changing magnetic fields. Loss of winding can be caused by the skin and proximity effects because of the applied frequency. In general, high-frequency losses should be considered when selecting the correct magnetic core material and designing the winding configuration. It is challenging to derive an accurate model for high-frequency losses due to the complexity of core materials and the difficulties of parameter identification. However, high-frequency loss can be evaluated through experimental tests in combination with the conduction loss. The temperature of the magnetic core and winding is an indicator for loss analysis.

5.7 Conversion Efficiency

The conversion efficiency is considered the most important measure of PV power interfaces. It is the ratio in percentage terms of the input to output power. A converter efficiency is not uniformly distributed at all power levels. Conventionally, peak efficiency is used as the performance index, because it represents the optimal operating point for the best conversion efficiency. However, the operation of PV power systems depends on the environmental conditions. The efficiency at a single operating condition will not be the best index to represent performance. Therefore, weighted values are introduced to evaluate the conversion efficiency of PV power interfaces.

The European efficiency and CEC efficiency measures are commonly applied and are expressed in (5.123) and (5.124), respectively.

$$\eta_{eu} = 0.03 \times \eta_{5\%} + 0.06 \times \eta_{10\%} + 0.13 \times \eta_{20\%} + 0.10 \times \eta_{30\%} + 0.48 \times \eta_{50\%} + 0.20 \times \eta_{100\%} \tag{5.123}$$

$$\eta_{cec} = 0.04 \times \eta_{10\%} + 0.05 \times \eta_{20\%} + 0.12 \times \eta_{30\%} + 0.21 \times \eta_{50\%} + 0.53 \times \eta_{75\%} + 0.05 \times \eta_{100\%} \tag{5.124}$$

The term "CEC" refers to the California Energy Commission. The coefficients indicate the importance of the efficiency of each level, based on assumptions about how often the PV converter will function at that level. The weighted values correspond to the climate in central Europe and California, USA. The symbol $\eta_{x\%}$ represents the efficiency tested at x percent of the rated power level. The symbol $\eta_{100\%}$ refers to the efficiency value at the rated power level.

Comparing the two performance indices, the European measure gives more weight at 50% of the inverter power rating, meanwhile, the CEC measure gives more at 70% of the conversion capacity. This reflects that the solar resource in California is greater than in central Europe.

5.8 Wide Band-gap Devices for Future Power Conversion

In general, the conversion efficiency in PV power systems has been pushed to a higher level than in other power electronic applications. The DC/AC converters that are applied at the string and array levels for grid connections have reached 97% or even higher efficiency. The DC/DC converters used for PV-side power interfaces are usually more than than 98% efficient. MIPIs have relatively lower conversion efficiencies of between