PHASE SHIFT FULL-BRIDGE MODULATION:

LEADING AND LAGGING LEG LOSSES DIFFERENCES

Frenetic

CASE OF STUDY

The Phase Shift Full Bridge (PSFB) with an external inductor (Lr) and two clamping diodes (Figure1) is a very common topology for high power applications. The behavior of the topology changes depending on the operation mode. The key aspect is the location of the external inductor. When the lagging leg is connected to the external inductor, the load range of ZVS is wider. On the other hand, with this configuration, the losses for conduction in the clamping diodes are increased.

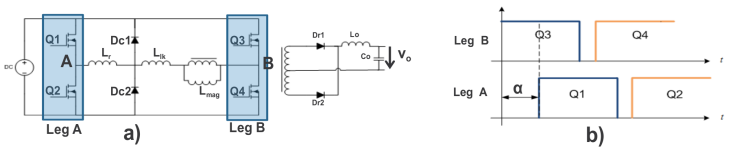

Figure1. FBPS with clamping diodes.

COMPARISON BETWEEN THE TWO OPERATION MODES

The following figures describes both possibilities of leading and lagging leg.

In the operation mode A Leg B is working as Lagging Leg

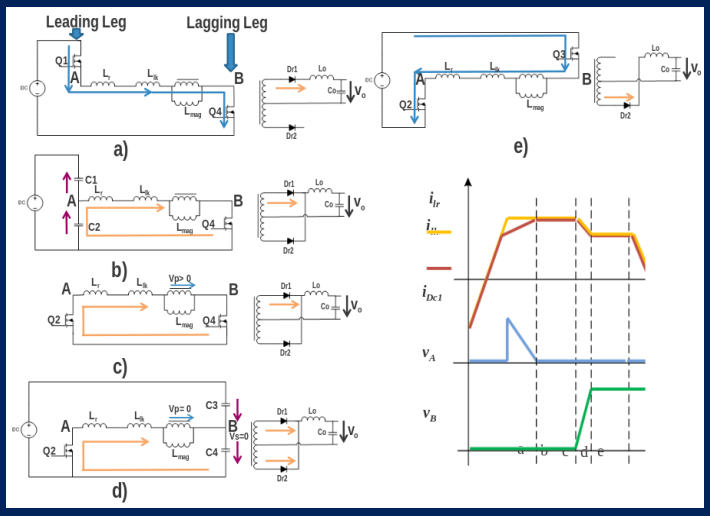

Figure2. Operation Mode A.

In the operation mode B, Leg A is working as Lagging Leg and the interval c shows the main differences. The current through the inductance and the transformer are different which affects to the energy stored for achieving ZVS.

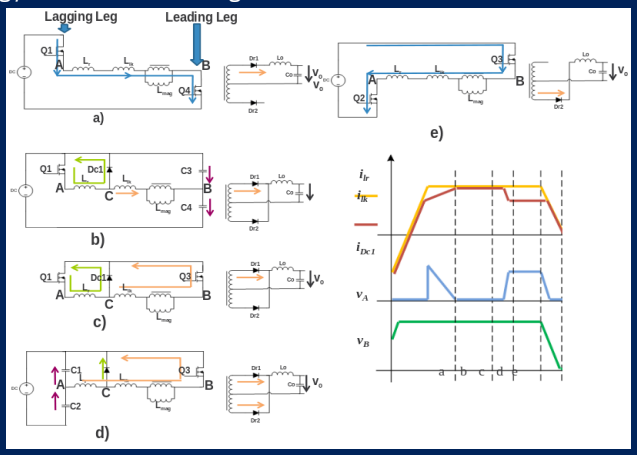

Figure3. Operation Mode B.

Operation mode B increases significantly conduction losses for in the diodes. It is possible that the diodes used in operation mode A, are not adequate in term of current for mode B. In order to choose the best operation mode in each application, a trade off between losses in clamping diodes and losses by commutation has to be achieved.

EXPERIMENTAL RESULTS

To demonstrate the analysis, a 270/48 V, 100 kHz, 600 W prototype of a PSFB have been built. In the Figure 4 is appreciated that Mode B presents better performance and low and medium power levels, with similar values at maximum power.

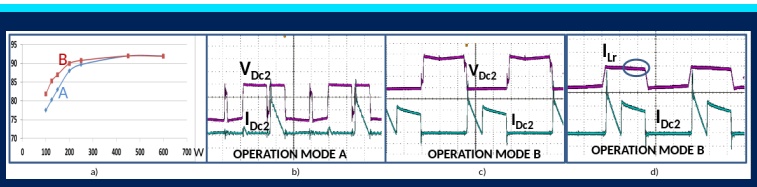

Figure 4. Experimental results.

CONCLUSIONS

An analysis of two operation modes of the PSFB depending on the location of the external inductor is presented. It is determined the energy available for the commutations, especially for the lagging leg, which is the most complicated to achieve ZVS under medium load conditions. In the analysis is shown that the energy available for the commutations in the lagging leg in operation mode A is lower than the energy in operation mode B. In addition a design guideline is presented. The experimental results for the prototype built shown that in mode B the efficiency is better at medium load.

Frenetic | Better Magnetics

Jose María Molina
jose@spfrenetic.com