

it has been shown that the energy efficiency can increase as overcharging or reverse charging is prevented.

### 19.1.2.2 The T-CHEQ principle

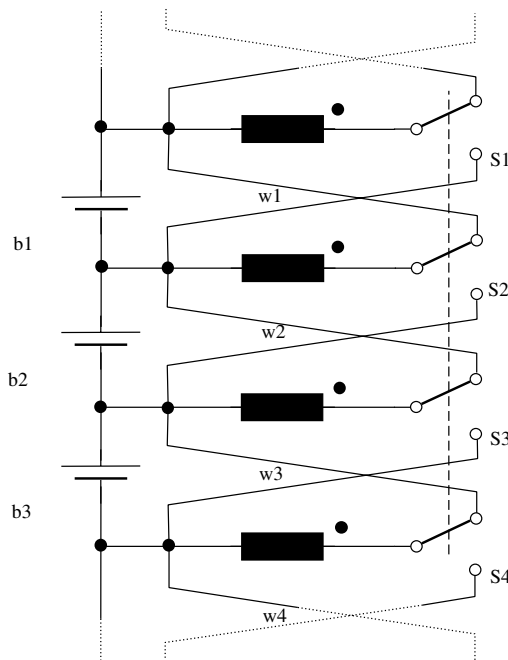
Several different procedures for active charge equalisation were developed and publicised under the name “CHarge EQualizer” (CHEQ) [1].

The “T-CHEQ” principle is based on a multiple-gate forward converter as shown in Figure 19.12. It can be used over a wide power range, but is particularly suited to higher power values. Here, the cells are coupled magnetically via coils, which are wound around a common core. The coils are periodically connected to the single cells with alternating polarity via semiconductor switches. As the same voltage is induced in all the coils due to the tight coupling, an equalising current automatically flows into or out of the cells if there is any deviation from the average cell voltage. It is advantageous that all cells can be treated simultaneously. Furthermore, this device can be extended to a battery charger by feeding energy into an additional coil wound around the core.

### 19.1.2.3 Operating experience

The working principle of active charge equalisation has been proven in numerous laboratory tests and pilot installations.

A typical charging cycle from a long-term test with a T-CHEQ system is shown in Figure 19.13. The battery was charged according to a CC/CV charging profile with a



**Figure 19.12** CHarge EQualizer with transformer coupling (T-CHEQ)