Operational Amplifiers / Comparators

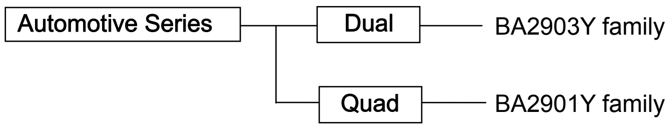
# Automotive Comparators: Ground Sense

## BA2903YF-C,BA2903YFVM-C,BA2901YF-C,BA2901YFV-C

No.11049EAT24

### ●Description

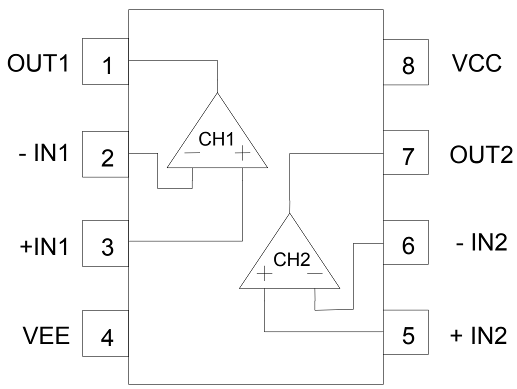
Automotive series BA2903Y family and BA2901Y family, integrate one, two or four independent high gain voltage comparator.
Some features are the wide operating voltage that is 2 to 36[V] and low supply current.
Therefore, this series is suitable for any application




### ●Features

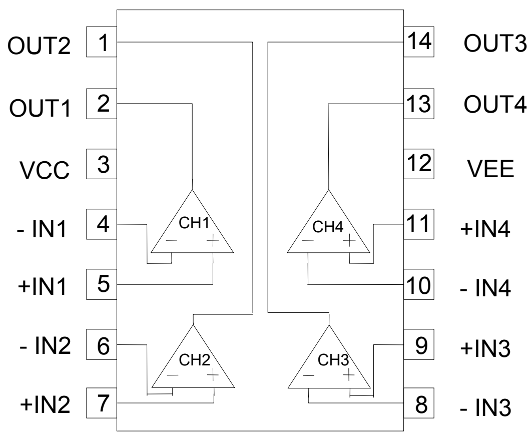
1) Operable with a signal power supply
2) Wide operating supply voltage
   +2.0[V]～+36.0[V] (single supply)
   ±1.0[V]～±18.0[V] (split supply)
3) Standard comparator pin-assignments
4) Input and output are operable ground sense
5) Internal ESD protection
   Human body model (HBM) ± 5000 [V](Typ.)
6) Wide temperature range
   -40[℃]～+125[℃]

### ●Pin Assignment




SOP8 MSOP8

BA2903YF-C BA2903YFVM-C




SOP14 SSOP-B14

BA2901YF-C BA2901YFV-C

●**Absolute Maximum Ratings** (Ta=25[℃])

○BA2903Y family , BA2901Y family

| Parameter | Symbol | Ratings | Unit |
|---|---|---|---|
| | | BA2903Y family , BA2901Y family | |
| Supply Voltage | VCC-VEE | +36 | V |
| Differential Input Voltage (*1) | Vid | 36 | V |
| Input Common-mode Voltage Range | Vicm | (VEE-0.3)～(VEE+36) | V |
| Operating Temperature Range | Topr | -40～+125 | ℃ |
| Storage Temperature Range | Tstg | -55～+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) 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.

●Electric Characteristics

○BA2903Y family (Unless otherwise specified VCC=+5[V], VEE=0[V])

| Parameter | Symbol | Temperature range | Limits | | | Unit | Conditions |
|---|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | | |
| Input Offset Voltage (*2) | Vio | 25℃ | - | 2 | 5 | mV | VOUT=1.4[V] |
| | | Full range | - | - | 15 | | VCC=5～36[V],VOUT=1.4[V] |
| Input Offset Current (*2) | Iio | 25℃ | - | 5 | 50 | nA | VOUT=1.4[V] |
| | | Full range | - | - | 200 | | |
| Input Bias Current (*2) | Ib | 25℃ | - | 50 | 250 | nA | VOUT=1.4[V] |
| | | Full range | - | - | 500 | | |
| 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=15[V], VOUT=1.4～11.4[V] RL=15[kΩ], VRL=15[V] |
| | | Full range | 74 | - | - | | |
| Supply Current | ICC | 25℃ | - | 0.6 | 1 | mA | VOUT=open |
| | | Full range | - | - | 2.5 | | VOUT=open, VCC=36[V] |
| Output Sink Current (*3) | IOL | 25℃ | 6 | 16 | - | mA | VIN+=0[V], VIN-=1[V], VOL=1.5[V] |
| Output Saturation Voltage (Low level output voltage) | VOL | 25℃ | - | 150 | 400 | mV | VIN+=0[V], VIN-=1[V], IOL=4[mA] |
| | | Full range | - | - | 700 | | |
| Output Leakage Current (High level output voltage) | Ileak | 25℃ | - | 0.1 | - | μA | VIN+=1[V], VIN-=0[V], VOH=5[V] |
| | | Full range | - | - | 1 | | VIN+=1[V], VIN-=0[V], VOH=36[V] |
| Operable Frequency | Fopr | 25℃ | 100 | - | - | kHz | VCC=5[V], RL=2[kΩ], VIN+=1.5[V], VIN-=5[Vp-p] (Duty 50% Rectangular Pulse) |

(*2) Absolute value

(*3) 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.

○BA2901Y family (Unless otherwise specified VCC=+5[V], VEE=0[V])

| Parameter | Symbol | Temperature range | Limits | | | Unit | Conditions |
|---|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | | |
| Input Offset Voltage (*4) | Vio | 25℃ | - | 2 | 5 | mV | VOUT=1.4[V] |
| | | Full range | - | - | 15 | | VCC=5～36[V], VOUT=1.4[V] |
| Input Offset Current (*4) | Iio | 25℃ | - | 5 | 50 | nA | VOUT=1.4[V] |
| | | Full range | - | - | 200 | | |
| Input Bias Current (*4) | Ib | 25℃ | - | 50 | 250 | nA | VOUT=1.4[V] |
| | | Full range | - | - | 500 | | |
| 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=15[V], VOUT=1.4～11.4[V] RL=15[kΩ], VRL=15[V] |
| | | Full range | 74 | - | - | | |
| Supply Current | ICC | 25℃ | - | 0.8 | 2 | mA | VOUT=open |
| | | Full range | - | - | 2.5 | | VOUT=open, VCC=36[V] |
| Output Sink Current (*5) | IOL | 25℃ | 6 | 16 | - | mA | VIN+=0[V], VIN-=1[V], VOL=1.5[V] |
| Output Saturation Voltage (Low level output voltage) | VOL | 25℃ | - | 150 | 400 | mV | VIN+=0[V], VIN-=1[V], IOL=4[mA] |
| | | Full range | - | - | 700 | | |
| Output Leakage Current (High level output voltage) | Ileak | 25℃ | - | 0.1 | - | μA | VIN+=1[V], VIN-=0[V], VOH=5[V] |
| | | Full range | - | - | 1 | | VIN+=1[V], VIN-=0[V], VOH=36[V] |
| Operable Frequency | Fopr | 25℃ | 100 | - | - | kHz | VCC=5[V], RL=2[kΩ], VIN+=1.5[V], VIN-=5[Vp-p] (Duty 50% Rectangular Pulse) |

(*4) Absolute value
(*5) 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.

## ●Reference Data BA2903Y family

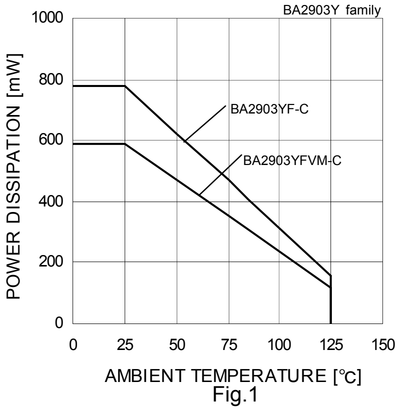



Fig.1
Derating Curve

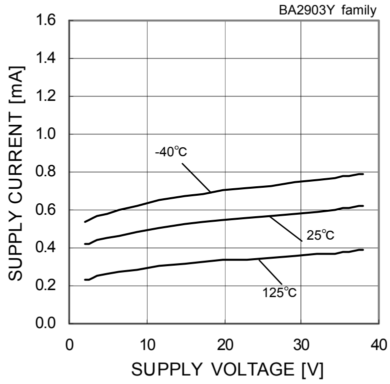



Fig.2
Supply Current – Supply Voltage

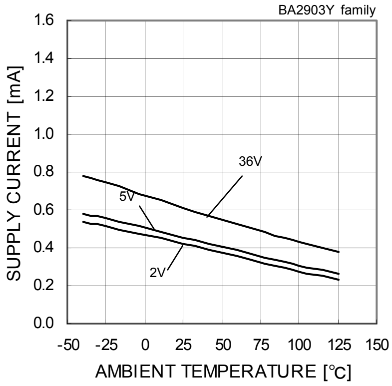



Fig.3
Supply Current – Ambient Temperature

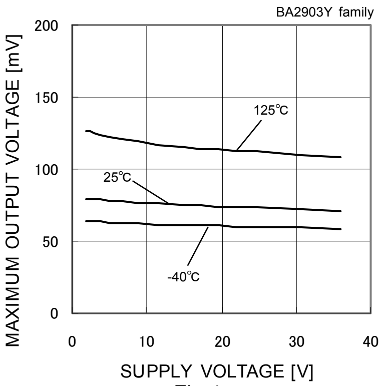



Fig.4
Maximum Output Voltage – Supply Voltage
(IOL=4[mA])

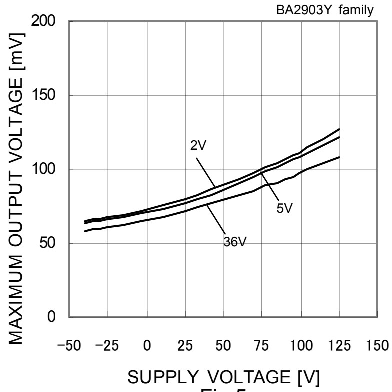



Fig.5
Maximum Output Voltage – Ambient Temperature
(IOL=4[mA])

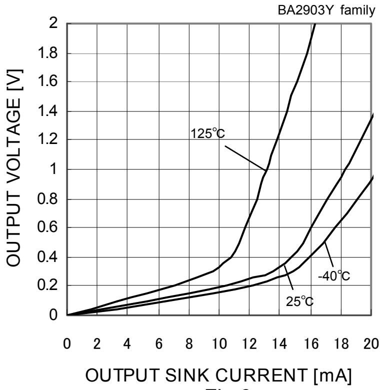



Fig.6
Output Voltage – Output Sink Current
(VCC=5[V])

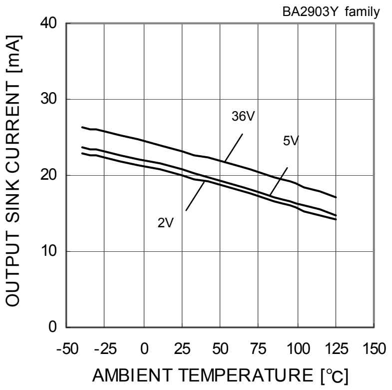



Fig.7
Output Sink Current – Ambient Temperature
(VOUT=1.5[V])

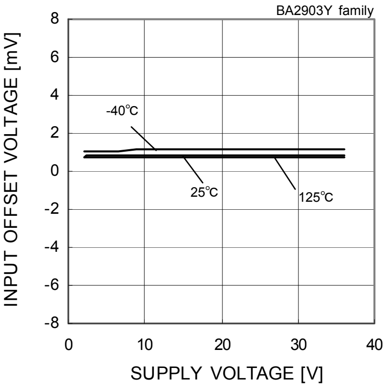



Fig.8
Input Offset Voltage – Supply Voltage

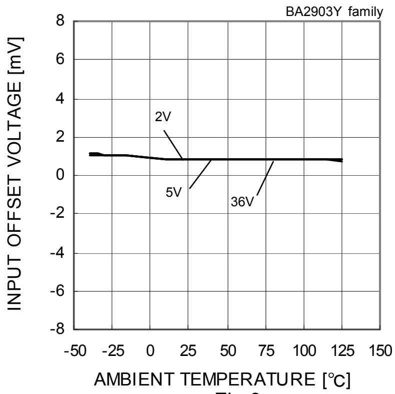



Fig.9
Input Offset Voltage – Ambient Temperature

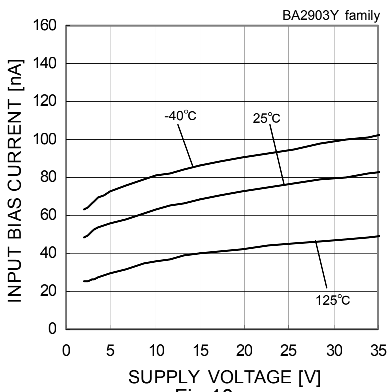



Fig.10
Input Bias Current – Supply Voltage

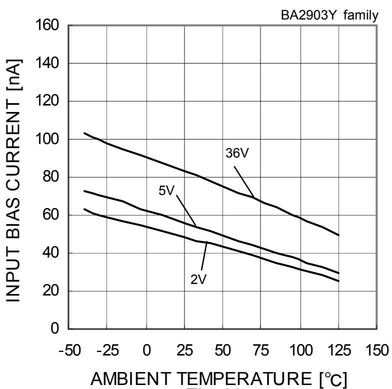



Fig.11
Input Bias Current – Ambient Temperature

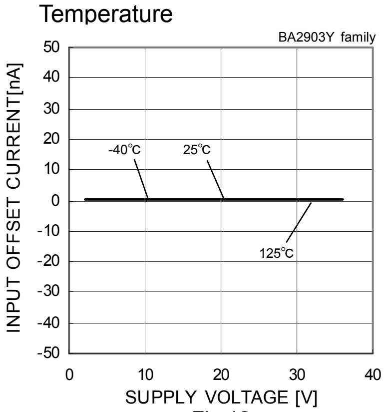



Fig.12
Input Offset Current – Supply Voltage

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

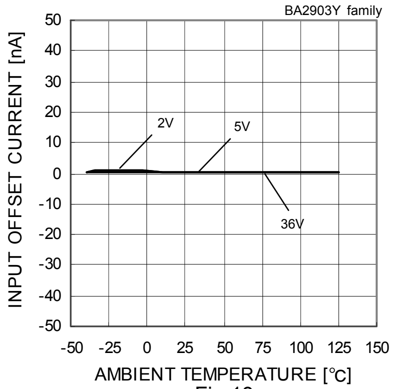


Fig.13
Input Offset Current
– Ambient Temperature

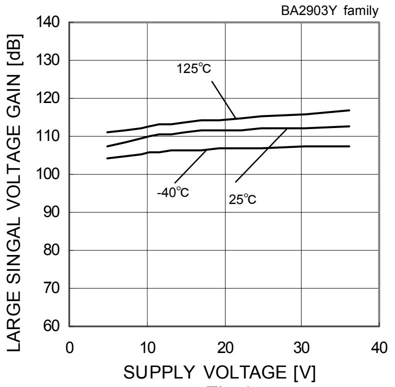


Fig.14
Large Signal Voltage Gain
– Supply Voltage

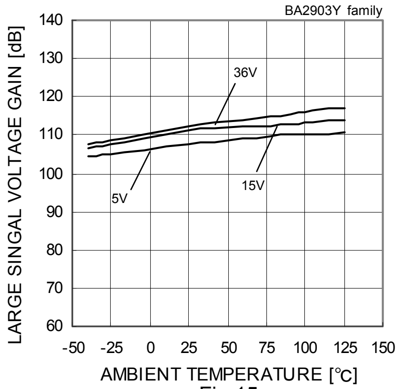


Fig.15
Large Signal Voltage Gain
– Ambient Temperature

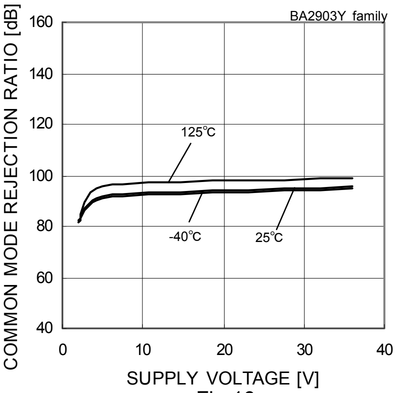


Fig.16
Common Mode Rejection Ratio
– Supply Voltage

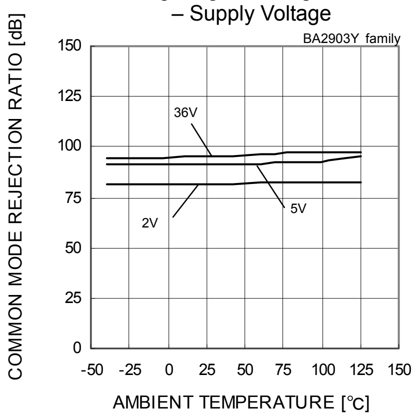


Fig.17
Common Mode Rejection Ratio
– Ambient Temperature

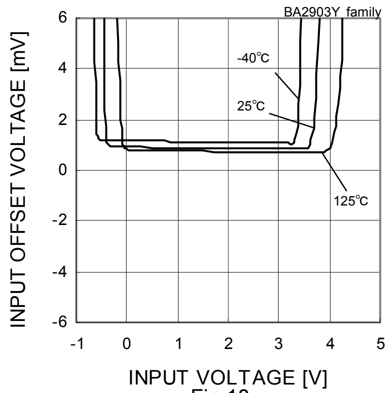


Fig.18
Input Offset Voltage – Input Voltage
(VCC=5V)

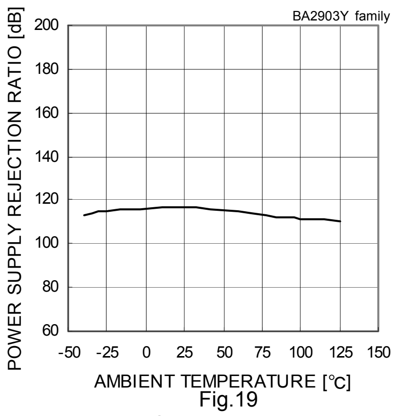


Fig.19
Power Supply Rejection Ratio
– Ambient Temperature

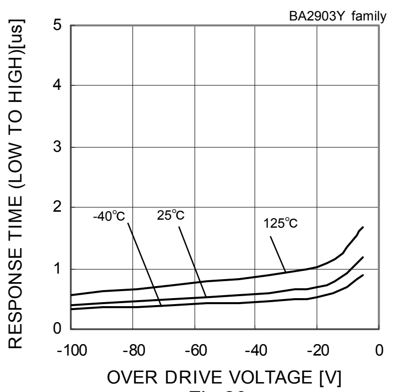


Fig.20
Response Time (Low to High) – Over Drive Voltage
(VCC=5[V],VRL=5[V],RL=5.1[kΩ])

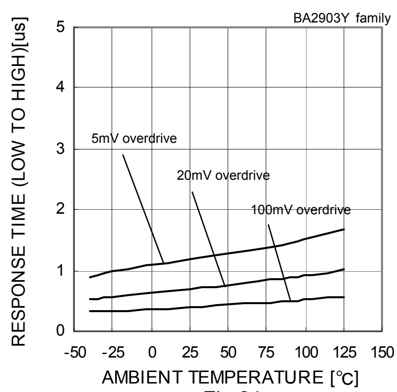


Fig.21
Response Time (Low to High)
– Ambient Temperature
(VCC=5[V],VRL=5[V],RL=5.1[kΩ])

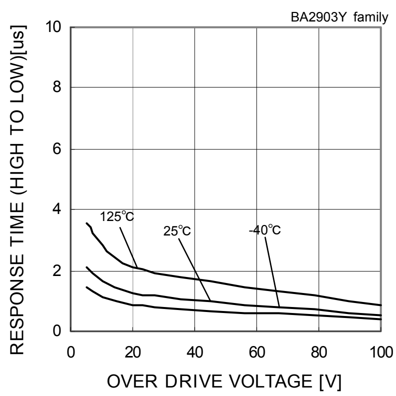


Fig.22
Response Time (High to Low)
– Over Drive Voltage
(VCC=5[V],VRL=5[V],RL=5.1[kΩ])

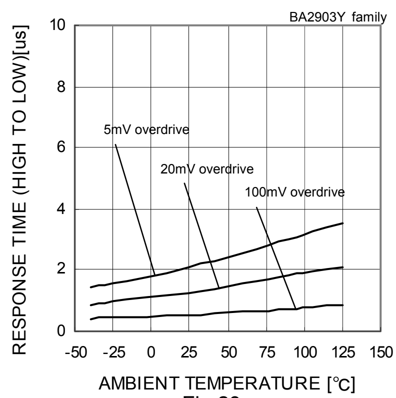


Fig.23
Response Time (High to Low)
– Ambient Temperature
(VCC=5[V],VRL=5[V],RL=5.1[kΩ])

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

## ●Reference Data BA2901Y family

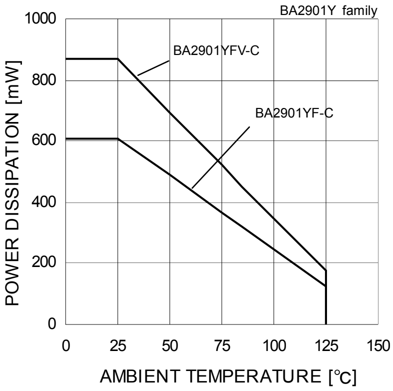


Fig.24
Derating Curve

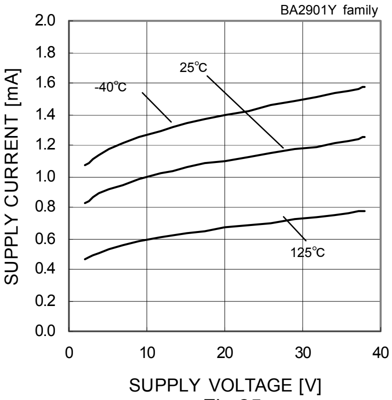


Fig.25
Supply Current – Supply Voltage

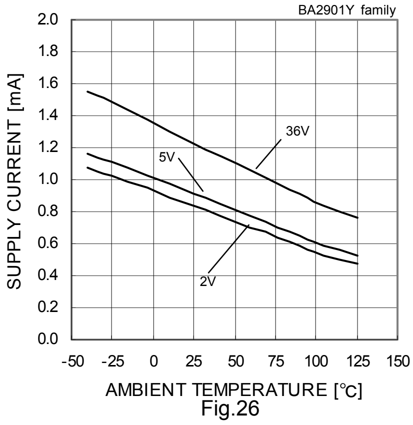


Fig.26
Supply Current – Ambient Temperature

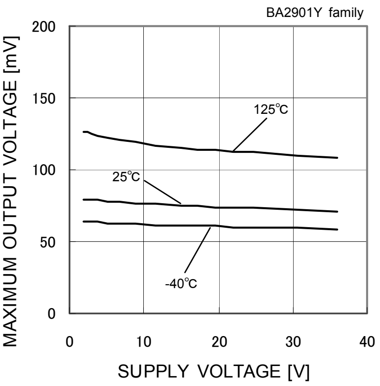


Fig.27
Maximum Output Voltage – Supply Voltage
(IOL=4[mA])

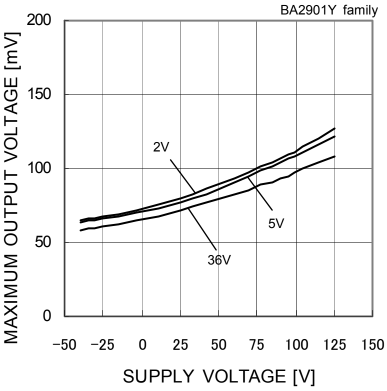


Fig.28
Maximum Output Voltage – Supply Voltage
(IOL=4[mA])

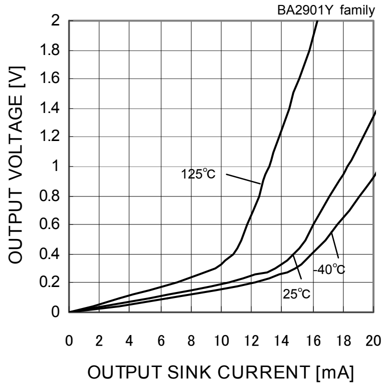


Fig.29
Output Voltage – Output Sink Current
(VCC=5[V])

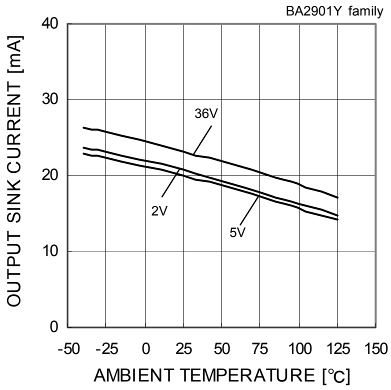


Fig.30
Output Sink Current – Ambient Temperature
(VOUT=1.5[V])

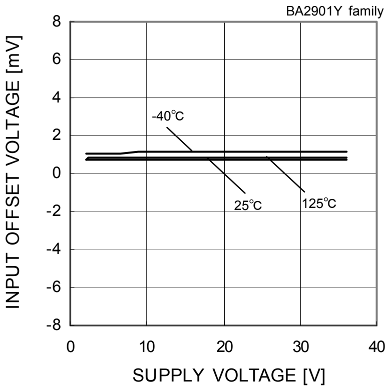


Fig.31
Input Offset Voltage – Supply Voltage

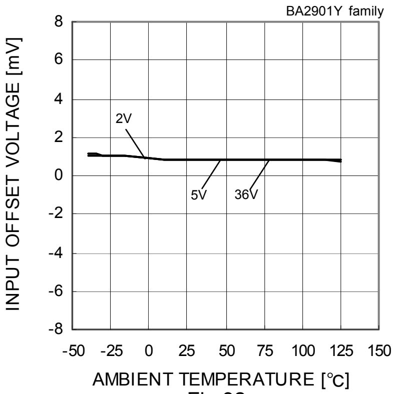


Fig.32
Input Offset Voltage – Ambient Temperature

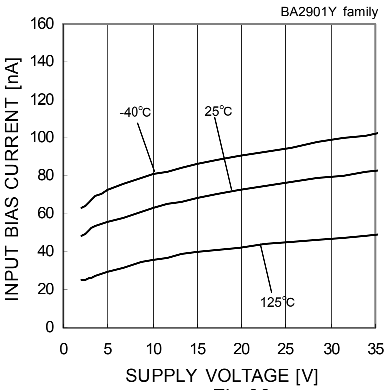


Fig.33
Input Bias Current – Supply Voltage

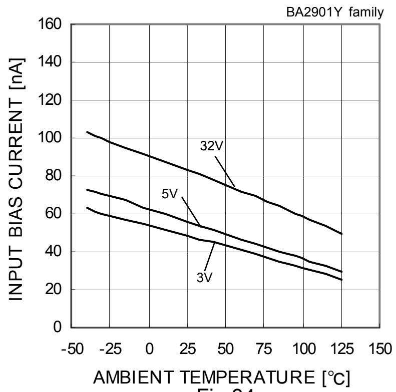


Fig.34
Input Bias Current – Ambient Temperature

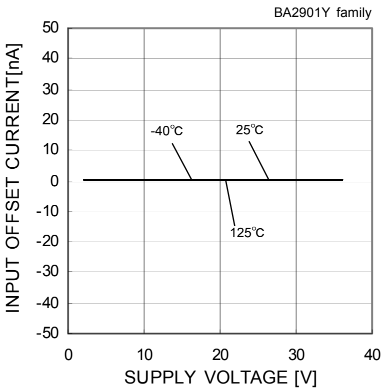


Fig.35
Input Offset Current – Supply Voltage

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

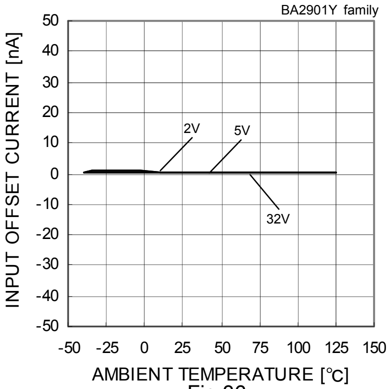


Fig.36
Input Offset Current
– Ambient Temperature

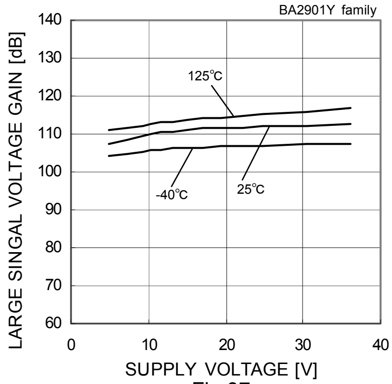


Fig.37
Large Signal Voltage Gain
– Supply Voltage

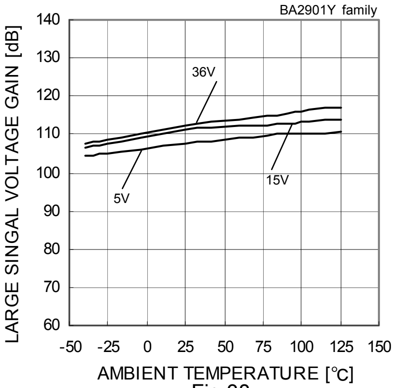


Fig.38
Large Signal Voltage Gain
– Ambient Temperature

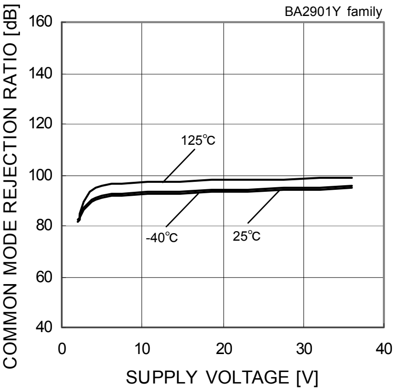


Fig.39
Common Mode Rejection Ratio
– Supply Voltage

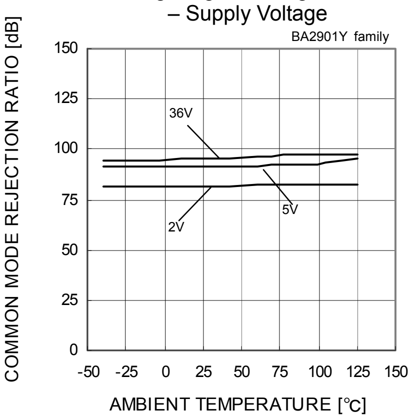


Fig.40
Power Supply Rejection Ratio
– Ambient Temperature

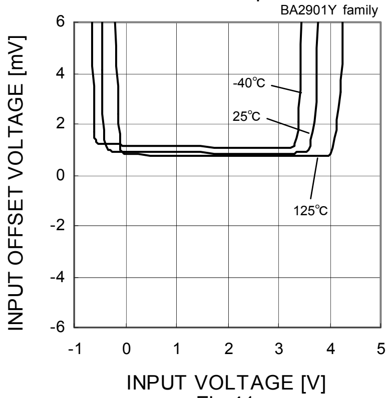


Fig.41
Input Offset Voltage – Input Voltage
(VCC=5[V])

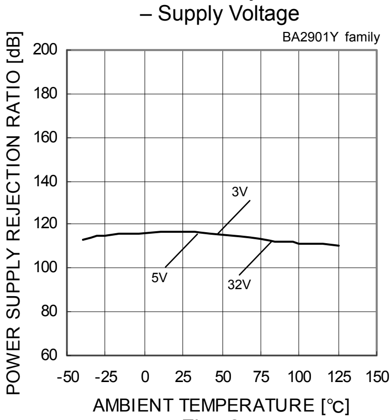


Fig.42
Power Supply Rejection Ratio
– Ambient Temperature

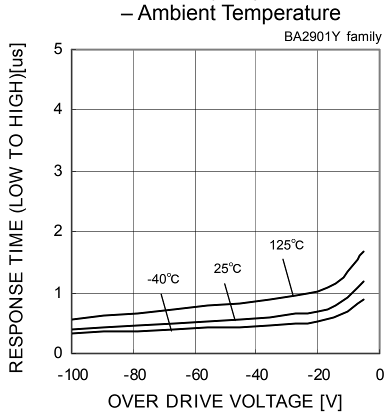


Fig.43
Response Time (Low to High)– Over Drive Voltage
(VCC=5[V],VRL=5[V],RL=5.1[kΩ])

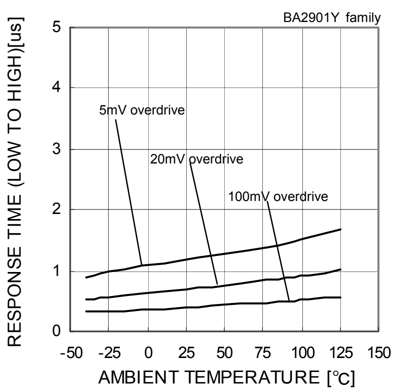


Fig.44
Response Time (Low to High)
– Ambient Temperature
(VCC=5[V],VRL=5[V],RL=5.1[kΩ])

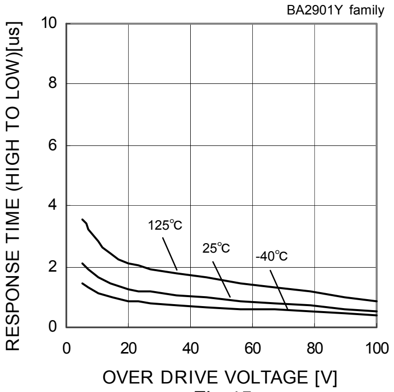


Fig.45
Response Time (High to Low)
– Over Drive Voltage
(VCC=5[V],VRL=5[V],RL=5.1[kΩ])

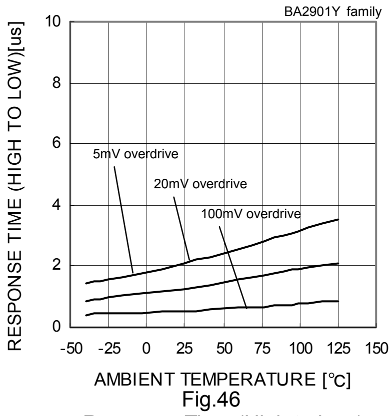
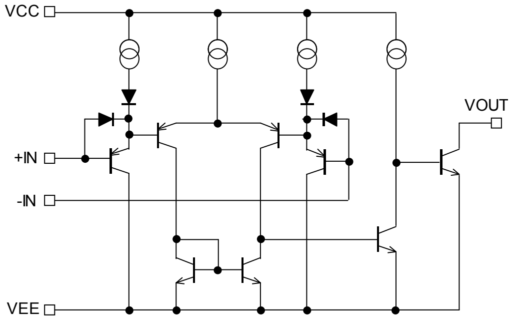


Fig.46
Response Time (High to Low)
– Ambient Temperature
(VCC=5[V],VRL=5[V],RL=5.1[kΩ])

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

●Circuit Diagram




BA2903Y / BA2901Y Schematic Diagram
Fig.47 Schematic Diagram (one channel only )

●Test Circuit 1 Null Method

VCC,VEE,EK,Vicm Unit : [V]

| Parameter | VF | S1 | S2 | S3 | BA2903Y family BA2901Y family | | | | Calculation |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Vcc | VEE | EK | Vicm | |
| 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)

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

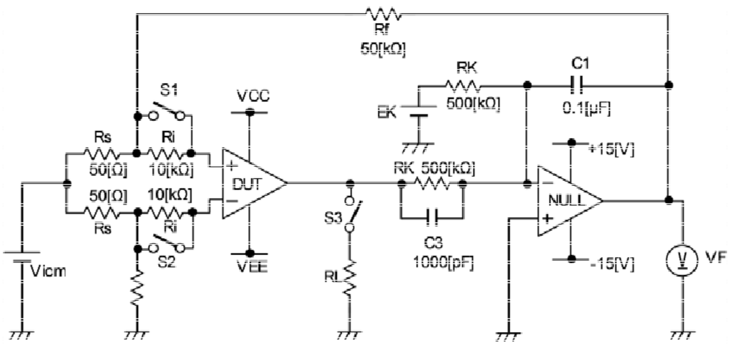



Fig.48 Test circuit1 (one channel only)

●Test Circuit 2: Switch Condition

| 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=1.5[V] | OFF | ON | ON | OFF | OFF | OFF | ON |
| Saturation Voltage | IOL=4[mA] | OFF | ON | ON | OFF | ON | ON | OFF |
| Output Leakage Current | VOH=36[V] | OFF | ON | ON | OFF | OFF | OFF | ON |
| Response Time | RL=5.1[kΩ], VRL=5[V] | ON | OFF | ON | ON | OFF | OFF | OFF |

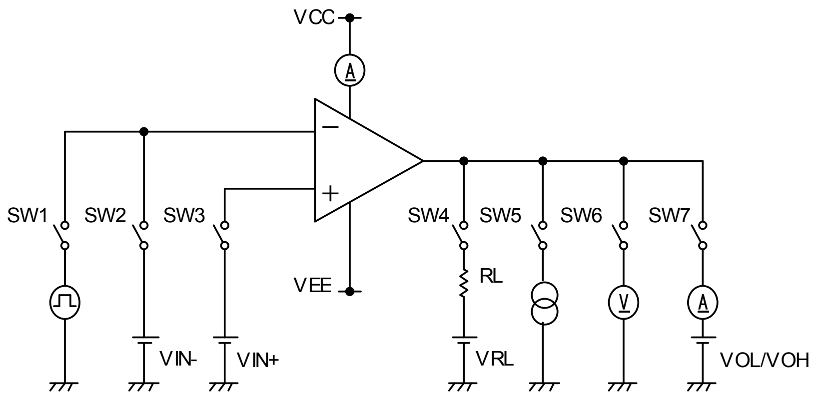



Fig.49 Test Circuit 2 (one channel only)

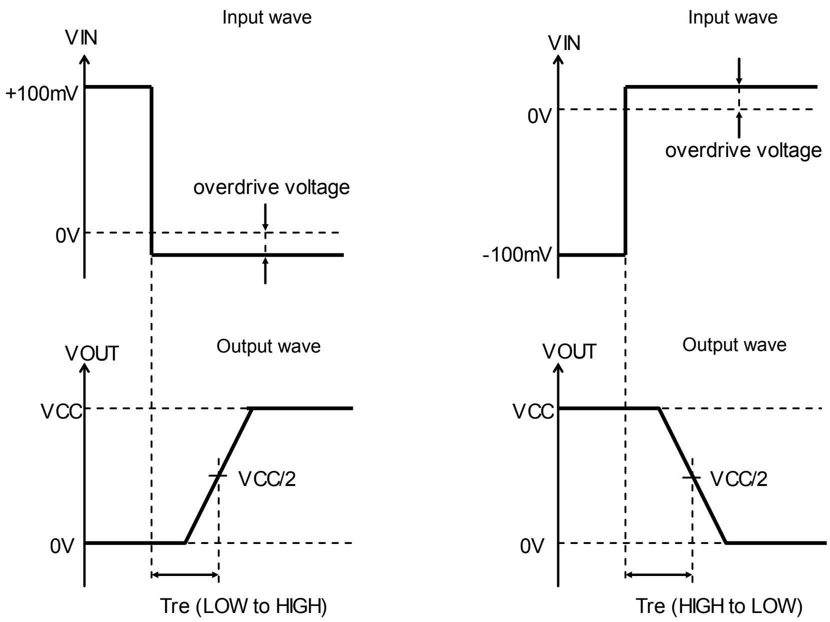
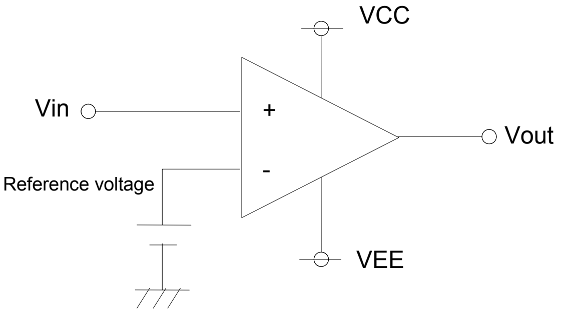
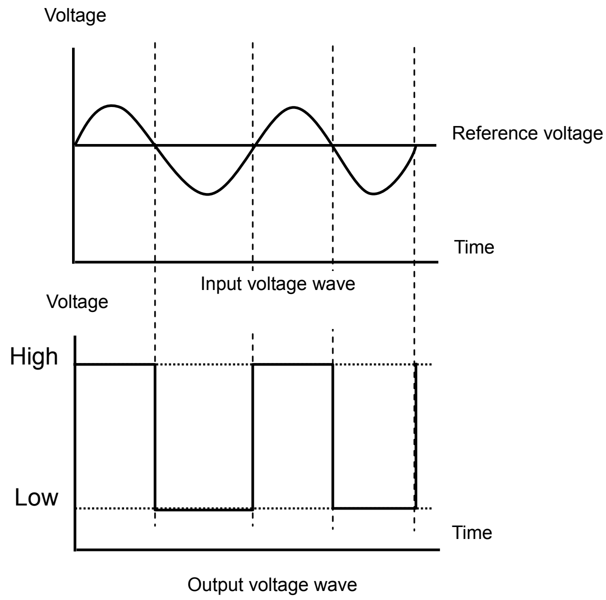



Fig.50 Response Time

●Example of circuit

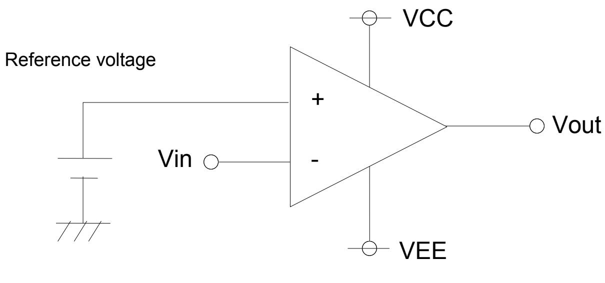
○Reference voltage is Vin-

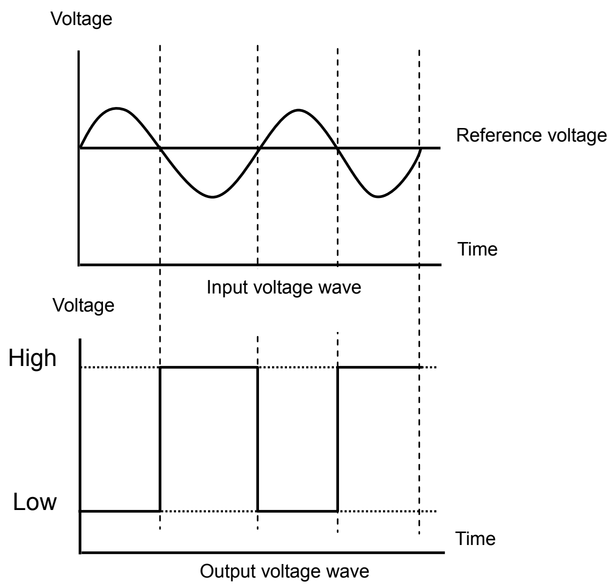



While input voltage is bigger than reference voltage, output voltage is high. While input voltage is smaller than reference voltage, output voltage is low.

○Reference voltage is Vin+



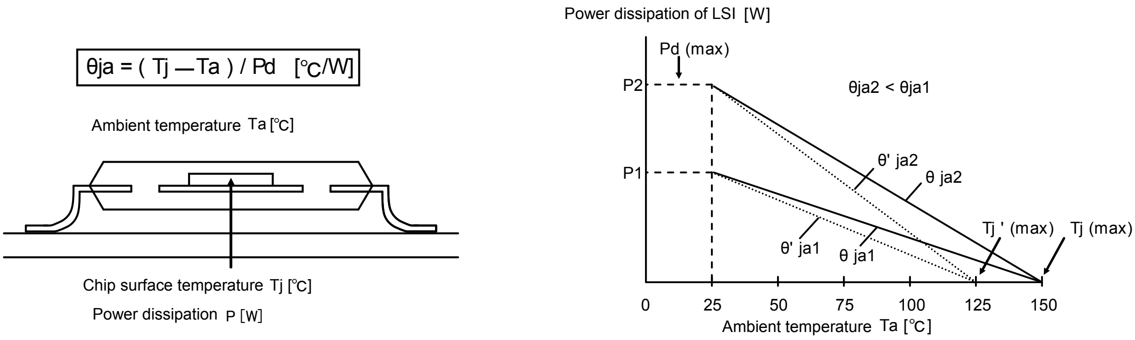

While input voltage is smaller than reference voltage, output voltage is high. While input voltage is bigger than reference voltage, output voltage is low.

## ●Derating curves

Power dissipation(total loss) indicates the power that can be consumed by IC at Ta=25℃(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 θja[℃/W].The temperature of IC inside the package can be estimated by this thermal resistance. Fig.51(a) shows the model of thermal resistance of the package. Thermal resistance θja, ambient temperature Ta, junction temperature Tj, and power dissipation Pd can be calculated by the equation below

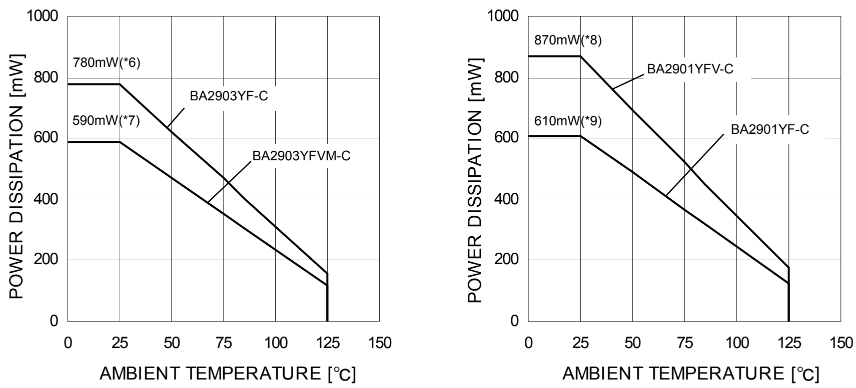
$$\theta ja = (Tj - Ta) / Pd \quad [℃/W] \quad \cdot\cdot\cdot\cdot\cdot \quad (\mathrm{I})$$

Derating curve in Fig.51(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 θja. Thermal resistance θja 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. Fig.52(c),(d) show a derating curve for an example of BA2903Y, BA2901Y.




(a) Thermal resistance (b) Derating curve

Fig.51 Thermal resistance and derating curve




(c) BA2903Y family (d) BA2901Y family

| (*6) | (*7) | (*8) | (*9) | Unit |
|---|---|---|---|---|
| 6.2 | 4.8 | 7.0 | 4.9 | [mW/℃] |

When using the unit above Ta=25[℃], subtract the value above per degree[℃].
Permissible dissipation is the value when FR4 glass epoxy board 70[mm]×70[mm]×1.6[mm](cooper foil area below 3[%]) is mounted.

Fig. 52 Derating curve

●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 power 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 electrical characteristics or damage to the IC itself. Normal operation is not guaranteed within the input common-mode voltage range of the maximum ratings – use within the input common-mode voltage range of the electric characteristics instead.

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 a particular mounted board at ambient temperature (25℃).
For packaged products, Pd is determined by maximum junction temperature and the thermal resistance.

2.Electrical characteristics

2.1 Input offset voltage (Vio)
Signifies the voltage difference between the non-inverting and inverting terminals. It can be thought of as the input voltage difference required for setting the output voltage to 0V.

2.2 Input offset current (Iio)
Indicates the difference of the input bias current between the non-inverting and inverting terminals.

2.3 Input bias current (Ib)
Denotes the current that flows into or out of the input terminal, it is defined by the average of the input bias current at the non-inverting terminal and the input bias current at the inverting terminal.

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

2.5 Large signal voltage gain (AV)
The amplifying rate (gain) of the output voltage against the voltage difference between the non-inverting and inverting terminals, it is (normally) the amplifying rate (gain) with respect to DC voltage.
AV = (output voltage fluctuation) / (input offset fluctuation)

2.6 Circuit current (ICC)
Indicates the current of the IC itself that flows under specific conditions and during no-load steady state.

2.7 Output sink current (IOL)
Denotes the maximum current that can be output under specific output conditions.

2.8 Output saturation voltage low level output voltage (VOL)
Signifies the voltage range that can be output under specific 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.

2.10 Response time (Tre)
The interval between the application of input and output conditions.

●Notes for use

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

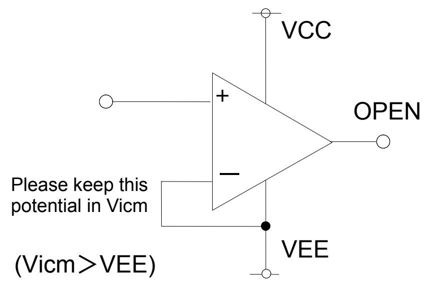



Fig. 53 Disable circuit example

2) Input terminal voltage
Applying VEE + 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.

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

4) Power dissipation Pd
Using the unit in excess of the rated power dissipation may cause deterioration in electrical characteristics due to a rise in chip temperature, including reduced current capability. 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
Incorrect mounting may damage the IC. In addition, the presence of foreign particles between the outputs, the output and the power supply, or the output and GND may result in IC destruction.

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
Operation in a strong electromagnetic field may cause malfunctions.

8) Radiation
This IC is not designed to withstand radiation.

9) IC handing
Applying mechanical stress to the IC by deflecting or bending the board may cause fluctuations in the electrical characteristics due to piezoelectric (piezo) effects.

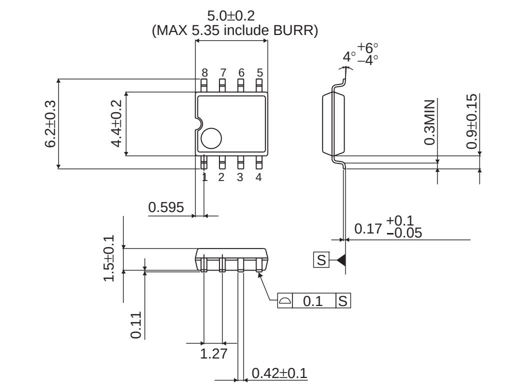
10) Board inspection
Connecting a capacitor to a pin with low impedance may stress the IC. Therefore, discharging the capacitor after every process is recommended. In addition, when attaching and detaching the jig during the inspection phase, ensure that the power is turned off before inspection and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

●Ordering part number

| B | A | 2 | 9 | 0 | 1 | Y | F | V | - | C | E | 2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

| Part No. | Part No. | Package | Automotive series | Packaging and forming specification |
|---|---|---|---|---|
| | 2903Y<br>2901Y | F : SOP8<br>SOP14<br>FV : SSOP-B14<br>FVM : MSOP8 | | E2: Embossed tape and reel<br>(SOP8/SOP14/ SSOP-B14)<br>TR: Embossed tape and reel<br>(MSOP8) |

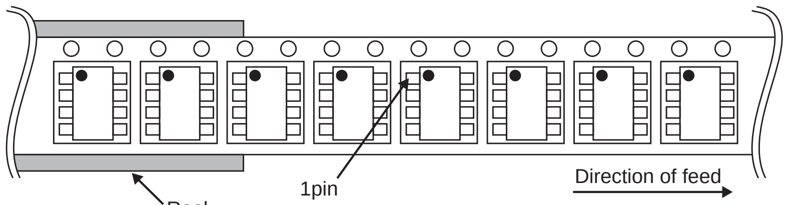
## SOP8




(Unit : mm)

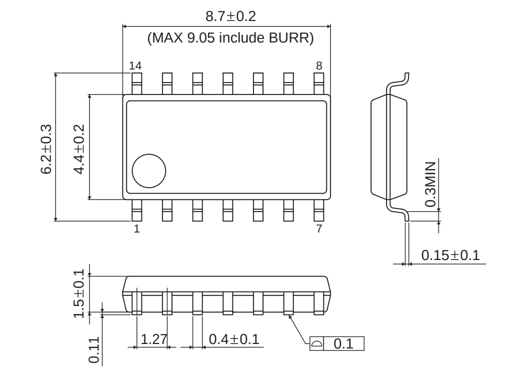
<Tape and Reel information>

| 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.

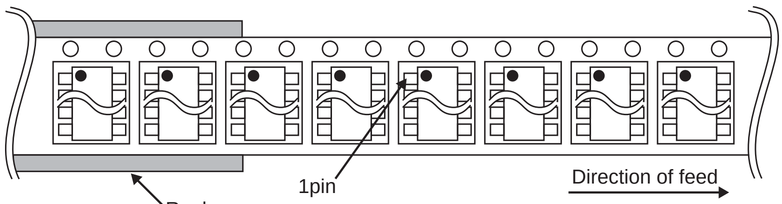
## SOP14




(Unit : mm)

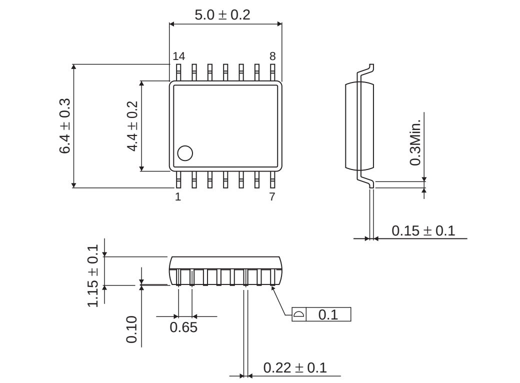
<Tape and Reel information>

| 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.

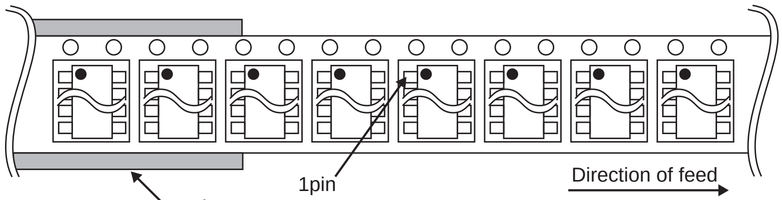
## SSOP-B14




(Unit : mm)

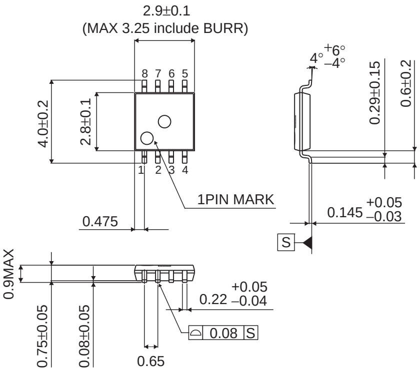
<Tape and Reel information>

| 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.

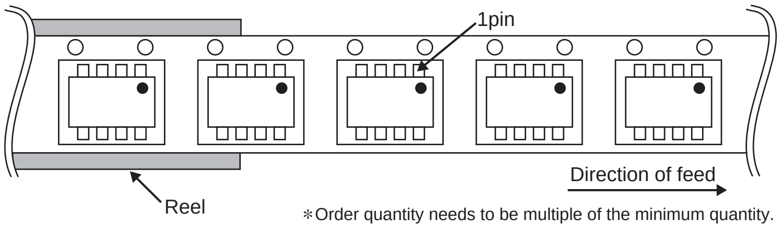
## MSOP8




(Unit : mm)

<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.

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