

## QUAD OPERATIONAL AMPLIFIERS

### DESCRIPTION

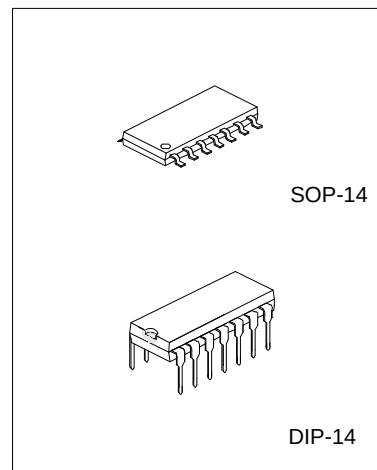
The LM324 consists of four independent, high gain internally frequency compensated operational amplifiers which were designed specifically to operate from a single power supply over a wide voltage range.

Operation from split power supplies is also possible so long as the difference between the two supplies is 3 Volts to 30 Volts.

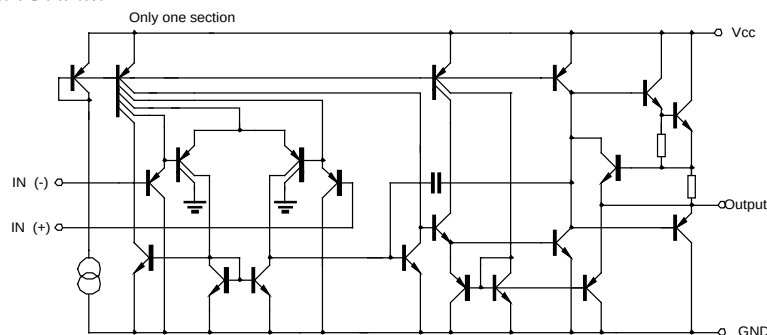
Application areas include transducer amplifier, DC gain blocks and all the conventional OP amp circuits which now can be easily implemented in single power supply system.

### FEATURES

- \*Internally frequency compensated for unity gain
- \*Large DC voltage gain :100dB
- \*Wide operating supply range( $V_{CC}=3V\sim 30V$ )
- \*Input common-mode voltage includes ground
- \*Large output voltage swing: From 0V to  $V_{CC}-1.5V$
- \*Power drain suitable for battery operation



### BLOCK DIAGRAM



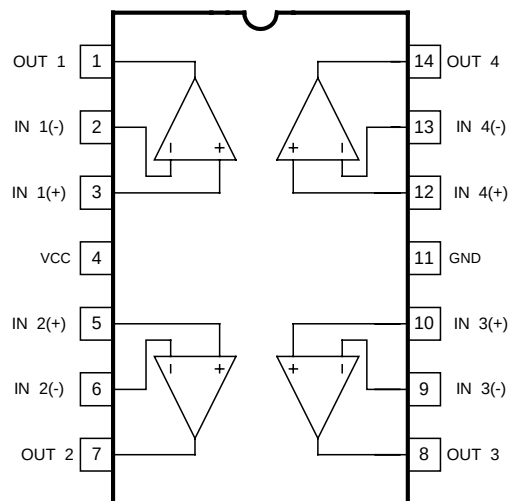
### ABSOLUTE MAXIMUM RATINGS ( $T_a=25^{\circ}C$ )

| Characteristic             | Symbol        | Value      | Unit        |
|----------------------------|---------------|------------|-------------|
| Supply Voltage             | $V_{CC}$      | $\pm 15$   | V           |
| Differential input voltage | $V_{I(diff)}$ | 30         | V           |
| Input Voltage              | $V_I$         | -0.3~30V   | V           |
| Power Dissipation          | $P_d$         | 570        | mW          |
| Operating Temperature      | $T_{opr}$     | 0 to +70   | $^{\circ}C$ |
| Storage Temperature        | $T_{stg}$     | -65 to 150 | $^{\circ}C$ |

**ELECTRICAL CHARACTERISTICS**( Ta=25°C )

(Vcc=5.0V, All voltage referenced to GND unless otherwise specified)

| Characteristic                  | Symbol       | Test Condition                                       | Min | Typ.         | Max      | Unit    |
|---------------------------------|--------------|------------------------------------------------------|-----|--------------|----------|---------|
| Input offset voltage            | $V_{IO}$     | $V_{CM}=0$ to $V_{CC}-1.5$<br>$V_{O(p)}=1.4V, R_S=0$ |     | 1.5          | 7.0      | mV      |
| Input offset current            | $I_{IO}$     |                                                      |     | 3.0          | 50       | nA      |
| Input Bias current              | $I_b$        |                                                      |     | 40           | 250      | nA      |
| Input Common-mode voltage range | $V_{I(R)}$   | $V_{CC}=30V$                                         | 0   | $V_{CC}-1.5$ |          | V       |
| Supply Current                  | $I_{CC}$     | $R_L=\infty, V_{CC}=30V$                             |     | 1.0          | 3        | mA      |
|                                 |              | $V_{CC}=5V$                                          |     | 0.7          | 1.2      | mA      |
| Large signal Voltage Gain       | $G_v$        | $V_{CC}=15V, R_L>2k\Omega$<br>$V_{O(p)}=1V$ to $11V$ | 25  | 100          |          | V/mV    |
| Output voltage Swing            | $V_{(OH)}$   | $V_{CC}=30V, R_L=2k\Omega$                           | 26  |              |          | V       |
|                                 |              | $V_{CC}=30V, R_L=10k\Omega$                          | 27  | 28           |          | V       |
|                                 | $V_{(OL)}$   | $V_{CC}=5, R_L>10k\Omega$                            |     | 5            | 20       | mV      |
| Common-mode rejection Ratio     | CMRR         |                                                      | 65  | 75           |          | dB      |
| Power supply rejection Ratio    | PSRR         |                                                      | 65  | 100          |          | dB      |
| Channel Separation              | CS           | $f=1kHz$ to $20kHz$                                  |     | 5            | 20       | mV      |
| Short circuit to GND            | $I_{SC}$     |                                                      |     | 40           | 60       | mA      |
| Output current                  | $I_{source}$ | $V_I(+)=1V, V_I(-)=0$<br>$V_{CC}=15V, V_{O(p)}=2V$   | 20  | 40           |          | mA      |
|                                 | $I_{sink}$   | $V_I(+)=0V, V_I(-)=1V$<br>$V_{CC}=15V, V_{O(p)}=2V$  | 10  | 13           |          | mA      |
|                                 |              | $V_I(+)=1V, V_I(-)=0$<br>$V_{CC}=15V, V_{O(p)}=200V$ | 12  | 45           |          | $\mu A$ |
| Differential input voltage      | $V_I(diff)$  |                                                      |     |              | $V_{CC}$ | V       |

**PIN CONFIGURATION**

## TYPICAL CHARACTERISTICS PERFORMANCE

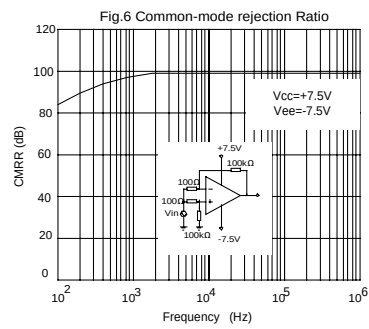
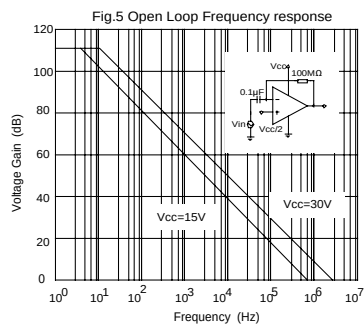
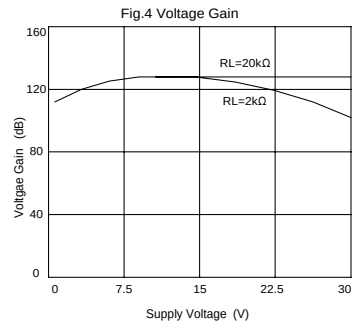
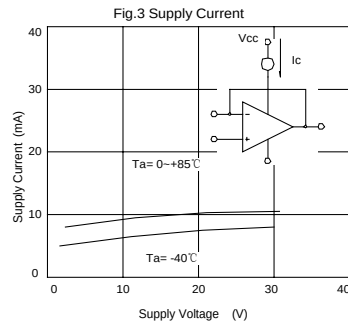
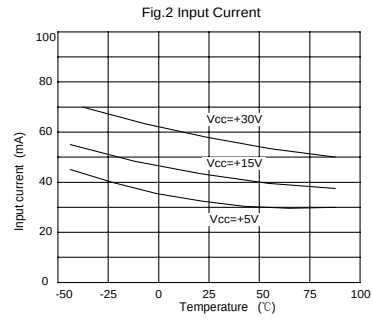
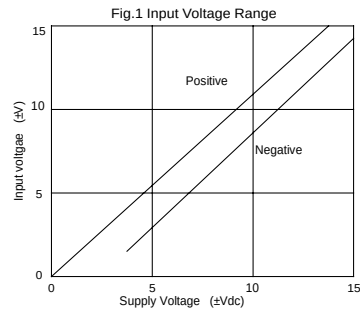


Fig.7

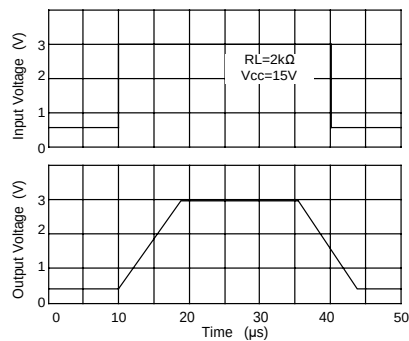


Fig.8 voltage Follower pulse response (small signal)

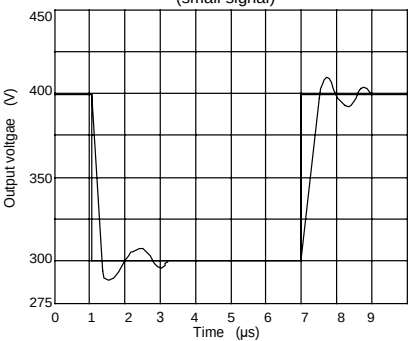


Fig.9 Large signal Frequency Response

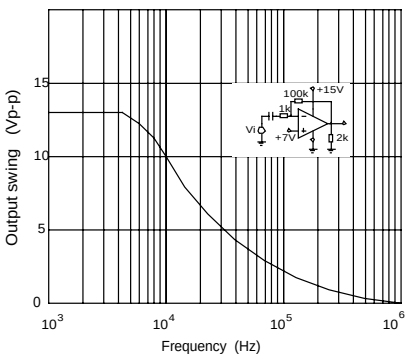


Fig.10 Output Characteristics current sourcing

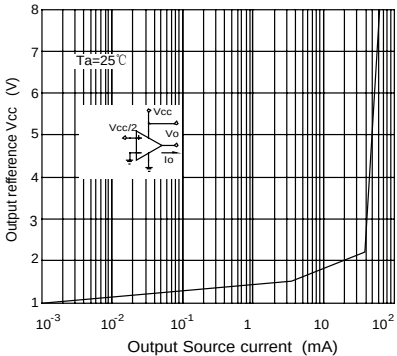


Fig.11 Output Characteristics Current sinking

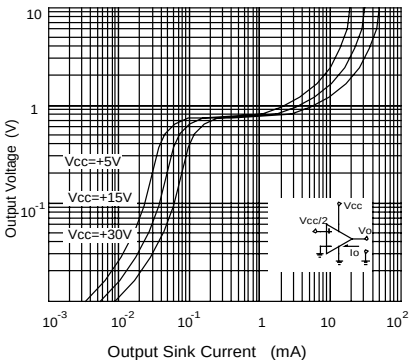


Fig.12 Current Limiting

