



TEST SERVICES

TEST REPORT #: Q03465

DATE: September 18, 2003

TITLE: Electromagnetic Immunity Tests of the Smart UPS RT Transformer

MODEL: SURT001 and SURT002

SERIAL NUMBER: Proto 2

STANDARDS:

EN50091-2, Uninterruptable Power Systems (UPS)

EN61000-4-1, 1994, Testing and Measurement Techniques

EN61000-4-2, Electrostatic Discharge

EN61000-4-3, Radiated Electromagnetic Fields

EN61000-4-4, Electrical Fast Transient/Burst

EN61000-4-5, Surge Immunity Requirements

EN61000-4-6, Conducted Disturbances Induced By Radio-Frequency Fields

EN61000-4-8, Power Frequency Magnetic Field Immunity Test

EN61000-4-11, Voltage Dips, Short Interruptions and Voltage Variations

IEC 1000-2-2, Compatibility levels for low-frequency conducted disturbances and signaling in public low-voltage supply systems

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TABLE OF CONTENTS

<u>Title</u>	<u>Page</u>
<u>SECTION 1 OVERVIEW</u>	3
1.1 Purpose of Test.....	3
1.2 Dates of Test.....	3
1.3 Summary of Test Results.....	3
<u>SECTION 2 REFERENCES</u>	4
2.1 Procedures/Standards.....	4
<u>SECTION 3 DETAILS</u>	4
3.1 Description of Product.....	4
3.2 Test Software/Operating Mode.....	4
3.3 Laboratory Test Configuration	4
3.4 Pictures	7
<u>SECTION 4 CONCLUSIONS</u>	13
4.1 Test Results.....	13
4.2 Special Notes.....	15
4.3 Required Compliance Modifications.....	16
<u>APPENDIX A EMI EMISSIONS and IMMUNITY TEST FORM</u>	17
<u>APPENDIX B QUEST CREDENTIALS</u>	22

SECTION 1 OVERVIEW**1.1 Purpose of Test**

To determine if the Smart UPS RT Transformer will meet the following immunity requirements:

EN50091-2, Uninterruptable Power Systems (UPS)
 EN61000-4-2, Electrostatic Discharge (ESD), 4 kV contact discharge, 8 kV air discharge, 4 kV Horizontal and Vertical Coupling Planes (HCP and VCP respectively)
 EN61000-4-3, Radiated Electromagnetic Fields, 3 V/m, 80-1000 MHz
 EN61000-4-4, Electrical Fast Transient/Burst (EFT), 1 kV mains, 0.5kV on data cables
 EN61000-4-5, Surge Immunity Requirements, 2 kV on mains
 EN61000-4-6, Conducted Immunity Requirements, 3 V on mains and data cables, .15 - 80 MHz.
 EN61000-4-8, Power Frequency Magnetic Field Immunity Test, 3A/m
 EN61000-4-11, Voltage Dips, 30% for 25 periods, Short Interruptions 95% for 250 periods and 100% for ½ period
 IEC 1000-2-2, Compatibility levels for low-frequency conducted disturbances and signaling in public low-voltage supply systems

1.2 Dates of Test

September 11 to September 16, 2003

1.3 Summary of Test Results

<u>Test</u>	<u>Result</u>	<u>Comments</u>
EN61000-4-2 Air Discharge	PASSED	
EN61000-4-2 Contact Discharge	PASSED	
EN61000-4-2 HCP	PASSED	
EN61000-4-2 VCP	PASSED	
EN61000-4-3	PASSED	
EN61000-4-4	PASSED	
EN61000-4-5	PASSED	
EN61000-4-6	PASSED	
EN61000-4-8	PASSED	
EN61000-4-11	PASSED	
IEC 1000-2-2	PASSED	

All of the above tests meet or exceed the required levels of EN50091-2. Refer to Section 4.0 for Test Result details.

SECTION 2 REFERENCES

2.1 Procedures/Standards

- EN61000-4-1, 1994, Testing and Measurement Techniques
- ° EN50091-2, Uninterruptable Power Systems (UPS)
 - ° EN61000-4-2, 1995, First Edition, Electrostatic Discharge
 - ° EN61000-4-3, 1995, Radiated, radio-frequency, electromagnetic field immunity test
 - ° EN61000-4-4, 1988, Electrical Fast Transient Burst
 - ° EN61000-4-5, 1995, Surge Immunity Test
 - ° EN61000-4-6, 1996, Conducted disturbances induced by radio-frequency fields - immunity test
 - ° EN61000-4-8, 1993, Power Frequency Magnetic Field Immunity Test
 - ° EN61000-4-11, 1994, Voltage dips, short interruptions and voltage variations immunity tests
- IEC 1000-2-2, 1990, Compatibility levels for low-frequency conducted disturbances and signaling in public low-voltage supply systems

SECTION 3 DETAILS

3.1 Description of Product

The Equipment Under Test (EUT) consisted of the Smart UPS RT Transformer. Model SURT002. The SURT001 is the same unit with a lower current rating.. The voltage supplied to the EUT was 230 VAC, 50 Hz. The voltage supplied to the support equipment was 120 VAC, 60 Hz.

The specific EUT information is listed in Appendix A.

3.2 Test Software/Operating Mode:

No software required/The EUT was tested with the UPS operating in the "Full Load Charging" mode as pre-scans of both Radiated and Conducted emissions demonstrated this to be worse case.

3.3 Laboratory Test Configuration

Test Equipment:

<u>MANUF.</u>	<u>EQUIPMENT</u>	<u>MODEL</u>	<u>SERIAL #</u>	<u>CAL. FREQ.</u>	<u>DUE</u>
GENERAL	TEST EQUIPMENT:				
HP	SPECTRUM ANALYZER	8568B	2634A02760	12 MONTHS	4/04
MARCONI	SIGNAL GENERATOR	2022D	119233/005	12 MONTHS	2/04
FISCHER	CURRENT PROBE	F-42	167	12 MONTHS	12/03
TANDY	THERMO & HYGRO.	63-855		12 MONTHS	04/04

<u>MANUF.</u>	<u>EQUIPMENT</u>	<u>MODEL</u>	<u>SERIAL #</u>	<u>CAL. FREQ.</u>	<u>DUE</u>
RADIATED	TEST EQUIPMENT:				

PANASHIELD	FERRITE CHAMBER	N/A	EMI#1	12 MONTHS	09/03
KALMUS	RF AMPLIFIER	757LCB-CE	7762-1	NO CAL NEEDED	
WANDEL & GOLTERMANN	FIELD SENSOR	EMR-200	2240/21	24 MONTHS	10/03
WANDEL & GOLTERMANN	PROBE	Type 8.2	0099	24 MONTHS	10/03
HP	POWER METER	436A	1803A0337 6	NO CAL NEEDED	
HP	POWER SENSOR	8482A	US3729293 3	NO CAL NEEDED	
WERLATONE	DIRECTIONAL COUPLER (HIGH)	C1500	7236	NO CAL NEEDED	
WERLATONE	DIRECTIONAL COUPLER (LOW)	C3908	7192	NO CAL NEEDED	
EMCO	BICONICAL (EMS)	3109	2314	NO CAL NEEDED	
EMCO	LOG PERIODIC (EMS)	3146	9203-3378	NO CAL NEEDED	

CONDUCTED	TEST EQUIPMENT:				
FISCHER	CDN	FCC-801-M3- 25	100	12 MONTHS	10/03
FISCHER	CDN	FCC-801-M2- 32	101	12 MONTHS	10/03
FISCHER	CDN	FCC-801-M1- 25	29	12 MONTHS	10/03
FISCHER	INJECTION PROBE	F-120-9B	22	12 MONTHS	10/03
BIRD	50 OHM LOAD	8166	4397	<u>NO CAL</u> <u>NEEDED</u>	
EMPIRE	3DB ATTENUATOR	At-70-3	U11492	12 MONTHS	05/04
WEINSCHEL	20DB ATTENUATOR, 50W	40-20-43	GP368	12 MONTHS	10/03

EFT/SURGE	TEST EQUIPMENT:				
KEYTEK	ECAT SYSTEM WITH EFT/B SOURCE SURGE NETWORK COUPLER/DECOUPLER	E103 E411 E501 E4554	9309426	12 MONTHS	11/03
KEYTEK	COUPLING CLAMP	CCL - 4/S	9309209	<u>NO CAL</u> <u>NEEDED</u>	
TEKTRONIX	FUNCTION GENERATOR	TM503	B127178	<u>NO CAL</u> <u>NEEDED</u>	
TEKTRONIX	OSCILLOSCOPE	7603	B378014	12 MONTHS	04/04

ESD	TEST EQUIPMENT:				
SCHAFFNER	ESD SIMULATOR	NSG 438	113	12 MONTHS	08/04

MAGNETIC	TEST EQUIPMENT:				
GENERAL RADIO	VARIAC	NONE	NONE	<u>NO CAL</u> <u>NEEDED</u>	
JAGABI	RHEOSTAT	NONE	NONE	<u>NO CAL</u> <u>NEEDED</u>	
EXTECH	CLAMPMETER	MA440	013351951	12 MONTHS	10/03

QUEST	HELMHOLTZ COIL	NONE	NONE	<u>NO CAL</u> <u>NEEDED</u>	
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VOLTAGE DIPS, INTERRUPTIONS & VARIATION TEST EQUIPMENT					
BEHLMAN	POWER SOURCE	ACP-3000-100	3209	<u>NO CAL</u> <u>NEEDED</u>	
TEKTRONIX	OSCILLOSCOPE	7603	B378014	12 MONTHS	04/04
TEKTRONIX	PROGRAMMABLE DIGITIZER	7D20	B063600	12 MONTHS	04/04

EMI #1 A 16 foot wide, 24 foot long, 12 foot high chamber with a 12 inch raised floor. The 4 walls and ceiling are covered with ferrite tile. The floor has a 10 foot by 10 foot ferrite patch that covers the area under the antenna and extends toward the EUT. All power and signal cables are run under the raised floor. An 8 foot wide, 12 foot long, 7 foot high control room is attached to the EUT end. Bulkheads and waveguides are provided to bring cables into the control room. All power entering the two rooms is filtered. The ferrite chamber is calibrated for Field Uniformity.

EMI #2 A 14 foot wide, 24 foot long 10 foot high screen room with no ferrite tiles or absorber cones.

EMI #3 An 8 foot wide, 8 foot long ground plane.

All test equipment used for measurements was calibrated and traceable to the US Department of Commerce, National Institute of Standards and Technology (NIST).

Test Environment: Temp.= 70°F, Relative Humidity = 42%

Note: In general, relative humidity levels below 30% represent conditions slightly more severe than required for some tests (i.e., ESD and EFT).

3.4 Pictures

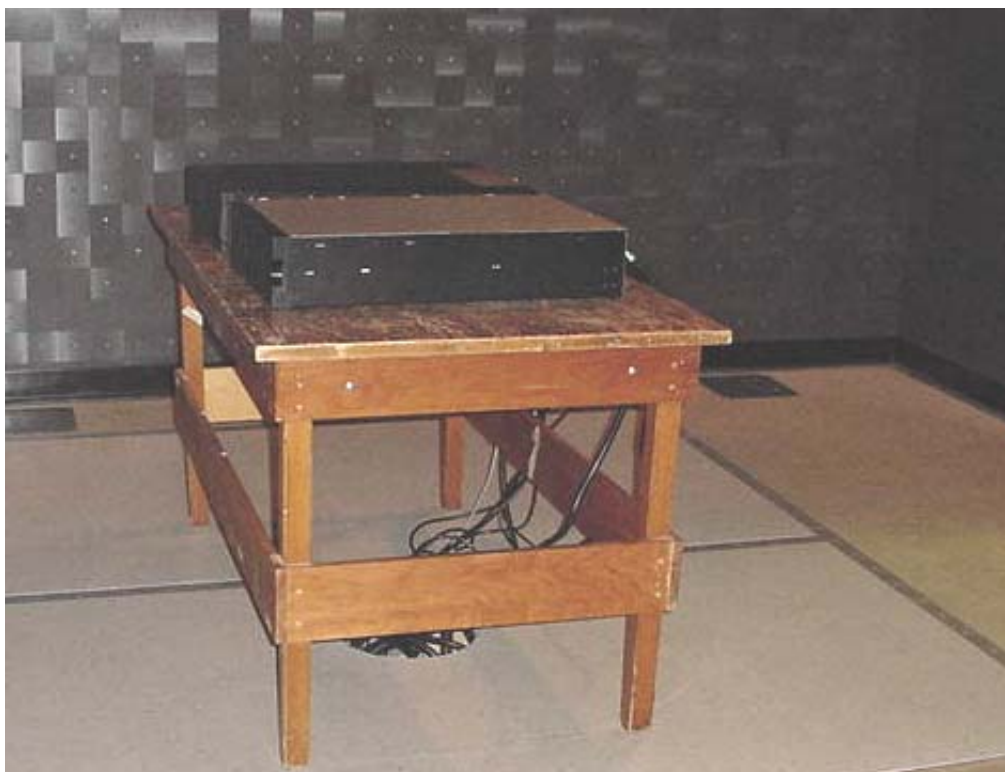


EUT Setup for EN61000-4-2



EUT Setup for EN61000-4-3 (0°)

3.4 Pictures (continued)



EUT Setup for EN61000-4-3 (90°)



EUT Setup for EN61000-4-3 (180°)

3.4 Pictures (continued)



EUT Setup for EN61000-4-3 (270°)



EUT Setup for EN61000-4-4 and -5 on Mains

3.4 Pictures (continued)



EUT Setup for EN61000-4-6 on Mains

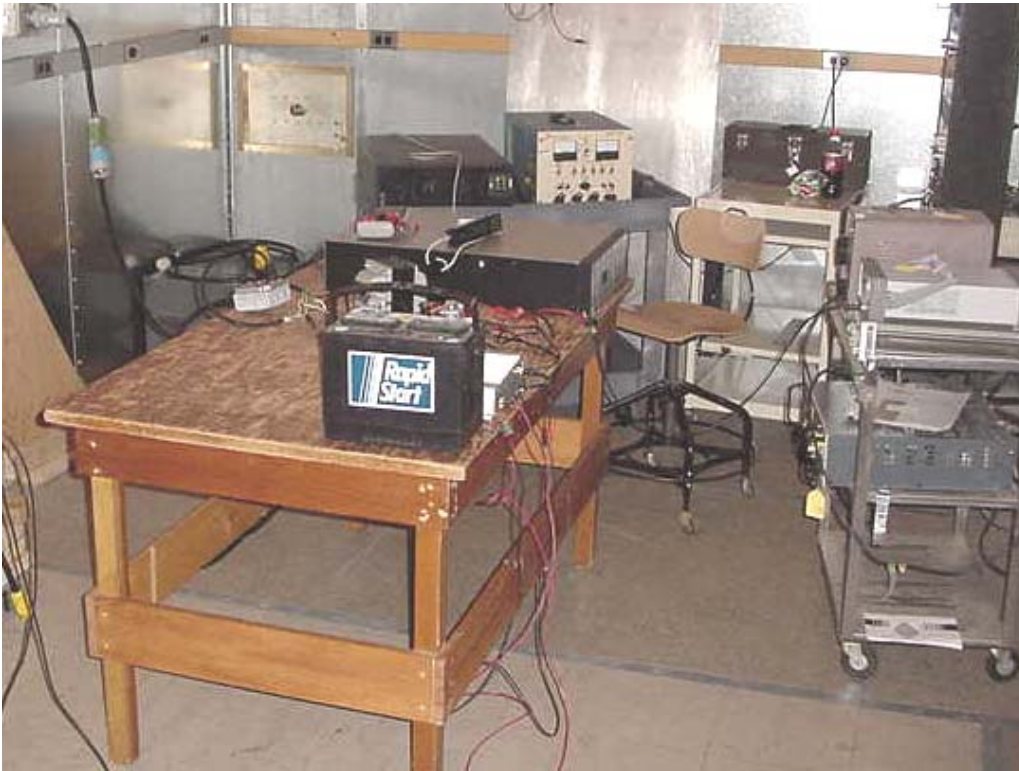


EUT Setup for EN61000-4-8

3.4 Pictures (continued)

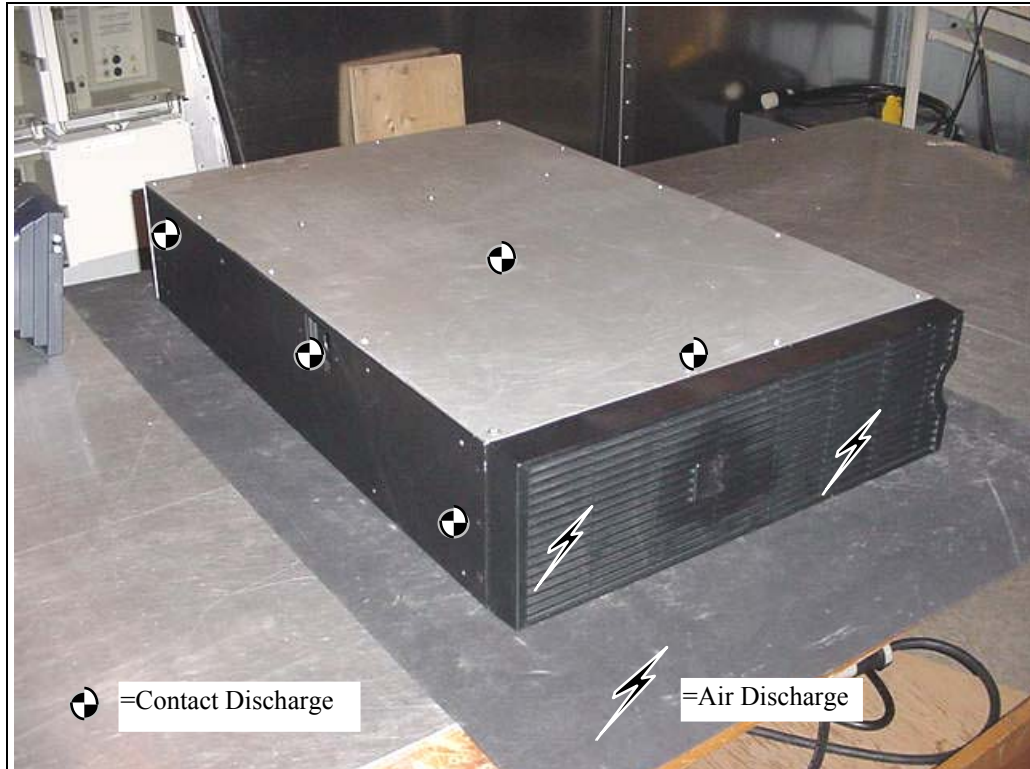


EUT Setup for EN61000-4-11



EUT Setup for IEC 1000-2-2

3.4 Pictures (continued)



ESD Discharge Points



ESD Discharge Points

SECTION 4 CONCLUSIONS**4.1 Test Results****EN61000-4-2, ELECTROSTATIC DISCHARGE**

Test facility used: EMI #2

<u>TEST</u>	<u>LEVEL</u>	<u>RESULTS</u>	<u>COMMENTS</u>
Air Discharge	± 8kV	PASSED	CRITERIA A
Direct Contact Discharge	± 4kV	PASSED	CRITERIA A
Horizontal Coupling Plane	± 4kV	PASSED	CRITERIA A
Vertical Coupling Plane	± 4kV	PASSED	CRITERIA A

Performance Criterion B of EN50091-2 was used in determining the results.

Note: Contact discharge points were applied to conductive surfaces of the EUT. Air discharge points were applied to non-conductive surfaces of the EUT. HCP was done with an insulating distance of 0.5 mm.

EN61000-4-3, RADIATED ELECTROMAGNETIC FIELDS

Test facility used: EMI #3

<u>TEST</u>	<u>LEVEL</u>	<u>RESULTS</u>	<u>COMMENTS</u>
27 to 1000 MHz at (80% AM @ 1 kHz)	3 V/M	PASSED	

Performance Criterion A of EN50091-2 was used in determining the results.

Note: The field uniformity was calibrated per EN61000-4-3. The frequency sweep rate 1% step size with a dwell of 3 seconds. Additional dwells were made to the 5th harmonic of the EUT clock frequencies or 1000MHz. For the frequency ranges that call for the use of the BICONICAL and Log Periodic antennas, both the horizontal and vertical polarities were done. The EUT to antenna distance was 3 meter(s). Testing was done with 80% AM at 1kHz applied.

EN61000-4-4, ELECTRICAL FAST TRANSIENT/BURST

Test facility used: EMI #2

<u>TEST</u>	<u>LINE</u>	<u>RESULTS</u>	<u>COMMENTS</u>
FAST TRANSIENTS/BURST TEST ON MAINS			
± 1 kV pulses, 5 nsec rise/50 nsec duration	Phase	PASSED	CRITERIA A
5.0 kHz pulse repetition rate	Neutral	PASSED	CRITERIA A

15 msec \pm 20% burst length
300 msec \pm 20% burst period
Applied for 1 minutes per polarity

Ground

Q03465 September 18, 2003
PASSED CRITERIA A

FAST TRANSIENTS/BURST TEST ON DATA CABLES

The product has no I/O cables

Performance Criterion B of EN50091-2 was applied in determining the results.

EN61000-4-5, SURGE IMMUNITY

Open circuit voltage: 1.2/50 μ s 6kV Maximum

Short circuit current: 8/20 μ s 3kA Maximum

The EUT is a single phase unit.

EUT Voltage = 230 VAC/50 Hz

Test facility used: EMI #2

MAINS:	<u>TEST</u>	<u>LEVEL</u>	<u>RESULTS</u>	<u>COMMENTS</u>
Phase to Ground:	Combination Wave			
	1.2/50, 8/20, with a 12 ohm resistor	\pm 2 kV	PASSED	CRITERIA A
Neutral to Ground:	Combination Wave			
	1.2/50, 8/20, with a 12 ohm resistor	\pm 2 kV	PASSED	CRITERIA A
Phase to Neutral:	Combination Wave			
	1.2/50, 8/20, with a 2 ohm resistor	\pm 1 kV	PASSED	CRITERIA A

Performance Criterion B was used in determining the results.

EN61000-4-6, CONDUCTED DISTURBANCES BY RF FIELDS

Test facility used: EMI #1

CONDUCTED DISTURBANCES ON MAINS

<u>TEST</u>	<u>LEVEL</u>	<u>LINE</u>	<u>RESULTS</u>	<u>COMMENTS</u>
0.150 to 80 MHz (80% AM @ 1 kHz)	3 V	Phase, Neutral, Ground	PASSED	

CONDUCTED DISTURBANCES ON DATA CABLES

The product has no I/O cables

Performance Criterion A was applied in determining the results.

Note: Coupling Decoupling Networks (CDNs) were used for the mains testing. The Coupling Factor of the CDNs was 0 ± 1 dB from 0.150 to 80 MHz. Injection Probe was used for the data cables testing. The frequency sweep rate 1% step size with a dwell of 3 seconds. Additional dwells were made to the 5th harmonic of the EUT clock frequencies Testing was done with 80% AM at 1kHz applied.

EN61000-4-8, POWER FREQUENCY MAGNETIC FIELD

Test facility used: EMI #3

<u>TEST</u>	<u>LEVEL</u>	<u>RESULTS</u>	<u>COMMENTS</u>
50 Hz	3 A/M	PASSED	

Performance Criterion A was applied in determining the results.

Note: A 2-meter by 2-meter square Helmholtz Coil was used. The two 10-turn coils are separated a distance of 1.5 meters.

EN61000-4-11, Voltage Dips, Interruptions and Variations

Test facility used: Safety Lab.

Voltage Dips

<u>TEST</u>	<u>RESULTS</u>	<u>COMMENTS</u>
70% for 25 periods	Passed	CRITERIA A

Voltage Interruptions

<u>TEST</u>	<u>RESULTS</u>	<u>COMMENTS</u>
5% for 250 periods	Passed	CRITERIA A
0% for ½period	Passed	CRITERIA A

Note: The UPS switched to battery back-up during the stimulus then back to normal with the stimulus removed. This is normal operation.

Performance Criterion A and B were applied in determining the results.

IEC 1000-2-2, Low Frequency Disturbances

Test facility used: EMI #2

<u>TEST</u>	<u>RESULTS</u>	<u>COMMENTS</u>
10V RMS from 140Hz to 360Hz	Passed	

Performance Criterion A of EN50091-2 was applied in determining the results.

4.2 Special Notes

The test engineer was B. Melanson.

The test results set forth in this report are expressly limited to the configuration and tests herein. Any changes in configuration may void test results. Quest agrees to quote charges for any retesting requested by the customer.

4.3 Required Compliance Modifications

None

APPENDIX A

EMI Emissions and Immunity Test Form

The information contained in this Appendix was provided by Bill Burks of American Power Conversion .
It contains specific configuration details of the system as tested.

Quest Engineering Solutions EMI Emissions and Immunity Test Form

Please complete all that applies for the equipment under test (EUT). Include a block diagram showing the EUT and all support equipment.

Date: _____
Company: American Power Conversion **Contact:** Bob Powers, Stephen Lee
Street: 85 Rangeway Road
City, State ZIP: North Billerica, MA 01862
Telephone: 978 - 670 - 2440 x 17252 **FAX:** 978-670-2380

Test Type:

Emissions

CISPR 11	<input type="checkbox"/>	FCC Part 15	<input checked="" type="checkbox"/>
CISPR 22	<input checked="" type="checkbox"/>	FCC Part 18	<input type="checkbox"/>
VCCI	<input checked="" type="checkbox"/>	CNS 13438	<input type="checkbox"/>
AUSTEL	<input checked="" type="checkbox"/>	Other <u>AS/NZS 3548</u>	
Class A (1)	<input checked="" type="checkbox"/>	Class B (2)	<input type="checkbox"/>

Immunity

EN50082-1	<input type="checkbox"/>	EN50082-2	<input type="checkbox"/>	IEC60601-1-2	<input type="checkbox"/>
EN61326	<input type="checkbox"/>	EN61000-6-2	<input type="checkbox"/>	Other _____	
EN61000-4-2	<input checked="" type="checkbox"/>	EN61000-4-6	<input checked="" type="checkbox"/>	Test Level 1	<input type="checkbox"/>
EN61000-4-3	<input checked="" type="checkbox"/>	EN61000-4-8	<input checked="" type="checkbox"/>	Test Level 2	<input type="checkbox"/>
EN61000-4-4	<input checked="" type="checkbox"/>	EN61000-4-11	<input checked="" type="checkbox"/>	Test Level 3	<input type="checkbox"/>
EN61000-4-5	<input checked="" type="checkbox"/>			Test Level 4	<input type="checkbox"/>

Special: EN50092-1 EMC for UPS's and BSMI certification

Equipment Under Test (EUT) Description:

Models SURT001, SURT002, SURT003 and SURT004, which are all accessories for the
Following models SURT5000XLI, SURT5000XLT, SURT5000XLJ, SURT5000UXI
SURT3000XLI, SURT3000XLT, SURT3000XLJ, SURT3000UXI, SURT3000XLIX322

Model Number(s): SURT001, SURT002 **Serial Number(s):** Prototypes
SURT003, SURT004

EUT Weight(lb.): _____ **EUT Size (LxWxH):** _____

Power Interface:

Frequency 50/60Hz
Voltage 200-240
No. of Phases 1
Current 1. 16 2. 25 3,4 24
Plug Type 1. C20 2. hardwire 3,4 L6-30
Cord Type 3/10AWG

Power Supply:

Description N/A
Manufacturer N/A
Model Number N/A
Switching Freq. N/A
RF Filter Manufac. N/A
RF Filter Model N/A

Equipment Cycle Time: Continuos

Failure Criteria: ± 5% Voltage variation

Equipment Configuration**Slot No.****Board Type**

N/A

Equipment Internal Devices (e.g. disks, tapes)**Manufacturer****Part No.****Serial No.**

N/A

Oscillator Frequencies of EUT (Please list all):

80Khz

RF Suppression Components of EUT (i.e., ferrites, gasketting, filters, etc.):

Manufacturer

Part No.

Locations used

None

Cabinet Shielding/Construction of EUT:

Metal Chassis

I/O Cables:

Note: Interconnecting cables shall be connected to one of each type of functional port of the EUT. Where there are multiple ports of the same type, additional cables shall be attached to each of these ports. These additional cables do not need to be terminated.

Quantity

Part No.

Function

Shield description (e.g. braid, foil, none)

Unshielded AC mains cords (Approximately 2 meters long)

Software Description:

Note: The EUT must be exercised by software or other means so as to ensure that the various parts of the system are active. The exercise shall generate traffic representative of typical equipment usage. For immunity testing, the software must be capable of reporting any errors that may occur.

No Software Required

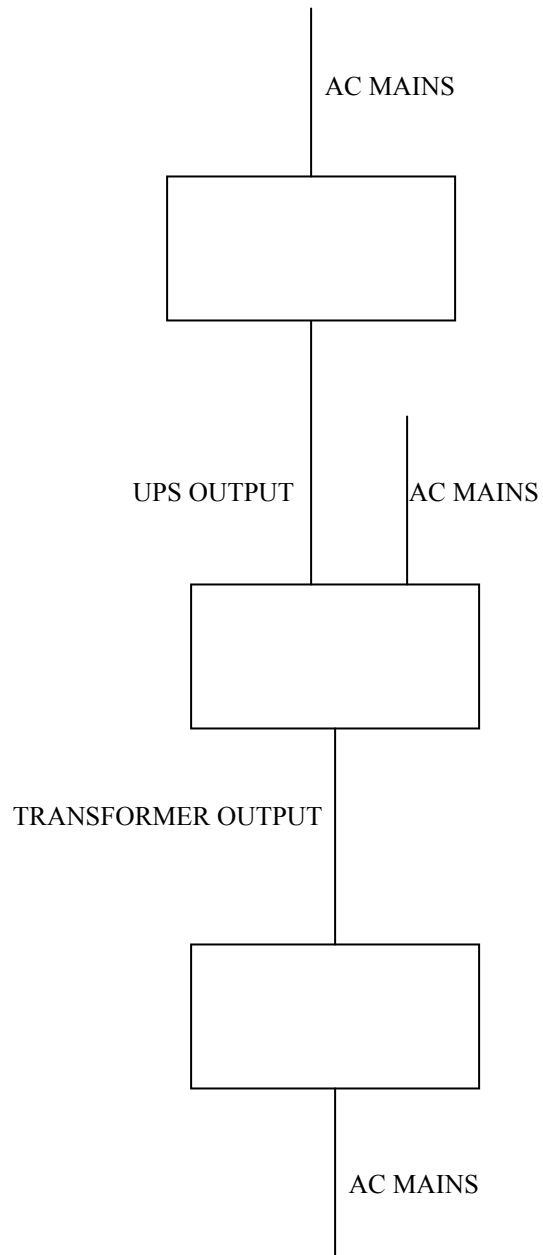
Support Equipment Description (Manufacturer, model number, serial number, cable numbers):

1. APC SURT5000XL

2. Avtron Model# K490 load

Additional Information:

Block Diagram



APPENDIX B

QUEST CREDENTIALS

FCC registered test site

NVLAP Lab Code 200036-0

ANSI C63-4, (2001), FCC Method-47 CFR Part 15 – Digital Devices

Conducted Emissions, Power Lines, 450 kHz to 30 MHz

Radiated Emissions

International Special Committee on Radio Interference (CISPR) Methods

IEC/CISPR 22 (1993) Amendment 1 (1995) and Amendment 2 (1996)

IEC/CISPR 22 (1997) and EN 55011 (1998)

CISPR 14-1 March 30, 2000

EN 55014-1 (1993) with Amendments A1 (1997) and A2 (1999)

IEC 61000-3-2, Edition 2.1 (2001-10) and EN61000-3-2 (2000)

IEC 61000-3-3 (1995) and EN61000-3-3 (1995)

IEC 61000-4-2 (1995) and Amendment 1 (1998)

IEC 61000-4-3 (1995) and Amendment 1 (1998)

IEC 61000-4-4 (1995)

IEC 61000-4-5 (1995)

IEC 61000-4-6 (1996)

IEC 61000-4-8 (1993)

IEC 61000-4-11 (1994)

CNS 13438, 1997, Accreditation No. SL2-IN-E-23R

Australian Standards, A96/TH/0079

AS/NZS CISPR 22 and AS/NZS 3548

AS/ZNS 1044 (1995)

Conformity Assessment Body (CAB) For the EMC annex

VCCI Registration Numbers R-712 and C732

TEST SERVICES

TEST REPORT POLL

Please rate the attached test report's quality by responding to the brief questions listed in this poll. Our goal is to provide you with high quality test reports in a timely manner. Therefore, your feedback is vital in order to determine how good our test reports are, and what areas could be improved.

Please indicate beside each question what you feel is the rating. Also, feel free to make comments directly on the poll, or by attaching a separate sheet. The completed form should then be returned by mail or FAX to Herman Held at 978-667-3388. Your cooperation and effort are truly appreciated.

TEST REPORT NUMBER: Q03465

YES NO

1. Was the information presented clearly?..... [][]
2. Was the report complete?..... [][]
3. Was the report timely?..... [][]
4. Did the report satisfy your requirements?..... [][]
5. Your organization type?. []Engineering.... []Manufacturing
..... []Marketing..... []Other
6. Your work environment?.. []Hardware..... []Software .[]Both

YOUR NAME (OPTIONAL): _____

OPTIONAL COMMENTS: _____

**To: Herman Held, President
Quest Engineering Solutions
7 Sterling Road
P.O. Box 125
North Billerica, MA 01862
FAX: 978-667-3388**



Issues

A CERTIFICATE OF TEST:

To

***American Power Conversion
85 Rangeway Road
Billerica, MA 01862, USA***

For

**Product: Smart UPS RT Transformer
Model: SURT001 and SURT002**

Date: September 18, 2003

Quest Engineering Solutions, a US and internationally approved test house, attests that compliance testing was completed satisfactorily on the aforementioned equipment as specified by the manufacturer and reported in Quest's test report number: Q03465. Quest Engineering Solutions acknowledges that the Equipment Under Test was found to be in compliance with the following standards:

EN50091-2, Uninterruptable Power Systems (UPS)

EN61000-4-2, Electrostatic Discharge

EN61000-4-3, Radiated Electromagnetic Fields

EN61000-4-4, Electrical Fast Transient/Burst

EN61000-4-5, Surge Immunity Requirements

EN61000-4-6, Conducted Disturbances Induced By Radio-Frequency Fields

EN61000-4-8, Power Frequency Magnetic Field Immunity Test

EN61000-4-11, Voltage Dips, Short Interruptions and Voltage Variations

Immunity Tests

IEC 1000-2-2, Compatibility levels for low-frequency conducted disturbances and signaling in public low-voltage supply systems

Q03465