DC CONTROLLERS

Primarily Four Basic Components

1. Oscillator with Pulse Width Modulation
2. Driver
3. Output
4. Feedback

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OSCILLATOR with PWM

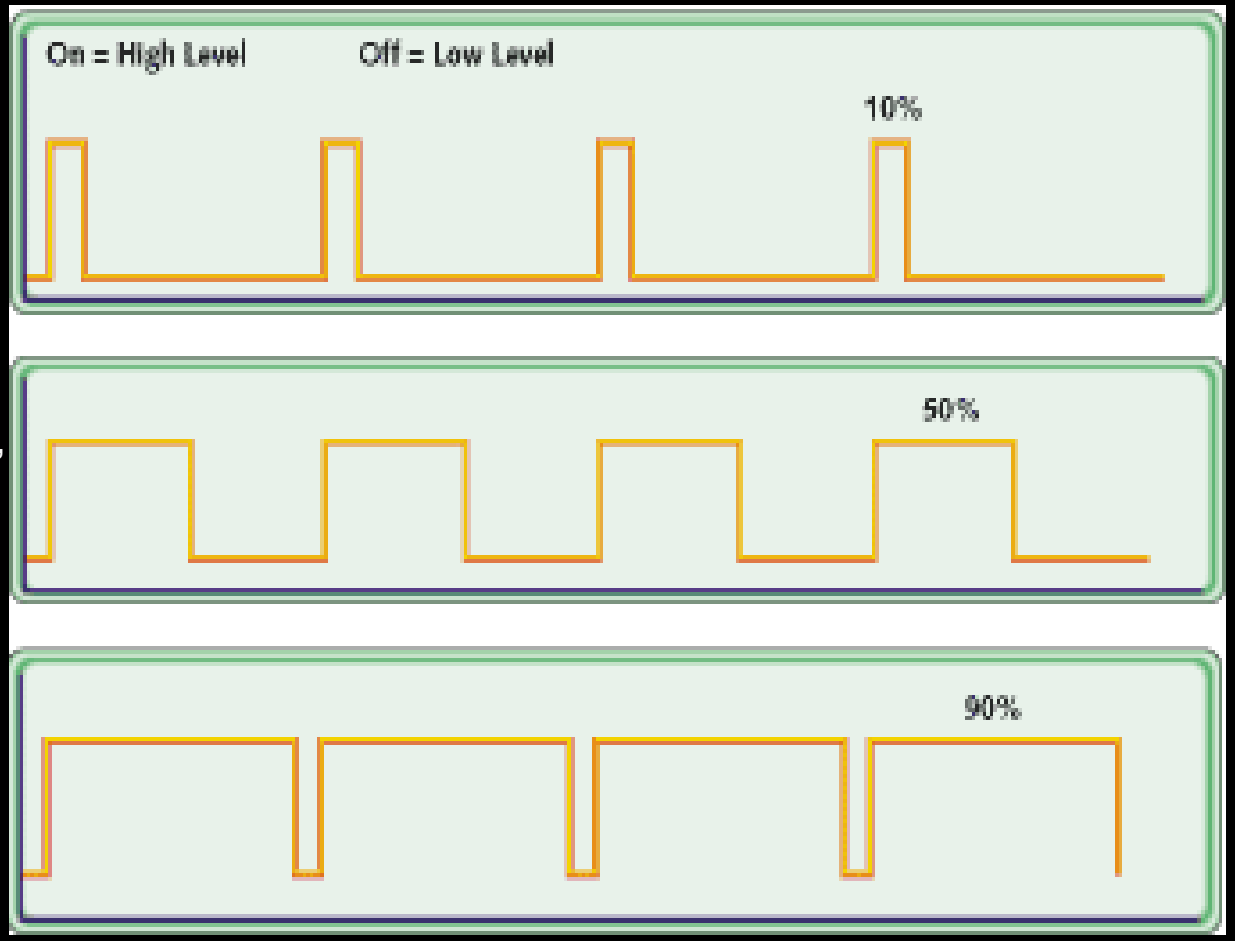
The Oscillator runs at a set frequency.

The pulse width modulation is used to drive the MOSFETs, that control the motor.

Pulse width modulation is the process of switching the power to a device on and off at a set frequency, with varying on and off times.

These power on and power off times are referred to as "duty cycle".

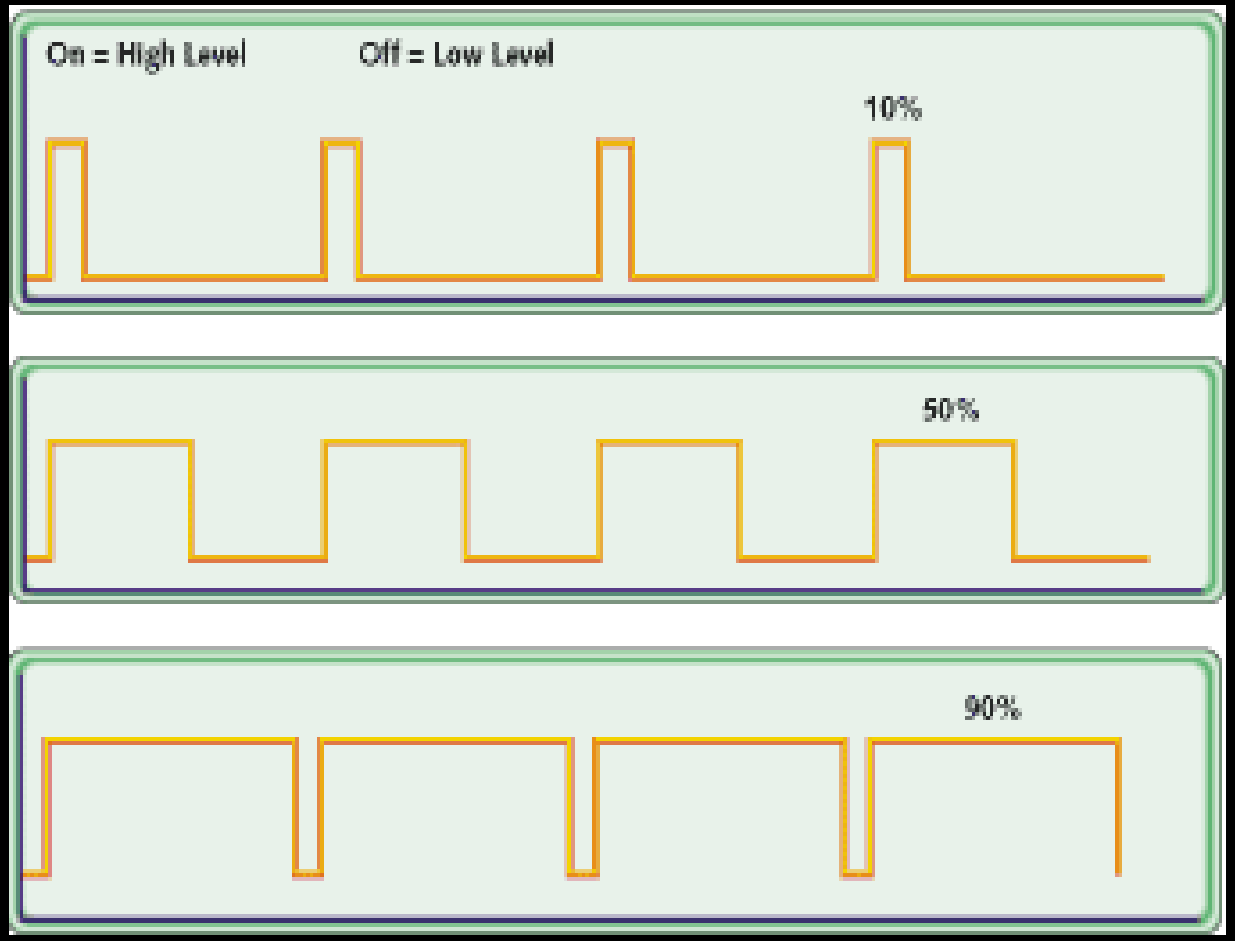
The diagram shows the waveform of power on for 10%, power on for 50%, and power on for 90% duty cycle signals.



A 10% duty cycle signal is on for 10% of the wavelength and off for 90%,
And a 90% duty cycle signal is on for 90% and off for 10%.

These signals are sent to the motor at a high enough frequency that the pulsing has no effect on the motor.

The end result of the PWM process is that the overall power sent to the motor can be adjusted from off (0% duty cycle) to full on (100% duty cycle) with good efficiency and stable control.



DRIVER

The driver amplifies the output of the PWM and couples it to the input of the Mosfet/s

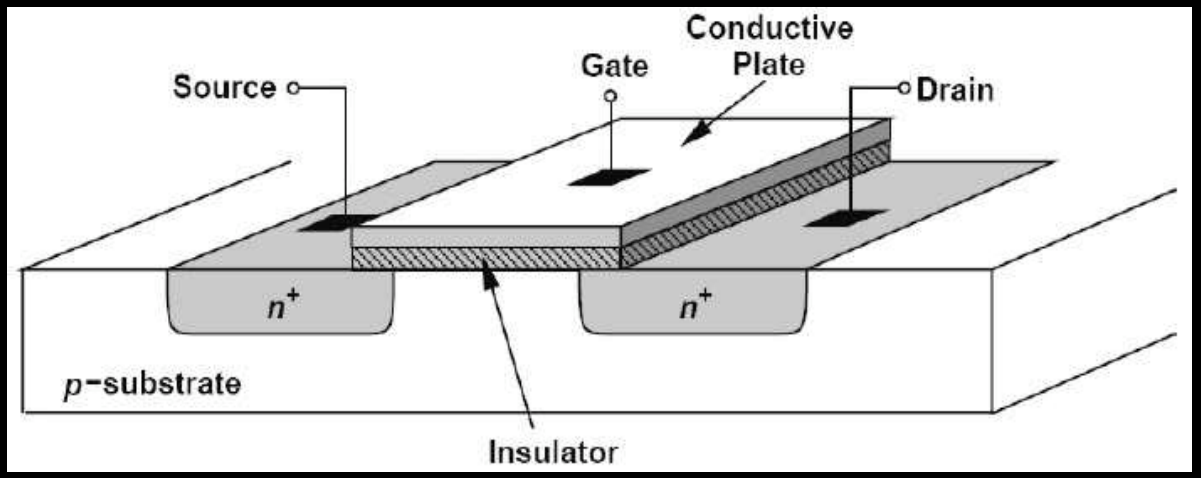
Drivers may be optically isolated

OUTPUT

THE MOSFET

Metal-Oxide-Semiconductor

Field-Effect Transistor



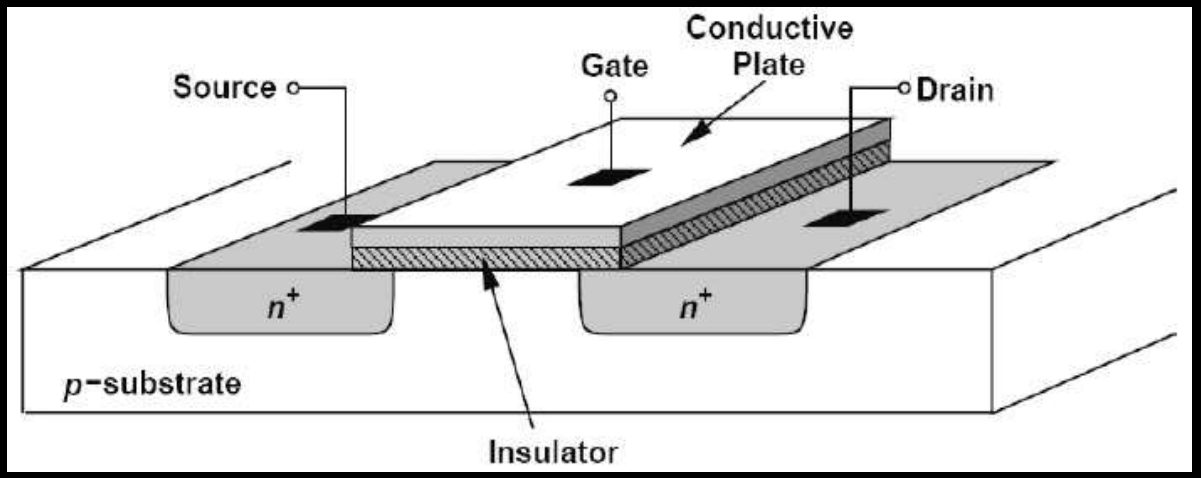
The majority of DC controllers use MOSFETs to manage the high voltages and currents required to drive electric vehicles.

A MOSFET consists of a conductive gate, a layer of insulating oxide, and a silicon substrate.

In modern MOSFETs polysilicon is generally used as the gate material (with a few exceptions that still use metal), and the insulating oxide material is typically silicon dioxide, again with few exceptions.

There are two types of MOSFETs. N-type MOSFET, and P-type MOSFET .

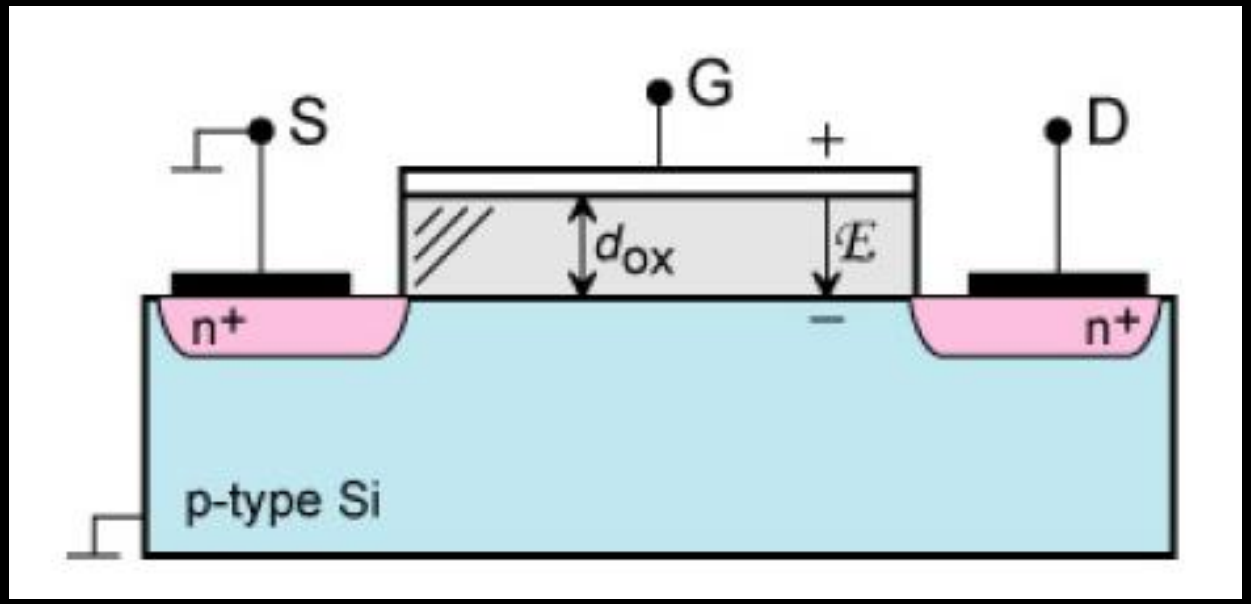
We will discuss the N type MOSFET.



P and N Type MATERIALS

N-type semiconductor materials have been doped with elements which have spare electrons in their outer shells. This gives N-type silicon free electrons (which are negatively charged particles) which can move about at will, with the potential to create current.

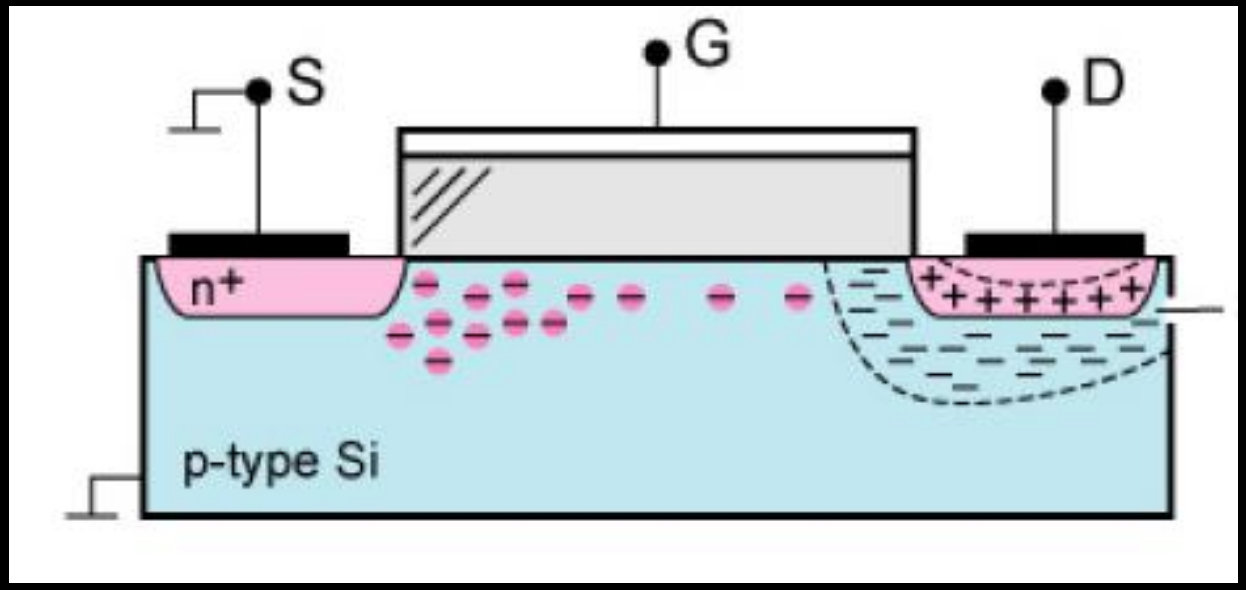
P-type semiconductor materials have been doped in the opposite way, with elements that have too few electrons in their outer shells. Therefore the opposite of electrons - holes - are free to move about within the material, with the potential to create current.



An N type MOSFET lies on a P-type substrate with an N-type source (S), drain (D), and gate (G).

The basic principle of the MOSFET is that the source (S) to drain (D) current is controlled by the gate (G) voltage.

The MOSFET is a voltage-controlled current source.



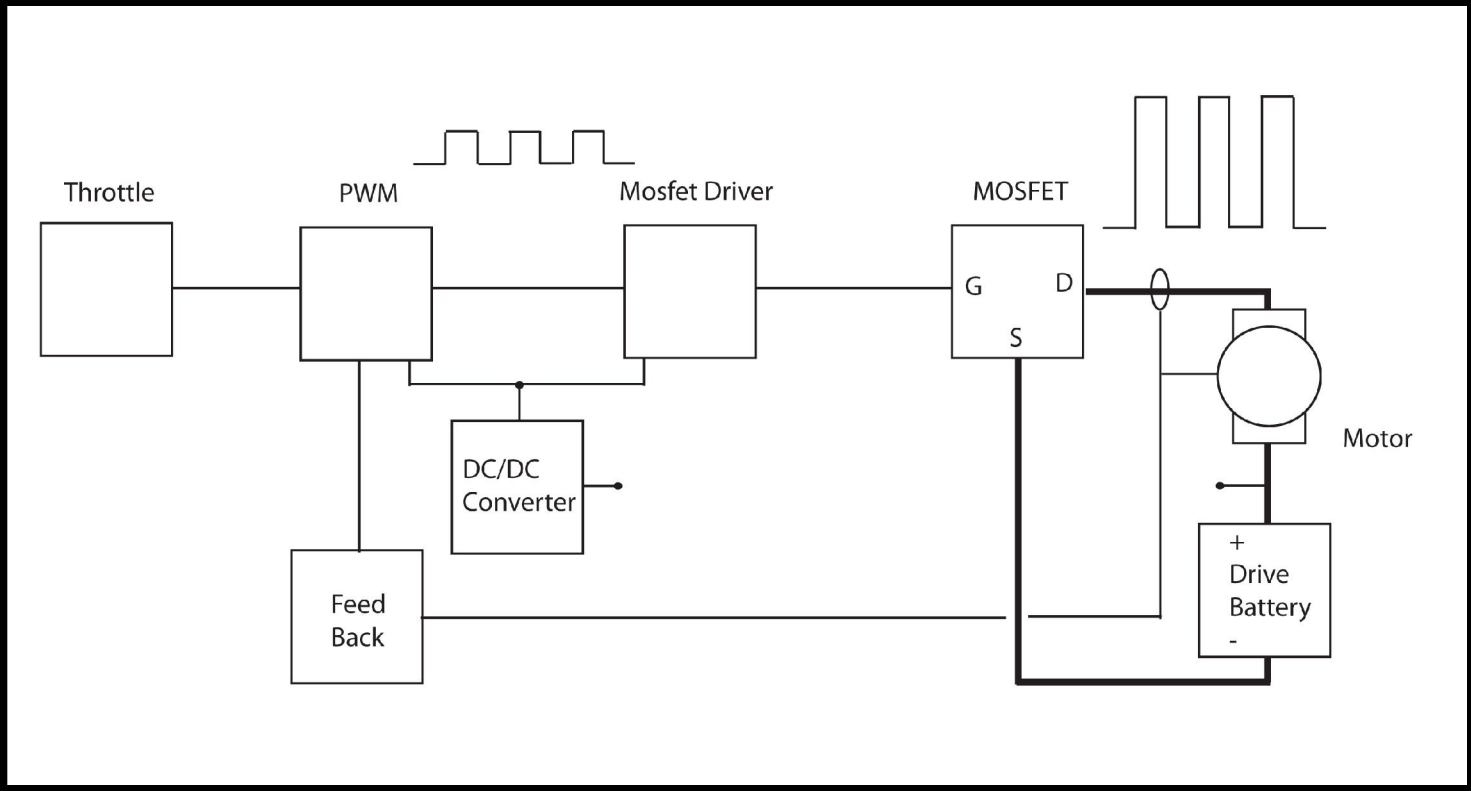
When the gate voltage is applied, it induces charge into the semiconductor at the insulating oxide interface.

The MOSFET then has a conducting channel formed by a layer of electrons, which connects the source (S) and drain (D).

When used in a controller the transition from on to off must be as fast as possible to avoid heat build up and possible damage to the MOSFET.

FEEDBACK

The Feedback component monitors the output of the Mosfets/Motor and modifies the operation of the PWM to suit the conditions



Above is a basic block diagram of a PWM controller using a MOSFET to drive the motor.

The Throttle controls the duty cycle of the PWM and inputs that to the Mosfet Driver. This provides sufficient energy to switch the MOSFETs. Some Drivers use an optical interface that to isolate the PWM from any high voltage that may destroy the Integrated Circuit.

The Feedback monitors the Mosfet output and Motor operation which over rides the throttle input to the PWM.

Thank You

Any Questions

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