

Empowering the All Electric Society 



The Importance of Connectivity within Battery Storage Systems



Power Electronics & Energy Storage event
27 juni 2023 | 1931 Congrescentrum 's-Hertogenbosch



Energy Dependency as a Weapon



Energy Imports Germany 2020^{*)}

- Natural Gas 94,4 %
- Crude Oil 98 %
- Uranium 100 %
- Hard Coal 100 %
- Lignite -2,2 %

^{*)}Source: Federal Environmental Agency

Introduction – Global Challenges

Climate Change becomes visible even in industrialized countries!



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Introduction – Global Challenges

Climate Change manifests itself in many different effects!



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The Vision of an All Electric Society...

... a world

- with unlimited energy based on renewable resources – without harmful emissions
- with sustainable growth and conservation of natural resources
- with great growth and development prospects for our society and economy

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Sector Coupling enables Efficient Use of Energy



- “Smartification” of all sectors
- Linking all sectors in terms of data and energy exchange
- Providing energy based on clean energy
- Using energy, when it is available
- Storing excess energy

Introduction – Campaign Energy Storage Systems

Electrification takes place in every sector of our economy!



Introduction – Campaign Energy Storage Systems

Energy Storage is the Key Element for Sector Coupling



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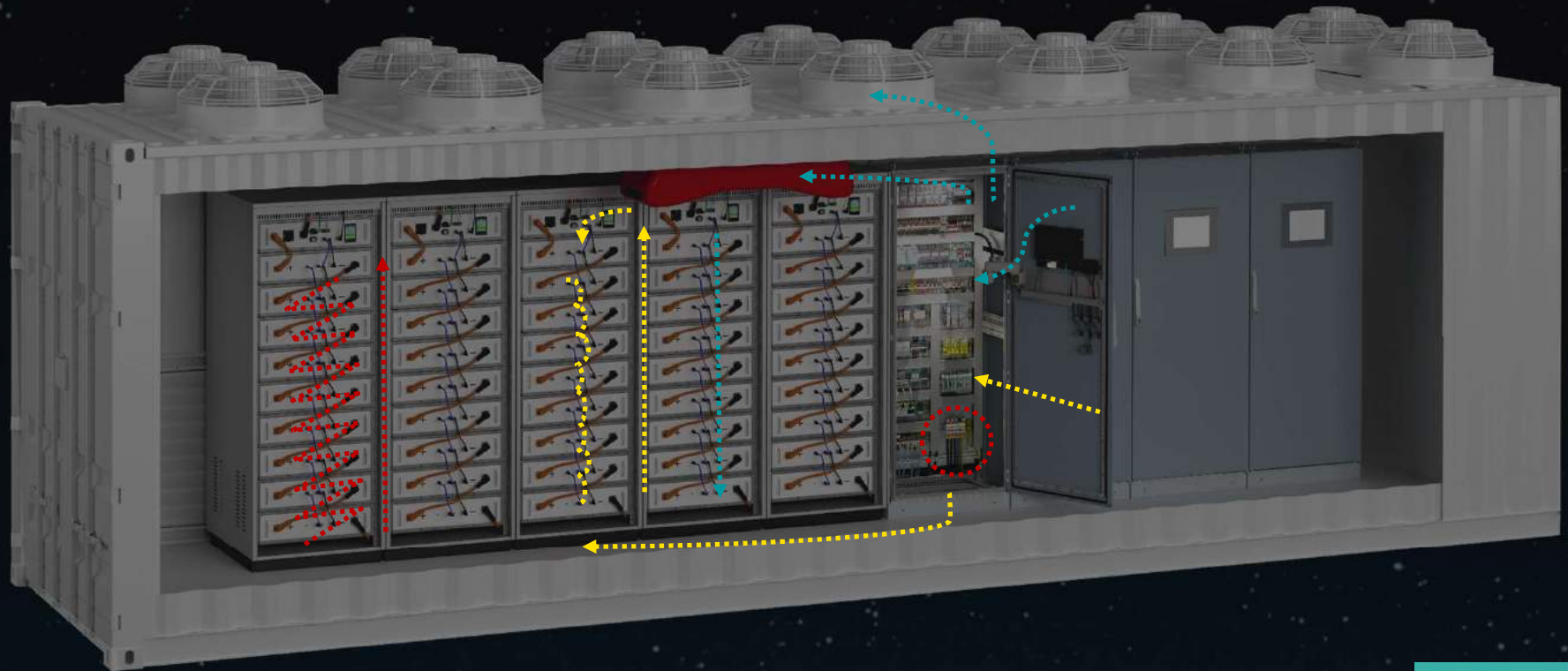
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Reliable Connection Technology for Resilient Energy Storage Systems



Energy Storage Systems

The Nerve System of a BESS



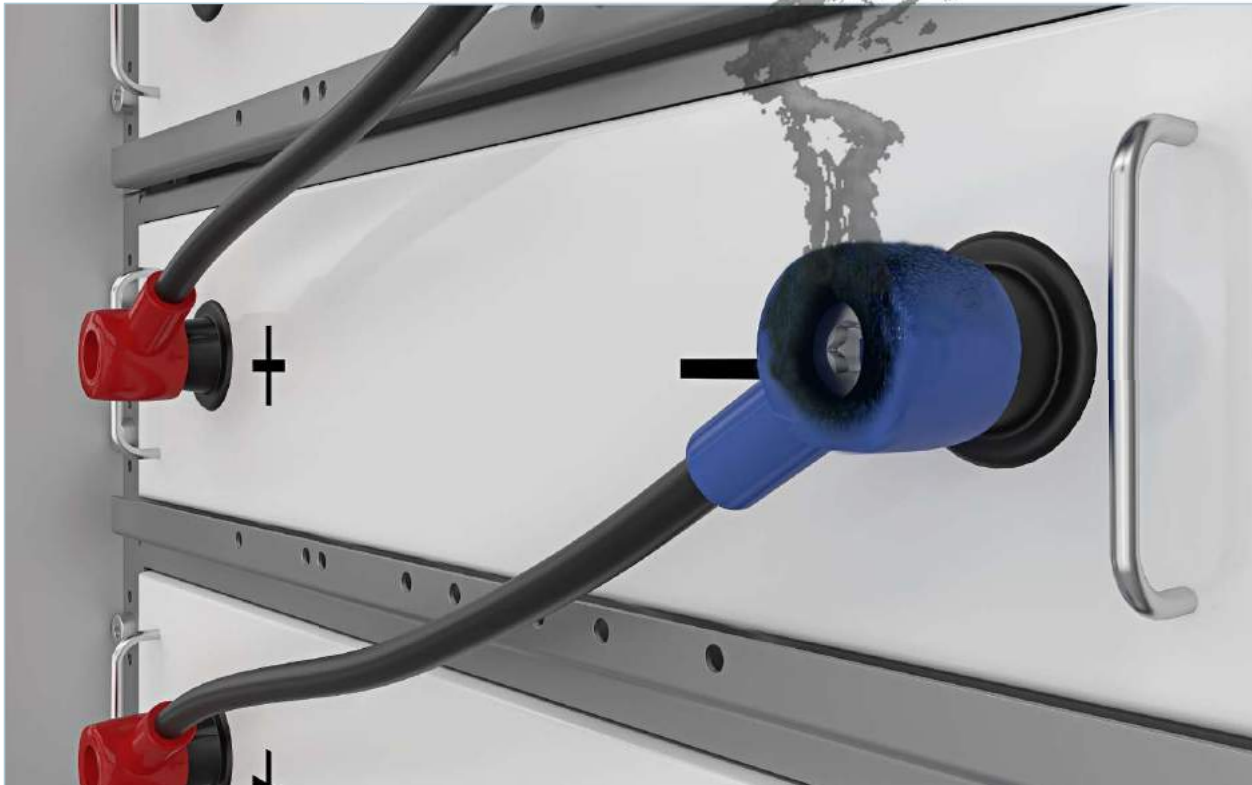
- Signal
- Data
- Power

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Causes and effects of errors in electrical interfaces

Failure @ Power Connections



Example: screw connections

- Torque not supervised
 - Vibrations or material fluctuation
- ↓
- Increased contact resistance
- ↓
- Heat losses – cost
 - Overheating – isolation failure
 - Strong overheating – fire!

Causes and effects of errors in electrical interfaces

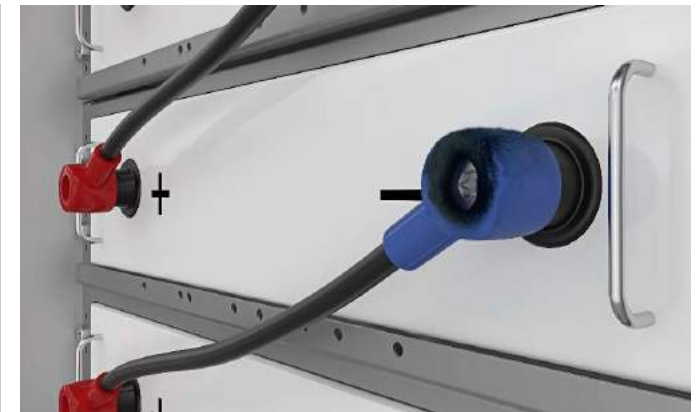
Loss Calculation Power Connection

Assumptions

- 10 kWh module capacity
- 48 V module voltage
- 50 A module current (mean)
- 5,000 full cycles

Loss energy at the power contacts (+/-)
of only one (!) ES module

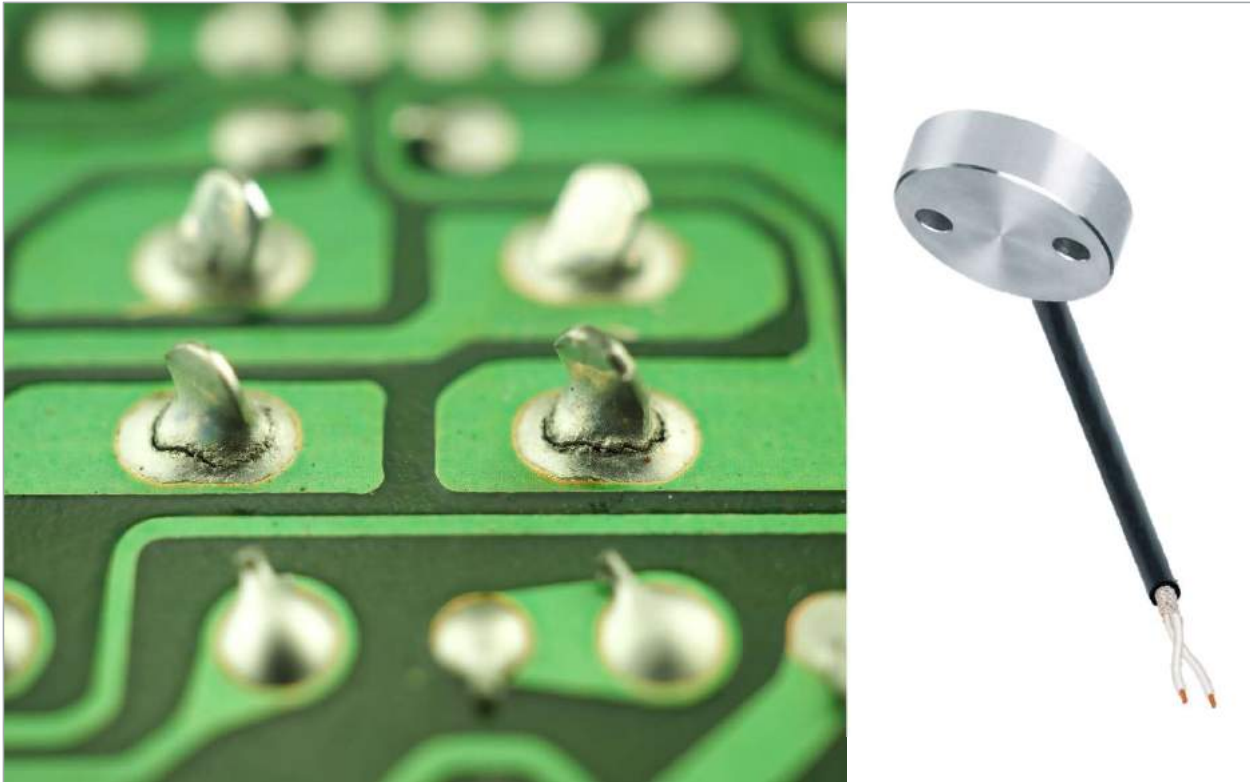
- 208 kWh @ 1 m Ω (“normal”)
- 3,125 kWh @ 15 m Ω (undetected failure)



Mean annual electrical
energy consumption of
a family of three!!!

Causes and effects of errors in electrical interfaces

Failure @ Sensor Connection Points



Example: solder connection

- Cold solder joint
- Poorly prepared wire



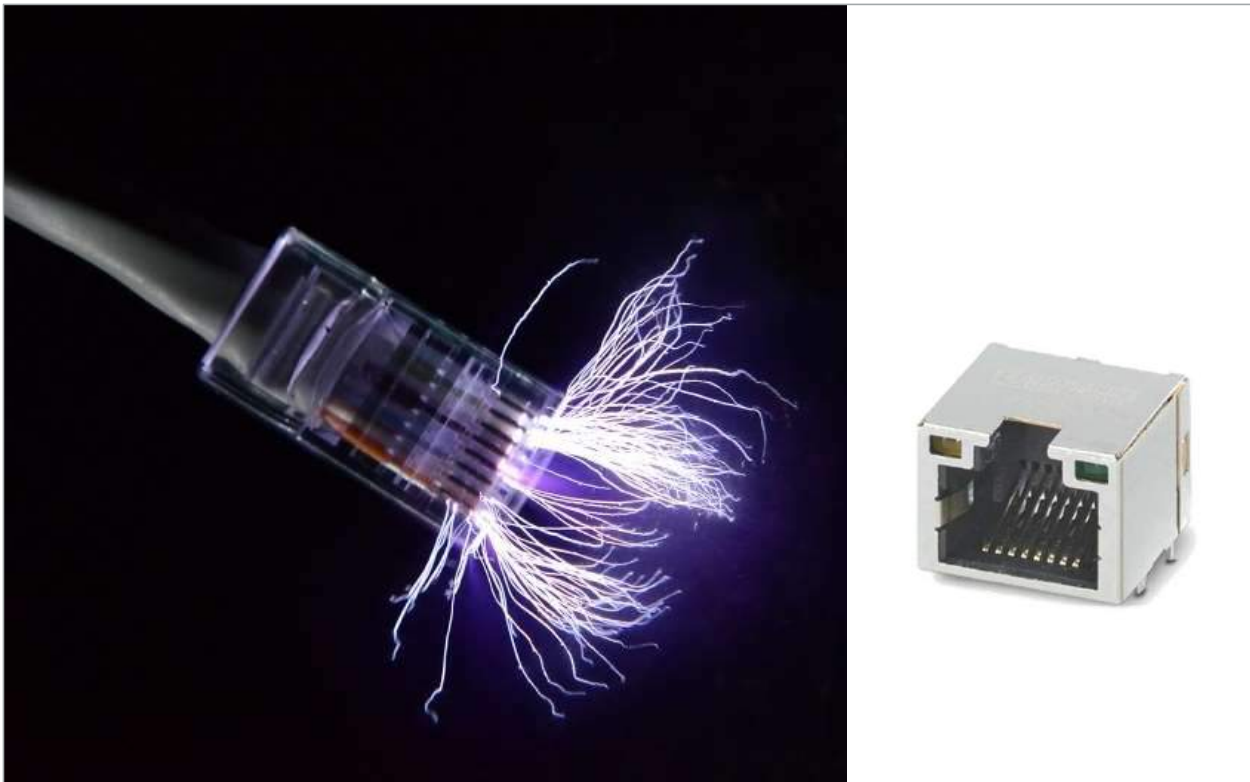
- Voltage drop at the contact



- Voltage failure – loss of capacity
- Current failure – early aging


Causes and effects of errors in electrical interfaces


Failure @ Data Interface



Example: plug connection

- High dimensional tolerances
- Low quality of the contact surfaces
- Poorly prepared wire

- 
- Low data transmission rate
 - Failure in the data transmission

- 
- Frequent system malfunctions
 - System failure
 - Damaged hardware

Connectivity within Battery Energy Storage Systems

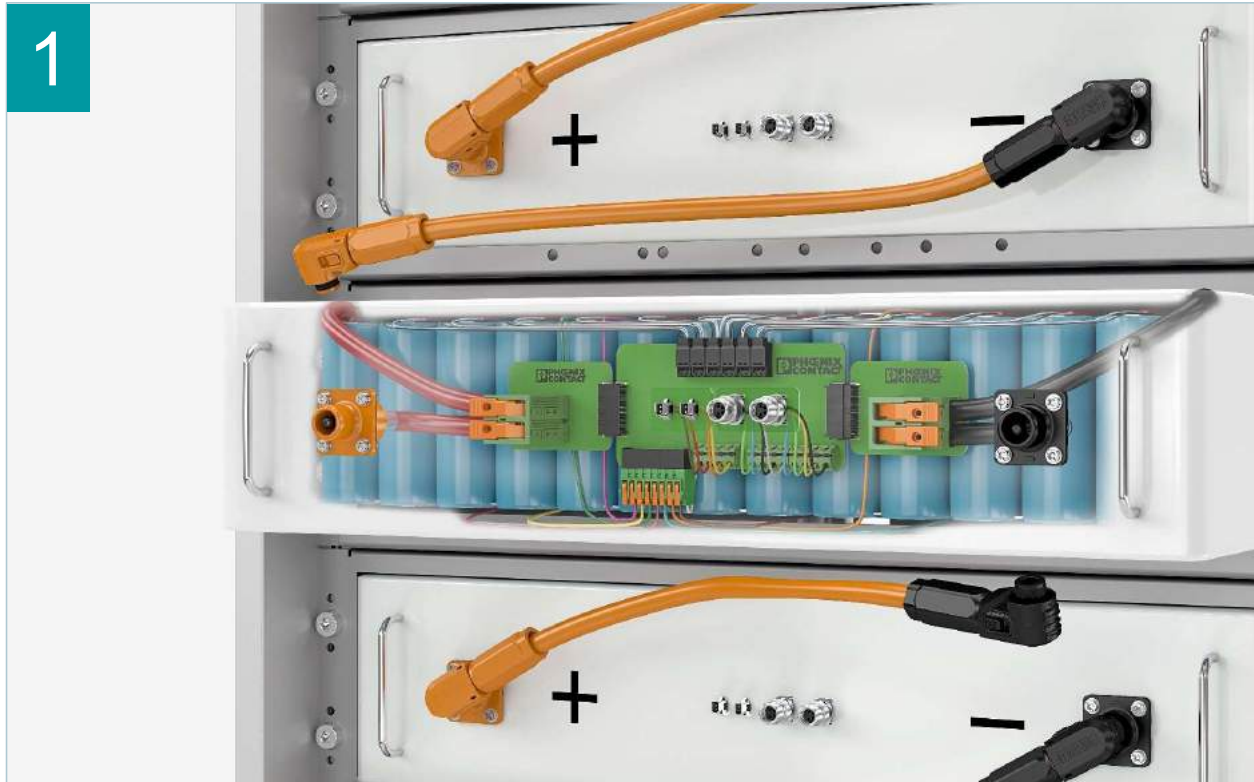


Energy Storage Systems

Structure of a typical Energy Storage System



Battery Module



Power

- Cell-to-Cell
- Charging / Discharging
- Balancing

Signal

- Temperature Sensors
- Fan Control

Data

- Control Board

Power Control Unit



Power

- Charging / Discharging
 - Module ↔ PCU
 - PCU ↔ System

Signal

- Control Signals
- Sensors

Data

- Communication with Modules
- Communication with higher-level System

Energy Storage Rack



3



Power

- Charging / Discharging

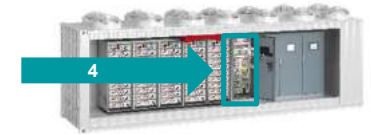
Signal

- Control Signals

Data

- Communication (CAN, ProfiNet, Modbus, Ethernet ...)

System Management



Power

- Interface to Racks
- External Interface

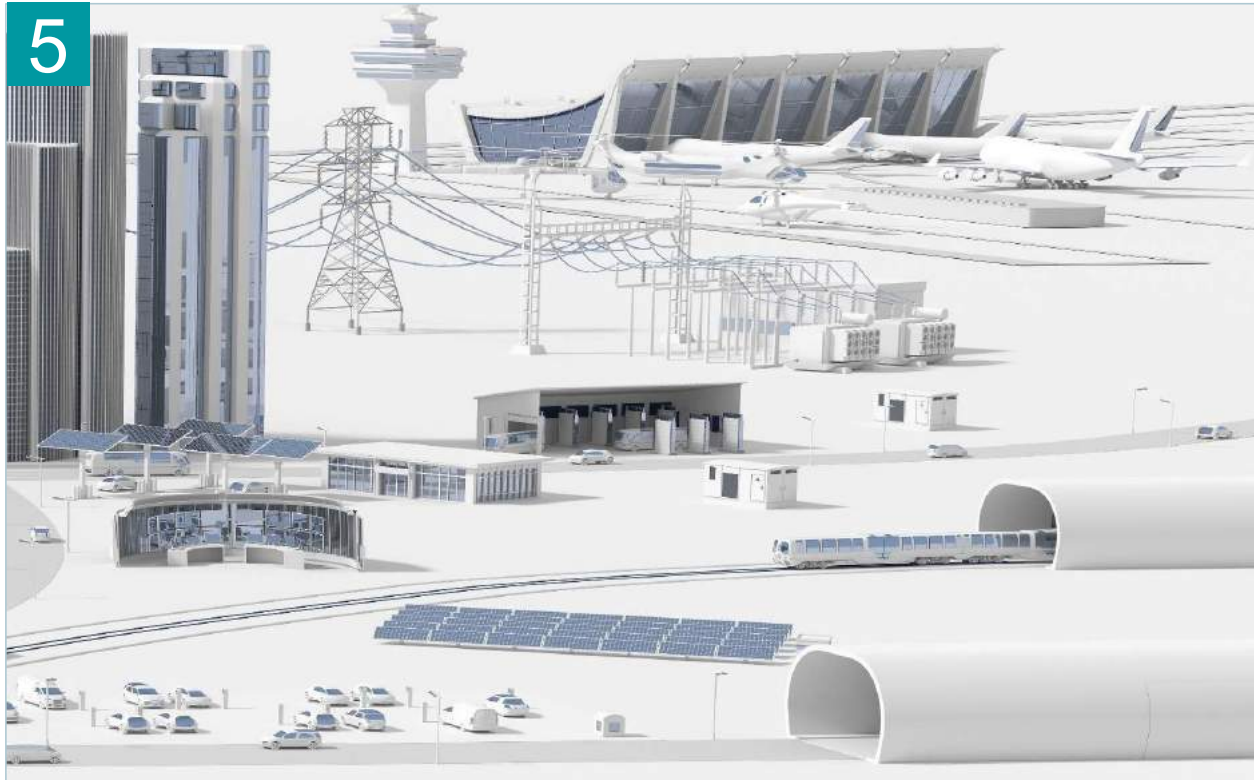
Signal

- Control Signals
- Sensors

Data

- Communication with Racks
- External Communication

External interface for Energy Storage Systems



Power

- Charging / Discharging Power

Signal

- Control Signals

Data

- PoC Communication
- Communication with Grid Operator
- 3rd Party Communication

Recommendations for Resilient Connectivity

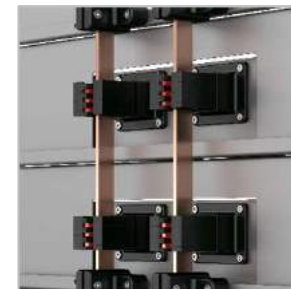


Reliable Connection Technology enables Resilient Energy Storage Systems

Recommendations

“Plug, not screw” for Power

- Easy and safe installation
- Maintenance-free connection
- Maximum protection during installation and system maintenance
- Established components are available
- Suitable for a wide range of system designs

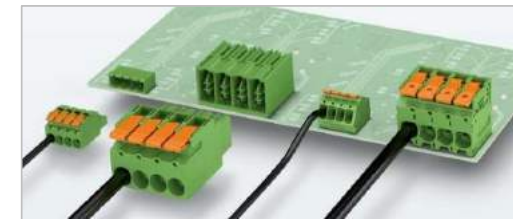
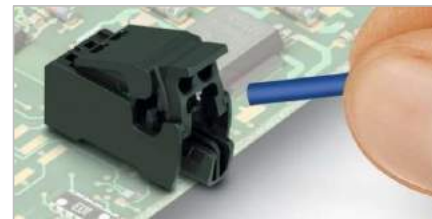


Reliable Connection Technology enables Resilient Energy Storage Systems

Recommendations

Innovative Connection Technology for PCBs

- Push-in spring contacts
→ easy, safe, reliable
- IDC contacts
→ no stripping required
- Lever-operated PCB terminals
→ push-in with even more comfort

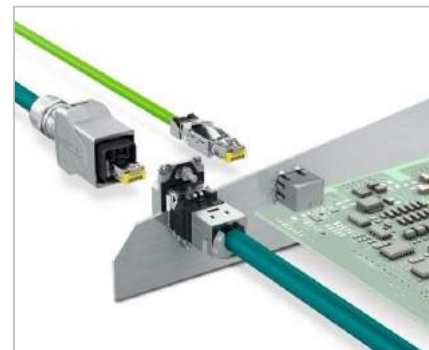


Reliable Connection Technology enables Resilient Energy Storage Systems

Recommendations

Design and Quality for Data Interfaces

- From SPE to ProfiNet – the requirement decides
- Low invest may cause high operating cost – industrial quality for maximum reliability
- IP protection against dust and humidity



Summary and Contact



Summary and Contact

Summary

- A transition to an electrified society paves the way out of climate crisis and energy dependencies
- Energy storage systems belong to the key elements of sector coupling
- Connectivity plays an important role in energy storage systems
- Saving on the initial investment often leads to high operating costs
- Design, quality and long-term reliability of all components are essential for reliable systems



Summary & Contact Information

Contact Information



Are you interested in an expert-level discussion concerning connectivity for energy storage systems?
Please get into contact with me when it suits you best!

Our Give-Away – The Battery Pole Connector Sample Set



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Company Details



Phoenix Contact is a privately owned company founded in 1923 with great depths of added value. It is independent and has the freedom to make its own decisions as a company.



More than
100,000
innovative
Products

11



Production sites

Germany | China | Taiwan |
India | Poland | Sweden |
Switzerland | Turkey |
Argentina | Greece | USA

100,000



Products

22,000



Employees worldwide



75%



Sales abroad

25%



Sales in Germany

10,200



Employees in Germany



1923



Founded in Germany



TODAY



Present in more than 100 countries

Group Executive Board:

Frank Stührenberg (CEO)
Axel Wachholz (CFO)
Frank Possil-Dölken (CDO)

Dirk Görlitzer (COO, President BA ICE)
Torsten Janwlecke (COO, President BA DC)
Ulrich Leidecker (COO, President BA IMA)



People and markets

Continuous growth together

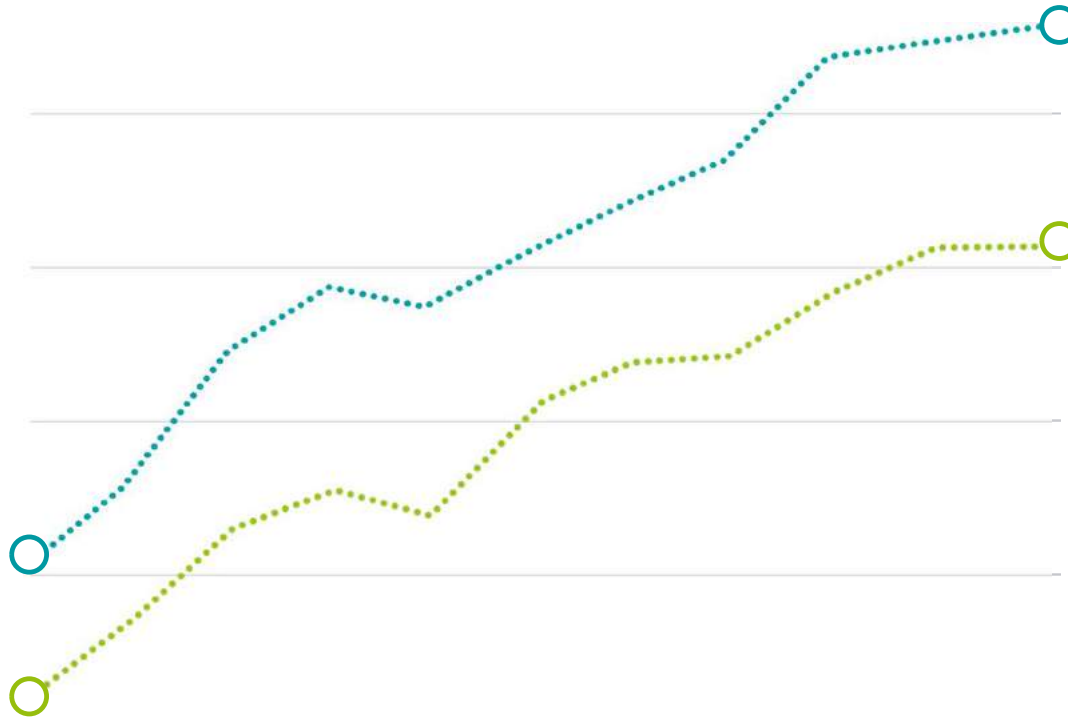
2007

1.0

€ Billion sales

6,800

Employees worldwide



3.6

€ Billion sales

22,000

Employees worldwide

2022