20ft Container
DC coupled Solar + Storage
Energy Storage System

Model: SES-2-501-xxx

Features
- Outdoor rated
- Built-in bi-directional Power Conversion System + DCDC PV charging system + STS cabinet (optional) (SINEXCEL)
- Grid-support & grid-forming
- Flexible energy
- Pre-engineered system

Specification

Utility-interactive Mode (PCS:PWS1-500KTL-xx)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal power</td>
<td>62.5 * n kW (n=1,2,...,8)</td>
</tr>
<tr>
<td>DC max current</td>
<td>109A * n (n=1,2,...,8)</td>
</tr>
<tr>
<td>AC voltage</td>
<td>380V at PCS</td>
</tr>
<tr>
<td>AC max current</td>
<td>480 or 400V at AC interface</td>
</tr>
<tr>
<td>AC frequency</td>
<td>50 Hz(49.5Hz<del>50.5Hz) / 60Hz(59.5Hz</del>60.5Hz)</td>
</tr>
<tr>
<td>Output THDi</td>
<td>≤3%</td>
</tr>
<tr>
<td>AC PF</td>
<td>Listed: 0.8~1 leading or lagging (Controllable)</td>
</tr>
<tr>
<td></td>
<td>Actual: 0.1~1 leading or lagging (Controllable)</td>
</tr>
</tbody>
</table>

Stand-alone Mode (PCS:PWS1-500KTL-xx)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC max current</td>
<td>109A * n (n=1,2,...,8)</td>
</tr>
<tr>
<td>AC output voltage</td>
<td>400 or 480V (±10% configurable)</td>
</tr>
<tr>
<td>AC output current</td>
<td>95A * n (n=1,2,...,8)</td>
</tr>
<tr>
<td>Nominal AC output power</td>
<td>62.5 * n kW (n=1,2,...,8)</td>
</tr>
<tr>
<td>AC Max Power</td>
<td>68.75 * n kW (n=1,2,...,8)</td>
</tr>
<tr>
<td>Output THDu</td>
<td>≤2%</td>
</tr>
<tr>
<td>AC frequency</td>
<td>50 or 60Hz</td>
</tr>
<tr>
<td>AC PF</td>
<td>Listed: 0.8~1 leading or lagging (Load-depend)</td>
</tr>
<tr>
<td></td>
<td>Actual: 0.1~1 leading or lagging (Load-depend)</td>
</tr>
<tr>
<td>Overload Capability</td>
<td>105%~115% 10min;</td>
</tr>
<tr>
<td></td>
<td>115%~125% 1min;</td>
</tr>
<tr>
<td></td>
<td>125%~150% 200ms</td>
</tr>
</tbody>
</table>

Compatible Battery System

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max Capacity</td>
<td>TBD by Battery System (up to 1000kwh)</td>
</tr>
<tr>
<td>Chemical</td>
<td>Lithium ion based</td>
</tr>
<tr>
<td>Battery Voltage Range</td>
<td>600~900V</td>
</tr>
</tbody>
</table>

Sinexcel Inc.  www.sinexcel.us  V0.2618
## 20ft Container DC coupled Solar + Storage Energy Storage System

**Driven By Sinexcel®**

<table>
<thead>
<tr>
<th>C rate</th>
<th>TBD by Battery System (less than 1C)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1C Discharging for 15min determined by Battery System</td>
</tr>
</tbody>
</table>

### Compatible PV System (PV charger: PDS1-400K)

<table>
<thead>
<tr>
<th>PV Voltage Range</th>
<th>250~ V\textsubscript{Batt}-40V (MPPT 250V~840V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PV Charging Current</td>
<td>120A * n (n=1,2,...,8)</td>
</tr>
<tr>
<td>Rated Charging Power</td>
<td>50kW * n (n=1,2,...,8)</td>
</tr>
<tr>
<td>Max Charging Power</td>
<td>70kW * n (n=1,2,...,8)</td>
</tr>
</tbody>
</table>

### Physical

- **Cooling**: Forced air cooling for power electronics.
- **Air conditioned for battery system with heater and dehumidifier, 5kW *1 or 2, UL compliant**
- **Noise**: 70dB
- **Enclosure**: NEMA 3R
- **Max elevation**: 3000m/10000feet (> 2000m/6500feet derating)
- **Operating ambient temperature**: -20°C to 50°C (De-rating over 45°C)
- **Humidity**: 0~95% (No condensing)
- **Aux power**: 220 or 120V single phase built-in, 5kW*2 transformer
- **Size (W×H×D)**: 6058×2591×2438mm / 20 * 8.6 * 8 ft
- **Weight**: TBD

### Fire system

- **Delays**: Configurable
- **Manual release**: Supported
- **Voltage**: 230/115V AC
- **Back up battery**: Two 12V 7Ah lead acid in series
- **Sensors**: Smoke detector and heat detector
- **Alarm**: Yes
  - Nominal pressure: 25 bar @ 21°C
  - Max pressure: 34.7 bar
  - Hydraulic test pressure: 69.0 bar
  - Capacity: 15KG
- **Agent container**
  - FM200 (HFC-227ea) or NOVEC 1230
  - Controller: UL864, FM listed
  - Strobe: UL1638
  - Horn: UL464

### Other

- **Peak efficiency for inverter**: 98.2%

---

Sinexcel Inc.  
www.sinexcel.us  
V0.2618
# 20ft Container
## DC coupled Solar + Storage
### Energy Storage System

![Sinexcel Logo]

- ** driven by Sinexcel ®**

---

<table>
<thead>
<tr>
<th>Feature</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEC efficiency for inverter</td>
<td>97% w/o transformer</td>
</tr>
<tr>
<td>Protection</td>
<td>OTP, AC OVP/UVP, OFP/UFP, EPO, AC Phase Reverse, Fan/Relay Failure, OLP, GFDI, Anti-islanding</td>
</tr>
<tr>
<td>Configurable protection limits</td>
<td>Upper/Lower AC Voltage/Frequency limit, Battery EOD voltage.</td>
</tr>
<tr>
<td>AC connection</td>
<td>3-Phase 3-wire+PE at PCS connection</td>
</tr>
<tr>
<td></td>
<td>3-Phase 4-wire+PE at AC connection</td>
</tr>
<tr>
<td>Communication</td>
<td>RS485, CAN, Ethernet / MODBUS TCP/IP</td>
</tr>
<tr>
<td>Isolation</td>
<td>Non-isolation (External Transformer Included in Container)</td>
</tr>
<tr>
<td>Certification for inverter</td>
<td>ETL listed conforming to UL1741/UL 1741SA/UL 9540, CPUC RULE 21, CSA 22.2</td>
</tr>
</tbody>
</table>

---

1. xxx standing for battery capacity.
2. xx standing for -NA (for American market) or -EX (for European/Australian/UK market)
3. n is the quantity of installed power modules.
20ft Container
DC coupled Solar + Storage
Energy Storage System

Applications

Demand Charge Management

Customer Self Supply

Micro-Grid

Backup power

Frequency regulation
PCS Functionalities

Four-quadrant operation

The energy storage inverter supports four-quadrant operation in both grid-tied mode and off-grid mode, which means the active power and the reactive power can be tuned to or showing to 4 characteristics:

- Import active power + inductive reactive power
- Import active power + capacitive reactive power
- Export active power + inductive reactive power
- Export active power + capacitive reactive power

Yet the energy conversion systems always consume certain active power as the loss. The actual PF range is 0.1~1.0 leading or lagging. The sign is indicating the reference direction of the power.

Grid-tied Power Regulation

2.1 Utility-interactive mode (Grid-tied mode / P-Q mode)

The P-Q mode is that the reference voltage and a constant frequency will be provided by another source (usually the utility grid), and the active power and the reactive power can be commanded to change on the inverter.
2.2 (Reactive power control mode) Constant PF

In grid tied mode, there are 3 variables in the equation defining power factor:

\[ \text{PF} = \frac{P}{\sqrt{P^2 + Q^2}} \]

where
P is active power,
Q is reactive power.
PF is power factor.

In constant PF mode, the active power (P), and power factor (PF) is specified by setpoint or EMS command (in PV inverters the active power is usually determined by the weather), the reactive power shall be determined with the variation of the active power setpoint. Sinexcel inverters are taking reactive power priority. If the determined PF cannot be reached within the apparent capability, the active power will be reduced automatically.

2.3 (Reactive power control mode) Constant reactive power

In constant reactive power mode, the active power (P), and reactive power (Q) is specified by setpoint or EMS, the reactive power shall be determined with the variation of the active power setpoint. Sinexcel inverters are taking reactive power priority. If the determined reactive power cannot be reached within apparent capability with the active power setpoint, the active power will be reduced automatically.

2.4 (Reactive power control mode) Volt-VAr control

Enabling Volt-VAr control will be supplying VArS when and where demanded is inherent to operating an electric power system.
The Volt VAr function varies reactive power to counteract voltage deviations. Specifically, in response to an increase in local voltage, the smart inverter will absorb reactive power, and in response to a decrease in local voltage, the smart inverter will inject reactive power. By acting in this manner, the voltage is kept within acceptable limits. The inverter can provide reactive power by utilizing available capacity or by decreasing active power production once the capacity of the inverter has been reached. The Volt-Var function may have a significant positive impact on mitigating DER grid integration costs.

2.5 (Active power control mode) Constant active power control
In this mode, the active power will be the same as active power setpoint, unless the reactive power setpoint contradicts with the active power.

2.6 (Active power control mode) Volt-Watt control
In this mode, the base active power will be specified by active power setpoint, however, the active power output will be linearly reducing if the grid voltage exceeds assigned threshold. The linear slope can also be assigned.

2.7 (Active power control mode) Frequency-Watt Control
In this mode, the base active power will be specified by active power setpoint, however, the active power output will be linearly reducing if frequency exceeds assigned threshold. The linear slope can also be assigned.

2.8 (Active power control mode) Volt-Watt and Frequency-Watt control
In this mode, the base active power will be specified by active power setpoint, however, the active power output will be linearly reducing if either frequency or grid voltage exceeds assigned threshold. The linear slope can also be assigned.

Ramp rates

3.1 Soft-start ramp rate (SS)
To avoid impact to the grid during the grid restores from a blackout or abnormal, the SS ramp rate will be implemented to make sure the active power setpoint will be slowly and linearly increasing when inverter reconnects to the grid.

3.2 Normal ramp rate (RR)
Similarly, to avoid impact to the grid during normal operation, the RR parameter will be utilized to make the change of active power is not transient.
Grid Forming

4.1 Stand-alone mode (V-F mode)

The V-F control mode is that no matter how the inverter power change does, the amplitude and frequency of output voltage would be constant, the inverter of V/F control can provide voltage and frequency support for the micro-grid during islanded operation. The inverter will act as a voltage source. And the current amplitude and PF will be determined by the vector sum of the generation (if exist) and the consumption load.

Anti-Islanding

Anti-islanding protection is a safety feature that is built into all grid-tied inverters that operate in the US. It may not be built into some inverters meant to operate in different countries.

Anti-islanding protection is a way for the inverter to sense when there is a problem with the power grid, such as a power outage, and shut itself off to stop feeding power back to the grid. This is because when problems arise with the power grid it is assumed that workers will be dispatched to deal with the issue, and they want the power lines to be completely safe, and not have electricity flowing from all the nearby grid-tie systems.

High/Low voltage frequency ride-through

Ride-through is a state or action in response to an abnormal excursion of the grid, such as high/low voltage and high/low frequency, in which the inverter does not trip in less than the minimum specified duration.

Voltage and frequency ride through functions are the most important features needed to improve grid stability.

Historically inverters were programmed to get offline quickly in response to grid voltage or frequency excursions.

Automatic switch-over between grid-tied and grid-forming (optional).

External STS (Smart-transfer-switch) cabinet with two AC disconnector enable the 20ms switch-over time when grid fails to provide the power supply to loads. It could be also used with Diesel Genset in off-grid mode to enable uninterrupted power supply.
Site Controller Functionalities

System Maintenance

Maintenance and trouble shooting for the whole system via LAN connection.

Real-time field data monitoring

The real-time operating status and running data of the system can be viewed on LAN WEB interface or background communication.

Data record, storage & display

Daily / monthly / annually operation data could be recorded stored and displayed. Including but not limited to operation and status records, the status of PCS, BMS and external meter, and energy generation / consumption.
Real-time Control

Operations of PCS could be controlled in real time via the web interface. Including but not limited to charging/discharging power, power on/off, reactive power control, etc.

Gateway

Operation of PCS via MODBUS TCP/IP protocol could be controlled by third party EMS / SCADA system. And also the system data could be accessed or uploaded.

Automatic control

Various setting points could be used to configure different conditions for different PCS to achieve several target applications. Including but not limited to.

- Micro-grid operation with PV and/or genset.
- Self-consumption.
- Zero export.
- Demand control.
- Diesel genset optimization.
- Schedule operation.
20ft Container
DC coupled Solar + Storage
Energy Storage System
20ft Container
DC coupled Solar + Storage Energy Storage System

Layout
20ft Container
DC coupled Solar + Storage
Energy Storage System

System Diagram
Battery System

To be determined.

Option #1:
One large battery bank with top BMS and several strings of battery racks paralleled into one single combination box.

Option #2:
Up to 8 strings of battery racks, which is connecting directly with single power module inside of PCS. No combination box and top BMS are required.
Easy to expand with fixed Power/Energy ratio.
Energy Management System

To be determined by exact application requirement.

Remote and cloud-based monitoring and controls over power and energy and battery system.