Get to know our business.

<table>
<thead>
<tr>
<th>Electrical Sector</th>
<th>Industrial Sector</th>
</tr>
</thead>
<tbody>
<tr>
<td>2016 Sales $12.6 B</td>
<td>2016 Sales $7.1 B</td>
</tr>
<tr>
<td>- Electrical Products</td>
<td>- Aerospace</td>
</tr>
<tr>
<td>- Electrical Systems &amp; Solutions</td>
<td>- Hydraulics</td>
</tr>
<tr>
<td></td>
<td>- Filtration</td>
</tr>
<tr>
<td></td>
<td>- Vehicle</td>
</tr>
<tr>
<td>Sales $19.7 Billion USD</td>
<td></td>
</tr>
<tr>
<td>Net income $1.9 Billion USD</td>
<td></td>
</tr>
<tr>
<td>Operating Earnings per share $4.22</td>
<td></td>
</tr>
</tbody>
</table>

- Chairman & CEO – Craig Arnold
- Key locations in Cleveland, United States; Shanghai, China; Morges, Switzerland; São Paulo, Brazil
- Regional engineering teams to support products and custom solutions
- Customers in more than 175 countries
- Approximately 95,000 employees
Solving industry’s toughest power management challenges around the world.

<table>
<thead>
<tr>
<th>Aerospace</th>
<th>Buildings</th>
<th>Data centers</th>
<th>Food and beverage</th>
<th>Government</th>
<th>Healthcare</th>
</tr>
</thead>
<tbody>
<tr>
<td>Machine building</td>
<td>Marine</td>
<td>Mining, metals and minerals</td>
<td>Mobile machinery and equipment</td>
<td>Oil and gas</td>
<td>Pharmaceuticals</td>
</tr>
<tr>
<td>Rail</td>
<td>Renewables</td>
<td>Residential</td>
<td>Utilities</td>
<td>Vehicles</td>
<td>Water/wastewater</td>
</tr>
</tbody>
</table>

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A portfolio designed to meet your power management needs.

**INDUSTRIAL**

- **Aerospace** – Hydraulic and fuel systems
- **Automotive** – Engine air mgmt., traction control and fluid products
- **Truck** – Commercial vehicle clutches and transmissions
- **Filtration** – Liquid filtration solutions
- **Hydraulics** – Fluid conveyance and power and motion control products

**ELECTRICAL**

- Power distribution and circuit protection
- Backup power protection

**Lighting and security**

**Control and automation**

**Structural solutions and wiring devices**

**Solutions for harsh and hazardous environments**

**Engineering services**

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Power Xpert Inverter – 1.0 – 2.5 MW

- Inverter
- Tracker (or AC) power and controls
- Throat – direct coupling
- Step-up Transformer
Power module design

- Latest generation of Semikron Skiip 4 IGBT – integrated driver & heat sink
- Rated for 175°C and high cyclic duty applications
- Vishay film capacitors
- User replaceable modules
Power Xpert Utility-Scale Solar Inverter
1500Vdc – 98.5% efficiency

DC Compartment
- Up to 21x 350A contactors with fuses
- DC Feeders From Combiner boxes
  - Contactor opens Positive and Negative poles

Power Conversion Compartments
- AC Line Filter
- AC Line Filter
- AC Line Filter

AC Compartment
- 3200A Main Breaker with MO and LOTO
- Open / Close SEL 751 Relay
- Inverter Control Power
- UPS
- 20A with LOTO
- DC LOTO
- Close coupled to Transformer
Battery Types

- LG Chem (LMO)
- Kokam (LTO)
- Enerdel (LTO)
- Altair Nano (LTO)
- ZBB (flow)
- Xtreme (ALA)
- Mitsubishi (LMO)
- JCI (NCA)
- Samsung (LMO)
- SPS/Lischen
- Powin
- Primus

Power Xpert™ Energy Storage Inverter
1250 V max

500kW outdoor Inverter

3MW site (indoor Inverters)

500kW Compact Pad Mount
Power Xpert® Energy Storage Inverter

- From Battery container
- Inverter DC connection
- Inverter Controls Power
- F.O. Ethernet Switch
- 3 x RJ-45 ports
- Modbus/TCP Fiber Optic/CAT-5
- From Transformer, weather station, etc
- 6 x DI's + 1 x AI
- 60A @ 480 VAC
- 3A @ 120VAC
- 15A @ 120VAC
Hybrid-solid state dc contactor

- 1000 Vdc
- 300 & 600 A
- Hybrid design for low loss and arc-less interruption
- Internal isolation contact
- 150,000 electrical operations
- 1,000,000 mechanical operations
S611
Soft Starter

Technical Specifications:
• 200-600 V 3-phase Rated
• 52 A to 414 A Rated
• -20°C to 50°C Rated
• 120 Vac Control Voltage
• 6 Frame Sizes
• 3-phase controller
• Globally Approvals

Product Features:
• Advanced overload protection through Eaton’s C441 overload
  • Provides unique protections – Stall/Jam, Phase loss, low voltage, high voltage
  • Advanced monitoring solutions
  • Fault History stores last 30 faults
  • Door mountable Display

• Fully field serviceable
• Extensive communication module options

Best in class motor protection and monitoring to extend motor life
• Spare parts available to make the product field serviceable to provide customers with additional value
• Uses the same communication modules as the S811+ product offering
S811+
Soft Starter

**Technical Specifications:**
- 200-690 V 3-phase Rated
- 37 A to 1000 A Rated
- -30°C to 40°C Rated
- 24 Vdc Control Voltage
- 5 Frame Sizes
- 3-phase controller
- Globally Approvals

**Product Features:**
- Digital Interface Module (DIM)
  - Copy/Paste functionality
  - Advanced Monitoring
  - Door Mounting Kit available
- Modbus RTU standard
  - Extensive communication module options

- Specialized Pump Algorithms
- Internal Bypass Contactor
- Electronic Overload Protection

- Industry’s smallest footprint reducing space needs up to 475% over current offering
- Extended Communication accessories which will allow for improved IoT compatibility
- Offered as both Open product to OEMs and enclosed though Eaton’s MCC and Enclosed Control groups
Product overview
Adjustable frequency drives

Technical Specifications:
• 230-600 V/3-ph
• 0.25-800 hp
• 2.2 A to 310 A at 480 V
• 150% overload for 1 minute
• Temperature rating -30°C to 50°C (60°C with de-rating)
• Real-time clock
• Active Energy Control for energy savings up to 10% beyond competitors’ VFDs

• Next generation PowerXL platform extremely price and feature competitive
• Over 9 million combinations of enclosed standard product
Power XL DG1
Power Section Features

- Integrated 5% dc link choke & input surge protection
- EMC filters standard on all drives
- Temperature controlled fan & cold weather feature
- Brake chopper standard on Frames 1-3
- Compact foot-print and conformal coated boards
State-of-the-art double-conversion UPS

- Transformer-less topologies with double conversion efficiencies reaching 97% with use of three-level converters and advanced digital signal processing
- High-frequency power conversion continues to increase power density
- Modular designs, allowing for N+1 redundant operation and scalable designs
- Flexible thermal management becoming increasingly more important
Comprehensive 3-phase BladeUPS offering to 60 kW

- Simplifies installation and service with true plug-and-power connections and hot-swappable batteries and electronics modules
- BladeUPS accessories extend runtime without dedicated module racks
- Preassembled start-up services are available that include installation and start-up configuration
## Product portfolio 8-400 KW

<table>
<thead>
<tr>
<th>Product</th>
<th>Power Range</th>
<th>Native Voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>9155</td>
<td>8-15kVA</td>
<td>208V</td>
</tr>
<tr>
<td>9355</td>
<td>10-15kVA</td>
<td>208V</td>
</tr>
<tr>
<td>9355</td>
<td>20-30kVA</td>
<td>208V</td>
</tr>
<tr>
<td>9390</td>
<td>20-160kVA</td>
<td>208V/480V</td>
</tr>
<tr>
<td>93PM</td>
<td>20-400kW</td>
<td>480V</td>
</tr>
<tr>
<td>93E</td>
<td>20-60kVA</td>
<td>208V/480V</td>
</tr>
</tbody>
</table>
Product portfolio 100-1200 KW

Power Xpert™ 9395P high performance UPS 200-1200 kW/kVA

93PM (400): 100-400 kW

9395/9395P: 225-1200 kVA

PDU/RPP
Solid state 1000 Vdc circuit breaker

- Liquid cooled package
- Air cooled package
- DC Contactor
- IGBTs
- Inductors
- Gate Drivers
- MOVs
- Diodes
- Current Sensors
## SC9000 EP Product Offering

### Air Cooled Single Inverter
- 250 – 2500 hp @ 2400V
- 250 – 3500 hp @ 4160V
- 250 – 3000 hp @ 3300V

### Air Cooled Parallel Inverters
- 3750 – 6000 hp @ 4160V
- 3250 – 5000 hp @ 3300V

### System Flexibility
- **Arc Resistant!**
- Up to 13,800V input/output for pump & fan applications
- Bypass starters available
- Synchronous Motor Control
Eaton SC9000 EP
Frame Size E

3250-4000 hp @ 3300V / 4750-6000 hp @ 4160V

222W x 92H x 50D
Powerpole sectionalizes the inverter into separate encapsulated phase sections versus one encapsulated Power Module.

Powerpole offers low overall lifecycle costs while maintaining the patented environmental protection of the SC9000 EP – encapsulation of devices, conformal coating on controls, and mechanical barriers to prevent damage to adjacent components in the event of a fault.

The reliability (FIT) of the SC9000 EP remains high with the 3-Level topology.
**Ampgard SC 9000**

Heat Pipe Thermal Management System

Closed and sealed system allowing for Harsh Environment applications
1-phase UPS using GaN devices

GaN for < 650V – for 1P UPS

Adapting existing UPS to GaN
SuNLaMP – Combined PV and battery grid integration using HF magnetics

**Funding agency:** DoE Solar Energy Program

**Opportunity**
- WBG devices using topology that enables integrated filtering and bidirectional converter implementation to enable solid state voltage transformation, SST
- Renewables and energy storage integration in HF magnetic component at different voltages
- Investigate the potential of dc and grid integration in residential and small commercial applications

**Program Description**
- Conversion Efficiency > 98%
- Service Life 25 yrs
- Power Density 100 W/in3
- System control, gate drivers and embedded systems simulation to allow efficient integration to MV grid
- 50 kW, 1000 V converter and HF transformer design and demonstration
- Scaled up 2 MW, 13.8 kV converter and HF transformer paper design

**Proposed Topology 50 kW, 1000 Vdc**

**System Integration, 2 MW, 13.8 kVac**
- Centralized module control
- Modules in Series/parallel for grid system integration
- OC/OV Protection
- Multi port for energy storage and PV integration
Value proposition – improve system efficiency & reliability

Traditional Solution

- Traditional compressor package
- Lube Oil Console
- Gear Box
- Gas Seal Panel
- Compressor
- Baseplate

Air Cooled Electric Motor
Variable Speed Drive

Integrated SiC ASD & Motor

- Adjustable Speed Drive
- PM Motor
- Compressor

10 kV 480 A SiC MOSFETs

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Technical advances continuing to shape the industry

- **Wide bandgap semiconductors and advanced magnetics** design resulting in higher efficiency power conversion - but high cost prevents wide commercial penetration

- **Faster DSP processors** and increased computational bandwidth further enabling advanced algorithms - "embedded software content" overcoming "hardware content"
Faster isn’t always better…
Selective coordination challenge

Cutout Fuse Link TCCs