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CURRENT RIPPLE REDUCTION IN THE HV SYSTEM THROUGH SYNCHRONISED PWR CLOCKING

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Initial situation:
Today's electric vehicles with pulse-wave inverters (PWR) for propulsion are operated in kHz and cause current ripples on the connected HV-DC lines due to the switching operations of the power semiconductors. The amount of line-emitted current ripple depends on the instantaneous power of the pulse inverter and may well be several 100 A.

Disadvantage:
The current ripples are transmitted to the complete high-voltage system (HV) of the vehicle and other HV control units must ensure that corresponding ripples do not cause any disturbances. In general, the greater the interference in the HV system, the more elaborate EMC filter measures are necessary (e.g. larger dimensioned HV intermediate circuit capacitors in the HV components or low-pass filters).
If several pulse inverters are installed in the vehicle, a superposition of the individually, emitted current ripples is possible, which carries a higher interference potential.

Solution:
The idea is to synchronise the clocking of the power semiconductors between two or more installed PWRs in the vehicle, in order to thereby reduce a possible superposition with a defined phase (with two installed PWRs with 180° phase offset) a resulting current ripple on the HV system.
The target phase offset is exchanged between the PWRs via a signal line (e.g. dedicated HW line or bus system). It is conceivable that one PWR acts as a master and specifies the clock behaviour or the target phase shift to the other installed PWRs.

Advantages:

- Lower current ripple on the entire HV system, which leads to lower expenses for filter measures in other control units.
- Since each current ripple represents a charge and discharge of the battery, the load and ageing of the battery cells is reduced with a smaller current ripple.
- Less capacitive losses on the HV lines with lower current ripple, which favours range potential through increased efficiency of the electric drive.

Technical implementation: