LM108/A/208/A/308/A-F,N,N-14,T
LH2108/A/2208/A/2308/A-F,N,N-14,T

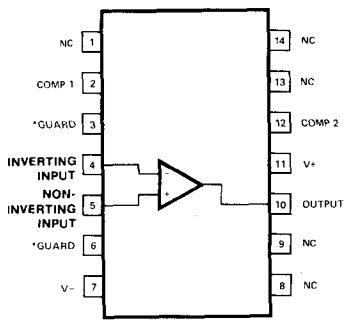
DESCRIPTION

The LM108/108A series are precision operational amplifiers having specifications a factor of ten better than FET amplifiers over their operating temperature range. In addition to low input currents, these devices have extremely low offset voltage, making it possible in most cases, to eliminate offset adjustments.

The LH2108 series are hybrids featuring two LM108A type dice in the same hermetic package. The electrical parameters are the same as the single amplifier.

PIN CONFIGURATIONS

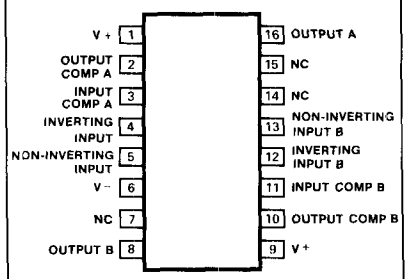
F PACKAGE



ORDER PART NO.
LM108AF, LM208AF, LM308AF
LM108F, LM208F, LM308F

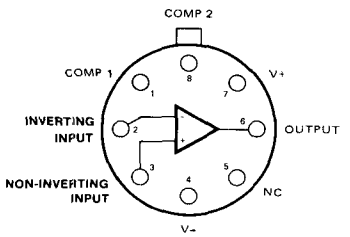
*Unused pin (no internal connection) to allow for input anti-leakage.

F PACKAGE



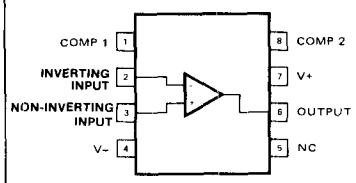
ORDER PART NO.
LH2108F LH2108AF
LH2208F LH2208AF
LH2308F LH2308AF

T PACKAGE



ORDER PART NO.
LM108AT, LM208AT, LM308AT,
LM108T, LM208T, LM308T

N PACKAGE

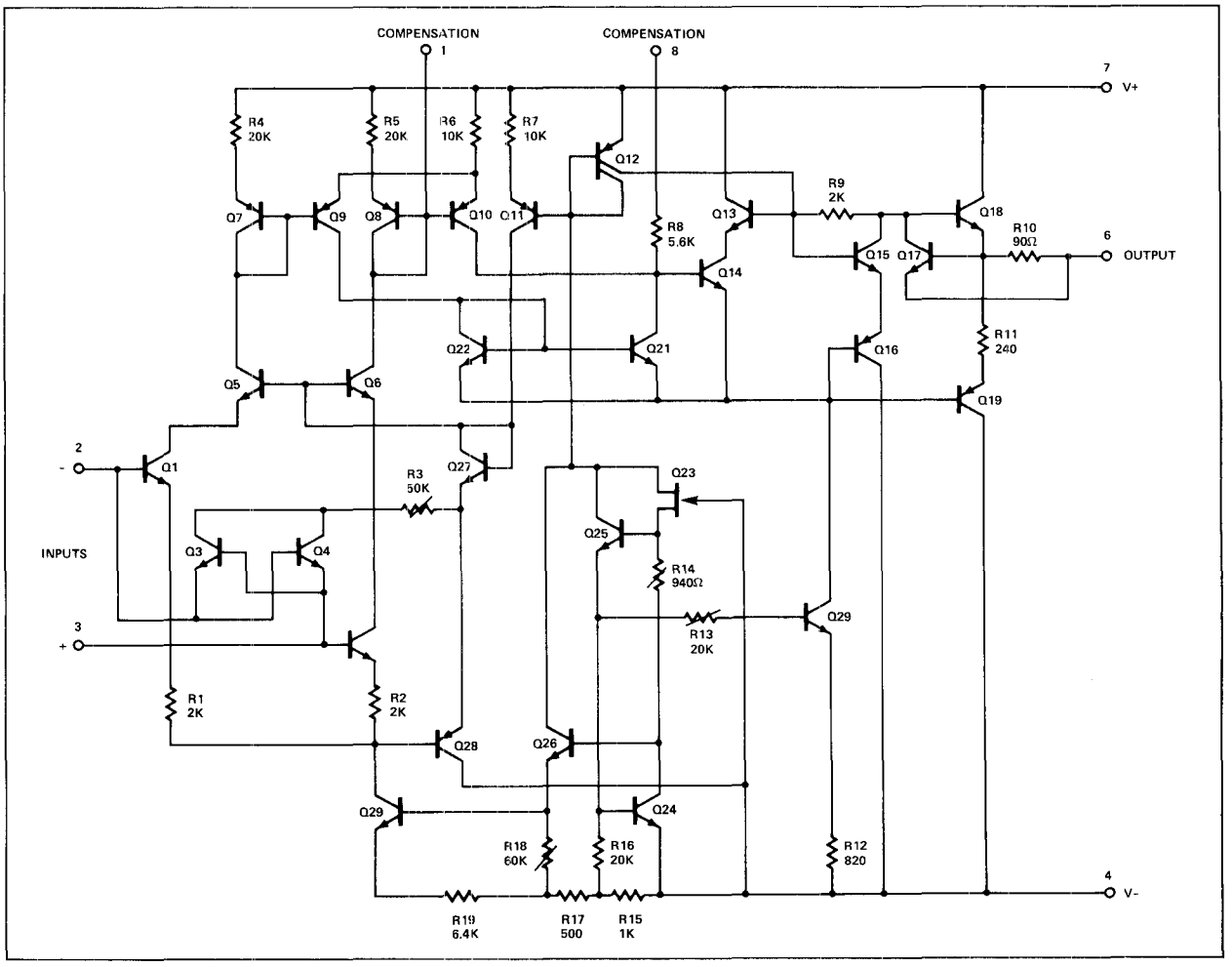


ORDER PART NO.
LM308AN, LM108N, LM208N, LM308N

FEATURES	LM108/208	LM308	LM108A/208A/308A
Maximum input bias current	3.0nA over temp.	7.0nA	3.0nA over temp.
Offset current	Less than 400pA over temp.	Less than 1.0nA	Less than 400pA over temp.
Supply current (even in saturation)	300μA	300μA	300μA
Guaranteed drift characteristics			5μV/°C
Offset voltage guaranteed Low current error LM108, 208, 308, 108A Mil std 883A, B,C available LM108A Mil std M38510 (JAN) planned LH2108A series—military qualification pending			Less than 0.5mV

LM108/A/208/A/308/A-F,N,N-14,T
LH2108/A/2208/A/2308/A-F,N,N-14,T

EQUIVALENT SCHEMATIC



ABSOLUTE MAXIMUM RATINGS

PARAMETER	RATING		UNIT
	LH2108/LH2208 LH2108A/LH2208A LM108A/208A/ 108/208	LM308A/308 LH2308A/LH2308	
Supply voltage	±20	±18	V
Power dissipation[1,4]	500	500	mW
Differential input current[2]	±10	±10	mA
Input voltage[3]	±15	±15	V
Output short-circuit duration	Continuous	Continuous	
Operating temperature range			
LM108, LH2108	-55 to +125	0 to +70	°C
LM208, LH2208	-25 to -85		°C
Storage temperature range	-65 to +150	-65 to +150	°C
Lead temperature (soldering 10sec)	+300	+300	°C

LM108/A/208/A/308/A-F,N,N-14,T
LH2108/A/2208/A/2308/A-F,N,N-14,T

NOTES

1. The maximum junction temperature of the LM108/108A is 150°C, while that of the LM208/208A is 100°C. For operating at elevated temperatures, devices in the TO-5 package must be derated based on a thermal resistance of 150°C/W, junction to ambient, or 45°C/W, junction to case. The thermal resistance of the dual-in-line package is 100°C/W, junction to ambient.
2. 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 1V is applied between the inputs unless some limiting resistance is used.
3. For supply voltages less than ±15V, the absolute maximum input voltage is equal to the supply voltage.
4. The maximum junction temperature of the LM308 is 85°C. For operation at elevated temperatures, devices in the TO-5 package must be derated based on a thermal resistance of 150°C/W, junction to ambient, or 45°C/W, junction to case. The thermal resistance of the dual-in-line package is 100°C/W, junction to ambient.

DC ELECTRICAL CHARACTERISTICS

$T_A = 25°C$, $\pm5V \le V_S \le \pm20V$ unless otherwise specified.[1,2]

PARAMETER		TEST CONDITIONS	LM108/LH2108			LM208/LH2208			UNIT
			Min	Typ	Max	Min	Typ	Max	
V_{OS}	Offset voltage	$R_S \le 10k\Omega$ $R_S \le 10k\Omega$, over temp.		.7	2.0 3.0		0.7	2.0 3.0	mV mV
V_{OS}	Drift	$R_S = 0\Omega$, over temp.		3.0	15		3.0	15	μV/°C
I_{OS}	Offset current	 Over temp.		0.05	0.2 0.4		0.05	0.2 0.4	nA nA
I_{OS}	Drift	Over temp.		0.5	2.5		0.5	2.5	pA/°C
I_{BIAS}	Input current	 Over temp.		0.8	2.0 3.0		0.8	2.0 3.0	nA nA
V_{CM}	Common mode voltage range	Over temp.	±13.5			±13.5			V
CMRR	Common mode rejection ratio	$R_S \le 10k\Omega$, over temp. $R_S \le 10k\Omega$, $-25 \le T_A \le 85°C$	85	100		 85	 100		dB dB
R_{IN}	Input resistance		30	70		30	70		MΩ
V_{OUT}	Output voltage swing	$R_L = 10k\Omega$, over temp.	±13	±14		±13	±14		V
I_{CC}	Supply current	 $T_A = +125°C$		0.3 0.15		0.6 0.4	0.3 0.15	0.6 0.4	mA mA
P_{SRR}	Supply voltage rejection ratio	$R_S \le 10k\Omega$, over temp. $\pm5V \le V_S \le \pm15V$, over temp.	80	96		80	96		dB
	Average temperature Coefficient of input Offset voltage[2]	$\pm5V \le V_S \le \pm15V$, over temp.		3.0	15		3.0	15	μV/°C
	Coefficient of input Offset current	Over temp. $\pm5V \le V_S \le \pm15V$		0.5	2.5		0.5	2.5	pA/°C

NOTES

1. The maximum junction temperature of the LM1XX is 150°C, while that of the LM2XX is 200°C. For operating at elevated temperatures, devices must be derated based on the thermal resistance of the package as given in the package information section.
2. The LM108A has a guaranteed offset voltage less than 0.5mV at 25°C and 1.0mV for -55°C ≤ 125°C and $V_S = \pm15V$. The average temperature coefficient of input offset voltage is guaranteed to be less than 5μV/°C for these same conditions.

LM108/A/208/A/308/A-F,N,N-14,T
LH2108/A/2208/A/2308/A-F,N,N-14,T

DC ELECTRICAL CHARACTERISTICS (Cont'd) $T_A = 25°C$, $\pm5V \le V_S \le \pm20V$ unless otherwise specified.[1,2]

PARAMETER		TEST CONDITIONS	LM308/LH2308			LM108A/LH2108A			UNIT
			Min	Typ	Max	Min	Typ	Max	
V_{OS}	Offset voltage	$R_S \le 10k\Omega$					0.3	0.5	mV
		$R_S \le 10k\Omega$, over temp.						1.0	mV
		$R_S \le 10k\Omega$, $\pm5V \le V_S \le \pm15V$		2.0	7.5				mV
		$R_S \le 10k\Omega$, $\pm5V \le V_S \le \pm15V$, over temp.			10				mV
V_{OS}	Drift	$R_S = 0\Omega$, over temp.					1.0	5.0	μV/°C
		$R_S = 0\Omega$, $\pm5V \le V_S \le \pm15V$, over temp.			10				μV/°C
I_{OS}	Offset current						0.05	0.2	nA
		Over temp.						0.4	nA
		$\pm5V \le V_S \le \pm15V$		0.2	1				nA
		$\pm5V \le V_S \le \pm15V$, over temp.			1.5				nA
I_{OS}	Drift	Over temp.					0.5	2.5	pA/°C
		$\pm5V \le V_S \le \pm15V$, over temp.		2.0	10				pA/°C
I_{BIAS}	Input current						0.8	2.0	nA
		Over temp.						3.0	nA
		$\pm5V \le V_S \le \pm15V$		1.5	7.0				nA
		$V_S = \pm15V$, over temp.			10				nA
V_{CM}	Common mode voltage range	Over temp.				±13.5			V
		$\pm5V \le V_S \le \pm15V$, over temp.	±14V						V
CMRR	Common mode rejection ratio	$R_S \le 10k\Omega$, over temp.				96	110		dB
		$R_S \le 10k\Omega$, $\pm5V \le V_S \le \pm15V$, over temp.	80	100					dB
R_{IN}	Input resistance		10	40		30	70		MΩ
V_{OUT}	Output voltage swing	$R_L = 10k\Omega$, over temp.				±13	±14		V
		$\pm5V \le V_S \le \pm15V$, over temp.	±13	±14					V
I_{CC}	Supply current						0.3	0.6	mA
		$T_A = +125°C$					0.15	0.4	mA
		$V_S = \pm15V$		0.3	0.8				mA
P_D	Power consumption	$\pm5V \le V_S \le \pm15V$		9.0	24				mW
P_{SRR}	Supply voltage rejection ratio	$R_S \le 10k\Omega$, over temp.				96	110		dB
		$\pm5V \le V_S \le \pm15V$, over temp.	80	96					dB
	Average temperature	$\pm5V \le V_S \le \pm15V$, over temp.					1.0	5.0	μV/°C
	Coefficient of input			6.0	30				μV/°C
	Offset voltage[2]								μV/°C
	Coefficient of input	Over temp.					0.5	2.5	pA/°C
	Offset current	$\pm5V \le V_S \le \pm15V$		2.0	10				pA/°C

NOTES

1. The maximum junction temperature of the LM1XX is 150°C, while that of the LM2XX is 200°C. For operating at elevated temperatures, devices must be derated based on the thermal resistance of the package as given in the package information section.
2. The LM108A has a guaranteed offset voltage less than 0.5mV at 25°C and 1.0mV for -55°C ≤ 125°C and $V_S = \pm15V$. The average temperature coefficient of input offset voltage is guaranteed to be less than 5μV/°C for these same conditions.

DC ELECTRICAL CHARACTERISTICS (Cont'd) $T_A = 25°C$, $\pm5V \le V_S \le \pm20V$ unless otherwise specified.[1,2]

PARAMETER		TEST CONDITIONS	LM208A/LH2208A			LM308A/LH2308A			UNIT
			Min	Typ	Max	Min	Typ	Max	
V_{OS}	Offset voltage	$R_S \le 10k\Omega$ $R_S \le 10k\Omega$, over temp.		0.3	0.5 1.0		0.3	0.5 .75	mV mV
V_{OS}	Drift	$R_S = 0\Omega$, over temp.		1.0	5.0		1.0	5.0	μV/°C
I_{OS}	Offset current	 Over temp.		0.05	0.2 0.4			1 1.5	nA nA
I_{OS}	Drift	Over temp.		0.5	2.5		2.0	10	pA/°C
I_{BIAS}	Input current	 Over temp.		0.8	2.0 3.0		1.5	7.0 10	nA nA
V_{CM}	Common mode voltage range	Over temp. $\pm5V \le V_S \le \pm15V$, over temp.	±13.5			 ±14			V V
CMRR	Common mode rejection ratio	$R_S \le 10k\Omega$, $-25 \le T_A \le 85°C$ $R_S \le 10k\Omega$, $\pm5V \le V_S \le \pm15V$, over temp.	96	110		 96	 110		dB dB
R_{IN}	Input resistance	 $R_S \le 10k\Omega$, $\pm5V \le V_S \le \pm15V$	30	70		 10	 40		MΩ MΩ
V_{OUT}	Output voltage swing	$R_L = 10k\Omega$, over temp. $\pm5V \le V_S \le \pm15V$, over temp.	±13	±14		 ±13	 ±14		V V
I_{CC}	Supply current	 $T_A = +125°C$ $V_S = \pm15V$		0.3 0.15	0.6 0.4		 0.3	 0.8	mA mA mA
P_D	Power consumption	$\pm5V \le V_S \le \pm15V$					9.0	24	mW
P_{SRR}	Supply voltage rejection ratio	$R_S \le 10k\Omega$, over temp. $\pm5V \le V_S \le \pm15V$, over temp.	96	110		 96	 110		dB dB
	Average temperature Coefficient of input Offset voltage[2] Coefficient of input Offset current	$\pm5V \le V_S \le \pm15V$, over temp. Over temp. $\pm5V \le V_S \le \pm15V$		1.0 0.5	5.0 2.5		 1.0 2.0	 5.0 10	μV/°C μV/°C pA/°C pA/°C

NOTES

1. The maximum junction temperature of the LM1XX is 150°C, while that of the LM2XX is 200°C. For operating at elevated temperatures, devices must be derated based on the thermal resistance of the package as given in the package information section.
2. The LM108A has a guaranteed offset voltage less than 0.5mV at 25°C and 1.0mV for -55°C ≤ 125°C and $V_S = \pm15V$. The average temperature coefficient of input offset voltage is guaranteed to be less than 5μV/°C for these same conditions.

LM108/A/208/A/308/A-F,N,N-14,T
LH2108/A/2208/A/2308/A-F,N,N-14,T

AC ELECTRICAL CHARACTERISTICS $T_A = 25°C$, $\pm5V \leq V_S \leq \pm20V$ unless otherwise specified.

PARAMETER	TEST CONDITIONS	LM108/LH2108			LM208/LH2208			LM308/LH2308			UNIT
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
A_{VOL} Large signal voltage gain[1]	$R_L \geq 10k\Omega$	50	300		50	300					V/mV
	Over temp.	25			25						V/mV
	$V_S = 15V$, $V_{OUT} = \pm10V$, $R_L \geq 10k$							25	300		V/mV
	Over temp.							15			V/mV

NOTE

1. The maximum junction temperature of the LM1XX is 150°C, while that of the LM2XX is 200°C. For operating at elevated temperatures, devices must be derated based on the thermal resistance of the package as given in the package information section.

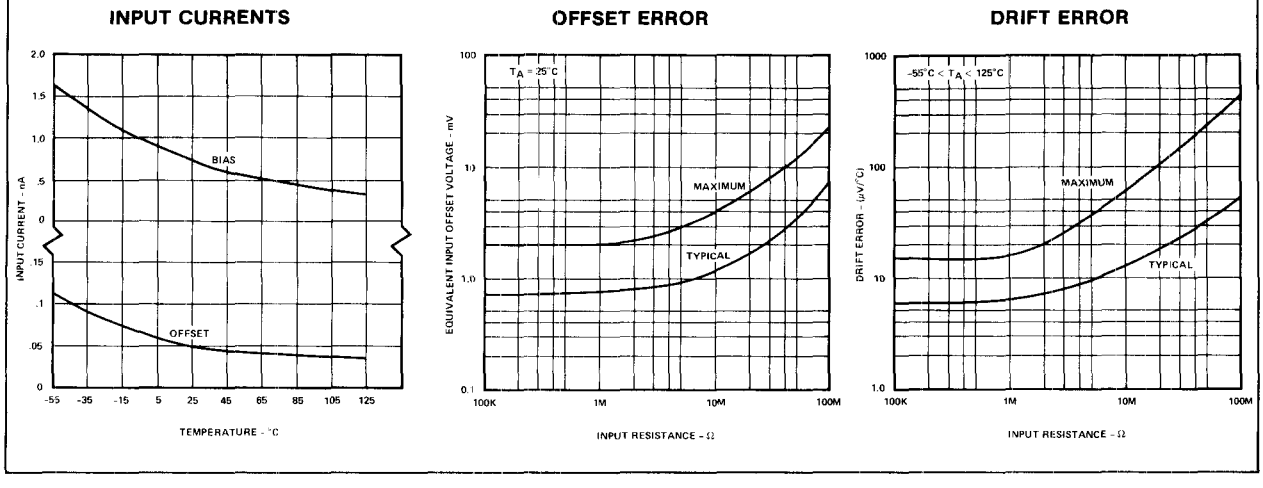
AC ELECTRICAL CHARACTERISTICS (Cont'd) $T_A = 25°C$, $\pm5V \leq V_S \leq \pm20V$ unless otherwise specified.

PARAMETER	TEST CONDITIONS	LM108A/LH2108A			LM208A/LH2208A			LM308A/LH2308A			UNIT
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
A_{VOL} Large signal voltage gain[1]	$R_L \geq 10k\Omega$	80	300		80	300					V/mV
	Over temp.	40			40						V/mV
	$V_S = 15V$, $V_{OUT} = \pm10V$, $R_L \geq 10k$							80	300		V/mV
	Over temp.							60			V/mV

NOTE

1. The maximum junction temperature of the LM1XX is 150°C, while that of the LM2XX is 200°C. For operating at elevated temperatures, devices must be derated based on the thermal resistance of the package as given in the package information section.

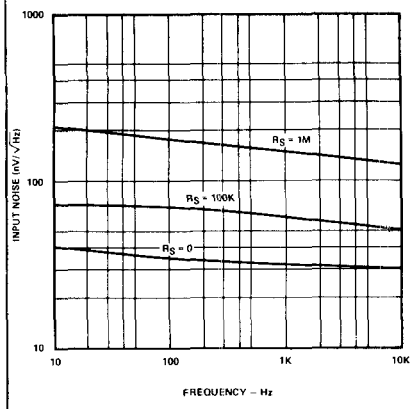
TYPICAL PERFORMANCE CHARACTERISTICS LM108/208



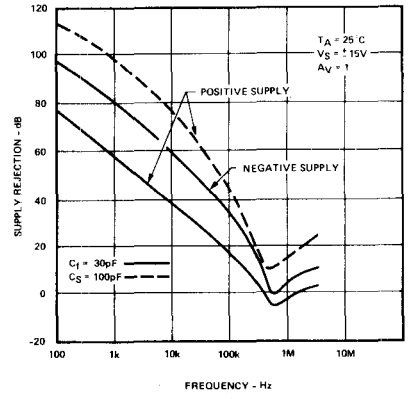
LM108/A/208/A/308/A-F,N,N-14,T
LH2108/A/2208/A/2308/A-F,N,N-14,T

TYPICAL PERFORMANCE CHARACTERISTICS LM108/208 (Cont'd)

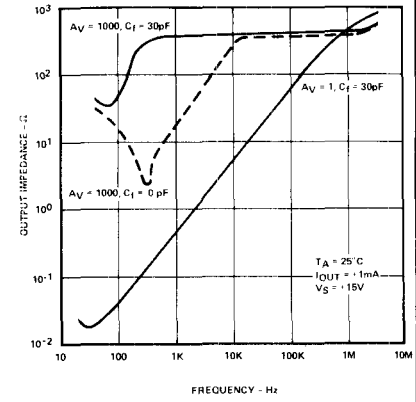
INPUT NOISE VOLTAGE



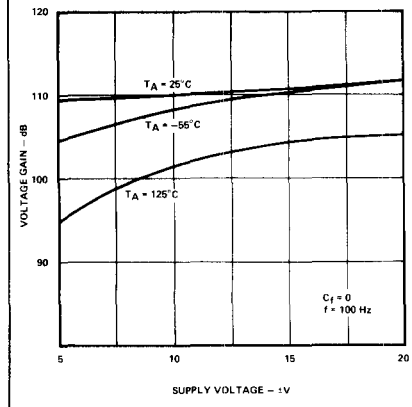
POWER SUPPLY REJECTION



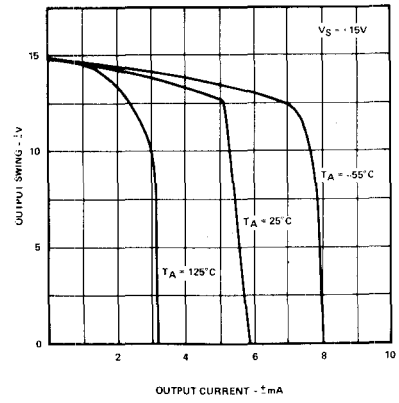
CLOSED LOOP OUTPUT IMPEDANCE



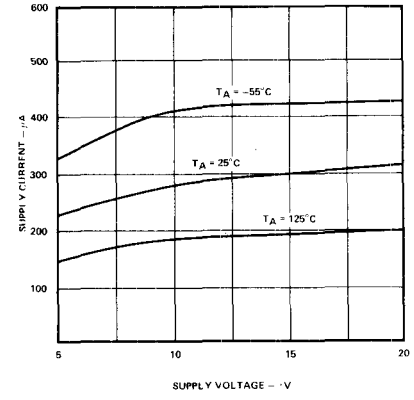
VOLTAGE GAIN



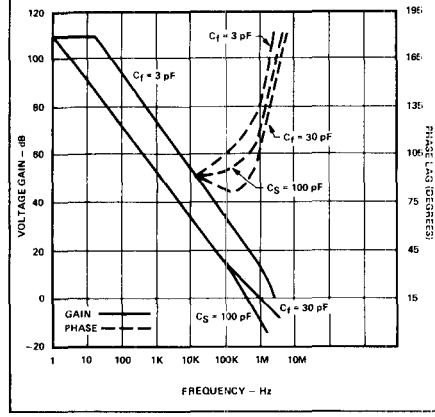
OUTPUT SWING



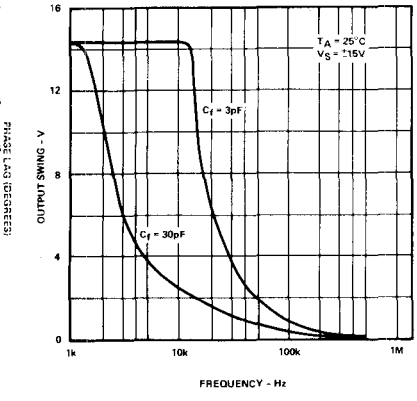
SUPPLY CURRENT



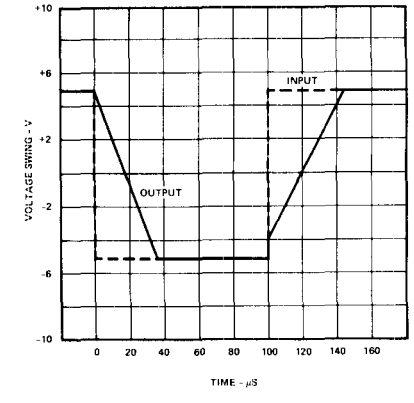
OPEN LOOP FREQUENCY RESPONSE



LARGE SIGNAL FREQUENCY RESPONSE



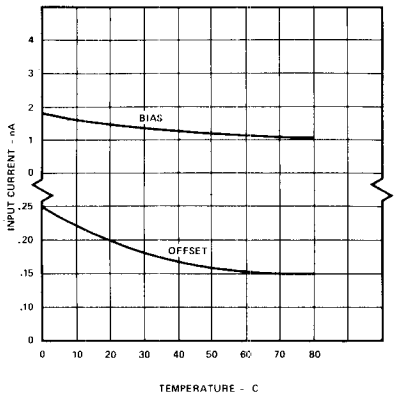
VOLTAGE FOLLOWER PULSE RESPONSE



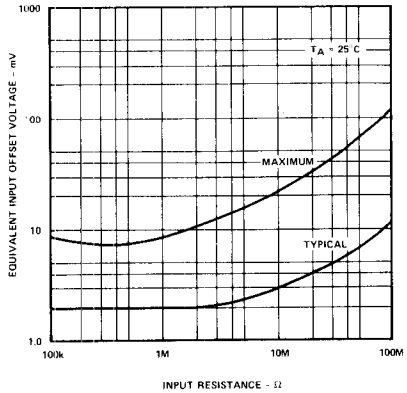
LM108/A/208/A/308/A-F,N,N-14,T
LH2108/A/2208/A/2308/A-F,N,N-14,T

TYPICAL PERFORMANCE CHARACTERISTICS LM308

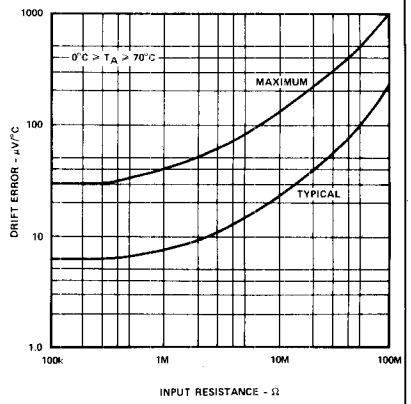
INPUT CURRENTS



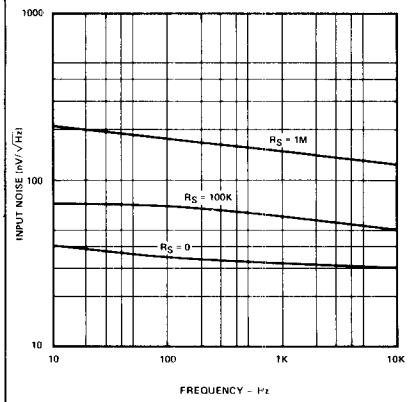
OFFSET ERROR



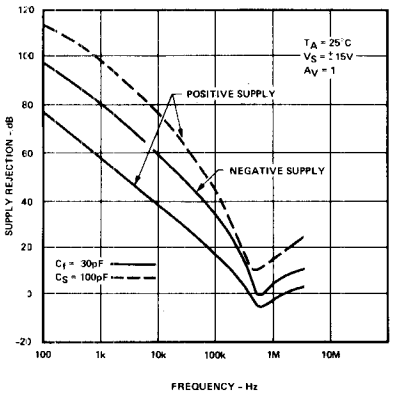
DRIFT ERROR



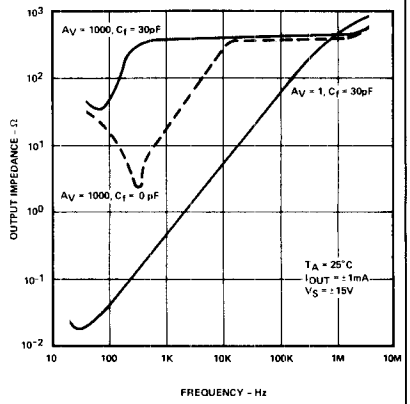
INPUT NOISE VOLTAGE



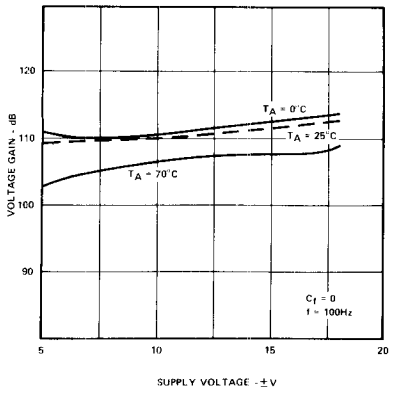
POWER SUPPLY REJECTION



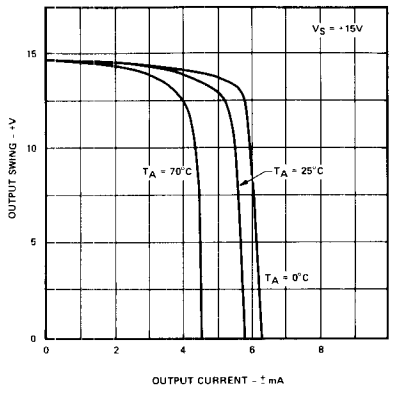
CLOSED LOOP OUTPUT IMPEDANCE



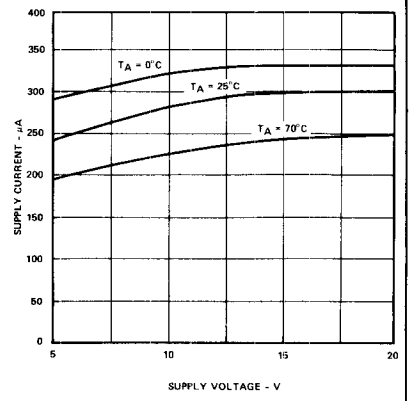
VOLTAGE GAIN



OUTPUT SWING



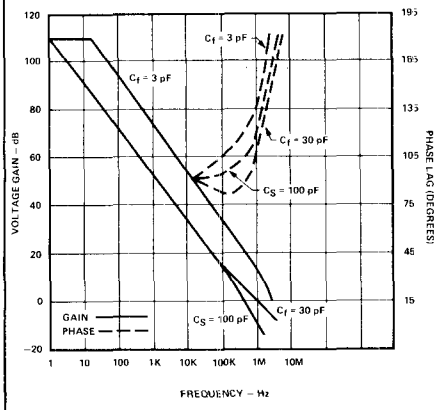
SUPPLY CURRENT



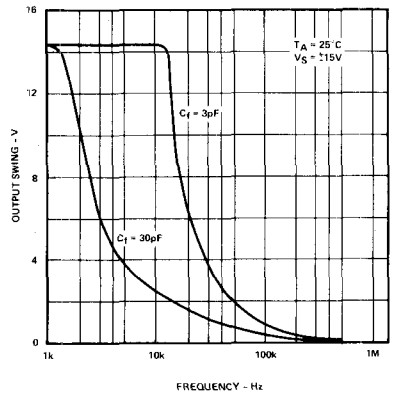
LM108/A/208/A/308/A-F,N,N-14,T
LH2108/A/2208/A/2308/A-F,N,N-14,T

TYPICAL PERFORMANCE CHARACTERISTICS LM308 (Cont'd)

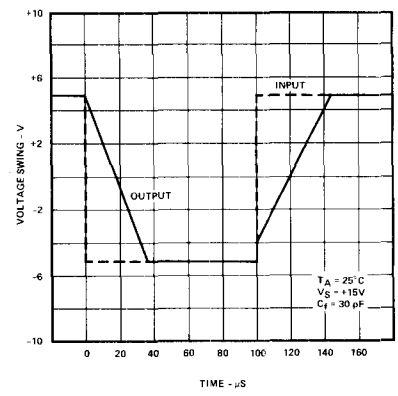
OPEN LOOP FREQUENCY RESPONSE



LARGE SIGNAL FREQUENCY RESPONSE

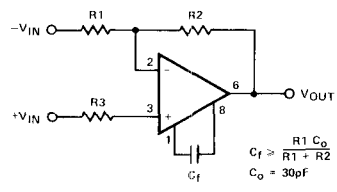


VOLTAGE FOLLOWER PULSE RESPONSE

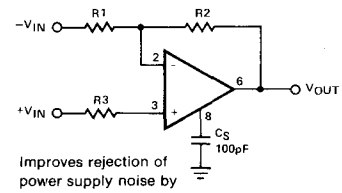


TEST LOAD CIRCUITS

STANDARD COMPENSATION CIRCUIT



ALTERNATE FREQUENCY COMPENSATION



Improves rejection of power supply noise by a factor of ten.