Forward converters have been popular on the market for switching-mode power suppliers. Like the flyback topology, the forward converter is best suited for an intermediate power output level of 100–200W. While its efficiency is comparable to the flyback configuration, it has the advantage over the flyback when high output currents are required. Nevertheless, the forward converter must have an extra inductor on the output side and is not suitable for high voltage outputs.
Although the general appearance of the power stage is similar to that of the flyback configuration, the mode of operation is completely different. The primary and secondary windings are in phase so that energy will be transferred to the output circuits when the transistor is “on”. The forward transformer operates with a low output resistance, and thus a filter inductor is required to limit the current flow in the output rectifier, the output capacitor, and the load.

Active Clamp Forward Converter:

Active clamp converter uses a compound gate drive to ensure a fast turn off and reduced switching losses. The converter is capable of operating at duty cycle over 50% to further reduce losses. When the Q1 switch is closed and Q2 is opened (Fig.5), the unit applies Vin across the transformer primary. During this period, energy is transferred from the primary to the secondary and the current passes through the output inductor to the load. The current rises until the unit the next power stage. (Fig.6). During this stage, the Q1 is opened and Q2 is closed and thus the magnetizing current flow through Q2 instead of through Q1.

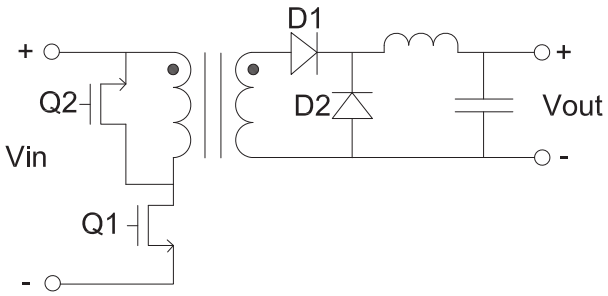

Fig.1: Typical Active Clamp Forward Converter Circuit Diagram

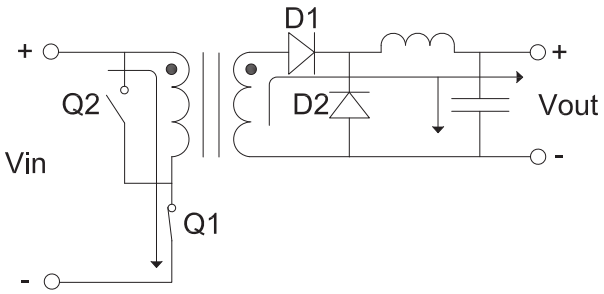

Fig.2: Current Flow w/ Q1 Closed, Q2 Open

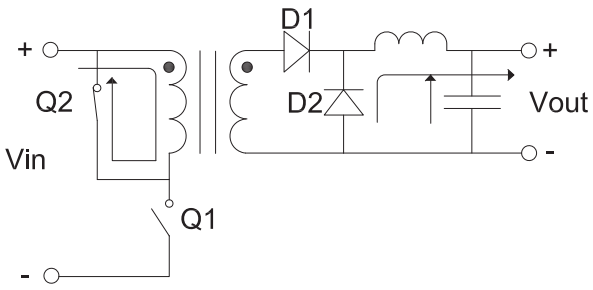

Fig.3: Current Flow w/ Q2 Closed, Q1 Open

Single Switch Forward Converter:

Derived from the buck topology, the single switch forward converter is an ideal choice for off-line applications which require galvanic isolation. The single active switch is sufficient at lower power levels below 200W. When the switch is closed (Fig.5), the supply is connected across the primary and the rectifier starts to conduct, and the current passes through the output inductor to the load. The current rises linearly until the switch is opened (Fig.6). At this point, the energy stored in the inductor is transferred into the load through diode D2.

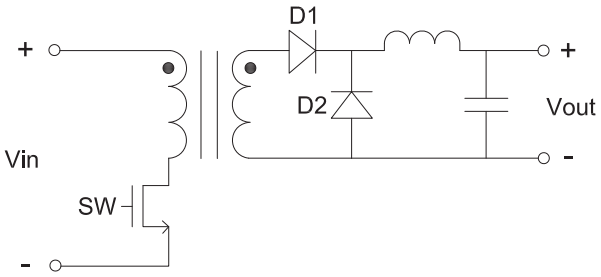

Fig.4: Typical Single Switch Forward Converter Circuit Diagram

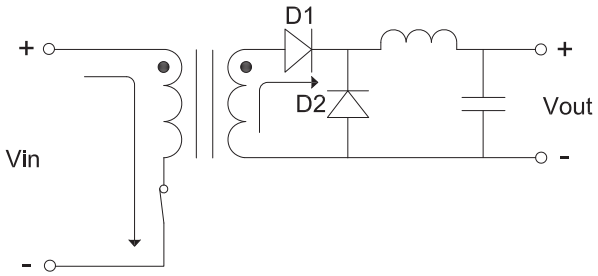

Fig.5: Current Flow w/ Switch Closed

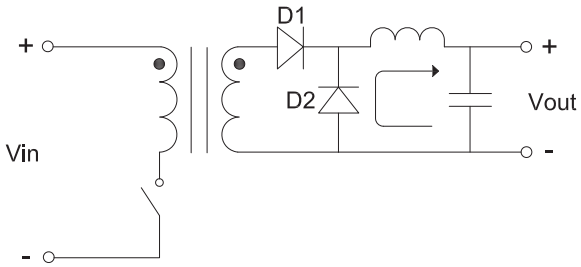

Fig.6: Current Flow w/ Switch Open

Two-Switch Forward Converter:

The two-switch topology has two switches that will open and close together. When both switches are closed (Fig.8), the transformer transfers energy through primary into the secondary. On the secondary, the diode D3 conducts, transferring the energy into the output inductor and the load. When both switches are open (Fig.9), the transformer current flow through D3 and D4 and then back into the source. Since diode D1 and D2 clamp the input voltage, no snubber circuit is required. Moreover, a demagnetizing winding is not required for 2 switch topology.

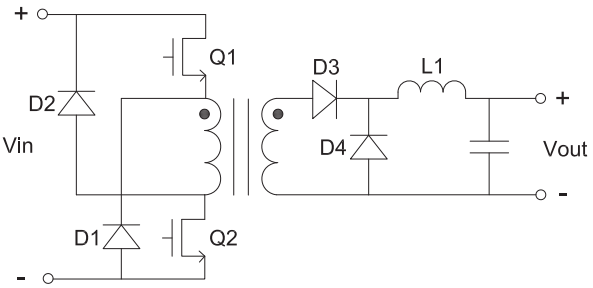

Fig.7: Typical 2-Switch Forward Converter Circuit Diagram

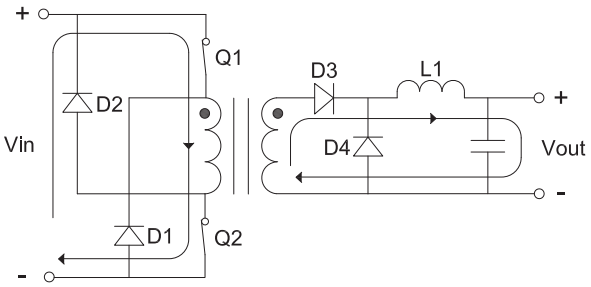

Fig.8: Current Flow w/ BOTH Switches Closed

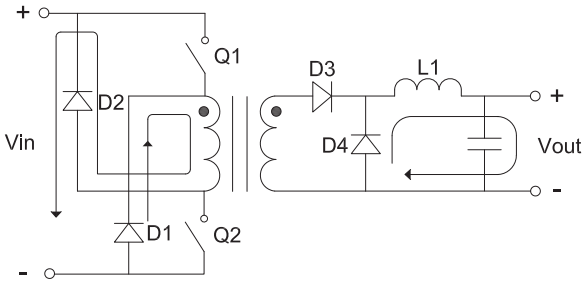

Fig.9: Current Flow w/ BOTH Switches Open

The forward transformers have been widely used for many different types of applications including and not limited to:

- Off-line supplies
- Solar Power Systems
- Hybrid Charging Techniques
- Computer power supply
- Aerospace supply

MPS Industries has been the designer and manufacturer of forward transformers and output inductors for forward converters used in medical, military, automotive, and other market segments. With our experienced engineering team working closely with our customer, we will meet the requirements of the customers in the business.