HARRIS

HA-7712
HA-7713

Low Power Precision BiMOS Operational Amplifiers

PRELIMINARY

August 1991

Features

- Low Power: HA-7712 ..... 150µA
  HA-7713 ..... 15µA
- Low Offset Voltage: A Grade 250µV
  B Grade 500µV
- Wide Operating Voltage Range..... 4V to 16V
- Low Input Bias Current
- Common Mode Range Includes the Negative Rail
- Output Voltage Swing to ±100mV of Supplies
- High Input Impedance ..... 10^{12}
- High Gain, CMRR and PSRR

Applications

- Portable Instruments
- Telephone Headsets
- Hearing Aid/Microphone Amplifiers
- Medical Instrumentation
- Meter Amplifiers
- High Performance Buffers
- Hand-Held Instrumentation

Description

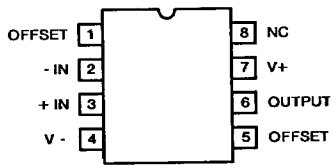
The HA-7712/13 are monolithic single operational amplifiers which use Harris' new BiMOS process. They offer precision performance and low power consumption, with quiescent currents of 150µA for the HA-7712 and 15µA for the HA-7713. These op amps have an input offset voltage of less than 250µV, an input offset current below 10pA, and an open-loop gain of 115dB.

The HA-7712/13 will operate at supply voltages ranging from ±2V to ±8V. The wide common mode voltage range, which includes the negative supply, allows for amplification of signals including ground in a single supply application.

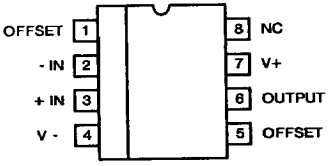
The HA-7712/13 are available in commercial and industrial temperature ranges. The high performance and low power consumption make the HA-7712/13 ideal for industrial applications.

Pinouts

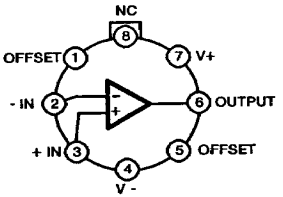
OUTLINE DRAWING
8-PIN MINIDIP
TOP VIEW



OUTLINE DRAWING
8-PIN SOIC
TOP VIEW



OUTLINE DRAWING
8-PIN TO-99
TOP VIEW



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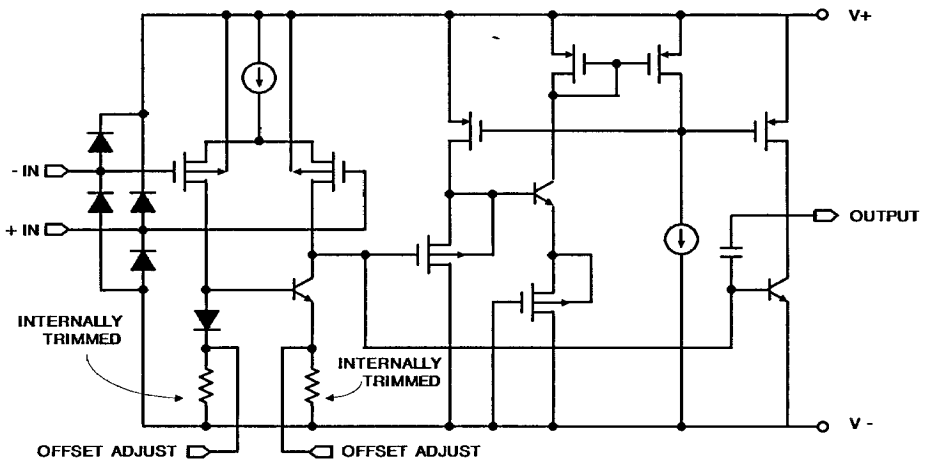
Block Diagram



Detailed Description

Overview

The HA-7712/13 BiMOS op amps are pin compatible with the ICL-7611 CMOS op amp, however pin 8 on the HA-7712/13 is not connected (pin 8 on the ICL-7611 is the I_Q set pin , which is not required for the HA-7712/13). The HA-7712 has a quiescent current of 150µA, and the HA-7713 has a quiescent current of 15µA.

These op amps operate with supply voltages of ±2V to ±8V. They have very low offset voltages: 250µV for the A grade and 500µV for the B grade. The HA-7712/13 op amps offer high open-loop gain, CMRR, PSRR, slew rate and unity-gain bandwidth. They also have excellent noise performance due to p-channel inputs and NPN loads. The common mode voltage range of the HA-7712/13 op amps include the negative supply rail which allows for amplication of signals including ground in a single supply application.

Static Protection

All devices are static protected by the use of input protection diodes. However, strong static fields should be avoided, as it is possible for the strong fields to cause degraded diode junction characteristics, which may result in increased input leakage currents.

Latchup Avoidance

Junction-isolated BiMOS circuits employ configurations which produce a parasitic 4-layer (p-n-p-n) structure. The 4-layer structure has characteristics similar to an SCR and under certain circumstances may be triggered into a low impedance state resulting in excessive supply current. To avoid this condition, no voltage greater than 0.3V beyond the supply rails may be applied to any pin. In general, the op amp supplies must be established simultaneously with, or before any input signals are applied. If this is not possible, the drive circuits must limit input current flow to 2mA to prevent latchup.

Output Stage and Load Driving Considerations

The HA-7712/13 op amps consist of three gain stages: input stage, intermediate stage and output stage. The quiescent current flows primarily in the intermediate and output stages. The intermediate stage is for level shifting and the output stage consists of a common source p-channel device for sourcing current and a common emitter NPN for sinking current. The outputs swing to almost the supply rails for output loads of 1MΩ for the HA-7713 and 100kΩ for the HA-7712. The gain of the op amp is directly proportional to the load impedance.

Input Offset Nulling

Offset nulling may be achieved by connecting a 20kΩ pot between the OFFSET terminals with the wiper connected to V-. If offset nulling is not required, the OFFSET terminals should be left open.

Frequency Compensation

The HA-7712/13 are internally compensated and are stable for closed loop gains as low as unity with capacitive loads up to 100pF.

Absolute Maximum Ratings

Total Supply Voltage (V+ to V-) 18V
Input Voltage ..... (V+ +0.3V) to (V- -0.3V)
Differential Input Voltage ..... ±[(V+ +0.3V) - (V- -0.3V)]
Duration of Output Short Circuit ..... Indefinite
Current Into Any Pin 10mA
Continuous Total Power Dissipation (T_A = +25°C)
Plastic Package 250mW
SOIC Package 200mW
TO-99 ..... 250mW

Storage Temperature Range ..... -65°C to +150°C
Lead Temperature (Soldering, 10 sec) ..... +300°C
Operating Temperature Range
HA-7712/13-5 (Commercial) ..... 0°C to +70°C
HA-7712/13-9 (Industrial) ..... -40°C to +85°C

Stress above those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other conditions above those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Electrical Specifications

Test Conditions: V+ = +5V, V- = -5V, T_A = +25°C Unless Otherwise Specified.

PARAMETER	SYMBOL	TEST CONDITIONS	HA-7712/13A			HA-7712/13B			UNITS
			MIN	TYP	MAX	MIN	TYP	MAX	
Input Offset Voltage	V_{OS}	HA-7712 R_L = 100kΩ HA-7713 R_L = 1MΩ							
		T_A = +25°C	-	-	250	-	-	500	µV
		0°C ≤ T_A ≤ +70°C	-	-	350	-	-	650	µV
		-40°C ≤ T_A ≤ +85°C	-	-	400	-	-	700	µV
Average Temperature Coefficient of Input Offset Voltage	$\Delta V_{OS}/\Delta T$	HA-7712 R_L = 100kΩ HA-7713 R_L = 1MΩ	-	2	-	-	2	-	µV/°C
Change in Input Offset With Time (Note 3)	$\Delta V_{OS}/\Delta t$	HA-7712 R_L = 100kΩ HA-7713 R_L = 1MΩ	-	2	-	-	2	-	µV/month
Input Offset Current | I(-) - I(+) | (Note 1)	I_{OS}	T_A = +25°C	-	-	10	-	-	10	pA
		0°C ≤ T_A ≤ +70°C	-	-	25	-	-	25	pA
		-40°C ≤ T_A ≤ +85°C	-	-	40	-	-	40	pA
Input Bias Current | I(+), I(-) | (Note 1)	I_{BIAS}	T_A = +25°C	-	-	20	-	-	20	pA
		0°C ≤ T_A ≤ +70°C	-	-	50	-	-	50	pA
		-40°C < T_A < +85°C	-	-	80	-	-	80	pA
Output Voltage Swing	V_{OUT}	HA-7712 R_L = 100kΩ HA-7713 R_L = 1MΩ							
		T_A = +25°C	±4.95	-	-	±4.95	-	-	V
		T_{MIN} ≤ T_A ≤ T_{MAX}	±4.9	-	-	±4.9	-	-	V
Input Resistance	R_{IN}		-	10^{12}	-	-	10^{12}	-	Ω
Large Signal Voltage Gain	A_{VOL}	HA-7712 R_L = 100kΩ HA-7713 R_L = 1MΩ							
		T_A = +25°C	108	115	-	100	110	-	dB
		0°C ≤ T_A ≤ +70°C	103	-	-	95	-	-	dB
		-40°C ≤ T_A ≤ +85°C	98	-	-	90	-	-	dB
Unity Gain Bandwidth	GBW	HA-7712 R_L = 100kΩ	-	1000	-	-	1000	-	kHz
		HA-7713 R_L = 1MΩ	-	120	-	-	120	-	kHz

Electrical Specifications (Continued) Test Conditions: V+ = +5V, V- = -5V, T_A = +25°C, Unless Otherwise Specified.

PARAMETER	SYMBOL	TEST CONDITIONS	HA-7712/13A			HA-7712/13B			UNITS
			MIN	TYP	MAX	MIN	TYP	MAX	
Common Mode Voltage Range	CMVR	HA-7712 R_L = 100kΩ HA-7713 R_L = 1MΩ	-5	-	4	-5	-	4	V
Common Mode Rejection Ratio	CMRR	HA-7712 R_L = 100kΩ	90	105	-	80	100	-	dB
		HA-7713 R_L = 1MΩ	90	105	-	80	100	-	dB
Power Supply Rejection Ratio	PSRR	HA-7712 R_L = 100kΩ	90	105	-	80	100	-	dB
		HA-7713 R_L = 1MΩ	90	105	-	80	100	-	dB
Positive Short Circuit Ouput Current	$+I_{OSC}$	HA-7712	-	25	-	-	25	-	mA
		HA-7713	-	10	-	-	10	-	mA
Negative Short Circuit Ouput Current	$-I_{OSC}$	HA-7712	-	25	-	-	25	-	mA
		HA-7713	-	10	-	-	10	-	mA
Input Noise Voltage	e_N	R_S = 100Ω, f = 1kHz							
		HA-7712 R_L = 100kΩ	-	30	-	-	30	-	$nV/\sqrt{Hz}$
		HA-7713 R_L = 1MΩ	-	60	-	-	60	-	$nV/\sqrt{Hz}$
Input Noise Current	I_N	R_S = 100Ω, f = 10kHz	-	0.001	-	-	0.001	-	$pA/\sqrt{Hz}$
Slew Rate	SR	HA-7712 R_L = 100kΩ	-	0.45	-	-	0.45	-	V/µs
		HA-7713 R_L = 1MΩ	-	0.04	-	-	0.04	-	V/µs
Rise Time	t_R	HA-7712 R_L = 100kΩ	-	0.35	-	-	0.35	-	µs
		HA-7713 R_L = 1MΩ	-	2.5	-	-	2.5	-	µs
Over Shoot		HA-7712 R_L = 100kΩ	-	7	-	-	7	-	%
		HA-7713 R_L = 1MΩ	-	17	-	-	17	-	%
Operating Supply Range	V+ to V-		4	-	16	4	-	16	V
Supply Current	I_S	HA-7712 R_L = 100kΩ	-	150	200	-	150	200	µA
		HA-7713 R_L = 1MΩ	-	15	30	-	15	30	µA

NOTES:

1. Parameter guaranteed by design and characterization, and is not production tested.
2. Typical values are guaranteed by design and characterization, and are not production tested.
3. Long term input offset voltage stability refers to the average trend line of V_{OS} vs time over extended periods after the first 24 hours of operation.

Ordering Information

PART	TEMPERATURE RANGE	PACKAGE
HA3-7712A-5	0°C to +70°C	8-Pin Plastic DIP
HA3-7712B-5		8-Pin Plastic DIP
HA9P7712B-5		8-Pin SOIC
HA2-7712A-5		8-Pin TO-99
HA2-7712B-5		8-Pin TO-99
HA3-7712A-9	-40°C to +85°C	8-Pin Plastic DIP
HA3-7712B-9		8-Pin Plastic DIP
HA9P7712B-9		8-Pin SOIC
HA2-7712A-9		8-Pin TO-99
HA2-7712B-9		8-Pin TO-99

PART	TEMPERATURE RANGE	PACKAGE
HA3-7713A-5	0°C to +70°C	8-Pin Plastic DIP
HA3-7713B-5		8-Pin Plastic DIP
HA9P7713B-5		8-Pin SOIC
HA2-7713A-5		8-Pin TO-99
HA2-7713B-5		8-Pin TO-99
HA3-7713A-9	-40°C to +85°C	8-Pin Plastic DIP
HA3-7713B-9		8-Pin Plastic DIP
HA9P7713B-9		8-Pin SOIC
HA2-7713A-9		8-Pin TO-99
HA2-7713B-9		8-Pin TO-99