POWER ELECTRONICS CONVERTERS IN ELECTRIC VEHICLES

Part 2

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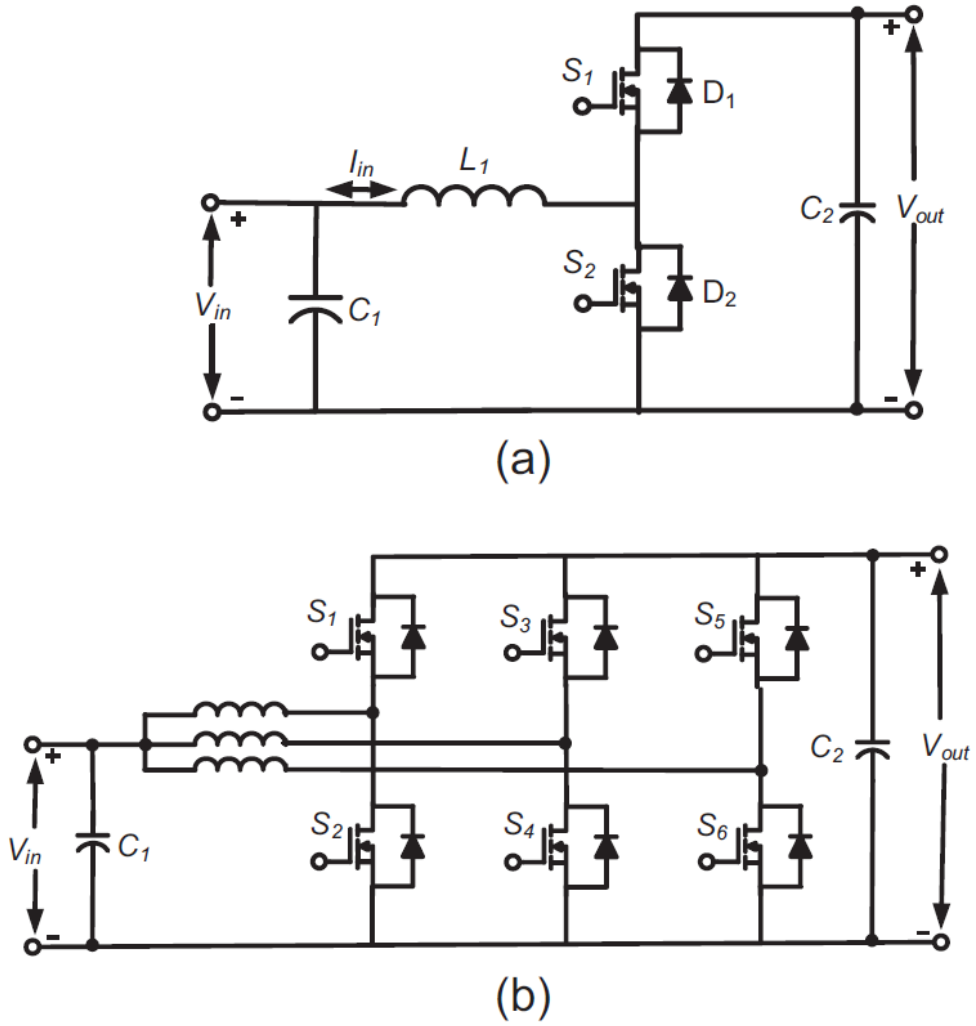
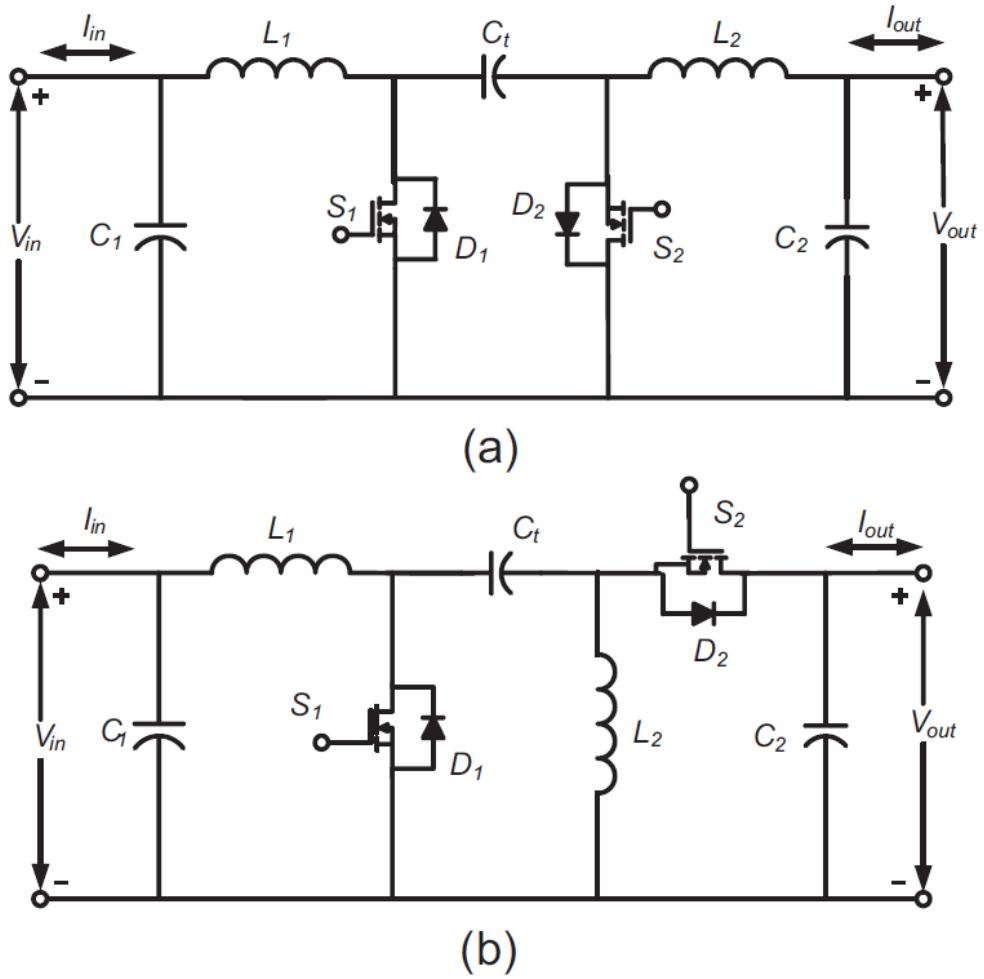
DC/DC converters



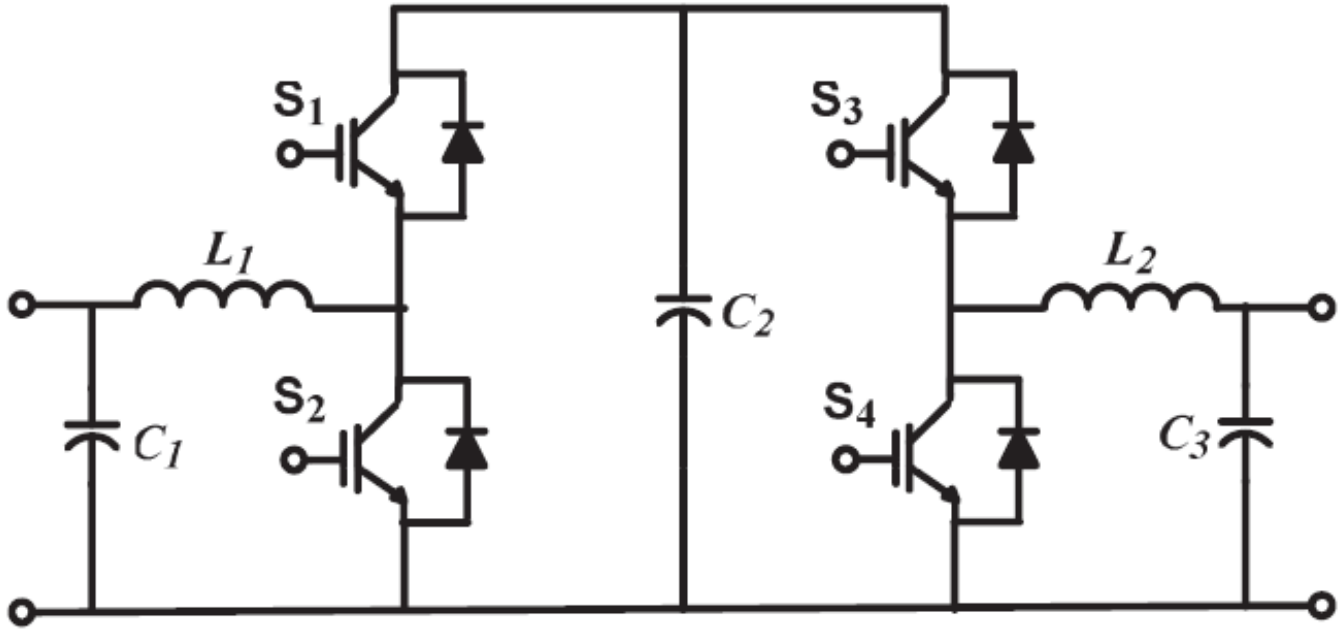
DC-DC half-bridge boost converter: (a) single-phase non-interleaved and (b) three-phase interleaved

DC/DC converters



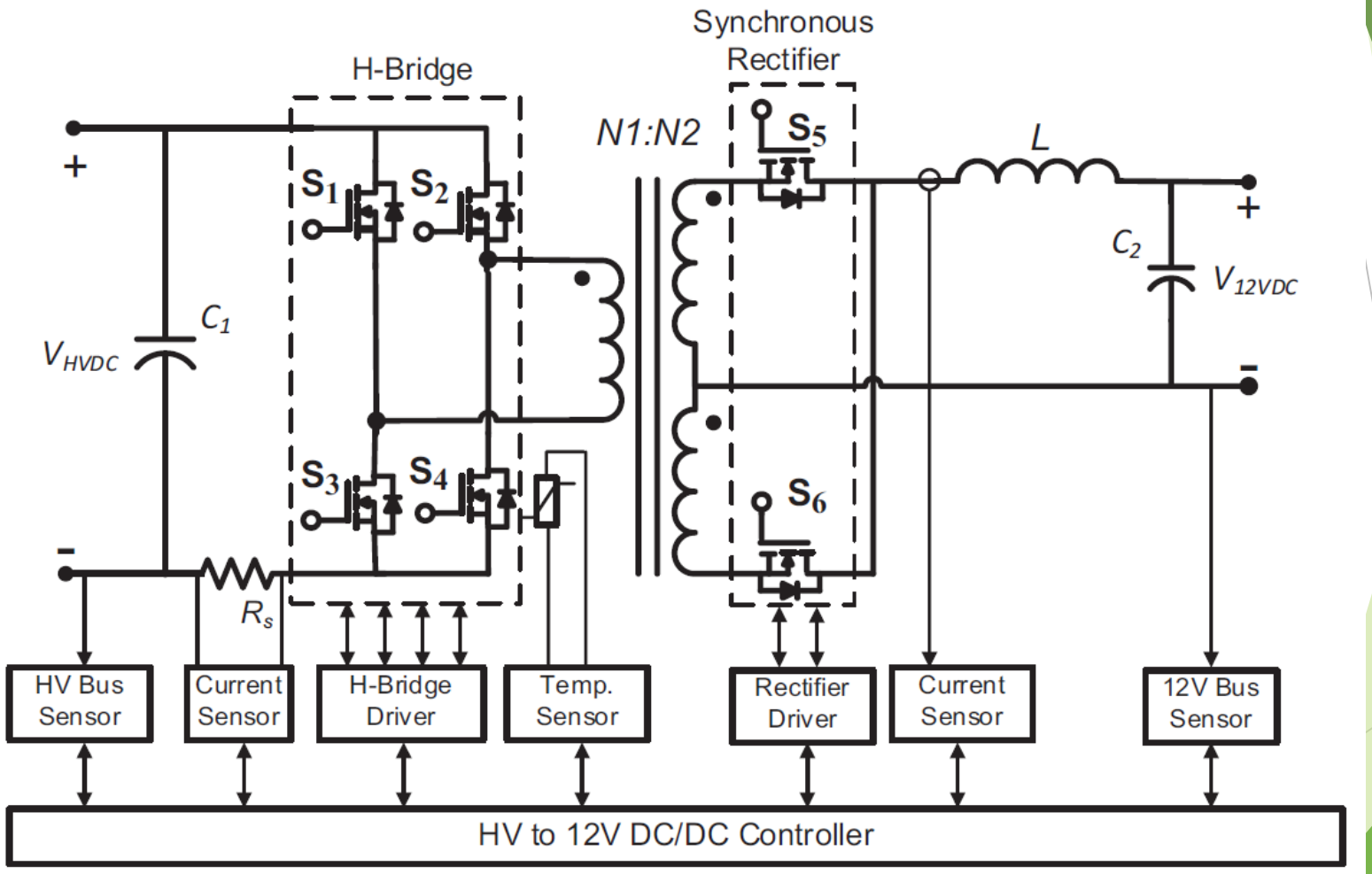
DC/DC converters: (a) Ćuk and (b) SEPIC/Luo

DC/DC converters



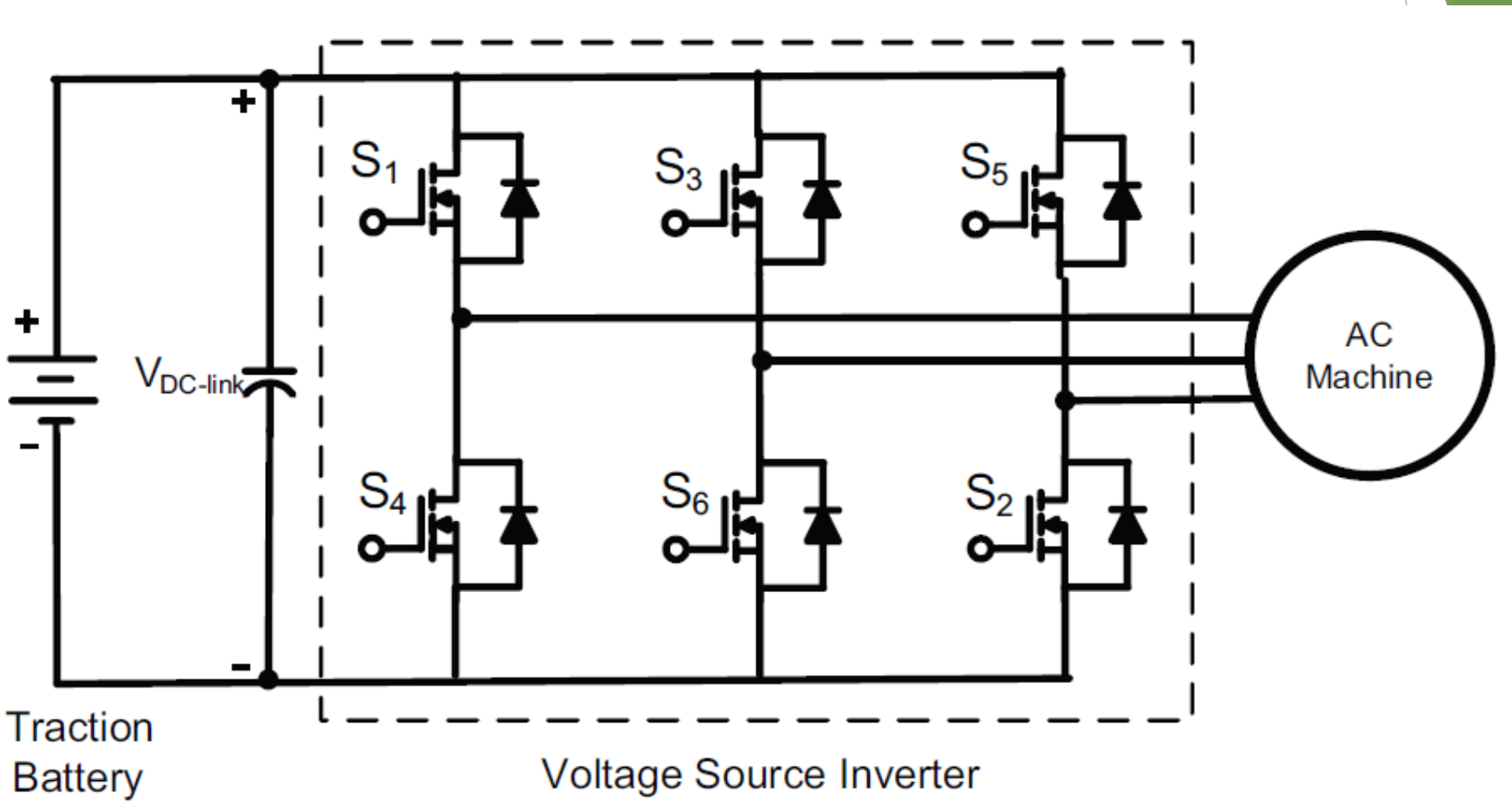
Boost-buck cascaded DC-DC converter

DC/DC converters



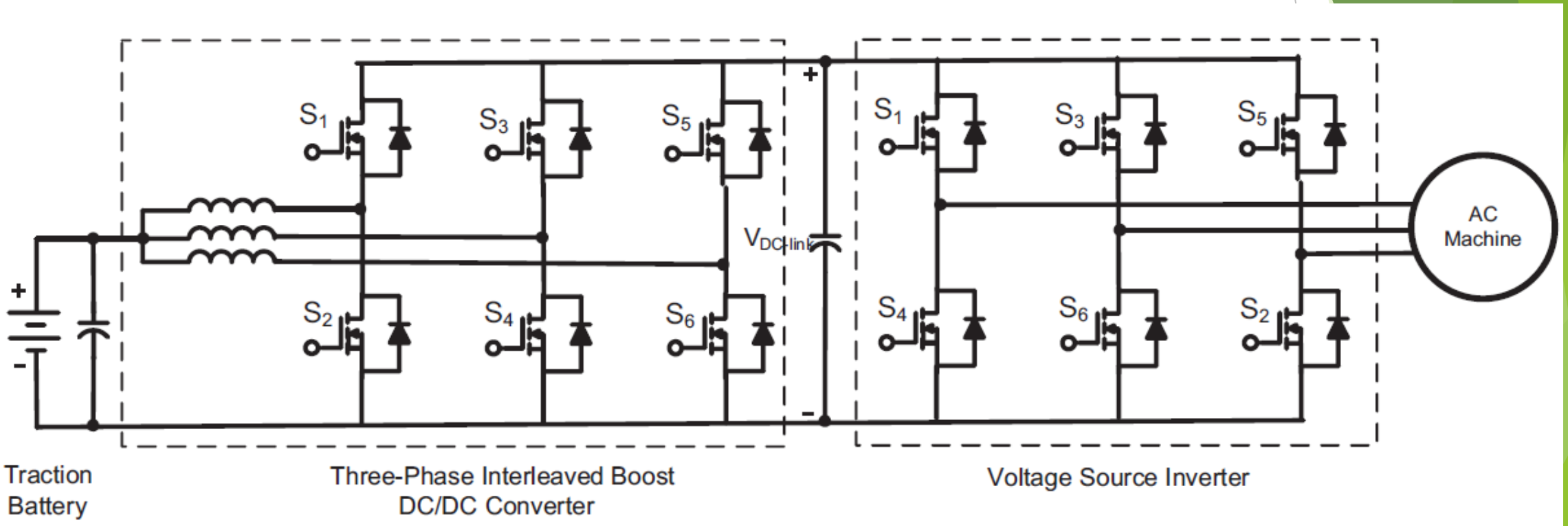
High-to-low voltage DC/DC converter with sensors and controller

DC/AC converters



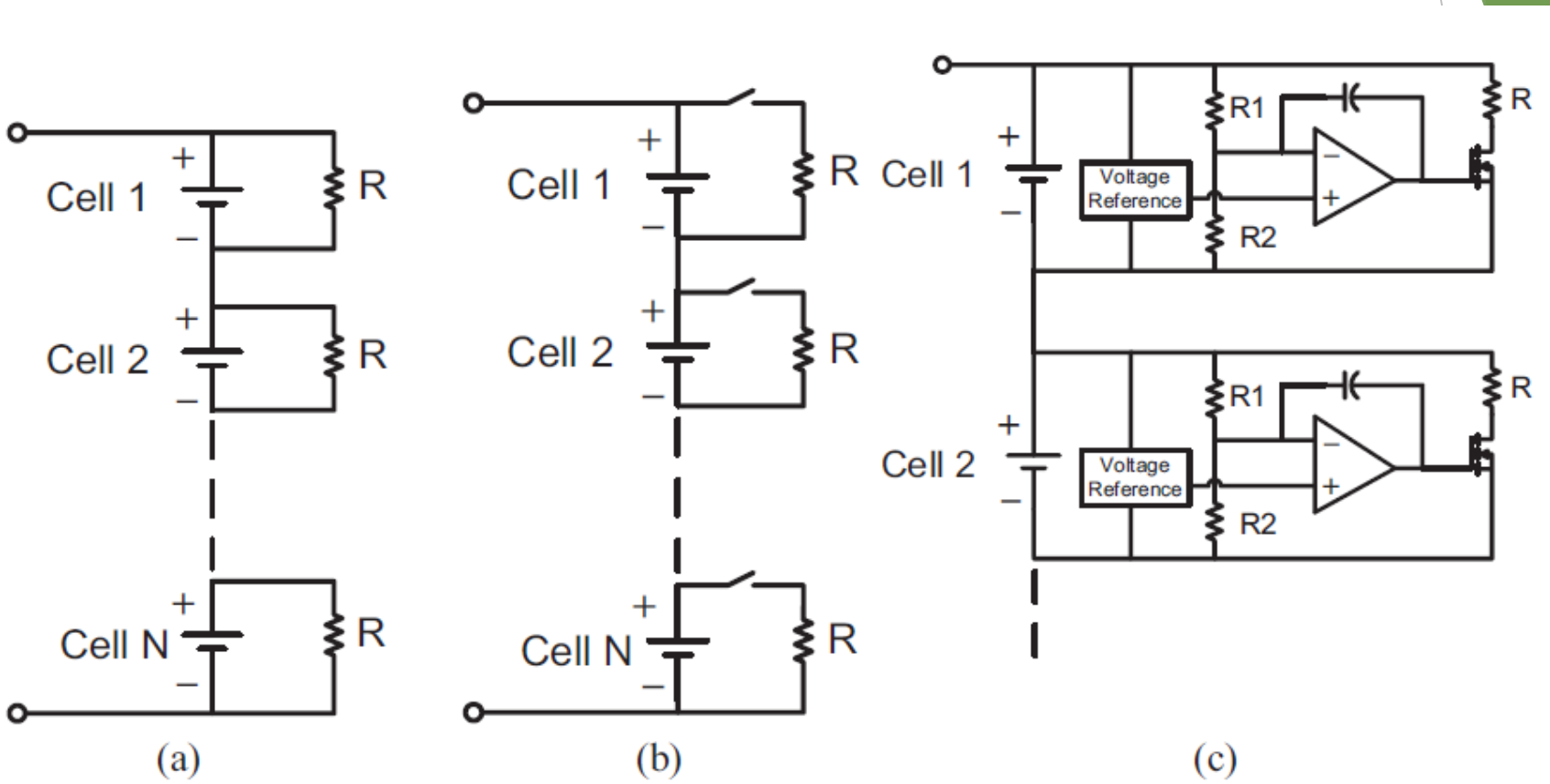
Powertrain non-boosted traction inverter

DC/AC converters



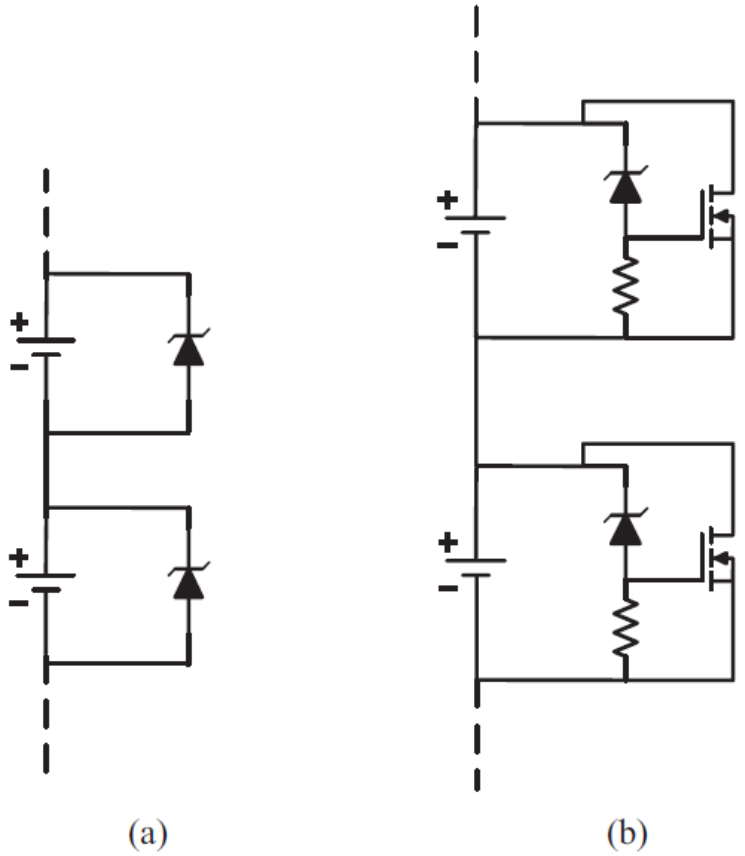
Powertrain-boosted inverter with interleaved DC/DC stage

Cell-balancing converters



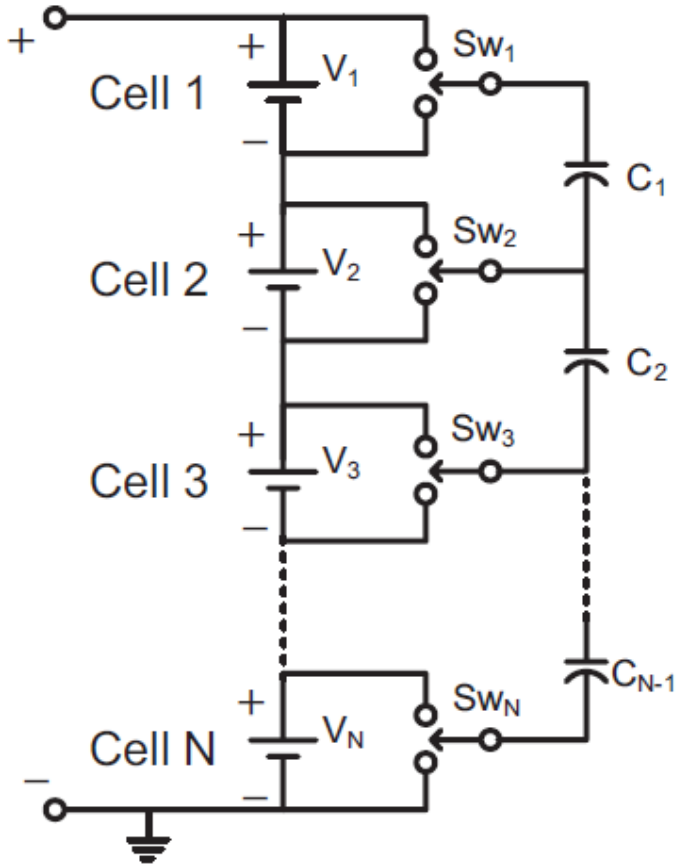
Passive cell voltage equalization: (a) resistive shunt, (b) resistor with switch and (c) analog shunt equalization

Cell-balancing converters



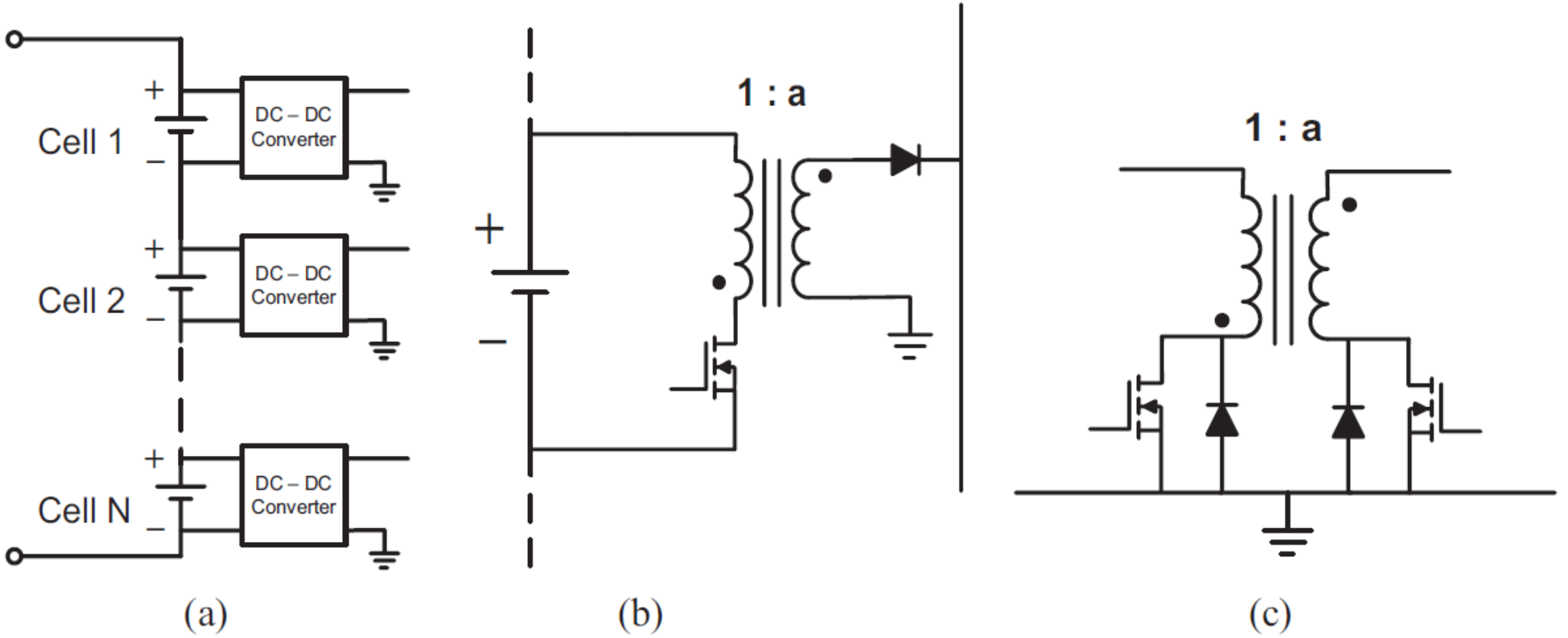
Passive cell voltage equalization: (a) zener diode clamping and (b) zener with switch

Cell-balancing converters



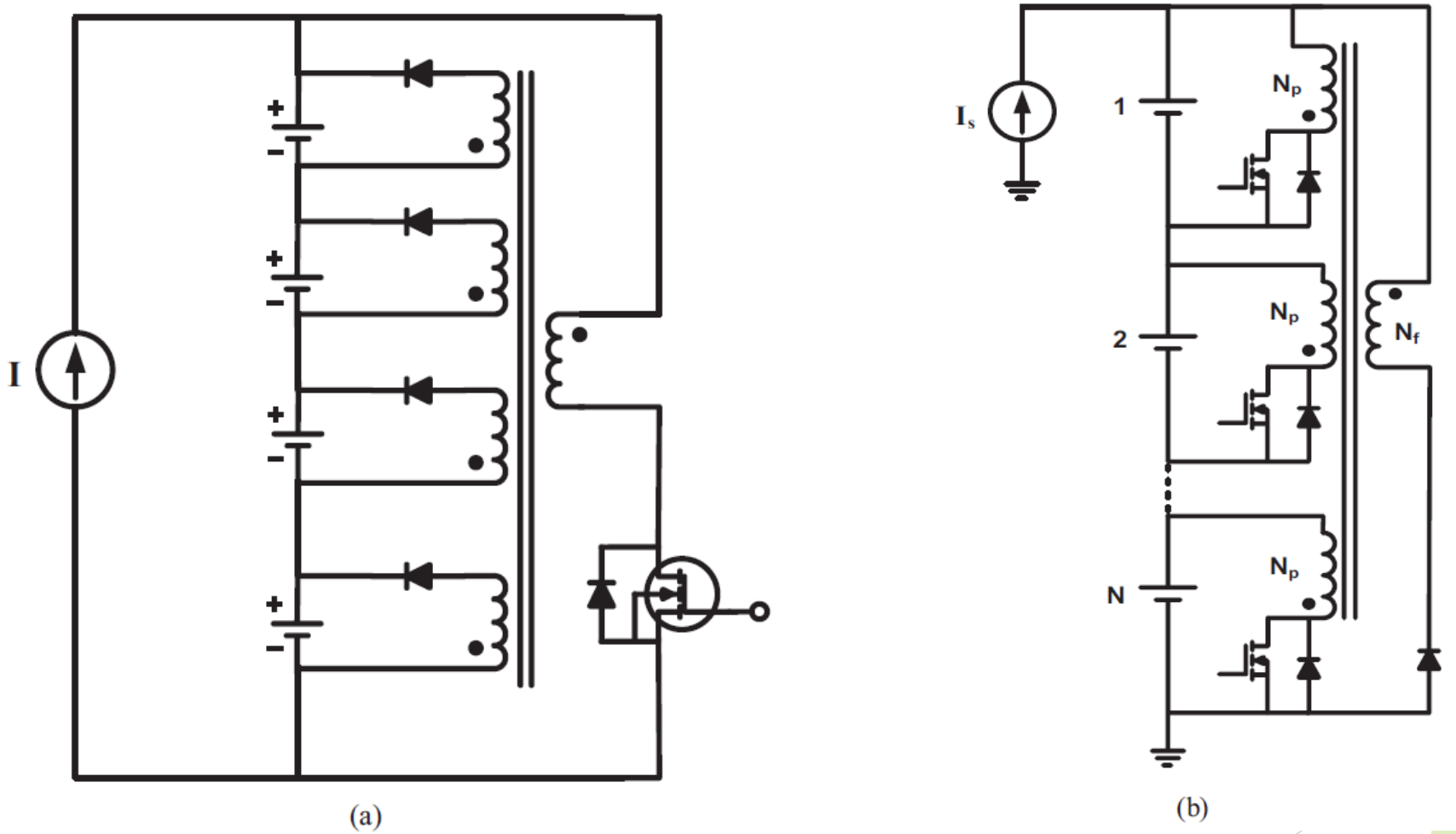
Switched capacitor circuit

Cell-balancing converters



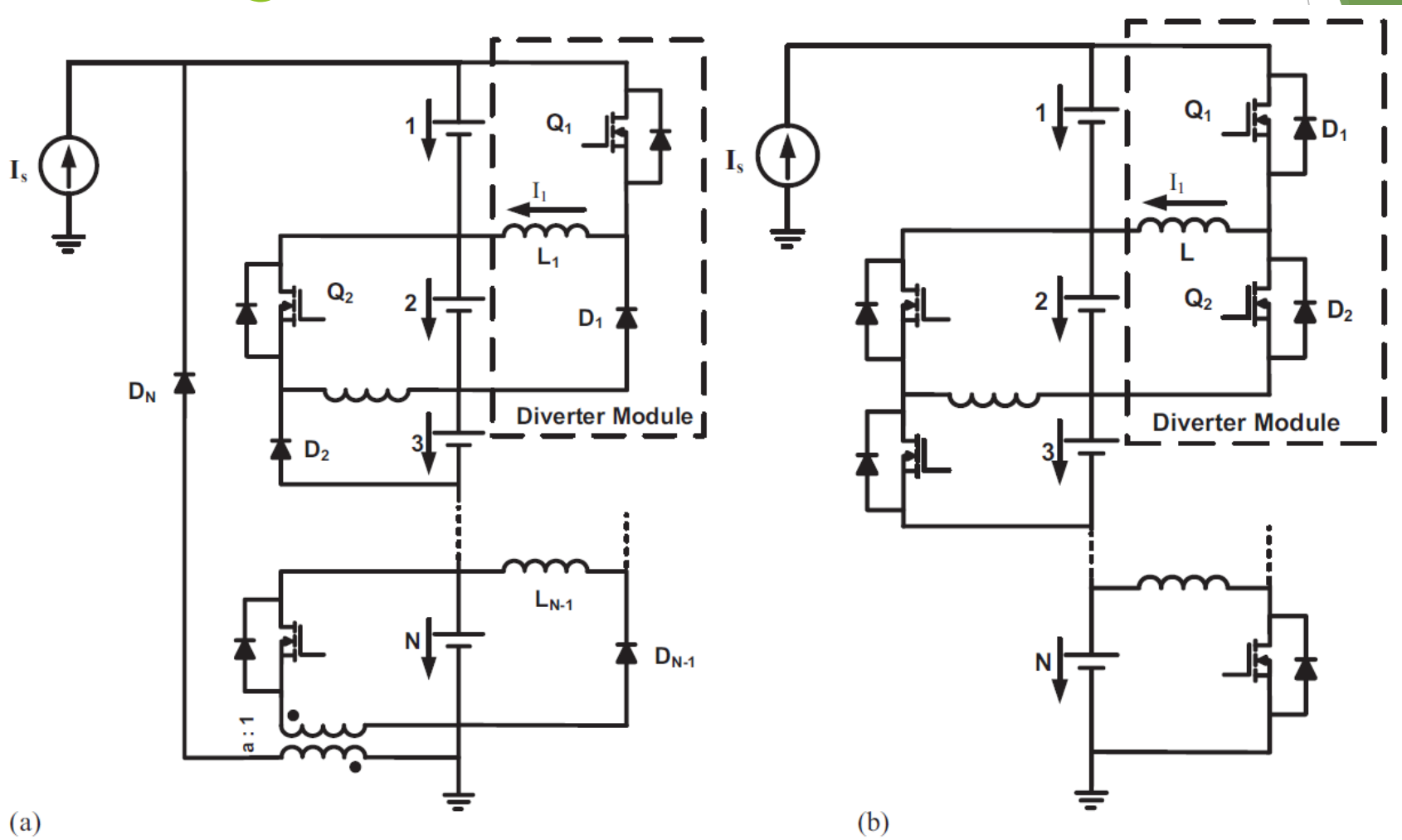
Active cell voltage equalization with: (a) isolated DC-DC converters, (b) unidirectional flyback converter and (c) bi-directional flyback converter

Cell-balancing converters



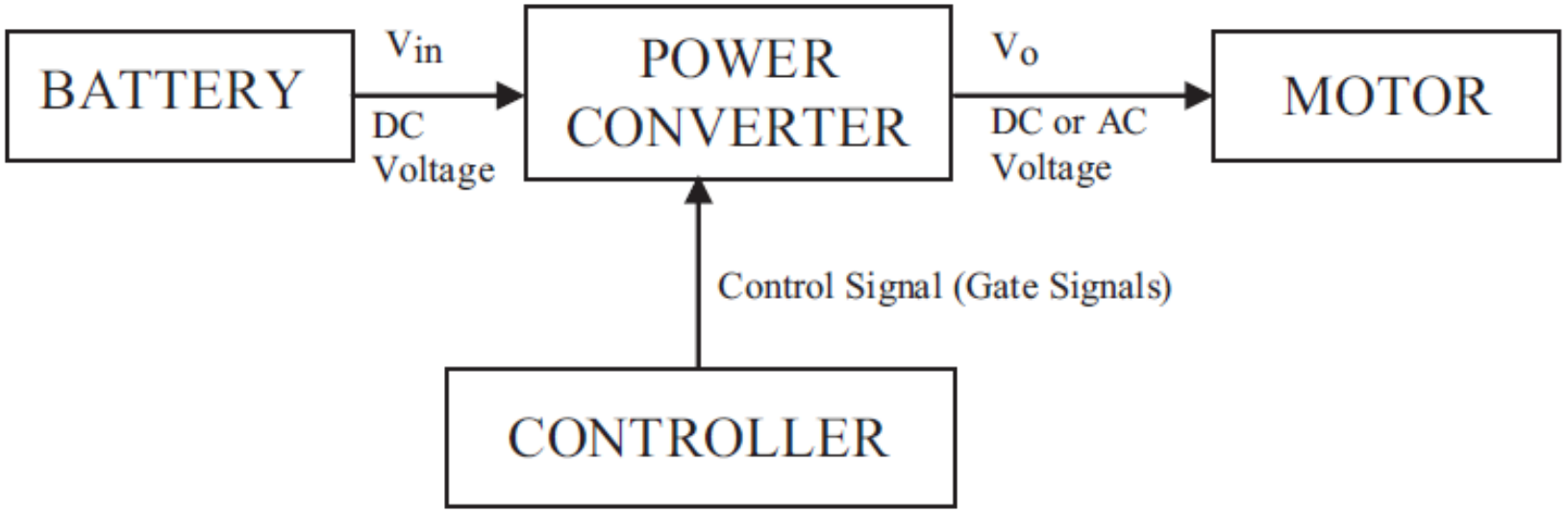
Charge equalization with: (a) centralized flyback converter and (b) centralized forward converter

Cell-balancing converters



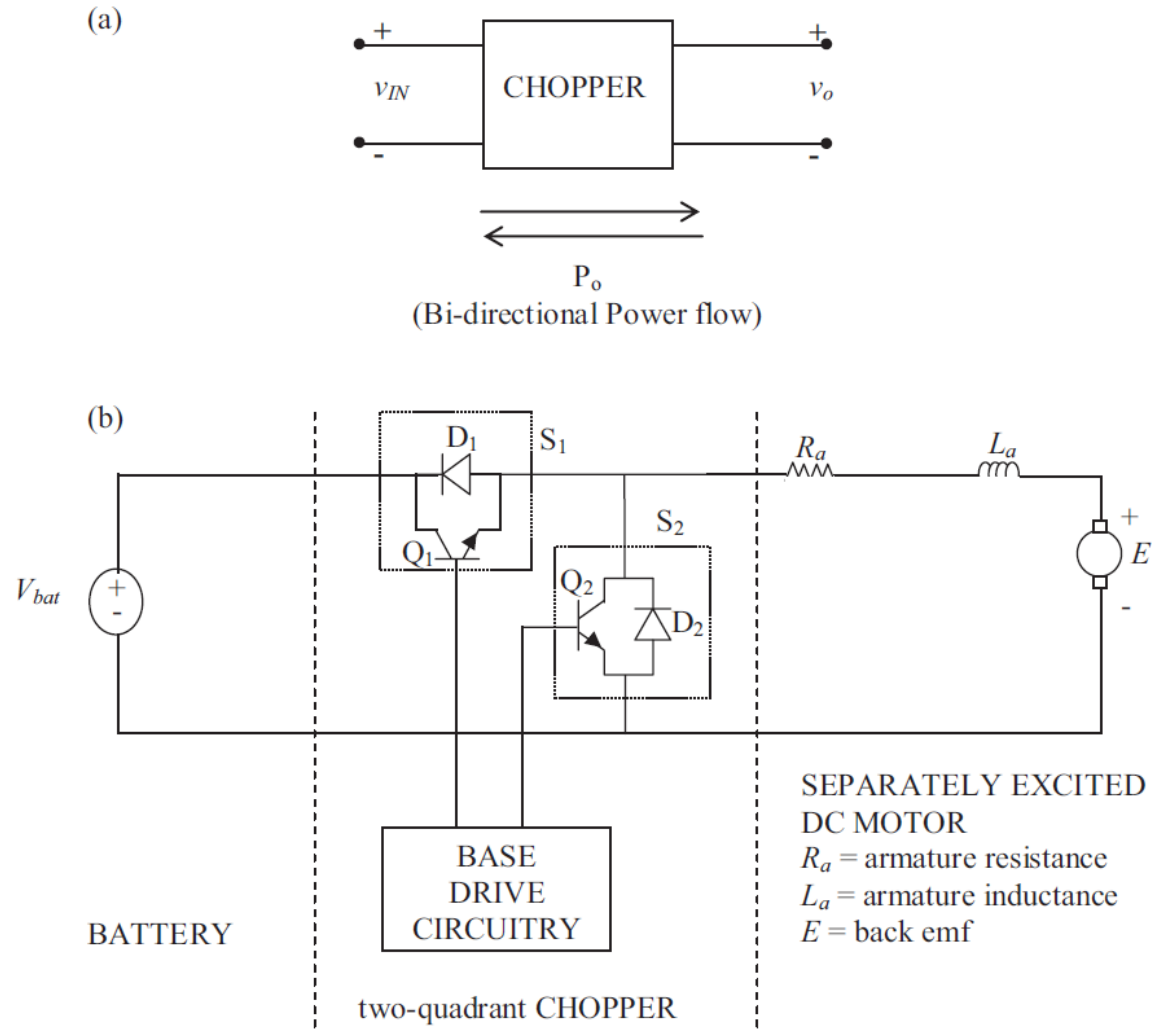
Current diverter circuits: (a) unidirectional and (b) bi-directional

Electric motor drives



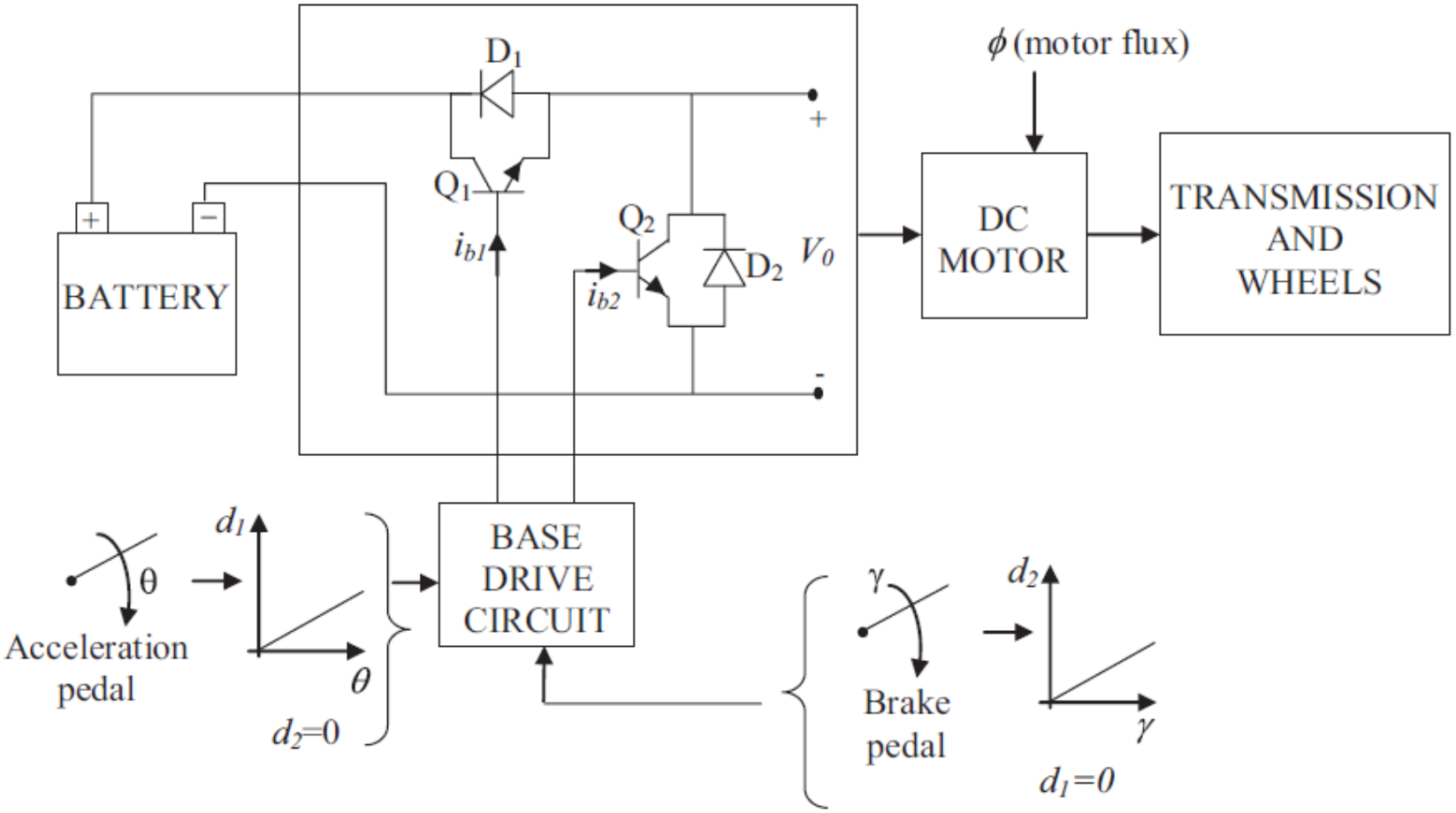
Block diagram of a motor drive

Electric motor drives



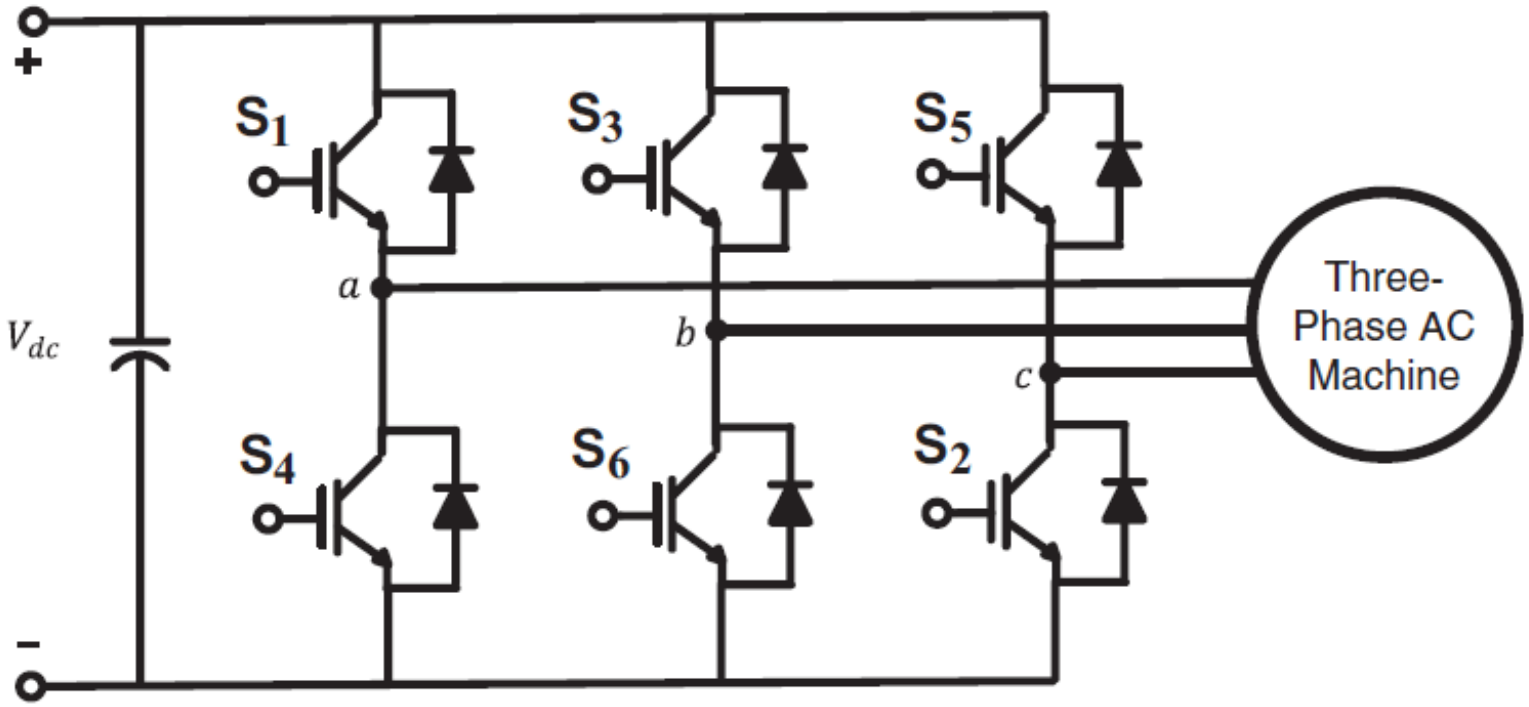
DC electric motor drive

Electric motor drives



Open loop drive for bi-directional power flow

Electric motor drives

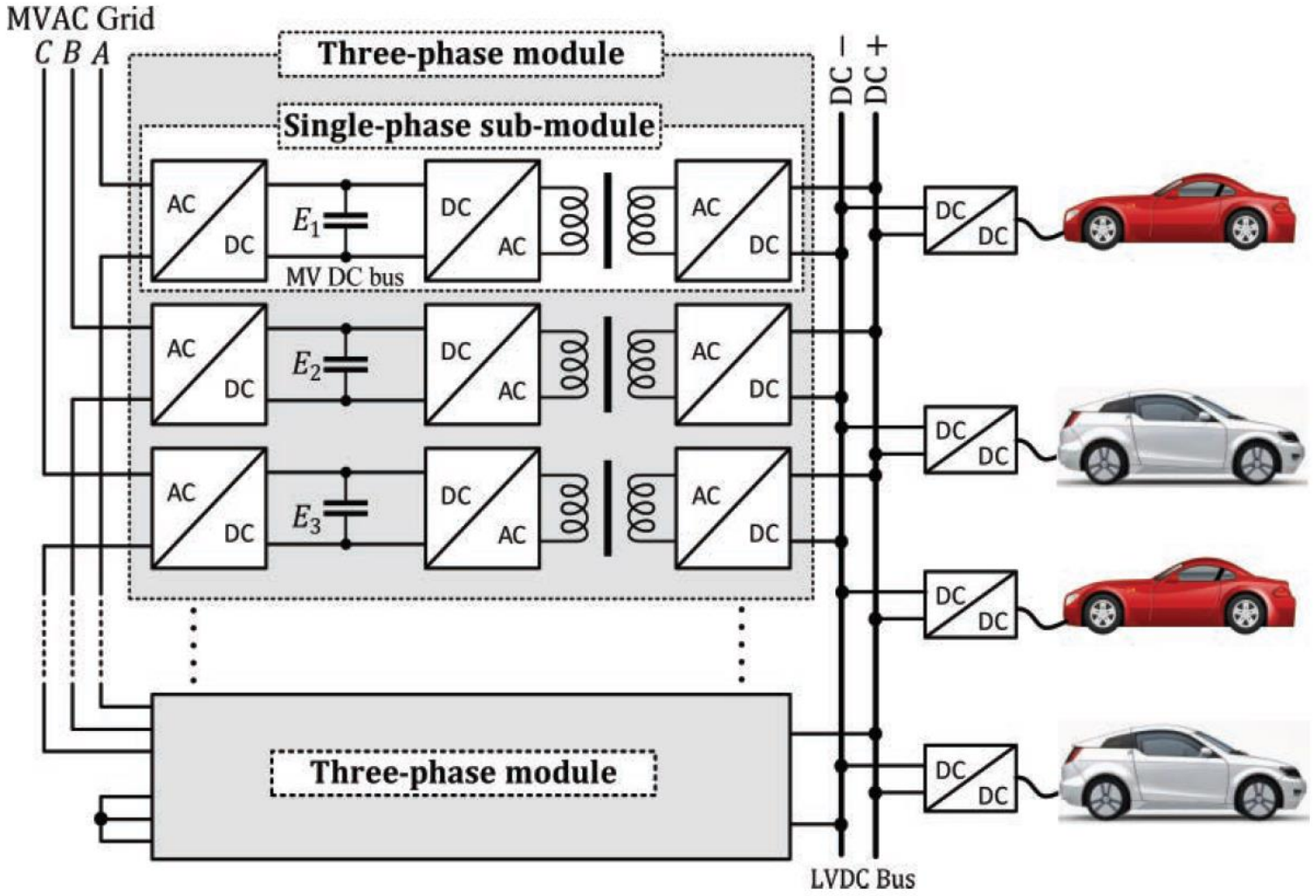


Six-switch voltage source inverter

EV -to- power grid interface

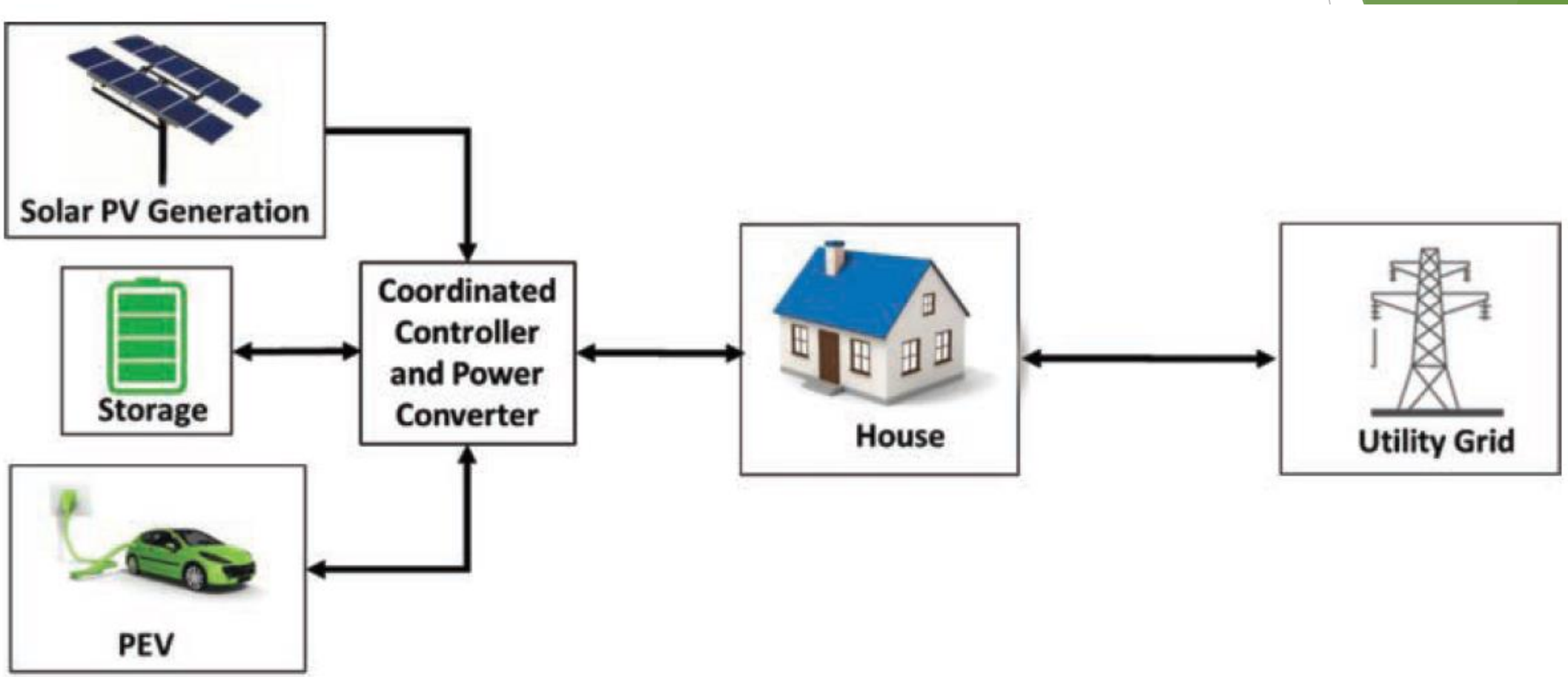
- Plug-in EVs (PEVs) interact with the power systems through the charging and discharging functions of the vehicle's energy storage unit.
- Charging the batteries to replenish the energy capacity, i.e., restoring the battery SOC as the batteries get exhausted due to the operation of the vehicle is the most common and frequent interaction mode between the PEV and the power grid.
- There are emerging technologies and evolving concepts that enable energy transfer from the PEV to the grid to support grid functionalities such as meeting consumer electricity load demands, and grid voltage and frequency support.
- There are three modes of interaction between the EV and the power grid based on the charging/discharging capability of the PEVs: grid-to-vehicle (G2V), vehicle-to-grid (V2G) and vehicle-to-home (V2H).

EV -to- power grid interface



The medium-voltage fast charger

EV -to- power grid interface



System overview with coordinated control at the residential level and benefits at different levels