Energy Infrastructure & Industrial Solutions

Energy Storage Solutions
State-of-the-art Grid Stabilization and Energy Control

www.deltaww.com
INDEX

06  Delta Energy Storage Solutions
12  Power Conditioning Systems
26  Battery Energy Storage Systems
35  DeltaGrid® EM Energy Management System
39  Worldwide Success Cases
Delta was founded in 1971 and has been the global leader in switching power supply solutions since 2002 and DC brushless fans since 2006. Delta offers some of the most energy efficient power products in the industry, including switching power supplies with efficient over 90%, telecom power with up to 98%, and PV inverters with up to 98.8% efficient. We have also developed the world’s first server power supply certified as 80 Plus Titanium with over 96% efficient. We regularly invest around 8% of our annual sales revenues in R&D and have worldwide R&D facilities in Taiwan, China, Europe, India, Japan, Singapore, Thailand, and the U.S.

ABOUT DELTA

DELTA JOINS RE100

100% Renewable Electricity and Carbon Neutrality Targets for Its Global Operations by 2030.

BUSINESS CATEGORIES

- Power Electronics
  - Components
  - Power and System
  - Fan & Thermal Management
  - Automotive Electronics
- Automation
  - Industrial Automation
  - Building Automation
- Infrastructure
  - ICT Infrastructure
  - Energy Infrastructure & Industrial Solutions
  - Display Solutions

FOCUSED ON SEVEN UN SUSTAINABLE DEVELOPMENT GOALS

- Science-based emissions reduction targets (SBT)
- Climate change information in main reports (TCFD)
- Responsible corporate engagement in climate policy

Scope:
Delta’s major operation sites

Commitment:
- Expansion of EV charging facilities
- Switch to using EVs for company vehicles by 2030
- Incentives for employees and customers to use EVs
- Use 100% renewable electricity in global operations by 2030
- Achieve carbon neutrality by 2030
- Signed business ambition to meet the 1.5ºC target
In the process of the energy transition, the increasing proportion of renewable energy sources supplying power to the grid means that the amount of generated power will be influenced by the weather, which presents problems for maintaining grid stability.

To improve grid stability and renewable energy utilization, smart grids must be developed and paired with energy storage systems to regulate and dispatch electricity efficiently.

Energy storage systems (ESSs) can control energy to enhance the reliability and energy through four critical technologies: energy management, power conditioning, battery management, and automation.

Energy Control and Management

- System Integration
  - Battery System and BMS
  - PCS
  - EMS
  - Control System

Control

- Energy Control and Dispatch
- Energy Management
- Power Conditioning
- Battery Management
Energy Storage Solutions

Delta provides energy storage solutions with one-stop manufacturing, integration and maintenance services by offering system design, power conditioning systems (PCS), battery energy storage systems (BESS), control systems, and energy management systems (EMS).

System Design and Simulation
- Service-life forecasting
- Optimal system configuration
- ROI calculations

Power Conditioning System (PCS)
- 100 / 125 kW
- 1 - 1.725 MW
- 1.8 - 2.8 MW
- 3.7 - 4.15 MW

Battery Energy Storage System
- LFP battery
- Outdoor cabinet and battery system

Control System
- Data logger
- Bridge controller
- Gateway
- Network switch
- Internal UPS

Energy Management System (EMS)
- Enterprise/system dashboard
- Energy view & reporting
- Multi-site management
- Alarm, event logs

Engineering, Procurement, Construction (EPC)
- Power distribution unit (PDU)
- MV transformer
- Civil engineering
- Commissioning tests

Energy Storage Applications in Grid Operations

Renewable Power Plants
- Energy shifting
- PV smoothing
- Capacity firming

Conventional Power Plants
- Black start
- Backup
- Frequency regulation
- Automatic Generation Control

Distribution Grid
- Backup supply
- Ancillary services, including frequency regulation

Commercial Buildings and Factories
- Peak shaving
- Load shifting
- PV self-consumption
- Cost optimization
- Power backup
- Demand response

EV Charging Stations and Microgrids
- Peak shaving
- PV self-consumption
- Power backup
System Architecture

Grid-Tied Applications
Applied to generator backup, grid ancillary services, energy shifting, and renewable energy smoothing.

Behind-the-Meter Applications
Applied to micro-grids, peak shaving, and PV self-consumption, power backup, and more.
Power Conditioning Systems

Power conditioning systems (PCSs) are bidirectional energy storage inverters for grid-tied and off-grid, for C&I and utility-scale applications. Their compactness saves space while offering scalability for various system configurations, as well as integrability with mainstream brand battery systems.

The Core to Control and Regulate Energy

Advanced Power Control
- P/Q control (active/reactive power)
- Frequency/voltage control

Modular Design Ensures High Availability
- Scalable to meet expansion needs
- N-1 redundancy systems

High Environmental Adaptability
- Outdoor protection: dust, water, salt spray, wind, snow and ice, vibration and shock
- Heat dissipation with air/liquid cooling

Dynamic Grid Support
- HVRT/LVRT
- FRT
- Anti-islanding
### UL version

<table>
<thead>
<tr>
<th>Model</th>
<th>PCS125</th>
<th>PCS125HV</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC Output</td>
<td>125 kW @ 50 °C</td>
<td>125 kW @ 45 °C</td>
</tr>
<tr>
<td>Normal Grid Voltage Vrms</td>
<td>480 Vac</td>
<td>480 Vac</td>
</tr>
<tr>
<td>Max. Efficiency</td>
<td>&gt; 97.6 %</td>
<td>&gt; 98 %</td>
</tr>
<tr>
<td>Dimensions (W x H x D)</td>
<td>600 x 1765 x 800 mm 23.6&quot; x 69.5&quot; x 31.5&quot;</td>
<td>600 x 2000 x 500 mm 23.6&quot; x 78.7&quot; x 9.7&quot;</td>
</tr>
<tr>
<td>Weight Appr.</td>
<td>310 kg 683 lbs</td>
<td>230 kg 508 lbs</td>
</tr>
<tr>
<td>Safety</td>
<td>UL 1741</td>
<td></td>
</tr>
<tr>
<td>EMC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grid Code</td>
<td>IEC61547 / UL1741SA</td>
<td>IEC61547-2018</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Model</th>
<th>PCS100</th>
<th>PCS100HV</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC Output</td>
<td>100 kW @ 50 °C</td>
<td>100 kW @ 45 °C</td>
</tr>
<tr>
<td>Normal Grid Voltage Vrms</td>
<td>400 Vac</td>
<td>400 Vac</td>
</tr>
<tr>
<td>Max. Efficiency</td>
<td>&gt; 97.9 %</td>
<td>&gt; 98 %</td>
</tr>
<tr>
<td>Dimensions (W x H x D)</td>
<td>600 x 1765 x 800 mm 23.6&quot; x 69.5&quot; x 31.5&quot;</td>
<td>600 x 2000 x 500 mm 23.6&quot; x 78.7&quot; x 9.7&quot;</td>
</tr>
<tr>
<td>Weight Appr.</td>
<td>310 kg 683 lbs</td>
<td>230 kg 508 lbs</td>
</tr>
<tr>
<td>Safety</td>
<td>IEC/EN 62477-1</td>
<td>IEC/EN 62477-1, EN52477-1</td>
</tr>
<tr>
<td>EMC</td>
<td>IEC 61000-6-2, IEC 61000-6-4 (Class A)</td>
<td>IEC 61000-6-2, IEC 61000-6-4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Model</th>
<th>PCS2000</th>
<th>PCS3000</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC Output @ 50 °C</td>
<td>1875 kW</td>
<td>2500 kW</td>
</tr>
<tr>
<td>Normal Grid Voltage Vrms</td>
<td>480 Vac</td>
<td>480 Vac</td>
</tr>
<tr>
<td>Max. Efficiency</td>
<td>&gt; 97.7 %</td>
<td>&gt; 98.4 %</td>
</tr>
<tr>
<td>Dimensions (W x H x D)</td>
<td>4230 x 2290 x 1650 mm 166.5&quot; x 90&quot; x 65&quot;</td>
<td>4460 x 2300 x 1650 mm 175&quot; x 90.5&quot; x 65&quot;</td>
</tr>
<tr>
<td>Weight Appr.</td>
<td>5500 kg 12125.4 lbs</td>
<td>6500 kg 14330 lbs</td>
</tr>
<tr>
<td>Safety / EMC</td>
<td>UL 1741 / FCC class A</td>
<td></td>
</tr>
<tr>
<td>Grid Code</td>
<td>IEC 1547 / UL1741SA</td>
<td>IEC1547-2018</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Model</th>
<th>PCS1500</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC Output @ 50 °C</td>
<td>1000 kW</td>
</tr>
<tr>
<td>Normal Grid Voltage Vrms</td>
<td>400 Vac</td>
</tr>
<tr>
<td>Max. Efficiency</td>
<td>&gt; 97.8 %</td>
</tr>
<tr>
<td>Dimensions (W x H x D)</td>
<td>2200 x 2260 x 1100 mm 86.6&quot; x 88.98&quot; x 43.4&quot;</td>
</tr>
<tr>
<td>Weight Appr.</td>
<td>2600 kg 5732 lbs</td>
</tr>
<tr>
<td>Safety / EMC</td>
<td>IEC 63477, IEC 61000</td>
</tr>
<tr>
<td>Grid Code</td>
<td>G99, VDE-AR-N 4110</td>
</tr>
</tbody>
</table>
## Power Conditioning System (PCS)

### PCS100 / PCS125

- **Power capacity**: 100 / 125 kW
- **AC voltage**: 400 / 480 Vac
- **Efficiency**: 97.9 % / 97.6 % (peak)
- **Certifications**: IEC, UL

### Specifications

- **AC Grid Connection**
  - Rated Grid Voltage: 400 Vac, 3P3W
  - Grid Voltage Range: 320 to 440 Vac (VDE-AR-N4105) \(^1\)
  - Grid Frequency: 50 (60 Hz optional)
  - Frequency Range: 47.5 to 51.5 Hz (VDE-AR-N4105/4110)
  - Rated AC Power / Current: 100 kVA / 144.3 A; 115 kVA / 150.4 A
- **DC Connection**
  - Voltage Range: 600 to 1,000 Vdc
  - Rated Voltage: 900 Vdc
  - Rated Discharge / Charge Power: 103 kW / 97 kW
  - Max. Discharge / Charge Current: 171.7 A / 161.7 A
- **Standalone Operation**
  - Rated Output Voltage: 400 Vac, 3P3W
  - Rated Output Power: 100 kVA with linear load; 125 kVA with linear load
  - Rated Output Current: 144.3 A
  - Power Factor: 0.8 to 1
  - Output Voltage THD: < 3 % @ linear load
  - Peak / CEC Efficiency: 97.9 %
- **Environmental**
  - Max. Altitude: 3,000 m, de-rating above 2,000 m
  - Operating Temperature: -25 to 60 °C, de-rating @ > 50 °C
  - Humidity: 0 to 95 % RH, non-condensing
- **General**
  - User Interface: 4.9” LCD screen
  - Emergency Stop: EPO button & remote control
  - Communication: Ethernet/Modbus TCP, RS-485/Modbus RTU (optional)
  - Certificates: IEC/EN 62477-1, Grid Code: VDE-AR-N4105/4110, 099, AS/NZS 4777.2, EMC: IEC EN 61000-6-2, IEC EN 61000-6-4 (Class A)
  - Product Conformity: CE, RCM

1) DC Voltage Range: 700 – 1000 V
2) DC Voltage Range: 750 – 1000 V
3) Transformer or motor load, which has large surge current (CF>2), is not included.
4) DC voltage should be higher than 800 V to support HVRT.

---

* A Dyn transformer is preferable for connecting to a PCS in standalone mode.
** If a transformer is required to be added between PCS and load, D type of transformer must be on PCS side.
Power Conditioning System (PCS)

**Power capacity**: 100 / 125 kW

**AC voltage**: 400 / 480 Vac

**Efficiency**: 98 % (peak)

**Certifications**: IEC, UL

---

**PCS100HV / PCS125HV**

- Power capacity: 100 / 125 kW; AC voltage: 400 / 480 Vac
- High voltage input: up to 1350 Vdc
- High efficiency: 98 % / above 98 % (peak)
- High power density: 167 W/l, 435 W/kg / 208 W/l, 543 W/kg
- Quick power response time: < 20 ms
- Connects to major battery types and energy storage media
- Scalable with a multi-unit configuration
- Black start capability for power backup
- Supports both grid-tied and power-backup operation modes

---

**AC Grid Connection**

<table>
<thead>
<tr>
<th>Model</th>
<th>PCS100HV</th>
<th>PCS125HV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated Grid Voltage</td>
<td>400 Vac (3P,N,PE) or (3P,PE)</td>
<td>480 Vac (3P,PE)</td>
</tr>
<tr>
<td>Grid Voltage Range</td>
<td>352 - 440 Vac</td>
<td>422 to 528 Vac (-12%, +10%)</td>
</tr>
<tr>
<td>Rated Grid Frequency</td>
<td>50 Hz</td>
<td>60 Hz</td>
</tr>
<tr>
<td>Frequency Range</td>
<td>45 to 55 Hz</td>
<td>59.3 to 60.5 Hz, adjustable</td>
</tr>
<tr>
<td>Rated AC Power</td>
<td>100 kVA / kW</td>
<td>125 kVA / kW</td>
</tr>
<tr>
<td>Rated AC Current</td>
<td>145 A</td>
<td>151 A</td>
</tr>
<tr>
<td>Current THD</td>
<td>&lt; 3 %</td>
<td>&lt; 3 %</td>
</tr>
<tr>
<td>DC Current Injection</td>
<td>&lt; 0.5 % rated current</td>
<td>&lt; 0.5 % rated current</td>
</tr>
<tr>
<td>Power Factor</td>
<td>-1 to 1, continuously adjustable</td>
<td>-1 to 1, continuously adjustable</td>
</tr>
</tbody>
</table>

**DC Connection**

<table>
<thead>
<tr>
<th>Model</th>
<th>PCS100HV</th>
<th>PCS125HV</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC Voltage Range</td>
<td>650 to 1,350 Vdc for 3P3W 1) / 700 ~ 1,350 Vdc for 3P4W in Off-grid mode 2)</td>
<td>750 to 1,350 Vdc 2)</td>
</tr>
<tr>
<td>Start Up DC Voltage</td>
<td>650 V</td>
<td>750 V</td>
</tr>
<tr>
<td>Rated Discharge / Charge Power</td>
<td>102 kW / 98 kW</td>
<td>128 kW / 122 kW</td>
</tr>
<tr>
<td>Max. Discharge / Charge Current</td>
<td>157 A / 151 A</td>
<td>157 A / 151 A</td>
</tr>
</tbody>
</table>

**Standalone Operation**

<table>
<thead>
<tr>
<th>Model</th>
<th>PCS100HV</th>
<th>PCS125HV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated Output Voltage</td>
<td>400Vac (3P,N,PE)</td>
<td>480Vac, 3P4W</td>
</tr>
<tr>
<td>Rated Output Power</td>
<td>100 kVA / kW with linear load ; 80 kVA with RCD load (Ip &lt; 240 A) 3)</td>
<td>125 kVA / 125 kW with linear load; 100 kVA with RCD load (Ip &lt; 240 A) 3)</td>
</tr>
<tr>
<td>Power Factor</td>
<td>0.8 to 1</td>
<td>0.8 to 1</td>
</tr>
<tr>
<td>Rated Output Current</td>
<td>145 A</td>
<td>151 A</td>
</tr>
<tr>
<td>Overload Capacity</td>
<td>110 % for 30 mins</td>
<td>110 % for 30 mins</td>
</tr>
<tr>
<td>Output Voltage THD</td>
<td>&lt; 3 % @ rated linear load</td>
<td>&lt; 3 % @ linear load</td>
</tr>
</tbody>
</table>

**Performance**

<table>
<thead>
<tr>
<th>Model</th>
<th>PCS100HV</th>
<th>PCS125HV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak Efficiency</td>
<td>98 %</td>
<td>&gt;98 %</td>
</tr>
<tr>
<td>Standby Loss</td>
<td>&lt; 25 W @ cold mode</td>
<td>&lt; 25 W @ cold mode</td>
</tr>
</tbody>
</table>

**Environment**

<table>
<thead>
<tr>
<th>Model</th>
<th>PCS100HV</th>
<th>PCS125HV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. Altitude</td>
<td>4,000 m, de-rating &gt; 2000 m</td>
<td>4,000 m, de-rating &gt; 2000 m</td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>30°C to + 60°C, de-rating &gt; 45°C</td>
<td>-30°C to 60°C, de-rating &gt; 45°C</td>
</tr>
<tr>
<td>Humidity</td>
<td>0 to 95 % RH, non-condensing</td>
<td>0 to 95 % RH, non-condensing</td>
</tr>
<tr>
<td>Acoustic Noise</td>
<td>&lt; 70 dB @ 1 m @25°C @ rated condition, max. 75 dB</td>
<td>&lt; 70 dBA @ 1 m @ rated condition, max. 75 dB</td>
</tr>
<tr>
<td>Cooling</td>
<td>Forced air with speed control</td>
<td>Forced air with speed control</td>
</tr>
<tr>
<td>Enclosure Rating</td>
<td>IP55</td>
<td>Type 3R / IP55</td>
</tr>
</tbody>
</table>

**General**

<table>
<thead>
<tr>
<th>Model</th>
<th>PCS100HV</th>
<th>PCS125HV</th>
</tr>
</thead>
<tbody>
<tr>
<td>User Interface</td>
<td>LED, EPO, Ethernet</td>
<td>LED, EPO, Ethernet</td>
</tr>
<tr>
<td>Communication</td>
<td>Ethernet / Modbus TCP</td>
<td>Ethernet / Modbus TCP</td>
</tr>
<tr>
<td>Dimension</td>
<td>600 x 2000 x 500 mm</td>
<td>600 x 2000 x 500 mm</td>
</tr>
<tr>
<td>Net Weight</td>
<td>230 kg</td>
<td>230 kg</td>
</tr>
</tbody>
</table>

**Certificates (in plan)**

Safety: IEC 62477-1, EN52477-1
EMC: IEC/EN 61000-6-2, IEC/EN 61000-6-4

**Protection**

<table>
<thead>
<tr>
<th>Model</th>
<th>PCS100HV</th>
<th>PCS125HV</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC reverse protection / OVP / UVP / OCP / DC insulation detection</td>
<td>DC reverse protection / OVP / UVP / OCP / DC insulation detection</td>
<td></td>
</tr>
</tbody>
</table>

**Product Conformity**

<table>
<thead>
<tr>
<th>Model</th>
<th>PCS100HV</th>
<th>PCS125HV</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE, RCM</td>
<td>CE, RCM</td>
<td>CE, RCM</td>
</tr>
</tbody>
</table>

**Applicable Battery Chemistry**

<table>
<thead>
<tr>
<th>Model</th>
<th>PCS100HV</th>
<th>PCS125HV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lithium-ion, lead-acid, flow battery</td>
<td>Lithium-ion, lead-acid, flow battery</td>
<td></td>
</tr>
</tbody>
</table>

1) Output power will be de-rating, if DC voltage is higher than 1250V
2) The minimum DC voltage should be larger than 750V, if the load is 100% unbalanced load
3) Transformer or motor load or rectifier load, which has large inrush current (Ip < 240A) is not included
Power Conditioning System (PCS)

**PCS1500**

- Power capacity: 1000 to 1725 kVA
- High DC voltage: up to 1500 Vdc
- 98.4 % efficiency for bi-directional power conversion
- Advanced P/Q, frequency/voltage and VSG control
- Modular design enables scalability and easy maintenance
- Utility-grade protection designed for outdoor use in harsh environments
- Compatible with major battery types and energy storage media
- DC and AC-coupled storage applications

**Power capacity** 1000 - 1725 kW

**AC voltage** 400 - 690 Vac

**Efficiency** 98.4 % (peak)

**Certificate** IEC
Power Conditioning System (PCS)

Power capacity: 2100 to 2800 kW
Efficiency: 97.7 % (peak)

AC voltage: 480 Vac
Certificate: UL

PCS2000

- Power capacity: 2100 to 2800 kVA
- 97.7 % efficiency for bi-directional power conversion
- Advanced P/Q and frequency/voltage control
- Modular design enables scalability and availability
- Compatible with major battery types and energy storage media
- Utility-grade protection designed for harsh environments
- AC coupled storage applications

Technical Specifications:

**Model** | DWE2100-US | DWE2800-US
--- | --- | ---
**DC Connection** | | |
Input Voltage Voc, full load | 760 to 1200 V | 2100 V / 1875 kVA | 2800 V / 2500 kVA |
Input Voltage Voc, max | 1200 V | 2526 A | 3370 A |
Max. Input Current IAC, max ( @ 50 °C ) | 2528 A | | 3370 A |
Number of DC Inputs | 1 | | |
**AC Connection** | | |
AC Power / Current ( @ 25 °C / 50 °C ) | 2100 kVA / 1875 kVA | | 2800 kVA / 2500 kVA |
Max. AC Current IAC, max ( @ 50 °C ) | 2526 A | 3370 A |
Max. Total Harmonic Distortion (1) | < 3 % at full load | | |
Nominal AC Voltage | 480 V | | |
AC Power Frequency | 60 Hz | | |
Power Factor | 0 to 1 leading or lagging | | |
Performance | | |
Max. Efficiency (2) | > 97.7 % | | |
CEC Efficiency | 97 % | | |
Standby Loss (3) | < 350 W | | |
Protection | | |
DC Side | DC load switch + fuses | | |
AC Side | AC circuit breaker | | |
DC Overvoltage | Surge arrester, class II | | |
AC Overvoltage | Surge arrester, class II | | |
Ingress Protection | IP 65 , Type 3R | | |
General | | |
Dimensions (W x H x D) | 4230 x 2290 x 1650 mm / 166.5 x 90 x 65 inches | | |
Weight | 5500 kg / 12125.4 lbs | 6500 kg / 14330 lbs |
Power Module | 3 | 4 |
**Environment** | | |
Operating Temperature | -30 °C to + 60 °C, de-rating > 50 °C | | |
Storage Temperature | -40 °C to + 70 °C | | |
Relative Humidity | 5 to 100 % RH | | |
Altitude | < 3000 m, de-rating > 2000 m | | |
Acoustic Noise (4) | < 85 dB (A) | | |
Cooling | Liquid cooling (integration) | | |
**Compliance** | | |
Safety | UL 1741 | | |
EMC | FCC class A | | |
Grid Interconnection | IEEE 1547 / UL 1741 SA / CSA C22.2 1071-1 | | |

1) THD measured under grid short current ratio ≤ 5.
2) Efficiency measured without internal auxiliary power loss.
3) Standby loss measured under external power supply.
4) Noise measured at a distance of 3 m.
## Power Conditioning System (PCS)

**Power capacity:** 3110 - 4150 kW  
**Efficiency:** 98.4 % (peak)  
**AC voltage:** 600 Vac  
**Certificate:** UL

### PCS3000

- Power capacity: 3110 to 4150 kVA  
- 98.4 % efficiency for bi-directional power conversion  
- Advanced P/Q and frequency/voltage control  
- Modular enables realizes scalability and availability  
- Compatible with major battery types and energy storage media  
- Utility-grade protection designed for harsh environments  
- AC coupled storage applications

### Power Conditioning System (PCS) Specification

<table>
<thead>
<tr>
<th>Model</th>
<th>DWE3110-EV-US</th>
<th>DWE4150-EV-US</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC Connection</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Input Voltage VDC Range (1)</td>
<td>875 - 1500 V</td>
<td>1500 V</td>
</tr>
<tr>
<td>Input Voltage VDC, max</td>
<td>1250 A</td>
<td>1500 V</td>
</tr>
<tr>
<td>Max. Input Current IDC, max (at 50ºC)</td>
<td>3299 A</td>
<td>4359 A</td>
</tr>
<tr>
<td>Number of DC inputs (optional)</td>
<td>1/2</td>
<td>3/4</td>
</tr>
<tr>
<td>AC Connection</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AC Power (25ºC / 50ºC)@ PF=1, 600Vac</td>
<td>3117 kVA / 2805 kVA</td>
<td>4156 kVA / 3741 kVA</td>
</tr>
<tr>
<td>Max. AC Current IAC, max (25ºC / 50ºC)</td>
<td>3000 A / 2700 A</td>
<td>4000 A / 3600 A</td>
</tr>
<tr>
<td>Max. Total Harmonic Distortion (3)</td>
<td>&lt; 3% at full load</td>
<td>&lt; 3% at full load</td>
</tr>
<tr>
<td>Nominal AC Voltage</td>
<td>600 V</td>
<td>600 V</td>
</tr>
<tr>
<td>AC Power Frequency</td>
<td>60 Hz</td>
<td>60 Hz</td>
</tr>
<tr>
<td>Power Factor (depending on voltage)</td>
<td>0 to 1 leading or lagging</td>
<td>0 to 1 leading or lagging</td>
</tr>
<tr>
<td>Performance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Max. Efficiency (3)</td>
<td>98.4 %</td>
<td>98.4 %</td>
</tr>
<tr>
<td>CEC Efficiency</td>
<td>98 %</td>
<td>98 %</td>
</tr>
<tr>
<td>Standby Loss (4)</td>
<td>&lt; 350 W</td>
<td>&lt; 350 W</td>
</tr>
<tr>
<td>Protection</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DC Side</td>
<td>DC switch + fuses</td>
<td>DC switch + fuses</td>
</tr>
<tr>
<td>AC Side</td>
<td>AC circuit breaker</td>
<td>AC circuit breaker</td>
</tr>
<tr>
<td>DC Overvoltage</td>
<td>Surge arrester, class II</td>
<td>Surge arrester, class II</td>
</tr>
<tr>
<td>AC Overvoltage</td>
<td>Surge arrester, class II</td>
<td>Surge arrester, class II</td>
</tr>
<tr>
<td>Ingress Protection</td>
<td>Type 4X</td>
<td>Type 4X</td>
</tr>
<tr>
<td>General</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dimensions (W x H x D)</td>
<td>4450 x 2300 x 1650 mm / 175 x 90.5 x 65 inches</td>
<td>4450 x 2300 x 1650 mm / 175 x 90.5 x 65 inches</td>
</tr>
<tr>
<td>Weight</td>
<td>5830 kg / 12853 lbs</td>
<td>6330 kg / 13955 lbs</td>
</tr>
<tr>
<td>Power Module</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Environment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>-30 ºC to +60 ºC, de-rating &gt; 50 ºC</td>
<td>-30 ºC to +60 ºC, de-rating &gt; 50 ºC</td>
</tr>
<tr>
<td>Storage Temperature</td>
<td>-40 ºC to +70 ºC</td>
<td>-40 ºC to +70 ºC</td>
</tr>
<tr>
<td>Relative Humidity</td>
<td>5 to 100 % RH</td>
<td>5 to 100 % RH</td>
</tr>
<tr>
<td>Altitude</td>
<td>&lt; 3000 m, de-rating &gt; 2000 m</td>
<td>&lt; 3000 m, de-rating &gt; 2000 m</td>
</tr>
<tr>
<td>Acoustic Noise (5)</td>
<td>&lt; 85 dB (A)</td>
<td>&lt; 85 dB (A)</td>
</tr>
<tr>
<td>Cooling</td>
<td>Liquid cooling (integration)</td>
<td>Liquid cooling (integration)</td>
</tr>
<tr>
<td>Compliance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Safety</td>
<td>UL 1741</td>
<td>UL 1741</td>
</tr>
<tr>
<td>EMC</td>
<td>FCC class A</td>
<td>FCC class A</td>
</tr>
<tr>
<td>Grid Interconnection</td>
<td>IEEE 1547</td>
<td>IEEE 1547</td>
</tr>
</tbody>
</table>

1) Consult Delta for de-rating curves.  
2) Ithd measured under grid short current ratio ≤ 5.  
3) Efficiency measured without internal auxiliary power loss.  
4) Standby loss measured under external power supply.  
5) Noise measured at a distance of 3 m.
Battery Energy Storage Systems

Delta’s BESS offer a complete system design with features such as high energy density, battery management, multi-level safety protection, and outdoor cabinets with a modular design. Furthermore, it meets international standards used worldwide.

Ensure Safe, Highly-Adaptable, and Scalable Systems

LFP Battery

- **Up to 315 kWh**
  - Outdoor cabinet
  - Up to 630 kWh
    - Paralleled outdoor cabinets

Scalable Capacity

- 2.5 MWh
  - 8 cabinets
- 3.1 MWh
  - 10 cabinets
- 4.4 MWh
  - 14 cabinets
Multi-Level Safety

- Integrates PCS, grid controller communication, and system protection mechanisms
- Diagnostics, monitoring and control with EMS

Battery System

- High-safety power circuit design
- Multiple environmental monitoring systems
- Multi-level BMS

Battery Cabinet

- HW: DC contactor, fast-melting fuse
- SW: Cell monitoring, alarm, and protection
- Safety: Anti-fire propagation, HVAC temperature control, auto fire suppression

Battery Module

- Thermal management, anti-propagation
- Integrated PCB to enhance reliability
- Multi-point temperature detection and protection design

Battery Cell

- International safety certifications
- IEC 62619, UL1973, UN 38.3

Battery Cabinet Safety Design

Thermal Management

- Thermal management in cabinet
- HVAC in each cabinet to optimize cooling efficiency
- Airflow guide to improve temperature consistency

Fire Proofing

- Fire-resistant fiber covers the inner walls to prevent fire propagation
- Alarm mechanisms: smoke and thermal detectors
- Automatic fire suspension system

Protection Design

- Flood detector
- Aseismic structure for GR63 Zone-4

Battery Verification Laboratory

Delta’s own battery verification lab was accredited by UL and DEKRA, and is qualified to verify the following standards to ensure the performance and reliability of our battery products.

UL:
- WTDP: UL1973
- CTF Stage 2: IEC 62619 and JIS C 8715-2 (S-mark)

DEKRA:
- IEC 62368-1:2014 and IEC 62619:2017
Battery Energy Storage System

LFP Battery Cabinet
- DC voltage: up to 1267 Vdc
- Max. installed capacity: up to 315 kWh per cabinet
- Scalable and flexible configuration
- IP55 stainless enclosure with corrosion-resistant painting
- Built-in battery management system, HVAC, and automatic fire suppression system
- Certification: UL9540A, UL1973, IEC 62619, IEC 62477-1, UL9540, UN38.3

<table>
<thead>
<tr>
<th>Battery Chemistry</th>
<th>Max. DC voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>LFP</td>
<td>1267 Vdc</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Max. Installed Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>315 kWh</td>
</tr>
</tbody>
</table>

LFP

<table>
<thead>
<tr>
<th>Model Series</th>
<th>EBSO-TE28XXS1PX00</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
<td>EBSO-TE2815S1PP00 (Primary)</td>
</tr>
<tr>
<td></td>
<td>EBSO-TE2815S1PS00 (Secondary)</td>
</tr>
<tr>
<td>Battery Solution</td>
<td>LFP 280Ah Cell</td>
</tr>
<tr>
<td>Cabinet Configuration</td>
<td>330S-1P</td>
</tr>
<tr>
<td>Cabinet Modules</td>
<td>15 Modules</td>
</tr>
<tr>
<td>Battery System Install Capacity</td>
<td>295.7 kWh</td>
</tr>
<tr>
<td>Recommend DC Operating Capacity</td>
<td>258.0 kWh</td>
</tr>
<tr>
<td>Recommend AC Operating Capacity</td>
<td>245.8 kWh</td>
</tr>
</tbody>
</table>

| Environment Condition | Outdoor |
|                      | Outdoor |
| Ingress Protection   | IP55, Type 3R, NEMA 3R compliance |
| Gross Weight         | 3500 kg / 7717 lbs |
|                      | 3700 kg / 8047 lbs |
| Dimension (W x D x H) | Include HVAC: 1200 x 1662 x 2440 mm |
|                      | 47.3 x 65.35 x 96.1 inches |

*www.deltaww.com*
Battery Energy Storage System

LFP Battery System

- DC voltage: up to 1267 Vdc
- Max. installed capacity: up to 4.4 MWh per battery system
- Scalable and flexible configuration
- IP55 stainless enclosure with corrosion-resistant painting
- Built-in battery management system, HVAC, and automatic fire suppression system
- Certification: UL9540A, UL1973, IEC 62619, IEC 62477-1, UL9540, UN38.3

Available Market: Global

Battery Chemistry

<table>
<thead>
<tr>
<th></th>
<th>Max. DC voltage</th>
<th>Max. Installed Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>LFP</td>
<td>1267 Vdc</td>
<td>4.4 MWh</td>
</tr>
</tbody>
</table>

LFP

Model Series | EBSB-TE2815SXXPP02 | EBSB-TE2815S12PP02 | EBSB-TE2815S14PP02
---|-------------------|-------------------|-------------------
Model | EBSB-TE2815SSL0PP02 | EBSB-TE2815S12PP02 | EBSB-TE2815S14PP02
Battery Solution | LFP 280 Ah Cell |
Cabinet Configuration | 3525-1P |
Modules Per Cabinet | 15 Modules |
Cabinet Installed Capacity | 295 kWh |
Battery System Cabinets | 10 | 12 | 14 |
Battery System Installed Capacity | 2956 kWh | 3548 kWh | 4139 kWh |
Recommended DC Operating Capacity | 2580 kWh | 3096 kWh | 3612 kWh |
Recommended AC Operating Capacity | 2457 kWh | 2949 kWh | 3440 kWh |
DC Voltage Range | 907 to 1188 Vdc |
Ingress Protection | IP55, Type 3R, NEMA 3R compliance |
Gross Weight | 37,500 kg | 44,500 kg | 51,500 kg |
Dimension (W x D x H) | 7300 x 3740 x 2440 mm (Include HVAC) | 8520 x 3740 x 2440 mm (Include HVAC) | 9740 x 3740 x 2440 mm (Include HVAC) |

Model Series | EBSB-CE2816SXXPP02 | EBSB-CE2816S12PP02 | EBSB-CE2816S14PP02
---|-------------------|-------------------|-------------------
Model | EBSB-CE2816S0PP02 | EBSB-CE2816S12PP02 | EBSB-CE2816S14PP02
Battery Solution | LFP 280 Ah Cell |
Cabinet Configuration | 3305-1P |
Modules Per Cabinet | 16 Modules |
Cabinet Installed Capacity | 315.3 kWh |
Battery System Cabinets | 10 | 12 | 14 |
Battery System Installed Capacity | 3153 kWh | 3783 kWh | 4414 kWh |
Recommended DC Operating Capacity | 2752 kWh | 3302 kWh | 3852 kWh |
Recommended AC Operating Capacity | 2643 kWh | 3171 kWh | 3700 kWh |
DC Voltage Range | 907 to 1232 Vdc |
Ingress Protection | IP55, Type 3R, NEMA 3R compliance |
Gross Weight | 39,500 kg | 46,900 kg | 54,300 kg |
Dimension (W x D x H) | 7300 x 3625 x 2440 mm (Include HVAC) | 8520 x 3625 x 2440 mm (Include HVAC) | 9740 x 3625 x 2440 mm (Include HVAC) |
DeltaGrid® EM
for Energy Storage System

The DeltaGrid® EM energy management system is a forward-looking digital platform that leverages novel AIoT technologies for energy control, cybersecurity and reliability, energy consumption optimization, utility ancillary services, distributed energy resource (DER) generation monitoring, reduction of carbon emissions tracking, and other applications.

Its control modes and AI algorithm can control energy flows precisely and automatically, thus optimising energy usage, maximizing system performance and making your energy systems greener and more economical. DeltaGrid® EM can be paired with the DeltaGrid® O&M digital services platform to upkeep energy assets, maximize uptime and increase operational efficiency.

System Design and Features

Advanced digital platform with up-to-date AIoT, security, and reliability technology to protect your energy system and maximize system uptime, thus optimizing your operational efficiency.

Cyber Security
Reduce maintenance and transaction risks
- IEC 62443-4-1
- IEC 62443-3-3
- VLAN/VPN/TLS

High Availability Redundancy
24/7 operation with self-detection and quick recovery
- Virtual Router Redundancy Protocol (VRRP)
- DeltaGrid IoT Hub

Container-based Architecture
Rapid extension, deployment, and integration
- Single UI with support for optional application modules
- IoT Hub & Virtual Gateway
- Micro service framework

Network System Diagnostics
Nonstop operation and services
- Network communication status
- System operational status
- Monitoring of platform service status

System Architecture
Application Highlights

Optimized Energy Dispatching for Nanogrids

Energy Control
- Peak shaving, including flattening of EV charging peaks
- Load shifting
- Self-consumption optimization
- Power backup

Nanogrid Energy Management
- Real-time energy monitoring and control
- Integrated operation with renewable energy
- Special features to support EV charging infrastructure

Frequency Regulation and Utility Ancillary Services

Energy Control
- FP, PQ, VP, VQ, VPQ, PF modes
- Backup power

Management of Grid Ancillary Service Operation
- Energy Trading

Renewable Energy Smoothing

Energy Control
- PV or wind smoothing
- Energy shifting
- Capacity firming

Multi-Site Management
- Real-time power generation
- Accumulative power generation
- Reporting

Single-Site Performance Management
- Day-by-day generation / sunlight monitoring
- Month-to-month comparison
- Predicted and actual power generation comparison

Digital Operation & Maintenance Services

Real-Time Device Management
- Remote access and OTA software updates
- Data collection

Predictive Maintenance
- Prescriptive maintenance
- Preventive maintenance

Work Order Management
- Repair status tracking
- Optimization scheduling
- Smart route planning

Inventory-Based Service Dispatching
- Customer information synchronization
- Spare parts tracking and procurement

Function List

<table>
<thead>
<tr>
<th>Model</th>
<th>Utility Ancillary Services</th>
<th>Nanogrid Energy Optimization</th>
<th>Distributed Energy Resources + ESS Control</th>
<th>Factory Carbon Emission Tracking</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic</td>
<td>Multi-site Management</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td></td>
<td>Metering</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td></td>
<td>Dashboard</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td></td>
<td>Scheduling</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td></td>
<td>Time of Use</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Energy Control Mode</td>
<td>Frequency Regulation</td>
<td>●</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Peak Shaving</td>
<td>●</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>PV Output Smoothing</td>
<td>●</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Energy Shifting</td>
<td>●</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Target SoC</td>
<td>●</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Analysis &amp; Management</td>
<td>Consumption Analysis</td>
<td>●</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Abnormal Usage Analysis</td>
<td>●</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Reporting</td>
<td>●</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Energy Trading &amp; Data Delivery</td>
<td>●</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operation &amp; Maintenance</td>
<td>Asset Management</td>
<td>●</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Error Notification &amp; Work Order</td>
<td>●</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Single Line Diagram</td>
<td>●</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Worldwide Success Cases

Utility and Grid Ancillary Services

Delta Pingjhen Plant
5 MW / 3.6 MWh

Taipower Kinmen XiaXing Power Plant
2 MW / 1 MWh

AIDC Taichung Factory
1 MW / 1 MWh

Solar Power Plants

Kaohsiung Yong-an Solar Power Plant
1 MW / 1 MWh

Changhua Coastal Park Solar Power Plant
1.5 MW / 1.5 MWh

Japan Delta Ako Energy Park
500 kW / 362 kWh

Commercial & Industrial Application

Cyntec Factory
500 kW / 3 MWh

National Changhua University of Education
1 MW / 1 MWh

Gravel in California, USA
500 kW / 880 kWh

Micro-Grid

CPC Corporation Chaiyi Gas Station
500 kW / 3 MWh

Taipower Fengshan Green Community
500 kW / 1 MWh

Japan Sahamihara Micro-grid
500 kW / 880 kWh

Taiwan Success Case Highlights

Utility and Grid Ancillary Services

Solar Power Plants

Taipower Kinmen XiaXing Power Plant
Generator backup, frequency regulation

AIDC Taichung Factory
Grid ancillary - regulation reserve

Taipower Fengshan Green Community
Microgrid, peak shaving

Commercial & Industrial Application

CPC Corporation Chaiyi Gas Station
E-Scooter charging, PV smoothing

National Changhua University of Education
Load shifting, peak shaving, backup power

Micro-Grid

Delta Pingjhen Plant 5MW
Grid ancillary - regulation reserve

Taipower Lanyu Power Plant
Generator backup, frequency regulation

Taiwan Power Research Institute
Grid research

CPC Corporation Chaiyi Gas Station
E-Scooter charging, PV smoothing

National Changhua University of Education
Load shifting, peak shaving, backup power

Cyntec Factory
Demand response, peak shaving

Gravel in California, USA
PV smoothing, demand response

Japan Sahamihara Micro-grid
Microgrid, peak sharing

Japan Delta Ako Energy Park
PV smoothing, demand response

Changhua Coastal Park Solar Power Plant
PV smoothing, demand response

Taipower Kinmen XiaXing Power Plant
PV smoothing, demand response

Taipower Fengshan Green Community
Microgrid, peak sharing
Success Story
Utility and Grid Support

Delta Taiwan Pingjhen Plant
• Grid Ancillary - regulation reserve • 5 MW / 3.6 MWh

Delta's 5 MW / 3.6 MWh ESS in the Delta Pingjhen Plant joined the Taipower Energy Trading Platform on November 1, 2021, providing auxiliary services to help regulate the grid frequency and stabilize the power grid.

Success Story
Utility and Grid Support

Taipower's Kinmen Xiaxing Power Plant
• Generator backup, frequency regulation, renewable energy smoothing • 2 MW / 1 MWh

Delta's ESS at Taipower's Kinmen Xiaxing Power Plant is a power dispatching tool for Kinmen's grid, designed to improve power supply stability. In daily operations, the system regulates the frequency of the power grid and renewable energy. When a generator trips, it can provide backup power to hold the grid within just 0.2 seconds.

Success Story
Utility and Grid Support

Taipower's Lanyu Power Plant
• Peak shaving, frequency regulation, spinning reserve • 500 kW / 1.1 MWh

This ESS can regulate the power frequency to stabilize the independent power grid of Lanyu Island. During tourism booms, it can perform peak shaving to solve the problem of power supply bottlenecks. When the generator trips, it can also provide power to support the grid in just 0.2 seconds.
Success Story
Solar Power Plant

Taipower’s Kaohsiung Yongan Solar Power Plant
• PV smoothing • 1 MW / 1 MWh

The Kaohsiung Yongan PV Power Plant was built in 2011. It covers a total area of 9.45 hectares, has a PV capacity of 5 MW, and an overall annual power generation of about 6 million kWh. To improve PV power generation efficiency, Delta helped the Kaohsiung Yongan solar power plant build a 1MW/1.1MWh ESS. This ESS has improved PV power generation performance with PV smoothing and frequency regulation while reducing grid stress due to large fluctuations in renewable energy.

Changhua Coastal Park Solar Power Plant
• PV smoothing, demand response • 1.5 MW / 1.5 MWh

The 1.5 MW / 1.5 MWh ESS built by Delta in the Taiwan Changbin Solar Power Plant was accepted in December 2020. This was Delta’s fourth megawatt-level ESS in Taiwan. It adopts a brand-new outdoor battery cabinet and PCS to regulate the solar power produced by the Changbin Solar Power Plant and eliminate intermittencies in renewable energy.

Japan Delta Ako Energy Park
• PV smoothing • 500 kW / 362 kWh
Success Story
Commercial & Industrial Application

National Changhua University of Education

• Peak shaving, offgrid operation, power backup • 1 MW / 1 MWh

The 1 MW / 1 MWh ESS created by Delta’s one-stop service (including investment benefit evaluation, customized solution planning, construction, orientation, and training) allows National Changhua University of Education to not only stabilize the grid and regulate electricity, but also to optimize contract capacity to reduce waste and minimize penalty charges while deepening academic research on micro-grids and intelligent energy.

Cyntec Factory

• Backup power, demand response • 500 kW / 3 MWh

Delta provided a 500 kW / 3 MWh ESS for its subsidiary Cyntec’s plant in Hsinchu Science Park. The system not only provides backup power for the plant, but it also supplies power to the plant through participating in Taipower’s demand response program and avoids affecting Taipower’s energy production.

Gravel in California, USA

• 500 kW / 880 kWh
CPC Corporation Chaiyi Gas Station

- Support E-Scooter charging, PV smoothing, load shifting
- 250 kW / 500 kWh

Delta assisted CPC Corporation, a Taiwan leading energy resource provider, to build their first green energy demonstration station by retrofitting a Chaiyi gas station into an e-scooter charging station by utilizing renewable energy generated by a rooftop solar system regulated by an ESS.

Japan MHIET’s Triple Hybrid Power Micro-Grid

- 500 kW / 250 kWh

Delta helped Mitsubishi Heavy Industries build a triple hybrid stand-alone power system, EBLOX, demonstrated in Sagamihara. The system adopts Delta’s ESS and solar inverters, and combines them with a gas engine generator. It is environmentally friendly and meets the increasing demand for safe energy in the event of a disaster.

Taipower Fengshan Green Community

- 500 kW / 1 MWh