360MHz, Low Power, Video Operational Amplifier with Output Limiting

The HFA1135 is a high speed, low power current feedback amplifier build with Intersil's proprietary complementary bipolar UHF-1 process. This amplifier features user programmable output limiting, via the V_H and V_L pins.

The HFA1135 is the ideal choice for high speed, low power applications requiring output limiting (e.g. flash A/D drivers), especially those requiring fast overdrive recovery times. The limiting function allows the designer to set the maximum and minimum output levels to protect downstream stages from damage or input saturation. The sub-nanosecond overdrive recovery time ensures a quick return to linear operation following an overdrive condition.

Component and composite video systems also benefit from this operational amplifier's performance, as indicated by the gain flatness, and differential gain and phase specifications.

The HFA1135 is a low power, high performance upgrade for the CLC501 and CLC502.

Ordering Information

PART NUMBER	PART MARKING	TEMP. RANGE (°C)	PACKAGE	PKG. DWG. #
HFA1135IB	1135IB	-40 to 85	8 Ld SOIC	M8.15
HFA1135IB96	1135IB	-40 to 85	8 Ld SOIC Tape and Reel	M8.15
HFA1135IBZ (See Note)	1135IBZ	-40 to 85	8 Ld SOIC (Pb-free)	M8.15
HFA1135IBZ96 (See Note)	1135IBZ	-40 to 85	8 Ld SOIC Tape and Reel (Pb-free)	M8.15
HFA11XXEVAL		DIP Evaluation Board for High Speed Op Amps		

NOTE: Intersil Pb-free plus anneal products employ special Pb-free material sets; molding compounds/die attach materials and 100% matte tin plate termination finish, which are RoHS compliant and compatible with both SnPb and Pb-free soldering operations. Intersil Pb-free products are MSL classified at Pb-free peak reflow temperatures that meet or exceed the Pb-free requirements of IPC/JEDEC J STD-020.

Features

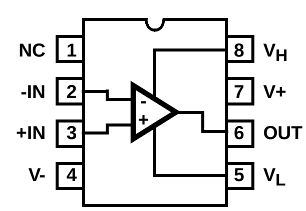
- User Programmable Output Voltage Limiting
- Fast Overdrive Recovery . . . . <1ns
- Low Supply Current 6.8mA
- High Input Impedance 2MΩ
- Wide -3dB Bandwidth. 360MHz
- Very Fast Slew Rate. 1200V/μs
- Gain Flatness (to 50MHz) . . . . ±0.07dB
- Differential Gain 0.02%
- Differential Phase. . . . . 0.04 Degrees
- Pin Compatible Upgrade to CLC501 and CLC502
- Pb-Free Plus Anneal Available (RoHS Compliant)

Applications

- Flash A/D Drivers
- High Resolution Monitors
- Professional Video Processing
- Video Digitizing Boards/Systems
- Multimedia Systems
- RGB Preamps
- Medical Imaging
- Hand Held and Miniaturized RF Equipment
- Battery Powered Communications

Pinout

HFA1135
(SOIC)
TOP VIEW



Absolute Maximum Ratings $T_A = 25^oC$

Voltage Between V+ and V- 11V
DC Input Voltage . . . . V_{SUPPLY}
Differential Input Voltage 8V
Output Current (Note 1) . . . . Short Circuit Protected
30mA Continuous
60mA ≤ 50% Duty Cycle
ESD Rating . . . . >600V

Operating Conditions

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

Thermal Information

Thermal Resistance (Typical, Note 1) θ_{JA} ($^oC/W$)
SOIC Package 165
Maximum Junction Temperature (Die Only) . . . . 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 a low effective thermal conductivity test board in free air. See Tech Brief TB379 for details.

Electrical Specifications $V_{SUPPLY} = \pm5V$, $A_V = +1$, $R_F = 510\Omega$ (Note 3), $R_L = 100\Omega$, Unless Otherwise Specified

PARAMETER	TEST CONDITIONS	(NOTE 2) TEST LEVEL	TEMP. (^oC)	MIN	TYP	MAX	UNITS
INPUT CHARACTERISTICS							
Input Offset Voltage		A	25	-	2	5	mV
		A	Full	-	3	8	mV
Average Input Offset Voltage Drift		B	Full	-	1	10	μV/^oC
Input Offset Voltage Common-Mode Rejection Ratio	$\Delta V_{CM} = \pm1.8V$	A	25	47	50	-	dB
	$\Delta V_{CM} = \pm1.8V$	A	85	45	48	-	dB
	$\Delta V_{CM} = \pm1.2V$	A	-40	45	48	-	dB
Input Offset Voltage Power Supply Rejection Ratio	$\Delta V_{PS} = \pm1.8V$	A	25	50	54	-	dB
	$\Delta V_{PS} = \pm1.8V$	A	85	47	50	-	dB
	$\Delta V_{PS} = \pm1.2V$	A	-40	47	50	-	dB
Non-Inverting Input Bias Current		A	25	-	6	15	μA
		A	Full	-	10	25	μA
Non-Inverting Input Bias Current Drift		B	Full	-	5	60	nA/^oC
Non-Inverting Input Bias Current Power Supply Sensitivity	$\Delta V_{PS} = \pm1.8V$	A	25	-	0.5	1	μA/V
	$\Delta V_{PS} = \pm1.8V$	A	85	-	0.8	3	μA/V
	$\Delta V_{PS} = \pm1.2V$	A	-40	-	0.8	3	μA/V
Non-Inverting Input Resistance	$\Delta V_{CM} = \pm1.8V$	A	25	0.8	2	-	MΩ
	$\Delta V_{CM} = \pm1.8V$	A	85	0.5	1.3	-	MΩ
	$\Delta V_{CM} = \pm1.2V$	A	-40	0.5	1.3	-	MΩ
Inverting Input Bias Current		A	25	-	0.1	4	μA
		A	Full	-	3	8	μA
Inverting Input Bias Current Drift		B	Full	-	60	200	nA/^oC
Inverting Input Bias Current Common-Mode Sensitivity	$\Delta V_{CM} = \pm1.8V$	A	25	-	3	6	μA/V
	$\Delta V_{CM} = \pm1.8V$	A	85	-	4	8	μA/V
	$\Delta V_{CM} = \pm1.2V$	A	-40	-	4	8	μA/V
Inverting Input Bias Current Power Supply Sensitivity	$\Delta V_{PS} = \pm1.8V$	A	25	-	2	5	μA/V
	$\Delta V_{PS} = \pm1.8V$	A	85	-	4	8	μA/V
	$\Delta V_{PS} = \pm1.2V$	A	-40	-	4	8	μA/V
Inverting Input Resistance		C	25	-	40	-	Ω
Input Capacitance (Either Input)		C	25	-	1.6	-	pF

Electrical Specifications V_{SUPPLY} = ±5V, A_V = +1, R_F = 510Ω (Note 3), R_L = 100Ω, Unless Otherwise Specified **(Continued)**

PARAMETER	TEST CONDITIONS	(NOTE 2) TEST LEVEL	TEMP. (°C)	MIN	TYP	MAX	UNITS
Input Voltage Common Mode Range (Implied by V_{IO} CMRR, $+R_{IN}$, and $-I_{BIAS}$ CMS tests)		A	25, 85	±1.8	±2.4	-	V
		A	-40	±1.2	±1.7	-	V
Input Noise Voltage Density (Note 5)	f = 100kHz	B	25	-	3.5	-	nV/√Hz
Non-Inverting Input Noise Current Density (Note 5)	f = 100kHz	B	25	-	2.5	-	pA/√Hz
Inverting Input Noise Current Density (Note 5)	f = 100kHz	B	25	-	20	-	pA/√Hz
TRANSFER CHARACTERISTICS							
Open Loop Transimpedance Gain (Note 5)	A_V = -1	C	25	-	500	-	kΩ
AC CHARACTERISTICS A_V = +2, R_F = 250Ω, Unless Otherwise Specified							
-3dB Bandwidth (V_{OUT} = 0.2V_{P-P}, Note 5)	A_V = +1, R_F = 1.5kΩ	B	25	-	660	-	MHz
	A_V = +2, R_F = 250Ω	B	25	-	360	-	MHz
	A_V = +2, R_F = 330Ω	B	25	-	315	-	MHz
	A_V = -1, R_F = 330Ω	B	25	-	290	-	MHz
Full Power Bandwidth (V_{OUT} = 5V_{P-P} at A_V = +2/-1, 4V_{P-P} at A_V = +1, Note 5)	A_V = +1, R_F = 1.5kΩ	B	25	-	90	-	MHz
	A_V = +2, R_F = 250Ω	B	25	-	130	-	MHz
	A_V = -1, R_F = 330Ω	B	25	-	170	-	MHz
Gain Flatness (to 25MHz, V_{OUT} = 0.2V_{P-P}, Note 5)	A_V = +1, R_F = 1.5kΩ	B	25	-	±0.10	-	dB
	A_V = +2, R_F = 250Ω	B	25	-	±0.02	-	dB
	A_V = +2, R_F = 330Ω	B	25	-	±0.02	-	dB
Gain Flatness (to 50MHz, V_{OUT} = 0.2V_{P-P}, Note 5)	A_V = +1, R_F = 1.5kΩ	B	25	-	±0.22	-	dB
	A_V = +2, R_F = 250Ω	B	25	-	±0.07	-	dB
	A_V = +2, R_F = 330Ω	B	25	-	±0.03	-	dB
Minimum Stable Gain		A	Full	-	1	-	V/V
OUTPUT CHARACTERISTICS R_F = 510Ω, Unless Otherwise Specified							
Output Voltage Swing (Note 5)	A_V = -1, R_L = 100Ω	A	25	±3	±3.4	-	V
		A	Full	±2.8	±3	-	V
Output Current (Note 5)	A_V = -1, R_L = 50Ω	A	25, 85	50	60	-	mA
		A	-40	28	42	-	mA
Output Short Circuit Current		B	25	-	90	-	mA
Closed Loop Output Resistance (Note 5)	DC, A_V = +2, R_F = 250Ω	B	25	-	0.07	-	Ω
Second Harmonic Distortion (A_V = +2, R_F = 250Ω, V_{OUT} = 2V_{P-P}, Note 5)	10MHz	B	25	-	-50	-	dBc
	20MHz	B	25	-	-45	-	dBc
Third Harmonic Distortion (A_V = +2, R_F = 250Ω, V_{OUT} = 2V_{P-P}, Note 5)	10MHz	B	25	-	-50	-	dBc
	20MHz	B	25	-	-45	-	dBc
TRANSIENT CHARACTERISTICS A_V = +2, R_F = 250Ω, Unless Otherwise Specified							
Rise and Fall Times (V_{OUT} = 0.5V_{P-P}, Note 5)	Rise Time	B	25	-	0.81	-	ns
	Fall Time	B	25	-	1.25	-	ns
Overshoot (Note 4) (V_{OUT} = 0 to 0.5V, V_{IN} t_{RISE} = 2.5ns)	+OS	B	25	-	3	-	%
	-OS	B	25	-	5	-	%
Overshoot (Note 4) (V_{OUT} = 0.5V_{P-P}, V_{IN} t_{RISE} = 2.5ns)	+OS	B	25	-	2	-	%
	-OS	B	25	-	10	-	%
Slew Rate (V_{OUT} = 4V_{P-P}, A_V = +1, R_F = 1.5kΩ)	+SR	B	25	-	875	-	V/μs
	-SR (Note 6)	B	25	-	510	-	V/μs
Slew Rate (V_{OUT} = 5V_{P-P}, A_V = +2, R_F = 250Ω)	+SR	B	25	-	1530	-	V/μs
	-SR (Note 6)	B	25	-	850	-	V/μs

Electrical Specifications V_{SUPPLY} = ±5V, A_V = +1, R_F = 510Ω (Note 3), R_L = 100Ω, Unless Otherwise Specified **(Continued)**

PARAMETER	TEST CONDITIONS	(NOTE 2) TEST LEVEL	TEMP. (°C)	MIN	TYP	MAX	UNITS
Slew Rate (V_{OUT} = $5V_{P-P}$, A_V = -1, R_F = 330Ω)	+SR	B	25	-	2300	-	V/µs
	-SR (Note 6)	B	25	-	1200	-	V/µs
Settling Time (V_{OUT} = +2V to 0V step, Note 5)	To 0.1%	B	25	-	23	-	ns
	To 0.05%	B	25	-	33	-	ns
	To 0.02%	B	25	-	45	-	ns
VIDEO CHARACTERISTICS A_V = +2, R_F = 250Ω, Unless Otherwise Specified							
Differential Gain (f = 3.58MHz)	R_L = 150Ω	B	25	-	0.02	-	%
	R_L = 75Ω	B	25	-	0.03	-	%
Differential Phase (f = 3.58MHz)	R_L = 150Ω	B	25	-	0.04	-	Degrees
	R_L = 75Ω	B	25	-	0.06	-	Degrees
OUTPUT LIMITING CHARACTERISTICS A_V = +2, R_F = 250Ω, V_H = +1V, V_L = -1V, Unless Otherwise Specified							
Limit Accuracy (Note 5)	V_{IN} = ±2V, A_V = -1, R_F = 510Ω	A	Full	-125	25	125	mV
Overdrive Recovery Time (Note 5)	V_{IN} = ±1V	B	25	-	0.8	-	ns
Negative Limit Range		B	25		-5.0 to +2.5		V
Positive Limit Range		B	25		-2.5 to +5.0		V
Limit Input Bias Current		A	25	-	50	200	µA
		A	Full	-	80	200	µA
POWER SUPPLY CHARACTERISTICS							
Power Supply Range		C	25	±4.5	-	±5.5	V
Power Supply Current (Note 5)		A	Full	6.4	6.9	7.3	mA

NOTES:

2. Test Level: A. Production Tested; B. Typical or Guaranteed Limit Based on Characterization; C. Design Typical for Information Only.
3. The optimum feedback resistor for the HFA1135 at A_V = +1 is 1.5kΩ. The Production Tested parameters are tested with R_F = 510Ω because the HFA1135 shares test hardware with the HFA1105 amplifier.
4. Undershoot dominates for output signal swings below GND (e.g., $0.5V_{P-P}$), yielding a higher overshoot limit compared to the V_{OUT} = 0V to 0.5V condition. See the “Application Information” section for details.
5. See Typical Performance Curves for more information.
6. Slew rates are asymmetrical if the output swings below GND (e.g., a bipolar signal). Positive unipolar output signals have symmetric positive and negative slew rates comparable to the +SR specification. See the “Application Information” section, and the pulse response graphs for details.

Application Information

Relevant Application Notes

The following Application Notes pertain to the HFA1135:

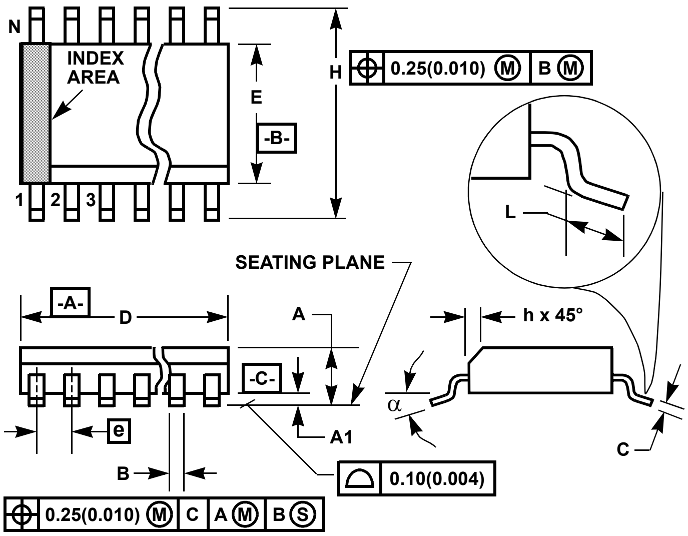
- AN9653-Use and Application of Output Limiting Amplifiers
- AN9752-Sync Stripper and Sync Inserter for Composite Video
- AN9787-An Intuitive Approach to Understanding Current Feedback Amplifiers
- AN9420-Current Feedback Amplifier Theory and Applications
- AN9663-Converting from Voltage Feedback to Current Feedback Amplifiers

These publications may be obtained from Intersil’s web site at www.intersil.com.

Optimum Feedback Resistor

Although a current feedback amplifier’s bandwidth dependency on closed loop gain isn’t as severe as that of a voltage feedback amplifier, there can be an appreciable decrease in bandwidth at higher gains. This decrease may be minimized by taking advantage of the current feedback amplifier’s unique relationship between bandwidth and R_F. All current feedback amplifiers require a feedback resistor, even for unity gain applications, and R_F, in conjunction with the internal compensation capacitor, sets the dominant pole of the frequency response. Thus, the amplifier’s bandwidth is inversely proportional to R_F. The HFA1135 design is optimized for a 250Ω R_F at a gain of +2. Decreasing R_F decreases stability, resulting in excessive peaking and overshoot (Note: Capacitive feedback will cause the same

Small Outline Plastic Packages (SOIC)



NOTES:

1. Symbols are defined in the “MO Series Symbol List” in Section 2.2 of Publication Number 95.
2. Dimensioning and tolerancing per ANSI Y14.5M-1982.
3. Dimension “D” does not include mold flash, protrusions or gate burrs. Mold flash, protrusion and gate burrs shall not exceed 0.15mm (0.006 inch) per side.
4. Dimension “E” does not include interlead flash or protrusions. Interlead flash and protrusions shall not exceed 0.25mm (0.010 inch) per side.
5. The chamfer on the body is optional. If it is not present, a visual index feature must be located within the crosshatched area.
6. “L” is the length of terminal for soldering to a substrate.
7. “N” is the number of terminal positions.
8. Terminal numbers are shown for reference only.
9. The lead width “B”, as measured 0.36mm (0.014 inch) or greater above the seating plane, shall not exceed a maximum value of 0.61mm (0.024 inch).
10. Controlling dimension: MILLIMETER. Converted inch dimensions are not necessarily exact.

M8.15 (JEDEC MS-012-AA ISSUE C)

8 LEAD NARROW BODY SMALL OUTLINE PLASTIC PACKAGE

SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN	MAX	MIN	MAX	
A	0.0532	0.0688	1.35	1.75	-
A1	0.0040	0.0098	0.10	0.25	-
B	0.013	0.020	0.33	0.51	9
C	0.0075	0.0098	0.19	0.25	-
D	0.1890	0.1968	4.80	5.00	3
E	0.1497	0.1574	3.80	4.00	4
e	0.050 BSC		1.27 BSC		-
H	0.2284	0.2440	5.80	6.20	-
h	0.0099	0.0196	0.25	0.50	5
L	0.016	0.050	0.40	1.27	6
N	8		8		7
α	0°	8°	0°	8°	-

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