

# LM108/LM108AQML

## Operational Amplifiers

### General Description

The LM108 is a precision operational amplifier having specifications a factor of ten better than FET amplifiers over a  $-55^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$  temperature range.

The devices operate with supply voltages from  $\pm 2\text{V}$  to  $\pm 20\text{V}$  and have sufficient supply rejection to use unregulated supplies. Although the circuit is interchangeable with, and uses the same compensation as the LM101A, an alternate compensation scheme can be used to make it particularly insensitive to power supply noise and to make supply bypass capacitors unnecessary.

The low current error of the LM108 makes possible many designs that are not practical with conventional amplifiers. In

fact, it operates from  $10\text{ M}\Omega$  source resistances, introducing less error than devices like the 709 with  $10\text{ k}\Omega$  sources. Integrators with drifts less than  $500\text{ }\mu\text{V}/\text{sec}$  and analog time delays in excess of one hour can be made using capacitors no larger than  $1\text{ }\mu\text{F}$ .

### Features

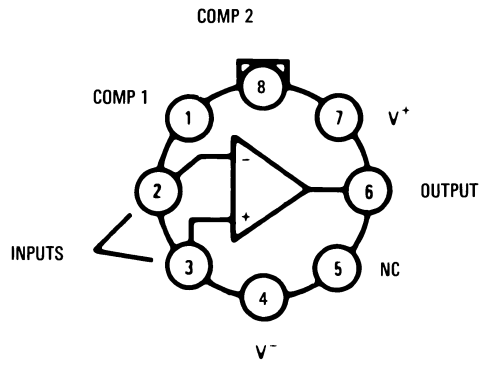
- Maximum input bias current of  $3.0\text{ nA}$  over temperature
- Offset current less than  $400\text{ pA}$  over temperature
- Supply current of only  $300\text{ }\mu\text{A}$ , even in saturation
- Guaranteed drift characteristics

### Ordering Information

| NS PART NUMBER | SMD PART NUMBER                | NS PACKAGE NUMBER | PACKAGE DISCRIPTION |
|----------------|--------------------------------|-------------------|---------------------|
| LM108AH/883    |                                | H08C              | 8LD Metal Can       |
| LM108AJ-8/883  |                                | J08A              | 8LD CERDIP          |
| LM108AJ/883    |                                | J14A              | 14LD CERDIP         |
| LM108AWG/883   |                                | WG10A             | 10LD Ceramic SOIC   |
| LM108AHRQML    | 5962R9863702QGA<br>100k rd(Si) | H08C              | 8LD Metal Can       |
| LM108AHRQMLV   | 5962R9863702VGA<br>100k rd(Si) | H08C              | 8LD Metal Can       |
| LM108AJ-8RQMLV | 5962R9863702VPA<br>100k rd(Si) | J08A              | 8LD CERDIP          |
| LM108AJRQML    | 5962R9863702QCA<br>100k rd(Si) | J14A              | 14LD CERDIP         |
| LM108AJRQMLV   | 5962R9863702VCA<br>100k rd(Si) | J14A              | 14LD CERDIP         |
| LM108AWGRQML   | 5962R9863702QZA<br>100k rd(Si) | WG10A             | 10LD Ceramic SOIC   |
| LM108AWGRQMLV  | 5962R9863702VZA<br>100k rd(Si) | WG10A             | 10LD Ceramic SOIC   |
| LM108AWRQML    | 5962R9863702QHA<br>100k rd(Si) | W10A              | 10LD CERPACK        |
| LM108AWRQMLV   | 5962R9863702VHA<br>100k rd(Si) | W10A              | 10LD CERPACK        |
| LM108H/883     |                                | H08C              | 8LD Metal Can       |
| LM108J/883     |                                | J14A              | 14LD CERDIP         |
| LM108J-8/883   |                                | J08A              | 8LD CERDIP          |

# Connection Diagrams

**Metal Can Package**



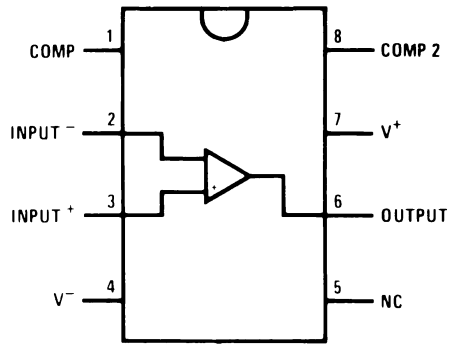
20120613

\*Package is connected to Pin 4 ( $V^-$ )

\*\*Unused pin (no internal connection) to allow for input anti-leakage guard ring on printed circuit board layout.

See NS Package Number H08C

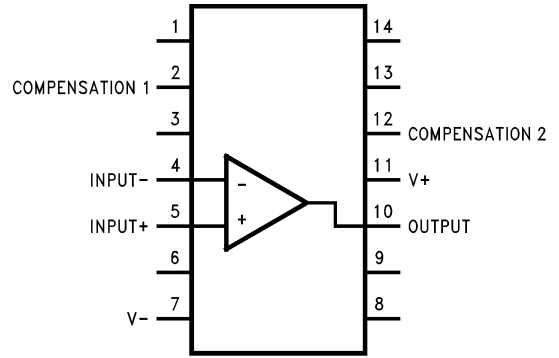
**8 Lead Dual-In-Line Package**



20120615

Top View  
See NS Package Number J08A

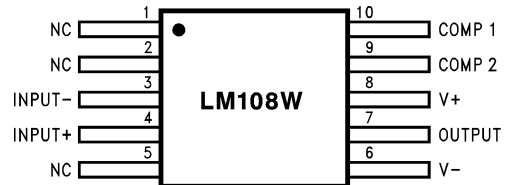
**14 Lead Dual-In-Line Package**



20120616

Top View  
See NS Package Number J14A

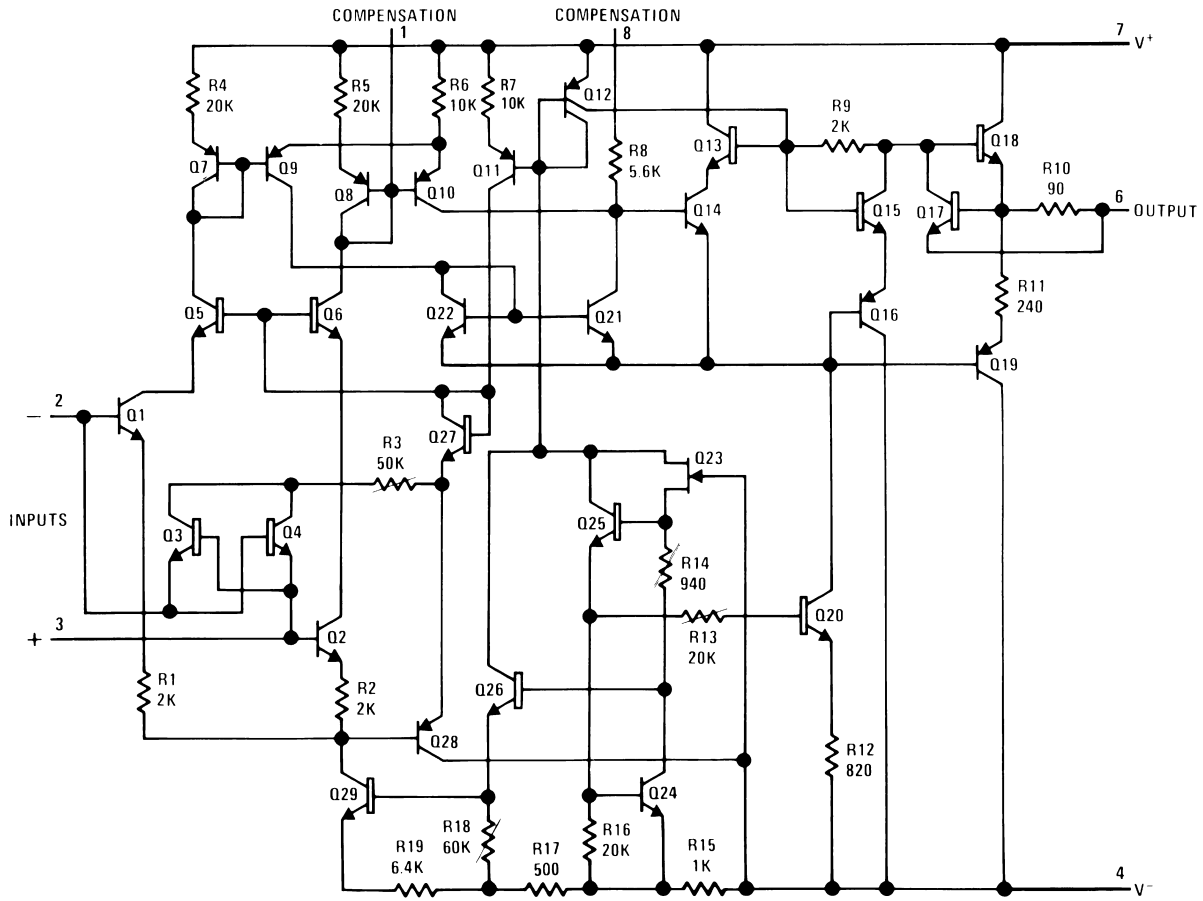
**10 Lead Flatpack/SOIC Package**



20120617

Top View  
See NS Package Number W10A, WG10A

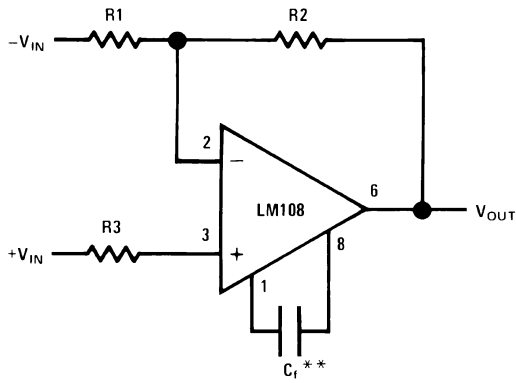
# Schematic Diagram



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## Compensation Circuits

Standard Compensation Circuit



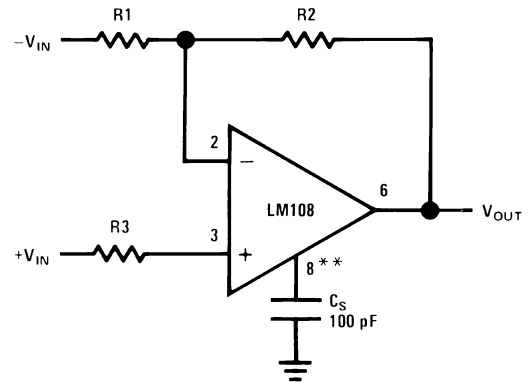
20120601

$$C_t \geq \frac{R_1 C_O}{R_1 + R_2}$$

$C_O = 30 \text{ pF}$

\*\*Bandwidth and slew rate are proportional to  $1/C_t$

Alternate Frequency Compensation (Note 1)

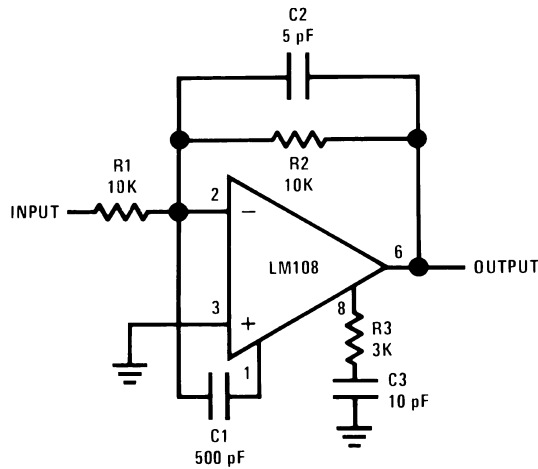


20120602

\*\*Bandwidth and slew rate are proportional to  $1/C_S$

**Note 1:** Improves rejection of power supply noise by a factor of ten.

Feedforward Compensation



20120603

**Absolute Maximum Ratings** (Notes 2, 3)

|                                      | <b>LM108RH</b>   | <b>LM108/LM108A</b> |
|--------------------------------------|--|---------------------|
| Supply Voltage                       | ±22V   | ±20V                |
| Power Dissipation (Note 4)           |  |                     |
| Metal Can 8 LD                       | 330mW @ +125°C   |                     |
| CERDIP 14LD                          | 400mW @ +125°C   |                     |
| CERDIP 8LD                           | 400mW @ +125°C   |                     |
| CERPACK 10LD                         | 330mW @ +125°C   |                     |
| Ceramic SOIC 10 LD                   | 330mW @ +125°C   |                     |
| Differential Input Current (Note 5)  | ±10 mA   |                     |
| Differential Input Voltage (Note 7)  | ±30V   | N/A                 |
| Input Voltage (Note 6)               | ±20V   | ±15V                |
| Output Short-Circuit Duration        | Continuous   |                     |
| Operating Temperature Range          | $-55^{\circ}\text{C} \leq T_A \leq +125^{\circ}\text{C}$ |                     |
| Storage Temperature Range            | $-65^{\circ}\text{C} \leq T_A \leq +150^{\circ}\text{C}$ |                     |
| Thermal Resistance                   |  |                     |
| $\theta_{JA}$                        |  |                     |
| Metal Can 8 LD Still Air             | 150°C/W  |                     |
| 500LF / Min Air Flow                 | 86°C/W   |                     |
| CERDIP 14LD Still Air                | 94°C/W   |                     |
| 500LF / Min Air Flow                 | 55°C/W   |                     |
| CERDIP 8LD Still Air                 | 120°C/W  |                     |
| 500LF / Min Air Flow                 | 68°C/W   |                     |
| CERPACK 10LD Still Air               | 225°C/W  |                     |
| 500LF / Min Air Flow                 | 142°C/W  |                     |
| Ceramic SOIC 10 LD Still Air         | 225°C/W  |                     |
| 500LF / Min Air Flow                 | 142°C/W  |                     |
| $\theta_{JC}$                        |  |                     |
| Metal Can 8 LD                       | 38°C/W   |                     |
| CERDIP 14LD                          | 13°C/W   |                     |
| CERDIP 8LD                           | 17°C/W   |                     |
| CERPACK 10LD                         | 21°C/W   |                     |
| Ceramic SOIC 10 LD                   | 21°C/W   |                     |
| Package Weight (typical)             |  |                     |
| Metal Can 8 LD                       | 990mg  |                     |
| CERDIP 14LD                          | 2,180mg  |                     |
| CERDIP 8LD                           | 1,090mg  |                     |
| CERPACK 10LD                         | 225mg  |                     |
| Ceramic SOIC 10 LD                   | 210mg  |                     |
| Maximum Junction Temperature         | 175°C  | 150°C               |
| Lead Temperature (Soldering, 10 sec) | 300°C  |                     |
| ESD Tolerance (Note 8)               | 2000V  |                     |

## Quality Conformance Inspection

Mil-Std-883, Method 5005 - Group A

| Subgroup | Description         | Temp (°C) |
|----------|---------------------|-----------|
| 1        | Static tests at     | +25°C     |
| 2        | Static tests at     | +125°C    |
| 3        | Static tests at     | -55°C     |
| 4        | Dynamic tests at    | +25°C     |
| 5        | Dynamic tests at    | +125°C    |
| 6        | Dynamic tests at    | -55°C     |
| 7        | Functional tests at | +25°C     |
| 8A       | Functional tests at | +125°C    |
| 8B       | Functional tests at | -55°C     |
| 9        | Switching tests at  | +25°C     |
| 10       | Switching tests at  | +125°C    |
| 11       | Switching tests at  | -55°C     |

## LM108 Electrical Characteristics

### DC Parameters

The following conditions apply to all the following parameters, unless otherwise specified.

$$V_{CC} = \pm 20V, V_{CM} = 0V$$

| Symbol       | Parameter                          | Conditions                        | Notes | Min  | Max | Units | Sub-groups |
|--------------|------------------------------------|-----------------------------------|-------|------|-----|-------|------------|
| $V_{IO}$     | Input Offset Voltage               | $V_{CM} = -15V$                   |       | -2.0 | 2.0 | mV    | 1          |
|              |                                    |                                   |       | -3.0 | 3.0 | mV    | 2, 3       |
|              |                                    | $V_{CM} = 15V$                    |       | -2.0 | 2.0 | mV    | 1          |
|              |                                    |                                   |       | -3.0 | 3.0 | mV    | 2, 3       |
|              |                                    | $V_{CC} = \pm 5V$                 |       | -2.0 | 2.0 | mV    | 1          |
|              |                                    |                                   |       | -3.0 | 3.0 | mV    | 2, 3       |
| $I_{IO}$     | Input Offset Current               | $V_{CM} = -15V$                   |       | -0.2 | 0.2 | nA    | 1          |
|              |                                    |                                   |       | -0.4 | 0.4 | nA    | 2, 3       |
|              |                                    | $V_{CM} = 15V$                    |       | -0.2 | 0.2 | nA    | 1          |
|              |                                    |                                   |       | -0.4 | 0.4 | nA    | 2, 3       |
|              |                                    | $V_{CC} = \pm 5V$                 |       | -0.2 | 0.2 | nA    | 1          |
|              |                                    |                                   |       | -0.4 | 0.4 | nA    | 2, 3       |
| $\pm I_{IB}$ | Input Bias Current                 | $V_{CM} = -15V$                   |       | -0.1 | 2.0 | nA    | 1          |
|              |                                    |                                   |       | -1.0 | 3.0 | nA    | 2,         |
|              |                                    |                                   |       | -0.1 | 3.0 | nA    | 3          |
|              |                                    | $V_{CM} = 15V$                    |       | -0.1 | 2.0 | nA    | 1          |
|              |                                    |                                   |       | -1.0 | 3.0 | nA    | 2,         |
|              |                                    |                                   |       | -0.1 | 3.0 | nA    | 3          |
|              |                                    | $V_{CC} = \pm 5V$                 |       | -0.1 | 2.0 | nA    | 1          |
|              |                                    |                                   |       | -1.0 | 3.0 | nA    | 2,         |
|              |                                    |                                   |       | -0.1 | 3.0 | nA    | 3          |
| PSRR         | Power Supply Rejection $\pm$ Ratio | $\pm 20V \leq V_{CC} \leq \pm 5V$ |       | 80   |     | dB    | 1, 2, 3    |

## LM108 Electrical Characteristics (Continued)

### DC Parameters (Continued)

The following conditions apply to all the following parameters, unless otherwise specified.

$$V_{CC} = \pm 20V, V_{CM} = 0V$$

| Symbol           | Parameter                   | Conditions  | Notes     | Min  | Max   | Units | Sub-groups |
|------------------|-----------------------------|---|-----------|------|-------|-------|------------|
| CMRR             | Common Mode Rejection Ratio | $-15V \leq V_{CM} \leq 15V$   |           | 85   |       | dB    | 1, 2, 3    |
| +I <sub>OS</sub> | Short Circuit Current       | $V_{CC} = \pm 15V$  |           | -30  | -1.0  | mA    | 1, 2, 3    |
| -I <sub>OS</sub> | Short Circuit Current       | $V_{CC} = \pm 15V$  |           | 1    | 30    | mA    | 1, 2, 3    |
| I <sub>CC</sub>  | Power Supply Current        |   |           |      | 0.6   | mA    | 1          |
|                  |                             |   |           |      | 0.4   | mA    | 2          |
|                  |                             |   |           |      | 0.8   | mA    | 3          |
| R <sub>IN</sub>  | Input Resistance            |   | (Note 13) | 30   |       | MΩ    | 1          |
| V <sub>IN</sub>  | Input Voltage Range         | $V_{CC} = \pm 15V$  | (Note 12) | 14   |       | V     | 1, 2       |
|                  |                             |   | (Note 12) |      | -14   | V     | 1, 2       |
|                  |                             |   | (Note 12) | 13.5 |       | V     | 3          |
|                  |                             |   | (Note 12) |      | -13.5 | V     | 3          |
|                  |                             |   | (Note 12) | 15   |       | V     | 1, 2, 3    |
|                  |                             |   | (Note 12) |      | -15   | V     | 1, 2, 3    |
| +V <sub>OP</sub> | Output Voltage Swing        | $V_{CC} = \pm 15V, R_L = 10K\Omega$                                   |           | 13   |       | V     | 4, 5, 6    |
| -V <sub>OP</sub> | Output Voltage Swing        | $V_{CC} = \pm 15V, R_L = 10K\Omega$                                   |           |      | -13   | V     | 4, 5, 6    |
| +A <sub>VS</sub> | Open Loop Voltage Gain      | $V_{CC} = \pm 15V, R_L = 10K\Omega,$<br>$V_{out} = 0 \text{ to } 10V$ | (Note 10) | 50   |       | V/mV  | 4          |
|                  |                             |   | (Note 10) | 25   |       | V/mV  | 5, 6       |
| -A <sub>VS</sub> | Open Loop Voltage Gain      | $V_{CC} = \pm 15V, R_L = 10K\Omega$<br>$V_{out} = 0 \text{ to } -10V$ | (Note 10) | 50   |       | V/mV  | 4          |
|                  |                             |   | (Note 10) | 25   |       | V/mV  | 5, 6       |

### AC Parameters

The following conditions apply to all the following parameters, unless otherwise specified.

$$V_{CC} = \pm 20V, V_{CM} = 0V.$$

| Symbol           | Parameter | Conditions | Notes     | Min | Max | Units | Sub-groups |
|------------------|-----------|------------|-----------|-----|-----|-------|------------|
| TR <sub>TR</sub> | Rise Time |            | (Note 13) |     | 1.0 | μS    | 7          |
| TR <sub>OS</sub> | Overshoot |            | (Note 13) |     | 30  | %     | 7          |

## LM108A Electrical Characteristics

### DC Parameters

The following conditions apply to all the following parameters, unless otherwise specified.

$$V_{CC} = \pm 20V, V_{CM} = 0V$$

| Symbol                     | Parameter                                       | Conditions         | Notes                        | Min                               | Max   | Units            | Sub-groups |    |         |
|----------------------------|---|--------------------|------------------------------|-----------------------------------|-------|------------------|------------|----|---------|
| $V_{IO}$                   | Input Offset Voltage                            | $V_{CM} = -15V$    |                              | -0.5                              | 0.5   | mV               | 1          |    |         |
|                            |   |                    |                              | -1.0                              | 1.0   | mV               | 2, 3       |    |         |
|                            |   | $V_{CM} = 15V$     |                              | -0.5                              | 0.5   | mV               | 1          |    |         |
|                            |   |                    |                              | -1.0                              | 1.0   | mV               | 2, 3       |    |         |
|                            |   | $V_{CC} = \pm 5V$  |                              | -0.5                              | 0.5   | mV               | 1          |    |         |
|                            |   |                    |                              | -1.0                              | 1.0   | mV               | 2, 3       |    |         |
| $I_{IO}$                   | Input Offset Current                            | $V_{CM} = -15V$    |                              | -0.2                              | 0.2   | nA               | 1          |    |         |
|                            |   |                    |                              | -0.4                              | 0.4   | nA               | 2, 3       |    |         |
|                            |   | $V_{CM} = 15V$     |                              | -0.2                              | 0.2   | nA               | 1          |    |         |
|                            |   |                    |                              | -0.4                              | 0.4   | nA               | 2, 3       |    |         |
|                            |   | $V_{CC} = \pm 5V$  |                              | -0.2                              | 0.2   | nA               | 1          |    |         |
|                            |   |                    |                              | -0.4                              | 0.4   | nA               | 2, 3       |    |         |
| $\pm I_{IB}$               | Input Bias Current                              | $V_{CM} = -15V$    |                              | -0.1                              | 2.0   | nA               | 1          |    |         |
|                            |   |                    |                              | -1.0                              | 3.0   | nA               | 2          |    |         |
|                            |   |                    |                              | -0.1                              | 3.0   | nA               | 3          |    |         |
|                            |   | $V_{CM} = 15V$     |                              | -0.1                              | 2.0   | nA               | 1          |    |         |
|                            |   |                    |                              | -1.0                              | 3.0   | nA               | 2          |    |         |
|                            |   |                    |                              | -0.1                              | 3.0   | nA               | 3          |    |         |
|                            |   | $V_{CC} = \pm 5V$  |                              | -0.1                              | 2.0   | nA               | 1          |    |         |
|                            |   |                    |                              | -1.0                              | 3.0   | nA               | 2          |    |         |
|                            |   |                    |                              | -0.1                              | 3.0   | nA               | 3          |    |         |
|                            |   | PSRR               | Power Supply Rejection Ratio | $\pm 20V \leq V_{CC} \leq \pm 5V$ |       | 96               |            | dB | 1, 2, 3 |
|                            |   | CMRR               | Common Mode Rejection Ratio  | $-15V \leq V_{CM} \leq 15V$       |       | 96               |            | dB | 1, 2, 3 |
|                            |   | $+I_{OS}$          | Short Circuit Current        | $V_{CC} = \pm 15V$                |       | -30              | -1.0       | mA | 1, 2, 3 |
| $-I_{OS}$                  | Short Circuit Current                           | $V_{CC} = \pm 15V$ |                              | 1.0                               | 30    | mA               | 1, 2, 3    |    |         |
| $I_{CC}$                   | Power Supply Current                            |                    |                              |                                   | 0.6   | mA               | 1          |    |         |
|                            |   |                    |                              |                                   | 0.4   | mA               | 2          |    |         |
|                            |   |                    |                              |                                   | 0.8   | mA               | 3          |    |         |
| $R_{IN}$                   | Input Resistance                                |                    | (Note 13)                    | 30                                |       | M $\Omega$       | 1          |    |         |
| $V_{IN}$                   | Input Voltage Range                             | $V_{CC} = \pm 15V$ | (Note 12)                    | 14                                |       | V                | 1, 2       |    |         |
|                            |   |                    | (Note 12)                    |                                   | -14   | V                | 1, 2       |    |         |
|                            |   |                    | (Note 12)                    | 13.5                              |       | V                | 3          |    |         |
|                            |   |                    | (Note 12)                    |                                   | -13.5 | V                | 3          |    |         |
|                            |   |                    | (Note 12)                    | 15                                |       | V                | 1, 2, 3    |    |         |
|                            |   |                    | (Note 12)                    |                                   | -15   | V                | 1, 2, 3    |    |         |
| $\Delta V_{IO} / \Delta T$ | Temperature Coefficient of Input Offset Voltage |                    | (Note 13)                    |                                   | 5.0   | $\mu V/^\circ C$ | 1, 2, 3    |    |         |



## LM108A Electrical Characteristics (Continued)

### DC Parameters (Continued)

The following conditions apply to all the following parameters, unless otherwise specified.

$$V_{CC} = \pm 20V, V_{CM} = 0V$$

| Symbol                      | Parameter                                       | Conditions   | Notes     | Min | Max | Units | Sub-groups |
|-----------------------------|---|--|-----------|-----|-----|-------|------------|
| Delta $I_{IO}$ /<br>Delta T | Temperature Coefficient of Input Offset Current |  | (Note 13) |     | 2.5 | pA/°C | 1, 2, 3    |
| + $V_{OP}$                  | Output Voltage Swing                            | $V_{CC} = \pm 15V, R_L = 10K\Omega$                                    |           | 13  |     | V     | 4, 5, 6    |
| - $V_{OP}$                  | Output Voltage Swing                            | $V_{CC} = \pm 15V, R_L = 10K\Omega$                                    |           |     | -13 | V     | 4, 5, 6    |
| + $A_{VS}$                  | Open Loop Voltage Gain                          | $V_{CC} = \pm 15V, R_L = 10K\Omega,$<br>$V_{out} = 0 \text{ to } 10V$  | (Note 10) | 80  |     | V/mV  | 4          |
|                             |   |  | (Note 10) | 40  |     | V/mV  | 5, 6       |
| - $A_{VS}$                  | Open Loop Voltage Gain                          | $V_{CC} = \pm 15V, R_L = 10K\Omega,$<br>$V_{out} = 0 \text{ to } -10V$ | (Note 10) | 80  |     | V/mV  | 4          |
|                             |   |  | (Note 10) | 40  |     | V/mV  | 5, 6       |

### AC Parameters

The following conditions apply to all the following parameters, unless otherwise specified.

$$V_{CC} = \pm 20V, V_{CM} = 0V$$

| Symbol    | Parameter                    | Conditions | Notes     | Min | Max | Units   | Sub-groups |
|-----------|------------------------------|------------|-----------|-----|-----|---------|------------|
| $TR_{TR}$ | Transient Response Rise Time |            | (Note 13) |     | 1.0 | $\mu S$ | 7          |

## LM108A Rad Hard — Electrical Characteristics

### DC Parameters

The following conditions apply to all the following parameters, unless otherwise specified.

$$\pm V_{CC} = \pm 20V, V_{CM} = 0V, R_S = 50\Omega$$

| Symbol                      | Parameter  | Conditions   | Notes     | Min  | Max | Units            | Sub-groups |
|-----------------------------|--|--|-----------|------|-----|------------------|------------|
| $V_{IO}$                    | Input Offset Voltage                               | $+V_{CC} = 35V, -V_{CC} = -5V,$<br>$V_{CM} = -15V$ |           | -0.5 | 0.5 | mV               | 1          |
|                             |  |  |           | -1.0 | 1.0 | mV               | 2, 3       |
|                             |  | $+V_{CC} = 5V, -V_{CC} = -35V,$<br>$V_{CM} = 15V$  |           | -0.5 | 0.5 | mV               | 1          |
|                             |  |  |           | -1.0 | 1.0 | mV               | 2, 3       |
|                             |  | $+V_{CC} = +5V, -V_{CC} = -5V$                     |           | -0.5 | 0.5 | mV               | 1          |
|                             |  |  |           | -1.0 | 1.0 | mV               | 2, 3       |
| Delta $V_{IO}$ /<br>Delta T | Temperature Coefficient of<br>Input Offset Voltage | $25^\circ C \leq T_A \leq +125^\circ C$            | (Note 9)  | -5.0 | 5.0 | $\mu V/^\circ C$ | 2          |
|                             |  | $-55^\circ C \leq T_A \leq 25^\circ C$             | (Note 9)  | -5.0 | 5.0 | $\mu V/^\circ C$ | 3          |
| $I_{IO}$                    | Input Offset Current                               | $+V_{CC} = 35V, -V_{CC} = -5V,$<br>$V_{CM} = -15V$ |           | -0.2 | 0.2 | nA               | 1          |
|                             |  |  |           | -0.4 | 0.4 | nA               | 2, 3       |
|                             |  | $+V_{CC} = 5V, -V_{CC} = -35V,$<br>$V_{CM} = 15V$  |           | -0.2 | 0.2 | nA               | 1          |
|                             |  |  |           | -0.4 | 0.4 | nA               | 2, 3       |
|                             |  | $+V_{CC} = +5V, -V_{CC} = -5V$                     |           | -0.2 | 0.2 | nA               | 1          |
|                             |  |  |           | -0.4 | 0.4 | nA               | 2, 3       |
| Delta $I_{IO}$ /<br>Delta T | Temperature Coefficient of<br>Input Offset Current | $25^\circ C \leq T_A \leq +125^\circ C$            | (Note 9)  | -2.5 | 2.5 | $pA/^\circ C$    | 2          |
|                             |  | $-55^\circ C \leq T_A \leq 25^\circ C$             | (Note 9)  | -2.5 | 2.5 | $pA/^\circ C$    | 3          |
| $\pm I_{IB}$                | Input Bias Current                                 | $+V_{CC} = 35V, -V_{CC} = -5V,$<br>$V_{CM} = -15V$ |           | -0.1 | 2.0 | nA               | 1          |
|                             |  |  |           | -1.0 | 2.0 | nA               | 2          |
|                             |  |  |           | -0.1 | 3.0 | nA               | 3          |
|                             |  | $+V_{CC} = 5V, -V_{CC} = -35V,$<br>$V_{CM} = 15V$  |           | -0.1 | 2.0 | nA               | 1          |
|                             |  |  |           | -1.0 | 2.0 | nA               | 2          |
|                             |  |  |           | -0.1 | 3.0 | nA               | 3          |
|                             |  | $+V_{CC} = +5V, -V_{CC} = -5V$                     |           | -0.1 | 2.0 | nA               | 1          |
|                             |  |  |           | -1.0 | 2.0 | nA               | 2          |
|                             |  |  |           | -0.1 | 3.0 | nA               | 3          |
| +PSRR                       | Power Supply Rejection Ratio                       | $+V_{CC} = 10V, -V_{CC} = -20V$                    |           | -16  | 16  | $\mu V/V$        | 1, 2, 3    |
| -PSRR                       | Power Supply Rejection Ratio                       | $+V_{CC} = 20V, -V_{CC} = -10V$                    |           | -16  | 16  | $\mu V/V$        | 1, 2, 3    |
| CMRR                        | Common Mode Rejection Ratio                        | $V_{CM} = \pm 15V$                                 |           | 96   |     | dB               | 1, 2, 3    |
| $+I_{OS}$                   | Short Circuit Current                              | $+V_{CC} = +15V,$<br>$-V_{CC} = -15V, t \leq 25mS$ |           | -20  |     | mA               | 1, 2, 3    |
| $-I_{OS}$                   | Short Circuit Current                              | $+V_{CC} = +15V,$<br>$-V_{CC} = -15V, t \leq 25mS$ |           |      | 20  | mA               | 1, 2, 3    |
| $I_{CC}$                    | Power Supply Current                               | $+V_{CC} = +15V,$<br>$-V_{CC} = -15V$              |           |      | 0.6 | mA               | 1, 2       |
|                             |  |  |           |      | 0.8 | mA               | 3          |
| $+V_{OP}$                   | Output Voltage Swing                               | $R_L = 10K\Omega$                                  |           | 16   |     | V                | 4, 5, 6    |
| $-V_{OP}$                   | Output Voltage Swing                               | $R_L = 10K\Omega$                                  |           |      | -16 | V                | 4, 5, 6    |
| $+A_{VS}$                   | Open Loop Voltage Gain                             | $R_L = 10K\Omega, V_{out} = +15V$                  | (Note 10) | 80   |     | V/mV             | 4          |
|                             |  |  | (Note 10) | 40   |     | V/mV             | 5, 6       |

## LM108A Rad Hard — Electrical Characteristics (Continued)

### DC Parameters (Continued)

The following conditions apply to all the following parameters, unless otherwise specified.

$$\pm V_{CC} = \pm 20V, V_{CM} = 0V, R_S = 50\Omega$$

| Symbol           | Parameter              | Conditions   | Notes     | Min | Max | Units | Sub-groups |
|------------------|------------------------|--|-----------|-----|-----|-------|------------|
| -A <sub>VS</sub> | Open Loop Voltage Gain | R <sub>L</sub> = 10K $\Omega$ , V <sub>out</sub> = -15V                                | (Note 10) | 80  |     | V/mV  | 4          |
|                  |                        |  | (Note 10) | 40  |     | V/mV  | 5, 6       |
| A <sub>VS</sub>  | Open Loop Voltage Gain | $\pm V_{CC} = \pm 5V$ , R <sub>L</sub> = 10K $\Omega$ ,<br>V <sub>out</sub> = $\pm 2V$ | (Note 10) | 20  |     | V/mV  | 4, 5, 6    |

### DC Drift Parameters

The following conditions apply to all the following parameters, unless otherwise specified.

$$\pm V_{CC} = \pm 20V, V_{CM} = 0V, R_S = 50\Omega$$

Delta calculations performed on JAN S and QMLV devices at group B, subgroup 5 only.

| Symbol          | Parameter            | Conditions | Notes | Min   | Max  | Units | Sub-groups |
|-----------------|----------------------|------------|-------|-------|------|-------|------------|
| V <sub>IO</sub> | Input Offset Voltage |            |       | -0.25 | 0.25 | mV    | 1          |
| $\pm I_{IB}$    | Input Bias Current   |            |       | -0.5  | 0.5  | nA    | 1          |

### AC Parameters

The following conditions apply to all the following parameters, unless otherwise specified.

$$AC \quad \pm V_{CC} = \pm 20V, V_{CM} = 0V, R_S = 50\Omega$$

| Symbol           | Parameter                    | Conditions   | Notes | Min  | Max   | Units                  | Sub-groups |
|------------------|------------------------------|--|-------|------|-------|------------------------|------------|
| TR <sub>TR</sub> | Transient Response Rise Time | R <sub>L</sub> = 10K $\Omega$ , C <sub>L</sub> = 100pF,<br>f < 1KHz, V <sub>in</sub> = +50mV |       |      | 1,000 | nS                     | 9, 10, 11  |
| TR <sub>OS</sub> | Transient Response Overshoot | R <sub>L</sub> = 10K $\Omega$ , C <sub>L</sub> = 100pF,<br>f < 1KHz, V <sub>in</sub> = +50mV |       |      | 50    | %                      | 9, 10, 11  |
| +S <sub>R</sub>  | Slew Rate                    | A <sub>V</sub> = 1,<br>V <sub>IN</sub> = -5V to +5V  |       | 0.05 |       | V/ $\mu$ S             | 9, 10, 11  |
| -S <sub>R</sub>  | Slew Rate                    | A <sub>V</sub> = 1,<br>V <sub>IN</sub> = +5V to -5V  |       | 0.05 |       | V/ $\mu$ S             | 9, 10, 11  |
| N <sub>IBB</sub> | Noise Broadband              | BW = 10Hz to 5KHz,<br>R <sub>S</sub> = 0 $\Omega$  |       |      | 15    | $\mu$ V <sub>RMS</sub> | 9          |
| N <sub>IPC</sub> | Noise Popcorn                | BW = 10Hz to 5KHz,<br>R <sub>S</sub> = 100K $\Omega$   |       |      | 40    | $\mu$ V <sub>PK</sub>  | 9          |

### Post Radiation Parameters @ +25°C (Note 11)

The following conditions apply to all the following parameters, unless otherwise specified.

$$DC: \quad \pm V_{CC} = \pm 20V, V_{CM} = 0V, R_S = 50\Omega$$

| Symbol       | Parameter          | Conditions  | Notes     | Min | Max | Units | Sub-groups |
|--------------|--------------------|---|-----------|-----|-----|-------|------------|
| $\pm I_{IB}$ | Input Bias Current | +V <sub>CC</sub> = 35V, -V <sub>CC</sub> = -5V,<br>V <sub>CM</sub> = -15V | (Note 11) |     | 5.0 | nA    | 1          |
|              |                    | +V <sub>CC</sub> = 5V, -V <sub>CC</sub> = -35V,<br>V <sub>CM</sub> = -15V | (Note 11) |     | 5.0 | nA    | 1          |
|              |                    |   | (Note 11) |     | 5.0 | nA    | 1          |
|              |                    | +V <sub>CC</sub> = +5V, -V <sub>CC</sub> = -5V                            | (Note 11) |     | 5.0 | nA    | 1          |

## LM108A Rad Hard — Electrical Characteristics (Continued)

### Post Radiation Parameters @ +25°C (Note 11) (Continued)

The following conditions apply to all the following parameters, unless otherwise specified.

DC:  $\pm V_{CC} = \pm 20V$ ,  $V_{CM} = 0V$ ,  $R_S = 50\Omega$

| Symbol   | Parameter            | Conditions   | Notes     | Min | Max | Units | Sub-groups |
|----------|----------------------|--|-----------|-----|-----|-------|------------|
| $I_{IO}$ | Input Offset Current | $+V_{CC} = 35V$ , $-V_{CC} = -5V$ ,<br>$V_{CM} = -15V$ | (Note 11) |     | 0.5 | nA    | 1          |
|          |                      | $+V_{CC} = 5V$ , $-V_{CC} = -35V$ ,<br>$V_{CM} = -15V$ | (Note 11) |     | 0.5 | nA    | 1          |
|          |                      |  | (Note 11) |     | 0.5 | nA    | 1          |
|          |                      | $+V_{CC} = +5V$ , $-V_{CC} = -5V$                      | (Note 11) |     | 0.5 | nA    | 1          |

**Note 2:** Parameters have only been entered in the LM108 / LM108A column if different from LM108RH

**Note 3:** Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is functional, but do not guarantee specific performance limits. For guaranteed specifications and test conditions, see the Electrical Characteristics. The guaranteed specifications apply only for the test conditions listed. Some performance characteristics may degrade when the device is not operated under the listed test conditions.

**Note 4:** The maximum power dissipation must be derated at elevated temperatures and is dictated by  $T_{Jmax}$  (maximum junction temperature),  $\theta_{JA}$  (package junction to ambient thermal resistance), and  $T_A$  (ambient temperature). The maximum allowable power dissipation at any temperature is  $P_{Dmax} = (T_{Jmax} - T_A) / \theta_{JA}$  or the number given in the Absolute Maximum Ratings, whichever is lower.

**Note 5:** 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 6:** For supply voltages less than  $\pm 20V$ , the absolute maximum input voltage is equal to the supply voltage.

**Note 7:** This rating is  $\pm 1.0V$  unless resistances of 2K Ohms or greater are inserted in series with the inputs to limit current in the input shunt diodes to the maximum allowable value.

**Note 8:** Human body model, 1.5 k $\Omega$  in series with 100 pF.

**Note 9:** Calculated parameter

**Note 10:** Datalog reading in  $K = V/mV$

**Note 11:** Pre and post irradiation limits are identical to those listed under AC and DC electrical characteristics except as listed in the Post Radiation Limits Table. These parts may be dose rate sensitive in a space environment and demonstrate enhanced low dose rate effect. Radiation end point limits for the noted parameters are guaranteed only for the conditions as specified in MIL-STD-883, Method 1019.5.

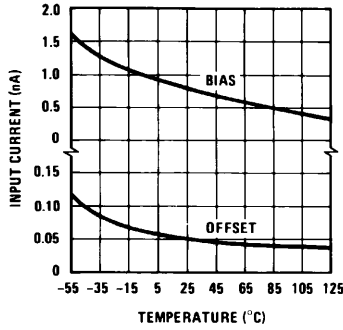
**Note 12:** Parameter tested Go-No-Go

**Note 13:** Guaranteed parameter not tested.

**Note 14:** Calculated parameter for Class "S" only

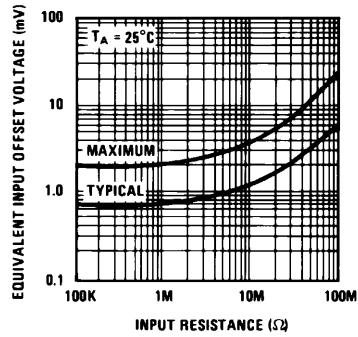
# Typical Performance Characteristics

Input Currents



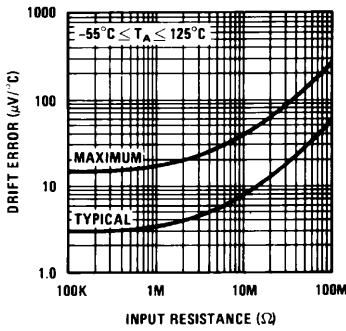
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Offset Error



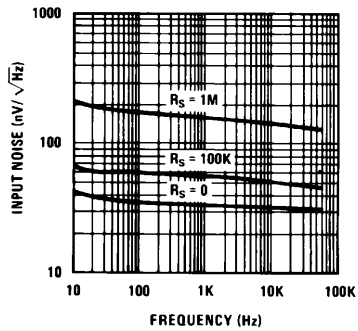
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Drift Error



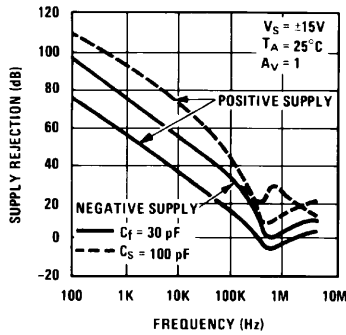
20120620

Input Noise Voltage



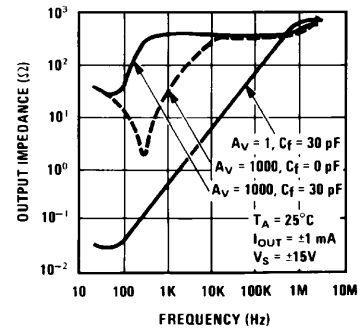
20120621

Power Supply Rejection



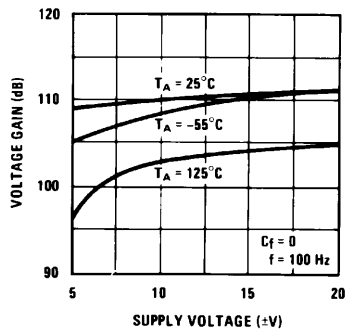
20120622

Closed Loop Output Impedance



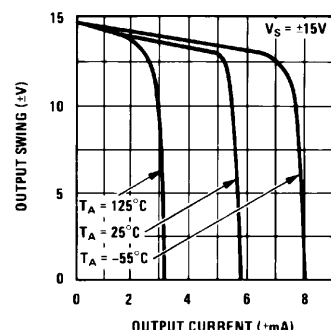
20120623

Voltage Gain



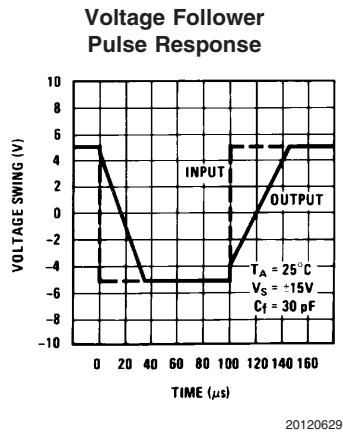
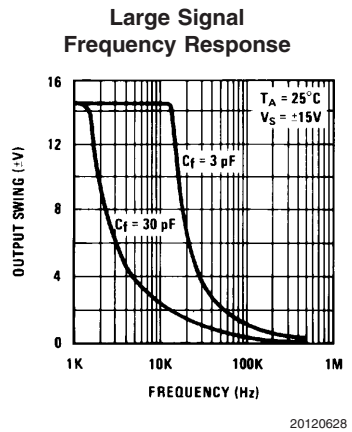
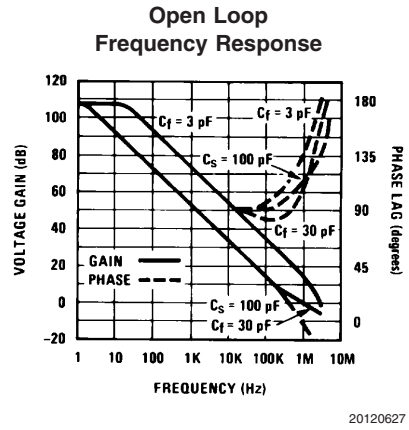
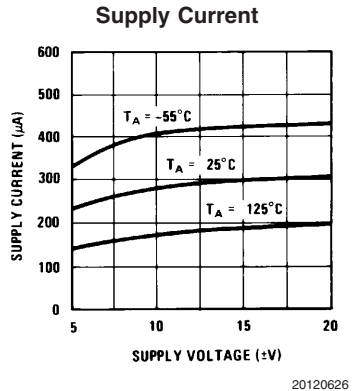
20120624

Output Swing



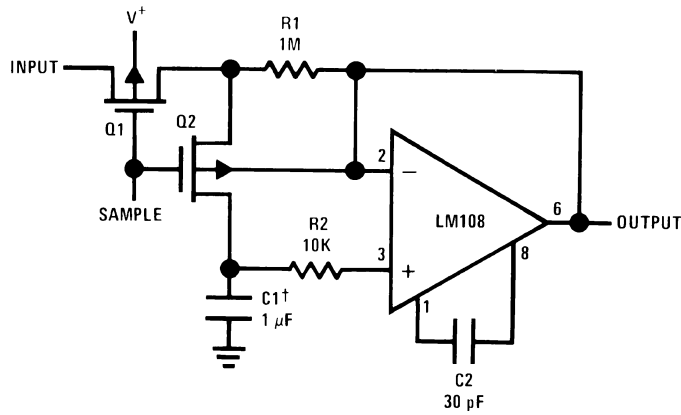
20120625

# Typical Performance Characteristics (Continued)



# Typical Applications

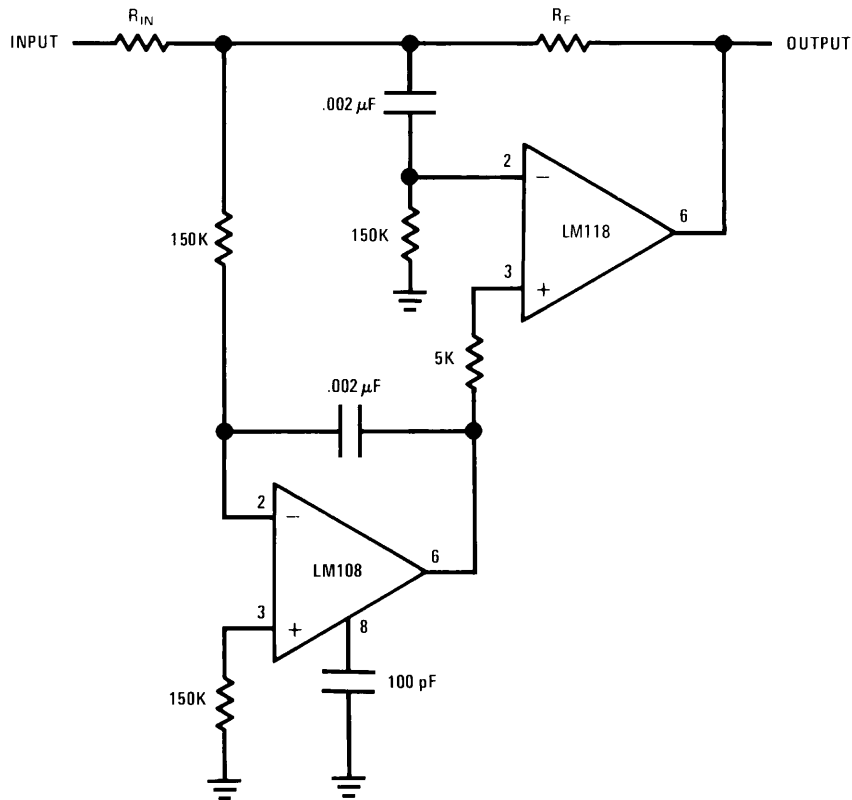
### Sample and Hold



20120604

†Teflon polyethylene or polycarbonate dielectric capacitor  
 Worst case drift less than 2.5 mV/sec

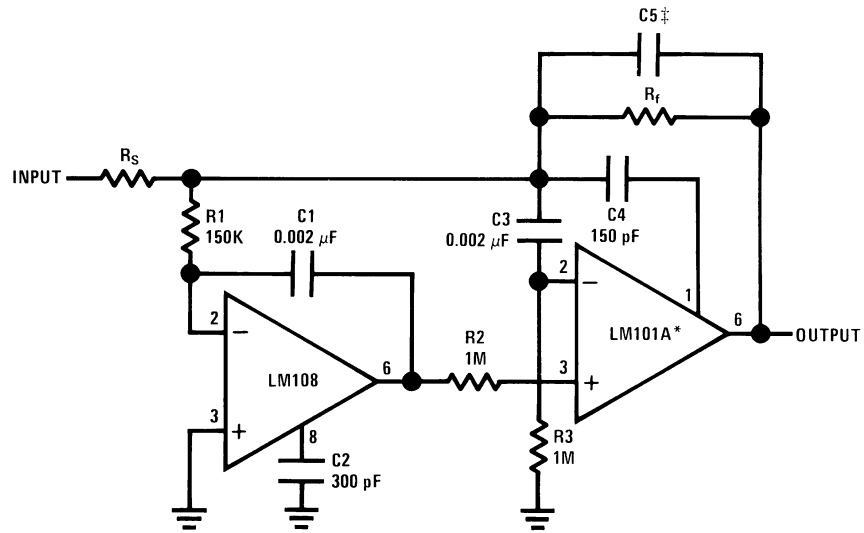
### High Speed Amplifier with Low Drift and Low Input Current



20120605

## Typical Applications (Continued)

### Fast Summing Amplifier (Note 15)



20120612

$$C5 = \frac{6 \times 10^{-8}}{R_f}$$

\*In addition to increasing speed, the LM101A raises high and low frequency gain, increases output drive capability and eliminates thermal feedback.

**Note 15:** Power Bandwidth: 250 KHz

Small Signal Bandwidth: 3.5 MHz

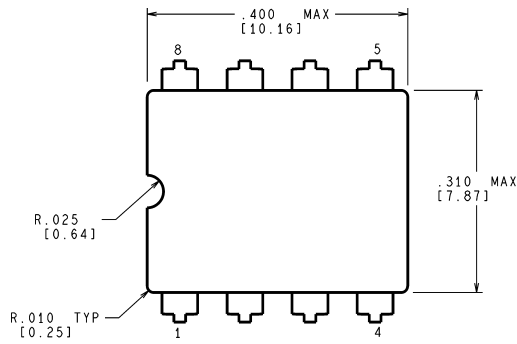
Slew Rate: 10V/μS



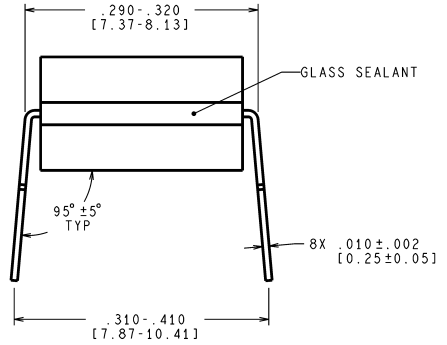
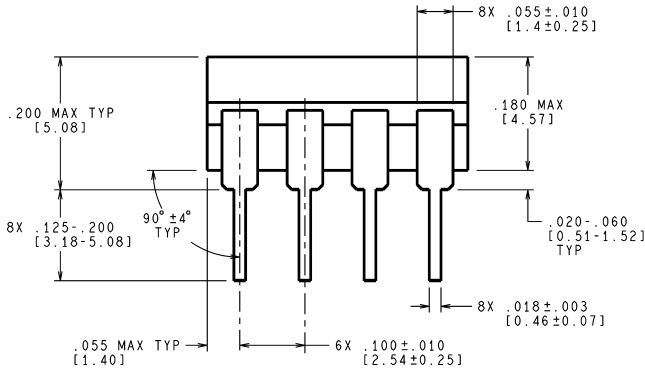
## Revision History

| Date Released | Revision | Section  | Originator | Changes  |
|---------------|----------|--|------------|--|
| 03/23/05      | A        | New release, corporate format. Ordering information table, Electrical sections for the LM108 and LM108A. | L. Lytle   | 3 MDS data sheets converted into one Corp. datasheet format. MRLM108A-X-RH rev. 1A0, MNLM108A-X rev 1A1, MNLM108-X rev 0BL. Deleted following: NSID LM108AW/883 and LM108AJ-8RQML, no longer offered; from LM108 electrical's Delta $V_{IO}/\Delta T$ , Delta $I_{IO}/\Delta T$ , Drift Parameters; from LM108A electrical's Drift Parameters. Reason: referenced products are 883 only. |
| 12/14/05      | B        | Rad Hard Electricals, DC Parameters  | R. Malone  | + $I_{OS}$ from -15 mA min to -20 mA min and - $I_{OS}$ from +15 mA max to +20 mA max. Reason: To reflect SMD update. Revision A will be archived.   |
|               |          |  |            |  |

**Physical Dimensions** inches (millimeters) unless otherwise noted

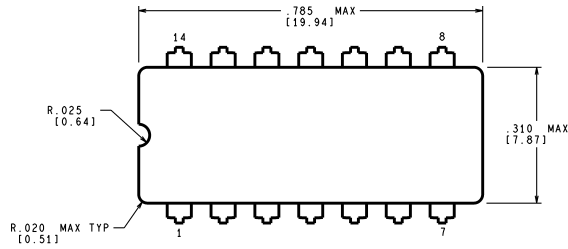


**CONTROLLING DIMENSION IS INCH  
VALUES IN [ ] ARE MILLIMETERS**

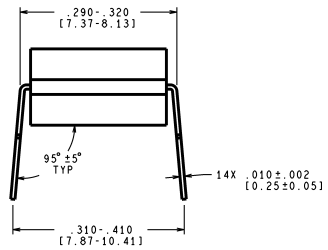
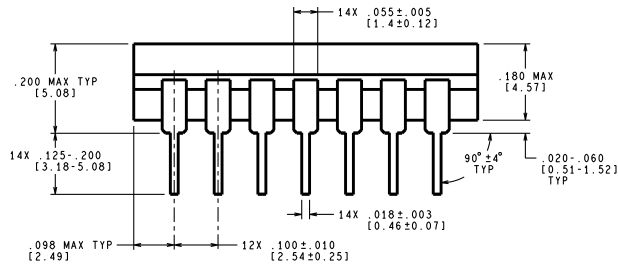


J08A (Rev M)

**Ceramic Dual-In-Line Package (J)  
NS Package Number J08A**



**CONTROLLING DIMENSION IS INCH  
VALUES IN [ ] ARE MILLIMETERS**



J14A (Rev J)

**Ceramic Dual-In-Line Package (J)  
NS Package Number J14A**



