Operational Amplifiers

High Speed with High Voltage Operational Amplifiers

BA3472xxx BA3472RFVM BA3474xxx BA3474RFV

General Description

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

Features

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

Application

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

Packages

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

Key Specifications

- Wide Operating Supply Voltage:
  - Single power supply +3.0V to +36.0V
  - Dual power supply ±1.5V to ±18.0V
- Operating Temperature Range:
  - BA3474F -40°C to +75°C
  - BA3472xxx BA3474xxx -40°C to +85°C
  - BA3472RFVM BA3474RFV -40°C to +105°C
- Slew Rate: 10V/µs(Typ)
- Unity Gain Frequency: 4MHz(Typ)

Simplified Schematic

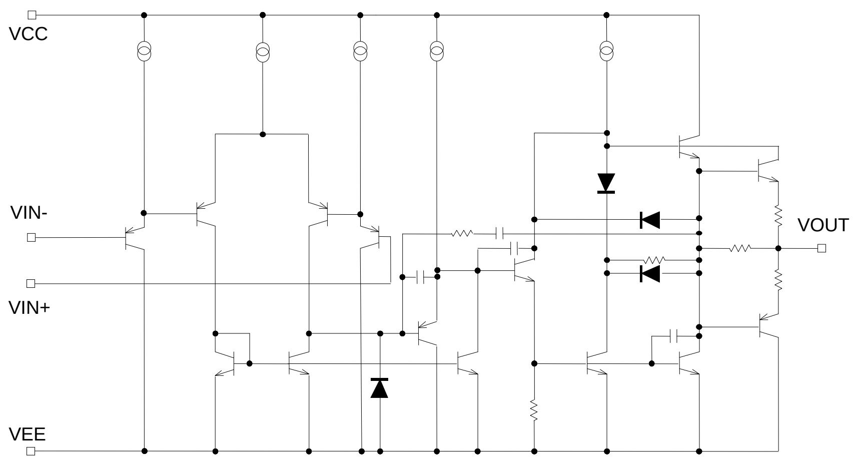
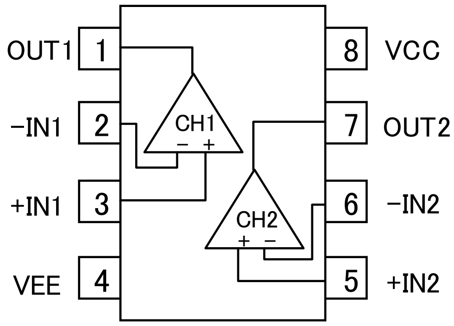


Figure 1. Simplified schematic (one channel only)

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

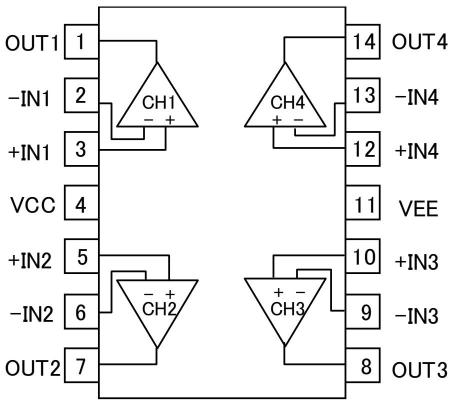
Pin Configuration

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



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

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



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

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

Ordering Information

B	A	3	4	7	x	x	x	x	x	-	xx

Part Number
BA3472xxx
BA3472Rxxx
BA3474xxx
BA3474Rxx

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

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

Line-up

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

Absolute Maximum Ratings (Ta=25℃)

Parameter	Symbol		Ratings				Unit
			BA3472	BA3474	BA3472R	BA3474R	
Supply Voltage	VCC-VEE		+36				V
Power Dissipation	Pd	SOP8	780*1*13	-	-	-	mW
		SSOP-B8	690*2*13	-	-	-	
		MSOP8	590*3*13	-	590*3*13	-	
			-	-	625*4*14	-	
			-	-	713*5*15	-	
			-	-	937*6*16	-	
		SOP-J8	675*7*13	-	-	-	
		TSSOP-B8	625*4*13	-	-	-	
		SOP14	-	610*8*13	-	-	
		SSOP-B14	-	870*9*13	-	870*9*13	
			-	-	-	1187*10*15	
			-	-	-	1689*11*16	
		TSSOP-B14	-	850*12*13	-	-	
Differential Input Voltage*17	Vid		+36				V
Input Common-mode Voltage Range	Vicm		(VEE - 0.3) to VEE + 36				V
Input Current*18	I_I		-10				mA
Operable with Low Voltage	Vopr		+3.0V to +36.0V (±1.5V to ±18.0V)				V
Operating Temperature Range	Topr		-40 to +85(SOP14:to +75)		-40 to +105		℃
Storage Temperature Range	Tstg		-55 to +150				℃
Maximum Junction Temperature	Tjmax		+150				℃

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

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

Electrical Characteristics

○BA3472 (Unless otherwise specified VCC=+15V, VEE=-15V , Ta=25℃)

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

*19 Absolute value
*20 Under high temperatures, please consider the power dissipation when selecting the output current.
When the output terminal is continuously shorted the output current reduces the internal temperature by flushing.

○BA3472R (Unless otherwise specified VCC=+15V, VEE=-15V, Ta=25℃)

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

*21 Absolute value
*22 Under high temperatures, please consider the power dissipation when selecting the output current.
When the output terminal is continuously shorted the output current reduces the internal temperature by flushing.

○BA3474 (Unless otherwise specified VCC=+15V, VEE=-15V, Ta=25℃)

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

*23 Absolute value
*24 Under high temperatures, please consider the power dissipation when selecting the output current.
When the output terminal is continuously shorted the output current reduces the internal temperature by flushing.

○BA3474R (Unless otherwise specified VCC=+15V, VEE=-15V, Ta=25℃)

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

*25 Absolute value
*26 Under high temperatures, please consider the power dissipation when selecting the output current.
When the output terminal is continuously shorted the output current reduces the internal temperature by flushing.

Description of Electrical Characteristics

Described below are descriptions of the relevant electrical terms
Please note that item names, symbols and their meanings may differ from those on another manufacturer's documents.

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

1.1 Power Supply Voltage (VCC/VEE)
Expresses the maximum voltage that can be supplied between the positive and negative supply terminals without causing deterioration of the electrical characteristics or destruction of the internal circuitry.

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

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

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

2. Electrical Characteristics

2.1 Input Offset Voltage (Vio)
Indicates the voltage difference between non-inverting terminal and inverting terminal. It can be translated into the input voltage difference required for setting the output voltage at 0 V.

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

2.3 Input Bias Current (Ib)
Indicates the current that flows into or out of the input terminal. It is defined by the average of input bias current at non-inverting terminal and input bias current at inverting terminal.

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

2.5 Maximum Output Voltage(High) / Maximum Output Voltage(Low) (VOH/VOL)
Indicates the voltage range that can be output by the IC under specified load condition. It is typically divided into maximum output voltage High and low. Maximum output voltage high indicates the upper limit of output voltage. Maximum output voltage low indicates the lower limit.

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

2.7 Input Common-mode Voltage Range (Vicm)
Indicates the input voltage range under which the IC operates normally.

2.8 Common-mode Rejection Ratio (CMRR)
Indicates the ratio of fluctuation of input offset voltage when in-phase input voltage is changed. It is normally the fluctuation of DC.
CMRR = (Change of Input common-mode voltage)/(Input offset fluctuation)

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

2.10 Output Source Current/ Output Sink Current (Isource/Isink)
The maximum current that can be output under specific output conditions, it is divided into output source current and output sink current. The output source current indicates the current flowing out of the IC, and the output sink current the current flowing into the IC.

2.11 Unity Gain Frequency (f_T)
Indicates a frequency where the voltage gain of operational amplifier is 1.

2.12 Gain Bandwidth (GBW)
Indicates to multiply by the frequency and the gain where the voltage gain decreases 6dB/octave.

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

2.14 Channel Separation (CS)
Indicates the fluctuation of input offset voltage or that of output voltage with reference to the change of output voltage of driven channel.

Typical Performance Curves

○BA3472, BA3472R

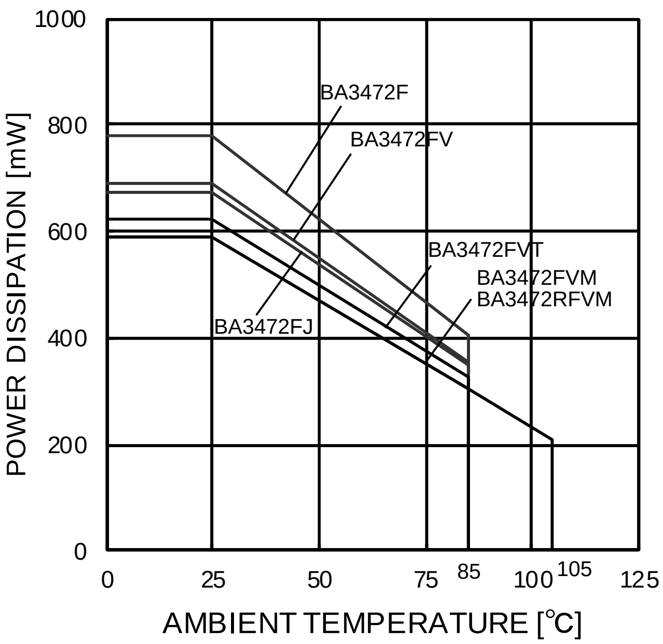


Figure 2.
Derating Curve

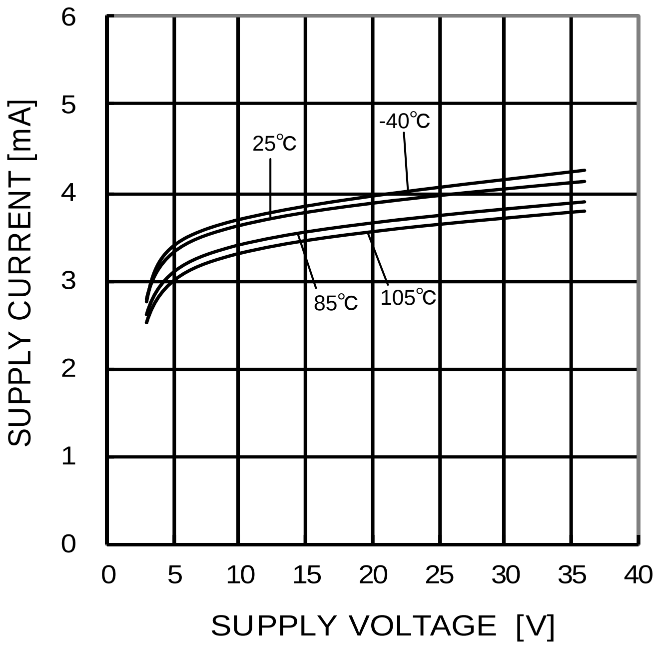


Figure 3.
Supply Current - Supply Voltage

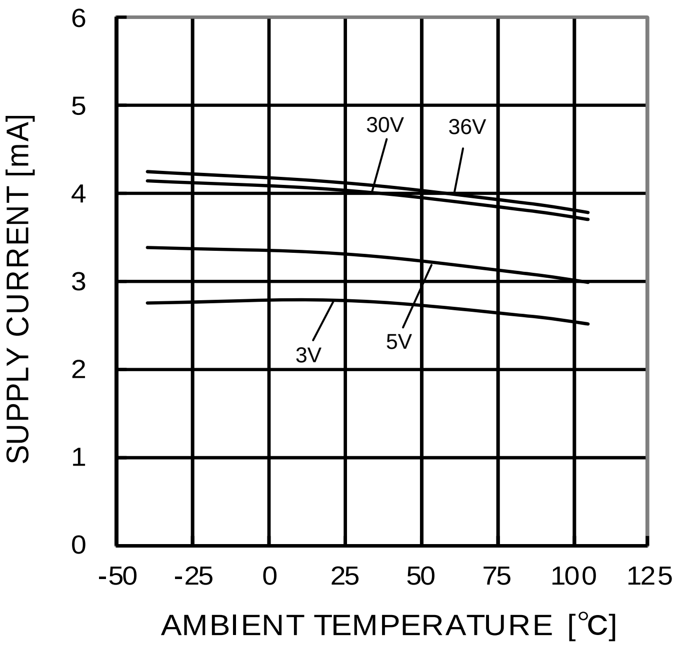


Figure 4.
Supply Current - Ambient Temperature

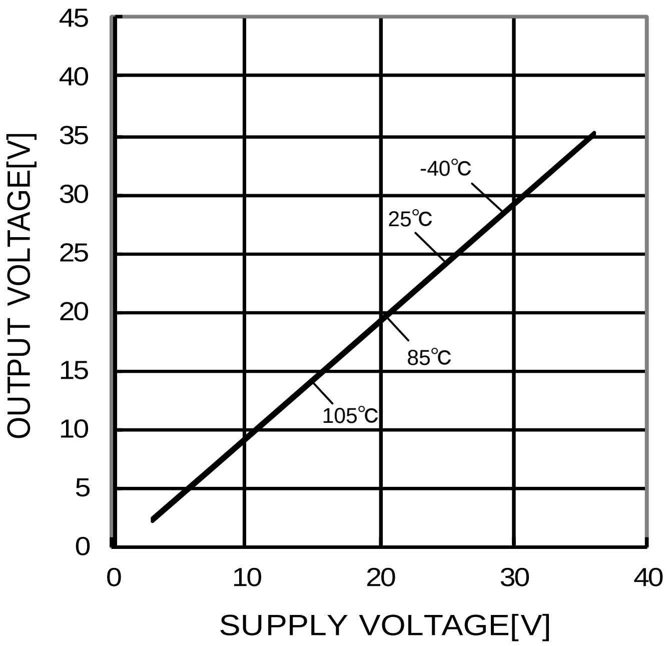


Figure 5.
High level Output Voltage - Supply Voltage
(RL=10kΩ)

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

○BA3472, BA3472R

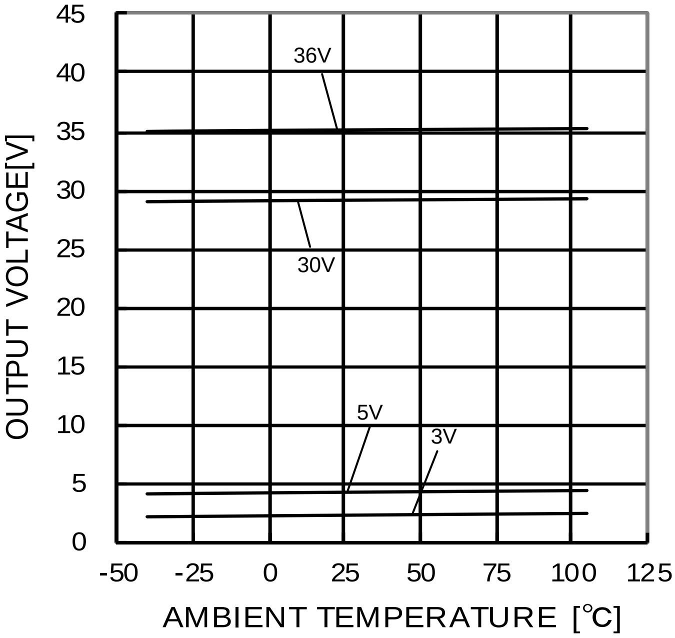


Figure 6.
High level Output Voltage
- Ambient Temperature
(RL=10kΩ)

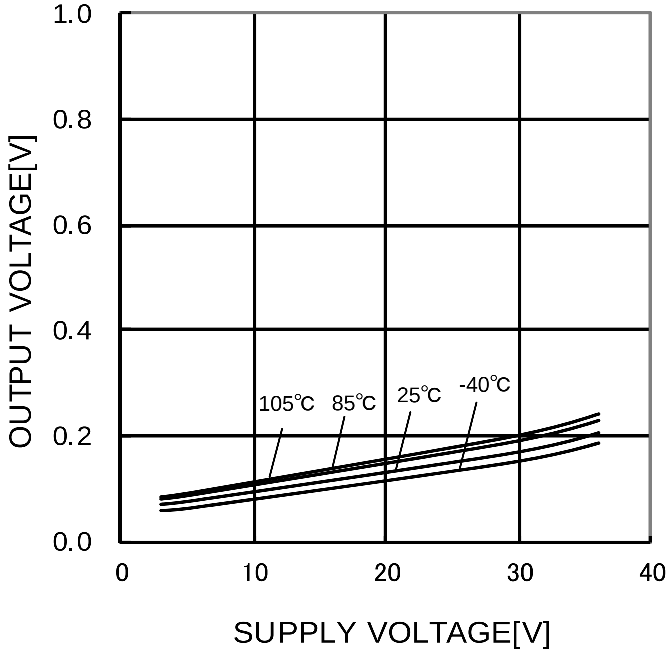


Figure 7.
Low level Output Voltage
- Supply Voltage
(RL=10kΩ)

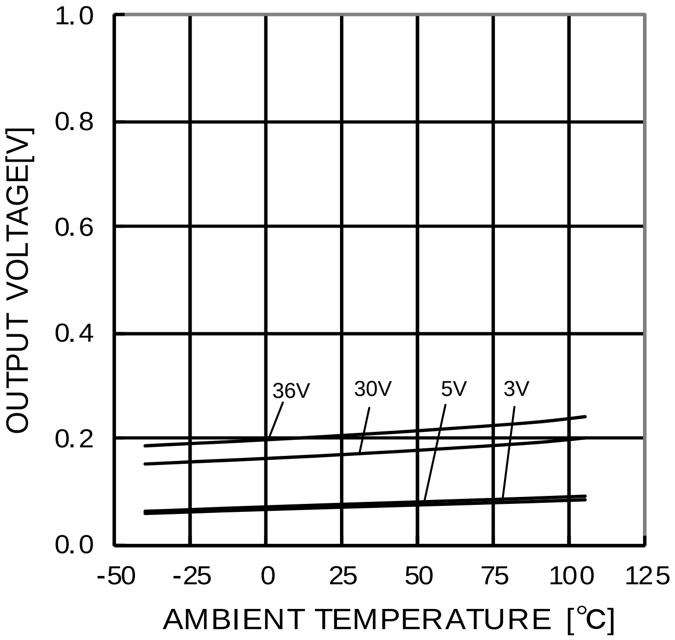


Figure 8.
Low level Output Voltage
- Ambient Temperature
(RL=10kΩ)

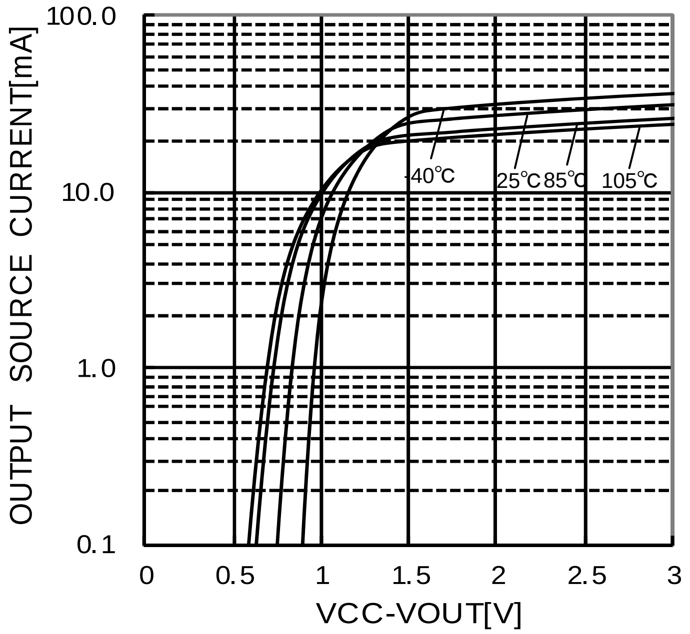


Figure 9.
Output Source Current - (VCC-VOUT)
(VCC/VEE=5V/0V)

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

○BA3472, BA3472R

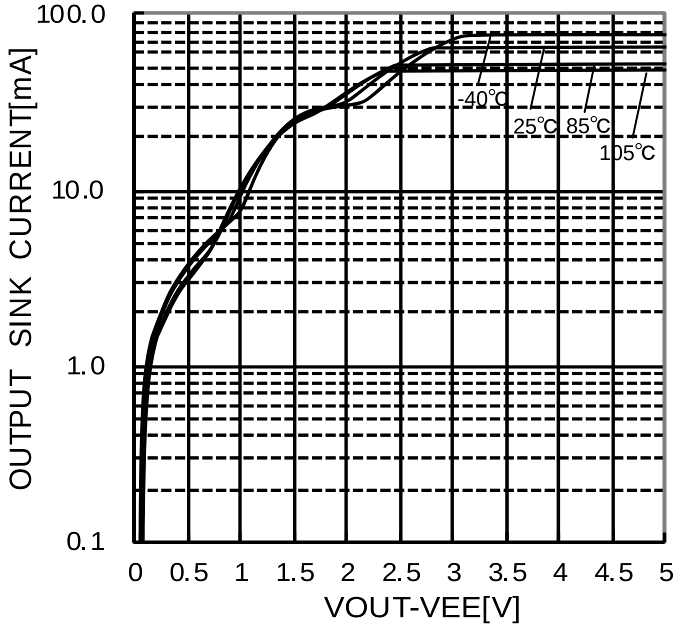


Figure 10.
Output Sink Current - (VOUT-VEE)
(VCC/VEE=5V/0V)

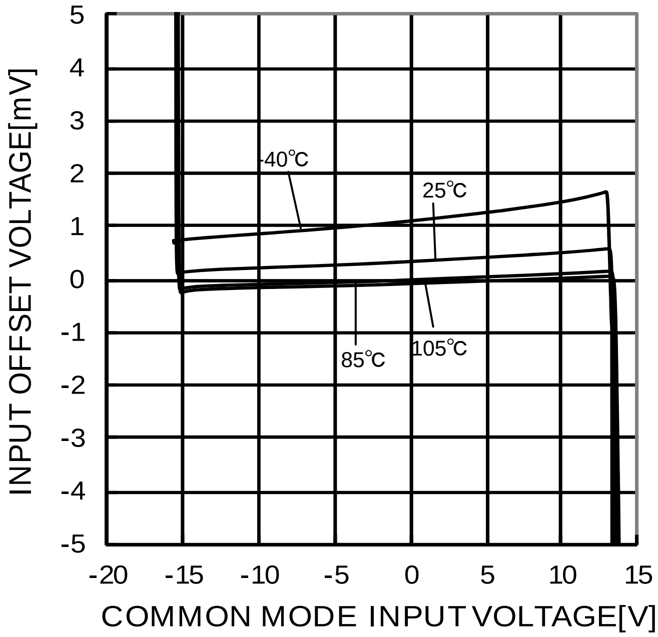


Figure 11.
Input Common-mode Voltage Range
(VCC/VEE=15V/-15V)

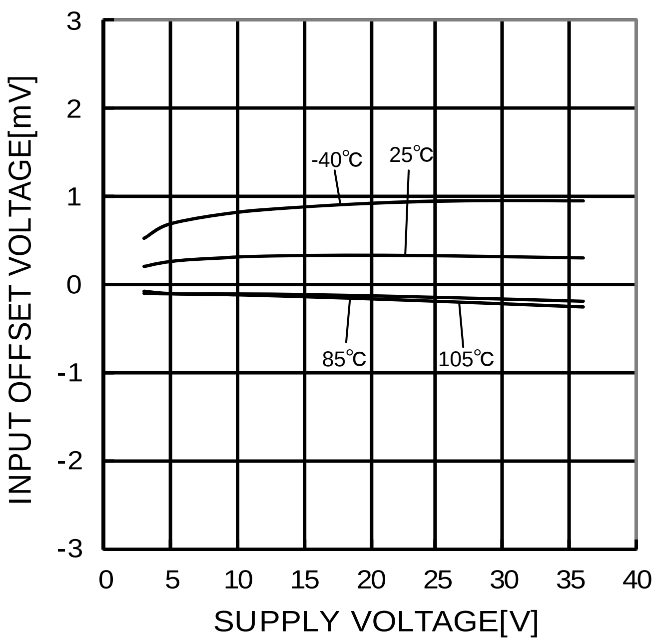


Figure 12.
Input Offset Voltage - Supply voltage

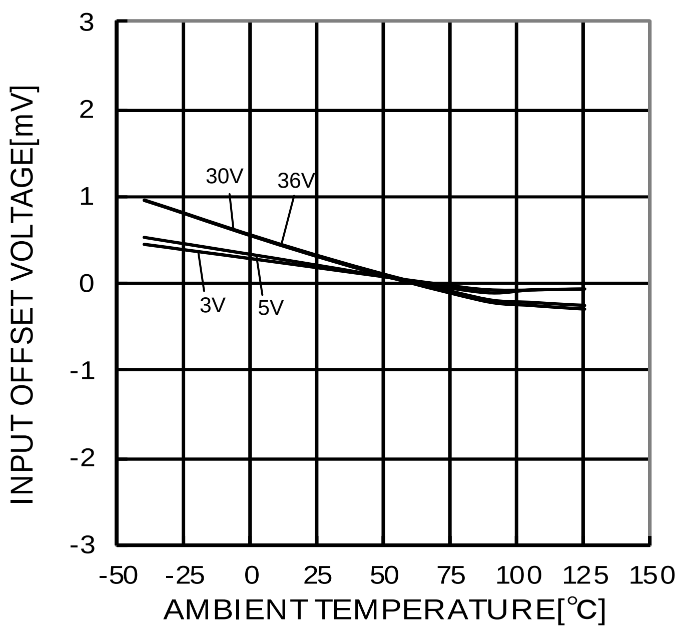


Figure 13.
Input Offset Voltage - Ambient Temperature

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

○BA3472, BA3472R

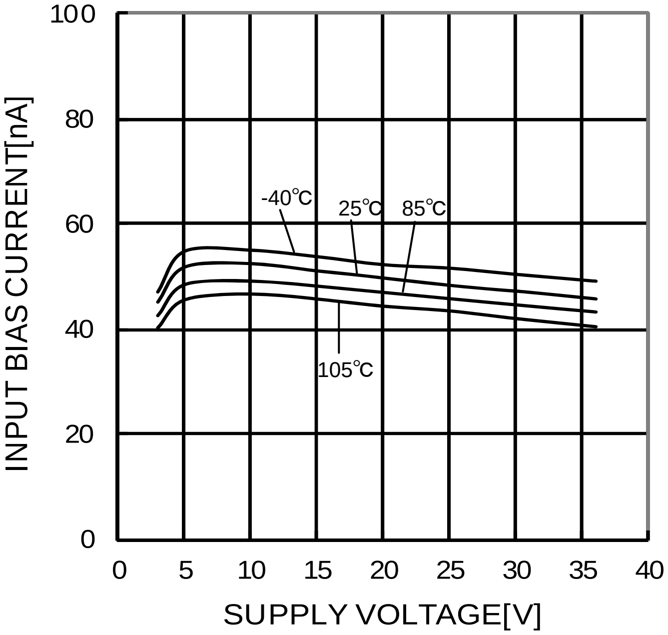


Figure 14.
Input Bias Current - Supply voltage

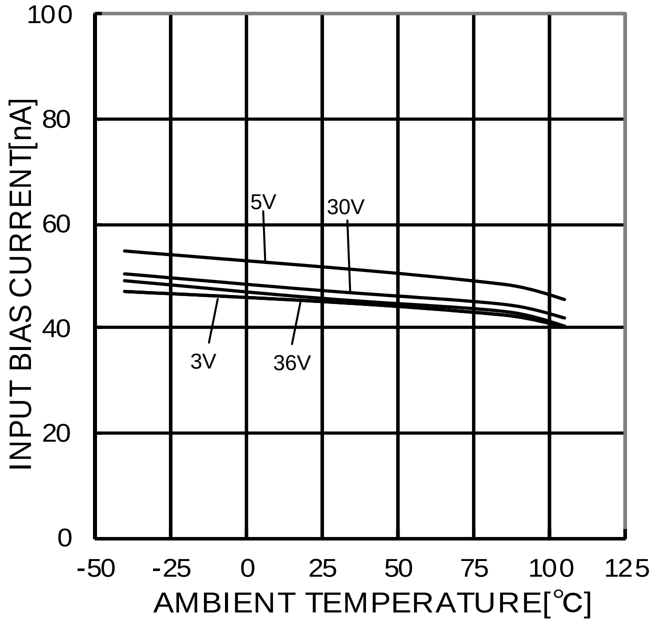


Figure 15.
Input Bias Current - Ambient Temperature

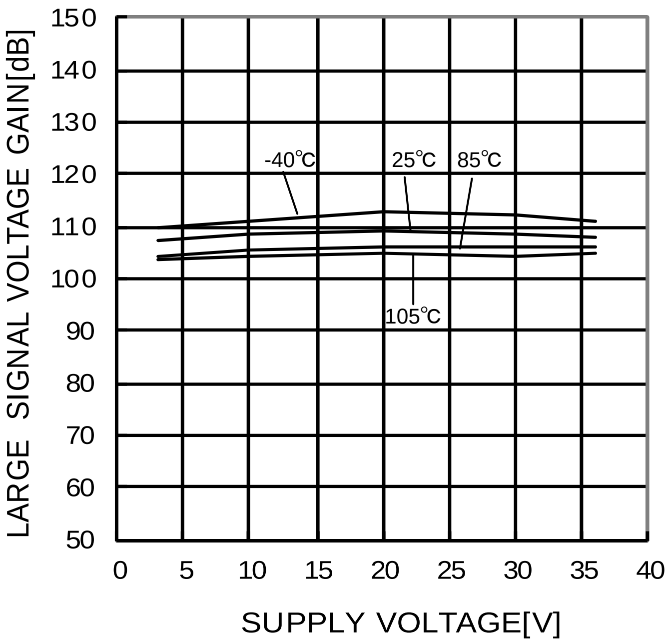


Figure 16.
Large Signal Voltage Gain
- Supply Voltage

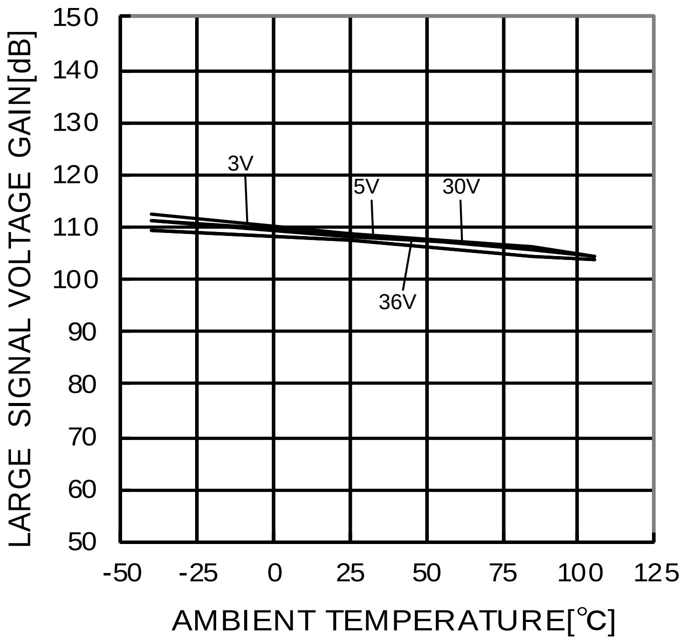


Figure 17.
Large Signal Voltage Gain
- Ambient Temperature

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

○BA3472, BA3472R

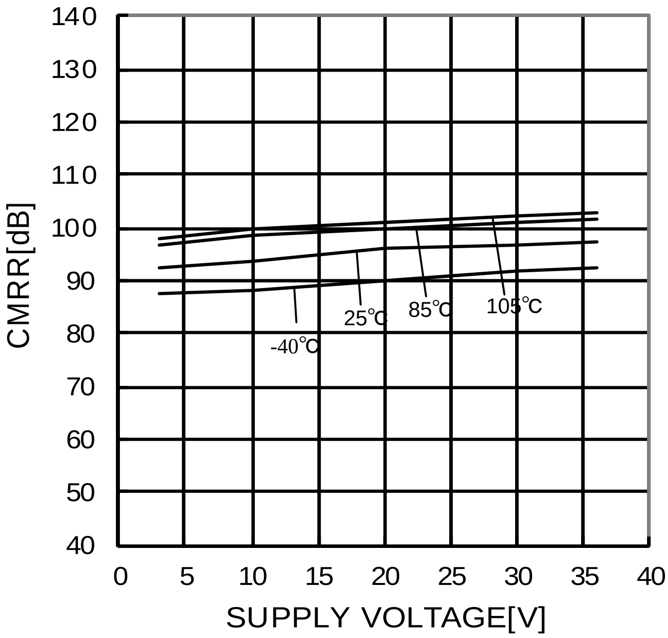


Figure 18.
Common Mode Rejection Ratio
- Supply Voltage

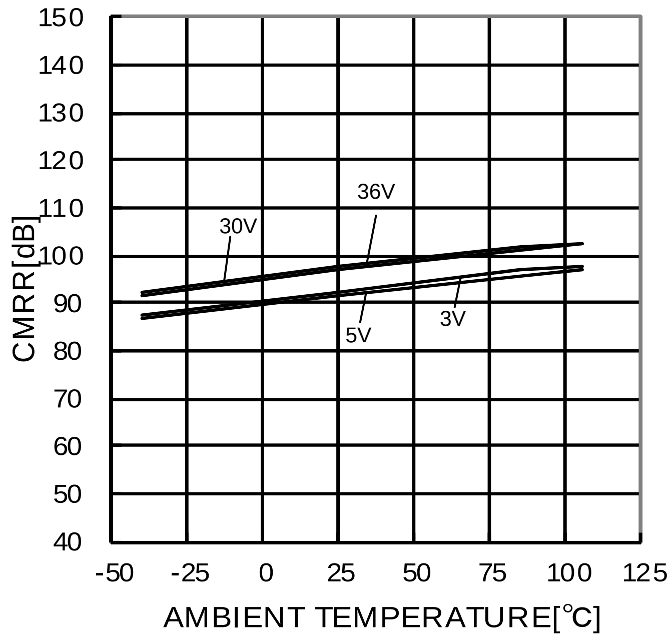


Figure 19.
Common Mode Rejection Ratio
- Ambient Temperature

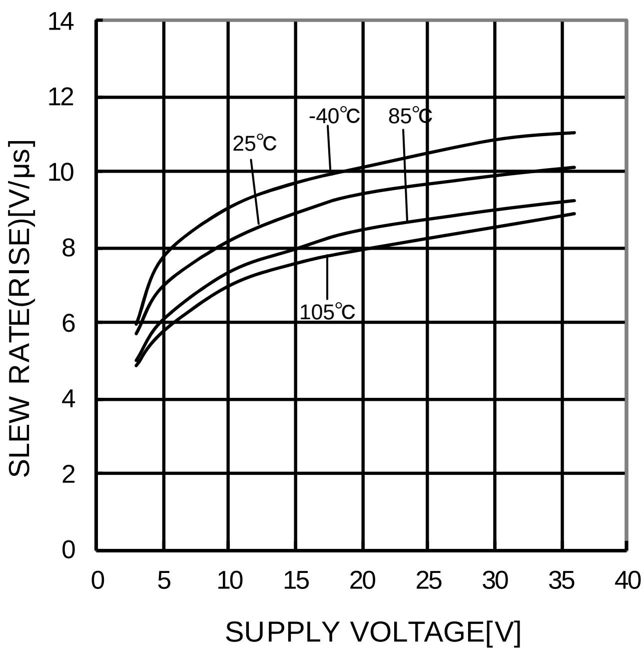


Figure 20.
Slew Rate L-H - Supply Voltage
(RL=10kΩ)

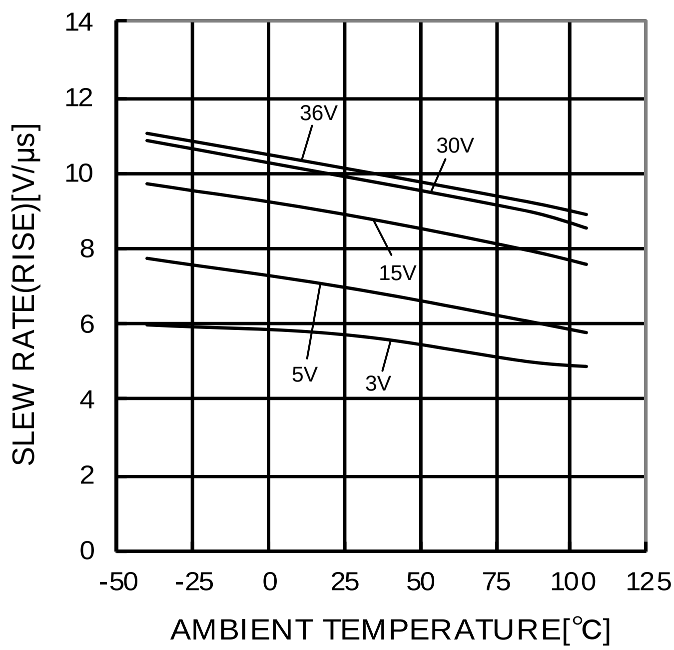


Figure 21.
Slew Rate L-H - Ambient Temperature
(RL=10kΩ)

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

○BA3472, BA3472R

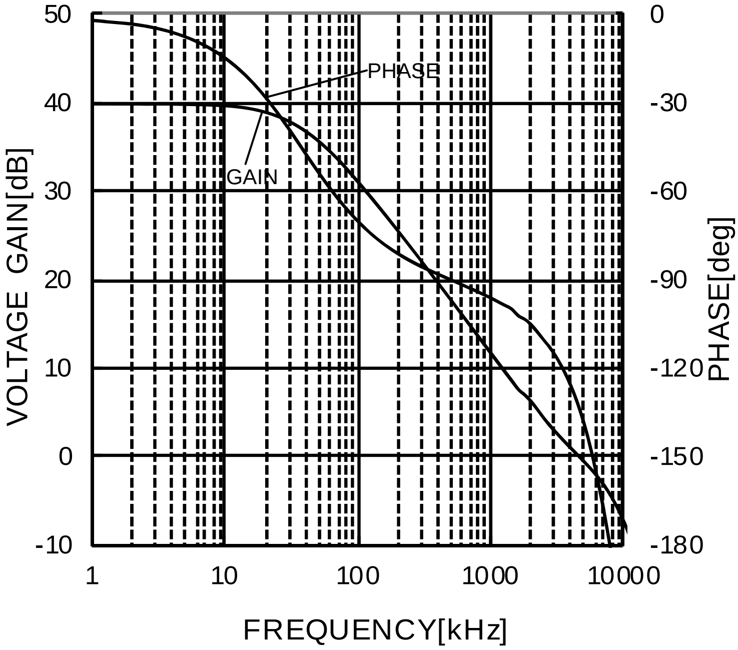


Figure 22.
Voltage Gain・Phase - Frequency
(VCC=7.5V/-7.5V, Av=40dB,
RL=2kΩ, CL=100pF, Ta=25℃)

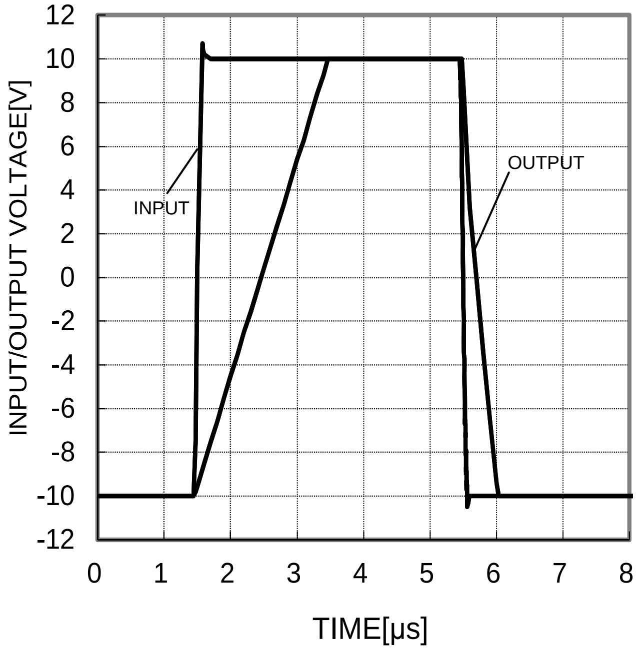


Figure 23.
Input / Output Voltage - Time
(VCC/VEE=15V/-15V, Av=0dB,
RL=2kΩ, CL=100pF, Ta=25℃)

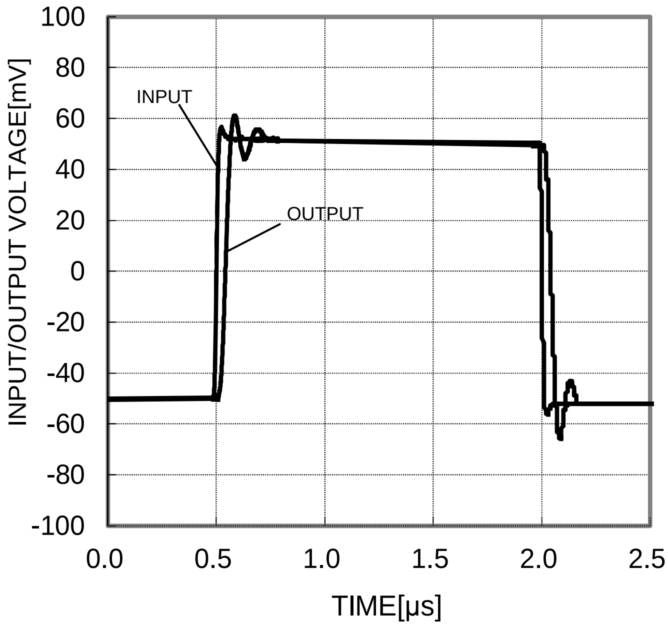


Figure 24.
Input / Output Voltage - Time
(VCC/VEE=15V/-15V, Av=0dB,
RL=2kΩ, CL=100pF, Ta=25℃)

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

○BA3474, BA3474R

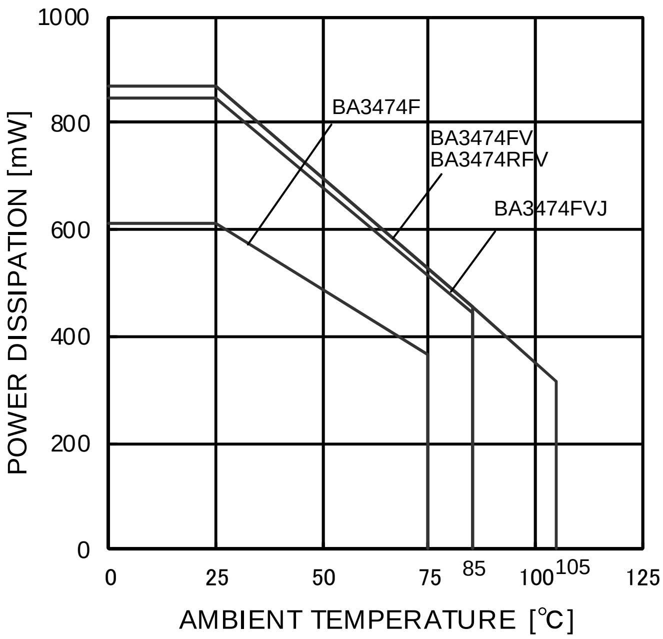


Figure 25.
Derating Curve

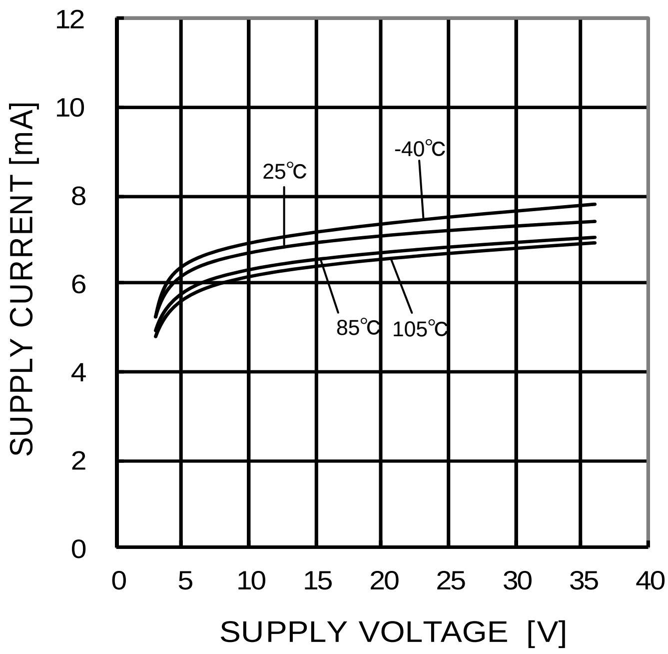


Figure 26.
Supply Current - Supply Voltage

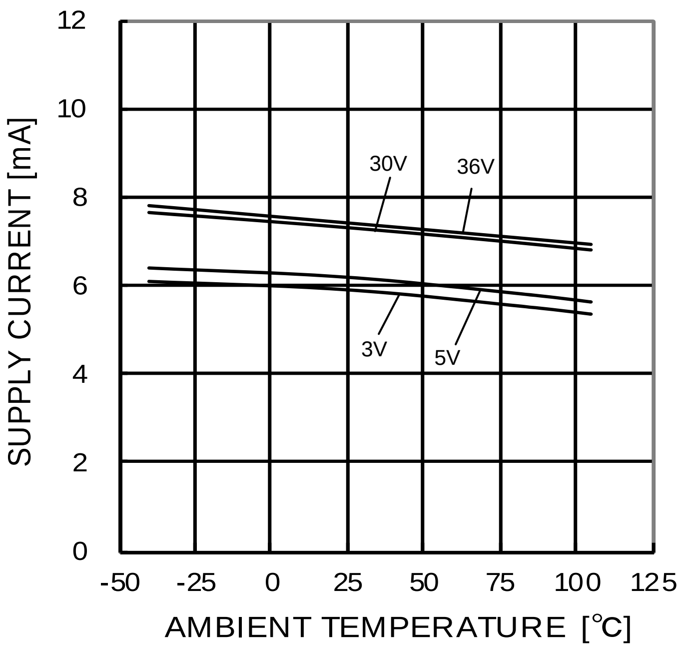


Figure 27.
Supply Current - Ambient Temperature

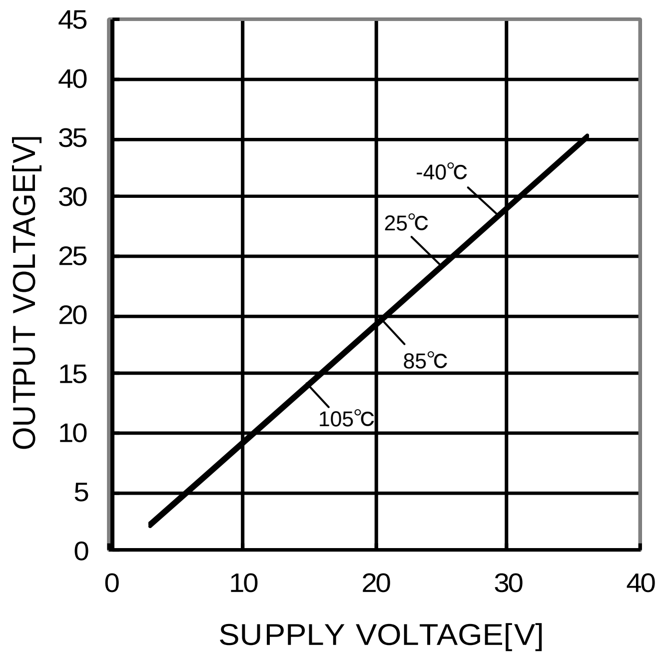


Figure 28.
High level Output Voltage
- Supply Voltage
(RL=10kΩ)

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

○BA3474, BA3474R

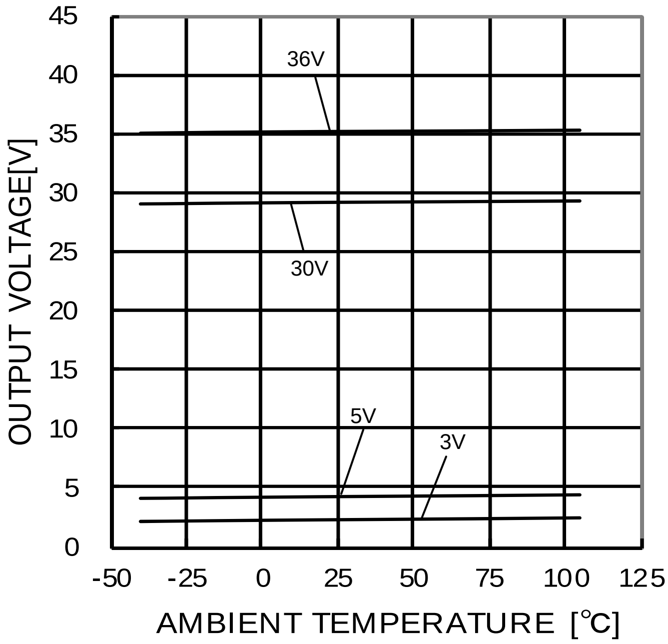


Figure 29.
High level Output Voltage
- Ambient Temperature
(RL=10kΩ)

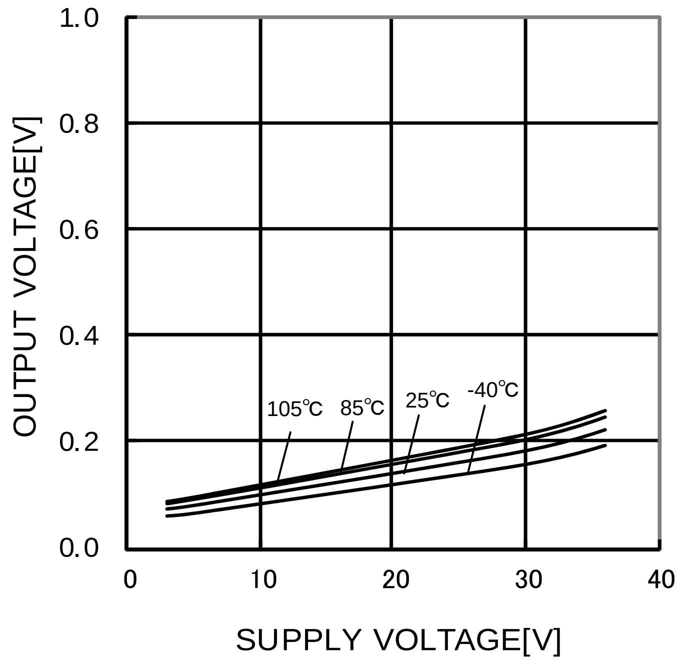


Figure 30.
Low level Output Voltage
- Supply Voltage
(RL=10kΩ)

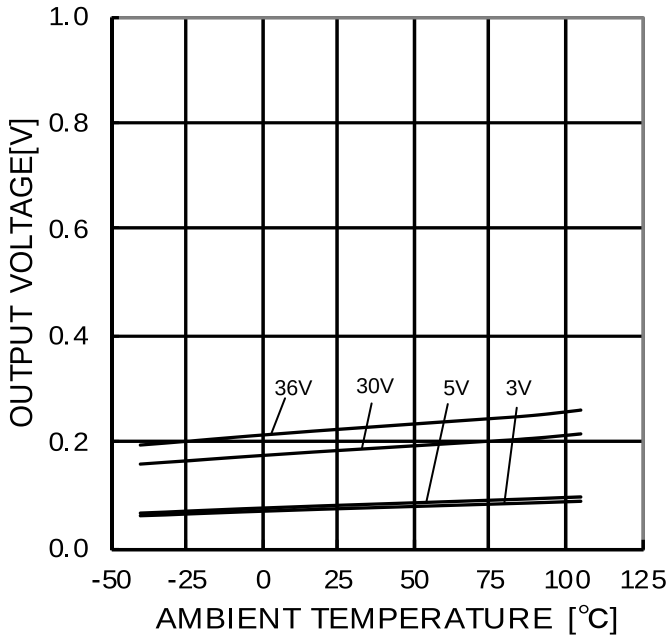


Figure 31.
Low level Output Voltage
－Ambient Temperature
(RL=10kΩ)

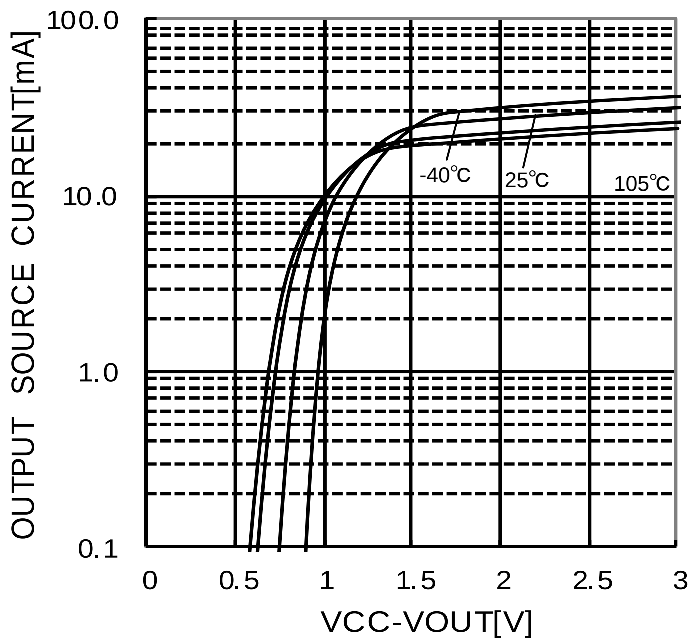


Figure 32.
Output Source Current - (VCC-VOUT)
(VCC/VEE=5V/0V)

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

○BA3474, BA3474R

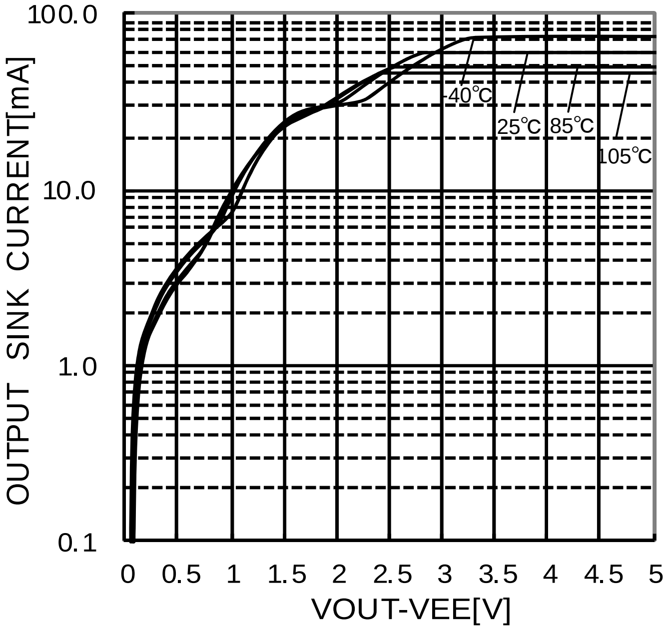


Figure 33.
Output Sink Current - (VOUT-VEE)
(VCC/VEE=5V/0V)

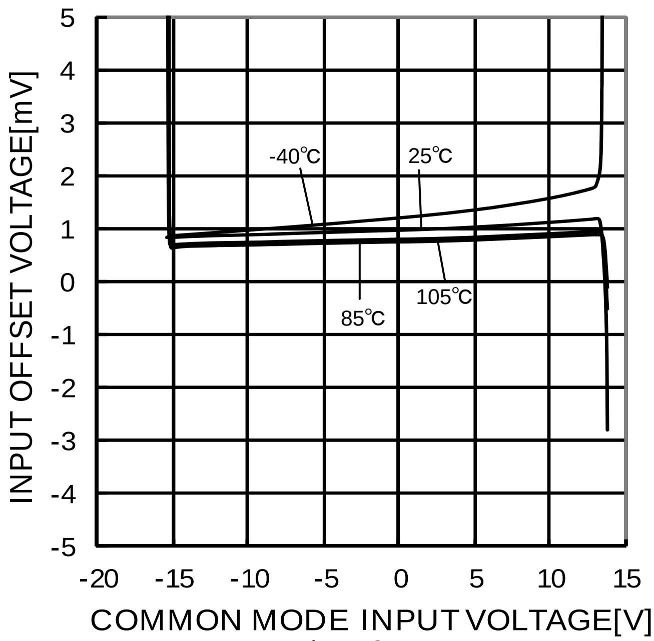


Figure 34.
Input Common-mode Voltage Range
(VCC/VEE=15V/-15V)

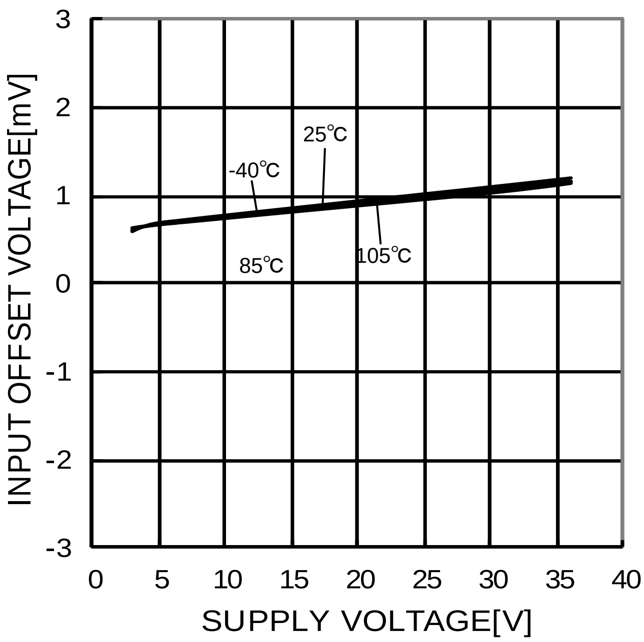


Figure 35.
Input Offset Voltage - Supply voltage

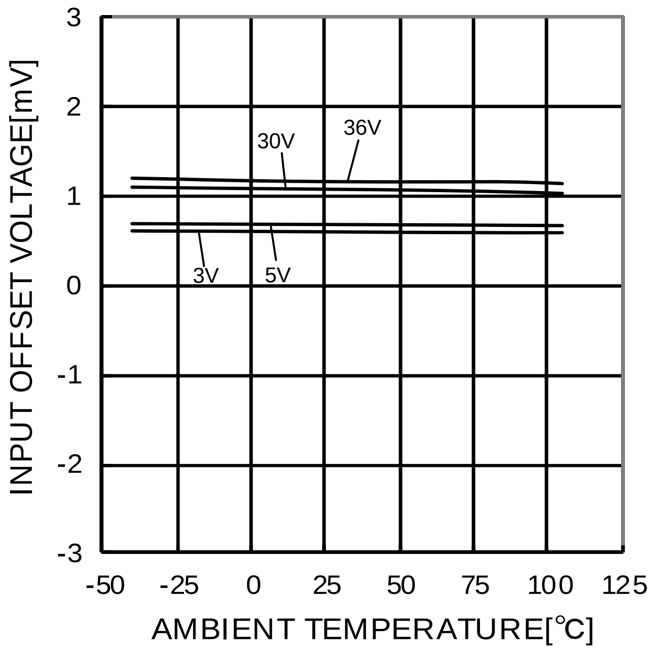


Figure 36.
Input Offset Voltage - Ambient Temperature

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

○BA3474, BA3474R

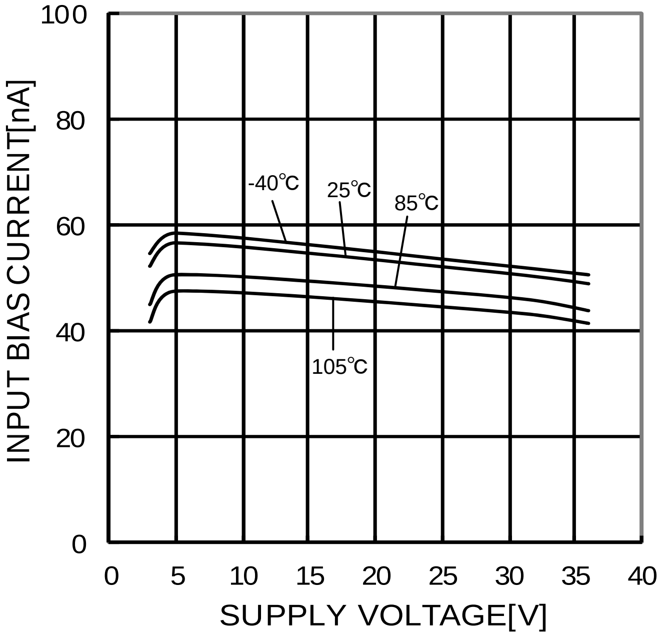


Figure 37.
Input Bias Current - Supply voltage

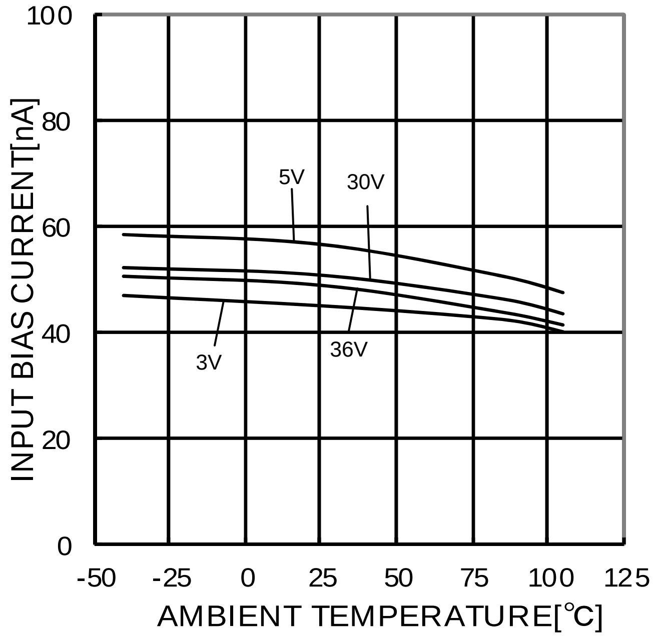


Figure 38.
Input Bias Current - Ambient Temperature

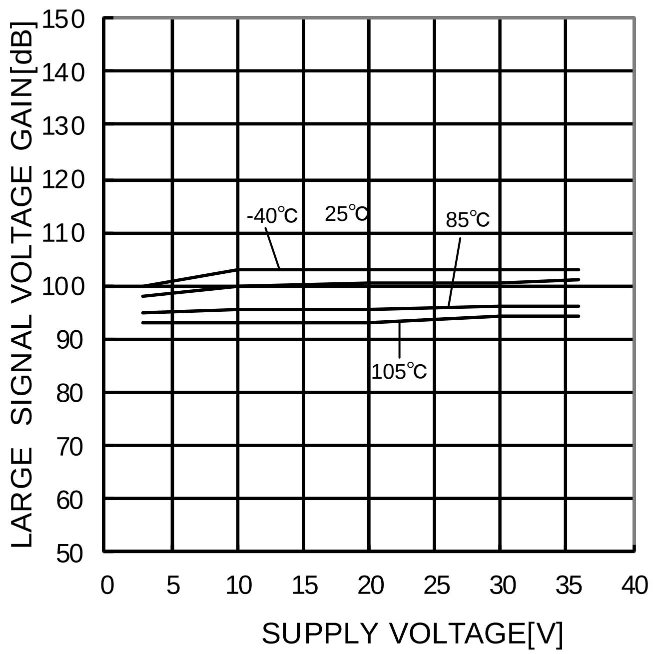


Figure 39.
Large Signal Voltage Gain
- Supply Voltage

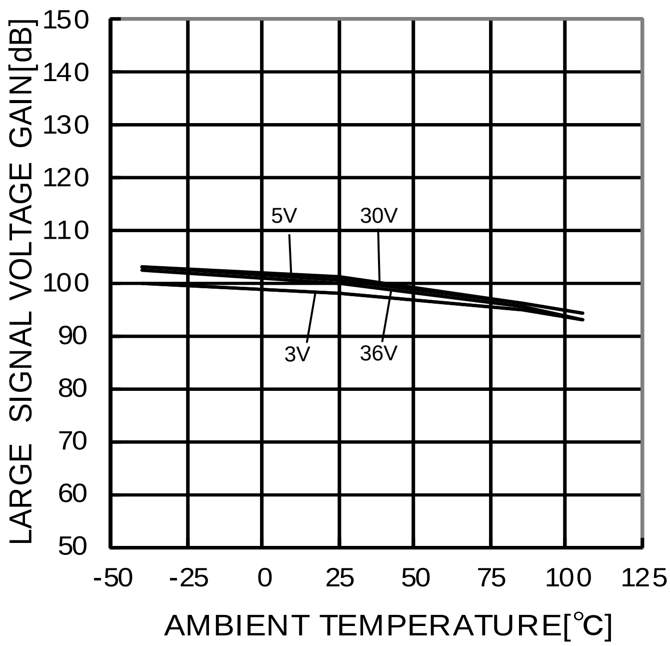


Figure 40.
Large Signal Voltage Gain
- Ambient Temperature

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

○BA3474, BA3474R

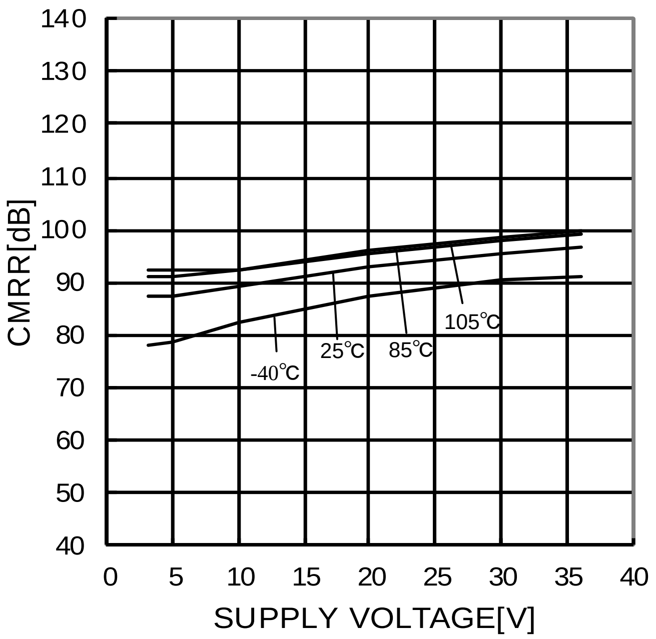


Figure 41.
Common Mode Rejection Ratio
- Supply Voltage

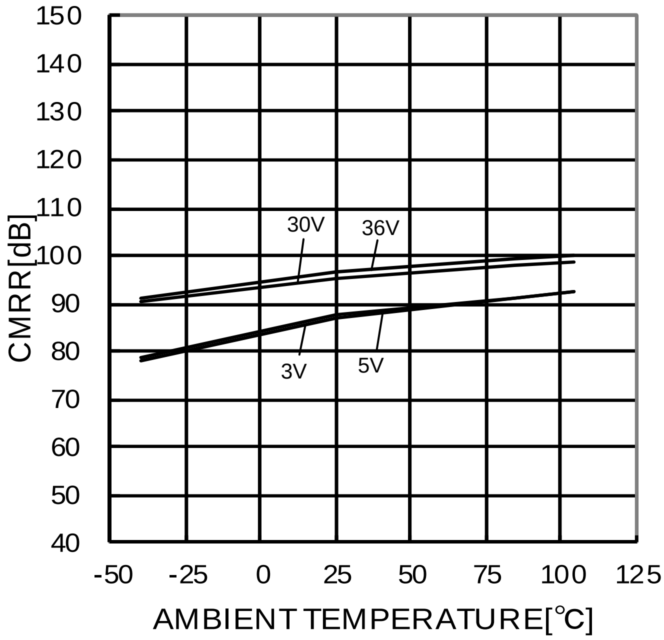


Figure 42.
Common Mode Rejection Ratio
- Ambient Temperature

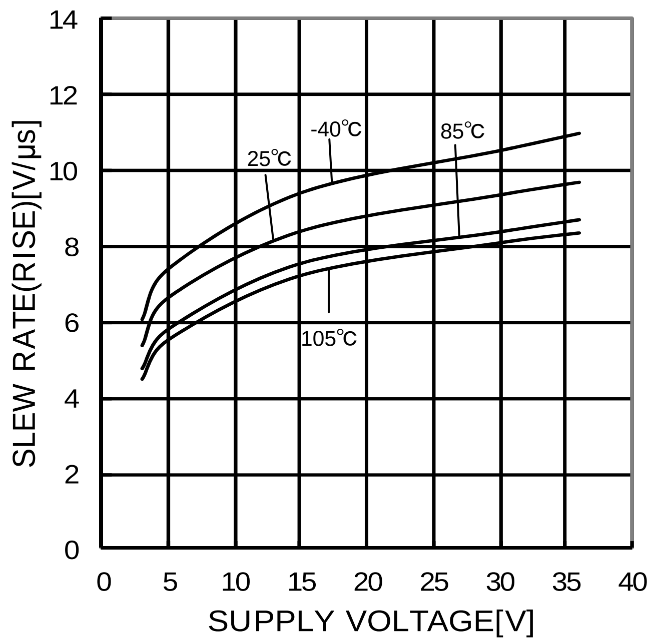


Figure 43.
Slew Rate L-H - Supply Voltage
(RL=10kΩ)

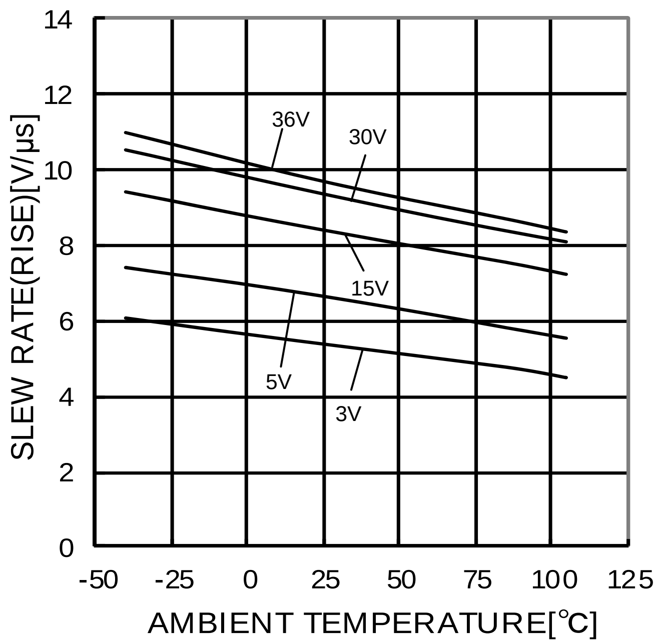


Figure 44.
Slew Rate L-H - Ambient Temperature
(RL=10kΩ)

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

○BA3474, BA3474R

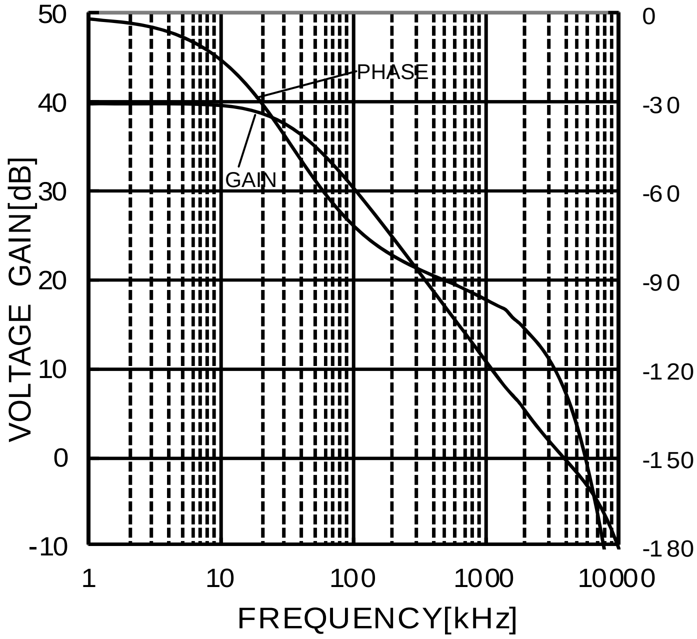


Figure 45.
Voltage Gain・Phase - Frequency
(VCC=7.5V/-7.5V, Av=40dB,
RL=2kΩ, CL=100pF, Ta=25℃)

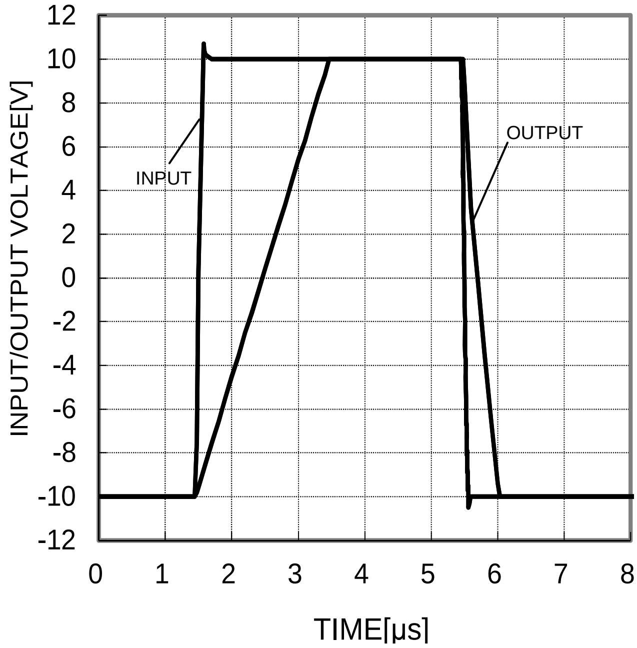


Figure 46.
Input / Output Voltage - Time
(VCC/VEE=15V/-15V, Av=0dB,
RL=2kΩ, CL=100pF, Ta=25℃)

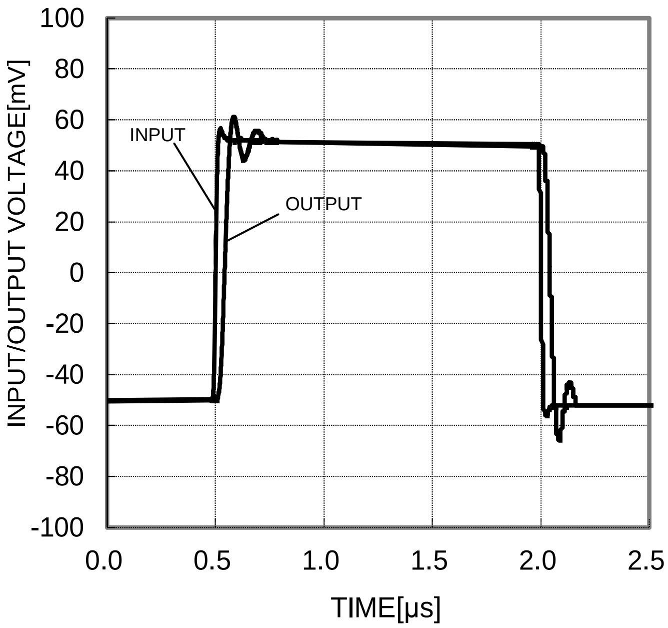


Figure 47.
Input / Output Voltage - Time
(VCC/VEE=15V/-15V, Av=0dB,
RL=2kΩ, CL=100pF, Ta=25℃)

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

Application Information

NULL method condition for Test Circuit 1

VCC, VEE, EK, Vicm Unit : V

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

－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)

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

5. Common-mode Rejection Ratio (CMRR)

$$CMRR = 20 \times Log \frac{\Delta Vicm \times (1+Rf/Rs)}{|VF8-VF7|} \quad [dB]$$

6. Power Supply Rejection Ratio (PSRR)

$$PSRR = 20 \times Log \frac{\Delta Vcc \times (1+Rf/Rs)}{|VF10-VF9|} \quad [dB]$$

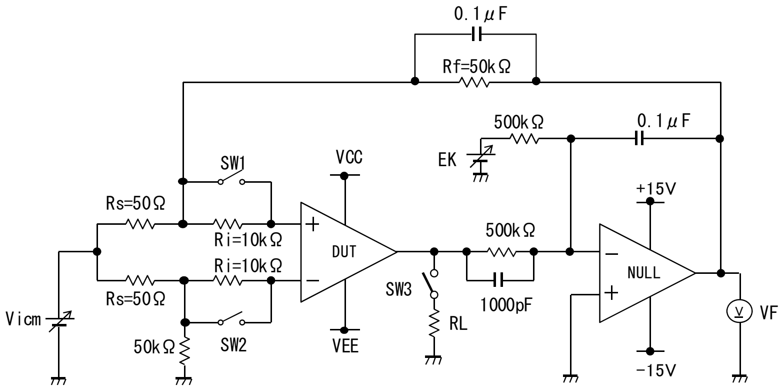


Figure 48. Test circuit 1 (one channel only)

Switch Condition for Test Circuit 2

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

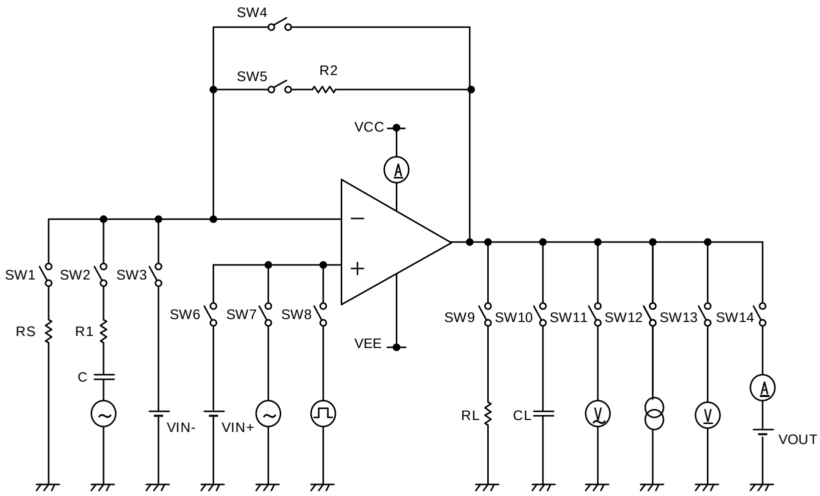


Figure 49. Test circuit 2 (one channel only)

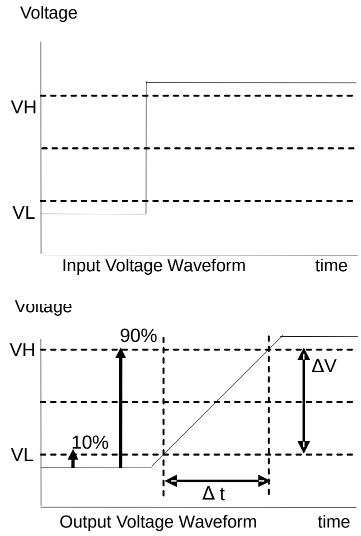
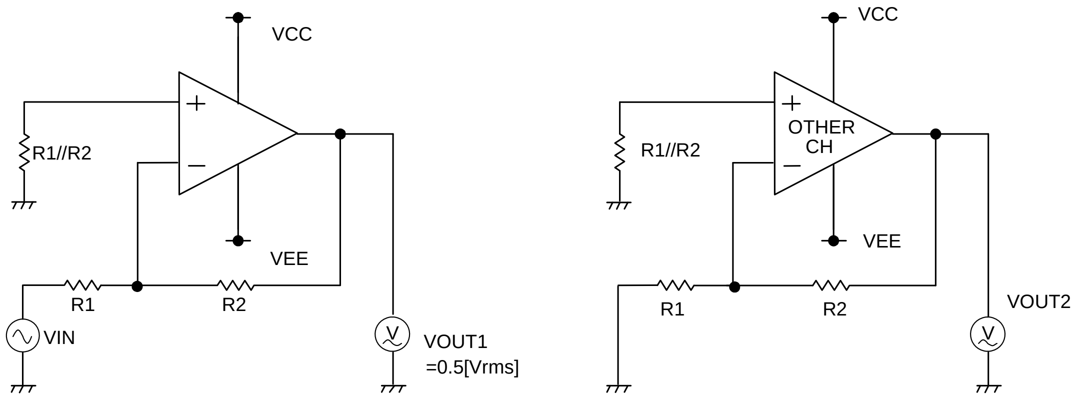


Figure 50. Slew rate input output wave



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

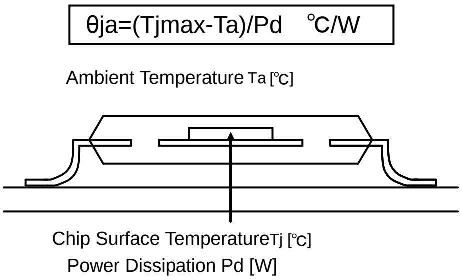
Figure 51. Test circuit 3 (Channel Separation)

Power Dissipation

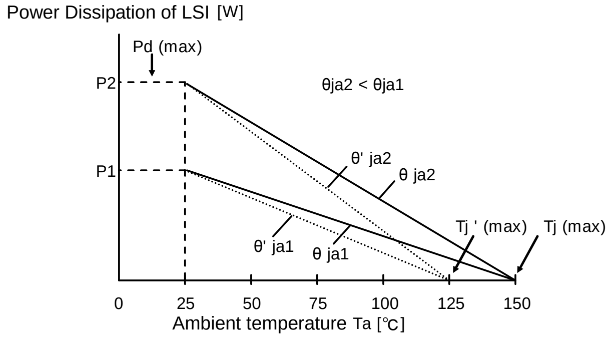
Power dissipation(total loss) indicates the power that can be consumed by IC at Ta=25℃(normal temperature). IC is heated when it consumed power, and the temperature of IC chip becomes higher than ambient temperature. The temperature that can be accepted by IC chip depends on circuit configuration, manufacturing 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. Figure 52. (a) shows the model of thermal resistance of the package. Thermal resistance θja, ambient temperature Ta, maximam junction temperature Tjmax, and power dissipation Pd can be calculated by the equation below:

θja = (Tjmax-Ta) / Pd ℃/W

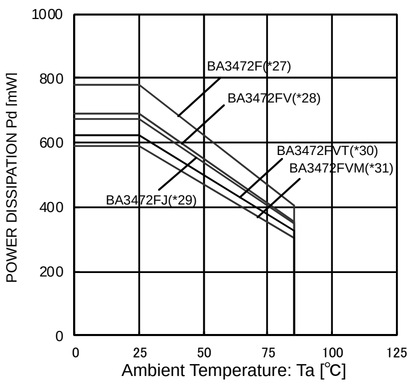
Derating curve in Figure 52. (b) indicates power that can be consumed by IC with reference to ambient temperature. Power that can be consumed by IC begins to attenuate at certain ambient temperature. This gradient iis determined by thermal resistance θja. Thermal resistance θja depends on chip size, 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. Figure 52. (c) to (f) shows a derating curve for an example of BA3472, BA3474, BA3472R, BA3474R.



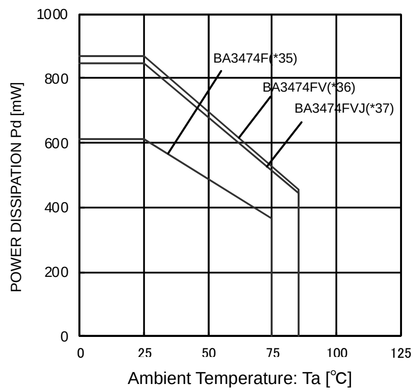
(a) Thermal Resistance



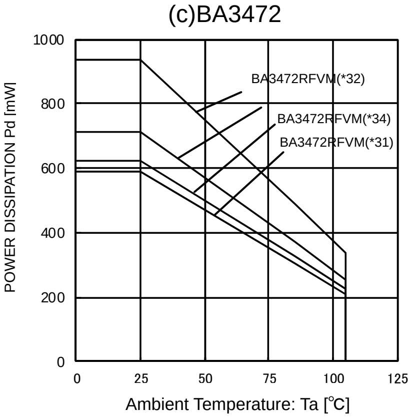
(b) Derating Curve



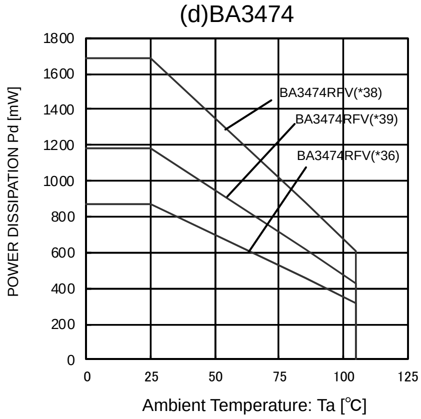
(c)BA3472



(d)BA3474



(e)BA3472R



(f)BA3474R

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

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

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

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

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

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

Figure 52. Thermal Resistance and Derating Curve

Operational Notes

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

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

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

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

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

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

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

8. **Operation Under Strong Electromagnetic Field**
Operating the IC in the presence of a strong electromagnetic field may cause the IC to malfunction.

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

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

Operational Notes – continued

11. Regarding the Input Pin of the IC
This monolithic IC contains P+ isolation and P substrate layers between adjacent elements in order to keep them isolated. P-N junctions are formed at the intersection of the P layers with the N layers of other elements, creating a parasitic diode or transistor. For example (refer to figure below):

When GND > Pin A and GND > Pin B, the P-N junction operates as a parasitic diode.
When GND > Pin B, the P-N junction operates as a parasitic transistor.

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

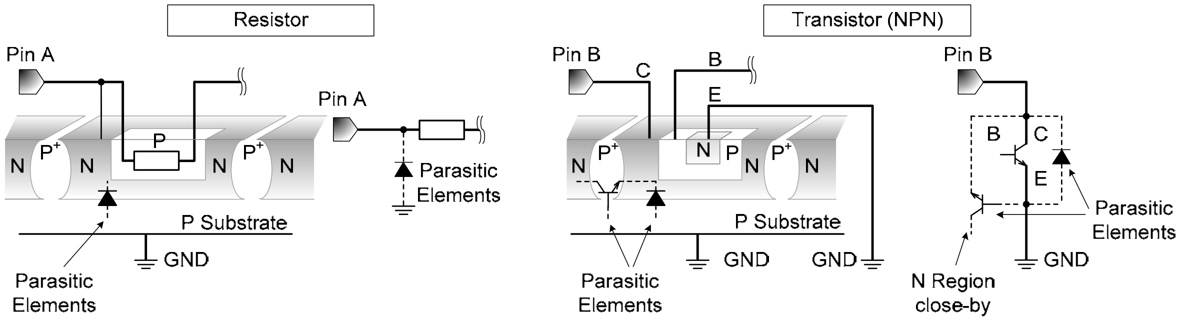


Figure 53. Example of monolithic IC structure

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

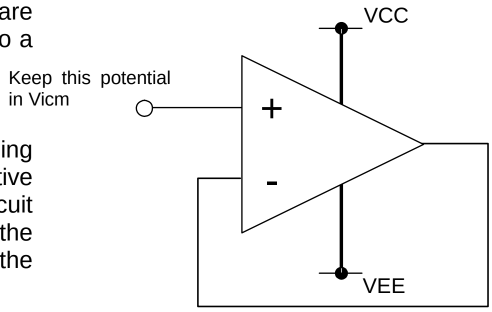


Figure 54. The Example of Application Circuit for Unused Op-amp

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

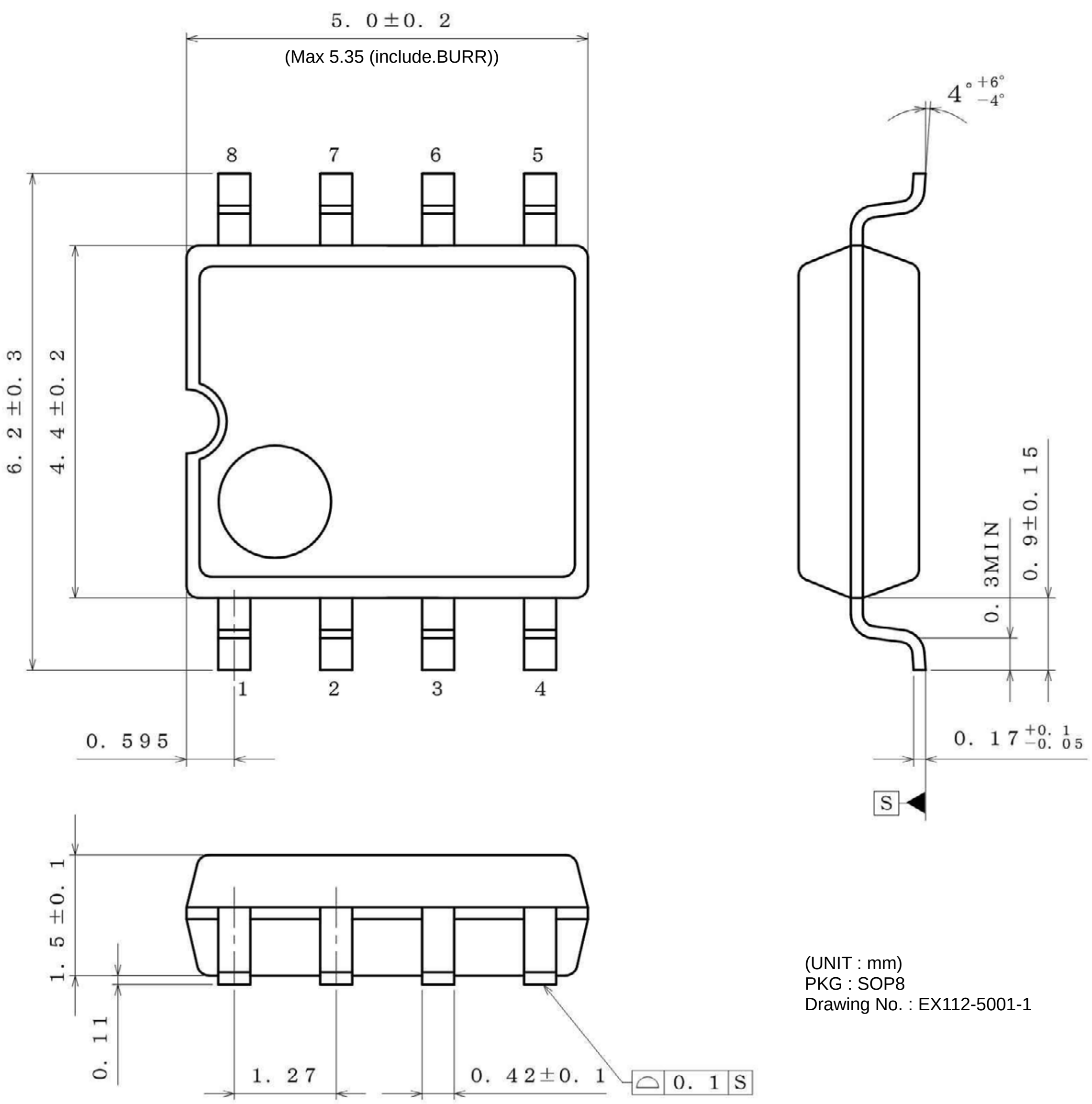
14. Power Supply (Single / Dual)
The op-amp operates when the specified voltage supplied is between VCC and VEE. Therefore, the single supply op-amp can be used as dual supply op-amp as well.

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

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

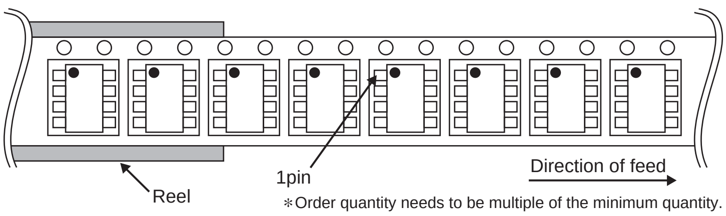
Physical Dimension, Tape and Reel Information

Package Name	SOP8



<Tape and Reel information>

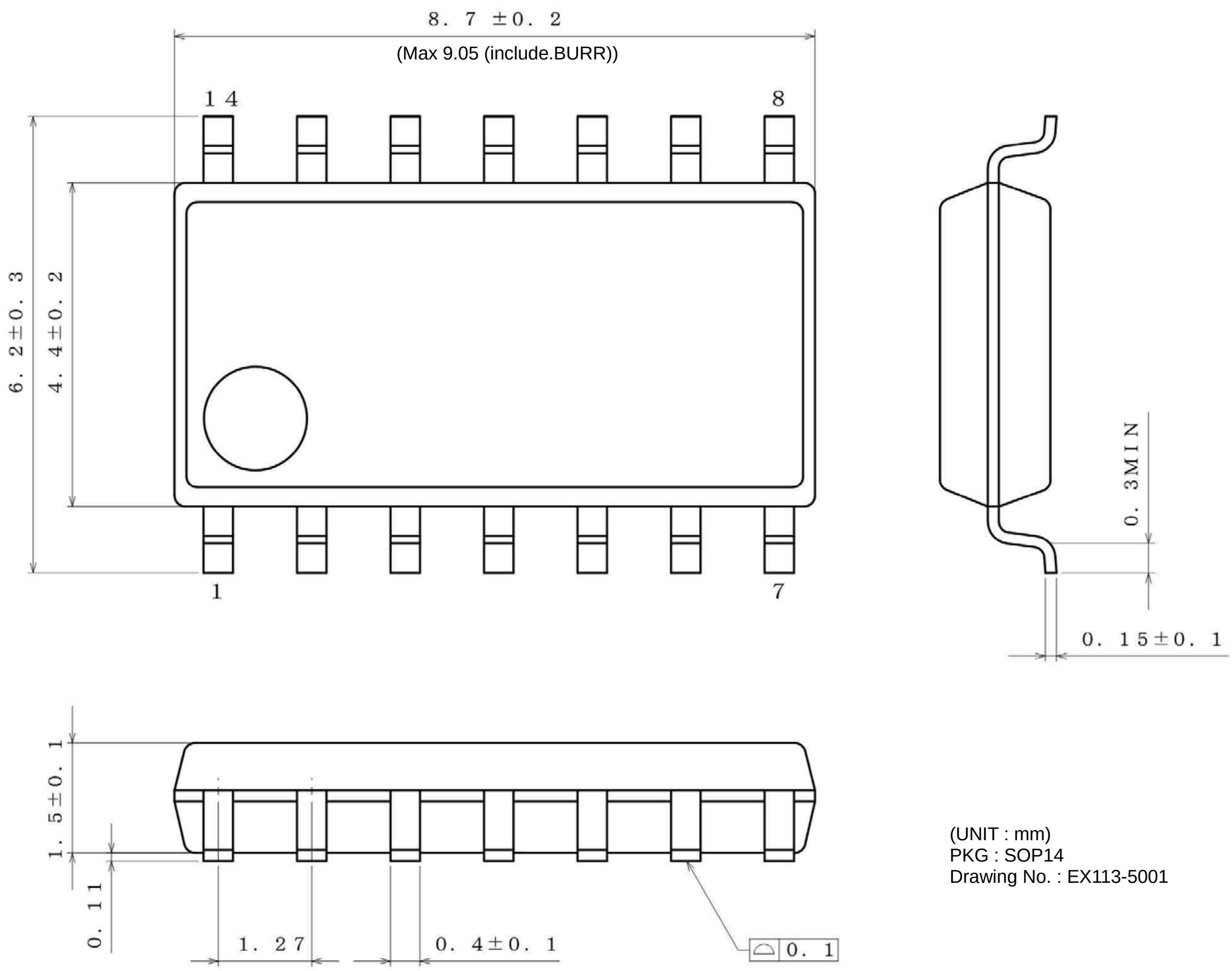
Tape	Embossed carrier tape
Quantity	2500pcs
Direction of feed	E2 (The direction is the 1pin of product is at the upper left when you hold reel on the left hand and you pull out the tape on the right hand)



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

Physical Dimension, Tape and Reel Information

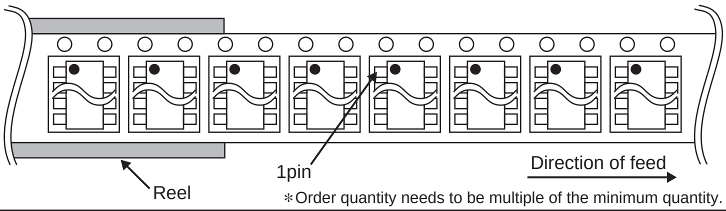
Package Name	SOP14



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

<Tape and Reel information>

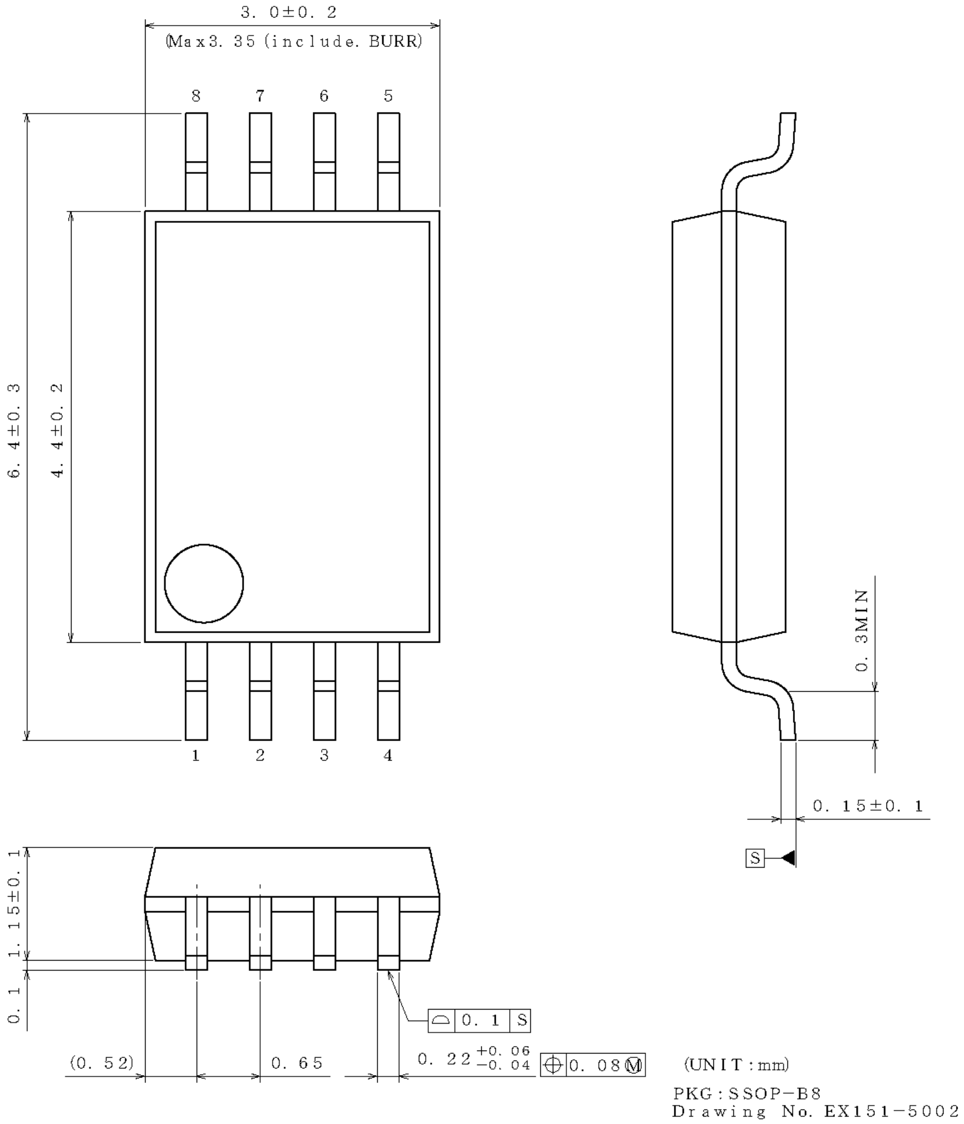
Tape	Embossed carrier tape
Quantity	2500pcs
Direction of feed	E2 (The direction is the 1pin of product is at the upper left when you hold reel on the left hand and you pull out the tape on the right hand)



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

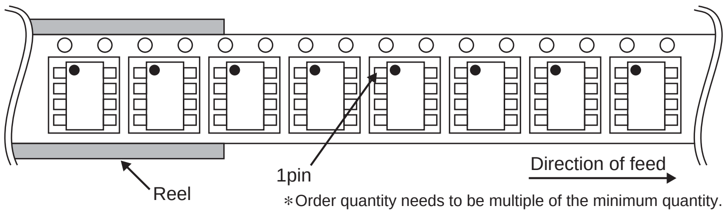
Physical Dimension, Tape and Reel Information

Package Name	SSOP-B8



<Tape and Reel information>

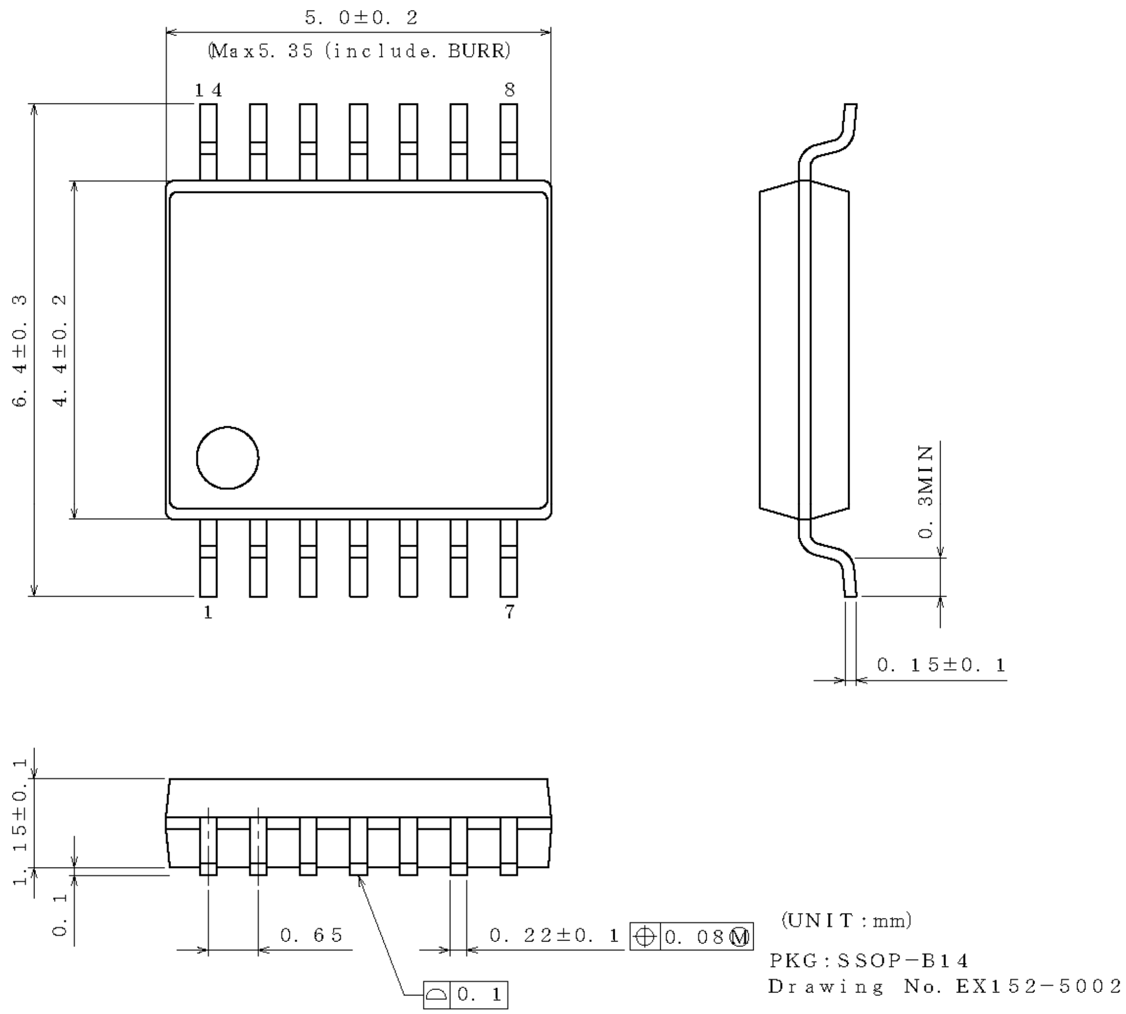
Tape	Embossed carrier tape
Quantity	2500pcs
Direction of feed	E2 (The direction is the 1pin of product is at the upper left when you hold reel on the left hand and you pull out the tape on the right hand)



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

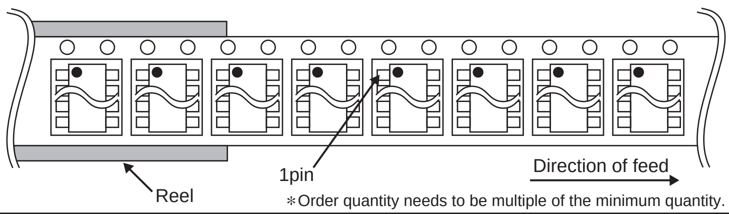
Physical Dimension, Tape and Reel Information

Package Name	SSOP-B14



<Tape and Reel information>

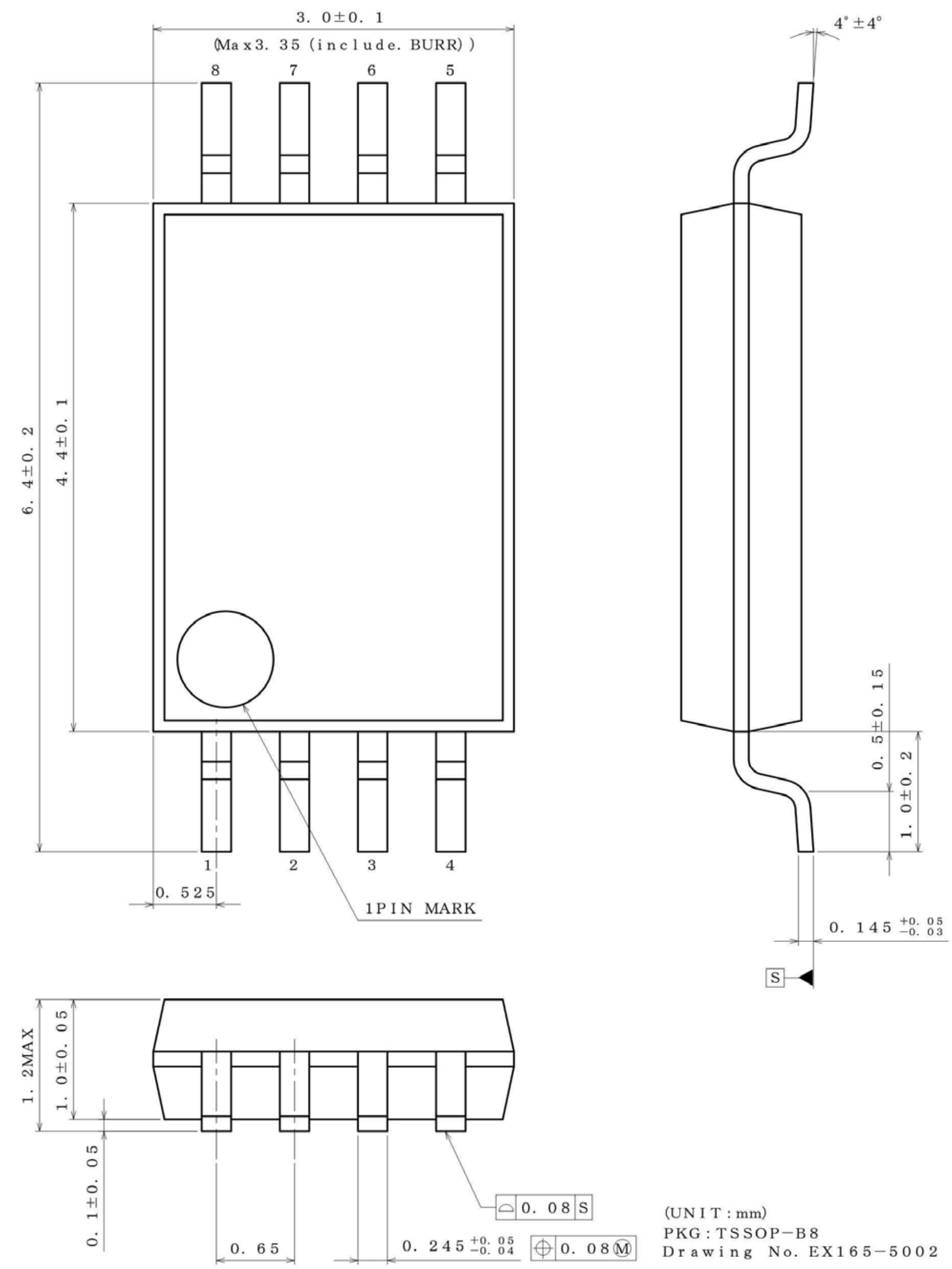
Tape	Embossed carrier tape
Quantity	2500pcs
Direction of feed	E2 (The direction is the 1pin of product is at the upper left when you hold reel on the left hand and you pull out the tape on the right hand)



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

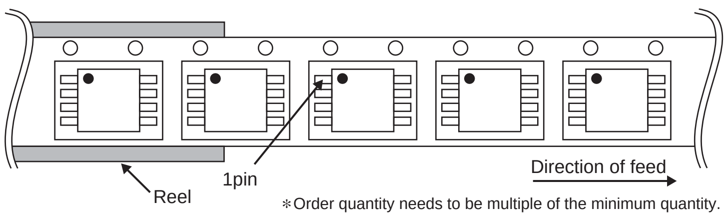
Physical Dimension, Tape and Reel Information

Package Name	TSSOP-B8



<Tape and Reel information>

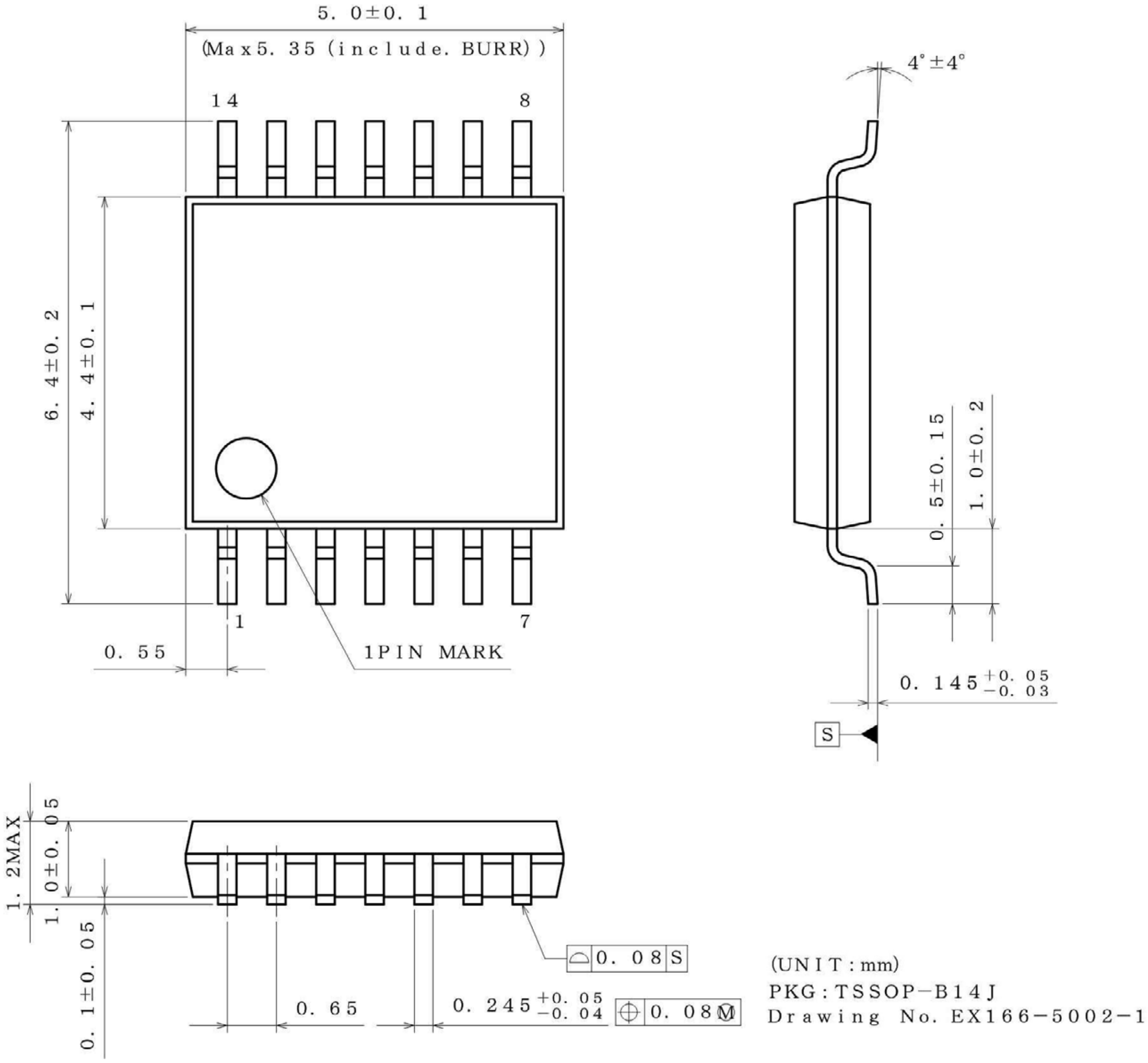
Tape	Embossed carrier tape
Quantity	3000pcs
Direction of feed	E2 (The direction is the 1pin of product is at the upper left when you hold reel on the left hand and you pull out the tape on the right hand)



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

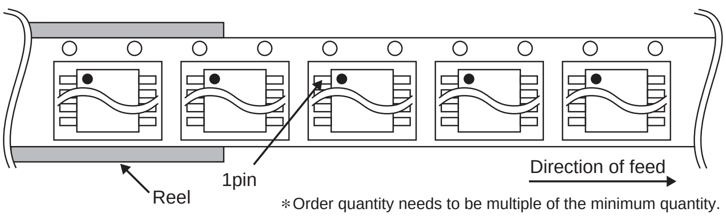
Physical Dimension, Tape and Reel Information

Package Name	TSSOP-B14J



<Tape and Reel information>

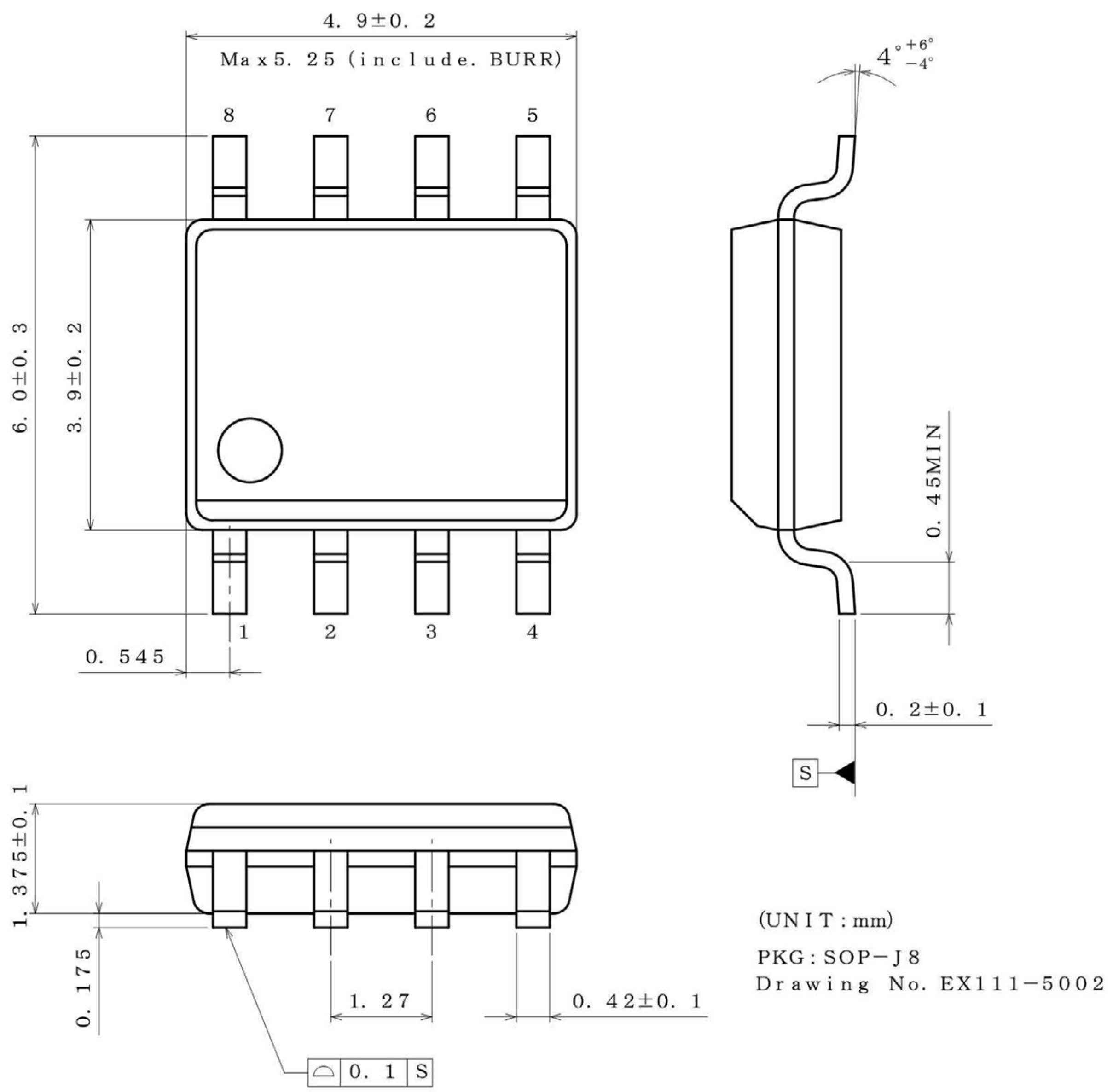
Tape	Embossed carrier tape
Quantity	2500pcs
Direction of feed	E2 (The direction is the 1pin of product is at the upper left when you hold reel on the left hand and you pull out the tape on the right hand)



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

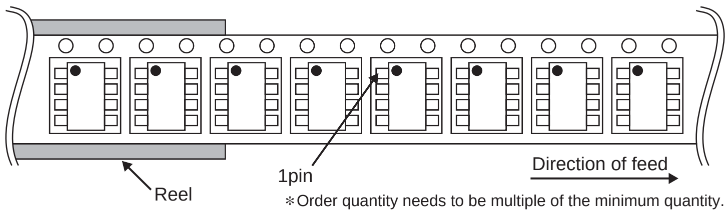
Physical Dimension, Tape and Reel Information

Package Name	SOP-J8



<Tape and Reel information>

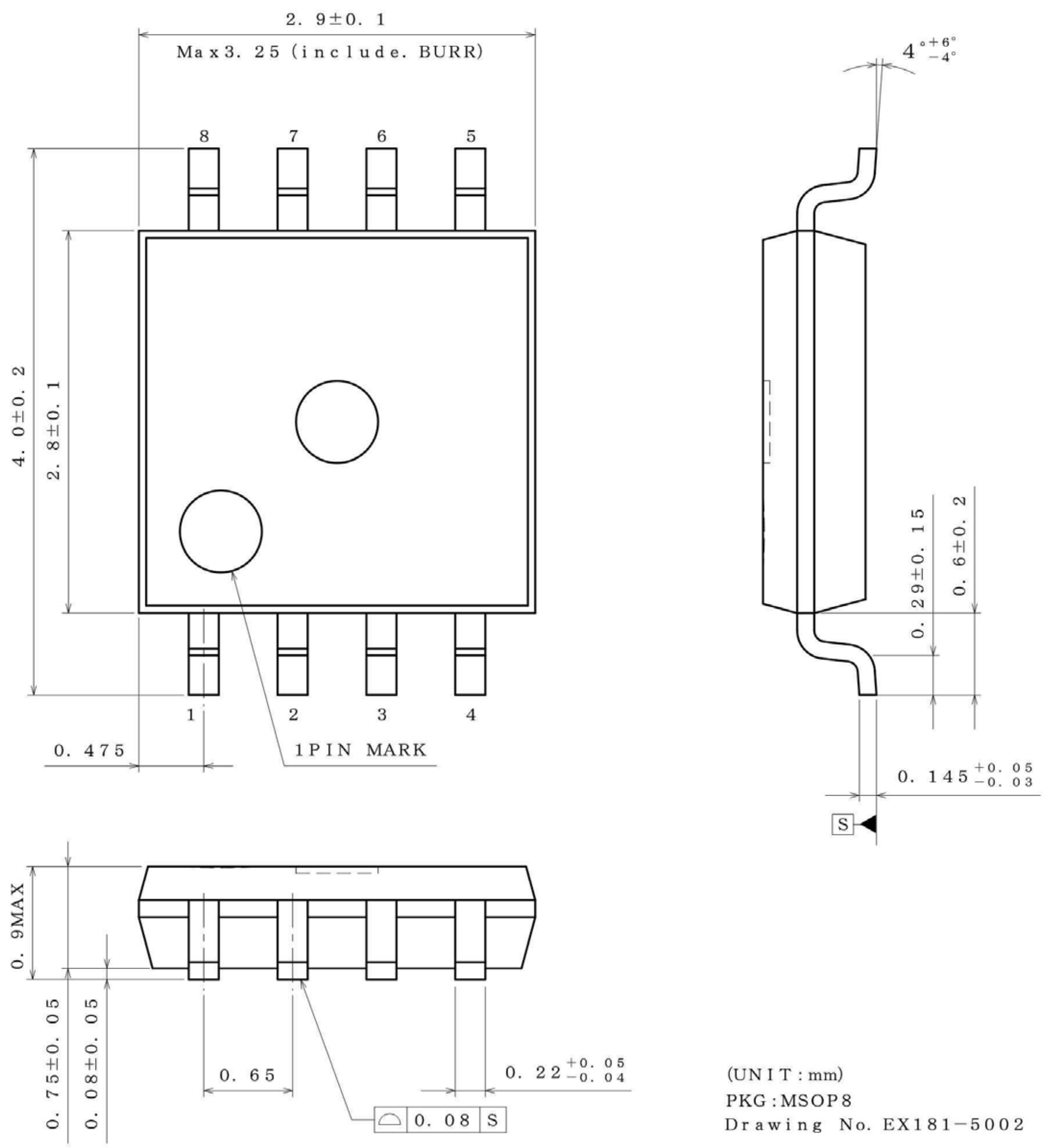
Tape	Embossed carrier tape
Quantity	2500pcs
Direction of feed	E2 (The direction is the 1pin of product is at the upper left when you hold reel on the left hand and you pull out the tape on the right hand)



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

Physical Dimension, Tape and Reel Information

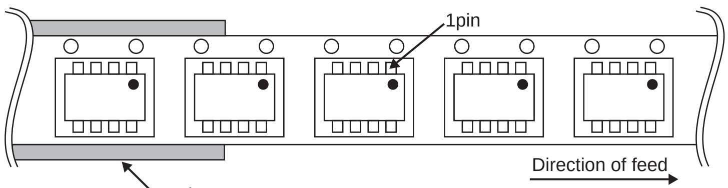
Package Name	MSOP8



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

<Tape and Reel information>

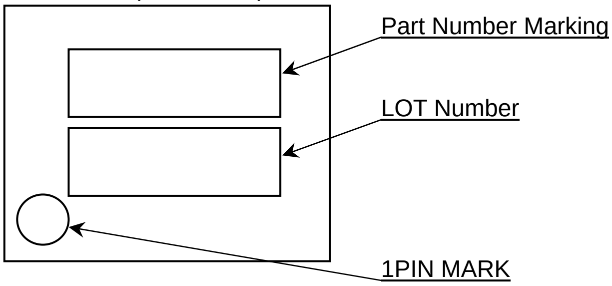
Tape	Embossed carrier tape
Quantity	3000pcs
Direction of feed	TR (The direction is the 1pin of product is at the upper right when you hold reel on the left hand and you pull out the tape on the right hand)



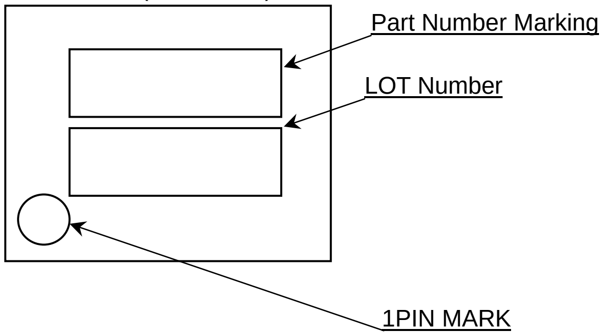
∗Order quantity needs to be multiple of the minimum quantity.

Marking Diagrams

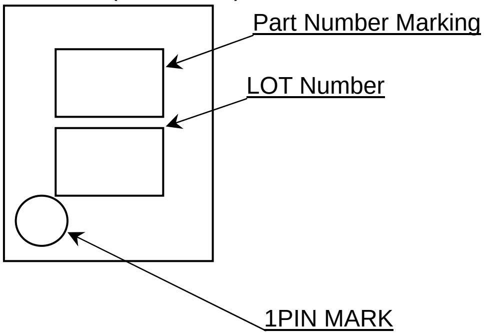
SOP8(TOP VIEW)



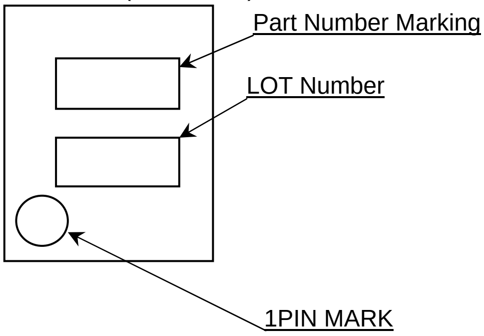
SOP14(TOP VIEW)



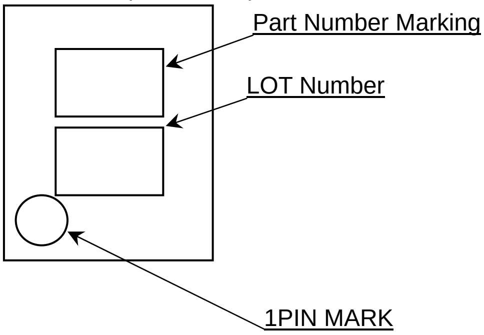
SSOP-B8(TOP VIEW)



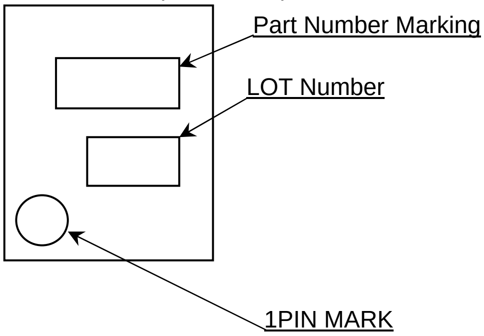
SSOP-B14(TOP VIEW)



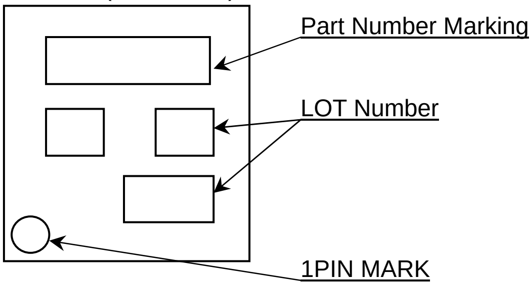
TSSOP-B8(TOP VIEW)



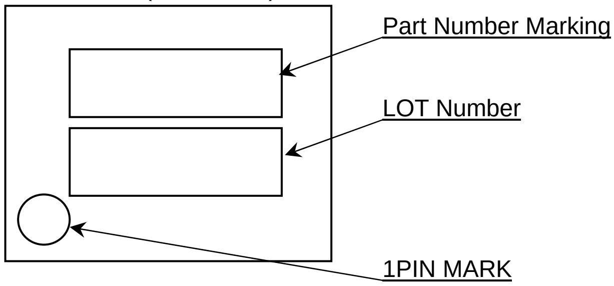
TSSOP-B14J (TOP VIEW)



MSOP8(TOP VIEW)



SOP-J8(TOP VIEW)

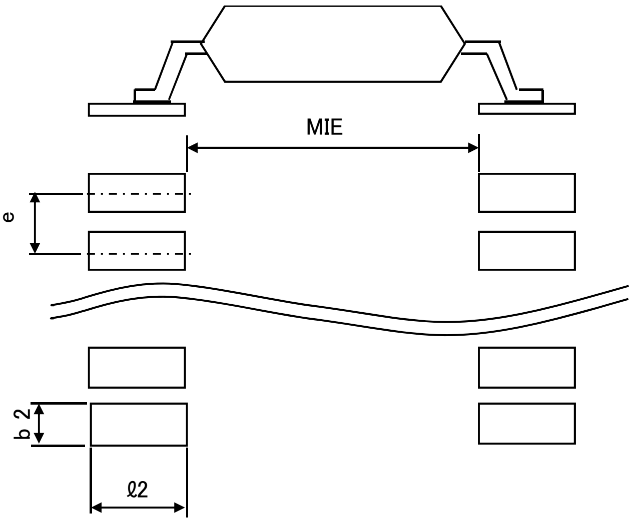


Product Name		Package Type	Marking
BA3472	F	SOP8	3472
	FV	SSOP-B8	
	FVM	MSOP8	
	FJ	SOP-J8	
	FVT	TSSOP-B8	
BA3472R	FVM	MSOP8	3472R
BA3474	F	SOP14	3474F
	FV	SSOP-B14	3474
	FVJ	TSSOP-B14J	
BA3474R	FV	SSOP-B14	3474R

Land pattern data

all dimensions in mm

PKG	Land pitch e	Land space MIE	Land length ≧ℓ 2	Land width b2
SOP8 SOP14	1.27	4.60	1.10	0.76
SOP-J8	1.27	3.90	1.35	0.76
SSOP-B8 SSOP-B14	0.65	4.60	1.20	0.35
MSOP8	0.65	2.62	0.99	0.35
TSSOP-B8	0.65	4.60	1.20	0.35
TSSOP-B14J	0.65	4.60	1.20	0.35



Revision History

Date	Revision	Changes
27.Feb.2012	001	New Release
26.Oct.2012	002	Addition BA3472FJ, BA3472FVT, BA3474FVJ Addition Land pattern data
23.Apr.2014	003	Addition Input Current of Absolute Maximum Ratings(Page 2) Addition of item of Operational Notes
11.Jul.2014	004	Correction of simplified schematic.(Page 1)

Notice

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1. Our Products are designed and manufactured for application in ordinary electronic equipments (such as AV equipment, OA equipment, telecommunication equipment, home electronic appliances, amusement equipment, etc.). If you intend to use our Products in devices requiring extremely high reliability (such as medical equipment (Note 1), transport equipment, traffic equipment, aircraft/spacecraft, nuclear power controllers, fuel controllers, car equipment including car accessories, safety devices, etc.) and whose malfunction or failure may cause loss of human life, bodily injury or serious damage to property ("Specific Applications"), please consult with the ROHM sales representative in advance. Unless otherwise agreed in writing by ROHM in advance, ROHM shall not be in any way responsible or liable for any damages, expenses or losses incurred by you or third parties arising from the use of any ROHM's Products for Specific Applications.

(Note1) Medical Equipment Classification of the Specific Applications

JAPAN	USA	EU	CHINA
CLASSⅢ	CLASSⅢ	CLASSⅡb	CLASSⅢ
CLASSⅣ		CLASSⅢ	

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   [b] Installation of redundant circuits to reduce the impact of single or multiple circuit failure

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   [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

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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.

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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.

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