

February 1995

LH4001 Wideband Current Buffer

General Description

The LH4001 is a high speed unity gain buffer designed to provide high current drive capability at frequencies from DC to over 25 MHz. It is capable of providing a continuous output current of ± 100 mA and a peak of ± 200 mA.

The LH4001 is designed to fulfill a wide range of applications such as impedance transformation, high impedance input buffers for A/D converters and comparators, as well as high speed line drivers. It is also suitable for use in current booster applications within an op amp loop. This allows the output current capability of existing op amps to be increased to ± 100 mA.

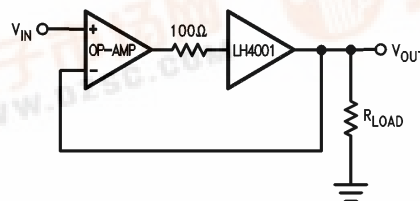
Features

- DC to 25 MHz bandwidth
- 125 V/ μ s slew rate
- Drives ± 10 V into 50Ω
- Operates from ± 5 to ± 20 V supplies
- Output swing approaches supply voltage

Applications

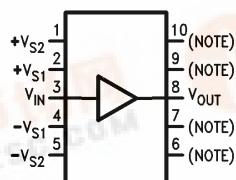
- Boost op amp output
- Buffer amplifiers
- Isolate capacitive loads
- Drive long cables

Typical Applications and Connection Diagram



TL/K/8628-1

Dual-In-Line Package



TL/K/8628-2

Top View

*Note: Electrically connected internally. No connection should be made to these pins.

Order Number LH4001CN
See NS Package Number N10A

LH4001 Wideband Current Buffer



Absolute Maximum Ratings

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

Supply Voltage, V_S	$\pm 22V$
Continuous Output Current, I_O	$\pm 100\text{ mA}$
Peak Output Current, $I_{O(\text{peak})}$ (50 ms On/1 Sec Off)	$\pm 200\text{ mA}$
Input Voltage Range, V_{IN}	$\pm V_S$
Power Dissipation	500 mW

Storage Temperature Range, T_{STG}	-65°C to $+150^\circ\text{C}$
Junction Temperature, T_J	150°C
Lead Temp. (Soldering, < 10 seconds)	260°C
ESD rating is to be determined.	

Operating Ratings

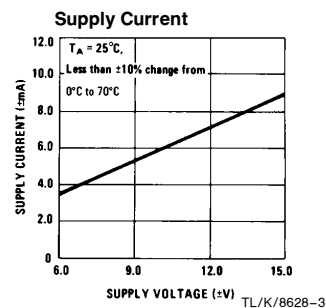
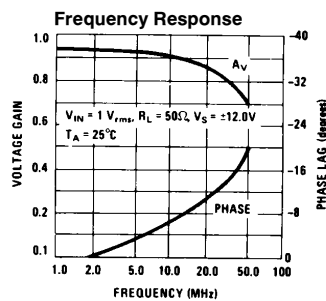
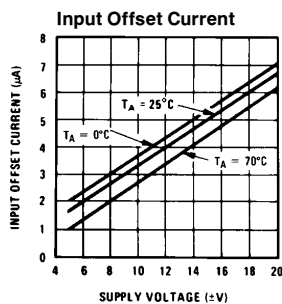
Temperature Range, T_A	0°C to $+70^\circ\text{C}$
Thermal Resistance θ_{JA}	120°C/W

Electrical Characteristics (Note 1)

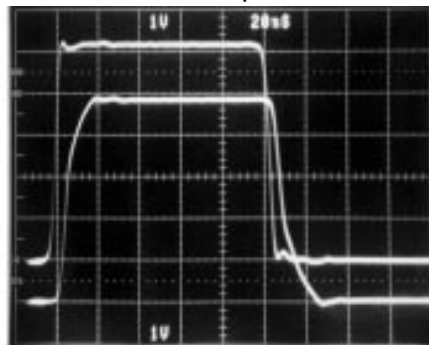
Symbol	Parameter	Conditions	Min	Typ	Max	Units
A_V	Voltage Gain	$R_S = 10\text{ k}\Omega$, $R_L = 1\text{ k}\Omega$ $V_{IN} = \pm 10V$	0.95	0.97	1	V/V
R_{IN}	Input Impedance	$R_S = 200\text{ k}\Omega$, $R_L = 1\text{ k}\Omega$ $V_{IN} = \pm 1.0V$	180	400		$\text{k}\Omega$
R_{OUT}	Output Impedance	$R_S = 10\text{ k}\Omega$, $R_L = 50\Omega$ $V_{IN} = \pm 1.0V$		6	10	Ω
V_O	Output Swing	$V_S = \pm 15V$, $R_S = 50\Omega$ $R_L = 100\Omega$, $V_{IN} = \pm 12V$	± 10	± 11		V
I_B	Input Bias Current	$R_S = 10\text{ k}\Omega$, $R_L = 1\text{ k}\Omega$		± 10	± 50	μA
t_r	Rise Time	$R_L = 100\Omega$, $\Delta V_{IN} = 100\text{ mV}$		7		ns
SR	Slew Rate	$V_{IN} = \pm 5V$, $R_L = 100\Omega$		125		V/ μs
I_S	Supply Current	$R_S = 10\text{ k}\Omega$		± 6	± 10	mA
V_{OS}	Offset Voltage	$R_S = 300\Omega$, $R_L = 1\text{ k}\Omega$		± 10	± 50	mV

Note 1: Specification applies for $T_A = 25^\circ\text{C}$ with $+12V$ on Pins 1 & 2; $-12V$ on Pins 4 & 5 unless otherwise specified.

Typical Performance Characteristics



Pulse Response



TOP TRACE = INPUT
BOTTOM TRACE = OUTPUT

$V_{IN} = \pm 2.5V$, $R_S = R_L = 50\Omega$

TL/K/8628-10

Applications Information

Figure 1 shows a simple implementation of a non-inverting buffer amplifier of unity gain. Popular industry standard operational amplifiers such as LF156, LF351, LF411, LF441, LM11, LM741, etc. can be used in this configuration. Due to the high bandwidth of the LH4001, it is suitable for use with most monolithic op amps.

Figure 2 shows an implementation of an inverting amplifier with output current capability in excess of ± 100 mA. The gain of this amplifier is determined by the values of R_F and R_{IN} . The resistor between the non-inverting input and ground is used to minimize the output offset voltage resulting from the input bias current.

Because of its high current drive capability, the LH4001 buffer amplifier is suitable for driving terminated or unterminated co-axial cables, and high current or reactive loads.

Figure 3 shows a co-axial cable drive circuit. The 43Ω resistor matches the driving source to the cable, however, its inclusion rarely will result in substantial improvement in pulse response into a terminated cable. If the 43Ω resistor is included, the output voltage to the load is about half what it would be without the near end termination.

Figure 4 shows a non-inverting amplifier with gain and output current capability in excess of ± 100 mA. It is capable of providing ± 10 mA into a $1\text{ k}\Omega$ load or ± 100 mA into a 100Ω load ($\pm 10\text{V}$ swing). Figures 5 and 6 show two different methods of providing current limit or short circuit protection for the LH4001. In Figure 6, the 10Ω resistor limits the output current to approximately 70 mA. This circuit is highly recommended if there is a potential for a short circuit to occur.

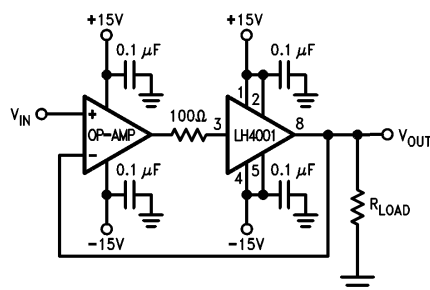


FIGURE 1. Non-Inverting Buffer Amplifier

TL/K/8628-4

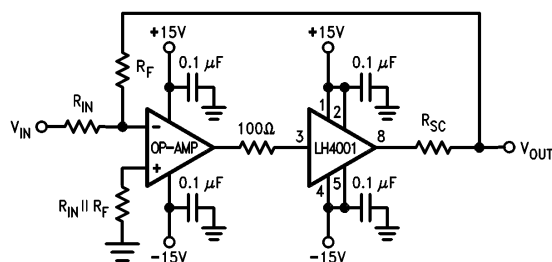


FIGURE 2. Inverting Buffer Amplifier with Current Limit

TL/K/8628-6

$$\frac{V_{OUT}}{V_{IN}} = -\frac{R_F}{R_{IN}}$$

Applications Information (Continued)

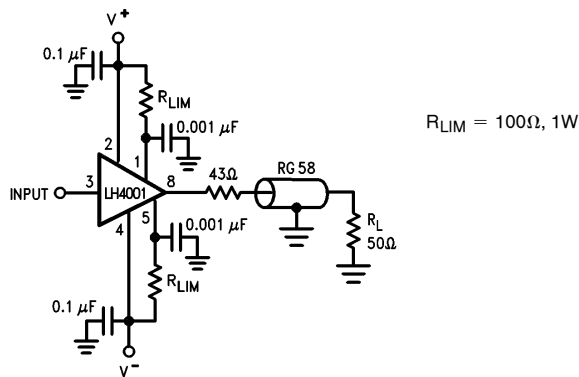
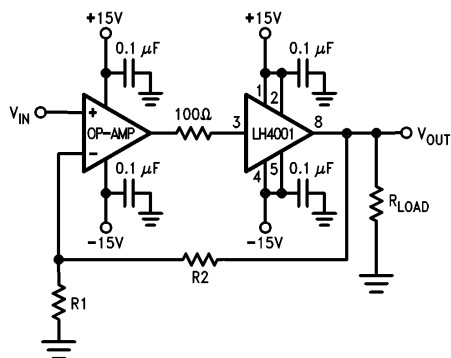


FIGURE 3. Coaxial Cable Drive Circuit

TL/K/8628-7



$$V_{OUT} = V_{IN} \left(1 + \frac{R_2}{R_1} \right)$$

FIGURE 4. Non-Inverting Buffer Amplifier with Gain

TL/K/8628-5

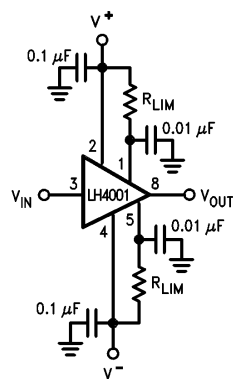


FIGURE 5. LH4001 Using Resistor Current Limiting

TL/K/8628-8

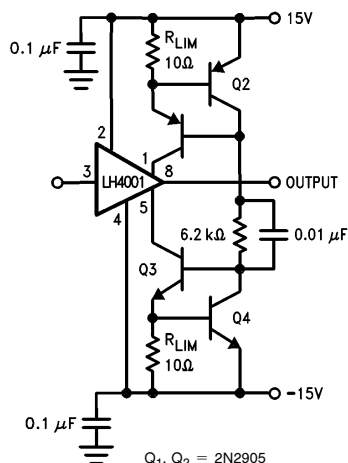
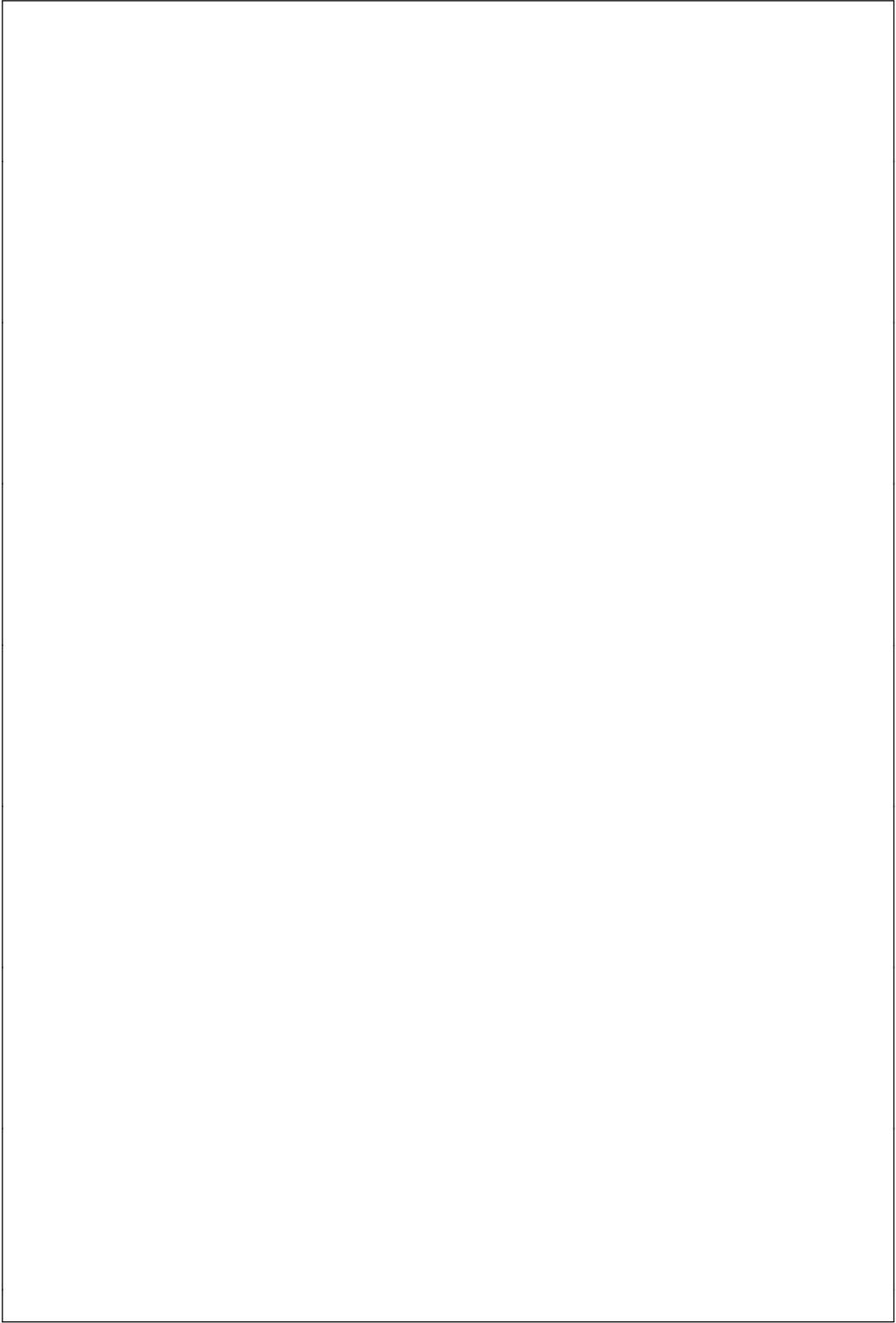


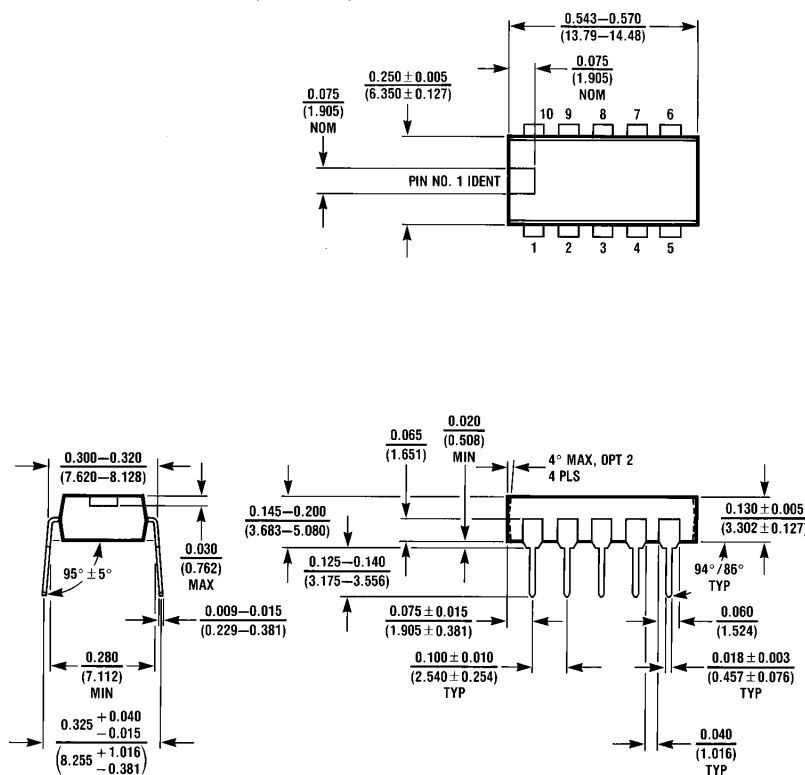
FIGURE 6. Current Limit Using Current Sources

TL/K/8628-9



Physical Dimensions inches (millimeters)

Lit. # 106408



Molded Dual-in-Line Package (N)
Order Number LH4001CN
NS Package Number N10A

N10A (REV A)

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