Bantam Clean Power

Surge Protector Test Results

Graphic Comparison of Bantam PP3002B with a Conventional Surge Protector UL1449 3rd Edition

www.bantamcleanpower.com

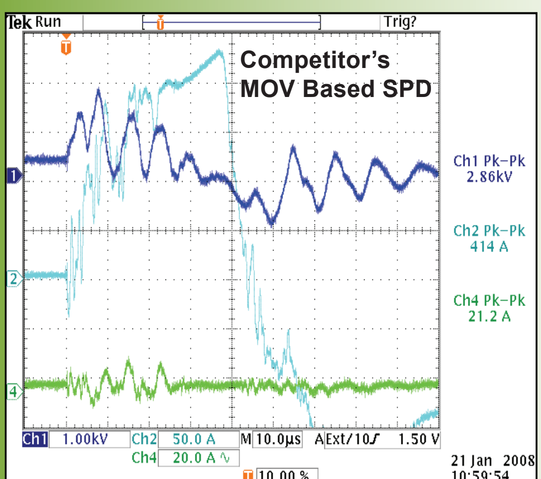
Professional Grade

Bantam Revolutionary Technology

The Patented Circuit

The patented Leveler circuit is revolutionary, providing unmatched transient protection, power filtering and harmonic attenuation. This circuit, licensed to Bantam Clean Power and Defense Protected Power Systems (DPPS), will absorb dangerous energy surges on Line, Neutral *and* Ground, then release the energy back into the circuit as safe usable energy. The circuit does not divert the energy pollution to ground where it can interfere with digital coding.

Bantam is a wave-shaping device, reducing the amplitude and stretching the wavelength of all non-fundamental frequencies. The technology does not rely on MOVs, is based on amperage, and the circuit can be scaled to any energy level. Bantam technology is never sleeping, working at surge inception so there is ***zero*** delay in protection. Short duration, high-energy pulses like lightning strikes, spikes, surges, and arc flash are extreme energy events the Bantam circuit will sense, delay and absorb, protecting the connected device.



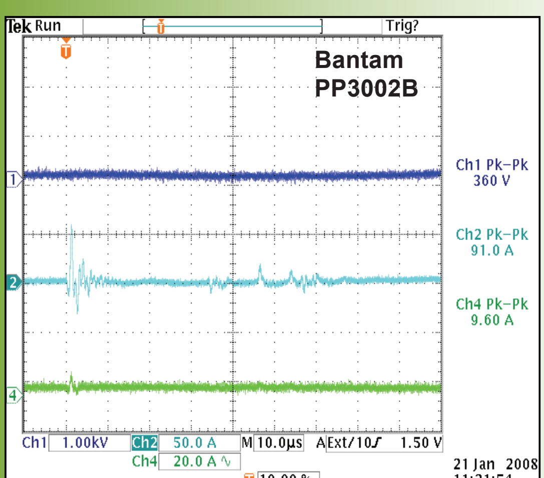
Joules Rating Limitations

Common MOV based products advertise their effectiveness using Joules as a proxy for how much energy can be dumped to ground before MOV failure. A Joules rating can be misleading when measuring surge events because it is affected by several variables. Manipulating the time period will significantly effect the a SPD's Joules rating. Since there is no industry standard, published Joules ratings may not accurately represent the ability of the surge protection device to limit surge damage.

Joules of energy tolerance before failure is not a very useful measure because it only tells the consumer how much energy a MOV suppressor can tolerate, not how much energy the MOV will let through to the protected device. MOVs do not respond instantaneously, so energy passes through the SPD to the protected device before the MOV's take effect. Once MOV's start diverting energy to ground, some portion of the harmful energy will still pass through to protected device.

A Better Measure

The point of surge protection is to keep harmful energy away from protected devices. A better measure compares the total surge destructive energy the SPD will experience to how much of that surge energy gets through to the protected device, the **Surge Residual Percent,** as the following formulas illustrate.



Surge Destructive Energy

SDE= Volts (Pk-Pk) x Amps (Pk-Pk) x Time (microseconds)

Surge Residual Percent, $SR(\%) = \frac{(SDE_{initial} - SDE_{suppressed})}{SDE_{initial}}$

Effective Surge Protection is a Surge Residual under 1%, keeping 99% of Destructive Energy from reaching protected devices.

UL1449 3rd Edition, the industry standard test for Surge Protection Devices, the device under test experiences a 6,000 volts, 3000 amp surge for 10 microseconds, or 180,000,000 total Destructive Surge Energy.

The graphs on the next page are screen shots of a comparison of the Bantam PP3002 to a competitor's widely used surge protector when tested under UL 1449 3rd Edition. This UL test subjects the two surge protection devices to a 10 micro second (µs), 6,000 volts and 3,000 amps surge at 45 second internals. This surge test is repeated every 45 seconds until the surge protection device fails.

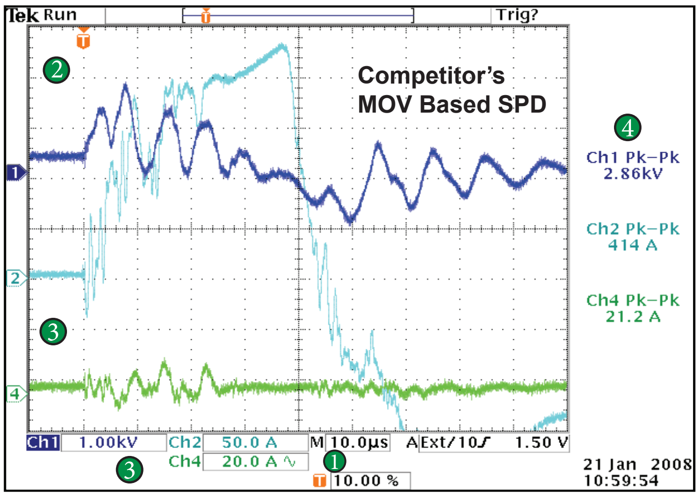
Graphic Comparison of Bantam PP3002B with a Conventional Surge Protector

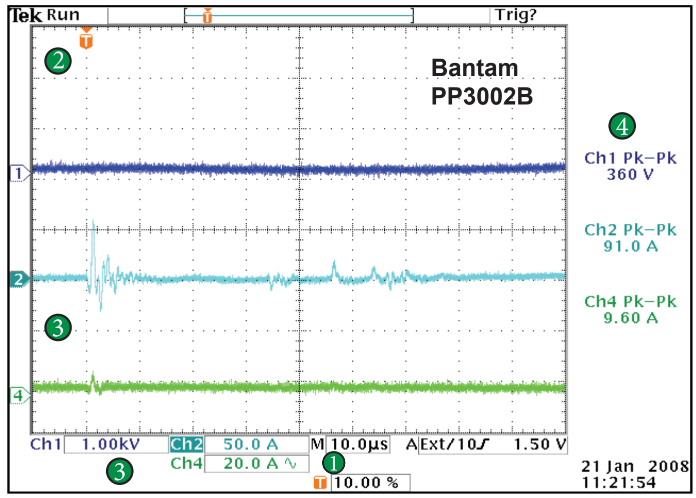
Tested under UL1449 3rd Edition

Continued

Understanding the Graphs

The graphs represent the amount of energy (starting at 6,000 volts and 3,000 amps) that passed through the surge protector onto the protected device. For these graphs, the surge was introduced in the second 1.0 µs interval to make the before and after surge comparison easier. The test set up for the competitors and the Bantam PP3002B surge protectors were identical as described in UL1449, 3rd Edition.





① The horizontal axis is time, each square represents 1.0 µs with a total of 10 µs displayed. ② The surge was injected into the units under test in the 2nd 1.0 µs interval. ③ The vertical axis is the energy level and represents a different scale depending on the type of energy being measured as noted in the legend at the bottom of each graph. Ch1 is volts, and each square in the vertical axis represents 1,000 volts. Ch2 is amps, and each square in the vertical axis represents 50 amps. Ch4 is amps on the ground, and each square in the vertical axis represents 20 amps. ④ The right margin of each graph shows the average Peak to Peak (Pk-Pk) value of the energy that passed through the surge protection device by channel, the energy that was not suppressed.

How to Compare Performance

This tests injected 6000V X 3000A X 9 µs = 162,000,000 Total Surge Destructive Energy into the each surge protector. In this test the surge was injected in the 2nd 0.1 µs interval to make the comparison easier. The average energy not suppressed and that passed through to the protected device can be characterized as the area under the above curves. This Pk to Pk value is similar to the Root Mean Squared (RMS) calculation common in wave-form evaluations. The Surge Destructive Energy calculations, SDE= (Pk-Pk) X Amps (Pk-Pk) X Time (µs), slightly understates the area under the curves but is a close approximation of the more complicated calculation. Taking the average Peak to Peak values from the graphs above, combining the Ch2 and Ch4 amp results into a single amp value, and applying them to this formula yields the following:

Competitor's Test Results

Ch1: 6,000 volts introduced, 2,860 volts were not suppressed,
Ch2: 3,000 amps introduced, 414 amps were not suppressed,
Ch4: 3,000 amps introduced, 21.2 amps were not suppressed.

2860 Volts X 435 Amps X 9 µs = 11,197,000 Surge Destructive Energy allowed to reach the protected device, or a **Surge Residual of 6.9%**. Significant suppression did not occur for 4 µs and energy continued to pass for all 9 µs. The remaining 93.1% was dumped to ground.

Bantam PP3002 Test Results

Ch1: 6,000 volts introduced, 360 volts were not suppressed.
Ch2: 3,000 amps introduced, 91 amps were not suppressed.
Ch4: 3,000 amps introduced, 9.6 amps were not suppressed.

360 Volts X 100.6 Amps X 9 µs = 325,944 Surge Destructive Energy allowed to reach the protected device, or a **Surge Residual of only 0.2%**. No delay in suppression. The remaining 99.8% was absorbed and released back into the power system as clean usable energy.

The Bantam with Leveler Technology met the 1% Surge Energy Residual threshold easily, allowing only 0.2% energy through, suppressing 99.8% of the Surge Energy. The competitor's unit had a typical Joules rating but blocked only 93.1% of the surge energy, allowed almost 7% of the surge energy pass to the protected device. In addition, a typical MOV based SPD can only tolerate a handful of surges of this magnitude before MOV failure. The Bantam doesn't fail, tolerating 6000 volts, 3000 amps surges every 45 seconds for 24 hours before the test was halted. The Bantam filters Line, Neutral and Ground, does not dump surge energy to ground and after over 1800 surges, no protection delay, no damage to the protected device, and no loss of Bantam effectiveness. Bantam products have a life-time warranty.

Total Surge Protection
<1%
<1% Surge Residual

Surge Residual is how surge protection should be measured.