Test Report for

Qualification Testing

Performed on an

Electrical Protective Technology Device

Issue Date: March, 12, 2018

Prepared for: **Digilant**
4767 E. Wesley Drive
Anaheim, CA 92807

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SIGNATURES

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Revision Log

Revision #	Description	Date
0	Original Copy	1/15/2018
1	Integrated customer edditorial comments	3/12/2018

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1.0 ADMINISTRATIVE DATA

1.1 Purpose of Tests

The purpose of this test was to characterize the Bantam's ability to suppress externally coupled RF signals onto the input power lines of a product. The CS114 Conducted Immunity test method specified by MIL-STD-461 (Requirements for the control of electromagnetic interference characteristics of subsystems and equipment) for military platforms was used as guidance. This test is intended to represent the typical or expected unwanted RF noise characteristics coupled onto power and signal lines from external sources present at the installation environment. Products undergoing the CS114 test are generally monitored for degraded performance and are required to pass the test without damage or need for manual intervention. The CS114 threat level (in terms of induced RF current) will vary dependent on the platform location. Therefore, a susceptibility risk can exist where a product was tested to a lesser threat level than actually installed and operated in. In these cases, supplemental RF protection may be required. However, the amount of protection needed is dependent on the delta between the level tested, and the actual platform threat plus a reliability factor. This modified test was intended to show the amount of coupled RF suppression the Bantam SPD will provide an inline product.

1.2 Description of Test Item

The DPU4 is a single phase 115VAC 3 Amp power outlet surge protection device manufactured by Digilant/Lodestone, but is branded by DPPS. The DPU4 uses a unique patented Leveler Technology to provide unsurpased transient spike and surge suppression as well as bi-directional electromagentic interference filtering.
The DPU4 has been approved for DOD internet power and security applications ("Meets Requirements of 2-95 Red-Black Engineering Guide for protection of classified and unclassified infrastructure").

1.3 Manufacturer

Digilant
4767 E. Wesley Drive
Anaheim, CA 92807

1.4 References

- Digilant Purchase Order No. 1011477 Dated 10/24/2017
- NTS quotation OP0234871 Dates 10/24/2017

- ANSI/NCSL Z540.3:2007, "Calibration Laboratories and Measuring and Test Equipment, General Requirements"
- Leveler Surge Protection Device (SPD) Test Plan dated 09/04/2015, Initial Release
- DI-EMCS-80200C, "Data Item Description for an Electromagnetic Interference Test Report (EMITR)"
- ISO 10012:2003, "Quality Assurance Requirements for Measuring Equipment"

1.4 References (Continued)

- ISO/IEC 17025:2005, "General Requirements for the Competence of Test and Calibration Laboratories"

1.5 Quantity of Items Tested

Table 1-1 Test Item

Quantity	Test Item Description	Part Number	Serial Number
1	Single phase AC power outlet surge protection device	550-PP4004A	1107-5-0027

1.6 Security Classification

Unclassified

1.7 Tests Conducted By

National Technical Systems
Plano Facility
1701 E. Plano Pkwy
Plano, TX 75074

1.8 Standard Test Conditions

Unless otherwise specified herein, all tests was performed at the following standard ambient conditions:

- Temperature: 60ºF ± 20ºF (15ºC ± 11ºC)
- Relative Humidity: 20% to 80%
- Atmospheric Pressure: 30 ± 2 inches-Hg (76 ± 5cm – Hg)

1.9 Test Equipment and Instrumentation

All instrumentation, measuring, and test equipment used in the performance of this test program was calibrated in accordance with NTS Plano Quality Assurance Program which complies with the requirements of ISO/IEC 17025:2005. Standards used in performing all calibrations are traceable to the National Institute of Standards and Technology (NIST) by report number and date. When no national standards exist, the standards are traceable to international standards or the basis for calibration is otherwise documented.

1.10 Test Tolerances

Test tolerances are used to maintain reasonable controls for obtaining consistent measurements. This tolerance should not be mistaken for measurement uncertainty.

Unless otherwise specified herein, the following tolerances were used:

- Time: ± 5%
- Temperature: ± 3.6°F (± 2°C)
- Relative Humidity: ± 5%
- Distance: ± 5%
- Frequency: ± 2%
- Amplitude, Measurement Receiver: ± 2dB
- Total Amplitude Measurement System: ± 3dB
  (Includes receivers, cabling, and transducer components)

1.11 Quality Assurance

All work performed on this program was in accordance with NTS Corporate Quality Policy Manual, Current Revision.

1.12 Source Inspection

NTS Plano QA

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2.0 TEST SUMMARY

The test program consisted of the tests listed in Table 2-1. Test performed in Sections 5 and 6

Table 2-1 Test Summary

Section	Test ID	Test Description	Requirements
3.4	Receipt Inspection	An inspection was performed upon receipt of the EUT at NTS Plano.	The EUT was checked to ensure that it was as described. Additionally, the EUT was visually inspected for any physical damage.
4.0	Conducted Immunity	Conducted Immunity	To evaluate the ability to suppress externally coupled RF signals onto input power lines.

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3.0 EUT INFORMATION

3.1 EUT Description

The test item is a single phase AC power outlet surge protection device, as indicated in Figure 3-1.

Figure 3-1 Electrical Protective Technology Device

3.2 EUT Support Equipment

No support equipment was required for this evaluation

3.3 EUT Test Setup

The EUT was configured in accordance with Leveler Surge Protection Device (SPD) Test Plan dated 09/04/2015, Initial Release, and/or as modified by the customer's instructions.

1. The EUT installation and operation was verified prior to start of testing.

2. The EUT physical layout was performed by NTS Plano personnel in accordance with the Leveler Surge Protection Device (SPD) Factory Acceptance Test Plan.

3.4 Receipt Inspection

On receipt of the EUT, NTS Plano personnel performed a visual receiving inspection for any damage that may have occurred during shipment. The results were recorded on the Receiving Inspection Form. This form was used to record part number(s), serial number(s), and description(s) of the EUT, quantity received, the date and documentation of any apparent physical damage that may have occurred during shipment of the EUT.

3.5 Test Setup

Test setup was assembled in accordance with Leveler Surge Protection Device (SPD) Factory Acceptance Test Plan as applicable to the associated test being performed.

3.6 Test Methods

All tests were conducted in accordance with the test methods specified per Leveler Surge Protection Device (SPD) factory acceptance test plan except where otherwise specified by the details as indicated from the customer.

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4.0 CONDUCTED IMMUNITY TEST MEASUREMENTS

4.1 Purpose

The purpose of the test was to determine the level of RF suppression the Bantam SPD will provide the protected equipment from unwanted coupled RF noise.
According to MIL-STD-461 Test method CS114, the forward power used to achieve the required injected current level into a 50 ohm environment is recorded then applied as a "not to exceed" level during the actual cable test. For high impedance lines, forward power would be reached before the test current level. Induced current is also monitored as a means to avoid applying excessive current where low impedance lines are tested.

This test method was modified to establish a reference current taken without the Bantam in place, then to play back the recorded settings with the Bantam inline to determine the level of signal attenuation. A reference current was established in a 50 ohm environment, and the signal settings were merely played back with and without the Bantam device installed on the line under test.

4.2 Requirements

The requirement of this test was to measure the RF suppression characteristics of the Bantam SPD.

4.3 Test Equipment

The test equipment required for this test is listed in Table 4-1.

Table 4-1 Conducted Immunity Test Equipment

Asset#	Description	Calibration Date
WC021591	Rhode & Schwarz SME03 Signal Generator	11/20/2018
WC020082	HP 8594E Spectrum Analyzer	4/12/2018
WC021610	HP 8595E Spectrum Analyzer	8/1/2019
WC021428	IFI 5000/28/40 Amplifier	NCR
WC021266	Solar 9144-1N Injection Probe	NCR
WC021265	Solar 9142-1N Injection Probe	NCR

WC021049	FCC F-55 Current Probe	6/22/2018
WC021587	HP 33120A Function generator	6/7/2019
WC021098	Weletone Dual Directional Coupler	NCR
WC021522	Solar 9125-1 Calibration Jig	NCR
WC020928	Solar 9125-1 Calibration Jig	NCR
WC020992	Termiline 8135 Coaxial Resistor	NCR
WC021803	FCC FCC-LISN-50-50-1-02 LISN	9/11/2018
WC038466	FCC FCC-LISN-50-50-1-02 LISN	12/15/2017
WC020079	Fluke 375 True RMS Clamp Meter	12/15/2017
WC021522	Solar 9125-1 Calibration Jig	NCR

4.4 Calibration (Measurement System Check)

The self-calibration routine was performed on the conducted immunity test equipment prior to conducting measurements.
The test equipment was configured per Figure 4.4-1. The injection probe was placed around the power cable connected between the Line Impedance Stabilization Networks (LISN) and the simulated load. A current monitoring probe was placed around the power cable between the injection probe and the simulated load. Sufficient space between the current monitor and injection probe was required for insertion of the Bantam SPD.

The check proceeded as follows:

1. A simulated resistive load of 2.9 amperes was turned on and sufficient time shall be allowed for stabilization. The load consisted of four 80 Watt incandescent light bulbs wired in parallel.
2. The signal generator was set to 10 kHz, unmodulated.
3. The applied signal was set to 110 dBuA and scanned across the test frequency range of 10 kHz to 200 MHz.
4. Receiver A recorded the induced current into the simulated load. The amount of induced current is based upon the impedance of the line under test and its variance from the assumed 50 ohm environment. For example, induced current will be reduced where the line impedance exceeds 50 ohms, and will increase where line impedance falls below 50 ohms.

4.5 Test Measurement

The Bantam SPD was installed between the injection probe and the current monitoring clamp as shown in Figure 4.4-2.

1. A simulated resistive load of 2.9 amperes was turned on and sufficient time shall be allowed for stabilization. The load consisted of four 80 Watt incandescent light bulbs wired in parallel.
2. The signal generator was set to 10 kHz, unmodulated.
3. The applied signal was set to 110 dBuA and scanned across the test frequency range of 10 kHz to 200 MHz.
4. Receiver A recorded the induced current into the simulated load through the Bantam SPD. The amount of induced current is based upon the impedance of the line under test and its variance from the measurement taken without the Bantam inline.

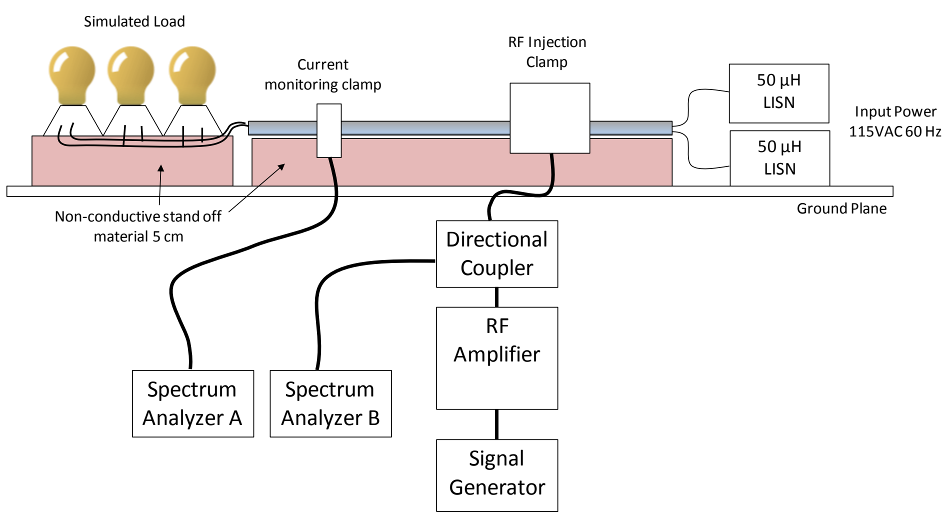

Figure 4.4-1 Conducted Immunity Calibration Setup

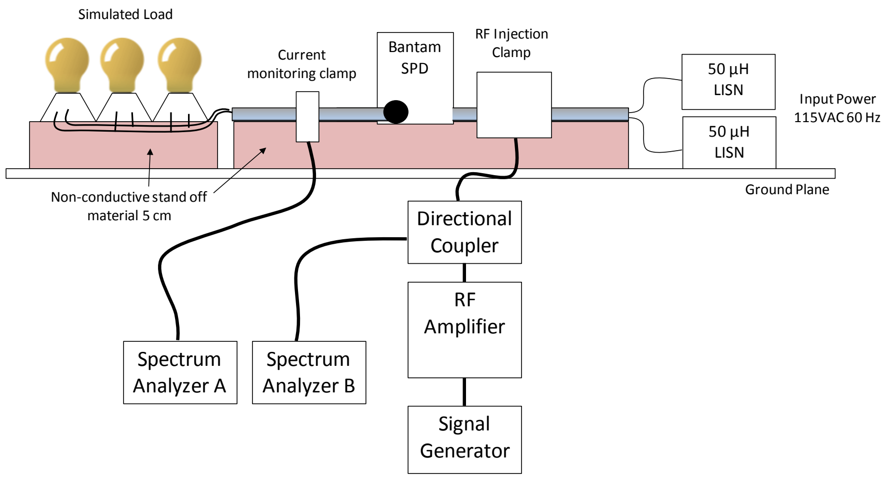

Figure 4.4-2 Conducted Immunity Test Setup

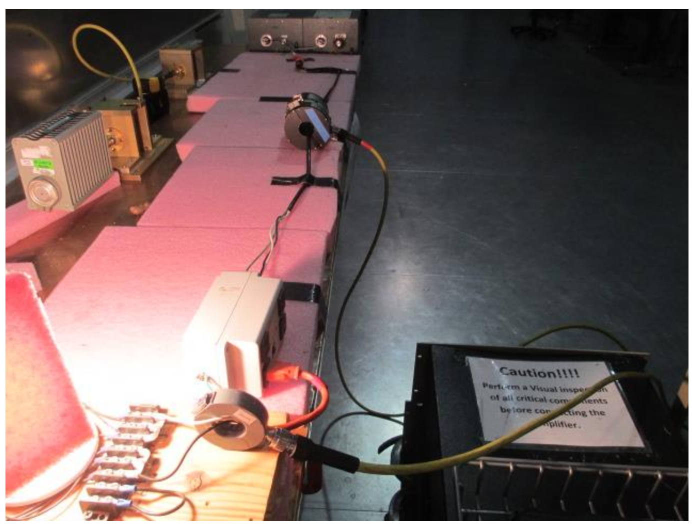

Figure 4.4-3 Conducted Immunity Test Setup photograph#1

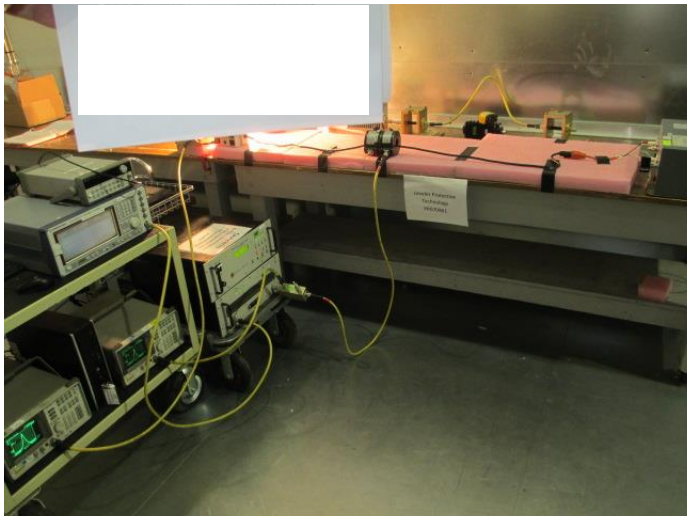

Figure 4.4-4 Conducted Immunity Test Setup photograph#2

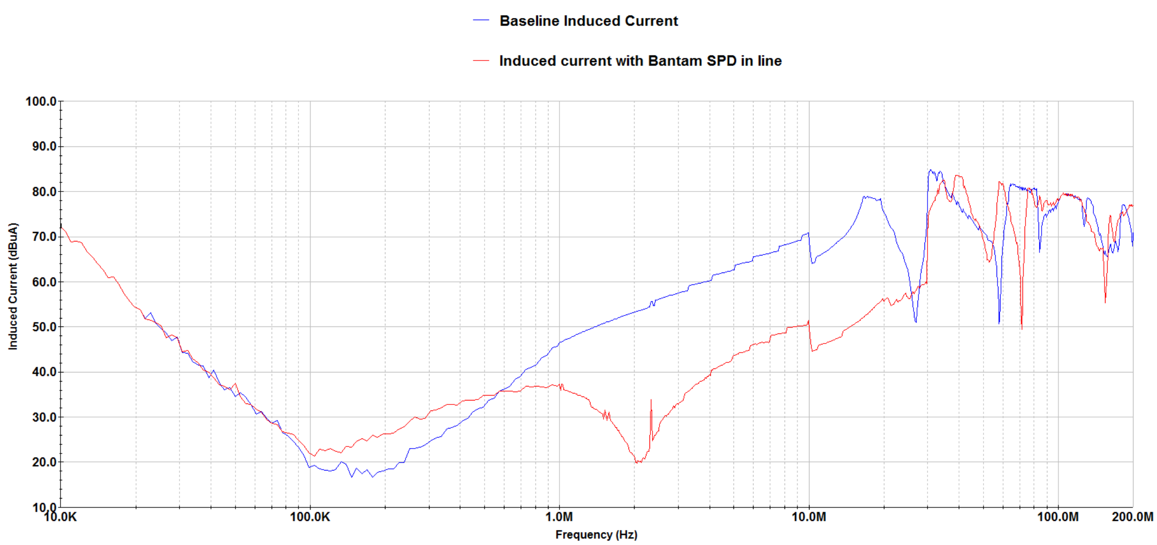

Figure 4.4-5 Conducted Immunity Induced Current mA

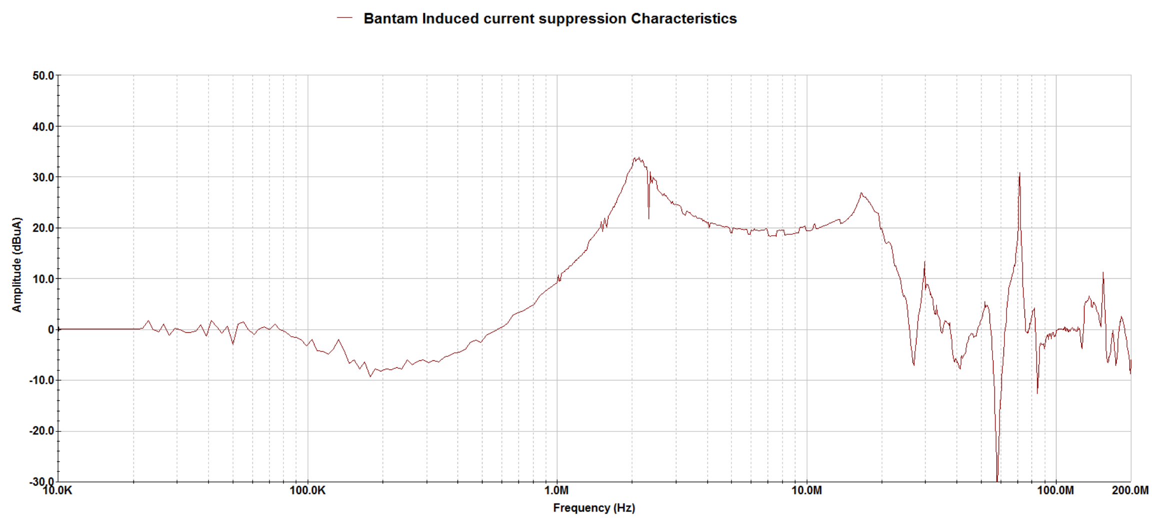

Figure 4.4-6 Bantam Induced current suppression Characteristics

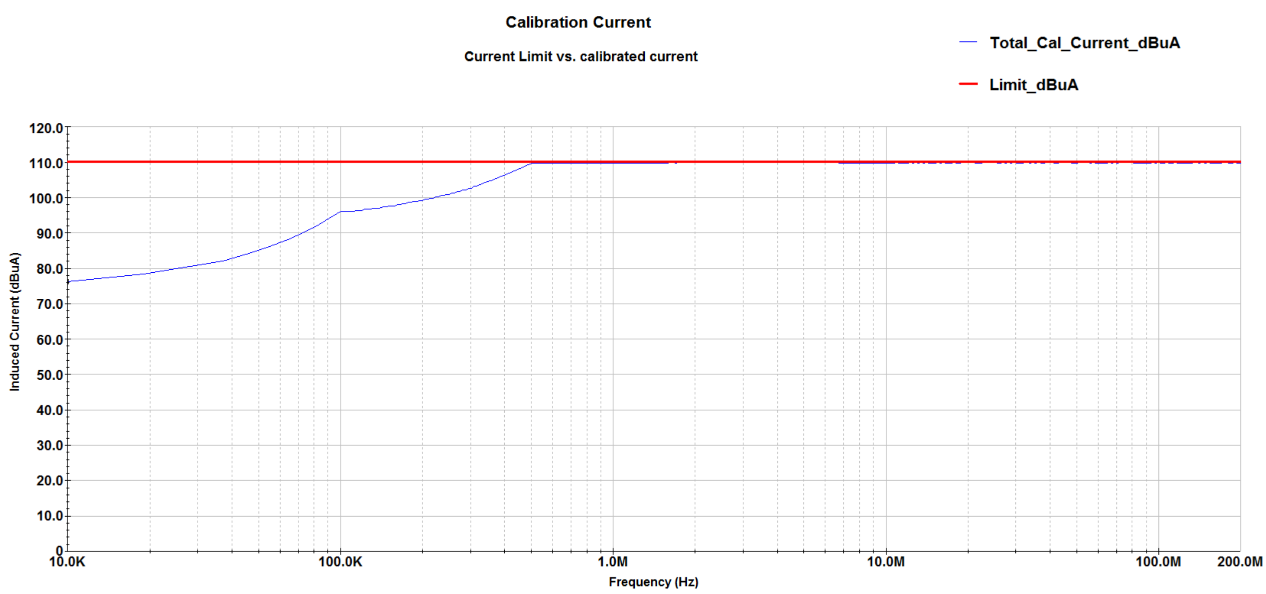

Figure 4.4-7 Calibration Current performed into 50 ohms

4.6 Test Results

The Bantam SPD demonstrated significant suppression characteristics in the 1 MHz to 20 MHz frequency spectrum. As shown in Figure 4.4-6, the Bantam shows at least 20 dB of suppression from 1.5 MHz to 20 MHz with a peak of approximately 34 dB at 2.2 MHz, and 26 dB at 16 MHz. This frequency band is commonly known to contain the majority of problematic EMI noise sources in nearly every industry platform. The Bantam’s ability to provide 20 dB of common mode noise suppression will reduce an interfering signal amplitude by a factor of 10 times, not only improving a product’s RF susceptibility threshold, but potentially extending product life expectancy.

END OF REPORT