

Operational Amplifiers

# High Speed with High Voltage Operational Amplifiers

**BA3472xxx BA3472RFVM BA3474xxx BA3474RFV**

**General Description**

BA3472xxx/BA3472RFVM/BA3474xxx/BA3474RFV are high speed operational amplifiers of dual circuits and quad circuits. An operational range is wide with +3V~+36V (single power supply), and gain bandwidth 4MHz and a high slew rate of in wideband and 10V/μs are good points.

**Features**

- Operable with a single power supply
- Wide operating supply voltage
- Internal phase compensation
- High open loop voltage gain
- Operable low input voltage around GND level
- Wide output voltage range

**Application**

- Current sense application
- Buffer application amplifier
- Active filter
- Consumer electronics

**Packages**

| Packages   | W(Typ) x D(Typ) x H(Max) |
|------------|--------------------------|
| SOP8       | 5.00mm x 6.20mm x 1.71mm |
| SOP-J8     | 4.90mm x 6.00mm x 1.65mm |
| SSOP-B8    | 3.00mm x 6.40mm x 1.35mm |
| TSSOP-B8   | 3.00mm x 6.40mm x 1.20mm |
| MSOP8      | 2.90mm x 4.00mm x 0.90mm |
| SOP14      | 8.70mm x 6.20mm x 1.71mm |
| SSOP-B14   | 5.00mm x 6.40mm x 1.35mm |
| TSSOP-B14J | 5.00mm x 6.40mm x 1.20mm |

**Key Specifications**

- Wide Operating Supply Voltage:
  - Single power supply +3.0V to +36.0V
  - Dual power supply ±1.5V to ±18.0V
- Operating Temperature Range:
 

|                      |                 |
|----------------------|-----------------|
| BA3474F              | -40°C to +75°C  |
| BA3472xxx BA3474xxx  | -40°C to +85°C  |
| BA3472RFVM BA3474RFV | -40°C to +105°C |
- Slew Rate: 10V/μs(Typ)
- Unity Gain Frequency: 4MHz(Typ)

**Simplified Schematic**

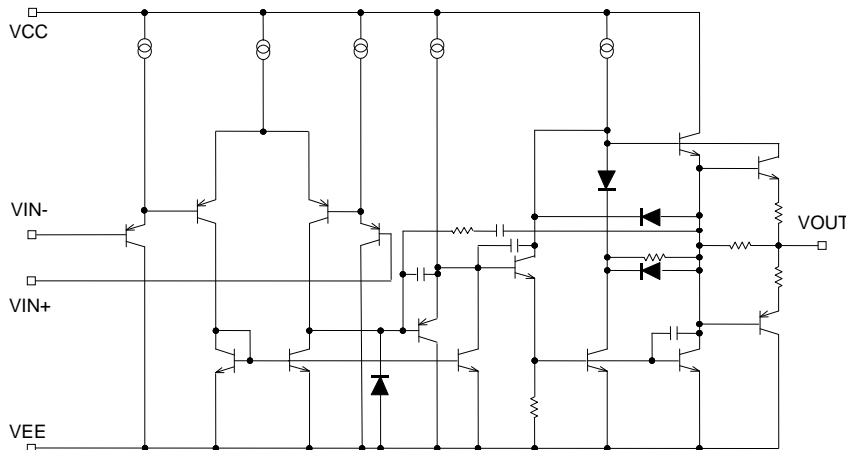
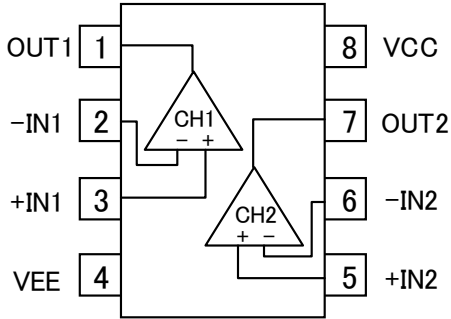


Figure 1. Simplified schematic (one channel only)

○Product structure : Silicon monolithic integrated circuit ○This product is not designed protection against radioactive rays.

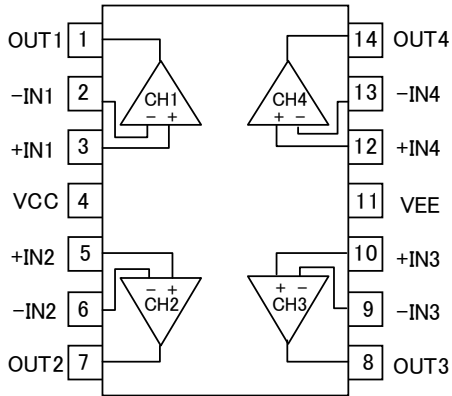
Pin Configuration

BA3472F :SOP8  
 BA3472FJ :SOP-J8  
 BA3472FV :SSOP-B8  
 BA3472FVT :TSSOP-B8  
 BA3472FVM, BA3472RFVM :MSOP8



| Pin No. | Symbol |
|---------|--------|
| 1       | OUT1   |
| 2       | -IN1   |
| 3       | +IN1   |
| 4       | VEE    |
| 5       | +IN2   |
| 6       | -IN2   |
| 7       | OUT2   |
| 8       | VCC    |

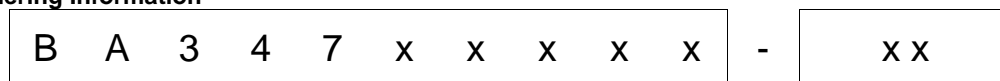
BA3474F :SOP14  
 BA3474FV, BA3474RFV :SSOP-B14  
 BA3474FVJ :TSSOP-B14J



| Pin No. | Symbol |
|---------|--------|
| 1       | OUT1   |
| 2       | -IN1   |
| 3       | +IN1   |
| 4       | VCC    |
| 5       | +IN2   |
| 6       | -IN2   |
| 7       | OUT2   |
| 8       | OUT3   |
| 9       | -IN3   |
| 10      | +IN3   |
| 11      | VEE    |
| 12      | +IN4   |
| 13      | -IN4   |
| 14      | OUT4   |

| Package |          |          |           |                         |         |                       |            |
|---------|----------|----------|-----------|-------------------------|---------|-----------------------|------------|
| SOP8    | SSOP-B8  | SOP-J8   | TSSOP-B8  | MSOP8                   | SOP14   | SSOP-B14              | TSSOP-B14J |
| BA3472F | BA3472FV | BA3472FJ | BA3472FVT | BA3472FVM<br>BA3472RFVM | BA3474F | BA3474FV<br>BA3474RFV | BA3474FVJ  |

Ordering Information



Part Number  
 BA3472xxx  
 BA3472Rxxx  
 BA3474xxx  
 BA3474Rxx

Package  
 F : SOP8  
   SOP14  
 FV : SSOP-B8  
      SSOP-B14  
 FJ : SOP-J8  
 FVT : TSSOP-B8  
 FVJ : TSSOP-B14J  
 FVM: MSOP8

Packaging and forming specification  
 E2: Embossed tape and reel  
     (SOP8/SOP14/SSOP-B8/SSOP-B14  
       SOP-J8/TSSOP-B8/TSSOP-B14J)  
 TR: Embossed tape and reel  
     (MSOP8)

Line-up

| Topr            | Supply Current (Typ) | Slew Rate (Typ) | Package    |              | Orderable Part Number |
|-----------------|----------------------|-----------------|------------|--------------|-----------------------|
| -40°C to +75°C  | 8.0mA                | 10V/μs          | SOP14      | Reel of 2500 | BA3474F-E2            |
| -40°C to +85°C  | 4.0mA                |                 | SOP8       | Reel of 2500 | BA3472F-E2            |
|                 |                      |                 | SSOP-B8    | Reel of 2500 | BA3472FV-E2           |
|                 |                      |                 | SOP-J8     | Reel of 2500 | BA3472FJ-E2           |
|                 |                      |                 | TSSOP-B8   | Reel of 2500 | BA3472FVT-E2          |
|                 |                      |                 | MSOP8      | Reel of 3000 | BA3472FVM-TR          |
|                 |                      |                 | SSOP-B14   | Reel of 2500 | BA3474FV-E2           |
| -40°C to +105°C | 8.0mA                |                 | TSSOP-B14J | Reel of 2500 | BA3474FVJ-E2          |
|                 |                      |                 | MSOP8      | Reel of 3000 | BA3472RFVM-TR         |
|                 |                      |                 | SSOP-B14   | Reel of 2500 | BA3474RFV-E2          |
|                 |                      |                 |            |              |                       |

Absolute Maximum Ratings (Ta=25°C)

| Parameter                                 | Symbol  | Ratings                              |                     |                     |                     | Unit                  |    |
|---|---------|--------------------------------------|---------------------|---------------------|---------------------|-----------------------|----|
|   |         | BA3472                               | BA3474              | BA3472R             | BA3474R             |                       |    |
| Supply Voltage                            | VCC-VEE | +36                                  |                     |                     |                     | V                     |    |
| Power Dissipation                         | Pd      | SOP8                                 | 780 <sup>*13</sup>  | -                   | -                   | -                     | mW |
|   |         | SSOP-B8                              | 690 <sup>*213</sup> | -                   | -                   | -                     |    |
|   |         | MSOP8                                | 590 <sup>*313</sup> | -                   | 590 <sup>*313</sup> | -                     |    |
|   |         |                                      | -                   | -                   | 625 <sup>*414</sup> | -                     |    |
|   |         |                                      | -                   | -                   | 713 <sup>*515</sup> | -                     |    |
|   |         | SOP-J8                               | 675 <sup>*713</sup> | -                   | -                   | -                     |    |
|   |         | TSSOP-B8                             | 625 <sup>*413</sup> | -                   | -                   | -                     |    |
|   |         | SOP14                                | -                   | 610 <sup>*813</sup> | -                   | -                     |    |
|   |         | SSOP-B14                             | -                   | 870 <sup>*913</sup> | -                   | 870 <sup>*913</sup>   |    |
|   |         |                                      | -                   | -                   | -                   | 1187 <sup>*1015</sup> |    |
|   |         |                                      | -                   | -                   | -                   | 1689 <sup>*1116</sup> |    |
| TSSOP-B14                                 | -       | 850 <sup>*1213</sup>                 | -                   | -                   |                     |                       |    |
| Differential Input Voltage <sup>*17</sup> | Vid     | +36                                  |                     |                     |                     | V                     |    |
| Input Common-mode Voltage Range           | Vicm    | (VEE - 0.3) to VEE + 36              |                     |                     |                     | V                     |    |
| Input Current <sup>*18</sup>              | Ii      | -10                                  |                     |                     |                     | mA                    |    |
| Operable with Low Voltage                 | Vopr    | +3.0V to +36.0V<br>(±1.5V to ±18.0V) |                     |                     |                     | V                     |    |
| Operating Temperature Range               | Topr    | -40 to +85(SOP14:to +75)             |                     | -40 to +105         |                     | °C                    |    |
| Storage Temperature Range                 | Tstg    | -55 to +150                          |                     |                     |                     | °C                    |    |
| Maximum Junction Temperature              | Tjmax   | +150                                 |                     |                     |                     | °C                    |    |

- \*1 To use at temperature above Ta=25°C reduce 6.2mW/°C.
- \*2 To use at temperature above Ta=25°C reduce 5.5mW/°C
- \*3 To use at temperature above Ta=25°C reduce 4.8mW/°C
- \*4 To use at temperature above Ta=25°C reduce 5.0mW/°C
- \*5 To use at temperature above Ta=25°C reduce 5.7mW/°C
- \*6 To use at temperature above Ta=25°C reduce 7.5mW/°C
- \*7 To use at temperature above Ta=25°C reduce 5.4mW/°C
- \*8 To use at temperature above Ta=25°C reduce 4.9mW/°C
- \*9 To use at temperature above Ta=25°C reduce 7.0mW/°C
- \*10 To use at temperature above Ta=25°C reduce 9.5mW/°C
- \*11 To use at temperature above Ta=25°C reduce 13.5mW/°C
- \*12 To use at temperature above Ta=25°C reduce 6.8mW/°C
- \*13 Mounted on a FR4 glass epoxy PCB(70mm×70mm×1.6mm).
- \*14 Mounted on a FR4 glass epoxy 2 layers PCB 70mm × 70mm × 1.6mm (occupied copper area : 15mm × 15mm).
- \*15 Mounted on a FR4 glass epoxy 2 layers PCB 70mm × 70mm × 1.6mm (occupied copper area : 70mm × 70mm).
- \*16 Mounted on a FR4 glass epoxy 4 layers PCB 70mm × 70mm × 1.6mm (occupied copper area : 70mm × 70mm).
- \*17 The voltage difference between inverting input and non-inverting input is the differential input voltage. Then input terminal voltage is set to more than VEE.
- \*18 An excessive input current will flow when input voltages of less than VEE-0.6V are applied. The input current can be set to less than the rated current by adding a limiting resistor.

**Caution:** Operating the IC over the absolute maximum ratings may damage the IC. The damage can either be a short circuit between pins or an open circuit between pins and the internal circuitry. Therefore, it is important to consider circuit protection measures, such as adding a fuse, in case the IC is operated over the absolute maximum ratings.

## Electrical Characteristics

OBA3472 (Unless otherwise specified VCC=+15V, VEE=-15V, Ta=25°C)

| Parameter                       | Symbol            | Limits |       |         | Unit | Condition  |
|---------------------------------|-------------------|--------|-------|---------|------|--|
|                                 |                   | Min    | Typ   | Max     |      |  |
| Input Offset Voltage *19        | Vio               | -      | 1     | 10      | mV   | Vicm=0V, VOUT=0V   |
|                                 |                   | -      | 1     | 10      |      | VCC=5V, VEE=0V, Vicm=0V<br>VOUT=VCC/2                            |
| Input Offset Current *19        | Iio               | -      | 6     | 75      | nA   | Vicm=0V, VOUT=0V   |
| Input Bias Current *19          | Ib                | -      | 100   | 500     | nA   | Vicm=0V, VOUT=0V   |
| Supply Current                  | ICC               | -      | 4     | 5.5     | mA   | RL=∞   |
| Maximum Output Voltage(High)    | VOH               | 3.7    | 4     | -       | V    | VCC=5V, RL=2kΩ   |
|                                 |                   | 13.7   | 14    | -       |      | RL=10kΩ  |
|                                 |                   | 13.5   | -     | -       |      | RL=2kΩ   |
| Maximum Output Voltage(Low)     | VOL               | -      | 0.1   | 0.3     | V    | VCC=5V, RL=2kΩ   |
|                                 |                   | -      | -14.7 | -14.3   |      | RL=10kΩ  |
|                                 |                   | -      | -     | -13.5   |      | RL=2kΩ   |
| Large Signal Voltage Gain       | Av                | 80     | 100   | -       | dB   | RL ≥ 2kΩ, VOUT=±10 V   |
| Input Common-mode Voltage Range | Vicm              | 0      | -     | VCC-2.0 | V    | VCC=5V, VEE=0V<br>VOUT=VCC/2                                     |
| Common-mode Rejection Ratio     | CMRR              | 60     | 97    | -       | dB   | Vicm=0V, VOUT=0V   |
| Power Supply Rejection Ratio    | PSRR              | 60     | 97    | -       | dB   | Vicm=0V, VOUT=0V   |
| Output Source Current *20       | Isource           | 10     | 30    | -       | mA   | VCC=5V, VIN+=1V<br>VIN-=0V, VOUT=0V<br>Only 1ch is short circuit |
| Output Sink Current *20         | I <sub>sink</sub> | 20     | 30    | -       | mA   | VCC=5V, VIN+=0V<br>VIN-=1V, VOUT=5V<br>Only 1ch is short circuit |
| Unity Gain Frequency            | f <sub>T</sub>    | -      | 4     | -       | MHz  | -  |
| Gain Bandwidth                  | GBW               | -      | 4     | -       | MHz  | f=100kHz<br>open loop  |
| Slew Rate                       | SR                | -      | 10    | -       | V/μs | Av=1, Vin=-10 to +10V<br>RL=2kΩ                                  |
| Channel Separation              | CS                | -      | 120   | -       | dB   | f=1kHz, input referred   |

\*19 Absolute value

\*20 Under high temperatures, please consider the power dissipation when selecting the output current.

When the output terminal is continuously shorted the output current reduces the internal temperature by flushing.

OBA3472R (Unless otherwise specified VCC=+15V, VEE=-15V, Ta=25°C)

| Parameter                            | Symbol         | Limits |       |         | Unit | Condition  |
|--------------------------------------|----------------|--------|-------|---------|------|--|
|                                      |                | Min    | Typ   | Max     |      |  |
| Input Offset Voltage <sup>*21</sup>  | Vio            | -      | 1     | 10      | mV   | Vicm=0V, VOUT=0V   |
|                                      |                | -      | 1     | 10      |      | VCC=5V, VEE=0V, Vicm=0V<br>VOUT=VCC/2                            |
| Input Offset Current <sup>*21</sup>  | Iio            | -      | 6     | 75      | nA   | Vicm=0V, VOUT=0V   |
| Input Bias Current <sup>*21</sup>    | Ib             | -      | 100   | 500     | nA   | Vicm=0V, VOUT=0V   |
| Supply Current                       | ICC            | -      | 4     | 5.5     | mA   | RL=∞   |
| Maximum Output Voltage(High)         | VOH            | 3.7    | 4     | -       | V    | VCC=5V, RL=2kΩ   |
|                                      |                | 13.7   | 14    | -       |      | RL=10kΩ  |
|                                      |                | 13.5   | -     | -       |      | RL=2kΩ   |
| Maximum Output Voltage(Low)          | VOL            | -      | 0.1   | 0.3     | V    | VCC=5V, RL=2kΩ   |
|                                      |                | -      | -14.7 | -14.3   |      | RL=10kΩ  |
|                                      |                | -      | -     | -13.5   |      | RL=2kΩ   |
| Large Signal Voltage Gain            | Av             | 80     | 100   | -       | dB   | RL ≥ 2kΩ, VOUT=±10 V   |
| Input Common-mode Voltage Range      | Vicm           | 0      | -     | VCC-2.0 | V    | VCC=5V, VEE=0V<br>VOUT=VCC/2                                     |
| Common-mode Rejection Ratio          | CMRR           | 60     | 97    | -       | dB   | Vicm=0V, VOUT=0V   |
| Power Supply Rejection Ratio         | PSRR           | 60     | 97    | -       | dB   | Vicm=0V, VOUT=0V   |
| Output Source Current <sup>*22</sup> | Isource        | 10     | 30    | -       | mA   | VCC=5V, VIN+=1V<br>VIN-=0V, VOUT=0V<br>Only 1ch is short circuit |
| Output Sink Current <sup>*22</sup>   | Isink          | 20     | 30    | -       | mA   | VCC=5V, VIN+=0V<br>VIN-=1V, VOUT=5V<br>Only 1ch is short circuit |
| Unity Gain Frequency                 | f <sub>T</sub> | -      | 4     | -       | MHz  | -  |
| Gain Bandwidth                       | GBW            | -      | 4     | -       | MHz  | f=100kHz<br>open loop  |
| Slew Rate                            | SR             | -      | 10    | -       | V/μs | Av=1, Vin=-10 to +10V, RL=2kΩ                                    |
| Channel Separation                   | CS             | -      | 120   | -       | dB   | f=1kHz, input referred   |

\*21 Absolute value

\*22 Under high temperatures, please consider the power dissipation when selecting the output current.

When the output terminal is continuously shorted the output current reduces the internal temperature by flushing.

OBA3474 (Unless otherwise specified VCC=+15V, VEE=-15V, Ta=25°C)

| Parameter                       | Symbol         | Limits |       |         | Unit | Condition  |
|---------------------------------|----------------|--------|-------|---------|------|--|
|                                 |                | Min    | Typ   | Max     |      |  |
| Input Offset Voltage *23        | Vio            | -      | 1     | 10      | mV   | Vicm=0V, VOUT=0V   |
|                                 |                | -      | 1     | 10      |      | VCC=5V, VEE=0V, Vicm=0V<br>VOUT=VCC/2                            |
| Input Offset Current *23        | Iio            | -      | 6     | 75      | nA   | Vicm=0V, VOUT=0V   |
| Input Bias Current *23          | Ib             | -      | 100   | 500     | nA   | Vicm=0V, VOUT=0V   |
| Supply Current                  | ICC            | -      | 8     | 11      | mA   | RL=∞   |
| Maximum Output Voltage(High)    | VOH            | 3.7    | 4     | -       | V    | VCC=5V, RL=2kΩ   |
|                                 |                | 13.7   | 14    | -       |      | RL=10kΩ  |
|                                 |                | 13.5   | -     | -       |      | RL=2kΩ   |
| Maximum Output Voltage(Low)     | VOL            | -      | 0.1   | 0.3     | V    | VCC=5V, RL=2kΩ   |
|                                 |                | -      | -14.7 | -14.3   |      | RL=10kΩ  |
|                                 |                | -      | -     | -13.5   |      | RL=2kΩ   |
| Large Signal Voltage Gain       | Av             | 80     | 100   | -       | dB   | RL ≥ 2kΩ, VOUT=±10 V   |
| Input Common-mode Voltage Range | Vicm           | 0      | -     | VCC-2.0 | V    | VCC=5V, VEE=0V,<br>VOUT=VCC/2                                    |
| Common-mode Rejection Ratio     | CMRR           | 60     | 97    | -       | dB   | Vicm=0V, VOUT=0V   |
| Power Supply Rejection Ratio    | PSRR           | 60     | 97    | -       | dB   | Vicm=0V, VOUT=0V   |
| Output Source Current *24       | Isource        | 10     | 30    | -       | mA   | VCC=5V, VIN+=1V<br>VIN-=0V, VOUT=0V<br>Only 1ch is short circuit |
| Output Sink Current *24         | Isink          | 20     | 30    | -       | mA   | VCC=5V, VIN+=0V<br>VIN-=1V, VOUT=5V<br>Only 1ch is short circuit |
| Unity Gain Frequency            | f <sub>T</sub> | -      | 4     | -       | MHz  | -  |
| Gain Bandwidth                  | GBW            | -      | 4     | -       | MHz  | f=100kHz<br>open loop  |
| Slew Rate                       | SR             | -      | 10    | -       | V/μs | Av=1, Vin=-10 to +10V, RL=2kΩ                                    |
| Channel Separation              | CS             | -      | 120   | -       | dB   | f=1kHz, input referred   |

\*23 Absolute value

\*24 Under high temperatures, please consider the power dissipation when selecting the output current.

When the output terminal is continuously shorted the output current reduces the internal temperature by flushing.

OBA3474R (Unless otherwise specified VCC=+15V, VEE=-15V, Ta=25°C)

| Parameter                       | Symbol         | Limits |       |         | Unit | Condition  |
|---------------------------------|----------------|--------|-------|---------|------|--|
|                                 |                | Min    | Typ   | Max     |      |  |
| Input Offset Voltage *25        | Vio            | -      | 1     | 10      | mV   | Vicm=0V, VOUT=0V   |
|                                 |                | -      | 1     | 10      |      | VCC=5V, VEE=0V, Vicm=0V<br>VOUT=VCC/2                            |
| Input Offset Current *25        | Iio            | -      | 6     | 75      | nA   | Vicm=0V, VOUT=0V   |
| Input Bias Current *25          | Ib             | -      | 100   | 500     | nA   | Vicm=0V, VOUT=0V   |
| Supply Current                  | ICC            | -      | 8     | 11      | mA   | RL=∞   |
| Maximum Output Voltage(High)    | VOH            | 3.7    | 4     | -       | V    | VCC=5V, RL=2kΩ   |
|                                 |                | 13.7   | 14    | -       |      | RL=10kΩ  |
|                                 |                | 13.5   | -     | -       |      | RL=2kΩ   |
| Maximum Output Voltage(Low)     | VOL            | -      | 0.1   | 0.3     | V    | VCC=5V, RL=2kΩ   |
|                                 |                | -      | -14.7 | -14.3   |      | RL=10kΩ  |
|                                 |                | -      | -     | -13.5   |      | RL=2kΩ   |
| Large Signal Voltage Gain       | Av             | 80     | 100   | -       | dB   | RL ≥ 2kΩ, VOUT=±10 V   |
| Input Common-mode Voltage Range | Vicm           | 0      | -     | VCC-2.0 | V    | VCC=5V, VEE=0V,<br>VOUT=VCC/2                                    |
| Common-mode Rejection Ratio     | CMRR           | 60     | 97    | -       | dB   | Vicm=0V, VOUT=0V   |
| Power Supply Rejection Ratio    | PSRR           | 60     | 97    | -       | dB   | Vicm=0V, VOUT=0V   |
| Output Source Current *26       | Isource        | 10     | 30    | -       | mA   | VCC=5V, VIN+=1V<br>VIN-=0V, VOUT=0V<br>Only 1ch is short circuit |
| Output Sink Current *26         | Isink          | 20     | 30    | -       | mA   | VCC=5V, VIN+=0V<br>VIN-=1V, VOUT=5V<br>Only 1ch is short circuit |
| Unity Gain Frequency            | f <sub>r</sub> | -      | 4     | -       | MHz  | -  |
| Gain Bandwidth                  | GBW            | -      | 4     | -       | MHz  | f=100kHz<br>open loop  |
| Slew Rate                       | SR             | -      | 10    | -       | V/μs | Av=1, Vin=-10 to +10V, RL=2kΩ                                    |
| Channel Separation              | CS             | -      | 120   | -       | dB   | f=1kHz, input referred   |

\*25 Absolute value

\*26 Under high temperatures, please consider the power dissipation when selecting the output current.

When the output terminal is continuously shorted the output current reduces the internal temperature by flushing.



**Description of Electrical Characteristics**

Described below are descriptions of the relevant electrical terms

Please note that item names, symbols and their meanings may differ from those on another manufacturer's documents.

**1. Absolute Maximum Ratings**

The absolute maximum ratings are values that should never be exceeded, since doing so may result in deterioration of electrical characteristics or damage to the part itself as well as peripheral components.

**1.1 Power Supply Voltage (VCC/VEE)**

Expresses the maximum voltage that can be supplied between the positive and negative supply terminals without causing deterioration of the electrical characteristics or destruction of the internal circuitry.

**1.2 Differential Input Voltage (Vid)**

Indicates the maximum voltage that can be supplied between the non-inverting and inverting terminals without damaging the IC.

**1.3 Input Common-mode Voltage Range (Vicm)**

Signifies the maximum voltage that can be supplied to non-inverting and inverting terminals without causing deterioration of the characteristics or damage to the IC itself. Normal operation is not guaranteed within the common-mode voltage range of the maximum ratings – use within the input common-mode voltage range of the electric characteristics instead.

**1.4 Power Dissipation (Pd)**

Indicates the power that can be consumed by a particular mounted board at ambient temperature (25°C). For packaged products, Pd is determined by the maximum junction temperature and the thermal resistance.

**2. Electrical Characteristics****2.1 Input Offset Voltage (Vio)**

Indicates the voltage difference between non-inverting terminal and inverting terminal. It can be translated into the input voltage difference required for setting the output voltage at 0 V.

**2.2 Input Offset Current (Iio)**

Indicates the difference of input bias current between the non-inverting and inverting terminals.

**2.3 Input Bias Current (Ib)**

Indicates the current that flows into or out of the input terminal. It is defined by the average of input bias current at non-inverting terminal and input bias current at inverting terminal.

**2.4 Circuit Current (ICC)**

Indicates the current of the IC itself that flows under specified conditions and during no-load steady state.

**2.5 Maximum Output Voltage(High) / Maximum Output Voltage(Low) (VOH/VOL)**

Indicates the voltage range that can be output by the IC under specified load condition. It is typically divided into maximum output voltage High and low. Maximum output voltage high indicates the upper limit of output voltage. Maximum output voltage low indicates the lower limit.

**2.6 Large Signal Voltage Gain (Av)**

The amplifying rate (gain) of the output voltage against the voltage difference between non-inverting and inverting terminals, it is (normally) the amplifying rate (gain) with respect to DC voltage.

$$AV = (\text{output voltage fluctuation}) / (\text{input offset fluctuation})$$

**2.7 Input Common-mode Voltage Range (Vicm)**

Indicates the input voltage range under which the IC operates normally.

**2.8 Common-mode Rejection Ratio (CMRR)**

Indicates the ratio of fluctuation of input offset voltage when in-phase input voltage is changed. It is normally the fluctuation of DC.

$$CMRR = (\text{Change of Input common-mode voltage}) / (\text{Input offset fluctuation})$$

**2.9 Power Supply Rejection Ratio (PSRR)**

Indicates the ratio of fluctuation of input offset voltage when supply voltage is changed. It is normally the fluctuation of DC. PSRR = (Change of power supply voltage) / (Input offset fluctuation)

**2.10 Output Source Current/ Output Sink Current (Isource/Isink)**

The maximum current that can be output under specific output conditions, it is divided into output source current and output sink current. The output source current indicates the current flowing out of the IC, and the output sink current the current flowing into the IC.

**2.11 Unity Gain Frequency (f<sub>T</sub>)**

Indicates a frequency where the voltage gain of operational amplifier is 1.

**2.12 Gain Bandwidth (GBW)**

Indicates to multiply by the frequency and the gain where the voltage gain decreases 6dB/octave.

**2.13 Slew Rate (SR)**

SR is a parameter that shows movement speed of operational amplifier. It indicates rate of variable output voltage as unit time.

**2.14 Channel Separation (CS)**

Indicates the fluctuation of input offset voltage or that of output voltage with reference to the change of output voltage of driven channel.

Typical Performance Curves

OBA3472, BA3472R

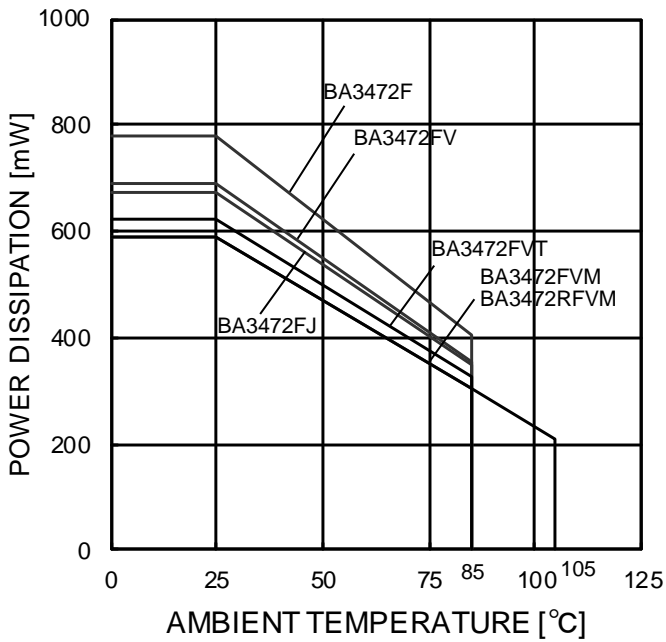


Figure 2. Derating Curve

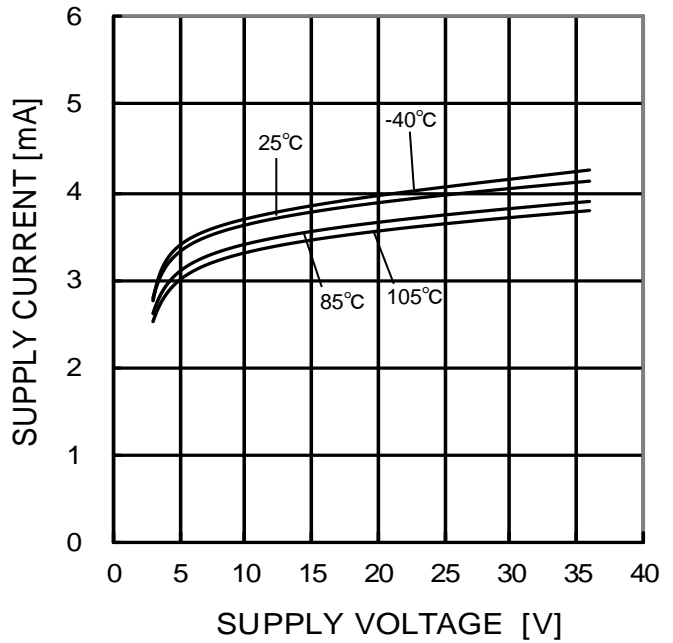


Figure 3. Supply Current - Supply Voltage

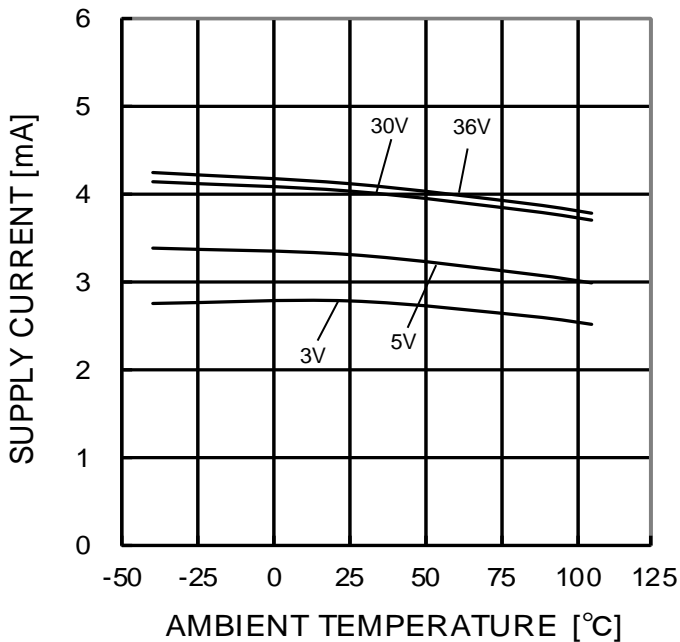


Figure 4. Supply Current - Ambient Temperature

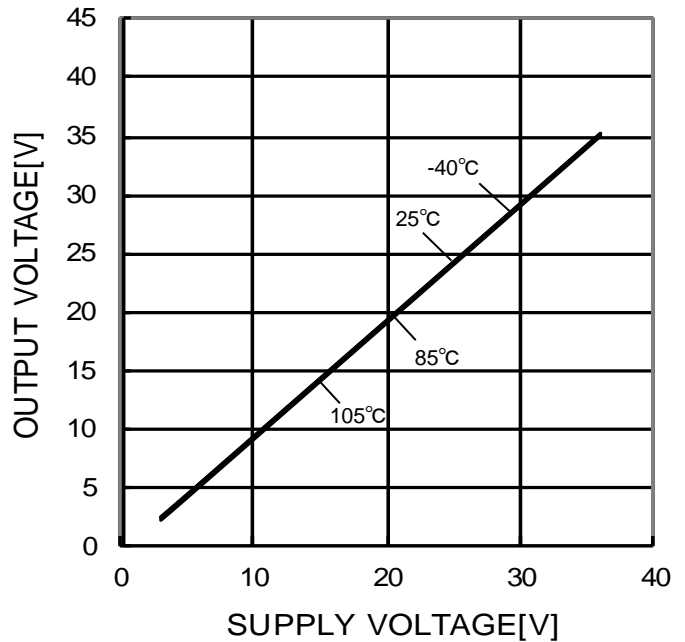


Figure 5. High level Output Voltage - Supply Voltage (RL=10kΩ)

(\*) The above data is measurement value of typical sample, it is not guaranteed.  
 BA3472 : -40°C~+85°C BA3472R : -40°C~+105°C

OBA3472, BA3472R

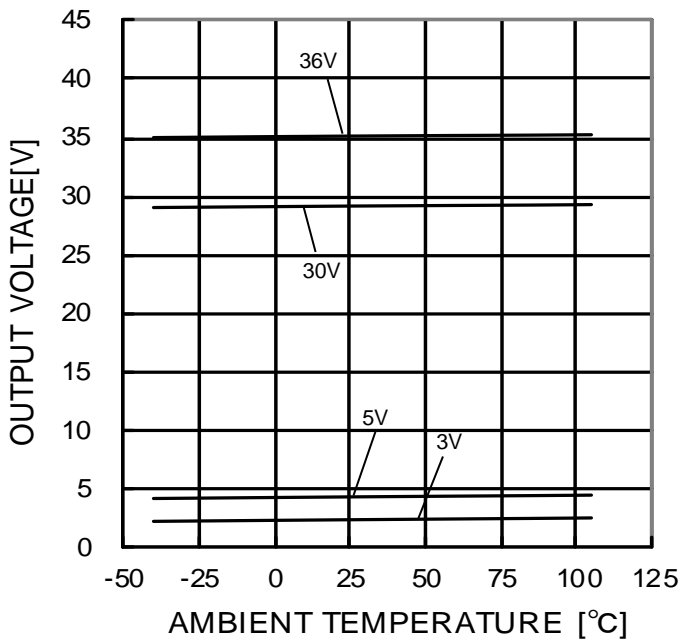


Figure 6.  
High level Output Voltage  
- Ambient Temperature  
(RL=10kΩ)

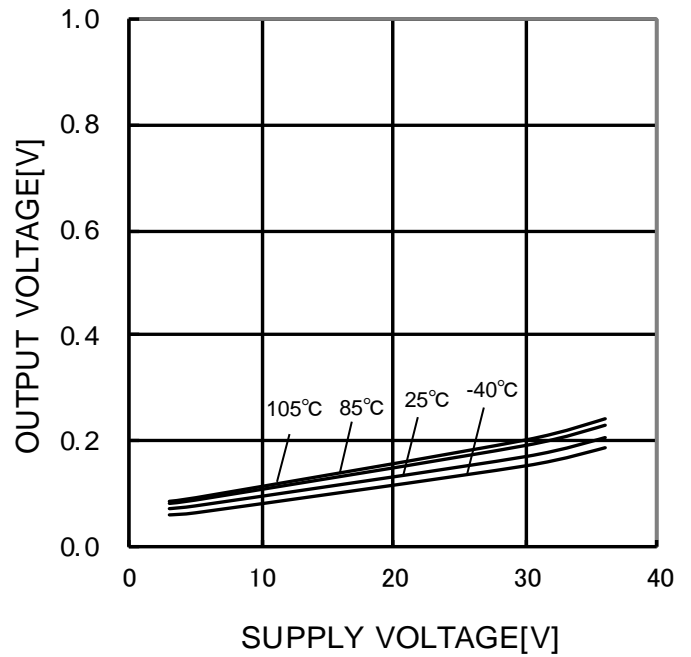


Figure 7.  
Low level Output Voltage  
- Supply Voltage  
(RL=10kΩ)

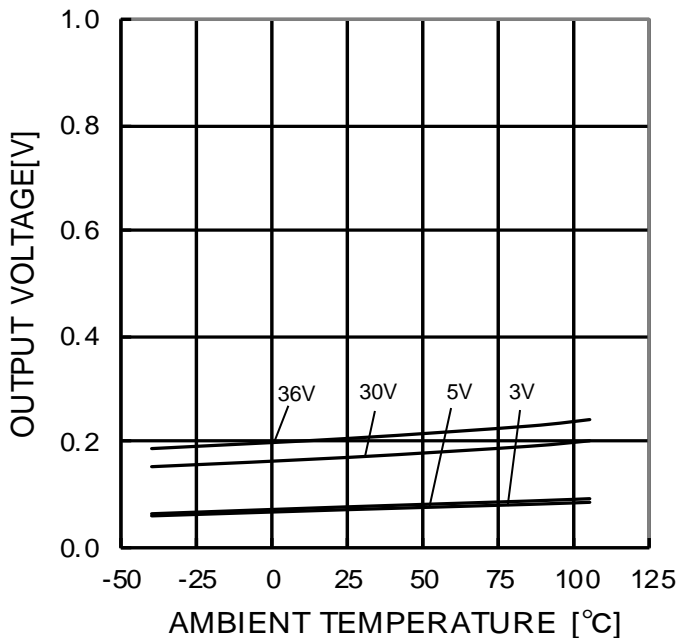


Figure 8.  
Low level Output Voltage  
- Ambient Temperature  
(RL=10kΩ)

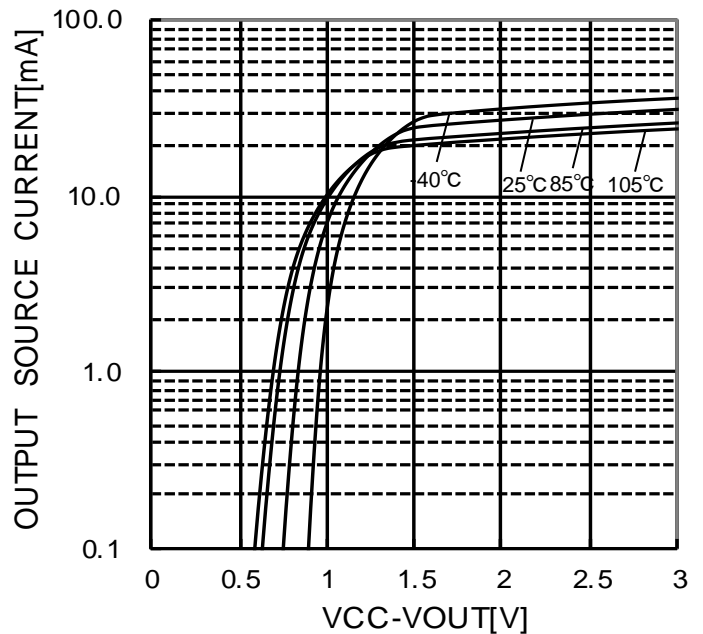


Figure 9.  
Output Source Current - (VCC-VOUT)  
(VCC/VEE=5V/0V)

(\*) The above data is measurement value of typical sample, it is not guaranteed.  
BA3472 : -40°C~+85°C BA3472R : -40°C~+105°C

OBA3472, BA3472R

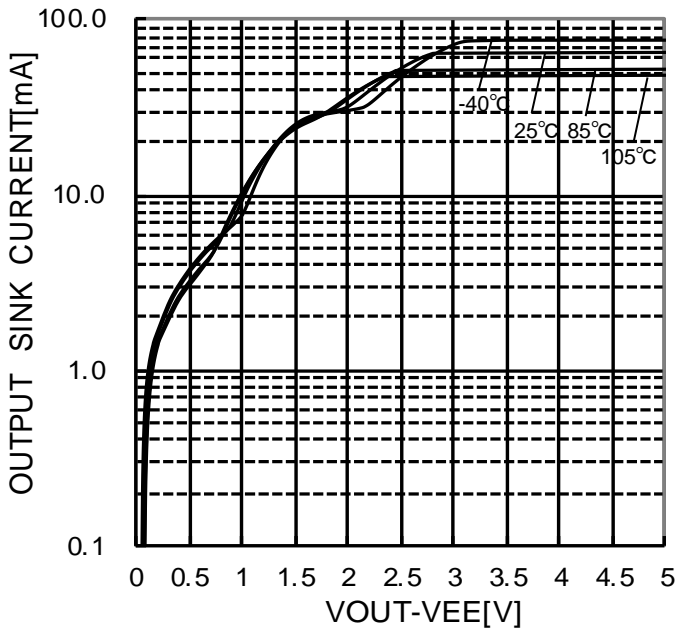


Figure 10.  
Output Sink Current - (VOUT-VEE)  
(VCC/VEE=5V/0V)

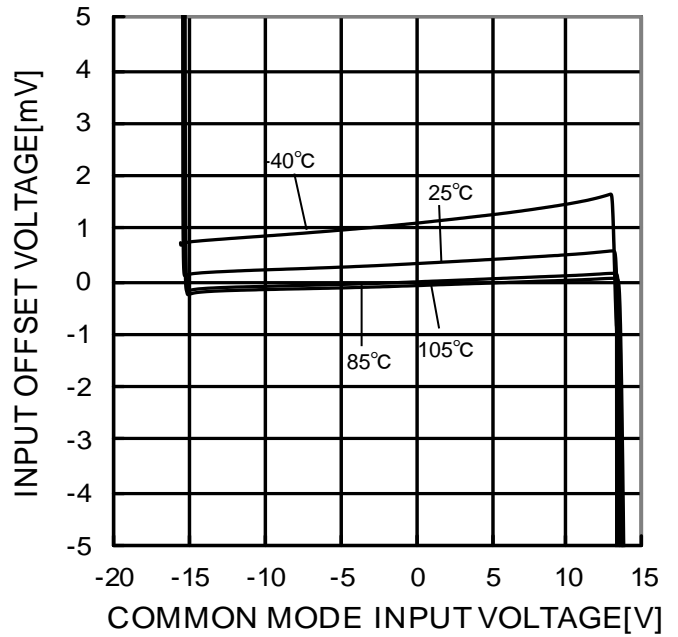


Figure 11.  
Input Common-mode Voltage Range  
(VCC/VEE=15V/-15V)

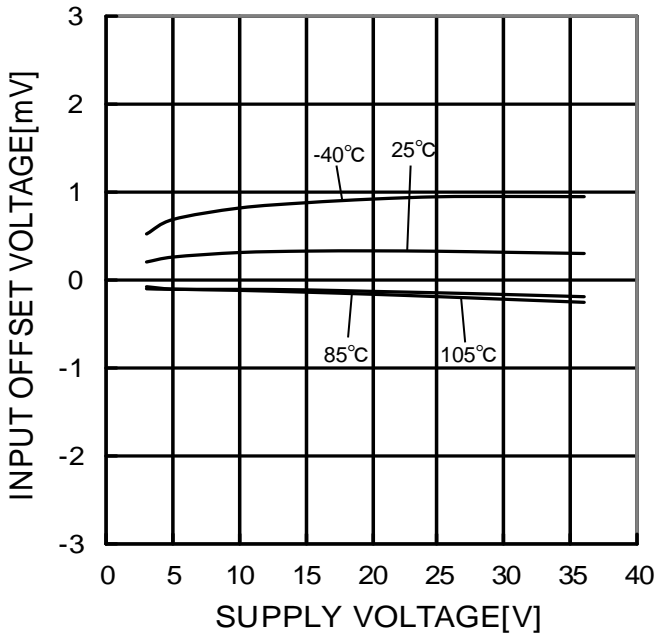


Figure 12.  
Input Offset Voltage - Supply voltage

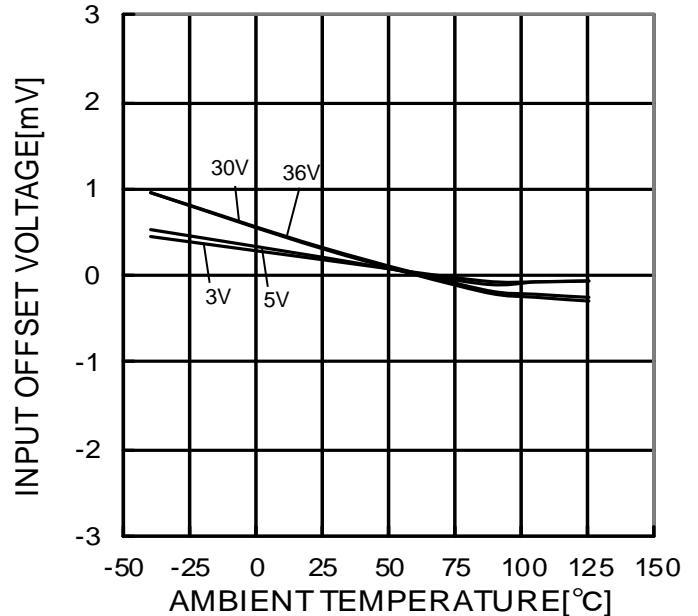


Figure 13.  
Input Offset Voltage - Ambient Temperature

(\*) The above data is measurement value of typical sample, it is not guaranteed.  
BA3472 : -40°C~+85°C BA3472R : -40°C~+105°C

OBA3472, BA3472R

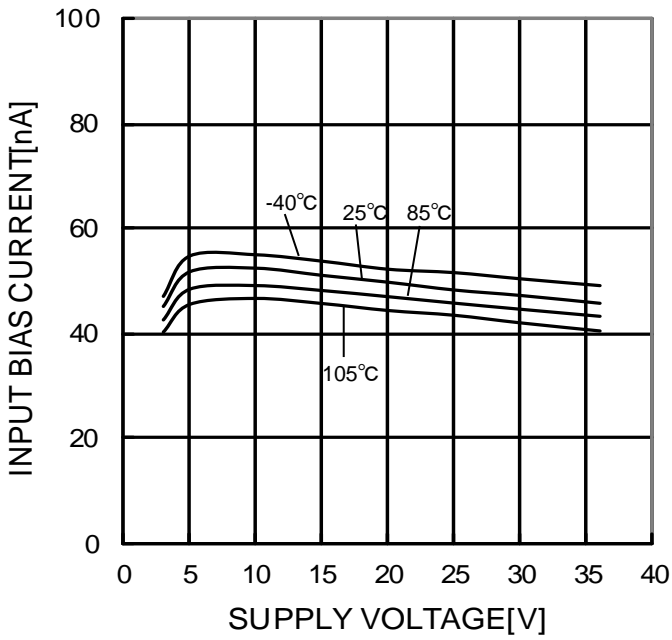


Figure 14.  
Input Bias Current - Supply voltage

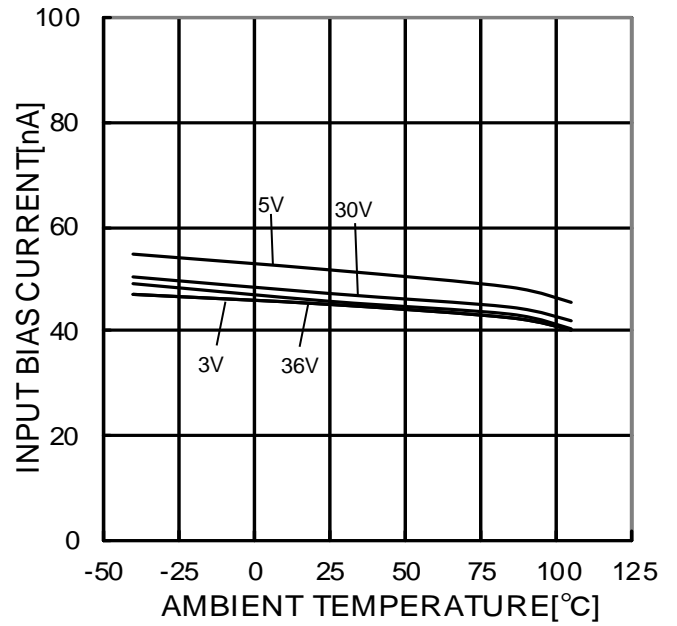


Figure 15.  
Input Bias Current - Ambient Temperature

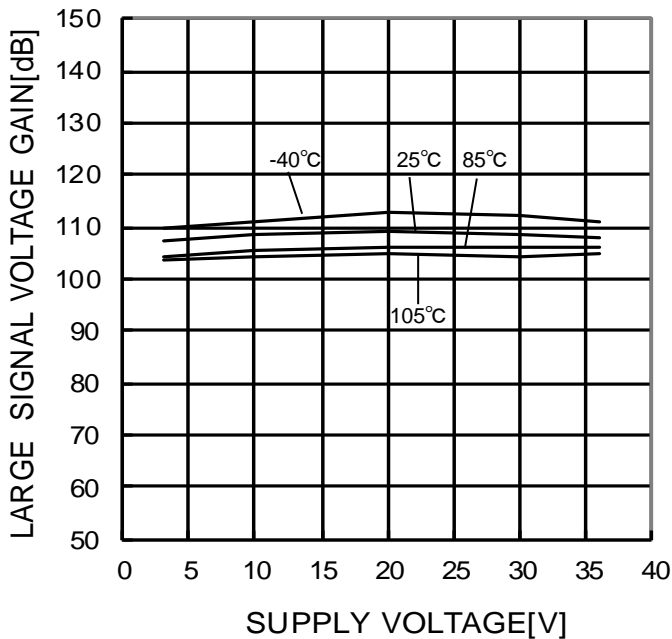


Figure 16.  
Large Signal Voltage Gain  
- Supply Voltage

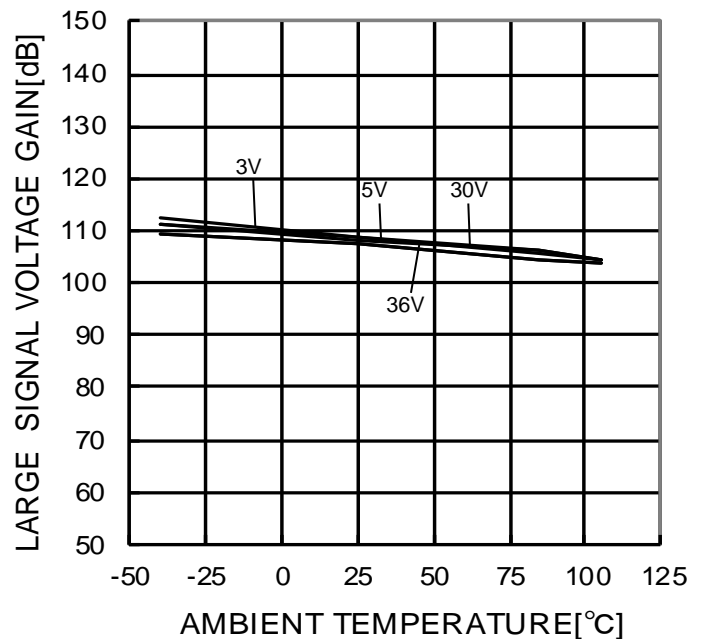


Figure 17.  
Large Signal Voltage Gain  
- Ambient Temperature

(\*) The above data is measurement value of typical sample, it is not guaranteed.  
BA3472 : -40°C~+85°C BA3472R : -40°C~+105°C

OBA3472, BA3472R

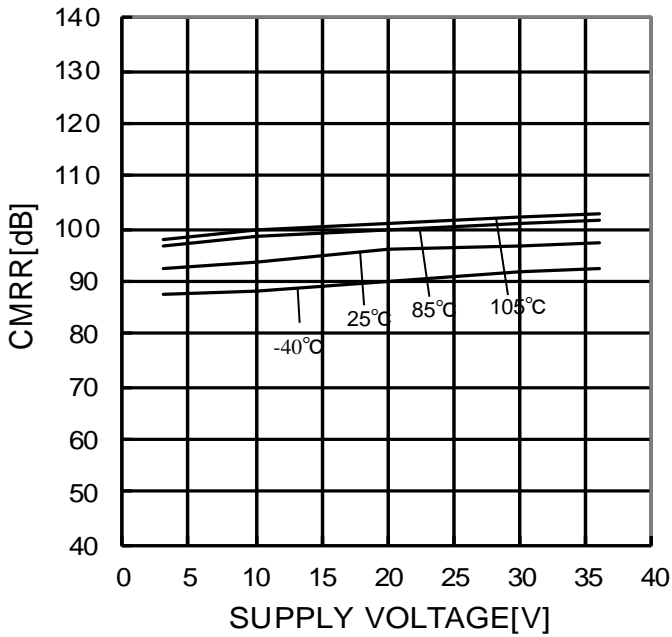


Figure 18.  
Common Mode Rejection Ratio  
- Supply Voltage

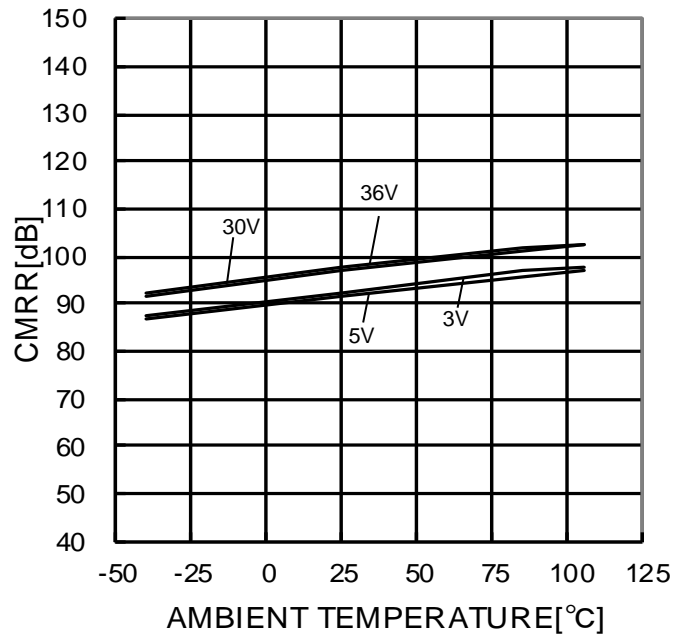


Figure 19.  
Common Mode Rejection Ratio  
- Ambient Temperature

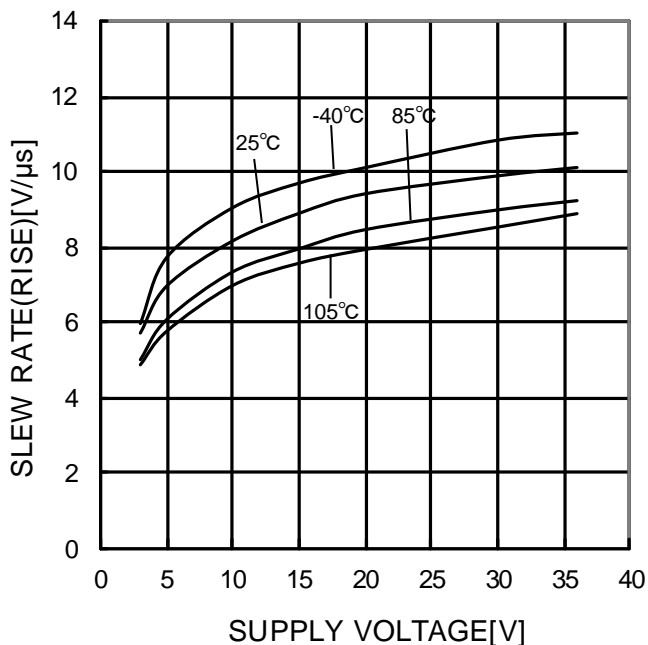


Figure 20.  
Slew Rate L-H - Supply Voltage  
(RL=10kΩ)

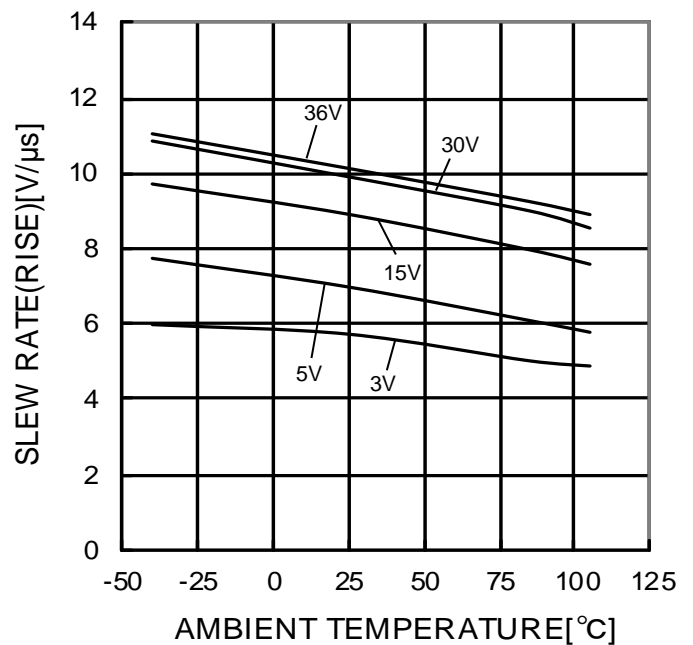


Figure 21.  
Slew Rate L-H - Ambient Temperature  
(RL=10kΩ)

(\*) The above data is measurement value of typical sample, it is not guaranteed.  
BA3472 : -40°C~+85°C BA3472R : -40°C~+105°C

OBA3472, BA3472R

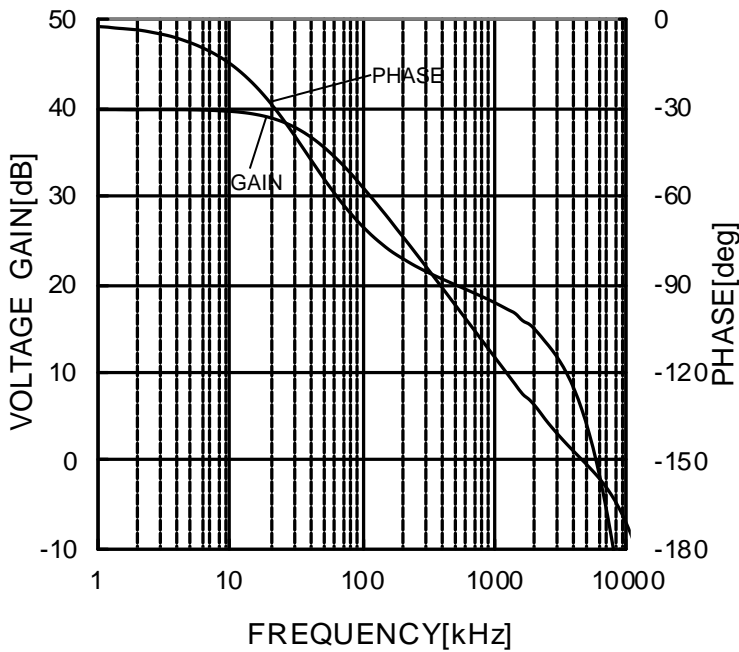


Figure 22.  
Voltage Gain - Phase - Frequency  
(VCC=7.5V/-7.5V, Av=40dB,  
RL=2kΩ, CL=100pF, Ta=25°C)

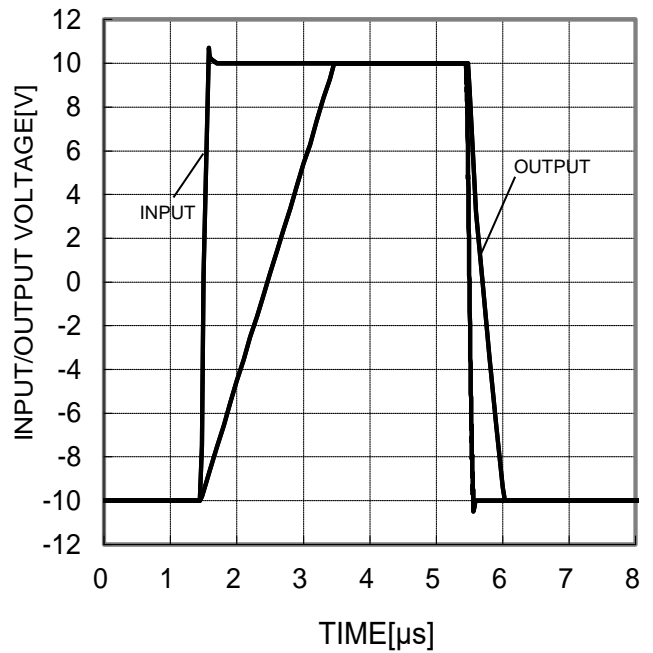


Figure 23.  
Input / Output Voltage - Time  
(VCC/VEE=15V/-15V, Av=0dB,  
RL=2kΩ, CL=100pF, Ta=25°C)

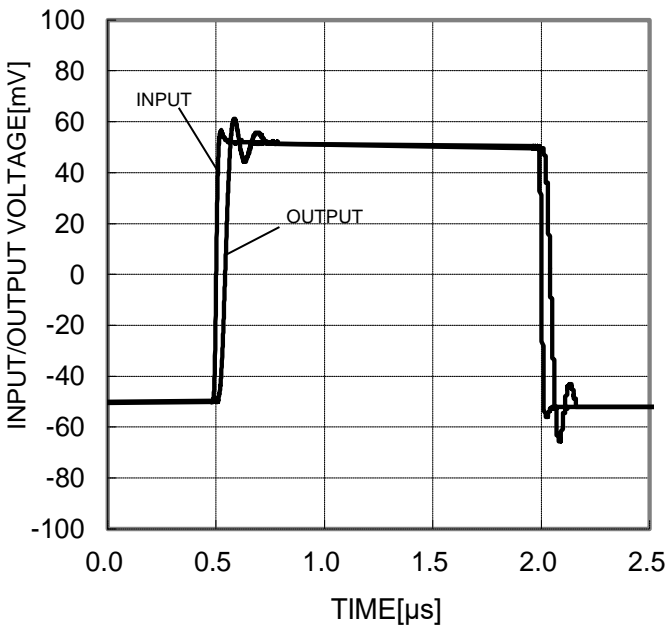


Figure 24.  
Input / Output Voltage - Time  
(VCC/VEE=15V/-15V, Av=0dB,  
RL=2kΩ, CL=100pF, Ta=25°C)

(\*) The above data is measurement value of typical sample, it is not guaranteed.  
BA3472 : -40°C~+85°C BA3472R : -40°C~+105°C

OBA3474, BA3474R

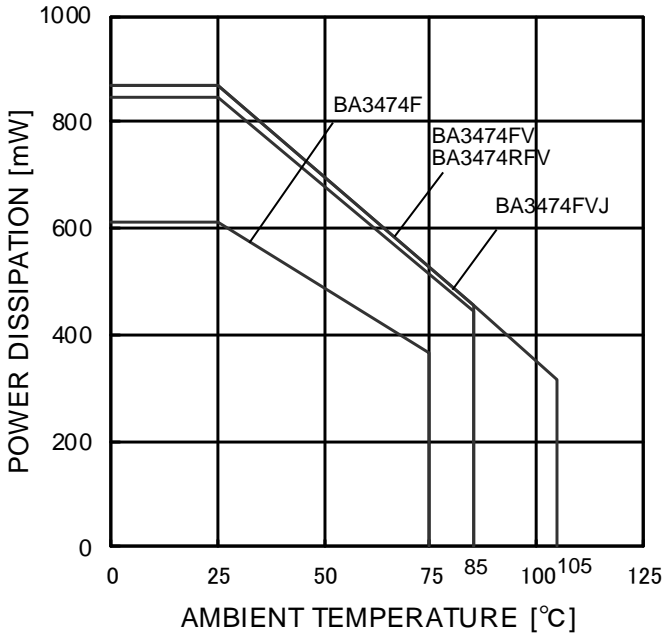


Figure 25.  
Derating Curve

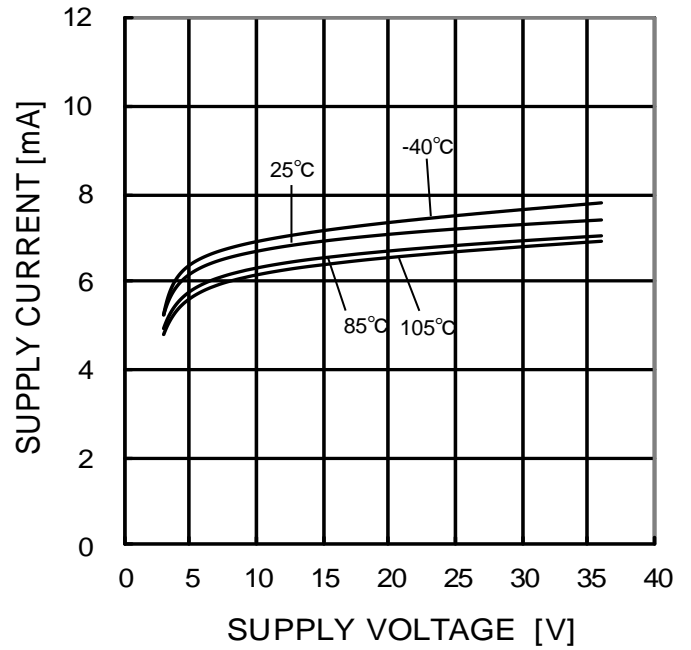


Figure 26.  
Supply Current - Supply Voltage

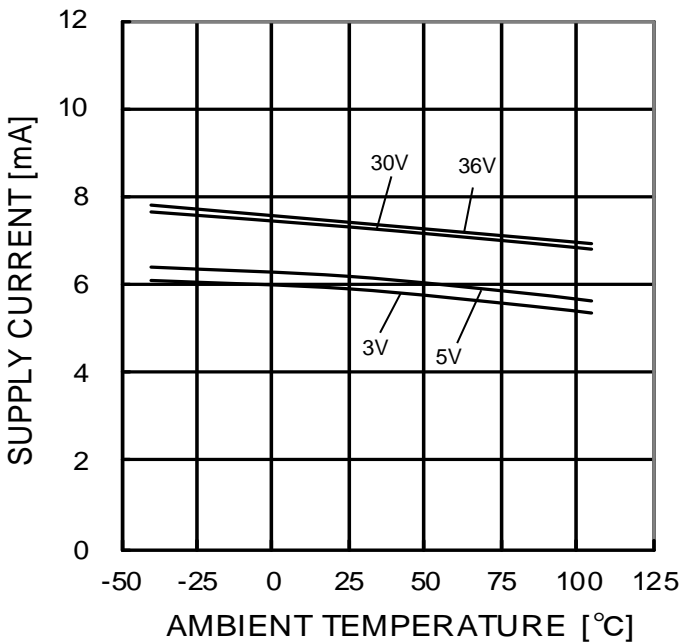


Figure 27.  
Supply Current - Ambient Temperature

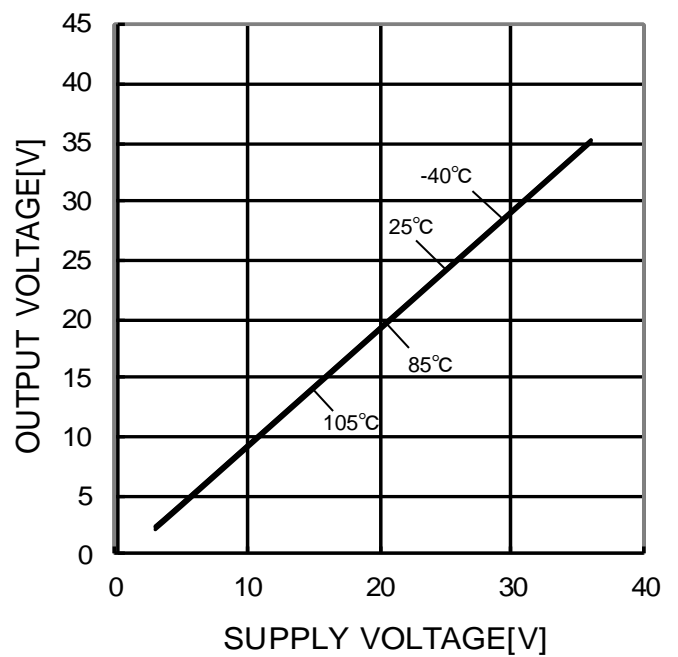


Figure 28.  
High level Output Voltage  
- Supply Voltage  
(RL=10kΩ)

(\*) The above data is measurement value of typical sample, it is not guaranteed.  
BA3474F : -40°C~+75°C BA3474 : -40°C~+85°C BA3474R : -40°C~+105°C



OBA3474, BA3474R

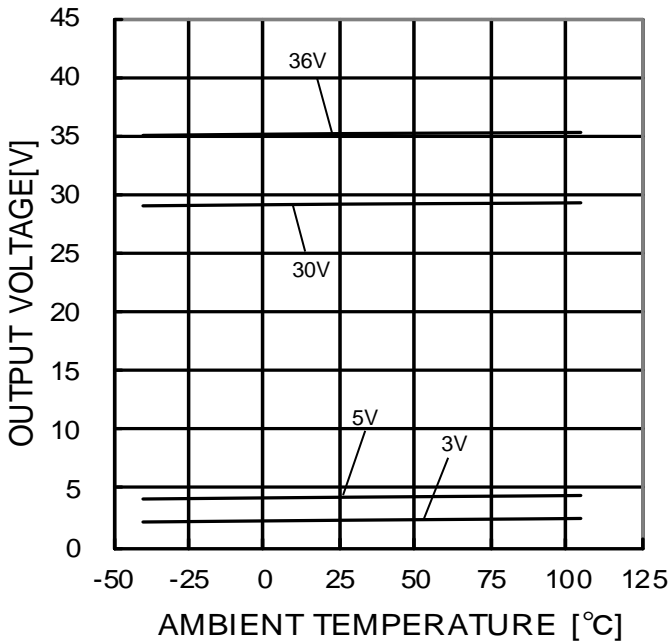


Figure 29.  
High level Output Voltage  
- Ambient Temperature  
( $R_L=10k\Omega$ )

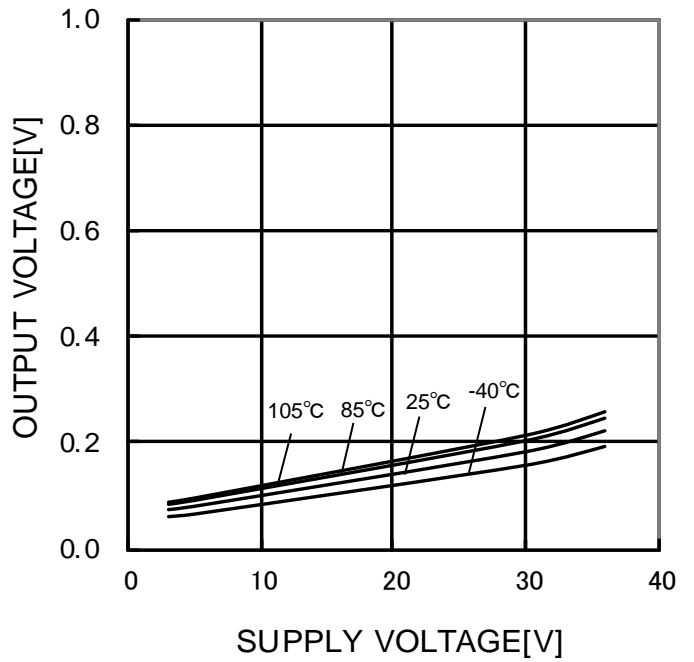


Figure 30.  
Low level Output Voltage  
- Supply Voltage  
( $R_L=10k\Omega$ )

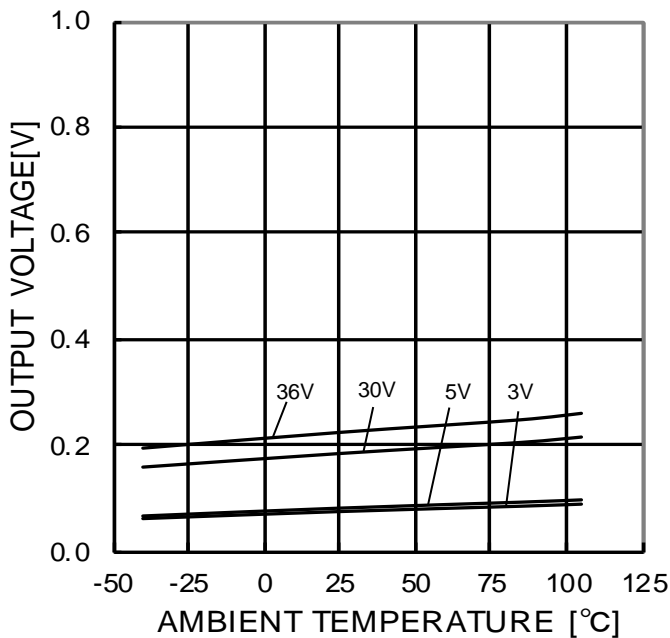


Figure 31.  
Low level Output Voltage  
- Ambient Temperature  
( $R_L=10k\Omega$ )

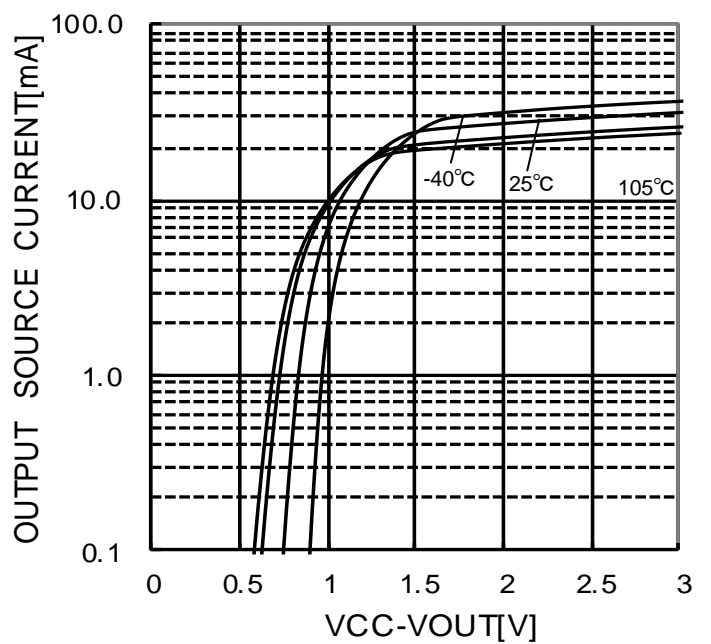


Figure 32.  
Output Source Current - ( $V_{CC}-V_{OUT}$ )  
( $V_{CC}/V_{EE}=5V/0V$ )

(\*) The above data is measurement value of typical sample, it is not guaranteed.  
BA3474F : -40°C~+75°C BA3474 : -40°C~+85°C BA3474R : -40°C~+105°C

OBA3474, BA3474R

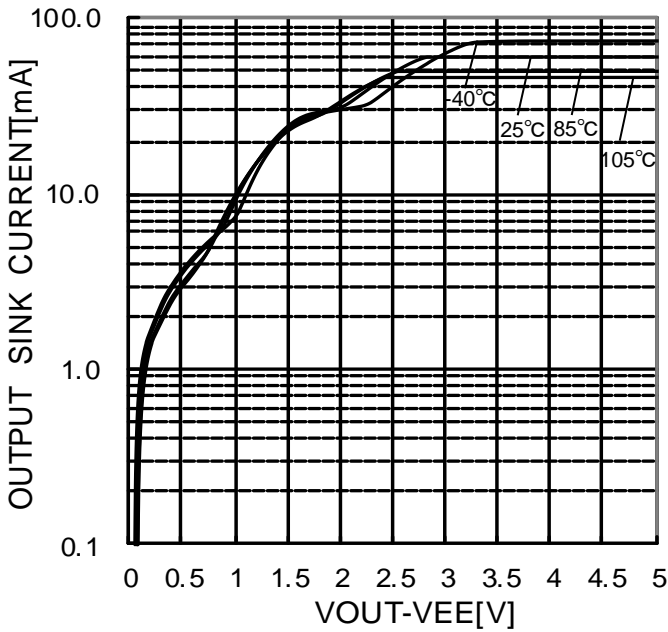


Figure 33.  
Output Sink Current - (VOUT-VEE)  
(VCC/VEE=5V/0V)

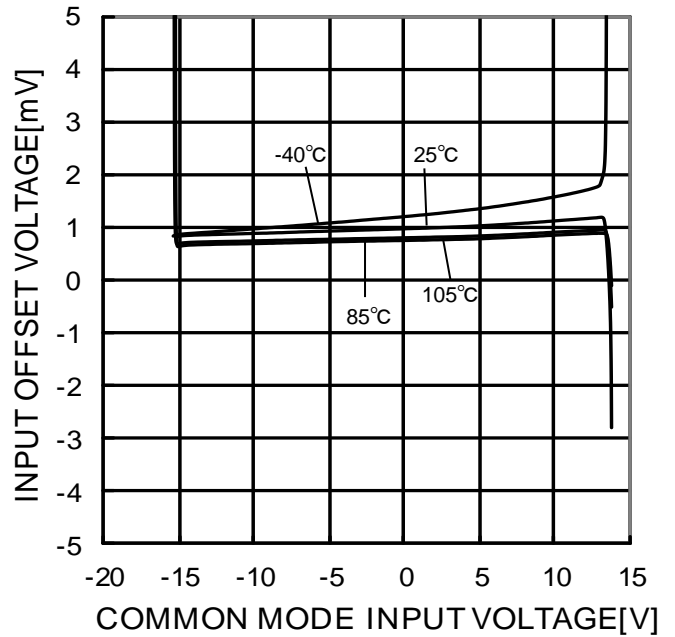


Figure 34.  
Input Common-mode Voltage Range  
(VCC/VEE=15V/-15V)

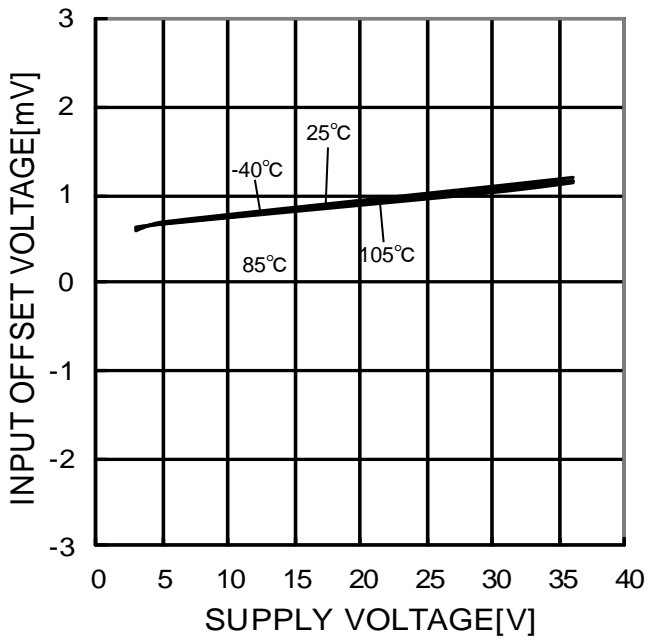


Figure 35.  
Input Offset Voltage - Supply voltage

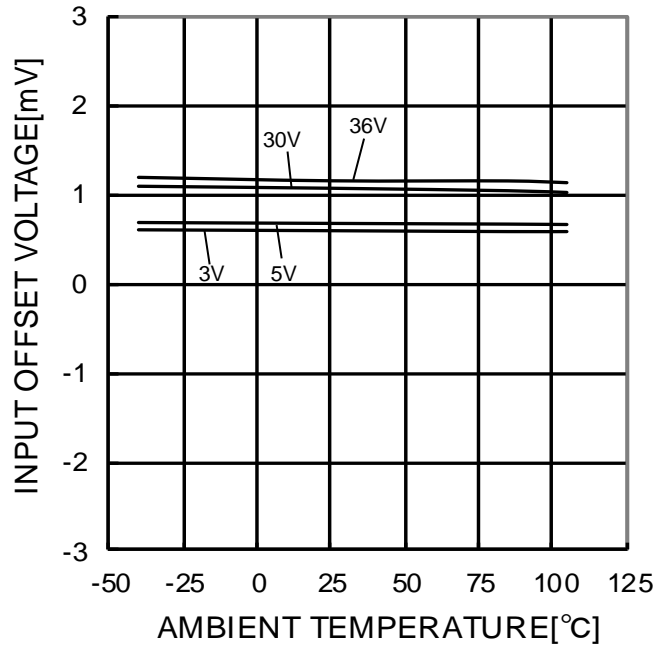


Figure 36.  
Input Offset Voltage - Ambient Temperature

(\*) The above data is measurement value of typical sample, it is not guaranteed.  
BA3474F : -40°C~+75°C BA3474 : -40°C~+85°C BA3474R : -40°C~+105°C

OBA3474, BA3474R

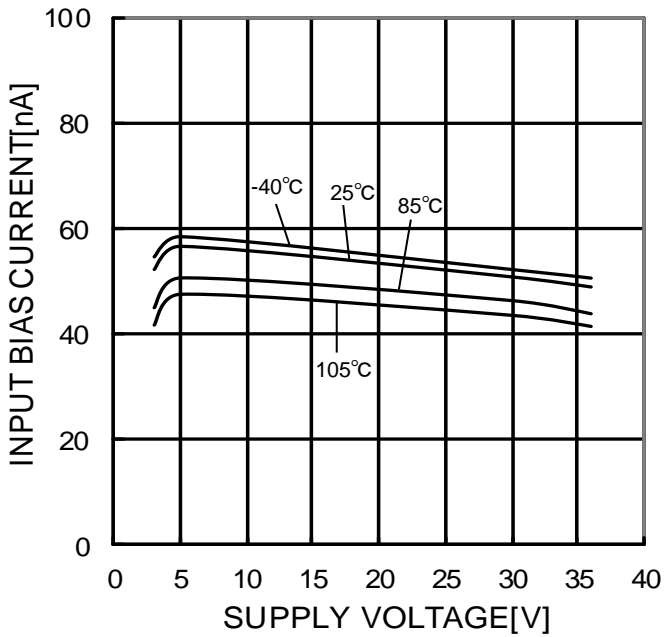


Figure 37.  
Input Bias Current - Supply voltage

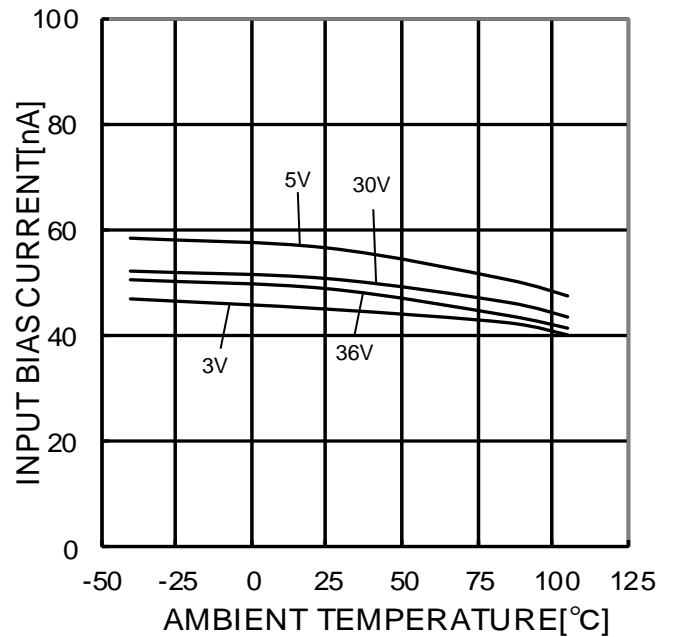


Figure 38.  
Input Bias Current - Ambient Temperature

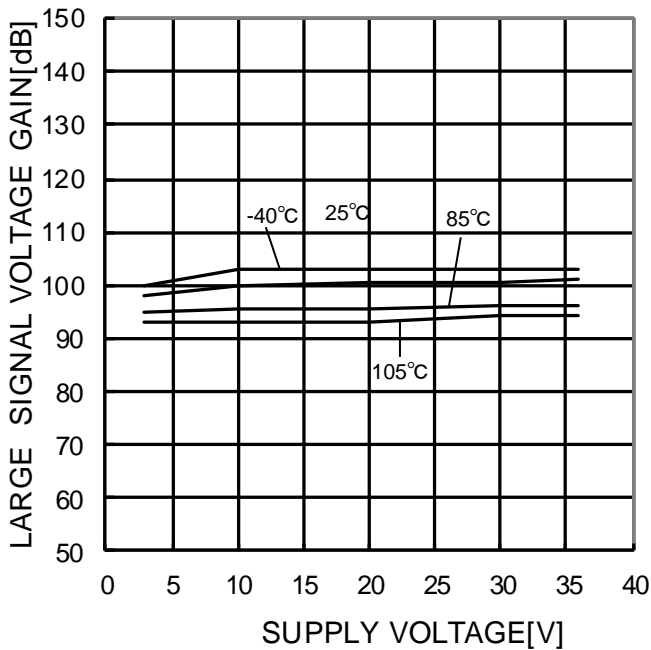


Figure 39.  
Large Signal Voltage Gain  
- Supply Voltage

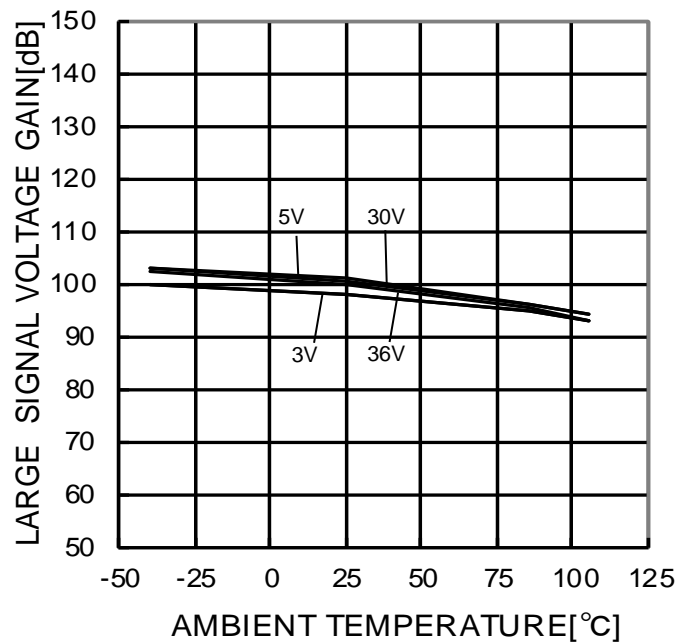


Figure 40.  
Large Signal Voltage Gain  
- Ambient Temperature

(\*) The above data is measurement value of typical sample, it is not guaranteed.  
BA3474F : -40°C~+75°C BA3474 : -40°C~+85°C BA3474R : -40°C~+105°C

OBA3474, BA3474R

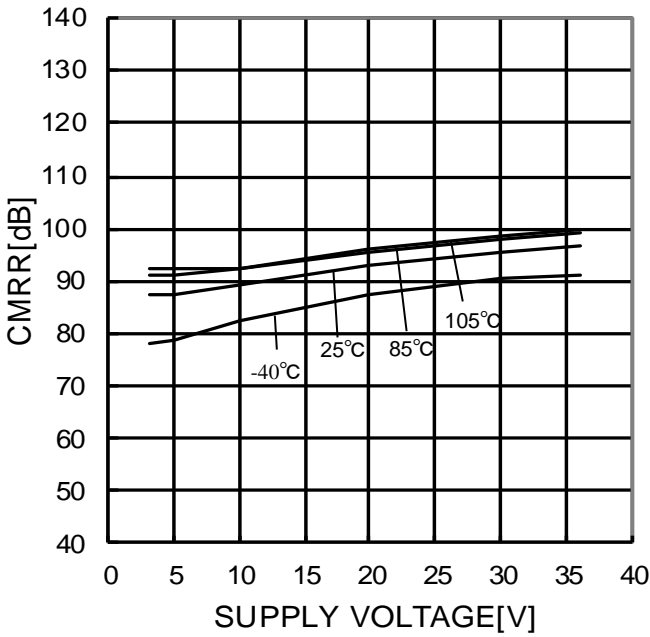


Figure 41.  
Common Mode Rejection Ratio  
- Supply Voltage

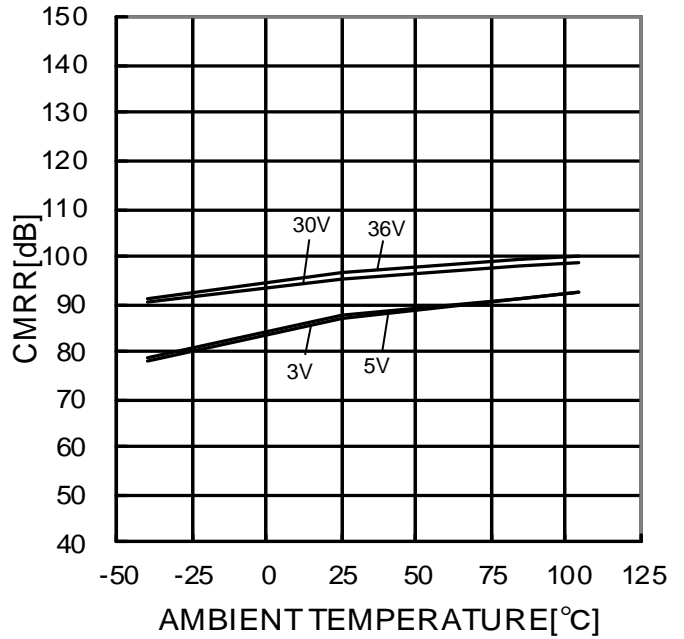


Figure 42.  
Common Mode Rejection Ratio  
- Ambient Temperature

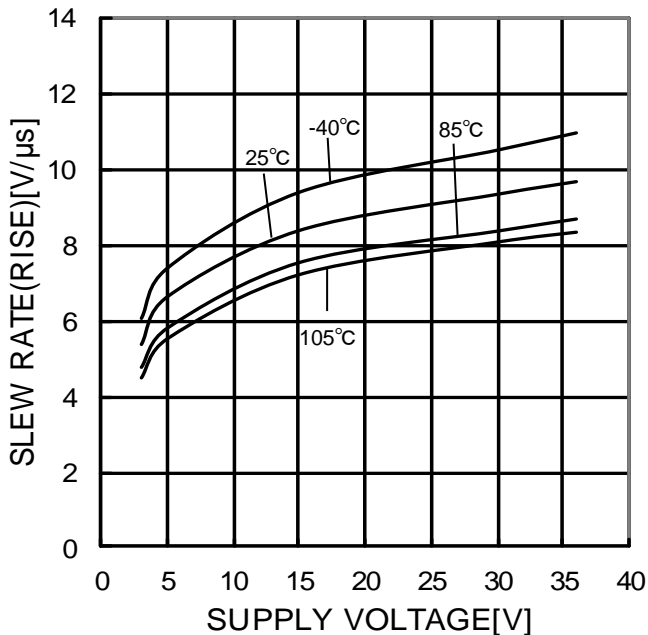


Figure 43.  
Slew Rate L-H - Supply Voltage  
(RL=10kΩ)

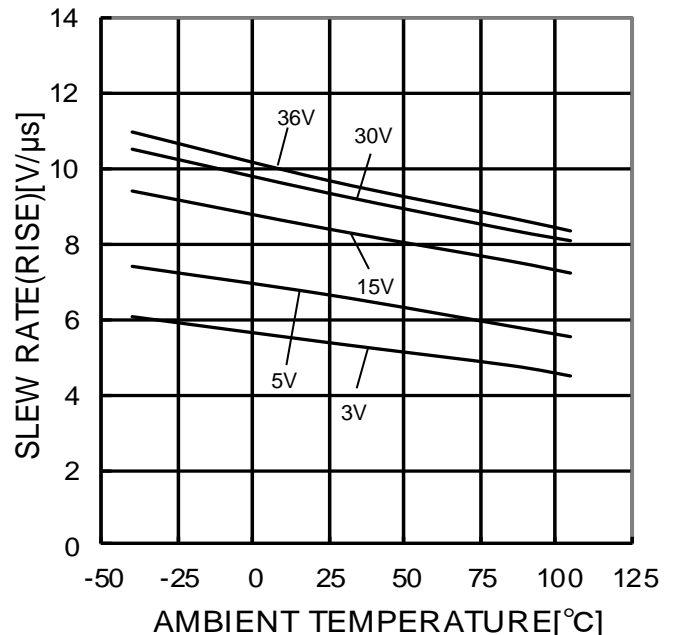


Figure 44.  
Slew Rate L-H - Ambient Temperature  
(RL=10kΩ)

(\*) The above data is measurement value of typical sample, it is not guaranteed.  
BA3474F : -40°C~+75°C BA3474 : -40°C~+85°C BA3474R : -40°C~+105°C

OBA3474, BA3474R

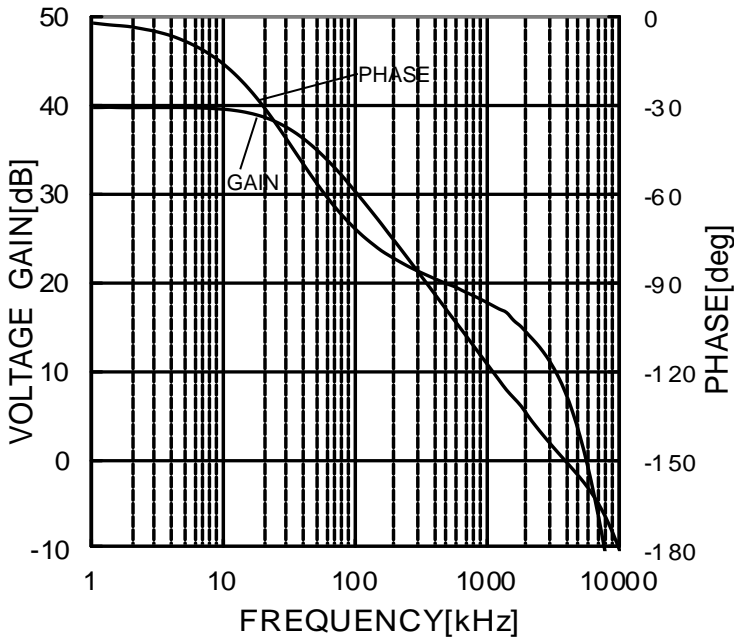


Figure 45.  
Voltage Gain · Phase - Frequency  
(VCC=7.5V/-7.5V, Av=40dB,  
RL=2kΩ, CL=100pF, Ta=25°C)

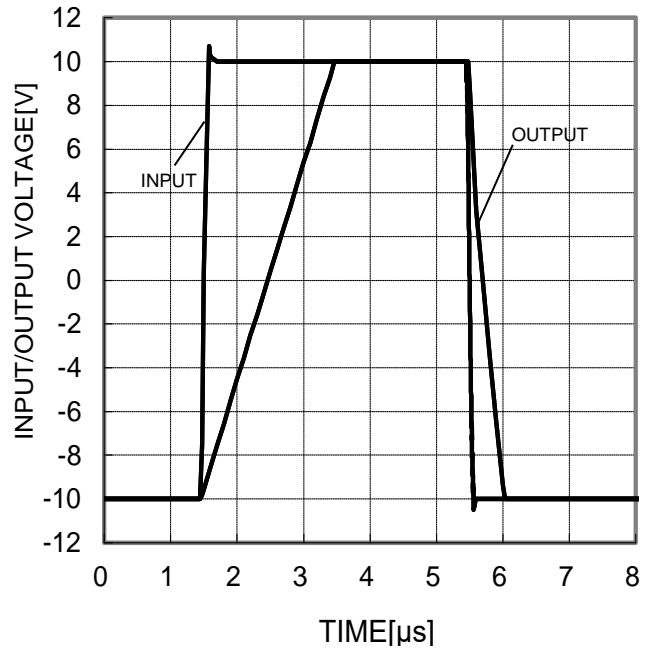


Figure 46.  
Input / Output Voltage - Time  
(VCC/VEE=15V/-15V, Av=0dB,  
RL=2kΩ, CL=100pF, Ta=25°C)

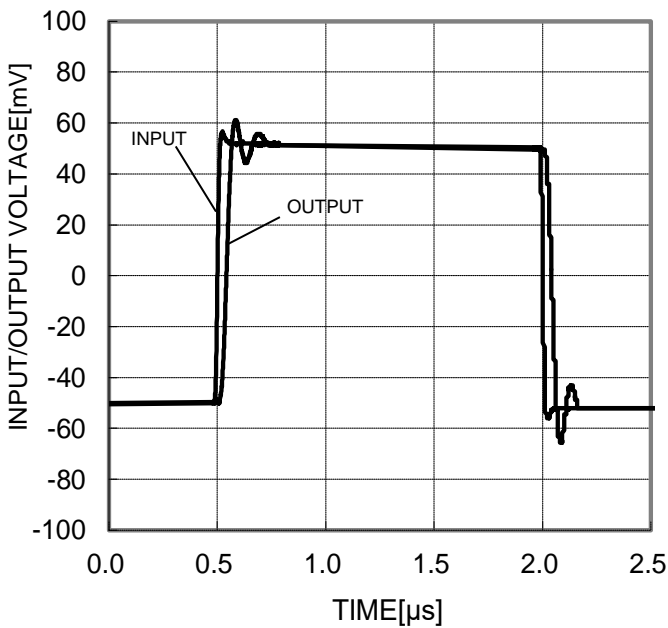


Figure 47.  
Input / Output Voltage - Time  
(VCC/VEE=15V/-15V, Av=0dB,  
RL=2kΩ, CL=100pF, Ta=25°C)

(\*) The above data is measurement value of typical sample, it is not guaranteed.  
BA3474F : -40°C~+75°C BA3474 : -40°C~+85°C BA3474R : -40°C~+105°C

Application Information

NULL method condition for Test Circuit 1

VCC, VEE, EK, Vicm Unit : V

| Parameter   | VF   | S1  | S2  | S3  | VCC | VEE | EK  | Vicm | Calculation |
|---|------|-----|-----|-----|-----|-----|-----|------|-------------|
| Input Offset Voltage  | VF1  | ON  | ON  | OFF | 15  | -15 | 0   | 0    | 1           |
| Input Offset Current  | VF2  | OFF | OFF | OFF | 15  | -15 | 0   | 0    | 2           |
| Input Bias Current  | VF3  | OFF | ON  | OFF | 15  | -15 | 0   | 0    | 3           |
|   | VF4  | ON  | OFF |     |     |     |     |      |             |
| Large Signal Voltage Gain                                     | VF5  | ON  | ON  | ON  | 15  | -15 | +10 | 0    | 4           |
|   | VF6  |     |     |     | 15  | -15 | -10 | 0    |             |
| Common-mode Rejection Ratio (Input Common-mode Voltage Range) | VF7  | ON  | ON  | OFF | 15  | -15 | 0   | -15  | 5           |
|   | VF8  |     |     |     | 15  | -15 | 0   | 13   |             |
| Power Supply Rejection Ratio                                  | VF9  | ON  | ON  | OFF | 2   | -2  | 0   | 0    | 6           |
|   | VF10 |     |     |     | 18  | -18 | 0   | 0    |             |

— Calculation —

1. Input Offset Voltage (Vio)

$$V_{io} = \frac{|VF1|}{1 + R_f / R_s} \text{ [V]}$$

2. Input Offset Current (Iio)

$$I_{io} = \frac{|VF2 - VF1|}{R_i \times (1 + R_f / R_s)} \text{ [A]}$$

3. Input Bias Current (Ib)

$$I_b = \frac{|VF4 - VF3|}{2 \times R_i \times (1 + R_f / R_s)} \text{ [A]}$$

4. Large Signal Voltage Gain (Av)

$$A_v = 20 \times \text{Log} \frac{\Delta E_k \times (1 + R_f / R_s)}{|VF5 - VF6|} \text{ [dB]}$$

5. Common-mode Rejection Ratio (CMRR)

$$\text{CMRR} = 20 \times \text{Log} \frac{\Delta V_{icm} \times (1 + R_f / R_s)}{|VF8 - VF7|} \text{ [dB]}$$

6. Power Supply Rejection Ratio (PSRR)

$$\text{PSRR} = 20 \times \text{Log} \frac{\Delta V_{cc} \times (1 + R_f / R_s)}{|VF10 - VF9|} \text{ [dB]}$$

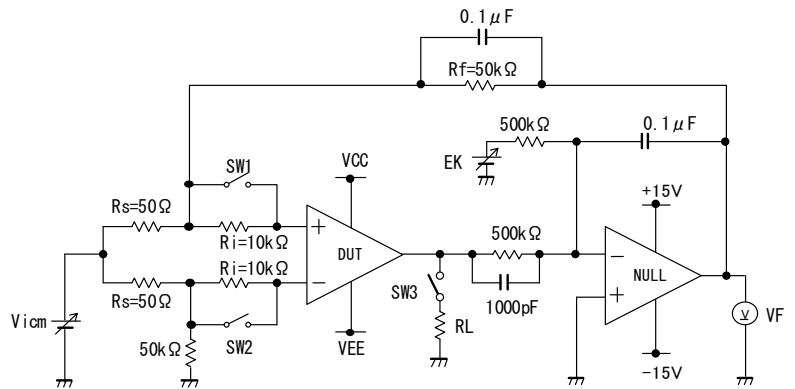


Figure 48. Test circuit 1 (one channel only)

Switch Condition for Test Circuit 2

| SW No.                         | SW 1 | SW 2 | SW 3 | SW 4 | SW 5 | SW 6 | SW 7 | SW 8 | SW 9 | SW 10 | SW 11 | SW 12 | SW 13 | SW 14 |
|--------------------------------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|-------|
| Supply Current                 | OFF  | OFF  | OFF  | ON   | OFF  | ON   | OFF  | OFF  | OFF  | OFF   | OFF   | OFF   | OFF   | OFF   |
| Maximum Output Voltage(High)   | OFF  | OFF  | ON   | OFF  | OFF  | ON   | OFF  | OFF  | ON   | OFF   | OFF   | OFF   | ON    | OFF   |
| Maximum Output Voltage(Low)    | OFF  | OFF  | ON   | OFF  | OFF  | ON   | OFF  | OFF  | OFF  | OFF   | OFF   | OFF   | ON    | OFF   |
| Output Source Current          | OFF  | OFF  | ON   | OFF  | OFF  | ON   | OFF  | OFF  | OFF  | OFF   | OFF   | OFF   | OFF   | ON    |
| Output Sink Current            | OFF  | OFF  | ON   | OFF  | OFF  | ON   | OFF  | OFF  | OFF  | OFF   | OFF   | OFF   | OFF   | ON    |
| Slew Rate                      | OFF  | OFF  | OFF  | ON   | OFF  | OFF  | OFF  | ON   | ON   | ON    | OFF   | OFF   | OFF   | OFF   |
| Gain Bandwidth Product         | OFF  | ON   | OFF  | OFF  | ON   | ON   | OFF  | OFF  | ON   | ON    | OFF   | OFF   | OFF   | OFF   |
| Equivalent Input Noise Voltage | ON   | OFF  | OFF  | OFF  | ON   | ON   | OFF  | OFF  | OFF  | OFF   | ON    | OFF   | OFF   | OFF   |

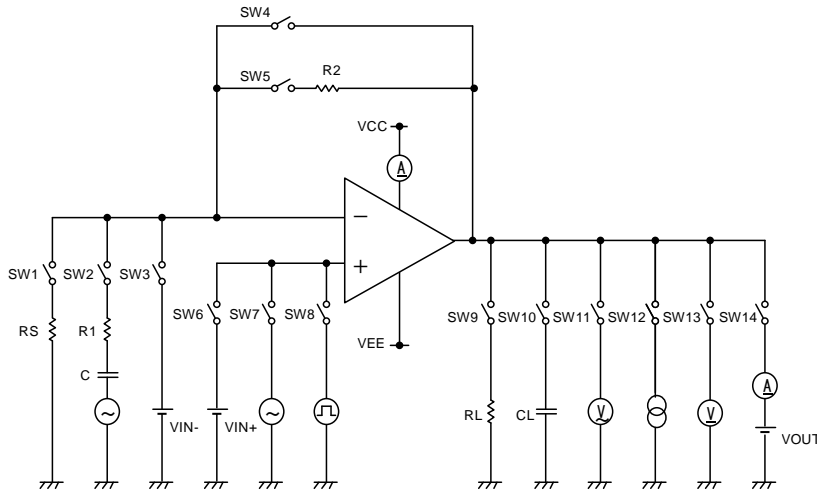


Figure 49. Test circuit 2 (one channel only)

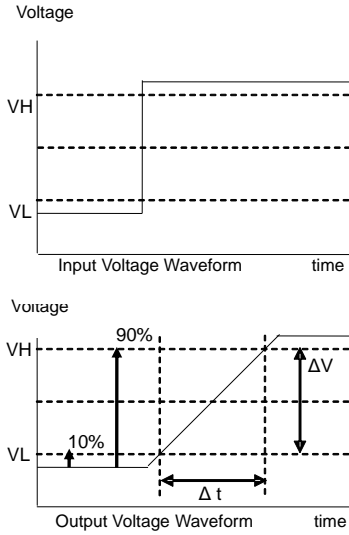
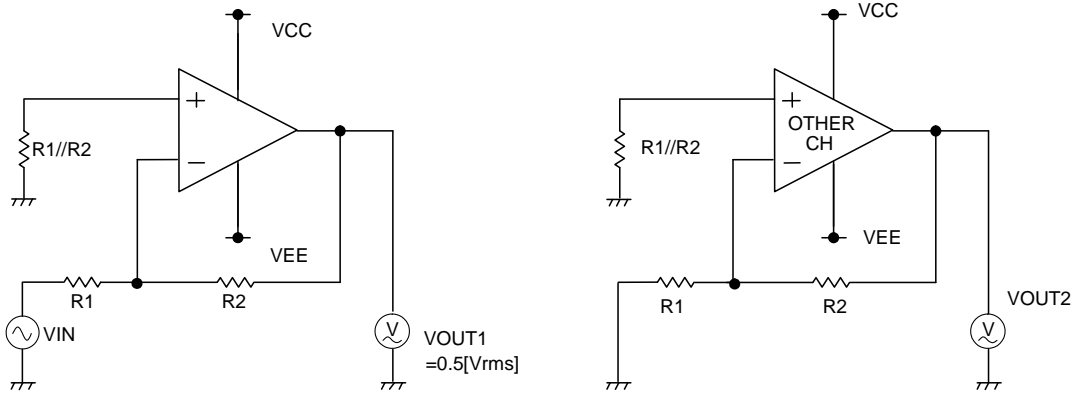


Figure 50. Slew rate input output wave



$$CS = 20 \times \log \frac{100 \times VOUT1}{VOUT2}$$

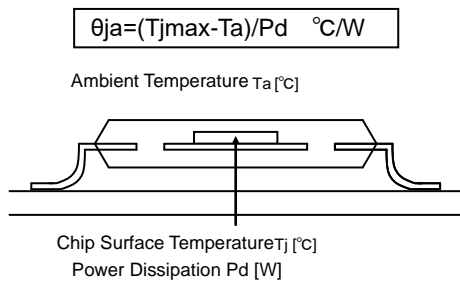
Figure 51. Test circuit 3 (Channel Separation)

**Power Dissipation**

Power dissipation (total loss) indicates the power that can be consumed by IC at Ta=25°C (normal temperature). IC is heated when it consumed power, and the temperature of IC chip becomes higher than ambient temperature. The temperature that can be accepted by IC chip depends on circuit configuration, manufacturing process, and consumable power is limited. Power dissipation is determined by the temperature allowed in IC chip (maximum junction temperature) and thermal resistance of package (heat dissipation capability). The maximum junction temperature is typically equal to the maximum value in the storage temperature range. Heat generated by consumed power of IC radiates from the mold resin or lead frame of the package. The parameter which indicates this heat dissipation capability (hardness of heat release) is called thermal resistance, represented by the symbol  $\theta_{ja}$  °C/W. The temperature of IC inside the package can be estimated by this thermal resistance. Figure 52. (a) shows the model of thermal resistance of the package. Thermal resistance  $\theta_{ja}$ , ambient temperature Ta, maximum junction temperature Tjmax, and power dissipation Pd can be calculated by the equation below:

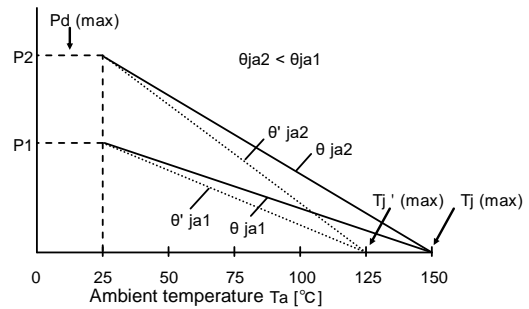
$$\theta_{ja} = (T_{jmax} - T_a) / P_d \quad \text{°C/W}$$

Derating curve in Figure 52. (b) indicates power that can be consumed by IC with reference to ambient temperature. Power that can be consumed by IC begins to attenuate at certain ambient temperature. This gradient is determined by thermal resistance  $\theta_{ja}$ . Thermal resistance  $\theta_{ja}$  depends on chip size, power consumption, package, ambient temperature, package condition, wind velocity, etc even when the same of package is used. Thermal reduction curve indicates a reference value measured at a specified condition. Figure 52. (c) to (f) shows a derating curve for an example of BA3472, BA3474, BA3472R, BA3474R.

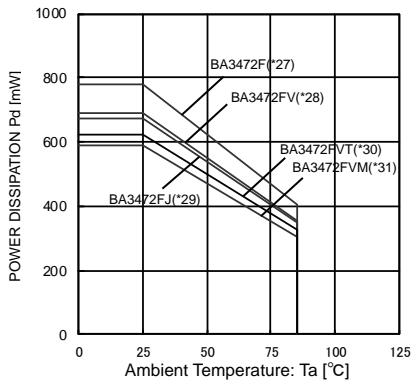


(a) Thermal Resistance

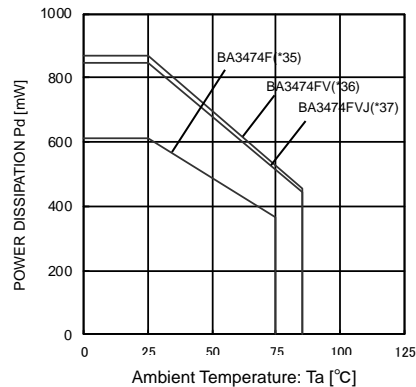
Power Dissipation of LSI [W]



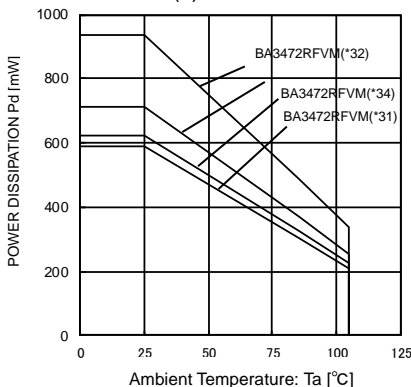
(b) Derating Curve



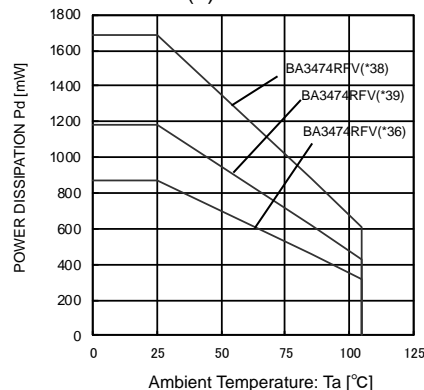
(c) BA3472



(d) BA3474



(e) BA3472R



(f) BA3474R

| (*27) | (*28) | (*29) | (*30) | (*31) | (*32) | (*33) | (*34) | (*35) | (*36) | (*37) | (*38) | (*39) | Unit  |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 6.2   | 5.5   | 5.4   | 5.0   | 4.8   | 7.5   | 5.7   | 5.0   | 4.9   | 7.0   | 6.8   | 13.5  | 9.5   | mW/°C |

When using the unit above Ta=25°C, subtract the value above per Celsius degree.

(\*27)(\*28)(\*29)(\*30)(\*31)(\*35)(\*36)(\*37) Mounted on a FR4 glass epoxy 1 layers PCB 70mm × 70mm × 1.6mm (copper foil area less than 3%).

(\*34) Mounted on a FR4 glass epoxy 2 layers PCB 70mm × 70mm × 1.6mm (occupied copper area : 15mm × 15mm).

(\*33) (\*39) Mounted on a FR4 glass epoxy 2 layers PCB 70mm × 70mm × 1.6mm (occupied copper area : 70mm × 70mm).

(\*32) (\*38) Mounted on a FR4 glass epoxy 4 layers PCB 70mm × 70mm × 1.6mm (occupied copper area : 70mm × 70mm).

Figure 52. Thermal Resistance and Derating Curve



**Operational Notes****1. Reverse Connection of Power Supply**

Connecting the power supply in reverse polarity can damage the IC. Take precautions against reverse polarity when connecting the power supply, such as mounting an external diode between the power supply and the IC's power supply pins.

**2. Power Supply Lines**

Design the PCB layout pattern to provide low impedance supply lines. Separate the ground and supply lines of the digital and analog blocks to prevent noise in the ground and supply lines of the digital block from affecting the analog block. Furthermore, connect a capacitor to ground at all power supply pins. Consider the effect of temperature and aging on the capacitance value when using electrolytic capacitors.

**3. Ground Voltage**

Ensure that no pins are at a voltage below that of the ground pin at any time, even during transient condition.

**4. Ground Wiring Pattern**

When using both small-signal and large-current ground traces, the two ground traces should be routed separately but connected to a single ground at the reference point of the application board to avoid fluctuations in the small-signal ground caused by large currents. Also ensure that the ground traces of external components do not cause variations on the ground voltage. The ground lines must be as short and thick as possible to reduce line impedance.

**5. Thermal Consideration**

Should by any chance the power dissipation rating be exceeded the rise in temperature of the chip may result in deterioration of the properties of the chip. The absolute maximum rating of the  $P_D$  stated in this specification is when the IC is mounted on a 70mm x 70mm x 1.6mm glass epoxy board. In case of exceeding this absolute maximum rating, increase the board size and copper area to prevent exceeding the  $P_D$  rating.

**6. Recommended Operating Conditions**

These conditions represent a range within which the expected characteristics of the IC can be approximately obtained. The electrical characteristics are guaranteed under the conditions of each parameter.

**7. Inrush Current**

When power is first supplied to the IC, it is possible that the internal logic may be unstable and inrush current may flow instantaneously due to the internal powering sequence and delays, especially if the IC has more than one power supply. Therefore, give special consideration to power coupling capacitance, power wiring, width of ground wiring, and routing of connections.

**8. Operation Under Strong Electromagnetic Field**

Operating the IC in the presence of a strong electromagnetic field may cause the IC to malfunction.

**9. Testing on Application Boards**

When testing the IC on an application board, connecting a capacitor directly to a low-impedance output pin may subject the IC to stress. Always discharge capacitors completely after each process or step. The IC's power supply should always be turned off completely before connecting or removing it from the test setup during the inspection process. To prevent damage from static discharge, ground the IC during assembly and use similar precautions during transport and storage.

**10. Inter-pin Short and Mounting Errors**

Ensure that the direction and position are correct when mounting the IC on the PCB. Incorrect mounting may result in damaging the IC. Avoid nearby pins being shorted to each other especially to ground, power supply and output pin. Inter-pin shorts could be due to many reasons such as metal particles, water droplets (in very humid environment) and unintentional solder bridge deposited in between pins during assembly to name a few.

Operational Notes – continued

11. Regarding the 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 the P layers with the N layers of other elements, creating a parasitic diode or transistor. For example (refer to figure below):

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 inevitably occur in the structure of the IC. The operation of parasitic diodes can result in mutual interference among circuits, operational faults, or physical damage. Therefore, conditions that cause these diodes to operate, such as applying a voltage lower than the GND voltage to an input pin (and thus to the P substrate) should be avoided.

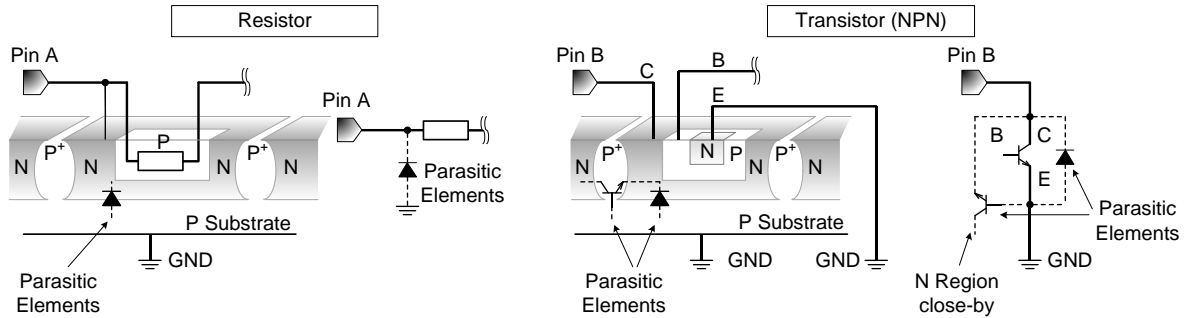


Figure 53. Example of monolithic IC structure

12. Unused Circuits

When there are unused circuits it is recommended that they are connected as in Figure 54, setting the non-inverting input terminal to a potential within input common-mode voltage range (Vicm).

13. Input Terminal Voltage

Applying GND + 36V to the input terminal is possible without causing deterioration of the electrical characteristics or destruction, irrespective of the supply voltage. However, this does not ensure normal circuit operation. Please note that the circuit operates normally only when the input voltage is within the common mode input voltage range of the electric characteristics.

14. Power Supply (Single / Dual)

The op-amp operates when the specified voltage supplied is between VCC and VEE. Therefore, the single supply op-amp can be used as dual supply op-amp as well.

15. IC Handling

Applying mechanical stress to the IC by deflecting or bending the board may cause fluctuations in the electrical characteristics due to piezo resistance effects.

16. Output Capacitor

Discharge of the external output capacitor to VCC is possible via internal parasitic elements when VCC is shorted to VEE, causing damage to the internal circuitry due to thermal stress. Therefore, when using this IC in circuits where oscillation due to output capacitive load does not occur, such as in voltage comparators, use an output capacitor with a capacitance less than 0.1µF.

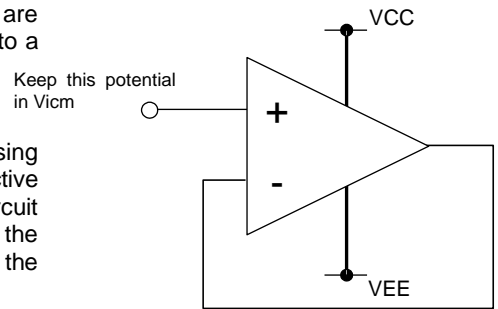
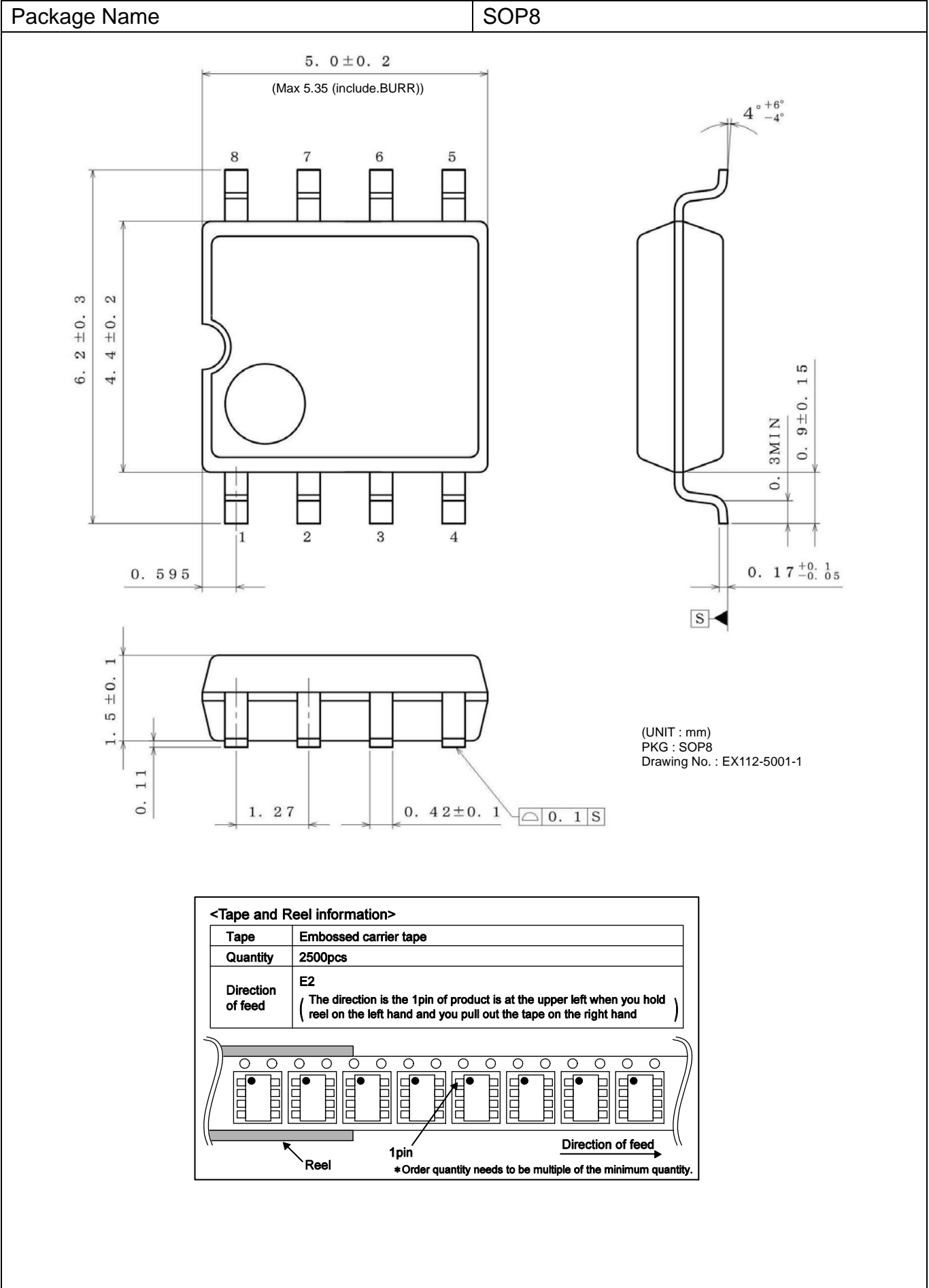


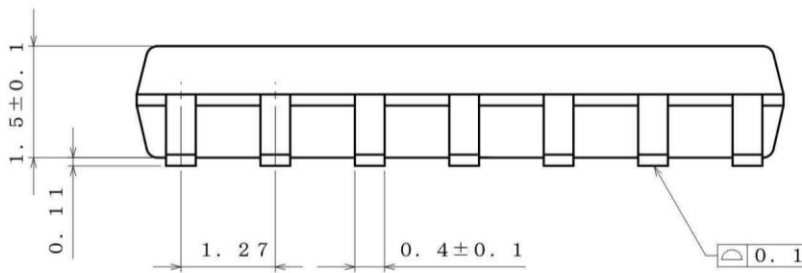
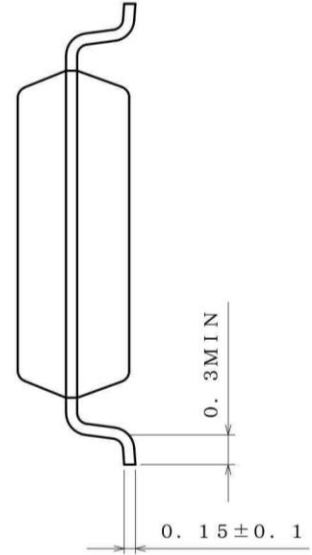
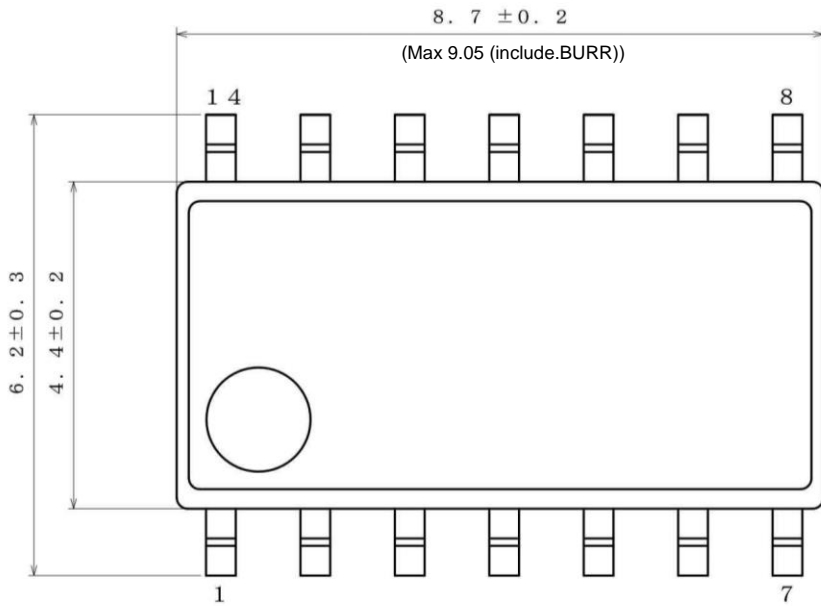
Figure 54. The Example of Application Circuit for Unused Op-amp

Physical Dimension, Tape and Reel Information



Physical Dimension, Tape and Reel Information

|              |       |
|--------------|-------|
| Package Name | SOP14 |
|--------------|-------|



(UNIT : mm)  
PKG : SOP14  
Drawing No. : EX113-5001

**<Tape and Reel information>**

|                   |   |
|-------------------|---|
| 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 ) |

Reel

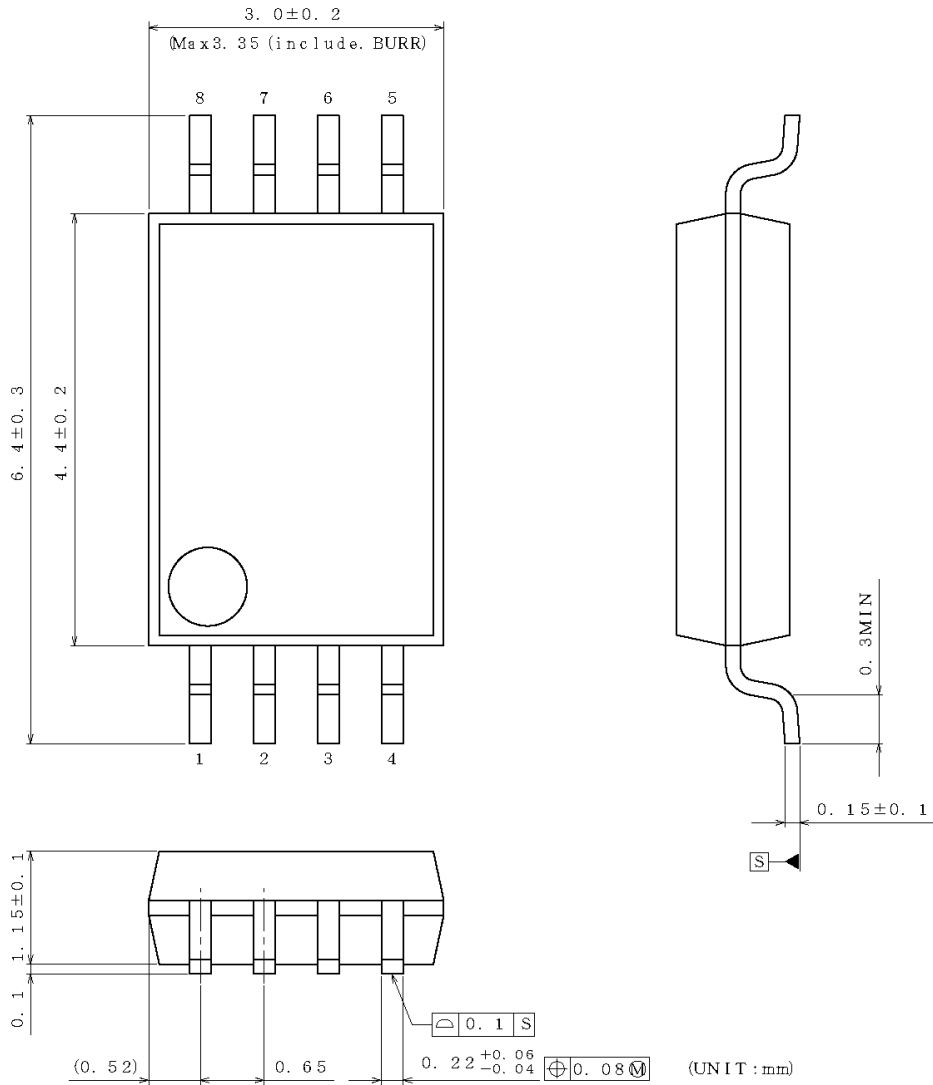
1pin

Direction of feed

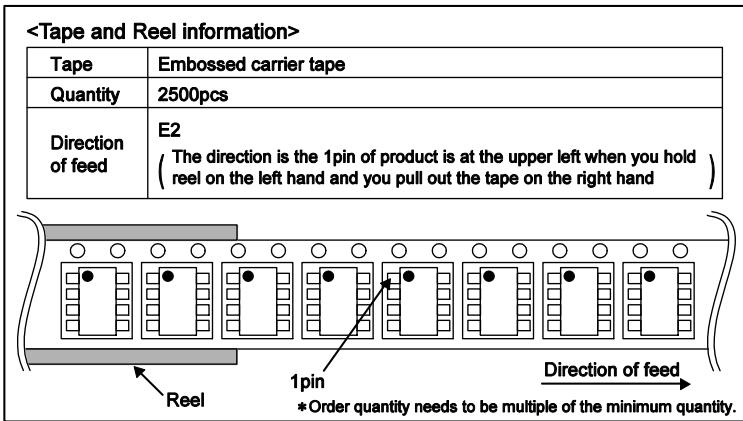
\*Order quantity needs to be multiple of the minimum quantity.

Physical Dimension, Tape and Reel Information

|              |         |
|--------------|---------|
| Package Name | SSOP-B8 |
|--------------|---------|

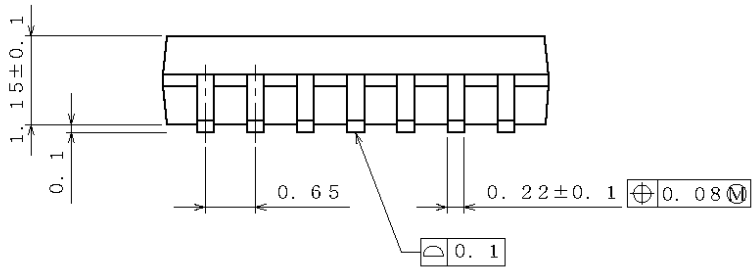
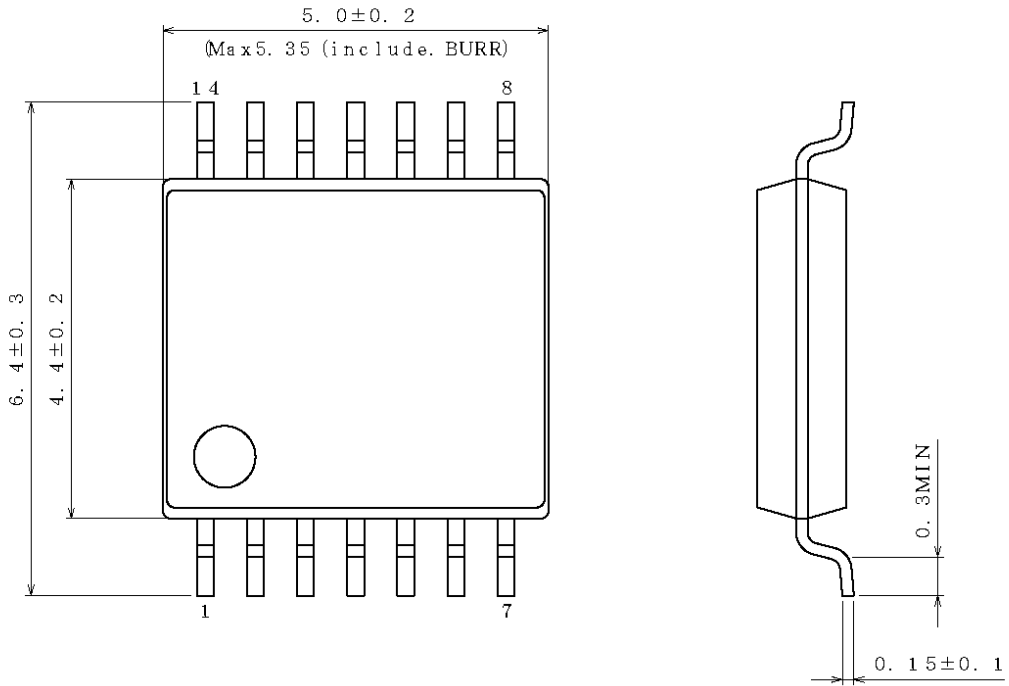


(UNIT : mm)  
 PKG : SSOP-B8  
 Drawing No. EX151-5002



Physical Dimension, Tape and Reel Information

|              |          |
|--------------|----------|
| Package Name | SSOP-B14 |
|--------------|----------|



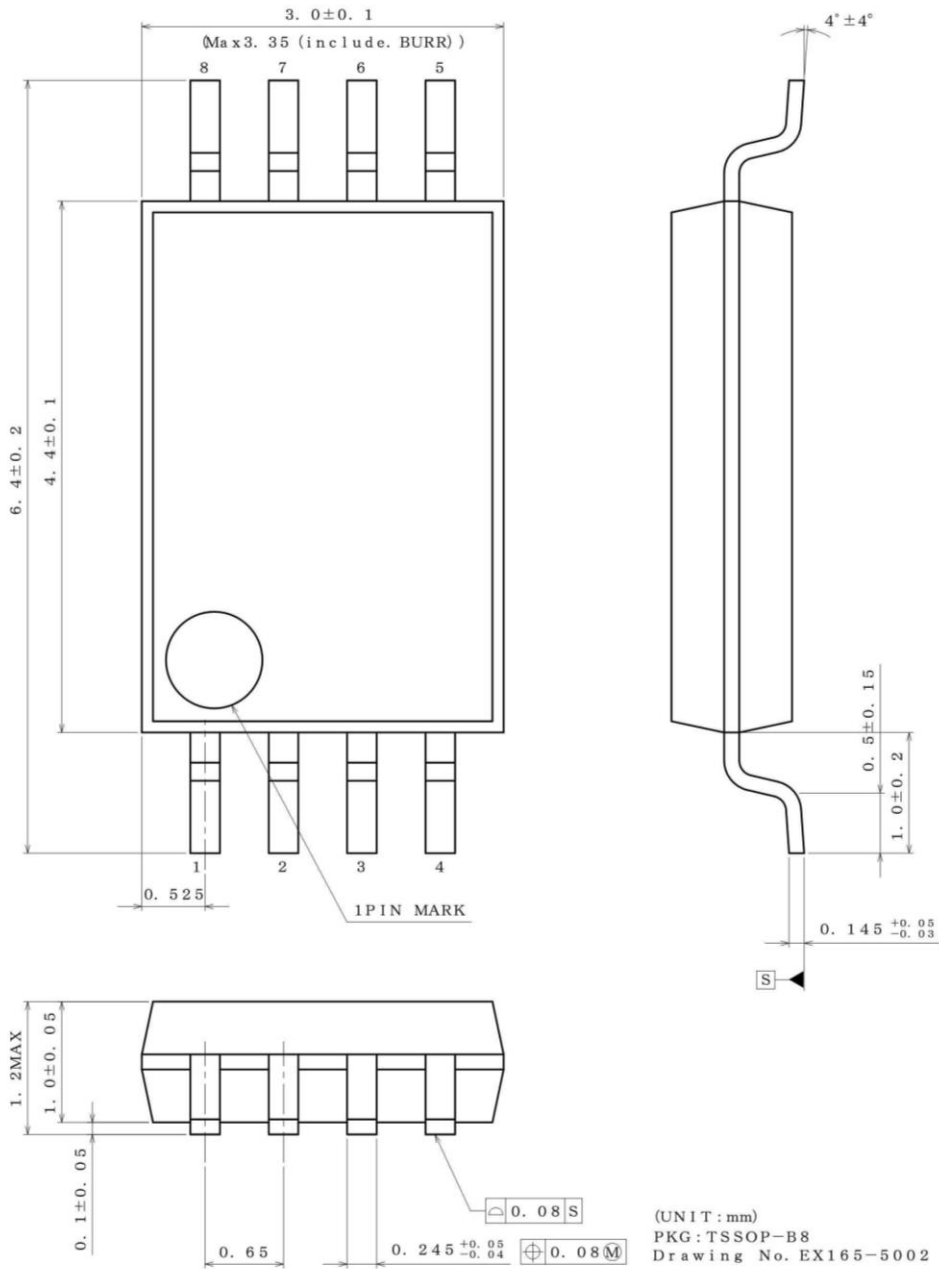
(UNIT : mm)  
 PKG : SSOP-B14  
 Drawing No. EX152-5002

**<Tape and Reel information>**

|                   |   |
|-------------------|---|
| 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 ) |

Physical Dimension, Tape and Reel Information

|              |          |
|--------------|----------|
| Package Name | TSSOP-B8 |
|--------------|----------|



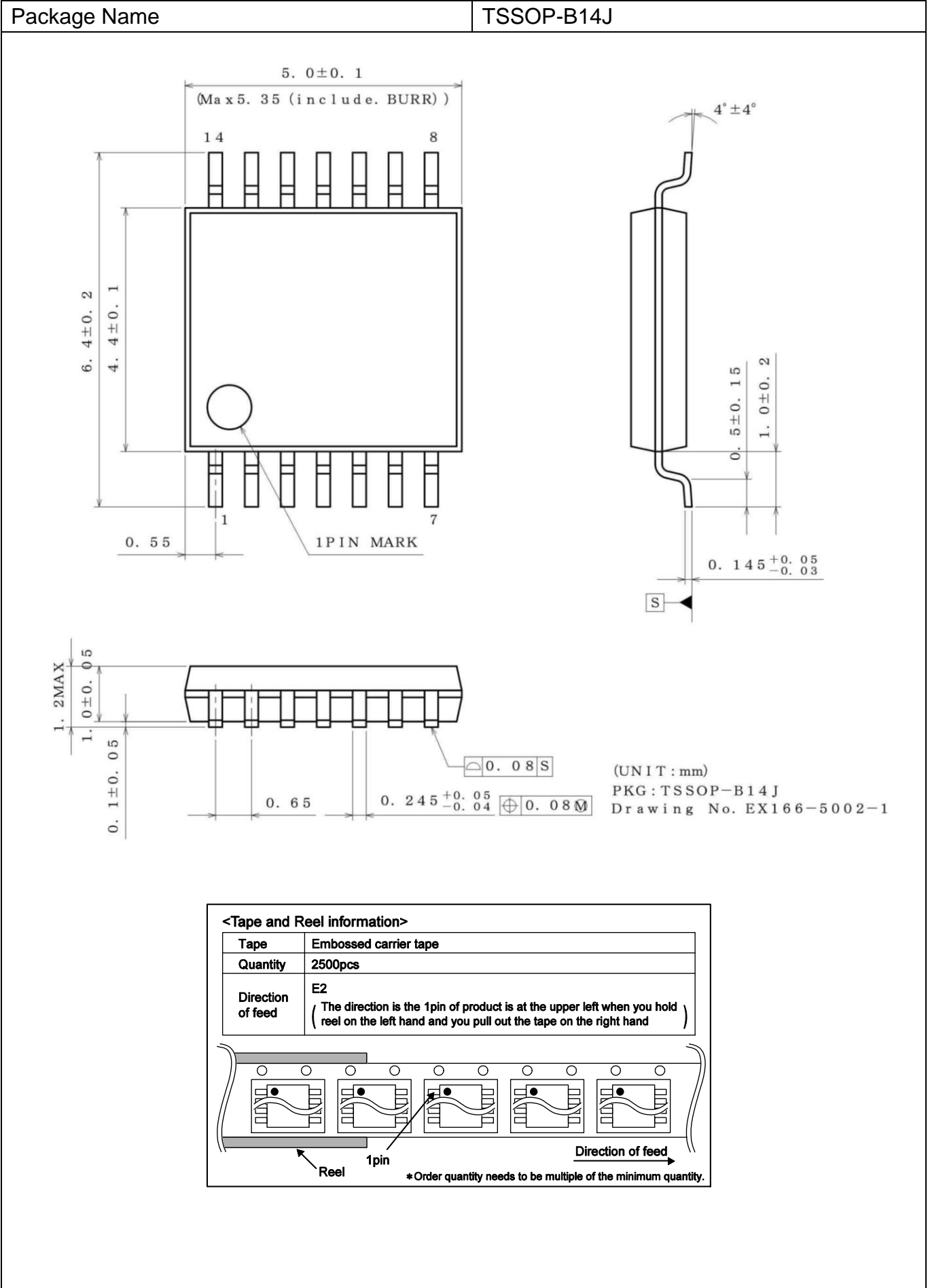
**<Tape and Reel information>**

|                   |   |
|-------------------|---|
| Tape              | Embossed carrier tape   |
| Quantity          | 3000pcs   |
| 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 ) |

Reel      1pin      Direction of feed

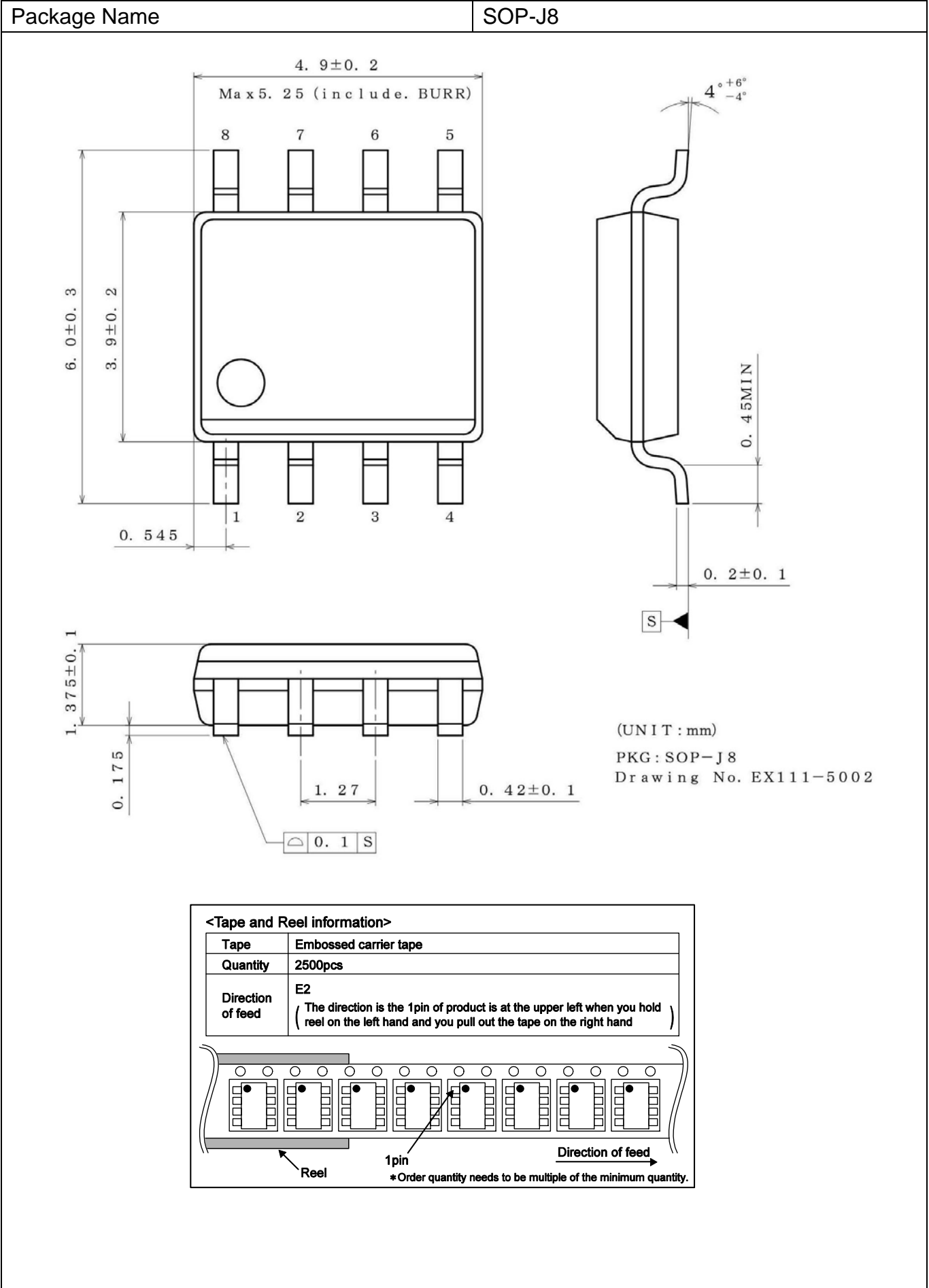
\*Order quantity needs to be multiple of the minimum quantity.

Physical Dimension, Tape and Reel Information





Physical Dimension, Tape and Reel Information



Physical Dimension, Tape and Reel Information

|              |       |
|--------------|-------|
| Package Name | MSOP8 |
|--------------|-------|

(UNIT : mm)  
 PKG : MSOP8  
 Drawing No. EX181-5002

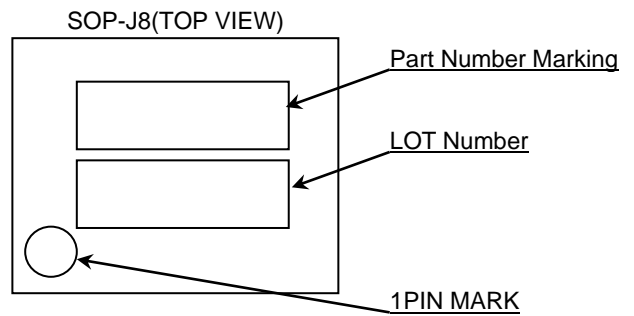
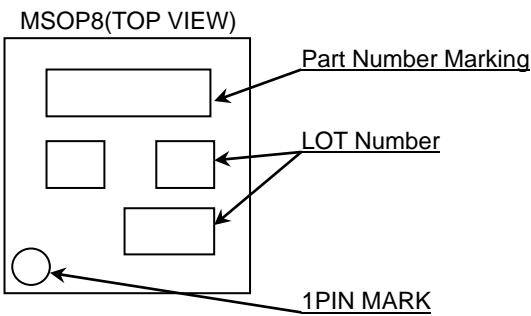
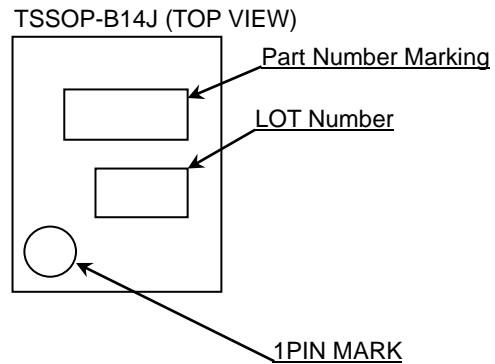
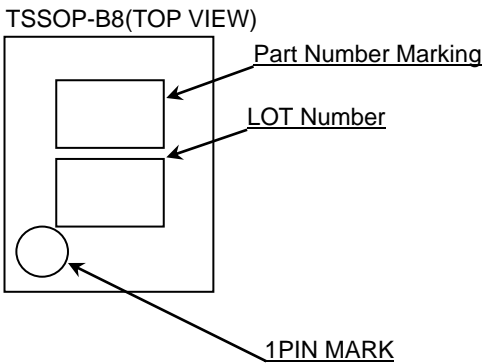
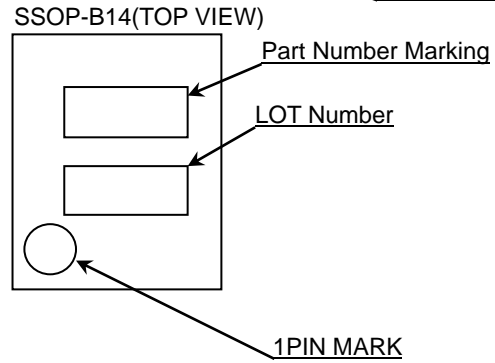
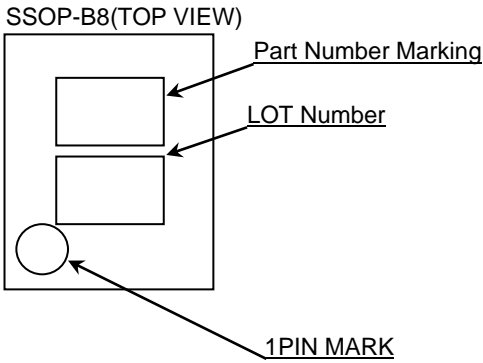
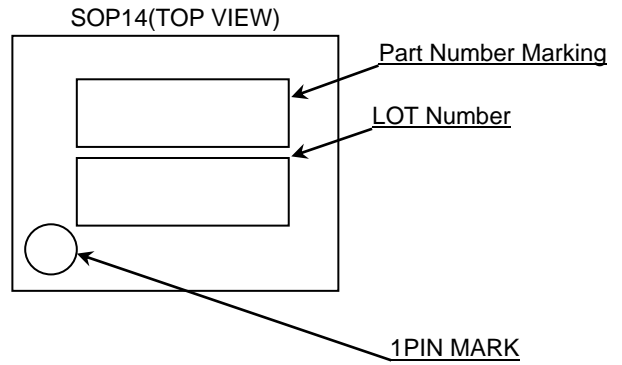
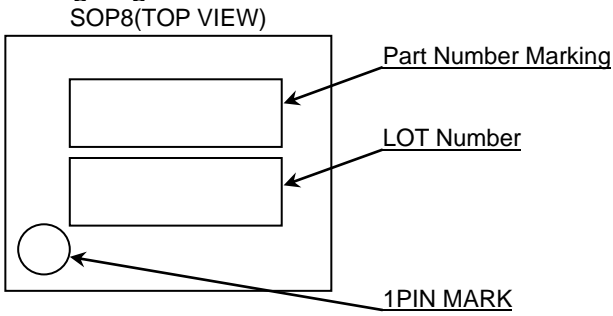
**<Tape and Reel information>**

|                          |  |
|--------------------------|--|
| <b>Tape</b>              | Embossed carrier tape  |
| <b>Quantity</b>          | 3000pcs  |
| <b>Direction of feed</b> | 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 ) |

\* Order quantity needs to be multiple of the minimum quantity.

Marking Diagrams

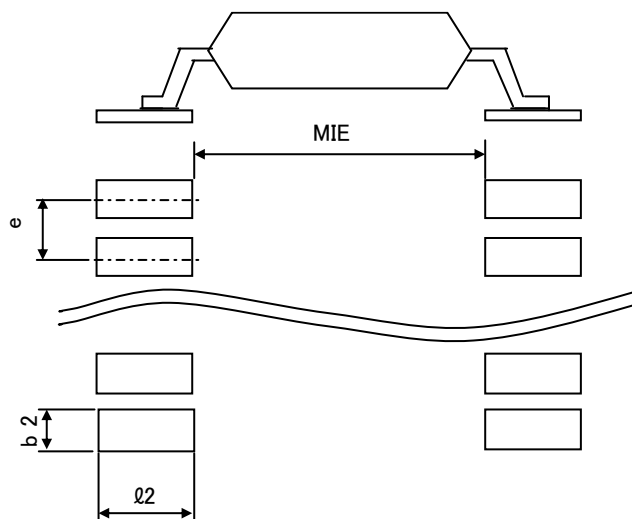


| Product Name | Package Type | Marking    |
|--------------|--------------|------------|
| BA3472       | F            | SOP8       |
|              | FV           | SSOP-B8    |
|              | FVM          | MSOP8      |
|              | FJ           | SOP-J8     |
|              | FVT          | TSSOP-B8   |
| BA3472R      | FVM          | MSOP8      |
| BA3474       | F            | SOP14      |
|              | FV           | SSOP-B14   |
|              | FVJ          | TSSOP-B14J |
| BA3474R      | FV           | SSOP-B14   |

Land pattern data

all dimensions in mm

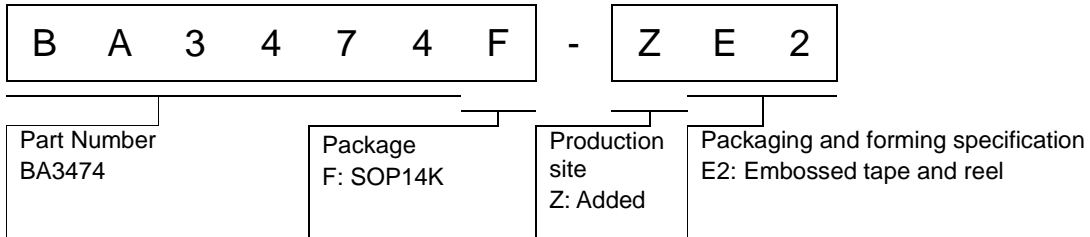
| PKG                 | Land pitch<br>e | Land space<br>MIE | Land length<br>$\geq \varnothing 2$ | Land width<br>b2 |
|---------------------|-----------------|-------------------|-------------------------------------|------------------|
| SOP8<br>SOP14       | 1.27            | 4.60              | 1.10                                | 0.76             |
| SOP-J8              | 1.27            | 3.90              | 1.35                                | 0.76             |
| SSOP-B8<br>SSOP-B14 | 0.65            | 4.60              | 1.20                                | 0.35             |
| MSOP8               | 0.65            | 2.62              | 0.99                                | 0.35             |
| TSSOP-B8            | 0.65            | 4.60              | 1.20                                | 0.35             |
| TSSOP-B14J          | 0.65            | 4.60              | 1.20                                | 0.35             |



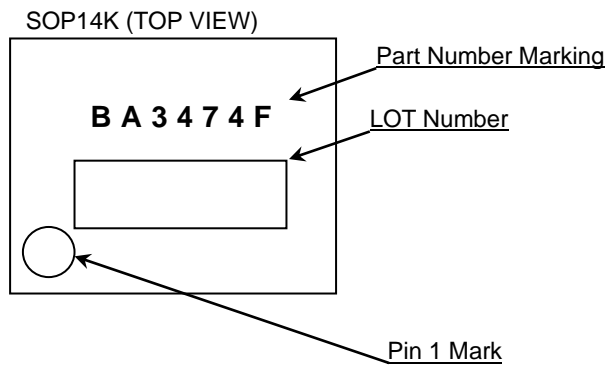
Revision History

| Date        | Revision | Changes   |
|-------------|----------|---|
| 27.Feb.2012 | 001      | New Release   |
| 26.Oct.2012 | 002      | Addition BA3472FJ, BA3472FVT, BA3474FVJ<br>Addition Land pattern data                               |
| 23.Apr.2014 | 003      | Addition Input Current of Absolute Maximum Ratings(Page 2)<br>Addition of item of Operational Notes |
| 11.Jul.2014 | 004      | Correction of simplified schematic.(Page 1)   |
| 11.Dec.2020 | 005      | P.36-2, 36-3, Updated packages and part numbers.  |

Ordering Information

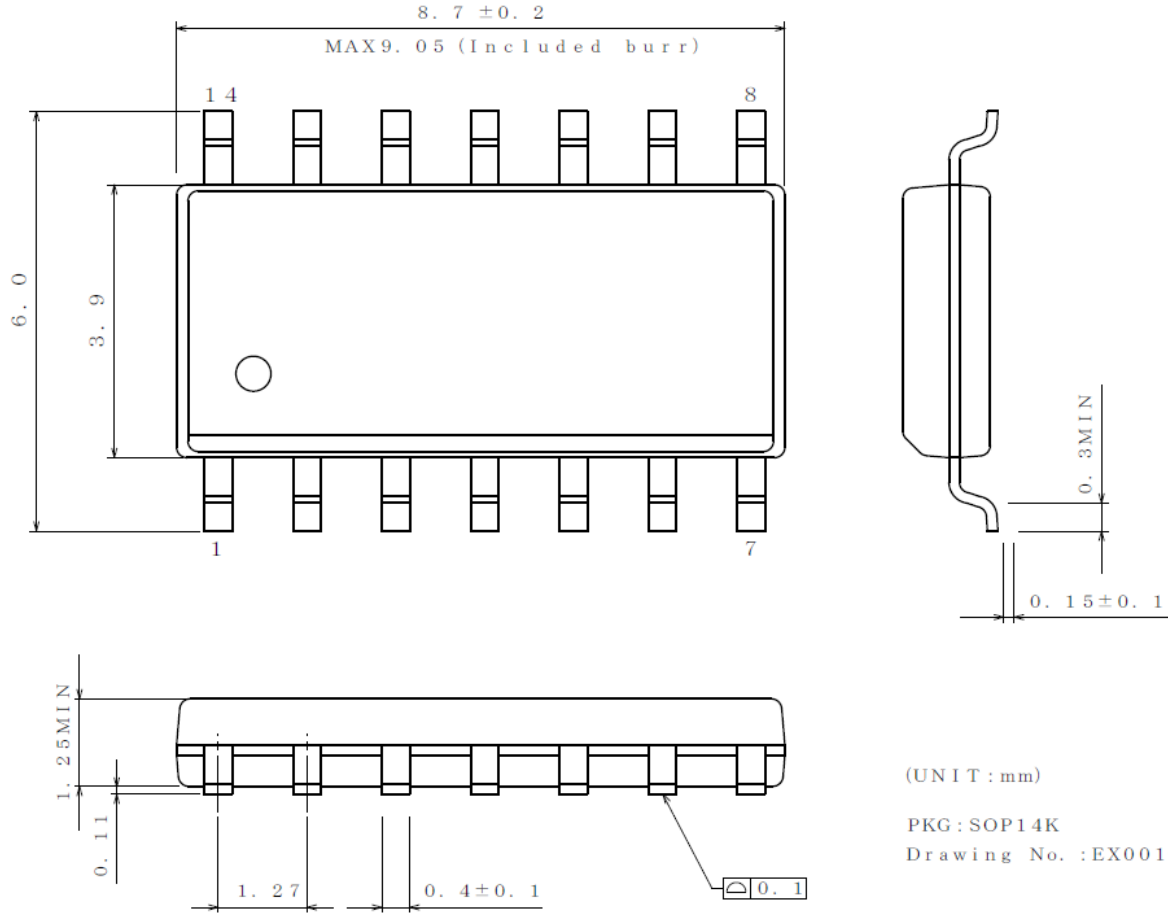


Marking Diagram



Physical Dimension and Packing Information

|              |        |
|--------------|--------|
| Package Name | SOP14K |
|--------------|--------|



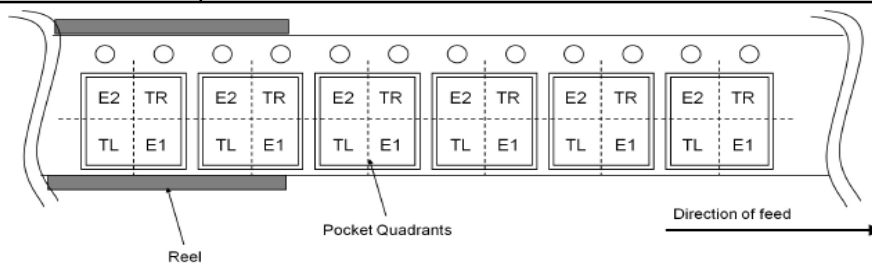
(UNIT : mm)

PKG : SOP14K

Drawing No. : EX001-0105

< Tape and Reel Information >

|                   |  |
|-------------------|--|
| Tape              | Embossed carrier tape  |
| Quantity          | 2500pcs  |
| Direction of feed | E2<br>The direction is the pin 1 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 |



# Notice

## Precaution on using ROHM Products

- Our Products are designed and manufactured for application in ordinary electronic equipment (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 <sup>(Note 1)</sup>, 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     |
|-----------|-----------|------------|-----------|
| CLASS III | CLASS III | CLASS II b | CLASS III |
| CLASS IV  |           | CLASS III  |           |

- 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:
  - Installation of protection circuits or other protective devices to improve system safety
  - Installation of redundant circuits to reduce the impact of single or multiple circuit failure
- 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:
  - Use of our Products in any types of liquid, including water, oils, chemicals, and organic solvents
  - Use of our Products outdoors or in places where the Products are exposed to direct sunlight or dust
  - 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 (Exclude cases where no-clean type fluxes is used. However, recommend sufficiently about the residue.) ; 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 depending on ambient temperature. When used in sealed area, confirm that it is the use in the range that does not exceed the maximum junction 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 on a surface-mount products, the flow soldering method must be used on a through hole mount products. If the flow soldering method is preferred on a surface-mount products, 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 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.

### Precaution for Product Label

A two-dimensional barcode 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 concerned goods might be fallen under listed items of export control prescribed by Foreign exchange and Foreign trade act, please consult with ROHM in case of export.

### Precaution Regarding Intellectual Property Rights

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### Other Precaution

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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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