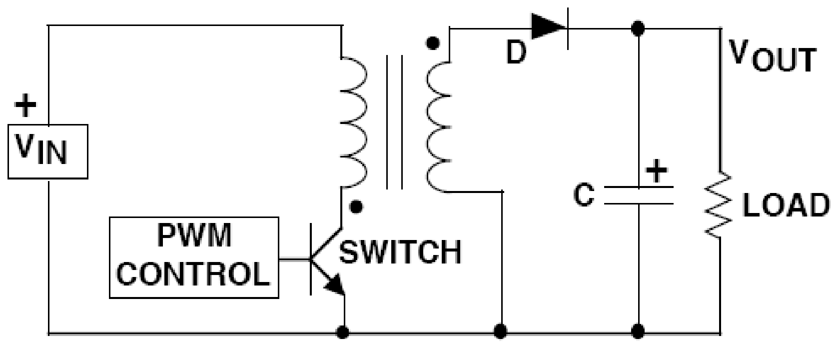
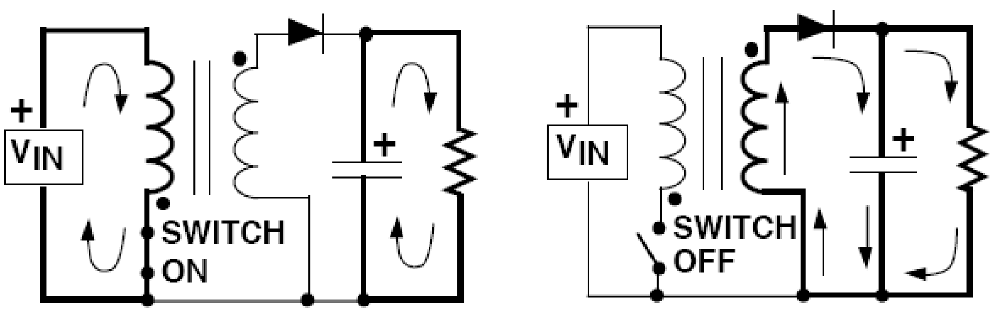
FLY BACK REGULATOR

The Flyback is the most versatile of all the topologies, allowing the designer to create one or more output voltages, some of which may be opposite in polarity. Flyback converters have gained popularity in battery-powered systems, where a single voltage must be converted into the required system voltages (for example, +5V, +12V and -12V) with very high power conversion efficiency. The basic single-output flyback converter is shown in Figure.





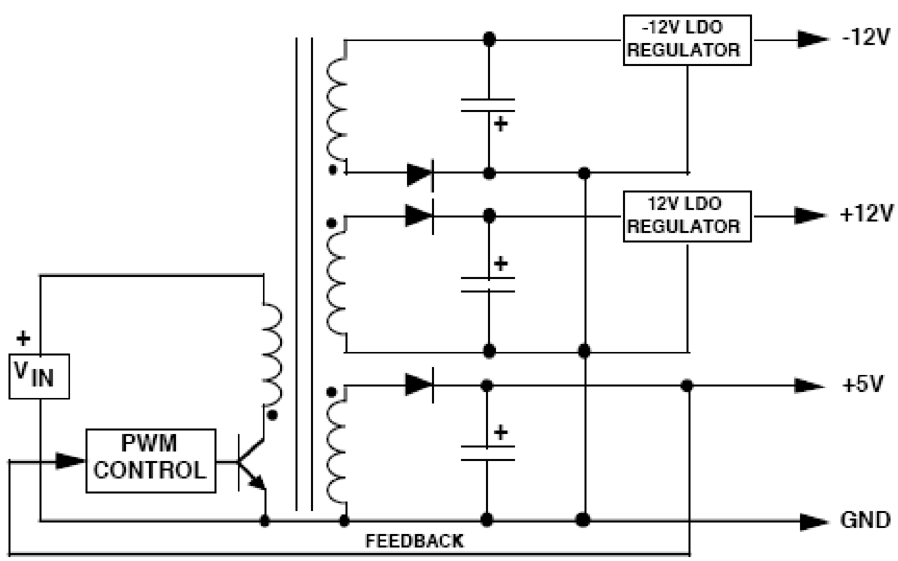
The most important feature of the Flyback regulator is the transformer phasing, as shown by the dots on the primary and secondary windings. When the switch is on, the input voltage is forced across the transformer primary which causes an increasing flow of current through it. Note that the polarity of the voltage on the primary is dot-negative (more negative at the dotted end), causing a voltage with the same polarity to appear at the transformer secondary (the magnitude of the secondary voltage is set by the transformer seconday-to-primary turns ratio).

The dot-negative voltage appearing across the secondary winding turns off the diode, reventing current flow in the secondary winding during the switch on time. During this time, the load current must be supplied by the output capacitor alone. When the switch turns off, the decreasing current flow in the primary causes the voltage at the dot end to swing positive. At the same time, the primary voltage is reflected to the secondary with the same polarity. The dot-positive voltage occurring across the secondary winding turns on the diode, allowing current to flow into both the load and the output capacitor. The output capacitor charge lost to the load during the switch on time is replenished during the switch off time. Flyback converters operate in either continuous mode (where the secondarycurrent is always >0) or discontinuous mode (where the secondary current falls to zero on each cycle).

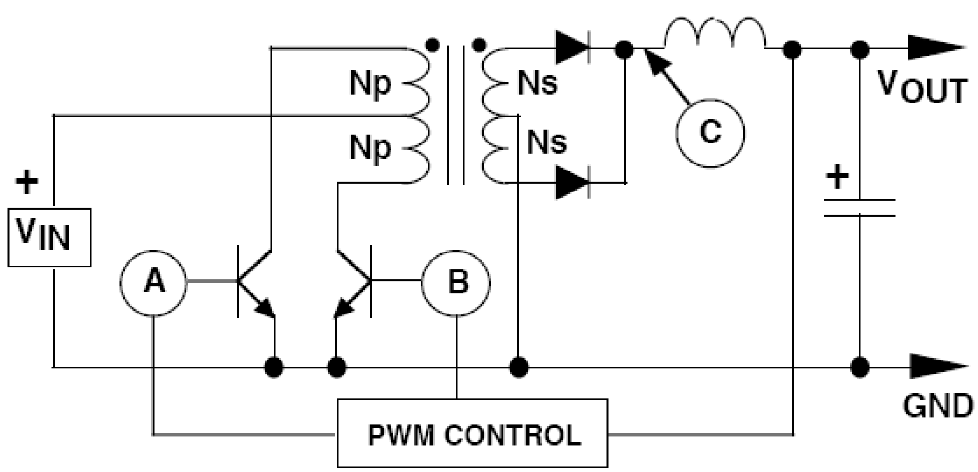
Generating Multiple Outputs:

Another big advantage of a Flyback is the capability of providing multiple outputs .In such applications, one of the outputs (usually the highest current) is selected to provide PWM feedback to the control loop, which means this output is directly regulated. The other secondary winding(s) are indirectly regulated, as their pulse widths will follow the regulated winding. The load regulation on the unregulated secondaries is not great (typically 5 - 10%), but is adequate for many applications.

If tighter regulation is needed on the lower current secondaries, an LDO post-regulator is an excellent solution. The secondary voltage is set about 1V above the desired output voltage, and the LDO provides excellent output regulation withvery little loss of efficiency.



The Push-Pull converter uses two to transistors perform DC-DC conversion.The converter operates by turning on each transistor on alternate cycles (the two transistors are never on at the same time). Transformer secondary current flows at the same time as primary current (when either of the switches is on). For example, when transistor "A" is turned on, the input voltage is forced across the upper primary winding with dot-negative polarity. On the secondary side, a dot-negative voltage will appear across the winding which turns on the bottom diode.This allows current to flow into the inductor to supply both the output capacitor and the load. When transistor "B" is on, the input voltage is forced across the lower primary winding with dot-positive polarity.



The same voltage polarity on the secondary turns on the top diode, and current flows into the output capacitor and the load. An important characteristic of a Push-Pull converter is that the switch transistors have to be able the stand off more than twice the input voltage: when one transistor is on (and the input voltage is forced across one primary winding) the same magnitude voltage is induced across the other primary winding, but it is "floating" on top of the input voltage. This puts the collector of the turned-off transistor at twice the input voltage with respect to ground. The "double input voltage" rating requirement of the switch transistors means the Push-Pull converter is best suited for lower input voltage applications. It has been widely used in converters operating in 12V and 24V battery-powered systems.

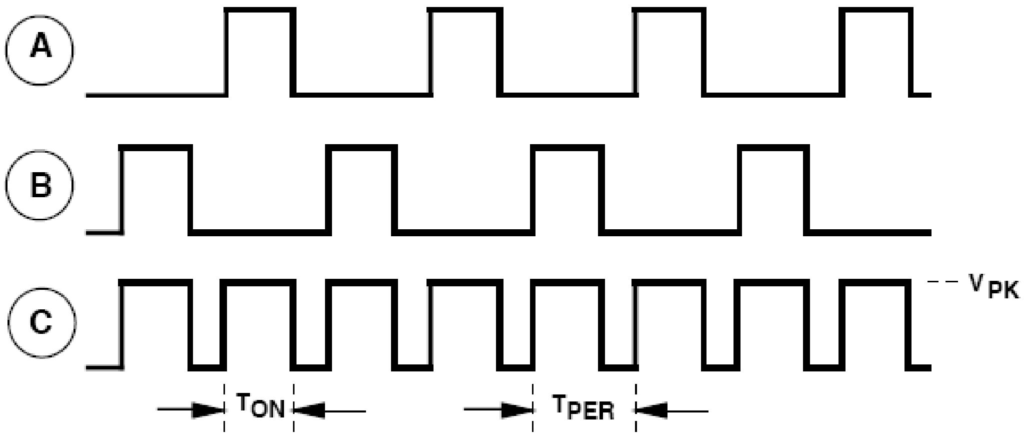


Figure shows a timing diagram which details the relationship of the input and output pulses. It is important to note that frequency of the secondary side voltage pulses is twice the frequency of operation of the PWM controller driving the two transistors. For example, if the PWM control chip was set up to operate at 50 kHz on the primary
side, the frequency of the secondary pulses would be 100 kHz.

This highlights why the Push-Pull converter is well-suited for low voltage converters.
The voltage forced across each primary winding (which provides the power for conversion) is the full input voltage minus only the saturation voltage of the switch. If MOS-FET power switches are used, the voltage drop across the switches can be made extremely small, resulting in very high utilization of the available input voltage. Another advantage of the Push-Pull converter is that it can also generate multiple output voltages (by adding more secondary windings), some of which may be negative in polarity. This allows a power supply operated from a single battery to provide all of the voltages necessary for system operation.

A disadvantage of Push-Pull converters is that they require very good matching of the switch transistors to prevent unequal on times, since this will result in saturation of the transformer core (and failure of the converter).