Comparator series

Automotive
Ground Sense Comparators

BA2903Yxxx-M, BA2901Yxx-M

●General Description

Automotive series BA2903Yxxx-M/BA2901Yxx-M, integrate two or four independent high gain voltage comparator.

Some features are the wide operating voltage that is 2 to 36V and low supply current. BA2903Yxxx-M, BA2901Yxx-M are manufactured for automotive requirements of car navigation system, car audio, etc.

.

●Features

- Operable with a single power supply
- Wide operating supply voltage
- Standard comparator pin-assignments
- Input and output are operable ground sense
- Internal ESD protection circuit
- Wide temperature range

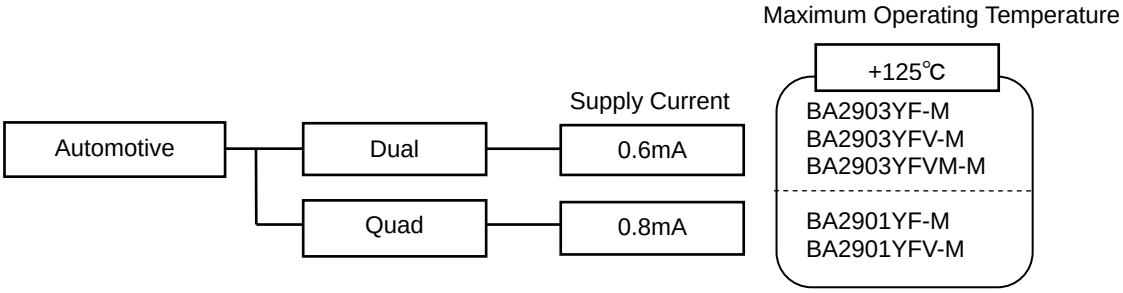
●Key Specifications

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

●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



●Block Diagram

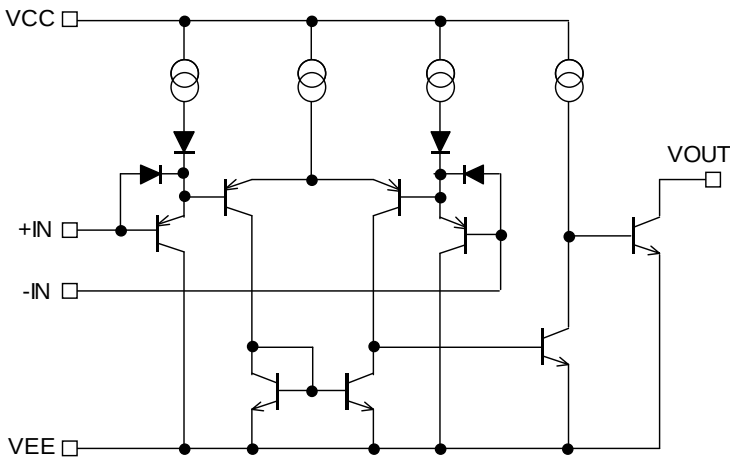
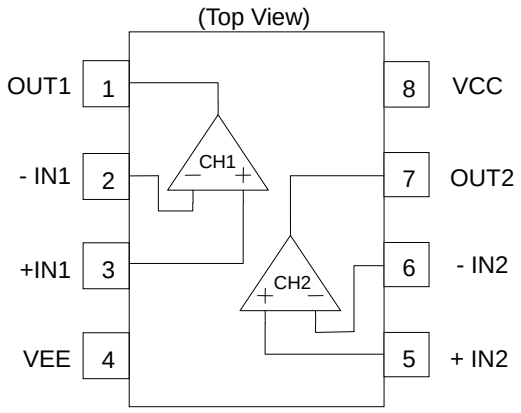


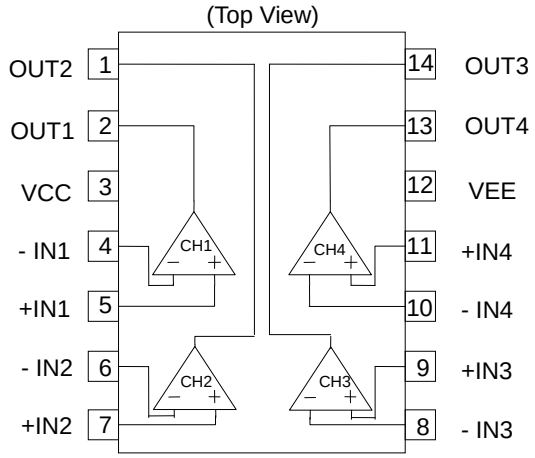
Fig.1 Simplified schematic (one channel only)

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

● **Pin Configuration**



SOP8 **SSOP-B8** **MSOP8**



SOP14 **SSOP-B14**

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

●**Ordering Information**

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

Part Number
BA2903Yxxx
BA2901Yxx

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

Packaging and forming specification
E2: Embossed tape and reel
(SOP8/SOP14/
SSOP-B8/SSOP-B14)
TR: Embossed tape and reel
(MSOP8)
M: Automotive (car navigation system, car audio, etc.)

●**Line-up**

Topr	**Operating Supply Voltage**	**Dual/Quad**	**Package**		**Orderable Part Number**
-40℃ to +125℃	+2.0V ~ +36V	Dual	SOP8	Reel of 2500	BA2903YF-ME2
			SSOP-B8	Reel of 2500	BA2903YFV-ME2
			MSOP8	Reel of 3000	BA2903YFVM-MTR
		Quad	SOP14	Reel of 2500	BA2901YF-ME2
			SSOP-B14	Reel of 2500	BA2901YFV-ME2

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

Parameter	Symbol		Ratings	Unit
Supply Voltage	VCC-VEE		+36	V
Power dissipation	Pd	SOP8	780[1*6]	mW
		SSOP-B8	690[*2*6]	
		MSOP8	590[3*6]	
		SOP14	610[*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
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.

●Electrical Characteristics

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

Parameter	Symbol	Temperature range	Limits			Unit	Conditions
			Min.	Typ.	Max.		
Input Offset Voltage *8	Vio	25℃	-	2	7	mV	VOUT=1.4V
		Full range	-	-	15		VCC=5 to 36V, VOUT=1.4V
Input Offset Current *8	Iio	25℃	-	5	50	nA	VOUT=1.4V
		Full range	-	-	200		
Input Bias Current *8	Ib	25℃	-	50	250	nA	VOUT=1.4V
		Full range	-	-	500		
Input Common-mode Voltage Range	Vicm	25℃	0	-	VCC-1.5	V	-
Large Signal Voltage Gain	AV	25℃	88	100	-	dB	VCC=15V, VOUT=1.4 to 11.4V RL=15kΩ, VRL=15V
		Full range	74	-	-		
Supply Current	ICC	25℃	-	0.6	1	mA	VOUT=open
		Full range	-	-	2.5		VOUT=open, VCC=36V
Output Sink Current *9	IOL	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 IOL=4mA
		Full range	-	-	700		
Output Leakage Current (High level output voltage)	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=5.1[kΩ],VRL=5[V], VIN=100[mVp-p], overdrive=5[mV]
		Full range	-	0.4	-		RL=5.1[kΩ],VRL=5[V],VIN=TTL Logic Swing, VREF=1.4[V]

*8 Absolute value

*9 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-M (Unless otherwise specified VCC=+5V, VEE=0V)

Parameter	Symbol	Temperature range	Limits			Unit	Conditions
			Min.	Typ.	Max.		
Input Offset Voltage *10	Vio	25℃	-	2	7	mV	VOUT=1.4V
		Full range	-	-	15		VCC=5 to 36V, VOUT=1.4V
Input Offset Current *10	Iio	25℃	-	5	50	nA	VOUT=1.4V
		Full range	-	-	200		
Input Bias Current *10	Ib	25℃	-	50	250	nA	VOUT=1.4V
		Full range	-	-	500		
Input Common-mode Voltage Range	Vicm	25℃	0	-	VCC-1.5	V	-
Large Signal Voltage Gain	AV	25℃	88	100	-	dB	VCC=15V, VOUT=1.4 to 11.4V RL=15kΩ, VRL=15V
		Full range	74	-	-		
Supply Current	ICC	25℃	-	0.8	2	mA	VOUT=open
		Full range	-	-	2.5		VOUT=open, VCC=36V
Output Sink Current *11	IOL	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 IOL=4mA
		Full range	-	-	700		
Output Leakage Current （High level output voltage）	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=5.1[kΩ],VRL=5[V], VIN=100[mVp-p], overdrive=5[mV]
		Full range	-	0.4	-		RL=5.1[kΩ],VRL=5[V],VIN=TTL Logic Swing, VREF=1.4[V]

*10 Absolute value

*11 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 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.

●Typical Performance Curves

○BA2903Yxxx-M

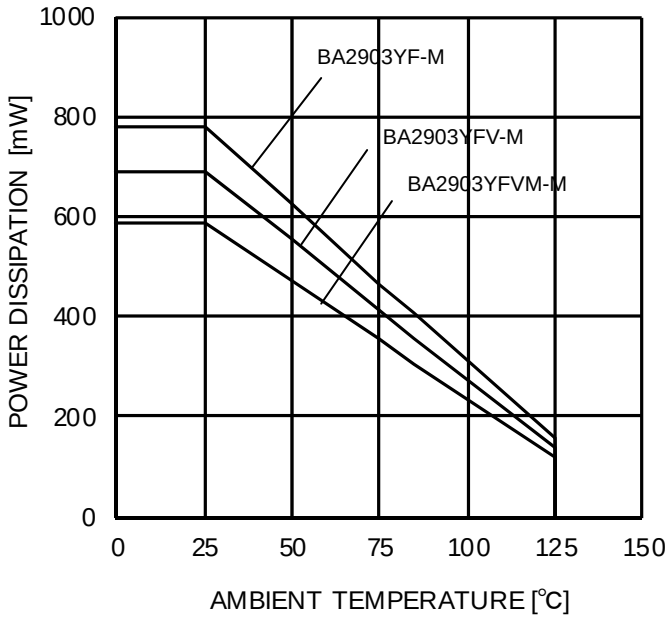


Fig.2
Derating Curve

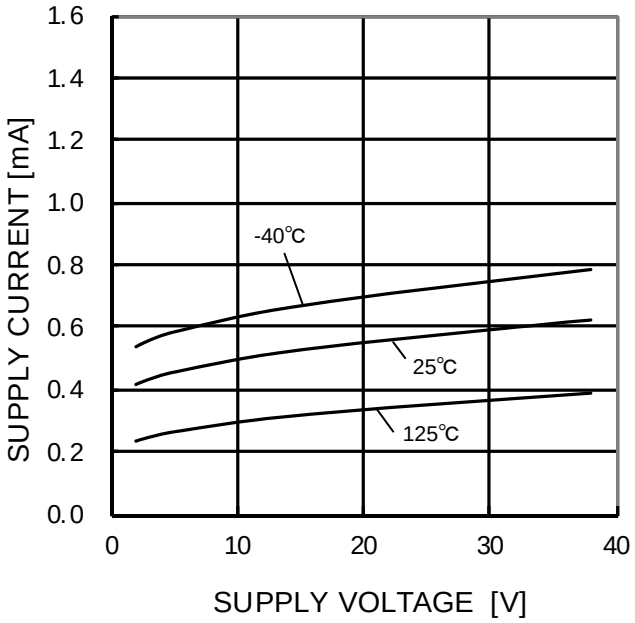


Fig.3
Supply Current – Supply Voltage

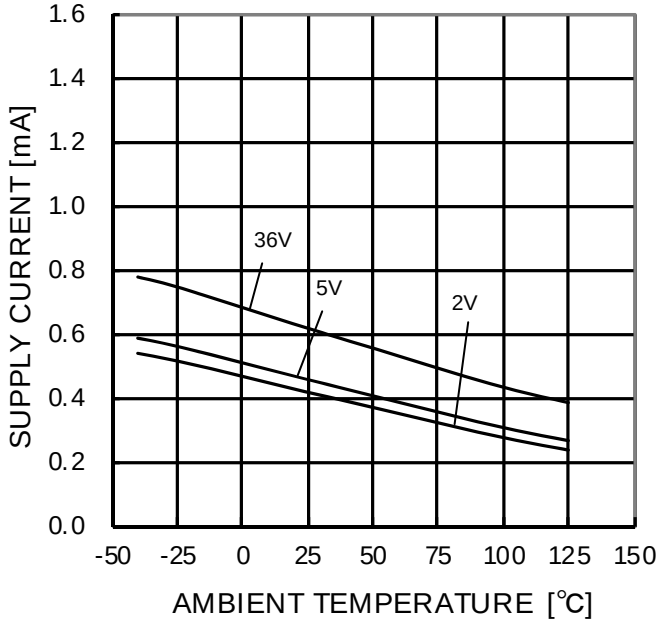


Fig.4
Supply Current – Ambient Temperature

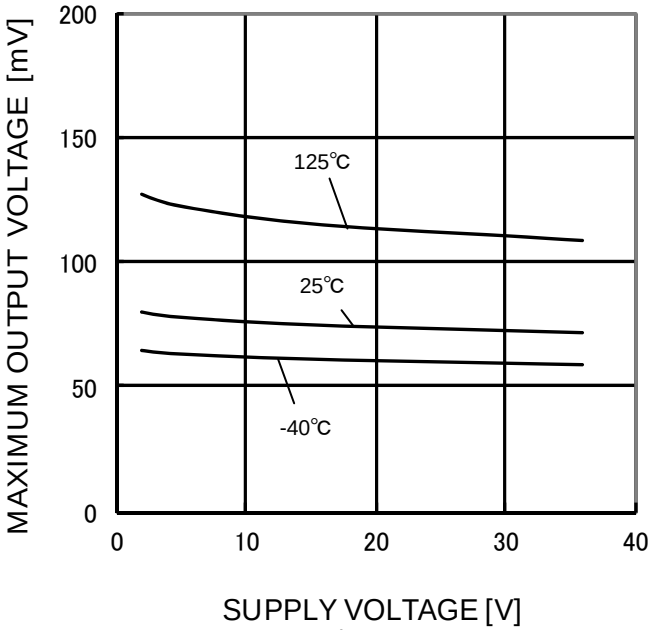


Fig.5
Maximum Output Voltage – Supply Voltage (IOL=4mA)

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

○BA2903Yxxx-M

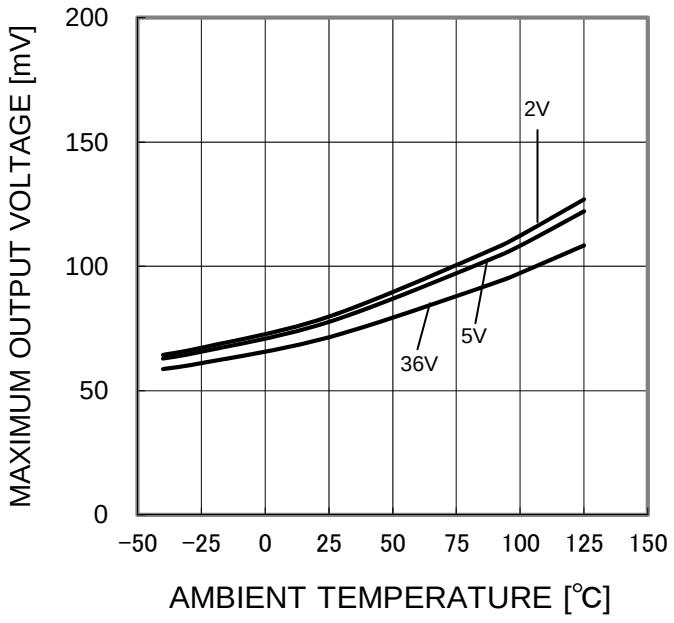


Fig.6
Maximum Output Voltage – Ambient Temperature
(IOL=4mA)

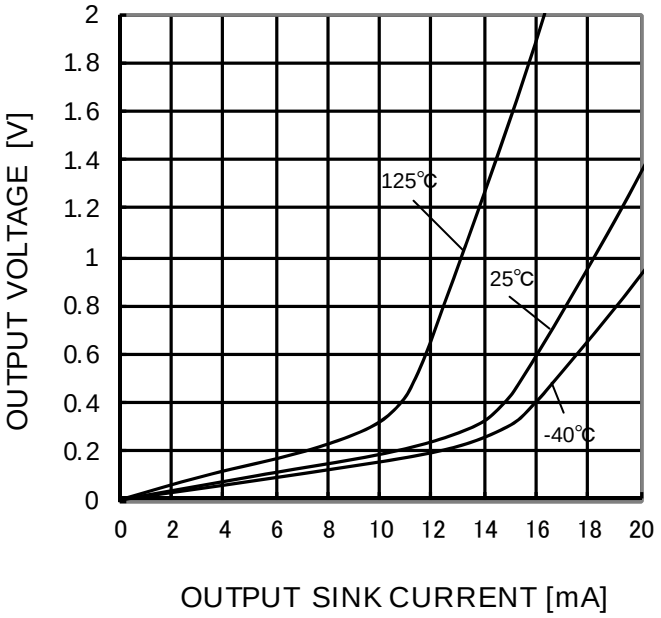


Fig.7
Output Voltage – Output Sink Current
(VCC=5V)

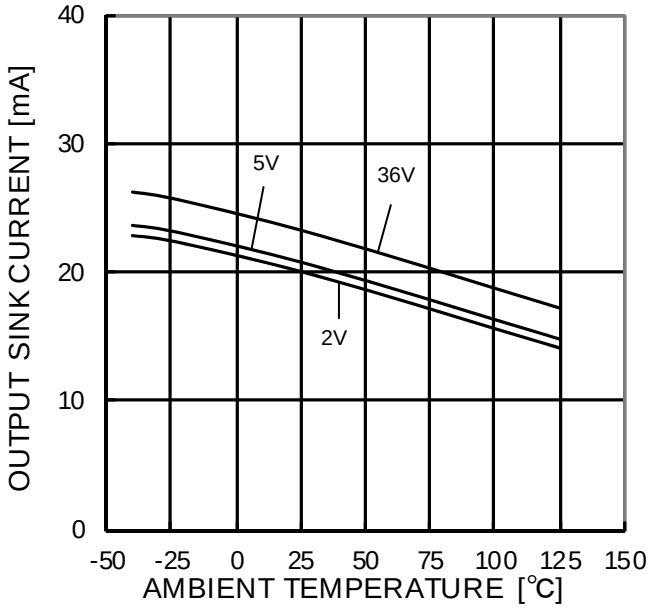


Fig.8
Output Sink Current – Ambient Temperature
(VOUT=1.5V)

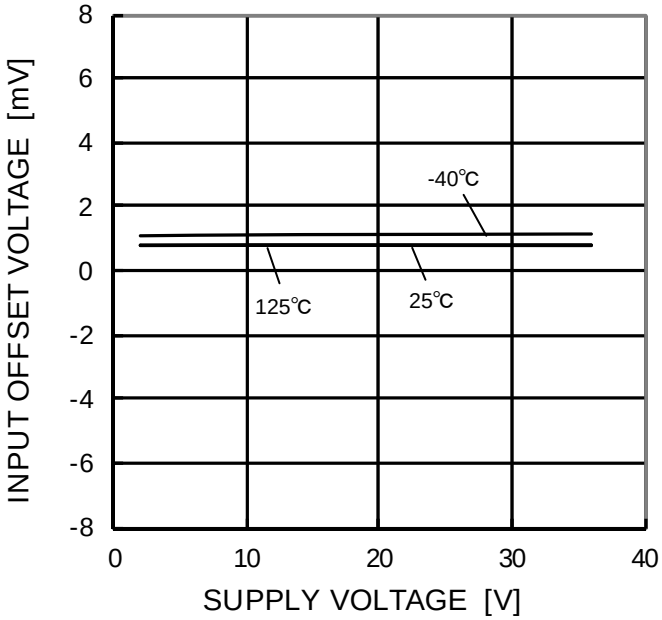


Fig.9
Input Offset Voltage – Supply Voltage

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

○BA2903Yxxx-M

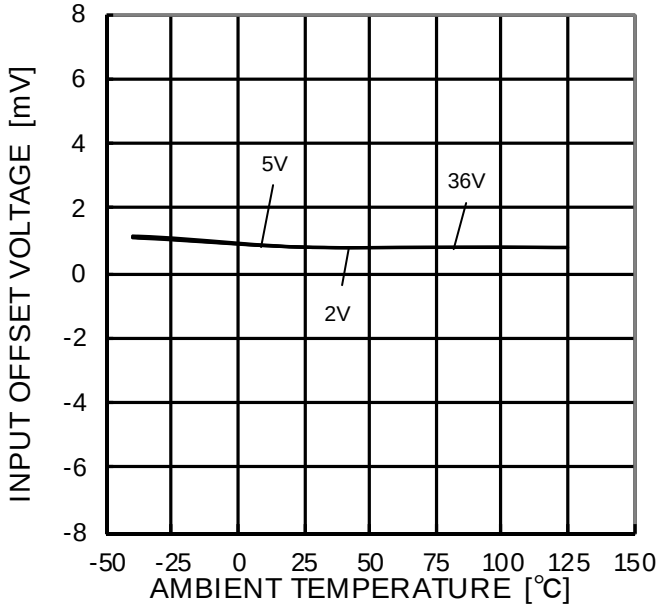


Fig.10
Input Offset Voltage – Ambient Temperature

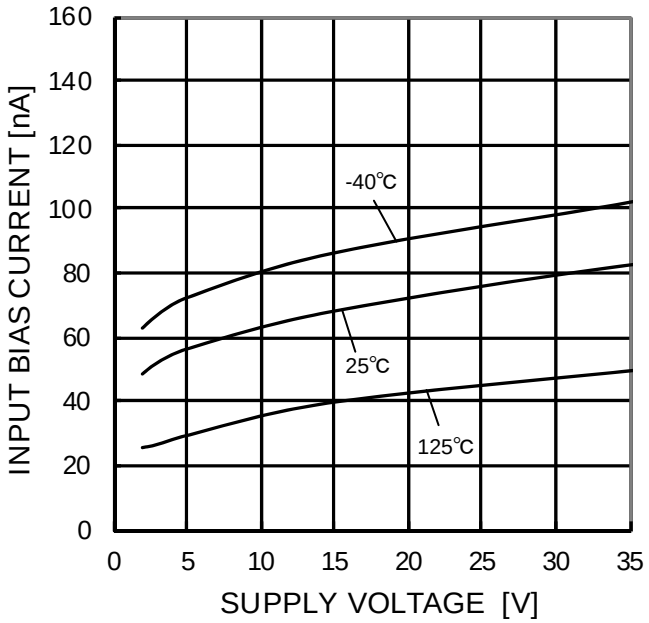


Fig.11
Input Bias Current – Supply Voltage

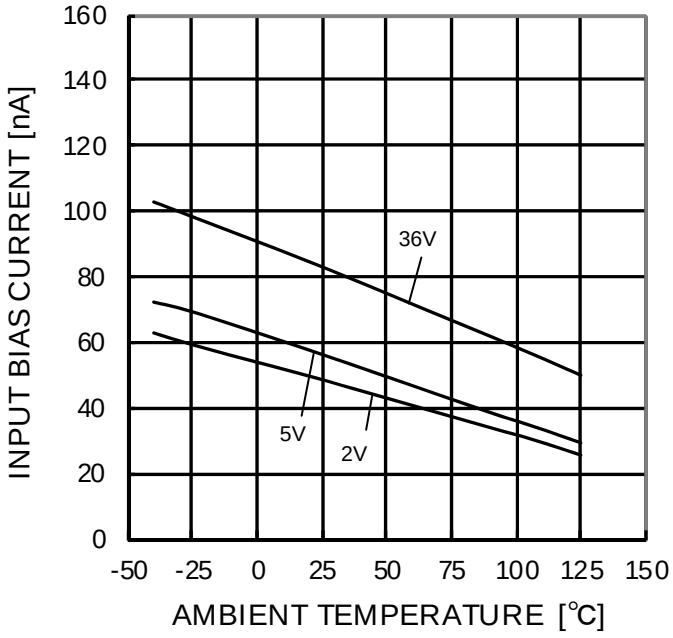


Fig.12
Input Bias Current – Ambient Temperature

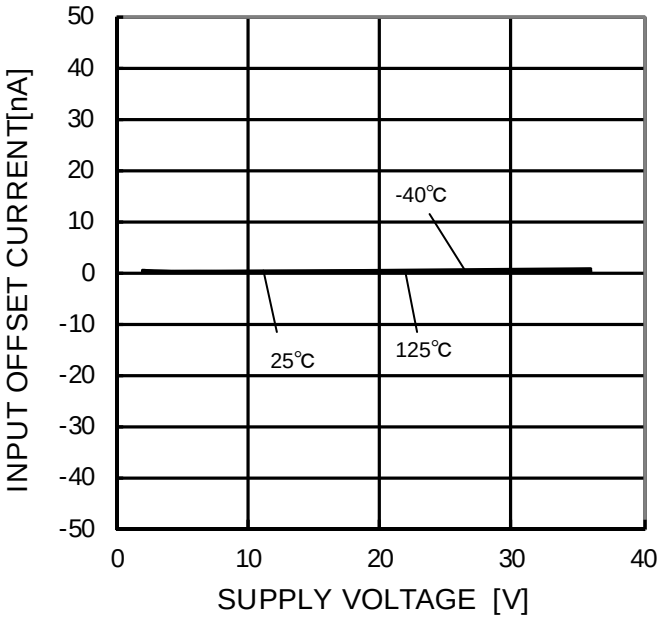


Fig.13
Input Offset Current – Supply Voltage

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

○BA2903Yxxx-M

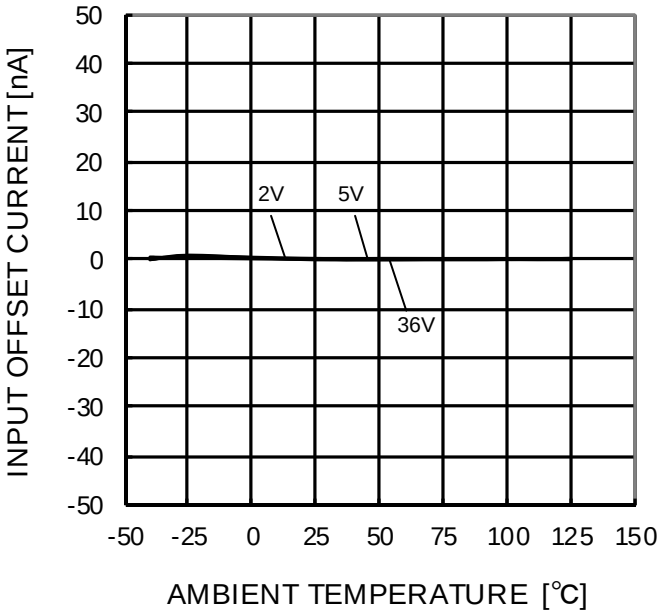


Fig.14
Input Offset Current
– Ambient Temperature

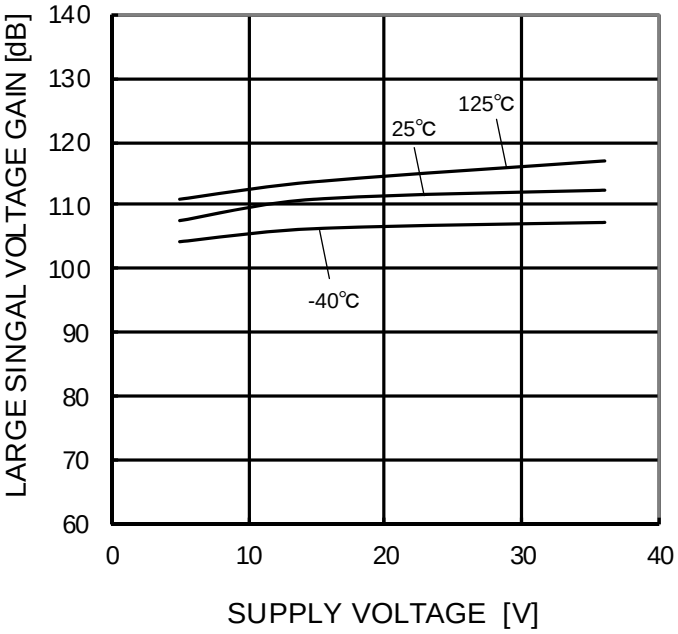


Fig.15
Large Signal Voltage Gain
– Supply Voltage

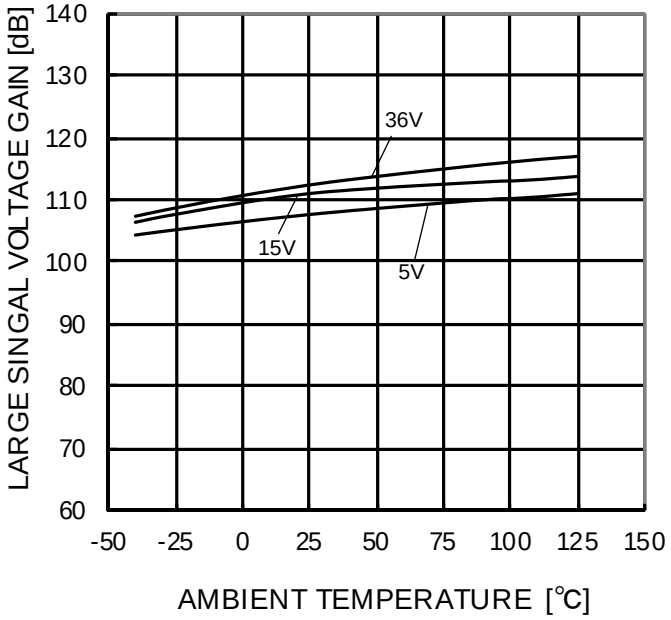


Fig.16
Large Signal Voltage Gain
– Ambient Temperature

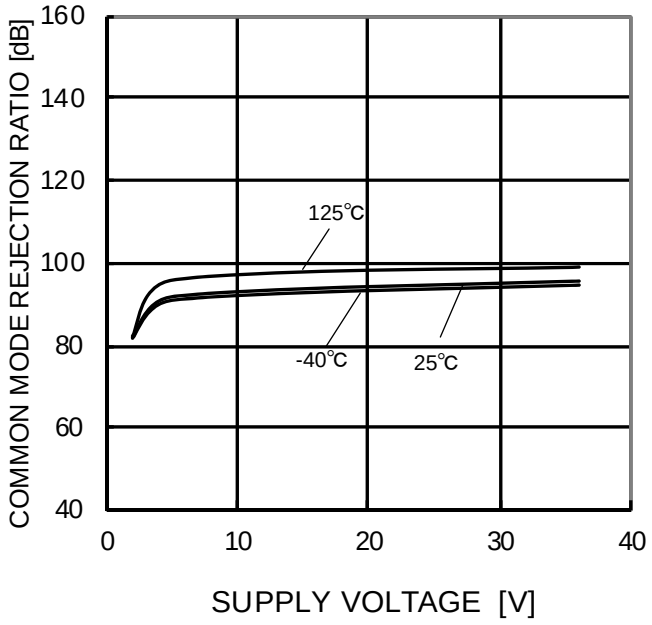


Fig.17
Common Mode Rejection Ratio
– Supply Voltage

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

○BA2903Yxxx-M

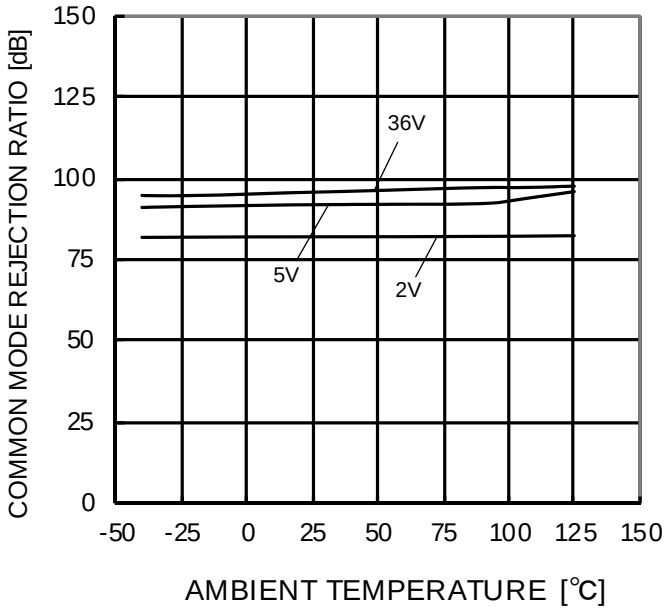


Fig.18
Common Mode Rejection Ratio
– Ambient Temperature

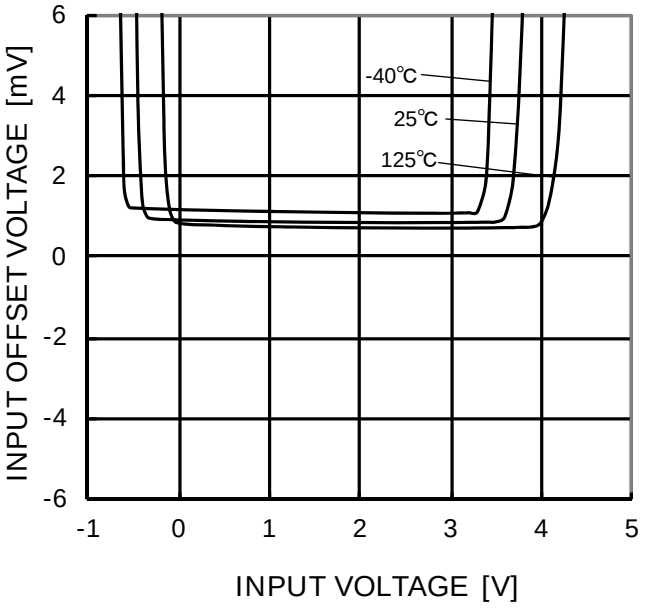


Fig.19
Input Offset Voltage – Input Voltage
(VCC=5V)

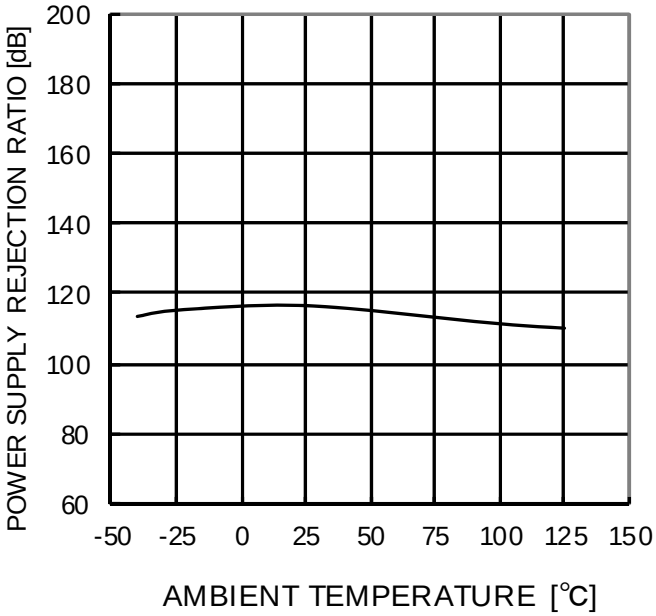


Fig.20
Power Supply Rejection Ratio
– Ambient Temperature

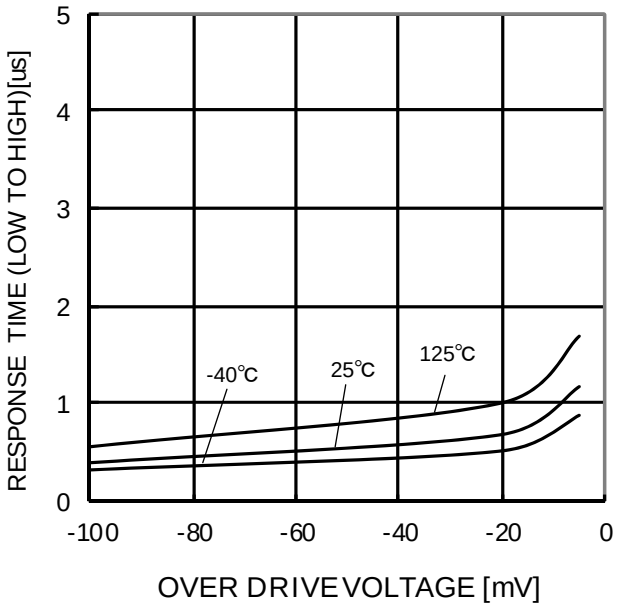


Fig.21
Response Time (Low to High) – Over Drive Voltage
(VCC=5V, VRL=5V, RL=5.1kΩ)

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

○BA2903Yxxx-M

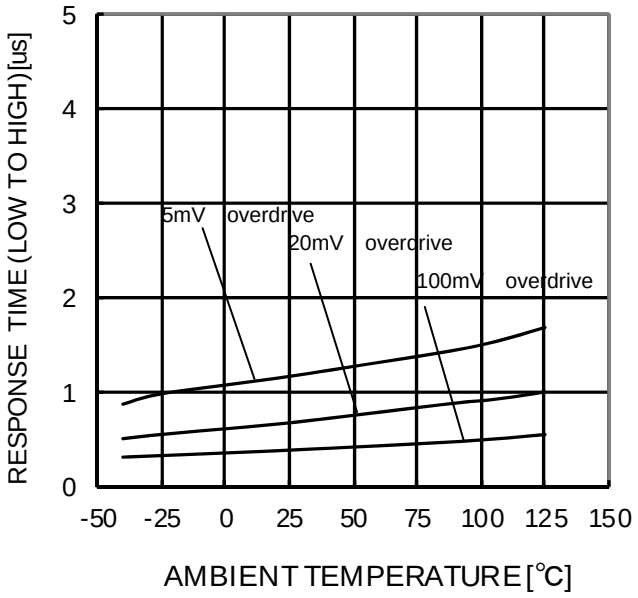


Fig.22
Response Time (Low to High)
– Ambient Temperature (VCC=5V, VRL=5V, RL=5.1kΩ)

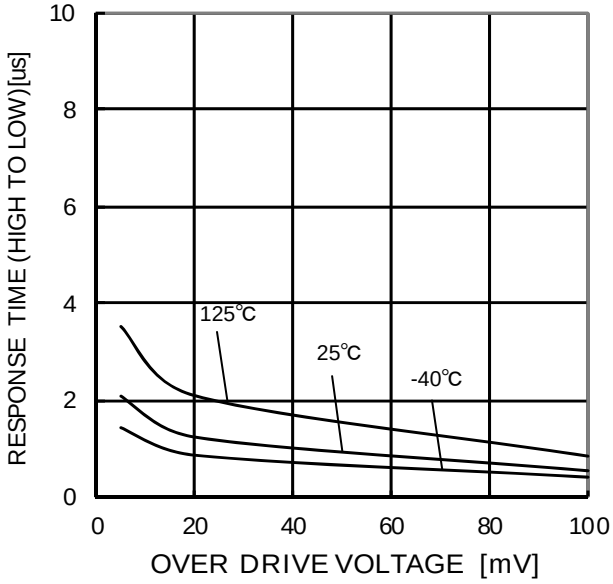


Fig.23
Response Time (High to Low)
– Over Drive Voltage
(VCC=5V, VRL=5V, RL=5.1kΩ)

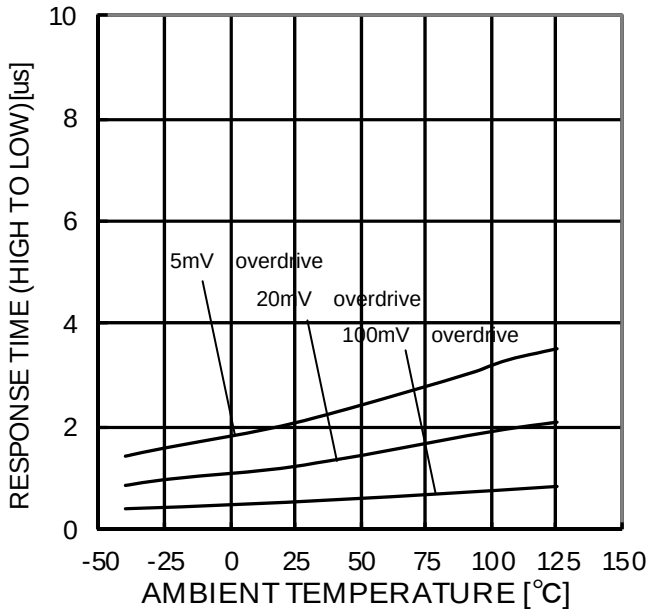


Fig.24
Response Time (High to Low)
– Ambient Temperature
(VCC=5V, VRL=5V, RL=5.1kΩ)

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

○BA2901Yxx-M

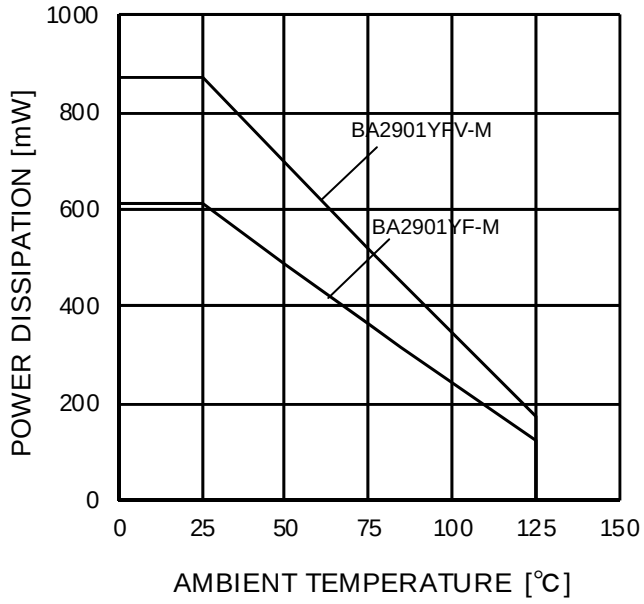


Fig.25
Derating Curve

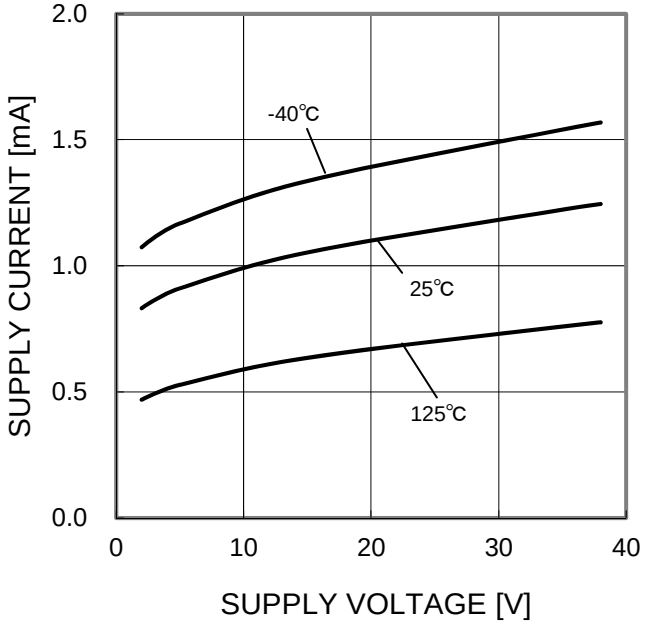


Fig.26
Supply Current – Supply Voltage

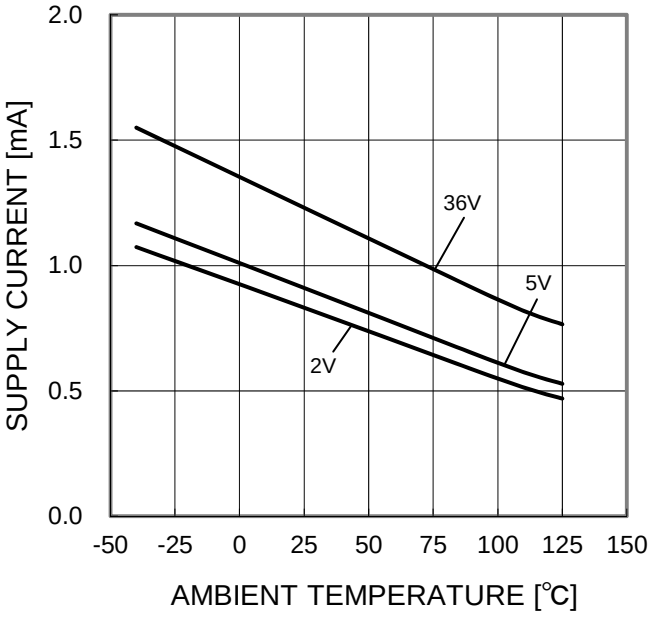


Fig.27
Supply Current – Ambient Temperature

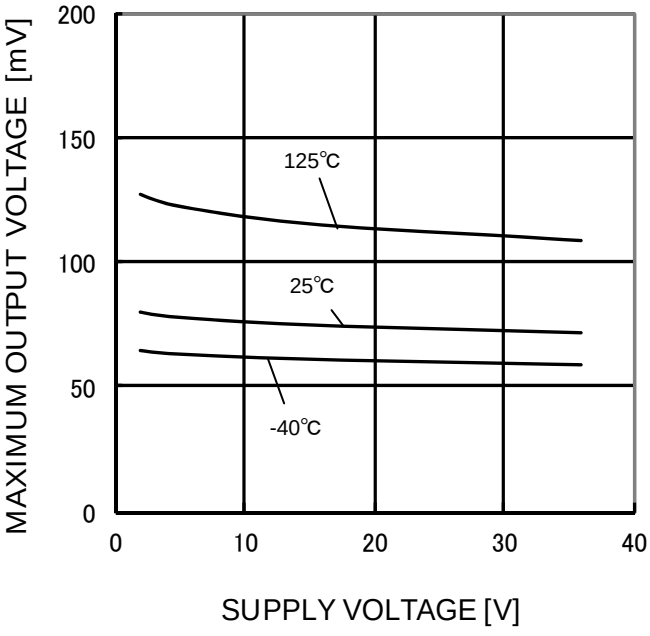


Fig.28
Maximum Output Voltage – Supply Voltage
(IOL=4mA)

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

○BA2901Yxx-M

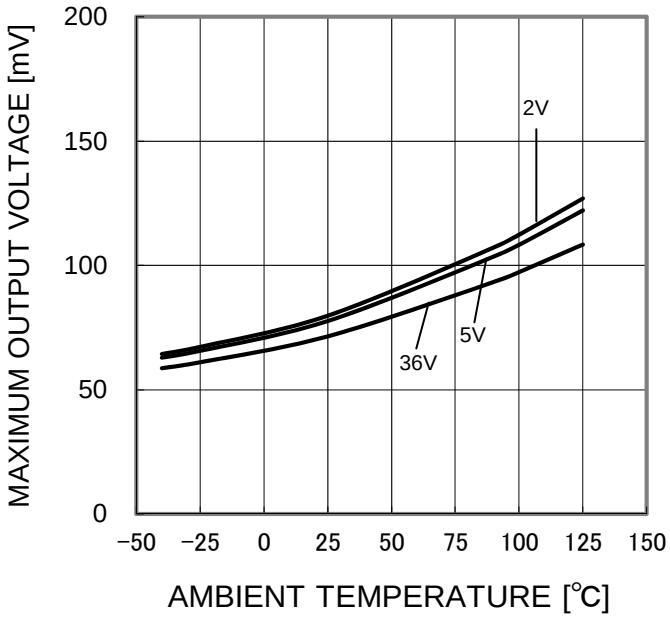


Fig.29
Maximum Output Voltage – Ambient Temperature
(IOL=4mA)

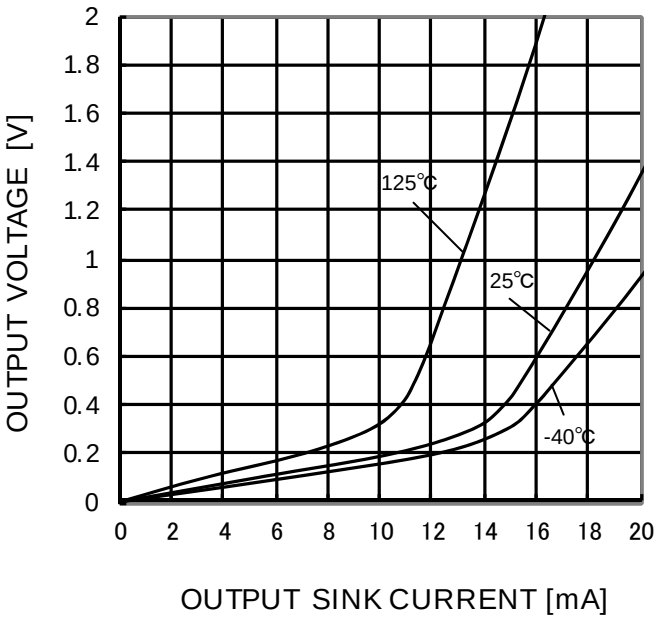


Fig.30
Output Voltage – Output Sink Current
(VCC=5V)

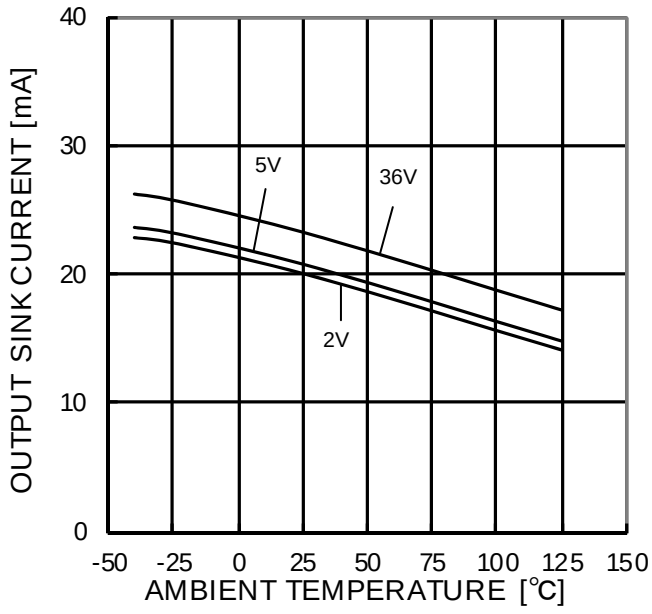


Fig.31
Output Sink Current – Ambient Temperature
(VOUT=1.5V)

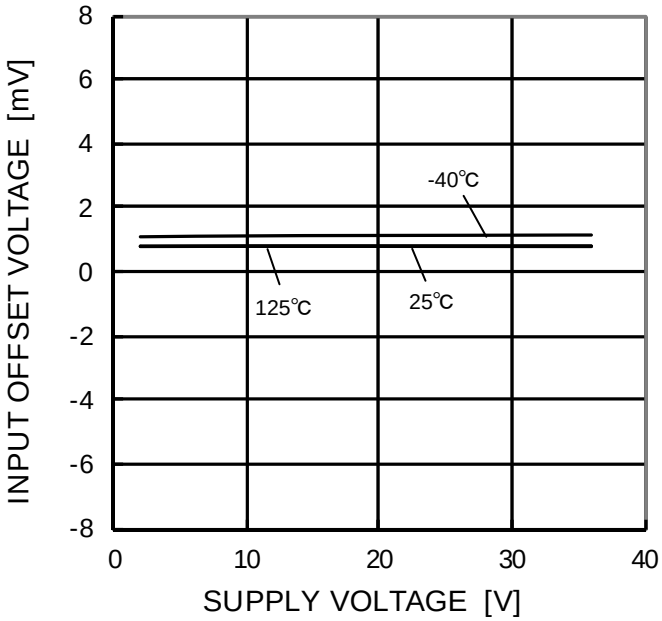


Fig.32
Input Offset Voltage – Supply Voltage

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

○BA2901Yxx-M

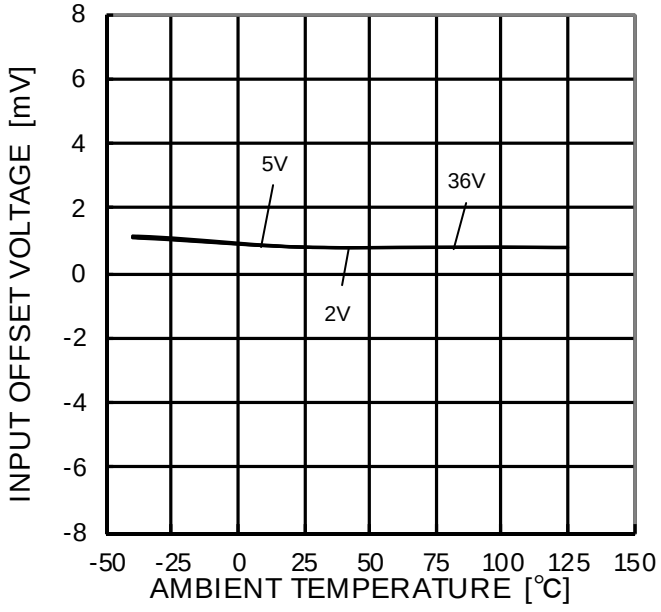


Fig.33
Input Offset Voltage – Ambient Temperature

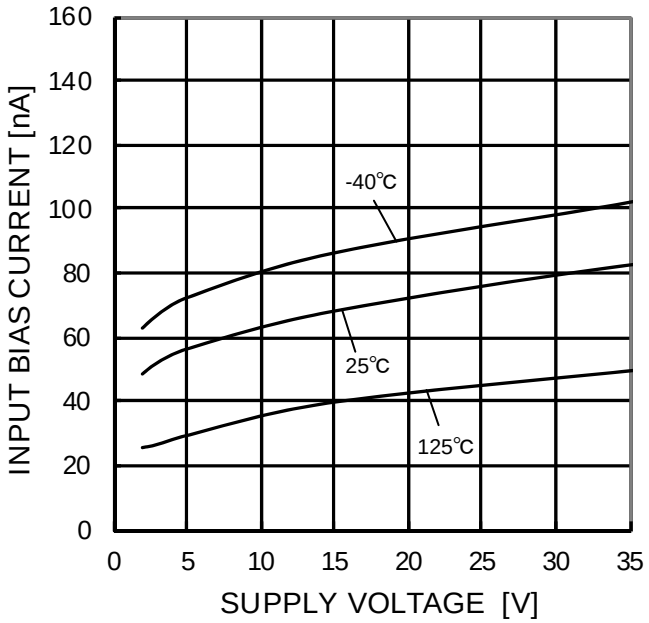


Fig.34
Input Bias Current – Supply Voltage

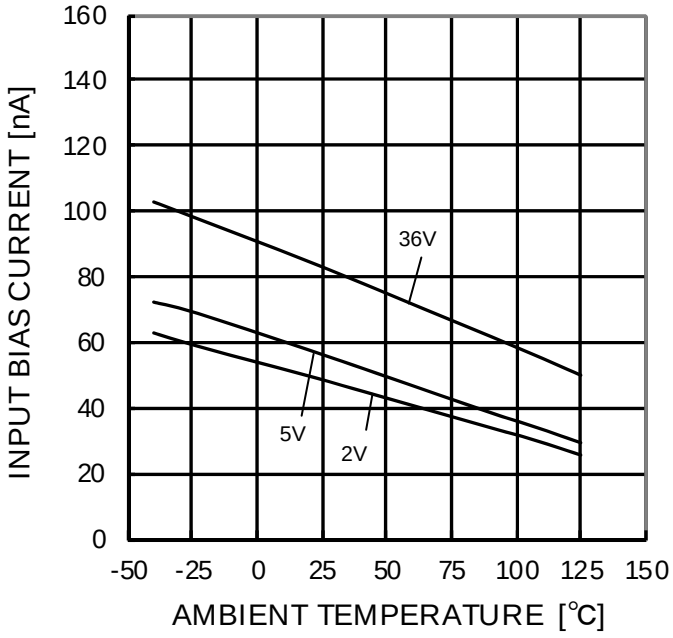


Fig.35
Input Bias Current – Ambient Temperature

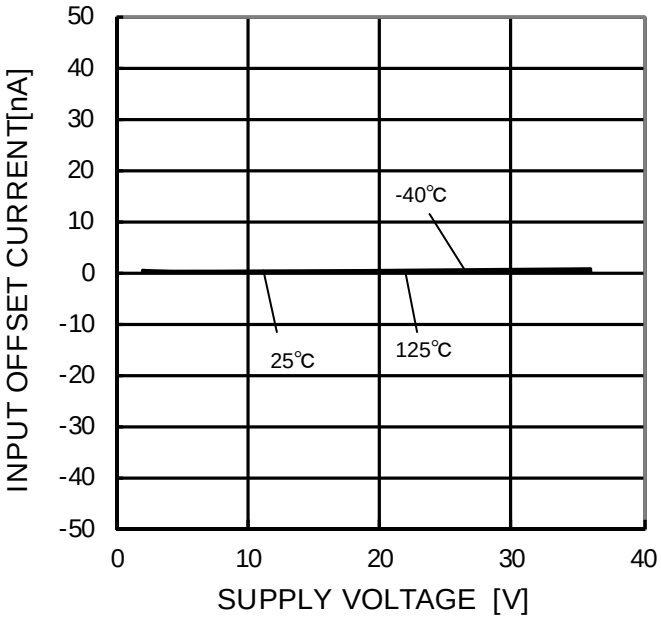


Fig.36
Input Offset Current – Supply Voltage

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

○BA2901Yxx-M

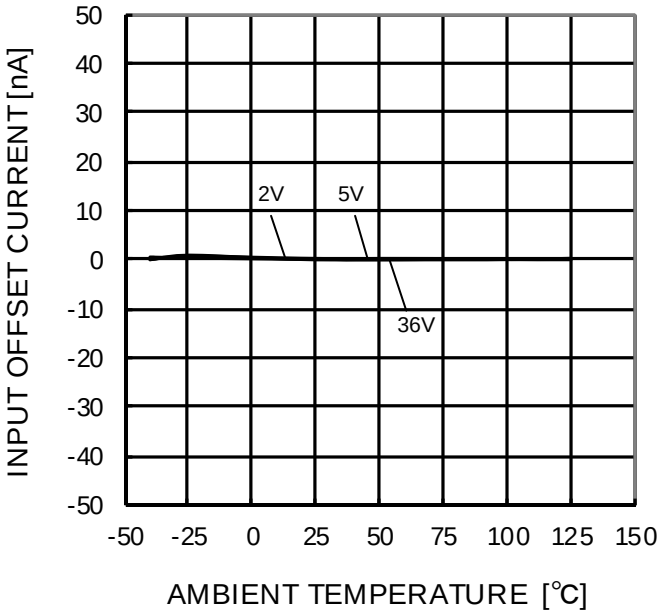


Fig.37
Input Offset Current
– Ambient Temperature

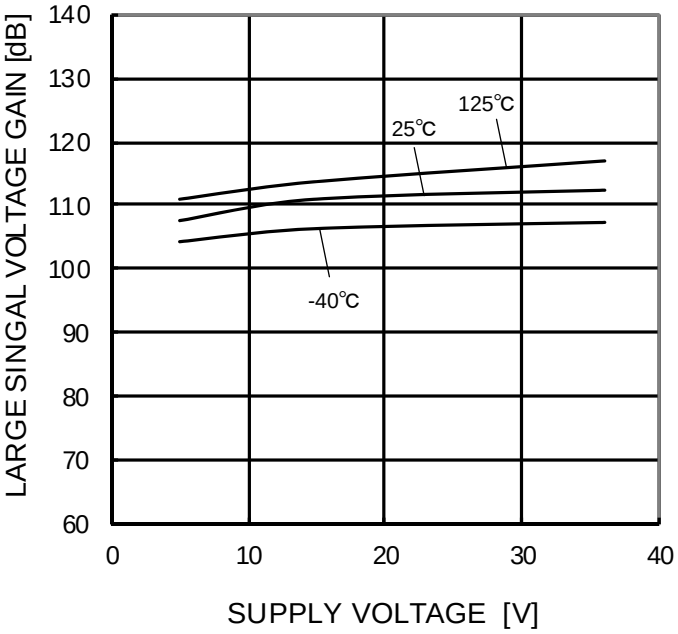


Fig.38
Large Signal Voltage Gain
– Supply Voltage

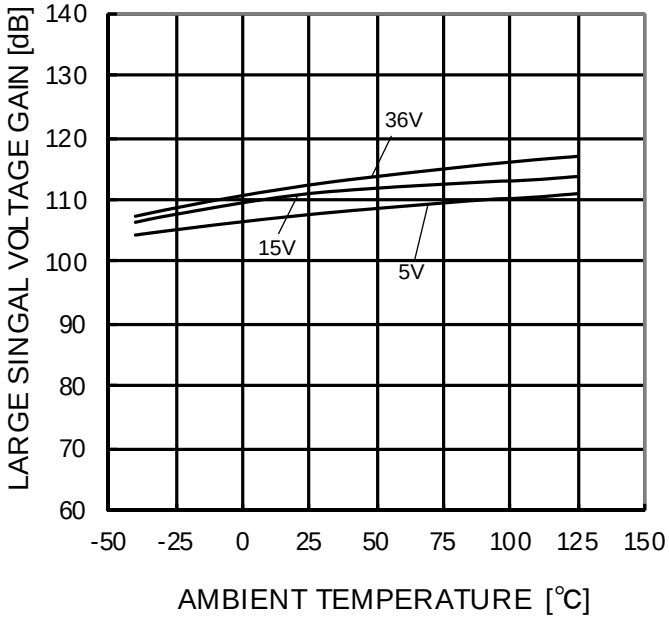


Fig.39
Large Signal Voltage Gain
– Ambient Temperature

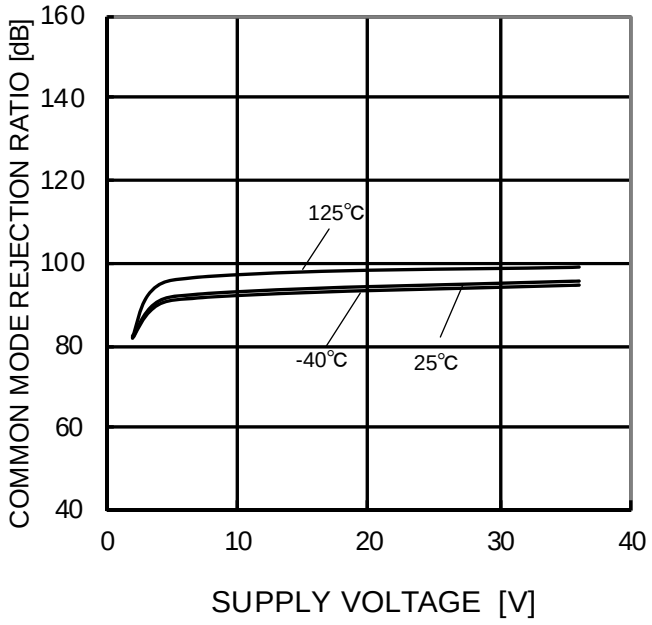


Fig.40
Common Mode Rejection Ratio
– Supply Voltage

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

○BA2901Yxx-M

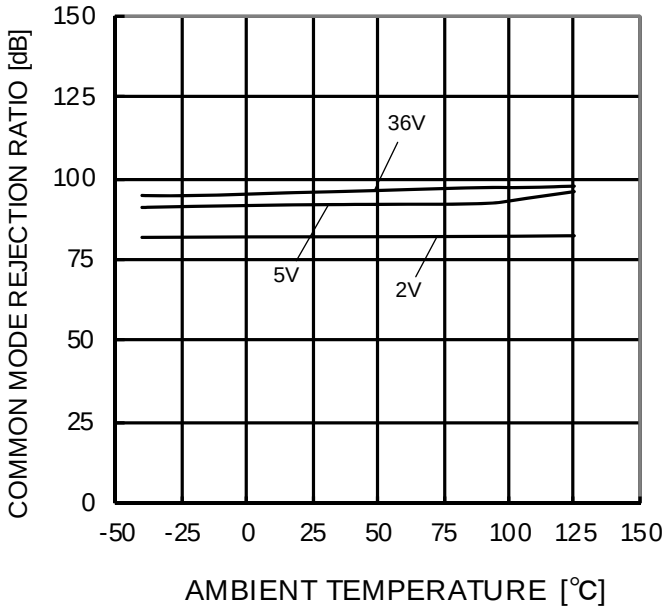


Fig.41
Common Mode Rejection Ratio
– Ambient Temperature

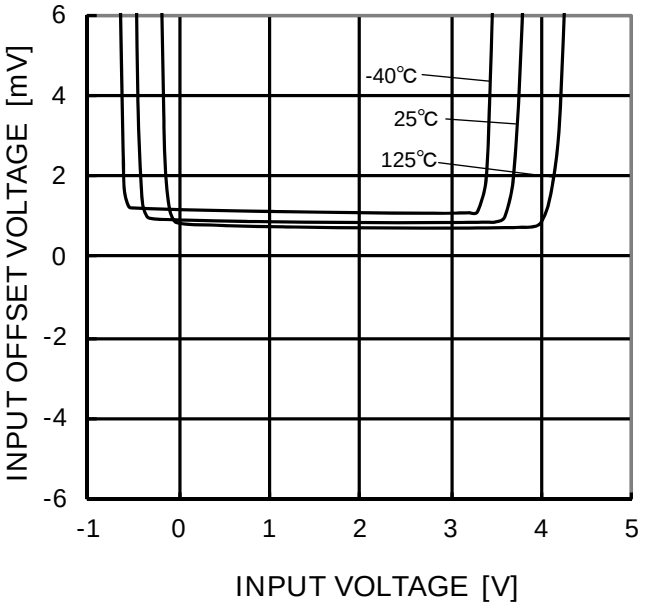


Fig.42
Input Offset Voltage – Input Voltage
(VCC=5V)

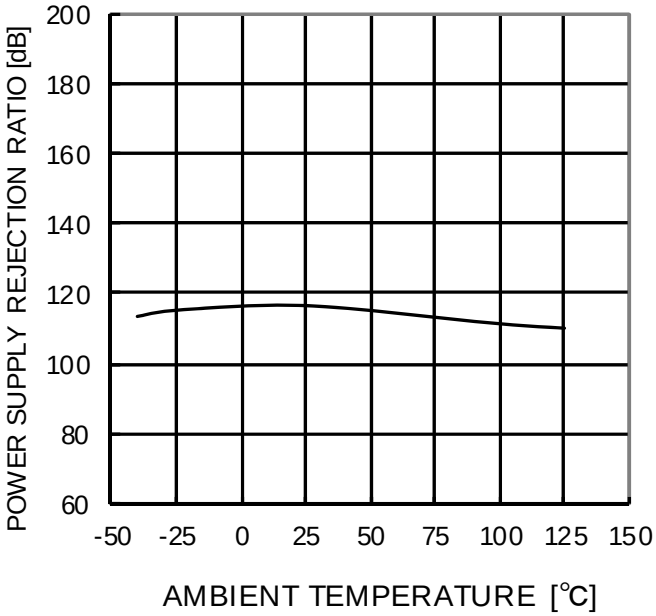


Fig.43
Power Supply Rejection Ratio
– Ambient Temperature

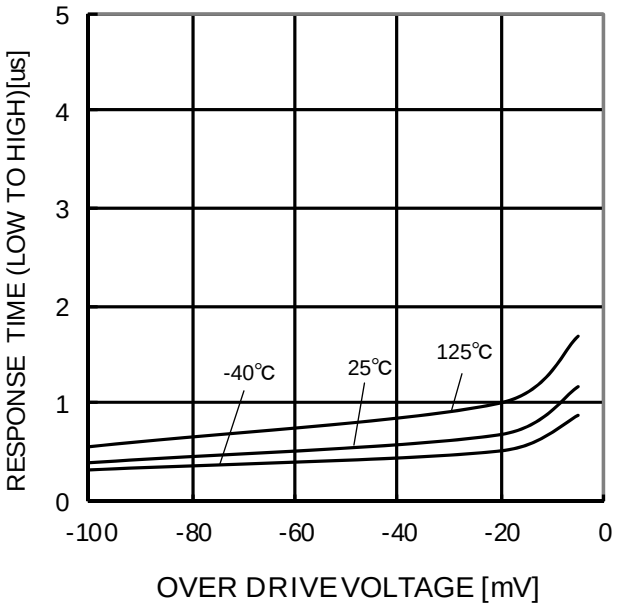


Fig.44
Response Time (Low to High) – Over Drive Voltage
(VCC=5V, VRL=5V, RL=5.1kΩ)

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

○BA2901Yxx-M

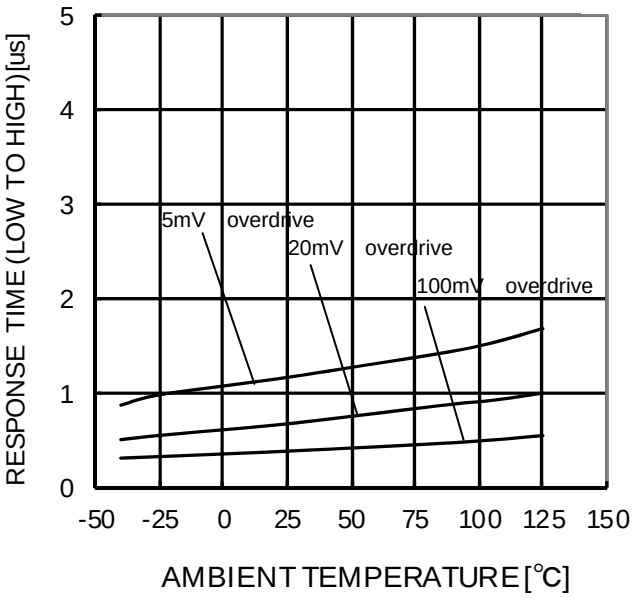


Fig.45
Response Time (Low to High)
– Ambient Temperature (VCC=5V, VRL=5V, RL=5.1kΩ)

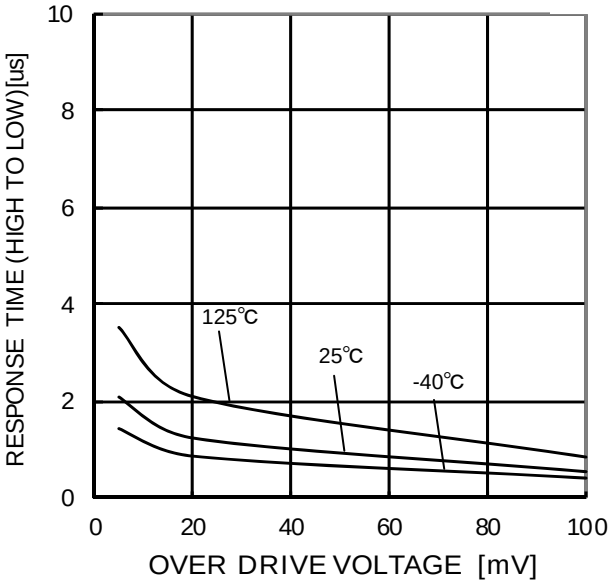


Fig.46
Response Time (High to Low)
– Over Drive Voltage
(VCC=5V, VRL=5V, RL=5.1kΩ)

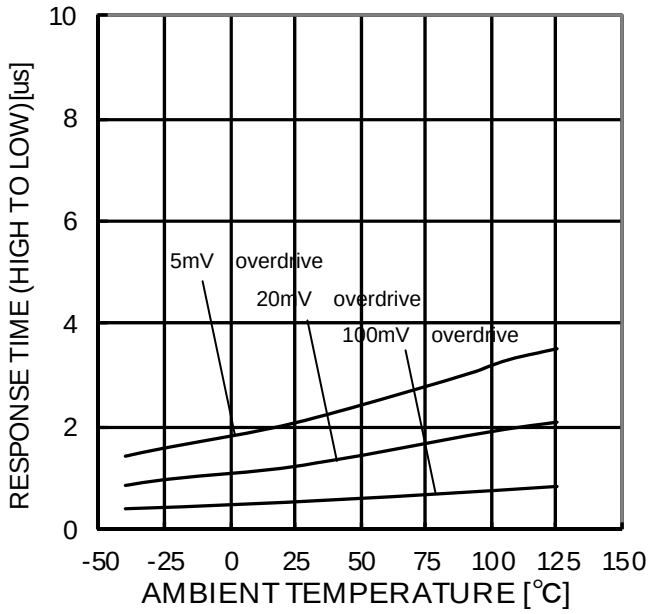


Fig.47
Response Time (High to Low)
– Ambient Temperature
(VCC=5V, VRL=5V, RL=5.1kΩ)

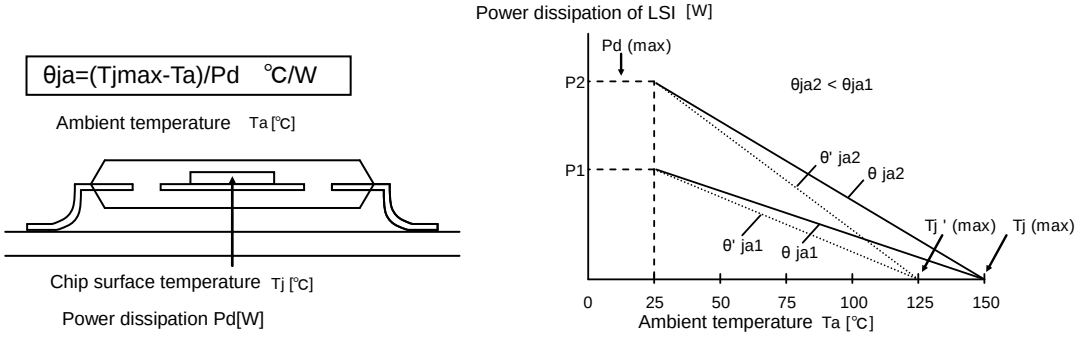
(*)The data above is measurement value of typical sample, it is not guaranteed.

●Power Dissipation

Power dissipation(total loss) indicates the power that 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.48(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

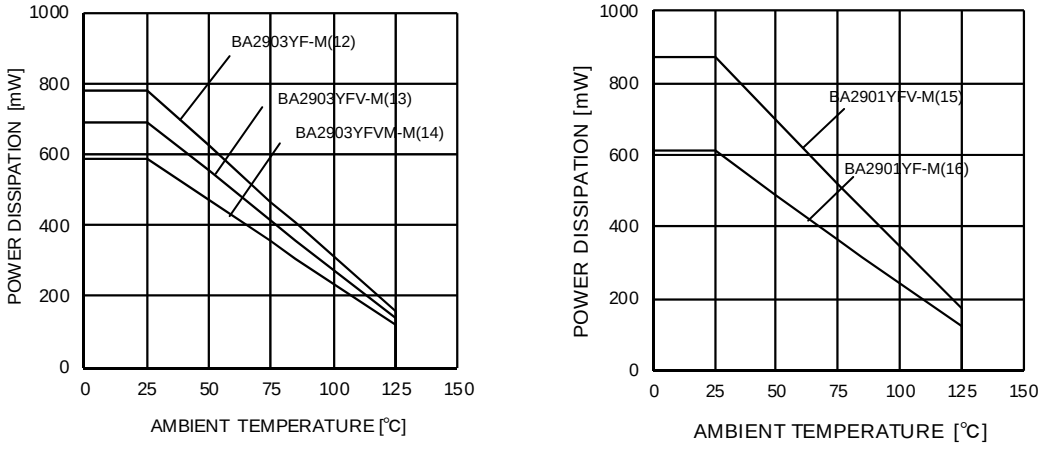
θja = (Tjmax-Ta) / Pd ℃/W ・・・・・ (Ⅰ)

Derating curve in Fig.48(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.49(c),(d) show a derating curve for an example of BA2903Yxxx-M and BA2901Yxx-M.



(a) Thermal resistance (b) Derating curve

Fig.48 Thermal resistance and derating curve



(c) BA2903Y (d) BA2901Y

(12)	(13)	(14)	(15)	(16)	UNIT
6.2	5.5	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 70mm×70mm×1.6mm(cooper foil area below 3%) is mounted.

Fig. 49 Derating curve

Test Circuit 1 Null Method

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)

$$Vio = \frac{|\ VF1\ |}{1 + Rf\ /\ Rs}\ [V]$$

2. Input Offset Current (Iio)

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

3. Input Bias Current (Ib)

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

4. Large Signal Voltage Gain (AV)

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

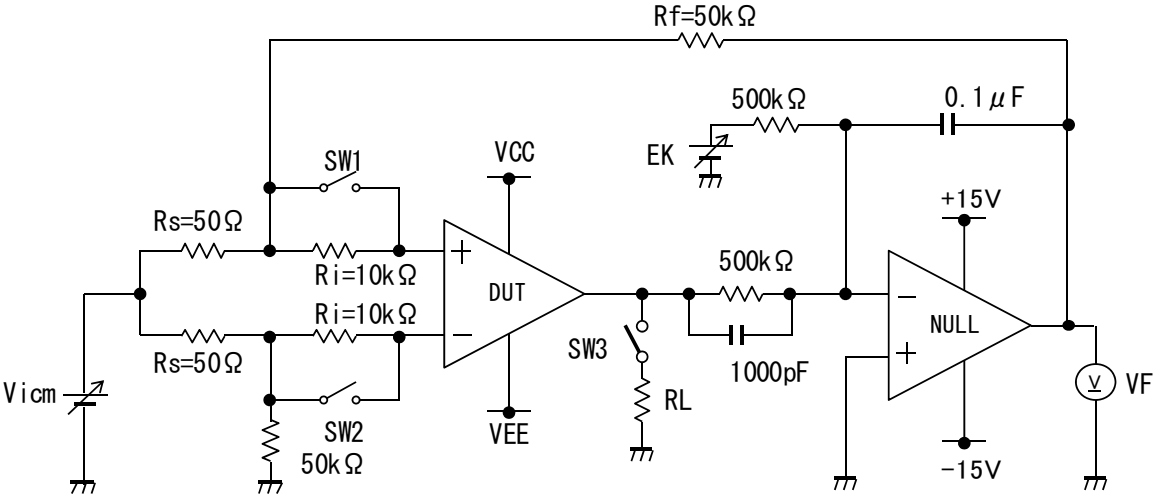


Fig.50 Test circuit1 (one channel only)

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=1.5V	OFF	ON	ON	OFF	OFF	OFF	ON
Saturation Voltage	IOL=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

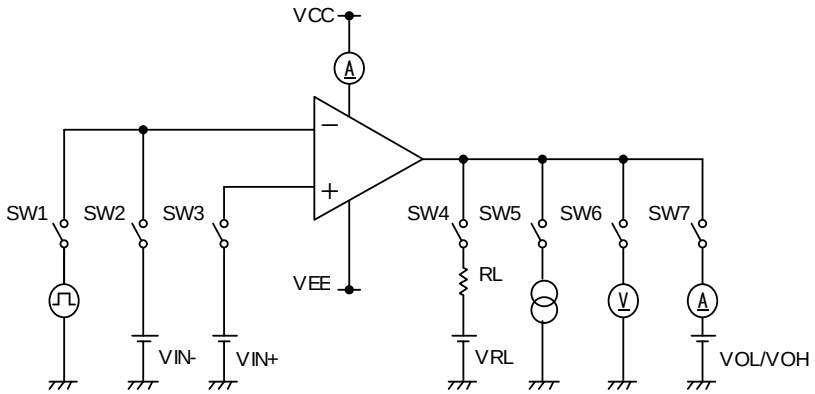


Fig.51 Test Circuit 2 (one channel only)

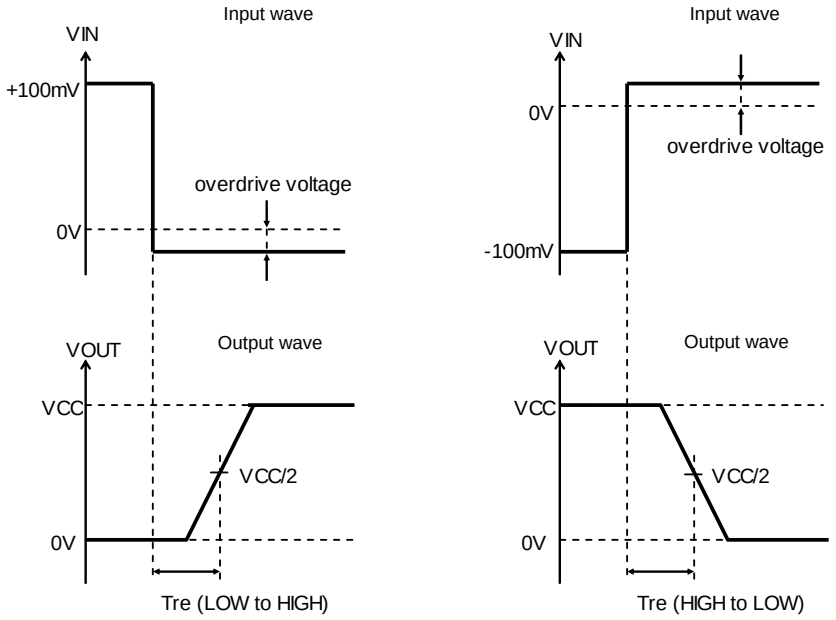
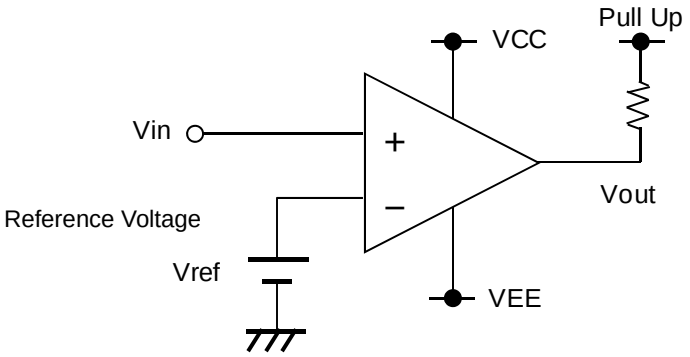
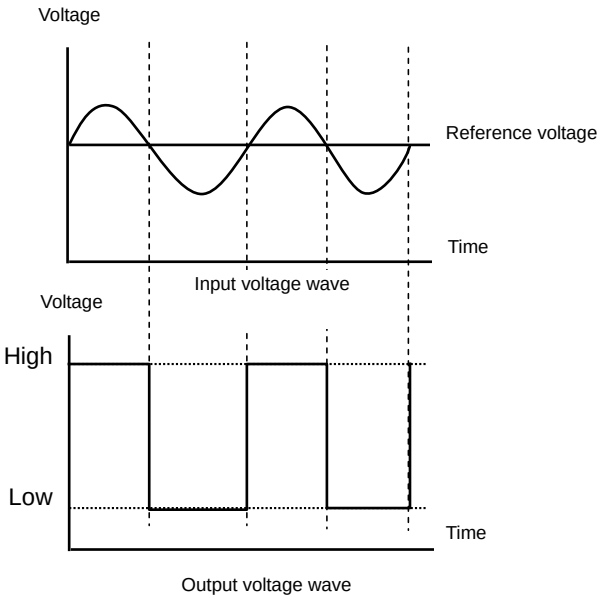


Fig.52 Response Time

Example of circuit

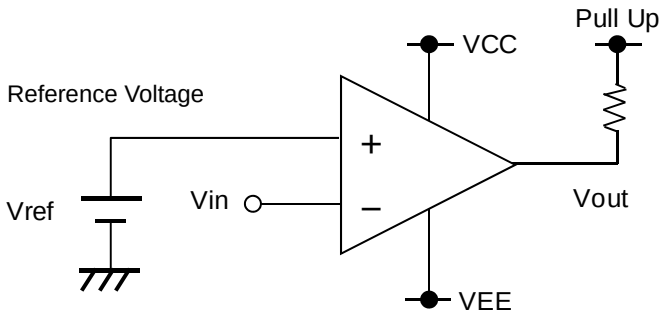
○Reference voltage is Vin-

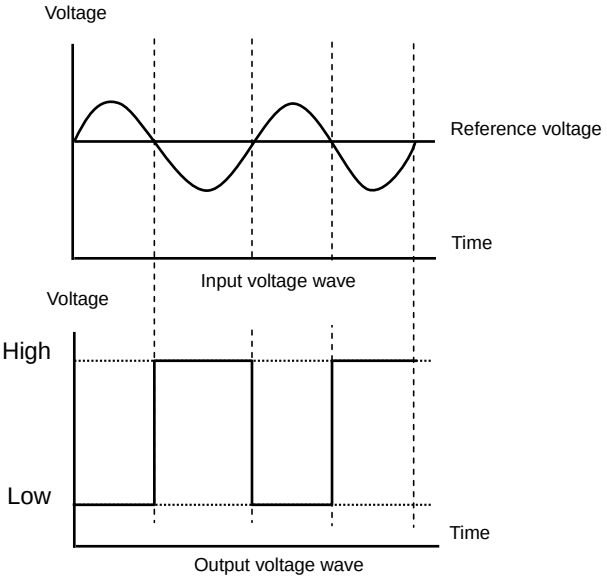




While input voltage is bigger than reference voltage, output voltage is high. While input voltage is smaller than reference voltage, output voltage is low.

○Reference voltage is Vin+

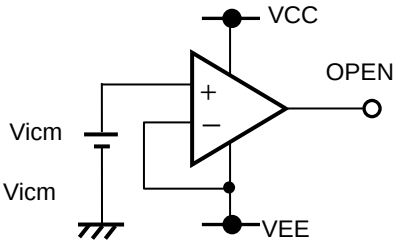




While input voltage is smaller than reference voltage, output voltage is high. While input voltage is bigger than reference voltage, output voltage is low.

●Operational Notes

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).



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

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 (single / 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.

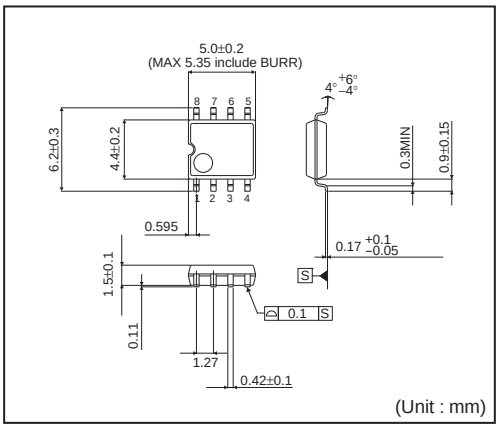
9) IC handing
Applying mechanical stress to the IC by deflecting or bending the board may cause fluctuations in the electrical characteristics due to piezo resistance effects.

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.

Status of this document
The Japanese version of this document is formal specification. A customer may use this translation version only for a reference to help reading the formal version.
If there are any differences in translation version of this document formal version takes priority.

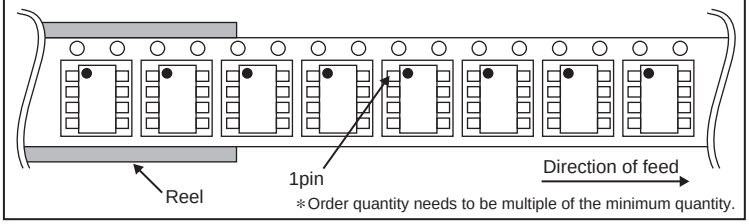
●Physical Dimensions Tape and Reel Information

SOP8



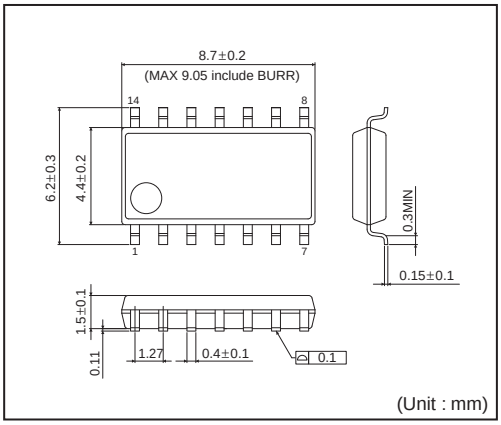
<Tape and Reel information>

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)



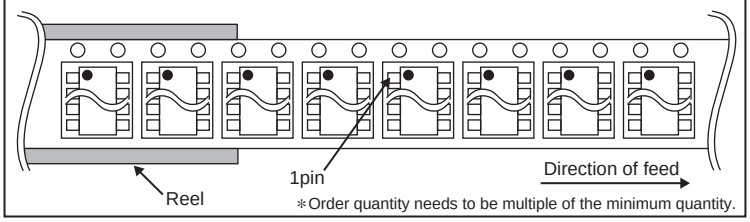
∗Order quantity needs to be multiple of the minimum quantity.

SOP14



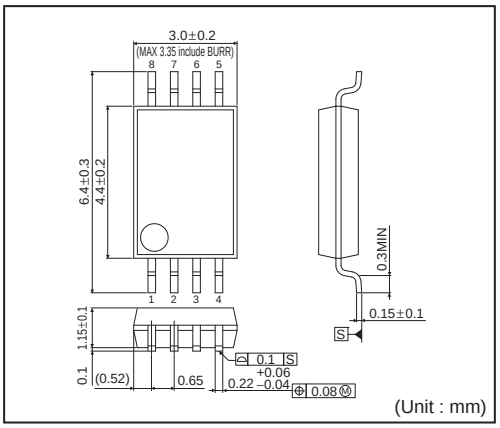
<Tape and Reel information>

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)



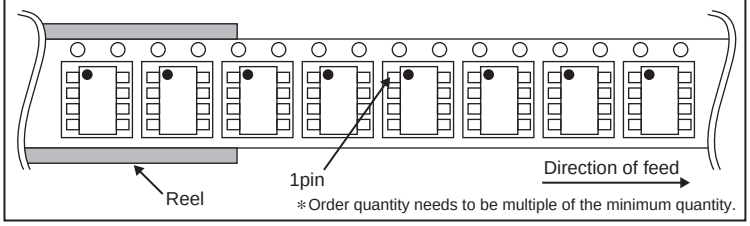
∗Order quantity needs to be multiple of the minimum quantity.

SSOP-B8



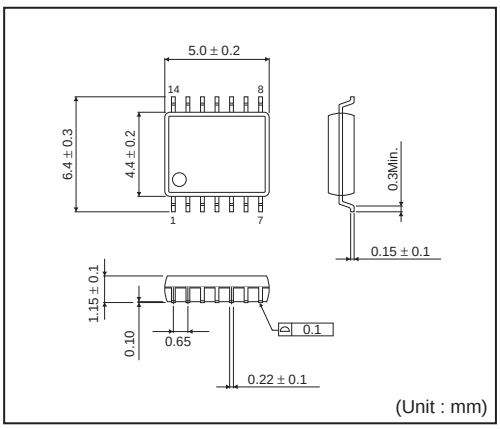
<Tape and Reel information>

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)



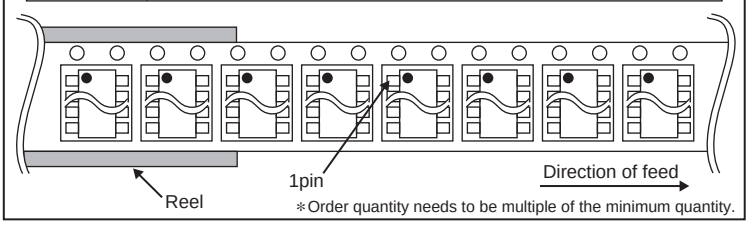
∗Order quantity needs to be multiple of the minimum quantity.

SSOP-B14



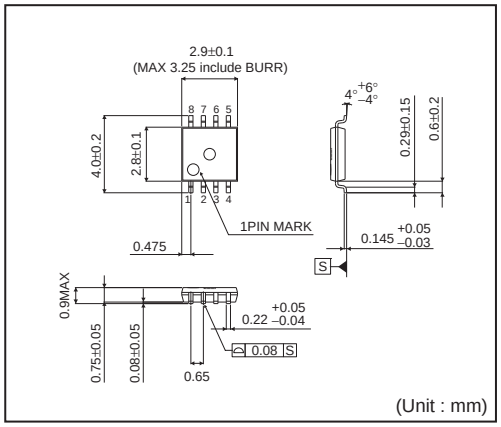
<Tape and Reel information>

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)



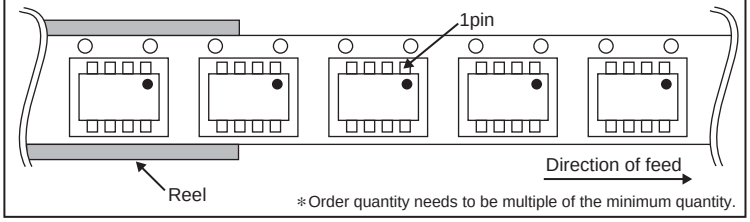
∗Order quantity needs to be multiple of the minimum quantity.

MSOP8



<Tape and Reel information>

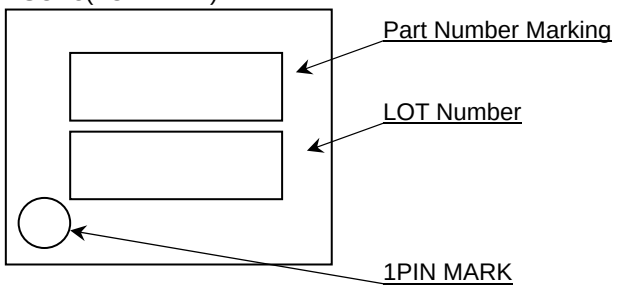
Tape	Embossed carrier tape
Quantity	3000pcs
Direction of feed	TR (The direction is the 1pin of product is at the upper right when you hold reel on the left hand and you pull out the tape on the right hand)



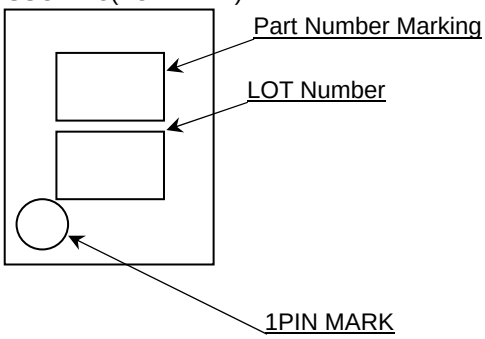
∗Order quantity needs to be multiple of the minimum quantity.

●Marking Diagrams

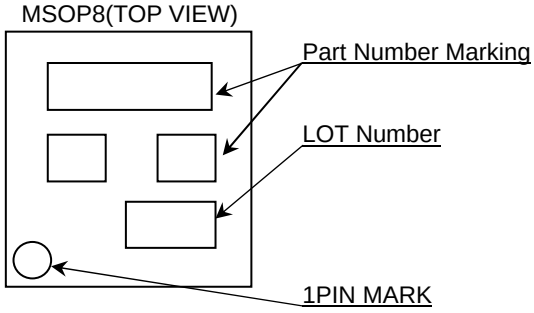
SOP8(TOP VIEW)



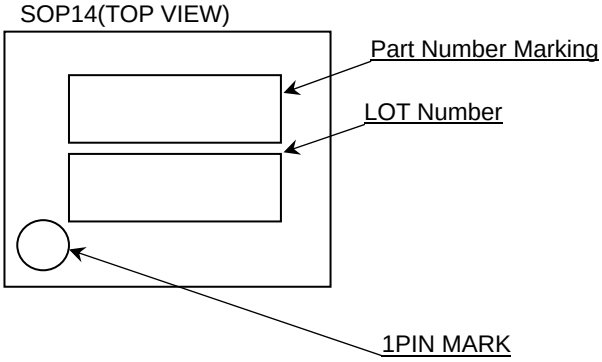
SSOP-B8(TOP VIEW)



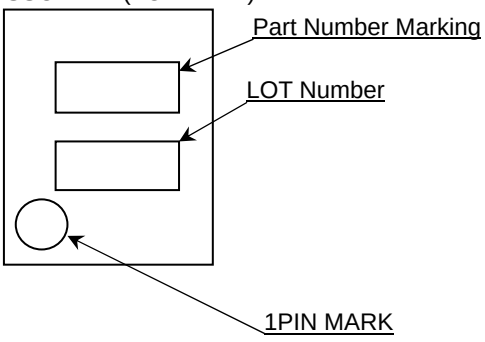
MSOP8(TOP VIEW)



SOP14(TOP VIEW)



SSOP-B14(TOP VIEW)



Product Name		Package Type	Marking
BA2903Y	F-M	SOP8	03YM
	FV-M	SSOP-B8	03YM
	FVM-M	MSOP8	03YM
BA2901Y	F-M	SOP14	BA2901YFM
	FV-M	SSOP-B14	01YM

Notice

Precaution on using ROHM Products

1. If you intend to use our Products in devices requiring extremely high reliability (such as medical equipment (Note 1), 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.

(Note1) Medical Equipment Classification of the Specific Applications

JAPAN	USA	EU	CHINA
CLASSⅢ	CLASSⅢ	CLASSⅡb	CLASSⅢ
CLASSⅣ		CLASSⅢ	

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.

Precaution Regarding Intellectual Property Rights

1. All information and data including but not limited to application example contained in this document is for reference only. ROHM does not warrant that foregoing information or data will not infringe any intellectual property rights or any other rights of any third party regarding such information or data. ROHM shall not be in any way responsible or liable for infringement of any intellectual property rights or other damages arising from use of such information or data.:

2. No license, expressly or implied, is granted hereby under any intellectual property rights or other rights of ROHM or any third parties with respect to the information contained in this document.

Other Precaution

1. This document may not be reprinted or reproduced, in whole or in part, without prior written consent of ROHM.

2. The Products may not be disassembled, converted, modified, reproduced or otherwise changed without prior written consent of ROHM.

3. In no event shall you use in any way whatsoever the Products and the related technical information contained in the Products or this document for any military purposes, including but not limited to, the development of mass-destruction weapons.

4. The proper names of companies or products described in this document are trademarks or registered trademarks of ROHM, its affiliated companies or third parties.

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.

3. The information contained in this document is provided on an "as is" basis and ROHM does not warrant that all information contained in this document is accurate and/or error-free. ROHM shall not be in any way responsible or liable for any damages, expenses or losses incurred by you or third parties resulting from inaccuracy or errors of or concerning such information.