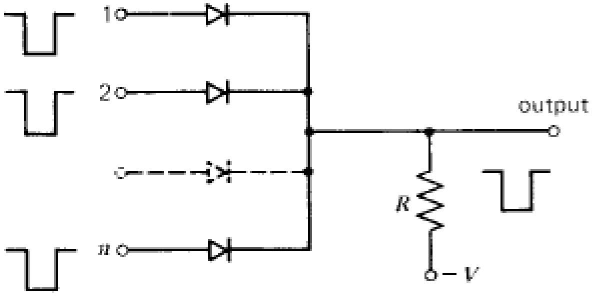
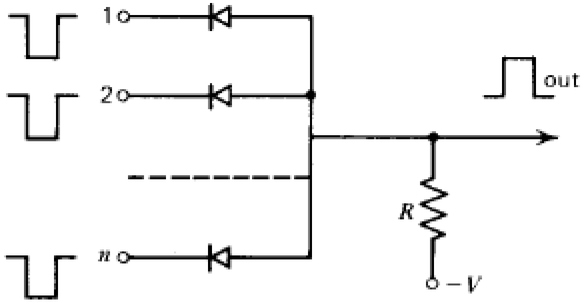
Diode in logic circuits

- The diode used in a lot of circuits such as the AND gate

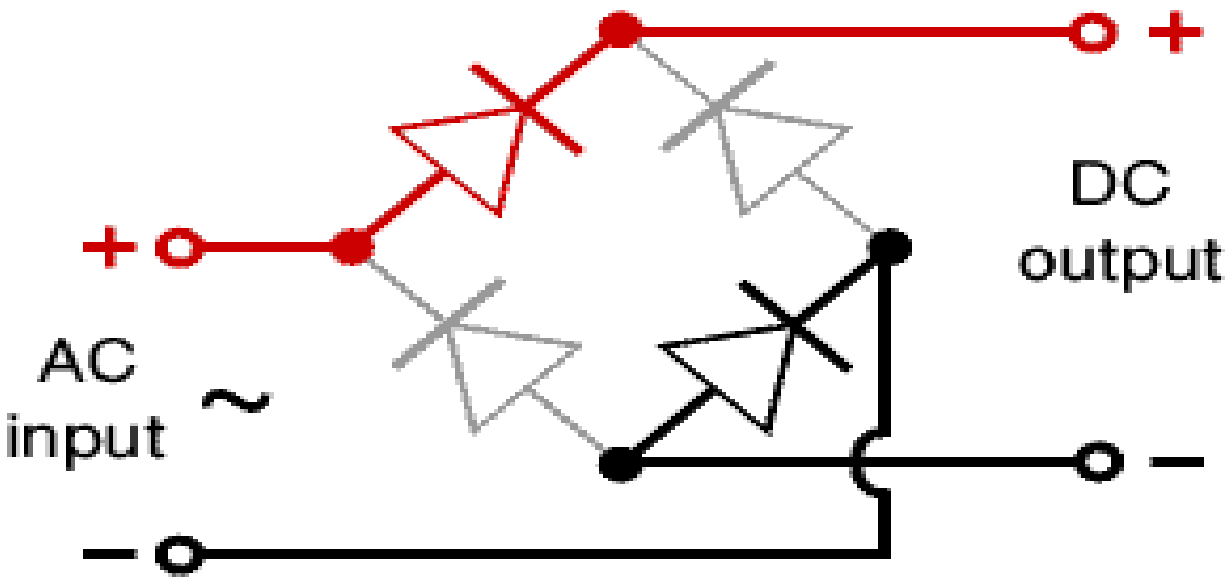


- The OR gate



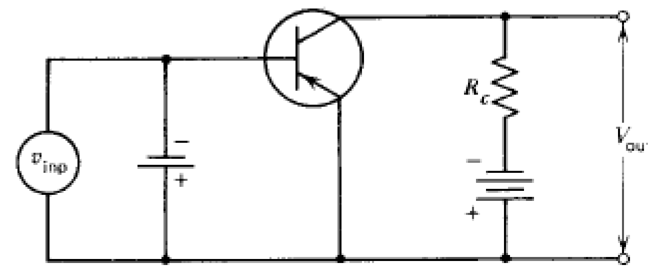
Diode in logic circuits

- Diode in rectifier circuits
- Full wave rectifier



Transistor in logic circuits

- As amplifier



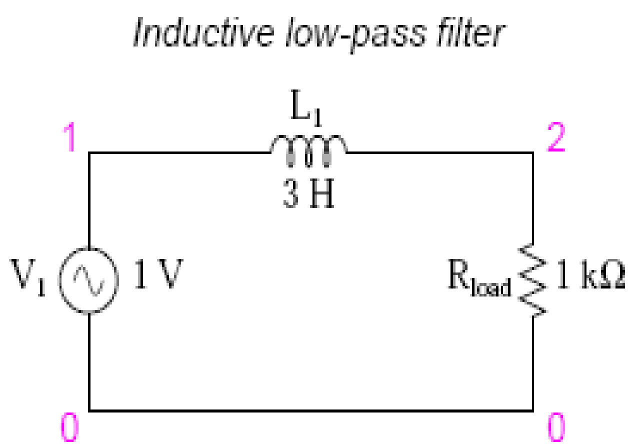
FILTERS

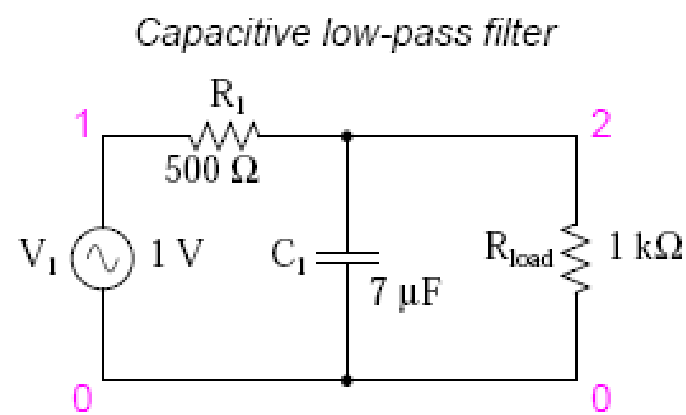
- It is sometimes desirable to have circuits capable of selectively filtering one frequency or range of frequencies out of a mix of different frequencies in a circuit. A circuit designed to perform this frequency selection is called a filter circuit, or simply a filter.

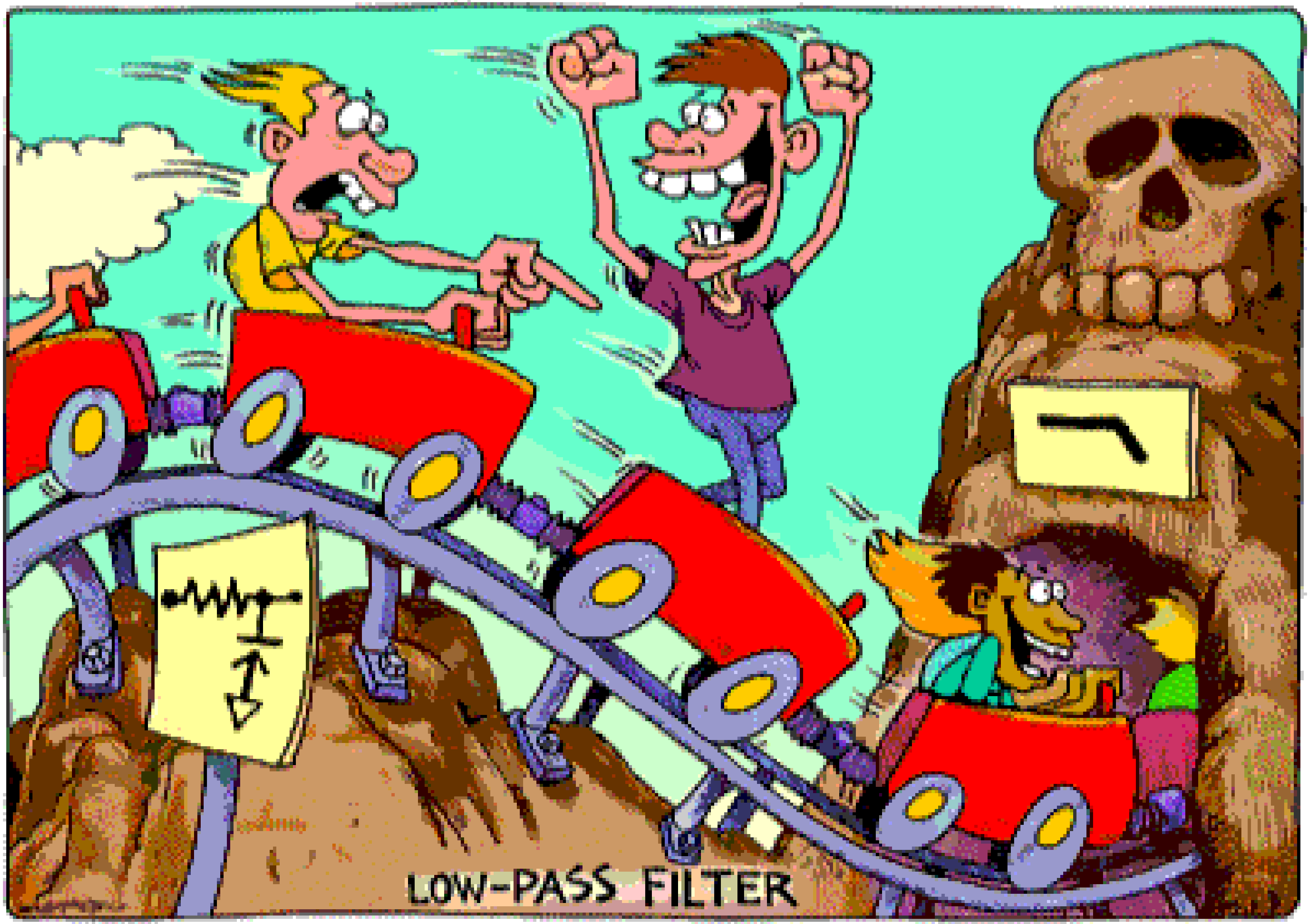
- A filter is an AC circuit that separates some frequencies from others in within mixed-frequency signals.
- Audio equalizers and crossover networks are two well-known applications of filter circuits.
- A Bode plot is a graph plotting waveform amplitude or phase on one axis and frequency on the other.

Low-pass filters

- By definition, a low-pass filter is a circuit offering easy passage to low-frequency signals and difficult passage to high-frequency signals. There are two basic kinds of circuits capable of accomplishing this objective, and ach



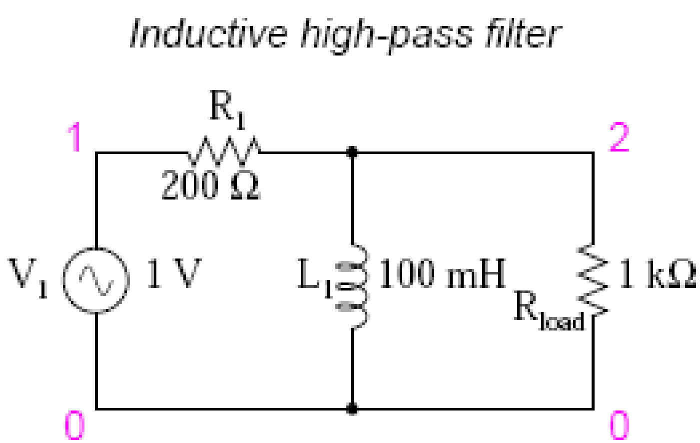


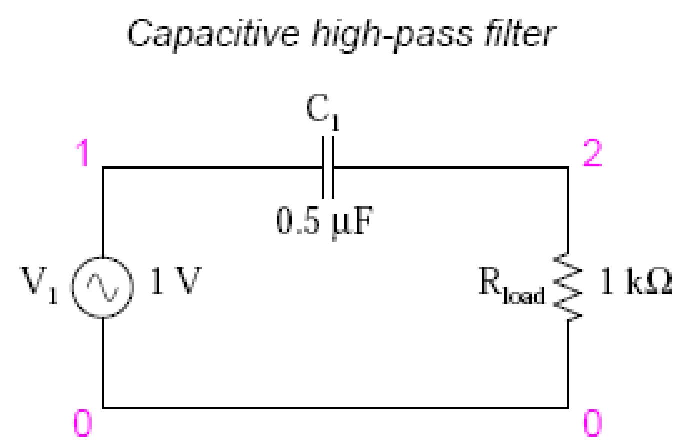


LOW-PASS FILTER

High-pass filters

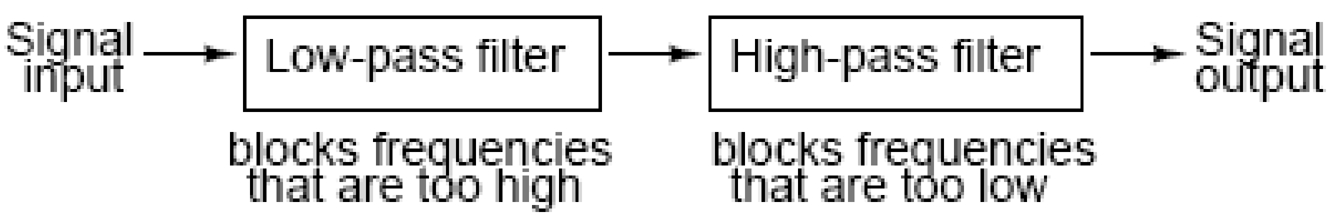
- A high-pass filter's task is just the opposite of a low-pass filter: to offer easy passage of a high- frequency signal and difficult passage to a low-frequency signal. As one might expect, the inductive and capacitive versions of the high-pass filter are just



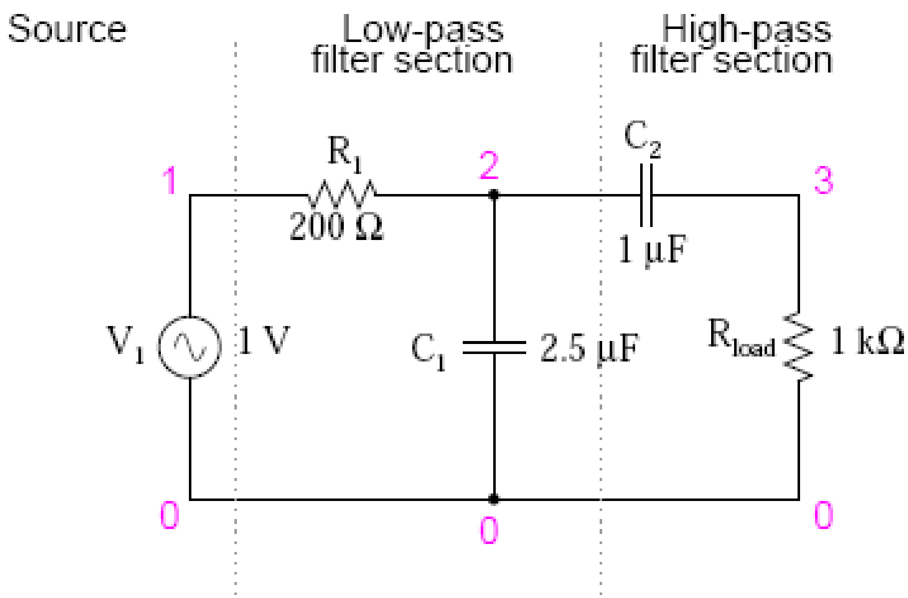


Band-pass filters

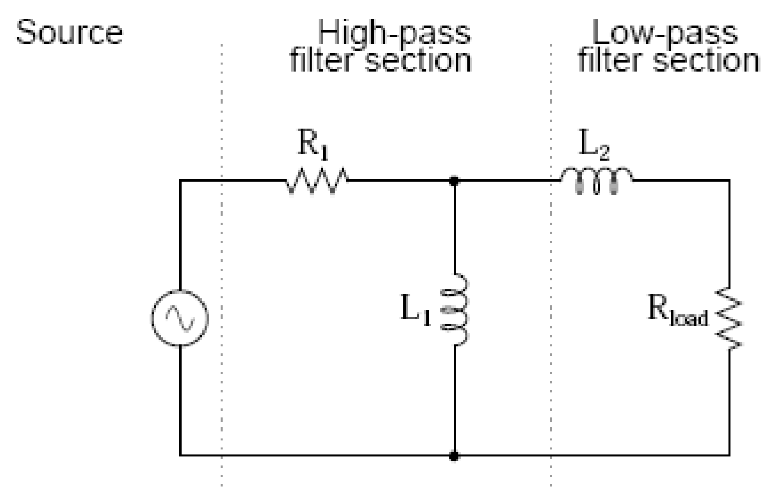
- There are applications where a particular band, or spread, or frequencies need to be filtered from a wider range of mixed signals. Filter circuits can be designed to accomplish this task by combining the properties of low-pass and high-pass into a single filter. The result is called a band-pass filter. Creating a ba… s filt…



Capacitive band-pass filter

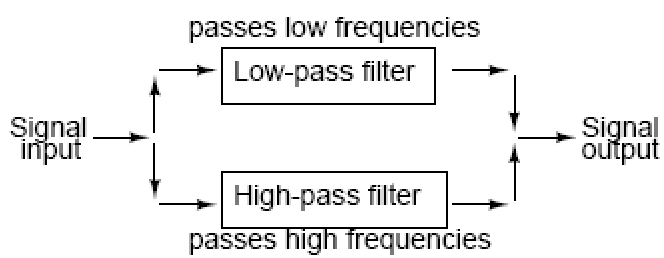


Inductive band-pass filter

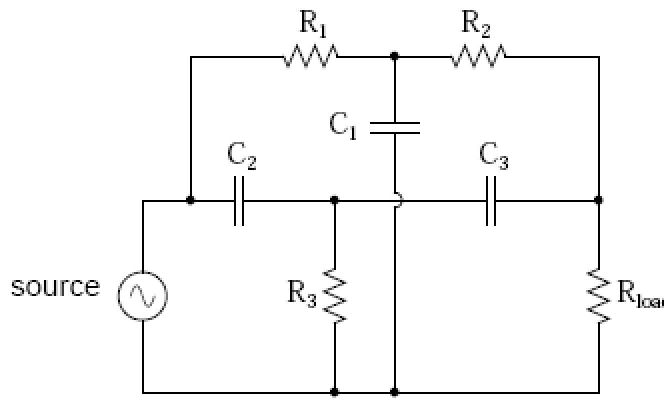


Band-stop filters

- Also called band-elimination, band-reject, or notch filters, this kind of filter passes all frequencies above and below a particular range set by the component values. Not surprisingly, it can be made out of a low-pass and a high-pass filter, just like the band-pass design, except that this time we connect the two filter s ith each other instead of



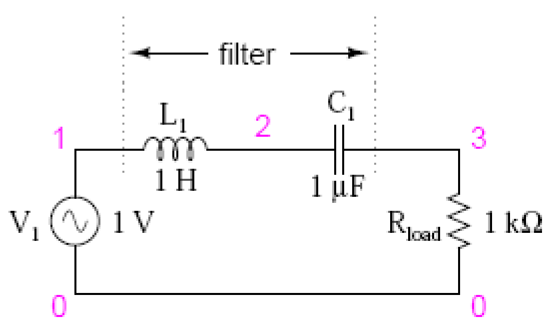
"Twin-T" band-stop filter



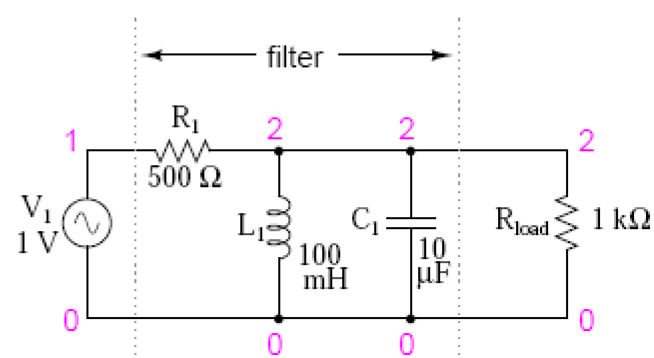
Resonant filters

- So far, the filter designs we've concentrated on have employed either capacitors or inductors, but never both at the same time. We should know by now that combinations of L and C will tend to resonate, and this
; band-

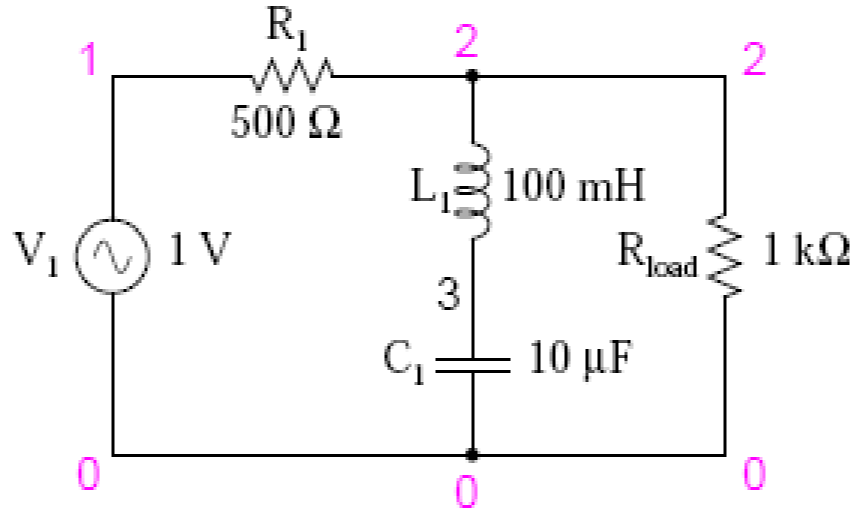
Series resonant band-pass filter



Parallel resonant band-pass filter



Series resonant band-stop filter



Problem 1:

- You have a signal that has frequency components at 100Hz or less. The signal is corrupted by a strong signal at 1000Hz. You need to reduce the effect of the 1000Hz signal by a factor of 10. The filter circuit below is proposed.
  - You need to design a filter (in this case, specify a time constant for the filter) that will reduce the 1000 Hz signal by a factor of 10.
  - When you put the entire signal into the filter, how much will the signal at 100Hz be affected?

Problem 2:

- You have a very slowly varying temperature signal that can be considered to have all frequency components below 1Hz. That temperature signal is measured with a sensor that is susceptible to 60Hz noise (from the power line). Here are the salient facts.
- At room temperature, the temperature sensor has an output of around 0.3v.
- The 60Hz signal has a peak amplitude of 0.1v.
- An RC filter is suggested as shown below.
- The capacitor is 1.0**m**f.
- Determine R so that the 60Hz noise is reduced to .01v.
- Determine how much a 1Hz signal will be affected in your design.

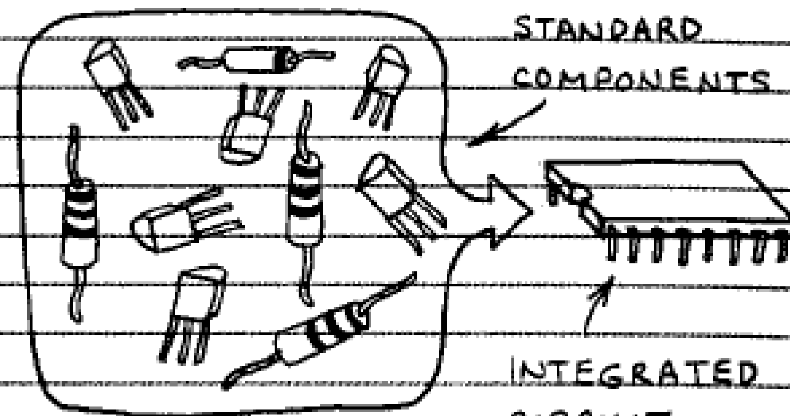
Problem 3:

- You need to filter some noise from a signal. The requirements are as follows.
- The signal has strong varying components that can be as high in frequency as 10 Hz.
- The noise is at 60 Hz.
- The signal must past through the filter without changing by more than 1%.
- Determine the most attenuation that can be achieved for the noise.

Problem 4:

- You need to filter some noise from a signal. The requirements are as follows.
- The signal has strong varying components that can be as high in frequency as 10 Hz.
- The noise is at 60 Hz.
- The signal must past through the filter without changing by more than 1%.
- The noise must be attenuated to less than 10% of the present value.
- Determine if you can use a two stage filter to achieve the specifications.

ELECTRONIC CIRCUITS CAN BE MADE BY SIMULTANEOUSLY FORMING INDIVIDUAL TRANSISTORS, DIODES AND RESISTORS ON A SMALL CHIP OF SILICON. THE COMPONENTS ARE CONNECTED TO ONE ANOTHER WITH ALUMINUM "WIRES" DEPOSITED ON THE SURFACE OF THE CHIP. THE RESULT IS AN INTEGRATED CIRCUIT.

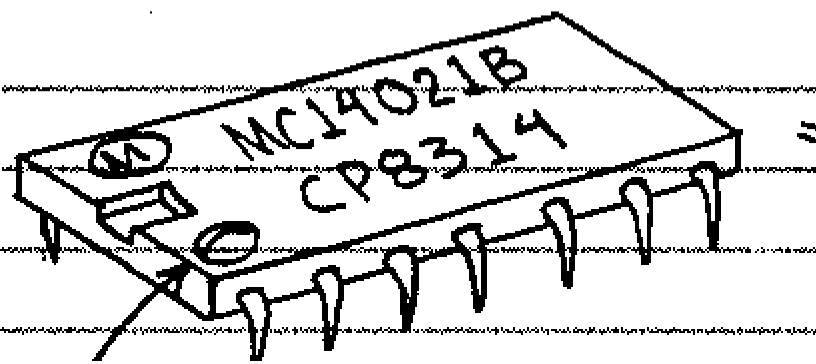


Integrated Circuits

☐ KINDS OF INTEGRATED CIRCUITS — INTEGRATED CIRCUITS ARE GROUPED INTO TWO MAJOR CATEGORIES:

1. ANALOG (OR LINEAR) IC'S PRODUCE, AMPLIFY OR RESPOND TO VARIABLE VOLTAGES. ANALOG IC'S INCLUDE MANY KINDS OF AMPLIFIERS, TIMERS, OSCILLATORS AND VOLTAGE REGULATORS.

2. DIGITAL (OR LOGIC) IC'S RESPOND TO OR PRODUCE SIGNALS HAVING ONLY TWO VOLTAGE LEVELS. DIGITAL IC'S INCLUDE MICROPROCESSORS, MEMORIES, MICROCOMPUTERS AND MANY KINDS OF SIMPLER CHIPS.

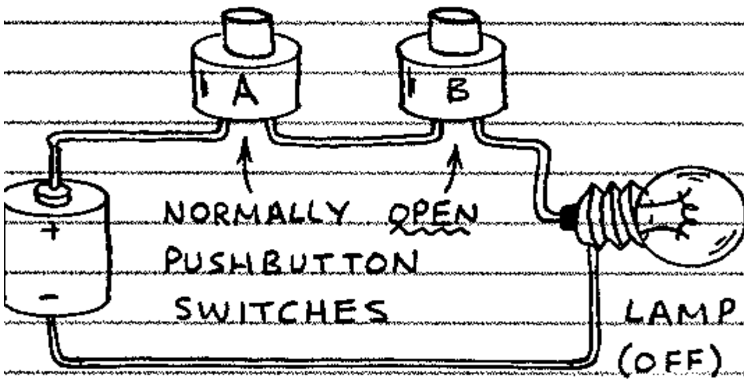


Digital integrated circuits

NO MATTER HOW COMPLICATED, ALL DIGITAL INTEGRATED CIRCUITS ARE MADE FROM SIMPLE BUILDING BLOCKS CALLED GATES. GATES ARE LIKE ELECTRONICALLY CON-TROLLED SWITCHES. THEY ARE EITHER ON OR OFF. HOW DO GATES WORK? LET'S START WITH THE BASICS...

☐ SWITCH "AND" GATE.

THE LAMP GLOWS ONLY WHEN SWITCHES A AND B ARE CLOSED. THE TABLE SUMMARIZES THE GATE'S OPERATION. IT'S CALLED A TRUTH TABLE.



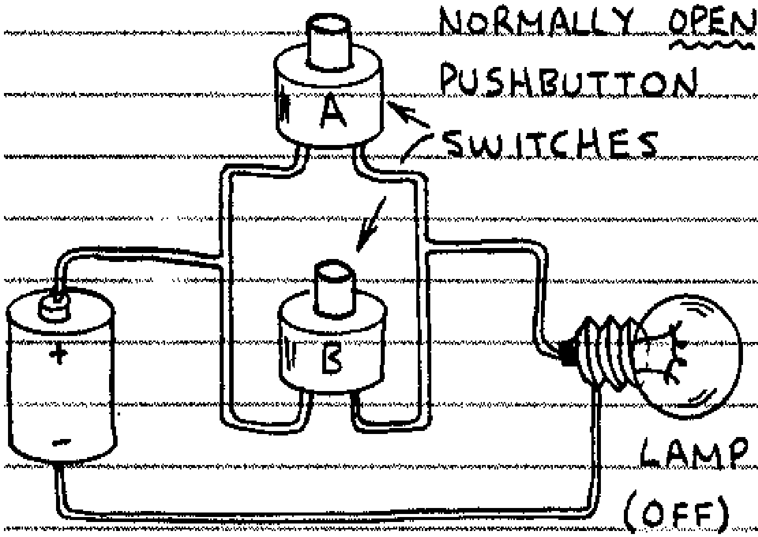
OPEN SWITCH = OFF
CLOSED SWITCH = ON

A	B	OUT
OFF	OFF	OFF
OFF	ON	OFF
ON	OFF	OFF
ON	ON	ON

ALL POSSIBLE ON-OFF COMBINATIONS

☐ SWITCH "OR" GATE.

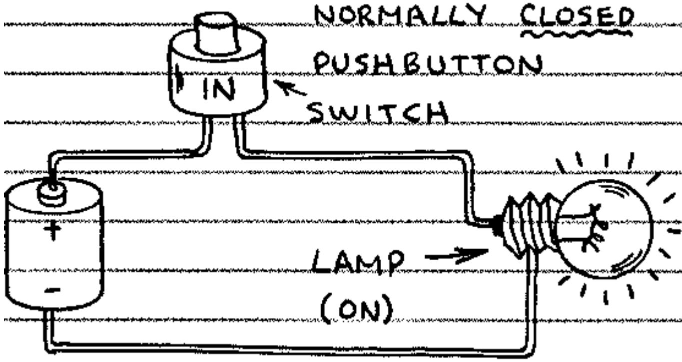
THE LAMP GLOWS ONLY WHEN SWITCH A OR SWITCH B OR BOTH SWITCHES A AND B ARE CLOSED. HERE'S THE TRUTH TABLE:



A	B	OUT
OFF	OFF	OFF
OFF	ON	ON
ON	OFF	ON
ON	ON	ON

THE SWITCHES ARE THE GATE'S INPUTS. THE LEAD WITHOUT SWITCHES IS THE COMMON OR GROUND LEAD.

☐ SWITCH "NOT" GATE.



THE LAMP NORMALLY GLOWS. ONLY WHEN THE SWITCH IS OPENED IS THE LAMP OFF. IN OTHER WORDS, THE "NOT" GATE REVERSES (INVERTS) THE USUAL ACTION OF A SWITCH. HERE'S THE TRUTH TABLE:

THE "NOT" GATE IS USUALLY CALLED THE INVERTER.

IN	OUT
OFF	ON
ON	OFF

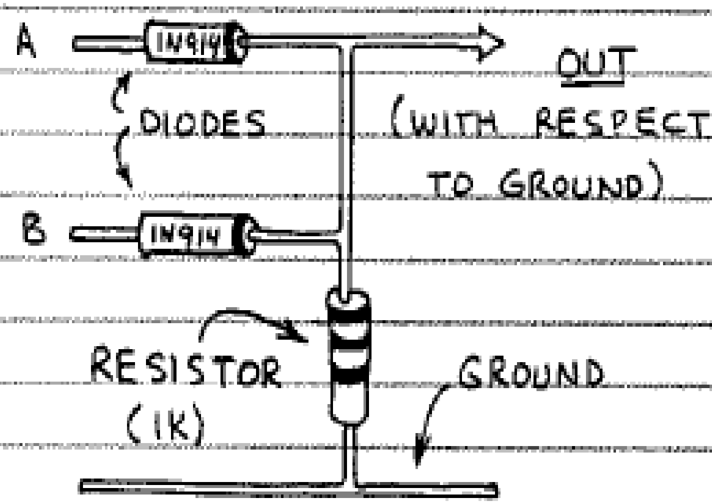
A BINARY 0 OR 1 IS A BIT.
A PATTERN OF 4 BITS IS A NIBBLE.
A PATTERN OF 8 BITS IS A BYTE.

BCD— EACH DECIMAL DIGIT IS ASSIGNED ITS BINARY EQUIVALENT. NOTE THAT LEADING ZEROS ARE SHOWN. IN DIGITAL ELECTRONICS ALL BIT LOCATIONS ARE OCCUPIED.

DIODE GATES

OFTEN IT'S DESIRABLE TO CONTROL A GATE ELECTRICALLY RATHER THAN MECHANICALLY. THE SIMPLEST ELECTRICALLY CONTROLLED GATE USES PN JUNCTION DIODES THAT ARE SWITCHED ON (FORWARD BIAS) OR OFF (REVERSE BIAS) BY AN INPUT SIGNAL OF SEVERAL VOLTS (BINARY 1 OR HIGH) OR AN INPUT NEAR OR AT GROUND (BINARY 0 OR LOW).

☐ DIODE "OR" GATE



☐ DIODE "AND" GATE