What is the difference between a regulated and a semi-regulated Intermediate Bus Converter?

A regulated IBC provides full regulation among the whole input voltage range (i.e., 12 V regulated output when $V_{in}$ changes from 40 V to 60 V. A semi-regulated IBC provides regulation only inside a sub-interval of the input range. RHSC 4:1 can regulate $V_{out} = 12$ V between $V_{in} = 48$ V and 60 V, while $V_{out} = V_{in}/4$ below the 48 V threshold.

How is the full system conversion affected by the use of a semi-regulated Intermediate Bus Converter?

The advantage of a semi-regulated solution is that a higher power-density can be achieved when compared to fully regulated standard solutions. In the case of RHSC, semi-regulation derives from the topology itself, while for DR-HSC semi-regulation can be imposed at firmware level to maintain a high efficiency (by lowering inductor current ripple).

What are the design steps required to design such systems?

In both cases, operation frequency is chosen based on power density requirements. Based on this, magnetic components’ sizes can be selected by considering processed current (DR-HSC: inductor design based on $V_{in}/4$ phase voltage and $I_{out,max}$- RHSC: autotransformer design based on $2: V_{out}$ excitation and rectified-sine wave current shape, boost inductor design is based on 20% of total power). After selecting resonant and/or sigma capacitors, best-in-class Infineon MOSFETs are chosen based on processed power. The process can be iterated until the best trade-off is reached. In general, circuit simulation is required. Infineon provides design support when choosing these topologies.

What is the difference between a module and a down-solution?

A module is a monolithic component which can be soldered on the main board. The design effort is very low, as a module is a pick-and-place block and only the input/output Power Delivery Network (PDN) requires a minimum analysis to be implemented. A down-solution (also know as discrete solution) is when the converter is directly implemented on the main board: every converter component is placed and routed to compose the complete solution, together with the controller. In general, a down-solution is less expensive than a module, and no module vendor is involved.
Q: What is the main difference between DR-HSC and RHSC?
› DR-HSC is more flexible and scalable than RHSC, and in general has a lower profile. RHSC can achieve a higher power density by exploiting autotransformer power delivery.

Q: The 48 V LLC solution is quite hot these days, they use GaN MOS, with high power density and easy control. What are the advantages of these two Infineon topologies over the LLC?
› Both solutions exploit non-isolation to push power density. In the case of RHSC, autotransformer and synchronous rectifiers’ current stress is greatly reduced.

Q: Can RHSC get higher step-down ratio? 8:1 or 10:1?
› Yes, RHSC can implement an 8:1 and 10:1 regulated conversion. The transformer is modified in a 4-winding arrangement, and the boost becomes a buck.

Q: Are flying cap convertors reliable since caps carry the power?
› In general, switched capacitor converters and widespread for many applications. Capacitor vendors can provide more information and certifications for a given solution. For sure, capacitors’ temperature and electrical specifications provide the safe operating area to operate within.

Q: What about GaN as SR?
› This kind of topologies obtain the maximum benefits provided by low-voltage Infineon MOSFETs. GaN can be used on the high-voltage side when the application requires it.