Output Voltage                        | V <sub>OMAX</sub> | 2.6  | 2.9  | 3.0             | V     | Ev=100 lx, RL=220kΩ<br>( H-Gain Mode ) ※             |
| GC1,GC2 Input 'L' Voltage                       | V <sub>IL</sub>   | 0    | -    | 0.4             | V     |                                                      |
| GC1,GC2 Input 'H' Voltage1                      | V <sub>IH1</sub>  | 1.4  | -    | V <sub>CC</sub> | V     | 2.4V ≤ V <sub>CC</sub> ≤ 3.6V                        |
| GC1,GC2 Input 'H' Voltage2                      | V <sub>IH2</sub>  | 2.0  | -    | V <sub>CC</sub> | V     | 3.6V < V <sub>CC</sub> ≤ 5.5V                        |
| Wake-up Time                                    | twu               | -    | 45   | 128             | μs    | Shutdown → H-Gain Mode<br>Ev=100lx ※                 |
| Gain Ratio<br>H-Gain Mode / L-Gain Mode         | rHL               | -    | 9.5  | 10              | times | Ev=100lx ※                                           |

※ White LED is used as optical source

## ●Reference Data

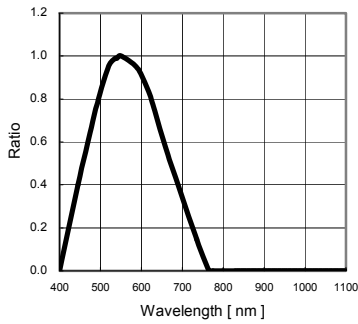


Fig.1 Spectral Response

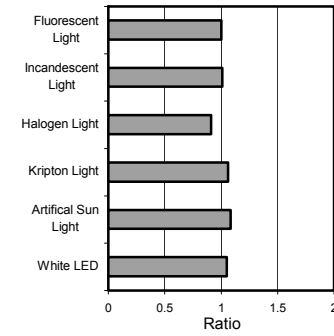
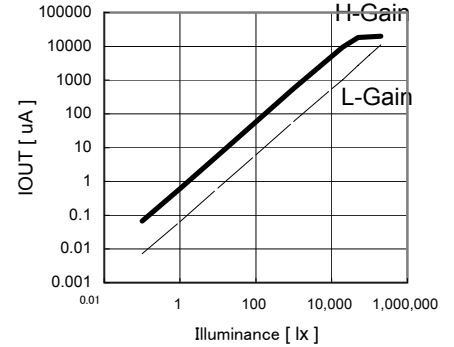
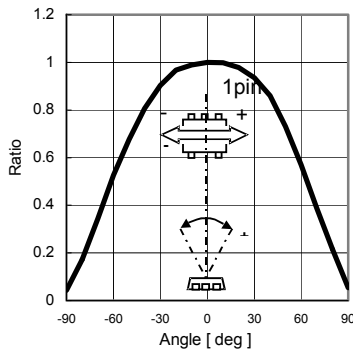
Fig.2 Light Source Dependency  
(Fluorescent Light is set to '1')Fig.3 Illuminance - IOU  
Characteristics

Fig.4 Directional Characteristics 1

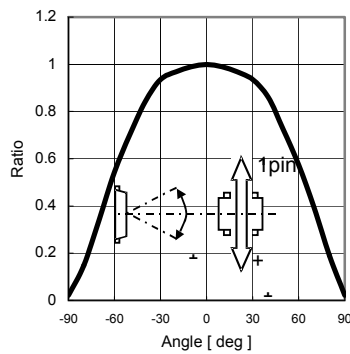


Fig.5 Directional Characteristics 2

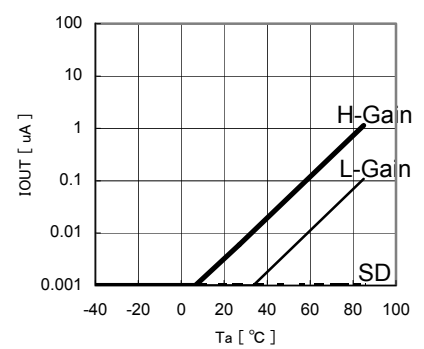


Fig.6 Ta - IOU ( 0 lx )

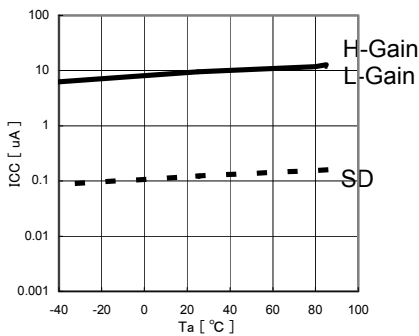


Fig.7 Ta - ICC ( 0 lx )

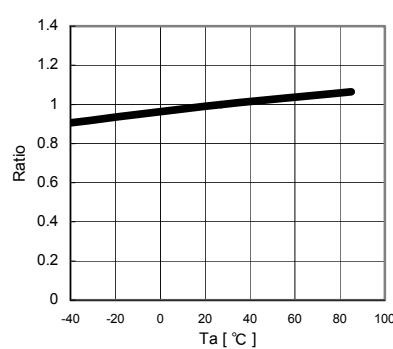
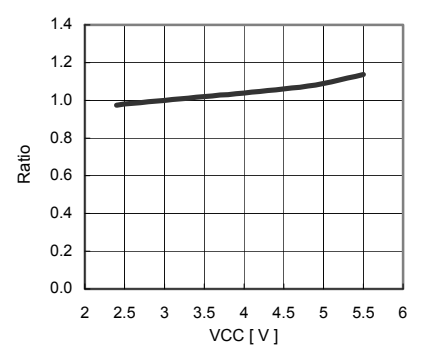
Fig.8 IOU Temperature dependency  
( 100 lx )

Fig.9 IOU VCC dependency

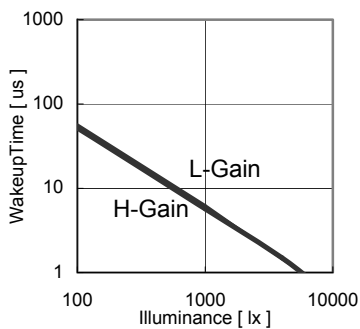
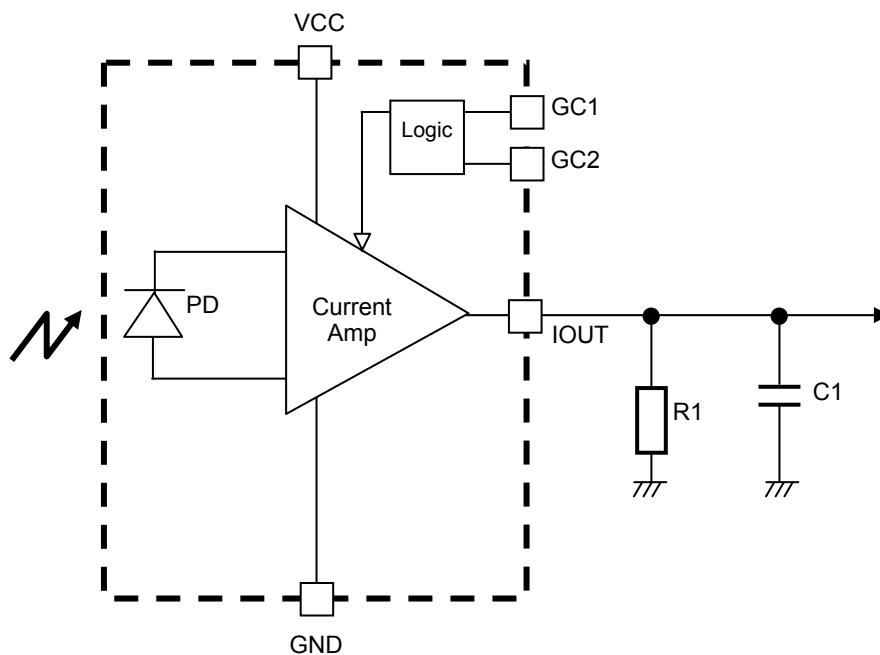


Fig.10 Illuminance - Wake up Time

## ●Block Diagram



## ●Block Diagram Descriptions

- PD  
QPhoto diode close to human eyes sensitivity.
- Current AMP  
To amplify Photo diode current ( H-Gain / L-Gain )  
Gain controllable in 2 steps by input voltage from GC1 and GC2.
- Logic  
Logic block for mode setting by input voltage from GC1 and GC2

## ●Mode Setting

| GC2 | GC1 | Mode        |
|-----|-----|-------------|
| 0   | 0   | Shutdown    |
| 0   | 1   | H-Gain Mode |
| 1   | 0   | L-Gain Mode |
| 1   | 1   | Shutdown    |

## ●External parts Setting

### 1) Gain setting of BH1621FVC

Please select the best gain controlled by 3 and 4pin based on the required illuminance range.  
The reference is as follows.

| Illuminance detection range [lx] | Gain Mode   |
|----------------------------------|-------------|
| ~1000                            | H-Gain Mode |
| ~50,000                          | L-Gain Mode |

This device will be mounted under the optical window in actual designing. Therefore, there is a possibility that the illuminance to ALS ( Ambient Light Sensor ) will be less than the illuminance on the final product surface.

Please consider the attenuation of light through the optical window.

It is possible to detect illuminance up to about 5000 lx even in the H-Gain mode. However, the maximum output current is about 3mA in this case. If you want to minimize consumption current, please use the L-Gain mode as much as possible. Please set output resistance value ( R1 ) within the range of 1 kΩ ~ 1MΩ which needs to be smaller than the input impedance of the next circuit.

### 2) Approximate formula of IOUT output voltage in each Gain Mode

#### (1) H-Gain mode

The output voltage is calculated as below.

$$V_{iout} = 0.60 \times 10^{-6} \times E_v \times R1$$

$V_{iout}$  is IOUT output voltage [V].  $E_v$  is an illuminance of the ALS surface [lx].

R1 is IOUT output resistor[Ω].

( For example ) In case you want to convert the illuminance value up to 500 lx by ADC.

If the maximum voltage of ADC input is 2V, output resistor value will be as below.

$$\begin{aligned} R1 &= V_{iout} / (0.60 \times 10^{-6} \times E_v) \\ &= 2 / (0.60 \times 10^{-6} \times 500) = 6667[\Omega] \\ &\Rightarrow 6.8[k\Omega] \end{aligned}$$

#### (2) L-Gain mode

$$V_{iout} = 0.063 \times 10^{-6} \times E_v \times R1$$

### 3) C1

#### (1) To reject the flicker light..

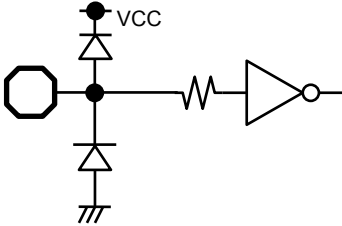
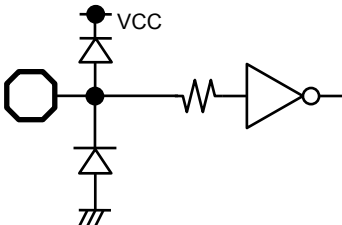
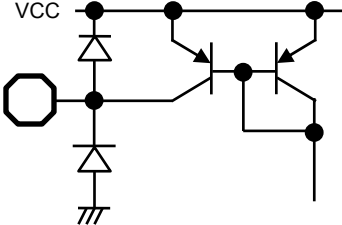
In case IOUT output is R1 only and an ALS receives the artificial lights such as fluorescent lamps and incandescent lamps synchronized with 50/60 Hz of AC power supplies, the output current has a ripple. If you want to reject this ripple, please add C1 to R1 in parallel. Please set it to  $C1 \times R1 =$  about 0.1 as a time constant.

#### (2) To control backlight smoothly by using illuminance value.

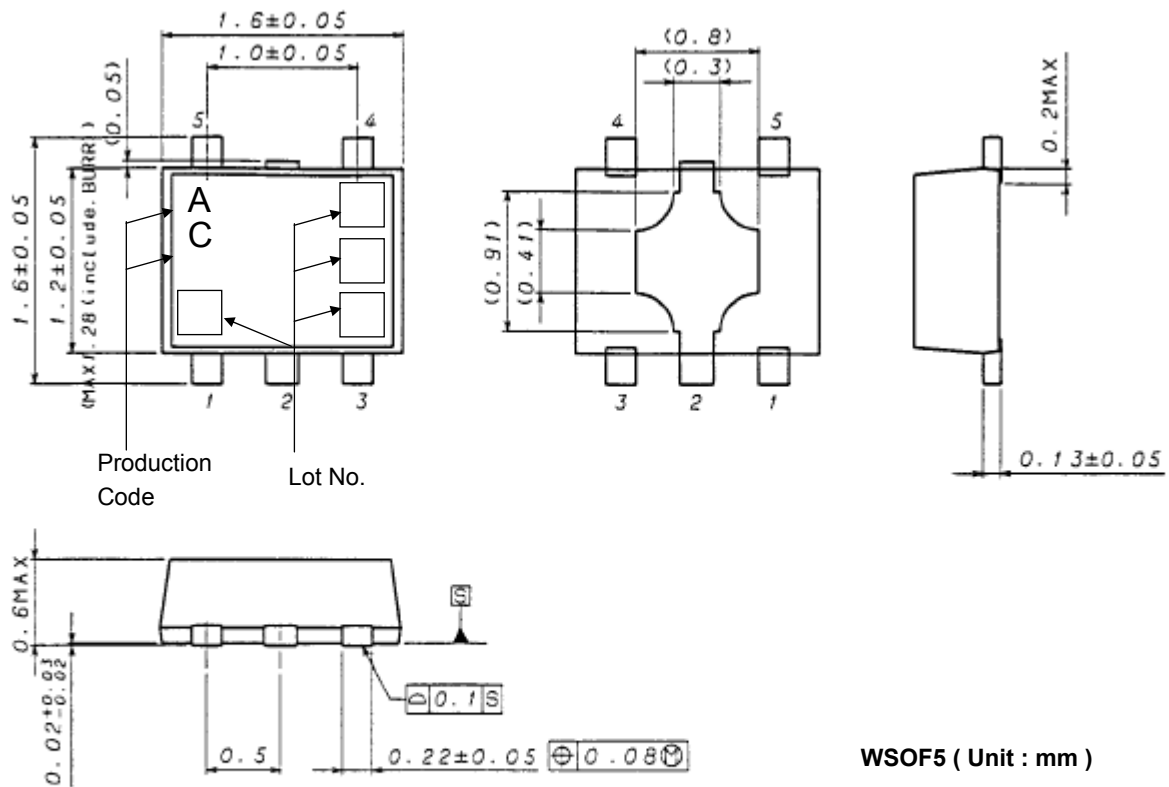
C1 is effective to control backlight smoothly for a rapid changing of the illuminance. In this case, please set it to  $C1 \times R1 =$  about 1 ~ 10 as a time constant. It is not necessary if you average illuminance value with software to change backlight smoothly.

Please note that the rise time becomes slow at power-on and recovery from shutdown mode to operation mode.

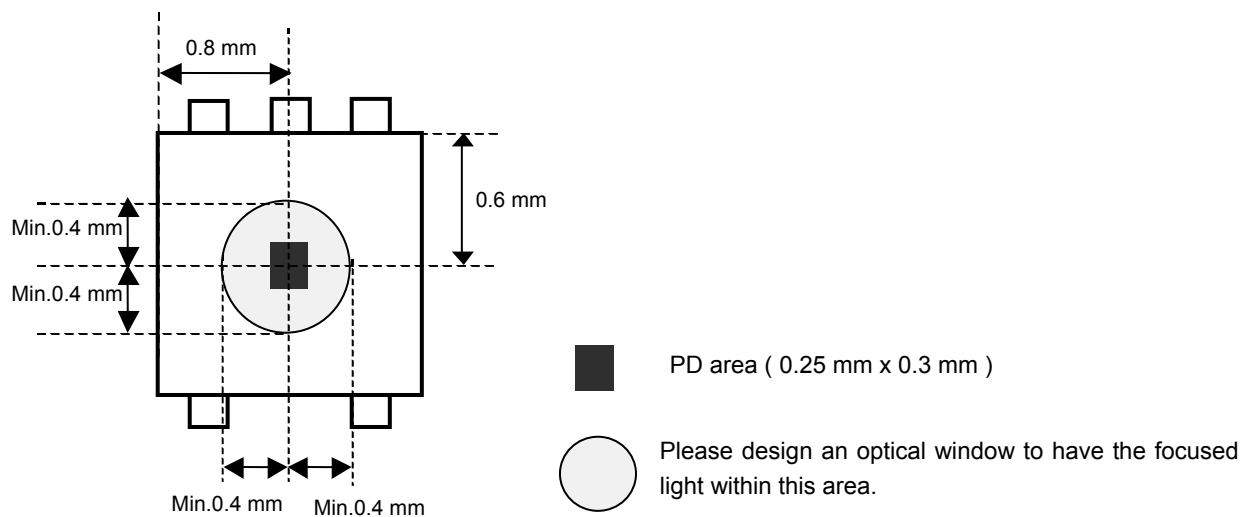
●Terminal Descriptions

| PIN No. | Terminal Name | Equivalent Circuit                                                                  | Function                                                                                                       |
|---------|---------------|-------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------|
| 1       | VCC           |                                                                                     | Power Supply Terminal                                                                                          |
| 2       | GND           |                                                                                     | GND Terminal                                                                                                   |
| 3       | GC1           |    | Mode Setting Terminal 1                                                                                        |
| 4       | GC2           |   | Mode Setting Terminal 2                                                                                        |
| 5       | IOUT          |  | This terminal outputs current depending on illuminance level.<br>Use this pin by putting resistor between GND. |

●Package Outlines



●Optical design for the device



## ●Cautions on use

## 1) Absolute Maximum Ratings

An excess in the absolute maximum ratings, such as supply voltage (  $V_{max}$  ), temperature range of operating conditions (  $T_{opr}$  ), etc., can break down devices, thus making impossible to identify breaking mode such as a short circuit or an open circuit. If any special mode exceeding the absolute maximum ratings is assumed, consideration should be given to take physical safety measures including the use of fuses, etc.

## 2) GND voltage

Make setting of the potential of the GND terminal so that it will be maintained at the minimum in any operating state. Furthermore, check to be sure no terminals are at a potential lower than the GND voltage including an actual electric transient.

## 3) Short circuit between terminals and erroneous mounting

In order to mount ICs on a set PCB, pay thorough attention to the direction and offset of the ICs. Erroneous mounting can break down the ICs. Furthermore, if a short circuit occurs due to foreign matters entering between terminals or between the terminal and the power supply or the GND terminal, the ICs can break down.

## 4) Operation in strong electromagnetic field

Be noted that using ICs in the strong electromagnetic field can malfunction them.

## 5) Inspection with set PCB

On the inspection with the set PCB, if a capacitor is connected to a low-impedance IC terminal, the IC can suffer stress. Therefore, be sure to discharge from the set PCB by each process. Furthermore, in order to mount or dismount the set PCB to/from the jig for the inspection process, be sure to turn OFF the power supply and then mount the set PCB to the jig. After the completion of the inspection, be sure to turn OFF the power supply and then dismount it from the jig. In addition, for protection against static electricity, establish a ground for the assembly process and pay thorough attention to the transportation and the storage of the set PCB.

## 6) Input terminals

In terms of the construction of IC, parasitic elements are inevitably formed in relation to potential. The operation of the parasitic element can cause interference with circuit operation, thus resulting in a malfunction and then breakdown of the input terminal. Therefore, pay thorough attention not to handle the input terminals; such as to apply to the input terminals a voltage lower than the GND respectively, so that any parasitic element will operate. Furthermore, do not apply a voltage to the input terminals when no power supply voltage is applied to the IC. In addition, even if the power supply voltage is applied, apply to the input terminals a voltage lower than the power supply voltage or within the guaranteed value of electrical characteristics.

## 7) Thermal design

Perform thermal design in which there are adequate margins by taking into account the permissible dissipation (pd) in actual states of use.

## 8) Treatment of package

Dusts or scratch on the photo detector may affect the optical characteristics. Please handle it with care.

## 9) Rush current

When power is first supplied to this IC, rush current may flow instantaneously. Because it is possible that the charge current to the parasitic capacitance of internal photo diode or the internal logic may be unstable. Therefore, give special consideration to power coupling capacitance, power wiring, width of GND wiring, and routing of connections.

## 10) The exposed central pad on the back side of the package

There is an exposed central pad on the back side of the package. Please mount by footprint dimensions described in the Jisso Information for WSOF5. This pad is GND pin, therefore there is a possibility that LSI malfunctions and heavy-current is generated.



●Ordering part number

B H

Part No.

1 6 2 1

Part No.

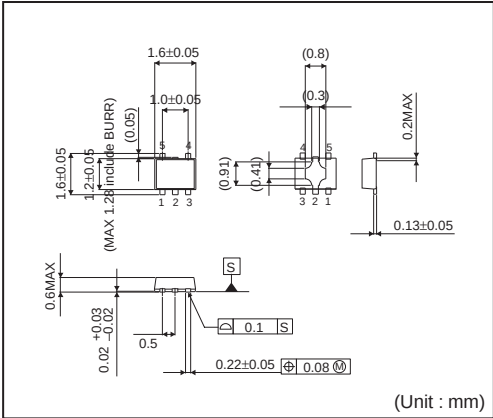
F V C

Package  
FVC: WSOF5

- T R

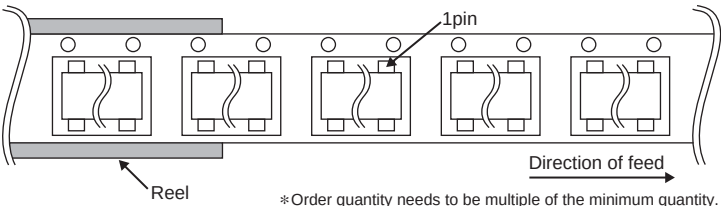
Packaging and forming specification  
TR: Embossed tape and reel

WSOF5



<Tape and Reel information>

|                   |                                                                                                                                                    |
|-------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|
| Tape              | Embossed carrier tape                                                                                                                              |
| Quantity          | 3000pcs                                                                                                                                            |
| Direction of feed | TR<br>(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) |



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