FAIRCHILD

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μA108/A • μA208/A • μA308/A Super Beta Operational Amplifiers

Description

The μA108 Super Beta Operational Amplifier series is constructed using the Fairchild Planar Epitaxial process. High input impedance, low noise, low input offsets, and low temperature drifts are made possible through use of super beta processing, making the device suitable for applications requiring high accuracy and low drift performance. The μA108 series is specially selected for extremely low offset voltage and drift, and high common mode rejection, giving superior performance in applications where offset nulling is undesirable. Increased slew rate without performance compromise is available through use of feed forward compensation techniques, maximizing performance in high speed sample-and-hold circuits and precision high speed summing amplifiers. The wide supply range and excellent supply voltage rejection assure maximum flexibility in voltage follower, summing, and general feedback applications.

- **Guaranteed Low Input Offset Characteristics**
- **High Input Impedance**
- **Low Offset Current**
- **Low Bias Current**
- **Operation Over Wide Supply Range**

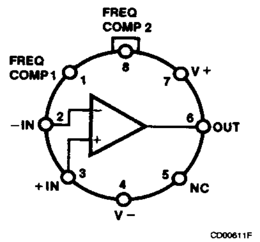
Absolute Maximum Ratings

Storage Temperature Range	
Metal Can	−65°C to +175°C
Molded DIP and SO-8	−65°C to +150°C
Operating Temperature Range	
Extended (μA108AM, μA108M)	−55°C to +125°C
Industrial (μA208AV, μA108V)	−25°C to +85°C
Commercial (μA308AC, μA308C)	0°C to +70°C
Lead Temperature	
Metal Can (soldering, 60 s)	300°C
Molded DIP and SO-8 (soldering, 10 s)	265°C
Internal Power Dissipation[1, 2]	
8L-Metal Can	1.00 W
8L-Molded DIP	0.93 W
SO-8	0.81 W
Supply Voltage	
μA108/A, μA208/A	±20 V
μA308/A	±18 V
Differential Input Current [3]	±10 mA
Input Voltage[4]	±15 V
Output Short Circuit Duration[5]	Indefinite

Notes

1. $T_{J\,Max}$ = 150°C for the Molded DIP and SO-8, and 175°C for the Metal Can.
2. Ratings apply to ambient temperature at 25°C. Above this temperature, derate the 8L-Metal Can at 6.7 mW/°C, the 8L-Molded DIP at 7.5 mW/°C, and the SO-8 at 6.5 mW/°C.
3. The inputs are shunted with back-to-back diodes for overvoltage protection. Therefore, excessive current will flow if a differential input voltage in excess of 1.0 V is applied between the inputs unless adequate limiting resistance is used.

Connection Diagram 8-Lead Metal Package (Top View)

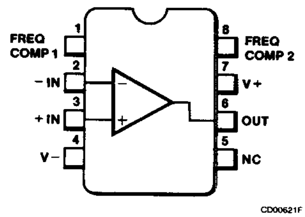


Lead 4 connected to case.

Order Information

Device Code	Package Code	Package Description
μA108HM	5W	Metal
μA108AHM	5W	Metal
μA208HV	5W	Metal
μA208AHV	5W	Metal
μA308HC	5W	Metal
μA308AHC	5W	Metal

Connection Diagram 8-Lead DIP and SO-8 Package (Top View)

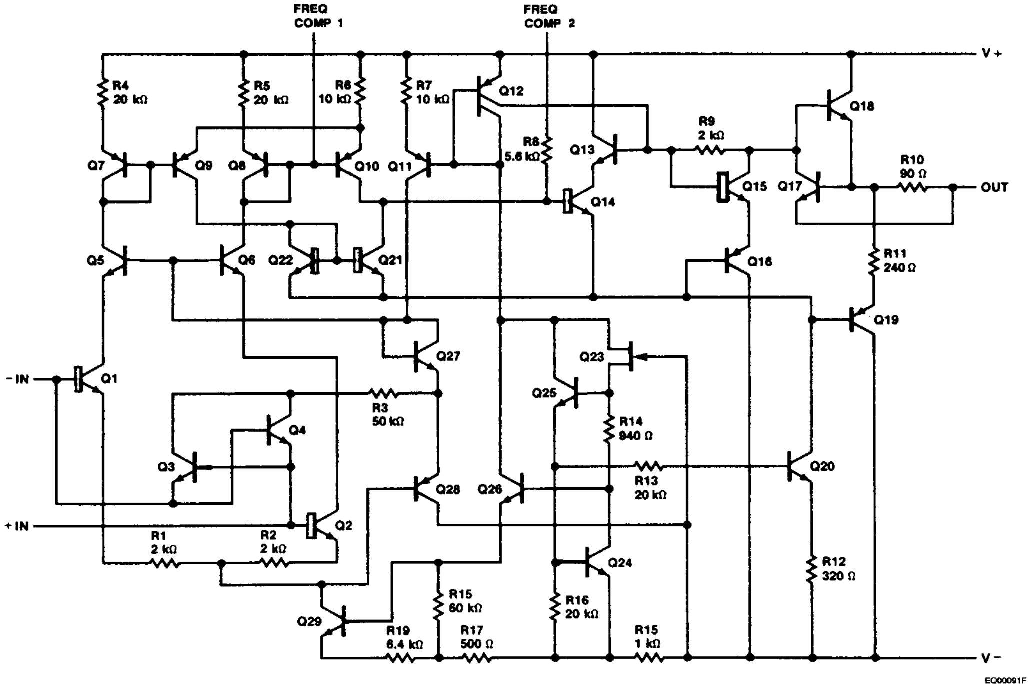


Order Information

Device Code	Package Code	Package Description
μA308SC	KC	Molded Surface Mount
μA308TC	9T	Molded DIP
μA308ASC	KC	Molded Surface Mount
μA308ATC	9T	Molded DIP

4. For supply voltages less than ±15 V, the absolute maximum input voltage is equal to the supply voltage.
5. Short circuit may be to either supply or ground. Rating applies to operation up to the maximum operating temperature range.

Equivalent Circuit



μA108/A and μA208/A
Electrical Characteristics ±5.0 V ≤ V_{CC} ≤ ±20 V, T_A = 25°C, unless otherwise specified.

Symbol	Characteristic	Condition	μA108A μA208A Min	μA108A μA208A Typ	μA108A μA208A Max	μA108 μA208 Min	μA108 μA208 Typ	μA108 μA208 Max	Unit
V_{IO}	Input Offset Voltage			0.3	0.5		0.7	2.0	mV
I_{IO}	Input Offset Current			0.05	0.2		0.05	0.2	nA
I_{IB}	Input Bias Current			0.8	2.0		0.8	2.0	nA
Z_I	Input Impedance		30	70		30	70		MΩ
I_{CC}	Supply Current	V_{CC} = ±20 V		.03	0.6		0.3	0.6	mA
A_{VS}	Large Signal Voltage Gain	V_{CC} = ±15 V, V_O = ±10 V, R_L ≥ 10 Ω	80	300		50	300		V/mV
The following specifications apply over the range of −55°C ≤ T_A ≤ +125°C for the μA108/A, and −25°C ≤ T_A ≤ +85°C for the μA208/A, unless otherwise specified.									
V_{IO}	Input Offset Voltage				1.0			3.0	mV
$\Delta V_{IO}/\Delta T$	Input Offset Voltage Temperature Sensitivity			1.0	5.0		3.0	15	μV/°C
I_{IO}	Input Offset Current				0.4			0.4	nA
$\Delta I_{IO}/\Delta T$	Input Offset Current Temperature Sensitivity			0.5	2.5		0.5	2.5	pA/°C
I_{IB}	Input Bias Current			0.8	3.0			3.0	nA
I_{CC}	Supply Current	V_{CC} = ±20 V, T_A = 125°C		0.15	0.4		0.15	0.4	mA
CMR	Common Mode Rejection		96	110		85	100		dB
V_{IR}	Input Voltage Range	V_{CC} = ±15 V	±13.5			±13.5			V
PSRR	Power Supply Rejection Ratio	V_{CC} = ±5.0 V to ±20 V	96	110		80	96		dB
A_{VS}	Large Signal Voltage Gain	V_{CC} = ±15 V, V_O = ±10 V, R_L ≥ 10 Ω	40			25			V/mV
V_{OP}	Output Voltage Swing	V_{CC} = ±15 V, R_L = 10 kΩ	±13	±14		±13	±14		V

μA308/A
Electrical Characteristics T_A = 25°C, ±5.0 V ≤ V_{CC} ≤ ±15 V, unless otherwise specified.

Symbol	Characteristic	Condition	μA308A Min	μA308A Typ	μA308A Max	μA308 Min	μA308 Typ	μA308 Max	Unit
V_{IO}	Input Offset Voltage			0.3	0.5		2.0	7.5	mV
I_{IO}	Input Offset Current			0.2	1.0		0.2	1.0	nA
I_{IB}	Input Bias Current			1.5	7.0		1.5	7.0	nA
Z_I	Input Impedance		10	40		10	40		MΩ

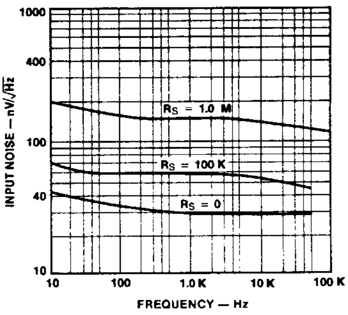
μA308/A (Cont.)

Electrical Characteristics $T_A = 25°C$, $\pm 5.0\ V \leqslant V_{CC} \leqslant \pm 15\ V$, unless otherwise specified.

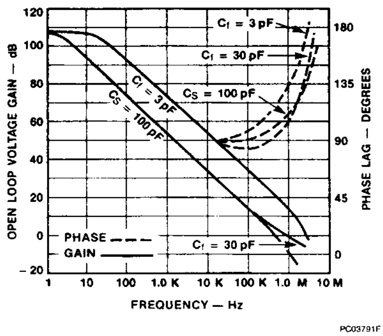
Symbol	Characteristic	Condition	μA308A Min	μA308A Typ	μA308A Max	μA308 Min	μA308 Typ	μA308 Max	Unit
I_{CC}	Supply Current	$V_{CC} = \pm 15\ V$		0.3	0.8		0.3	0.8	mA
A_{VS}	Large Signal Voltage Gain	$V_{CC} = \pm 15\ V$, $V_O = \pm 10\ V$, $R_L \geqslant 10\ \Omega$	80	300		25	300		V/mV
The following specifications apply over the range of $0°C \leqslant T_A \leqslant +70°C$									
V_{IO}	Input Offset Voltage				0.73			10	mV
$\Delta V_{IO}/\Delta T$	Input Offset Voltage Temperature Sensitivity			1.0	5.0		6.0	30	μV/°C
I_{IO}	Input Offset Current				1.5			1.5	nA
$\Delta I_{IO}/\Delta T$	Input Offset Current Temperature Sensitivity			2.0	10		2.0	10	pA/°C
I_{IB}	Input Bias Current				10			10	nA
CMR	Common Mode Rejection		96	110		80	100		dB
V_{IR}	Input Voltage Range	$V_{CC} = \pm 15\ V$	±13.5			±13.5			V
PSRR	Power Supply Rejection Ratio	$V_{CC} = \pm 5.0\ V$ to $\pm 18\ V$	96	110		80	96		dB
A_{VS}	Large Signal Voltage Gain	$V_{CC} = \pm 15\ V$, $V_O = \pm 10\ V$, $R_L \geqslant 10\ k\Omega$	60			15			V/mV
V_{OP}	Output Voltage Swing	$V_{CC} = \pm 15\ V$, $R_L = 10\ k\Omega$	±13	±14		±13	±14		V

Typical Performance Curves for μA108 Series

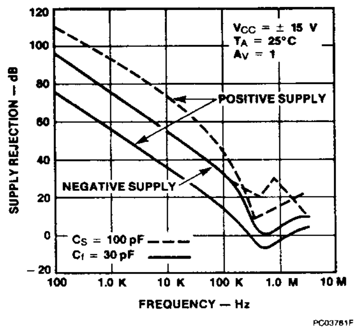
Input Noise Voltage vs Frequency



Open Loop Frequency Response

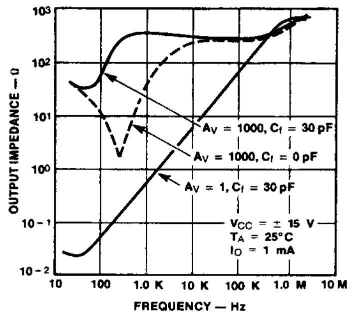


Supply Rejection vs Frequency



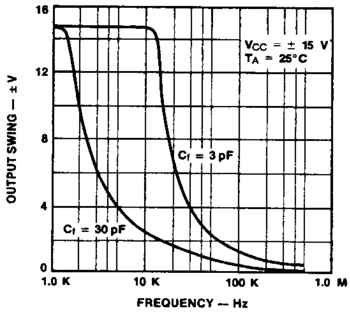
Typical Performance Curves for μA108 Series (Cont.)

Closed Loop Output Impedance vs Frequency



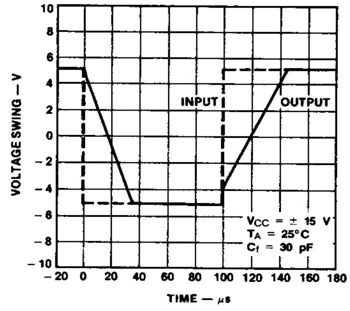
PC03801F

Large Signal Frequency Response



PC03811F

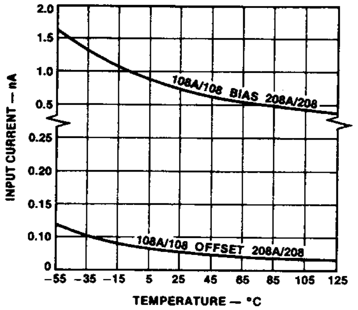
Voltage Follower Pulse Response



PC03820F

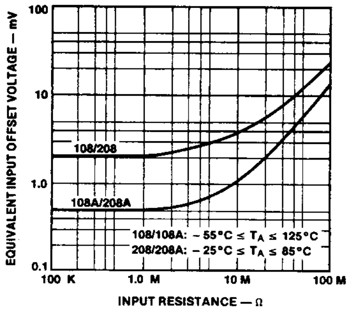
Typical Performance Curves for μA108/A, and μA208/A (Unless otherwise specified)

Input Currents vs Temperature



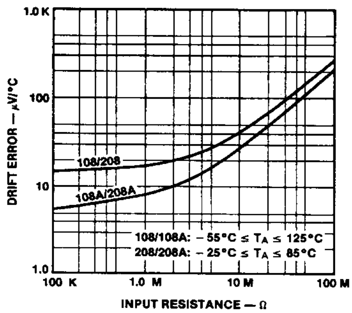
PC03831F

Maximum Offset Error



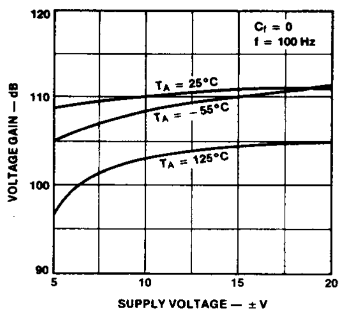
PC03841F

Maximum Drift Error



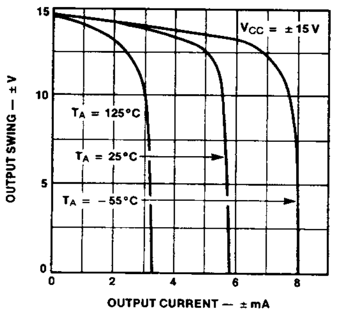
PC03851F

Voltage Gain vs Supply Voltage (μA108)



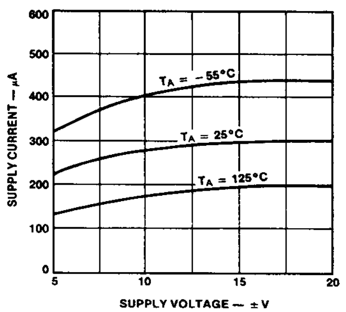
PC03860F

Output Swing vs Output Current (μA108)



PC03870F

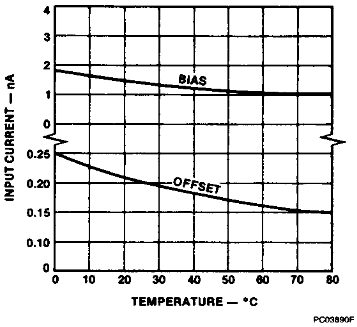
Supply Current vs Supply Voltage (μA108)



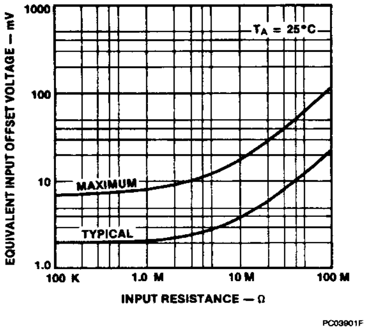
PC03880F

Typical Performance Curves for μA308/A (Unless otherwise specified)

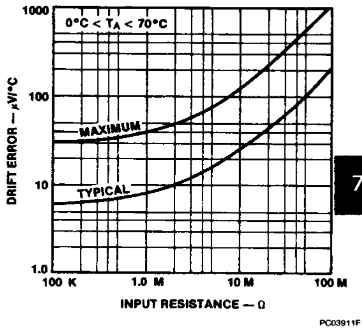
Input Current vs Temperature



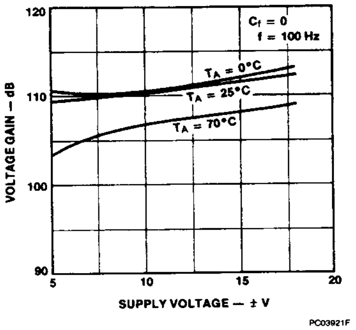
Maximum Offset Error (μA308)



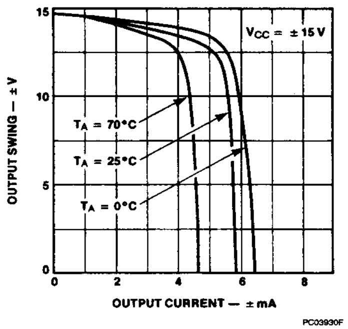
Maximum Drift Error (μA308)



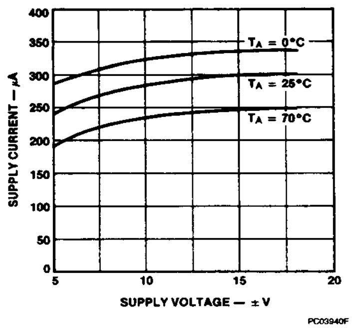
Voltage Gain vs Supply Voltage



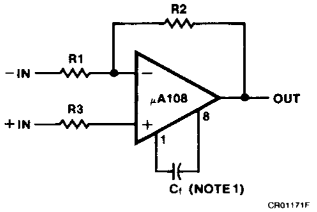
Output Swing vs Output Current

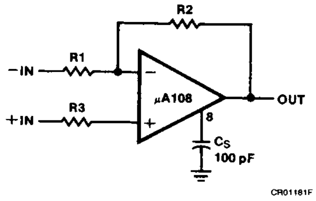


Supply Current vs Supply Voltage



Standard Compensation Circuits



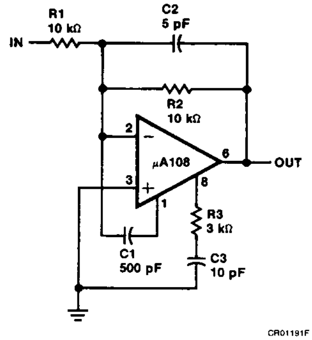


Note

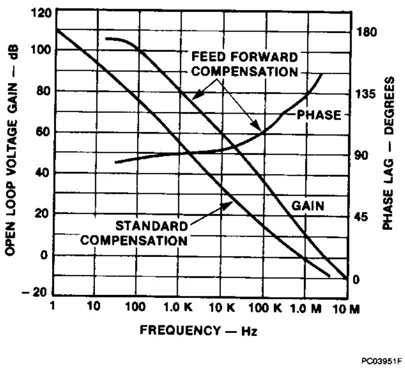
1. $C_F \geq 30\left(\frac{1}{1+\frac{R_2}{R_1}}\right)$

Feed Forward Compensation Higher Slew Rate and Wider Bandwidth

Standard Feed Forward



Open Loop Frequency Response

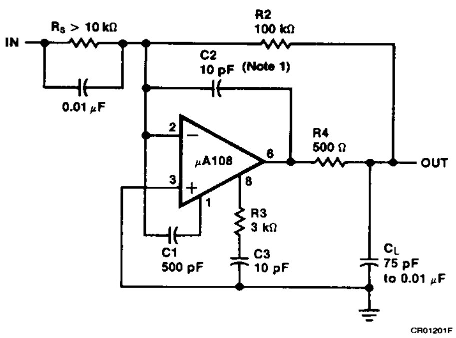


Guarding

Extra care must be taken in the assembly of printed circuit boards to take full advantage of the low input currents of the μA108 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 leads are adjacent to leads 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 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 as the inputs. Leakage currents from high voltage leads are then absorbed by the guard.

The lead configuration of the dual-in-line package is designed to facilitate guarding, since the leads adjacent to the inputs are not used (this is different from the standard μA741 and μA101A lead configuration).

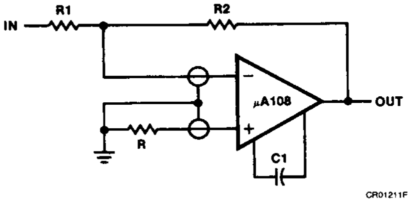
Feed Forward Compensation for Decoupling Load Capacitance



Note

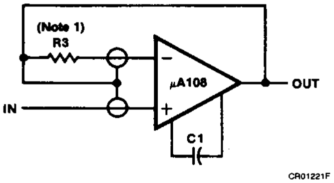
1. $C_2 > \frac{5 \times 10^5}{R_2}$ pF

Inverting Amplifier

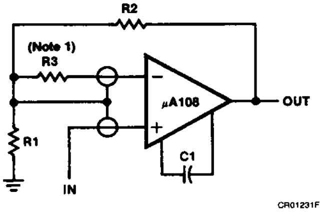


$R = R_1 || R_2$ (must be low impedance)

Follower



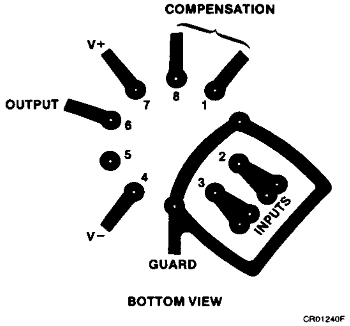
Non-Inverting Amplifier



Note

1. Use to compensate for large source resistances.

Board Layout for Input Guarding With Metal Package



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