4-7 The Comparator.

A device that discriminates between two unequal voltages is called a comparator.

The circuit shown above is called a zero crossing detector.

If $V_P > V_N$ then $V_o = +$ saturation

If $V_P < V_N$ then $V_o = -$ saturation

Input/output signals:

$+5$

Threshold can be shifted by putting a voltage on $V_N$
Example 4-24

No feedback so this is a comparator. The threshold (switching point) is at $V = +5\,\text{volts}$.

When $V_S < +5\,\text{volts}$, $V_o = 0 \Rightarrow \text{Lamp 1 ON, Lamp 2 OFF}$

$V_S > +5\,\text{volts}$, $V_o = +15 \Rightarrow \text{Lamp 1 OFF, Lamp 2 ON}$
Instrumentation Systems

Transducer → Signal Conditioning → Amplification → ADC

- can be filtering, linearization, etc.
- need amplification to get signal up to useful level.
- converts analog to digital
Example

Voltage (mV)

Characteristics of photocell transducer

need to measure 5-20 lumens input to a 0-5V ADC

We need to convert

\[ 5 \text{ lumens} \rightarrow 0.2 \text{ mV} \rightarrow 0 \text{ volts} \]

\[ 20 \text{ lumens} \rightarrow 0.6 \text{ mV} \rightarrow 5 \text{ volts} \]

physical input from transducer to ADC

This requires an amplifier with a DC offset

The amplifier gain necessary is

\[ k = \frac{\text{desired output}}{\text{transducer output}} = \frac{5 - 0}{(0.6 - 0.2) \times 10^{-3}} = 1250 \]

This is a lot of gain so we implement it as two amplifiers

0.2-0.6 mV \rightarrow \text{K}_1 = 100 \rightarrow + \rightarrow \text{K}_2 = 125 \rightarrow 0-5 \text{ volts} \]

shift to 0-40 mV

20-60 mV

20 mV