The Problem

Cutler-Hammer was the first to introduce the “direct bus bar” connected SPD that provides customers with the lowest system let through voltage at the bus bar when compared to traditional cable connected surge protectors.

By utilizing a direct bus bar connection the CPS achieves the industry's lowest system let through voltage - effectively suppressing both high and low energy transient events providing protection for all connected electronic loads. This design provides superior suppression ratings and eliminates poor performance that results from cable connections and/or long lead lengths.

The Solution

Cutler-Hammer has developed the Clipper Power System (CPS) family of products to ensure that the quality power required to maximize productivity in today's competitive environment is supplied to commercial, industrial, institutional, medical and telecommunications facilities.

The CPS family of products used for Surge Protection Devices (SPDs), also known as Transient Voltage Surge Suppression (TVSS), incorporates clamping and filter components that are integrated into low voltage distribution equipment or assemblies—switchboards, switchgear, panelboards, MCCs, automatic transfer switches, and busway. Cutler-Hammer also offers CPS units that can be externally mounted to any manufactures distribution equipment on new or existing installations (Retrofit CPS).

Due to the integrated “Direct Bus Bar” design, Cutler-Hammer has been able to eliminate many problems and performance issues commonly faced in the field. The CPS offers superior performance by minimizing the overall let-through voltage, a significant advantage when compared to cable-connected solutions.

Other Products

Other surge suppressor manufactures measurements are made at the SPD module or the suppressor terminals, not at the electrical distribution equipment's bus bar. The distance between module or suppressor terminals and the distribution equipment bus bar is often 14 inches or more. The impedance associated with cabling required to connect the surge suppressor to the electrical distribution equipment also referred to lead length significantly affects the overall performance of the surge suppressor and results in an increase in let through voltage.

The CPS also eliminates:

- Expensive horizontal “outboard” wall space;
- Field installation costs;
- Potential electrical code violations due to improper installation; and
- Invalidation of third party certifications when connecting to existing products.

Industry Breakthrough

Cutler-Hammer was the first to introduce the “direct bus bar” connected SPD that provides customers with the lowest system let through voltage at the bus bar when compared to traditional cable connected surge protectors.

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Other Products

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Clipper Power System Features

Best-In-Class Extended Range Filter
The UL 1283 listed filter offers noise attenuation over the entire frequency spectrum that consist of 50 kHz to 100 MHz. Based upon recommended ANSI/IEEE Category B3 Ringwave (6 kV, 500 Amp @ 100 kHz) the filter reduces this ringing transient to under 150 volts. Note: most suppression manufacturers claim “sine-wave tracking” or “EMI/RFI noise filtering,” however, few publish filter performance at 100 kHz as most offer inadequate filtering protection.

Industry Performance and Safety Standards
The CPS has been tested by all industry standards (UL 1449 2nd Edition, UL 1283, ANSI/IEEE C62.41 & C62.45, NEMA LS 1-1992, MIL-STD-220A, and CSA C22.2). All CPS products have been independent tested to verify published surge current ratings.

Ten (10) Year Extended Warranty
An extended ten (10) year warranty is provided on all CPS units.

Low Impedance Surge Plane™ Construction
The Surge Plane™ diverts surge currents equally to all MOVs, resulting in lower let through Voltage and longer life (see page 4).

Conductor Level Fusing Ensures Equal Current Diversion to all MOVs
High surge rated conductor level fusing ensures all surge components are equally stressed and provides effective short circuit protection. Other designs using individually fused MOVs have up to 20% variation in fuse performance, resulting in unequal MOV current sharing.

Internal Component Diagnostics
Monitoring and diagnostics of all internal components is provided by our patented TRI-Monitor™ system (see page 4).

Pow-R-Line 3a Panelboard with integrated CPS-S and direct bus bar connection. CPS can also be integrated into Pow-R-Line 1a and 2a panelboards. Disconnect option also available.

Freedom 2100 or Advantage MCC buckets with integrated CPS-S for retrofit and new installations.

1. CPS Hybrid Surge Filter
2. Direct Bus Bar Connection
3. TRI-Monitor™ Diagnostic System
4. Integral Circuit Breaker Disconnect

CPS Power System Family
Cutler-Hammer is the first manufacturer to develop a low impedance suppression platform that results in low let through voltages for all ANSI/IEEE defined surges. This is achieved by lowering the overall system inductance and ensuring rated surge current is equally diverted to all suppression components when compared to other designs that incorporate traces or internal wiring with different lengths. The addition of EMI/RFI filtering further enhances performance by providing an additional path for transients. SPD devices that employ modular components or printed circuit boards do not incorporate surge plane technology, thereby limiting their performance and system integrity.

**Surge Plane™ Features Standard on All Clipper Models:**
- lowest possible self-inductance due to the 2 layer copper plane construction that maximizes surface area for shunting high frequency surges. For example: the surface area of the Surge Plane™ is 15 times that of #10 AWG wire, a commonly used conductor in suppression devices
- mutual inductance is reduced as the Surge Plane™ design minimizes the loop area of all modes, resulting in lower let-through voltages
- diverts surge current equally to all matched MOVs within each phase to ensure MOVs are stressed equally and life expectancy is maximized
- 500 kA/phase tested suppression paths eliminate weak links associated with printed circuit board or modular designs.

**Cutler-Hammer's Surge Plane™ - Innovation Based on Proven Ground Plane Technology**

Cutler-Hammer's SPD TRI-Monitor™ – Internal Real Time Monitoring

Until now, surge suppressors relied solely on fuses for monitoring and alarm activation. However, fuses and circuit breakers cannot determine if an MOV has failed open. Even individually fused MOVs do not provide 100% comprehensive monitoring reliability as the fuses are not individually monitored.

Cutler-Hammer offers the most advanced safety system in the industry—the TRI-Monitor™ system. This patented design is the first system to incorporate three monitoring levels:

1. **Primary Protection:** Monitoring of Coordinated Overcurrent Protection is continuously displayed on the front panel using red/green indicator lights.
2. **Secondary Protection:** Internal Infrared Detection is used to monitor any change in the status of the suppression components. Using an optical detection circuit, the unit can identify a fault condition not detected by the primary protection circuit (i.e., Open circuit MOV failure in any mode including N-G).
3. **Tertiary Protection:** Thermal Detection provides a back-up monitor for slow thermal overheating.

If a secondary or tertiary fault is identified, the SPD unit will signal a fault condition. This provides the maximum level of safety to operating personnel and the electrical system. Each level of monitoring activates a flashing trouble light and alarm annunciators. Unlike conventional systems, our infrared sensor system is a fool-proof method for detecting damaged suppression components in any mode, including N-G. The TRI-monitor™ provides continuous online monitoring 24 hours a day.

Note: The TRI-Monitor™ is standard on CPS-S, CPS-S2, CPS-S3, CPS-H, CPS-H2, CPS-M, and CPS-M3 versions. TRI-Monitor™ is optional for CPS-B.
The Clipper Power System Ensures Complete Facility Protection

A Facility-Wide Protection Approach Should Be Employed to Address Power Quality Issues.

Why Cascaded (Coordinated) Facility-Wide Protection?

As recommended in the IEEE Emerald Book, a cascaded or staged protection approach should be employed to reduce an external/internal impulse waveforms to a harmless level. A SPD filter should be installed at the main service entrance and key distribution or branch panelboards to eliminate ringing and impulse disturbances as well as high frequency EMI/RFI noise.

All CPS units are coordinated to work on a “system basis”. CPS units installed at each level in the system work together to isolate and remove external/internal generated disturbances, creating superior facility-wide performance and reliability. Integrated CPS units are available in switchboards, switchgear, panelboards, MCCs, automatic transfer switches and retrofit.

Benefits of CPS Facility-Wide Protection

- High amplitude lightning impulses reduced to negligible levels
- The industry’s lowest system let through voltage (under 200 volts using ANSI/IEEE Category C3 Combination Waveform (20 kV, 3 kA)
- The electrical distribution’s noise attenuation is significantly enhanced
- The coordinated design ensures effective current sharing between main and branch SPD devices

*High Frequency Extended Range EMI/RFI Filter Performance

**Cascaded Facility Wide Filter Performance


<table>
<thead>
<tr>
<th>Frequency (MHz)</th>
<th>50 MHz</th>
<th>100 MHz</th>
<th>1 MHz</th>
<th>10 MHz</th>
<th>100 MHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insertion Loss (in)</td>
<td>184-1</td>
<td>10,000-1</td>
<td>100,000-1</td>
<td>1,776,279-1</td>
<td>1,900,080-1</td>
</tr>
<tr>
<td>Insertion Loss (db)</td>
<td>64</td>
<td>80</td>
<td>100</td>
<td>125</td>
<td>120</td>
</tr>
</tbody>
</table>

(Note: Single Device) *(Note: 100 ft. cable between device)*
Low Voltage Distribution Equipment—Complete Guide to Features and Applicable Safety Standards

<table>
<thead>
<tr>
<th>Switchboard</th>
<th>Switchgear</th>
<th>Motor Control Centers</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Features:</strong></td>
<td><strong>Features:</strong></td>
<td><strong>Features:</strong></td>
</tr>
<tr>
<td>■ CPS can be integrated into any switchboard</td>
<td>■ Available on all switchgear designs</td>
<td>■ Ideal protection for PCs, sensors, drives, electronic starters, or other digital equipment</td>
</tr>
<tr>
<td>■ Specifiers have the flexibility to install the CPS in any location within the switchboard</td>
<td>■ Disconnect switch is a standard feature</td>
<td>■ CPS designed to fit in a standard (2x) size compartment (12&quot;) for Freedom 2100 and Advantage MCCs</td>
</tr>
<tr>
<td>■ Disconnect switch is a standard feature</td>
<td>■ Unique design minimizes installation impedance</td>
<td>■ May be used in new/aftermarket applications</td>
</tr>
<tr>
<td>■ Unique design minimizes installation impedance</td>
<td>■ CPS-H ideal for critical industrial switchgear applications</td>
<td>■ Ideal for water treatment, petrochemical and other industrial applications</td>
</tr>
<tr>
<td><strong>Safety Standards:</strong></td>
<td><strong>Safety Standards:</strong></td>
<td><strong>Safety Standards:</strong></td>
</tr>
<tr>
<td>UL 981 (Switchboard)</td>
<td>UL 1556 (Switchgear)</td>
<td>LL485 (MCC)</td>
</tr>
<tr>
<td>UL 1449 2nd Edition (Surge Suppressor)</td>
<td>UL 1449 2nd Edition (Surge Suppressor)</td>
<td>UL 1449 2nd Edition (Surge Suppressor)</td>
</tr>
<tr>
<td>UL 1283 (EMI/RFI Filter)</td>
<td>UL 1283 (EMI/RFI Filter)</td>
<td>UL 1283 (EMI/RFI Filter)</td>
</tr>
<tr>
<td>CSA C22.2 Certified (suppressor)</td>
<td>CSA C22.2 Certified (suppressor)</td>
<td>CSA C22.2 Certified (suppressor)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Panelboards</th>
<th>Busway</th>
<th>Retrofit</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Features:</strong></td>
<td><strong>Features:</strong></td>
<td><strong>Features:</strong></td>
</tr>
<tr>
<td>■ CPS used extensively on branch panel boards for computer rooms, laboratories, schools, hospitals, industrial applications</td>
<td>■ Ideal for busway fed distribution systems</td>
<td>■ TVSS Filters can be externally mounted to existing distribution equipment</td>
</tr>
<tr>
<td>■ 200% rated neutral is provided for nonlinear loads</td>
<td>■ Easy to install CPS units, fit in standard bus plug assembly</td>
<td>■ Standard NEMA 12 enclosures</td>
</tr>
<tr>
<td>■ Cost effective branch protection (assumes main panel protection employed)</td>
<td>■ Full diagnostic and monitoring capabilities</td>
<td>■ Requires field installation</td>
</tr>
<tr>
<td>■ Isolates critical busway sections from nearby disturbance producing loads</td>
<td>■ Design for new &amp; existing facilities</td>
<td>■ Clipper Retrofit 100 to 400 kA/phase units</td>
</tr>
<tr>
<td>■ Designed for new &amp; existing facilities</td>
<td>■ Integral disconnect</td>
<td>■ Clipper VL 50 and 75 kA/phase units</td>
</tr>
<tr>
<td><strong>Safety Standards:</strong></td>
<td><strong>Safety Standards:</strong></td>
<td><strong>Safety Standards:</strong></td>
</tr>
<tr>
<td>UL 67 (Panelboards)</td>
<td>UL 675 (Busway)</td>
<td>UL 1285 (EMI/RFI Filter)</td>
</tr>
<tr>
<td>UL 1449 2nd Edition (Surge Suppressor)</td>
<td>UL 1449 2nd Edition (Surge Suppressor)</td>
<td>UL 1449 2nd Edition (Surge Suppressor)</td>
</tr>
<tr>
<td>UL 1283 (EMI/RFI Filter)</td>
<td>UL 1283 (EMI/RFI Filter)</td>
<td>UL 1283 (EMI/RFI Filter)</td>
</tr>
<tr>
<td>CSA C22.2 Certified (suppressor)</td>
<td>CSA C22.2 Certified (suppressor)</td>
<td>CSA C22.2 Certified (suppressor)</td>
</tr>
</tbody>
</table>

The CPS surge components can be integrated into Safety Switches, Automatic Transfer Switches (ATS) and other assemblies.
Engineers and specifiers now have the flexibility to select the required CPS model for any construction project, facility expansion, or retrofit application.

Clipper Model CPS-H - The standard offering for service entrance or high exposure locations.

Clipper Model CPS-S2 - For protecting large distribution panelboards or distribution switchboards, heavy equipment, or variable speed drives.

Clipper Model CPS-S - For protecting branch panelboards feeding sensitive electronic equipment.

Clipper Model CPS-B - An economical solution for protecting non-critical branch panels or panels with upstream TVSS protection and located deep within the facility.

Cutler-Hammer Clipper Power System Specifications
(Guide for applying the appropriate surge suppressor based upon life expectancy and performance.)

<table>
<thead>
<tr>
<th>CPS Models</th>
<th>CPS-B</th>
<th>CPS-S</th>
<th>CPS-S2</th>
<th>CPS-S3</th>
<th>CPS-H</th>
<th>CPS-H2</th>
<th>CPS-M</th>
<th>CPS-M3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surge Current Per Phase</td>
<td>100 kA</td>
<td>120 kA</td>
<td>180 kA</td>
<td>200 kA</td>
<td>250 kA</td>
<td>300 kA</td>
<td>400 kA</td>
<td>500 kA</td>
</tr>
<tr>
<td>Surge Current Mode</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L-N (Line-to-Neutral)</td>
<td>50 kA</td>
<td>60 kA</td>
<td>80 kA</td>
<td>100 kA</td>
<td>125 kA</td>
<td>150 kA</td>
<td>200 kA</td>
<td>250 kA</td>
</tr>
<tr>
<td>N-G (Neutral-to-Ground)</td>
<td>50 kA</td>
<td>60 kA</td>
<td>80 kA</td>
<td>100 kA</td>
<td>125 kA</td>
<td>150 kA</td>
<td>200 kA</td>
<td>250 kA</td>
</tr>
<tr>
<td>L-L (Line-to-Line, Delta, and Ungrounded Applications Only)</td>
<td>50 kA</td>
<td>60 kA</td>
<td>80 kA</td>
<td>100 kA</td>
<td>125 kA</td>
<td>150 kA</td>
<td>200 kA</td>
<td>250 kA</td>
</tr>
<tr>
<td>Single Pulse Surge Current Test</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Based on ANSI/IEEE C62.41 8x20 microsecond waveform</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Modes of Protection</td>
<td>All</td>
<td>All</td>
<td>All</td>
<td>All</td>
<td>All</td>
<td>All</td>
<td>All</td>
<td>All</td>
</tr>
<tr>
<td>3-Phase Wye System</td>
<td>7</td>
<td>7</td>
<td>7</td>
<td>7</td>
<td>7</td>
<td>7</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>3-Phase Delta System</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Failure Alarmation</td>
<td>(Based on MIL-STD-220A @ 100 kHz)</td>
<td>55 dB</td>
<td>65 dB</td>
<td>55 dB</td>
<td>65 dB</td>
<td>55 dB</td>
<td>65 dB</td>
<td>55 dB</td>
</tr>
<tr>
<td>Surge Withstand Capabilities</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ANSI/IEEE C3 Wave (10 kA)</td>
<td>8,000</td>
<td>9,000</td>
<td>10,000</td>
<td>11,000</td>
<td>12,000</td>
<td>13,000</td>
<td>14,000</td>
<td>15,000</td>
</tr>
<tr>
<td>SPD TR-Monitor™ System:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overcurrent Protection</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Thermal Detection</td>
<td>Optional</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Diagnostic Package</td>
<td>BD</td>
<td>SD</td>
<td>SD</td>
<td>SD</td>
<td>SD</td>
<td>SD</td>
<td>SD</td>
<td>SD</td>
</tr>
<tr>
<td>Direct Bus Bar Connection</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Warranty</td>
<td>10 Years</td>
<td>10 Years</td>
<td>10 Years</td>
<td>10 Years</td>
<td>10 Years</td>
<td>10 Years</td>
<td>10 Years</td>
<td>10 Years</td>
</tr>
</tbody>
</table>

*Optional sizes to meet competitive specifications.

All CPS have been independent tested to verify all suppressor components can survive published surge current ratings. Test documents are available upon request.

CPS Retrofit Ordering Guidelines

<table>
<thead>
<tr>
<th>Catalog #:</th>
<th>CPS</th>
<th>CH</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
</table>

CPS integrated assemblies can be ordered from your nearest Cutler-Hammer sales engineer or distributor.
Clipper Power System Family

Let through Voltage is the key performance measure for a suppression device. NEMA LS 1-1992 and ANSI/IEEE C62.41 & 45 recommend testing SPD using high energy combination waveforms (i.e. Cat. C3 & C1) and internally generated ringwave transients (i.e. Cat. B3). The CPS design offers superior performance on all ANSI/IEEE recommended waveforms because of our unique low impedance Surge Plane™, matched MOVs on each mode and phase, tuned suppression filter, and high quality construction/manufacturing process.

**Exceptional Let Through Performance**

**Test Surge Waveforms**

**CPS Let Through Ratings**

**Retrofit Installation Recommendations**

When installing a surge suppressor in a retrofit environment, it is important to mount the suppressor as close to the electrical equipment as possible, keep the wiring (lead length) between the electrical equipment and the suppressor as short as possible (less than 14 inches is recommended), and twist/wire tie the conductors to reduce inductive effects.

---

**Retrofit Installation Recommendations**

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In addition to the Clipper Power System family of products, Cutler-Hammer offers a complete line of surge protection devices designed for the industrial, commercial, automation, residential and telecommunication markets.

**The AEGIS Family of Surge Filters:**
Protection for PLCs and critical loads.

**Reflected Wave Trap (RWT):**
Protection for drives/motors against reflected wave spikes.

**Datacom Family of Surge Suppressors:**
For all telephone and data communication lines.

**Residential Package:**
Complete Home Surge Protector (CHSP) and Surge Trap surge strips.

Cutler-Hammer products are designed to provide facility-wide surge protection.
Cutler-Hammer is committed to the highest level of customer service. Our global strategy – with sales and manufacturing operations in strategic worldwide locations – is positioned to fulfill our customer’s needs, wherever they are located.

In North America we ensure quality service through:
- Main manufacturing facilities for distribution assemblies
- "Quick ship" local satellite locations specializing in panelboards/switchboards or Motor Control Centers

Main Manufacturing Plant Locations:
- Sumter, SC
- Grand Prairie, TX
- Fayetteville, NC
- Greenwood, SC
- Asheville, NC
- Airdrie, Alberta
- Calgary, Alberta
- Toronto, ON
- Oakville, Ontario
- Raleigh, NC
- San Juan, Costa Rica
- Rio de Janeiro, Brazil

Satellite Manufacturing Plant Locations:
- Atlanta, GA (2)
- Baltimore, MD
- Calgary, AB
- Chicago, IL (2)
- Cleveland, OH
- Dallas, TX
- Denver, CO (2)
- Halifax, NS
- Houston, TX (2)
- Los Angeles, CA (2)
- Montreal, PQ
- Portland, OR
- Orlando, FL
- Phoenix, AZ
- Windsor, CT (2)
- St. Louis, MO
- Seattle, WA
- Vancouver, BC

Internationally, we have sales and marketing representatives in the following countries:
- Argentina
- Chile
- Brazil
- Mexico
- Australia
- Philippines
- Venezuela
- United Kingdom
- Thailand
- Germany
- Korea
- Venezuela
- China
- Malaysia
- Singapore

Cutler-Hammer is a part of Eaton Corporation, is a leader in the development and manufacturing of power distribution equipment, electrical control products, and advanced industrial automation solutions.

For more information on Cutler-Hammer products and services, call 1-800-525-2000 or 1-616-982-1059. Or contact our web site at www.cutlerhammer.eaton.com