

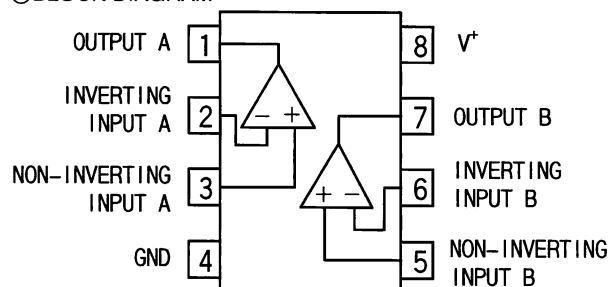
STRUCTURE SILICON MONOLITHIC INTEGRATED CIRCUIT

FUNCTION NOW SERIES GROUND SENSE DUAL OPERATIONAL AMPLIFIERS

PRODUCT SERIES **LM2904MX**

- FEATURES
- Operating temperature range $-40[^{\circ}\text{C}]$ to $+85[^{\circ}\text{C}]$ (Commercial grade)
 - Large signal voltage gain $100[\text{V/mV}]$ Typ
 - Wide supply voltage range
Single supply $+3[\text{V}]$ to $+26[\text{V}]$
Dual supply $\pm 1.5[\text{V}]$ to $\pm 13[\text{V}]$
 - Low supply current drain $0.5[\text{mA}]$ Typ
 - Common-Mode input voltage range includes ground
 - Low input offset voltage $2[\text{mV}]$ Typ
 - Differential input voltage range equal to the power supply voltage
 - Large output voltage swing $0[\text{V}]$ to $V^{+} - 1.5[\text{V}]$

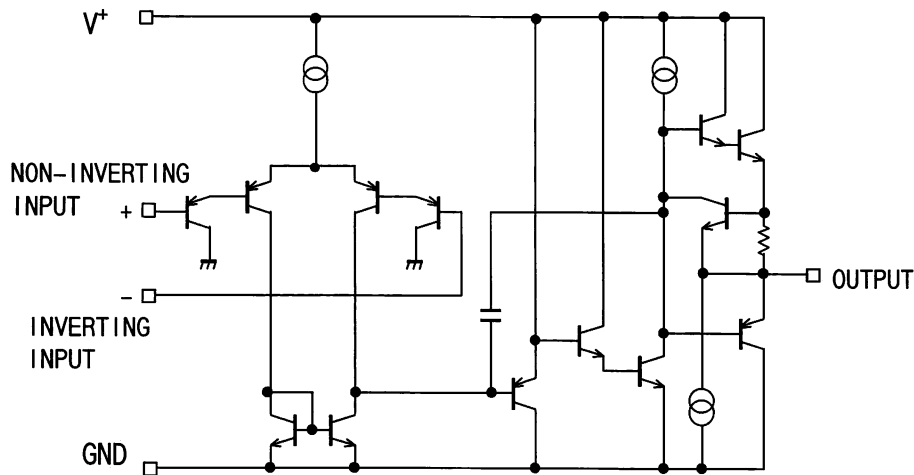
○BLOCK DIAGRAM



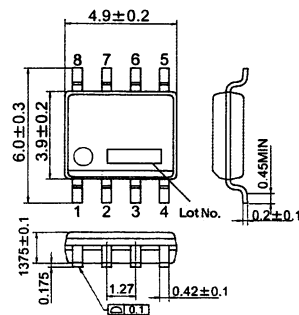
○PIN No. • PIN NAME

PIN No.	PIN NAME
1	OUTPUT A
2	INVERTING INPUT A
3	NON-INVERTING INPUT A
4	GND
5	NON-INVERTING INPUT B
6	INVERTING INPUT B
7	OUTPUT B
8	V^{+}

SCHEMATIC DIAGRAM (Each Operational Amplifier)



PHYSICAL DIAGRAM



This drawing is subject to change without notice.

LM2904MX (S.O package8) (Unit : [mm])

ABSOLUTE MAXIMUM RATING (Ta=25[°C])

Parameter	Symbol	Rating	Unit
Supply Voltage	V ⁺ – GND	+26	V
Power Dissipation	P _d	450(*1)(*2)	mW
Differential Input Voltage (*3)	V _{id}	26	V
Input Common-mode Voltage Range	V _{icm}	– 0.3 to +26	V
Operating Temperature	T _{opr}	– 40 to +85	°C
Storage Temperature Range	T _{stg}	– 65 to +150	°C
Maximum junction Temperature	T _{jmax}	+150	°C

(*1) To use at temperature above Ta=25[°C] reduce 3.60[mW]/[°C].

(*2) Mounted on a glass epoxy PCB(70[mm]×70[mm]×1.6[mm]).

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

OPERATING CONDITION (Ta=– 40[°C] to +85[°C])

Parameter	Symbol	Rating	Unit
Supply Voltage	V ⁺	+3.0 to +26.0 (Single Supply)	V
		± 1.5 to ± 13.0 (Dual Supply)	

○ELECTRICAL CHARACTERISTICS (Unless otherwise specified $V^+ = +5[V]$)

Parameter	Symbol	Temperature Range	Guaranteed Limit			Unit	Condition
			Min.	Typ.	Max.		
Input Offset Voltage (*4)	VIO	25°C	-	2	7	mV	RS=0[Ω],VO=1.4[V] V*=5[V] to 26[V]
		Full range	-	-	10		
Input Offset Voltage Drift	αVIO	-	-	7	-	μV/°C	RS=0[Ω]
Input Bias Current (*4)	IIB	25°C	-	45	250	nA	VO=1.4[V],IIN(+) or IIN(-) VCM=0[V]
		Full range	-	40	500		
Input Offset Current (*4)	IIO	25°C	-	5	50	nA	IIN(+)-IIN(-),VCM=0[V]
		Full range	-	45	200		IIN(+)-IIN(-)
Input Offset Current Drift	αIIO	-	-	10	-	pA/°C	RS=0[Ω]
Input Common-mode Voltage Range	VICR	25°C	-	-	V*-1.5	V	V*=26[V] (*6)
		Full range	-	-	V*-2.0		
Supply Current	ICC	Full range	-	0.5	1.2	mA	V*=5[V],RL=∞ All Op Amps
			-	1	2		V*=26[V], RL=∞ All Op Amps
Output Voltage Swing	VOH	Full range	23	24	-	V	V*=26[V],RL=10[kΩ]
	VOL		-	5	100	mV	RL=10[kΩ],V*=5[V]
Large Signal Voltage Gain	AV	25°C	25	100	-	V/mV	V*=15[V],VO=1[V] to 11[V] RL≥2[kΩ]
Common-mode Rejection Ratio	CMRR	25°C	50	70	-	dB	VCM=0[V] to V*-1.5[V]
Power Supply Rejection Ratio	PSRR	25°C	50	100	-	dB	V*=5[V] to 26[V]
Amplifier-to-Amplifier Coupling	VO1/VO2	25°C	-	120	-	dB	f=1[kHz] to 20[kHz]
Output Current (*5)	Source	25°C	20	40	-	mA	V*=15[V],VO=2[V] VIN+=1[V],VIN=0[V]
		Full range	10	20	-		
	Sink	25°C	10	20	-	mA	V*=15[V],VO=2[V] VIN+=0[V],VIN=-1[V]
		Full range	2	8	-		
		Full range	12	50	-		

(*4) Absolute value.

(*5) Under the high temperature environment, consider the power dissipation of IC when select the output current.

When output terminal short-circuits continuously, the output current reduce to climb temperature inside IC by flash.

(*6) The input common-mode voltage range of ether input voltage should not be allowed to go negative by more than 0.3[V].

The upper end of input common-mode voltage range is +26[V] without damage independent of the magnitude of V⁺.

○APPLICATION EXAMPLE

(1) Absolute maximum ratings

Absolute maximum ratings are the values, which indicate the limits, within which the given voltage range can be safely charged to the terminal. However, it does not guarantee the circuit operation.

(2) The example of disabled circuit application

When there is a circuit not in use, it is recommended to make the non-inverting input terminal be the potential in the common-mode input voltage range like in Fig.1.

(3) Applied voltage to the input terminal

Regardless of power supply voltage, GND +26 [V] can be applied to input terminals without deterioration or destruction of its characteristics. However, this does not guarantee a circuit operation. Note that circuits do not operate normally with input voltage not within input common mode voltage in terms of the electrical characteristics.

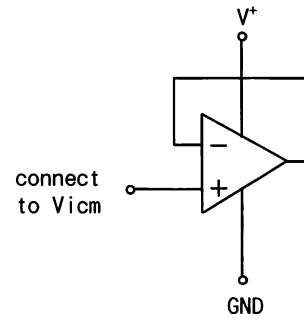


Fig.1 The example of disable circuit

(4) Operating power supply (single power supply/dual power supply)

The OP-Amp operates if a given level of voltage is applied between V^+ and GND. Therefore, the OP-Amp can be operated under single power supply or dual power supply.

(5) Power dissipation

If the IC is used under excessive power dissipation. An increase in the chip temperature will cause deterioration of the radical characteristics of IC. For example, reduction of current capability. Take consideration of the effective power dissipation and thermal design with a sufficient margin. Pd is reference to the provided power dissipation curve.

(6) Short circuits between pins and incorrect mounting

Short circuits between pins and incorrect mounting when mounting the IC on a printed circuits board, take notice of the direction and positioning of the IC. If IC is mounted erroneously, It may be damaged. Also, when a foreign object is inserted between output, between output and V^+ terminal or GND terminal which causes short circuit, the IC may be damaged.

(7) Using under strong electromagnetic field

Be careful when using the IC under strong electromagnetic field because it may malfunction.

(8) Usage of IC

When stress is applied to the IC through warp of the printed circuit board, The characteristics may fluctuate due to the piezo effect. Be careful of the warp of the printed circuit board.

(9) Output operation

This IC is configured with a push-pull circuit and Class C output stage. Therefore, when load resistance is connected to the middle point potential of V^+ and GND, this configuration generates crossover distortion when switching between source and sink current. To suppress crossover distortion, connect a resistor between the output terminal and GND then increase the bias current to enable Class A operation.

(10) Testing IC on the set board

When testing IC on the set board, in cases where the capacitor is connected to the low impedance, make sure to discharge per fabrication because there is a possibility that IC may be damaged by stress. When removing IC from the set board, it is essential to cut supply voltage. As a countermeasure against the static electricity, observe proper grounding during fabrication process and take due care when carrying and storage it.

(11) Output terminal capacitor

Transistor in circuits may be damaged when V^+ terminal and GND terminal is shorted with the charged output terminal capacitor.

When IC is used as a comparator or as an application circuit, where oscillation is not activated by an output capacitor, the output capacitor must be kept below 0.1[μ F] in order to prevent the damage mentioned above.

Be carefull when IC is used as voltage follower application with output capacitance. If capacitance connect output terminal then evaluate for output terminal oscillation.

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Japan /
(Internal Sales)

Tokyo	2-1-1, Yaesu, Chuo-ku, Tokyo 104-0082	
	TEL : +81(3)5203-0321	FAX : +81(3)5203-0300
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Nagoya	Dainagayo Building 9F 3-28-12, Meieki, Nakamura-ku, Nagoya, Aichi 450-0002	
	TEL : +81(52)581-8521	FAX : +81(52)561-2173
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