MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

LM108, LM108A
LM208, LM208A
LM308, LM308A

2

SUPER GAIN OPERATIONAL AMPLIFIERS

SILICON MONOLITHIC INTEGRATED CIRCUIT

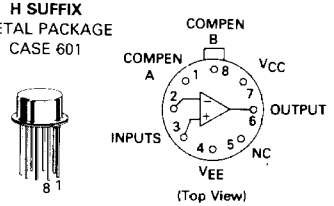
PRECISION OPERATIONAL AMPLIFIERS

The LM108/LM208/LM308 Series operational amplifiers provide high input impedance, low input offsets and temperature drifts, and low noise. These characteristics are made possible by use of a special Super Beta processing technology. This series of amplifiers is particularly useful for applications where high-accuracy and low-drift performance are essential. In addition high-speed performance may be improved by employing feed-forward compensation techniques to maximize slew rate without compromising other performance criteria.

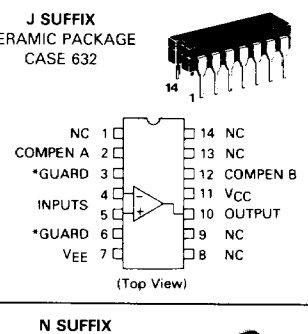
The LM108A/LM208A/LM308A Series offers extremely low input offset voltage and drift specifications allowing usage in even the most critical applications without external offset nulling.

- Operation From a Wide Range of Power Supply Voltages
- Low Input Bias and Offset Currents
- Low Input Offset Voltage and Guaranteed Offset Voltage Drift Performance
- High Input Impedance

H SUFFIX
METAL PACKAGE
CASE 601

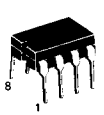


J SUFFIX
CERAMIC PACKAGE
CASE 632

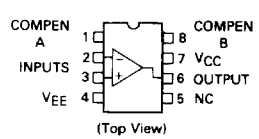


N SUFFIX
PLASTIC PACKAGE
CASE 626
(LM208, LM208A)
(LM308, LM308A Only)

J-8 SUFFIX
CERAMIC PACKAGE
CASE 693



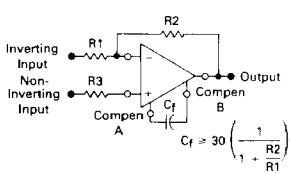
D SUFFIX
PLASTIC PACKAGE
CASE 751
(SO-8)



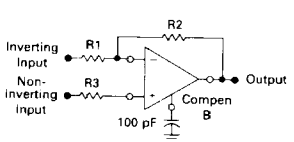
*Unused pin (no internal connection) to allow for input anti-leakage guard ring on printed circuit board layout.

FREQUENCY COMPENSATION

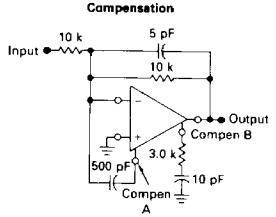
Standard Compensation



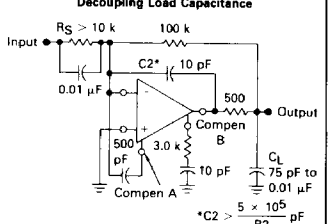
Modified Compensation



Standard Feedforward Compensation



Feedforward Compensations for Decoupling Load Capacitance



ORDERING INFORMATION

Device	Temperature Range	Package
LM108AH, H LM108AJ, J, AJ-8, J-8	−55 to +125°C	Metal Can Ceramic DIP
LM208AH, H LM208AJ, J, AJ-8, J-8 LM208AN, N LM208AD, D	−25 to +85°C	Metal Can Ceramic DIP Plastic DIP SO-8
LM308H, H LM308AJ, J, AJ-8, J-8 LM308AN, N LM308AD, D	0 to +70°C	Metal Can Ceramic DIP Plastic DIP SO-8

MAXIMUM RATINGS (T_A = +25°C unless otherwise noted.)

Rating	Symbol	Value			Unit
		LM108, LM108A	LM208, LM208A	LM308, LM308A	
Power Supply Voltage	V_{CC}, V_{EE}	±20	±20	±18	Vdc
Input Voltage (See Note 1)	V_I	±15			Volts
Input Differential Current (See Note 2)	I_{ID}	±10			mA
Output Short-Circuit Duration	t_S	Indefinite			
Operating Ambient Temperature Range	T_A	−55 to +125	−25 to +85	0 to +70	°C
Storage Temperature Range	T_{stg}	−65 to +150			°C
Junction Temperature Metal, Ceramic Package Plastic Package	T_J	 +175 +150			°C

Note 1. For supply voltages less than ±15 V, the maximum input voltage is equal to the supply voltage.

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 1.0 V is applied between the inputs unless some limiting resistance is used.

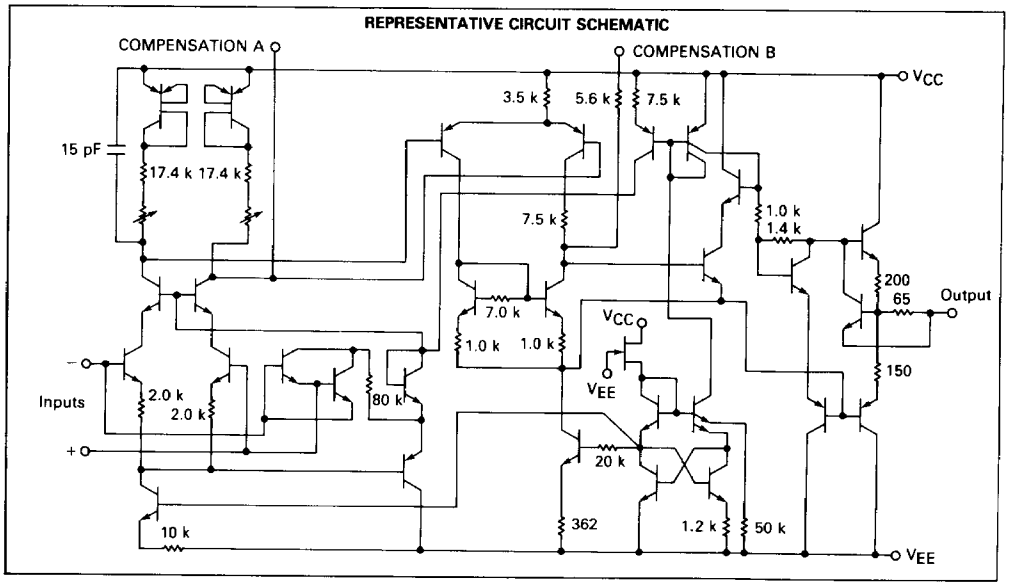
ELECTRICAL CHARACTERISTICS (Unless otherwise noted these specifications apply for supply voltages of +5.0 V ≤ V_{CC} ≤ +20 V and −5.0 V ≥ V_{EE} ≥ −20 V, T_A = +25°C.)

Characteristic	Symbol	LM108A LM208A			LM108 LM208			Unit
		Min	Typ	Max	Min	Typ	Max	
Input Offset Voltage	V_{IO}	—	0.3	0.5	—	0.7	2.0	mV
Input Offset Current	I_{IO}	—	0.05	0.2	—	0.005	0.2	nA
Input Bias Current	I_{IB}	—	0.8	2.0	—	0.8	2.0	nA
Input Resistance	r_i	30	70	—	30	70	—	Megohms
Power Supply Currents V_{CC} = +20 V, V_{EE} = −20 V	I_{CC},I_{EE}	—	±0.3	±0.6	—	±0.3	±0.6	mA
Large Signal Voltage Gain V_{CC} = $\|V_{EE}\|$ = +15 V, V_O = ±10 V, R_L ≥ 10 kΩ	A_{VOL}	80	300	—	50	300	—	V/mV
The following specifications apply over the operating temperature range.								
Input Offset Voltage	V_{IO}	—	—	1.0	—	—	3.0	mV
Input Offset Current	I_{IO}	—	—	0.4	—	—	0.4	nA
Average Temperature Coefficient of Input Offset Voltage T_A(min)≤T_A≤T_A(max)	$\Delta V_{IO}/\Delta T$	—	1.0	5.0	—	3.0	15	μV/°C
Average Temperature Coefficient of Input Offset Current	$\Delta I_{IO}/\Delta T$	—	0.5	2.5	—	0.5	2.5	pA/°C
Input Bias Current	I_{IB}	—	—	3.0	—	—	3.0	nA
Large Signal Voltage Gain V_{CC} = $\|V_{EE}\|$ = +15 V, V_O = ±10 V, R_L = 10 kΩ	A_{VOL}	40	—	—	25	—	—	V/mV
Input Voltage Range V_{CC} = $\|V_{EE}\|$ = +15 V	V_{IR}	±13.5	—	—	±13.5	—	—	V
Common-Mode Rejection Ratio	CMRR	96	110	—	85	100	—	dB
Power Supply Voltage Rejection Ratio	PSRR	96	100	—	80	96	—	dB
Output Voltage Range V_{CC} = $\|V_{EE}\|$ = +15 V, R_L = 10 kΩ	V_{OR}	±13	±14	—	±13	±14	—	V
Supply Current (T_A = T_A[max])	I_{CC},I_{EE}	—	±0.15	±0.4	—	±0.15	±0.4	mA

ELECTRICAL CHARACTERISTICS (Unless otherwise noted these specifications apply for supply voltages of $+5.0\ V \leq V_{CC} \leq +15\ V$ and $-5.0V \geq V_{EE} \geq -15\ V$, $T_A = +25°C$.)

Characteristic	Symbol	LM308A			LM308			Unit
		Min	Typ	Max	Min	Typ	Max	
Input Offset Voltage	V_{IO}	—	0.3	0.5	—	2.0	7.5	mV
Input Offset Current	I_{IO}	—	0.2	1.0	—	0.2	1.0	nA
Input Bias Current	I_{IB}	—	1.5	7.0	—	1.5	7.0	nA
Input Resistance	r_i	10	40	—	10	40	—	Megohms
Power Supply Currents $V_{CC} = +15\ V, V_{EE} = -15\ V$	I_{CC}/I_{EE}	—	±0.3	±0.8	—	±0.3	±0.8	mA
Large Signal Voltage Gain $V_{CC} = +15\ V, V_{EE} = -15\ V, V_O = ±10\ V, R_L \geq 10\ k\Omega$	A_{VOL}	80	300	—	25	300	—	V/mV
The following specifications apply over the operating temperature range.								
Input Offset Voltage	V_{IO}	—	—	0.73	—	—	10	mV
Input Offset Current	I_{IO}	—	—	1.5	—	—	1.5	nA
Average Temperature Coefficient of Input Offset Voltage $T_A(min) \leq T_A \leq T_A(max)$	$\Delta V_{IO}/\Delta T$	—	1.0	5.0	—	6.0	30	µV/°C
Average Temperature Coefficient of Input Offset Current	$\Delta I_{IO}/\Delta T$	—	2.0	10	—	2.0	10	pA/°C
Input Bias Current	I_{IB}	—	—	10	—	—	10	nA
Large Signal Voltage Gain $V_{CC} + 15\ V, V_{EE} = -15\ V, V_O = ±10\ V, R_L \geq 10\ k\Omega$	A_{VOL}	60	—	—	15	—	—	V/mV
Input Voltage Range $V_{CC} = +15\ V, V_{EE} = -15\ V$	V_{IR}	±14	—	—	±14	—	—	V
Common-Mode Rejection Ratio $R_S \leq 50\ k\Omega$	CMRR	96	110	—	80	100	—	dB
Supply Voltage Rejection Ratio $R_S \leq 50\ k\Omega$	PSRR	96	110	—	80	96	—	dB
Output Voltage Range $V_{CC} = +15\ V, V_{EE} = -15\ V, R_L = 10\ k\Omega$	V_{OR}	±13	±14	—	±13	±14	—	V

REPRESENTATIVE CIRCUIT SCHEMATIC



TYPICAL CHARACTERISTICS

FIGURE 1 – INPUT BIAS AND INPUT OFFSET CURRENTS

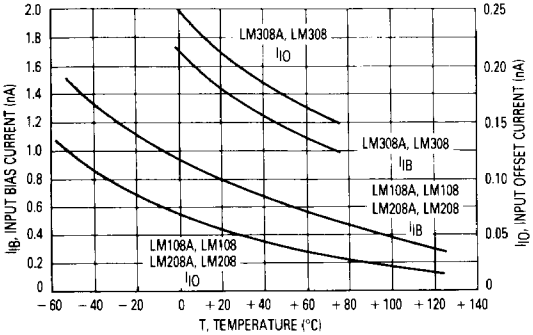


FIGURE 2 – MAXIMUM EQUIVALENT INPUT OFFSET VOLTAGE ERROR versus INPUT RESISTANCE

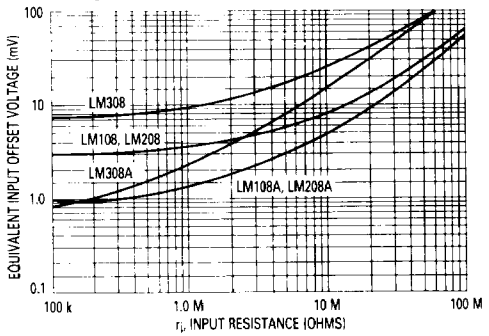


FIGURE 3 – VOLTAGE GAIN versus SUPPLY VOLTAGES

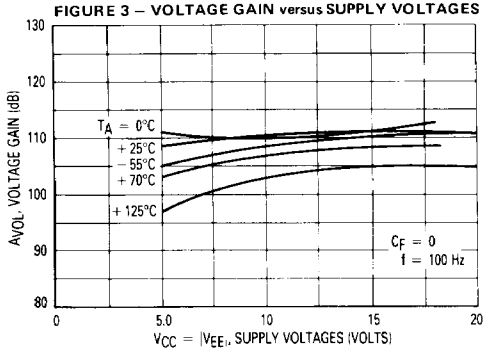


FIGURE 4 – POWER SUPPLY CURRENTS versus POWER SUPPLY VOLTAGE

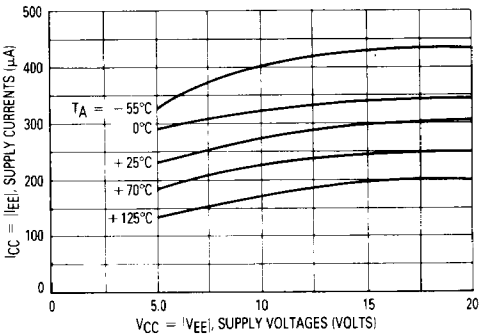


FIGURE 5 – OPEN-LOOP FREQUENCY RESPONSE

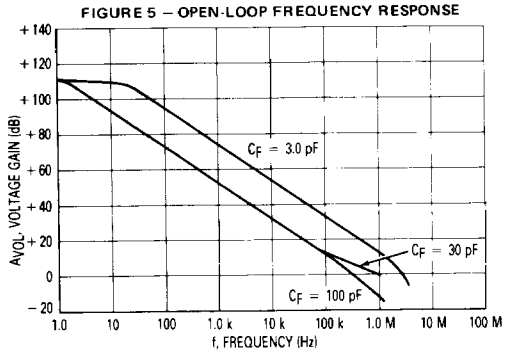
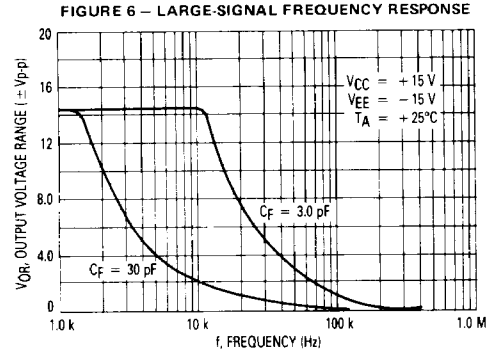


FIGURE 6 – LARGE-SIGNAL FREQUENCY RESPONSE



LM140A/340A — 5.0

ELECTRICAL CHARACTERISTICS (V_{in} = 10 V, I_O = 1.0 A, T_J = T_{low} to T_{high} (Note 1), unless otherwise noted).

Characteristic	Symbol	Min	Typ	Max	Unit
Output Voltage (T_J = +25°C) I_O = 5.0 mA to 1.0 A	V_O	4.9	5.0	5.1	Vdc
Line Regulation (Note 2) 7.5 to 20 Vdc, I_O = 500 mA 7.3 to 20 Vdc (T_J = +25°C) 8.0 to 12 Vdc 8.0 to 12 Vdc (T_J = +25°C)	Reg_{line}	 — — — —	 — 3.0 — —	 10 10 12 4.0	mV
Load Regulation (Note 2) 5.0 mA ≤ I_O ≤ 1.0 A 5.0 mA ≤ I_O ≤ 1.5 A (T_J = +25°C) 250 mA ≤ I_O ≤ 750 mA (T_J = +25°C)	Reg_{load}	 — — —	 — — —	 25 25 15	mV
Output Voltage 7.5 ≤ V_{in} ≤ 20 Vdc, 5.0 mA ≤ I_O ≤ 1.0 A, P_D ≤ 15 W	V_O	4.8	—	5.2	Vdc
Quiescent Current (T_J = +25°C)	I_B	— —	— 3.5	6.5 6.0	mA
Quiescent Current Change 5.0 mA ≤ I_O ≤ 1.0 A, V_{in} = 10 V 8.0 ≤ V_{in} ≤ 25 Vdc, I_O = 500 mA 7.5 ≤ V_{in} ≤ 20 Vdc, I_O = 1.0 A (T_J = +25°C)	ΔI_B	 — — —	 — — —	 0.5 0.8 0.8	mA
Ripple Rejection 8.0 ≤ V_{in} ≤ 18 Vdc, f = 120 Hz I_O = 500 mA I_O = 1.0 A (T_J = +25°C)	RR	 68 68	 — 80	 — —	dB
Dropout Voltage	$V_{in} - V_O$	—	1.7	—	Vdc
Output Resistance (f = 1.0 kHz)	r_O	—	2.0	—	mΩ
Short-Circuit Current Limit (T_J = +25°C)	I_{sc}	—	2.0	—	mA
Output Noise Voltage (T_A = +25°C) 10 Hz ≤ f ≤ 100 kHz	V_n	—	40	—	μV
Average Temperature Coefficient of Output Voltage I_O = 5.0 mA	TCV_O	—	±0.6	—	mV/°C
Peak Output Current (T_J = +25°C)	I_O	—	2.4	—	A
Input Voltage to Maintain Line Regulation (T_J = +25°C)		7.3	—	—	Vdc

NOTES:

1. T_{low} = −55°C for LM140A T_{high} = +150°C for LM140A
   = 0°C for LM340A = +125°C for LM340A
2. Load and line regulation are specified at constant junction temperature. Changes in V_O due to heating effects must be taken into account separately. Pulse testing with low duty cycle is used.