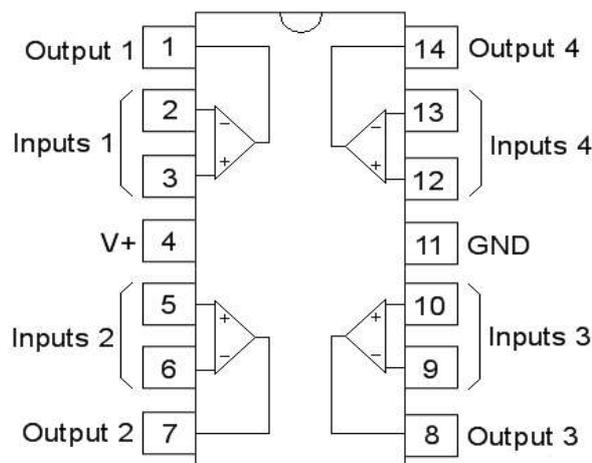


LM324 Quad Op-Amp

Overview

The LM324 integrated circuit is a quad operational amplifier (Op-Amp). The device has four individual Op-Amp circuits housed in a single package.

Pin Outs



Pin Descriptions

V+	=	Supply voltage.
GND	=	Gnd (0V) connection for supply voltage.
Input(s)	=	Input to Op-Amp.
Output	=	Output of Op-Amp.

Electrical Characteristics

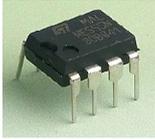
Operating Voltage	=	3.0V to 32V
Maximum Supply Current	=	1.2mA @ 5V Operating Voltage 3.0mA @ 30V Operating Voltage

High Level Output Voltage	=	3.5V @ 5V Operating Voltage 28V @ 30V Operating Voltage
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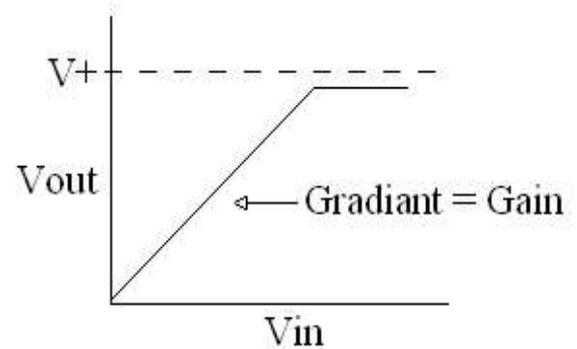
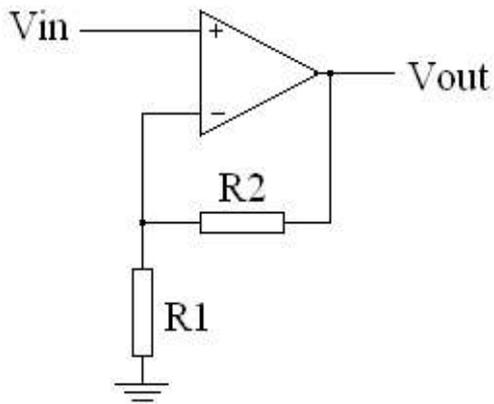
Maximum Output Current	=	40mA @ 5V Operating Voltage
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Environmental

Operating Temperature	=	0°C to 70°C
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Non-inverting amplifier



This is a very simple non inverting amplifier circuit.

The output (V_{out}) of the amplifier is given by:

$$V_{out} = V_{in} \times \text{Gain of the amplifier}$$

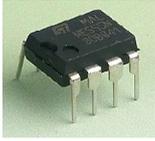
The Gain of the amplifier is given by:

$$\text{Gain} = 1 + (R2 / R1)$$

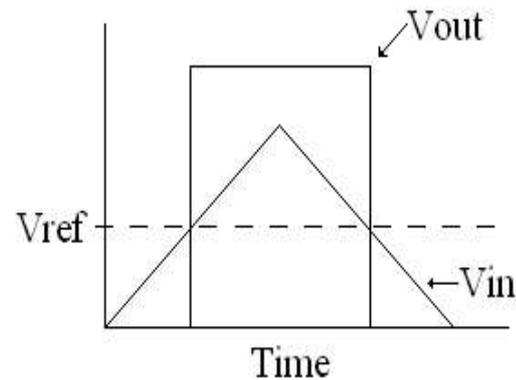
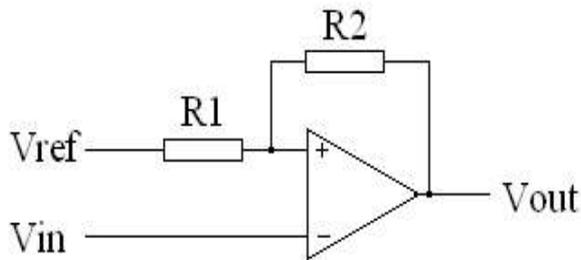
A graph of V_{in} vs V_{out} is shown above right.

Note: The output of the amplifier can not exceed the supply voltage. This is shown by the flattening of the graph near $V+$ above.

Typical values for $R1$ would be 10Kohm and for $R2$ would be 1Mohm. This would result in a gain of 101.



Comparator with hysteresis



A comparator circuit is used to compare a signal to a defined reference voltage. In the above circuit, when V_{in} is lower than V_{ref} the output will be low (GND). When V_{in} is greater than V_{ref} the output will switch to a high state ($V+$). This is shown by the graph above right.

Hysteresis is used to ensure a clean transition when the V_{in} crosses the reference voltage. Without it the output could bounce on, off, on, off, etc.. between the two possible output levels. Hysteresis is the amount by which the V_{in} signal, once it has caused the output to switch, would have to change in the opposite direction (high or low) to result in V_{out} switching back.

The resistors $R1$ and $R2$ provide the hysteresis function.

The amount of hysteresis is given by:

$$dV = V+ \times (R1/R2)$$

Typical values for $R1$ would be 10Kohm and for $R2$ would be 1Mohm. This would result in a dV of 0.01V.