Are you searching for Switching and Protection solutions to protect and secure DC combiners and keep them running in Utility Scale Battery Energy Storage Systems (BESS)?

You can easily find the best solution to fit in your DC combiner and quickly configure your BESS installation thanks to our Application Bundle based on concrete examples.

**What is a DC Combiner?**
If you want to connect several battery racks in parallel prior to connecting to the DC side of the Power Conversion System (PCS) or to the DC Recombiner, you need a DC Combiner. The DC Combiner is a switchboard where switching and protective devices are installed along with auxiliary and/or communication circuits.

**Why you need Switching & Protection solutions**
Every feeder supplying the relative battery rack requires adequate disconnecting means and overcurrent protective device (OCPD) to guard against faults and overloads, which can also come from the other battery racks connected in parallel.

**Main benefits**
- **Smarter protection**
  Increases the power in your installation and reduces CAPEX by using the full range of 1500 VDC LV components.
- **Safety**
  Avoids the risk of fire in your facility and loss of valuable assets by using a complete range of Surge Protection Devices (SPDs) to protect the whole electrical system from lightning and surges.
- **Speeds up your projects**
  Reduces CAPEX and speeds up your projects by using a range of products in compact sizes able to provide excellent performance at different temperatures and humidity ratings.
- **Smarter metering & monitoring**
  Maximizes power yield and cash generation by correct measurement of your BESS parameters.
Utility Scale Battery Systems

Utility scale stationary battery storage systems, also known as grid-scale front-of-the-meter storage systems, play a key role in integrating variable energy resources while providing the required flexibility. Battery storage increases flexibility in power systems, enabling an optimal use of variable electricity sources like photovoltaic and wind energy. Batteries can provide services for system operation, defer investments in peak generation and grid reinforcement.

Key characteristics of BESS in a Front-of-the-meter configuration:
- Direct connection to the AC Utility without the User’s plant in parallel
- Grid support (ancillary services, fast power injection for peak requirements)
- Storage capacity typically ranging from just a few, to hundreds of MWh.
DC Combiner
Fundamentals, main components & functionalities

The power stored in battery racks and re-injected into the Utility through the Power Conversion System is collected by DC Combiners (in some cases also by a DC Recombiner).

The DC Combiner is a switchboard where several battery racks are placed in parallel by the relative feeder. Every feeder requires adequate switching and protection against overcurrents.

**DC combiner components**
- Main Switch: Air switch disconnectors (E4.2 MS/DC-E)
- Surge Protection Device: OVR PV T1-T2
- Feeder switch disconnector: OTDC400UFV11-ESS
- ARC flash mitigation: Active, Passive & Preventive solutions

**Main subsystem functionalities**
- Combining of battery racks (range of hundreds of A)
- Overcurrent Protection of battery rack feeder
- Switching of battery rack feeder
- Main Switching to segregate the group of battery racks from the rest of the BESS (range of thousands of A)
- Surge Protection to protect against voltage spikes, such as those caused by lightning

**Additional subsystem functionalities**
- Monitoring: mainly where any drop in BESS plant performance may represent a significant economic loss
- Voltage, current, or temperature monitoring
- Communication: for communicating parameters to a centralized monitoring system.
- Remote-operation: when remote control is required
- Arc flash mitigation
Discover our Switching & Protection solutions for easy DC combiner configuration considering 4MWh BESS architecture with two 2MWh main system modules in parallel.

Single-line diagram of a 4MWh, 4MW Utility Scale application

Specifications of electrical quantities for a 2MWh, 2MW module

<table>
<thead>
<tr>
<th>Input data</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated power [MW]</td>
<td>1.5</td>
</tr>
<tr>
<td>Rated stored energy [MWh]</td>
<td>1.5</td>
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<tr>
<td>Rated DC voltage [V]</td>
<td>1500</td>
</tr>
<tr>
<td>Rated AC voltage [V]</td>
<td>600</td>
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<tr>
<td>Rated AC current [A]</td>
<td>1445</td>
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<tr>
<td>Prospective AC short circuit current [kA]</td>
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<tr>
<td>Rack rated current [A]</td>
<td>320</td>
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<tr>
<td>Rack short circuit current [kA]</td>
<td>15</td>
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<tr>
<td>N. containers</td>
<td>10</td>
</tr>
<tr>
<td>N. racks per container</td>
<td>6</td>
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<tr>
<td>DC bus max current [A]</td>
<td>1720</td>
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<tr>
<td>DC bus short circuit current [kA]</td>
<td>60</td>
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<tr>
<td>DC recombiner box</td>
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</tr>
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</table>
DC combiner panel

Battery rack
Battery rack
Battery rack
Battery rack
Battery rack
Battery rack
Battery rack
Battery rack

Power conversion system (PCS)

MV/LV transformer

MV utility

DC combiner

1500V DC combiner box components

On each feeder inside the DC combiner:

• OTDC400UFV11-ESS switch disconnector combined with any suitable PV fuse or PV circuit breaker

As main combiner switch:

• Emax 2 E4.2V-A MS/DC-E 1500V DC 2000A is installed for combiner switching function. The switch disconnector is installed in the fixed version and is equipped with undervoltage release YU and motor operator to open/close remotely.

• Protection against overvoltages: OVR PV T1-T2 10-1500P QS

• Arc flash mitigation solution: TVOC-2 + shunt opening release YO installed in Emax 2

ABB offering (UL)
## Main components

<table>
<thead>
<tr>
<th>Device</th>
<th>Part number</th>
<th>Total quantity</th>
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<tbody>
<tr>
<td>E4.2V-A MS/DC-E 2000 VR</td>
<td>1SDA115449R1</td>
<td>2</td>
</tr>
<tr>
<td>KitJump E4.2 1600-2000 UL-B-2psUS INST</td>
<td>1SDA115489R1</td>
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<tr>
<td>ME2.2..E6.2 24-30V AC/DC + MC 24V</td>
<td>1SDA073729R1</td>
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<tr>
<td>YU E1.2..E6.2 24V AC/DC</td>
<td>1SDA073694R1</td>
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<tr>
<td>AUX 4Q 24V E2.2..E6.2</td>
<td>1SDA073754R1</td>
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<tr>
<td>OTDC400UFV11-ESS</td>
<td>1SCA158216R1001</td>
<td>12</td>
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<tr>
<td>OVR PV T1-T2 10-1500P QS</td>
<td>2CTB812100R1500</td>
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## Optional components

<table>
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<th>Device</th>
<th>Part number</th>
<th>Total quantity</th>
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<td>YO E1.2..E6.2 24 Vac/dc</td>
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<td>TVOC-2-48C</td>
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<td>TVOC-2-DP2</td>
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<tr>
<td>TVOC-2-OP2</td>
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Product offering

Emax 2

OVR

TVOC

DC switch-disconnectors