A Power Quality Improved Bridgeless Converter Based Computer Power Supply

Introduction:

Many electronic appliances powered up from the utility, utilize the classical method of ac-dc rectification which involves a diode bridge rectifier (DBR) followed by a large electrolytic capacitor. The uncontrolled charging and discharging of this capacitor instigates harmonic rich current being drawn from the utility which goes against the international power quality standard limits. Modern ac-dc converters incorporate power factor correction (PFC) and harmonic current reduction at the point of common coupling (PCC) which improves voltage regulation and efficiency at the load end. Personal computer (PC) is one of the electronic equipment which is severely affected by power quality problems. Single stage and two stage conversions of ac voltage into dc voltage have been used in computers to maintain harmonic contents within limits and also to obtain stiffly regulated multiple outputs. Single stage power conversion is simple, compact and cost-effective. However, it suffers from poor dynamic response, control complexity, high capacitance value and high component stress. So, two stage conversion of ac voltage into multiple dc voltages is mostly preferred in computers. The component count in a two stage power supply is much higher than its single stage counterpart. But, it provides better output voltage regulation, fast dynamic response and blocks the second harmonic (100Hz or 120Hz) component in the first stage itself so that large capacitors at the output side are avoided.
Existing system:

A boost converter is the common choice for providing PFC in power supplies. However, it is not the preferred choice in computer power supplies due to its requirement for a large input voltage range. The output voltage of a boost converter cannot be controlled to a value less than 300V for a 220V ac input. So, a buck-boost converter is preferred in PCs where wide variations in input voltages and load are expected. Low output voltage ripple is preferred in a computer power supply as it is connected to various ICs. Single stage power supplies are used in many applications where power quality improvement and voltage regulation take place in a single stage. However, in computers, single stage configuration increases the stress across the switches and slows the voltage regulation under varying loads.

Drawbacks:

- Increases the stress across the switches.
- Slows the voltage regulation under varying loads.

Proposed system:

A bridgeless single ended primary inductance converter (SEPIC) operating in discontinuous conduction mode (DCM) is being used at the front end of the SMPS which offers excellent PFC at the rated as well as light load condition. Upper converter operates in the positive half cycle of the ac voltage while the lower converter operates in the negative half cycle. The output of the bridgeless PFC converter is connected to the isolated converter.
The proposed computer power supply consists of mainly two parts, bridgeless front end ac-dc converter and multi-output isolated dc-dc converter. The operating mode out of CCM (Continuous Conduction Mode) or DCM of the bridgeless front end converter may be selected on the requirement of the user. A DCM is selected if the cost is a major consideration; if not, CCM is adopted that reduces device stresses, and despite the fact that two voltages and one current sensor are required which makes it costlier. Therefore, a DCM operation of the front end PFC converter is preferred in PCs where only one voltage sensor is needed for sensing and control. Here, the front end converter is designed in DCM for achieving inherent PFC which requires only one voltage sensor while the isolated converter is designed in CCM.
Advantages:
- Reduced stress.
- Operate satisfactorily under wide variations in input voltages and loads.

Applications:
- Computers and other similar appliances.

Black diagram: