HFA1114

850MHz Video Cable Driving Buffer

FN3151
Rev 5.00
September 2004

Features

- **Access to Summing Node Allows Circuit Customization**
- **User Programmable For Closed-Loop Gains of +1, -1 or +2 Without Use of External Resistors**
- **Wide -3dB Bandwidth 850MHz**
- **Very Fast Slew Rate 2400V/µs**
- **Fast Settling Time (0.1%) 11ns**
- **High Output Current 60mA**
- **Excellent Gain Accuracy 0.99V/V**
- **Overdrive Recovery . . . . . <10ns**
- **Standard Operational Amplifier Pinout**

Applications

- **RF/IF Processors**
- **Driving Flash A/D Converters**
- **High Speed Communications**
- **Impedance Transformation**
- **Line Driving**
- **Video Switching and Routing**
- **Radar Systems**
- **Medical Imaging Systems**

Description

The HFA1114 is a closed loop Buffer featuring user programmable gain and ultra high speed performance. Manufactured on Intersil' proprietary complementary bipolar UHF-1 process, the HFA1114 offers a wide -3dB bandwidth of 850MHz, very fast slew rate, excellent gain flatness, low distortion and high output current.

A unique feature of the pinout allows the user to select a voltage gain of +1, -1, or +2, without the use of any external components. Gain selection is accomplished via connections to the inputs, as described in the "Application Information" section. The result is a more flexible product, fewer part types in inventory, and more efficient use of board space.

Compatibility with existing op amp pinouts provides flexibility to upgrade low gain amplifiers, while decreasing component count. Unlike most buffers, the standard pinout provides an upgrade path should a higher closed loop gain be needed at a future date.

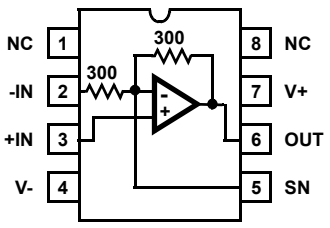
For applications requiring a standard buffer pinout, please refer to the HFA1110 datasheet.

Part # Information

PART NUMBER (BRAND)	TEMP. RANGE (^{o}C)	PACKAGE	PKG. NO.
HFA1114IB (H1114I)	-40 to 85	8 Ld SOIC	M8.15
HFA11XXEVAL	DIP Evaluation Board for High Speed Op Amps		

Pinout

HFA1114 (SOIC)
TOP VIEW



Pin Descriptions

NAME	PIN NUMBER	DESCRIPTION
NC	1, 8	No Connection
-IN	2	Inverting Input
+IN	3	Non-Inverting Input
V-	4	Negative Supply
SN	5	Summing Node
OUT	6	Output
V+	7	Positive Supply

Absolute Maximum Ratings

Voltage Between V+ and V- 12V
DC Input Voltage . . . . . V_{SUPPLY}
Differential Input Voltage 5V
Output Current 60mA

Operating Conditions

Temperature Range . . . . . -40^oC to 85^oC

Thermal Information

Thermal Resistance (Typical, Note 1)	θ_{JA} ($^oC/W$)
SOIC Package	170

Maximum Junction Temperature (Die). . . . . 175^oC
Maximum Junction Temperature (Plastic Package) . . . . . 150^oC
Maximum Storage Temperature Range . . . . . -65^oC to 150^oC
Maximum Lead Temperature (Soldering 10s). . . . . 300^oC
(SOIC - Lead Tips Only)

CAUTION: Stresses above those listed in "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress only rating and operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied.

NOTE:

1. θ_{JA} is measured with the component mounted on an evaluation PC board in free air.

Electrical Specifications $V_{SUPPLY} = \pm5V$, $A_V = +1$, $R_L = 100\Omega$, Unless Otherwise Specified

PARAMETER	TEST CONDITIONS	TEMP. (^oC)	MIN	TYP	MAX	UNITS
INPUT CHARACTERISTICS						
Output Offset Voltage		25	-	8	25	mV
		Full	-	-	35	mV
Output Offset Voltage Drift		Full	-	10	-	$\mu V/^oC$
PSRR		25	39	45	-	dB
		Full	35	-	-	dB
Input Noise Voltage	100kHz	25	-	9	-	$nV/\sqrt{Hz}$
Non-Inverting Input Noise Current	100kHz	25	-	37	-	$pA/\sqrt{Hz}$
Non-Inverting Input Bias Current		25	-	25	40	μA
		Full	-	-	65	μA
Non-Inverting Input Resistance		25	25	50	-	$k\Omega$
Inverting Input Resistance		25	240	300	360	Ω
Input Capacitance	Either Input	25	-	2	-	pF
Input Common Mode Range		Full	±2.5	±2.8	-	V
TRANSFER CHARACTERISTICS						
Gain	$A_V = +1$, $V_{IN} = +2V$	25	0.980	0.990	1.02	V/V
		Full	0.975	-	1.025	V/V
	$A_V = +2$, $V_{IN} = +1V$	25	1.96	1.98	2.04	V/V
		Full	1.95	-	2.05	V/V
DC Non-Linearity	$A_V = +2$, $\pm2V$ Full Scale	25	-	0.02	-	%
OUTPUT CHARACTERISTICS						
Output Voltage	$A_V = -1$	25	±3.0	±3.3	-	V
		Full	±2.5	±3.0	-	V
Output Current	$A_V = -1$, $R_L = 50\Omega$	25, 85	50	60	-	mA
		-40^oC	35	50	-	mA
Closed Loop Output Impedance	$A_V = +2$, DC	25	-	0.3	-	Ω

Electrical Specifications V_{SUPPLY} = ±5V, A_V = +1, R_L = 100Ω, Unless Otherwise Specified **(Continued)**

PARAMETER	TEST CONDITIONS	TEMP. (°C)	MIN	TYP	MAX	UNITS
POWER SUPPLY CHARACTERISTICS						
Supply Voltage Range		Full	±4.5	-	±5.5	V
Supply Current		25	-	21	26	mA
		Full	-	-	33	mA
AC CHARACTERISTICS						
-3dB Bandwidth (V_{OUT} = 0.2V_{P-P})	A_V = -1	25	-	800	-	MHz
	A_V = +1	25	-	850	-	MHz
	A_V = +2	25	-	550	-	MHz
Slew Rate (V_{OUT} = 5V_{P-P})	A_V = -1	25	-	2400	-	V/µs
	A_V = +1	25	-	1500	-	V/µs
	A_V = +2	25	-	1900	-	V/µs
Full Power BW	5V_{P-P}, A_V = +2	25	-	220	-	MHz
Gain Flatness	To 30MHz, A_V = +2	25	-	±0.015	-	dB
Gain Flatness	To 100MHz, A_V = +2	25	-	±0.07	-	dB
2nd Harmonic Distortion	50MHz, V_{OUT} = 2V_{P-P}	25	-	-53	-	dBc
3rd Harmonic Distortion	50MHz, V_{OUT} = 2V_{P-P}	25	-	-68	-	dBc
3rd Order Intercept	100MHz, A_V = +2	25	-	28	-	dBm
1dB Compression	100MHz, A_V = +2	25	-	19	-	dBm
Rise Time (V_{OUT} = 0.5V Step)	A_V = +2	25	-	700	-	ps
	A_V = +1	25	-	480	-	ps
Overshoot	V_{OUT} = 0.5V Step, A_V = +2	25	-	6	-	%
0.1% Settling Time	V_{OUT} = 2V to 0V	25	-	11	-	ns
0.05% Settling Time	V_{OUT} = 2V to 0V	25	-	15	-	ns
Overdrive Recovery Time		25	-	8.5	-	ns
Differential Gain	A_V = +1, 3.58MHz, R_L = 150Ω	25	-	0.03	-	%
	A_V = +2, 3.58MHz, R_L = 150Ω	25	-	0.02	-	%
Differential Phase	A_V = +1, 3.58MHz, R_L = 150Ω	25	-	0.05	-	Degrees
	A_V = +2, 3.58MHz, R_L = 150Ω	25	-	0.04	-	Degrees

Application Information

Closed Loop Gain Selection

The HFA1114 features a novel design which allows the user to select from three closed loop gains, without any external components. The result is a more flexible product, fewer part types in inventory, and more efficient use of board space.

This “buffer” operates in closed loop gains of -1, +1, or +2, and gain selection is accomplished via connections to the ±inputs. Applying the input signal to +IN and floating -IN selects a gain of +1, while grounding -IN selects a gain of +2. A gain of -1 is obtained by applying the input signal to -IN with +IN grounded.

The table below summarizes these connections:

GAIN (A_{CL})	CONNECTIONS	
	+INPUT (PIN 3)	-INPUT (PIN 2)
-1	GND	Input
+1	Input	NC (Floating)
+2	Input	GND

PC Board Layout

The frequency response of this amplifier depends greatly on the amount of care taken in designing the PC board. **The use of low inductance components such as chip resistors and chip capacitors is strongly recommended, while a solid ground plane is a must!**

Attention should be given to decoupling the power supplies. A large value (10µF) tantalum in parallel with a small value (0.1µF) chip capacitor works well in most cases.

Terminated microstrip signal lines are recommended at the input and output of the device. Capacitance directly on the output must be minimized, or isolated as discussed in the next section.

For unity gain applications, care must also be taken to minimize the capacitance to ground seen by the amplifier’s inverting input. At higher frequencies this capacitance will tend to short the -INPUT to GND, resulting in a closed loop gain which increases with frequency. This will cause excessive high frequency peaking and potentially other problems as well.

An example of a good high frequency layout is the Evaluation Board shown in Figure 2.

Driving Capacitive Loads

Capacitive loads, such as an A/D input, or an improperly terminated transmission line will degrade the amplifier’s phase margin resulting in frequency response peaking and possible oscillations. In most cases, the oscillation can be avoided by placing a resistor (R_S) in series with the output prior to the capacitance.

Figure 1 details starting points for the selection of this resistor. The points on the curve indicate the R_S and C_L combinations for the optimum bandwidth, stability, and settling time, but experimental fine tuning is recommended. Picking a point above or to the right of the curve yields an overdamped response, while points below or left of the curve indicate areas of underdamped performance.

R_S and C_L form a low pass network at the output, thus limiting system bandwidth well below the amplifier bandwidth of 850MHz. By decreasing R_S as C_L increases (as illustrated in the curves), the maximum bandwidth is obtained without sacrificing stability. Even so, bandwidth does decrease as you move to the right along the curve. For example, at A_V = +1, R_S = 50Ω, C_L = 30pF, the overall bandwidth is limited to 300MHz, and bandwidth drops to 100MHz at A_V = +1, R_S = 5Ω, C_L = 340pF.

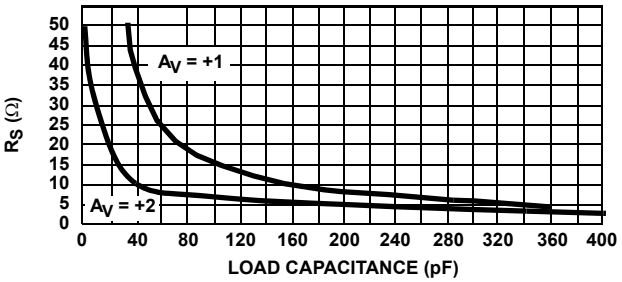


FIGURE 1. RECOMMENDED SERIES OUTPUT RESISTOR vs LOAD CAPACITANCE

Evaluation Board

The performance of the HFA1114 may be evaluated using the HFA11XX Evaluation Board, slightly modified as follows:

2. Remove the 500Ω feedback resistor (R_2), and leave the connection open.
3. a. For A_V = +1 evaluation, remove the 500Ω gain setting resistor (R_1), and leave pin 2 floating.
   b. For A_V = +2, replace the 500Ω gain setting resistor with a 0Ω resistor to GND.
4. Isolate Pin 5 from the stray board capacitance to minimize peaking and overshoot.

The layout and modified schematic of the board are shown in Figure 2.

To order evaluation boards (part number HFA11XXEVAL), please contact your local sales office.

Note: The SOIC version may be evaluated in the DIP board by using a SOIC-to-DIP adapter such as Aries Electronics Part Number 08-350000-10.

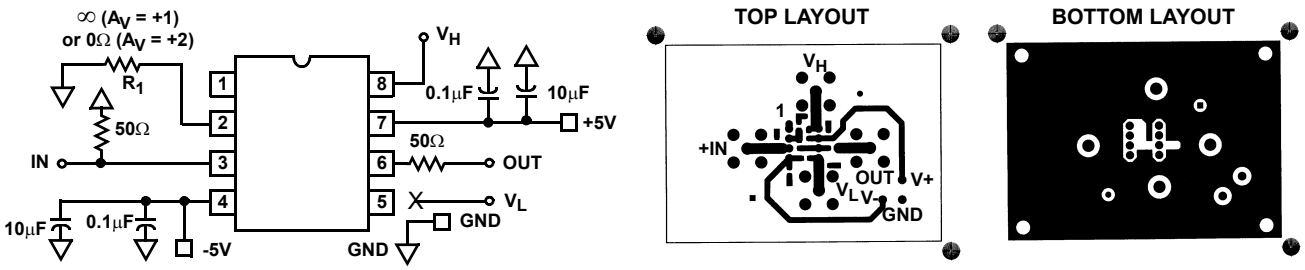


FIGURE 2. EVALUATION BOARD SCHEMATIC AND LAYOUT

Die Characteristics

DIE DIMENSIONS:

63 mils x 44 mils x 19 mils
1600µm x 1130µm x 483µm

METALLIZATION:

Type: Metal 1: AlCu(2%)/TiW
Thickness: Metal 1: 8kÅ ±0.4kÅ

Type: Metal 2: AlCu(2%)
Thickness: Metal 2: 16kÅ ±0.8kÅ

PASSIVATION:

Type: Nitride
Thickness: 4kÅ ±0.5kÅ

TRANSISTOR COUNT:

52

SUBSTRATE POTENTIAL (Powered Up):

Floating (Recommend Connection to V-)

Metallization Mask Layout

HFA1114