Operational Amplifiers / Comparators

Ground Sense Operational Amplifiers

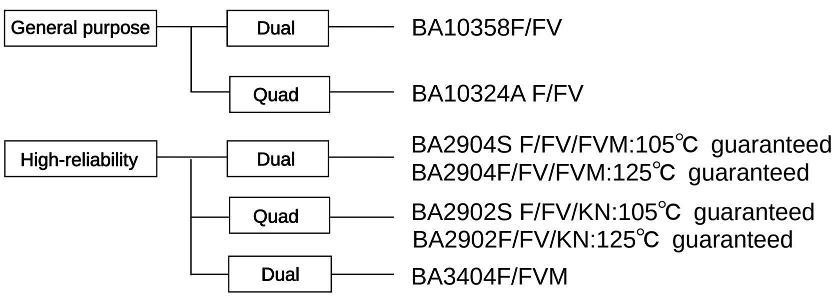
Pb Free ROHM Electronic Components · RoHS Directive Compliance

BA10358F/FV,BA10324AF/FV,BA2904S F/FV/FVM,BA2904F/FV/FVM BA2902SF/FV/KN,BA2902F/FV/KN,BA3404F/FVM

No.11049EBT15

●Description

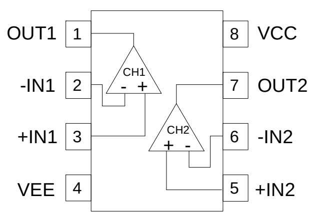
General-purpose BA10358/BA10324A family and high-reliability BA2904 /BA2902 family integrate two or four independent Op-Amps and phase compensation capacitors on a single chip and have some features of high-gain, low power consumption, and operating voltage range of 3[V] to 32[V] (single power supply). BA3404 family is realized high speed operation and reduces the crossover distortions that compare with BA10358 family.

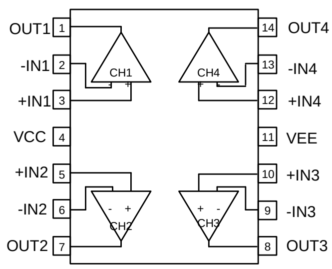


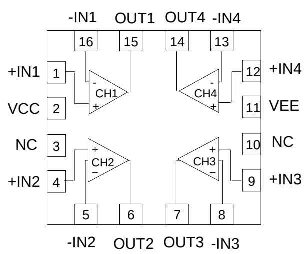
●Characteristics

1) Operable with a single power supply
2) Wide operating supply voltage
   +3.0[V]～+32.0[V](single supply) (BA10358/BA10324A/BA2904/BA2902 family)
   +4.0[V]～+36.0[V](single supply) (BA3404 family)
3) Standard Op-Amp Pin-assignments
4) Input and output are operable GND sense
5) Internal phase compensation type
6) Low supply current
7) High open loop voltage gain
8) Internal ESD protection
   Human body model (HBM) ±5000[V](Typ.)(BA2904/BA2902/BA3404 family)
9) Gold PAD (BA2904/BA2902/BA3404 family)
10) Wide temperature range
   -40[℃]～+85[℃] (BA10358/BA10324/BA3404 family)
   -40[℃]～+105[℃] (BA2904S/BA2902S family)
   -40[℃]～+125[℃] (BA2904/BA2902 family)

●Pin Assignment







SOP8	SSOP-B8	MSOP8	SOP14	SSOP-B14	VQFN16
BA10358F BA2904SF BA2904F BA3404F	BA10358FV BA2904SFV BA2904FV	BA2904SFVM BA2904FVM BA3404FVM	BA10324AF BA2902SF BA2902F	BA10324AFV BA2902SFV BA2902FV	BA2902SKN BA2902KN

●Absolute Maximum Ratings (Ta=25[℃])

○BA10358 family,BA10324A family

Parameter	Symbol	Ratings		Unit
		BA10358 family	BA10324A family	
Supply Voltage	VCC-VEE	+32		V
Differential Input Voltage (*1)	Vid	VCC-VEE		V
Input Common-mode Voltage Range	Vicm	(VEE-0.3)～VCC		V
Operating Temperature Range	Topr	-40～+85		℃
Storage Temperature Range	Tstg	-55～+125		℃
Maximum Junction Temperature	Tjmax	+125		℃

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

(*1) The voltage difference between inverting input and non-inverting input is the differential input voltage.
Then input terminal voltage is set to more than VEE.

●Electric Characteristics

○BA10358 family (Unless otherwise specified VCC=+5[V], VEE=0[V], Ta=25[℃])

Parameter	Symbol	Temperature Range	Limits			Unit	Condition
			BA10358F/FV				
			Min.	Typ.	Max.		
Input Offset Voltage (*2)	Vio	25℃	-	2	7	mV	VOUT=1.4[V]
Input Offset Current (*2)	Iio	25℃	-	5	50	nA	VOUT=1.4[V]
Input Bias Current (*3)	Ib	25℃	-	45	250	nA	VOUT=1.4[V]
Supply Current	ICC	25℃	-	0.7	1.2	mA	RL=∞ All Op-Amps
Large Signal Voltage Gain	AV	25℃	25	100	-	V/mV	RL≧2[kΩ],VCC=15[V], VOUT=1.4～11.4[V]
Input Common-mode Voltage Range	Vicm	25℃	0	-	VCC-1.5	V	(VCC-VEE)=5[V], VOUT=VEE+1.4[V]
Common-mode Rejection Ratio	CMRR	25℃	65	80	-	dB	VOUT=1.4[V]
Power Supply Rejection Ratio	PSRR	25℃	65	100	-	dB	VCC=5～30[V]
Output Source Current	IOH	25℃	10	20	-	mA	VIN+=1[V],VIN-=0[V], VOUT=0[V], 1CH is short circuit
Output Sink Current	IOL	25℃	10	20	-	mA	VIN+=0[V],VIN-=1[V], VOUT=5[V], 1CH is short circuit
Output Voltage Range	Vo	25℃	0	-	VCC-1.5	V	RL=2[kΩ]
Channel Separation	CS	25℃	-	120	-	dB	f=1[kHz], input referred

(*2) Absolute value

(*3) Current direction: Since first input stage is composed with PNP transistor, input bias current flows out of IC.

○BA10324A family (Unless otherwise specified VCC=+5[V], VEE=0[V], Ta=25[℃])

Parameter	Symbol	Temperature Range	Limits BA10324A F/FV			Unit	Condition
			Min.	Typ.	Max.		
Input Offset Voltage (*4)	Vio	25℃	-	2	7	mV	VOUT=1.4[V]
Input Offset Current (*4)	Iio	25℃	-	5	50	nA	VOUT=1.4[V]
Input Bias Current (*5)	Ib	25℃	-	20	250	nA	VOUT=1.4[V]
Supply Current	ICC	25℃	-	0.6	2	mA	RL=∞ All Op-Amps
High Level Output Voltage	VOH	25℃	3.5	-	-	V	RL=2[kΩ]
Low Level Output Voltage	VOL	25℃	-	-	250	mV	RL=∞ All Op-Amps
Large Signal Voltage Gain	AV	25℃	25	100	-	V/mV	RL≧2[kΩ],VCC=15[V], VOUT=1.4～11.4[V]
Input Common-mode Voltage range	Vicm	25℃	0	-	VCC-1.5	V	(VCC-VEE)=5[V], VOUT=VEE+1.4[V]
Common-mode Rejection Ratio	CMRR	25℃	65	75	-	dB	VOUT=1.4[V]
Power Supply Rejection Ratio	PSRR	25℃	65	100	-	dB	VCC=5～30[V]
Output Source Current	IOH	25℃	20	35	-	mA	VIN+=1[V],VIN-=0[V], VOUT=0[V], 1CH is short circuit
Output Sink Current	IOL	25℃	10	20	-	mA	VIN+=0[V],VIN-=1[V], VOUT=5[V] 1CH is short circuit
Channel Separation	CS	25℃	-	120	-	dB	f=1[kHz], input referred

(*4) bsolute value
(*5) Current direction: Since first input stage is composed with PNP transistor, input bias current flows out of IC.

● Absolute Maximum Ratings (Ta=25[℃])

○BA2904/BA2902 family

Parameter	Symbol	Ratings		Unit
		BA2904S F/FV/FVM BA2902S F/FV/KN	BA2904F/FV/FVM BA2902F/FV/KN	
Supply Voltage	VCC-VEE	+32		V
Differential Input Voltage (*6)	Vid	32		V
Input Common-mode Voltage Range	Vicm	(VEE-0.3)～(VEE+32)		V
Operating Temperature Range	Topr	-40～+105	-40～+125	℃
Storage Temperature Range	Tstg	-55～+150		℃
Maximum Junction Temperature	Tjmax	+150		℃

Note:Absolute maximum rating item indicates the condition which must not be exceeded.
Application if voltage in excess of absolute maximum rating or use out of absolute maximum rated temperature environment may cause deterioration of characteristics.
(*6) The voltage difference between inverting input and non-inverting input is the differential input voltage. Then input terminal voltage is set to more than VEE.

● Electric Characteristics

○BA2904 family (Unless otherwise specified VCC=+5[V], VEE=0[V])

Parameter	Symbol	Temperature Range	Limits BA2904S F/FV/FVM BA2904F/FV/FVM			Unit	Condition
			Min.	Typ.	Max.		
Input Offset Voltage (*7) (*8)	Vio	25℃	-	2	7	mV	VOUT=1.4[V]
		Full range	-	-	10		VCC=5～30[V],VOUT=1.4[V]
Input Offset Voltage Drift	△Vio/△T	-	-	±7	-	μV/℃	VOUT=1.4[V]
Input Offset Current (*7) (*8)	Iio	25℃	-	2	50	nA	VOUT=1.4[V]
		Full range	-	-	200		
Input Offset Current Drift	△Iio/△T	-	-	±10	-	pA/℃	VOUT=1.4[V]
Input Bias Current (*7) (*8)	Ib	25℃	-	20	250	nA	VOUT=1.4[V]
		Full range	-	-	250		
Supply Current (*8)	ICC	25℃	-	0.7	1.2	mA	RL=∞All Op-Amps
		Full range	-	-	2		
High Level Output Voltage (*8)	VOH	25℃	3.5	-	-	V	RL=2[kΩ]
		Full range	27	28	-		VCC=30[V],RL=10[kΩ]
Low Level Output Voltage (*8)	VOL	Full range	-	5	20	mV	RL=∞ All Op-Amps
Large Signal Voltage Gain	AV	25℃	25	100	-	V/mV	RL≧2[kΩ],VCC=15[V] VOUT=1.4～11.4[V]
Input Common-mode Voltage Range	Vicm	25℃	0	-	VCC-1.5	V	(VCC-VEE)=5[V], VOUT=VEE+1.4[V]
Common-mode Rejection Ratio	CMRR	25℃	50	80	-	dB	VOUT=1.4[V]
Power Supply Rejection Ratio	PSRR	25℃	65	100	-	dB	VCC=5~30[V]
Output Source Current (*8) (*9)	IOH	25℃	20	30	-	mA	VIN+=1[V],VIN-=0[V] VOUT=0[V] 1CH is short circuit
		Full range	10	-	-		
Output Sink Current (*8) (*9)	IOL	25℃	10	20	-	mA	VIN+=0[V],VIN-=1[V] VOUT=5[V] 1CH is short circuit
		Full range	2	-	-		
	Isink	25℃	12	40	-	μA	VIN+=0[V],VIN-=1[V] VOUT=200[mV]
Channel Separation	CS	25℃	-	120	-	dB	f=1[kHz], input referred
Slew rate	SR	25℃	-	0.2	-	V/μs	VCC=15[V],AV=0[dB], RL=2[kΩ],CL=100[pF]
Maximum frequency	ft	25℃	-	0.5	-	MHz	VCC=30[V],RL=2[kΩ], CL=100[pF]
Input referred noise voltage	Vn	25℃	-	40	-	$nV/\sqrt{Hz}$	VCC=15[V],VEE=-15[V], RS=100[Ω],Vi=0[V],f=1[kHz]

(*7) Absolute value
(*8) BA2904S family:Full range -40～+105℃ BA2904 family:Full range -40～+125℃
(*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.

○BA2902 family (Unless otherwise specified VCC=+5[V], VEE=0[V])

Parameter	Symbol	Temperature Range	Limits BA2902S F/FV/KN BA2902F/FV/KN Min.	Typ.	Max.	Unit	Condition
Input Offset Voltage (*10) (*11)	Vio	25℃	-	2	7	mV	VOUT=1.4[V]
		Full range	-	-	10		VCC=5～30[V],VOUT=1.4[V]
Input Offset Voltage Drift	△Vio/△T	-	-	±7	-	μV/℃	VOUT=1.4[V]
Input Offset Current (*10) (*11)	Iio	25℃	-	2	50	nA	VOUT=1.4[V]
		Full range	-	-	200		
Input Offset Current Drift	△Iio/△T	-	-	±10	-	pA/℃	VOUT=1.4[V]
Input Bias Current (*10) (*11)	Ib	25℃	-	20	250	nA	VOUT=1.4[V]
		Full range	-	-	250		
Supply Current (*10)	ICC	25℃	-	0.7	2	mA	RL=∞ All Op-Amps
		Full range	-	-	3		
High Level Output Voltage (*11)	VOH	25℃	3.5	-	-	V	RL=2[kΩ]
		Full range	27	28	-		VCC=30[V],RL=10[kΩ]
Low Level Output Voltage (*11)	VOL	Full range	-	5	20	mV	RL=∞All Op-Amps
Large Signal Voltage Gain	AV	25℃	25	100	-	V/mV	RL≧2[kΩ],VCC=15[V] VOUT=1.4～11.4[V]
Input Common-mode Voltage Range	Vicm	25℃	0	-	VCC-1.5	V	(VCC-VEE)=5[V], VOUT=VEE+1.4[V]
Common-mode Rejection Ratio	CMRR	25℃	50	80	-	dB	VOUT=1.4[V]
Power Supply Rejection Ratio	PSRR	25℃	65	100	-	dB	VCC=5~30[V]
Output SourceCurrent (*11) (*12)	IOH	25℃	20	30	-	mA	VIN+=1[V],VIN-=0[V] VOUT=0[V] 1CH is short circuit
		Full range	10	-	-		
Output Sink Current (*11) (*12)	IOL	25℃	10	20	-	mA	VIN+=0[V],VIN-=1[V] VOUT=5[V] 1CH is short circuit
		Full range	2	-	-		
	Isink	25℃	12	40	-	μA	VIN+=0[V],VIN-=1[V] VOUT=200[mV]
Channel Separation	CS	25℃	-	120	-	dB	f=1[kHz], input referred
Slew rate	SR	25℃	-	0.2	-	V/μs	VCC=15[V],AV=0[dB], RL=2[kΩ],CL=100[pF]
Maximum frequency	ft	25℃	-	0.5	-	MHz	VCC=30[V],RL=2[kΩ], CL=100[pF]
Input referred noise voltage	Vn	25℃	-	40	-	$nV/\sqrt{Hz}$	VCC=15[V],VEE=-15[V], RS=100[Ω],Vi=0[V],f=1[kHz]

(*10) Absolute value
(*11) BA2902S family:Full range -40～+105℃ ,BA2902 family:Full range -40～+125℃
(*12) Under high temperatures, please consider the power dissipation when selecting the output current.
When the output terminal is continuously shorted the output current reduces the internal temperature by flushing.

●Absolute Maximum Ratings (Ta=25[℃])

○BA3404 family

Parameter	Symbol	Ratings	Unit
Supply Voltage	VCC-VEE	+36	V
Differential Input Voltage (*13)	Vid	36	V
Input Common-mode Voltage Range	Vicm	(VEE-0.3)～(VEE+36)	V
Operating Temperature Range	Topr	-40～+85	℃
Storage Temperature Range	Tstg	-55～+150	℃
Maximum Junction Temperature	Tjmax	+150	℃

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

(*13) The voltage difference between inverting input and non-inverting input is the differential input voltage.
Then input terminal voltage is set to more than VEE.

●Electric Characteristics

○BA3404 family (Unless otherwise specified VCC=+15[V], VEE=-15[V], Ta=25[℃])

Parameter	Symbol	Temperature Range	Limits BA3404 family Min.	Typ.	Max.	Unit	Condition
Input Offset Voltage (*14)	Vio	25℃	-	2	5	mV	VOUT=0[V], Vicm=0[V]
Input Offset Current (*14)	Iio	25℃	-	5	50	nA	VOUT=0[V], Vicm=0[V]
Input Bias Current (*14)	Ib	25℃	-	70	200	nA	VOUT=0[V], Vicm=0[V]
Large Signal Voltage Gain	AV	25℃	88	100	-	dB	RL≧2[kΩ], VOUT=±10[V],Vicm=0[V]
Maximum Output Voltage	VOM	25℃	±13	±14	-	V	RL≧2[kΩ]
Input Common-mode Voltage Range	Vicm	25℃	-15	-	13	V	VOUT=0[V]
Common-mode Rejection Ratio	CMRR	25℃	70	90	-	dB	VOUT=0[V], Vicm=-15[V]～+13[V]
Power Supply Rejection Ratio	PSRR	25℃	80	94	-	dB	Ri≦10[kΩ], VCC=+4[V]～+30[V]
Supply Current	ICC	25℃	-	2.0	3.5	mA	RL=∞ All Op-Amps, VIN+=0[V]
Output Source Current	Isource	25℃	20	30	-	mA	VIN+=1[V],VIN-=0[V], VOUT=+12[V], Output of one channel only
Output Sink Current	Isink	25℃	10	20	-	mA	VIN+=0[V], VIN-=1[V], VOUT= -12[V], Output of one channel only
Slew rate	SR	25℃	-	1.2	-	V/μs	AV=0[dB], RL=2[kΩ],CL=100[pF]
Unity Gain Frequency	ft	25℃	-	1.2	-	MHz	RL=2[kΩ]
Total Harmonic Distortion	THD	25℃	-	0.1	-	%	VOUT=10[Vp-p],f=20[kHz], AV=0[dB],RL=2[kΩ]

(*14) Absolute value

●Reference Data (The data is ability value of sample, it is not guaranteed.)

○BA10358 family

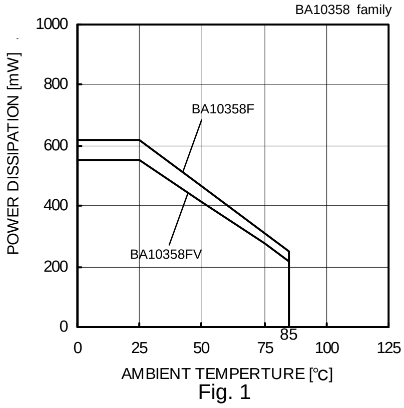


Fig. 1
Derating Curve

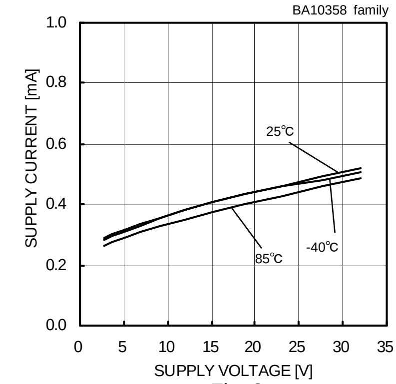


Fig. 2
Supply Current - Supply Voltage

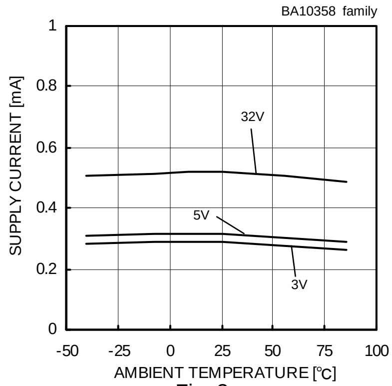


Fig. 3
Supply Current - Ambient Temperature

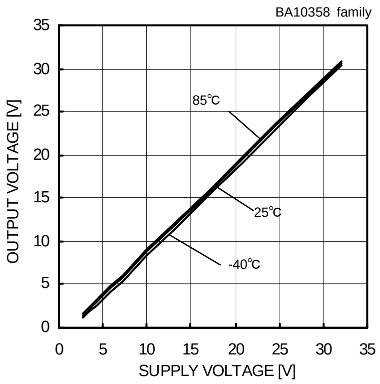


Fig. 4
Maximum Output Voltage - Supply Voltage
((RL=10[kΩ]))

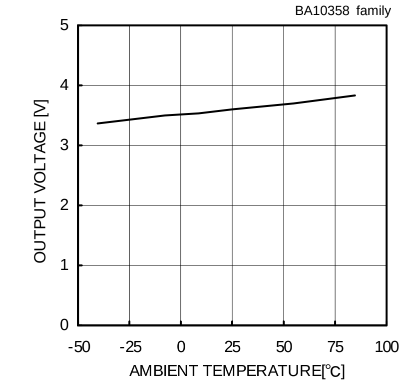


Fig. 5
Maximum Output Voltage - Ambient Temperature
(VCC=5[V],RL=2[kΩ])

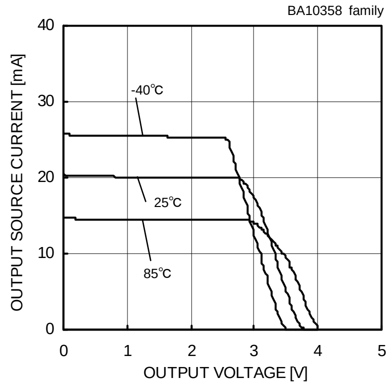


Fig. 6
Output Source Current - Output Voltage
(VCC=5[V])

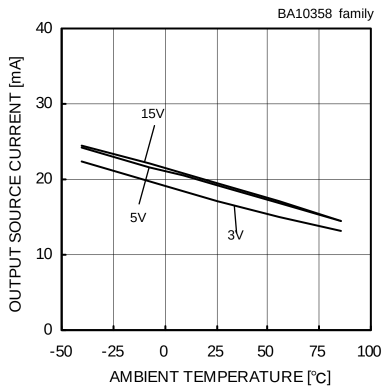


Fig. 7
Output Source Current - Ambient Temperature
(VOUT=0[V])

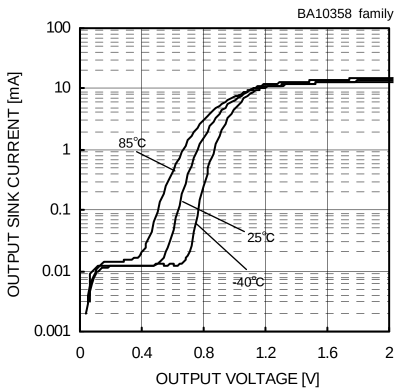


Fig. 8
Output Sink Current - Output Voltage
(VCC=5[V])

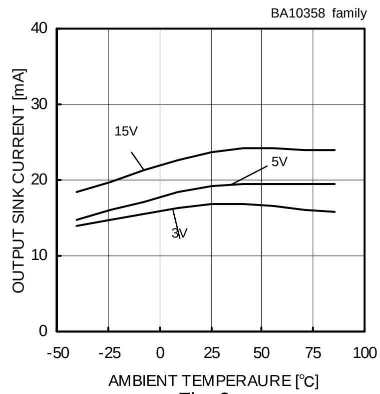


Fig. 9
Output Sink Current - Ambient Temperature
(VOUT=VCC)

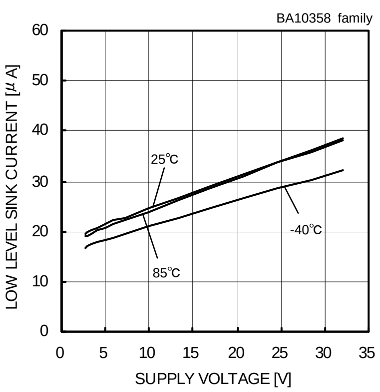


Fig. 10
Low Level Sink Current - Supply Voltage
(VOUT=0.2[V])

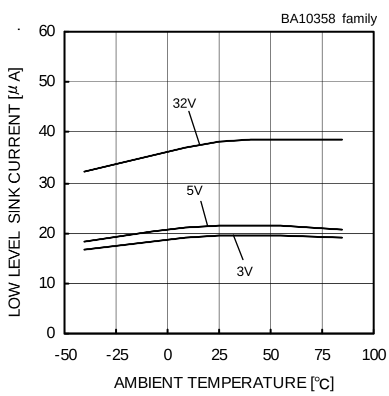


Fig. 11
Low Level Sink Current - Ambient Temperature
(VOUT=0.2[V])

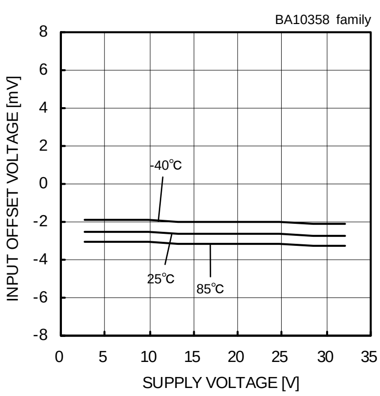


Fig. 12
Input Offset Voltage - Supply Voltage
(Vicm=0[V], VOUT=1.4[V])

○BA10358 family

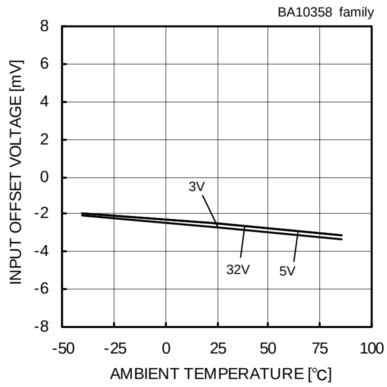


Fig. 13

Input Offset Voltage - Ambient Temperature
(Vicm=0[V], VOUT=1.4[V])

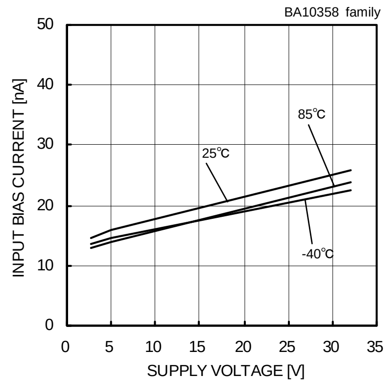


Fig. 14

Input Bias Current - Supply Voltage
(Vicm=0[V], VOUT=1.4[V])

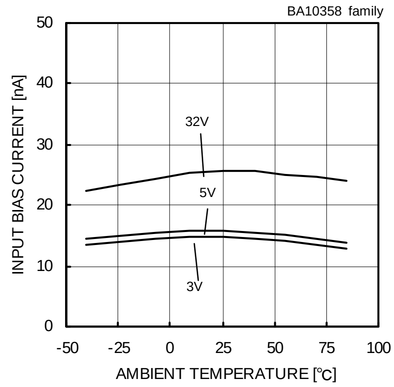


Fig. 15

Input Bias Current - Ambient Temperature
(Vicm=0[V],VOUT=1.4[V])

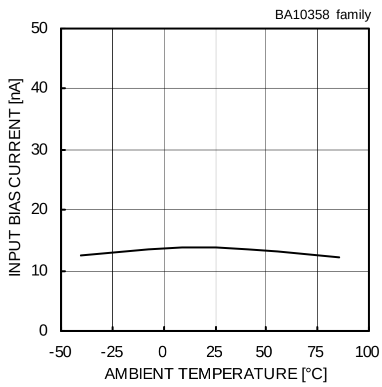


Fig. 16

Input Bias Current - Ambient Temperature
(VCC=30[V],Vicm=28[V],VOUT=1.4[V])

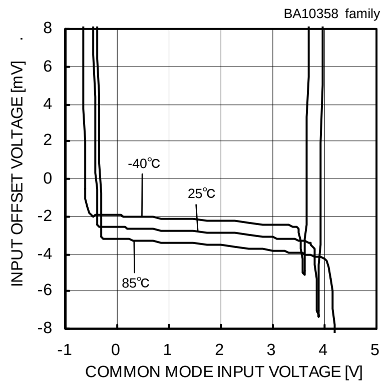


Fig. 17

Input Offset Voltage - Common Mode Input Voltage
(VCC=5[V])

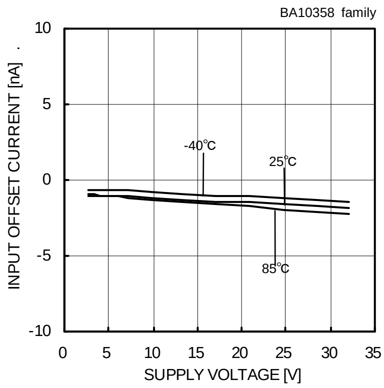


Fig. 18

Input Offset Current - Supply Voltage
(Vicm=0[V],VOUT=1.4[V])

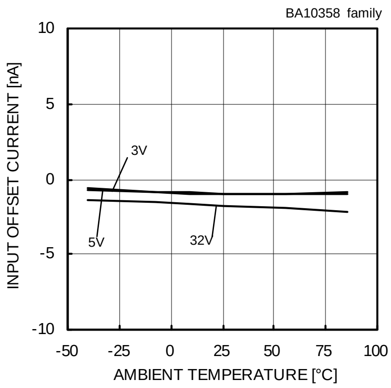


Fig. 19

Input Offset Current - Ambient Temperature
(Vicm=0[V],VOUT=1.4[V])

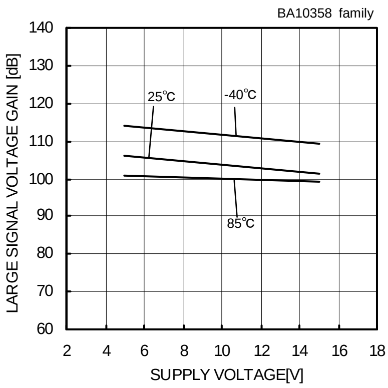


Fig. 20

Large Signal Voltage Gain - Supply Voltage
(RL=2[kΩ])

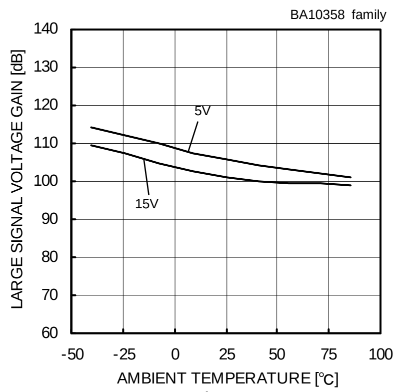


Fig. 21

Large Signal Voltage Gain - Ambient Temperature
(RL=2[kΩ])

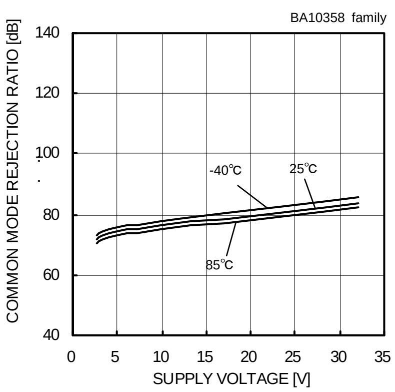


Fig. 22

Common Mode Rejection Ratio
- Supply Voltage

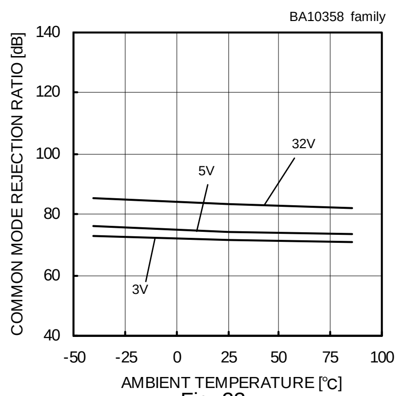


Fig. 23

Common Mode Rejection Ratio
- Ambient Temperature

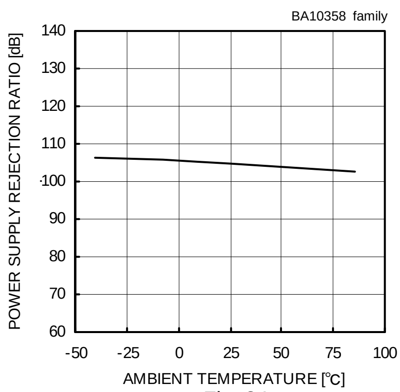


Fig. 24

Power Supply Rejection Ratio
- Ambient Temperature

○BA10324A family

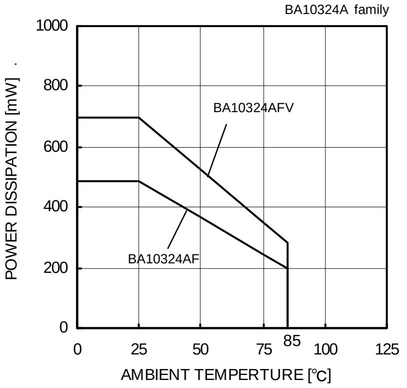


Fig. 25
Derating Curve

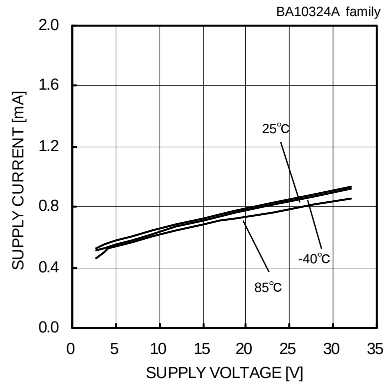


Fig. 26
Supply Current - Supply Voltage

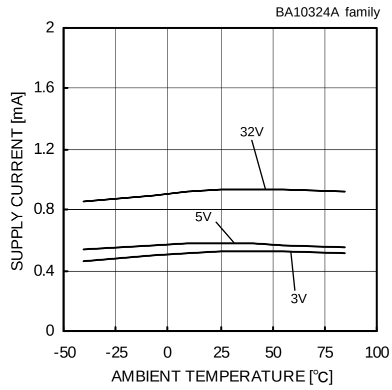


Fig. 27
Supply Current - Ambient Temperature

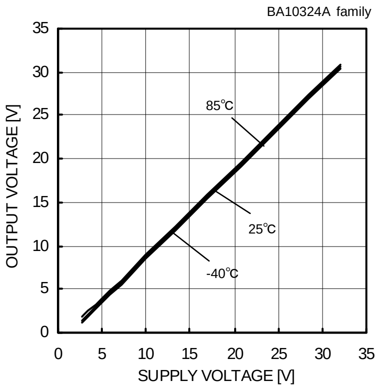


Fig. 28
Maximum Output Voltage - Supply Voltage
(RL=10[kΩ])

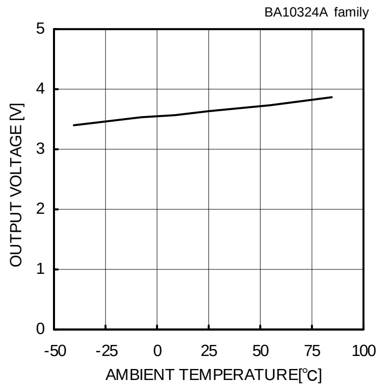


Fig. 29
Maximum Output Voltage - Ambient Temperature
(VCC=5[V],RL=2[kΩ])

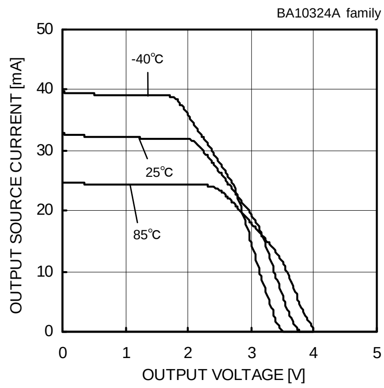


Fig. 30
Output Source Current - Output Voltage
(VCC=5[V])

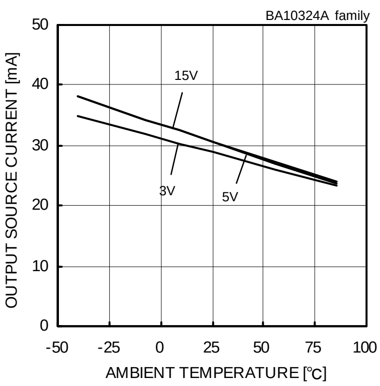


Fig. 31
Output Source Current - Ambient Temperature
(VOUT=0[V])

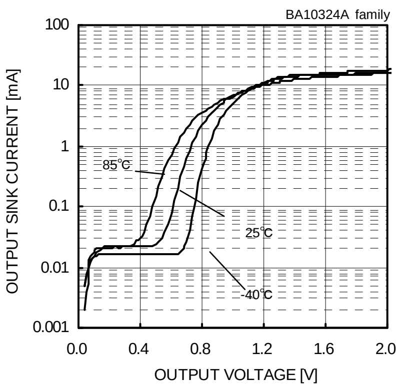


Fig. 32
Output Sink Current - Output Voltage
(VCC=5[V])

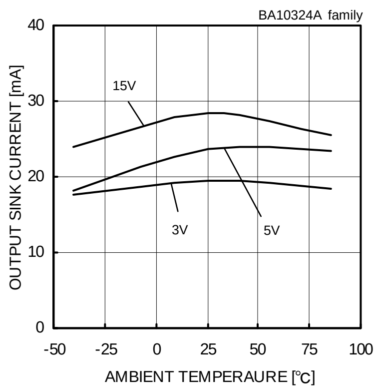


Fig. 33
Output Sink Current - Ambient Temperature
(VOUT=VCC)

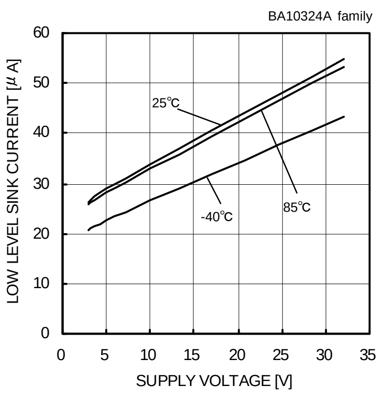


Fig. 34
Low Level Sink Current - Supply Voltage
(VOUT=0.2[V])

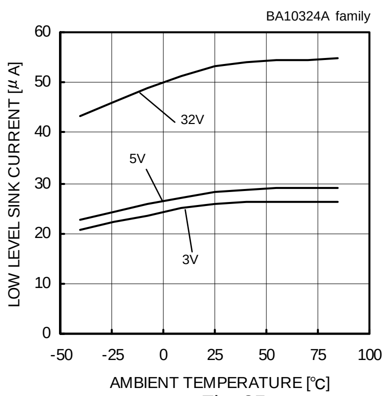


Fig. 35
Low Level Sink Current - Ambient Temperature
(VOUT=0.2[V])

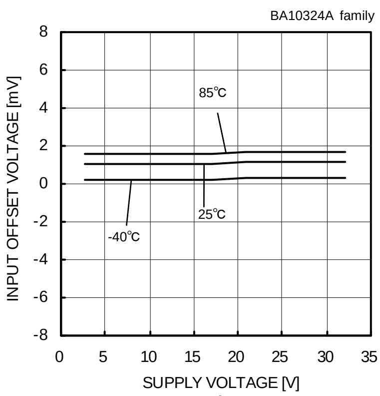


Fig. 36
Input Offset Voltage - Supply Voltage
(Vicm=0[V], VOUT=1.4[V])

○BA10324A family

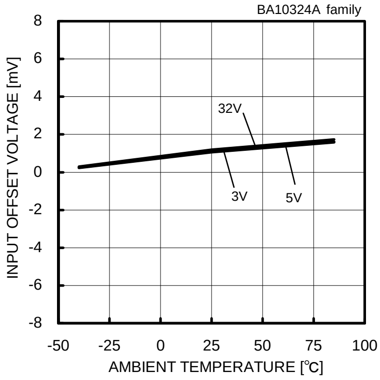


Fig. 37
Input Offset Voltage - Ambient Temperature
(Vicm=0[V], VOUT=1.4[V])

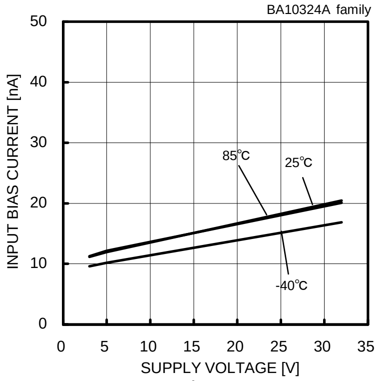


Fig. 38
Input Bias Current - Supply Voltage
(Vicm=0[V], VOUT=1.4[V])

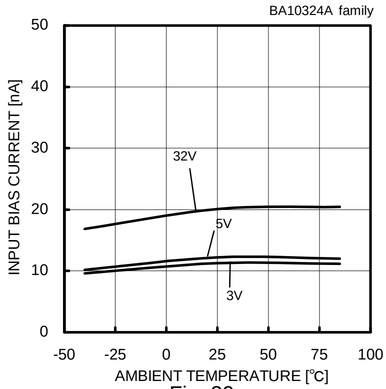


Fig. 39
Input Bias Current - Ambient Temperature
(Vicm=0[V],VOUT=1.4[V])

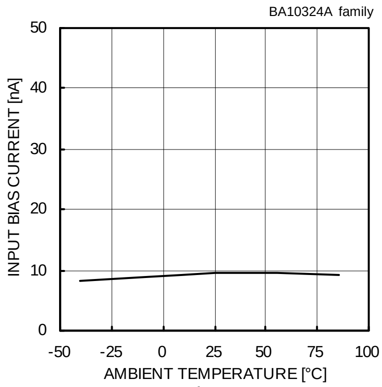


Fig. 40
Input Bias Current - Ambient Temperature
(VCC=30[V],Vicm=28[V],VOUT=1.4[V])

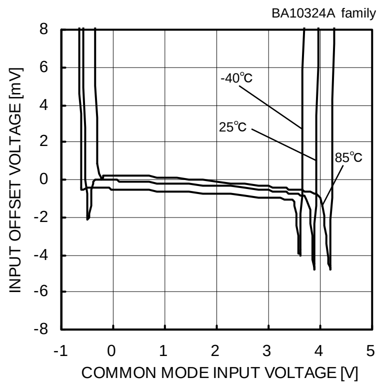


Fig. 41
Input Offset Voltage
- Common Mode Input Voltage
(VCC=5[V])

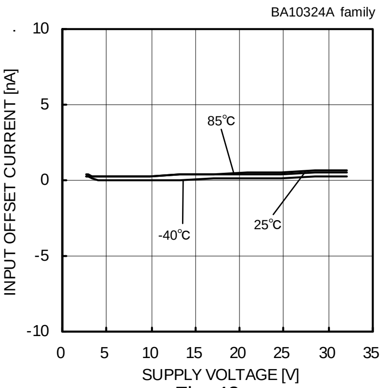


Fig. 42
Input Offset Current - Supply Voltage
(Vicm=0[V],VOUT=1.4[V])

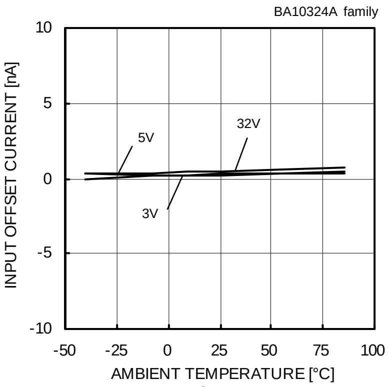


Fig. 43
Input Offset Current - Ambient Temperature
(Vicm=0[V],VOUT=1.4[V])

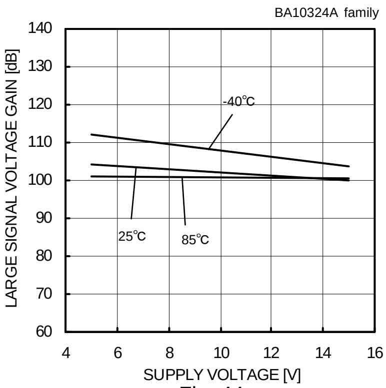


Fig. 44
Large Signal Voltage Gain - Supply Voltage
(RL=2[kΩ])

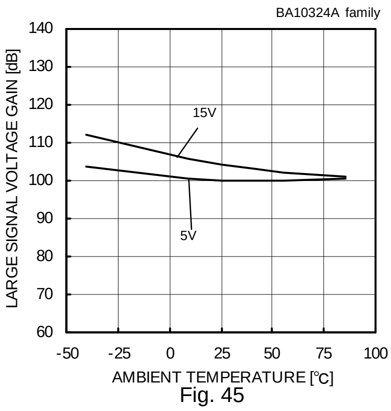


Fig. 45
Large Signal Voltage Gain
- Ambient Temperature
(RL=2[kΩ])

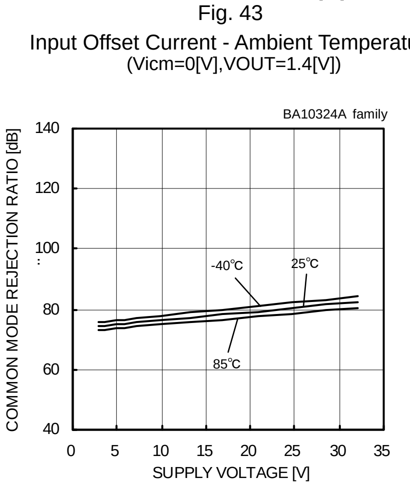


Fig. 46
Common Mode Rejection Ratio -
Supply Voltage

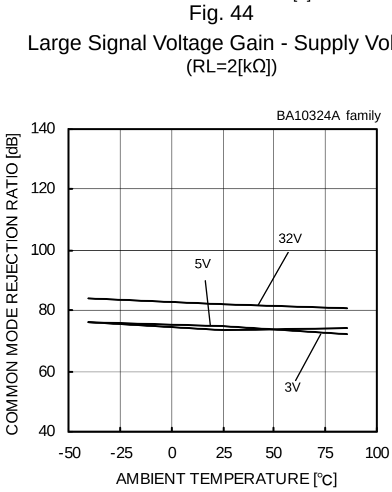


Fig. 47
Common Mode Rejection Ratio
- Ambient Temperature

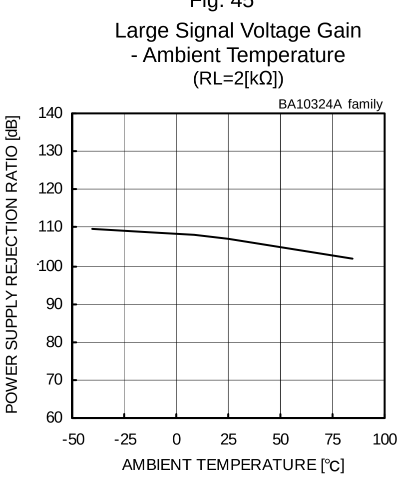


Fig. 48
Power Supply Rejection Ratio
- Ambient Temperature

○BA2904 family

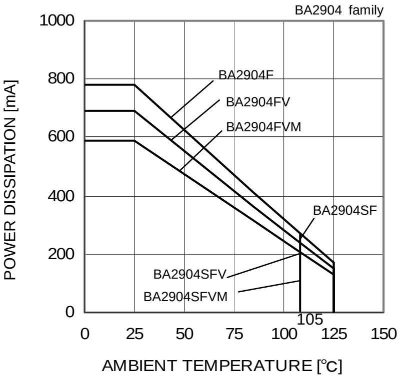


Fig. 49
Derating Curve

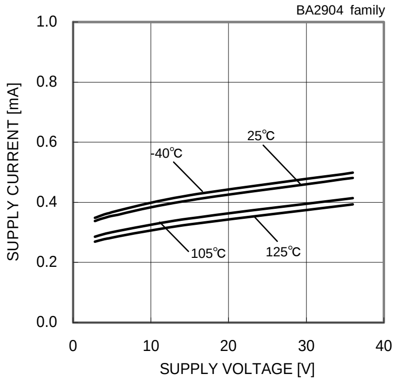


Fig. 50
Supply Current - Supply Voltage

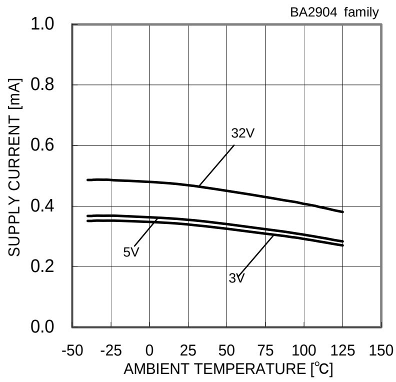


Fig. 51
Supply Current - Ambient Temperature

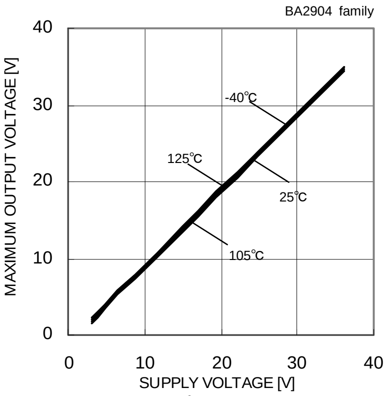


Fig. 52
Maximum Output Voltage - Supply Voltage
(RL=10[kΩ])

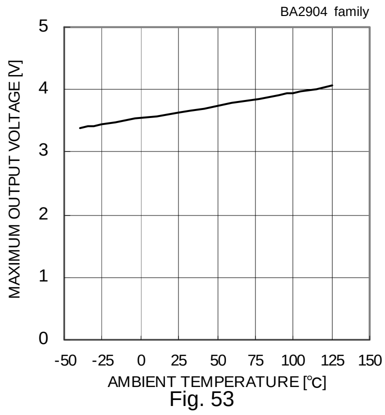


Fig. 53
Maximum Output Voltage - Ambient Temperature
(VCC=5[V],RL=2[kΩ])

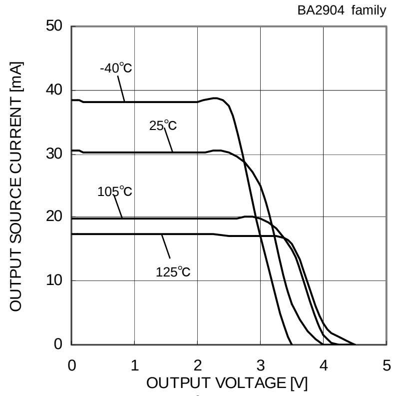


Fig. 54
Output Source Current - Output Voltage
(VCC=5[V])

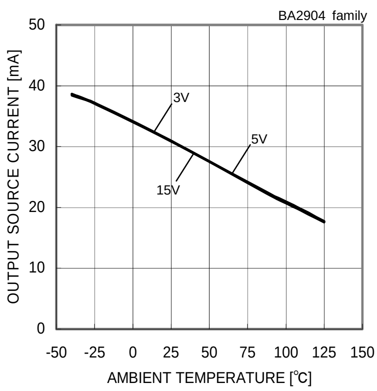


Fig. 55
Output Source Current - Ambient Temperature
(VOUT=0[V])

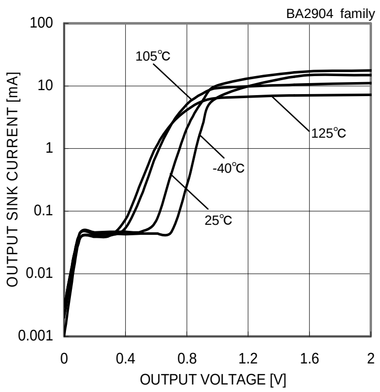


Fig. 56
Output Sink Current - Output Voltage
(VCC=5[V])

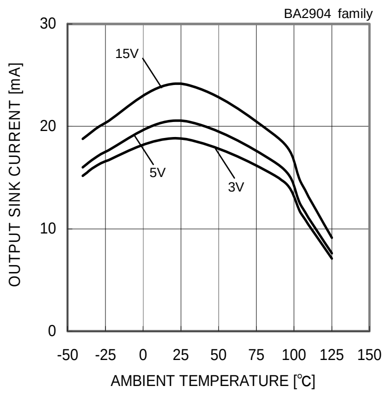


Fig. 57
Output Sink Current - Ambient Temperature
(VOUT=VCC)

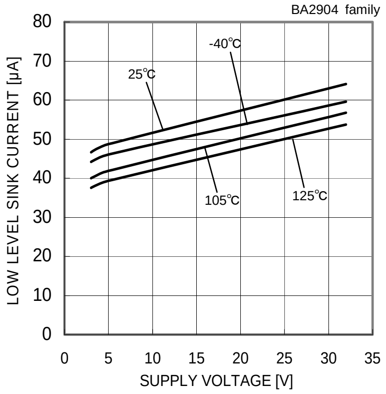


Fig. 58
Low Level Sink Current - Supply Voltage
(VOUT=0.2[V])

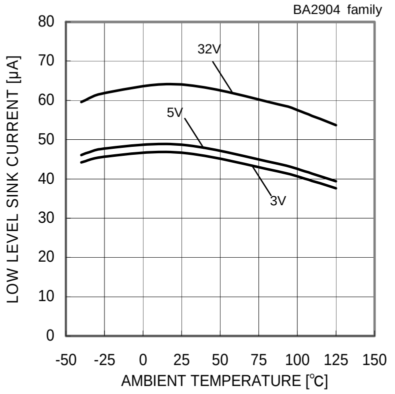


Fig. 59
Low Level Sink Current - Ambient Temperature
(VOUT=0.2[V])

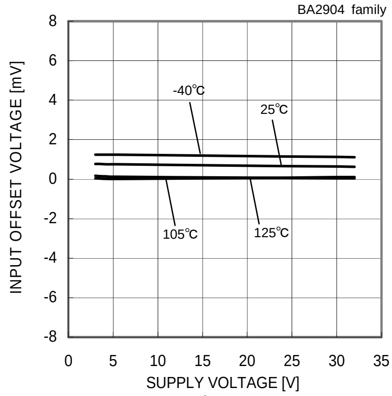


Fig. 60
Input Offset Voltage - Supply Voltage
(Vicm=0[V], VOUT=1.4[V])

○BA2904 family

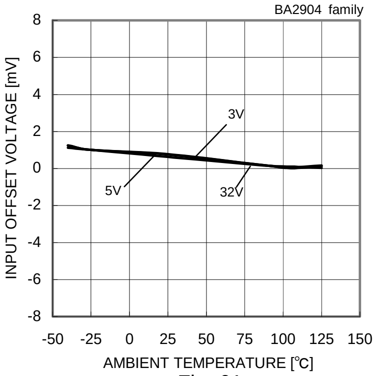


Fig. 61
Input Offset Voltage - Ambient Temperature
(Vicm=0[V], VOUT=1.4[V])

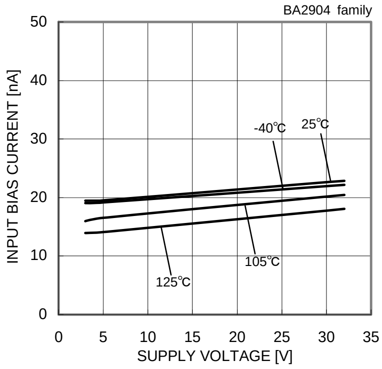


Fig. 62
Input Bias Current - Supply Voltage
(Vicm=0[V], VOUT=1.4[V])

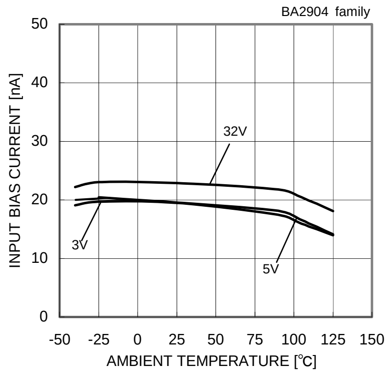


Fig. 63
Input Bias Current - Ambient Temperature
(Vicm=0[V],VOUT=1.4[V])

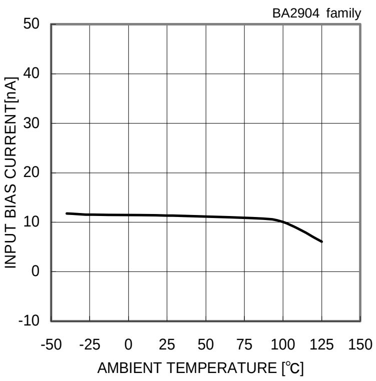


Fig. 64
Input Bias Current - Ambient Temperature
(VCC=30[V],Vicm=28[V],VOUT=1.4[V])

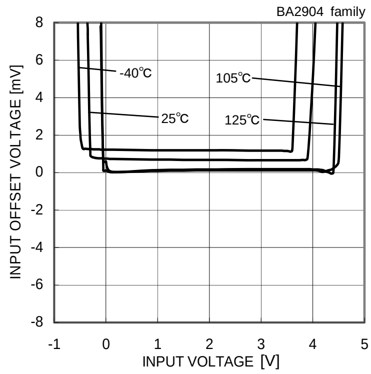


Fig. 65
Input Offset Voltage - Common Mode Input Voltage
(VCC=5[V])

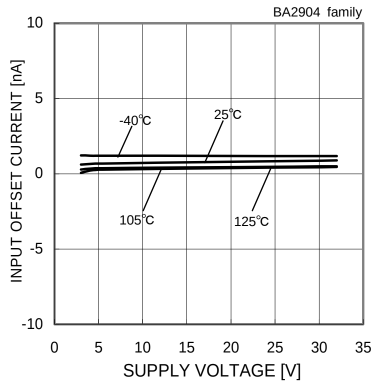


Fig. 66
Input Offset Current - Supply Voltage
(Vicm=0[V],VOUT=1.4[V])

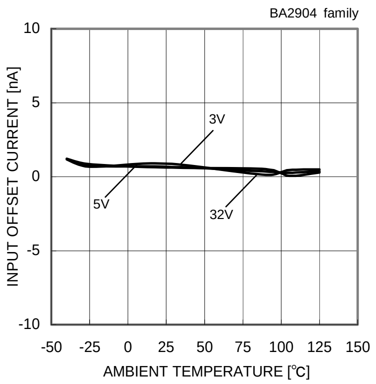


Fig. 67
Input Offset Current - Ambient Temperature
(Vicm=0[V],VOUT=1.4[V])

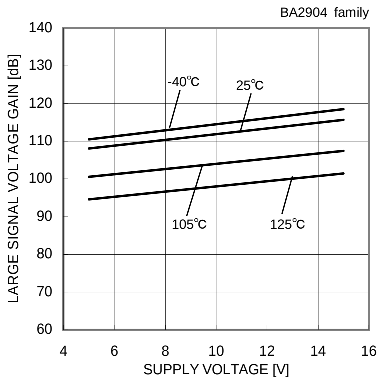


Fig. 68
Large Signal Voltage Gain - Supply Voltage
(RL=2[kΩ])

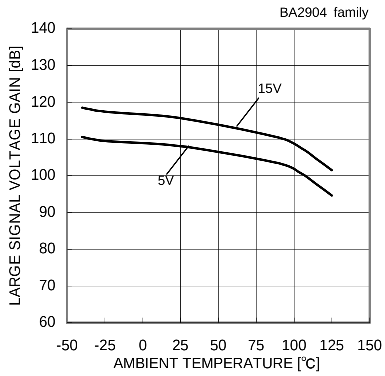


Fig. 69
Large Signal Voltage Gain
- Ambient Temperature
(RL=2[kΩ])

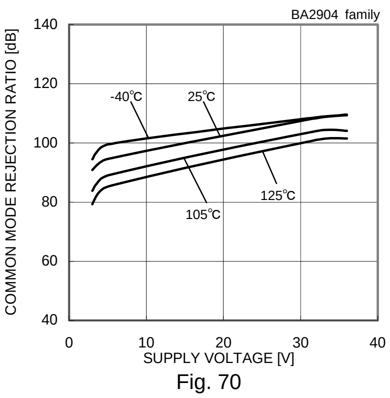


Fig. 70
Common Mode Rejection Ratio
- Supply Voltage

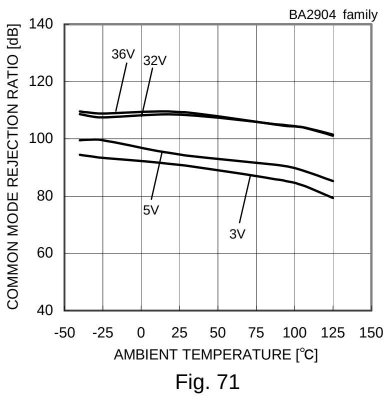


Fig. 71
Common Mode Rejection Ratio
- Ambient Temperature

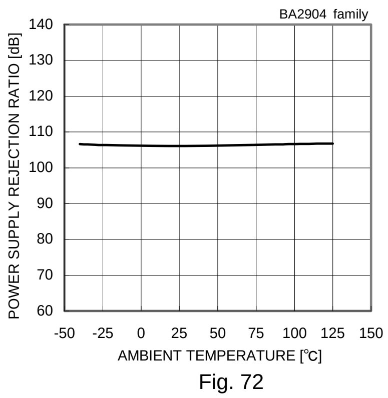


Fig. 72
Power Supply Rejection Ratio
- Ambient Temperature

○BA2902 family

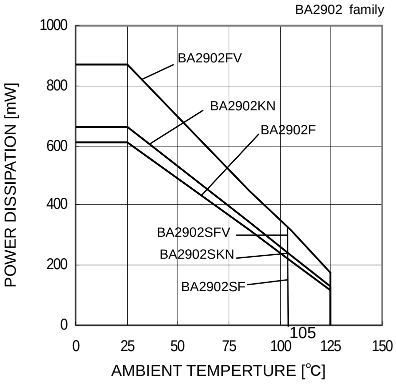


Fig. 73

Derating Curve

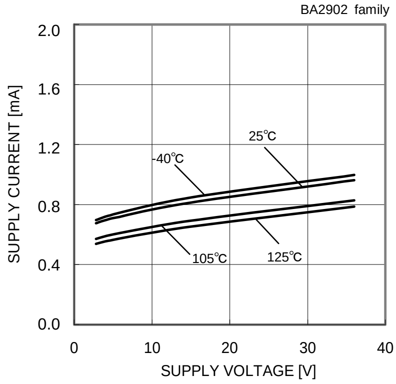


Fig. 74

Supply Current - Supply Voltage

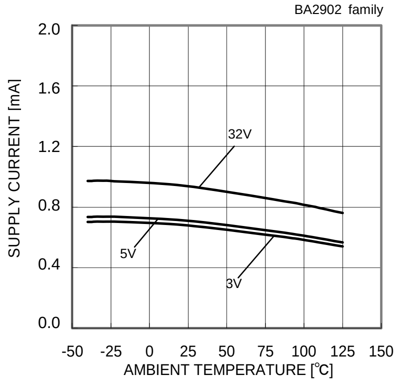


Fig. 75

Supply Current - Ambient Temperature

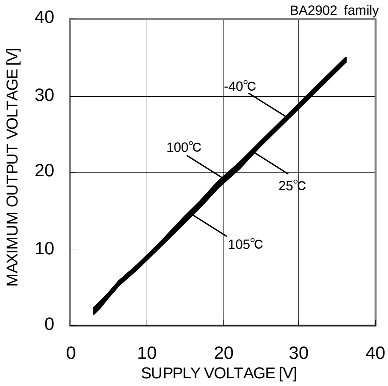


Fig. 76

Maximum Output Voltage - Supply Voltage

(RL=10[kΩ])

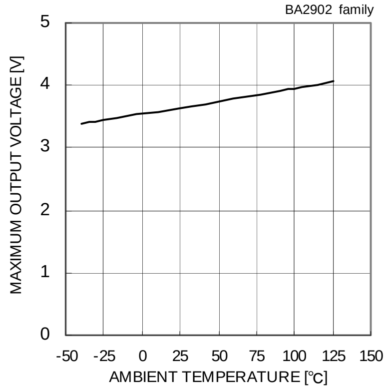


Fig. 77

Maximum Output Voltage - Ambient Temperature

(VCC=5[V],RL=2[kΩ])

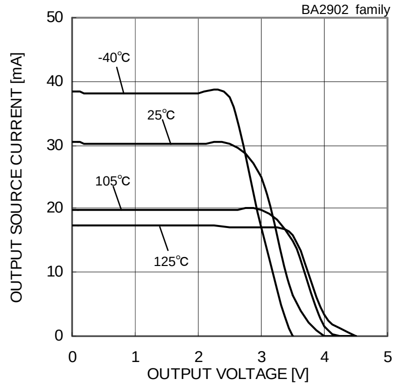


Fig. 78

Output Source Current - Output Voltage

(VCC=5[V])

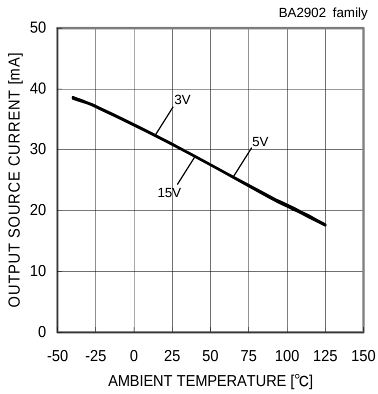


Fig. 79

Output Source Current - Ambient Temperature

(VOUT=0[V])

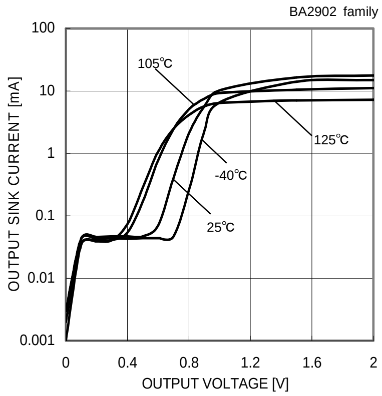


Fig. 80

Output Sink Current - Output Voltage

(VCC=5[V])

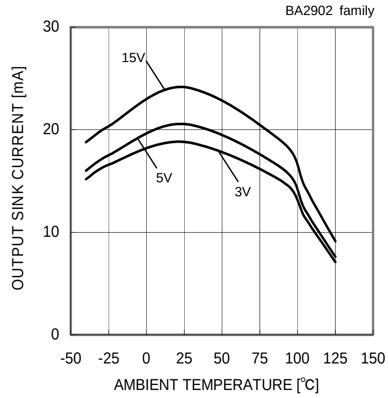


Fig. 81

Output Sink Current - Ambient Temperature

(VOUT=VCC)

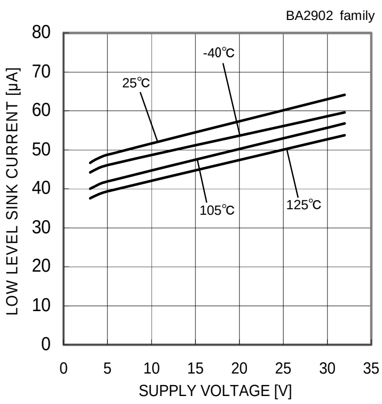


Fig. 82

Low Level Sink Current - Supply Voltage

(VOUT=0.2[V])

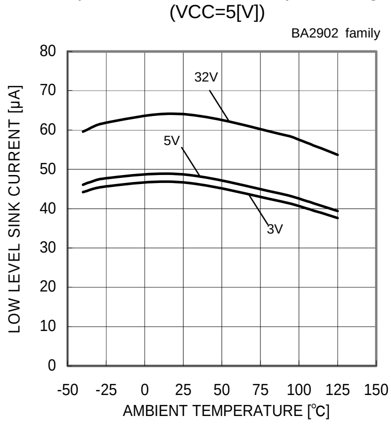


Fig. 83

Low Level Sink Current - Ambient Temperature

(VOUT=0.2[V])

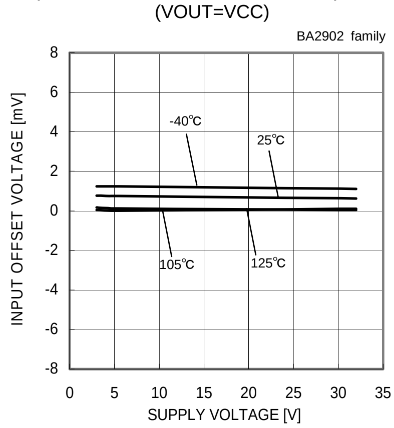


Fig. 84

Input Offset Voltage - Supply Voltage

(Vicm=0[V], VOUT=1.4[V])

○BA2902 family

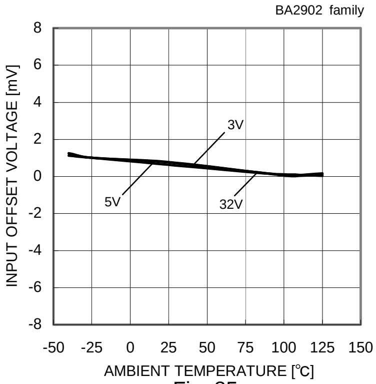


Fig. 85

Input Offset Voltage - Ambient Temperature
(Vicm=0[V], VOUT=1.4[V])

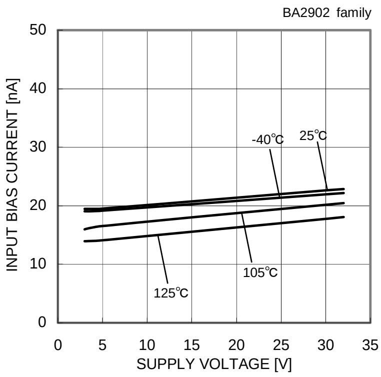


Fig. 86

Input Bias Current - Supply Voltage
(Vicm=0[V], VOUT=1.4[V])

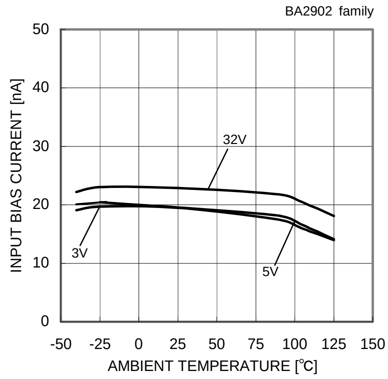


Fig. 87

Input Bias Current - Ambient Temperature
(Vicm=0[V],VOUT=1.4[V])

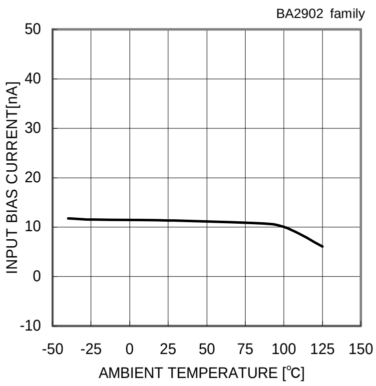


Fig. 88

Input Bias Current - Ambient Temperature
(VCC=30[V],Vicm=28[V],VOUT=1.4[V])

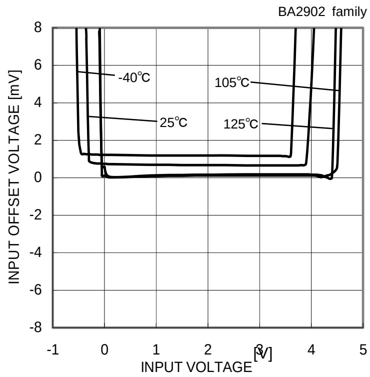


Fig. 89

Input Offset Voltage - Common Mode Input Voltage
(VCC=5[V])

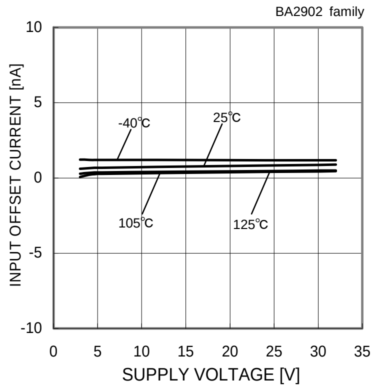


Fig. 90

Input Offset Current - Supply Voltage
(Vicm=0[V],VOUT=1.4[V])

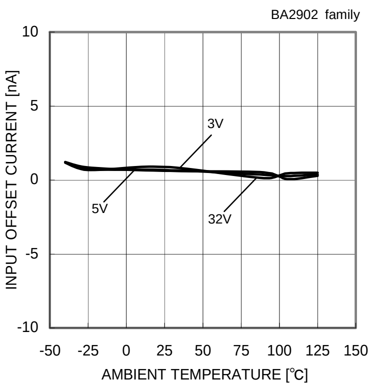


Fig. 91

Input Offset Current - Ambient Temperature
(Vicm=0[V],VOUT=1.4[V])

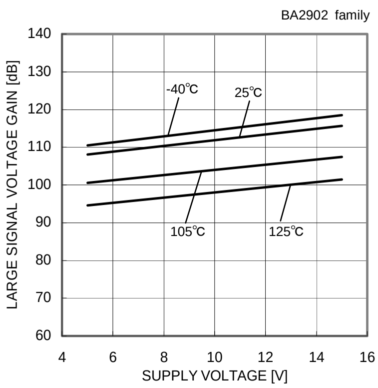


Fig. 92

Large Signal Voltage Gain - Supply Voltage
(RL=2[kΩ])

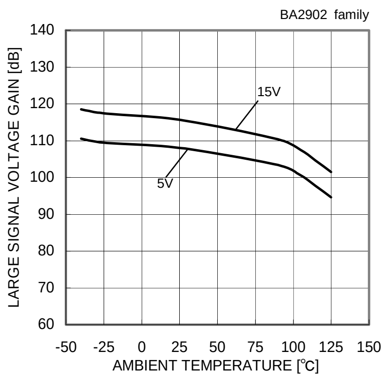


Fig. 93

Large Signal Voltage Gain - Ambient Temperature
(RL=2[kΩ])

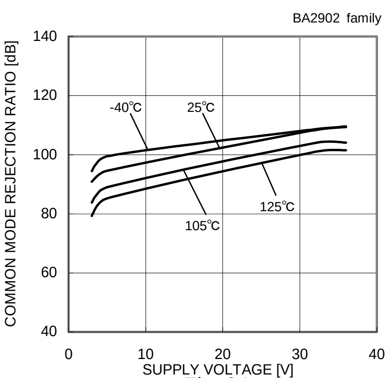


Fig. 94

Common Mode Rejection Ratio
- Supply Voltage

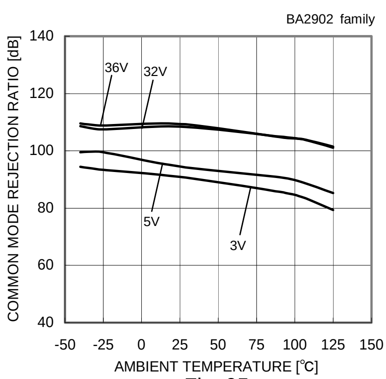


Fig. 95

Common Mode Rejection Ratio
- Ambient Temperature

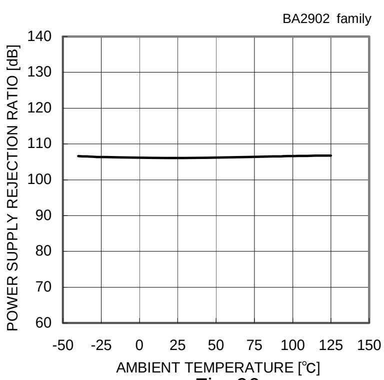


Fig. 96

Power Supply Rejection Ratio
- Ambient Temperature

○BA3404 family

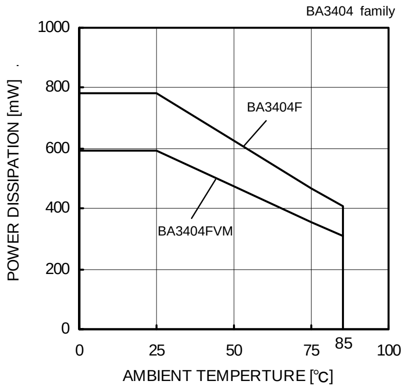


Fig. 97
Derating Curve

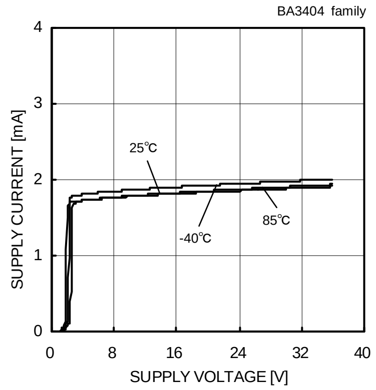


Fig. 98
Supply Current - Supply Voltage

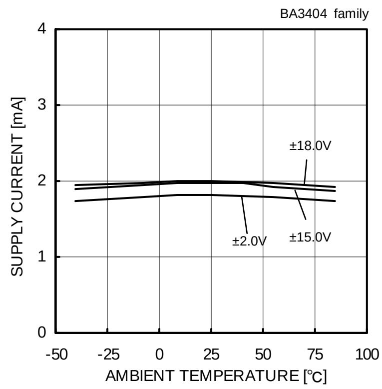


Fig. 99
Supply Current - Ambient Temperature

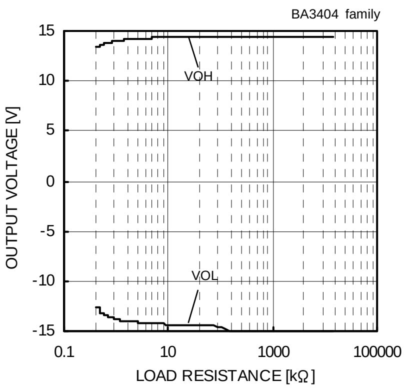


Fig. 100
Maximum Output Voltage - Load Resistance
(VCC/VEE=+15[V]/-15[V],Ta=25[℃])

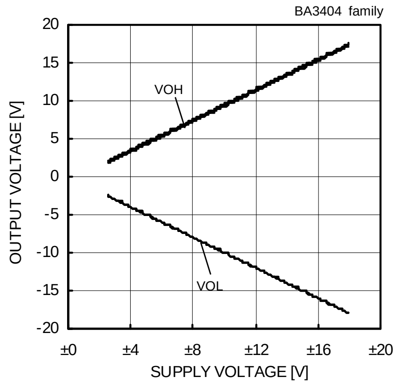


Fig. 101
Maximum Output Voltage - Supply Voltage

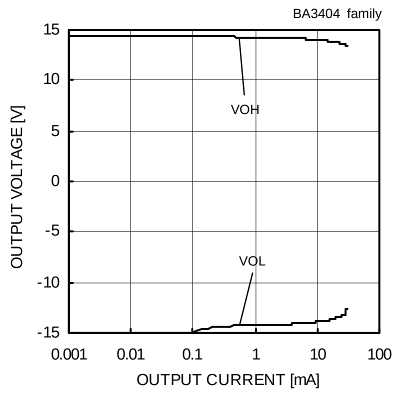


Fig. 102
Output Voltage - Output Current
(VCC/VEE=+15[V]/-15[V],Ta=25[℃])

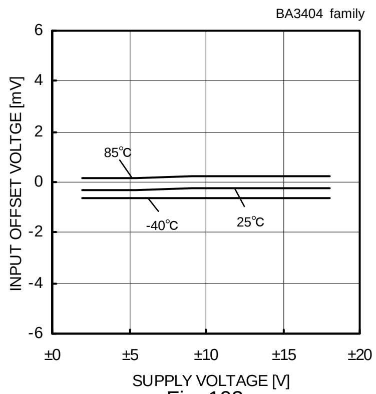


Fig. 103
Input Offset Voltage - Supply voltage
(Vicm=0[V], VOUT=0[V])

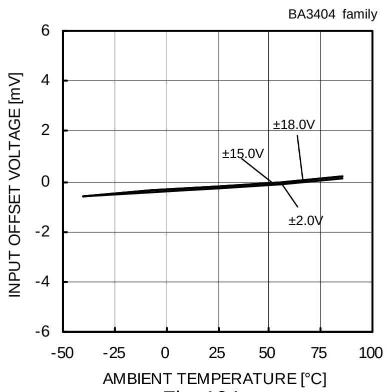


Fig. 104
Input Offset Voltage - Ambient Temperature
(Vicm=0[V], VOUT=0[V])

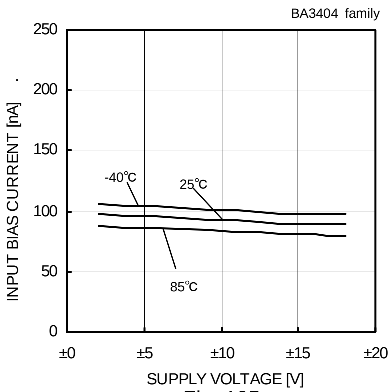


Fig. 105
Input Bias Current - Supply Voltage
(Vicm=0[V], VOUT=0[V])

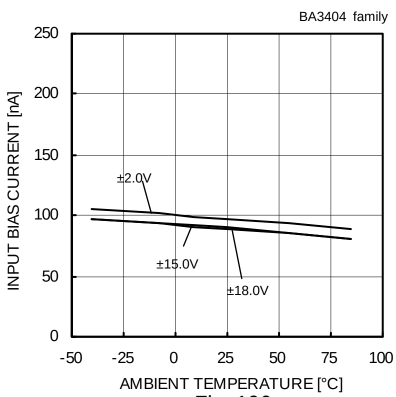


Fig. 106
Input Bias Current - Ambient Temperature
(Vicm=0[V], VOUT=0[V])

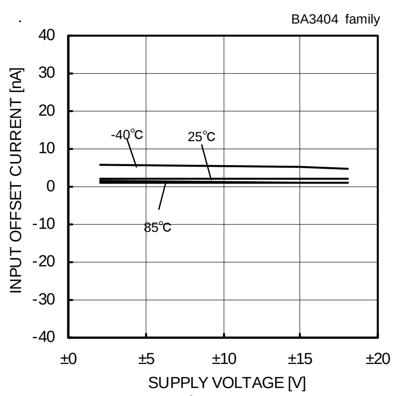


Fig. 107
Input Offset Current - Supply Voltage
(Vicm=0[V], VOUT=0[V])

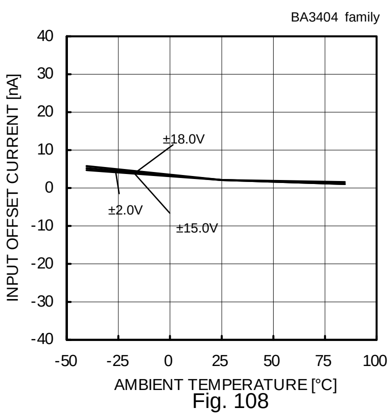


Fig. 108
Input Offset Current - Ambient Temperature
(Vicm=0[V], VOUT=0[V])

○BA3404 family

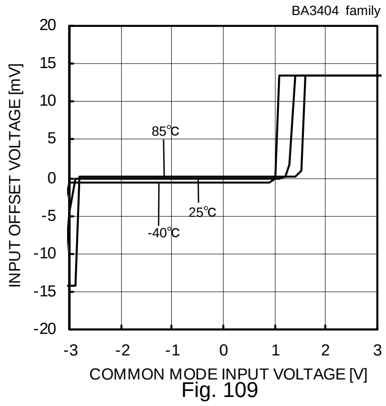


Fig. 109
Input Offset Voltage
- Common Mode Input Voltage
(VCC/VEE=+2.5[V]/-2.5[V])

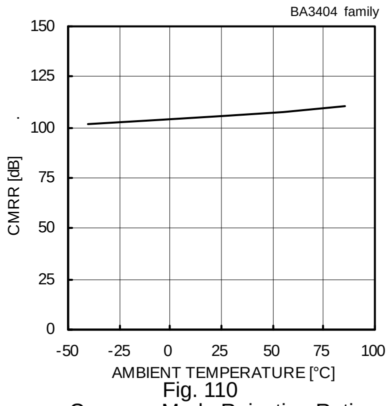


Fig. 110
Common Mode Rejection Ratio
- Ambient Temperature
(VCC/VEE=+15[V]/-15[V])

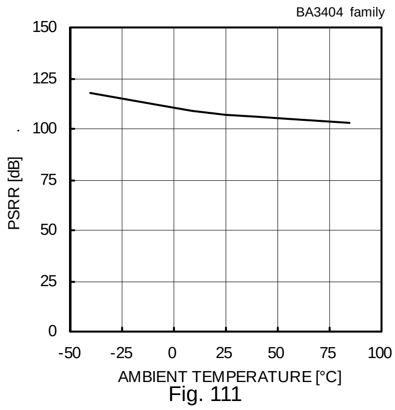


Fig. 111
Power Supply Rejection Ratio
- Ambient Temperature
(VCC/VEE=+15[V]/-15[V])

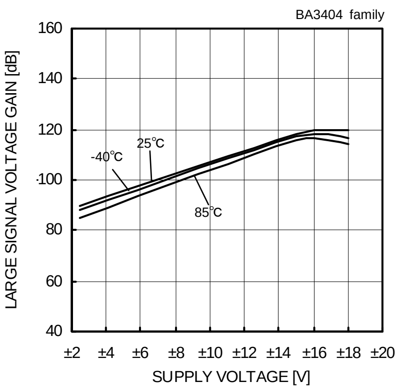


Fig. 112
Large Signal Voltage Gain
- Supply Voltage (RL=2[kΩ])

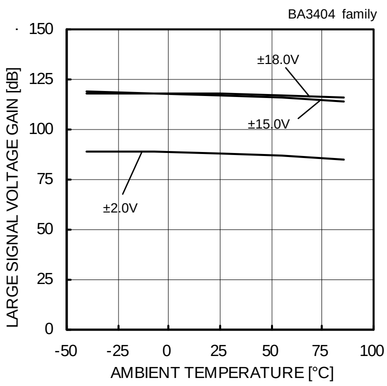


Fig. 113
Large Signal Voltage Gain
- Ambient Temperature (RL=2[kΩ])

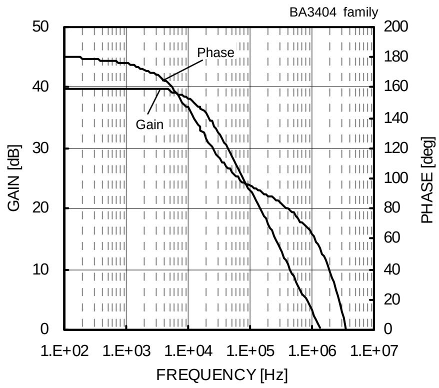


Fig. 114
Voltage Gain - Frequency
(VCC=±15V)

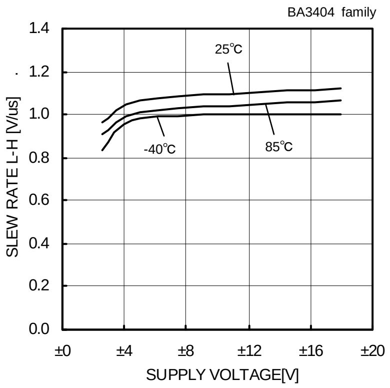


Fig. 115
Slew Rate L-H - Supply Voltage

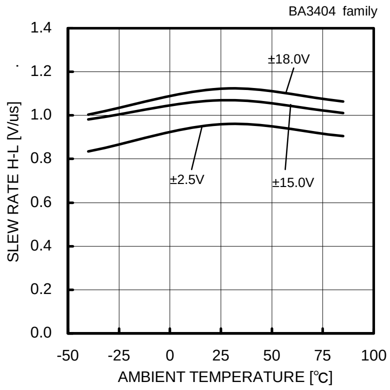


Fig. 116
Slew Rate H-L - Ambient Temperature

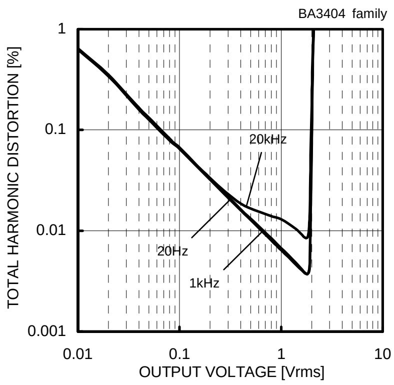


Fig. 117
Total Harmonic Distoration - Output Voltage
(VCC/VEE=+4[V]/-4[V],Av=0[dB],
RL=2[kΩ],80[kHz]-LPF,Ta=25[℃])

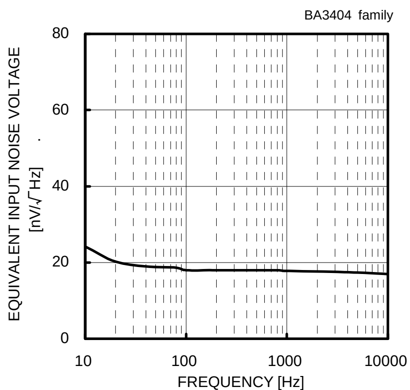


Fig. 118
Equivalent Input Noise Voltage - Frequency
(VCC/VEE=+15[V]/-15[V],Rs=100[Ω],Ta=25[℃])

●Circuit Diagram

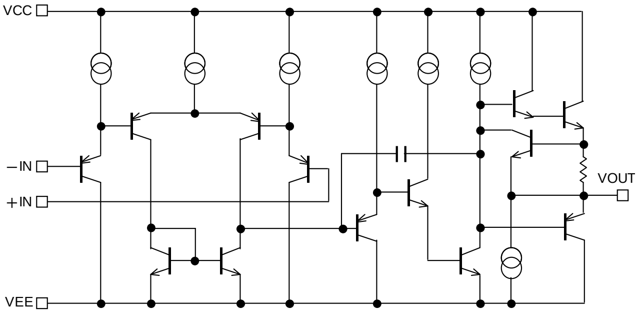


Fig. 119 Schematic Diagram
(BA10358/BA10324A/BA2904S/
BA2904/BA2902S/BA2902)

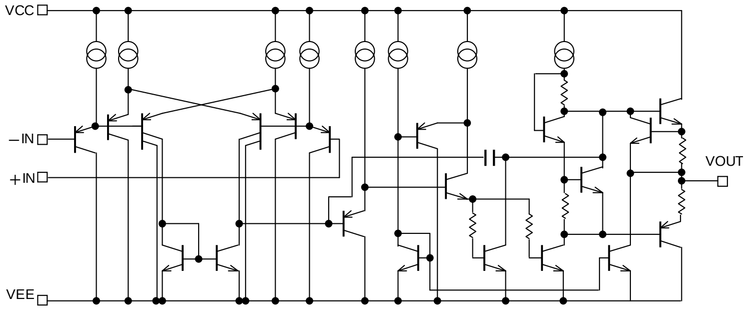


Fig. 120 Schematic Diagram
(BA3404)

●Test circuit1 NULL method

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

Parameter	VF	S1	S2	S3	BA10358 family BA10324A family				BA2904 family BA2902 family				BA3404 family				calculation
					VCC	VEE	EK	Vicm	VCC	VEE	EK	Vicm	VCC	VEE	EK	Vicm	
Input Offset Voltage	VF1	ON	ON	OFF	5	0	-1.4	0	5~30	0	-1.4	0	15	-15	0	0	1
Input Offset Current	VF2	OFF	OFF	OFF	5	0	-1.4	0	5	0	-1.4	0	15	-15	0	0	2
Input Bias Current	VF3	OFF	ON	OFF	5	0	-1.4	0	5	0	-1.4	0	15	-15	0	0	3
	VF4	ON	OFF														
Large Signal Voltage Gain	VF5	ON	ON	ON	15	0	-1.4	0	15	0	-1.4	0	15	-15	10	0	4
	VF6				15	0	-11.4	0	15	0	-11.4	0	15	-15	-10	0	
Common-mode Rejection Ratio (Input common-mode Voltage Range)	VF7	ON	ON	OFF	5	0	-1.4	0	5	0	-1.4	0	15	-15	0	-15	5
	VF8				5	0	-1.4	3.5	5	0	-1.4	3.5	15	-15	0	13	
Power Supply Rejection Ratio	VF9	ON	ON	OFF	5	0	-1.4	0	5	0	-1.4	0	2	-2	0	0	6
	VF10				30	0	-1.4	0	30	0	-1.4	0	15	-15	0	0	

-Calculation-

1. Input Offset Voltage (Vio)

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

2. Input Offset Current (Iio)

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

3. Input Bias Current (Ib)

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

4. Large Signal Voltage Gain (Av)

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

5. Common-mode Rejection Ration (CMRR)

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

6. Power supply rejection ratio (PSRR)

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

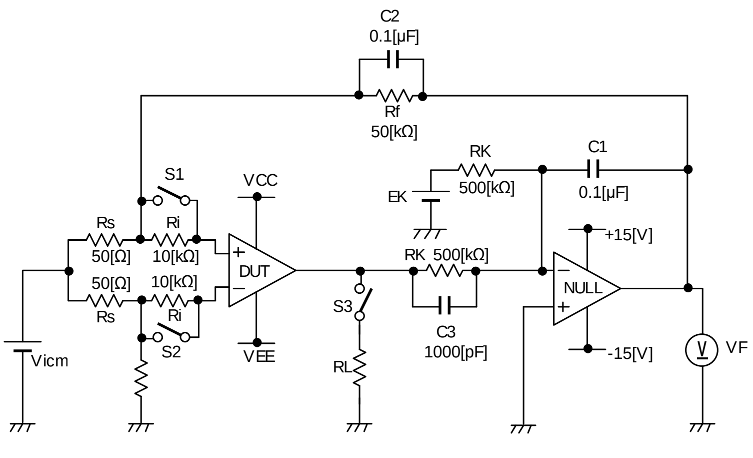


Fig. 121 Test circuit1 (one channel only)

●Test Circuit 2 Switch Condition

SW No.	SW 1	SW 2	SW 3	SW 4	SW 5	SW 6	SW 7	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
High Level Output Voltage	OFF	OFF	ON	OFF	OFF	ON	OFF	OFF	ON	OFF	OFF	OFF	ON	OFF
Low Level Output Voltage	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

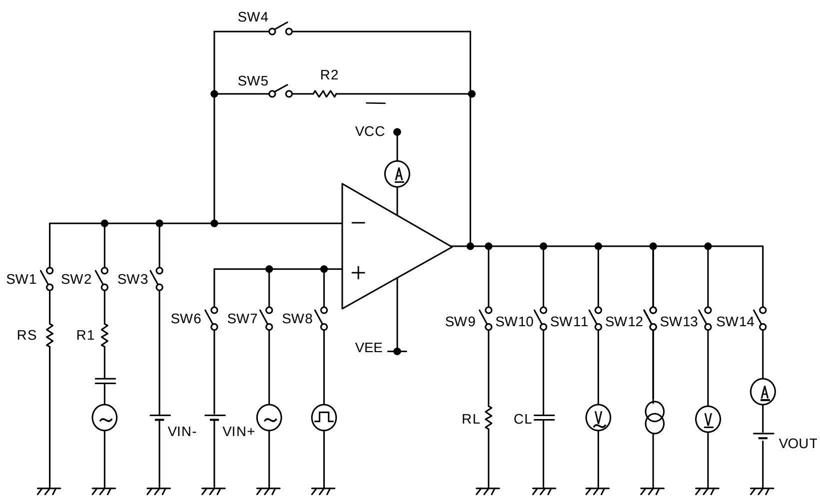


Fig.122 Test Circuit 2 (each Op-Amp)

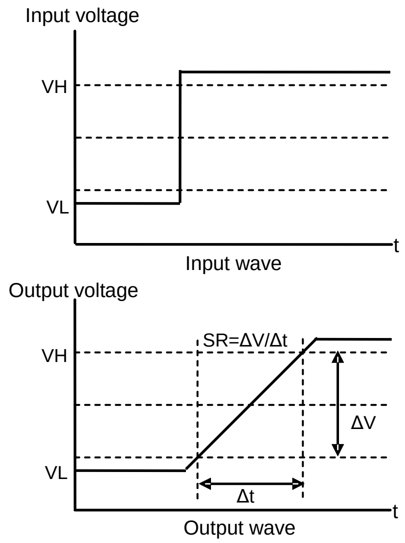
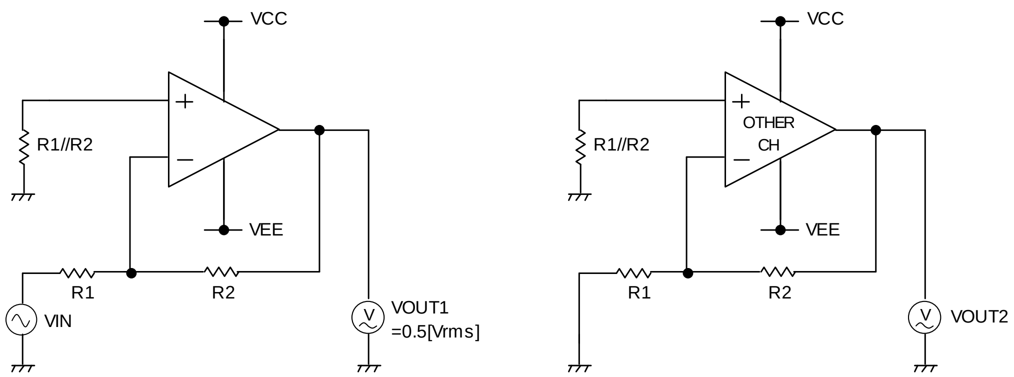


Fig. 123 Slew Rate Input Waveform

●Measurement Circuit 3 Amplifier To Amplifier Coupling

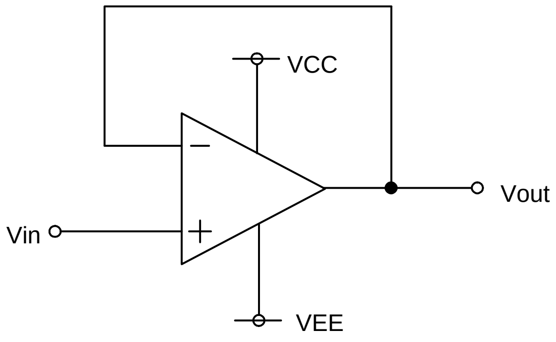


$$CS = 20 \times \log \frac{100 \times VOUT1}{VOUT2}$$

Fig. 124 Test Circuit 3

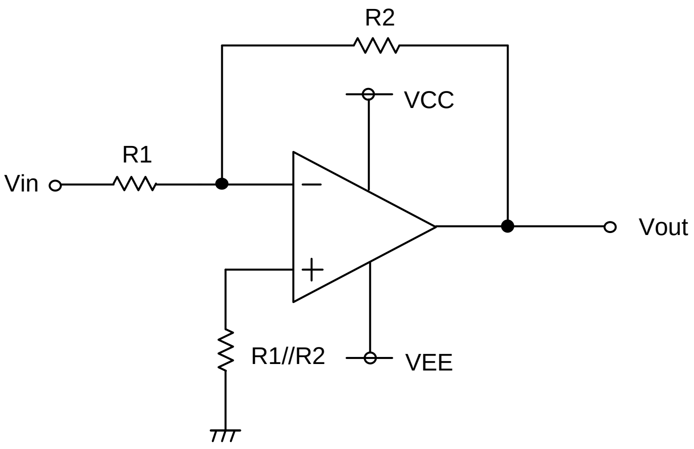
● Examples of circuit

○ Voltage follower



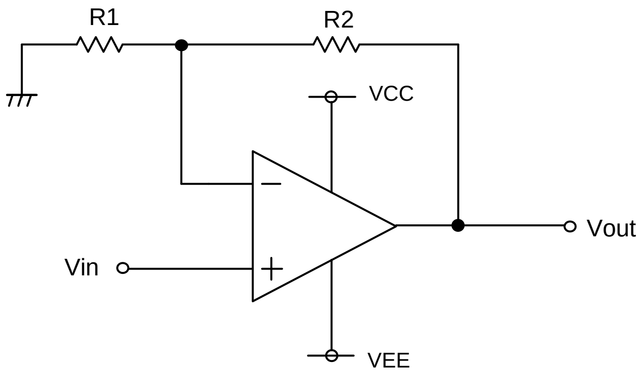
Voltage gain is 0 [dB].
This circuit controls output voltage (Vout) equal input voltage (Vin), and keeps Vout with stable because of high input impedance and low output impedance.
Vout is shown next formula.
Vout=Vin

○ Inverting amplifier



For inverting amplifier, Vin is amplified by voltage gain decided R1 and R2, and phase reversed voltage is outputed.
Vout is shown next formula.
Vout=-(R2/R1)・Vin
Input impedance is R1.

○ Non-inverting amplifier



For non-inverting amplifier, Vin is amplified by voltage gain decided R1 and R2, and phase is same with Vin.
Vout is shown next formula.
Vout=(1+R2/R1)・Vin
This circuit realizes high input impedance because Input impedance is operational amplifier's input Impedance.

●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 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 the 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 0 V.

2.2 Input offset voltage drift (△Vio/△T)
Denotes the ratio of the input offset voltage fluctuation to the ambient temperature fluctuation.

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

2.4 Input offset current drift (△Iio/△T)
Signifies the ratio of the input offset current fluctuation to the ambient temperature fluctuation.

2.5 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.

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

2.7 High level output voltage/low level output voltage (VOH/VOL)
Signifying the voltage range that can be output under specified load conditions, it is in general divided into high level output voltage and low level output voltage. High level output voltage indicates the upper limit of the output voltage, while low level output voltage the lower limit.

2.8 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)

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

2.10 Common-mode rejection ratio (CMRR)
Signifies the ratio of fluctuation of the input offset voltage when the in-phase input voltage is changed (DC fluctuation).
CMRR = (change in input common-mode voltage) / (input offset fluctuation)

2.11 Power supply rejection ratio (PSRR)
Denotes the ratio of fluctuation of the input offset voltage when supply voltage is changed (DC fluctuation).
SVR = (change in power supply voltage) / (input offset fluctuation)

2.12 Output source current/ output sink current (IOH/IOL)
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.

2.13 Channel separation (CS)
Expresses the amount of fluctuation of the input offset voltage or output voltage with respect to the change in the output voltage of a driven channel.

2.14 Slew rate (SR)
Indicates the time fluctuation ratio of the output voltage when an input step signal is supplied.

2.15 Gain bandwidth product (GBW)
The product of the specified signal frequency and the gain of the op-amp at such frequency, it gives the approximate value of the frequency where the gain of the op-amp is 1 (maximum frequency, and unity gain frequency).

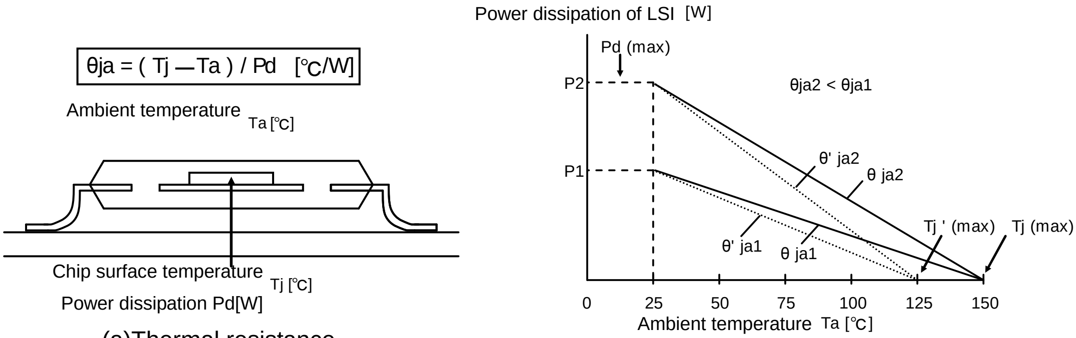
●Derating curves

Power dissipation(total loss) indicates the power that can be consumed by IC at Ta=25℃(normal temperature). IC is heated when it consumed power, and the temperature of IC chip becomes higher than ambient temperature. The temperature that can be accepted by IC chip depends on circuit configuration, manufacturing process, and consumable power is limited. Power dissipation is determined by the temperature allowed in IC chip(maximum junction temperature) and thermal resistance of package(heat dissipation capability). The maximum junction temperature is typically equal to the maximum value in the storage temperature range. Heat generated by consumed power of IC radiates from the mold resin or lead frame of the package. The parameter which indicatesthis 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.125(a) shows the model of thermal resistance of the package. Thermal resistance θja, ambient temperature Ta, junction temperature Tj, and power dissipation Pd can be calculated by the equation below:

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

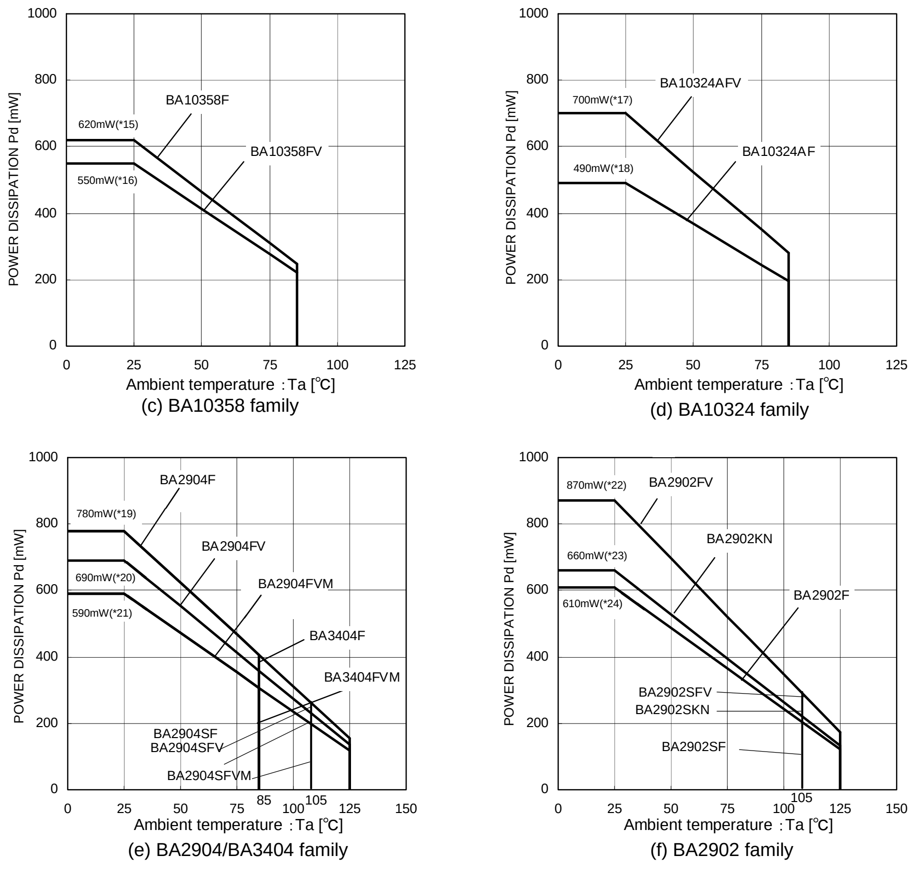
Derating curve in Fig.125(b) indicates power that can be consumed by IC with reference to ambient temperature.Power that can be consumed by IC begins to attenuate at certain ambient temperature. This gradient iis determined by thermal resistance θja. Thermal resistance θja depends on chip size, power 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. Fig.126(c)～(f) show a derating curve for an example of BA10358, BA10324A, BA2904S, BA2904, BA2902S, BA2902, BA3404.



(a)Thermal resistance (b) Derating curve

Fig. 125 Thermal resistance and derating



(c) BA10358 family (d) BA10324 family

(e) BA2904/BA3404 family (f) BA2902 family

(*15)	(*16)	(*17)	(*18)	(*19)	(*20)	(*21)	(*22)	(*23)	(*24)	Unit
6.2	5.5	7.0	4.9	6.2	5.5	4.8	7.0	5.3	4.9	[mW/℃]

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

Fig. 126 Derating curve

●Notes for use

1) Unused circuits
When there are unused circuits, it is recommended that they be connected as in Fig.127, setting the non-inverting input terminal to a potential within the in-phase input voltage range (Vicm).

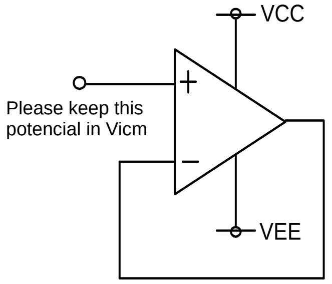


Fig. 127 Example of processing unused circuit

2) Input voltage
Applying VEE+32[V] (BA2904S / BA2904 /BA2902S / BA2902 family, BA2904HFVM-C) and VEE+36[V](BA3404 family) 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 voltage supplied is between VCC and VEE Therefore, the single supply op-mp 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 the 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 substances between the outputs, the output and the power supply, or the output and GND may result in IC destruction.

6) Operation in a strong electromagnetic field
Operation in a strong electromagnetic field may cause malfunctions.

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

8) IC handing
Applying mechanical stress to the IC by deflecting or bending the board may cause fluctuation of the electrical characteristics due to piezoelectric (piezo) effects.

9) IC operation
The output stage of the IC is configured using Class C push-pull circuits. Therefore, when the load resistor is connected to the middle potential of VCC and VEE, crossover distortion occurs at the changeover between discharging and charging of the output current. Connecting a resistor between the output terminal and GND, and increasing the bias current for Class A operation will suppress crossover distortion.

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.

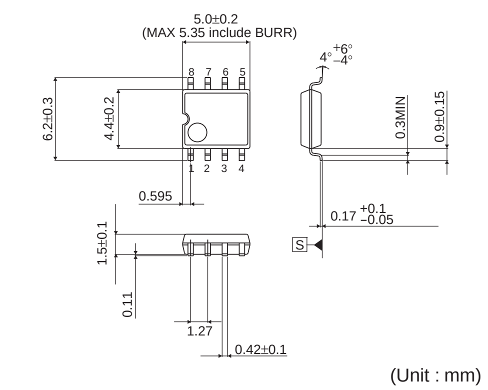
11) Output capacitor
Discharge of the external output capacitor to VCC is possible via internal parasitic elements when VCC is shorted to VEE, causing damage to the internal circuitry due to thermal stress. Therefore, when using this IC in circuits where oscillation due to output capacitive load does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

●Ordering part number

B	A		2	9	0	4		F	V	-	E	2

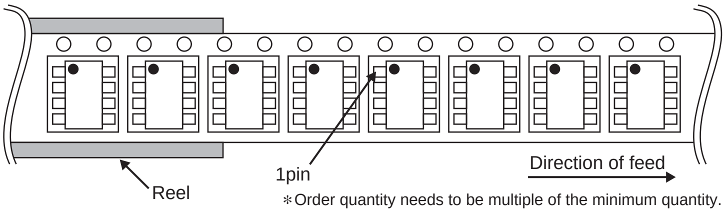
- **Part No.** (BA)
- **Part No.** 10358,10324A / 2904S,2904 / 2902S, 2902 / 3404
- **Package**
  - F : SOP8, SOP14
  - FV : SSOP-B8, SSOP-B14
  - FVM : MSOP8
  - KN : VQFN16
- **Packaging and forming specification**
  - E2: Embossed tape and reel (SOP8/SOP14/SSOP-B8/ SSOP-B14/VQFN16)
  - TR: Embossed tape and reel (MSOP8)

SOP8



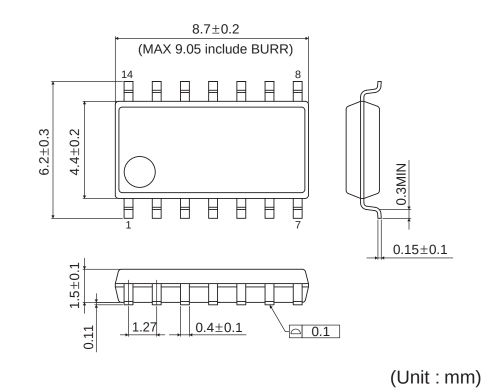
<Tape and Reel information>

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)



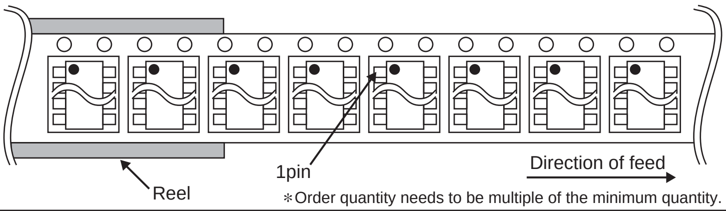
∗Order quantity needs to be multiple of the minimum quantity.

SOP14



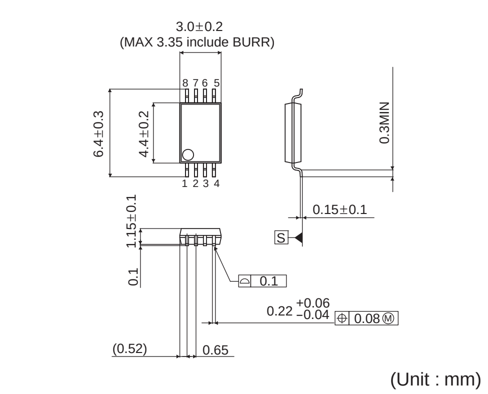
<Tape and Reel information>

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)



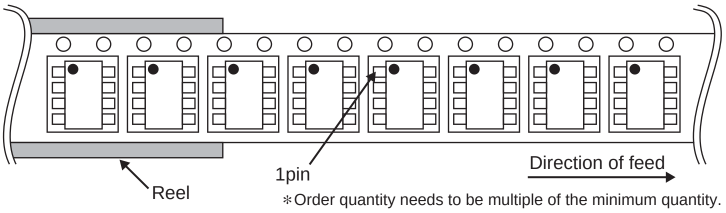
∗Order quantity needs to be multiple of the minimum quantity.

SSOP-B8



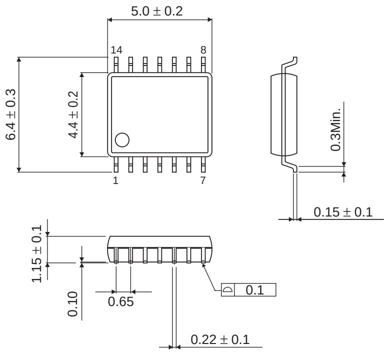
<Tape and Reel information>

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.

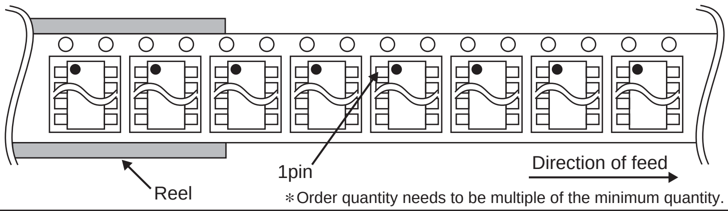
SSOP-B14



(Unit : mm)

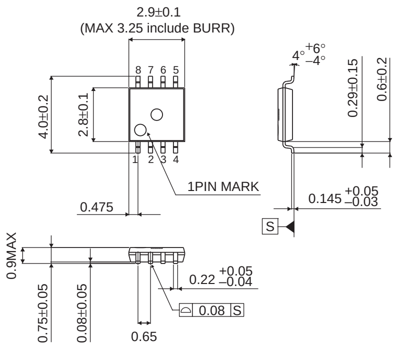
<Tape and Reel information>

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.

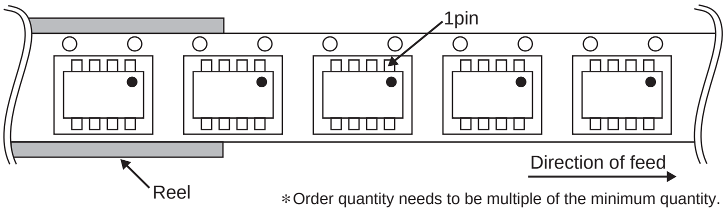
MSOP8



(Unit : mm)

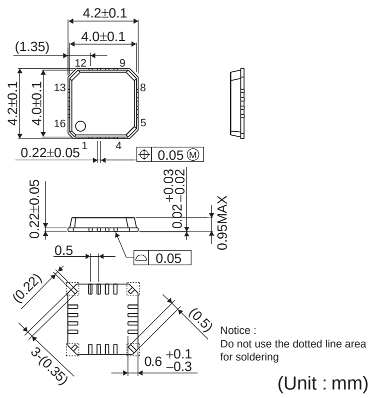
<Tape and Reel information>

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.

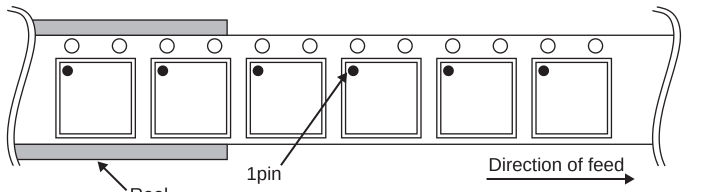
VQFN16



(Unit : mm)

<Tape and Reel information>

Tape	Embossed carrier tape (with dry pack)
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.

Notes

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