A Little Theory of Class-D Amplifiers

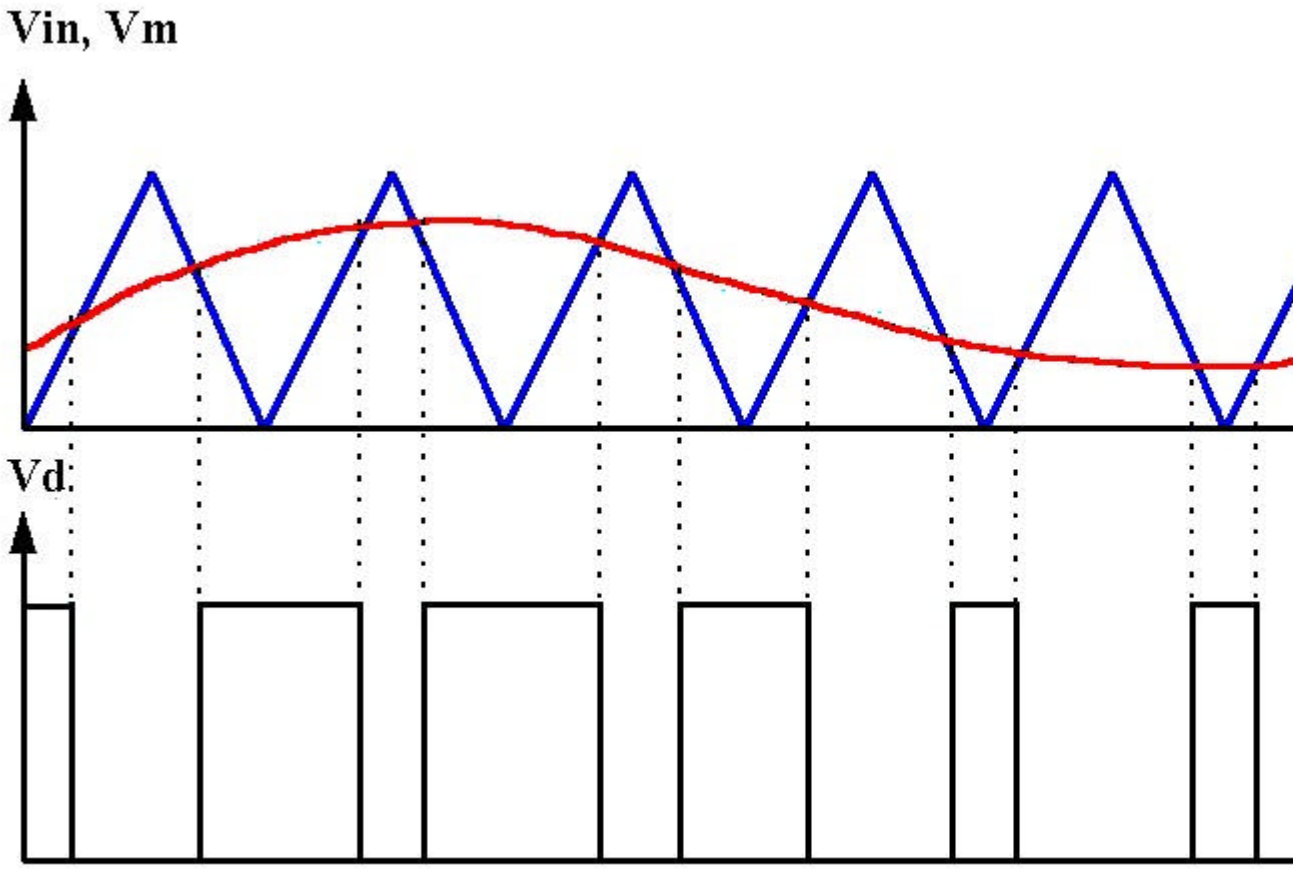
Why Class-D

It is a known fact that Class-A or Class-AB amplifiers are rather inefficient and therefore produces rather little power for the buck. When it comes to subwoofers, and electrical low frequency enhanced subwoofers in particular, the requirement for high power is quite evident, which makes such a system unnecessarily expensive if the power is delivered with conventional amplifier technique. This is where the class-d amp has it's strength. A class-d amplifier has an efficiency degree of normally more than 90%. That means that more than 90% of the power which is delivered into the amp from the power supply is transferred to the load, and less than 10% is transformed into heat.

This means that cost can be reduced for needed cooling, power supply and output transistors.

How does it work

A class-d amplifier uses Pulse Wide Modulation PWM (sometimes referred to as pulse duration modulation. This means that the original signal Vin at the input is modulated with another signal Vm which has a much higher fixed frequency. The waveform which is used as carrier wave or modulation signal is normally a sawtooth signal. The principle is actually quite simple to understand if you look at the figure below:

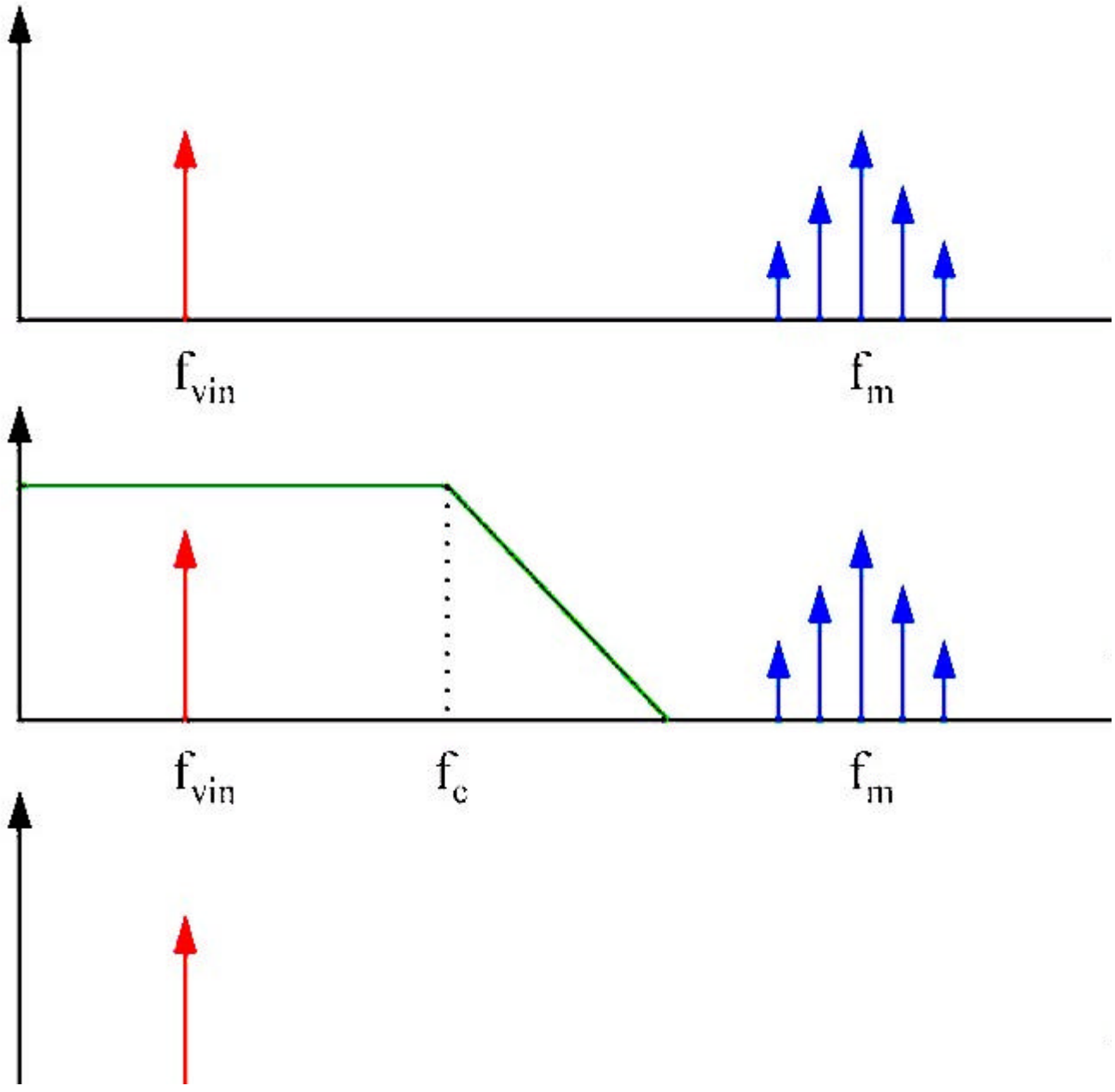


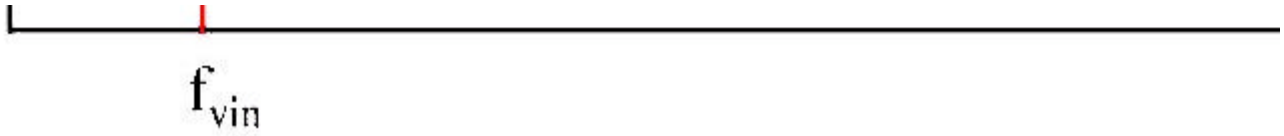
The red signal is Vin and the blue signal is the modulation signal Vm. The pulse width modulated signal Vd can be expressed as:

Vd = "1" if Vin > Vm

Now we have a discreet or digital signal which can only be either "0" or "1". The signal has a fundamental frequency equal to that of the modulation frequency fm (the frequency of the modulation signal Vm) but will also contain the input signal and a band of frequency components around the modulation frequency.

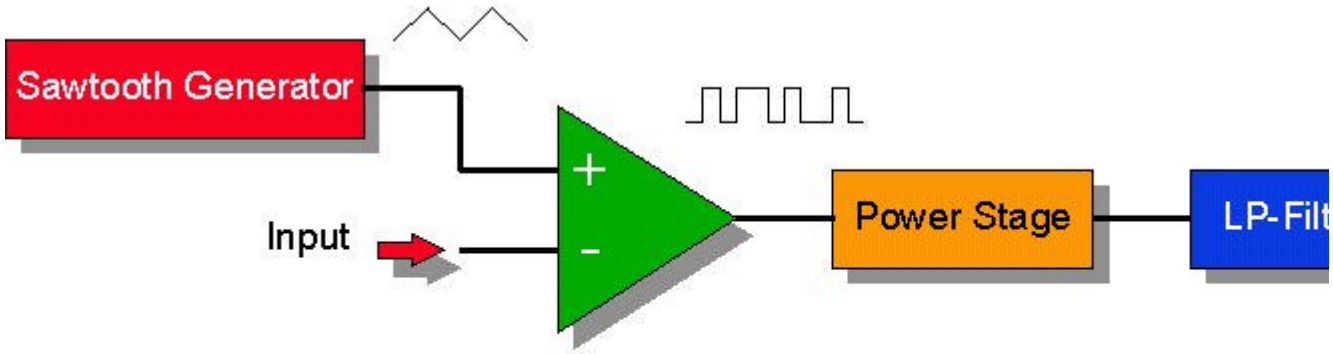
If the modulation frequency is much higher than that of the input signal Vin



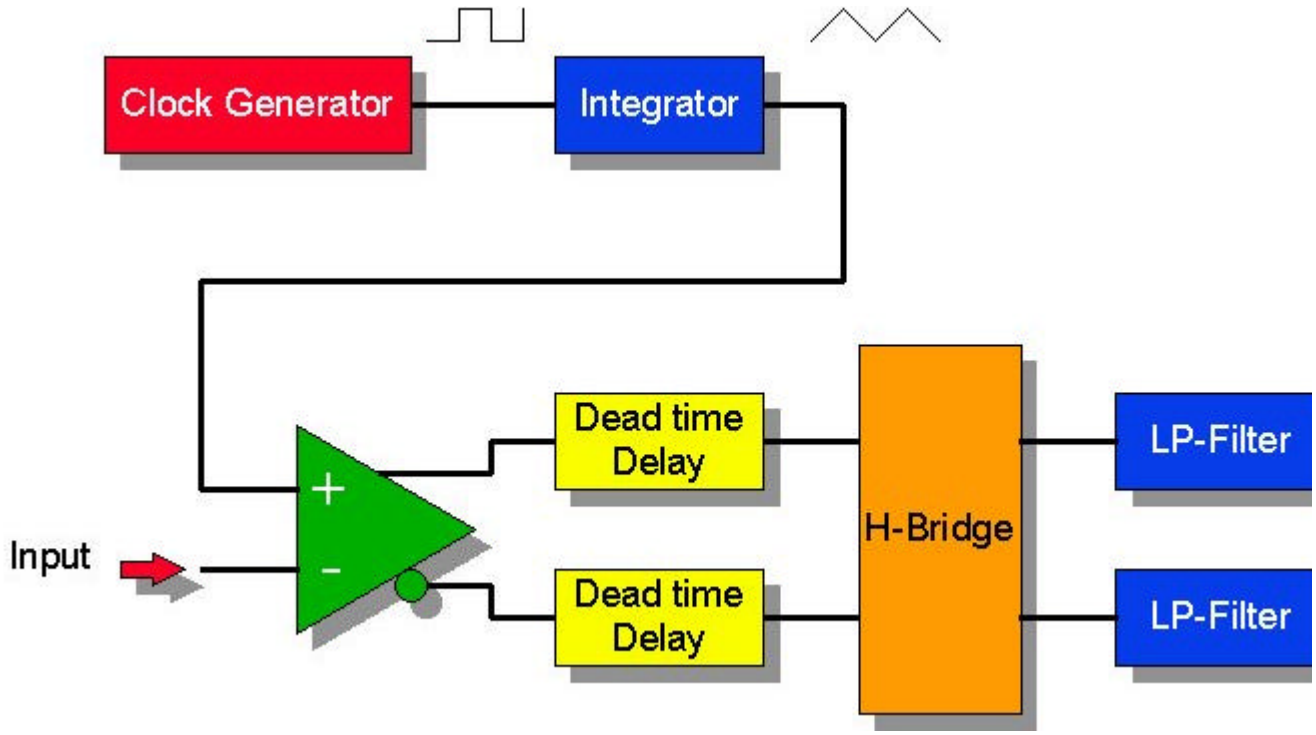


Schematics

Single push pull output stage:



Balanced output stage:

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