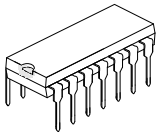
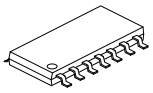
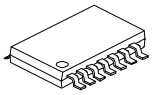
# QUADRUPLE OPERATIONAL AMPLIFIERS



DIP-14



SOP-14U



TSSOP-14U

## ■ DESCRIPTION

UTC **LM224** consist of four independent, high-gain, frequency-compensated operational amplifiers which are designed to operate from a single power supply over a wide range of voltage. Operation from split supplies is also possible so long as the difference between the two supplies is 3V ~ 32V. The low supply current drain is independent of the magnitude of the supply voltage.

The device can easily be implemented in single supply voltage system, including transducer amplifiers, DC gain blocks, and all of conventional OP Amp circuits.

## ■ FEATURES

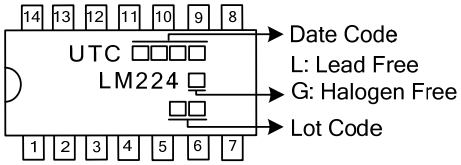
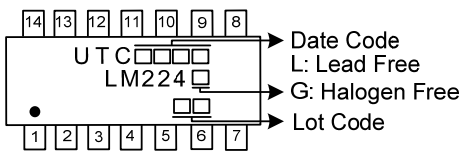
*Internally frequency compensated for unity gain
*Large DC voltage gain :100dB
*Wide operating supply range ($V_{CC}$=3V~32V)
*Input common-mode voltage includes ground
*Large output voltage swing: From 0V to $V_{CC}$-1.5V
*Power drain suitable for battery operation

## ■ ORDERING INFORMATION

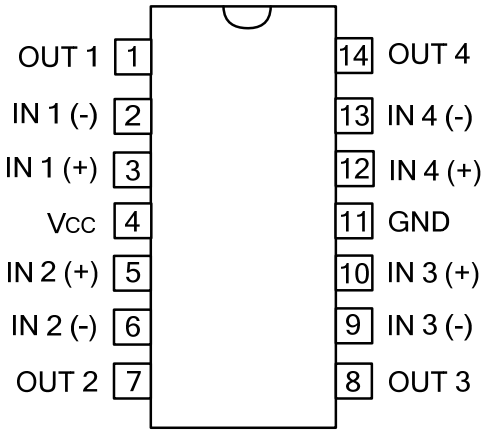
| Ordering Number | | Package | Packing |
|---|---|---|---|
| Lead Free | Halogen-Free | | |
| LM224L-D14-T | LM224G-D14-T | DIP-14 | Tube |
| LM224L-UEA-R | LM224G-UEA-R | SOP-14U | Tape Reel |
| LM224L-UEB-R | LM224G-UEB-R | TSSOP-14U | Tape Reel |

| | |
|---|---|
| LM224G-D14-T<br>(1)Packing Type<br>(2)Package Type<br>(3)Green Package | (1) T: Tube, R: Tape Reel<br>(2) DIP: DIP-14, UEA: SOP-14U, UEB: TSSOP-14U<br>(3) G: Halogen Free and Lead Free, L: Lead Free |

## ■ MARKING

| DIP-14 | SOP-14U / TSSOP-14U |
|---|---|
|  |  |

■ PIN CONFIGURATION



## ■ ABSOLUTE MAXIMUM RATINGS

| PARAMETER | | SYMBOL | RATINGS | UNIT |
|---|---|---|---|---|
| Supply Voltage (Note 1) | | $V_{CC}$ | ±16 or 32 | V |
| Differential Input voltage (Note 2) | | $V_{I(DIFF)}$ | ± 32 | V |
| Input Voltage | | $V_{IN}$ | -0.3 ~ +32 | V |
| Output Short Circuit (one amplifier) to Ground ($T_A$ ≤25°C, $V_{CC}$ ≤15V) (Note 3) | | | Continuous | |
| Power Dissipation | DIP-14 | $P_D$ | 800 | mW |
| | SOP-14U | | 480 | mW |
| | TSSOP-14U | | 360 | mW |
| Operation Temperature | | $T_{OPR}$ | -40 ~ +105 | °C |
| Storage Temperature | | $T_{STG}$ | -65 ~ +150 | °C |

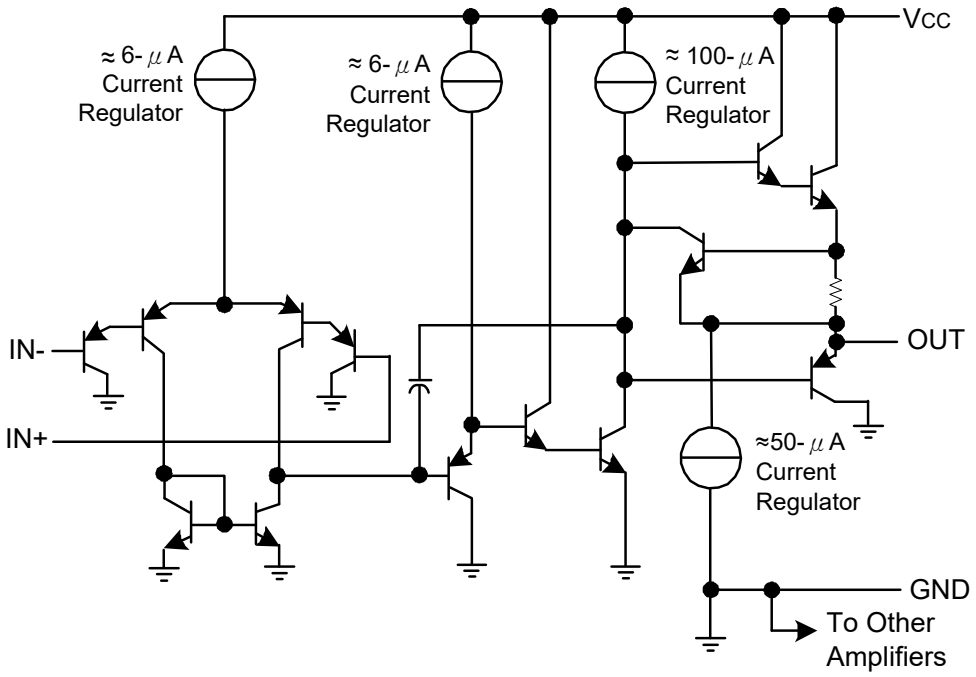
Notes: 1. All voltage values(except differential voltages and $V_{CC}$ specified for the measurement of $I_{IN(OS)}$ are with respect to the network GND.
2. Differential voltages are at IN+ with respect to IN-.
3. Short circuits from outputs to $V_{CC}$ can cause excessive heating and eventual destruction.

## ■ ELECTRICAL CHARACTERISTICS ($V_{CC}$=5V, unless otherwise specified, $V_{CC}$=30V for testing only.)

| PARAMETER | | SYMBOL | TEST CONDITIONS* | | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|---|
| Input Offset Voltage | | $V_{I(OFF)}$ | $V_{CC}$=5V to 30V, $V_{IC}=V_{ICR(min)}$, $V_{OUT}$=1.4V | $T_A$=25°C | | 3 | 5 | mV |
| | | | | $T_A$=-40~+105°C | | | 7 | mV |
| Input Offset Current | | $I_{I(OFF)}$ | $V_{OUT}$=1.4V | $T_A$=25°C | | 2 | 30 | nA |
| | | | | $T_A$=-40~+105°C | | | 100 | nA |
| Input Bias Current | | $I_{I(BIAS)}$ | $V_{OUT}$=1.4V | $T_A$=25°C | | -20 | -150 | nA |
| | | | | $T_A$=-40~+105°C | | | -300 | nA |
| Input Common-mode Voltage Range | | $V_{I(CM)}$ | $V_{CC}$=5V to 30V | $T_A$=25°C | 0 | | $V_{CC}$-1.5 | V |
| | | | | $T_A$=-40~+105°C | 0 | | $V_{CC}$-2 | V |
| Output Voltage Level | High | $V_{OH}$ | $R_L$=2kΩ | $T_A$=25°C | $V_{CC}$-1.5 | | | V |
| | | | $V_{CC}$=30V, $R_L$=2kΩ | $T_A$=-40~+105°C | 26 | | | V |
| | | | $V_{CC}$=30V, $R_L$≥10kΩ | | 27 | 28 | | V |
| | Low | $V_{OL}$ | $R_L$ ≤ 10kΩ | $T_A$=-40~+105°C | | 5 | 20 | mV |
| Large Signal Current Gain | | $G_V$ | $V_{CC}$=15V, $V_{OUT}$=1V ~ 11V $R_L$≥2kΩ | $T_A$=25°C | 50 | 100 | | V/mV |
| | | | | $T_A$=-40~+105°C | 25 | | | V/mV |
| Common-mode Rejection Ratio | | CMRR | $V_{IC}=V_{ICR(min)}$ | $T_A$=25°C | 70 | 80 | | dB |
| Supply Voltage Rejection Ratio ($\Delta V_{CC}/\Delta V_{IO}$) | | PSRR | | $T_A$=25°C | 65 | 100 | | dB |
| Crosstalk Attenuation | | $V_{O1}/V_{O2}$ | f =1kHz ~ 20 kHz | $T_A$=25°C | | 120 | | dB |
| Output Current | | $I_{OUT}$ | $V_{CC}$=15V, $V_{ID}$=1V, $V_{OUT}$=0 | $T_A$=25°C | -20 | -30 | -60 | mA |
| | | | | $T_A$=-40~+105°C | -10 | | | mA |
| | | | $V_{CC}$=15V, $V_{ID}$=-1V, $V_{OUT}$=15V | $T_A$=25°C | 10 | 20 | | mA |
| | | | | $T_A$=-40~+105°C | 5 | | | mA |
| | | | $V_{ID}$=-1V, $V_{OUT}$=200mV | $T_A$=25°C | 12 | 30 | | µA |
| Short-circuit Output Current | | $I_{OS}$ | $V_{CC}$=5V, $V_{OUT}$=0, GND at -5V | $T_A$=25°C | | ± 40 | ± 60 | mA |
| Supply Current (four amplifiers) | | $I_{CC}$ | $V_{OUT}$=2.5V, $R_L$=∞ | $T_A$=-40~+105°C | | 0.7 | 1.2 | mA |
| | | | $V_{CC}$=30V, $V_{OUT}$=0.5$V_{CC}$, $R_L$=∞ | | | 1.4 | 3 | mA |

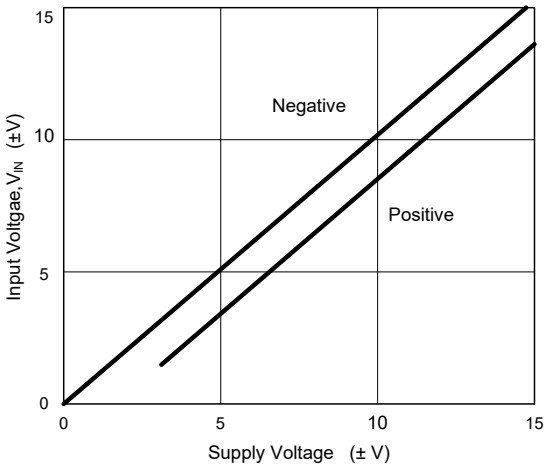
Note: All characteristics are measured under open-loop conditions with zero common-mode input voltage.

■ SCHEMATIC DIAGRAM (One Section Only)

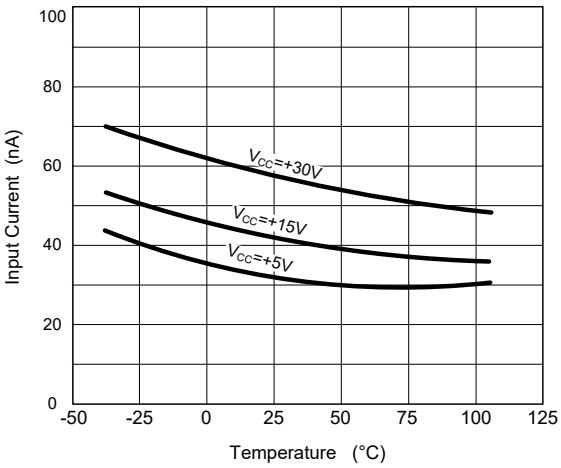


## ■ TYPICAL CHARACTERISTICS

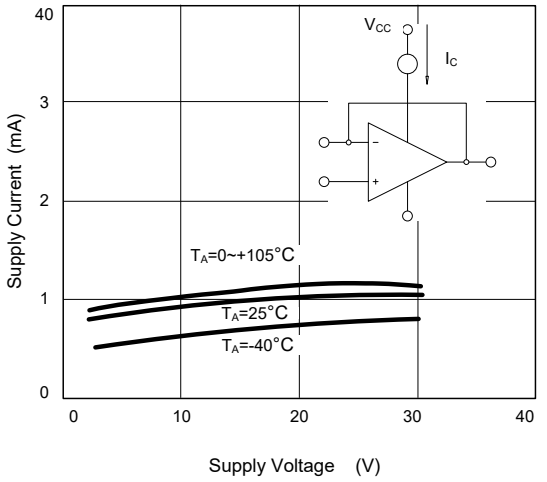
Input Voltage Range



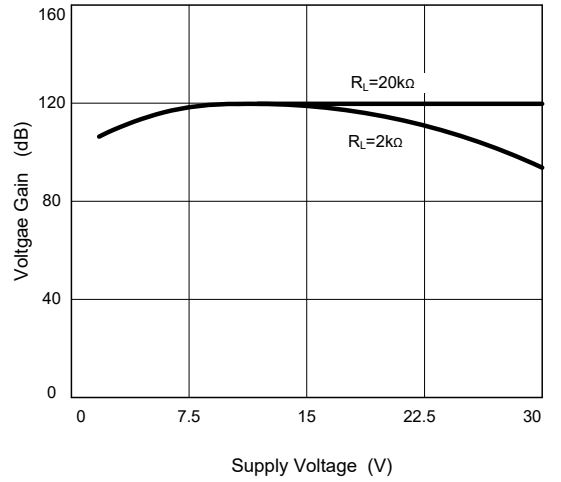

Input Current



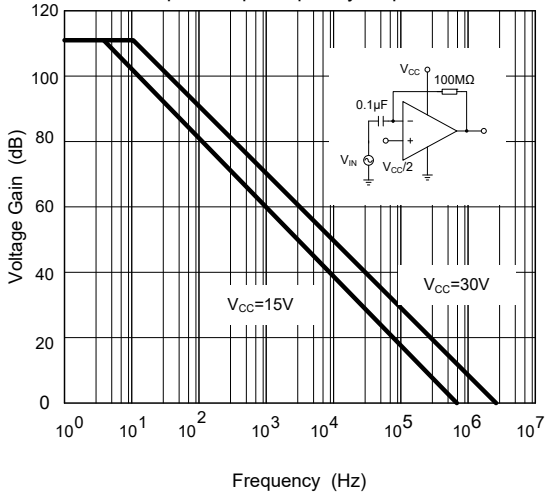

Supply Current



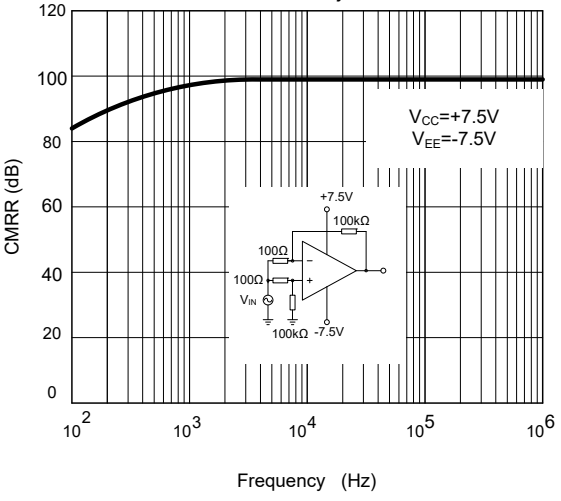

Voltage Gain




Open Loop Frequency response

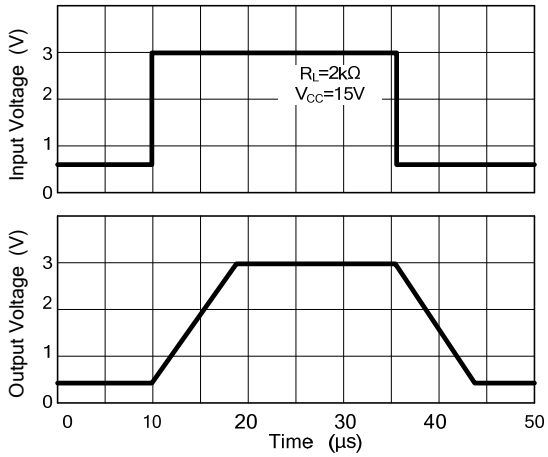



Common-Mode Rejection Ratio

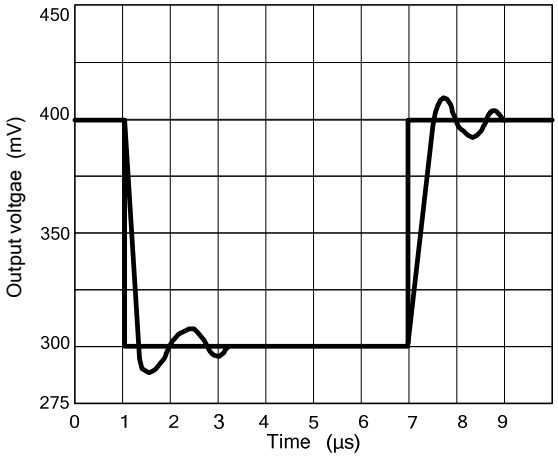


## ■ TYPICAL CHARACTERISTICS (Cont.)

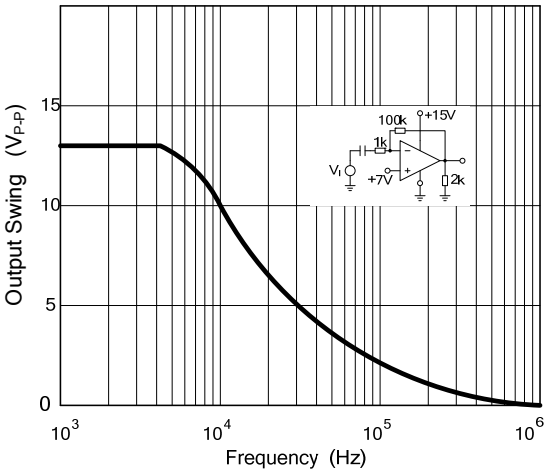
Voltage Follower Pulse Response




Voltage Follower pulse response (small signal)




Large Signal Frequency Response




Output Characteristics Current Sourcing