

# LM108/A, LM308/A

## Low Level Operational Amplifiers

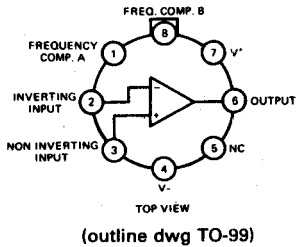
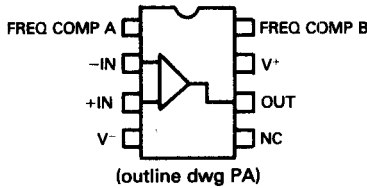
### FEATURES

- Input Bias Current – 2 nA max to 7 nA max
- Input Offset Current – 0.2 nA max to 1 nA max
- Input Offset Voltage – 0.5 mV max to 7.5 mV max
- $\Delta V_{os}/\Delta T$  – 5  $\mu V/^{\circ}C$  to 30  $\mu V/^{\circ}C$
- $\Delta I_{os}/\Delta T$  – 2.5 pA/ $^{\circ}C$  to 10 pA/ $^{\circ}C$
- Pin for Pin Replacement for 101A/301A

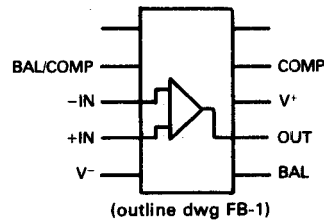
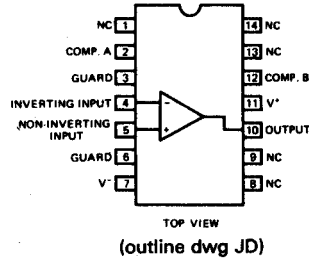
### GENERAL DESCRIPTION

These differential input, precision amplifiers provide low input currents and offset voltages competitive with FET and chopper stabilized amplifiers. They feature low power consumption over a supply voltage range of  $>2V$  to  $\pm 20V$ . The amplifiers may be frequency compensated with a single external capacitor. The LM108A and LM308A are high performance selections from the 108/308 amplifier family.

### PIN CONFIGURATIONS



### DUAL-IN-LINE PACKAGE



### ORDERING INFORMATION

| Part number      | TO-99 Can           | 8 pin MiniDIP | 14 pin Cerdip      | 10 pin Flatpak     | Dice                 |
|------------------|---------------------|---------------|--------------------|--------------------|----------------------|
| LM108A<br>LM308A | LM108AH*<br>LM308AH | LM308AN       | LM108AJ<br>LM308AJ | LM108AF<br>LM308AF | LM108A/D<br>LM308A/D |
| LM108<br>LM308   | LM108H*<br>LM308H   | LM308N        | LM108J<br>LM308J   | LM108F<br>LM308F   | LM108/D<br>LM308/D   |

\*If 883B processing is desired add /883B to order number.

## ABSOLUTE MAXIMUM RATINGS

|                                     |        |                                       |                 |
|-------------------------------------|--------|---------------------------------------|-----------------|
| Supply Voltage                      |        | Output Short-Circuit Duration         | Indefinite      |
| 108, 108A                           | ±20V   | Operating Temperature Range           |                 |
| 308, 308A                           | ±18V   | 108, 108A                             | -55°C to +125°C |
| Internal Power Dissipation (Note 1) |        | 308, 308A                             | 0°C to +70°C    |
| Metal Can (TO-99)                   | 500 mW | Storage Temperature Range             | -65°C to +150°C |
| DIP                                 | 500 mW | Lead Temperature (Soldering, 60 sec.) | 300°C           |
| Differential Input Current (Note 2) | ±10 mA |                                       |                 |
| Input Voltage (Note 3)              | ±15V   |                                       |                 |

## ELECTRICAL CHARACTERISTICS (T<sub>A</sub> = 25°C unless otherwise specified) (Note 4)

| PARAMETER                 | CONDITIONS   | 308 |     |     | 308A |     |     | 108 |      |     | 108A |      |      | UNITS |
|---------------------------|--|-----|-----|-----|------|-----|-----|-----|------|-----|------|------|------|-------|
|                           |  | MIN | TYP | MAX | MIN  | TYP | MAX | MIN | TYP  | MAX | MIN  | TYP  | MAX  |       |
| Input Offset Voltage      |  |     | 2.0 | 7.5 |      | 0.3 | 0.5 |     | 0.7  | 2.0 |      | 0.3  | 0.5  | mV    |
| Input Offset Current      |  |     | 0.2 | 1.0 |      | 0.2 | 1.0 |     | 0.05 | 0.2 |      | 0.05 | 0.2  | nA    |
| Input Bias Current        |  |     | 1.5 | 7   |      | 1.5 | 7   |     | 0.8  | 2.0 |      | 0.8  | 2.0  | nA    |
| Input Resistance          |  | 10  | 40  |     | 10   | 40  |     | 30  | 70   |     | 30   | 70   | MΩ   |       |
| Supply Current            | V <sub>S</sub> = ±20V  |     |     |     |      |     |     |     | 0.3  | 0.6 |      | 0.3  | 0.6  | mA    |
|                           | V <sub>S</sub> = ±15V  |     | 0.3 | 0.8 |      | 0.3 | 0.8 |     |      |     |      |      |      | mA    |
| Large Signal Voltage Gain | V <sub>S</sub> = ±15V, V <sub>OUT</sub> = ±10V, R <sub>L</sub> ≥ 10 kΩ | 25  | 300 |     | 80   | 300 |     | 50  | 300  |     | 80   | 300  | V/mV |       |

### THE FOLLOWING SPECIFICATIONS APPLY OVER THE OPERATING TEMPERATURE RANGES

|   |  |  |  |       |     |  |  |       |     |  |  |       |     |       |      |       |
|---|--|--|--|-------|-----|--|--|-------|-----|--|--|-------|-----|-------|------|-------|
| Input Offset Voltage                                    |  |  |  | 10    |     |  |  | 0.73  |     |  |  | 3.0   |     | 1.0   | mV   |       |
| Input Offset Current                                    |  |  |  |       |     |  |  | 1.5   |     |  |  | 0.4   |     | 0.4   | nA   |       |
| Average Temperature Coefficient of Input Offset Voltage |  |  |  | 6.0   | 30  |  |  | 1.0   | 5.0 |  |  | 3.0   | 15  | 1.0   | 5.0  | μV/°C |
| Average Temperature Coefficient of Input Offset Current |  |  |  | 2     | 10  |  |  | 2.0   | 10  |  |  | 0.5   | 2.5 | 0.5   | 2.5  | pA/°C |
| Input Bias Current                                      |  |  |  |       |     |  |  |       |     |  |  | 3.0   |     | 3.0   | nA   |       |
| Large Signal Voltage Gain                               | V <sub>S</sub> = ±15V, V <sub>OUT</sub> = ±10V, R <sub>L</sub> ≥ 10 kΩ |  |  | 15    |     |  |  | 60    |     |  |  | 25    |     | 40    | V/mV |       |
| Input Voltage Range                                     | V <sub>S</sub> = ±15V  |  |  | ±13.5 |     |  |  | ±13.5 |     |  |  | ±13.5 |     | ±13.5 | V    |       |
| Common Mode Rejection Ratio                             |  |  |  | 80    | 100 |  |  | 96    | 110 |  |  | 85    | 100 | 96    | 110  | dB    |
| Supply Voltage Rejection Ratio                          |  |  |  | 80    | 96  |  |  | 96    | 110 |  |  | 80    | 96  | 96    | 110  | dB    |
| Output Voltage Swing                                    | V <sub>S</sub> = ±15V, R <sub>L</sub> = 10 kΩ                          |  |  | ±13   | ±14 |  |  | ±13   | ±14 |  |  | ±13   | ±14 | ±13   | ±14  | V     |
| Supply Current  | T <sub>A</sub> = +125°C, V <sub>S</sub> = ±20V                         |  |  |       |     |  |  |       |     |  |  | 0.15  | 0.4 | 0.15  | 0.4  | mA    |

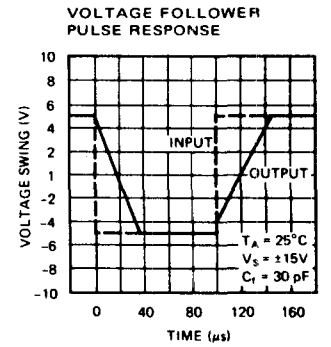
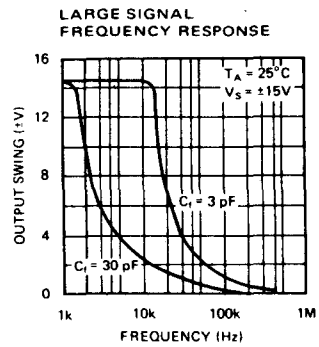
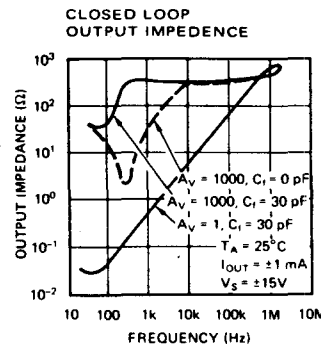
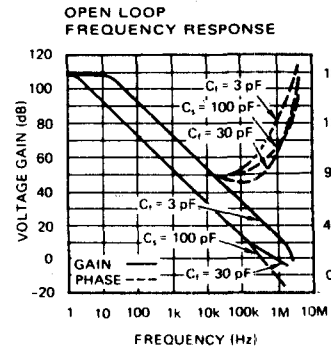
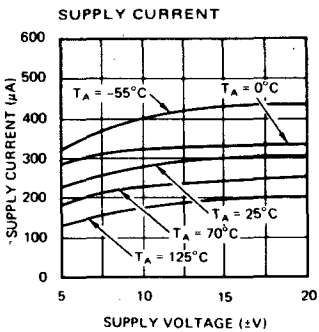
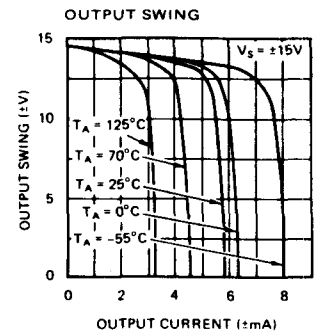
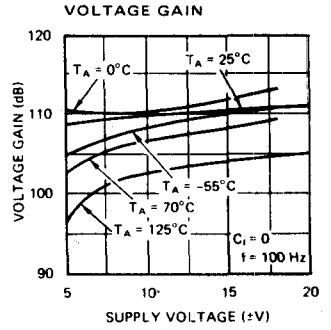
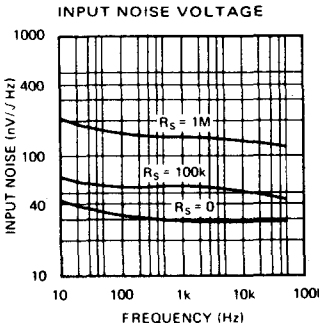
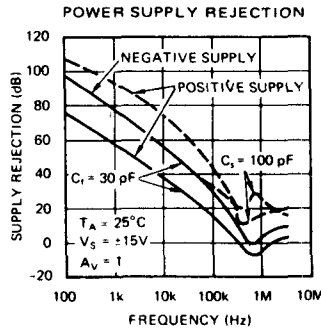
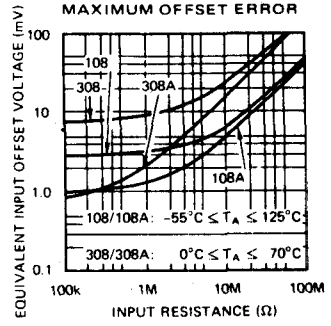
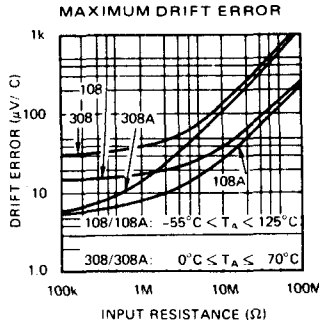
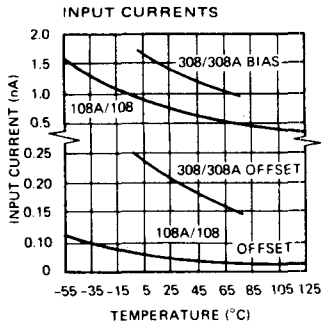
**NOTE 1:** Derate Metal Can package at 6.8 mW/°C for operation at ambient temperatures above 75°C and the Dual In-Line package at 9 mW/°C for operation at ambient temperatures above 95°C.

**NOTE 2:** The inputs are shunted with back-to-back diodes for over-voltage protection. Therefore, excessive current will flow if a differential input voltage in excess of 1V is applied between the inputs unless some limiting resistance is used.

**NOTE 3:** For supply voltages less than ±15V, the maximum input voltage is equal to the supply voltage.

**NOTE 4:** Unless otherwise specified, these specifications apply for supply voltages from ±5V to ±20V for the 108, and 108A and ±5V to ±15V for the 308 and 308A.

TYPICAL PERFORMANCE CURVES



## GUARDING

Extra care must be taken in the assembly of printed circuit boards to take full advantage of the low input currents of the 108 amplifier. Boards must be thoroughly cleaned with TCE or alcohol and blown dry with compressed air. After cleaning, the boards should be coated with epoxy or silicone rubber to prevent contamination.

Even with properly cleaned and coated boards, leakage currents may cause trouble at 125°C, particularly since the input pins are adjacent to pins that are at supply potentials. This leakage can be significantly reduced by using guarding to lower the voltage difference between the inputs and adjacent metal runs. Input guarding of the 8-lead TO-99

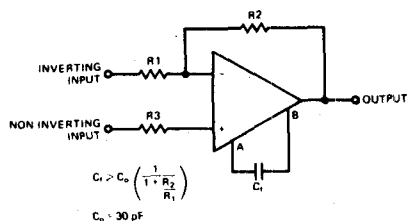
package is accomplished by using a 10-lead pin circle, with the leads of the device formed so that the holes adjacent to the inputs are empty when it is inserted in the board. The guard, which is a conductive ring surrounding the inputs, is connected to a low impedance point that is at approximately the same voltage at the inputs. Leakage currents from high-voltage pins are then absorbed by the guard.

The pin configuration of the dual in-line package is designed to facilitate guarding, since the pins adjacent to the inputs are not used (this is different from the standard 741 and 101A pin configuration).

5

## FREQUENCY COMPENSATION CIRCUITS

STANDARD CIRCUIT



ALTERNATE CIRCUIT: IMPROVES REJECTION OF POWER SUPPLY NOISE BY A FACTOR OF TEN.

