Using 380vDC Power Feeds for Data Centers

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Presentation Overview

- AC vs. DC Infrastructure Comparison
- Key Benefits of a 380vDC Data Center
- Available DC Products
- Demonstrations Sites
- Industry Updates
- Q&A
AC vs. DC Infrastructure Comparison

 UPS

 AC/DC

 DC/AC

 +/- Battery

 480v 3φ AC

 PDU

 208v 1φ AC

 Server

 PSU

 AC/DC

 DC/DC

 DC/AC

 12v DC

 Rack

 Fans

 VR

 Server Loads

 DC/DC

 Server

 Rack

 Level Power Strip

 380v DC

 380v DC

 UPS

 AC/DC

 +/- Battery

 480v 3φ AC

 Rack

 Fans

 VR

 Server Loads
Key Benefits of a 380v DC Data Center

- **Efficiency**
  - Estimated 7% minimum increase in efficiency
  - Potential cost savings

- **Reliability**
  - Less component counts
  - Less floor space requirement
  - Server loads connect directly to battery

- **Modularity**
  - Rack level cooling solutions
  - Ability to scale data center as needed
Available DC Products
DC UPS Product

- Modular design
- Hot-swappable control module
- 20kW per power module
- Redundancy Configuration

Facility Configuration

Row Configuration

80kW 120kW 160kW ... 280kW
Input Voltage: 300Vac ~ 480Vac
Output Voltage: 380V

- Efficiency: 97.14% at 100% load (20kW)
- Peak Efficiency: 97.84 % at 35% load (7kW)
System Specification

- Capacity: 40 - 280KW
- Input range: +15%~20% of Nominal Voltage
- 380/220Vac, 400/230Vac, 480/277Vac
- Current Total Harmonic Distortion <5%
- Power Factor >0.99
- Efficiency >96% (power module)
- Output voltage 350/380/400Vdc (Nominal)
- Output regulation < 1%
- Current sharing < 3%
- Charge Current: Programmable through LCM panel
- Modular design with Power Module Redundancy
- Built-in SRAM (W/ RTC) up to 500 event logs
- Schedule battery test and battery replacement warning
- Local and remote emergency power off function
Rectifier Module Specification

- Power Module capacity 20KW.
- Input voltage: 480/277V, 400/230V, 380/220V
- Input range: +15%~ -20% of Nominal Voltage.
- Input power factor >0.99.
- Current Total Harmonic Distortion <5%.
- Output voltage 350/380/400Vdc (Nominal).
- Current balance accuracy < 3%.
- Output Voltage regulation < 1%
- Output short current limit: 75A.
- AC – DC efficiency : 96%.
- Fully DSP based digital control.
- Delta patented topology for 3 phase buck boost PFC.
- Swappable power module design.
- Dimension: 129(H) x 219(W) x 700(D) mm.
- Weight: 16.1 Kg
DC Server Power Supply

Specifications

<table>
<thead>
<tr>
<th>No.</th>
<th>Item</th>
<th>Specification</th>
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<tbody>
<tr>
<td>1</td>
<td>Input voltage</td>
<td>270VDC~430VDC</td>
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<tr>
<td>2</td>
<td>Input current</td>
<td>2.67A@200VDC</td>
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<tr>
<td>3</td>
<td>Output</td>
<td>12V/54A, 5VSB/3A</td>
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<tr>
<td>4</td>
<td>Hold-up time</td>
<td>&gt; 10mS</td>
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<tr>
<td>5</td>
<td>Interface</td>
<td>PMBUS</td>
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<tr>
<td>6</td>
<td>Form Factor</td>
<td>40.2 x 54.5 x 322mm</td>
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Efficiency

<table>
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<tr>
<th>Load</th>
<th>20%</th>
<th>50%</th>
<th>80%</th>
<th>100%</th>
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<tbody>
<tr>
<td>208v AC</td>
<td>85</td>
<td>93.2</td>
<td>93.7</td>
<td>93.6</td>
</tr>
<tr>
<td>400v DC (wide range)</td>
<td>85.5</td>
<td>94.1</td>
<td>94.8</td>
<td>94.5</td>
</tr>
<tr>
<td>400v DC (narrow range)</td>
<td>89.8</td>
<td>95.6</td>
<td>96.2</td>
<td>94.9</td>
</tr>
</tbody>
</table>

Wide range: 270vDC – 430vDC
Narrow range: 350vDC – 430vDC
DC Rack Level Power Strip

DC Breaker

L945*W55*H103mm
Arc Flash Prevention Mechanism

Signal high: no output
Signal low: output power

- PDU
- Power Cable
- MCU
- PSU
- System

P2 pin, Last mate, first break
Pin C
Pin B, Last mate, first break
P1 Last mate, first break
Demonstration Sites
Demonstration Sites

US
- Intel Corp. 400 VDC
- UC San Diego 380 VDC
- Duke Energy 380 VDC

France
- Telecom 350 VDC

Japan
- NTT Group 380/400 VDC

Sweden
- UPN AB. 350 /380VDC

China
- Telecomm 380 VDC

Taiwan
- IT Manufacturer 380 VDC

US
- UC San Diego 380 VDC

New Zealand
- Telecom NZ 220 VDC
Duke Energy Site
Industry Updates

• **Harmonizing Multiple 380vDC specs**
  – DC Power Partners joined eMerge in 2010
  – Working with ETSI to utilize similar infrastructure
  – Working with key representatives within US 380vdc community to finalize the spec.

• **Key players are involved**
  – UPS and power equipment providers such as Delta and Emerson.
  – IT server manufacturers such as IBM.
  – Data center end users
  – Telecommunication operators such as NTT and France Telecom.
Challenges

• **Safety Agency Approval**
  – Waiting for finalized standard from different agencies.
  – Waiting for final configuration of the system and infrastructure to apply for safety.
  – All safety requirements were considered during the design of the products but none is UL listed at the moment.

• **Working Together**
  – Need collaboration of different companies such as component and equipment providers, IT manufacturers, data center design firms and data center end users to work together.
  – Need expertise and experience from different fields to come up a safe and reliable systems

• **Vendor Selection**
  – Not as many components are available such as DC breakers.
Q&A

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