ROHM's Selection Operational Amplifier/Comparator Series

Operational Amplifiers: High Speed

BA3472F,BA3472FV,BA3472FVM

No.09049EBT01

●Description

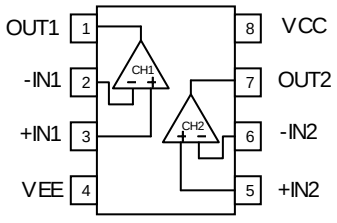
General-purpose BA3472 family integrate two Independent Op-amps and phase compensation capacitors on a single chip and have some features of high-gain, low power consumption, and wide operating voltage range of +3[V]～+36[V](single power supply). Especially, characteristics are high slew rate and high unity gain frequency.

General-purpose — Dual — **BA3472F,BA3472FV,BA3472FVM**

●Characteristics

1) Operable with a single power supply
2) Wide operating supply voltage
   ＋3.0[V]～＋36.0[V](single supply)
   ±1.5[V]～±18.0[V](split supply)
3) Standard Op-Amp. Pin-assignments
4) Internal phase compensation
5) High slew rate：10[V/μs]
6) Unity gain frequency：4[MHz]
7) High open loop voltage gain
8) Internal ESD protection
   Human body model (HBM) ±5000[V](Typ.)
9) Operable low input voltage around GND level
10) Wide output voltage range
    VEE+0.3[V]～VCC-1.0[V](Typ.) with VCC-VEE=30[V]

●Pin Assignment



SOP8	SSOP-B8	MSOP8
BA3472F	BA3472FV	BA3472FVM

●Absolute Maximum Ratings (Ta=25[℃])

Parameter	Symbol	Rating	Unit
		BA3472F,BA3472FV,BA3472FVM	
Supply Voltage	VCC-VEE	+36	V
Differential Input Voltage (*1)	Vid	+36	V
Input Common-mode Voltage Range	Vicm	（VEE-0.3）～ VCC	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.
(*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

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

Parameter	Symbol	Temperature range	Guaranteed limit			Unit	Condition
			Min.	Typ.	Max.		
Input Offset Voltage (*2)	Vio	25℃	-	1	10	mV	Vicm=0[V],VOUT=0[V]
			-	1.5	10		VCC=5[V],VEE=0[V], Vicm=0[V],VOUT=VCC/2
Input Offset Current (*2)	Iio	25℃	-	6	75	nA	Vicm=0[V],VOUT=0[V]
Input Bias Current (*2)	Ib	25℃	-	100	500	nA	Vicm=0[V],VOUT=0[V]
Supply Current	ICC	25℃	-	4	5.5	mA	RL=∞
High Level Output Voltage	VOH	25℃	3.7	4	-	V	VCC=5[V],RL=2[kΩ]
			13.7	14	-		RL=10[kΩ]
			13.5	-	-		RL=2[kΩ]
Low Level Output Voltage	VOL	25℃	-	0.1	0.3	V	VCC=5[V],RL=2[kΩ]
			-	-14.7	-14.3		RL=10[kΩ]
			-	-	-13.5		RL=2[kΩ]
Large Single Voltage Gain	AV	25℃	80	100	-	dB	RL≧2[kΩ],VOUT=±10 [V]
Input Common-mode Voltage Range	Vicm	25℃	0	-	VCC-2.0	V	VCC=5[V],VEE=0[V], VOUT=VCC/2
Common-mode Rejection Ratio	CMRR	25℃	60	97	-	dB	Vicm=0[V],VOUT=0[V]
Power Supply Rejection Ratio	PSRR	25℃	60	97	-	dB	Vicm=0[V],VOUT=0[V]
Output Source Current (*3)	IOH	25℃	10	30	-	mA	VIN+=1[V],VIN-=0[V], VOUT=0[V], Only 1ch is short circuit
Output Sink Current (*3)	IOL	25℃	20	30	-	mA	VIN+=0[V],VIN-=1[V], VOUT=5[V], Only 1ch is short circuit
Unity Gain Frequency	ft	25℃	-	4	-	MHz	
Slew Rate	SR	25℃	-	10	-	V/μs	Av=1,Vin=-10 to +10[V],RL=2[kΩ]
Channel Separation	CS	25℃	-	120	-	dB	

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

●Reference Data

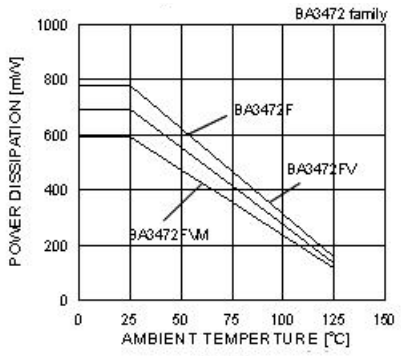


Fig.1
Derating Curve

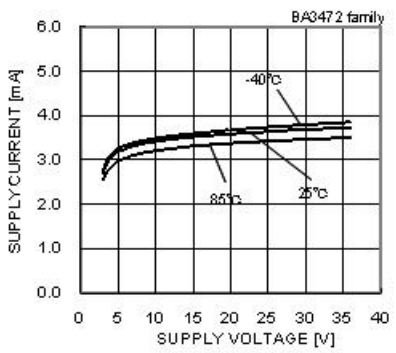


Fig.2
Supply Current – Supply Voltage

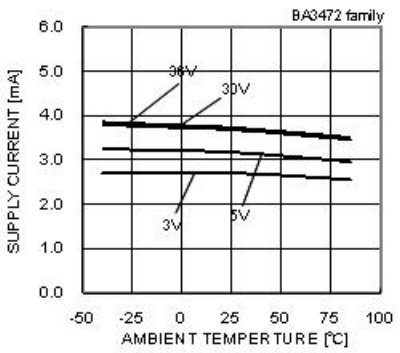


Fig.3
Supply Current – Ambient Temperature

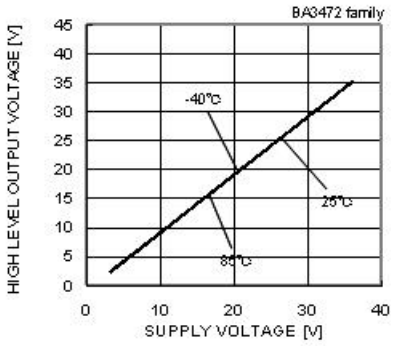


Fig.4
High Level Output Voltage
– Supply Voltage
(RL=10[kΩ])

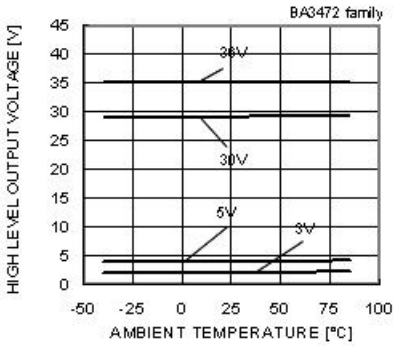


Fig.5
High Level Output Voltage
– Ambient Temperature
(RL=10[kΩ])

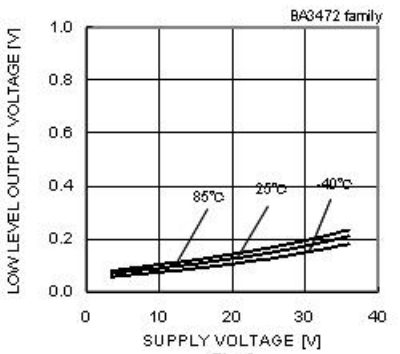


Fig.6
Low Level Output Voltage
– Supply Voltage
(RL=10[kΩ])

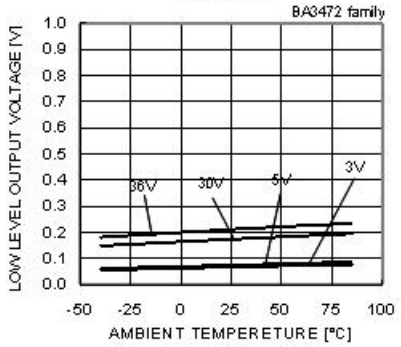


Fig.7
Low Level Output Voltage
– Ambient Temperature
(RL=10[kΩ])

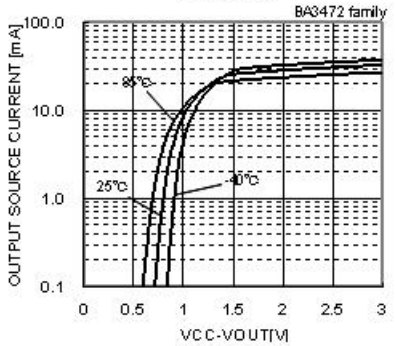


Fig.8
Output Source Current – (VCC-VOUT)
(VCC/VEE=5[V]/ 0[V])

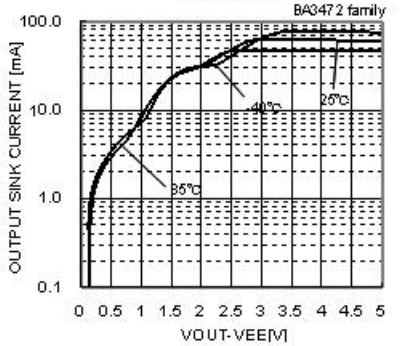


Fig.9
Output Sink Current – (VOUT-VEE)
(VCC/VEE=5[V]/ 0[V])

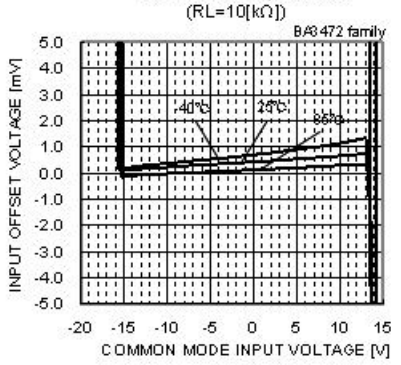


Fig.10
Input Offset Voltage
– Common Mode Input Voltage
(VCC/VEE=15[V]/-15[V])

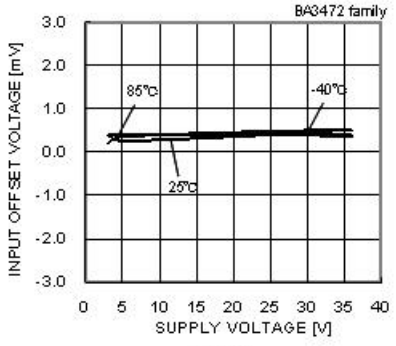


Fig.11
Input Offset Voltage – Supply Voltage

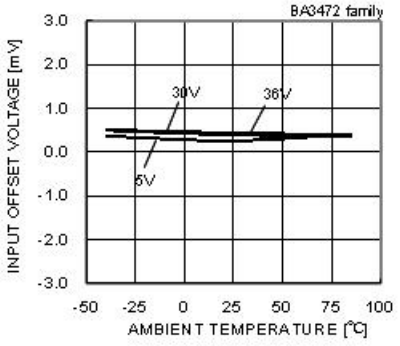


Fig.12
Input Offset Voltage – Ambient Temperature

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

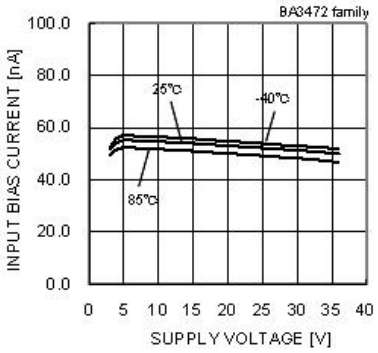


Fig.13
Input Bias Current – Supply Voltage

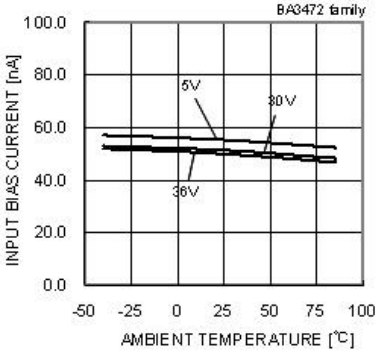


Fig.14
Input Bias Current – Ambient Temperature

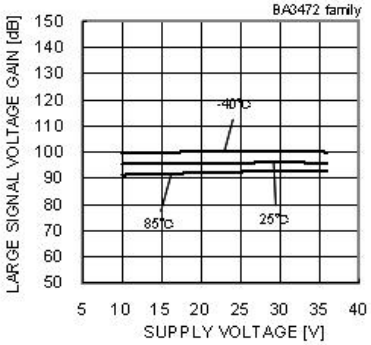


Fig.15
Large Signal Voltage Gain
– Supply Voltage

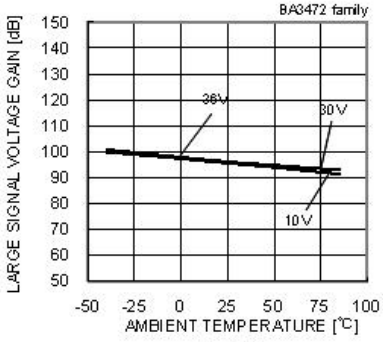


Fig.16
Large Signal Voltage Gain
– Ambient Temperature

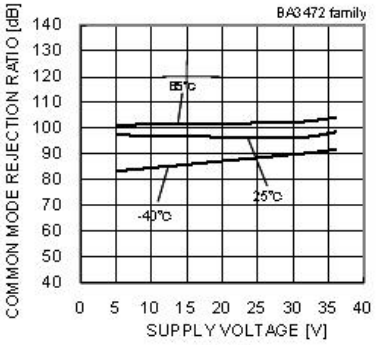


Fig.17
Common Mode Rejection Ratio
– Supply Voltage

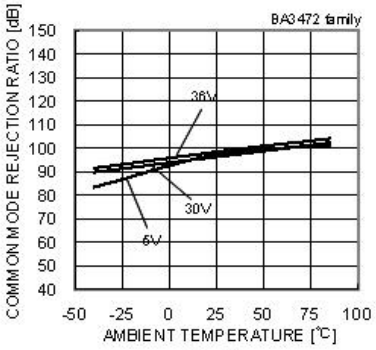


Fig.18
Common Mode Rejection Ratio
– Ambient Temperature

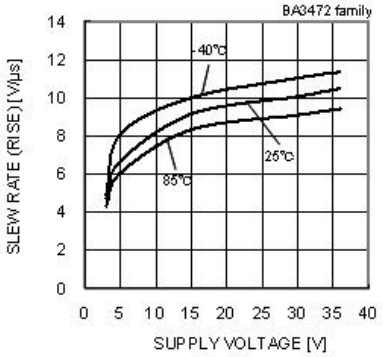


Fig.19
Slew Rate L-H – Supply Voltage
(RL=10[kΩ])

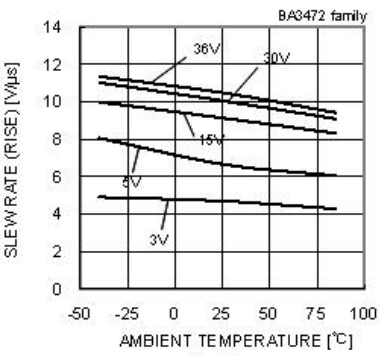


Fig.20
Slew Rate L-H – Ambient Temperature
(RL=10[kΩ])

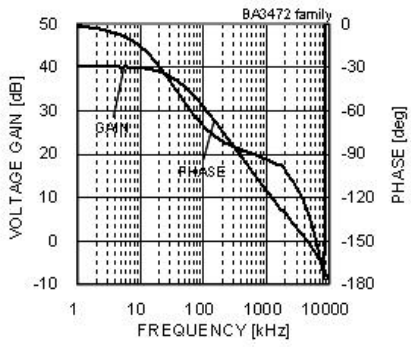


Fig.21
Voltage Gain – Frequency
(VCC=7.5[V]/-7.5[V],Av=40[dB],
RL=2[kΩ],CL=100[pF],Ta=25[℃])

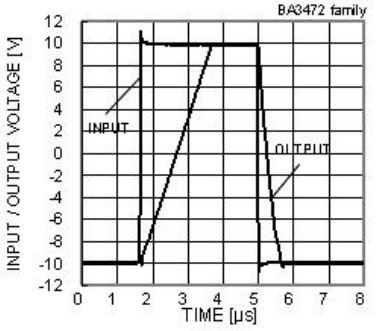


Fig.22
Input / Output Voltage – Time
(VCC/VEE=15[V]/-15[V],Av=0[dB],
RL=2[kΩ],CL=100[pF],Ta=25[℃])

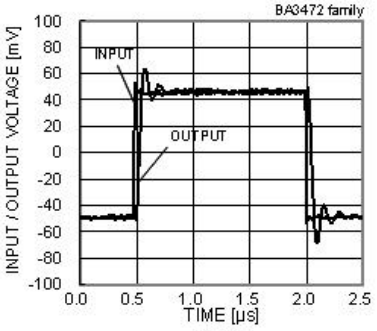


Fig.23
Input / Output Voltage – Time
(VCC/VEE=15[V]/-15[V],Av=0[dB],
RL=2[kΩ],CL=100[pF],Ta=25[℃])

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

●Schematic diagram

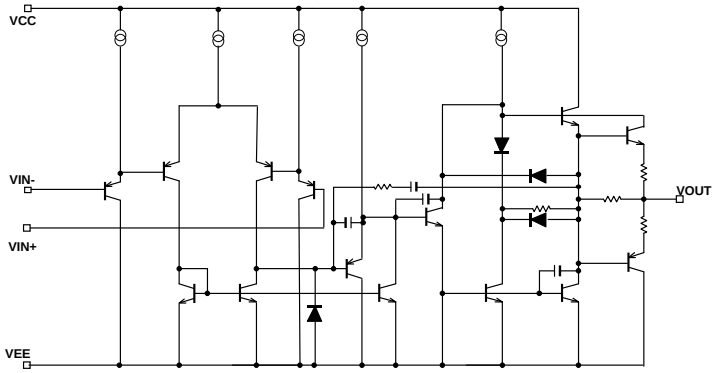


Fig24. Schematic diagram (one channel only)

●Test circuit1 NULL method

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

Parameter	VF	S1	S2	S3	BA3472 family				Calculation
					VCC	VEE	EK	Vicm	
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
	VF4	ON	OFF						
Large Signal Voltage Gain	VF5	ON	ON	ON	15	-15	+10	0	4
	VF6				15	-15	-10	0	
Common-mode Rejection Ratio (Input Common-mode Voltage Range)	VF7	ON	ON	OFF	15	-15	0	-15	5
	VF8				15	-15	0	13	
Power Supply Rejection Ratio	VF9	ON	ON	OFF	2	-2	0	0	6
	VF10				18	-18	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 Ratio (CMRR)

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

6. Power Supply Rejection Ratio (PSRR)

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

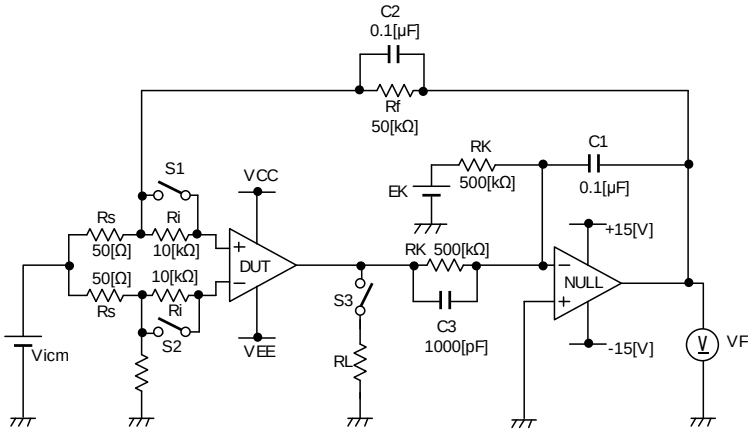


Fig.25 Test circuit 1 (one channel only)

●Test circuit2 switch condition

Unit : [V]

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

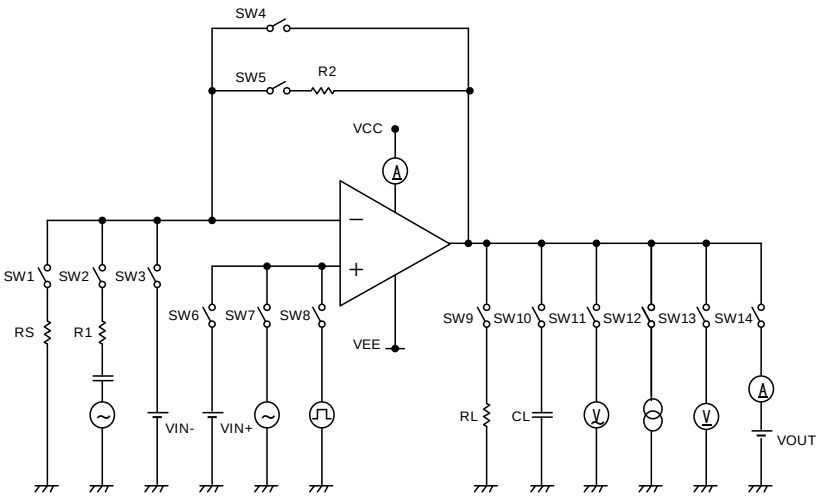


Fig26. Test circuit2 (one channel only)

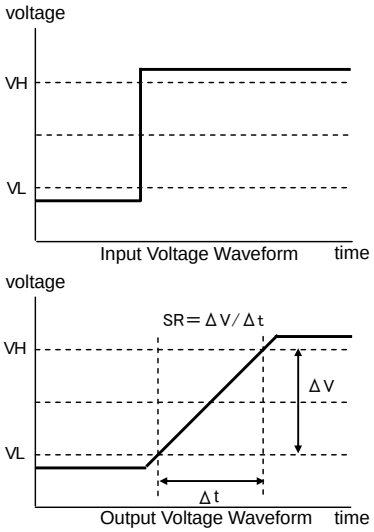


Fig27. Slew rate input output wave

●Test circuit3 Channel separation

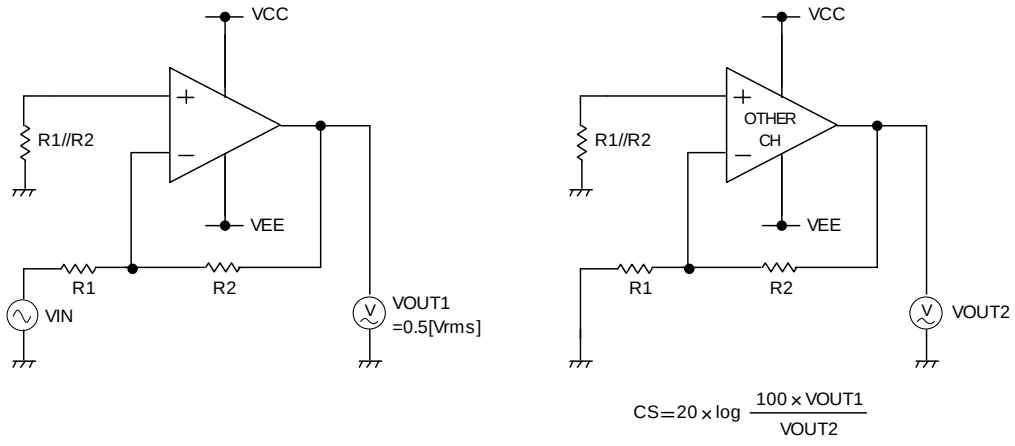


Fig28. Test circuit3

●Notes for use

1)Unused circuits
When there are unused circuits it is recommended that they are connected as in Fig.29, setting the non-inverting input terminal to a potential within input common-mode voltage range (Vicm).

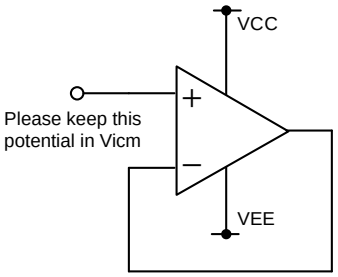


Fig.29Unused circuit example

2) 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.

3) 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.

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

5) Short-circuit between pins and erroneous mounting
Incorrect mounting may damage the IC. In addition, the presence of foreign particles between the outputs, the output and the power supply, or the output and GND may result in IC destruction.

6) 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 fluctuations in the electrical characteristics due to piezoelectric (piezo) effects.

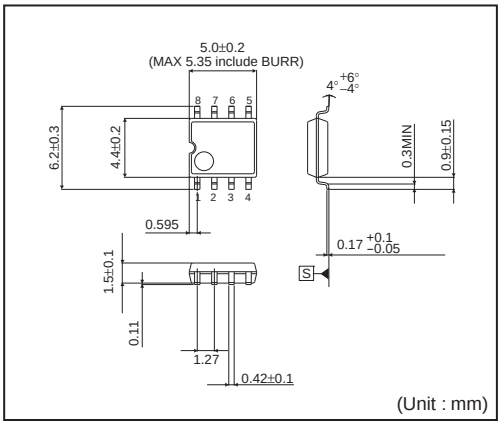
9) Board inspection
Connecting a capacitor to a pin with low impedance may stress the IC. Therefore, discharging the capacitor after every process is recommended. In addition, when attaching and detaching the jig during the inspection phase, ensure that the power is turned OFF before inspection and removal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

10)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

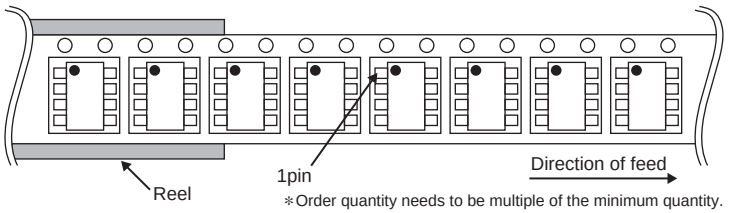
B	A		3	4	7	2		F	V	-	E	2
Part No.			Part No.					Package F: SOP8 FV: SSOP-B8 FVM: MSOP8			Packaging and forming specification E2: Embossed tape and reel (SOP8/SSOP-B8) TR: Embossed tape and reel (MSOP8)	

SOP8



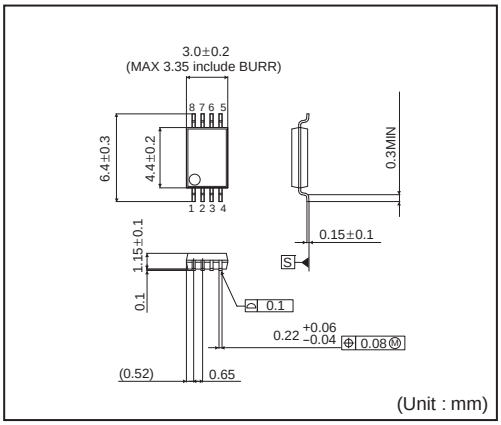
<Tape and Reel information>

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)



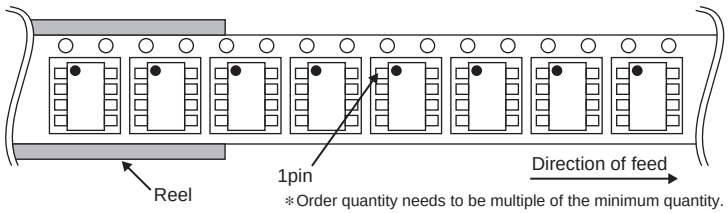
∗Order quantity needs to be multiple of the minimum quantity.

SSOP-B8



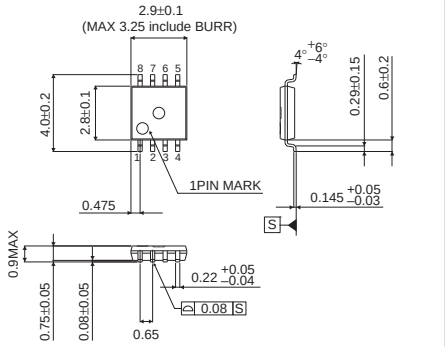
<Tape and Reel information>

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.

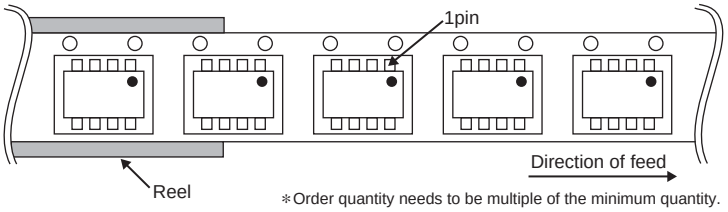
MSOP8



(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.

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