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# **Power Conditioner & Electronic Power Conditioner Testing Report**

**Prepared for  
Smart Power Systems**

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## Power Conditioner Testing

### Background

Smart Power Systems retained PowerCET Corporation to test and verify the performance of their electronic power conditioners and of several other power conditioning products. Tests performed on the products included:

- Surge voltage testing with ANSI/IEEE C62.41-1991 waveforms -- The surge voltages were generated with a KeyTek model 711 surge generator. Surge voltages were applied normal mode (L/N) and common mode (N/G). All test pulses were category A ringwaves (6kV L/N & 3kV N/G). This test verifies withstand and voltage let-through.
- Momentary over-voltages -- 150% over-voltages were generated with a Power Science line disturbance simulator. Three second over-voltage events were applied to the devices and the output voltages were recorded with a Dranetz 658 power monitor. The monitor simultaneously recorded the voltage at the input and output of various power protection devices.
- Wiring problems -- Open ground and line/neutral reversals were applied to the products. The output electrical conditions were visually checked with light bulbs and multimeters. The wiring problems reflect conditions that are commonly found in residential and commercial facilities.

Products included in the testing:

- Smart Power Systems — Smart Cord\* — model UTBF07SG-120
- Smart Power Systems — Digital TBF POS Guardian\* — model TBF15P-1121TN
- Oneac—ONEGround — model PC180AG
- Powervar — GroundGuard — model ABCEG152-11

\* Electronic Power Conditioner

### Synopsis of test results

- Surge voltage Testing: All products maintained L/N voltage differentials below 10 volts and N/G voltage differentials below 0.5 volts.
- Over-voltage Testing: The Smart Power products removed output power when applied voltages exceeded preset limits and automatically reset when applied voltage returned to normal levels. The other products passed the over-voltage conditions through to their outputs.
- Wiring Faults: The Smart Power products removed power for their outputs with open ground and with line/neutral reversals. The other products provided visual warning lights but maintained output voltages.

## Surge Tests

### Background

The power conditioning products were tested with standard ANSI/IEEE C62.41-1991 waveforms generated with a KeyTek model 711 surge generator. Surge voltages were applied normal mode (L/N) and common mode (N/G). All test pulses were category A ringwaves (6kV L/N & 3kV N/G).

Products included in the testing are:

- Smart Power Systems — Smart Cord
- Smart Power Systems — Digital TBF — POS Guardian
- Oneac — ONEGround
- Powervar — GroundGuard

Differential let-through voltages were measured with a Tektronix digital storage oscilloscope. L/N measurements were performed with differential Tektronix scope probes and a high pass filter. The high pass filter was used solely to remove the 60 Hz waveform and passes signals above 10kHz. N/G tests were performed with differential 50 Ohm coaxial cables and low pass filter. The low pass filter passes signals up to 4MHz.

### Numeric test results

**Table 1 – Synopsis of numeric test results.**

<b>6 kV Normal Mode (L/N applied test pulse &amp; L/N measured differential voltage)</b>			
	<b>Volts Peak-to-Peak</b>	<b>Vmax</b>	<b>Vmin</b>
Smart Power Smart Cord	4.40	1.70	-2.70
Smart Power POS Guardian	12.8	9.8	-3.0
Oneac ONEGround	7.30	3.20	-4.10
Powervar GroundGuard	12.6	8.0	-4.60
<b>3 kV Common Mode (N/G applied test pulse &amp; N/G measured differential voltage)</b>			
Smart Power Smart Cord	0.680	0.390	-0.290
Smart Power POS Guardian	0.180	0.390	0.210
Oneac ONEGround	0.550	0.270	-0.280
Powervar GroundGuard	0.660	0.400	-0.260

## Smart Power Smart Cord



Photo 1 – Smart Power Systems Smart Cord (Electronic Power Conditioner) Model: UTBFSG07-120

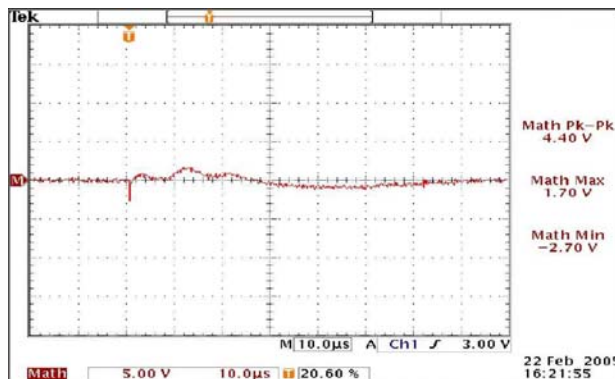


Figure 1: Smart Power - Smart Cord  
Line/Neutral Let-through

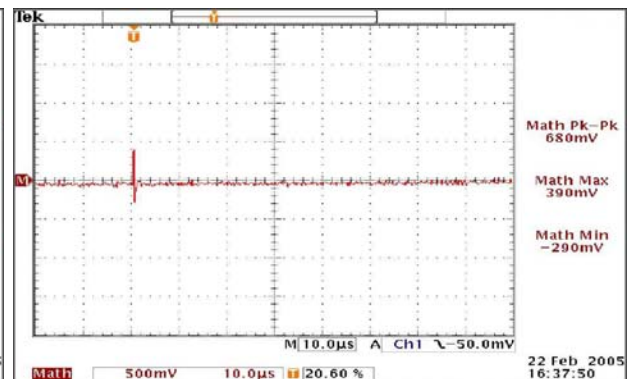


Figure 2: Smart Power - Smart Cord  
Neutral/Ground Let-through

## Smart Power POS Guardian



Photo 2 - Smart Power Systems TBF15 POS Guardian (Electronic Power Conditioner) Model: TBF15P-1121TN

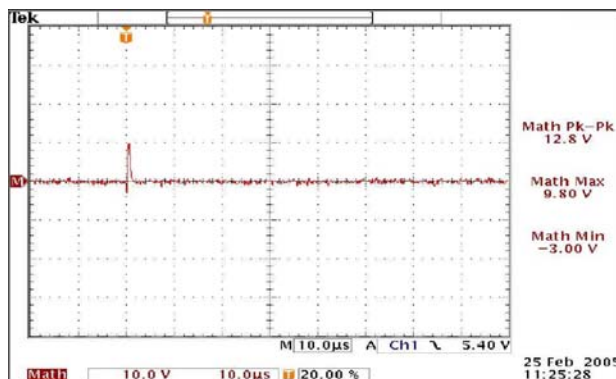


Figure 3: Smart Power - POS Guardian Line/Neutral Let-through

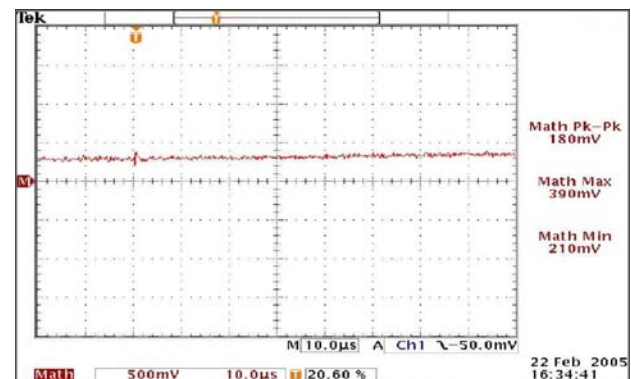


Figure 4: Smart Power - POS Guardian Neutral/Ground Let-through

## Oneac ONEGround



Photo 3 – Oneac Power Conditioner with ONE Ground Model: PC180AG

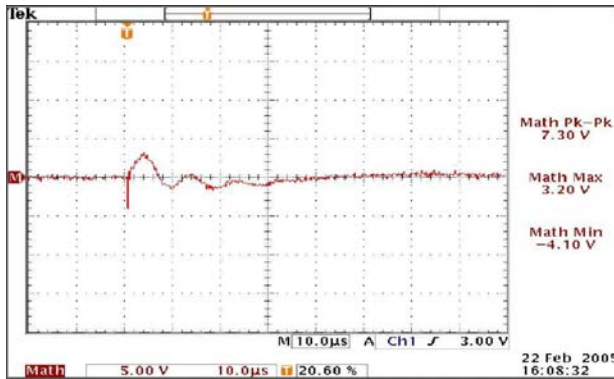


Figure 5: Oneac ONEGround Line/Neutral Let-through

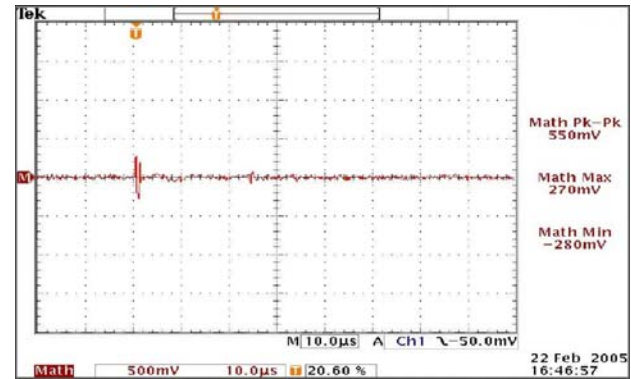


Figure 6: Oneac ONEGround Neutral/Ground Let-through

## Powervar GroundGuard



Photo 4 – Powervar Power Conditioner with Ground Guard Model: ABCG152-11

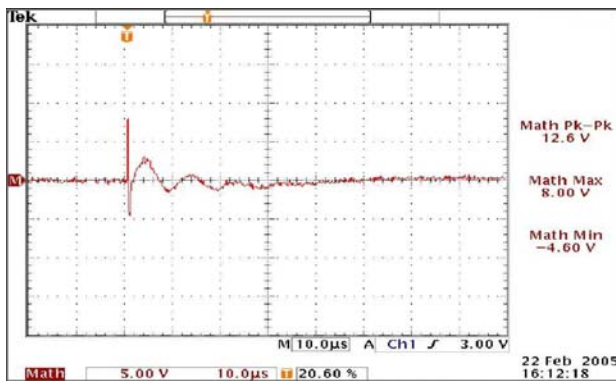


Figure 7: Powervar GroundGuard  
Line/Neutral Let-through

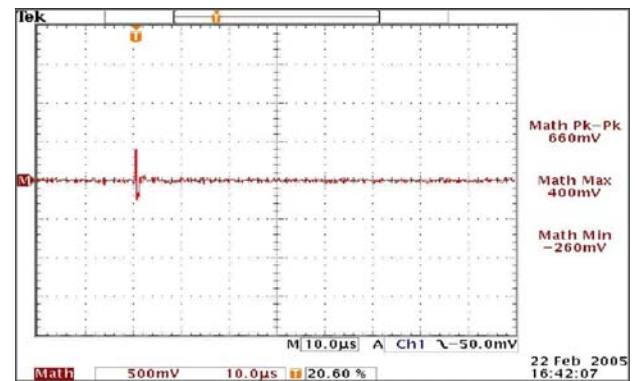


Figure 8: Powervar GroundGuard  
Neutral/Ground Let-through

## Over-Voltage Tests

### Background

The power conditioning products were tested with momentary over-voltage. A Power Science line disturbance simulator generated three second over-voltage events. A Dranetz 658 power monitor recorded the voltage at the input and output of various power protection devices.

Products included in the testing are:

- Smart Power Systems – Smart Cord
- Smart Power Systems – Digital TBF – POS Guardian
- Oneac — ONEGround
- Powervar — GroundGuard

### Monitor Setup

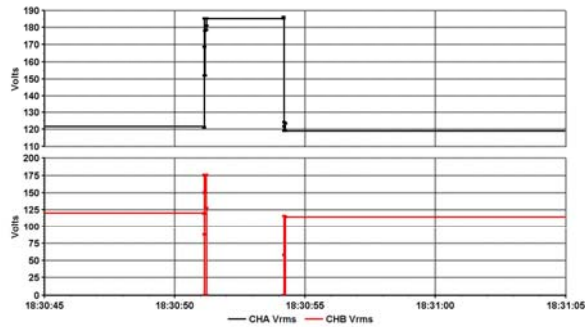
- ChA = voltage input to protection device
- ChB = voltage output from protection device

### Test results

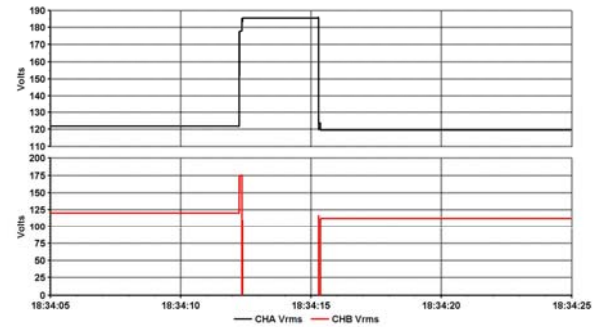
- Smart Power – Smart Cord: Removes over-voltage from output 100mS after voltage reaches high limits and returns voltage automatically when voltage returns to normal levels.
- Smart Power – Digital TBF – POS Guardian: Removes over-voltage from output 100mS after voltage reaches high limits and returns voltage automatically when voltage returns to normal levels.
- Oneac ONEGround: Passes over-voltage event through to output. <sup>[1]</sup>
- Powervar GroundGuard: Passes over-voltage event through to output. <sup>[1]</sup>

<sup>[1]</sup> Sustained over-voltage conditions can cause failure of components in the protection device as well as the connected load.

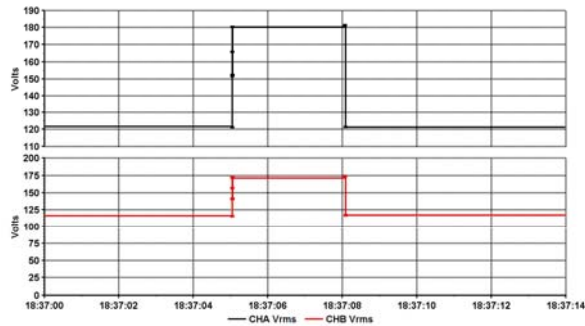




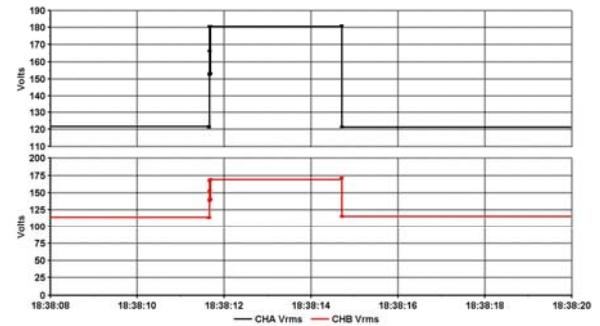
**Figure 9: Smart Power Smart Cord – Over-voltage test**



**Figure 10: Smart Power POS Guardian – over-voltage test**



**Figure 11: PowerVAR GroundGuard – over-voltage test**



**Figure 12: Oneac ONEGround – over-voltage test**

## Wiring Fault Tests

### Background

The power conditioning products were tested with two types of wiring problems commonly found in residential and commercial facilities: Open ground and line/neutral reversal. Ideally, a protection device should disable the output if severe wiring problems are present.

Products included in the testing are:

- Smart Power Systems – Smart Cord
- Smart Power Systems – Digital TBF – POS Guardian
- Oneac — ONEGround
- Powervar — GroundGuard

**Table 2 - Wiring problems**

<b>Wiring Problem: Open Ground</b>		
	<b>Indicator Status</b>	<b>Output Voltage</b>
Smart Power POS Guardian	Red light	Disabled
Smart Power Smart Cord	Red light	Disabled
Powervar GroundGuard	Flashing red ground light	Voltage Present
Oneac ONEGround	Red light - wiring fault	Voltage Present
<b>Wiring Problem: Line/neutral reversed</b>		
Smart Power POS Guardian	Red light	Disabled
Smart Power Smart Cord	Red light	Disabled
Powervar GroundGuard	Green light	Voltage Present
Oneac ONEGround	Red light - wiring fault	Voltage Present