HARRIS SEMICONDUCTOR PRODUCTS DIVISION
A DIVISION OF HARRIS CORPORATION

HA-909/911

Wideband, Low Noise, Operational Amplifiers

2

FEATURES

- LOW BROADBAND NOISE — 1μV R.M.S.
- LOW NOISE VOLTAGE — $7nV/\sqrt{Hz}$
- LOW OFFSET VOLTAGE — 2mV
- WIDE BANDWIDTH — 7MHz
- POWER BANDWIDTH — 20kHz
- SUPPLY RANGE — ±5V TO ±20V
- INTERNALLY COMPENSATED

APPLICATIONS

- HIGH Q, WIDEBAND FILTERS
- AUDIO AMPLIFIERS
- SIGNAL GENERATORS

DESCRIPTION

HA-909 and HA-911 are monolithic ampliifers delivering very low noise and excellent bandwidth specifications without the need for external compensation. Additional features of these dielectrically isolated devices include low offset voltage, offset trim capabitlity (14-pin flat package only), and high output current drive capabitlity.

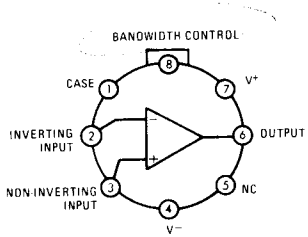
With 7MHz bandwidth and internal compensation these amplifiers are extremely useful in many active filter designs. In audio circuitry requiring quiet operation these devices offer 1 μ V typical broadband noise (10Hz to 1kHz) and 20kHz power bandwidth. 2mV typical offset voltage, offset trim capability, and 20mA output current drive capability (±10.0V swing) make these amplifiers useful in signal conditioning circuits.

HA-909 and HA-911 are available in metal can (TO-99) and 14-pin flat packages. HA-909 is specified over the -55°C to +125°C range. HA-911 is specified from 0°C to +75°C.

PINOUT

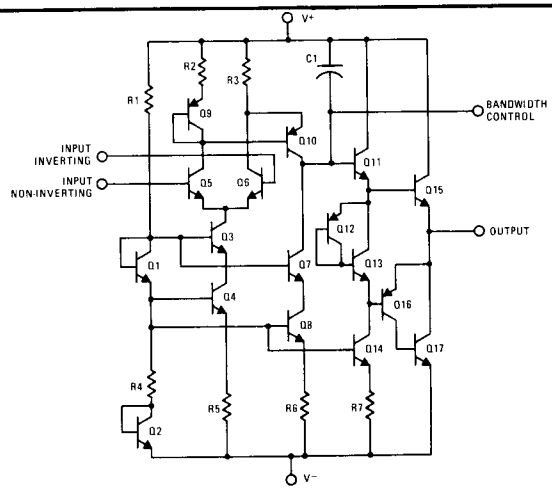
Package Code 2A

TO-99 TOP VIEW



CAUTION: These devices are sensitive to electrostatic discharge. Users should follow IC Handling Procedures specified on pg. 1-4.

SCHEMATIC



ABSOLUTE MAXIMUM RATINGS

Voltage Between V^+ and V^- Terminals	50.0V
Differential Input Voltage	±7.0V
Peak Output Current	±50mA
Internal Power Dissipation (Note 10)	300mW
Operating Temperature Range – HA-909	$-55^oC \leq T_A \leq +125^oC$
HA-911	$0^oC \leq T_A \leq +75^oC$
Storage Temperature Range	$-65^oC \leq T_A \leq +150^oC$

ELECTRICAL CHARACTERISTICS

TEST CONDITIONS: V_{Supply} = ±15.0V unless otherwise specified.

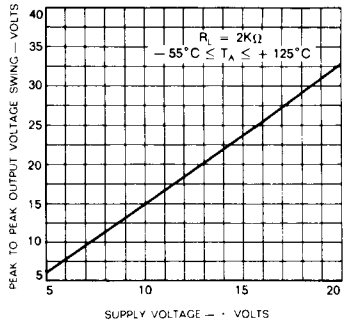
PARAMETER	TEMP.	HA-909 -55°C to +125°C MIN.	HA-909 TYP.	HA-909 MAX.	HA-911 0°C to +75°C MIN.	HA-911 TYP.	HA-911 MAX.	UNITS
INPUT CHARACTERISTICS								
* Offset Voltage	+25°C		2.0	5.0		2.0	6.0	mV
	Full			6.0			7.5	mV
Equivalent Input Noise (Note 9)	+25°C		1.0	5.0		1.0		μV
Input Noise Voltage	+25°C		7			7		$nV\cdot\sqrt{Hz}$
* Bias Current	+25°C		87	300		200	500	nA
	Full			750		300	750	nA
* Offset Current	+25°C		25	150		100	300	nA
	Full		50	300		150	450	nA
Offset Current Average Drift	Full		1.0			1.0		nA/°C
Input Resistance (Note 12)	+25°C	200	600		100	250		KΩ
	Full	100	300					KΩ
Common Mode Range	Full	+12.0			+12.0			V
TRANSFER CHARACTERISTICS								
* Large Signal Voltage Gain (Notes 1, 4)	+25°C	25K	45K		20K	45K		V/V
	Full	25K	45K		15K	45K		V/V
Full Power BW	+25°C		20			20		KHz
* Common Mode Rejection Ratio (Note 2)	Full	80	96		74	90		dB
Unity Gain Bandwidth (Note 3)	+25°C		7			7		MHz
OUTPUT CHARACTERISTICS								
Output Voltage Swing (Note 1)	Full	+12.0			+11.0			V
* Output Current (Note 4)	+25°C	+20			+15			mA
Output Resistance	+25°C		150			500		Ohms
TRANSIENT RESPONSE								
Rise Time (Notes 1, 5, 6, 8 & 11)	+25°C		40	75		40	75	ns
Overshoot (Notes 1, 5, 6, 8 & 11)	+25°C		15	40		15	40	%
* Slew Rate (Notes 1, 5 & 8)	+25°C	+3.5	+5.0			+5.0		V/μs
		-1.2	-2.0			-2.0		
POWER SUPPLY CHARACTERISTICS								
* Supply Current	+25°C		1.8	2.5		1.8	2.5	mA
* Power Supply Rejection Ratio (Note 7)	Full	80	92		74	90		dB

NOTES:
1. R_L = 2KΩ
2. V_{CM} = ±10V
3. V_O < 90mV
4. V_O = ±10.0V
5. C_L = 100pF
6. V_O = +200mV
7. ΔV_{Sup} = ±5V
8. See Transient Response test circuits and waveforms
9. 10 - 1000Hz, R_S = 10K
10. Derate by 6.6mW/°C above 105°C
11. Positive Transitions only.
12. This parameter based on design calculation.

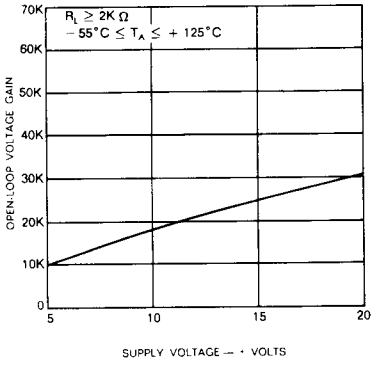
*100% Tested For DASH 8

GUARANTEED ELECTRICAL CHARACTERISTICS

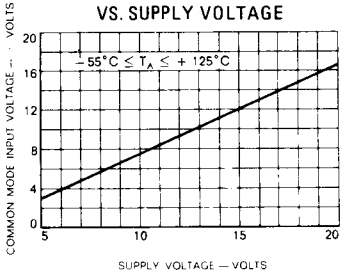
OUTPUT VOLTAGE SWING VS. SUPPLY VOLTAGE



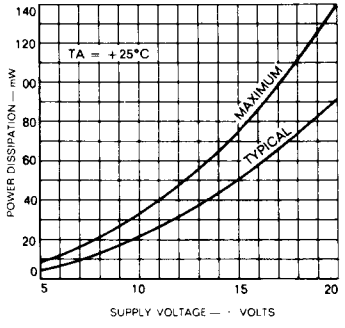
OPEN LOOP VOLTAGE GAIN VS. SUPPLY VOLTAGE



COMMON MODE INPUT VOLTAGE VS. SUPPLY VOLTAGE

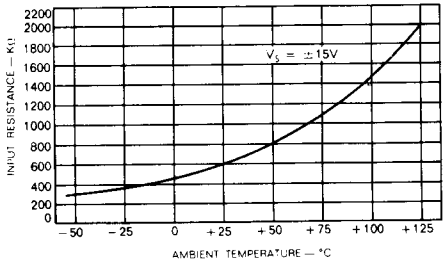


POWER DISSIPATION VS. SUPPLY VOLTAGE

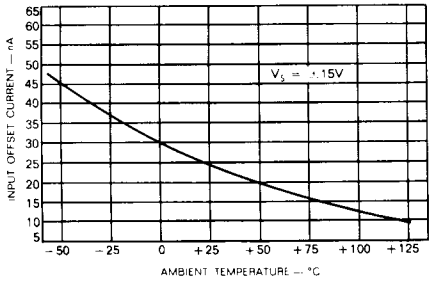


TYPICAL PERFORMANCE CURVES

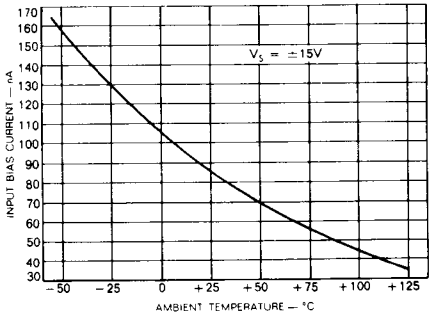
INPUT RESISTANCE VS. AMBIENT TEMPERATURE



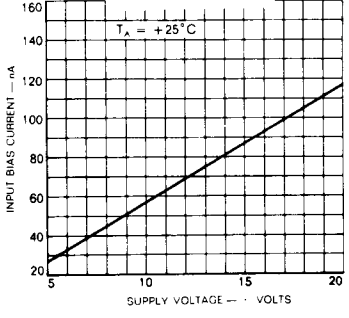
INPUT OFFSET CURRENT VS. AMBIENT TEMPERATURE



INPUT BIAS CURRENT VS. AMBIENT TEMPERATURE

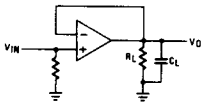


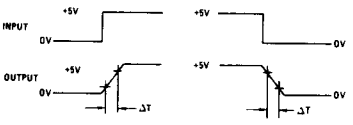
INPUT BIAS CURRENT VS. SUPPLY VOLTAGE



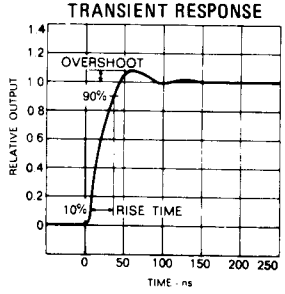
TYPICAL PERFORMANCE CURVES(continued)

SLEW RATE TEST CIRCUIT

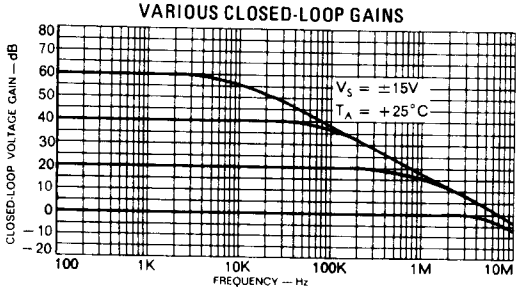




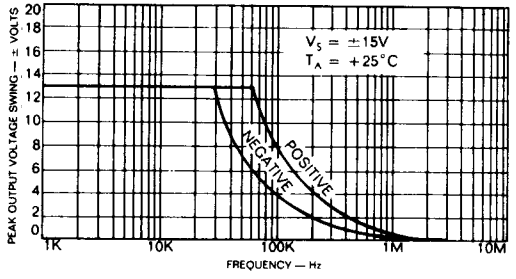
TRANSIENT RESPONSE



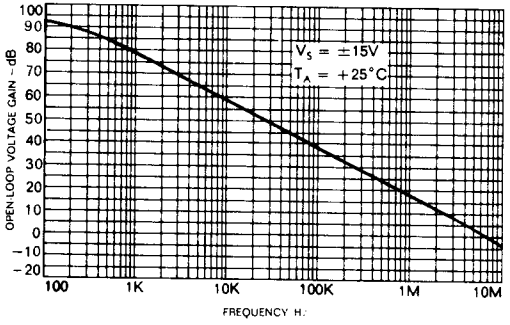
FREQUENCY RESPONSE FOR VARIOUS CLOSED-LOOP GAINS



OUTPUT VOLTAGE SWING VS. FREQUENCY



OPEN LOOP FREQUENCY RESPONSE



DEFINITIONS

INPUT OFFSET VOLTAGE – That voltage which must be applied between the input terminals through two equal resistances to force the output voltage to zero.

INPUT OFFSET CURRENT – The difference in the currents into the two input terminals when the output is at zero voltage.

INPUT BIAS CURRENT – The average of the currents flowing into the input terminals when the output is at zero voltage.

INPUT COMMON MODE VOLTAGE – The average referred to ground of the voltages at the two input terminals.

COMMON MODE RANGE – The range of voltages which is exceeded at either input terminal will cause the amplifier to cease operating.

COMMON MODE REJECTION RATIO – The ratio of a specified range of input common mode voltage to the peak-to-peak change in input offset voltage over this range.

OUTPUT VOLTAGE SWING – The peak symmetrical output voltage swing, referred to ground, that can be obtained without clipping.

INPUT RESISTANCE – The ratio of the change in input voltage to the change in input current.

OUTPUT RESISTANCE – The ratio of the change in output voltage to the change in output current.

POSITIVE OUTPUT VOLTAGE SWING – The peak positive output voltage swing, referred to ground, that can be obtained without clipping.

NEGATIVE OUTPUT VOLTAGE SWING – The peak negative output voltage swing, referred to ground, that can be obtained without clipping.

VOLTAGE GAIN – The ratio of the change in output voltage to the change in input voltage producing it.

BANDWIDTH – The frequency at which the voltage gain is 3dB below its low frequency value.

UNITY GAIN BANDWIDTH – The frequency at which the voltage gain of the amplifier is unity.

POWER SUPPLY REJECTION RATIO – The ratio of the change in input offset voltage to the change in power supply voltage producing it.

TRANSIENT RESPONSE – The closed loop step function response of the amplifier under small signal conditions.

PHASE MARGIN – $(180^o - (\phi_1 - \phi_2))$ where ϕ_1 is the phase shift at the frequency where the absolute magnitude of gain is unity ϕ_2 is the phase shift at a frequency much lower than the open loop bandwidth.