Circuit Idea
20041201

Input Bridge Rectifier with Fast Recovery Diodes for Reduced EMI

Summary of the Idea

This circuit simplifies and reduces the cost of the electromagnetic interference (EMI) filter circuitry for ac-dc converters by using fast recovery diodes in the input bridge rectifier.

Description

Meeting EMI standards with AC-DC power supplies requires a number of EMI filter components, such as X and Y capacitors. The standard input circuitry of AC-DC power supplies includes a bridge rectifier, which rectifies the line input voltage (typically 50-60 Hz) of the power supply. Since the AC input voltage is low frequency, standard diodes (such as the 1N400X series of diodes) are generally used due to their low cost. The standard diodes used in the bridge rectifier (shown in Figure 1) have slow reverse recovery times and are typically not directly associated with EMI generation since measurements used to record EMI start only at 150 kHz while the ac input voltage line frequency is approximately 50 or 60 Hz.

Previous input filter circuitry has included capacitors in parallel to the diodes of the bridge rectifier to dampen high frequency waveforms caused by the rectification of the low frequency AC input line voltage.

Use of fast recovery diodes in the bridge rectifier eliminates the need for these capacitors. The fast recovery diodes recover very quickly when the voltage across the reverses (shown in Figure 2). This reduces excitation of stray line inductance in the AC input voltage line by reducing the subsequent high frequency turnoff snap and therefore reduces EMI. Of the four diodes generally used in the bridge recitifier, only two diodes need to be fast recovery diodes since two diodes conduct in each half-cycle. As such, only one of the two diodes conducting during each half-cycle is required to be a fast recovery diode.
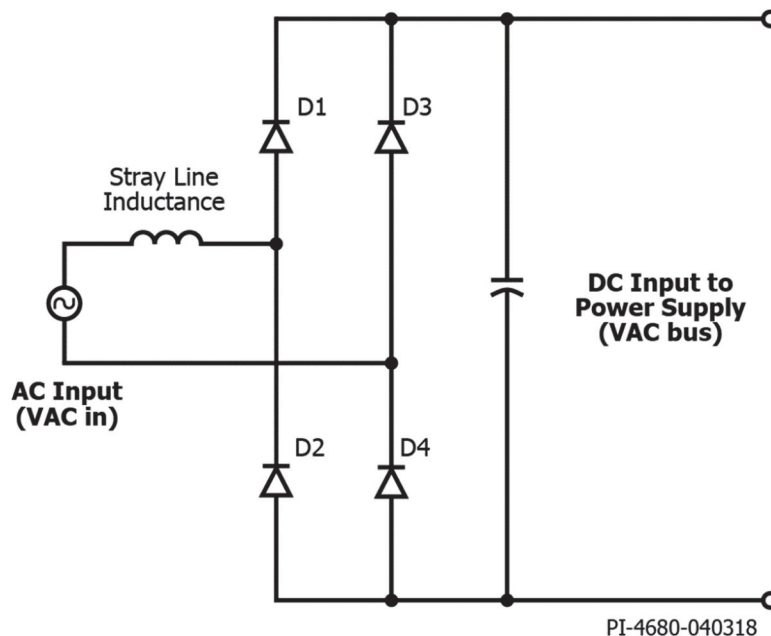

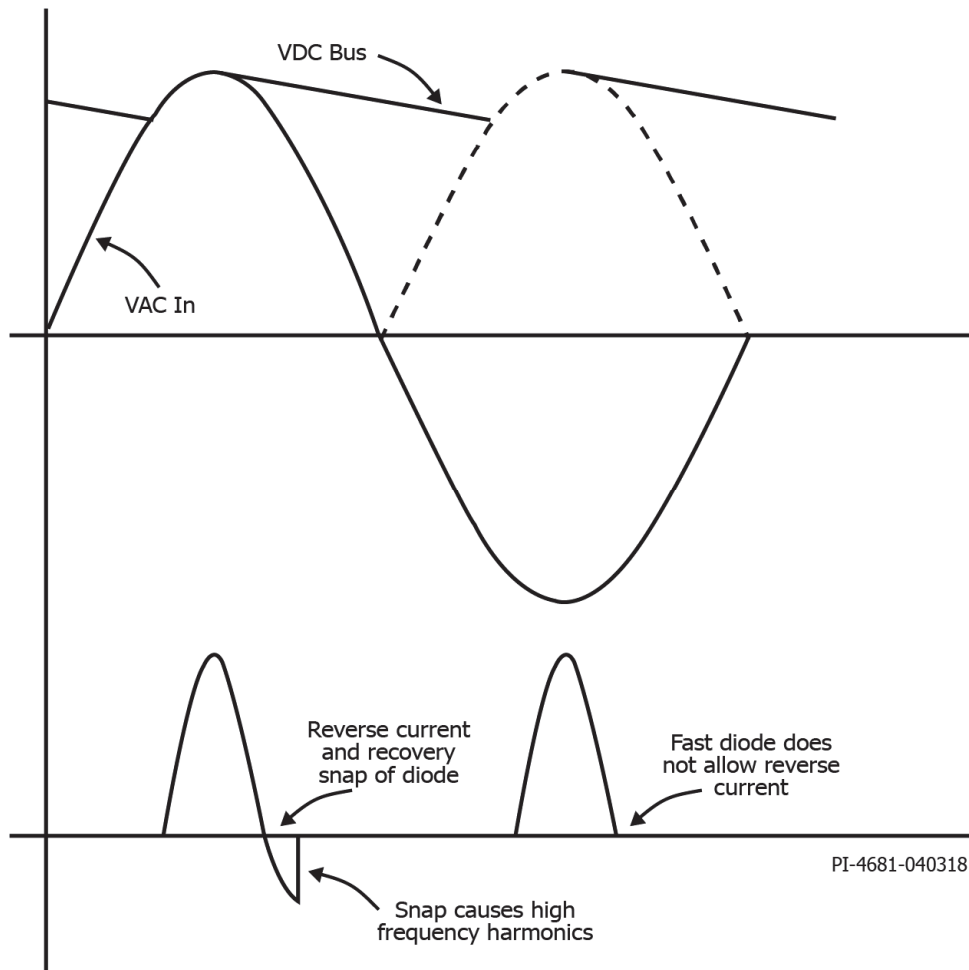Figure 1. Typical input stage of an SMPS using bridge rectifier at AC input.

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Figure 2. Input voltage and current waveforms showing diode snap at end of reverse recovery.