

741 OPERATIONAL AMPLIFIER

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741 OPERATIONAL AMPLIFIER

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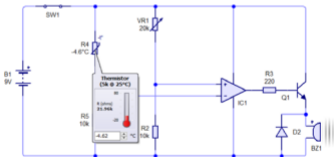
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INTRODUCTION - THE 741 OPERATIONAL AMPLIFIER

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741 Operational Amplifiers (also known as Op Amps), are used in a range of circuits. They are generally used to amplify weak electrical current in a circuit. Radios, stereo systems, headphones, TVs and many other electrical products include an operational amplifier, as a component in many of their circuits. Circuits such as moisture sensors, light / dark sensors, movement sensors, sound sensors etc.. often include operational amplifiers. A typical Op Amp circuit is shown below.

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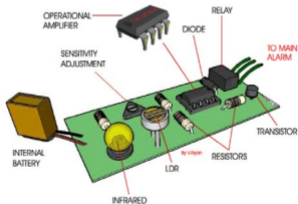
Op Amp ALARM CIRCUIT

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The circuit below is part of a larger alarm circuit.

When it detects movement (ie. an intruder) it sends a signal to the main alarm system which sounds the siren. Without the Operational Amplifier Integrated Circuit, the signal would be too weak for the main alarm system to detect. The Operational Amplifier increases the signal, so that it is strong enough and the main alarm circuit sounds the siren.

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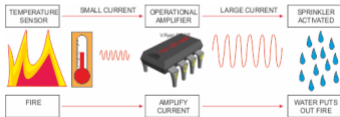


THE Op Amp USED AS AN AMPLIFIER WITH SENSORS

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Sometimes it is necessary to increase the current in a circuit. This is especially important if a sensor is being used as an input. Sensors are often used to switch on other devices. For example, a temperature sensor may be used to detect fire and then to turn on a water sprinkler system to put the fire out. Look at the example below.

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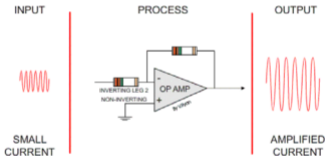


THE Op Amp USED AS AN AMPLIFIER WITH SENSORS

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The diagram below clearly shows how a small current (sometimes called a signal) is amplified by the Operational Amplifier to produce a larger current (signal)

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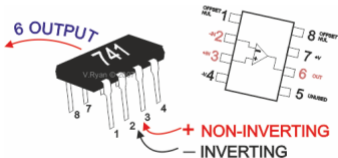
THE 741 Op Amp – MORE DETAIL

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The Operational Amplifier is probably the most versatile Integrated Circuit available. It is very cheap especially keeping in mind the fact that it contains several hundred components. The most common Op-Amp is the 741 and it is used in many circuits. The OP AMP is a 'Linear Amplifier' with an amazing variety of uses. Its main purpose is to amplify (increase) a weak signal - a little like a Darlington Pair.

The OP-AMP has two inputs, INVERTING (-) and NON-INVERTING (+), and one output at pin 6.

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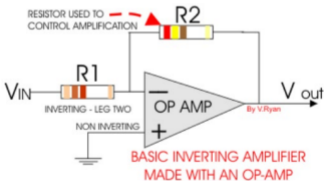


NON-INVERTING AND INVERTING 741 AMPLIFIERS

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Below, is a diagram of an INVERTING AMPLIFIER. This means that if the voltage going into the 741 chip is positive, it is negative when it comes out of the 741. In other words it reverses polarity (inverts polarity). Two resistors are needed to make the 741 work as an amplifier, R1 and R2. In most text books diagrams like this are used to represent the 741.

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HOW TO CALCULATE THE 'GAIN'

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An operational amplifiers purpose is to amplify a weak signal and this is called the GAIN.

Tap the image below for information / an exercise, calculating GAIN

INVERTING AMPLIFIER

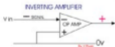
$$\text{GAIN (AV)} = -R2 / R1$$

Example : if R2 is 100 kilo-ohm and R1 is 10 kilo-ohm the gain would be :

$$-100 / 10 = -10 \text{ (Gain AV)}$$

If the input voltage is 0.5v the output voltage would be :

$$0.5v \times -10 = -5v$$



The polarity of a signal is reversed at the output, pin six.

A negative input becomes a positive output.

NON-INVERTING AMPLIFIER

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

Example : if R2 is 1000 kilo-ohm and R1 is 100 kilo-ohm the gain would be :

$$1 + (1000/100) = 1 + 10$$

OR

$$\text{GAIN (AV)} = 11$$

If the input voltage is 0.5v the output voltage would be :

$$0.5 \times 11 = 5.5v$$



A signal applied keeps its polarity at the output, pin six.

A positive input remains a positive output.

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OP-AMPS AS COMPARATORS

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The 741 can be used as a comparator and not an amplifier. A 'comparator' is an circuit that compares two input voltages. One voltage is called the reference voltage (V_{ref}) and the other is called the input voltage (V_{in}).

When V_{in} rises above or falls below V_{ref} the output changes polarity (+ becomes -).

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OP-AMPS AS COMPARATORS

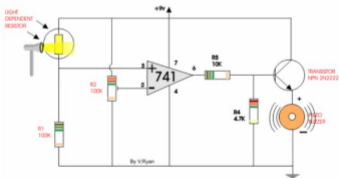
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EXAMPLE CIRCUIT - LIGHT ACTIVATED ALERTER

The buzzer emits a tone when light falls on the light dependent resistor. Resistor 2 controls the sensitivity of the circuit.

The 741 is working as a comparator and the piezo buzzer sounds when the output from the 741 goes 'low' or in other words, changes from a positive to a negative.

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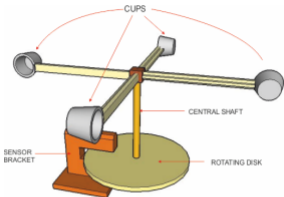


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741 OPERATIONAL AMPLIFIER COMPARATOR EXAMINATION QUESTION AND INFORMATION

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VIDEOS OF 741 CIRCUITS

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Light / Dark
Sensor



Temperature
Sensor

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