

LM108AJAN

LM108AJAN Operational Amplifiers



Literature Number: SNOSAJ6B

Operational Amplifiers

General Description

The LM108 is a precision operational amplifier having specifications a factor of ten better than FET amplifiers over a -55°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 such as the 709 with $10\text{ k}\Omega$ sources. Integrators with drifts less than $500\ \mu\text{V}/\text{sec}$ and analog time delays in excess of one hour can be made using capacitors no larger than $1\ \mu\text{F}$.

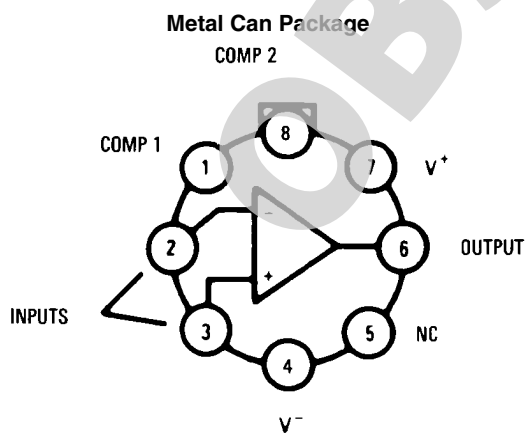
Features

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

Ordering Information

NS PART NUMBER	SMD PART NUMBER	NS PACKAGE NUMBER	PACKAGE DESCRIPTION
JL108ABGA	JM38510/10104BGA	H08C	8LD Metal Can
JL108ABPA	JM38510/10104BPA	J08A	8LD CERDIP
JL108ABCA	JM38510/10104BCA	J14A	14LD CERDIP
JL108ABHA	JM38510/10104BHA	W10A	10LD CERPACK
JL108ABZA	JM38510/10104BZA	WG10A	10LD Ceramic SOIC
JL108ASGA	JM38510/10104SGA	H08C	8LD Metal Can
JL108ASPA	JM38510/10104SPA	J08A	8LD CERDIP
JL108ASCA	JM38510/10104SCA	J14A	14LD CERDIP
JL108ASHA	JM38510/10104SHA	W10A	10LD CERPACK

Connection Diagrams

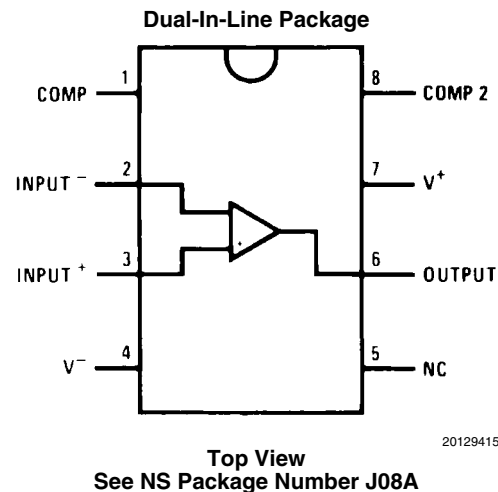


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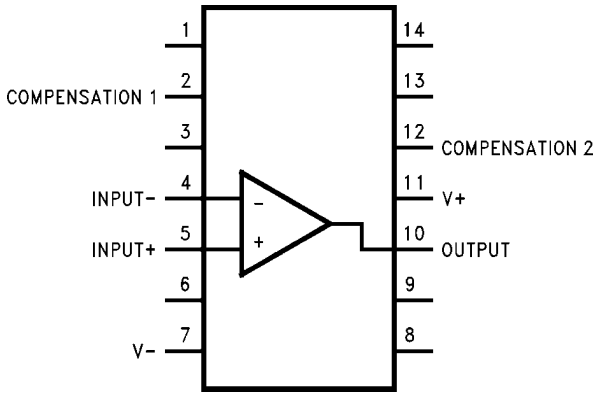
*Package is connected to Pin 4 (V⁻)

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

See NS Package Number H08C

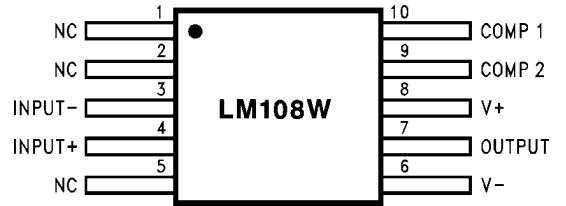


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Top View
See NS Package Number J14A

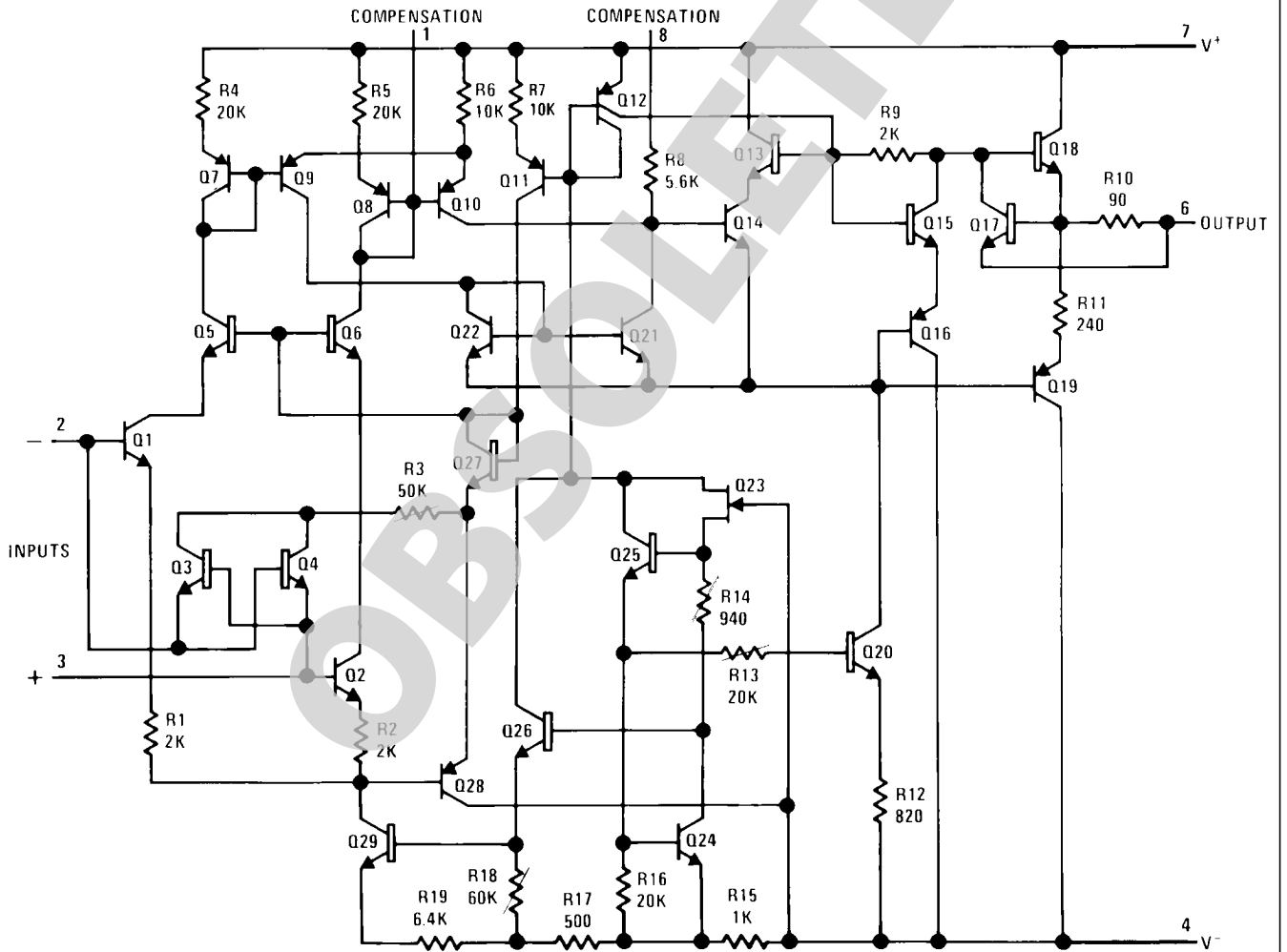
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Top View
See NS Package Number W10A, WG10A

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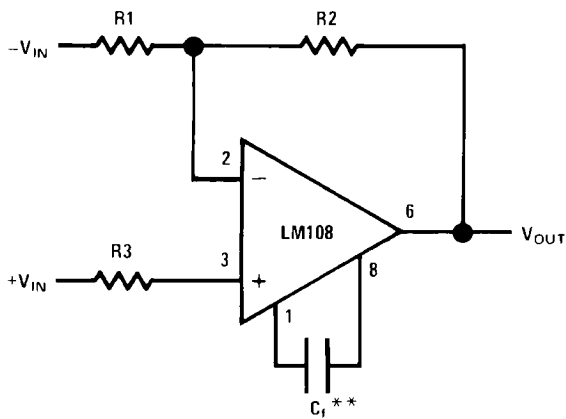
Schematic Diagram



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Compensation Circuits

Standard Compensation Circuit



$$C_f \geq \frac{R1 C_o}{R1 + R2}$$

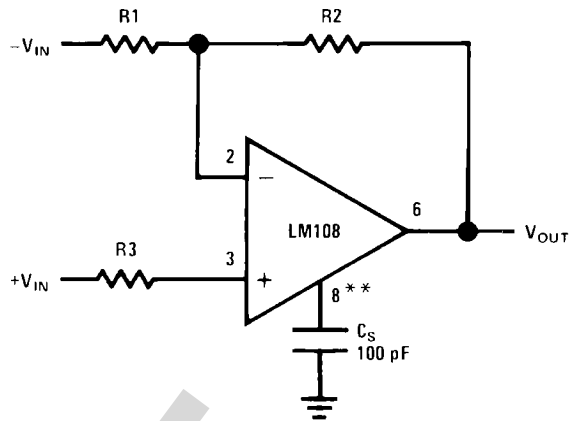
C_o = 30 pF

**Bandwidth and slew rate are proportional to 1/C_f

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Alternate Frequency Compensation

(Note 1)

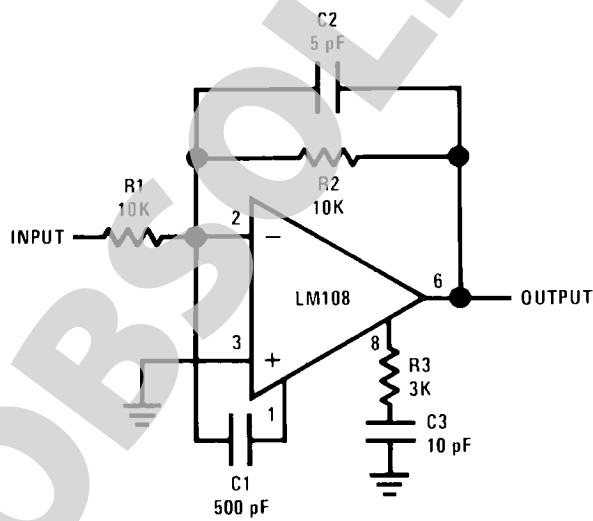


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**Bandwidth and slew rate are proportional to 1/C_s

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

Feedforward Compensation



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Absolute Maximum Ratings *(Note 2)*

Supply Voltage	±22V
Power Dissipation <i>(Note 3)</i>	
Metal Can 8LD	330mW @ +125°C
CERDIP 14LD	400mW @ +125°C
CERDIP 8LD	400mW @ +125°C
CERPACK 10LD	330mW @ +125°C
Ceramic SOIC 10LD	330mW @ +125°C
Differential Input Current <i>(Note 4)</i>	±10 mA
Differential Input Voltage <i>(Note 6)</i>	±30V
Input Voltage <i>(Note 5)</i>	±20V
Output Short-Circuit Duration	Continuous
Operating Temperature Range	-55°C ≤ T _A ≤ +125°C
Storage Temperature Range	-65°C ≤ T _A ≤ +150°C
Thermal Resistance	
θ _{JA}	
Metal Can 8LD 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 10LD Still Air	225°C/W
500LF / Min Air Flow	142°C/W
θ _{JC}	
Metal Can 8LD	38°C/W
CERDIP 14LD	13°C/W
CERDIP 8LD	17°C/W
CERPACK 10LD	21°C/W
Ceramic SOIC 10LD	21°C/W
Package Weight (typical)	
Metal Can 8LD	990mg
CERDIP 14LD	2,180mg
CERDIP 8LD	1,090mg
CERPACK 10LD	225mg
Ceramic SOIC 10LD	210mg
Maximum Junction Temperature	175°C
Lead Temperature (Soldering, 10 sec)	300°C
ESD Tolerance <i>(Note 7)</i>	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

LM108A Electrical Characteristics

DC Parameters

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

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

Symbol	Parameter	Conditions	Notes	Min	Max	Units	Sub-groups
V_{IO}	Input Offset Voltage	$+V_{CC} = 35V$, $-V_{CC} = -5V$, $V_{CM} = -15V$		-0.5	0.5	mV	1
				-1	1	mV	2, 3
		$+V_{CC} = 5V$, $-V_{CC} = -35V$, $V_{CM} = 15V$		-0.5	0.5	mV	1
				-1	1	mV	2, 3
		$+V_{CC} = +5V$, $-V_{CC} = -5V$		-0.5	0.5	mV	1
				-1	1	mV	2, 3
Delta V_{IO} / Delta T	Temperature Coefficient of Input Offset Voltage	$25^\circ C \leq T_A \leq +125^\circ C$	(Note 8)	-5	5	$\mu V/^\circ C$	2
		$25^\circ C \leq T_A \leq -55^\circ C$	(Note 8)	-5	5	$\mu V/^\circ C$	3
I_{IO}	Input Offset Current	$+V_{CC} = 35V$, $-V_{CC} = -5V$, $V_{CM} = -15V$		-0.2	0.2	nA	1
				-0.4	0.4	nA	2, 3
		$+V_{CC} = 5V$, $-V_{CC} = -35V$, $V_{CM} = 15V$		-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} / Delta T	Temperature Coefficient of Input Offset Current	$25^\circ C \leq T_A \leq +125^\circ C$	(Note 8)	-2.5	2.5	$pA/^\circ C$	2
		$25^\circ C \leq T_A \leq -55^\circ C$	(Note 8)	-2.5	2.5	$pA/^\circ C$	3

Symbol	Parameter	Conditions	Notes	Min	Max	Units	Sub-groups
$\pm I_{IB}$	Input Bias Current	$+V_{CC} = 35V, -V_{CC} = -5V,$ $V_{CM} = -15V$		-0.1	2	nA	1
				-1	2	nA	2
				-0.1	3	nA	3
		$+V_{CC} = 5V, -V_{CC} = -35V,$ $V_{CM} = 15V$		-0.1	2	nA	1
				-1	2	nA	2
				-0.1	3	nA	3
		$+V_{CC} = +5V, -V_{CC} = -5V$		-0.1	2	nA	1
				-1	2	nA	2
				-0.1	3	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	$+V_{CC} = +15V, -V_{CC} = -15V,$ $t \leq 25mS$		-20		mA	1, 2, 3
$-I_{OS}$	Short Circuit Current	$+V_{CC} = +15V, -V_{CC} = -15V,$ $t \leq 25mS$			20	mA	1, 2, 3
I_{CC}	Power Supply Current	$+V_{CC} = +15V, -V_{CC} = -15V$			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	$R_L = 10K\Omega, V_O = +15V$	(Note 9)	80		V/mV	4
			(Note 9)	40		V/mV	5, 6
$-A_{VS}$	Open Loop Voltage Gain	$R_L = 10K\Omega, V_O = -15V$	(Note 9)	80		V/mV	4
			(Note 9)	40		V/mV	5, 6
A_{VS}	Open Loop Voltage Gain	$+V_{CC} = \pm 5V,$ $R_L = 10K\Omega, V_O = \pm 2V$	(Note 9)	20		V/mV	4, 5, 6

AC Parameters

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

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

Symbol	Parameter	Conditions	Notes	Min	Max	Units	Sub-groups
TR_{TR}	Transient Response Rise Time	$R_L = 10K\Omega, C_L = 100pF,$ $f < 1KHz, V_I = +50mV$			1000	nS	7, 8A, 8B
TR_{OS}	Transient Response Overshoot	$R_L = 10K\Omega, C_L = 100pF,$ $f < 1KHz, V_I = +50mV$			50	%	7, 8A, 8B
+SR	Slew Rate	$A_V = 1, V_I = -5V \text{ to } +5V$		0.05		V/ μS	7, 8A, 8B
-SR	Slew Rate	$A_V = 1, V_I = +5V \text{ to } -5V$		0.05		V/ μS	7, 8A, 8B
NI_{BB}	Noise Broadband	$BW = 10Hz \text{ to } 5KHz, R_S = 0\Omega$			15	μV_{rms}	7
NI_{PC}	Noise Popcorn	$BW = 10Hz \text{ to } 5KHz,$ $R_S = 100K\Omega$			40	μV_{pk}	7

DC Parameters Drift Values

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

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

Delta calculations performed on JAN S devices at group B, Subgroup 5 only.

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

Note 2: 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 3: The maximum power dissipation must be derated at elevated temperatures and is dictated by $T_{j,max}$ (maximum junction temperature), θ_{JA} (package junction to ambient thermal resistance), and T_A (ambient temperature). The maximum allowable power dissipation at any temperature is $P_{D,max} = (T_{j,max} - T_A) / \theta_{JA}$ or the number given in the Absolute Maximum Ratings, whichever is lower.

Note 4: 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 5: For supply voltages less than $\pm 20V$, the absolute maximum input voltage is equal to the supply voltage.

Note 6: This rating is $\pm 1.0V$ unless resistances of $2K\Omega$ or greater are inserted in series with the inputs to limit current in the input shunt diodes to the maximum allowable value.

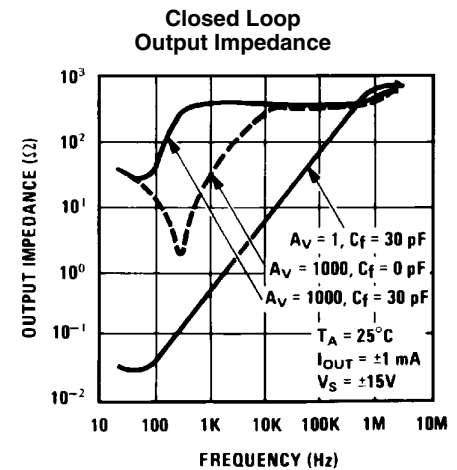
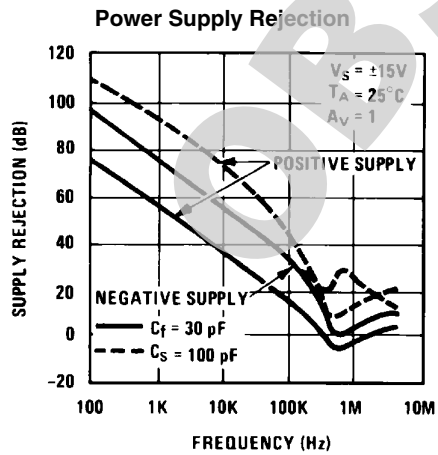
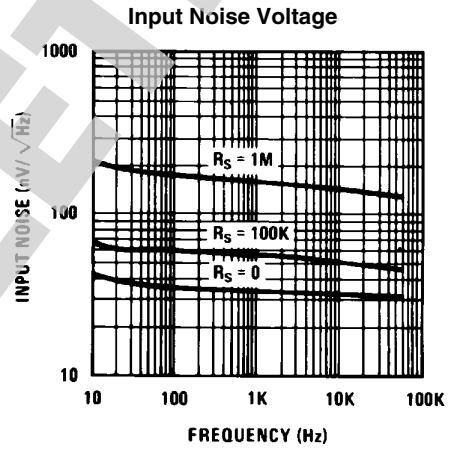
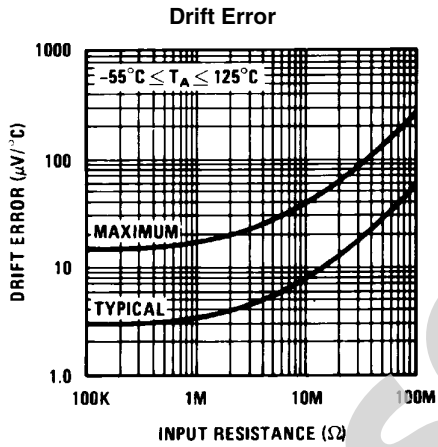
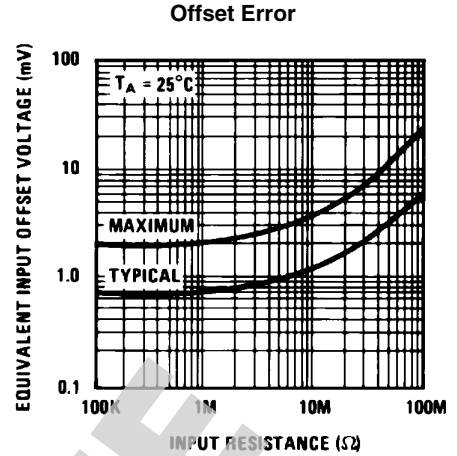
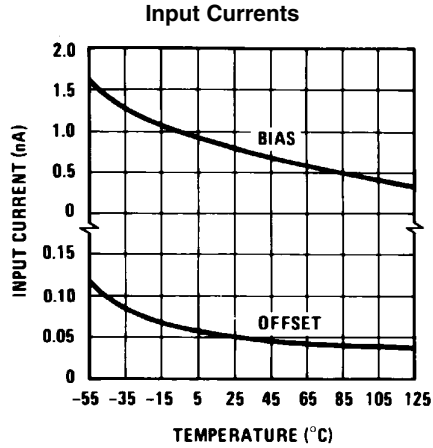
Note 7: Human body model, $1.5 k\Omega$ in series with $100 pF$.

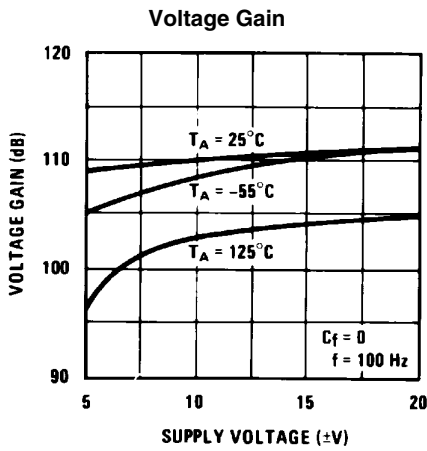
Note 8: Calculated parameter

Note 9: Datalog reading in $K = V/mV$

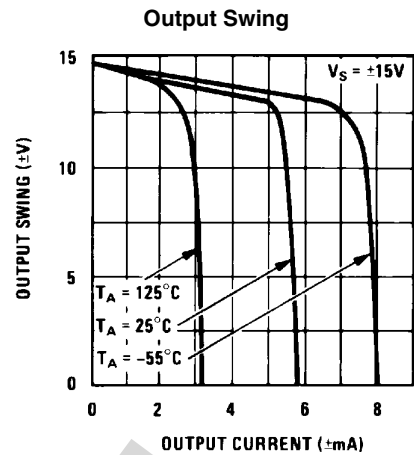
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Typical Performance Characteristics

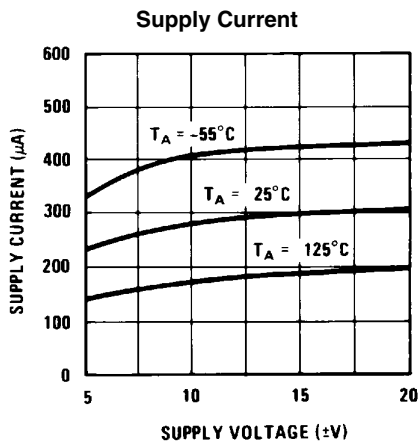




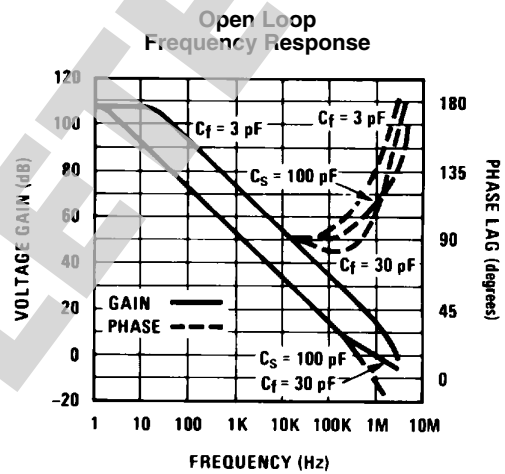
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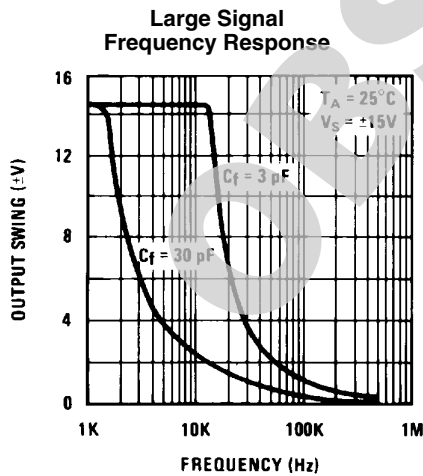
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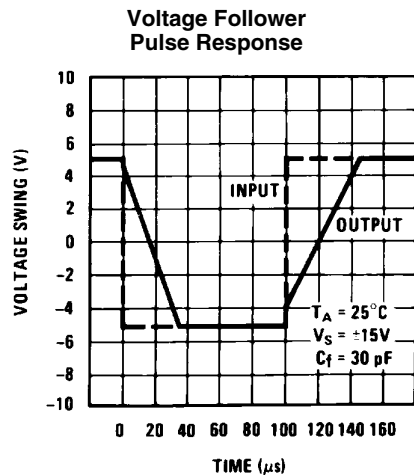
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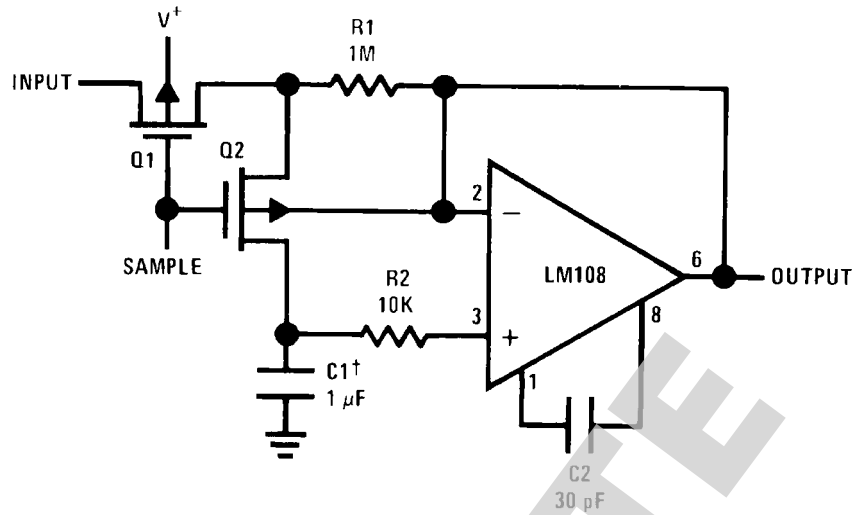
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Typical Applications

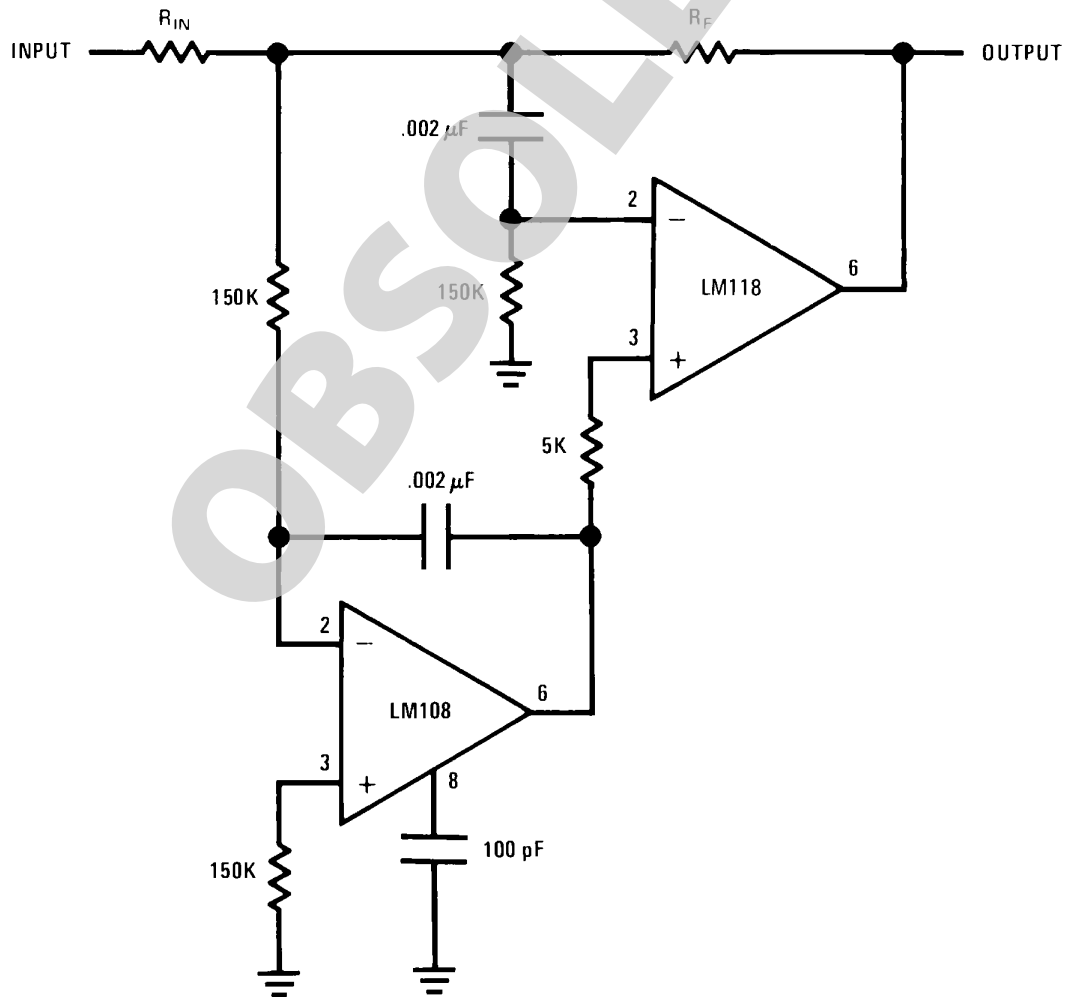
Sample and Hold



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

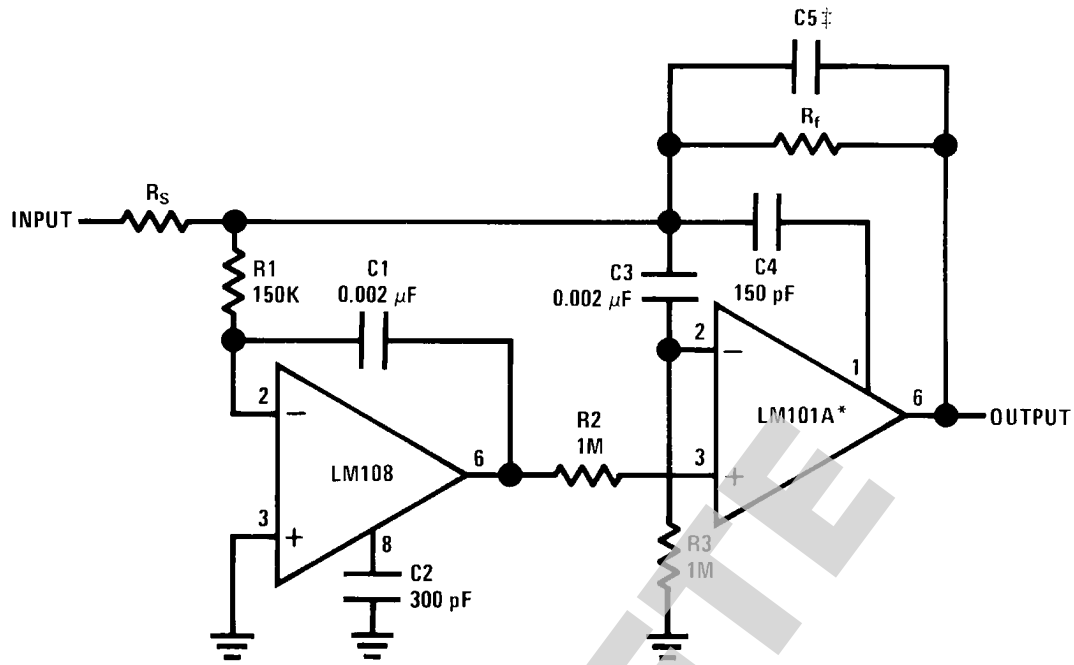
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High Speed Amplifier with Low Drift and Low Input Current



20129405

Fast Summing Amplifier (Note 10)



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$$C_5 = \frac{6 \times 10^{-8}}{R_f}$$

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

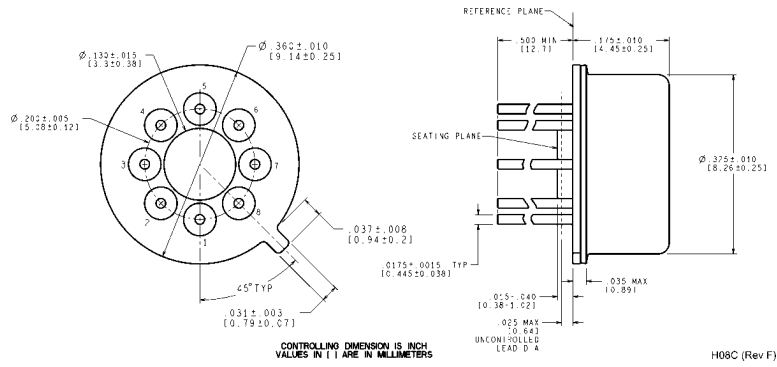
Note 10: Power Bandwidth: 250 KHz
 Small Signal Bandwidth: 3.5 MHz
 Slew Rate: 10V/μS

Revision History Section

Date Released	Revision	Section	Changes
02/25/05	A	New release, corporate format	1 MDS data sheets converted into one Corp. datasheet format. MJLM108A-X Rev 2A0. MDS will be archived.
01/05/06	B	DC Electrical's	All temps. +los from -15 mA Min to -20 mA Min and -los from +15 mA Max to +20 mA Max
09/24/10	C	Obsolete Data Sheet	Revision C, End of Life on Product/NSID Dec. 2008/09 Obsolete Data Sheet

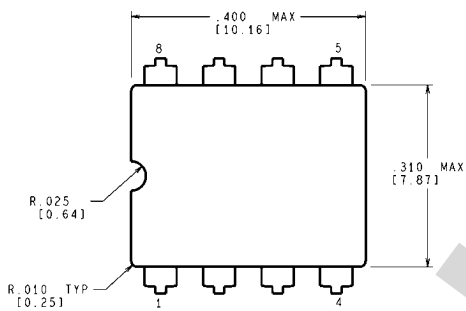
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Physical Dimensions inches (millimeters) unless otherwise noted

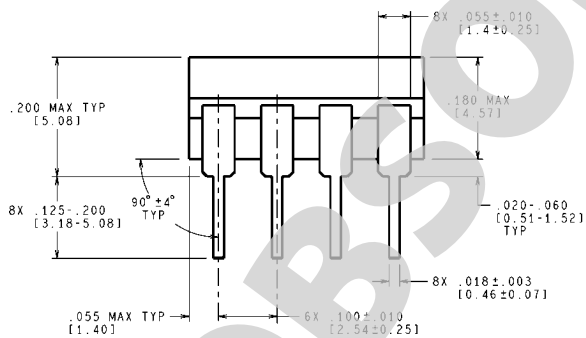


Metal Can Package (H)
NS Package Number H08C

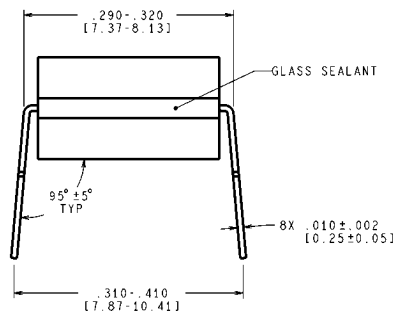
H08C (Rev F)



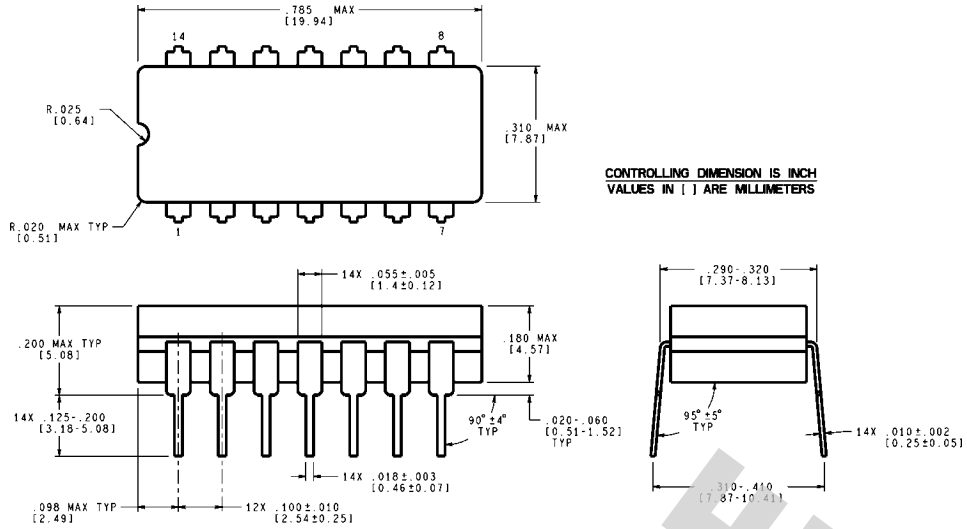
CONTROLLING DIMENSION IS INCH
VALUES IN [] ARE MILLIMETERS



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



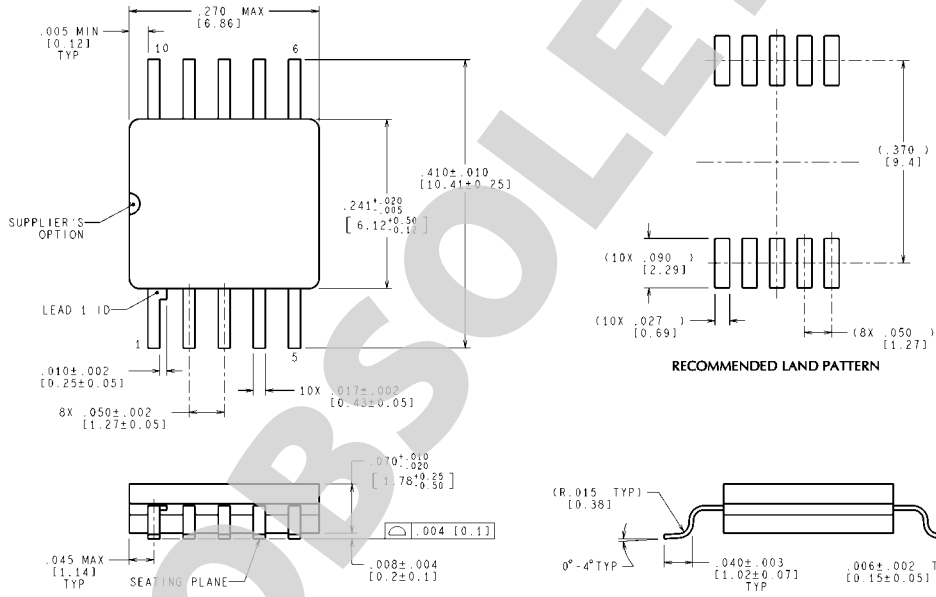
J08A (Rev M)



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J14A (Rev J)

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



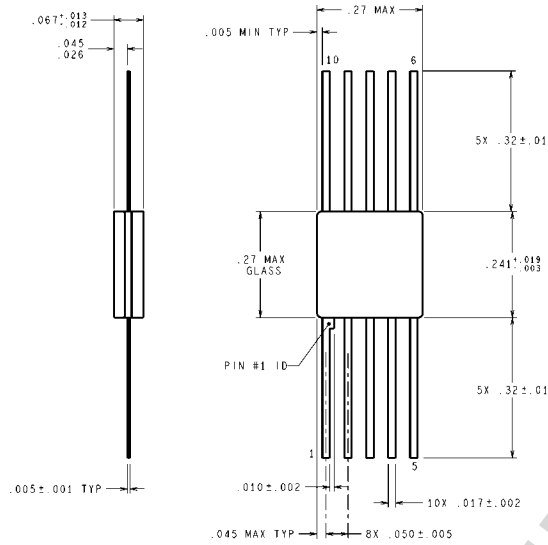
RECOMMENDED LAND PATTERN

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VALUES IN [] ARE MILLIMETERS
DIMENSIONS IN () FOR REFERENCE ONLY

WG10A (Rev F)

S.O. Package (WG)
NS Package Number WG10A

MIL-PRF-38535
CONFIGURATION CONTROL



DIMENSIONS ARE IN INCHES

W10A (Rev H)

**Ceramic Flatpack Package (W)
NS Package Number W10A**

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Switching Regulators	www.national.com/switchers	Distributors	www.national.com/contacts
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LED Lighting	www.national.com/led	Feedback/Support	www.national.com/feedback
Voltage References	www.national.com/vref	Design Made Easy	www.national.com/easy
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