# Utility Scale Energy Storage Systems

## Description

Power Conversion Systems for energy storage depend on proven, reliable inverter technology, and Parker Hannifin has a proven track record in their design and manufacture. The bidirectional PCS efficiently channels energy into storage elements and retrieves stored energy for fast delivery on demand to the power grid. Applications include frequency regulation, support for wind and solar power, peak shaving, VAR control, and ancillary services.

## Utility Scale, Modular Design

Parker power conversion technologies are scalable from 100kW to multiple megawatts of power. For typical utility scale installations, multiple megawatt-class modules are integrated into shipping containers, buildings, or custom outdoor enclosures for quick delivery and commissioning.

## Application Specific Control Logic

Through the use of an industry accepted programmable logic controller (PLC) and the appropriate energy management interfaces, the Parker PCS can be customized to assume various application response profiles in order to meet specific utility duty cycles.

## Speed and Efficiency

The IGBT-based Active Bridge Bidirectional Inverter within the PCS is capable of delivering full power in either direction within 10ms, making it suitable for demanding applications like grid frequency stabilization.

## Experience

Parker has successfully commissioned battery energy storage systems throughout North America and abroad. With an ever-growing installed base, our experience is second to none. For examples and case studies, please contact us. While utility scale energy storage is a relatively young technology, Parker has over 35 years of experience in the business of manufacturing solid state power conversion equipment, producing over 100,000 inverters and drives per year.

## Quality and Protection

The core of the PCS, Parker's AC890PX Inverter technology, provides quality power by incorporating an advanced Pulse-Width-Modulated (PWM) switching technology, automatically synchronizing to the AC power grid. Integral harmonic filters deliver pure sine wave power well within IEEE519 guidelines for Total Harmonic Distortion. The Parker system provides automated sequenced shutdown and disconnection under power loss events, in compliance with IEEE 1547 guidelines. Inverters and balance of PCS are manufactured at our ISO9001:2008 certified facility in Charlotte, NC, and satisfy ARRA "Buy American" provision.

## About Parker

With annual sales exceeding $13 billion in fiscal year 2012, Parker Hannifin is the world's leading diversified manufacturer of motion and control technologies and systems, providing precision-engineered solutions for a wide variety of mobile, industrial and aerospace markets.

Aerial view of 12 MW installation

4 Megawatt PCS container (Part of 32 MW installation)

Custom outdoor enclosure for the ultimate in efficiency and compactness


PCS interior view showing inverter stacks and connection cabinets

Parker

ENGINEERING YOUR SUCCESS.

## Typical System Specifications

| | |
|---|---|
| Rated Power | PCS can be configured to any requirement, limited only by transformer capacity |
| VAR Capability | +/- 1 to  MVAR |
| Maximum MVA | 110% of rated power |
| Overload | 150% of MVA rating for 60 seconds |
| Power Factor | > 0.99 |
| Peak Inverter Efficiency | > 98% |
| DC Bus Voltage Range | 750-1000 VDC standard |
| Nominal Output Voltage | 480 VAC standard, others optional |
| Ambient Temperature | 0° to 55°C |
| Line Frequency | 50 or 60 Hz |
| Altitude | 0-1000m (to 3000m with derating) |
| Compliances | Built to comply with IEEE519, IEEE1547, UL1741, LVRT |
| Cooling System | Air or 2-phase refrigerant cooled (Parker Precision Cooling) |
| Refrigerant | R134a - Non conductive, non corrosive, CFC-free |
| Communications (SCADA) | Ethernet/IP, Modbus/TCP, CANopen, Profinet, DeviceNet, Firewire, EtherCat, RS485 |
| Enclosure | Standard ISO shipping container or custom outdoor control house with integral cooling |
| Dimensions (Up to 4 MW) | 20' x 10' x 10' approx. (ISO container configuration) |
| System status parameters | Grid Voltage, Total System Current, Total System KVA, Total System KVAR, Power Factor, Total System Power, Inverter Current, Battery State of Charge, DC Voltage and DC Current, Run Status, Fault/Healthy Status, Temperature (Examples from a typical PCS) |

## Building Block Inverter

In both air cooled and refrigerant cooled systems, SSD PowerPak modules plug into a common bus rail system to form a COMPLETE Inverter section. Disassembly or removal of power wiring is not required when changing a module!

## Plug-in Modularity

Sealed PowerPak modules are easy to install and service

- Modules replace in minutes
- Easy-to-handle
- Under 50 pounds
- Replaceable by local technical staff
- Freight friendly, easily shipped around the world using major overnight carriers

## Integrated Bus System

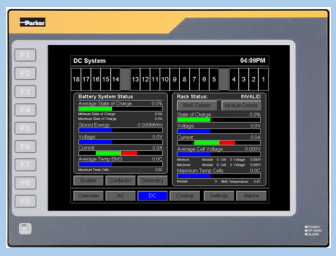
- Power wiring minimized
- Keyed modules eliminate errors
- Compact Size
- Saves floor space
- Advanced Cooled units are Smallest-in-Class!

## VAR Support

Provides the ability to supply reactive power to the grid, thus regulating system voltage and enhancing the stability of a weak grid. Solid state VAR control provides a response time measured in milliseconds, ensuring that momentary fluctuations on the grid are minimized. Real or reactive power can be regulated.

1.5 Megawatt Parker Precision Cooled Inverter Stack

Removable Phase Module



Operator display - sample screen

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