Datasheet

Comparator series

# Automotive Ground Sense Comparators

## BA2903Yxxx-C, BA2901Yxx-C

### ●General Description

BA2903Yxxx-C/BA2901Yxx-C, integrate two or four independent high gain voltage comparator.
Some features are the wide operating voltage that is 2 V to 36V and low supply current. BA2903Yxxx-C, BA2901Yxx-C are manufactured for automotive requirements of engine control unit, electric power steering, antilock brake system, etc.

### ●Features

- AEC-Q100 Qualified
- Single or dual supply operation
- Wide operating supply voltage
- Standard comparator Pin-assignments
- Common-mode Input Voltage Range includes ground level, allowing direct ground sensing
- Internal ESD protection circuit
- Wide temperature range

### ●Application

- Engine Control Unit
- Electric Power Steering (EPS)
- Anti-Lock Braking System (ABS)
- Automotive electronics

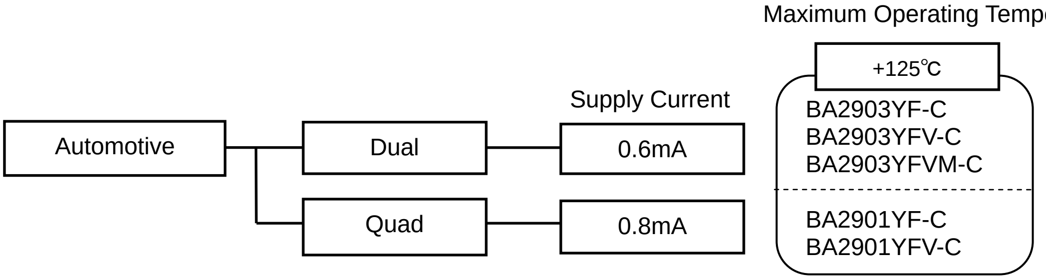
### ●Key Specifications

- Wide operating supply voltage
  - single supply : +2.0V to +36V
  - split supply : ±1.0V to ±18V
- Very low supply current
  - BA2903Yxxx-C 0.6mA(Typ.)
  - BA2901Yxx-C 0.8mA(Typ.)
- Low input bias current : 50nA(Typ.)
- Low input offset current : 5nA(Typ.)
- Operating temperature range : -40℃ to +125℃

### ●Packages

| Packages | W(Typ.) x D(Typ.) x H(Max.) |
|---|---|
| SOP8 | 5.00mm x 6.20mm x 1.71mm |
| SOP14 | 8.70mm x 6.20mm x 1.71mm |
| SSOP-B8 | 3.00mm x 6.40mm x 1.35mm |
| SSOP-B14 | 5.00mm x 6.40mm x 1.35mm |
| MSOP8 | 2.90mm x 4.00mm x 0.90mm |

### ●Selection Guide




### ●Simplified schematic

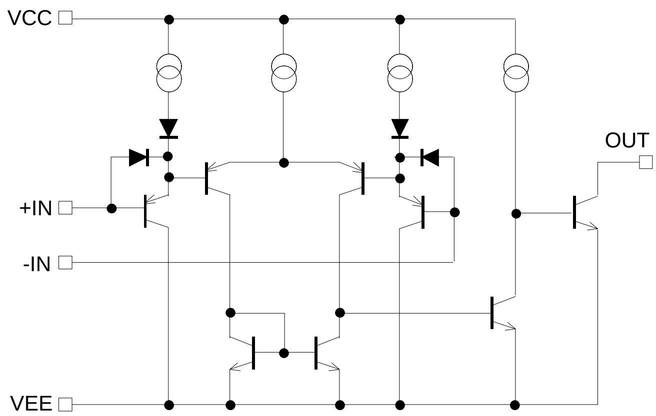
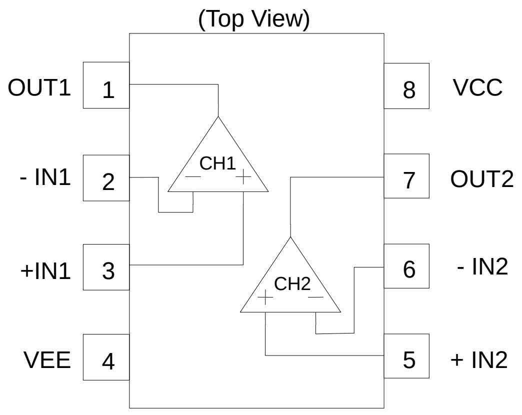



Figure 1. Simplified schematic (one channel only)

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

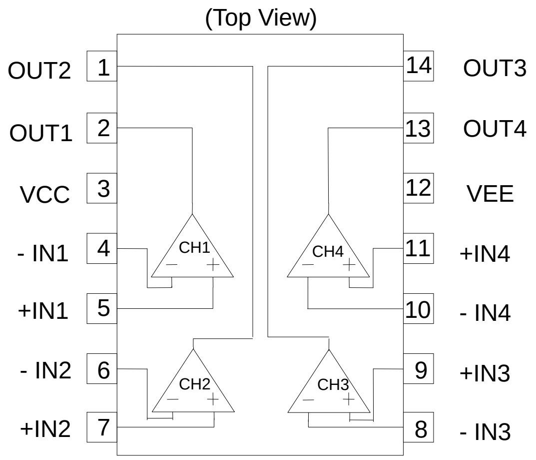
## ●Pin Configuration

BA2903YF-C : SOP8
BA2903YFV-C : SSOP-B8
BA2903YFVM-C : MSOP8




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

BA2901YF-C : SOP14
BA2901YFV-C : SSOP-B14




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

| Package | | | | |
|---|---|---|---|---|
| SOP8 | SSOP-B8 | MSOP8 | SOP14 | SSOP-B14 |
| BA2903YF-C | BA2903YFV-C | BA2903YFVM-C | BA2901YF-C | BA2901YFV-C |

## ●Ordering Information

B A 2 9 0 x Y x x x - C x x

Part Number
BA2903Yxxx
BA2901Yxx

Package
F : SOP8
SOP14
FV : SSOP-B8
: SSOP-B14
FVM : MSOP8

Packaging and forming specification
C: Automotive (engine control unit, electric power steering, antilock braking system, etc.)
E2: Embossed tape and reel (SOP8/SOP14/SSOP-B8/ SSOP-B14)
TR: Embossed tape and reel (MSOP8)

## ●Line-up

| Topr | Operating Supply Voltage | Dual/Quad | Package | | Orderable Part Number |
|---|---|---|---|---|---|
| -40℃ to +125℃ | +2.0V ~ +36V | Dual | SOP8 | Reel of 2500 | BA2903YF-CE2 |
| | | | SSOP-B8 | Reel of 2500 | BA2903YFV-CE2 |
| | | | MSOP8 | Reel of 3000 | BA2903YFVM-CTR |
| | | Quad | SOP14 | Reel of 2500 | BA2901YF-CE2 |
| | | | SSOP-B14 | Reel of 2500 | BA2901YFV-CE2 |

## ●Absolute Maximum Ratings (Ta=25℃)

| Parameter | Symbol | | Ratings | Unit |
|---|---|---|---|---|
| Supply Voltage | VCC-VEE | | +36 | V |
| Power dissipation | Pd | SOP8 | 775 *1*6 | mW |
| | | SSOP-B8 | 625 *2*6 | |
| | | MSOP8 | 600 *3*6 | |
| | | SOP14 | 560 *4*6 | |
| | | SSOP-B14 | 870 *5*6 | |
| Differential Input Voltage *7 | Vid | | +36 | V |
| Input Common-mode Voltage Range | Vicm | | (VEE-0.3) to (VEE+36) | V |
| Input Current *8 | Ii | | -10 | mA |
| Operating Temperature Range | Topr | | -40 to +125 | ℃ |
| Storage Temperature Range | Tstg | | -55 to +150 | ℃ |
| Maximum junction Temperature | Tjmax | | +150 | ℃ |

Note : Absolute maximum rating item indicates the condition which must not be exceeded.
Application if voltage in excess of absolute maximum rating or use out of absolute maximum rated temperature environment may cause deterioration of characteristics.

*1 To use at temperature above Ta＝25℃ reduce 6.2mW/℃.
*2 To use at temperature above Ta＝25℃ reduce 5.5mW/℃.
*3 To use at temperature above Ta＝25℃ reduce 4.8mW/℃.
*4 To use at temperature above Ta＝25℃ reduce 4.9mW/℃.
*5 To use at temperature above Ta＝25℃ reduce 7.0mW/℃.
*6 Mounted on a FR4 glass epoxy PCB(70mm×70mm×1.6mm).
*7 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.
*8 Excessive input current will flow if a differential input voltage in excess of approximately 0.6V is applied between the input unless some limiting resistance is used.

**Electrical Characteristics**

○BA2903Yxxx-C (Unless otherwise specified VCC=+5V, VEE=0V)

| Parameter | Symbol | Temperature range | Limits Min. | Limits Typ. | Limits Max. | Unit | Conditions |
|---|---|---|---|---|---|---|---|
| Input Offset Voltage *9 | Vio | 25℃ | - | 2 | 4 | mV | OUT=1.4V |
| | | Full range | - | - | 5 | | VCC=5～36V,OUT=1.4V |
| Input Offset Current *9 | Iio | 25℃ | - | 5 | 40 | nA | OUT=1.4V |
| | | Full range | - | - | 50 | | |
| Input Bias Current *9 | Ib | 25℃ | - | 50 | 250 | nA | OUT=1.4V |
| | | Full range | - | - | 275 | | |
| Input Common-mode Voltage Range | Vicm | 25℃ | 0 | - | VCC-1.5 | V | - |
| | | Full range | 0 | - | VCC-2.0 | | |
| Large Signal Voltage Gain | Av | 25℃ | 88 | 100 | - | dB | VCC=15V, OUT=1.4～11.4V RL=15kΩ, VRL=15V |
| | | Full range | 74 | - | - | | |
| Supply Current | ICC | 25℃ | - | 0.6 | 1 | mA | OUT=open |
| | | Full range | - | - | 2.5 | | OUT=open, VCC=36V |
| Output Sink Current *10 | Isink | 25℃ | 6 | 16 | - | mA | VIN+=0V, VIN-=1V, VOL=1.5V |
| Output Saturation Voltage (Low level output voltage) | VOL | 25℃ | - | 150 | 400 | mV | VIN+=0V, VIN-=1V, Isink=4mA |
| | | Full range | - | - | 700 | | |
| Output Leakage Current (High level output current) | Ileak | 25℃ | - | 0.1 | - | μA | VIN+=1V, VIN-=0V, VOH=5V |
| | | Full range | - | - | 1 | | VIN+=1V, VIN-=0V, VOH=36V |
| Response Time | Tre | 25℃ | - | 1.3 | - | μs | RL=5.1kΩ, VRL=5V VIN=100mV$_{P-P}$, overdrive=5mV |
| | | | - | 0.4 | - | | RL=5.1kΩ, VRL=5V, VIN=TTL Logic Swing, VREF=1.4V |
| Operable Frequency | Fopr | 25℃ | 100 | - | - | kHz | VCC=5V, RL=2kΩ, VIN+=1.5V,VIN-=5Vp-p (Duty 50% Rectangular Pulse) |

*9 Absolute value

*10 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.

○BA2901Yxx-C (Unless otherwise specified VCC=+5V, VEE=0V)

| Parameter | Symbol | Temperature range | Limits Min. | Limits Typ. | Limits Max. | Unit | Conditions |
|---|---|---|---|---|---|---|---|
| Input Offset Voltage *11 | Vio | 25℃ | - | 2 | 4 | mV | OUT=1.4V |
| | | Full range | - | - | 5 | | VCC=5～36V,OUT=1.4V |
| Input Offset Current *11 | Iio | 25℃ | - | 5 | 40 | nA | OUT=1.4V |
| | | Full range | - | - | 50 | | |
| Input Bias Current *11 | Ib | 25℃ | - | 50 | 250 | nA | OUT=1.4V |
| | | Full range | - | - | 275 | | |
| Input Common-mode Voltage Range | Vicm | 25℃ | 0 | - | VCC-1.5 | V | - |
| | | Full range | 0 | - | VCC-2.0 | | |
| Large Signal Voltage Gain | Av | 25℃ | 88 | 100 | - | dB | VCC=15V, OUT=1.4～11.4V RL=15kΩ, VRL=15V |
| | | Full range | 74 | - | - | | |
| Supply Current | ICC | 25℃ | - | 0.8 | 2 | mA | OUT=open |
| | | Full range | - | - | 2.5 | | OUT=open, VCC=36V |
| Output Sink Current *12 | Isink | 25℃ | 6 | 16 | - | mA | VIN+=0V, VIN-=1V, VOL=1.5V |
| Output Saturation Voltage (Low level output voltage) | VOL | 25℃ | - | 150 | 400 | mV | VIN+=0V, VIN-=1V, Isink=4mA |
| | | Full range | - | - | 700 | | |
| Output Leakage Current (High level output current) | Ileak | 25℃ | - | 0.1 | - | μA | VIN+=1V, VIN-=0V, VOH=5V |
| | | Full range | - | - | 1 | | VIN+=1V, VIN-=0V, VOH=36V |
| Response Time | Tre | 25℃ | - | 1.3 | - | μs | RL=5.1kΩ, VRL=5V VIN=100mV$_{P-P}$, overdrive=5mV |
| | | | - | 0.4 | - | | RL=5.1kΩ, VRL=5V, VIN=TTL Logic Swing, VREF=1.4V |
| Operable Frequency | Fopr | 25℃ | 100 | - | - | kHz | VCC=5V, RL=2kΩ, VIN+=1.5V,VIN-=5Vp-p (Duty 50% Rectangular Pulse) |

*11 Absolute value

*12 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 used in this datasheet. Items and symbols used are also shown. Note that item name and symbol and their meaning may differ from those on another manufacturer's document or general document.

**1. Absolute maximum ratings**

Absolute maximum rating items indicate the condition which must not be exceeded. Application of voltage in excess of absolute maximum rating or use out of absolute maximum rated temperature environment may cause deterioration of characteristics.

1.1 Power supply voltage (VCC-VEE)
Indicates the maximum voltage that can be applied between the positive power supply terminal and negative power supply terminal without deterioration or destruction of characteristics of internal circuit.

1.2 Differential input voltage (Vid)
Indicates the maximum voltage that can be applied between non-inverting and inverting terminals without damaging the IC.

1.3 Input common-mode voltage range (Vicm)
Indicates the maximum voltage that can be applied to the non-inverting and inverting terminals without deterioration or destruction of electrical characteristics. Input common-mode voltage range of the maximum ratings does not assure normal operation of IC. For normal operation, use the IC within the input common-mode voltage range characteristics.

1.4 Operating and storage temperature ranges (Topr,Tstg)
The operating temperature range indicates the temperature range within which the IC can operate. The higher the ambient temperature, the lower the power consumption of the IC. The storage temperature range denotes the range of temperatures the IC can be stored under without causing excessive deterioration of the electrical characteristics.

1.5 Power dissipation (Pd)
Indicates the power that can be consumed by the IC when mounted on a specific board at the ambient temperature 25℃ (normal temperature). As for package product, Pd is determined by the temperature that can be permitted by the IC in the package (maximum junction temperature) and the thermal resistance of the package.

**2.Electrical characteristics**

2.1 Input offset voltage (Vio)
Indicates the voltage difference between non-inverting terminal and inverting terminals. 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 currents at the non-inverting and inverting terminals.

2.4 Input common-mode voltage range (Vicm)
Indicates the input voltage range where IC normally operates.

2.5 Large signal voltage gain (Av)
Indicates the amplifying rate (gain) of output voltage against the voltage difference between non-inverting terminal and inverting terminal. It is normally the amplifying rate (gain) with reference to DC voltage.
Av = (Output voltage) / (Differential input voltage)

2.6 Circuit current (ICC)
Indicates the current that flows within the IC under specified no-load conditions.

2.7 Output sink current (Isink)
Indicates the current flowing into the IC under specific output conditions.

2.8 Output saturation voltage ( Low level output voltage) (VOL)
Indicates the lower limit of output voltage under specific input and output conditions.

2.9 Output leakage current( High level output current) (Ileak)
Indicates the current that flows into the IC under specific input and output conditions.

2.11 Response Time (Tre)
Indicates the time interval between the application of input and output conditions.

2.10 Operable Frequency (Fopr)
Indicates minimum frequency that IC moves under specific conditions..

●**Typical Performance Curves**

○BA2903Yxxx-C

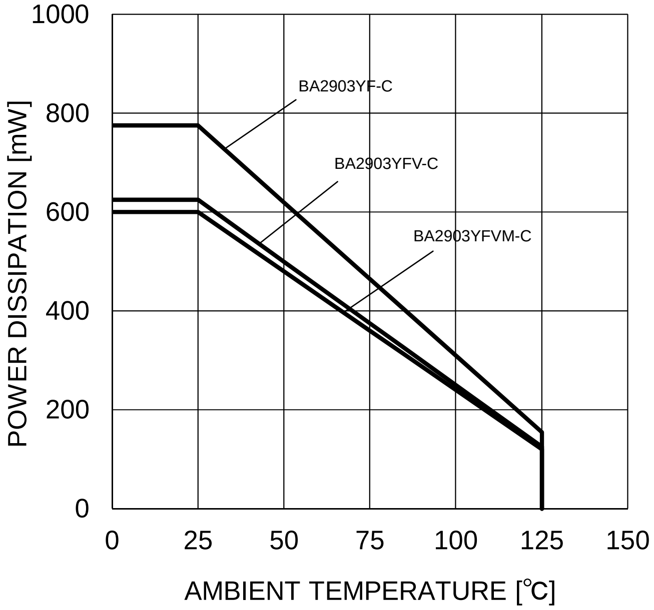



Figure 2.
Derating Curve

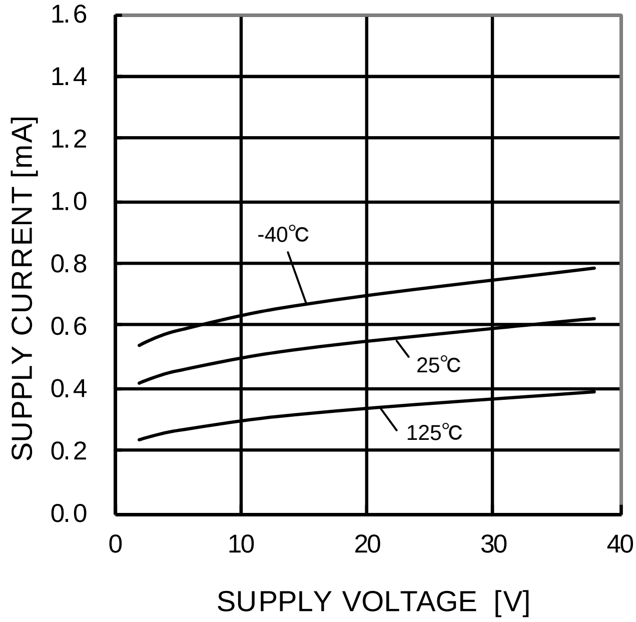



Figure 3.
Supply Current – Supply Voltage

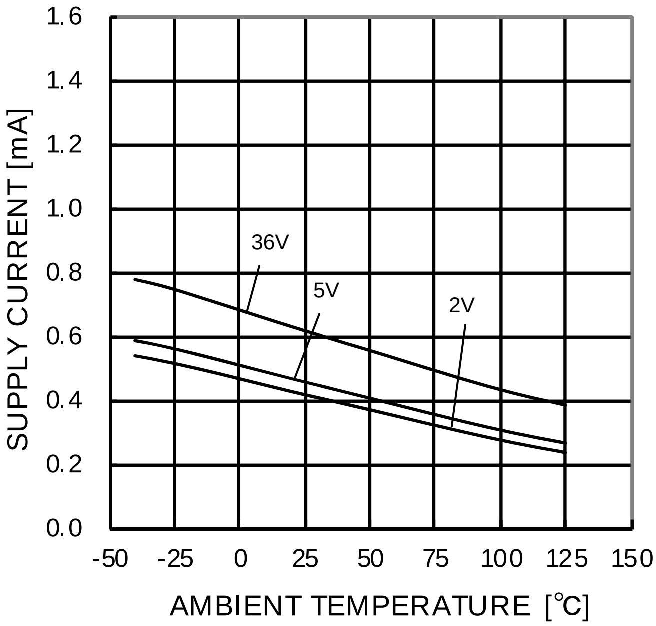



Figure 4.
Supply Current – Ambient Temperature

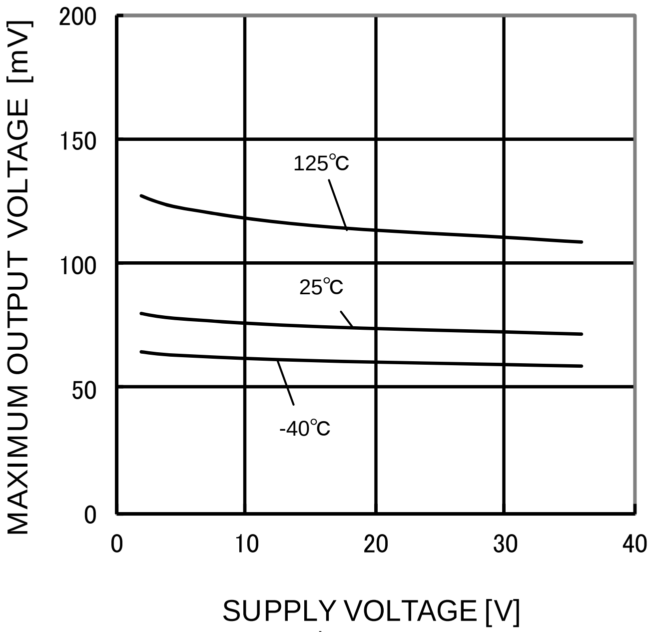



Figure 5.
Maximum Output Voltage – Supply Voltage
(Isink=4mA)

(*)The data above is measurement value of typical sample, it is not guaranteed.

○BA2903Yxxx-C

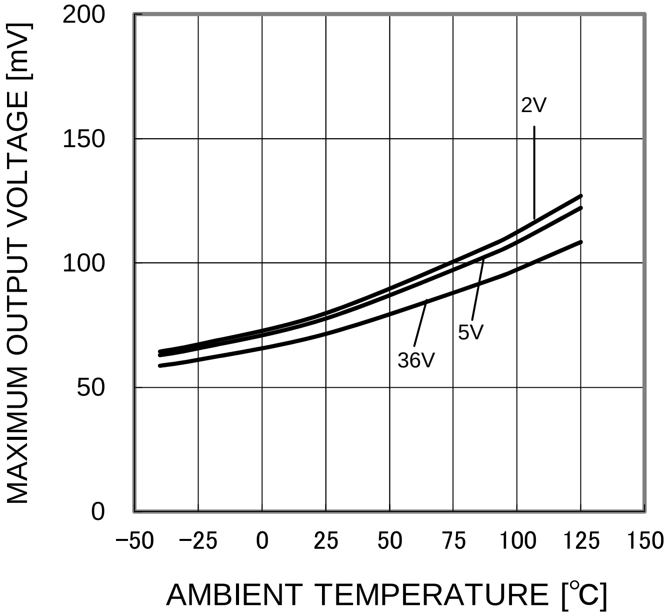



Figure 6.
Maximum Output Voltage – Ambient Temperature
(Isink=4mA)

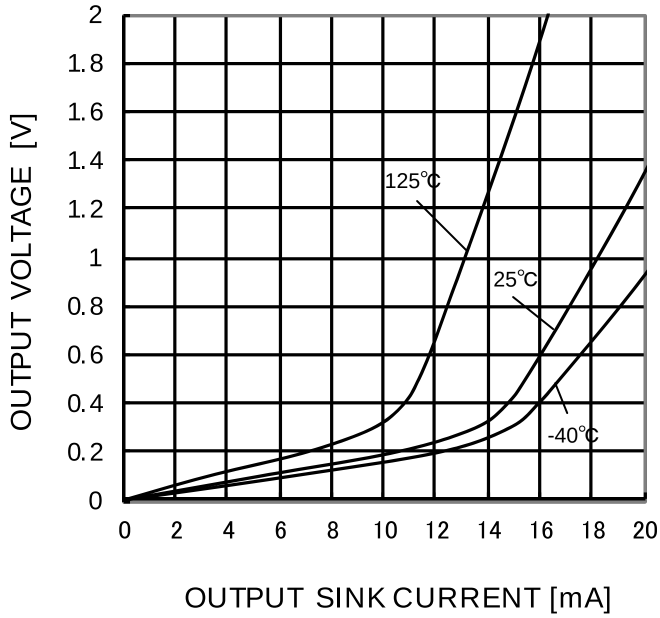



Figure 7.
Output Voltage – Output Sink Current
(VCC=5V)

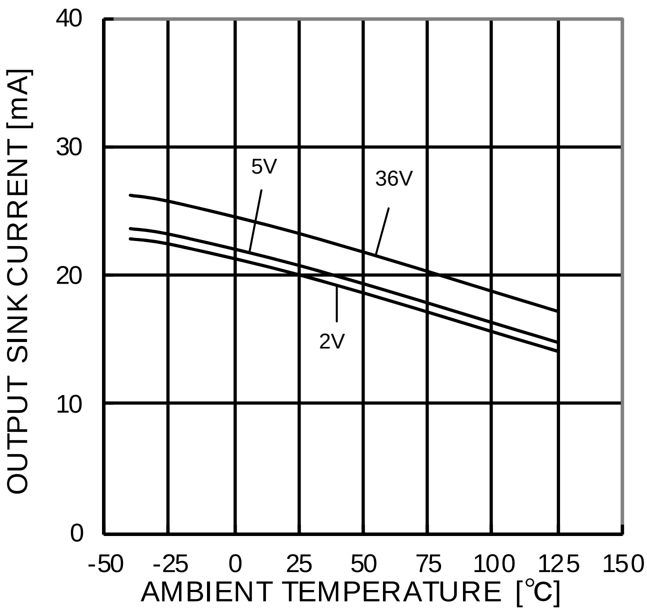



Figure 8.
Output Sink Current – Ambient Temperature
(OUT=1.5V)

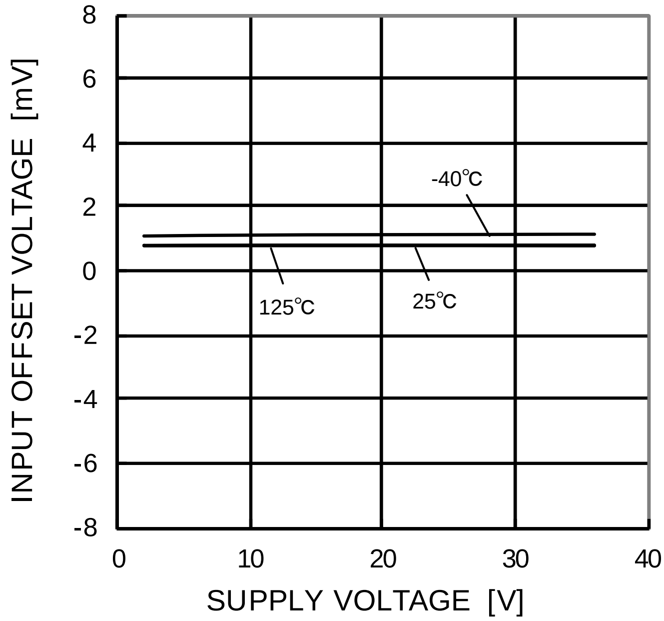



Figure 9.
Input Offset Voltage – Supply Voltage

(*)The data above is measurement value of typical sample, it is not guaranteed.

○BA2903Yxxx-C

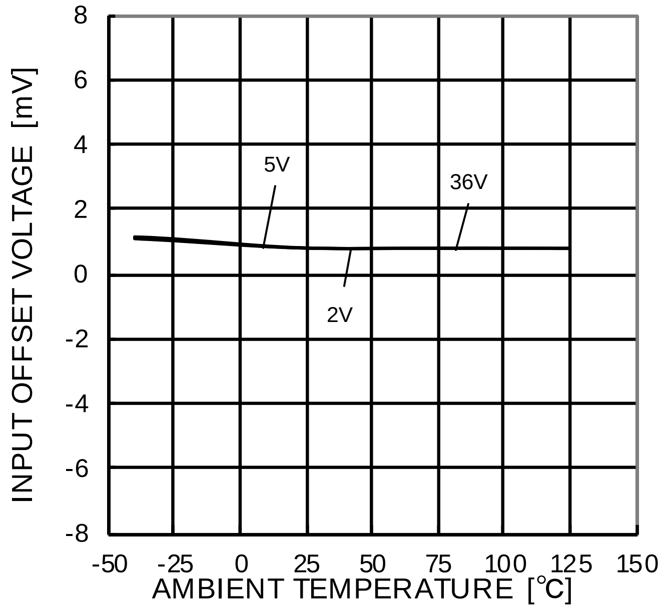



Figure 10.
Input Offset Voltage – Ambient Temperature

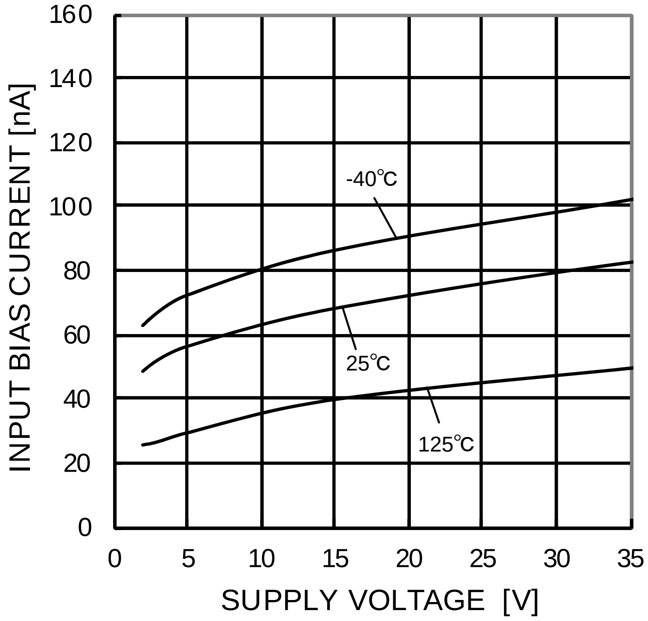



Figure 11.
Input Bias Current – Supply Voltage

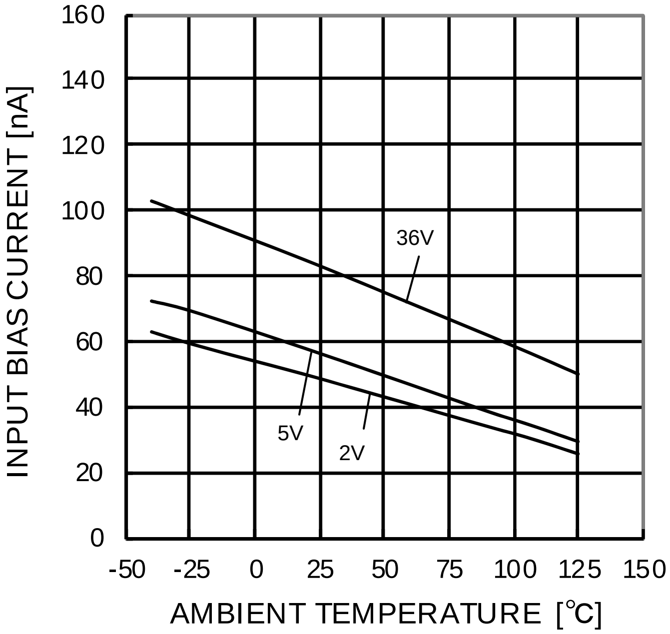



Figure 12.
Input Bias Current – Ambient Temperature

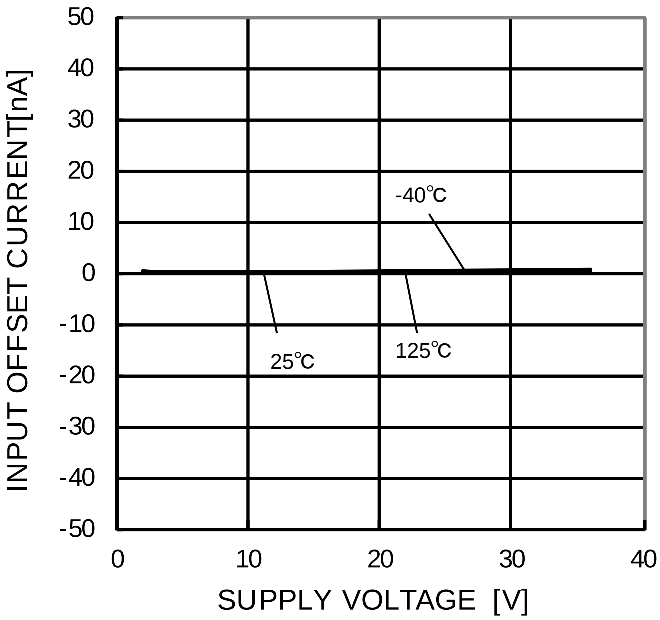



Figure 13.
Input Offset Current – Supply Voltage

(*)The data above is measurement value of typical sample, it is not guaranteed.

○BA2903Yxxx-C

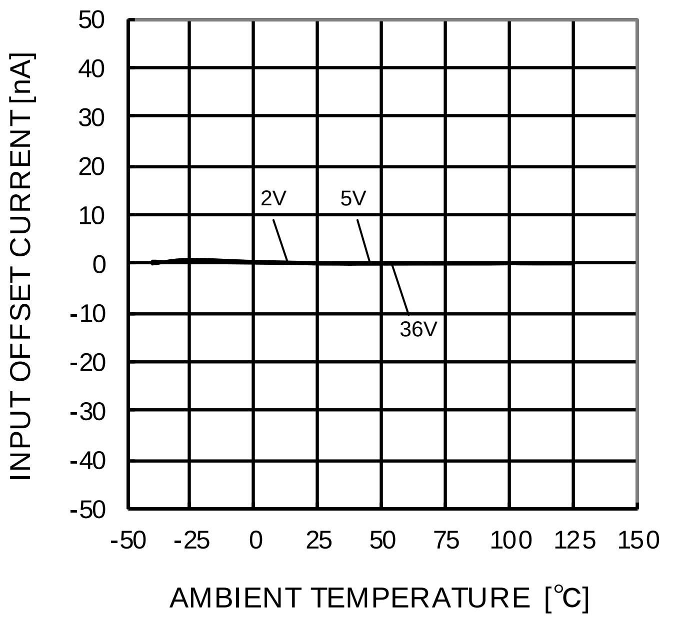



Figure 14.
Input Offset Current
– Ambient Temperature

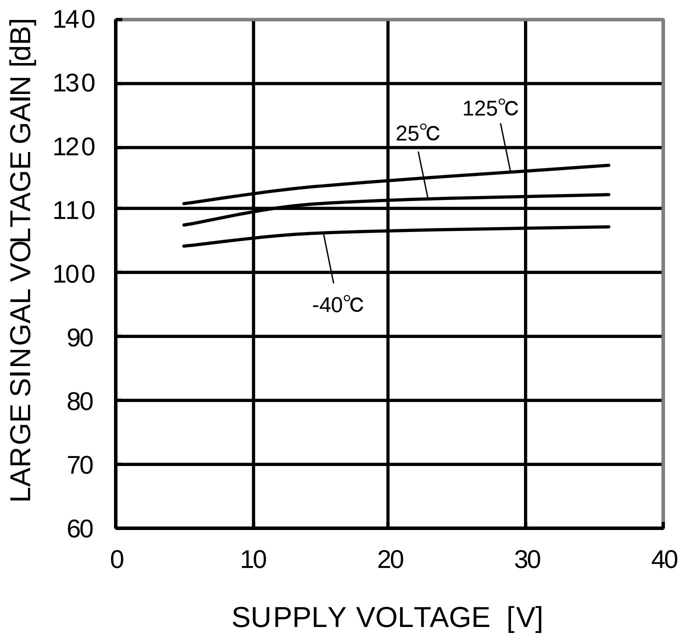



Figure 15.
Large Signal Voltage Gain
– Supply Voltage

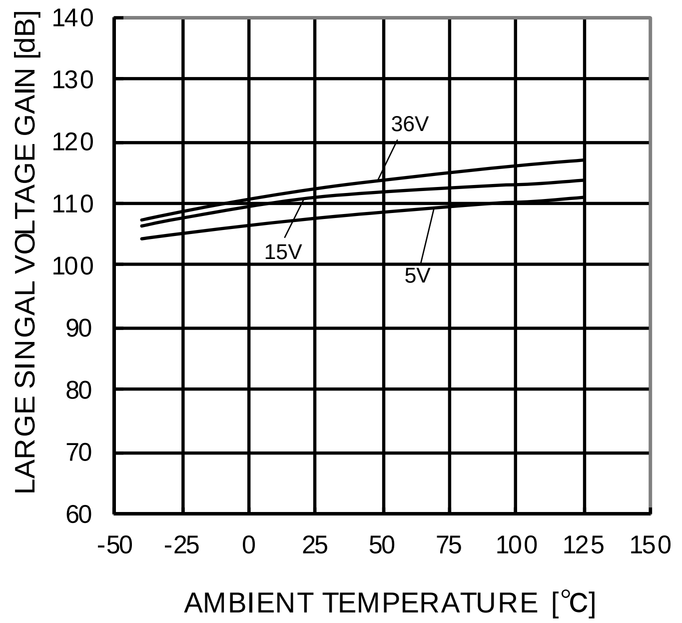



Figure 16.
Large Signal Voltage Gain
– Ambient Temperature

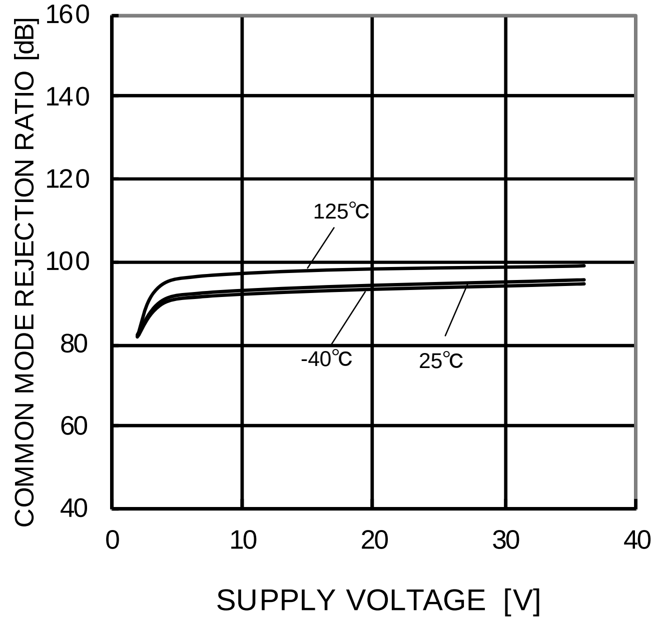



Figure 17.
Common Mode Rejection Ratio
– Supply Voltage

(*)The data above is measurement value of typical sample, it is not guaranteed.

○BA2903Yxxx-C

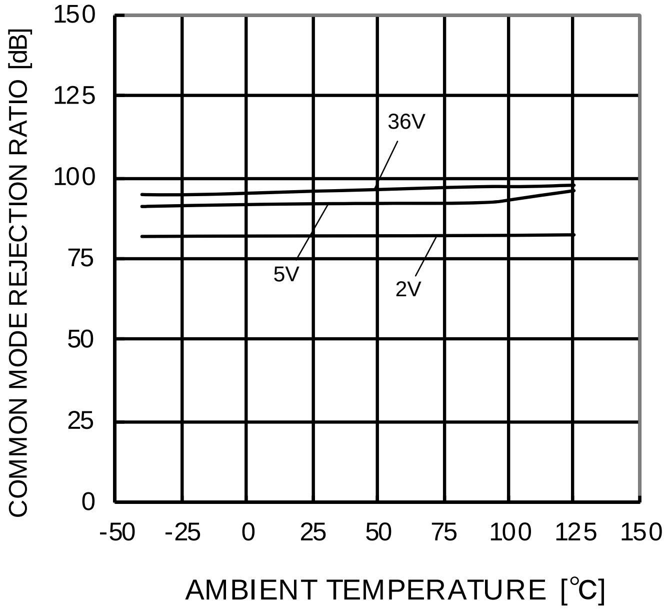



Figure 18.
Common Mode Rejection Ratio
– Ambient Temperature

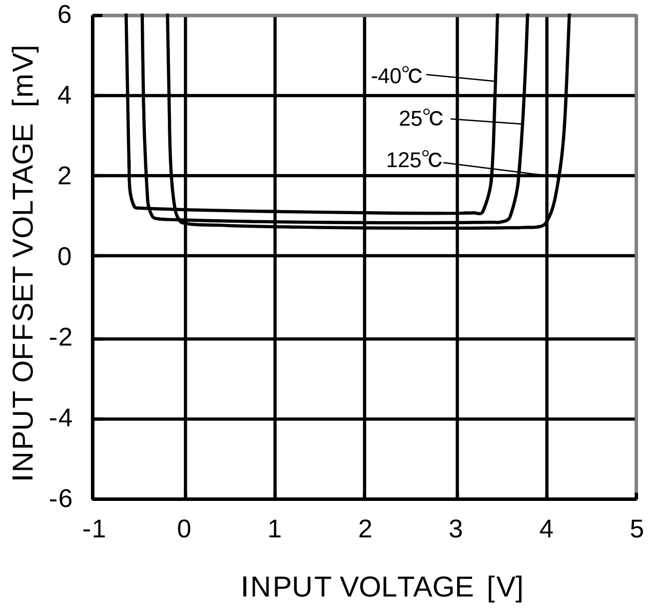



Figure 19.
Input Offset Voltage – Input Voltage
(VCC=5V)

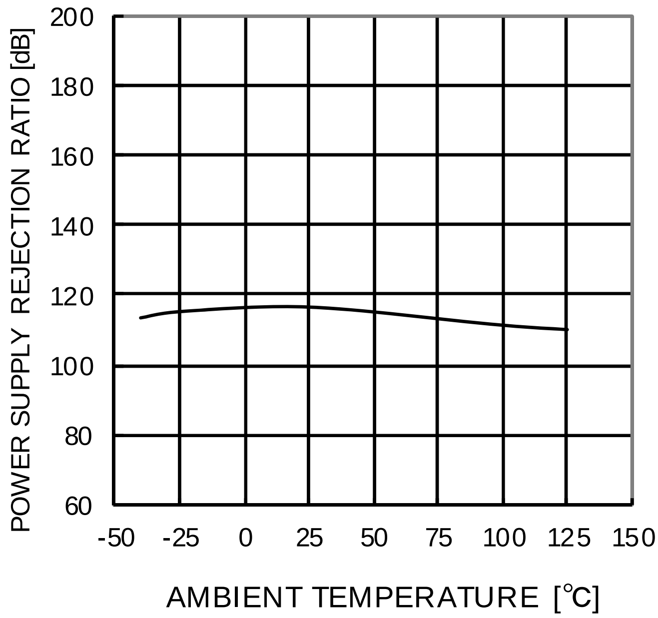



Figure 20.
Power Supply Rejection Ratio
– Ambient Temperature

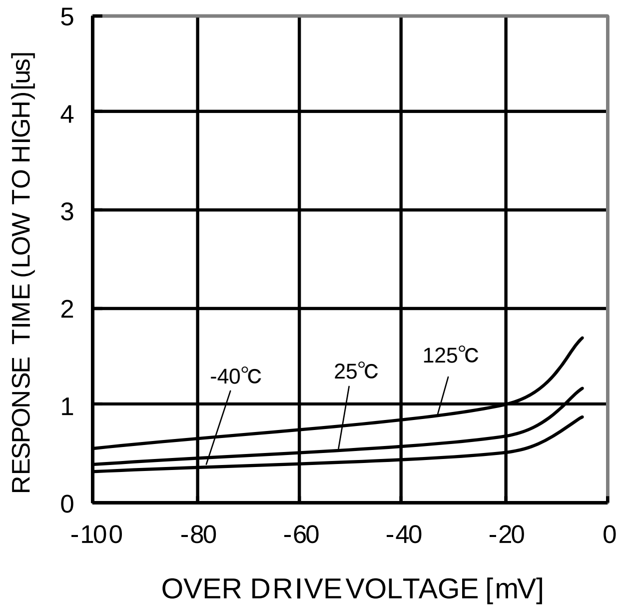



Figure 21.
Response Time (Low to High) – Over Drive Voltage
(VCC=5V, VRL=5V, RL=5.1kΩ)

(*)The data above is measurement value of typical sample, it is not guaranteed.

○BA2903Yxxx-C

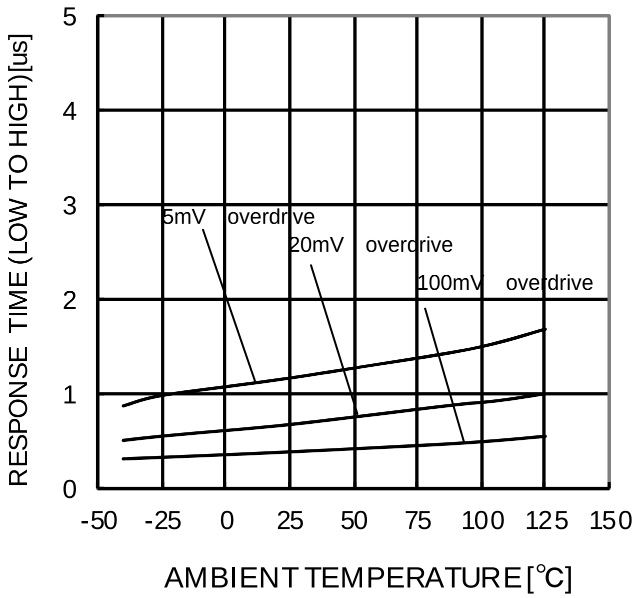



Figure 22.
Response Time (Low to High)
– Ambient Temperature (VCC=5V, VRL=5V, RL=5.1kΩ)

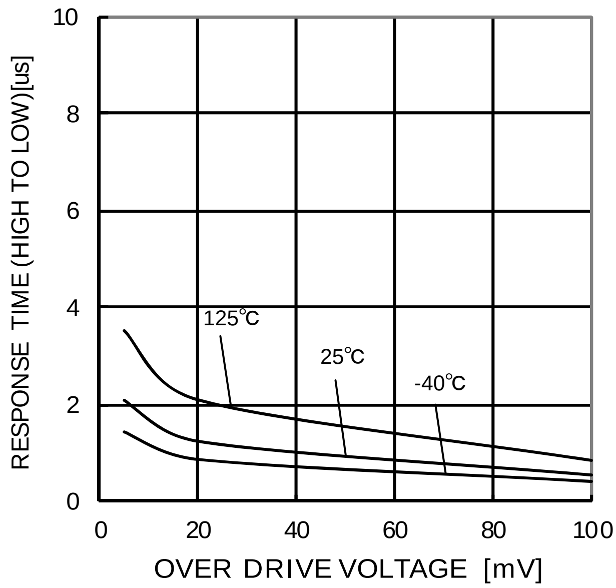



Figure 23.
Response Time (High to Low)
– Over Drive Voltage
(VCC=5V, VRL=5V, RL=5.1kΩ)

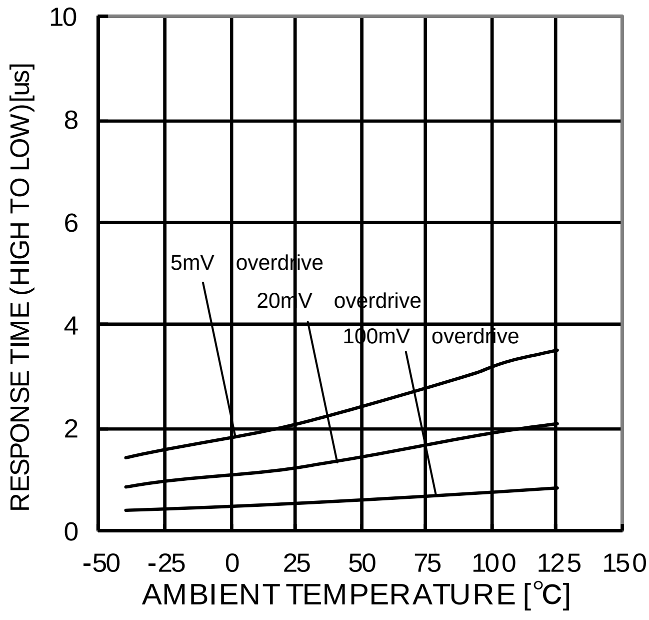



Figure 24.
Response Time (High to Low)
– Ambient Temperature
(VCC=5V, VRL=5V, RL=5.1kΩ)

(*)The data above is measurement value of typical sample, it is not guaranteed.

○BA2901Yxx-C

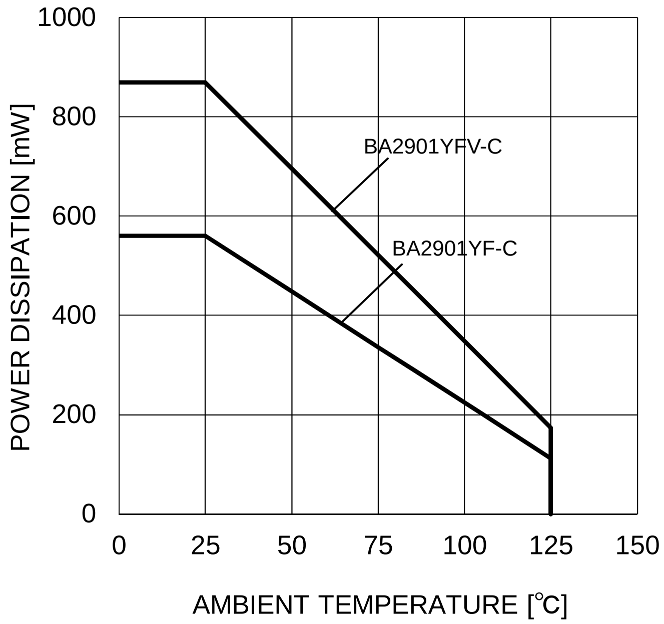



Figure 25.
Derating Curve

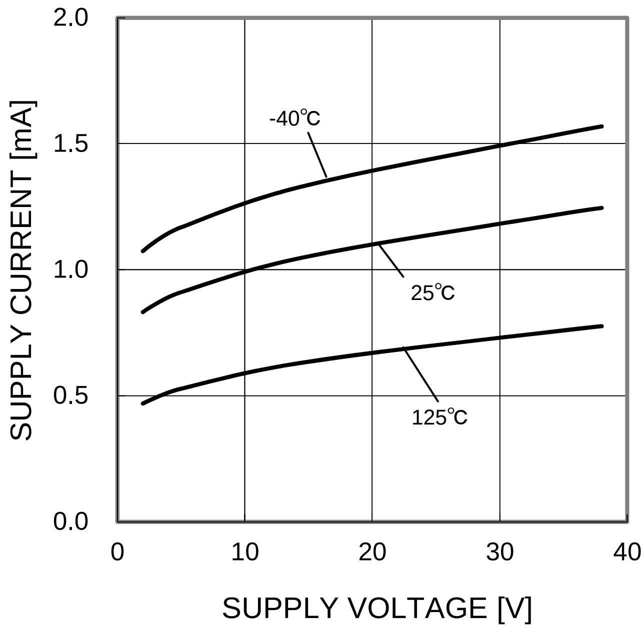



Figure 26.
Supply Current – Supply Voltage

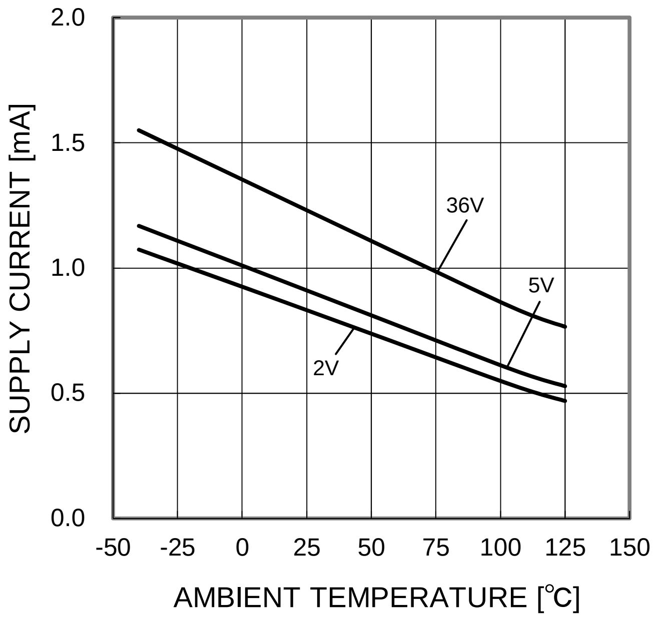



Figure 27.
Supply Current – Ambient Temperature

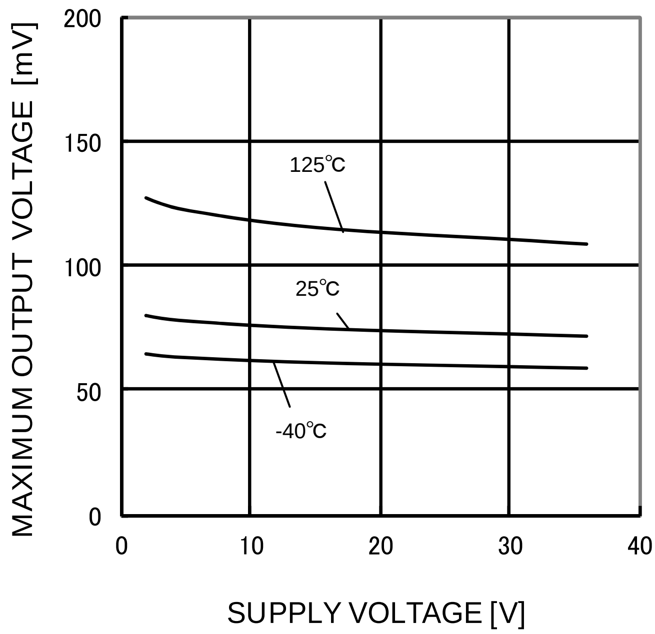



Figure 28.
Maximum Output Voltage – Supply Voltage
(Isink=4mA)

(*)The data above is measurement value of typical sample, it is not guaranteed.

○BA2901Yxx-C

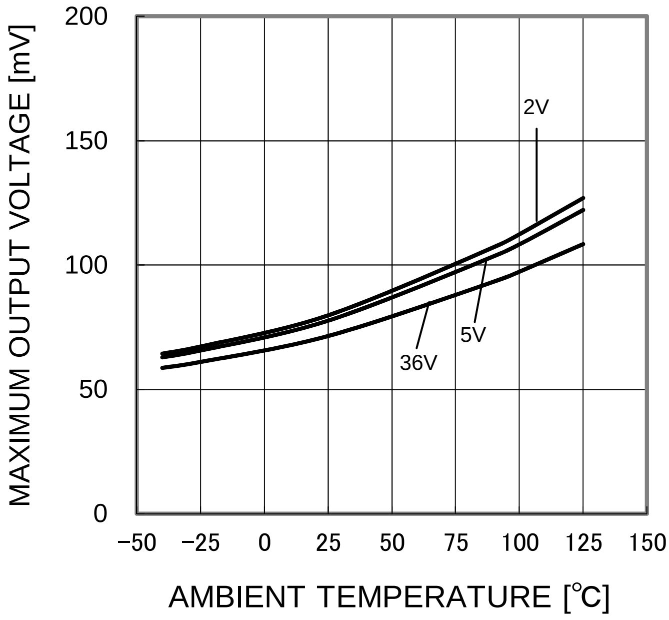



Figure 29.
Maximum Output Voltage – Ambient Temperature
(Isink=4mA)

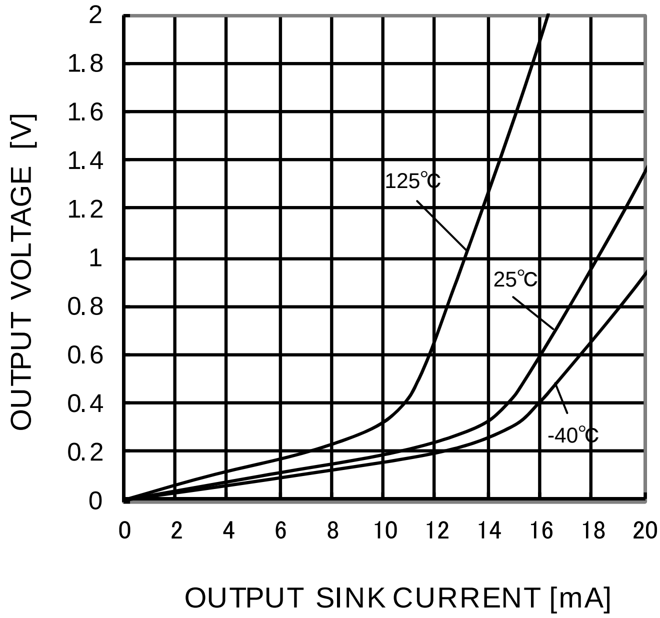



Figure 30.
Output Voltage – Output Sink Current
(VCC=5V)

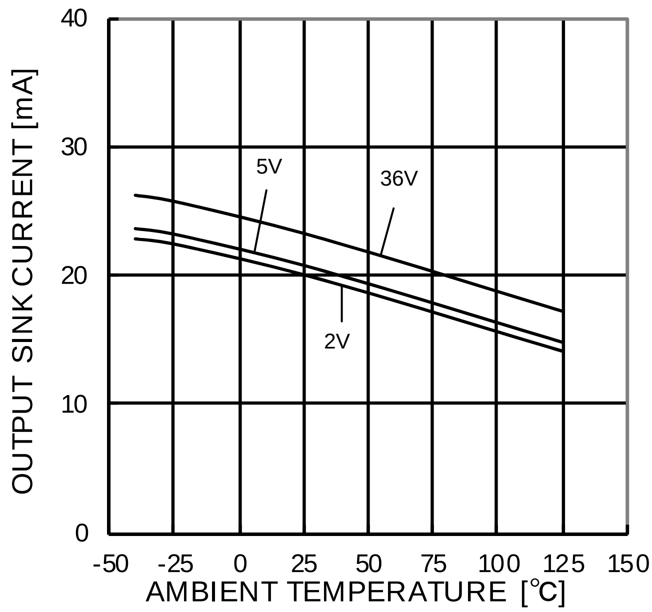



Figure 31.
Output Sink Current – Ambient Temperature
(OUT=1.5V)

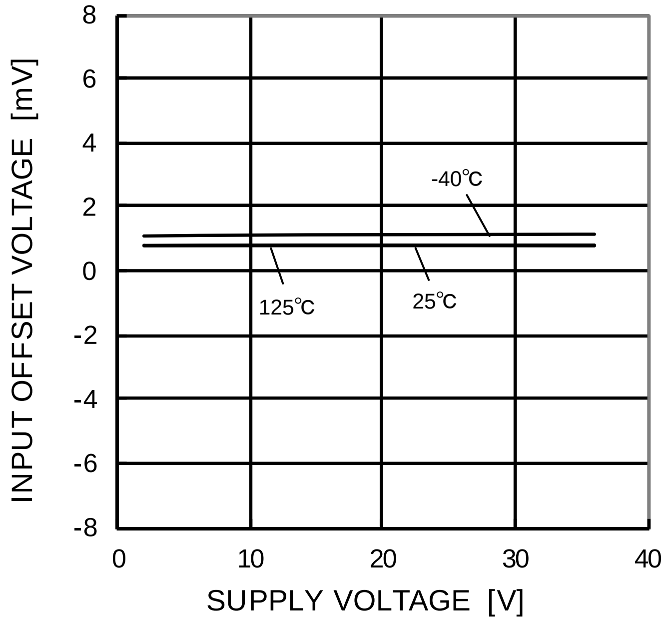



Figure 32.
Input Offset Voltage – Supply Voltage

(*)The data above is measurement value of typical sample, it is not guaranteed.

○BA2901Yxx-C

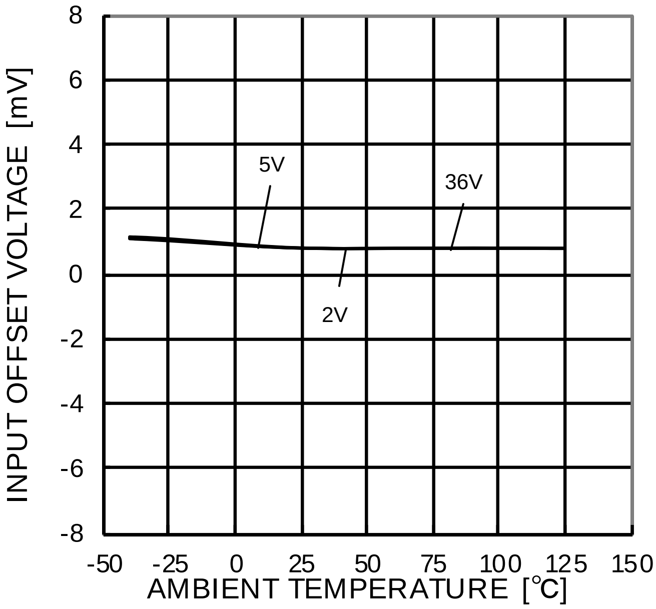



Figure 33.
Input Offset Voltage – Ambient Temperature

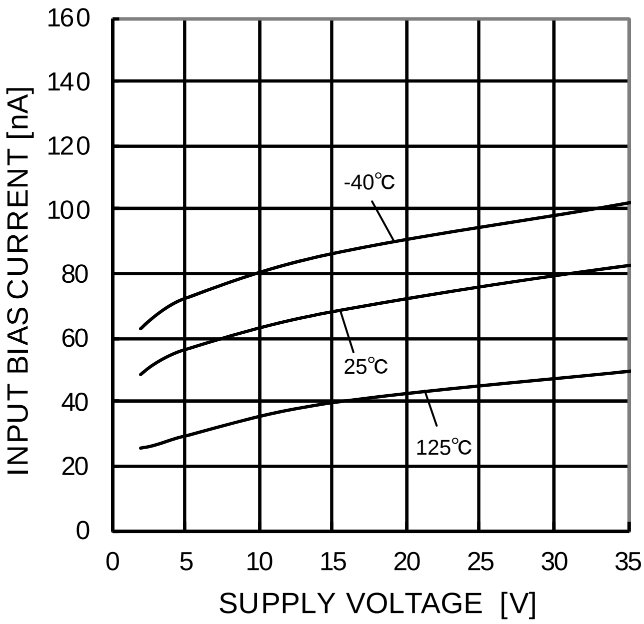



Figure 34.
Input Bias Current – Supply Voltage

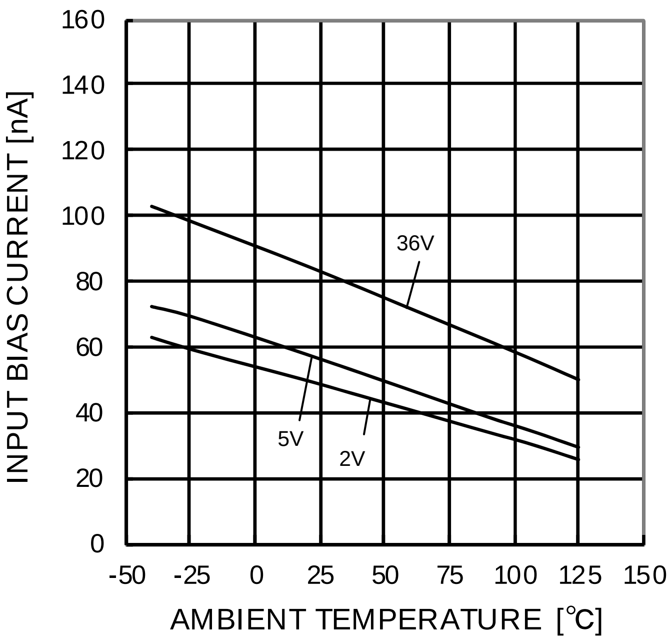



Figure 35.
Input Bias Current – Ambient Temperature

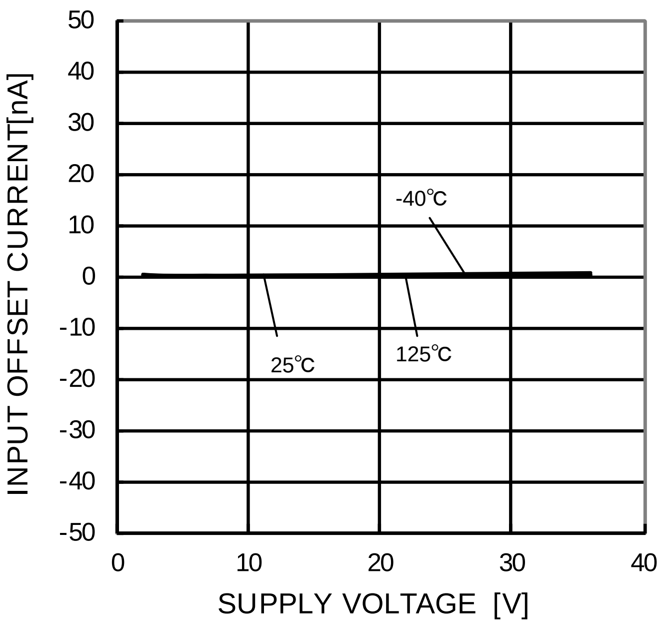



Figure 36.
Input Offset Current – Supply Voltage

(*)The data above is measurement value of typical sample, it is not guaranteed.

○BA2901Yxx-C

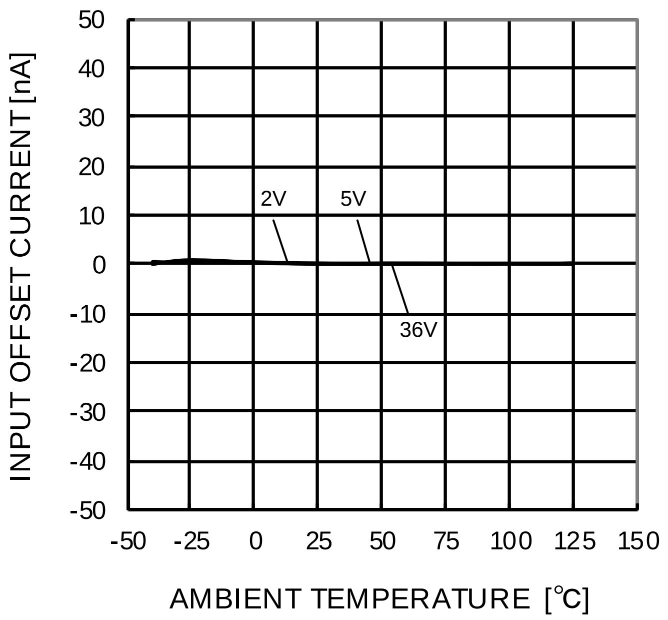



Figure 37.
Input Offset Current
– Ambient Temperature

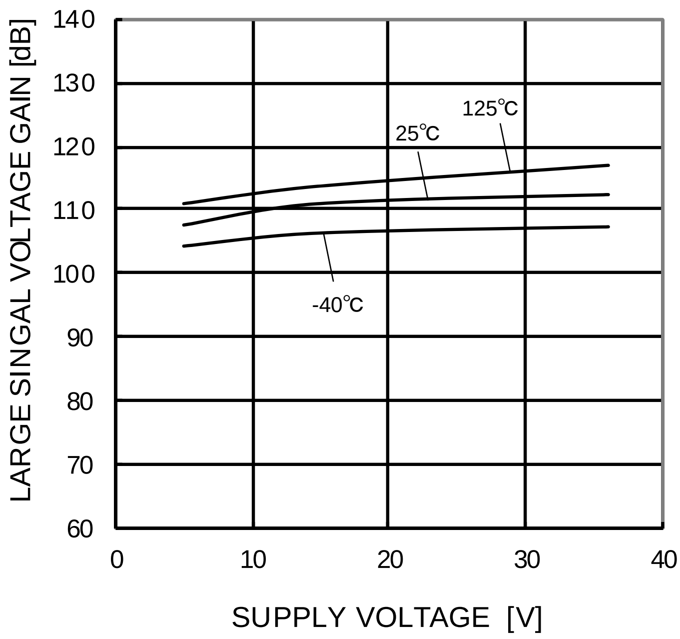



Figure 38.
Large Signal Voltage Gain
– Supply Voltage

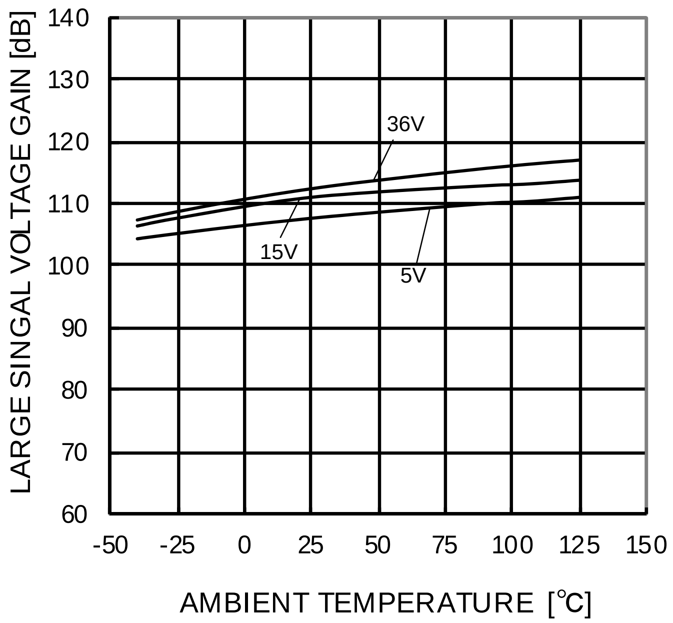



Figure 39.
Large Signal Voltage Gain
– Ambient Temperature

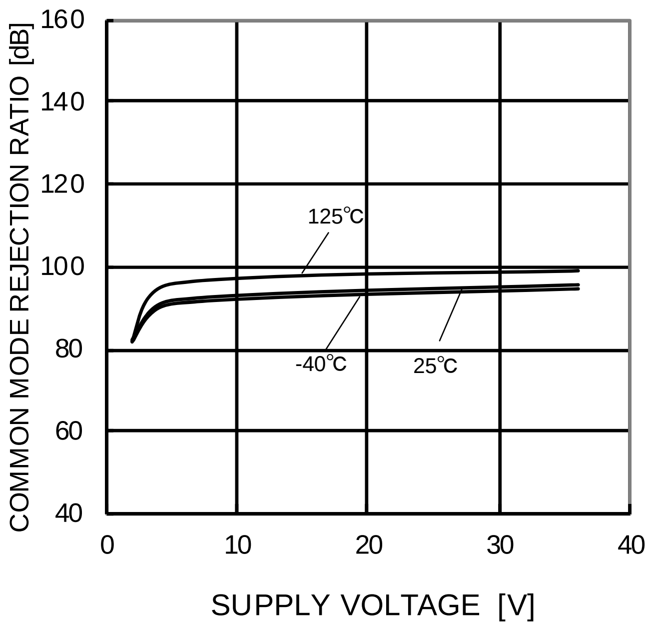



Figure 40.
Common Mode Rejection Ratio
– Supply Voltage

(*)The data above is measurement value of typical sample, it is not guaranteed.

○BA2901Yxx-C

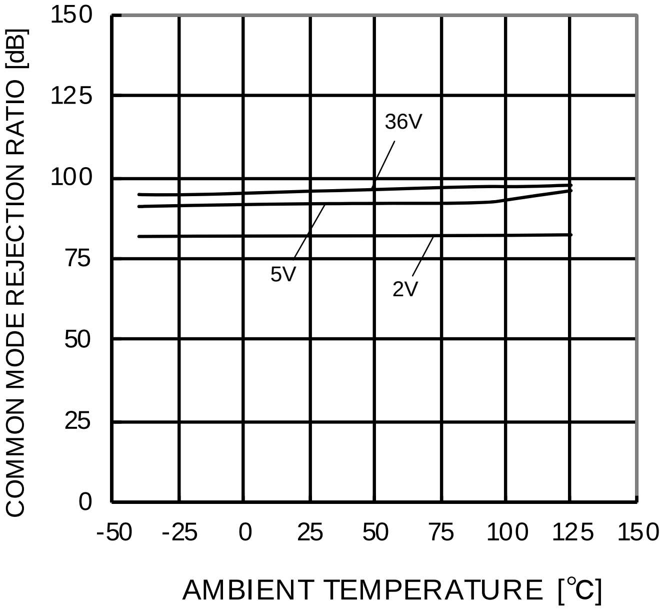



Figure 41.
Common Mode Rejection Ratio
– Ambient Temperature

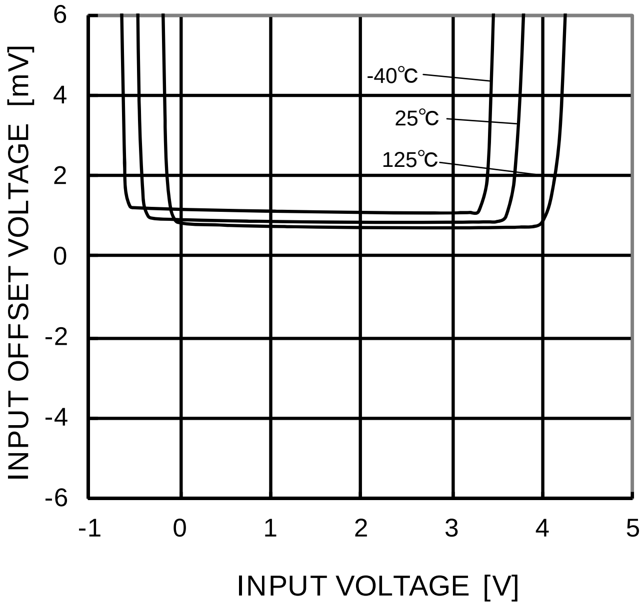



Figure 42.
Input Offset Voltage – Input Voltage
(VCC=5V)

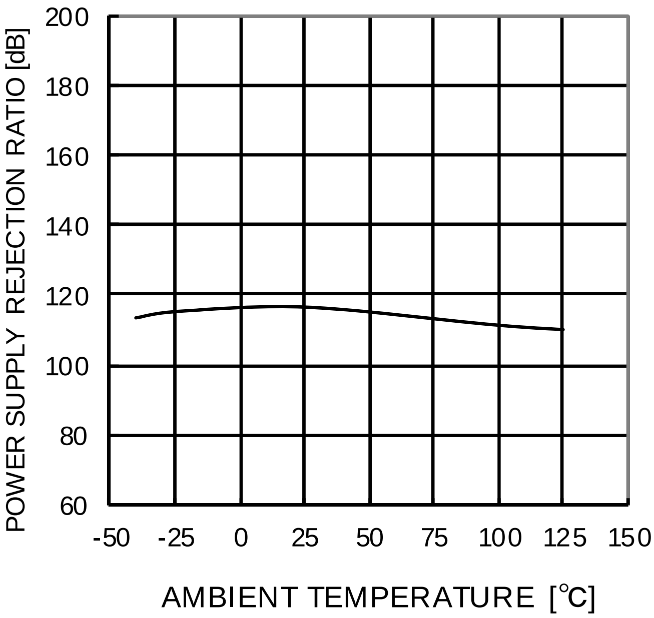



Figure 43.
Power Supply Rejection Ratio
– Ambient Temperature

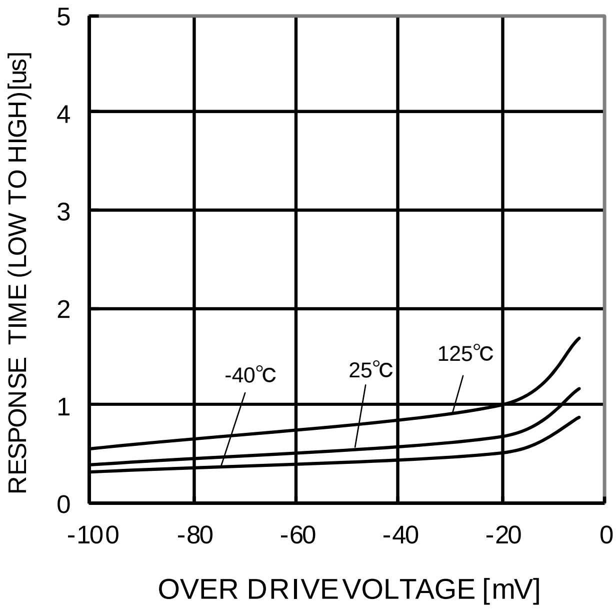



Figure 44.
Response Time (Low to High) – Over Drive Voltage
(VCC=5V, VRL=5V, RL=5.1kΩ)

(*)The data above is measurement value of typical sample, it is not guaranteed.

○BA2901Yxx-C

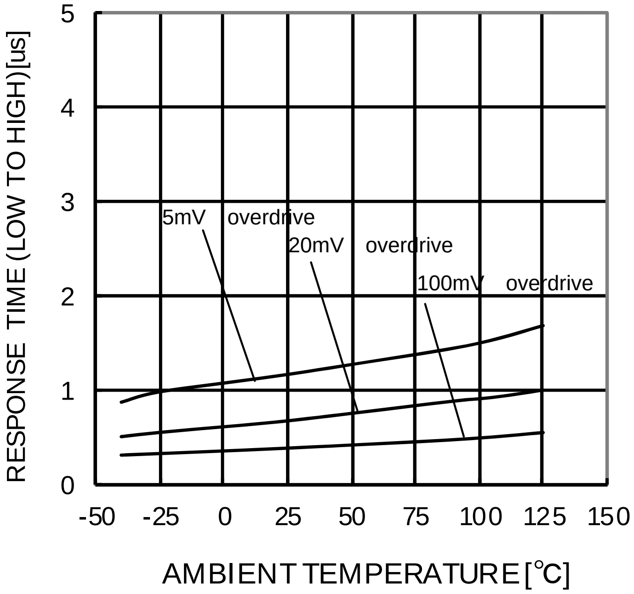



Figure 45.
Response Time (Low to High)
– Ambient Temperature (VCC=5V, VRL=5V, RL=5.1kΩ)

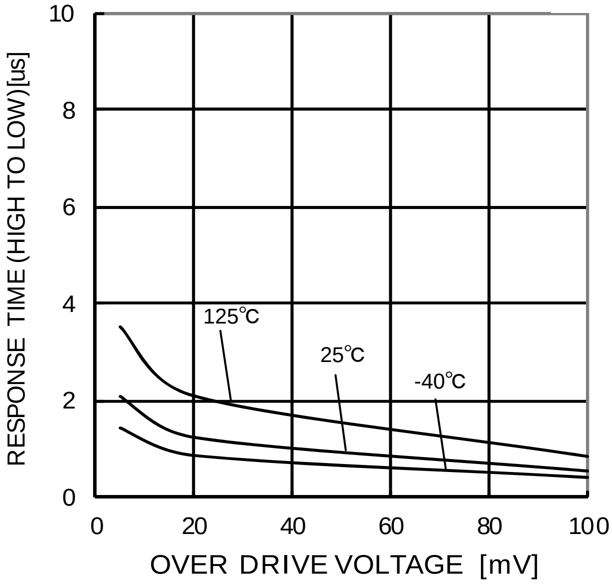



Figure 46.
Response Time (High to Low)
– Over Drive Voltage
(VCC=5V, VRL=5V, RL=5.1kΩ)

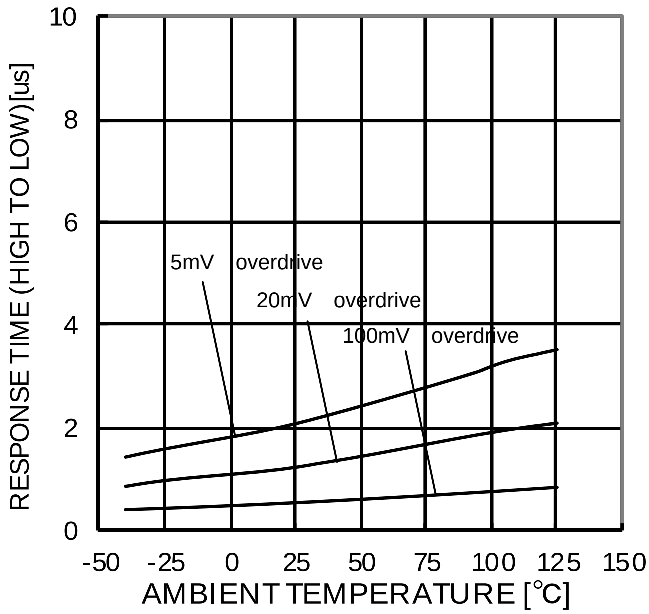



Figure 47.
Response Time (High to Low)
– Ambient Temperature
(VCC=5V, VRL=5V, RL=5.1kΩ)

(*)The data above is measurement value of typical sample, it is not guaranteed.

●**Power Dissipation**

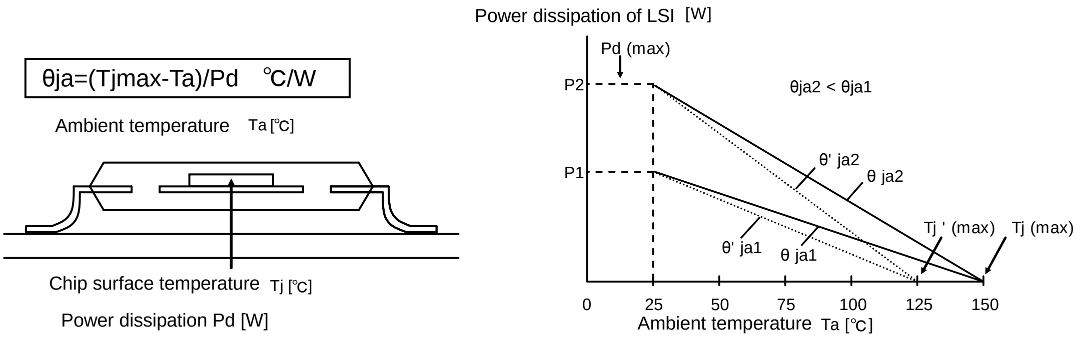
Power dissipation (total loss) indicates the power that the IC can consume at Ta=25°C (normal temperature). As the IC consumes power, it heats up, causing its temperature to be higher than the ambient temperature. The allowable temperature that the IC can accept is limited. This depends on the circuit configuration, manufacturing process, and consumable power.

Power dissipation is determined by the allowable temperature within the IC (maximum junction temperature) and the thermal resistance of the package used (heat dissipation capability). Maximum junction temperature is typically equal to the maximum storage temperature. The heat generated through the consumption of power by the IC radiates from the mold resin or lead frame of the package. Thermal resistance, represented by the symbol θja°C/W, indicates this heat dissipation capability. Similarly, the temperature of an IC inside its package can be estimated by thermal resistance.

Figure 50. (a) shows the model of the thermal resistance of the package. The equation below shows how to compute for the Thermal resistance (θja), given the ambient temperature (Ta), junction temperature (Tj), and power dissipation (Pd).

$$\theta ja = (Tjmax - Ta) / Pd \quad ℃/W \quad \cdot\cdot\cdot\cdot\cdot \quad (I)$$

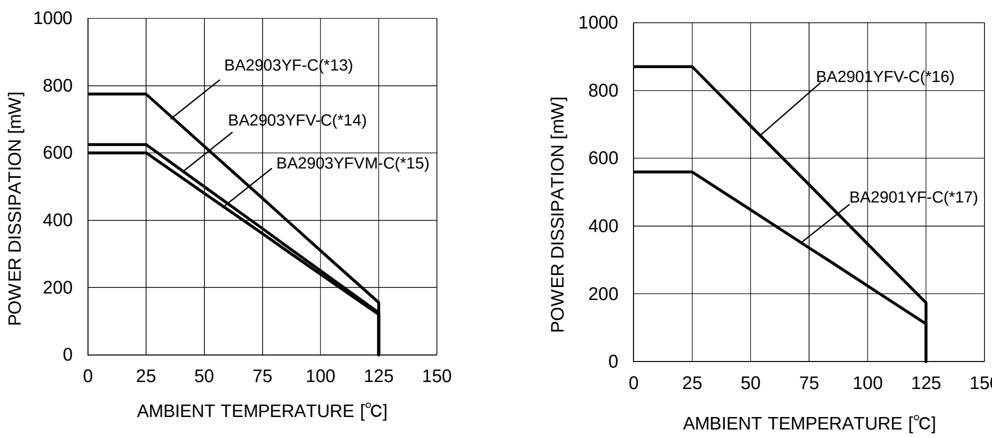
The Derating curve in Figure 48. (b) indicates the power that the IC can consume with reference to ambient temperature. Power consumption of the IC begins to attenuate at certain temperatures. This gradient is determined by Thermal resistance (θja), which depends on the chip size, power consumption, package, ambient temperature, package condition, wind velocity, etc. This may also vary even when the same of package is used. Thermal reduction curve indicates a reference value measured at a specified condition. Figure 49. (c),(d) shows an example of the derating curve for BA2903Yxxx-C, BA2901Yxx-C.




(a) Thermal resistance

(b) Derating curve

Figure 48. Thermal resistance and derating




(c) BA2903Y

(d) BA2901Y

| (*13) | (*14) | (*15) | (*16) | (*17) | UNIT |
|---|---|---|---|---|---|
| 6.2 | 5.0 | 4.8 | 7.0 | 4.5 | mW/℃ |

When using the unit above Ta=25℃, subtract the value above per degree℃.

Permissible dissipation is the value when FR4 glass epoxy board 70mm×70mm×1.6mm(cooper foil area below 3%) is mounted.

Figure 49. Derating curve

## ●Application Information

**NULL method condition for Test circuit1**

VCC,VEE,EK,Vicm Unit：V

| Parameter | VF | S1 | S2 | S3 | Vcc | VEE | EK | Vicm | Calculation |
|---|---|---|---|---|---|---|---|---|---|
| Input Offset Voltage | VF1 | ON | ON | ON | 5～36 | 0 | -1.4 | 0 | 1 |
| Input Offset Current | VF2 | OFF | OFF | ON | 5 | 0 | -1.4 | 0 | 2 |
| Input Bias Current | VF3 | OFF | ON | ON | 5 | 0 | -1.4 | 0 | 3 |
| | VF4 | ON | OFF | | 5 | 0 | -1.4 | 0 | |
| Large Signal Voltage Gain | VF5 | ON | ON | ON | 15 | 0 | -1.4 | 0 | 4 |
| | VF6 | | | | 15 | 0 | -11.4 | 0 | |

- Calculation -

1. Input Offset Voltage (Vio)

$$Vio = \frac{|VF1|}{1+RF/RS} \quad [V]$$

2. Input Offset Current (Iio)

$$Iio = \frac{|VF2-VF1|}{Ri\times(1+RF/RS)} \quad [A]$$

3. Input Bias Current (Ib)

$$Ib = \frac{|VF4-VF3|}{2\times Ri\times(1+RF/RS)} \quad [A]$$

4. Large Signal Voltage Gain (Av)

$$Av = 20\times Log\frac{\Delta EK\times(1+RF/RS)}{|VF5-VF6|} \quad [dB]$$

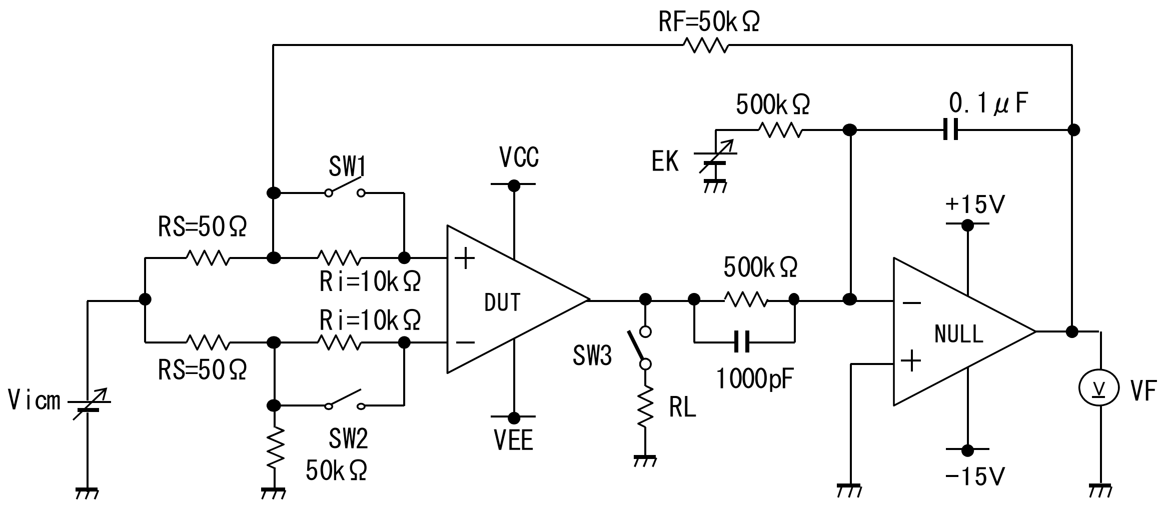



Figure 50. Test circuit1 (one channel only)

**Switch Condition for Test Circuit 2**

| SW No. | | SW 1 | SW 2 | SW 3 | SW 4 | SW 5 | SW 6 | SW 7 |
|---|---|---|---|---|---|---|---|---|
| Supply Current | | OFF | OFF | OFF | OFF | OFF | OFF | OFF |
| Output Sink Current | VOL=1.5V | OFF | ON | ON | OFF | OFF | OFF | ON |
| Output Saturation Voltage | Isink=4mA | OFF | ON | ON | OFF | ON | ON | OFF |
| Output Leakage Current | VOH=36V | OFF | ON | ON | OFF | OFF | OFF | ON |
| Response Time | RL=5.1kΩ, VRL=5V | ON | OFF | ON | ON | OFF | OFF | OFF |

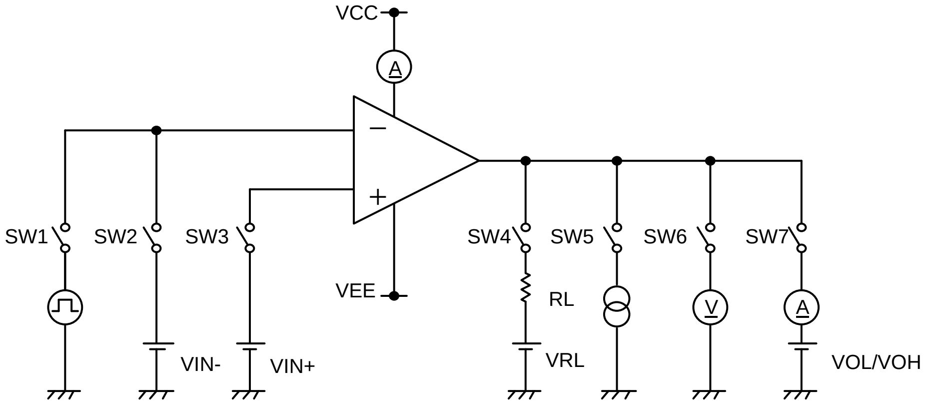



Figure 51. Test Circuit 2 (one channel only)

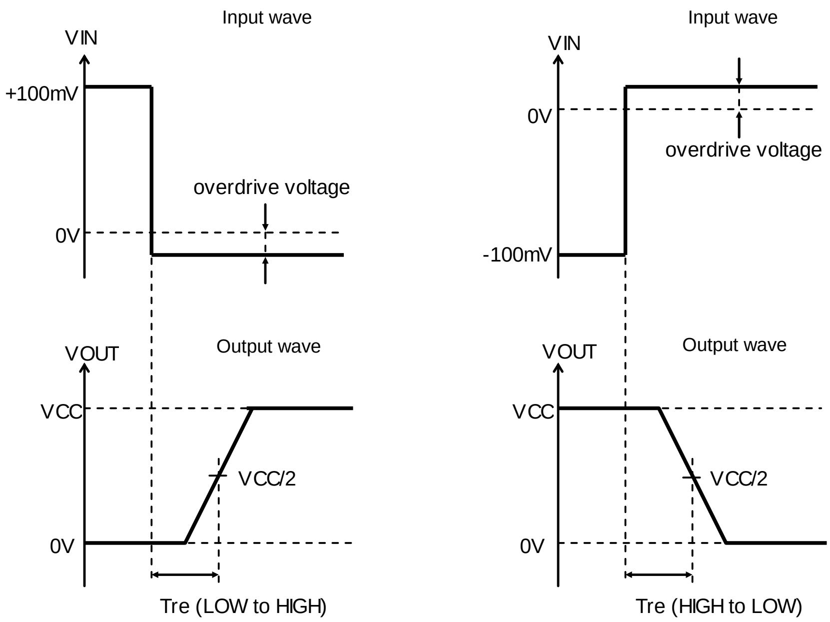
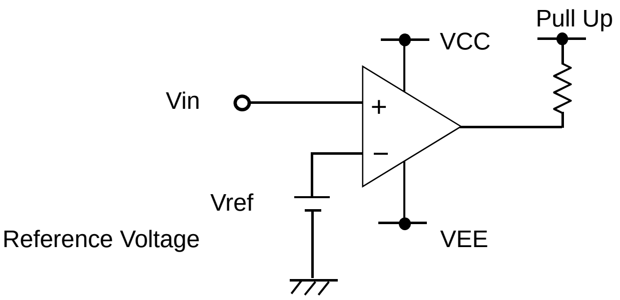
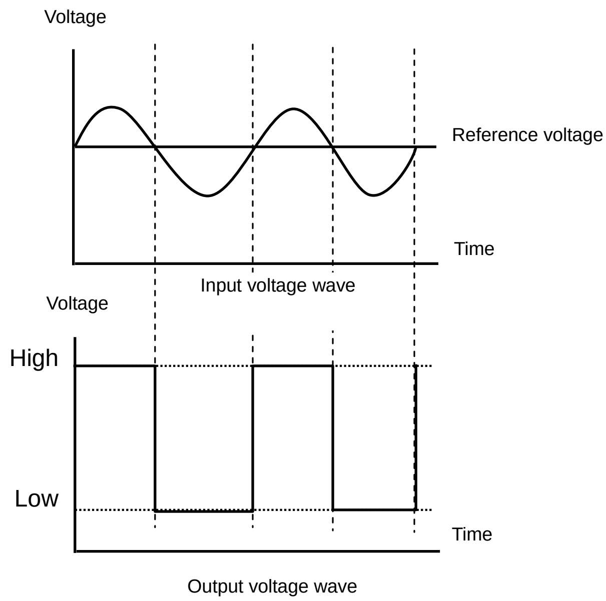



Figure 52. Response Time

**Example of circuit**

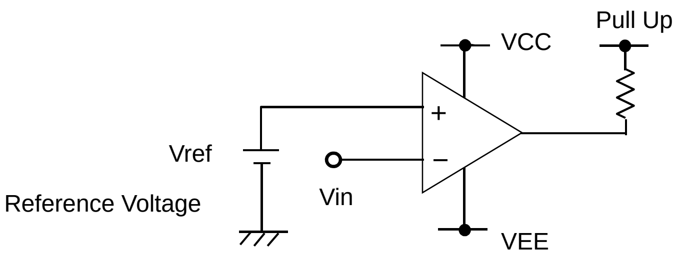
○Reference voltage is Vin-

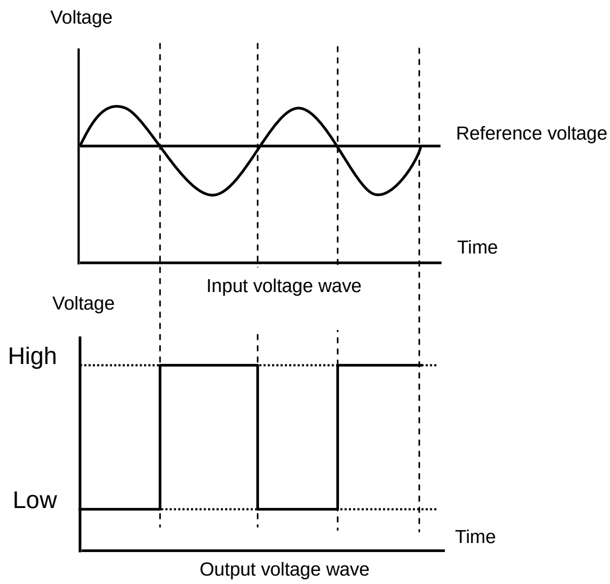



While the input voltage is higher that the reference voltage, the output voltage remains high. In case the input voltage becomes lower than the reference voltage, the output voltage will turn low.

○Reference voltage is Vin+




While the input voltage is smaller that the reference voltage, the output voltage remains high. In case the input voltage becomes higher than the reference voltage, the output voltage will turn low.

## ●Operational Notes

1) Unused circuits
When there are unused comparators, it is recommended that they are connected as in Figure 53. , setting the non-inverting input terminal to a potential within the in-phase input voltage range (Vicm).

Please keep this potential in Vicm
VCC-1.5V＞Vicm＞VEE

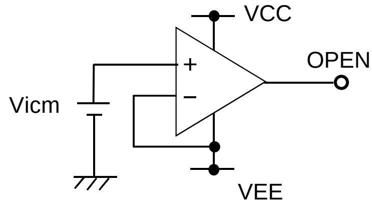



Figure 53. Disable circuit example

2) Input voltage
Applying VEE +36V to the input terminal is possible without causing deterioration of the electrical characteristics or destruction, regardless 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.

3) Power supply (single / dual)
The comparator operates when the voltage supplied is between VCC and VEE. Therefore, the signal supply comparator can be used as a dual supply comparator as well.

4) Power dissipation Pd
Using the unit in excess of the rated power dissipation may cause deterioration in electrical characteristics including reduced current capability due to the rise of chip temperature. Therefore, please take into consideration the power dissipation (Pd) under actual operating conditions and apply a sufficient margin in thermal design. Refer to the thermal derating curves for more information.

5) Short-circuit between pins and erroneous mounting
Be careful when mounting the IC on printed circuit boards. The IC may be damaged if it is mounted in a wrong orientation or if pins are shorted together. Short circuit may be caused by conductive particles caught between the pins.

6) Terminal short-circuits
When the output and VCC terminals are shorted, excessive output current may flow, resulting in undue heat generation and, subsequently, destruction.

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

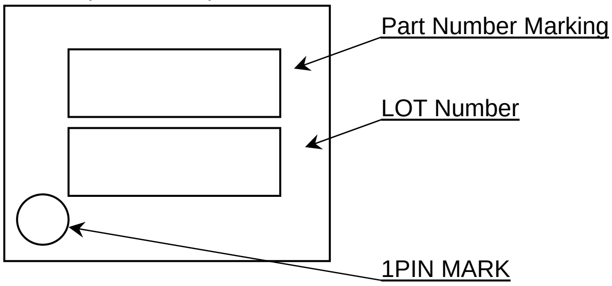
8) Radioactive rays
This IC is not designed protection against radioactive rays.

9) 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.

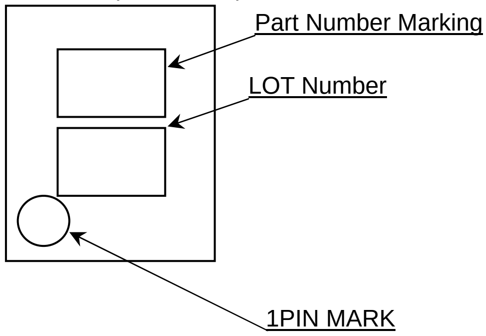
10) Board inspection
Connecting a capacitor to a pin with low impedance may stress the IC. Therefore, discharging the capacitor after every process is recommended. In addition, when attaching and detaching the jig during the inspection phase, ensure that the power is turned OFF before inspection and removal. Furthermore, please take measures against ESD in the assembly process as well as during transportation and storage.

●Marking Diagrams

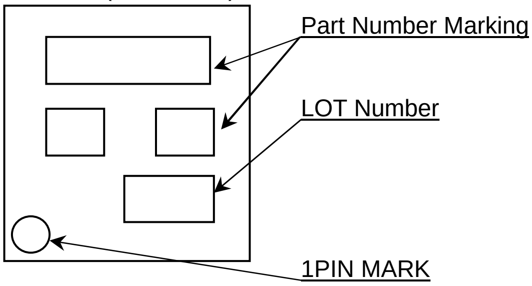
SOP8(TOP VIEW)



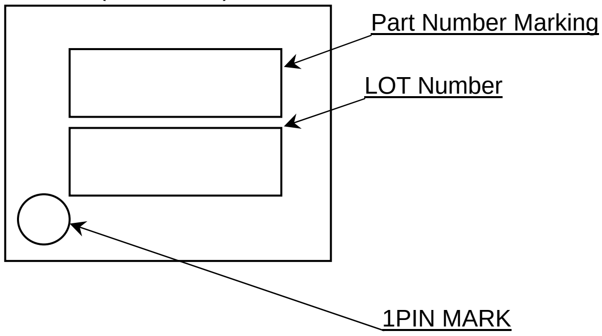

SSOP-B8(TOP VIEW)



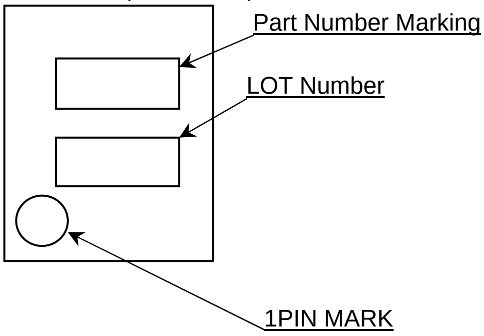

MSOP8(TOP VIEW)




SOP14(TOP VIEW)



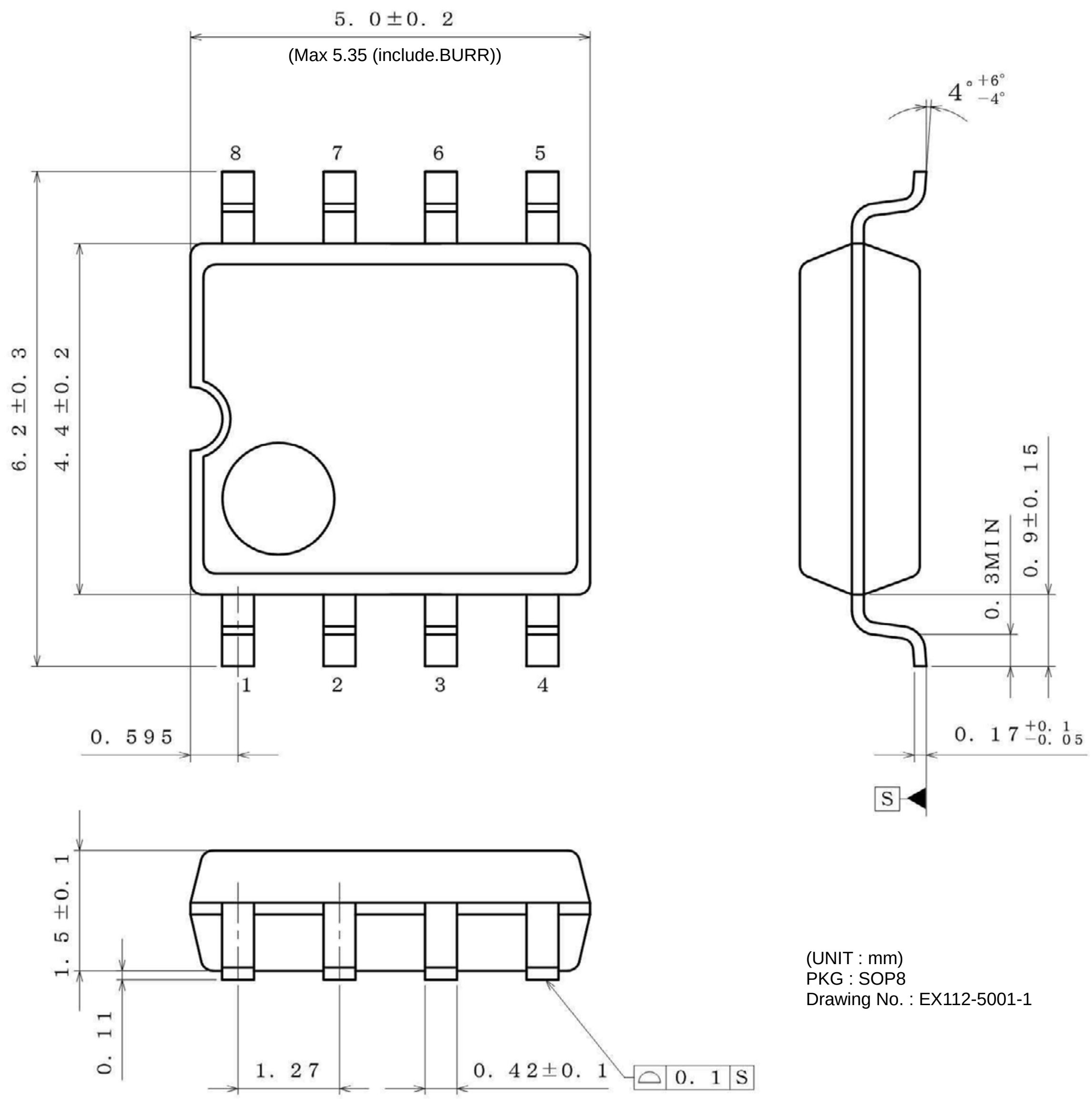

SSOP-B14(TOP VIEW)




| Product Name | | Package Type | Marking |
|---|---|---|---|
| BA2903Y | F-C | SOP8 | 2903Y |
| | FV-C | SSOP-B8 | 03Y |
| | FVM-C | MSOP8 | 2903Y |
| BA2901Y | F-C | SOP14 | BA2901YF |
| | FV-C | SSOP-B14 | 2901Y |

●**Physical Dimension, Tape and Reel Information**

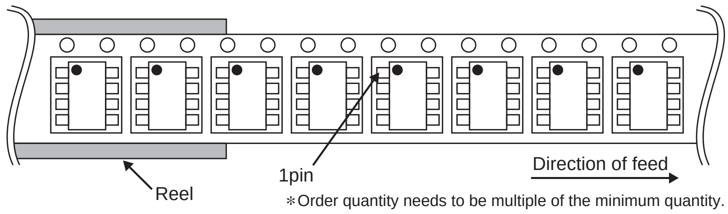
| Package Name | SOP8 |
|---|---|




(UNIT : mm)
PKG : SOP8
Drawing No. : EX112-5001-1

<Tape and Reel information>

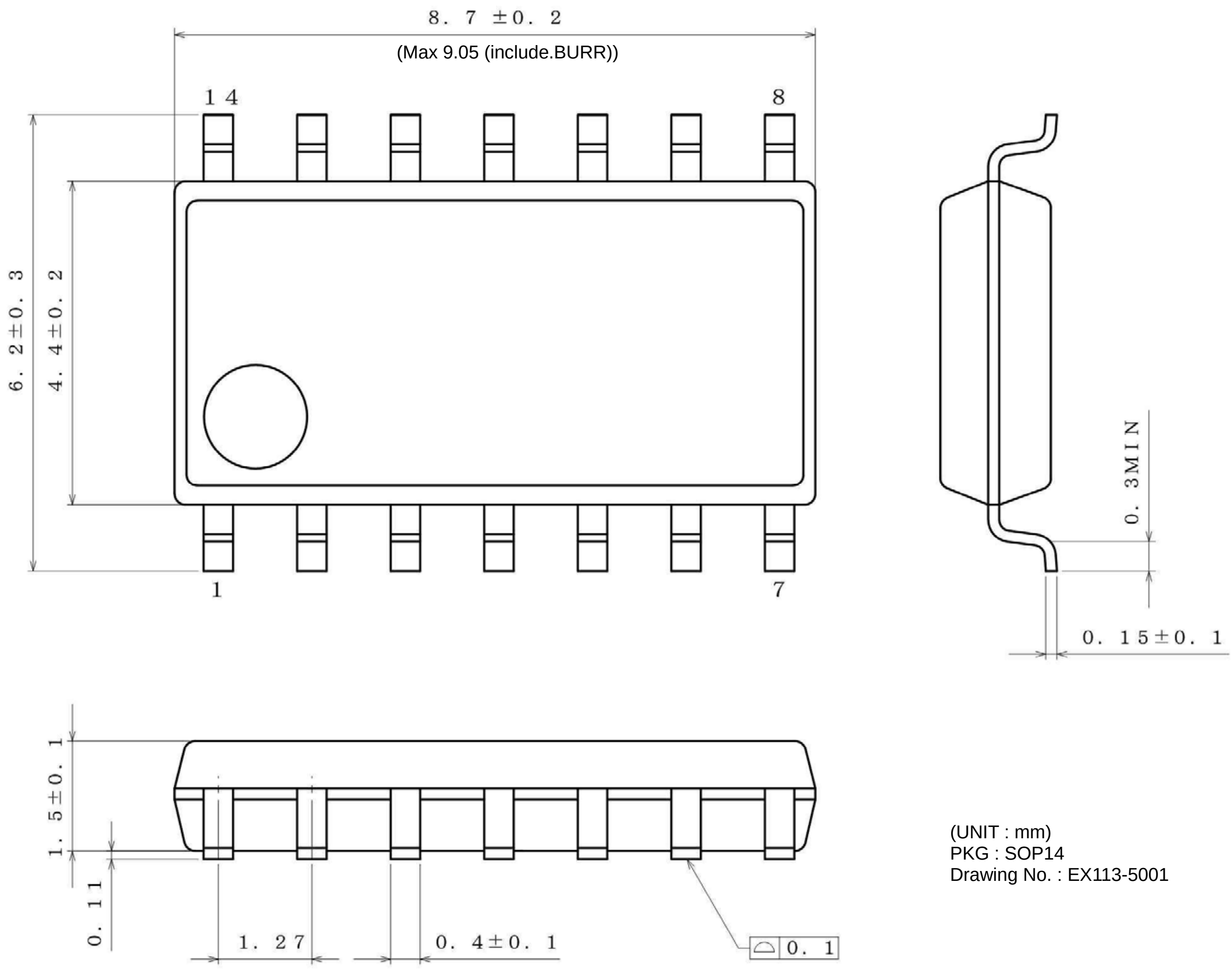
| | |
|---|---|
| Tape | Embossed carrier tape |
| Quantity | 2500pcs |
| Direction of feed | E2<br>( The direction is the 1pin of product is at the upper left when you hold reel on the left hand and you pull out the tape on the right hand ) |




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

## ●Physical Dimension, Tape and Reel Information

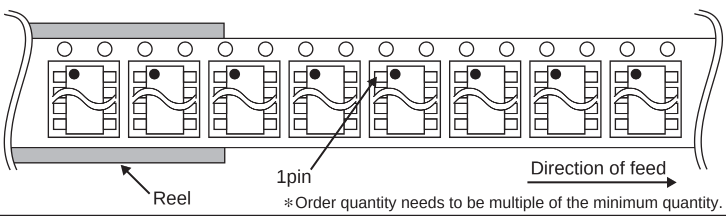
| Package Name | SOP14 |
|---|---|




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

<Tape and Reel information>

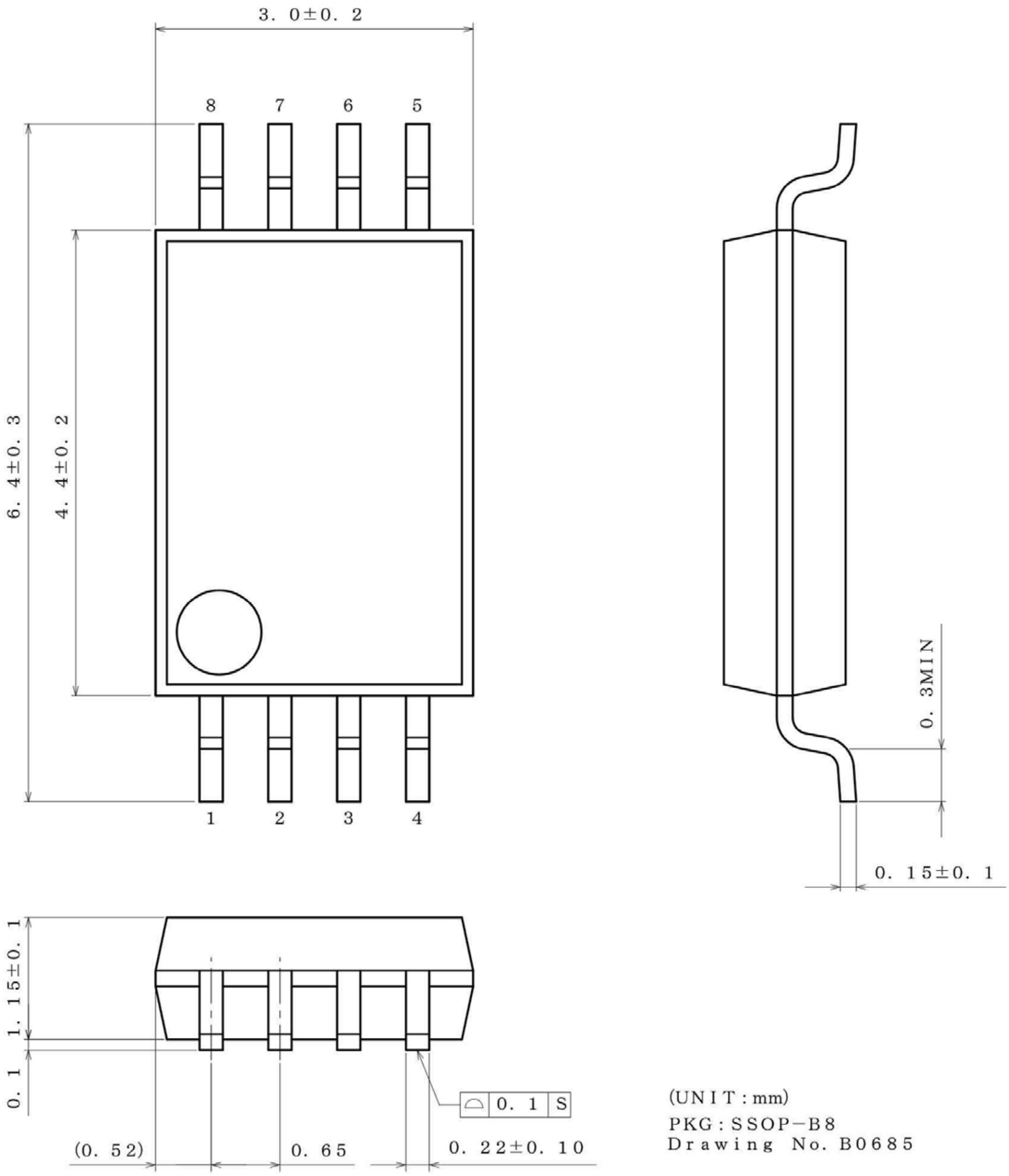
| Tape | Embossed carrier tape |
|---|---|
| Quantity | 2500pcs |
| Direction of feed | E2<br>( The direction is the 1pin of product is at the upper left when you hold reel on the left hand and you pull out the tape on the right hand ) |




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

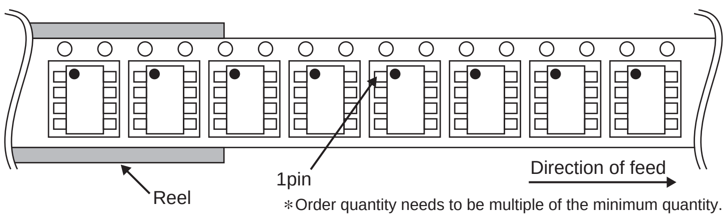
●**Physical Dimension, Tape and Reel Information**

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




<Tape and Reel information>

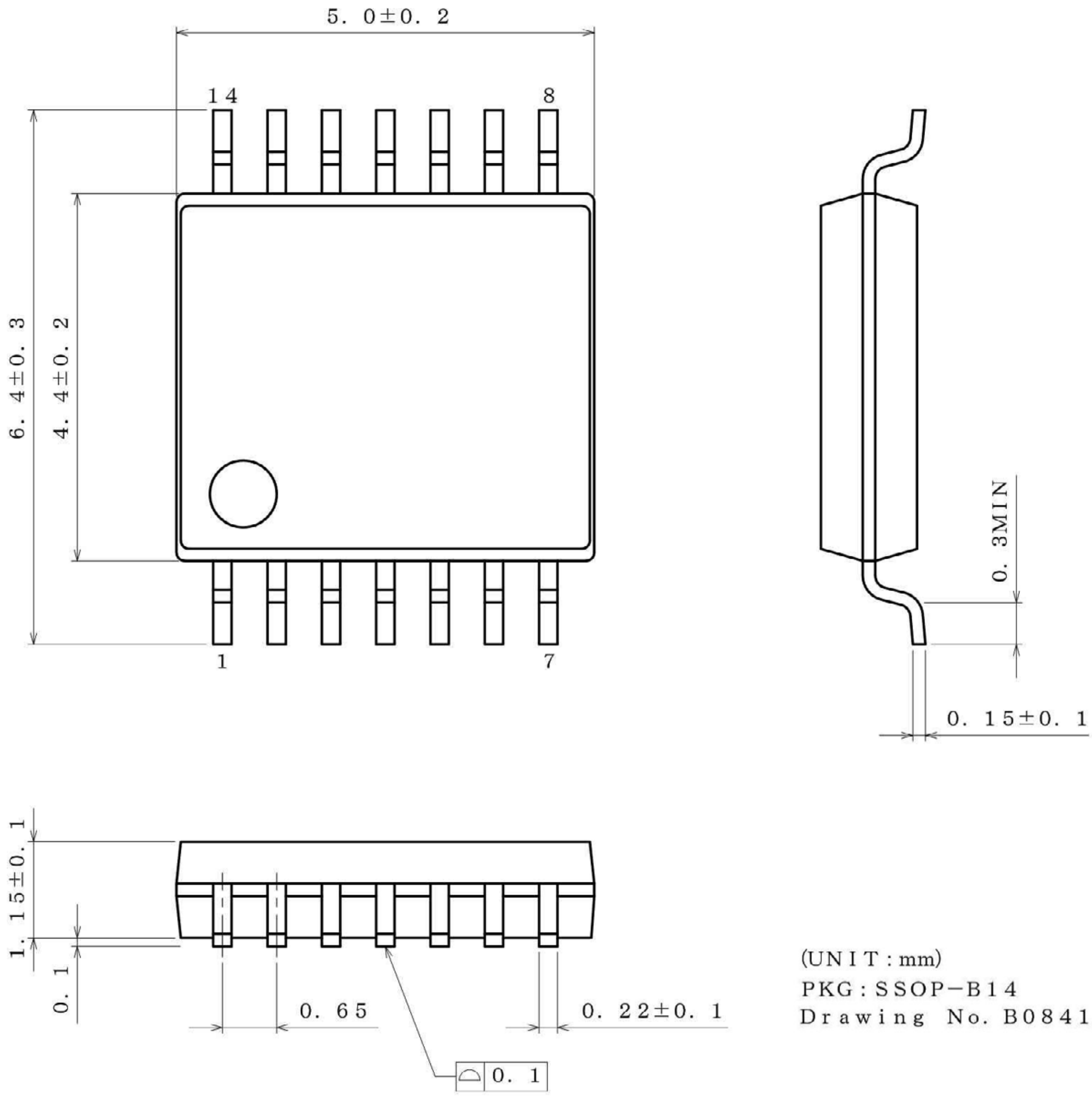
| | |
|---|---|
| Tape | Embossed carrier tape |
| Quantity | 2500pcs |
| Direction of feed | E2 ( The direction is the 1pin of product is at the upper left when you hold reel on the left hand and you pull out the tape on the right hand ) |




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

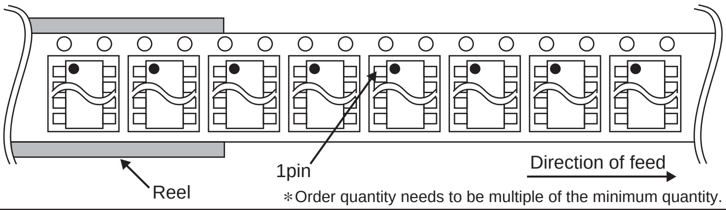
●**Physical Dimension, Tape and Reel Information**

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




<Tape and Reel information>

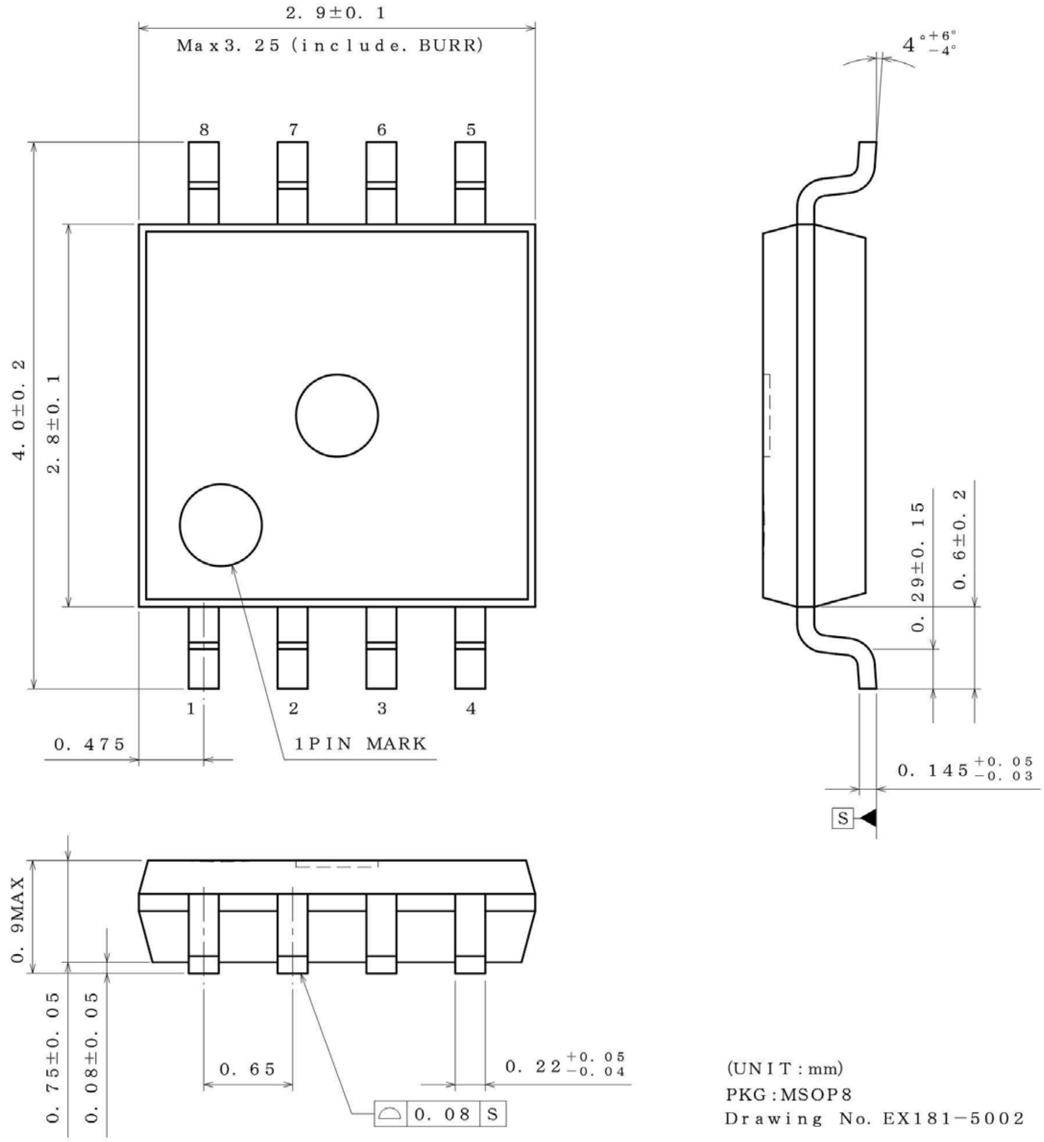
| Tape | Embossed carrier tape |
|---|---|
| Quantity | 2500pcs |
| Direction of feed | E2 (The direction is the 1pin of product is at the upper left when you hold reel on the left hand and you pull out the tape on the right hand) |




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

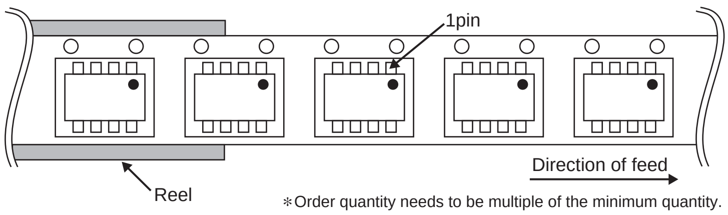
## ●Physical Dimension, Tape and Reel Information

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



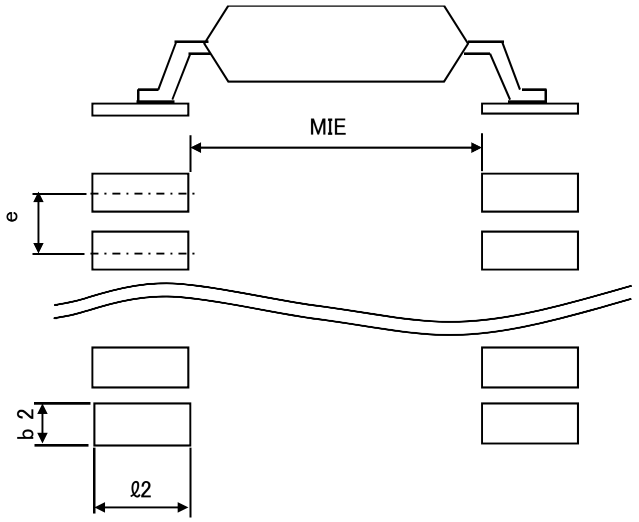

<Tape and Reel information>

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




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

**●Land pattern data**




SOP8, SSOP-B8, MSOP8
SOP14, SSOP-B14

All dimensions in mm

| Package | Land pitch e | Land space MIE | Land length ≧ℓ 2 | Land width b2 |
|---|---|---|---|---|
| SOP8<br>SOP14 | 1.27 | 4.60 | 1.10 | 0.76 |
| SSOP-B8<br>SSOP-B14 | 0.65 | 4.60 | 1.20 | 0.35 |
| MSOP8 | 0.65 | 2.62 | 0.99 | 0.35 |

**●Revision History**

| Date | Revision | Changes |
|---|---|---|
| 11.Apr.2012 | 001 | New Release |
| 21.Jan.2013 | 002 | Land pattern data inserted. |
| 11.Mar.2013 | 003 | Input offset voltage, Input offset current limit (Temp=25℃) changed.<br>Description of Physical Dimension, Tape and Reel Information changed. |

# Notice

## 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.

2. All information contained in this document is current as of the issuing date and subject to change without any prior notice. Before purchasing or using ROHM's Products, please confirm the latest information with a ROHM sales representative.

## Precaution on using ROHM Products

1. If you intend to use our Products in devices requiring extremely high reliability (such as medical equipment, aircraft/spacecraft, nuclear power controllers, 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.

2. ROHM designs and manufactures its Products subject to strict quality control system. However, semiconductor products can fail or malfunction at a certain rate. Please be sure to implement, at your own responsibilities, adequate safety measures including but not limited to fail-safe design against the physical injury, damage to any property, which a failure or malfunction of our Products may cause. The following are examples of safety measures:
   [a] Installation of protection circuits or other protective devices to improve system safety
   [b] Installation of redundant circuits to reduce the impact of single or multiple circuit failure

3. Our Products are not designed under any special or extraordinary environments or conditions, as exemplified below. Accordingly, ROHM shall not be in any way responsible or liable for any damages, expenses or losses arising from the use of any ROHM's Products under any special or extraordinary environments or conditions. If you intend to use our Products under any special or extraordinary environments or conditions (as exemplified below), your independent verification and confirmation of product performance, reliability, etc, prior to use, must be necessary:
   [a] Use of our Products in any types of liquid, including water, oils, chemicals, and organic solvents
   [b] Use of our Products outdoors or in places where the Products are exposed to direct sunlight or dust
   [c] Use of our Products in places where the Products are exposed to sea wind or corrosive gases, including $Cl_2$, $H_2S$, $NH_3$, $SO_2$, and $NO_2$
   [d] Use of our Products in places where the Products are exposed to static electricity or electromagnetic waves
   [e] Use of our Products in proximity to heat-producing components, plastic cords, or other flammable items
   [f] Sealing or coating our Products with resin or other coating materials
   [g] Use of our Products without cleaning residue of flux (even if you use no-clean type fluxes, cleaning residue of flux is recommended); or Washing our Products by using water or water-soluble cleaning agents for cleaning residue after soldering
   [h] Use of the Products in places subject to dew condensation

4. The Products are not subject to radiation-proof design.

5. Please verify and confirm characteristics of the final or mounted products in using the Products.

6. In particular, if a transient load (a large amount of load applied in a short period of time, such as pulse. is applied, confirmation of performance characteristics after on-board mounting is strongly recommended. Avoid applying power exceeding normal rated power; exceeding the power rating under steady-state loading condition may negatively affect product performance and reliability.

7. De-rate Power Dissipation (Pd) depending on Ambient temperature (Ta). When used in sealed area, confirm the actual ambient temperature.

8. Confirm that operation temperature is within the specified range described in the product specification.

9. ROHM shall not be in any way responsible or liable for failure induced under deviant condition from what is defined in this document.

## Precaution for Mounting / Circuit board design

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

2. In principle, the reflow soldering method must be used; if flow soldering method is preferred, please consult with the ROHM representative in advance.

For details, please refer to ROHM Mounting specification

## Precautions Regarding Application Examples and External Circuits

1. If change is made to the constant of an external circuit, please allow a sufficient margin considering variations of the characteristics of the Products and external components, including transient characteristics, as well as static characteristics.

2. You agree that application notes, reference designs, and associated data and information contained in this document are presented only as guidance for Products use. Therefore, in case you use such information, you are solely responsible for it and you must exercise your own independent verification and judgment in the use of such information contained in this document. ROHM shall not be in any way responsible or liable for any damages, expenses or losses incurred by you or third parties arising from the use of such information.

## Precaution for Electrostatic

This Product is electrostatic sensitive product, which may be damaged due to electrostatic discharge. Please take proper caution in your manufacturing process and storage so that voltage exceeding the Products maximum rating will not be applied to Products. Please take special care under dry condition (e.g. Grounding of human body / equipment / solder iron, isolation from charged objects, setting of Ionizer, friction prevention and temperature / humidity control).

## Precaution for Storage / Transportation

1. Product performance and soldered connections may deteriorate if the Products are stored in the places where:
   - [a] the Products are exposed to sea winds or corrosive gases, including Cl2, H2S, NH3, SO2, and NO2
   - [b] the temperature or humidity exceeds those recommended by ROHM
   - [c] the Products are exposed to direct sunshine or condensation
   - [d] the Products are exposed to high Electrostatic

2. Even under ROHM recommended storage condition, solderability of products out of recommended storage time period may be degraded. It is strongly recommended to confirm solderability before using Products of which storage time is exceeding the recommended storage time period.

3. Store / transport cartons in the correct direction, which is indicated on a carton with a symbol. Otherwise bent leads may occur due to excessive stress applied when dropping of a carton.

4. Use Products within the specified time after opening a humidity barrier bag. Baking is required before using Products of which storage time is exceeding the recommended storage time period.

## Precaution for Product Label

QR code printed on ROHM Products label is for ROHM’s internal use only.

## Precaution for Disposition

When disposing Products please dispose them properly using an authorized industry waste company.

## Precaution for Foreign Exchange and Foreign Trade act

Since our Products might fall under controlled goods prescribed by the applicable foreign exchange and foreign trade act, please consult with ROHM representative in case of export.

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