

## A Brief Note on Soft Switching Power Conversion

Nasser Kutkut - PowerDesigners, LLC - Madison, WI

Switchmode AC to DC battery chargers (SMPS) is a class of power converters that convert the AC line voltage into a regulated DC voltage to meet the charging needs of the battery. Unlike ferroresonant or linear types, switchmode chargers operate by chopping the incoming power source utilizing power switching devices, mainly MOSFETs or IGBTs. By controlling the switching speed, the on and off times of these switching devices, the output current and voltage can be regulated. Although MOSFETs and IGBTs switch rapidly, the switching action yields unwanted switching losses every time the power devices are turned on and off. This is due to the transient existence of both voltage across and current in the power device (see Fig. 1). These switching losses limit the maximum operating switching frequency and may result in significant device derating especially at higher switching frequencies.

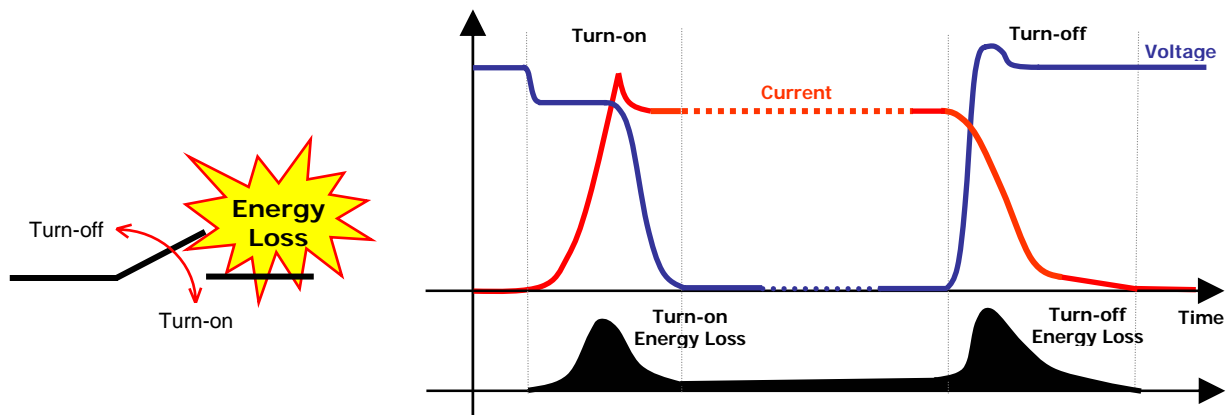


Fig. 1: Power Device Switching Behavior Showing Turn-on and Turn-off Switching Losses

A new technology that has demonstrated great promise in reducing device stresses associated with switching losses is **Soft Switching**. **Soft Switching Power Conversion** encompasses a class of power converters that **constrain the switching of the power devices to time intervals when the voltage across the device or the current through it is nearly zero** (see Fig. 2). This significantly reduces the device switching losses allowing higher switching frequencies of operation and resulting in higher efficiencies and reduced charger size and weight.

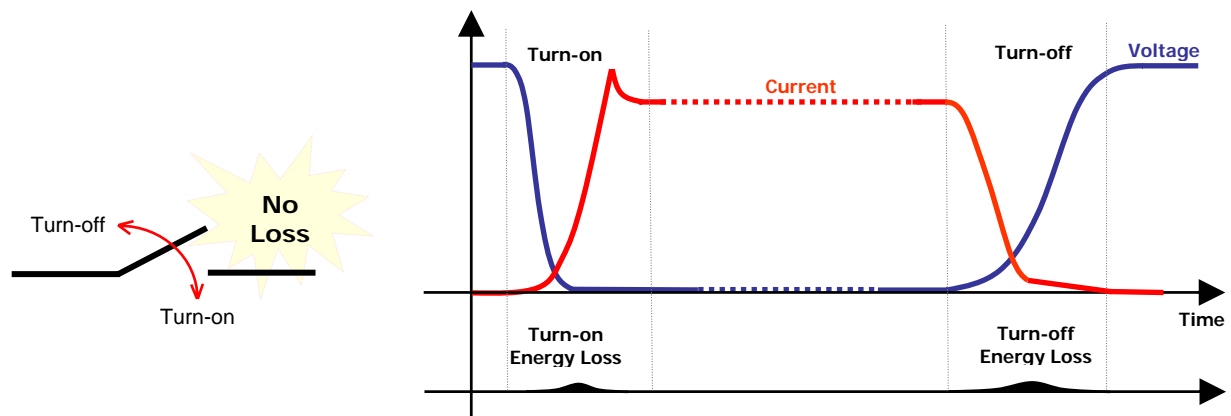


Fig. 2: Power Device Switching Behavior under Soft Switching: Almost No Turn-on or Turn-off Switching Losses

In summary, soft switching technology promises marked gains in performance in terms of lower losses, higher efficiencies, and smaller charger size and weight. Soft switching power converters have been successfully used in AC to DC and DC to DC power converters rated at few hundred watts to hundreds of kilowatts.