**Technical Assistant Request**

In designing a high frequency, in the range of 100-150 kHz, multi-port isolated inverters and converters, the technical challenges becomes major issues. Even though faster switching capabilities of SiC devices bring many advantages, at the same time high dv/dt and di/dt issues bring many disadvantages. Therefore, system designers have to take an extreme care of designing the DC bus power structure, selection of the DC capacitors, and the protection schemes.

When designing the laminated DC bus structures for SiC applications, where the di/dt’s is in the range of several kA/s, and therefore the equivalent inductance seen by the switching devices has to be in the range of single digit of Nano-Henry’s. Therefore, the laminated DC bus structure needs lots of pre-design magnetic analysis to ensure that the optimum design is selected. Imagen Energy does not have a sophisticated magnetic analysis tools and therefore, the technical simulation and analysis support from a national lab or commercial bus bar manufacturer will be extremely helpful. If the bus structure inductance cannot be minimized, it will penalize the device current and voltage utilization factors, resulting in lower power density of the system, and reduce the performance enhancement achievable with SiC. Typically, commercial laminated DC bus manufacturers do not pay much attention to pilot projects like the nature of the proposed project, and therefore making this request to broader network, and finding help will be extremely helpful for the on-setting of the project.

The other parameter that is critical is the power module stray inductance. Especially at the higher current level, it is extremely difficult to design to achieve a single digit nano-henry stray inductance, as the module gets bigger. Imagen is extremely happy that Infineon Technologies, the major module manufacturer with so much knowledge in module design and packaging is willing to partner with Imagen to develop an application specific power module. However, still the project may require much expertise help form Infineon design headquarters in Germany, and if the prize administrator can request for help, when needed, it will be highly beneficial

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Another unique challenge in high frequency switching power electronics systems, like in the proposed system, is the inherent common mode current issues. These unwanted high frequency current interfere with controls and disturbs the controllability of the system to a certain level, if an extremely care is not taken to eliminate, or minimize them. This must be done at the power structure design and board design level and high frequency circuit simulation and analysis at the power structure and circuit board level would help to minimize the risk associated with them. Imagen Energy has the capability to address this issue to a certain level, but having an expertise help in modeling and simulating to identify the possible issues before move forward with the design will help with the aggressive project schedule.

For the design of the isolated-multiport system, the high frequency transformer thermal design becomes extremely critical, since at such higher switching frequencies the core likely to get to very high temperatures and thermal runaway occurs if extensive analysis is not conducted to find the thermally optimal design. Especially, with very low core volume, the high temperature condition is most likely to happen, and finding the right core material and correct operating points are extremely critical. Imagen Energy does not have the required software packages for the simulation and analysis of the HF transformer thermal analysis at the integrated system level. This is one of the great help that a national lab can provide to support the effort.

In the past, Imagen has worked with different manufacturers, and found thermal performance issues creating system breakdown over the time. On the other hand, the transformer’s leakage inductance can be effectively used, if ZVS or ZCS is employed for the controls. However, this inductance higher will also cause the device overvoltage to occur during extremely high di/dt switching. Therefore, a detail analysis to find the optimum solution for the design of the HF transformer, compromising between the core size, leakage inductance, and thermal performance is a must. This can be accomplished through detail magnetic analysis, and having an institution who has expertise in these simulation and analysis will help to move the project forward smoothly, without any issues once the system is running at full power ratings.