The Art of Electronics

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Start Date: July 16, 2025 || Last Modified: July 16, 2025

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1 Digital Locic

1.1 Basic Logic Concept

1.1.1 Digital versus Analog

Thus far we have been dealing with circuit in which the input and output voltages have varied over a continuous range of values:

(a) RC Circuti

(b) amplifiers

(c) integrators

(d) rectifiers

(e) op-amp

This is natural when dealing with signals that are continuous (e.g., audio signal) or continuously varying voltages from measuring instrument (e.g., temperataure-reading or light-detecting devices, or biological or chemical probe).

However, there are instances in which the input signal is naturally discrete in form e.g., Pulse from a Particle Detector, or ”bits” of data from a switch, keybord, or computer. Furthermore, it is often desirable to convert continuous (analog) data to digital form, and vice versa using Digital-to-Analog Convertres (DACs) or Analog-to-Digital Convertres (ADCs).

Another interesting example of the power of digital techniques is the transmission of analog signals without degradation by noise: an analog audio or video signal, for instance, picks up ”noise” while being transmitted by cable or wireless that cannot be removed. If, instead, the signal is converted to a series of numbers representing its amplitude at successive instants of time, and these numbers are transmitted as digital signal, the analog signal reconstruction at the receiving end (done with DACs) will be without error, providing the noise level on the transmission channel isn't great enough to prevent accurate recognition of 1s and 0s. This technique, known as PCM (Pulse-Code-Modulation), is particularly attractive where a signal must pass through a series of ”repeaters”, simce digital regeneration at each stage gurantees noiseless transmission.

The information and stunning pictures sent back by planetary deep space probes, for example the Pioneer 10 mission to Jupiter in 1973, were stored and transmitted with PCM.

1.1.2 Logic States

By "Digital Electronics" we means circuit in which there are only two (usually) states possible at any point e.g., a transistor that can either be in saturation or be nonconducting.

A. HIGH and LOW

The HIGH and LOW voltage states represent the TRUE and FALSE states of Boolean logic, in some predefined way. If at some point a HIGH voltage represents TRUE, that signal line is called "actice high" (or "HIGH true") Figure below shows an example. SWITCH CLOSED is true when the output is low; that's an "active-LOW" (or "LOW-true") signal, and you might label the lead as shown (a bar over a symbol means NOT; that line is HIGH when the swithc is *not* closed)

Just remember the presence of **negation bar** over the label tells whether the wire is at a LOW or HIGH voltage state when the stated condition (SWITHC CLOSED) is true.[1]

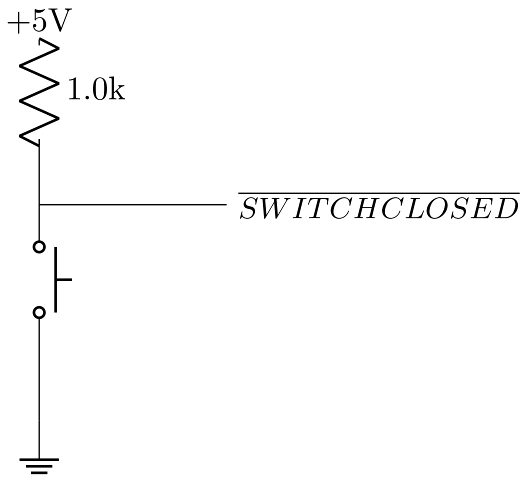

Figure 1: A LOW-true ("active-LOW") logic level.

B. Voltage range of HIGH and LOW

[1] "Positive-true" and "Negative-ture" used for HIGH-true and LOW-true, respectively.

2 Computer, Controller, and Data Link

In Ch 14 and 15 we will deal with computer and controllers (with the common alternative name of microcontroller).

3 Microcontrollers