500W LCLC Resonant DC/DC Converter Demo-Board Description

This demo is a 500W LCLC DC/DC converter using GaNPower's proprietary GaN power HEMTs. This module can be used in telecommunications, servers, and personal computer systems where holdup time operation is required. To provide energy during holdup time, bulky capacitor must be added on input side. Fig.1 shows the structure of a front-end server power supply system. When using a wide operation input voltage range, the holdup time capacitance could be reduced, thus size and cost of the bulky capacitor could be decreased. Fig. 2 shows holdup time performance requirement. To meet the holdup time requirement, it is crucial to extend input voltage operation range of DC/DC converters.

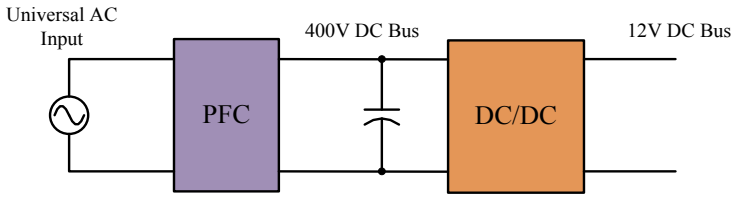

Figure 1. Front-end Power Supply System

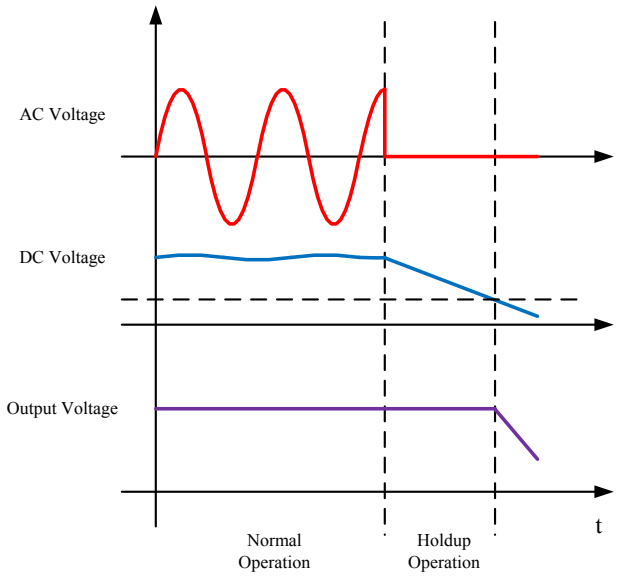

Figure 2. Holdup Time Performance Requirement

A modified LLC resonant topology, which is also known as LCLC resonant topology is adopted as the power converter to narrow switching frequency range and improve efficiency under wide input voltage variation range. LCLC resonant converter consisted of two inductors and two capacitors, can be viewed as an LLC resonant converter with changeable magnetizing inductor.

Of all different resonant converters, an LLC resonant configuration consisted of two inductors and one capacitor provides many added benefits over other resonant converter configurations. For example, it can regulate output voltage over wide input voltage and/or load variations with a relatively small variation of switching frequency while maintaining excellent efficiency. However, if input voltage range is too wide, the performance of LLC resonant converter will be deteriorated, especially at high input voltage. This is because a small magnetizing inductor needs to be used to ensure enough high voltage gain at low input voltage conditions. Such design will significantly increase primary side RMS current, and thus, increasing conduction loss of primary side switches. To find a suitable solution for wide input voltage operation, a modified LLC resonant converter, also known as LCLC resonant converter, is proposed. LCLC resonant converter is consisted by two inductors and two capacitors, as shown in Fig. 3.

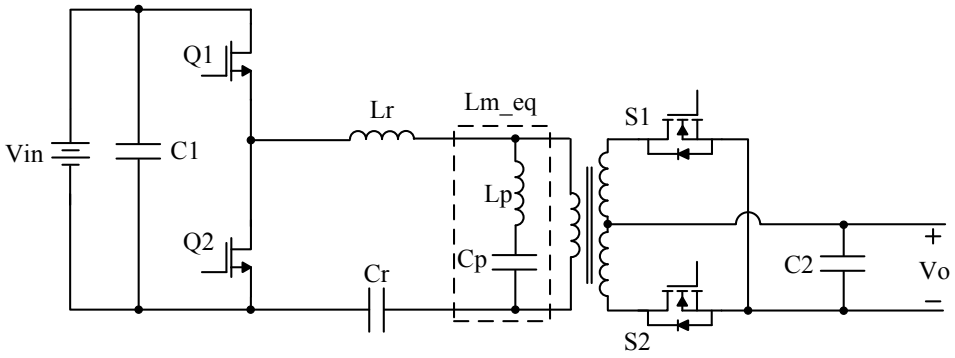

Figure 3: Topology of the LCLC Resonant Converter

The equivalent magnetizing inductor L_{m_eq} of LCLC resonant converter can be changed along with switching frequency. For example, with high input voltage, the equivalent magnetizing inductor is of a large value as switching frequency is high. In this way, primary side RMS current can be reduced and efficiency can be increased. With low input voltage, the equivalent magnetizing inductor is decreased because of reduction of switching frequency; thus, high voltage gain can be achieved.

Table I lists the parameters of the 500W LCLC resonant converter. Fig. 4 is a family of efficiency curve measured from the LCLC converter using Our 30A TO220 devices (GPI65030TO).

Table I: Parameters of the 500W LCLC Resonant Converter

Description	*Value*
Input Voltage	250 VDC to 400 VDC
Nominal Input Voltage	400 VDC
Output Voltage	12 VDC
Rated Output Current	42 A

Rated Output Power	500 W
Series Resonant Frequency	350 kHz
Switching Frequency	170 kHz to 250 kHz

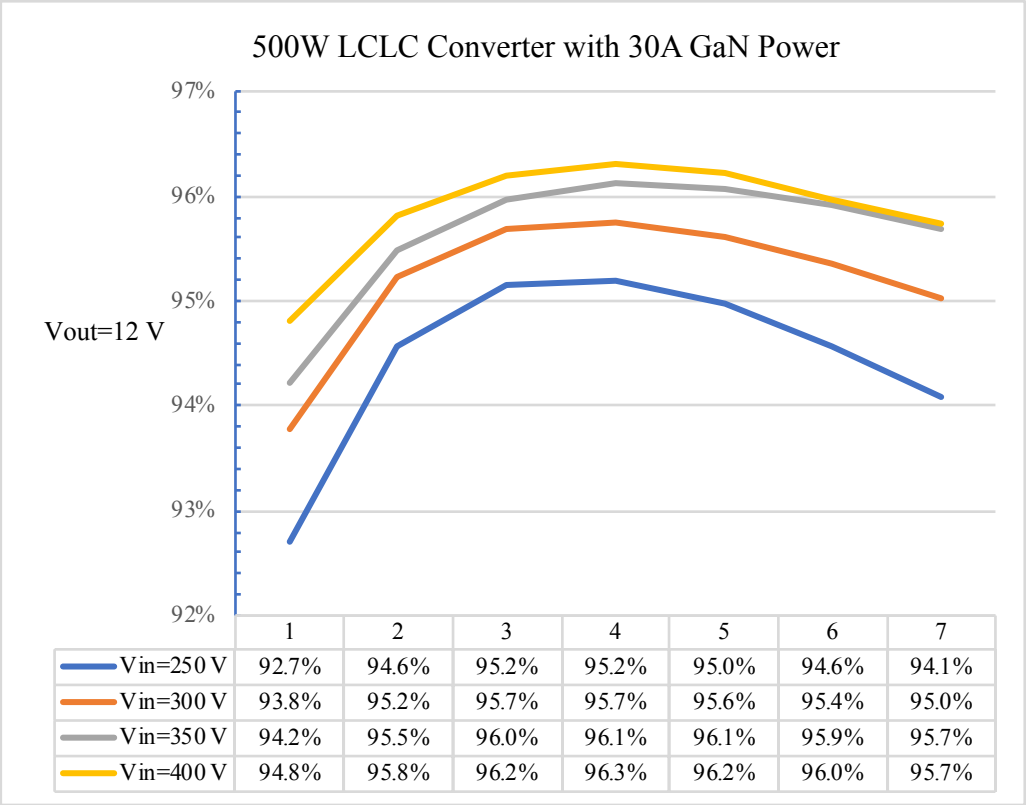

Figure 3: Topology of the LCLC Resonant Converter

For more information about this demo boards, please contact GaNPower at information@iganpower.com