HT9274
Quad Micropower Op Amp

Features

- Quad micro power op amp
- Wide range of supply voltage: 1.6V~5.5V
- High input impedance
- Single supply operation
- Low current consumption: < 5μA per amp
- Rail to rail output
- Provides both sink and source output drive capability
- Common mode input extends below negative rail
- Pin compatible with LM324/WT274 (14-pin DIP)
- 14-pin DIP/SOP package

Applications

- Battery powered system
- Sensor amplifier
- Low power gain blocks
- Low power comparators
- Signal detectors
- Active filters
- Caller ID systems
- Communication systems

General Description

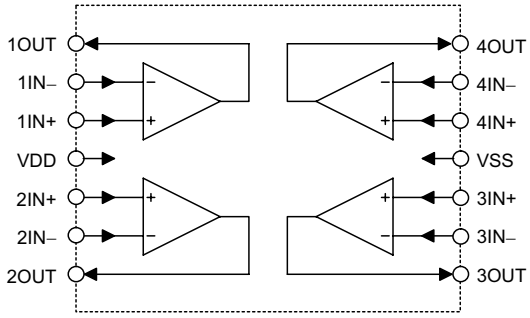
The HT9274 is a CMOS quad micro-power operational amplifier featuring high input impedance, extremely low power, high gain and high stability.

It allows common mode input voltage range which extends below the negative rail, output swings to both rails with a reasonable sink and souce capability of the output drive current. This cost-effective device is suitable for high gain, low frequency, low power applications, especially ideal for battery powered systems where μA range of standby current is essential for long battery life span. For example, in multi-standard Caller ID systems, HT9274 is ideal as a low power line signal monitor/detector, and in car alarm systems, the HT9274 is excellent for piezo vibratile detector signal amplifier application.

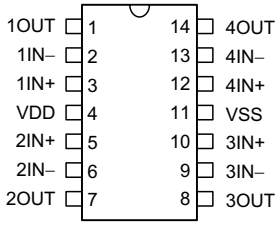
Comparison Table

ITEM	Operating Voltage	Operating Current	Output Source Current	Output Sink Current	Input Bias Current	GBW	Max. load (To VDD or VSS)
HT9274	1.6~5.5V	5μA	500μA	500μA	1pA	0.1MHz	>10kΩ
WT274	1.35~10V	9μA	16μA	2mA	1pA	0.1MHz	>500kΩ
LM324	3~32V	400μA	20mA	8mA	45nA	1MHz	>2kΩ

Block Diagram



Pin Assignment



HT9274
–14 DIP/SOP

Pin Description

Pin No.	Pin Name	I/O	Internal Connection	Description
1	1OUT	O	CMOS OUT	Output pin of the op amp 1
2	1IN–	I	PMOS IN	Inverting input pin of the op amp 1
3	1IN+	I	PMOS IN	Noninverting input pin of the op amp 1
4	VDD	—	—	Positive power supply
5	2IN+	I	PMOS IN	Noninverting input pin of the op amp 2
6	2IN–	I	PMOS IN	Inverting input pin of the op amp 2
7	2OUT	O	CMOS OUT	Output pin of the op amp 2
8	3OUT	O	CMOS OUT	Output pin of the op amp 3
9	3IN–	I	PMOS IN	Inverting input pin of the op amp 3
10	3IN+	I	PMOS IN	Noninverting input pin of the op amp 3
11	VSS	—	—	Negative power supply
12	4IN+	I	PMOS IN	Noninverting input pin of the op amp 4
13	4IN–	I	PMOS IN	Inverting input pin of the op amp 4
14	4OUT	O	CMOS OUT	Output pin of the op amp 4

Absolute Maximum Ratings

Supply Voltage.....–0.3V to 6V

Input Voltage.....V_{SS}–0.3V to V_{DD}+0.3V

Storage Temperature.....–50°C to 125°C

Operating Temperature .....–20°C to 75°C

Note: These are stress ratings only. Stresses exceeding the range specified under "Absolute Maximum Ratings" may cause substantial damage to the device. Functional operation of this device at other conditions beyond those listed in the specification is not implied and prolonged exposure to extreme conditions may affect device reliability.

Electrical Characteristics

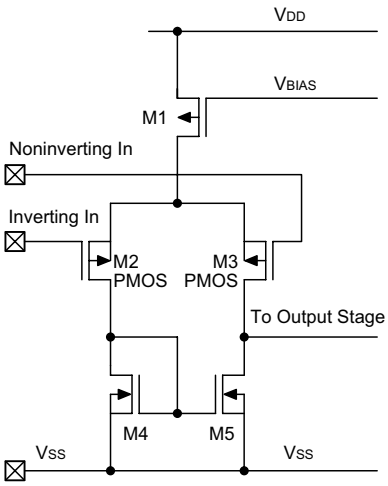
Ta=25°C

Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Unit
		V_{DD}	Conditions				
V_{OS}	Input Offset Voltage	5V	Vo=1.4V	—	—	5	mV
$\Delta V_{OS}/\Delta T$	Temperature Coefficient of V_{OS}	5V	—	—	2	—	μV/°C
I_{OS}	Input Offset Current	5V	V_i=Vo=1.4V −20°C<Ta<75°C	—	1	100	pA
I_b	Input Bias Current	5V	Vi=Vo=1.4V −20°C<Ta<75°C	—	1	150	pA
V_{OUT+}	Positive Output Voltage Swing	5V	R_L=1MΩ $V_{IN+}-V_{IN}$ ≥10mV	4.9	4.95	—	V
V_{OUT}	Negative Output Voltage Swing	5V	R_L=1MΩ $V_{IN-}-V_{IN+}$≥10mV	—	0.01	0.05	V
A_{VOL}	Large Signal Voltage Gain	5V	Vi=1.4V R_L=1MΩ V_O=1 to 4V	20	200	—	V/mV
GBW	Gain Band Width Product	5V	R_L=1MΩ C_L=100pF	—	0.1	—	MHz
CMRR	Common Mode Rejection Ratio	5V	Vo=1.4V Vi=0V	60	80	—	dB
PSRR	Power Supply Rejection Ratio	1.8~5V	Vo=1.4V	60	80	—	dB
I_{CC}	Supply Current Per Single Amplifier	5V	Av=1 Vo=1.4V No load	—	3	5	μA
SR	Slew Rate at Unity Gain	5V	No load	—	0.03	—	V/μs
Φm	Phase Margin at Unity Gain	5V	R_L=1MΩ C_L=100pF	—	55	—	Degree
e_n	Input Equivalent Noise Voltage	5V	f=1kHz R_S=10Ω	Σ	50	Σ	$nV/\sqrt{Hz}$
V_{01}/V_{02}	Cross Talk Attenuation	5V	—	—	100	—	dB
I_{OH}	Output Source Current	5V	$V_{IN+}-V_{IN-}$≥10mV	−300	−500	—	μA
I_{OL}	Output Sink Current	5V	$V_{IN-}-V_{IN+}$≥10mV	300	500	—	μA

Functional Description

Input stage

The input stage of op amps are nominal PMOS differential amplifiers (see the following diagram), therefore the common mode input voltage can extend to V_{SS}-0.6V. On the other hand the common mode input voltage has to be maintained below (V_{DD}-1)V to keep the input device (M2 and M3) active. This implies that when using HT9274 as a voltage follower, the input as well as output active range will be limited between V_{SS} ~ V_{DD}-1V (approx.). Avoid applying any voltage greater than V_{DD}+0.6V or less than V_{SS}-0.6V to the input pins, otherwise the internal input protection devices may be damaged.



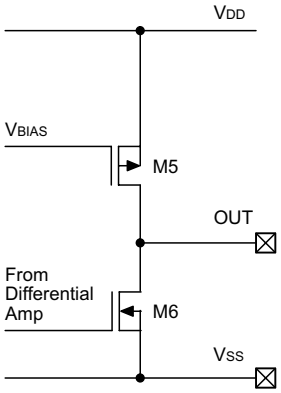
Since the input impedance of PMOS is inherently very high, it can directly couple to high impedance elements without loading effect. For example, coupling to ceramic transducers, integrating capacitor and resistor networks.

Actually the extremly high input impedance is its major advantage over the bipolar counterpart, in some application fields such as integrators where the input current of op amp can cause significant error, the HT9274 is a better choice than the popular LM324.

Output stage

The HT9274 uses push-pull CMOS configuration as the output stage of op amps to minimize low power consumption and to provide adequate output driving current.

Note that the output is an unbuffered structure, therefore the open loop gain will be affected by the load resistor since the voltage gain of this stage can be expressed as (gm5+gm6)×R_L.

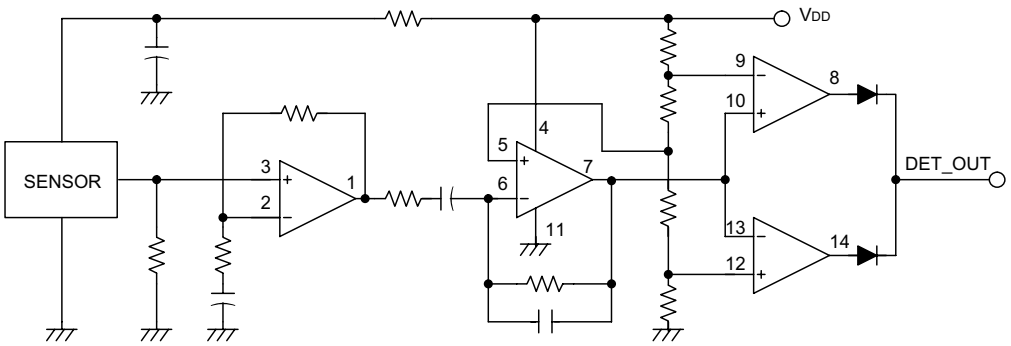


Because of the consideration for minimized power consumption, the max. output current is limited to about 400μA for both source and sink drive. This is believed to be enough for most low power systems, however it is recommended to use the load resistor of >10kΩ for normal applications. In case of heavy load driving, an external buffer stage using bipolar transistors is recommended.

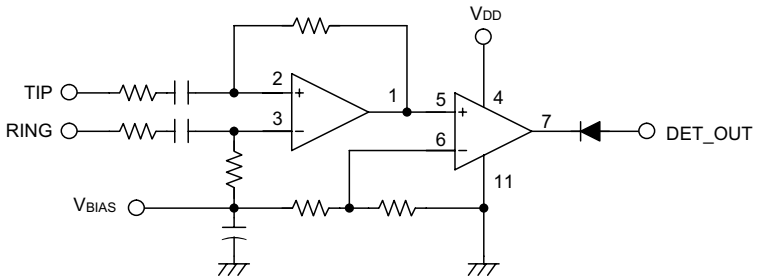
The HT9274 is internally compensated for AC stability and capable to withstand up to a 100pF capacitive load.

Application Circuits

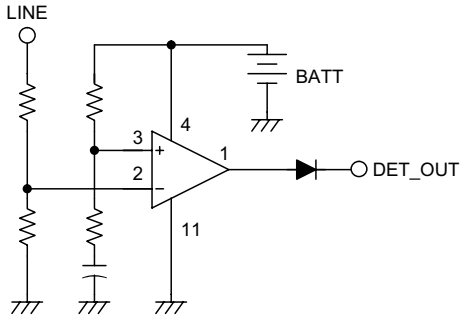
Micro power sensor amplifier & detector



Micro power line signal monitor



Micro power line voltage monitor



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