Bi-directional DC/DC converters essential in battery-operated machinery

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Machinebouw
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Elincom Electronics B.V.

- Since 1975 specialist distributor of components for industrial electronics and industrial automation
- Over 800 B-to-B customers in the Benelux
- Focus at technical design-in

Waterproof connectors | Power supplies / Transformers / EMC filters / Electronic fuses | Solid state relais | Li-Ion battery packs | DC/DC convertors / Battery chargers | Waterproof cable connectors / Industrial connectors / HV DC connectors | Bi-directional DC/DC converters / Energy management systems | Brake resistors / DC energy management systems | UL/CSA fuses / Fuse holders | Industrial cabinet coolers / Chillers – water coolers / LED cabinet lighting

Amphenol LTW — BLOCK — celduc relais — cleantron cleantech batteries — DEUTRONIC Elektronik GmbH — DEGSON — epic power — KOCH — MERSEN — SEIFERT

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Epic Power Converters S.L.

Bidirectional DC/DC Converters for

Lift / Cranes

Intralogistics

Energy storage

Machinery operating without mains

Shuttles in automated warehouses with batteries and supercapacitors

Automated Guided Vehicles with batteries

Machinery operating without mains - Options

Low-voltage battery Low-voltage electronics		Low-voltage battery Industrial electronics		High-voltage battery Industrial electronics	
Battery → Standard	✓	Battery → Standard	✓	Battery → Special	✗
Inverter → Special	✗	Inverter → Standard	✓	Inverter → Standard	✓
Charger → Required	✗	Charger → Embedded	✓	Charger → Required	✗

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Low voltage architecture

48 Vdc

Low Voltage Inverter

DC/AC

External Charger

AC/DC
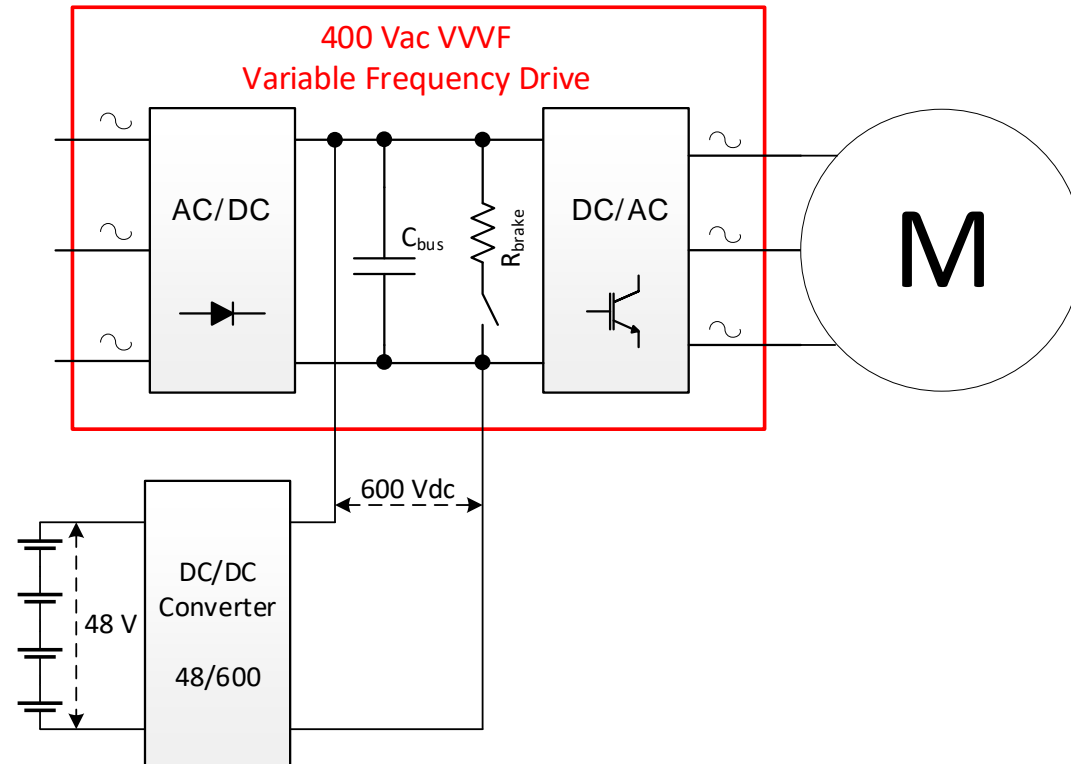
M
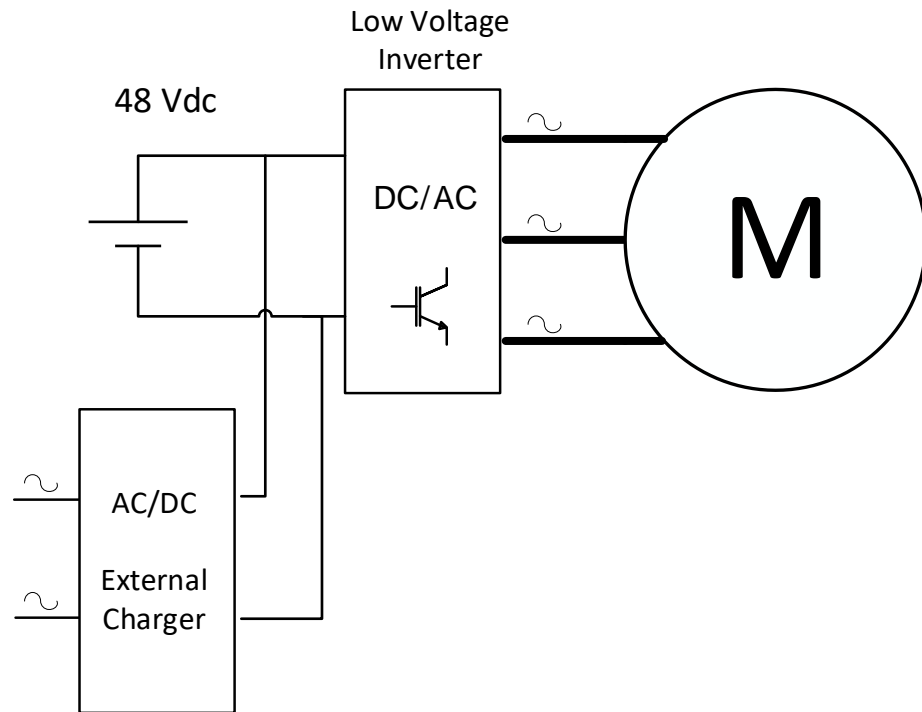
Low voltage power train

- High current requirements

- Special low-voltage inverter & motor

- Long time to tune it for application

- External charger required with space consumption in the client
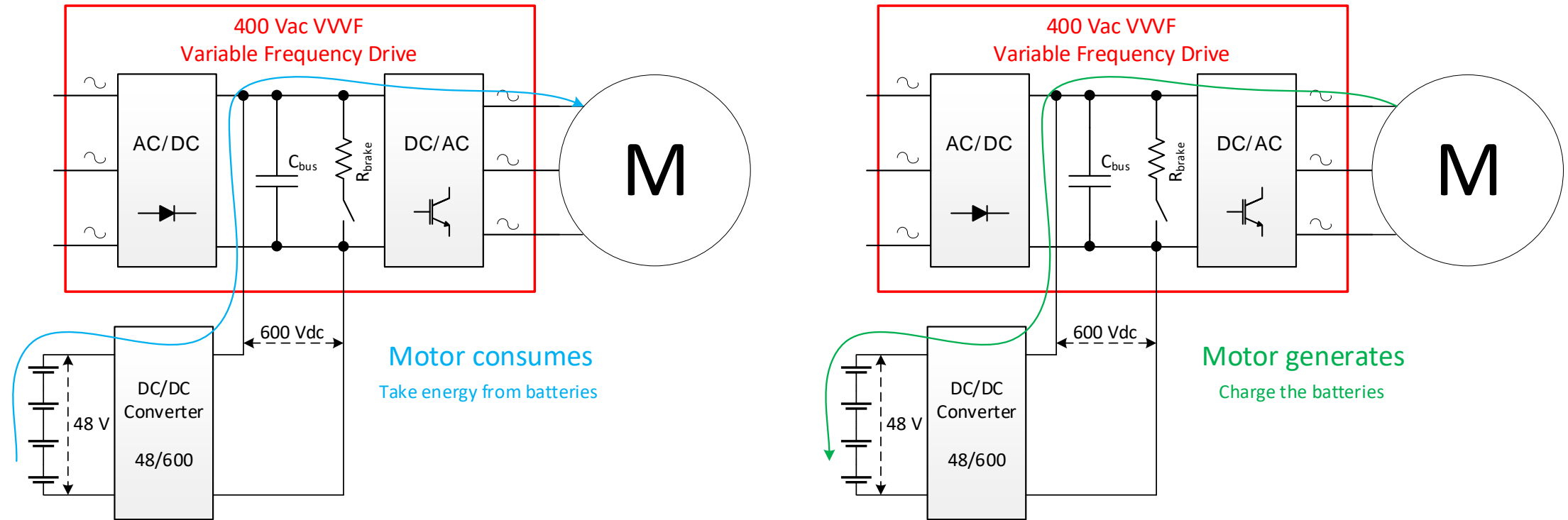
- Limited work duty

New – Industrial voltages architecture

Industrial 400 Vac power train

- Low current requirements (up to 12 times smaller)

- Standard 400 Vac inverter and motor

- Easy to tune in any application

- No need for external charger

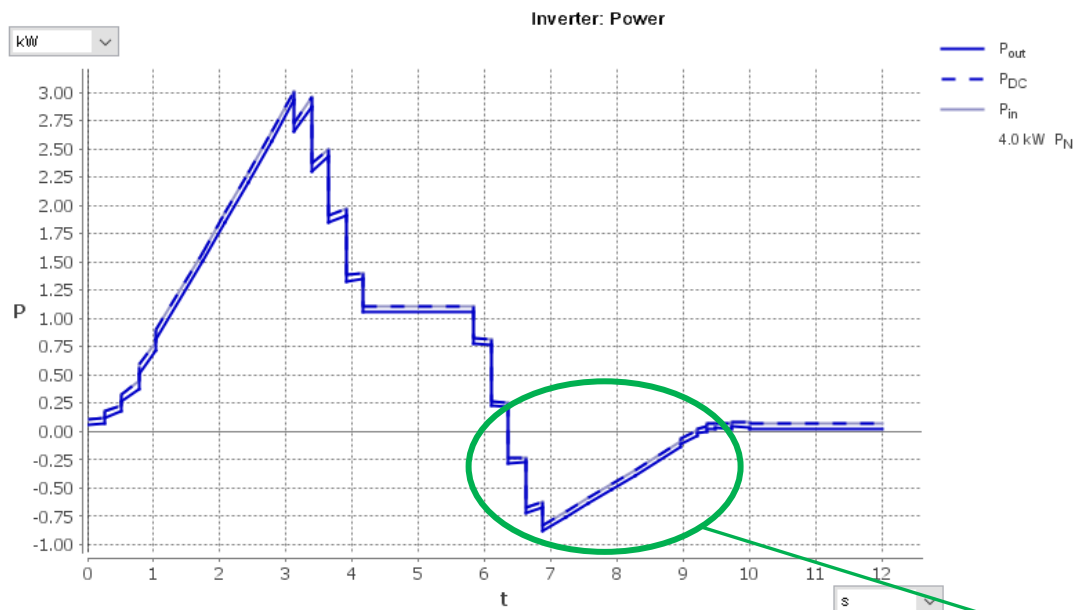- Can operate in duty of work > 80 %

400 Vac VVVF
Variable Frequency Drive

AC/DC — C_{bus} — R_{brake} — DC/AC — M

600 Vdc

DC/DC Converter 48/600

48 V

Operation and benefits of bidirectionality

Motor consumes
Take energy from batteries

Motor generates
Charge the batteries

Standard cycle profile

FEM Cycle

Longest Cycle
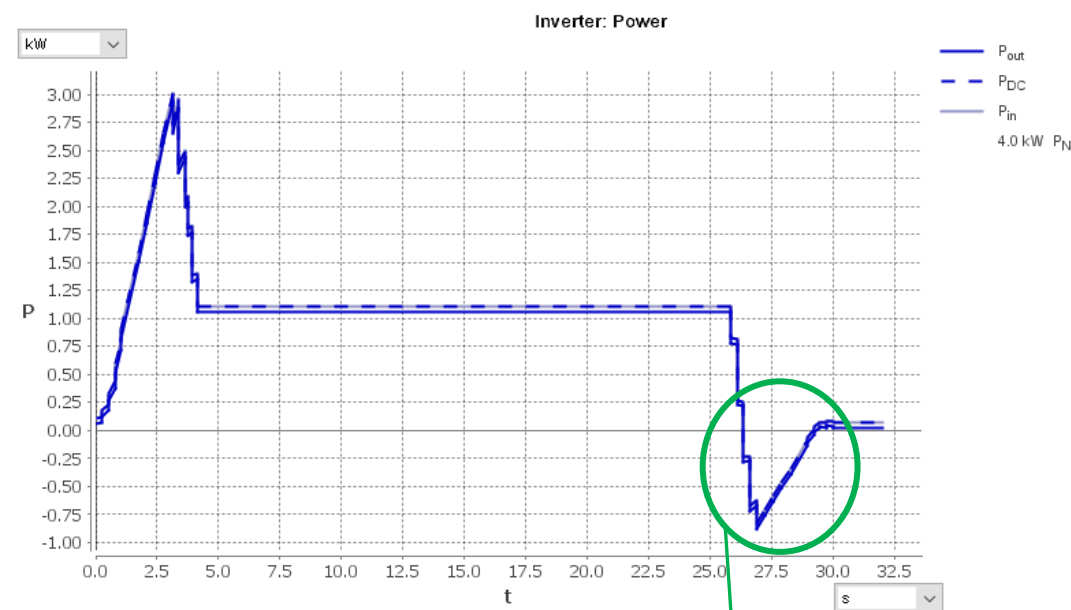
Up to 9% energy saving per FEM cycle

Save space and money charging

400 Vac VVVF
Variable Frequency Drive

AC/DC

C_{bus} R_{brake} DC/AC

M

DC/DC
Converter

48 / 600

600 Vdc

48 V
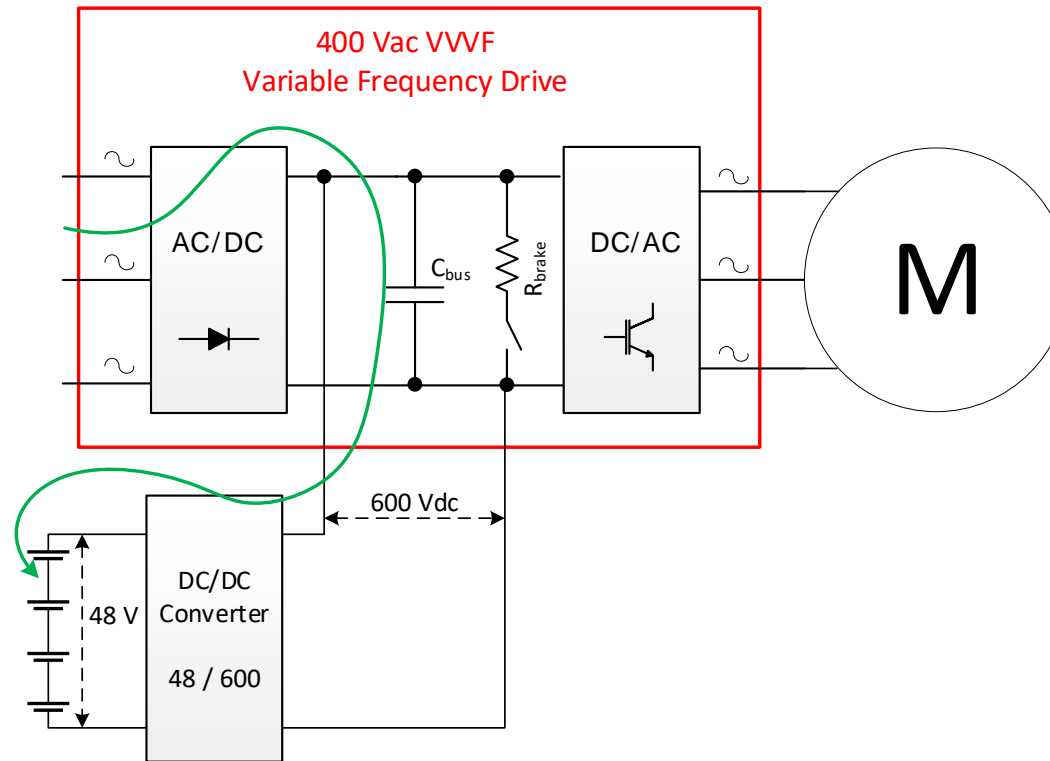
Making opportunity charge while in motion

Electrified rail

400 Vac VVVF
Variable Frequency Drive

AC/DC

C_{bus}

R_{brake}

DC/AC

M

600 Vdc

DC/DC Converter

48 V

48/600
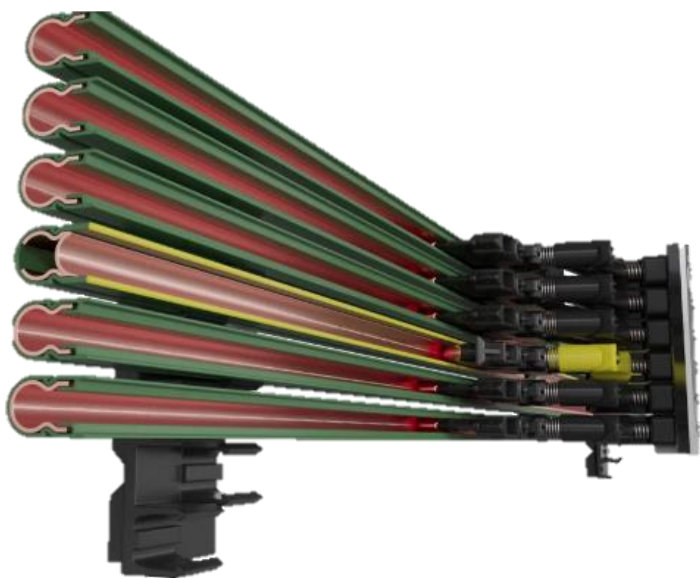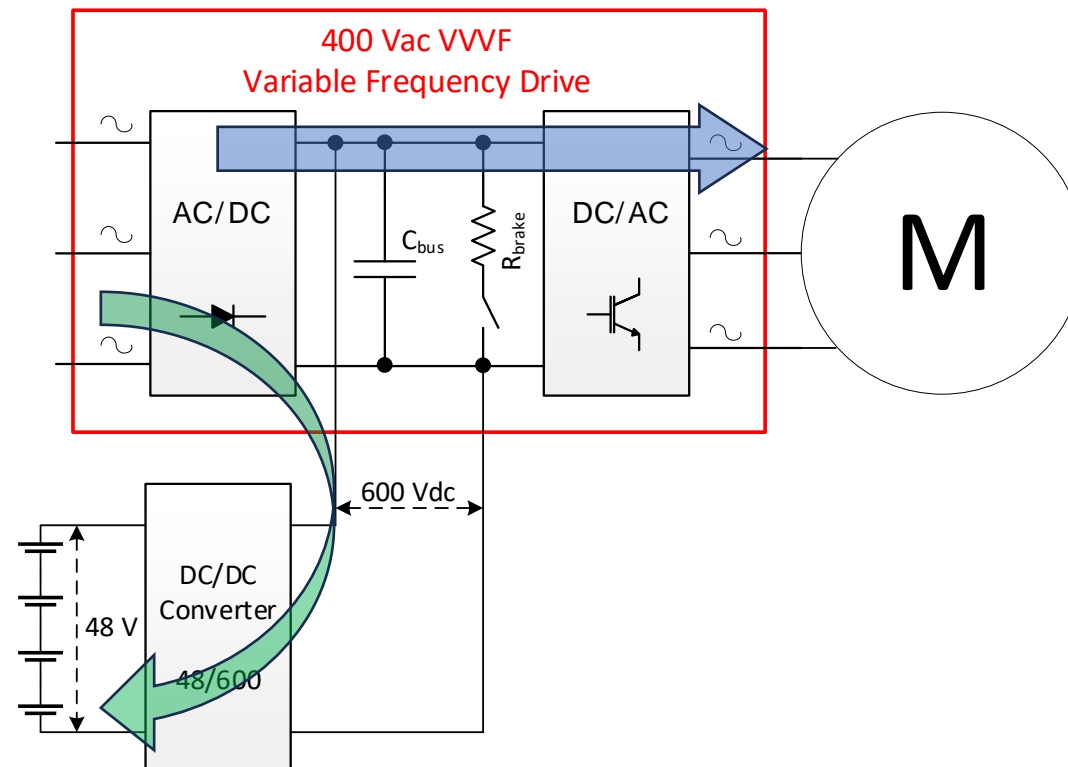
*Image obtained from link

Control strategy

Vdc

900 — EPC shows overvoltage error

800 — Braking resistor is enabled

600 — EPC converter regulates DC bus

570 — Three phase mains rectified

kW

Ppeak

0

- Ppeak

① Consumption: Energy from battery to drive

② Standby regulation

③ Generation: Energy from drive to battery

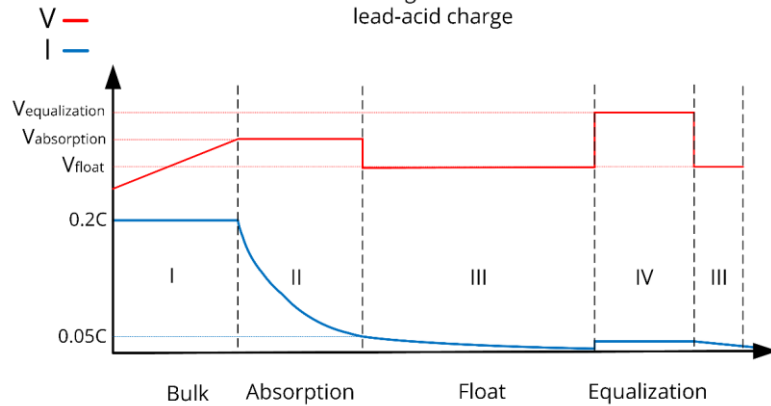④ Generation: Excess of energy

⑤ Battery charging mode
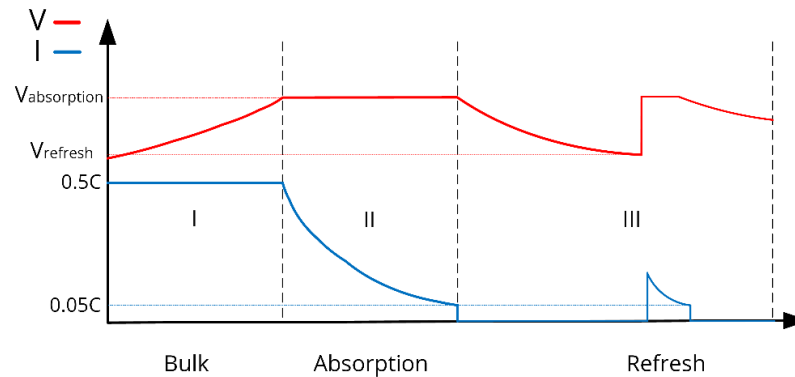
Time (s)

① ② ① ③ ① ④ ⑤
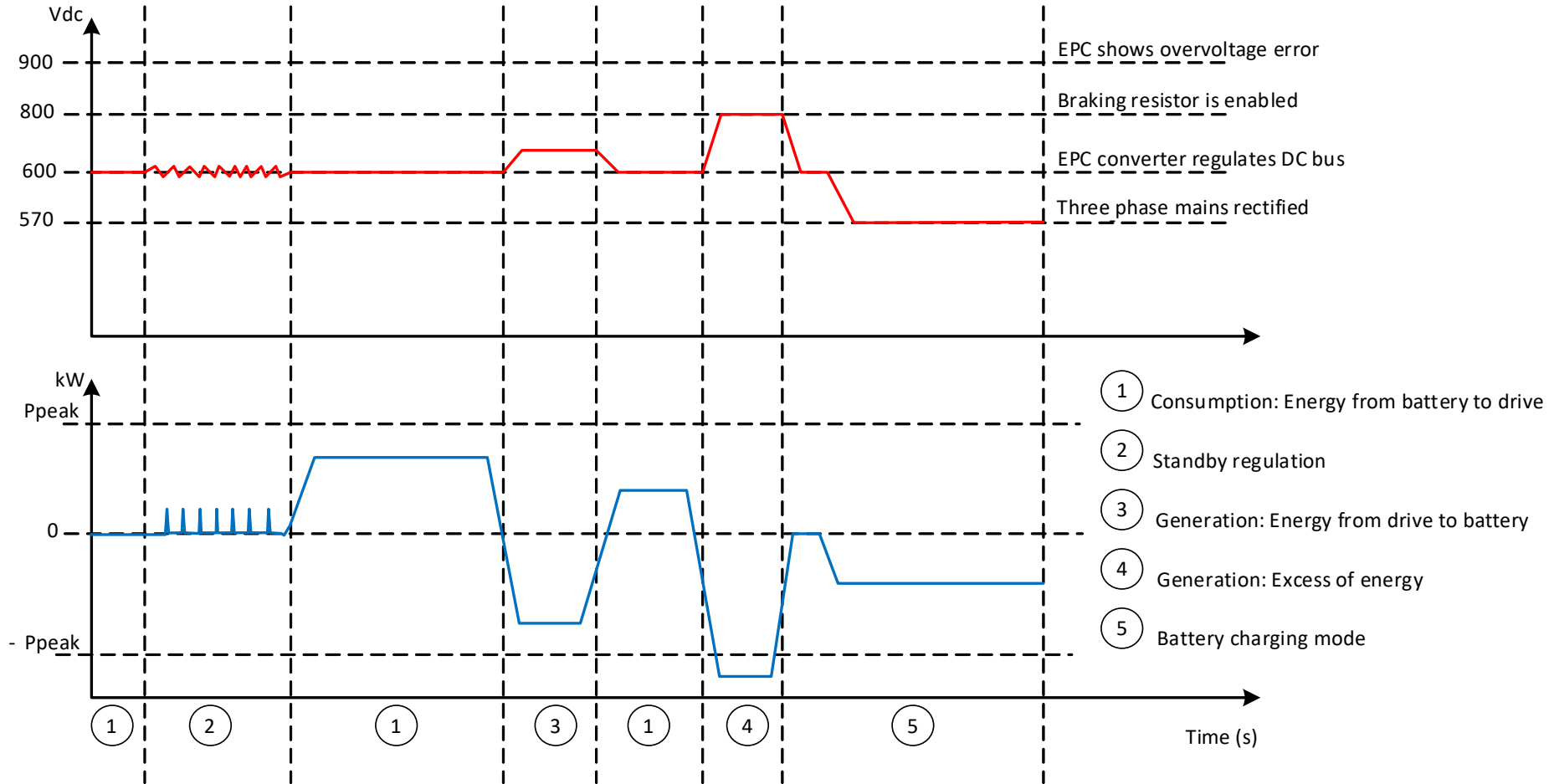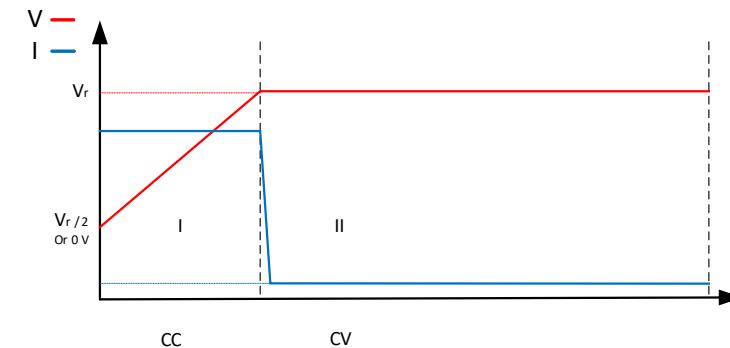
Battery flexibility

4-stage flooded
lead-acid charge
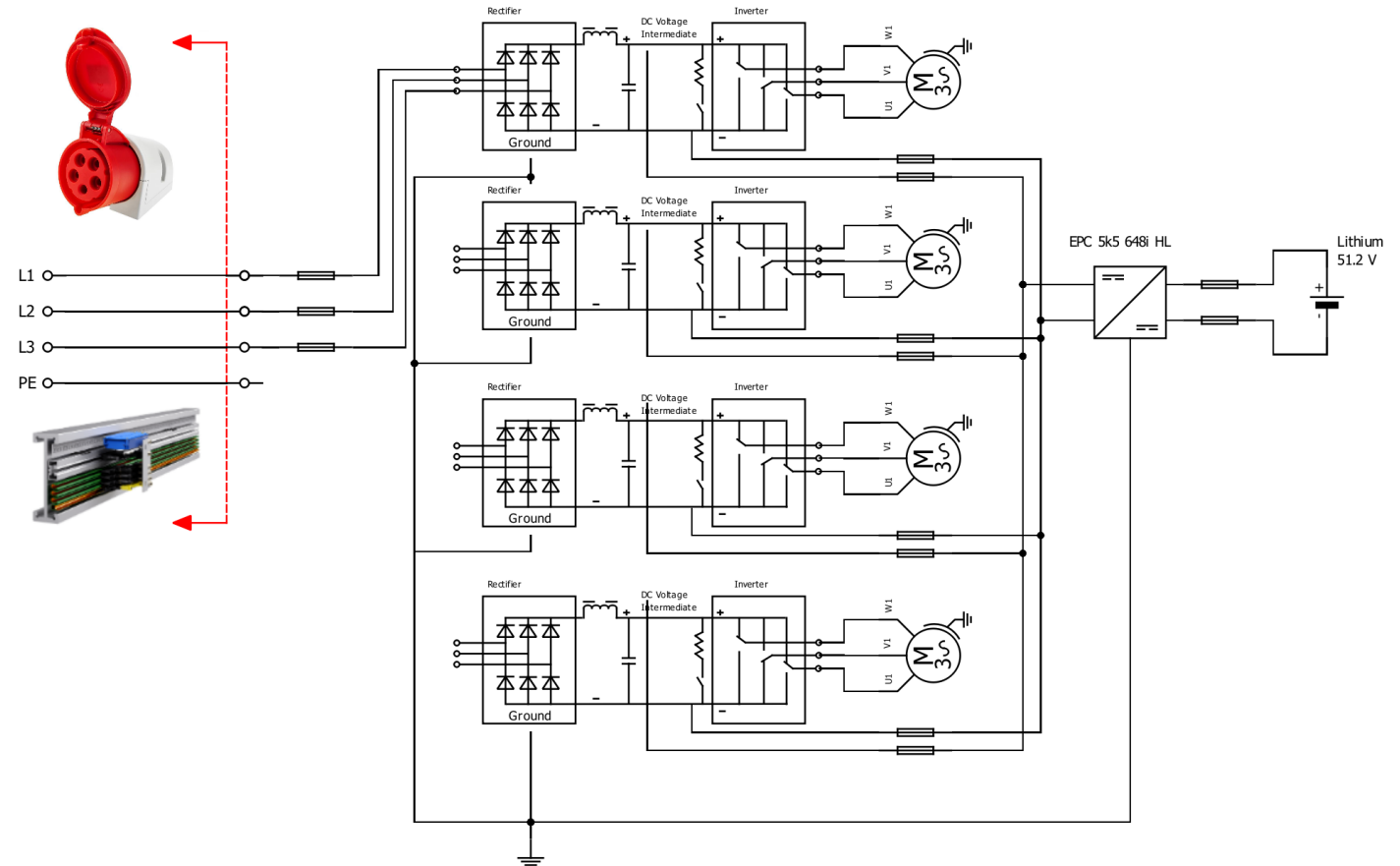
3-stage lithium charge

2-stage charge
Supercapacitor

Electrical power design
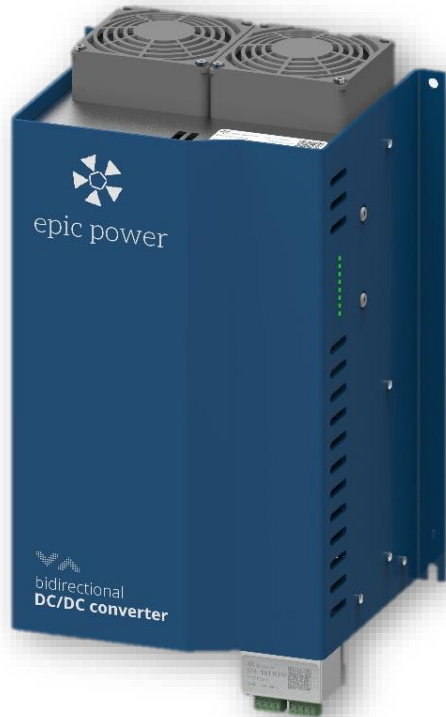
With industrial VFD and DC/DC converters

- Optimized energy consumption

- Easy adaptation in new projects

- Any battery can be used

- No need for external charger

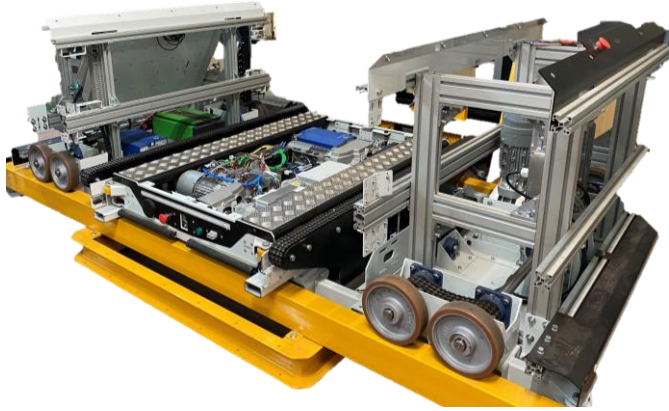- Opportunity charges available anywhere

DC/DC converter control and data

To control application:

- Regulate Voltage on DC bus.
- Regulate Current on battery.
- Implement automatic control.
- Optimize energy consumption.

CAN 2.0B

To monitor application:

- Power, voltage and current values.
- Temperature warnings.
- Errors logs.
- Status feedback of control.

Some success cases

Shuttles in automatic warehouse
Supercapacitors + DC converter

AGV in industrial bearing factory
Batteries + DC converter

Forklift in cardboard manufacturer
Batteries + DC converter

Summary

- Energy consumption can be optimized

- Energy storage capacity can be reduced with opportunity charging

- Charging time can be highly reduced

- The use of industrial inverters and motors reduce the time to market

- Using DC/DC converters add flexibility to the electrical design

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