# LM348/LM248

## Quad Operational Amplifier

### Features

- LM741 OP Amp operating characteristics
- Low supply current drain
- Class AB output stage no crossover distortion
- Pin compatible with the LM324/LM248
- Low input offset voltage : 1mV Typ.
- Low input offset current : 4nA Typ.
- Low input bias current : 30nA Typ.
- Gain bandwidth (unity gain): 1.0MHz Typ.
- High degree of isolation between amplifiers: 120dB
- Overload protection for inputs and outputs

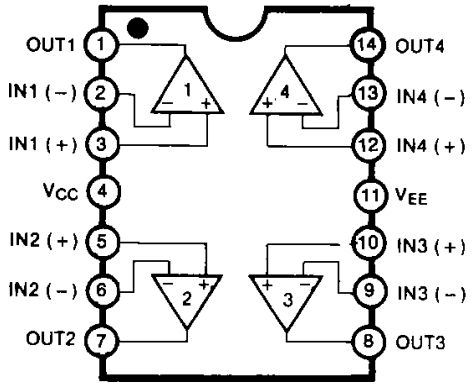
### Description

TheLM348/LM248 is a true quad LM741. It consists of four independent, high-gain, internally compensated, low power operational amplifiers which have been designed to provide functional characteristics identical to those of the familiar LM741 operational amplifier. In addition the total supply current for all four amplifiers is comparable to the supply current of a single LM741 type OP Amp. Other features include input offset currents and input bias current which are much less than those of a standard LM741. Also, excellent isolation between amplifiers has been achieved by independently biasing each amplifier and using layout techniques which minimize thermal coupling.

**14-DIP**

**14-SOP**

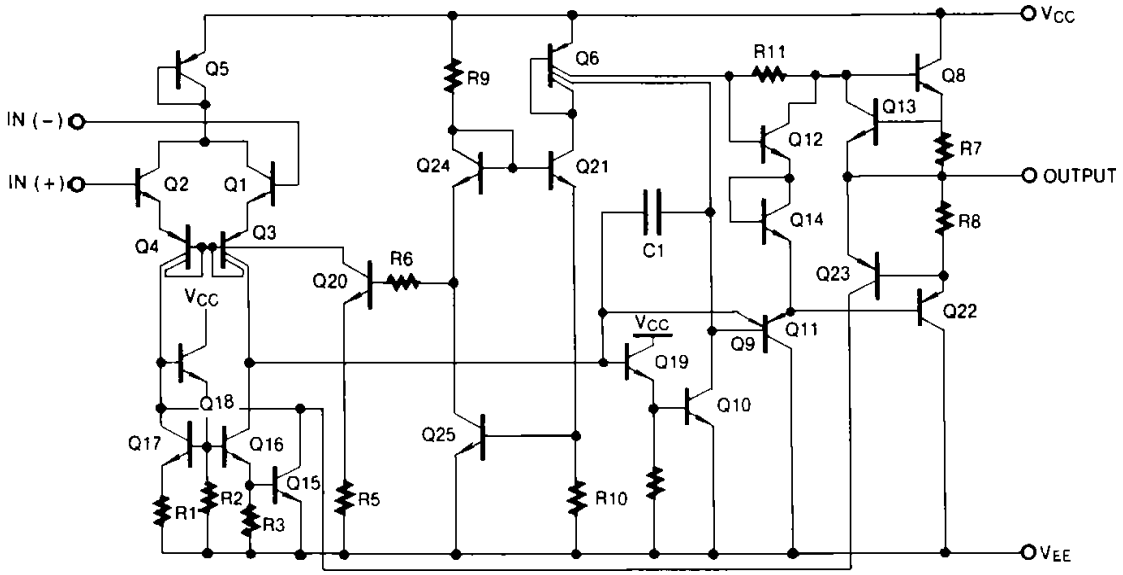
### Internal Block Diagram




Rev. 1.0.1

## Schematic Diagram

(One Section Only)




## Absolute Maximum Ratings

| Parameter | Symbol | Value | Unit |
|---|---|---|---|
| Supply Voltage | $V_{CC}$ | ±18 | V |
| Differential Input Voltage | $V_{I(DIFF)}$ | 36 | V |
| Input Voltage | $V_I$ | ±18 | V |
| Output Short Circuit Duration | - | Continuous | - |
| Operating Temperature<br>LM348<br>LM248 | $T_{OPR}$ | <br>0 ~ +70<br>-25 ~ +85 | °C |
| Storage Temperature | $T_{STG}$ | - 65~ +150 | °C |

## Electrical Characteristics

($V_{CC}$ =15V, $V_{EE}$= -15V, $T_A$=25 °C, unless otherwise specified)

| Parameter | Symbol | Conditions | | LM248 | | | LM348 | | | Unit |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Min. | Typ. | Max. | Min. | Typ. | Max. | |
| Input Offset Voltage | $V_{IO}$ | $R_S$≤10KΩ | | - | 1 | 6.0 | - | 1 | 6.0 | mV |
| | | | Note 1 | - | - | 7.5 | - | - | 7.5 | |
| Input Offset Current | $I_{IO}$ | | | - | 4 | 50 | - | 4 | 50 | nA |
| | | | Note 1 | - | - | 125 | - | - | 100 | |
| Input Bias Current | $I_{BIAS}$ | | | - | 30 | 200 | - | 30 | 200 | nA |
| | | | Note 1 | - | - | 500 | - | - | 400 | |
| Input Resistance | $R_I$ | - | | 0.8 | 2.5 | - | 0.8 | 2.5 | - | MΩ |
| Supply Current (all Amplifiers) | $I_{CC}$ | - | | - | 2.4 | 4.5 | - | 2.4 | 4.5 | mA |
| Large Signal Voltage Gain | $G_V$ | $R_L$≥2KΩ | | 25 | 160 | - | 25 | 160 | - | V/mV |
| | | | Note 1 | 15 | - | - | 15 | - | - | |
| Channel Separation | CS | f = 1KHz to 20KHz | | - | 120 | - | - | 120 | - | dB |
| Common Mode Input Voltage Range | $V_{I(R)}$ | Note 1 | | ±12 | - | - | ±12 | - | - | V |
| Small Signal Bandwidth | BW | $G_V$ = 1 | | - | 1.0 | - | - | 1.0 | - | MHz |
| Phase Margin (Note2) | MPH | $G_V$ = 1 | | - | 60 | - | - | 60 | - | Degree |
| Slew Rate (Note2) | SR | $G_V$ = 1 | | - | 0.5 | - | - | 0.5 | - | V/μs |
| Output Short Circuit Current | $I_{SC}$ | - | | - | 25 | - | - | 25 | - | mA |
| Output Voltage Swing | $V_{O(P-P)}$ | $R_L$≥10KΩ | Note 1 | ±12 | ±13 | - | ±12 | ±13 | - | V |
| | | $R_L$≥2KΩ | | ±10 | ±12 | - | ±10 | ±12 | - | |
| Common Mode Rejection Ratio | CMRR | $R_S$≥10KΩ | Note 1 | 70 | 90 | - | 70 | 90 | - | dB |
| Power Supply Rejection Ratio | PSRR | $R_S$≥10KΩ | Note 1 | 77 | 96 | - | 77 | 96 | - | dB |

**Note :**

1. LM348: 0 ≤ $T_A$ ≤ +70 °C , LM248: -25 ≤ $T_A$ ≤ +85 °C
2. Guaranteed by design.

# Typical Performance Characteristics

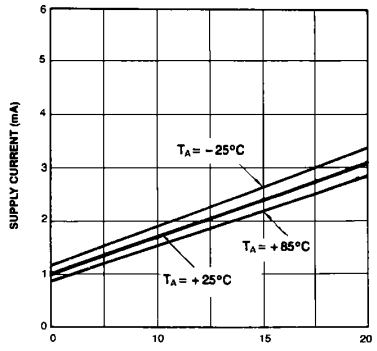



**Figure 1. Supply Current vs Supply voltage**

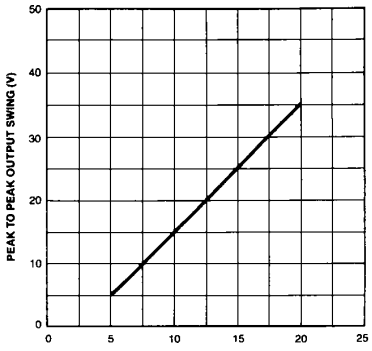



**Figure 2. Output Voltage Swing vs Supply voltage**

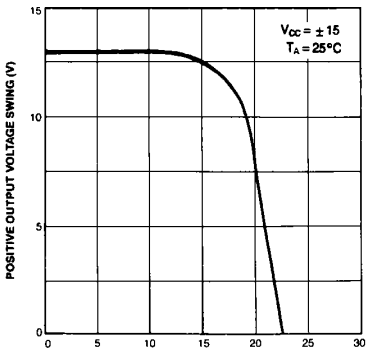



**Figure 3. Output voltage swing vs Source Current (mA)**

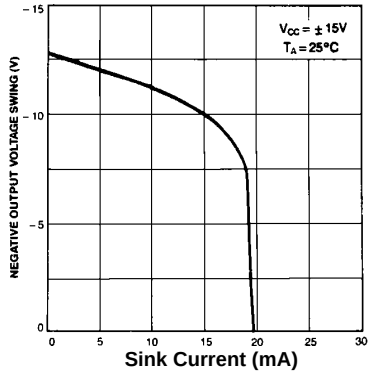



**Figure 4. Output voltage swing vs Sink Current (mA)**

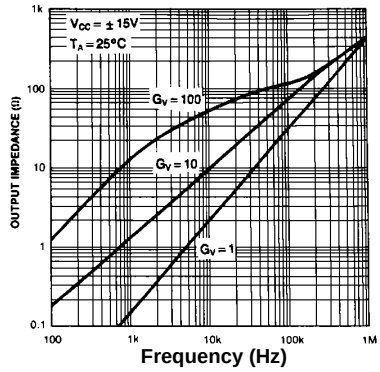



**Figure 5. Output Impedance vs Frequency**

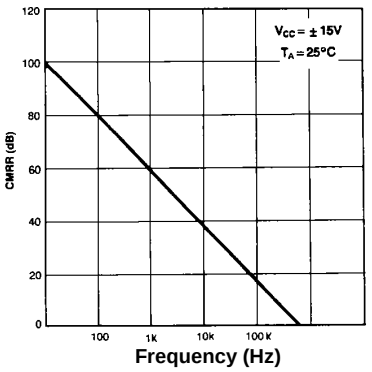



**Figure 6. Common-mode Rejection Ratio vs Frequency**

## Typical Performance Characteristics (continued)

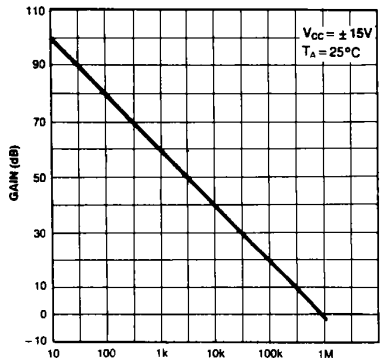



**Figure 7. Open Loop Frequency Response**

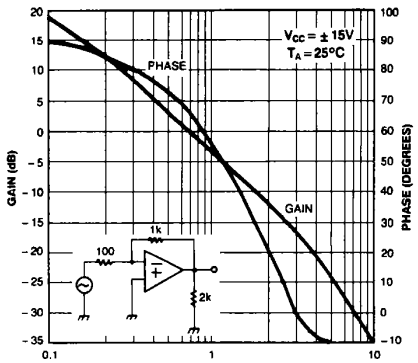



**Figure 8. Bode Plot**

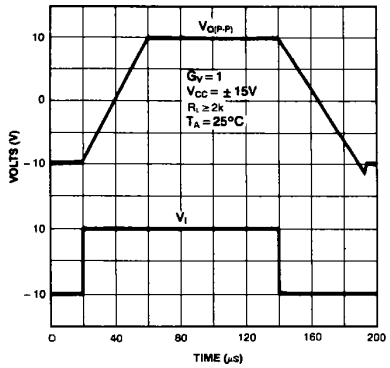



**Figure 9. Large Signal Pulse Response**

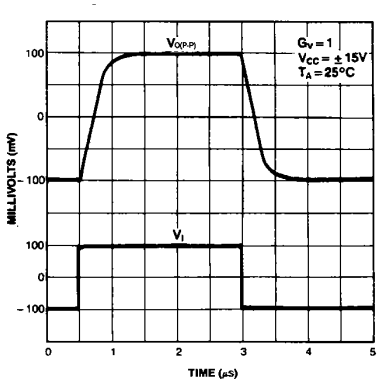



**Figure 10. Small Signal Pulse Response**

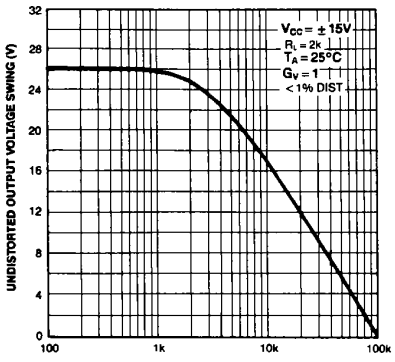



**Figure 11. Undistorted Output Voltage Swing vs Frequency**

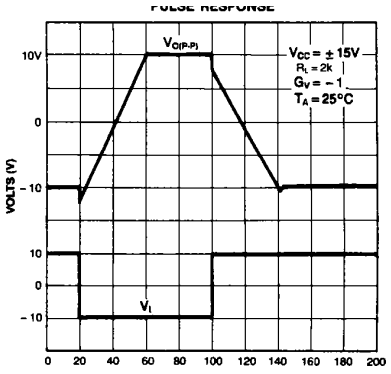



**Figure 12. Inverting Large Signal Pulse Response**

## Typical Performance Characteristics (continued)

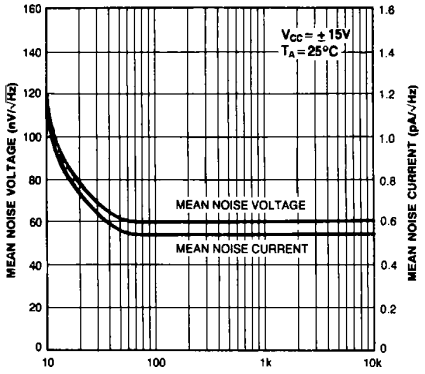



**Figure 13. Input Noise Voltage And Noise Current vs Frequency**

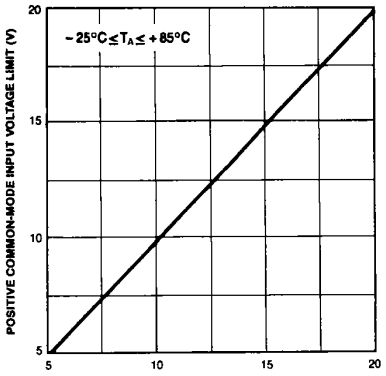



**Figure 14. Positive Common Mode Input Voltage Limit vs Positiue Supply Voltage**

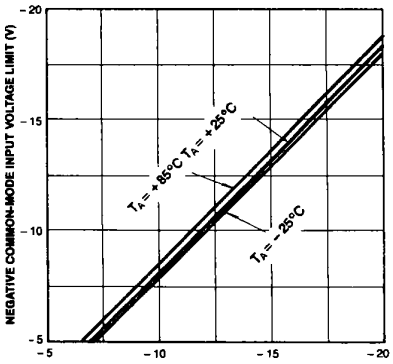
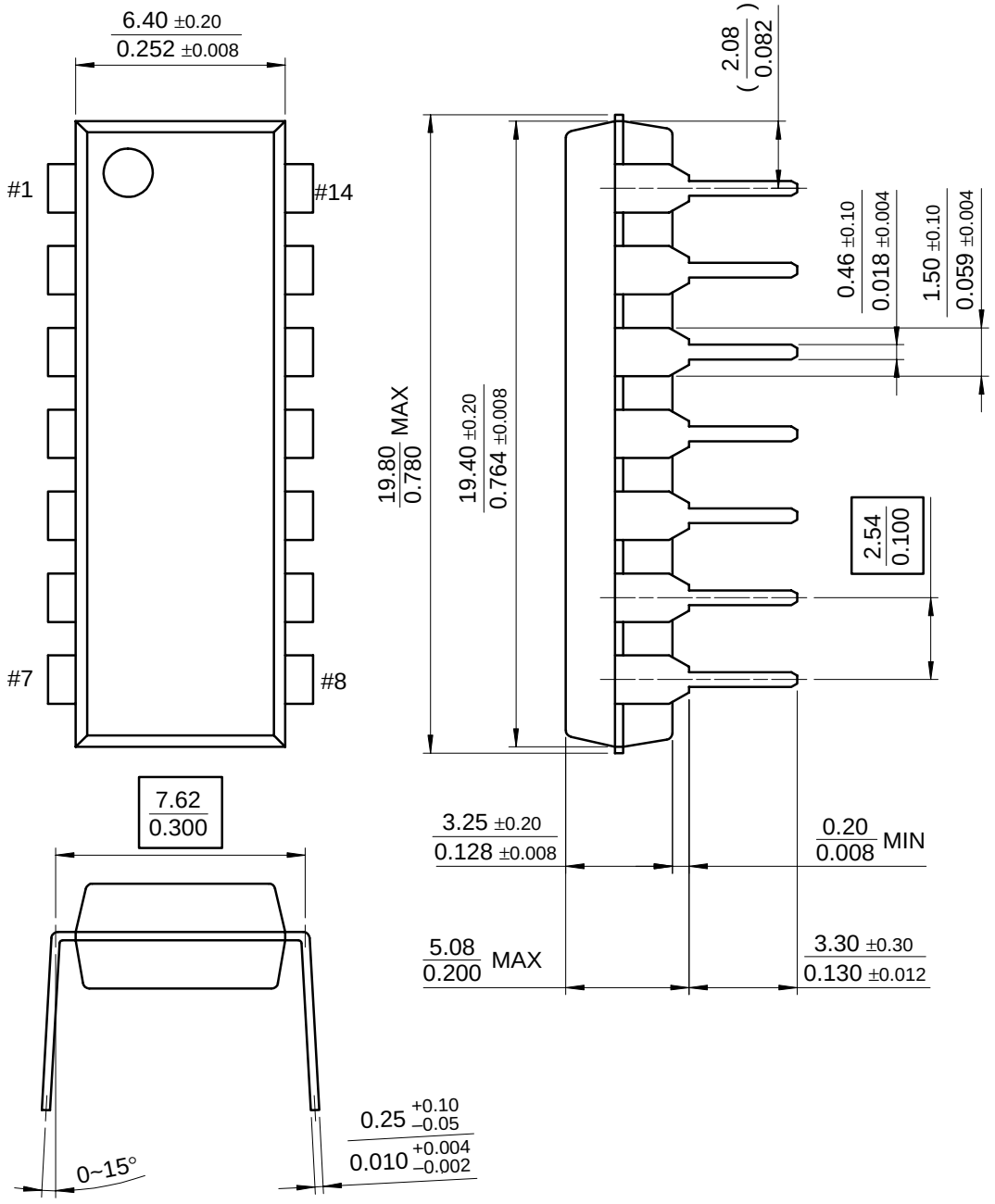



**Figure 15. Negative Common.mode Input Voltage Limit vs Negative Supply Voltage**

## Mechanical Dimensions

### Package

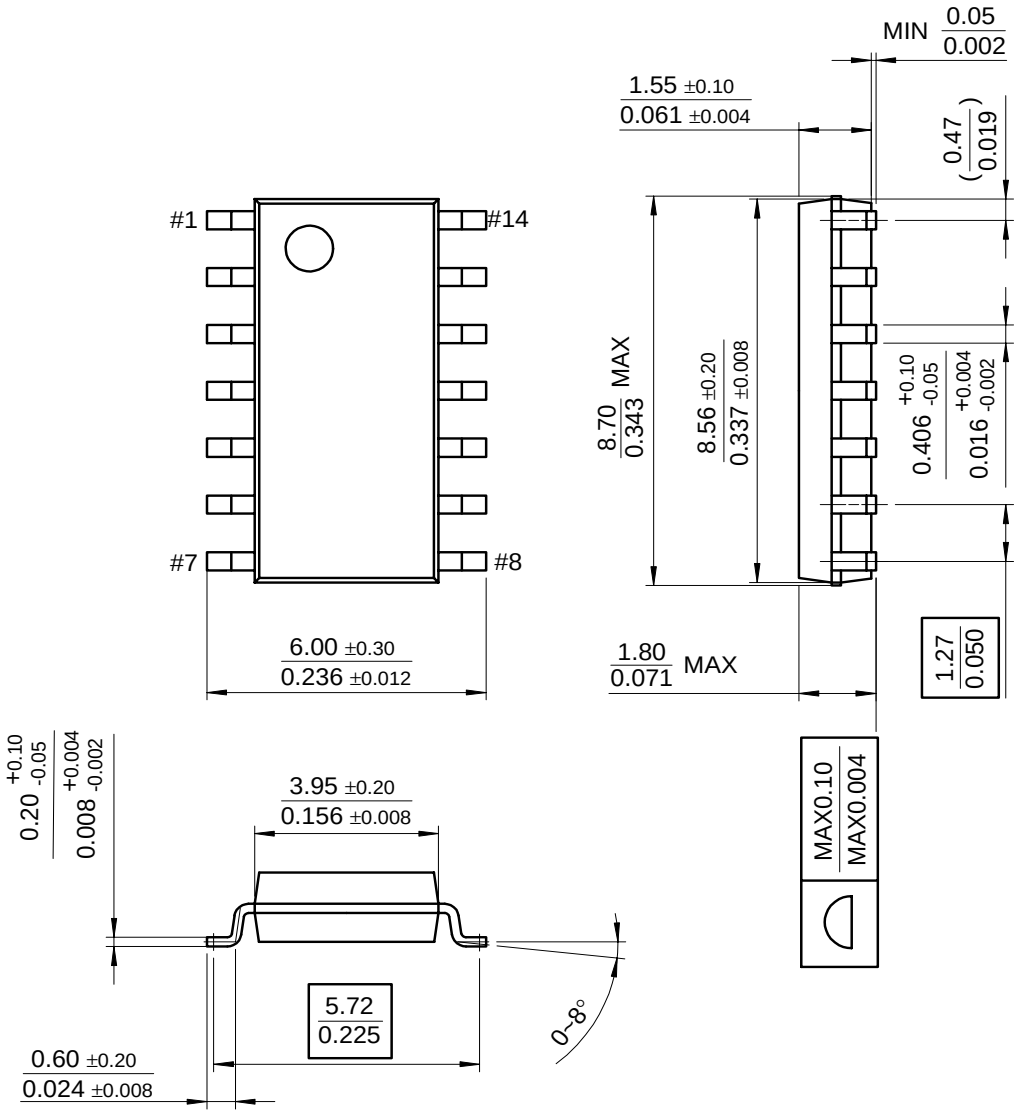
**14-DIP**



## Mechanical Dimensions

### Package

# 14-SOP



## Ordering Information

| Product Number | Package | Operating Temperature |
|---|---|---|
| LM348N | 14-DIP | 0 ~ + 70°C |
| LM348M | 14-SOP | |
| LM248N | 14-DIP | -25 ~ + 85°C |
| LM248M | 14-SOP | |

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