

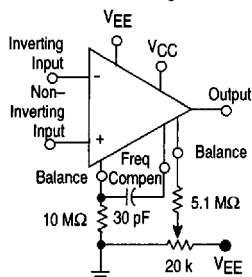


# Operational Amplifiers

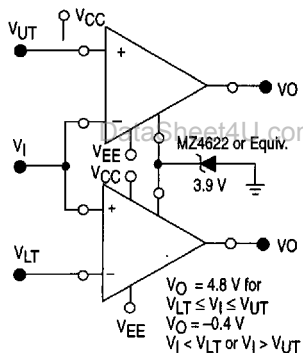
A general purpose operational amplifier that allows the user to choose the compensation capacitor best suited to his needs. With proper compensation, summing amplifier slew rates to 10 V/ $\mu$ s can be obtained.

- Low Input Offset Current: 20 nA Maximum Over Temperature Range
- External Frequency Compensation for Flexibility
- Class AB Output Provides Excellent Linearity
- Output Short Circuit Protection
- Guaranteed Drift Characteristics

**Figure 1. Standard Compensation and Offset Balancing Circuit**

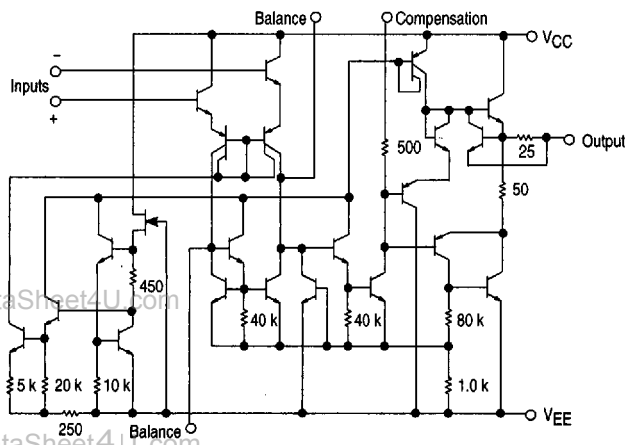


**Figure 2. Double-Ended Limit Detector**



(Pins Not Shown Are Not Connected)

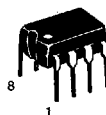
**Figure 3. Representative Circuit Schematic**



## LM301A LM201A

### OPERATIONAL AMPLIFIERS

#### SEMICONDUCTOR TECHNICAL DATA

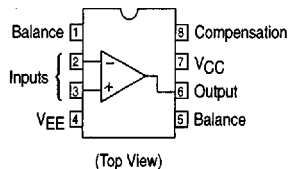


**N SUFFIX**  
PLASTIC PACKAGE  
CASE 626



**D SUFFIX**  
PLASTIC PACKAGE  
CASE 751  
(SO-8)

#### PIN CONNECTIONS



#### ORDERING INFORMATION

| Device             | Operating Temperature Range                      | Package             |
|--------------------|--------------------------------------------------|---------------------|
| LM301AD<br>LM301AN | $T_A = 0^\circ \text{ to } +70^\circ \text{C}$   | SO-8<br>Plastic DIP |
| LM201AD<br>LM201AN | $T_A = -25^\circ \text{ to } +85^\circ \text{C}$ | SO-8<br>Plastic DIP |

## MAXIMUM RATINGS

| Rating                                                                                                                          | Symbol           | Value                                                   |              | Unit                       |
|---------------------------------------------------------------------------------------------------------------------------------|------------------|---------------------------------------------------------|--------------|----------------------------|
|                                                                                                                                 |                  | LM201A                                                  | LM301A       |                            |
| Power Supply Voltage                                                                                                            | $V_{CC}, V_{EE}$ | $\pm 22$                                                | $\pm 18$     | Vdc                        |
| Input Differential Voltage                                                                                                      | $V_{ID}$         | $\longleftrightarrow \pm 30 \longrightarrow$            |              | V                          |
| Input Common Mode Range (Note 1)                                                                                                | $V_{ICR}$        | $\longleftrightarrow \pm 15 \longrightarrow$            |              | V                          |
| Output Short Circuit Duration                                                                                                   | $t_{SC}$         | $\longleftrightarrow \text{Continuous} \longrightarrow$ |              |                            |
| Power Dissipation (Package Limitation)<br>Plastic Dual-In-Line Package (LM201A/<br>Derate above $T_A = +25^\circ\text{C}$ 301A) | $P_D$            | 625<br>5.0                                              | 625<br>5.0   | mW<br>mW/ $^\circ\text{C}$ |
| Operating Ambient Temperature Range                                                                                             | $T_A$            | $-25$ to $+85$                                          | $0$ to $+70$ | $^\circ\text{C}$           |
| Storage Temperature Range                                                                                                       | $T_{stg}$        | $\longleftrightarrow -65$ to $+150 \longrightarrow$     |              | $^\circ\text{C}$           |

**NOTE:** 1. For supply voltages less than  $\pm 15$  V, the absolute maximum input voltage is equal to the supply voltage.

**ELECTRICAL CHARACTERISTICS** ( $T_A = +25^\circ\text{C}$ , unless otherwise noted.) Unless otherwise specified, these specifications apply for supply voltages from  $\pm 5.0$  V to  $\pm 20$  V for the LM201A, and from  $\pm 5.0$  V to  $\pm 15$  V for the LM301A.

| Characteristic                                                                                        | Symbol           | LM201A |          |          | LM301A |          |          | Unit       |
|-------------------------------------------------------------------------------------------------------|------------------|--------|----------|----------|--------|----------|----------|------------|
|                                                                                                       |                  | Min    | Typ      | Max      | Min    | Typ      | Max      |            |
| Input Offset Voltage ( $R_S \leq 50$ k $\Omega$ )                                                     | $V_{IO}$         | –      | 0.7      | 2.0      | –      | 2.0      | 7.5      | mV         |
| Input Offset Current                                                                                  | $I_{IO}$         | –      | 1.5      | 10       | –      | 3.0      | 50       | nA         |
| Input Bias Current                                                                                    | $I_{IB}$         | –      | 30       | 75       | –      | 70       | 250      | nA         |
| Input Resistance                                                                                      | $r_i$            | 1.5    | 4.0      | –        | 0.5    | 2.0      | –        | M $\Omega$ |
| Supply Current<br>$V_{CC}/V_{EE} = \pm 20$ V<br>$V_{CC}/V_{EE} = \pm 15$ V                            | $I_{CC}, I_{EE}$ | –<br>– | 1.8<br>– | 3.0<br>– | –<br>– | –<br>1.8 | –<br>3.0 | mA         |
| Large Signal Voltage Gain<br>( $V_{CC}/V_{EE} = \pm 15$ V, $V_O = \pm 10$ V, $R_L > 2.0$ k $\Omega$ ) | $A_V$            | 50     | 160      | –        | 25     | 160      | –        | V/mV       |

The following specifications apply over the operating temperature range.

|                                                                                                                                                              |                          |                      |                      |            |                      |                      |            |                              |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|----------------------|----------------------|------------|----------------------|----------------------|------------|------------------------------|
| Input Offset Voltage ( $R_S \leq 50$ k $\Omega$ )                                                                                                            | $V_{IO}$                 | –                    | –                    | 3.0        | –                    | –                    | 10         | mV                           |
| Input Offset Current                                                                                                                                         | $I_{IO}$                 | –                    | –                    | 20         | –                    | –                    | 70         | nA                           |
| Avg Temperature Coefficient of Input Offset Voltage<br>$T_A(\text{min}) \leq T_A \leq T_A(\text{max})$                                                       | $\Delta V_{IO}/\Delta T$ | –                    | 3.0                  | 15         | –                    | 6.0                  | 30         | $\mu\text{V}/^\circ\text{C}$ |
| Avg Temperature Coefficient of Input Offset Current<br>$+25^\circ\text{C} \leq T_A \leq T_A(\text{max})$<br>$T_A(\text{min}) \leq T_A \leq 25^\circ\text{C}$ | $\Delta I_{IO}/\Delta T$ | –<br>–               | 0.01<br>0.02         | 0.1<br>0.2 | –<br>–               | 0.01<br>0.02         | 0.3<br>0.6 | nA/ $^\circ\text{C}$         |
| Input Bias Current                                                                                                                                           | $I_{IB}$                 | –                    | –                    | 100        | –                    | –                    | 300        | nA                           |
| Large Signal Voltage Gain<br>( $V_{CC}/V_{EE} = \pm 15$ V, $V_O = \pm 10$ V, $R_L > 2.0$ k $\Omega$ )                                                        | $A_{VOL}$                | 25                   | –                    | –          | 15                   | –                    | –          | V/mV                         |
| Input Voltage Range<br>$V_{CC}/V_{EE} = \pm 20$ V<br>$V_{CC}/V_{EE} = \pm 15$ V                                                                              | $V_{ICR}$                | $-15$<br>–           | –<br>–               | $+15$<br>– | –<br>$-12$           | –<br>–               | –<br>$+12$ | V                            |
| Common Mode Rejection ( $R_S \leq 50$ k $\Omega$ )                                                                                                           | CMR                      | 80                   | 96                   | –          | 70                   | 90                   | –          | dB                           |
| Supply Voltage Rejection ( $R_S \leq 50$ k $\Omega$ )                                                                                                        | PSR                      | 80                   | 96                   | –          | 70                   | 96                   | –          | dB                           |
| Output Voltage Swing<br>( $V_{CC}/V_{EE} = \pm 15$ V, $R_L = \pm 10$ k $\Omega$ , $R_L > 2.0$ k $\Omega$ )                                                   | $V_O$                    | $\pm 12$<br>$\pm 10$ | $\pm 14$<br>$\pm 13$ | –<br>–     | $\pm 12$<br>$\pm 10$ | $\pm 14$<br>$\pm 13$ | –<br>–     | V                            |
| Supply Currents ( $T_A = T_A(\text{max})$ , $V_{CC}/V_{EE} = \pm 20$ V)                                                                                      | $I_{CC}, I_{EE}$         | –                    | 1.2                  | 2.5        | –                    | –                    | –          | mA                           |

## LM301A LM201A

Figure 4. Minimum Input Voltage Range

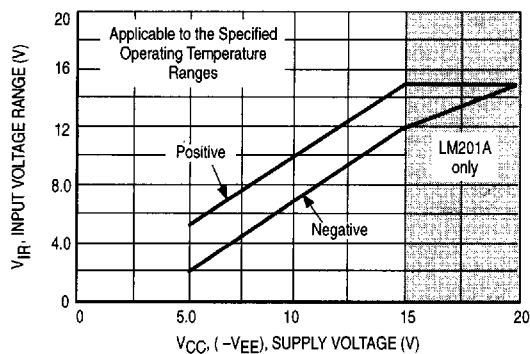


Figure 5. Minimum Output Voltage Swing

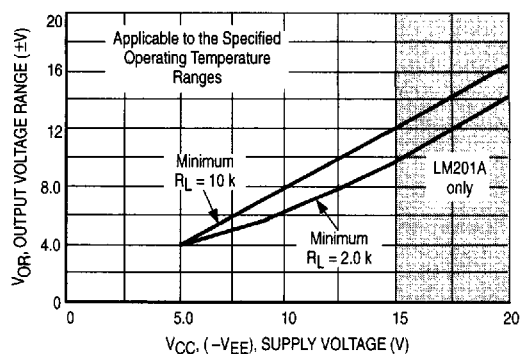


Figure 6. Minimum Voltage Gain

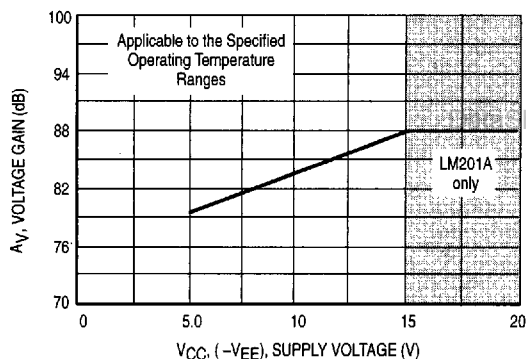


Figure 7. Typical Supply Currents

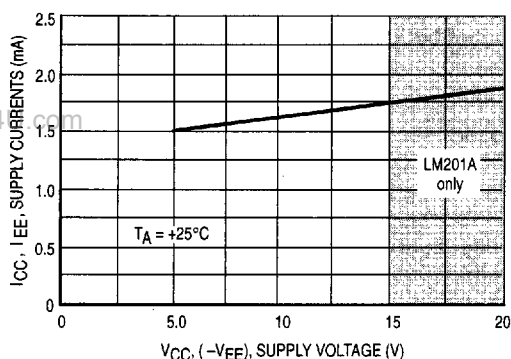


Figure 8. Open Loop Frequency Response

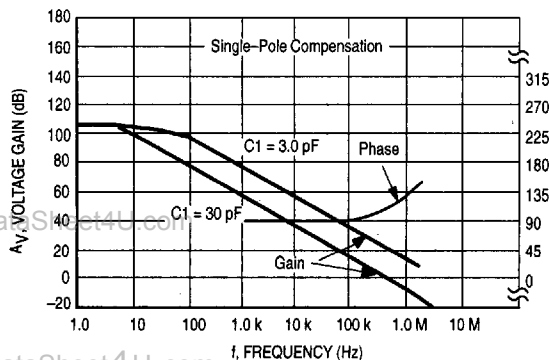
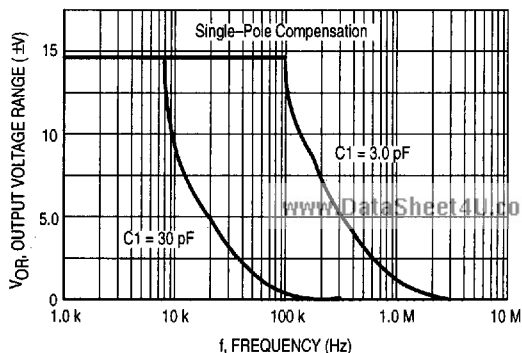


Figure 9. Large Signal Frequency Response



## LM301A LM201A

Figure 10. Voltage Follower Pulse Response

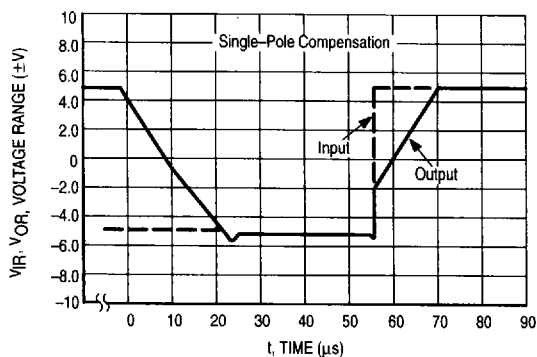


Figure 11. Open Loop Frequency Response

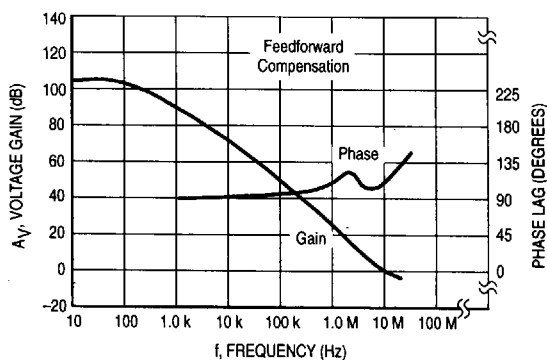


Figure 12. Large Signal Frequency Response

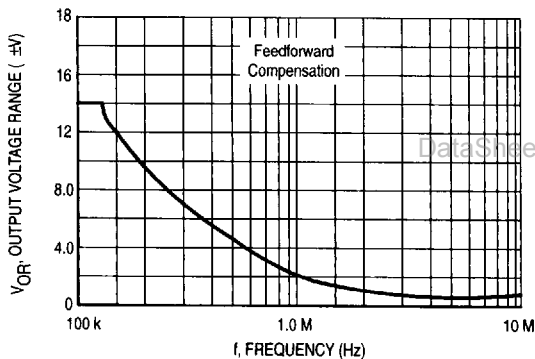


Figure 13. Inverter Pulse Response

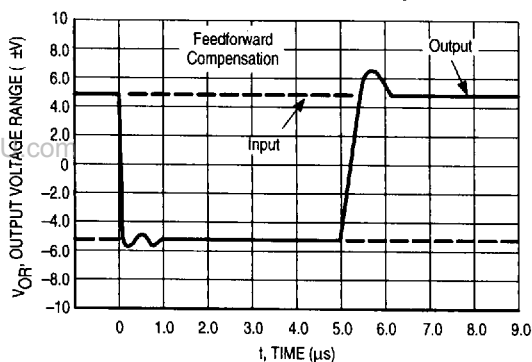


Figure 14. Single-Pole Compensation

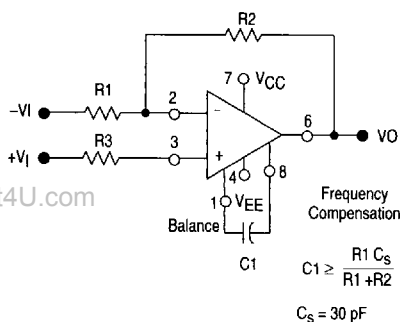


Figure 15. Feedforward Compensation

